

TEST REPORT

for the

Apple Bluetooth Module

Model # A1114

Apple Computer, Inc.

January 24, 2005

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1 Test Report Summary

Specification	Test or Requirement	Result	Comment
N/A – For reporting purposes only	20 dB Bandwidth	N/A	Section 7.1
CFR 15.247(a)(1)	Hopping Frequency Separation	Pass	Section 7.2
CFR 15.247(a)(1)(iii)	Numer of Hopping Channels	Pass	Section 7.3
CFR 15.247(b)(1)(iii)	Average Time of Occupancy	Pass	Section 7.4
CFR 15.247(b)(1) CFR 15.247(b)(4)	Peak Output Power	Pass	Section 7.5
N/A – For reporting purposes only	Average Power	N/A	Section 7.6
CFR 15.247(d) CFR 15.247(f)	Peak Power Spectral Density	Pass	Section 7.7
CFR 15.247(c)	Conducted Spurious Emissions	Pass	Section 7.8
CFR 15.205(a) CFR 15.209(a)	Radiated Emissions	Pass	Section 7.9
CFR 15.207(a)	AC Power Line Conducted Emissions	Pass	Section 7.10

2 EUT Description

The Apple Bluetooth Module, model number A1114, operates in the 2.4 GHz unlicensed Industrial, Scientific and Medical band and uses Frequency Hopping Spread Spectrum. This device uses a single chip radio and baseband IC. Technical Information on the Apple Bluetooth Module is provided in the table below.

Apple Bluetooth Module Information	
Product	Tranceiver
Trade Name	Apple Bluetooth Module
Model Number	A1114
Power Supply	3.3V DC Power Supply
Frequency Range	2402-2480 MHz
Transmit Power	5.5 mWatt
Modulation Technique	FHSS
Emission Designator	880KF1D

Apple Bluetooth Module Antenna Information

Antenna Model Number	Maximum Gain (dBi)
603-2672	-3.1
603-1203	-5.3
613-4689	-4.3

3 Test Methodology

The tests documented in this report were performed in accordance with ANSI C63.4 and FCC CFR 47 Part 2 and Part 15.

4 Facilities and Accreditation

4.1 Facilities and Equipment

The ac power line and RF conducted emissions measurements were performed at the Apple Computer, Inc. facility located at 20650 Valley Green Drive, Cupertino, California 95014. The radiated emissions measurements were performed at the Apple Computer, Inc. Evelyn 1, 10 meter semi-anechoic chamber located at 123 East Evelyn Ave., Mountain View, California 94041. Both of these facilities are constructed in conformance with the requirements of ANSI C63.4 and CISPR Publication 22.

All Receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

4.2 Laboratory Accreditation

The test facilities at Apple Computer, Inc. used to perform radiated and conducted emissions measurements are accredited by National Voluntary Laboratory Accreditation Program to perform Electromagnetic Interference tests according to FCC Part 15 and CISPR 22. Apple Computer, Inc. NVLAP Lab Code is 200071-0 and is effective through September 30, 2005. No part of this report may be used to claim or endorsement by NVLAP or any agency of the US Government.

The Apple Computer, Inc Evelyn 1 10 meter Semi-anechoic chamber is currently listed with the FCC. The FCC Registration Number is 90450 and is effective through Jan 5, 2007.

5 Calibration and Uncertainty

5.1 Measurement Instrument Calibration

The measurement instruments utilized to perform the tests documented in this report have been calibrated in accordance with the manufacturer's recommendations and are traceable to national standards.

5.2 Measurement Uncertainty

The Apple measurement uncertainty policy, available upon request under Apple File Number EMC20, ensures uncertainty has been calculated using the proper procedure. Apple will use this measurement uncertainty knowledge in determining the pass / fail criteria from the test data. The measurement uncertainty has been determined to be the following:

Conducted Emissions = +/- 2.3 dB

Radiated Emissions = +/- 4.1 dB

5.3 Test Equipment

The following test equipment was used.

Description	Manufacturer	Model No.	Identification No.	Last Cal	Next Cal
Spectrum Analyzer	R&S	ESIB 40	100105	Oct 2004	Oct 2005
Spectrum Analyzer	R&S	ESCI	1166.5950.03	July 2004	July 2005
Spectrum Analyzer	HP	4403B	MY41140805	May 2003	May 2005
Receiver	R & S	ESCS 30	1102.4500.30	Jan 2004	Jan 2005
Antenna	Sunol	JB1	A122302-1	Dec 2003	Dec 2004
Antenna	Sunol	JB1	A122302-2	Dec 2003	Dec 2004
Amplifier	Amplifier Research	AR	Amp 16	Nov 2003	Nov 2004
Amplifier	Amplifier Research	AR	Amp 17	Nov 2003	Nov 2004
Amplifier	HP	8449	3008A00713	March, 2004	March 2005
Horn Antenna	EMCO	3117	34197	March 2004	March 2009
Horn Antenna	EMCO	3160-09	011269-0041264	Sept 2001	Sept 2006
Power Meter	Boonton	4532	165201	May 2004	May 2005
Power Meter Sensor	Boonton	57318	3890	May 2004	May 2005

6 Setup of Equipment Under Test

EUT Support Equipment

Peripheral Support Equipment				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop Computer	Apple	A1054	PT342059	DoC
Bluetooth USB Adapter	Apple	PCX0149	31	N/A
USB Printer	Epson	Stylus C62	EJSY153329	DoC
17" Studio Display	Apple	M6496	Cy9171NTCV2	DoC
20 GB iPod	Apple	A1059	JQ436JMXP59	DoC
Headphones	Emerson	Emerson	N/A	N/A
Laptop AC adapter	Apple	M8482	ADP-U45H	DoC

EUT I/O Cables

I/O Cable List				
Port	Manufacturer	Shielded?	Ferrite?	Length
AC Power	Apple	No	No	1.8 meters
USB Printer	Copartner	Yes	No	1.5 meters
Modem	Apple	No	No	1.5 meters
Ethernet	CMG	Yes	No	2.2 meters
Audio	Emerson	No	No	1 meter
Bluetooth USB Adapter	Haurtain	Yes	No	1 meter
Firewire	Apple	Yes	No	1 meter
VGA	Apple	Yes	Yes	1.5 meters

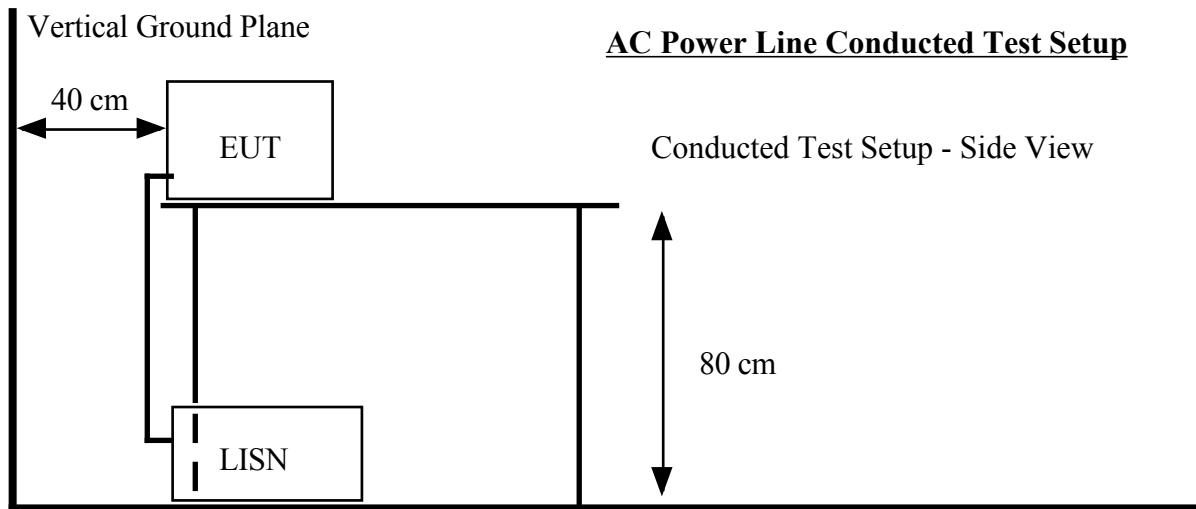
EUT Operating Conditions

All of the equipment and cables were placed in the worst-case configuration to maximize the emissions during the tests. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

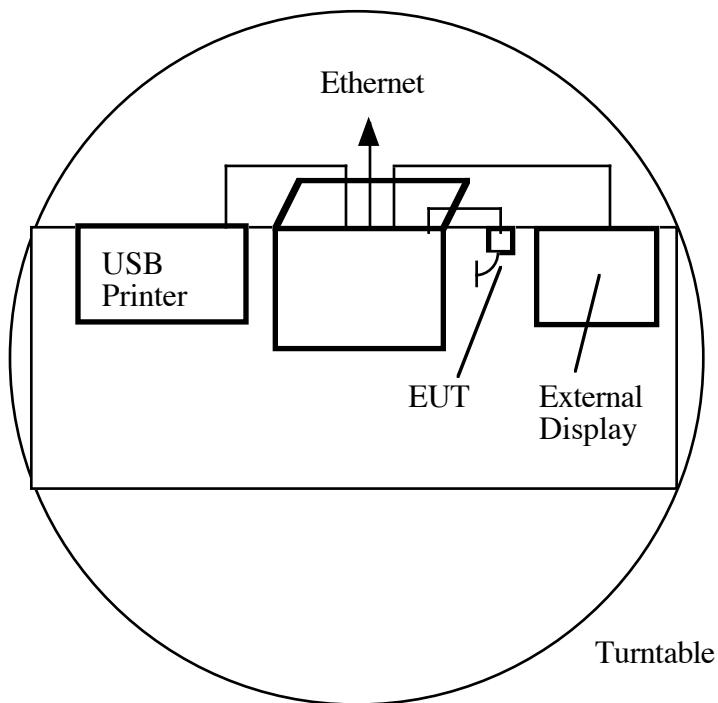
For scans below 1 GHz, the EUT transceiver and all the host system I/O ports were filled. The EUT was activated by using special test software which put the EUT into a continuous transmit mode. Each of the low, mid and high channels was activate at full power and the EUT continuously transmitted at the active channel.

Test Setup Block Diagrams

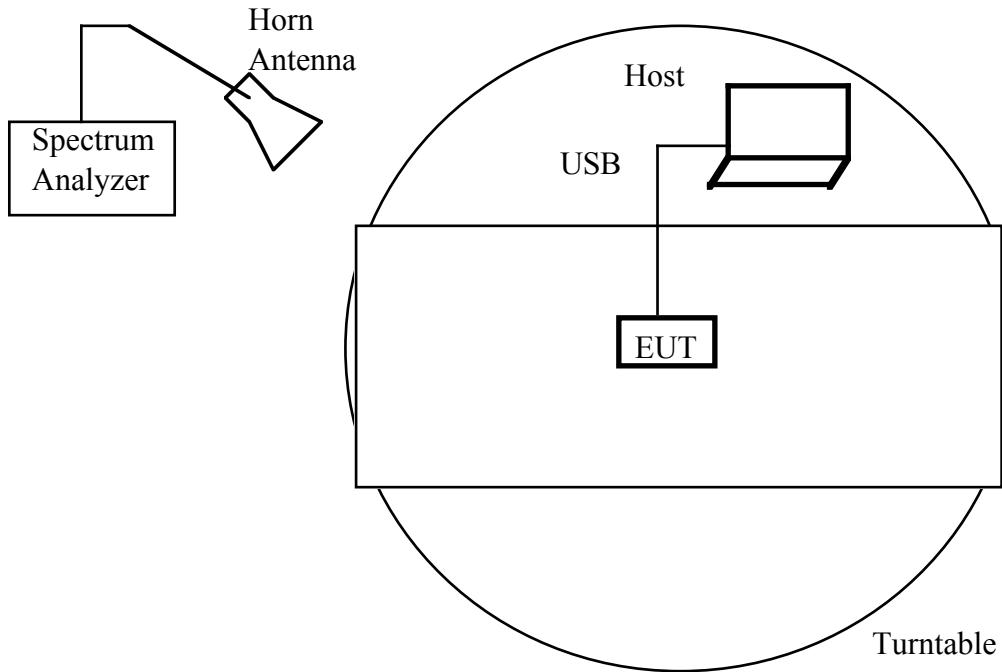
For AC Power Line conducted and RF Radiated Emissions, the EUT was placed on a nonmetallic table, 80 cm above the metallic ground-plane. The EUT and peripherals were powered from a filtered ac mains supply. Since the EUT power comes from the USB connection to the host, ac power line emissions were measured from the host computer.



RF Radiated Emissions Test Setup Below 1 GHz



RF Radiated Emissions Test Setup Above 1 GHz



7 Applicable Limits and Test Results

7.1 20 dB Bandwidth

Limit

None; for reporting purposes only

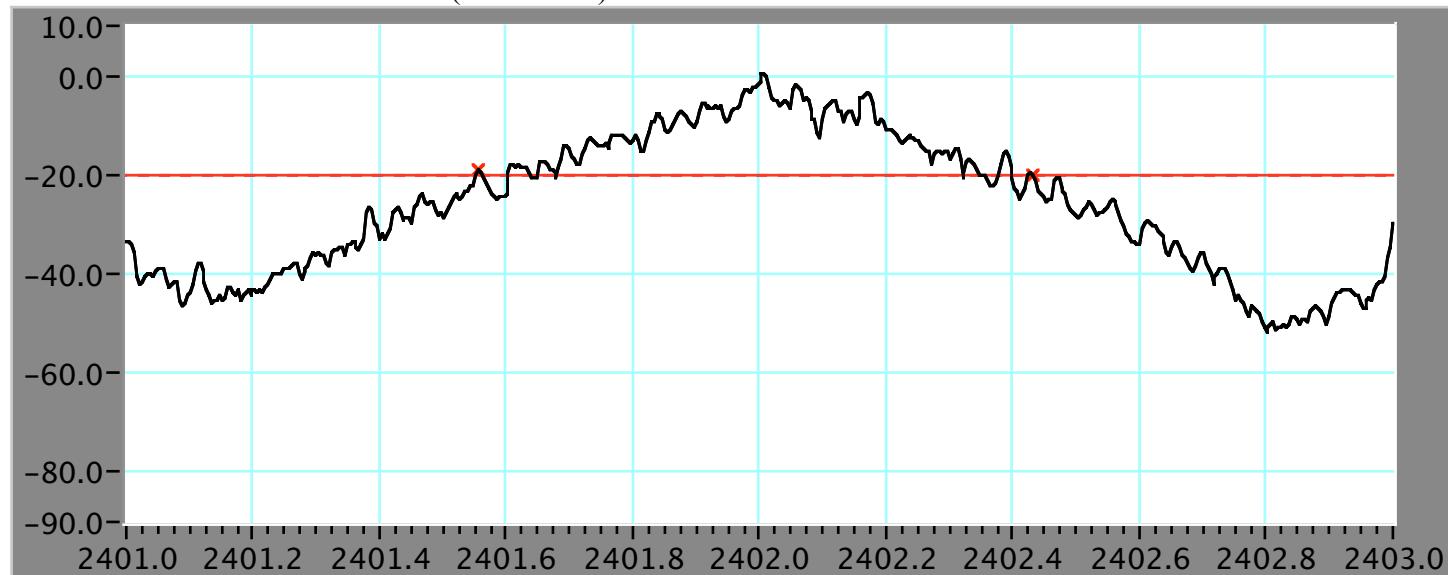
Test Procedure

The transmitter is connected to a spectrum analyzer and set to continuously transmit. The resolution Bandwidth is set to 10 kHz and the Video Bandwidth is set to 10 kHz.

Results

Channel	Frequency - (MHz)	20 dB Bandwidth (kHz)
Low	2402	870
Mid	2441	880
High	2480	870

20 dB Bandwidth – Low Channel (2402 MHz)



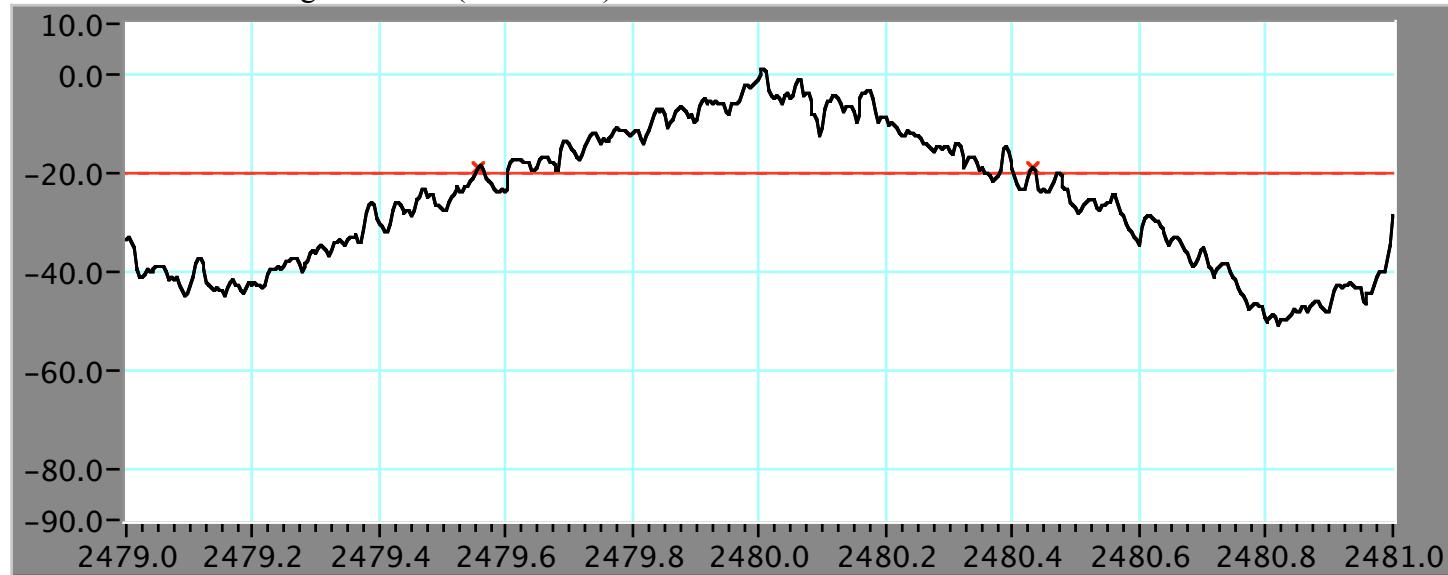
Channel	Frequency (MHz)	Marker 1 (MHz)	Marker 2 (MHz)	20 dB Bandwidth (kHz)
1	2402	2401.56	2402.43	870 kHz

20 dB Bandwidth – Mid Channel (2441 MHz)



Channel	Frequency (MHz)	Marker 1 (MHz)	Marker 2 (MHz)	20 dB Bandwidth (kHz)
40	2441	2440.55	2441.43	880 kHz

20 dB Bandwidth – High Channel (2480 MHz)



Channel	Frequency (MHz)	Marker 1 (MHz)	Marker 2 (MHz)	20 dB Bandwidth (kHz)
79	2480	2479.56	2480.43	870 kHz

Date of Test: November 22, 2004

7.2 Hopping Frequency Separation

Limit

Frequency Hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB Bandwidth of the hopping channel, whichever is greater, CFR 15.247(a)(1).

Test Procedure

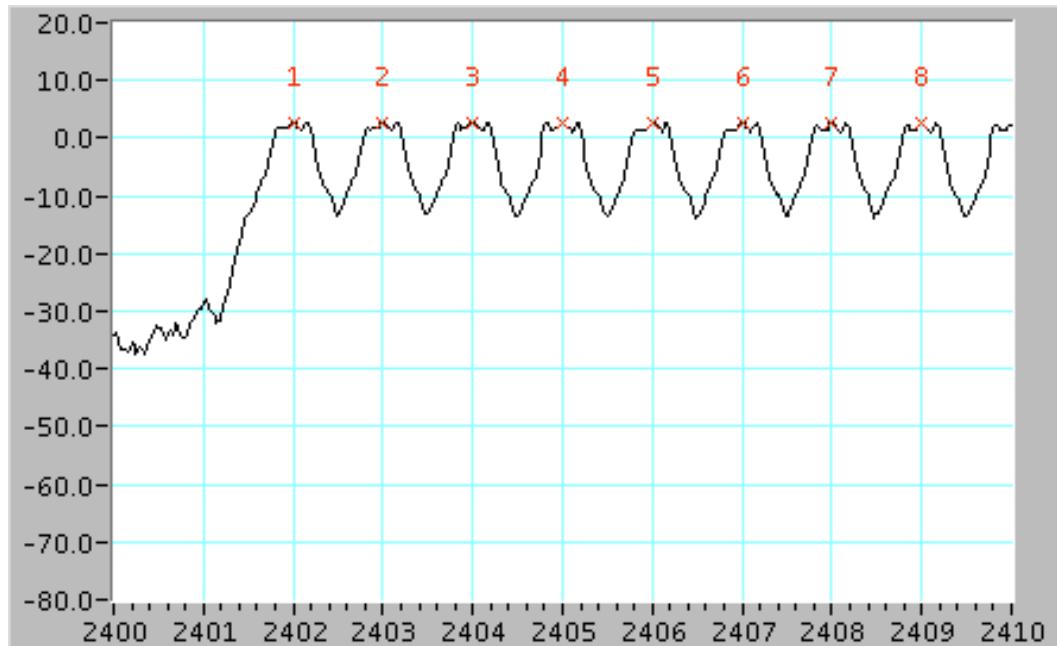
The Apple Blutooth module was placed in continuous transmit mode while hopping over all 79 channels. The transmitter output is connected to a spectrum analyzer RF input. The bandwidth of the spectrum analyzer is set to 100 kHz.

Test Results

No non-compliance was found.

Hopping Frequency Separation Instrument Settings:

Reference Level	Attenuation	Resolution BW	Video Bandwidth	Span	Sweep Time
10 dBm	10 dB	100 kHz	100 kHz	10 MHz	200 Seconds



Date of Test: January 17, 2005

7.3 Number of Hopping Channels

Limit

15.247(a)(1)(iii) Frequency Hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Procedure

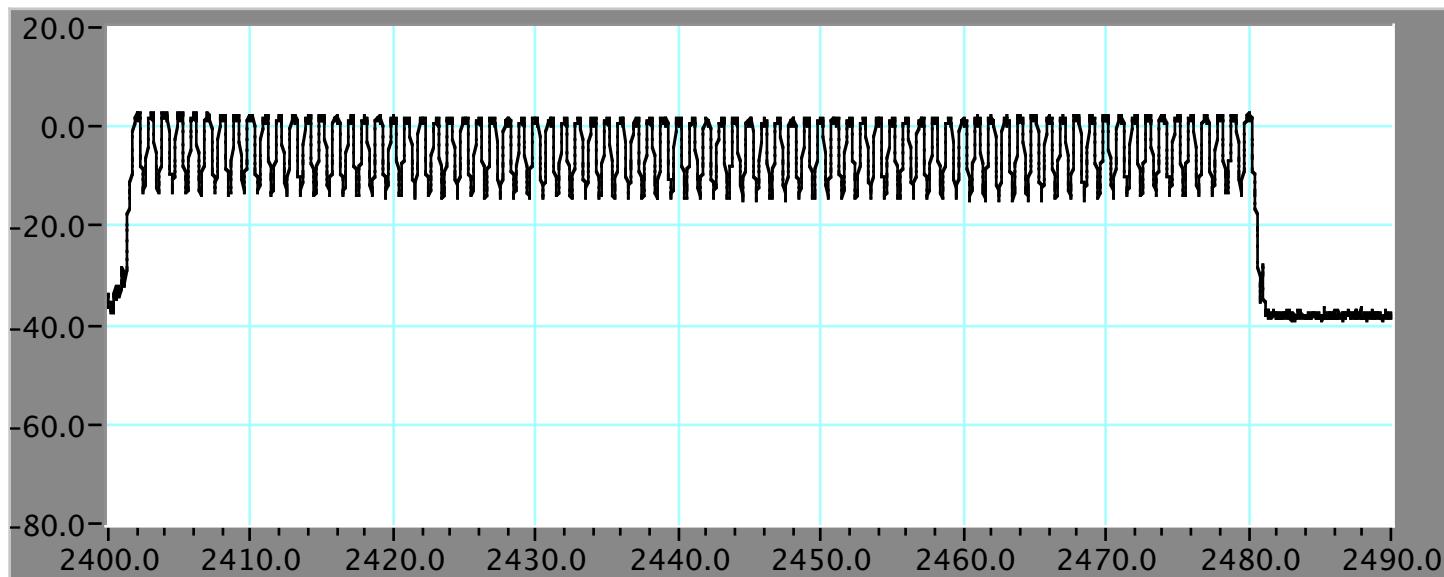
The Apple Blutooth module was placed in continuous transmit mode while hopping over all 79 channels. The transmitter output is connected to a spectrum analyzer RF input. A total of 9 adjacent spans (10 MHz Spans each) were measured from 2400 to 2490. These scans were combined into a single graph to reveal a total of 79 channels.

Test Results

79 Hopping Channels were observed. No non-compliance was found.

Number of Hopping Channels - Instrument Settings:

Reference Level	Attenuation	Resolution BW	Video Bandwidth	Span	Sweep Time
20 dBm	50 dB	100 kHz	100 kHz	10 MHz	200 Seconds



Date of Test: January 17, 2004

7.4 Average Time of Occupancy

Limit

15.247(a)(1)(iii) Frequency Hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test Procedure

The Apple Blutooth module was placed in continuous transmit mode while hopping over all 79 channels. The transmitter output is connected to a spectrum analyzer RF input. The width of a single channel is measured in a fast scan of 1 mS sweep time. The number of pulses in a 3.16 second period are counted and multiplied by 10.

The average occupancy time in the specified 31.6 second period (79 channels x 0.4 S = 31.6) is equal to

$10 \times (\text{number of pulses in 3.16 s}) \times \text{pulse width.}$

Test Results

No non-compliance was found.

Reference Level	Attenuation	Resolution BW	Video Bandwidth	Span	Sweep Time
20 dBm	50 dB	1 MHz	1 MHz	0 Hz	0.001 Seconds or 3.16 Seconds

Average Time of Occupancy - Instrument Settings:

Pulse Width (DH1) = 418 uS

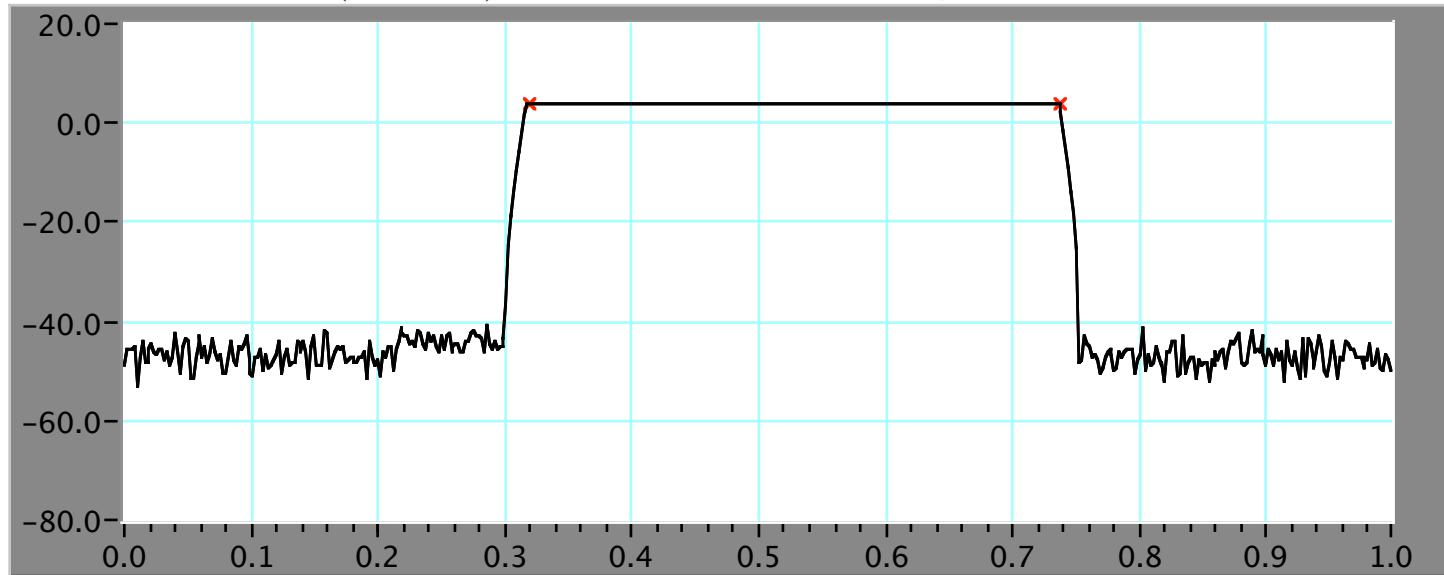
Number of Pulses in 3.16 Seconds = 32

Number of Pulses in 31.6 Seconds = 320

Average Time of occupancy = $320 \times 418 \text{ uS} = 134 \text{ mS}$

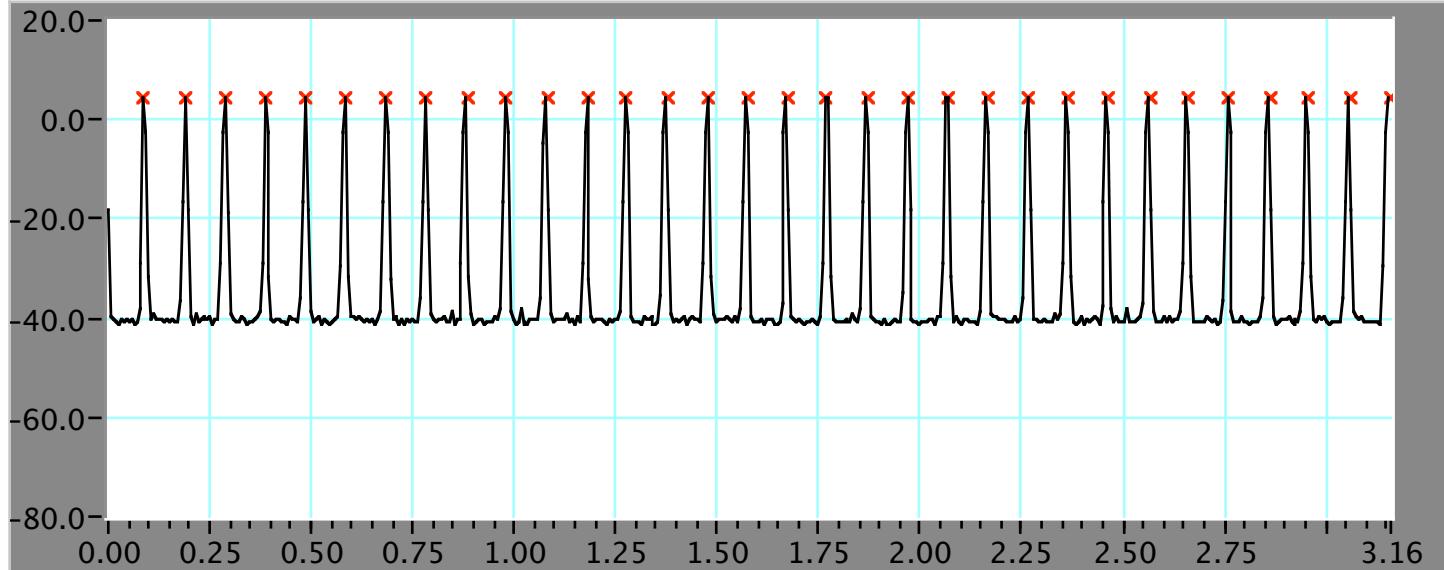
Average Time of Occupancy (Seconds)	Limit (Seconds)	Margin (Seconds)
0.134	0.4	0.266

Pulse Width – Channel 1 (2402 MHz) Horizontal scale set to 1 mSecond, Pulse Width = 738-320 = 418 uS



Channel	Frequency (MHz)	Marker 1 (microSeconds)	Marker 2 (microSeconds)	Pulse Width (microSeconds)
1	2402	320	738	418

Number of Pulses on Channel 1 (2402 MHz) with a 0 Hz Span. Horizontal Scale set to 3.16 Seconds. The Number of Pulses observed in a 3.16 Second period = 32



Date of Test: November 24, 2004

7.5 Maximum Peak Output Power

Limit

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

15.247 (b) (1) For frequency hopping systems operating in the 2400 – 2483.5 MHz band employing at least 75 hopping channels: 1 watt.

15.247 (b) (4) Except as shown in paragraph (b)(3)(i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum gain for the Apple Bluetooth module is –3.1 dBi therefore the limit is 30 dBm.

Test Setup

The transmitter is connected to a peak power meter and set to continuously transmit..

Maximum Peak Output Power Test Results

No non-compliance were found.

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	4.89	30	-25.11
Mid	2441	5.28	30	-24.72
High	2480	5.4	30	-24.6

Date of Test: November 11, 2004

7.6 Average Power

Average Power Limit

None; for reporting purposes only

Test Procedure

The transmitter is connected to an average power meter and set to transmit continuously.

Average Power Test Results

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	3.3
Mid	2441	3.7
High	2480	3.8

Date of Test: November 24, 2004

7.7 Peak Power Spectral Density

Limit

15.247 (d) For direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

15.247 (f) The digital modulation operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this section.

Test Procedure

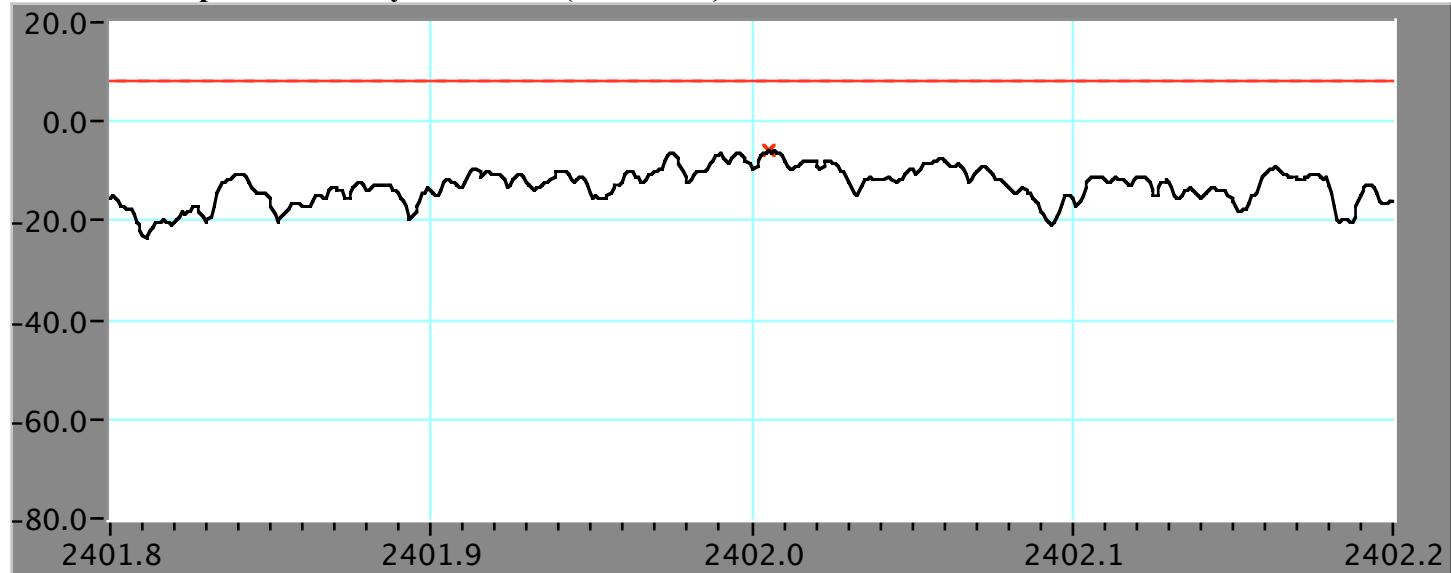
The transmitter is connected to a spectrum analyzer. The maximum level in a 3 kHz bandwidth is measured with the spectrum analyzer using RBW = 3 kHz and VBW = 10 kHz, sweep time = span / 3 kHz. A span of 400 kHz was used for the final measurement and the sweep time was 100 Seconds.

Peak Power Spectral Density Test Results

No non-compliance was found.

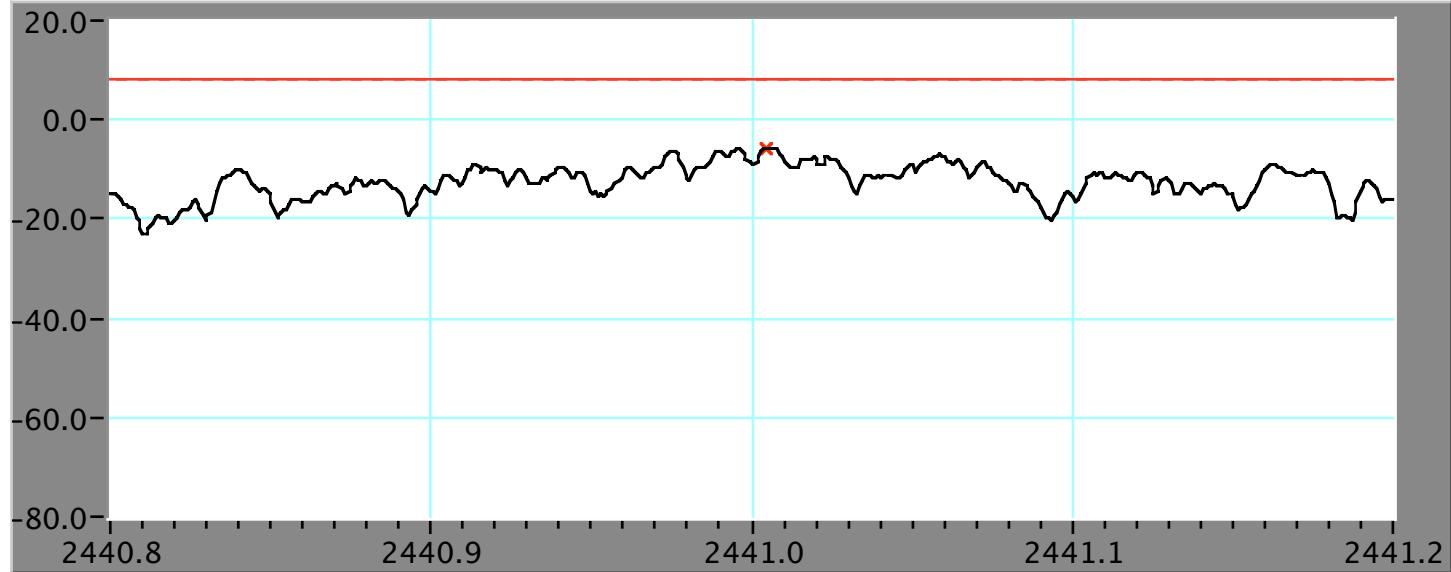
Channel	Frequency (MHz)	Peak Power Spectral Density (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-6	8	-14.0
Mid	2441	-5.7	8	-13.7
High	2480	-5.7	8	-13.7

Peak Power Spectral Density Channel 1 (2402 MHz)



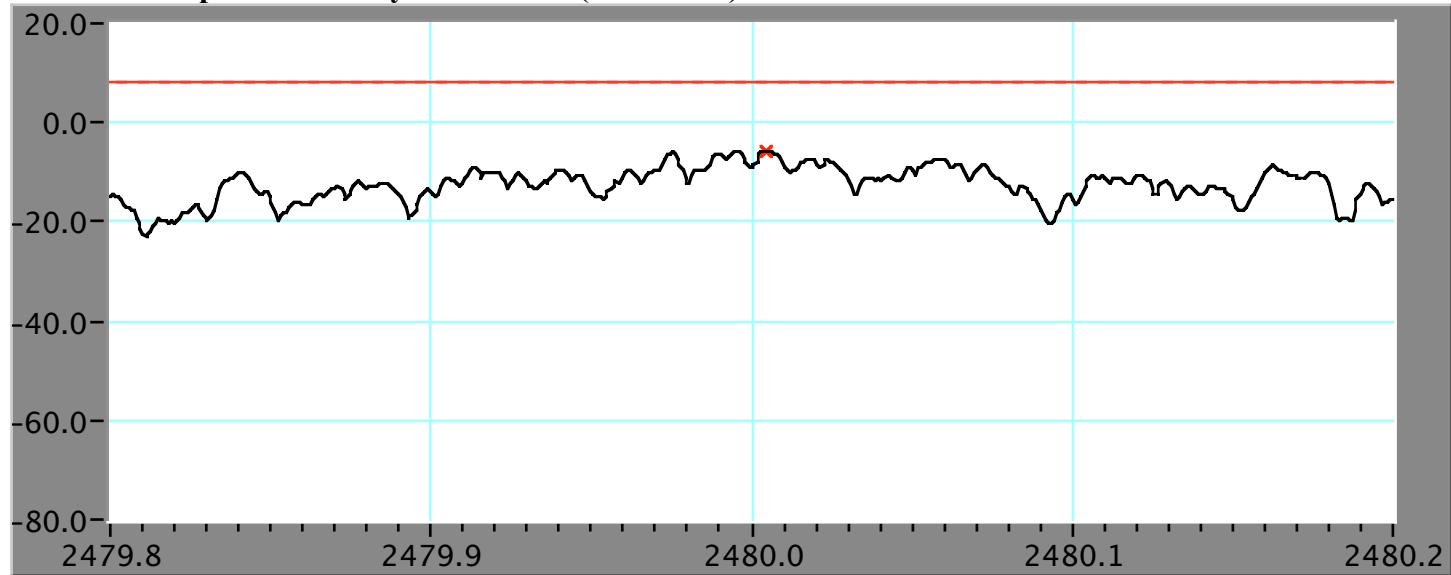
Date of Test: November 24, 2004

Peak Power Spectral Density Channel 40 (2441 MHz)



Date of Test: November 24, 2004

Peak Power Spectral Density Channel 79 (2480 MHz)



Date of Test: November 24, 2004

7.8 Conducted Spurious Emissions

Limit

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

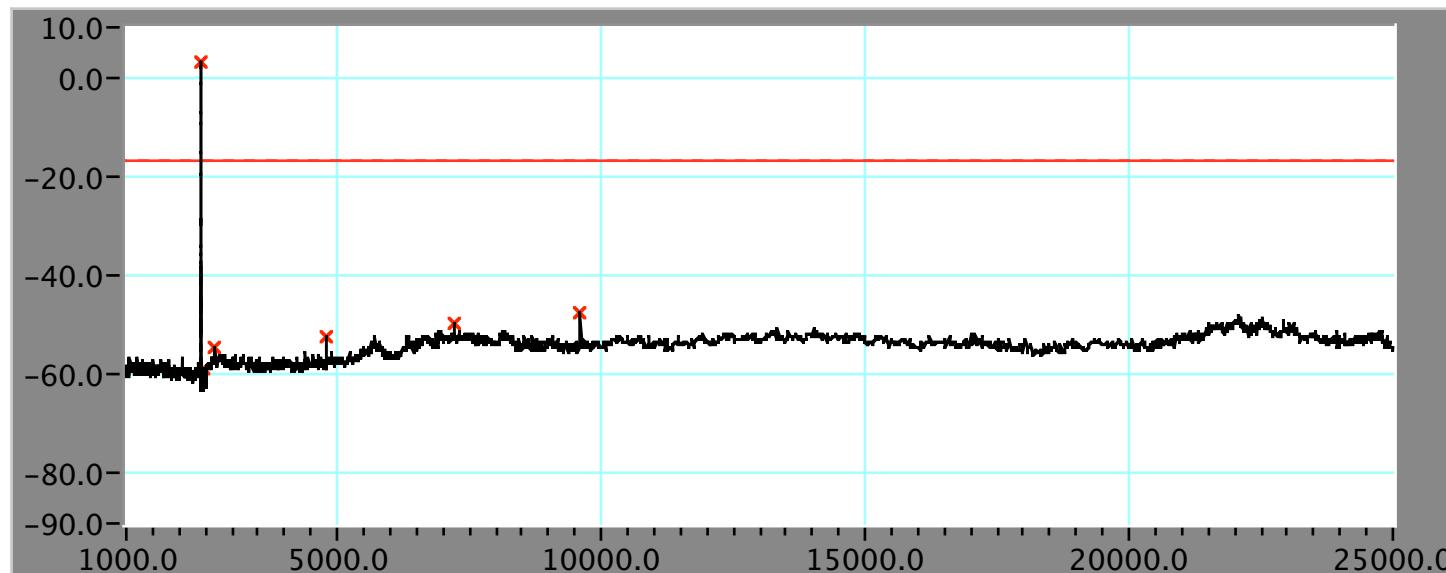
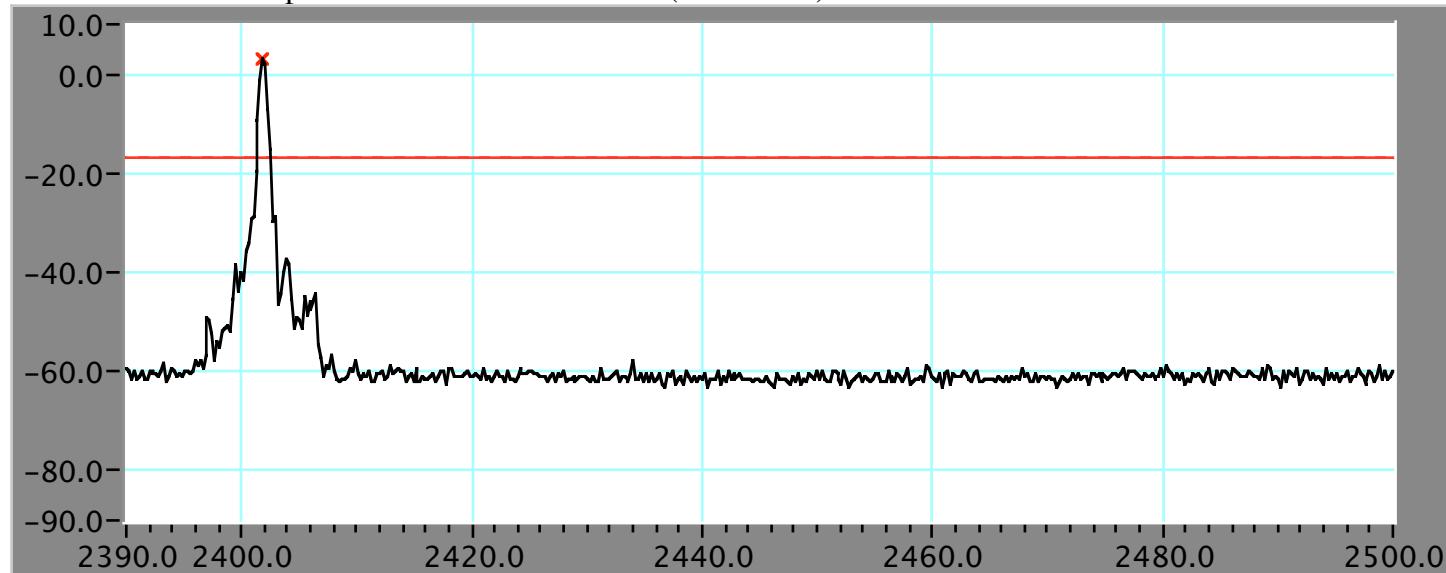
Test Procedure

The transmitter is set to continuously transmit using iperf as described in Section 6 and the transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The spectrum from 30 MHz to 25 GHz is investigated when transmitting on the low, mid and high channels for 802.11b and 802.11g mode.

Test Results

No non-compliance was found.

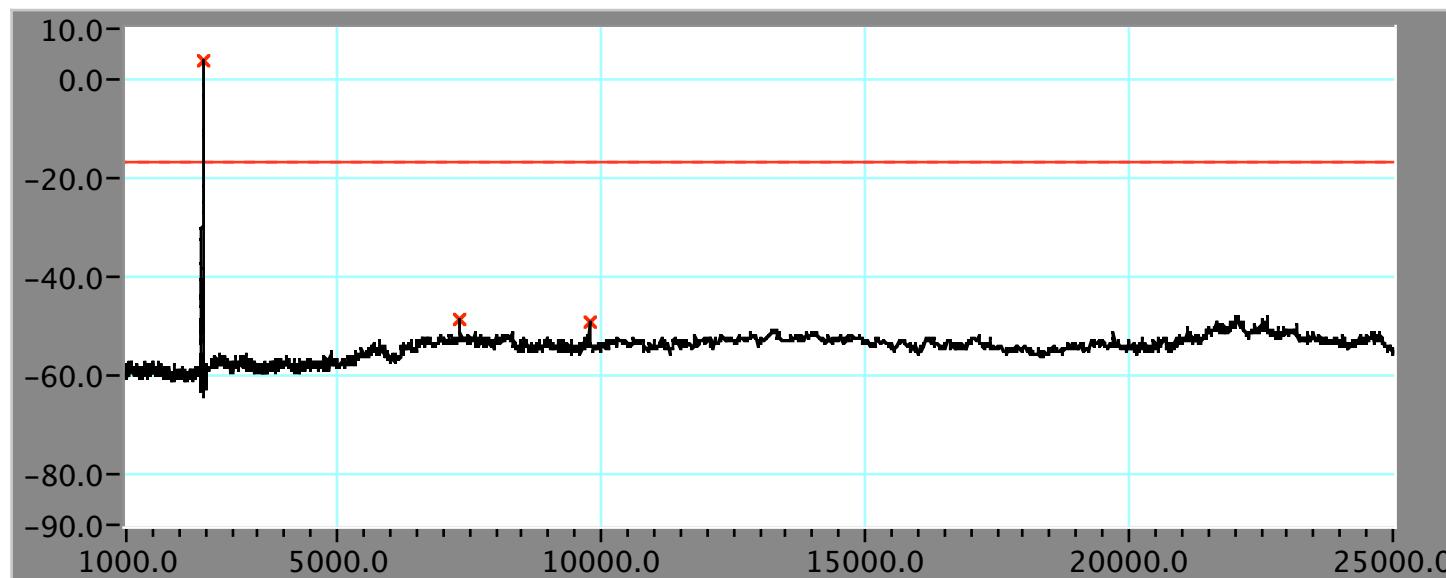
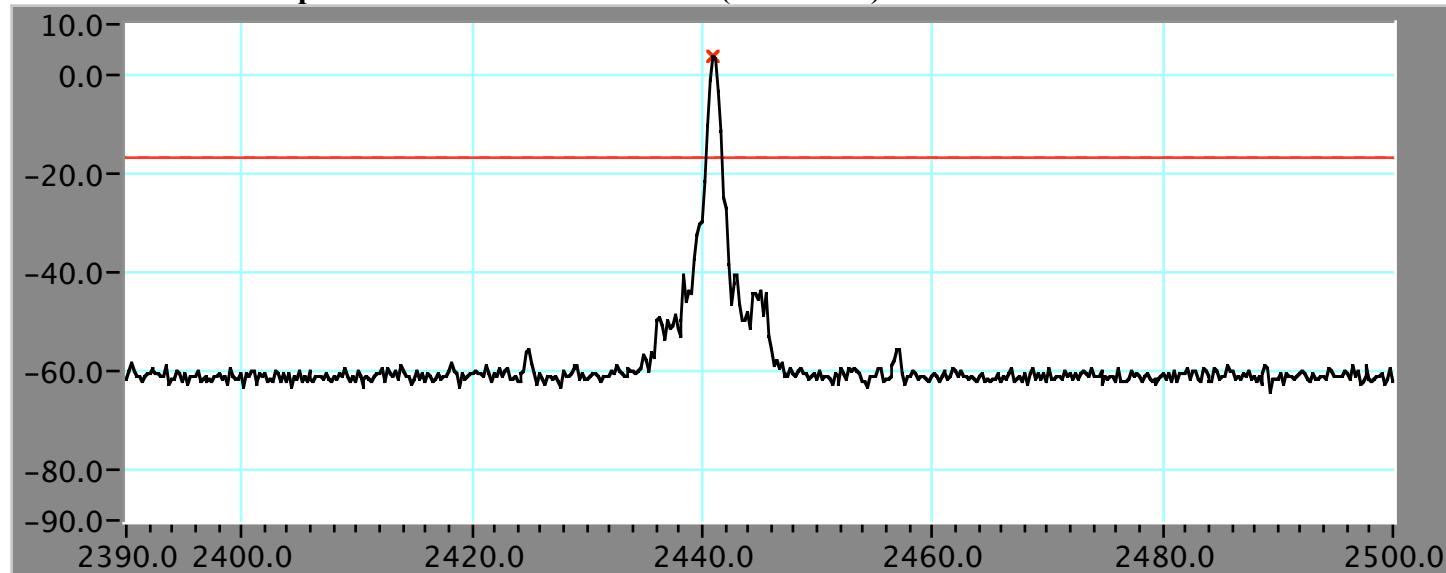
-20 dBc Conducted Spurious Emissions Channel 1 (2402 MHz)



Frequency - MHz	Level - dBm	Limit - dBm	Delta - dB
2402	3.1	3.1 dBm -20 = -16.9 dBm	N/A
2489.2	-58.9	-16.9	-42
2690.4	-54.7	-16.9	-37.8
4804.6	-52.5	-16.9	-35.6
7204.4	-49.8	-16.9	-32.9
9609.2	-47.3	-16.9	-30.4

Date of Test: Oct 28, 2004

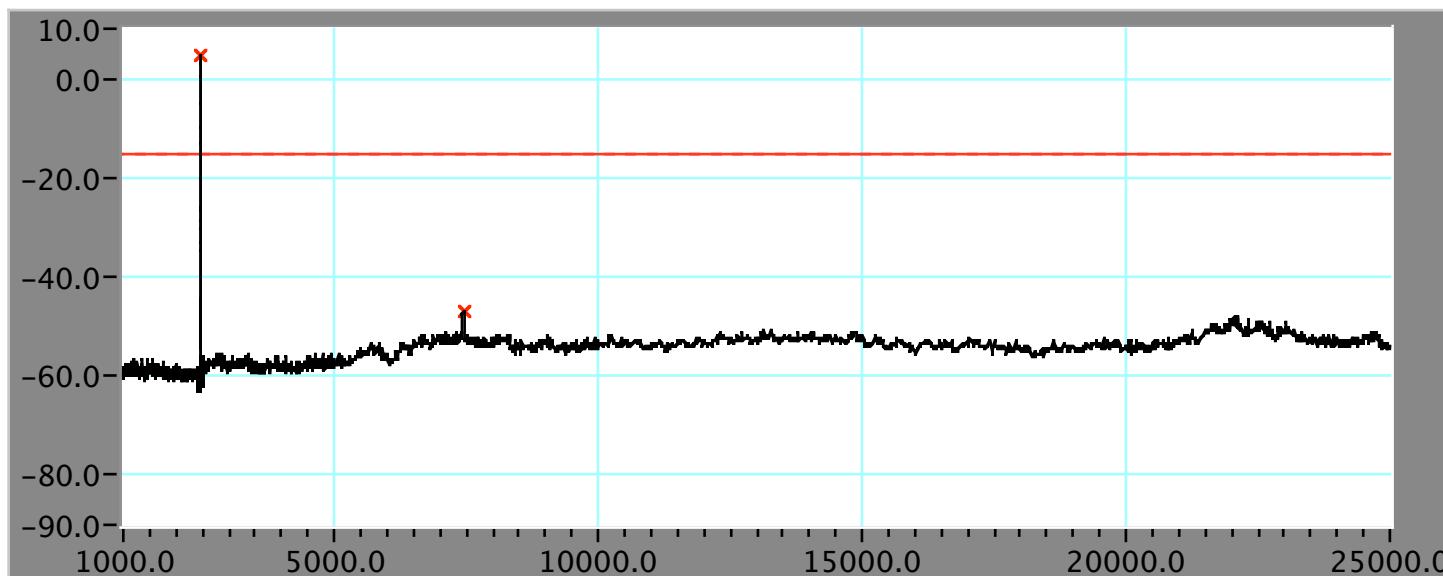
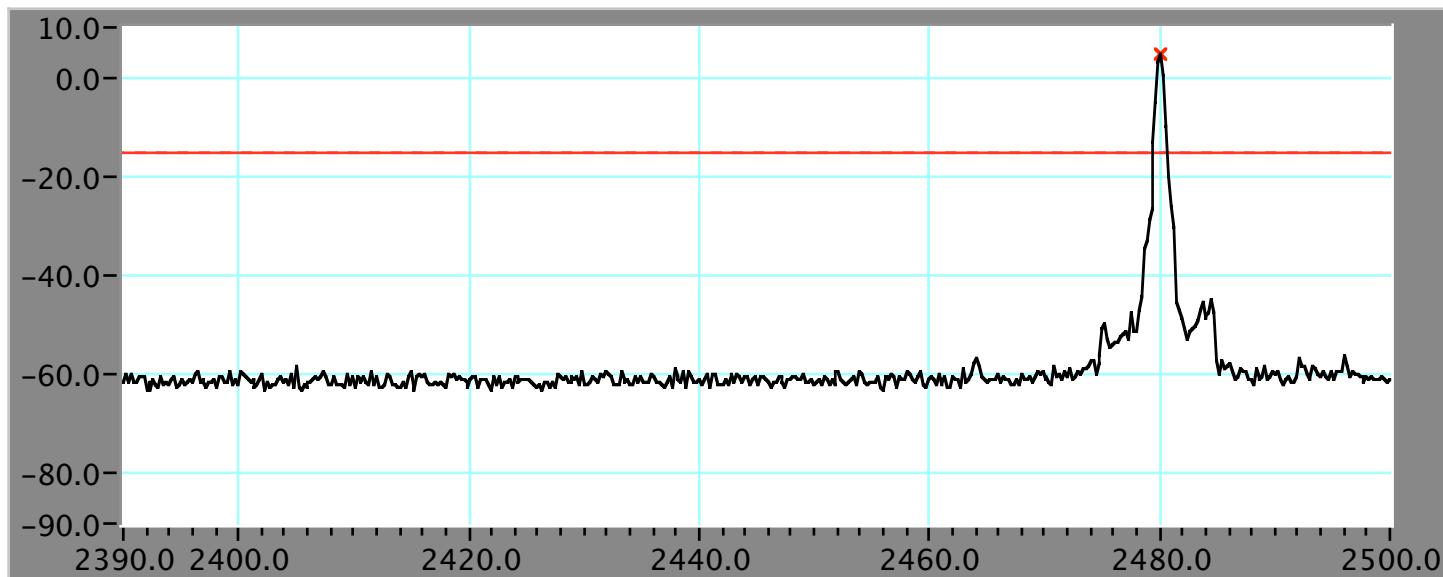
-20 dBc Conducted Spurious Emissions Channel 40 (2441 MHz)



Frequency - MHz	Level - dBm	Limit - dBm	Delta – dB
2441	3.5	3.5 dBm -20 = -16.5 dBm	N/A
7324.7	-48.8	-16.5	-32.2
9769.5	-49.2	-16.5	-32.7

Date of Test: Oct 28, 2004

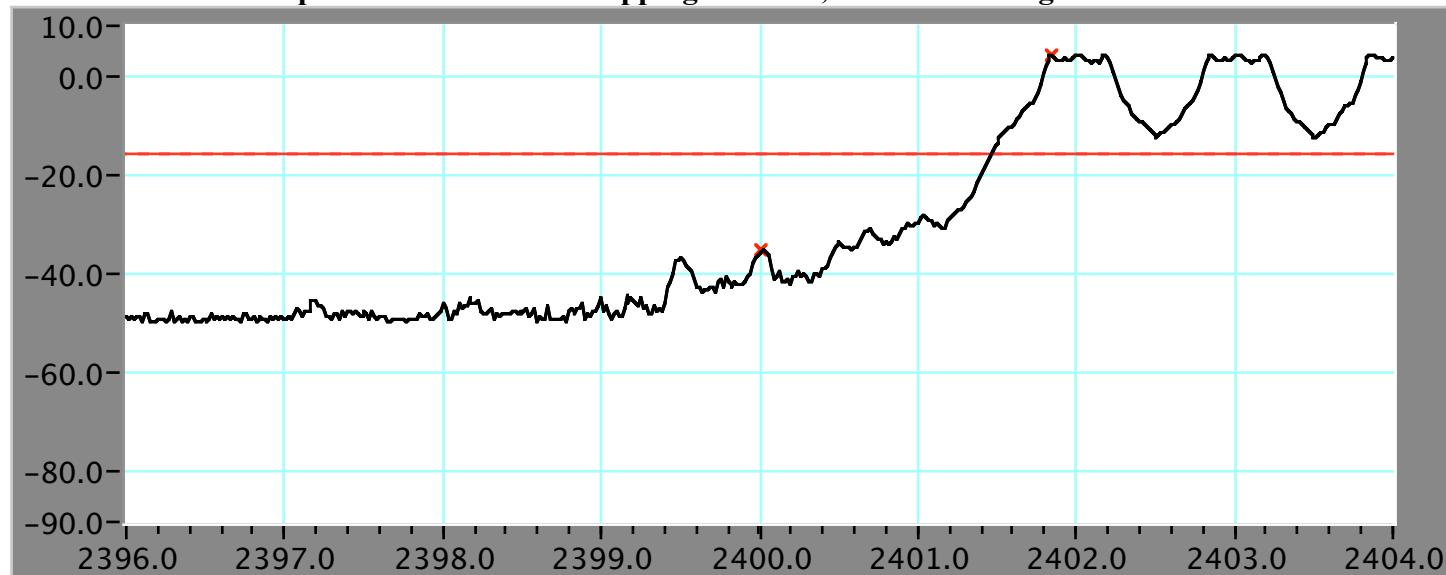
-20 dBc Conducted Spurious Emissions Channel 79 (2480 MHz)



Frequency - MHz	Level - dBm	Limit - dBm	Delta – dB
2480	4.6	4.6 dBm -20 = -15.4 dBm	N/A
7444.9	-47	-15.4	-31.6

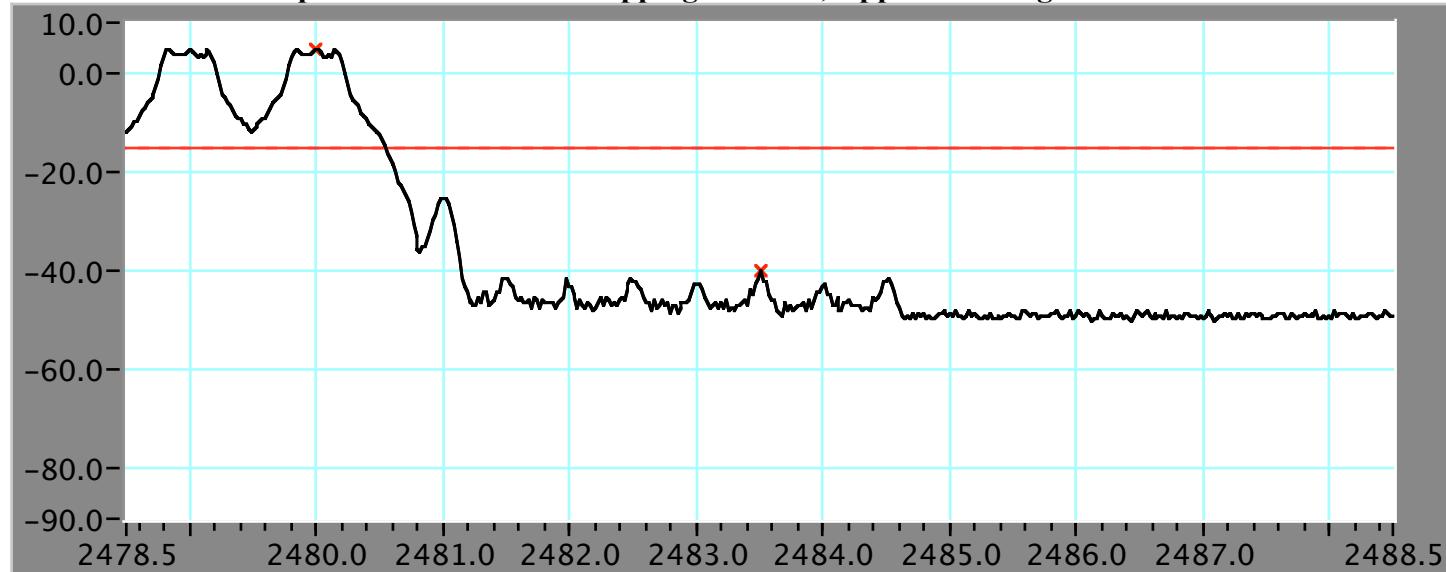
Date of Test: Oct 28, 2004

-20 dBc Conducted Spurious Emissions – Hopping Enabled, Lower Bandedge



Frequency - MHz	Level - dBm	Limit - dBm	Delta - dB
2400	-35	-15.9	-19.1
2402	4.1	4.1 dBm - 20 dBc = -15.9	N/A

-20 dBc Conducted Spurious Emissions – Hopping Enabled, Upper Bandedge



Frequency - MHz	Level - dBm	Limit - dBm	Delta - dB
2480	4.7	4.7 dBm - 20 dBc = -15.3	N/A
2402	-40	-15.3	-24.7

7.9 Radiated Emissions

7.9.1 Transmitter Radiated Spurious Emissions

Limits

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)
13.36 - 13.41			

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

Section 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

Section 15.209 (b) In the emission table above, the tighter limit applies at the band edges.

Test Procedure

Radiated Emission measurements were performed at the Apple Computer Evelyn 1, semi-anechoic chamber located at 123 East Evelyn Avenue, Mountain View, California. The EUT was placed on a nonmetallic table, 80 cm above the metallic ground-plane. The EUT and peripherals were powered from a filtered main supply.

The frequency spectrum from 30 MHz to 25 GHz was scanned and the emission levels maximized at each frequency. The antenna was varied in height and the system was rotated 360 degrees while scanning for maximum emission amplitudes. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

For Peak Detection measurements below 1 GHz, the RBW is set to 100 kHz and the VBW is set to 100 kHz. For Quasi-Peak detection measurements, 120 kHz bandwidths were used. Peak detection was used unless otherwise noted as Quasi-Peak. For peak measurements above 1 GHz, the RBW is set to 1 MHz and the VBW is set to 1 MHz. For Average measurements the RBW is set to 1 MHz and the VBW is set to 10 Hz. Radiated Emission measurements below 1 GHz were performed at an EUT to antenna distance of 3 meters and measurements above 1 GHz were performed at an EUT to antenna distance of 1 meter.

Radiated emissions measurements were performed with the transmitter set to continuously transmit using the low, mid and highest channel using maximum transmit power.

- low (channel 1) - 2.402 GHz
- mid (channel 40) - 2.441 GHz
- high (channel 80) - 2.480 GHz

Test Results

No non-compliance was found.

7.9.2 Transmitter Radiated Spurious Emissions above 1 GHz

Restricted Bands

The adjacent restricted bands at the lower and upper edges of the 2.4 GHz ISM band were scanned for the maximum radiated emissions with the transmitter set to continuously transmit at the corresponding lowest and highest channels.

The actual frequency range of the adjacent restricted bands is from 2310 MHz to 2390 MHz and from 2483.5 MHz to 2500 MHz. However, for testing purposes, the scanned range was extended to allow maximizing on the intentional transmitter emissions.

Restricted Bands Instrument Settings

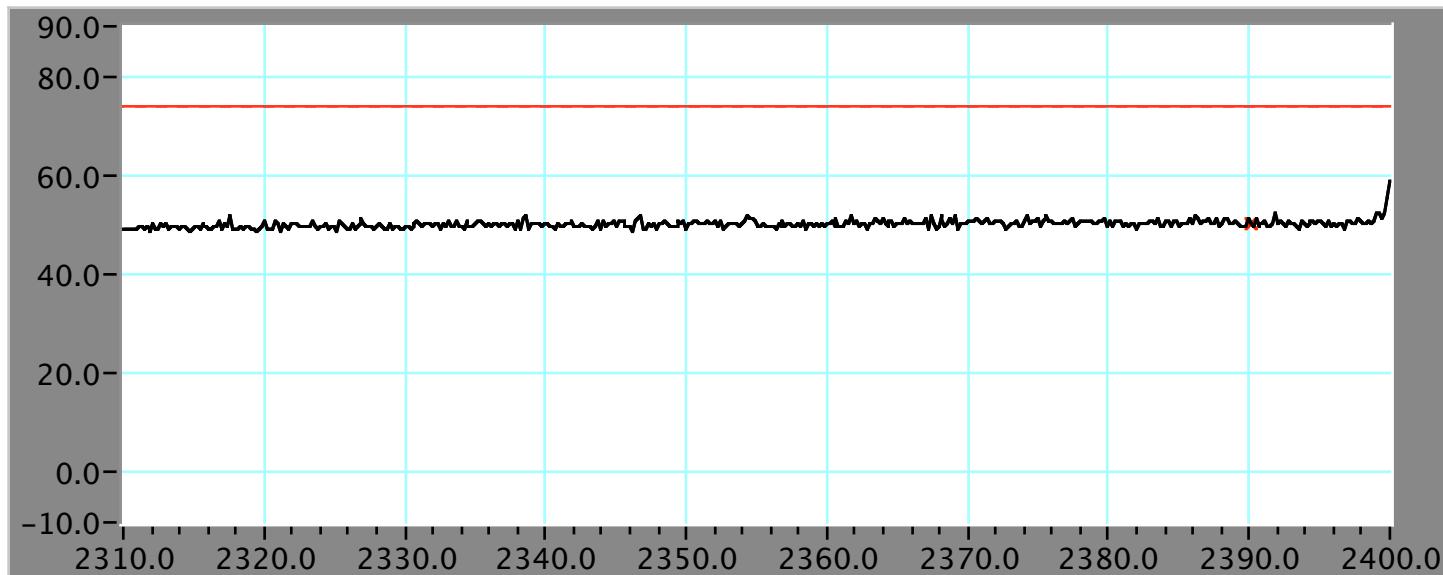
Peak Measurement Instrument Settings

Frequency Range	Reference Level	Attenuation	Resolution BW	Video BW	Sweep Rate
2310-2400 MHz	80 dBuV/m	10 dB	1 MHz	1 MHz	5 mS
2482-2500 MHz	80 dBuV/m	10 dB	1 MHz	1 MHz	5 mS

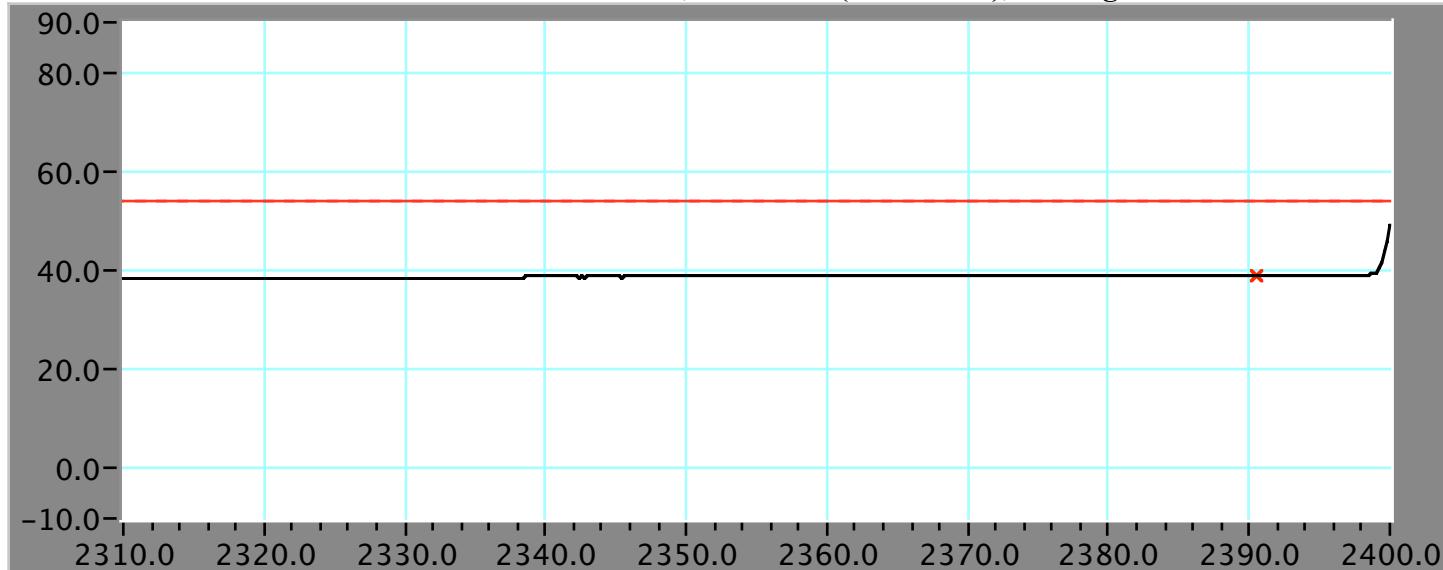
Average Measurement Instrument Settings

Frequency Range	Reference Level	Attenuation	Resolution BW	Video BW	Sweep Rate
2310-2400 MHz	80 dBuV/m	10 dB	1 MHz	10 Hz	22.5 Seconds
2482-2500 MHz	80 dBuV/m	10 dB	1 MHz	10 Hz	6.4 Seconds

2310 MHz - 2390 MHz Restricted Band - Vertical, channel 1 (2.402 GHz), Peak Detection



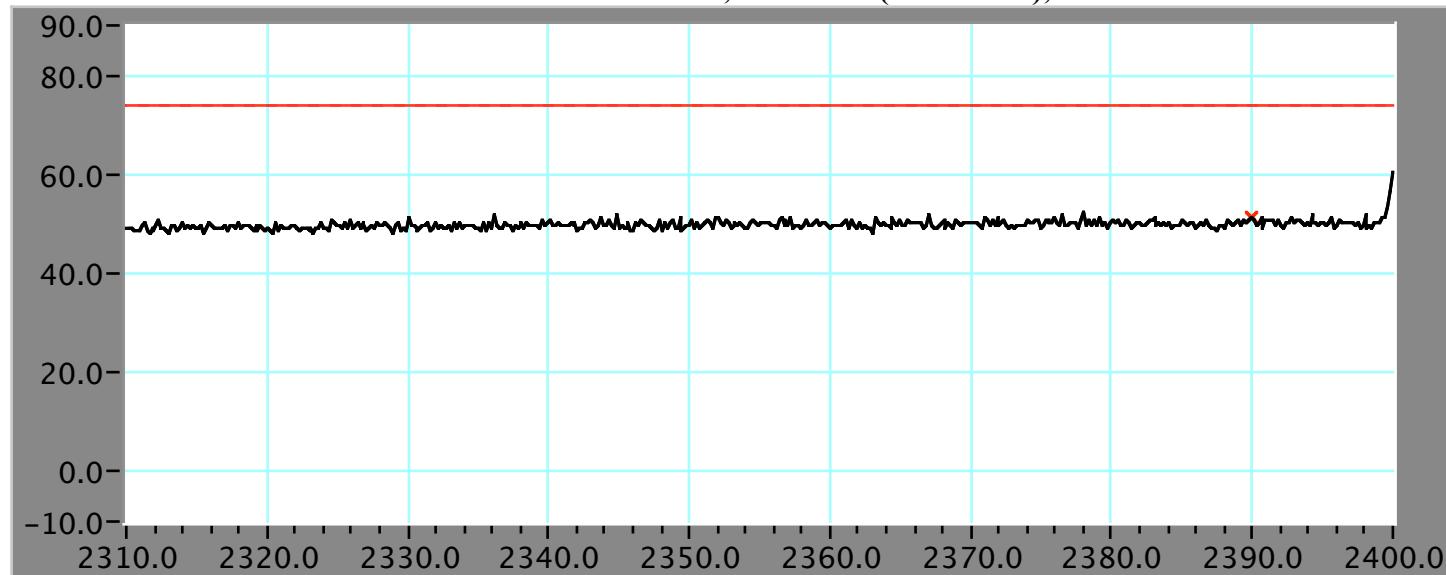
2310 MHz - 2390 MHz Restricted Band - Vertical, channel 1 (2.402 GHz), Average Detection



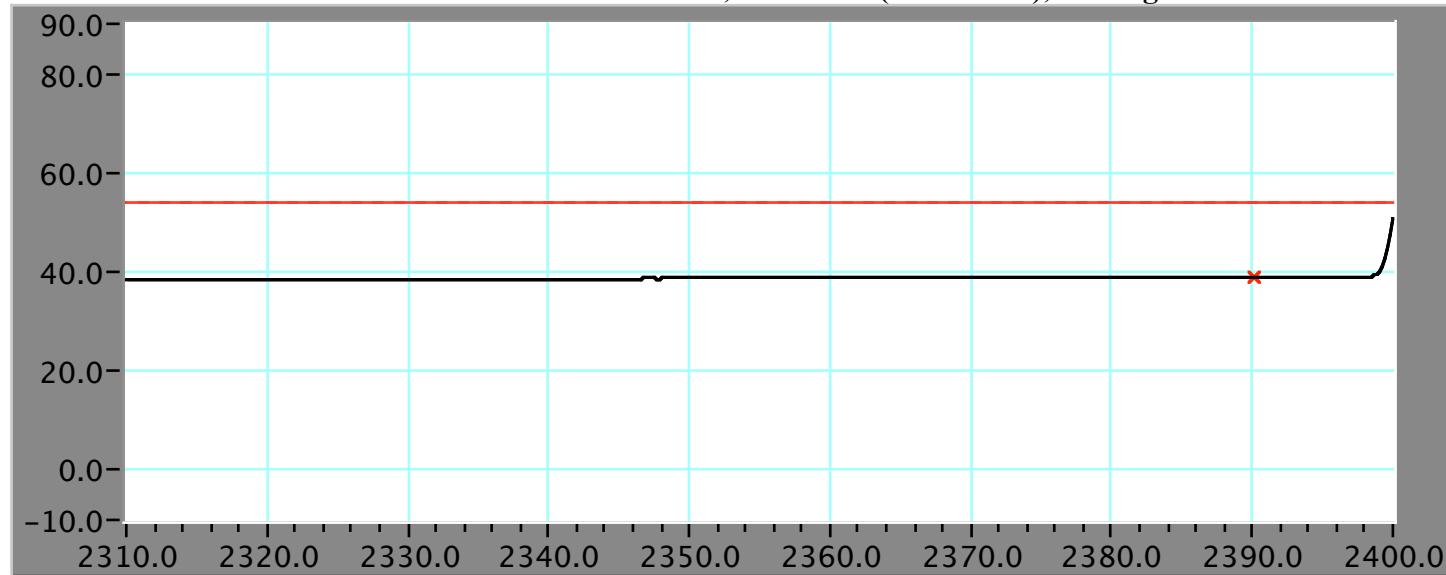
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
2390	50.4	74	-23.6	25.29	30.27	4.31	9.5
2390	39.1	54	-14.9	14.05	30.27	4.31	9.5

Date of Test: Oct 25, 2004

2310 MHz - 2390 MHz Restricted Band - Horizontal, channel 1 (2.402 GHz), Peak Detection



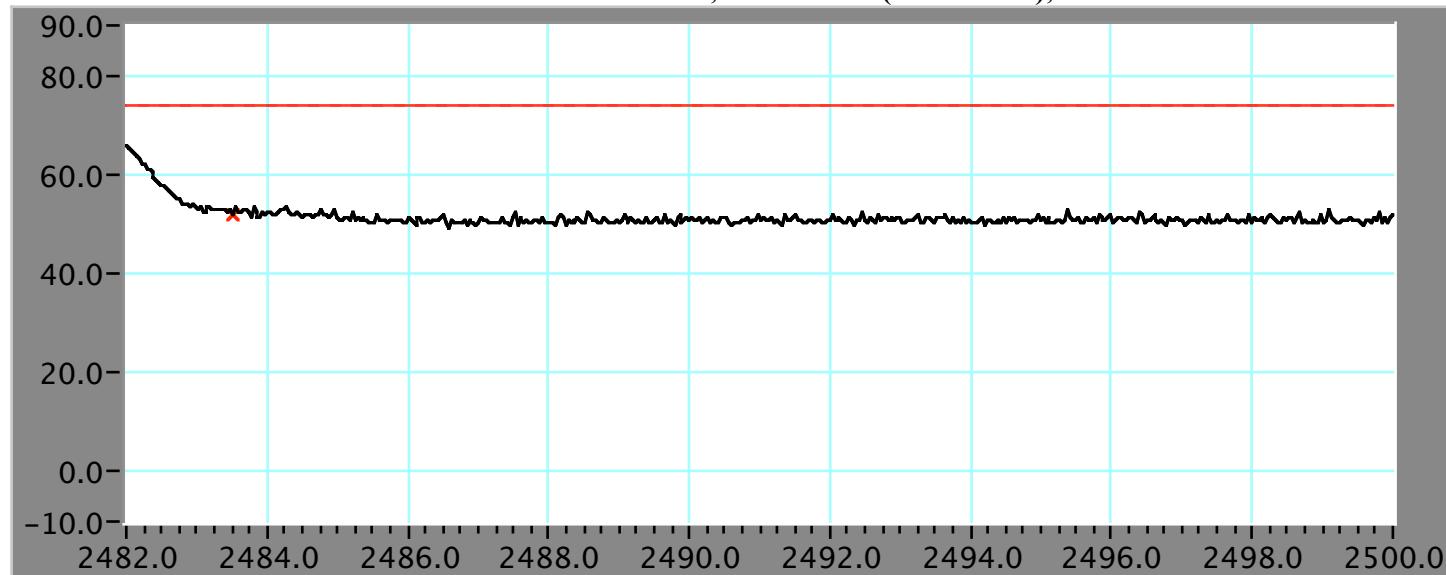
2310 MHz - 2390 MHz Restricted Band - Horizontal, channel 1 (2.402 GHz), Average Detection



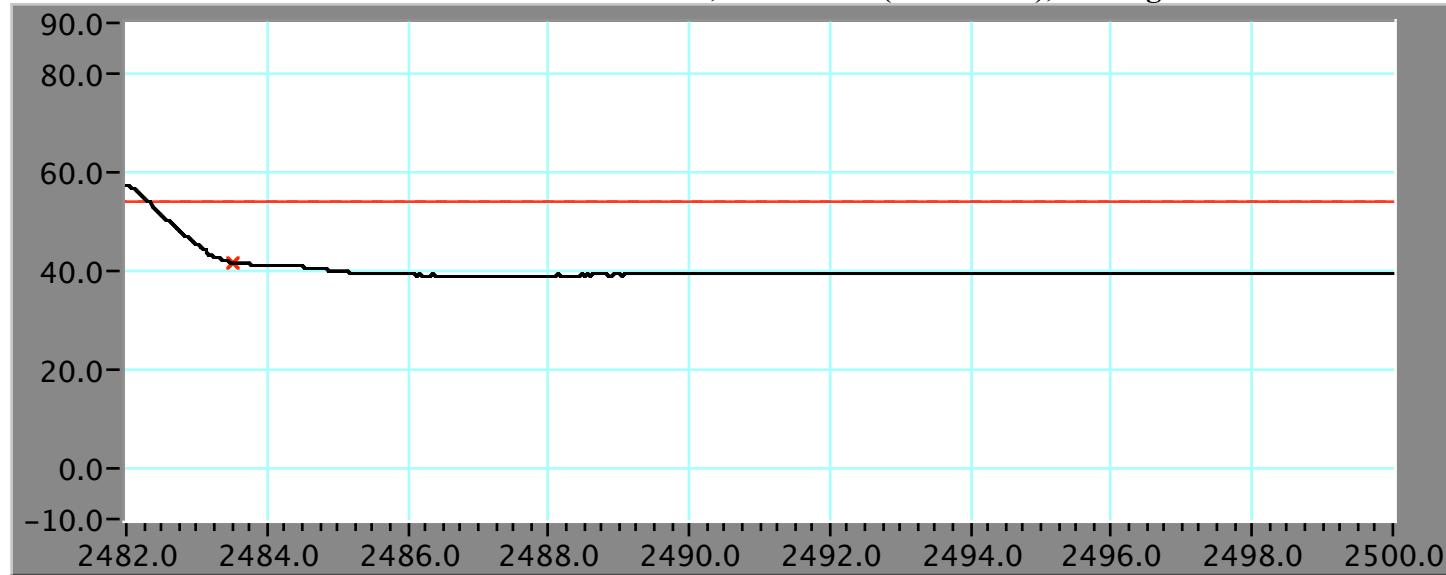
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
2390	51.5	74	-22.5	26.49	30.16	4.31	9.5
2390	39	54	-15	13.99	30.16	4.31	9.5

Date of Test: Oct 25, 2004

2483.5 MHz - 2500 MHz Restricted Band - Vertical, channel 79 (2.480 GHz), Peak Detection



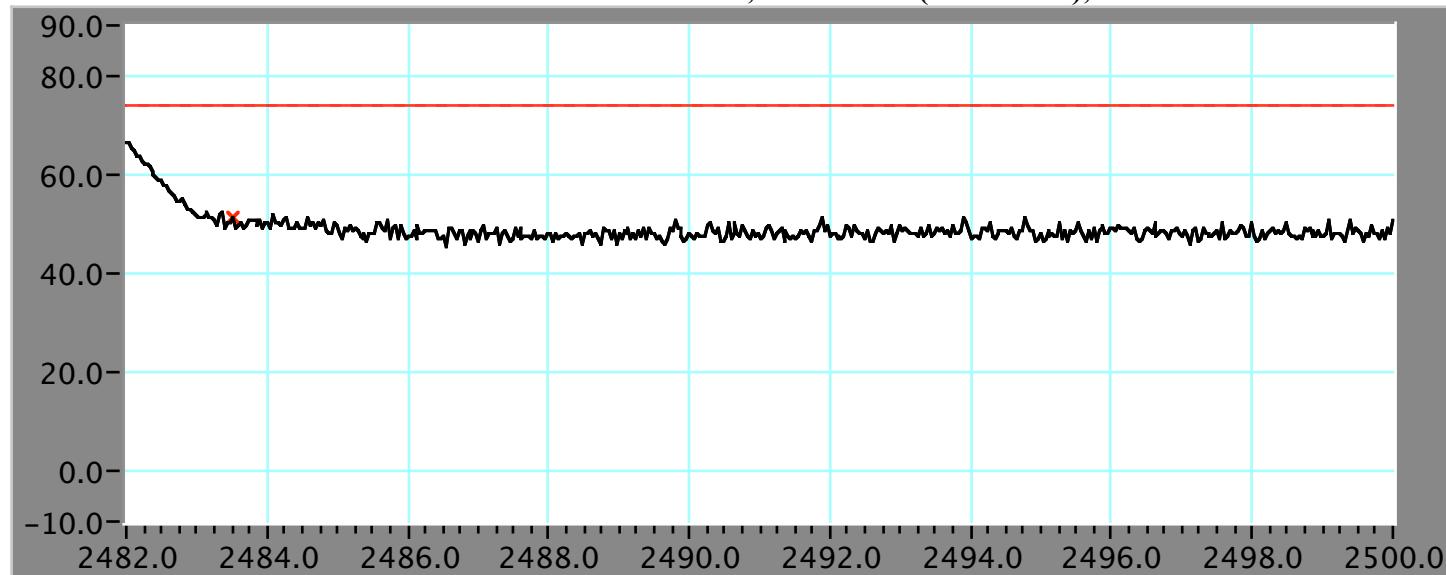
2483.5 MHz - 2500 MHz Restricted Band - Vertical, channel 79 (2.480 GHz), Average Detection



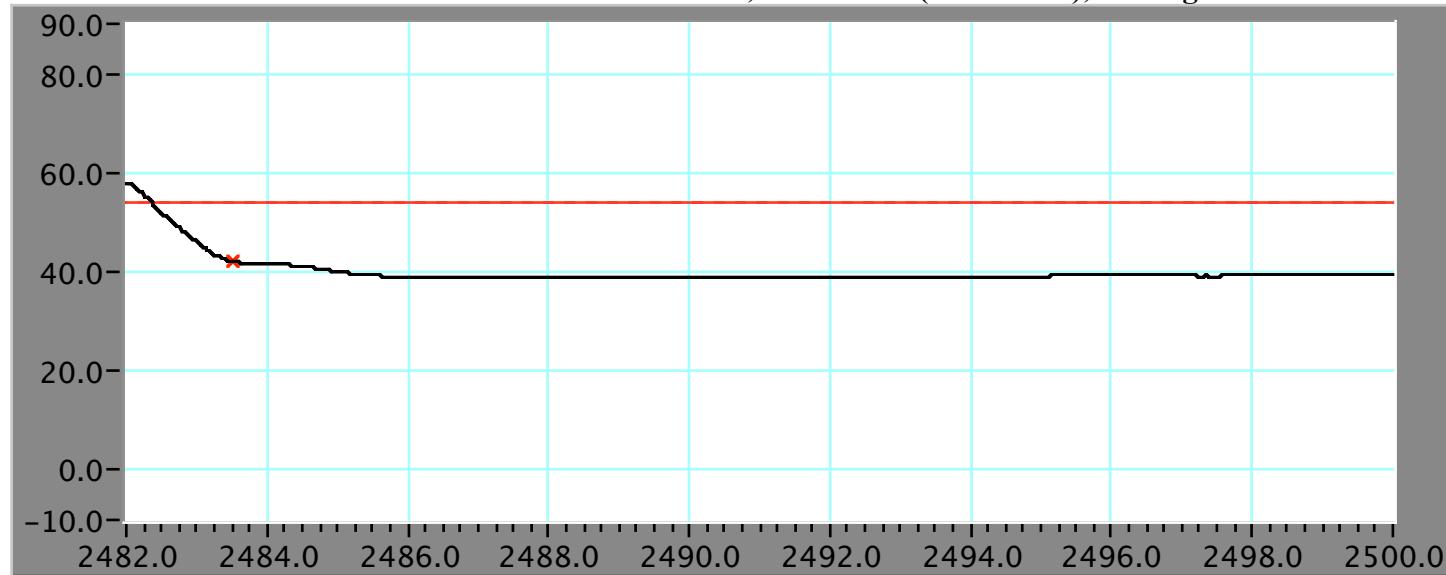
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dB ^u V/m	dB ^u V/m	dB	dB ^u V	dB	dB	dB
2483.52	52	74	-22	16.51	30.55	4.4	9.5
2483.52	41.7	54	-12.3	16.29	30.55	4.4	9.5

Date of Test: Oct 25, 2004

2483.5 MHz - 2500 MHz Restricted Band - Horizontal, channel 79 (2.480 GHz), Peak Detection



2483.5 MHz - 2500 MHz Restricted Band - Horizontal, channel 79 (2.480 GHz), Average Detection



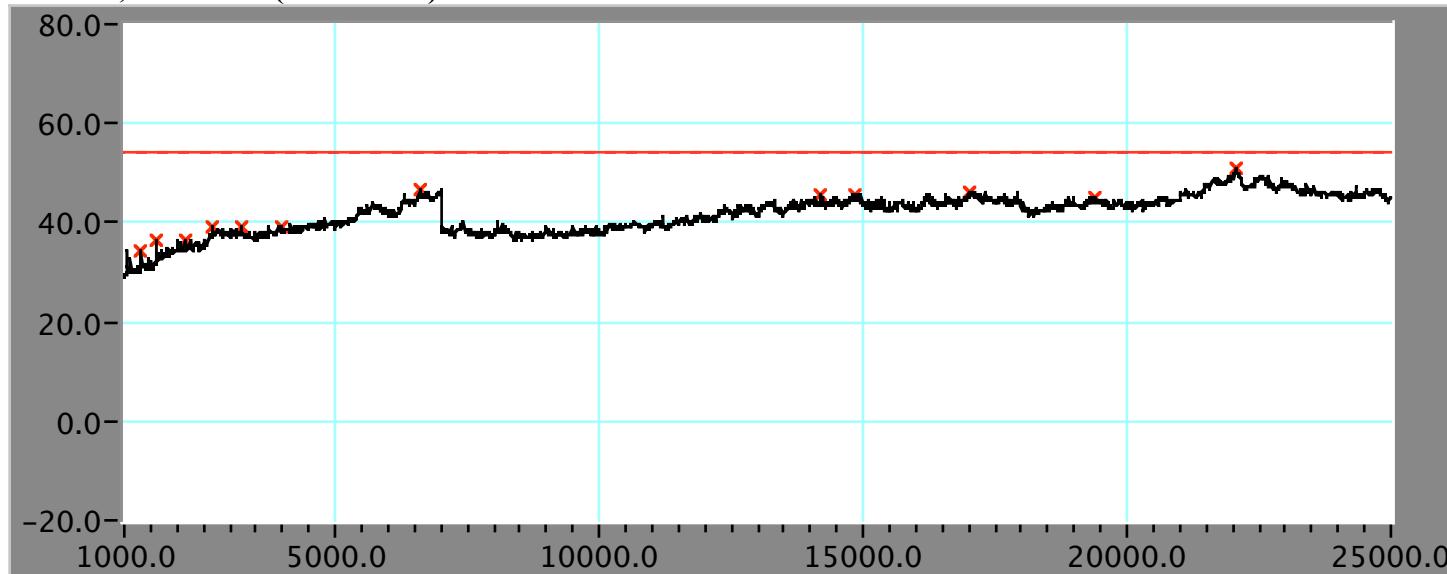
Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB
2483.5	51.3	74	-22.7	26.02	30.36	4.4	9.5
2483.52	42.1	54	-11.9	16.86	30.36	4.4	9.5

Date of Test: Oct 25, 2004

Spurious Radiated Emissions above 1 GHz

Radiated Emissions scans from 1 to 25 GHz for the low, mid and high channels were performed to demonstrate compliance with all of the restricted bands in CFR 47 Section 205(a). The data from the Radiated Emissions scans are presented in the following pages.

Vertical, channel 1 (2.402 GHz)

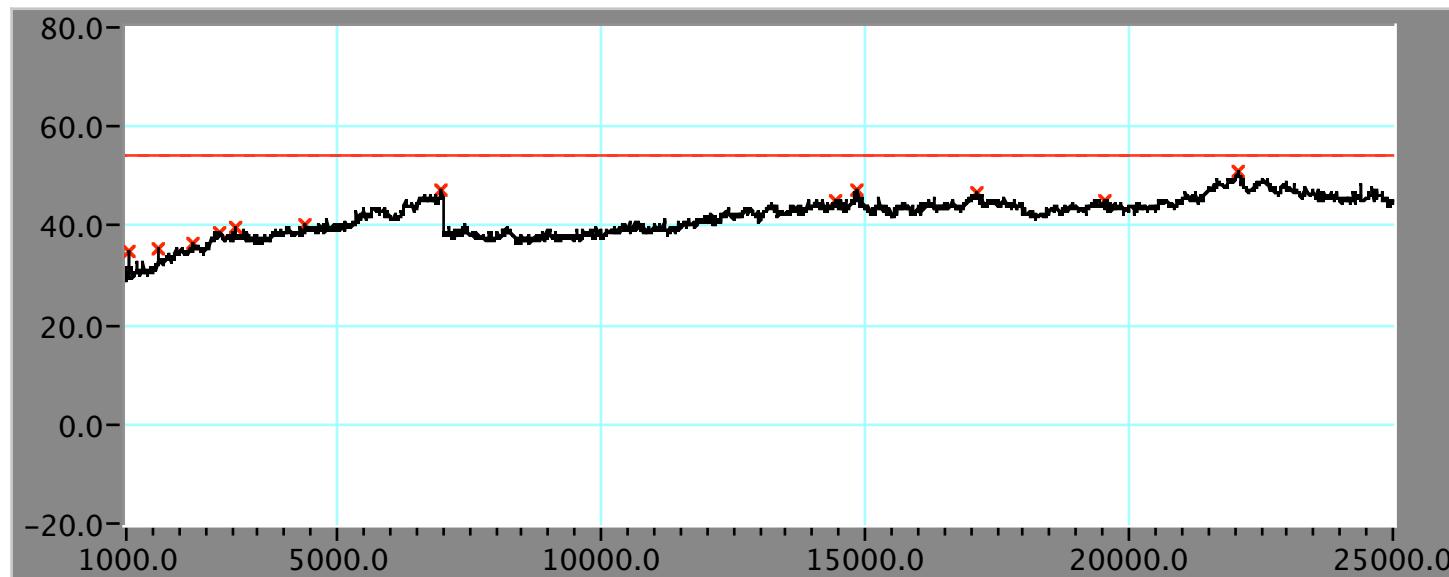


Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp	All Factor
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB	dB
1324.65	34.5	54.0	-19.5	49.53	27.85	1.02	43.89	15.01
1601.20	36.7	54.0	-17.3	50.33	28.87	1.30	43.81	13.64
2142.28	36.4	54.0	-17.6	46.30	32.04	1.76	43.68	9.88
2659.32	38.9	54.0	-15.1	47.90	32.72	1.99	43.72	9.01
3224.45	38.9	54.0	-15.1	47.42	33.36	2.22	44.11	8.54
3969.94	39.3	54.0	-14.7	46.64	33.58	2.49	43.44	7.36
6603.21	46.5	54.0	-7.5	51.25	36.04	3.46	44.21	4.71
14212.42	45.5	54.0	-8.5	44.53	39.67	5.51	44.20	-0.98
14853.71	45.8	54.0	-8.2	43.98	40.18	5.60	43.92	-1.86
16998.00	46.1	54.0	-7.9	42.84	41.70	5.88	44.35	-3.23
19374.75	45.3	54.0	-8.7	42.77	40.25	7.00	44.77	-2.49
22054.11	50.8	54.0	-3.2	48.05	40.35	7.17	44.73	-2.79

All levels are with a peak detector unless otherwise indicated.

Date of Test: Oct 27, 2004

Horizontal, channel 1 (2.402 GHz)

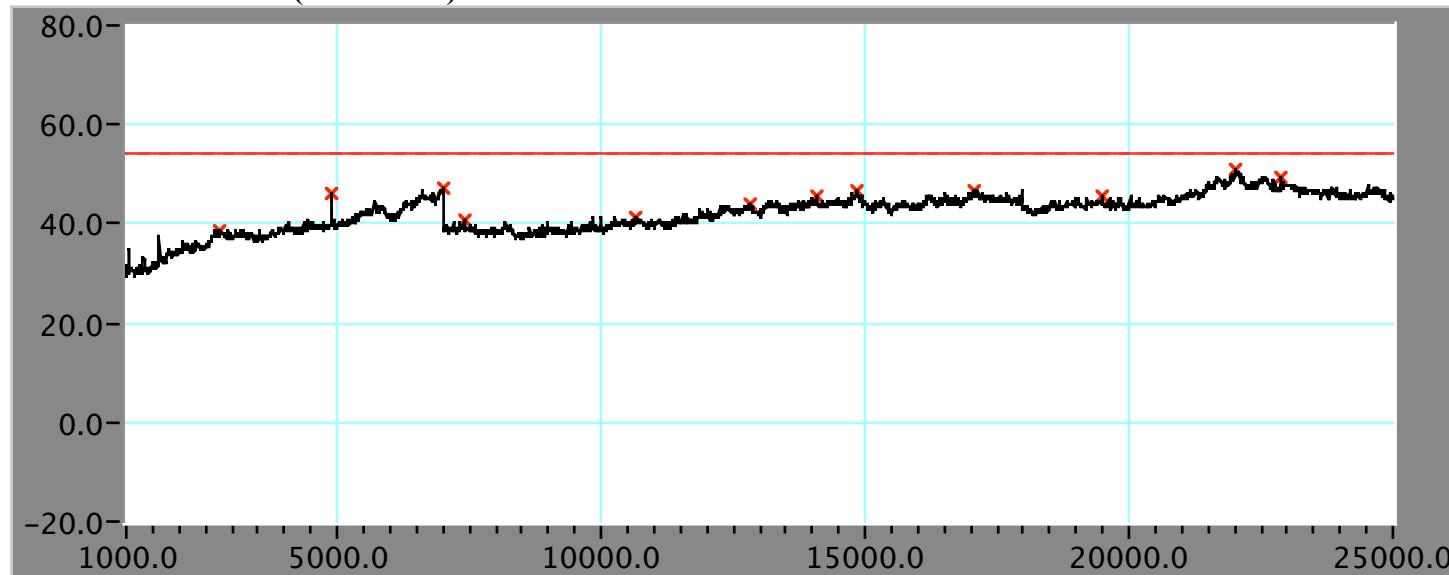


Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp	All Factor
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB	dB
1060.12	34.7	54.0	-19.3	50.90	27.48	0.76	44.46	16.22
1601.20	35.6	54.0	-18.4	49.26	28.87	1.30	43.81	13.64
2262.53	36.7	54.0	-17.3	46.44	32.16	1.82	43.72	9.74
2791.58	38.8	54.0	-15.2	47.51	32.98	2.05	43.72	8.69
3068.14	39.8	54.0	-14.2	48.23	33.39	2.16	43.95	8.39
4390.78	40.5	54.0	-13.5	47.07	34.38	2.65	43.65	6.62
6963.93	47.2	54.0	-6.8	51.59	36.19	3.59	44.20	4.43
14452.91	45.2	54.0	-8.8	43.84	39.86	5.54	44.10	-1.31
14863.73	47.1	54.0	-6.9	45.26	40.19	5.60	43.92	-1.87
17128.26	46.5	54.0	-7.5	43.21	41.88	5.90	44.47	-3.31
19529.06	45.3	54.0	-8.7	42.92	40.26	7.01	44.94	-2.33
22068.14	51.0	54.0	-3.0	48.27	40.35	7.17	44.74	-2.78

All levels are with a peak detector unless otherwise indicated.

Date of Test: Oct 27, 2004

Vertical Channel 40 (2.441 GHz)

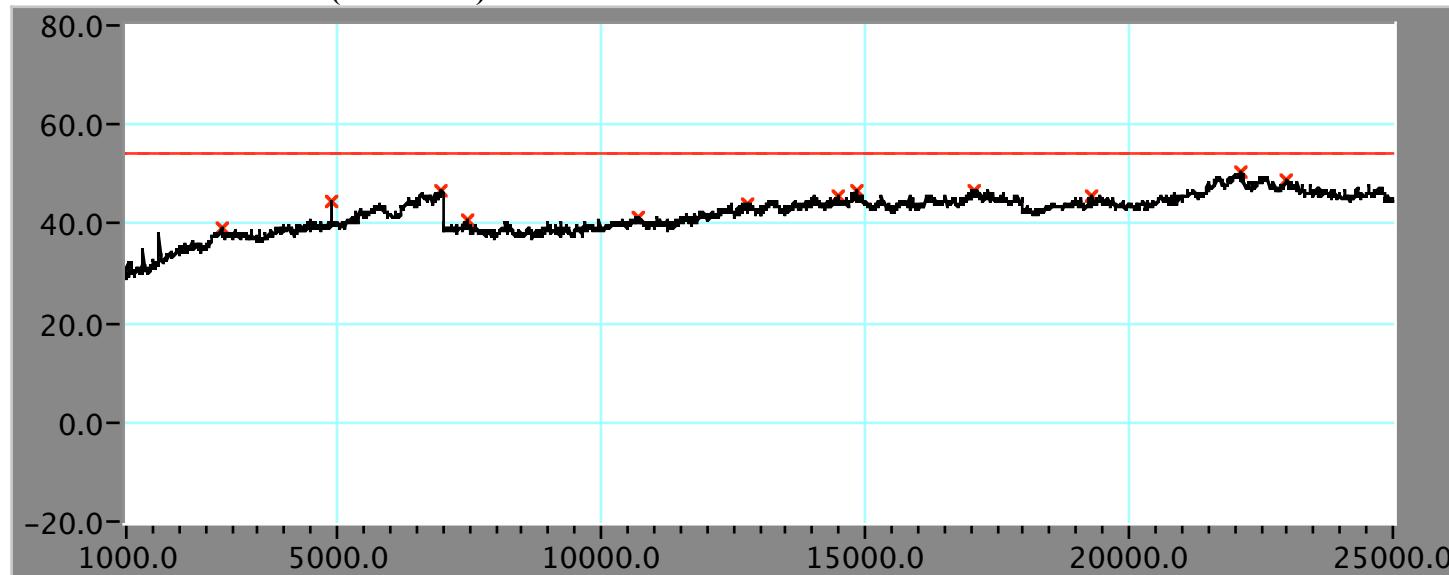


Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp	All Factor
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB	dB
2791.58	38.6	54.0	-15.4	47.28	32.98	2.05	43.72	8.69
4883.77	46.1	54.0	-7.9	52.60	34.83	2.83	44.12	6.46
7000.00	47.2	54.0	-6.8	51.61	36.20	3.60	44.24	4.44
7396.79	40.7	54.0	-13.3	45.44	36.04	3.66	44.46	4.76
10667.33	41.5	54.0	-12.5	43.83	37.97	4.46	44.79	2.36
12807.62	44.0	54.0	-10.0	44.20	39.28	5.33	44.83	0.22
14082.16	45.5	54.0	-8.5	44.71	39.57	5.50	44.26	-0.80
14853.71	46.4	54.0	-7.6	44.56	40.18	5.60	43.92	-1.86
17058.12	46.8	54.0	-7.2	43.57	41.78	5.89	44.40	-3.27
19486.97	45.4	54.0	-8.6	43.01	40.26	7.01	44.89	-2.37
22012.02	50.9	54.0	-3.1	48.11	40.35	7.16	44.70	-2.82
22881.76	49.2	54.0	-4.8	46.39	40.38	7.23	44.77	-2.84

All levels are with a peak detector unless otherwise indicated.

Date of Test: Oct 27, 2004

Horizontal Channel 40 (2.441GHz)

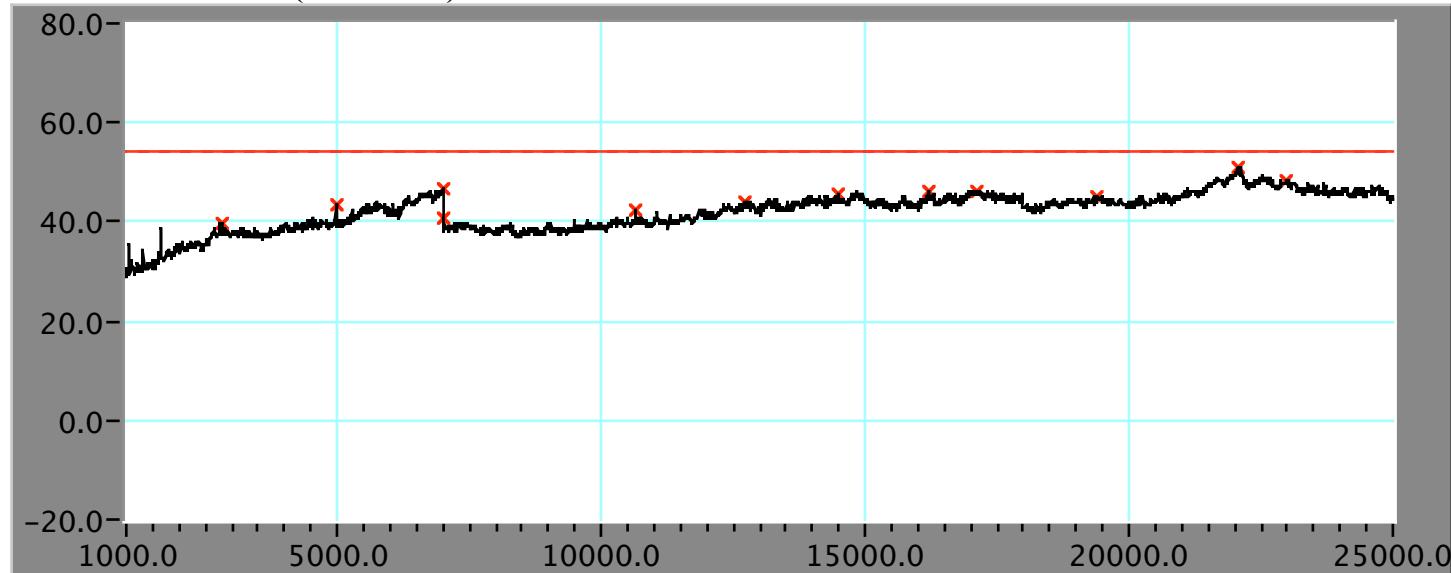


Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp	All Factor
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB	dB
2803.61	39.1	54.0	-14.9	47.81	33.01	2.05	43.74	8.68
4883.77	44.6	54.0	-9.4	51.04	34.83	2.83	44.12	6.46
6963.93	46.7	54.0	-7.3	51.08	36.19	3.59	44.20	4.43
7468.94	40.8	54.0	-13.2	45.61	36.01	3.67	44.48	4.80
10715.43	41.4	54.0	-12.6	43.67	37.99	4.48	44.76	2.29
12795.59	44.1	54.0	-9.9	44.31	39.28	5.33	44.83	0.23
14482.97	45.4	54.0	-8.6	44.01	39.89	5.55	44.08	-1.35
14833.67	46.5	54.0	-7.5	44.71	40.17	5.60	43.93	-1.83
17058.12	46.9	54.0	-7.1	43.59	41.78	5.89	44.40	-3.27
19304.61	45.7	54.0	-8.3	43.14	40.25	7.00	44.69	-2.56
22110.22	50.4	54.0	-3.6	47.67	40.35	7.17	44.78	-2.75
22993.99	48.8	54.0	-5.2	46.07	40.39	7.25	44.87	-2.77

All levels are with a peak detector unless otherwise indicated.

Date of Test: Oct 27, 2004

Vertical Channel 79 (2.480 GHz)

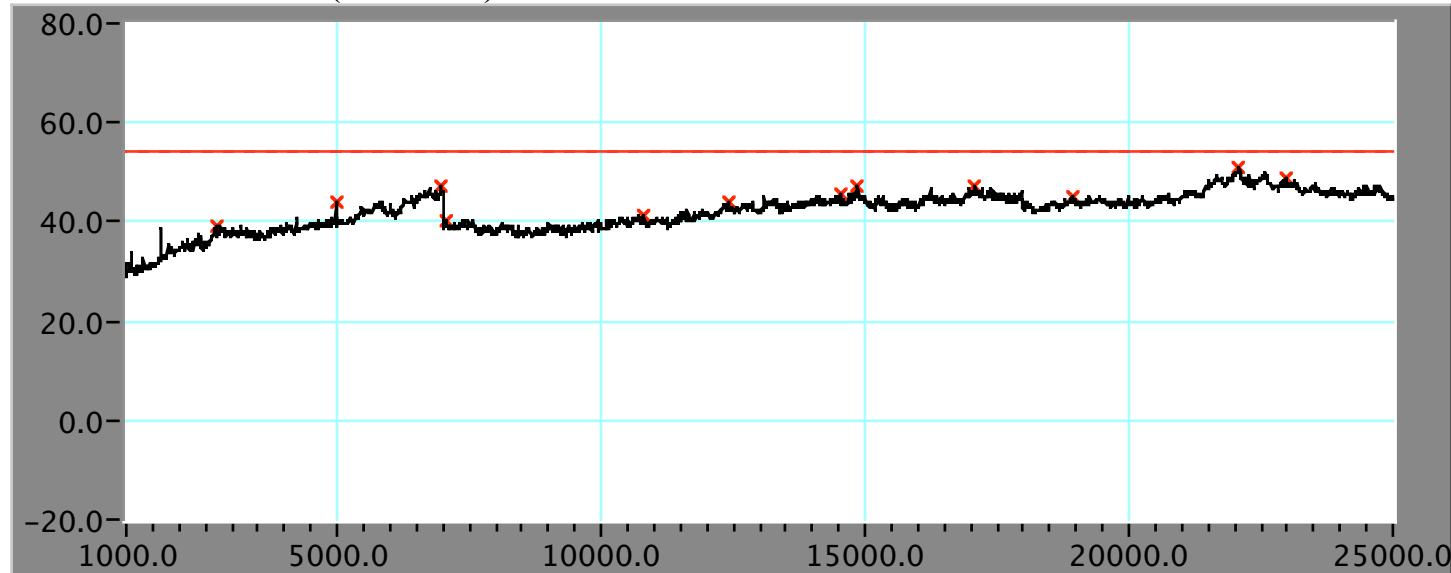


Frequency MHz	Level dBuV/m	Limit dBuV/m	Delta dB	Raw Data dBuV	Antenna dB	Cable dB	Amp dB	All Factor dB
2803.61	39.5	54.0	-14.5	48.15	33.01	2.05	43.74	8.68
4967.94	43.7	54.0	-10.3	49.97	34.88	2.86	44.03	6.29
6987.98	46.8	54.0	-7.2	51.19	36.20	3.60	44.22	4.43
7012.02	40.6	54.0	-13.4	45.04	36.20	3.60	44.25	4.45
10655.31	42.4	54.0	-11.6	44.78	37.96	4.46	44.79	2.37
12735.47	43.9	54.0	-10.1	44.22	39.24	5.32	44.86	0.30
14482.97	45.5	54.0	-8.5	44.14	39.89	5.55	44.08	-1.35
16186.37	46.1	54.0	-7.9	43.92	41.56	5.77	45.13	-2.21
17128.26	46.4	54.0	-7.6	43.04	41.88	5.90	44.47	-3.31
19402.80	45.0	54.0	-9.0	42.59	40.25	7.01	44.80	-2.46
22054.11	50.8	54.0	-3.2	48.01	40.35	7.17	44.73	-2.79
22993.99	48.5	54.0	-5.5	45.73	40.39	7.25	44.87	-2.77

All levels are with a peak detector unless otherwise indicated.

Date of Test: Oct 27, 2004

Horizontal Channel 79 (2.480 GHz)



Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp	All Factor
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB	dB
2695.39	39.2	54.0	-14.8	48.22	32.79	2.01	43.77	8.98
4967.94	44.0	54.0	-10.0	50.25	34.88	2.86	44.03	6.29
6963.93	47.0	54.0	-7.0	51.40	36.19	3.59	44.20	4.43
7060.12	40.2	54.0	-13.8	44.69	36.18	3.61	44.30	4.51
10787.58	41.1	54.0	-12.9	43.25	38.02	4.51	44.72	2.19
12398.80	44.0	54.0	-10.0	44.72	39.08	5.21	45.01	0.72
14553.11	45.4	54.0	-8.6	43.93	39.94	5.56	44.05	-1.45
14863.73	47.0	54.0	-7.0	45.08	40.19	5.60	43.92	-1.87
17088.18	47.2	54.0	-6.8	43.89	41.82	5.89	44.43	-3.29
18911.82	45.1	54.0	-8.9	42.63	40.23	6.72	44.45	-2.51
22082.16	51.1	54.0	-2.9	48.30	40.35	7.17	44.75	-2.77
22965.93	48.8	54.0	-5.2	46.01	40.39	7.24	44.84	-2.79

All levels are with a peak detector unless otherwise indicated.

Date of Test: Oct 27, 2004

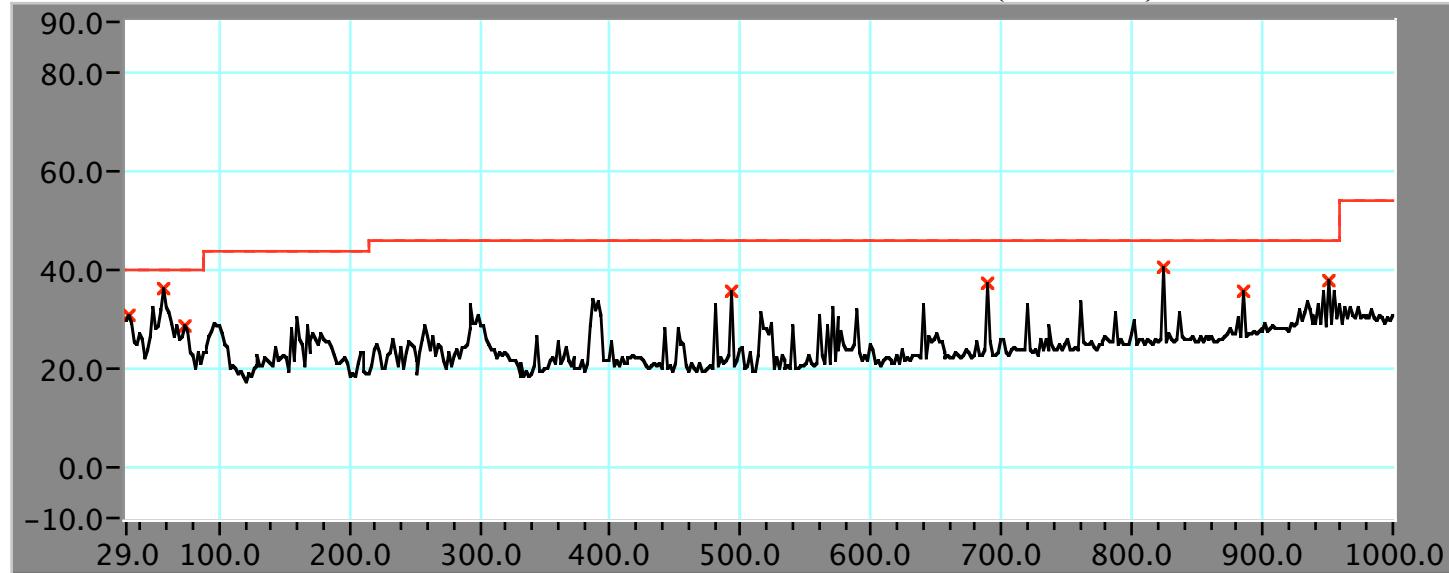
Radiated Emissions less than 1 GHz Instrument Settings:

Instrument Settings				
Frequency Range	Reference Level	Attenuation	Resolution BW	Video BW
30 MHz - 1 GHz	90 dBuV	10	100 kHz	100 kHz

Radiated emissions measurements from 30 MHz - 1 GHz were performed with the transmitter set to low, mid and high channels. In each of these cases, the results were similar. Only the data from the scans with channel 1 transmitting is presented.

Radiated Emissions less than 1 GHz

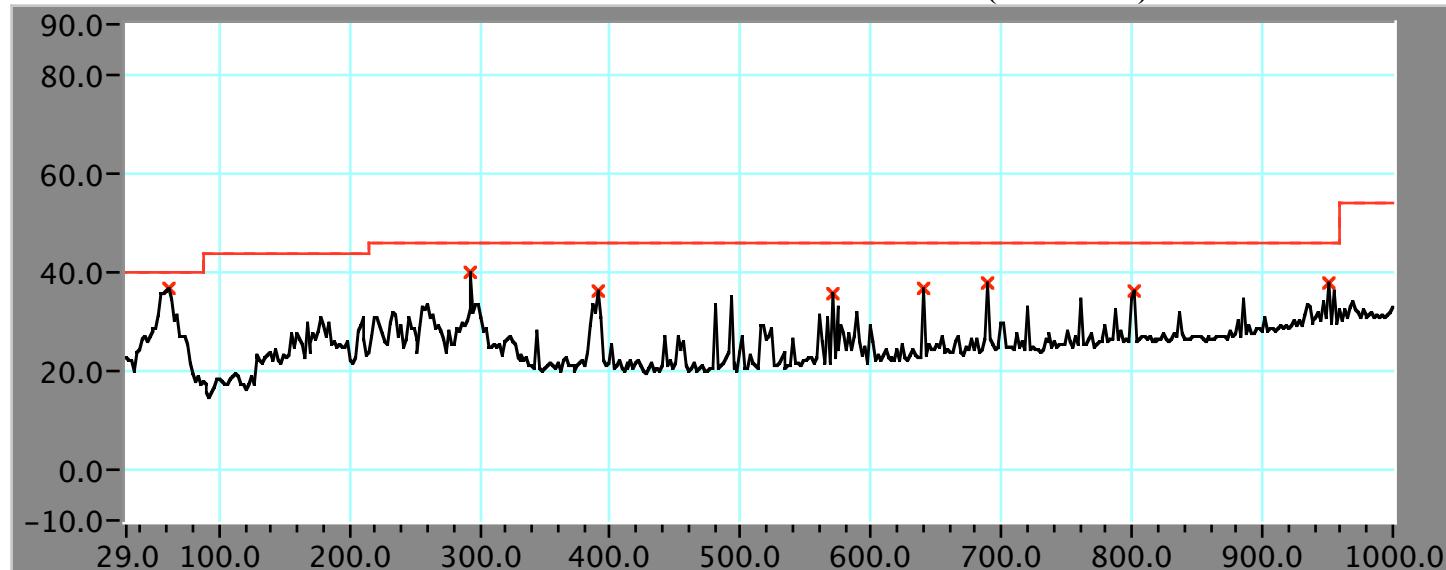
Radiated Emissions Data less than 1 GHz. Transmitter set to channel 1 (2402 MHz) Vertical



Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp	All Factor
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB	dB
30.95	30.8	40.0	-9.2	42.97	20.04	1.19	33.40	12.17
58.19	36.3	40.0	-3.7	61.28	6.73	1.57	33.24	24.94
73.76	28.5	40.0	-11.5	52.51	7.40	1.75	33.15	24.01
492.12	35.8	46.0	-10.2	46.34	17.90	4.80	33.19	10.49
688.66	37.3	46.0	-8.7	45.18	19.95	5.89	33.76	7.92
824.87	40.4	46.0	-5.6	45.99	21.46	6.74	33.83	5.63
885.19	35.6	46.0	-10.4	40.23	21.82	7.15	33.59	4.63
951.35	37.8	46.0	-8.2	40.29	22.80	7.59	32.84	2.45

Date of Test: Oct 7, 2004

Radiated Emissions Data less than 1 GHz. Transmitter set to channel 1 (2402 MHz) Horizontal



Frequency	Level	Limit	Delta	Raw Data	Antenna	Cable	Amp	All Factor
MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB	dB
62.08	36.5	40.0	-3.5	60.11	8.00	1.62	33.21	23.58
293.64	40.2	46.0	-5.8	55.40	14.13	3.53	32.91	15.24
390.94	36.4	46.0	-9.6	49.00	16.10	4.18	32.85	12.57
569.96	35.4	46.0	-10.6	44.26	19.22	5.25	33.29	8.83
640.01	36.8	46.0	-9.2	44.86	20.05	5.63	33.77	8.10
688.66	38.0	46.0	-8.0	44.73	21.10	5.89	33.76	6.77
801.52	36.1	46.0	-9.9	41.64	21.80	6.60	33.88	5.49
951.35	38.1	46.0	-7.9	39.94	23.40	7.59	32.84	1.85

Date of Test: Oct 10, 2004

7.10 AC Power Line

Limit

The emissions from the ac power line must conform to the limits specified in CFR 15.207(a).

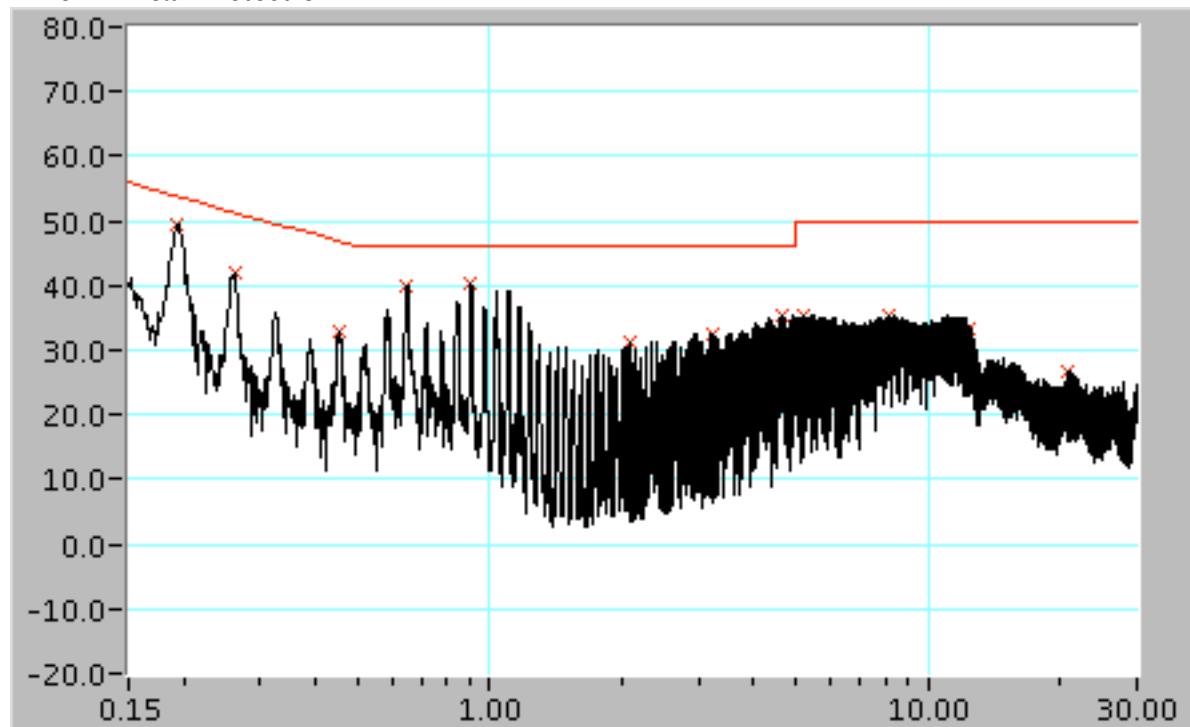
Test Procedure

The EUT is a 3.3 Volt DC device. However, it can be powered from a host system which does have an ac adapter. The power line measurements were performed at the ac power terminals of the host system. The transmitter was set to continuously transmit. Prescans were performed with the transmitter set to low, mid and high channels as well as hopping over 79 channels. In each of these cases, no difference in the ac power line conducted emission levels was detected. The data shown is with the transmitter set to continuously transmit on the low channel.

AC Power Line Results

No non-compliance was found.

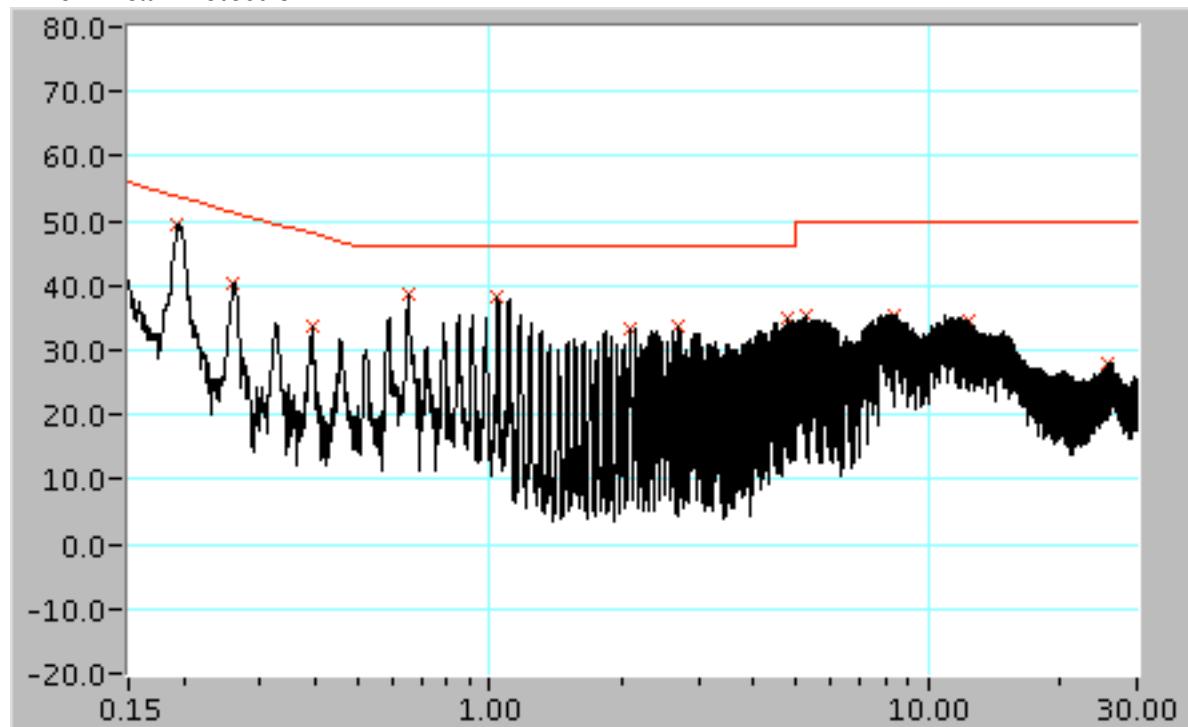
Line 1 – Peak Detection



Frequency	Level	Limit	Delta	Raw Data	LISN	Cable	All Factors
MHz	dBuV	dBuV	dB	dBuV	dB	dB	dB
0.194	49.6	53.9	-4.3	48.37	1.12	0.06	-1.18
0.262	41.9	51.4	-9.4	41.07	0.79	0.07	-0.85
0.453	33.0	46.8	-13.8	32.62	0.33	0.07	-0.40
0.645	39.8	46.0	-6.2	39.45	0.23	0.08	-0.32
0.908	40.4	46.0	-5.6	40.12	0.16	0.09	-0.25
2.083	31.4	46.0	-14.6	31.11	0.12	0.14	-0.26
3.247	32.5	46.0	-13.5	32.16	0.13	0.17	-0.30
4.679	35.3	46.0	-10.7	34.99	0.14	0.20	-0.35
5.210	35.4	50.0	-14.6	35.08	0.15	0.22	-0.37
8.136	35.3	50.0	-14.7	34.86	0.20	0.27	-0.47
12.408	33.5	50.0	-16.5	32.72	0.42	0.35	-0.77
20.908	26.7	50.0	-23.3	25.40	0.83	0.46	-1.29

Date of Test: November 10, 2004

Line 2 Peak Detection



Frequency	Level	Limit	Delta	Raw Data	LISN	Cable	All Factors
MHz	dBuV	dBuV	dB	dBuV	dB	dB	dB
0.194	49.6	53.9	-4.3	48.36	1.17	0.06	-1.23
0.260	40.3	51.4	-11.2	39.38	0.83	0.07	-0.89
0.393	33.5	48.0	-14.5	33.07	0.39	0.07	-0.46
0.653	38.5	46.0	-7.5	38.22	0.23	0.09	-0.31
1.045	38.2	46.0	-7.8	37.94	0.15	0.10	-0.25
2.097	33.4	46.0	-12.6	33.18	0.12	0.14	-0.26
2.690	33.5	46.0	-12.5	33.26	0.12	0.16	-0.28
4.778	35.0	46.0	-11.0	34.67	0.14	0.21	-0.35
5.243	35.3	50.0	-14.7	34.89	0.15	0.22	-0.37
8.391	35.6	50.0	-14.4	35.08	0.19	0.28	-0.47
12.425	34.6	50.0	-15.4	33.89	0.36	0.35	-0.71
25.715	28.1	50.0	-21.9	26.62	0.98	0.52	-1.49

Date of Test: November 10, 2004