



**FCC CFR47 PART 15 SUBPART C
CERTIFICATION**

TEST REPORT

FOR

ORION 1200B CNFG 802.11G RADIO MOD, PROFESSIONAL

MODEL NUMBER: AIR-MP21G-A-K9-B-P

FCC ID: LDK102052P

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1. TEST RESULT CERTIFICATION

COMPANY NAME: CISCO SYSTEMS, INC.
170 WEST TASMAN
SAN JOSE, CA 95134, USA

EUT DESCRIPTION: Orion 1200B Cnfg 802.11g Radio Mod, Professional

MODEL: AIR-MP21G-A-K9-B-P

DATE TESTED: AUGUST 20 – DECEMBER 2, 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
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EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. EUT DESCRIPTION

The EUT is an 802.11b/g radio module with a MiniPCI interface. It operates in the 2400 – 2483.5 MHz band. 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	23.47	222.33
2412 - 2462	802.11g	18.14	65.16

This module is intended to be professionally installed, and to be used with the following antennas:

Antenna Type	Model Number	Operational Mode	Gain (dBi)
Dish	AIR-ANT3338	Point-to-Point	21
Sector	Mfg. by Cushcraft	Point-to-Point	15
Patch Array	Mfg. by Cisco	Point-to-Point	13.5
Yagi	AIR-ANT1949	Point-to-Point	13.5
Omni	AIR-ANT24120	Omnidirectional	12
Yagi	AIR-ANT2410Y-R	Point-to-Point	10
Patch	AIR-ANT3549	Point-to-Point	8.5
Patch	AIR-ANT2012	Point-to-Point	6.5
Patch	AIR-ANT1729	Point-to-Point	6.0
Omni	AIR-ANT2506	Omnidirectional	5
Omni	AIR-ANT3213	Omnidirectional	5
Omni	AIR-ANT1728	Omnidirectional	5
Omni	Maxrad MUF24005	Omnidirectional	5
Omni	Maxrad MAXC24505	Omnidirectional	5
Omni	AIR-ANT3551	Omnidirectional	2.2
Omni	AIR-ANT5959	Omnidirectional	2.0
Dipole	AIR-ANT4941	Omnidirectional	2.2
Two Dipoles (Tx and Rx Diversity)	AIR-ANT4941	Omnidirectional	2.2

The maximum Antenna Gain that may be used with each discrete power setting is listed below.

Power Setting in 802.11b Mode (mW)	Maximum Antenna Gain (dBi)
100	13.5
50	15
20	21

Power Setting in 802.11g Mode (mW)	Maximum Antenna Gain (dBi)
30	13.5
20	15
10	21

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				
Name of Equipment	Manufacturer	Model No.	Serial No.	Due Date
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	2/4/2004
Antenna, Horn, 18 ~ 26 GHz	ARA	MWH-2640/B	1029	12/3/2004
Amplifier 1-26GHz	MITEQ	NSP2600-SP	924341	4/25/2004
Spectrum Analyzer	Agilent	E4446A	US42510266	7/23/2004
EMI Receiver, 9 kHz ~ 2.9 GHz	HP	8542E	3942A00286	11/21/2004
RF Filter Section	HP	85420E	3705A00256	11/21/2004
Antenna, Bicon/Log, 25 ~ 2000 MHz	ARA	LPB-2520/A	1185	3/6/2004
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
EMI Test Receiver	R & S	ESHS 20	827129/006	7/17/2004
Peak / Average Power Sensor	Agilent	E9327A	US40440755	11/7/2004
Power Meter	Agilent	E4416A	GB41291160	11/7/2004
Band Reject 2.4GHz	Micro-Tronics	BRM50702	003	N.C.R.
DC Power Supply	HP	6325A	2450A-08312	N.C.R.
DC Power Supply	HP	E3610A	KR24104150	N.C.R.

6. SETUP OF EQUIPMENT UNDER TEST

SUPPORT EQUIPMENT

Device Type	Manufacturer	Model Number	Serial Number	FCC ID
Laptop	IBM	2647	78-B3952	DoC
Power Adapter	IBM	02K6665	11502K66657A2U81385RR	DoC
Power Supply 1	HP	E3610A	LR85750C	N/A
Power Supply 2	KRM	AEEC-350	9712154746	N/A

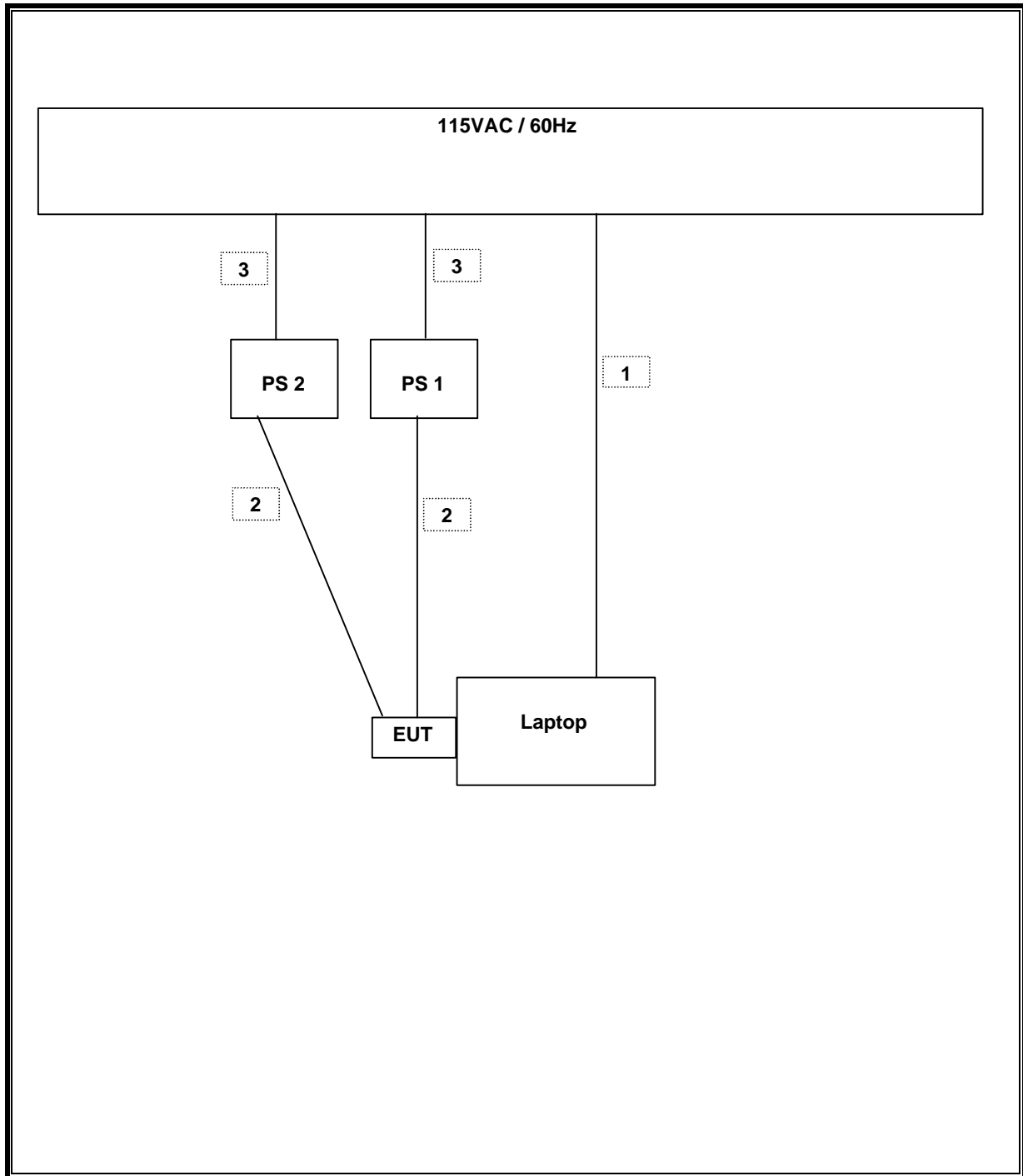
I/O CABLES

Cable No	I/O Port	# of I/O Port	Connector Type	Type of Cable	Cable Length	Data Traffic	Bundled	Remark
1	AC	1	US 115V	Un-shielded	2m	No	No	Integrated with Adapter
2	DC	2	DC	Un-shielded	1m	No	No	N/A
3	AC	2	US115	Un-shielded	1m	No	No	N/A

TEST SETUP

The EUT is 802.11b/g mini PCI radio. It was connected to a laptop via a cardbus-to-miniPCI adapter / extension board during the tests. Power was furnished by two external power supplies, set to 3.3 VDC and 5 VDC, respectively. Test software exercised the radio card.

SETUP DIAGRAM



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:

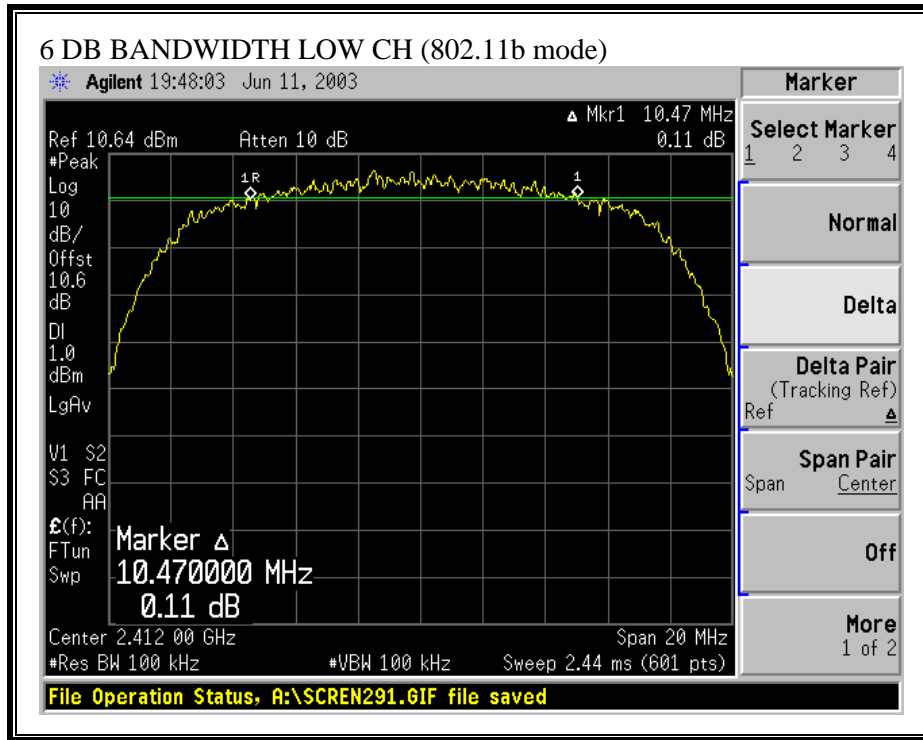
802.11b Mode

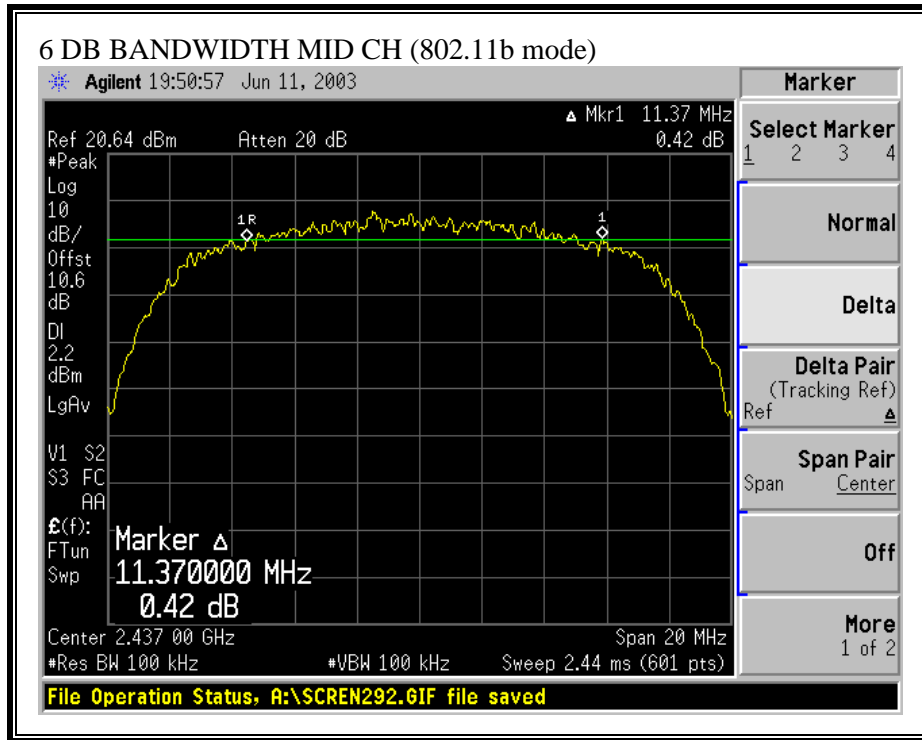
Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Low	2412	10470	500	9970
Middle	2437	11370	500	10870
High	2462	11930	500	11430

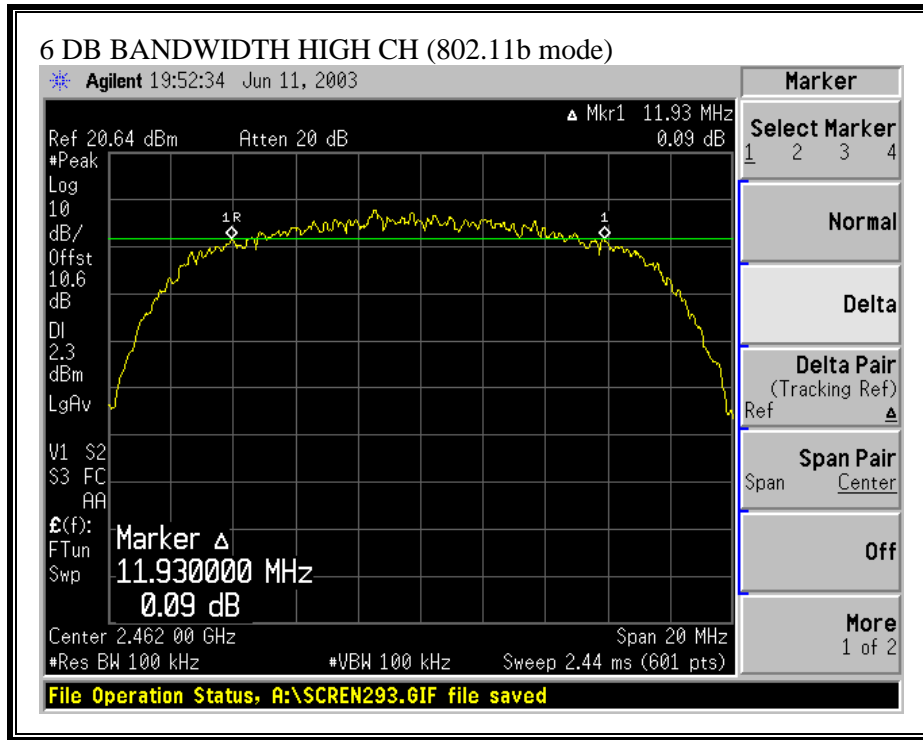
802.11g Mode

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Low	2412	16430	500	15930
Middle	2437	16400	500	15900
High	2462	16430	500	15930

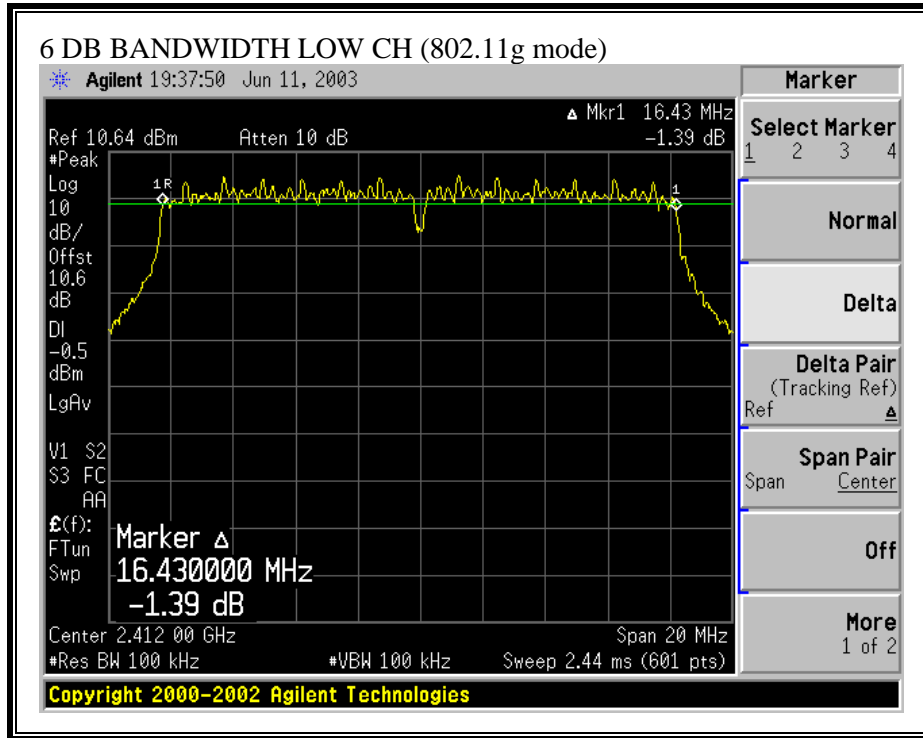
6 DB BANDWIDTH (802.11b MODE)

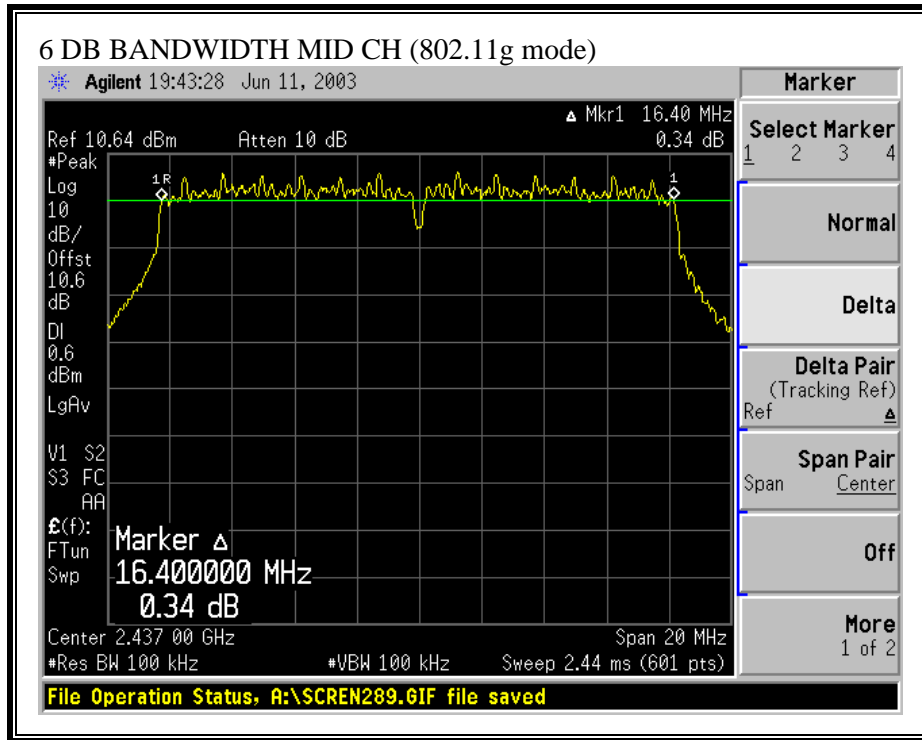


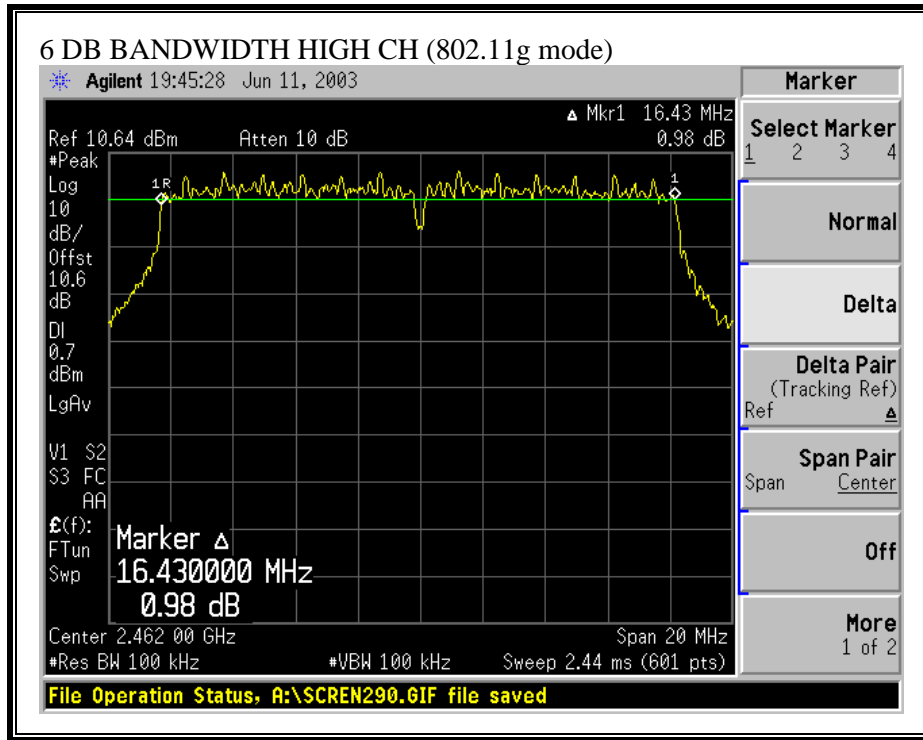




6 DB BANDWIDTH (802.11g MODE)







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.

RESULTS

No non-compliance noted:

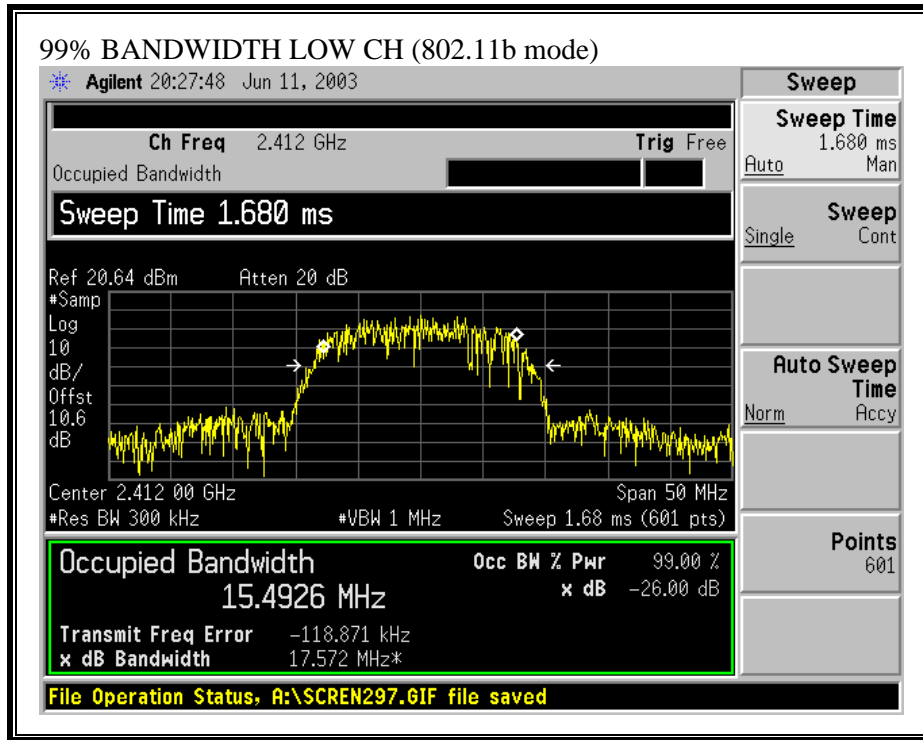
802.11b Mode

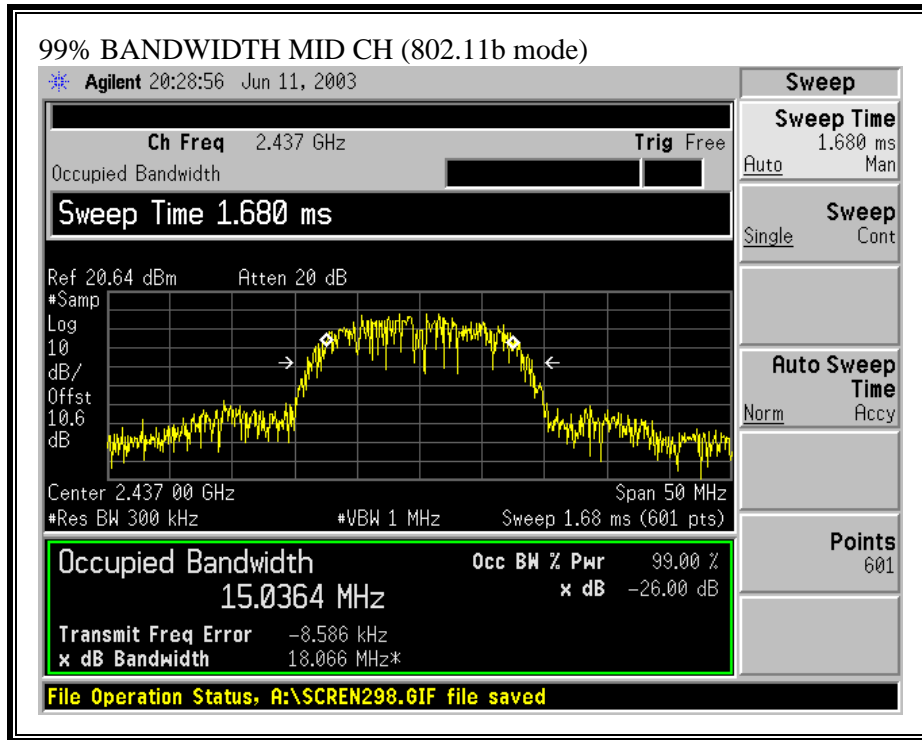
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	15.4926
Middle	2437	15.0364
High	2462	15.2277

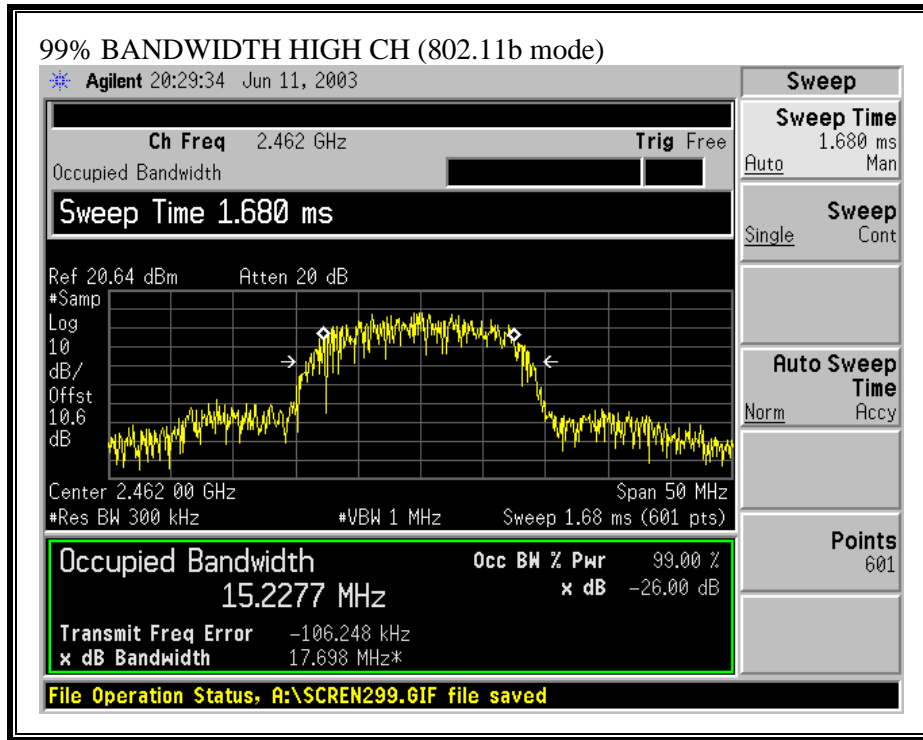
802.11g Mode

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	16.3025
Middle	2437	16.3495
High	2462	16.1143

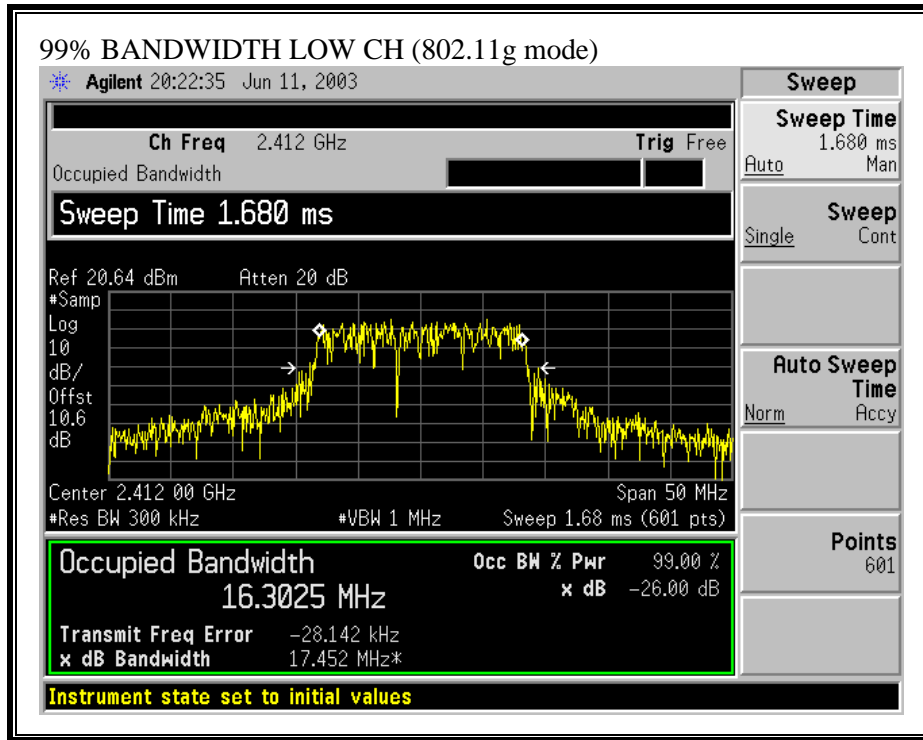
99% BANDWIDTH (802.11b MODE)

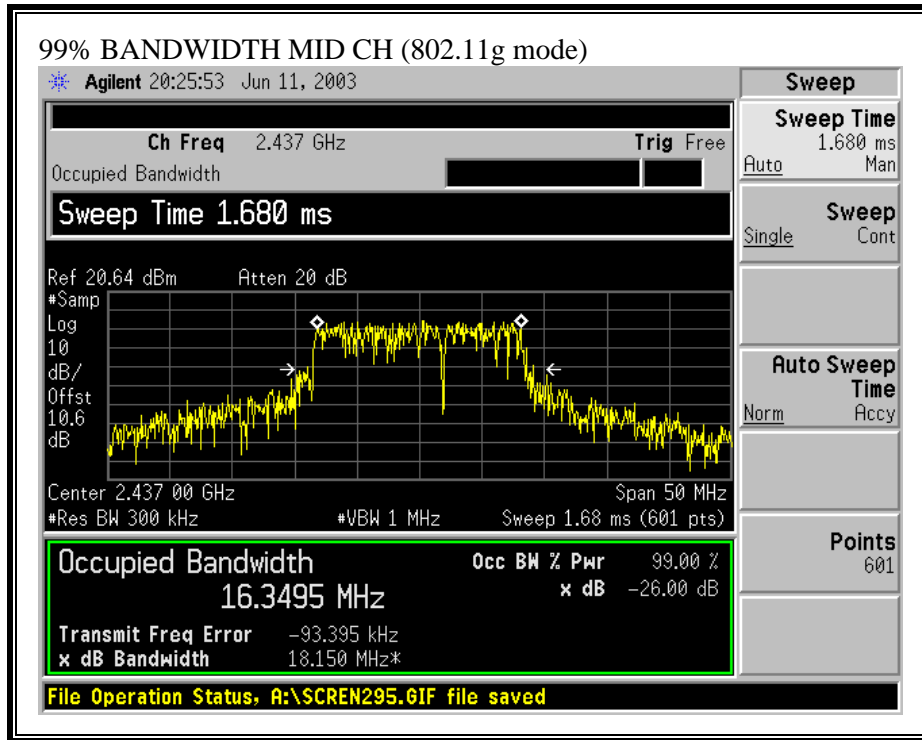


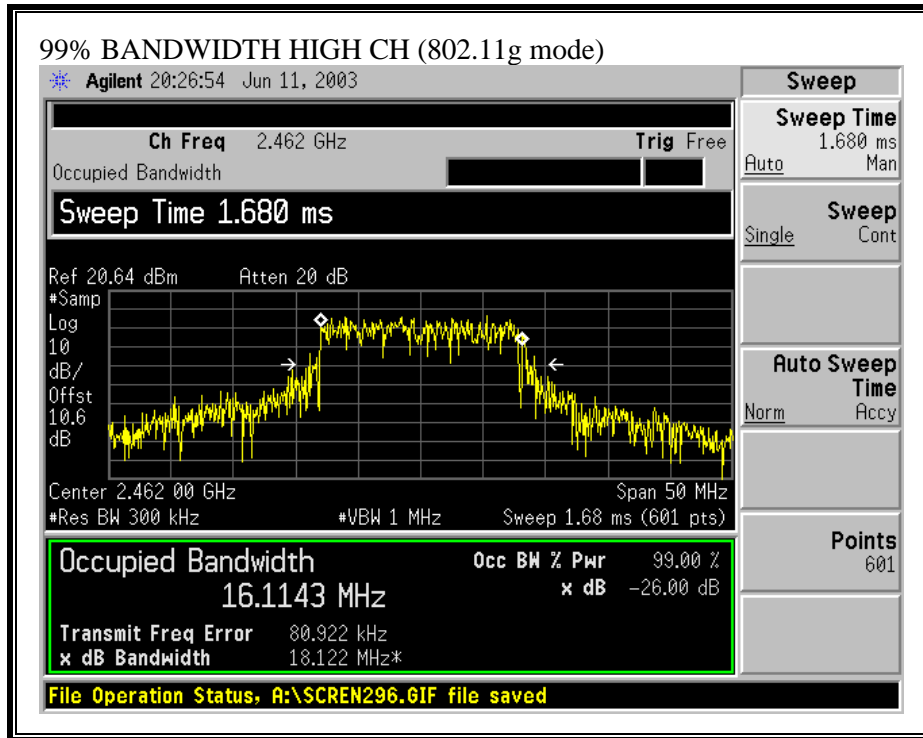




99% BANDWIDTH (802.11g MODE)







7.3. PEAK OUTPUT POWER FOR ANTENNAS UP TO 13.5 dBi GAIN

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)(4) (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.

§15.247 (b) (4) (i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is 12 dBi for omnidirectional operation, therefore the omnidirectional limitation is 24 dBm.

The maximum antenna gain is 13.5 dBi for point-to-point operation, therefore the point-to-point limitation is $30 - \{(13.5 - 6) \div 3\} = 27.5$ dBm.

The lowest of these two limitation values will apply, therefore the peak power limit is 24 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

The power settings for antennas up to 13.5 dBi gain are 100mW for b mode and 30mW for g mode.

No non-compliance noted:

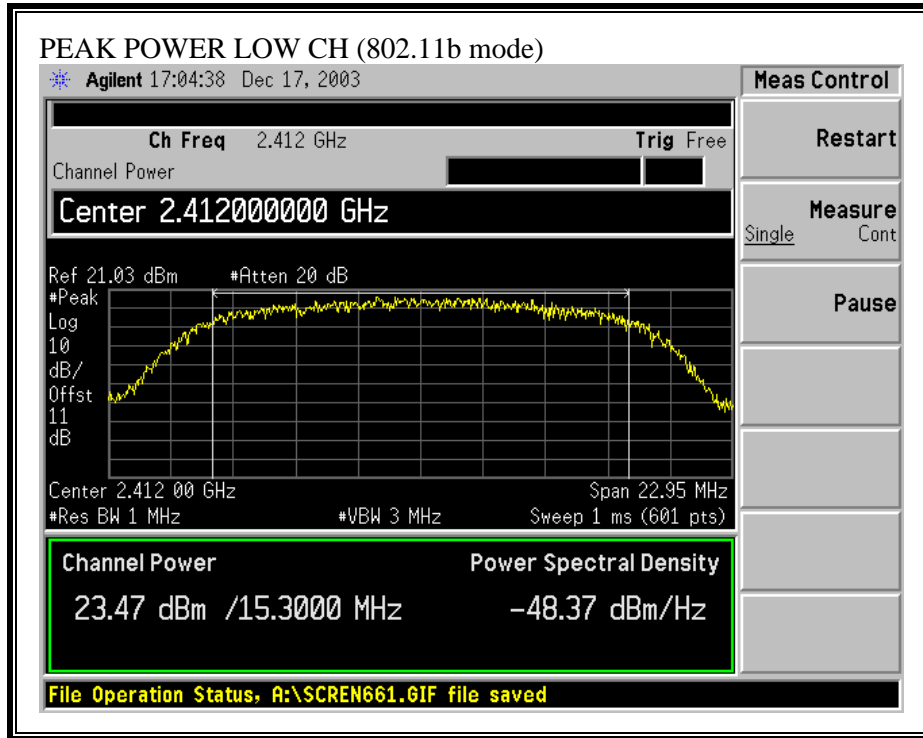
802.11b Mode

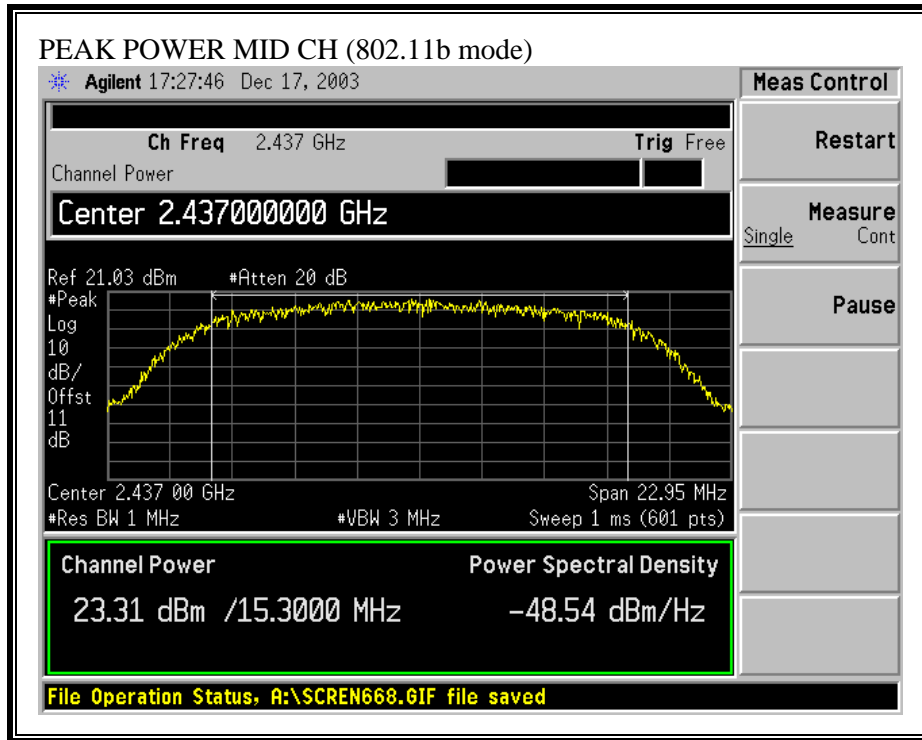
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	23.47	24	-0.53
Middle	2437	23.31	24	-0.69
High	2462	23.23	24	-0.77

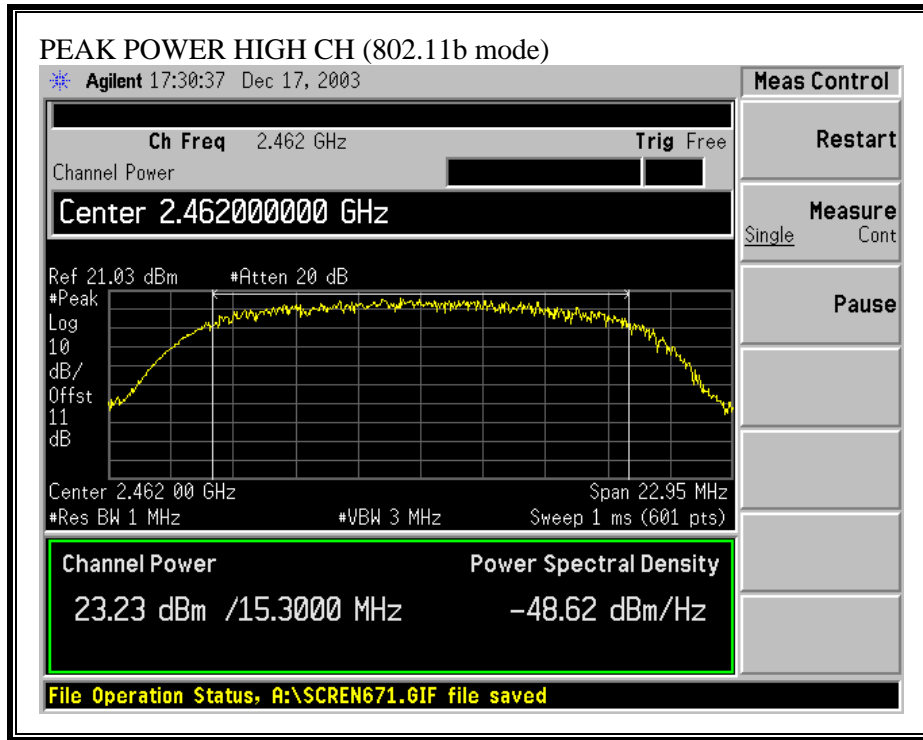
802.11g Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	18.33	24	-5.67
Middle	2437	18.14	24	-5.86
High	2462	18.23	24	-5.77

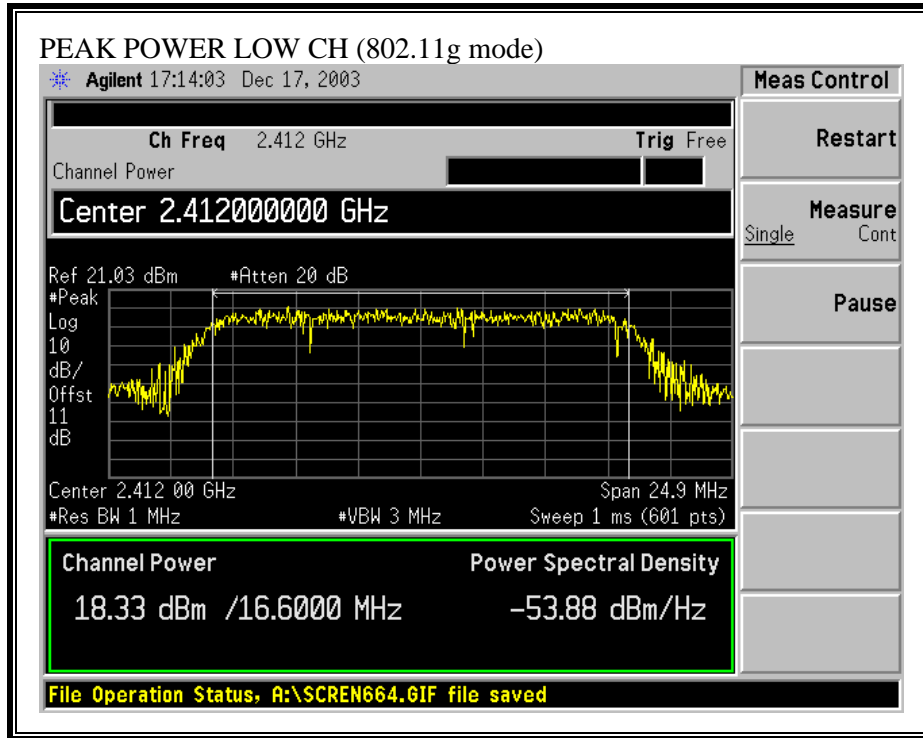
OUTPUT POWER (802.11b MODE)

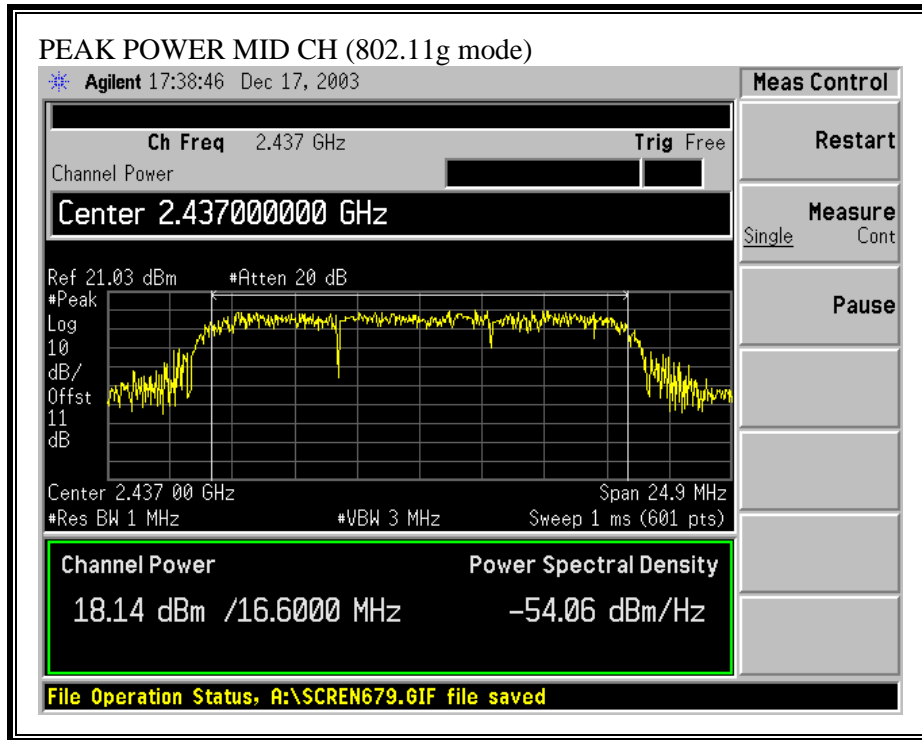


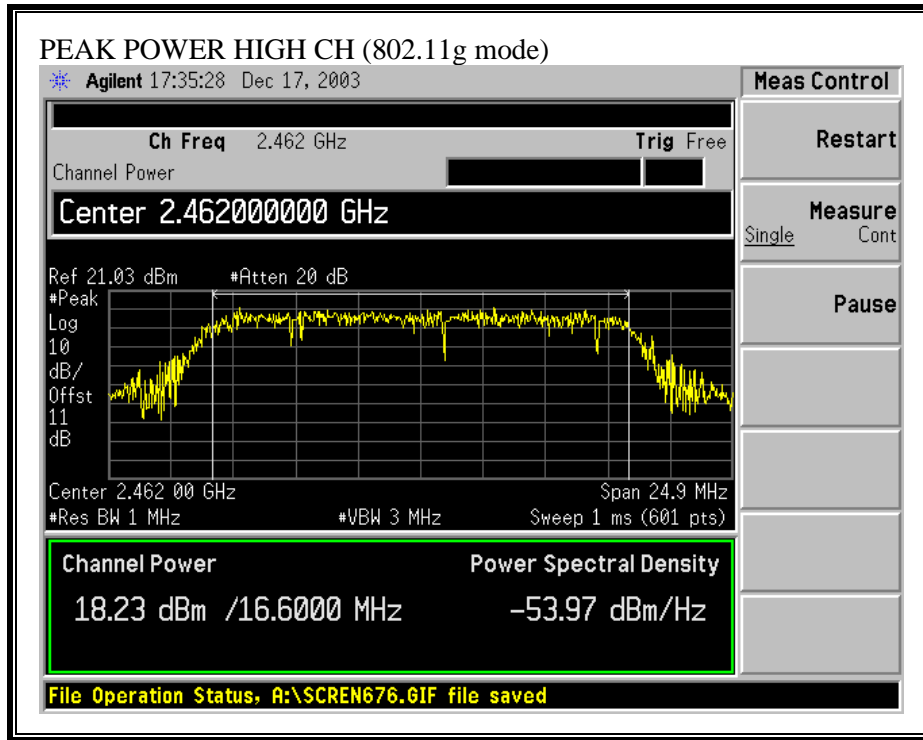




OUTPUT POWER (802.11g MODE)







7.4. PEAK OUTPUT POWER FOR 15 dBi SECTOR ANTENNA

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)(4) (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.

§15.247 (b) (4) (i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

The antenna gain is 15 dBi with point-to-point operation, therefore the limit is $30 - \{(15-6) \div 3\} = 27$ 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

The power settings for the 15 dBi Sector Antenna are 50mW for b mode and 20mW for g mode.

No non-compliance noted:

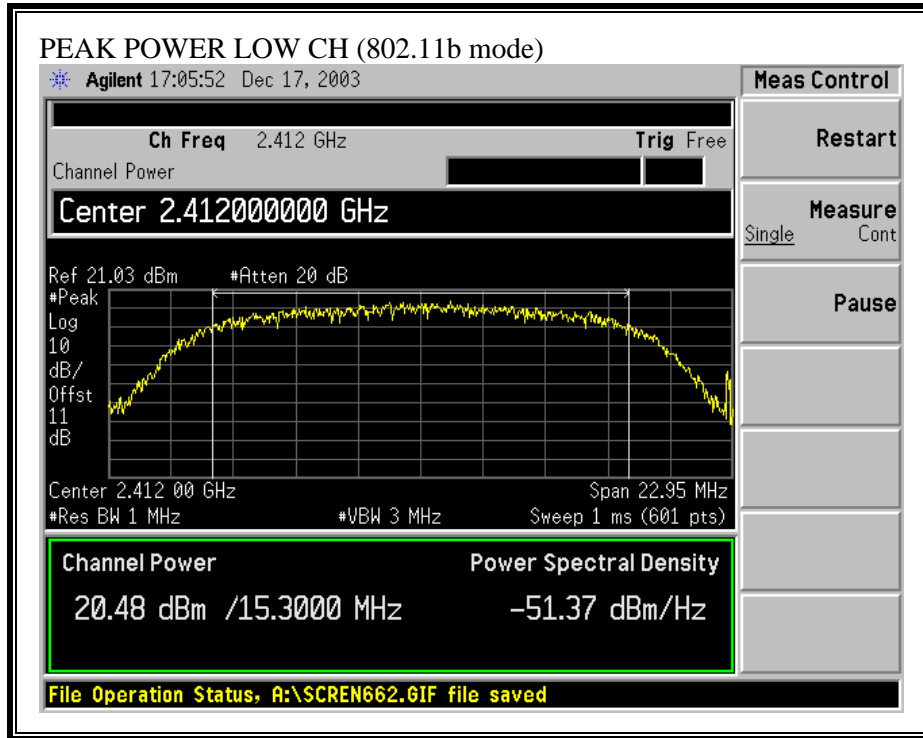
802.11b Mode

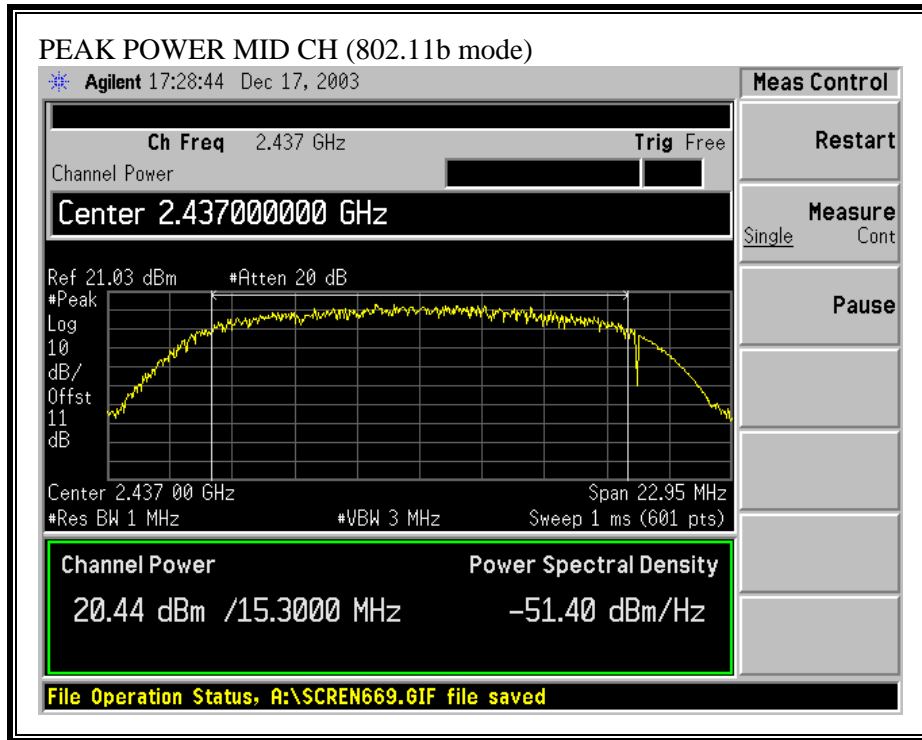
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	20.48	27	-6.52
Middle	2437	20.44	27	-6.56
High	2462	20.39	27	-6.61

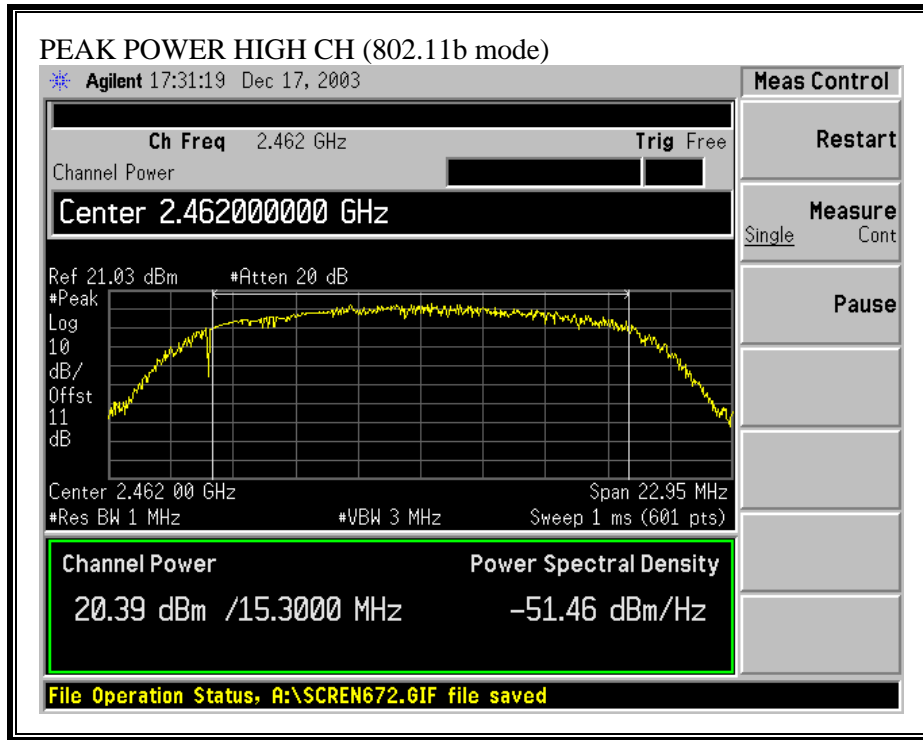
802.11g Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	16.49	27	-10.51
Middle	2437	16.76	27	-10.24
High	2462	16.69	27	-10.31

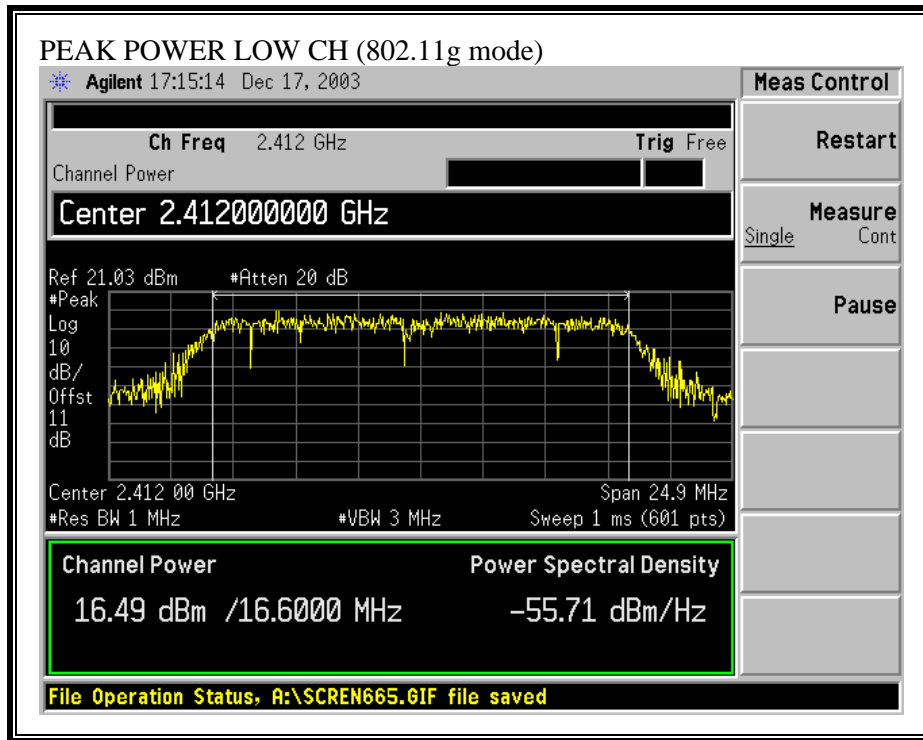
OUTPUT POWER (802.11b MODE)

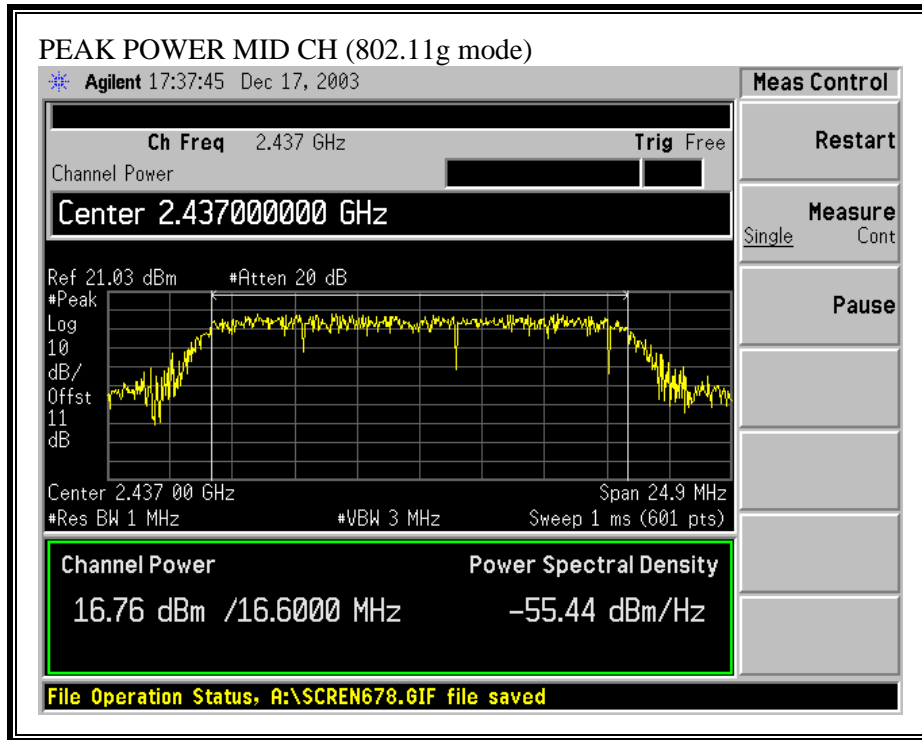


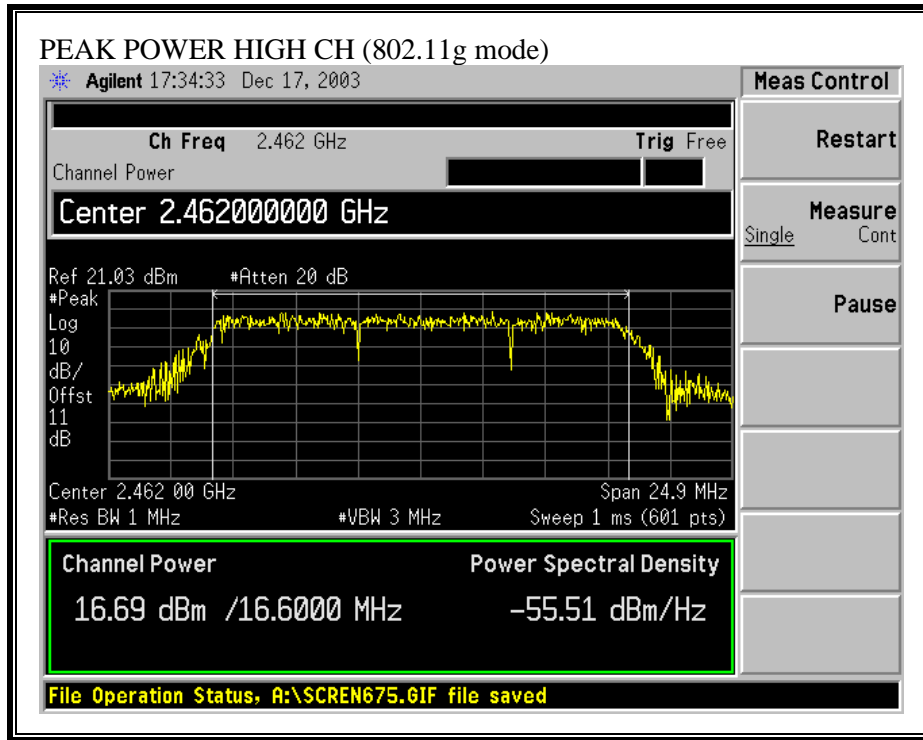




OUTPUT POWER (802.11g MODE)







7.5. PEAK OUTPUT POWER FOR 21dBi DISH ANTENNA

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)(4) (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.

§15.247 (b) (4) (i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Since the antenna gain is 21 dBi with point-to-point operation, therefore the limit is $30 - \{(21-6) \div 3\} = 25$ 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

The power settings for the 21 dBi Dish Antenna are 20 mW for b mode and 10 mW for g mode.

No non-compliance noted:

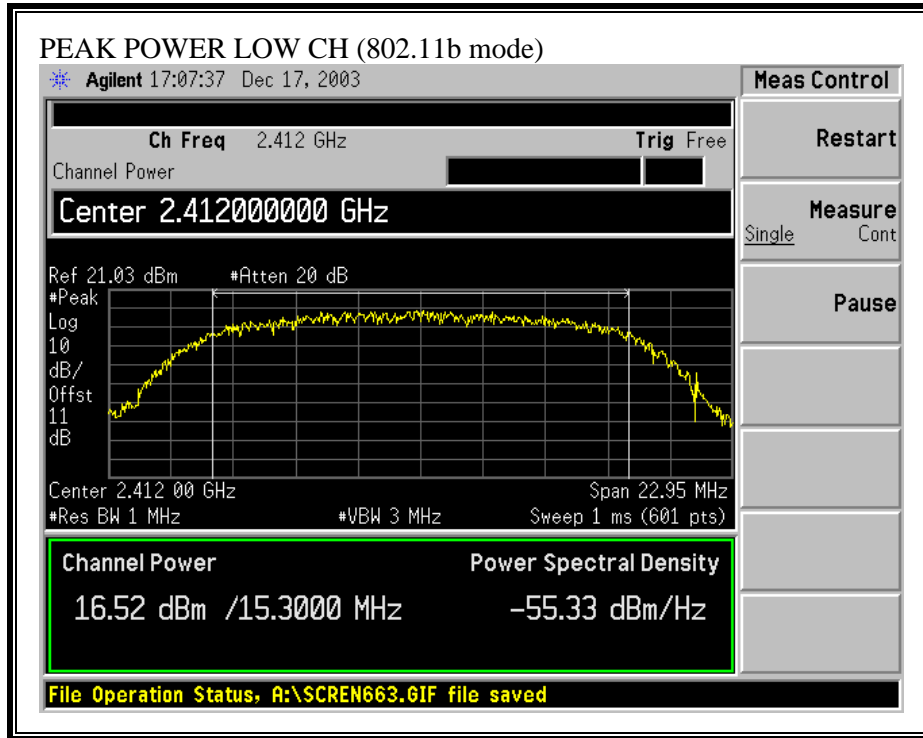
802.11b Mode

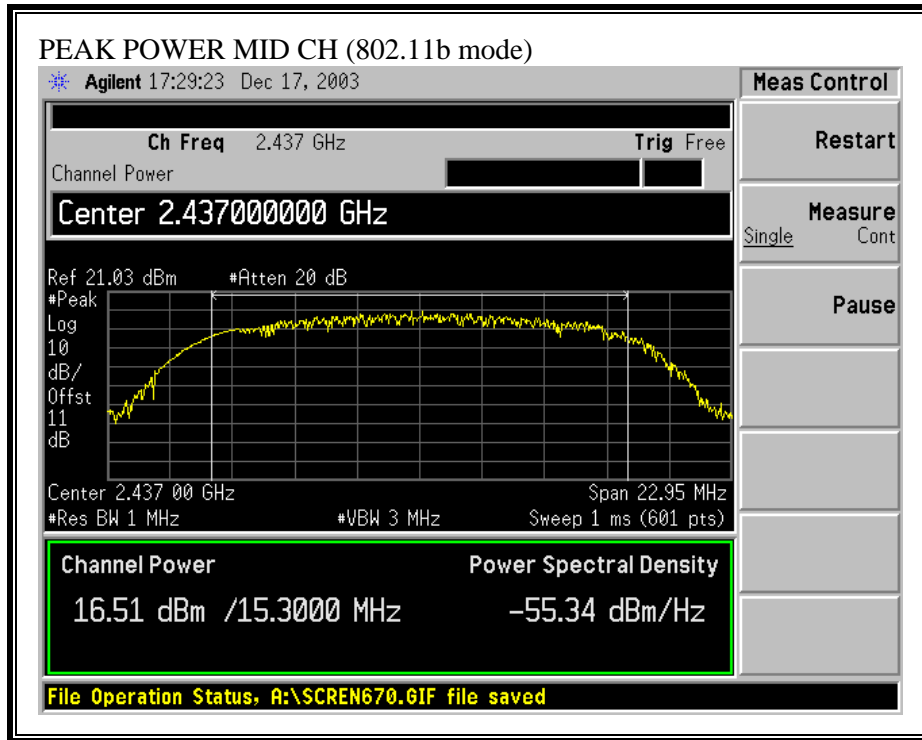
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	16.52	25	-8.48
Middle	2437	16.51	25	-8.49
High	2462	16.33	25	-8.67

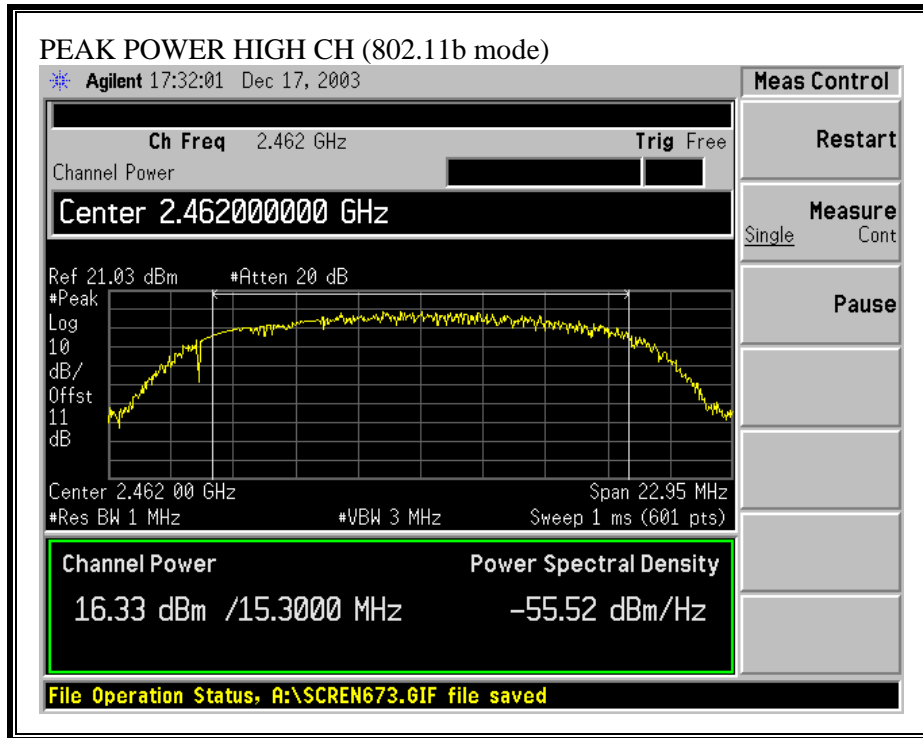
802.11g Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	13.45	25	-11.55
Middle	2437	13.93	25	-11.07
High	2462	13.86	25	-11.14

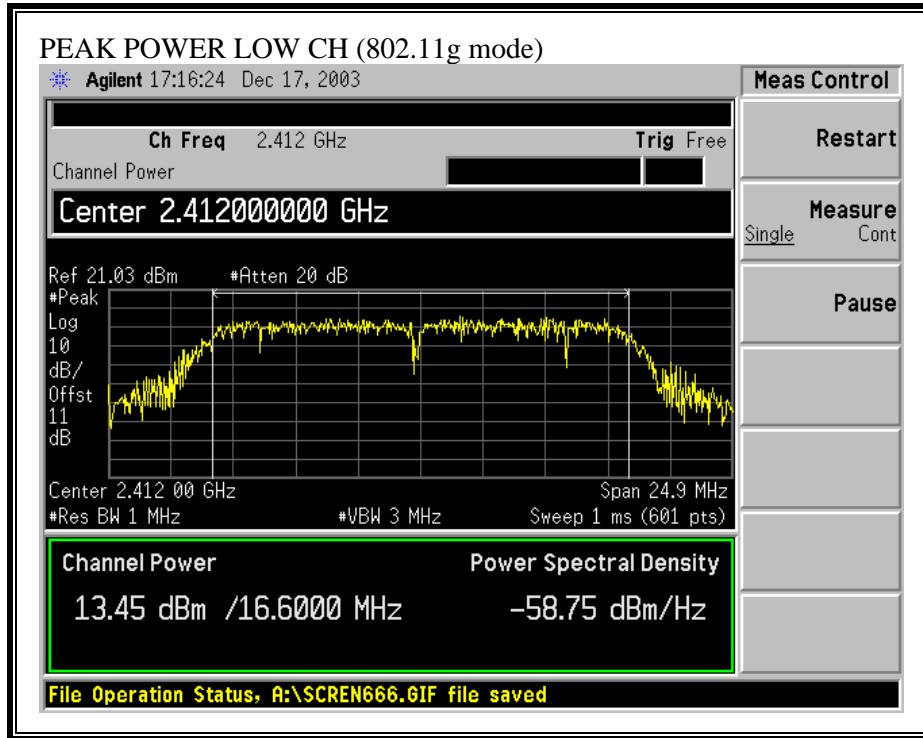
OUTPUT POWER (802.11b MODE)

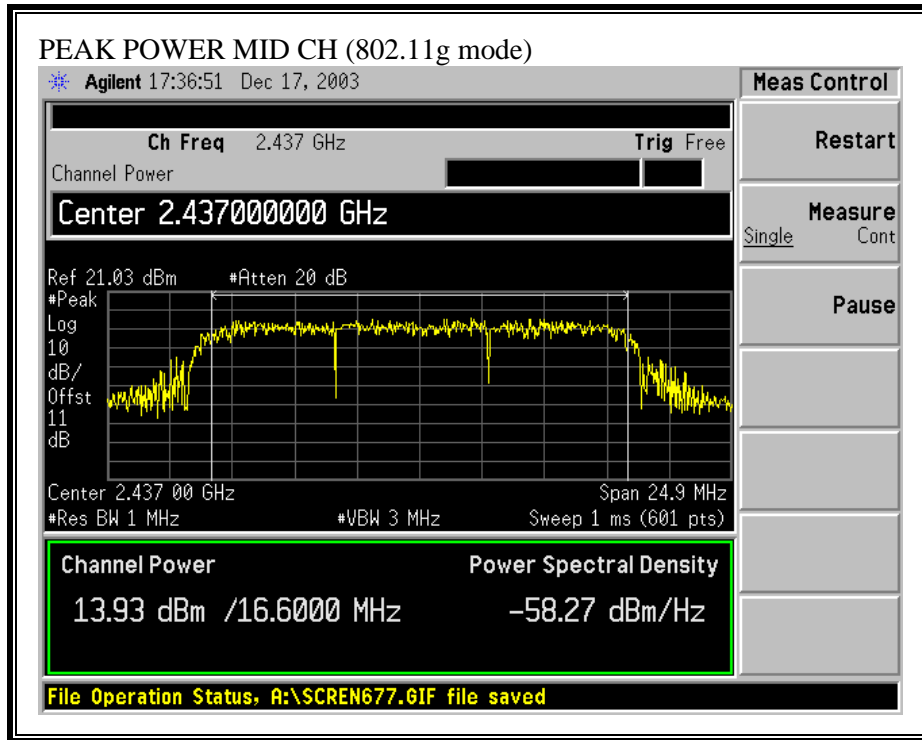


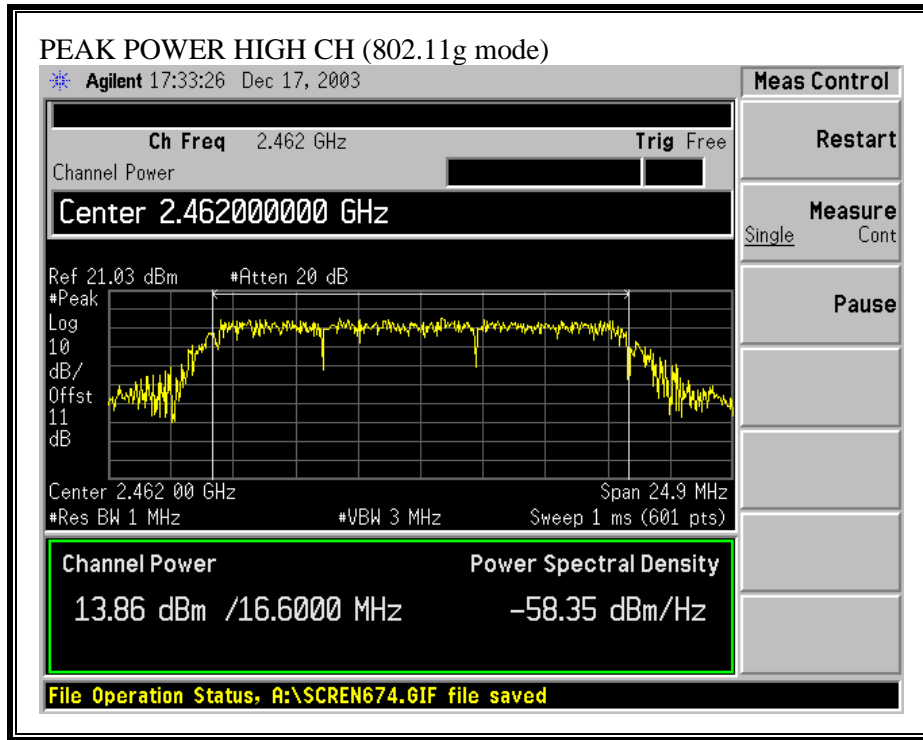




OUTPUT POWER (802.11g MODE)







7.6. 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

$$S = E^2 / 3770$$

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:

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

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

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

From §1.1310 Table 1 (B), S = 1.0 mW/cm²

RESULTS

No non-compliance noted:

Mode	Power Density Limit (mW/cm²)	Output Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)
802.11b	1.0	23.47	13.50	19.90
802.11g	1.0	18.14	13.50	10.77
802.11b	1.0	20.48	15.00	16.76
802.11g	1.0	16.76	15.00	10.92
802.11b	1.0	16.52	21.00	21.20
802.11g	1.0	13.93	21.00	15.73

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.

7.7. 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.

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:

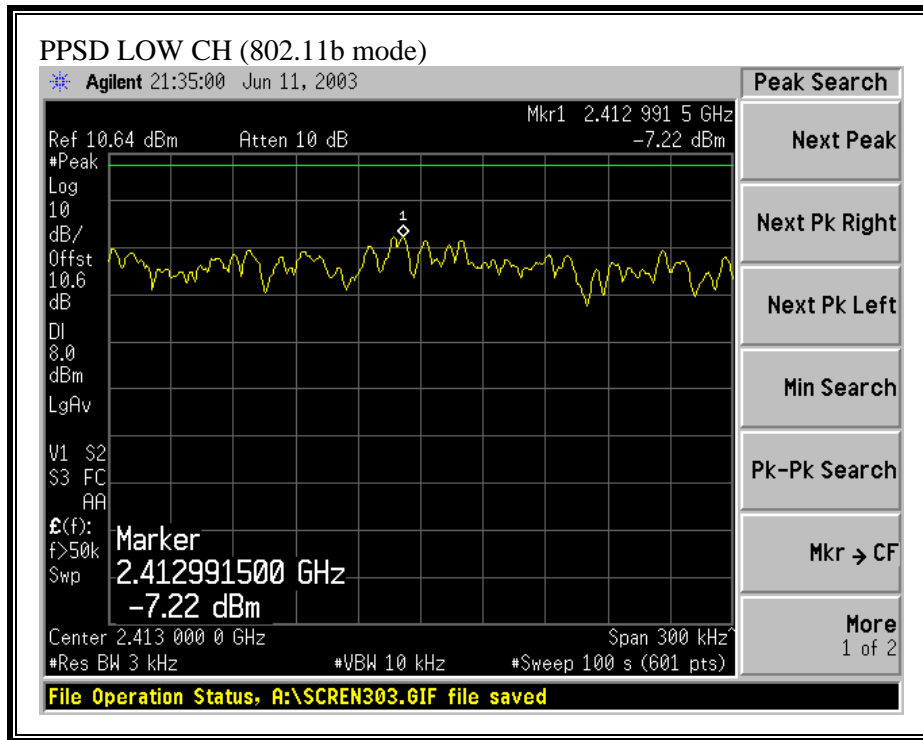
802.11b Mode

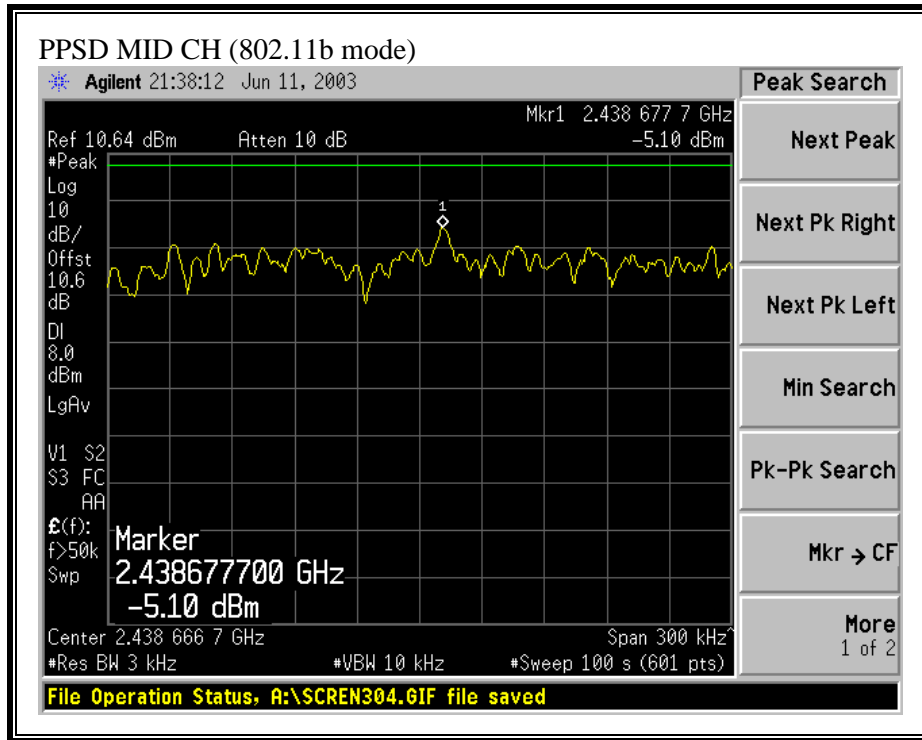
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-7.22	8	-15.22
Middle	2437	-5.10	8	-13.10
High	2462	-5.63	8	-13.63

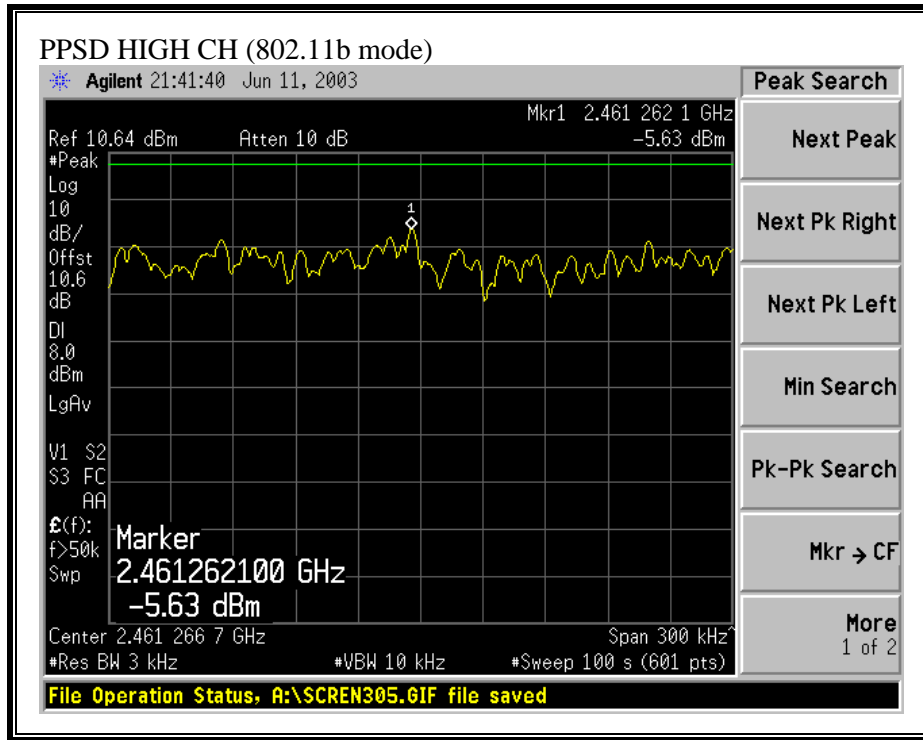
802.11g Mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-8.53	8	-16.53
Middle	2437	-7.07	8	-15.07
High	2462	-6.53	8	-14.53

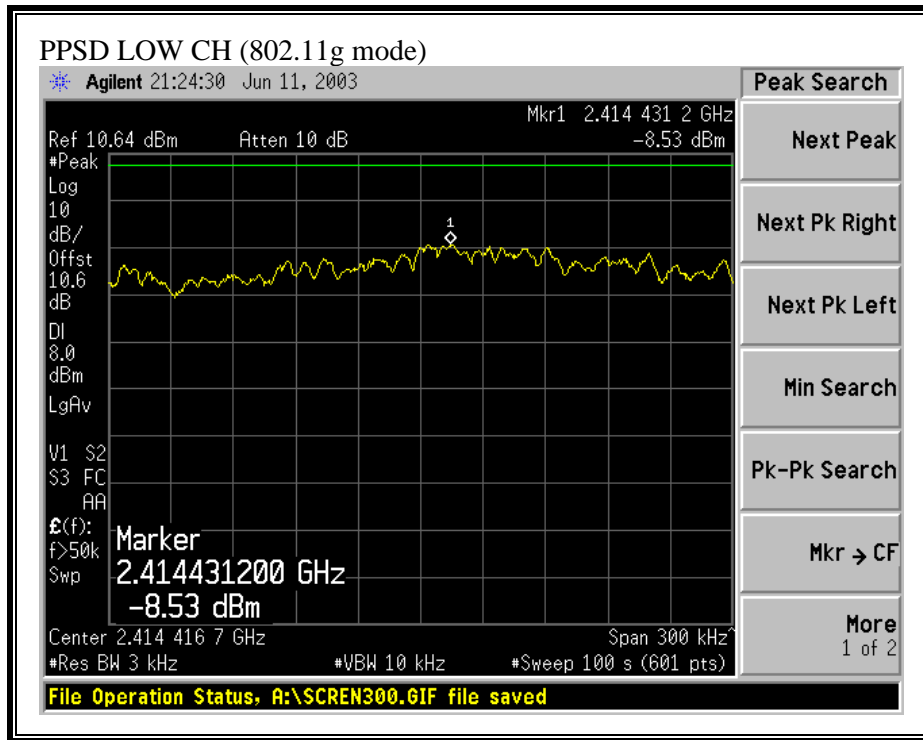
PEAK POWER SPECTRAL DENSITY (802.11b MODE)

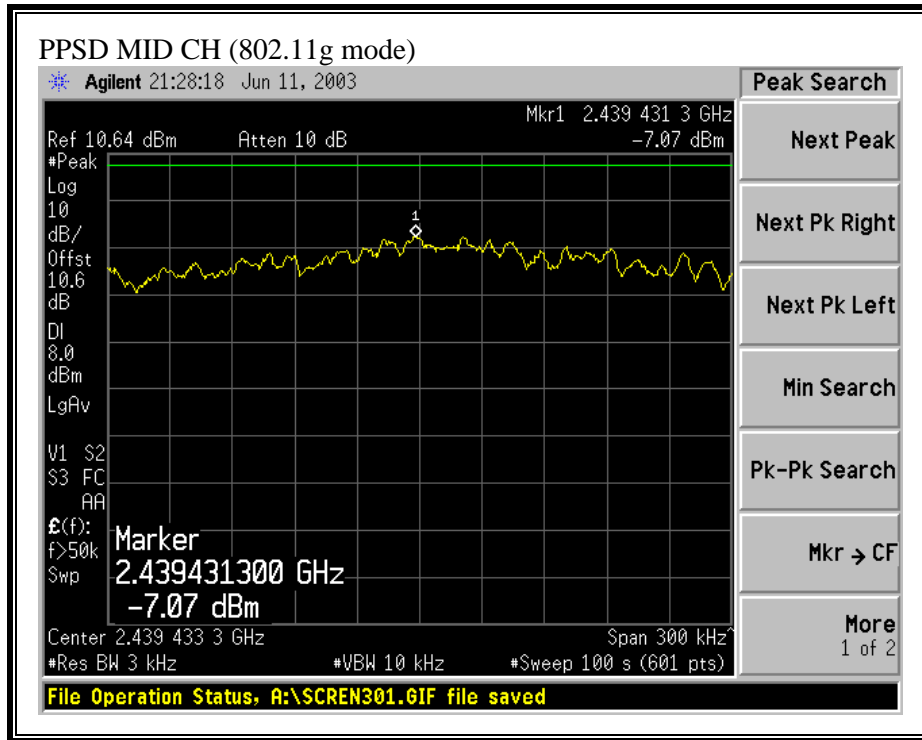


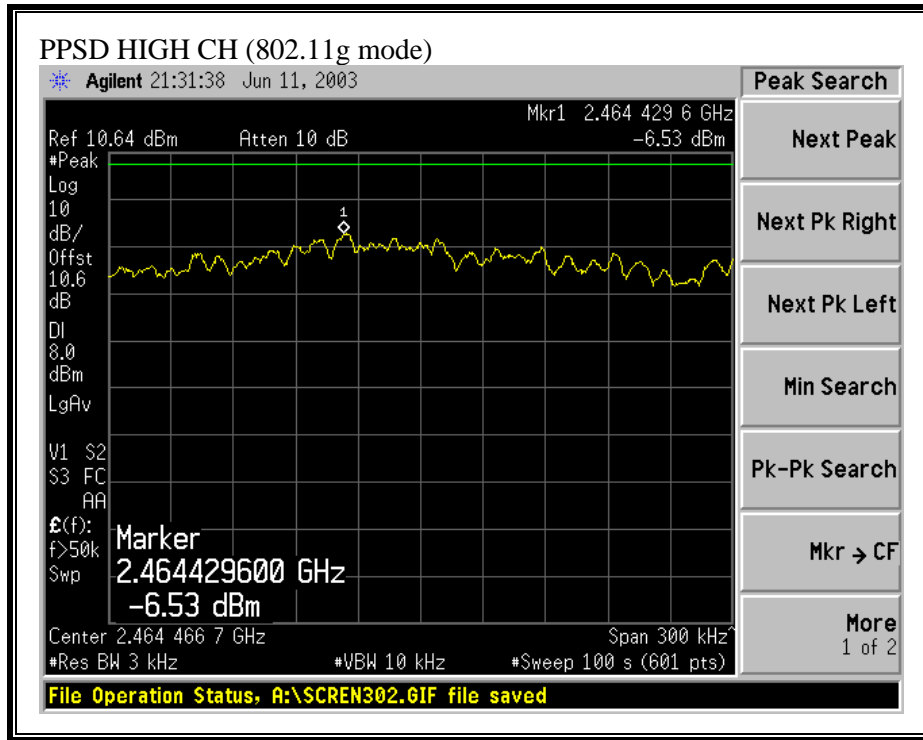




PEAK POWER SPECTRAL DENSITY (802.11g MODE)







7.8. 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

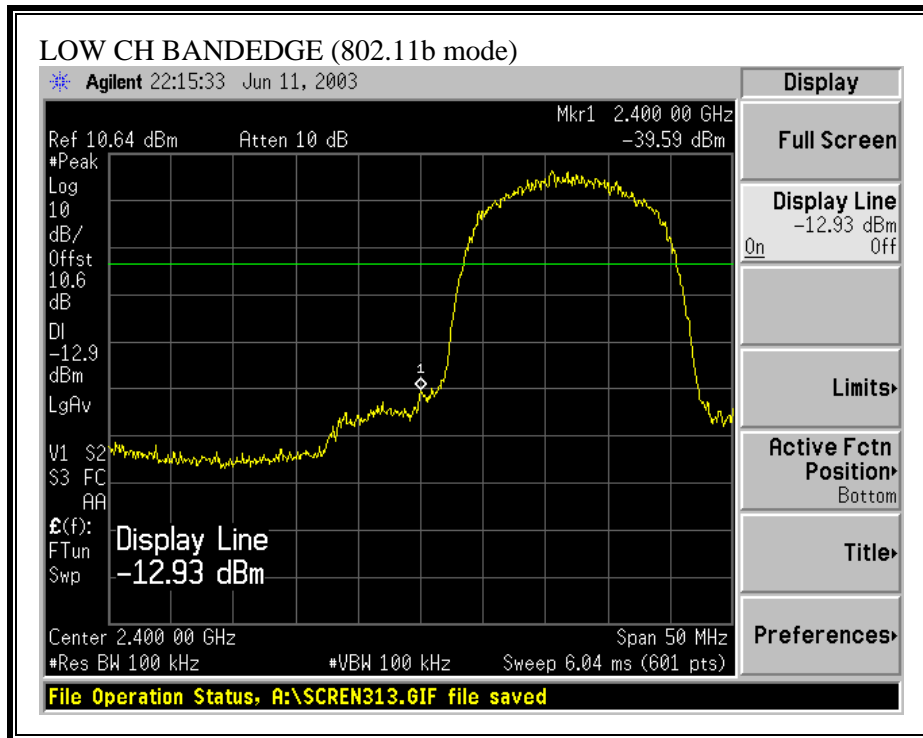
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 kHz.

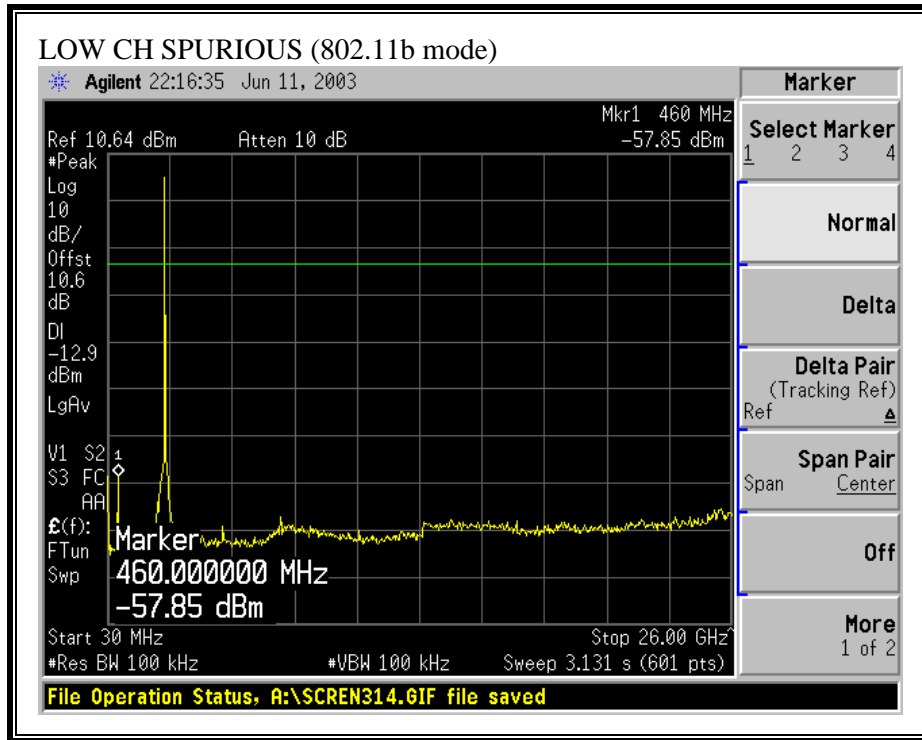
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

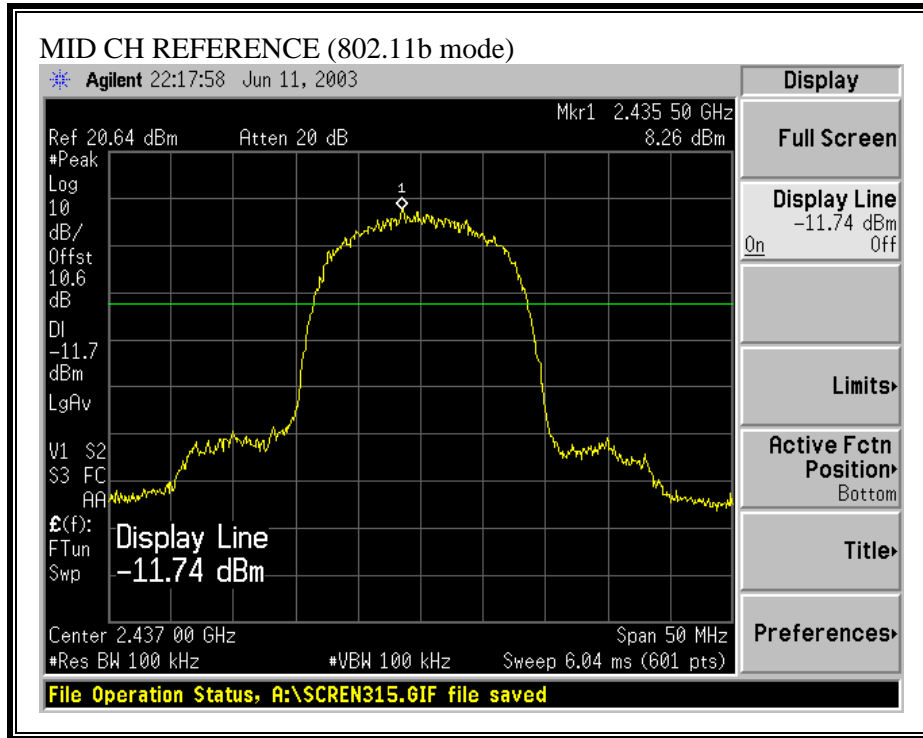
No non-compliance noted:

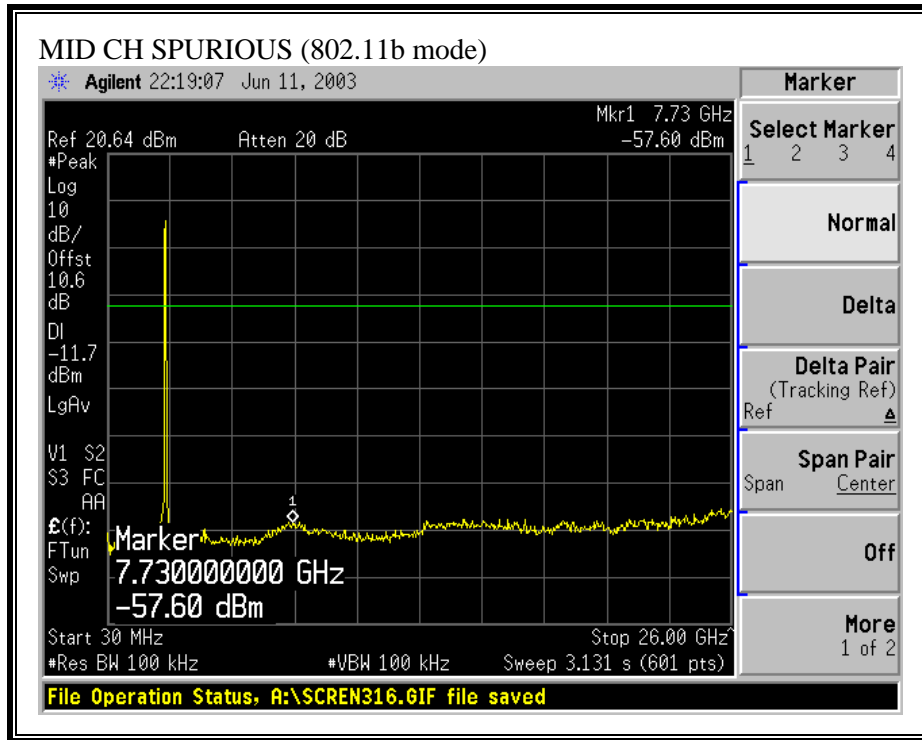
SPURIOUS EMISSIONS, LOW CHANNEL (802.11b MODE)



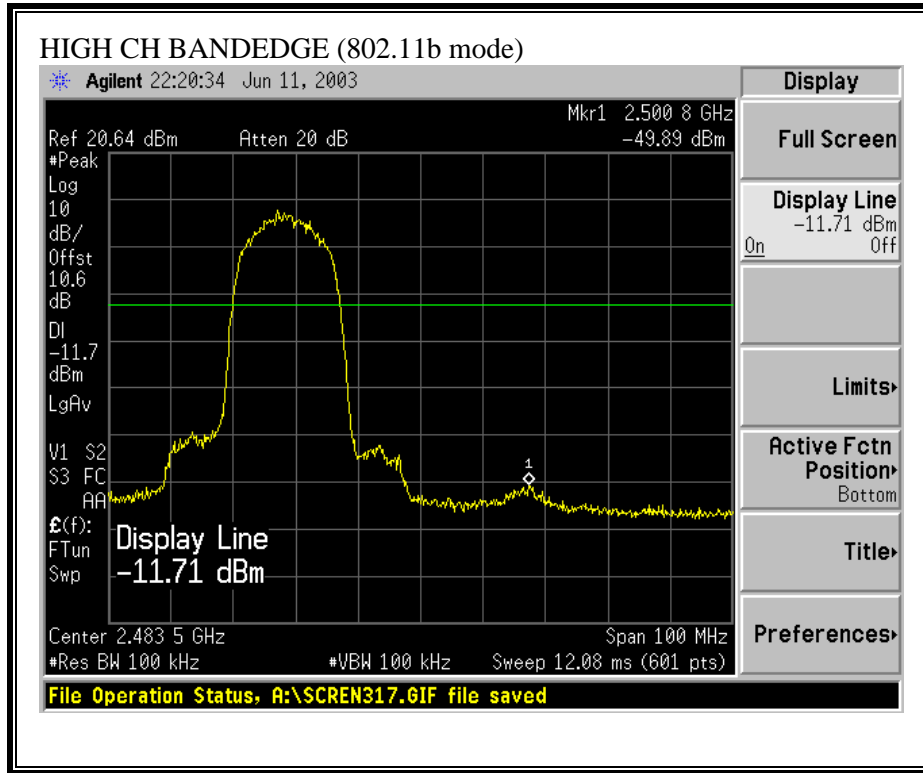


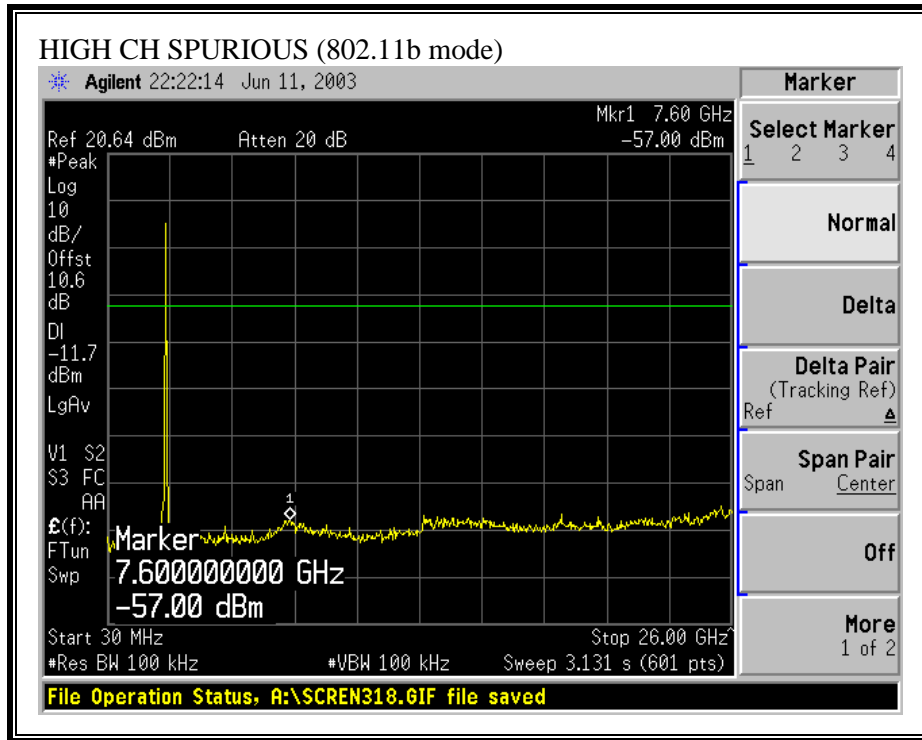
SPURIOUS EMISSIONS, MID CHANNEL (802.11b MODE)



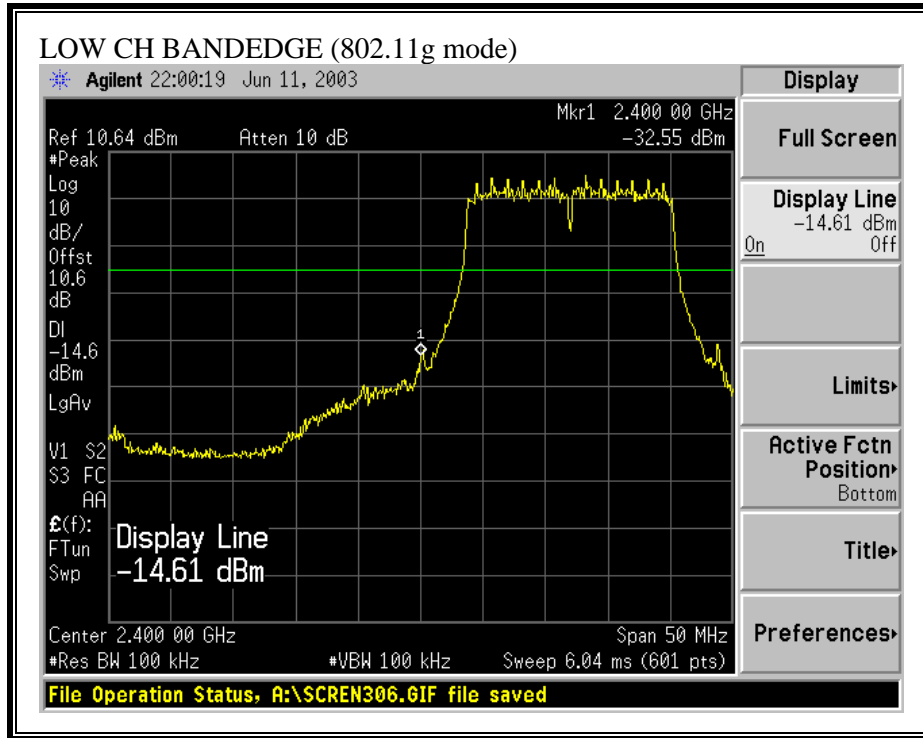


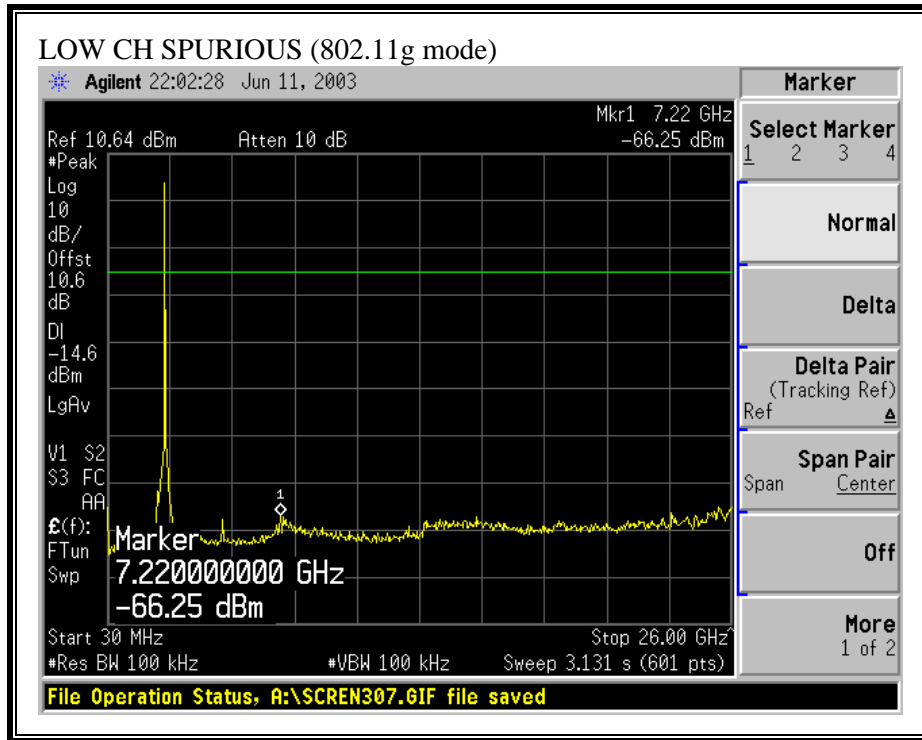
SPURIOUS EMISSIONS, HIGH CHANNEL (802.11b MODE)



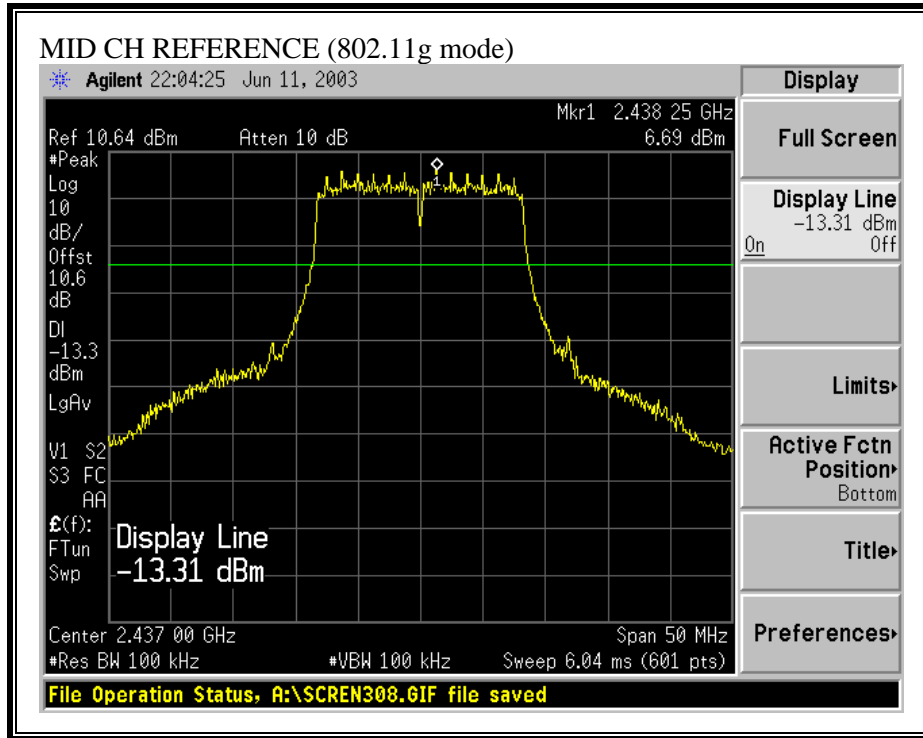


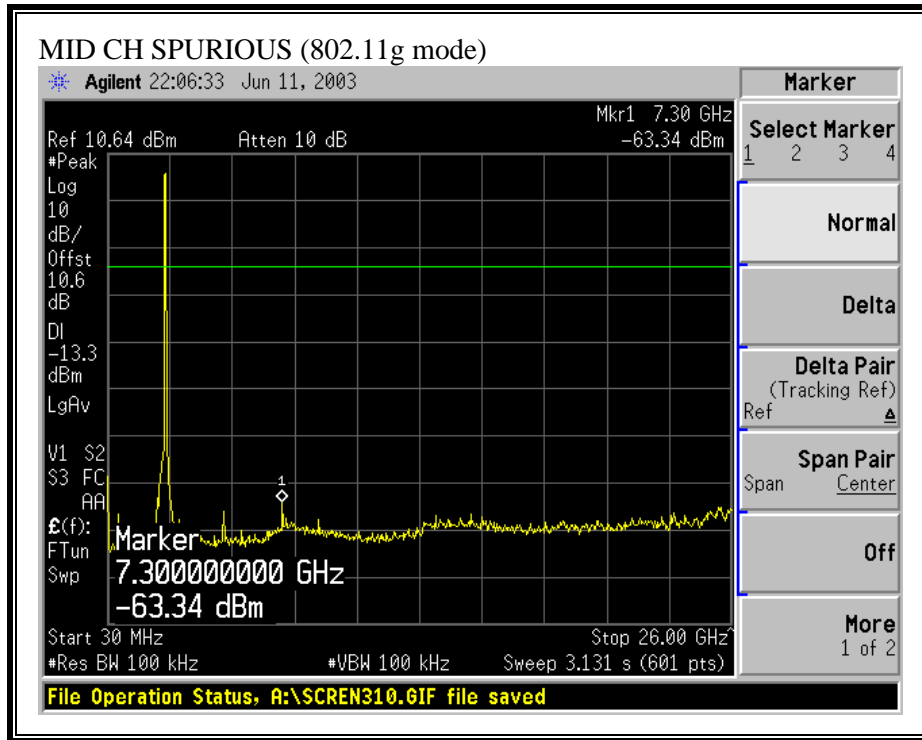
SPURIOUS EMISSIONS, LOW CHANNEL (802.11g MODE)



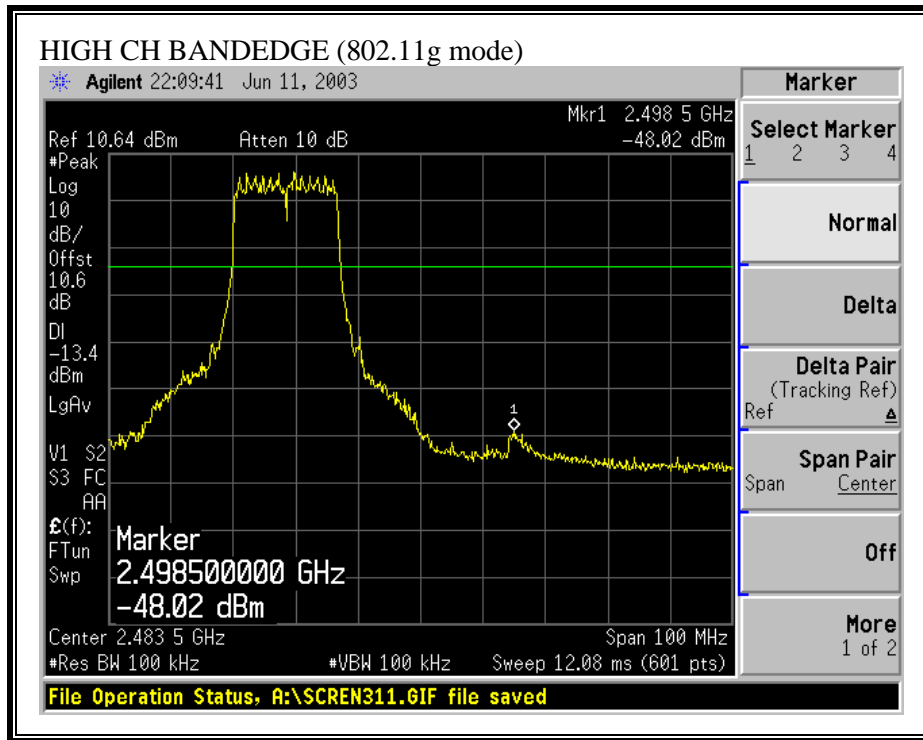


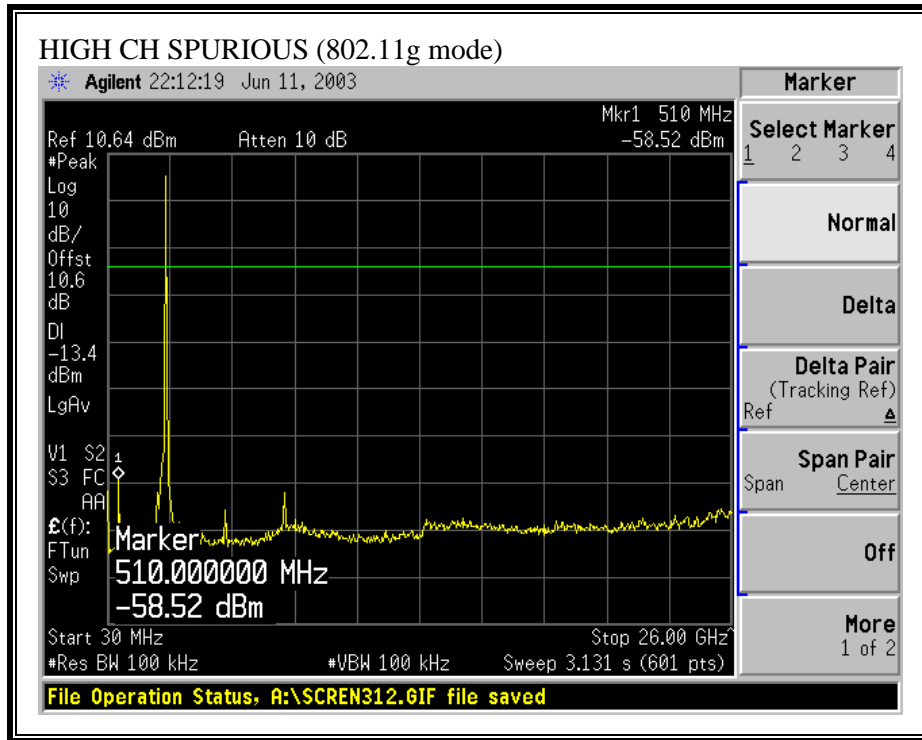
SPURIOUS EMISSIONS, MID CHANNEL (802.11g MODE)





SPURIOUS EMISSIONS, HIGH CHANNEL (802.11g MODE)





7.9. RADIATED EMISSIONS

7.9.1. 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.

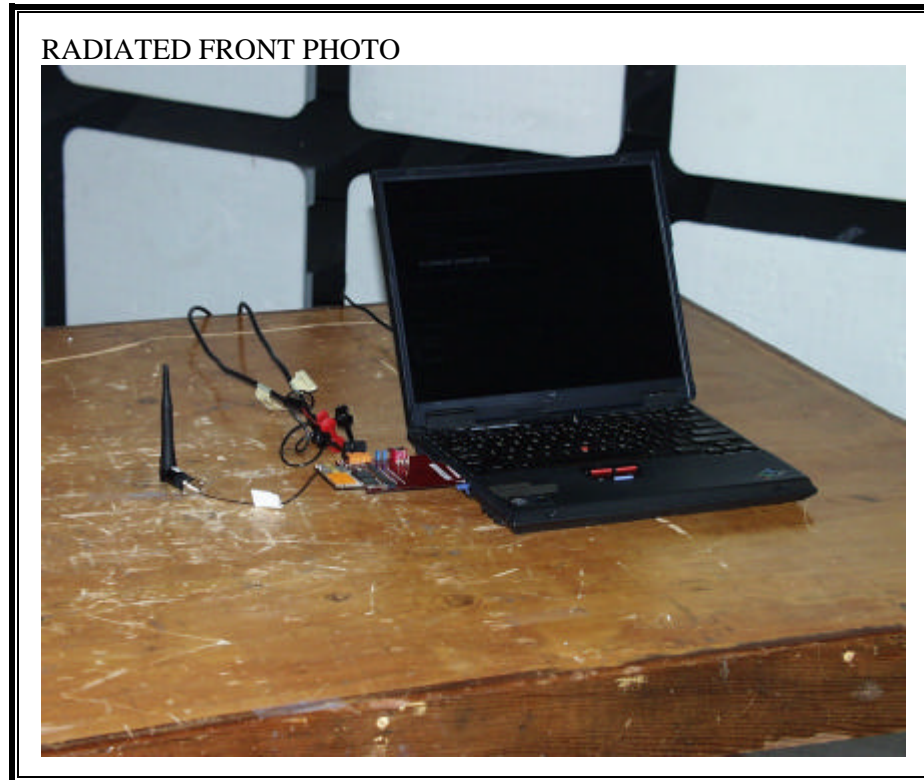
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

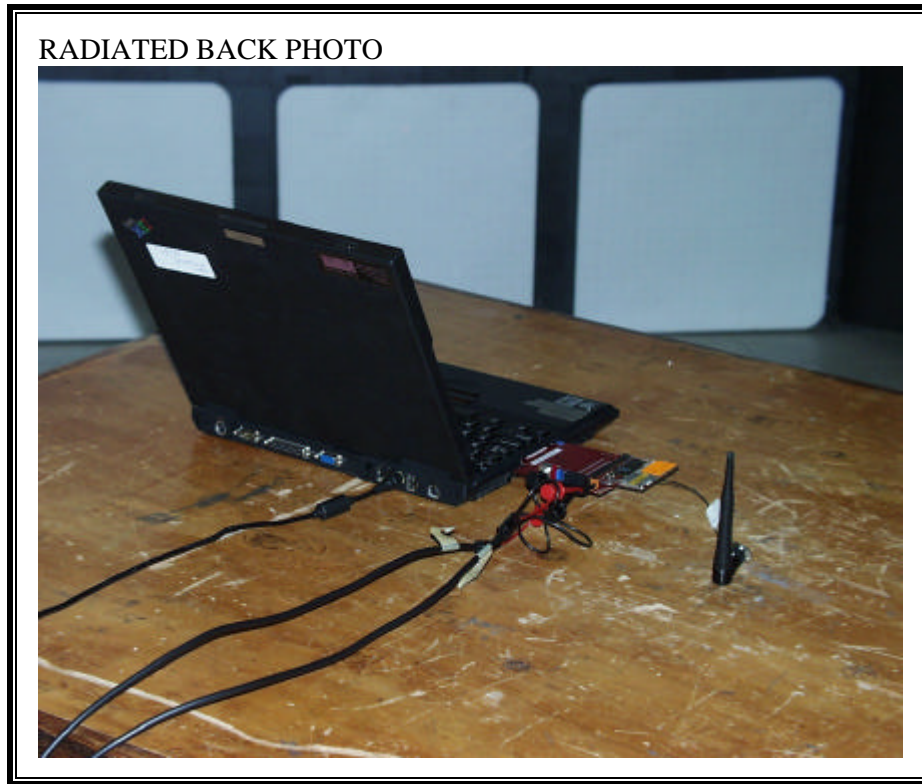
RESULTS

No non-compliance noted:

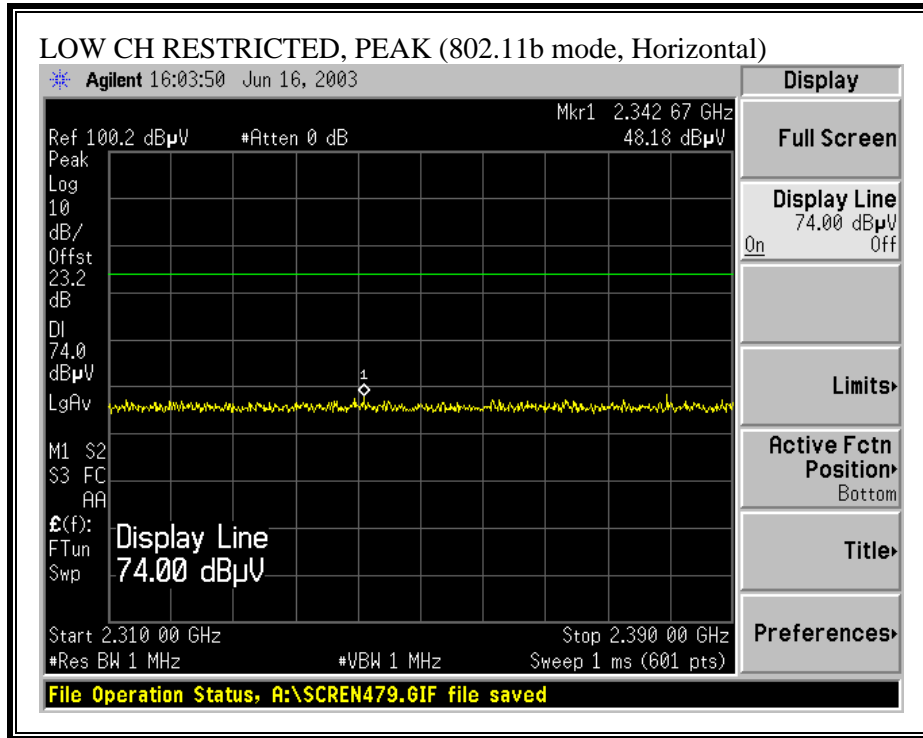
7.9.2. RADIATED EMISSIONS WITH 2.2 dBi DIPOLE ANTENNA

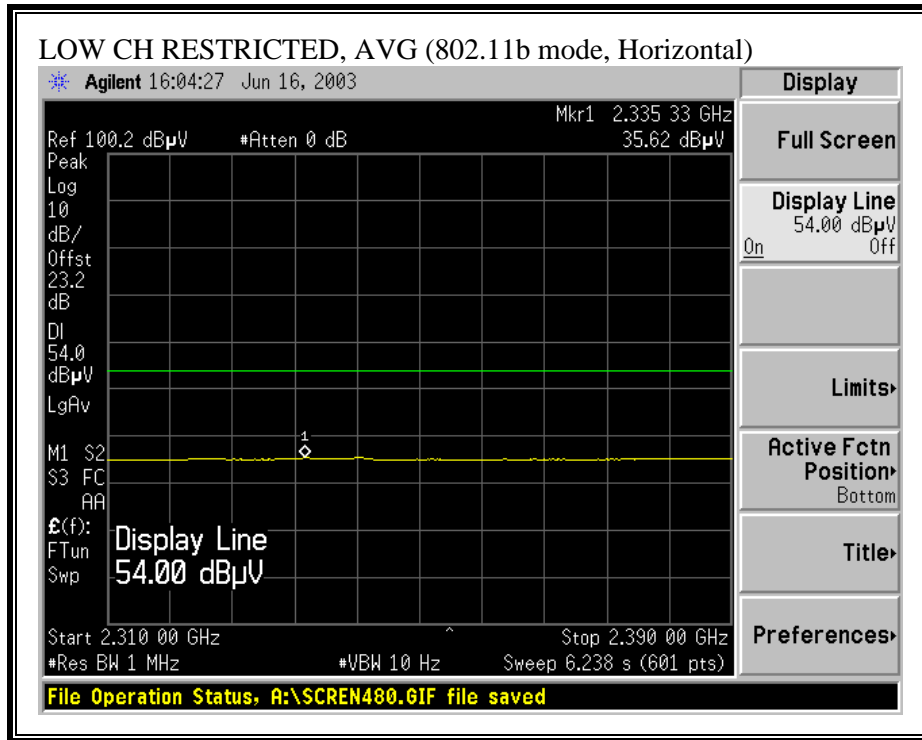
RADIATED RF MEASUREMENT SETUP



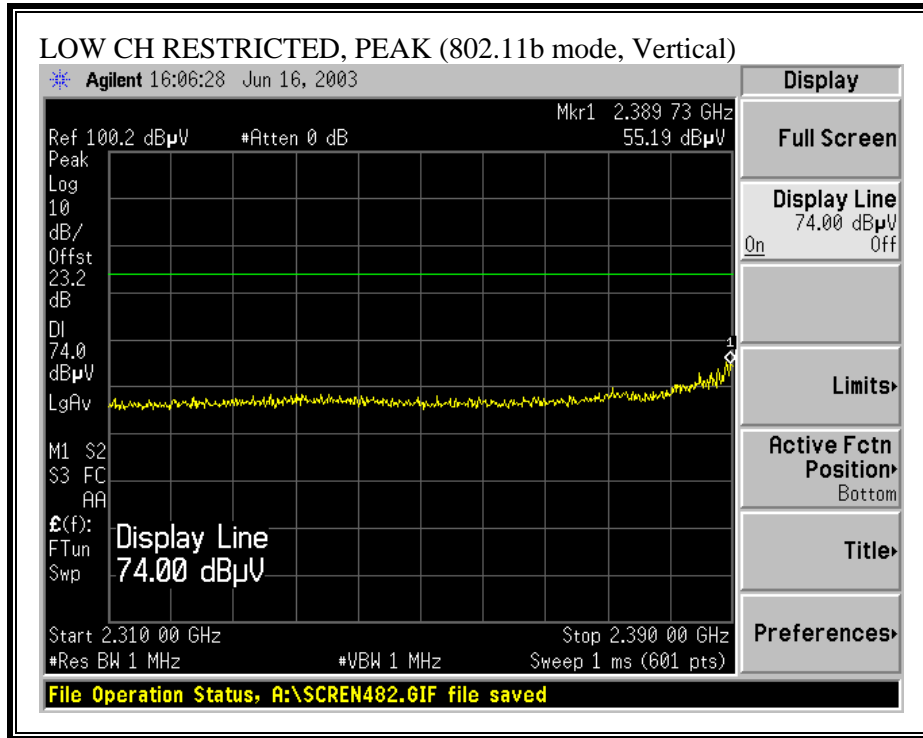


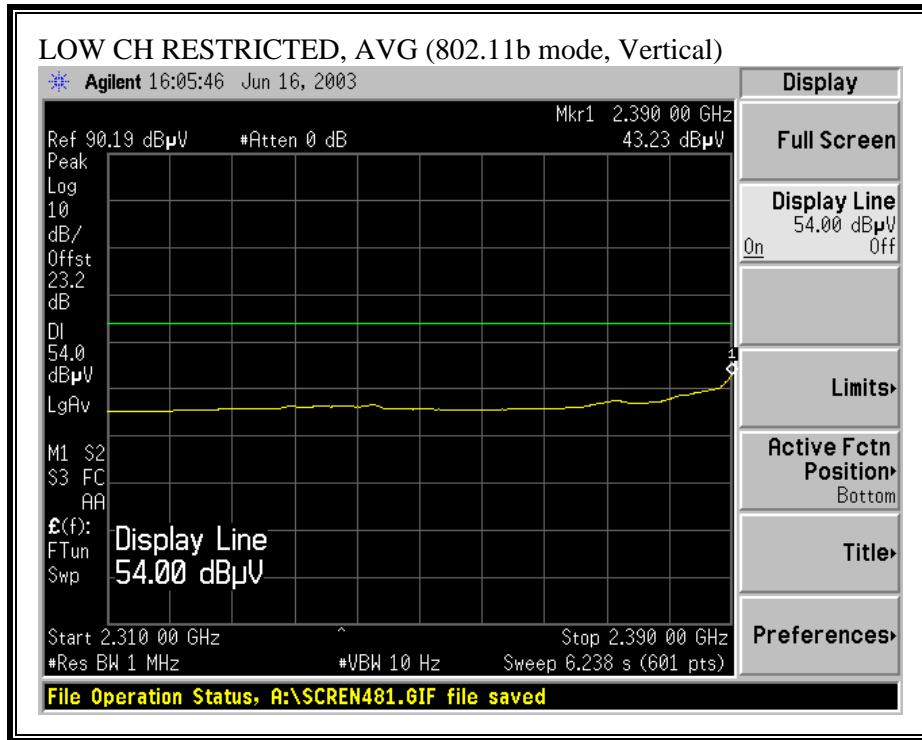
RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, HORIZONTAL)



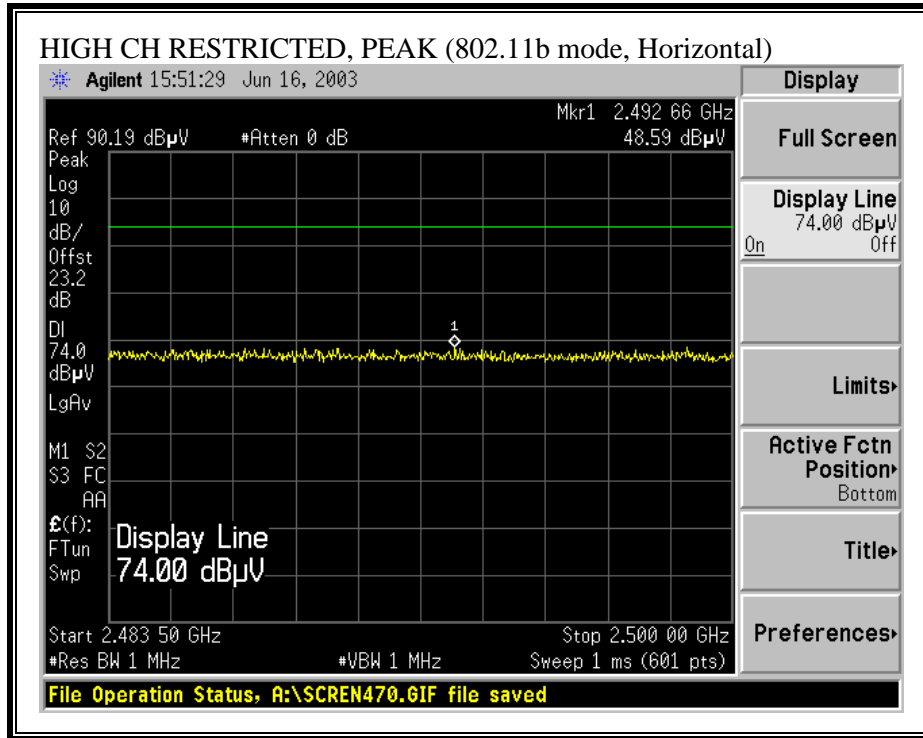


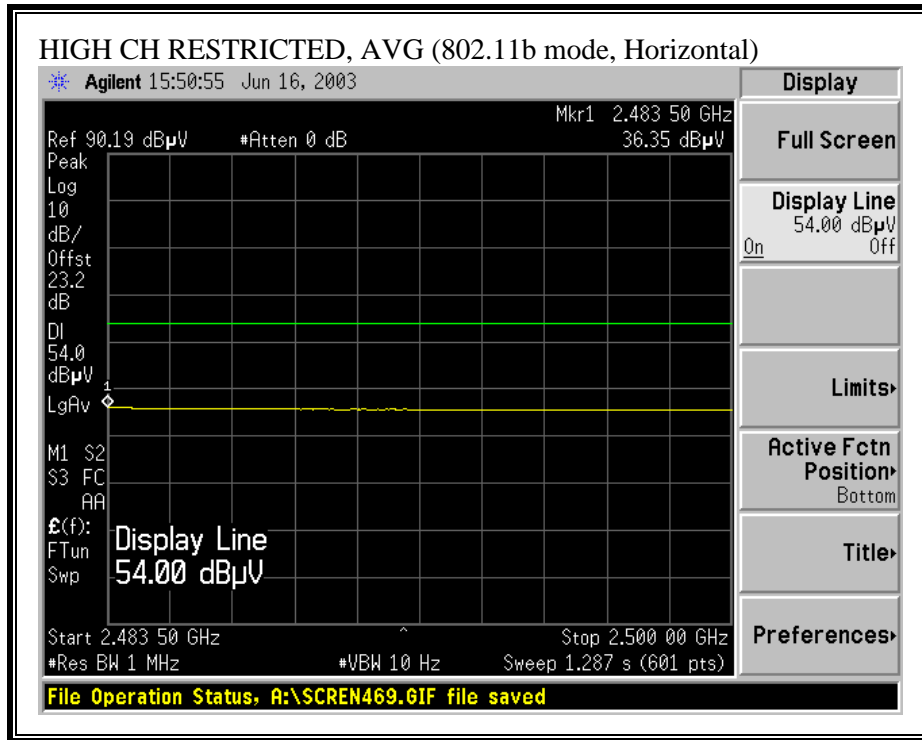
RESTRICTED BANDEGE (b MODE, LOW CHANNEL, VERTICAL)



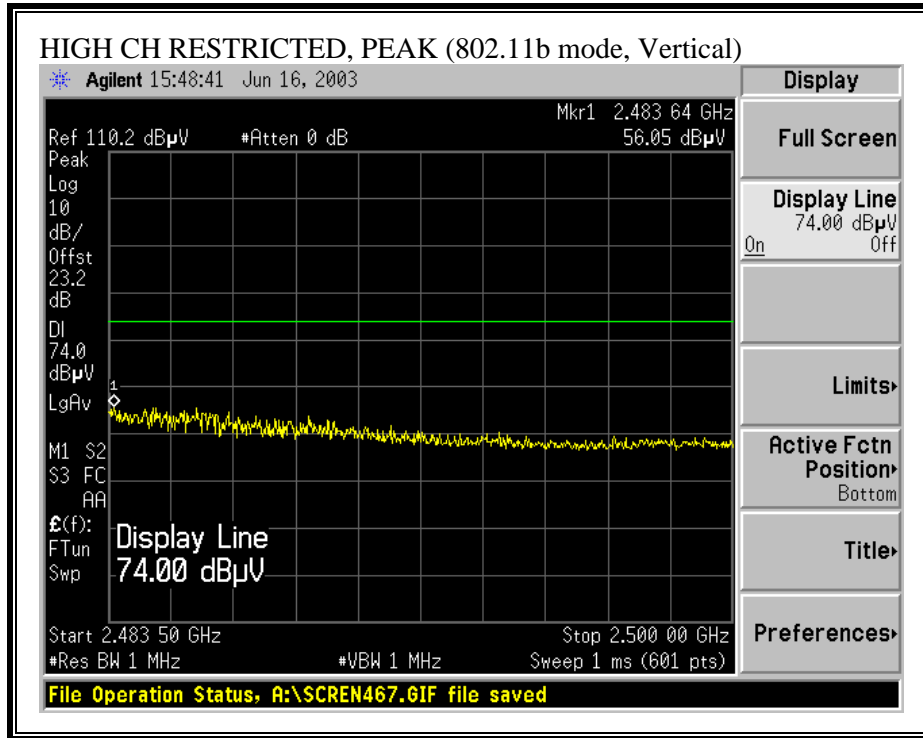


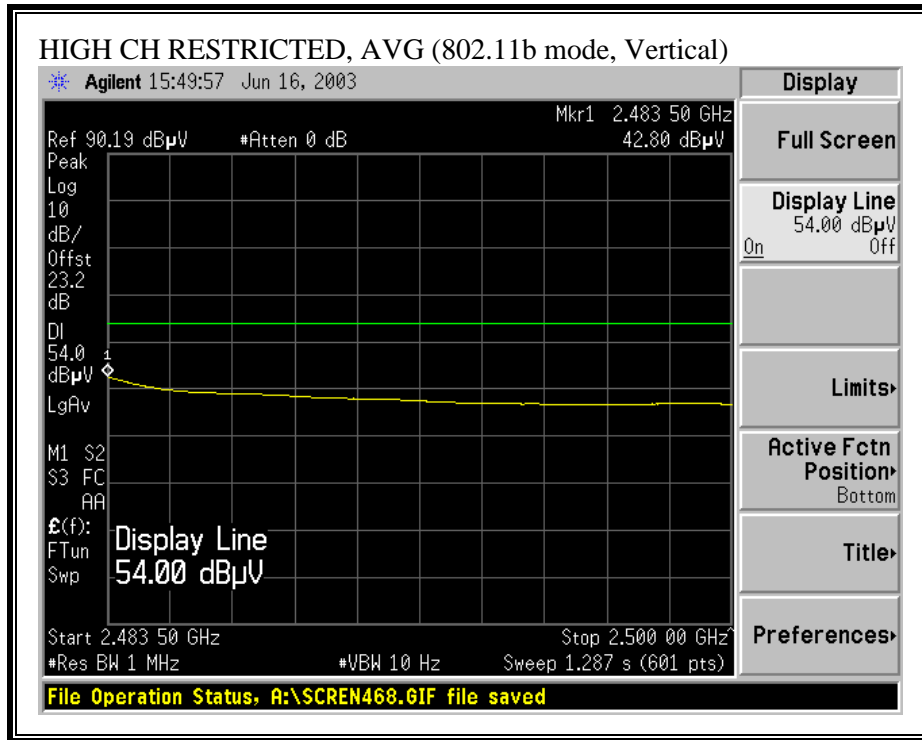
RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, VERTICAL)

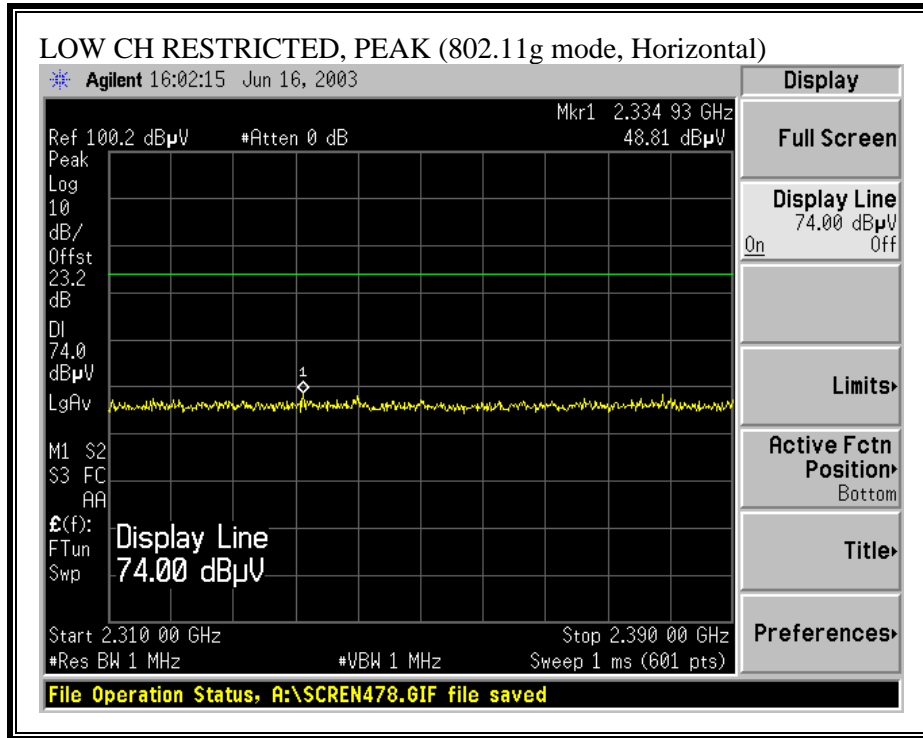


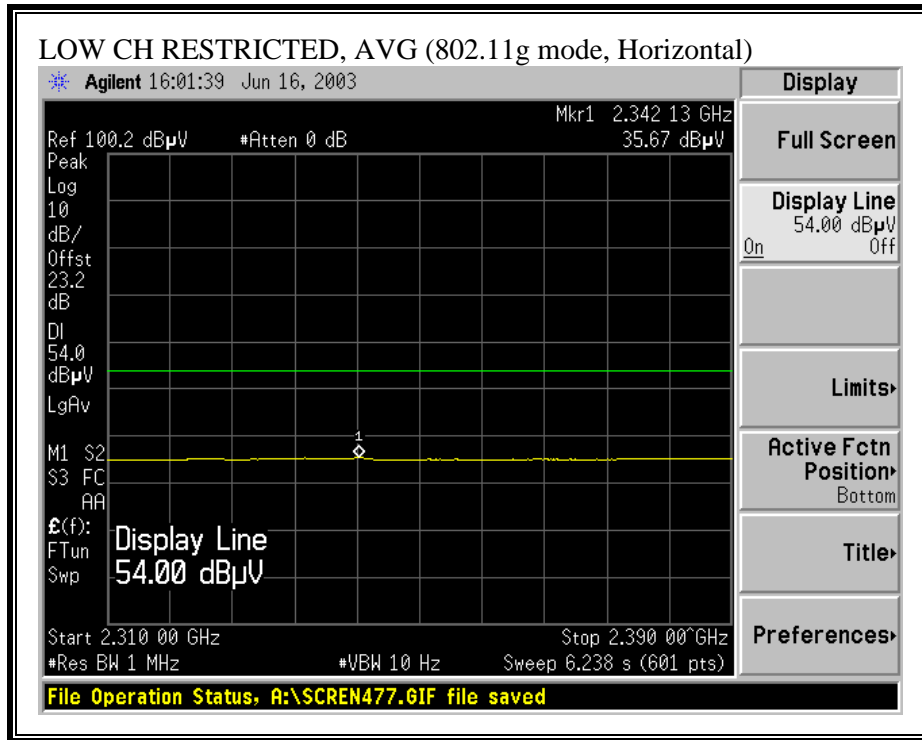


HARMONICS AND SPURIOUS EMISSIONS (b MODE)

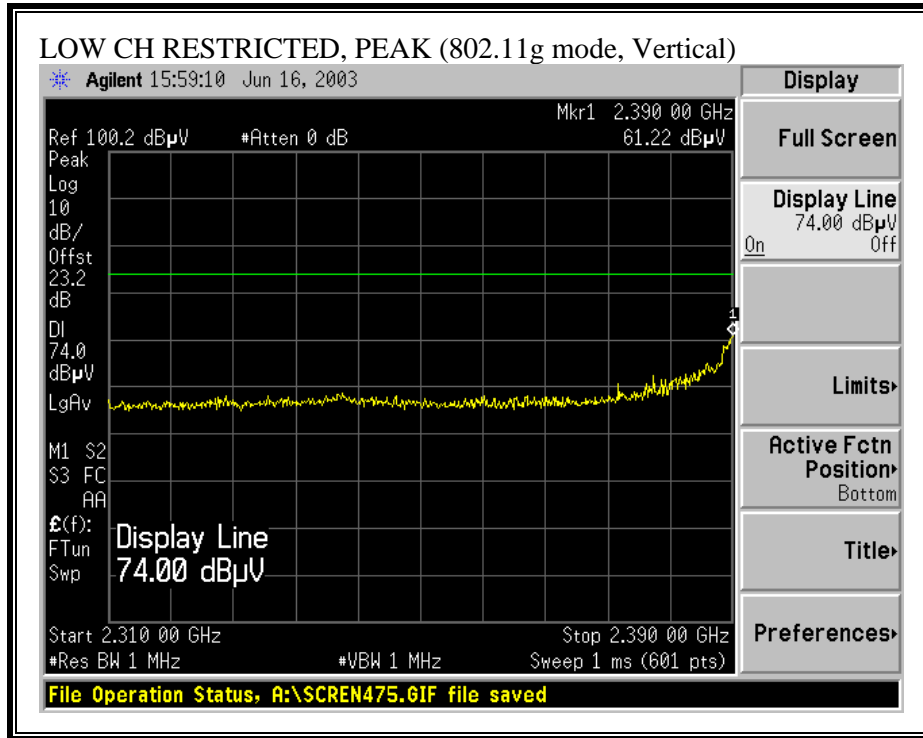
12/02/03 High Frequency Measurement Compliance Certification Services, Morgan Hill Open Field Site Test Engr: Ben Du Project #: 03U2409 Company: CISCO EUT Descrip.: WLAN Card and 2.2 dBi Dipole Antenna EUT M/N: Test Target: FCC 15 HARMONICS Mode Oper: Tx mode Test Equipment: EMCO Horn 1-18GHz Pre-amplifier 1-26GHz Spectrum Analyzer Horn > 18GHz T59; S/N: 3245 @3m T86 Miteq 924341 Agilent E4446A Analyzer Hi Frequency Cables: <input type="checkbox"/> (2 ft) <input checked="" type="checkbox"/> (2 ~ 3 ft) <input type="checkbox"/> (4 ~ 6 ft) <input checked="" type="checkbox"/> (12 ft) Peak Measurements: 1 MHz Resolution Bandwidth 1 MHz 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
Tx at 2.412GHz															
4.824	9.8	61.3	49.3	33.1	3.1	-45.6	0.0	1.0	52.9	40.9	74.0	54.0	-21.1	-13.1	V
4.824	9.8	54.6	42.9	33.1	3.1	-45.6	0.0	1.0	46.2	34.5	74.0	54.0	-27.8	-19.5	H
Tx at 2.437GHz															
4.874	9.8	56.7	48.2	33.1	3.2	-45.6	0.0	1.0	48.3	39.8	74.0	54.0	-25.7	-14.2	V
7.311	9.8	51.7	39.8	36.0	4.1	-46.6	0.0	1.0	46.2	34.3	74.0	54.0	-27.8	-19.7	V
4.874	9.8	52.9	42.5	33.1	3.2	-45.6	0.0	1.0	44.5	34.1	74.0	54.0	-29.5	-19.9	H
7.311	9.8	49.1	39.9	36.0	4.1	-46.6	0.0	1.0	43.5	34.4	74.0	54.0	-30.5	-19.6	H
Tx at 2.62GHz															
4.924	9.8	59.4	52.4	33.1	3.2	-45.7	0.0	1.0	51.0	44.0	74.0	54.0	-23.0	-10.0	V
7.386	9.8	54.8	39.7	36.1	4.1	-46.5	0.0	1.0	49.4	34.3	74.0	54.0	-24.6	-19.7	V
4.924	9.8	54.3	42.3	33.1	3.2	-45.7	0.0	1.0	45.9	33.9	74.0	54.0	-28.1	-20.1	H
7.386	9.8	49.1	39.7	36.1	4.1	-46.5	0.0	1.0	43.7	34.4	74.0	54.0	-30.3	-19.6	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															

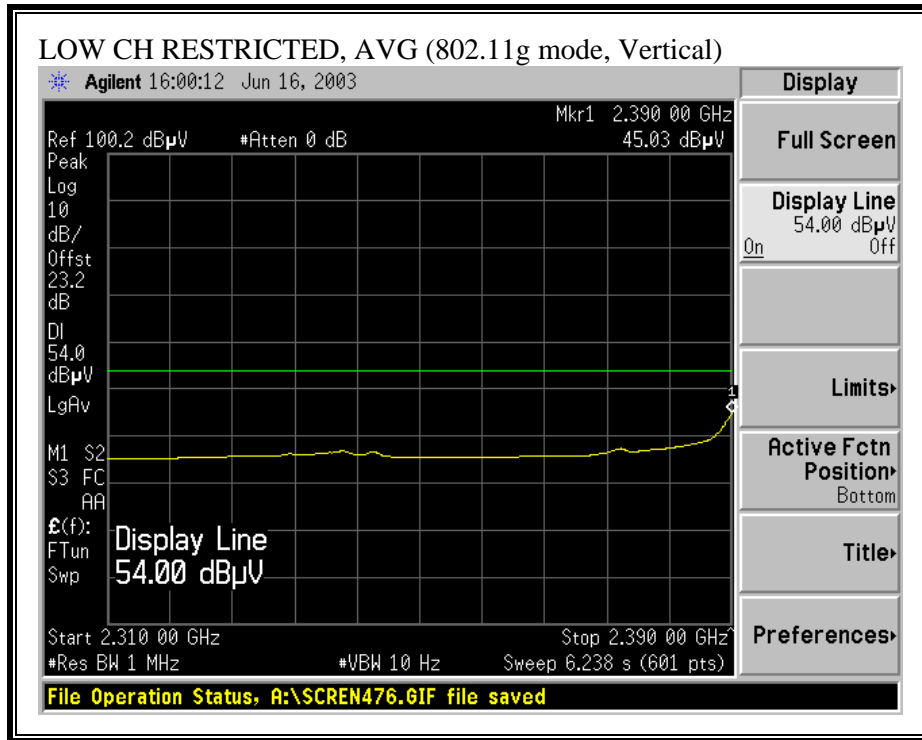
RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, HORIZONTAL)



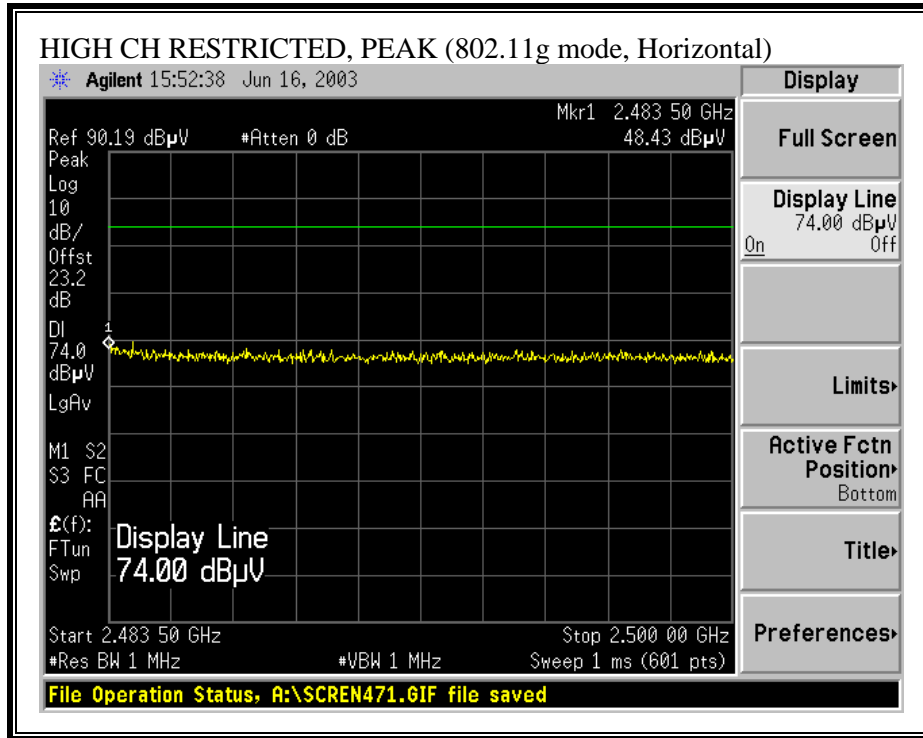


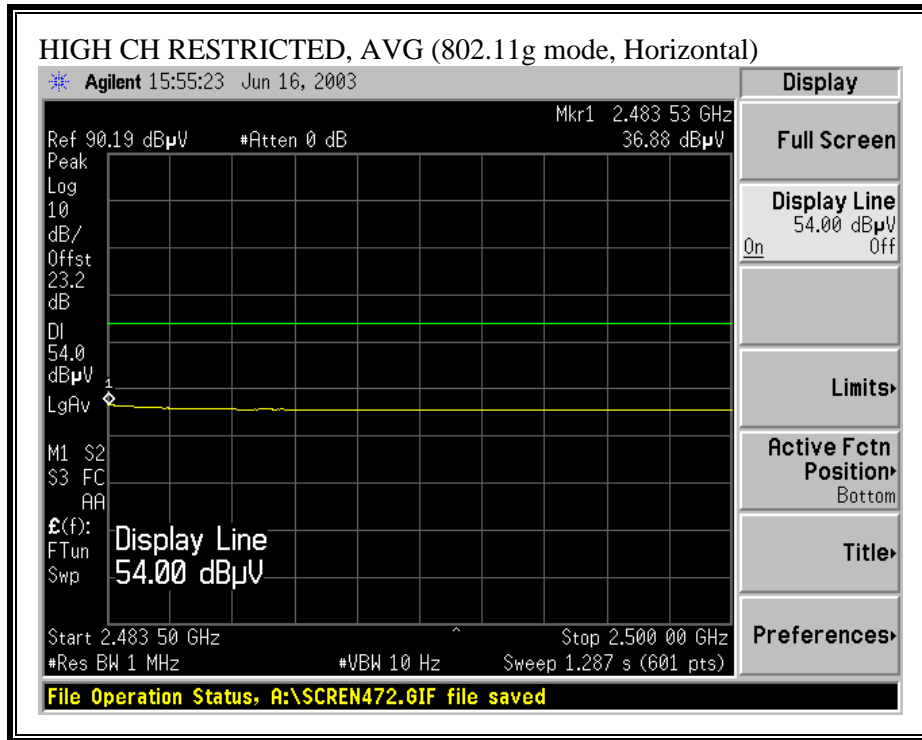
RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, VERTICAL)



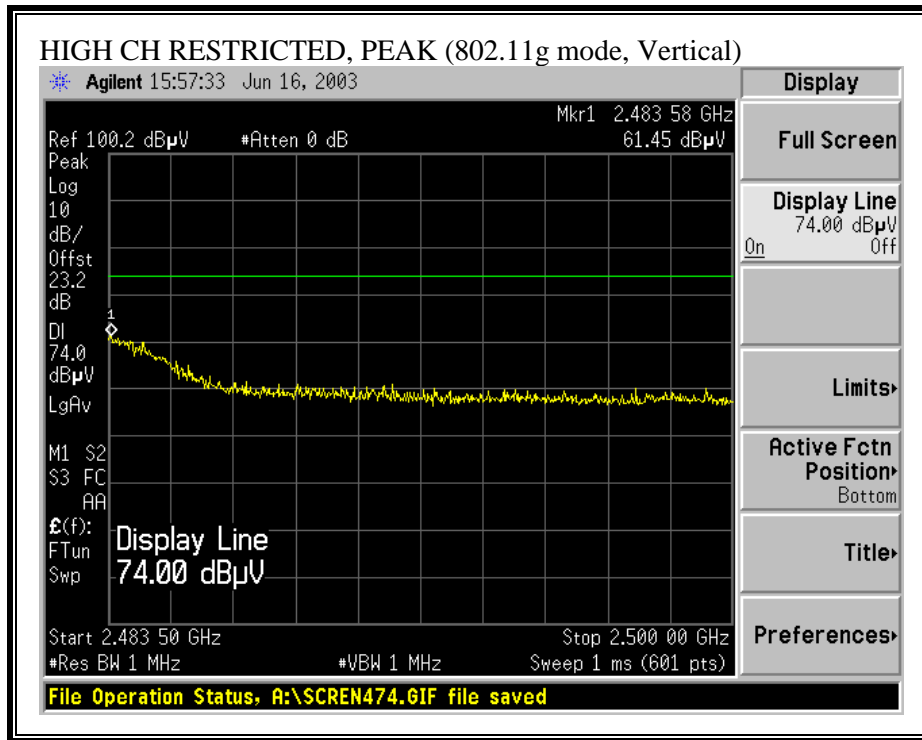


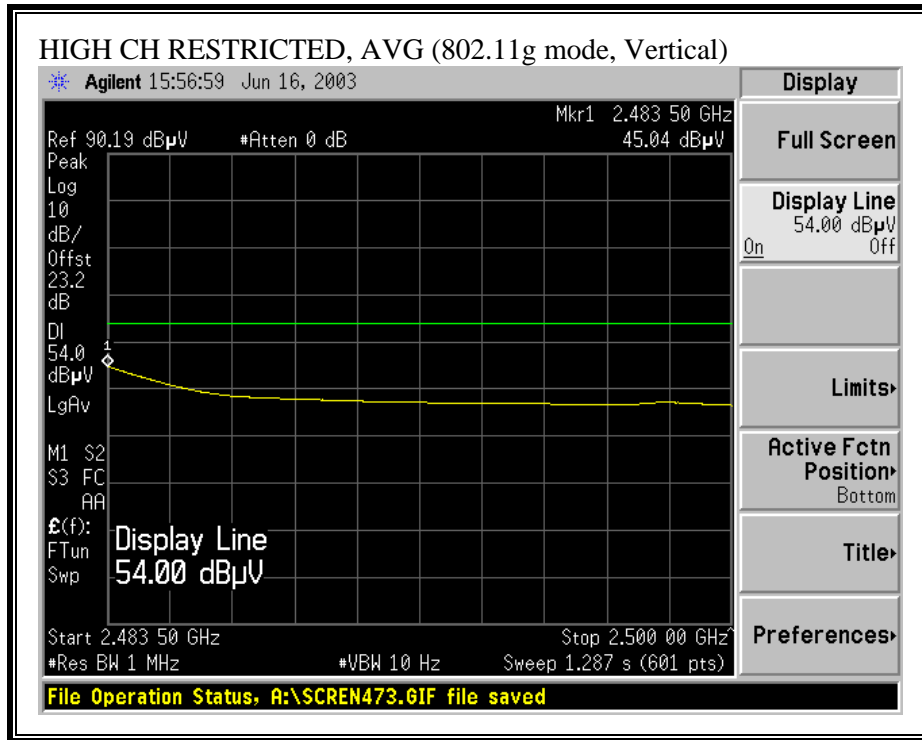
RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, VERTICAL)



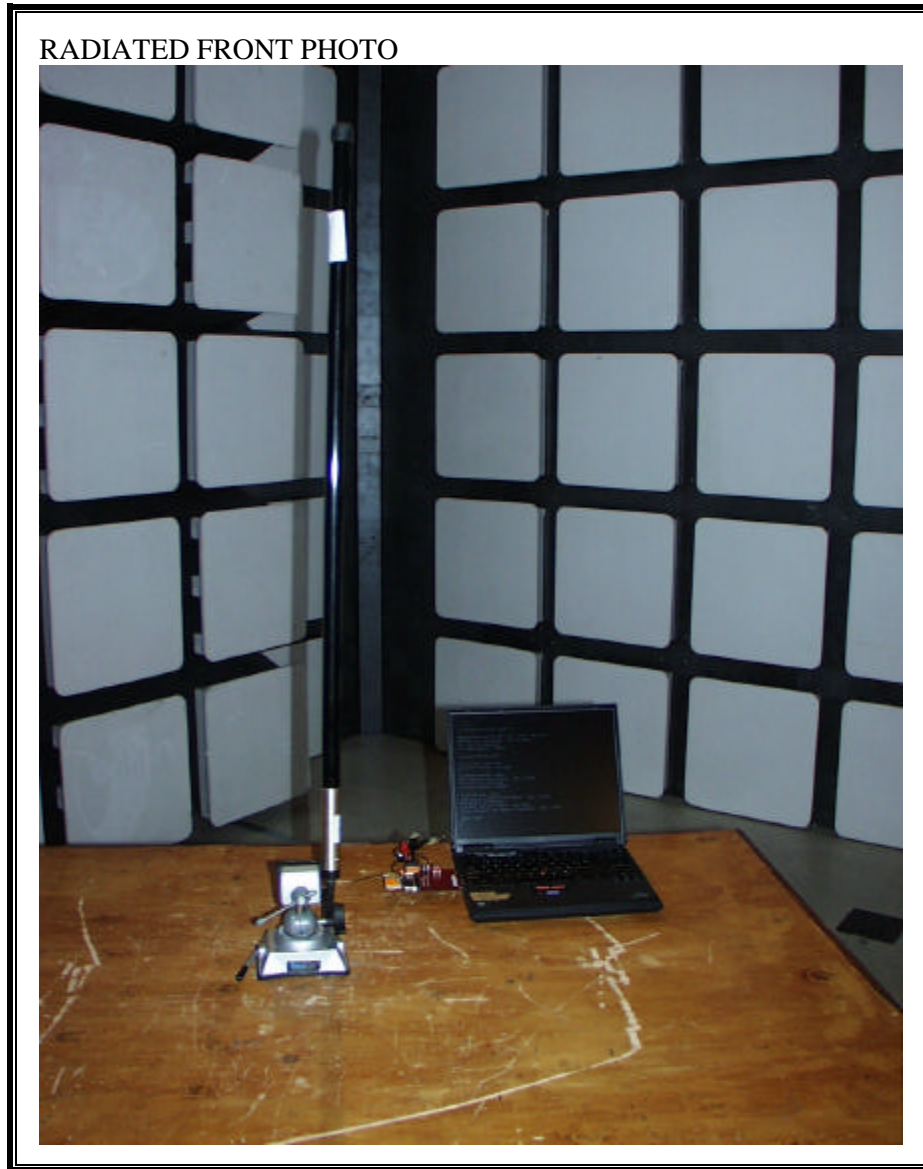


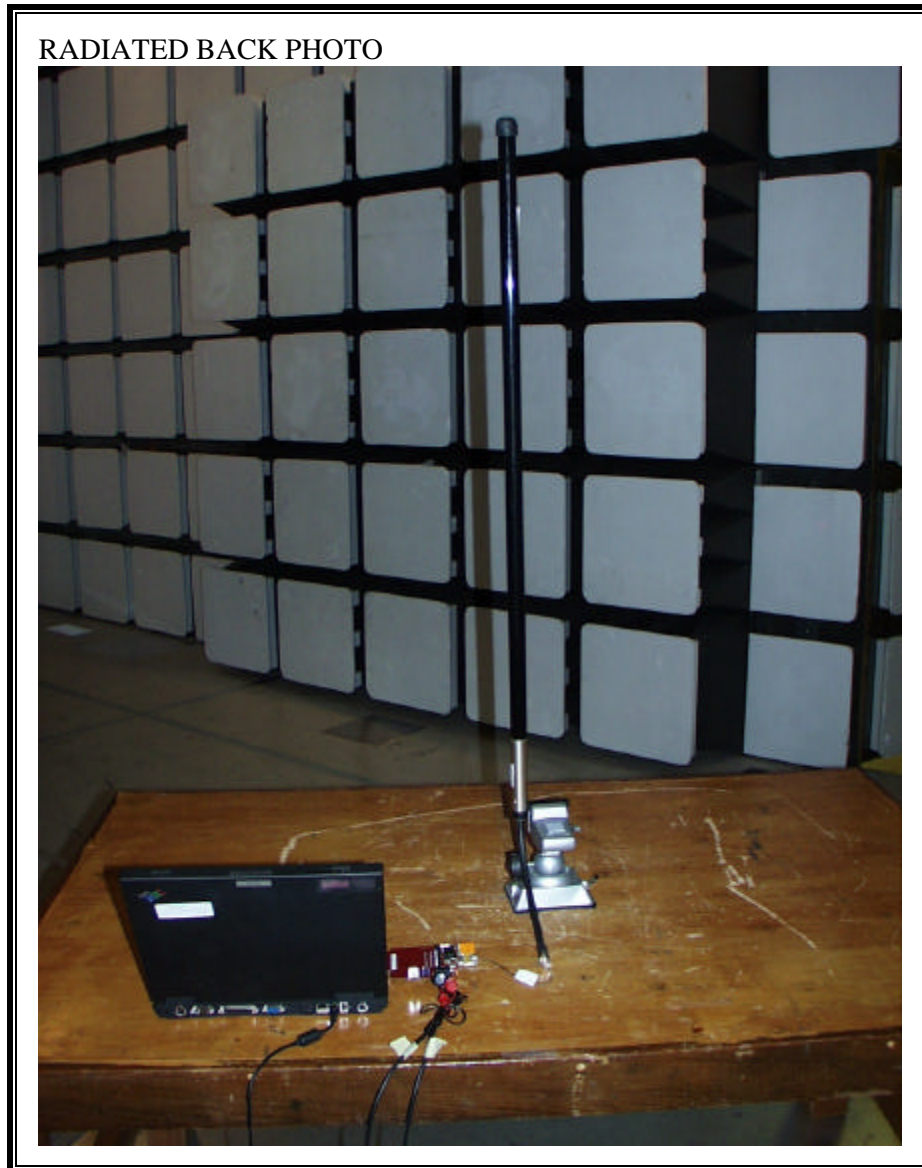
HARMONICS AND SPURIOUS EMISSIONS (g MODE)

12/02/03 High Frequency Measurement Compliance Certification Services, Morgan Hill Open Field Site Test Engr: Ben Du Project #: 03U2409 Company: CISCO EUT Descrip.: WLAN Card and 2.2 dBi Dipole Antenna EUT M/N: Test Target: FCC 15 HARMONICS Mode Oper: Tx mode Test Equipment: EMCO Horn 1-18GHz Pre-amplifier 1-26GHz Spectrum Analyzer Horn > 18GHz T59; S/N: 3245 @3m T86 Miteq 924341 Agilent E4446A Analyzer Hi Frequency Cables: <input type="checkbox"/> (2 ft) <input checked="" type="checkbox"/> (2 ~ 3 ft) <input type="checkbox"/> (4 ~ 6 ft) <input checked="" type="checkbox"/> (12 ft) Peak Measurements: 1 MHz Resolution Bandwidth 1 MHz 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	
Tx at 2.412GHz																
4.824	9.8	53.8	48.4	33.1	3.1	-45.6	0.0	1.0	45.4	40.0	74.0	54.0	-28.6	-14.0	V	
4.824	9.8	50.7	40.6	33.1	3.1	-45.6	0.0	1.0	42.3	32.2	74.0	54.0	-31.7	-21.8	H	
Tx at 2.437GHz																
4.874	9.8	47.4	37.6	33.1	3.2	-45.6	0.0	1.0	39.0	29.2	74.0	54.0	-35.0	-24.8	V	
7.311	9.8	48.6	39.3	36.0	4.1	-46.6	0.0	1.0	43.1	33.8	74.0	54.0	-30.9	-20.2	V	
4.874	9.8	48.0	38.0	33.1	3.2	-45.6	0.0	1.0	39.6	29.6	74.0	54.0	-34.4	-24.4	H	
7.311	9.8	48.1	39.6	36.0	4.1	-46.6	0.0	1.0	42.5	34.1	74.0	54.0	-31.5	-19.9	H	
Tx at 2.62GHz																
4.924	9.8	59.6	55.8	33.1	3.2	-45.7	0.0	1.0	51.2	47.4	74.0	54.0	-22.8	-6.6	V	
7.386	9.8	50.9	39.4	36.1	4.1	-46.5	0.0	1.0	45.5	34.0	74.0	54.0	-28.5	-20.0	V	
4.924	9.8	54.3	46.8	33.1	3.2	-45.7	0.0	1.0	45.9	38.4	74.0	54.0	-28.1	-15.6	H	
7.386	9.8	48.7	38.9	36.1	4.1	-46.5	0.0	1.0	43.3	33.5	74.0	54.0	-30.7	-20.5	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																

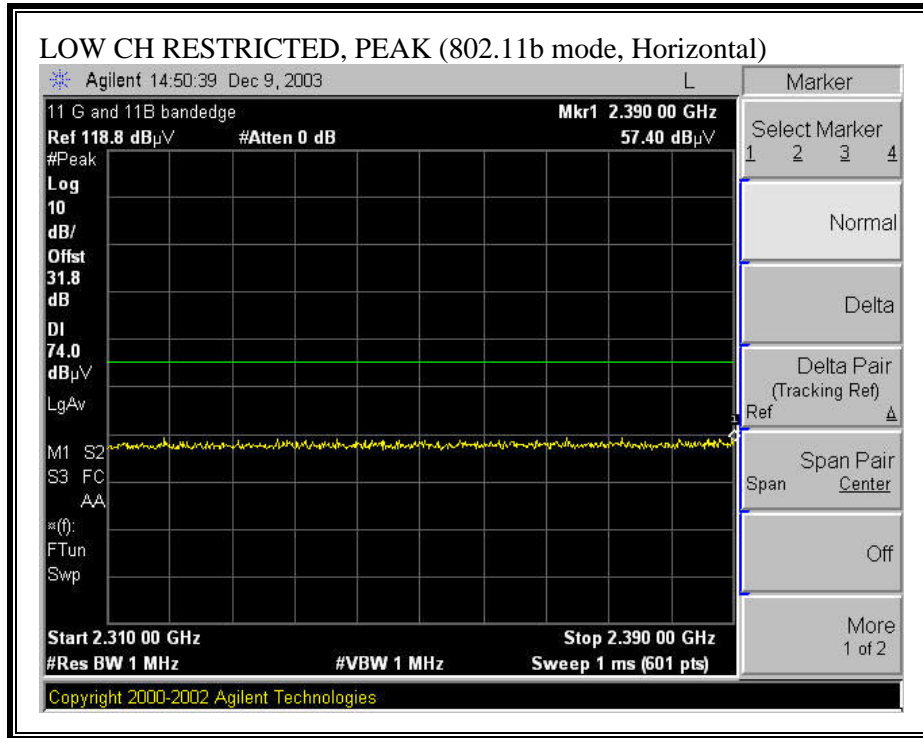
7.9.3. RADIATED EMISSIONS WITH 12 dBi OMNI ANTENNA

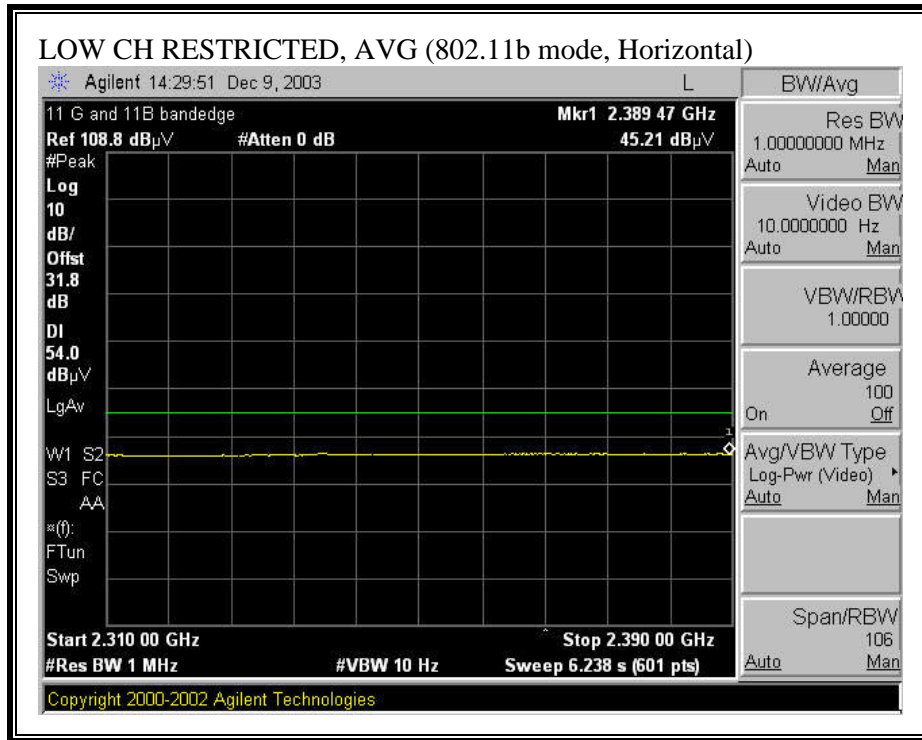
RADIATED RF MEASUREMENT SETUP



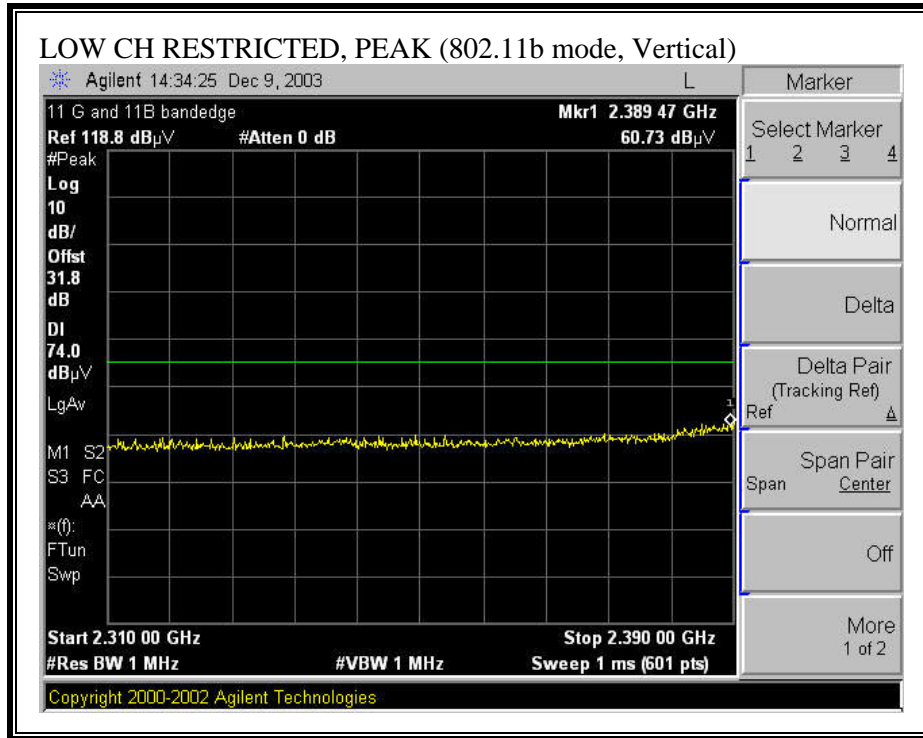


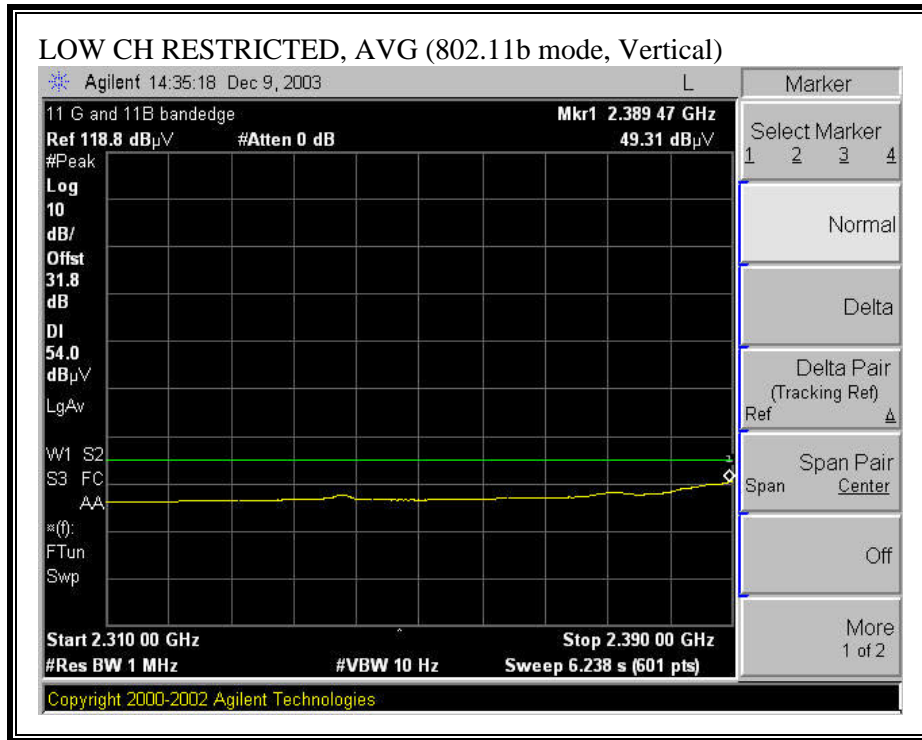
RESTRICTED BANDEGE (b MODE, LOW CHANNEL, HORIZONTAL)



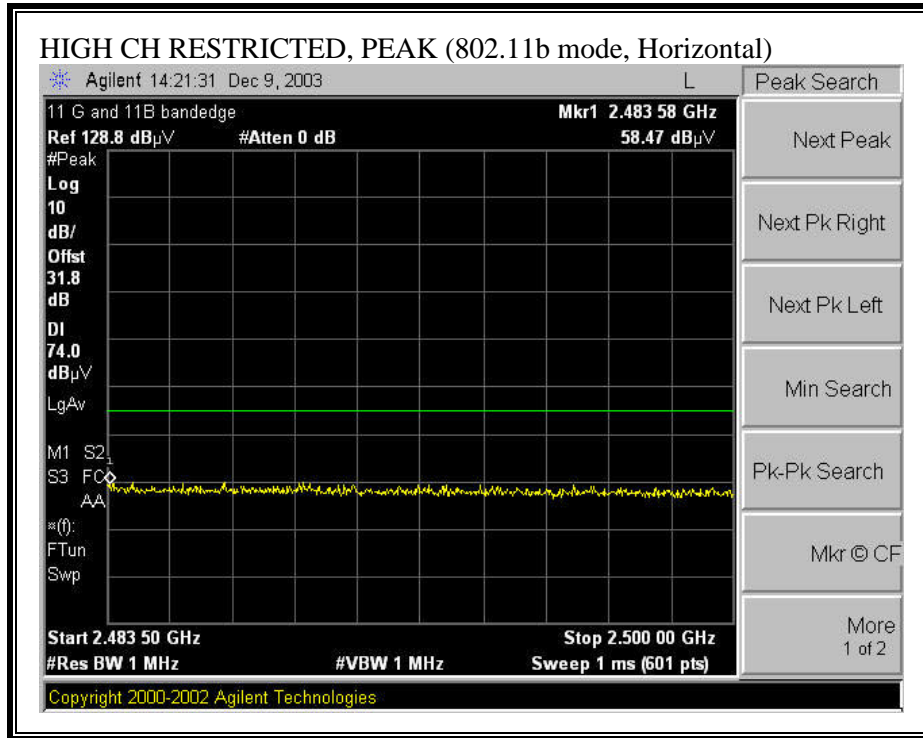


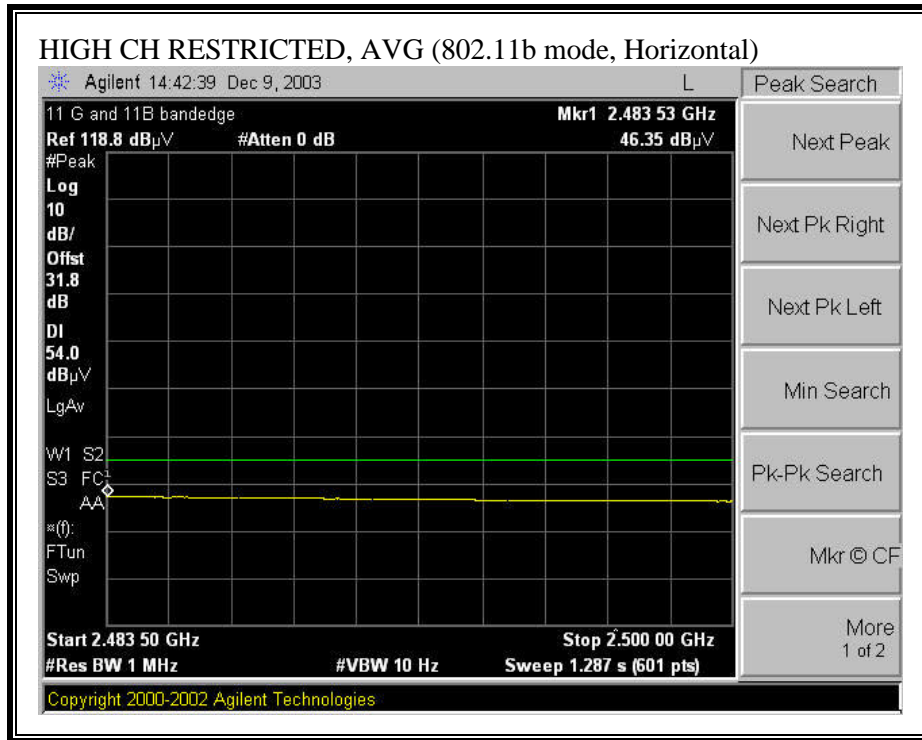
RESTRICTED BANDEGE (b MODE, LOW CHANNEL, VERTICAL)



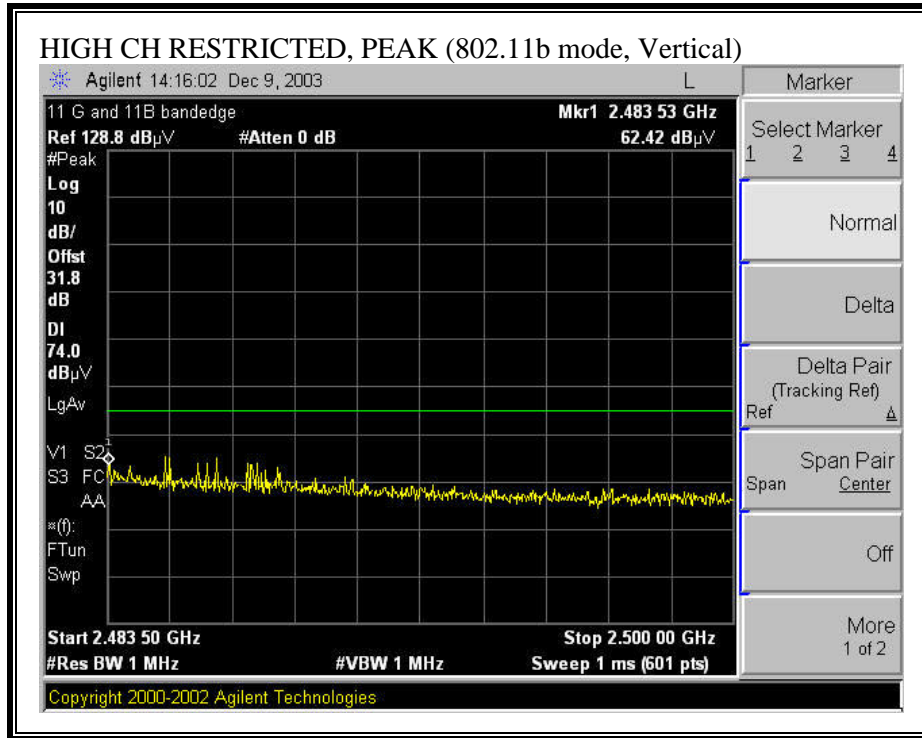


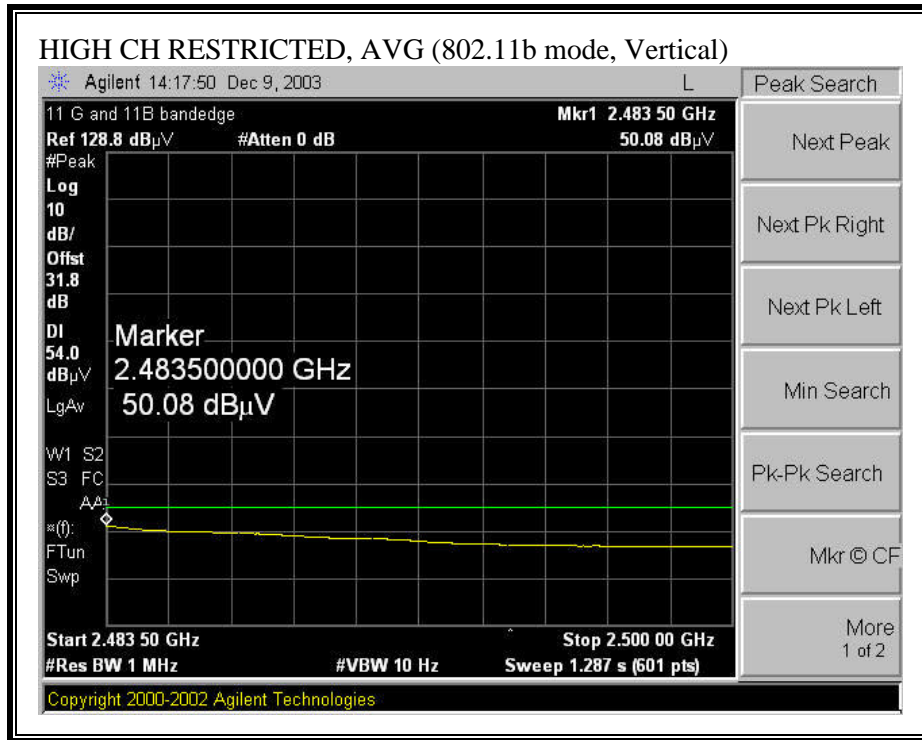
RESTRICTED BANDEGE (b MODE, HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEGE (b MODE, HIGH CHANNEL, VERTICAL)

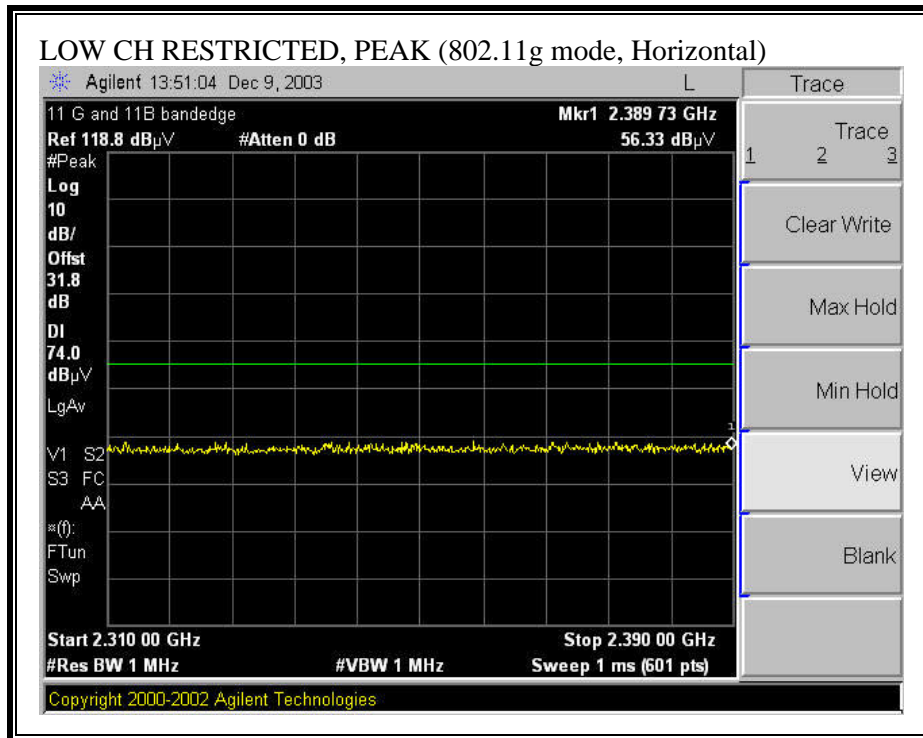


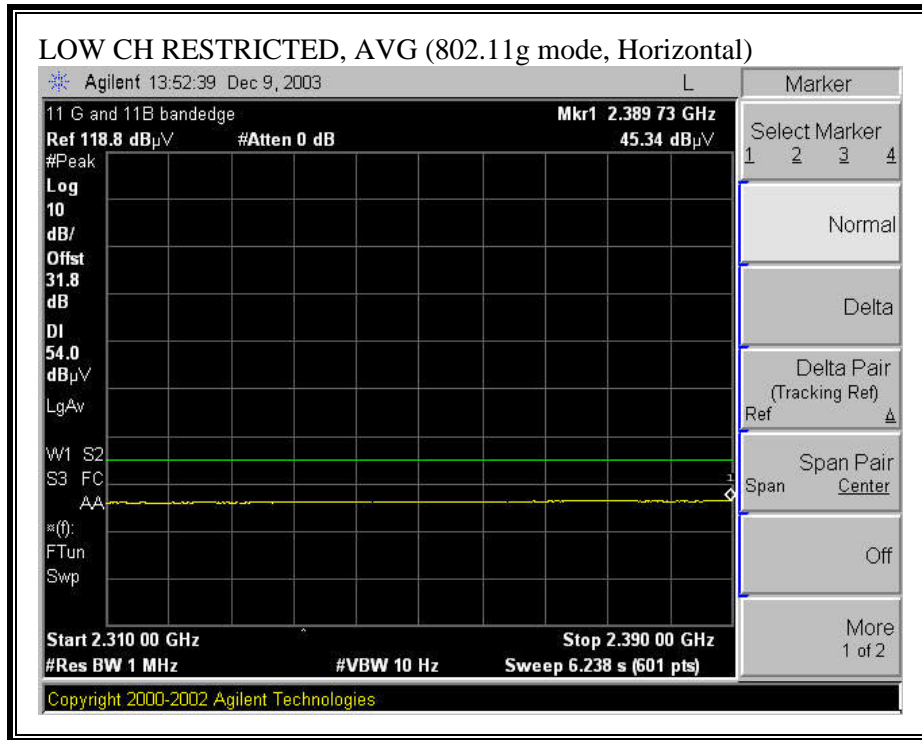


HARMONICS AND SPURIOUS EMISSIONS (b MODE)

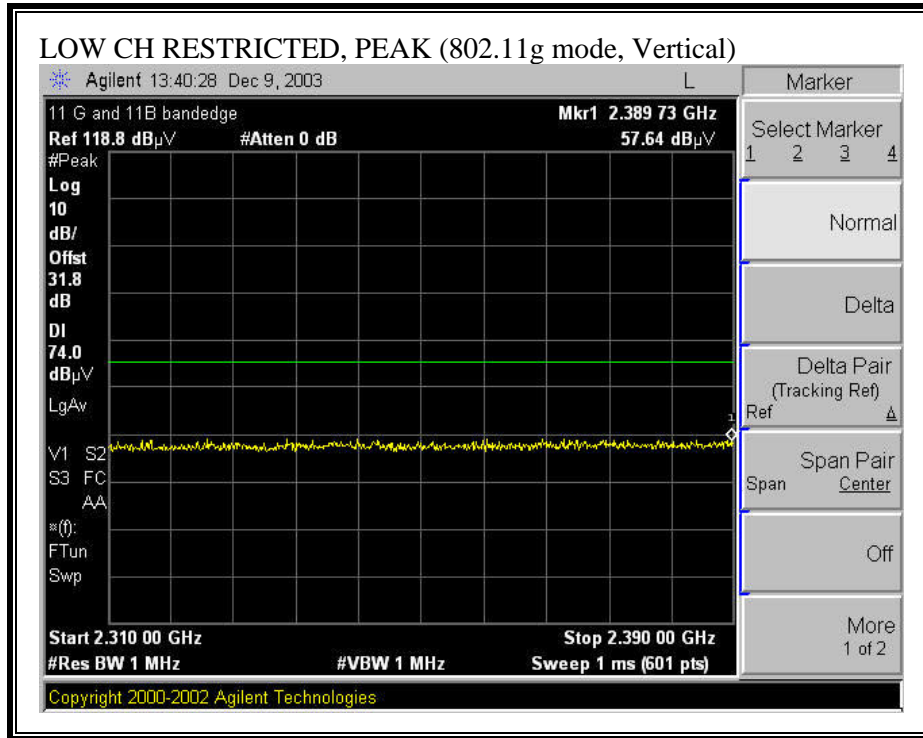
12/09/03 High Frequency Measurement Compliance Certification Services, Morgan Hill Open Field Site Test Engr: Ben Du Project #: 03U2409 Company: CISCO EUT Descrip.: WLAN Card and 12 dBi Omni Antenna EUT M/N: Test Target: FCC 15 HARMONICS Mode Oper: Tx mode Test Equipment: <table style="width: 100%; border: none;"> <tr> <td style="border: 1px solid black; padding: 2px;">EMCO Horn 1-18GHz</td> <td style="border: 1px solid black; padding: 2px;">Pre-amplifier 1-26GHz</td> <td style="border: 1px solid black; padding: 2px;">Spectrum Analyzer</td> <td style="border: 1px solid black; padding: 2px;">Horn > 18GHz</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">T59; S/N: 3245 @3m</td> <td style="border: 1px solid black; padding: 2px;">T86 Miteq 924341</td> <td style="border: 1px solid black; padding: 2px;">Agilent E4446A Analyzer</td> <td style="border: 1px solid black; padding: 2px;"></td> </tr> </table> <p>Hi Frequency Cables: <input type="checkbox"/> (2 ft) <input checked="" type="checkbox"/> (2 ~ 3 ft) <input type="checkbox"/> (4 ~ 6 ft) <input checked="" type="checkbox"/> (12 ft)</p> <p>Peak Measurements: 1 MHz Resolution Bandwidth 1 MHz Video Bandwidth Average Measurements: 1 MHz Resolution Bandwidth 10Hz Video Bandwidth</p>																EMCO Horn 1-18GHz	Pre-amplifier 1-26GHz	Spectrum Analyzer	Horn > 18GHz	T59; S/N: 3245 @3m	T86 Miteq 924341	Agilent E4446A Analyzer																							
EMCO Horn 1-18GHz	Pre-amplifier 1-26GHz	Spectrum Analyzer	Horn > 18GHz																																										
T59; S/N: 3245 @3m	T86 Miteq 924341	Agilent E4446A Analyzer																																											
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																														
Tx at 2.412GHz																																													
4.824	9.8	47.8	39.2	33.1	3.1	-45.6	0.0	1.0	39.4	30.8	74.0	54.0	-34.6	-23.2	V																														
4.824	9.8	50.1	38.2	33.1	3.1	-45.6	0.0	1.0	41.7	29.8	74.0	54.0	-32.3	-24.2	H																														
Tx at 2.437GHz																																													
4.874	9.8	45.2	35.1	33.1	3.2	-45.6	0.0	1.0	36.8	26.7	74.0	54.0	-37.2	-27.3	V																														
7.311	9.8	39.6	31.2	36.0	4.1	-46.6	0.0	1.0	34.1	25.7	74.0	54.0	-39.9	-28.3	V																														
4.874	9.8	48.9	37.2	33.1	3.2	-45.6	0.0	1.0	40.5	28.8	74.0	54.0	-33.5	-25.2	H																														
7.311	9.8	40.6	30.7	36.0	4.1	-46.6	0.0	1.0	35.1	25.2	74.0	54.0	-38.9	-28.8	H																														
Tx at 2.62GHz																																													
4.924	9.8	46.4	40.4	33.1	3.2	-45.7	0.0	1.0	38.0	32.0	74.0	54.0	-36.0	-22.0	V																														
7.386	9.8	40.4	30.0	36.1	4.1	-46.5	0.0	1.0	35.0	24.6	74.0	54.0	-39.0	-29.4	V																														
4.924	9.8	47.4	38.6	33.1	3.2	-45.7	0.0	1.0	39.0	30.2	74.0	54.0	-35.0	-23.8	H																														
7.386	9.8	38.5	29.3	36.1	4.1	-46.5	0.0	1.0	33.1	23.9	74.0	54.0	-40.9	-30.1	H																														
<table style="width: 100%; border: none;"> <tr> <td>f</td> <td>Measurement Frequency</td> <td>Amp</td> <td>Preamp Gain</td> <td>Avg Lim</td> <td>Average Field Strength Limit</td> </tr> <tr> <td>Dist</td> <td>Distance to Antenna</td> <td>D Corr</td> <td>Distance Correct to 3 meters</td> <td>Pk Lim</td> <td>Peak Field Strength Limit</td> </tr> <tr> <td>Read</td> <td>Analyzer Reading</td> <td>Avg</td> <td>Average Field Strength @ 3 m</td> <td>Avg Mar</td> <td>Margin vs. Average Limit</td> </tr> <tr> <td>AF</td> <td>Antenna Factor</td> <td>Peak</td> <td>Calculated Peak Field Strength</td> <td>Pk Mar</td> <td>Margin vs. Peak Limit</td> </tr> <tr> <td>CL</td> <td>Cable Loss</td> <td>HPF</td> <td>High Pass Filter</td> <td></td> <td></td> </tr> </table>																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		
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																																								
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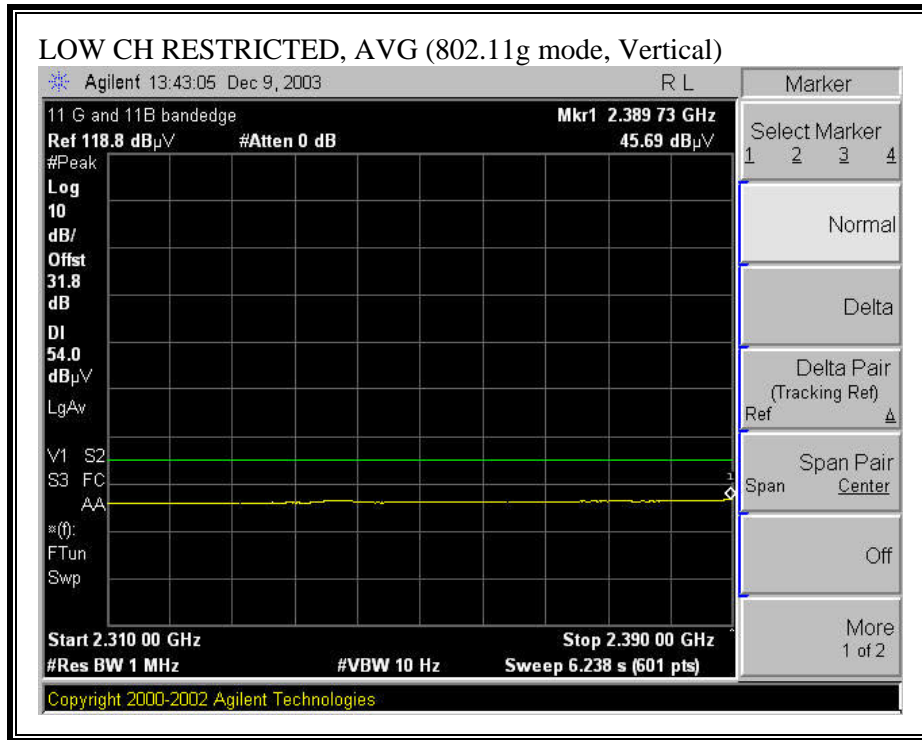
RESTRICTED BANDEGE (g MODE, LOW CHANNEL, HORIZONTAL)



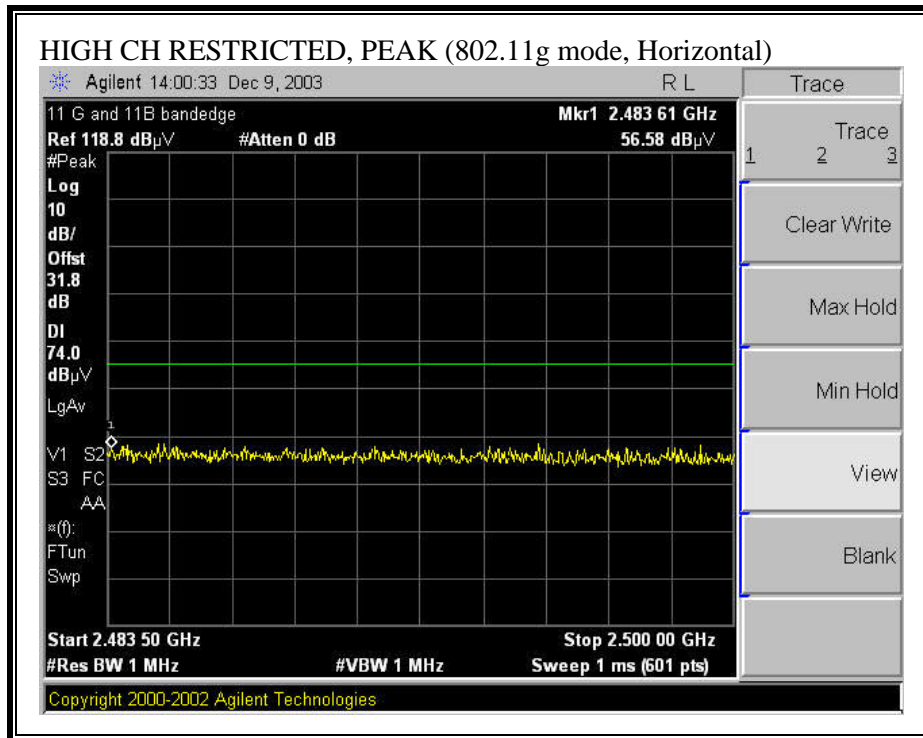


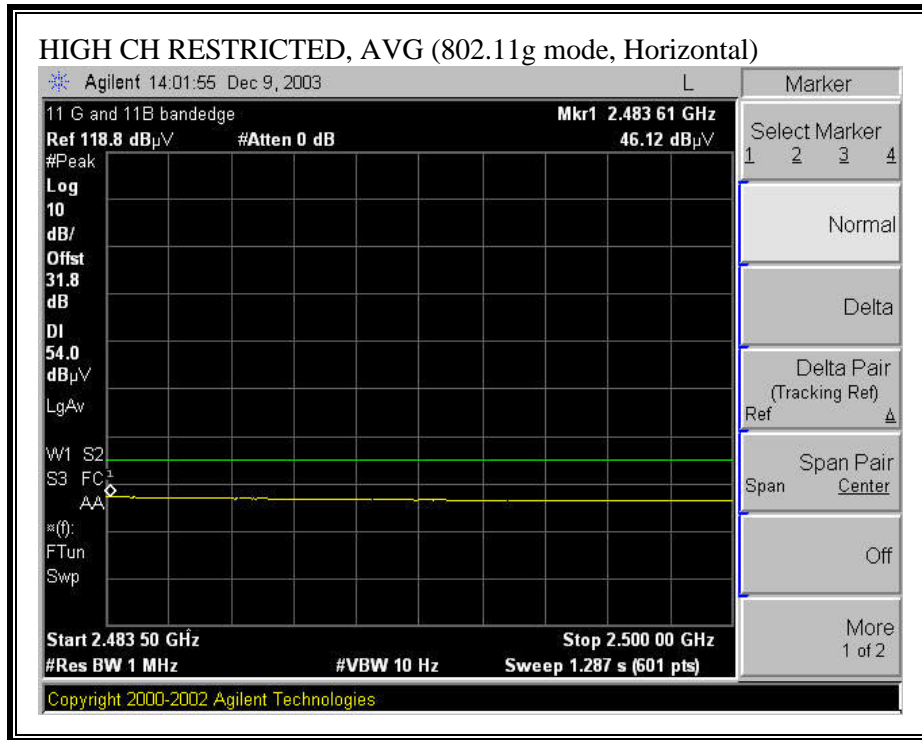
RESTRICTED BANDEGE (g MODE, LOW CHANNEL, VERTICAL)



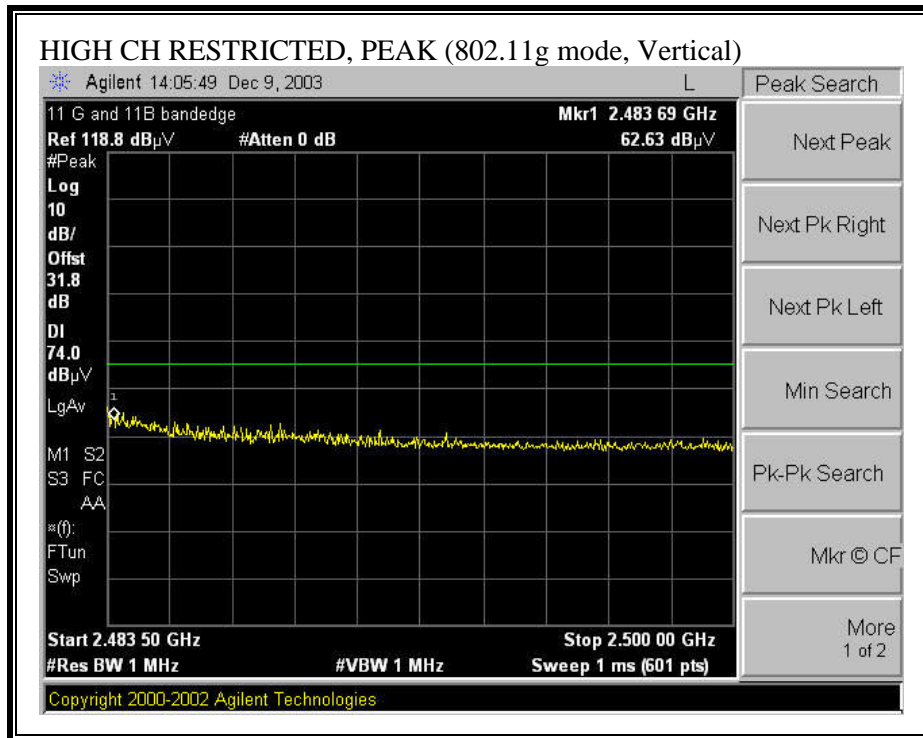


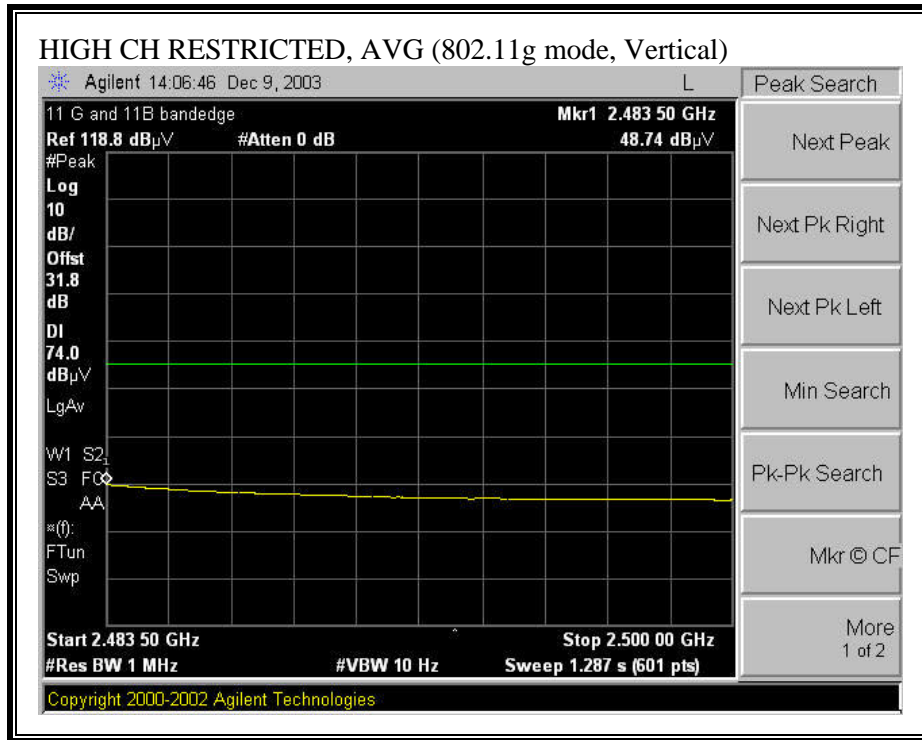
RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, VERTICAL)



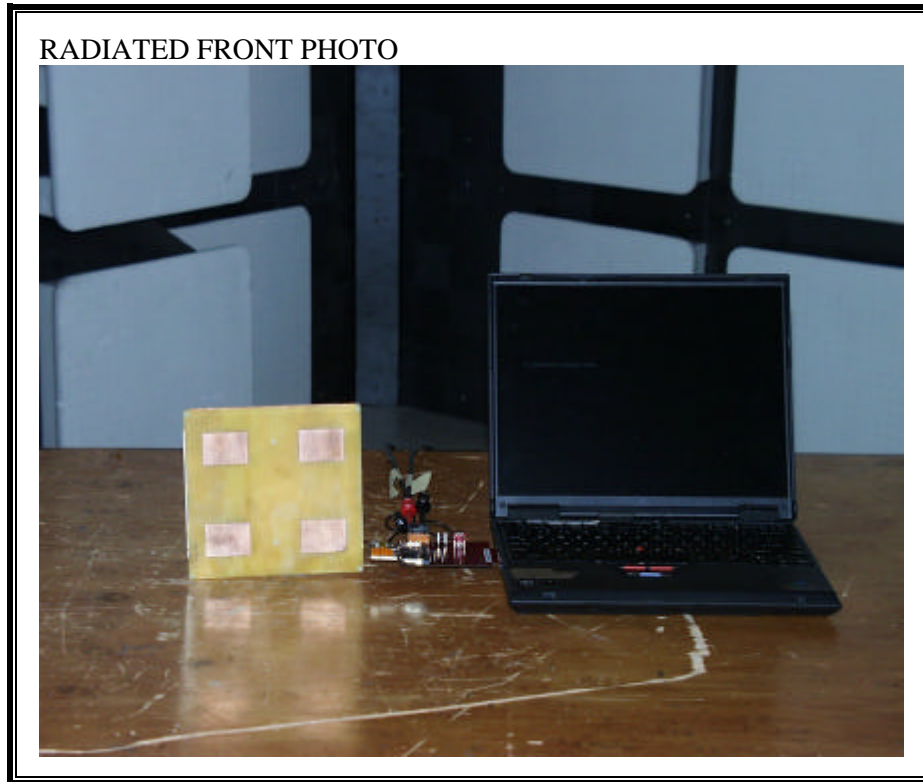


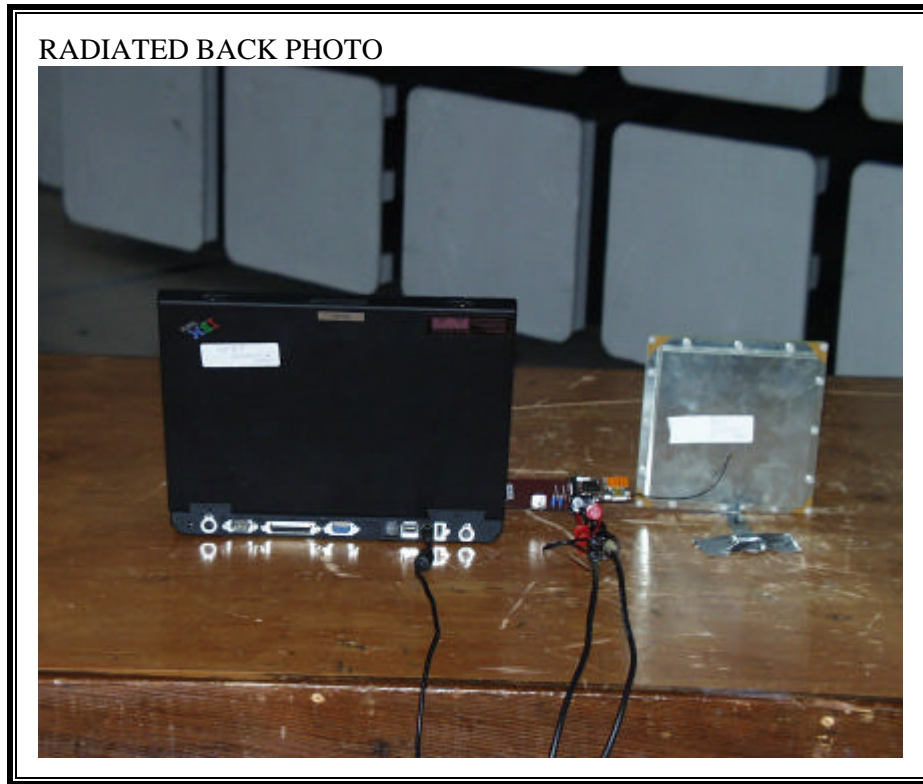
HARMONICS AND SPURIOUS EMISSIONS (g MODE)

12/09/03 High Frequency Measurement Compliance Certification Services, Morgan Hill Open Field Site Test Engr: Ben Du Project #: 03U2409 Company: CISCO EUT Descrip.: WLAN Card and 12 dBi Omni Antenna EUT M/N: Test Target: FCC 15 HARMONICS Mode Oper: Tx mode Test Equipment: EMCO Horn 1-18GHz Pre-amplifier 1-26GHz Spectrum Analyzer Horn > 18GHz T59; S/N: 3245 @3m T86 Miteq 924341 Agilent E4446A Analyzer Hi Frequency Cables: <input type="checkbox"/> (2 ft) <input checked="" type="checkbox"/> (2 ~ 3 ft) <input type="checkbox"/> (4 ~ 6 ft) <input checked="" type="checkbox"/> (12 ft) Peak Measurements: 1 MHz Resolution Bandwidth 1 MHz 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		
Tx at 2.412GHz																	
4.824	9.8	44.3	35.3	33.1	3.1	-45.6	0.0	1.0	35.9	26.9	74.0	54.0	-38.1	-27.1	V		
4.824	9.8	43.7	34.5	33.1	3.1	-45.6	0.0	1.0	35.3	26.1	74.0	54.0	-38.7	-27.9	H		
Tx at 2.437GHz																	
4.874	9.8	44.2	35.8	33.1	3.2	-45.6	0.0	1.0	35.8	27.4	74.0	54.0	-38.2	-26.6	V		
7.311	9.8	42.7	30.9	36.0	4.1	-46.6	0.0	1.0	37.2	25.4	74.0	54.0	-36.8	-28.6	V		
4.874	9.8	44.5	36.3	33.1	3.2	-45.6	0.0	1.0	36.1	27.9	74.0	54.0	-37.9	-26.1	H		
7.311	9.8	42.6	30.9	36.0	4.1	-46.6	0.0	1.0	37.0	25.4	74.0	54.0	-37.0	-28.6	H		
Tx at 2.62GHz																	
4.924	9.8	47.3	41.8	33.1	3.2	-45.7	0.0	1.0	38.9	33.4	74.0	54.0	-35.1	-20.6	V		
7.386	9.8	39.7	30.0	36.1	4.1	-46.5	0.0	1.0	34.3	24.6	74.0	54.0	-39.7	-29.4	V		
4.924	9.8	45.0	37.0	33.1	3.2	-45.7	0.0	1.0	36.6	28.6	74.0	54.0	-37.4	-25.4	H		
7.386	9.8	40.3	29.3	36.1	4.1	-46.5	0.0	1.0	34.9	23.9	74.0	54.0	-39.1	-30.1	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										

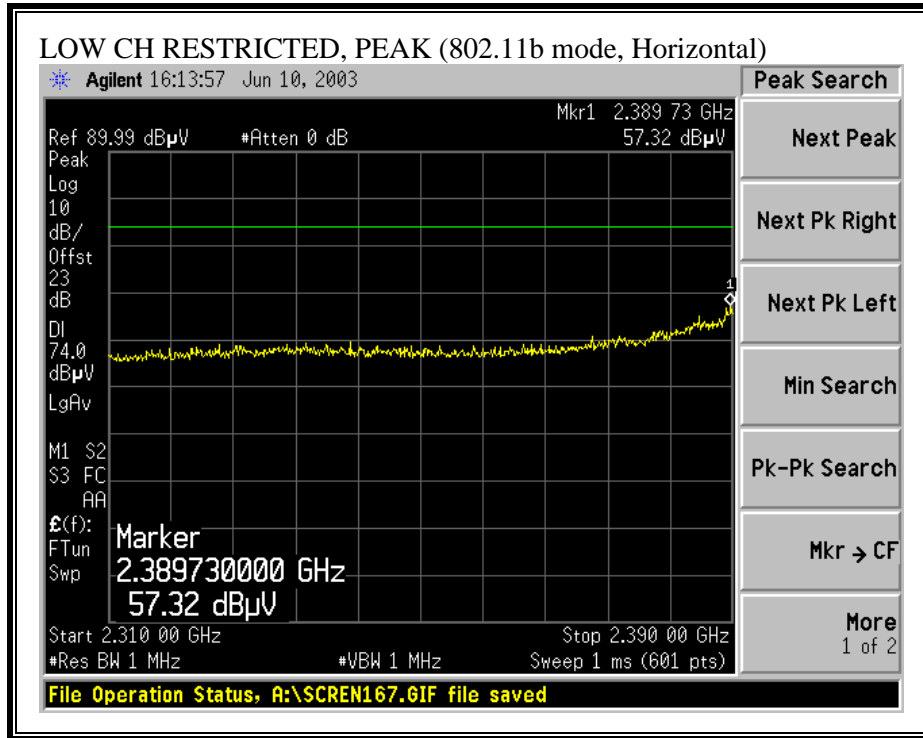
7.9.4. RADIATED EMISSIONS WITH 13.5 dBi PATCH ANTENNA

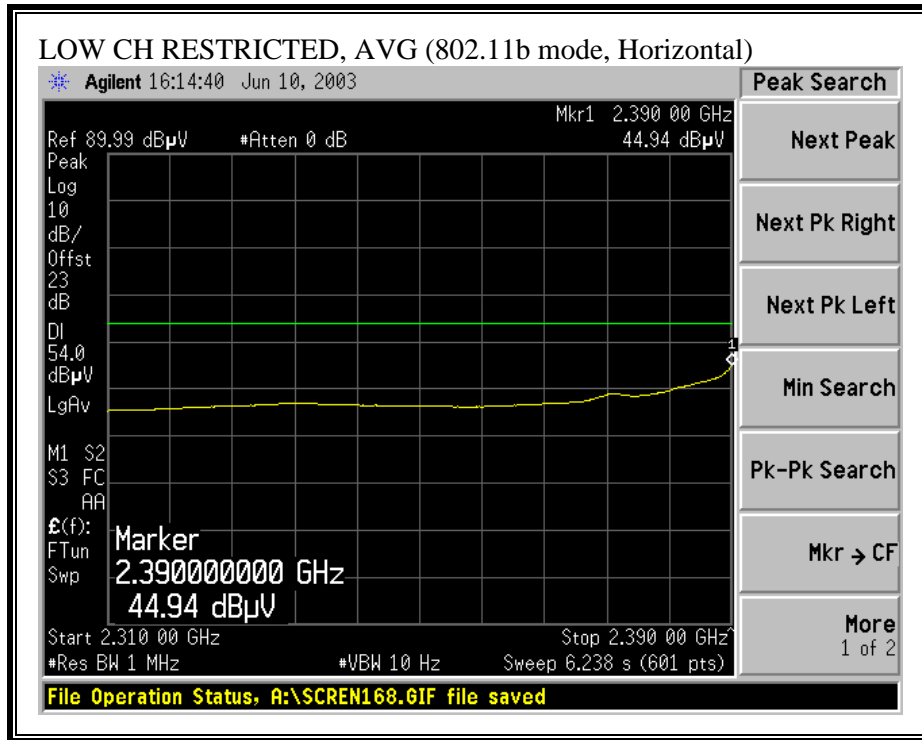
RADIATED RF MEASUREMENT SETUP





RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, VERTICAL)

