vocera COMMUNICATIONS
20600 Lazaneo Drive
3rd Floor
Cupertino, CA 95014
www.vocera.com

FCC Part 15.247 Certification Application

EMI Test Report
and
Technical Documentation
on
Vocera Communications badge
Model: B1000A

FCC ID: QGZB1000A

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

Table of Contents

General Information

Unit(s) Under Test: (UUT) Vocera Communications badge

Model: B1000A

Product Description: IEEE 802.11 B voice communications device

FCC ID: **QGZB1000A**

Tested For: Vocera Communications
20600 Lazaneo Drive
3rd Floor
Cupertino, CA 95014

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

Tested By: Juan Martinez, Sr. Test Engineer, Elliott Laboratories
David Waitt, (Independent Consultant)

Test Specifications: FCC CFR 47, Part 15.247, 2.4 GHz DSSS

Test Date: October 29, 2003

Requested Certification: Part 15.247 / Part 15 Subpart C Certification

Detailed Product Information

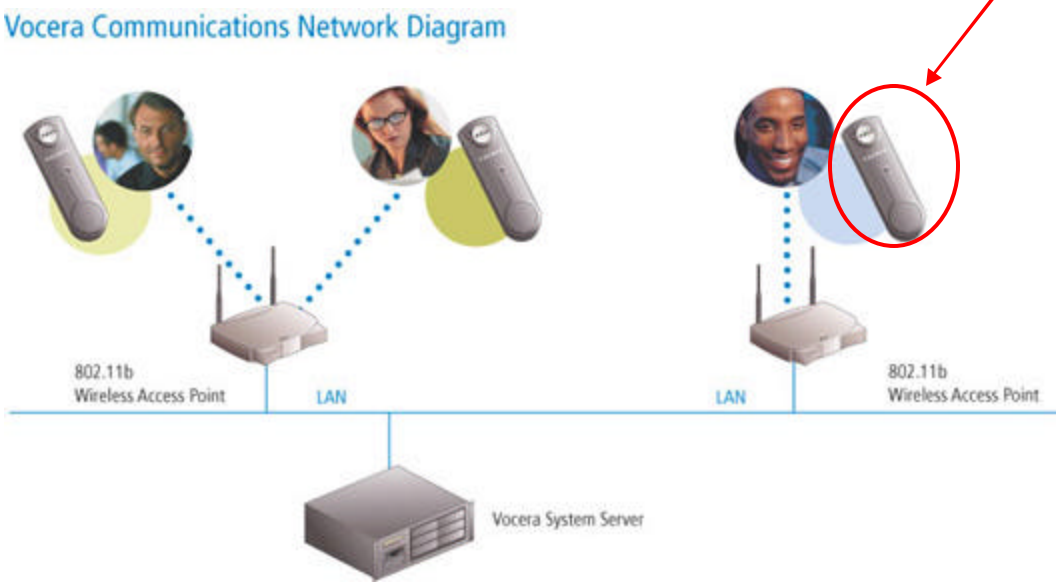
The Vocera Communications system provides hands-free, voice-activated communications throughout any 802.11b networked building or campus. The Vocera Communications system is made up of two elements:

- Vocera Server Software
- Vocera Communications Badge.

Vocera Communications Badge is a wearable IEEE802.11 B device that weighs less than two ounces and can be clipped to a shirt pocket or worn on a lanyard. It enables two-way voice conversation through a campus 802.11 B network infrastructure.

The unit also has an internal antenna with a measured peak gain of -1.5 dBi.

The unit is powered by a removable rechargeable battery.



Only the communications badge is being certified by Vocera. The wireless access points shown above are not part of the Vocera product line

Test Results Summary

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

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 at Antenna Terminal	17.95 dBm Max
15.247(a)(2)	6.2.2(o)(e1)	6dB Bandwidth	10.33 MHz Min
15.247(d)	6.2.2(o)(d1)	Power Spectral Density	-7.92 dBm/3kHz Max
15.247(c)	6.2.2(o)(a) 4	Out of Band Spurious Emissions	-12.7 dB below limit max
15.205	6.3(c)	Radiated Emissions in Restricted bands	-5.2 dB in spec Max

Test Facilities

The certification tests were performed at:

Elliott Labs
684 West Maude Ave
Sunnyvale, CA 94086

General:

Final radiated test measurements were taken in October 2003 at the Elliott Laboratories anechoic chamber #5

The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

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

Antenna, Antenna Mast and Turntable

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

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

Equipment Lists

Instrument Calibration

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. 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 #	Assett #	Cal Due
Hewlett Packard	EMC Spectrum Analyzer 9kHz - 6.5GHz	8595EM	787	04-Dec-03
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	868	14-Mar-04
EMCO	Horn Antenna D. Ridge 1-18 GHz (SA40 horn)	3115	1386	12-Mar-04
Hewlett Packard	Microwave EMI test system (SA40, 30Hz - 40GHz), system 2	84125C	1410	02-Apr-04
Elliott Laboratories	RF Emissions Chamber #5	Chamber 5	1560	03-Mar-04
Thinking Assets	Weather Forecaster	Baro/Press/Humidity	648	16-Apr-04

Test Methods

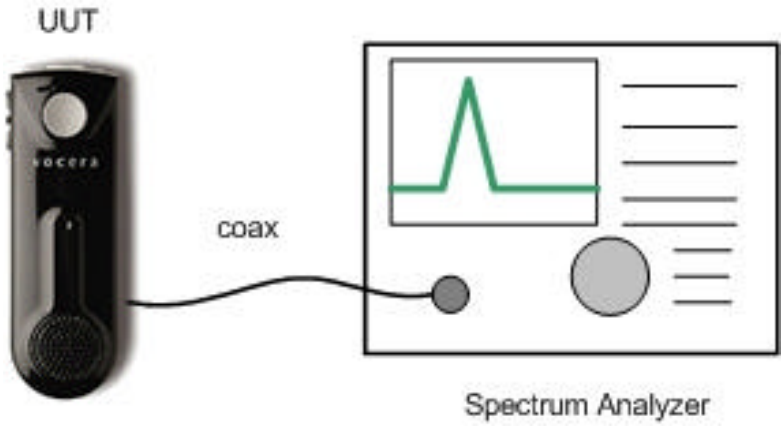
The tests are performed at a low, middle and high channel of the applicable band. The typical frequencies used for the Part 15.247 , 2.4 GHz tests are listed to the right.. Unless otherwise noted, all testing was performed on these channels / frequencies

ISM 802.11 B
2400 – 2483.5 MHz

Channel	Freq(MHz)
Low CH 1	2412
Mid CH 6	2437
High Ch 11	2462

The tests listed below are performed using the basic “conducted” test setup shown below unless otherwise noted. Since the UUT does nto have an antenna connector, the UUT was modified by installing a coax to allow the measurements to be made and 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 Bandwidth
15.247(c)	Out of Band Conducted RF Emissions
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**
NONE				

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	Approx 18C	**Humidity:**	Approx 60%
ATM pressure	Approx 1005 mBar	**Grounding:**	None
Tested By	David Waitt , Juan Martinez	**Date of Test:**	Oct 29 2003
Test Reference	Refer to individual test results		
Tested Range	Test Dependent		
Test Voltage	Internal battery		
Modifications	No modifications were made to the unit during the tests		

802.11 B Maximum RF Power Output at Antenna Terminals

Specification:

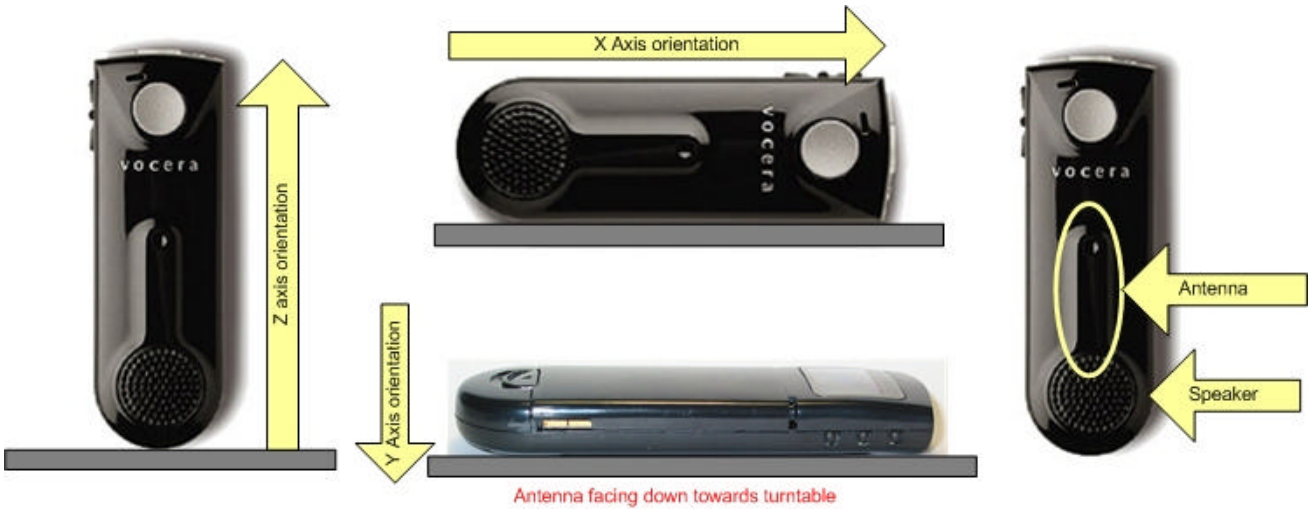
FCC Specification: Paragraph 15.247(b)

Procedure:

The Vocera communication badge does not have an accessible antenna connector to measure RF transmit power directly. To make the "conducted" RF measurements, a unit was modified and the antenna removed and replaced with a small length of semi-rigid coax that had to be soldered directly to the trace on the printed circuit board. This allowed direct measurements of the RF transmit power, bandwidth and so on. However, it was not possible to use this unit for the radiated emissions testing since the antenna had been removed and could not be re-installed with a high level of confidence that the performance would be similar to that of a new, "never modified" badge.

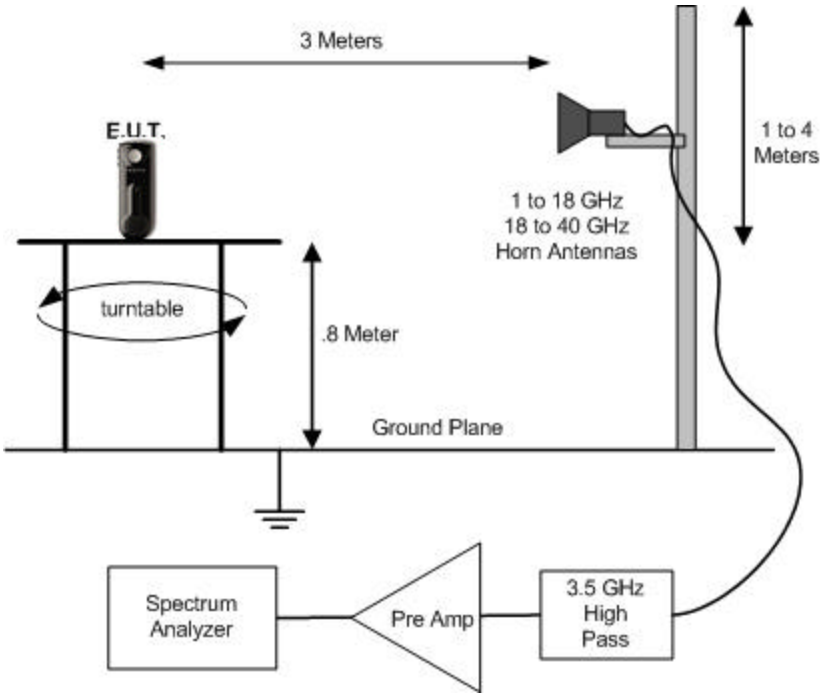
The manufacturing tolerance of the RF power out of the communications badge is 17 dBm + 1dB / - .5 dB total integrated power, therefore the maximum RF transmit power of any badge is expected not to exceed +18dBm. Taking into the account the peak internal antenna gain of -1.5 dBi, this yields a maximum of 16.5 dBm EIRP.

For the power measurement the badge was positioned on a turntable on a 3 meter range within an anechoic chamber. In order to determine the maximum level of the radiated emissions during testing the worst case orientation of the badge was determined for each test channel. (The different orientations are defined below).



Once the worst case orientation was determined for each test channel, the RF transmit power of the badge was adjusted (using test software installed within the UUT) until the level of the received signal (*at 3 meters, when referenced back to the Unit Under Test - See Free Space calculation and measurement bandwidth correction calculation in the appendix)* was determined to be approximately 16.5 dBm EIRP total integrated power over the 20 dB bandwidth of the signal. This level is the maximum transmit level (including manufacturing tolerance) that units will be calibrated to in production. Note that the production units incorporate "production" software where the transmit power is NOT adjustable by the user.

The worst case UUT orientation was determined for each of the test channels and that orientation was used to determine the EIRP



Transmit Power (dBm EIRP) test setup diagram

RF Transmit Power Result:

The following EIRP levels were measured on low, mid and high channels of the ISM bands. The EIRP of the communication badge, for each channel tested, is listed below.

802.11a/b Channel	Freq MHz	Msrd Field Str dBuV/m	Free Space Correction dBuV to dBm EIRP	BW Correction 10Log (BWmsrd/RBW)	**Pout (Pk , dBm EIRP)**	Ant Gain MAX dBi	**RF Pout (dBm)**	Worst Case Orientation
1	2412	104.2	95.27	7.52	**16.45**	-1.5	**17.95**	Y
6	2437	104.1	95.27	7.51	**16.34**	-1.5	**17.84**	X
11	2462	104.1	95.27	7.52	**16.35**	-1.5	**17.85**	Y

20 dB BW (MHz)	Msmt BW (MHz)
16.95	3
16.9	3
16.95	3

Example Calculations (2412 MHz):
BW Correction = 10 log (20 dB BW / msmt BW)
7.52 = 10 log (16.95 / 3)

dBm EIRP = dBuV/m @ 3m - 95.27 + BW Correction
16.45 =104.2 - 95.27 + 7.52

See appendix for additional detail

ISM 6 dB bandwidth

Specifications

FCC Specification: Paragraph 15.247(a)(2)

Procedure:

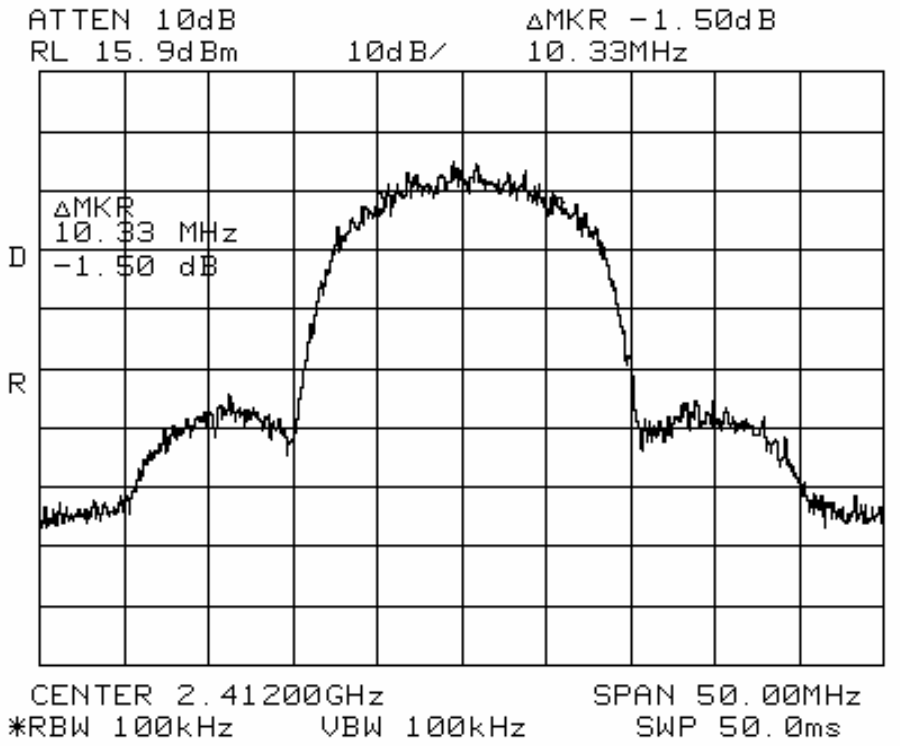
The Vocera communications badge operates on the standard IEEE 802.11 A / B channels. The 6dB bandwidth was measured on the low, middle and high channel of the 2.4 GHz ISM band using the bench conducted RF test setup presented earlier. The spectrum analyzer was configured for MAX HOLD and the trace allowed to stabilize. A peak search was performed and the then delta-marker used to locate the point –6dB below the peak.

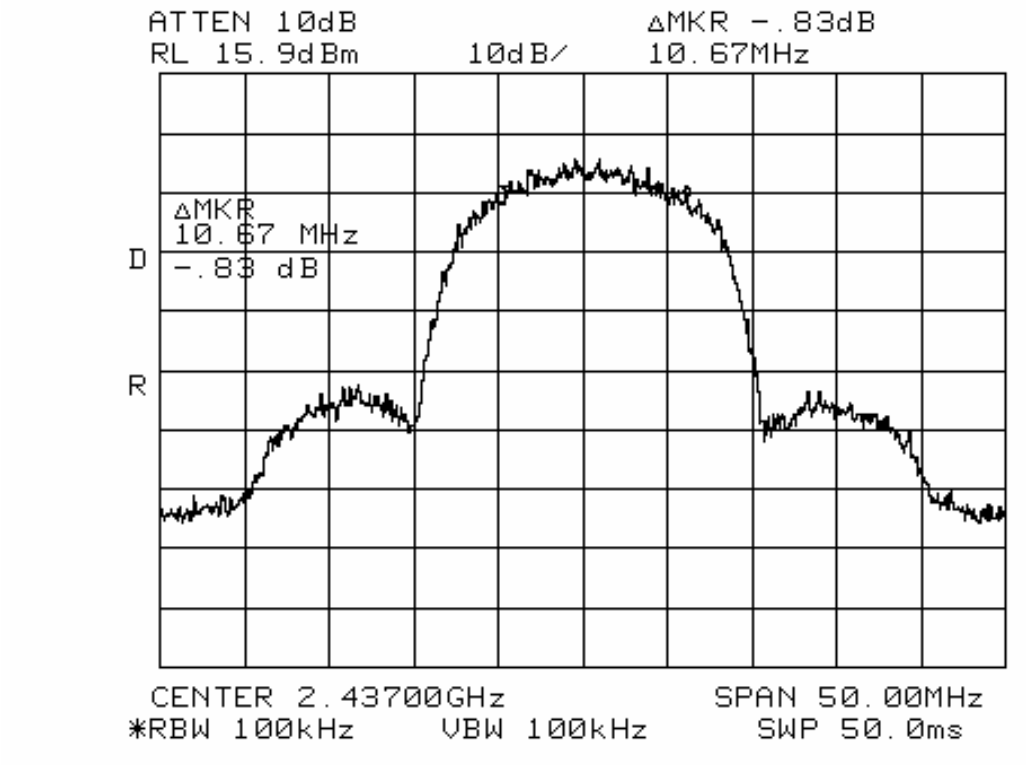
Once this initial reference measurement was complete, the point was used as a reference and another delta-marker measurement was performed and an attempt made to make the two markers "level" (0dB difference). The delta frequency between the two markers was measured as the 6 dB BW of the signal. The bandwidth test was performed at the power settings that will be used in the final system configuration.

Results:

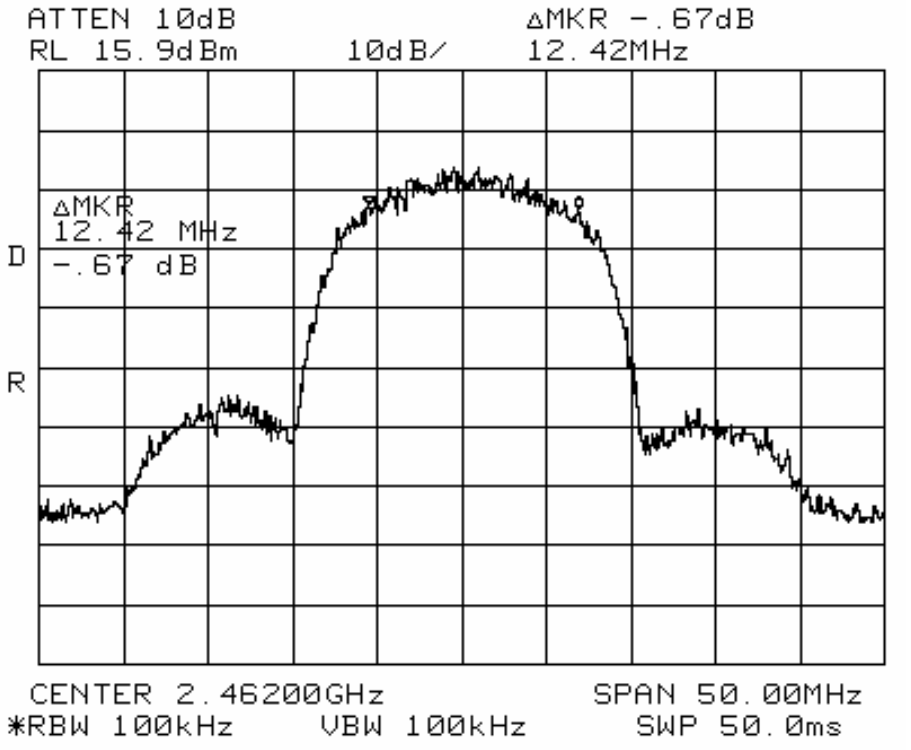
Band	802.11a/b Channel	Frequency (MHz)	Measured BW (MHz)
2.4 GHz ISM 6 dB BW	1	2412.00	**10.33**
	6	2437.00	**10.67**
	11	2462.00	**12.42**

6 dB BW, Channel 1, 2412 MHz





6 dB BW, Channel 6, 2437 MHz



6 dB BW, Channel 11, 2462 MHz

ISM Power Spectral Density

FCC Specification: Paragraph: 15.247(4)(d)

Procedure

The test setup was configured as shown in the bench conducted RF test setup. The UUT was configured to continuously transmit data.

Procedure(2.4 GHz):

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 and the sweep time set to 100 sec. This method averages the data for 1 second for every 3 kHz BW.

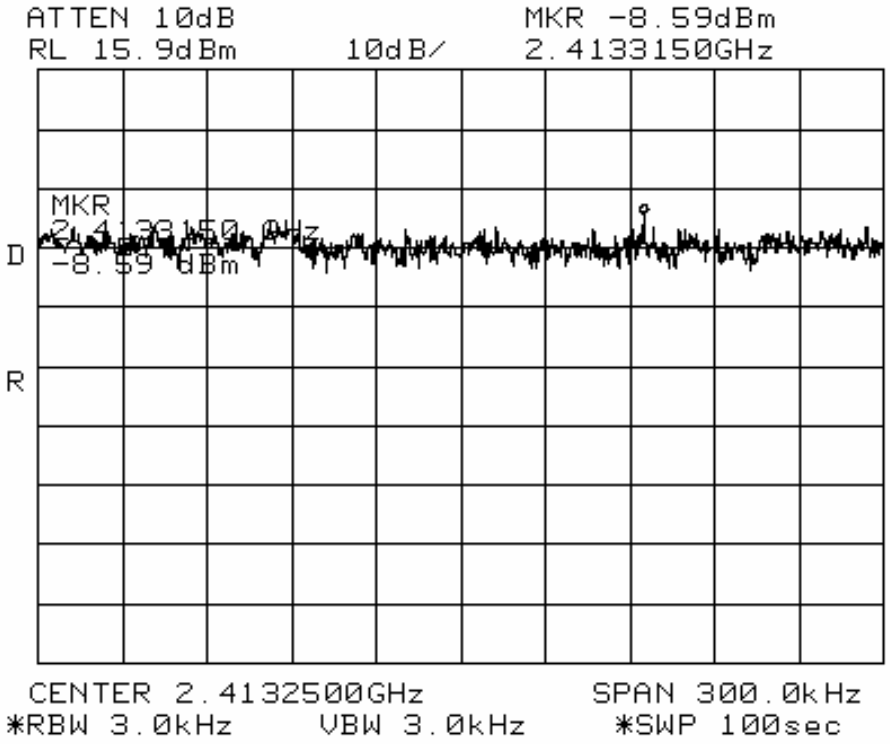
The analyzer was then set to MAX HOLD and a display line placed at +8dBm.

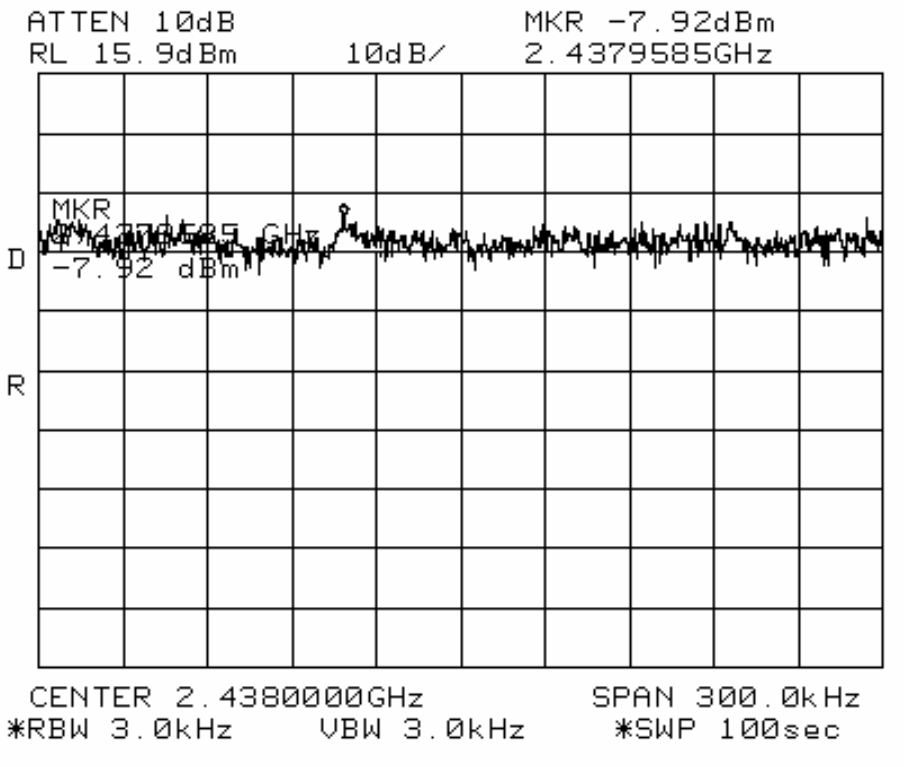
The power spectral density was measured at the low, middle and high-test channels with the appropriate power setting for the given test channel.

Results:

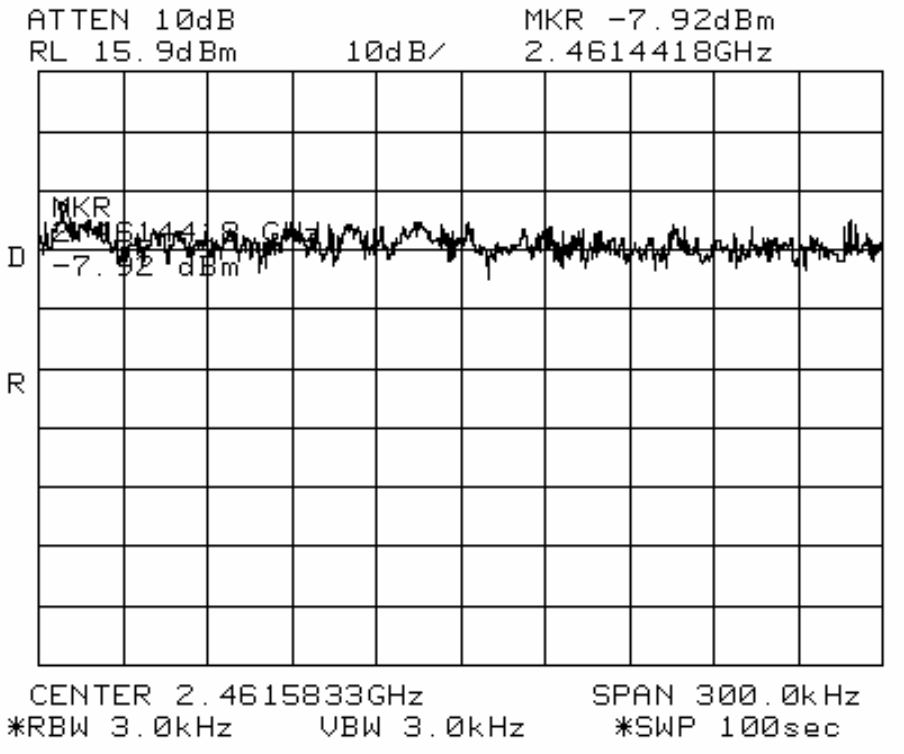
Band	802.11a/b Channel	Frequency (MHz)	Specification dBm /	Measured PSD (dBm)
2.4 GHz ISM PSD	1	2412.00	8dBm/3kHz	**-8.59**
	6	2437.00	8dBm/3kHz	**-7.92**
	11	2462.00	8dBm/3kHz	**-7.92**

Power Spectral Density, LOW Channel, 2412MHz





Power Spectral Density, MID Channel, 2437MHz



Power Spectral Density, HIGH Channel, 2462MHz

ISM Out of Band Emissions

Specifications:

FCC Part 15 Paragraph 15.247(c)

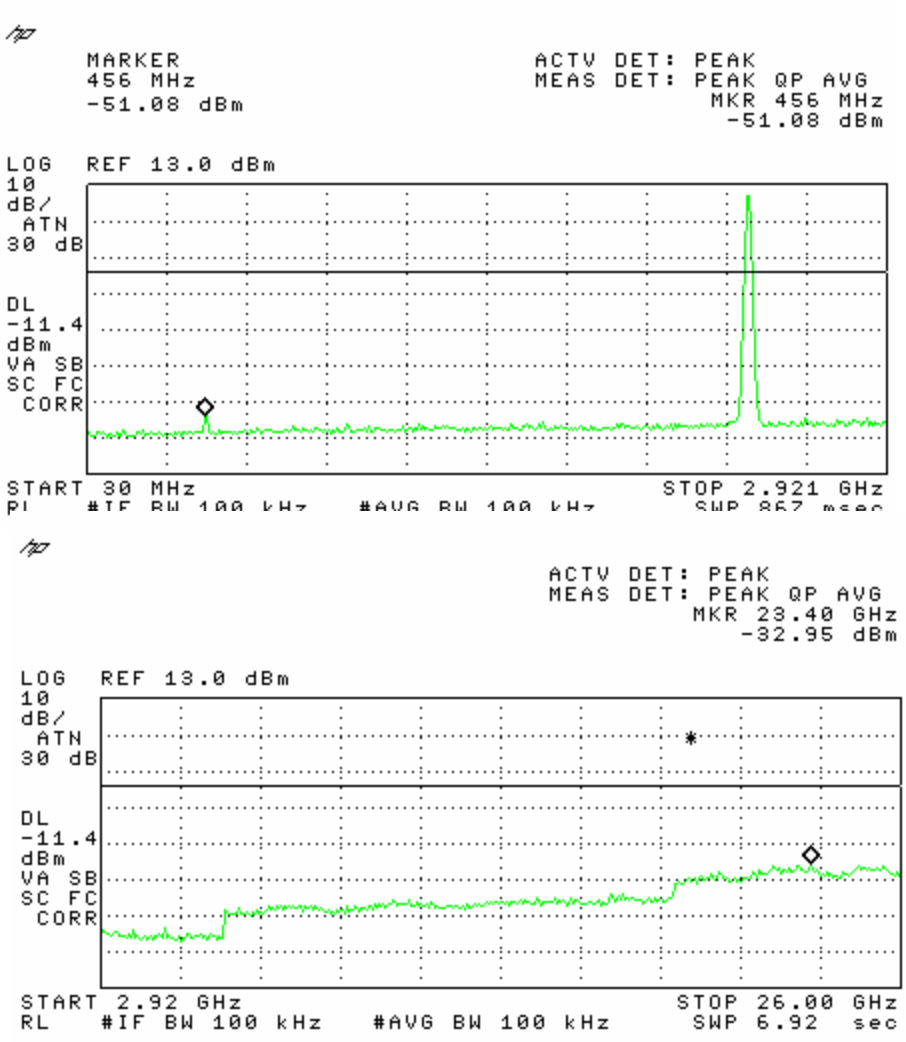
Procedure:

The test was configured as shown in the bench conducted RF test setup. The UUT was configured to continuously transmit random data. The band from 1 GHz to 25GHz was examined for spurious emissions. This test was conducted the low middle and high channels.

Results:

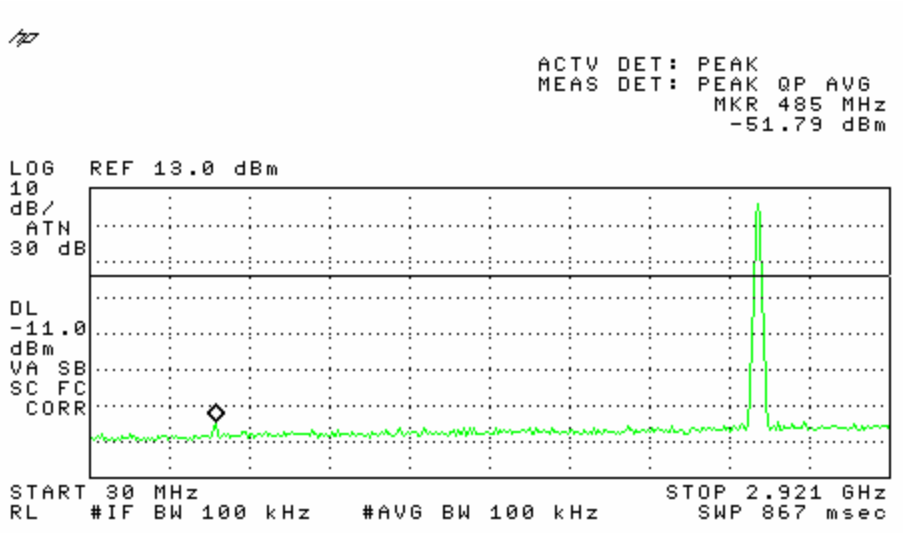
The entire band of interest was examined at one time to clearly demonstrate compliance. There were no spurious emissions above the limit (-20dBc)

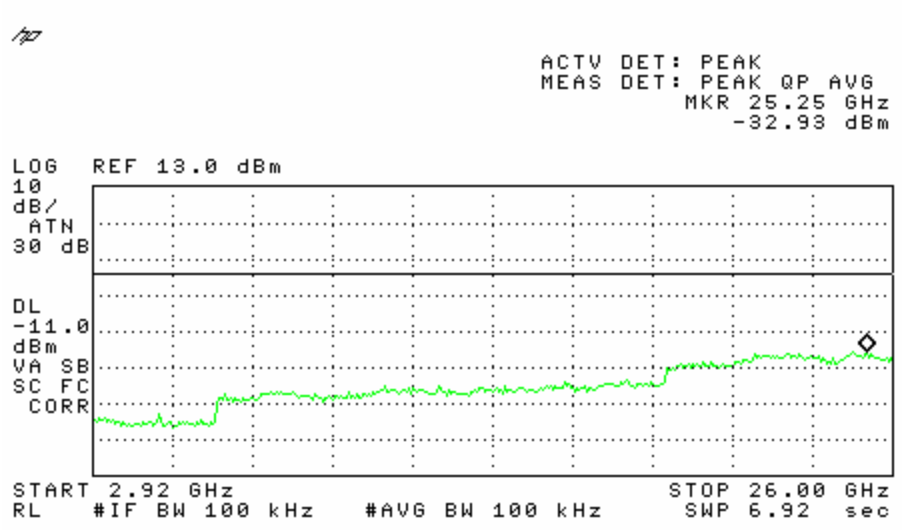
Out of Band Emissions Plots



OOB Emissions, Transmit on Channel 1 (2412MHz)

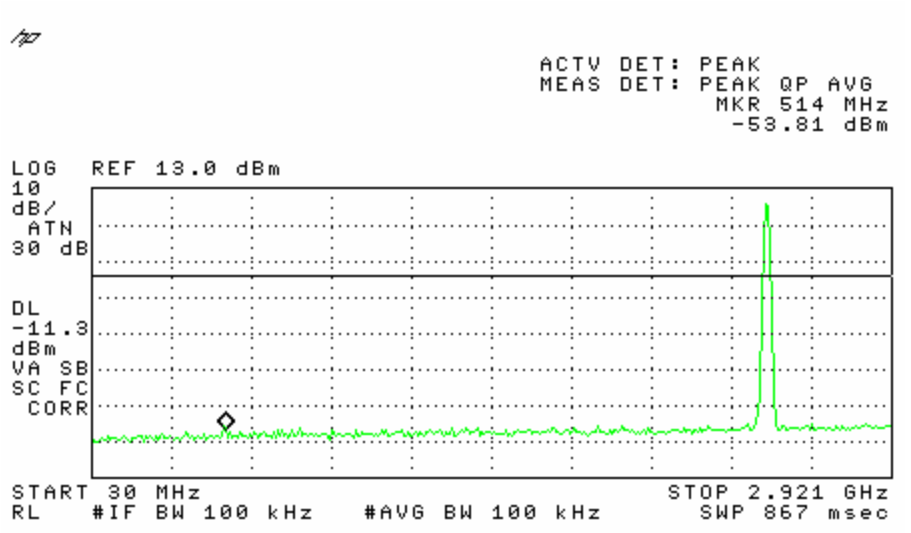
ISM Out of Band emisssions (Continued)

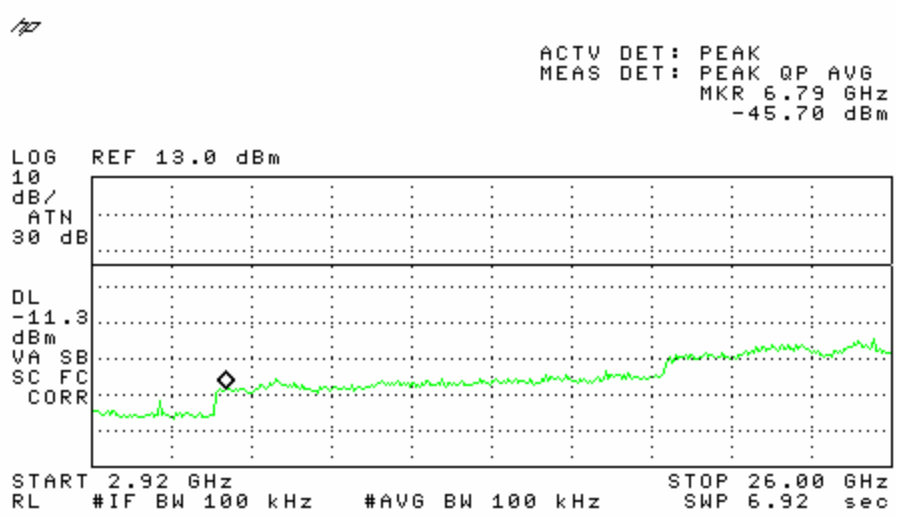




OOB Emissions, Transmit on Channel 6 (2437MHz)

ISM Out of Band emisssions (Continued)





OOB Emissions,, Transmit on Channel 11 (2462MHz)

ISM Radiated Emissions in Restricted bands

Specifications:

FCC Part 15 Paragraph 15.247(c)

Procedure:

This test was conducted on a 5-meter anechoic chamber at Elliott Laboratories Fremont, California facility 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 for out of band / restricted band emissions at the Low, Mid and High test channels. The UUT was running in the diagnostic mode and set to transmit continuous data at the maximum rated transmit power. (The power was adjusted for each channel to the maximum power). The test equipment was configured as shown below.

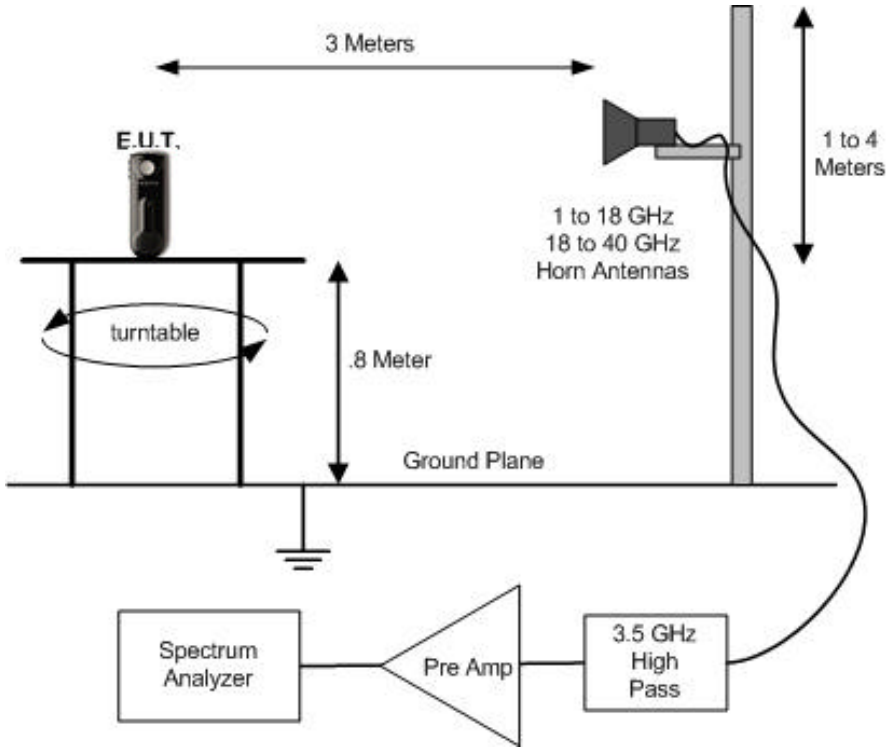
The emissions up to 26 GHz were examined. Those emission falling within a restricted band were evaluated against the "restricted band emission limit" (54 / 74 dBuV), while those outside of a restricted band were evaluated against the "out of band emissions" limit (-20 dBc)

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 emission was measured in two modes, "Peak" and "Average" using the following measurement bandwidths

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

The spectrum analyzer reading was corrected by the measurement software to take into account the various equipment characteristics (antenna factor, cable loss, pre-amplifier gain, HPF loss...) to obtain a final corrected measurement.

This procedure was repeated for channel 6 and 11 within the 802.11 B band.



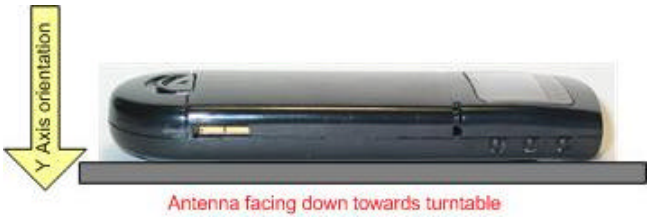
Radiated Emissions in Restricted Bands Test Setup

Support Equipment				
Description	Model number	FCC ID or SN	Mfg	Power Cable
NONE				

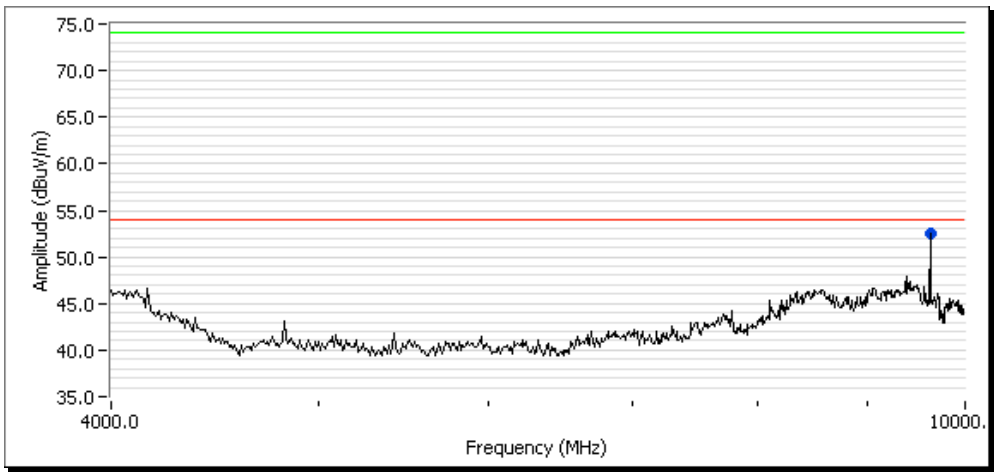
Test Conditions			
Temperature	Approx 23 C	Humidity:	Approx 42%
ATM pressure	Approx 1003mBar	Grounding:	None
Tested By	David Waitt, Juan Martinez	Date of Test:	28 Oct 2003
Test Reference	FCC Part 15.205 IC Paragraph RSS210, 6.2.3 (c)		
Setup Method	ANSI C63.4		
Tested Range	1 GHz to 26 GHz		
Test Voltage	4.2 VDC internal battery		
Modifications	No modifications were made to the unit		

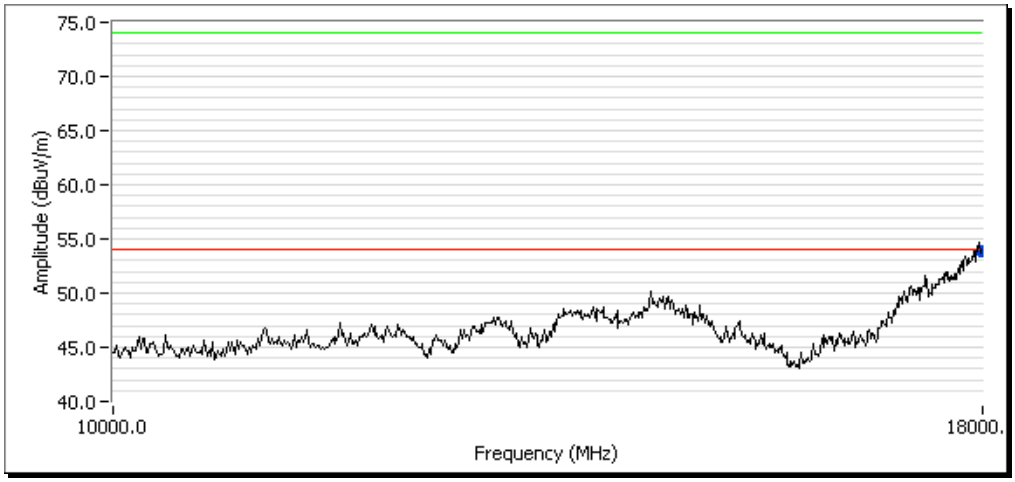
Results (Channel 1):

Measurements of the fundamental were made in each of the three orientations. The orientation with the highest emission level was used for the test. In this case, it was the 'Y' axis orientation.



The plots below show the peak emission levels with the unit transmitting continuous data on channel #1 (2412MHz)





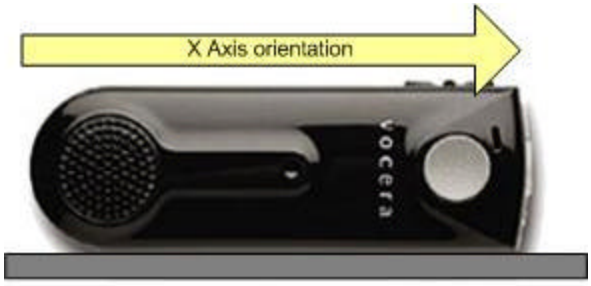
Restricted band emission in RED, 15.209 emission in BLUE

Maximized Emissions: 1000 - 26,000 MHz							
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height
MHz	dBmV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters
Harmonics tested with EUT laying Flat as this was the worst case Fundamental measurement							
9630.615	52.5	V	84.2	-31.7	Peak	189	1.5
17985.38	48.8	H	54.0	-5.2	AVG	173	1.5
17985.38	60.2	H	74.0	-13.8	PK	173	1.5

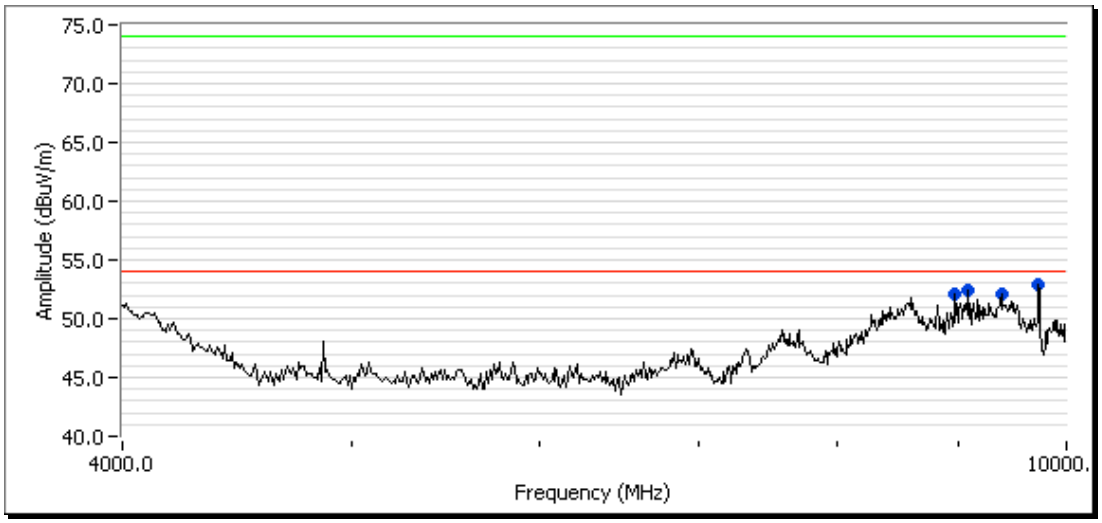
The limit for the emission in the NON-restricted band is the 15.209, fundamental -20 dB limit
The restricted band emission was taken with RBW=VBW=1MHz (Peak) and RBW=1MHz, VBW=10Hz (Average). There were no emissions detected above 18GHz

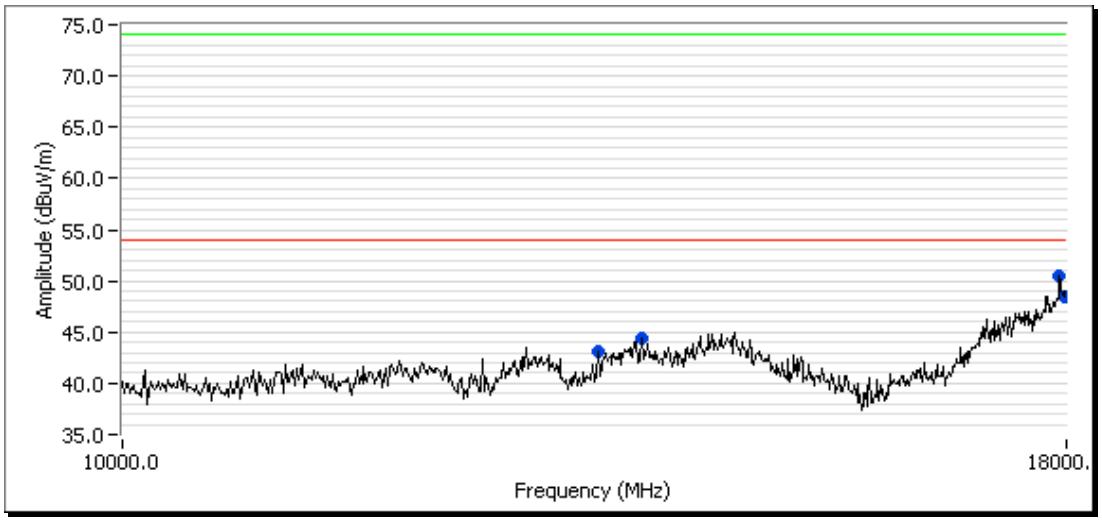
Results (Channel 6):

Measurements of the fundamental were made in each of the three orientations. The orientation with the highest emission level was used for the test. In this case, it was the 'X' axis orientation.



The plots below show the peak emission levels with the unit transmitting continuous data on channel #6 (2437MHz)





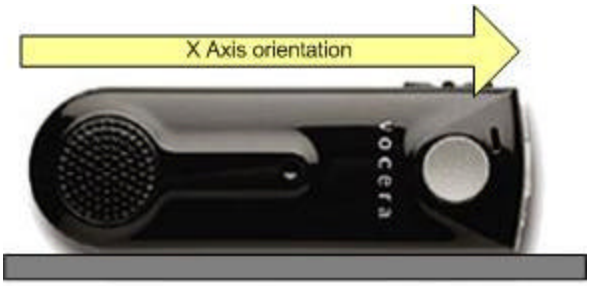
Restricted band emission in RED, 15.209 emission in BLUE
There were no emissions detected above 18GHz

Maximized Emissions: 1000 - 26,000 MHz

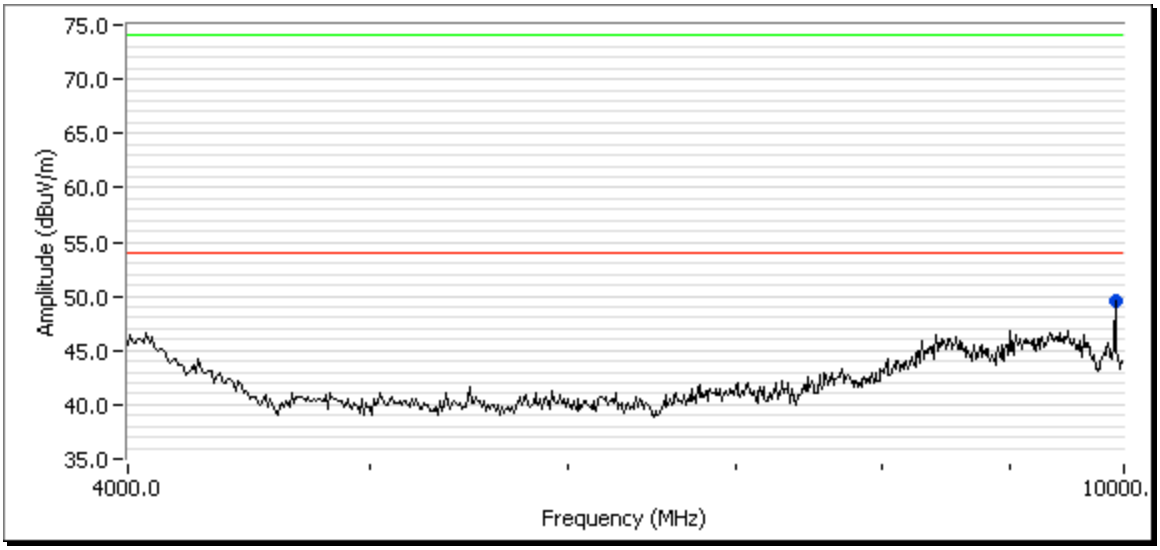
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height
MHz	dB?V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters
Harmonics tested with EUT laying side as this was the worst case Fundamental measurement							
9392.433	41.4	V	54.0	-12.7	AVG	295	1.0
9392.433	54.2	V	74.0	-19.9	PK	295	1.0
9731.205	39.3	V	84.1	-44.8	AVG	0	1.3
9731.205	51.4	V	84.1	-32.7	PK	0	1.3
13447.59	43.2	V	84.1	-40.9	Peak	2	1.0
13820.30	44.3	V	84.1	-39.8	Peak	2	1.0

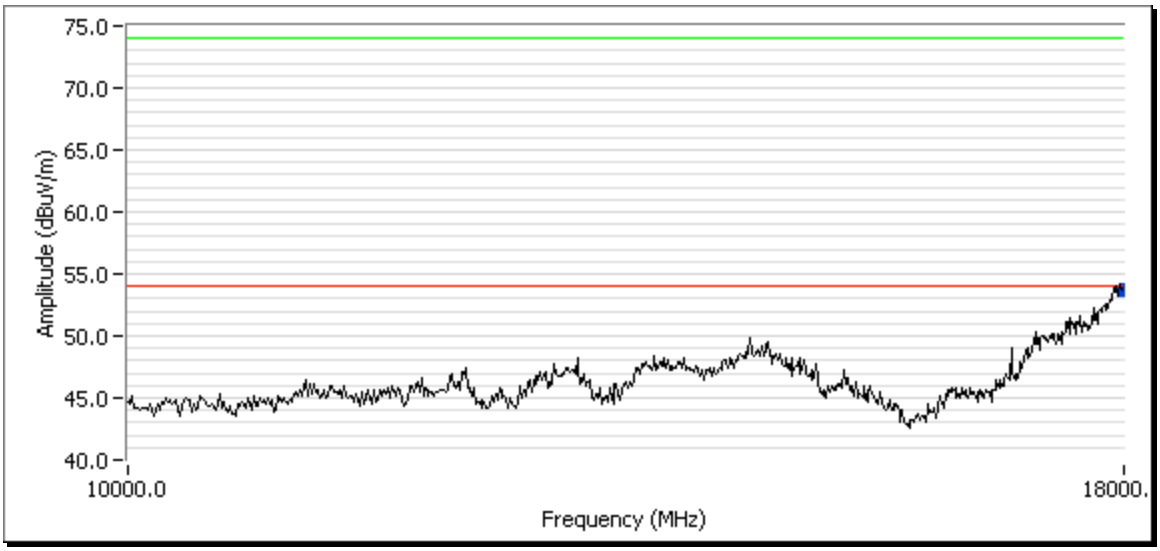
Results (Channel 11):

Measurements of the fundamental were made in each of the three orientations. The orientation with the highest emission level was used for the test. In this case, it was the 'X' axis orientation.



The plots below show the peak emission levels with the unit transmitting continuous data on channel #11 (2462MHz)





Restricted band emission in RED, 15.209 emission in BLUE

There were no emissions detected above 18GHz

Maximized Emissions: 1000 - 26,000 MHz							
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height
MHz	dB?V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters
Harmonics tested with EUT laying on side as this was the worst case Fundamental measurement							
9920.133	49.6	V	84.1	-34.5	Peak	360	1.5
17987.4	48.7	V	54.0	-5.3	AVG	0	1.0
17987.4	60.9	V	74.0	-13.1	PK	0	1.0

Radiated emissions in the restricted bands near the operating band edge

Since this is an 802.11 B 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.

Restricted Bands close to the ISM operating band

Procedure

There are two steps to performing this test. 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 (Channels 1 and 11). This measurement is made using the peak and average RBW and VBW of 1MHz/1MHz and 1MHz/10Hz. This measured radiated level is then used as a "fundamental reference" level. The test setup for this measurement is the same as the one used for the radiated emissions in restricted bands

Then, a second measurement (conducted) is made using narrower bandwidths (100 kHz) to determine a –dBc (delta dB) level between the peak of the fundamental level (measured in a 100 kHz BW) and the highest level within the restricted band near the operating band. This measurement was mad by placing the antenna close to the UUT (1meter) in order to obtain the necessary measurement dynamic range.

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

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

Test Results

2.400 ISM Band Edge (Restricted band @ 2.390GHz)

Pol	Fundamental Ref Msmt		Delta Msmt		Radiated Level at Band Edge		Specification		Delta (dB below Limit)	
	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg	Peak	Avg
	dbuv/m	dbuv/m	dBc	dBc	dBuv/m	dBuv/m	dBuv/m	dBuv/m	dBuv/m	dBuv/m
Vert	94.2	92.4	44.86	52.26	49.34	40.14	74	54	**24.66**	**13.86**
Horz	89.4	82.3	44.86	52.26	44.54	30.04	74	54	**29.46**	**23.96**

2.4835 ISM Band Edge (Restricted band @ 2.4835 GHz)

Chan	Fundamental Ref Msmt		Delta Msmt		Radiated Level at Band Edge		Specification		Delta (dB below Limit)	
	Peak	Avg			Peak	Avg	Peak	Avg	Peak	Avg
	dbuv/m	dbuv/m	dBc	dBc	dBuv/m	dBuv/m	dBuv/m	dBuv/m	dBuv/m	dBuv/m
Vert	93.9	86.3	51.17	56.26	42.73	30.04	74	54	**31.27**	**23.96**
Horz	97.1	90	51.17	56.26	45.93	33.74	74	54	**40.26**	**20.26**

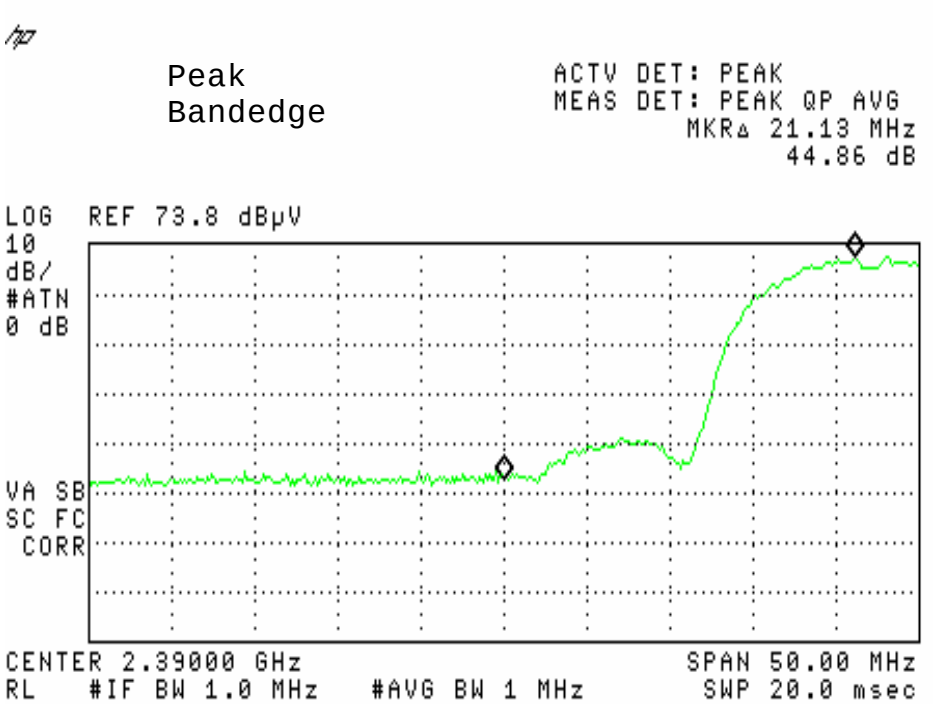
Radiated emissions at band edge sample calculation:

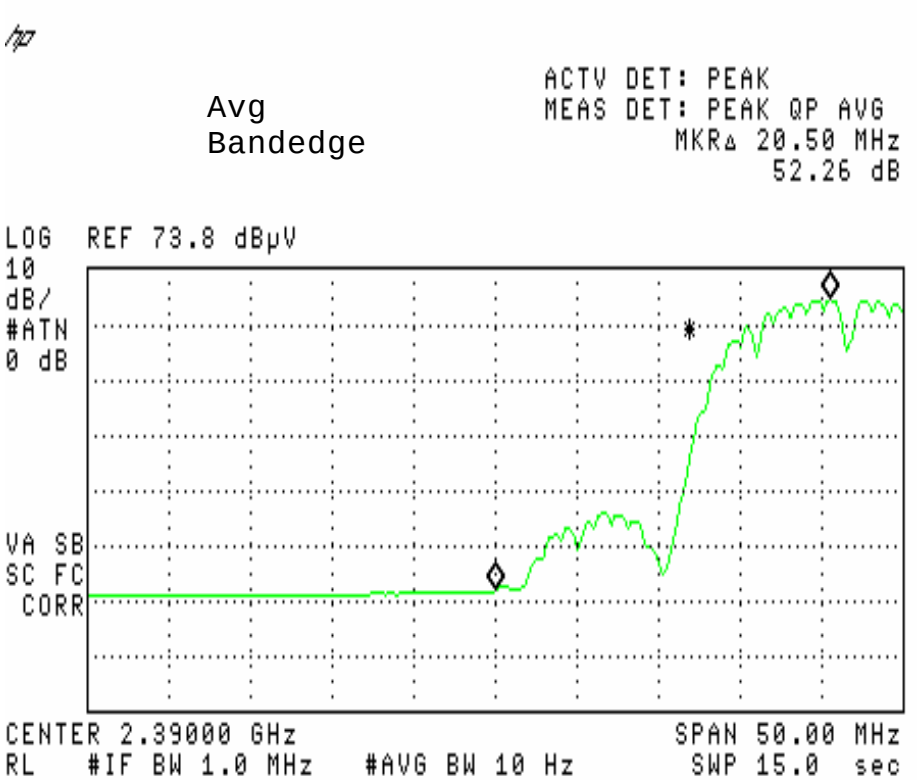
Emission Level = Fund Ref Msmt – Delta msmt

Example: 92.4dBuV/m – 52.26dBc = 40.14dBuv/m
54 dBuv/m - 40.14dBuv/m = 13.86dB margin

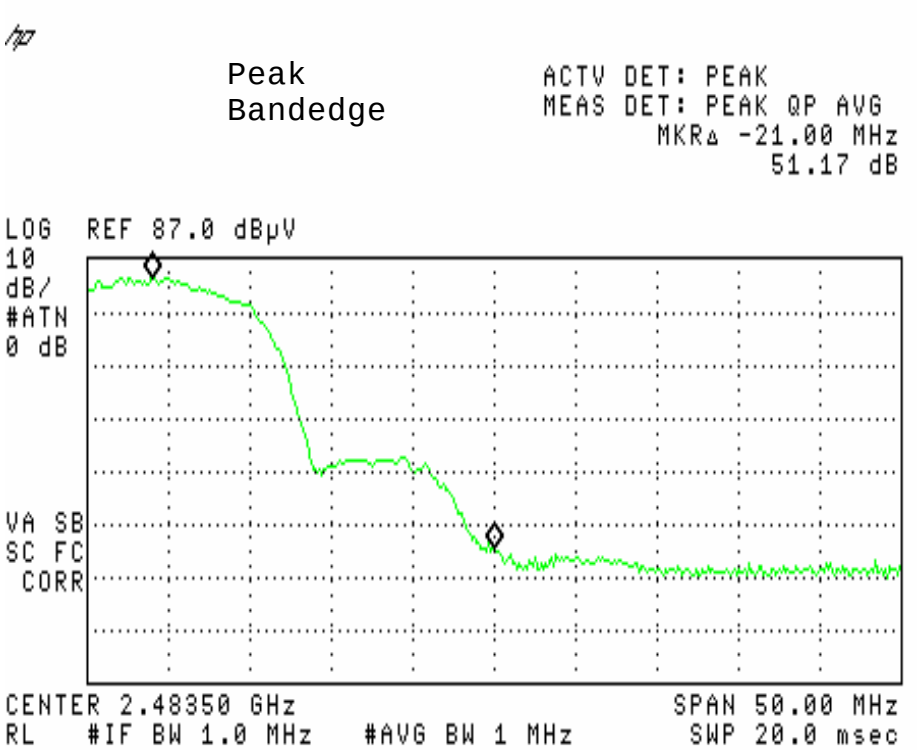
Radiated Emissions in Restricted bands

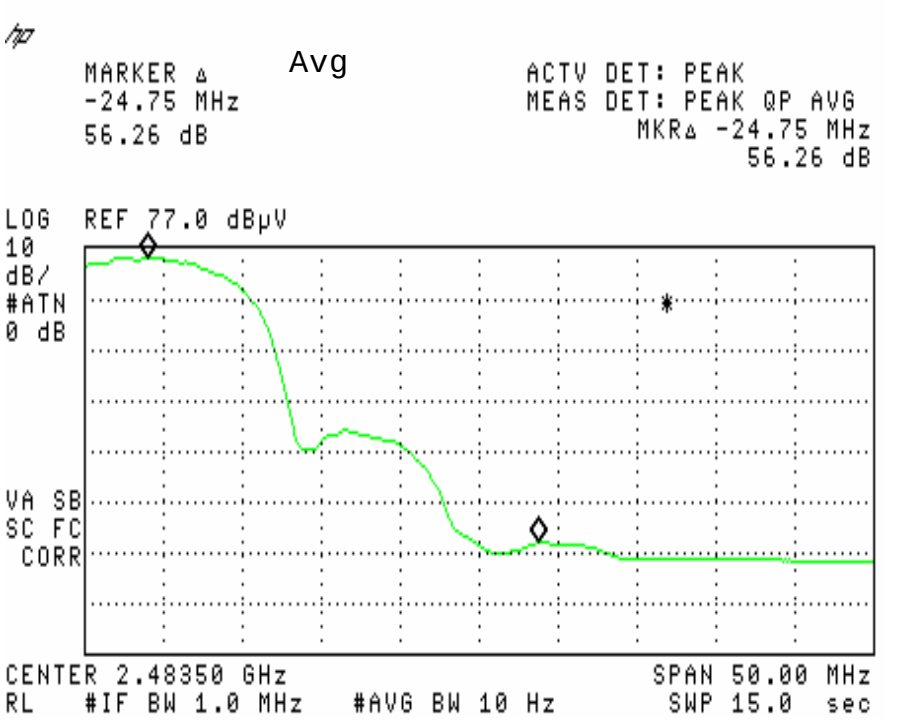
-dBc measurement for the low band edge restricted band @ 2390.0 MHz





Radiated Emissions in Restricted bands
-dBc measurement for the high band edge restricted band @ 2483.5 MHz



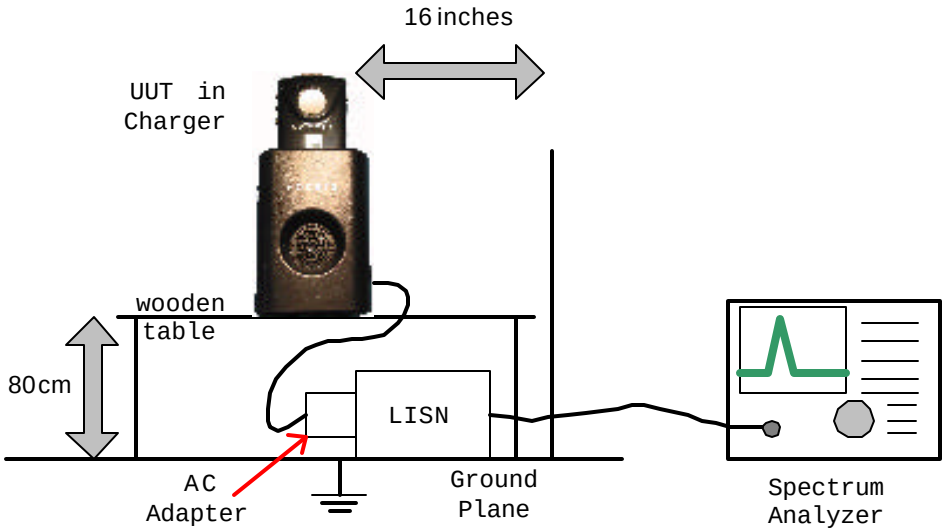


AC Line Conducted Emissions

Specification:
FCC 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 compared to the average limit. The unit was configured to transmit packets at the max data rate.

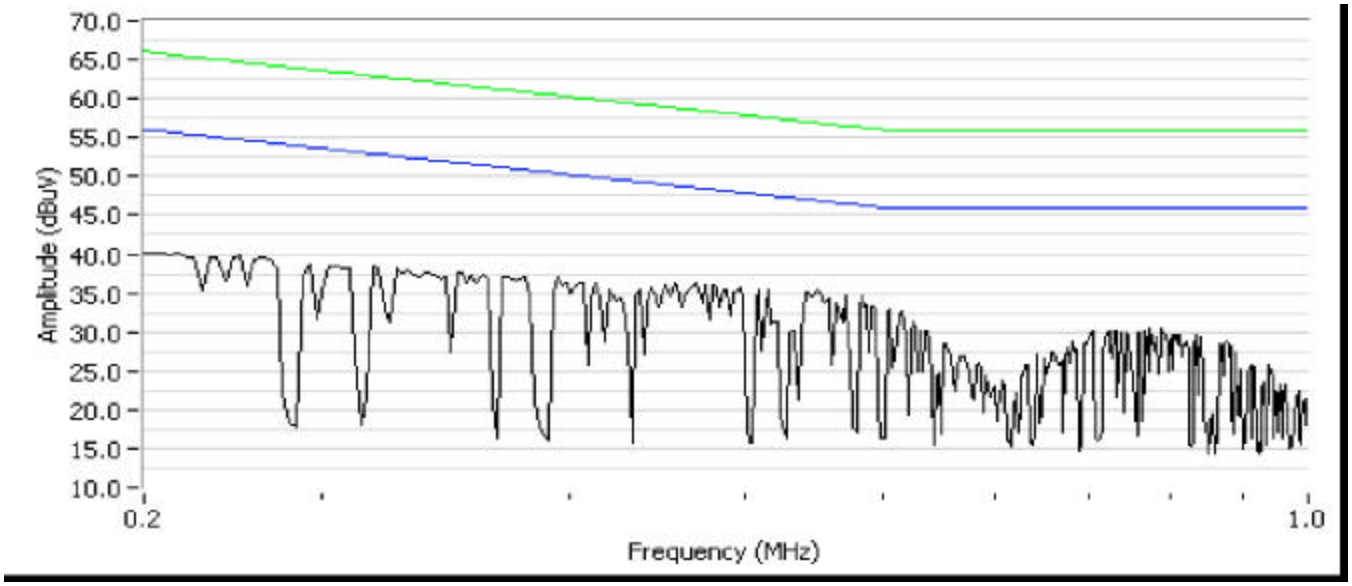
The test was configured as shown below. The product was tested while running on 120 VAC @ 60 Hz .

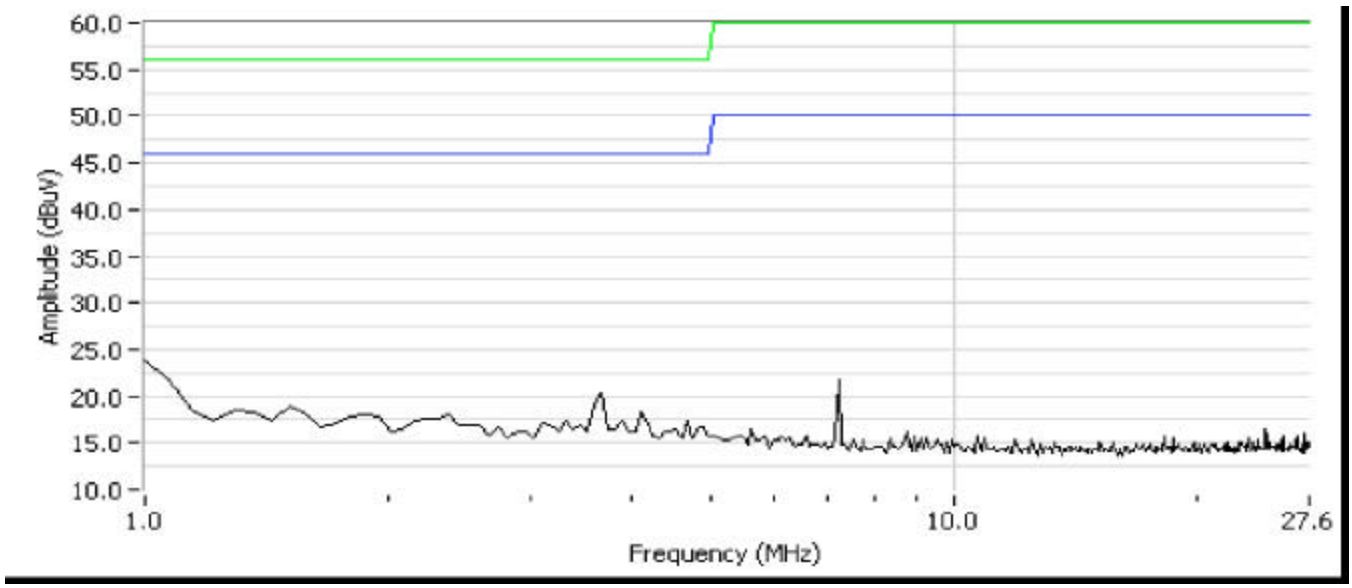


Test Results:
The AC Line conducted Emissions test results, relative to the EN55022 B limits, are shown below. None of the peak readings below were within 6 dB of the average limit therefore no measurements were Quasi-peaked.

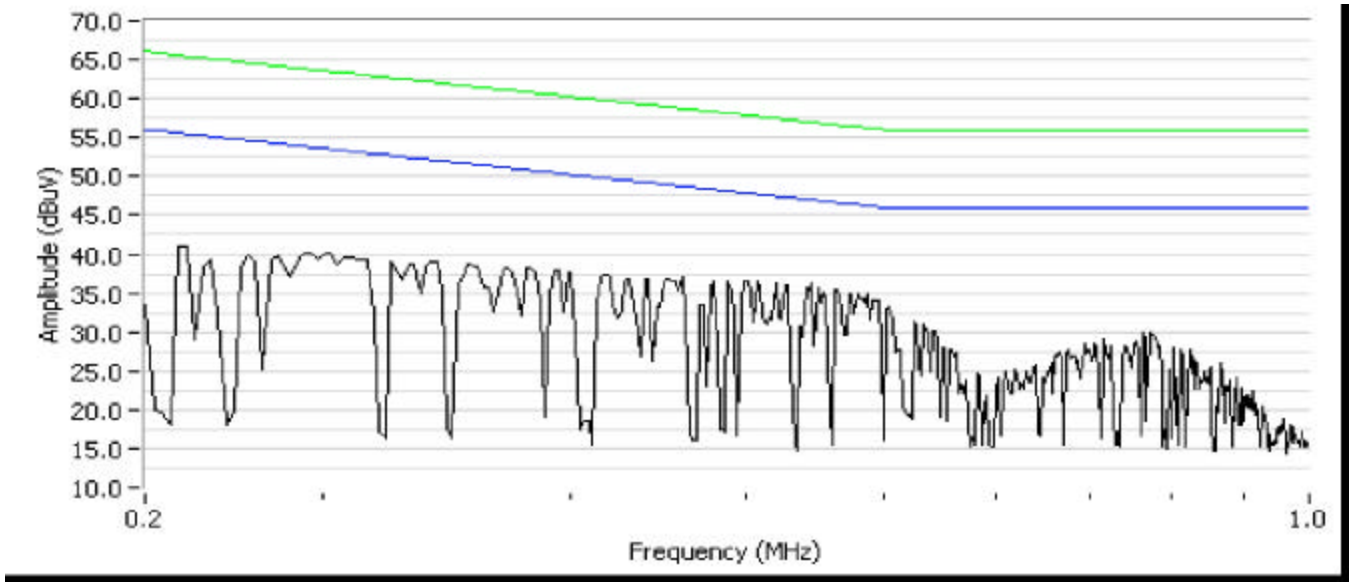
	Level	AC	EN55022 B		Detector
MHz	dBmV	Line	Limit	Margin	QP/Ave
0.483	34.5	Line	46.3	-11.8	Peak
0.254	38.9	Neutral	51.6	-12.8	Peak
0.161	40.9	Neutral	55.4	-14.5	Peak
0.158	40.0	Line	55.5	-15.5	Peak
1.000	23.9	Line	46.0	-22.2	Peak
3.603	21.7	Neutral	46.0	-24.3	Peak
3.676	20.3	Line	46.0	-25.7	Peak
7.219	21.7	Line	50.0	-28.3	Peak
7.219	21.3	Neutral	50.0	-28.7	Peak

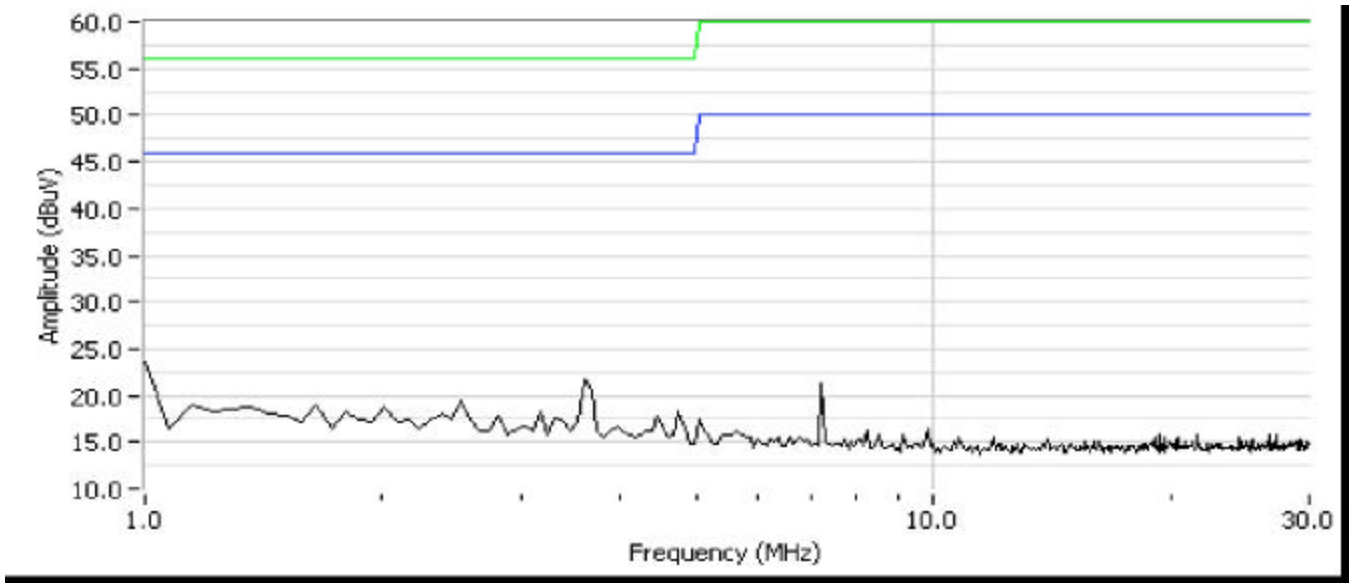
AC Line conducted emissions, Vocera single bay charger. 120 VAC, Line.





AC Line conducted emissions, Vocera single bay charger. 120 VAC, Neutral.





20600 Lazaneo Drive
3rd Floor
Cupertino, CA 95014
www.vocera.com

FCC Part 15.247 Certification Application

APPENDIX

Free Space Calculation

The calculation to reference the received signal level back to the unit under test at a distance of three meters is shown below.

$$E = \frac{\sqrt{(30*P*G)}}{d}$$

Where:
E is the radiated field strength in V/m;
P is the power transmitted in Watts;
G is the gain of the transmit antenna;
d is the distance from the transmitter at which field strength E was recorded
Rearranging gives:

$$P = \frac{E^2*d^2}{30*G}$$

Converting to logarithmic units gives:

$$P\ dB(W) = E\ dB(V/m) + 20\log10\ (d) - 10\log10(30) - 10\log10(G).$$

For the purposes of calculating the EIRP of the unit under test is assumed. This means that the gain of the antenna is essentially included in E, the radiated field

$$P\ dB(W) = E\ dB(V/m) + 20\log10\ (d) - 10\log10(30)$$

Converting to dBm from dB(W)and converting to dB(µV/m) from dB(V/m) (subtract 120) giving:

$$P\ dBm - 30 = E\ dB(\mu V/m) - 120 + 20\log10\ (d) - 10\log10(30)$$

$$P\ dBm - 30 = E\ dB(\mu V/m) -120 + 20\log10\ (d) - 14.77$$

Therefore, to reference a field strength measured at 3 meters back to an EIRP of the unit under test (UUT), the final calculation is:

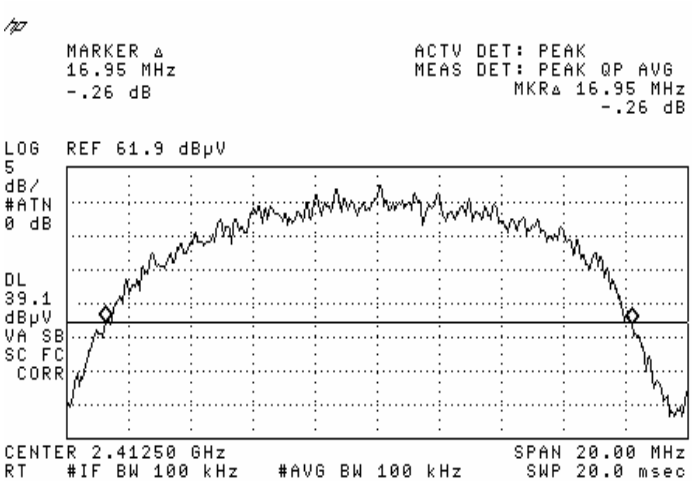
$$P\ dBm = E\ dB(\mu V/m) -120 + 9.5 - 14.77 +30$$

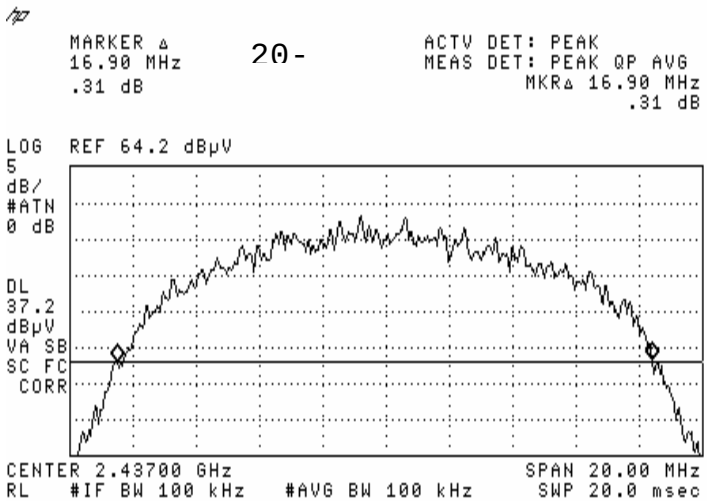
$$\mathbf{P\ dBm = E\ dB(\mu V/m) - 95.27}$$

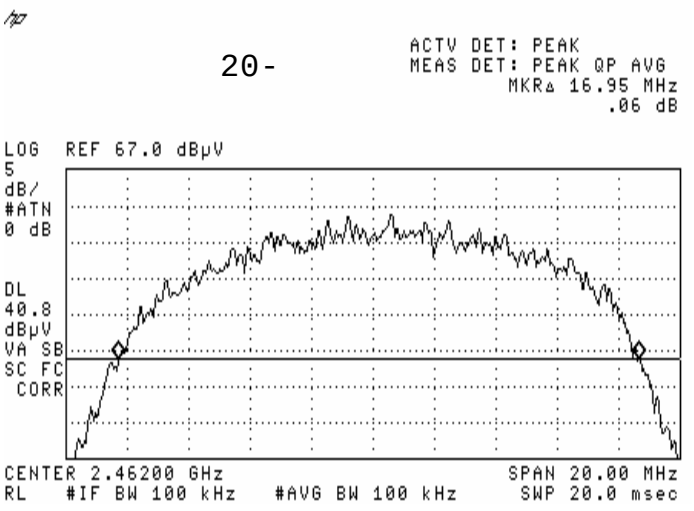
Measurement Bandwidth Correction

The received signal power was measured on the spectrum analyzer in a 3 MHz bandwidth. The 20 dB bandwidth of the signal was measured as shown below:

Channel 1: 16.95 MHz
Channel 6: 16.90 MHz
Channel 11: 16.95 MHz







The ratio of the 3 MHz resolution bandwidth and the desired measurement bandwidth (the 20 dB signal bandwidth) was calculation as shown below

3 MHz RBW correction factor = 10 * log10 (signal BW / 3 MHz RBW)
3 MHz RBW correction factor =
10 * log10 (16.9 MHz / 3 MHz RBW)
3 MHz RBW correction factor = 7.50 dB

Thus the measured received signal level was corrected by approx 7.5 dB then the 95.2 dBuV to dBm EIRP correction was applied to get back to the desired 16.5 dBm EIRP unit under test transmit level.