



FCC Part 15.247 Certification Application

**Industrie Canada RSS210 Certification
Application**

**EMI Test Report
on
IEEE 802.11 Access Point.
Model: 2330**

FCC ID: [RVW2330](#)

IC ID: [332R-2330](#)

Prepared by:
David Waitt
202 Calvert Drive #217
Cupertino, Ca. 95014
david@waitt.us
(408) 832 7053

Table of Contents

Section	Page
General Information	3
Detailed Product Information	4
Internal Antennas.....	5
Test Results Summary	6
Test Facilities	7
Equipment Lists	8
Instrument Calibration	8
Elliott Test Equipment.....	8
Test Methods	9
Test Results	10
802.11 B/G/A Maximum RF Power Output at Antenna Terminals	11
802.11 B/G (ISM) Transmit power.....	12
802.11 A (ISM) Transmit power	12
6 dB and 99% Bandwidth	13
Power Spectral Density.....	23
Specifications:.....	23
Procedure:	23
Results:.....	23
5.725 & 5.85 GHz Band Edge.....	29
Specifications:.....	29
Procedure:	29
Results:.....	29
Radiated Emissions In Restricted Bands & Out Of Band Emissions	30
Specifications:.....	30
Procedure:	30
Results:.....	32
802.11 B 15 dBi Yagi Antenna	32
802.11 G 15 dBi Yagi Antenna.....	35
802.11 B 9 dBi Panel Antenna	38
802.11 G 9 dBi Panel Antenna.....	41
802.11 B 5 dBi Omni Antenna.....	44
802.11 G 5 dBi Omni Antenna	47
802.11 B Internal Antenna	49
802.11 A 14 dBi Panel Antenna	55
802.11 A 3 dBi “Squint” Antenna	Error! Bookmark not defined.
802.11 A 5 dBi Omni Antenna.....	58
Radiated Emissions in Restricted bands (2.4 GHz Band Edges).....	60
Results Summary Table (2.4 GHz 802.11 B & G)	61
<i>(Low Power Setting)</i>	61
<i>(Med Power Setting)</i>	61
<i>(High Power Setting)</i>	61

General Information

Unit(s) Under Test: IEEE 802.11 Access Point (AP)
Model(s): 2330

Product Description: IEEE 802.11 A/B/G Access point

FCC ID: RVW2330
IC ID: 332R-2330

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

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

Tested By: Yalda Noor, Test Engineer, Elliott Laboratories
Juan Martinez, Test Engineer, Elliott Laboratories
Mark Briggs, VP Engineering, Elliott Labs
David Waitt, (Independent Consultant)

Test Specifications: FCC CFR 47, Part 15.247, 2.4 GHz / 5.8 GHz

Test Date: April / May 2005

**Requested
Certifications:** FCC Part 15 Subpart C certification application
IC RSS-210 Certification application

Detailed Product Information

The access point radio is an IEEE 802.11 A/B/G access point (AP) intended to be professionally installed and configured in corporate and industrial environments. The unit has internal antennas and is also capable of being configured to use external antennas.

This certification application follows FCC policy that allows use of antennas of the same type of equal or lesser gain to be used with the product from various manufacturers, a table of the desired antennas and those that were actually tested with the access point is below. The antennas actually tested for Compliance with the unit are highlighted in green. It is anticipated that the other antennas highlighted in yellow will also be used in various installations.

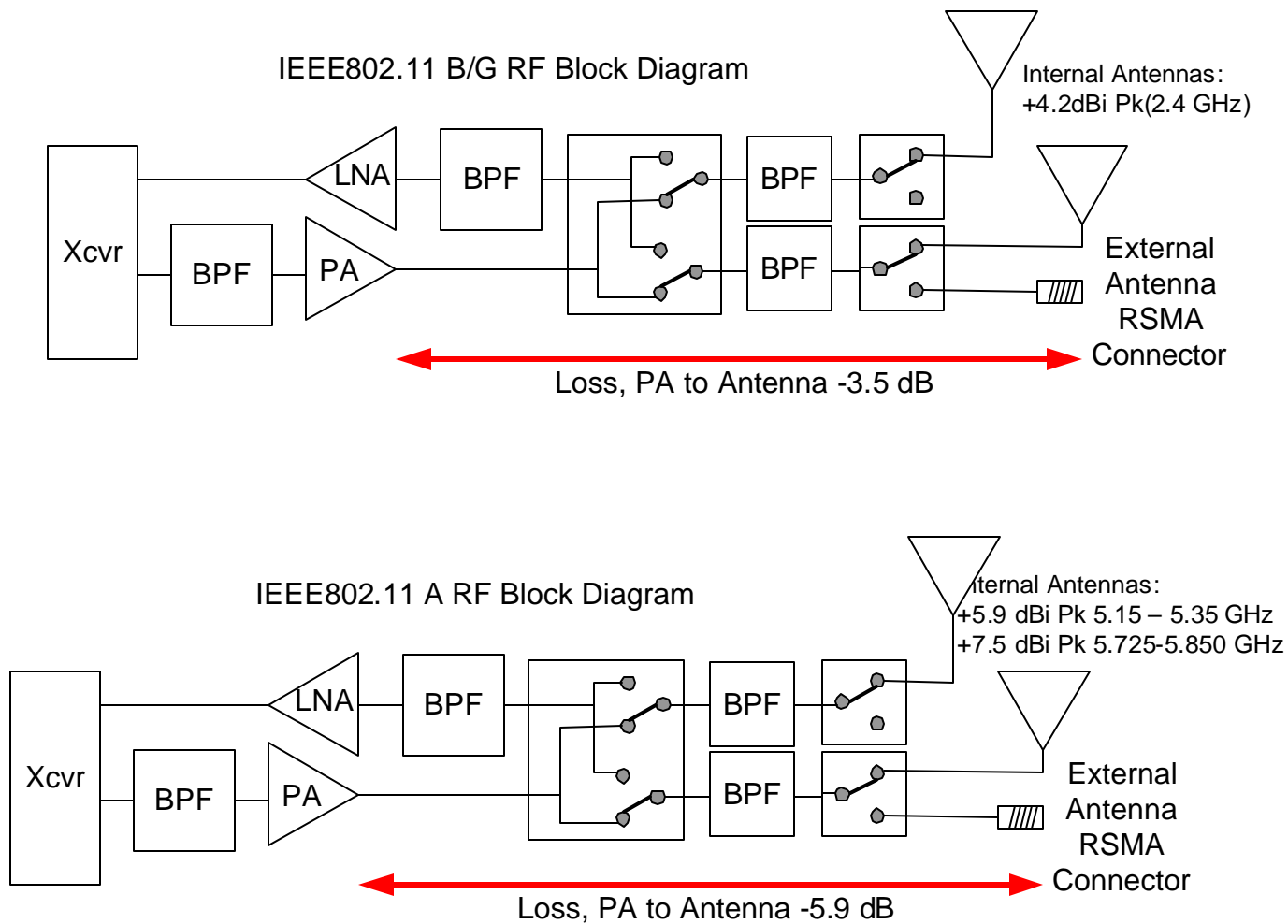
The last column indicates the maximum power setting that is allowed to be used with the particular type of antenna in order to ensure compliance with FCC rules. For more information on the power settings see the section of this report on RF transmit power.

BAND	CushCraft / Max Rad Antenna	Freq Band	Net Gain (dBi)	Type	Comment	Allowed Power Stg
UNII	S5153WPBN36RSM	5.15 - 5.35	6.0	Omni	Similar to S2403, Colinear omni 2 element	HIGH
	S51514WPN36RSM	5.15 - 5.35	14.0	Patch	Patch Directional	LOW
	S24493DS	5.15 - 5.35	5.9	Omni	Internal	HIGH
5 GHz DTS	S5153WPBN36RSM	5.725 - 5.85	6.0	Omni	Similar to S2403, Colinear omni 2 element	HIGH
	S51514WPN36RSM	5.725 - 5.85	14.0	Patch	Patch Directional	LOW
	S24493DS	5.725 - 5.85	7.5	Omni	Internal	HIGH
2.4 GHz DTS	SQ2405DDN36RSM	2.4-2.5	4.0	Panel	Panel, similar to 2402 / 2409	MED
	SL2402PN36RSM	2.4-2.5	2.0	Panel	Panel	MED
	S2406PN36RSM	2.4-2.5	5.5	Panel	Panel	MED
	S2409PN36RSM	2.4-2.5	8.5	Panel	Panel, higher gain S2402	MED
	MYP24015PRSM	2.4-2.5	15.0	Yagi	Yagi (Made by Max Rad)	LOW
	S24493DS	2.4 - 2.5	4.2	Omni	Internal	HIGH

Internal Antennas

The AP utilizes integral antennas for use with 802.11 A/B/G. The access point includes four broad band antennas. Two of the antennas are used for 802.11 B/G operation, the remaining two are used for 802.11 A operation. For a given band, the AP switches rapidly between the two antennas associated with that band and when a signal is detected, the access point uses the antenna offering the best transmission characteristics. At any one time, there is only one antenna connected to the internal transceiver

The specified peak gain of the 2.4 GHz internal antenna is approx 4.2 dBi under ideal conditions. The gain of the 5 GHz internal antenna is approx 5.9 dBi peak under ideal conditions. The diagrams below outline the RF path from the output of the RF circuitry to the integral antennas within the access point.



2.4 GHz & 5 GHz RF Block Diagrams

Test Results Summary

This report presents the results of the tests that verify compliance with FCC Part 15.247 and

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

Part 15 Paragraph	RSS-210 Paragraph	Test	Results
15.247(b)	6.2.2(o)(a) 3	Maximum Power Output (802.11 G)	17.91 dBm Max
15.247(b)	6.2.2(o)(a) 3	Maximum Power Output (802.11 A)	19.39dBm Max
15.247(a)(2)	6.2.2(o)(e1)	6dB Bandwidth (802.11 B)	15.56 MHz Min
15.247(a)(2)	6.2.2(o)(e1)	6dB Bandwidth (802.11 G)	16.55 MHz Min
15.247(a)(2)	6.2.2(o)(e1)	6dB Bandwidth (802.11 A)	16.55 MHz Min
15.247(d)	6.2.2(o)(d1)	Power Spectral Density (2.4GHz)	-8.04 dBm/3kHz Max
15.247(d)	6.2.2(o)(d1)	Power Spectral Density (5GHz)	--5.764 dBm/3kHz Max
15.247(c)	6.2.2(o)(a) 4	Out of Band Spurious Emissions(2.4GHz) Av, 7312 MHz,	-1.4dB under limit
15.247(c)	6.2.2(o)(a) 4	Out of Band Spurious Emissions(5 GHz) Av, 11645MHz,	-8 dB Under limit
15.205	6.3(c)	Radiated Emissions in Restricted bands	.6 dB in spec min @7384.73 MHz (802.11 G)
15.109		AC Line Conducted Emissions Line, Avg @ 469kHz	-19.1 dB below limit
15.109		Rcvr Spurs @ 94.354 MHz	-6.8 dB below limit

Test Facilities

The radiated emissions tests were performed at:

Elliott Labs
684 West Maude Ave
Sunnyvale, CA 94086

The tests performed at Elliott include:

- All radiated emissions tests required in FCC Part 15.205 for 2.4 GHz.
- Out of band emissions (Conducted) (for 2.4 GHz)

General:

Final 802.11 B/G/A radiated test measurements were taken at Elliott Laboratories 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 used to measure radiated emissions above 1000MHz are mounted 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. An exhibit of this report contains the list of test equipment used and calibration information.

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	18-Jan-06
Hewlett Packard	EMC Spectrum Analyzer 9KHz-26.5GHz, non programmable	8563E	284	22-Apr-06
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	868	20-Apr-06
Hewlett Packard	Microwave EMI test system (SA40, 9kHz - 40GHz) Fremont	84125C	1410	24-Jul-05
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1290	09-May-06
Rohde & Schwarz	Peak Power Sensor 100uW - 2 Watts	NRV-Z32	1536	09-May-06

Test Methods

The tests are performed at a low, middle and high channel of the applicable band. The typical frequencies used for the Part15.247 ISM tests are shown in the table to the right. Unless otherwise noted, all testing was performed on these channels / frequencies

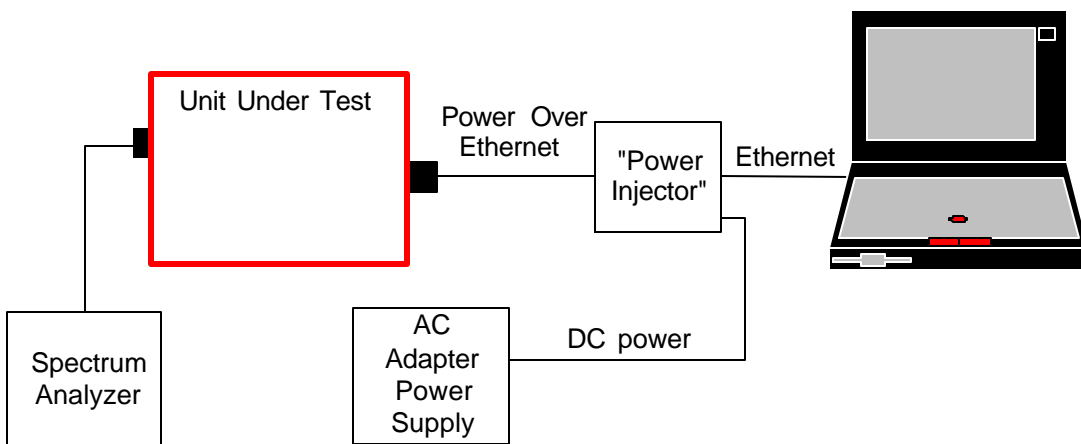
ISM 802.11 B / G 2400 – 2483.5 MHz			ISM 802.11 A 5725 - 5825 MHz	
Channel		Freq(MHz)	Channel	Freq(MHz)
Low	Chan 1	2412	Low	5745
Mid	Chan 6	2437	Mid	5805
High	Chan 11	2462	High	5825

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 operating band. The maximum power setting that allowed 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, these same settings were also used during the “bench top” conducted RF tests (Spectral density, bandwidth etc).

The tests listed below are performed using the basic “conducted” test setup shown below unless otherwise noted. In most cases, the EUT was running special diagnostic software to allow it to transmit random data on a particular channel indefinitely.

Part 15 **Test**
 15.247(a)(1)(i) 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	A20	DOC	IBM	Laptop PS
Test Software	Atheros Radio Test		Atheros	
48VDC AC adapter	Generic		Generic	CAT 5 Ethernet cable

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	22C	Humidity:	45%
ATM pressure	1010 mBar	Grounding:	None
Tested By	David Waitt	Date of Test:	May 2005
Test Reference	Refer to individual test results		
Tested Range	Test Dependent		
Test Voltage	48 VDC to the AP		
Modifications	No modifications were made to the unit during the tests		

802.11 B/G/A Maximum RF Power Output at Antenna Terminals

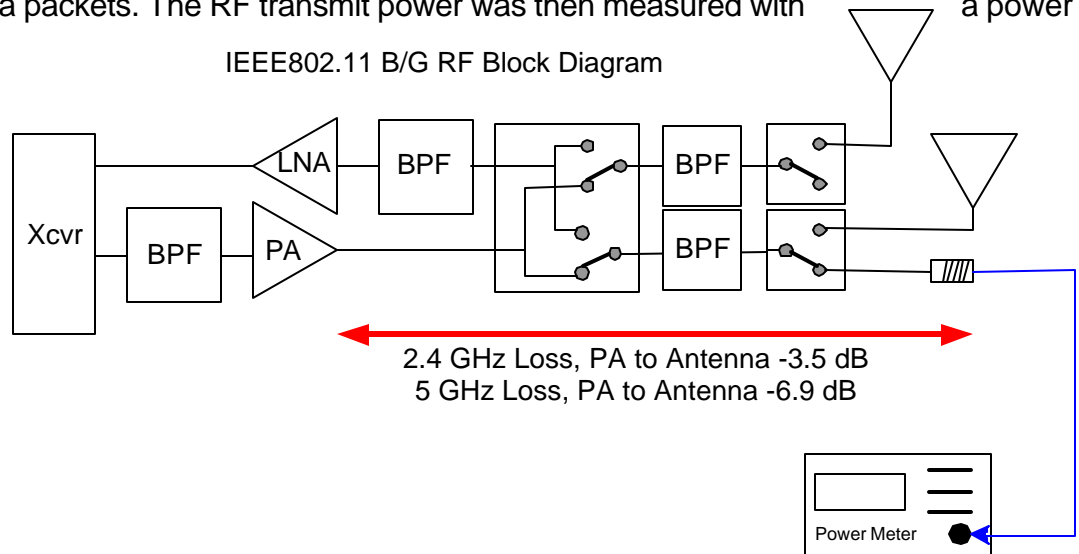
Specifications:

FCC Specification: Paragraph: 15.247(b)

IC Specification: RSS-210, 6.2.2.(o)(b)

Procedure:

The test was configured as shown below. The unit was tuned to the test channels and configured to transmit random data packets. The RF transmit power was then measured with a power meter.



There are three power settings used for operation on 2.4 GHz.

The lower power settings are used for the higher gain antennas. Higher power settings are allowed for the lower gain antennas. Utilization of these different power levels ensures compliance with the FCC 2.4 GHz ISM “restricted band” emission requirements while attempting to maximize EIRP for field performance. See the table in this earlier in this report that outlines applicable power level for each of the external antennas

Results:

IEEE802.11 B power levels were measured with a peak power meter. IEEE802.11 G and A measurements were made with a spectrum analyzer with the following settings: RBW=1 MHz, VBW=3MHz, with a sample detector and power averaging. The channel power was integrated over the 6 dB BW

The unit is compliant with a single transmit power setting for the 802.11 A ISM band. (EIRP for the 14 dBi panel is shown below)

802.11 B/G (ISM) Transmit power

	Freq (MHz)	Power Setting (HIGH) Antenna gain < 5.15 dBi)			Powwer setting MED (Antenna Gain < 8.5 dBi)			Power Setting LOW (Antenna gain < 15 dBi)		
		Power (mW)	Power (dBm)	Power (Max EIRP)	Power (mW)	Power (dBm)	Power (Max EIRP)	Power (mW)	Power (dBm)	Power (Max EIRP)
802.11 B	2412	59.704	17.76	22.91	26.36	14.21	22.71	11.12	10.46	25.46
	2437	51.050	17.08	22.23	51.05	17.08	25.58	51.05	17.08	32.08
	2462	51.523	17.12	22.27	23.99	13.80	22.30	11.35	10.55	25.55
802.11 G	2412	47.863	16.80	21.95	30.20	14.80	23.30	12.02	10.80	25.80
	2437	61.660	17.90	23.05	61.66	17.90	26.40	61.66	17.90	32.90
	2462	48.753	16.88	22.03	26.30	14.20	22.70	10.74	10.31	25.31

802.11 A (ISM) Transmit Power (Max antenna gain: 14 dBi)

	Freq (MHz)	Power (dBm)	Power (mW)	Power (Max EIRP)
802.11 A	5745	17.830	60.67	31.83
	5805	19.390	86.90	33.39
	5825	18.170	65.61	32.17

6 dB and 99% Bandwidth

Specifications

FCC Specification: Paragraph 15.247(a)(2)

IC Specification: RSS-210 .6.2.2(o)

Procedure:

The access point operates on the standard IEEE 802.11 A / B / G channels. The 6dB bandwidth was measured on the low middle and high channels of the 2.4 and 5.8 GHz ISM bands using the conducted RF test setup. The spectrum analyzer was configured for MAX HOLD and the trace allowed to stabilize. A peak search was performed and the then “Delta-Marker” used to locate the points at –6dB below the peak. Additionally, the “Channel Bandwidth” function of the spectrum analyzer was used to measure the 99% occupied bandwidth

The bandwidth test was performed at the high power settings that will be used in the final system.

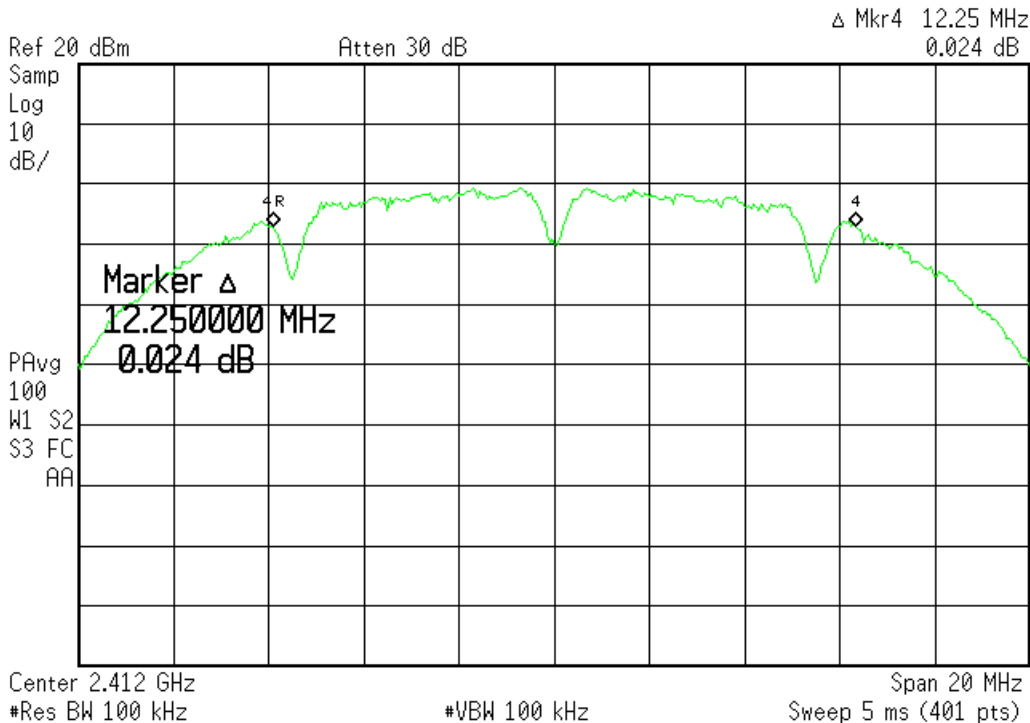
Results:

Freq (MHz)	802.11 B Bandwidth (MHz)		802.11 G Bandwidth (MHz)		Spec (MHz)	Delta (min)
	6 dB	99%	6 dB	99%		
2412	12.25	15.7227	16.6	16.5182	0.5	15.2227
2437	12.3	15.5606	16.6	16.4719	0.5	15.0606
2462	12.5	15.7667	16.55	16.5595	0.5	15.2667

Freq (MHz)	802.11 A Bandwidth (MHz)		Spec (MHz)	Delta (min)
	6 dB	99%		
5745	16.55	16.6538	0.5	16.05
5805	16.5	16.6924	0.5	16.00
5825	16.6	16.6477	0.5	16.10

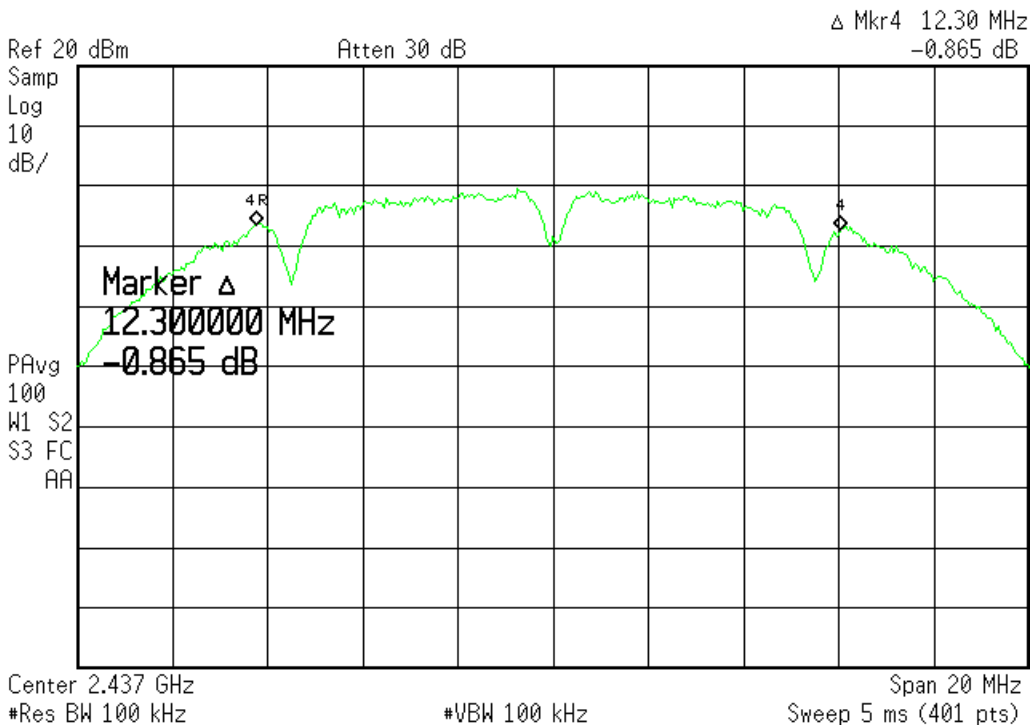
Agilent 10:11:39 May 30, 2005

6 dB BW, 2412MHz,
802.11 B



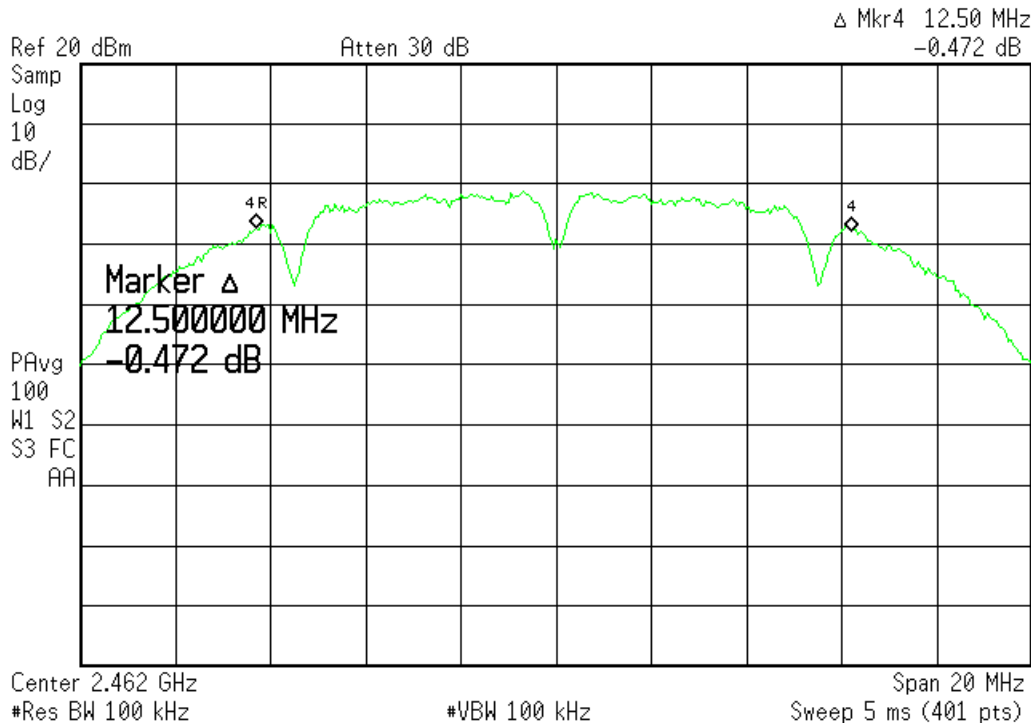
Agilent 10:09:36 May 30, 2005

6 dB BW, 2437MHz,
802.11 B



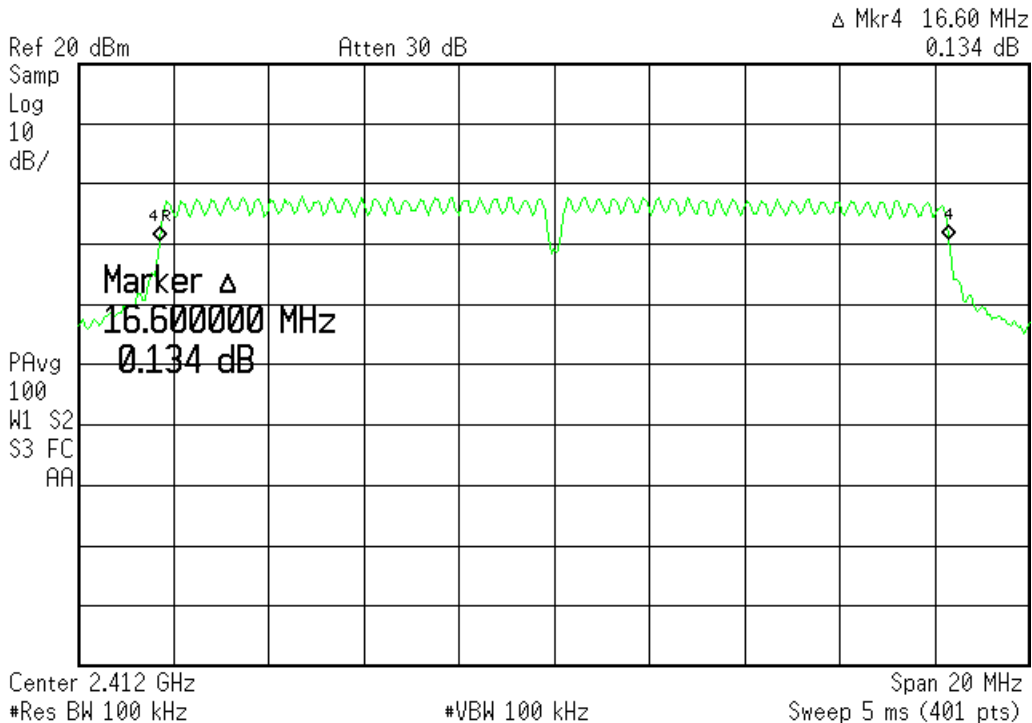
Agilent 10:08:06 May 30, 2005

6 dB BW, 2462MHz,
802.11 B



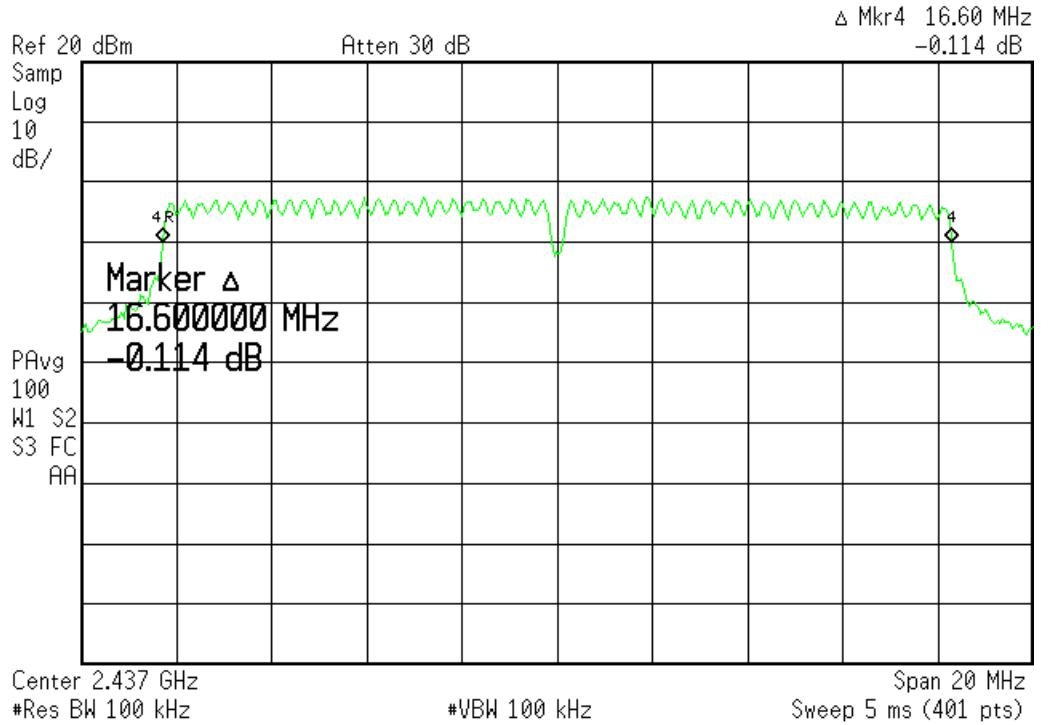
Agilent 10:14:49 May 30, 2005

6 dB BW, 2412MHz,
802.11 G



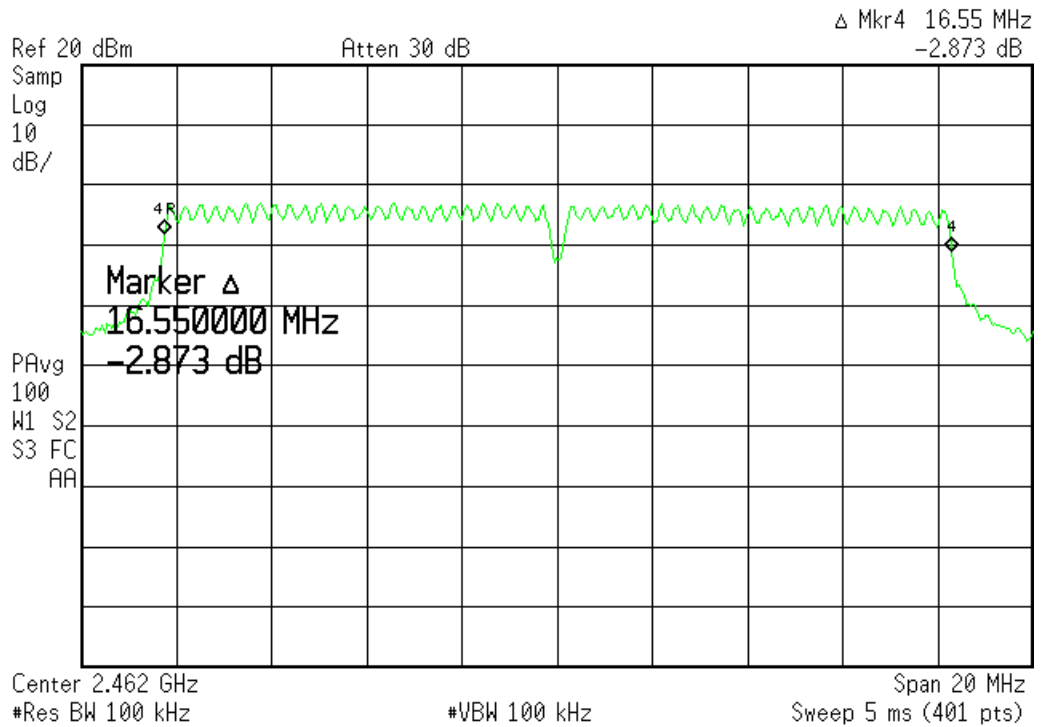
Agilent 10:16:27 May 30, 2005

6 dB BW, 2437MHz,
802.11 G



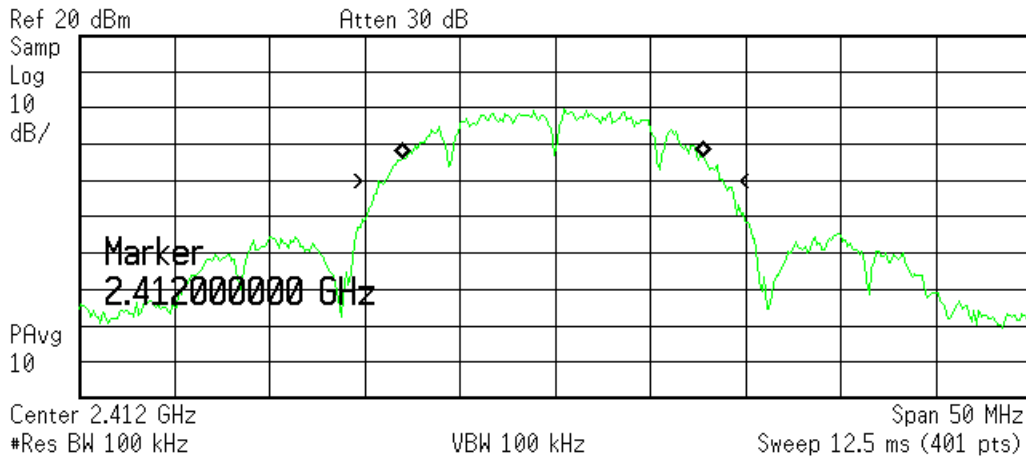
Agilent 10:17:51 May 30, 2005

6 dB BW, 2462MHz,
802.11 G



Agilent 10:00:52 May 30, 2005

99% BW, 2412MHz,
802.11 B

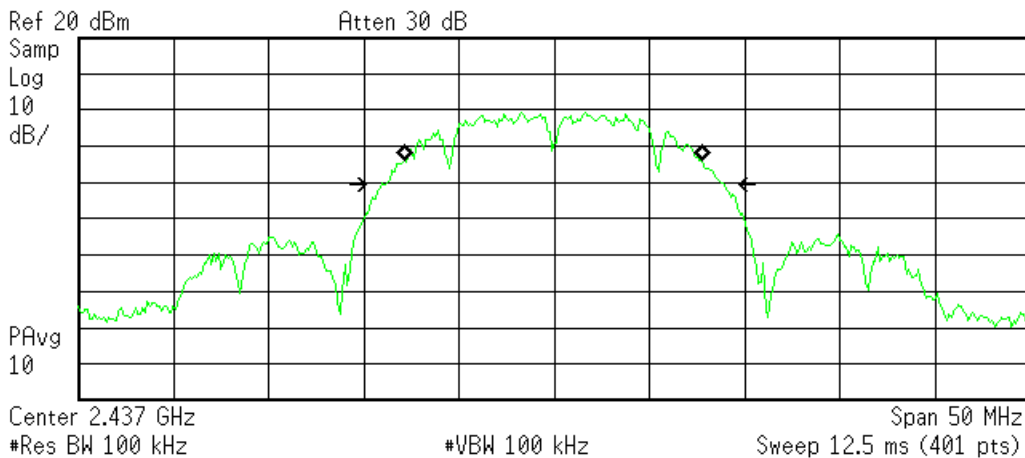


Occupied Bandwidth **Occ BW % Pwr** 99.00 %
15.7227 MHz

Transmit Freq Error -97.210 kHz
x dB Bandwidth 17.689 MHz*

Agilent 10:02:34 May 30, 2005

99% BW, 2437MHz,
802.11 B

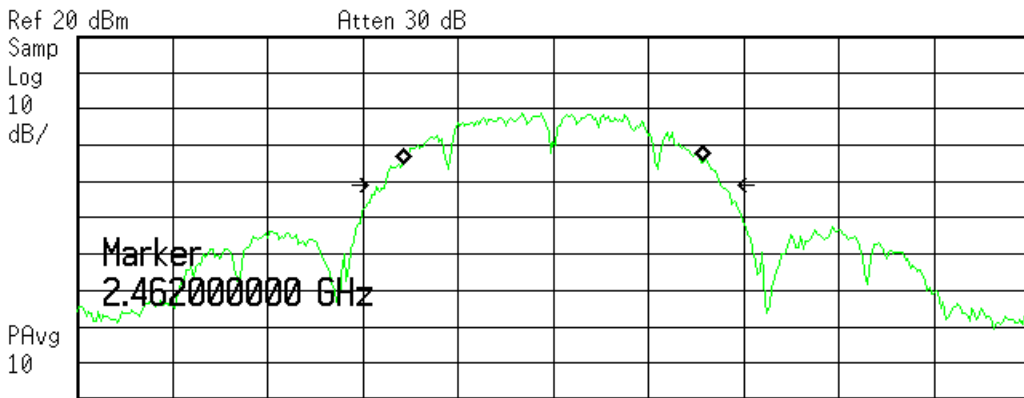


Occupied Bandwidth **Occ BW % Pwr** 99.00 %
15.5606 MHz

Transmit Freq Error -78.003 kHz
x dB Bandwidth 17.850 MHz*

Agilent 10:03:59 May 30, 2005

99% BW, 2462MHz,
802.11 B



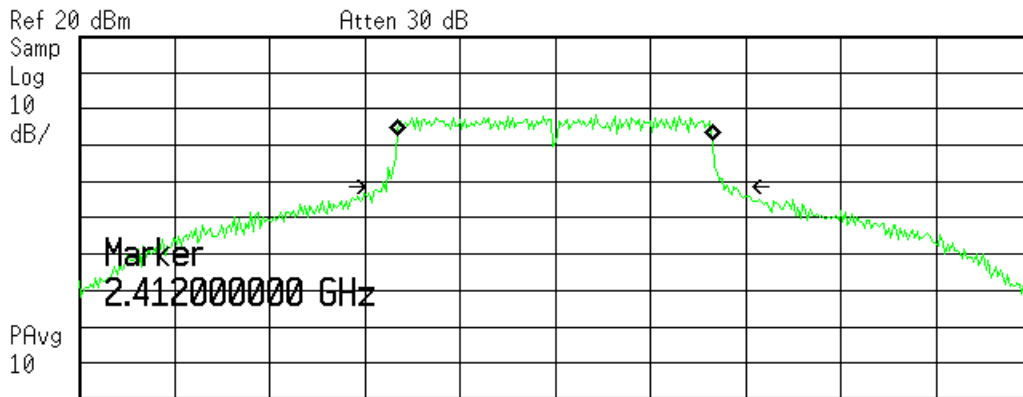
Center 2.462 GHz Span 50 MHz
#Res BW 100 kHz #VBW 100 kHz Sweep 12.5 ms (401 pts)

Occupied Bandwidth **Occ BW % Pwr** 99.00 %
15.7667 MHz

Transmit Freq Error -28.557 kHz
x dB Bandwidth 17.742 MHz*

Agilent 10:22:14 May 30, 2005

99% BW, 2412MHz,
802.11 G



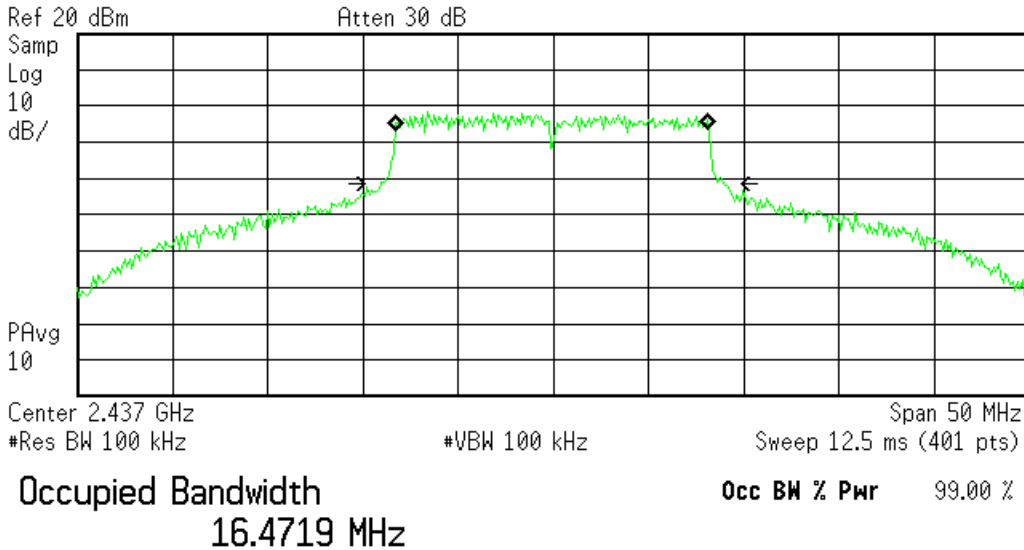
Center 2.412 GHz Span 50 MHz
#Res BW 100 kHz #VBW 100 kHz Sweep 12.5 ms (401 pts)

Occupied Bandwidth **Occ BW % Pwr** 99.00 %
16.5487 MHz

Transmit Freq Error -22.578 kHz
x dB Bandwidth 18.585 MHz*

Agilent 10:20:06 May 30, 2005

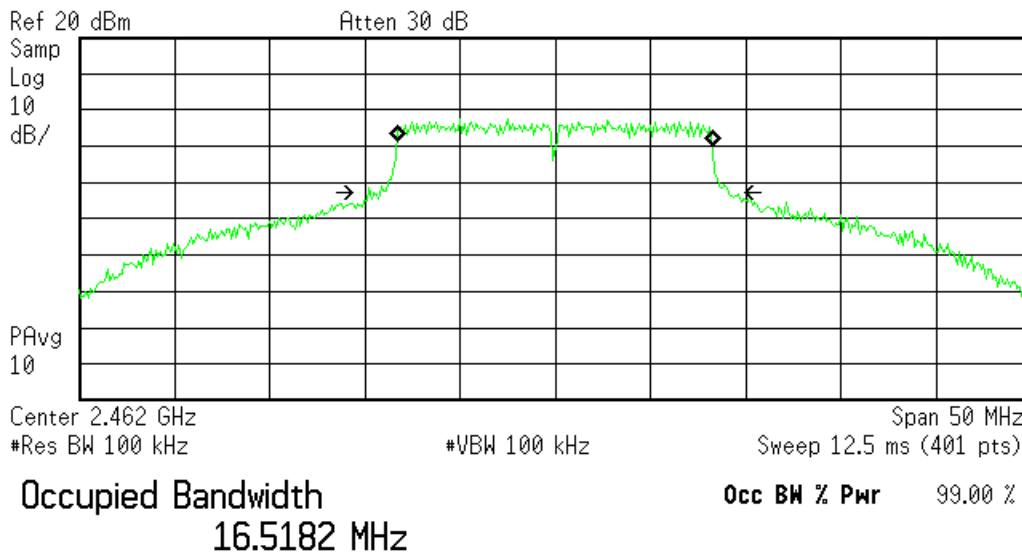
99% BW, 2437MHz,
802.11 G



Transmit Freq Error -50.815 kHz
x dB Bandwidth 18.686 MHz*

Agilent 10:18:58 May 30, 2005

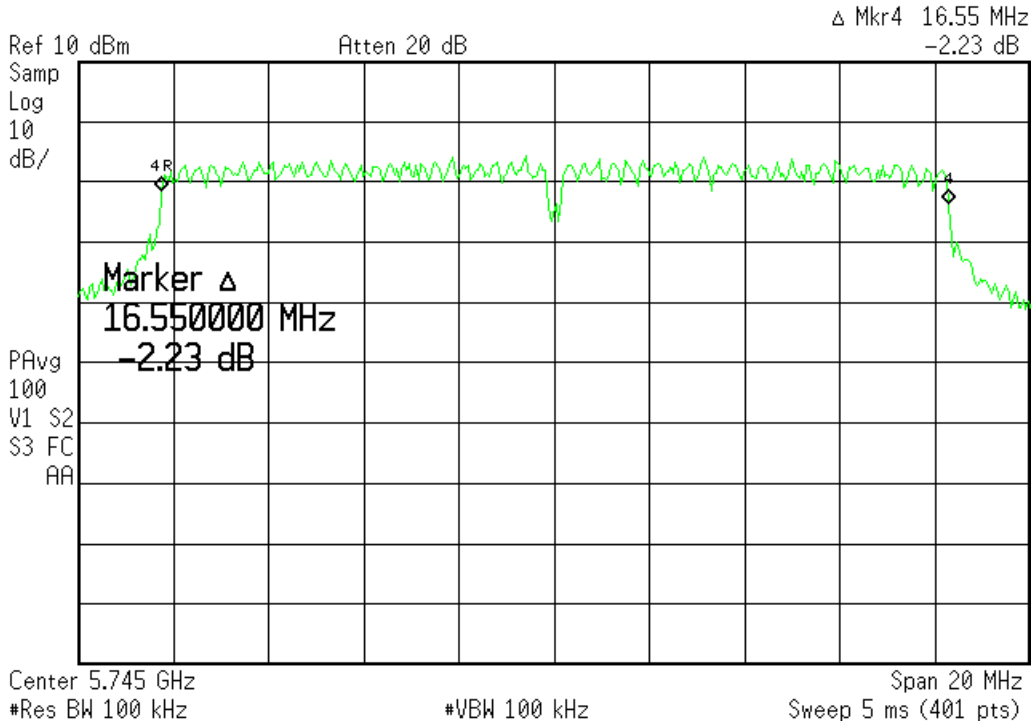
99% BW, 2462MHz,
802.11 G



Transmit Freq Error -27.369 kHz
x dB Bandwidth 18.894 MHz*

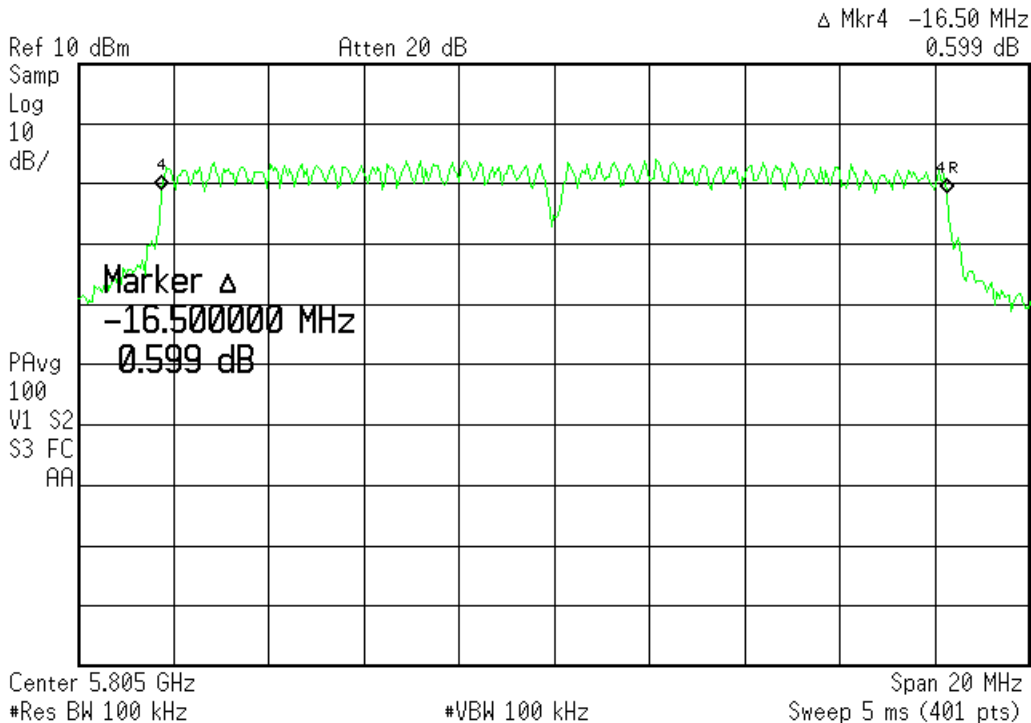
Agilent 18:01:08 May 30, 2005

6 dB BW, 5745MHz,
802.11 A



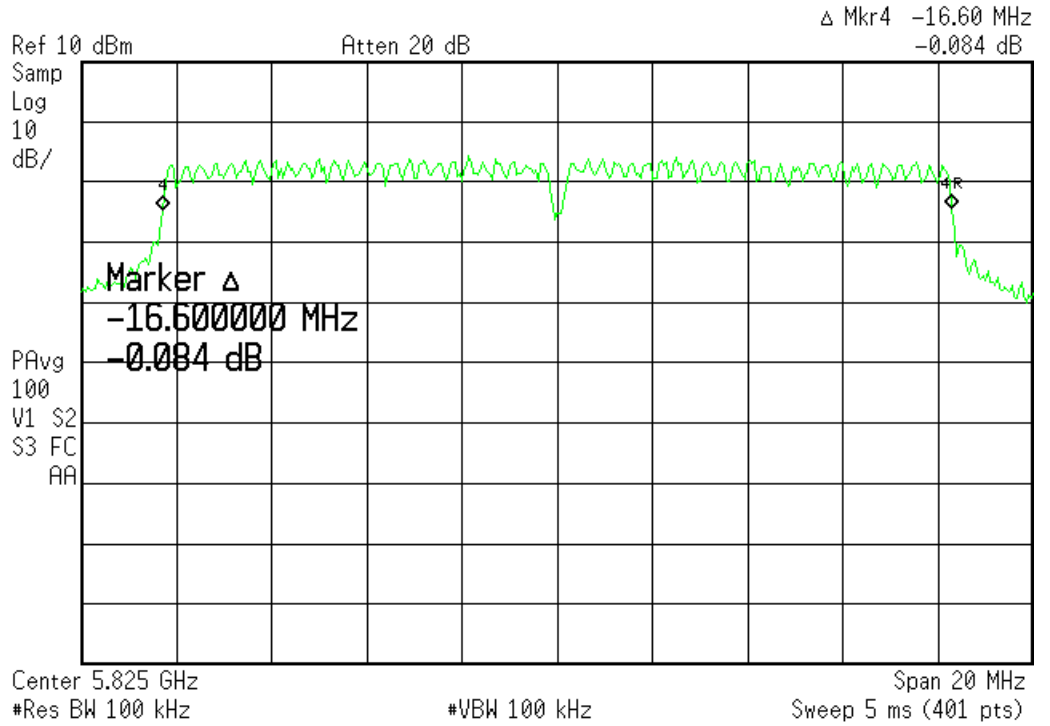
Agilent 17:59:52 May 30, 2005

6 dB BW, 5805MHz,
802.11 A



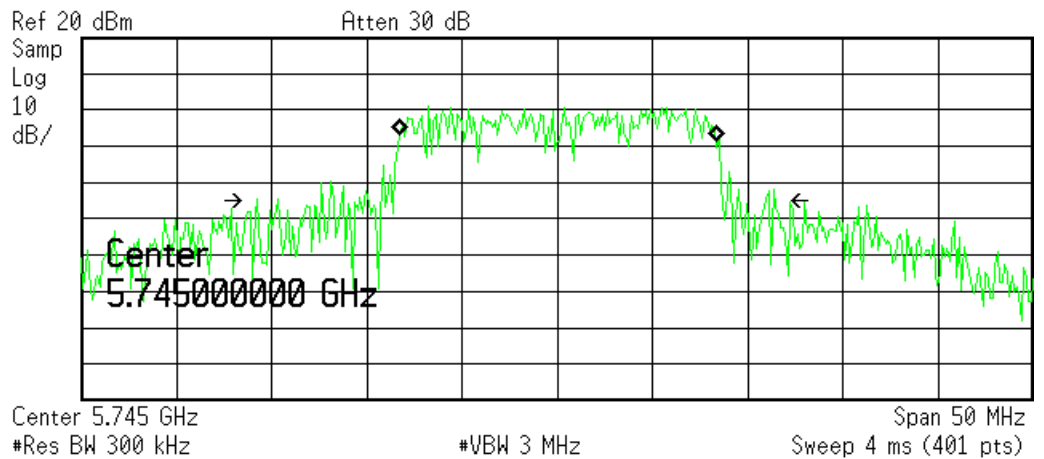
Agilent 17:58:19 May 30, 2005

6 dB BW, 5825MHz,
802.11 A



Agilent 17:53:42 May 30, 2005

99% BW, 5745MHz,
802.11 A



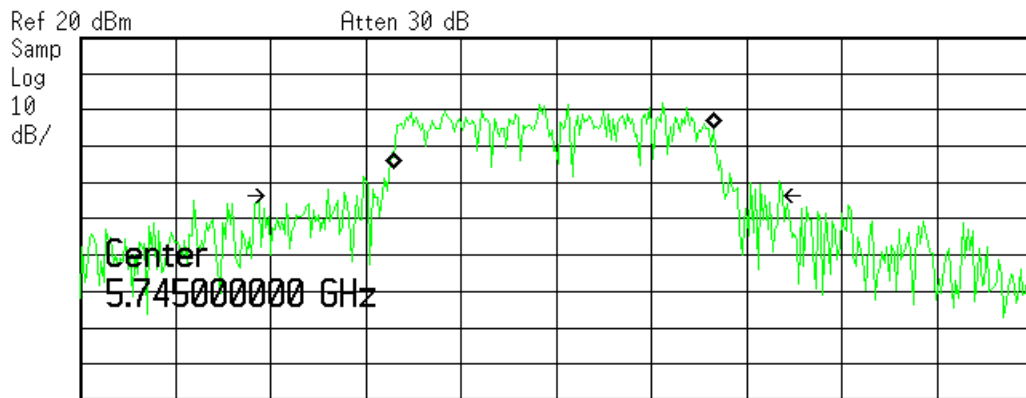
Occupied Bandwidth
16.6538 MHz

Occ BW % Pwr 99.00 %

Transmit Freq Error -43.470 kHz
x dB Bandwidth 25.835 MHz*

Agilent 17:54:32 May 30, 2005

99% BW, 5805MHz,
802.11 A



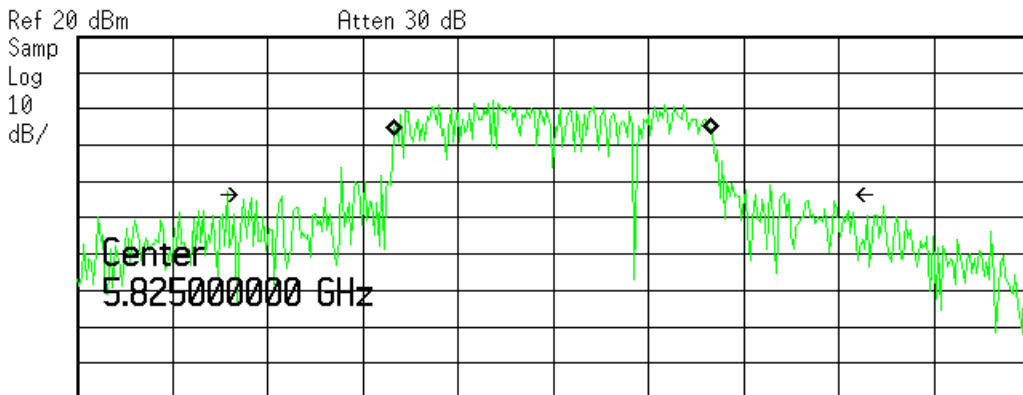
Center 5.805 GHz Span 50 MHz
 #Res BW 300 kHz #VBW 3 MHz Sweep 4 ms (401 pts)

Occupied Bandwidth **Occ BW % Pwr** 99.00 %
 16.6924 MHz

Transmit Freq Error -64.007 kHz
x dB Bandwidth 27.597 MHz*

Agilent 17:55:19 May 30, 2005

99% BW, 5825MHz,
802.11 A



Center 5.825 GHz Span 50 MHz
 #Res BW 300 kHz #VBW 3 MHz Sweep 4 ms (401 pts)

Occupied Bandwidth **Occ BW % Pwr** 99.00 %
 16.6477 MHz

Transmit Freq Error -40.792 kHz
x dB Bandwidth 27.386 MHz*

Power Spectral Density

Specifications:

FCC Specification: Paragraph 15.247(4)(d)

IC Specification: RSS-210 .6.2.2(o)(b)

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, the trace was allowed to stabilize. Once the trace was stable, a peak search was performed and the frequency with the maximum power was determined.

The measurement span was then narrowed to 300kHz and centered on the “MAX power” frequency, the RBW was then set to 3 kHz with a 100 second sweep. The analyzer was then set to MAX HOLD and a display line placed at +8dBm.

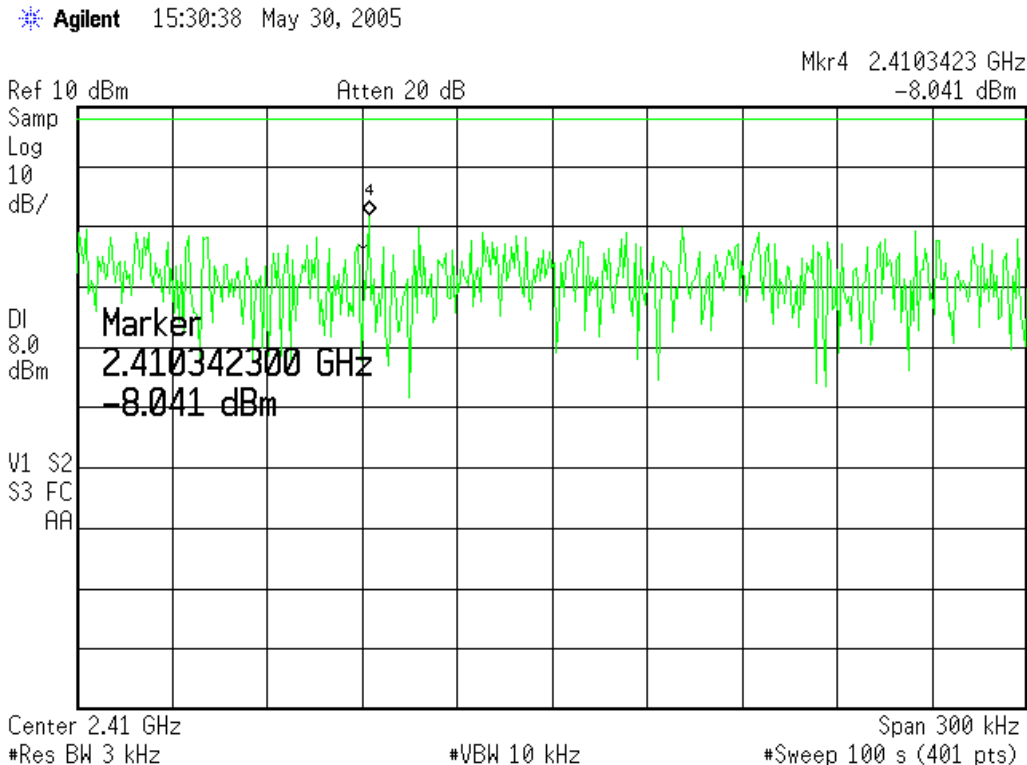
The power spectral density was measured at the low, middle and high-test channels with the appropriate power setting for the given test channel. [The power spectral density data was gathered at the high power setting.](#)

Results:

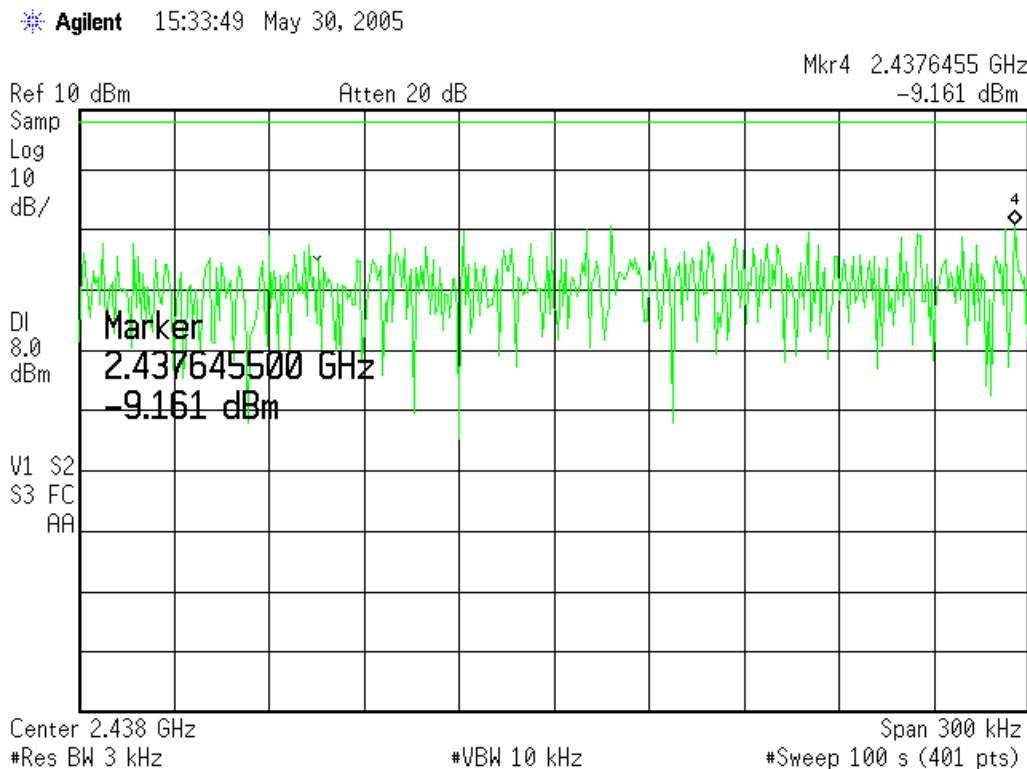
The power spectral density was measured at the highest power setting for each band / mode that will be used in the operation of the radio.

	Frequency (MHz)	Specification (8dBm / 3kHz)	Measured PSD (dBm)	Spec Delta (dB)
802.11 B	2412	8	-8.04	16.04
	2437	8	-9.161	17.161
	2462	8	-9.868	17.868
802.11 G	2412	8	-10.67	18.67
	2437	8	-11.27	19.27
	2462	8	-11.25	19.25
802.11 A	5745	8	-7.873	15.873
	5785	8	-5.764	13.764
	5825	8	-7.042	15.042

Power Spectral Density,
802.11 B, ISM 2412MHz

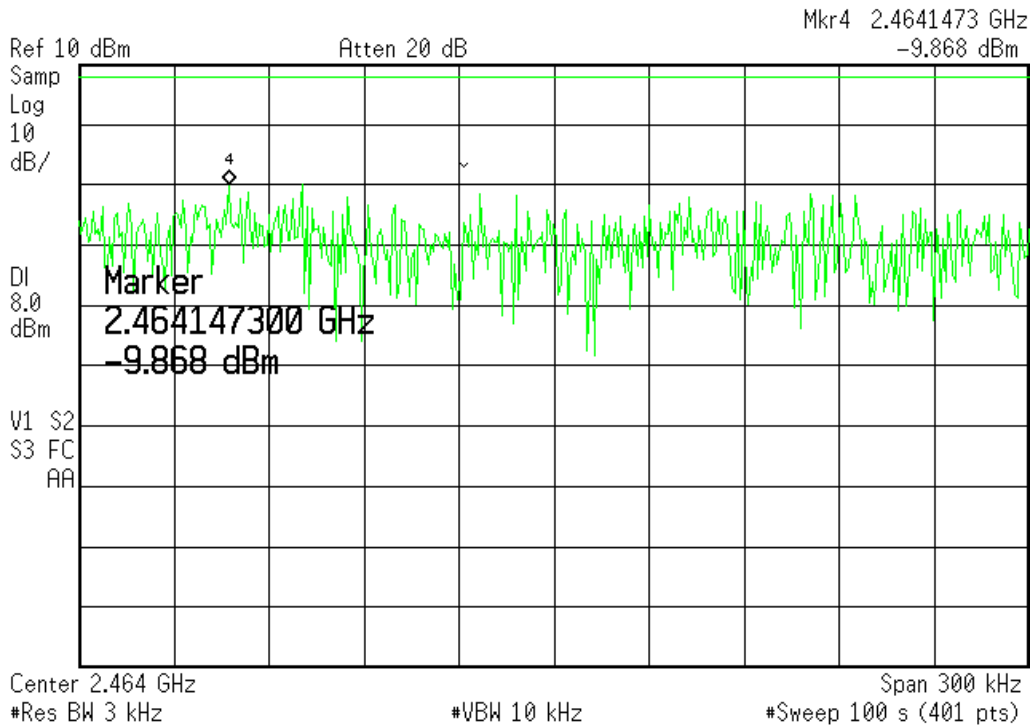


Power Spectral Density,
802.11 B, ISM 2437MHz



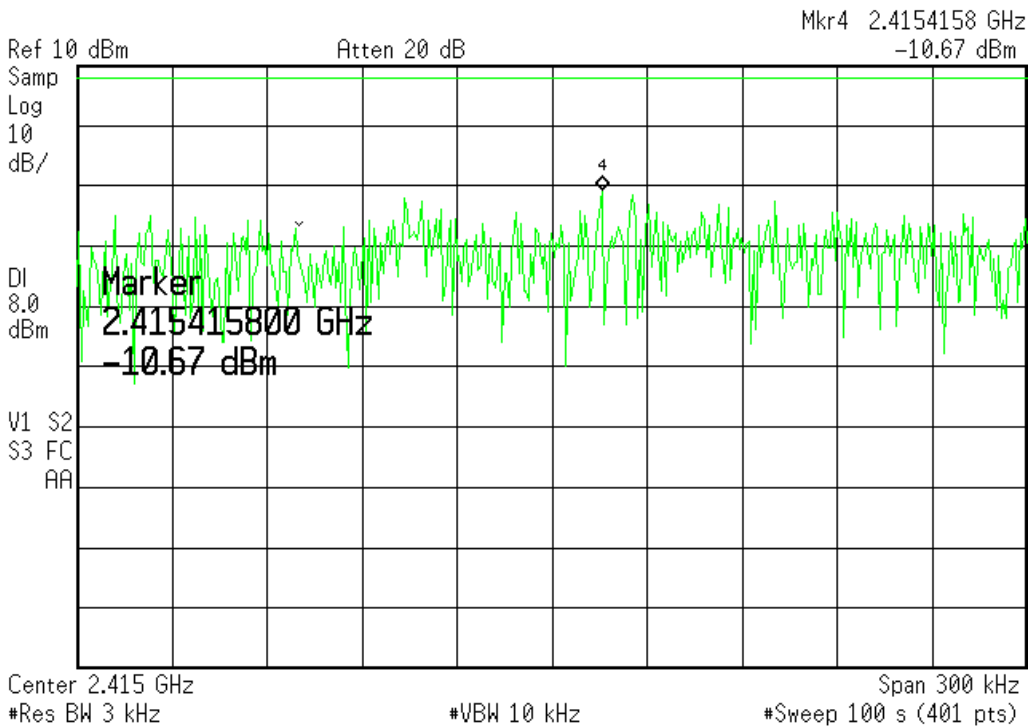
Agilent 15:37:20 May 30, 2005

Power Spectral Density,
802.11 B, ISM 2462MHz



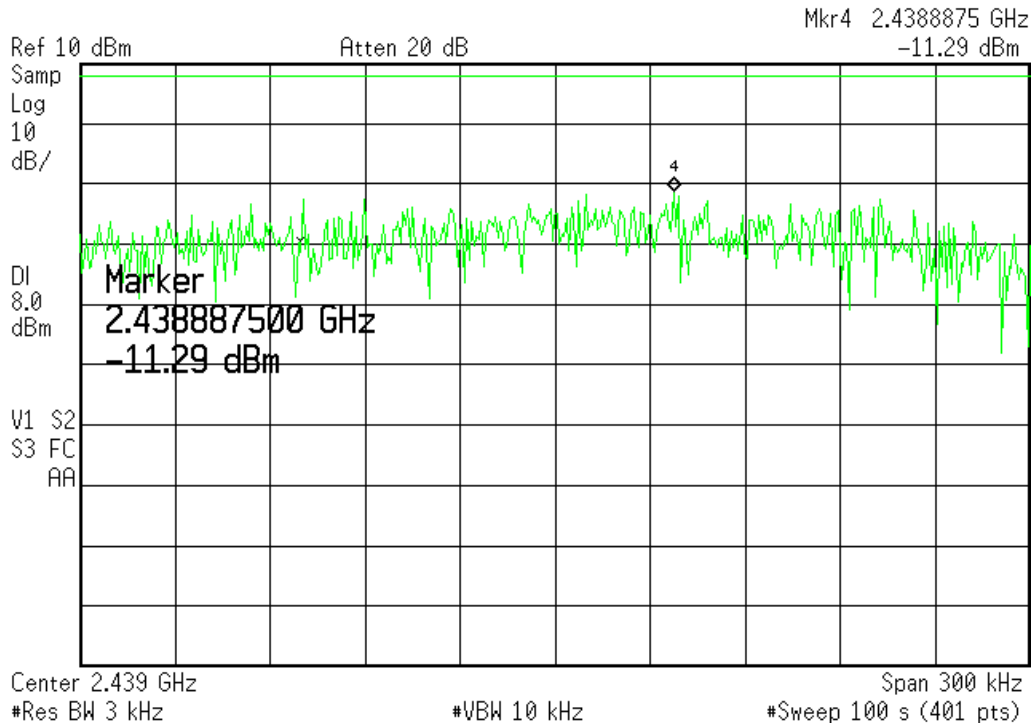
Agilent 15:26:51 May 30, 2005

Power Spectral Density,
802.11 G, ISM 2412MHz



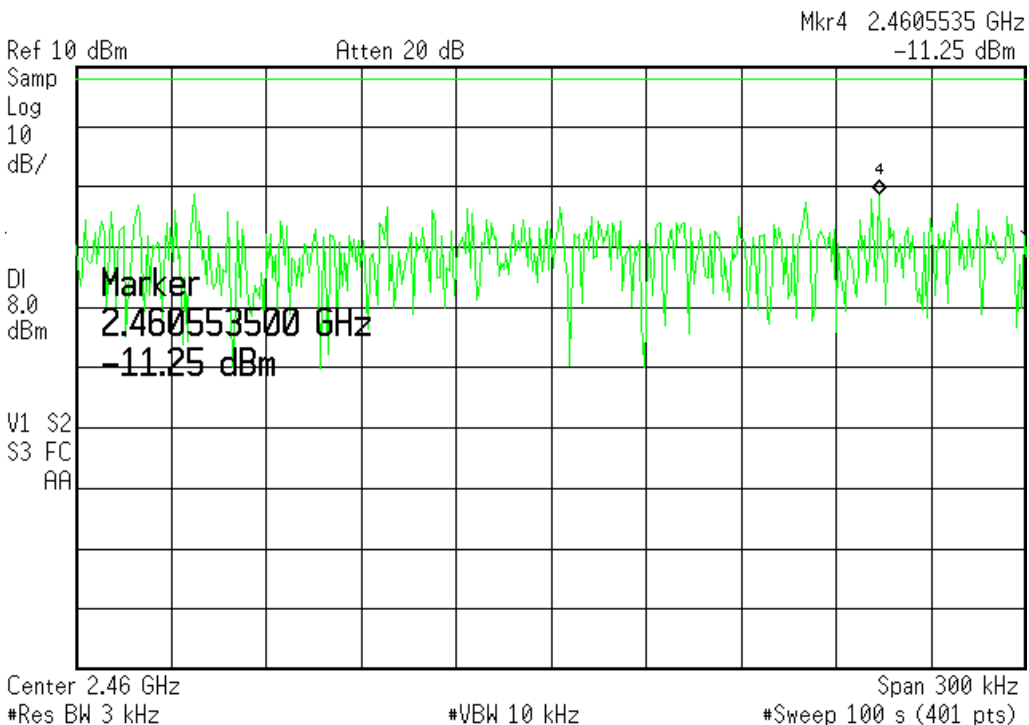
Agilent 15:22:51 May 30, 2005

Power Spectral Density, 802.11 G, ISM 2437MHz



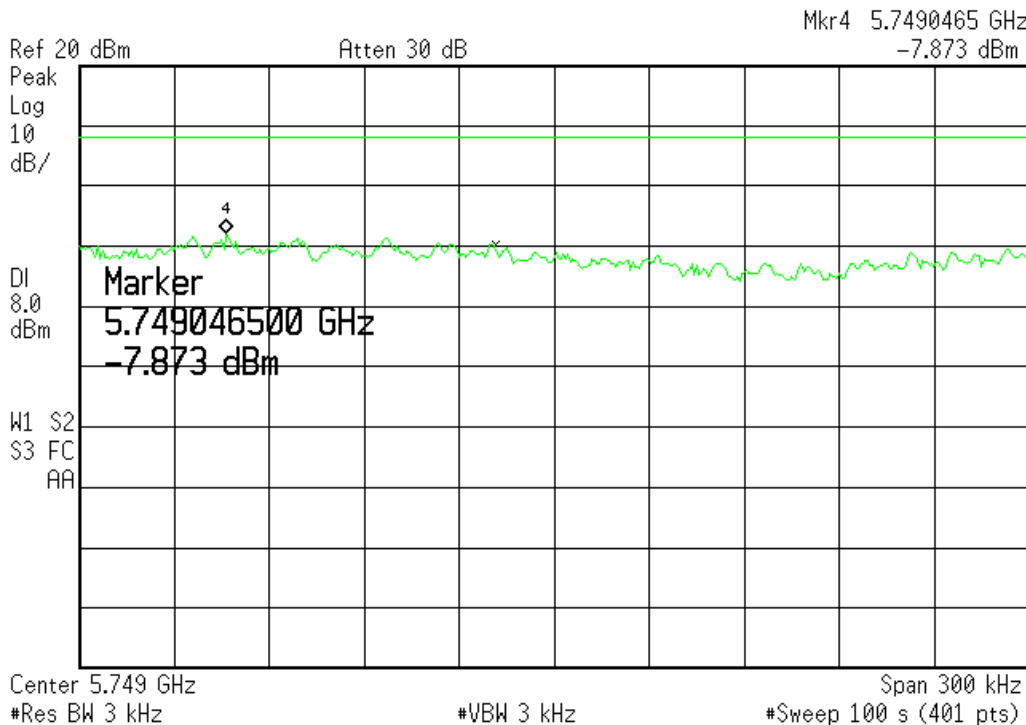
Agilent 15:04:51 May 30, 2005

Power Spectral Density, 802.11 G, ISM 2462MHz



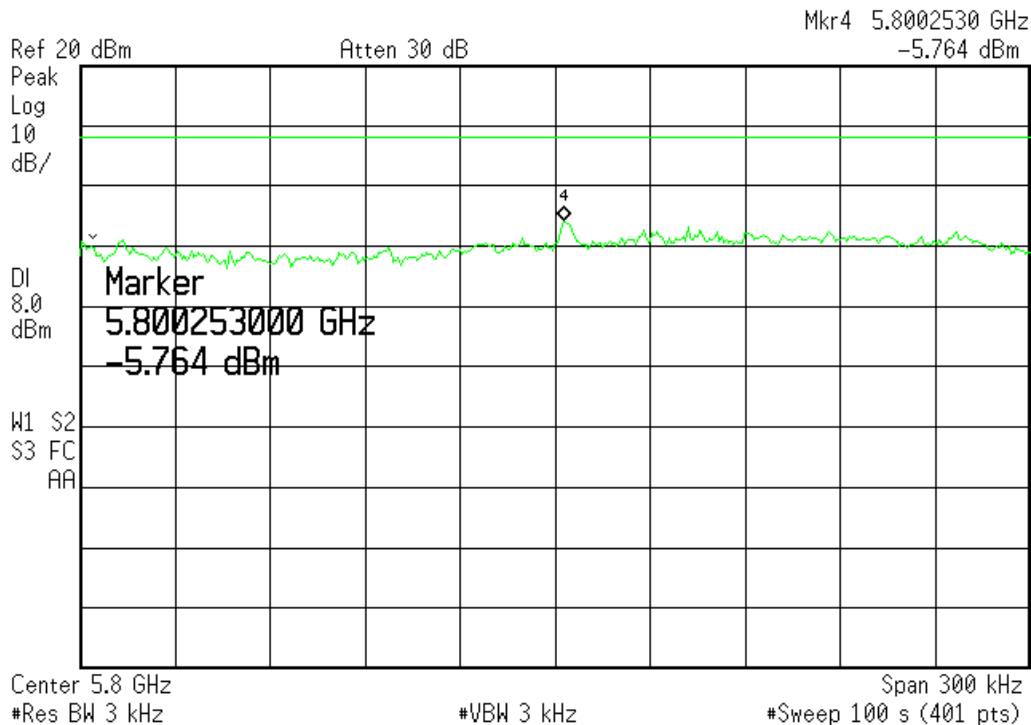
Agilent 19:30:43 May 30, 2005

Power Spectral Density,
802.11 A, ISM 5745MHz



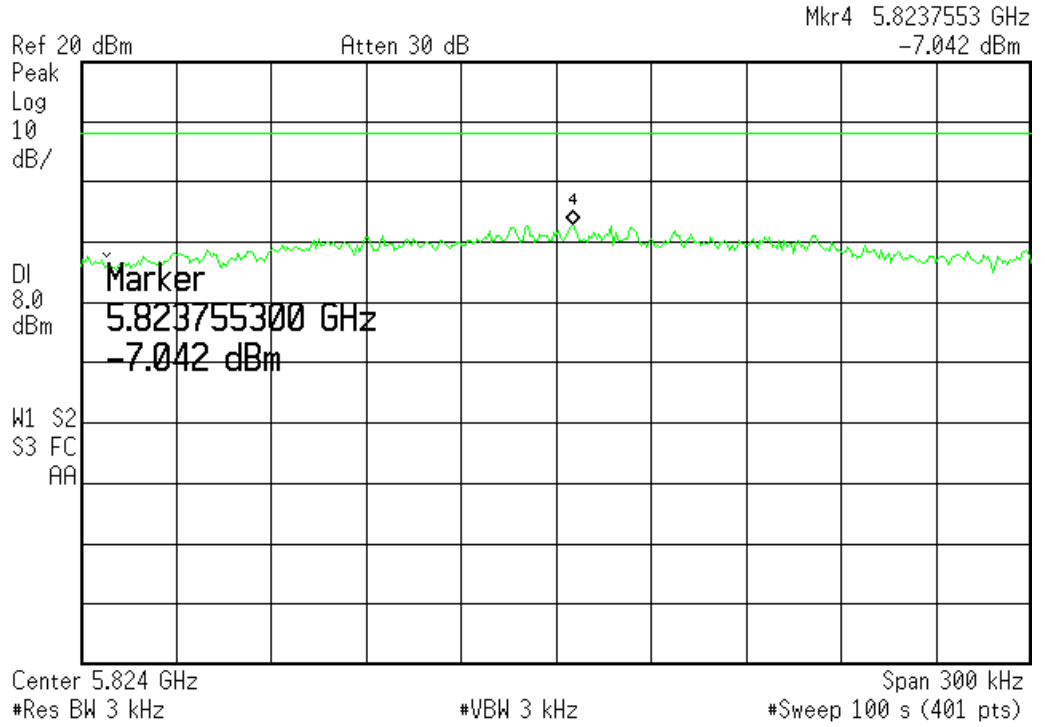
Agilent 19:34:21 May 30, 2005

Power Spectral
Density, 802.11 A, ISM
5805MHz



Agilent 19:37:07 May 30, 2005

Power Spectral Density,
802.11 A, ISM 5825MHz



5.725 & 5.85 GHz Band Edge

Specifications:

FCC Specification: Paragraph 15.247(4)(d)

IC Specification: RSS-210 .6.2.2(o)(b)

Procedure:

The test setup was configured as shown in the conducted test setup. The UUT was configured to continuously transmit random data packets. The span of the analyzer was centered on the 5.725 and 5.85 GHz band edge respectively.

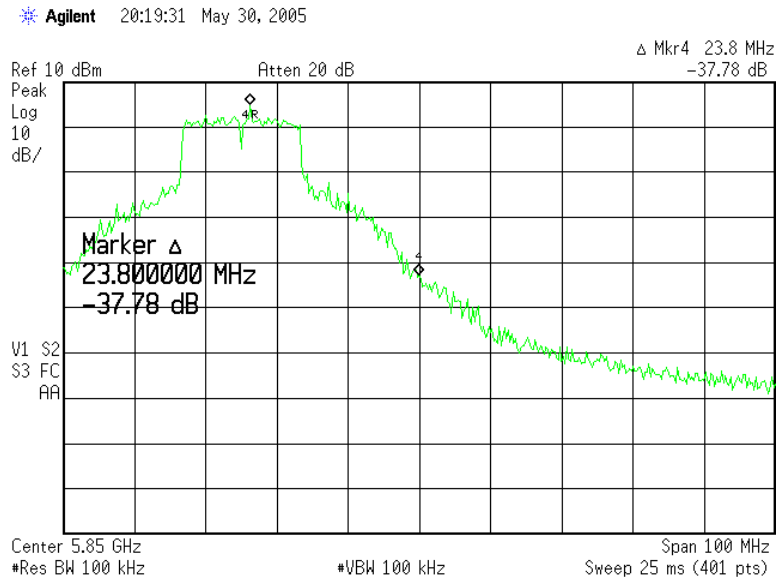
The RBW & VBW were set to 100 kHz. The trace was allowed to stabilize then a Peak-search and a marker delta to the band edge was performed to determine that the carrier power at the band edge was at least 20 dB below the peak of the fundamental level.

Results:

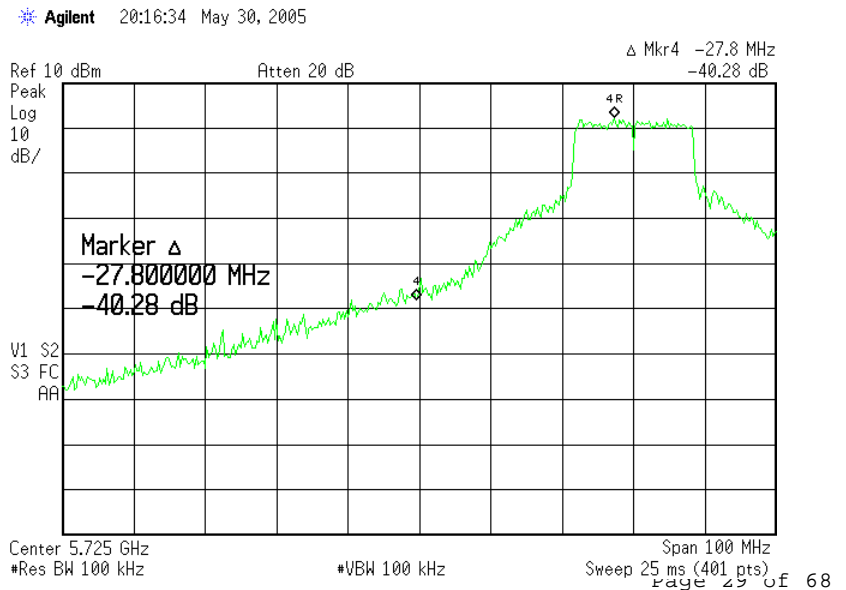
Level at 5.725 GHz: -40.28dBc Spec -20 dBc

Level at 5.85 GHz: -37.78dBc Spec -20 dBc

5.85GHz Bandedge



5.725GHz Bandedge



Radiated Emissions In Restricted Bands & Out Of Band Emissions

Specifications:

FCC Specification: Paragraph 15.247(c)

IC Specification: RSS-210 6.3(c) & RSS-210 .6.2.2(o)(e1)

Procedure:

This test was conducted inside a semi-anechoic chamber at Elliott Laboratories. The unit was placed on a rotating wooden table 80cm above the ground plane. A Horn antenna was 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 at maximum power on each of the channels. The test equipment was configured as shown below.

Out of band emissions starting at 1GHz were measured. A notch or a high pass filter prior to the pre-amplifier was required to prevent the large signal level of the fundamental frequency from overloading the front end preamplifier 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 made by the test software and the appropriate 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.

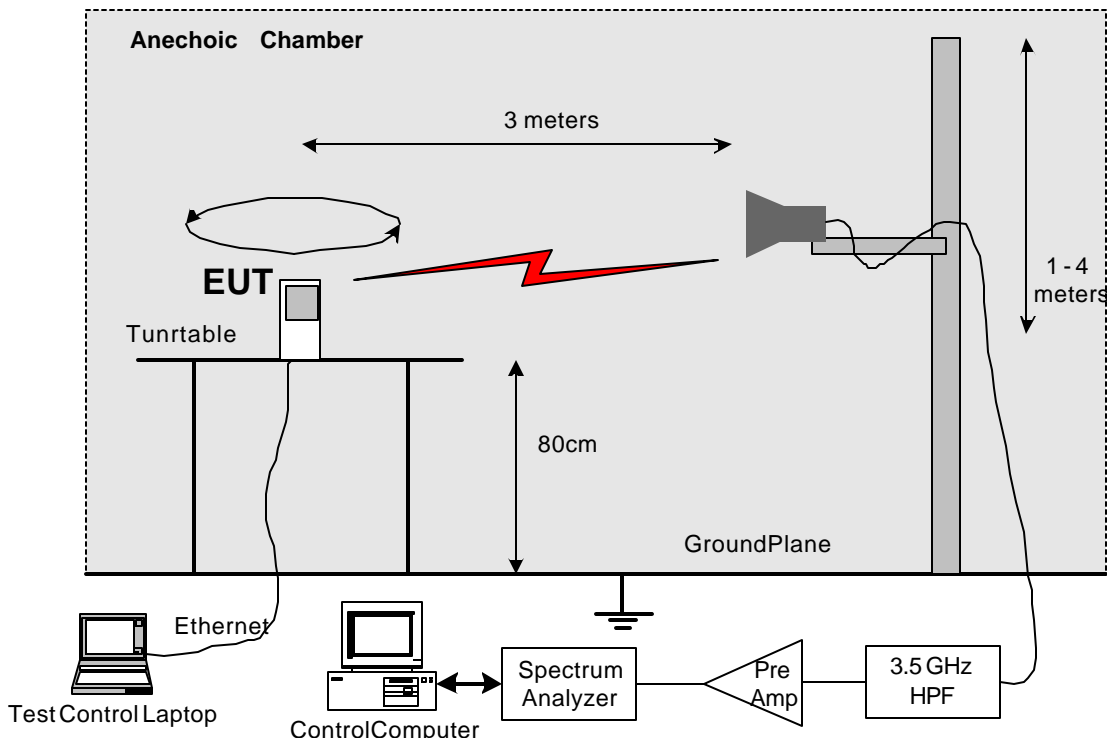
This procedure was performed for all of the channels outlined in the Test Methods section of this report.

The band up to 40 GHz was examined, however there were no spurious emissions noted above approximately 18 GHz. The table below indicates the harmonics that fall within restricted bands.c

Harmonic									
Fund	2	3	4	5	6	7	8	9	10
2412	4824	7236	9648	12060	14472	16884	19296	21708	24120
2437	4874	7311	9748	12185	14622	17059	19496	21933	24370
2462	4924	7386	9848	12310	14772	17234	19696	22158	24620
5745	11490	17235	22980	28725	34470	40215	45960	51705	57450
5805	11610	17415	23220	29025	34830	40635	46440	52245	58050
5825	11650	17475	23300	29125	34950	40775	46600	52425	58250

15.205 Harmonic test tables

NOTE: RED indicates a harmonic that falls within a restricted band and is subject to 15.205. The harmonics in Green are NOT in restricted bands and are subject to 15.20. Orange is in a restricted band that does not require testing.



Radiated Emissions in Restricted Bands Test Setup

Support Equipment				
Description	Model number	FCC ID or SN	Manufacturer	Power Cable
Laptop, Generic	A20	DoC	IBM	Laptop PS
Test Software	Atheros Radio Test		Atheros	
48VDC AC adapter	Generic		Generic	Standard Twin lead DC wire

Test Conditions			
Temperature	22 C	Humidity:	43%
ATM pressure	1023 mBar	Grounding:	None
Tested By	Various Test Engineers of Elliott Labs (Y Noor, J Martinez, C Chu, A LaCrosse)	Date of Test:	April 2005
Test Reference	FCC Part 15.205 IC Paragraph RSS210, 6.2.3 (c)		
Setup Method	ANSI C63.4		
Tested Range	1 GHz to 25GHz (Data for 1 – 18GHz presented, No describable emission above 18 GHz)		
Test Voltage	48 VDC		
Modifications	No modifications were made to the unit		

NOTES: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.

No Emissions were detected above 18 GHz

Restricted Band Peak Measurements: Resolution and Video BW: 1 MHz
 Restricted Band Average Measurements: Resolution BW: 1MHz and Video BW: 10 Hz.
 All other measurements, RBW = 1MHz and VBW = 3MHz, video averaging on (100 samples).

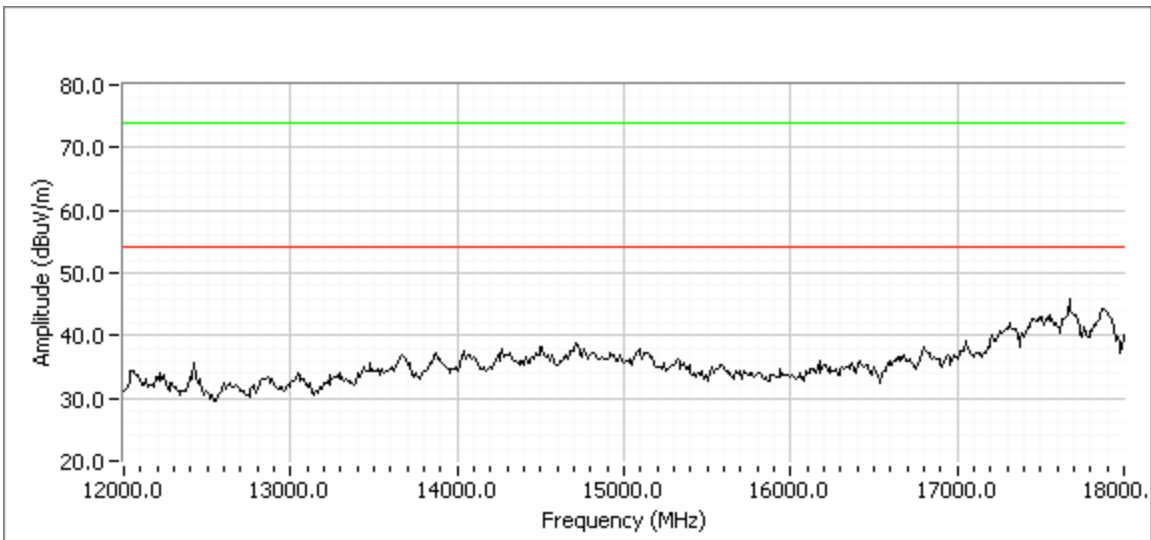
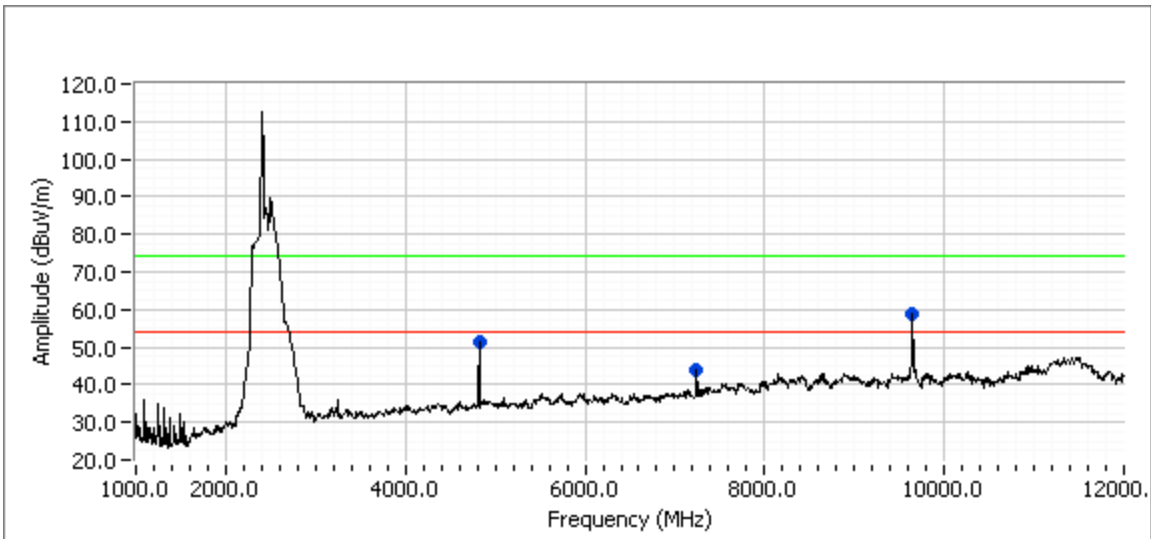
Results:

The tables below presents a summary of the radiated emission in restricted bands for the low, middle and high channels for both 802.11 B , 802.11 G SM modes of operation. Associated plots follow each table. In no case were there describable emissions above 18GHz

802.11 B 15 dBi Yagi Antenna

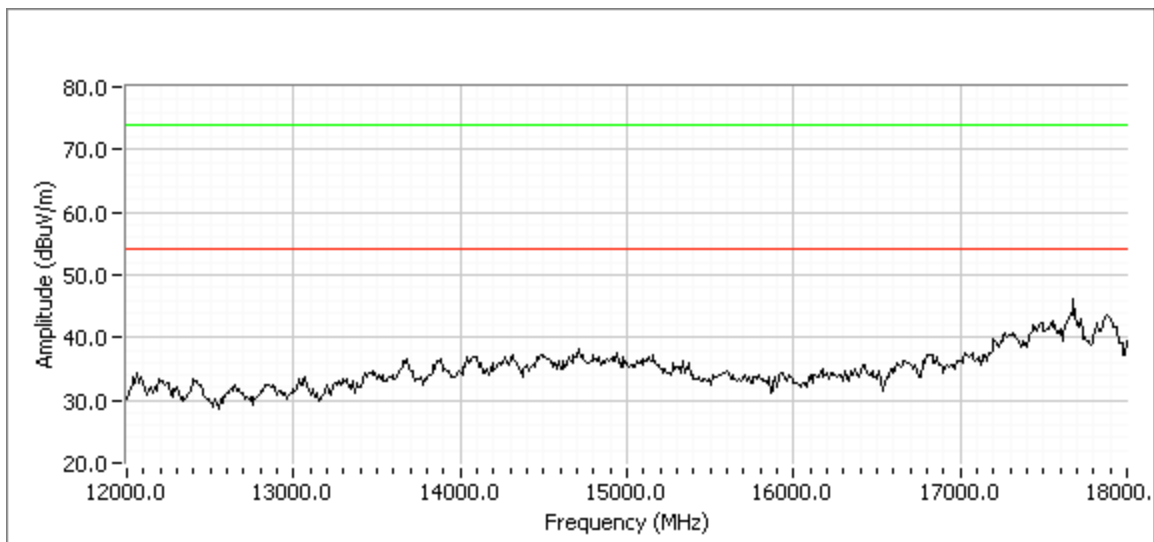
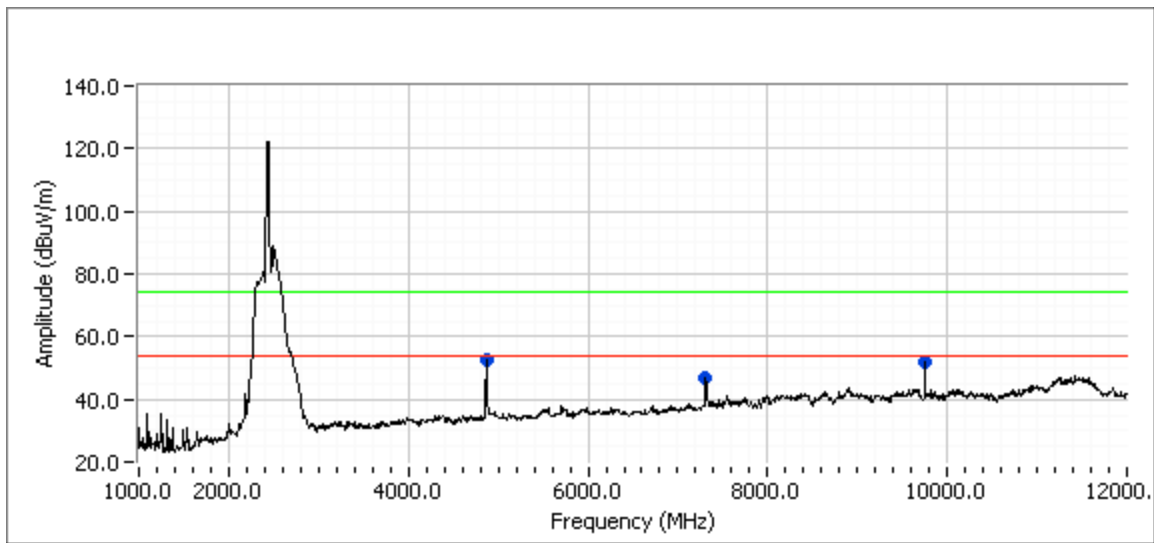
2412 MHz B 15 dBi Yagi

Frequency MHz	Level dBµV/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2412b	117.8	V	-	-	AVG	350	1.0	Ch#1 Fundamental
2412b	120.7	V	-	-	PK	350	1.0	Ch#1 Fundamental
2412b	97.1	H	-	-	AVG	147	1.5	Ch#1 Fundamental
2412b	100.3	H	-	-	PK	147	1.5	Ch#1 Fundamental
4824.040	50.6	V	54.0	-3.4	AVG	80	1.5	Restricted
4824.040	52.7	V	74.0	-21.3	PK	80	1.5	Restricted
9648.011	60.6	V	90.7	-30.1	PK	270	1.6	Non-restricted
7239.091	49.0	V	90.7	-41.7	PK	73	2.0	Non-restricted



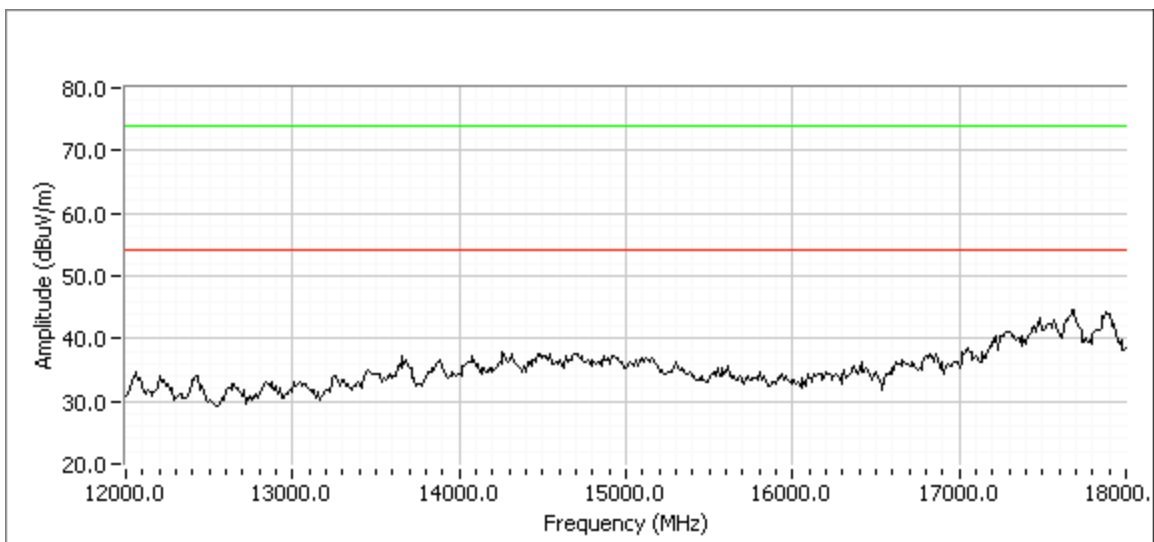
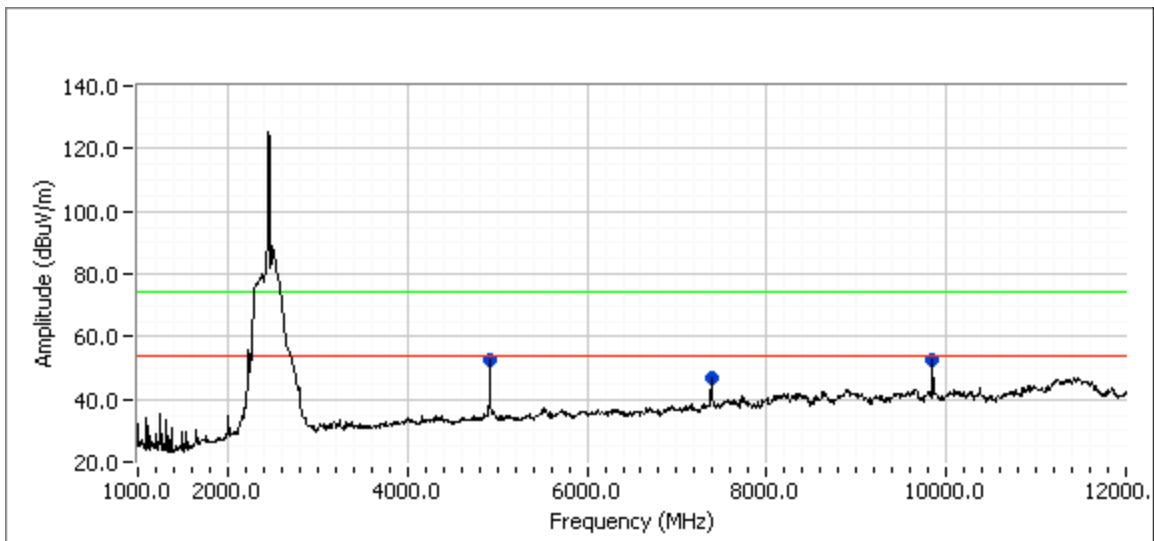
2437MHz B 15 dBi Yagi

Frequency MHz	Level dBµV/m	Pol v/h	FCC 15.209/15.247		Detector PK/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2437b	118.1	V	-	-	AVG	347	1.0	Ch#6 Fundamental
2437b	120.4	V	-	-	PK	347	1.0	Ch#6 Fundamental
2437b	98.9	H	-	-	AVG	150	1.2	Ch#6 Fundamental
2437b	101.7	H	-	-	PK	150	1.2	Ch#6 Fundamental
4873.893	49.7	V	54.0	-4.3	AVG	81	1.5	Restricted
4873.893	51.5	V	74.0	-22.5	PK	81	1.5	Restricted
7308.336	48.5	V	54.0	-5.5	AVG	147	1.5	Restricted
7308.336	53.4	V	74.0	-20.6	PK	147	1.5	Restricted
9748.021	53.9	V	90.4	-36.5	PK	248	1.5	Non-restricted



2462MHz B 15 dBi Yagi

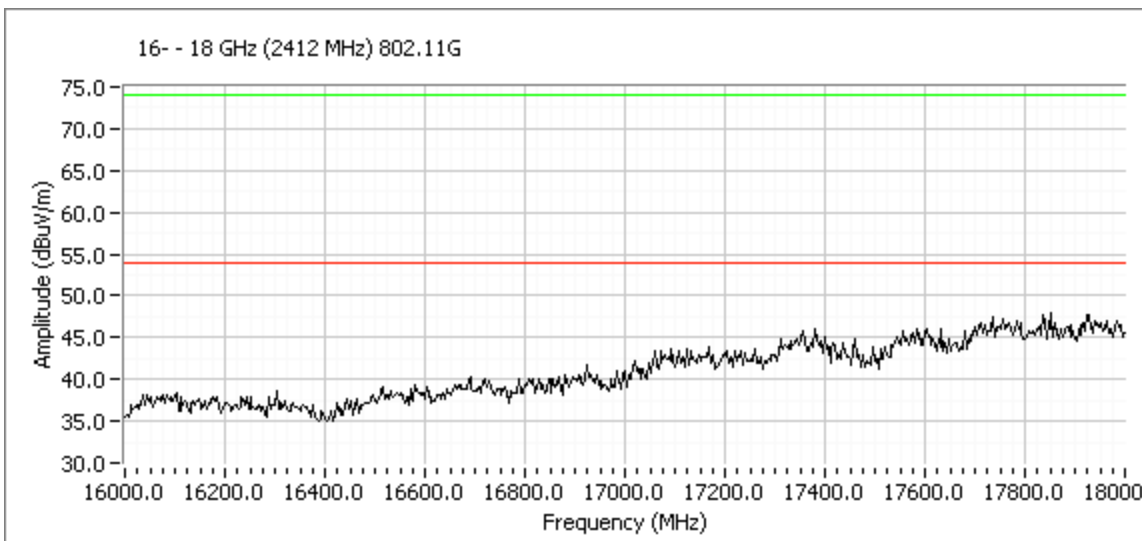
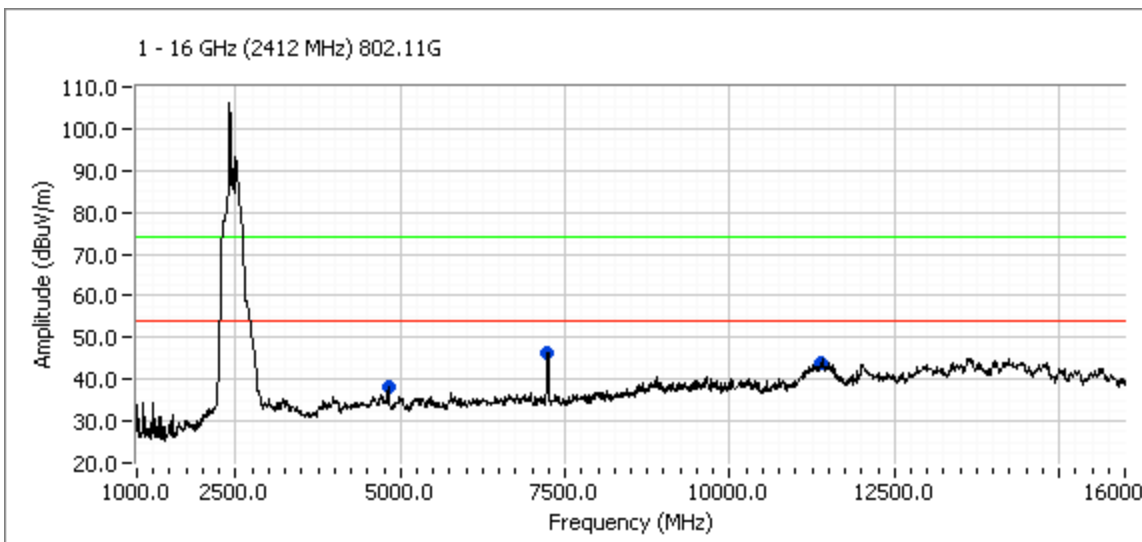
Frequency MHz	Level dBµV/m	Pol v/h	FCC 15.209/15.247		Detector PK/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2462b	117.6	V	-	-	AVG	354	1.0	Ch#11 Fundamental
2462b	120.4	V	-	-	PK	354	1.0	Ch#11 Fundamental
2462b	99.2	H	-	-	AVG	146	1.0	Ch#11 Fundamental
2462b	101.9	H	-	-	PK	146	1.0	Ch#11 Fundamental
4923.965	48.8	V	54.0	-5.2	AVG	76	1.5	Restricted
4923.965	51.1	V	74.0	-22.9	PK	76	1.5	Restricted
7385.430	45.8	V	54.0	-8.2	AVG	142	2.3	Restricted
7385.430	51.2	V	74.0	-22.8	PK	142	2.3	Restricted
9847.980	54.9	V	90.4	-35.5	PK	274	1.5	Non-Restricted



802.11 G 15 dBi Yagi Antenna

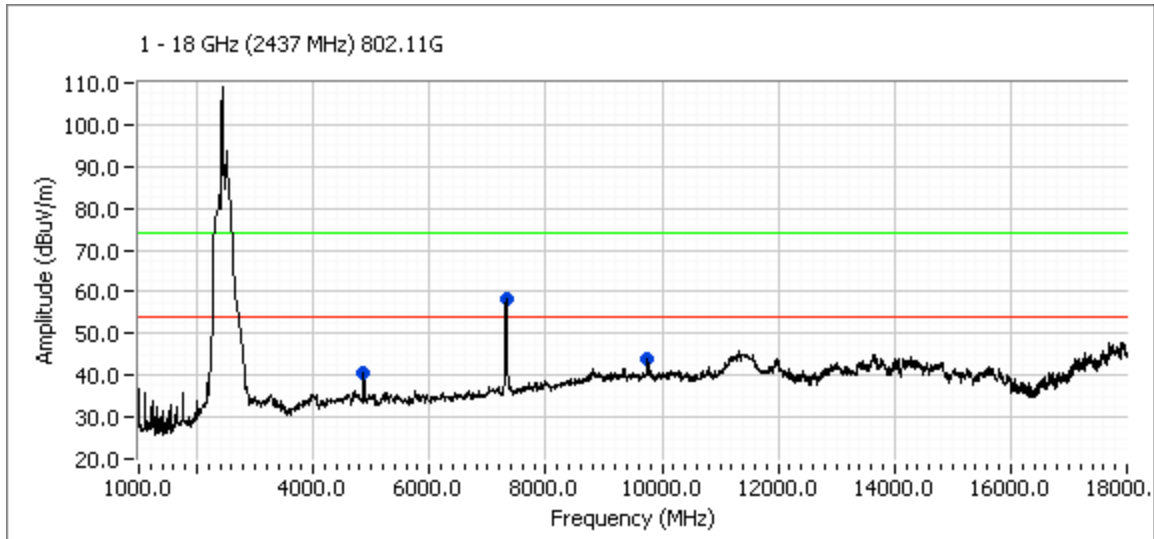
2412MHz G 15 dBi Yagi

Frequency MHz	Level dBmV/m	Pol v/h	FCC 15.209/15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2412.975	88.6	H	-	-	AVG	200	1.3	Fundamental
2412.975	97.6	H	-	-	PK	200	1.3	Fundamental
2413.375	109.0	V	-	-	AVG	-4	1.5	Fundamental
2413.375	118.2	V	-	-	PK	-4	1.5	Fundamental
7233.405	59.2	V	98.2	-32.6	PK	352	1.0	Non-Restricted
11391.69	40.3	V	54.0	-13.7	AVG	271	1.0	Restricted
11391.69	50.9	V	74.0	-23.1	PK	271	1.0	Restricted
4820.00	38.1	V	54.0	-15.9	Peak	165	1.2	Restricted



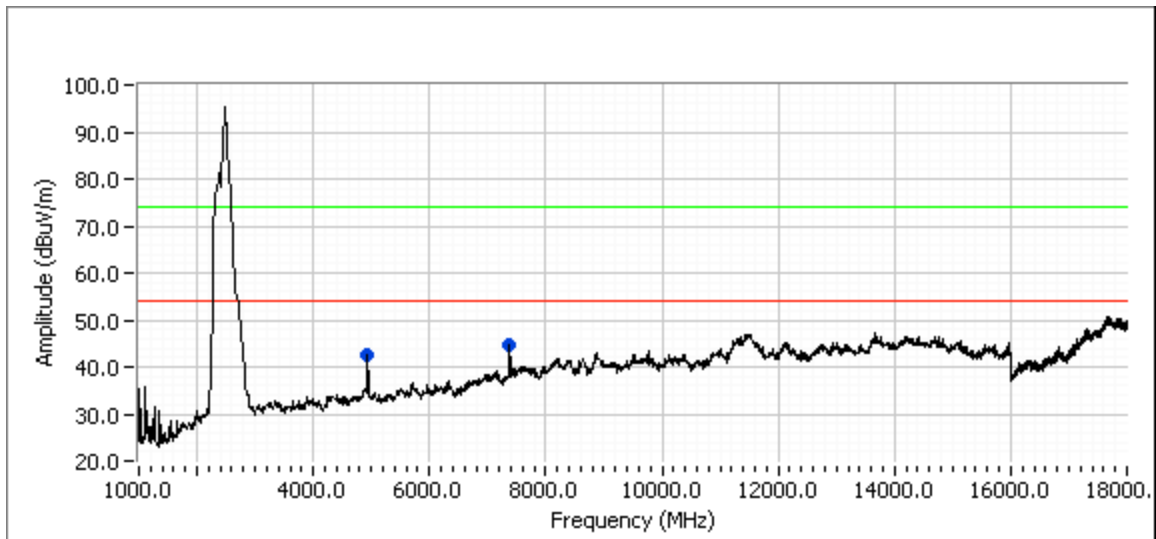
2437MHz G 15 dBi Yagi

Frequency MHz	Level dB μ V/m	Pol v/h	FCC 15.209/15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
9751.556	40.2	V	54.0	-13.8	AVG	334	1.0	Non-Restricted
9751.556	54.5	V	74.0	-19.5	PK	334	1.0	Non-Restricted
7312.192	52.6	V	54.0	-1.4	AVG	173	1.8	Restricted
7312.192	67.9	V	74.0	-6.2	PK	173	1.8	Restricted
4872.396	35.3	V	54.0	-18.7	AVG	159	1.2	Restricted
4872.396	46.9	V	74.0	-27.1	PK	159	1.2	Restricted



2462MHz G 15 dBi Yagi

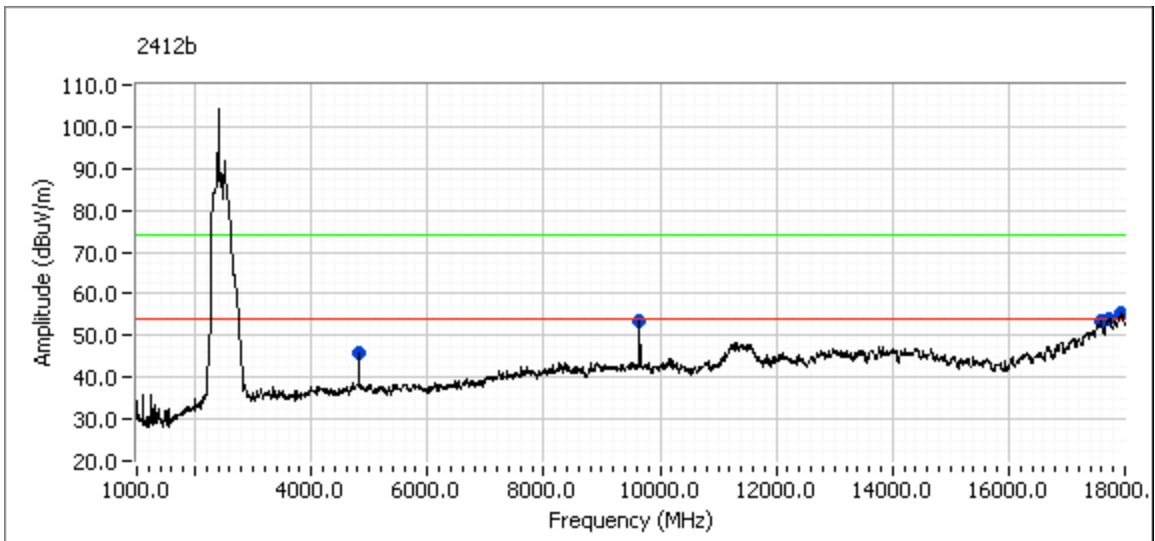
Frequency MHz	Level dBμV/m	Pol v/h	FCC 15.209/15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2463.067	124.7	V	-	-	AVG	350	1.5	Fundamental
2463.067	133.7	V	-	-	PK	350	1.5	Fundamental
2463.010	106.9	H	-	-	AVG	83	1.0	Fundamental
2463.010	115.2	H	-	-	PK	83	1.0	Fundamental
7388.231	48.3	V	54.0	-5.7	AVG	354	1.0	Restricted
7388.231	63.2	V	74.0	-10.8	PK	354	1.0	Restricted
4923.312	51.2	V	54.0	-2.8	AVG	71	1.0	Restricted
4923.312	65.8	V	74.0	-8.2	PK	71	1.0	Restricted



802.11 B 8.5 dBi Panel Antenna

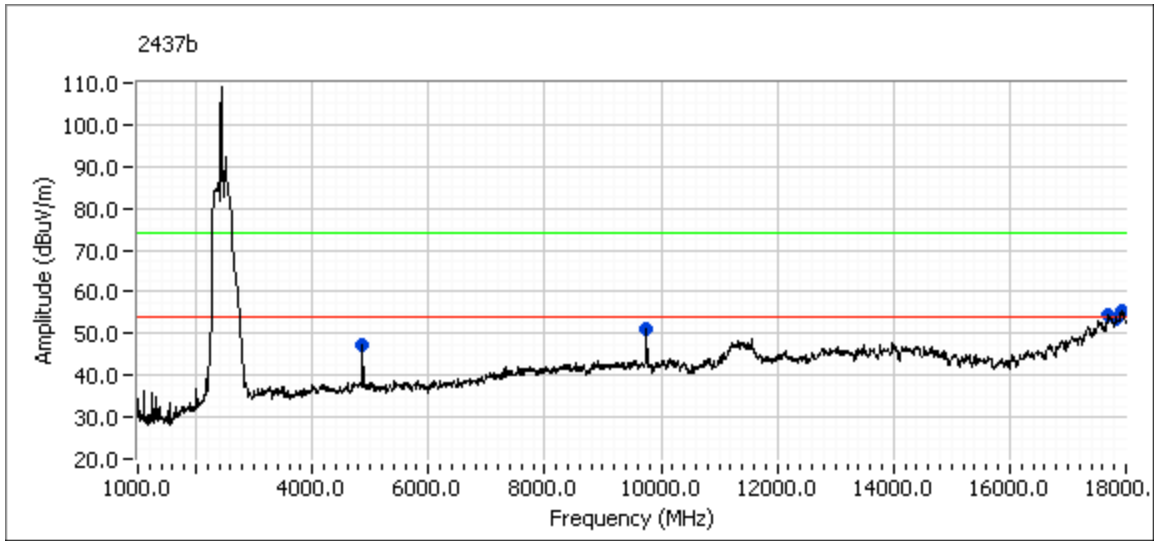
2412 MHz B, 8.5 dBi Panel

Frequency MHz	Level dBµV/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2412b	111.6	V	-	-	AVG	354	1.0	CH#1 Fundamental
2412b	114.6	V	-	-	PK	354	1.0	CH#1 Fundamental
2412b	95.5	H	-	-	AVG	329	1.0	CH#1 Fundamental
2412b	98.5	H	-	-	PK	329	1.0	CH#1 Fundamental
17718.14	49.6	H	54.0	-4.4	AVG	186	2.0	Restricted
17718.14	60.3	H	74.0	-13.7	PK	186	2.0	Restricted
17592.99	59.9	V	84.6	-24.7	PK	241	2.2	Non-restricted
4824.13	45.2	V	54.0	-8.8	AVG	251	1.5	Restricted
4824.13	49.7	V	74.0	-24.4	PK	251	1.5	Restricted
9647.86	58.5	V	84.6	-26.1	PK	272	1.2	Non-restricted
17932.89	50.8	H	54.0	-3.2	AVG	297	2.0	Restricted
17932.89	61.9	H	74.0	-12.1	PK	297	2.0	Restricted



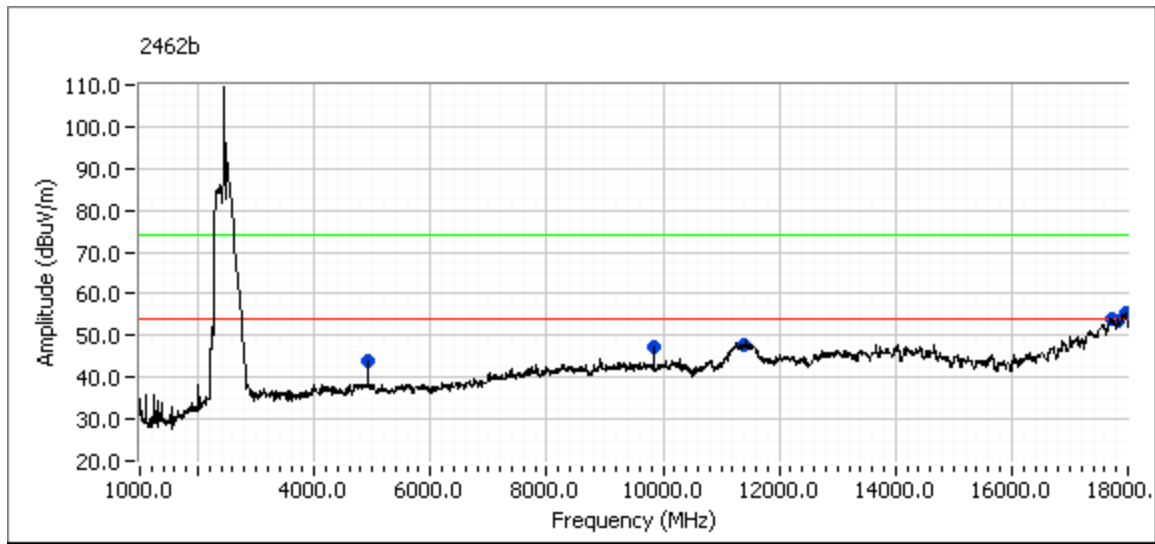
2437 MHz B, 8.5 dBi Panel

Frequency MHz	Level dBµV/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2437b	112.8	V	-	-	AVG	0	1.0	Ch#6 Fundamental
2437b	115.4	V	-	-	PK	0	1.0	Ch#6 Fundamental
2437b	97.7	H	-	-	AVG	330	1.0	Ch#6 Fundamental
2437b	100.5	H	-	-	PK	330	1.0	Ch#6 Fundamental
4874.061	47.8	V	54.0	-6.2	AVG	77	1.1	Restricted
4874.061	51.6	V	74.0	-22.4	PK	77	1.1	Restricted
17944.34	50.8	V	54.0	-3.2	AVG	181	1.0	Restricted
17944.34	61.4	V	74.0	-12.6	PK	181	1.0	Restricted
9747.91	54.9	V	85.4	-30.5	PK	270	1.0	Non-restricted
17691.34	48.9	H	54.0	-5.1	AVG	292	2.0	Restricted
17691.34	59.7	H	74.0	-14.3	PK	292	2.0	Restricted
17845.28	49.6	V	54.0	-4.4	AVG	348	1.5	Restricted
17845.28	60.4	V	74.0	-13.6	PK	348	1.5	Restricted



2462 MHz B, 8.5 dBi Panel

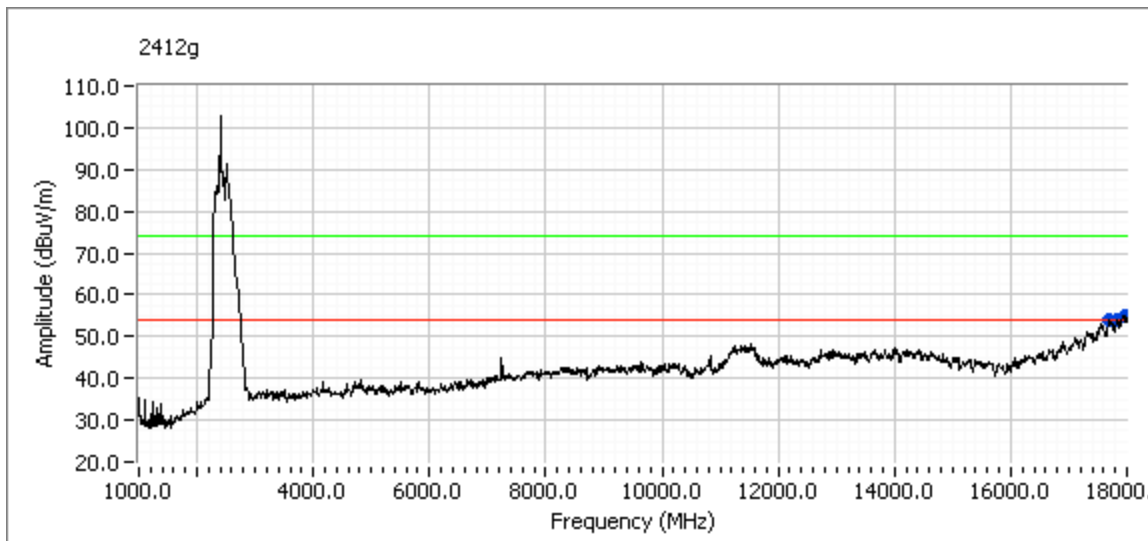
Frequency MHz	Level dBµV/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2462b	111.8	V	-	-	AVG	355	1.0	Ch#11 Fundamental
2462b	114.5	V	-	-	PK	355	1.0	Ch#11 Fundamental
2462b	93.3	H	-	-	AVG	324	1.0	Ch#11 Fundamental
2462b	96.0	H	-	-	PK	324	1.0	Ch#11 Fundamental
11395.51	43.4	H	54.0	-10.7	AVG	0	2.5	Restricted
11395.51	54.6	H	74.0	-19.4	PK	0	2.5	Restricted
4924.01	40.6	H	54.0	-13.4	AVG	35	1.0	Restricted
4924.01	47.9	H	74.0	-26.1	PK	35	1.0	Restricted
17970.07	51.1	V	54.0	-2.9	AVG	199	1.0	Restricted
17970.07	62.1	V	74.0	-11.9	PK	199	1.0	Restricted
17833.03	49.3	H	54.0	-4.7	AVG	203	2.5	Restricted
17833.03	60.5	H	74.0	-13.5	PK	203	2.5	Restricted
9847.84	52.1	V	84.5	-32.4	PK	280	1.0	Non-restricted
17712.99	49.7	H	54.0	-4.3	AVG	305	2.0	Restricted
17712.99	61.1	H	74.0	-12.9	PK	305	2.0	Restricted



802.11 G 9 dBi Panel Antenna

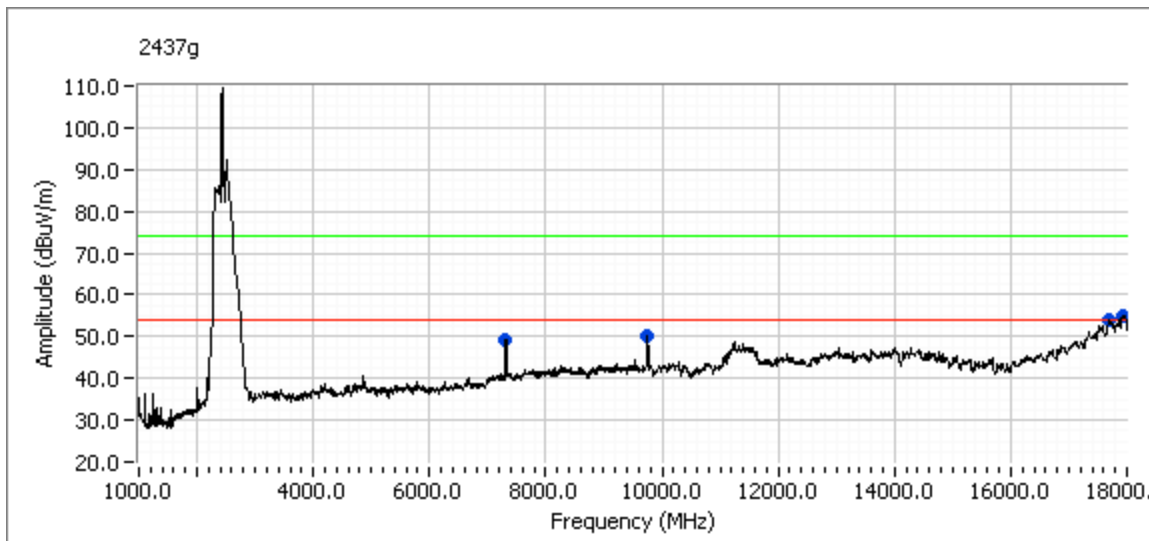
2412 MHz G, 8.5 dBi Panel

Frequency MHz	Level dBµV/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2412g	109.4	V	-	-	AVG	359	1.0	CH#1 Fundamental
2412g	117.7	V	-	-	PK	359	1.0	CH#1 Fundamental
2412g	95.7	H	-	-	AVG	331	1.0	CH#1 Fundamental
2412g	104.5	H	-	-	PK	331	1.0	CH#1 Fundamental
17701.91	49.2	H	54.0	-4.8	AVG	21	2.3	Restricted
17701.91	61.2	H	74.0	-12.8	PK	21	2.3	Restricted
17833.78	49.0	H	54.0	-5.0	AVG	121	2.5	Restricted
17833.78	60.4	H	74.0	-13.6	PK	121	2.5	Restricted
17955.98	51.0	H	54.0	-3.0	AVG	278	1.0	Restricted
17955.98	61.4	H	74.0	-12.6	PK	278	1.0	Restricted



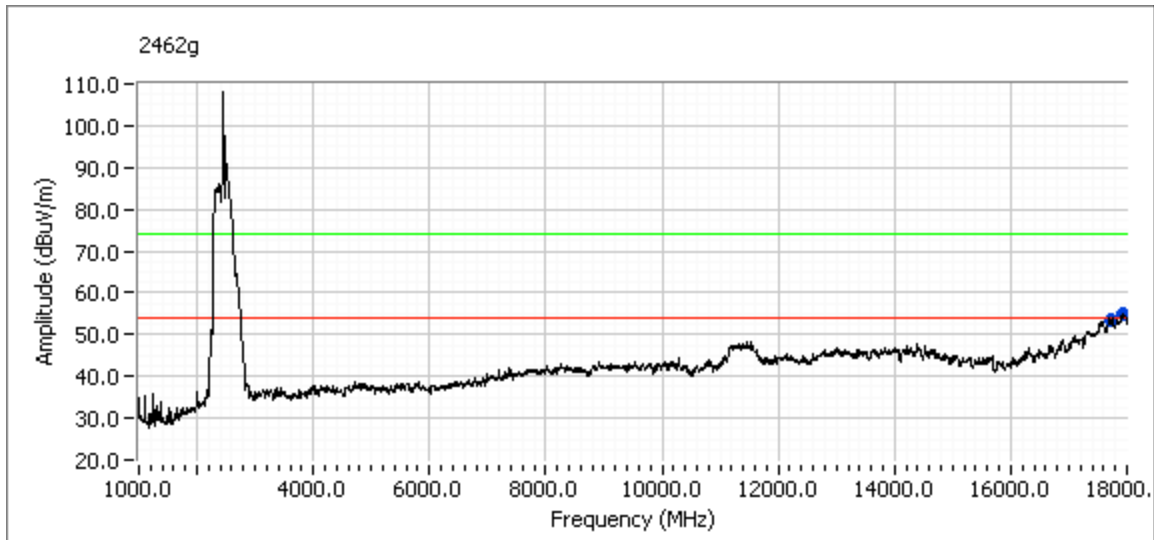
2437 MHz G, 8.5 dBi Panel

Frequency MHz	Level dBµV/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2437g	112.2	V	-	-	AVG	0	1.0	Ch#6 Fundamental
2437g	120.6	V	-	-	PK	0	1.0	Ch#6 Fundamental
2437g	97.3	H	-	-	AVG	332	1.0	Ch#6 Fundamental
2437g	106.1	H	-	-	PK	332	1.0	Ch#6 Fundamental
7303.311	43.5	H	54.0	-10.5	AVG	34	1.5	Restricted
7303.311	59.2	H	74.0	-14.8	PK	34	1.5	Restricted
17924.40	50.4	V	54.0	-3.6	AVG	155	1.5	Restricted
17924.40	61.4	V	74.0	-12.6	PK	155	1.5	Restricted
17689.22	60.8	V	90.6	-29.8	PK	266	2.5	Non-restricted
9740.31	59.5	V	90.6	-31.1	PK	276	1.2	Non-restricted



2462 MHz G, 8.5 dBi Panel

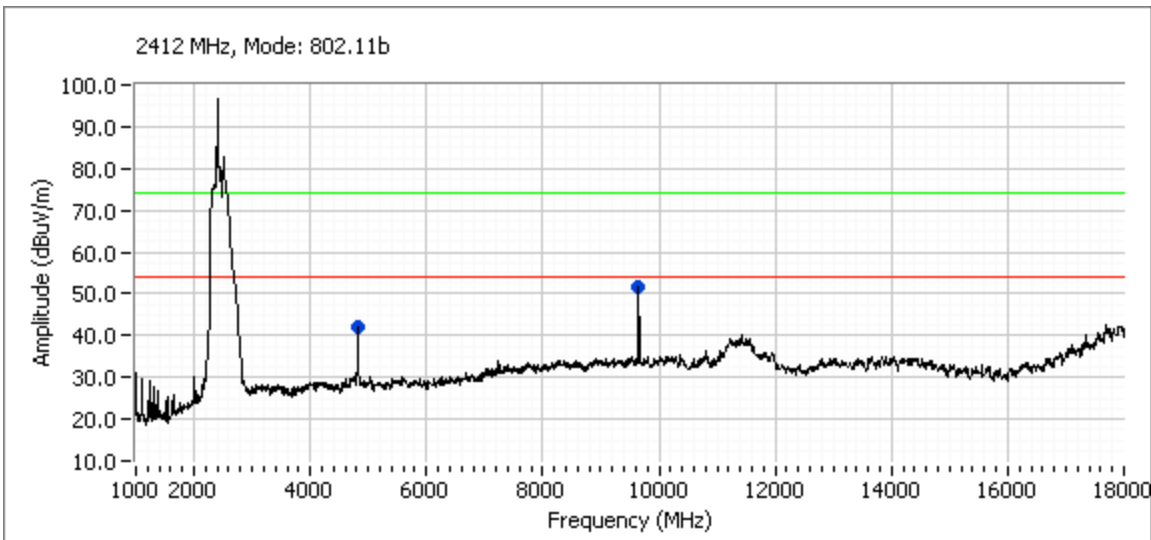
Frequency MHz	Level dB μ V/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2462g	108.2	V	-	-	AVG	359	1.0	Ch#11 Fundamental
2462g	116.4	V	-	-	PK	359	1.0	Ch#11 Fundamental
2462g	92.7	H	-	-	AVG	343	1.0	Ch#11 Fundamental
2462g	101.0	H	-	-	PK	343	1.0	Ch#11 Fundamental
17916.38	50.1	H	54.0	-3.9	AVG	261	1.5	Restricted
17916.38	61.1	H	74.0	-12.9	PK	261	1.5	Restricted
17740.52	49.5	V	54.0	-4.5	AVG	222	2.5	Restricted
17740.52	59.9	V	74.0	-14.1	PK	222	2.5	Restricted



802.11 B 5 dBi Omni Antenna

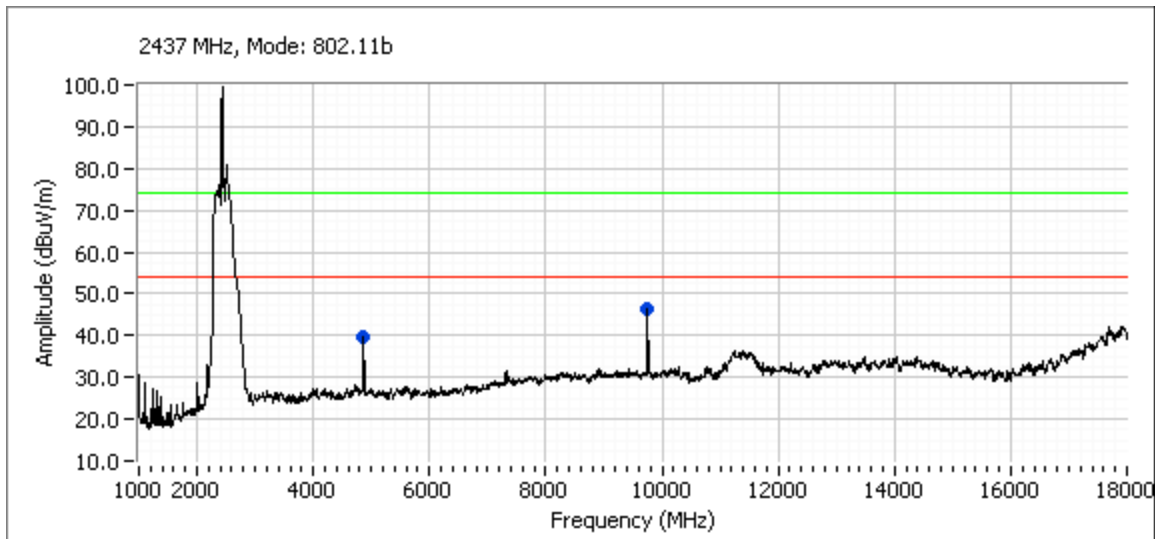
2412 MHz, B, 5.15 dBi Omni

Frequency MHz	Level dB μ V/m	Pol v/h	N/A		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2411.340	108.2	V	-	-	AVG	327	1.0	
2411.340	110.9	V	-	-	PK	327	1.0	
2413.620	107.5	V	-	-	Pk	1.0	1.0	
4823.933	40.2	V	54.0	-13.8	AVG	240	1.0	Restricted
4823.933	43.5	V	74.0	-30.6	PK	240	1.0	Restricted
9647.928	50.2	V	77.5	-27.3	AVG	261	1.0	Non-Restricted
4823.953	32.1	H	54.0	-21.9	AVG	104	1.0	Restricted
4823.953	39.2	H	74.0	-34.8	PK	104	1.0	Restricted
9647.983	48.6	H	77.5	-28.9	PK	262	1.0	Restricted



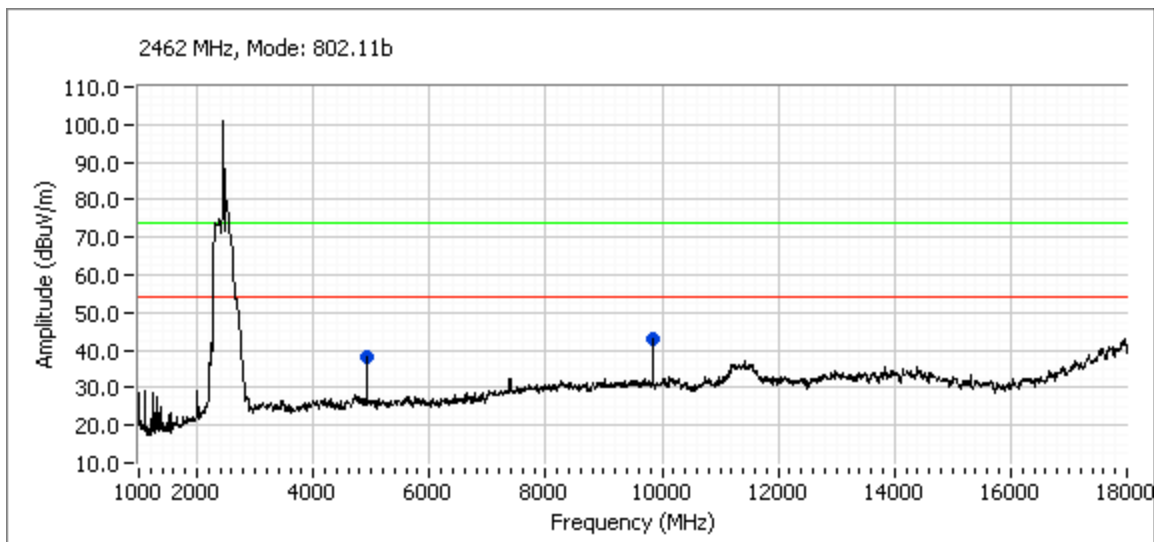
2437 MHz, B, 5.15 dBi Omni

Frequency	Level	Pol	N/A		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2434.465	110.1	V	V	-	-	AVG	1.0	
2434.465	112.7	V	V	-	-	PK	1.0	
2434.560	109.4	V	V	-	-	Pk	1.0	
4873.995	46.2	V	54.0	-7.8	AVG	49	1.1	Restricted
4873.995	50.7	V	74.0	-23.3	PK	49	1.1	Restricted
4873.835	37.6	H	54.0	-16.4	AVG	288	1.0	Restricted
4873.835	46.0	H	74.0	-28.0	PK	288	1.0	Restricted
9747.989	49.1	V	79.4	-30.3	Pk	273	1.0	Non-Restricted
9747.981	48.8	H	79.4	-30.7	Pk	256	1.2	Non-Restricted



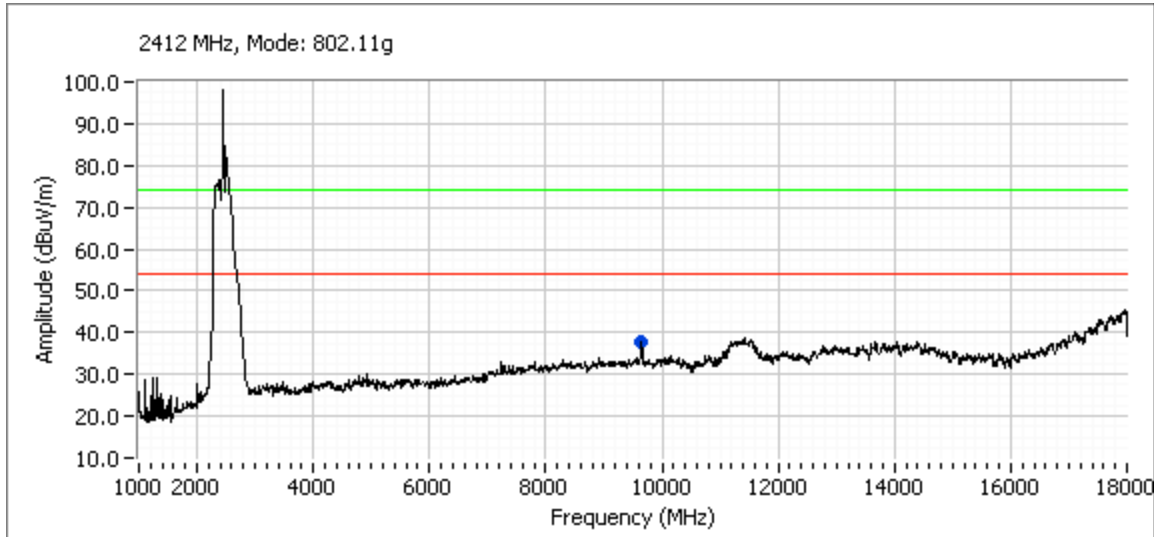
2462 MHz, B, 5.15 dBi Omni

Frequency MHz	Level dBμV/m	Pol v/h	N/A		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2461.225	109.2	V	-	-	AVG	270	1.0	
2461.225	112.0	V	-	-	PK	270	1.0	
2460.005	107.2	V	-	-	Pk	268	1.0	
9848.05	45.7	V	77.2	-31.5	Pk	269	1.0	Non-Restricted
9847.98	44.6	H	77.2	-32.6	Pk	223	1.0	Non-Restricted
4924.04	43.5	V	54.0	-10.5	AVG	262	1.0	Restricted
4924.04	49.0	V	74.0	-25.0	PK	262	1.0	Restricted
4923.92	38.0	H	54.0	-16.0	AVG	30	1.5	Restricted
4923.92	45.7	H	74.0	-28.3	PK	30	1.5	Restricted



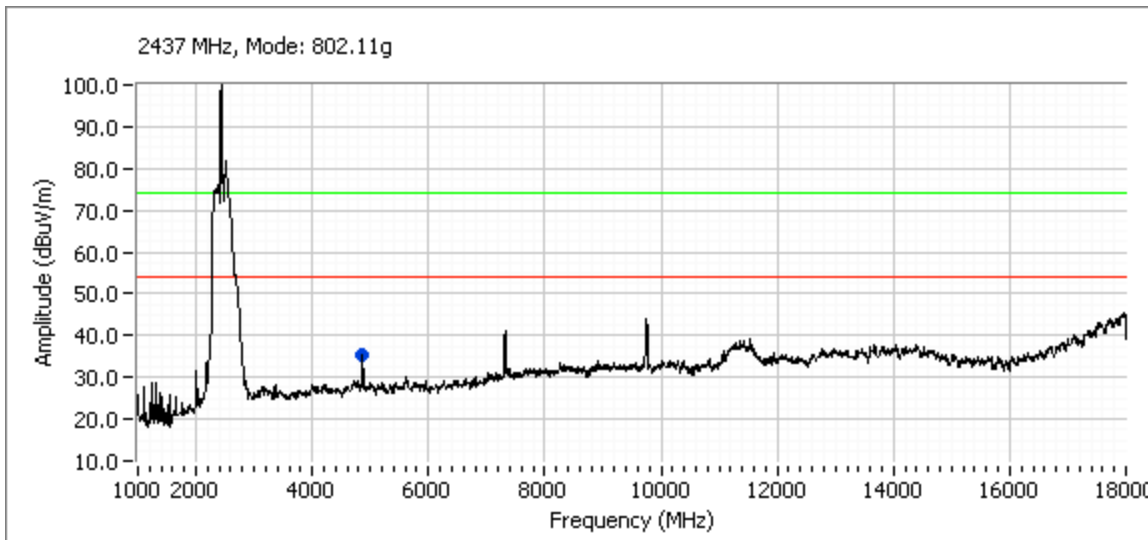
802.11 G 5.15 dBi Omni Antenna
2412 MHz G, 5.15 dBi Omni

Frequency	Level	Pol	N/A		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2405.775	105.1	V	-	-	AVG	315	1.5	
2405.775	113.5	V	-	-	PK	315	1.5	
2410.745	92.6	H	-	-	AVG	156	1.0	
2410.745	100.7	H	-	-	PK	156	1.0	
2419.083	101.8	V	-	-	Pk	315	1.5	RB=VB=100kHz



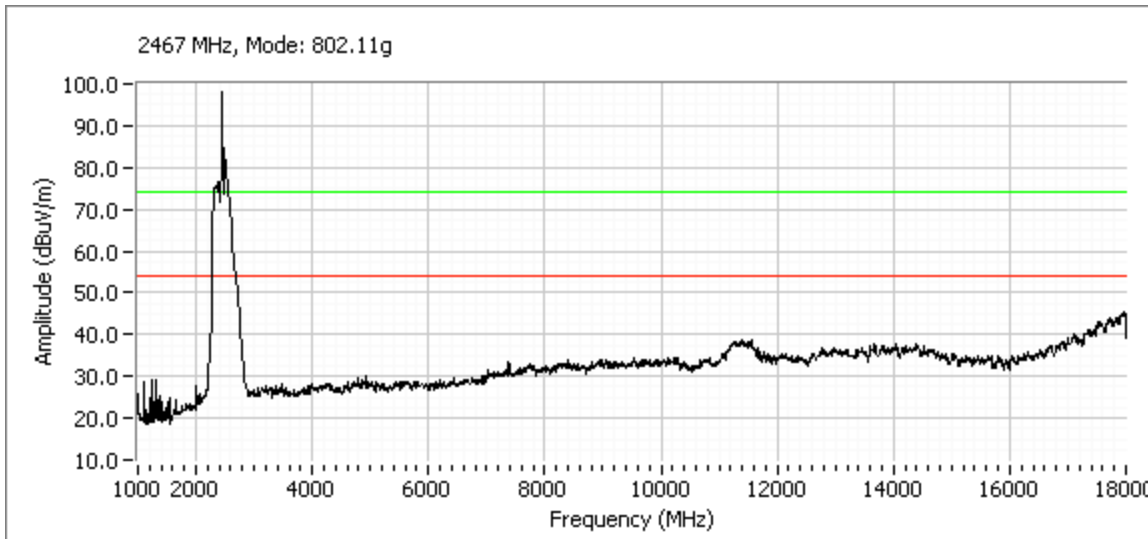
2437 MHz G, 5.15 dBi Omni

Frequency MHz	Level dBμV/m	Pol v/h	N/A		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2432.200	110.0	V	-	-	AVG	354	1.0	
2432.200	119.0	V	-	-	PK	354	1.0	
2432.450	107.6	V	-	-	Pk	356	1.0	
7307.733	42.6	V	54.0	-11.4	AVG	132	1.5	Restricted
7308.092	41.1	H	54.0	-12.9	AVG	158	1.5	Restricted
7307.733	56.4	V	74.0	-17.6	PK	132	1.5	Restricted
7308.092	55.8	H	74.0	-18.2	PK	158	1.5	Restricted
9746.784	49.1	V	77.6	-28.6	PK	262	1.0	Non-Restricted



2462 MHz G, 5.15 dBi Omni

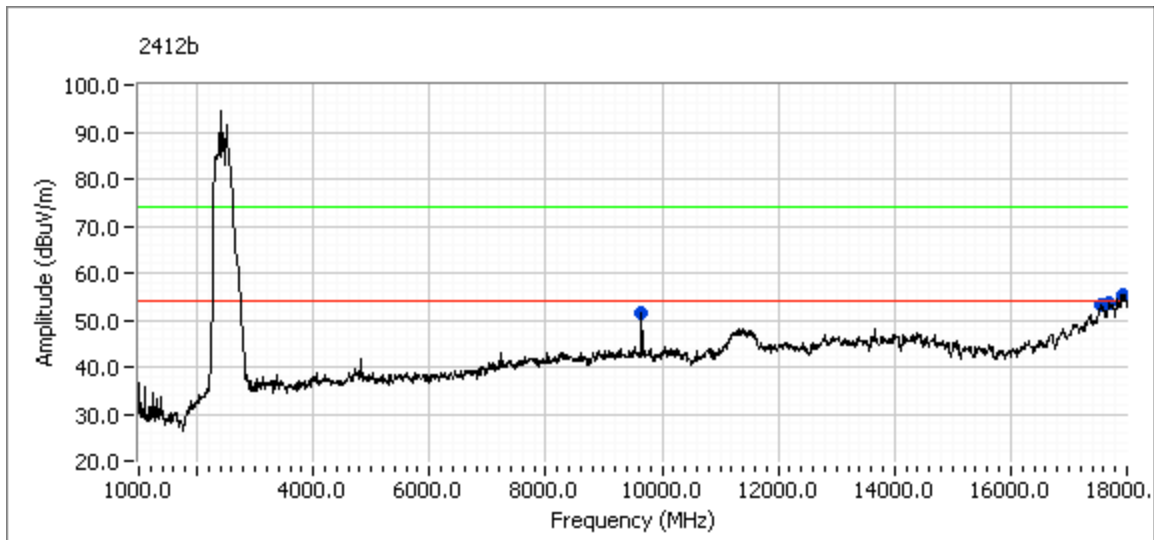
Frequency MHz	Level dBμV/m	Pol v/h	N/A		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2456.017	104.9	V	-	-	AVG	270	1.0	Fundamental
2456.017	113.8	V	-	-	PK	270	1.0	Fundamental
2454.517	103.8	V	-	-	Pk	270	1.0	Fundamental



802.11 B Internal Antenna

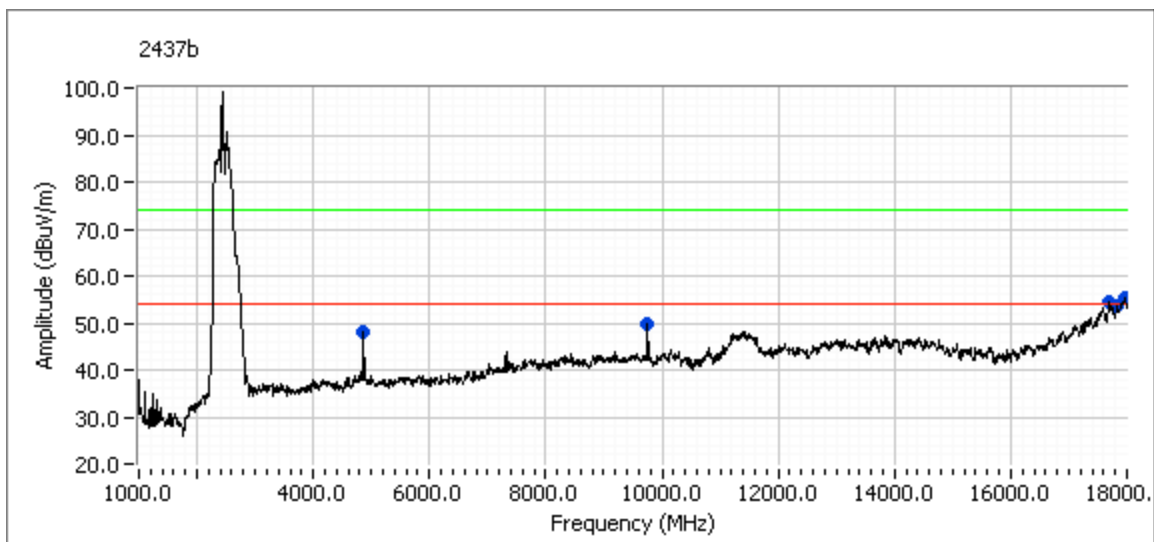
2412 MHz B, Internal Antenna

Frequency MHz	Level dBμV/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2412b	100.7	V	-	-	AVG	293	1.7	CH#1 Fundamental
2412b	107.4	V	-	-	PK	293	1.7	CH#1 Fundamental
2412b	99.9	H	-	-	AVG	260	2.2	CH#1 Fundamental
2412b	106.7	H	-	-	PK	260	2.2	CH#1 Fundamental
17938.06	50.7	V	54.0	-3.3	AVG	270	2.0	Restricted
17708.62	49.5	V	54.0	-4.5	AVG	301	1.0	Restricted
17938.06	62.0	V	74.0	-12.0	PK	270	2.0	Restricted
17708.62	60.0	V	74.0	-14.0	PK	301	1.0	Restricted
17557.95	59.3	V	77.4	-18.1	PK	151	1.1	Non-restricted
9647.93	55.4	V	77.4	-22.0	PK	262	1.5	Non-restricted



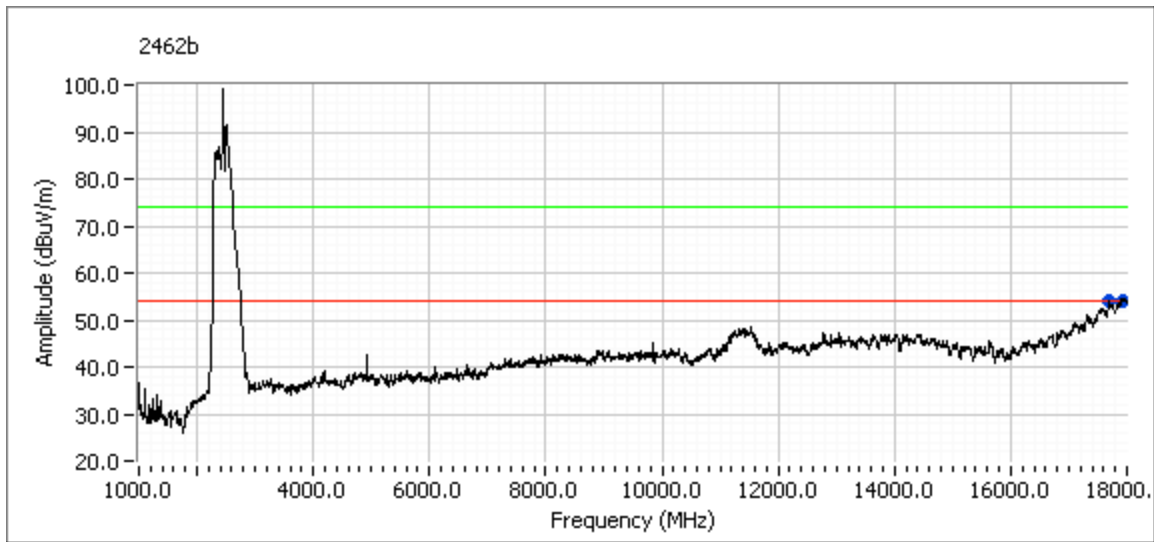
2437 MHz B, Internal Antenna

Frequency MHz	Level dBµV/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2437b	101.1	V	-	-	AVG	295	2.0	Ch#6 Fundamental
2437b	107.7	V	-	-	PK	295	2.0	Ch#6 Fundamental
2437b	101.7	H	-	-	AVG	218	2.2	Ch#6 Fundamental
2437b	108.1	H	-	-	PK	218	2.2	Ch#6 Fundamental
17955.89	50.6	V	54.0	-3.4	AVG	191	2.0	Restricted
17707.08	49.2	V	54.0	-4.8	AVG	198	2.5	Restricted
17835.30	48.9	V	54.0	-5.1	AVG	138	2.0	Restricted
17955.89	61.7	V	74.0	-12.3	PK	191	2.0	Restricted
17707.08	60.0	V	74.0	-14.0	PK	198	2.5	Restricted
17835.30	59.3	V	74.0	-14.7	PK	138	2.0	Restricted
4873.964	38.7	V	54.0	-15.3	AVG	76	1.0	Restricted
4873.964	50.4	V	74.0	-23.6	PK	76	1.0	Restricted
9747.955	52.2	V	78.1	-25.9	PK	83	1.5	Non-restricted



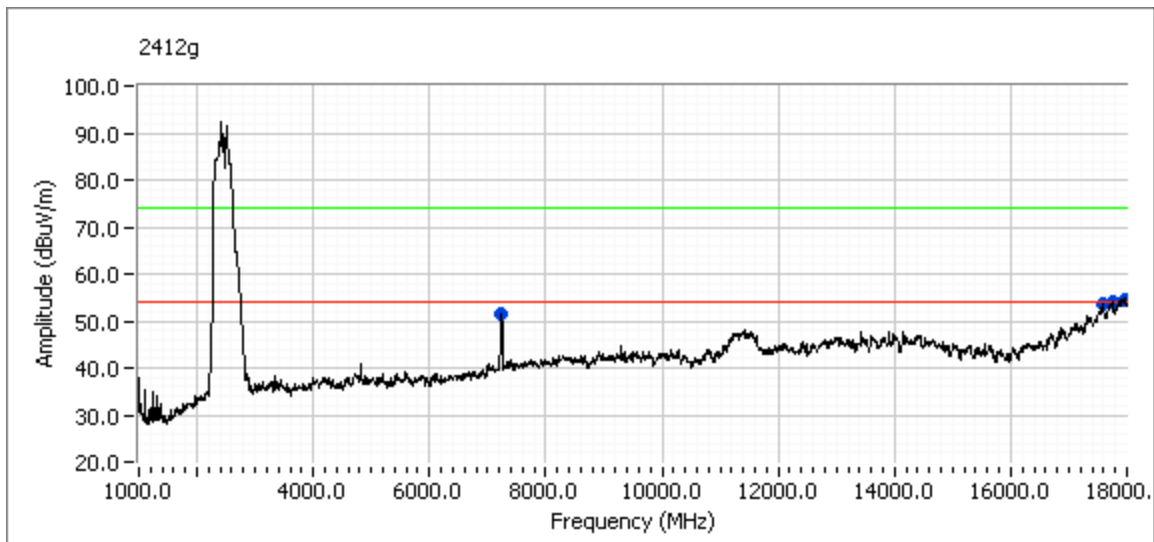
2462 MHz B, Internal Antenna

Frequency MHz	Level dB μ V/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2462b	101.1	V	-	-	AVG	295	1.7	Ch#11 Fundamental
2462b	107.6	V	-	-	PK	295	1.7	Ch#11 Fundamental
2462b	98.4	H	-	-	AVG	130	2.0	Ch#11 Fundamental
2462b	104.9	H	-	-	PK	130	2.0	Ch#11 Fundamental
17928.13	50.4	V	54.0	-3.6	AVG	265	2.5	Restricted
17697.67	48.8	H	54.0	-5.2	AVG	171	1.0	Restricted
17928.13	61.3	V	74.0	-12.7	PK	265	2.5	Restricted
17697.67	60.3	H	74.0	-13.7	PK	171	1.0	Restricted



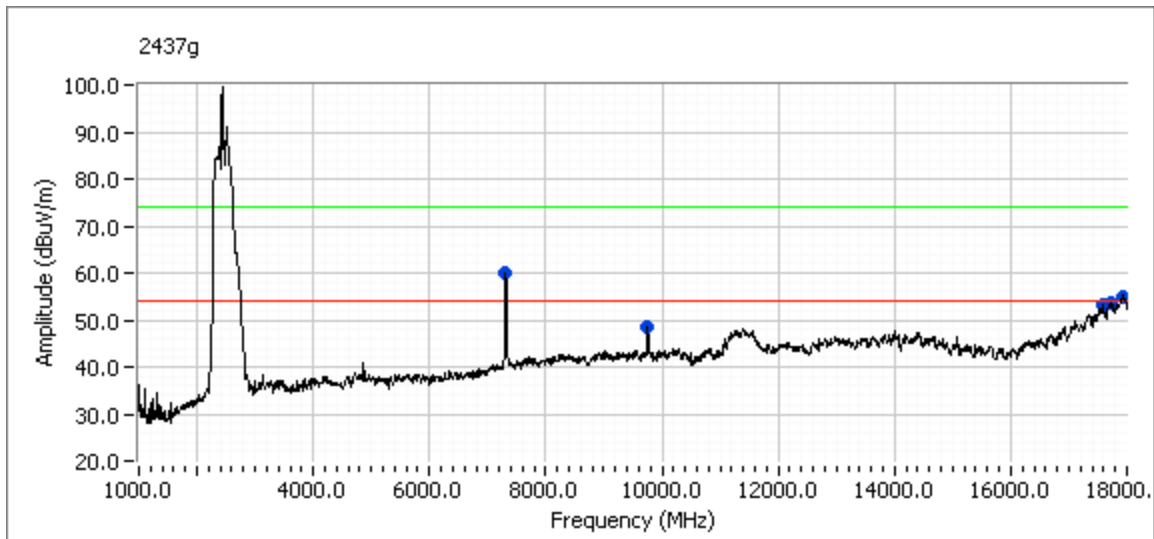
2412 MHz G, Internal Antenna

Frequency MHz	Level dB μ V/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2412g	99.3	V	-	-	AVG	262	1.6	CH#1 Fundamental
2412g	107.5	V	-	-	PK	262	1.6	CH#1 Fundamental
2412g	95.7	H	-	-	AVG	152	2.3	CH#1 Fundamental
2412g	104.0	H	-	-	PK	152	2.3	CH#1 Fundamental
17943.03	50.6	H	54.0	-3.4	AVG	266	1.5	Restricted
17746.22	49.2	V	54.0	-4.8	AVG	115	2.5	Restricted
7228.90	65.9	H	77.5	-11.6	PK	20	1.5	Non-restricted
17943.03	62.0	H	74.0	-12.0	PK	266	1.5	Restricted
17746.22	59.8	V	74.0	-14.2	PK	115	2.5	Restricted
17594.59	59.4	V	77.5	-18.2	PK	10	2.0	Non-restricted



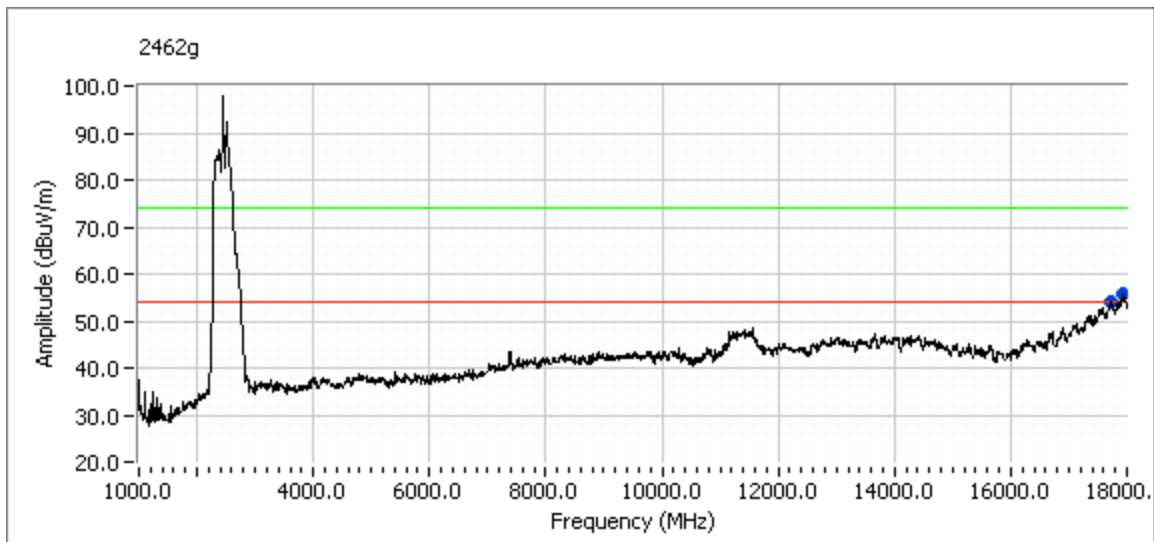
2437 MHz G, Internal Antenna

Frequency MHz	Level dB μ V/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2437g	101.5	V	-	-	AVG	263	1.0	Ch#6 Fundamental
2437g	110.1	V	-	-	PK	263	1.0	Ch#6 Fundamental
2437g	97.2	H	-	-	AVG	47	2.5	Ch#6 Fundamental
2437g	106.3	H	-	-	PK	47	2.5	Ch#6 Fundamental
7307.264	51.7	V	54.0	-2.3	AVG	316	1.5	Restricted
17930.36	50.6	V	54.0	-3.5	AVG	243	2.5	Restricted
17708.85	49.3	H	54.0	-4.7	AVG	140	1.5	Restricted
7307.264	67.0	V	74.0	-7.0	PK	316	1.5	Restricted
17930.36	63.1	V	74.0	-10.9	PK	243	2.5	Restricted
17708.85	60.7	H	74.0	-13.3	PK	140	1.5	Restricted
17584.17	60.1	H	80.1	-20.0	PK	334	0.0	Non-restricted
9743.004	58.9	V	80.1	-21.2	PK	256	1.0	Non-restricted



2462 MHz G, Internal Antenna

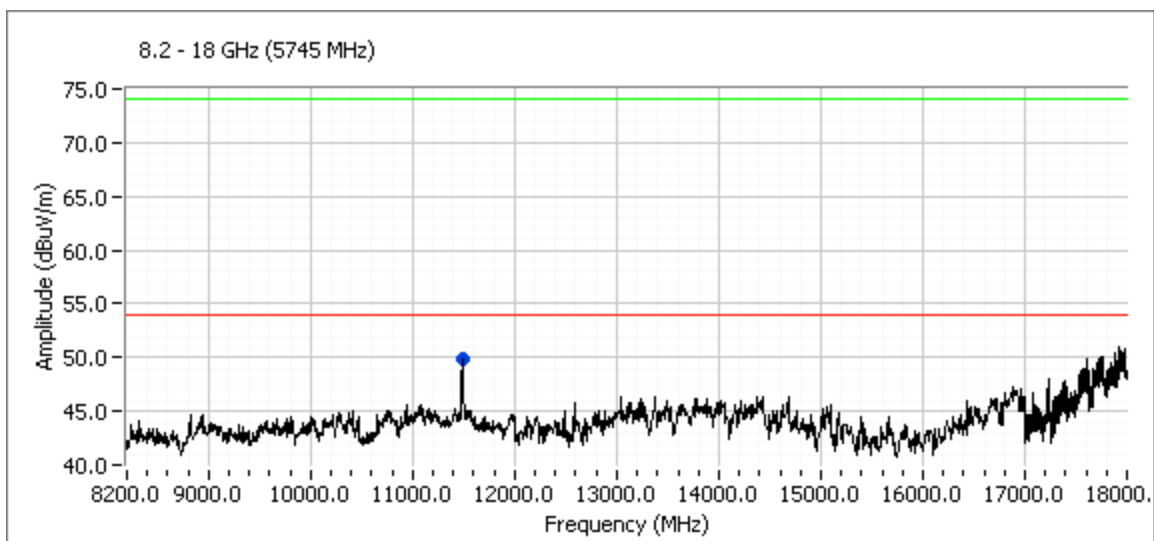
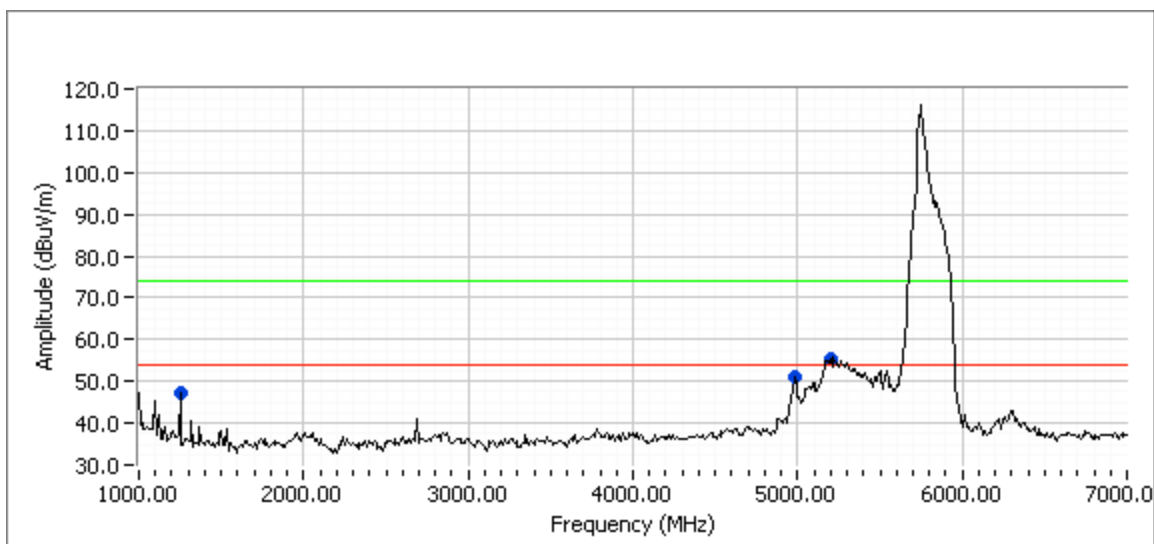
Frequency MHz	Level dB μ V/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
2462g	98.4	V	-	-	AVG	267	1.0	Ch#11 Fundamental
2462g	107.2	V	-	-	PK	267	1.0	Ch#11 Fundamental
2462g	97.9	H	-	-	AVG	220	1.8	Ch#11 Fundamental
2462g	107.1	H	-	-	PK	220	1.8	Ch#11 Fundamental
17939.52	50.8	V	54.0	-3.2	AVG	316	2.5	Restricted
17718.65	49.5	V	54.0	-4.5	AVG	94	1.0	Restricted
17939.52	62.0	V	74.0	-12.1	PK	316	2.5	Restricted
17718.65	60.5	V	74.0	-13.5	PK	94	1.0	Restricted



802.11 A 14 dBi Panel Antenna

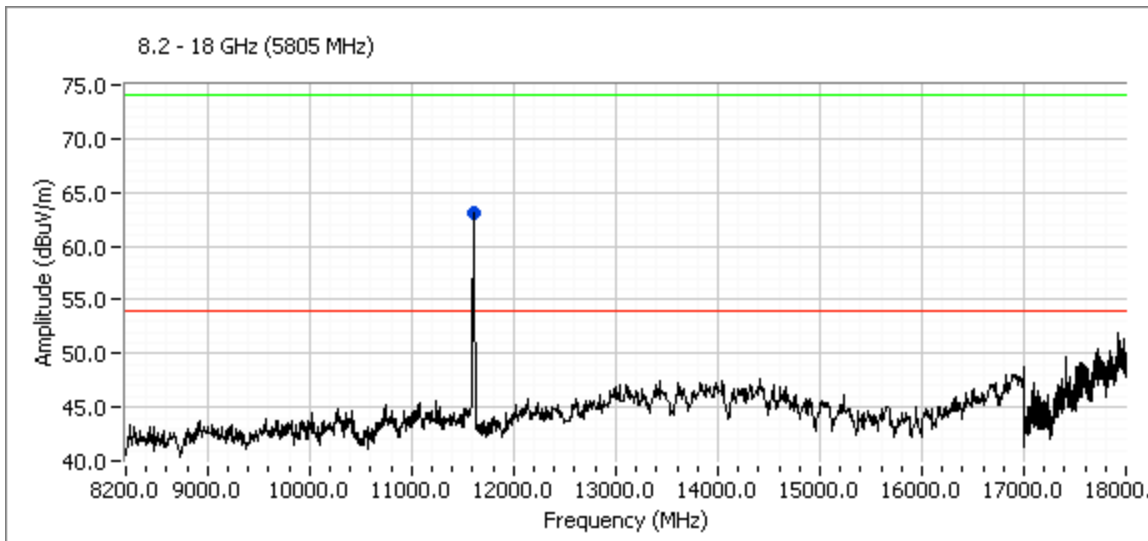
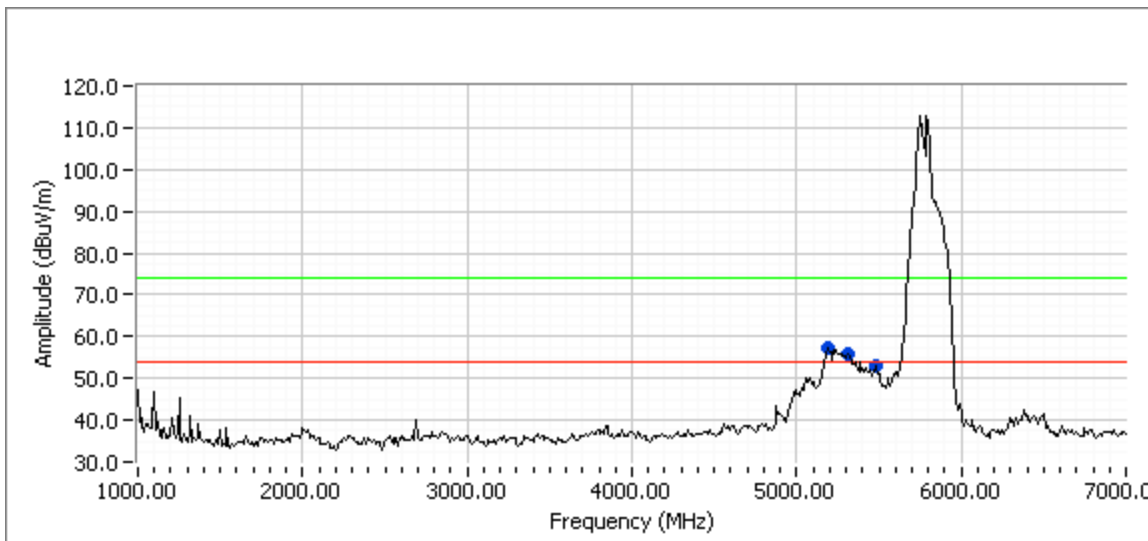
5745 MHz, A 14 dBi panel

Frequency MHz	Level dBμV/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
5745.00	111.6	V	-	-	AVG	360	1.0	
5745.00	120.0	V	-	-	PK	360	1.0	
5745.00	95.5	H	-	-	AVG	21	1.0	
5745.00	104.0	H	-	-	PK	21	1.0	
11490.21	46.9	V	54.0	-7.1	AVG	173	1.0	Restricted
11490.21	59.6	V	74.0	-14.4	PK	173	1.0	Restricted
4988.69	44.8	V	54.0	-9.2	AVG	1	1.0	Restricted
4988.69	56.6	V	74.0	-17.4	PK	1	1.0	Restricted
1250.09	50.1	H	90.0	-39.9	PK	134	1.0	Non-restricted
5188.95	63.6	V	90.0	-26.4	PK	359	1.5	Non-restricted



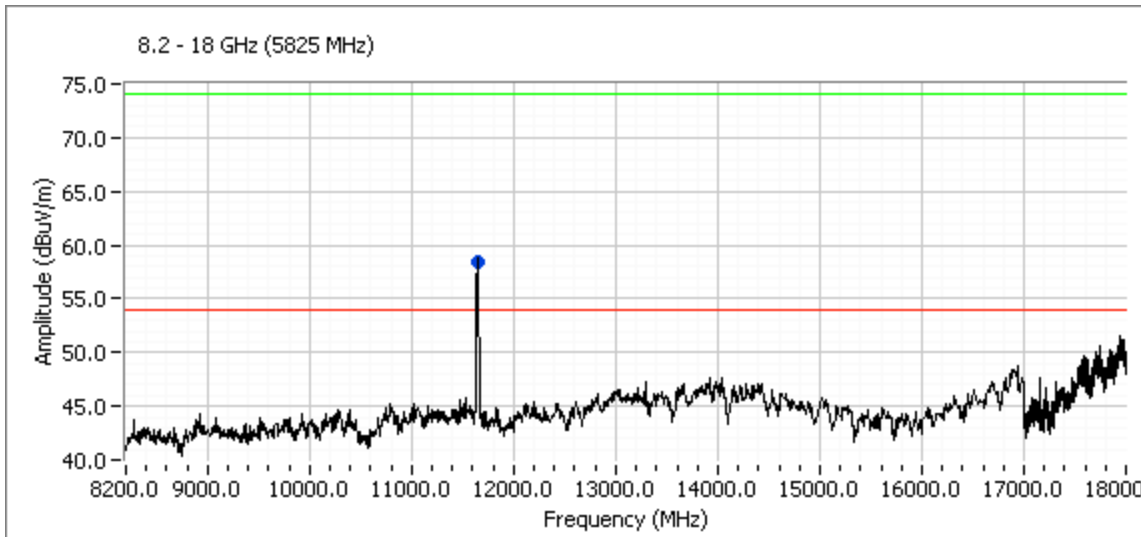
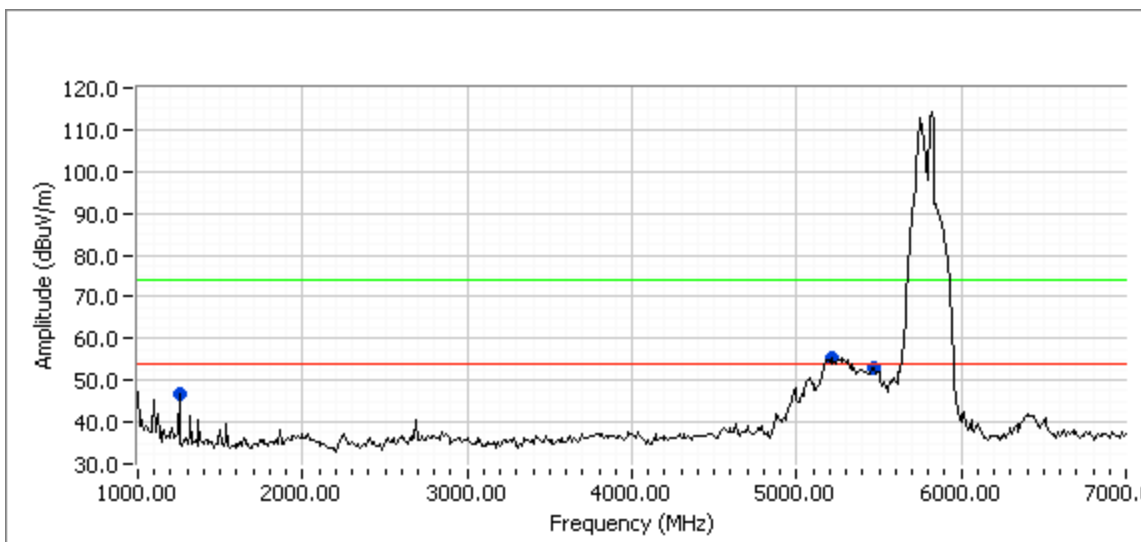
5805 MHz, A 14 dBi panel

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5805.00	110.9	V	-	-	AVG	360	1.0	
5805.00	118.7	V	-	-	PK	360	1.0	
5805.00	93.5	H	-	-	AVG	14	1.0	
5805.00	102.2	H	-	-	PK	14	1.0	
11609.29	51.6	V	54.0	-2.4	AVG	175	1.0	Restricted
11609.29	64.4	V	74.0	-9.6	PK	175	1.0	Restricted
5484.79	60.2	V	88.7	-28.5	PK	0	1.5	Non-restricted
5209.59	63.6	V	88.7	-25.1	PK	6	1.0	Non-restricted
5320.29	64.6	V	88.7	-24.1	PK	6	1.0	Non-restricted



5825 MHz, A 14 dBi panel

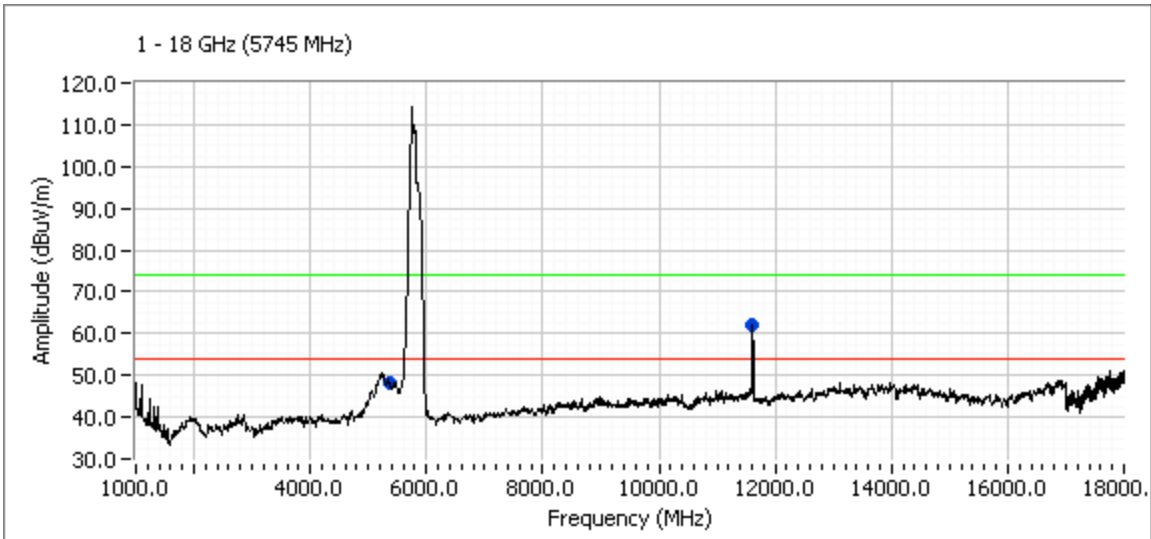
Frequency MHz	Level dBµV/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
5825.00	110.6	V	-	-	AVG	360	1.0	
5825.00	119.3	V	-	-	PK	360	1.0	
5825.00	91.9	H	-	-	AVG	317	1.0	
5825.00	100.6	H	-	-	PK	317	1.0	
11649.14	52.2	V	54.0	-1.8	AVG	170	1.0	Restricted
11649.14	64.9	V	74.0	-9.1	PK	170	1.0	Restricted
5497.43	60.7	V	89.3	-28.6	PK	0	1.0	Non-Restricted
1250.13	50.1	H	89.3	-39.2	PK	134	1.0	Non-Restricted
5229.18	62.3	V	89.3	-27.0	PK	358	1.5	Non-Restricted



802.11 A 6 dBi Omni Antenna

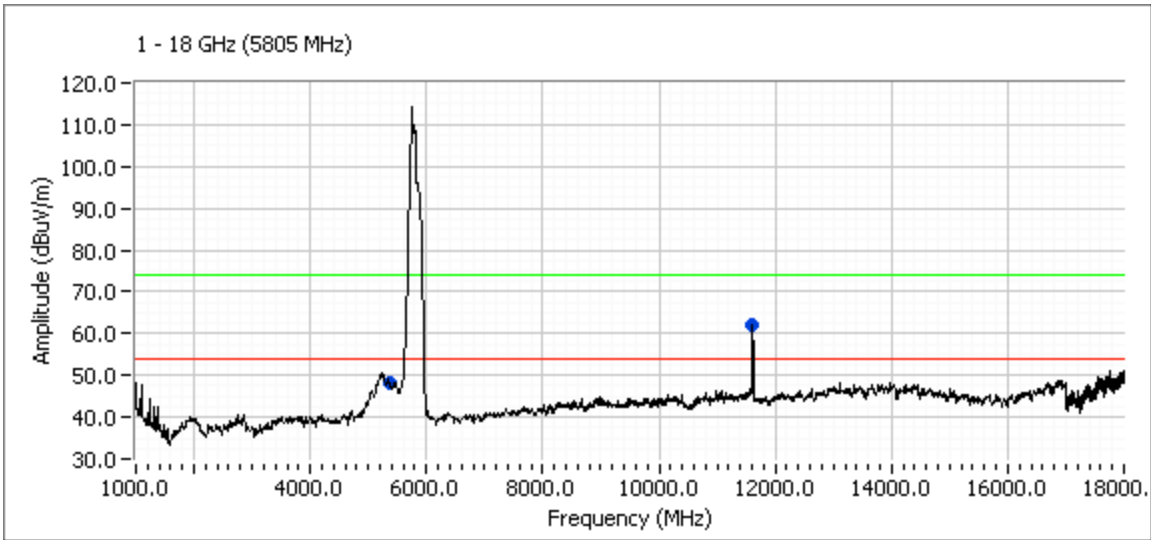
5745 MHz A, 6 dBi Omni

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/OP/Avg	degrees	meters	
5355.680	44.0	V	54.0	-10.0	AVG	173	1.0	Restricted
5355.680	56.2	V	74.0	-17.8	PK	173	1.0	Restricted
11492.12	48.4	H	54.0	-5.7	AVG	253	1.4	Restricted
11492.12	59.8	H	74.0	-14.2	PK	253	1.4	Restricted



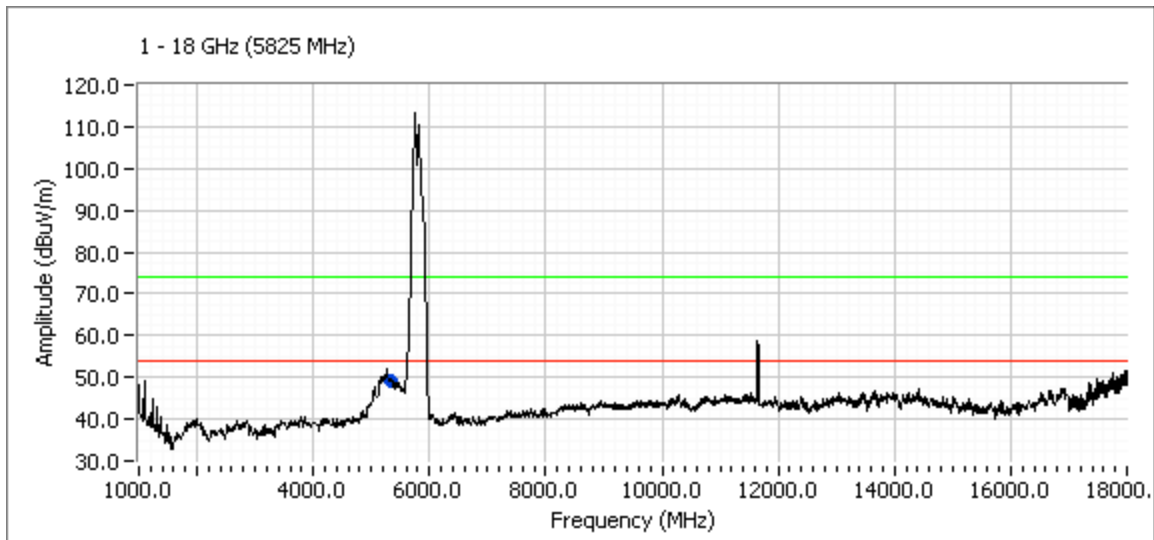
5805 MHz A, 6 dBi Omni

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/OP/Avg	degrees	meters	
5356.000	48.2	V	54.0	-5.8	AVG	144	1.2	Restricted
5356.000	59.0	H	74.0	-15.0	PK	88	1.2	Restricted
11610.20	53.8	H	54.0	-0.2	AVG	88	1.2	Restricted
11610.20	66.8	H	74.0	-7.2	PK	88	1.2	Restricted



5805 MHz A, 6 dBi Omni

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/OP/Avg	degrees	meters	
11646.37	52.4	V	54.0	-1.7	AVG	161	1.0	Restricted
11646.37	64.3	V	74.0	-9.7	PK	161	1.0	Restricted
11645.78	53.2	H	54.0	-0.8	AVG	154	1.0	Restricted
11645.78	64.9	H	74.0	-9.1	PK	154	1.0	Restricted
5344.42	45.4	V	54.0	-8.6	AVG	91	1.4	Restricted
5344.42	56.5	V	74.0	-17.5	PK	91	1.4	Restricted



Radiated Emissions in Restricted bands (2.4 GHz Band Edges)

FCC Specifications: Paragraph 15.247(c)

Procedure (Marker Delta Method):

The procedure outlined below was used for the bandedge measurement for IEEE802.11 B ONLY. IEEE 802.11 G and A were performed using the direct measurement procedure.

Since this is a 2.4 GHz product, there is a restricted band that begins immediately at the high end of the operating band and another that begins 10 MHz below the low end of the operating band.



This test was conducted in a semi-anechoic chamber #5 4 at Elliott labs Fremont facility. There are three steps to performing this test.

STEP 1) The first involves making a radiated measurement of the fundamental signal with the UUT on the operating channel closest to the edge of the band. The unit was placed on a rotating wooden table 80cm above the OATS ground plane. A Horn antenna was secured to a mast 3 meters away. The test equipment was configured as shown below.

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 fundamental emission was measured in two modes, “Peak” and “Average” using RBW and VBW of 1MHz/1MHz and 1MHz/10Hz respectively.

STEP 2) A second measurement (conducted) is made using to determine a Peak (RBW 1 MHz / VBW 1 MHz) and Avg (RBW 1 MHz / VBW 10 Hz) -dBc value. This value is measured from the peak of the “carrier” to the highest point within the restricted band.

In some cases, this third measurement was not made if compliance was demonstrated without this measurement. In this case, if this measurement were made, it would only serve to increase the margin.

The level of the emission in the restricted band is then calculated using the following formulas.

$\text{Restricted band level (AVG)} = \text{AVG reference level} - \text{delta dB} - \text{BW Delta dB}$ $\text{Restricted band level (Peak)} = \text{Peak reference level} - \text{delta dB} - \text{BW Delta dB}$

Results Summary Table (2.4 GHz 802.11 B)

(Low Power Setting)

802.11 B Band Edge (Restricted band @ 2.390GHz)										
Pol	Fundamental Radiated Ref Msmt		Delta Msmt		Radiated Level at Band Edge		Specification		Delta (dB below Limit)	
	Peak dbuv/m	Avg dbuv/m	Peak dBc	Avg dBc	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m
Vert	113.8	110.7	52	58.71	61.8	51.99	74	54	12.2	2.01
Horz	94.3	91.3			42.3	32.59			31.7	21.41
802.11 B Band Edge (Restricted band @ 2.4835GHz)										
Pol	Fundamental Radiated Ref Msmt		Delta Msmt		Radiated Level at Band Edge		Specification		Delta (dB below Limit)	
	Peak dbuv/m	Avg dbuv/m	Peak dBc	Avg dBc	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m
Vert	112.7	109.8	55.39	57.84	57.31	51.96	74	54	16.69	2.04
Horz	94.4	91.4			39.01	33.56			34.99	20.44

Radiated emissions at band edge sample calculation
(Vertical, Avg, 802.11 B, Low Edge -2390MHz):

Fund Ref msmt - Delta msmt = Emission Level

Example: 110.7 dBuV/m - 58.71dBc = 51.99dBuv/m

54 dBuv/m - 51.99dBuv/m = 2.01 dB margin

(Med Power Setting)

802.11 B Band Edge (Restricted band @ 2.390GHz)										
Pol	Fundamental Radiated Ref Msmt		Delta Msmt		Radiated Level at Band Edge		Specification		Delta (dB below Limit)	
	Peak dbuv/m	Avg dbuv/m	Peak dBc	Avg dBc	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m
Vert	113	110.1	52	58.71	61	51.39	74	54	13	2.61
Horz	96.8	94.2			44.8	35.49			29.2	18.51
802.11 B Band Edge (Restricted band @ 2.4835GHz)										
Pol	Fundamental Radiated Ref Msmt		Delta Msmt		Radiated Level at Band Edge		Specification		Delta (dB below Limit)	
	Peak dbuv/m	Avg dbuv/m	Peak dBc	Avg dBc	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m
Vert	113	110.1	55.39	57.84	57.61	52.26	74	54	16.39	1.74
Horz	93.8	90.8			38.41	32.96			35.59	21.04

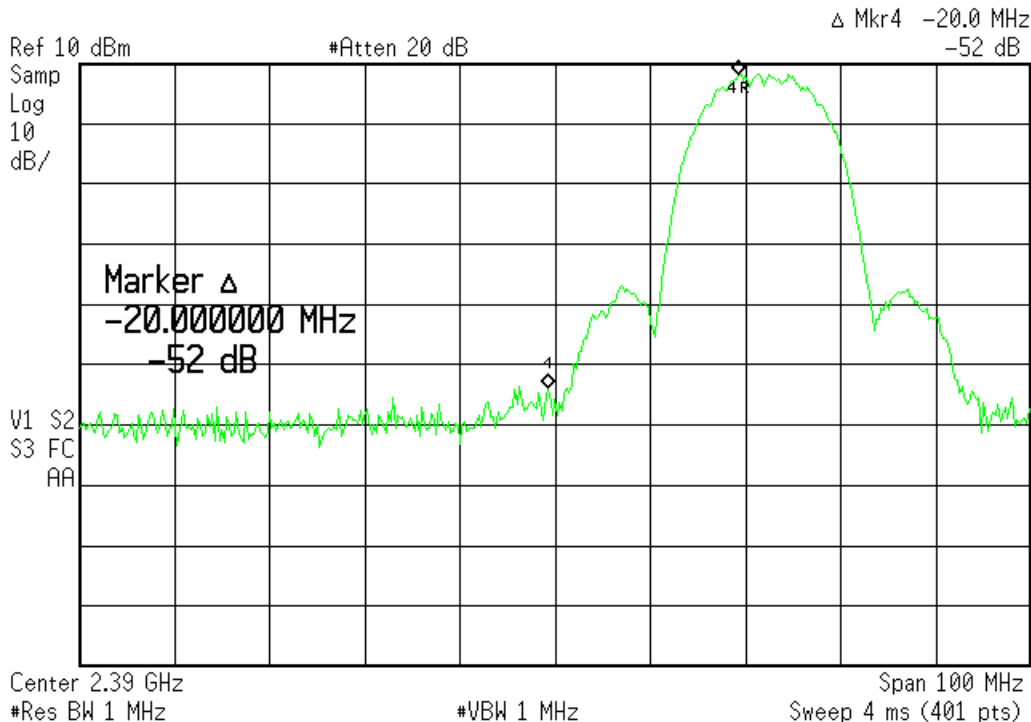
(High Power Setting)

802.11 B Band Edge (Restricted band @ 2.390GHz)										
Pol	Fundamental Radiated Ref Msmt		Delta Msmt		Radiated Level at Band Edge		Specification		Delta (dB below Limit)	
	Peak dbuv/m	Avg dbuv/m	Peak dBc	Avg dBc	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m
Vert	111.7	108.6	52	58.71	59.7	49.89	74	54	14.3	4.11
Horz	99	95.7			47	36.99			27	17.01
802.11 B Band Edge (Restricted band @ 2.4835GHz)										
Pol	Fundamental Radiated Ref Msmt		Delta Msmt		Radiated Level at Band Edge		Specification		Delta (dB below Limit)	
	Peak dbuv/m	Avg dbuv/m	Peak dBc	Avg dBc	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m	Peak dBuv/m	Avg dBuv/m
Vert	111.6	108.7	55.39	57.84	56.21	50.86	74	54	17.79	3.14
Horz	96.9	93.7			41.51	35.86			32.49	18.14

The plots below show the -dBc measurements for the restricted band edge measurements. These measurements were taken at the high power setting. There was negligible difference in the measurements between the high, med and low power level settings.

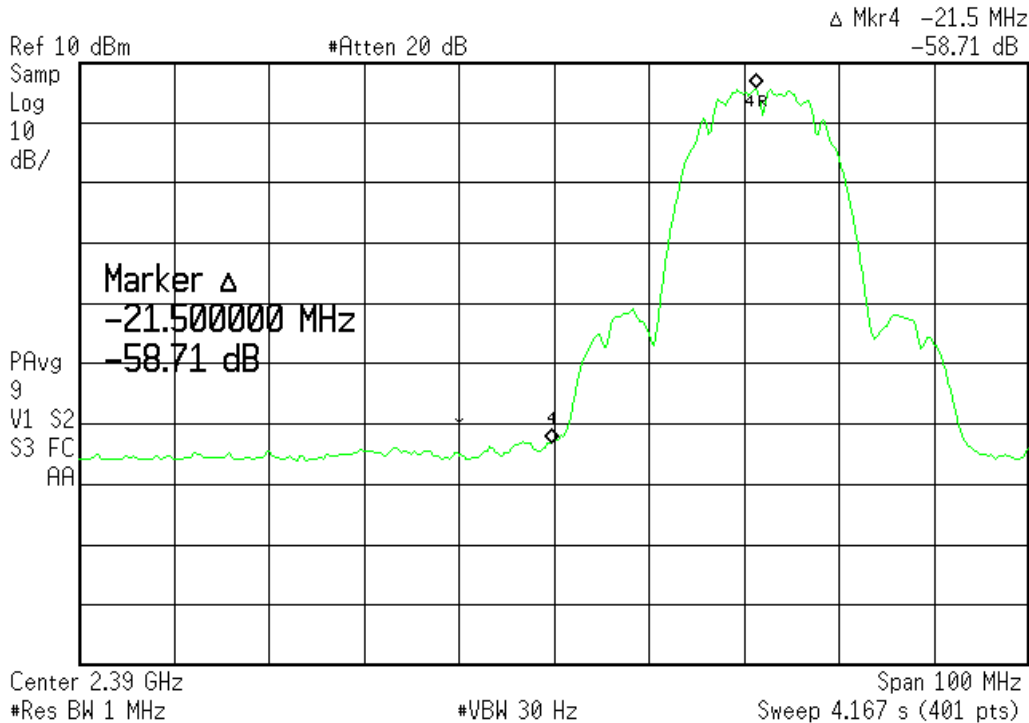
Agilent 13:58:19 May 30, 2005

802.11 B
-dBc Msmt @ 2390
Peak



Agilent 14:00:09 May 30, 2005

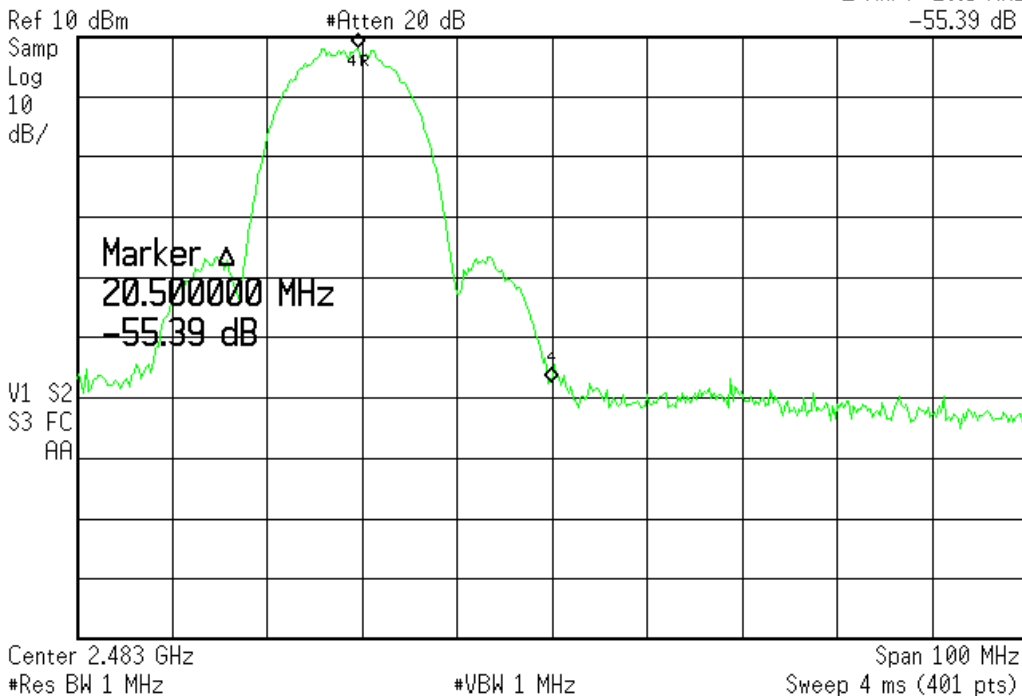
802.11 B
-dBc Msmt @ 2390
Avg



Agilent 14:14:37 May 30, 2005

Δ Mkr4 20.5 MHz
-55.39 dB

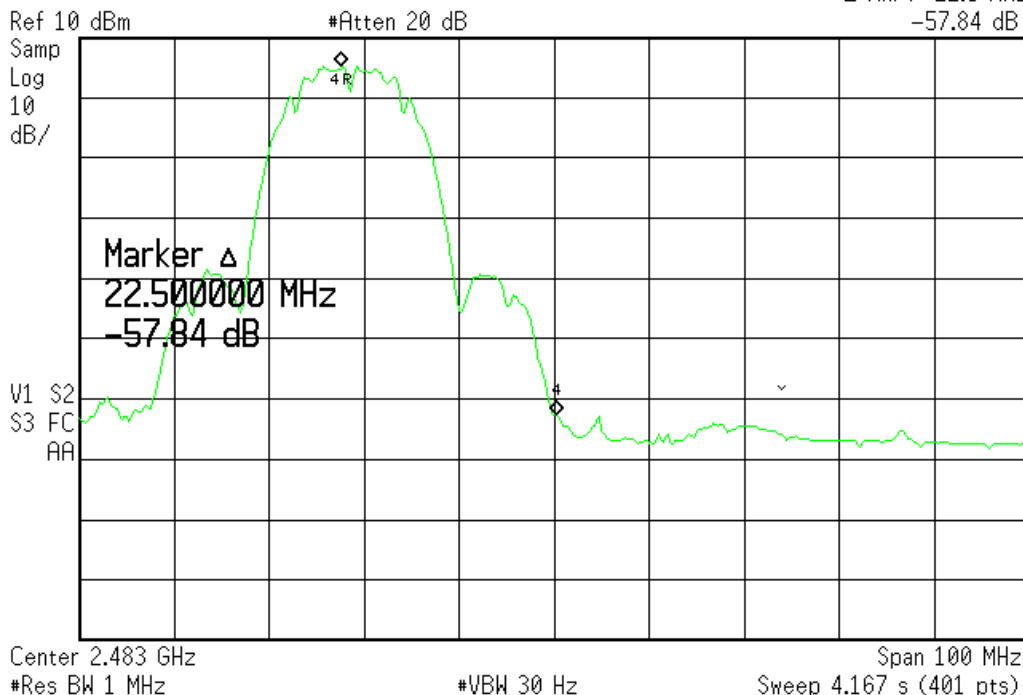
802.11 B
-dBc Msmt @ 2483.5
Peak



Agilent 14:16:40 May 30, 2005

Δ Mkr4 22.5 MHz
-57.84 dB

802.11 B
-dBc Msmt @ 2483.5 Avg



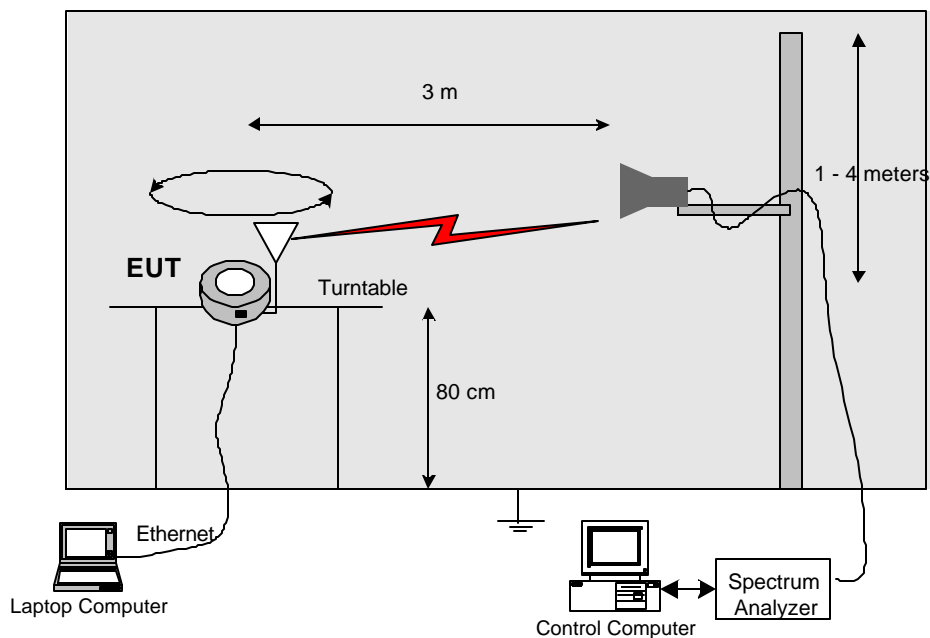
Radiated Emissions at the Band Edge Procedure (Direct Measurement Method)

An alternative procedure to the Marker delta method was used for IEEE802.11 A and G measurements.

The analyzer was set to examine the restricted band at the edges of the 2.4 GHz ISM band.

The maximum level within the band was determined and then moved to the center of the span. The span was then narrowed to 10kHz with the RBW= 1MHz and VBW = 10 Hz for the average measurement and RBW = VBW = 1MHz for the peak measurement.

The test equipment was configured as shown below.



The measurement was made at the band edges for the restricted bands just below 2390MHz and just above 2483.5MHz. The level for the emission within the restricted band was measured for each of the three power settings / antenna combinations. (low power high gain antenna, high power low gain antenna)

Results Summary Table (2.4 GHz 802.11 G)

Radiated Spurious Emissions, Low Channel @ 2412 MHz

Power Setting	Frequency MHz	Level dBmV/m	Pol v/h	15.209 / 15.247 Limit	Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
High	w/ 2403 Antenna								
	2388.496	53.7	V	54.0	-0.3	Avg	117	1.0	2403 Antenna, 17.5 STG
	2388.498	73.9	V	74.0	-0.1	PK	117	1.0	2403 Antenna, 17.5 STG
Med	w/ Patch Antenna								
	2388.495	53.4	V	54.0	-0.6	Avg	346	1.2	2409 Antenna, 15.0 STG
	2388.495	72.9	V	74.0	-1.1	PK	346	1.2	2409 Antenna, 15.0 STG
Low	w/ Yagi Antenna								
	2388.497	50.2	V	54.0	-3.8	Avg	1	1.1	Yagi Antenna, 11.0 STG
	2388.503	73.6	V	74.0	-0.4	PK	1	1.1	Yagi Antenna, 11.0 STG

Radiated Spurious Emissions, High Channel @ 2462 MHz

Power Setting	Frequency MHz	Level dBmV/m	Pol v/h	15.209 / 15.247 Limit	Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
High	w/ 2403 Antenna								
	2484.995	52.8	V	54.0	-1.2	Avg	114	1.0	2403 Antenna, 17.5 STG
	2485.003	72.9	V	74.0	-1.1	PK	114	1.0	2403 Antenna, 17.5 STG
Med	w/ Patch Antenna								
	2484.995	53.5	V	54.0	-0.5	Avg	359	1.1	2409 Antenna, 15.0 STG
	2485.002	73.6	V	74.0	-0.4	PK	359	1.1	2409 Antenna, 15.0 STG
Low	w/ Yagi Antenna								
	2484.999	50.6	V	54.0	-3.4	Avg	359	1.1	Yagi Antenna, 11.0 STG
	2485.003	70.6	V	74.0	-3.4	PK	359	1.1	Yagi Antenna, 11.0 STG

Receiver Spurious Radiated Emissions

Specification:

Specification: 15.109(f)

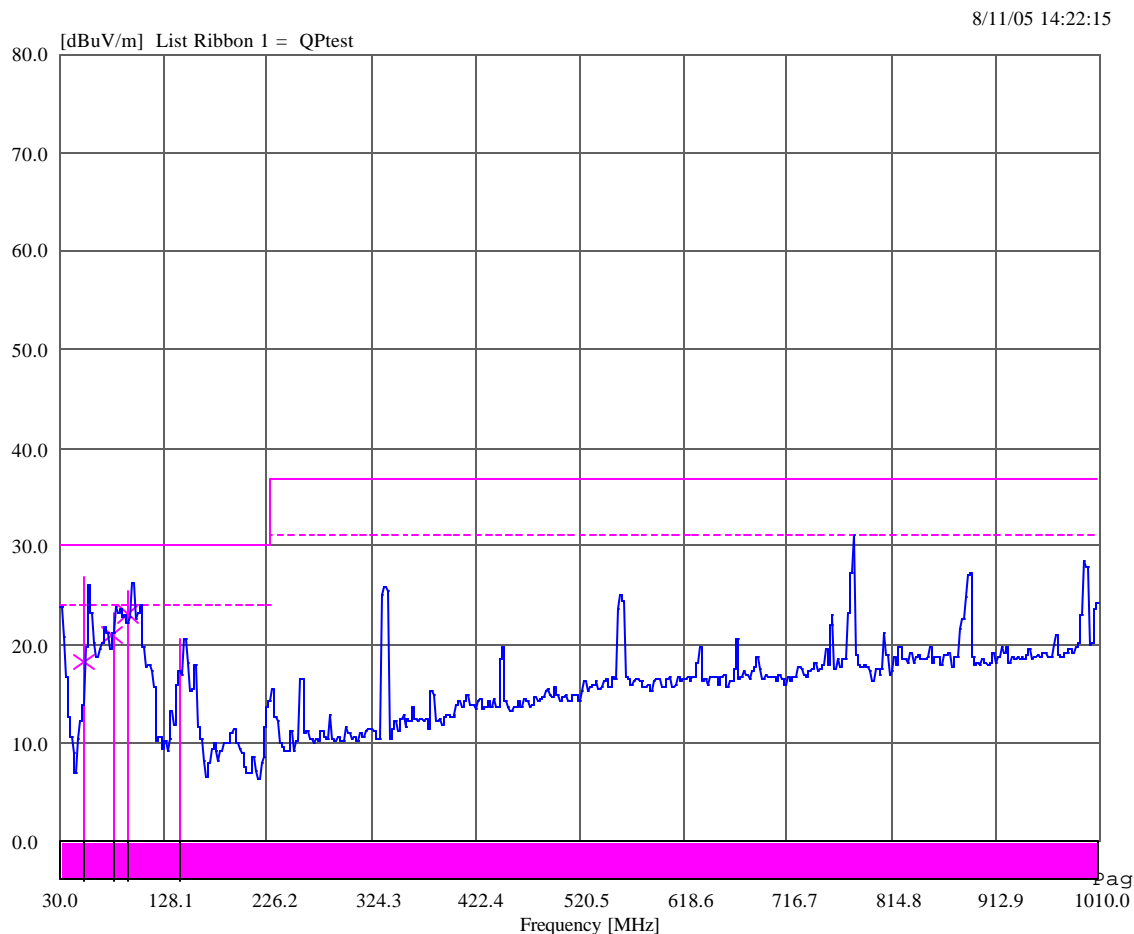
Procedure:

The test was configured as a standard EN55022 Class B radiated emissions test setup. Emissions were measured on the entire access point, not only the receiver. The access point was not transmitting at the time. The frequency range of 30 to 1000 MHz was scanned. The Radiated emissions in restricted bands data demonstrate compliance with this section above 1000MHz.

Results:

The detected emissions are presented in the tables below. The worst case vertical polarization results are shown. A pre-scan was performed with the AP in receive only mode and then transmit mode. The worst case emissions occurred when the unit was transmitting.

Frequency MHz	10 M Pk dBuV/m	10 M QP dBuV/m	3 M Pk dBuV/m	3M QP dBuV/m	3 M QP Limt dBuV/m	QP Margin dB	Angle deg	Hgt cm	Pol
53.913776	26.9	18.32	36.4	27.82	40	12.18	171	98	Vert
79.73056	23.33	21.02	32.83	30.52	40	9.48	98	127	Vert
94.35464	25.52	23.2	35.02	32.7	43.5	10.8	98	103	Vert
144.6	20.56	--.--	30.06		43.5		76	99	Vert



AC Line Conducted Emissions

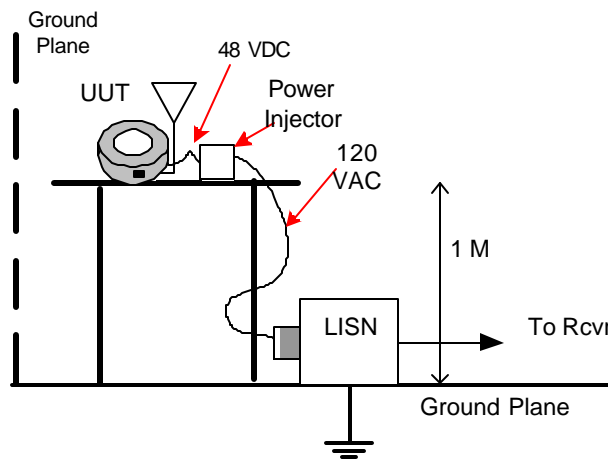
Specification:

Specification: CISPR 22

Procedure:

The test was set up according to the guidelines set forth in EN55022:1998 and FCC Part 2 for AC Line Conducted Emissions. The measurement used a LISN line on each AC line and an EMI receiver. A peak scan was made over the measurement frequency range (150 kHz to 30 MHz). The highest peaks were then marked and re-measured and quasi-peaked and averaged.

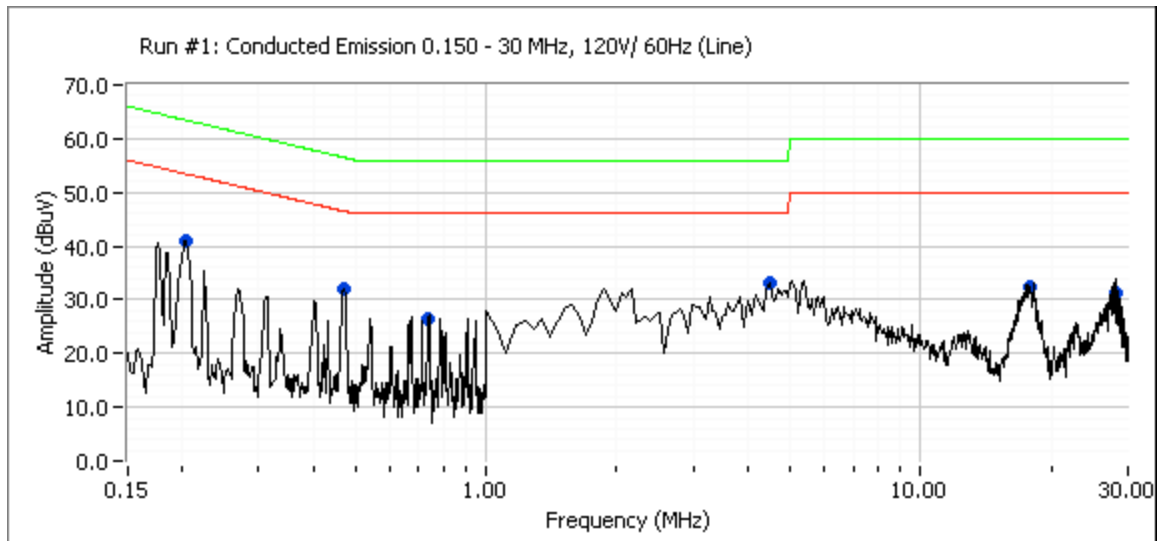
The test was configured as shown below. The product was tested with “power injector” running on 120 VAC @ 60 Hz. The power injector provides - 48VDC onto an Ethernet cable to power the access point. The AP was configured to transmit high power on both 2.4 and 5 GHz simultaneously. This presents the largest t load to the power supply and results in the worst case conducted emissions.



AC line Conducted Emissions Results

Frequency MHz	Level dBµV	AC Line	EN55022 B		Detector QP/Ave
			Limit	Margin	
0.469	27.4	Line	46.5	-19.1	Average
4.478	26.9	Neutral	46.0	-19.1	Average
0.469	26.2	Neutral	46.5	-20.3	Average
2.206	24.7	Line	46.0	-21.3	Average
17.440	28.2	Line	50.0	-21.8	Average
0.200	30.4	Neutral	53.6	-23.2	Average
0.200	40.0	Neutral	63.6	-23.6	QP
4.478	31.6	Neutral	56.0	-24.4	QP
0.202	38.5	Line	63.5	-25.0	QP
0.469	31.2	Line	56.5	-25.4	QP
0.469	31.1	Neutral	56.5	-25.5	QP
0.736	20.5	Neutral	46.0	-25.5	Average
0.202	27.8	Line	53.5	-25.8	Average
2.206	27.9	Line	56.0	-28.2	QP
17.440	30.4	Line	60.0	-29.6	QP
0.164	35.4	Line	65.3	-29.8	QP
0.736	25.3	Neutral	56.0	-30.7	QP
0.164	13.4	Line	55.3	-41.8	Average

AC Line conducted emissions, LINE



AC Line conducted emissions, NEUTRAL

