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FCC Part 15.247 Certification Application

Industrie Canada RSS210 Certification Application

EMI Test Report on Outdoor IEEE 802.11 Radio Models: 1300

FCC ID: QTZ1300

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General Information

Unit(s) Under Test: IEEE 802.11 Outdoor Access Point (AP)
Model(s): 1300

Product Description: Outdoor IEEE 802.11 A/B Access point

FCC ID: QTZ1300

Tested For: Airespace Inc.
110 Nortech Parkway
San Jose, CA 95134

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 15.247, 2.4 & 5.8 GHz DSSS

Test Date: Oct / Nov 2004, March 2005

**Requested
Certifications:** FCC Part 15.247 Certification
IC RSS-210

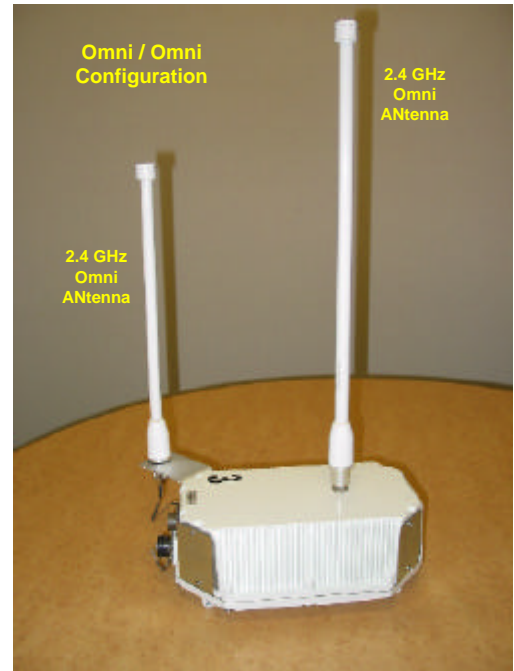
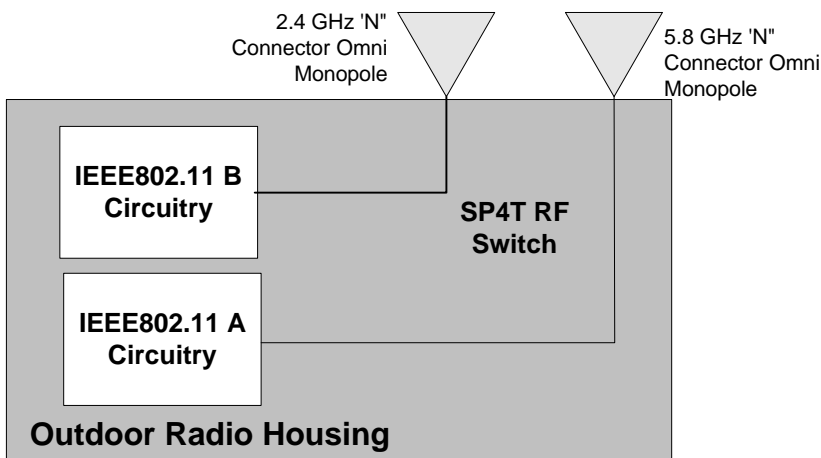
Detailed Product Information

The outdoor radio is an IEEE802.11 A B G access point intended to be installed in an outdoor environment to allow a wireless network infrastructure to be installed outside.

The device operates on the 2.4 GHz and 5.8 GHz ISM bands and uses two omni antennas, one for each band. Both the 2.4 and 5 GHz bands are using N connector omni directional monopole antennas. The antennas are :

2.4 GHz Omni: MaxRad 8dBi (MFB24008NM)

5.8 GHz Omni: MaxRad 9dBi (MFB58009)



The outdoor radio is intended to be installed on building rooftops and other structures such a commercial radio towers and out on the end of a streetlight arm. Due to the commercial nature of the product and the typical installation location, the unit will be professionally installed and configured by trained personnel.

The unit is powered by wither 48 VDC or 120 VAC.

The unit includes an externally accessible Ethernet connector and a power connector.

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 (2.4 GHz)	24.1 dBm Max
15.247(b)	6.2.2(o)(a) 3	Maximum Power Output (5.8 GHz)	25.43 dBm Max
15.247(a)(2)	6.2.2(o)(e1)	6dB Bandwidth (2.4 GHz)	12.6 MHz Min
15.247(a)(2)	6.2.2(o)(e1)	6dB Bandwidth (5.8GHz)	16.5 MHz Min
15.247(d)	6.2.2(o)(d1)	Power Spectral Density (2.4 GHz)	2.73dBm/3kHz Max
15.247(d)	6.2.2(o)(d1)	Power Spectral Density (5.8 GHz)	-1.01 dBm/3kHz Max
15.205	6.3(c)	Radiated Emissions in Restricted bands Out of band emissions	(2.4GHz) .2 dB in spec (5.8 GHz) 12.9 dB in spec
15.109		AC Line Conducted Emissions	6.4 dB in spec
15.209		Rcvr Spurious	.1 dB in spec

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 15.247
- Out of band emissions (Conducted) (for 2.4 & 5.8 GHz)

General:

Final 802.11 A/B/G 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

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263	09-Jan-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	26-Mar-05
Hewlett Packard	EMC Spectrum Analyzer 9KHz-26.5GHz, non programmable	8563E	284	15-Mar-05
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1290	22-Apr-05
Rohde & Schwarz	Peak Power Sensor 100uW - 2 Watts	NRV-Z32	1536	22-Apr-05

Additional Test Equipment

<u>Item</u>	<u>Desc.</u>	<u>Manufacturer</u>	<u>Model</u>	<u>S/N</u>	<u>Cal due date</u>
1.	Spectrum Analyzer	Agilent	E4440A	MY43362314	16 Jan 2006

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

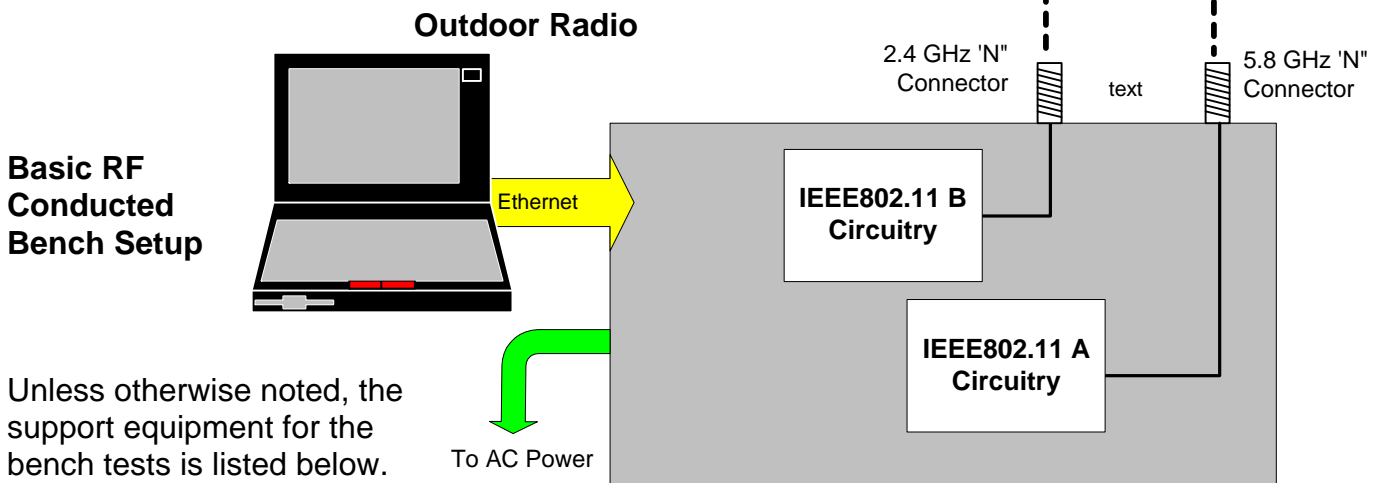
	2.4GHz		5.8GHz	
	Channel	Freq(MHz)	Channel	Freq(MHz)
LOW	1	2412	149	5745
MID	6	2437	157	5785
HIGH	11	2462	165	5825

In order to comply with the “radiated emissions in restricted bands” requirements the transmit power had to be lowered by 1 dB (relative to the other channels) on Channel 1 of the 2.4 GHz band (2412 MHz) 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 power setting will be correct for each channel.

The power levels were determined during the radiated emissions testing and those same power 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)	6dB / 99% Bandwidth
15.247(c)	Out of Band Conducted
Emissions	
15.247(a)(1)(i)	Power Spectral Density
15.247(b)	Transmit Power



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	21C	Humidity:	40%
ATM pressure	1010 mBar	Grounding:	3 rd Prong on AC plug
Tested By	David Waitt / Yalda Noor	Date of Test:	Nov 2004
Test Reference	Refer to individual test results		
Tested Range	Test Dependent		
Test Voltage	120 VAC		
Modifications	No modifications were made to the unit during the tests		

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 and the 99% occupied bandwidth was measured on the low middle and high channel of the 2.4 and 5.8 GHz ISM bands using the conducted RF test setup.

6dB: 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.

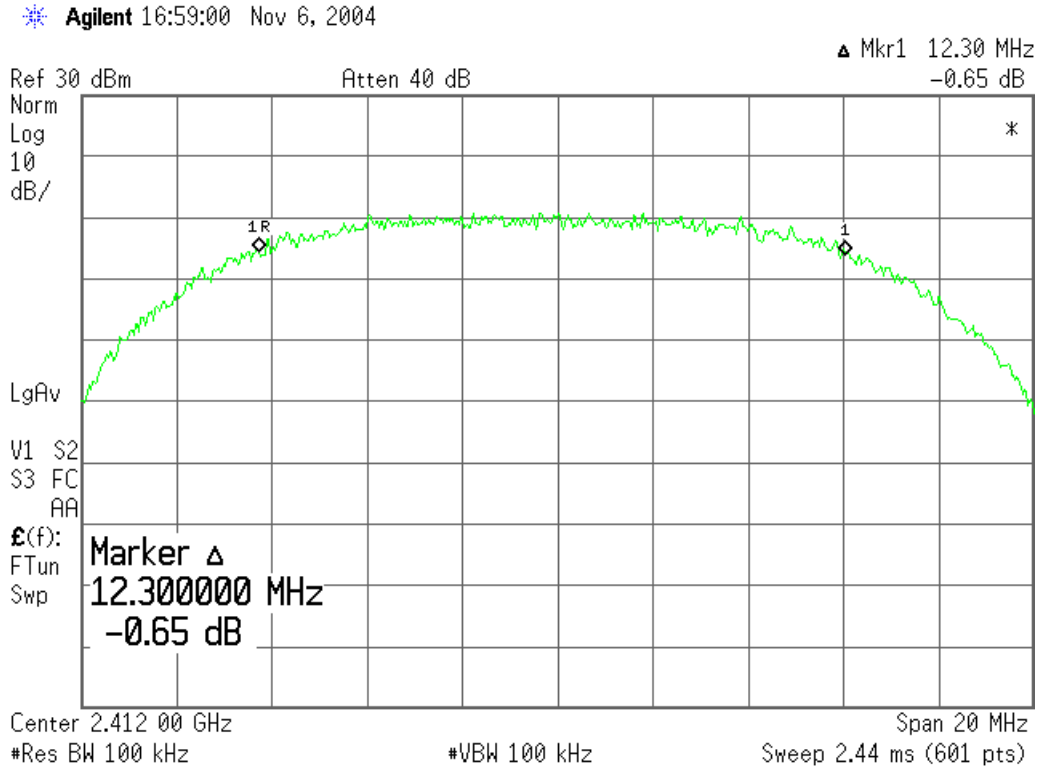
99% BW: The “Channel Bandwidth” function of the spectrum analyzer was used to measure the 99% occupied bandwidth

Test results summary table

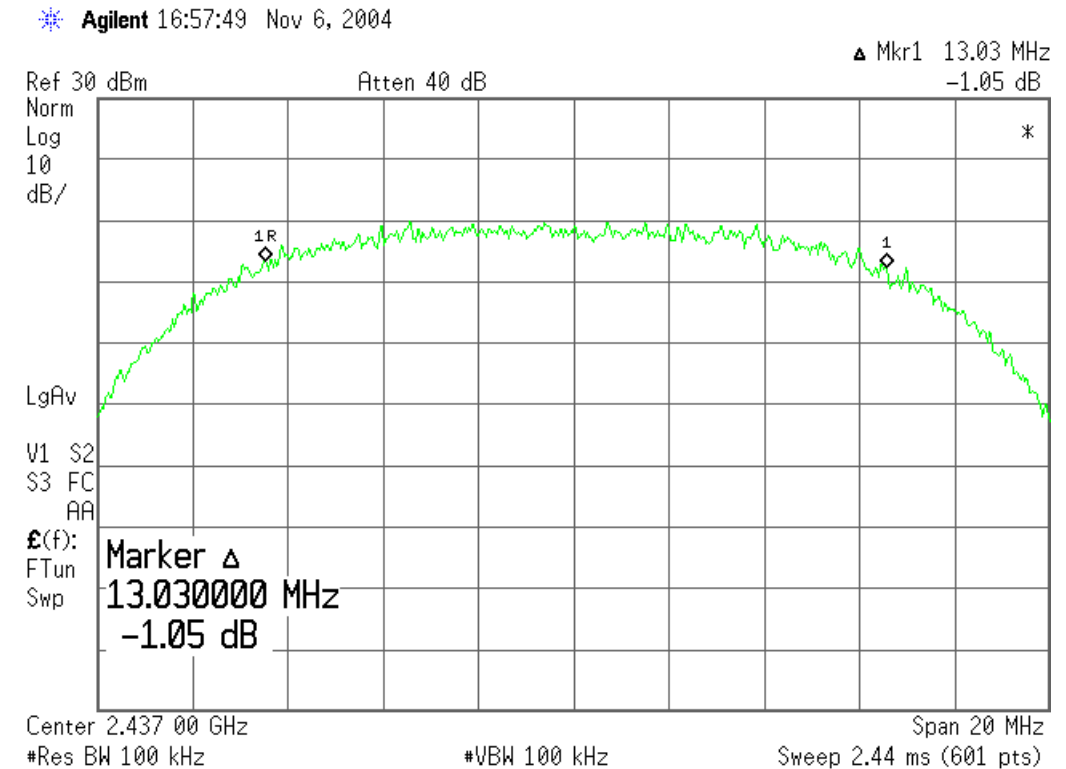
Freq (MHz)	Mode	Bandwidth (MHz)		Spec (MHz)	Delta (min)
		6 dB	99%		
2412	B	12.30	15.80	0.5	11.80
2437	B	13.03	15.70	0.5	12.53
2462	B	12.47	15.40	0.5	11.97
2412	G	16.66	16.43	0.5	16.16
2437	G	16.53	16.45	0.5	16.03
2462	G	16.57	16.45	0.5	16.07
5745	A	16.50	16.78	0.5	16.00
5785	A	16.50	16.75	0.5	16.00
5825	A	16.50	16.78	0.5	16.00

2.4GHz 802.11 B 6 dB BW Results:

2412 B 6 dB BW



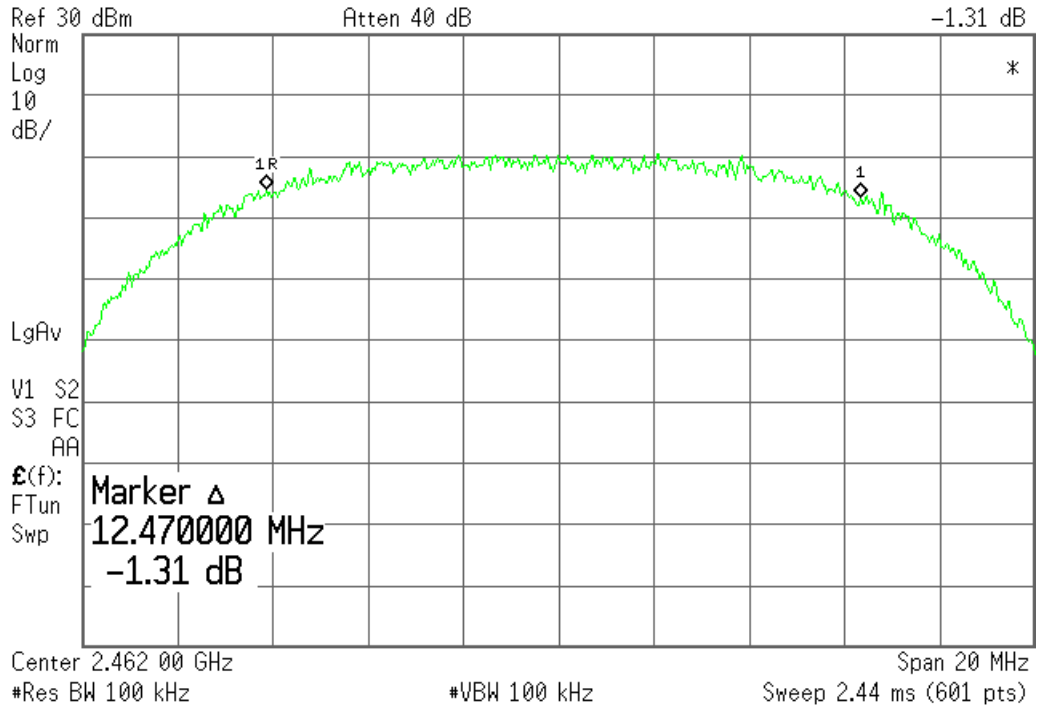
2437 B 6 dB BW



Agilent 16:56:36 Nov 6, 2004

Mkr1 12.47 MHz
-1.31 dB

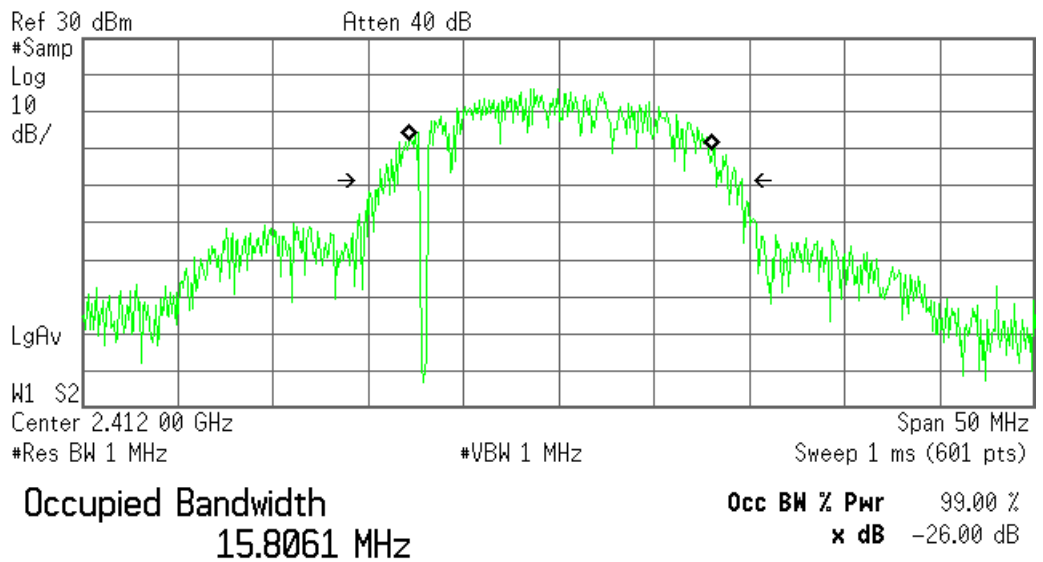
2462 B 6 dB BW



2.4GHz 802.11 B 99% BW Results:

Agilent 16:52:34 Nov 6, 2004

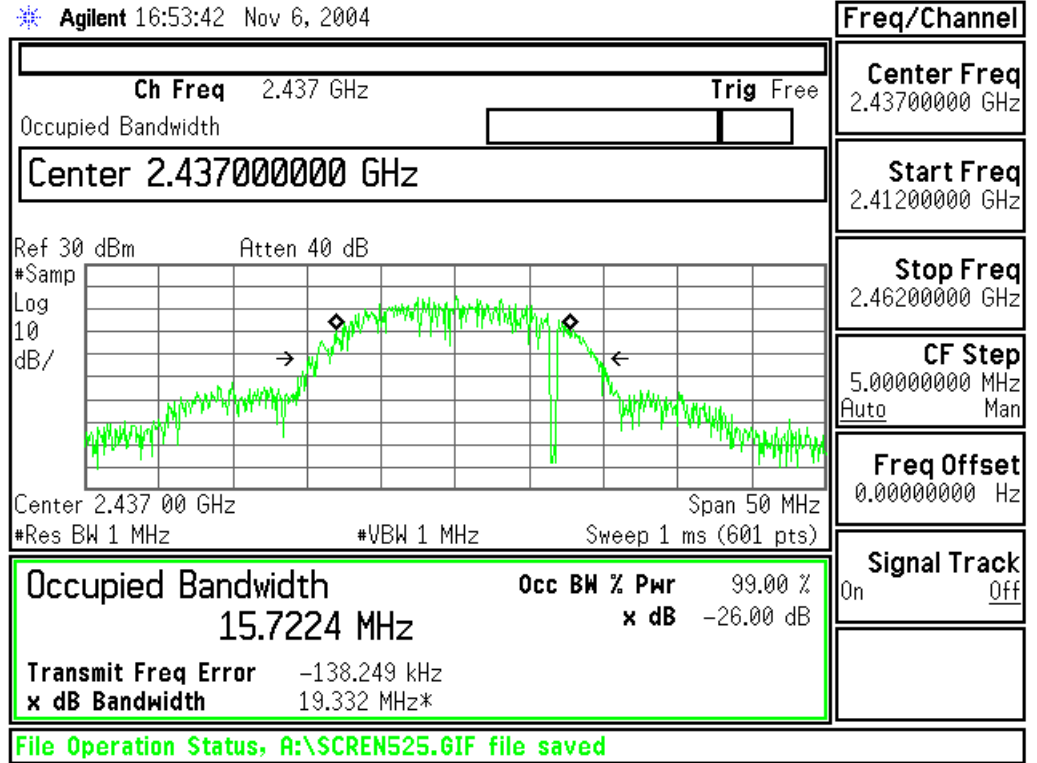
2412 B 99% BW



Transmit Freq Error 94.149 kHz
x dB Bandwidth 19.291 MHz*

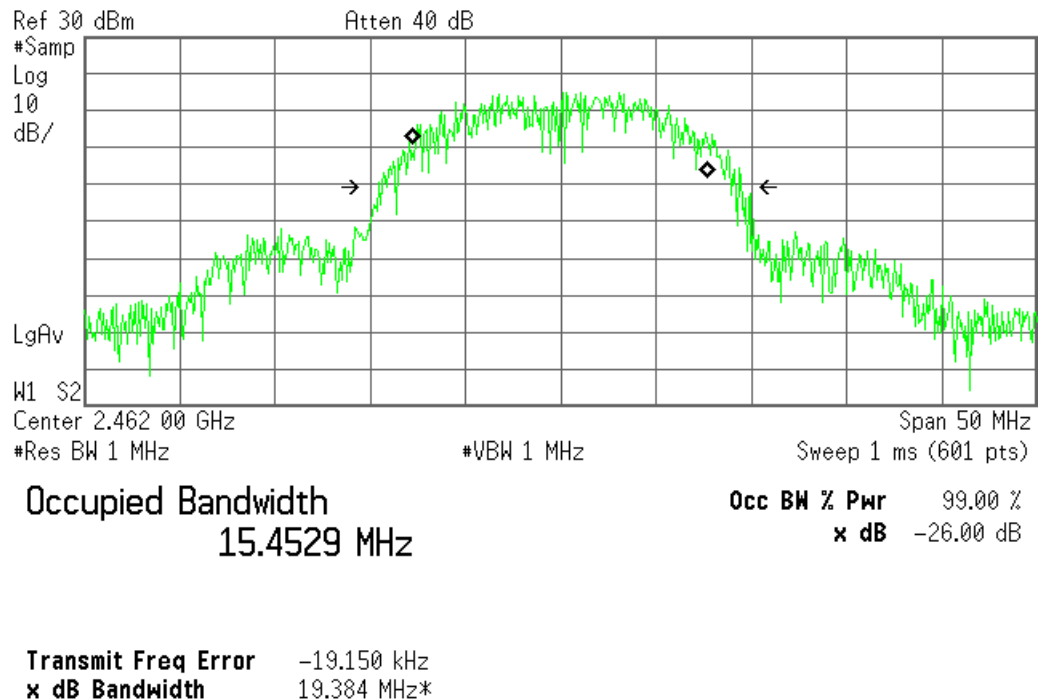
Agilent 16:53:42 Nov 6, 2004

2437 B 99% dB BW



Agilent 16:54:37 Nov 6, 2004

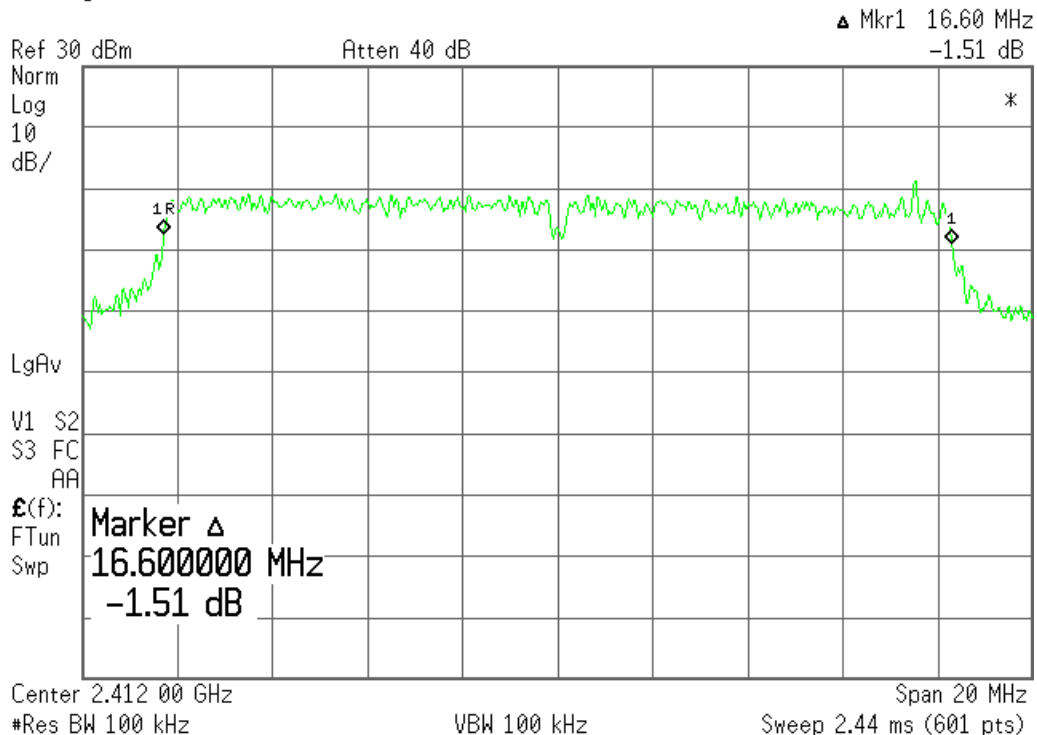
2462 B 99% dB BW



2.4GHz 802.11 G 6dB BW Results:

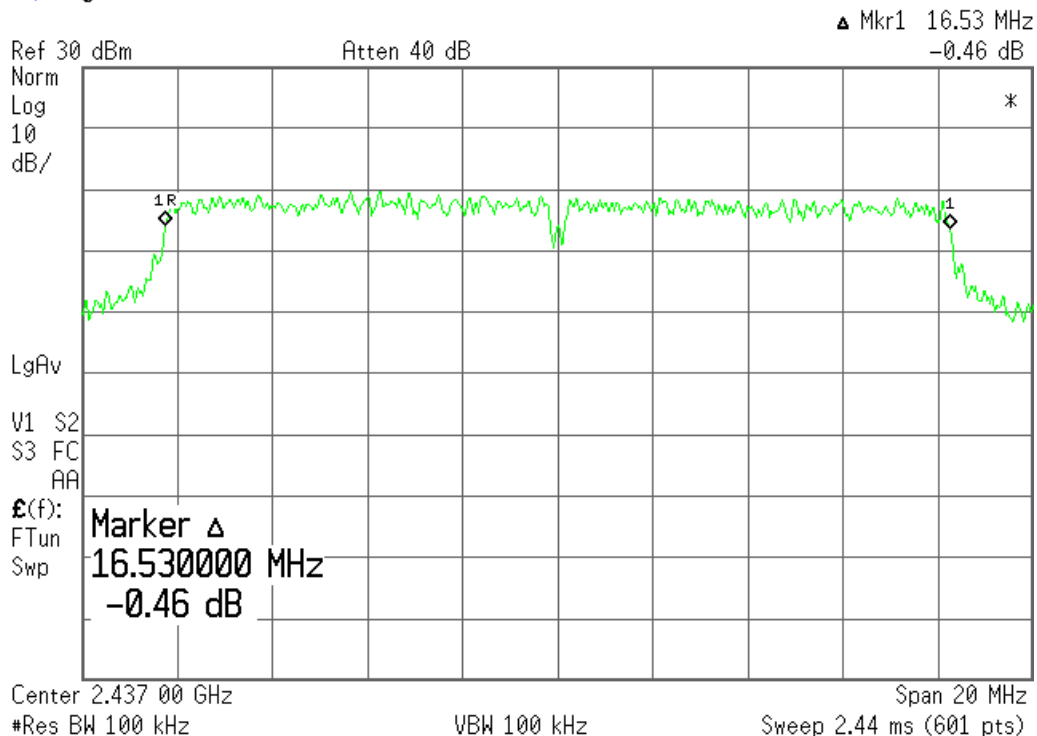
Agilent 18:17:36 Nov 17, 2004

2412 G 6 dB BW



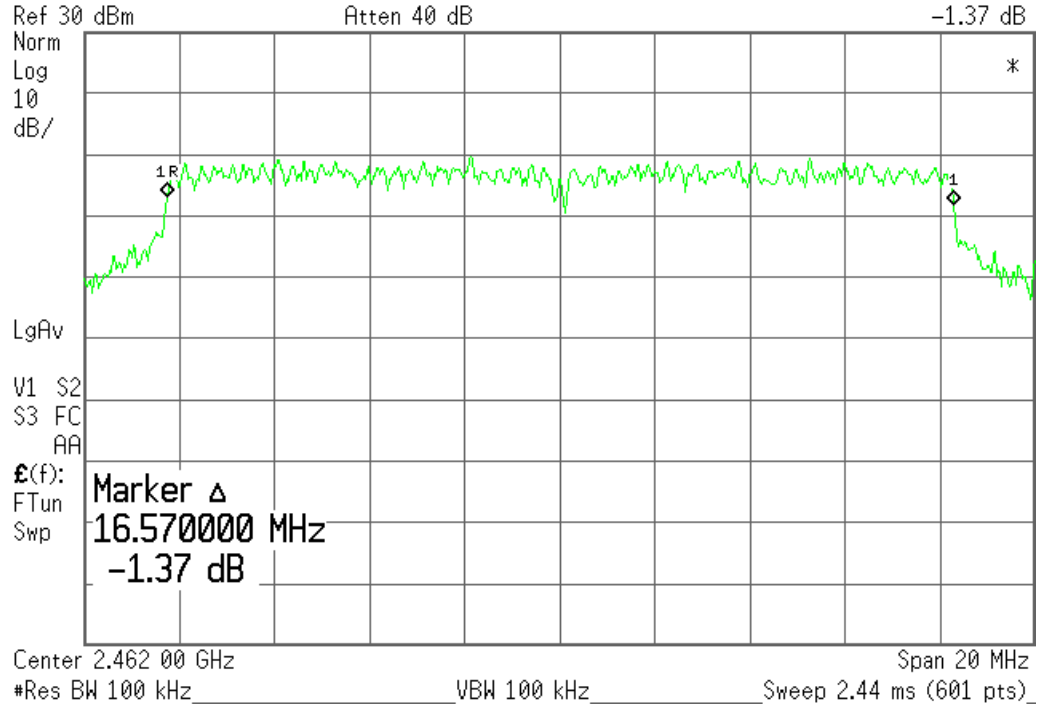
Agilent 18:18:43 Nov 17, 2004

2437 G 6 dB BW



Agilent 18:19:30 Nov 17, 2004

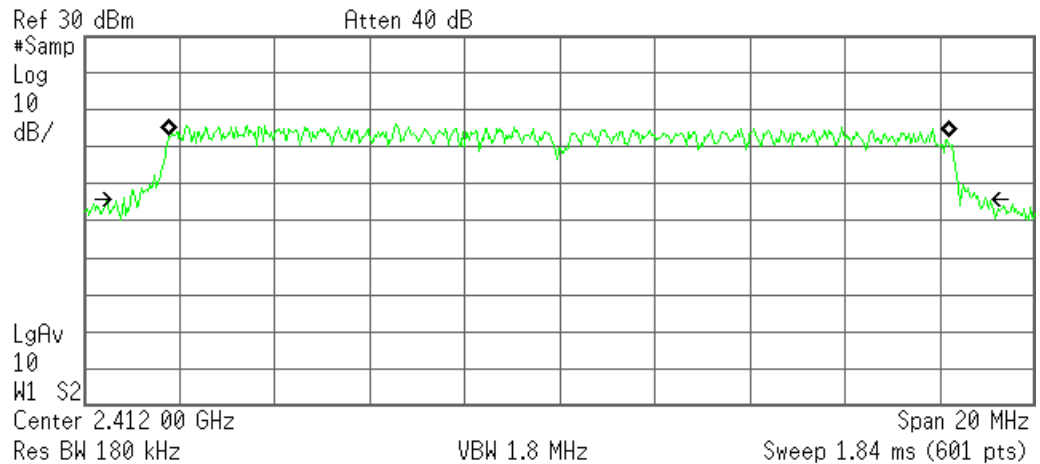
Mkr1 16.57 MHz
-1.37 dB



2462 G 6 dB BW

2.4GHz 802.11 G 99% BW Results:

Agilent 18:22:04 Nov 17, 2004



2412 G 99% dB BW

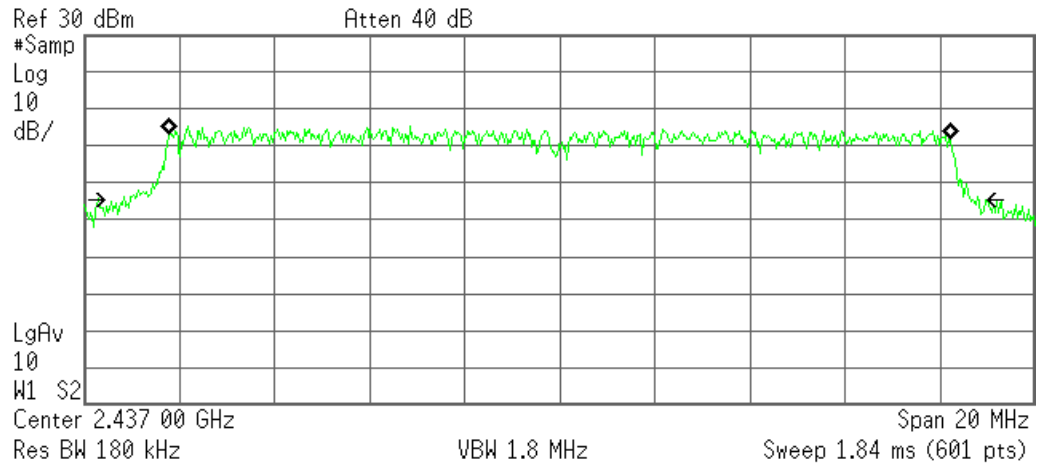
Occupied Bandwidth
16.4361 MHz

Occ BW % Pwr 99.00 %
x dB -20.00 dB

Transmit Freq Error -19.347 kHz
x dB Bandwidth 17.869 MHz*

Agilent 18:21:23 Nov 17, 2004

2437 G 99% dB BW



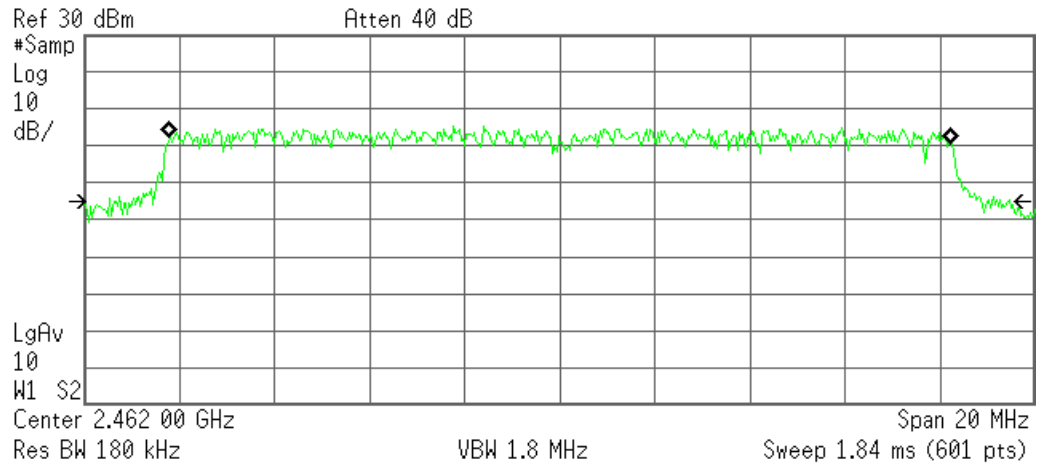
Occupied Bandwidth
16.4532 MHz

Occ BW % Pwr 99.00 %
x dB -20.00 dB

Transmit Freq Error -8.752 kHz
x dB Bandwidth 17.907 MHz*

Agilent 18:20:44 Nov 17, 2004

2462 G 99% dB BW



Occupied Bandwidth
16.4597 MHz

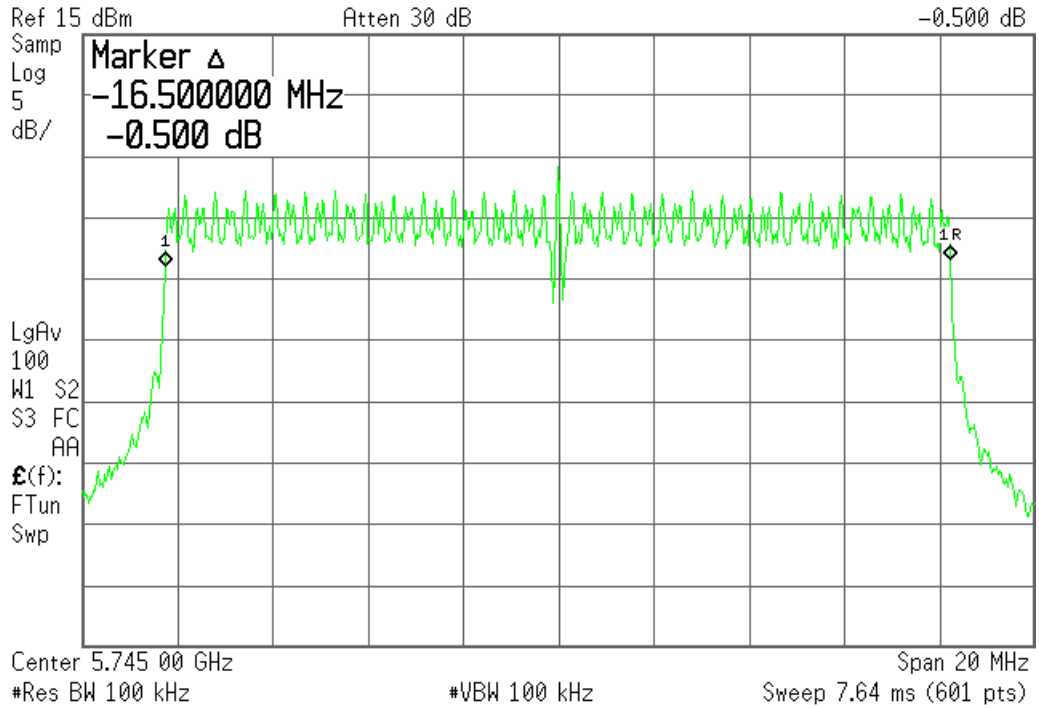
Occ BW % Pwr 99.00 %
x dB -20.00 dB

Transmit Freq Error -6.194 kHz
x dB Bandwidth 18.867 MHz*

5.8GHz 802.11 A 6 dB BW Results:

Agilent 14:23:02 Mar 6, 2005

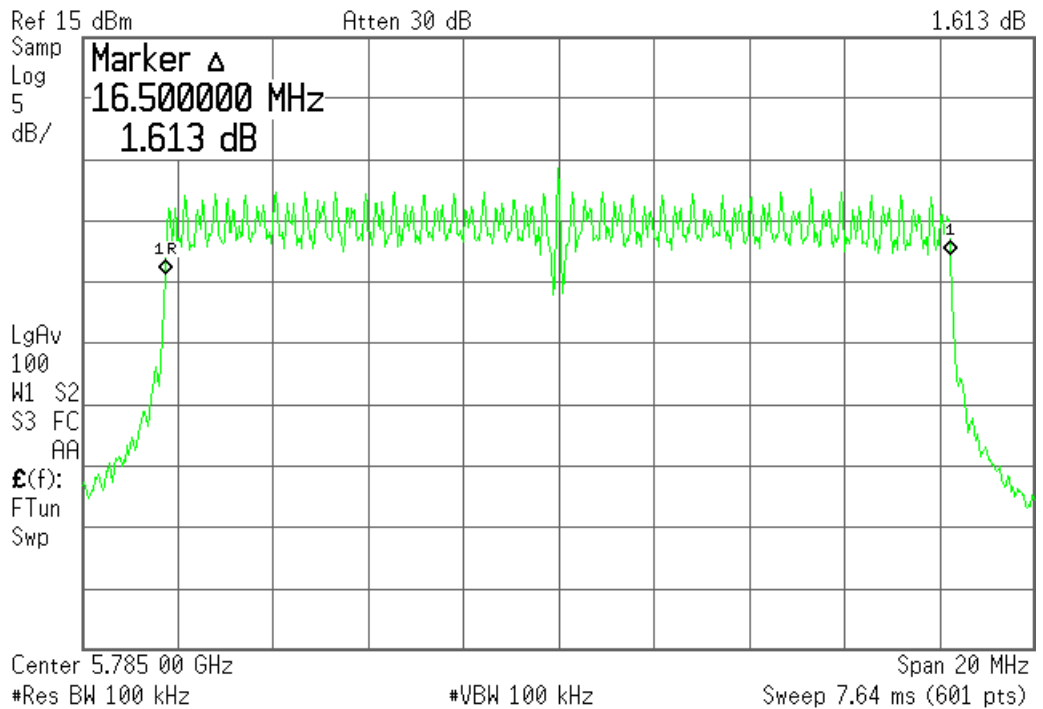
Mkr1 -16.50 MHz
-0.500 dB



5745 MHz A 6 dB BW

Agilent 14:19:57 Mar 6, 2005

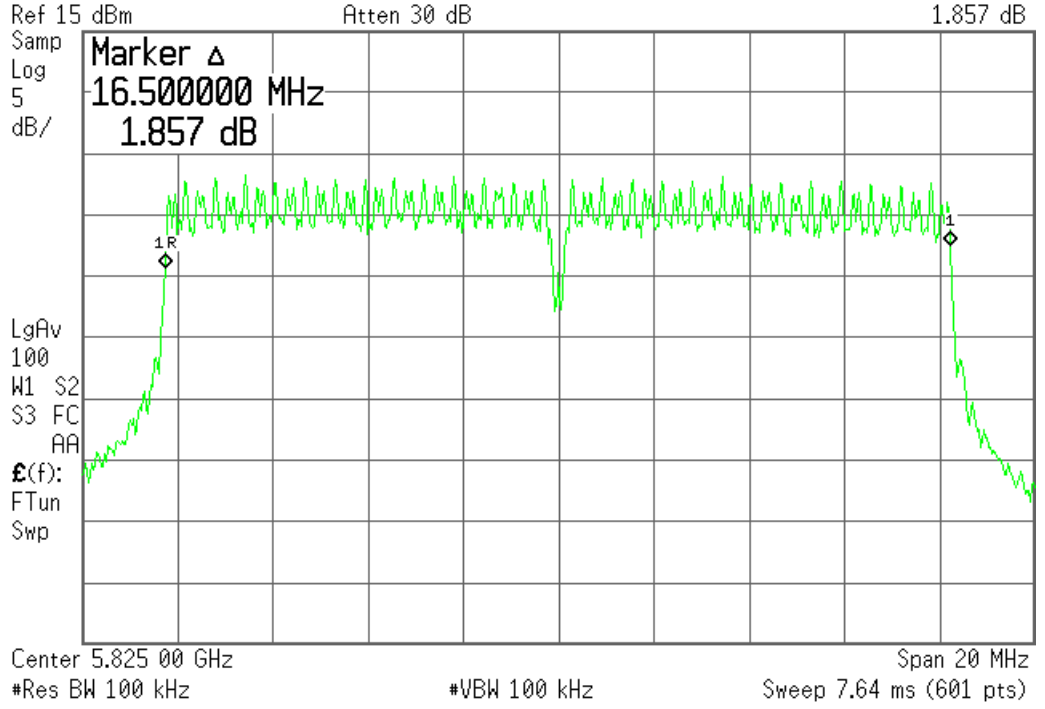
Mkr1 16.50 MHz
1.613 dB



5785 MHz A 6 dB BW

Agilent 14:21:14 Mar 6, 2005

Mkr1 16.50 MHz
1.857 dB

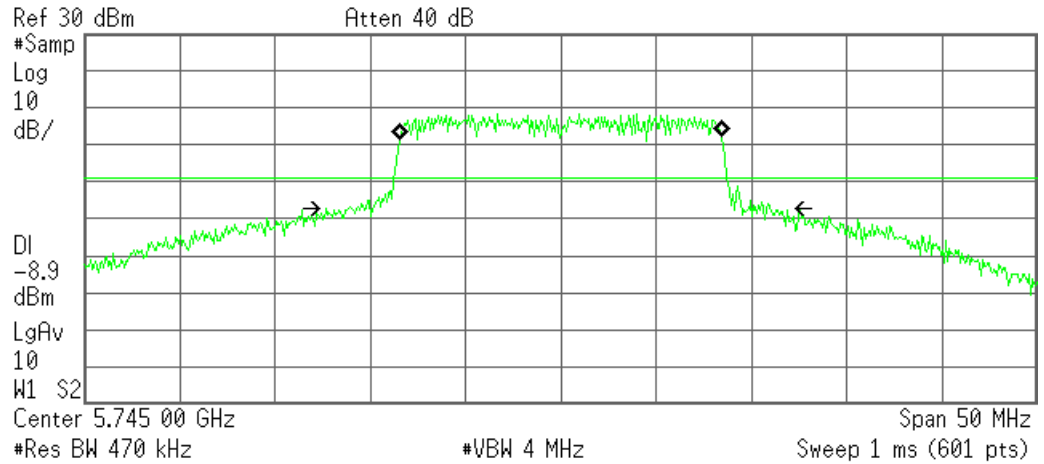


5825 MHz A 6 dB BW

5.8GHz 802.11 A 99% BW Results:

Agilent 18:28:05 Nov 6, 2004

5745 MHz A 99% BW



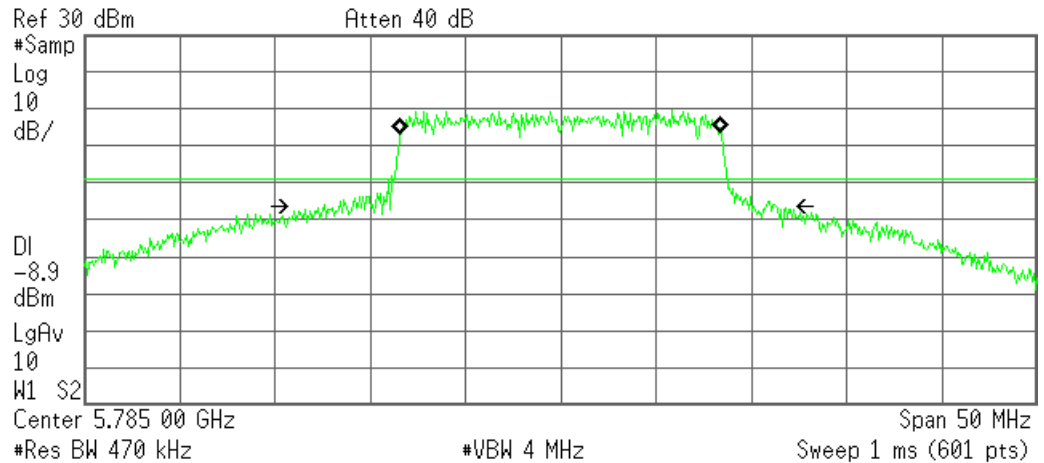
Occupied Bandwidth
16.7887 MHz

Occ BW % Pwr 99.00 %
x dB -26.00 dB

Transmit Freq Error 7.191 kHz
x dB Bandwidth 23.350 MHz*

Agilent 18:29:09 Nov 6, 2004

5785 MHz A 99% BW



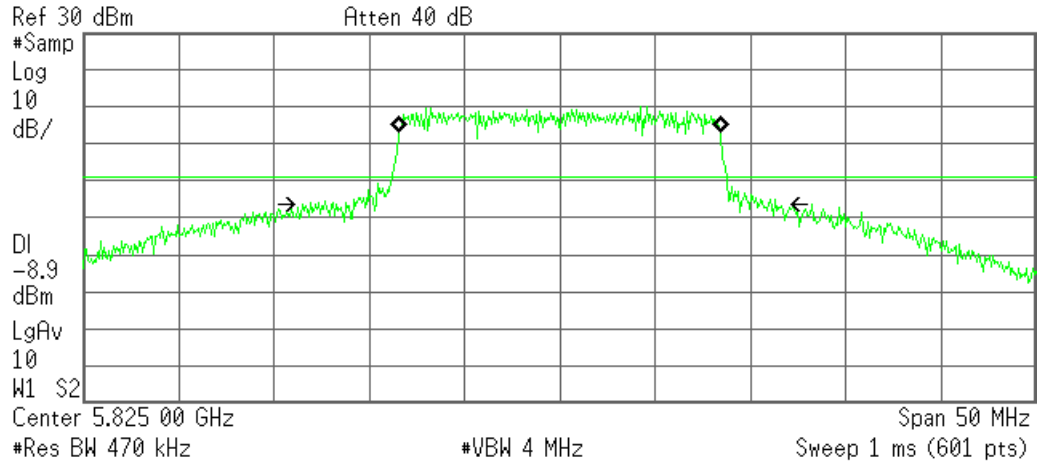
Occupied Bandwidth
16.7559 MHz

Occ BW % Pwr 99.00 %
x dB -26.00 dB

Transmit Freq Error -19.888 kHz
x dB Bandwidth 25.094 MHz*

Agilent 18:30:02 Nov 6, 2004

5825 MHz A 99% BW



Occupied Bandwidth
16.7874 MHz

Occ BW % Pwr 99.00 %
x dB -26.00 dB

Transmit Freq Error -2.925 kHz
x dB Bandwidth 24.487 MHz*

802.11 B Maximum RF Power Output at Antenna Terminals

Specifications:

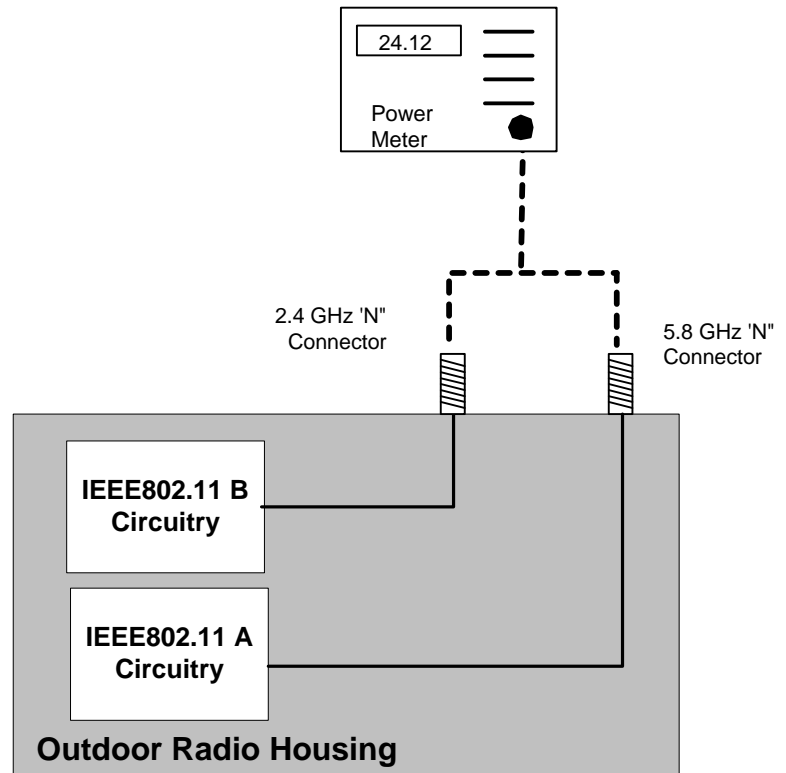
FCC Specification: Paragraph: 15.247(b)

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

Procedure:

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

The power output of the 2.4 GHz band channel 1 had to be lowered to accommodate the restricted band at 2390. It was not necessary to lower the power to accommodate the restricted band at the 2483.5 band edge.



RF Power Output summary table

	Freq (MHz)	Mode	Power into antenna (dBm)	Power into antenna (mW)	MAX Antenna Gain (dBi)	MAX EIRP	Max allowed Pwr into antenna (dBm)	Max Allowed EIRP	EIRP Delta (dB)
Point to Multipoint Omni Operation	2412	B	23.1	204.17	8	31.1	28	36	4.9
	2437	B	23.8	239.88	8	31.8	28	36	4.2
	2462	B	24.1	257.04	8	32.1	28	36	3.9
	2412	G	23.86	243.22	8	31.86	28	36	4.1
	2437	G	23.96	248.89	8	31.96	28	36	4.0
	2437	G	23.93	247.17	8	31.93	28	36	4.1
Point to Multipoint Omni Operation	5745	A	25.43	349.14	9	34.43	27	36	1.6
	5785	A	25.08	322.11	9	34.08	27	36	1.9
	5825	A	24.9	309.03	9	33.9	27	36	2.1

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 set to 3 kHz with a 100 second sweep. The analyzer was then set to MAX HOLD and a display line placed at +8dBm.

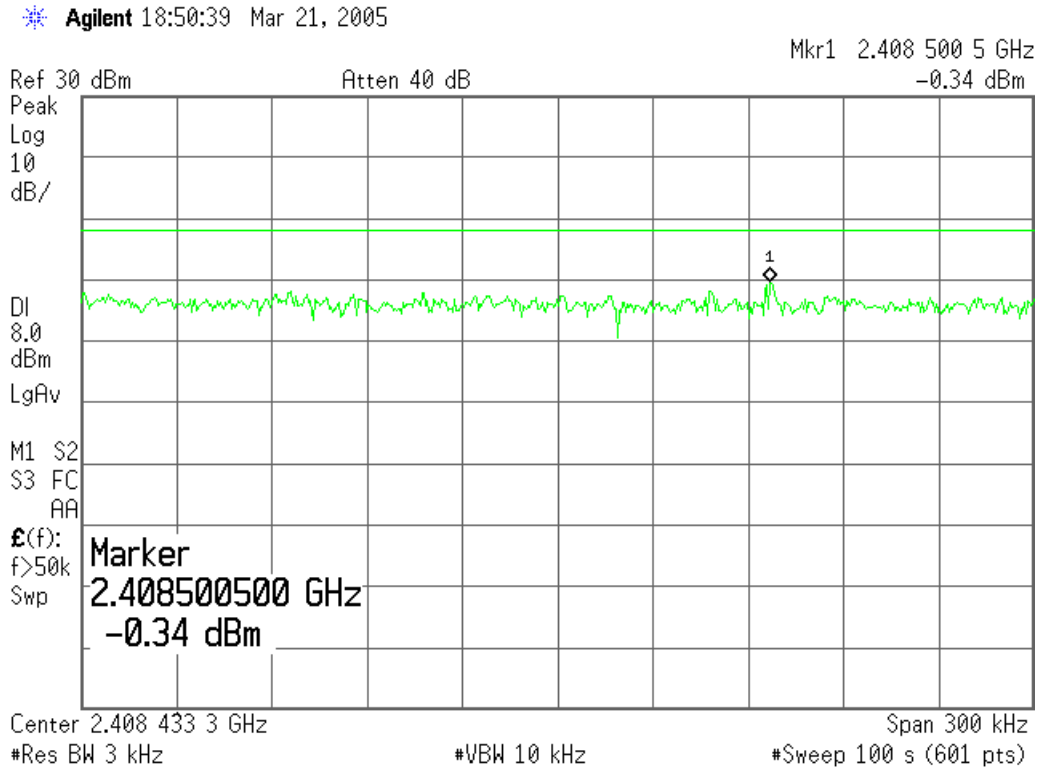
The power spectral density was measured at the low, middle and high-test channels with the appropriate power setting for the given test channel.

Power Spectral Summary Results

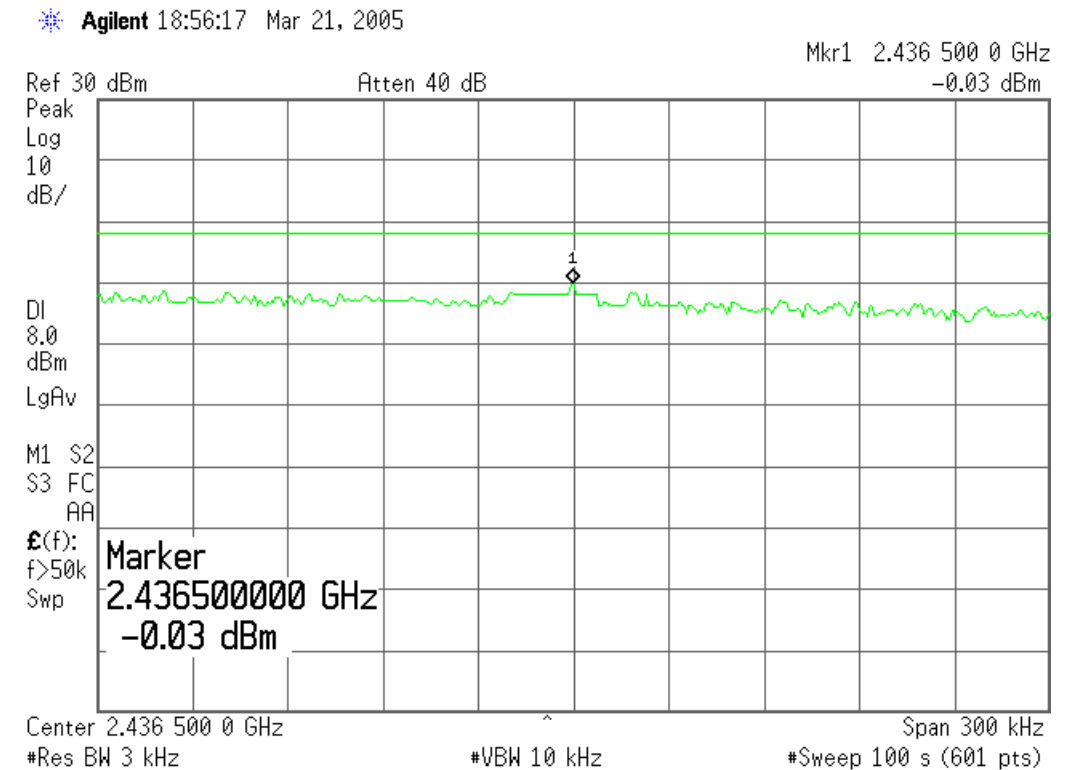
	Frequency (MHz)	Specification (dBm/3KHz)	Measured PSD / 3 KHz	Delta Spec dB
B	2412	8	-0.34	8.34
	2437	8	-0.03	8.03
	2462	8	-0.16	8.16
G	2412	8	-2.11	10.11
	2437	8	-1.26	9.26
	2462	8	-1.8	9.8
A	5745	8	-0.99	8.99
	5785	8	-0.71	8.71
	5825	8	-0.06	8.06

802.11 B PSD Results

2412 MHz B PSD



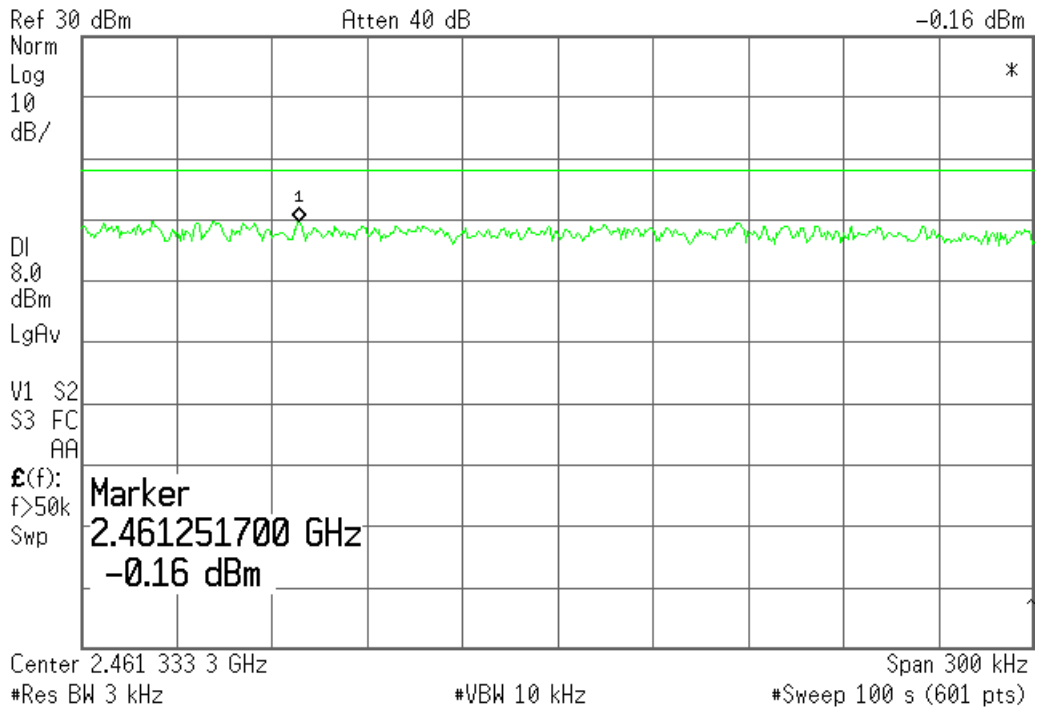
2437 MHz B PSD



Agilent 19:00:37 Mar 21, 2005

Mkr1 2.461 251 7 GHz
-0.16 dBm

2462 MHz B PSD

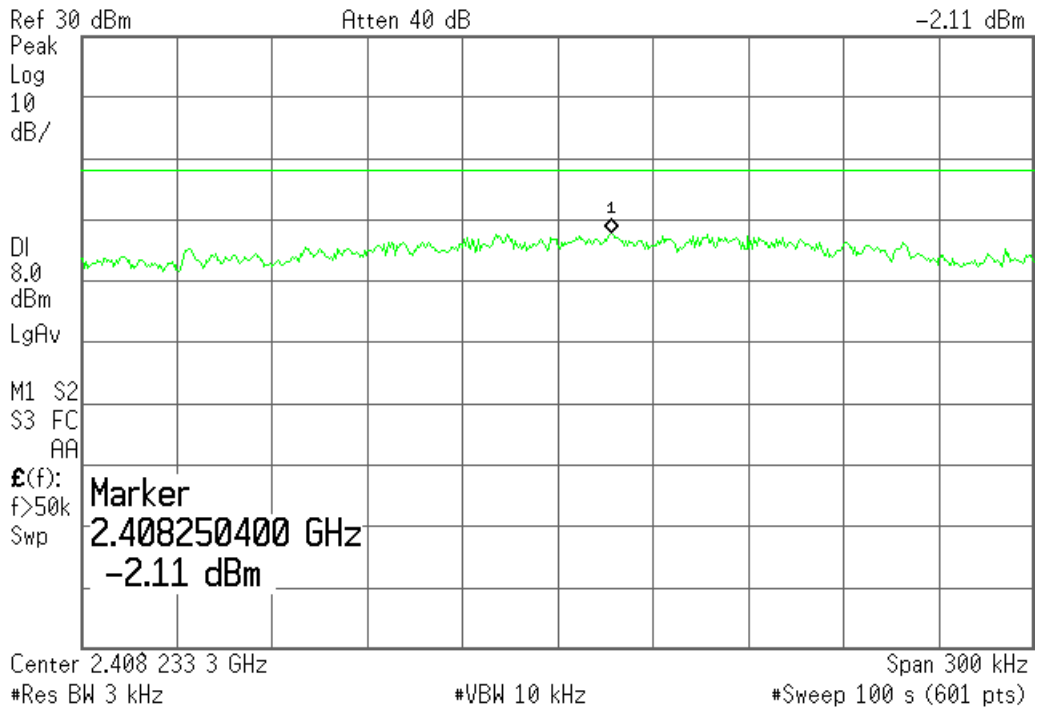


802.11 G PSD Results

Agilent 19:11:05 Mar 21, 2005

Mkr1 2.408 250 4 GHz
-2.11 dBm

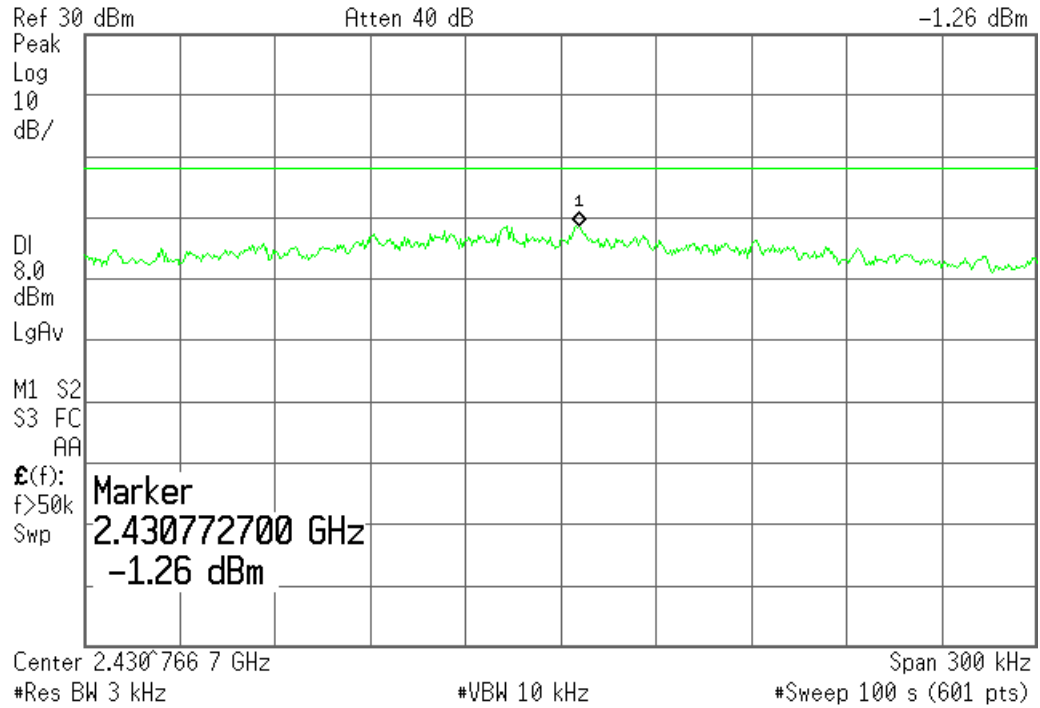
2412 MHz G PSD



Agilent 19:08:13 Mar 21, 2005

Mkr1 2.430 772 7 GHz
-1.26 dBm

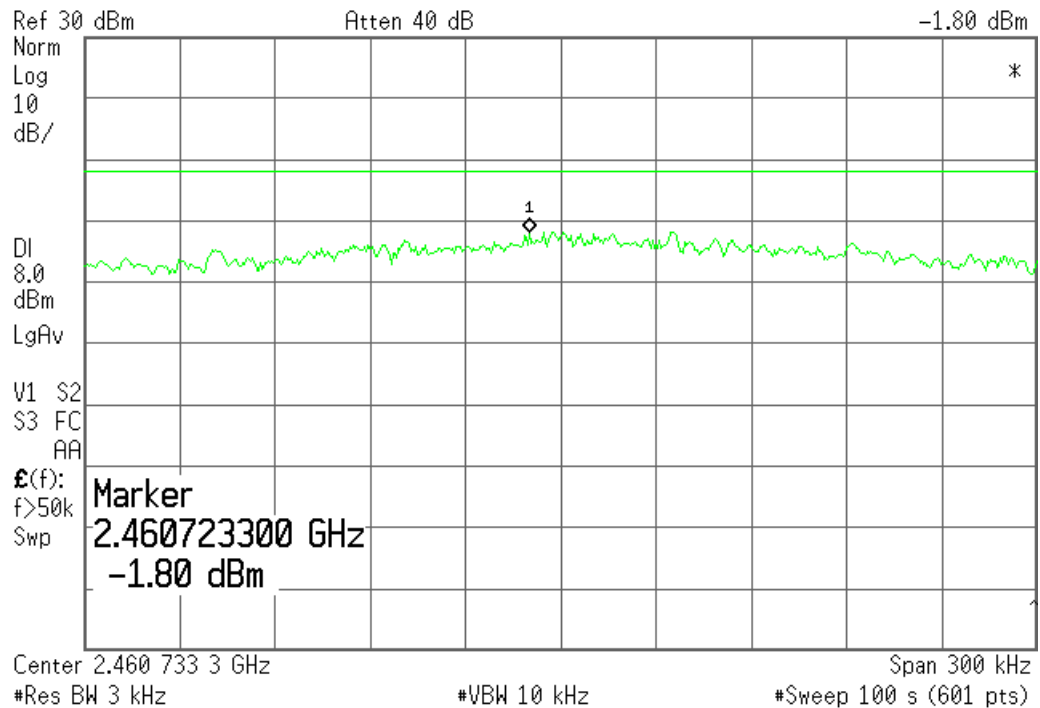
2437 MHz G PSD



Agilent 19:04:27 Mar 21, 2005

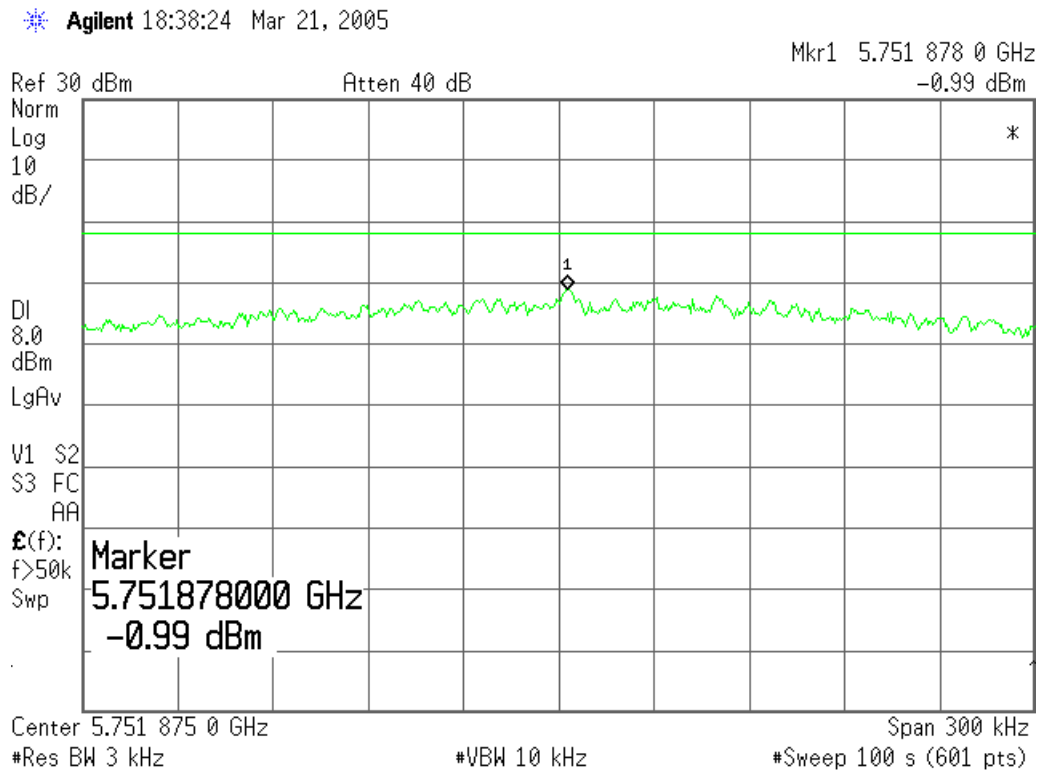
Mkr1 2.460 723 3 GHz
-1.80 dBm

2462 MHz G PSD

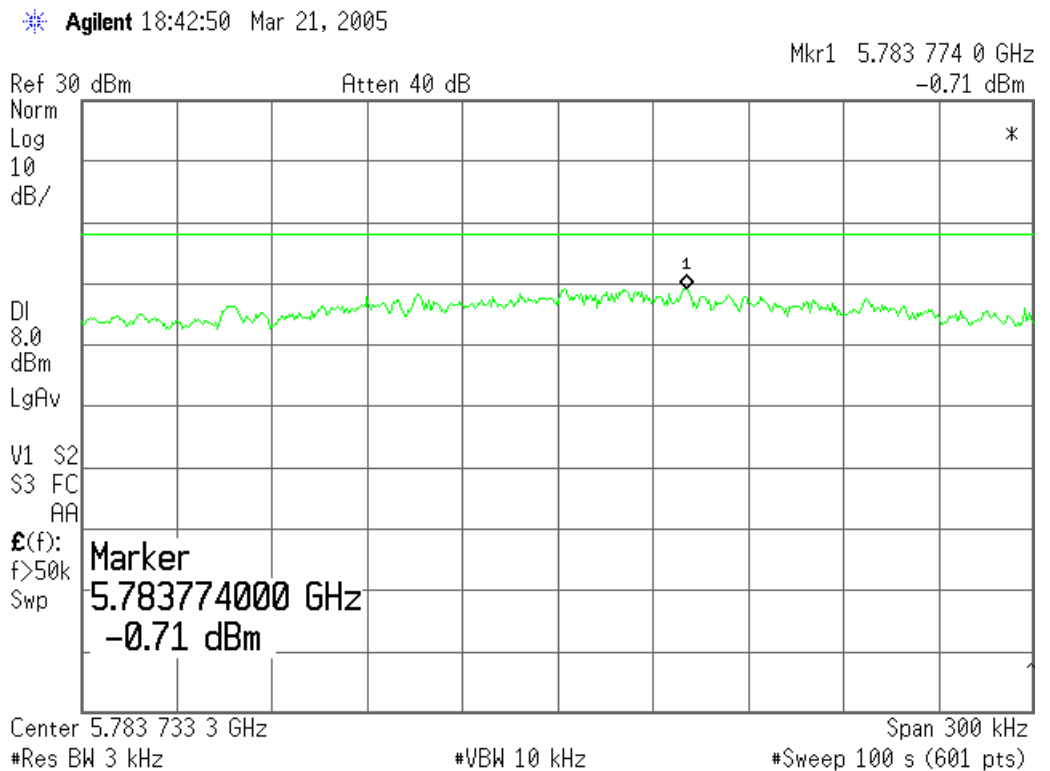


802.11 A PSD Results

5745 MHz A PSD



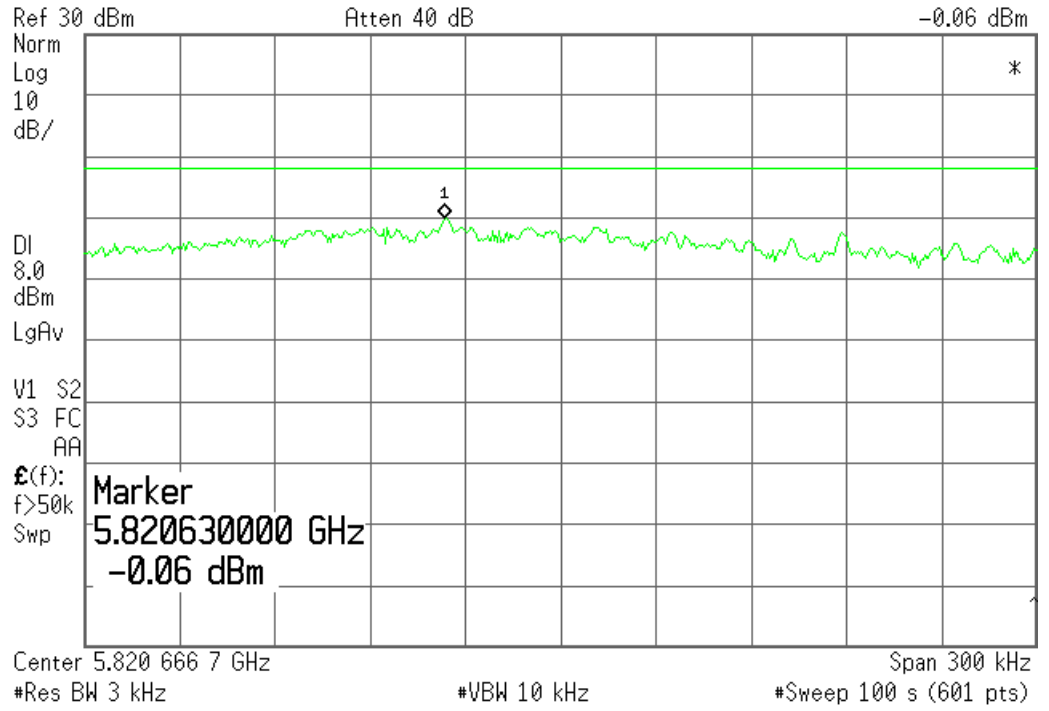
5785 MHz A PSD



Agilent 18:46:16 Mar 21, 2005

Mkr1 5.820 630 0 GHz
-0.06 dBm

5825 MHz A PSD



Out of Band Emissions

Specifications:

FCC Specification: Paragraph 15.247(c)

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

Procedure:

The test was configured as shown in the bench conducted RF test setup. The UUT was configured to transmit random data packets. The band from 1 GHz to 25GHz (1 – 40 GHz for 802.11 A) was examined for spurious emissions. This test was conducted the low middle and high channels. The UUT was configured to transmit at the appropriate power levels for each channel that was used in the RF power test.

Results:

The entire band of interest was examined at one time to clearly demonstrate compliance. There were no spurious emissions above the limit (-20dBc).

The display line in the following plots is set to the -20dBc level corresponding to each channels fundamental signal level.

Out of Band Emissions Summary Results

No noticeable emissions were detected with the unit transmitting on 2.4 GHz either 802.11 B or while transmitting on 2412 802.11 G

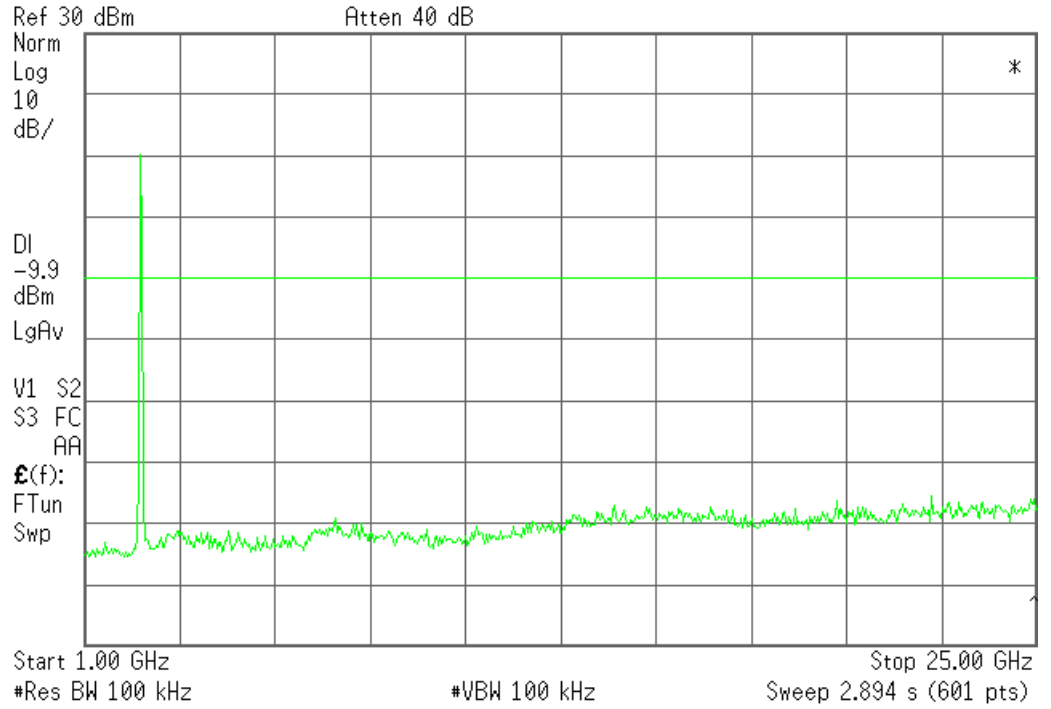
	Xmit Frequency (MHz)	Highest Emission (MHz)	Max Allowed Level (dBm)	Emission Level (dBm)	Delta Spec dB
A	5745	5280	-5.7	-38.74	33.04
	5785	5280	-4.9	-38.43	33.53
	5825	5280	-4.8	-38.73	33.93

	Xmit Frequency (MHz)	Highest Emission (MHz)	Max Allowed Level (dBm)	Emission Level (dBm)	Delta Spec dB
G	2437	7320	-12.9	-56.33	43.43
	2462	7400	-13	-57.79	44.79

802.11 B Out of Band Emissions Results

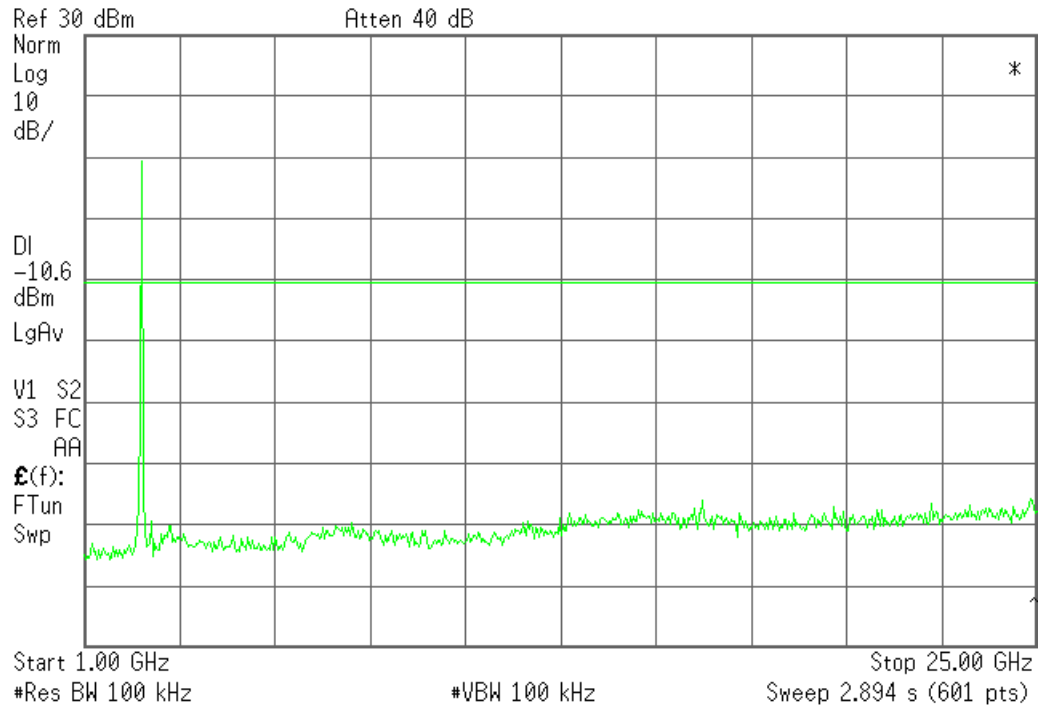
Agilent 17:59:53 Nov 6, 2004

UUT Transmitting on 2412 MHz, 802.11B



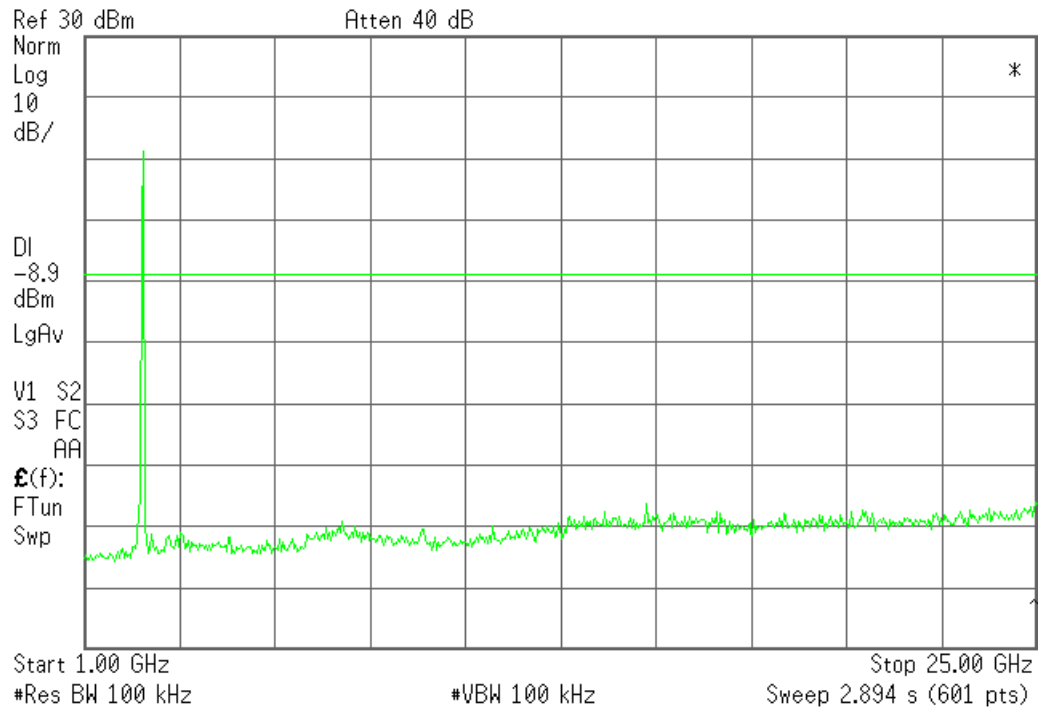
Agilent 18:01:03 Nov 6, 2004

UUT Transmitting on 2437 MHz, 802.11B



Agilent 18:01:56 Nov 6, 2004

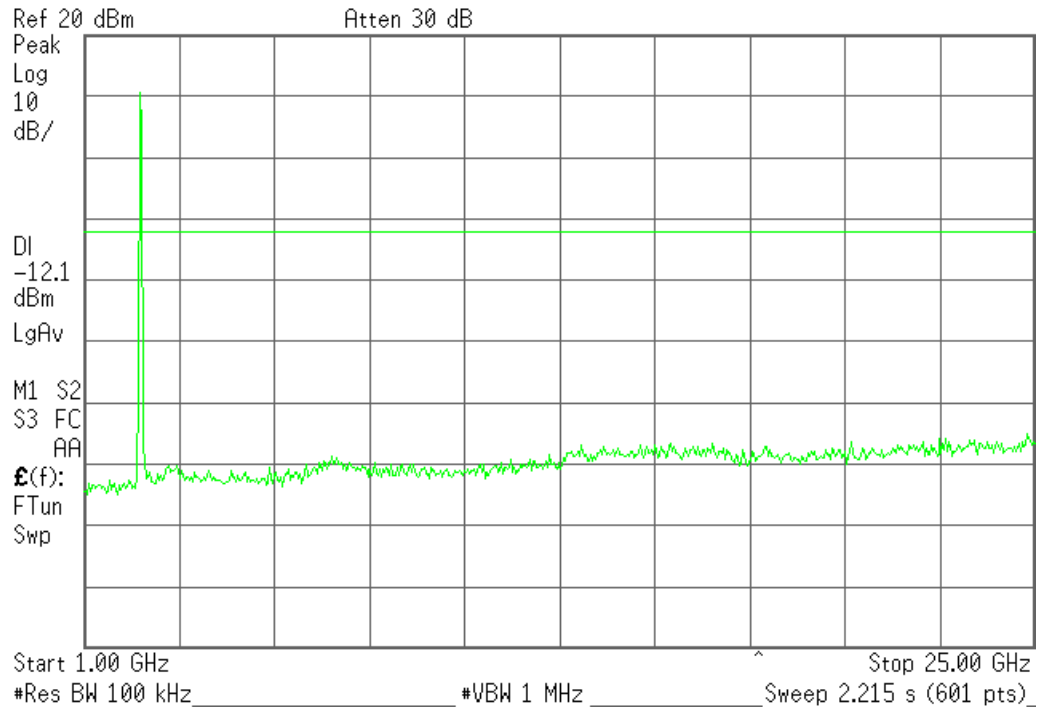
UUT Transmitting on 2462 MHz, 802.11B



802.11G Out of Band Emissions Results

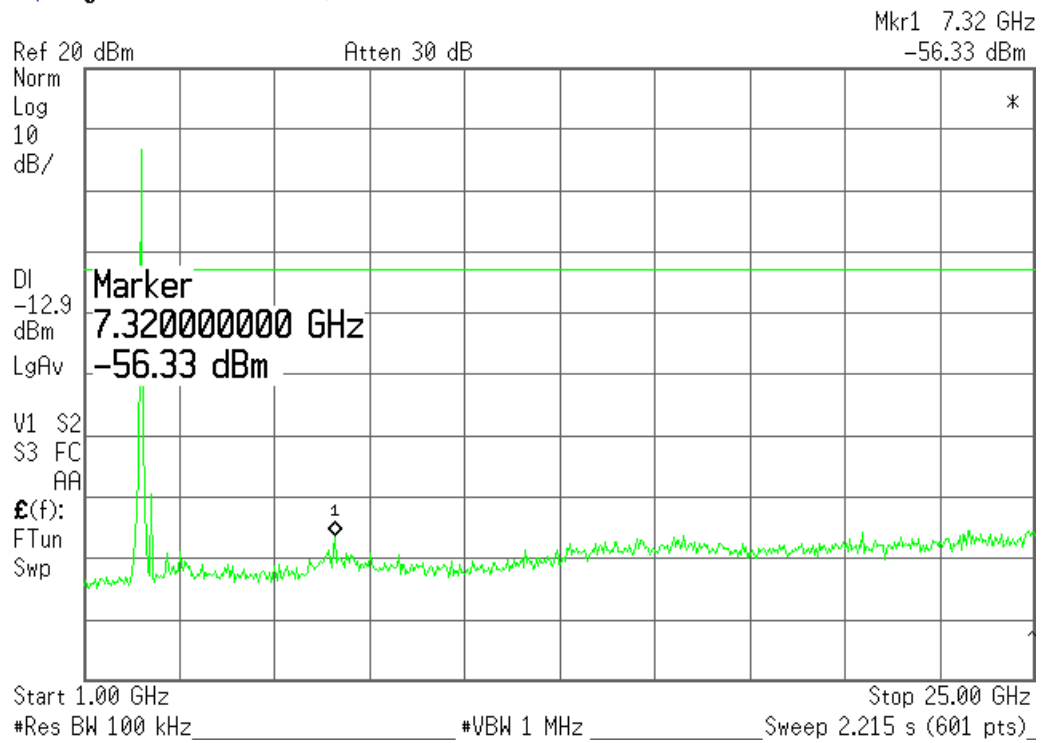
Agilent 18:47:49 Nov 17, 2004

UUT Transmitting on 2412 MHz, 802.11G



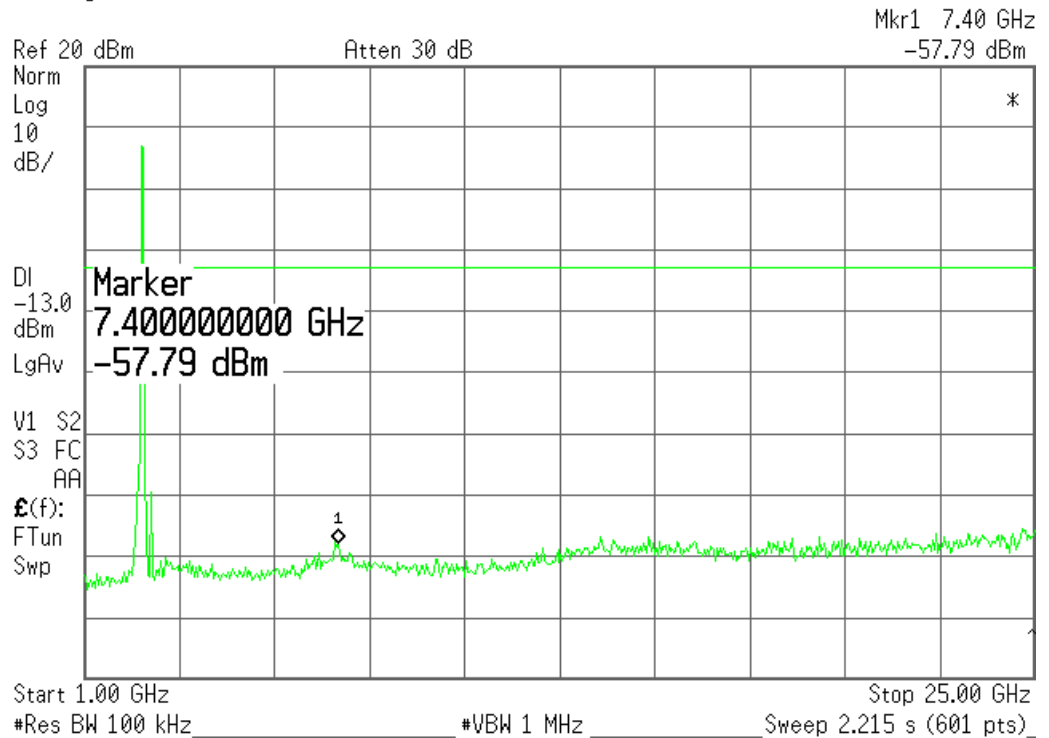
Agilent 18:49:35 Nov 17, 2004

UUT Transmitting on
2437 MHz, 802.11G



Agilent 18:50:53 Nov 17, 2004

UUT Transmitting on
2462 MHz, 802.11G

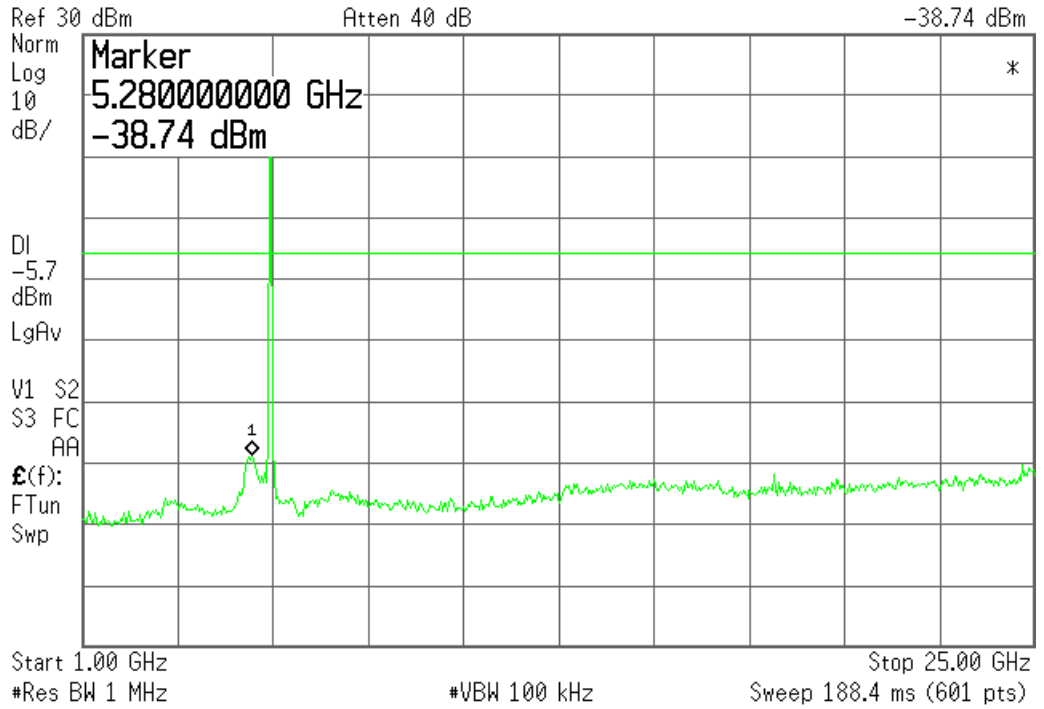


802.11 A Out of Band Emissions Results

UUT Transmitting on
5745 MHz, 802.11A

Agilent 18:55:14 Nov 6, 2004

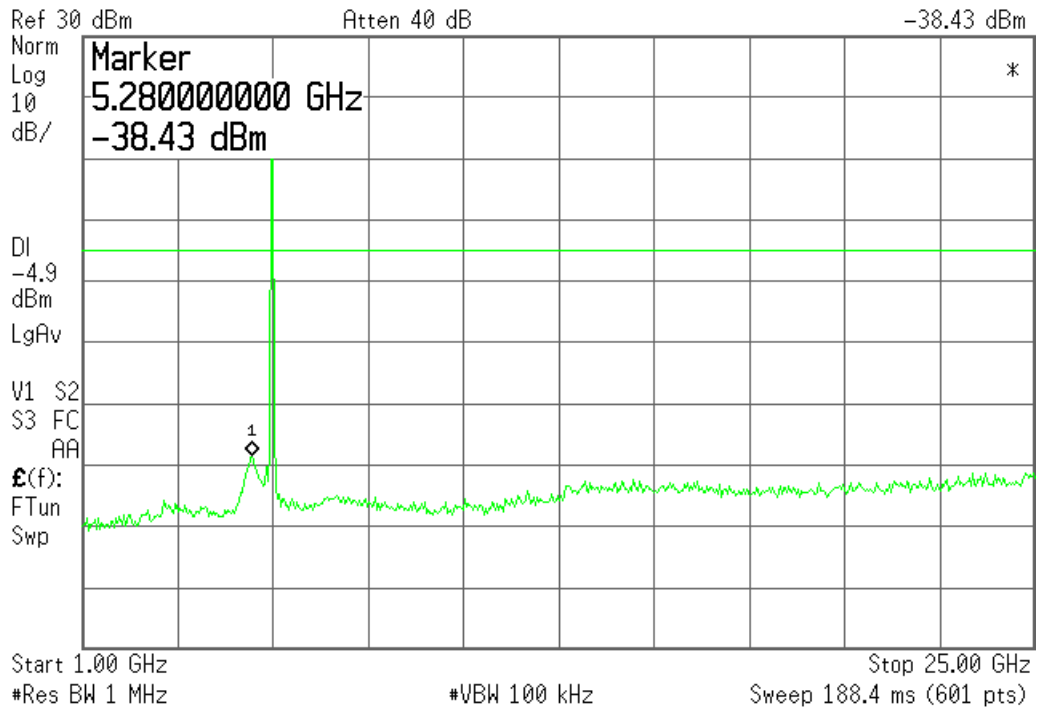
Mkr1 5.28 GHz
-38.74 dBm



UUT Transmitting on
5785 MHz, 802.11A

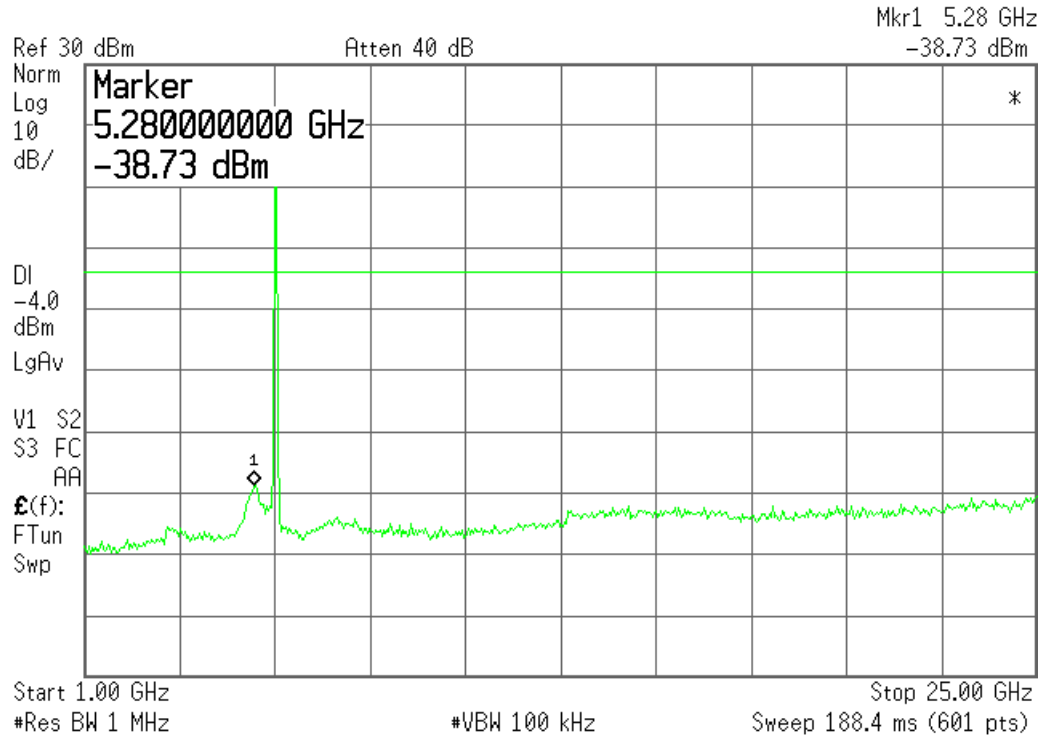
Agilent 18:53:33 Nov 6, 2004

Mkr1 5.28 GHz
-38.43 dBm



Agilent 18:52:18 Nov 6, 2004

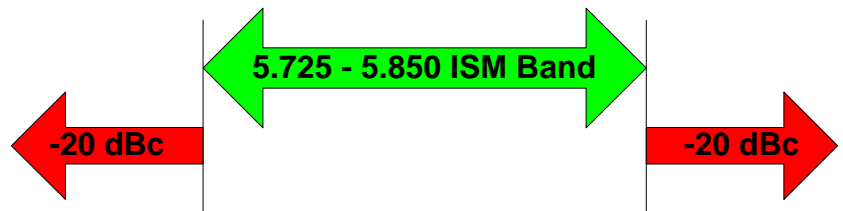
UUT Transmitting on 5825 MHz, 802.11A



5.8 GHz Band Edge Emissions

Specifications:

FCC Specification: Paragraph 15.247(c)
 IC Specification: RSS-210 .6.2.2(o)(e1)



Procedure:

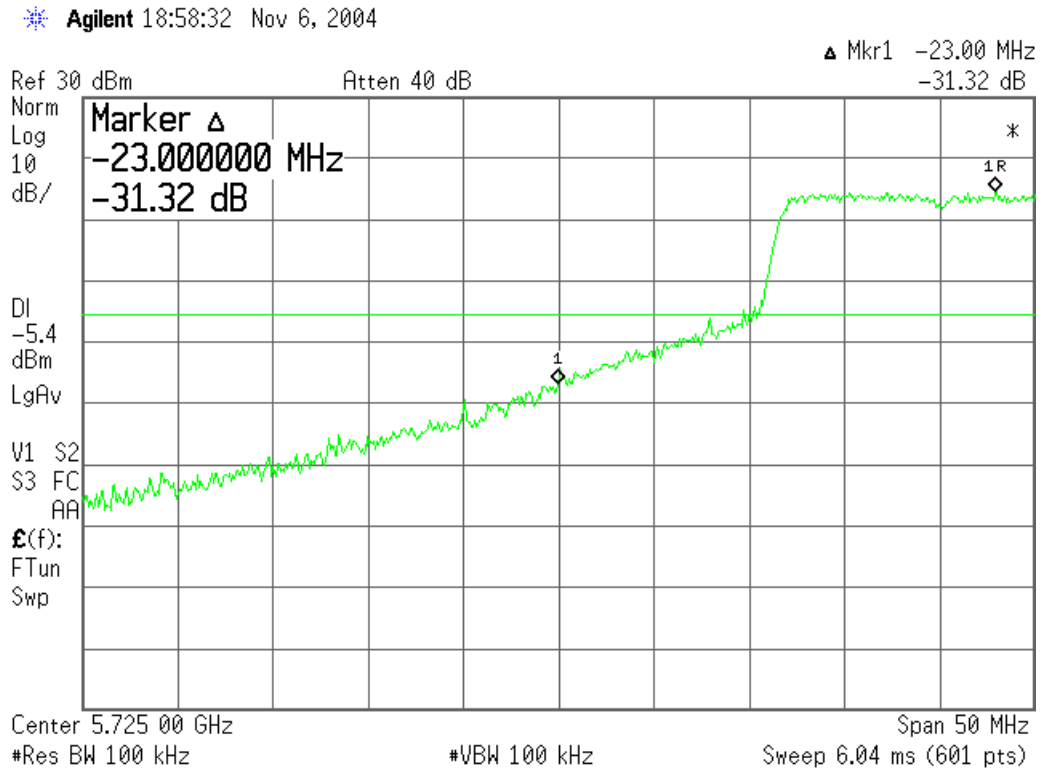
The test was configured as shown in the bench conducted RF test setup. The UUT was configured to transmit random data packets. The unit was tuned to transmit in the channel closest to the edge of the band. A marker peak search was performed and using the marker delta function, the relative signal level at the edge of the band was determined.

5.725 - 5.85GHz Band Edge Summary Results

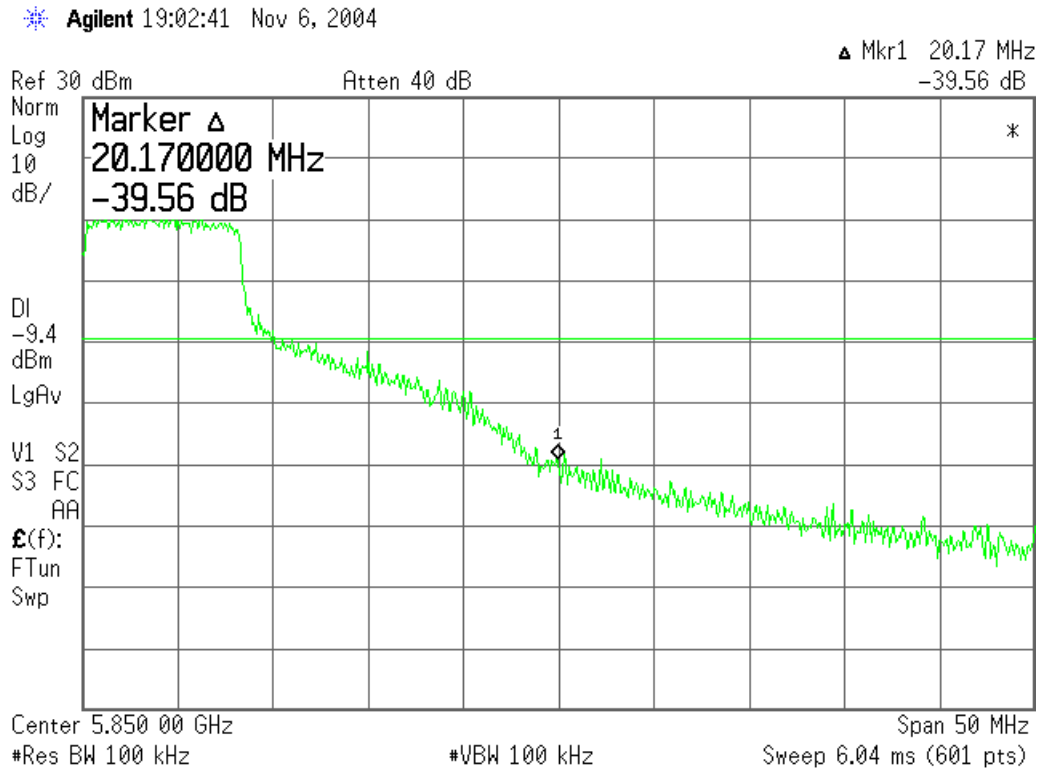
	Xmit Frequency (MHz)	Band Edge	Max Allowed Level (dBc)	Emission Level (dBc)	Delta Spec dB
A	5745	5725	-20	-31.32	11.32
	5825	5850	-20	-39.56	19.56

5.725 - 5.85GHz Bandedge Results

5725 MHz Band Edge



5850 MHz Band Edge



Radiated Emissions in Restricted Bands

Specifications:

FCC Specification: Paragraph 15.247(c)

IC Specification: RSS-210 6.3(c)

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.

The harmonics of the fundamental that fell within restricted bands (up to the tenth) were measured (See table 1 below). 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 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 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.

The band up to 40 GHz was examined, however there were no spurious emissions noted above approximately 18 GHz.

The tables below indicate the harmonics that fall within restricted bands.

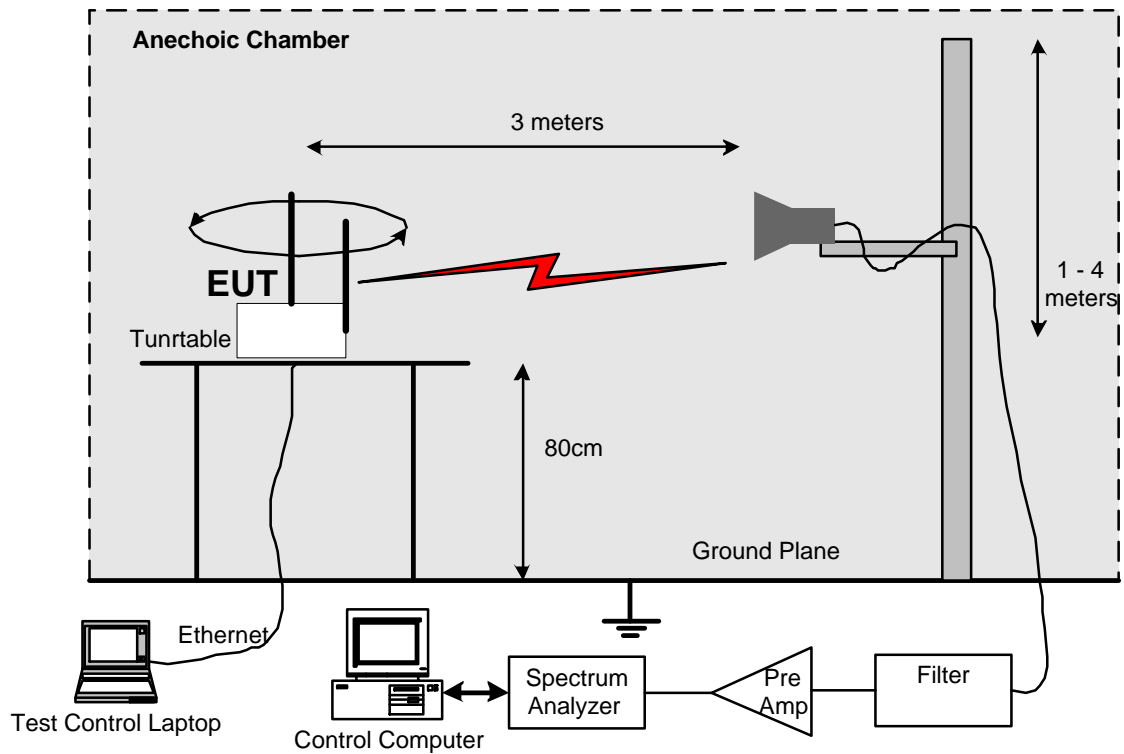
FUND	Harmonic (MHz)								
	2	3	4	5	6	7	8	9	10
2412	4824	7236	9648	12060	14472	16884	19296	21708	24120
2437	4874	7311	9748	12185	14622	17059	19496	21933	24370
2462	4924	7386	9848	12310	14772	17234	19696	22158	24620

2.4 GHz Harmonics

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

5.8 GHz Harmonics

NOTE: RED indicates a harmonic that falls within a restricted band and is subject to 15.205. The harmonics in black are NOT in restricted bands and are subject to 15.209



Radiated Emissions in Restricted Bands Test Setup

Support Equipment				
Description	Model number	FCC ID or SN	Manufacturer	Power Cable
Laptop	Armada E 500	P31000T4X20DC12N2	Compaq	Laptop PS
Test Software	Atheros Radio Test		Atheros	
48VDC AC adapter	Generic		Generic	Standard Twin lead DC wire

Test Conditions			
Temperature	19.8 C	Humidity:	41%
ATM pressure	1022 mBar	Grounding:	None
Tested By	Yalda Noor Elliott Labs	Date of Test:	Nov 2004
Test Reference	FCC Part 15.205 IC Paragraph RSS210, 6.2.3 (c)		
Setup Method	ANSI C63.4		
Tested Range	1 GHz to 24 GHz		
Test Voltage	120 VAC		
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).

The table below presents a summary of the radiated emission in restricted bands for the low, middle and high channels for both 802.11 B and 802.11 G modes of operation. Plots follow the table.

802.11 B Radiated Emissions Summary

Xmit	Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
	MHz	dBmV/m	v/h	Limit	Margin				
2412 B	2386.49	53.8	V	54.0	-0.2	AVG	360	1.2	
	2385.79	66.4	V	74.0	-7.6	PK	360	1.2	
2437 B	4890.58	32.4	V	54.0	-21.6	AVG	89	1.0	Restricted
	4890.58	43.5	V	74.0	-30.5	PK	89	1.0	Restricted
	7299.46	32.6	V	54.0	-21.4	AVG	187	1.8	Restricted
	7299.46	44.0	V	74.0	-30.0	PK	187	1.8	Restricted
2462 B	4940.53	31.5	V	54.0	-22.6	AVG	242	1.0	Restricted
	4940.53	42.5	V	74.0	-31.5	PK	242	1.0	Restricted
	7375.68	35.3	V	54.0	-18.7	AVG	132	1.8	Restricted
	7375.68	46.1	V	74.0	-27.9	PK	132	1.8	Restricted

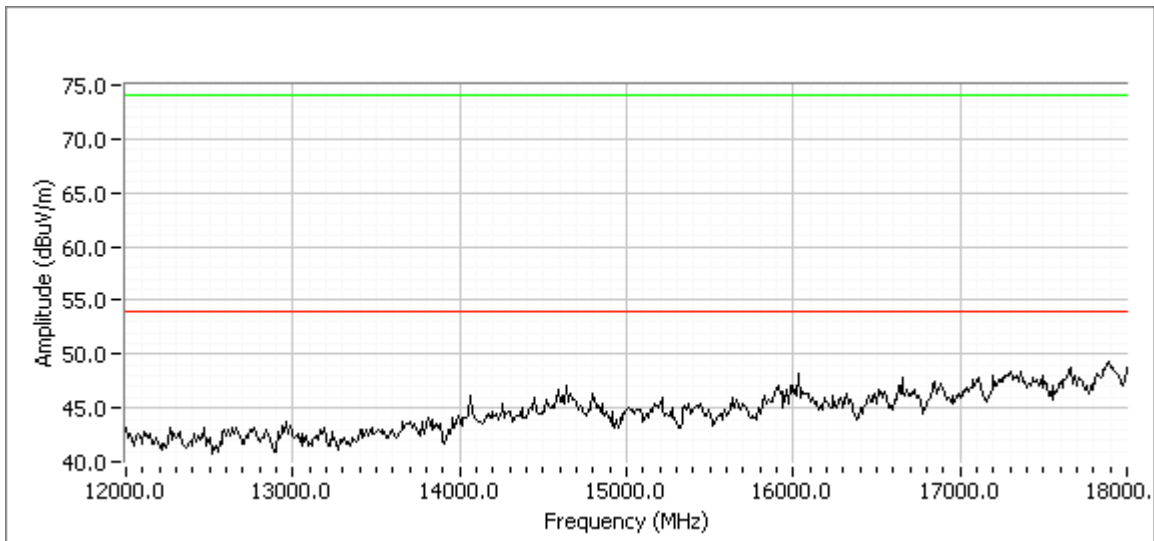
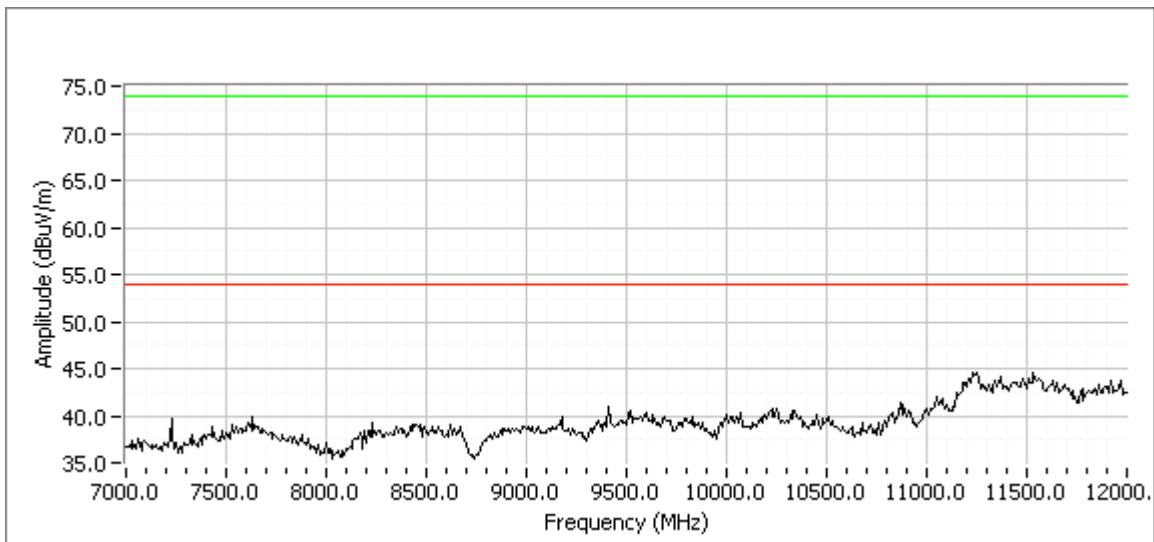
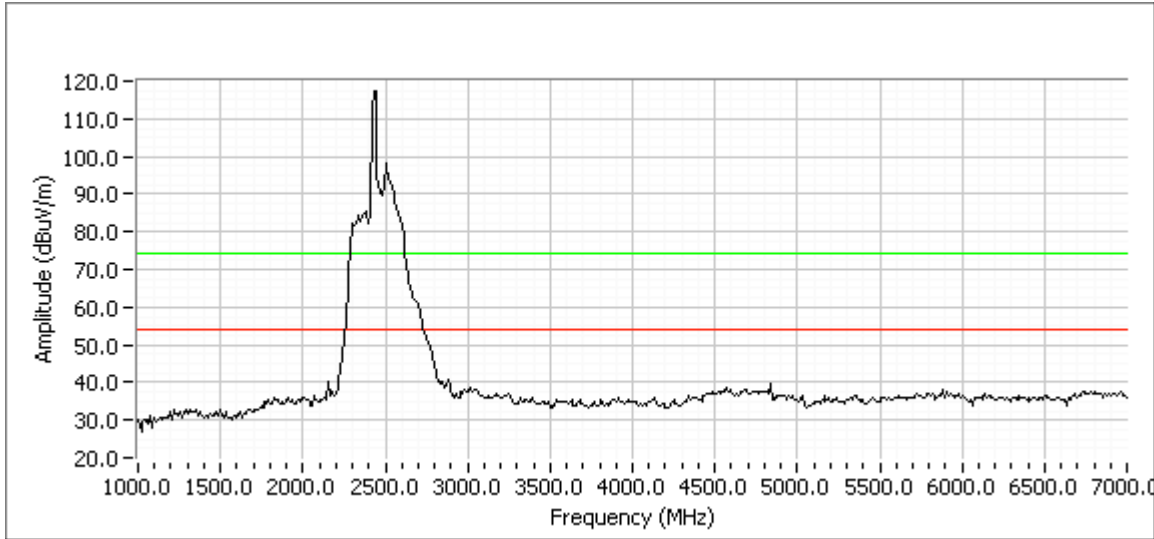
802.11 G Radiated Emissions Summary

Xmit	Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
	MHz	dBmV/m	v/h	Limit	Margin				
2412 G	7234.709	51.1	H	76.3	25.3	PK	214	1.0	Non-restricted
2437 G	No Emissions Detected								
2462 G	7374.562	33.8	V	54.0	-20.2	AVG	166	1.0	Restricted
	7374.562	44.7	V	54.0	-9.3	PK	166	1.0	Restricted

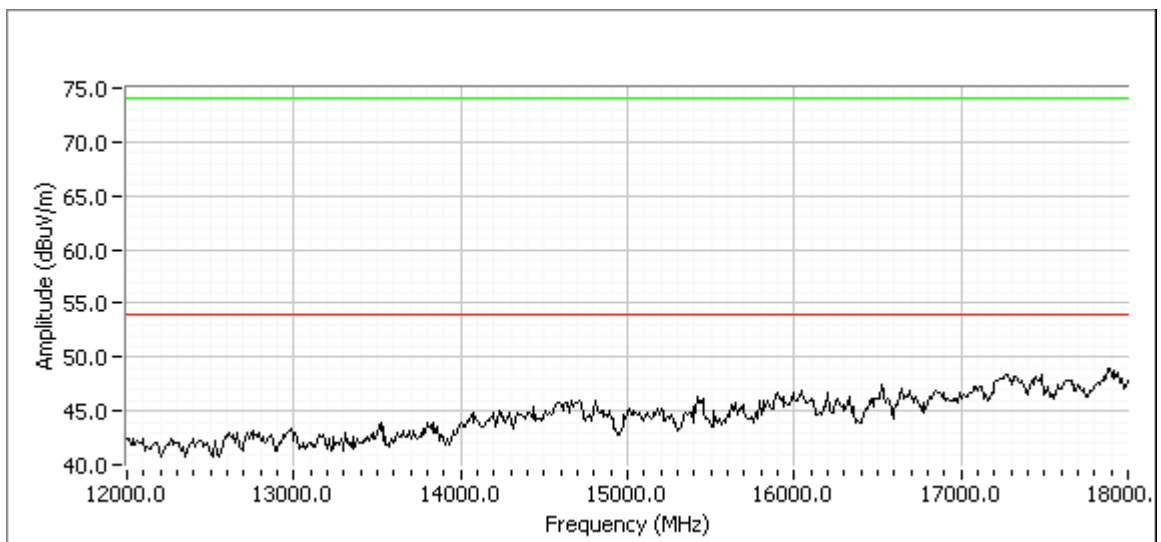
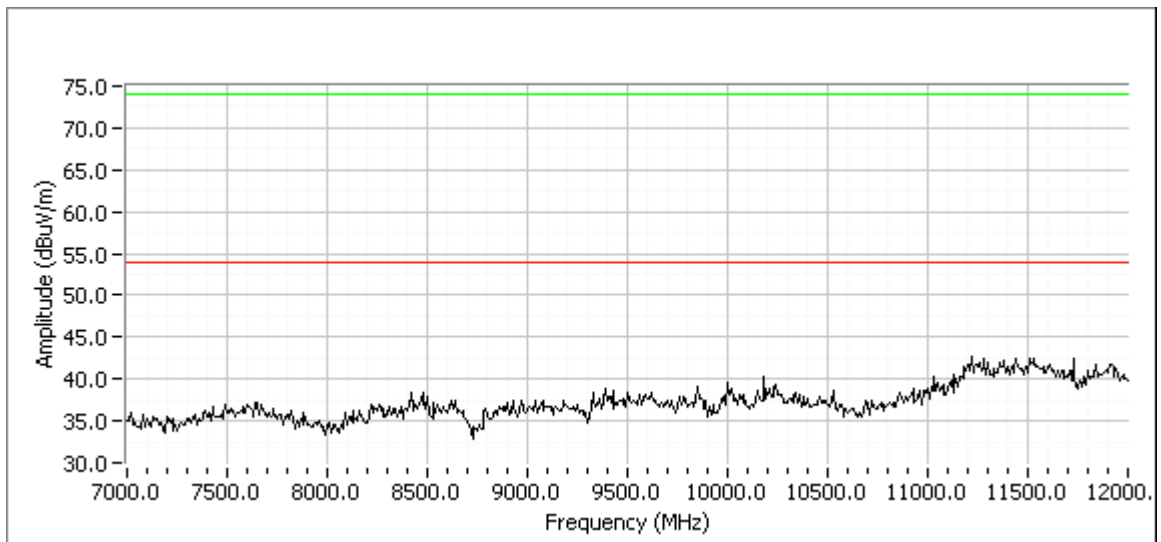
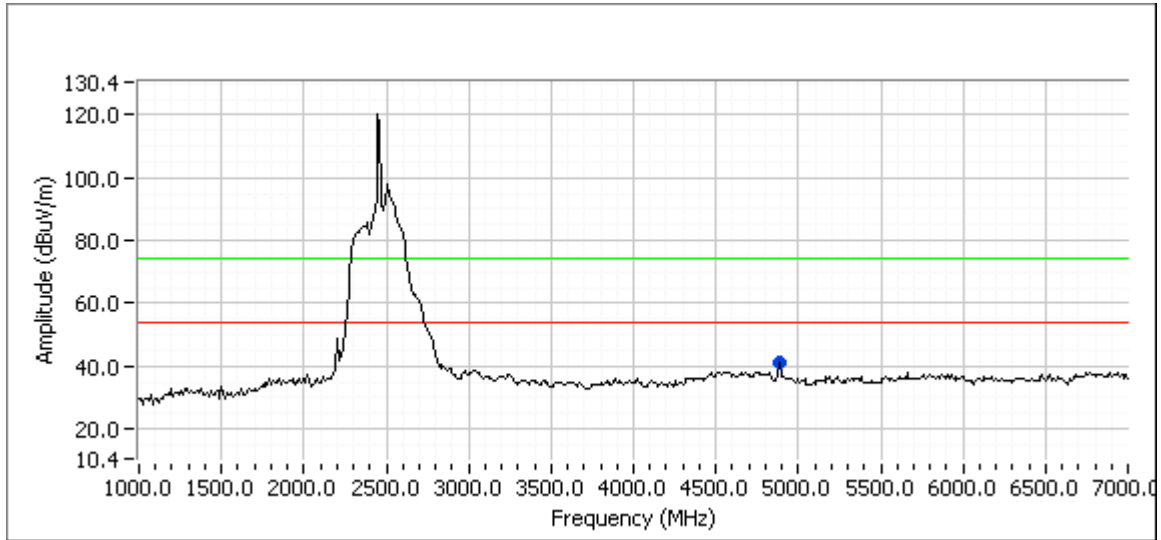
802.11A Radiated Emissions Summary

Xmit	Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
	MHz	dBmV/m	v/h	Limit	Margin				
5745	6120.045	53.9	V	93.1	-39.3	PK	99	1.3	
	5348.085	62.1	V	93.1	-31.1	PK	288	1.0	
5785	11569.63	41.1	H	54.0	-12.9	AVG	209	1.1	Restricted
	11569.63	52.6	H	74.0	-21.4	PK	209	1.1	Restricted
	5342.24	70.0	V	94.7	-24.7	PK	152	1.0	Non-restricted
	5190.87	59.5	V	94.7	-35.2	PK	23	1.0	Non-restricted
	6142.37	55.8	V	94.7	-38.9	PK	105	1.3	Non-restricted
	6318.74	56.7	V	94.7	-38.0	PK	148	1.3	Non-restricted
5825	5337.559	67.7	V	93.4	-25.7	PK	75	1.3	Non-restricted
	6178.965	55.7	V	93.4	-37.7	PK	88	1.3	Non-restricted
	6304.100	54.0	V	93.4	-39.4	PK	153	1.3	Non-restricted

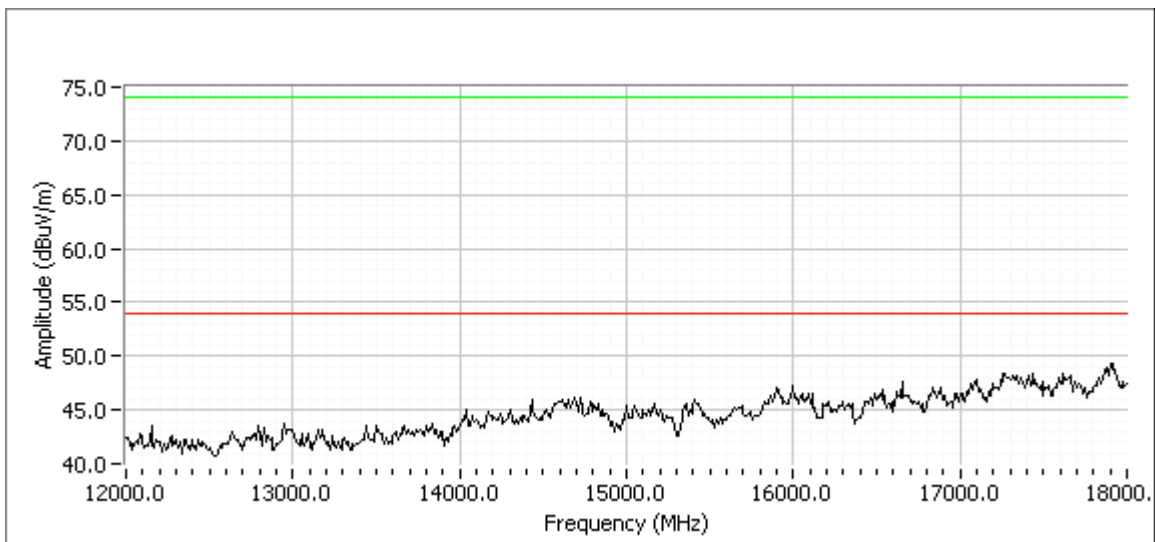
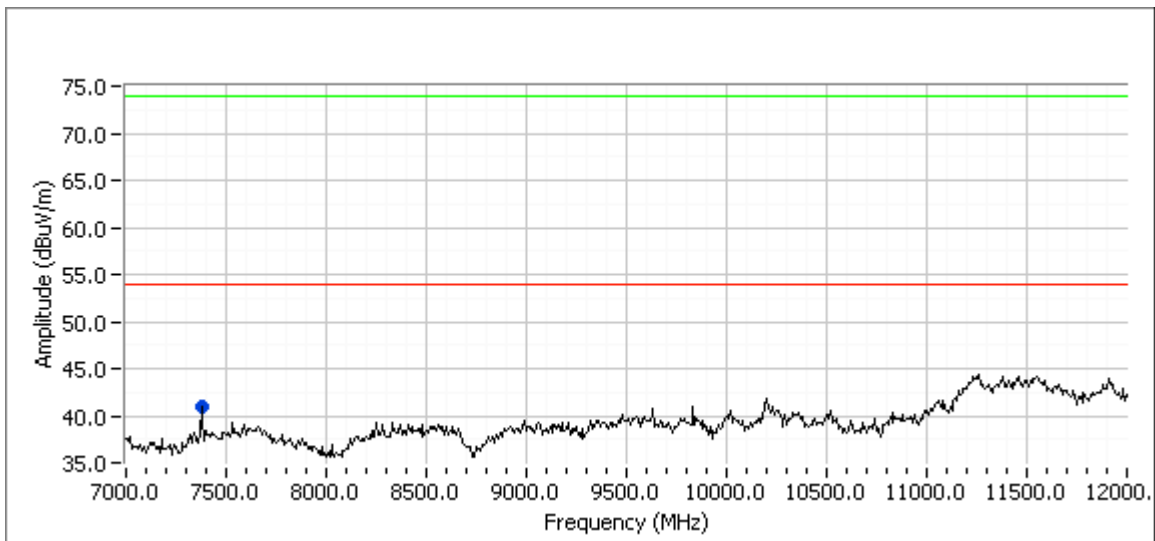
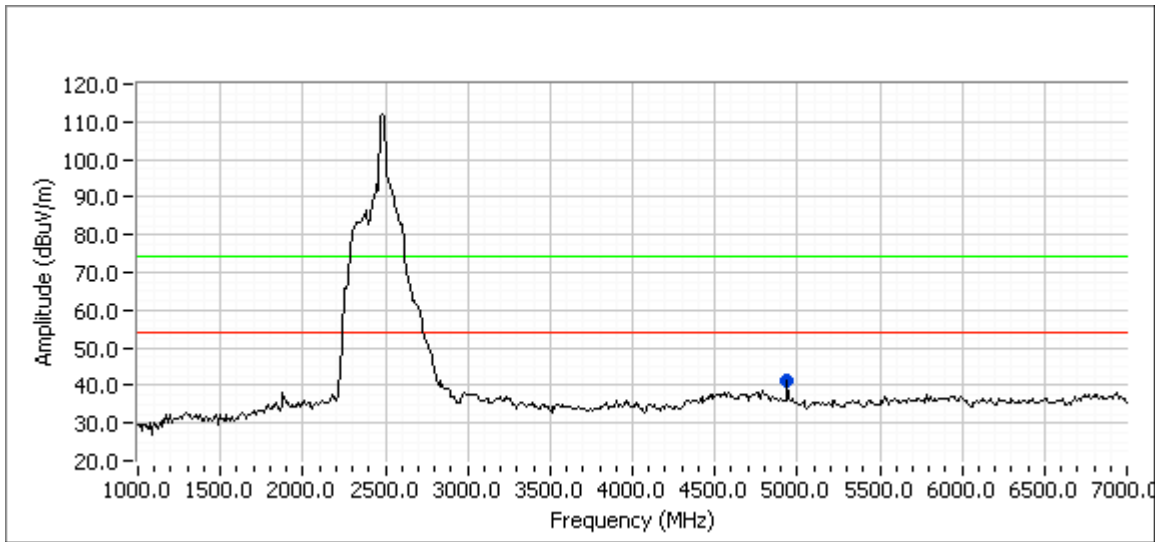
UUT Xmitting 802.11 B on low Channel: 2412 MHz



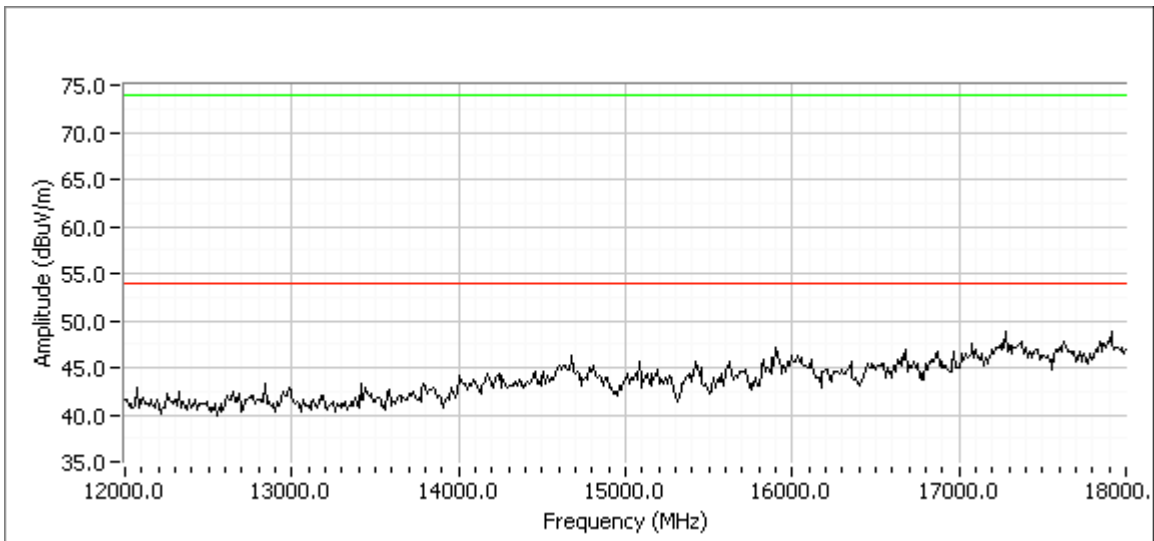
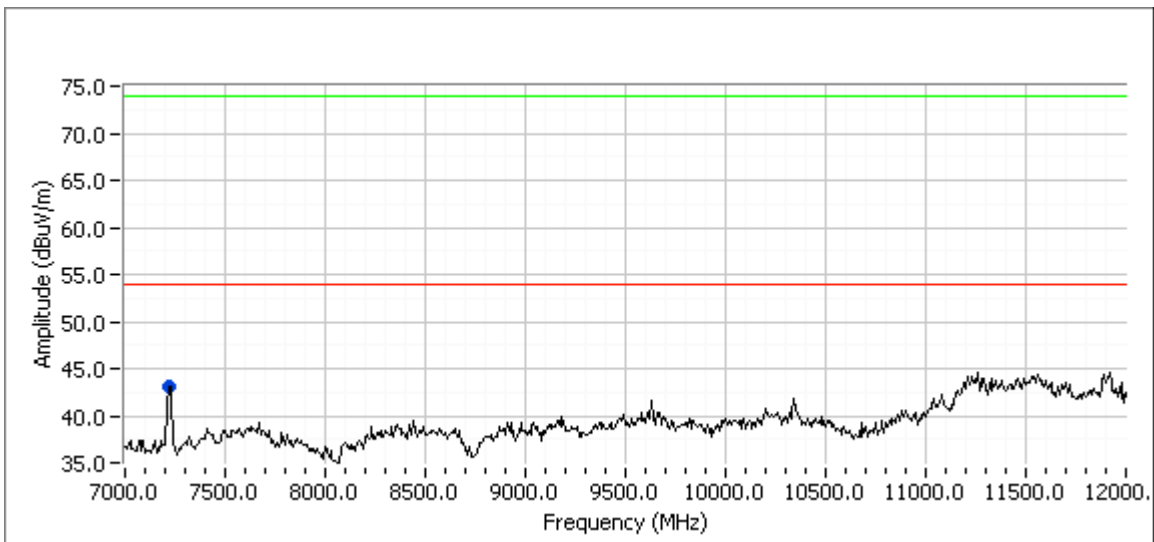
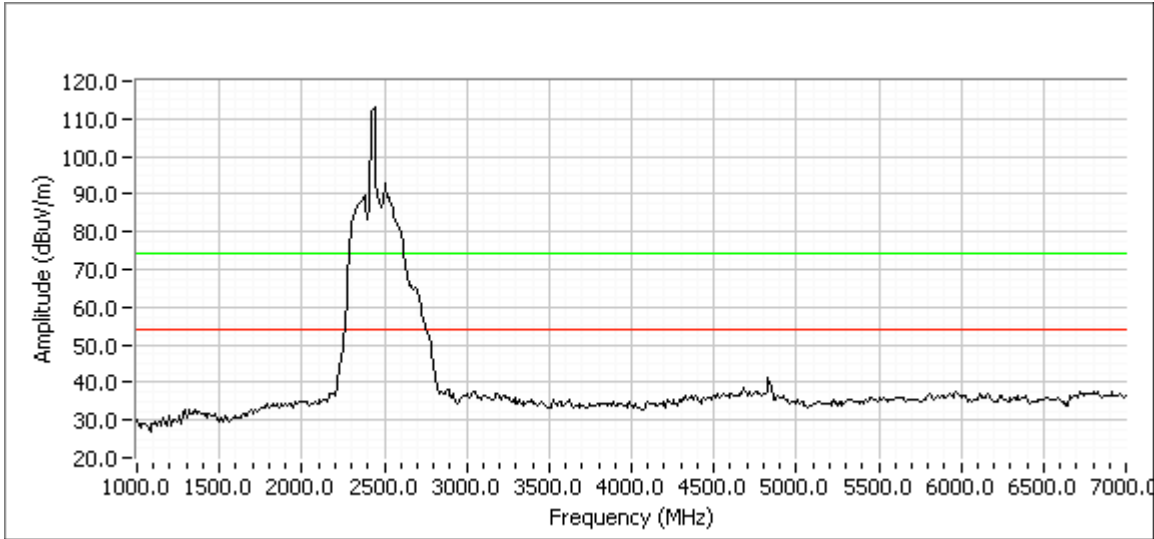
UUT Xmitting 802.11 B on mid Channel: 2437 MHz



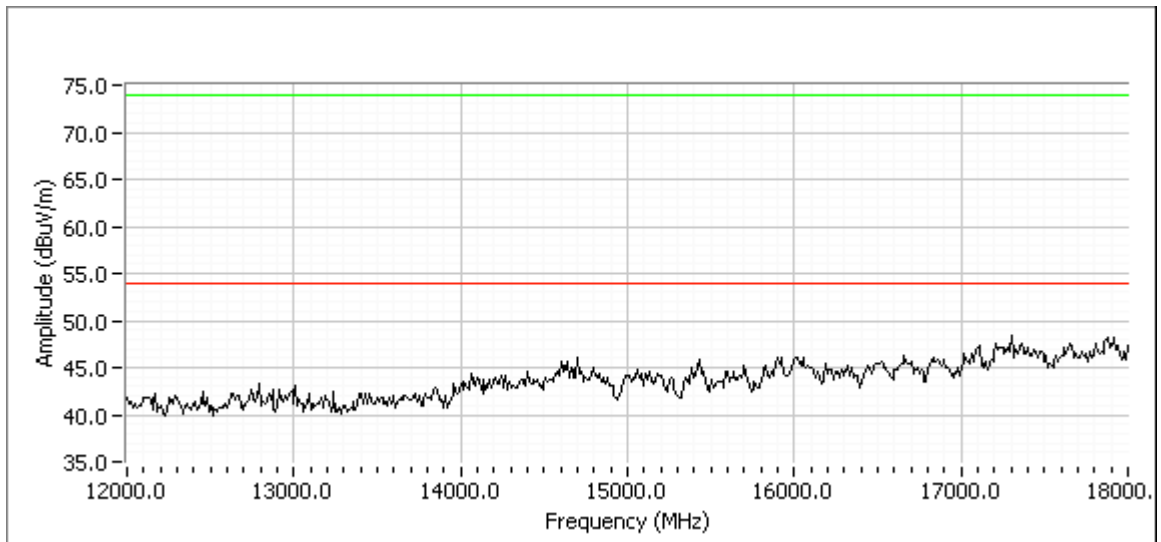
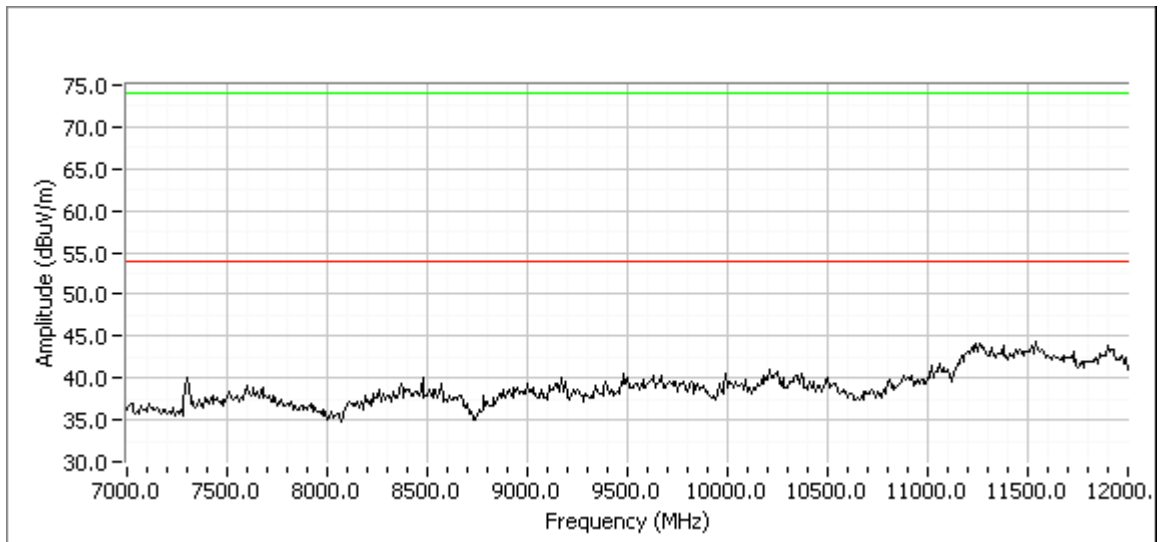
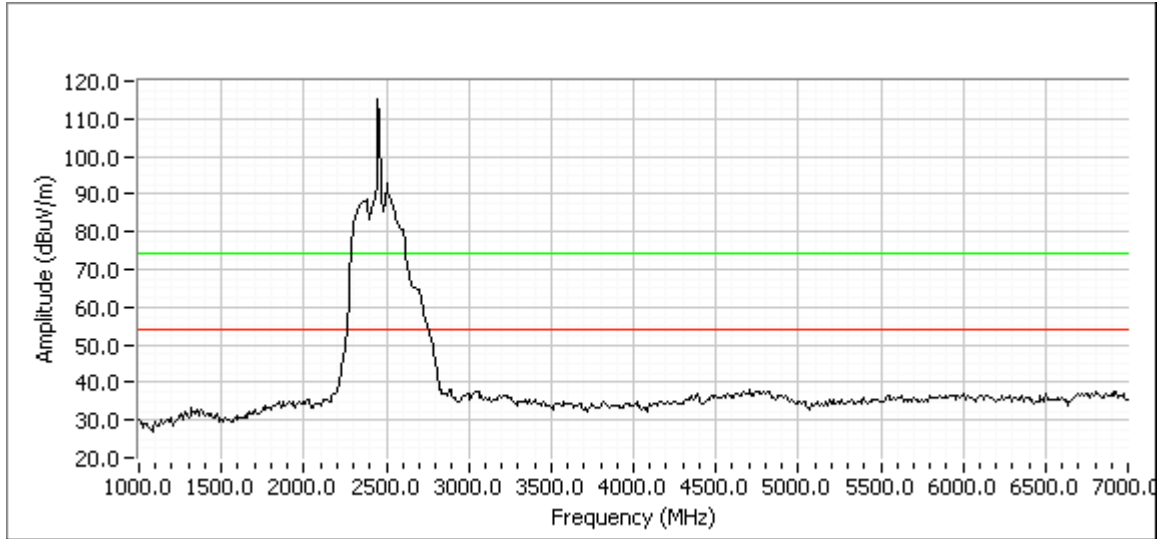
UUT Xmitting 802.11 B on high Channel: 2462 MHz



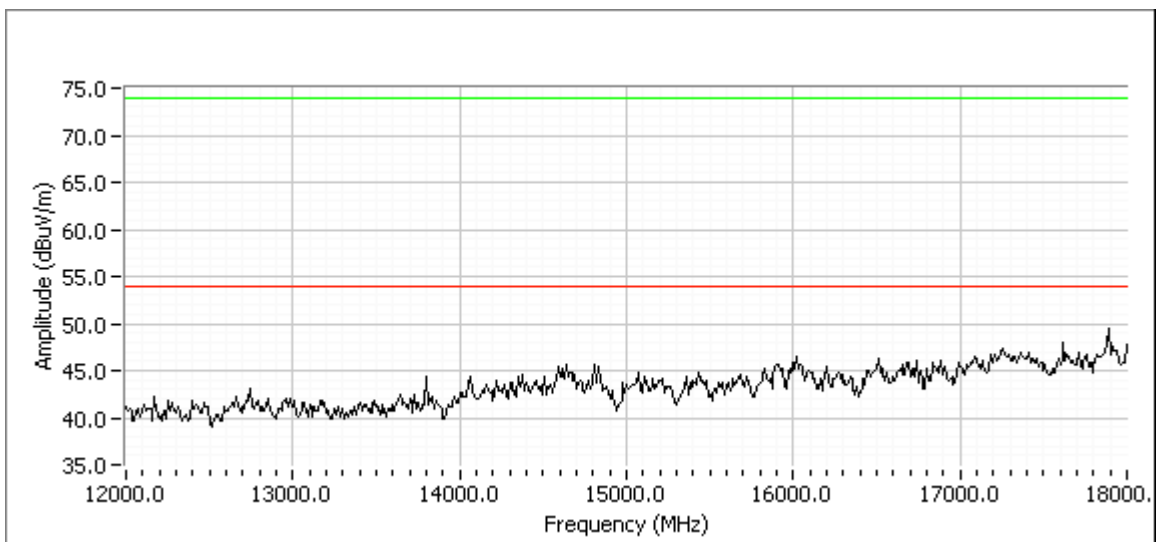
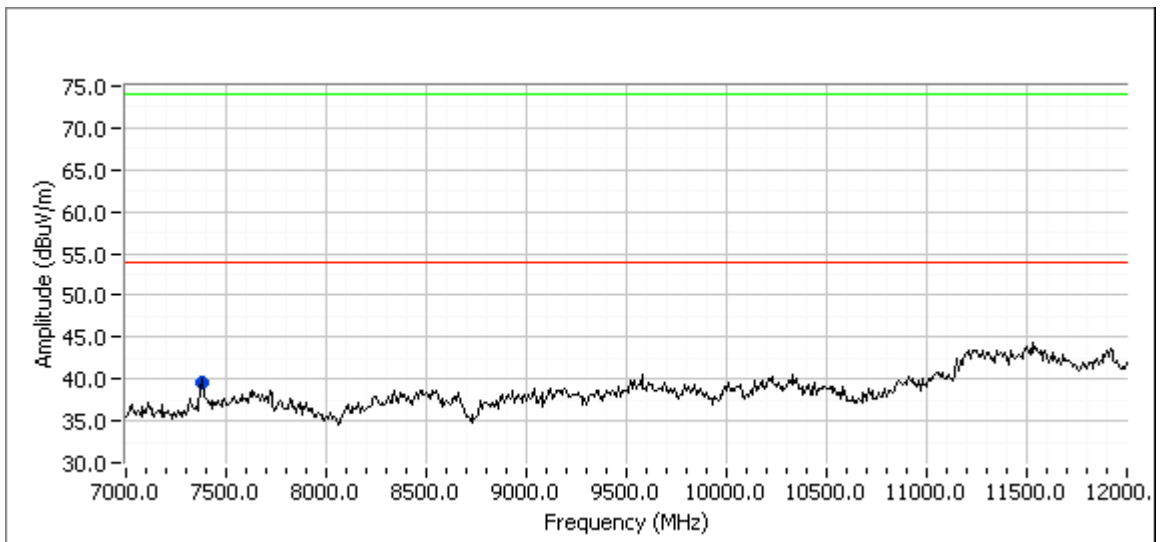
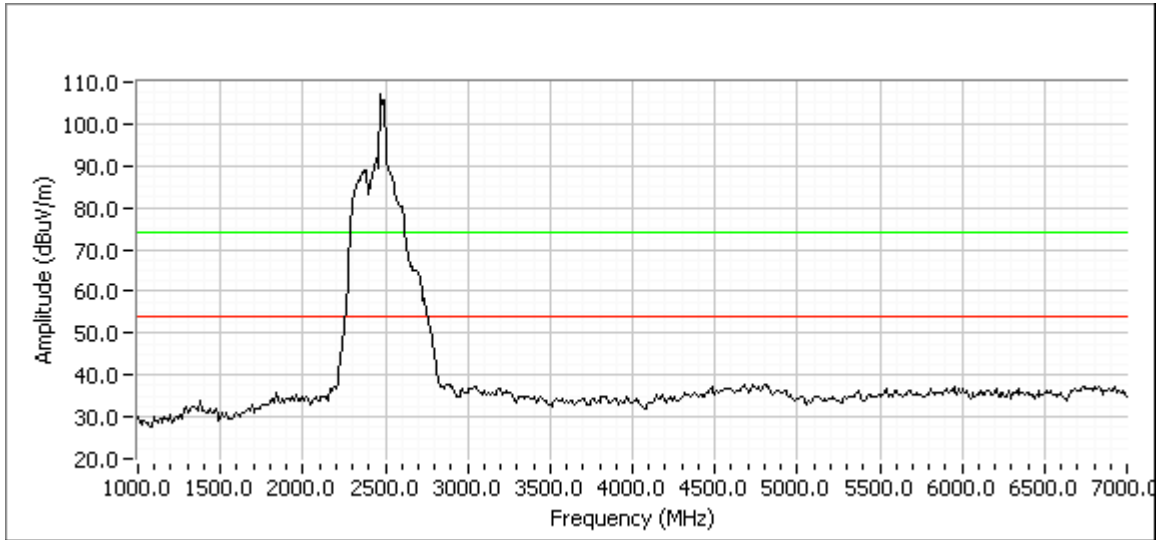
UUT Xmitting 802.11 G on Low Channel: 2412 MHz



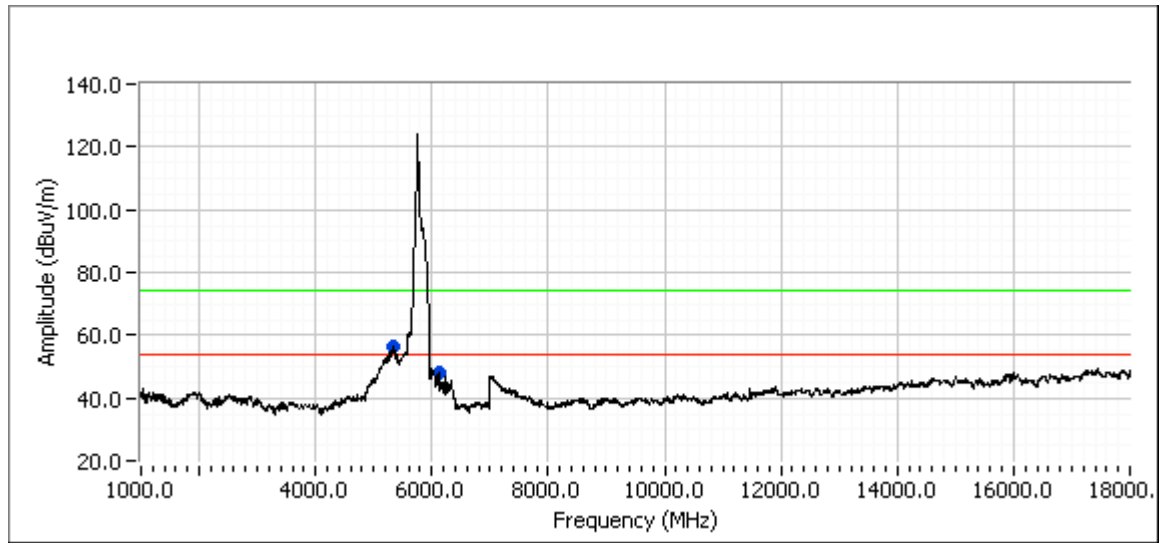
UUT Xmitting 802.11 G on Mid Channel: 2437 MHz



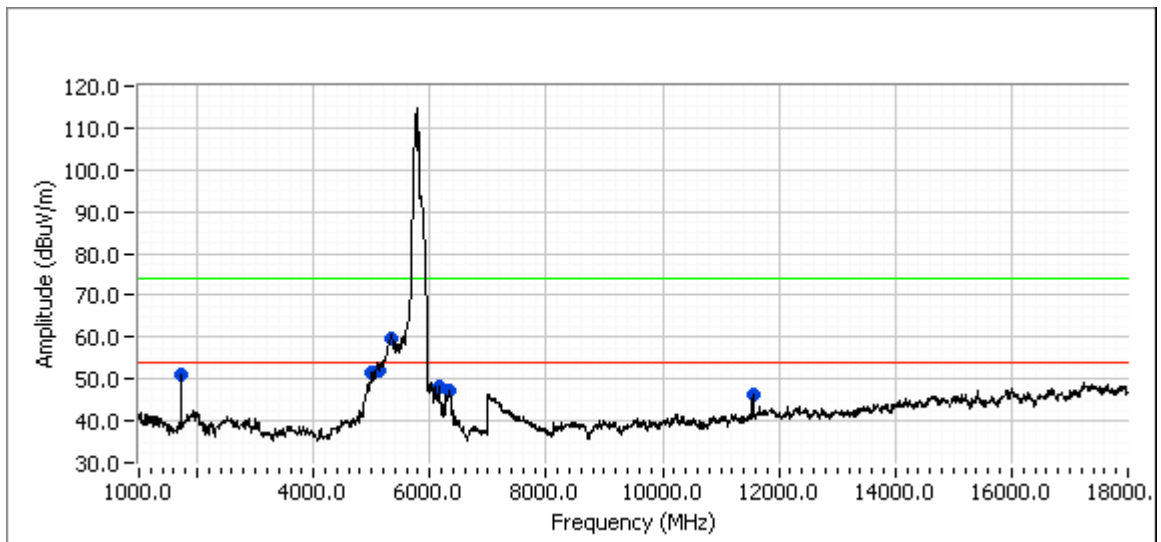
UUT Xmitting 802.11 G on High Channel: 2462 MHz



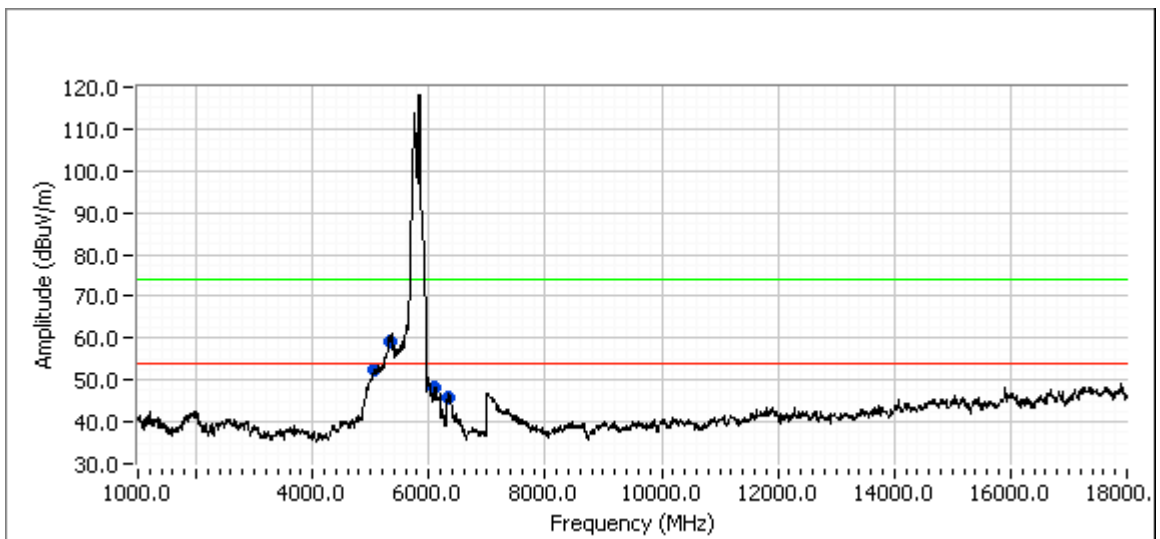
UUT Xmitting 802.11 A on low Channel: 5745 MHz



UUT Xmitting 802.11 A on Mid Channel: 5785 MHz



UUT Xmitting 802.11 A on high Channel: 5825 MHz



Dual Transmit Test (2.4GHz and 5.8 GHz)

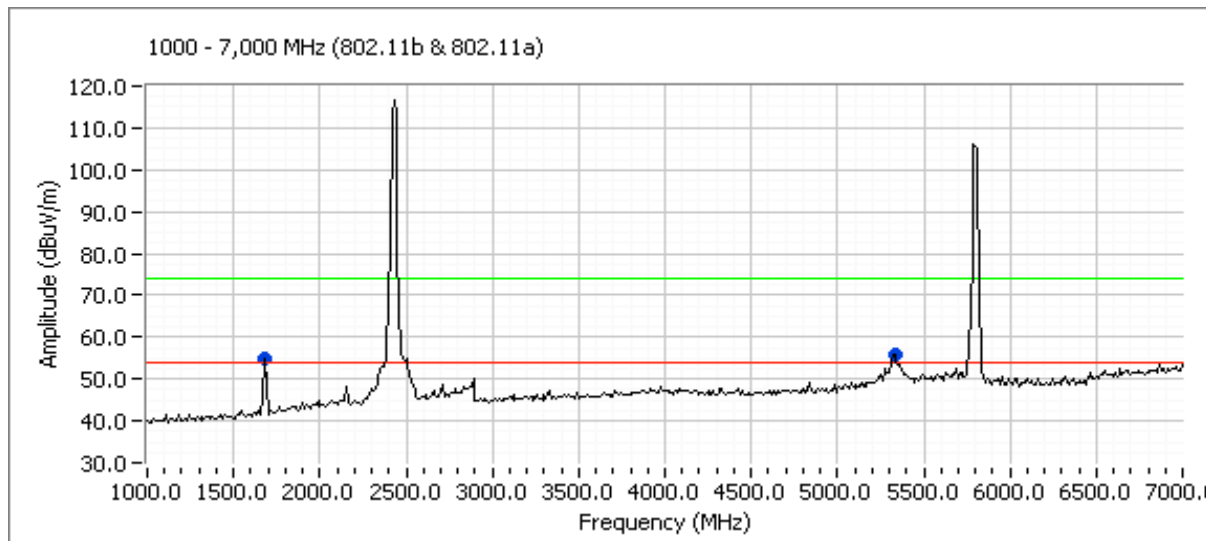
FCC Specifications: Paragraph 15.247(c)

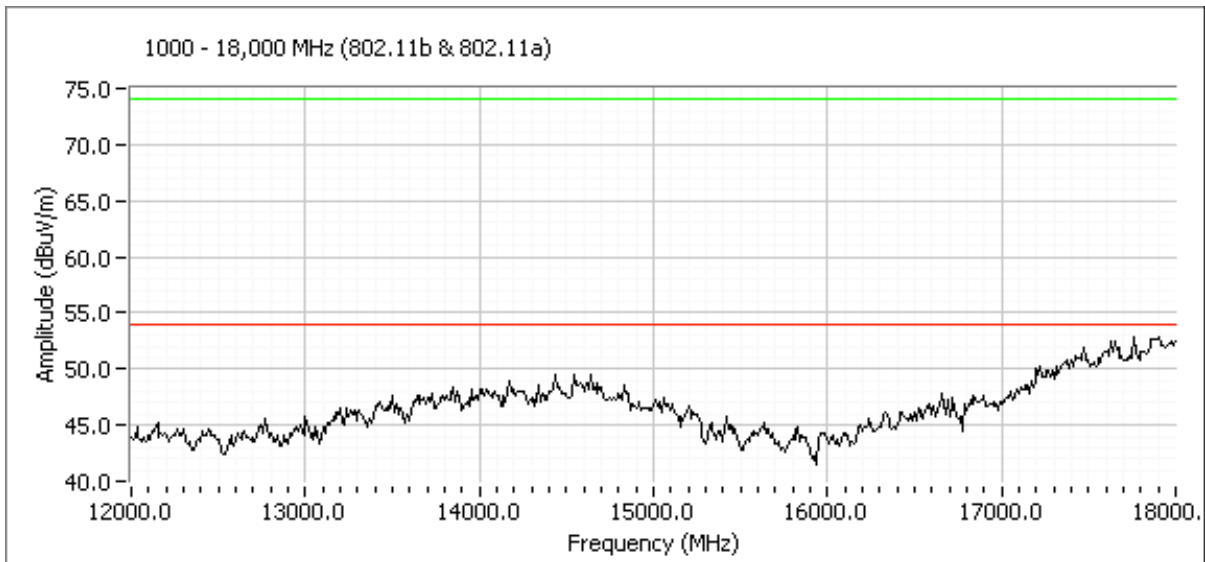
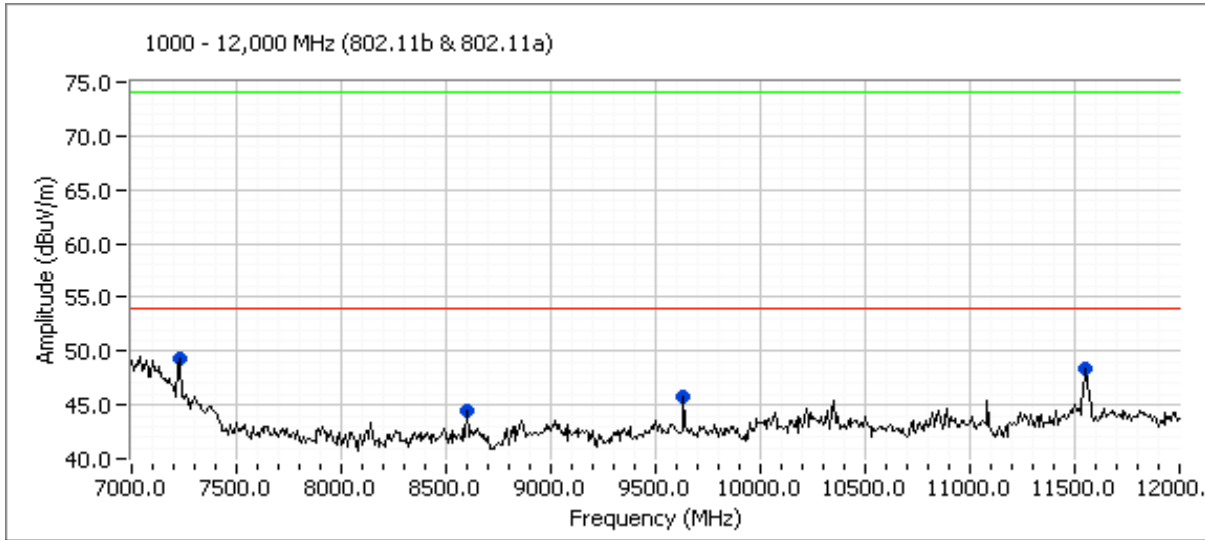
Procedure:

Since this product is capable of transmitting on 2.4 GHz and 5.8 GHz simultaneously, it was tested for radiated emission with both transmitters on and transmitting at maximum power. The UUT was transmitting on the center test channel of each band (2437 and 5785 GHz)

Results:

Frequency MHz	Level dBµV/m	Pol v/h	15.209 / 15.247		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
5329.72	49.2	V	54.0	-4.8	AVG	33	1.0	Restricted
5329.72	59.8	V	74.0	-14.2	PK	33	1.0	Restricted
1661.678	53.5	V	54.0	-0.5	AVG	158	1.2	Restricted
1661.678	58.0	V	74.0	-16.0	PK	158	1.2	Restricted
8599.505	49.1	V	107.0	-58.0	PK	321	1.0	Non-Restricted
11570.33	42.5	H	54.0	-11.6	AVG	163	1.4	Restricted
11570.33	54.3	H	74.0	-19.8	PK	163	1.4	Restricted
9634.513	49.5	H	107.0	-57.5	PK	91	1.6	Non-Restricted
7298.685	51.6	V	107.0	-55.4	PK	62	1.2	Non-Restricted



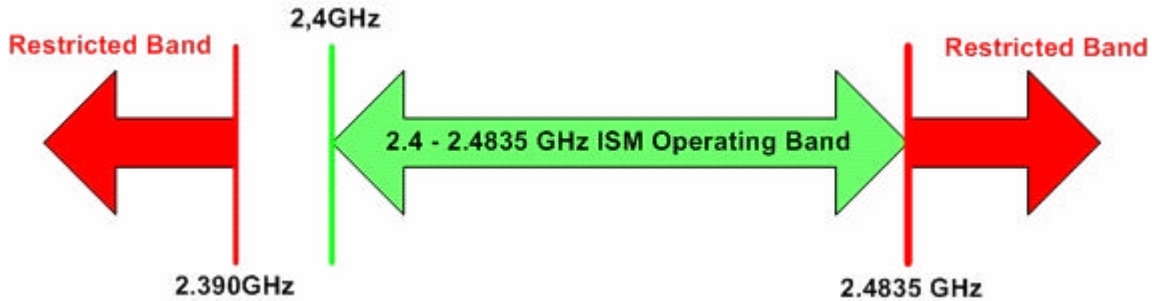


Radiated Emissions in Restricted bands (2.4 GHz Band Edges)

FCC Specifications: Paragraph 15.247(c)

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.

STEP 3) A third and final measurement (conducted) is made to determine the apparent drop in signal level when the RBW is narrowed from 1MHz (in the reference measurement) to 100kHz (the bandwidth required for the restricted band emission measurement). This is referred to below as the “BW Delta”.

Peak Delta: RBW 1MHz VBW 1 MHz to RBW 100 kHz VBW 1 MHz

Avg Delta: RBW 1MHz VBW 10 Hz to RBW 100 kHz VBW 10 Hz

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

802.11 B Band Edge (Restricted band @ 2.390GHz)												
Pol	Fundamental 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	123.7	116.8	53.75	55.78	10.54	10.83	59.415	50.19	74	54	14.585	3.81
Horz	103.4	96.4					39.115	29.79			34.885	24.21
802.11 B Band Edge (Restricted band @ 2.4835GHz)												
Pol	Fundamental 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	122.6	115.6	55.102	54.7	10.19	9.51	57.304	51.39	74	54	16.696	2.61
Horz	102.7	95.8					37.404	31.59			36.596	22.41
802.11 G Band Edge (Restricted band @ 2.390GHz)												
Pol	Fundamental 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	123.8	115.3	47.153	48.815	14.43	12.749	62.217	53.736	74	54	11.783	0.264
Horz	106.3	98.1					44.717	36.536			29.283	17.464
802.11 G Band Edge (Restricted band @ 2.4835GHz)												
Pol	Fundamental 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	123.8	115.3	43.275	50.76	10.35	12.15	70.177	52.39	74	54	3.823	1.61
Horz	103	93.7					49.377	30.79			24.623	23.21

Radiated emissions at band edge sample calculation (Vertical, Avg, 802.11 B,High Edge):

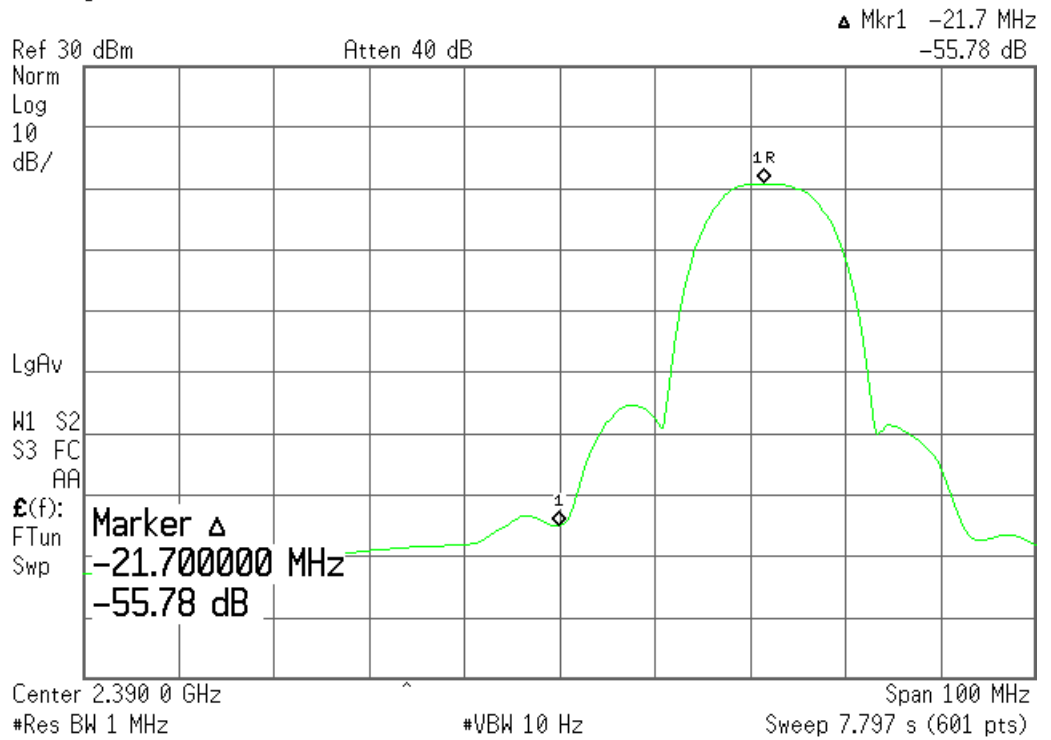
$$\text{Emission Level} = \text{Fund Ref msmt} - \text{Delta msmt} - \text{RBW Delta msmt}$$

Example: 115.3 dBuV/m – 48.815dBc – 12.749dB = 53.736dBuv/m
 54 dBuv/m - 53.736dBuv/m = ..264 dB margin

802.11 B Bandedge Plots

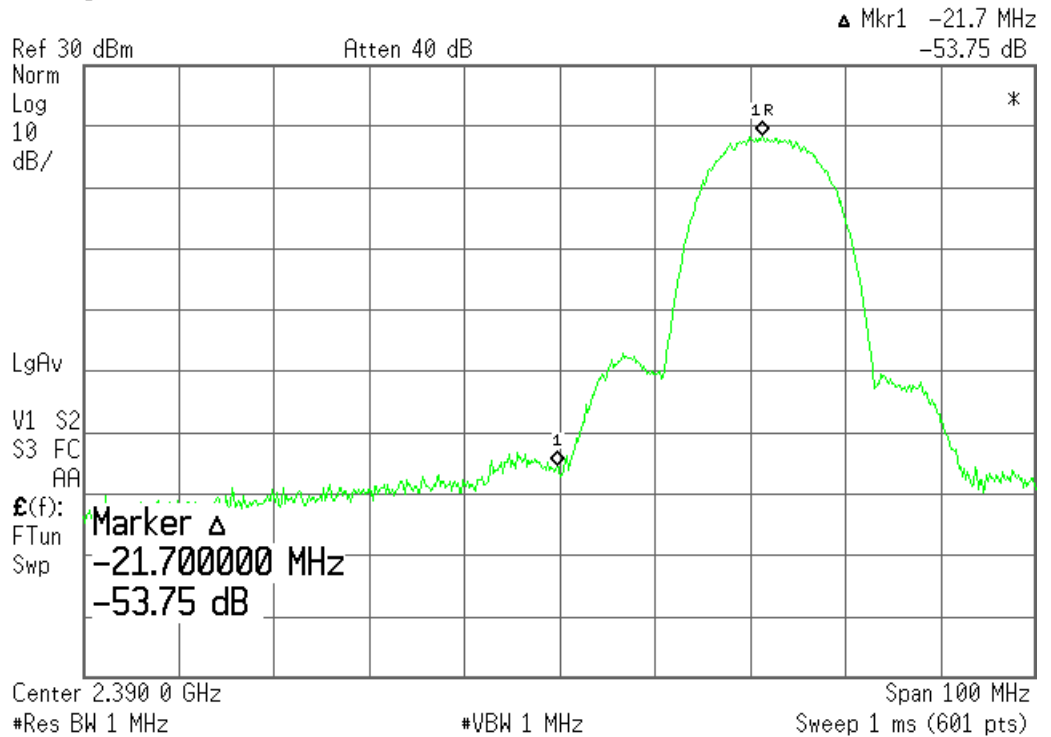
Agilent 16:36:47 Nov 6, 2004

802.11 B
-dBc Msmt @ 2390
Avg



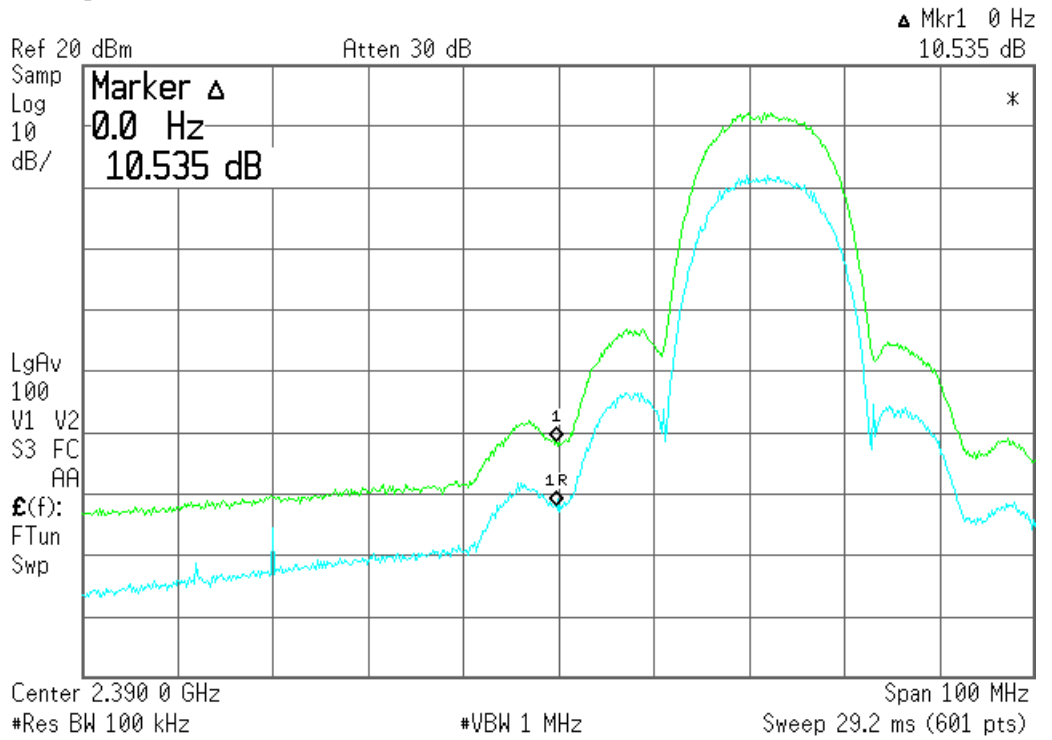
Agilent 16:38:23 Nov 6, 2004

802.11 B
-dBc Msmt @ 2390
Pk



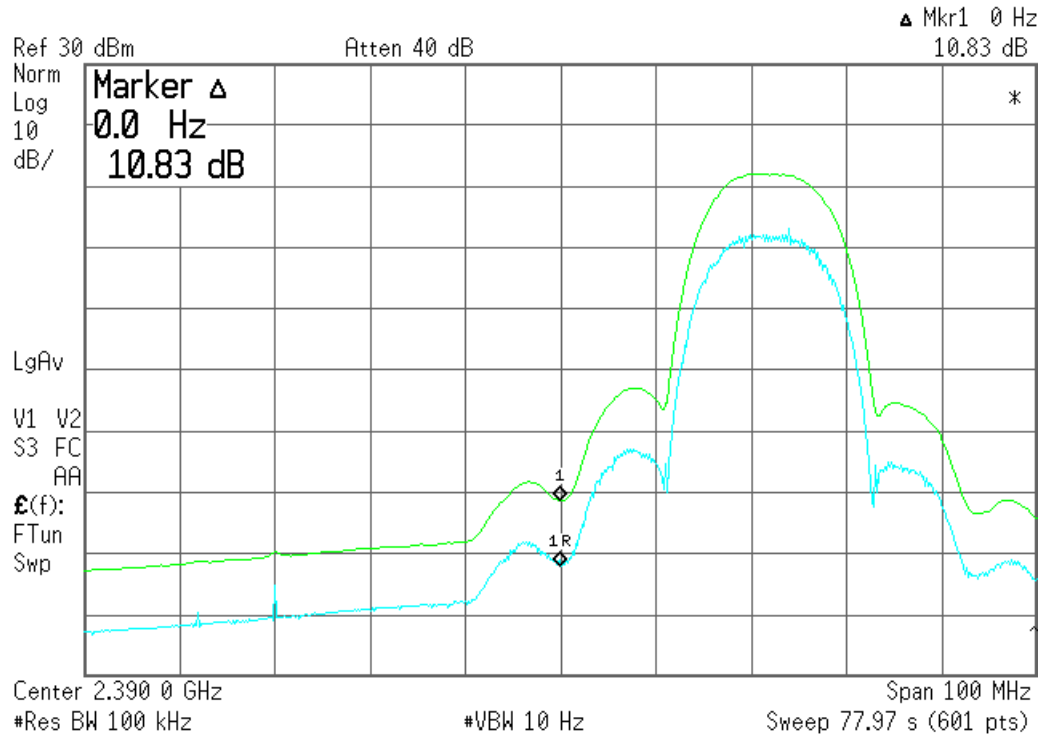
Agilent 17:13:14 Nov 6, 2004

802.11 B
 BW Delta Msmt @ 2390
 MHz Peak



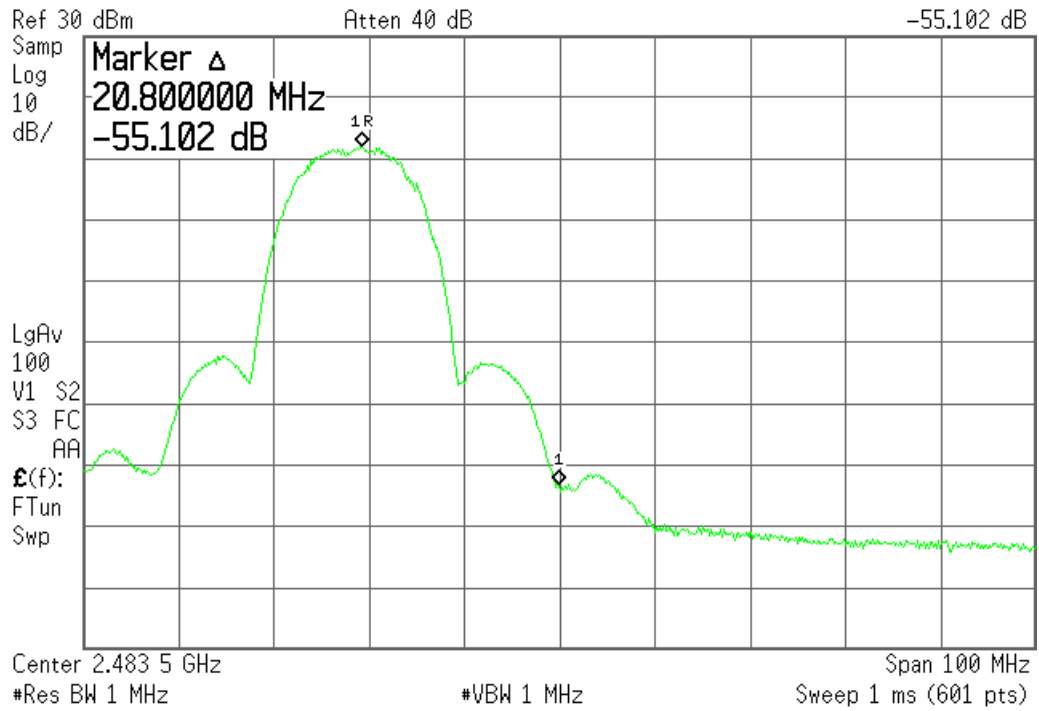
Agilent 17:20:32 Nov 6, 2004

802.11 B
 BW Delta Msmt @ 2390
 MHz Avg



Agilent 17:25:13 Nov 6, 2004

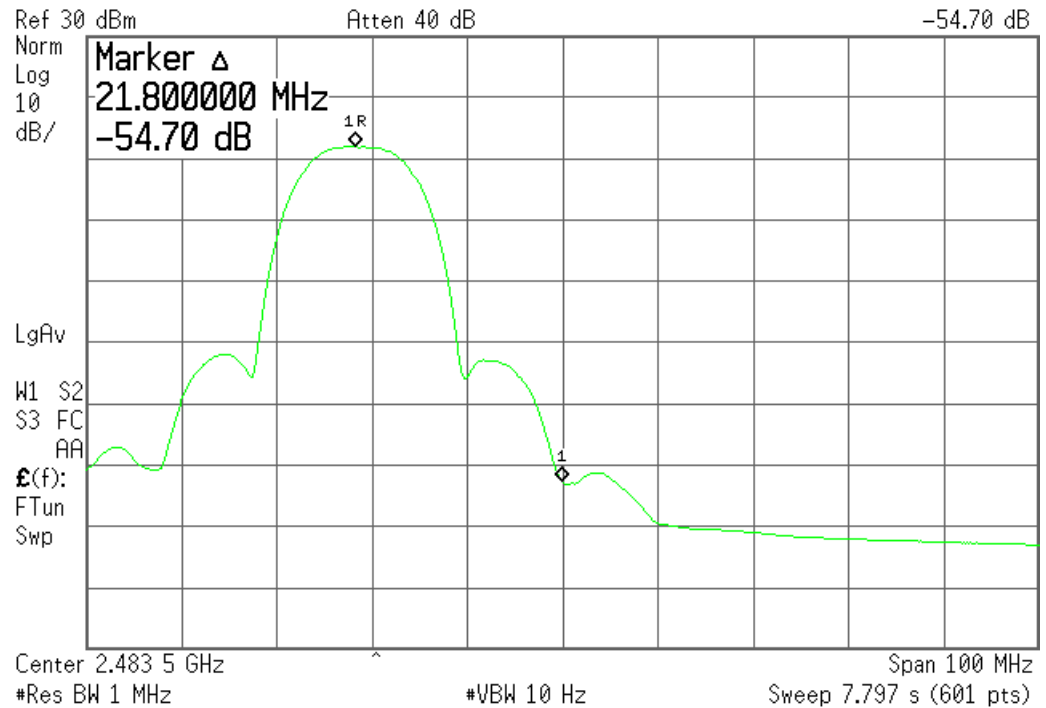
Mkr1 20.8 MHz
-55.102 dB



802.11 B
-dBc Msmt @ 2462
Peak

Agilent 17:26:52 Nov 6, 2004

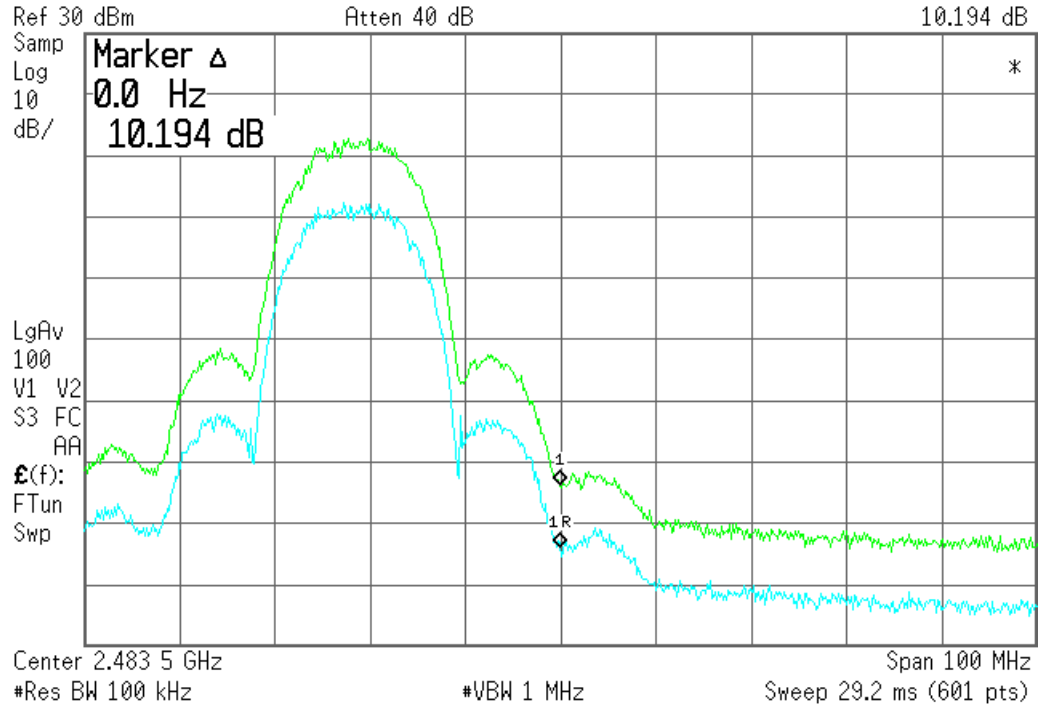
Mkr1 21.8 MHz
-54.70 dB



802.11 B
-dBc Msmt @ 2462
Avg

Agilent 17:31:30 Nov 6, 2004

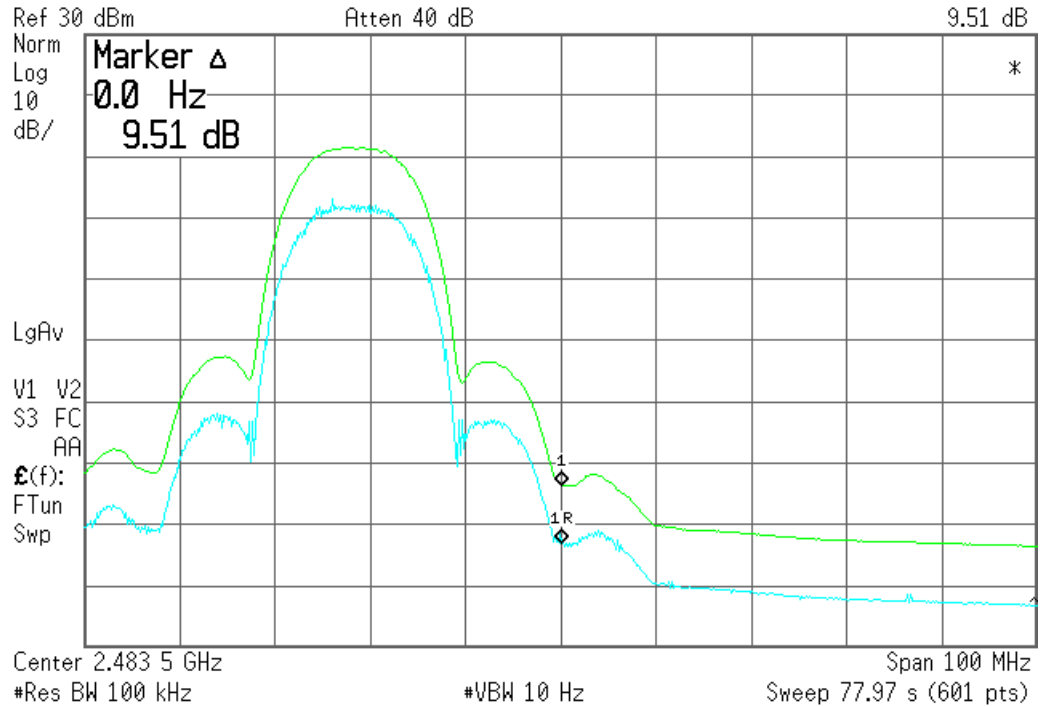
Mkr1 0 Hz
10.194 dB



802.11 B
BW Delta
Msmt @ 2462 PK

Agilent 17:35:10 Nov 6, 2004

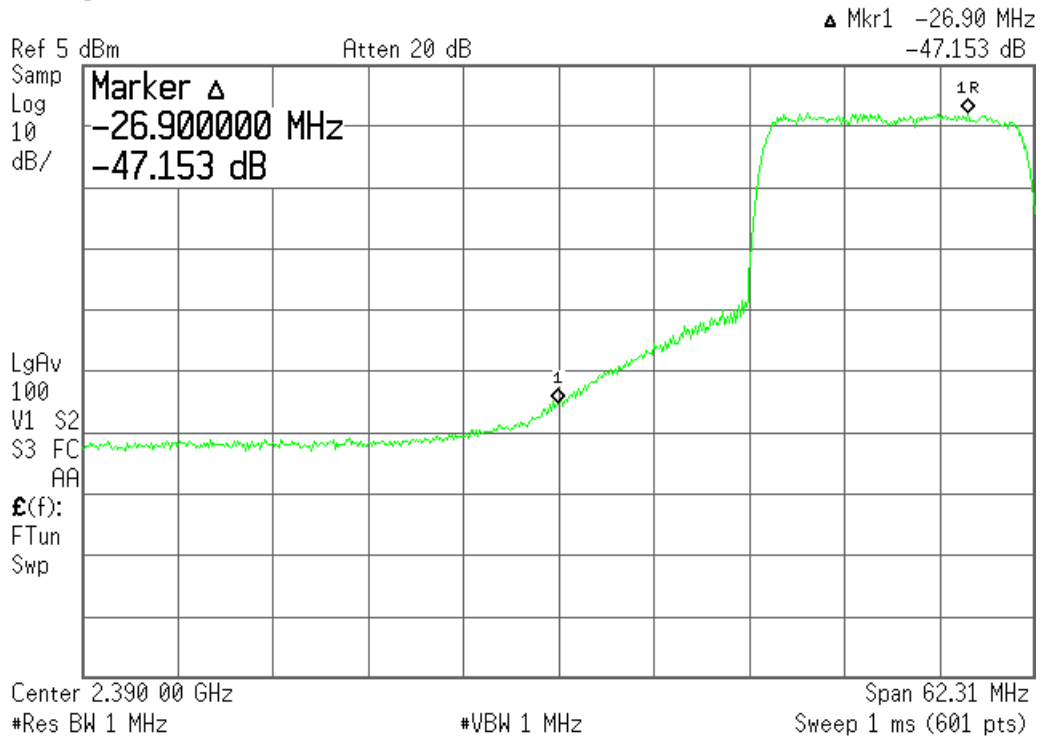
Mkr1 0 Hz
9.51 dB



802.11 B
BW Delta
Msmt @ 2462 AVG

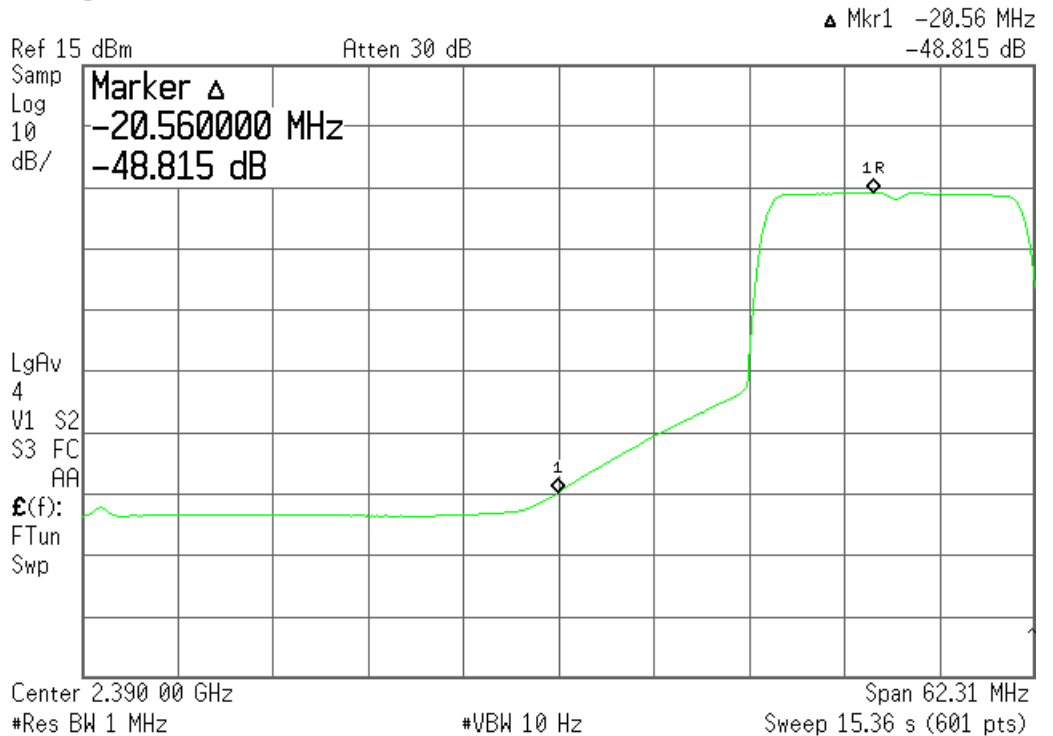
802.11 B Bandedge Plots

Agilent 14:30:05 Mar 6, 2005



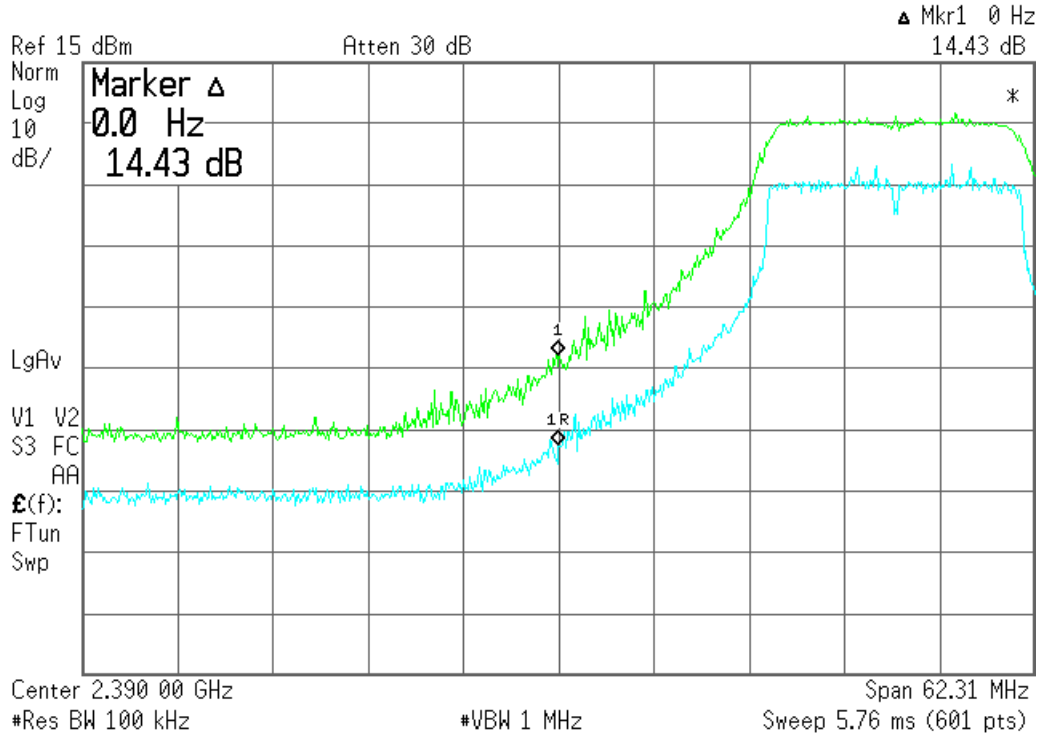
802.11 G
 -dBc
 Msmt @ 2412 PK

Agilent 15:24:41 Mar 6, 2005



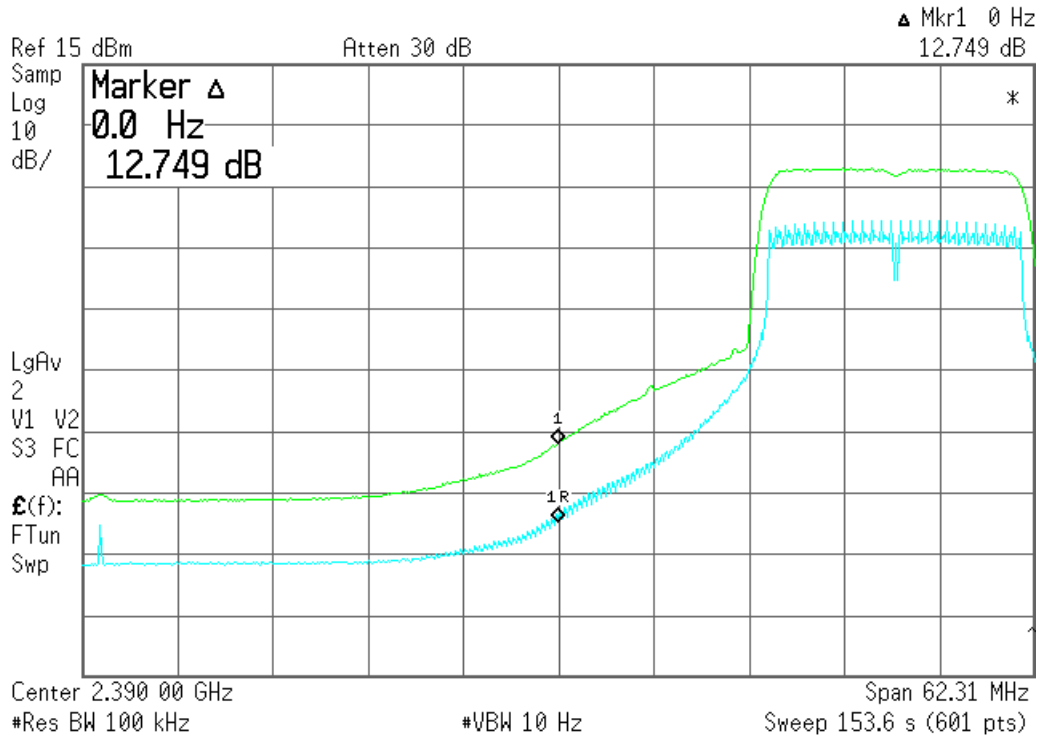
802.11 G
 -dBc
 Msmt @ 2412 AVG

Agilent 14:40:23 Mar 6, 2005



802.11 G
BW Delta
Msmt @ 2412 PK

Agilent 15:21:31 Mar 6, 2005

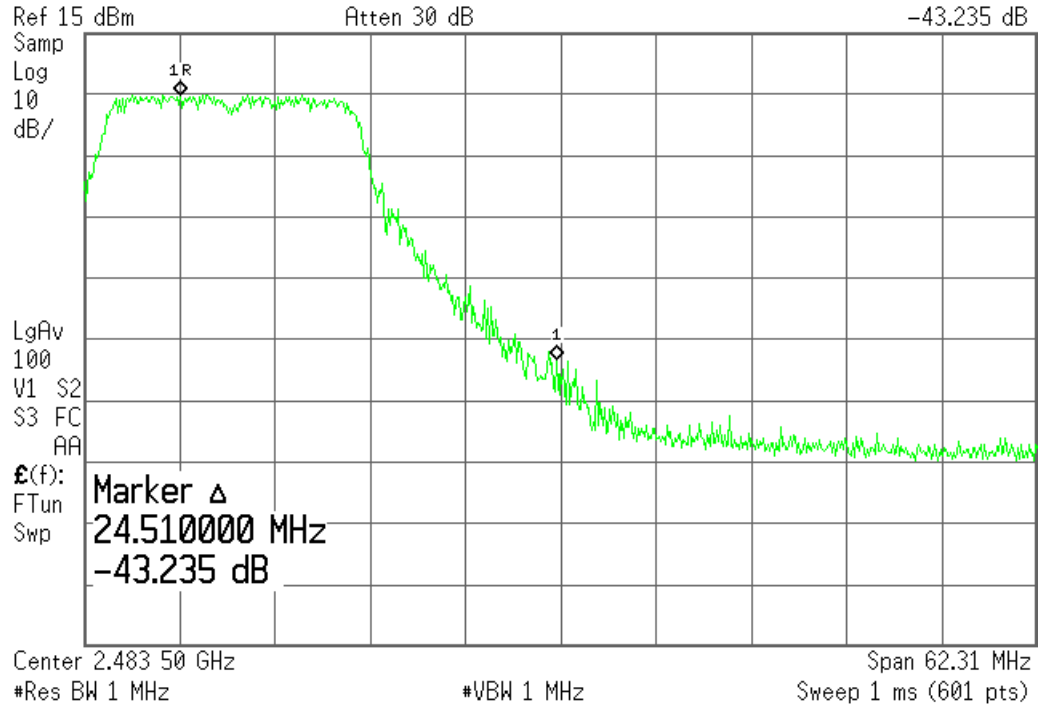


802.11 G
BW Delta
Msmt @ 2412 AVG

Agilent 15:44:04 Mar 6, 2005

Mkr1 24.51 MHz
-43.235 dB

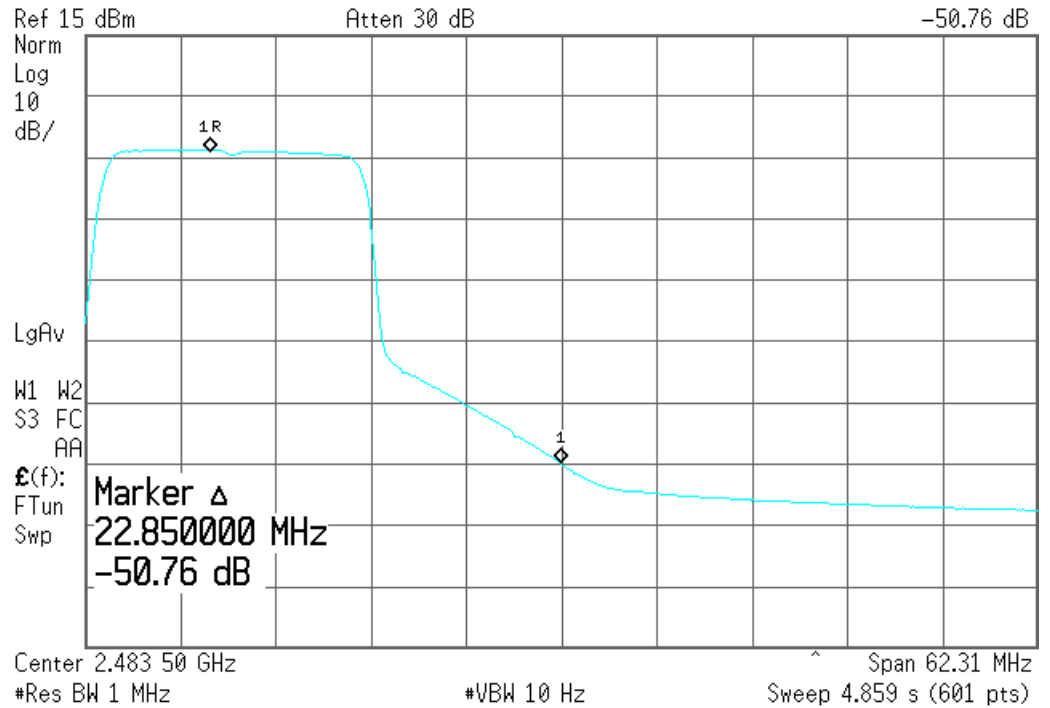
802.11 G
-dBc
Msmt @ 2462 PK



Agilent 15:41:18 Mar 6, 2005

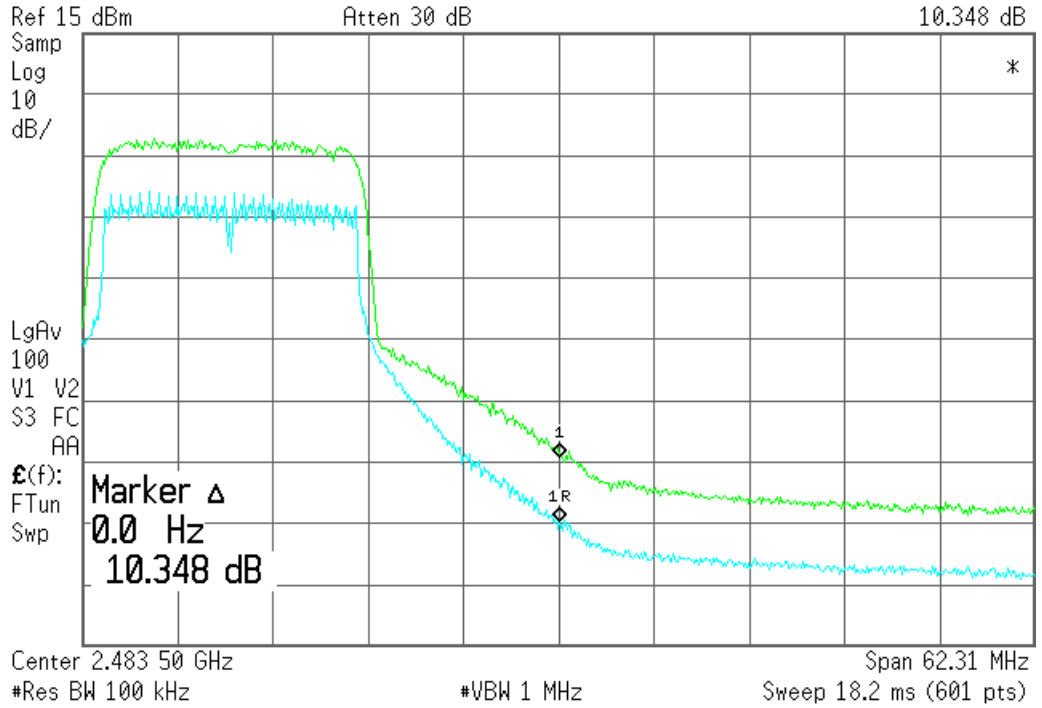
Mkr1 22.85 MHz
-50.76 dB

802.11 G
-dBc
Msmt @ 2462 AVG



Agilent 15:50:56 Mar 6, 2005

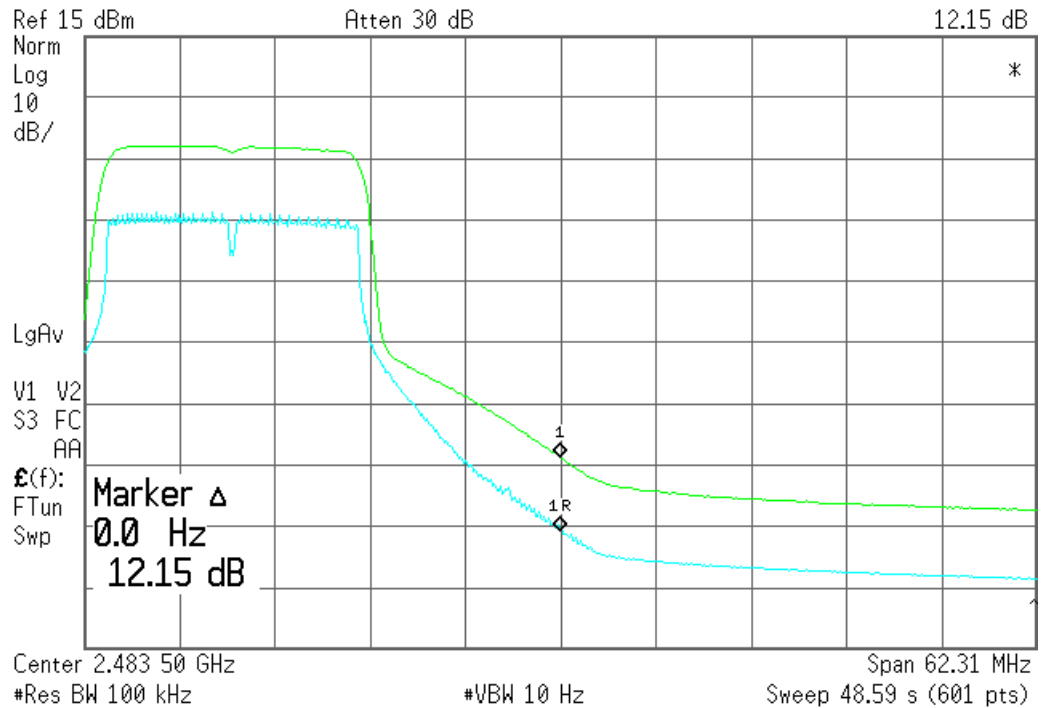
Mkr1 0 Hz
10.348 dB



802.11 G
BW Delta
Msmt @ 2462 PK

Agilent 16:09:18 Mar 6, 2005

Mkr1 0 Hz
12.15 dB



802.11 G
BW Delta
Msmt @ 2462 AVG

AC Line Conducted Emissions

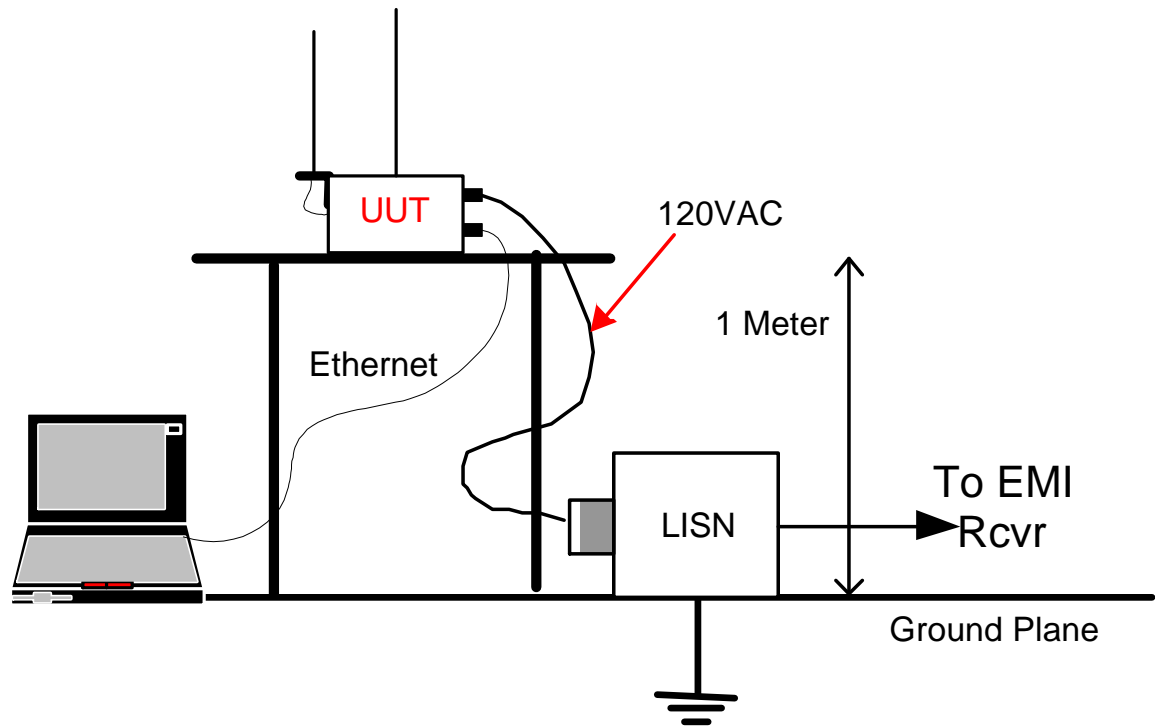
Specification:

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 UUT was configured to transmit maximum power on both 2.4 and 5 GHz during the test.



AC Line Conducted Emissions Results

The “Quasi-peak” and the AVG results for the unit transmitting packets are contained in the table below

Frequency MHz	Level dB μ V	AC Line	EN55022 B		Detector QP/Ave
			Limit	Margin	
9.631	53.6	neutral	60.0	-6.4	QP
9.631	39.8	neutral	50.0	-10.2	Average
5.779	38.2	neutral	50.0	-11.8	Average
5.707	37.4	line	50.0	-12.6	Average
10.108	47.0	neutral	60.0	-13.0	QP
9.352	46.3	neutral	60.0	-13.7	QP
5.779	45.4	neutral	60.0	-14.6	QP
5.707	43.7	line	60.0	-16.3	QP
10.108	31.7	neutral	50.0	-18.3	Average
9.352	31.0	neutral	50.0	-19.0	Average
9.613	38.3	line	60.0	-21.7	QP
9.613	24.6	line	50.0	-25.4	Average
10.414	23.8	line	50.0	-26.2	Average
10.414	33.4	line	60.0	-26.6	QP

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:

To simplify yhr testing, the entire outdoor radio was tested, not just the receiver. The Outdoor radio is a Class A device, however the receiver must pass Classs B emissions. The outdoor radio was tested to the Class B limits since if emissions from the entire radio are below the Class B limit, so must be the emissions from the receiver.

Frequency	Level	Pol	FCC Class B		Detector	Azimuth	Height
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters
Maximized quasi-peak readings (includes manipulation of EUT interface cables)							
143.244	43.4	H	43.5	-0.1	QP	114	2.0
153.048	41.5	H	43.5	-2.0	QP	96	2.0
329.997	40.3	V	46.0	-5.8	QP	207	1.0
212.235	33.1	H	43.5	-10.4	QP	268	1.5
312.978	27.3	H	46.0	-18.7	QP	268	1.0
440.001	21.7	H	46.0	-24.3	QP	141	1.0

