MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE ● BALTIMORE, MARYLAND 21230-3432 ● PHONE (410) 354-3300 ● FAX (410) 354-3313
33439 WESTERN AVENUE ● UNION CITY, CALIFORNIA 94587 ● PHONE (510) 489-6300 ● FAX (510) 489-6372
3162 BELICK STREET ● SANTA CLARA, CALIFORNIA 95054 ● PHONE (408 748-3585 ● FAX (510) 489-6372

June 28, 2010

Quatech, Inc.
5675 Hudson Indl. Pkwy.
Hudson, OH 44236

Dear Chris Myers,

Enclosed is the EMC Wireless test report for compliance testing of the Quatech, Inc., WLRG-RA-DP601 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), ICES-003, Issue 4 February 2004 for Digital Devices and FCC Part 15 Subpart C, RSS-210, Issue 7, June 2007 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: (\Quatech, Inc.\EMC28457-FCC247 Rev. 2)

Electromagnetic Compatibility Criteria
Test Report

for the

Quatech, Inc.
WLRG-RA-DP601

Tested under
the FCC Certification Rules
contained in
ICES-003
for Digital Devices
&
15.247 Subpart C & RSS-210, Issue 7, June 2007
for Intentional Radiators

MET Report: EMC28457-FCC247 Rev. 2

June 28, 2010

Prepared For:

Quatech, Inc.
5675 Hudson Indl. Pkwy.
Hudson, OH 44236

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

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for Intentional Radiators

Len Knight, 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 the FCC Rules Part 15.247 and Industry Canada standards ICES-003, Issue 4 February 2004, RSS-210, Issue 7, June 2007 under normal use and maintenance.

Shawn McMillen,
Wireless Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	June 23, 2010	Initial Issue.
1	June 28, 2010	Engineer corrections.
2	June 28, 2010	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**ilovolt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**micro**henry
µ	**micro**farad
µs	**micros**econds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Quatech, Inc. WLRG-RA-DP601, with the requirements of Part 15, §15.247. 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 WLRG-RA-DP601. Quatech, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the WLRG-RA-DP601, 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, §15.247, in accordance with Quatech, Inc., purchase order number 437169. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference 47 CFR Part 15.247:2005	IC Reference RSS-210 Issue 7: 2007	Description	Compliance
47 CFR Part 15.107 (a)	ICES-003 Issue 4 February 2004	Conducted Emission Limits for a B Digital Device	Compliant
47 CFR Part 15.109 (a)	ICES-003 Issue 4 February 2004	Radiated Emission Limits for a A Digital Device	Compliant
Title 47 of the CFR, Part 15 §15.203	N/A	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	RSS-210(7.2.2)	Conducted Emission Voltage	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	RSS-210(A8.1)	Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	RSS-210(A8.4)	RF Output Power	Compliant
Title 47 of the CFR, Part 15 §15.209, §15.247(d)	RSS-210(A8.5)	Radiated Spurious Emissions	Compliant
Title 47 of the CFR, Part 15 §15.205	RSS-210(A8.5)	Emissions at Restricted Band	Compliant
Title 47 of the CFR, Part 15 §15.209, §15.247(d)	RSS-210(A8.5)	Conducted Spurious Emissions	Compliant
Title 47 of the CFR, Part 15; §15.247(e)	RSS-210(A8.3)	Power Spectral Density	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	RSS-Gen(5.5)	Maximum Permissible Exposure	Compliant
N/A	RSS-Gen(4.8)	Receiver Spurious Emissions	Compliant

Table 1. Executive Summary of EMC Part 15.247 ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Quatech, Inc. to perform testing on the WLRG-RA-DP601, under Quatech, Inc.'s purchase order number 437169.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Quatech, Inc., WLRG-RA-DP601.

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

Model(s) Tested:	WLRG-RA-DP601	
Model(s) Covered:	WLRG-RA-DP601	
EUT Specifications:	Primary Power: 3.3 VDC	
	FCC ID: F4AWLRG601 IC: 3913A-RA-DP601	
	Type of Modulations:	DSSS, OFDM
	Equipment Code:	DTS
	Peak RF Output Power:	82.41 mW (19.16 dBm)
	EUT Frequency Ranges:	2.412 GHz – 2.462 GHz
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:	Len Knight	
Report Date(s):	June 28, 2010	

Table 2. EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
RSS-210, Issue 7, June 2007	Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
CFR 47, Part 15, Subpart B	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
ICES-003, Issue 4 February 2004	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
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
ANSI/NCSL Z540-1-1994	Calibration Laboratories and Measuring and Test Equipment - General Requirements
ANSI/ISO/IEC 17025:2000	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 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The Quatech, Inc. WLRG-RA-DP601, Equipment Under Test (EUT), is a 802.11 b/g wireless radio module and the intended use is integration into OEM products.

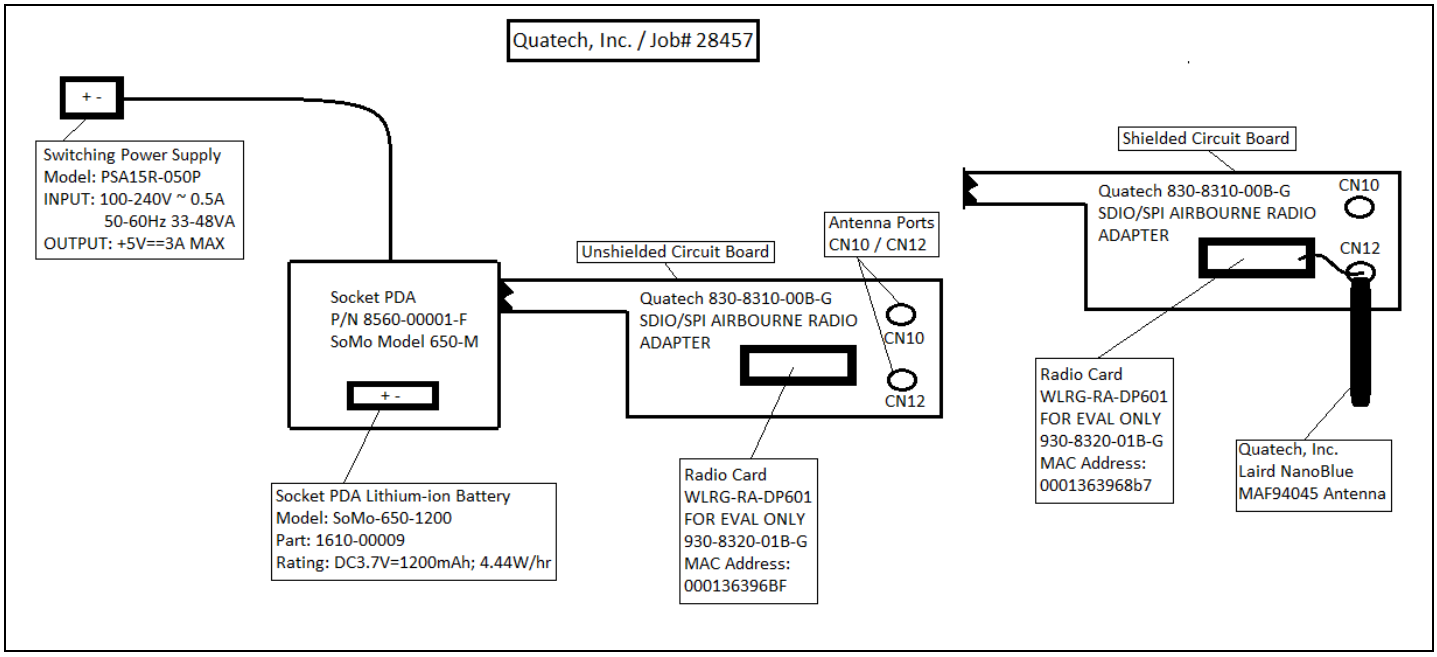


Figure 1. Block Diagram of Test Configuration

E. Equipment Configuration

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

Ref. ID	Name / Description	Model Number	Serial Number
1	WLRG-RA-DP601 radio module	WLRG-RA-DP601	0001363965BC
1	WLRG-RA-DP601 radio module	WLRG-RA-DP601	0001363965BF
1	WLRG-RA-DP601 radio module	WLRG-RA-DP601	000136396B2E
5	Antenna, 2 dBi omni, Quatech	ACH2-AT-DP002	n/a
6	Antenna, 5 dBi omni, Quatech	ACH2-AT-DP003	n/a
7	Antenna, 2 dBi Centurion NanoBlue	MAF94045	n/a

Table 4. Equipment Configuration

F. Support Equipment

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

Ref. ID	Name / Description	Manufacturer	Model Number	Serial Number
2	carrier board w/ U.FL-to-U.FL cable	Quatech	830-8310-00B-G	n/a
3	handheld computer with stylus	Socket	SoMo650	n/a
4	Power charger for Socket SoMo650	n/a	n/a	n/a

Table 5. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded? (Y/N)	Termination Box ID & Port ID
8	U.FL	Antenna connection	1	N/A	Y	n/a

Table 6. Ports and Cabling Information

H. Mode of Operation

Unit was tested using the Marvell LabTools application running on a handheld WinCE computer. The EUT was will run with manufacturing/test firmware allowing for continuous transmit mode.

The EUT was mounted to a carrier board. Carrier board had an SDIO finger to allow insertion into the WinCE handheld computer. Carrier board also had RP-SMA antenna connectors to allow attachment of external antennas provided by Quatech. One U.FL-to-U.FL cable connection is made between the unit and the carrier board.

There was no GUI adjustment for the output power. The output power was static.

I. 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.

J. Disposition of EUT

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

III. Electromagnetic Compatibility Criteria for Unintentional Radiators

Electromagnetic Compatibility Criteria

§ 15.107 Conducted Emissions Limits

Test Requirement(s):

15.107 (a) Except for Class A digital devices, for equipment 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 30 MHz shall not exceed the limits in Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

15.107 (b) For a Class A digital device 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 30 MHz shall not exceed the limits in Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

15.207(a), Except as shown in paragraphs (b) and (c) of this section*, charging, AC adapters or battery eliminators the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the Table 7, as measured using a 50 µH/50 ohms 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 frequencies ranges.

Frequency range (MHz)	Class A Conducted Limits (dBµV)		*Class B Conducted Limits (dBµV)	
	Quasi-Peak	Average	Quasi-Peak	Average
* 0.15- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 30	73	60	60	50
Note 1 — The lower limit shall apply at the transition frequencies. Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz. * -- Limits per Subsection 15.207(a).				

Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b) and 15.207(a)

Test Results: The EUT was compliant with the B requirement(s) of this section. Measured emissions were below applicable limits.

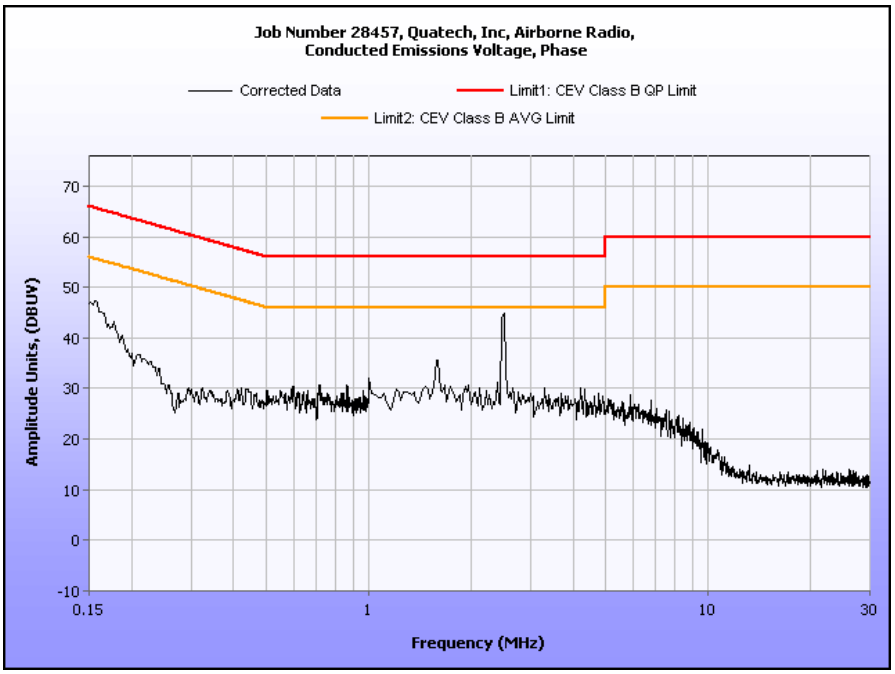
Test Engineer(s): Michael Cherewka

Test Date(s): 01/21/10

Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.1501	52.41	0.08517	52.49517	65.99	-13.4948	39.27	0.08517	39.35517	55.99	-16.6348
0.1741	30.19	0.12597	30.31597	64.76	-34.444	17.11	0.12597	17.23597	54.76	-37.524
0.2069	43.31	0.17	43.48	63.33	-19.85	26.55	0.17	26.72	53.33	-26.61
1.01	21.64	0.17	21.81	56	-34.19	7.75	0.17	7.92	46	-38.08
1.59	30.37	0.17	30.54	56	-25.46	21.33	0.17	21.5	46	-24.5
2.333	21.25	0.17	21.42	56	-34.58	7.337	0.17	7.507	46	-38.493

Table 8. Conducted Emissions - Voltage, AC Power, Phase Line (120 VAC, 60 Hz)

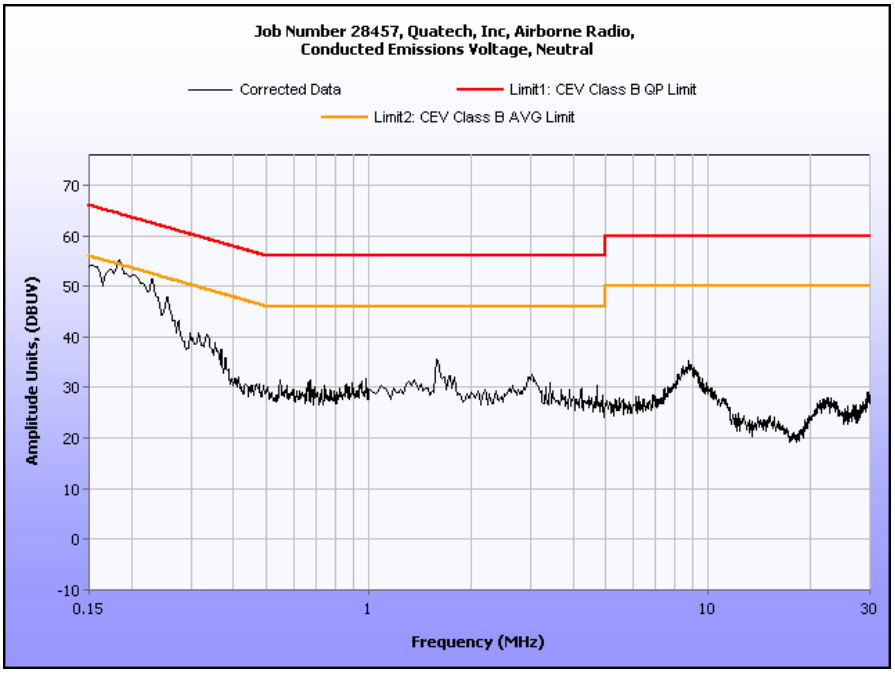


Plot 1. Conducted Emission, Phase Line Plot

Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.1505	48.56	0.08585	48.64585	65.97	-17.3242	34.06	0.08585	34.14585	55.97	-21.8242
0.1942	49.12	0.16014	49.28014	63.86	-14.5799	35.37	0.16014	35.53014	53.86	-18.3299
0.2306	45.83	0.17	46	62.43	-16.43	35.35	0.17	35.52	52.43	-16.91
0.2453	43.73	0.17	43.9	61.92	-18.02	33.66	0.17	33.83	51.92	-18.09
1.59	33.48	0.17	33.65	56	-22.35	28.55	0.17	28.72	46	-17.28
8.795	28.95	0.26573333	29.21573333	60	-30.7843	23.49	0.26573333	23.75573333	50	-26.2443

Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line (120 VAC, 60 Hz)



Plot 2. Conducted Emission, Neutral Line Plot

Conducted Emission Limits Test Setup

Photograph 1. Conducted Emissions, Test Setup

Radiated Emission Limits

§ 15.109 Radiated Emissions Limits

Test Requirement(s): **15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 10.

15.109 (b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the Class A limits expressed in Table 10.

Frequency (MHz)	Field Strength (dBµV/m)	
	§15.109 (b), Class A Limit (dBµV) @ 10m	§15.109 (a),Class B Limit (dBµV) @ 3m
30 - 88	39.00	40.00
88 - 216	43.50	43.50
216 - 960	46.40	46.00
Above 960	49.50	54.00

Table 10. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)

Test Procedures: The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 3 m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

Test Results: The EUT was compliant with the A requirement(s) of this section. Measured emissions were below applicable limits.

Test Engineer(s): Michael Cherewka

Test Date(s): 01/20/10

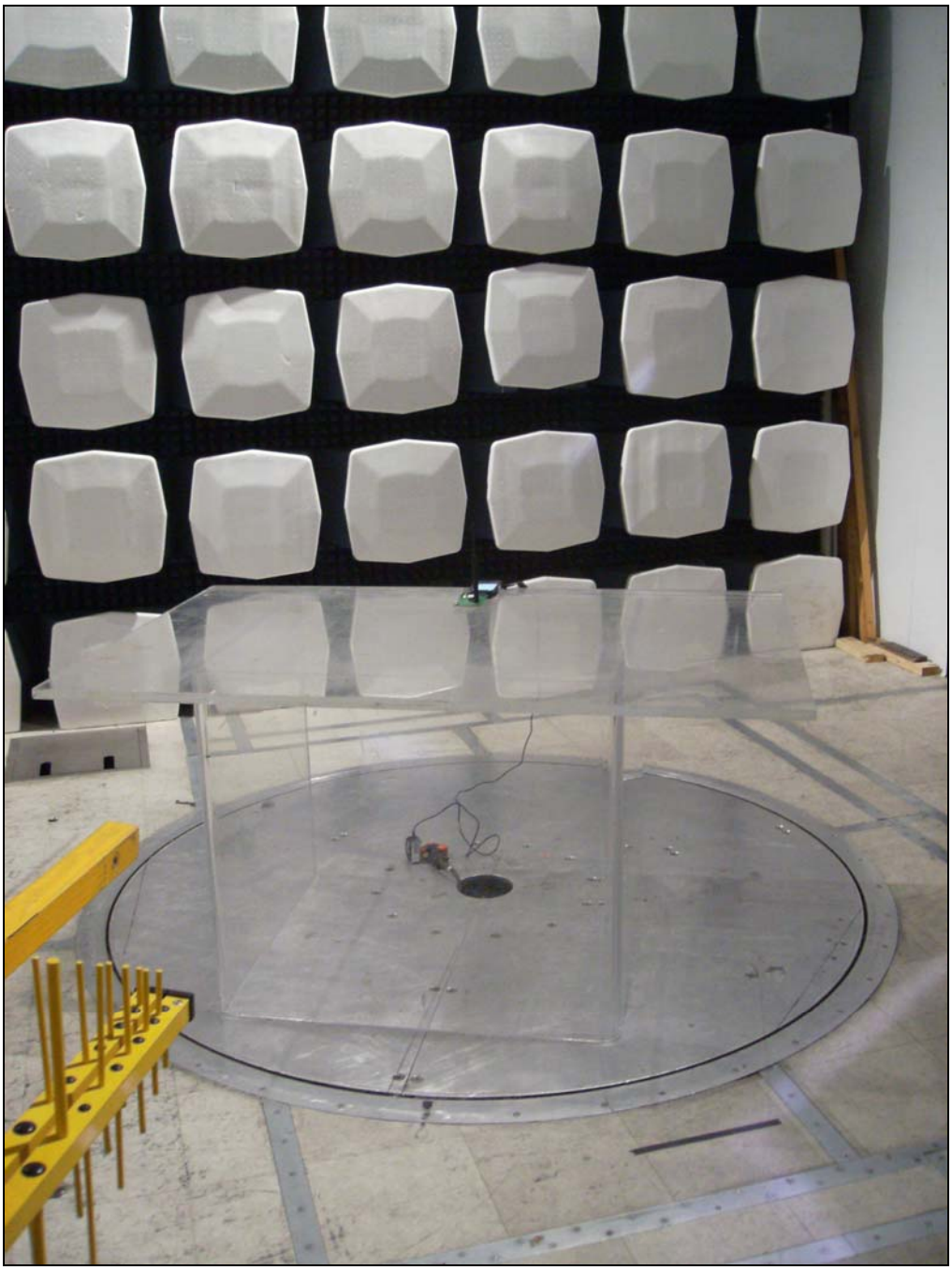
Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Antenna HEIGHT (m)	Uncorrected Amplitude (dBuV)	Antenna Correction Factor (dB) (+)	Cable Loss (dB) (+)	Distance Correction Factor (dB) (-)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
40.135	63	H	1.03	10.54	8.71	0.23	10.46	9.02	40.00	-30.98
40.135	359	V	1.00	26.70	7.92	0.23	10.46	24.39	40.00	-15.61
108.659	171	H	1.65	8.19	7.25	0.23	10.46	5.21	40.00	-34.79
108.659	1	V	1.01	19.23	7.53	0.23	10.46	16.53	40.00	-23.47
214.471	79	H	1.08	35.15	10.59	0.23	10.46	35.51	40.00	-4.49
214.471	46	V	1.01	28.16	10.49	0.23	10.46	28.42	40.00	-11.58
253.475	73	H	1.07	39.05	12.98	0.52	10.46	42.09	47.00	-4.91
253.475	267	V	1.01	31.83	12.86	0.52	10.46	34.75	47.00	-12.25
292.480	84	H	1.06	35.74	13.10	0.78	10.46	39.16	47.00	-7.84
292.480	249	V	1.14	28.48	12.40	0.78	10.46	31.20	47.00	-15.80
331.483	290	H	1.01	28.88	13.63	0.83	10.46	32.88	47.00	-14.12
331.483	219	V	1.39	25.32	14.32	0.83	10.46	30.01	47.00	-16.99
448.465	99	H	2.16	28.02	16.37	1.00	10.46	34.93	47.00	-12.07
448.465	80	V	1.27	22.67	16.74	1.00	10.46	29.95	47.00	-17.05
487.467	84	H	1.77	32.51	17.25	1.00	10.46	40.30	47.00	-6.70
487.467	218	V	1.01	25.06	16.95	1.00	10.46	32.55	47.00	-14.45
526.463	61	H	1.61	27.73	17.50	1.00	10.46	35.77	47.00	-11.23
526.463	93	V	1.01	26.54	17.72	1.00	10.46	34.80	47.00	-12.20
565.461	287	H	1.32	22.64	18.40	1.11	10.46	31.69	47.00	-15.31
565.461	13	V	1.02	21.29	18.40	1.11	10.46	30.34	47.00	-16.66
604.454	80	H	1.30	24.27	18.70	1.17	10.46	33.68	47.00	-13.32
604.454	331	V	0.99	21.34	18.79	1.17	10.46	30.84	47.00	-16.16
643.469	291	H	1.09	18.00	20.07	1.17	10.46	28.78	47.00	-18.22
643.469	324	V	1.03	14.43	20.10	1.17	10.46	25.24	47.00	-21.76

Table 11. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, ICES-003 Limits

Note: The EUT was tested at 3 m.

Radiated Emission Limits Test Setup



Photograph 2. Radiated Emission, Test Setup

IV. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

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

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

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

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

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

Results: The EUT as tested is compliant the criteria of §15.203. The module has a unique connector. In addition, the intent of the module is to be sold and used as integration into OEM products.

Test Engineer(s): Len Knight

Test Date(s): 04/12/10

Gain	Type	Model	Manufacturer
2 dBi	Portable Rubber duck Antenna	ACH2-AT-DP002	Quatech
5 dBi	Portable Rubber duck Antenna	ACH0-AT-DP003	Quatech
2 dBi	Centurion NanoBlue	MAF94045	Laird

Table 12. Antenna List

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 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

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

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

Test Procedure: The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-2003 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were preformed with the transmitter on.

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

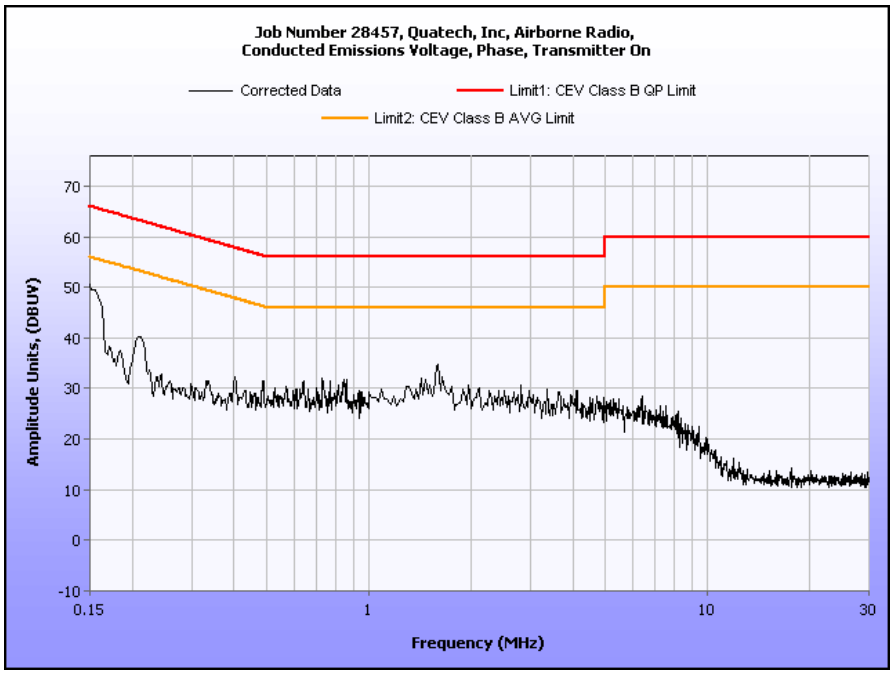
Test Engineer(s): Michael Cherewka

Test Date(s): 01/21/10

15.207 Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.1503	50.22	0.08551	50.30551	65.98	-15.6745	40.51	0.08551	40.59551	55.98	-15.3845
0.1713	29.68	0.12121	29.80121	64.9	-35.0988	15.7	0.12121	15.82121	54.9	-39.0788
0.2117	39.21	0.17	39.38	63.14	-23.76	23.97	0.17	24.14	53.14	-29
0.4021	22.13	0.17	22.3	57.81	-35.51	7.967	0.17	8.137	47.81	-39.673
0.7403	22.11	0.17	22.28	56	-33.72	10.23	0.17	10.4	46	-35.6
1.591	30.61	0.17	30.78	56	-25.22	21.54	0.17	21.71	46	-24.29

Table 14. Conducted Emissions, 15.207, Phase Line, Test Results

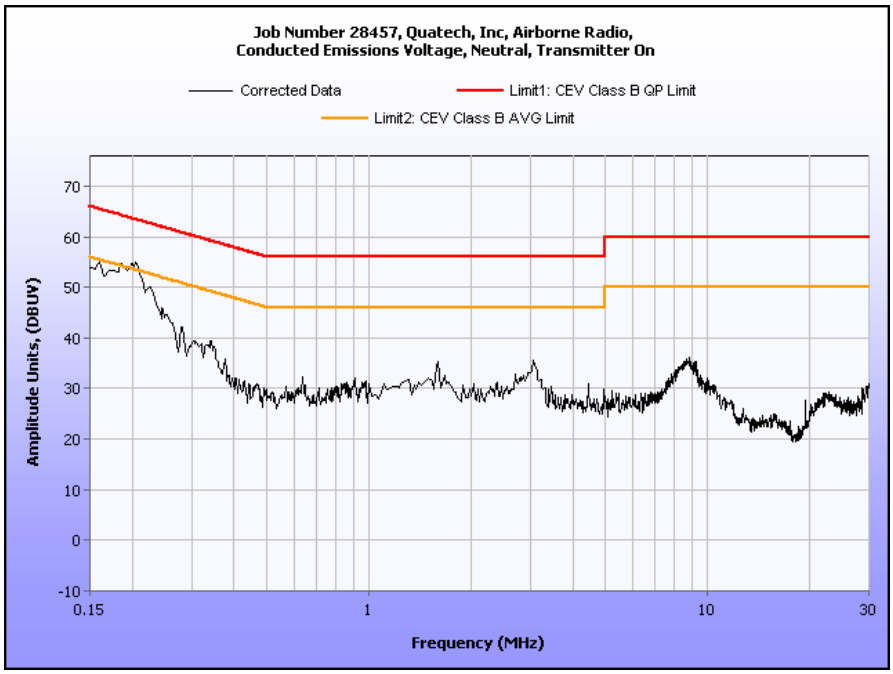


Plot 3. Conducted Emissions, Phase Line

15.207 Conducted Emissions Test Results

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.1646	49.4	0.10982	49.50982	65.23	-15.7202	31.22	0.10982	31.32982	55.23	-23.9002
0.1926	51.25	0.15742	51.40742	63.92	-12.5126	38.66	0.15742	38.81742	53.92	-15.1026
0.2157	48.48	0.17	48.65	62.98	-14.33	34.47	0.17	34.64	52.98	-18.34
0.2621	40.69	0.17	40.86	61.36	-20.5	27.64	0.17	27.81	51.36	-23.55
0.3537	32.4	0.17	32.57	58.88	-26.31	22.38	0.17	22.55	48.88	-26.33
3.018	27.45	0.17	27.62	56	-28.38	18.79	0.17	18.96	46	-27.04

Table 15. Conducted Emissions, 15.207, Neutral Line, Test Results



Plot 4. Conducted Emissions, Neutral Line

15.207 Conducted Emissions Test Setup Photo

Photograph 3. Conducted Emissions, 15.207, Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a) 6 dB and 99% Bandwidth

Test Requirements: **§ 15.247(a):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Procedure: The transmitter was on and transmitting. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately 1% of the total emission bandwidth, VBW > RBW. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels and at data rates of 1 Mbps, 6 Mbps, and 54 Mbps.

Test Results The EUT was compliant with § 15.247 (a).

The 6 dB and 99% Bandwidth was determined from the plots on the following pages.

Test Engineer(s): Len Knight

Test Date(s): 01/25/10

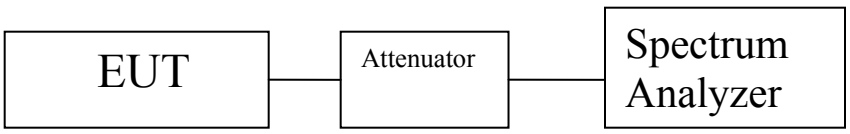


Figure 2. Block Diagram, Occupied Bandwidth Test Setup

Occupied Bandwidth Test Results

Mode Tested	Band	Channel	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (kHz)
1 Mbps	LOW	1	10.013 MHz	13.7529	≥ 500 kHz
	MID	6	9.736 MHz	13.7178	≥ 500 kHz
	HIGH	11	8.991 MHz	13.7188	≥ 500 kHz

Table 16. Occupied Bandwidth, Test Results, 1 Mbps

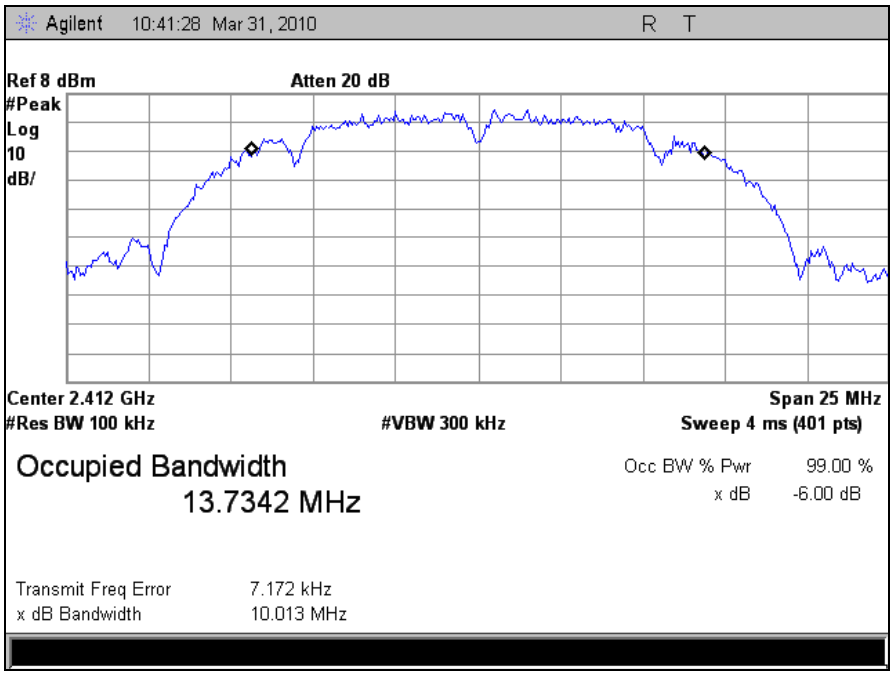
Mode Tested	Band	Channel	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (kHz)
6 Mbps	LOW	1	16.493 MHz	16.7733	≥ 500 kHz
	MID	6	16.453 MHz	16.8208	≥ 500 kHz
	HIGH	11	16.470 MHz	16.8258	≥ 500 kHz

Table 17. Occupied Bandwidth, Test Results, 6 Mbps

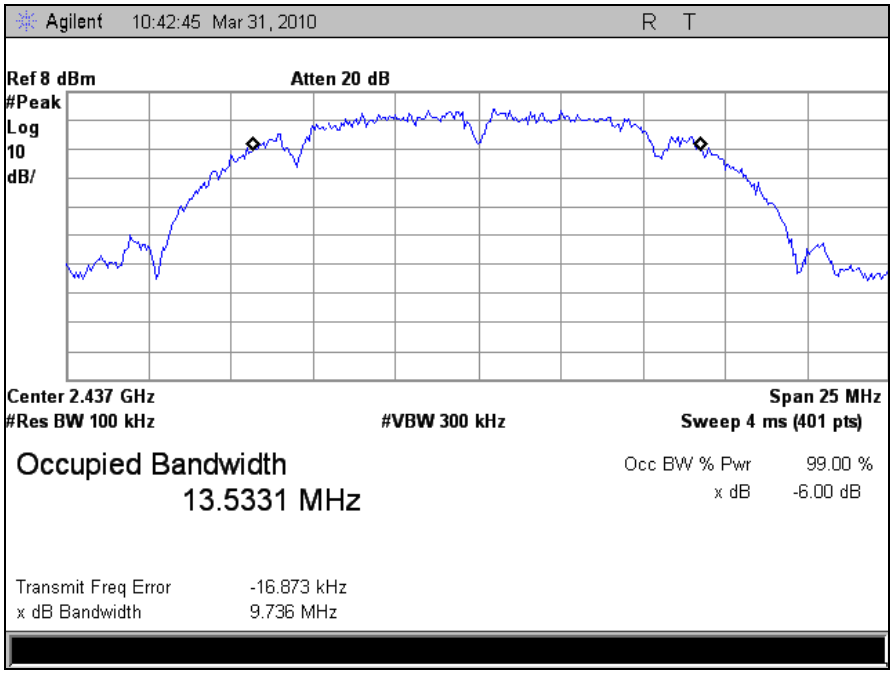
Mode Tested	Band	Channel	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (kHz)
54 Mbps	LOW	1	16.553 MHz	16.7487	≥ 500 kHz
	MID	6	16.503 MHz	16.6993	≥ 500 kHz
	HIGH	11	16.488 MHz	16.7467	≥ 500 kHz

Table 18. Occupied Bandwidth, Test Results, 54 Mbps

Occupied Bandwidth Test Results

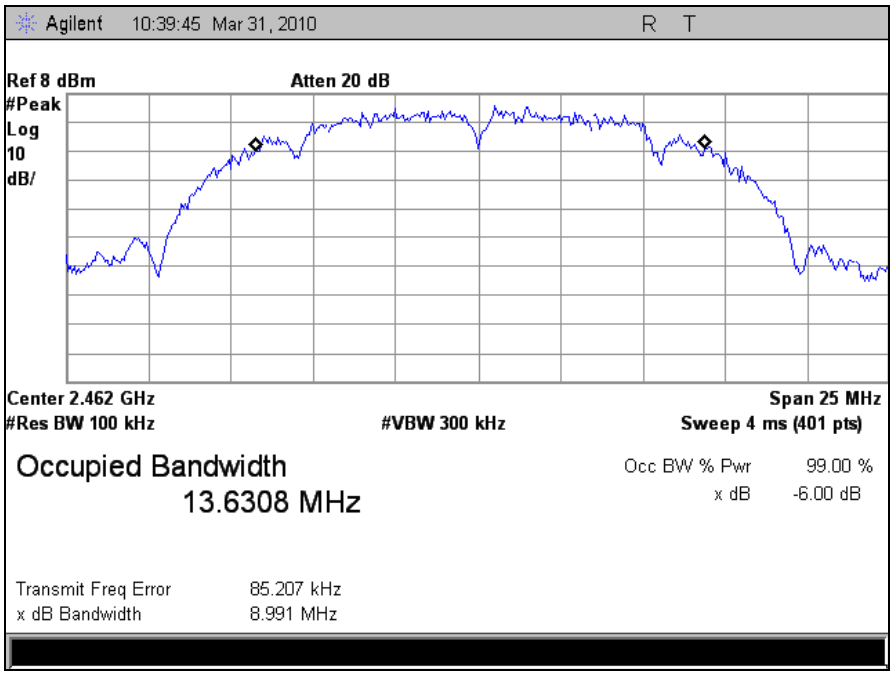


Plot 5. 6 dB OBW, Channel 1, 1 Mbps

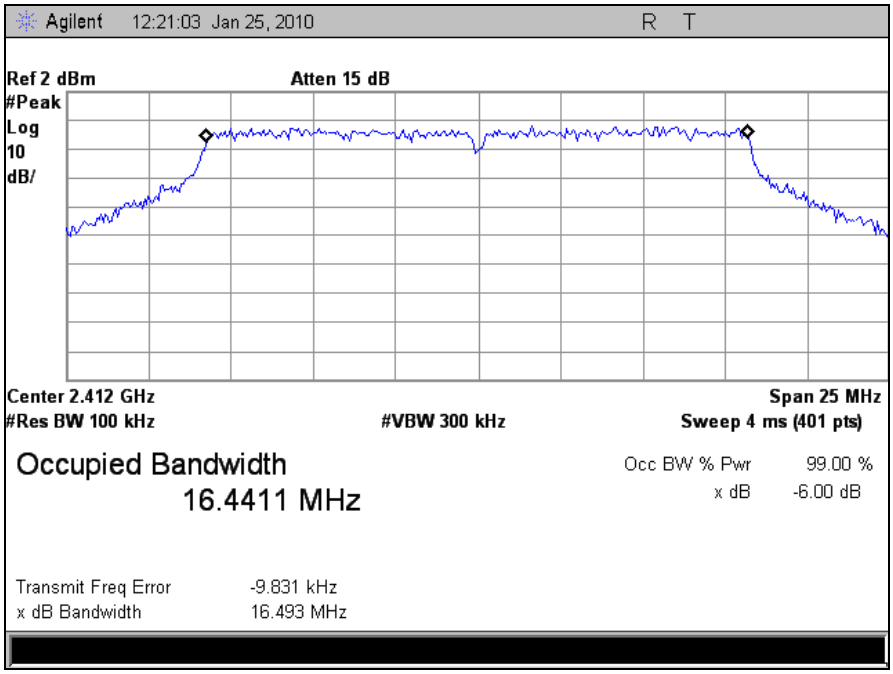


Plot 6. 6 dB OBW, Channel 6, 1 Mbps

Occupied Bandwidth Test Results

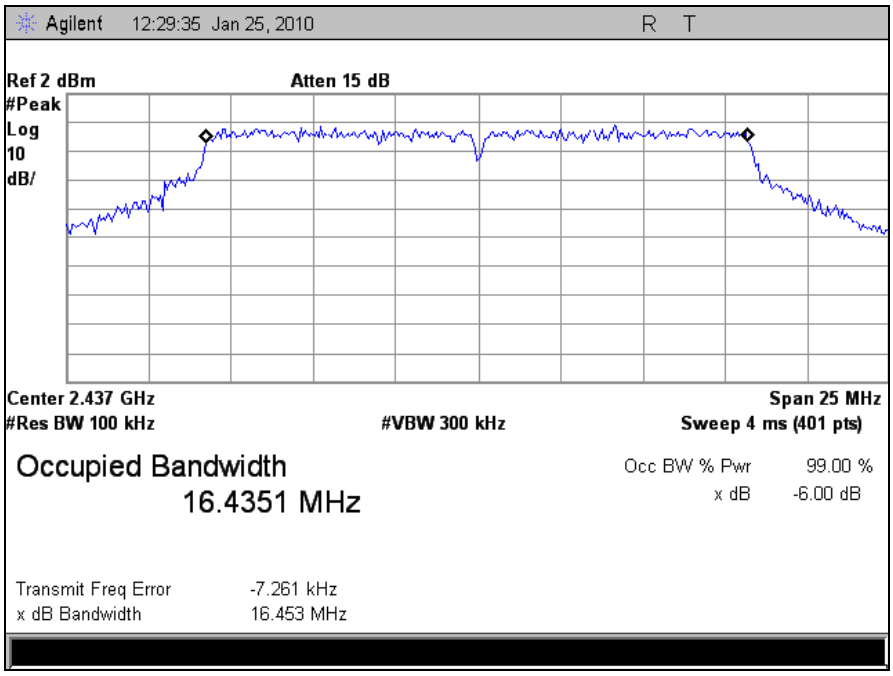


Plot 7. 6 dB OBW, Channel 11, 1 Mbps

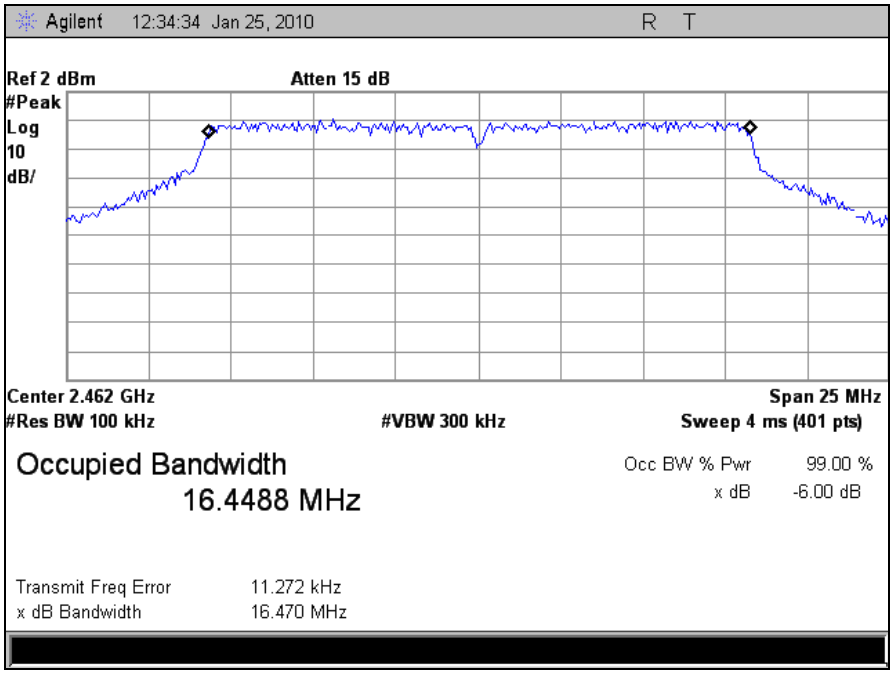


Plot 8. 6 dB OBW, Channel 1, 6 Mbps

Occupied Bandwidth Test Results

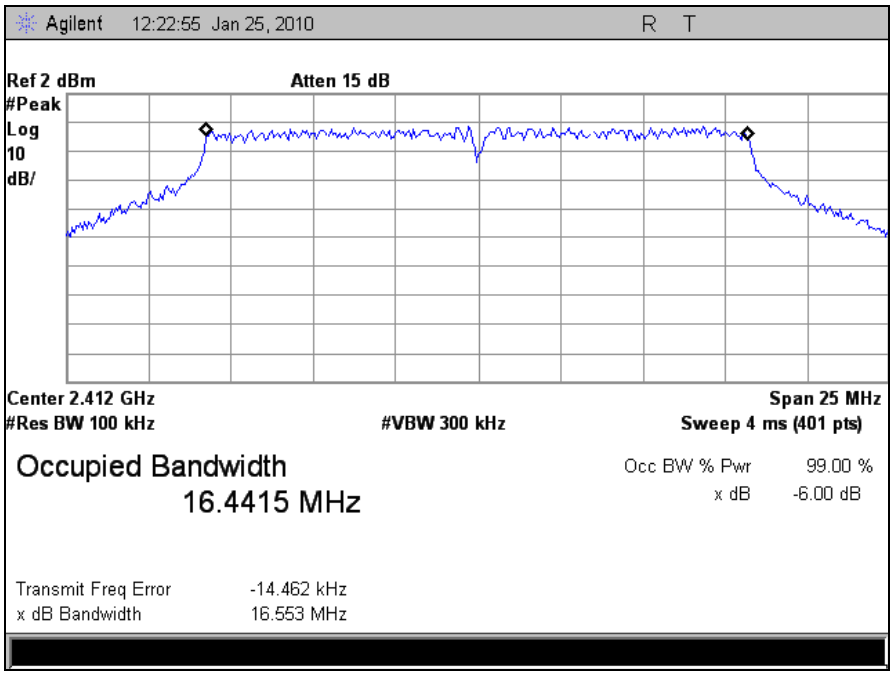


Plot 9. 6 dB OBW, Channel 6, 6 Mbps

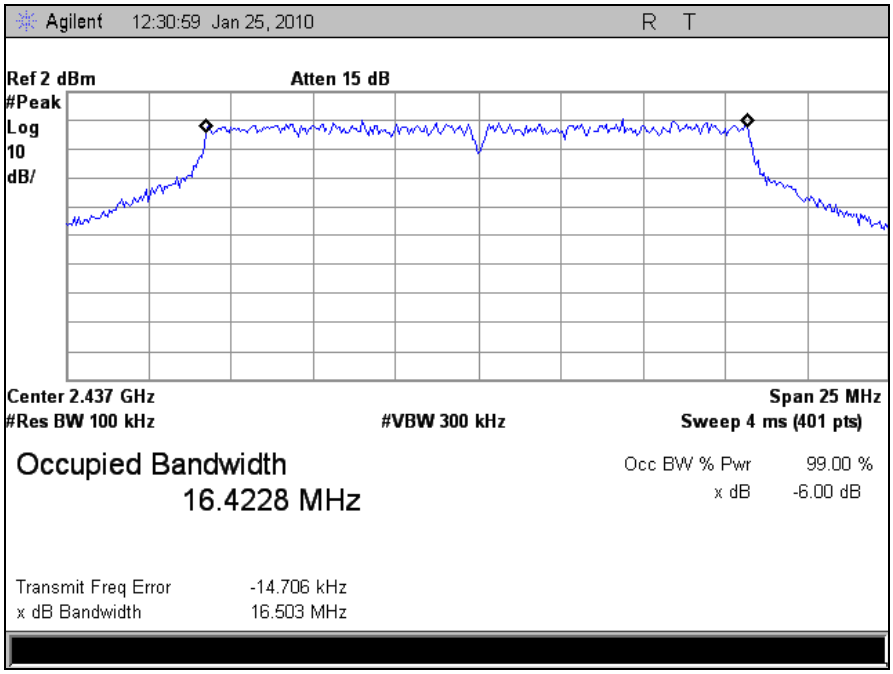


Plot 10. 6 dB OBW, Channel 11, 6 Mbps

Occupied Bandwidth Test Results

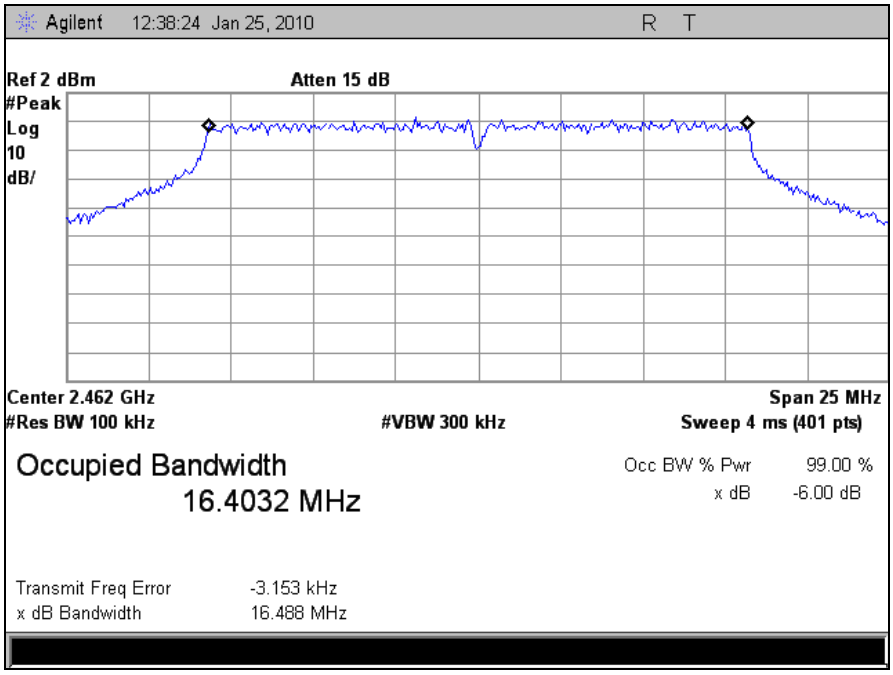


Plot 11. 6 dB OBW, Channel 1, 54 Mbps



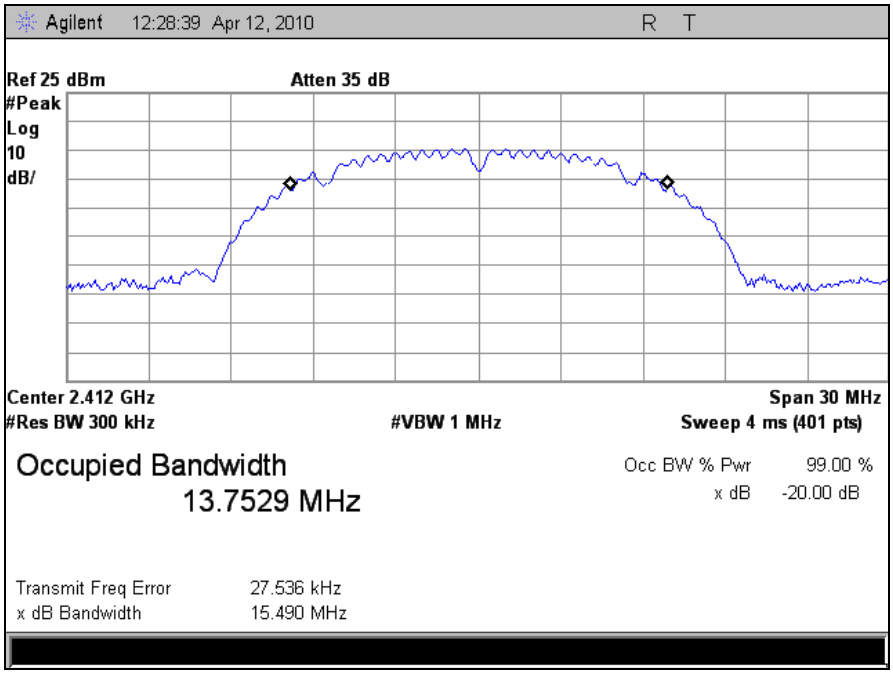
Plot 12. 6 dB OBW, Channel 6, 54 Mbps

Occupied Bandwidth Test Results

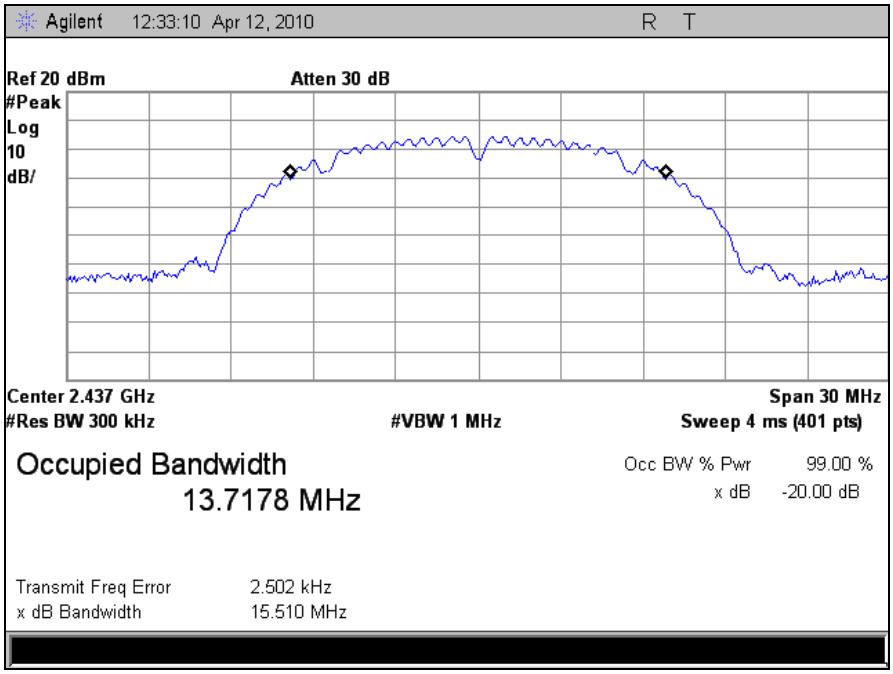


Plot 13. 6 dB OBW, Channel 11, 54 Mbps

Occupied Bandwidth Test Results

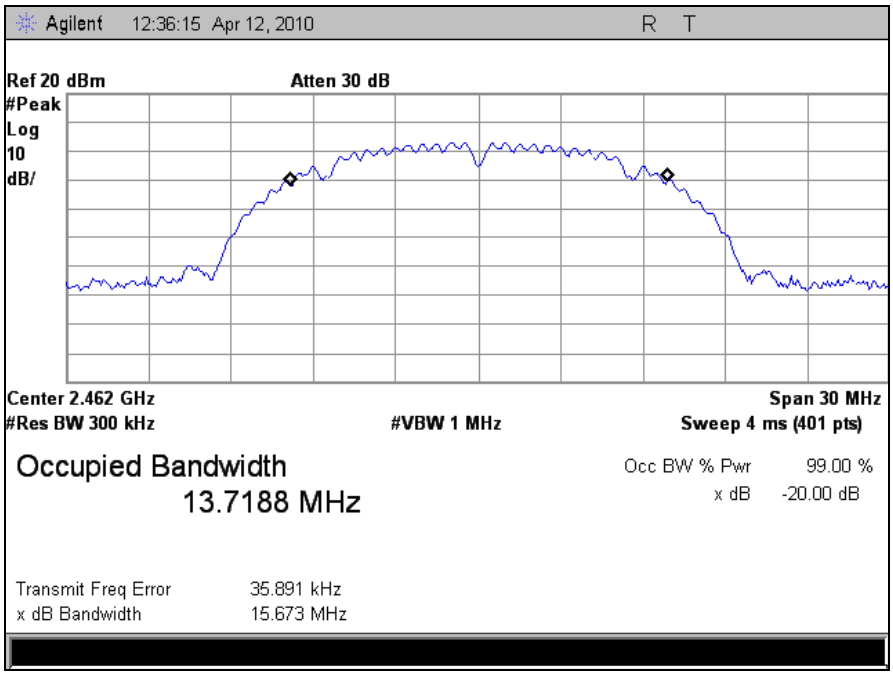


Plot 14. 99% OBW, Channel 1, 1 Mbps

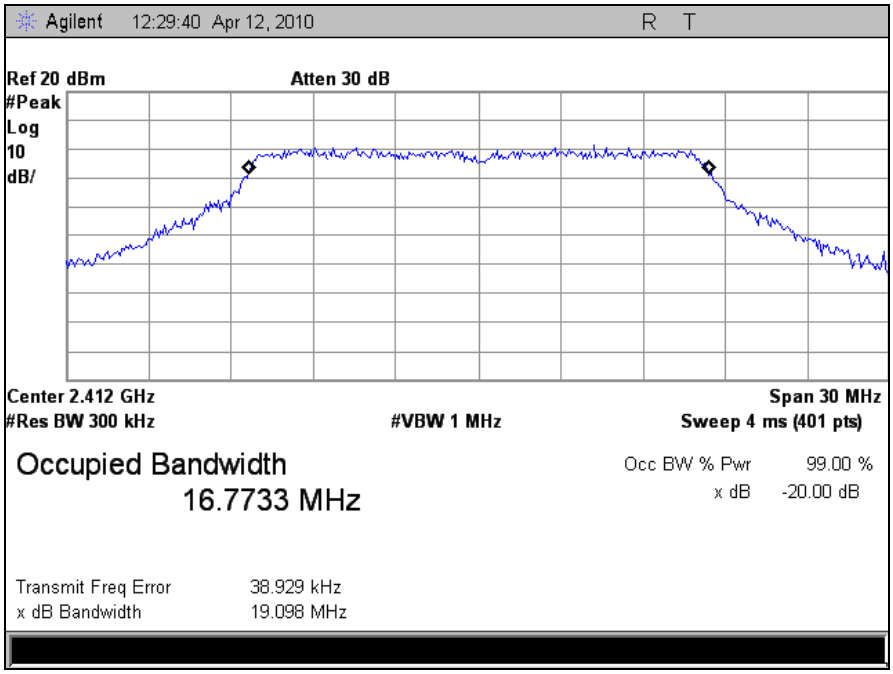


Plot 15. 99% OBW, Channel 6, 1 Mbps

Occupied Bandwidth Test Results

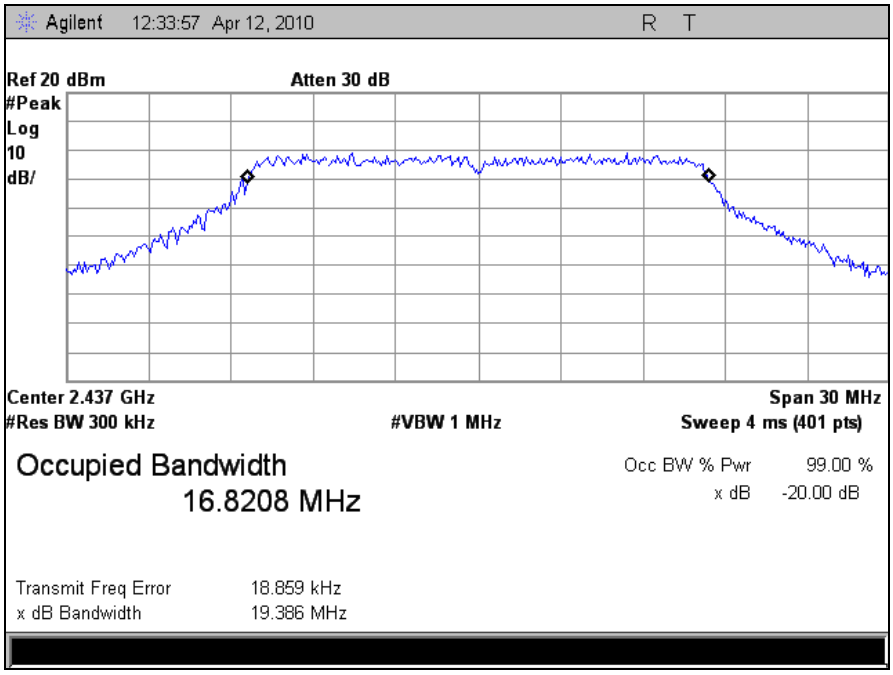


Plot 16. 99% OBW, Channel 11, 1 Mbps

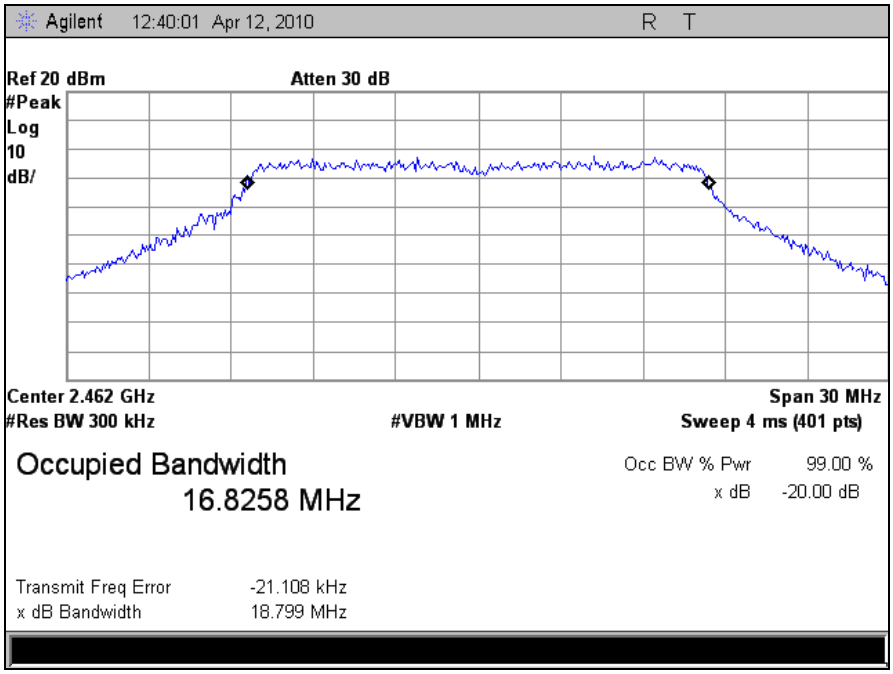


Plot 17. 99% OBW, Channel 1, 6 Mbps

Occupied Bandwidth Test Results

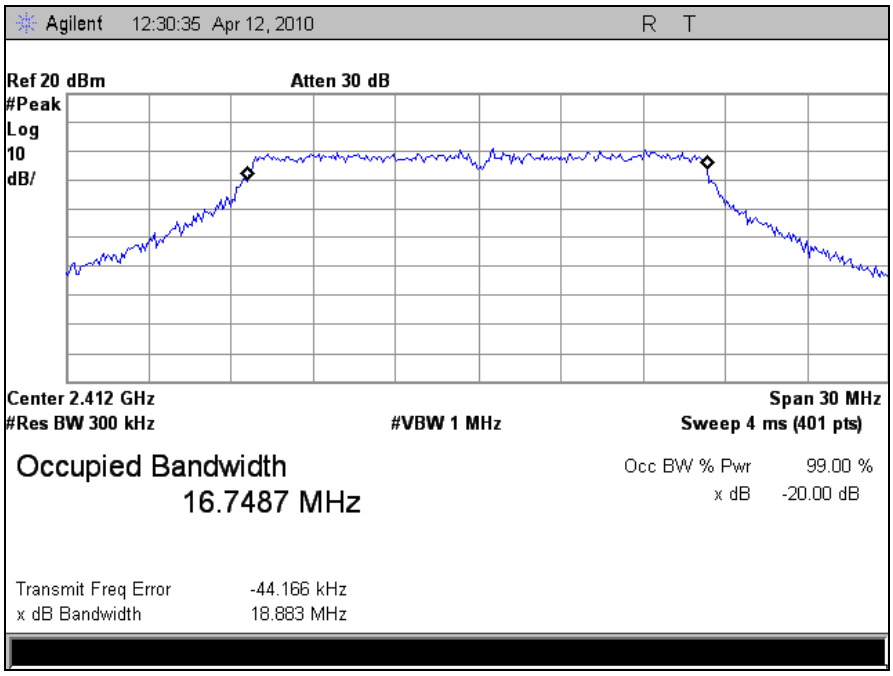


Plot 18. 99% OBW, Channel 6, 6 Mbps

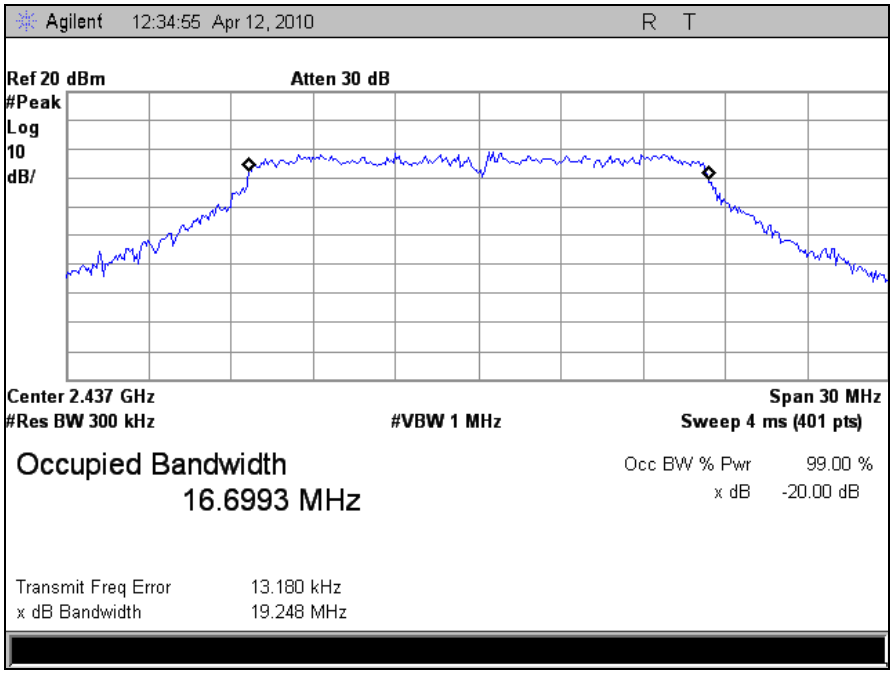


Plot 19. 99% OBW, Channel 11, 6 Mbps

Occupied Bandwidth Test Results

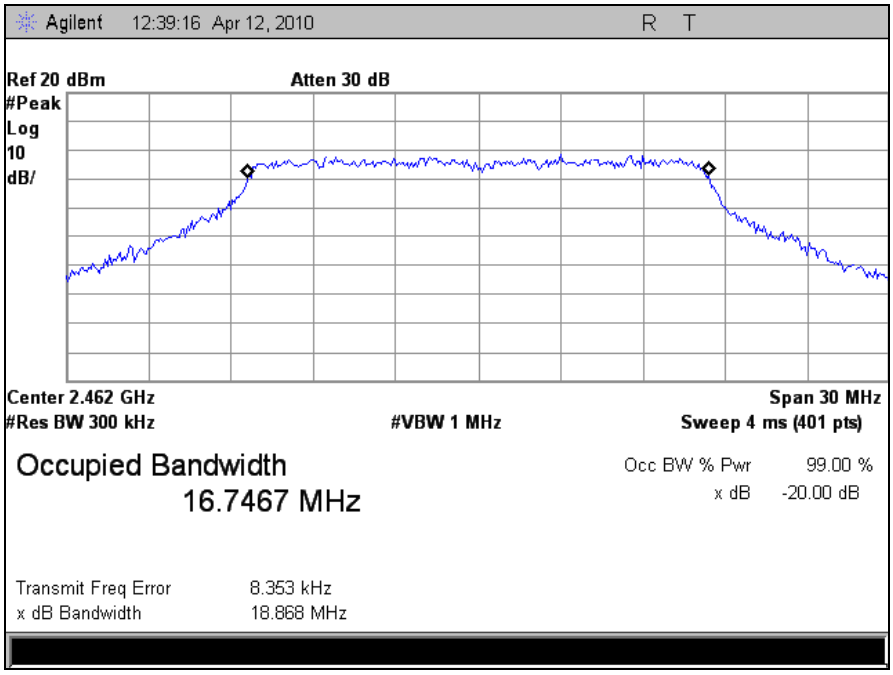


Plot 20. 99% OBW, Channel 1, 54 Mbps



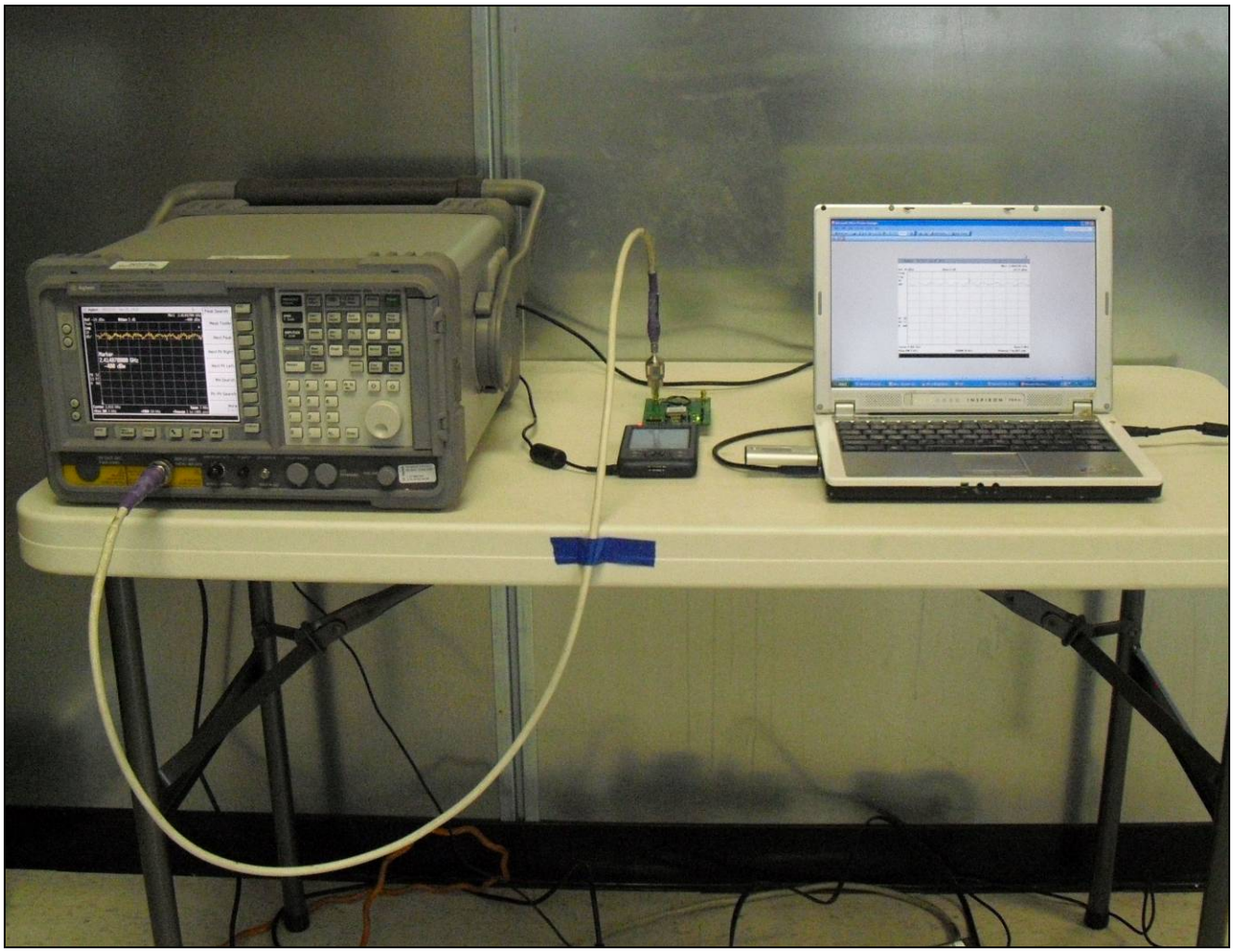
Plot 21. 99%OBW, Channel 6, 54 Mbps

Occupied Bandwidth Test Results



Plot 22. 99% OBW, Channel 11, 54 Mbps

Occupied Bandwidth Test Setup



Photograph 4. Occupied Bandwidth, Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output and RF Exposure

Test Requirements: **§15.247(b):** The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (Watts)
902-928	1.000
2400–2483.5	1.000
5725– 5850	1.000

Table 19. Output Power Requirements from §15.247

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Table 19, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400 – 2483.5 MHz band and using a point to point application may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Fixed, point-to-point operation excludes the use of point-to-multipoint systems, omni-directional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

Test Procedure: The transmitter was connected to a calibrated spectrum analyzer. The EUT was measured at the low, mid and high channels at 1 Mbps, 6 Mbps, and 54 Mbps data rates.

Test Results: The EUT was compliant with the Peak Power Output limits of **§15.247(b)**.

Test Engineer(s): Len Knight

Test Date(s): 01/25/10

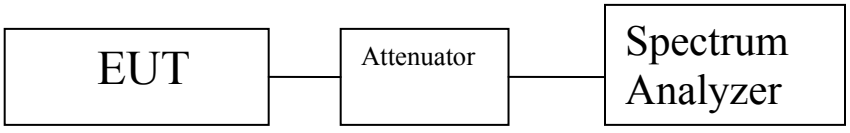


Figure 3. Peak Power Output Test Setup

RF Power Output Test Results

Mode Tested	Channel	Frequency (GHz)	Power Measurement (dBm)	Power Limit (dBm)
1 Mbps	1	2.412	19.16 dBm	30 dBm
	6	2.437	18.44 dBm	30 dBm
	11	2.462	17.83 dBm	30 dBm

Table 20. RF Output Power, Test Results, 1 Mbps

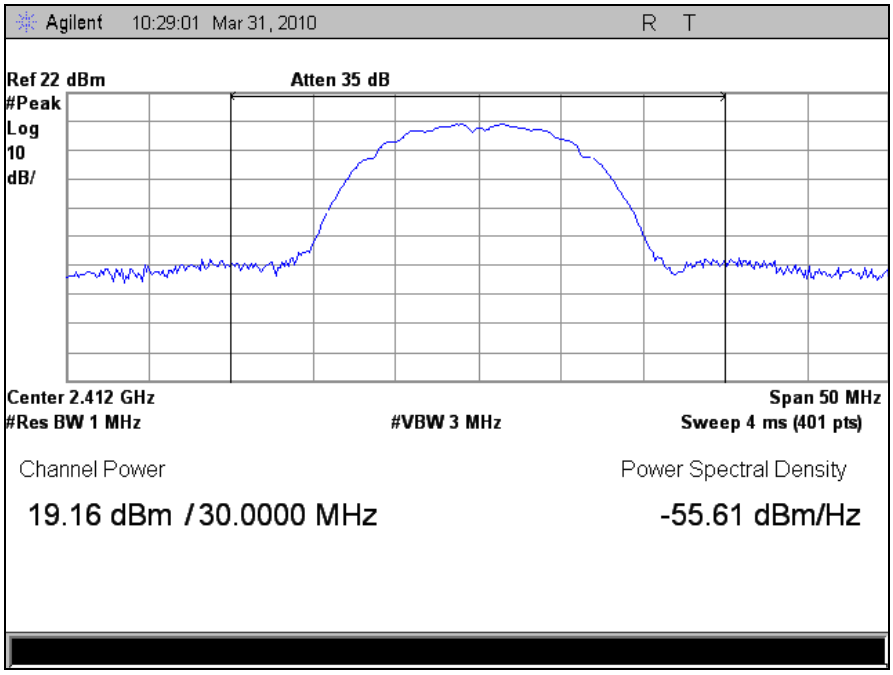
Mode Tested	Channel	Frequency (GHz)	Power Measurement (dBm)	Power Limit (dBm)
6 Mbps	1	2.412	11.41 dBm	30 dBm
	6	2.437	12.23 dBm	30 dBm
	11	2.462	11.83 dBm	30 dBm

Table 21. RF Output Power, Test Results, 6 Mbps

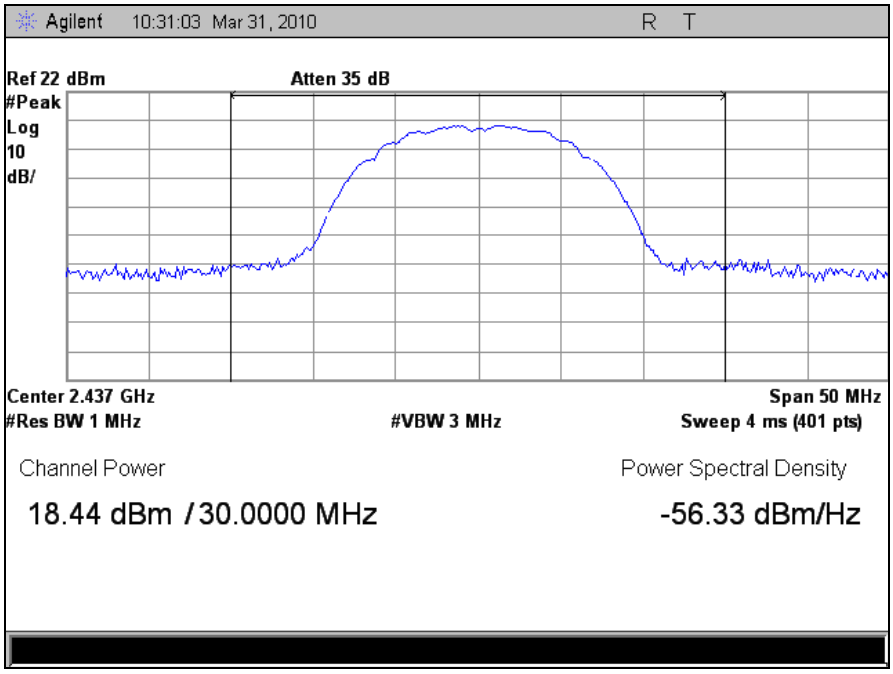
Mode Tested	Channel	Frequency (GHz)	Power Measurement (dBm)	Power Limit (dBm)
54 Mbps	1	2.412	12.02 dBm	30 dBm
	6	2.437	12.56 dBm	30 dBm
	11	2.462	12.16 dBm	30 dBm

Table 22. RF Output Power, Test Results, 54 Mbps

RF Output Power Test Results

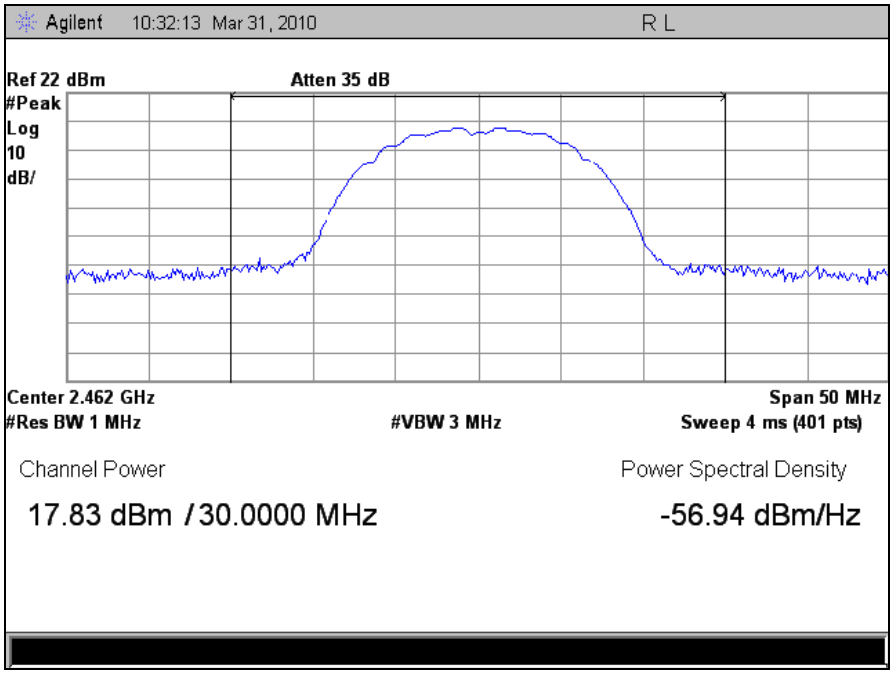


Plot 23. Peak Output Power, Channel 1, 1 Mbps

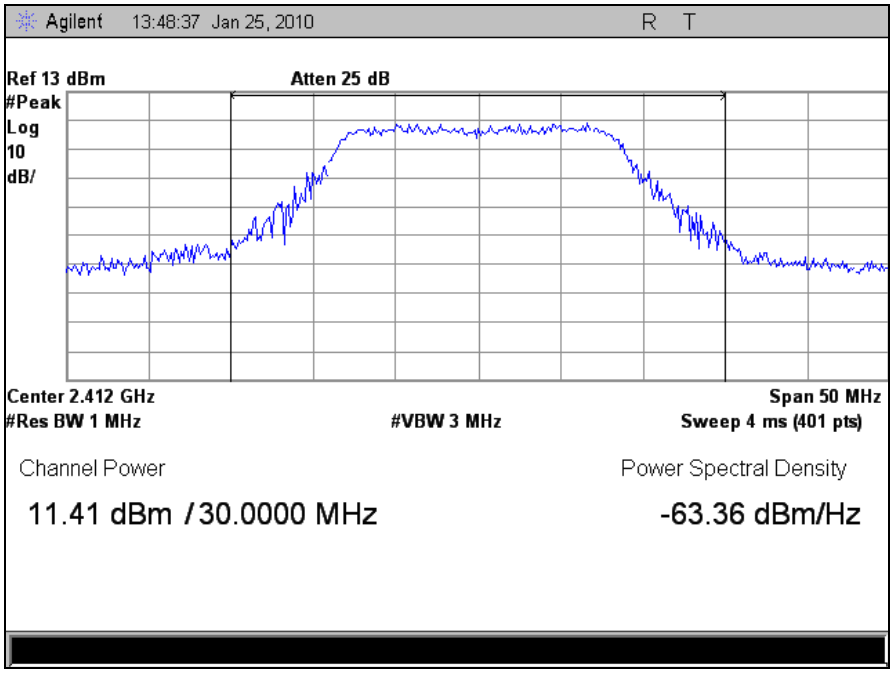


Plot 24. Peak Output Power, Channel 6, 1 Mbps

RF Output Power Test Results

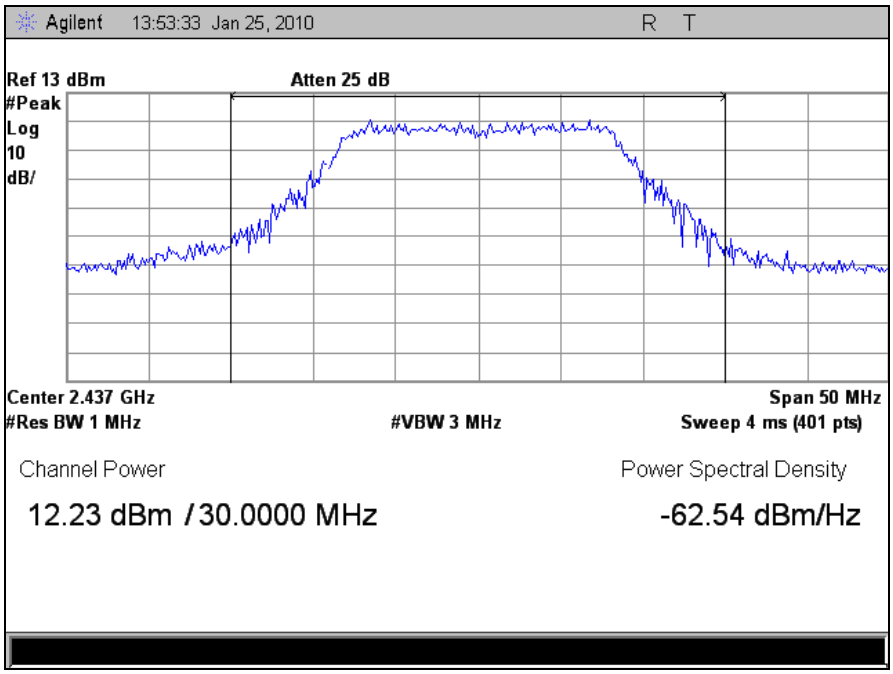


Plot 25. Peak Output Power, Channel 11, 1 Mbps

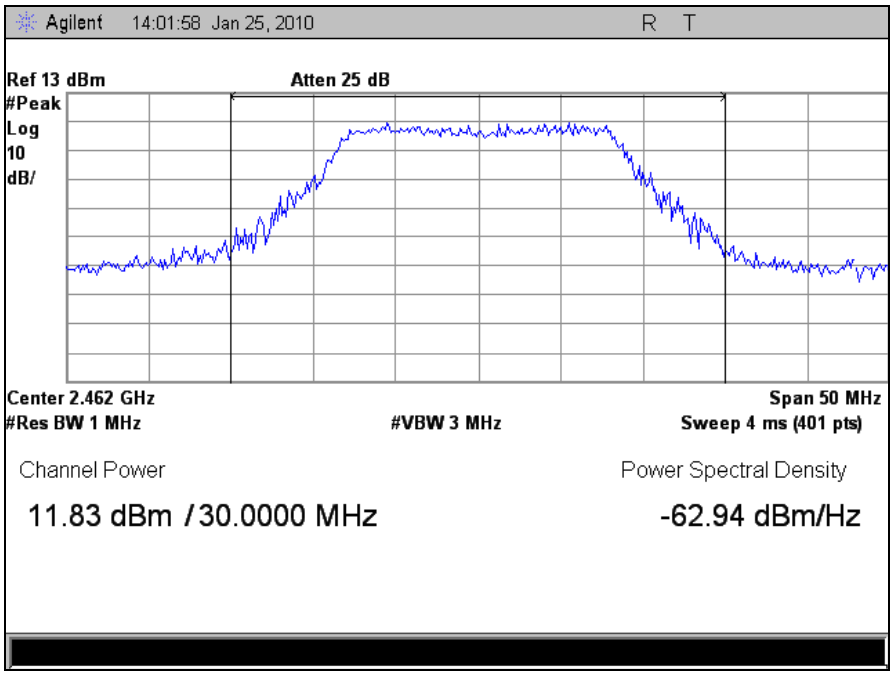


Plot 26. Peak Output Power, Channel 1, 6 Mbps

RF Output Power Test Results

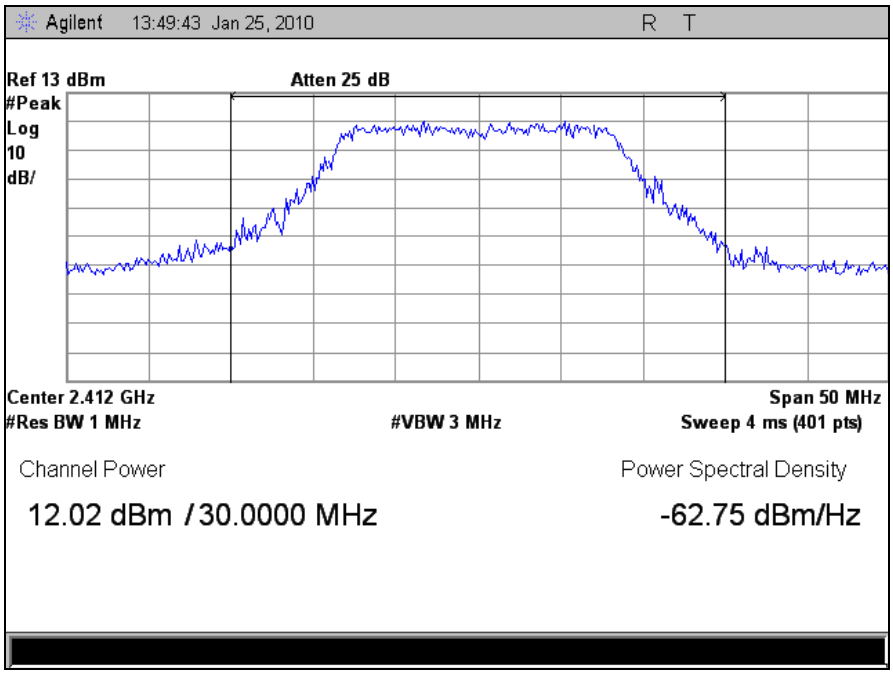


Plot 27. Peak Output Power, Channel 6, 6 Mbps

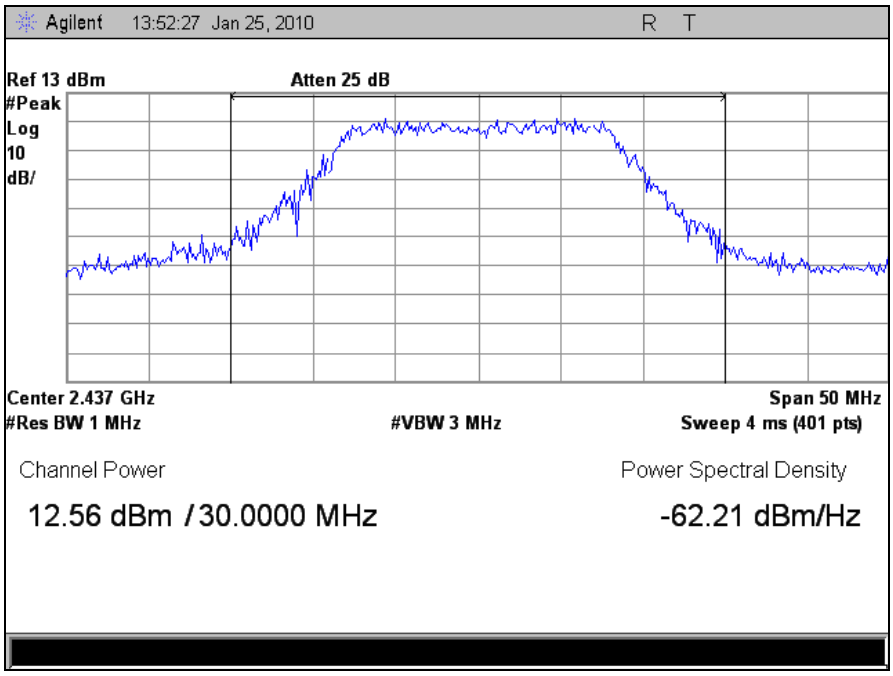


Plot 28. Peak Output Power, Channel 11, 6 Mbps

RF Output Power Test Results

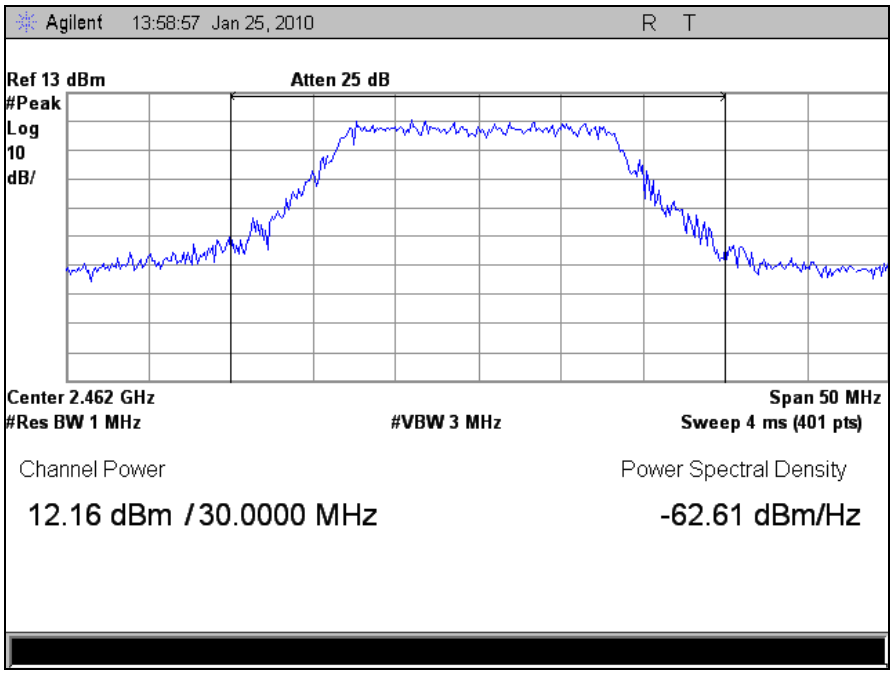


Plot 29. Peak Output Power, Channel 1, 54 Mbps



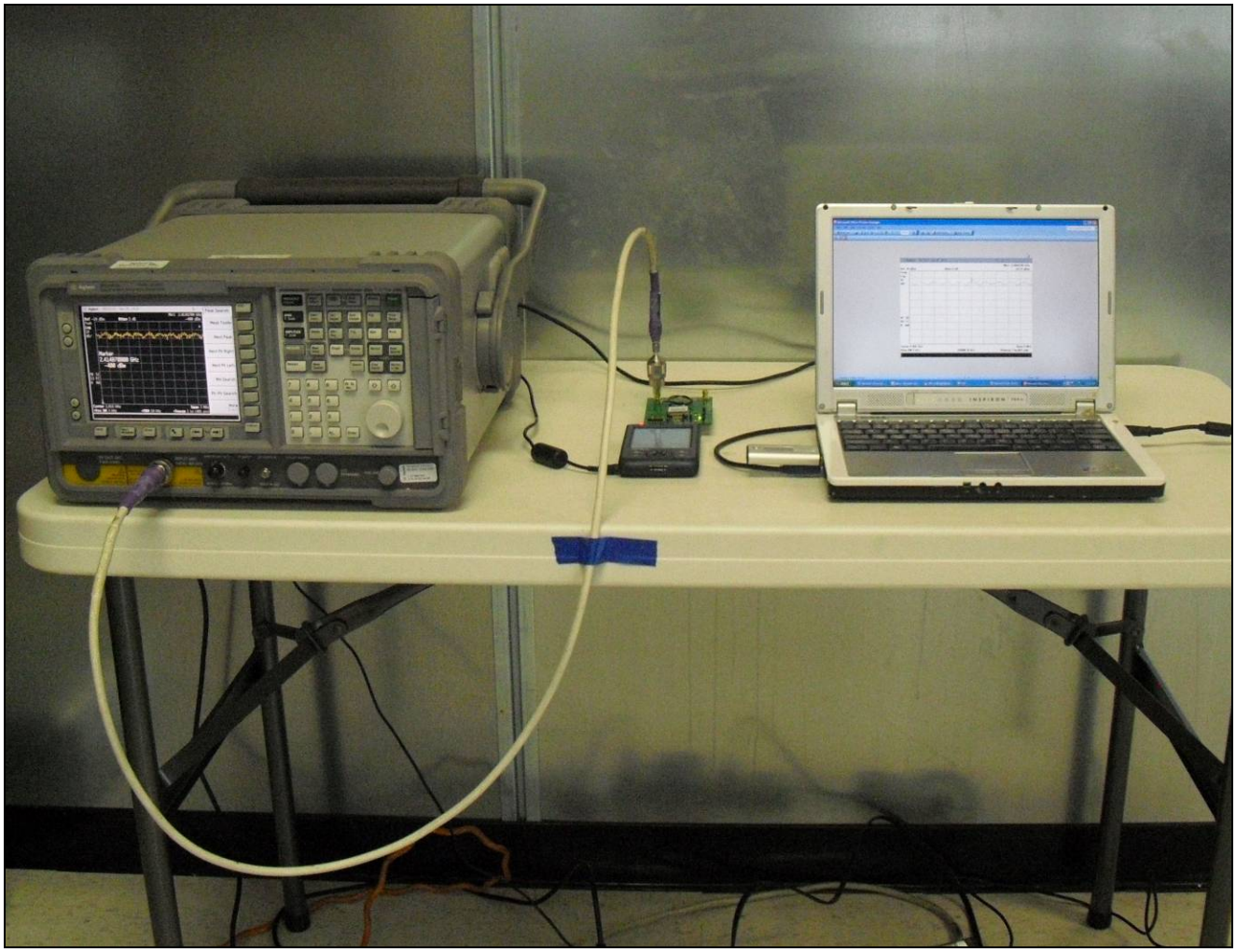
Plot 30. Peak Output Power, Channel 6, 54 Mbps

RF Output Power Test Results



Plot 31. Peak Output Power, Channel 11, 54 Mbps

RF Output Power Test Setup



Photograph 5. Peak Output Power, Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: **§15.247(d); §15.205:** Emissions outside the frequency band.

§15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

§15.205(a): Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110----------	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505----------	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905----------	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128----------	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775----------	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775----------	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218----------	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825----------	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225----------	123–138	2200–2300	14.47–14.5
8.291–8.294----------	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366----------	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675----------	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475----------	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293----------	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025----------	240–285	3345.8–3358 36.	43–36.5
12.57675–12.57725----------	322–335.4	3600–4400	([2])

Table 23. Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 24.

Frequency (MHz)	§ 15.209(a),Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Table 24. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

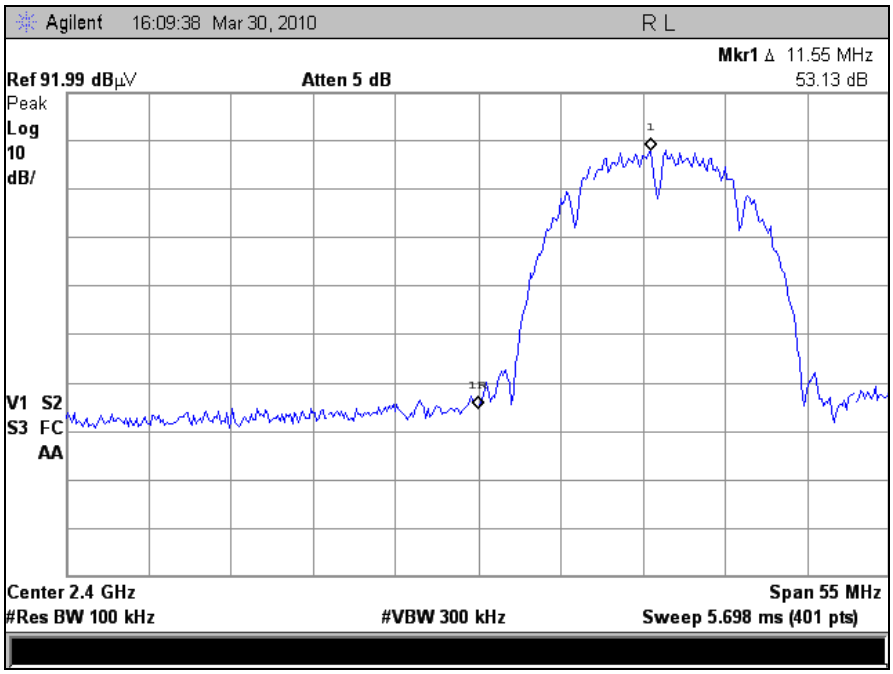
Test Procedures: The transmitter was turned on and set to the low, mid, and high channels and at the 1 Mbps, 6 Mbps, and 54 Mbps data rates. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. The RBW was set to 1 MHz and the VBW to 3 MHz.

Test Results: The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.247(d)**.

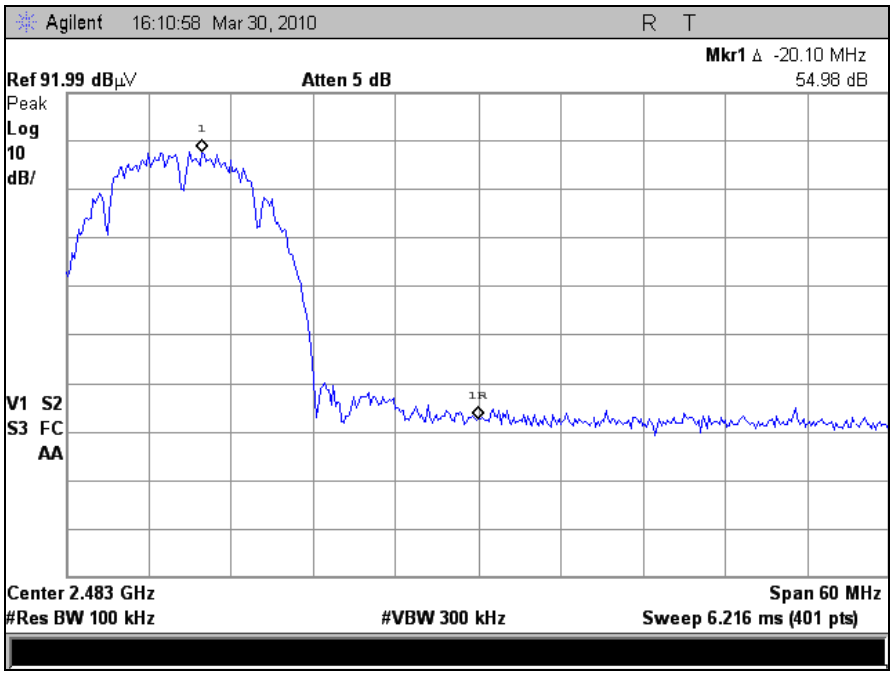
Test Engineer(s): Len Knight

Test Date(s): 04/02/10

Radiated Spurious Emissions Test Results

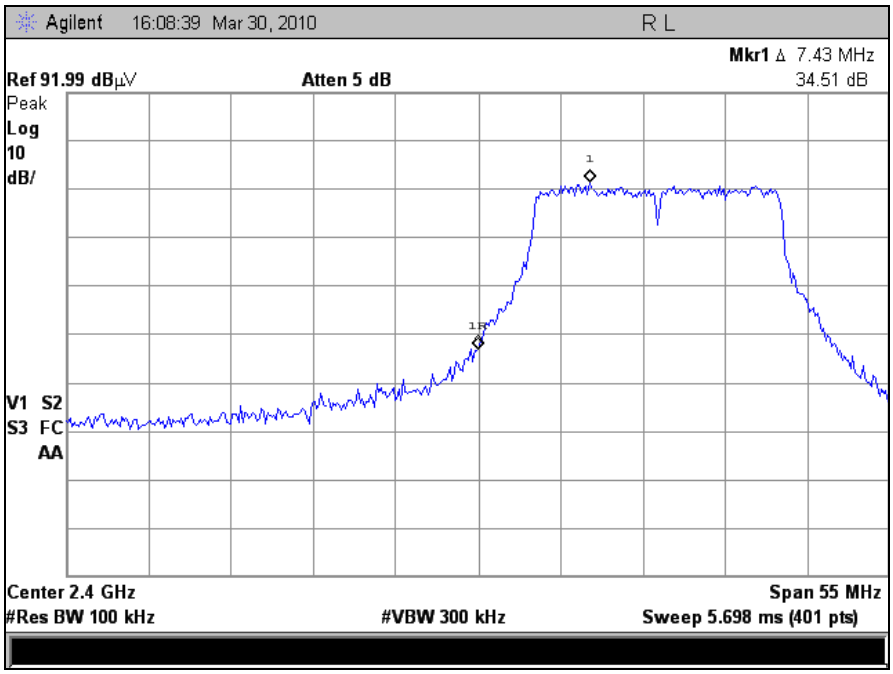


Plot 32. Radiated Spurious Emissions, 2 dBi, 20 dBc, Low Channel, 1 Mbps

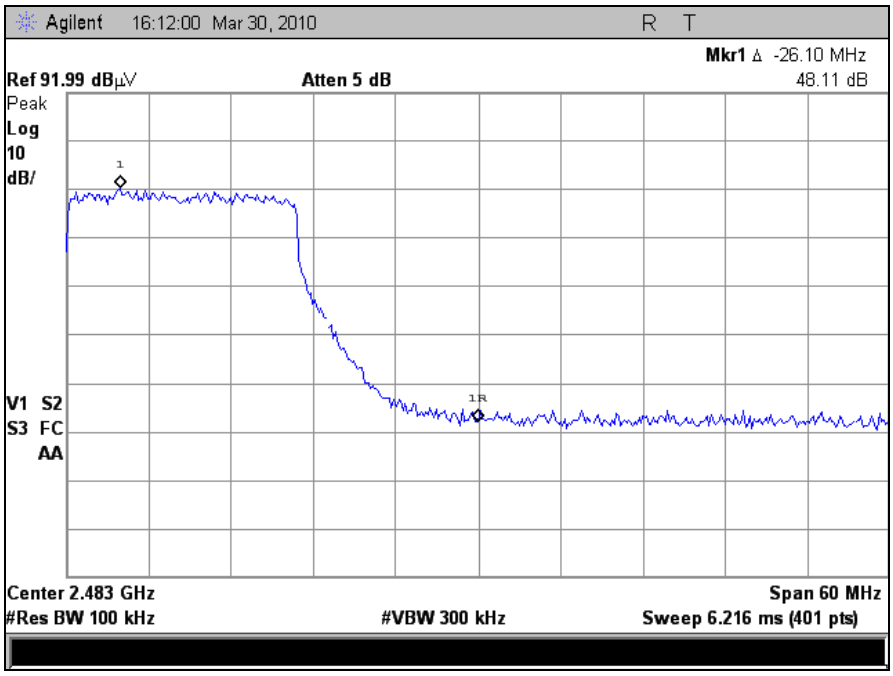


Plot 33. Radiated Spurious Emissions, 2 dBi, 20 dBc, High Channel, 1 Mbps

Radiated Spurious Emissions Test Results

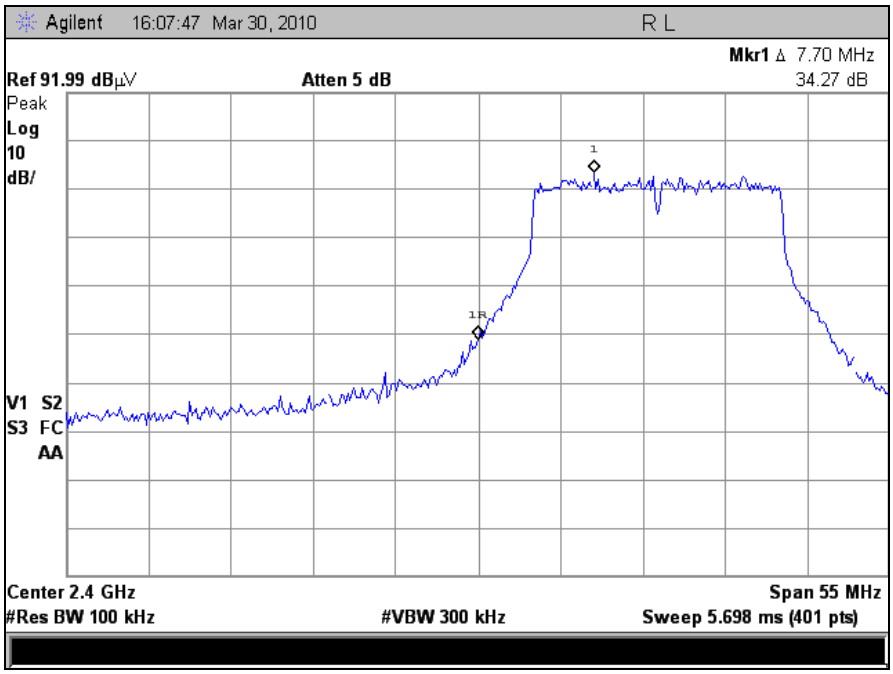


Plot 34. Radiated Spurious Emissions, 2 dBi, 20 dBc, Low Channel, 6 Mbps

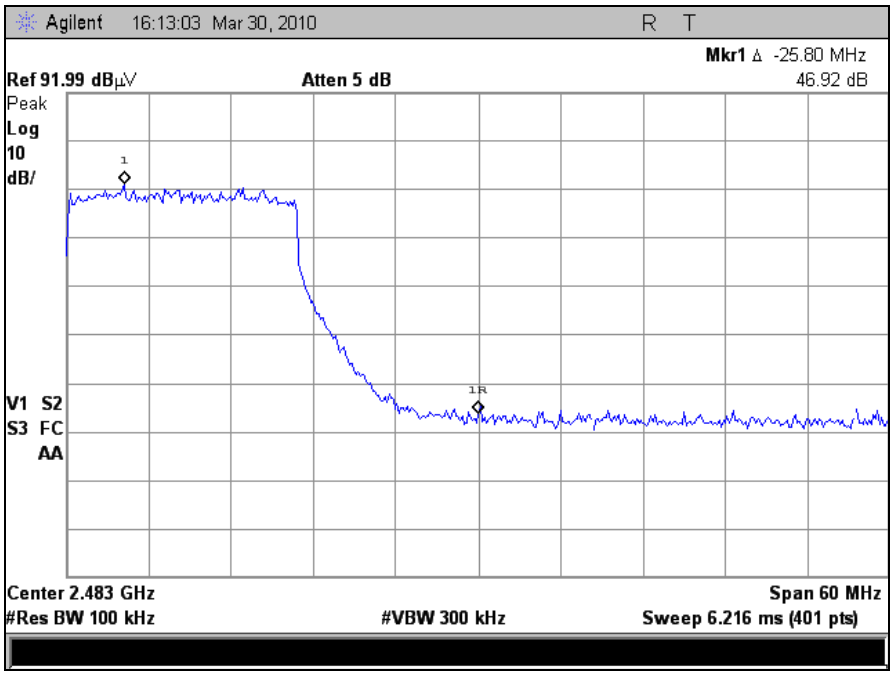


Plot 35. Radiated Spurious Emissions, 2 dBi, 20 dBc, High Channel, 6 Mbps

Radiated Spurious Emissions Test Results

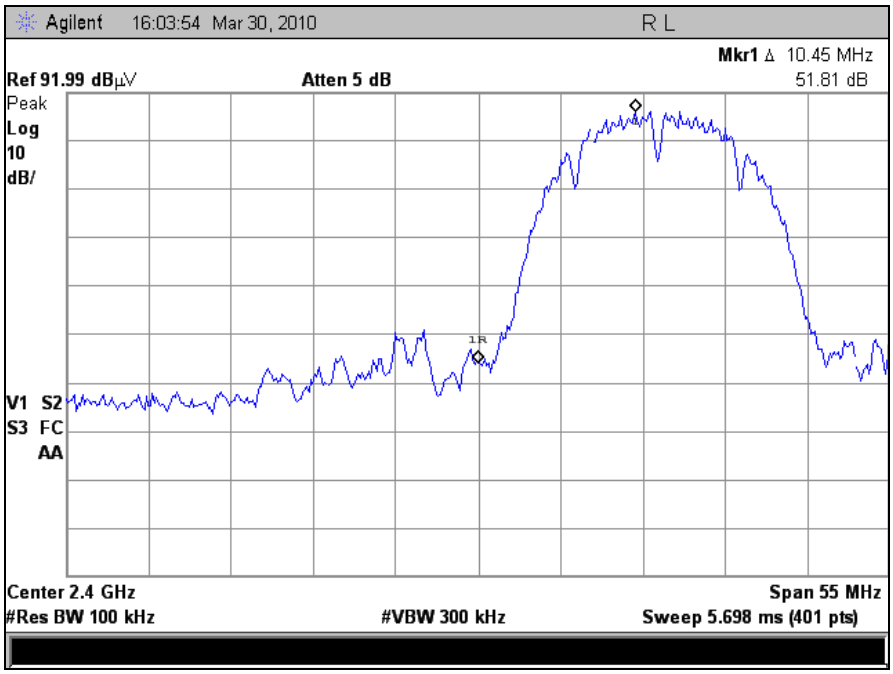


Plot 36. Radiated Spurious Emissions, 2 dBi, 20 dBc, Low Channel, 54 Mbps

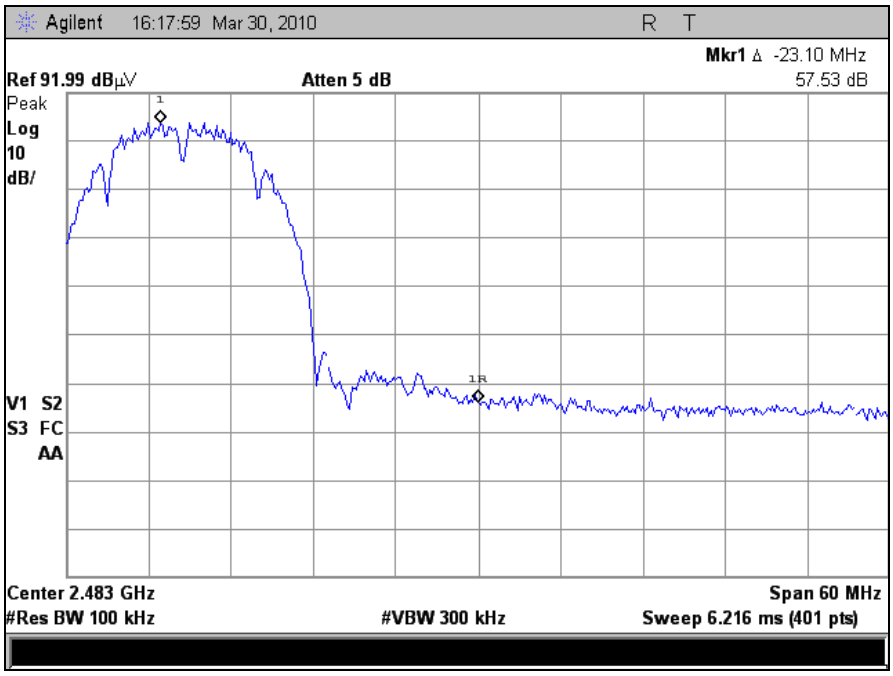


Plot 37. Radiated Spurious Emissions, 2 dBi, 20 dBc, High Channel, 54 Mbps

Radiated Spurious Emissions Test Results

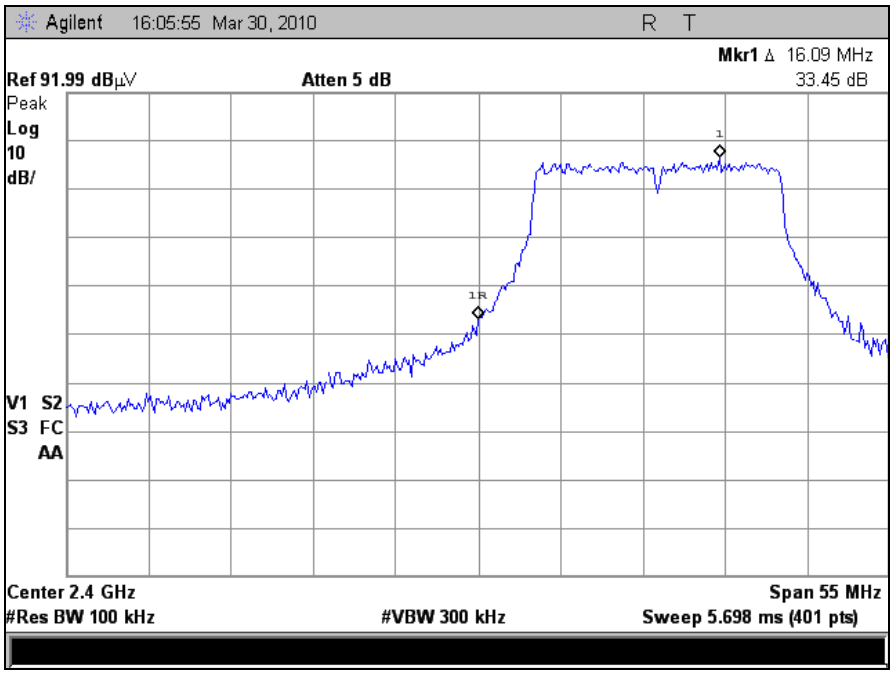


Plot 38. Radiated Spurious Emissions, 5 dBi, 20 dBc, Low Channel, 1 Mbps

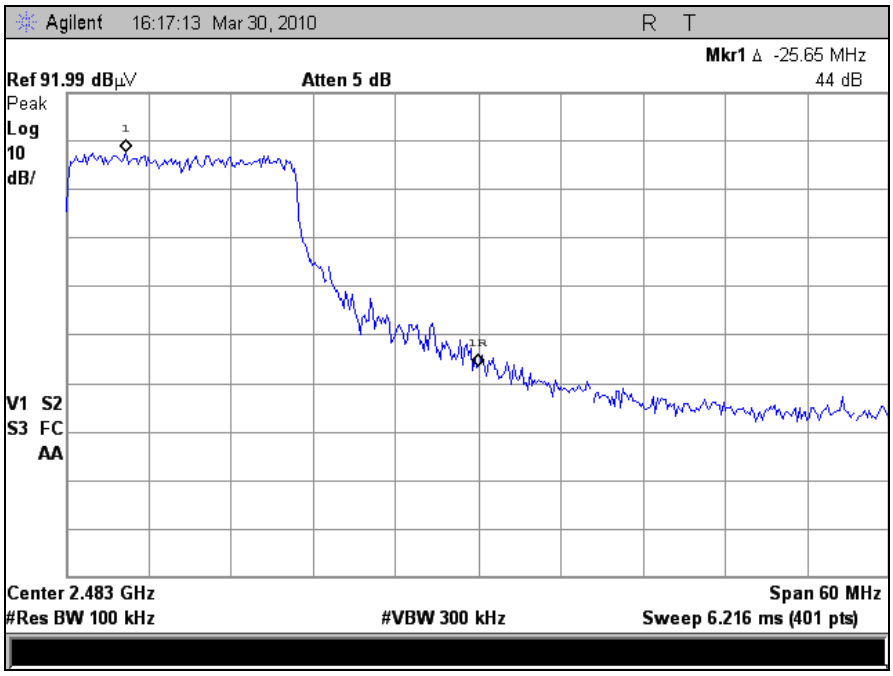


Plot 39. Radiated Spurious Emissions, 5 dBi, 20 dBc, High Channel, 1 Mbps

Radiated Spurious Emissions Test Results

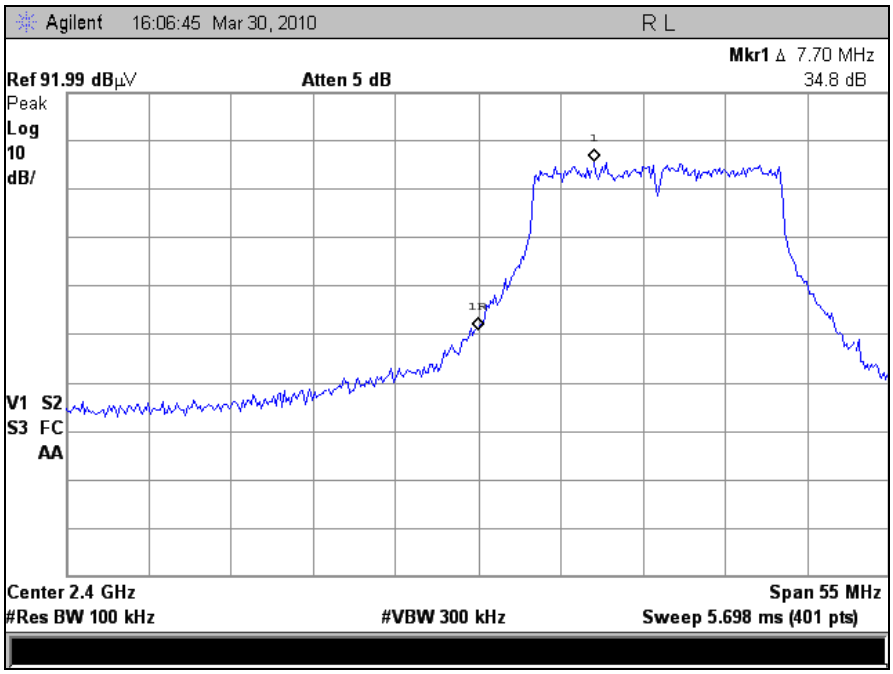


Plot 40. Radiated Spurious Emissions, 5 dBi, 20 dBc, Low Channel, 6 Mbps

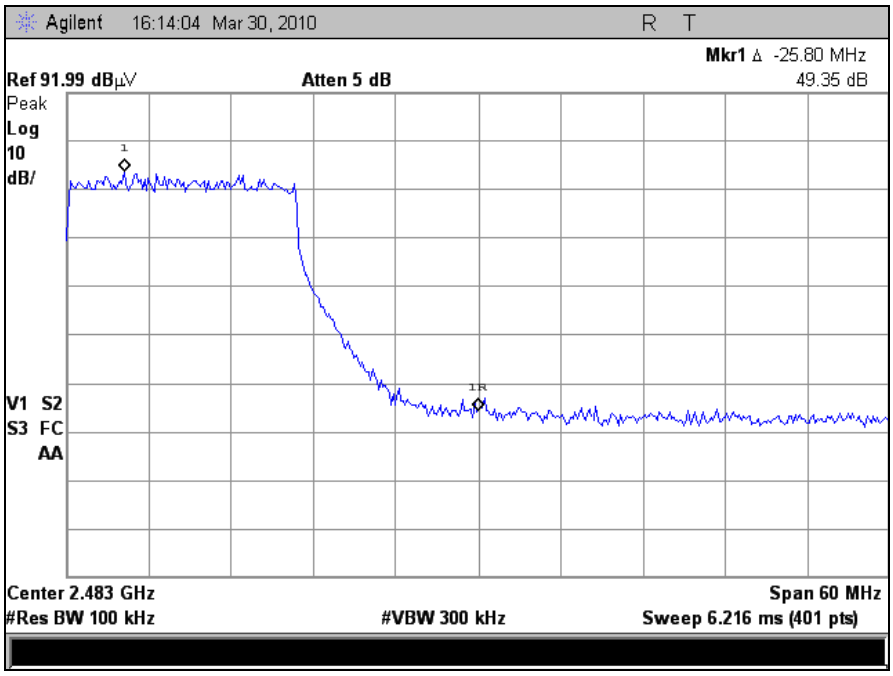


Plot 41. Radiated Spurious Emissions, 5 dBi, 20 dBc, High Channel, 6 Mbps

Radiated Spurious Emissions Test Results

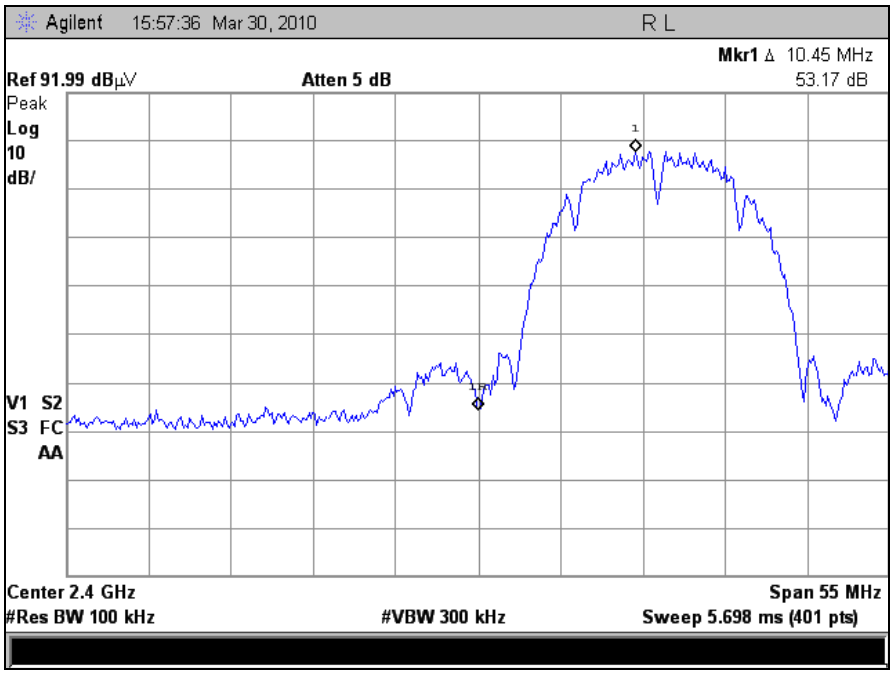


Plot 42. Radiated Spurious Emissions, 5 dBi, 20 dBc, Low Channel, 54 Mbps

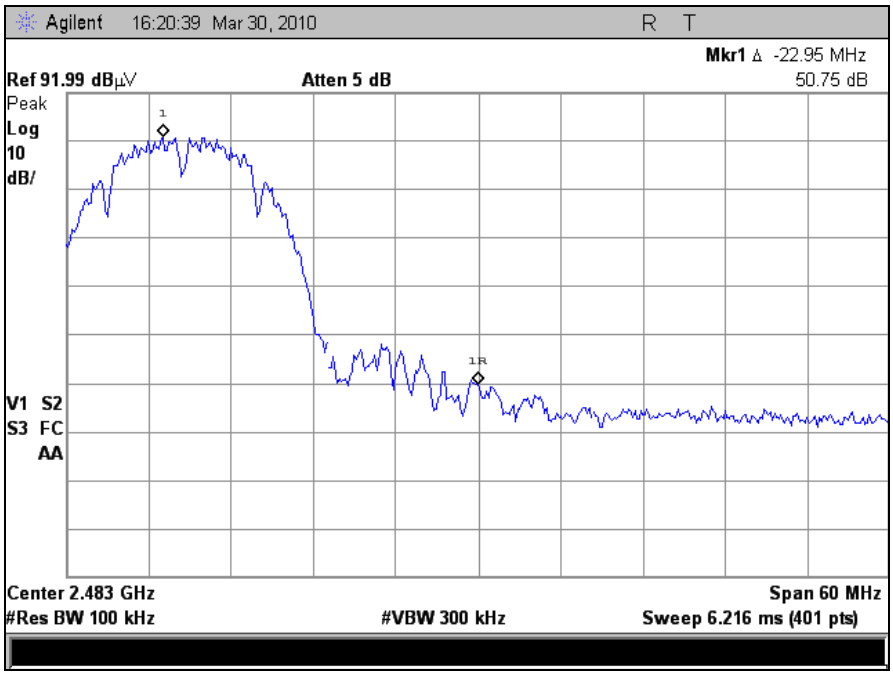


Plot 43. Radiated Spurious Emissions, 5 dBi, 20 dBc, High Channel, 54 Mbps

Radiated Spurious Emissions Test Results

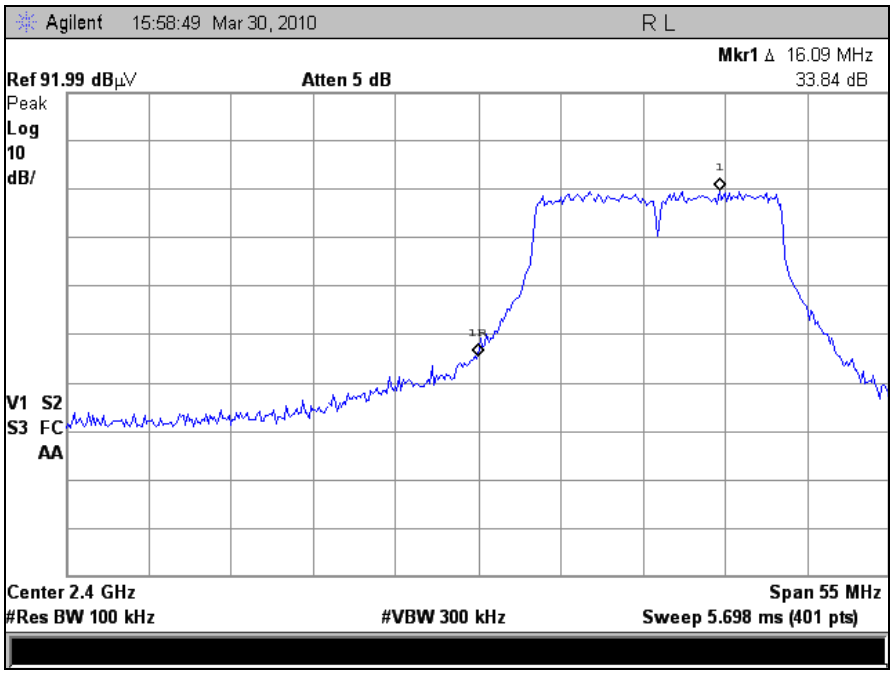


Plot 44. Radiated Spurious Emissions, 2 dBi, PCB, Low Channel, 1 Mbps

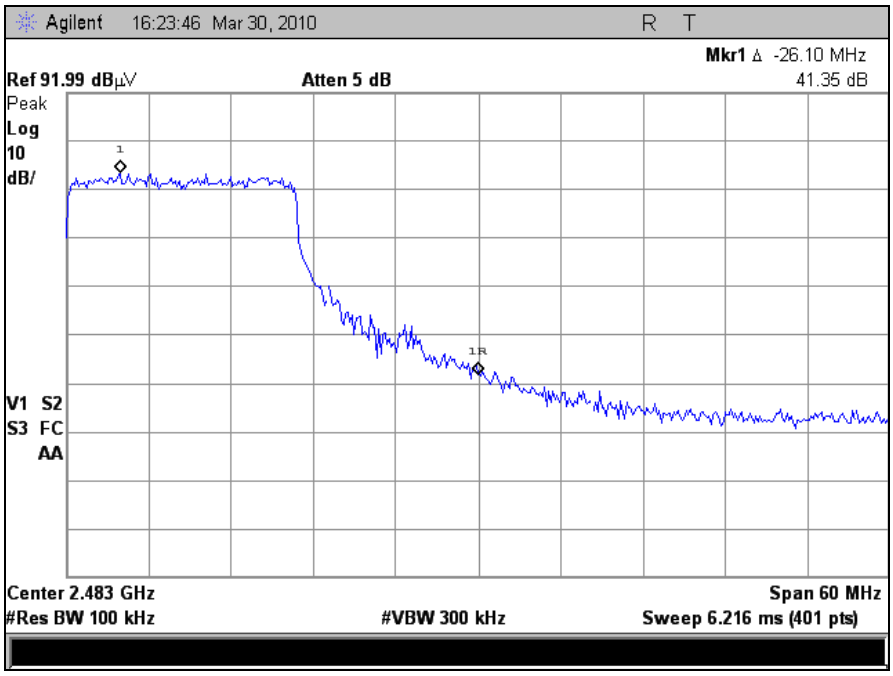


Plot 45. Radiated Spurious Emissions, 2 dBi, PCB, 20 dBc, High Channel, 1 Mbps

Radiated Spurious Emissions Test Results

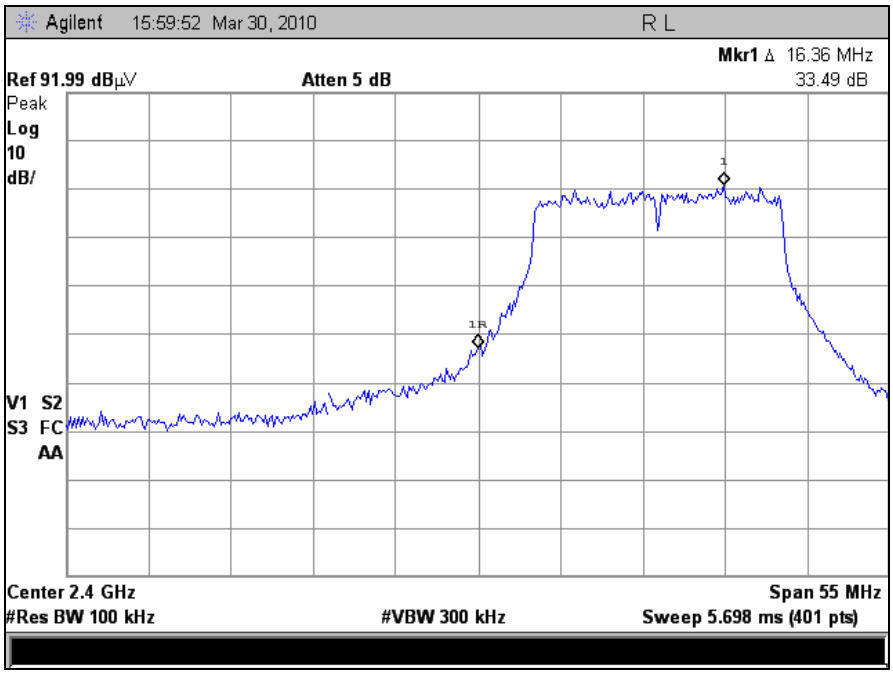


Plot 46. Radiated Spurious Emissions, 2 dBi, PCB, 20 dBc, Low Channel, 6 Mbps

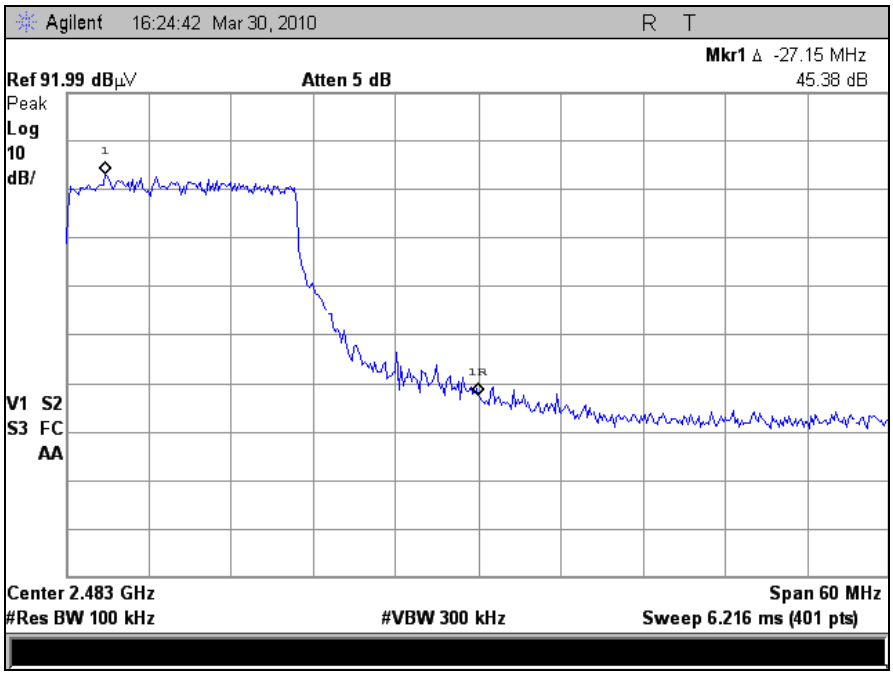


Plot 47. Radiated Spurious Emissions, 2 dBi, PCB, 20 dBc, High Channel, 6 Mbps

Radiated Spurious Emissions Test Results

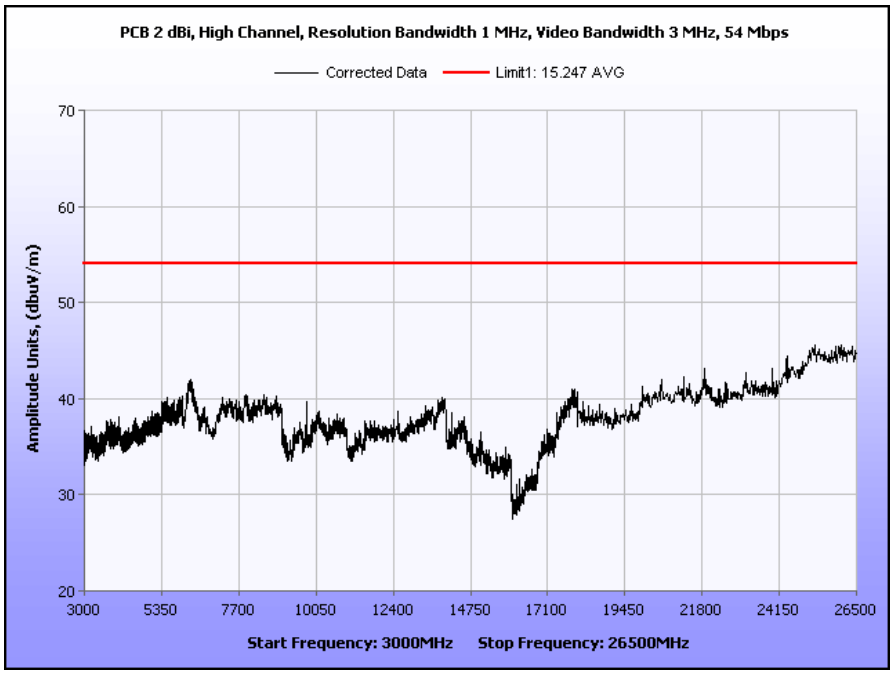


Plot 48. Radiated Spurious Emissions, 2 dBi, PCB, 20 dBc, Low Channel, 54 Mbps

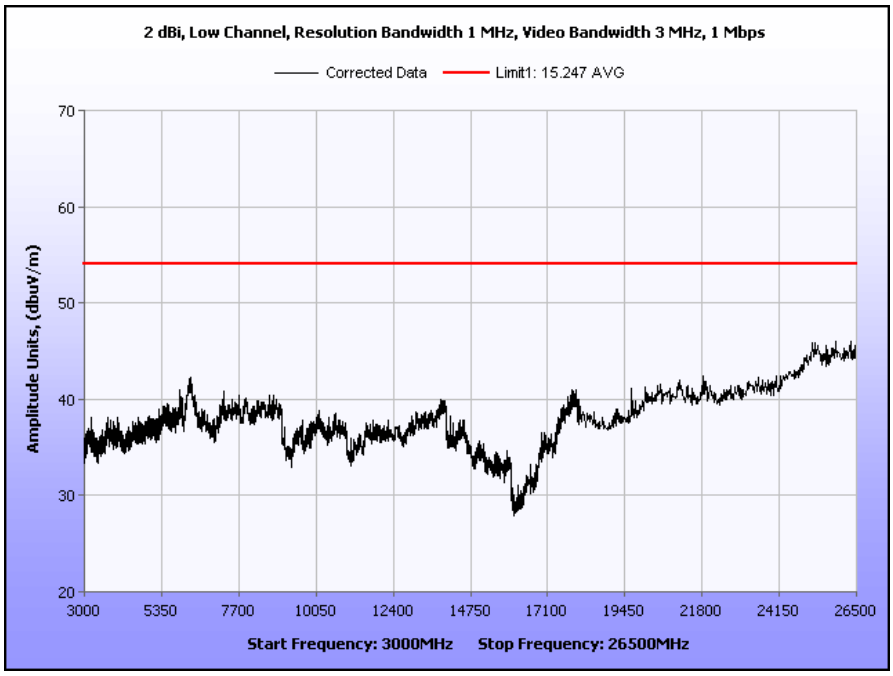


Plot 49. Radiated Spurious Emissions, 2 dBi, PCB, 20 dBc, High Channel, 54 Mbps

Radiated Spurious Emissions Test Results

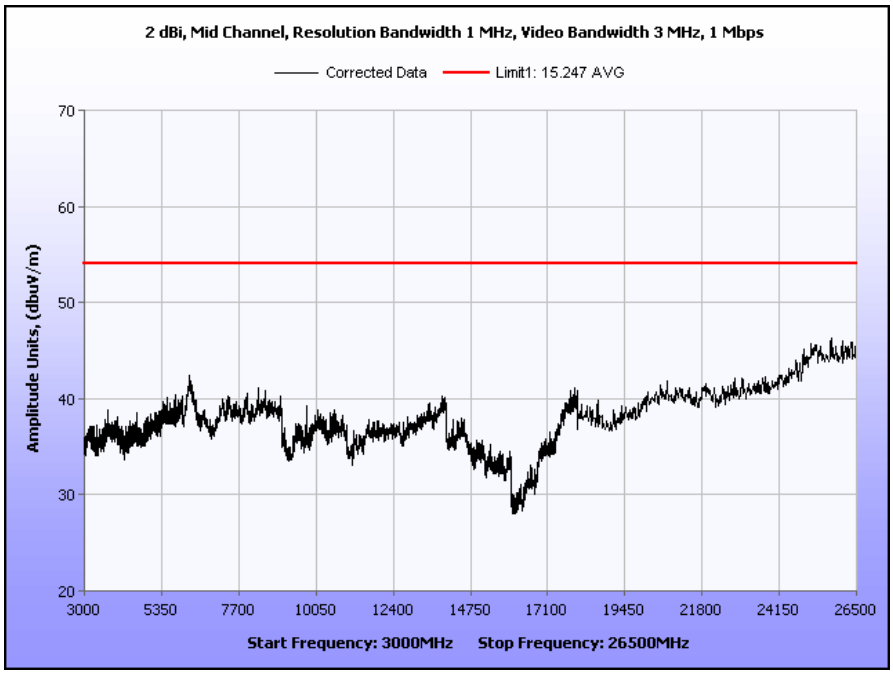


Plot 50. Radiated Spurious Emissions, 2 dBi, PCB, Mid Channel, 54 Mbps

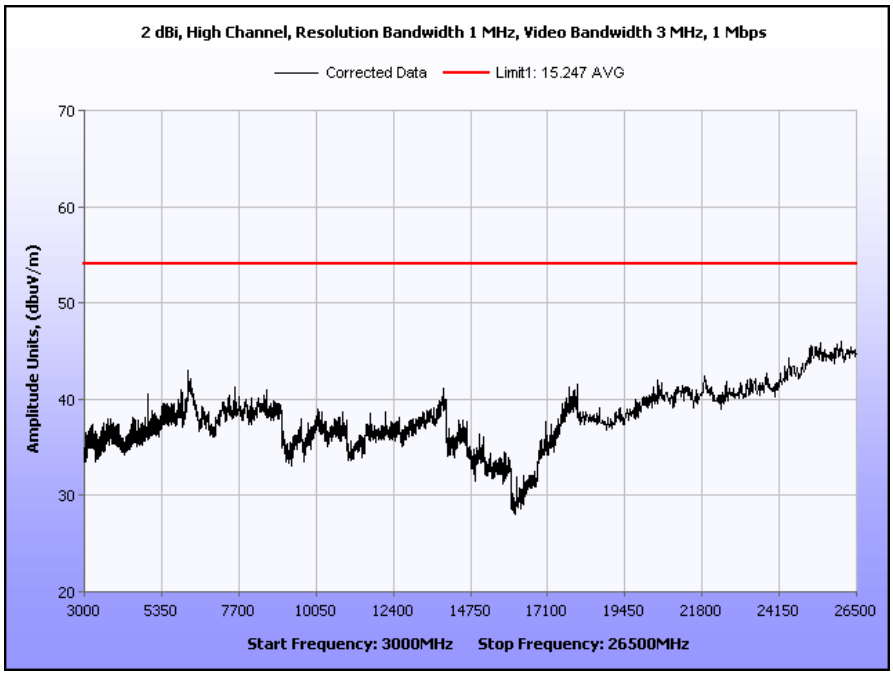


Plot 51. Radiated Spurious Emissions, 2 dBi, Low Channel, 1 Mbps

Radiated Spurious Emissions Test Results

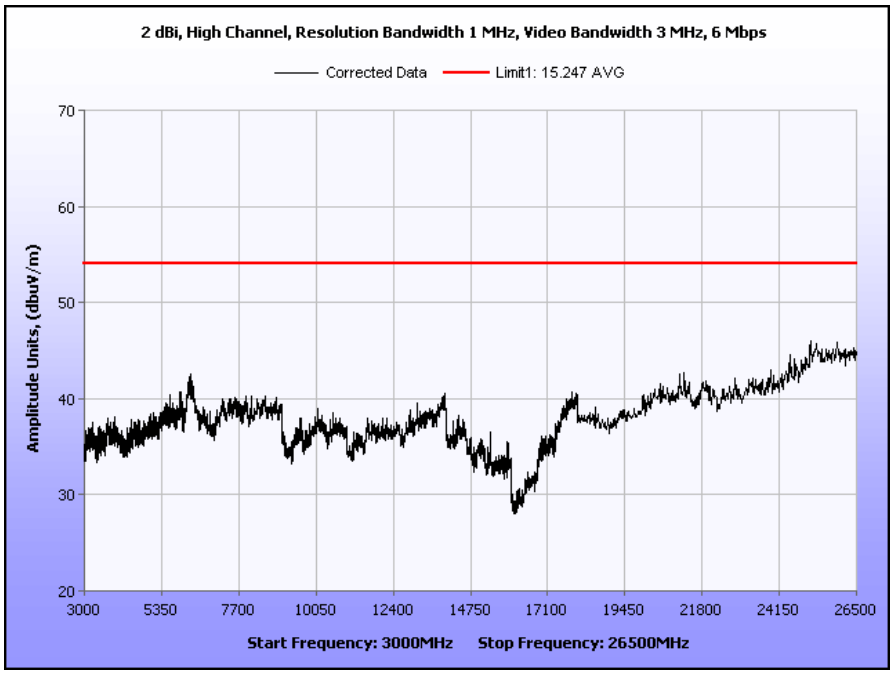


Plot 52. Radiated Spurious Emissions, 2 dBi, Mid Channel, 1 Mbps

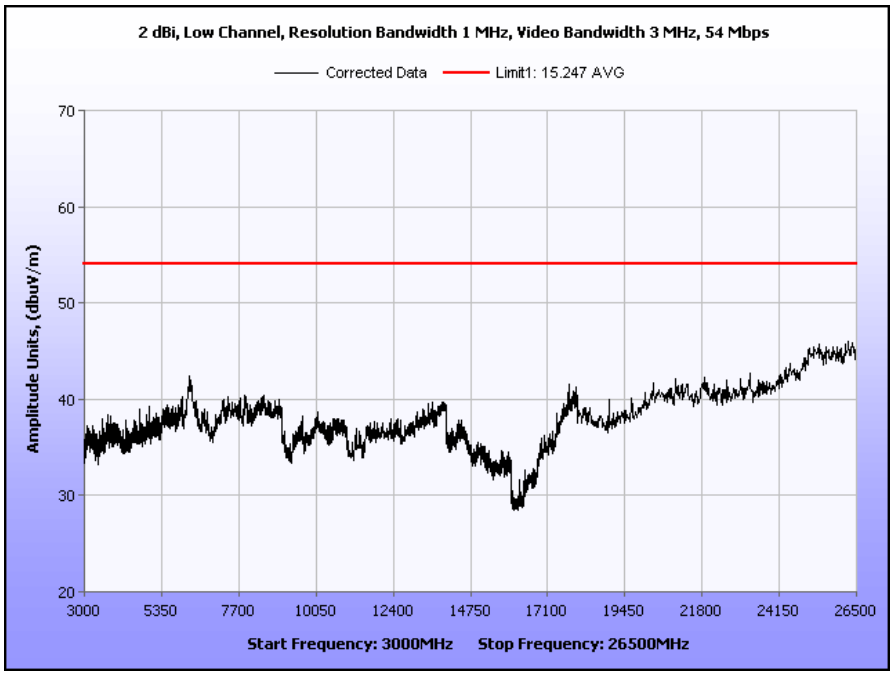


Plot 53. Radiated Spurious Emissions, 2 dBi, High Channel, 1 Mbps

Radiated Spurious Emissions Test Results

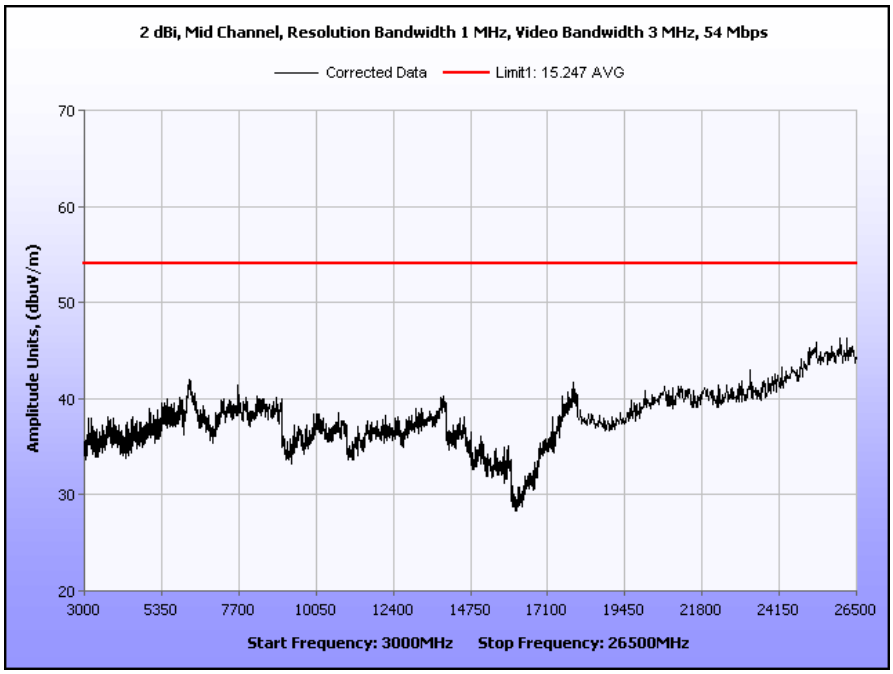


Plot 54. Radiated Spurious Emissions, 2 dBi, High Channel, 6 Mbps

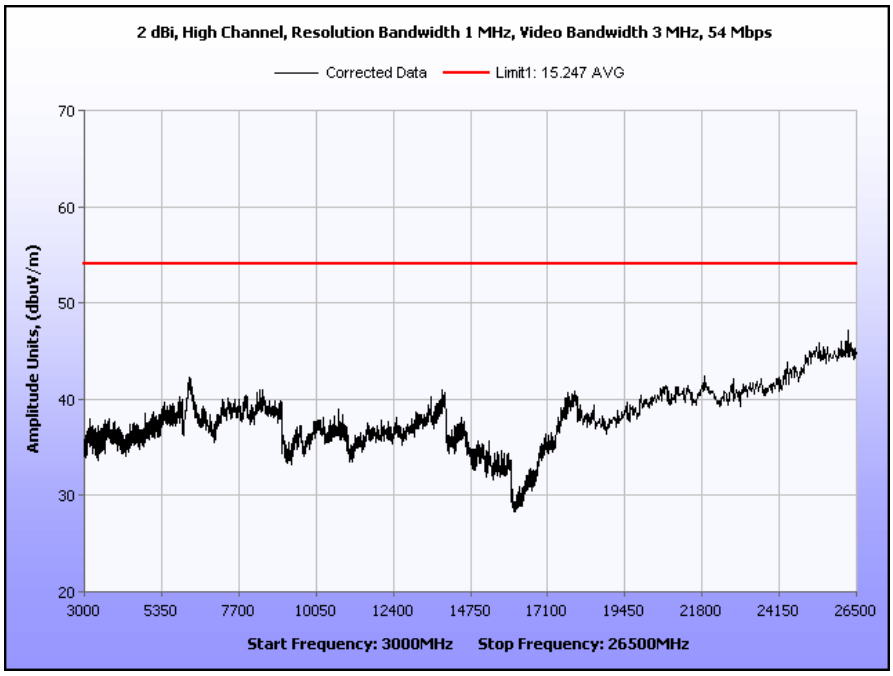


Plot 55. Radiated Spurious Emissions, 2 dBi, Low Channel, 54 Mbps

Radiated Spurious Emissions Test Results

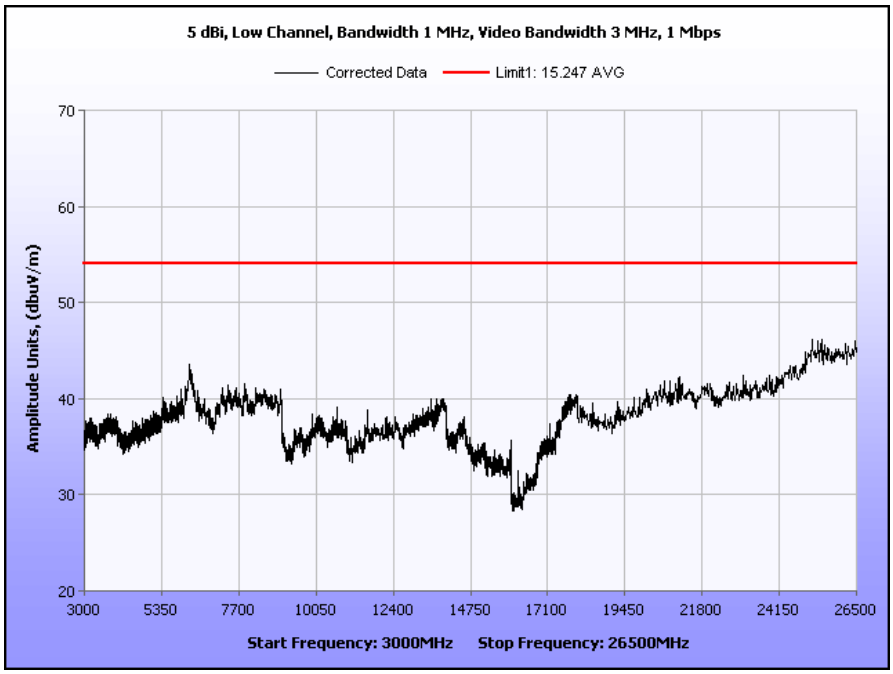


Plot 56. Radiated Spurious Emissions, 2 dBi, Mid Channel, 54 Mbps

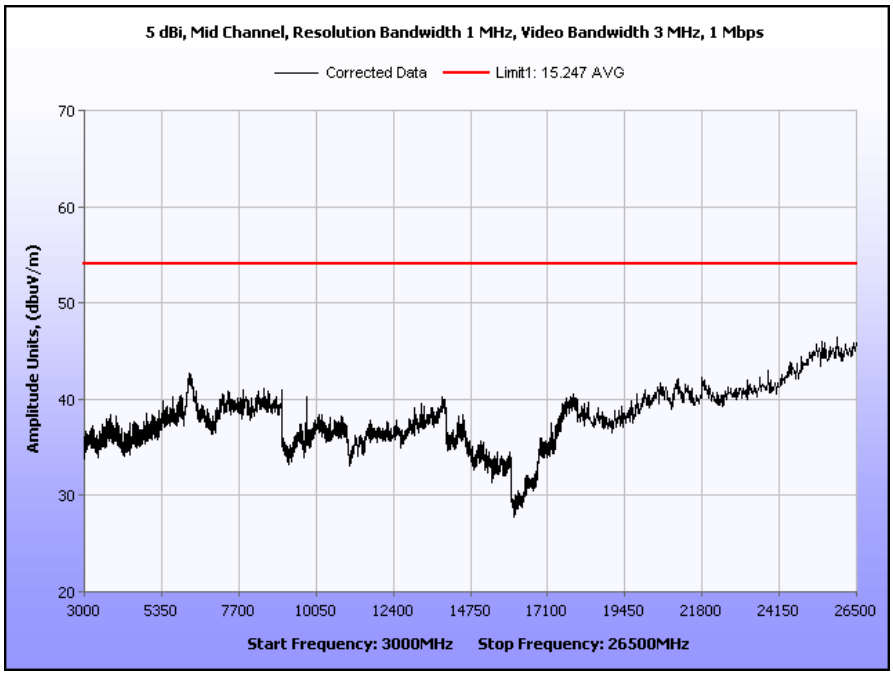


Plot 57. Radiated Spurious Emissions, 2 dBi, High Channel, 54 Mbps

Radiated Spurious Emissions Test Results

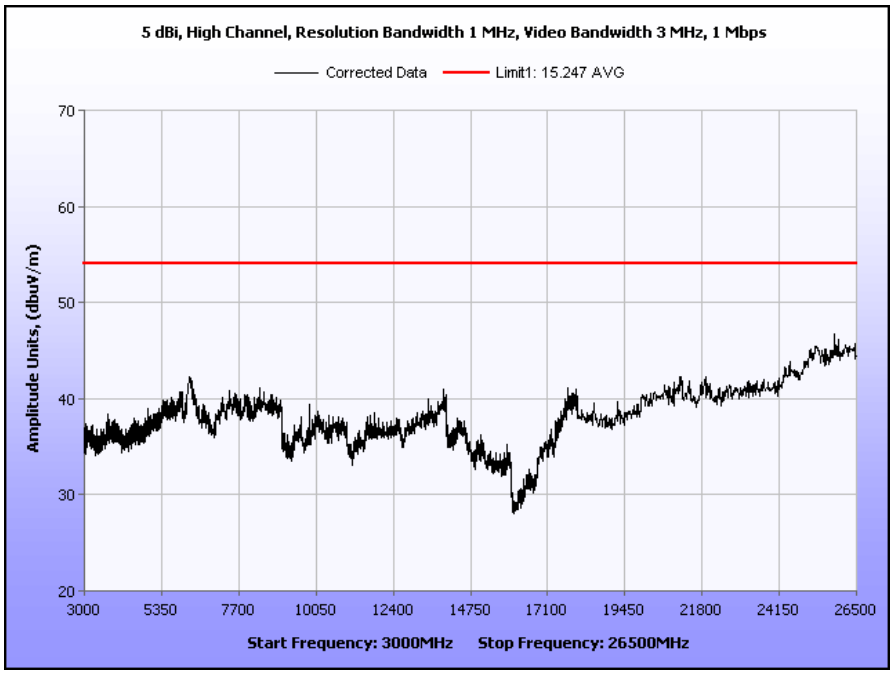


Plot 58. Radiated Spurious Emissions, 5 dBi, Low Channel, 1 Mbps

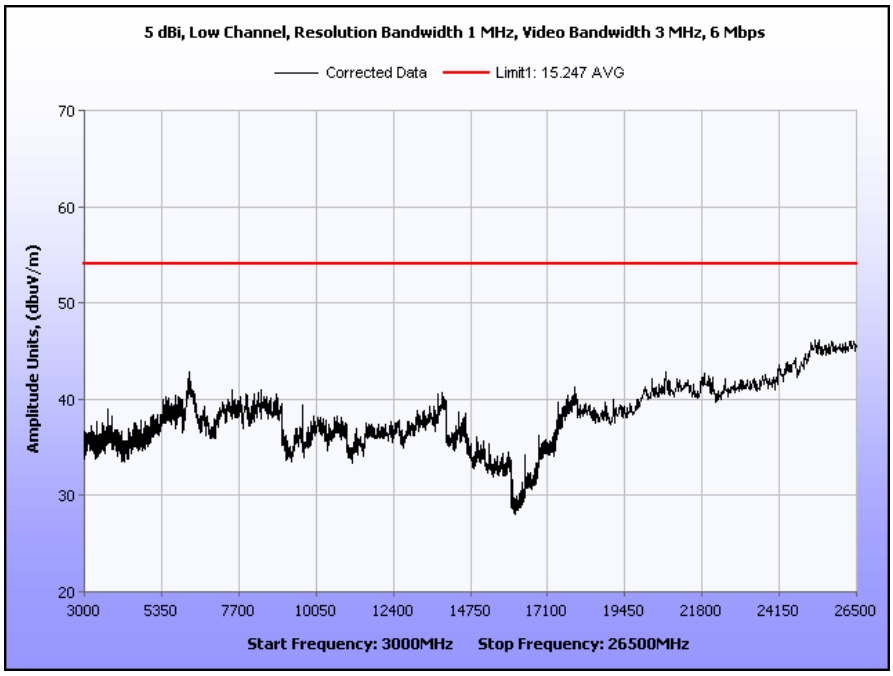


Plot 59. Radiated Spurious Emissions, 5 dBi, Mid Channel, 1 Mbps

Radiated Spurious Emissions Test Results

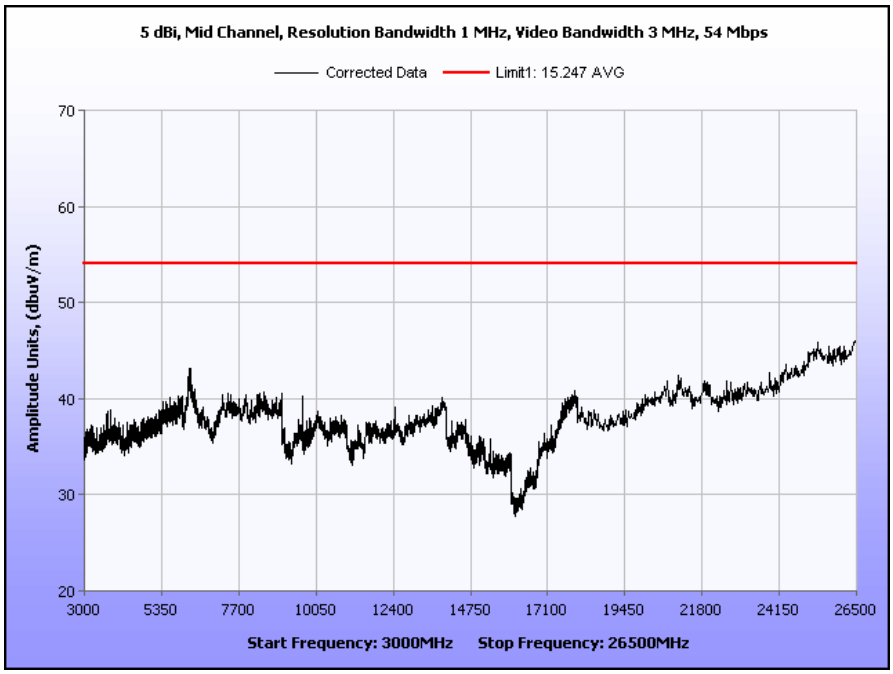


Plot 60. Radiated Spurious Emissions, 5 dBi, High Channel, 1 Mbps

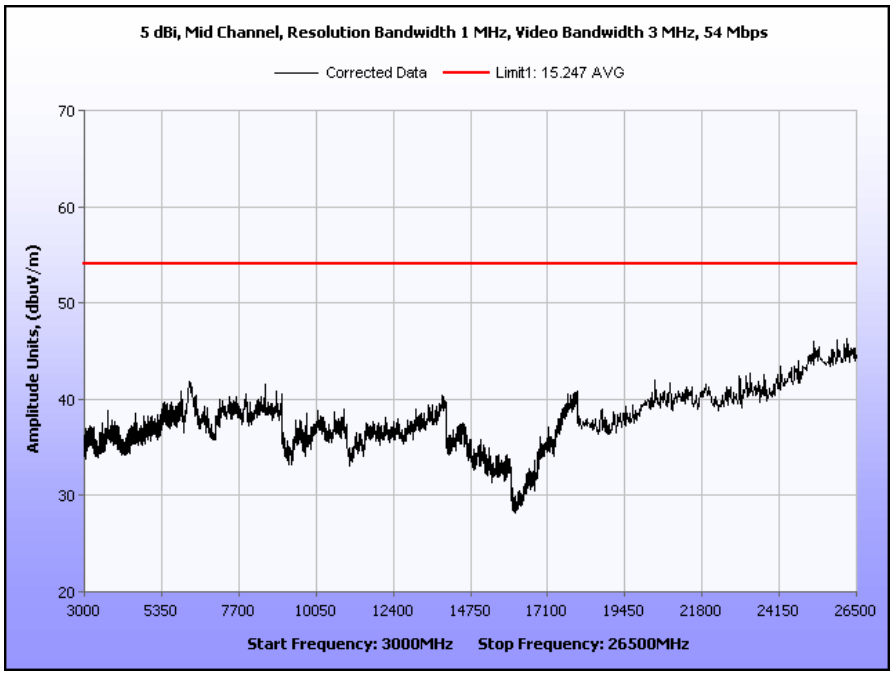


Plot 61. Radiated Spurious Emissions, 5 dBi, Low Channel, 6 Mbps

Radiated Spurious Emissions Test Results

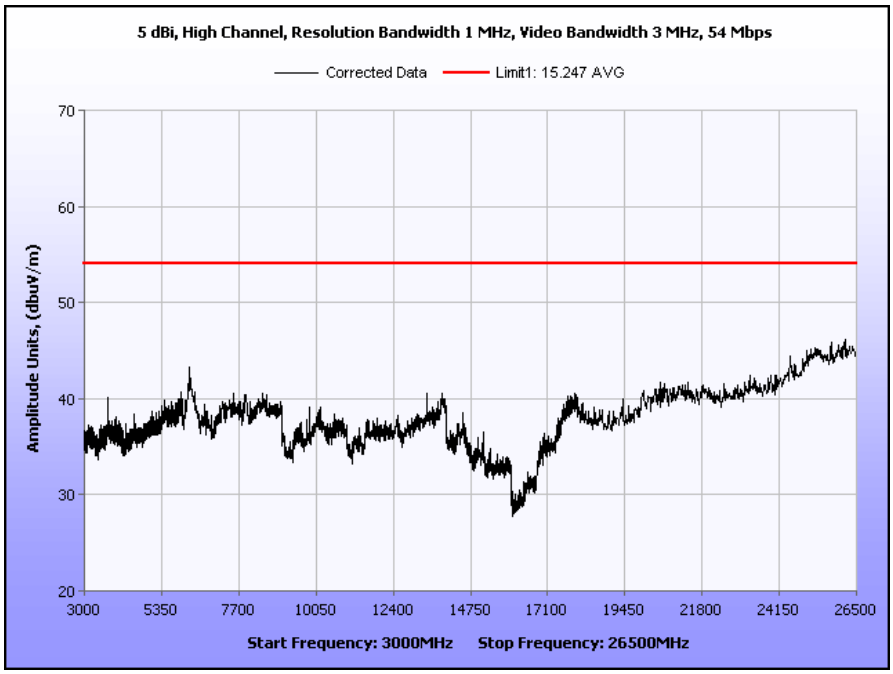


Plot 62. Radiated Spurious Emissions, 5 dBi, Low Channel, 54 Mbps

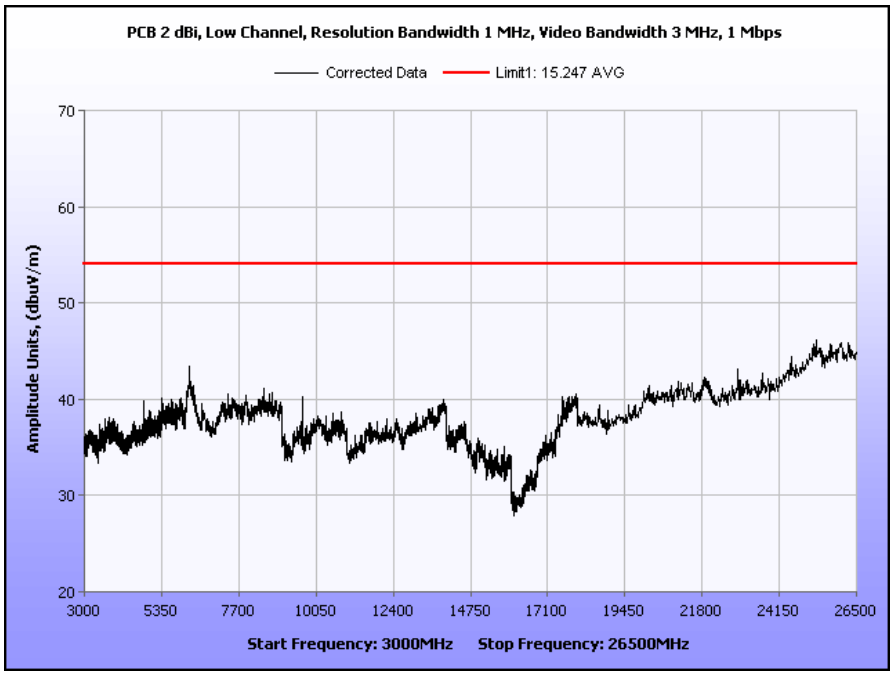


Plot 63. Radiated Spurious Emissions, 5 dBi, Mid Channel, 54 Mbps

Radiated Spurious Emissions Test Results

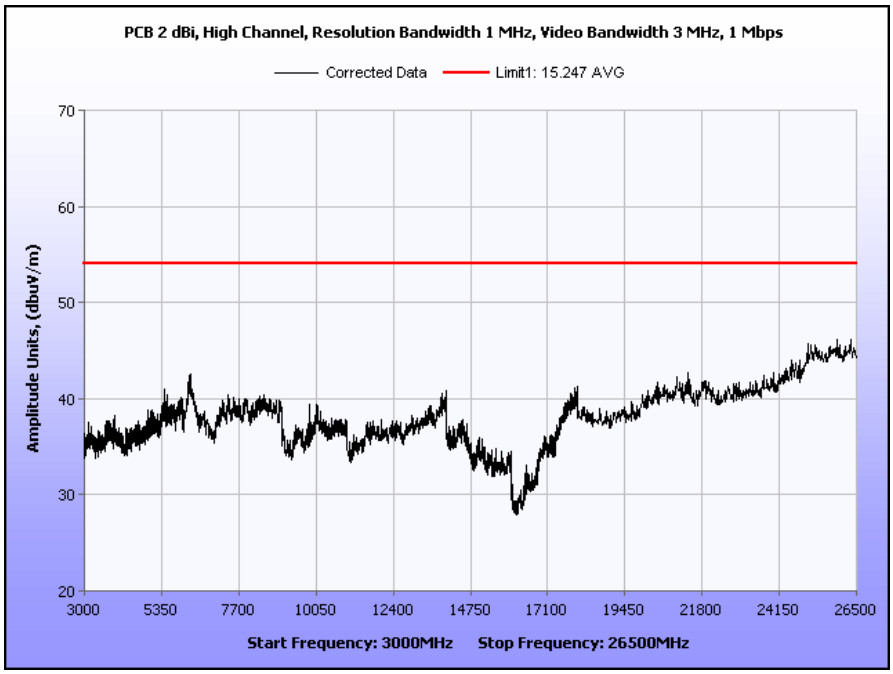


Plot 64. Radiated Spurious Emissions, 5 dBi, High Channel, 54 Mbps

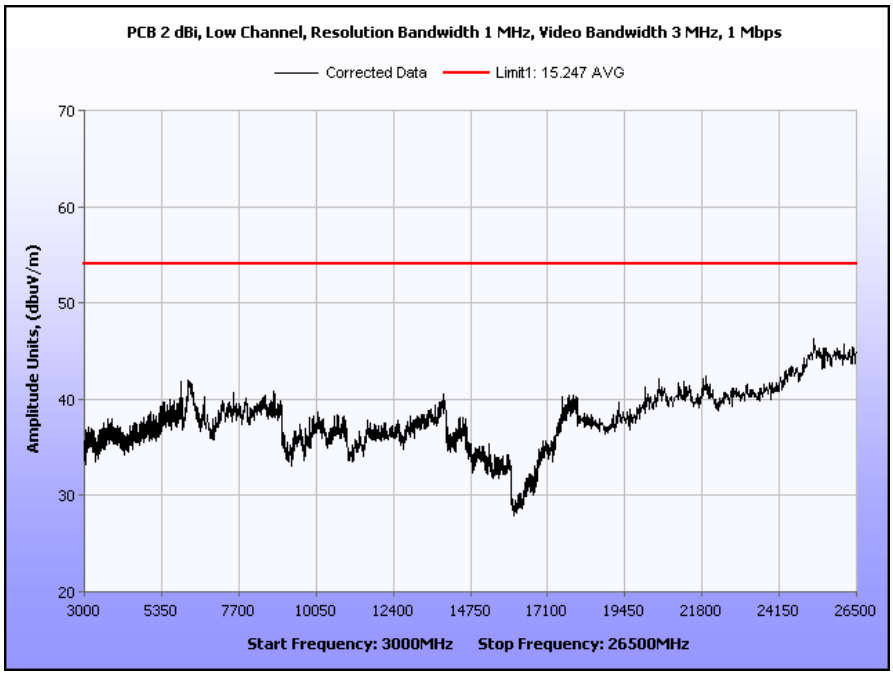


Plot 65. Radiated Spurious Emissions, 2 dBi, PCB, Low Channel, 1 Mbps

Radiated Spurious Emissions Test Results

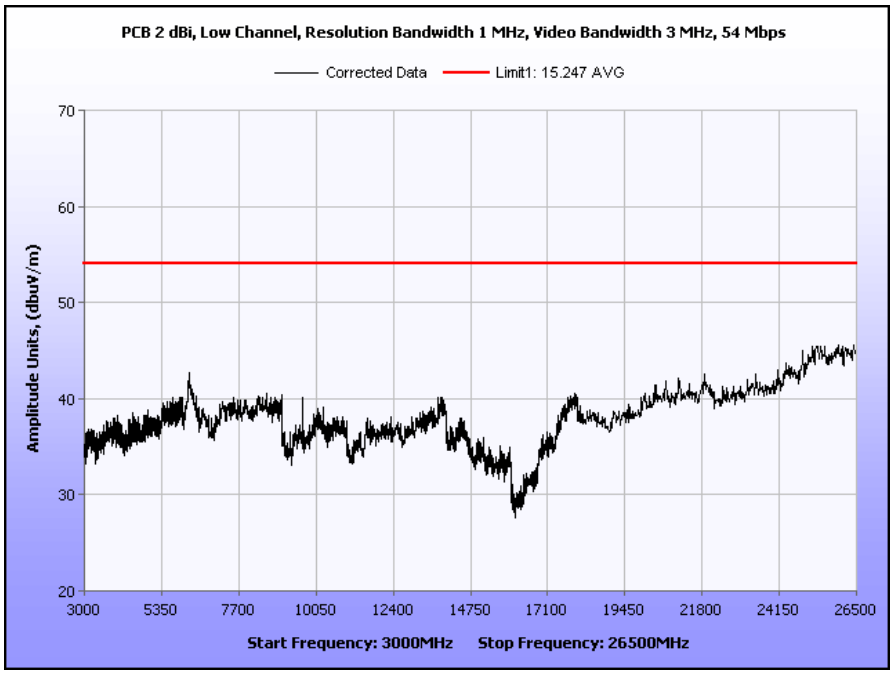


Plot 66. Radiated Spurious Emissions, 2 dBi, PCB, High Channel, 1 Mbps

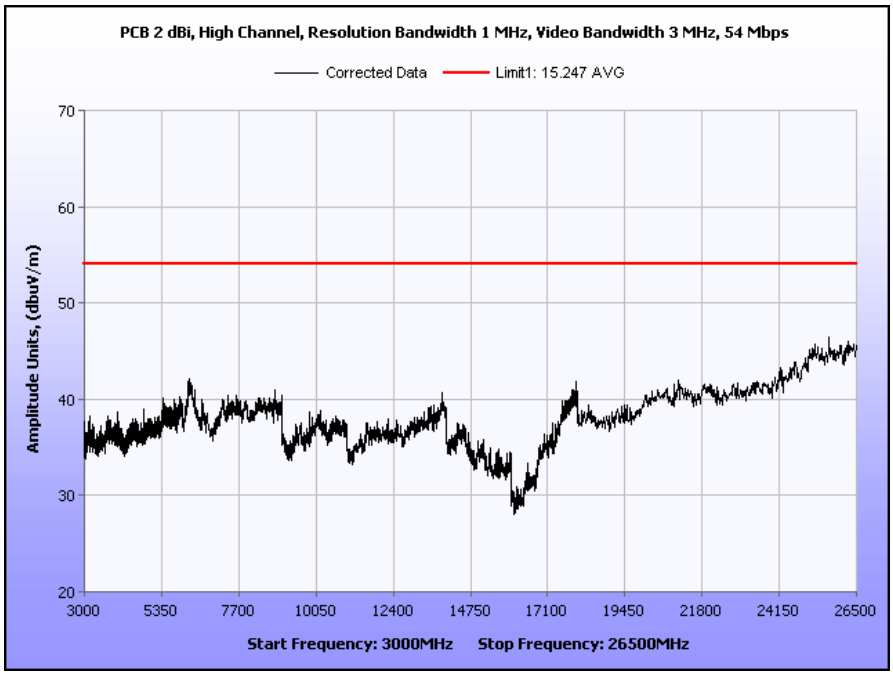


Plot 67. Radiated Spurious Emissions, 2 dBi, PCB, Low Channel, 6 Mbps

Radiated Spurious Emissions Test Results



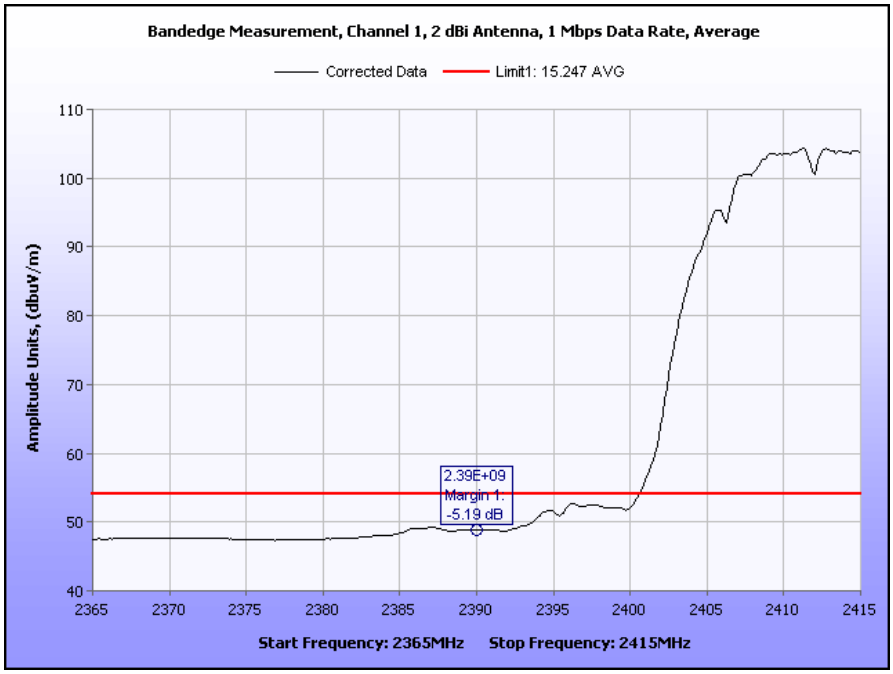
Plot 68. Radiated Spurious Emissions, 2 dBi, PCB, Low Channel, 54 Mbps



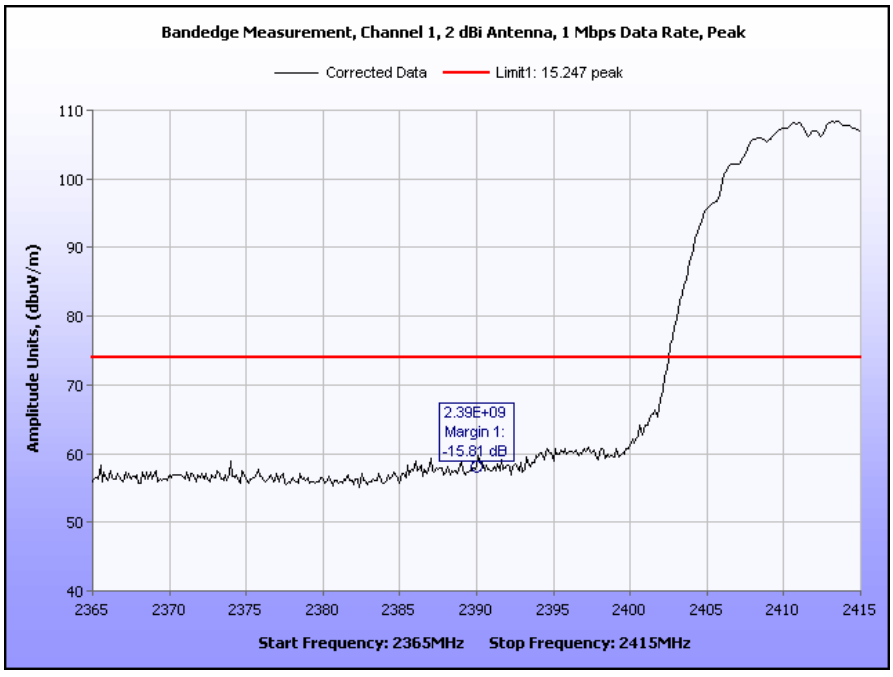
Plot 69. Radiated Spurious Emissions, 2 dBi, PCB, High Channel, 54 Mbps

Radiated Band Edge Measurements

Test Procedures: The transmitter was turned. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line.

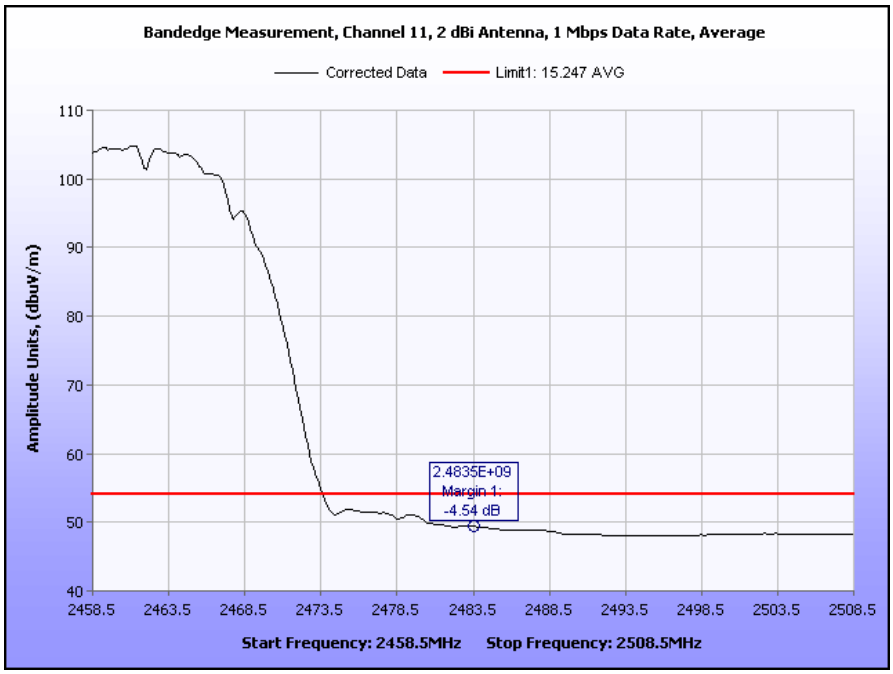


Plot 70. Restricted Band Edge, Channel 1, 2 dBi Antenna, 1 Mbps, Average

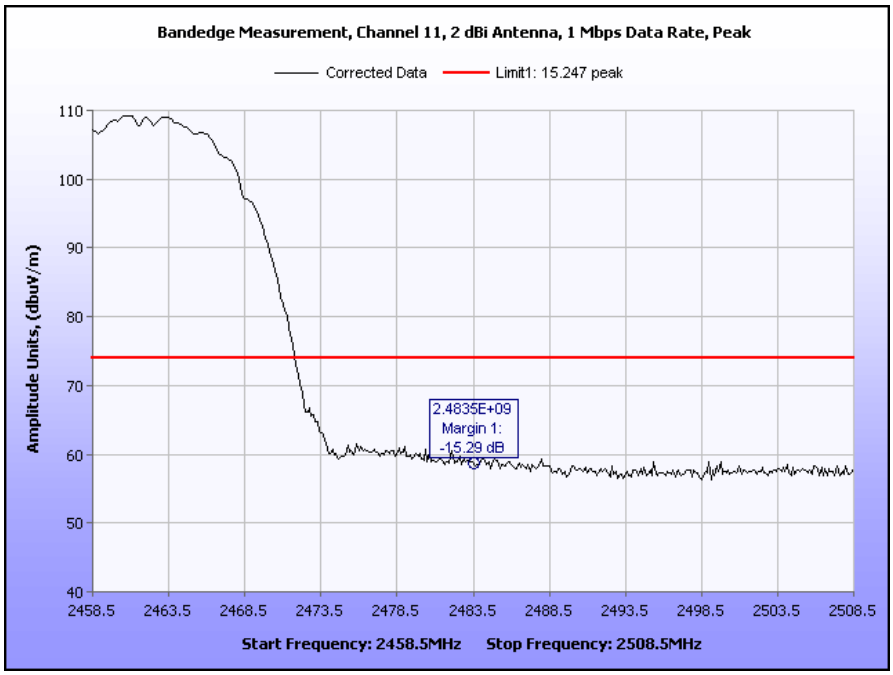


Plot 71. Restricted Band Edge, Channel 1, 2 dBi Antenna, 1 Mbps, Peak

Radiated Band Edge Measurements

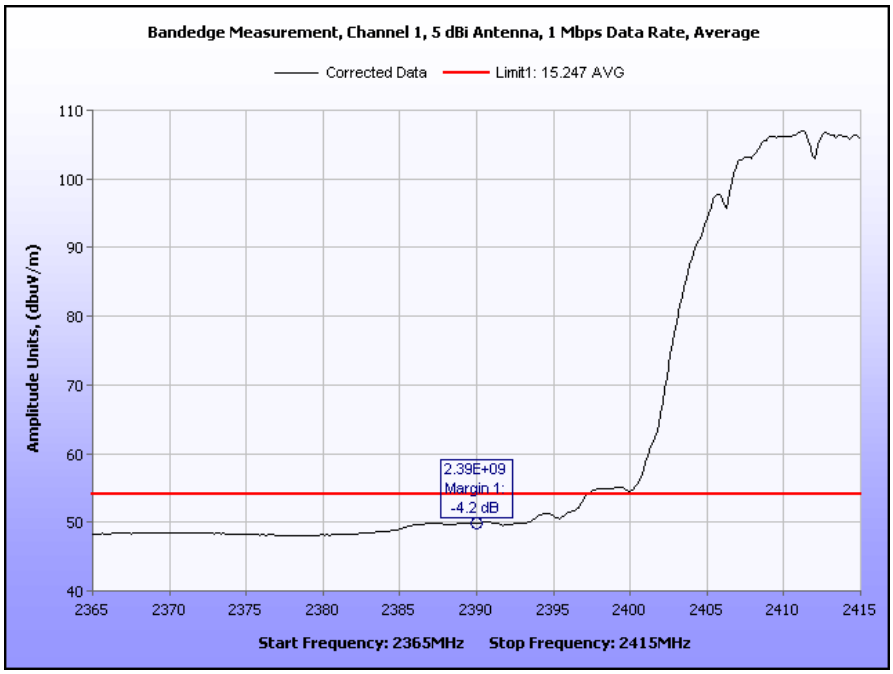


Plot 72. Restricted Band Edge, Channel 11, 2 dBi Antenna, 1 Mbps, Average

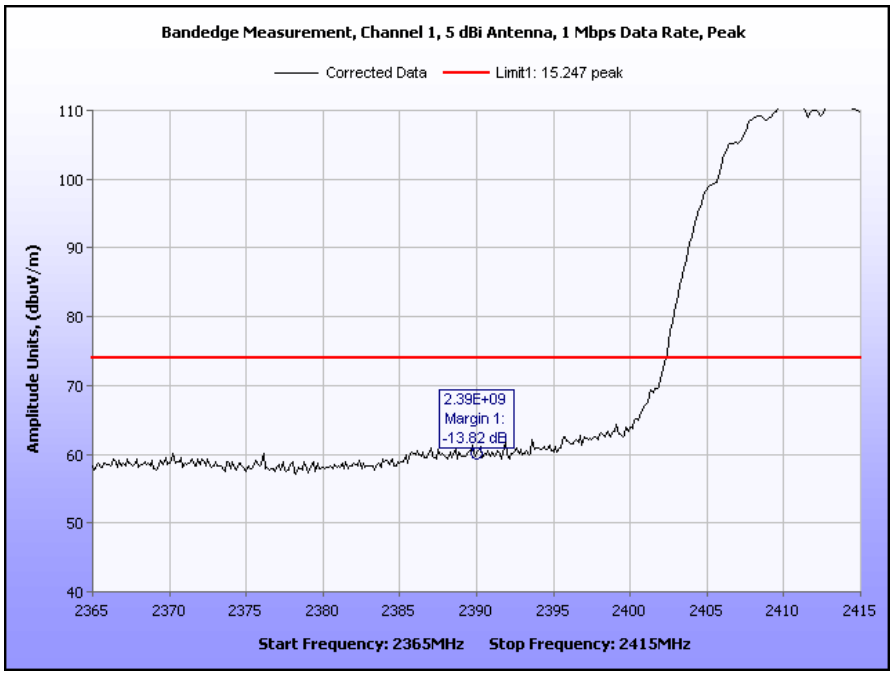


Plot 73. Restricted Band Edge, Channel 11, 2 dBi Antenna, 1 Mbps, Peak

Radiated Band Edge Measurements

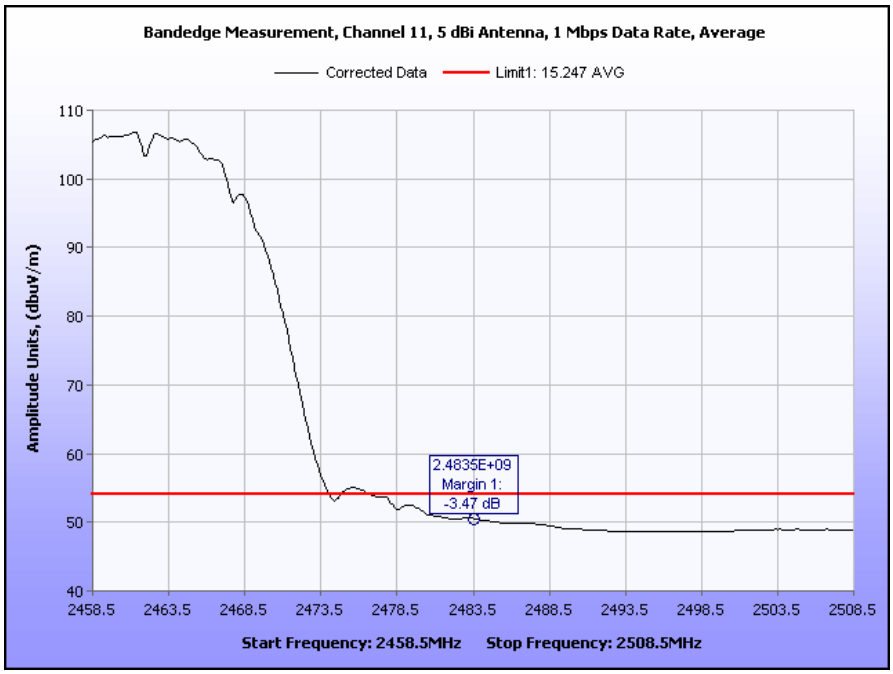


Plot 74. Restricted Band Edge, Channel 1, 5 dBi Antenna, 1 Mbps, Average

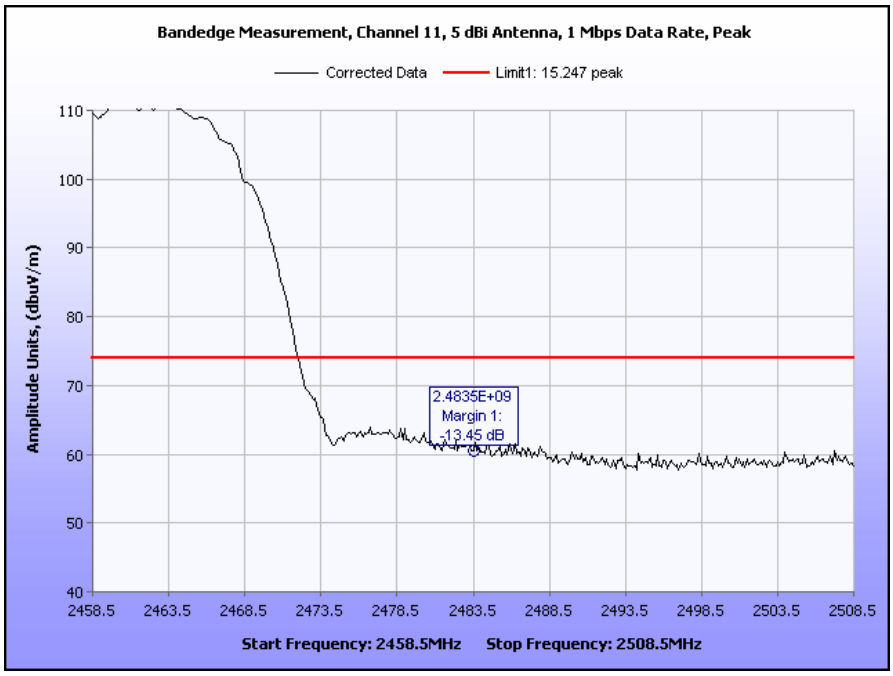


Plot 75. Restricted Band Edge, Channel 1, 5 dBi Antenna, 1 Mbps, Peak

Radiated Band Edge Measurements

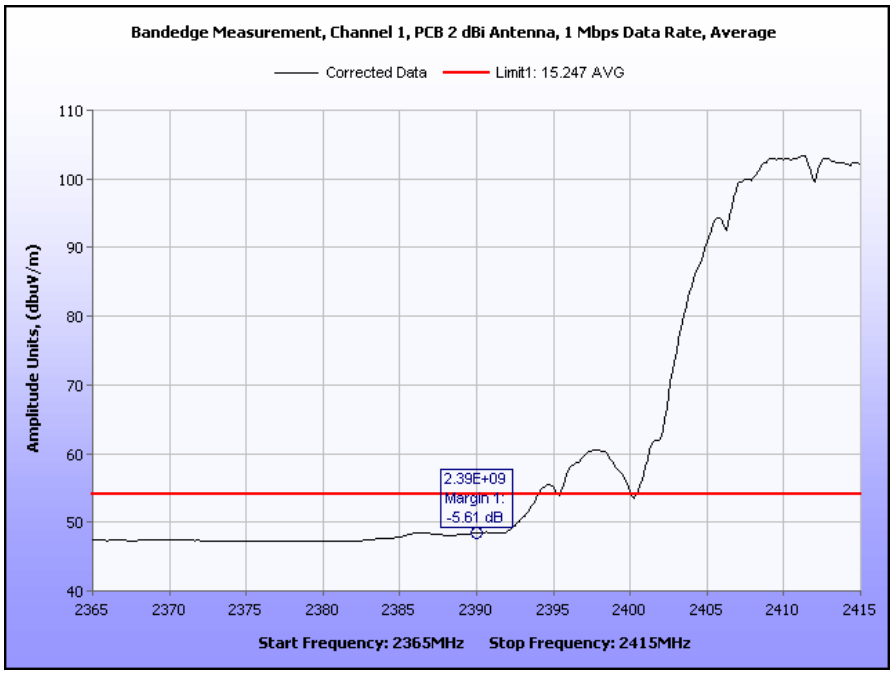


Plot 76. Restricted Band Edge, Channel 11, 5 dBi Antenna, 1 Mbps, Average

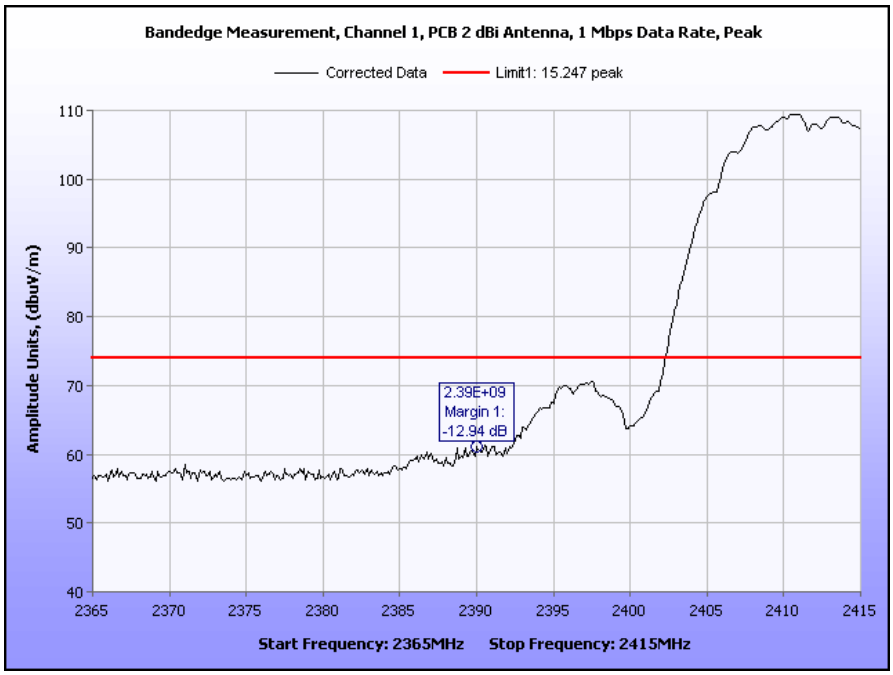


Plot 77. Restricted Band Edge, Channel 11, 5 dBi Antenna, 1 Mbps, Peak

Radiated Band Edge Measurements

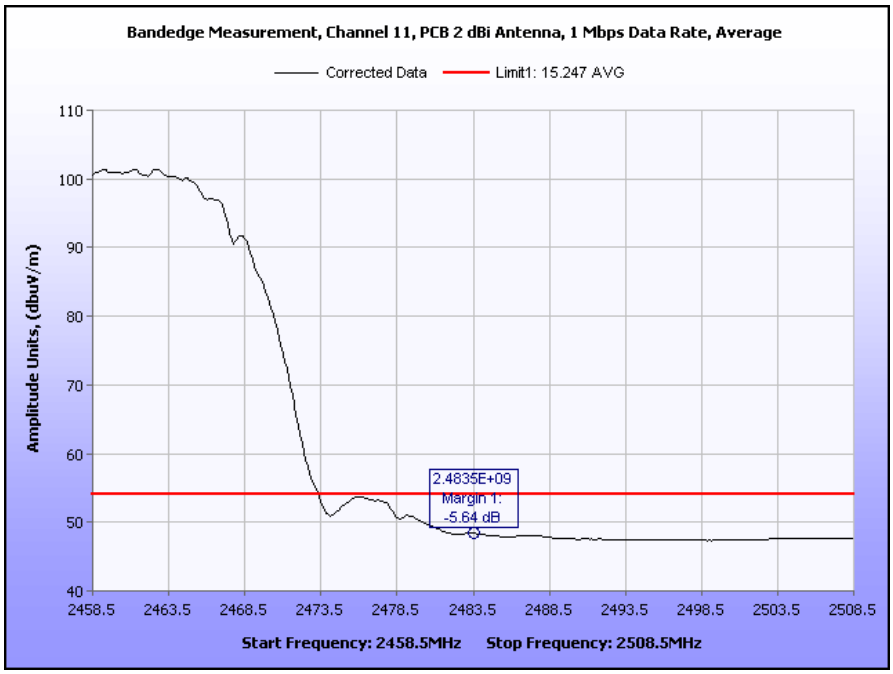


Plot 78. Restricted Band Edge, Channel 1, PCB, 2 dBi Antenna, 1 Mbps, Average

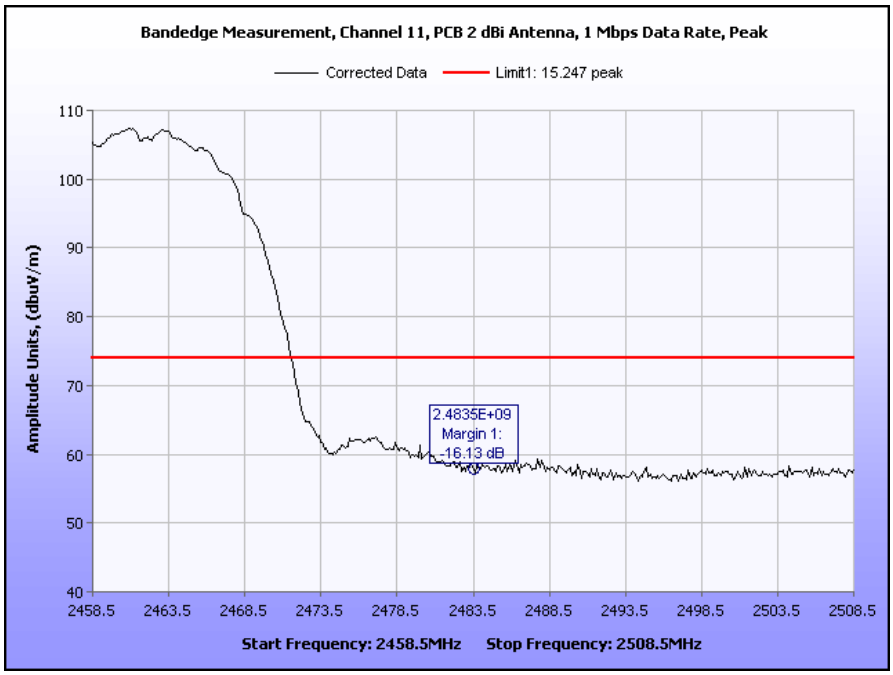


Plot 79. Restricted Band Edge, Channel 1, PCB, 2 dBi Antenna, 1 Mbps, Peak

Radiated Band Edge Measurements

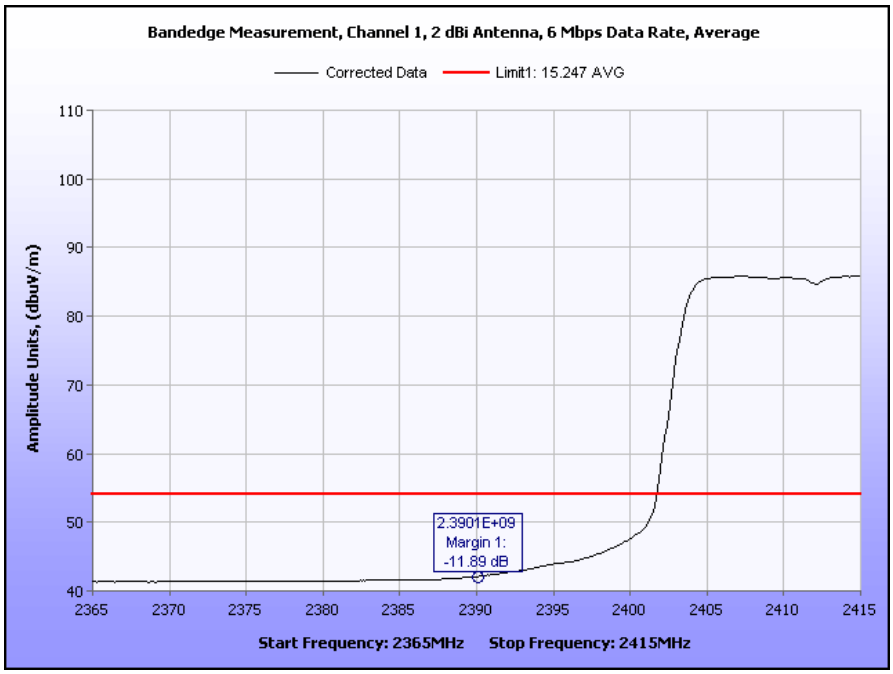


Plot 80. Restricted Band Edge, Channel 11, PCB, 2 dBi Antenna, 1 Mbps, Average

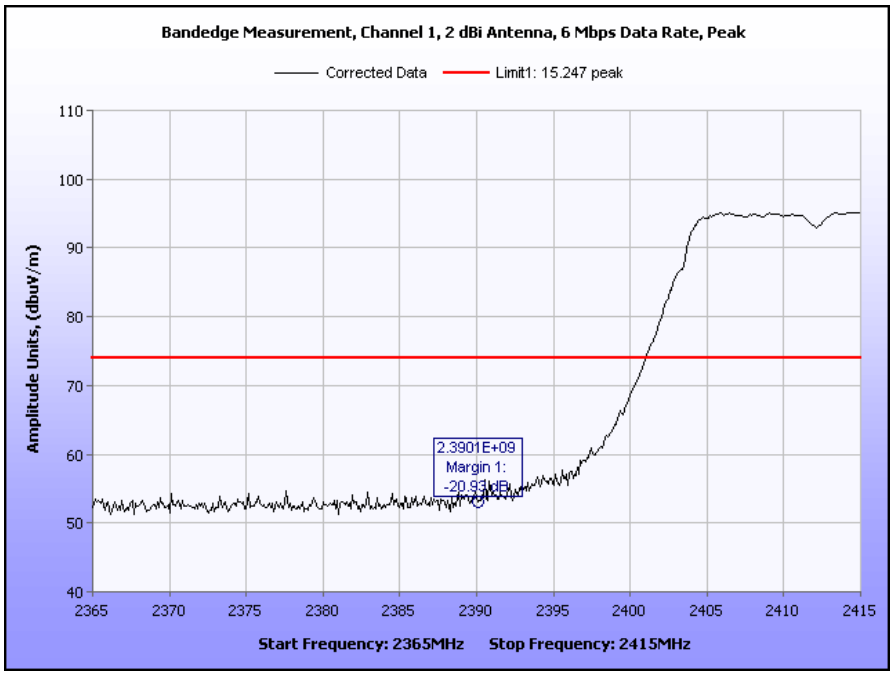


Plot 81. Restricted Band Edge, Channel 11, PCB, 2 dBi Antenna, 1 Mbps, Peak

Radiated Band Edge Measurements

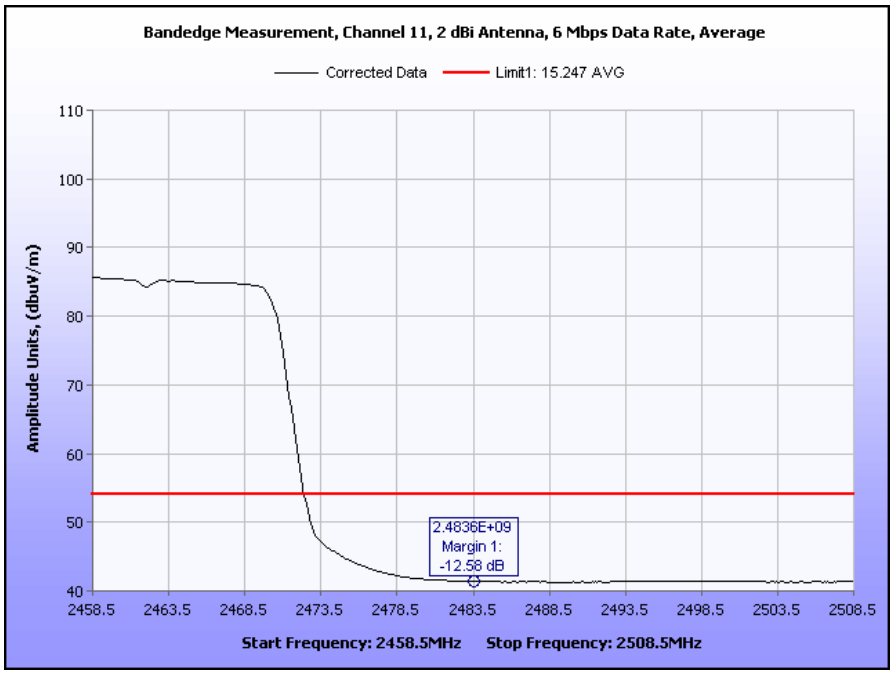


Plot 82. Restricted Band Edge, Channel 1, 2 dBi Antenna, 6 Mbps, Average

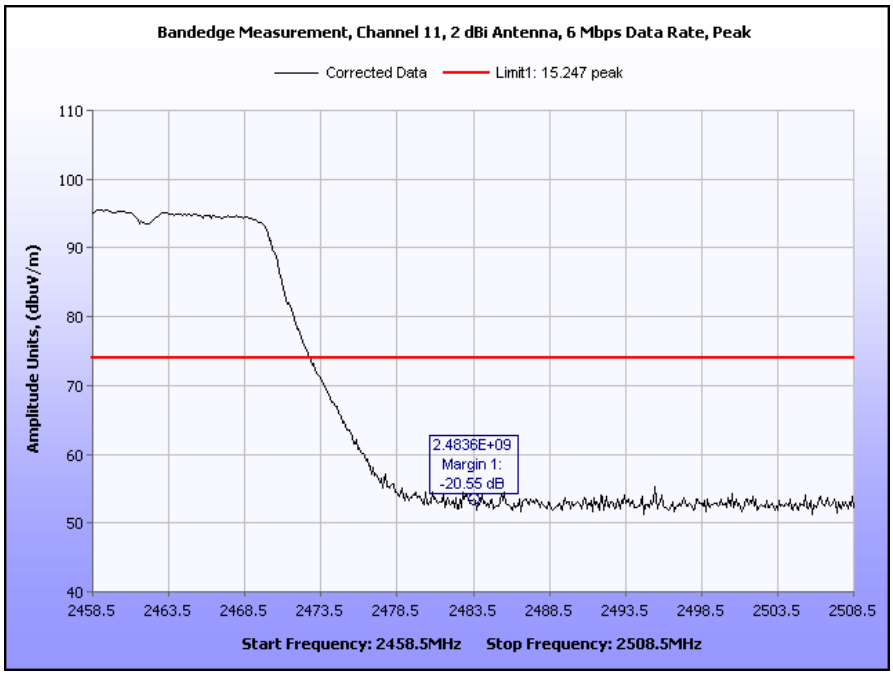


Plot 83. Restricted Band Edge, Channel 1, 2 dBi Antenna, 6 Mbps, Peak

Radiated Band Edge Measurements

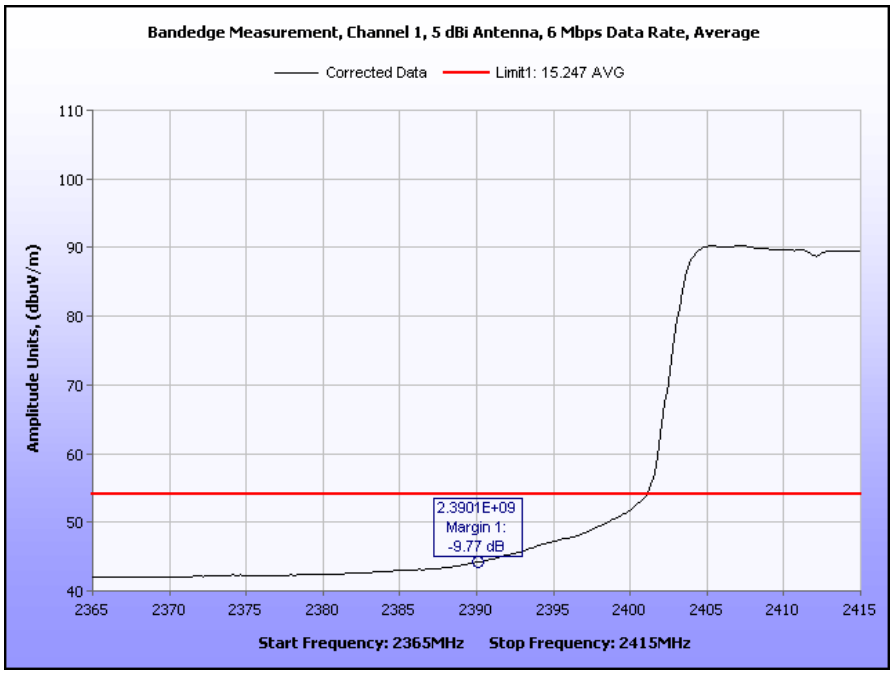


Plot 84. Restricted Band Edge, Channel 11, 2 dBi Antenna, 6 Mbps, Average

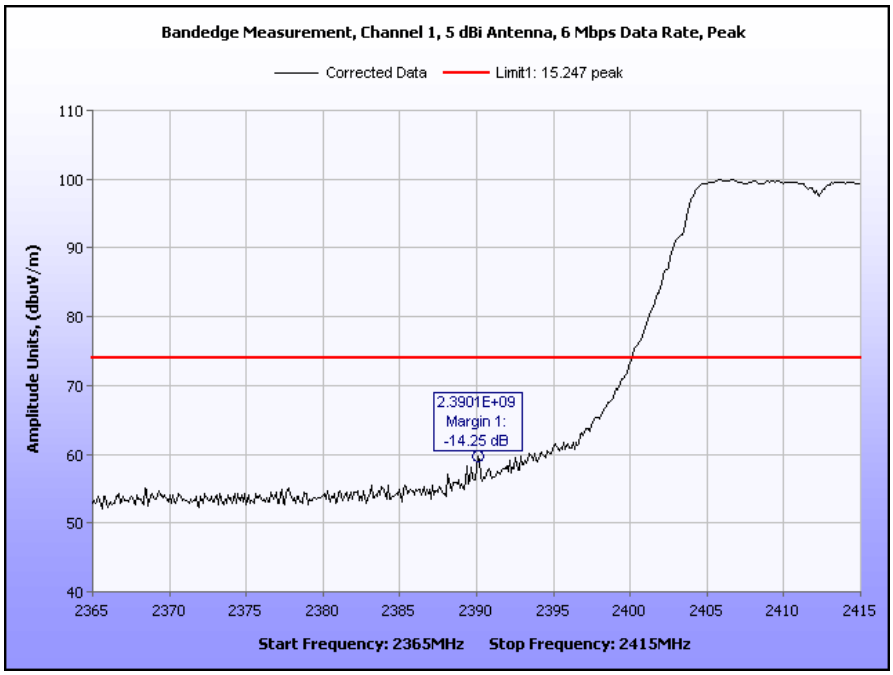


Plot 85. Restricted Band Edge, Channel 11, 2 dBi Antenna, 6 Mbps, Peak

Radiated Band Edge Measurements

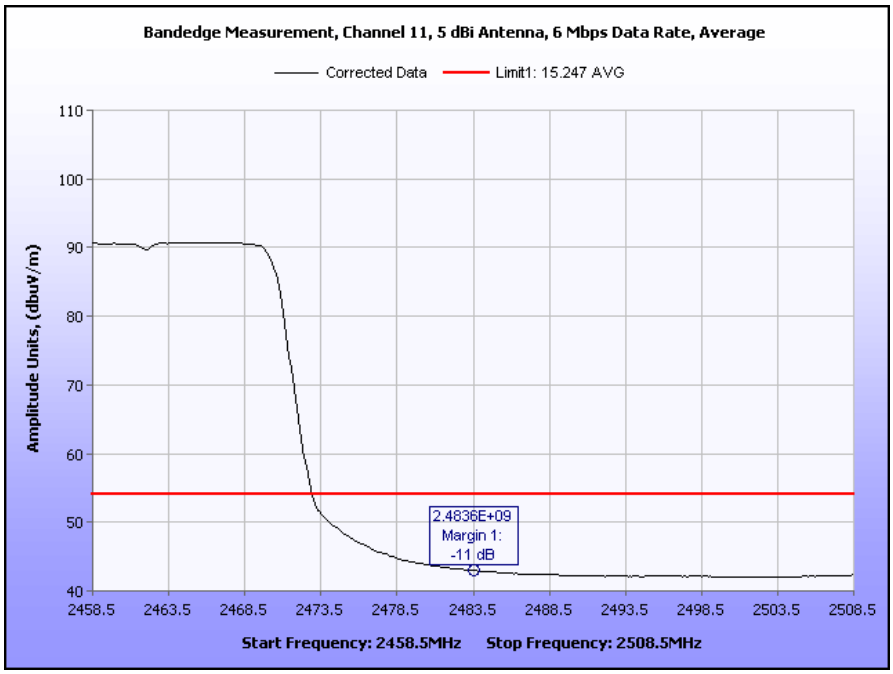


Plot 86. Restricted Band Edge, Channel 1, 5 dBi Antenna, 6 Mbps, Average

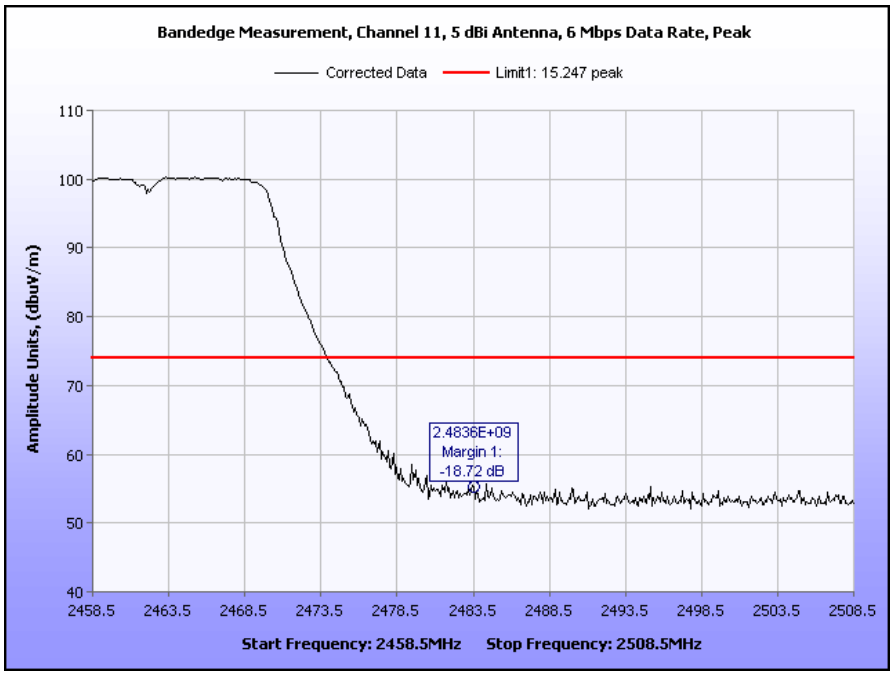


Plot 87. Restricted Band Edge, Channel 1, 5 dBi Antenna, 6 Mbps, Peak

Radiated Band Edge Measurements

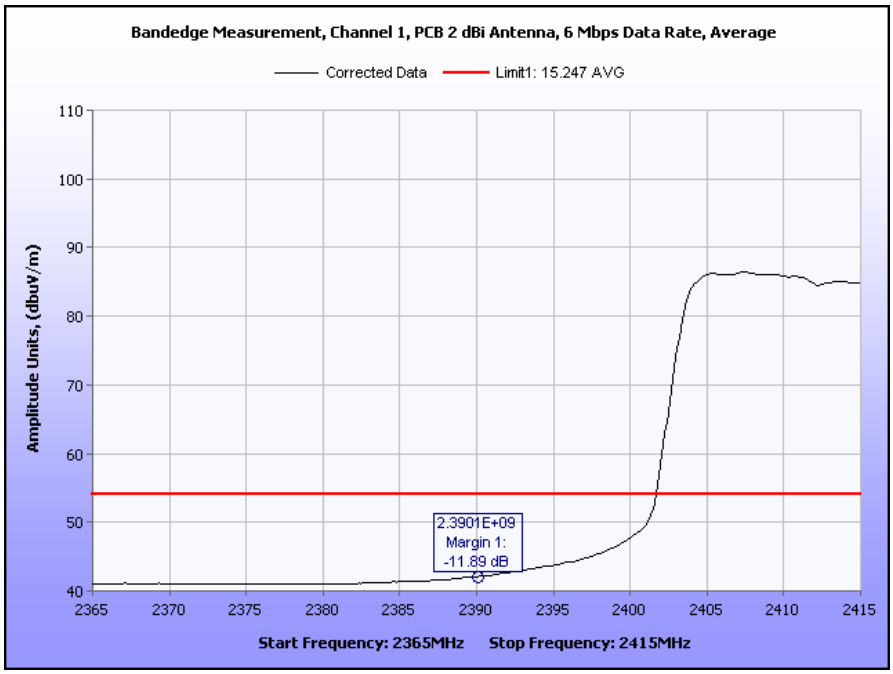


Plot 88. Restricted Band Edge, Channel 11, 5 dBi Antenna, 6 Mbps, Average

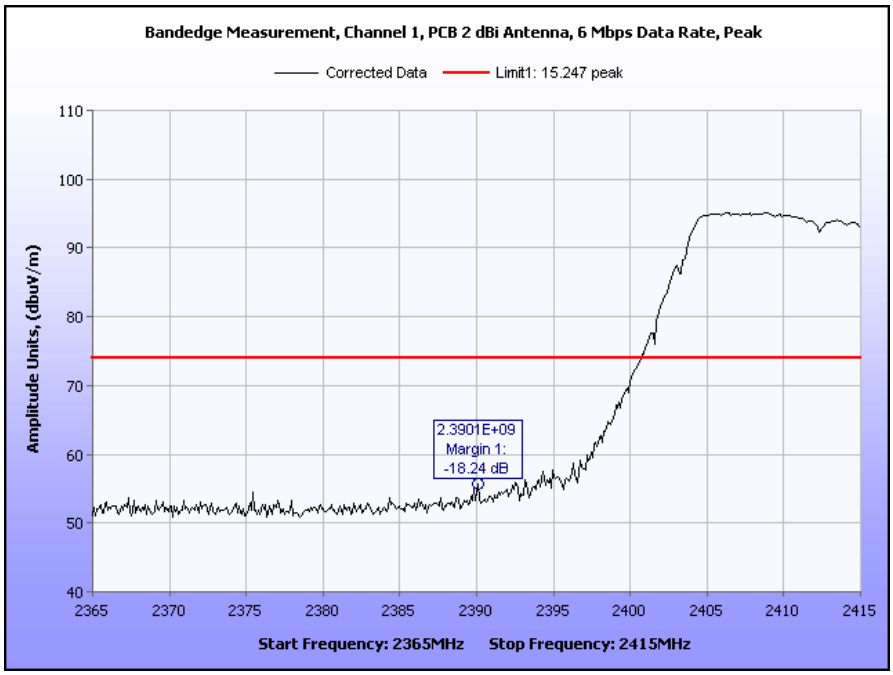


Plot 89. Restricted Band Edge, Channel 11, 5 dBi Antenna, 6 Mbps, Peak

Radiated Band Edge Measurements

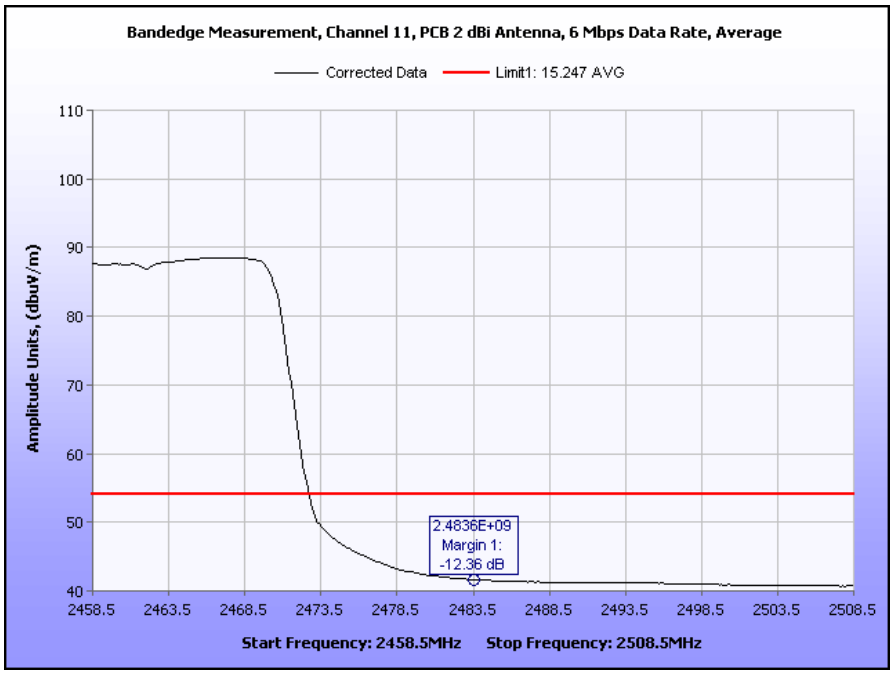


Plot 90. Restricted Band Edge, Channel 1, PCB, 2 dBi Antenna, 6 Mbps, Average

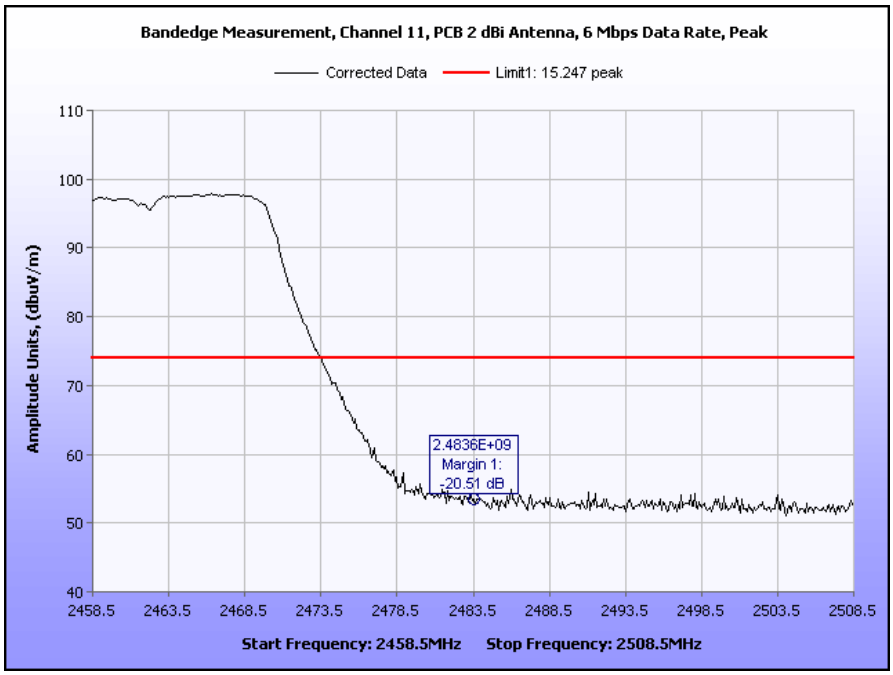


Plot 91. Restricted Band Edge, Channel 1, PCB, 2 dBi Antenna, 6 Mbps, Peak

Radiated Band Edge Measurements

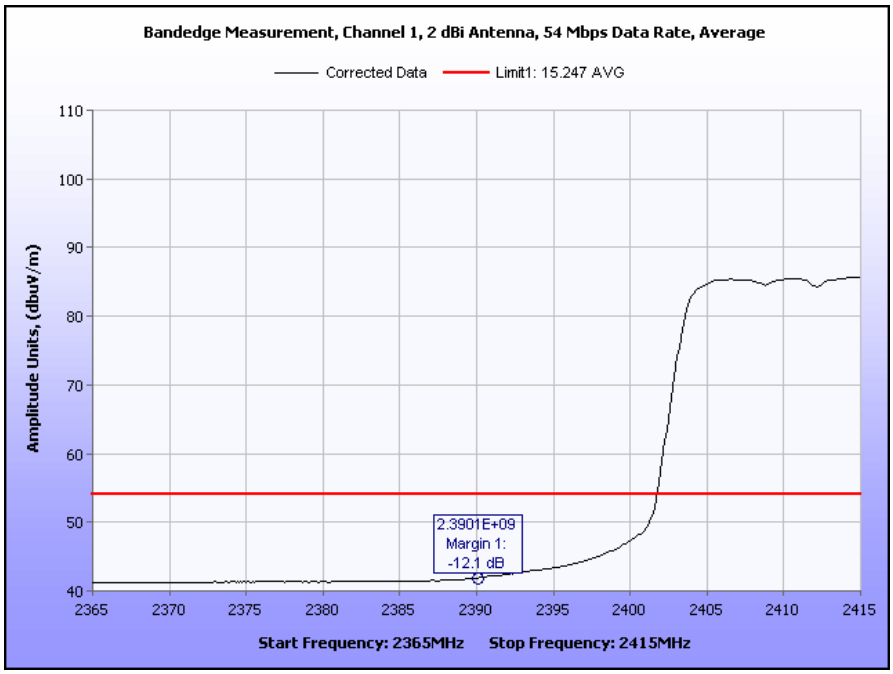


Plot 92. Restricted Band Edge, Channel 11, PCB, 2 dBi Antenna, 6 Mbps, Average

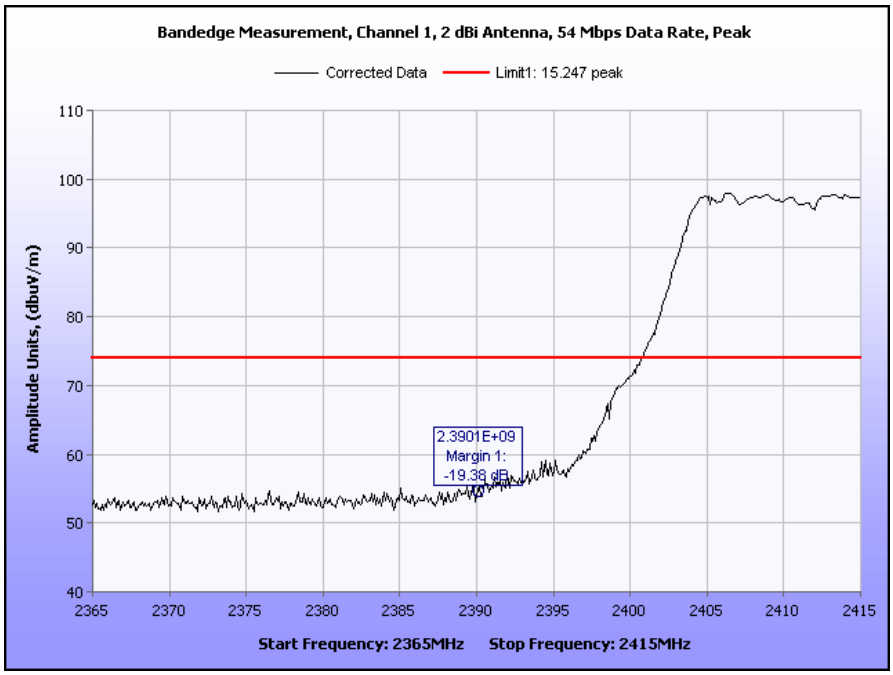


Plot 93. Restricted Band Edge, Channel 11, PCB, 2 dBi Antenna, 6 Mbps, Peak

Radiated Band Edge Measurements

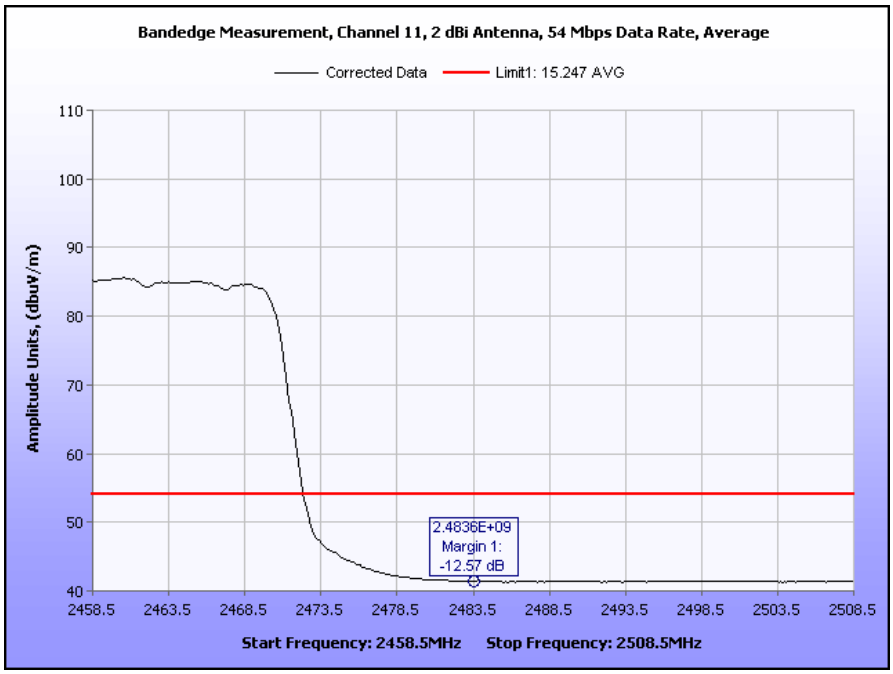


Plot 94. Restricted Band Edge, Channel 1, 2 dBi Antenna, 54 Mbps, Average

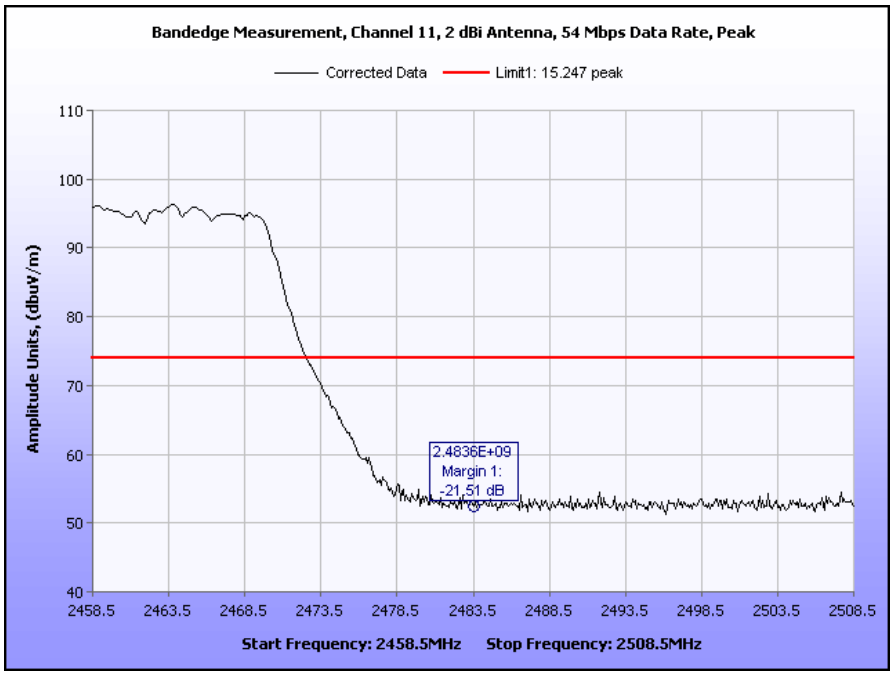


Plot 95. Restricted Band Edge, Channel 1, 2 dBi Antenna, 54 Mbps, Peak

Radiated Band Edge Measurements

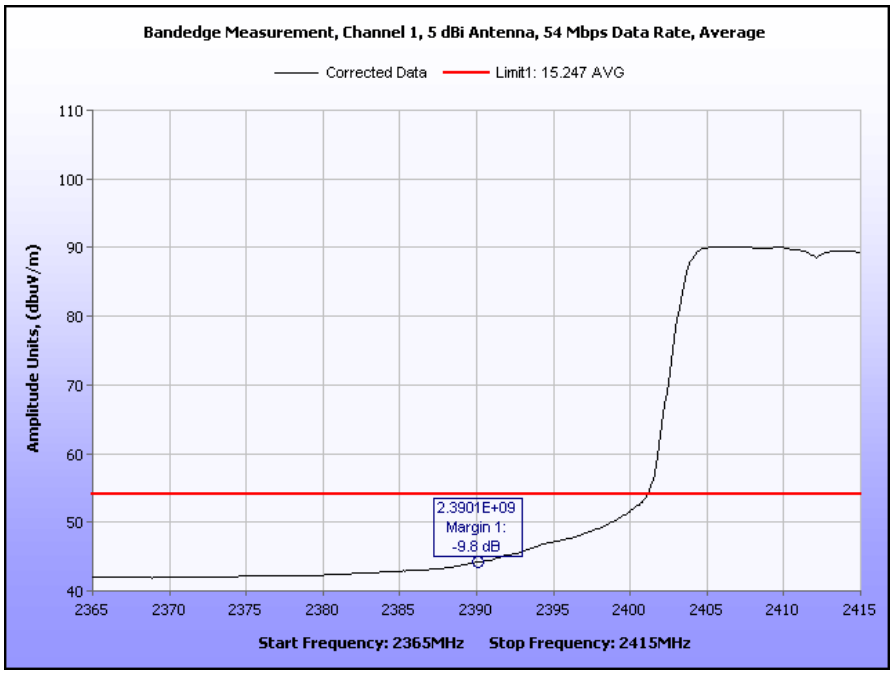


Plot 96. Restricted Band Edge, Channel 11, 2 dBi Antenna, 54 Mbps, Average

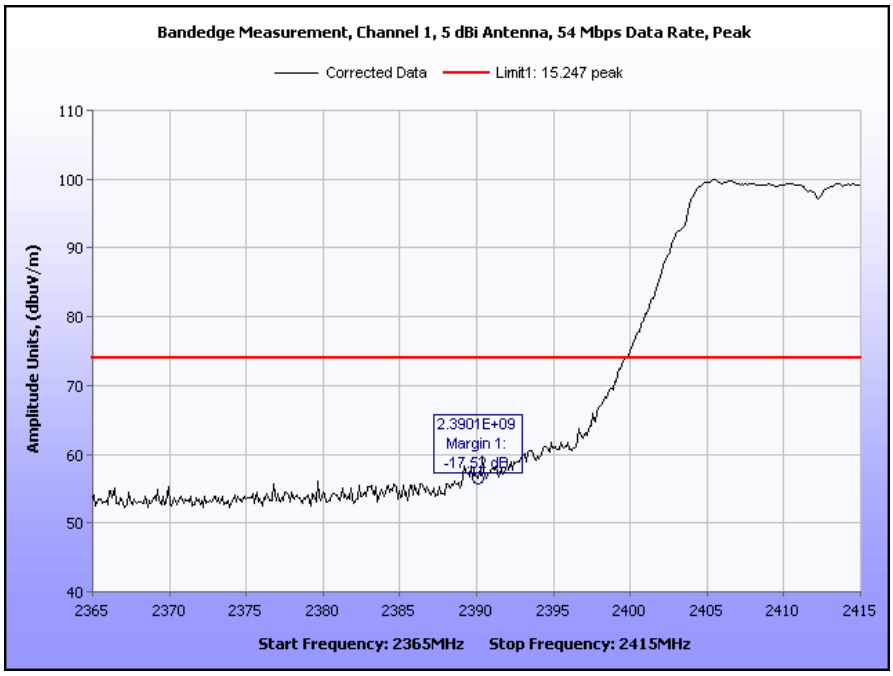


Plot 97. Restricted Band Edge, Channel 11, 2 dBi Antenna, 54 Mbps, Peak

Radiated Band Edge Measurements

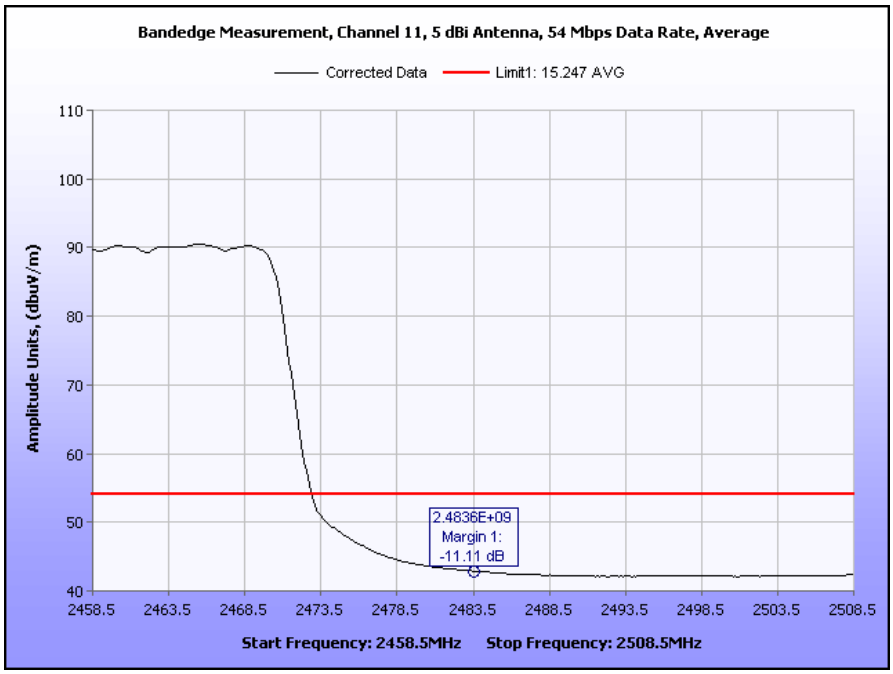


Plot 98. Restricted Band Edge, Channel 1, 5 dBi Antenna, 54 Mbps, Average

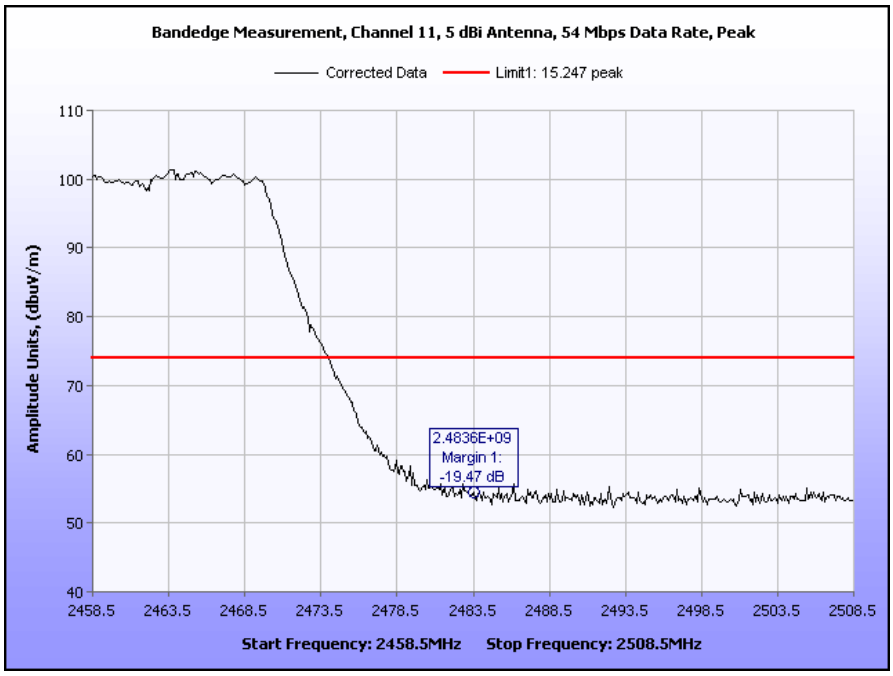


Plot 99. Restricted Band Edge, Channel 1, 5 dBi Antenna, 54 Mbps, Peak

Radiated Band Edge Measurements

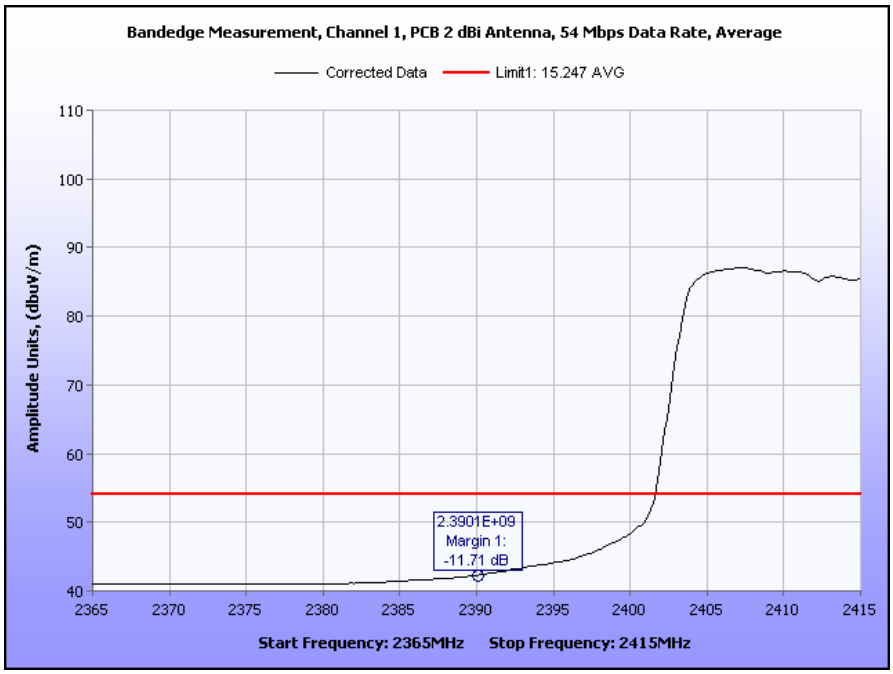


Plot 100. Restricted Band Edge, Channel 11, 5 dBi Antenna, 54 Mbps, Average

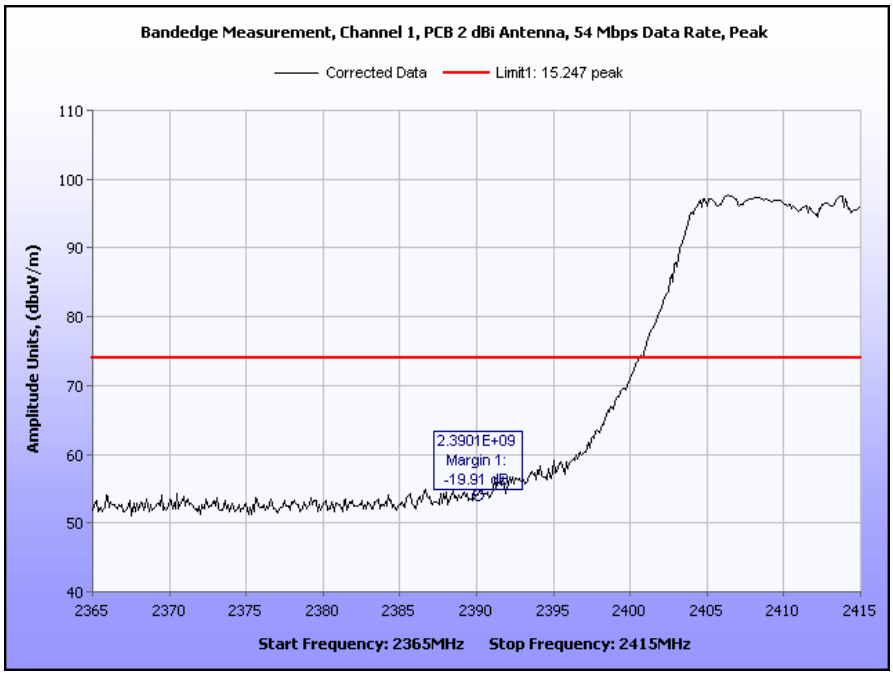


Plot 101. Restricted Band Edge, Channel 11, 5 dBi Antenna, 54 Mbps, Peak

Radiated Band Edge Measurements

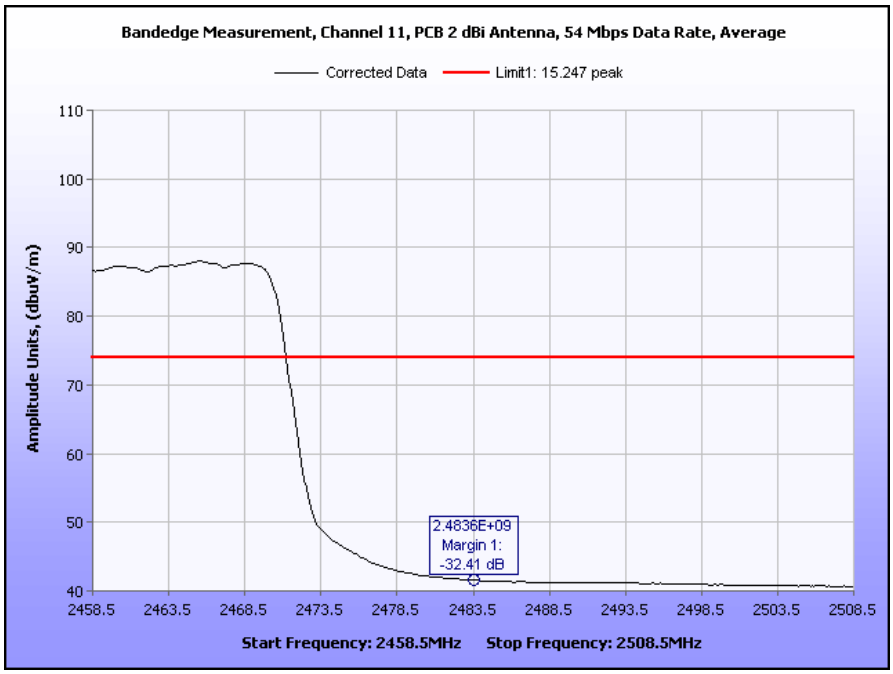


Plot 102. Restricted Band Edge, Channel 1, PCB, 2 dBi Antenna, 54 Mbps, Average

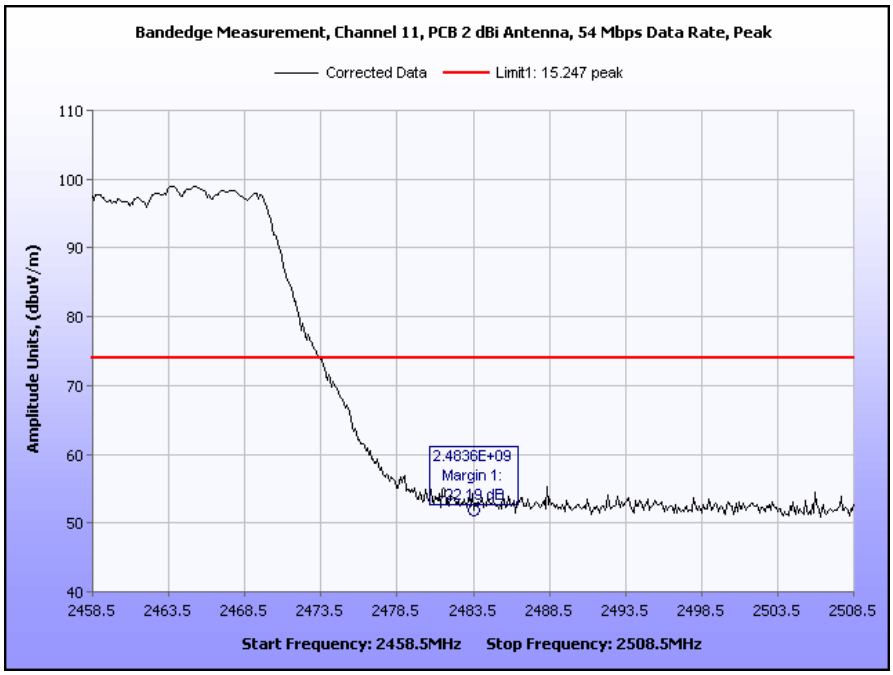


Plot 103. Restricted Band Edge, Channel 1, PCB, 2 dBi Antenna, 54 Mbps, Peak

Radiated Band Edge Measurements



Plot 104. Restricted Band Edge, Channel 11, PCB, 2 dBi Antenna, 54 Mbps, Average



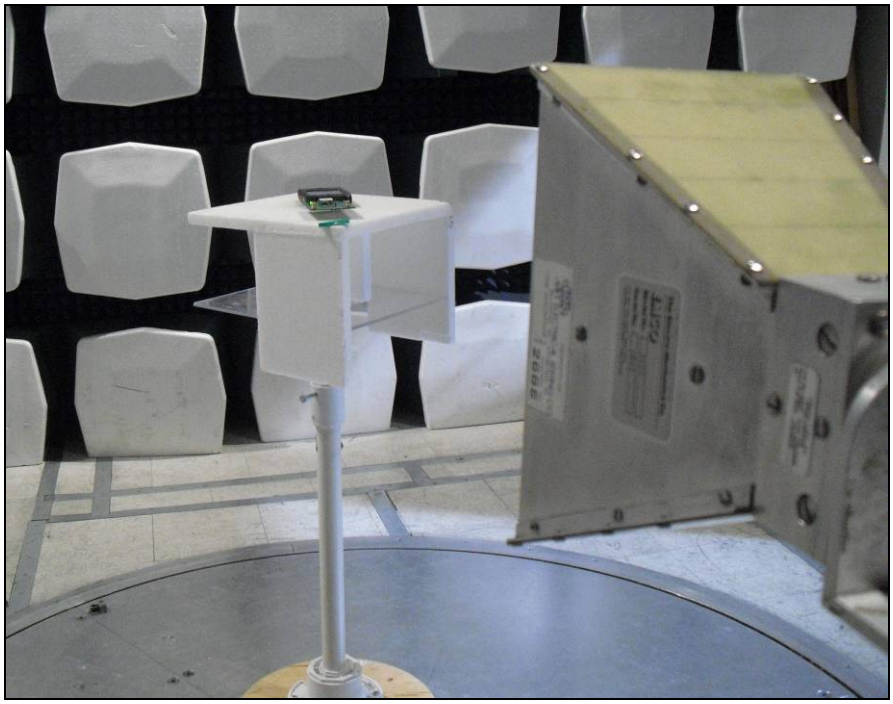
Plot 105. Restricted Band Edge, Channel 11, PCB, 2 dBi Antenna, 54 Mbps, Peak

Radiated Spurious Emissions Test Setup

Photograph 6. Restricted Band Edge, 2 dBi Antenna, Test Setup

Photograph 7. Restricted Band Edge, 5 dBi Antenna, Test Setup

Radiated Spurious Emissions Test Setup



Photograph 8. Restricted Band Edge, PCB, 2 dBi Antenna, Test Setup

Electromagnetic Compatibility Criteria for Intentional Radiators

RSS-GEN Receiver Spurious Emissions Requirements

Test Requirements: The following receiver spurious emission limits shall be complied with:

(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 25.

Spurious Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

Table 25. Spurious Emission Limits for Receivers

(b) If a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2 nanowatts per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5 nanowatts above 1 GHz.

Test Procedures: The EUT was programmed for receive mode only. Conducted measurements were taken at the antenna port of the EUT. A 9 kHz resolution bandwidth was used. All plots are corrected for cable loss.

Test Results: Equipment is compliant with the Receiver Spurious Emissions Requirements of RSS-GEN.

Test Engineer(s): Len Knight

Test Date(s): 04/12/10

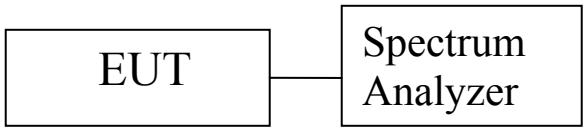
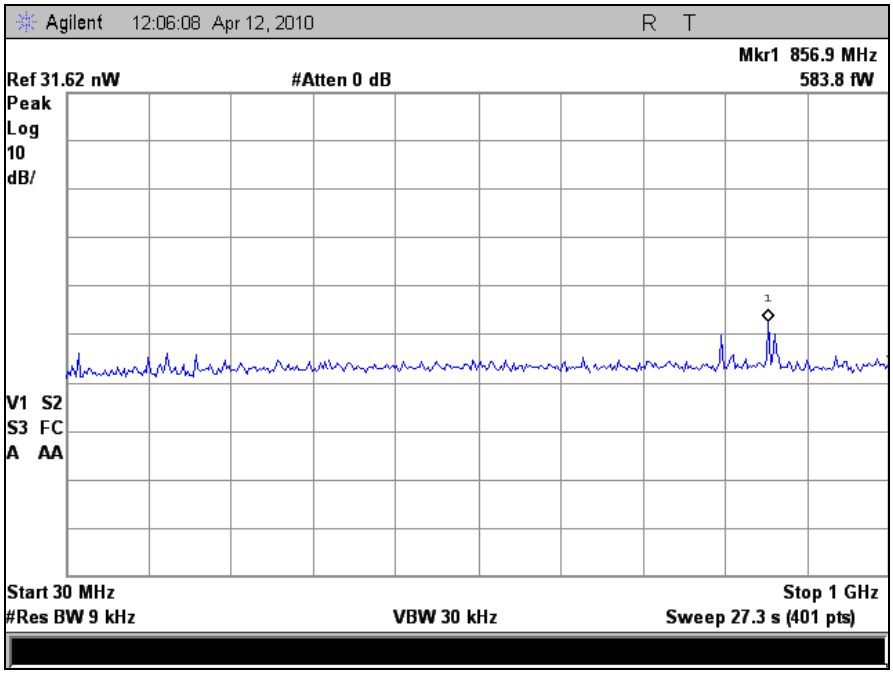
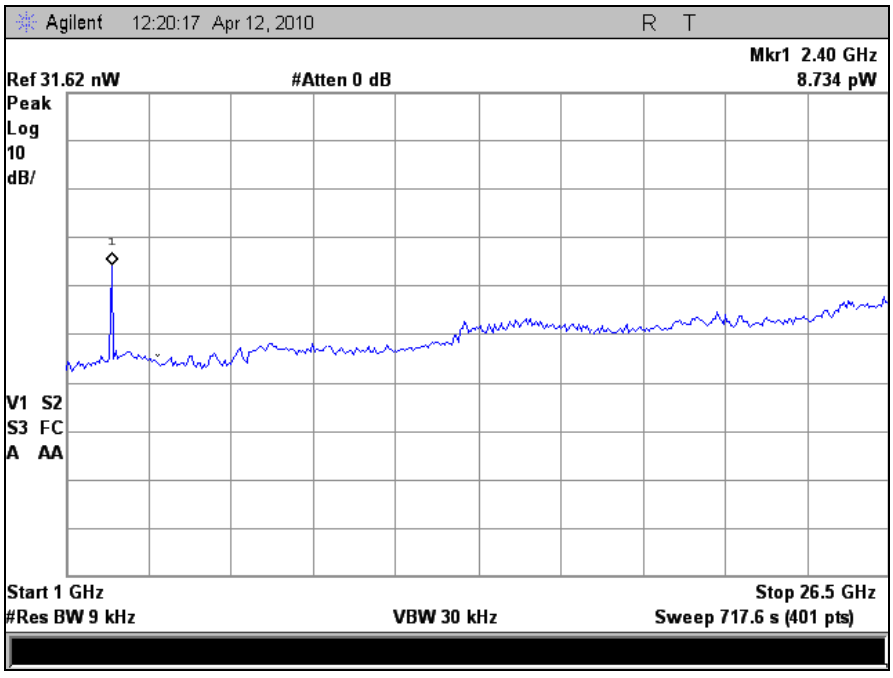


Figure 4. Block Diagram, Conducted Receiver Spurious Emissions Test Setup

Conducted Receiver Spurious Emissions



Plot 106. Receiver Spurious Emission, 30 MHz – 1 GHz



Plot 107. Receiver Spurious Emission, 1 GHz – 26.5 GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge

Test Requirement: **15.247(d)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at leas 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Test Procedure: For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

The antenna port of the EUT was connected to a spectrum analyzer. Measurements were made at low, mid, and high channel at 1 Mbps, 6 Mbps, and 54 Mbps data rates. The RBW was set at 100 kHz and the VBW was at 300 kHz.

See following pages for detailed test results with RF Conducted Spurious Emissions.

Test Results: The EUT was compliant with the Conducted Spurious Emission limits of **§15.247(d)**.

Test Engineer(s): Len Knight

Test Date(s): 01/26/10

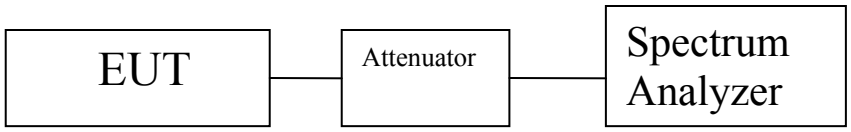
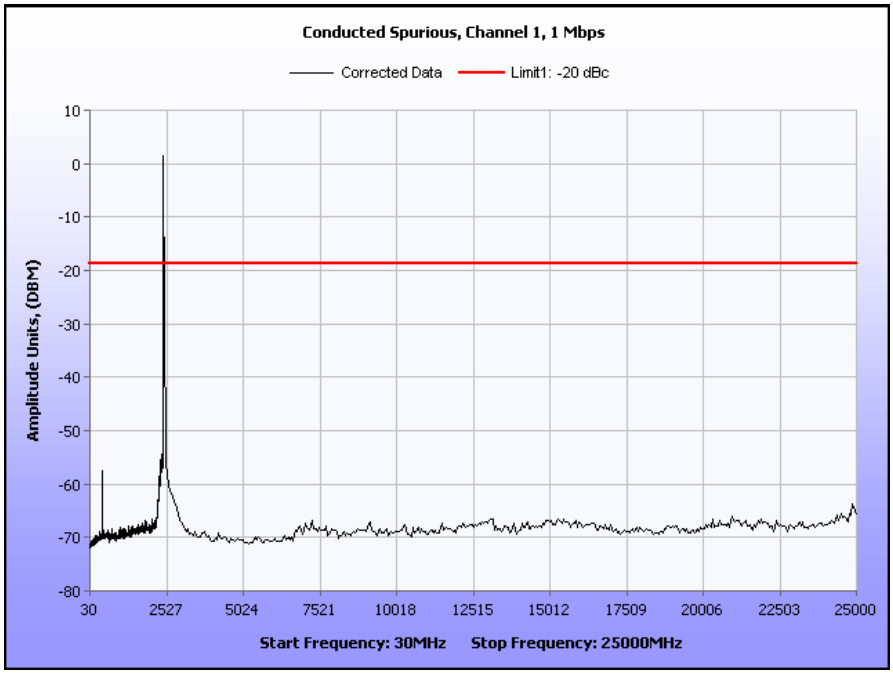
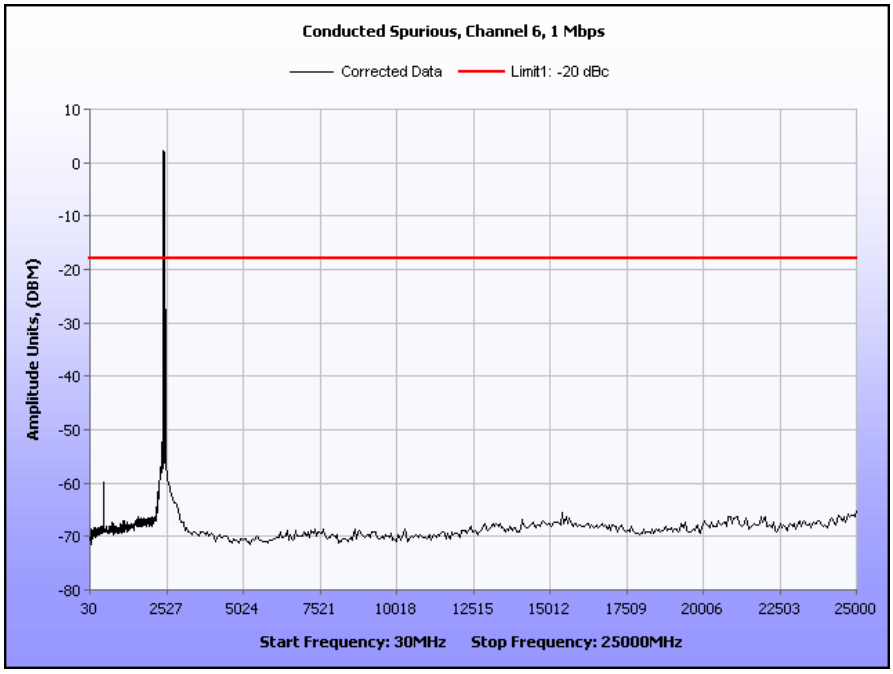


Figure 5. Block Diagram, Conducted Spurious Emissions Test Setup

Conducted Spurious Emissions Test Results

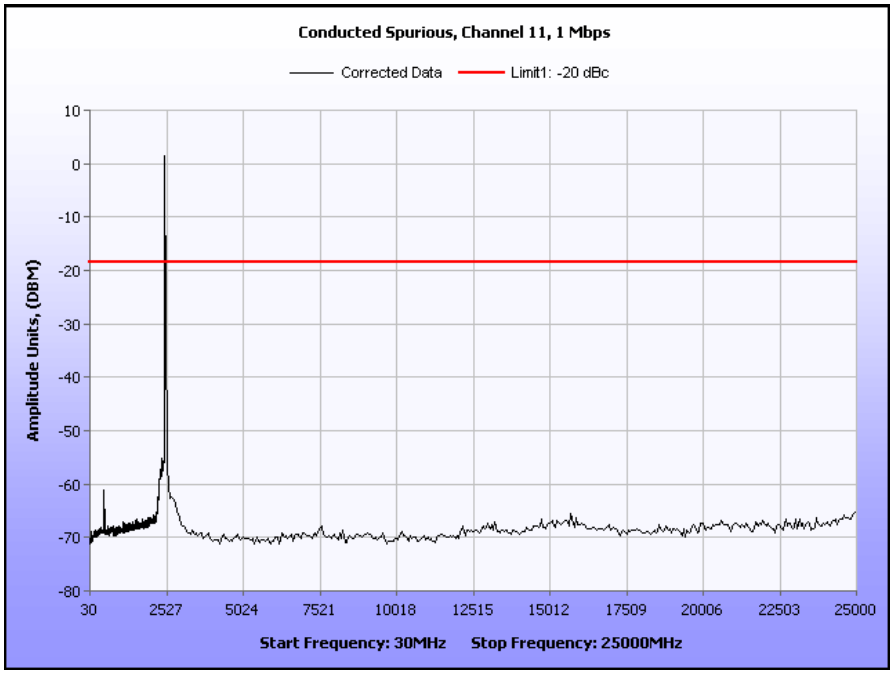


Plot 108. Conducted Emissions, Channel 1, 1 Mbps

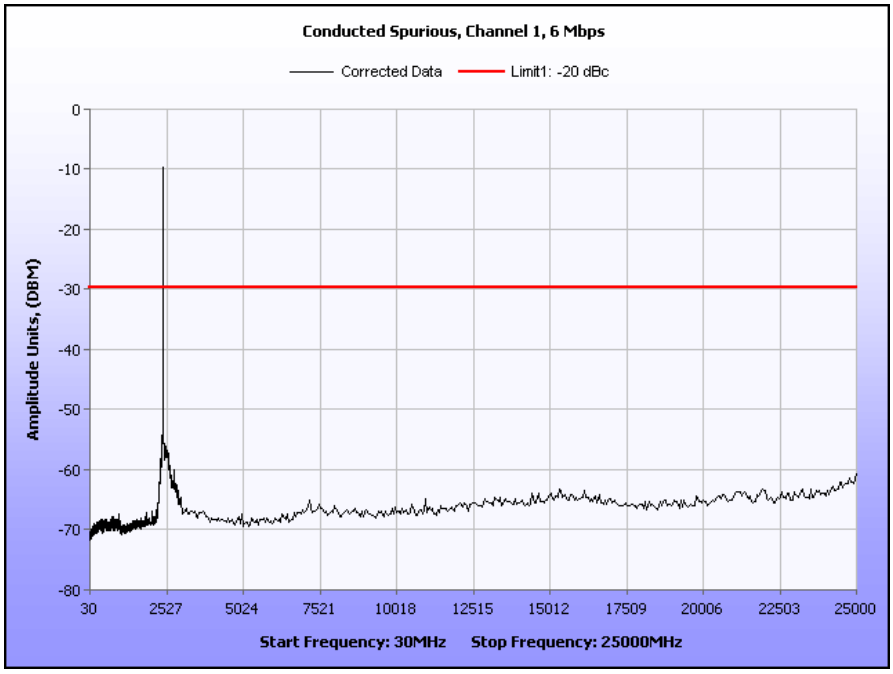


Plot 109. Conducted Emissions, Channel 6, 1 Mbps

Conducted Spurious Emissions Test Results

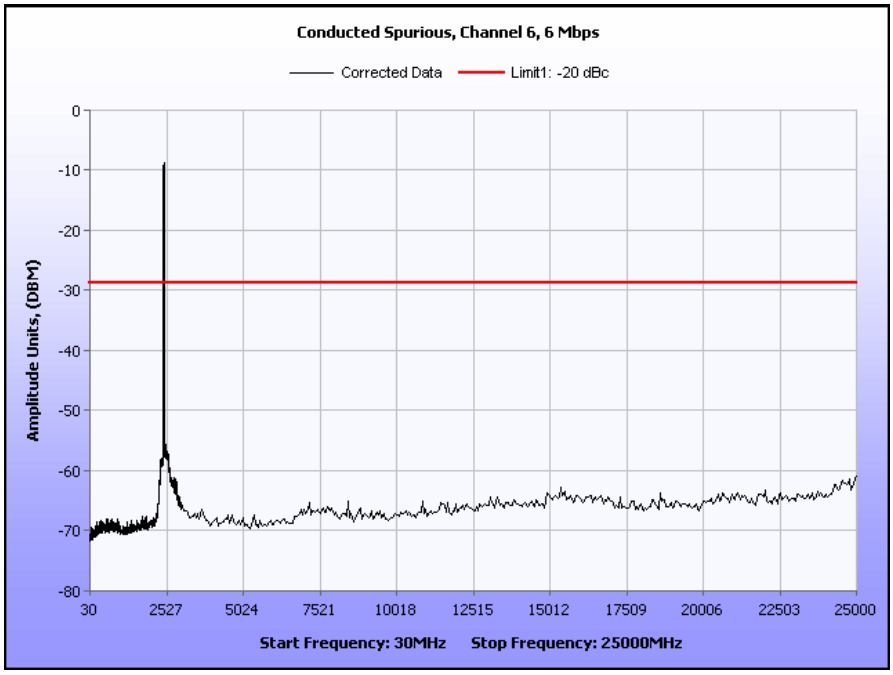


Plot 110. Conducted Emissions, Channel 11, 1 Mbps

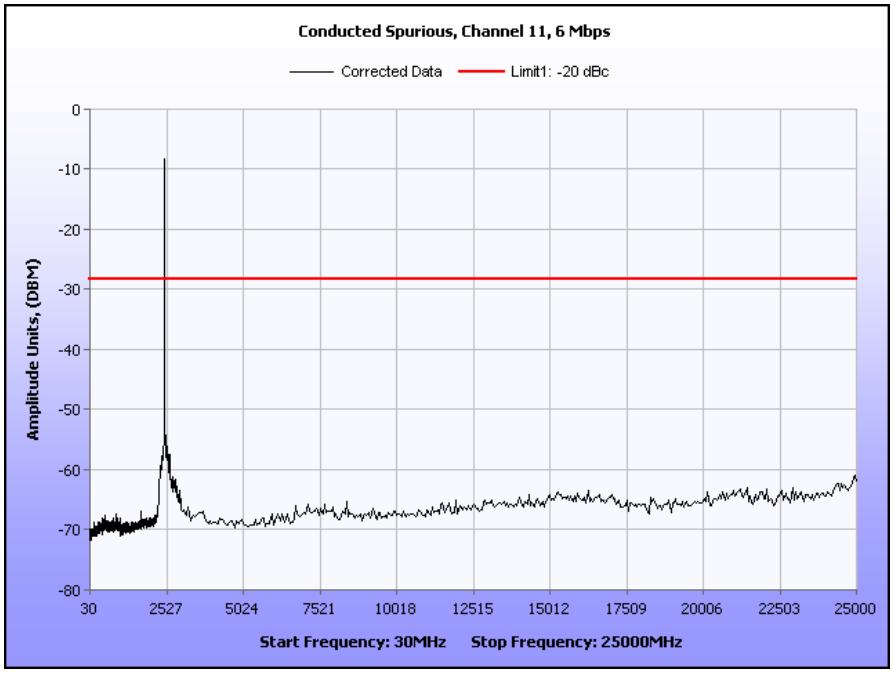


Plot 111. Conducted Emissions, Channel 1, 6 Mbps

Conducted Spurious Emissions Test Results

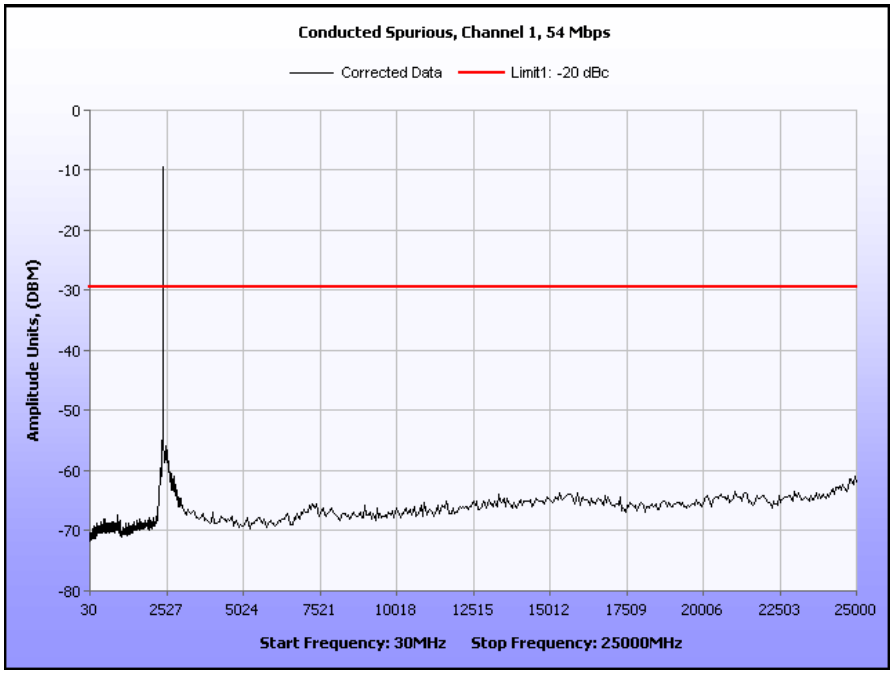


Plot 112. Conducted Emissions, Channel 6, 6 Mbps

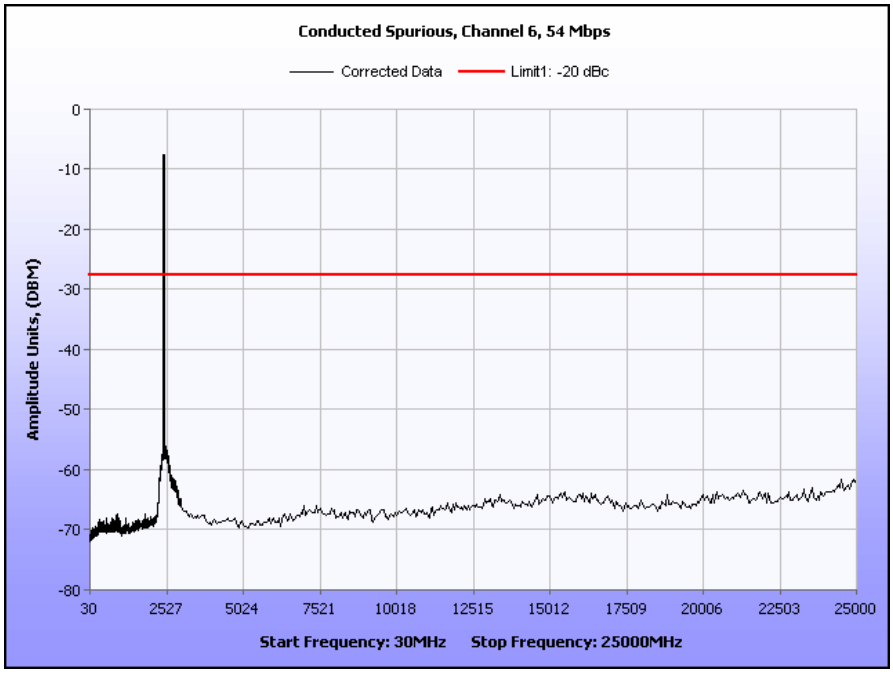


Plot 113. Conducted Emissions, Channel 11, 6 Mbps

Conducted Spurious Emissions Test Results

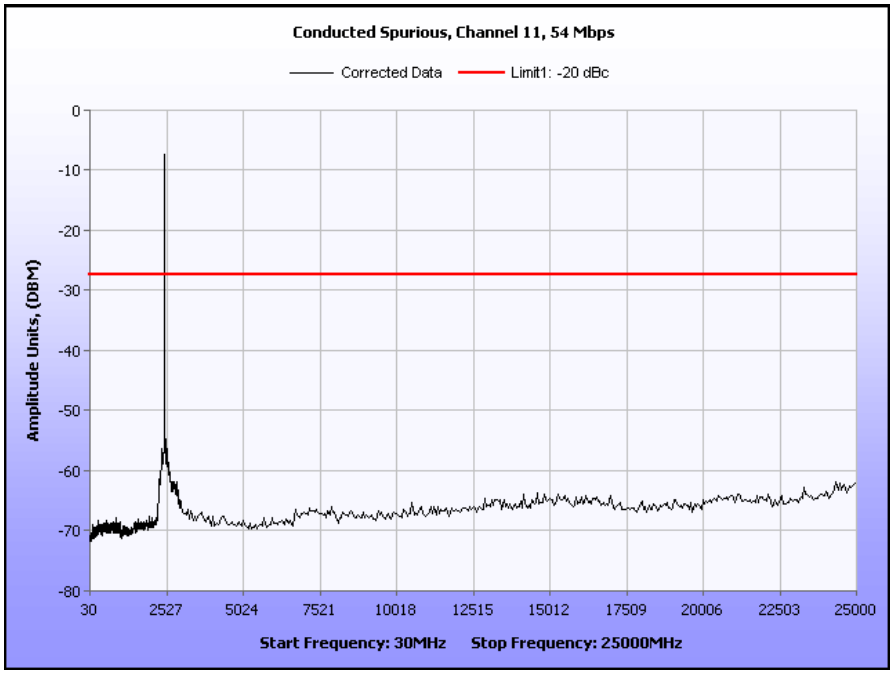


Plot 114. Conducted Emissions, Channel 1, 54 Mbps



Plot 115. Conducted Emissions, Channel 6, 54 Mbps

Conducted Spurious Emissions Test Results



Plot 116. Conducted Emissions, Channel 11, 54 Mbps

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(e) Peak Power Spectral Density

Test Requirements: **§15.247(e):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure: The transmitter was connected directly to a Spectrum Analyzer through an attenuator. The RBW was set to 3 kHz and a VBW set to 10 kHz. The spectrum analyzer was set to a sweep time span/RBW and with a peak detector. Measurements were carried out at the low, mid and high channels, and at 1 Mbps, 6 Mbps, and 54 Mbps data rates.

Test Results: The EUT was compliant with the peak power spectral density limits of **§ 15.247 (e)**.

The peak power spectral density was determined from plots on the following page(s).

Test Engineer: Len Knight

Test Date: 01/25/10

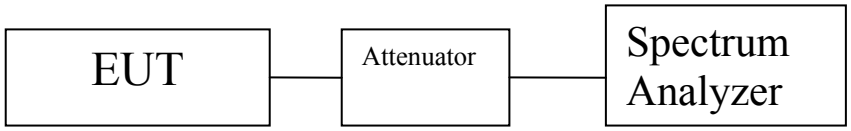


Figure 6. Block Diagram, Peak Power Spectral Density Test Setup

Peak Power Spectral Density Test Results

Mode Tested	Band	Channel	Measured Power Spectral Density (dB)	Test Limit (dBm)
1 Mbps	LOW	1	-20.04	8
	MID	6	-20.25	8
	HIGH	11	-19.86	8

Table 26. Spectral Density, Test Results, 1 Mbps

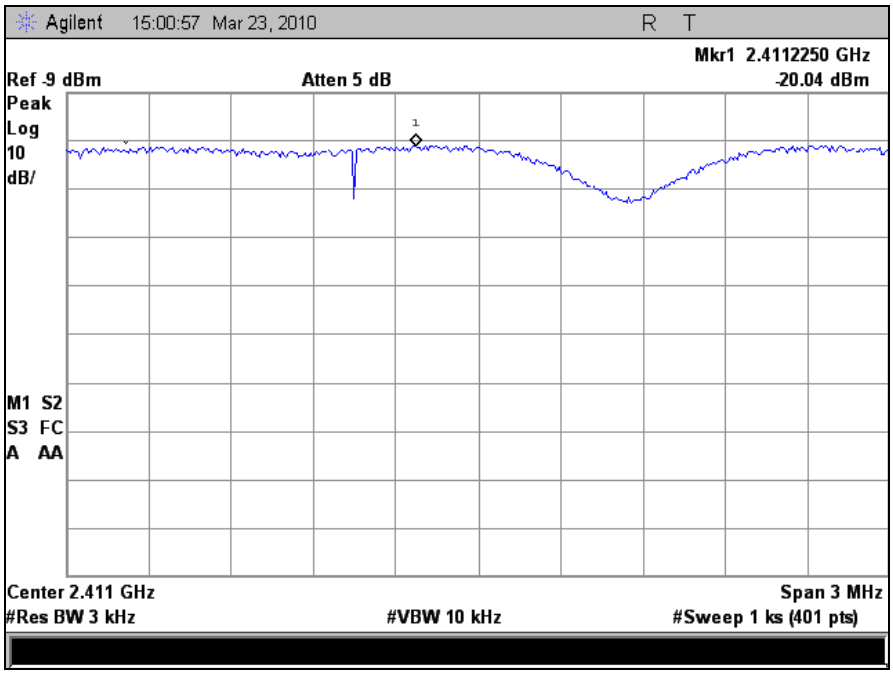
Mode Tested	Band	Channel	Measured Power Spectral Density (dB)	Test Limit (dBm)
6 Mbps	LOW	1	-23.31	8
	MID	6	-23.31	8
	HIGH	11	-23.08	8

Table 27. Spectral Density, Test Results, 6 Mbps

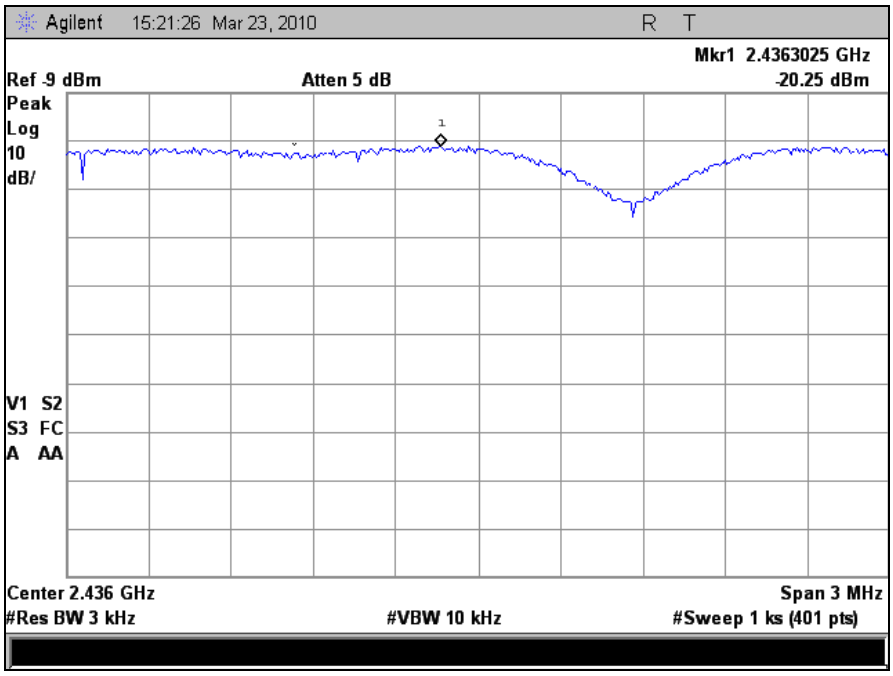
Mode Tested	Band	Channel	Measured Power Spectral Density (dB)	Test Limit (dBm)
54 Mbps	LOW	1	-22.58	8
	MID	6	-21.6	8
	HIGH	11	-21.94	8

Table 28. Spectral Density, Test Results, 54 Mbps

Peak Power Spectral Density

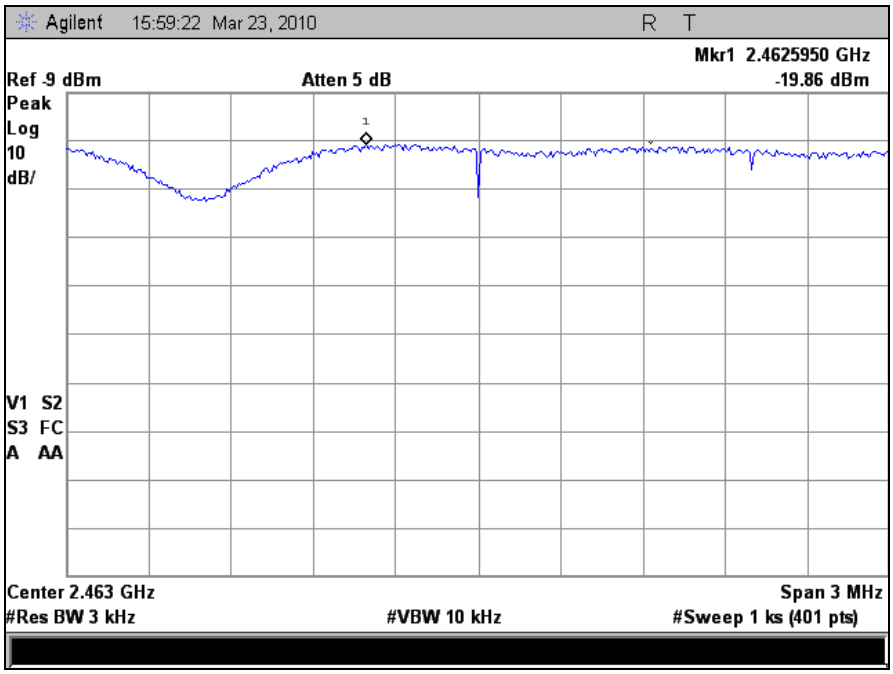


Plot 117. Peak Power Spectral Density, Channel 1, 1 Mbps

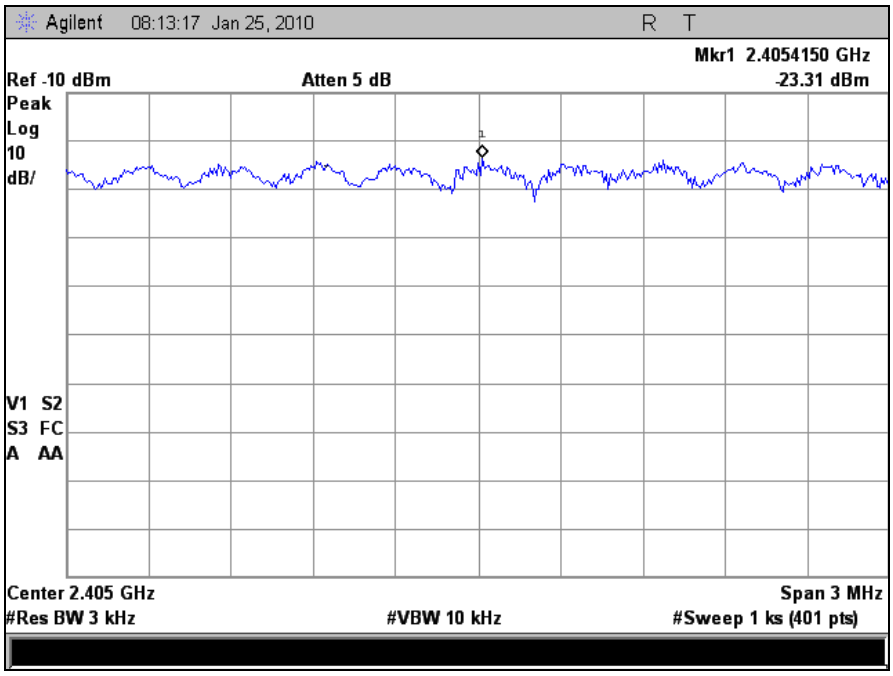


Plot 118. Peak Power Spectral Density, Channel 6, 1 Mbps

Peak Power Spectral Density

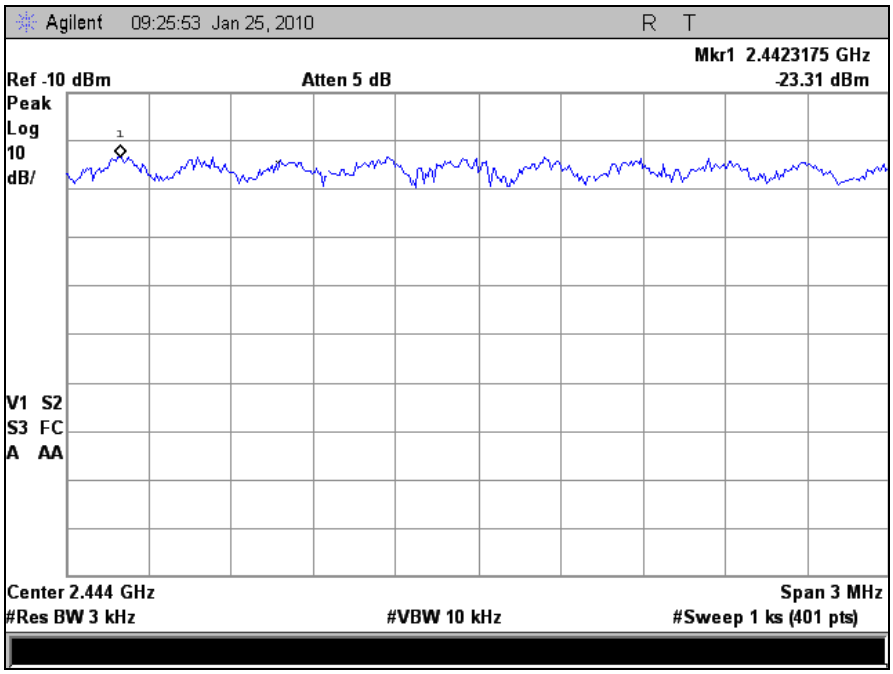


Plot 119. Peak Power Spectral Density, Channel 11, 1 Mbps

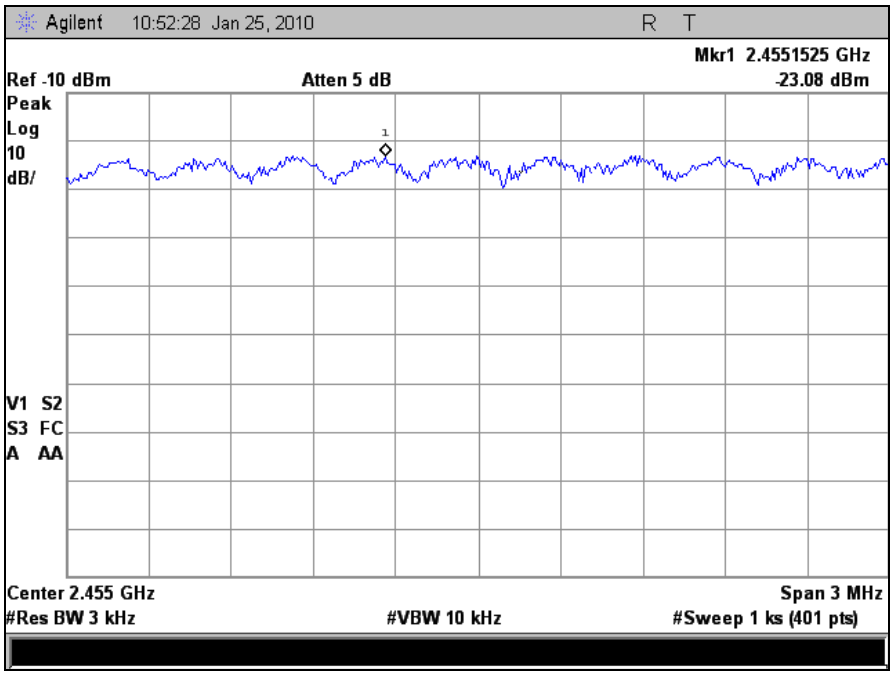


Plot 120. Peak Power Spectral Density, Channel 1, 6 Mbps

Peak Power Spectral Density

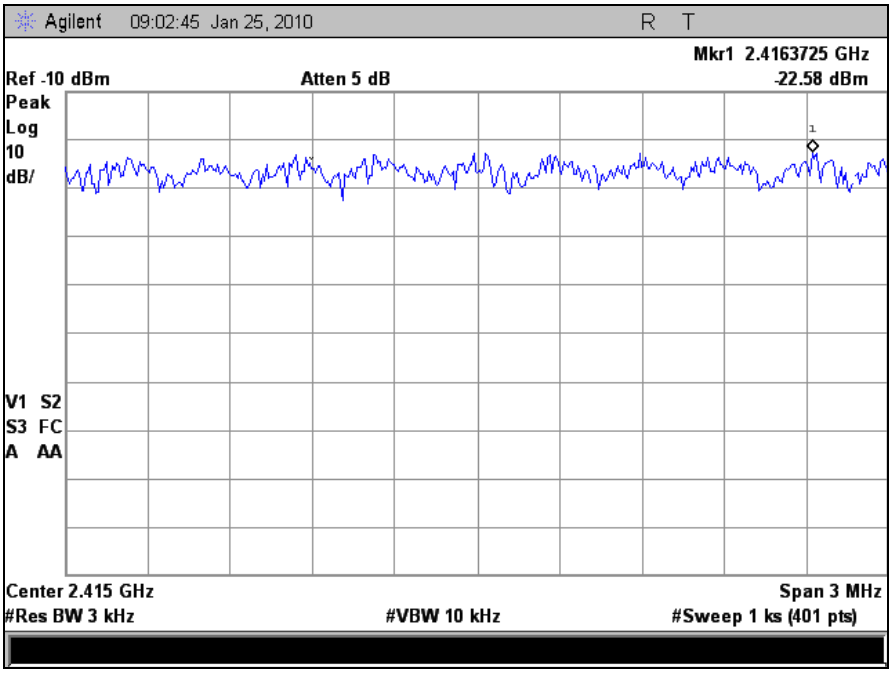


Plot 121. Peak Power Spectral Density, Channel 6, 6 Mbps

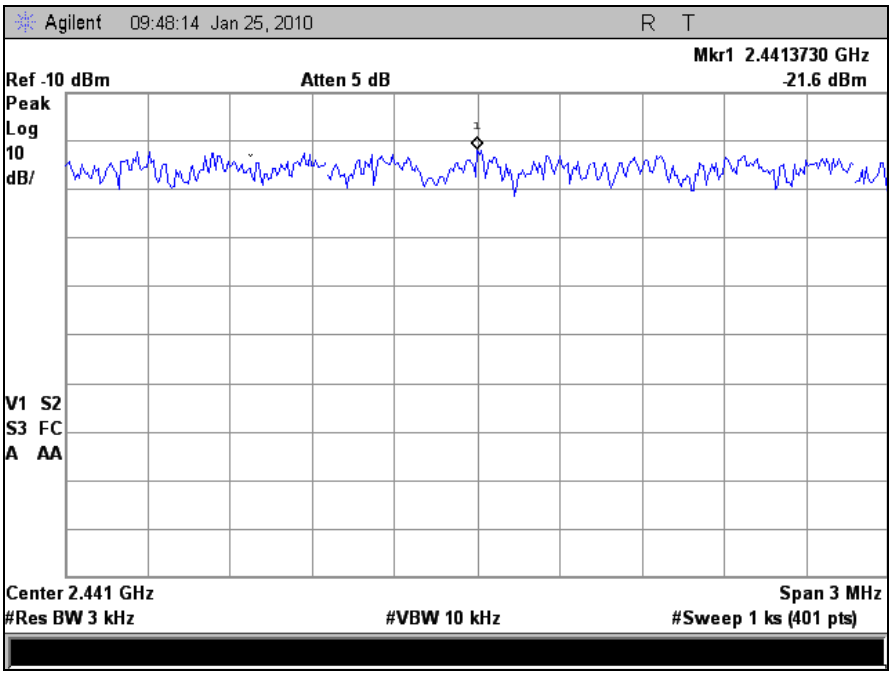


Plot 122. Peak Power Spectral Density, Channel 11, 6 Mbps

Peak Power Spectral Density

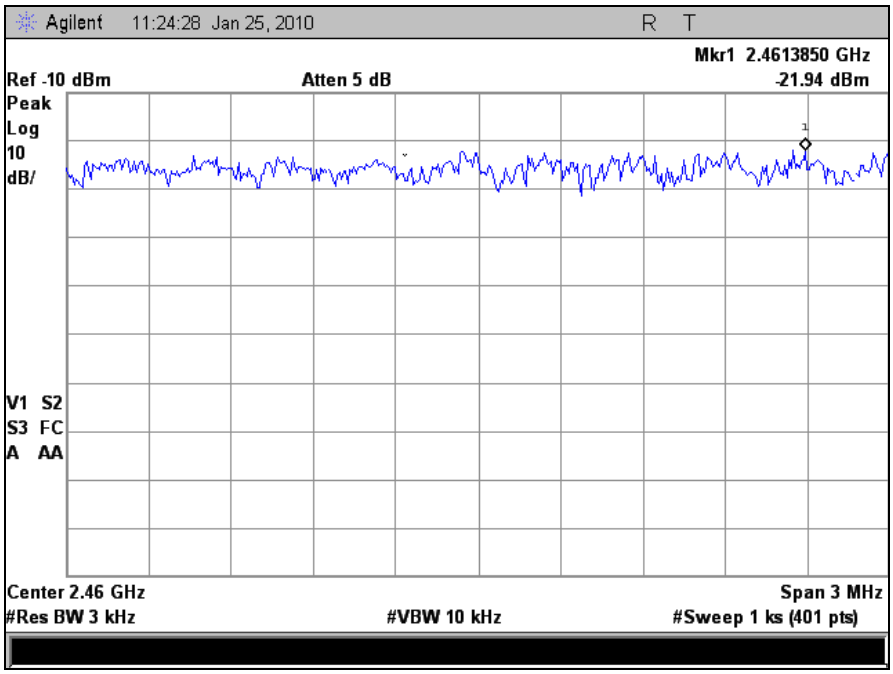


Plot 123. Peak Power Spectral Density, Channel 1, 54 Mbps



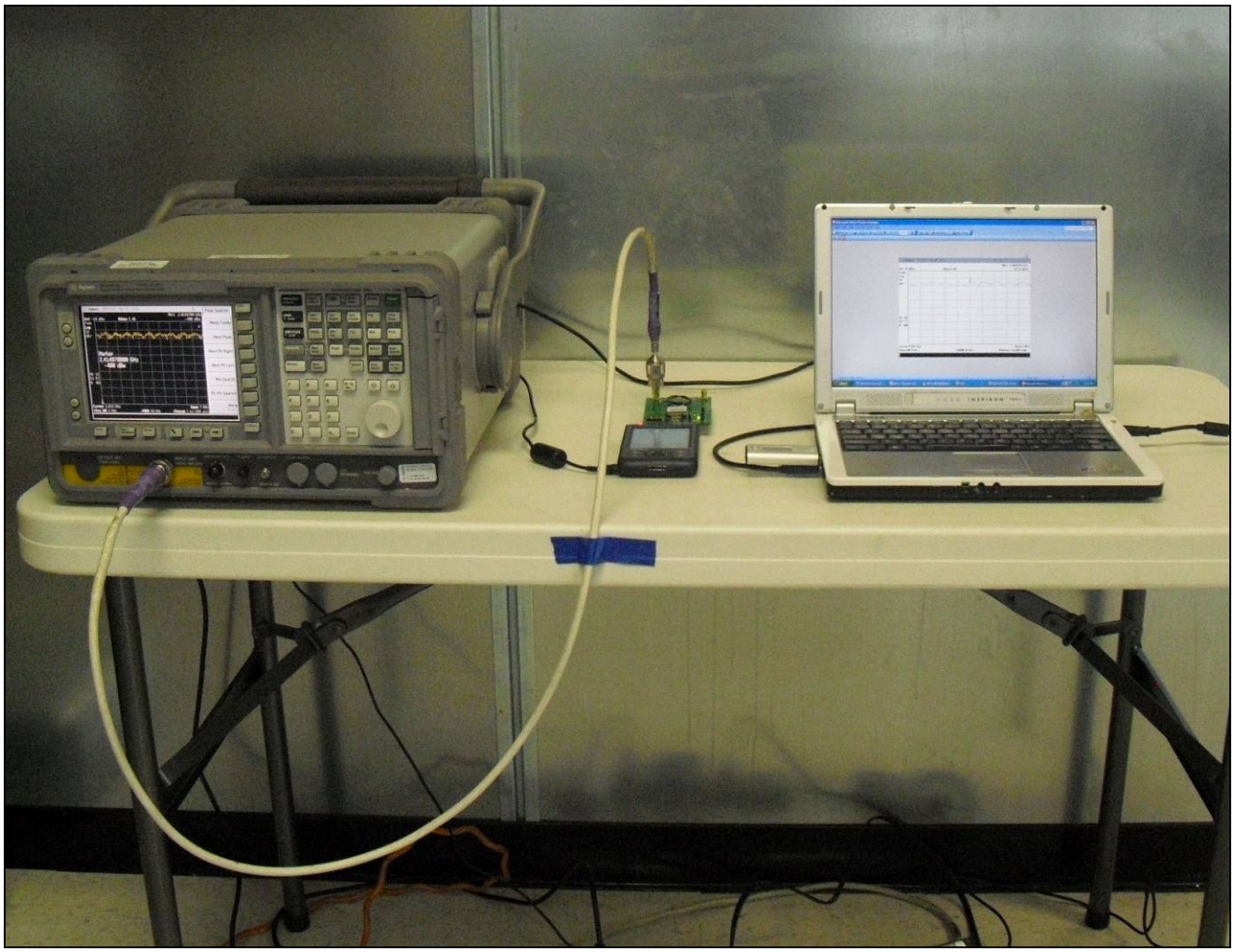
Plot 124. Peak Power Spectral Density, Channel 6, 54 Mbps

Peak Power Spectral Density



Plot 125. Peak Power Spectral Density, Channel 11, 54 Mbps

Peak Power Spectral Density, Test Setup



Photograph 9. Peak Power Spectral Density, Test Setup

IV. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	08/24/2007	08/24/2010
1T4303	ANTENNA; BILOG	SCHAFNER - CHASE EMC	CBL6140A	07/29/2009	07/29/2010
1T4568	RADIATING NOISE SOURCE	MET LABORATORIES	N/A	SEE NOTE	
1T4409	EMI RECEIVER	ROHDE & SCHWARZ	ESIB7	05/07/2009	05/07/2010
1T4619	THERMO-HYGROMETER	CONTROL COMPANY	S6-627-9	11/07/2008	11/07/2010
1T4565	LISN (24 AMP)	SOLAR ELECTRONICS	9252-50-R-24-BNC	10/14/2009	10/14/2010
1T4502	COMB GENERATOR	COM-POWER	CGC-255	09/23/2009	09/23/2010
1T4621	ESA-E SERIES SPECTRUM ANALYZER	AGILENT	E4402B	03/20/2009	03/20/2010
1T4578	THERMO/HYGROMETER	CONTROL COMPANY	S6-627-9	11/06/2008	11/06/2010
1T4214	SHIELD ROOM #4	UNIVERSAL SHIELD INC	N/A	SEE NOTE	
1T4612	ESA-E SERIES SPECTRUM ANALYZER	AGILENT	E4407B	09/09/2009	09/09/2010
1T4688	HORN ANTENNA	CUSTOM MICROWAVE, INC.	HO42S	SEE NOTE	
1T4592	RF FILTER KIT	VARIOUS	N/A	SEE NOTE	
1T2665	HORN ANTENNA	EMCO	3115	07/06/2009	07/06/2010
1T4442	PRE-AMPLIFIER, MICROWAVE	MITEQ	AFS42-01001800-30-10P	SEE NOTE	

Table 29. Test Equipment List

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

V. Certification & User's Manual Information

Certification & User's Manual Information

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.

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

(i) Compliance testing;

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

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

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

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

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

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

Certification & User's Manual Information

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

§ 2.901 Basis and Purpose

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

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

§ 2.907 Certification.

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

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

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

Certification & User's Manual Information

§ 2.948 Description of measurement facilities.

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

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

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

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

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

Certification & User's Manual Information

Label and User's Manual Information

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

§ 15.19 Labeling requirements.

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

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

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

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

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

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

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

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

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

§ 15.21 Information to user.

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

Verification & User's Manual Information

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

§ 15.105 Information to the user.

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

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

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

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

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

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

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

ICES-003 Procedural & Labeling Requirements

From the Industry Canada Electromagnetic Compatibility Advisory Bulletin entitled, "Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003" (EMCAB-3, Issue 2, July 1995):

> "At present, CISPR 22: 2002 and ICES technical requirements are essentially equivalent. Therefore, if you have CISPR 22: 2002 approval by meeting CISPR Publication 22, the only additional requirements are: to attach a note to the report of the test results for compliance, indicating that these results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations; to maintain these records on file for the requisite five year period; and to provide the device with a notice of compliance in accordance with ICES-003."

Procedural Requirements:

According to Industry Canada's Interference Causing Equipment Standard for Digital Apparatus ICES-003 Issue 4, February 2004:

Section 6.1: A record of the measurements and results, showing the date that the measurements were completed, shall be retained by the manufacturer or importer for a period of at least five years from the date shown in the record and made available for examination on the request of the Minister.

Section 6.2: A written notice indicating compliance must accompany each unit of digital apparatus to the end user. The notice shall be in the form of a label that is affixed to the apparatus. Where because of insufficient space or other constraints it is not feasible to affix a label to the apparatus, the notice may be in the form of a statement in the user's manual.

Labeling Requirements:

The suggested text for the notice, in English and in French, is provided below, from the Annex of ICES-003:

> This Class [2] digital apparatus complies with Canadian ICES-003.
>
> Cet appareil numérique de la classe [1] est conforme à la norme NMB-003 du Canada.

[2] Insert either A or B but not both as appropriate for the equipment requirements.

End of Report