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13501 MCCALLEN PASS ● AUSTIN, TX 78753 ● PHONE (512) 287-2500 ● FAX (512) 287-2513

May 8, 2015

Amimon
2 Maskit St. Building D, 2nd Floor
Herzelia, Israel 46733

Dear Arik Israel,

Enclosed is the EMC Wireless test report for compliance testing of the Amimon, Connex Air-Unit as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Title 47 of the CFR, Part 15, Subpart B and ICES-003, Issue 5, August 2012 for Unintentional Radiators and Part 15.407 and RSS-210, Issue 8, December 2010 for Intentional Radiators.

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

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Warnell
Documentation Department

Reference: (\Amimon\EMC85243A-FCC407 RSS-210 UNII 2 Rev. 4)

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Electromagnetic Compatibility Criteria
Test Report

for the

Amimon
Connex Air-Unit

Tested under
the Certification Rules
contained in
Title 47 of the CFR, Part 15, Subpart B & ICES-003
for Unintentional Radiators
and
Title 47 of the CFR, Part 15.407 & RSS-210
for Intentional Radiators

MET Report: EMC85243A-FCC407 RSS-210 UNII 2 Rev. 4

May 8, 2015

Prepared For:

Amimon
2 Maskit St. Building D, 2nd Floor
Herzelia, Israel 46733

Prepared By:
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for Intentional Radiators

Djed Mouada, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Parts 15B, 15.407, of the FCC Rules and Industry Canada standards ICES-003, Issue 5, August 2012 and RSS-210, Issue 8, December 2010 under normal use and maintenance.

Asad Bajwa, Director
Electromagnetic Compatibility Lab

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Report Status Sheet

Revision	Report Date	Reason for Revision
∅	April 6, 2015	Initial Issue.
1	April 13, 2015	Revised to reflect engineer corrections.
2	April 20, 2015	Editorial Corrections.
3	April 30, 2015	Revised to reflect engineer corrections.
4	May 8, 2015	Editorial corrections.

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List of Terms and Abbreviations

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

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I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Amimon Connex Air-Unit, 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 Connex Air-Unit. Amimon should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Connex Air-Unit, 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 Amimon, purchase order number 15000104. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference	IC Reference	Description	Results
15.203	N/A	Antenna Requirements	Compliant
15.207	RSS-GEN (7.2.4)	AC Conducted Emissions 150KHz – 30MHz	Not Applicable
15.403 (i)	RSS-Gen (4.6)	26dB Occupied Bandwidth	Compliant
15.407 (a)(2)	RSS-210 (A9.2)	Conducted Transmitter Output Power	Compliant
15.407 (a)(2)	RSS-210 (A9.2)	Power Spectral Density	Compliant
15.407 (b)(2), (3), (5), (6)	RSS-210 (A9.2)	Undesirable Emissions (15.205/15.209 - General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Compliant
15.407(f)	RSS-102 (4.1)	RF Exposure	Compliant
15.407(h)(1)	RSS-210 A9.2(2),(3)	Transmit Power Control (TPC)	N/A – EIRP is less than 500 mW
15.407 (h)(2)(iii)	RSS-210 A9.3(b)(iii),(iv)	Channel Move Time and Channel Closing Time	Compliant
15.407 (h)(2)(iv)	RSS-210 A9.3(b)(v)	Non-Occupancy Period	Compliant

Table 1. Executive Summary of EMC Part 15.407 ComplianceTesting

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II. Equipment Configuration

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A. Overview

MET Laboratories, Inc. was contracted by Amimon to perform testing on the Connex Air-Unit, under Amimon's purchase order number 15000104.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Amimon Connex Air-Unit.

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

Model(s) Tested:	Connex Air-Unit	
Model(s) Covered:	Connex Air-Unit	
EUT Specifications:	Primary Power: DC	
	FCC ID: VQSAMNBZT1	
	Type of Modulations:	OFDM
	Emission Designators:	D7F
	Equipment Code:	NII
	Peak RF Output Power:	22.189 dBm 22.863 dBm 22.619 dBm
	EUT Frequency Ranges:	5260 – 5320 MHz 5500-5580 MHz 5660-5700 MHz
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Djed Mouada	
Report Date(s):	May 8, 2015	

Table 2. EUT Summary

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B. References

CFR 47, Part 15, Subpart E	Unlicensed National Information Infrastructure Devices (UNII)
RSS-210, Issue 8, Dec. 2010	Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
RSS-GEN, Issue 3, Dec. 2010	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.4:2003	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 C63.10-2009	American National Standard for Testing Unlicensed Wireless Devices

Table 3. References

C. Test Site

All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Ave., Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

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

D. Description of Test Sample

The Amimon Connex Air-Unit, Equipment Under Test (EUT), is designed to modulate and transmit downstream video and audio content over the wireless medium and receive a control channel over the wireless upstream. The modulation uses a 40 or 20 MHz bandwidth and is carried over the 5GHz unlicensed band.

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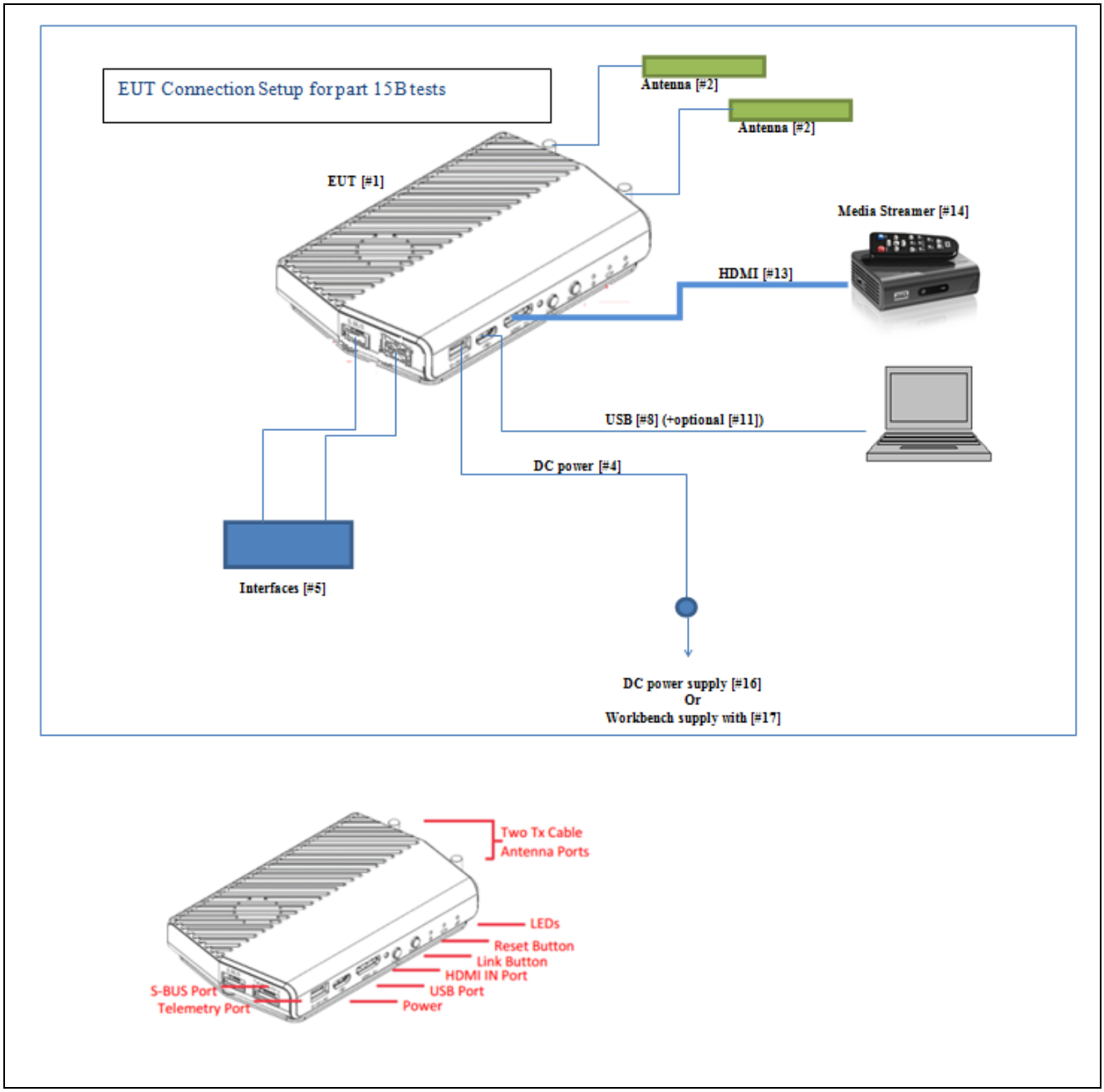

Figure 1. Block Diagram of Test Configuration

E. Equipment Configuration

All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Revision
1	EUT – Connex Air-Unit	--	--	--	--
2	Antenna	--	--	--	--

Table 4. Equipment Configuration

F. Support Equipment

Amimon supplied support equipment necessary for the operation and testing of the Connex Air-Unit. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number
5	S-Bus + Telemetry terminated cable	Amimon	--
4	DC Power cable	Amimon	--
8	USB Cable	Wanshih	--
13	HDMI Type A-B cable	Wanshih	--
14	HDMI Media streamer	WD	--
--	PC	Dell	--

Table 5. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
--	S-Bus Port	--	1	--	No	--
--	Telemetry Port	--	1	--	No	--
--	Power	--	1	--	No	--
--	USB Port	--	1	--	Yes	--
--	HDMI in Port	--	1	--		--

Table 6. Ports and Cabling Information

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H. Mode of Operation

The Connex Air-Unit is programmed to transmit a 100% duty cycle of streaming auto generated video test pattern. The frequency and power of operation may be programmed by the LAB using a PC tool and a serial communication connector.

I. Method of Monitoring EUT Operation

Slow blinking (on-off once during 1sec) blue LED indicates that board is functioning.

Fast blinking (on-off 3-4 times during 1sec) same LED, means that the board is out of calibration.

When this LED is not blinking this means that board has a certain problem

Using the SW tool to configure the board, when configuration ended successfully a clear green indication appears, while a red bad indication appears when the desired configuration fails

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 Amimon upon completion of testing.

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III. Electromagnetic Compatibility Criteria for Intentional Radiators

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

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

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

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

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

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

Results: The EUT as tested is compliant the criteria of §15.203. The EUT has a unique antenna connector. EUT uses two types of antennas.

Antenna Type	Gain (dBi)
Dipole Rubber Ducky	2
PCB	2

Table 7. Antenna List

Test Engineer(s): Djed Mouada

Test Date(s): 03/18/15

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207 Conducted Emissions Limits

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

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

Table 8. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Test Results: The EUT was not applicable with this requirement. The EUT is DC powered.

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 403(i) 26dB Bandwidth

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

Test Procedure: The 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 and was determined from the plots on the following pages.

Test Engineer(s): Djed Mouada

Test Date(s): 03/23/15

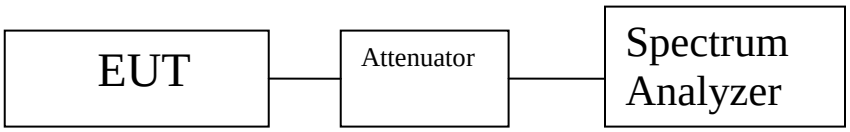

Figure 2. Occupied Bandwidth, Test Setup

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Occupied Bandwidth Test Results

	Frequency (MHz)	Occupied Bandwidth (MHz)
Antenna 1	5260 (20MHz)	19.517
	5280 (20MHz)	19.608
	5300 (20MHz)	19.622
	5310 (40MHz)	49.979
	5500 (20MHz)	23.449
	5510 (40MHz)	50.000
	5550 (40MHz)	50.000
	5560 (20MHz)	19.849
	5590 (40MHz)	50.000
	5630 (40MHz)	50.000
	5670 (40MHz)	50.000
	5700 (20MHz)	19.600
Antenna 2	5260 (20MHz)	19.479
	5280 (20MHz)	19.248
	5300 (20MHz)	19.536
	5310 (40MHz)	49.753
	5500 (20MHz)	26.954
	5510 (40MHz)	50.000
	5550 (40MHz)	50.000
	5560 (20MHz)	24.695
	5590 (40MHz)	50.000
	5630 (40MHz)	50.000
	5670 (40MHz)	50.000
	5700 (20MHz)	19.988

Table 9. 26 dB Occupied Bandwidth, Test Results

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	Frequency (MHz)	Occupied Bandwidth (MHz)
Antenna 1	5260 (20MHz)	17.9927
	5280 (20MHz)	17.9230
	5300 (20MHz)	17.9438
	5310 (40MHz)	37.5671
	5500 (20MHz)	17.9660
	5510 (40MHz)	37.5866
	5550 (40MHz)	37.6030
	5560 (20MHz)	17.9326
	5590 (40MHz)	37.5744
	5630 (40MHz)	37.5983
	5670 (40MHz)	37.5983
	5700 (20MHz)	18.0174
Antenna 2	5260 (20MHz)	17.8375
	5280 (20MHz)	17.8738
	5300 (20MHz)	18.0055
	5310 (40MHz)	37.5325
	5500 (20MHz)	17.9214
	5510 (40MHz)	37.5705
	5550 (40MHz)	37.7079
	5560 (20MHz)	18.0530
	5590 (40MHz)	37.6624
	5630 (40MHz)	37.5983
	5670 (40MHz)	37.5269
	5700 (20MHz)	17.9903

Table 10. 99% Occupied Bandwidth, Test Results

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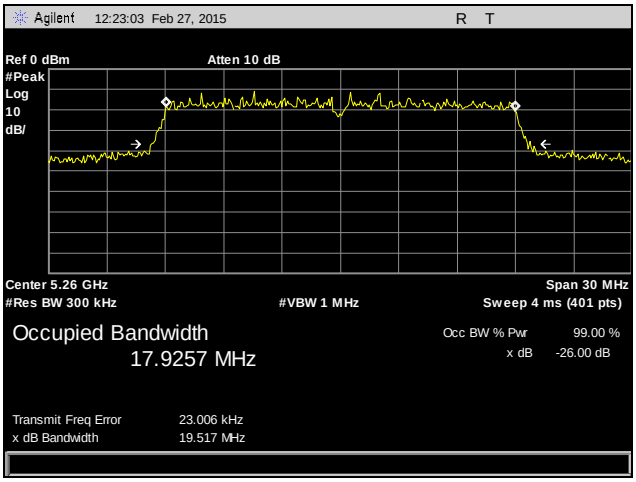
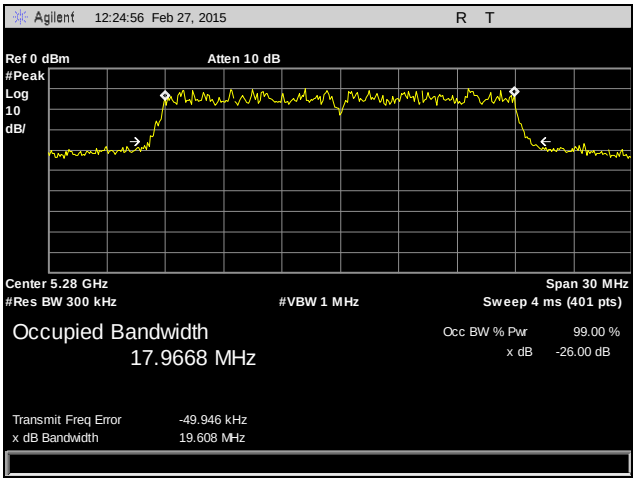
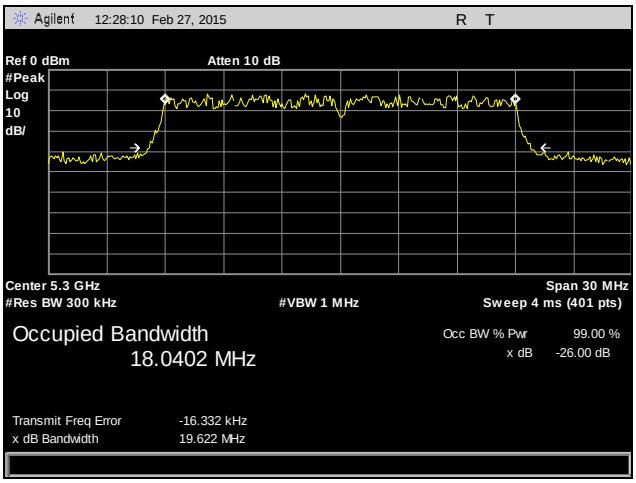
26 dB Occupied Bandwidth Test Results, Antenna 1



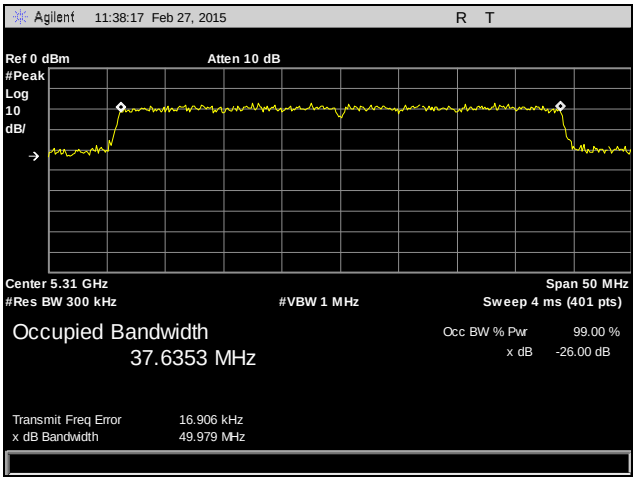
Plot 1. 26 dB Occupied Bandwidth, 5260 MHz, Antenna 1



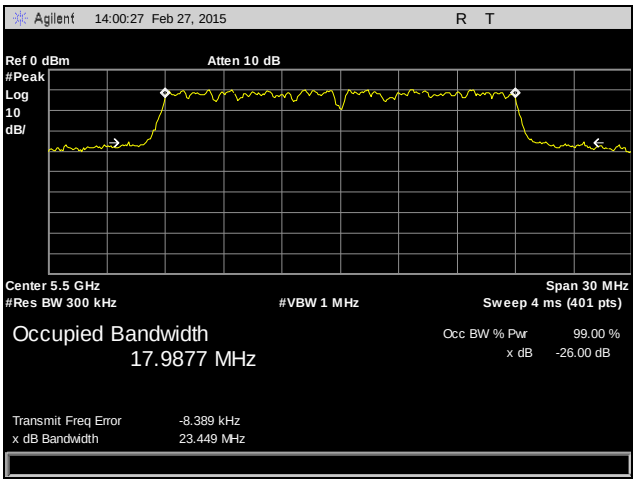
Plot 2. 26 dB Occupied Bandwidth, 5280 MHz, Antenna 1



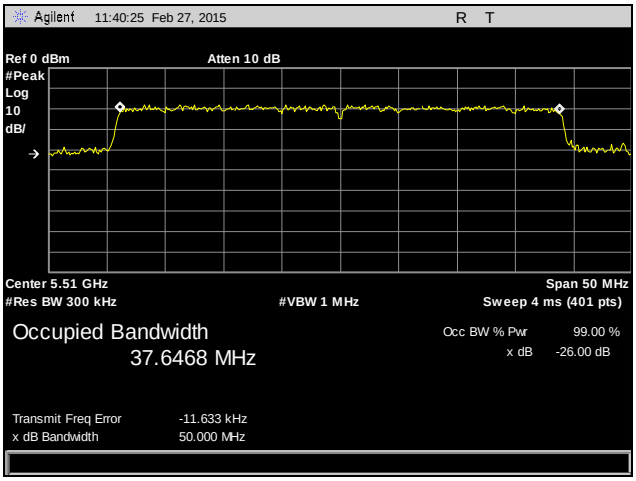
Plot 3. 26 dB Occupied Bandwidth, 5300 MHz, Antenna 1



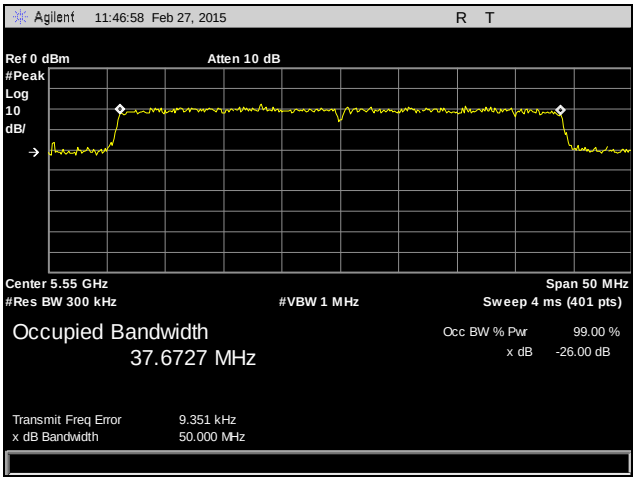
Plot 4. 26 dB Occupied Bandwidth, 5310 MHz, Antenna 1



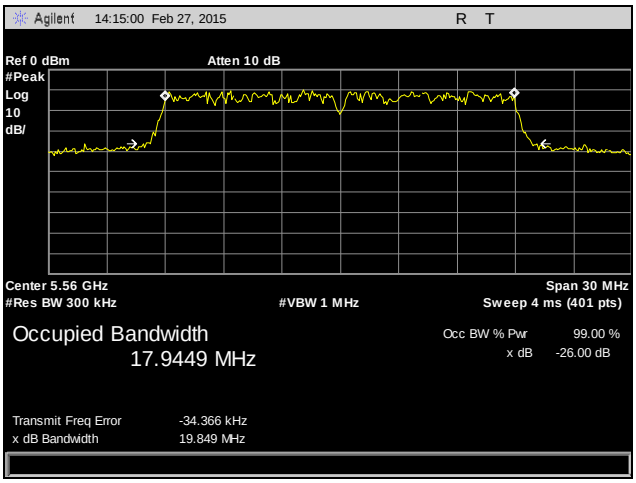
Plot 5. 26 dB Occupied Bandwidth, 5500 MHz, Antenna 1



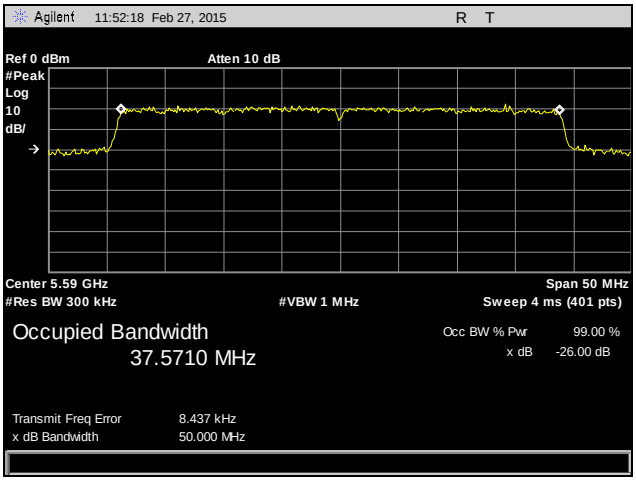
Plot 6. 26 dB Occupied Bandwidth, 5510 MHz, Antenna 1



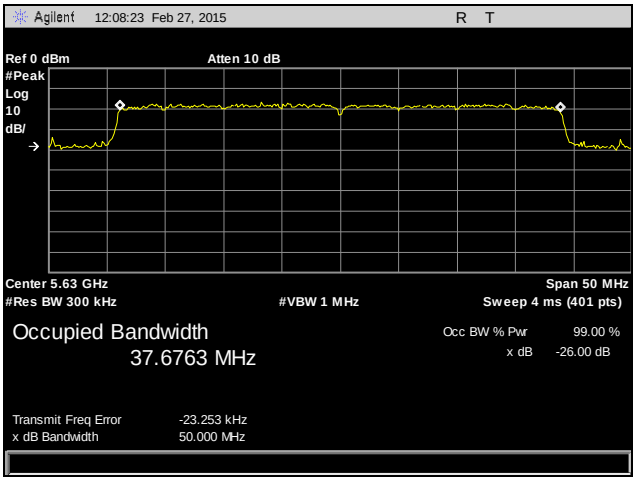
Plot 7. 26 dB Occupied Bandwidth, 5550 MHz, Antenna 1



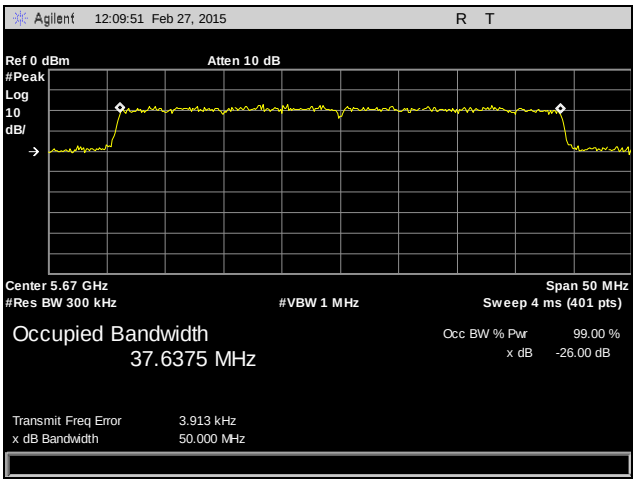
Plot 8. 26 dB Occupied Bandwidth, 5560 MHz, Antenna 1



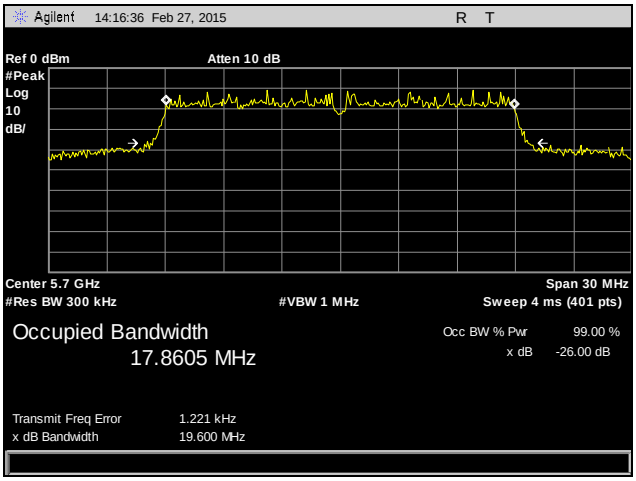
Plot 9. 26 dB Occupied Bandwidth, 5590 MHz, Antenna 1



Plot 10. 26 dB Occupied Bandwidth, 5630 MHz, Antenna 1



Plot 11. 26 dB Occupied Bandwidth, 5670 MHz, Antenna 1



Plot 12. 26 dB Occupied Bandwidth, 5700 MHz, Antenna 1

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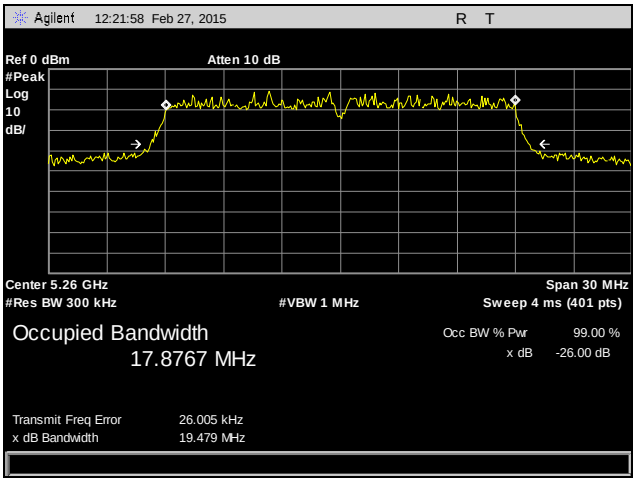
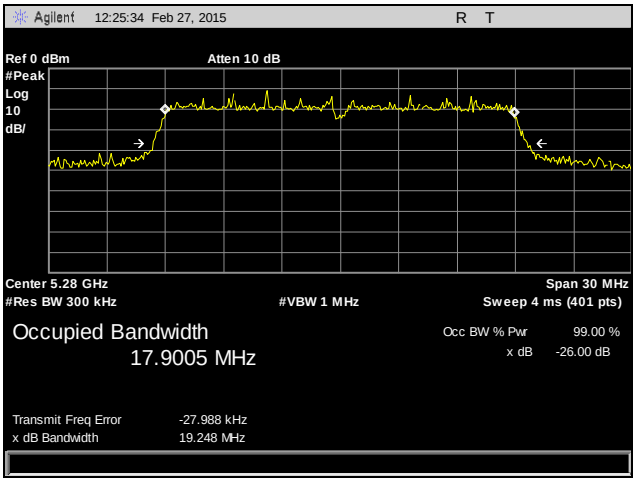
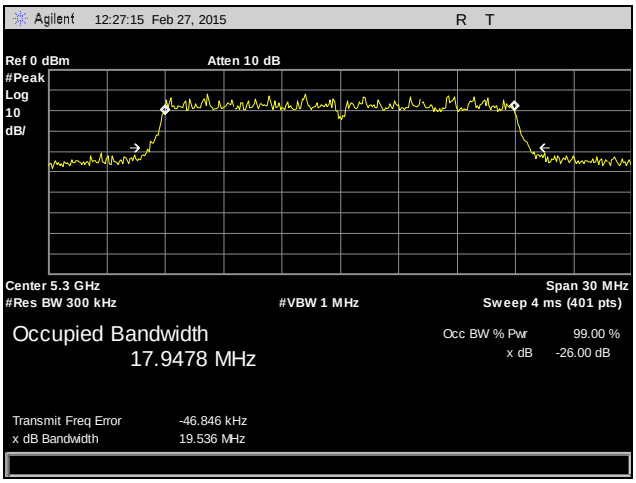
26 dB Occupied Bandwidth Test Results, Antenna 2



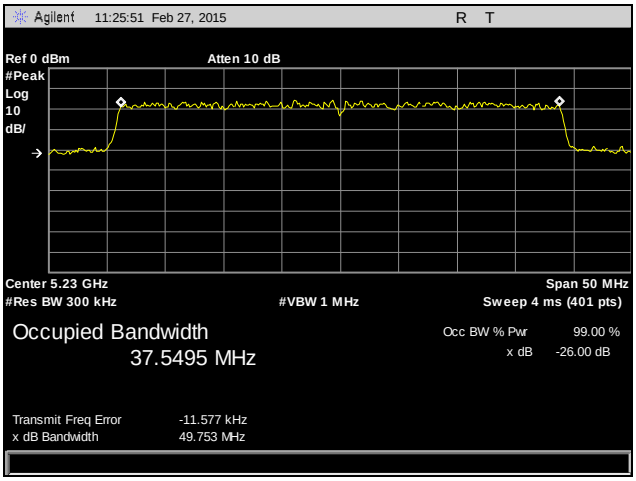
Plot 13. 26 dB Occupied Bandwidth, 5260 MHz, Antenna 2



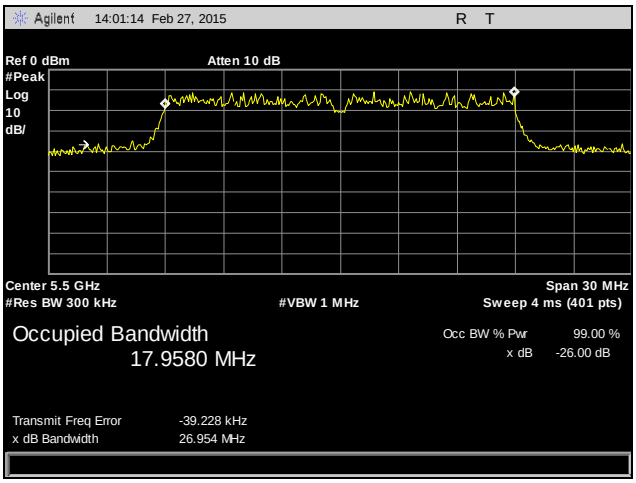
Plot 14. 26 dB Occupied Bandwidth, 5280 MHz, Antenna 2



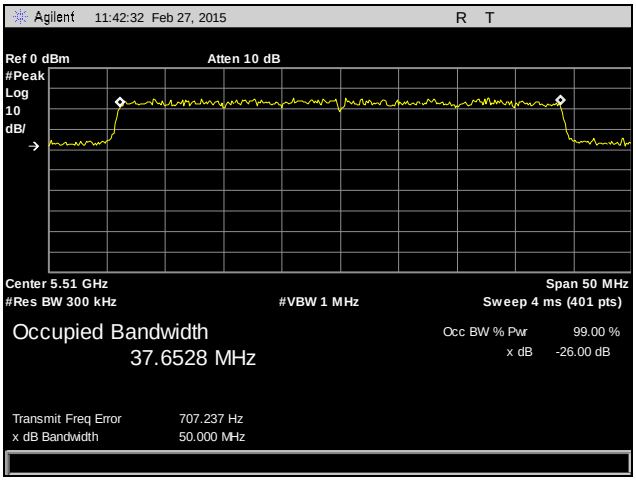
Plot 15. 26 dB Occupied Bandwidth, 5300 MHz, Antenna 2



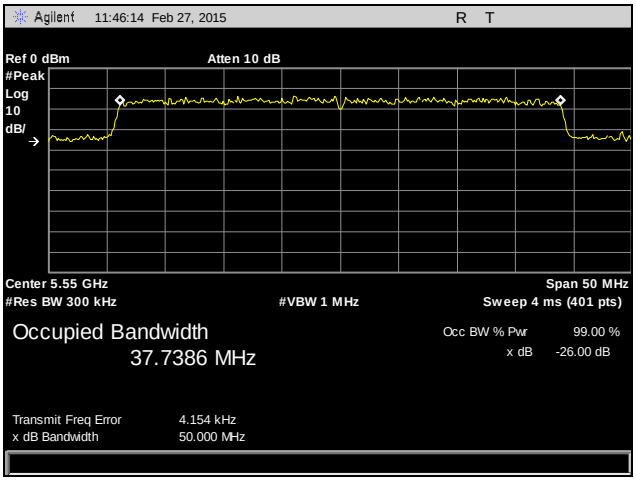
Plot 16. 26 dB Occupied Bandwidth, 5310 MHz, Antenna 2



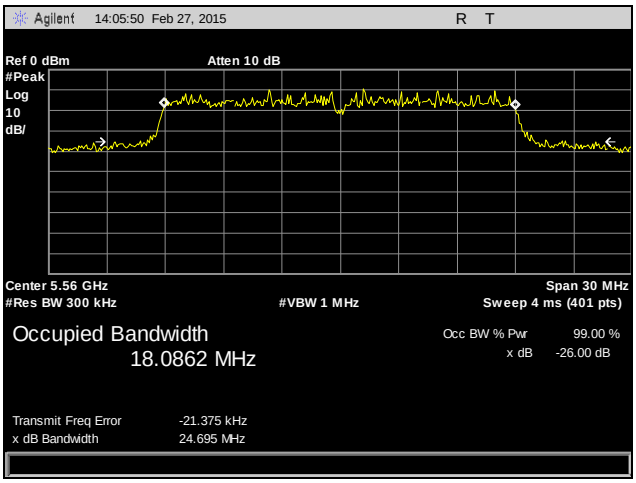
Plot 17. 26 dB Occupied Bandwidth, 5500 MHz, Antenna 2



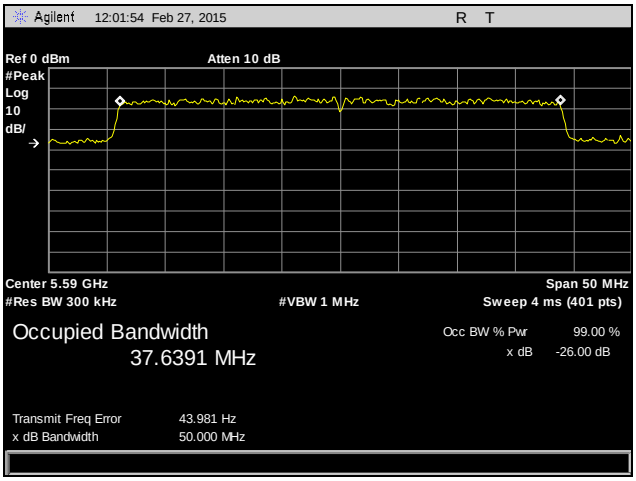
Plot 18. 26 dB Occupied Bandwidth, 5510 MHz, Antenna 2



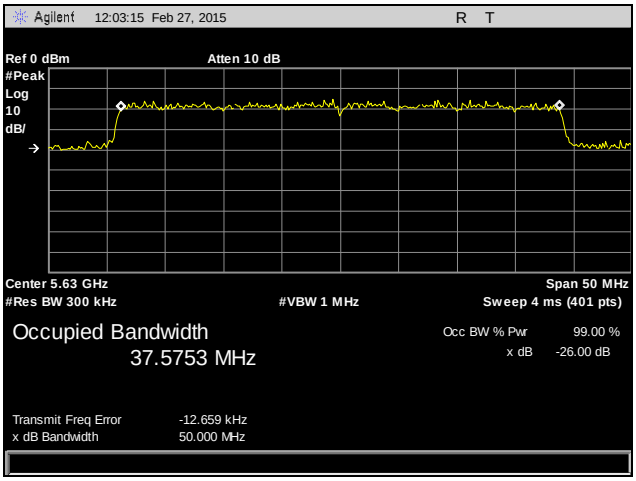
Plot 19. 26 dB Occupied Bandwidth, 5550 MHz, Antenna 2



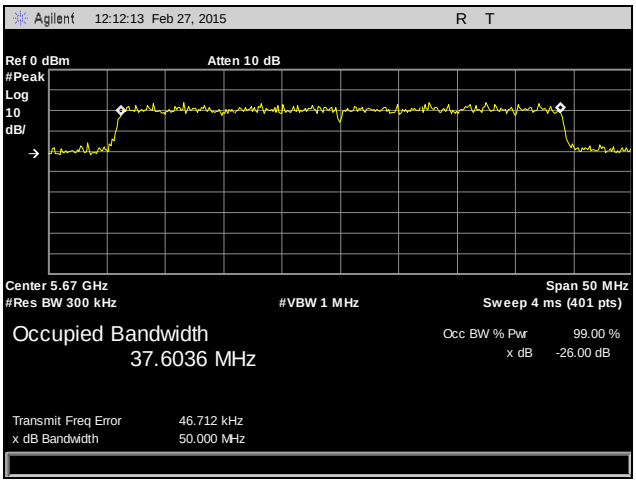
Plot 20. 26 dB Occupied Bandwidth, 5560 MHz, Antenna 2



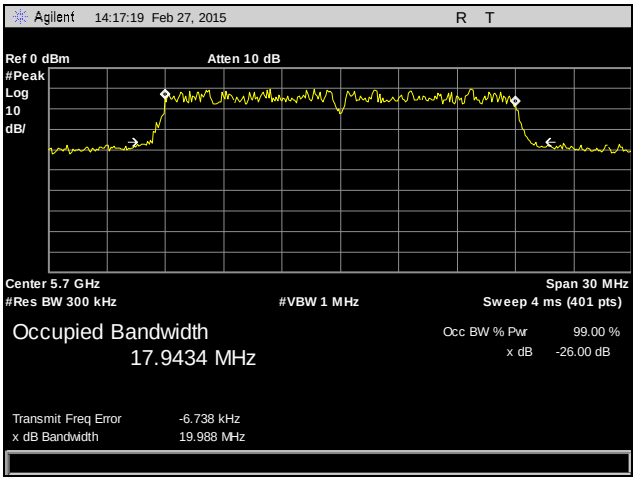
Plot 21. 26 dB Occupied Bandwidth, 5590 MHz, Antenna 2



Plot 22. 26 dB Occupied Bandwidth, 5630 MHz, Antenna 2



Plot 23. 26 dB Occupied Bandwidth, 5670 MHz, Antenna 2



Plot 24. 26 dB Occupied Bandwidth, 5700 MHz, Antenna 2

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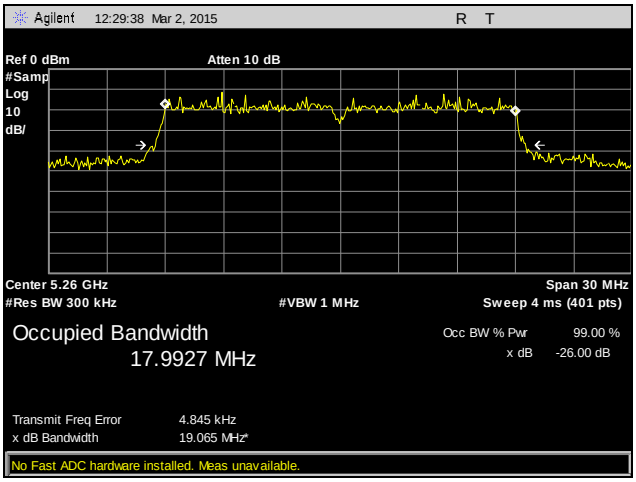
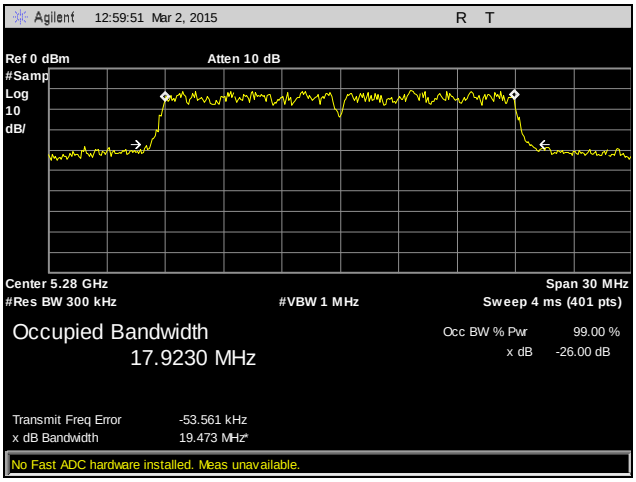
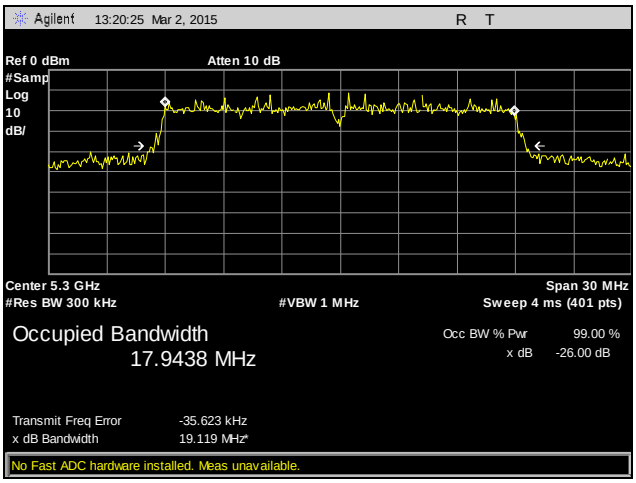
99% Occupied Bandwidth Test Results, Antenna 1



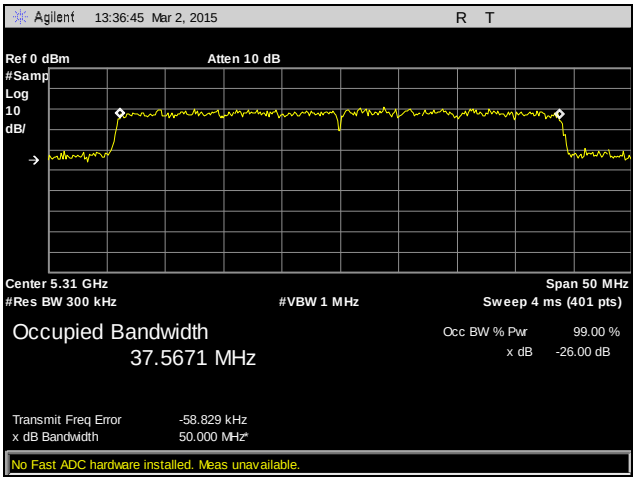
Plot 25. 99% Occupied Bandwidth, 5260 MHz, Antenna 1



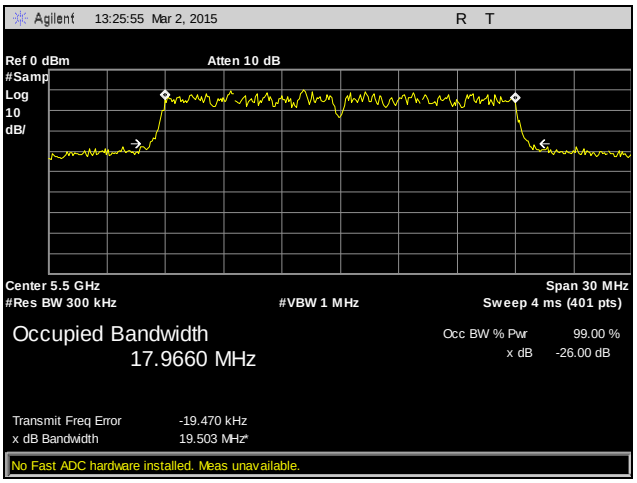
Plot 26. 99% Occupied Bandwidth, 5280 MHz, Antenna 1



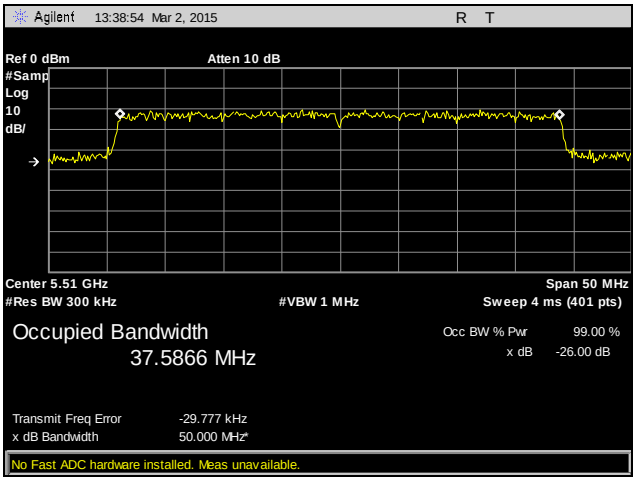
Plot 27. 99% Occupied Bandwidth, 5300 MHz, Antenna 1



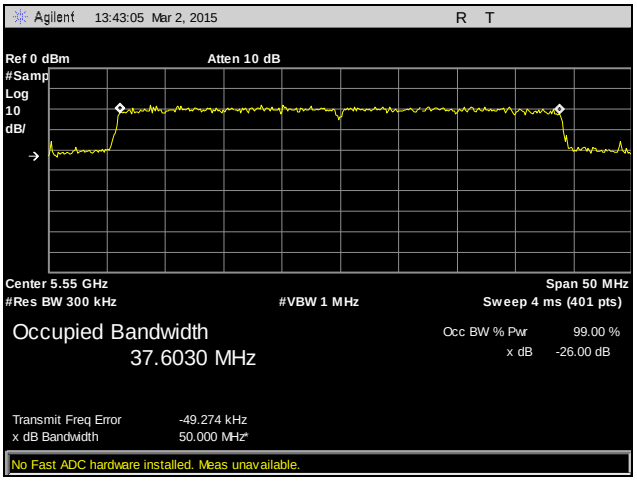
Plot 28. 99% Occupied Bandwidth, 5310 MHz, Antenna 1



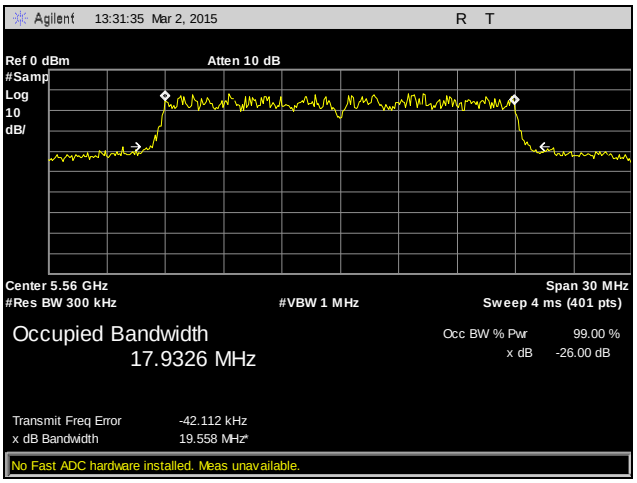
Plot 29. 99% Occupied Bandwidth, 5500 MHz, Antenna 1



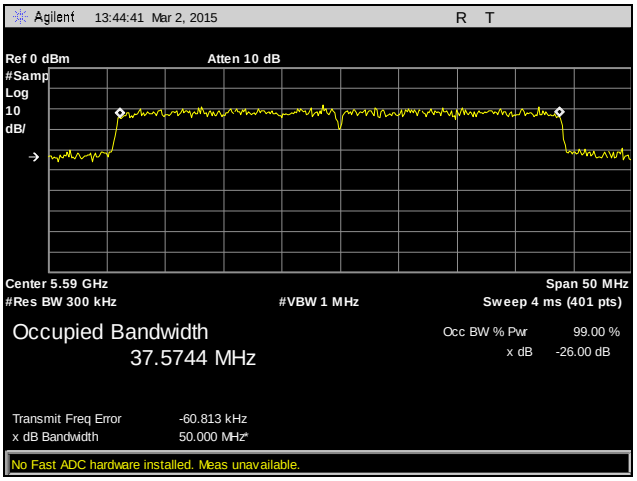
Plot 30. 99% Occupied Bandwidth, 5510 MHz, Antenna 1



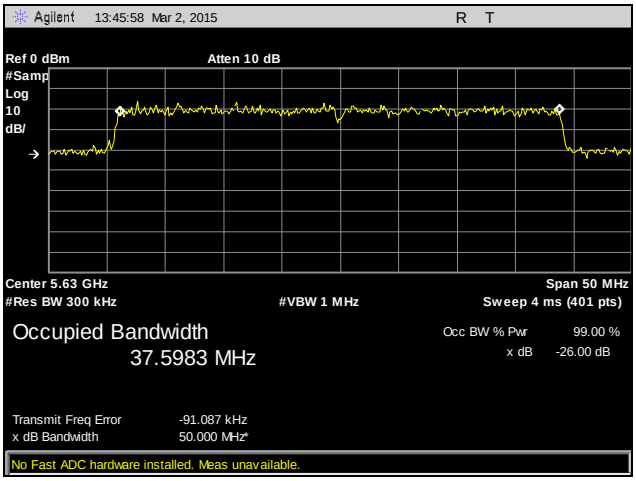
Plot 31. 99% Occupied Bandwidth, 5550 MHz, Antenna 1



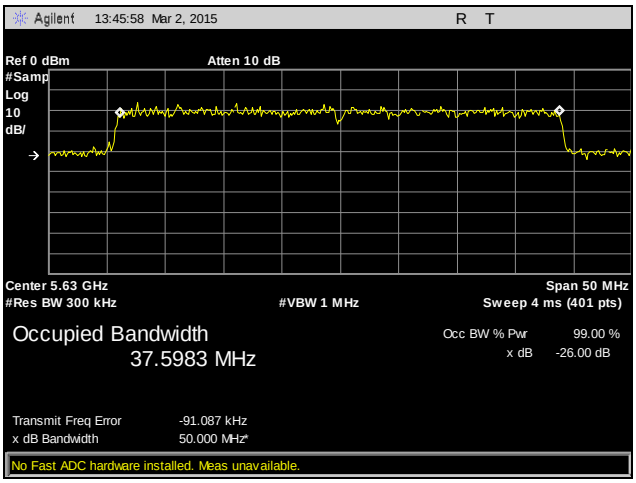
Plot 32. 99% Occupied Bandwidth, 5560 MHz, Antenna 1



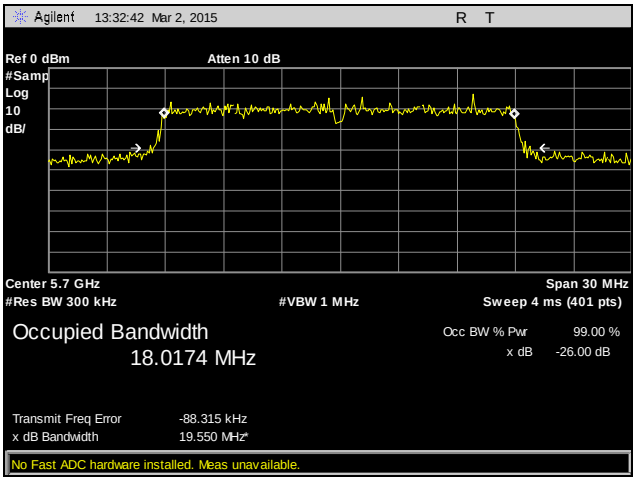
Plot 33. 99% Occupied Bandwidth, 5590 MHz, Antenna 1



Plot 34. 99% Occupied Bandwidth, 5630 MHz, Antenna 1

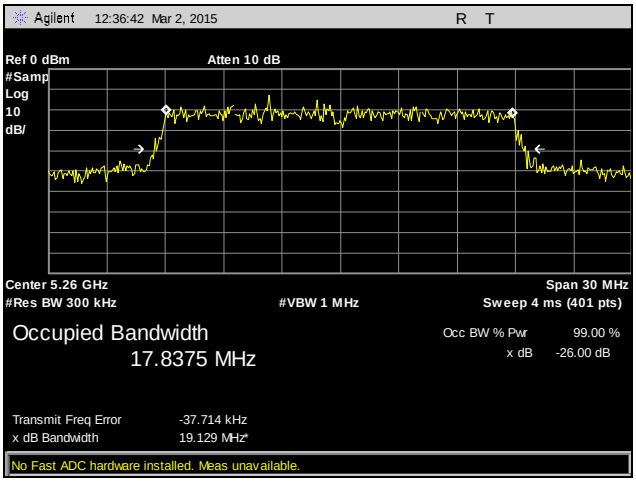


Plot 35. 99% Occupied Bandwidth, 5670 MHz, Antenna 1

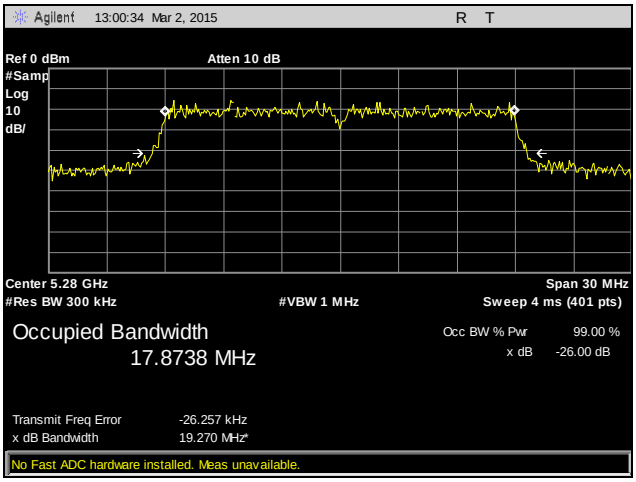


Plot 36. 99% Occupied Bandwidth, 5700 MHz, Antenna 1

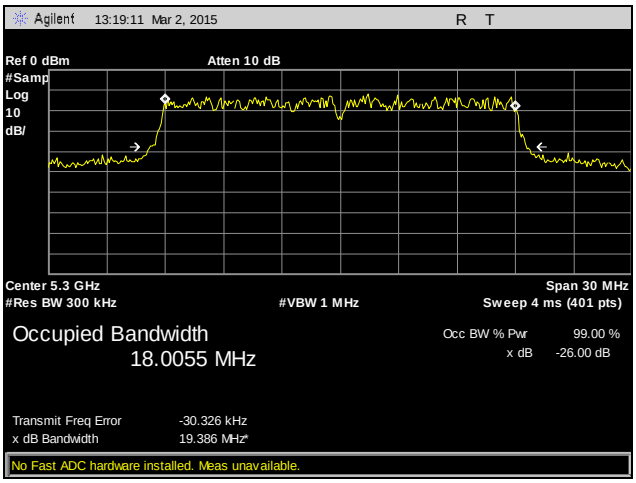
99% Occupied Bandwidth Test Results, Antenna 2



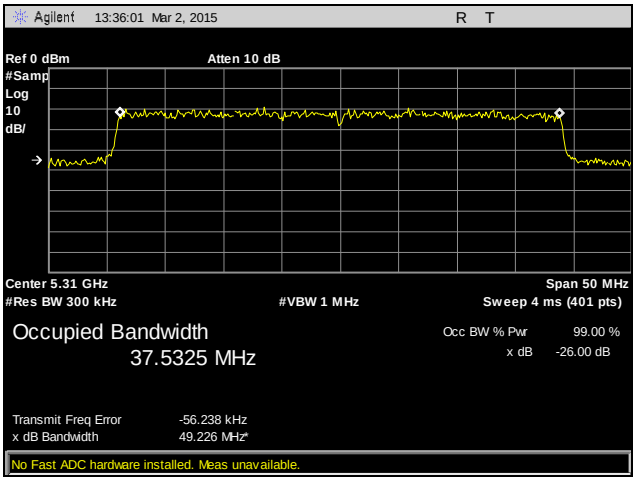
Plot 37. 99% Occupied Bandwidth, 5260 MHz, Antenna 2



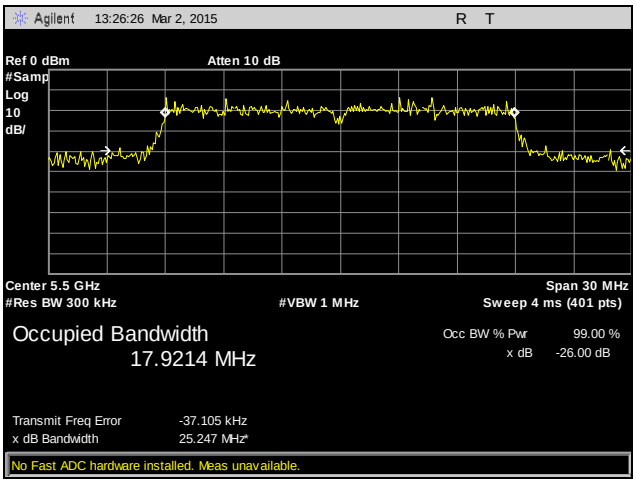
Plot 38. 99% Occupied Bandwidth, 5280 MHz, Antenna 2



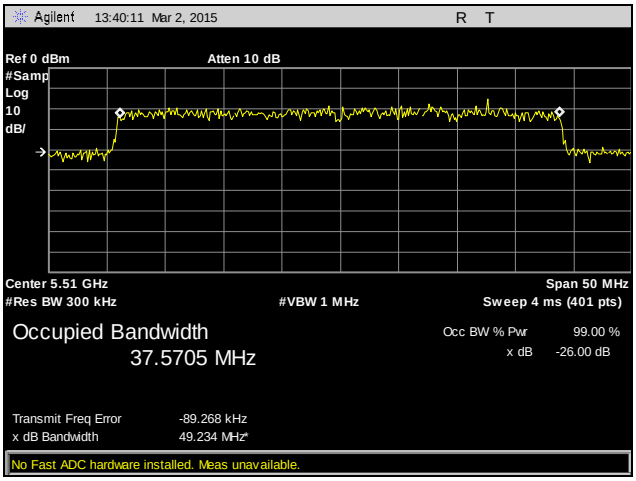
Plot 39. 99% Occupied Bandwidth, 5300 MHz, Antenna 2



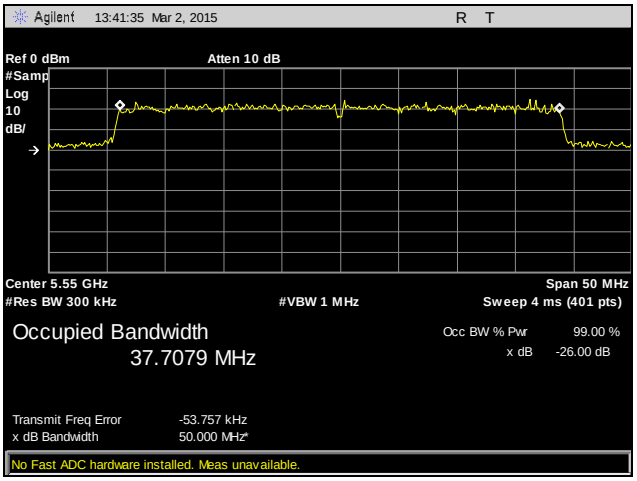
Plot 40. 99% Occupied Bandwidth, 5310 MHz, Antenna 2



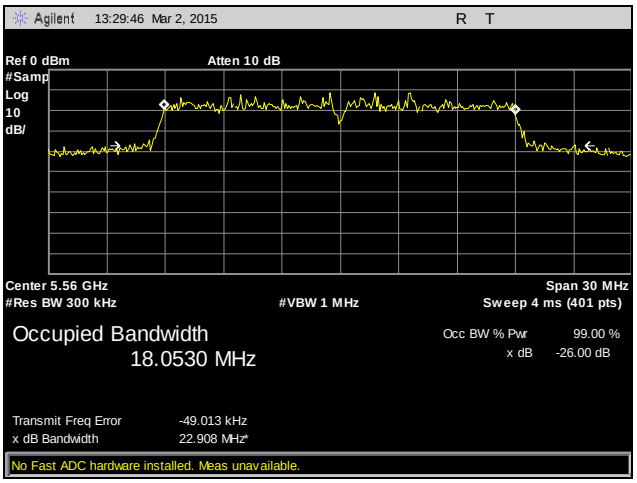
Plot 41. 99% Occupied Bandwidth, 5500 MHz, Antenna 2



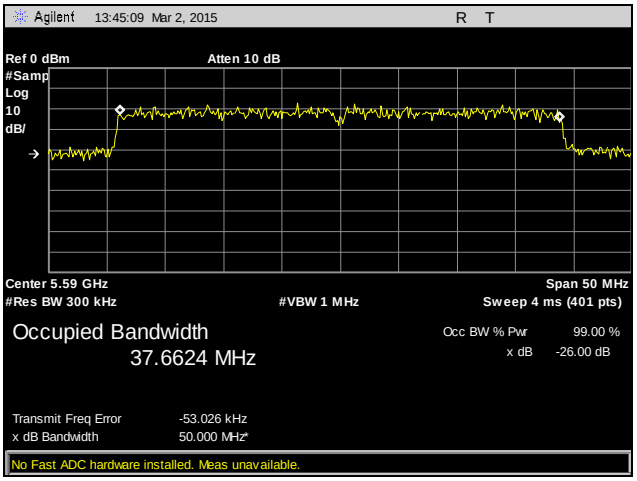
Plot 42. 99% Occupied Bandwidth, 5510 MHz, Antenna 2



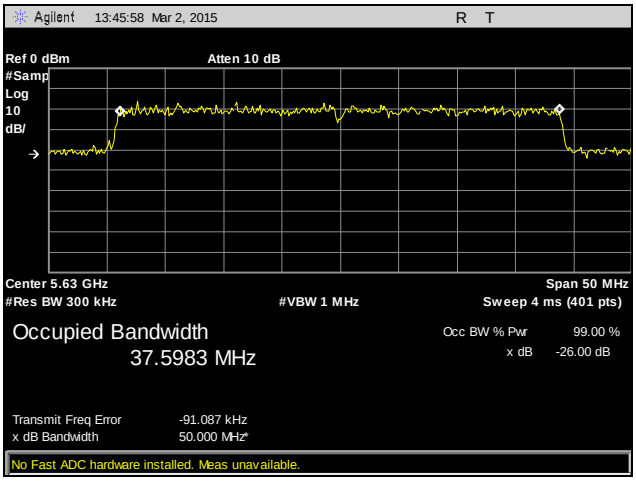
Plot 43. 99% Occupied Bandwidth, 5550 MHz, Antenna 2



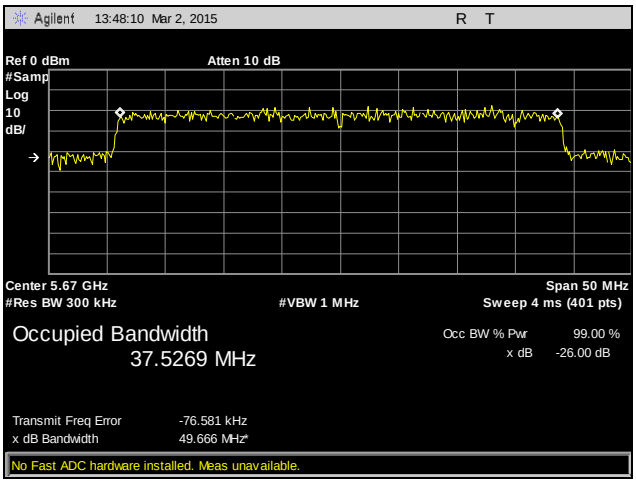
Plot 44. 99% Occupied Bandwidth, 5560 MHz, Antenna 2



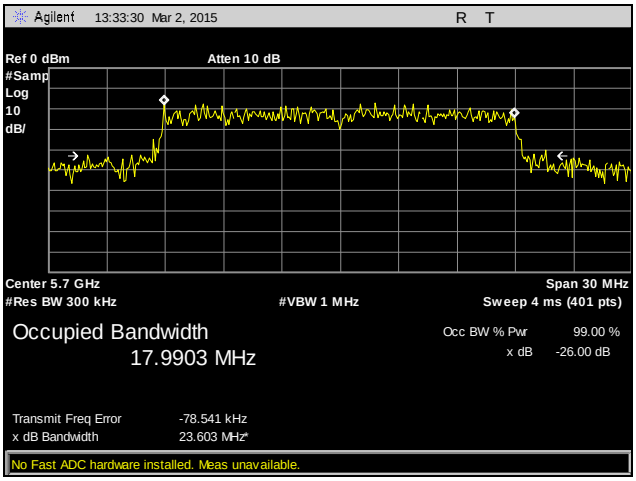
Plot 45. 99% Occupied Bandwidth, 5590 MHz, Antenna 2



Plot 46. 99% Occupied Bandwidth, 5630 MHz, Antenna 2



Plot 47. 99% Occupied Bandwidth, 5670 MHz, Antenna 2



Plot 48. 99% Occupied Bandwidth, 5700 MHz, Antenna 2

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15. 407(a)(2) RF Power Output

Test Requirements: **§15.407(a)(2)**: For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz..

Test Procedure: The EUT was connected to a spectrum analyzer through a attenuator and set to transmit continuously on the low, mid, and high channels. Its power was measured according to measurement method SA-1, as described in 789033 D01 General UNII Test Procedures v01r02.

Test Engineer(s): Djed Mouada

Test Date(s): 03/23/15

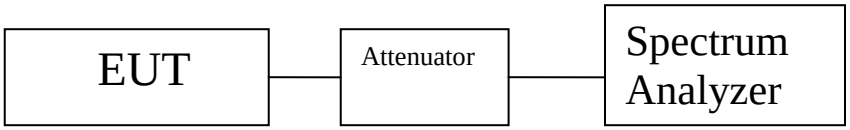


Figure 3. Power Output Test Setup

Frequency (MHz)	Antenna 1 Power (dBm)	Antenna 2 Power (dBm)	Sum (dBm)	Limit (dBm)	Margin (dB)	GUI Setting
5260	19.81	18.44	22.189	24	-1.811	20
5280	19.4	18.43	21.952	24	-2.048	22
5300	18.91	17.33	21.202	24	-2.798	21
5500	15.53	14.81	18.195	24	-5.805	17
5560	17.71	19.19	21.523	24	-2.477	20
5700	16.07	16.38	19.238	24	-4.762	17
5310	16.78	17.14	19.974	24	-4.026	22
5510	15.45	16.67	19.113	24	-4.887	18
5550	19.39	20.27	22.863	24	-1.137	22
5590	18.91	20.21	22.619	24	-1.381	22
5630	18.63	19.17	21.919	24	-2.081	22
5670	18.81	19.09	21.963	24	-2.037	22

Table 11. RF Power Output, Test Results

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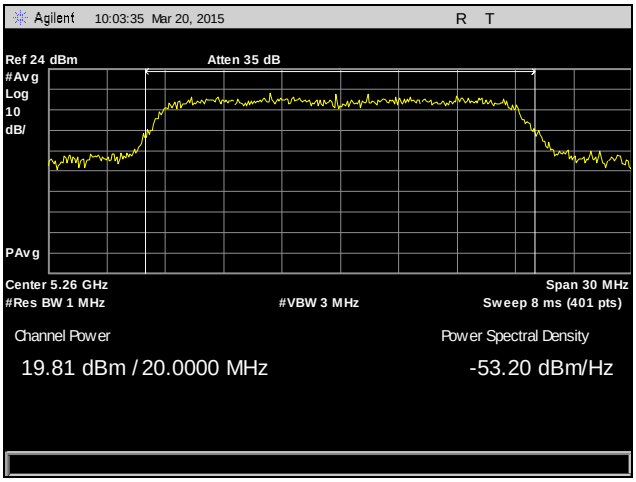
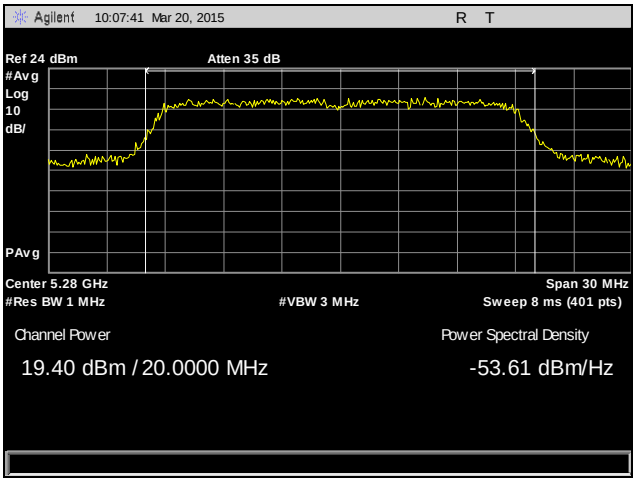
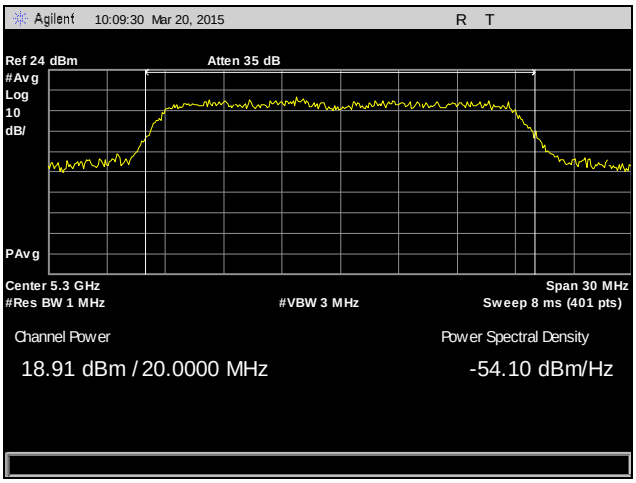
RF Output Power Test Results, Antenna 1



Plot 49. RF Output Power, 5260 MHz, Antenna 1



Plot 50. RF Output Power, 5280 MHz, Antenna 1



Plot 51. RF Output Power, 5300 MHz, Antenna 1

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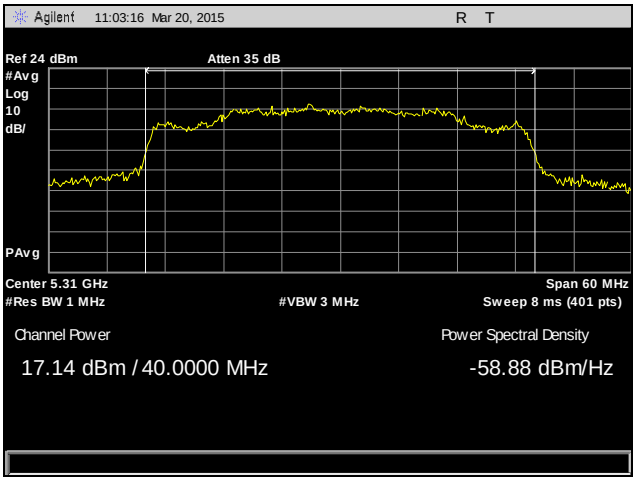
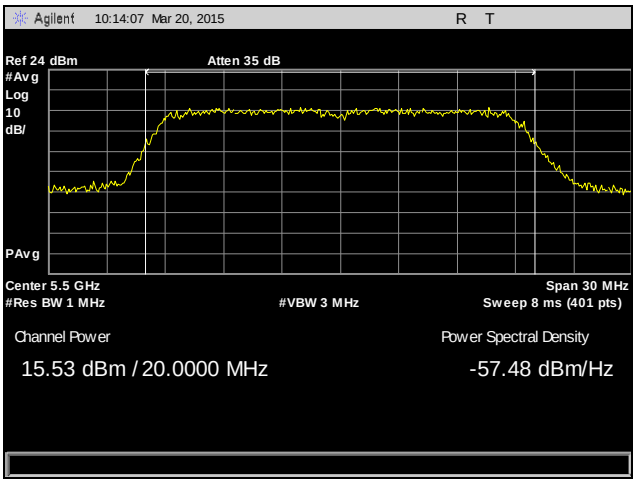
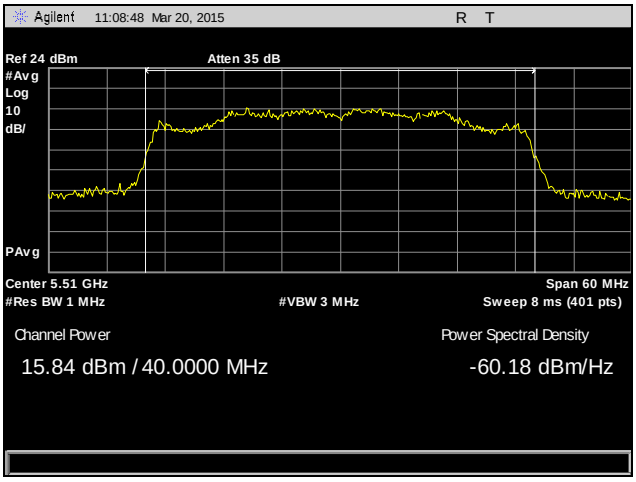


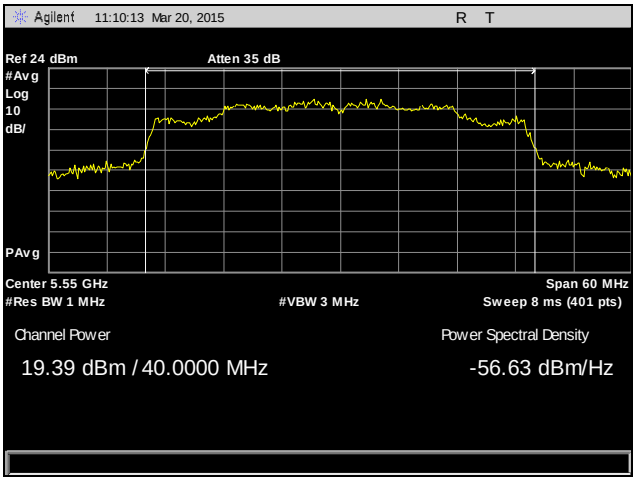
Plot 52. RF Output Power, 5310 MHz, Antenna 1



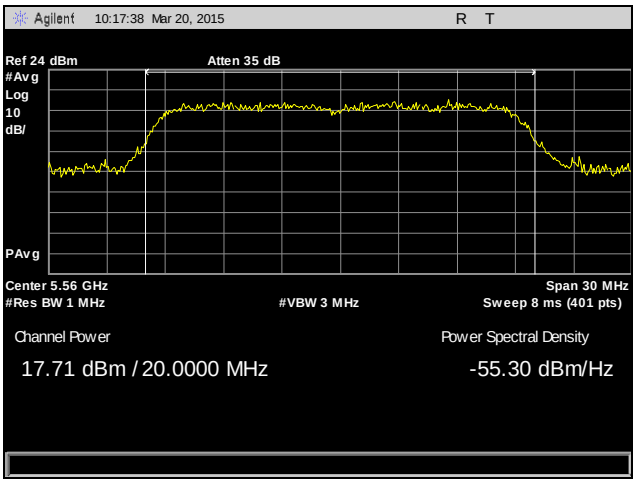
Plot 53. RF Output Power, 5500 MHz, Antenna 1



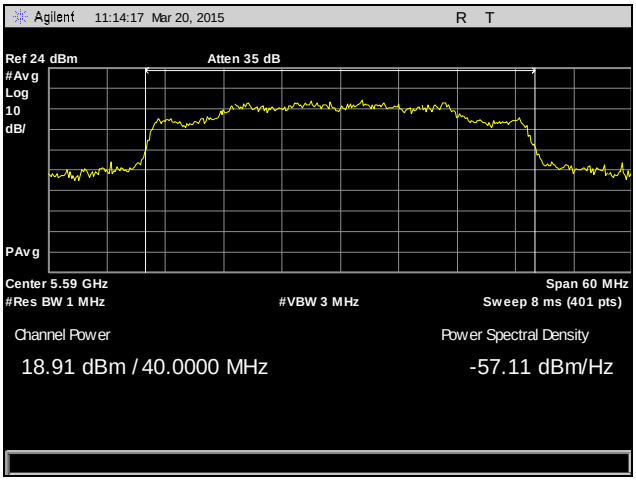
Plot 54. RF Output Power, 5510 MHz, Antenna 1



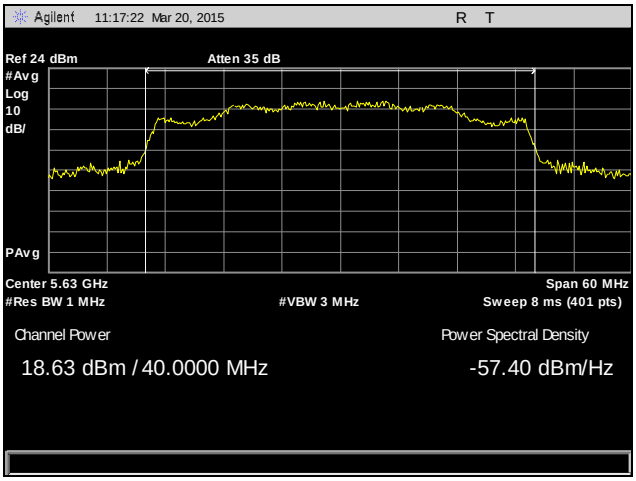
Plot 55. RF Output Power, 5550 MHz, Antenna 1



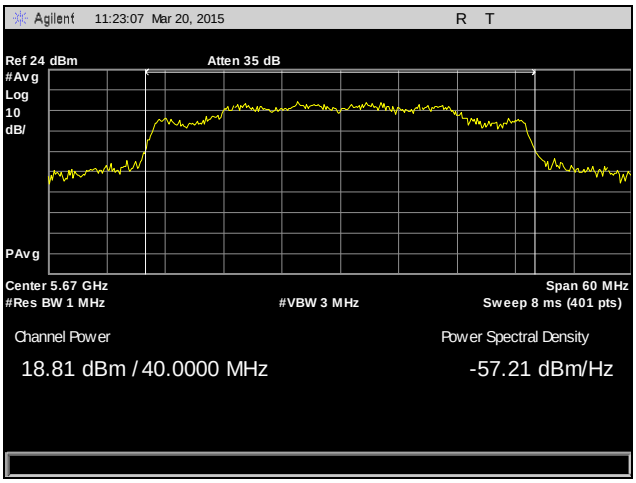
Plot 56. RF Output Power, 5560 MHz, Antenna 1



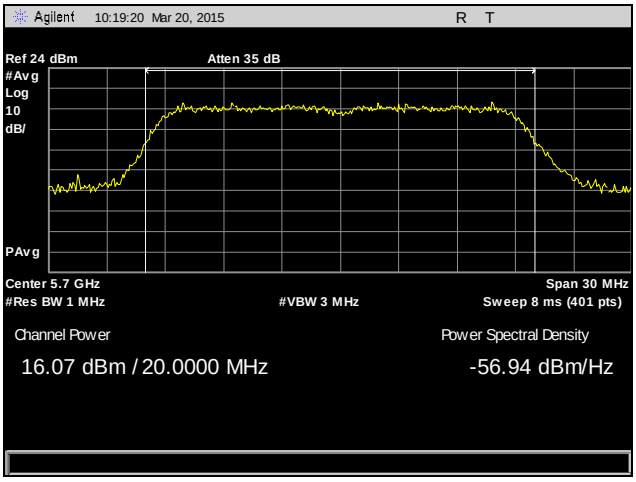
Plot 57. RF Output Power, 5590 MHz, Antenna 1



Plot 58. RF Output Power, 5630 MHz, Antenna 1



Plot 59. RF Output Power, 5670 MHz, Antenna 1



Plot 60. RF Output Power, 5700 MHz, Antenna 1

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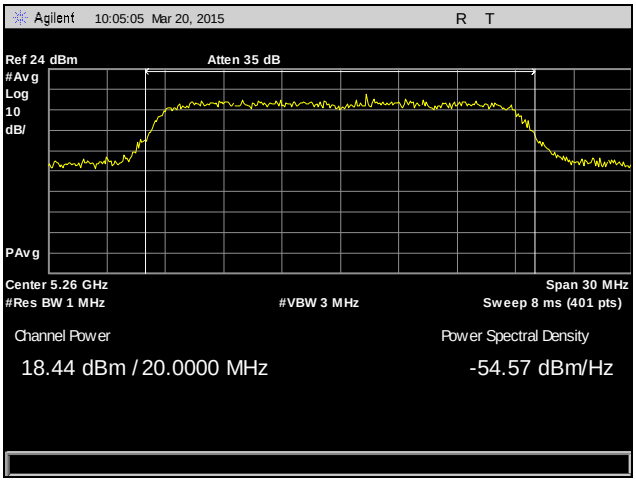
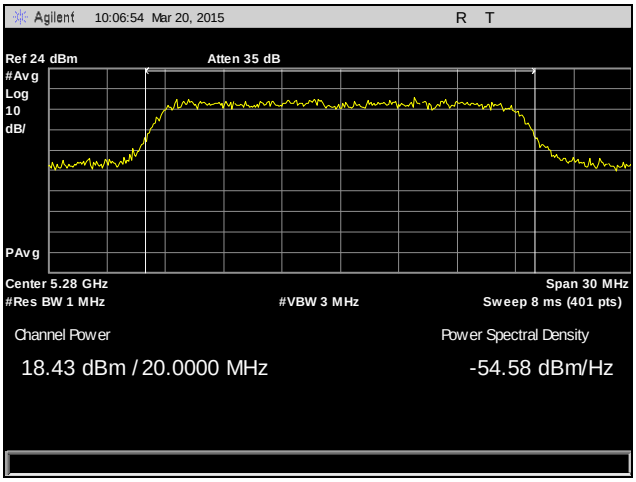
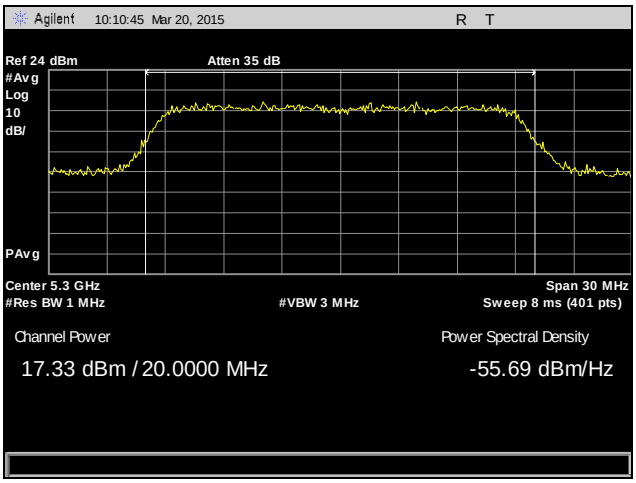
RF Output Power Test Results, Antenna 2



Plot 61. RF Output Power, 5260 MHz, Antenna 2



Plot 62. RF Output Power, 5280 MHz, Antenna 2



Plot 63. RF Output Power, 5300 MHz, Antenna 2

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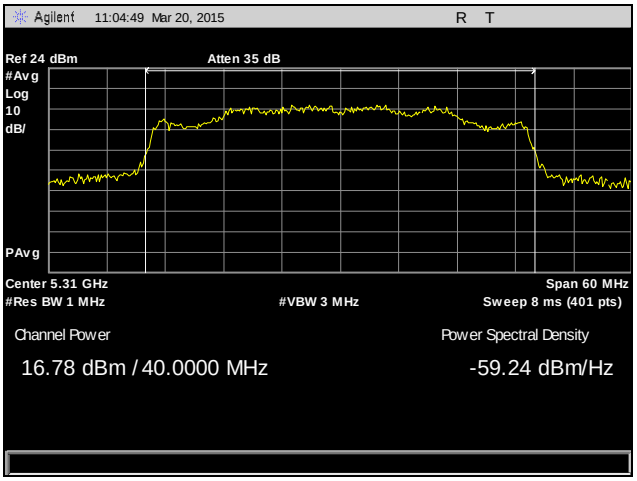
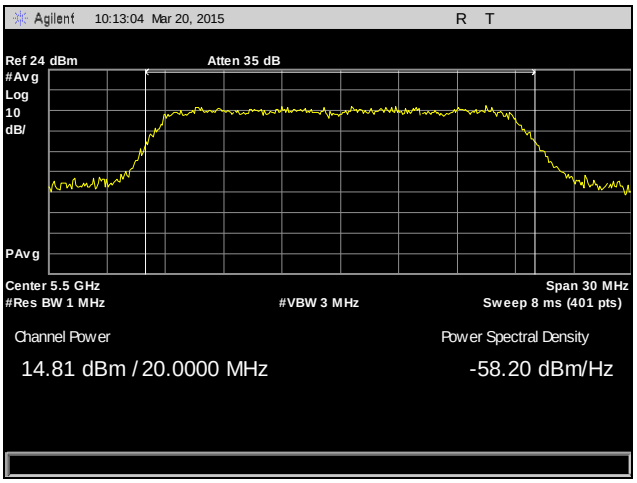
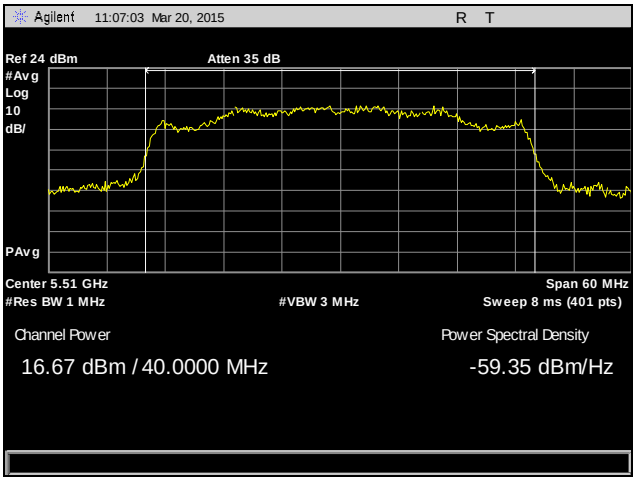


Plot 64. RF Output Power, 5310 MHz, Antenna 2



Plot 65. RF Output Power, 5500 MHz, Antenna 2



Plot 66. RF Output Power, 5510 MHz, Antenna 2

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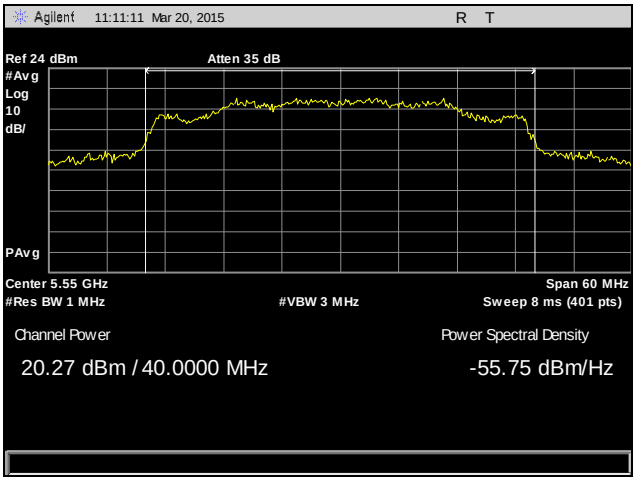
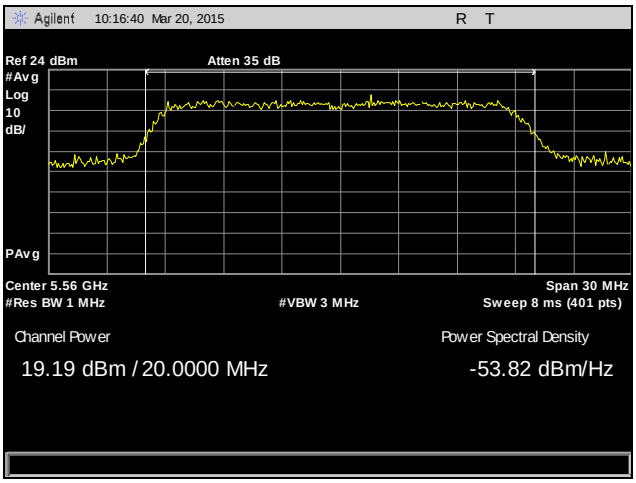
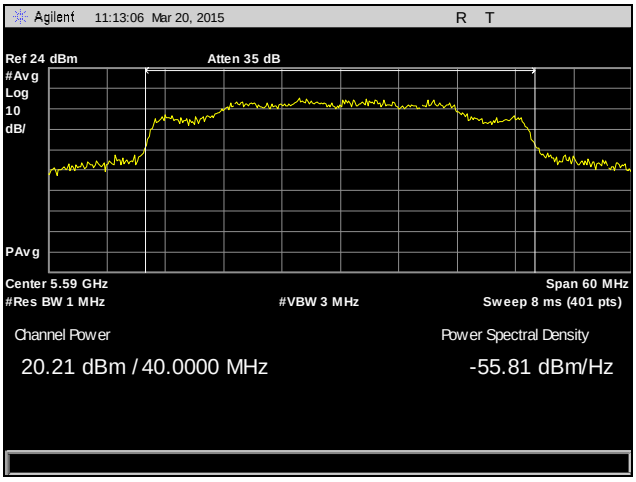


Plot 67. RF Output Power, 5550 MHz, Antenna 2



Plot 68. RF Output Power, 5560 MHz, Antenna 2



Plot 69. RF Output Power, 5590 MHz, Antenna 2

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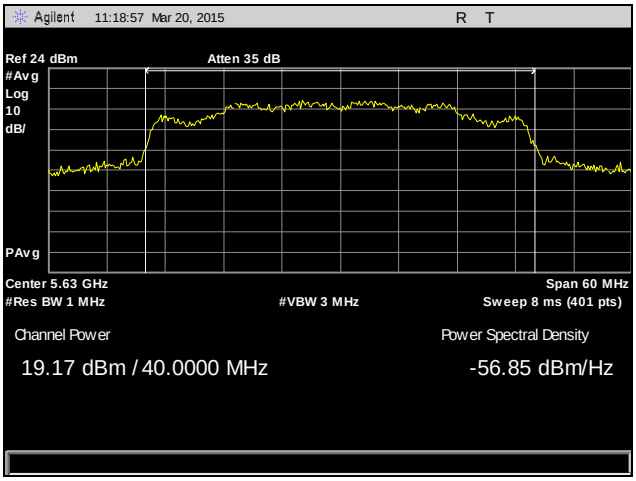
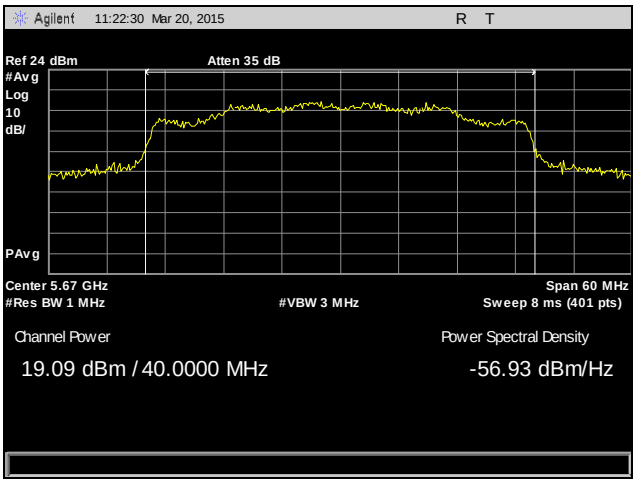
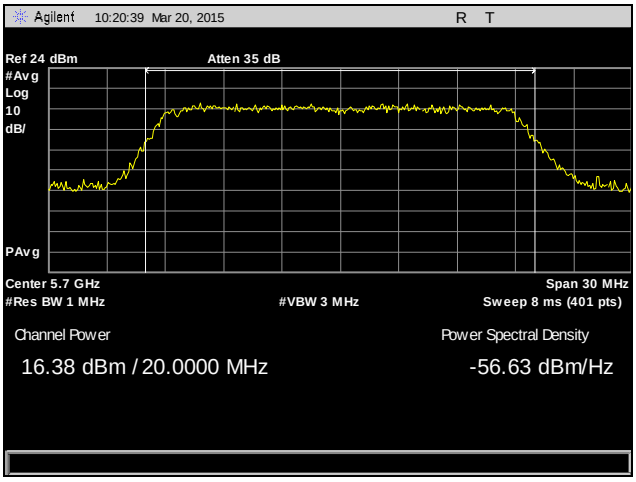


Plot 70. RF Output Power, 5630 MHz, Antenna 2



Plot 71. RF Output Power, 5670 MHz, Antenna 2



Plot 72. RF Output Power, 5700 MHz, Antenna 2

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Electromagnetic Compatibility Criteria for Intentional Radiators

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

Test Requirements: **§ 15.407(a)(2):** In addition, the peak power spectral density shall not exceed 11 dBm in any 1 megahertz band.

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The power level was set to the maximum level on the EUT. The RBW was set to 1MHz and the VBW was set to 3MHz. The method of measurement used was method SA-1 from 789033 D01 General UNII Test Procedures v01r02.

Test Results: Equipment was compliant with the peak power spectral density limits of **§ 15.407 (a)(2).** The peak power spectral density was determined from plots on the following page(s).

The following table presents the 99% bandwidth measurements and their average peak spectral density per MHz. The PSD measurements are below the average and thus fulfill the requirements of RSS-210 Annex 9.4.

Test Engineer(s): Djed Mouada

Test Date(s): 03/23/15

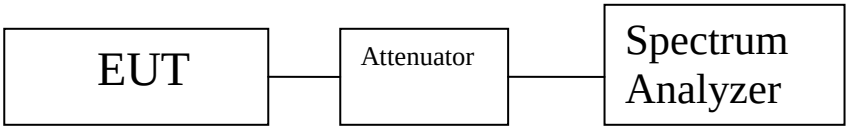

Figure 4. Power Spectral Density Test Setup

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Frequency	Antenna 1 PSD (dBm)	Antenna 2 PSD (dBm)	Sum (dBm)	Limit (dBm)	Margin (dB)	GUI Setting
5260	7.893	6.025	10.069	11	-0.931	20
5280	9.116	5.282	10.619	11	-0.381	22
5300	8.237	6.521	10.474	11	-0.526	21
5500	5.509	6.14	8.846	11	-2.154	17
5560	8.535	5.853	10.408	11	-0.592	20
5700	4.672	2.469	6.719	11	-4.281	17
5310	6.05	2.63	7.679	11	-3.321	22
5510	3.53	2.779	6.181	11	-4.819	18
5550	6.219	8.24	10.356	11	-0.644	22
5590	4.951	5.914	8.469	11	-2.531	22
5630	6.75	7.18	9.981	11	-1.019	22
5670	7.065	6.745	9.918	11	-1.082	22

Table 12. Peak Power Spectral Density, Test Results

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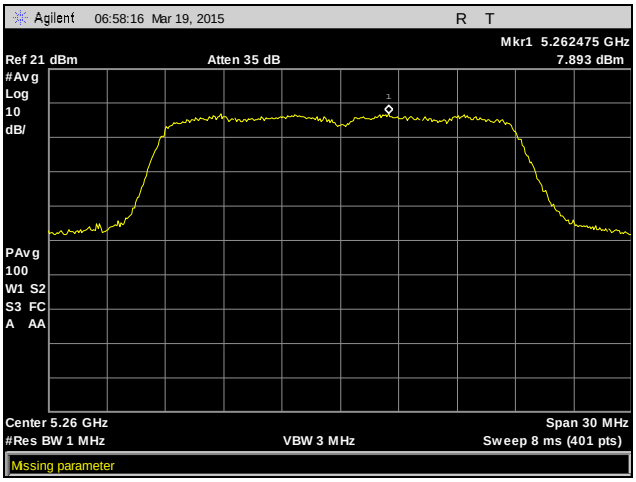
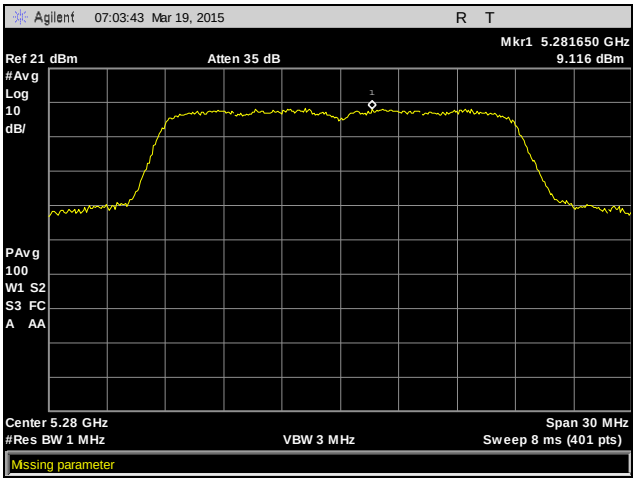
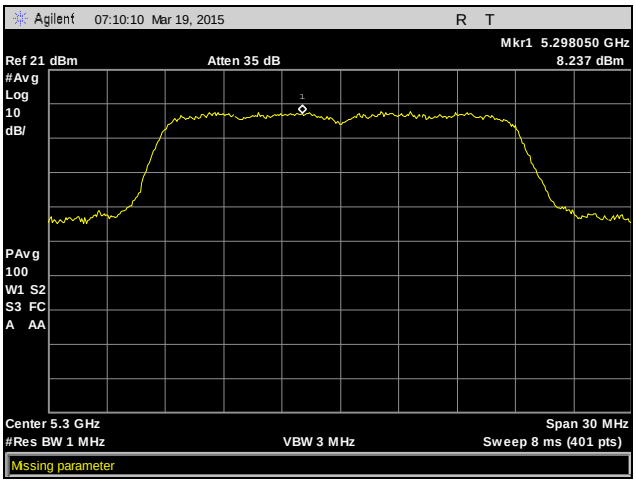
Peak Power Spectral Density Test Results, Antenna 1



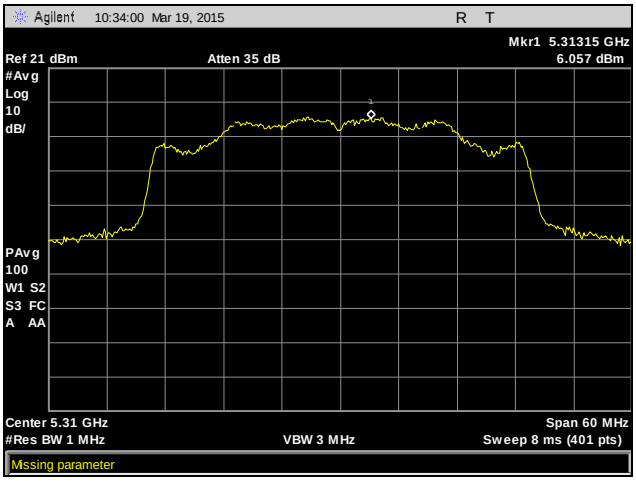
Plot 73. Peak Power Spectral Density, 5260 MHz, Antenna 1



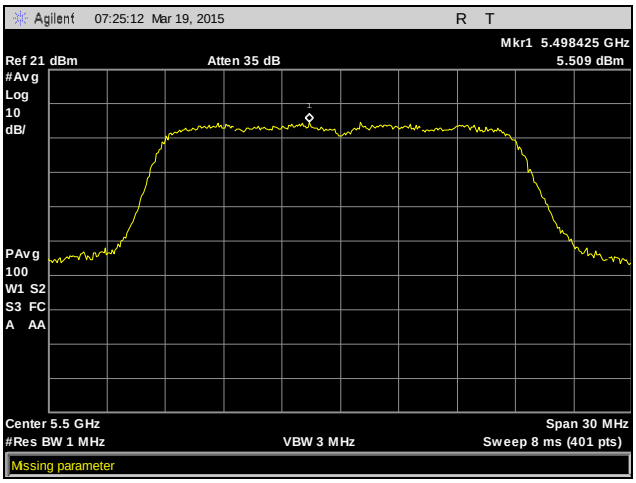
Plot 74. Peak Power Spectral Density, 5280 MHz, Antenna 1



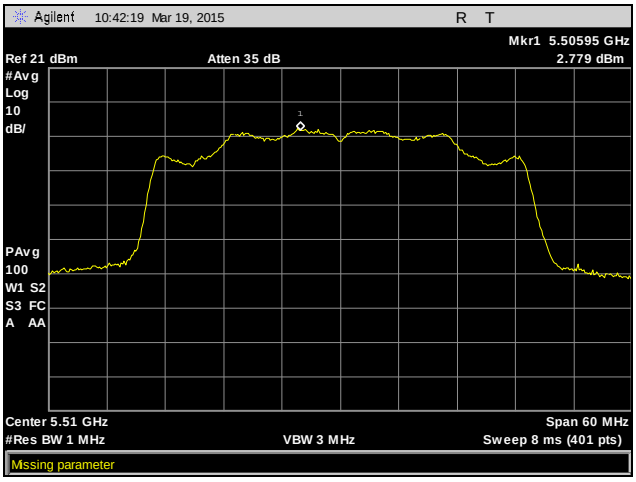
Plot 75. Peak Power Spectral Density, 5300 MHz, Antenna 1



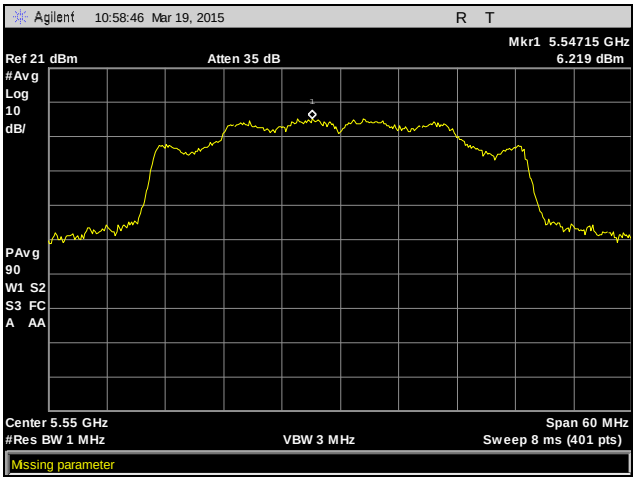
Plot 76. Peak Power Spectral Density, 5310 MHz, Antenna 1



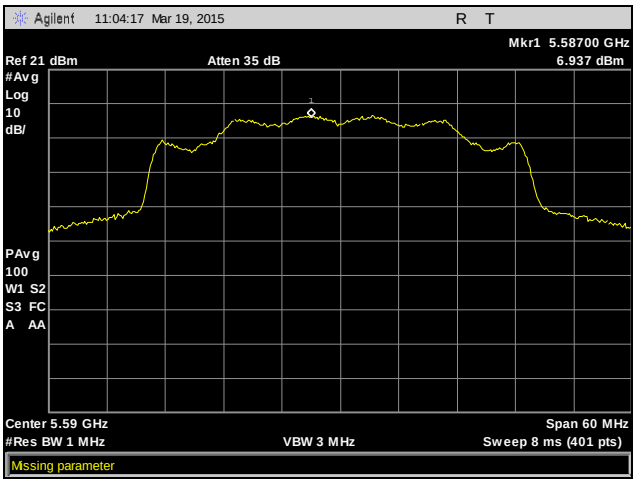
Plot 77. Peak Power Spectral Density, 5500 MHz, Antenna 1



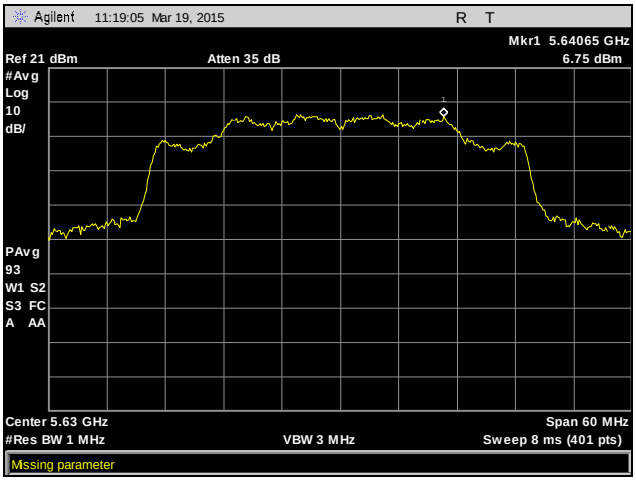
Plot 78. Peak Power Spectral Density, 5510 MHz, Antenna 1



Plot 79. Peak Power Spectral Density, 5550 MHz, Antenna 1

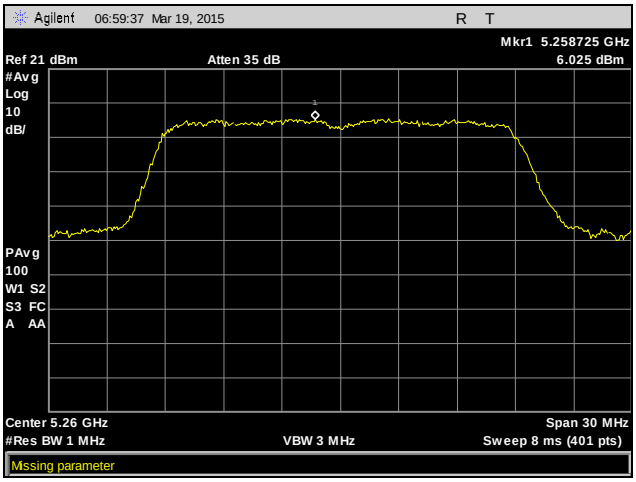


Plot 80. Peak Power Spectral Density, 5590 MHz, Antenna 1

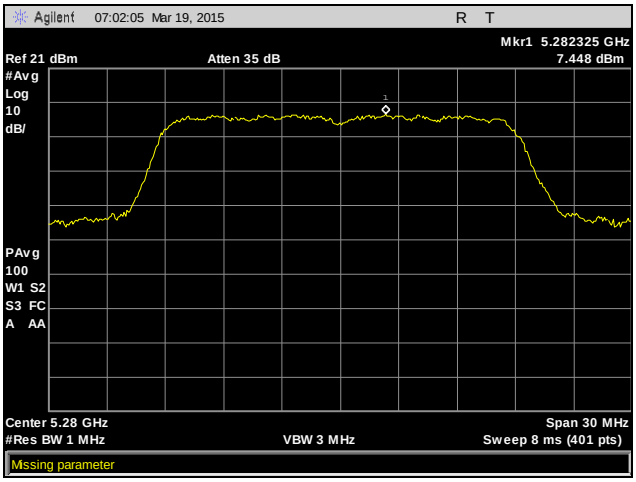


Plot 81. Peak Power Spectral Density, 5630 MHz, Antenna 1

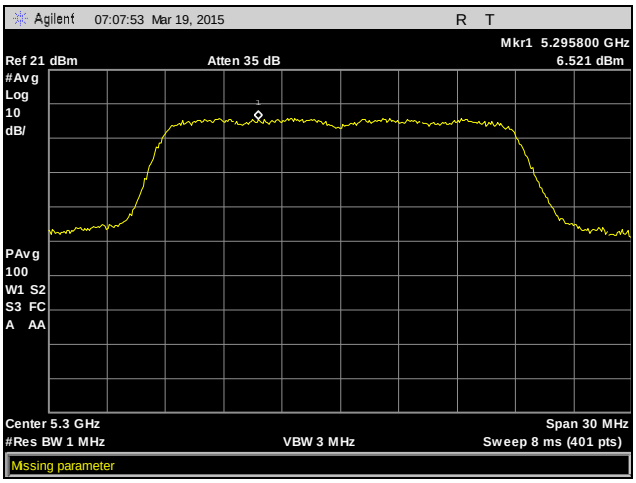
Peak Power Spectral Density Test Results, Antenna 2



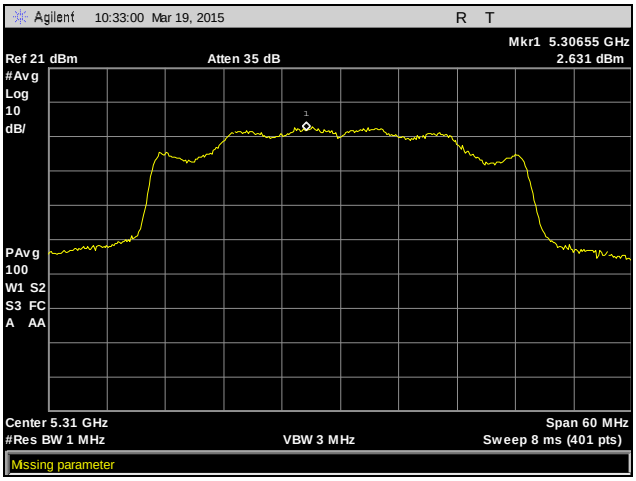
Plot 82. Peak Power Spectral Density, 5260 MHz, Antenna 2



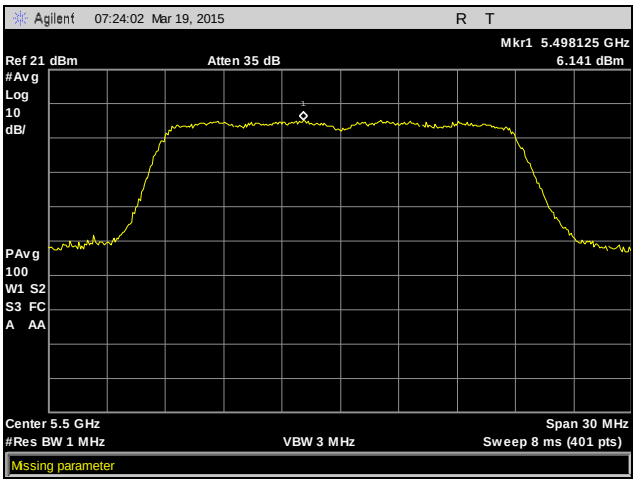
Plot 83. Peak Power Spectral Density, 5280 MHz, Antenna 2



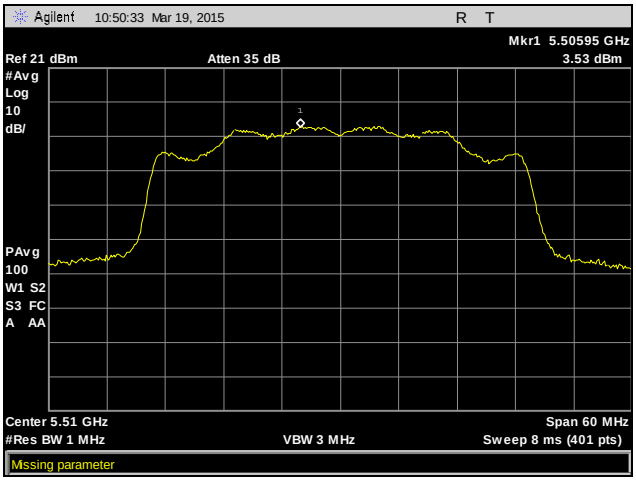
Plot 84. Peak Power Spectral Density, 5300 MHz, Antenna 2



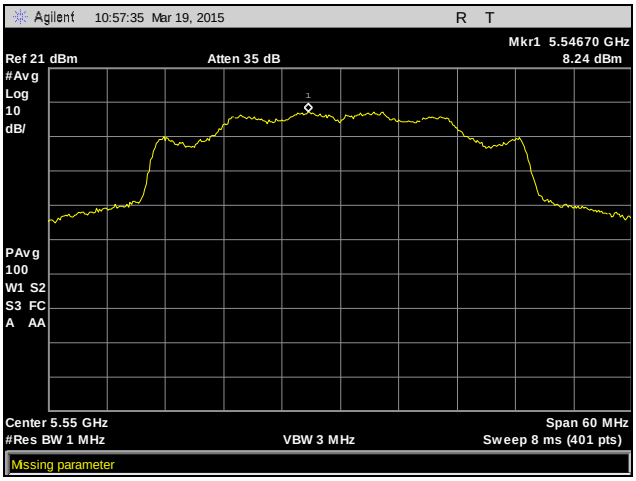
Plot 85. Peak Power Spectral Density, 5310 MHz, Antenna 2



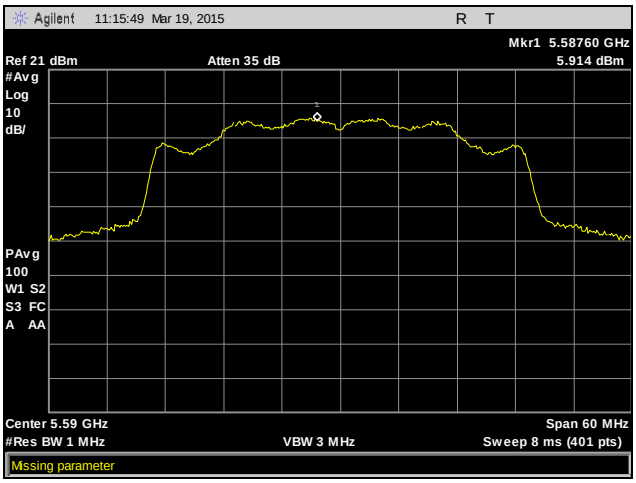
Plot 86. Peak Power Spectral Density, 5500 MHz, Antenna 2



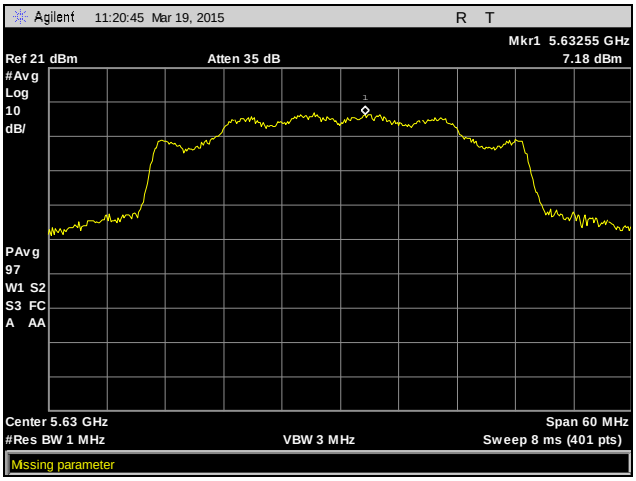
Plot 87. Peak Power Spectral Density, 5510 MHz, Antenna 2



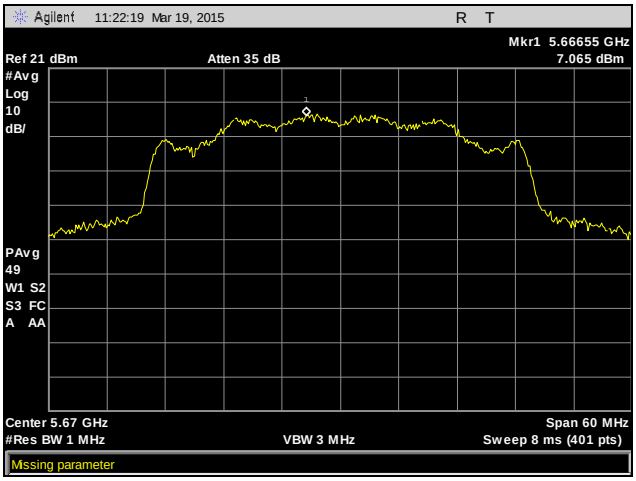
Plot 88. Peak Power Spectral Density, 5550 MHz, Antenna 2



Plot 89. Peak Power Spectral Density, 5590 MHz, Antenna 2



Plot 90. Peak Power Spectral Density, 5630 MHz, Antenna 2



Plot 91. Peak Power Spectral Density, 5670 MHz, Antenna 2

Electromagnetic Compatibility Criteria for Intentional Radiators
§ 15.407(b)(2), (3), (7) Undesirable Emissions

Test Requirements: **§ 15.407(b)(2), (3), (7)**; **§15.205:** Emissions outside the frequency band.

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

§ 15.407(b)(3): For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

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

Test Procedure: The transmitter was placed on an 80cm table inside in a semi-anechoic chamber. Measurements were performed with the EUT rotated 360 degrees and varying the adjustable antenna mast height to determine worst case orientation for maximum emissions. A preamp was used in the range from 7-18GHz to improve noise floor. Plots were corrected for cable loss, antenna, and preamp gain.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

For measurements above 1 GHz, measurements were made with a Peak detector with 1 MHz resolution bandwidth. A notch filter was use to filter out the transmitting channel. Where the spurious emissions fell into a restricted band, measurements were also made with an average detector to make sure they complied with 15.209 limits. Only noise floor was seen above 18 GHz. Worst case emissions shown by antenna.

Test Results: The EUT was compliant with the Radiated Emission limits for Intentional Radiators. See following pages for detailed test results.

Test Engineer(s): Djed Mouada

Test Date(s): 03/23/15

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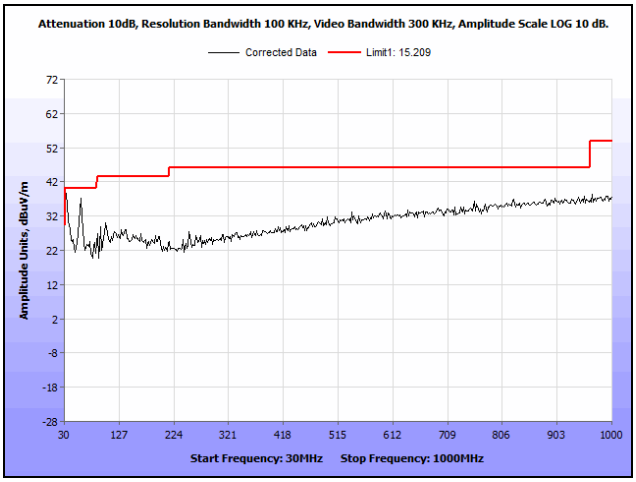
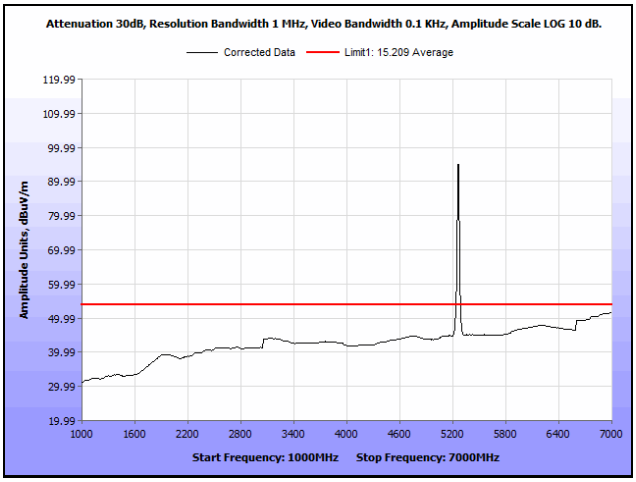
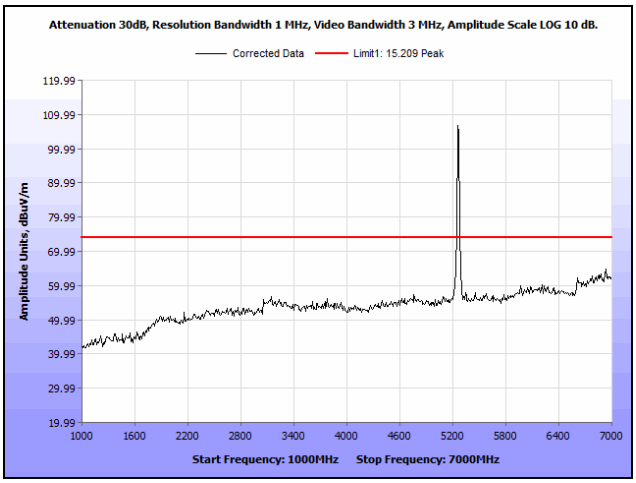
Radiated Spurious Emissions, Rubber Ducky Antenna



Plot 92. Radiated Spurious Emissions, 5260 MHz, Rubber Ducky Antenna, 30 MHz – 1 GHz



Plot 93. Radiated Spurious Emissions, 5260 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Average



Plot 94. Radiated Spurious Emissions, 5260 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Peak

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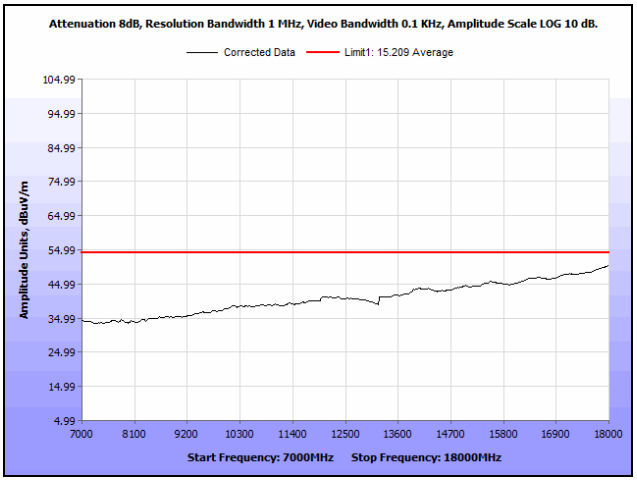
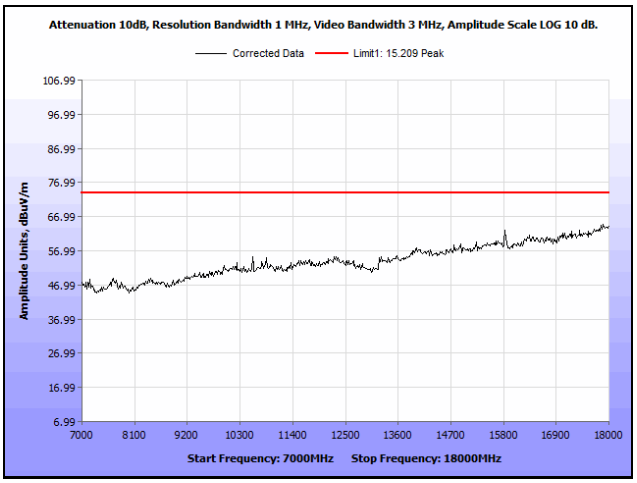
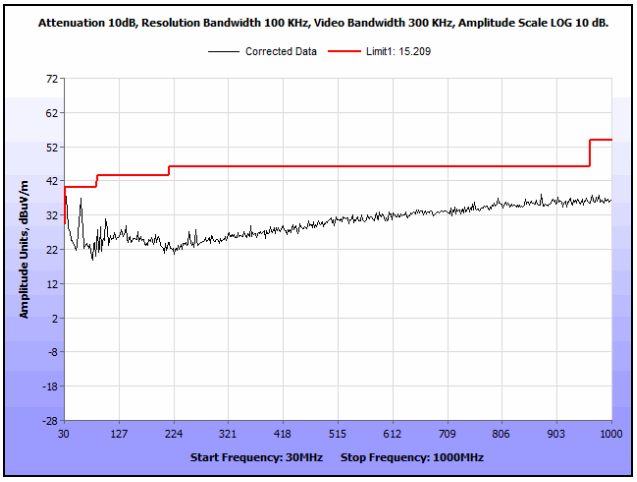


Plot 95. Radiated Spurious Emissions, 5260 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Average



Plot 96. Radiated Spurious Emissions, 5260 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Peak



Plot 97. Radiated Spurious Emissions, 5280 MHz, Rubber Ducky Antenna, 30 MHz – 1 GHz

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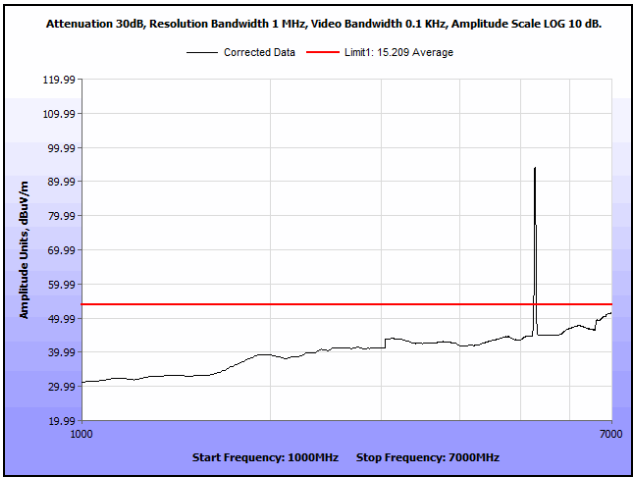
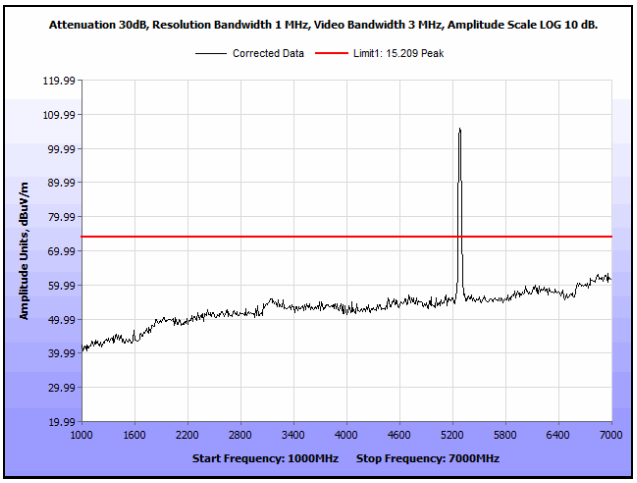
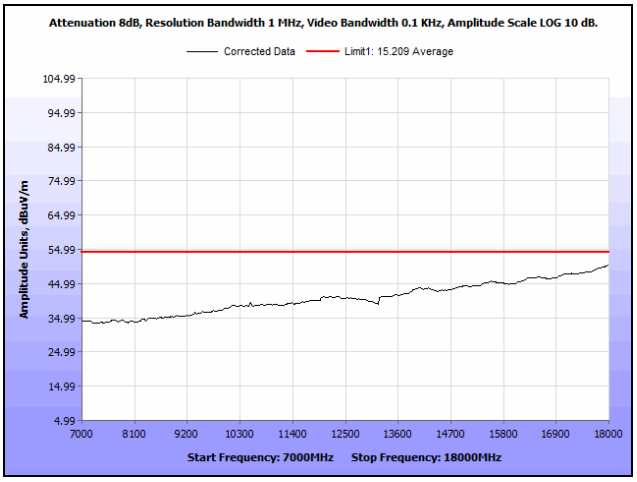


Plot 98. Radiated Spurious Emissions, 5280 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Average



Plot 99. Radiated Spurious Emissions, 5280 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Peak



Plot 100. Radiated Spurious Emissions, 5280 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Average

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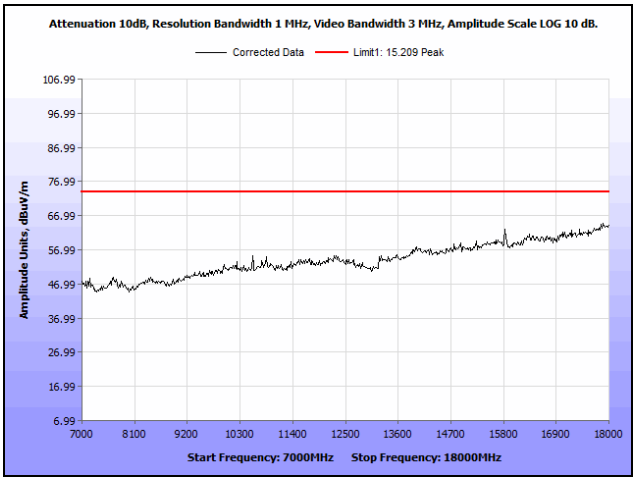
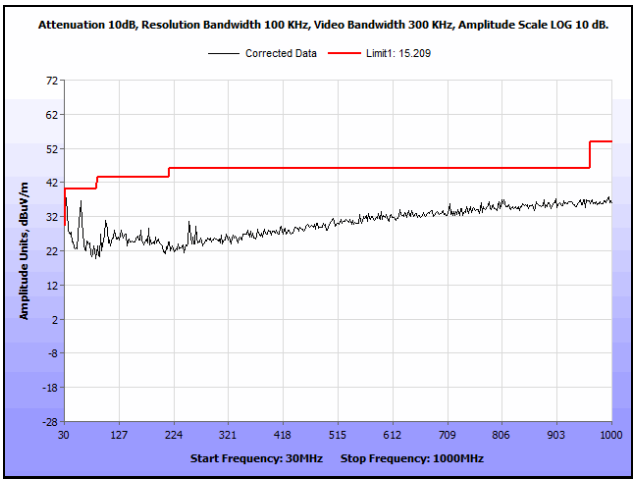
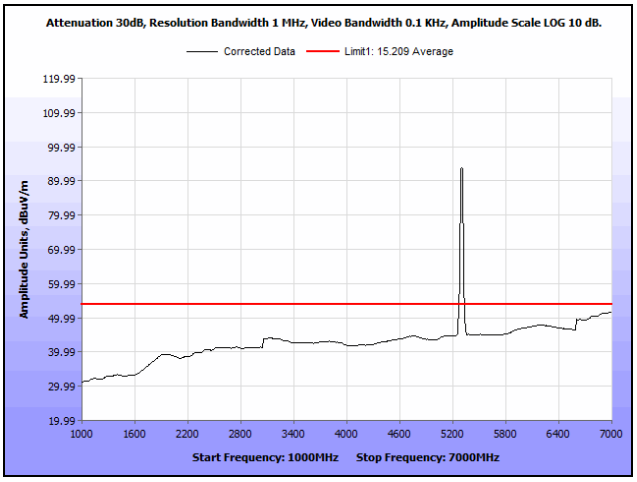


Plot 101. Radiated Spurious Emissions, 5280 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Peak



Plot 102. Radiated Spurious Emissions, 5300 MHz, Rubber Ducky Antenna, 30 MHz – 1 GHz



Plot 103. Radiated Spurious Emissions, 5300 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Average

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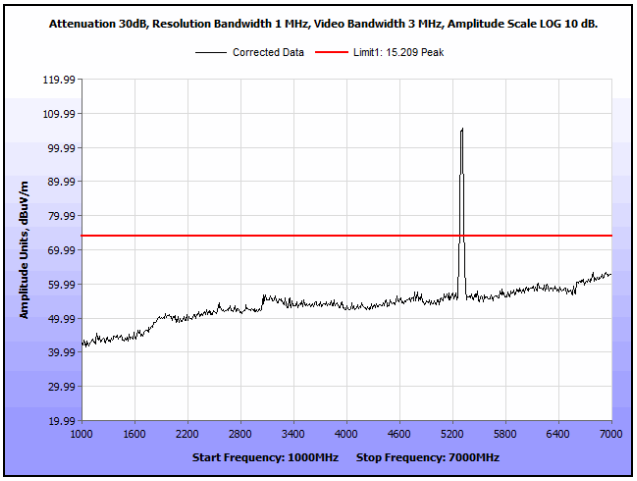
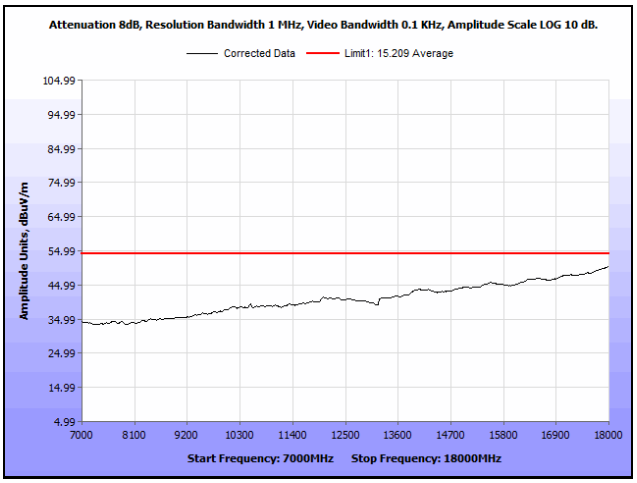
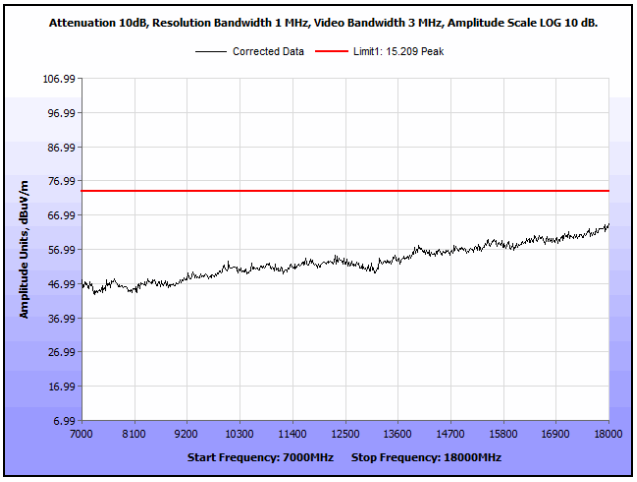


Plot 104. Radiated Spurious Emissions, 5300 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Peak



Plot 105. Radiated Spurious Emissions, 5300 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Average



Plot 106. Radiated Spurious Emissions, 5300 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Peak

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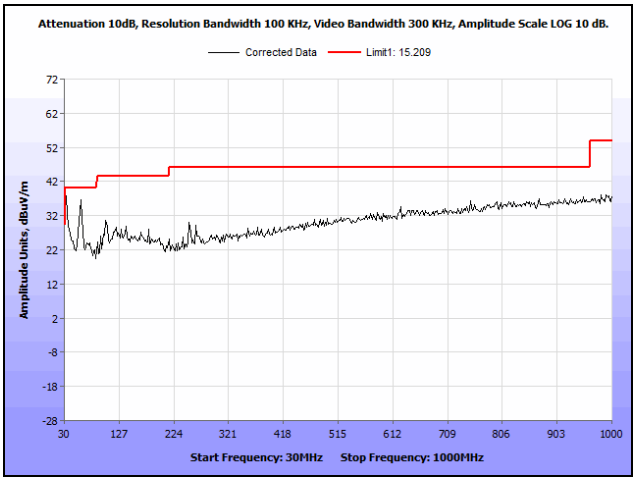
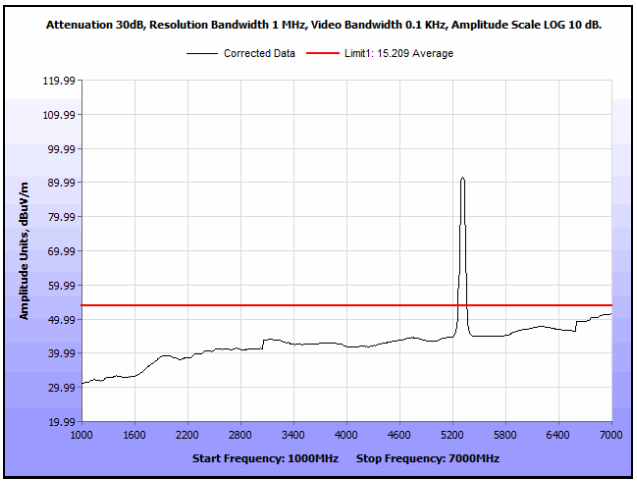
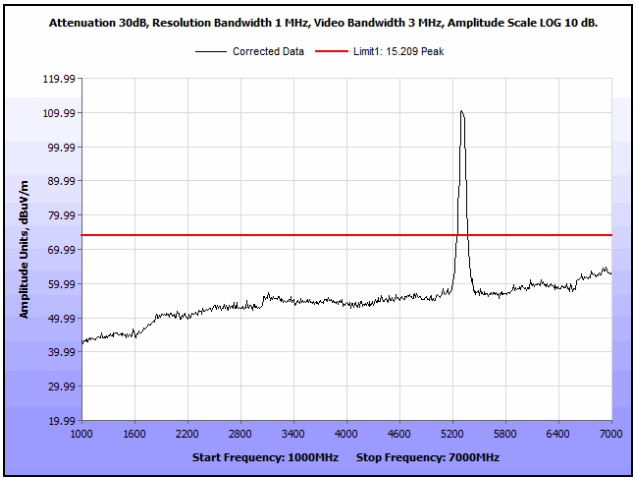


Plot 107. Radiated Spurious Emissions, 5310 MHz, Rubber Ducky Antenna, 30 MHz – 1 GHz



Plot 108. Radiated Spurious Emissions, 5310 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Average



Plot 109. Radiated Spurious Emissions, 5310 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Peak

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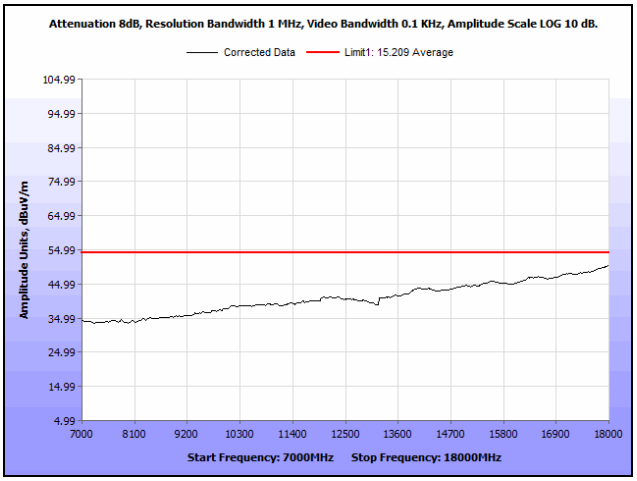
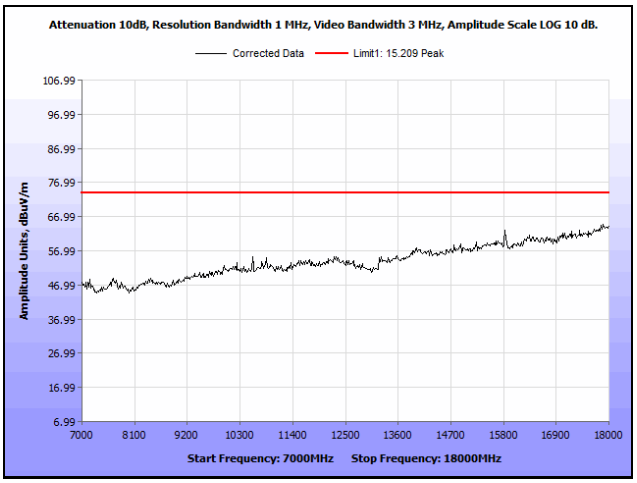
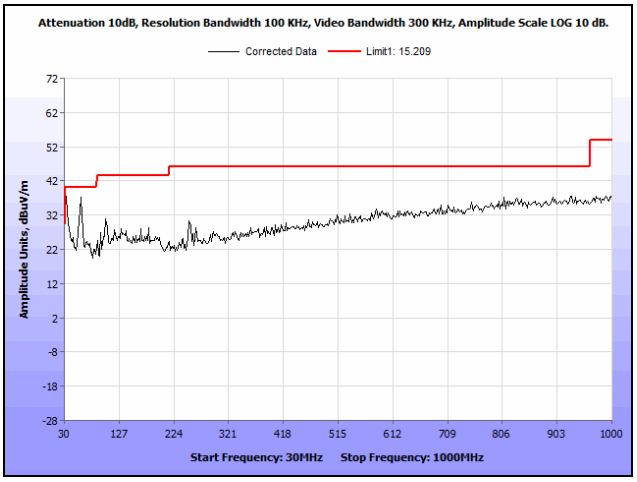


Plot 110. Radiated Spurious Emissions, 5310 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Average



Plot 111. Radiated Spurious Emissions, 5310 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Peak



Plot 112. Radiated Spurious Emissions, 5500 MHz, Rubber Ducky Antenna, 30 MHz – 1 GHz

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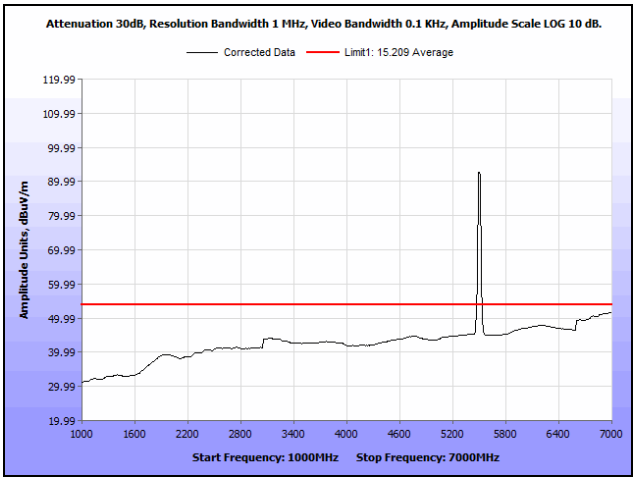
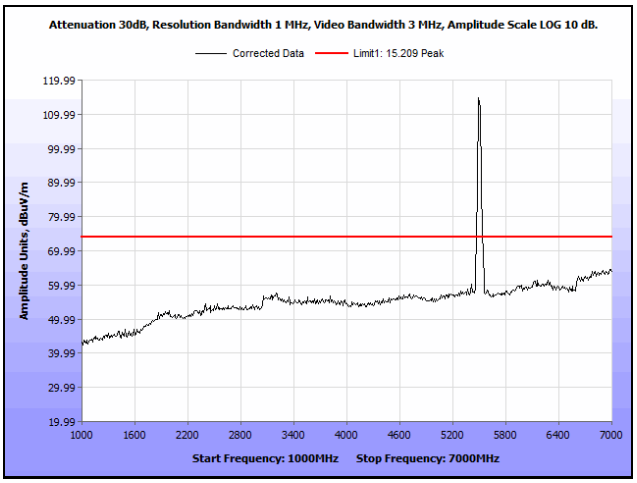
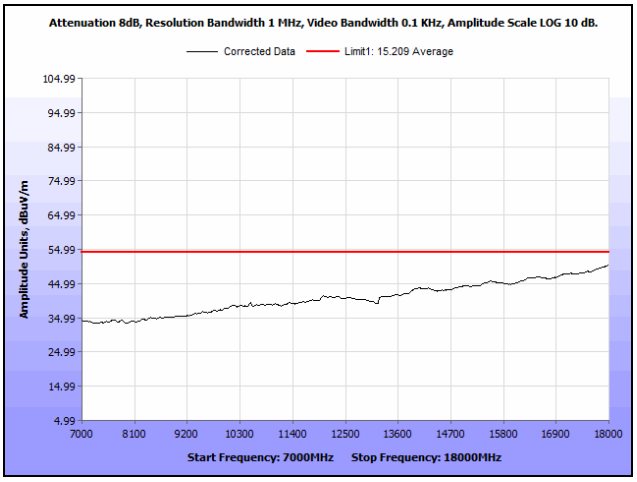


Plot 113. Radiated Spurious Emissions, 5500 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Average

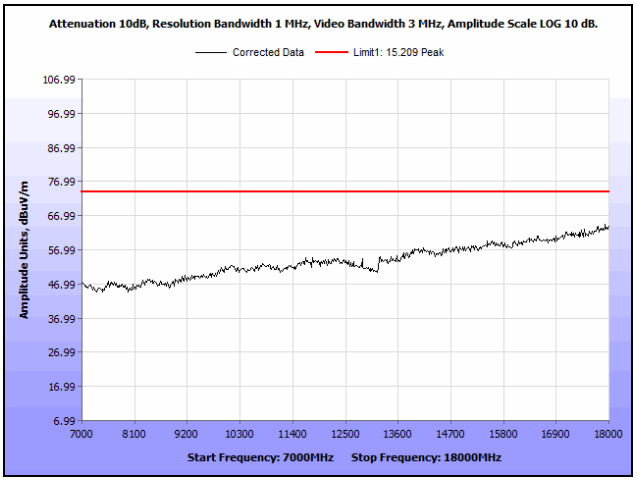


Plot 114. Radiated Spurious Emissions, 5500 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Peak

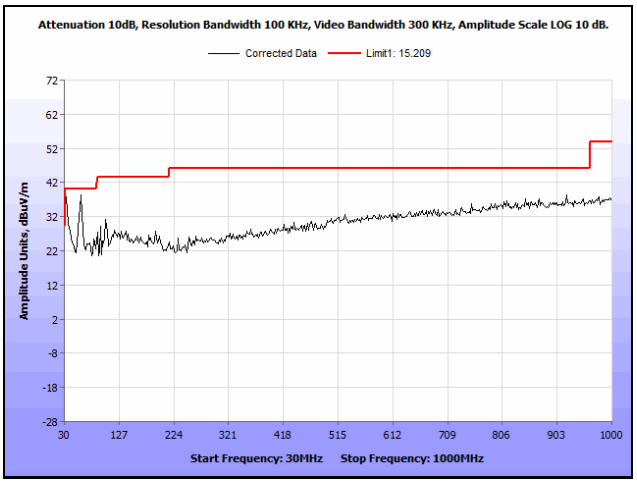


Plot 115. Radiated Spurious Emissions, 5500 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Average

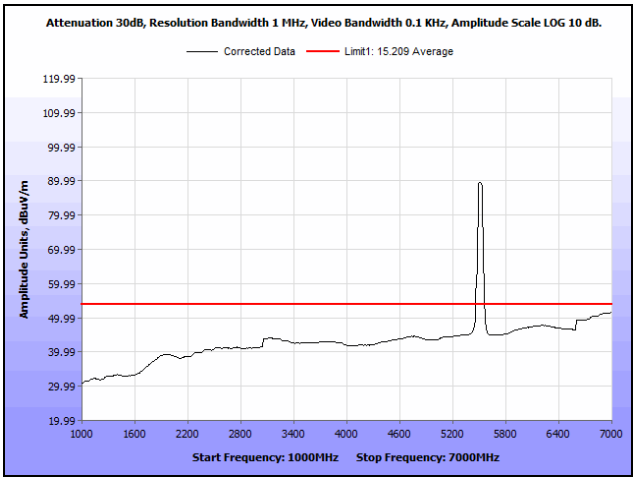
 © 2015, MET Laboratories, Inc.



Plot 116. Radiated Spurious Emissions, 5500 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Peak



Plot 117. Radiated Spurious Emissions, 5510 MHz, Rubber Ducky Antenna, 30 MHz – 1 GHz



Plot 118. Radiated Spurious Emissions, 5510 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Average

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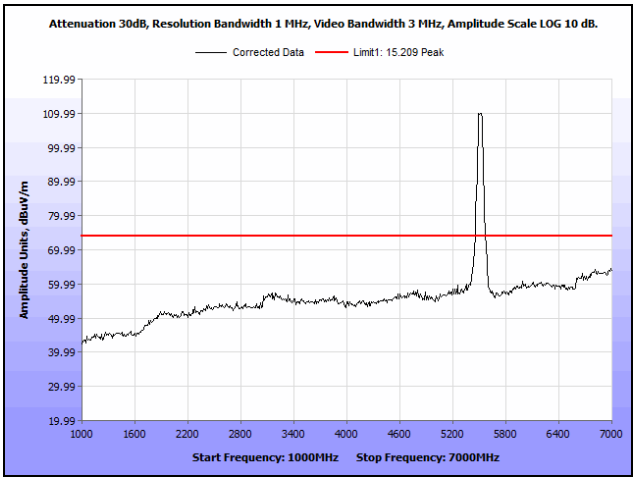
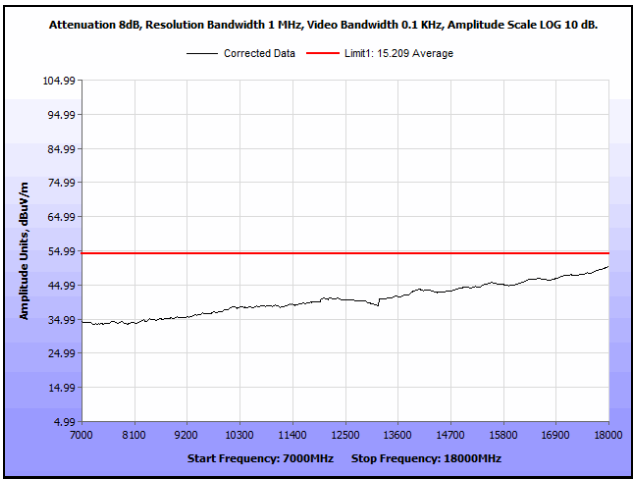
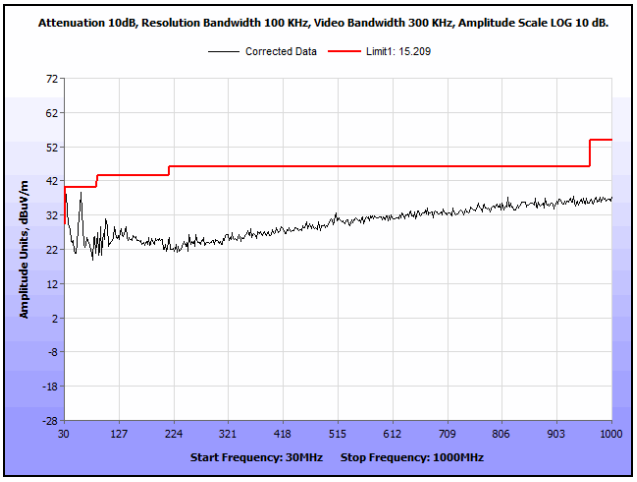


Plot 119. Radiated Spurious Emissions, 5510 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Peak

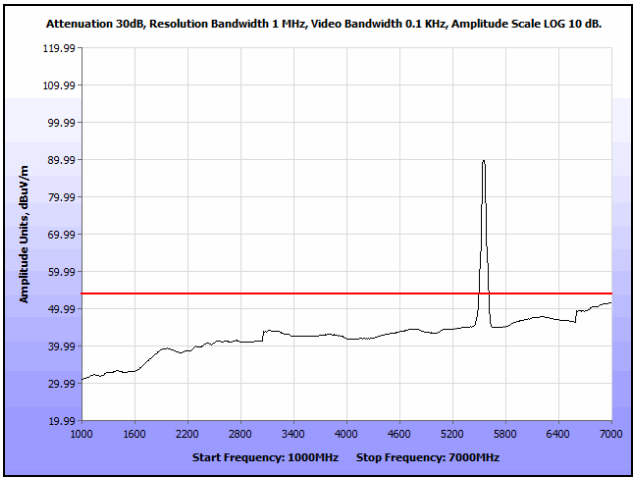


Plot 120. Radiated Spurious Emissions, 5510 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Average

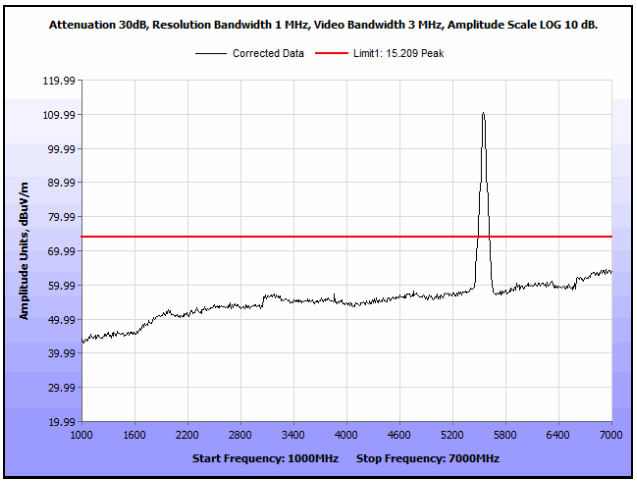


Plot 121. Radiated Spurious Emissions, 5550 MHz, Rubber Ducky Antenna, 30 MHz – 1 GHz

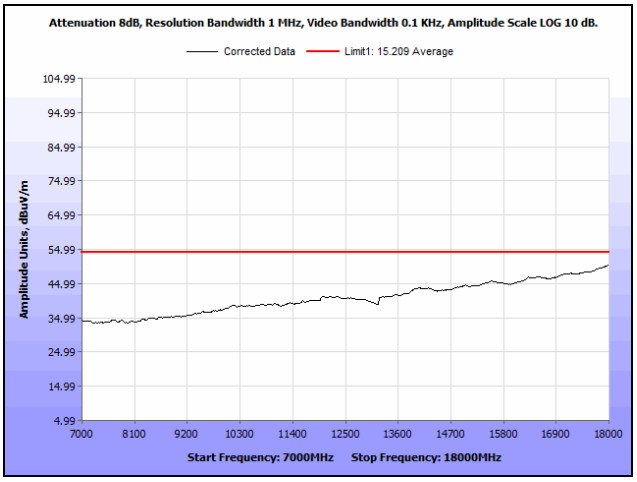
 © 2015, MET Laboratories, Inc.



Plot 122. Radiated Spurious Emissions, 5550 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Average

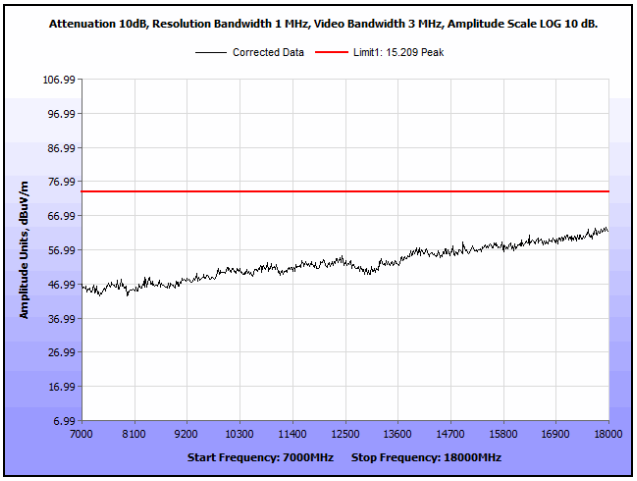


Plot 123. Radiated Spurious Emissions, 5550 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Peak

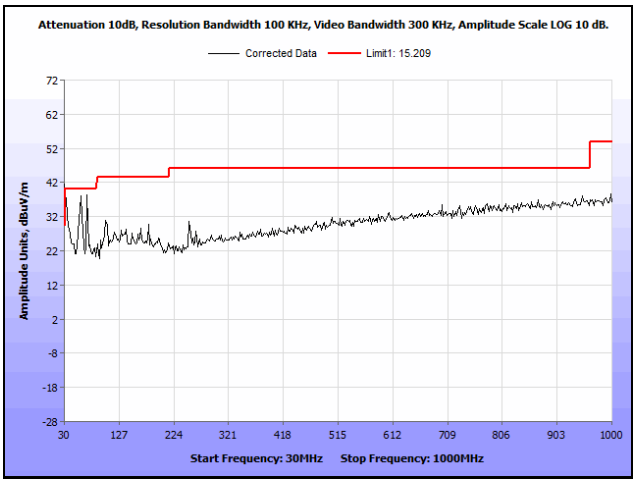


Plot 124. Radiated Spurious Emissions, 5550 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Average

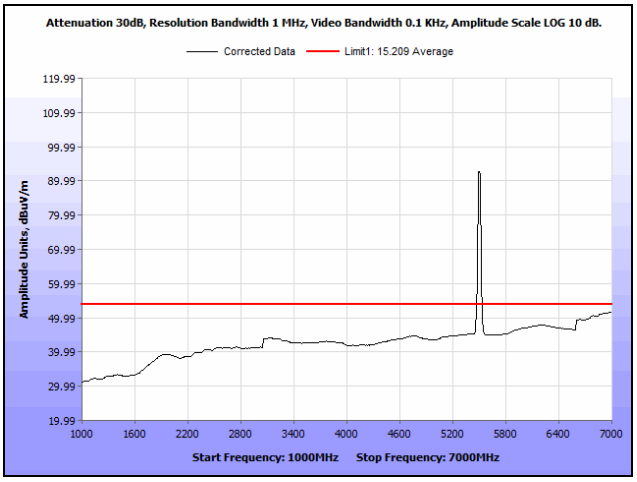
 © 2015, MET Laboratories, Inc.



Plot 125. Radiated Spurious Emissions, 5550 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Peak

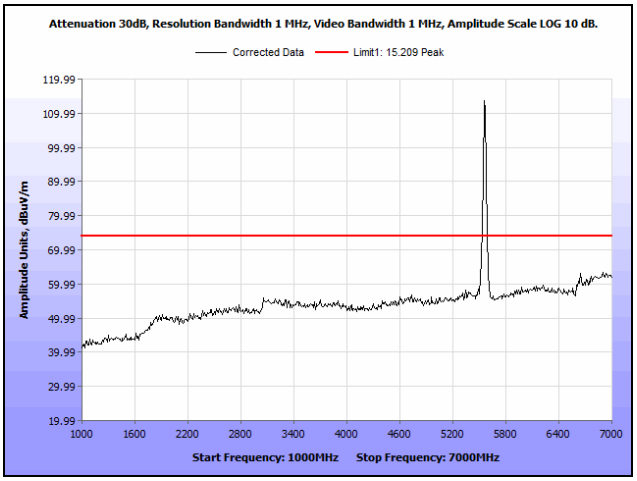


Plot 126. Radiated Spurious Emissions, 5560 MHz, Rubber Ducky Antenna, 30 MHz – 1 GHz

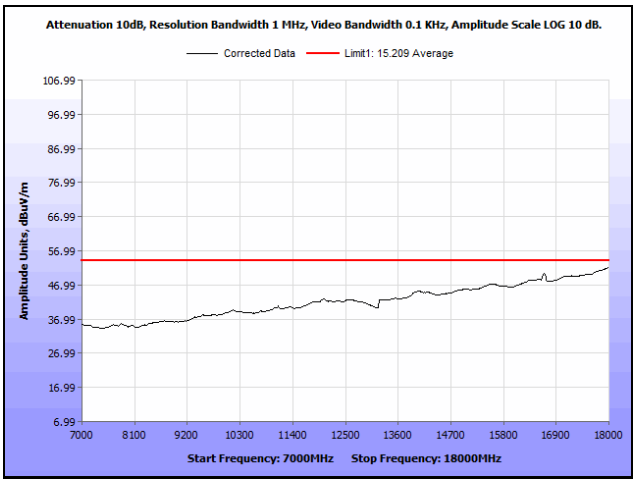


Plot 127. Radiated Spurious Emissions, 5560 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Average

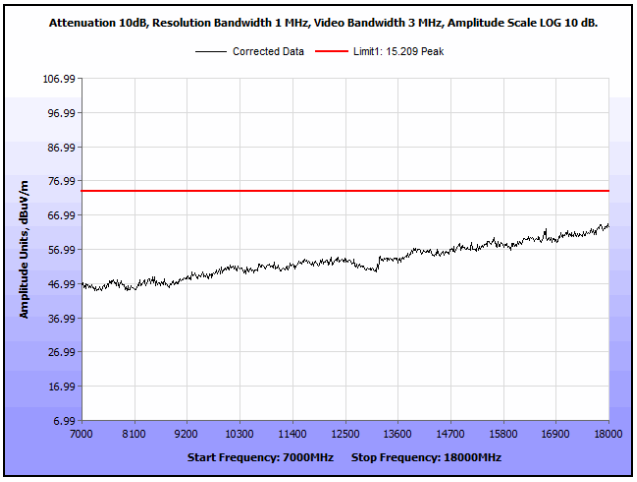
 © 2015, MET Laboratories, Inc.



Plot 128. Radiated Spurious Emissions, 5560 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Peak

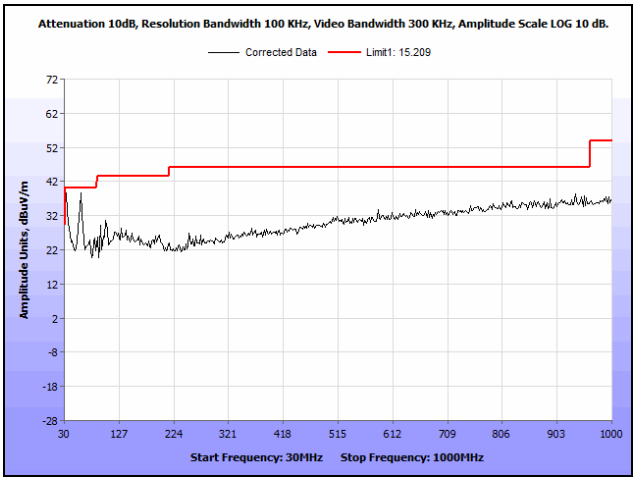


Plot 129. Radiated Spurious Emissions, 5560 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Average

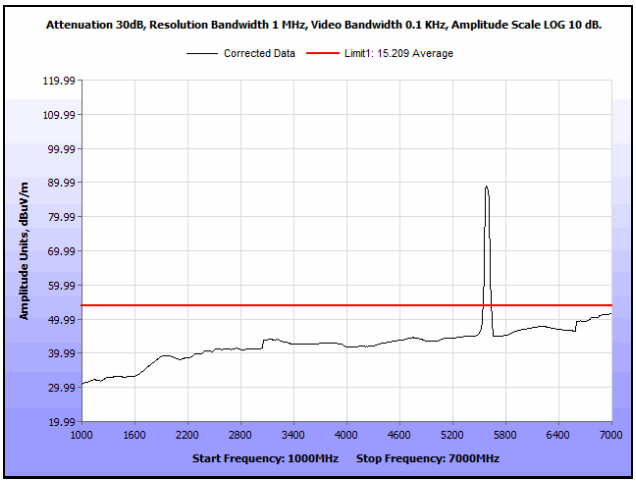


Plot 130. Radiated Spurious Emissions, 5560 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Peak

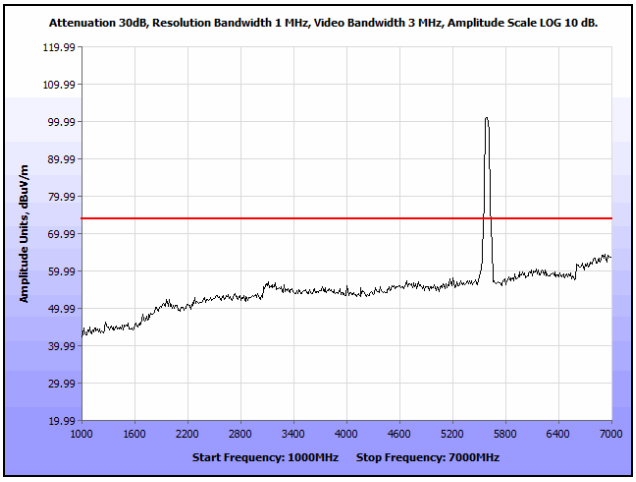
 © 2015, MET Laboratories, Inc.



Plot 131. Radiated Spurious Emissions, 5590 MHz, Rubber Ducky Antenna, 30 MHz – 1 GHz

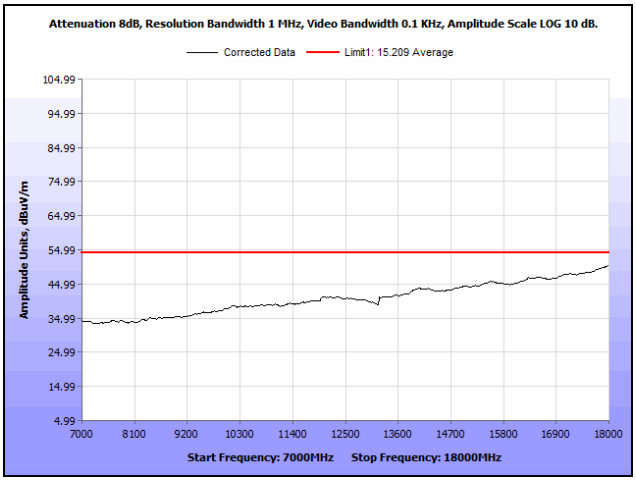


Plot 132. Radiated Spurious Emissions, 5590 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Average

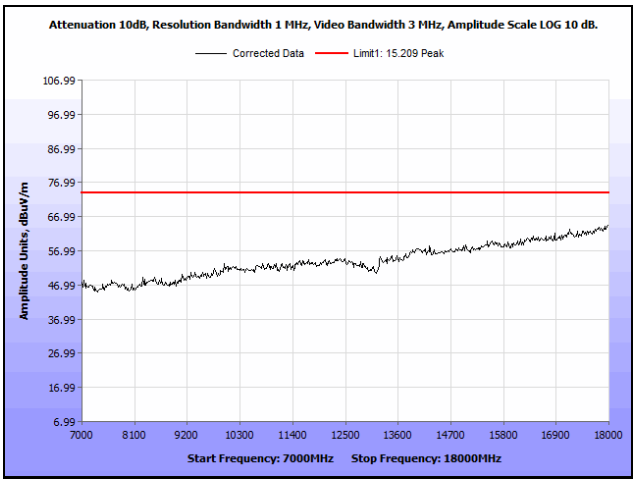


Plot 133. Radiated Spurious Emissions, 5590 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Peak

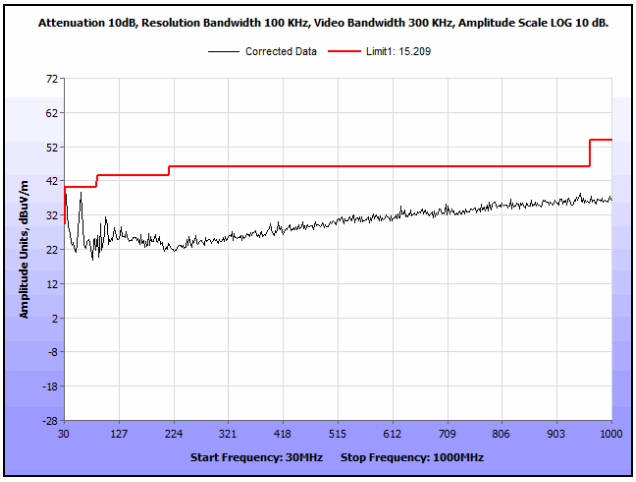
 © 2015, MET Laboratories, Inc.



Plot 134. Radiated Spurious Emissions, 5590 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Average

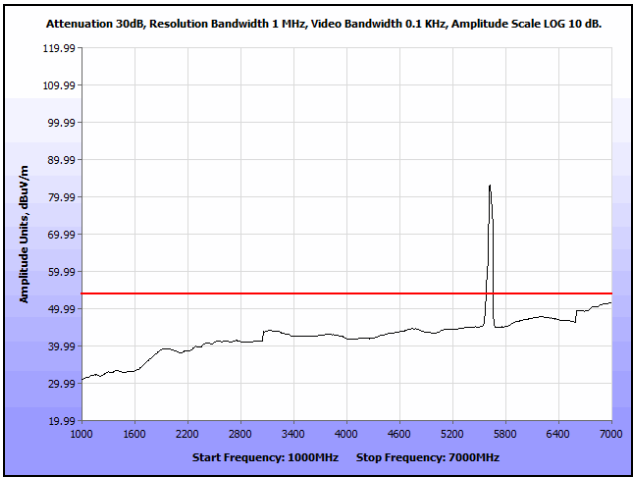


Plot 135. Radiated Spurious Emissions, 5590 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Peak

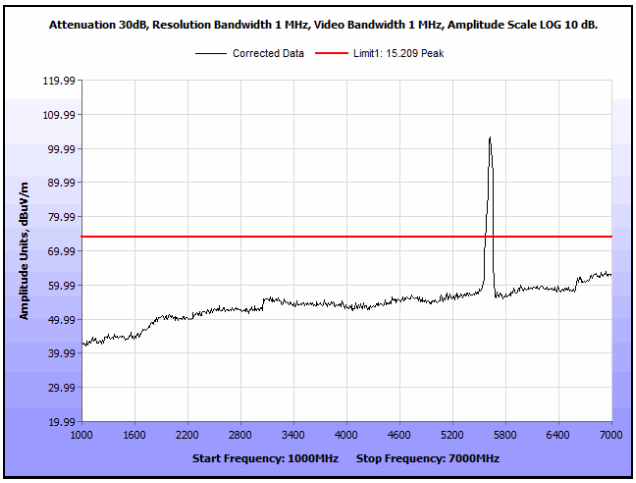


Plot 136. Radiated Spurious Emissions, 5630 MHz, Rubber Ducky Antenna, 30 MHz – 1 GHz

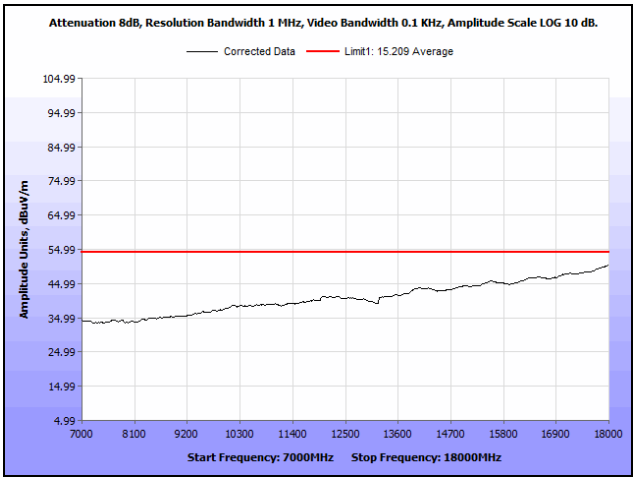
 © 2015, MET Laboratories, Inc.



Plot 137. Radiated Spurious Emissions, 5630 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Average

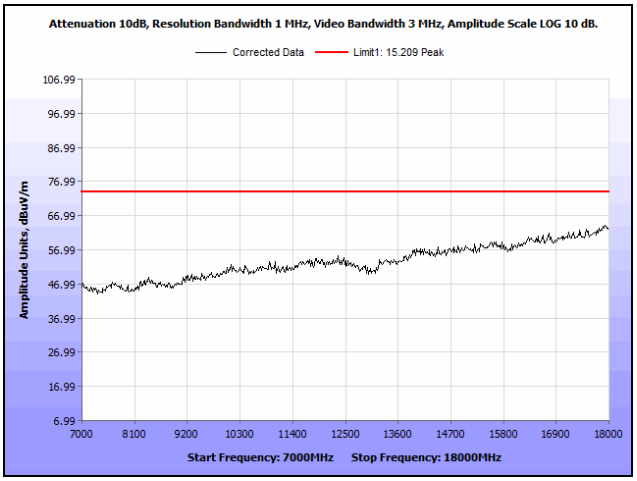


Plot 138. Radiated Spurious Emissions, 5630 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Peak

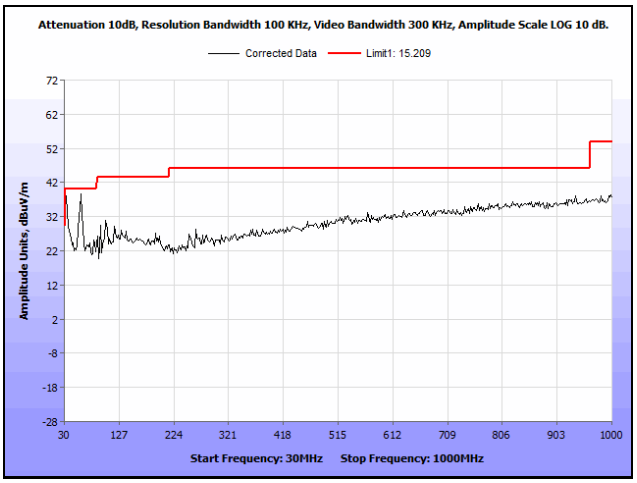


Plot 139. Radiated Spurious Emissions, 5630 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Average

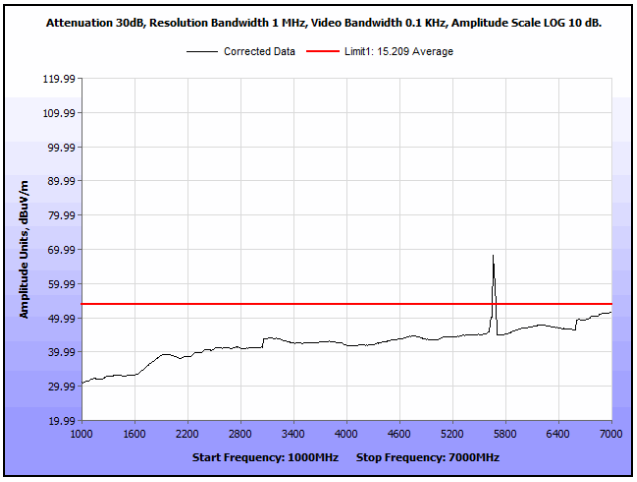
 © 2015, MET Laboratories, Inc.



Plot 140. Radiated Spurious Emissions, 5630 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Peak

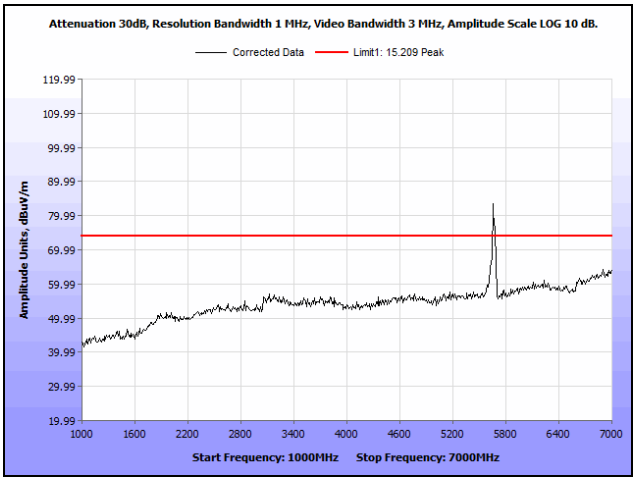


Plot 141. Radiated Spurious Emissions, 5670 MHz, Rubber Ducky Antenna, 30 MHz – 1 GHz

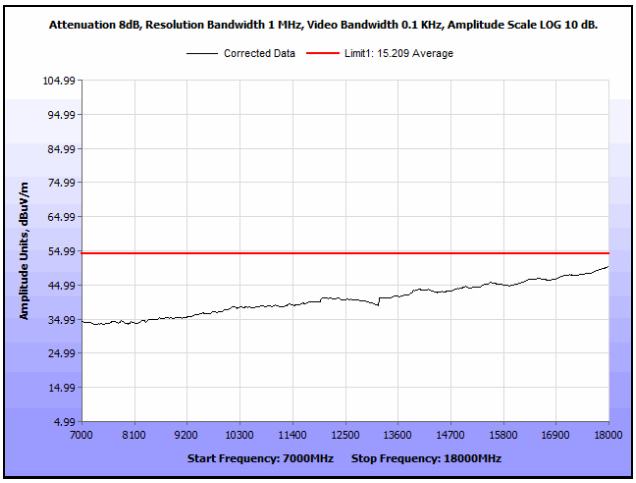


Plot 142. Radiated Spurious Emissions, 5670 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Average

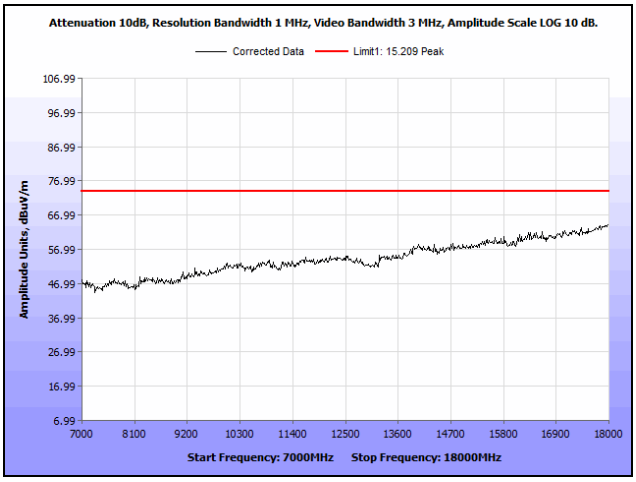
 © 2015, MET Laboratories, Inc.



Plot 143. Radiated Spurious Emissions, 5670 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Peak



Plot 144. Radiated Spurious Emissions, 5670 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Average



Plot 145. Radiated Spurious Emissions, 5670 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Peak

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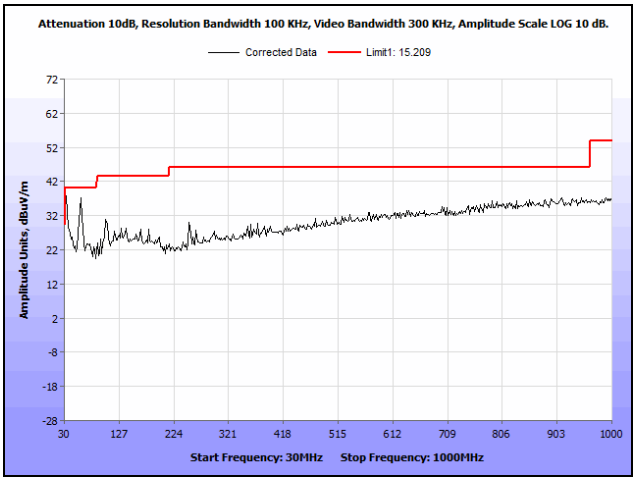
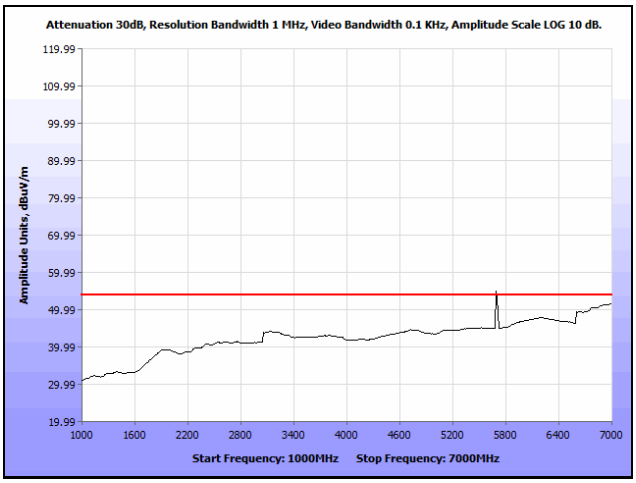
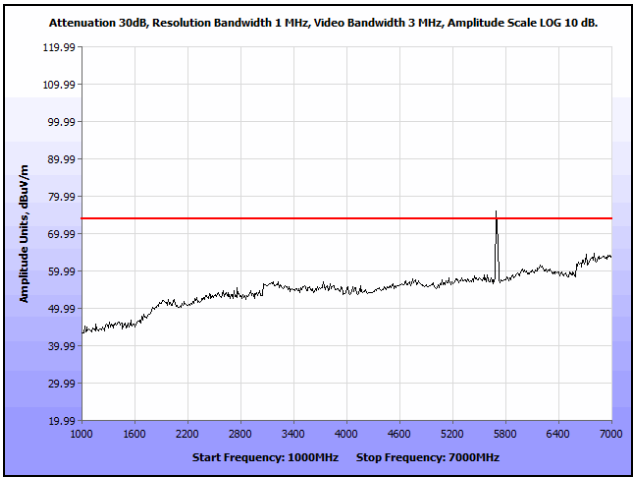


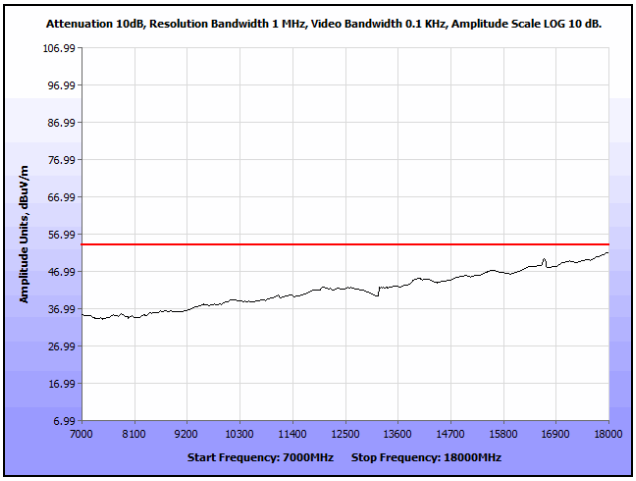
Plot 146. Radiated Spurious Emissions, 5700 MHz, Rubber Ducky Antenna, 30 MHz – 1 GHz



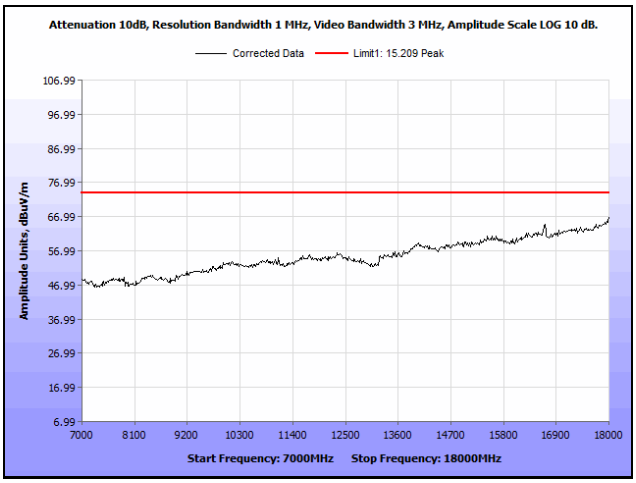
Plot 147. Radiated Spurious Emissions, 5700 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Average



Plot 148. Radiated Spurious Emissions, 5700 MHz, Rubber Ducky Antenna, 1 GHz – 7 GHz, Peak



Plot 149. Radiated Spurious Emissions, 5700 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Average



Plot 150. Radiated Spurious Emissions, 5700 MHz, Rubber Ducky Antenna, 7 GHz – 18 GHz, Peak

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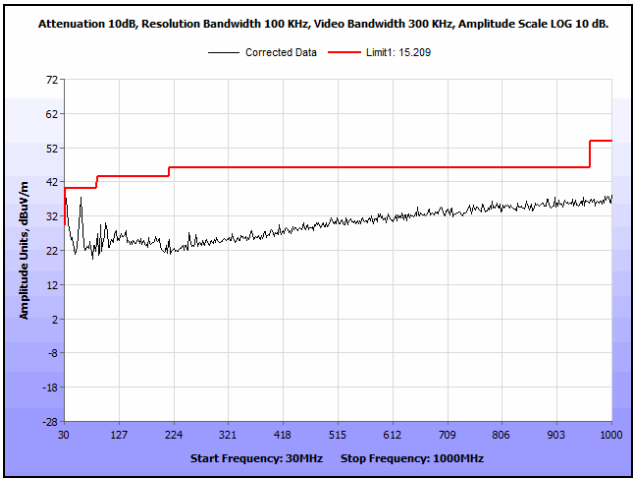
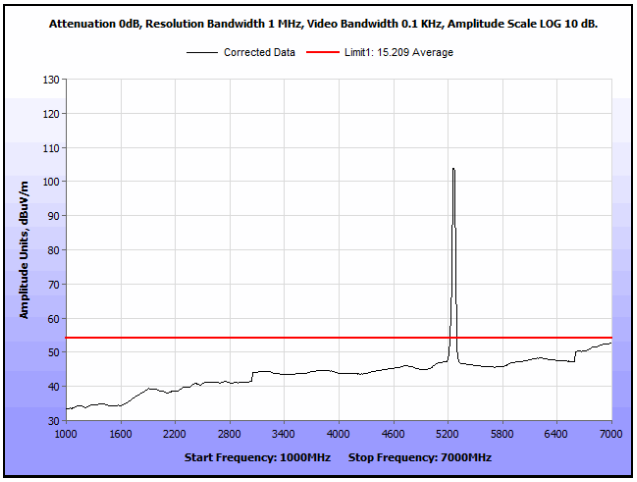
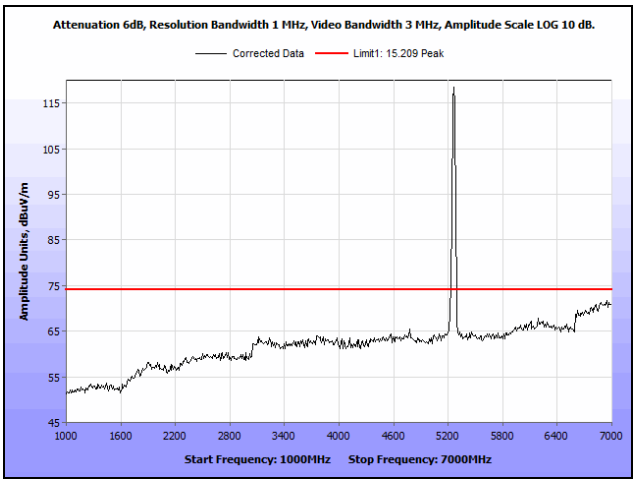
Radiated Spurious Emissions, PCB Antenna



Plot 151. Radiated Spurious Emissions, 5260 MHz, PCB Antenna, 30 MHz – 1 GHz

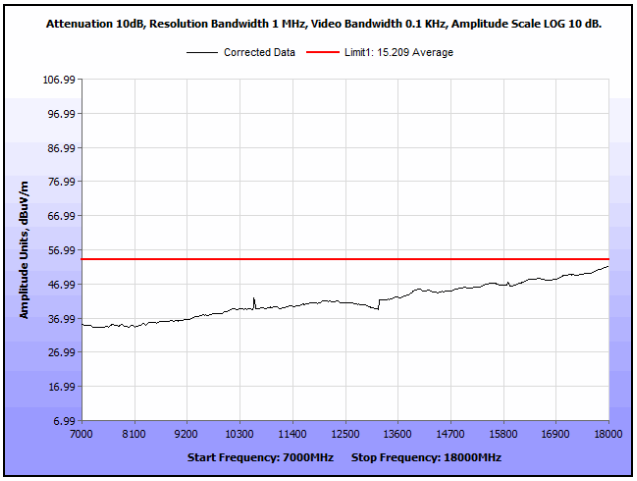


Plot 152. Radiated Spurious Emissions, 5260 MHz, PCB Antenna, 1 GHz – 7 GHz, Average

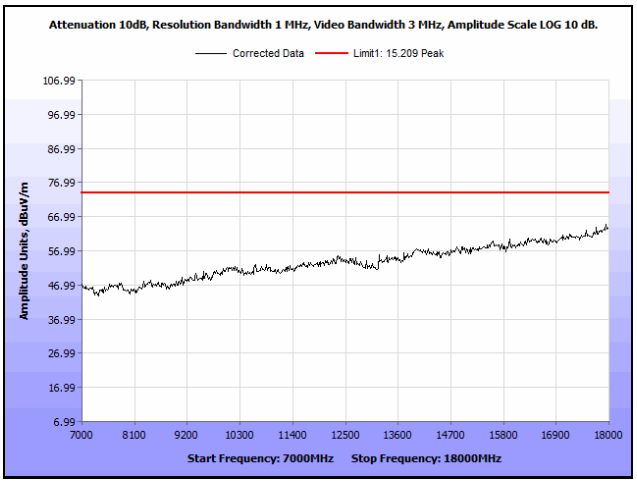


Plot 153. Radiated Spurious Emissions, 5260 MHz, PCB Antenna, 1 GHz – 7 GHz, Peak

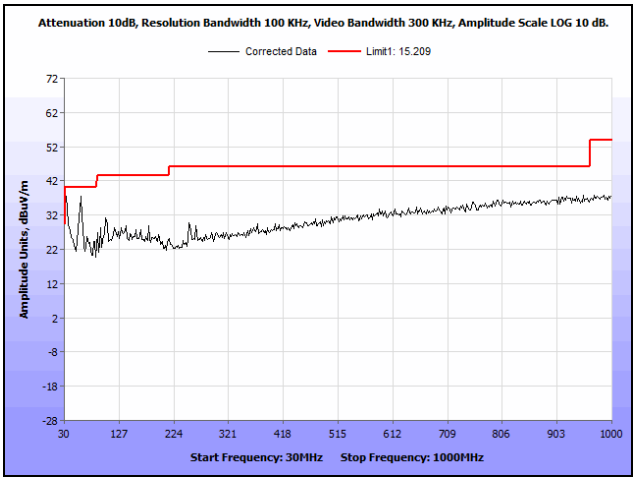
 © 2015, MET Laboratories, Inc.



Plot 154. Radiated Spurious Emissions, 5260 MHz, PCB Antenna, 7 GHz – 18 GHz, Average

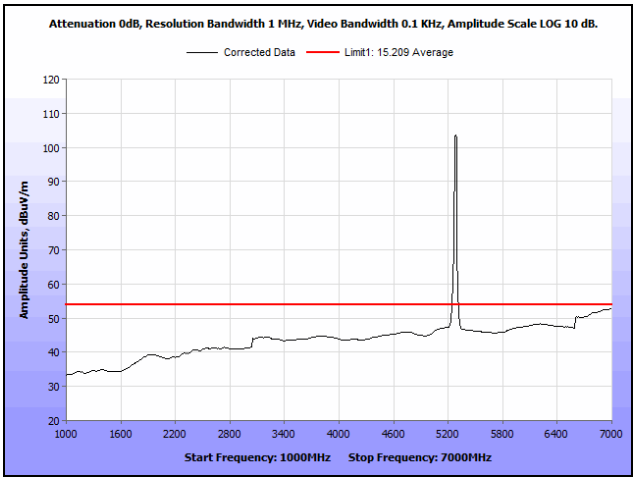


Plot 155. Radiated Spurious Emissions, 5260 MHz, PCB Antenna, 7 GHz – 18 GHz, Peak

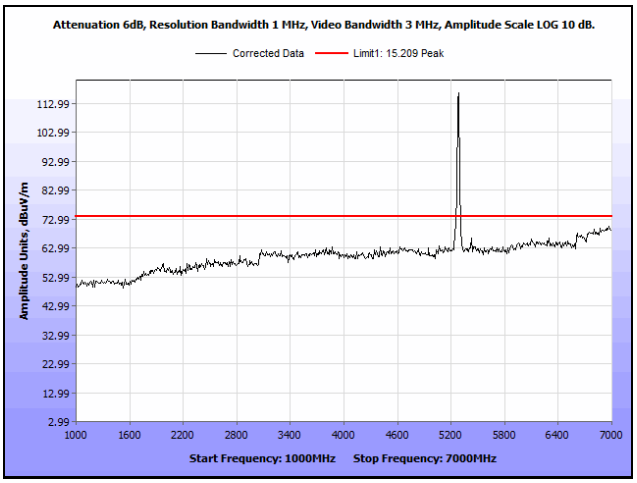


Plot 156. Radiated Spurious Emissions, 5280 MHz, PCB Antenna, 30 MHz – 1 GHz

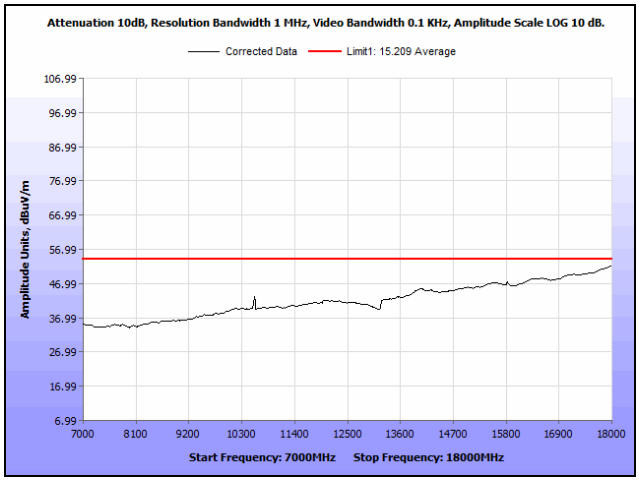
 © 2015, MET Laboratories, Inc.



Plot 157. Radiated Spurious Emissions, 5280 MHz, PCB Antenna, 1 GHz – 7 GHz, Average

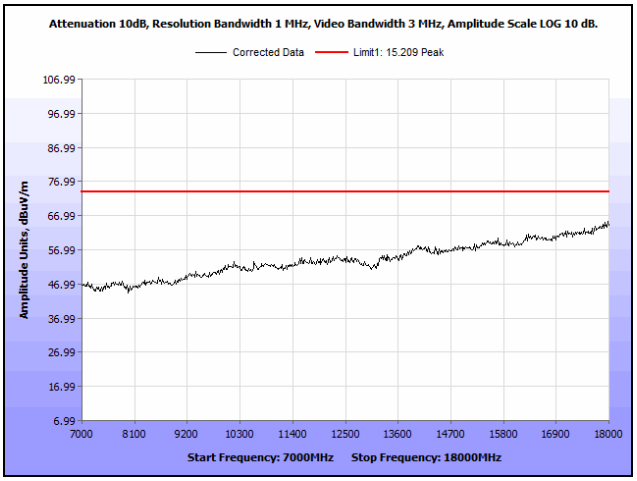


Plot 158. Radiated Spurious Emissions, 5280 MHz, PCB Antenna, 1 GHz – 7 GHz, Peak

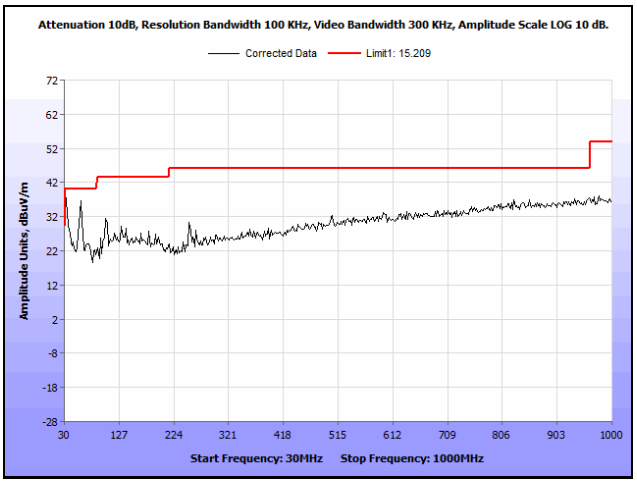


Plot 159. Radiated Spurious Emissions, 5280 MHz, PCB Antenna, 7 GHz – 18 GHz, Average

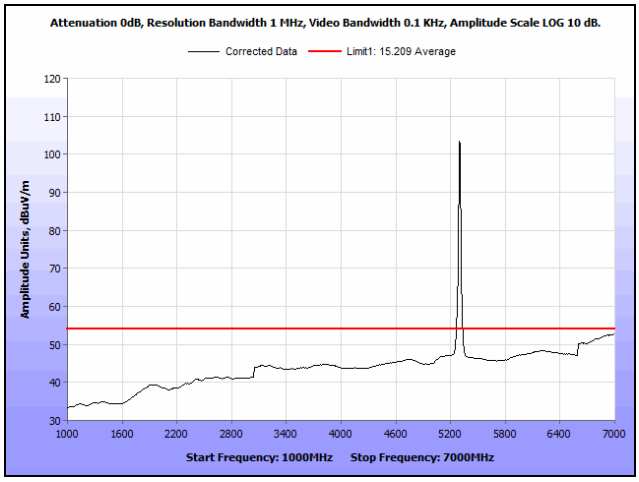
 © 2015, MET Laboratories, Inc.



Plot 160. Radiated Spurious Emissions, 5280 MHz, PCB Antenna, 7 GHz – 18 GHz, Peak

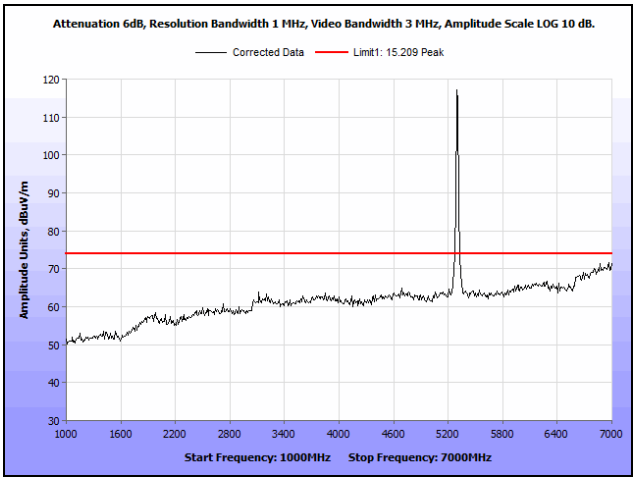


Plot 161. Radiated Spurious Emissions, 5300 MHz, PCB Antenna, 30 MHz – 1 GHz

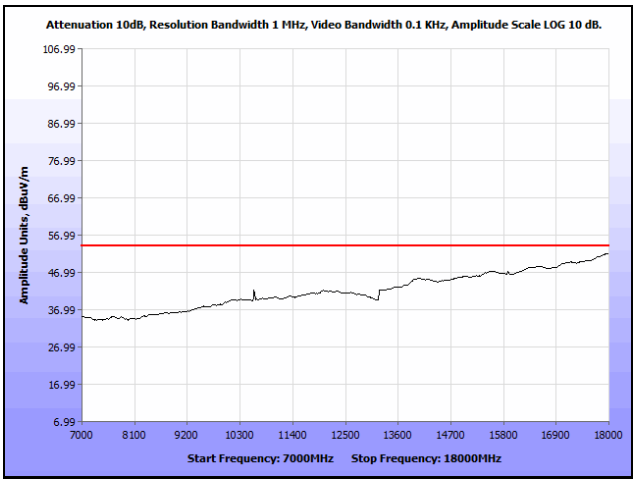


Plot 162. Radiated Spurious Emissions, 5300 MHz, PCB Antenna, 1 GHz – 7 GHz, Average

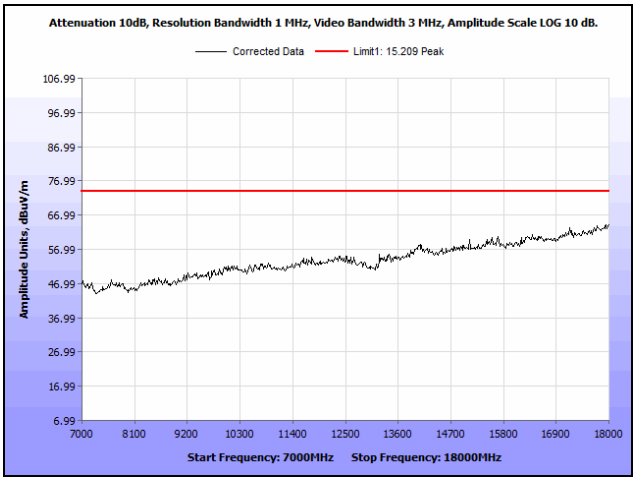
 © 2015, MET Laboratories, Inc.



Plot 163. Radiated Spurious Emissions, 5300 MHz, PCB Antenna, 1 GHz – 7 GHz, Peak

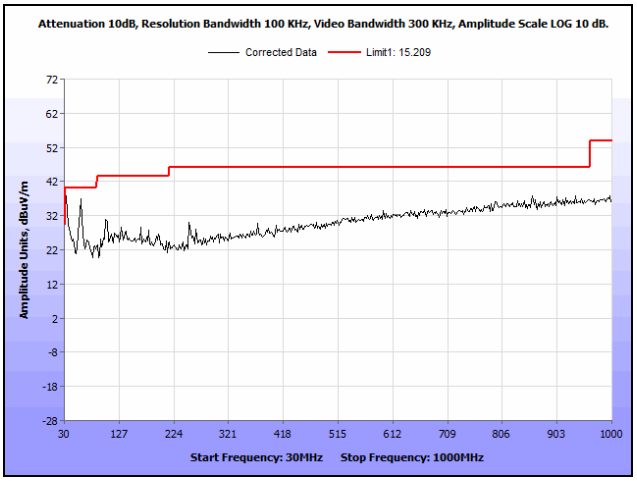


Plot 164. Radiated Spurious Emissions, 5300 MHz, PCB Antenna, 7 GHz – 18 GHz, Average

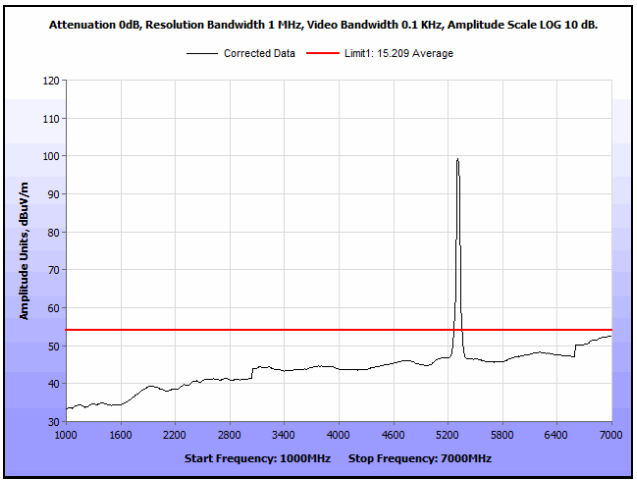


Plot 165. Radiated Spurious Emissions, 5300 MHz, PCB Antenna, 7 GHz – 18 GHz, Peak

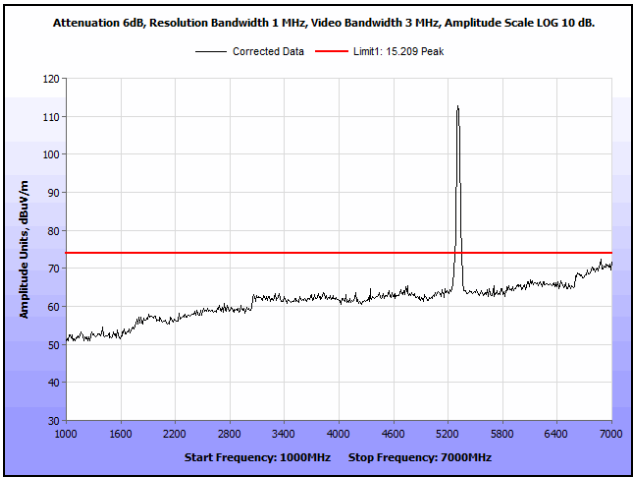
 © 2015, MET Laboratories, Inc.



Plot 166. Radiated Spurious Emissions, 5310 MHz, PCB Antenna, 30 MHz – 1 GHz

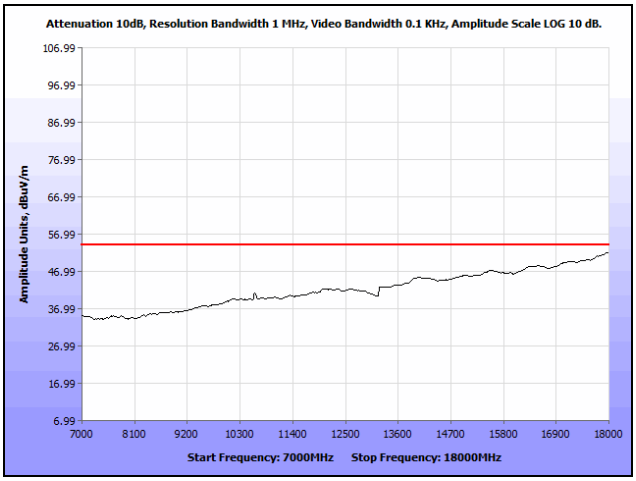


Plot 167. Radiated Spurious Emissions, 5310 MHz, PCB Antenna, 1 GHz – 7 GHz, Average

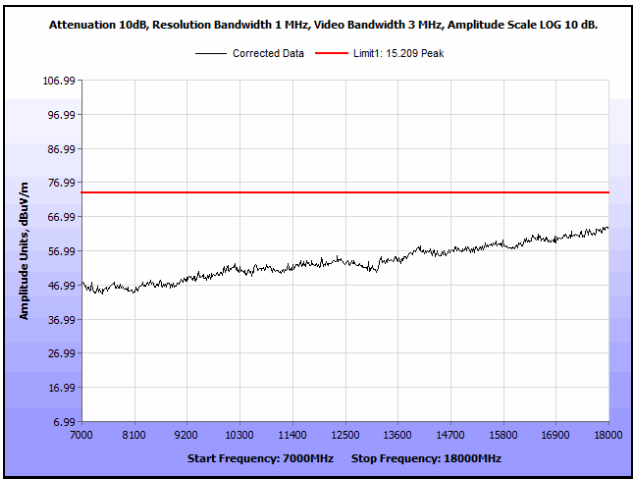


Plot 168. Radiated Spurious Emissions, 5310 MHz, PCB Antenna, 1 GHz – 7 GHz, Peak

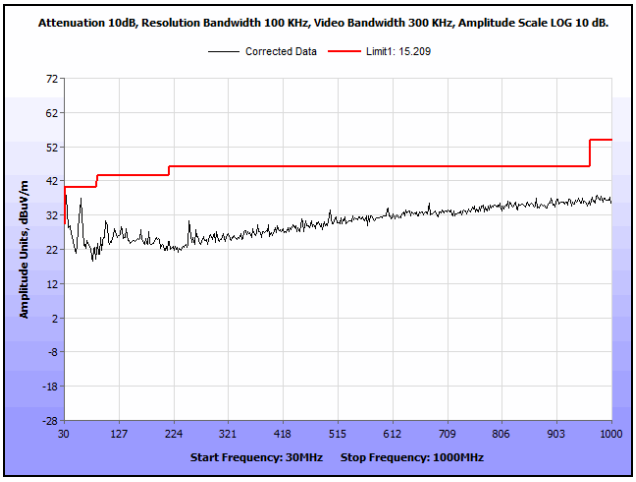
 © 2015, MET Laboratories, Inc.



Plot 169. Radiated Spurious Emissions, 5310 MHz, PCB Antenna, 7 GHz – 18 GHz, Average



Plot 170. Radiated Spurious Emissions, 5310 MHz, PCB Antenna, 7 GHz – 18 GHz, Peak



Plot 171. Radiated Spurious Emissions, 5500 MHz, PCB Antenna, 30 MHz – 1 GHz

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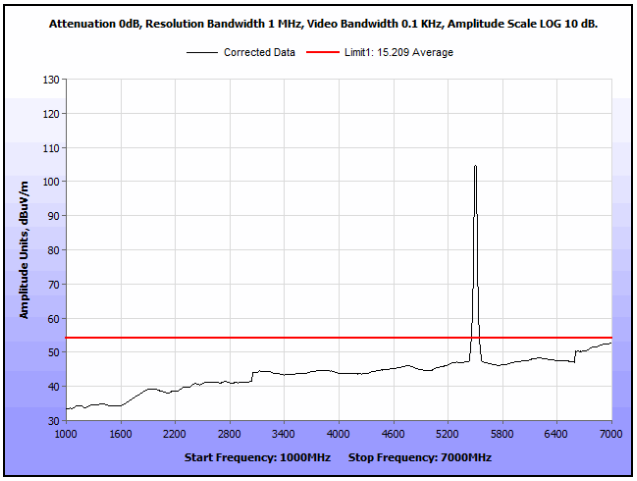
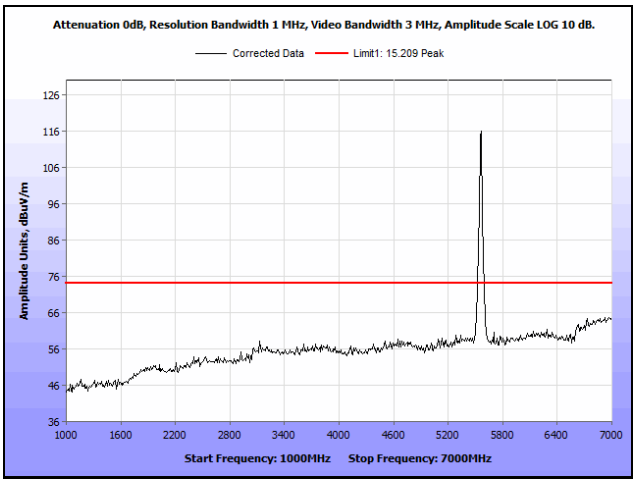
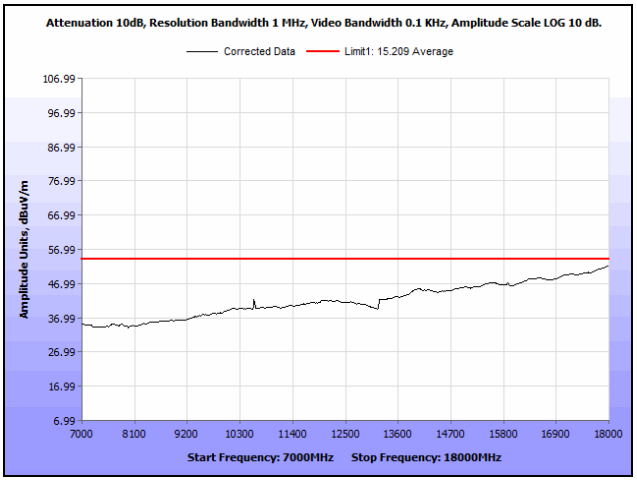


Plot 172. Radiated Spurious Emissions, 5500 MHz, PCB Antenna, 1 GHz – 7 GHz, Average

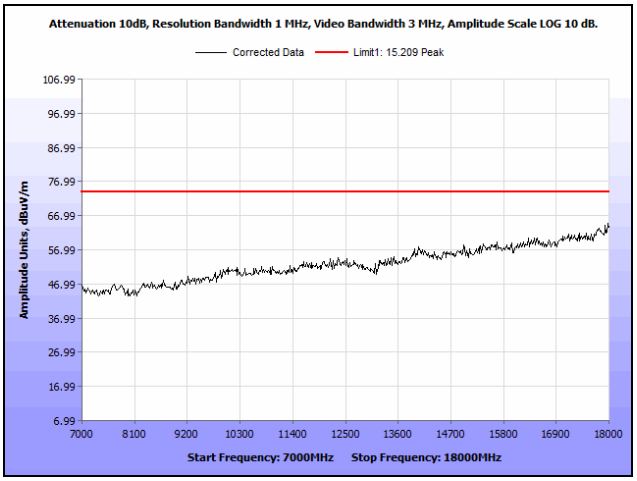


Plot 173. Radiated Spurious Emissions, 5500 MHz, PCB Antenna, 1 GHz – 7 GHz, Peak

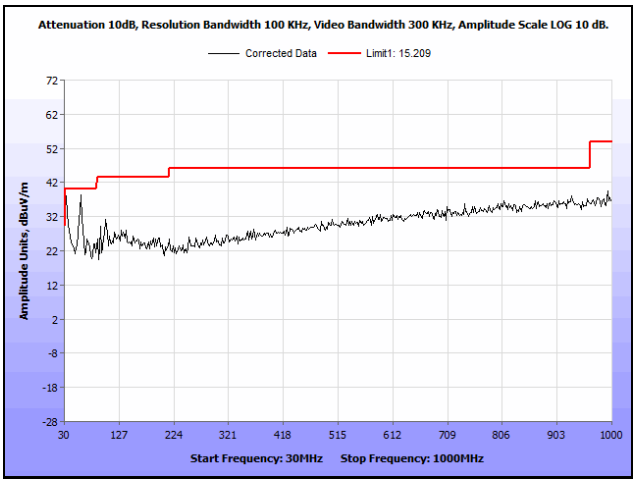


Plot 174. Radiated Spurious Emissions, 5500 MHz, PCB Antenna, 7 GHz – 18 GHz, Average

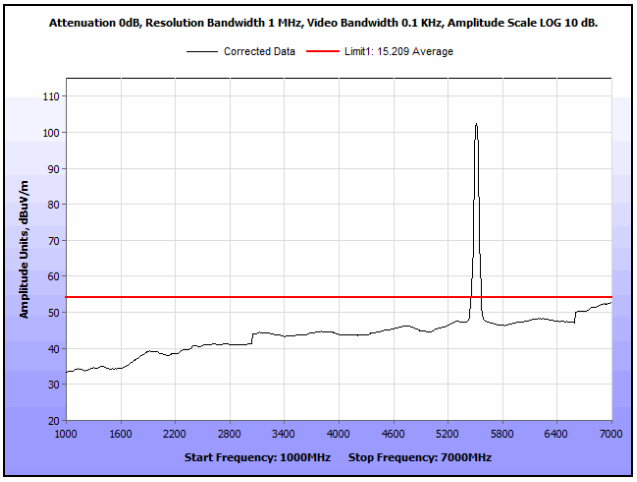
 © 2015, MET Laboratories, Inc.



Plot 175. Radiated Spurious Emissions, 5500 MHz, PCB Antenna, 7 GHz – 18 GHz, Peak

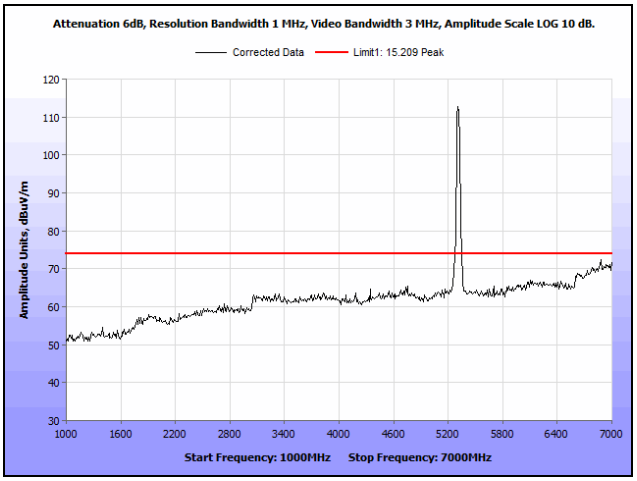


Plot 176. Radiated Spurious Emissions, 5510 MHz, PCB Antenna, 30 MHz – 1 GHz

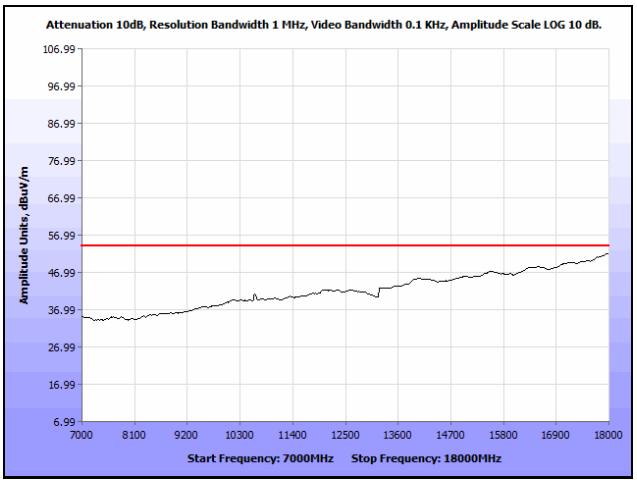


Plot 177. Radiated Spurious Emissions, 5510 MHz, PCB Antenna, 1 GHz – 7 GHz, Average

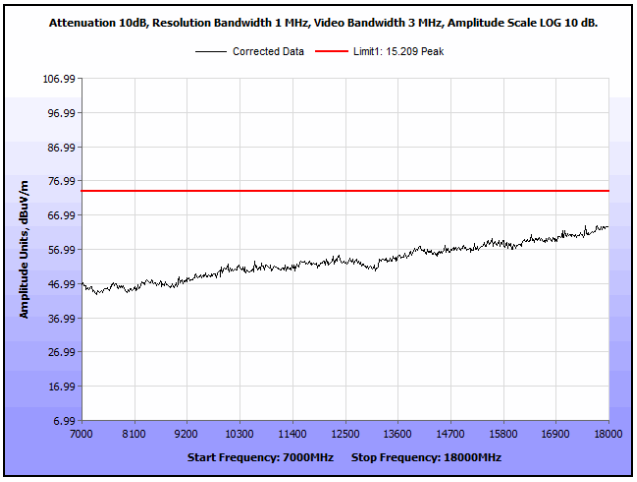
 © 2015, MET Laboratories, Inc.



Plot 178. Radiated Spurious Emissions, 5510 MHz, PCB Antenna, 1 GHz – 7 GHz, Peak



Plot 179. Radiated Spurious Emissions, 5510 MHz, PCB Antenna, 7 GHz – 18 GHz, Average



Plot 180. Radiated Spurious Emissions, 5510 MHz, PCB Antenna, 7 GHz – 18 GHz, Peak

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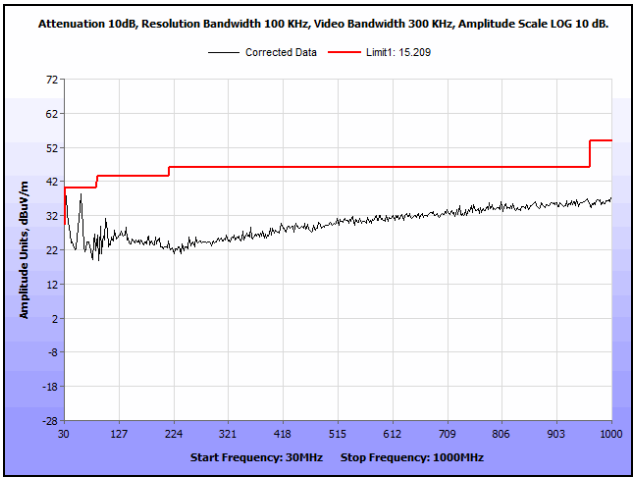
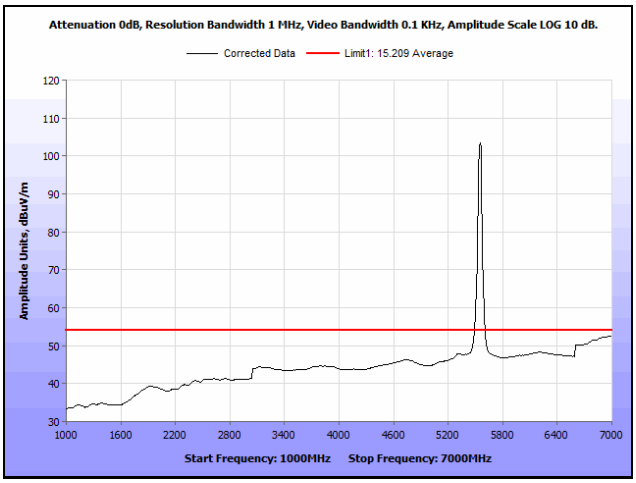
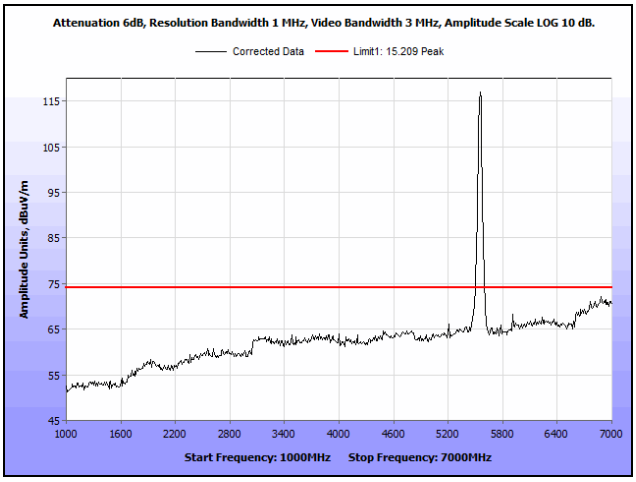


Plot 181. Radiated Spurious Emissions, 5550 MHz, PCB Antenna, 30 MHz – 1 GHz

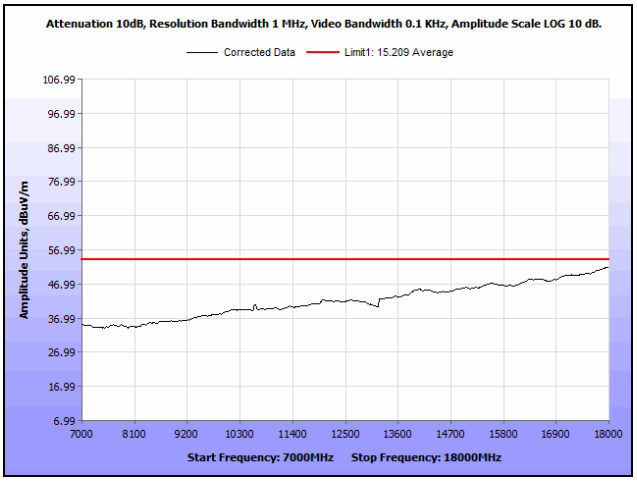


Plot 182. Radiated Spurious Emissions, 5550 MHz, PCB Antenna, 1 GHz – 7 GHz, Average

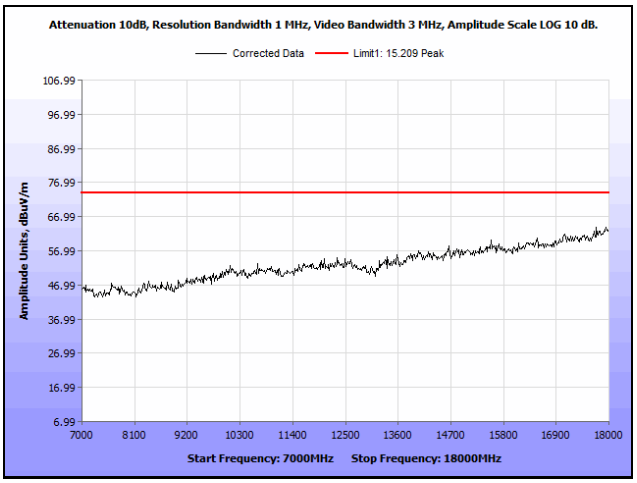


Plot 183. Radiated Spurious Emissions, 5550 MHz, PCB Antenna, 1 GHz – 7 GHz, Peak

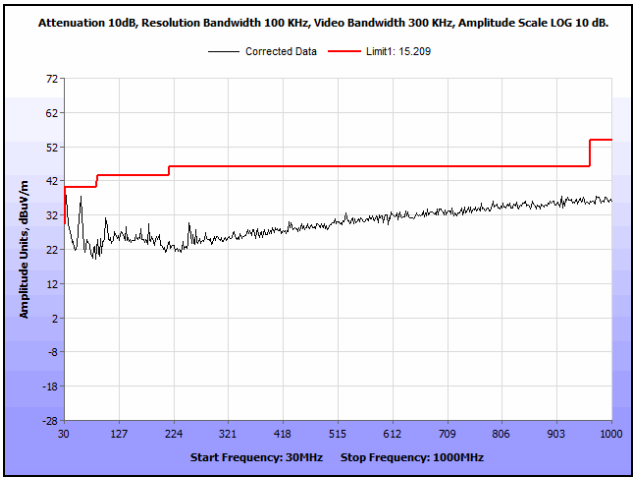
 © 2015, MET Laboratories, Inc.



Plot 184. Radiated Spurious Emissions, 5550 MHz, PCB Antenna, 7 GHz – 18 GHz, Average

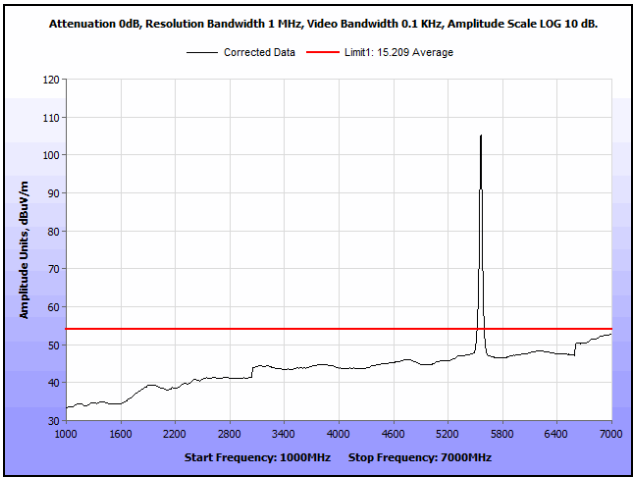


Plot 185. Radiated Spurious Emissions, 5550 MHz, PCB Antenna, 7 GHz – 18 GHz, Peak

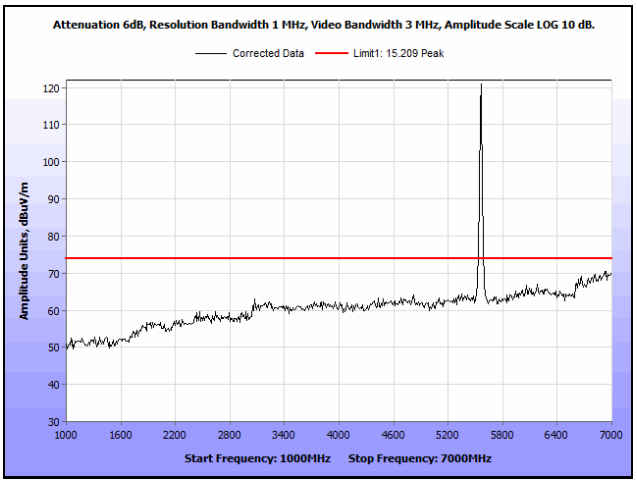


Plot 186. Radiated Spurious Emissions, 5560 MHz, PCB Antenna, 30 MHz – 1 GHz

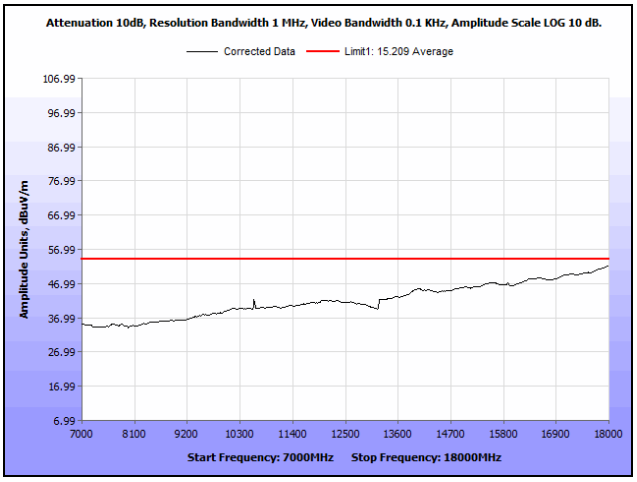
 © 2015, MET Laboratories, Inc.



Plot 187. Radiated Spurious Emissions, 5560 MHz, PCB Antenna, 1 GHz – 7 GHz, Average

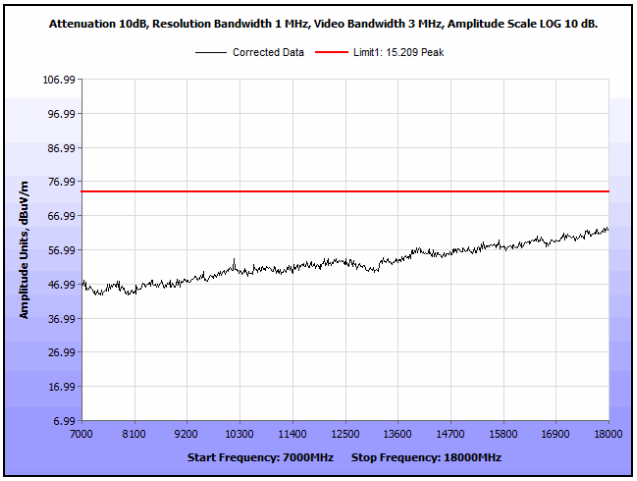


Plot 188. Radiated Spurious Emissions, 5560 MHz, PCB Antenna, 1 GHz – 7 GHz, Peak

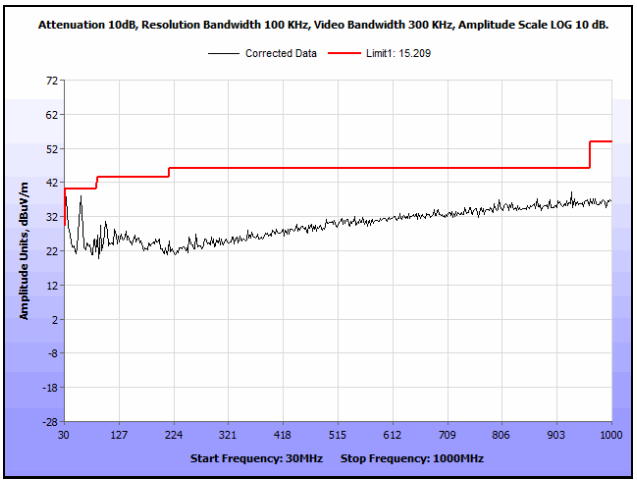


Plot 189. Radiated Spurious Emissions, 5560 MHz, PCB Antenna, 7 GHz – 18 GHz, Average

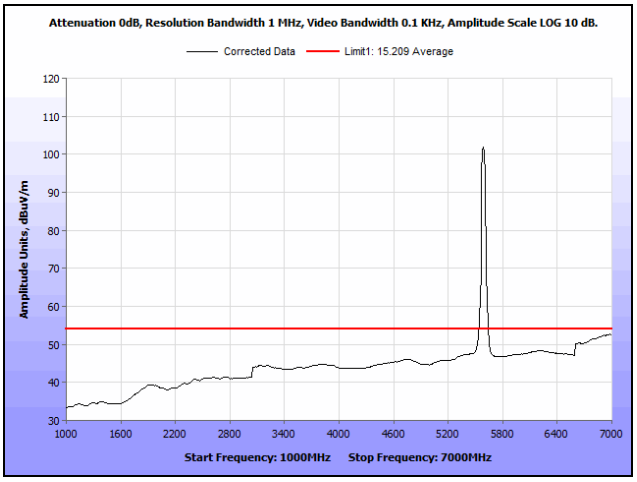
 © 2015, MET Laboratories, Inc.



Plot 190. Radiated Spurious Emissions, 5560 MHz, PCB Antenna, 7 GHz – 18 GHz, Peak



Plot 191. Radiated Spurious Emissions, 5590 MHz, PCB Antenna, 30 MHz – 1 GHz



Plot 192. Radiated Spurious Emissions, 5590 MHz, PCB Antenna, 1 GHz – 7 GHz, Average

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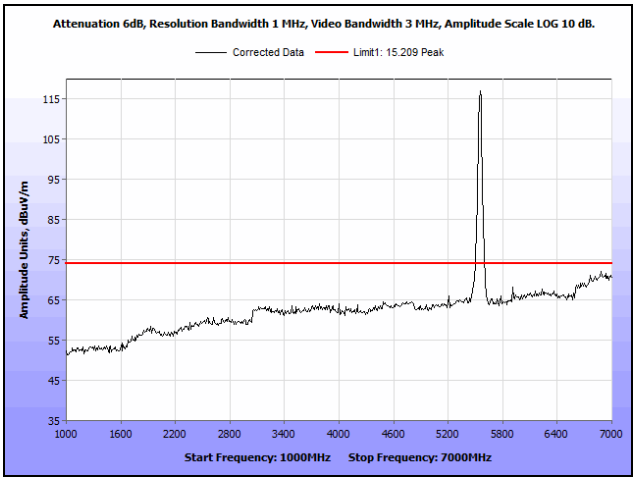
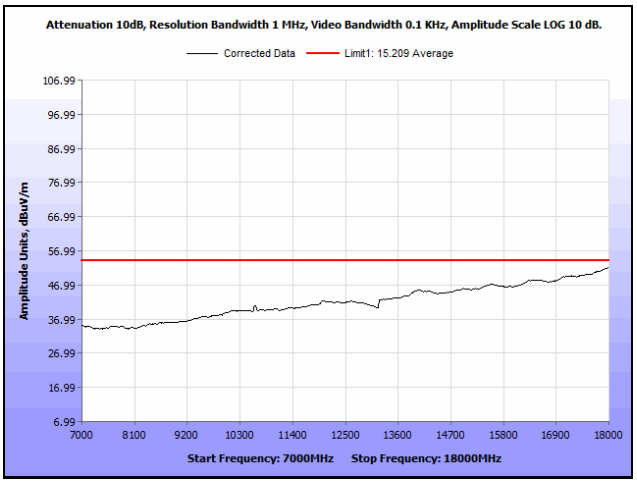
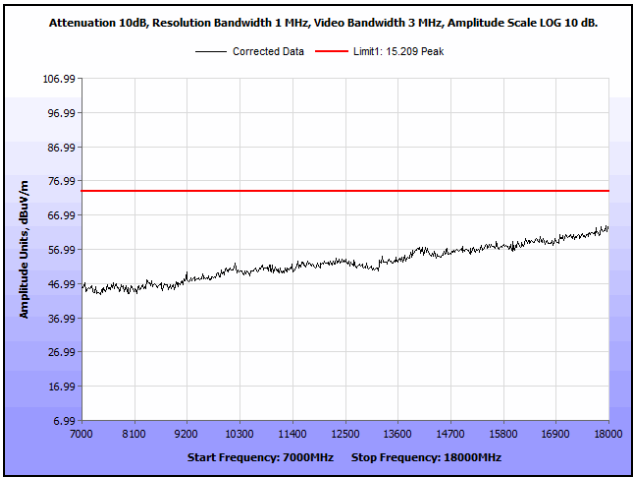


Plot 193. Radiated Spurious Emissions, 5590 MHz, PCB Antenna, 1 GHz – 7 GHz, Peak



Plot 194. Radiated Spurious Emissions, 5590 MHz, PCB Antenna, 7 GHz – 18 GHz, Average



Plot 195. Radiated Spurious Emissions, 5590 MHz, PCB Antenna, 7 GHz – 18 GHz, Peak

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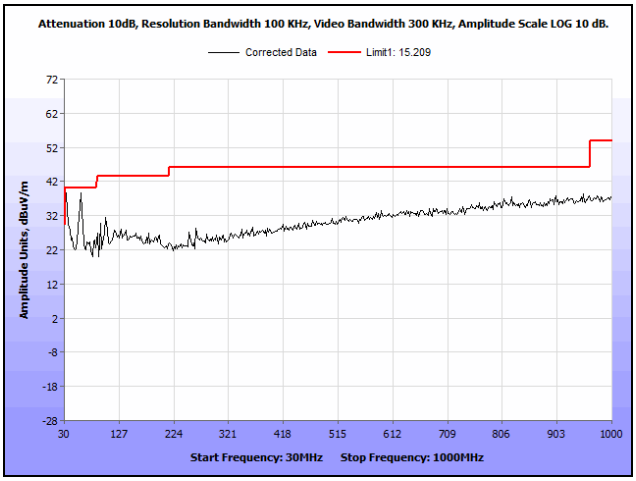
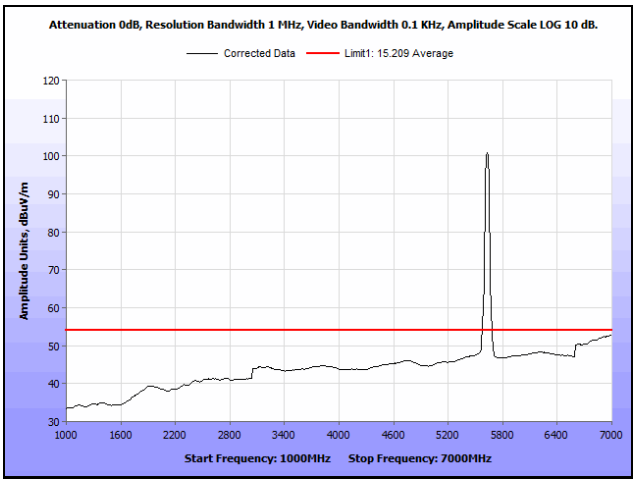
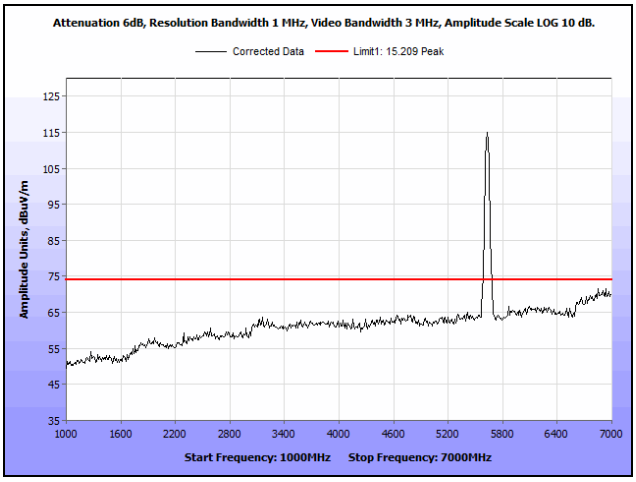


Plot 196. Radiated Spurious Emissions, 5630 MHz, PCB Antenna, 30 MHz – 1 GHz



Plot 197. Radiated Spurious Emissions, 5630 MHz, PCB Antenna, 1 GHz – 7 GHz, Average



Plot 198. Radiated Spurious Emissions, 5630 MHz, PCB Antenna, 1 GHz – 7 GHz, Peak

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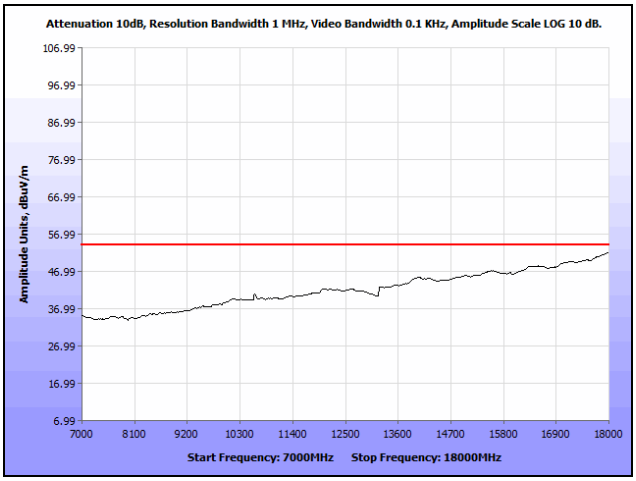
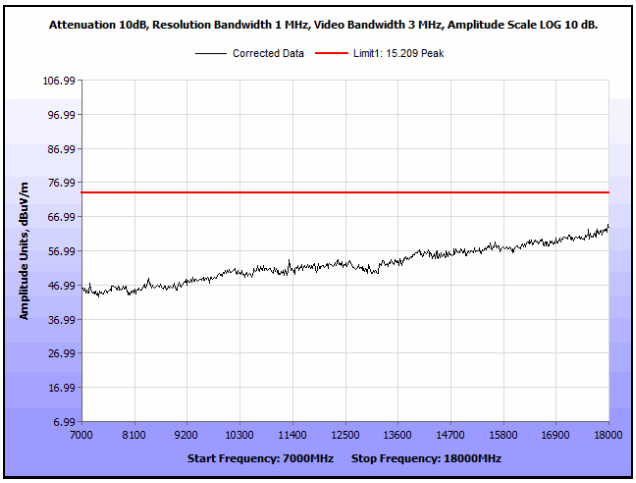
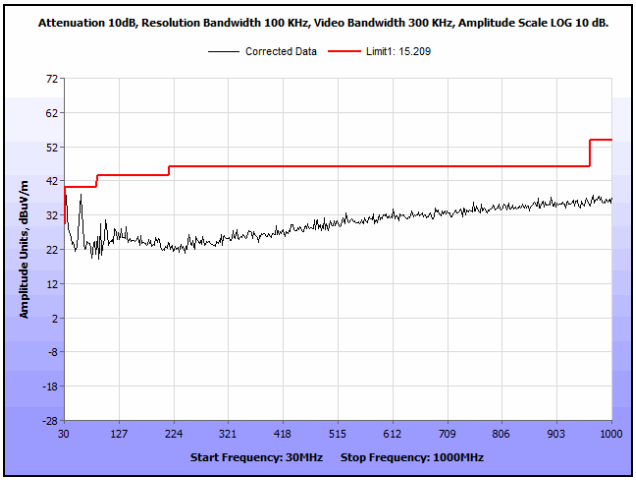


Plot 199. Radiated Spurious Emissions, 5630 MHz, PCB Antenna, 7 GHz – 18 GHz, Average



Plot 200. Radiated Spurious Emissions, 5630 MHz, PCB Antenna, 7 GHz – 18 GHz, Peak



Plot 201. Radiated Spurious Emissions, 5670 MHz, PCB Antenna, 30 MHz – 1 GHz

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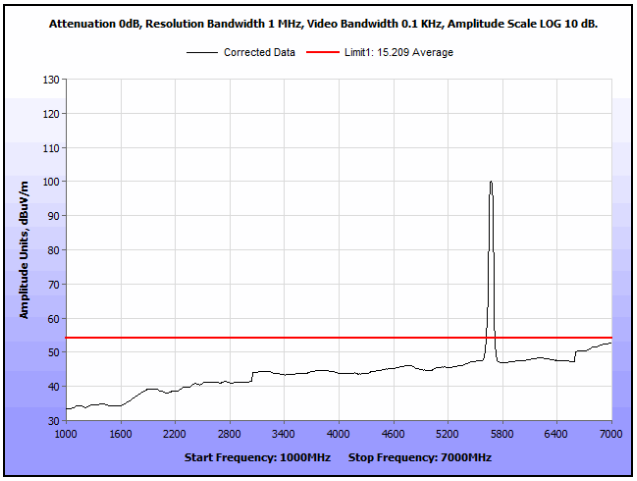
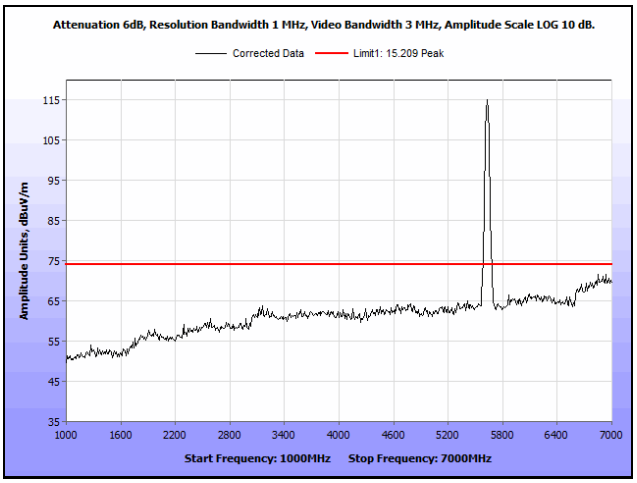
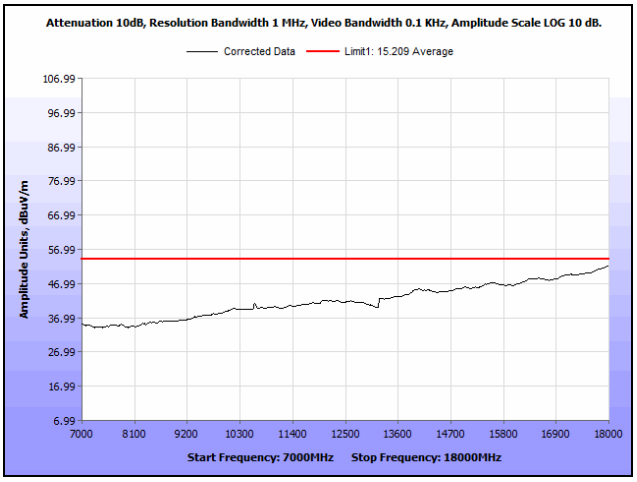


Plot 202. Radiated Spurious Emissions, 5670 MHz, PCB Antenna, 1 GHz – 7 GHz, Average



Plot 203. Radiated Spurious Emissions, 5670 MHz, PCB Antenna, 1 GHz – 7 GHz, Peak



Plot 204. Radiated Spurious Emissions, 5670 MHz, PCB Antenna, 7 GHz – 18 GHz, Average

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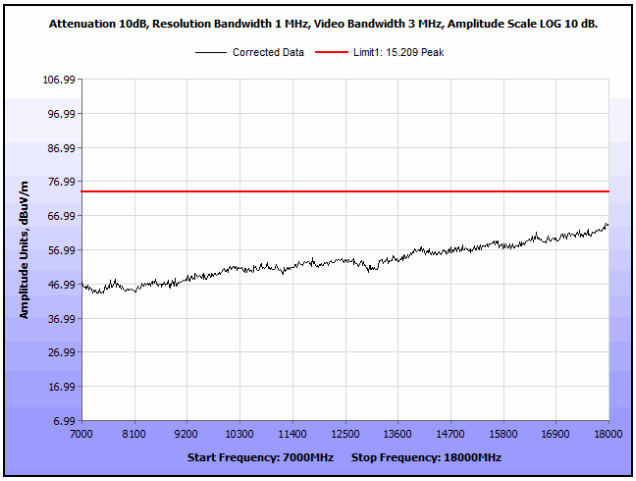
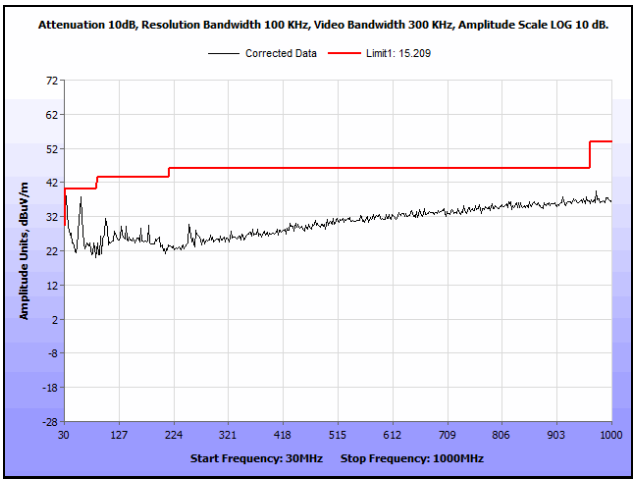
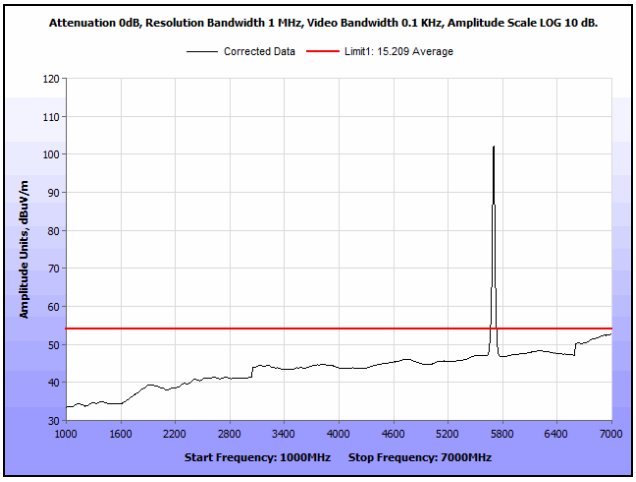


Plot 205. Radiated Spurious Emissions, 5670 MHz, PCB Antenna, 7 GHz – 18 GHz, Peak



Plot 206. Radiated Spurious Emissions, 5700 MHz, PCB Antenna, 30 MHz – 1 GHz



Plot 207. Radiated Spurious Emissions, 5700 MHz, PCB Antenna, 1 GHz – 7 GHz, Average

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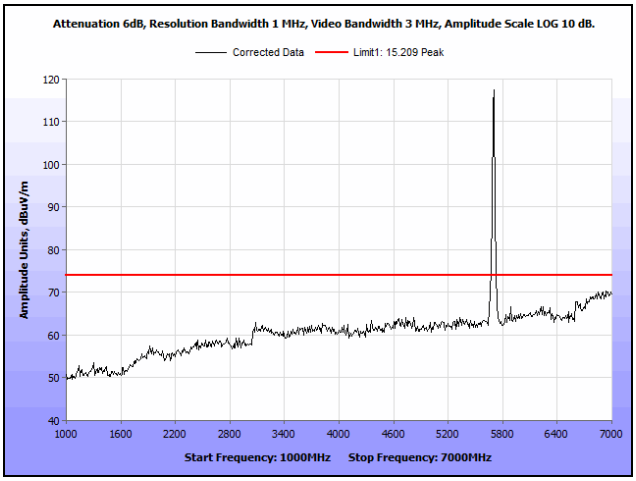
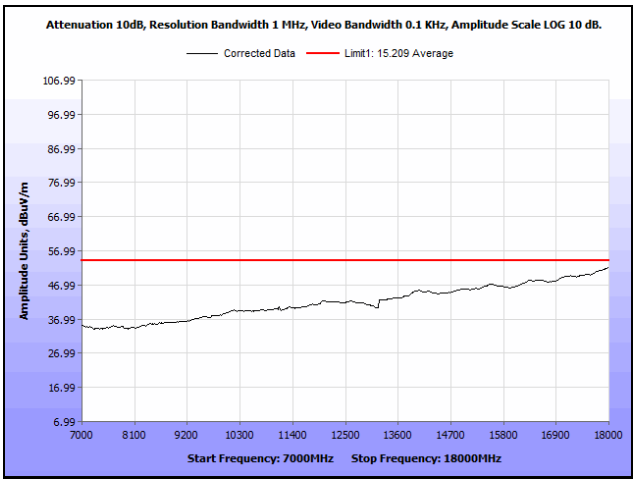
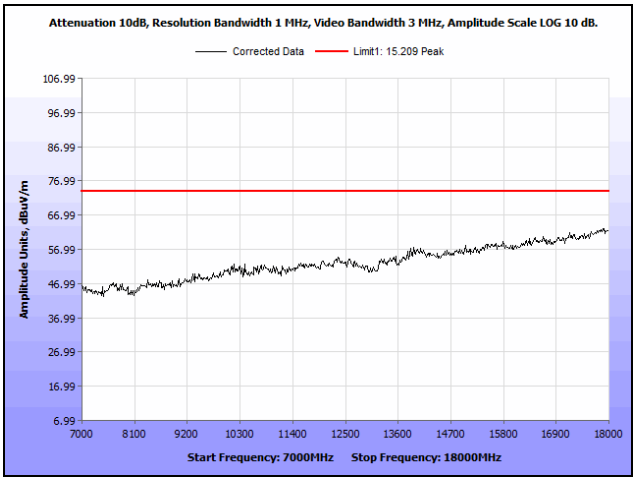


Plot 208. Radiated Spurious Emissions, 5700 MHz, PCB Antenna, 1 GHz – 7 GHz, Peak



Plot 209. Radiated Spurious Emissions, 5700 MHz, PCB Antenna, 7 GHz – 18 GHz, Average



Plot 210. Radiated Spurious Emissions, 5700 MHz, PCB Antenna, 7 GHz – 18 GHz, Peak

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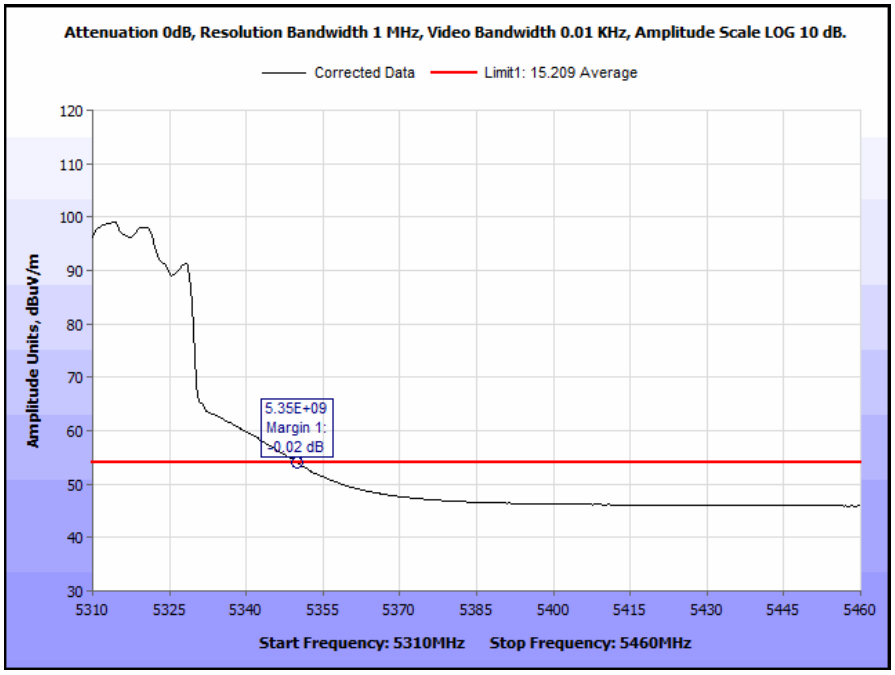
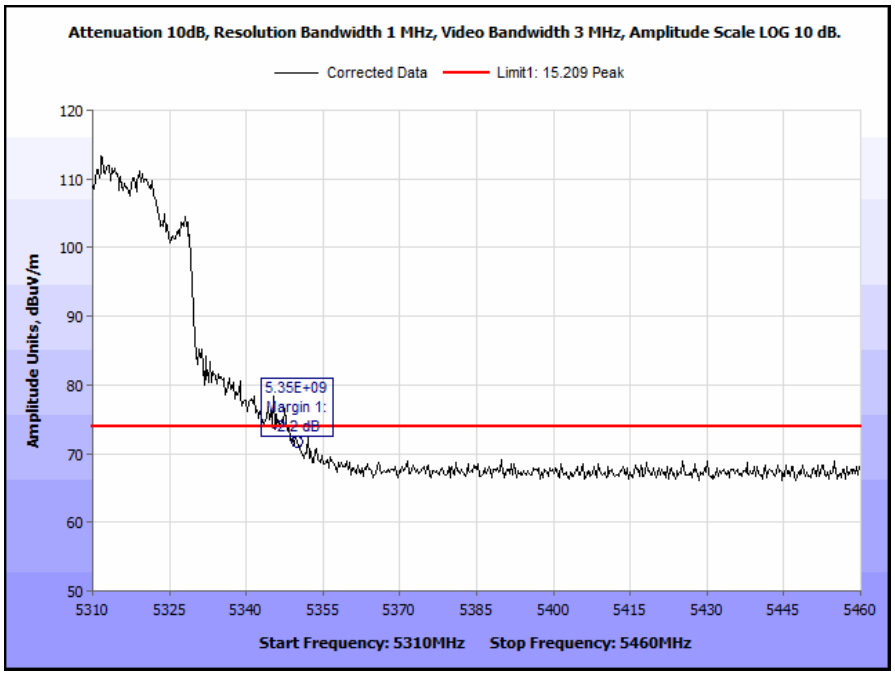
Band Edge, Rubber Ducky Antenna



Plot 211. Radiated Band Edge, 5310 MHz @ 5350 MHz, Average, Rubber Ducky Antenna



Plot 212. Radiated Band Edge, 5310 MHz @ 5350 MHz, Peak, Rubber Ducky Antenna

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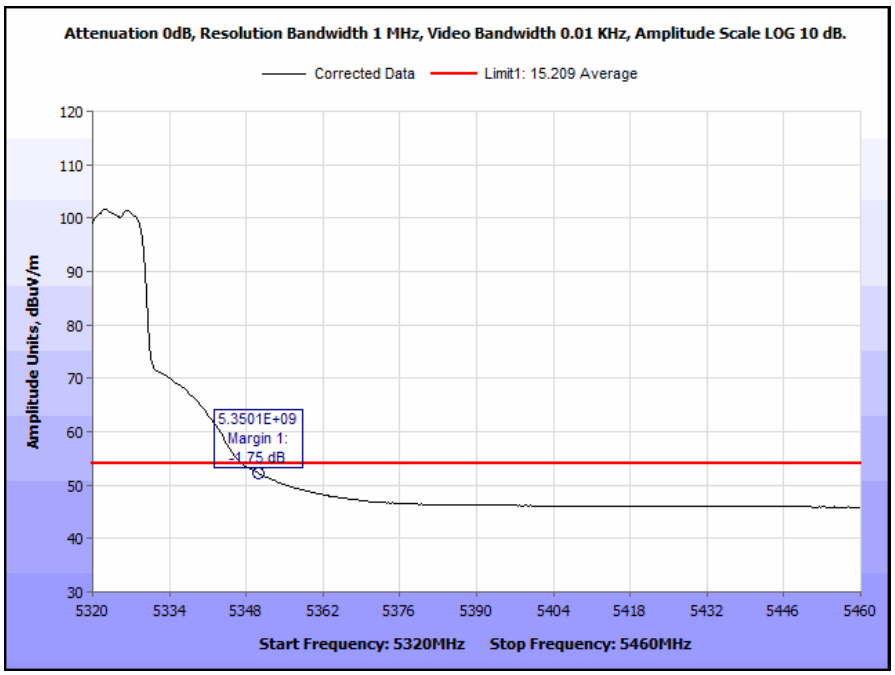
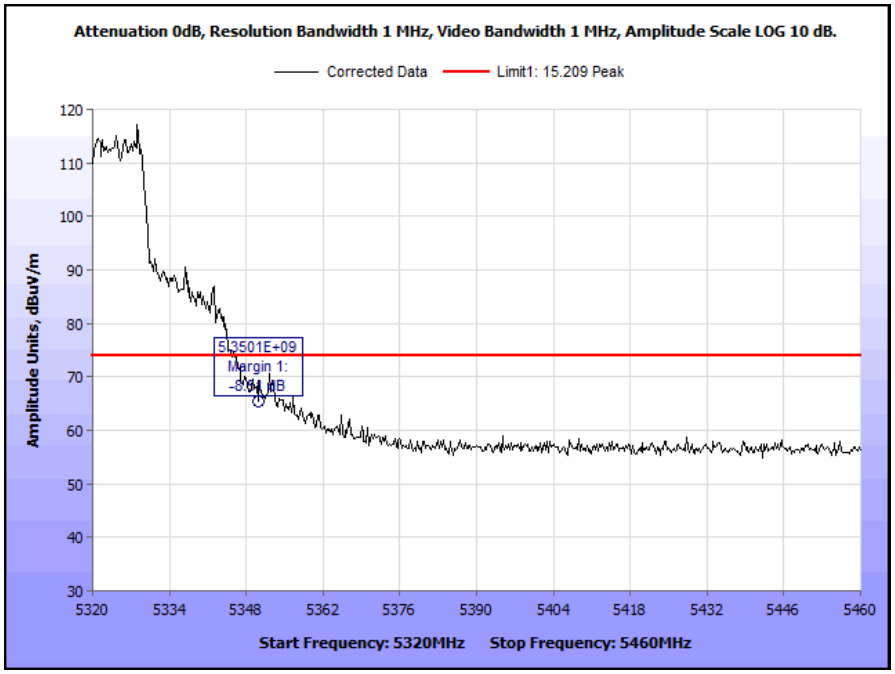


Plot 213. Radiated Band Edge, 5320 MHz @ 5350 MHz, Average, Rubber Ducky Antenna



Plot 214. Radiated Band Edge, 5320 MHz @ 5350 MHz, Average, Rubber Ducky Antenna

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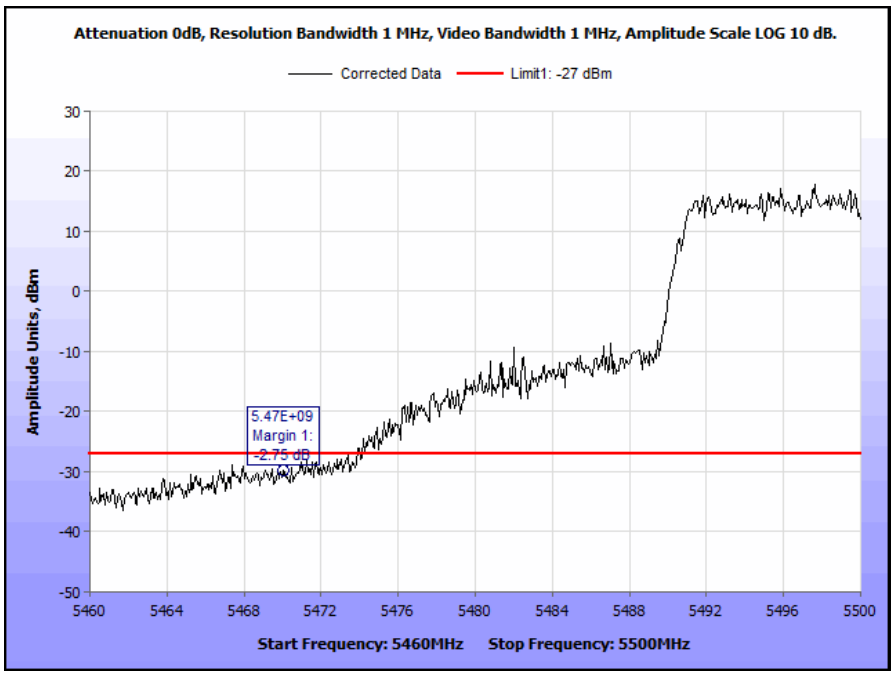
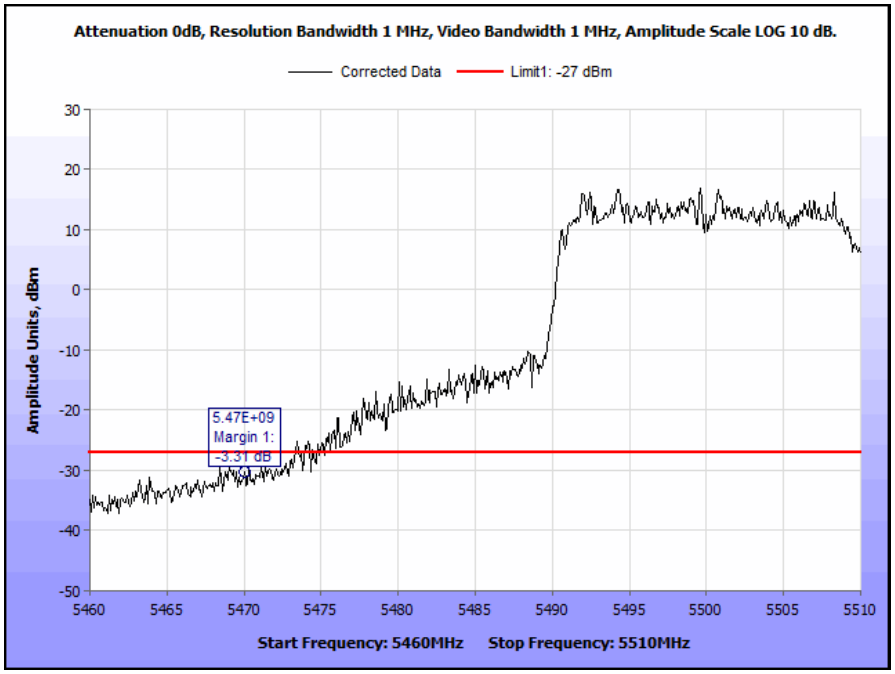


Plot 215. Radiated Band Edge, 5500 MHz @ 5470 MHz, -27 dBm, Rubber Ducky Antenna



Plot 216. Radiated Band Edge, 5510 MHz @ 5470 MHz, -27 dBm, Rubber Ducky Antenna

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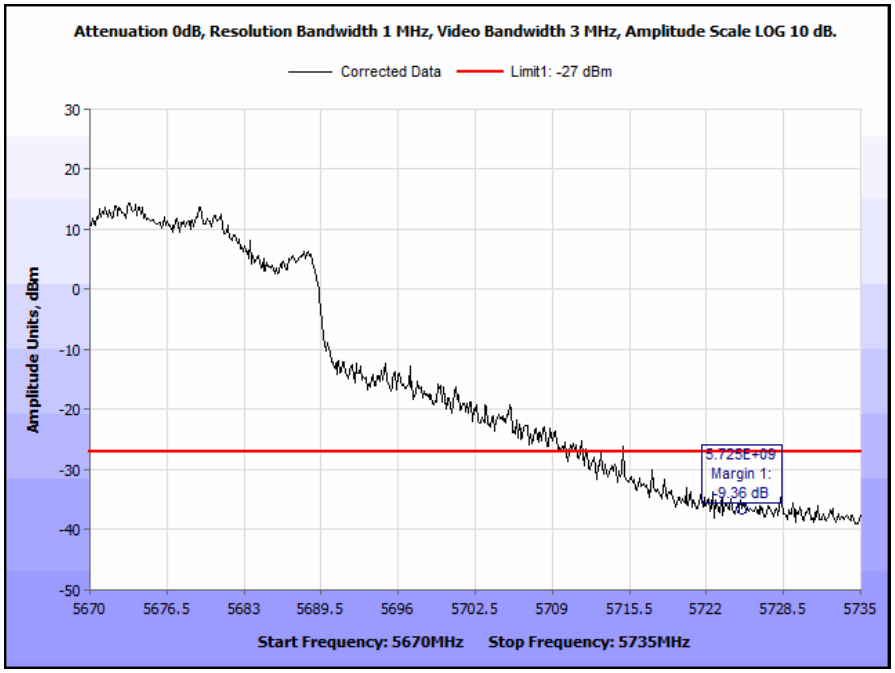
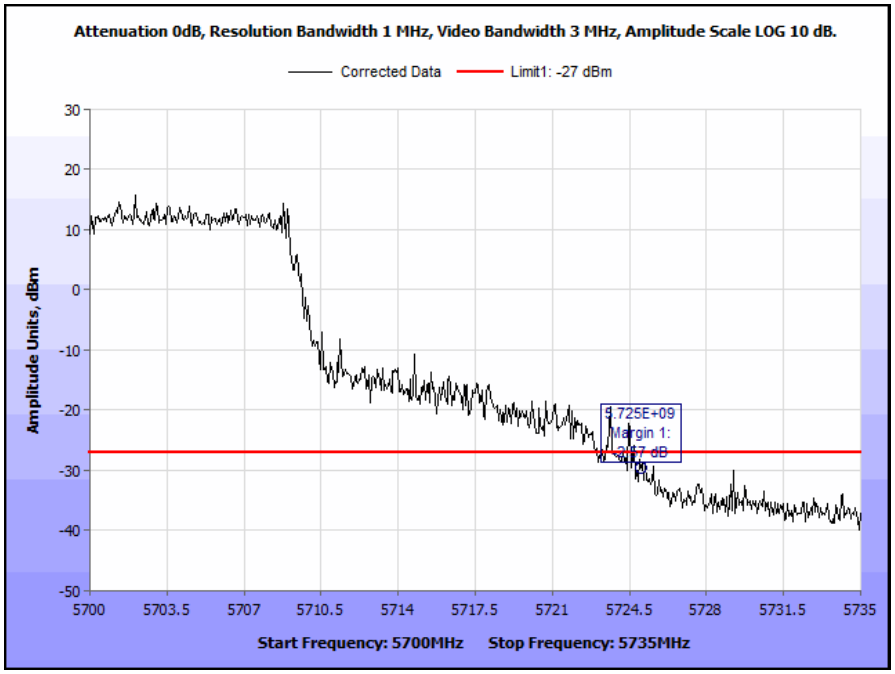


Plot 217. Radiated Band Edge, 5670 MHz @ 5725 MHz, -27 dBm, Rubber Ducky Antenna



Plot 218. Radiated Band Edge, 5700 MHz @ 5725 MHz, -27 dBm, Rubber Ducky Antenna

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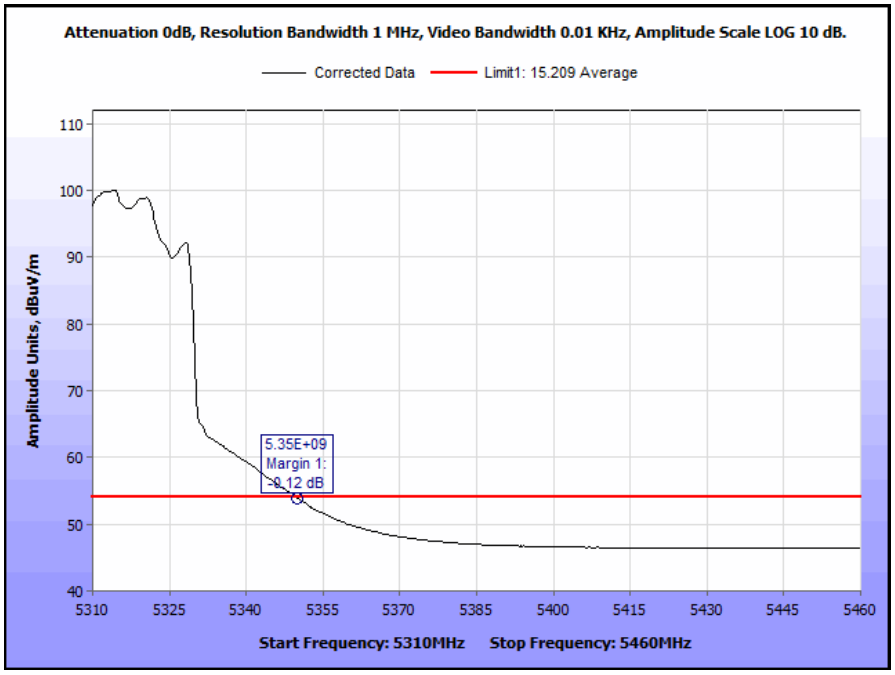
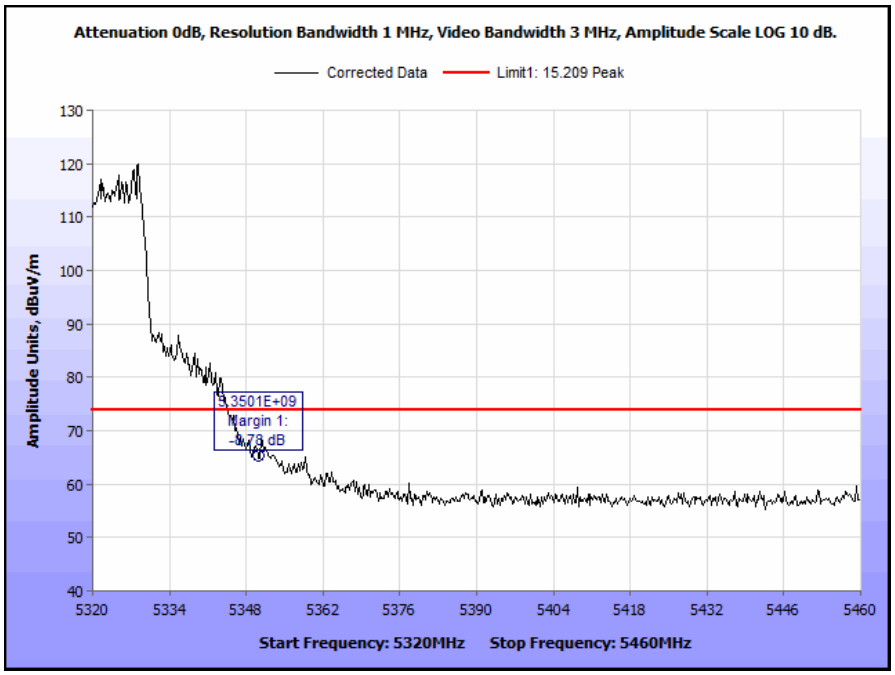
Band Edge, PCB Antenna



Plot 219. Radiated Band Edge, 5310 MHz @ 5350 MHz, Average, PCB Antenna



Plot 220. Radiated Band Edge, 5310 MHz @ 5350 MHz, Peak, PCB Antenna

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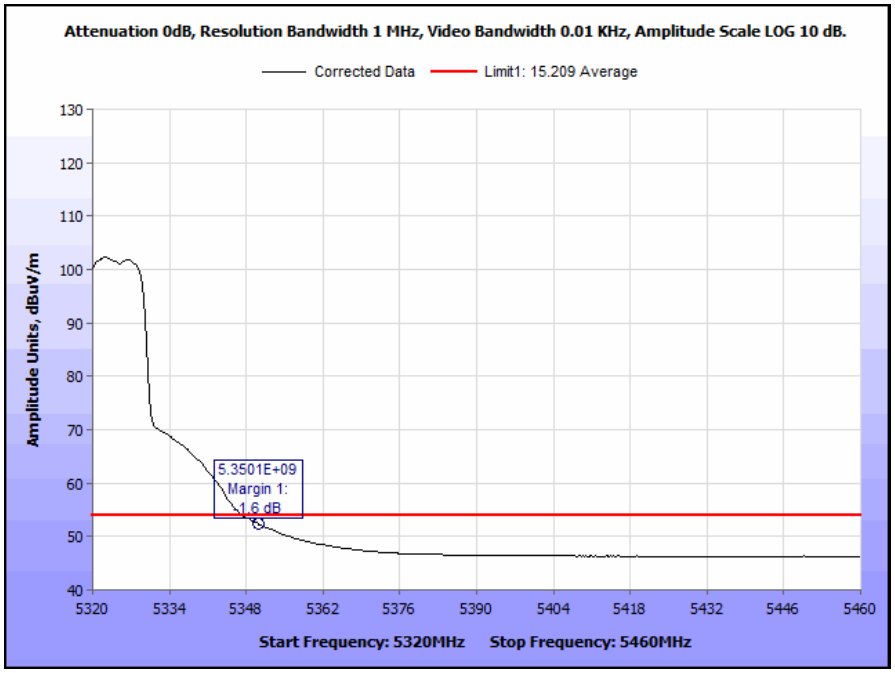
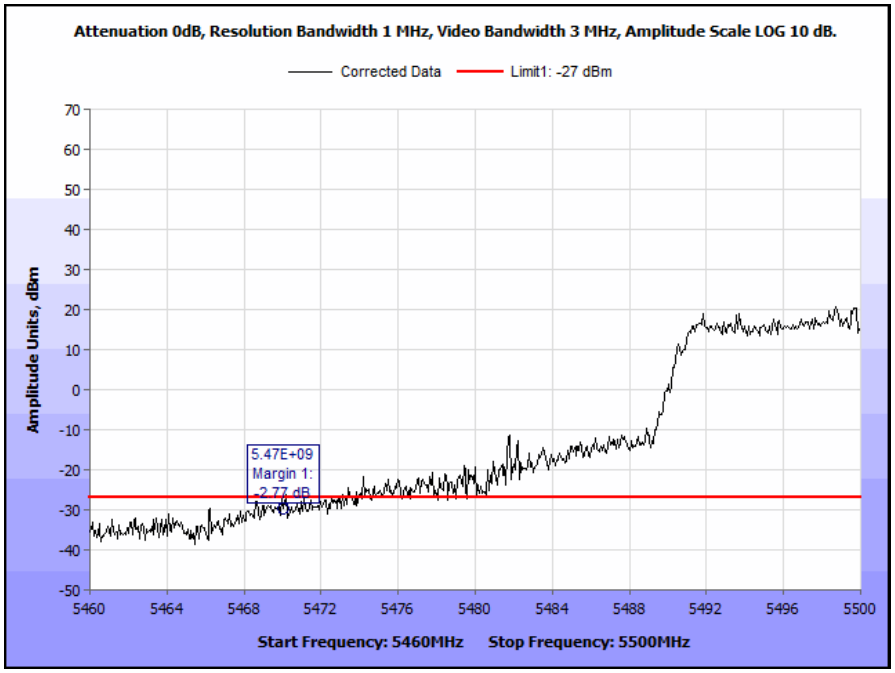
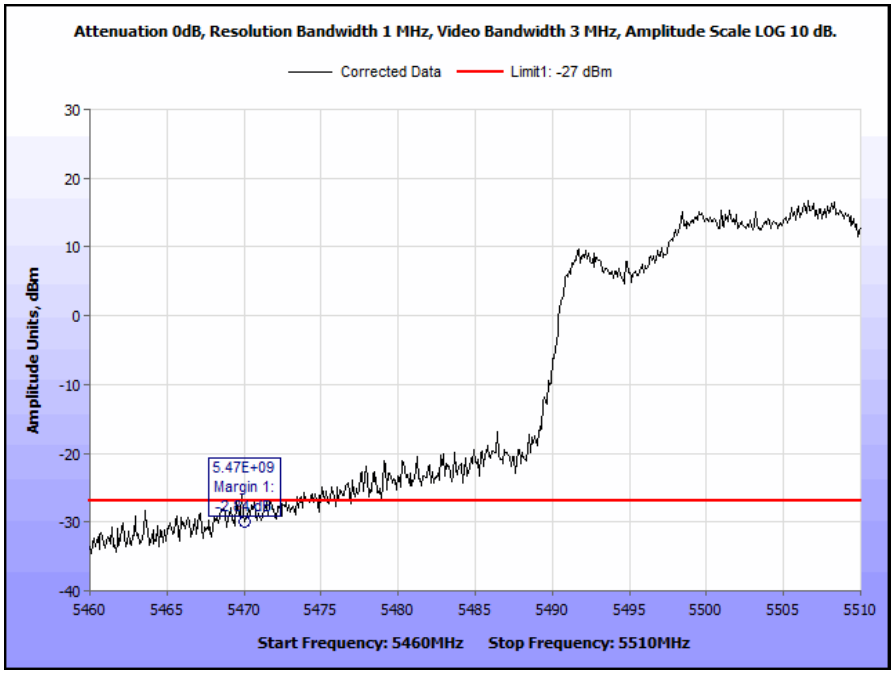


Plot 221. Radiated Band Edge, 5320 MHz @ 5350 MHz, Average, PCB Antenna



Plot 222. Radiated Band Edge, 5500 MHz @ 5470 MHz, -27 dBm, PCB Antenna



Plot 223. Radiated Band Edge, 5510 MHz @ 5470 MHz, -27 dBm, PCB Antenna

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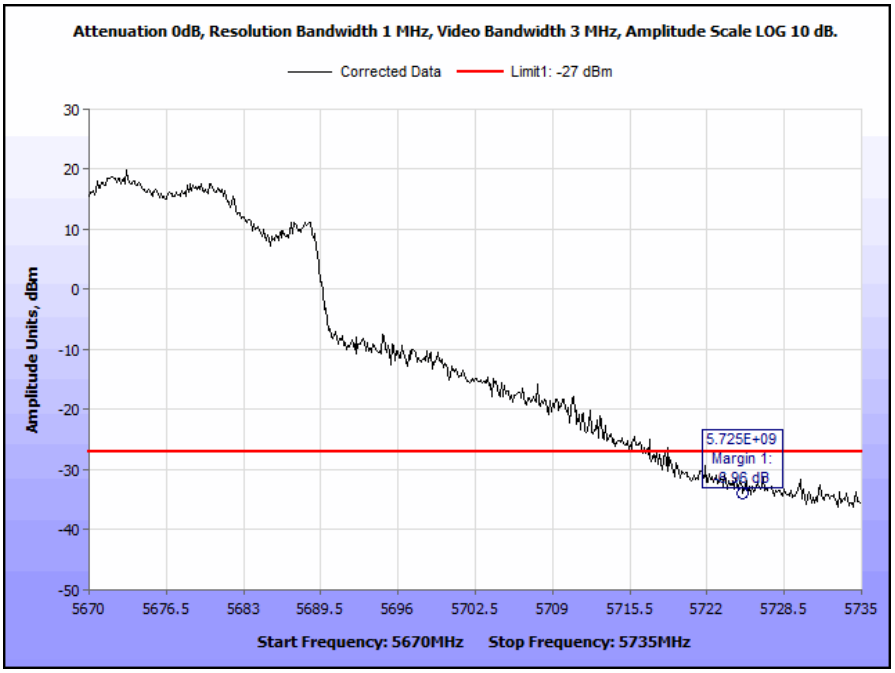
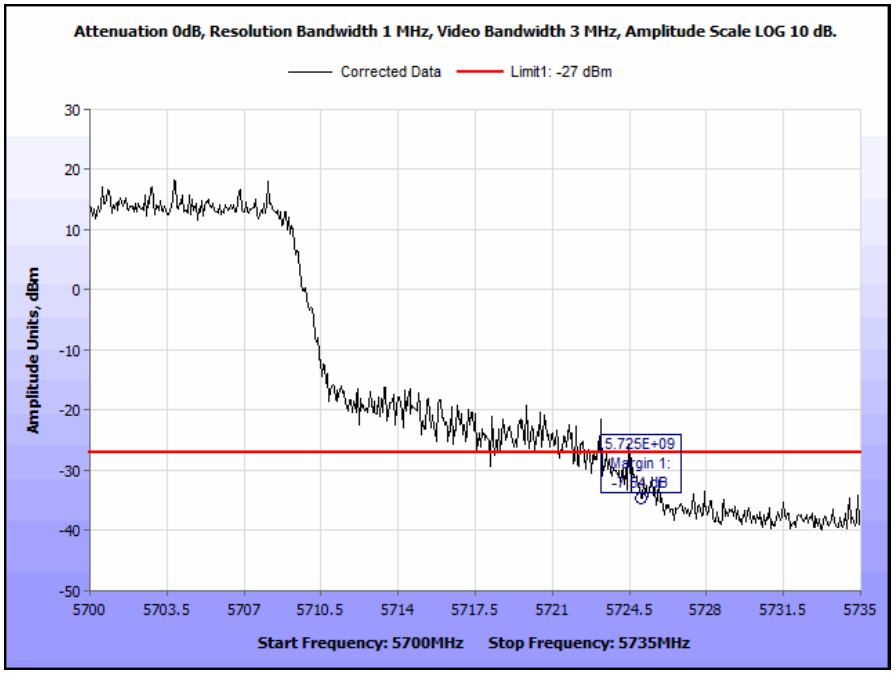


Plot 224. Radiated Band Edge, 5670 MHz @ 5725 MHz, -27 dBm, PCB Antenna



Plot 225Radiated Band Edge, 5700 MHz @ 5725 MHz, -27 dBm, PCB Antenna

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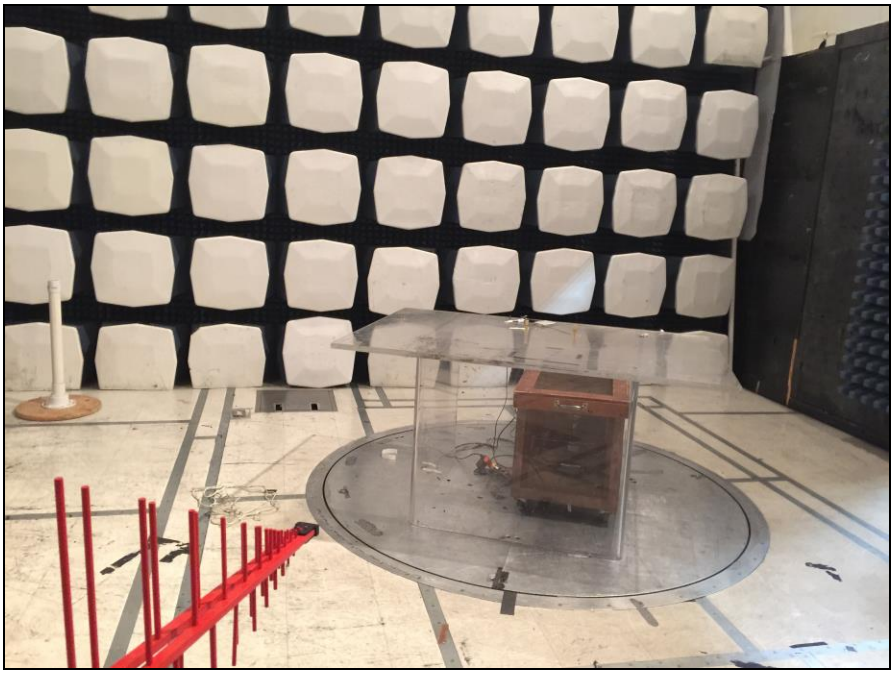

Photograph 1. Radiated Spurious Emissions, Test Setup, 30 MHz – 1 GHz

Photograph 2. Radiated Spurious Emissions, Test Setup, Above 1 GHz

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(f) RF Exposure

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

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

MPE Limit Calculation: EUT's operating frequencies @ 5.25-5.35 GHz and 5.47-5.725 GHz; highest conducted power = 22.863dBm (Avg) therefore, **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

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

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

where, S = Power Density (<1 mW/cm^2)
P = Power Input to antenna (193.33 mW)
G = Antenna Gain (1.58numeric)
R = Minimum Distance between User and Antenna (20 cm)

$S = (19.33*158)/ (4*3.14*20^2) = 0.061$ mW/cm^2

Since S < 1 mW/cm^2, the minimum distance (R) is 20cm

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IV. DFS Requirements and Radar Waveform Description & Calibration

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A. DFS Requirements

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

Table 13. Applicability of DFS Requirements Prior to Use of a Channel

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

Table 14. Applicability of DFS Requirements During Normal Operation

Maximum Transmit Power	Value
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna **Note 2:** Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.	

Table 15. DFS Detection Thresholds for Master or Client Devices Incorporating DFS

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Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2
U-NII Detection Bandwidth	Minimum 80% of the 99% power bandwidth. See Note 3.

Note 1: The instant that the *Channel Move Time* and the *Channel Closing Transmission Time* begins is as follows:

- For the Short pulse radar Test Signals this instant is the end of the *Burst*.
- For the Frequency Hopping radar Test Signal, this instant is the end of the last radar *Burst* generated.
- For the Long Pulse radar Test Signal this instant is the end of the 12 second period defining the radar transmission.

Note 2: The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required facilitating *Channel* changes (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

Note 3: During the *U-NII Detection Bandwidth* detection test, radar type 1 is used and for each frequency step the minimum percentage of detection is 90%. Measurements are performed with no data traffic.

Table 16. DFS Response Requirement Values

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B. Radar Test Waveforms

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

Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Trials
1	1	1428	18	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120

A minimum of 30 unique waveforms are required for each of the short pulse radar types 2 through 4. For short pulse radar type 1, the same waveform is used a minimum of 30 times. If more than 30 waveforms are used for short pulse radar types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. The aggregate is the average of the percentage of successful detections of short pulse radar types 1-4.

Long Pulse Radar Test Waveform

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

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

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Each waveform is defined as follows:

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

A representative example of a Long Pulse radar test waveform:

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

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Graphical Representation of a Long Pulse radar Test Waveform

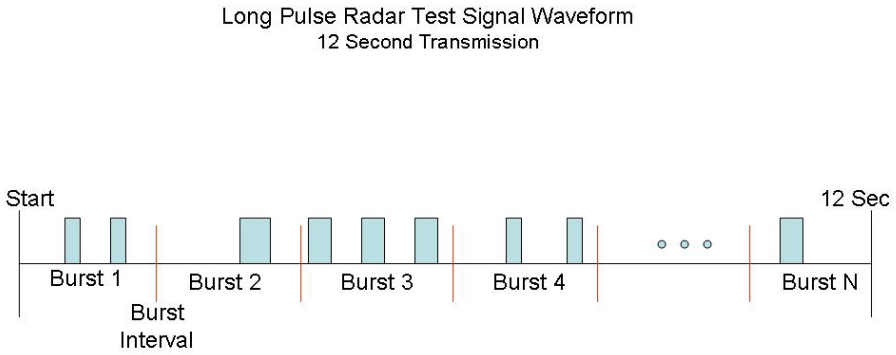

Figure 5. Long Pulse Radar Test Signal Waveform

Frequency Hopping Radar Test Waveform

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

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

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

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C. Radar Waveform Calibration

The following equipment setup was used to calibrate the radiated Radar Waveform. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were no transmissions by either the Master or Client Device. The spectrum analyzer was switched to the zero span (Time Domain) mode at the frequency of the Radar Waveform generator. Peak detection was utilized. The spectrum analyzer's resolution bandwidth (RBW) was set to 3 MHz and the video bandwidth (VBW) was set to 3 MHz. The calibration setup is diagrammed in Figure 6, and the radar test signal generator is shown in Photograph 3.

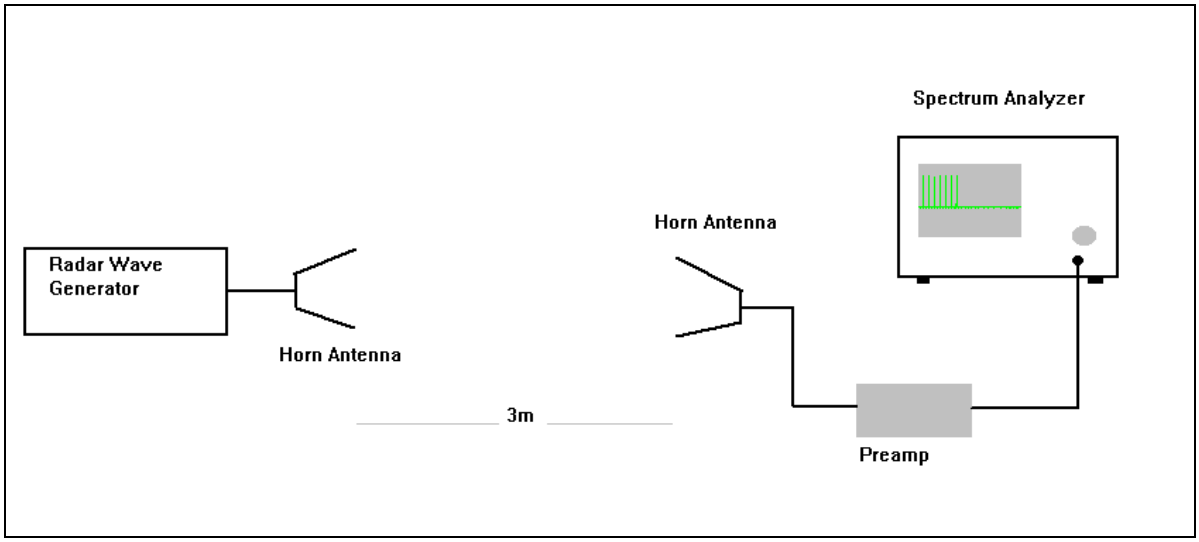
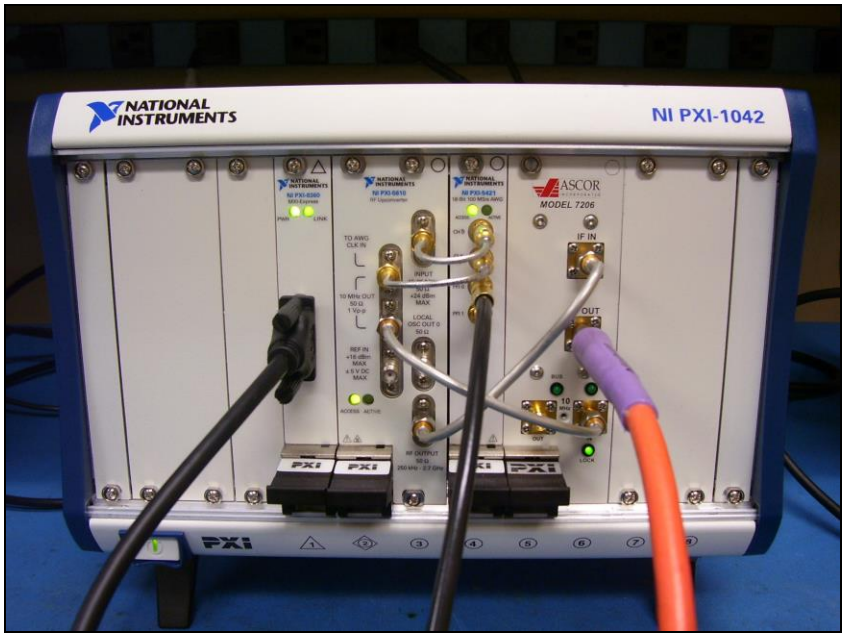
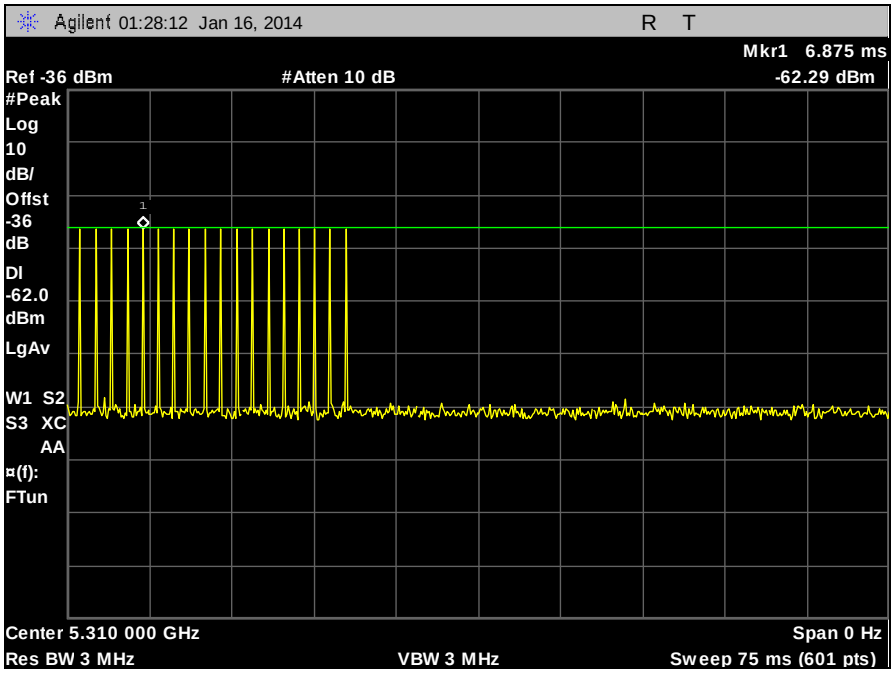


Figure 6. Calibration Test setup

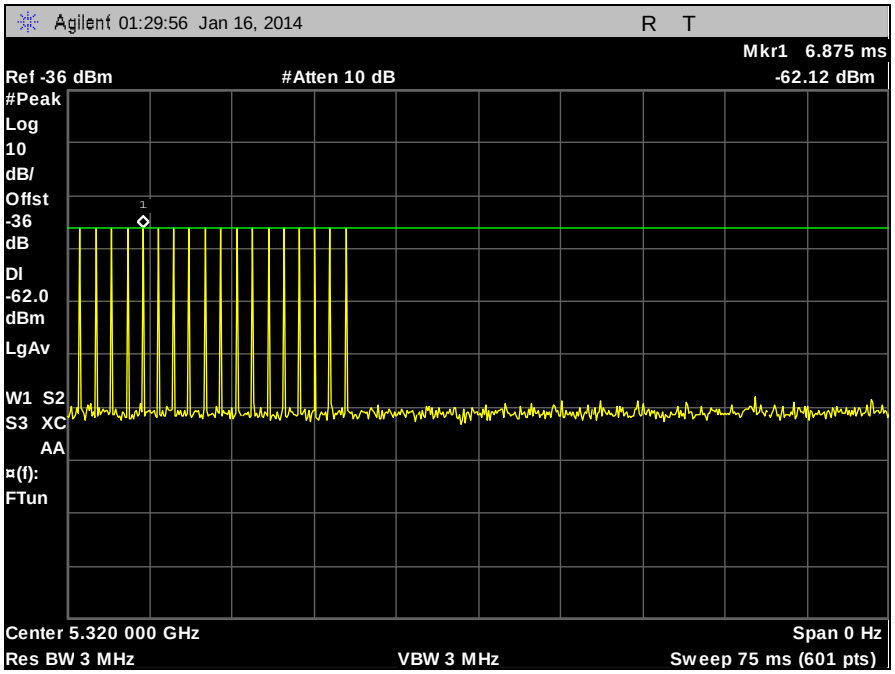


Photograph 3. DFS Radar Test Signal Generator

Radar Waveform Calibration



Plot 226. Calibration, 5310 (40MHz)



Plot 227. Calibration, 5320 (20MHz)

V. DFS Test Procedure and Test Results

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A. DFS Test Setup

1. A spectrum analyzer is used as a monitor to verify that the Unit Under Test (UUT) has vacated the Channel within the Channel Closing Transmission Time and Channel Move Time, and does not transmit on a Channel during the Non-Occupancy Period after the detection and subsequent Channel move. It is also used to monitor UUT transmissions during the Channel Availability Check Time.
2. The test setup, which consists of test equipment and equipment under test (EUT), is diagrammed in Figure 7 and pictured in Photograph 4

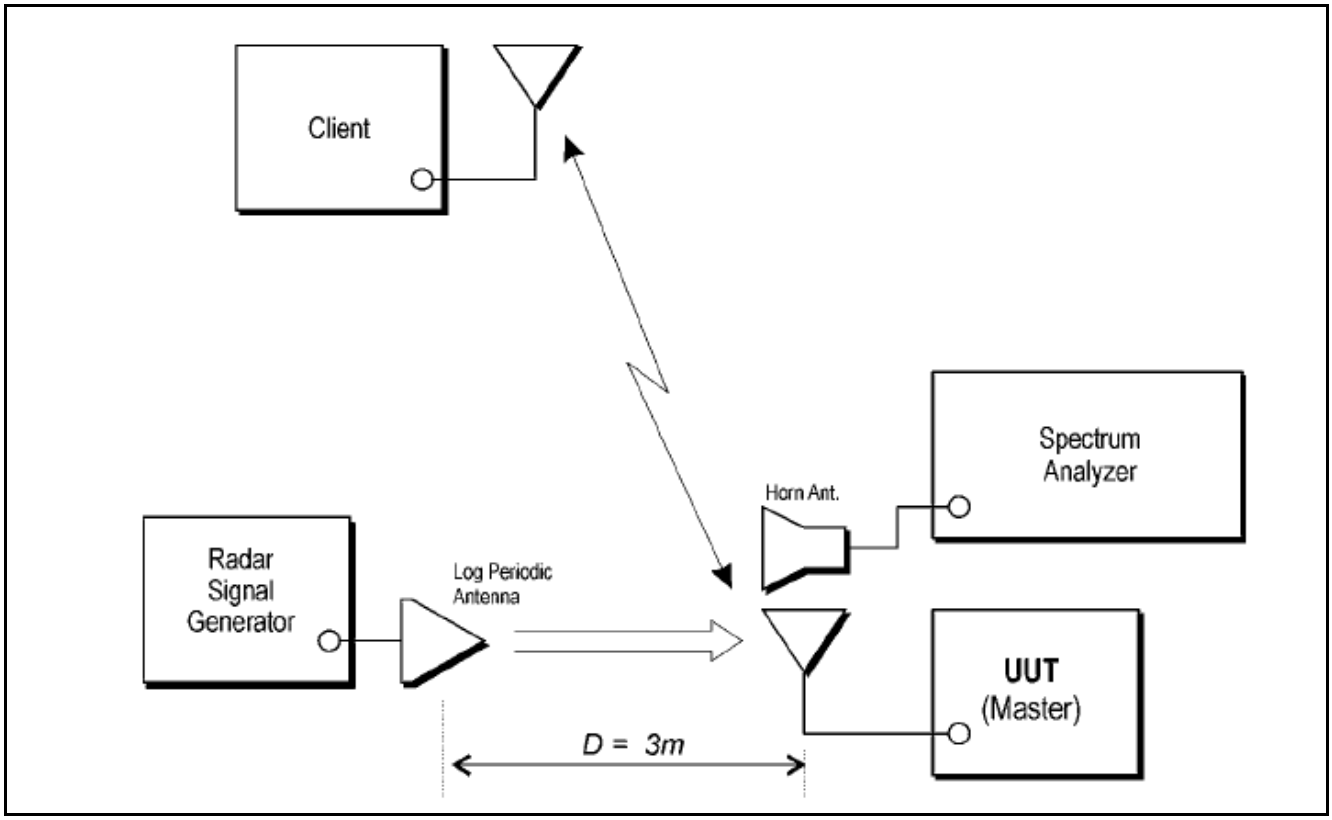
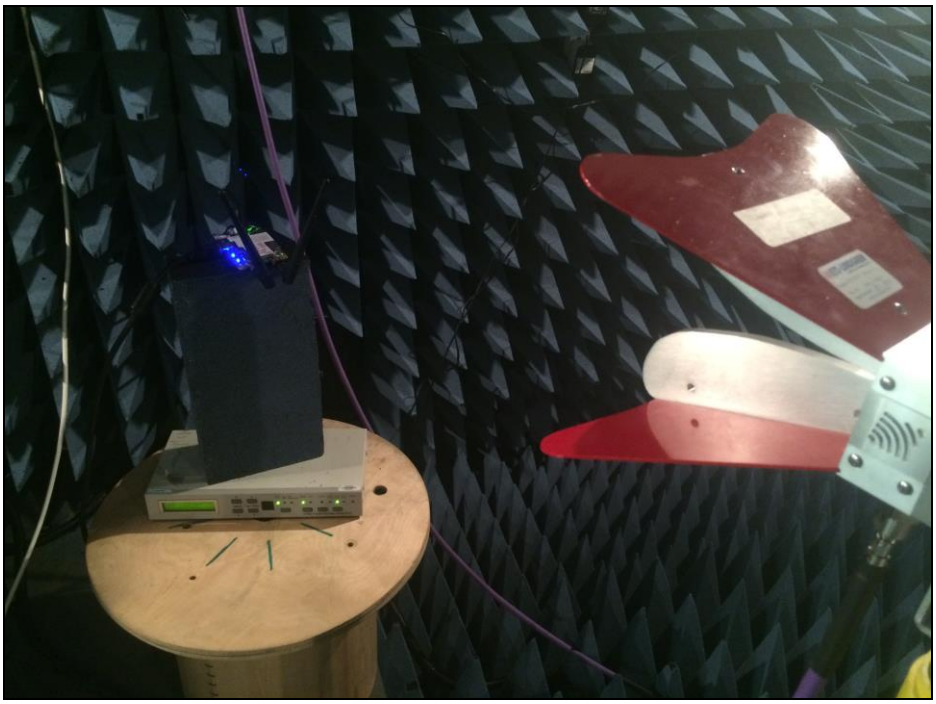
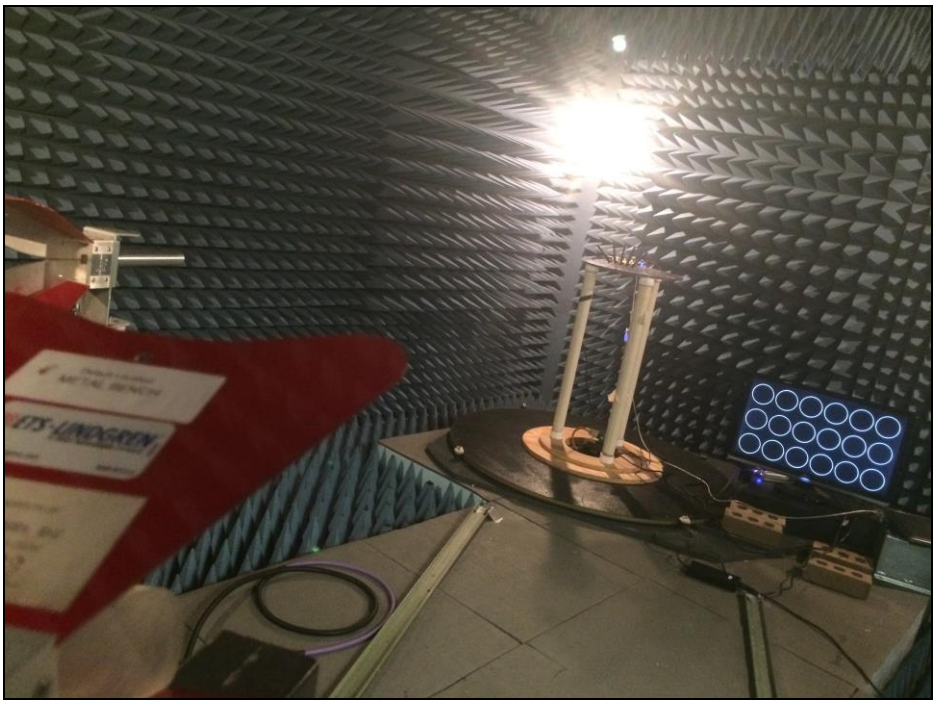


Figure 7. Test Setup Diagram



Photograph 4. Client, Test Setup



Photograph 8. Master, Test Setup

B. EUT Information

1. Operating frequency range is 5150-5825 MHz

2. The EUT is a Client device without radar detection

3. The Client device does not have radar capability. It was tested with an approved Master (FCC ID: VQSAMN36254)

4. Highest EIRP = 22.863 dBm; Lowest EIRP = 2dBm

5. 2 dBi Omni-directional antennas

6. For loading the channel in 96% of the time we transmit 1080p60 video resolution pattern. This video pattern is played from video source device that is connected to Falcon TX module through HDMI cable.

7. The goal of the TPC is to maintain average input power of the received antennas within a certain range.
   The RX should measure the Pin of the 5 received antennas, calculate the average power ant then instruct the TX how much output power to transmit.

8. System block diagram is included in user manual Data rate - 63Mbps per channel Channel BW - 20MHz or 40MHz Frame based.

9. 60 seconds to complete power-on cycle.

10. Manufacturer statement confirming that information regarding the parameters of the detected Radar Waveforms is not available to the end user is submitted as a separate declaration in the filing.

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

Test Requirements:

§ 15.407 (Refer to DFS Response Requirement Values table in section III-A of this report.) The UUT shall continuously monitor for radar transmissions in the operating test channel. When a radar burst occurs in the test channel, it has 10 seconds to move to another channel. This 10 second window is termed Channel Move Time (CMT).

When a radar burst occurs, the UUT has 200 milliseconds, plus an aggregate of 60 milliseconds, to cease transmission in the operating test channel. This 200 ms + 60 ms requirement is termed Channel Closing Transmission Time (CCT).

After radar burst and subsequent move to another channel, the UUT shall not resume transmission, on the channel it moved from, for a period of 30 minutes. This requirement is termed Non-Occupancy Period (NOP).

Test Procedure:

These tests define how the following DFS parameters are verified during In-Service Monitoring: Channel Closing Transmission Time, Channel Move Time, and Non-Occupancy Period.

The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold + 1dB (-62dBm) is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the UUT (Master) at 5310 , and 5320 MHz. Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test.

At time T0 the Radar Waveform generator sends a Burst of pulses for each of the radar types at -62dBm.

Observe the transmissions of the UUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the UUT during the observation time (Channel Move Time). Compare the Channel Move Time and Channel Closing Transmission Time results to the limits defined in the *DFS Response Requirement Values table*.

Test Results: The EUT was compliant with § 15.407 In-Service Monitoring for Channel Move Time, and Channel Closing Transmission Time.

Test Engineer: Djed Mouada

Test Date: 01/17/14

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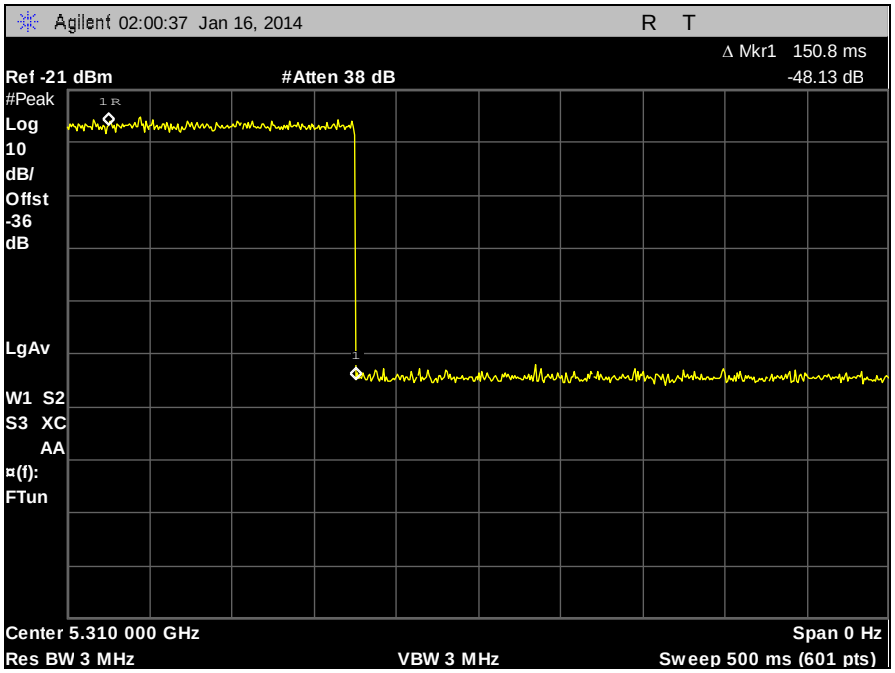
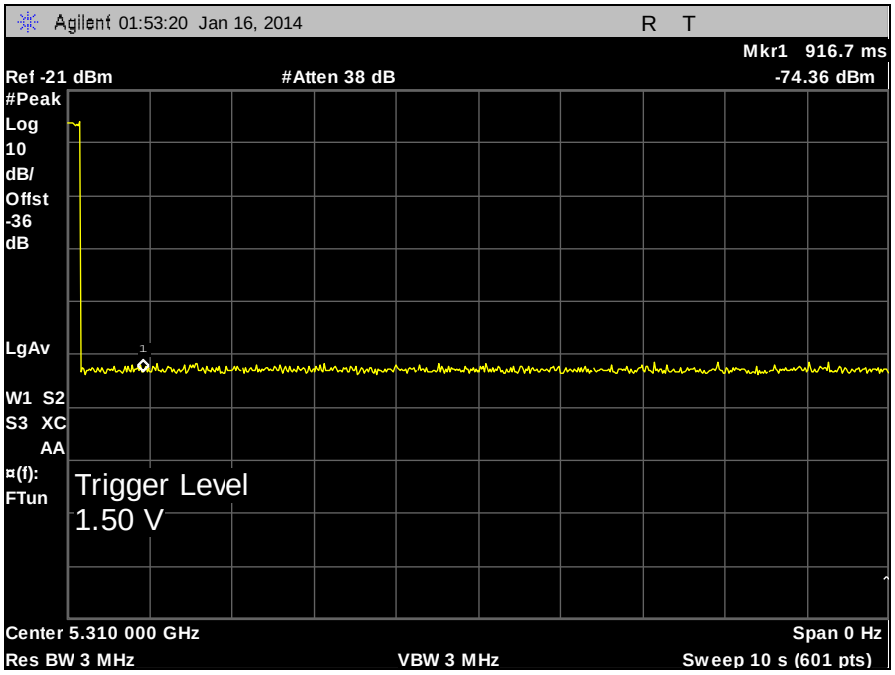
Channel Move Time – Plots



Plot 228. Channel Close, 5310 (40MHz) MHz



Plot 229. Closing Time, 5310 (40MHz) MHz

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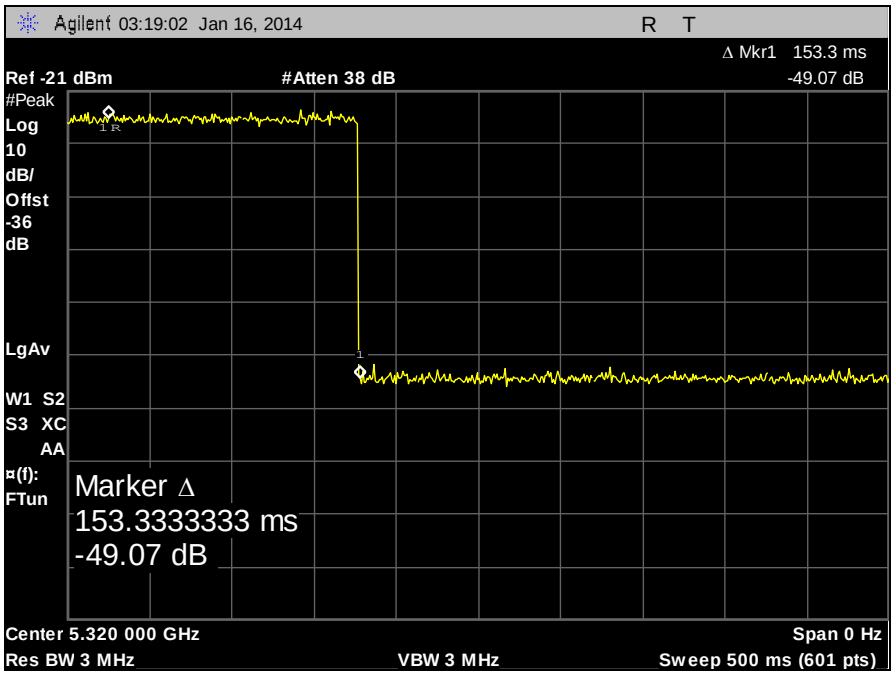
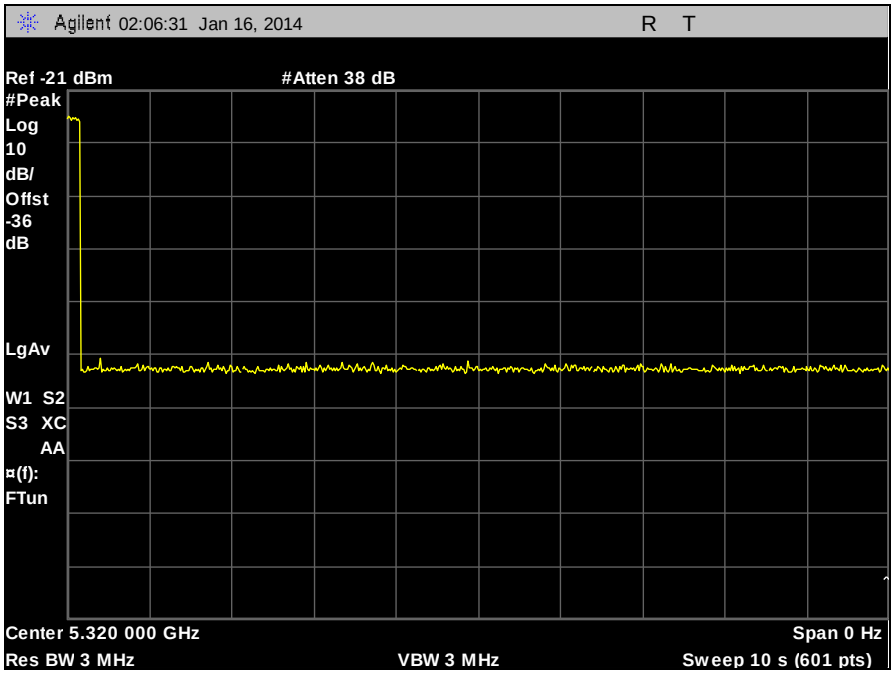


Plot 230. Channel Close, 5320 (20MHz) MHz



Plot 231. Closing Time, 5320 (20MHz) MHz

IV. Test Equipment

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Test Equipment

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

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	10/29/2014	10/29/2016
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	7/29/2014	1/29/2016
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	11/25/2014	11/25/2015
1T4745	ANTENNA, HORN	ETS-LINDGREN	3116	11/14/2013	5/14/2015
1T4612	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	7/25/2014	7/25/2015
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	2/28/2014	8/28/2015
1T2665	ANTENNA; HORN	EMCO	3115	4/3/2014	10/3/2015
1T4565	LISN (24 AMP)	SOLAR ELECTRONICS	9252-50-R-24-BNC	6/26/2014	12/26/2015

Table 17. Test Equipment List

MET ASSET #	EQUIPMENT	MANUFACTURER	MODEL	LAST CAL DATE	CAL DUE DATE
1T4504	SHIELDED ROOM	UNIVERSAL SHIELDING CORP	N/A	SEE NOTE	
1T4752	PRE-AMPLIFIER	MITEQ	JS44-18004000-35-8P	SEE NOTE	
1S2602	DFS SIGNAL GENERATOR	NATIONAL INSTRUMENTS	NIPXI-1042	SEE NOTE	
1T4568	RADIATING NOISE SOURCE	MET LABORATORIES	N/A	SEE NOTE	
1T4814	COMB GENERATOR	COM-POWER	CGO-5100	SEE NOTE	

Table 18. DFS Test Equipment List

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

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V. Certification & User's Manual Information

Certification & User's Manual Information

A. Certification Information

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

§ 2.801 Radio-frequency device defined.

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

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

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

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

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

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

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

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

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

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

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

(i) Compliance testing;

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

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

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

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

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

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

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Certification & User's Manual Information

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

§ 2.901 Basis and Purpose

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

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

§ 2.907 Certification.

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

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

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

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Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

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

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

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

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

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

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Certification & User's Manual Information

Label and User's Manual Information

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

§ 15.19 Labeling requirements.

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

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

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

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

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

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

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

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

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

§ 15.21 Information to user.

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

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Verification & User's Manual Information

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

§ 15.105 Information to the user.

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

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

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

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

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

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

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

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End of Report

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