FCC CFR47 PART 15 SUBPART C CERTIFICATION

TEST REPORT

FOR

802.11 B/G MINI PCI TRANSCEIVER MODULE

MODEL NUMBER: AR5BMB-43

FCC ID: PPD-AR5BMB-00043

REPORT NUMBER: 04U2554-1

ISSUE DATE: APRIL 12, 2004

Prepared for
ATHEROS COMMUNICATIONS, INC.
529 ALMANOR AVENUE
SUNNYVALE
CA 94085, USA

Prepared by
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1. TEST RESULT CERTIFICATION

COMPANY NAME: ATHEROS COMMUNICATIONS, INC.
529 ALMANOR AVENUE
SUNNYVALE, CA 94085, USA

EUT DESCRIPTION: 802.11 b/g Mini PCI transceiver module

MODEL: AR5BMB-43

DATE TESTED: FEBRUARY 24 – MARCH 19, 2004

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 15 SUBPART C	NO NON-COMPLIANCE NOTED

Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: This document reports conditions under which testing was conducted and results of tests performed. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document.

Approved & Released For CCS By:

MIKE HECKROTTE
ENGINEERING MANAGER
COMPLIANCE CERTIFICATION SERVICES

Tested By:

YAN ZHENG
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. EUT DESCRIPTION

The EUT is an 802.11b/g Mini PCI transceiver module.

The transmitter has a maximum peak conducted output power as follows:

Frequency Band (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2462	802.11b	20.62	115.35
2412 - 2462	802.11g	24.49	281.19
2437	802.11g Turbo	24.64	291.07

The radio utilizes two film antennas for diversity (main and auxiliary), Hitachi model HTL017 with maximum gain of 4.24 dBi in the 2.4 GHz band.

The radio alternately utilizes three other film antenna models: Hitachi model HTL004, Hitachi model HTL008 and Tyco model TIAN001 antennas. These all have lower gain in the 2.4GHz band compared to the HTL017.

Two HTL017 antennas were utilized during final compliance tests.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4/2001, FCC CFR 47 Part 2 and FCC CFR 47 Part 15.

4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government.

5. CALIBRATION AND UNCERTAINTY

5.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

5.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Radiated Emission, 30 to 200 MHz	+/- 3.3 dB
Radiated Emission, 200 to 1000 MHz	+4.5 / -2.9 dB
Radiated Emission, 1000 to 2000 MHz	+4.5 / -2.9 dB
Power Line Conducted Emission	+/- 2.9 dB

Uncertainty figures are valid to a confidence level of 95%.

5.3. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**Cal Due**
Spectrum Analyzer	Agilent	E4446A	MY43360112	1/13/2005
Peak Power Meter	Agilent	E4416A	GB41291160	11/7/2004
Peak / Average Power Sensor	Agilent	E9327A	US40440755	11/7/2004
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	2/4/2005
Antenna, Horn 18 ~ 26 GHz	ARA	SWH-28	1007	2/24/2005
PreAmplifier 1-26GHz	MITEQ	NSP2600-SP	924341	4/25/2004
7.6GHz High Pass Filter	Micro-tronics	HPM13195	SN-002	N/A
4.0GHz High Pass Filter	Micro-tronics	HPM13351	SN-001	N/A
EMI Receiver, 9 kHz ~ 2.9 GHz	HP	8542E	3942A00286	11/20/2004
RF Filter Section	HP	85420E	3705A00256	11/20/2004
Antenna, Bicon/Log, 30 ~ 2000 MHz	Sunol Sciences	JB1	A121003	12/22/2004
LISN, 10 kHz ~ 30 MHz	FCC	50/250-25-2	114	10/13/2004
Line Filter	Lindgren	LMF-3489	497	CNR
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	10/13/2004

6. SETUP OF EQUIPMENT UNDER TEST

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
LAPTOP	DEL	PP01L	DS/N CN-04P240-48643-2BK-4144	DOC
AC ADAPTER	DELL	AA20031	DS/N CN-09364U-16291-2A9-01LG	DOC
CARDBUS ADAPTER	STELLCOM	STCBMP13	SN-022	DOC

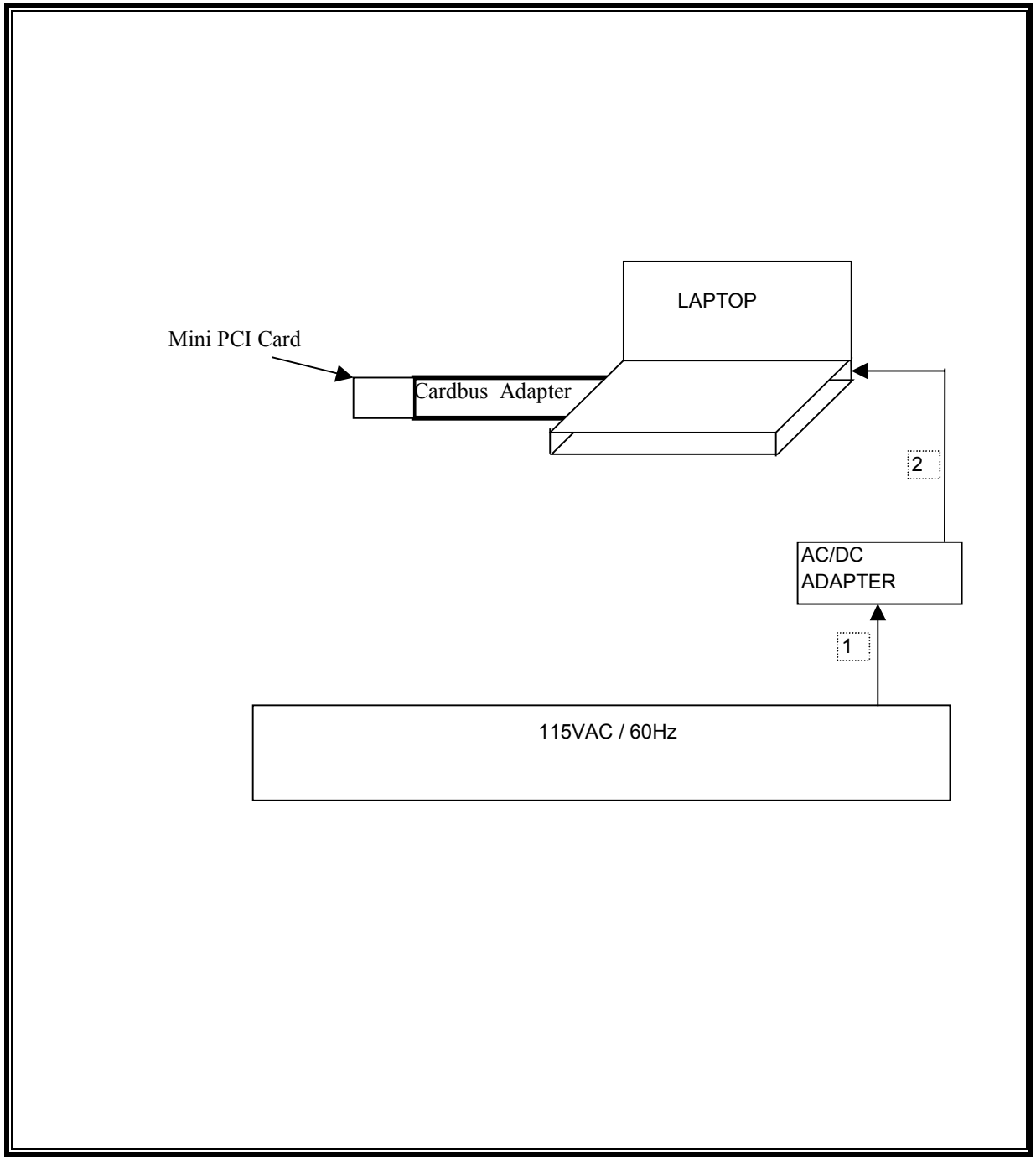
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	2	US115	UNSHIELDED	2m	NO
2	DC	1	DC	UNSHIELDED	2m	NO

TEST SETUP

The EUT is installed in a host laptop computer via a cardbus-to-miniPCI adapter / extension board during the tests. Test software exercised the radio card.

SETUP DIAGRAM FOR TESTS



7. APPLICABLE LIMITS AND TEST RESULTS

7.1. 6 dB BANDWIDTH

LIMIT

§15.247 (a) (2) For direct sequence systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

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 sweep time is coupled.

RESULTS

No non-compliance noted:

802.11b Mode

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Low	2412	12167	500	11667
Middle	2437	12000	500	11500
High	2462	12083	500	11583

802.11g Normal Mode

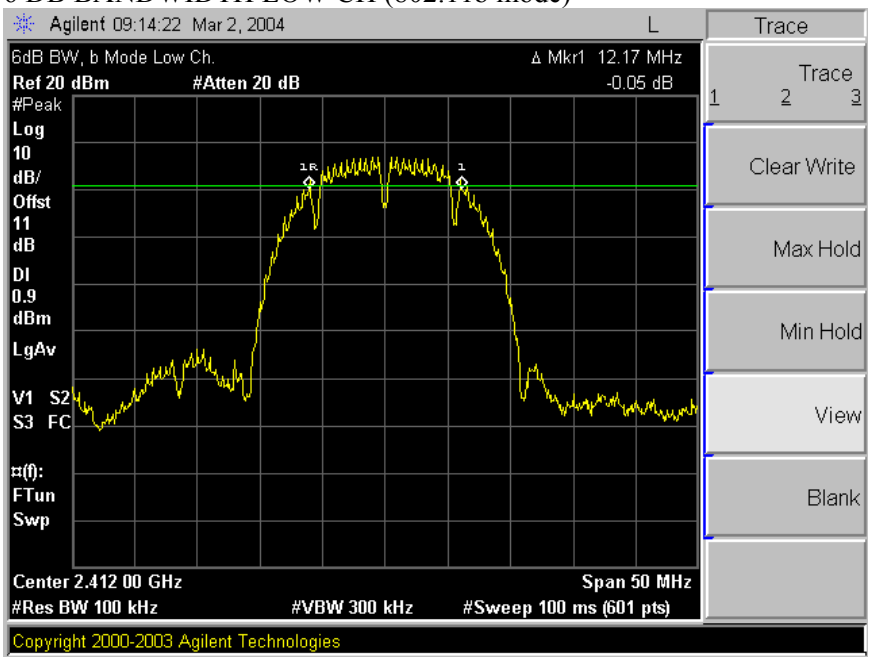
Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Low	2412	16500	500	16000
Middle	2437	16417	500	15917
High	2462	16417	500	15917

802.11g Turbo Mode

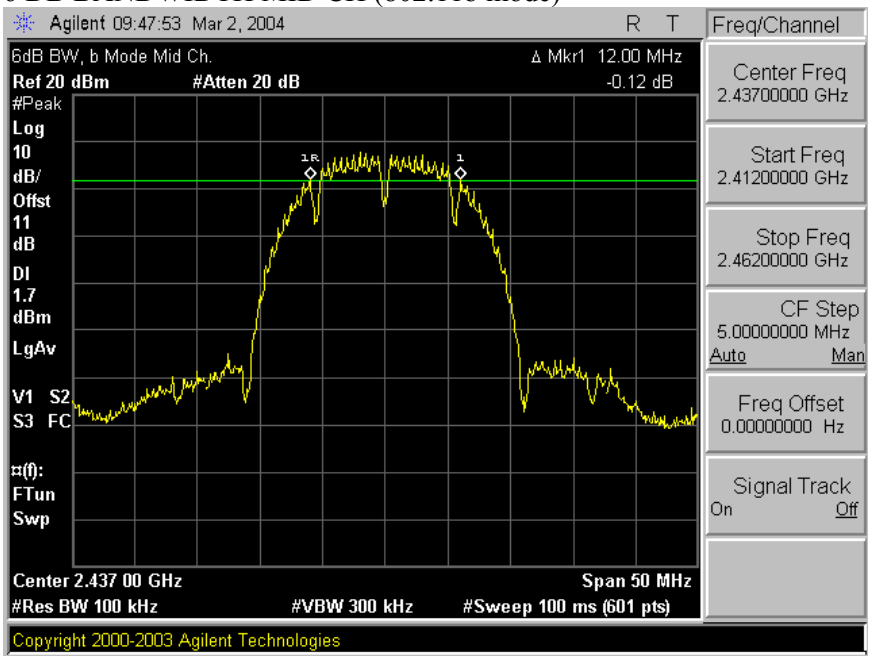
Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Middle	2437	31500	500	31000

6 DB BANDWIDTH (802.11b MODE)

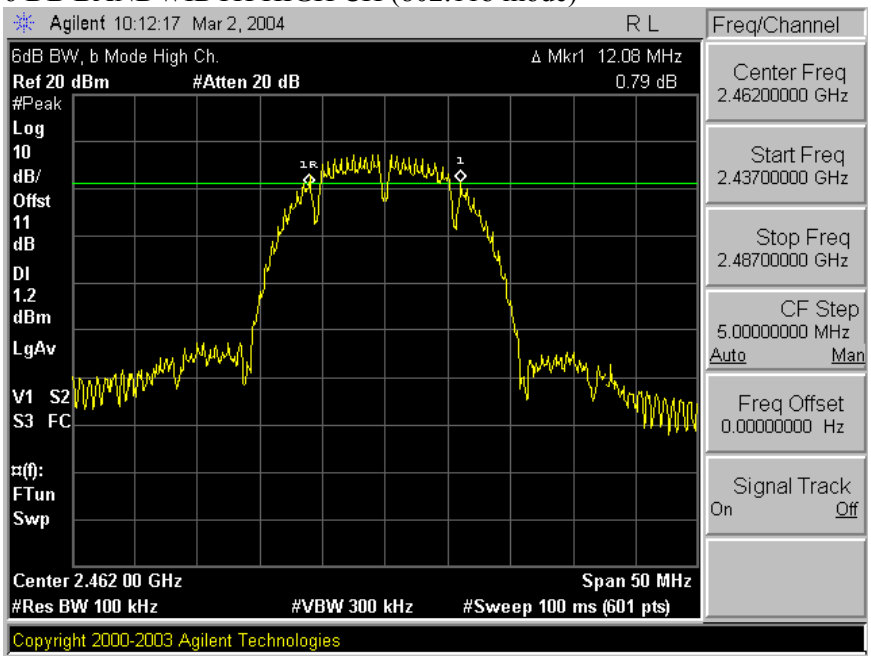
6 DB BANDWIDTH LOW CH (802.11b mode)



6 DB BANDWIDTH MID CH (802.11b mode)

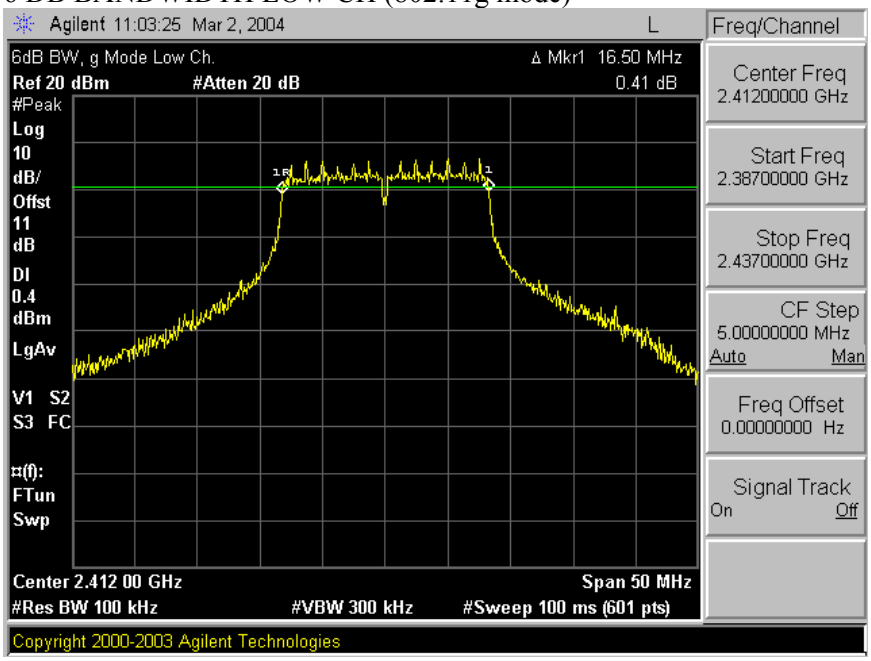


6 DB BANDWIDTH HIGH CH (802.11b mode)

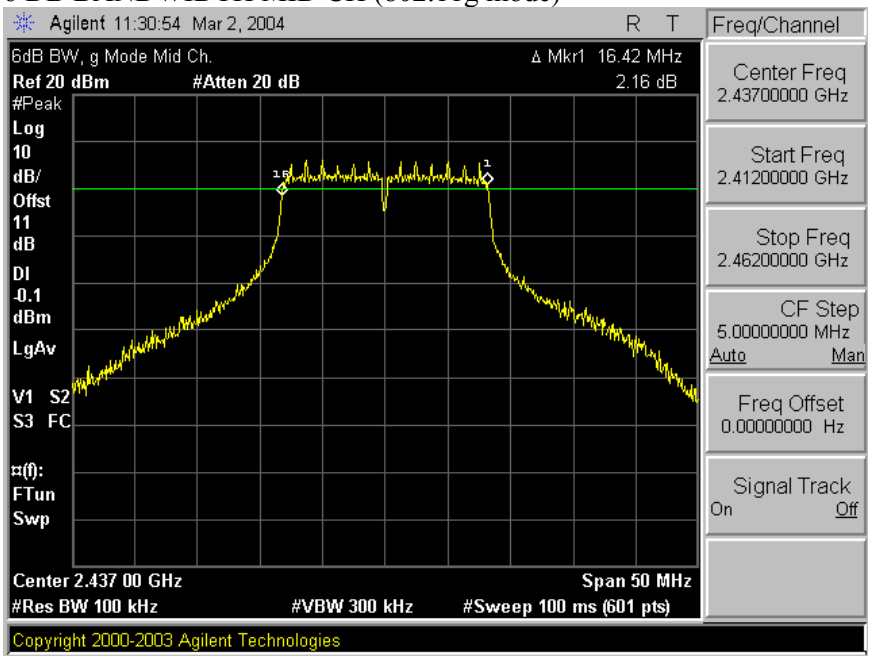


6 DB BANDWIDTH (802.11g MODE)

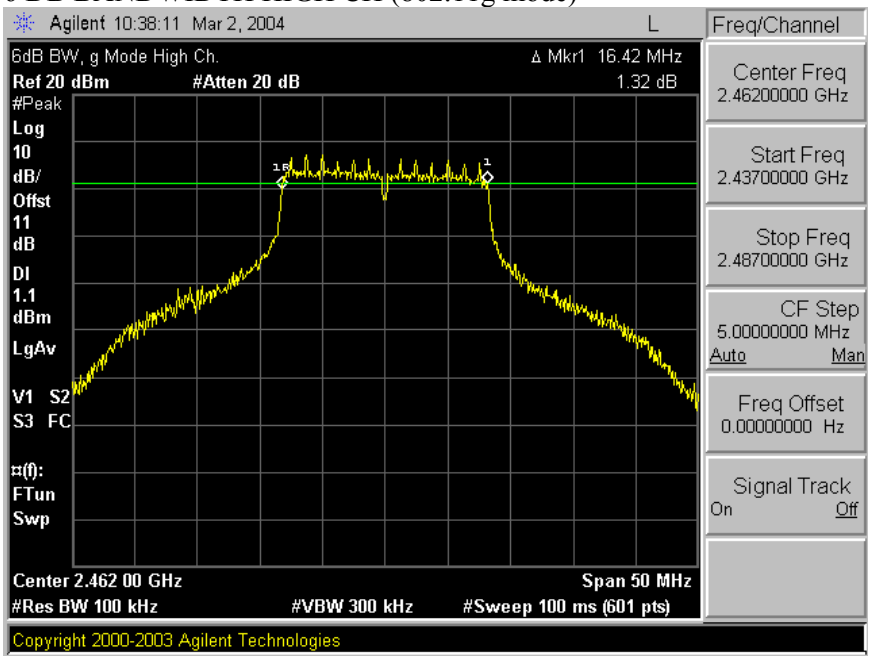
6 DB BANDWIDTH LOW CH (802.11g mode)



6 DB BANDWIDTH MID CH (802.11g mode)

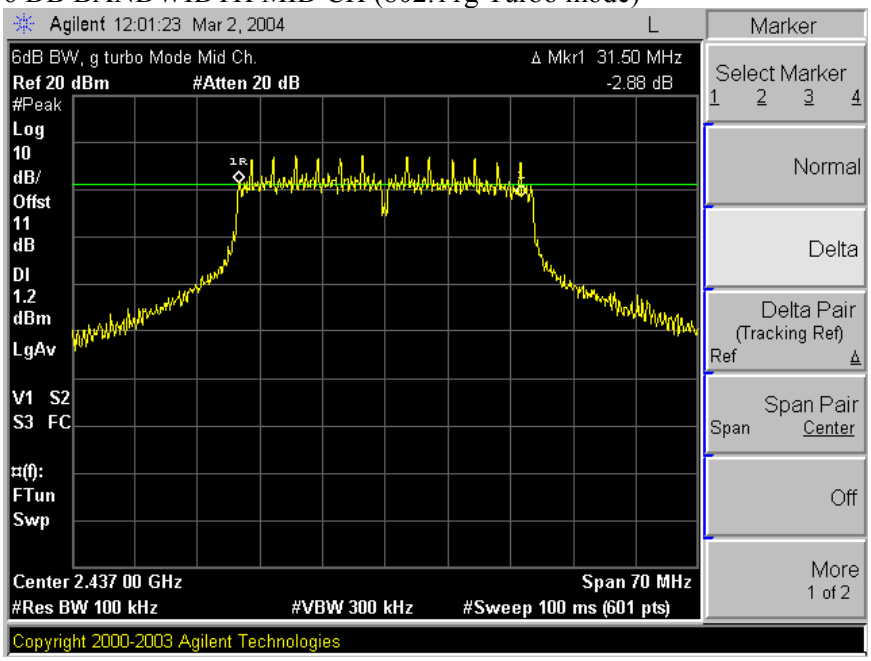


6 DB BANDWIDTH HIGH CH (802.11g mode)



6 DB BANDWIDTH (802.11g TURBO MODE)

6 DB BANDWIDTH MID CH (802.11g Turbo mode)



7.2. 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

2.4 GHz BAND RESULTS

No non-compliance noted:

802.11b Mode

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	15.64
Middle	2437	15.82
High	2462	15.37

802.11g Normal Mode

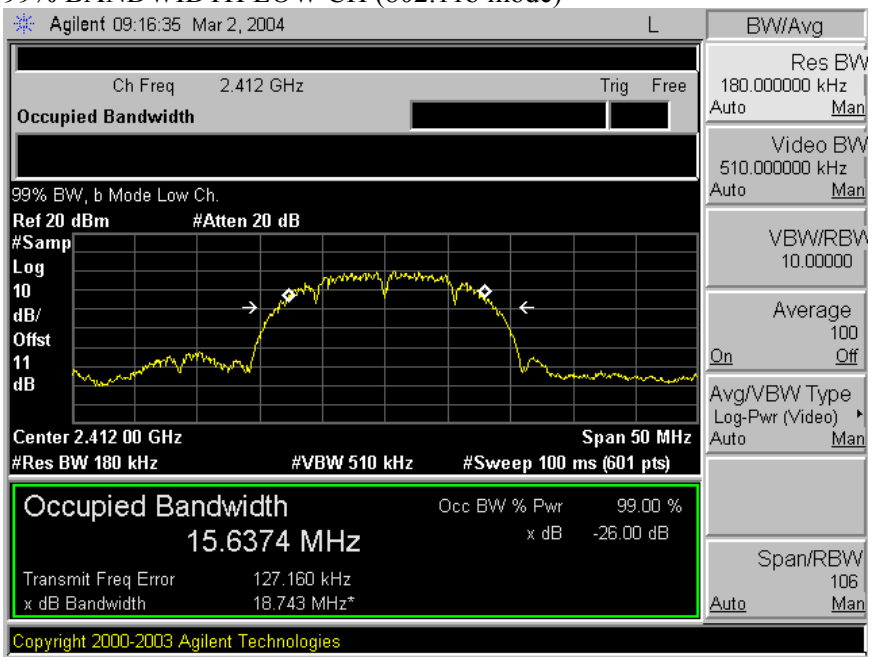
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	16.57
Middle	2437	16.43
High	2462	16.59

802.11g Turbo Mode

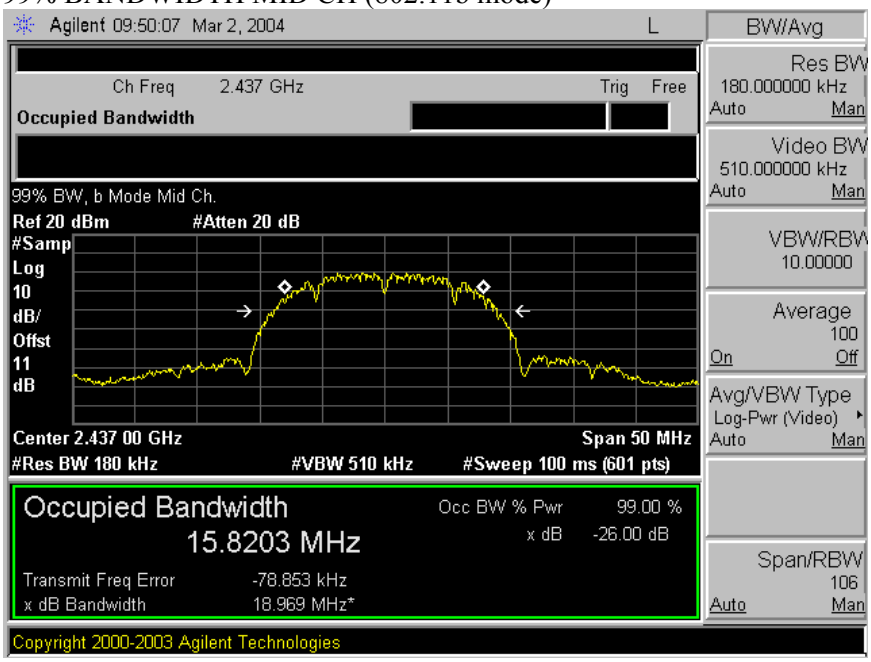
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Middle	2437	32.77

99% BANDWIDTH (802.11b MODE)

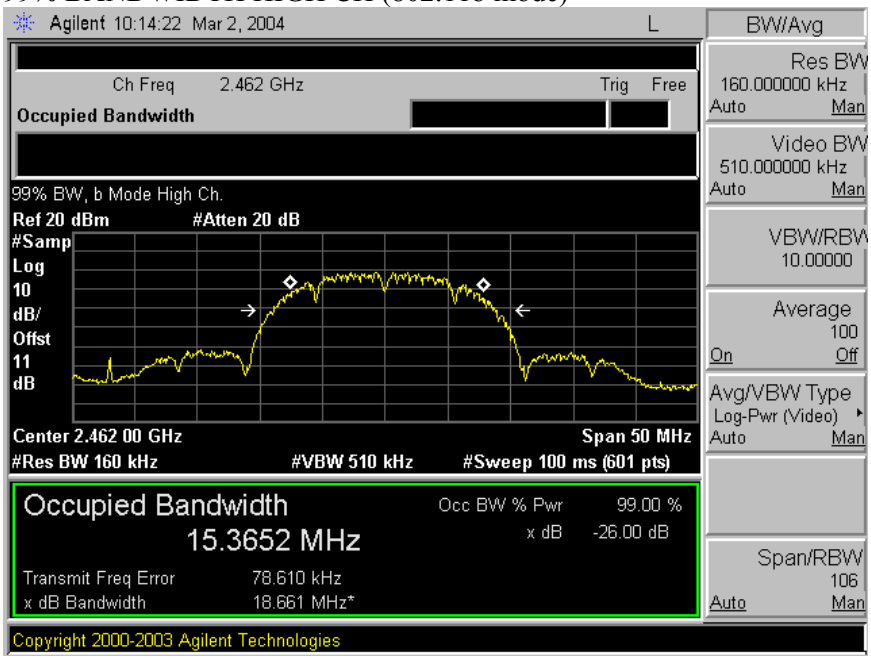
99% BANDWIDTH LOW CH (802.11b mode)



99% BANDWIDTH MID CH (802.11b mode)

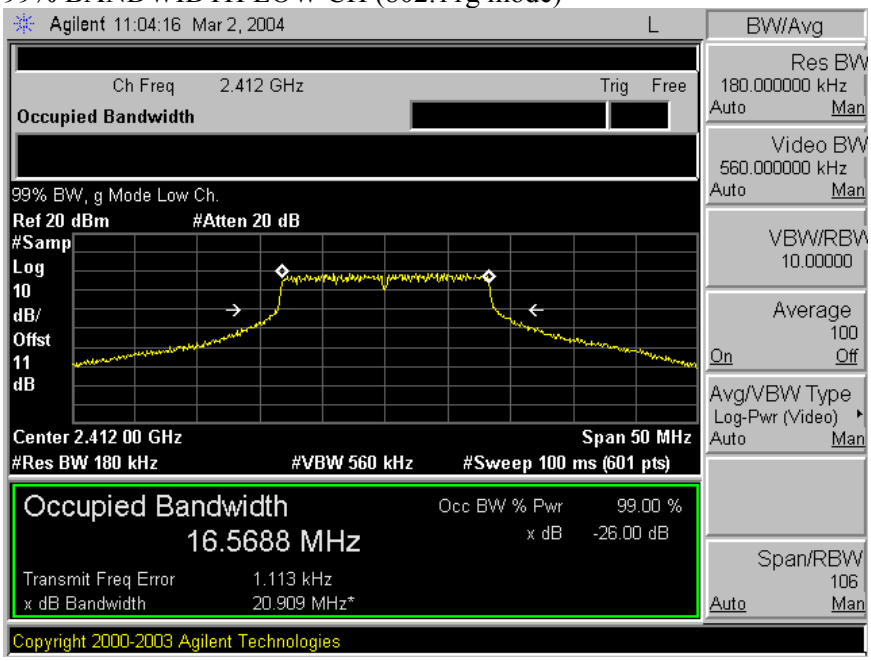


99% BANDWIDTH HIGH CH (802.11b mode)

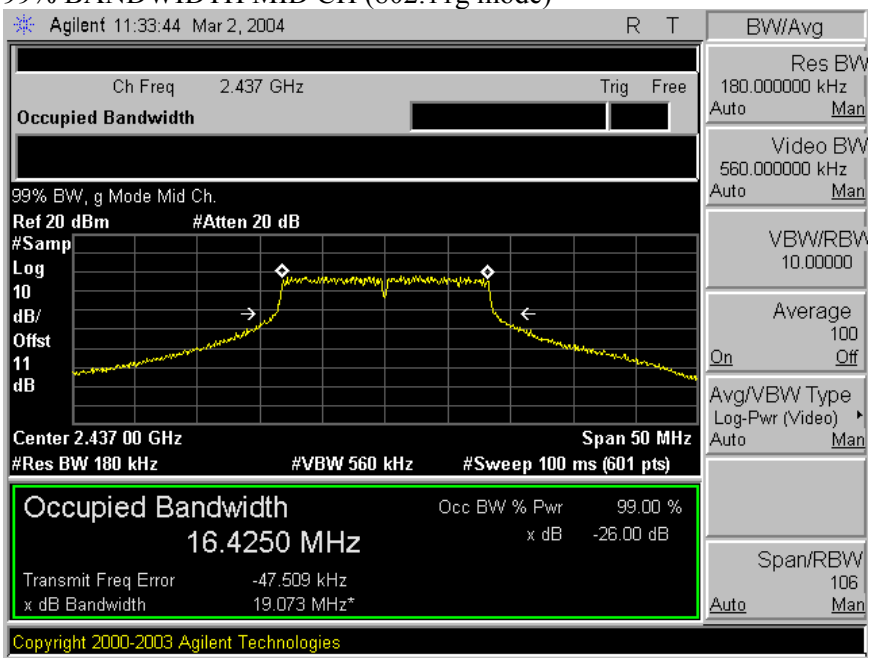


99% BANDWIDTH (802.11g MODE)

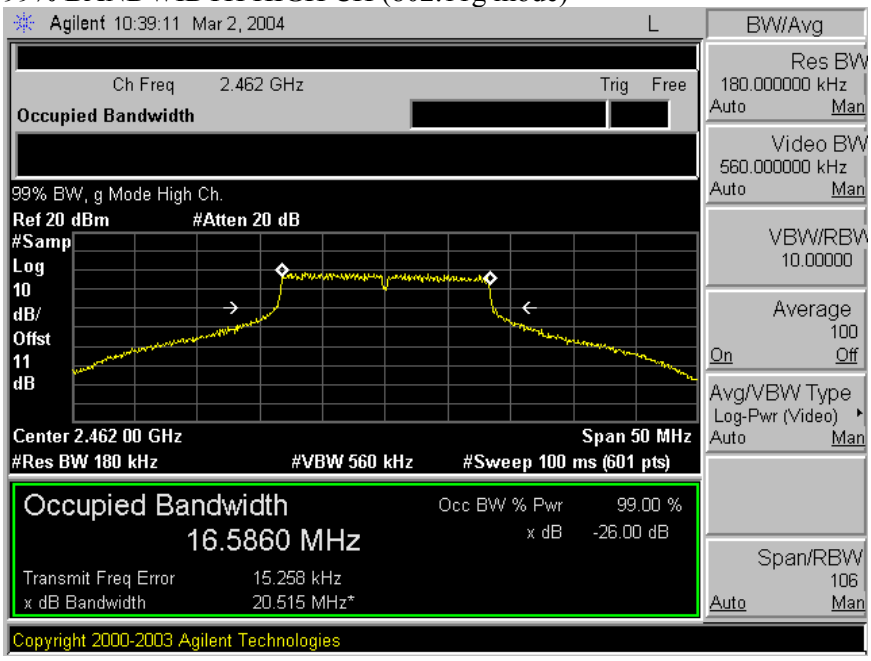
99% BANDWIDTH LOW CH (802.11g mode)



99% BANDWIDTH MID CH (802.11g mode)

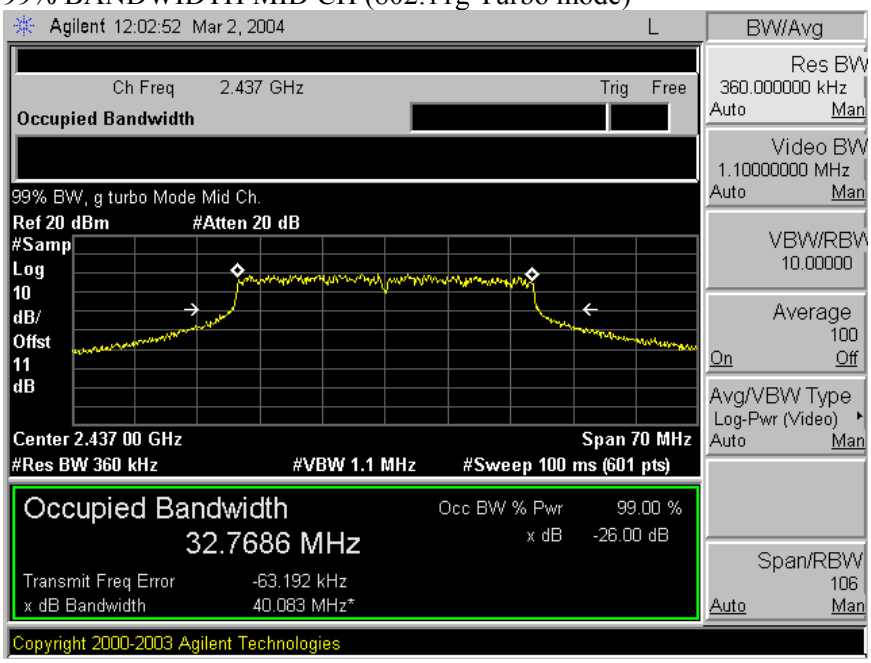


99% BANDWIDTH HIGH CH (802.11g mode)



99% BANDWIDTH (802.11g TURBO MODE)

99% BANDWIDTH MID CH (802.11g Turbo mode)



7.3. PEAK OUTPUT POWER

PEAK POWER LIMIT

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

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz , and 5725-5850 MHz bands: 1 watt.

§15.247 (b) (4) Except as shown in paragraphs (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 antenna gain is 4.24 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer and the analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth.

RESULTS

No non-compliance noted:

802.11b Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	20.25	30	-9.75
Middle	2437	20.62	30	-9.38
High	2462	20.12	30	-9.88

802.11g Normal Mode

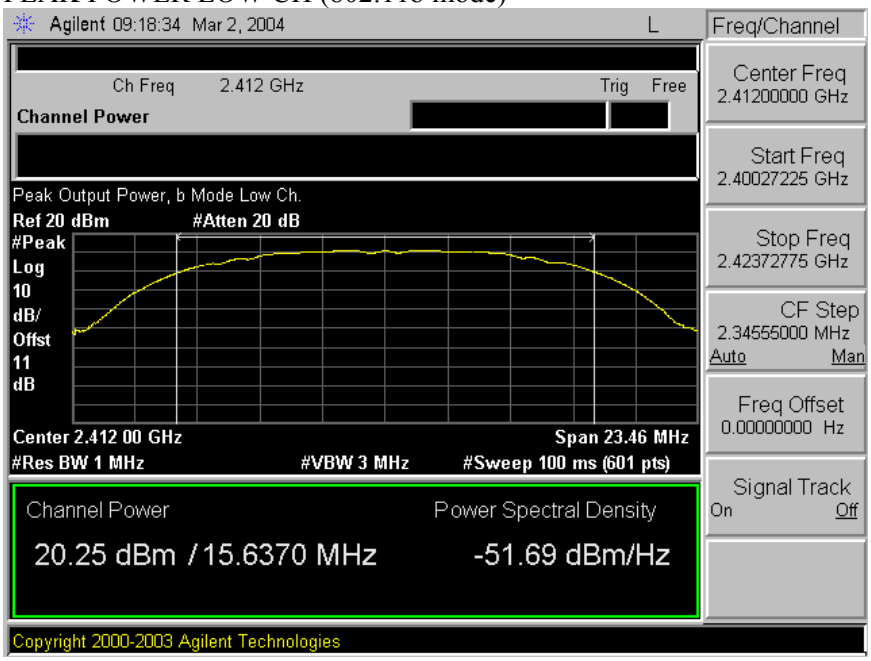
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	19.35	30	-4.58
Middle	2437	24.49	30	-5.51
High	2462	19.11	30	-4.92

802.11g Turbo Mode

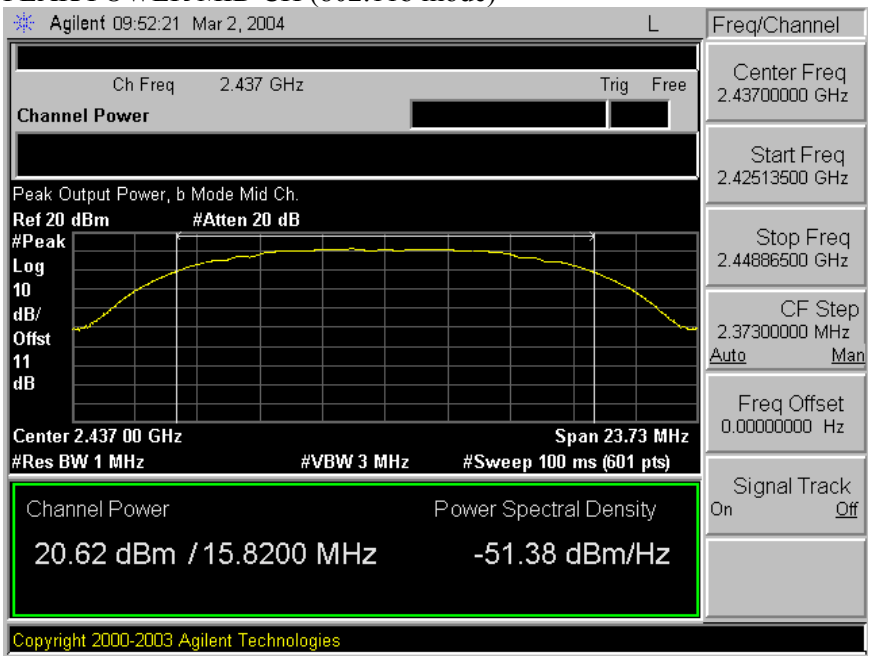
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Middle	2437	24.64	30	-5.36

OUTPUT POWER (802.11b MODE)

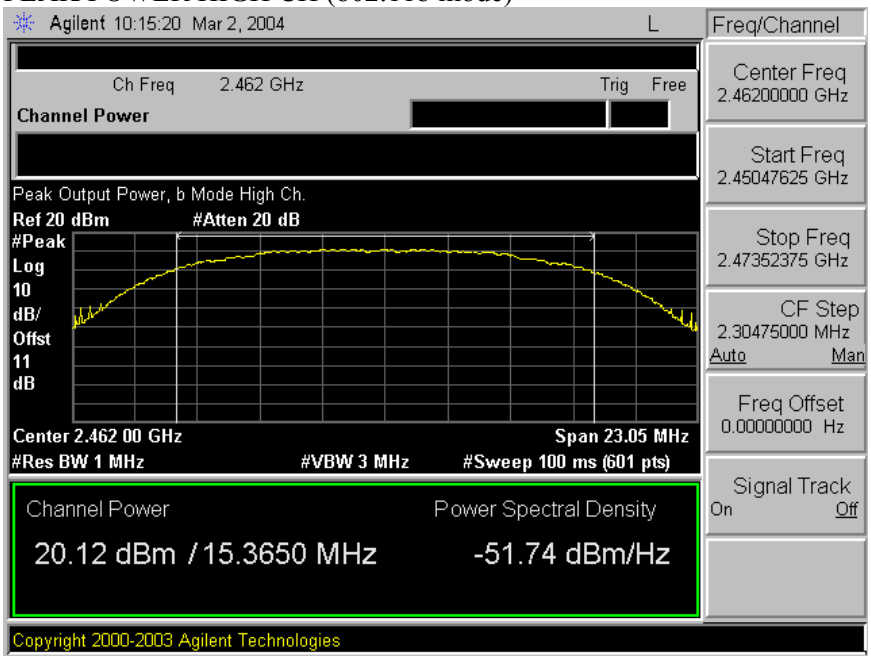
PEAK POWER LOW CH (802.11b mode)



PEAK POWER MID CH (802.11b mode)

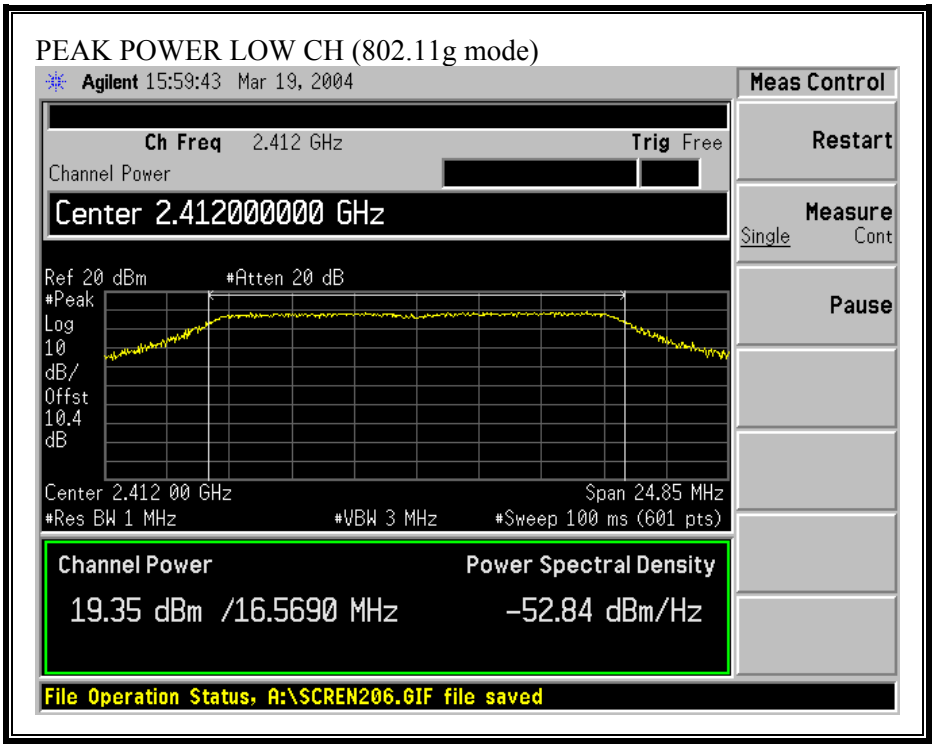


PEAK POWER HIGH CH (802.11b mode)

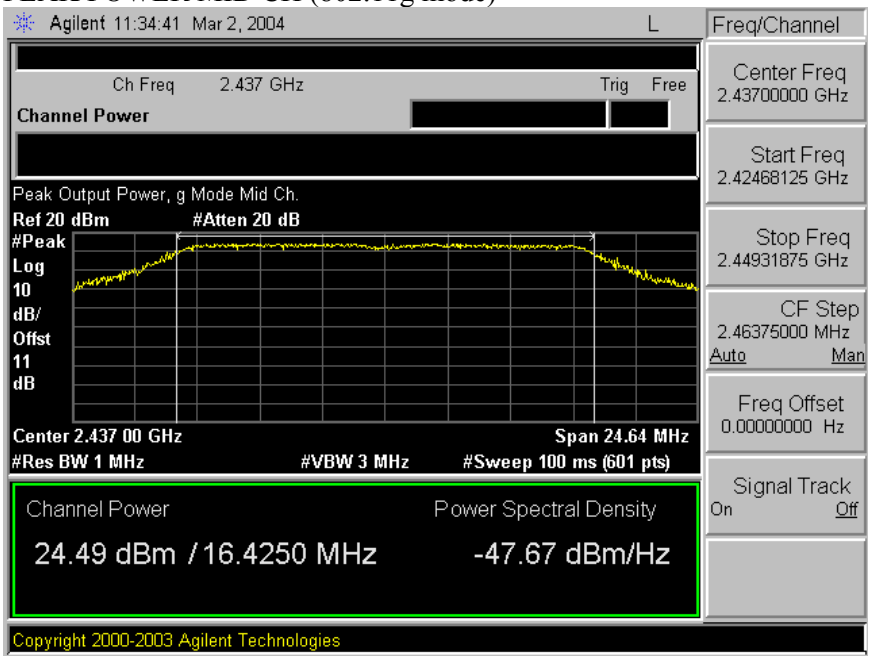


OUTPUT POWER (802.11g MODE)

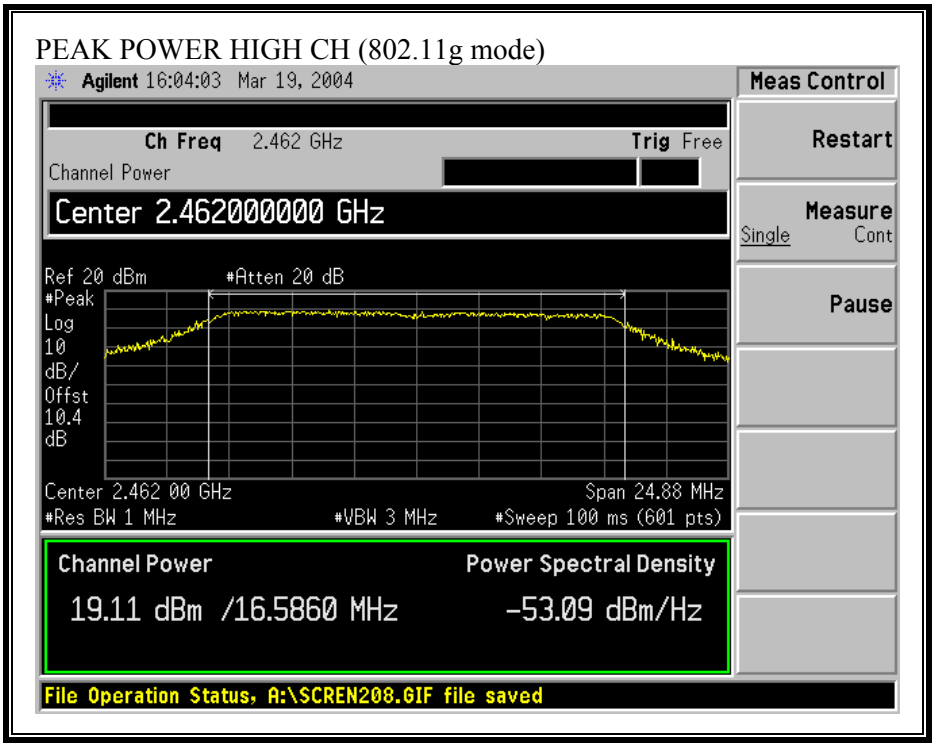
PEAK POWER LOW CH (802.11g mode)



PEAK POWER MID CH (802.11g mode)

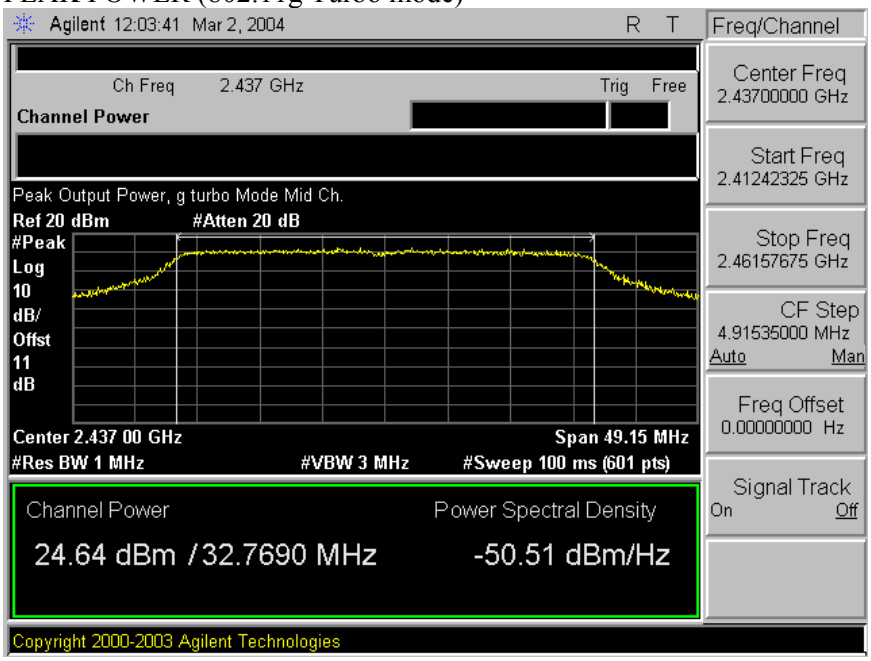


PEAK POWER HIGH CH (802.11g mode)



OUTPUT POWER (802.11g TURBO MODE)

PEAK POWER (802.11g Turbo mode)



7.4. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f^2)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f^2)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

CALCULATIONS

Given

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

and

$S = E \wedge 2 / 3770$

where

E = Field Strength in Volts/meter
P = Power in Watts
G = Numeric antenna gain
d = Distance in meters
S = Power Density in milliwatts/square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

$d = \sqrt{((30 * P * G) / (3770 * S))}$

Changing to units of Power to mW and Distance to cm, using:

P (mW) = P (W) / 1000 and
d (cm) =100 * d (m)

yields

$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$
$d = 0.282 * \sqrt{(P * G / S)}$

where

d = distance in cm
P = Power in mW
G = Numeric antenna gain
S = Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P (mW) = 10 ^ (P (dBm) / 10) and
G (numeric) = 10 ^ (G (dBi) / 10)

yields

$d = 0.282 * 10 \wedge ((P + G) / 20) / \sqrt{S}$ Equation (1)

where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW/cm^2

Equation (1) and the measured peak power is used to calculate the MPE distance.

LIMITS

From §1.1310 Table 1 (B), S = 1.0 mW/cm^2

RESULTS

No non-compliance noted:

Mode	Power Density Limit (mW/cm^2)	Output Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)
802.11b	1.0	20.62	4.24	4.93
802.11g	1.0	24.49	4.24	7.70
802.11g Turbo	1.0	24.64	4.24	7.84

NOTE: For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.

7.5. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

No non-compliance noted:

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

802.11b Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	2412	18.90
Middle	2437	19.30
High	2462	18.70

802.11g Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	2412	16.30
Middle	2437	18.90
High	2462	16.20

802.11g Turbo Mode

Channel	Frequency (MHz)	Average Power (dBm)
Middle	2437	18.60

7.6. 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.

TEST PROCEDURE

The transmitter output 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 > 3 kHz, sweep time = span / 3 kHz, and video averaging is turned off. The PPSD is the highest level found across the emission in any 3 kHz band.

RESULTS

No non-compliance noted:

802.11b Mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-6.37	8	-14.37
Middle	2437	-4.75	8	-12.75
High	2462	-6.58	8	-14.58

802.11g Normal Mode

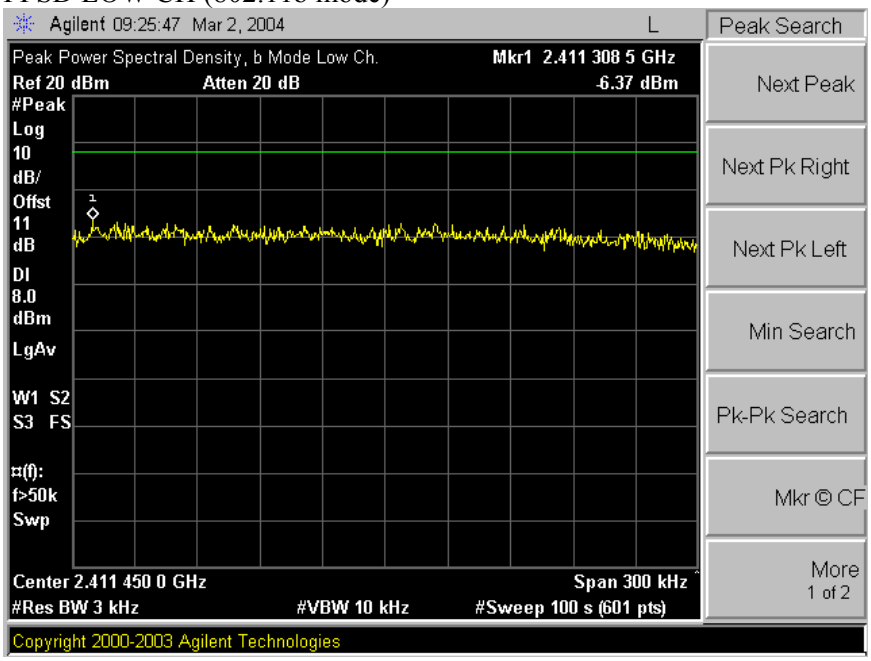
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-12.88	8	-20.88
Middle	2437	-6.54	8	-14.54
High	2462	-11.49	8	-19.49

802.11g Turbo Mode

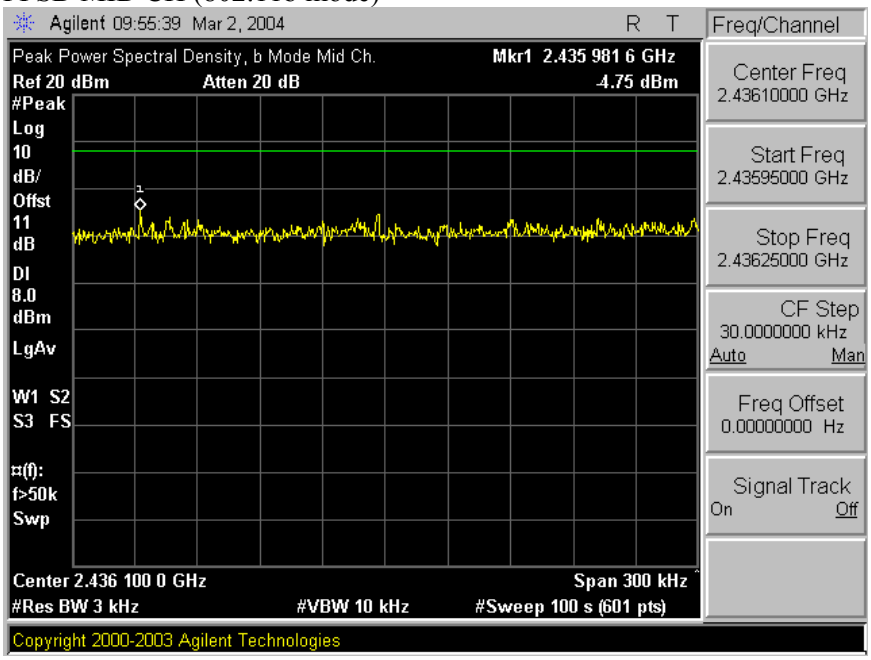
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Middle	2437	-8.48	8	-16.48

PEAK POWER SPECTRAL DENSITY (802.11b MODE)

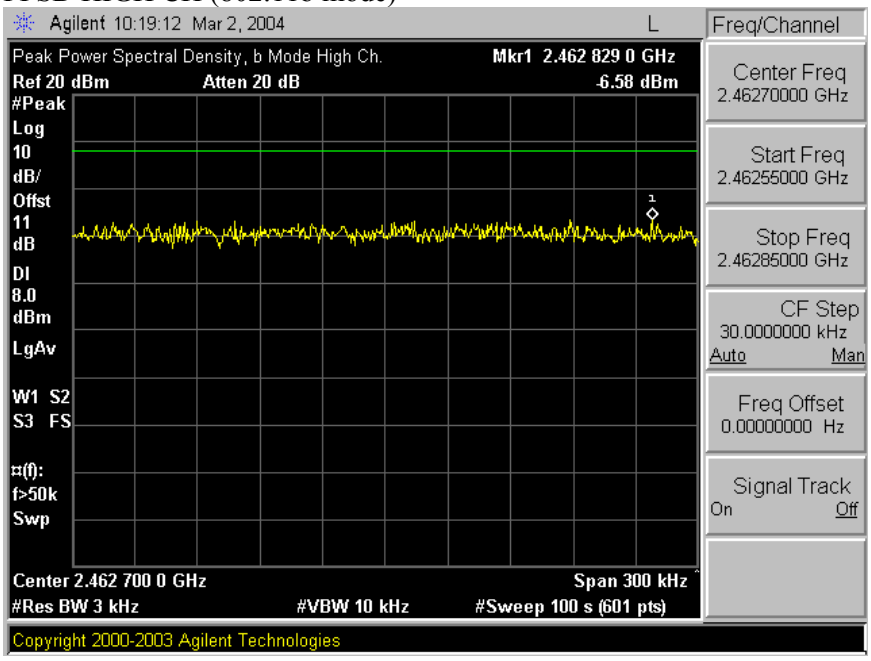
PPSD LOW CH (802.11b mode)



PPSD MID CH (802.11b mode)

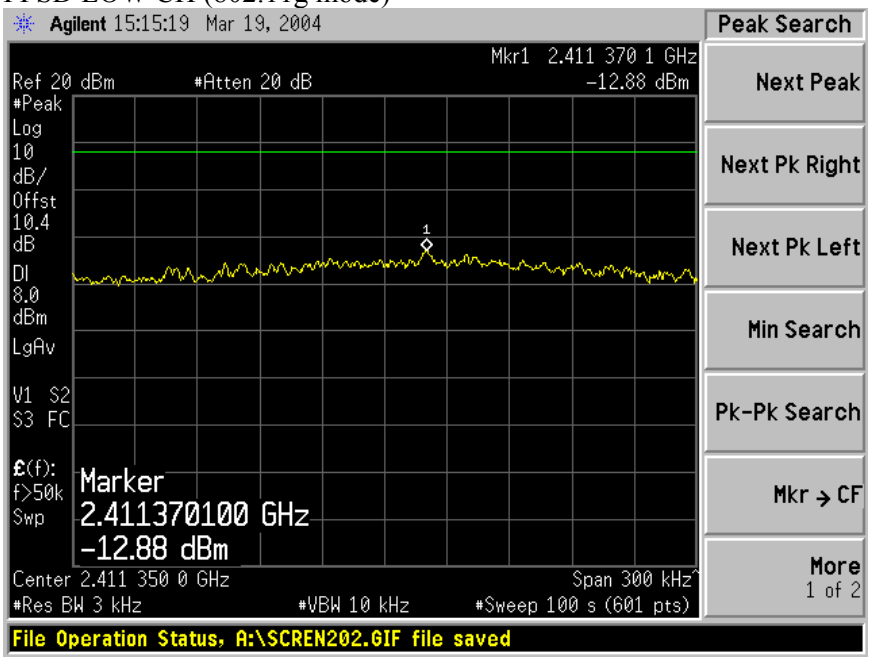


PPSD HIGH CH (802.11b mode)

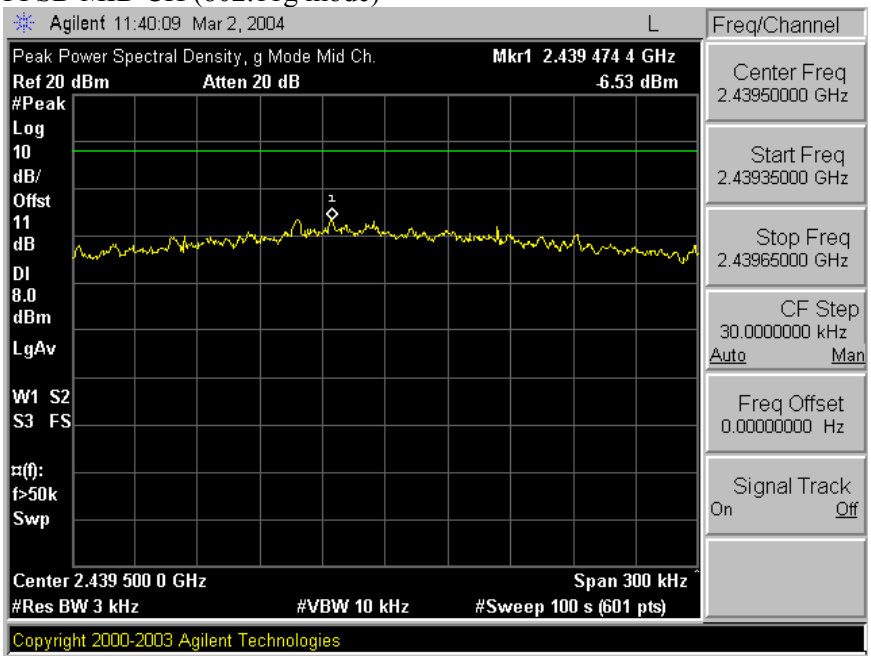


PEAK POWER SPECTRAL DENSITY (802.11g MODE)

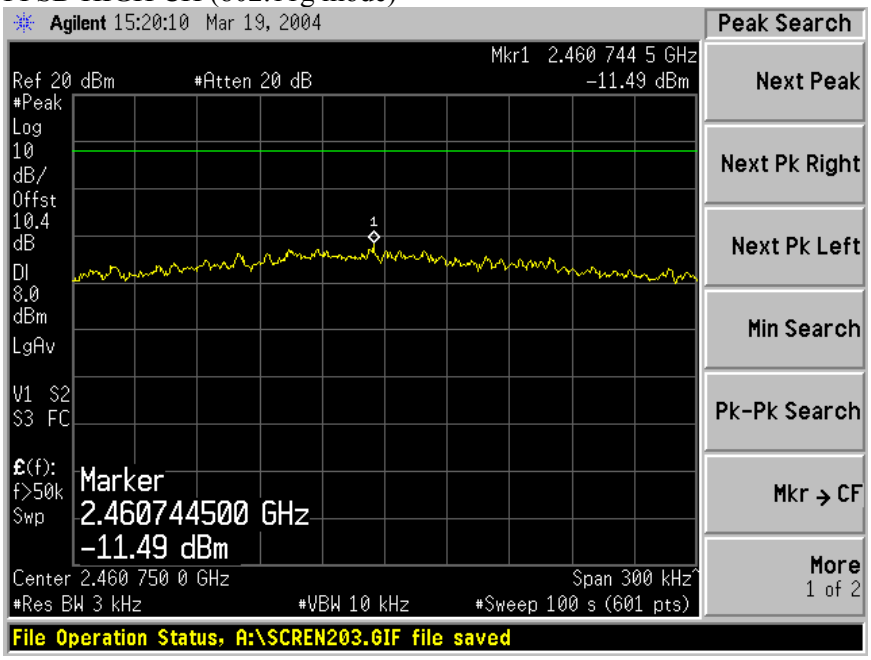
PPSD LOW CH (802.11g mode)



PPSD MID CH (802.11g mode)

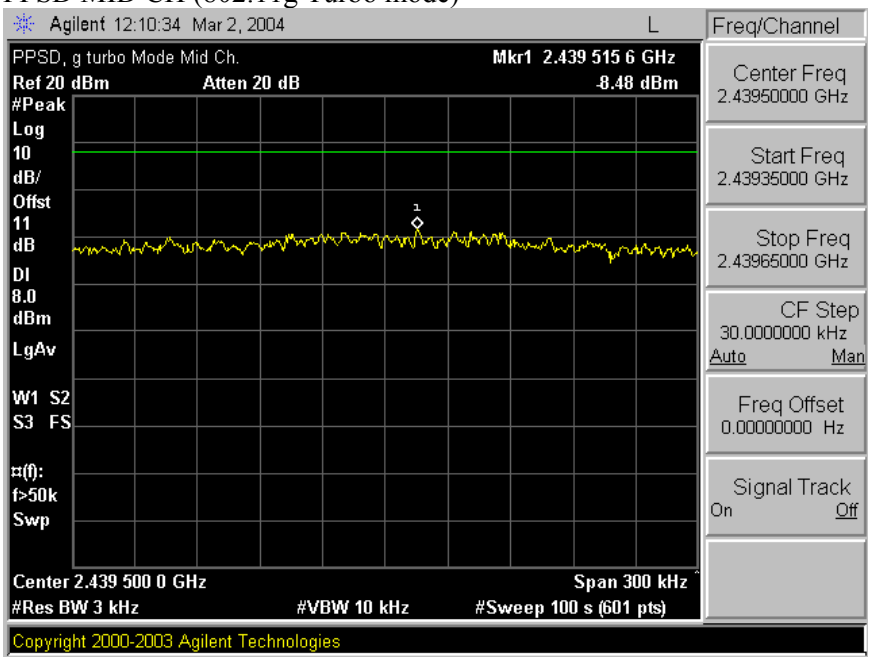


PPSD HIGH CH (802.11g mode)



PEAK POWER SPECTRAL DENSITY (802.11g TURBO MODE)

PPSD MID CH (802.11g Turbo mode)



7.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

§15.247 (c) 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 the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in§15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

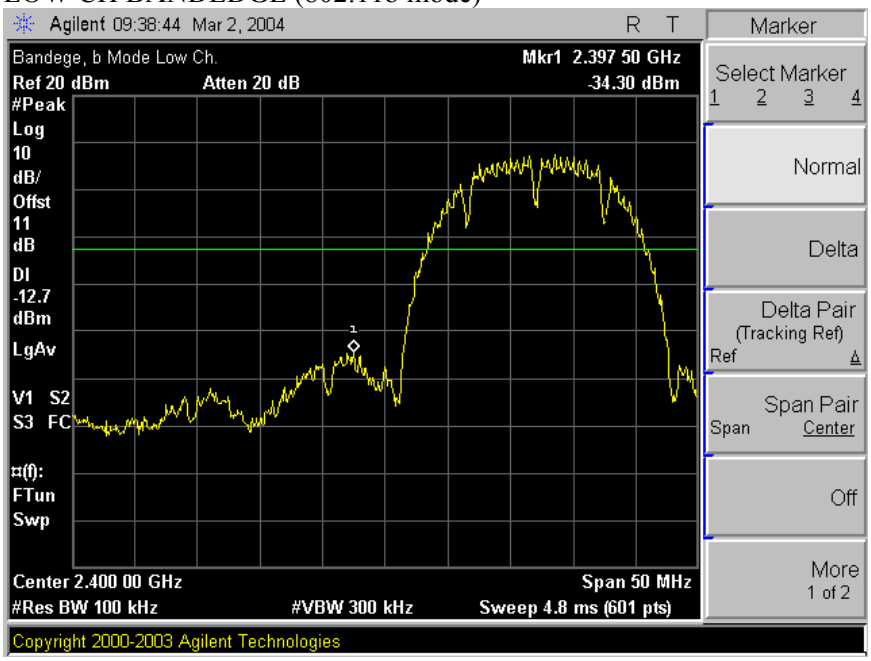
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

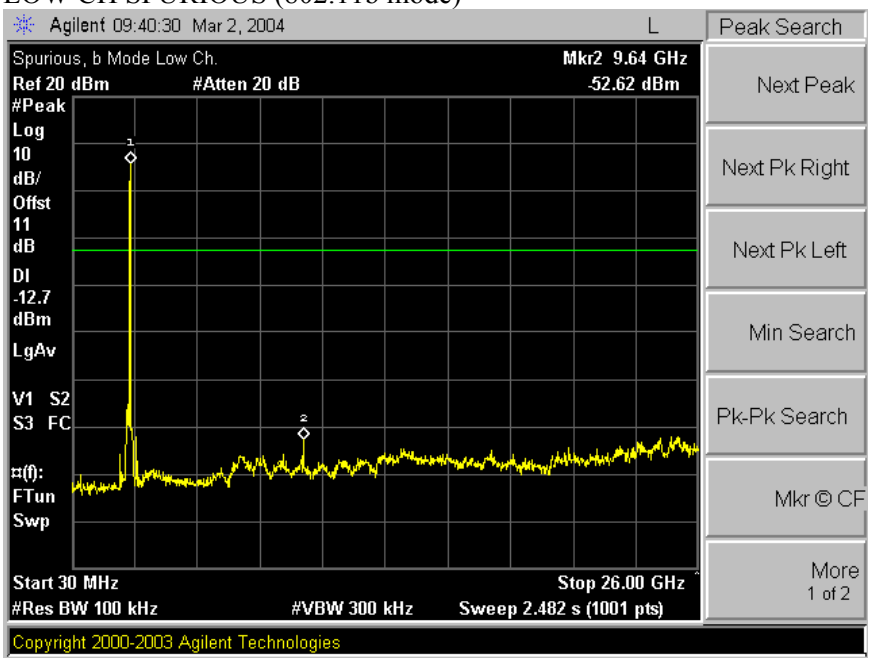
No non-compliance noted:

SPURIOUS EMISSIONS, LOW CHANNEL (802.11b MODE)

LOW CH BANDEDGE (802.11b mode)

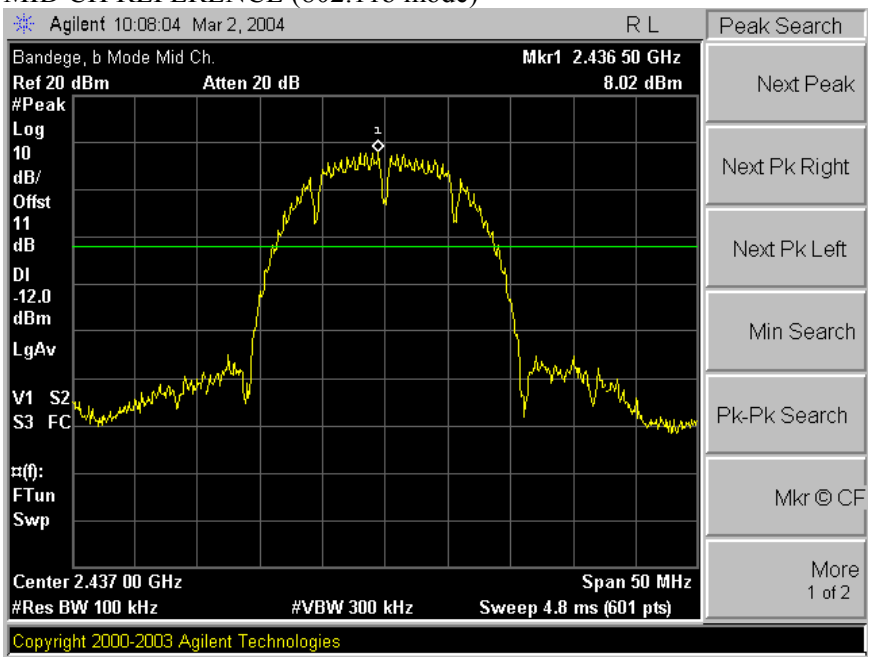


LOW CH SPURIOUS (802.11b mode)

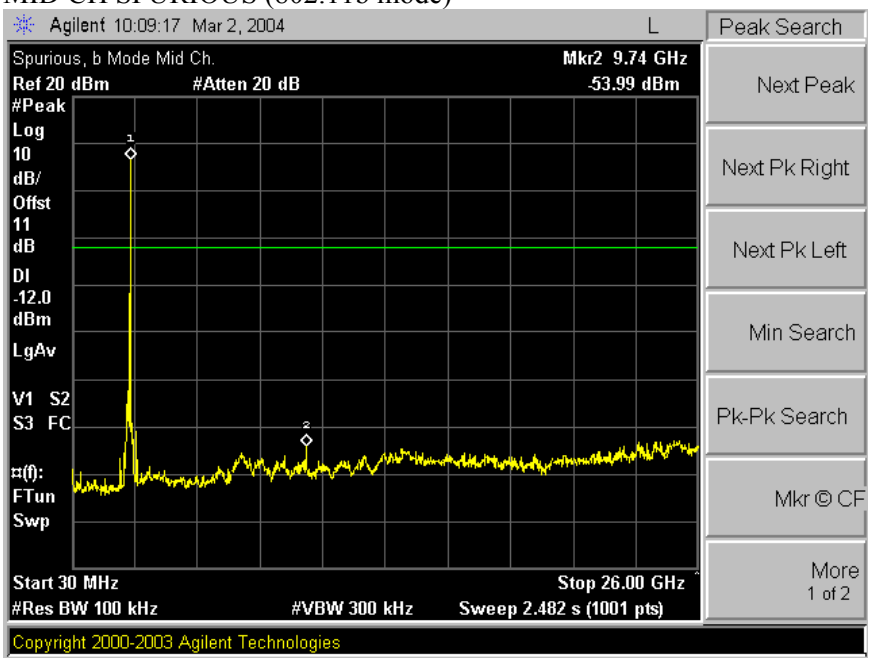


SPURIOUS EMISSIONS, MID CHANNEL (802.11b MODE)

MID CH REFERENCE (802.11b mode)

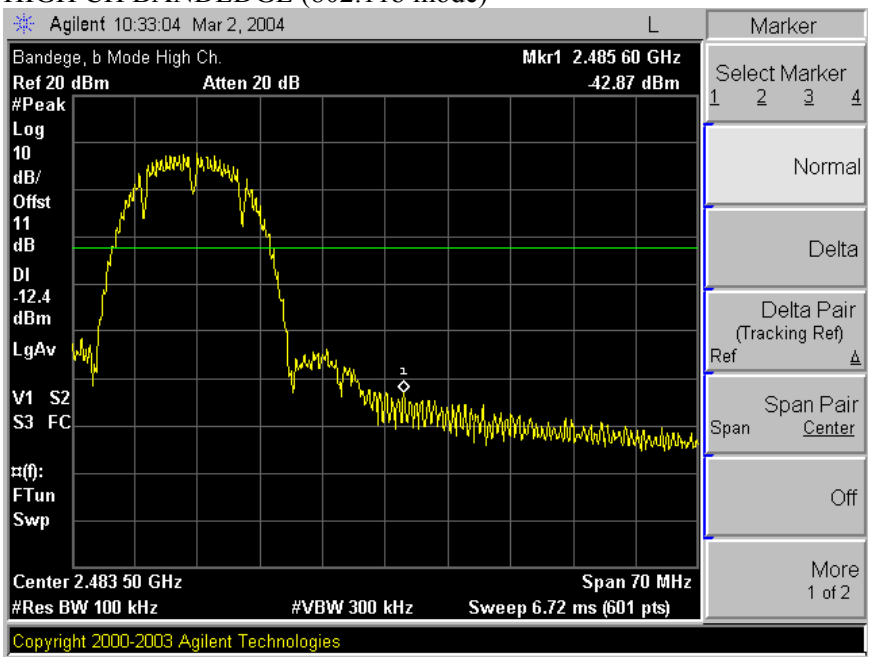


MID CH SPURIOUS (802.11b mode)

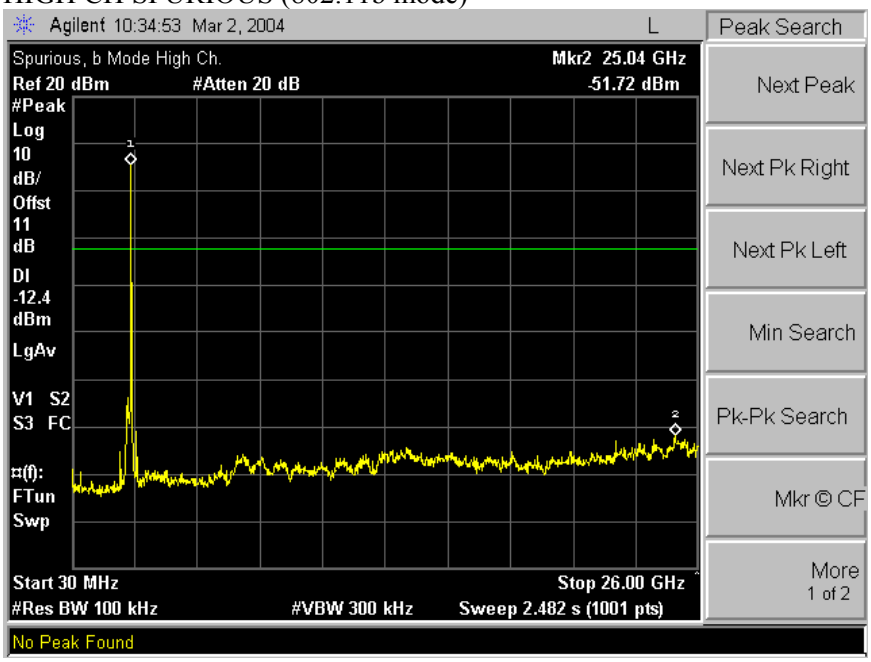


SPURIOUS EMISSIONS, HIGH CHANNEL (802.11b MODE)

HIGH CH BANDEDGE (802.11b mode)

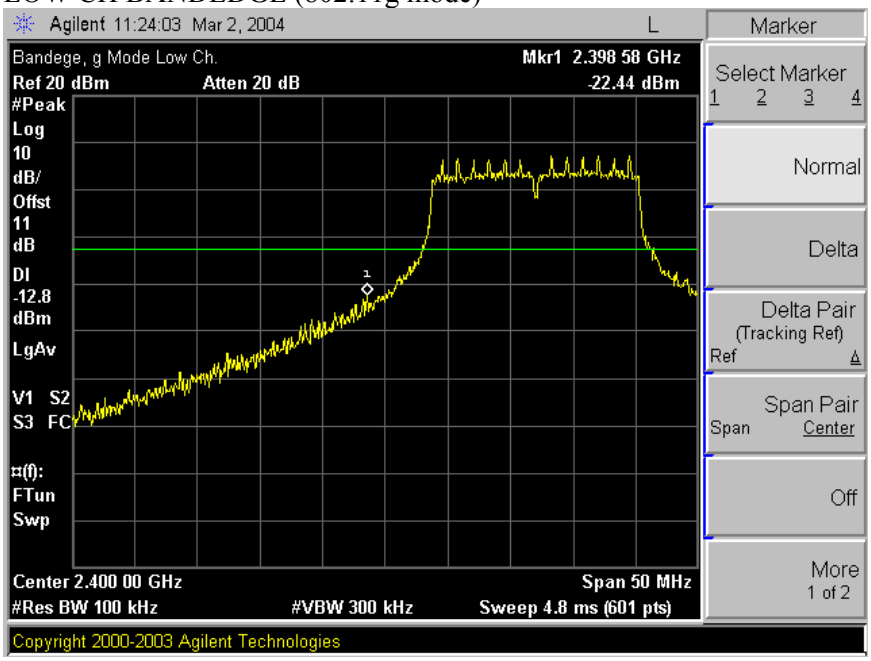


HIGH CH SPURIOUS (802.11b mode)

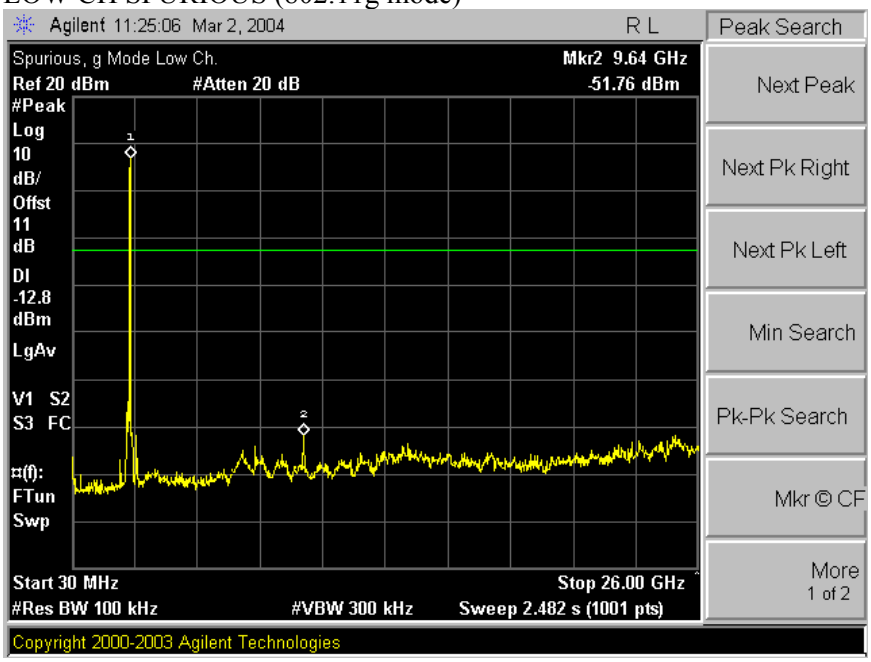


SPURIOUS EMISSIONS, LOW CHANNEL (802.11g MODE)

LOW CH BANDEDGE (802.11g mode)

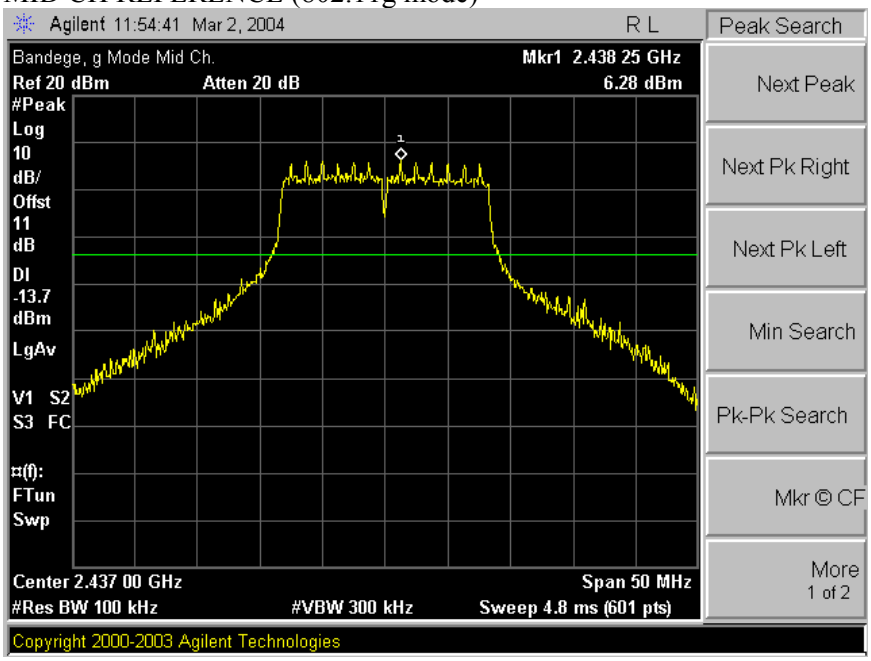


LOW CH SPURIOUS (802.11g mode)

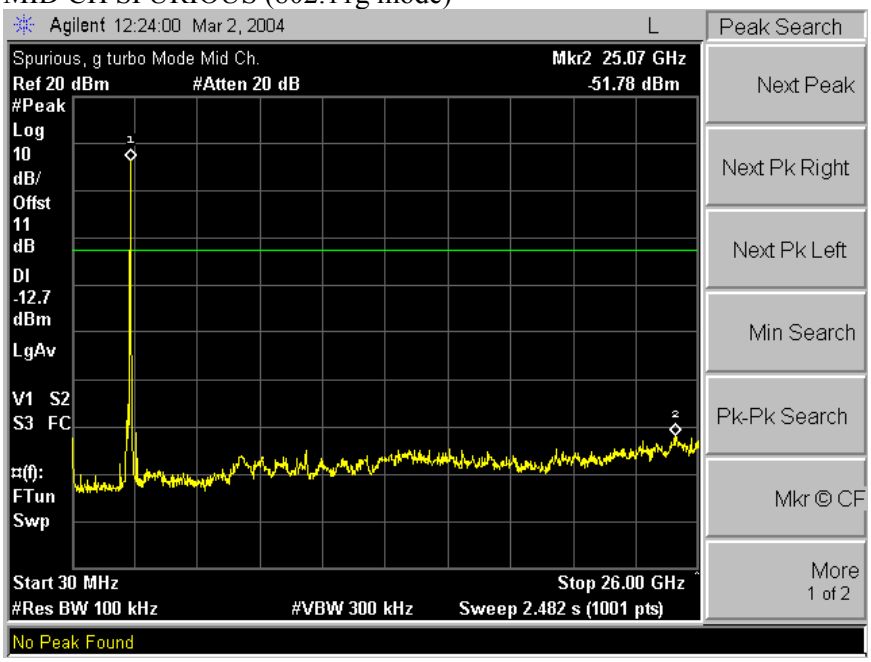


SPURIOUS EMISSIONS, MID CHANNEL (802.11g MODE)

MID CH REFERENCE (802.11g mode)

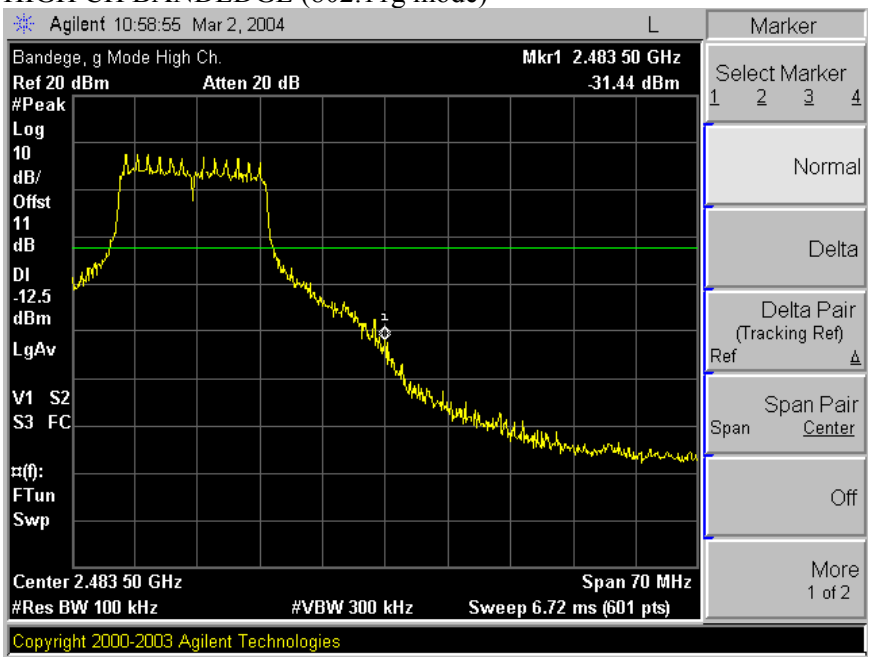


MID CH SPURIOUS (802.11g mode)

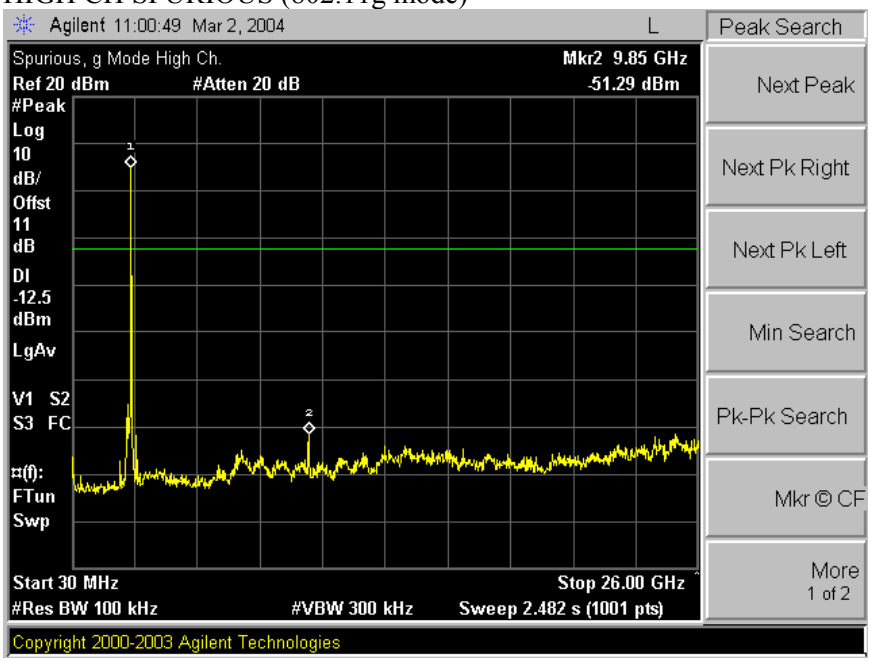


SPURIOUS EMISSIONS, HIGH CHANNEL (802.11g MODE)

HIGH CH BANDEDGE (802.11g mode)

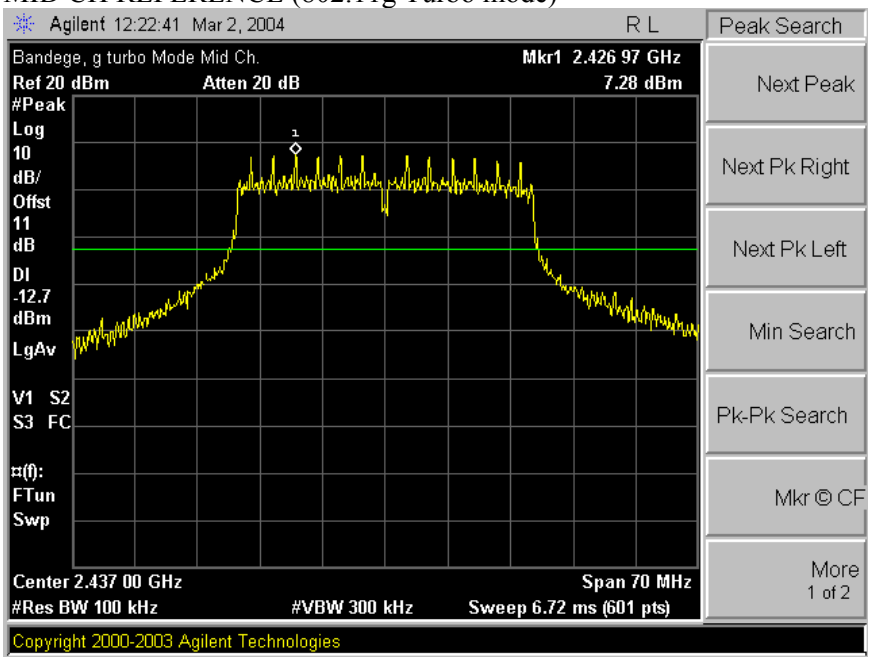


HIGH CH SPURIOUS (802.11g mode)

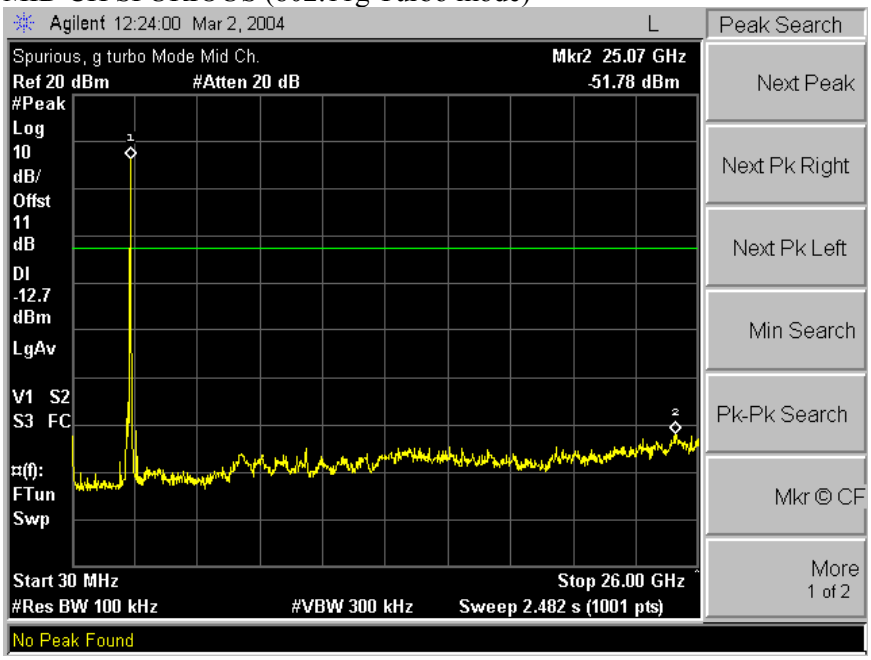


SPURIOUS EMISSIONS, MID CHANNEL (802.11g TURBO MODE)

MID CH REFERENCE (802.11g Turbo mode)



MID CH SPURIOUS (802.11g Turbo mode)



7.8. RADIATED EMISSIONS

7.8.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS

LIMITS

§15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

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	2655 - 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

§15.205 (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.

§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.

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

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

The worst-case operating point for radiated emissions tests below 1 GHz is determined by the mode and channel that operates at the highest peak output power level.

The correction factor to convert the received voltage (dBuV) to field strength (dBuV/m) is entered as a reference level offset in the spectrum analyzer to allow for direct reading of field strength.

RESULTS

For radiated emissions tests below 1 GHz the EUT is set to the 802.11g Turbo mode at 2437 MHz, at an average power setting of 18.6 dBm, peak power level of 24.64 dBm.

No non-compliance noted:

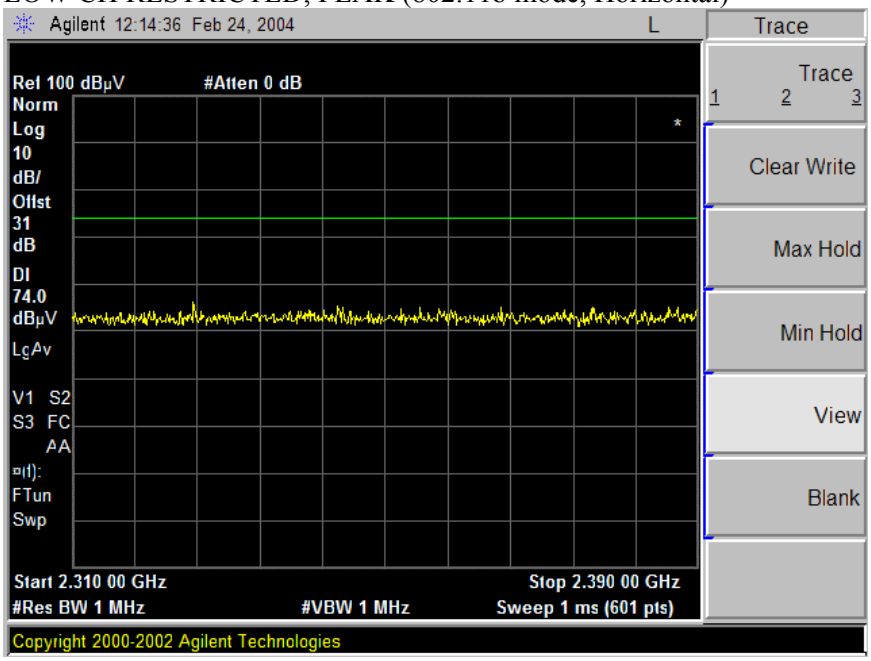
7.8.2. TRANSMITTER RADIATED EMISSIONS ABOVE 1 GHZ

CORRECTION FACTOR FOR RESTRICTED BANDEDGE MEASUREMENTS

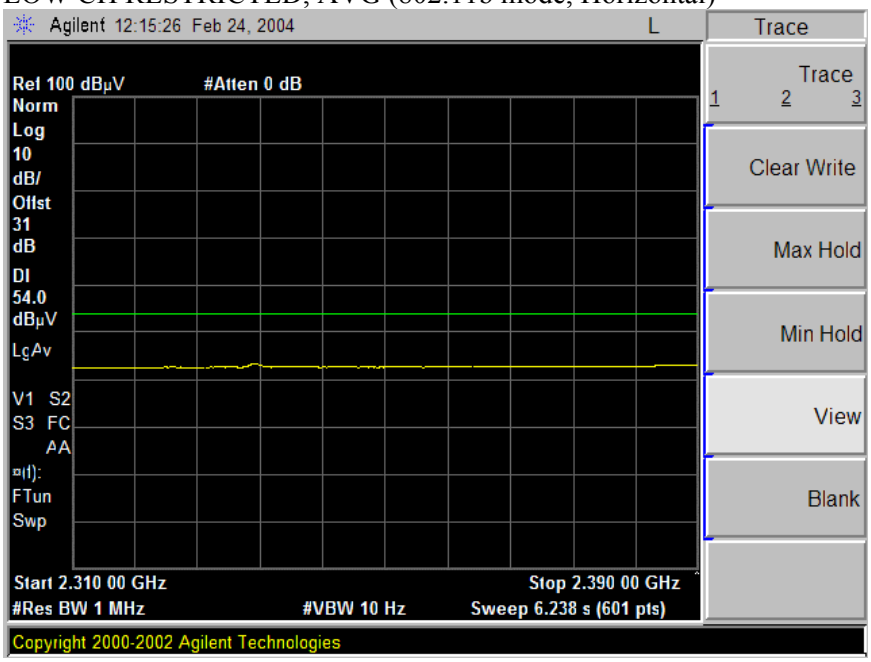
The reference level offset is equal to the test antenna gain + the test cable loss (29.4 dBi + 1.6 dBm)

RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, HORIZONTAL)

LOW CH RESTRICTED, PEAK (802.11b mode, Horizontal)

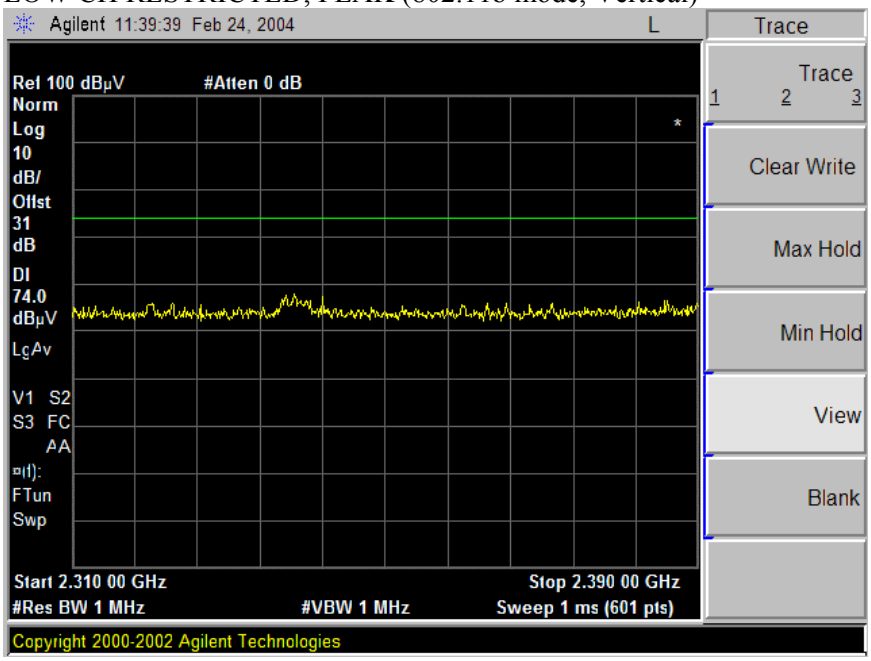


LOW CH RESTRICTED, AVG (802.11b mode, Horizontal)

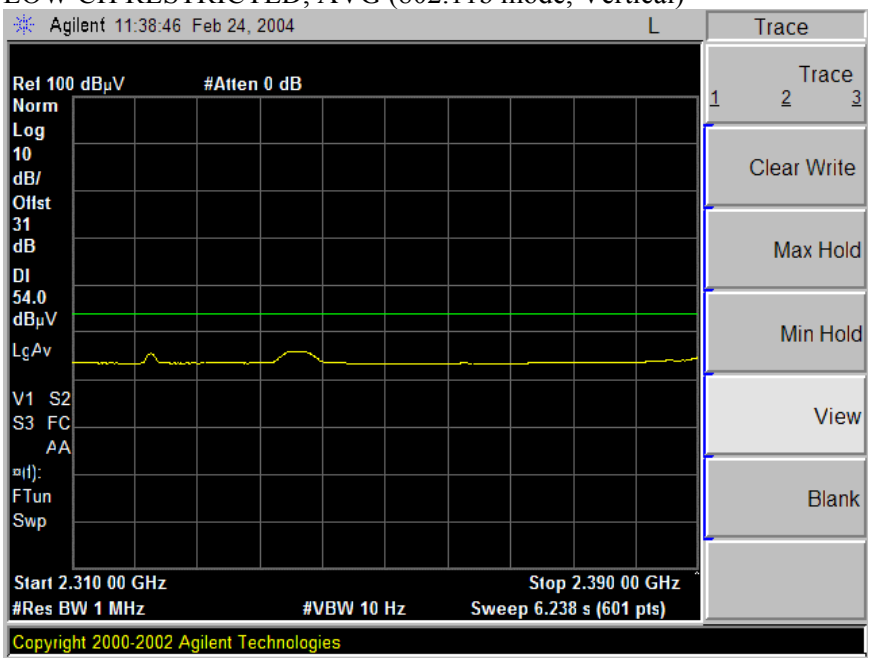


RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, VERTICAL)

LOW CH RESTRICTED, PEAK (802.11b mode, Vertical)

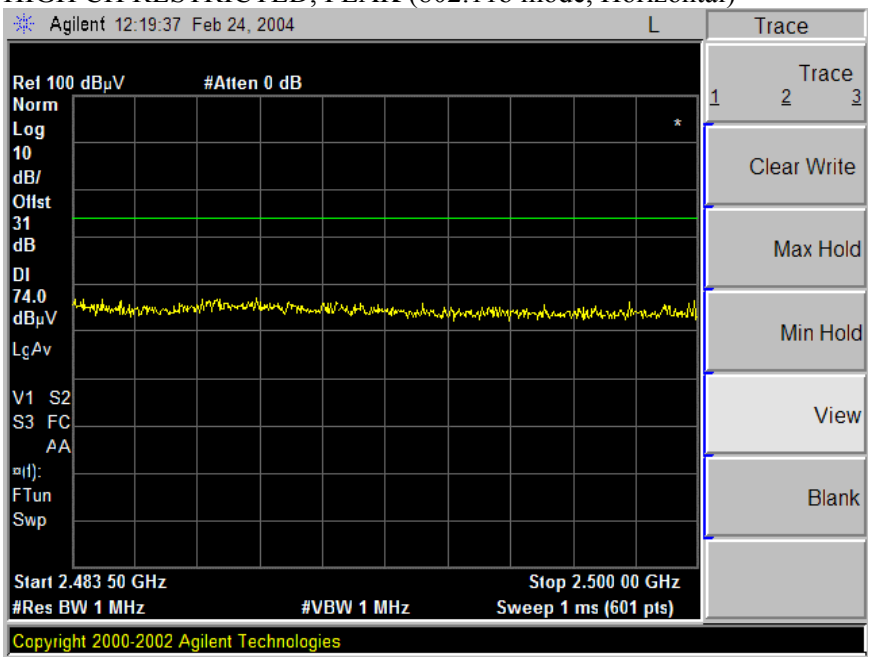


LOW CH RESTRICTED, AVG (802.11b mode, Vertical)

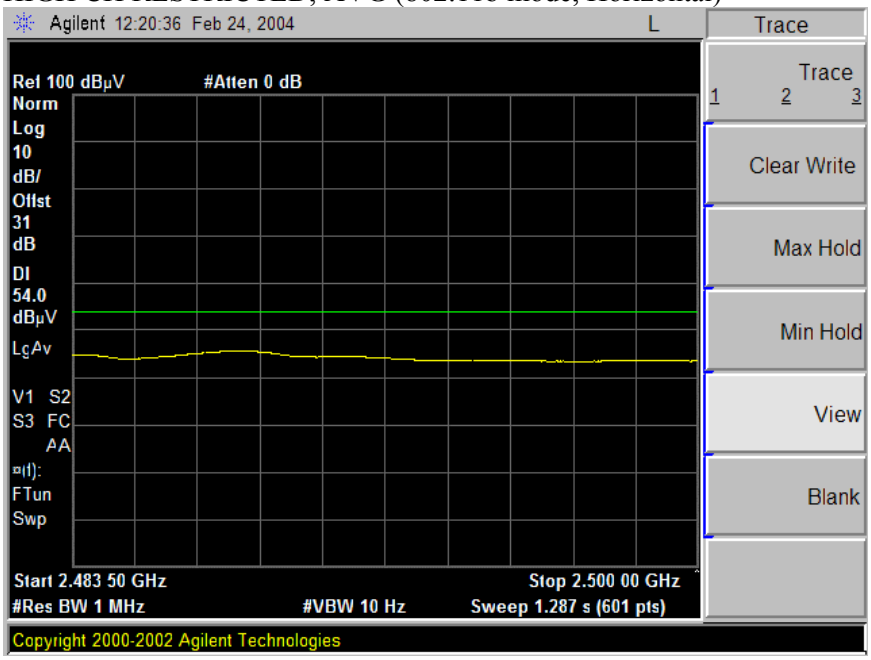


RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, HORIZONTAL)

HIGH CH RESTRICTED, PEAK (802.11b mode, Horizontal)

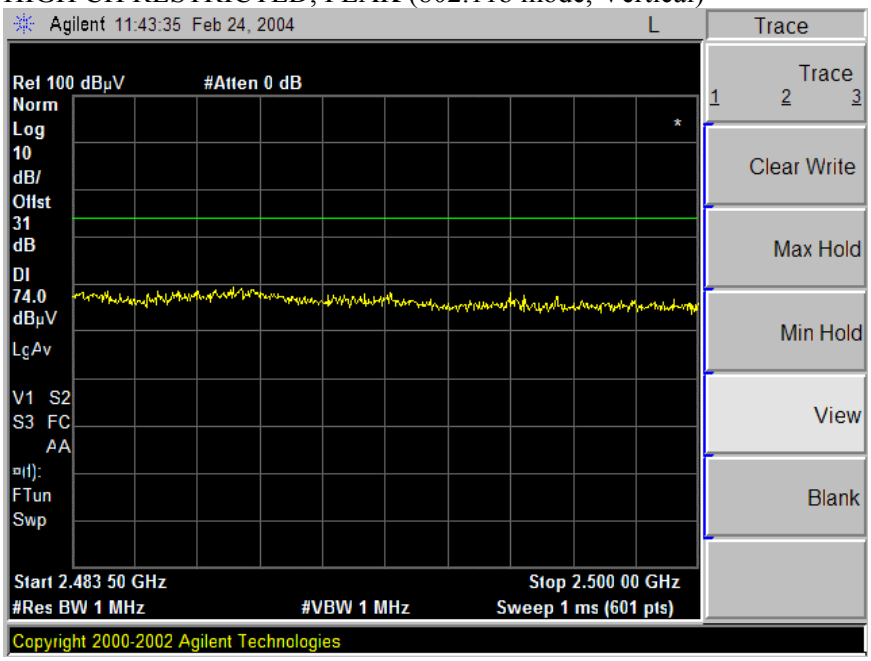


HIGH CH RESTRICTED, AVG (802.11b mode, Horizontal)

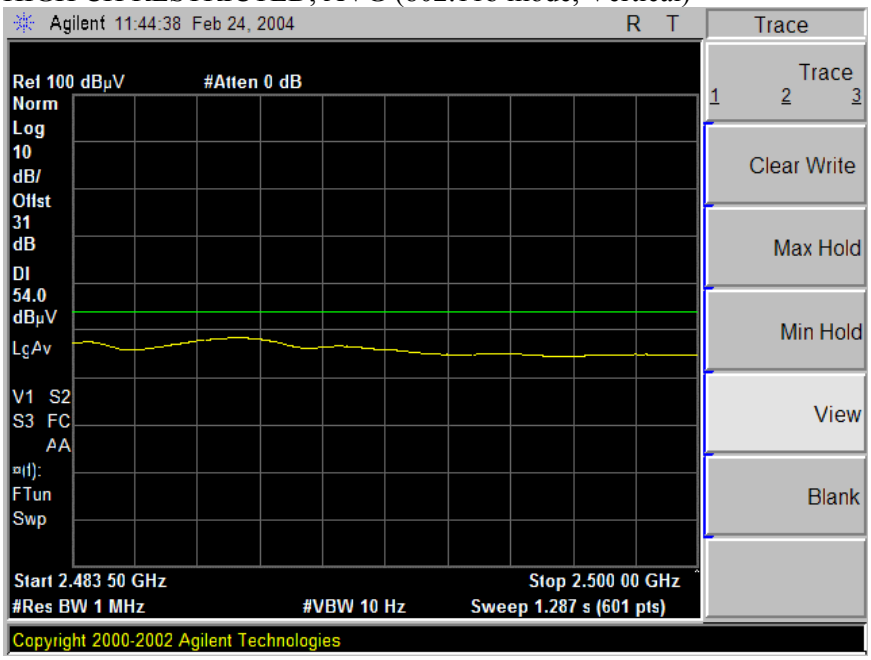


RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, VERTICAL)

HIGH CH RESTRICTED, PEAK (802.11b mode, Vertical)



HIGH CH RESTRICTED, AVG (802.11b mode, Vertical)



HARMONICS AND SPURIOUS EMISSIONS (b MODE)

02/24/04 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: David Garcia
Project #: 04U2554
Company: Atheros Communications, Inc.
EUT Descrip.:
EUT M/N: MB43
Test Target:
Mode Oper: ART program

Test Equipment:

EMCO Horn 1-18GHz	Spectrum Analyzer	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz
T59; S/N: 3245 @3m	Agilent E4446A Analyzer	T63 Miteq 646456		

Hi Frequency Cables: ☑ (2 ft) ☐ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☑ (12 ft)

Limit: FCC 15.209

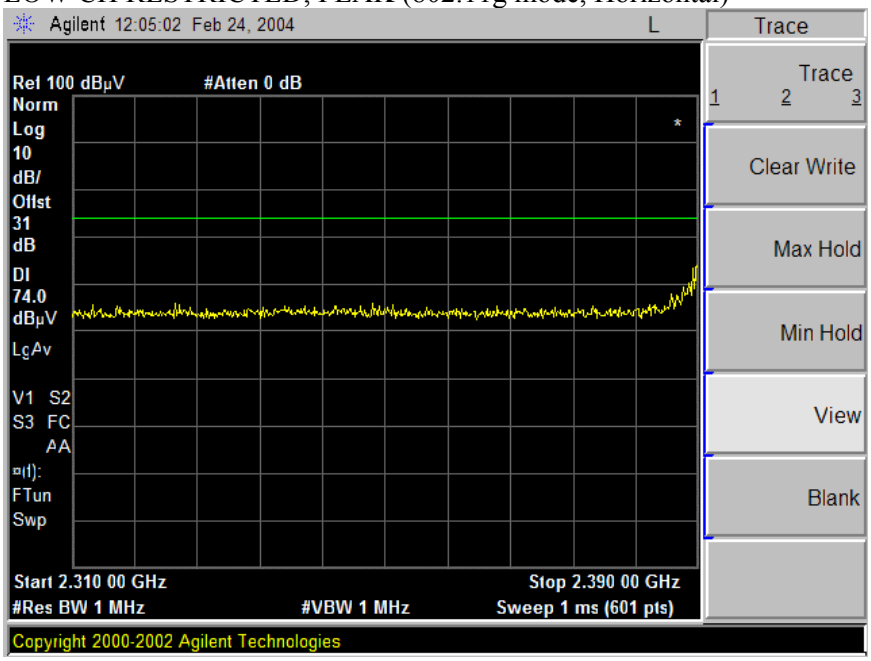
Peak Measurements: 1 MHz Resolution Bandwidth, 1MHz Video Bandwidth
Average Measurements: 1 MHz Resolution Bandwidth, 10Hz Video Bandwidth

f GHz	Dist feet	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	HPF	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes
11b low															
4.824	9.8	48.6	39.4	33.1	2.9	-35.3	0.0	1.0	50.2	41.0	74.0	54.0	-23.8	-13.0	V
9.648	9.8	46.8	39.1	37.9	4.0	-33.3	0.0	1.0	56.3	48.6	74.0	54.0	-17.7	-5.4	V
11b mid															
4.874	9.8	46.1	36.3	33.1	2.9	-35.3	0.0	1.0	47.7	37.9	74.0	54.0	-26.3	-16.1	V
9.748	9.8	43.6	34.5	37.8	4.1	-33.4	0.0	1.0	53.1	44.0	74.0	54.0	-20.9	-10.0	V
11b high															
4.924	9.8	46.9	37.0	33.1	2.9	-35.3	0.0	1.0	48.6	38.7	74.0	54.0	-25.4	-15.3	V
9.848	9.8	44.8	34.8	37.7	4.1	-33.4	0.0	1.0	54.2	44.2	74.0	54.0	-19.8	-9.8	V
11b low															
4.824	9.8	46.7	39.1	33.1	2.9	-35.3	0.0	1.0	48.3	40.7	74.0	54.0	-25.7	-13.3	H
9.648	9.8	44.7	36.4	37.9	4.0	-33.3	0.0	1.0	54.2	45.9	74.0	54.0	-19.8	-8.1	H
11b mid															H
4.874	9.8	44.2	34.5	33.1	2.9	-35.3	0.0	1.0	45.8	36.1	74.0	54.0	-28.2	-17.9	H
9.748	9.8	41.0	32.9	37.8	4.1	-33.4	0.0	1.0	50.5	42.4	74.0	54.0	-23.5	-11.6	H
11b high															H
4.924	9.8	43.4	33.5	33.1	2.9	-35.3	0.0	1.0	45.1	35.2	74.0	54.0	-28.9	-18.8	H

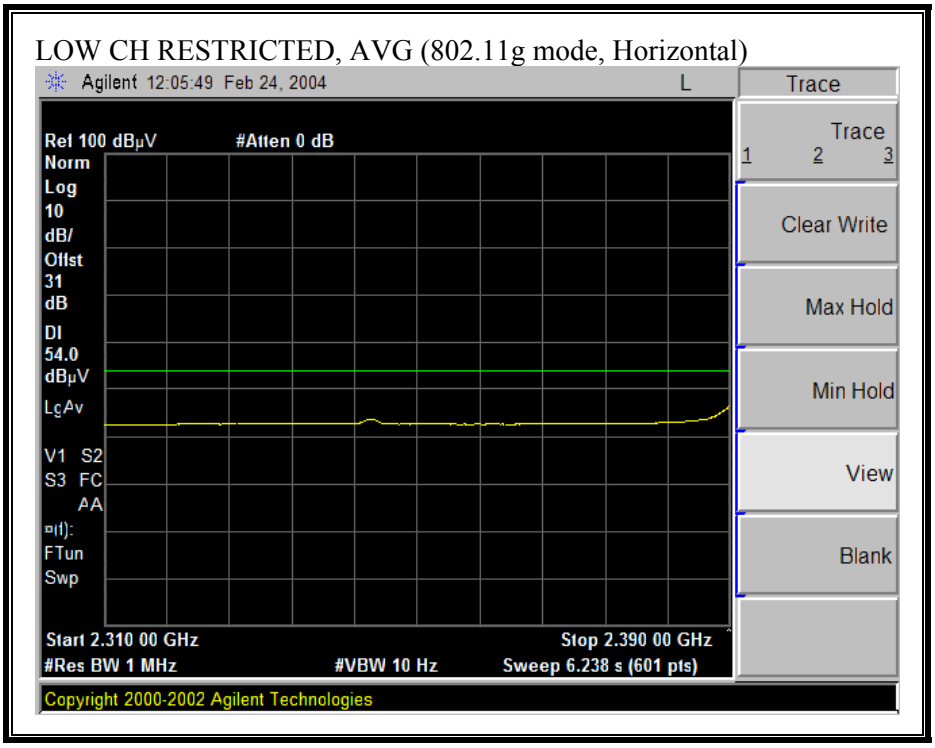
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, HORIZONTAL)

LOW CH RESTRICTED, PEAK (802.11g mode, Horizontal)

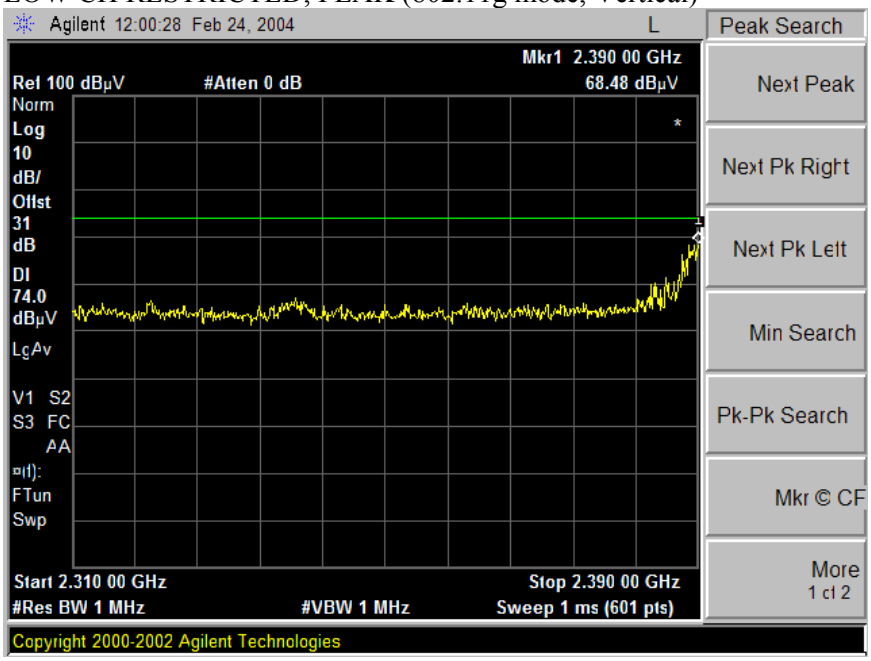


LOW CH RESTRICTED, AVG (802.11g mode, Horizontal)

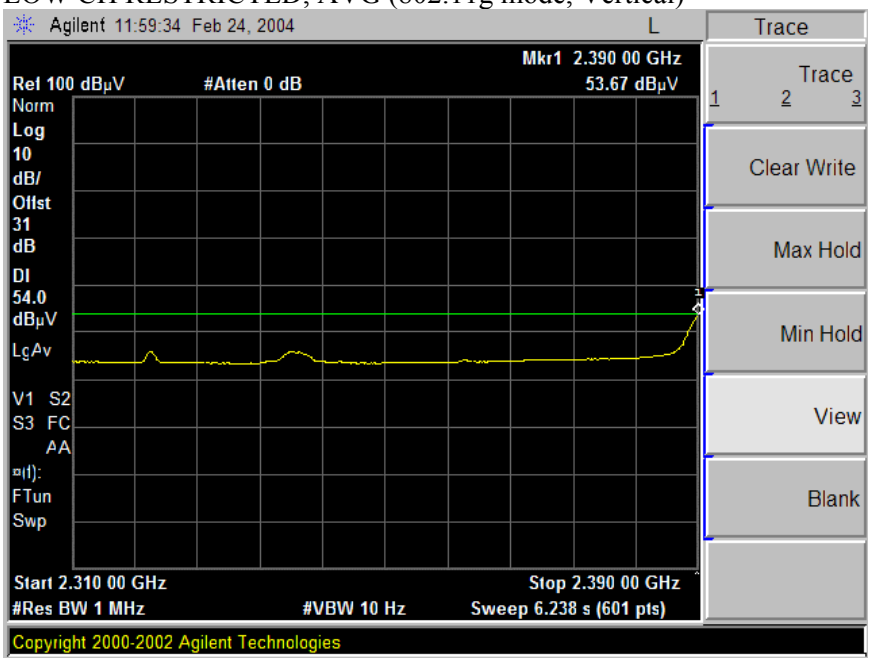


RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, VERTICAL)

LOW CH RESTRICTED, PEAK (802.11g mode, Vertical)

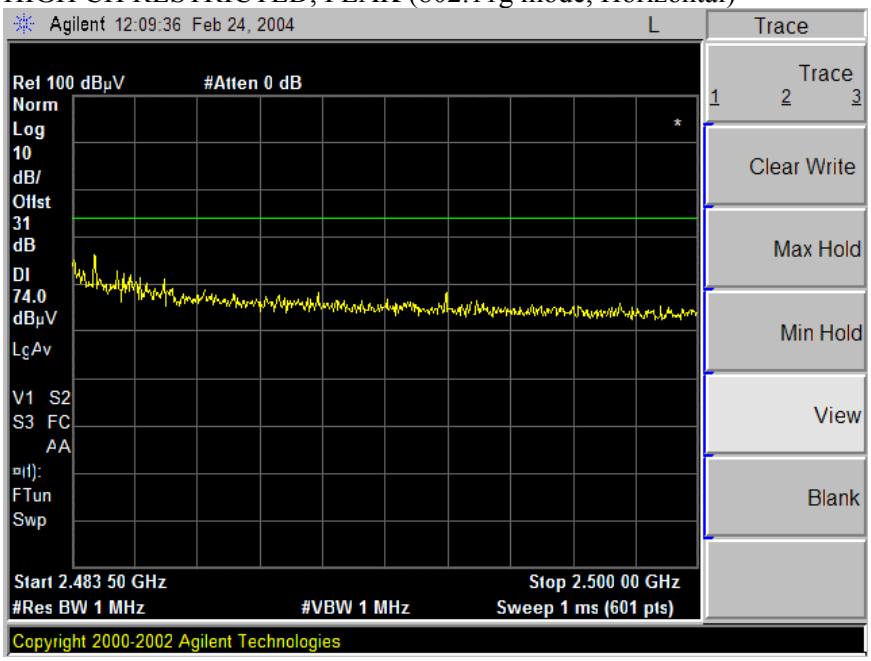


LOW CH RESTRICTED, AVG (802.11g mode, Vertical)

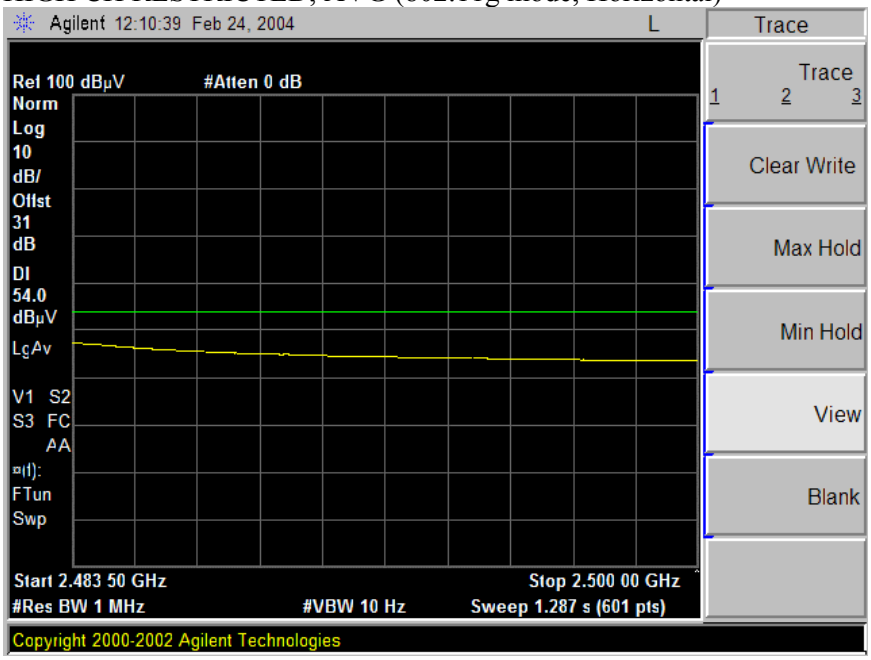


RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, HORIZONTAL)

HIGH CH RESTRICTED, PEAK (802.11g mode, Horizontal)

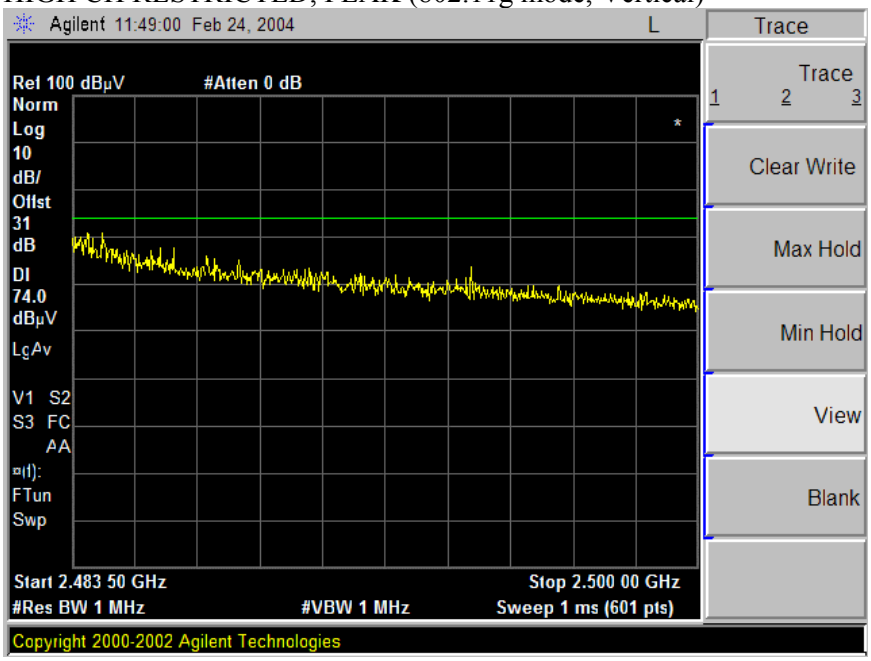


HIGH CH RESTRICTED, AVG (802.11g mode, Horizontal)

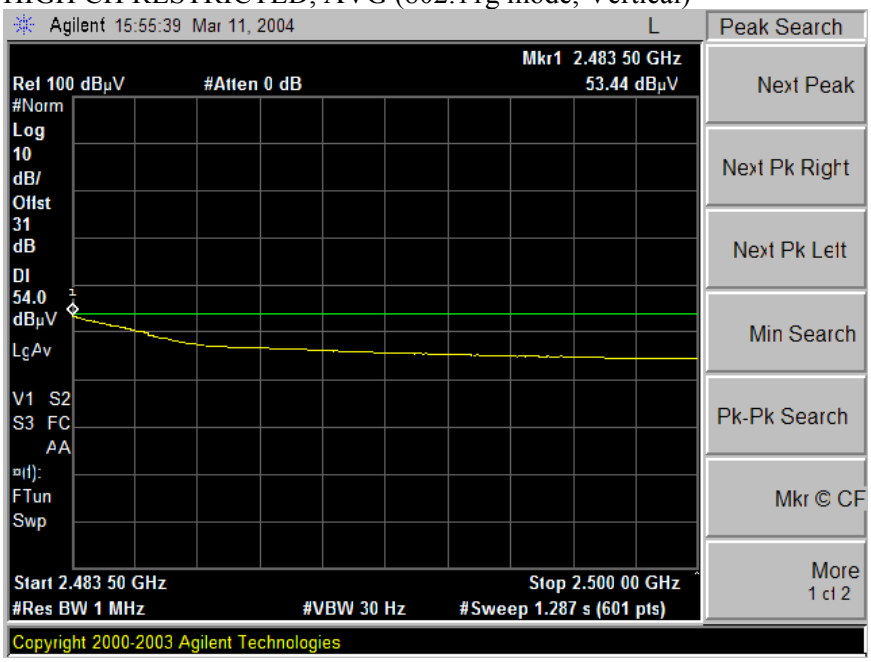


RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, VERTICAL)

HIGH CH RESTRICTED, PEAK (802.11g mode, Vertical)



HIGH CH RESTRICTED, AVG (802.11g mode, Vertical)



HARMONICS AND SPURIOUS EMISSIONS (g MODE)

03/04/04 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: VIEN TRAN
Project #: 04U2554
Company: ATHEROS
EUT Descrip.:
EUT M/N: MB43
Test Target: 15.247
Mode Oper: Tx_11g

Test Equipment:

EMCO Horn 1-18GHz	Spectrum Analyzer	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz
T60; S/N: 2238 @3m	Agilent E4446A Analyzer	T63 Miteq 646456		

Hi Frequency Cables: ☑ (2 ft) ☐ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☑ (12 ft)

Limit: FCC 15.209

Peak Measurements: 1 MHz Resolution Bandwidth, 1MHz Video Bandwidth

Average Measurements: 1 MHz Resolution Bandwidth, 10Hz Video Bandwidth

f GHz	Dist feet	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	HPF	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes
LOW CH															
4.824	9.8	48.7	34.6	33.1	2.9	-35.3	0.0	1.0	50.3	36.2	74.0	54.0	-23.7	-17.8	V
7.326	9.8	45.5	33.2	36.2	3.8	-34.6	0.0	1.0	52.0	39.7	74.0	54.0	-22.0	-14.3	V
4.824	9.8	45.3	33.1	33.1	2.9	-35.3	0.0	1.0	46.9	34.7	74.0	54.0	-27.1	-19.3	H
7.326	9.8	43.9	32.7	36.2	3.8	-34.6	0.0	1.0	50.4	39.2	74.0	54.0	-23.6	-14.8	H
MID CH															
4.874	9.8	45.6	33.7	33.1	2.9	-35.3	0.0	1.0	47.2	35.3	74.0	54.0	-26.8	-18.7	V
9.748	9.8	35.4	33.0	38.5	5.6	-33.4	0.0	1.0	44.9	42.5	74.0	54.0	-29.1	-11.5	V
4.874	9.8	49.6	37.3	33.1	2.9	-35.3	0.0	1.0	51.3	39.0	74.0	54.0	-22.7	-15.0	H
7.311	9.8	45.8	33.6	36.2	3.8	-34.6	0.0	1.0	52.2	40.0	74.0	54.0	-21.8	-14.0	H
HI CH															
4.924	9.8	49.2	36.7	33.2	2.9	-35.3	0.0	1.0	50.9	38.4	74.0	54.0	-23.1	-15.6	V
7.386	9.8	44.9	32.8	36.3	3.9	-34.5	0.0	1.0	51.5	39.4	74.0	54.0	-22.5	-14.6	V
4.924	9.8	47.7	34.9	33.2	2.9	-35.3	0.0	1.0	49.4	36.6	74.0	54.0	-24.6	-17.4	H
7.386	9.8	44.8	33.0	36.3	3.9	-34.5	0.0	1.0	51.4	39.6	74.0	54.0	-22.6	-14.4	H

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

HARMONICS AND SPURIOUS EMISSIONS (g TURBO MODE)

03/04/04 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: VIEN TRAN
Project #: 04U2554
Company: ATHEROS
EUT Descrip.:
EUT M/N: MB43
Test Target: 15.247
Mode Oper: Tx_11g TURBO MODE

Test Equipment:

EMCO Horn 1-18GHz	Spectrum Analyzer	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz
T60; S/N: 2238 @3m	Agilent E4446A Analyzer	T63 Miteq 646456		

Hi Frequency Cables: ☑ (2 ft) ☐ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☑ (12 ft)

Limit: FCC 15.209

Peak Measurements: 1 MHz Resolution Bandwidth, 1MHz Video Bandwidth

Average Measurements: 1 MHz Resolution Bandwidth, 10Hz Video Bandwidth

f GHz	Dist feet	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	HPF	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes
CH 2437MHz															
4.874	9.8	55.4	41.2	33.1	2.9	-35.3	0.0	1.0	57.1	42.9	74.0	54.0	-16.9	-11.1	V
7.311	9.8	44.5	33.6	36.2	3.8	-34.6	0.0	1.0	50.9	40.0	74.0	54.0	-23.1	-14.0	V
4.874	9.8	46.2	34.6	33.1	2.9	-35.3	0.0	1.0	47.9	36.3	74.0	54.0	-26.1	-17.7	H
7.311	9.8	42.9	31.6	36.2	3.8	-34.6	0.0	1.0	49.3	38.0	74.0	54.0	-24.7	-16.0	H

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

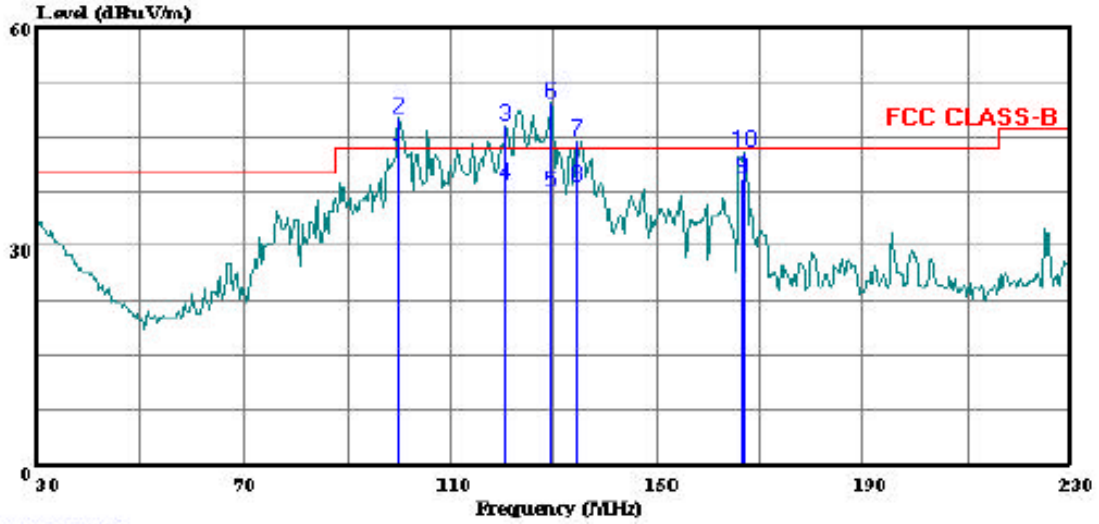
7.8.3. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 230 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT 30 TO 230

COMPLIANCE Engineering Services, Inc.
561F Monterey Road
San Jose, CA 95131
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 4 File#: MB43_BELOW 1GHz.EMI
Date: 02-28-2004 Time: 14:45:01



Trace: 1 Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Eng: : VIEN TRAN
Project #: : 04U2554
Company: : ATHEROS
EUT: : 802.11b, g MINI PCI CARD
Model No: : MB43
Configuration: : EUT/ LAPTOP
Target of Test: : FCC-B
Mode of Operation: TX (WORST CASE)
: 30-230MHz_QP

HORIZONTAL DATA 30 TO 230

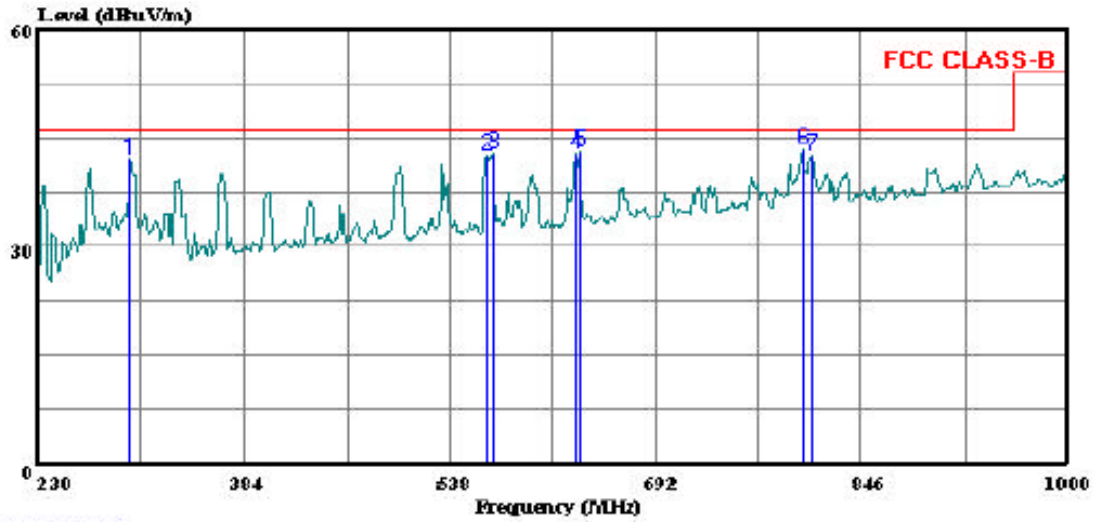
		Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
		MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1		99.800	QP	31.77	10.41	42.18	43.50	-1.32
2	*	99.800	Peak	37.20	10.41	47.61	43.50	4.11
3	*	120.800	Peak	31.45	15.03	46.48	43.50	2.98
4		120.800	QP	23.50	15.01	38.51	43.50	-5.00
5		129.400	QP	21.95	15.55	37.50	43.50	-6.00
6	*	129.400	Peak	34.00	15.54	49.54	43.50	6.04
7	*	134.400	Peak	29.09	15.43	44.52	43.50	1.02
8		134.400	QP	22.70	15.43	38.13	43.50	-5.37
9		166.400	QP	25.65	13.63	39.28	43.50	-4.22
10		166.800	Peak	29.28	13.61	42.89	43.50	-0.61

SPURIOUS EMISSIONS 230 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT 230 TO 1000

COMPLIANCE Engineering Services, Inc.
561F Monterey Road
San Jose, CA 95131
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 6 File#: MB43_BELOW 1GHz.EMI
Date: 02-28-2004 Time: 14:56:27



Trace: 5 Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Eng: : VIEN TRAN
Project #: : 04U2554
Company: : ATHEROS
EUT: : 802.11b, g MINI PCI CARD
Model No: : MB43
Configuration: : EUT/ LAPTOP
Target of Test: : FCC-B
Mode of Operation: TX (WORST CASE)
: 230-1000MHz

HORIZONTAL DATA 230 TO 1000

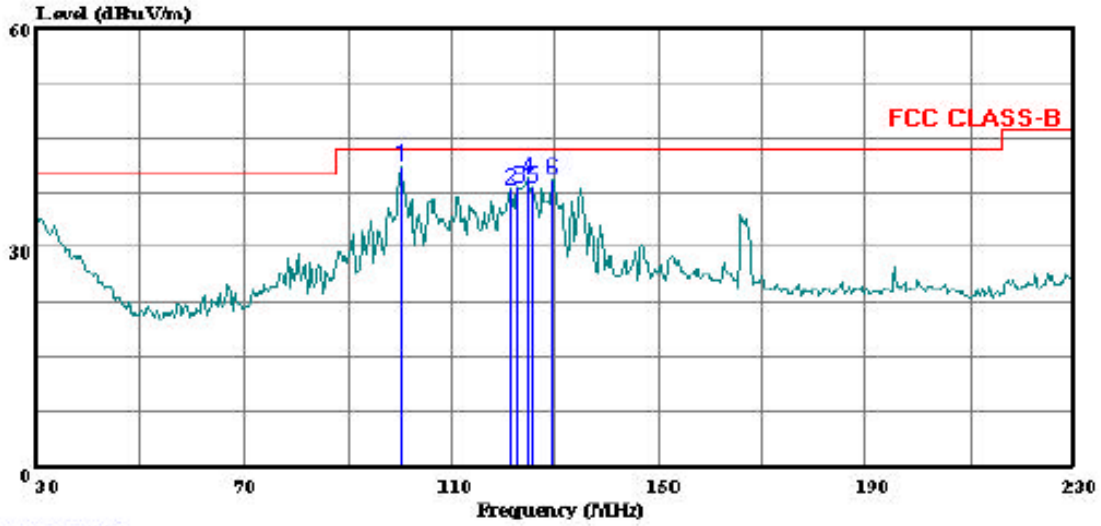
	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	298.530	Peak	26.20	15.91	42.11	46.00	-3.90
2	566.490	Peak	21.00	21.49	42.49	46.00	-3.51
3	570.340	Peak	21.33	21.65	42.97	46.00	-3.03
4	631.940	Peak	20.39	22.41	42.80	46.00	-3.20
5	635.790	Peak	20.66	22.53	43.19	46.00	-2.81
6	801.340	Peak	18.32	25.03	43.35	46.00	-2.65
7	809.040	Peak	17.50	25.09	42.59	46.00	-3.41

SPURIOUS EMISSIONS 30 TO 230 MHz (WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL PLOT 30 TO 230

COMPLIANCE Engineering Services, Inc.
561F Monterey Road
San Jose, CA 95131
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 10 File#: MB43_BELOW 1GHz.EMI
Date: 02-28-2004 Time: 15:30:23



(Audix ATC)
Trace: 9 Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Eng: : VIEN TRAN
Project #: : 04U2554
Company: : ATHEROS
EUT: : 802.11b, g MINI PCI CARD
Model No: : MB43
Configuration: : EUT/ LAPTOP
Target of Test: : FCC-B
Mode of Operation: TX (WORST CASE)
: 30-230MHz

VERTICAL DATA 30 TO 230

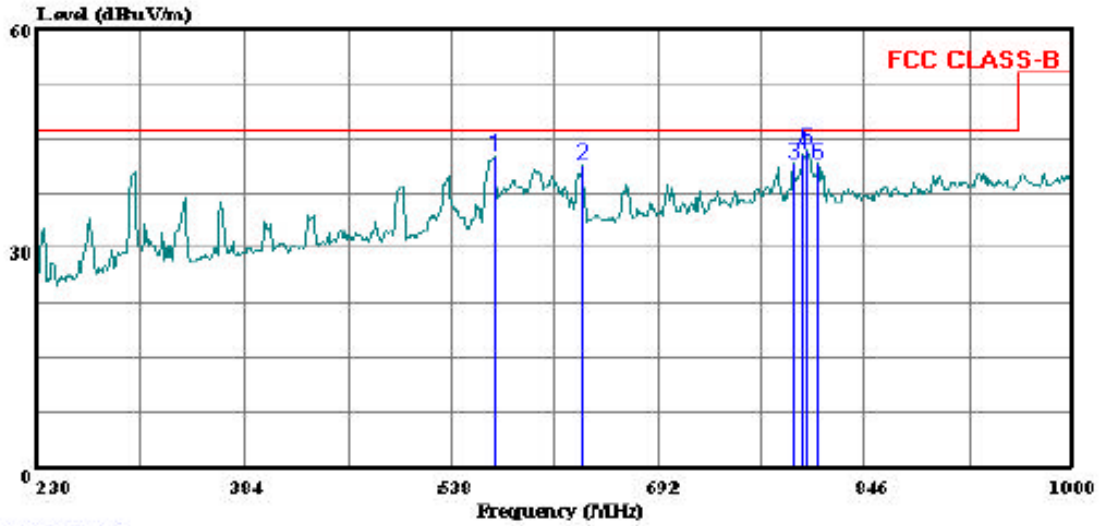
	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	100.400	Peak	30.50	10.59	41.09	43.50	-2.41
2	121.400	Peak	22.88	15.09	37.97	43.50	-5.53
3	122.800	Peak	22.86	15.25	38.11	43.50	-5.39
4	124.400	Peak	24.00	15.41	39.41	43.50	-4.09
5	125.400	Peak	22.74	15.47	38.21	43.50	-5.29
6	129.400	Peak	23.81	15.54	39.35	43.50	-4.15

SPURIOUS EMISSIONS 230 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL PLOT 230 TO 1000

561F Monterey Road
San Jose, CA 95131
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 8 File#: MB43_BELOW 1GHz.EMI
Date: 02-28-2004 Time: 15:09:15



(Audix ATC)
Trace: 7 Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Eng: : VIEN TRAN
Project #: : 04U2554
Company: : ATHEROS
EUT: : 802.11b, g MINI PCI CARD
Model No: : MB43
Configuration: : EUT/ LAPTOP
Target of Test: : FCC-B
Mode of Operation: TX (WORST CASE)
: 230-1000MHz

VERTICAL DATA 230 TO 1000

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	570.340	Peak	21.02	21.65	42.66	46.00	-3.34
2	635.790	Peak	18.81	22.53	41.34	46.00	-4.66
3	791.330	Peak	16.57	24.86	41.43	46.00	-4.57
4	799.030	Peak	17.75	25.01	42.76	46.00	-3.24
5	802.880	Peak	18.27	25.06	43.33	46.00	-2.67
6	810.580	Peak	16.53	25.10	41.62	46.00	-4.38

7.9. POWERLINE CONDUCTED EMISSIONS

LIMIT

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The resolution bandwidth is set to 9 kHz for both peak detection and quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

Line conducted data is recorded for both NEUTRAL and HOT lines.

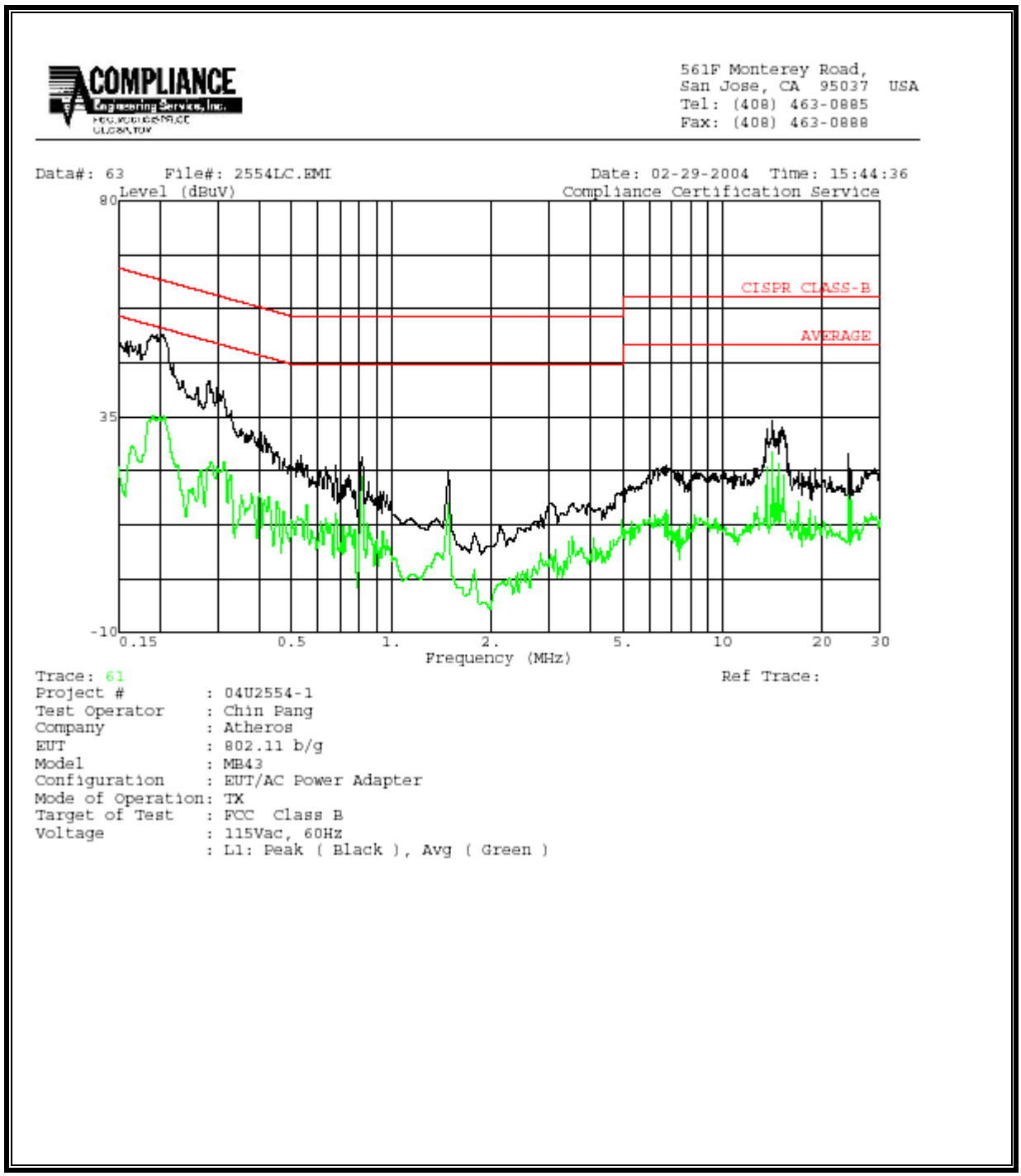
RESULTS

No non-compliance noted:

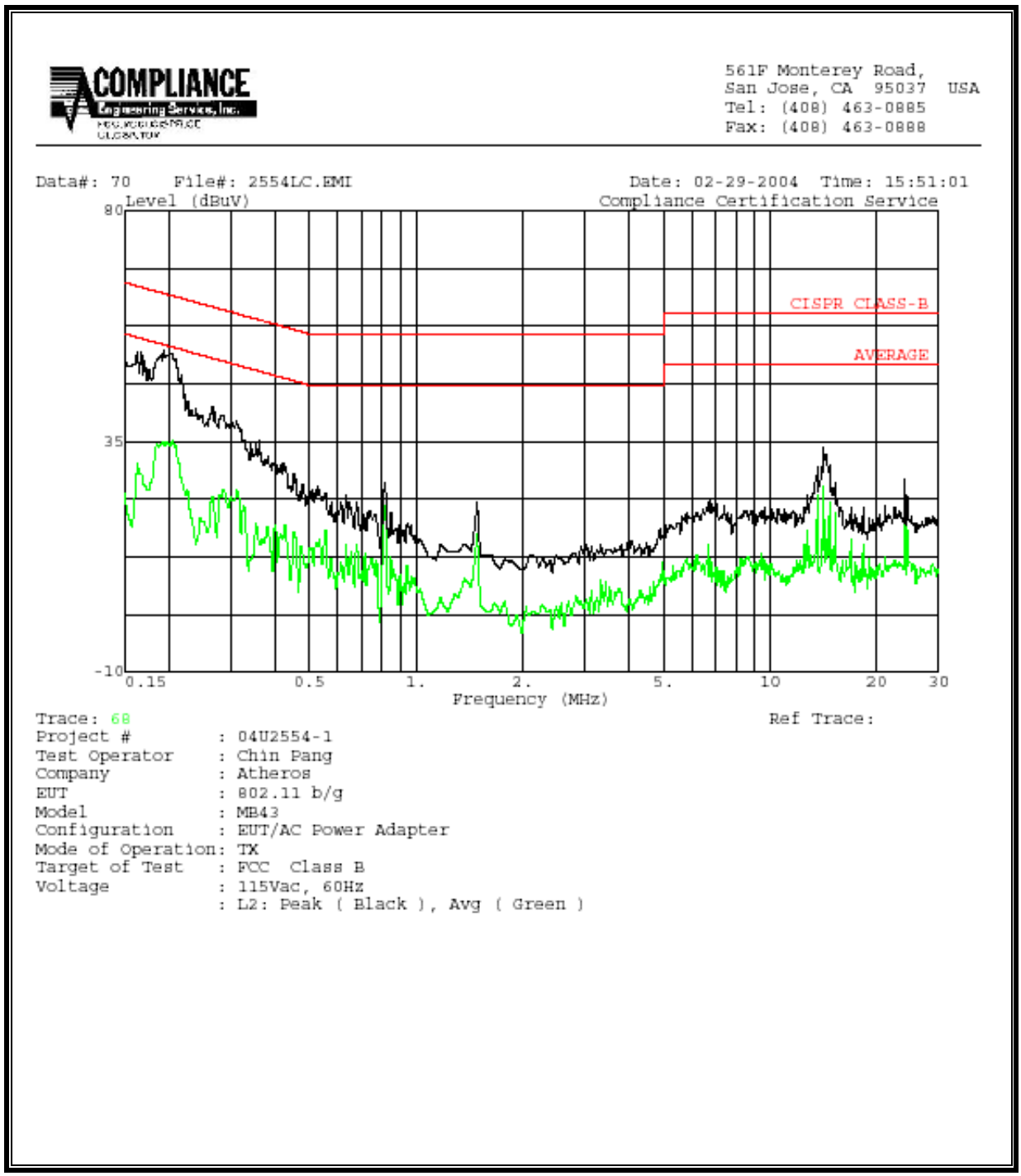
6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.16	51.77	--	29.50	0.00	65.69	55.69	-13.92	-26.19	L1
0.21	52.88	--	36.09	0.00	64.43	54.43	-11.55	-18.34	L1
14.36	35.18	--	29.10	0.00	60.00	50.00	-24.82	-20.90	L1
0.16	53.44	--	31.70	0.00	65.60	55.60	-12.16	-23.90	L2
0.21	53.12	--	36.05	0.00	64.43	54.43	-11.31	-18.38	L2
14.36	35.28	--	27.14	0.00	60.00	50.00	-24.72	-22.86	L2
6 Worst Data									

LINE 1 RESULTS



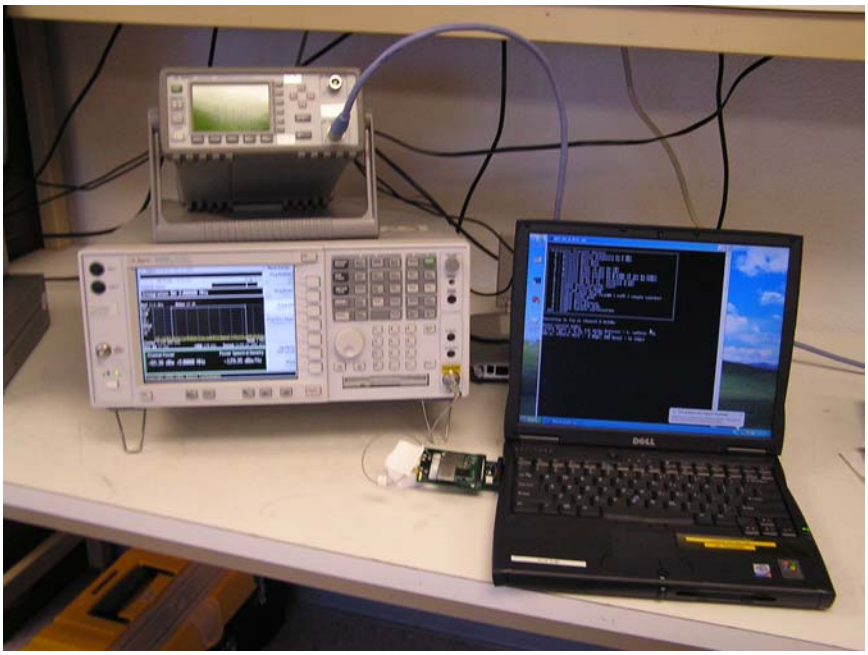
LINE 2 RESULTS



8. SETUP PHOTOS

ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP

ANTENNA PORT CONDUCTED PHOTO



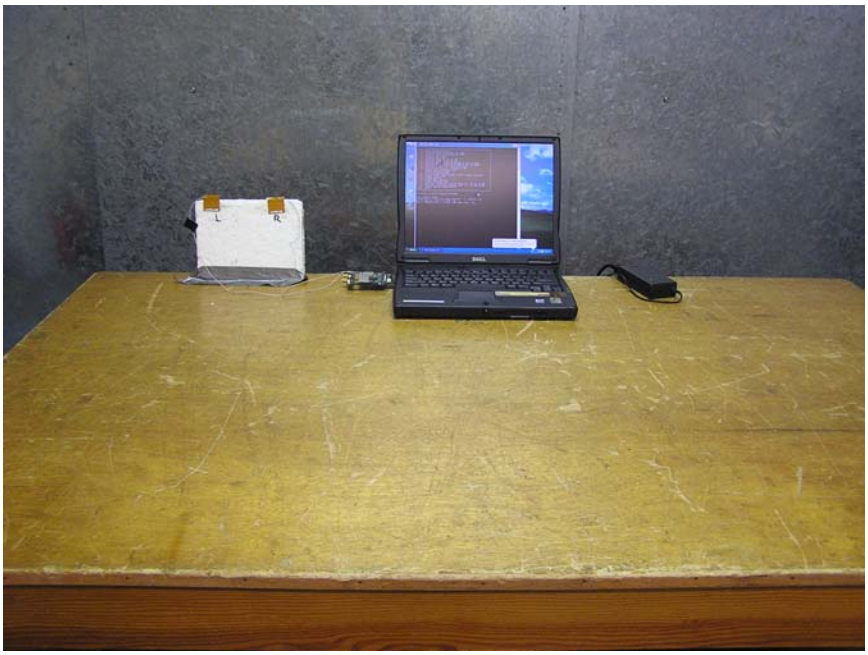
RADIATED RF MEASUREMENT SETUP

RADIATED FRONT PHOTO

RADIATED BACK PHOTO

POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP

LINE CONDUCTED FRONT PHOTO



LINE CONDUCTED BACK PHOTO

END OF REPORT