



**FCC CFR47 PART 15 SUBPART C
CERTIFICATION
TEST REPORT**

FOR

802.11 b WLAN MINI PCI CARD

MODEL NUMBER: BCM94301MPL

FCC ID: QDS-BRCM1002-H

REPORT NUMBER: 03U2061-1

ISSUE DATE: June 19, 2003

Prepared for

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Prepared by

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1. TEST RESULT CERTIFICATION

COMPANY NAME: BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE,
CA. 94086, U.S.A

EUT DESCRIPTION: 802.11b WLAN MINI PCI CARD

MODEL: BCM94301MPL

DATE TESTED: 6/13 – 6/17/2003

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:

Tested By:



MIKE HECKROTTE
CHIEF ENGINEER
COMPLIANCE CERTIFICATION SERVICES

CHIN PANG
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. EUT DESCRIPTION

The EUT is an 802.11b WLAN Mini PCI Card operating in the 2400 – 2483.5 MHz band with a peak output power of 19.36dBm (86.3 mW) has a peak antenna gain of 0.48dBi. The EUT is tested with two hosts computers as below:

The host computer #1 is a HP model CRVSA-02T1-75.

The host computer #2 is a HP model PP2180.

One set of RF conducted emissions measurement were made on the radio card, and radiated and line conduction emissions measurements were made with the radio installed in each host computer.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4/1992, FCC CFR 47 Part 2 and FCC CFR 47 Part 15.







4. FACILITIES AND ACCREDITATION

4.1. FACILITIES AND EQUIPMENT

The open area test sites and conducted measurement facilities used to collect the radiated data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.7, 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. TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	FCC	3/10 meter Open Area Test Sites to perform FCC Part 15/18 measurements	 1300
Japan	VCCI	CISPR 22 Two OATS and one conducted Site	 R-1014, R-619, C-640
Norway	NEMKO	EN50081-1, EN50081-2, EN50082-1, EN50082-2, IEC61000-6-1, IEC61000-6-2, EN50083-2, EN50091-2, EN50130-4, EN55011, EN55013, EN55014-1, EN55104, EN55015, EN61547, EN55022, EN55024, EN61000-3-2, EN61000-3-3, EN60945, EN61326-1	 ELA 117
Norway	NEMKO	EN60601-1-2 and IEC 60601-1-2, the Collateral Standards for Electro-Medical Products. MDD, 93/42/EEC, AIMD 90/385/EEC	 ELA-171
Taiwan	BSMI	CNS 13438	 SL2-IN-E-1012
Canada	Industry Canada	RSS210 Low Power Transmitter and Receiver	 IC2324 A,B,C, and F

5. CALIBRATION AND UNCERTAINTY

5.1. MEASURING 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

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

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 AND MEASUREMENT EQUIPMENT LIST				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due Date
LISN, 10 kHz ~ 30 MHz	FCC	50/250-25-2	114	9/6/03
Line Filter	Lindgren	LMF-3489	497	NCR
EMI Test Receiver	R & S	ESHS 20	827129/006	4/11/04
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	NCR
PreAmp	Miteq	NSP2600-SP	924341	4/25/04
Spectrum Analyzer	Agilent	8564E	821460	5/13/05
Quasi-Peak Adaptor	HP	85650A	2811A01155	5/16/04
SA RF Section, 1.5 GHz	HP	85680B	2732A03661	5/16/04
SA Display Section 2	HP	85662A	2816A16696	5/16/04
Antenna, Bilog	Chase	CBL6112B	2586	3/6/04
Preamplifier, 1300 MHz	HP	8447D	2944A06589	8/22/03

6. SETUP OF EQUIPMENT UNDER TEST

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Device Type	Manufacturer	Model	Serial Number	FCC ID
Laptop #1	HP	CRVSA-02T1-75	CN31021563	DoC
Laptop #2	HP	PP2180	N/A	DoC
AC adapter	HP	ADP-75HB	MVT0236126269	DoC

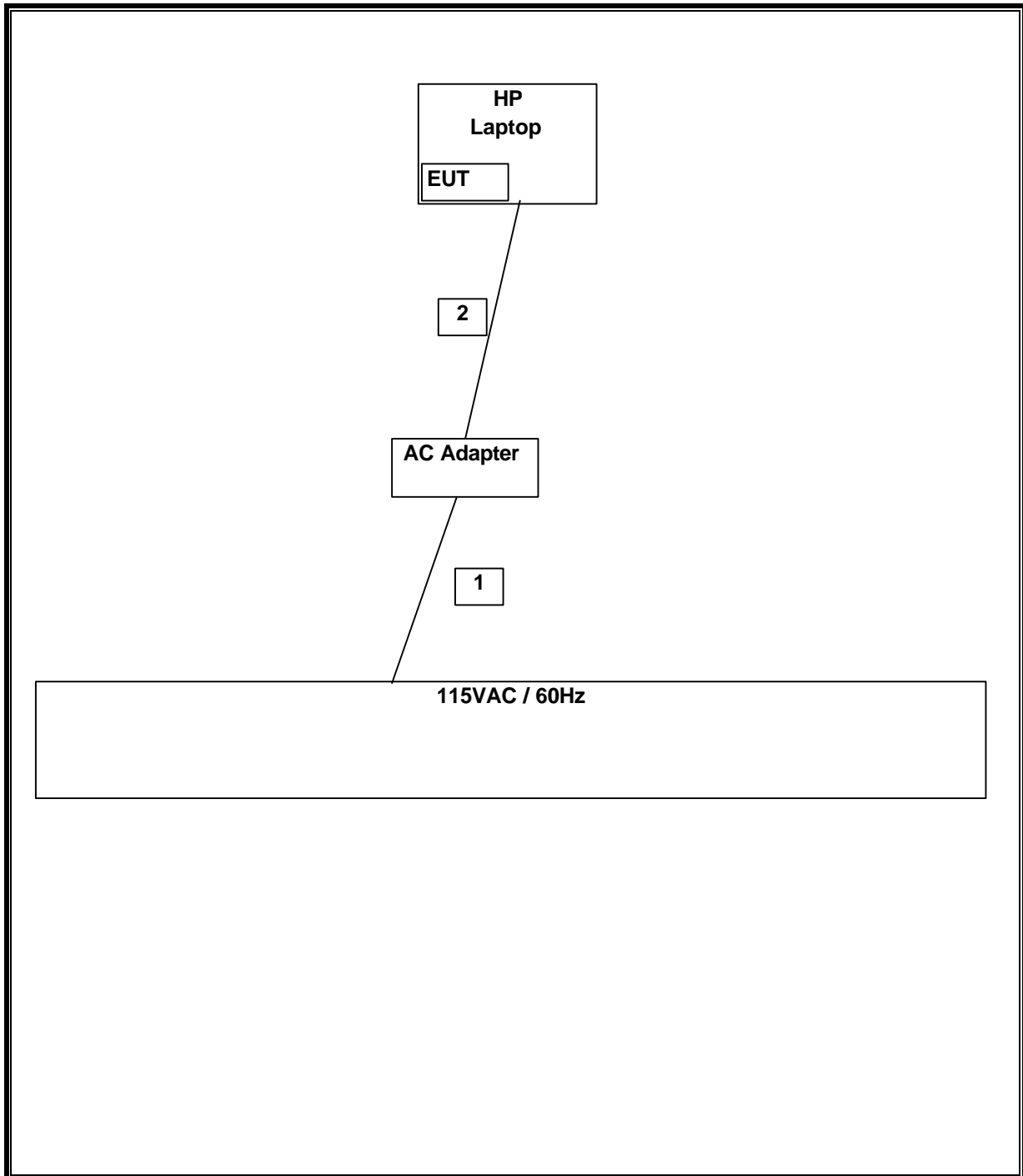
I/O CABLES

Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	3	US 115V	Un-shielded	2m	No
2	DC	1	DC	Un-shielded	1m	No

TEST SETUP

The EUT was installed in a host computer.

SETUP DIAGRAM



SETUP FOR DIGITAL DEVICE TESTS

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Device Type	Manufacturer	Model	Serial Number	FCC ID
PRINTER	HP	2225C	2541S41679	BS46XU2225C
MOUSE	HP	M-S34	LZB75200323	D2L211029
MODEM	ACEEX	1414	9013540	IFAXDM1414
Laptop #1	HP	CRVSA-02T1-75	CN31021563	DoC
Laptop #2	HP	PP2180	N/A	DoC
AC adapter	HP	ADP-75HB	MVT0236126269	DoC

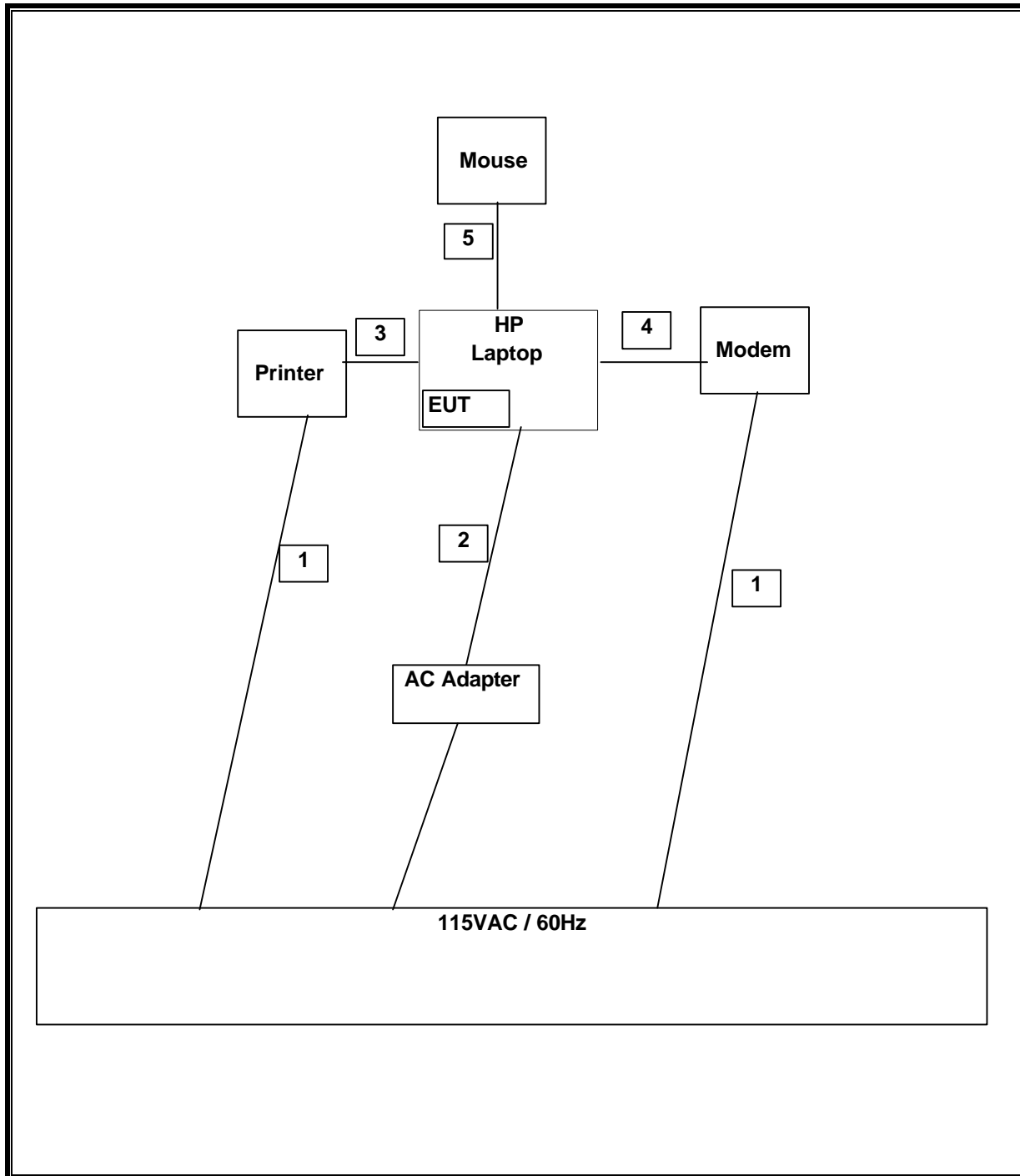
I/O CABLES

Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	3	US 115V	Un-shielded	2m	No
2	DC	1	DC	Un-shielded	1m	No
3	Parallel	1	DB25	Shielded	2m	Yes
4	Serial	1	DB9	Shielded	1m	Yes
5	Mouse	1	PS/2	Un-shielded	2m	Yes

TEST SETUP

The EUT was installed in a host computer.

SETUP DIAGRAM FOR DIGITAL DEVICE 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.

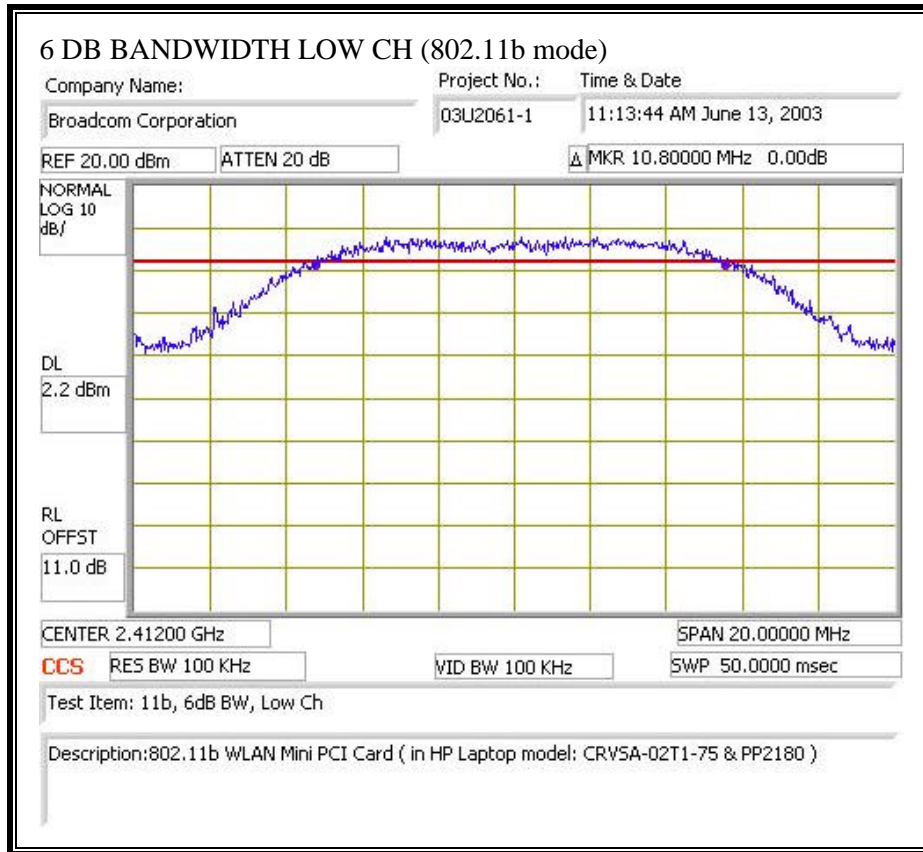
RESULTS

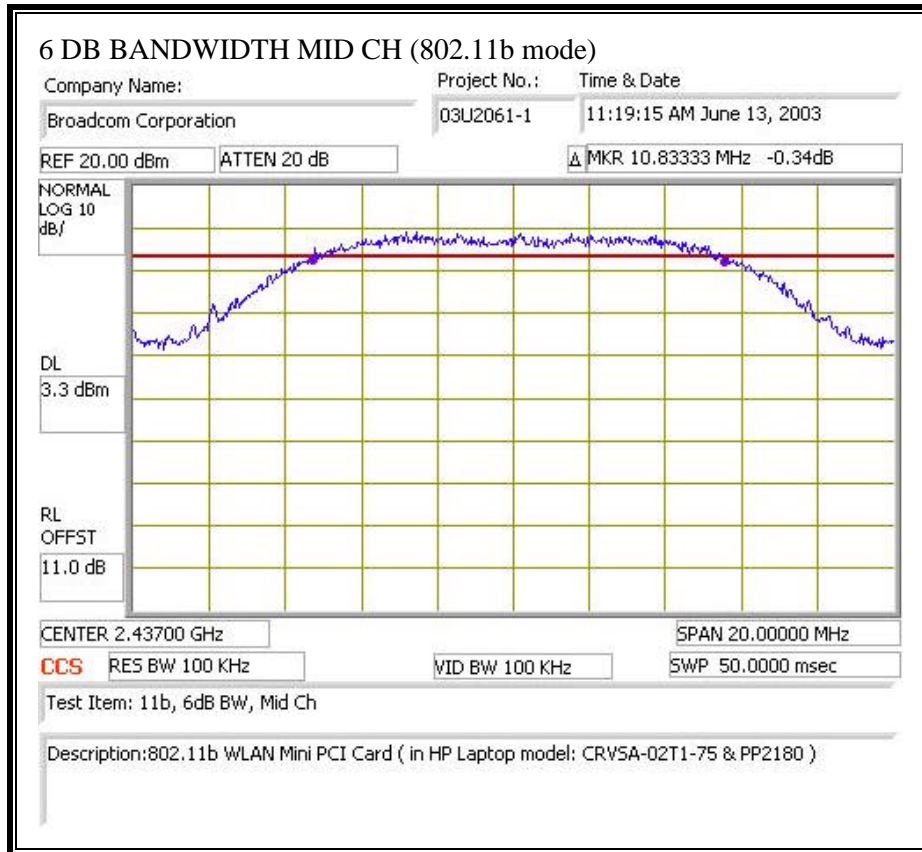
No non-compliance noted:

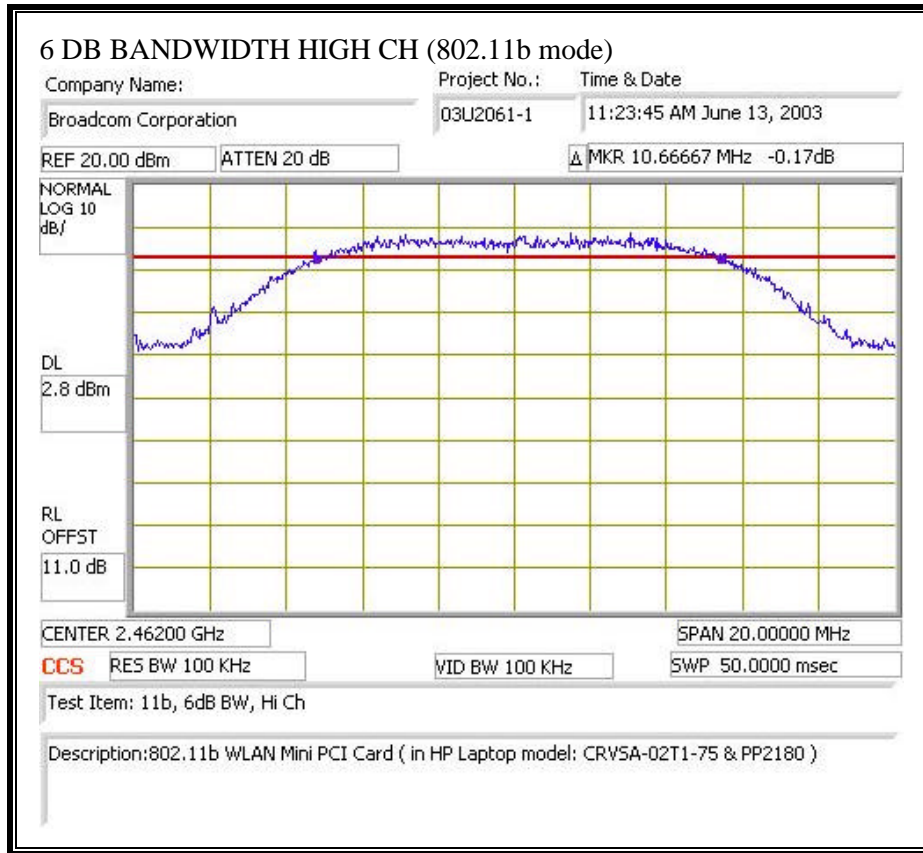
802.11b Mode

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Low	2412	10800	500	10300
Middle	2437	10830	500	10330
High	2462	10670	500	10170

6 DB BANDWIDTH (802.11b MODE)







7.2. 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 -0.65 dBi, therefore the limit is 30 dBm.

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter. The power meter is set to simultaneously read peak power and average power.

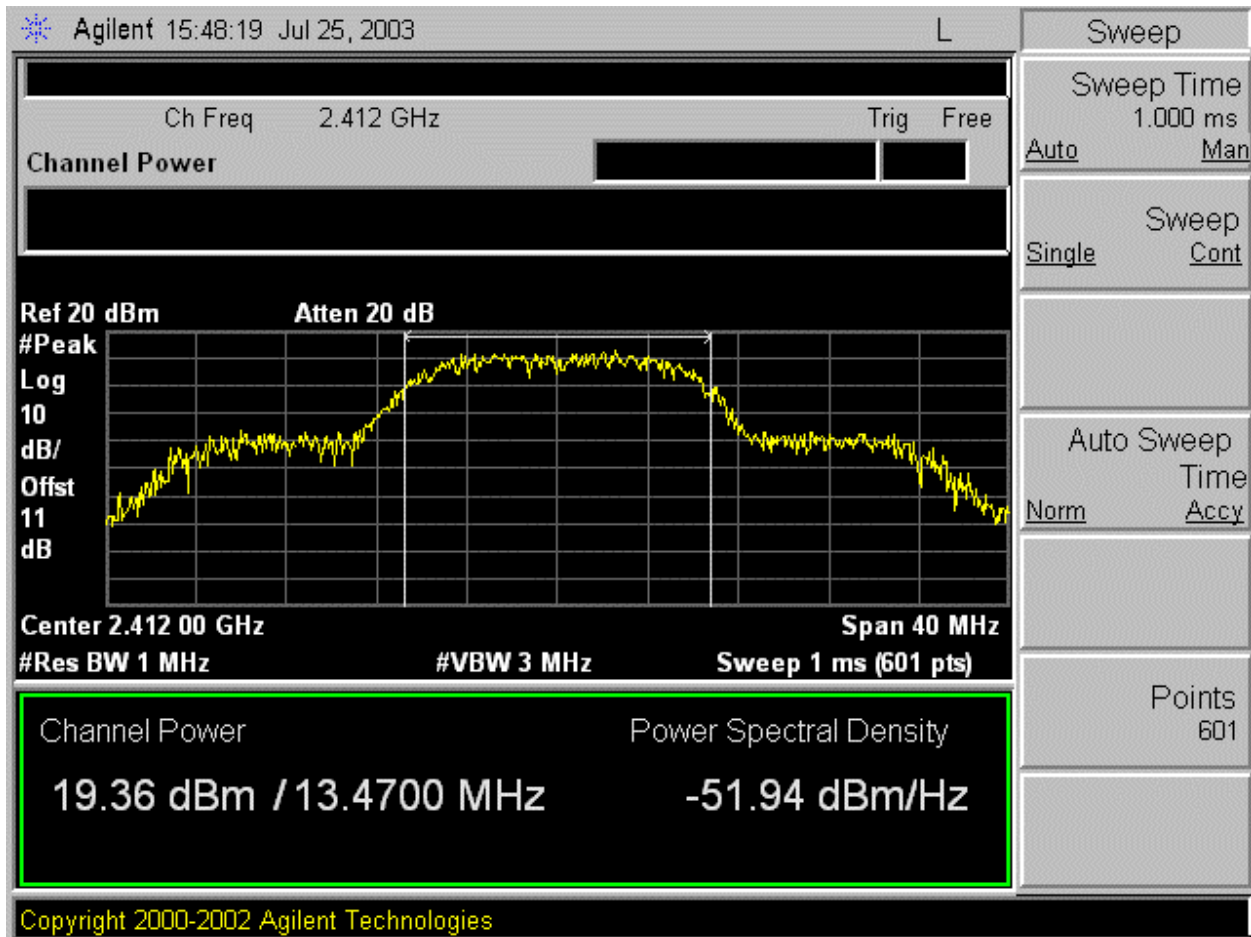
RESULTS

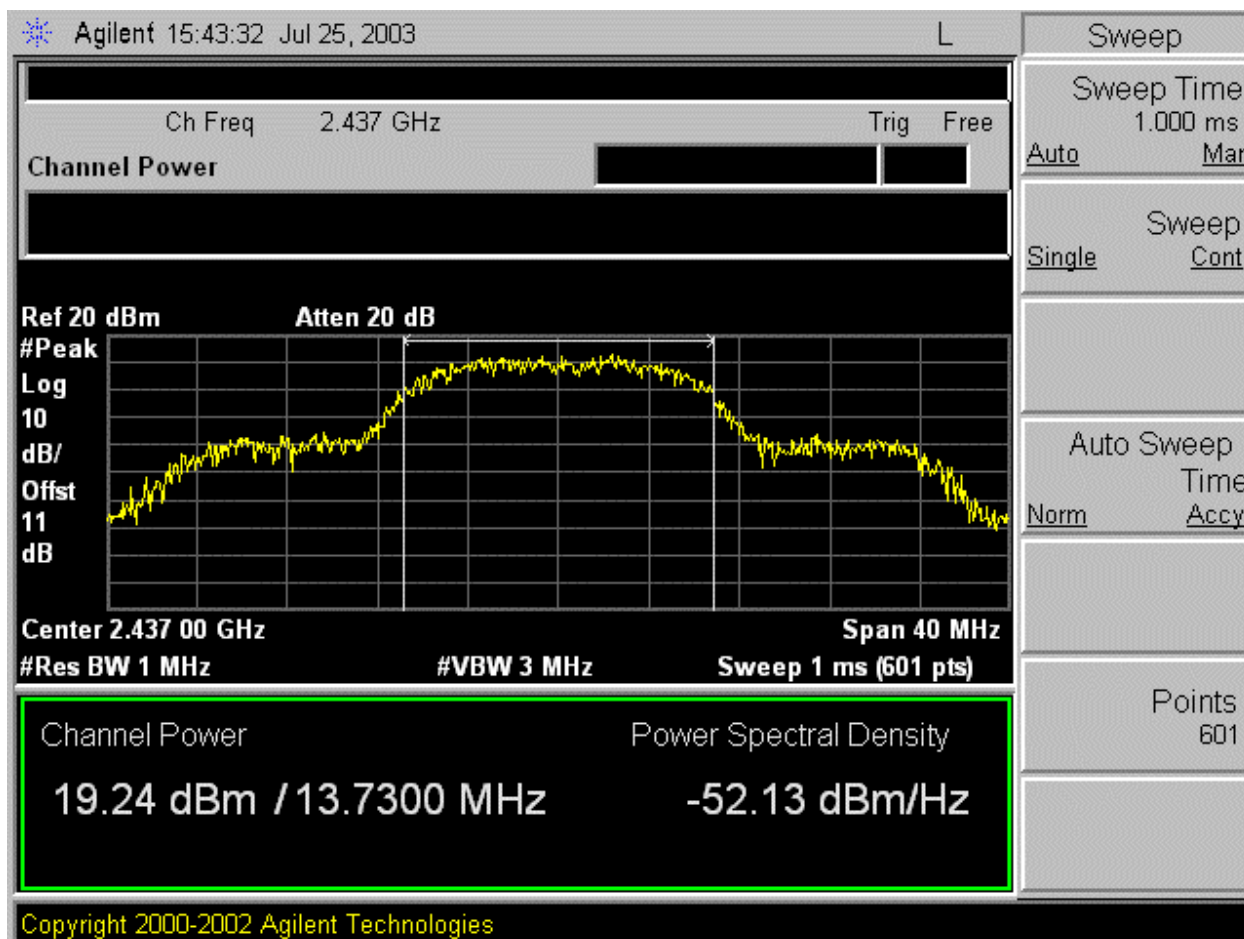
No non-compliance noted:

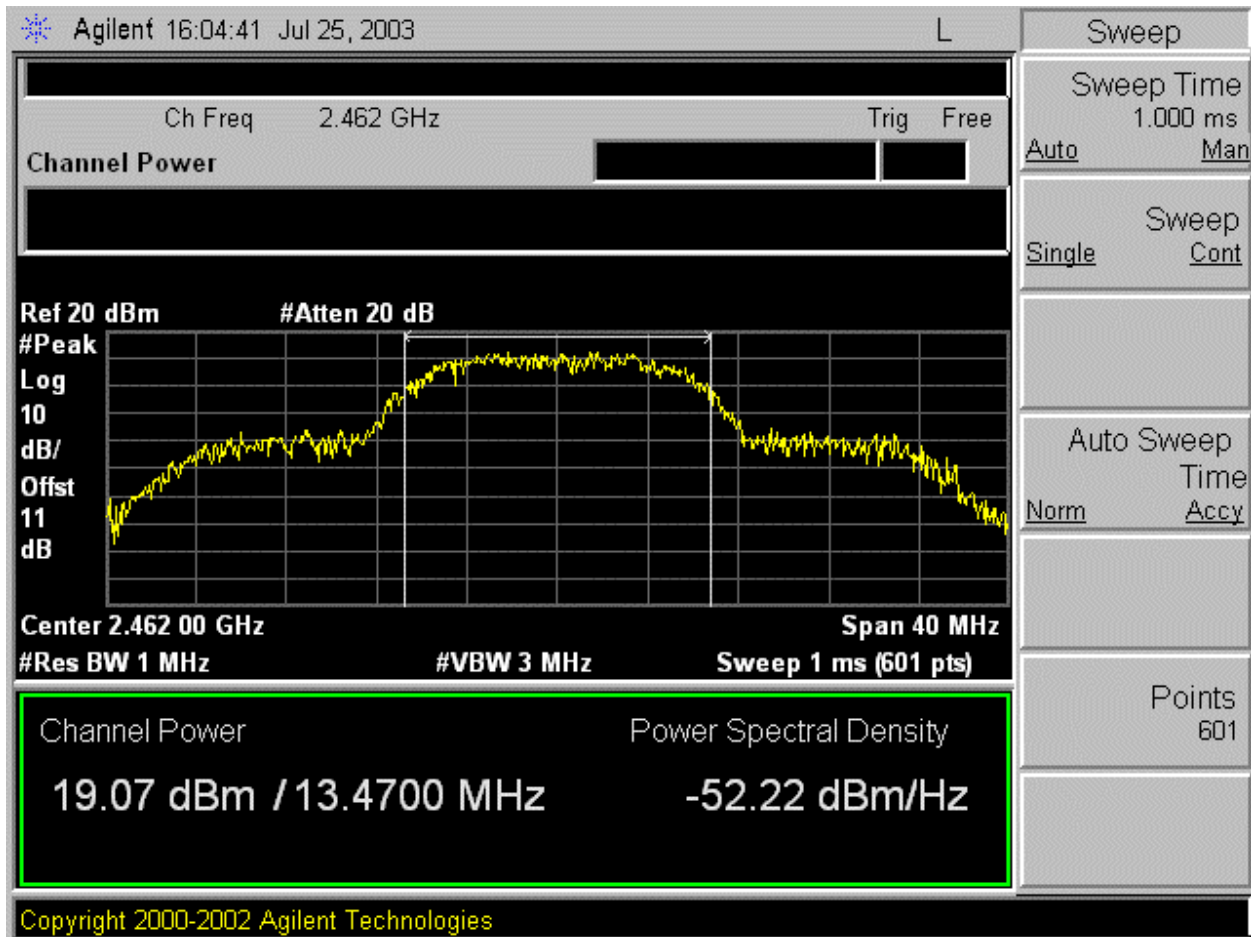
The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

802.11b Mode

Channel	Frequency (MHz)	Average Power (dBm)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	15.77	19.36	30	-10.64
Middle	2437	15.75	19.24	30	-10.76
High	2462	15.69	19.07	30	-10.93







7.3. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

§15.247 (b) (5) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See §1.1307(b)(1) of this chapter.

CALCULATIONS

Given

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

and

$$S = E^2 / 3770$$

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 mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = 100 * d \text{ (m)}$$

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 / cm²

Substituting the logarithmic form of power and gain using:

$$P \text{ (mW)} = 10^{(P \text{ (dBm)} / 10)} \text{ and}$$
$$G \text{ (numeric)} = 10^{(G \text{ (dBi)} / 10)}$$

yields

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

where

- d = MPE distance in cm
- P = Power in dBm
- G = Antenna Gain in dBi
- S = Power Density Limit in mW / cm²

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

LIMITS

S = 1.0 mW / cm² from 1.1310 Table 1

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	18.24	-0.65	2.14

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.

7.4. 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 \geq 3KHz, 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.

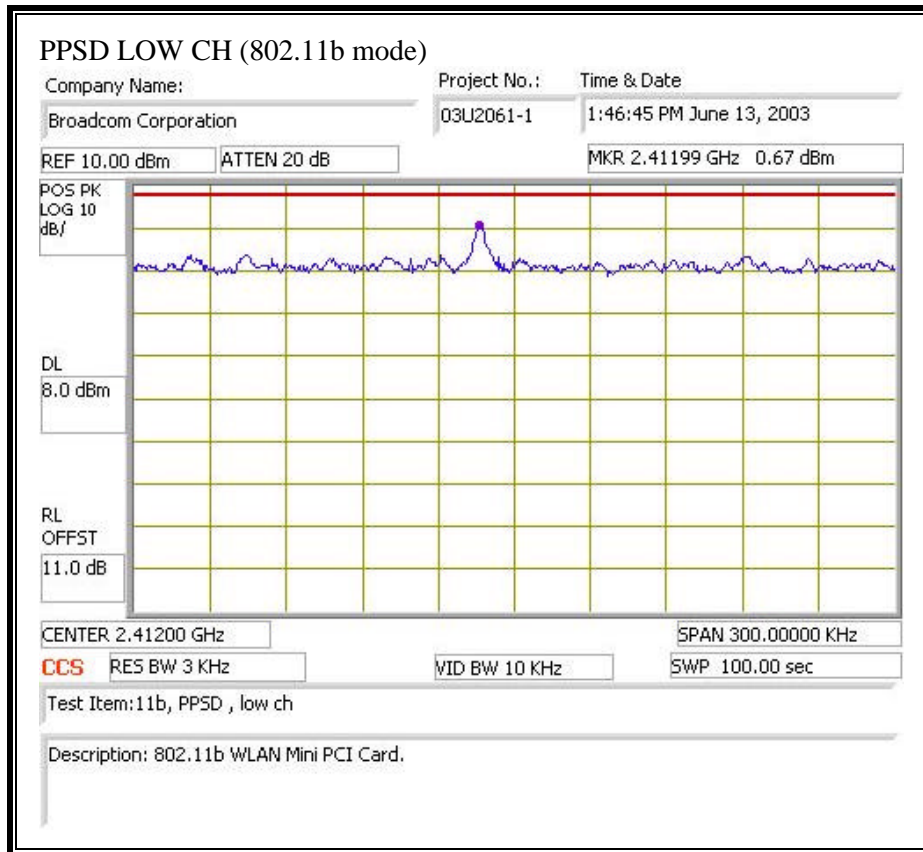
RESULTS

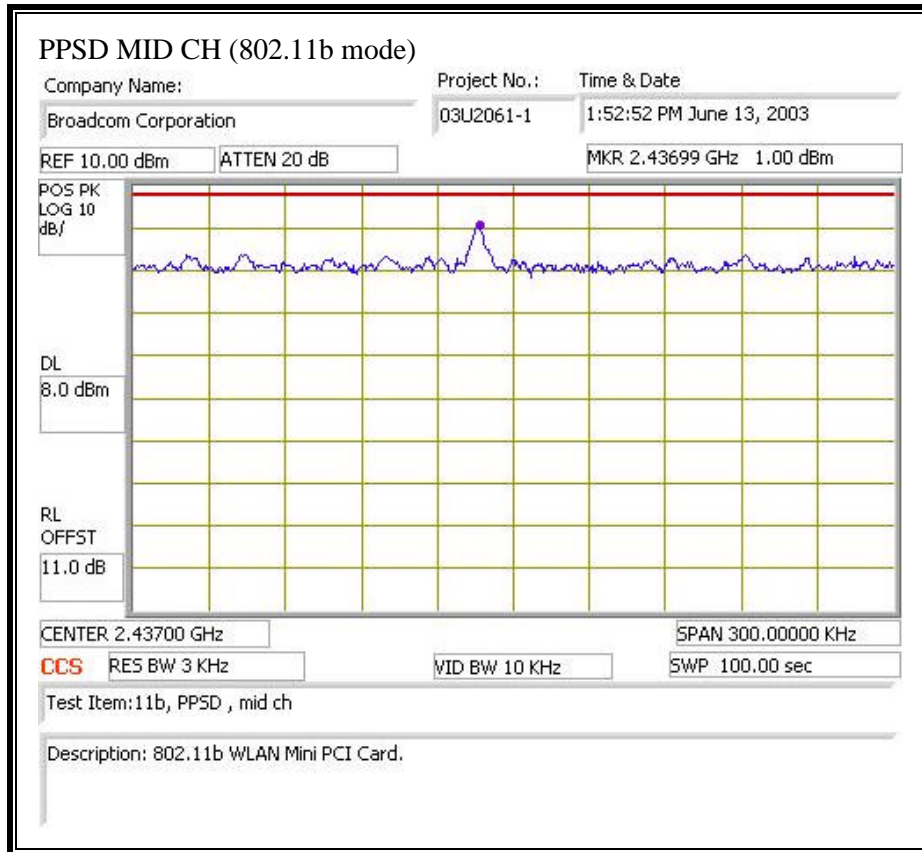
No non-compliance noted:

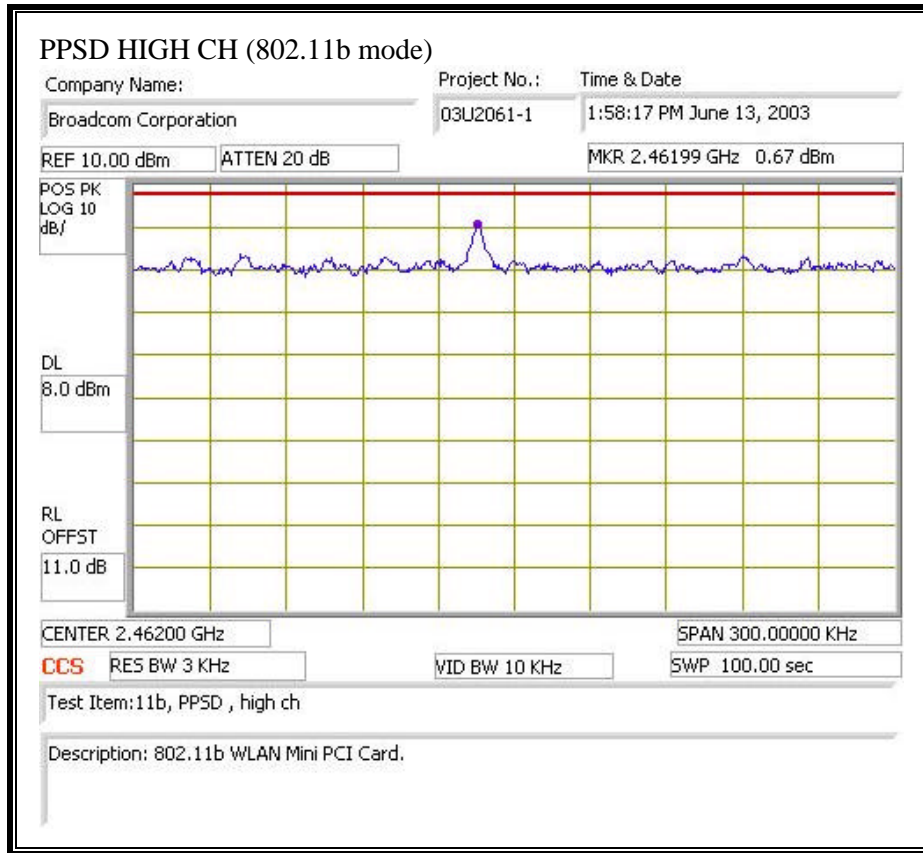
802.11b Mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	0.67	8	-7.33
Middle	2437	1.00	8	-7.00
High	2462	0.67	8	-7.33

PEAK POWER SPECTRAL DENSITY (802.11b MODE)







7.5. 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

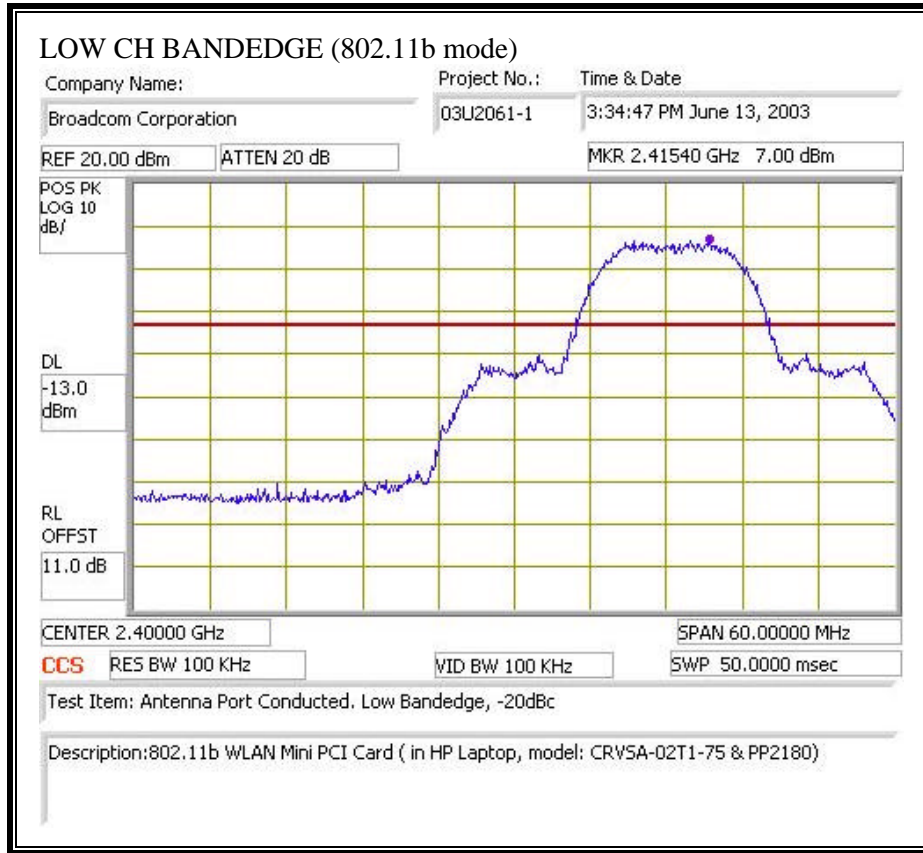
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

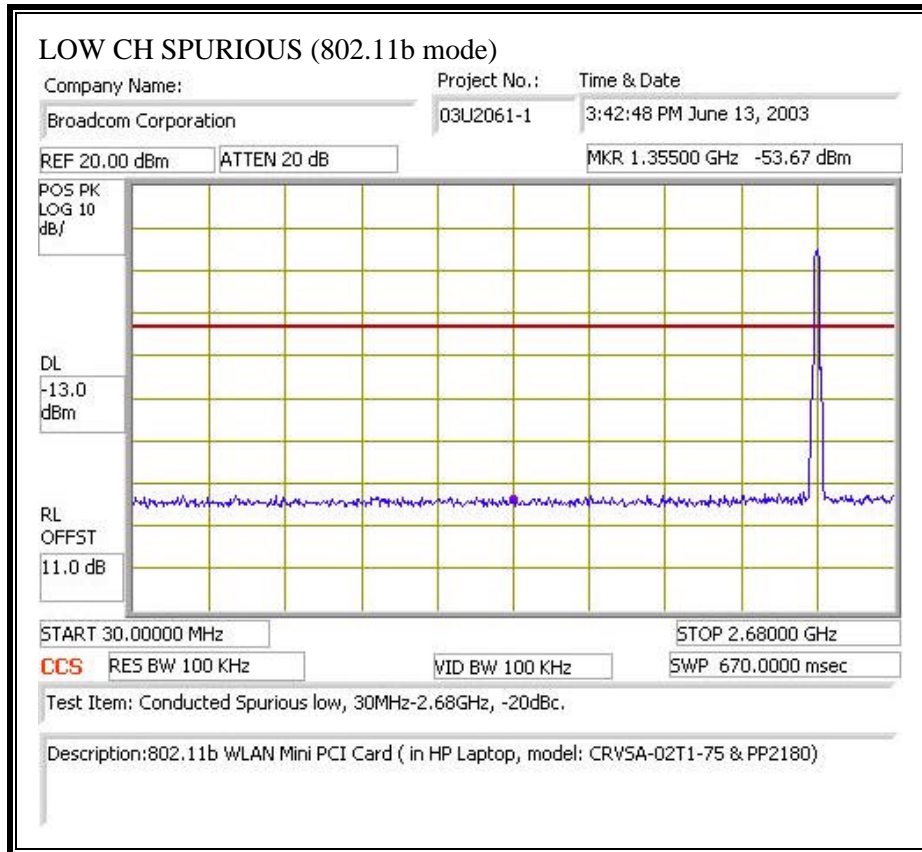
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

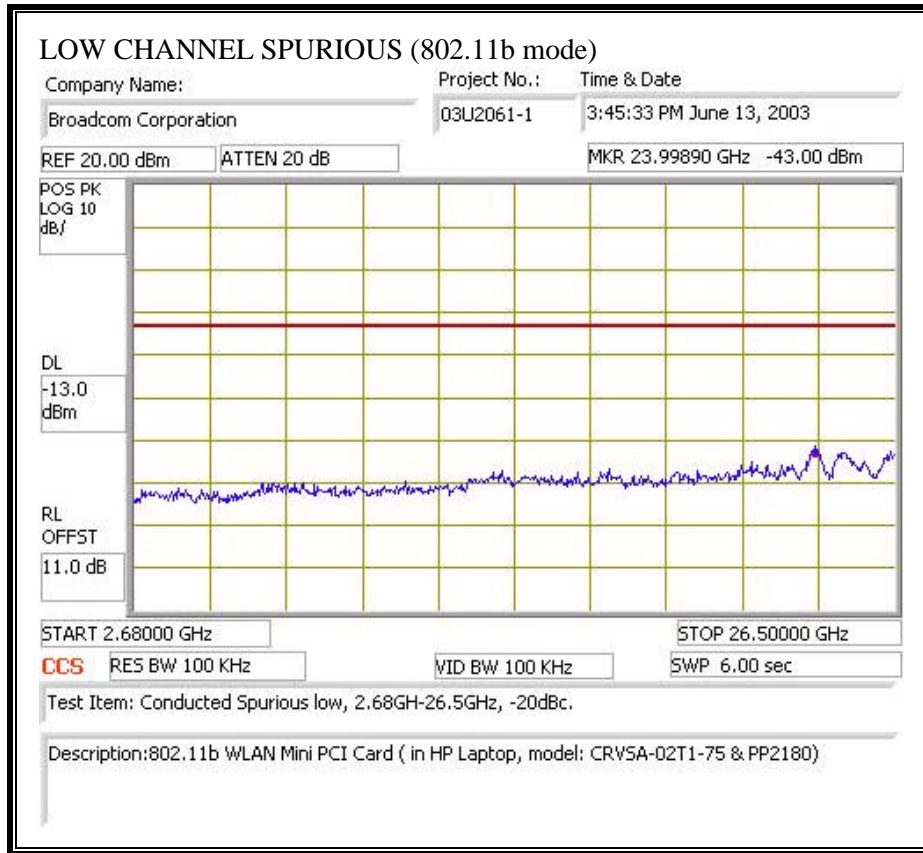
RESULTS

No non-compliance noted:

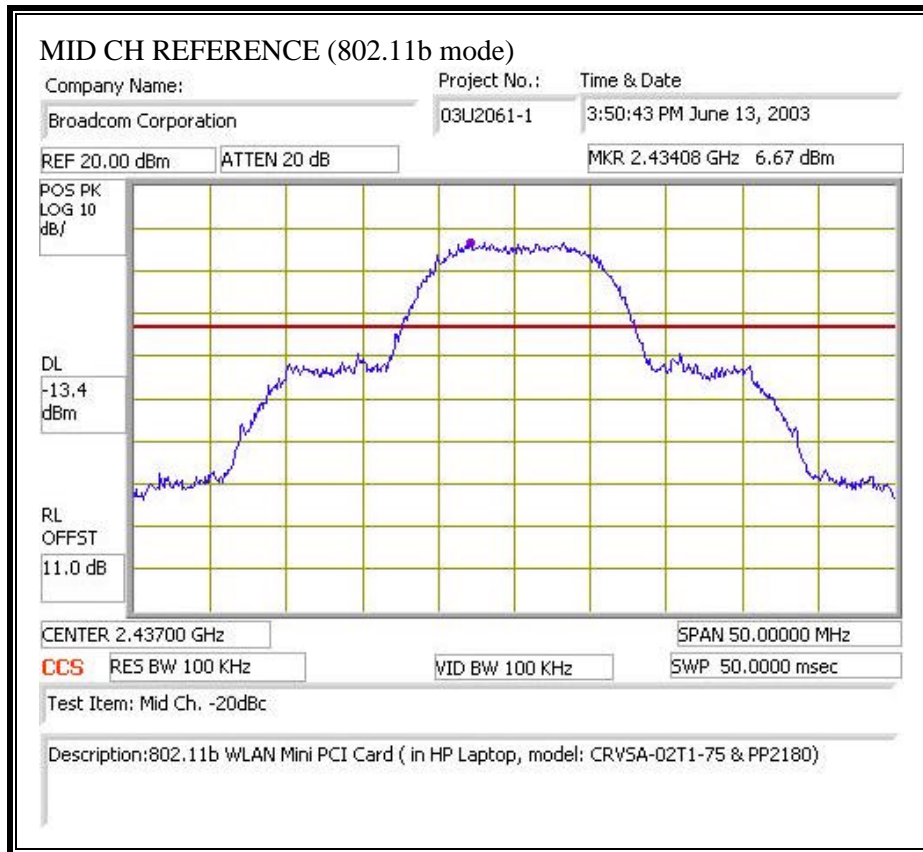
SPURIOUS EMISSIONS, LOW CHANNEL (802.11b MODE)

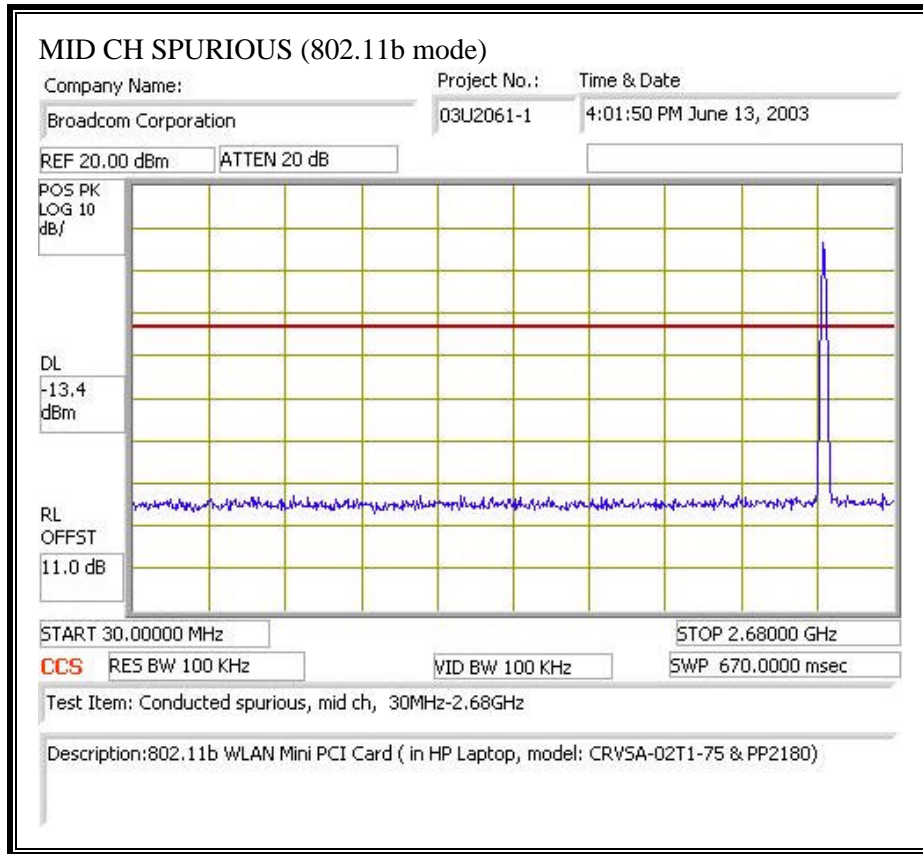


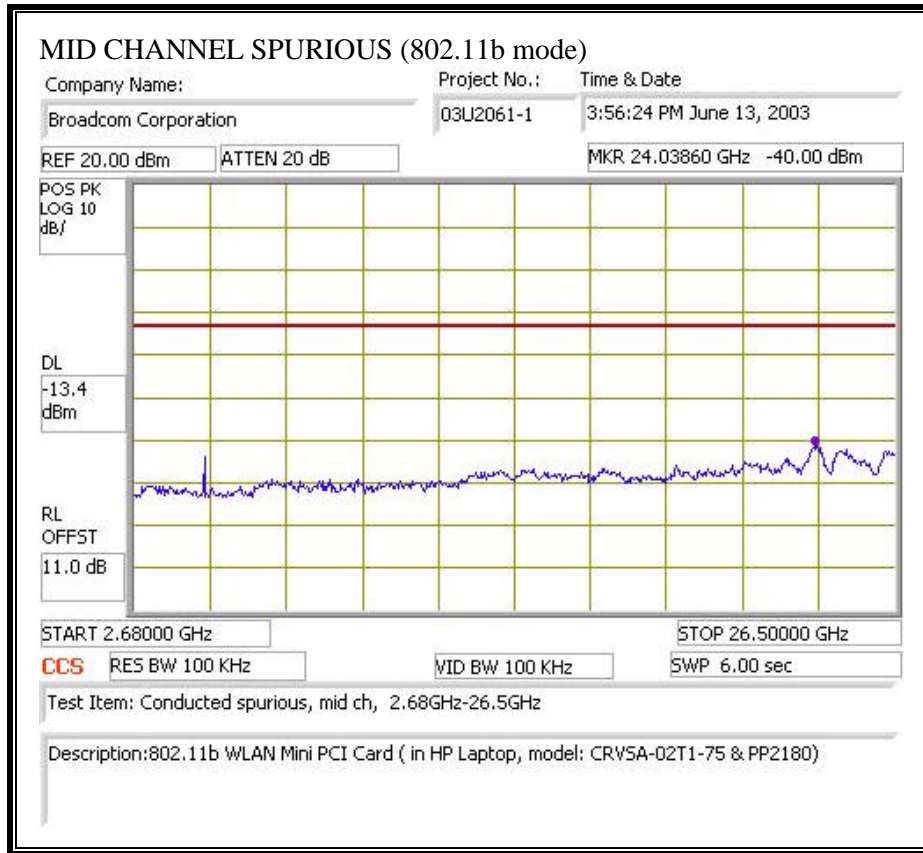




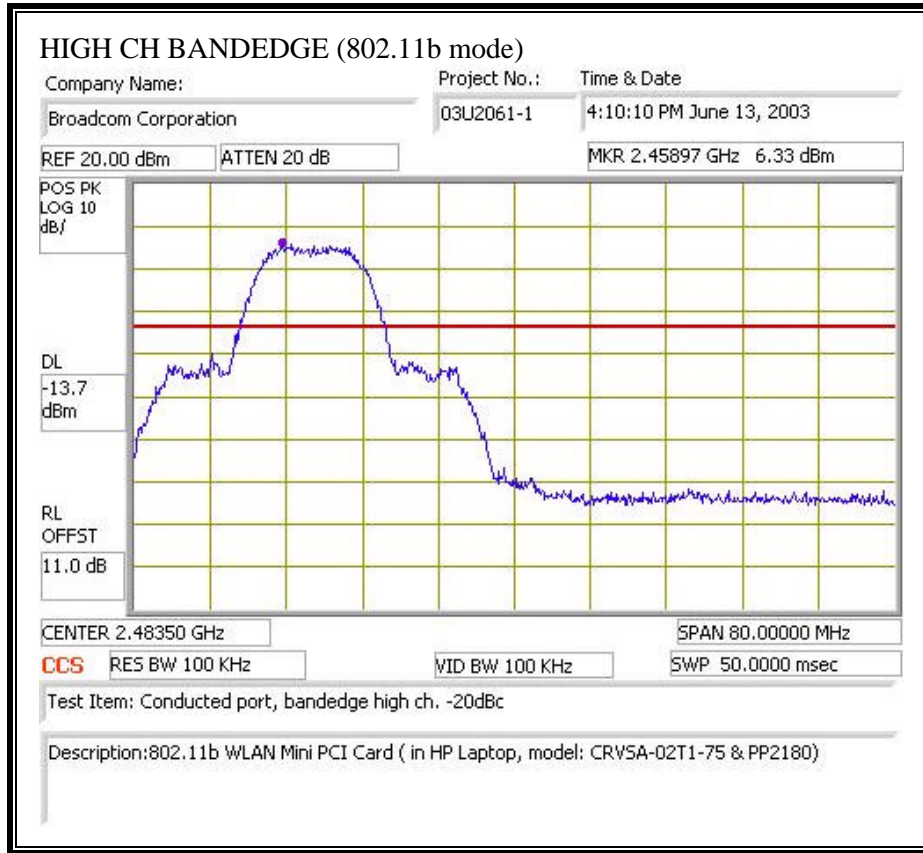
SPURIOUS EMISSIONS, MID CHANNEL (802.11b MODE)

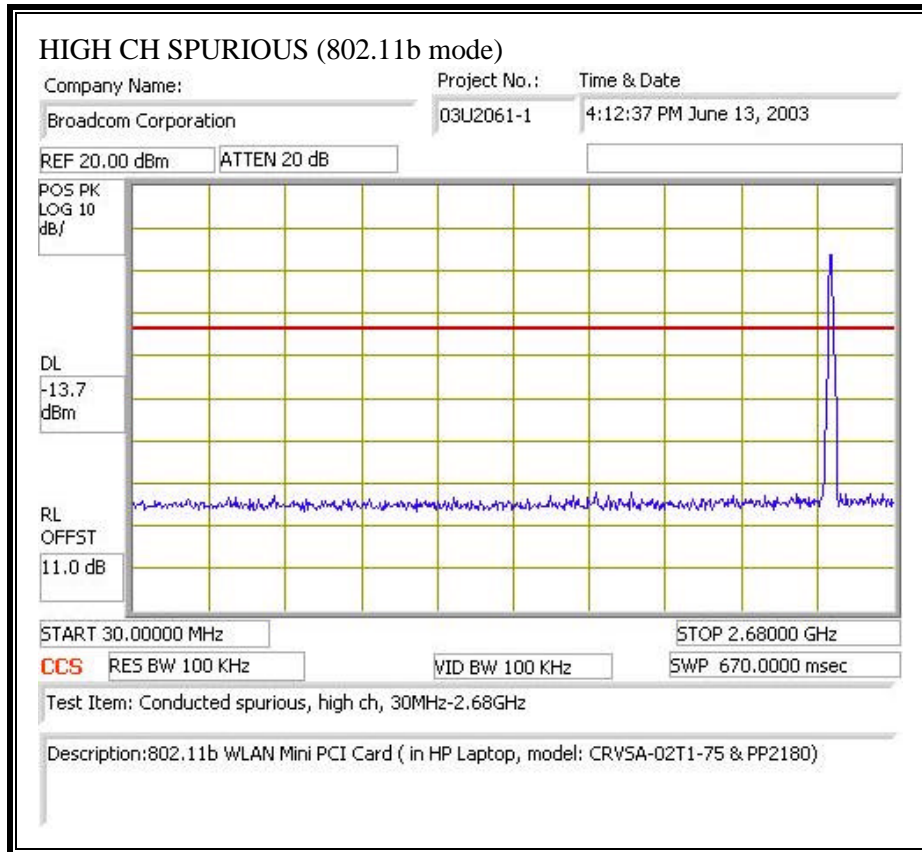


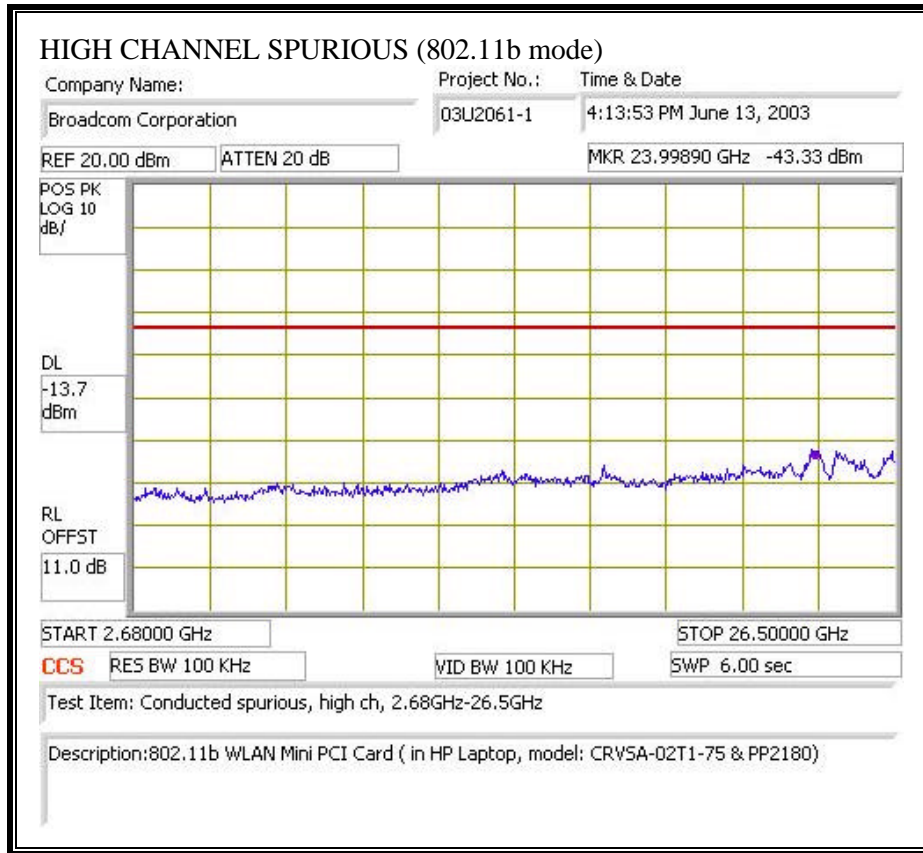




SPURIOUS EMISSIONS, HIGH CHANNEL (802.11b MODE)







7.6. RADIATED 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.

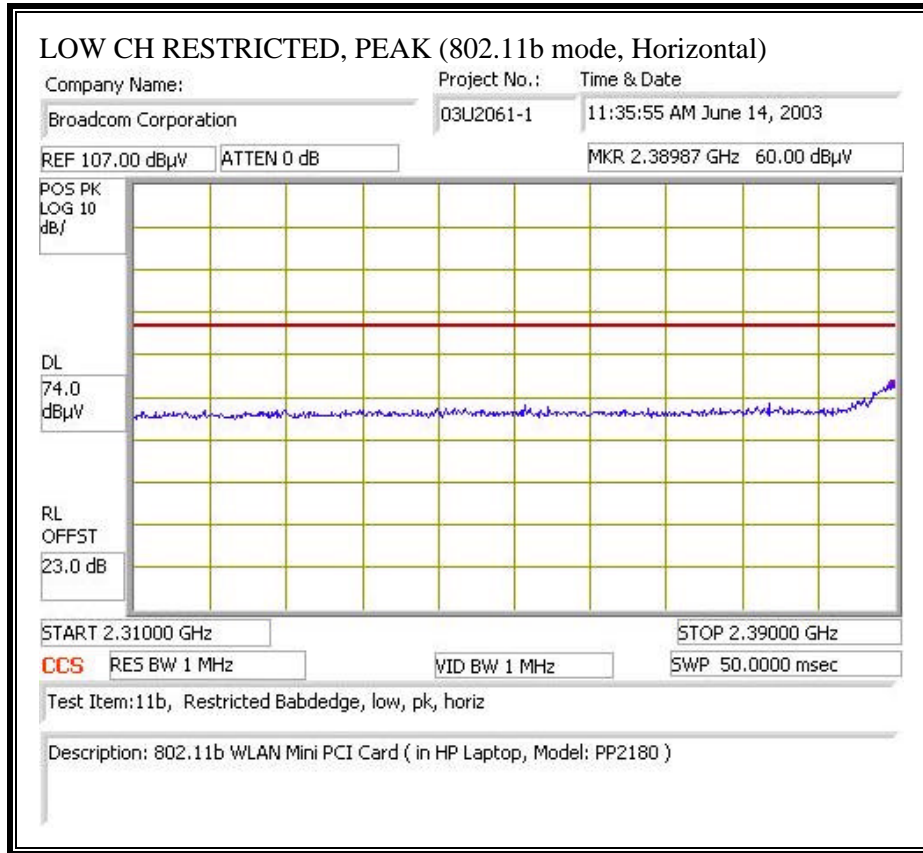
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

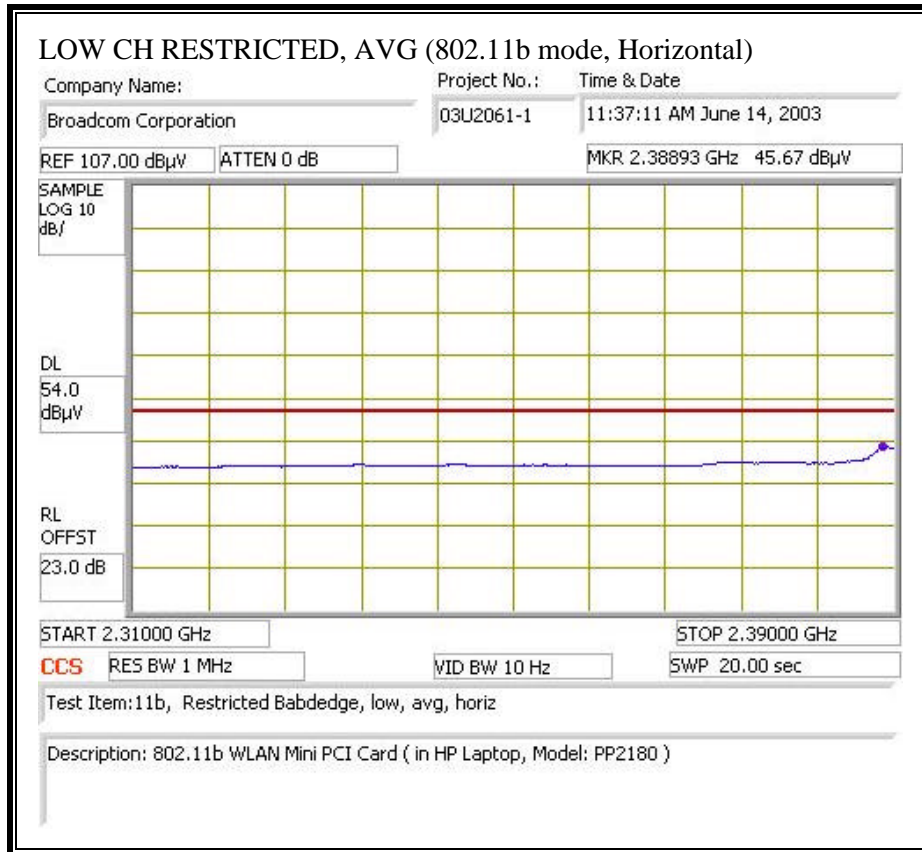
RESULTS

No non-compliance noted:

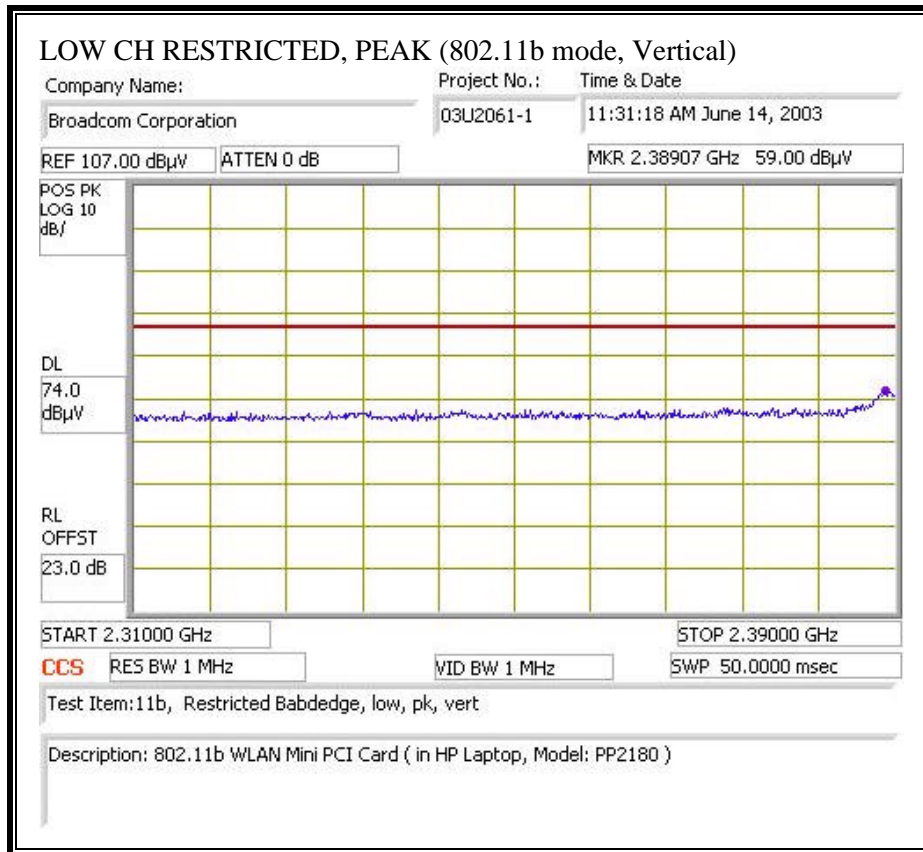
7.6.1. RADIATED EMISSIONS WITH PP2180 HOST COMPUTER:

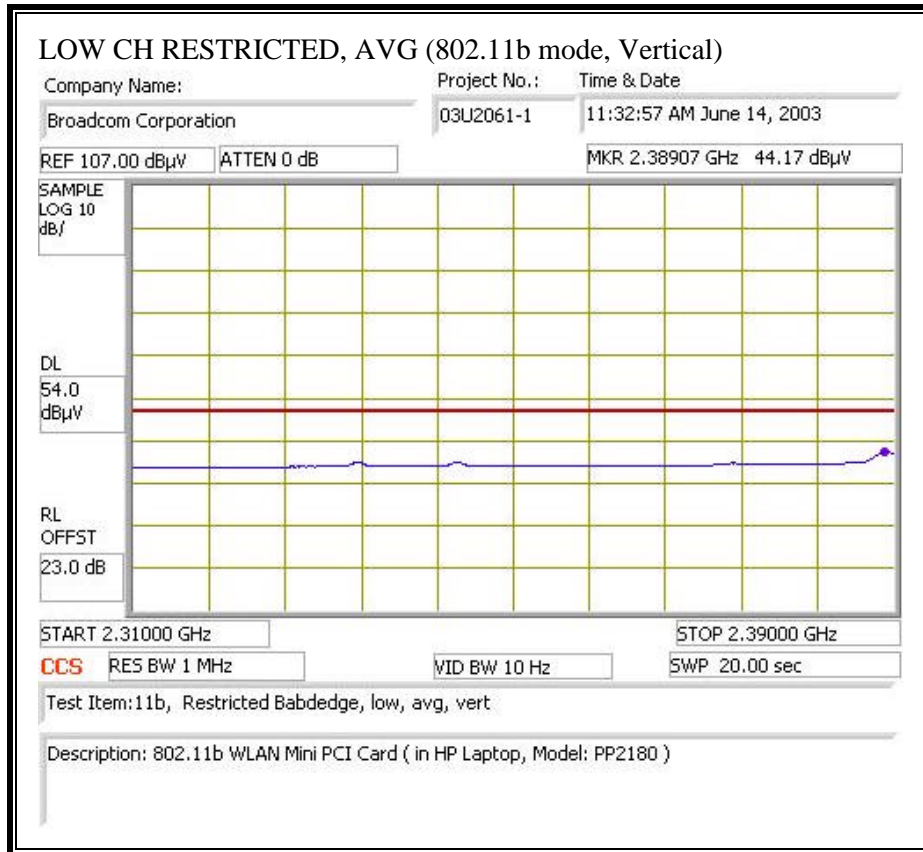
RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, HORIZONTAL)



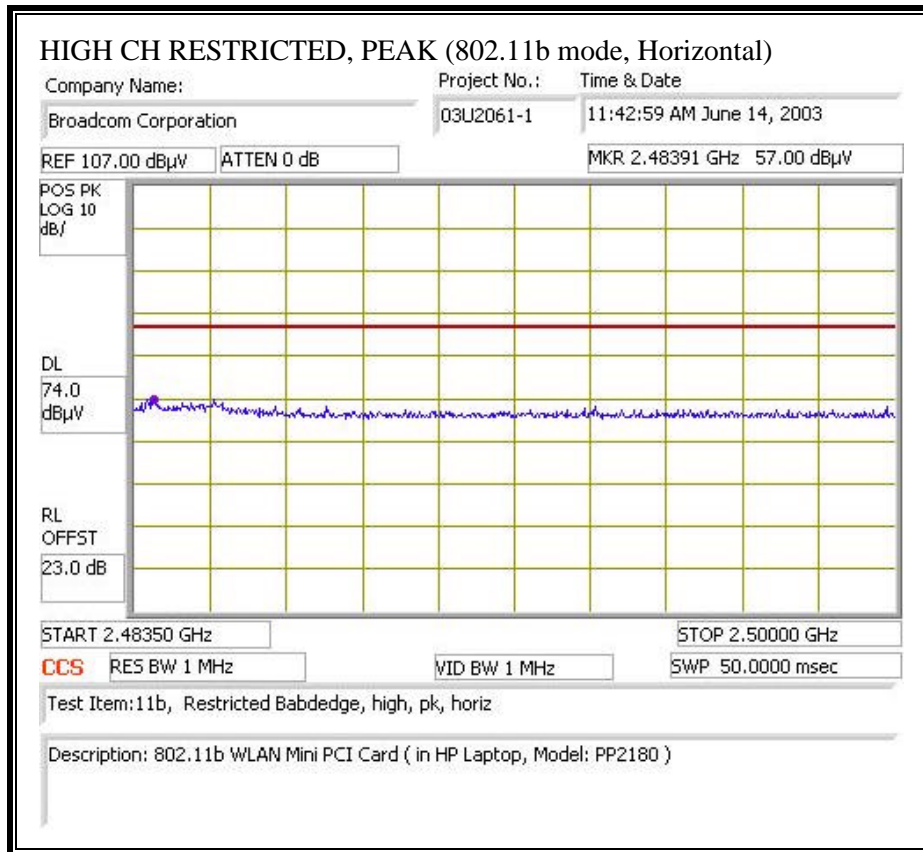


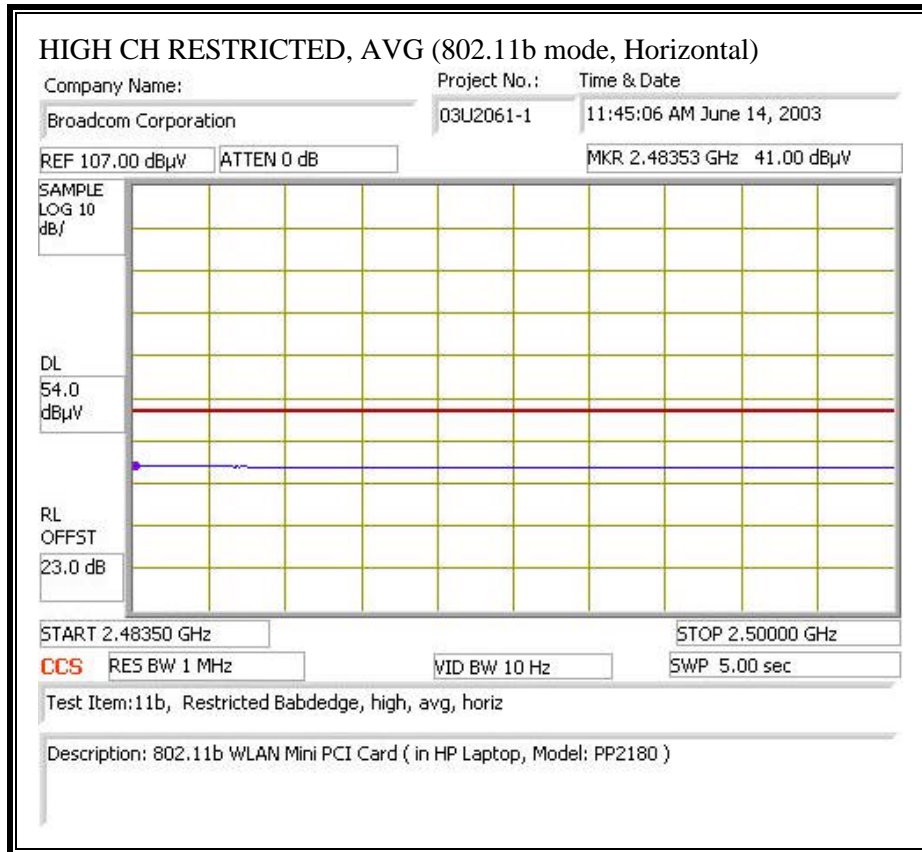
RESTRICTED BANDEGE (b MODE, LOW CHANNEL, VERTICAL)



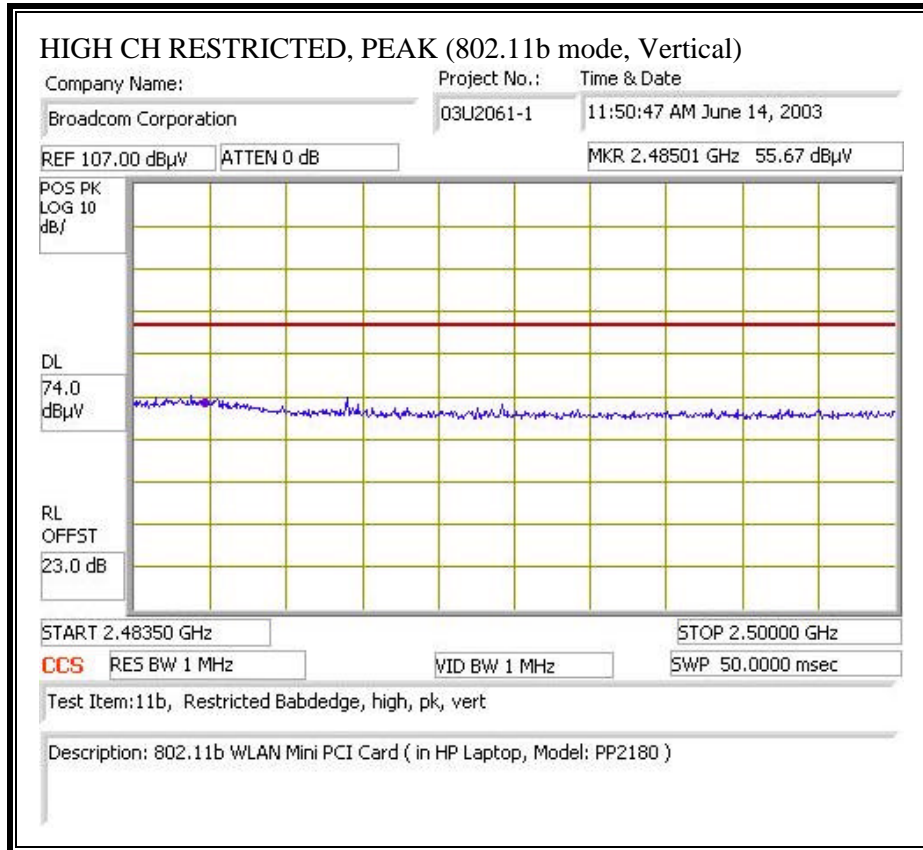


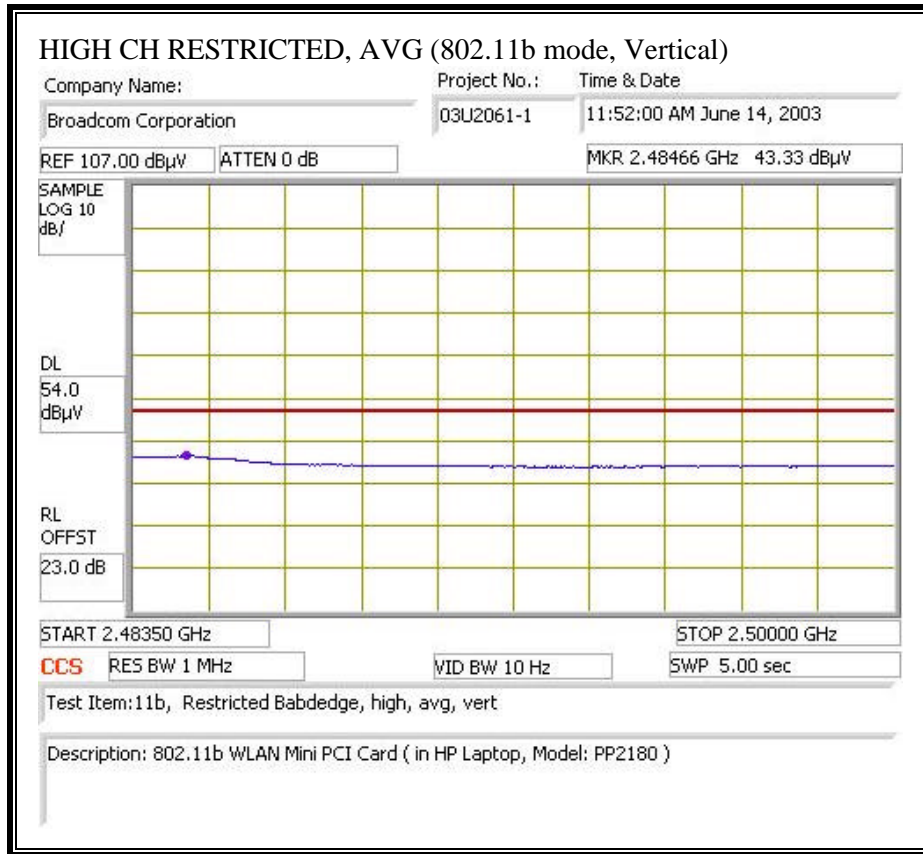
RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

06/15/03 **High Frequency Measurement**
 Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: Chin Pang
 Project #: 03U2061-1
 Company: Broadcom Corporation
 EUT Descr.: 802.11b WLAN Mini PCI Card (in HP Laptop, model: PP2180)
 EUT M/N: BCM94301MPL
 Test Target:FCC 15.247
 Mode Oper:TX

Test Equipment:

EMCO Horn 1-18GHz T60; S/N: 2238 @ 3m	Pre-amplifier 1-26GHz T86 Miteq 924341	Spectrum Analyzer Agilent 8564E Analyzer	Horn > 18GHz
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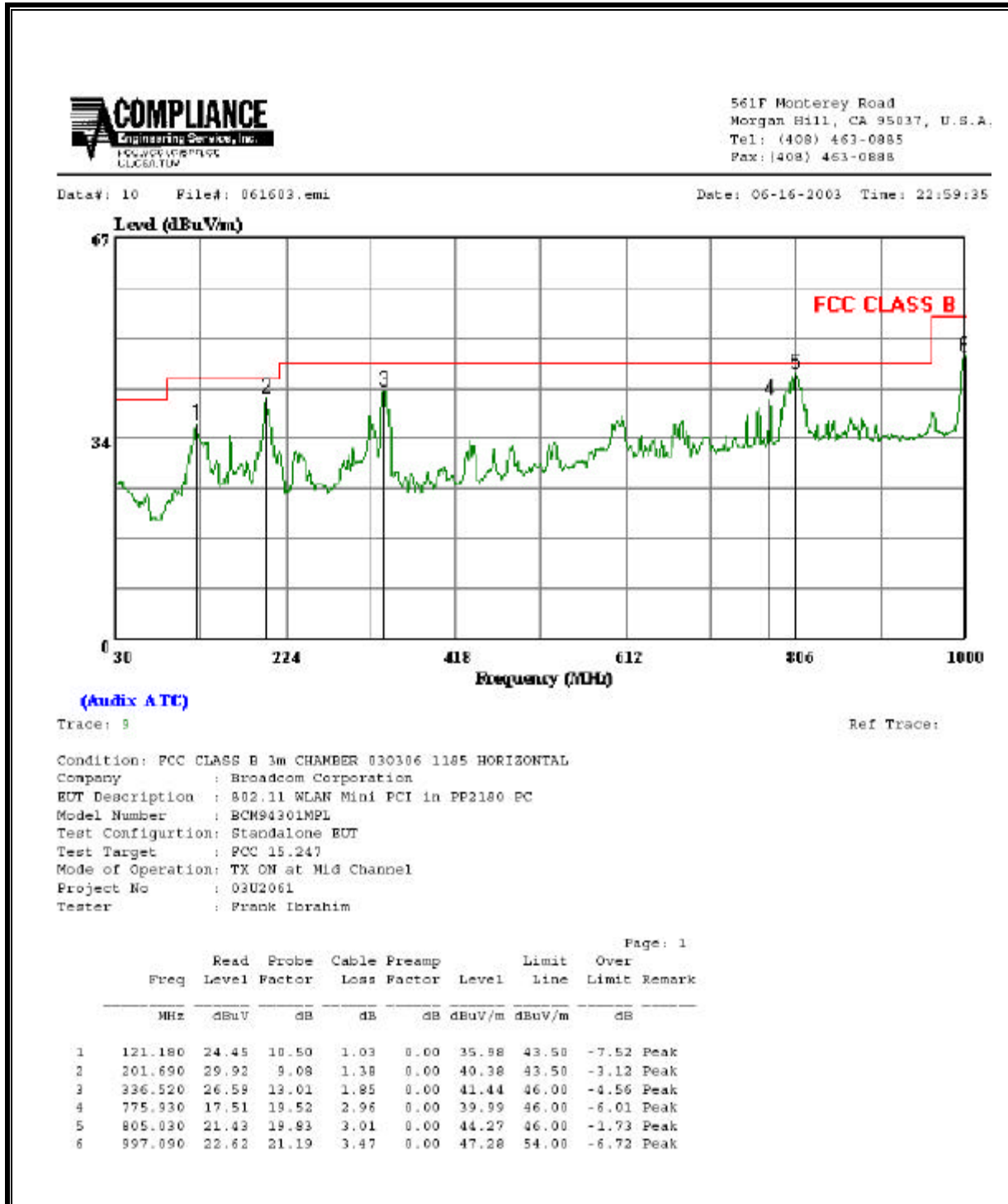
Hi Frequency Cables:
 (2 ft) (2 ~ 3 ft) (4 ~ 6 ft) (12 ft)

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
2.412															
4.824	9.8	58.3	42.8	33.1	3.9	-45.6	0.0	1.0	50.8	35.3	74.0	54.0	-23.2	-18.7	V
4.824	9.8	65.2	49.7	33.1	3.9	-45.6	0.0	1.0	57.6	42.1	74.0	54.0	-16.4	-11.9	H
7.236	9.8	52.8	39.8	36.1	5.1	-46.6	0.0	1.0	48.4	35.4	74.0	54.0	-25.6	-18.6	V
7.236	9.8	52.7	39.5	36.1	5.1	-46.6	0.0	1.0	48.3	35.1	74.0	54.0	-25.7	-18.9	H
2.437															
4.874	9.8	60.6	46.2	33.1	4.0	-45.6	0.0	1.0	53.0	38.6	74.0	54.0	-21.0	-15.4	V
4.874	9.8	63.7	47.5	33.1	4.0	-45.6	0.0	1.0	56.1	39.9	74.0	54.0	-17.9	-14.1	H
7.311	9.8	53.6	41.0	36.2	5.2	-46.6	0.0	1.0	49.4	36.8	74.0	54.0	-24.6	-17.2	V
7.311	9.8	53.3	40.5	36.2	5.2	-46.6	0.0	1.0	49.1	36.3	74.0	54.0	-24.9	-17.7	H
2.462															
4.924	9.8	60.7	45.8	33.2	4.0	-45.7	0.0	1.0	53.2	38.3	74.0	54.0	-20.8	-15.7	V
4.924	9.8	60.2	45.5	33.2	4.0	-45.7	0.0	1.0	52.7	38.0	74.0	54.0	-21.3	-16.0	H
7.386	9.8	51.8	39.6	36.3	5.2	-46.5	0.0	1.0	47.8	35.5	74.0	54.0	-26.2	-18.5	V
7.386	9.8	51.9	39.7	36.3	5.2	-46.5	0.0	1.0	47.8	35.6	74.0	54.0	-26.2	-18.4	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

DIGITAL DEVICE EMISSIONS

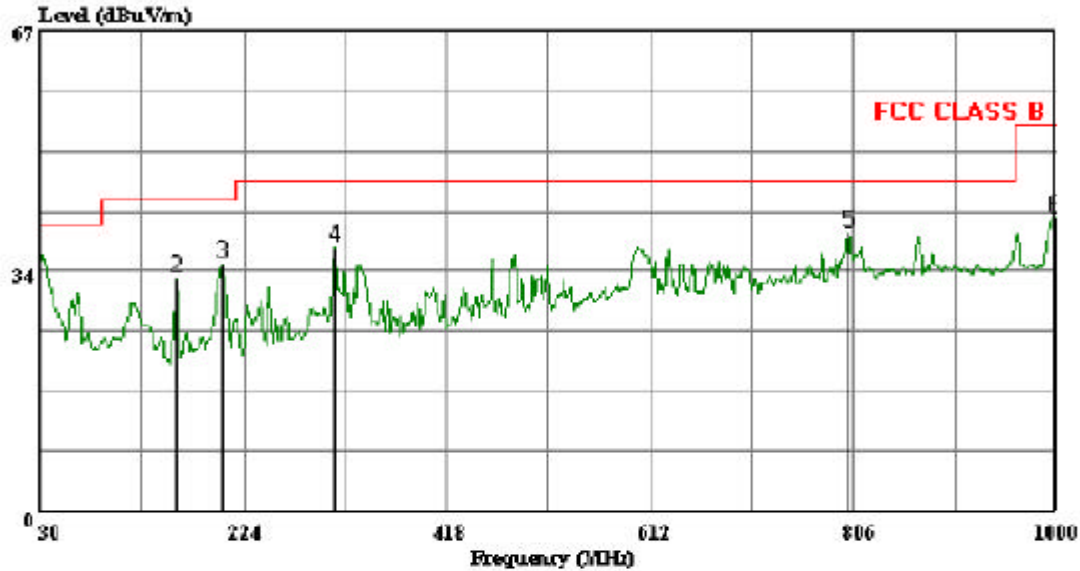




561F Monterey Road
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Data#: 12 File#: 061603.emi

Date: 06-16-2003 Time: 23:09:58



(AudiX ATC)

Trace: 11

Ref Trace:

Condition: FCC CLASS B 3m CHAMBER 030306 1165 VERTICAL
 Company : Broadcom Corporation
 EUT Description : 802.11 WLAN Mini PCI in CRVSA-02T1-75 PC
 Model Number : BCM94301MPL
 Test Configuration: Standalone EUT
 Test Target : FCC 15.247
 Mode of Operation: TX ON at Mid Channel
 Project No : 03U2061
 Tester : Frank Ibrahim

Page: 1

	Read Freq	Probe Level	Probe Factor	Cable Loss	Preamp Factor	Level	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dBuV/m	dBuV/m	dB	
1	30.000	20.61	16.99	0.55	0.00	38.15	40.00	-1.85	Peak
2	159.980	22.71	8.60	1.23	0.00	32.54	43.50	-10.96	Peak
3	203.630	23.81	9.21	1.38	0.00	34.40	43.50	-9.10	Peak
4	310.330	22.74	12.32	1.78	0.00	36.84	46.00	-9.16	Peak
5	800.180	16.07	19.80	3.01	0.00	38.88	46.00	-7.12	Peak
6	997.090	16.36	21.19	3.47	0.00	41.02	54.00	-12.98	Peak