NORTEL NETWORKS
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FCC Part 15, Subparts C & E, Class II Permissive Change Application

Industrie Canada RSS-210 Reassessment

EMI Test Report and Technical Documentation on Nortel 802.11 Access Point. Model: 2230

FCC ID: RVW2230
IC: 332R-2230

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General Information

Unit(s) Under Test: Nortel access point
Model: 2230
Product Description: IEEE 802.11A / B / G Access point

FCC ID: **RVW2230**

Tested For: Nortel Networks
4655 Great America Parkway
Santa Clara, CA, 95054, USA

Tested At: Elliott Laboratories
684 West Maude Ave
Sunnyvale, CA 94086

Tested By: Yalda Noor Test Engineer, Elliott Laboratories
David Waitt, (Independent Consultant)

Test Specifications: FCC CFR 47, Part Subpart E, (15 401 UNII)

Test Date: Nov / Dec 2004

Date of Original Grant: 26 March 2004

Initial Class II Permissive Change Granted: 29 Sept 2004

Requested Certification: Part 15 Subpart E Permissive Change Request

Reason for Permissive Change Request:

- Add additional external antennas for use with the AP
- Reclassify the band 5.725 to 5.825 GHz from UNII to ISM

Background Information from Original Application

Detailed Product Information / Operational Description

General Information

The Nortel radio is an IEEE 802.11 A / B /G Access point is intended to be professionally installed and configured in corporate and industrial environments.

The device utilizes a mini PCI module manufactured by an outside vendor. The module was certified with lower gain antennas and the manufacturer would not permit an outside company to request a permissive change to its grant. For this reason, Nortel is pursuing its own certification.

The device does not include a “Turbo” mode.

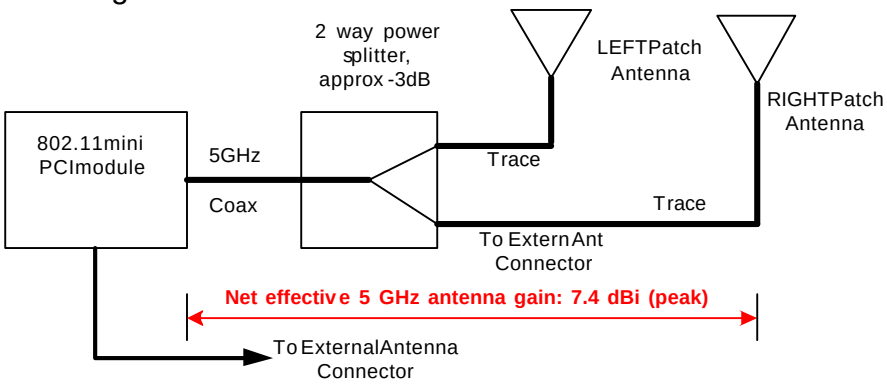
The access point is powered either by an external 48V power supply or via power over Ethernet.

Additionally, the device has been tested for compliance to the FCC Part 15 Class A limits. A report has been prepared and is on file at Nortel Internetworking Inc.

Internal / External Antenna Version

There is a version of the access point which allows the connection of an external 5 GHz antenna. This option can be selected by the configuration software. If an external 5 GHz antenna is used, it is permanently attached to the access point to meet FCC “Integral” antenna requirements and it is below 7.4 dBi net effective gain (antenna gain - cable loss) Note that in contrast to the internal antennas, only ONE external 5 GHz antenna can be used. The configuration software cannot be configured to rapidly switch between the internal and external antenna.

The only difference between the two versions is the inclusion of a short coax and external connector in the housing.



5 GHz RF Path Block Diagram (Internal / External Antenna Version)

Class II Permissive Change Request Information

Nortel wishes to authorize the use of additional external antennas with the access point. The specific antennas are outlined below, and these antennas will be offered to the users of the access point by Nortel. However, additional antennas may be used providing that they are of the same type of antenna (omni) and equal or lower gain than the antennas below.

All of the antennas tested are complaint with 15.203 since the access point utilizes R-TNC external antenna connectors.

The table below summarizes the additional 5 GHz antennas to be used with the access point. Test data was recorded for two of the three antennas. Data was not gathered for the RTN5150MRA antenna since it is of the same type as the other two antennae and is of lower gain.

Note that all of these antennas have lower gain than the unit was originally certified with. The difference is in the type of antenna used.

Cushcraft Part Number	Freq Range (GHz)	Gain (dBi)	Antenna Type	Description	Tested
S5153BHN36RTN	5.15 - 5.35	4.3	Dipole	Co-located dipoles	YES
S5703BHN36RTN	5.725 - 5.875	4.3	Dipole	Co-located dipoles	YES
RTN5150MRA	5.15 - 5.850	2.1	Dipole	Dipole	NO

The following tests were conducted for the S5153BHN36RTN and S5703PN36RTN antennas. Additionally, the tests were performed at the same RF transmit power level as specified in the original Grant of Authorization.

TEST	Performed (Y / N)	Justification
Radiated emissions in Restricted bands / Out of band emissions	Y	It is reasonable to assume that the radiated emissions performance of the AP may be affected by utilizing an different antenna
Power Spectral Density (ISM)	N	The power spectral density limit for an ISM device is not an EIRP limit, therefore compliance would not be affected with a different antenna.
Power Spectral Density (UNII)	Y	The power spectral density specification is a EIRP limit, therefore, with the addition of different antennas, PSD must be re-measured
RF Transmit power	N	While the transmit power was verified for the radiated emissions testing, to ensure it is the same as the original grant, it is not presented in this report
Bandwidth	N	There is no reason to expect that the use of a different antenna would affect the bandwidth of the signal
Line Conducted Emissions	N	There is no reason to expect that the use of a different antenna would affect the AC line conducted emissions of the access point
Peak Excursion	N	There is no reason to expect that the use of a different antenna would affect the peak excursion of the access point

5825 MHz Operation

A permissive change request to the original certification was granted on 29 Sept 2004. This change added the ISM channel #165 at 5.825 GHz to the allowable operating frequencies of the access point.

With this permissive change, Nortel wishes to re-classify the device for the band 5.725 to 5.825 as ISM from UNII.

The data for the 5.725 to 5.825 GHz band is included in this report along with the test data for the UNII frequencies (5.15 to 5.35 GHz). The limits presented are the applicable ISM (15.247)or UNII (15.407) limits.

The ISM and the UNII data is presented in this report simply to group together the 802.11-A data into one concise report.

Due to the operation on 5825 MHz the test channels used to verify compliance for this permissive change are shown below.

UNII 802.11 A	
5.15 – 5.25 GHz & 5.25 – 5.35 GHz	
Channel	Freq(MHz)
Low	5180
Mid	5260
High	5320

UNII / ISM 802.11 A	
5.725 - 5.850 GHz	
Channel	Freq(MHz)
Low	5745
Mid	5785
High	5825

Report Organization and Results Summary

This report presents the results of the tests that verify compliance with FCC Part 15.401 abd FCC Part 15.247. The results are grouped together in this single report only to consolidate the 802.11 A test results in one report.

A brief results summary of all the in this report is below.

Part 15 Paragraph	**Test**	**Results**
15.407(a)(5)	Power Spectral Density	3.29 dB below Limit
15.407(b)(1) 15.209	Out of Band Emissions	0.1 dB below Limit
15.205	Restricted band emissions	0.4 dB below limit

Test Facilities

All of the certification tests were performed at:

Elliott Labs
684 West Maude Ave
Sunnyvale, CA 94086

General:

Final radiated test measurements were taken in Nov / Dec 2004 at Elliott Laboratories semi anechoic chamber #5. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

OATS:

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated emissions are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 Guidelines.

Antenna, Antenna Mast and Turntable

The Horn antennas that are use to measure radiated emissions above 1000MHz are amounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

ANSI C63.4 specifies that the test height above the ground plane shall be 80cm unless the equipment is intended to be floor mounted. During the radiated emissions tests the equipment is positioned on a motorized turntable in conformance with the ANSI requirement.

Equipment Lists

Instrument Calibration

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles.

The following test equipment was used to perform the testing

Elliott Test Equipment

Manufacturer	Description	Model #	Asset #	Cal Due
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263	08-Jan-05
Hewlett Packard	EMC Spectrum Analyzer 9KHz-26.5GHz, non programmable	8563E	284	15-Mar-05
ETS-Lindgren	Horn Antenna, D. Ridge 1-18GHz	3117	1662	30-Mar-05

Additional Test Equipment

Item Desc.	Manufacturer	Model	S/N	Cal due date
Spectrum Analyzer	Agilent	E4404B	US40521093	3 Sep 05

Test Methods

Many of the tests are performed at a low, middle and high channel of the applicable band The typical frequencies used for the test for each band are listed below. Where applicable, the test procedures outlined in FCC Public notice DA 02-2138 (30 Aug 2002) were used.

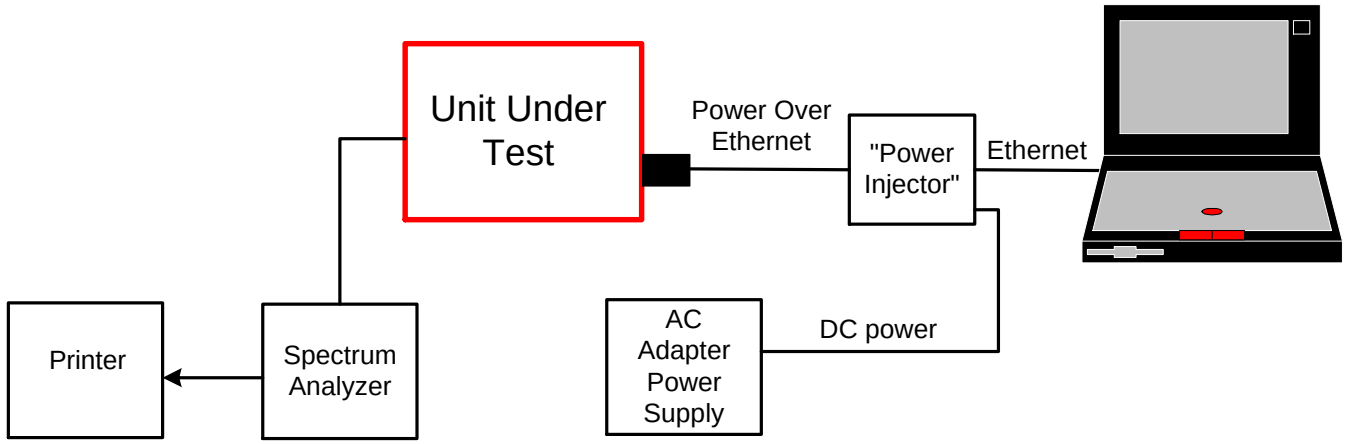
UNII 802.11 A	
5.15 – 5.25 GHz & 5.25 – 5.35 GHz	
Channel	Freq(MHz)
Low	5180
Mid	5260
High	5320

ISM 802.11 A	
5.725 5.850 GHz	
Channel	Freq(MHz)
Low	5745
Mid	5785
High	5825

In order to comply with the “radiated emissions in restricted bands” requirements the transmit power had to be lowered on some of the channels at the edges of the band. The maximum power setting that yielded compliance with the radiated emissions requirements will be programmed into the configuration firmware of the access point ensuring that maximum possible power setting will be correct for each channel. Given that the access point will normally be operated at these power settings, they were also used during the “bench top” conducted RF tests (spectral density, bandwidth etc).

The tests listed below are performed using the basic test setup shown below. In several cases, the EUT was running special diagnostic firmware to allow it to transmit random data on a particular channel indefinitely.

Part 15	**Test**
15.407(a)(5)	Power Spectral Density



Basic Conducted RF Bench Test Setup

Unless otherwise noted, the support equipment for the bench tests is listed below.

Support Equipment				
Description	Model number	FCC ID or SN	Manufacturer	Power Cable
Laptop	Thinkpad	--	IBM	Laptop PS
Test Software	Atheros Radio Test		Atheros	
48VDC AC adapter	Generic		Generic	Standard Twin lead DC wire

Test Results

Detailed test procedures and test results are contained in the following sections. In cases where the test setup differs from the Conducted RF test setup shown earlier, the test setup is also presented.

Test Conditions			
Temperature	23 C	**Humidity:**	43%
ATM pressure	1020 mBar	**Grounding:**	None
Tested By	David Waitt / Y Noor	**Date of Test:**	Nov / Dec 2004
Test Reference	Refer to individual test results		
Tested Range	Test Dependent		
Test Voltage	48 VDC to the access point		
Modifications	No modifications were made to the unit during the tests		

802.11 A Maximum RF Power Output at Antenna Terminals

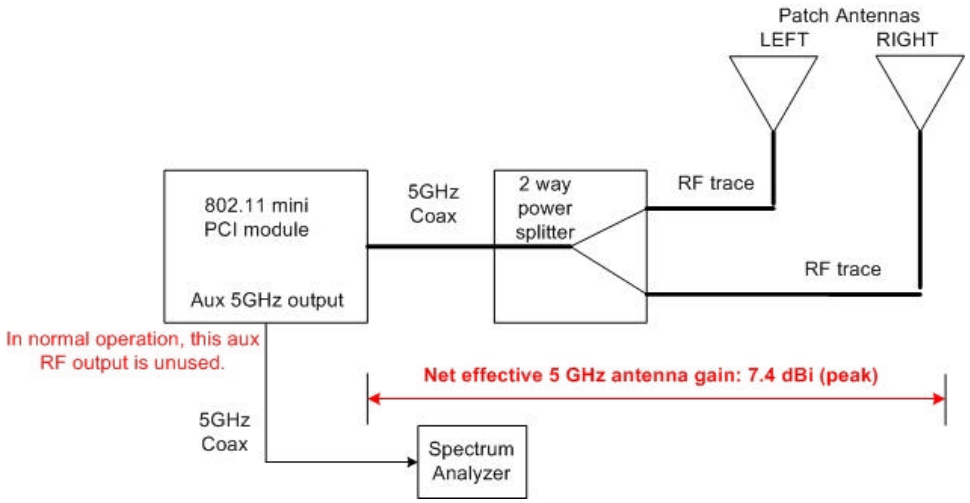
(For Reference only from original certification test report - edited)

Specifications:

FCC Specification: Paragraph(s): 15.401(a)(1), 15.401(a)(2), 15.401(a)(3)

Procedure:

The test was conducted by connecting the secondary output of the 802.11 module directly to a spectrum analyzer. This measured power is therefore the same level that will be present at the input of the FET antenna switch under normal operation.



The unit was tuned to the test channels and configured to transmit continuous random data packets. The integrated power over the 26 dB bandwidth was read directly off the spectrum analyzer

RF Transmit Power Result:

Pout settings Vs. Channel	Frequency (MHz)	Spec (dBm) into 6 dBi	Msrd 26 dB Chan power from module (dBm/26 dB BW)	Pwr into antenna after power divider (- 3dB) (dBm)	Pwr into antenna (mWatts)
5 GHz UNII upper	5745.00	30	20.9	17.9	61.66
	5765.00	30	20.3	17.3	53.70
	5805.00	30	19.0	16.0	39.80
5 GHz UNII lower	5180.00	17	14.8	11.8	15.13
	5240.00	17	15.5	12.5	17.78
	5260.00	24	17.3	14.3	26.91
	5320.00	24	14.1	11.1	12.88

RF Power Output for 5825 MHz

This frequency was not tested as part of the initial certification therefore the RF transmit power was not reported in the initial test report. The transmit power was measured for a previous Class II Permissive change that added operation on5825 MHz to the initial grant. The table below is from the permissive change test report.

Pout settings Vs. Channel	Frequency (MHz)	Spec (dBm) into 6 dBi	Msrd Chan power from module (dBm/ 30 MHzBW)	Pwr into antenna after power divider (- 3dB) (dBm)	Pwr into each antenna (mWatts)
5 GHz ISM	5825	30	**17. 35**	14.35	27.227

5 GHz Power Spectral Density

Specification

FCC Specification: Paragraph 15.407(a)(5)

Procedure:

The test setup was configured as shown in the conducted test setup. The UUT was configured to continuously transmit random data packets. Initially the bandwidth of the entire channel was examined. Using MAX HOLD and peak search, the frequency with the maximum power was determined.

The measurements were made using RBW = 1MHz, VBW = 1MHz, video averaging on. The peak PSD of -4 dBm/MHz did not exceed the maximum permitted average PSD in any band, (Peak PSD limits have an additional 6 dB) so no restriction are placed on the output power or average PSD)

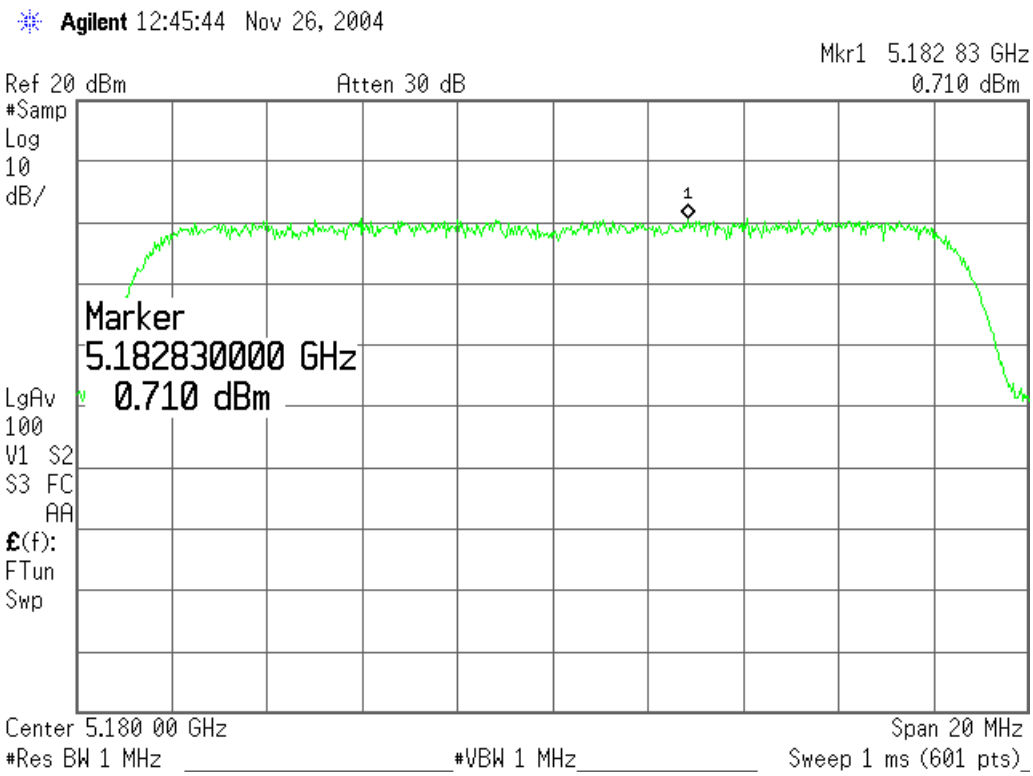
The power spectral density was measured on the designated test channels with the appropriate power setting for the given test channel.

Note that the frequency 5825MHz was measured relative to the PSD limit in FCC Part 15.247. Other test channels were tested to the limits in 15.407.

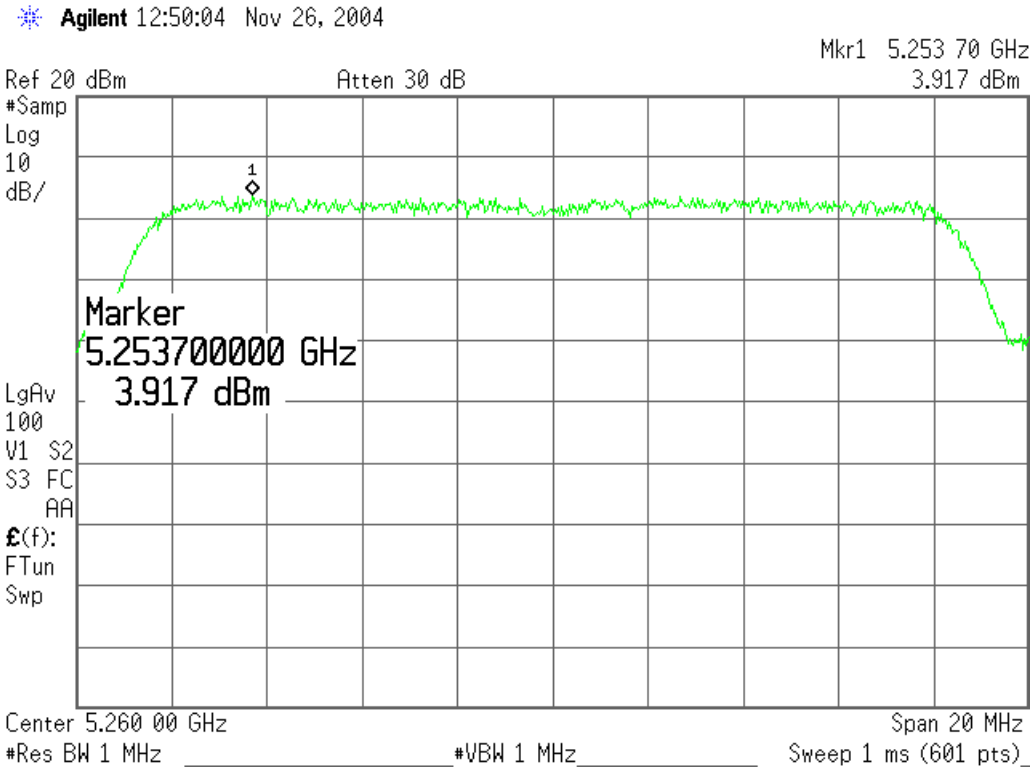
Results:

Frequency (MHz)	Antenna	Antenna Gain (dBi)	Measured FCC P.S.D. (dBm/MHz)	FCC Limit (dBm/MHz)	Margin (dB)
5180	S5153BHN36RTN	5	0.71	4	3.29
5260	S5153BHN36RTN	5	3.92	11	7.08
5320	S5153BHN36RTN	5	0.28	11	10.72

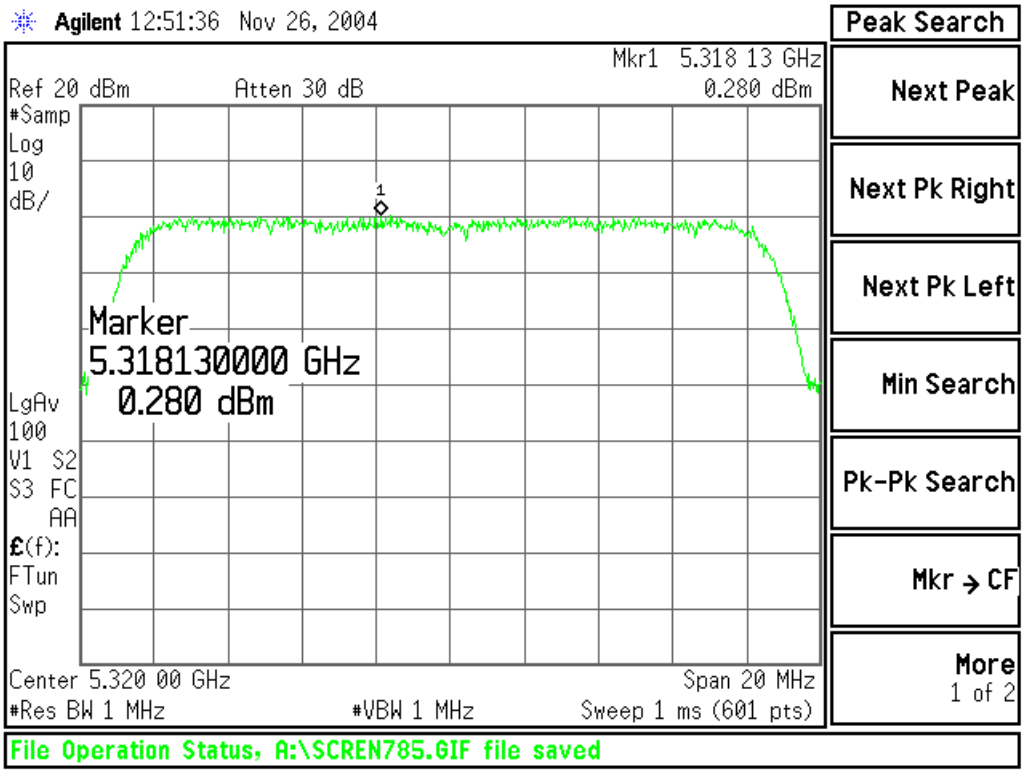
PSD @ 5180MHz
UNII limit of
4dBm/MHz applies
(#784)



PSD @ 5260MHz
UNII limit of
11dBm/MHz applies
(#785)



PSD @ 5320MHz (#786)
UNII limit of 11 dBm/MHz applies



Out of Band Emissions / Radiated Emissions in Restricted bands

Specification:

FCC Specification: Paragraph 15.407(b)(6)

Procedure:

This test was conducted on a 3-meter semi anechoic chamber site at Elliott Laboratories The unit was placed on a rotating wooden table 80cm above the ground plane. A Horn antenna(s) were secured to a mast 3 meters away. The unit was tested at each of the Low, Mid and High channels. The UUT was running in the diagnostic mode and set to transmit random data. The transmit power was set to the settings outlined in the power setting table. The test equipment was configured as shown below.

The band from 1 to 40 GHz was scanned (40 GHz is the limit of the available test equipment). A high pass filter prior to the pre-amplifier was required to prevent the signal level of the fundamental frequency from overloading the front end of the spectrum analyzer and creating harmonics within the analyzer.

The EUT was rotated 360 degrees and the height of the antenna adjusted from 1 to 4 meters above the ground plane to determine the maximum level of the emission. The level of the harmonic emission was measured in two modes, “Peak” and “Average” .

The spectrum analyzer reading was entered into a spreadsheet where correction factors (antenna factor, cable loss, pre-amplifier gain, HPF loss...) were then applied by Elliott Lab’s Software to obtain a final corrected measurement.

This procedure was repeated for the low mid and high channels across the 5 GHz bands.

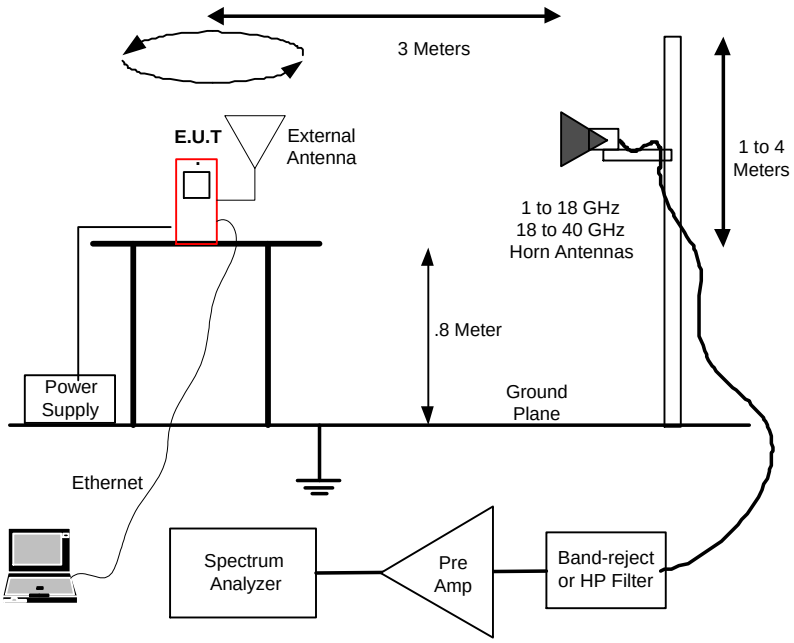
Fund	2	3	4	5	6	7	8	9	10
5180	**10360**	**15540**	20720	25900	31080	36260	**41440**	**46620**	**51800**
5260	**10520**	**15780**	21040	26300	**31560**	36820	**42080**	**47340**	**52600**
5320	**10640**	**15960**	21280	26600	31920	**37240**	**42560**	**47880**	**53200**
5745	**11490**	17235	**22980**	28725	34470	**40215**	**45960**	**51705**	**57450**
5765	**11530**	17295	**23060**	28825	34590	**40355**	**46120**	**51885**	**57650**
5805	**11610**	17415	**23220**	29025	34830	**40635**	**46440**	**52245**	**58050**

15.407(b)(6) Harmonic test table

*NOTE: **RED** indicates a harmonic that falls within a restricted band, the harmonics in **gray** are NOT in restricted bands.*

Test Setup

Radiated Emissions in Restricted Bands Test Setup



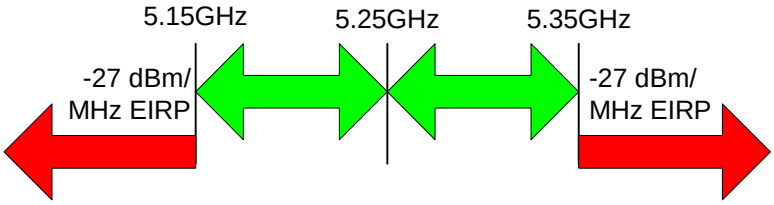
Support Equipment				
Description	**Model number**	**FCC ID or SN**	**Manufacturer**	**Power Cable**
Laptop	Thinkpad	---	IBM	Laptop PS
Test Software	Atheros Radio Test		Atheros	“Zip” cord

Test Conditions			
Temperature	23 C	**Humidity:**	43%
ATM pressure	1020 mBar	**Grounding:**	None
Tested By	Y Noor	**Date of Test:**	Nov/Dec 2004
Test Reference	FCC Part 15.205 IC Paragraph RSS210, 6.2.3 (c)		
Setup Method	ANSI C63.4		
Tested Range	1 GHz to 40 GHz		
Test Voltage	120 VAC / 60 Hz		
Modifications	No modifications were made to the unit		

Limit Calculation:

UNII:

For emissions NOT falling with a restricted band, the out of band emission limit for the AP operating in the UNII band(s) from 5.15 - 5.35 GHz was calculated as follows.



Out Of Band Spurious Emissions Limits

FCC LIMIT: -27 dBm/MHz EIRP
PRACTICAL RADIATED LIMIT: -27 dBm/MHz EIRP + 95.2 = 68.2 dBuV/M @ 3M

ISM:

For emissions NOT falling with a restricted band the out of band emission limit of -20 dBc (-30 dBc for a peak measurement due to BW correction) was applied. This was done by subtracting 20dB (or 30dB if applicable) from the measured level of the fundamental signal.

RESTRICTED BAND LIMIT (UNII and ISM):

Peak measurements: Resolution and Video BW: 1 MHz, 74 dBuV Limit
Average Measurements: Resolution BW: 1MHz and Video BW: 10 Hz, 54 dBuV Limit

Results:

There were some emissions detected during the test. The results are below. In some cases the emission was not within a restricted band. These emissions are highlighted in yellow. The spectrum up to 40 GHz was scanned. No emissions above approximately the third harmonic (17 GHz) were detected.

5.15 - 5.35 GHz (UNII)

AP Transmitting on 5180 MHz with S5153BHN36RTN (Low Band) antenna

UNII Limits applied to non-restricted band emissions

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1125.493	43.5	H	54.0	-10.5	AVG	260	1.0	Restricted
1125.493	51.5	H	74.0	-22.5	PK	260	1.0	Restricted
6215.930	54.3	V	68.2	-13.9	PK	357	1.0	Non-restricted
10361.725	63.8	V	68.2	-4.5	PK	140	1.0	Non-restricted
15537.674	44.5	V	54.0	-9.5	AVG	141	1.0	Restricted
15537.674	57.5	V	74.0	-16.5	PK	141	1.0	Restricted
15538.368	46.0	H	54.0	-8.0	AVG	188	1.0	Restricted
15538.368	58.6	H	74.0	-15.5	PK	188	1.0	Restricted

AP Transmitting on 5260 MHz with S5153BHN36RTN (Low Band) antenna

UNII Limits applied to non-restricted band emissions

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1125.065	43.6	V	54.0	-10.4	AVG	236	1.0	Restricted
1125.065	51.7	V	74.0	-22.3	PK	236	1.0	Restricted
6313.580	54.2	V	68.2	-14.0	PK	255	1.0	Non-restricted
10529.359	64.0	V	68.2	-4.3	PK	244	1.4	Non-restricted
15775.215	49.2	V	54.0	-4.8	AVG	136	1.0	Restricted
15775.215	61.8	V	74.0	-12.2	PK	136	1.0	Restricted
15774.665	50.2	H	54.0	-3.8	AVG	195	1.0	Restricted
15774.665	63.2	H	74.0	-10.8	PK	195	1.0	Restricted

AP Transmitting on 5320 MHz with S5153BHN36RTN (Low Band) antenna

UNII Limits applied to non-restricted band emissions

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
39797.516	37.5	H	54.0	-16.5	AVG	87	1.0	Restricted
39797.516	49.4	H	74.0	-24.6	PK	87	1.0	Restricted
21279.914	37.5	V	54.0	-16.5	AVG	265	1.0	Restricted
21279.914	49.4	V	74.0	-24.6	PK	265	1.0	Restricted
10639.919	51.3	V	54.0	-2.7	AVG	212	1.2	Restricted
10639.919	62.8	V	74.0	-11.2	PK	212	1.2	Restricted
15957.779	48.0	H	54.0	-6.0	AVG	303	1.0	Restricted
15957.779	61.2	H	74.0	-12.8	PK	303	1.0	Restricted

5.725 - 5.825 GHz (ISM)

AP Transmitting on 5745 MHz with S5153BHN36RTN (Low Band) antenna

ISM Limits applied to non-restricted band emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBmV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5745.570	96.4	V	-	-	AVG	274	1.0	Fundamental
5745.570	105.4	V	-	-	PK	274	1.0	Fundamental
5746.330	89.0	H	-	-	AVG	48	1.0	Fundamental
5746.330	97.4	H	-	-	PK	48	1.0	Fundamental
1074.927	37.3	V	54.0	-16.8	AVG	107	1.0	Restricted
1074.927	51.3	V	74.0	-22.7	PK	107	1.0	Restricted
4596.017	49.2	V	54.0	-4.8	AVG	94	1.0	Restricted
4596.017	53.0	V	74.0	-21.0	PK	94	1.0	Restricted
5312.001	49.3	V	75.4	-26.1	Peak	249	2.0	Non restricted
11495.060	52.4	V	54.0	-1.6	AVG	288	1.0	Restricted
11495.060	64.9	V	74.0	-9.1	PK	288	1.0	Restricted
17233.496	57.9	H	67.4	-9.5	Peak	225	1.0	Non restricted

AP Transmitting on 5785 MHz with S5153BHN36RTN (Low Band) antenna

ISM Limits applied to non-restricted band emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBmV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5783.765	102.0	V	-	-	AVG	246	1.0	Fundamental
5783.765	111.8	V	-	-	PK	246	1.0	Fundamental
5783.905	94.0	H	-	-	AVG	46	1.0	Fundamental
5783.905	104.0	H	-	-	PK	46	1.0	Fundamental
4628.135	50.4	V	54.0	-3.6	AVG	23	1.0	Restricted
4628.135	54.4	V	74.0	-19.6	PK	23	1.0	Restricted
1023.565	45.0	V	54.0	-9.1	AVG	165	1.0	Restricted
1023.565	55.6	V	74.0	-18.4	PK	165	1.0	Restricted
1925.025	52.6	V	81.8	-29.2	Peak	267	2.0	Non restricted
5280.108	48.4	V	81.8	-33.4	Peak	26	1.0	Non restricted
11574.134	53.0	V	54.0	-1.0	AVG	106	1.0	Restricted
11574.134	64.4	V	54.0	10.4	PK	106	1.0	Restricted
17350.191	60.5	V	81.8	-21.4	Peak	262	1.0	Non restricted

AP Transmitting on 5825 MHz with S5153BHN36RTN (Low Band) antenna

ISM Limits applied to non-restricted band emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5824.790	102.0	V	-	-	AVG	138	1.0	Fundamental
5824.790	110.3	V	-	-	PK	138	1.0	Fundamental
5826.305	94.6	H	-	-	AVG	50	1.0	Fundamental
5826.305	102.9	H	-	-	PK	50	1.0	Fundamental
11644.270	41.0	V	54.0	-13.0	AVG	247	1.0	Restricted
11644.270	53.6	V	74.0	-20.4	PK	247	1.0	Restricted
17472.434	51.8	H	72.9	-21.1	Peak	291	1.0	Non restricted
1025.265	38.9	V	54.0	-15.1	AVG	107	1.0	Restricted
1025.265	53.2	V	74.0	-20.8	PK	107	1.0	Restricted
4659.933	53.6	V	54.0	-0.4	AVG	81	1.0	Restricted
4659.933	57.0	V	74.0	-17.0	PK	81	1.0	Restricted
5312.276	52.3	V	54.0	-1.7	AVG	261	2.0	Restricted
5312.276	59.5	V	74.0	-14.5	PK	261	2.0	Restricted

5150 - 5350MHz (UNII)

AP Transmitting on 5180 MHz with S5703BHN36RTN (High Band) antenna

UNII Limits applied to non-restricted band emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1310.000	45.7	V	54.0	-8.3	AVG	168	1.2	Restricted
1310.000	52.4	V	74.0	-21.6	PK	168	1.2	Restricted
6230.000	58.0	V	68.3	-10.3	Peak	82	1.8	Non Restricted
15540.000	49.6	V	54.0	-4.4	Peak	225	1.5	Restricted
10361.077	65.4	V	68.3	-2.9	AVG	333	1.0	Non Restricted

AP Transmitting on 5260 MHz with S5703BHN36RTN (High Band) antenna

UNII Limits applied to non-restricted band emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1026.285	40.1	V	54.0	-13.9	AVG	334	1.0	Restricted
1026.285	55.7	V	74.0	-18.3	PK	334	1.0	Restricted
1500.101	47.7	V	54.0	-6.4	AVG	94	1.0	Restricted
1500.101	51.1	V	74.0	-22.9	PK	94	1.0	Restricted
6312.134	54.3	V	68.3	-14.0	Peak	206	2.0	Non-restricted
15779.885	48.4	V	54.0	-5.6	AVG	276	1.0	Restricted
15779.885	60.4	V	74.0	-13.6	PK	276	1.0	Restricted
10517.581	68.2	H	68.3	-0.1	AVG	221	1.0	Non restricted

AP Transmitting on 5320 MHz with S5703BHN36RTN (High Band) antenna

UNII Limits applied to non-restricted band emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1394.152	44.9	V	54.0	-9.1	AVG	175	1.0	Restricted
1394.152	58.1	V	74.0	-15.9	PK	175	1.0	Restricted
6383.928	50.0	V	68.3	-18.3	Peak	133	1.5	Non restricted
10639.030	51.2	V	54.0	-2.9	AVG	288	1.0	Restricted
10639.030	65.7	V	74.0	-8.3	PK	288	1.0	Restricted
15958.238	46.5	H	54.0	-7.5	AVG	204	1.0	Restricted
15958.238	60.3	H	74.0	-13.7	PK	204	1.0	Restricted

5725 - 5825 MHz (ISM)

AP Transmitting on 5745 MHz with S5703BHN36RTN (High Band)antenna

ISM Limits applied to non-restricted band emissions

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5743.535	107.6	V	-	-	AVG	126	1.0	Fundamental
5743.535	116.8	V	-	-	PK	126	1.0	Fundamental
5746.265	98.0	H	-	-	AVG	305	1.3	Fundamental
5746.265	107.3	H	-	-	PK	305	1.3	Fundamental
4596.069	43.6	V	54.0	-10.4	AVG	27	1.0	Restricted
4596.069	49.8	V	74.0	-24.2	PK	27	1.0	Restricted
17228.053	59.3	H	77.3	-18.0	PK	254	1.4	Non-restricted
11489.273	48.2	V	54.0	-5.8	AVG	187	1.6	Restricted
11489.273	60.1	V	74.0	-13.9	PK	187	1.6	Restricted

AP Transmitting on 5785 MHz with S5703BHN36RTN (High Band) antenna

ISM Limits applied to non-restricted band emissions

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5783.710	104.9	V	-	-	AVG	119	1.4	Fundamental
5783.710	114.4	V	-	-	PK	119	1.4	Fundamental
5785.560	94.0	H	-	-	AVG	301	1.0	Fundamental
5785.560	103.4	H	-	-	PK	301	1.0	Fundamental
11568.422	48.0	V	54.0	-6.0	AVG	270	2.0	Restricted
11568.422	61.5	V	74.0	-12.5	PK	270	2.0	Restricted
17353.191	72.3	H	73.4	-1.1	PK	249	1.4	Non-restricted
4627.802	46.1	V	54.0	-7.9	AVG	296	1.0	Restricted
4627.802	51.3	V	74.0	-22.7	PK	296	1.0	Restricted
5311.922	54.9	V	84.4	-29.6	PK	341	1.0	Non-restricted

AP Transmitting on 5825 MHz with S5703BHN36RTN (High Band)antenna

ISM Limits applied to non-restricted band emissions

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5823.535	99.8	V	-	-	AVG	149	1.0	Fundamental
5823.535	108.4	V	-	-	PK	149	1.0	Fundamental
5823.560	92.7	H	-	-	AVG	312	1.0	Fundamental
5823.560	101.5	H	-	-	PK	312	1.0	Fundamental
23284.17	46.4	H	71.4	-25.0	PK	320	1.0	Non-restricted
4660.170	53.3	V	54.0	-0.7	AVG	209	1.0	Restricted
4660.170	56.0	V	74.0	-18.0	PK	209	1.0	Restricted
5312.182	57.4	V	78.4	-21.0	PK	0	1.0	Non-restricted
11646.243	48.8	V	54.0	-5.2	AVG	215	1.4	Restricted
11646.243	61.1	V	74.0	-12.9	PK	215	1.4	Restricted
17474.369	63.7	H	71.5	-7.8	PK	317	1.4	Non-restricted

Radiated Emissions in Restricted bands at the Band Edges.

Ending at 5.15 GHz and beginning at 5.35 GHz

Procedure

There are three steps to performing this test.

STEP 1: Make a radiated measurement of the fundamental signal with the UUT on the highest channel. This measurement is used using the peak and average RBW and VBW of 1MHz/1MHz and 1MHz/10Hz. This measured radiated level is then used as a reference and is referred to as the *Fundamental Reference Measurement* in the table below

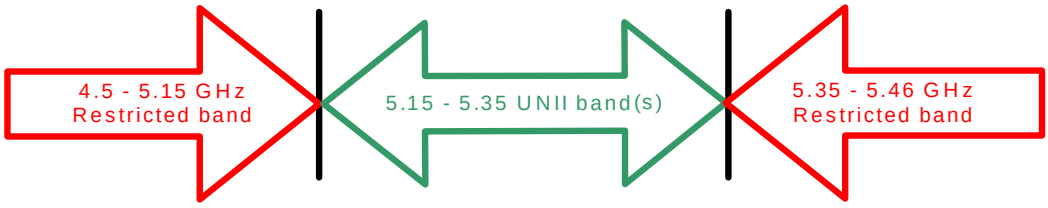
STEP 2: Additional conducted measurements are made for Peak and Average -dBc values. The peak and average bandwidths are:
PEAK: RBW = 1 MHz VBW = 1 MHz
AVG: RBW = 1 MHz VBW = 10 Hz
These measurements determine a –dBc (delta dB) level between the fundamental reference level (in a 1 MHz BW) and the actual level at highest point within the restricted band. This dBc is then subtracted from the associated (peak or avg) radiated field strength reference measurement made earlier.

STEP 3 A third and final measurement is made to determine the apparent drop in fundamental carrier power when the RBW is narrowed from 1MHz (in the reference measurement) to 100kHz (the specification BW) This is referred to below as the “BW Delta”. This correction factor is only allowed in the highest emission in the restricted band is less than 2 “standard bandwidths” from the edge of the restricted band.

This measurement is made at the highest emission within the restricted band and is the apparent drop in level when the RBW is narrowed from 1 MHz to 100 kHz.

This procedure is outline in FCC Public Notice DA 00-705, released on 30 March 2000 and is referred to as the “Marker-Delta Method”

The restricted bands that are of concern in the test are 4.5 – 5.15 GHz and 5.35 – 5.46GHz because these restricted bands are adjacent to the operating bands of the AP.



Results

802.11 A Band Edge (Restricted band @ 5.15GHz)												
Pol	Fundemental Radiated Ref Msmt		Delta Msmt		RBW Msmt		Radiated Level at Band Edge		Specification		Delta (dB below Limit)	
	Peak dbuv/m	Avg dbuv/m	Peak dBc	Avg dBc	Pk dB	Avg dB	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m
Vert	106	97.5	49.178	49.08			56.822	48.42	74	54	**17.178**	**5.58**
Horz	99.8	91.3					50.622	42.22			**23.378**	**11.78**

802.11 A Band Edge (Restricted band @ 5.35GHz)												
Pol	Fundemental Radiated Ref Msmt		Delta Msmt		RBW Msmt		Radiated Level at Band Edge		Specification		Delta (dB below Limit)	
	Peak dbuv/m	Avg dbuv/m	Peak dBc	Avg dBc	Pk dB	Avg dB	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m
Vert	106.9	98.7	41.66	46.92			65.24	51.78	74	54	**8.76**	**2.22**
Horz	99.1	90.7					57.44	43.78			**16.56**	**10.22**

The RBW BW Delta measurement in the table above was not required in order to show compliance. Therefore, the measurement is not included in the table above.

Restricted band level (AVG) = AVG reference level - AVG delta dB
Restricted band level (Peak) = Peak reference level - Peak delta dB

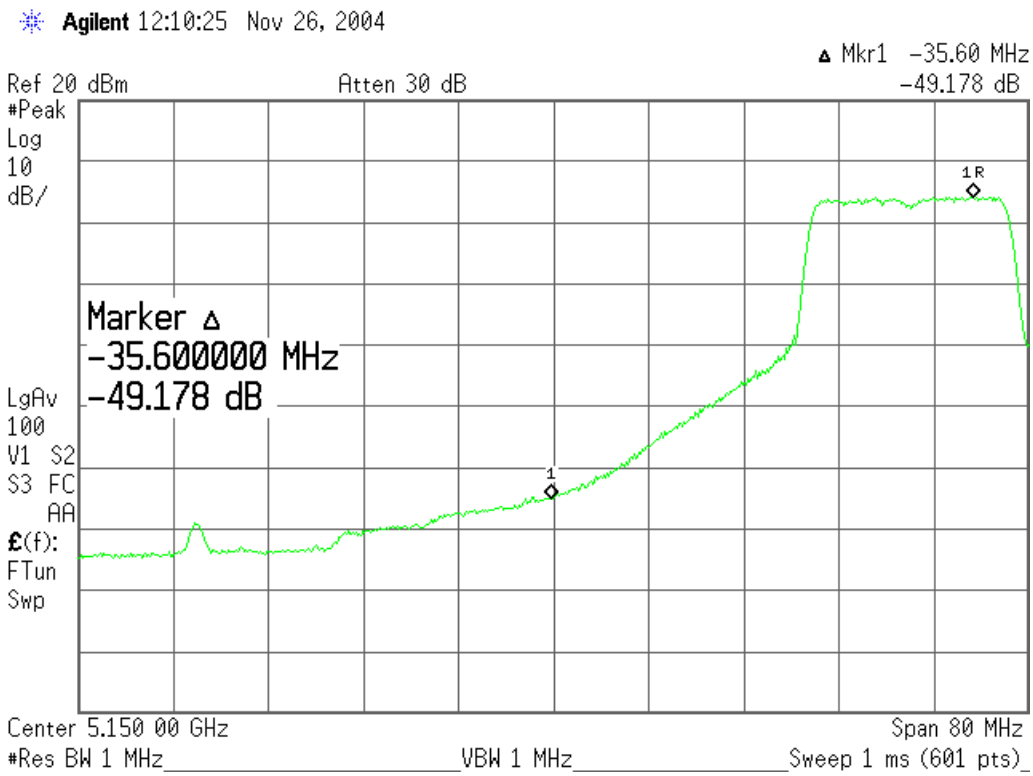
Radiated Emissions Sample Calculations

Bandedge @ 5.35 GHz, AVG

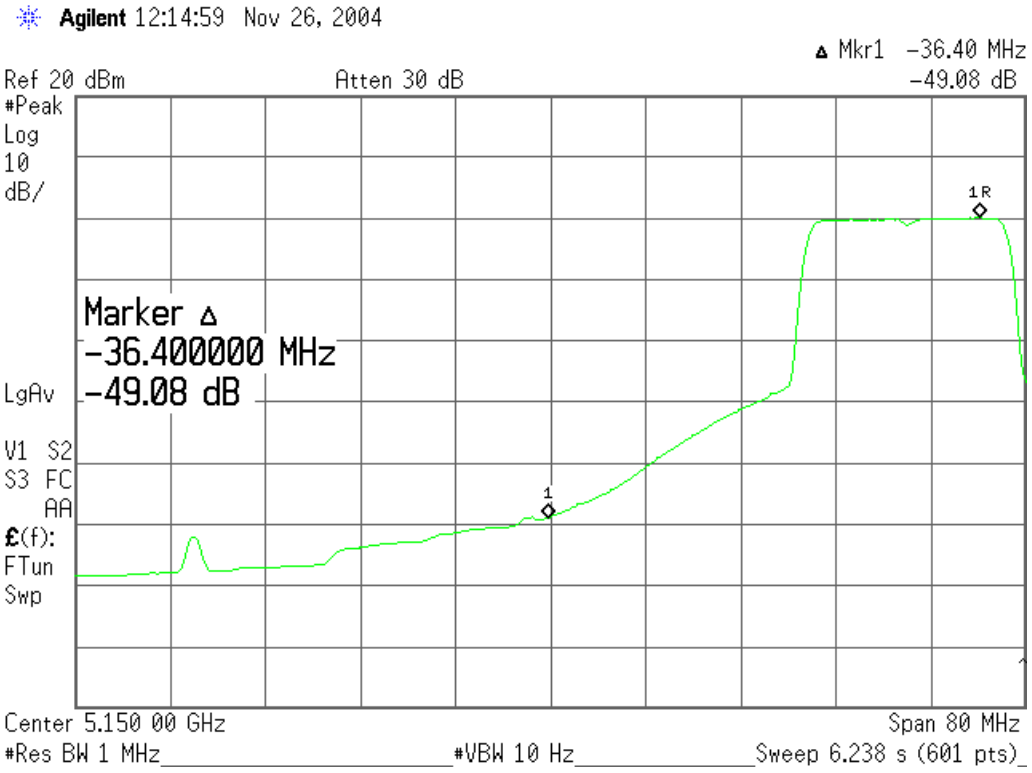
98.7 dBuV/m - 46.92dB = 51.78

54 - 51.78 = 2.22 dB margin

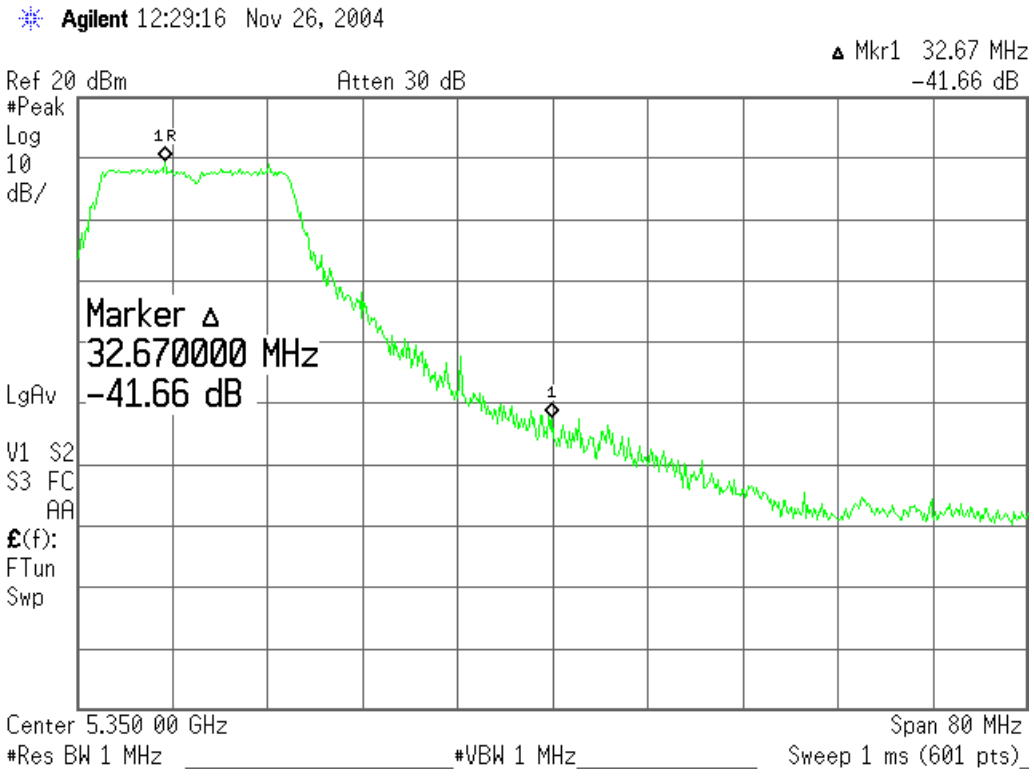
5.15GHz Bandedge PEAK -dBc Measurement (#775)



5.15GHz Bandedge AVG -dBc Measurement (#776)



5.35GHz Bandedge PEAK -dBc Measurement (#779)



5.35GHz Bandedge AVG -dBc Measurement (#780)