



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

**FOR**

**802.11a/b/g CARDBUS CARD**

**MODEL NUMBER: AR5BCB-00062**

**FCC ID: PPD-AR5BCB-00062**

**REPORT NUMBER: O4U3043-1**

**ISSUE DATE: DECEMBER 21, 2004**

*Prepared for*

**ATHEROS COMMUNICATIONS, INC.**

**529 ALMANOR AVE.**

**SUNNYVALE, CA 94085**

**U.S.A.**

*Prepared by*

**COMPLIANCE CERTIFICATION SERVICES**

**561F MONTEREY ROAD,**

**MORGAN HILL, CA 95037, USA**

**TEL: (408) 463-0885**

**FAX: (408) 463-0888**

**NVLAP<sup>®</sup>**

**LAB CODE:200065-0**

Revision History

<u>Rev.</u>	<u>Revisions</u>	<u>Revised By</u>
-------------	------------------	-------------------

## TABLE OF CONTENTS

<b>1. ATTESTATION OF TEST RESULTS.....</b>	<b>5</b>
<b>2. TEST METHODOLOGY .....</b>	<b>6</b>
<b>3. FACILITIES AND ACCREDITATION .....</b>	<b>6</b>
<b>4. CALIBRATION AND UNCERTAINTY.....</b>	<b>6</b>
4.1. MEASURING INSTRUMENT CALIBRATION.....	6
4.2. MEASUREMENT UNCERTAINTY.....	6
<b>5. EQUIPMENT UNDER TEST.....</b>	<b>7</b>
5.1. DESCRIPTION OF EUT.....	7
5.2. MAXIMUM OUTPUT POWER.....	7
5.3. DESCRIPTION OF AVAILABLE ANTENNAS.....	8
5.4. SOFTWARE AND FIRMWARE.....	8
5.5. WORST-CASE CONFIGURATION AND MODE.....	8
5.6. DESCRIPTION OF TEST SETUP.....	9
<b>6. TEST AND MEASUREMENT EQUIPMENT .....</b>	<b>11</b>
<b>7. LIMITS AND RESULTS .....</b>	<b>12</b>
7.1. CHANNEL TESTS FOR THE 2400 TO 2483.5 MHz BAND.....	12
7.1.1. 6 dB BANDWIDTH.....	12
7.1.2. 99% BANDWIDTH.....	25
7.1.3. PEAK OUTPUT POWER.....	37
7.1.4. MAXIMUM PERMISSIBLE EXPOSURE.....	50
7.1.5. AVERAGE POWER.....	53
7.1.6. PEAK POWER SPECTRAL DENSITY.....	54
7.1.7. CONDUCTED SPURIOUS EMISSIONS.....	67
7.2. CHANNEL TESTS FOR THE 5725 TO 5850 MHz BAND.....	90
7.2.1. 6 dB BANDWIDTH.....	90
7.2.2. 99% BANDWIDTH.....	96
7.2.3. PEAK OUTPUT POWER.....	102
7.2.4. MAXIMUM PERMISSIBLE EXPOSURE.....	109
7.2.5. AVERAGE POWER.....	112
7.2.6. PEAK POWER SPECTRAL DENSITY.....	113
7.2.7. CONDUCTED SPURIOUS EMISSIONS.....	119
7.3. RADIATED EMISSIONS.....	130
7.3.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS.....	130
7.3.2. TRANSMITTER ABOVE 1 GHz FOR 2400 TO 2483.5 MHz BAND.....	133
7.3.3. TRANSMITTER ABOVE 1 GHz FOR 5725 TO 5850 MHz BAND.....	151
7.3.4. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz.....	153

7.4. *POWERLINE CONDUCTED EMISSIONS* ..... 157

**8. SETUP PHOTOS** ..... **161**

# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** ATHEROS COMMUNICATIONS, INC.  
529 ALMANOR AVE.  
SUNNYVALE, CA 94085  
U.S.A.

**EUT DESCRIPTION:** 802.11a/b/g CARDBUS CARD

**MODEL:** AR5BCB-00062

**SERIAL NUMBER:** CB62-420-36

**DATE TESTED:** NOVEMBER 30 – DECEMBER 20, 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:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. 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. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

Tested By:



---

YAN ZHENG  
EMC SUPERVISOR  
COMPLIANCE CERTIFICATION SERVICES

---

HITESH SOLANKI  
EMC ENGINEER  
COMPLIANCE CERTIFICATION SERVICES

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2 and FCC CFR 47 Part 15.

## 3. 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>.

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. 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.

### 4.2. 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. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is an 802.11a/b/g with turbo mode transceiver Cardbus Card.

The radio module is manufactured by Atheros Communications Inc.

### 5.2. MAXIMUM OUTPUT POWER

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

2400 to 2483.5 MHz Authorized Band

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2462	802.11b	22.92	195.88
2412 - 2462	802.11g	26.41	437.52
2412 - 2462	802.11g Turbo	25.14	326.59

5725 to 5850 MHz Authorized Band

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5745 - 5825	802.11a	24.44	277.97
5760 - 5805	802.11a Turbo	23.64	231.21

### **5.3. DESCRIPTION OF AVAILABLE ANTENNAS**

The radio utilizes two integrated TX/RX antennas for diversity, each with a maximum gain of 0 dBi.

### **5.4. SOFTWARE**

The test utility software used during testing was “ART program” rev. V5\_2\_b55.

### **5.5. WORST-CASE CONFIGURATION AND MODE**

The worst-case channel is determined as the channel with the highest output power.



## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERALS SUPPORT EQUIPMENT				
Description	Manufacturer	Model Number	Serial Number	FCC ID
Laptop PC	IBM	R40	FX-28550	DoC
AC Adapter	IBM	02K6657	A261766	N/A
Laptop PC	Dell	PP05L	CN-04Y212-484643-34-T-3374	DoC
AC Adapter	Dell	AA22850	CN-045U092-16291-34K-03NQ	N/A
Laptop PC	Dell	PP011	52XMUL-36273-FB-E	DoC
AC Adapter	Dell	AA20031	9364U	N/A

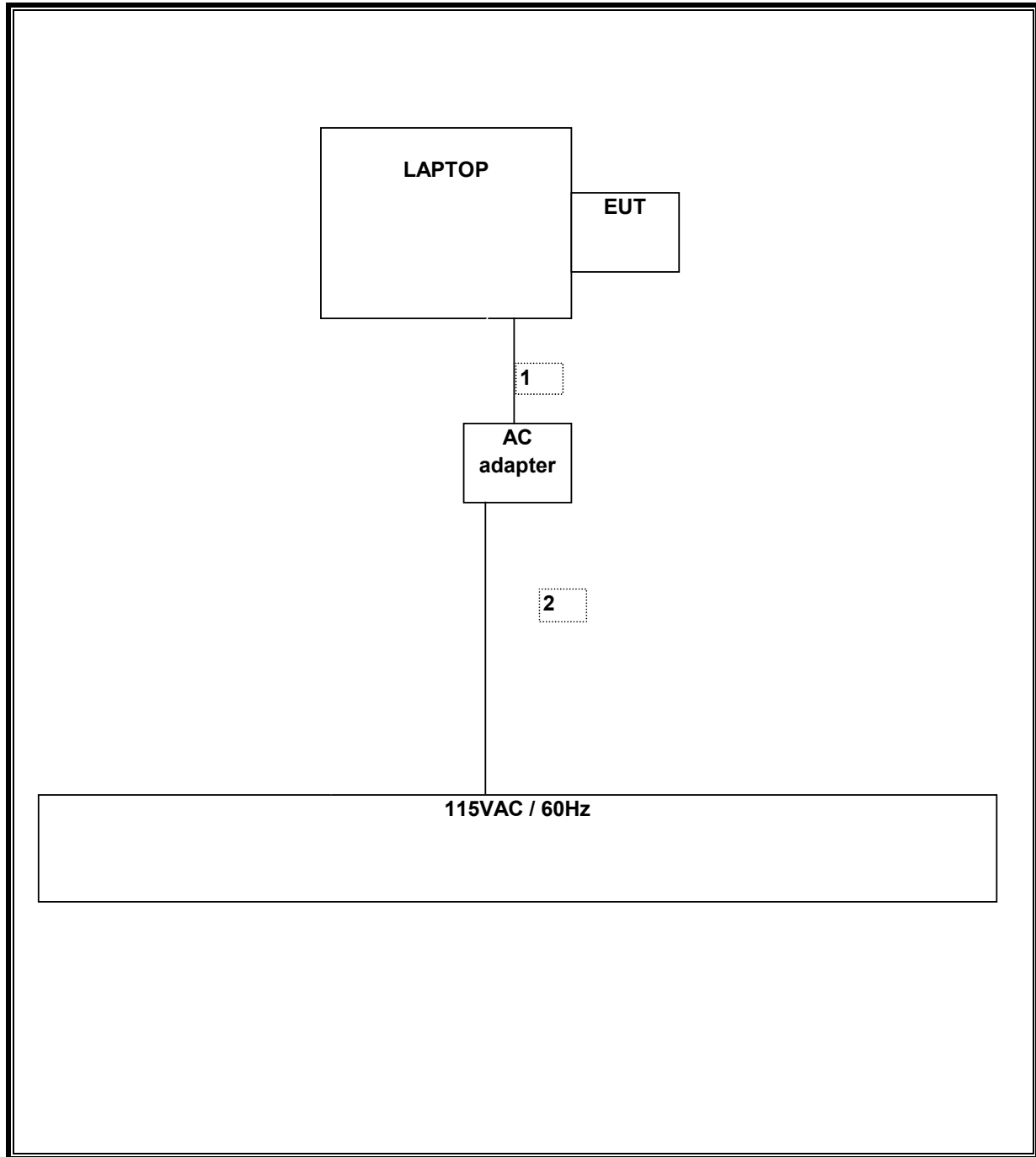
### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	DC	1	DC	Unshielded	1.8	No
2	AC	1	IEC	Unshielded	1.5	No

### TEST SETUP

The EUT is installed in a host laptop computer via a PCMCIA slot during the tests. The test software exercised the radio card.

**SETUP DIAGRAM FOR TESTS**



## 6. 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
Peak Power Meter	Agilent	E4416A	GB41291160	2/9/2006
Peak / Average Power Sensor	Agilent	E9327A	US40440755	2/10/2006
Spectrum Analyzer 20 Hz ~ 44 GHz	Agilent	E4446A	US42070220	4/1/2005
Antenna, Horn 1 ~ 18 GHz	EMCO	3117	29310	9/12/2005
Preamplifier, 1 ~ 26 GHz	Miteq	NSP2600-44	646456	8/17/2005
5.15-5.35 GHz Rejection filter	Microtronics	BRC13190	2	CNR
5.47-5.725 GHz Rejection filter	Microtronics	BRC13191	1	CNR
5.725-5.825 GHz Rejection filter	Microtronics	BRC13192	1	CNR
1.5 GHz High pass filter	Microtronics	HPM13193	3	CNR
EMI Test Receiver	R & S	ESHS 20	827129/006	10/22/2005
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	8/30/2005
Site A Line Stabilizer / Conditioner	Tripplite	LC-1800a	A0051681	CNR
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	10/21/2005
AC Power Source, 10KVA	ACS	AFC-10K-AFC-2	J1568	CNR
Temperature / Humidity Chamber	Thermotron	SE 600-10-10	29800	5/13/2005
AC Power Source, 8KVA	APC	AFP2-8KVA	J5061	CNR

## 7. LIMITS AND RESULTS

### 7.1. CHANNEL TESTS FOR THE 2400 TO 2483.5 MHz BAND

#### 7.1.1. 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 300 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	10080	500	9580
Low	2417	12000	500	11500
Middle	2437	10170	500	9670
High	2457	12080	500	11580
High	2462	12080	500	11580

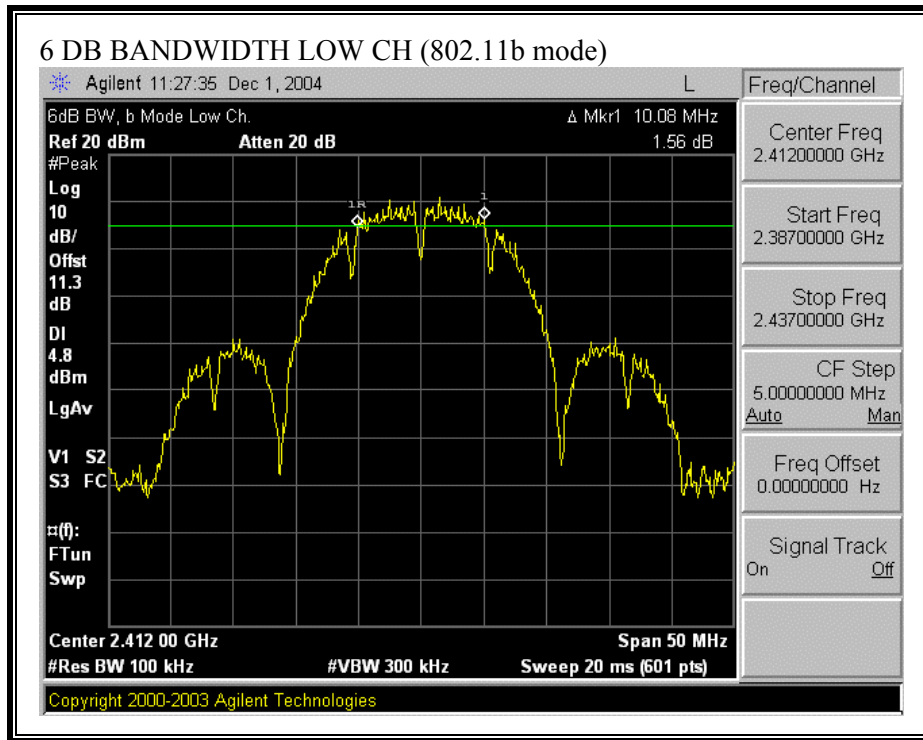
802.11g Mode

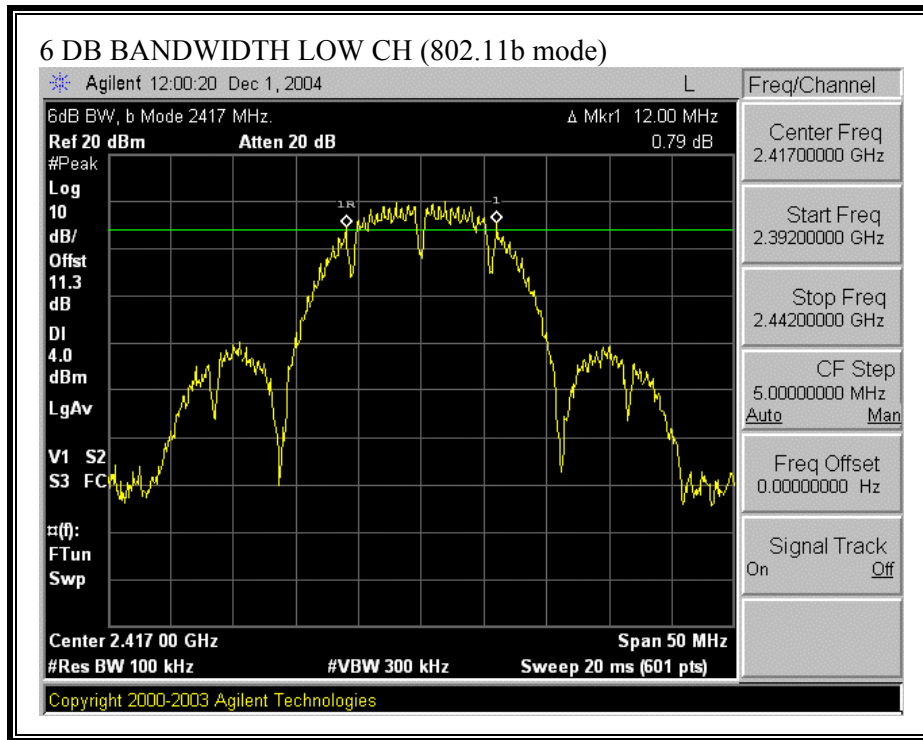
Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Low	2412	16420	500	15920
Low	2417	16420	500	15920
Middle	2437	16330	500	15830
High	2457	16330	500	15830
High	2462	16330	500	15830

802.11g Turbo Mode

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Middle	2437	31330	500	30830

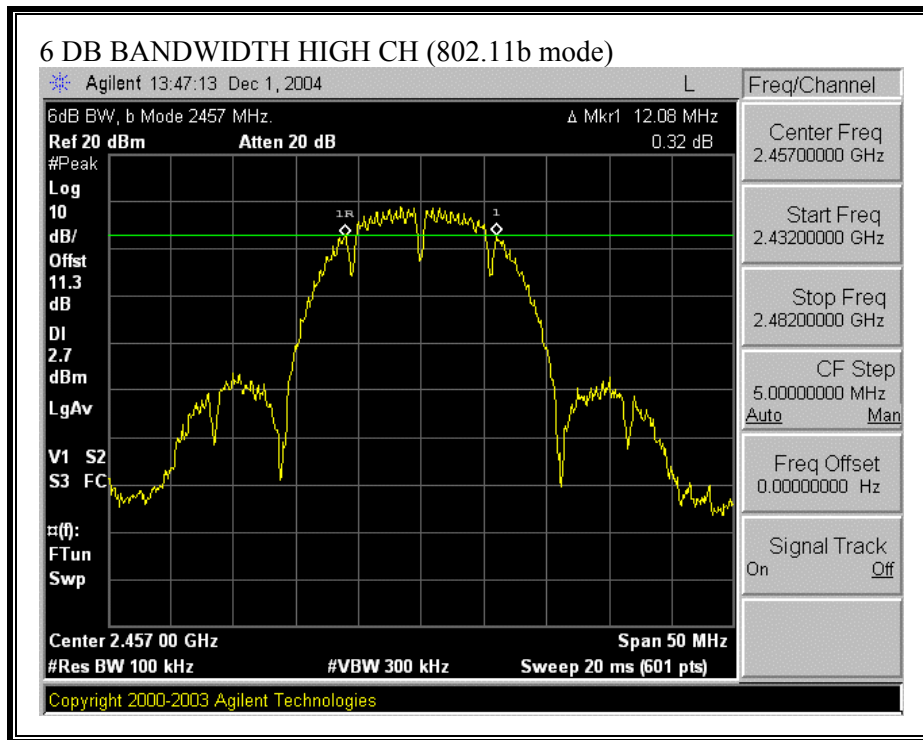
**6 DB BANDWIDTH (802.11b MODE)**

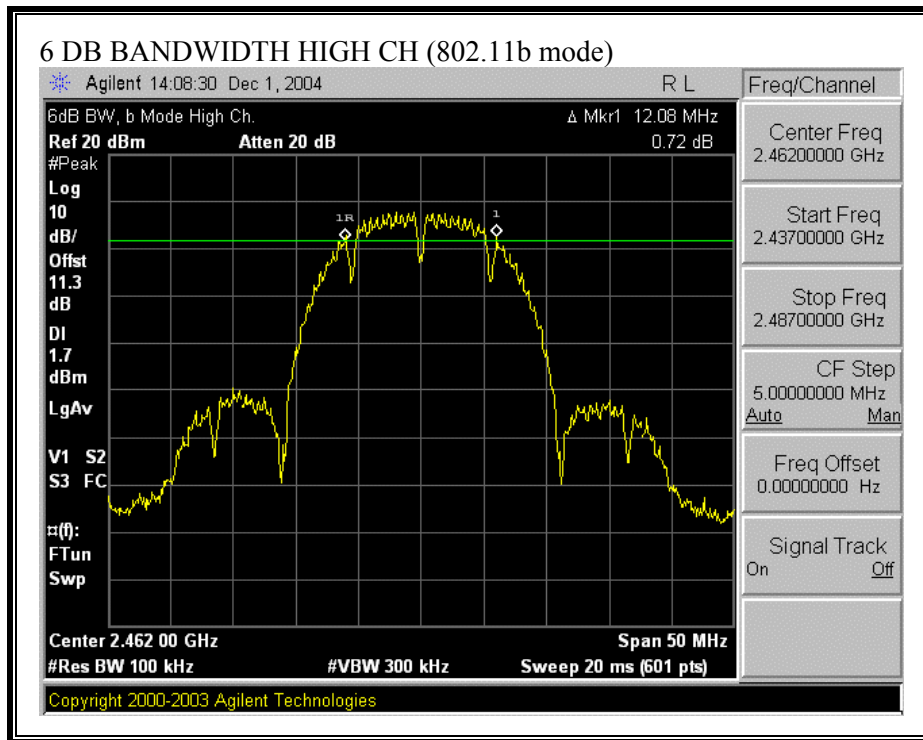




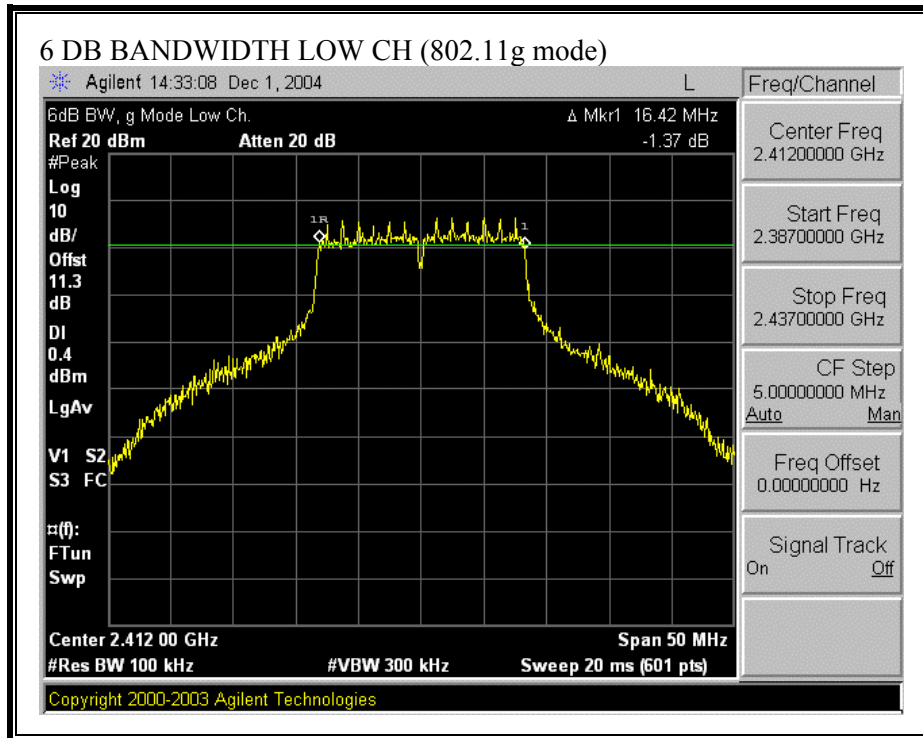


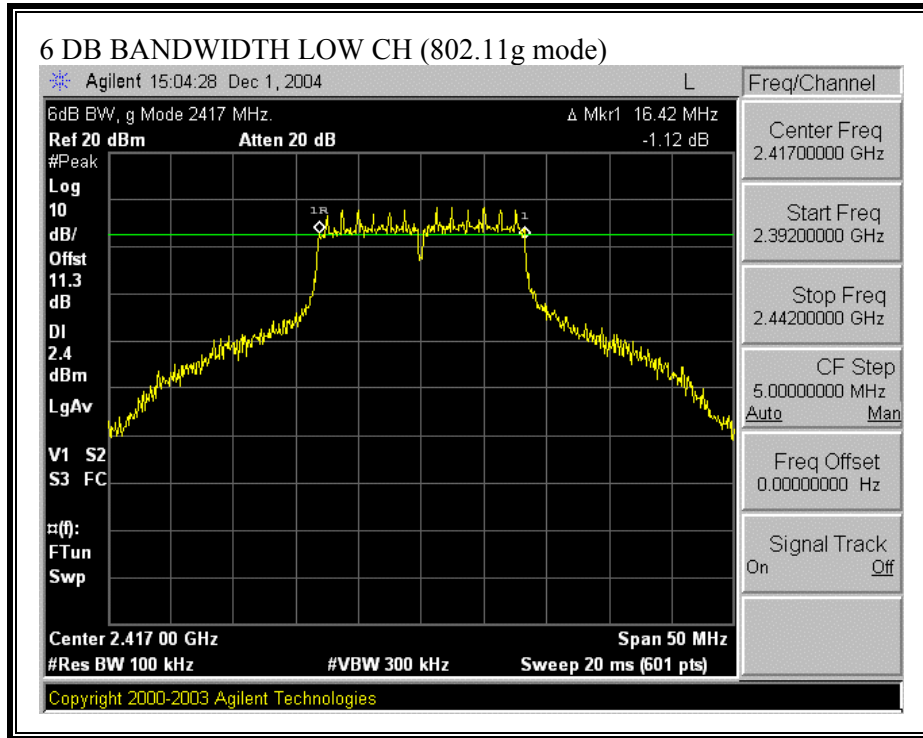


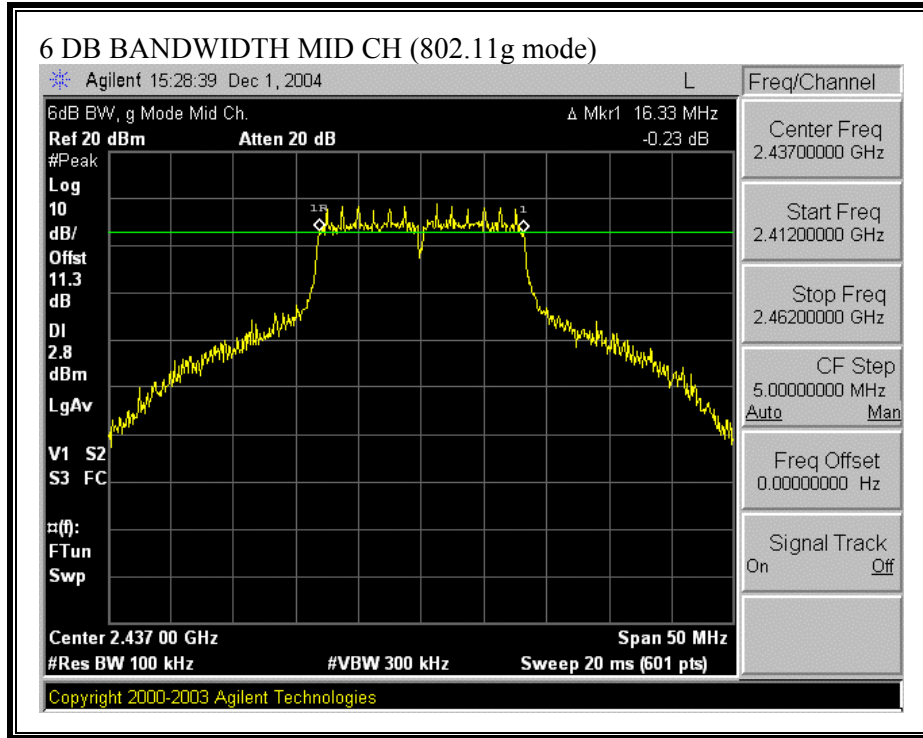


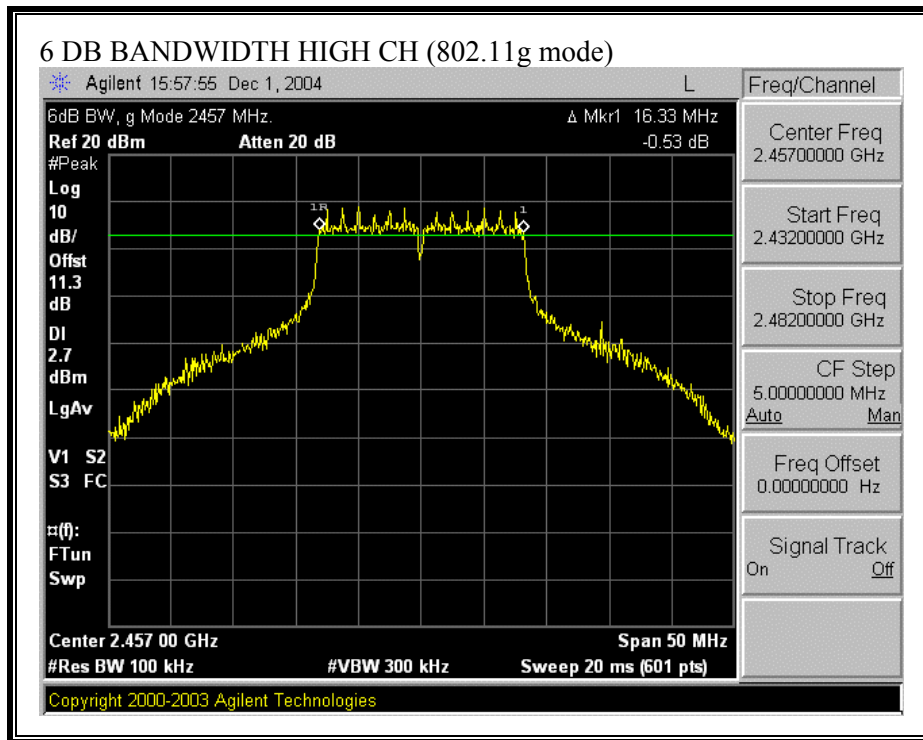


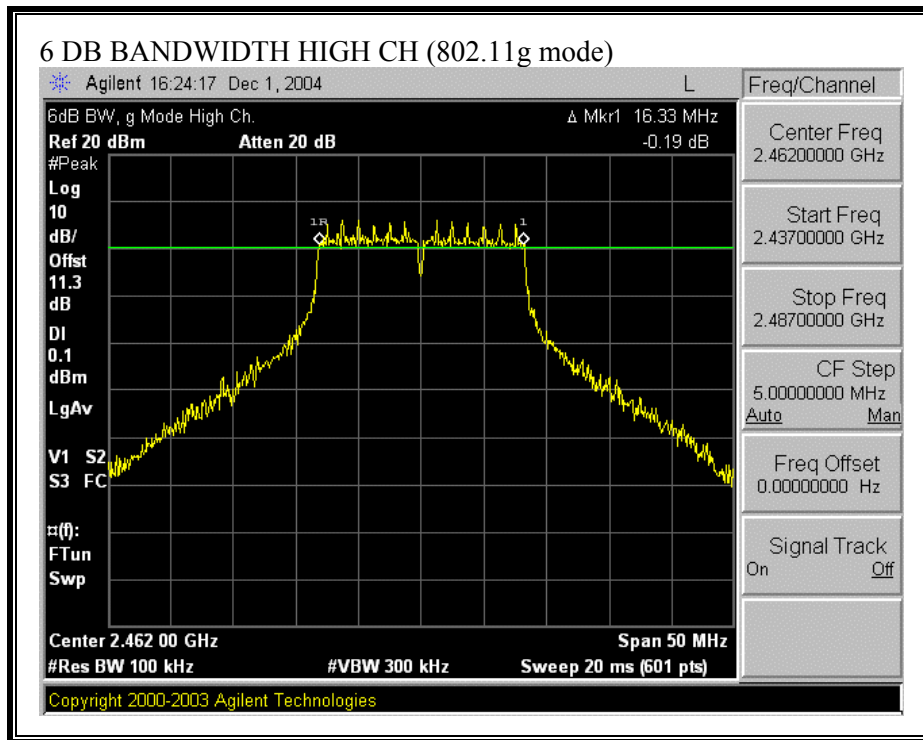
**6 DB BANDWIDTH (802.11g MODE)**



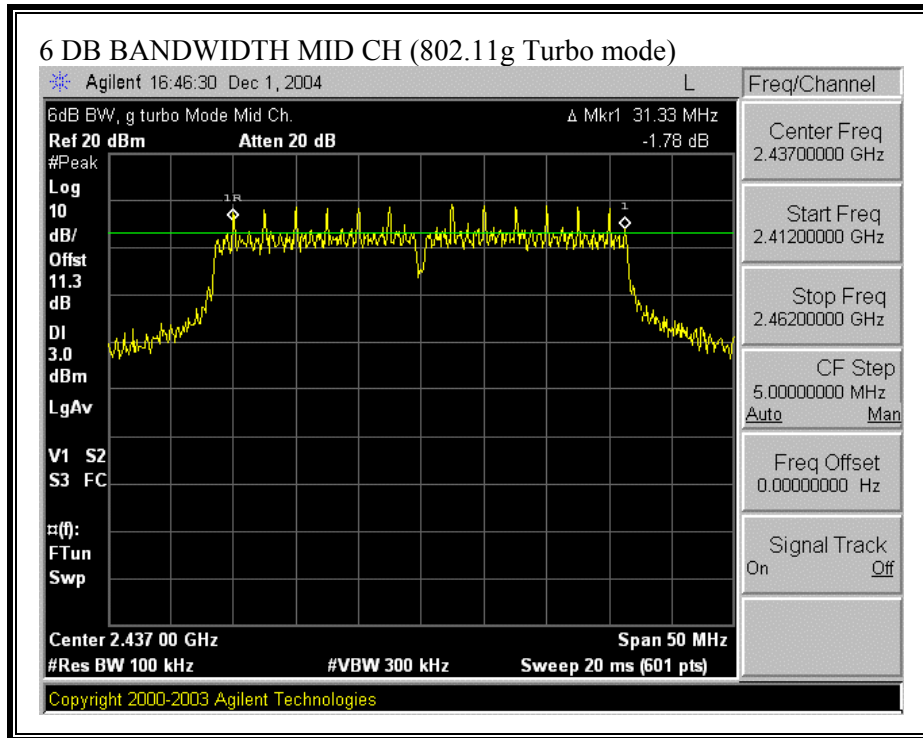








**6 DB BANDWIDTH (802.11g TURBO MODE)**





### 7.1.2. 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	15.9103
Low	2417	15.8737
Middle	2437	15.6847
High	2457	15.6077
High	2462	15.5654

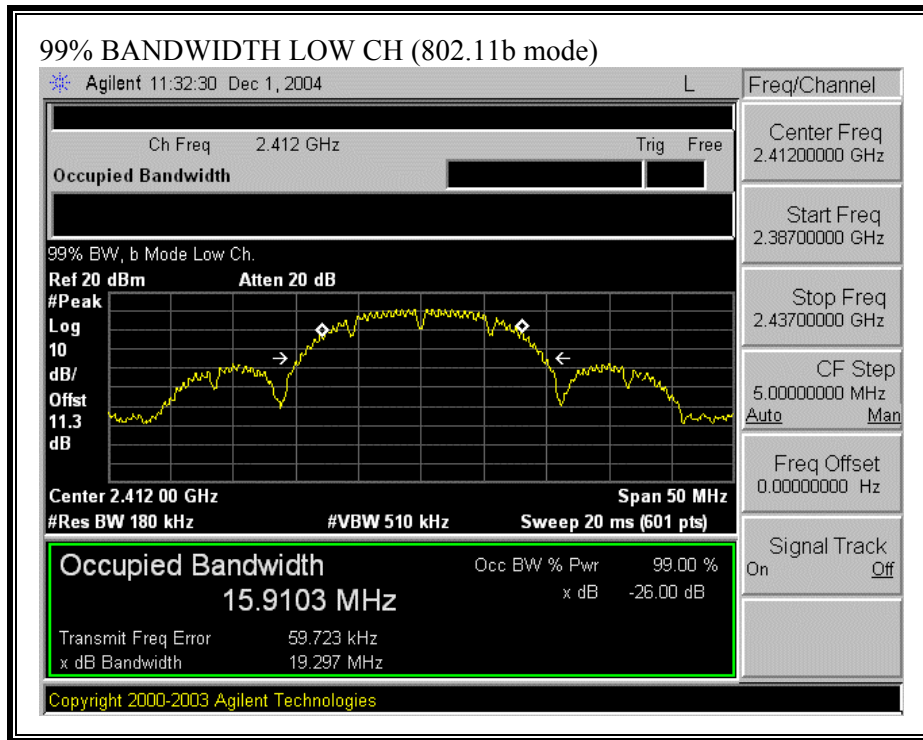
##### 802.11g Mode

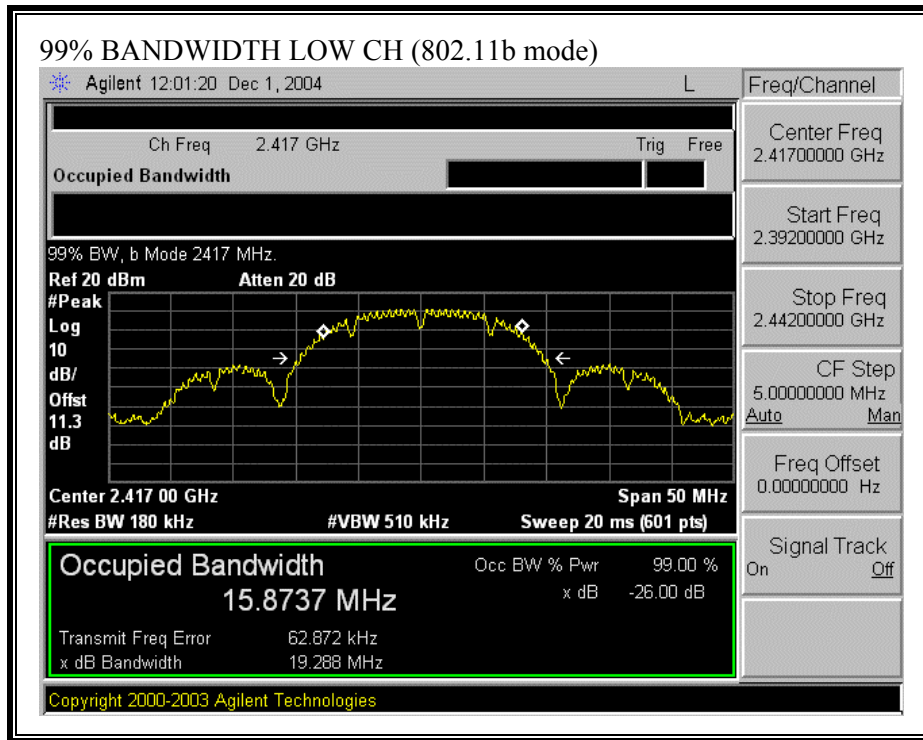
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	17.0955
Low	2417	17.8001
Middle	2437	17.4479
High	2457	17.3394
High	2462	16.7586

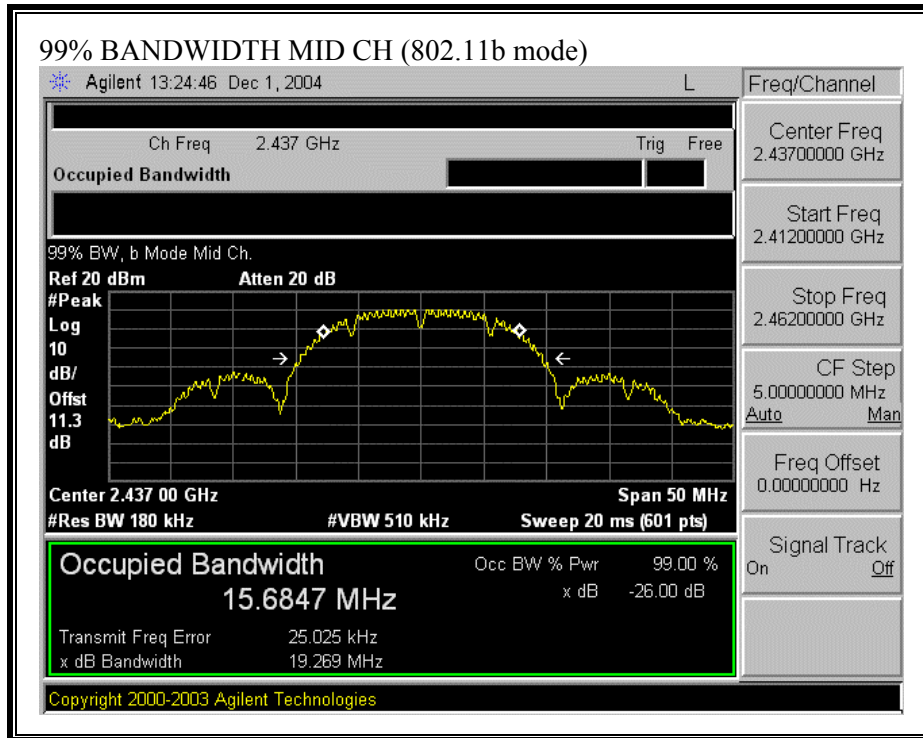
##### 802.11g Turbo Mode

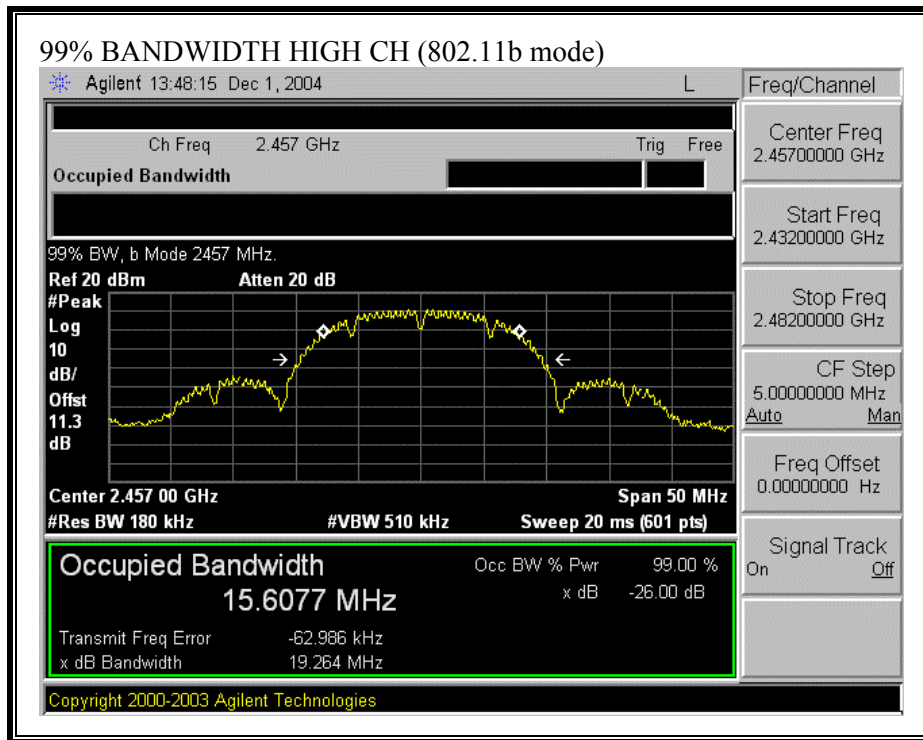
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Middle	2437	33.7235

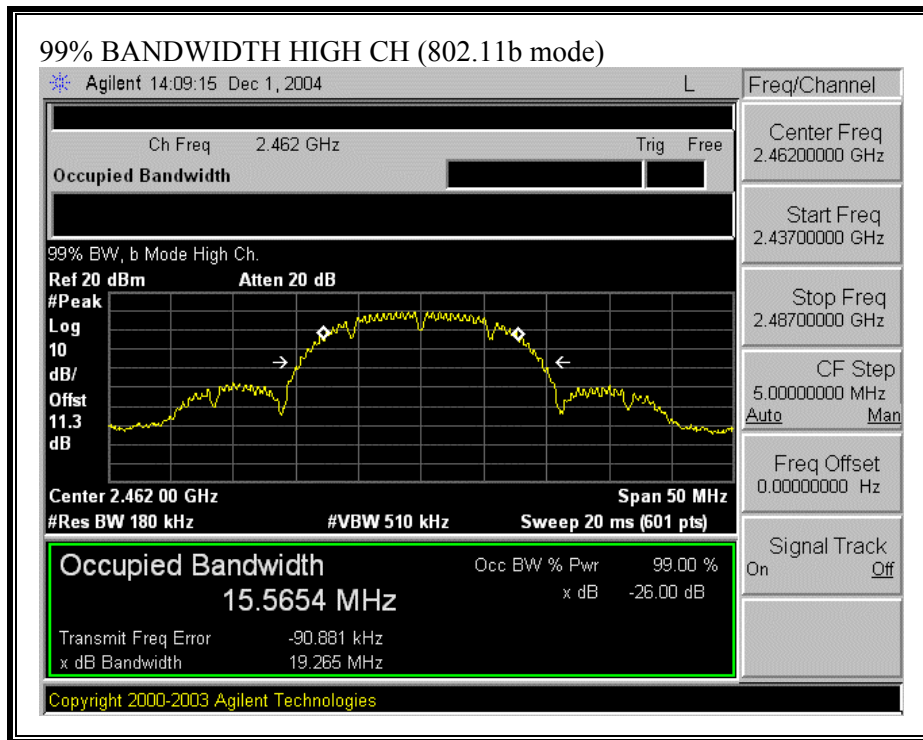
**99% BANDWIDTH (802.11b MODE)**



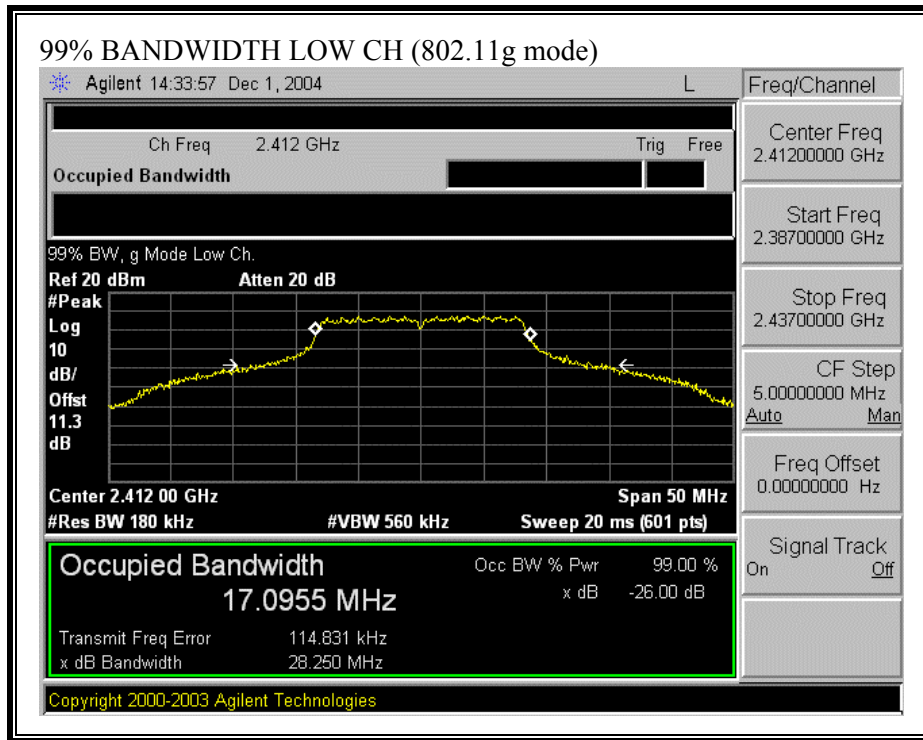


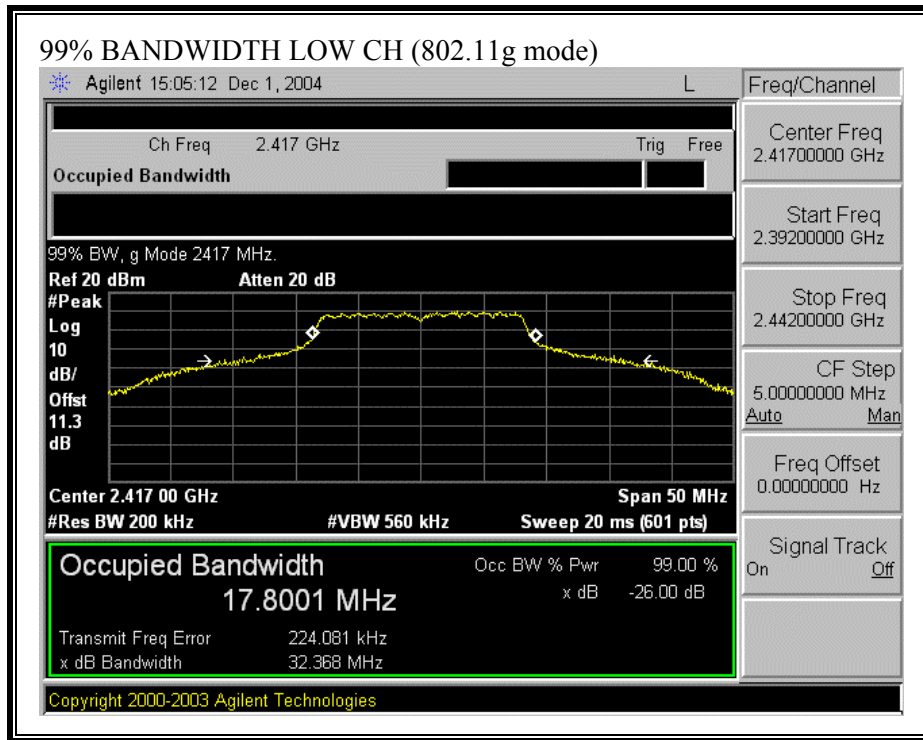




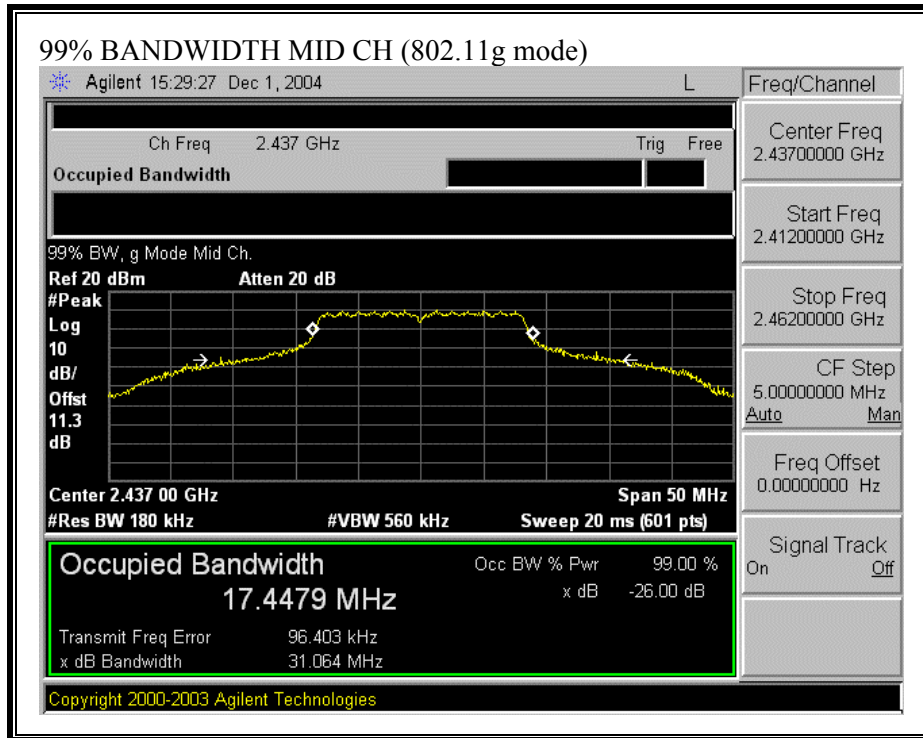


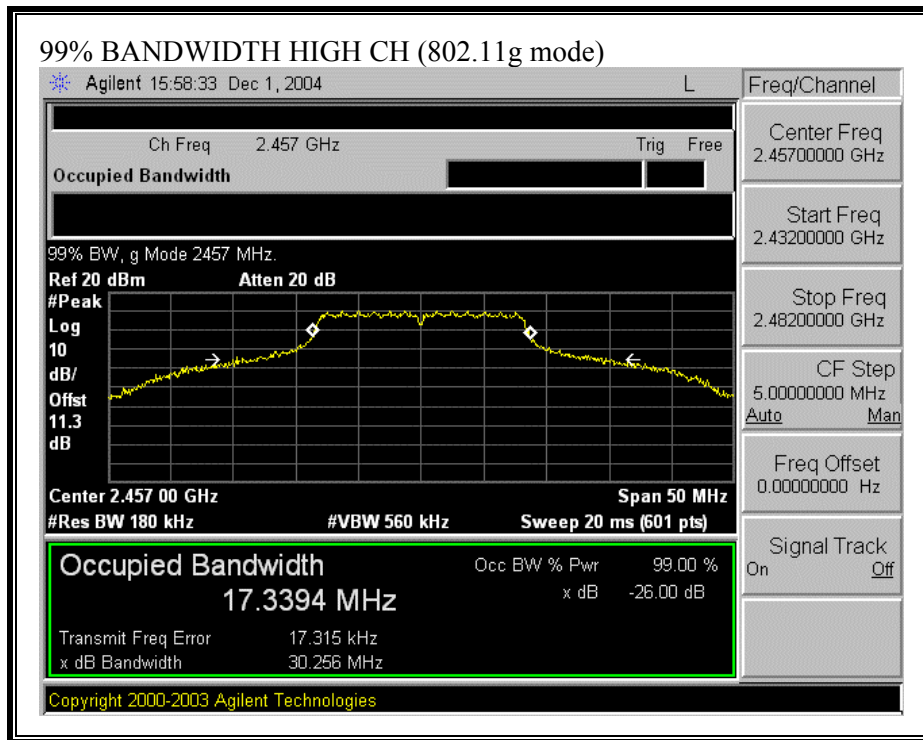
**99% BANDWIDTH (802.11g MODE)**

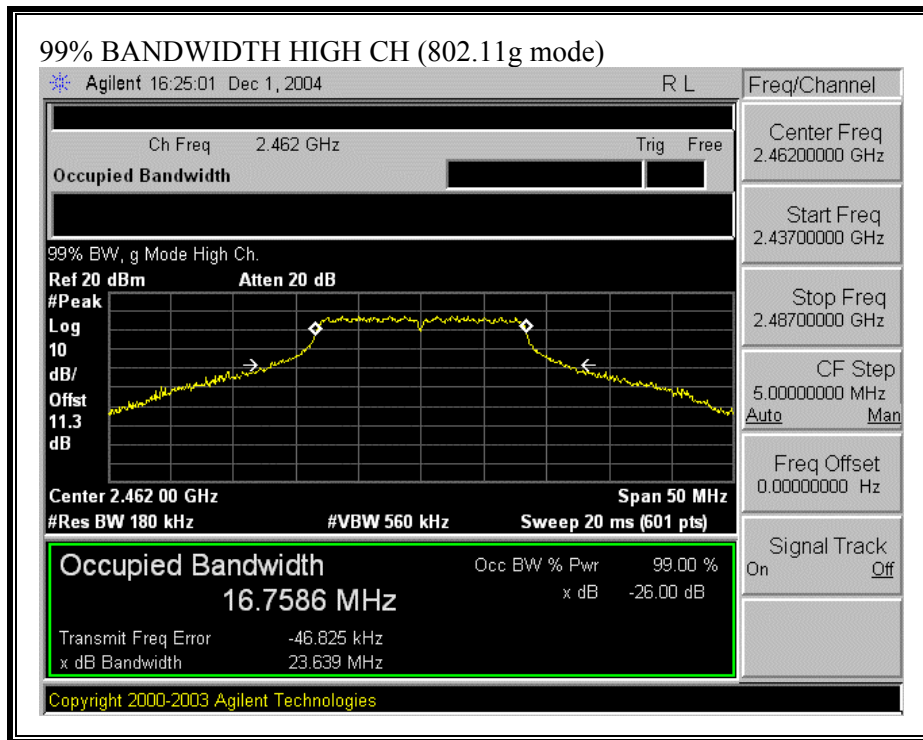




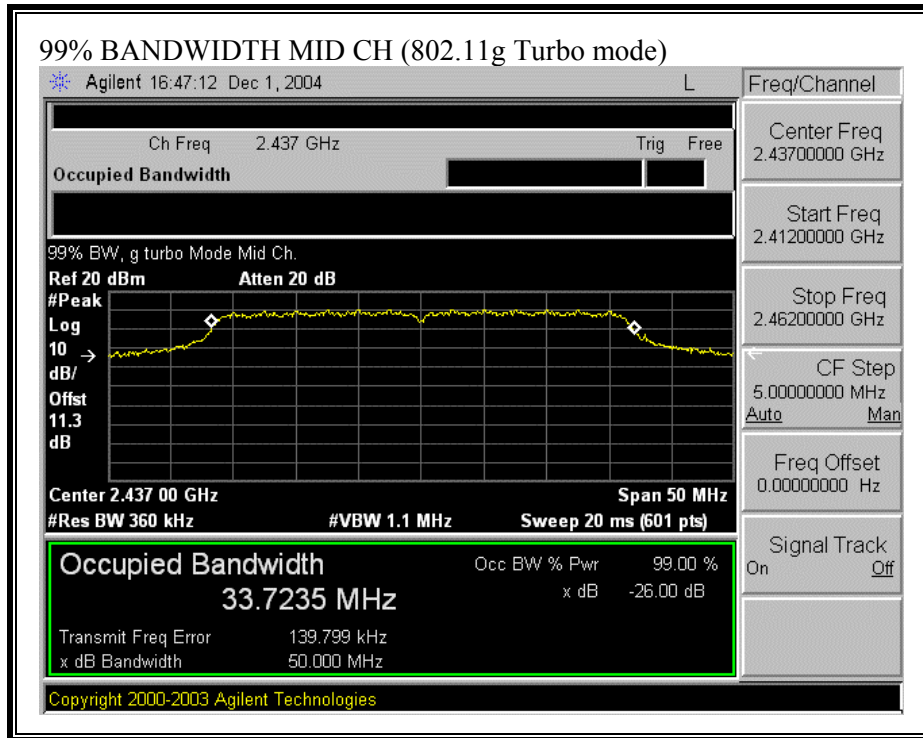








**99% BANDWIDTH (802.11g TURBO MODE)**



### **7.1.3. 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)(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.

#### **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 maximum antenna gain is 0 dBi for other than fixed, point-to-point operations, therefore the limit is 30 dBm.

No non-compliance noted:

### 802.11b Mode

<b>Channel</b>	<b>Frequency (MHz)</b>	<b>Peak Power (dBm)</b>	<b>Limit (dBm)</b>	<b>Margin (dB)</b>
Low	2412	22.92	30	-7.08
Low	2417	22.55	30	-7.45
Middle	2437	22.62	30	-7.38
High	2457	22.20	30	-7.80
High	2462	21.39	30	-8.61

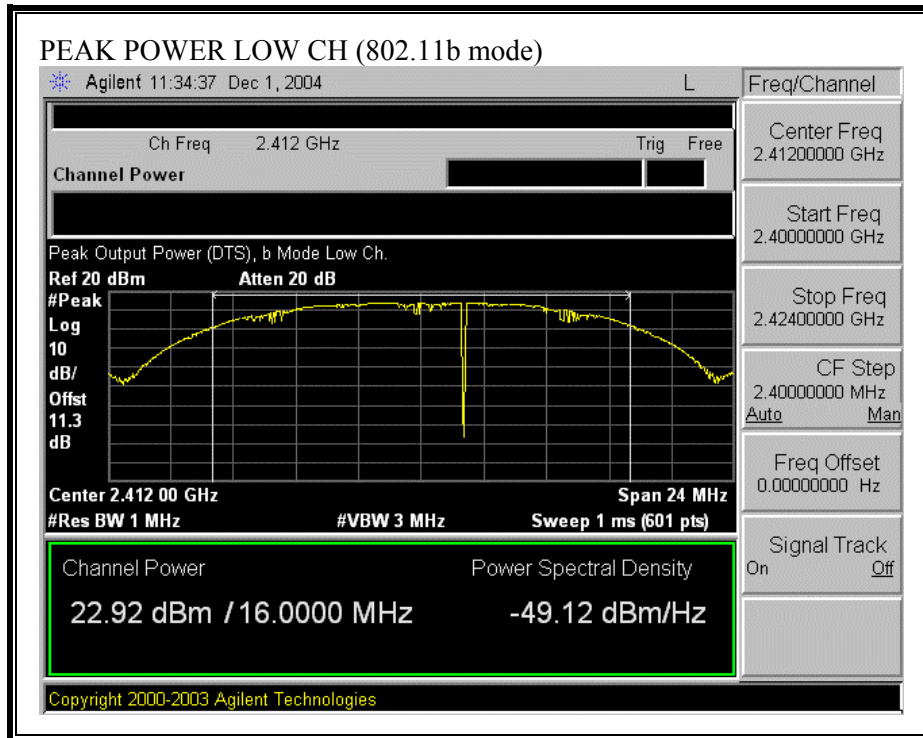
### 802.11g Mode

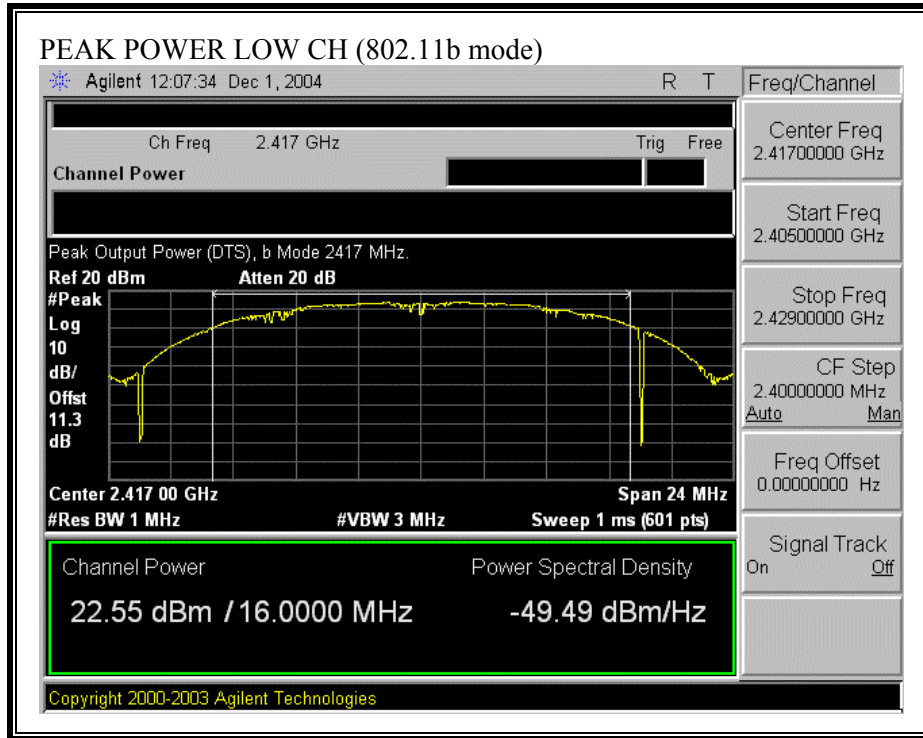
<b>Channel</b>	<b>Frequency (MHz)</b>	<b>Peak Power (dBm)</b>	<b>Limit (dBm)</b>	<b>Margin (dB)</b>
Low	2412	25.39	30	-4.61
Low	2417	25.94	30	-4.06
Middle	2437	26.37	30	-3.63
High	2457	26.41	30	-3.59
High	2462	25.51	30	-4.49

### 802.11g Turbo Mode

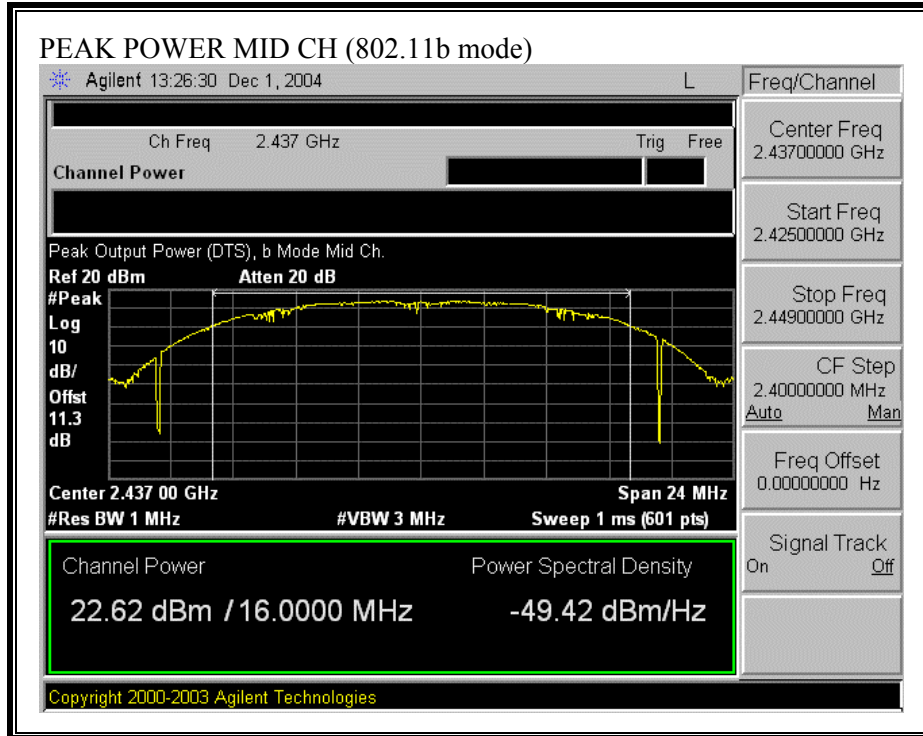
<b>Channel</b>	<b>Frequency (MHz)</b>	<b>Peak Power (dBm)</b>	<b>Limit (dBm)</b>	<b>Margin (dB)</b>
Middle	2437	25.14	30	-4.86

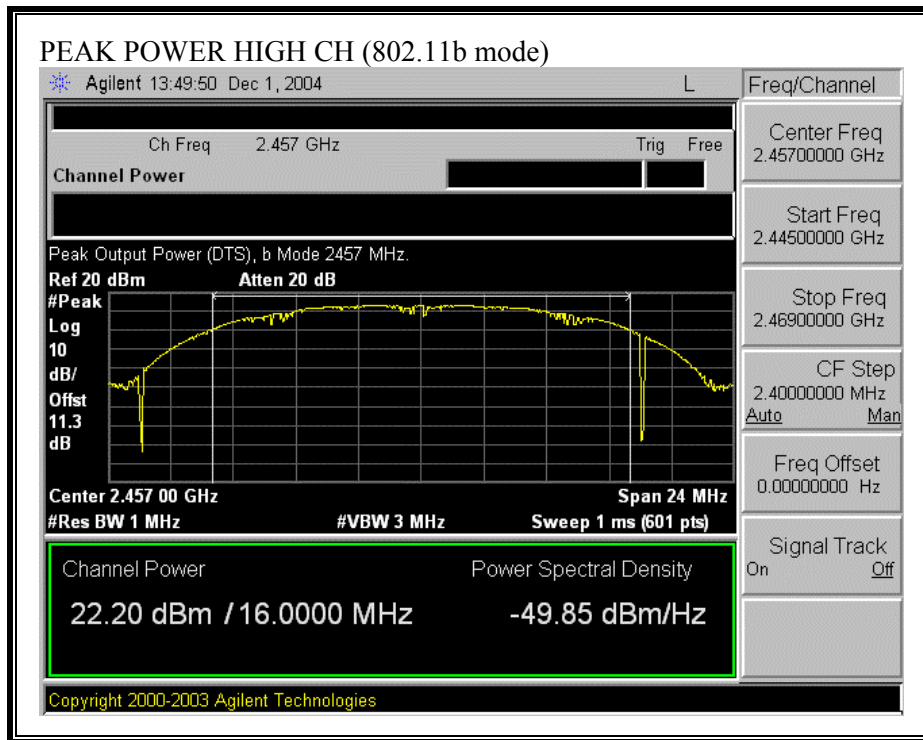
**OUTPUT POWER (802.11b MODE)**

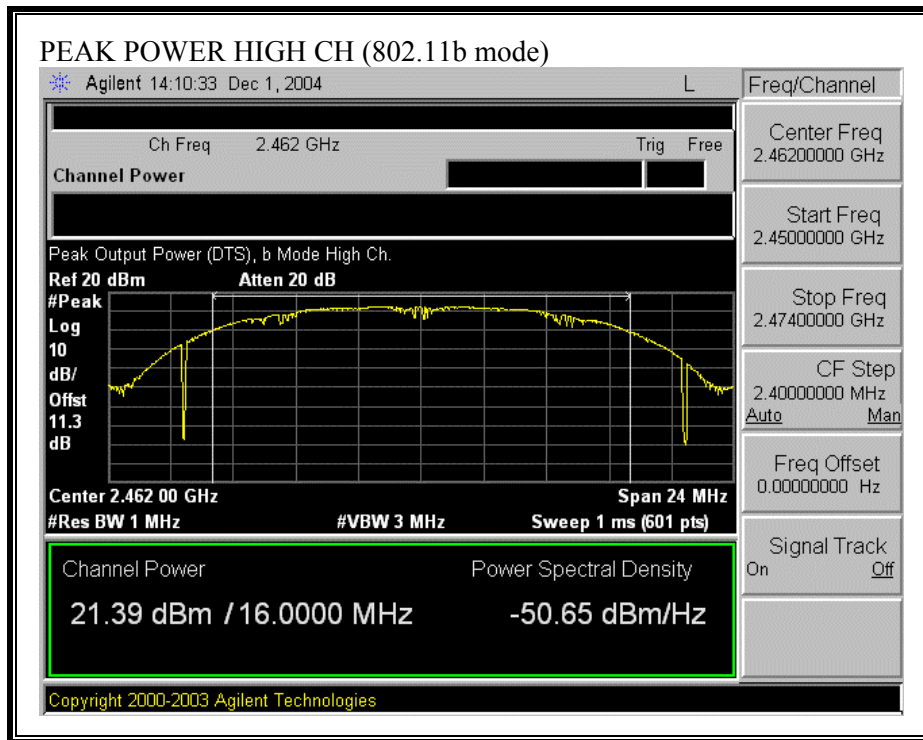




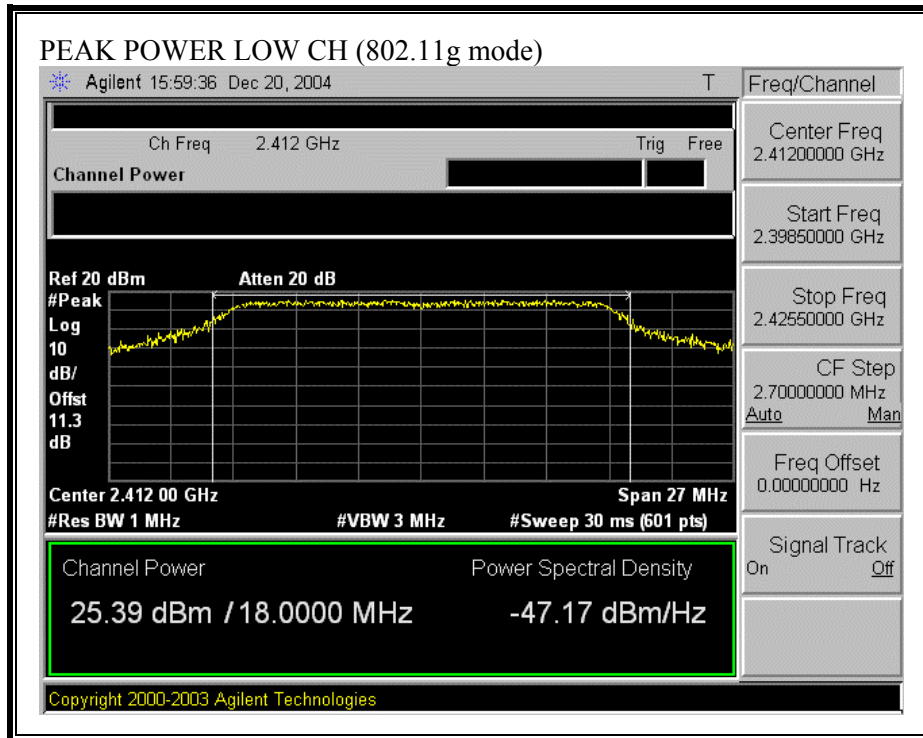


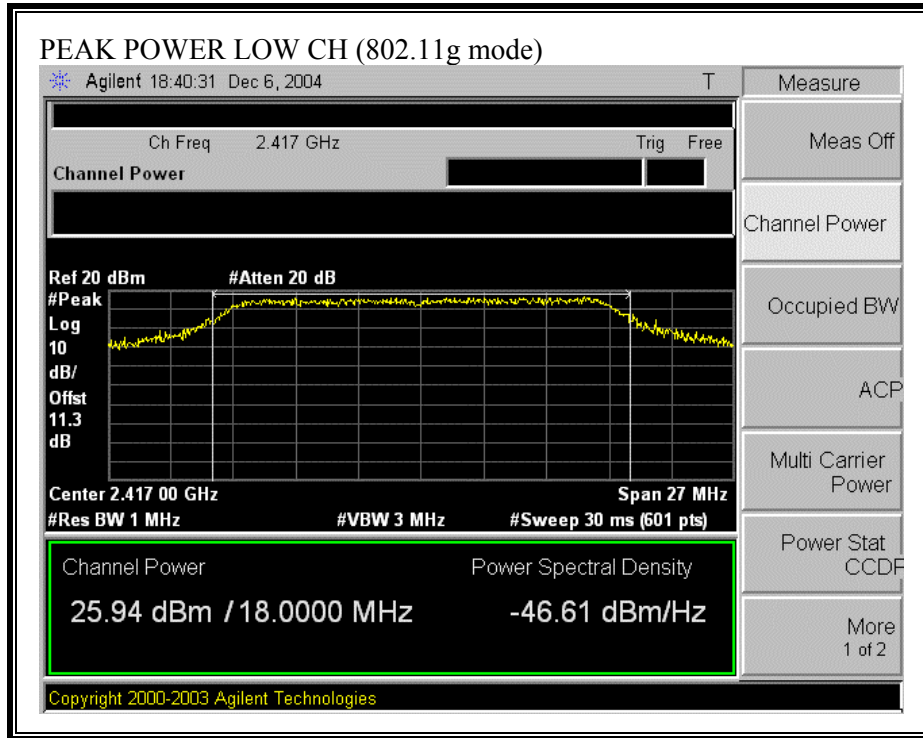


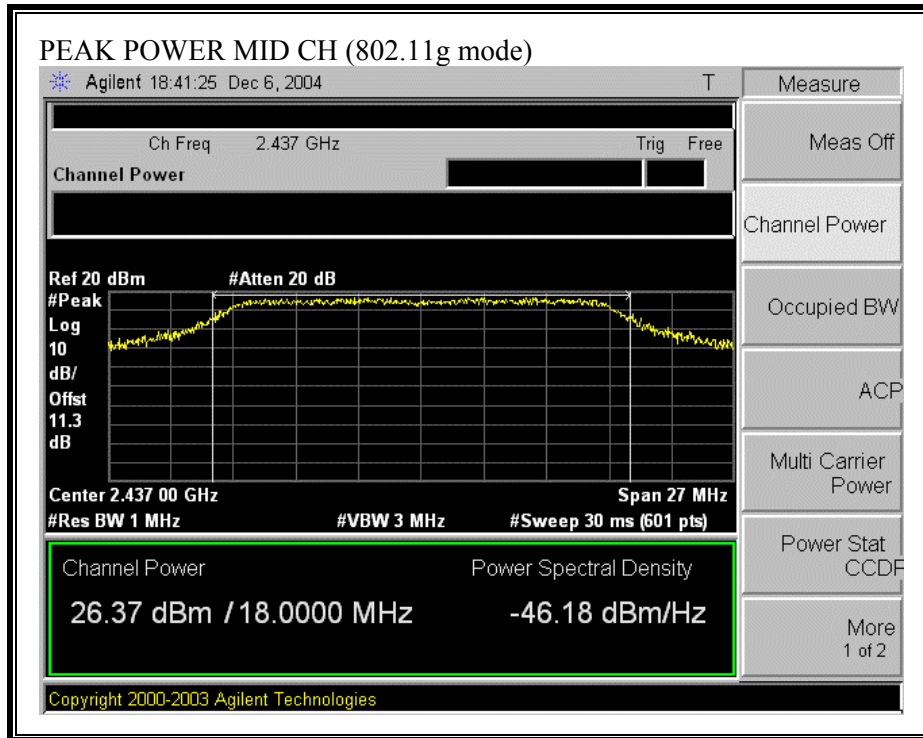


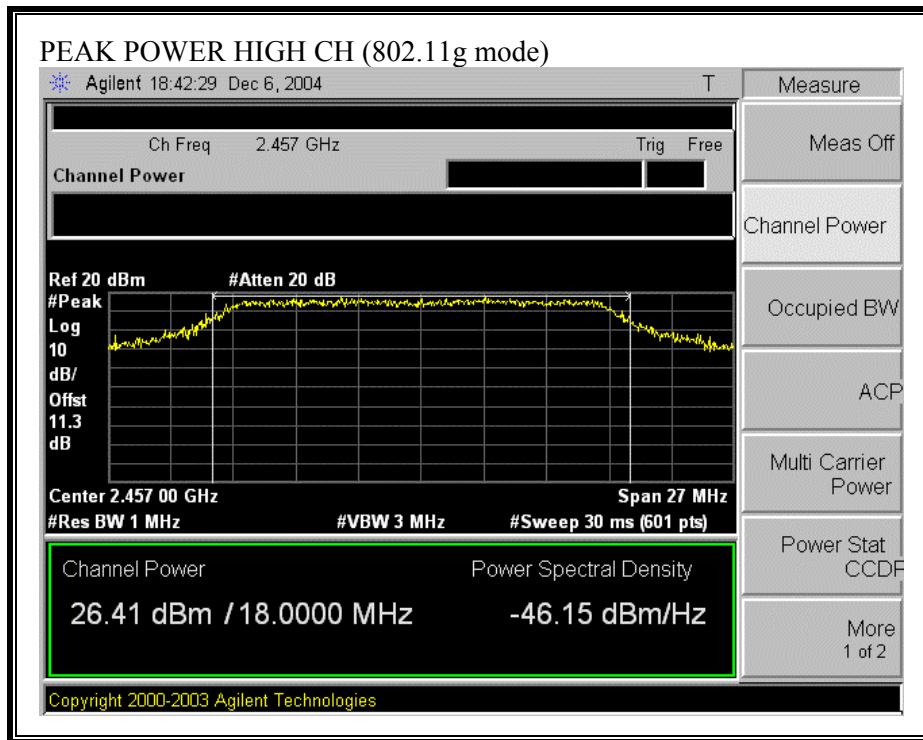


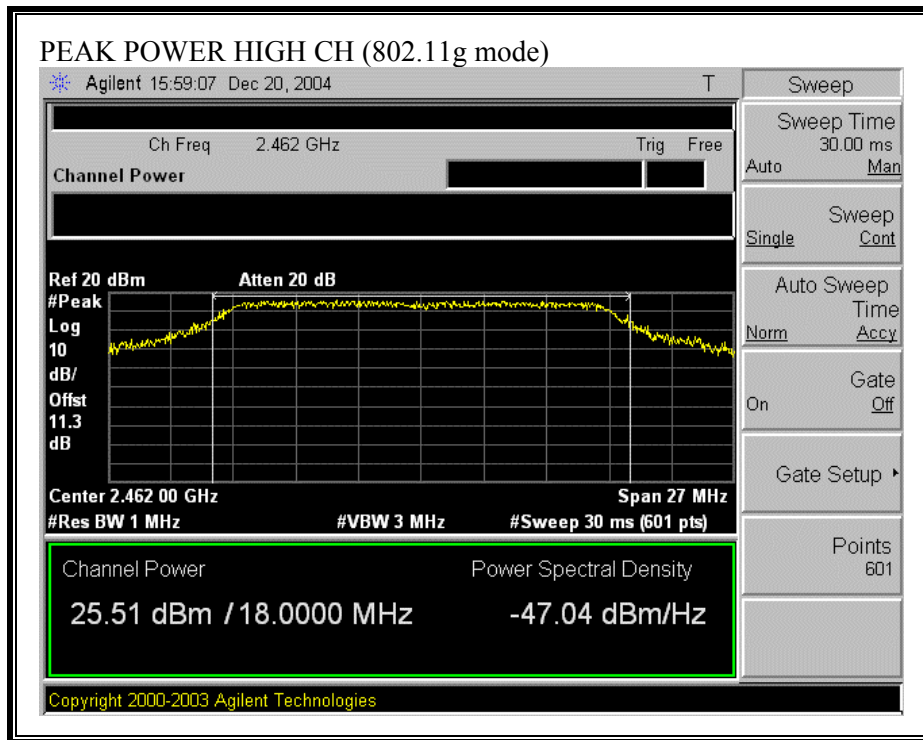
**OUTPUT POWER (802.11g MODE)**





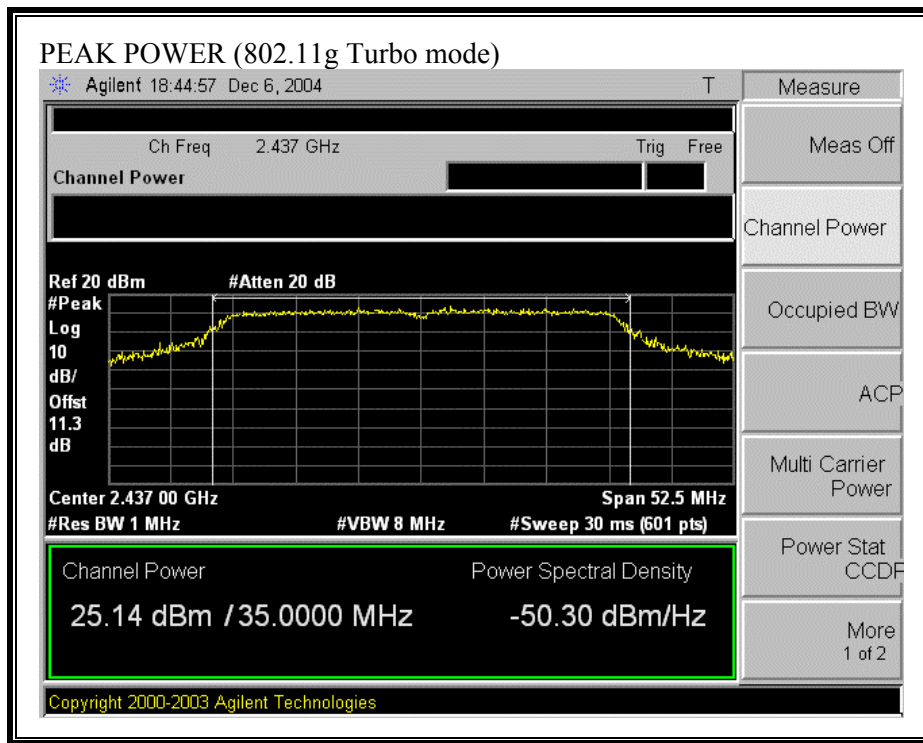








**OUTPUT POWER (802.11g TURBO MODE)**



### 7.1.4. 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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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/cm<sup>2</sup>

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/cm<sup>2</sup>

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

**LIMITS**

From §1.1310 Table 1 (B),  $S = 1.0 \text{ mW/cm}^2$

**RESULTS**

No non-compliance noted:

<b>Mode</b>	<b>Power Density Limit (mW/cm<sup>2</sup>)</b>	<b>Output Power (dBm)</b>	<b>Antenna Gain (dBi)</b>	<b>MPE Distance (cm)</b>
802.11b	1.0	22.92	0.00	3.95
802.11g	1.0	26.41	0.00	5.90
802.11g Turbo	1.0	25.15	0.00	5.10

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.

### 7.1.5. 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 11.3 dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

##### 802.11b Mode

Channel	Frequency (MHz)	Power (dBm)
Low	2412	20.3
Low	2417	20.1
Middle	2437	19.7
High	2457	19.6
High	2462	18.6

##### 802.11g Mode

Channel	Frequency (MHz)	Power (dBm)
Low	2412	18.4
Low	2417	19.3
Middle	2437	19.3
High	2457	19.4
High	2462	18.7

##### 802.11g Turbo Mode

Channel	Frequency (MHz)	Power (dBm)
Middle	2437	19.0

## 7.1.6. 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	-3.33	8	-11.33
Low	2417	-4.25	8	-12.25
Middle	2437	-3.86	8	-11.86
High	2457	-4.38	8	-12.38
High	2462	-5.00	8	-13.00

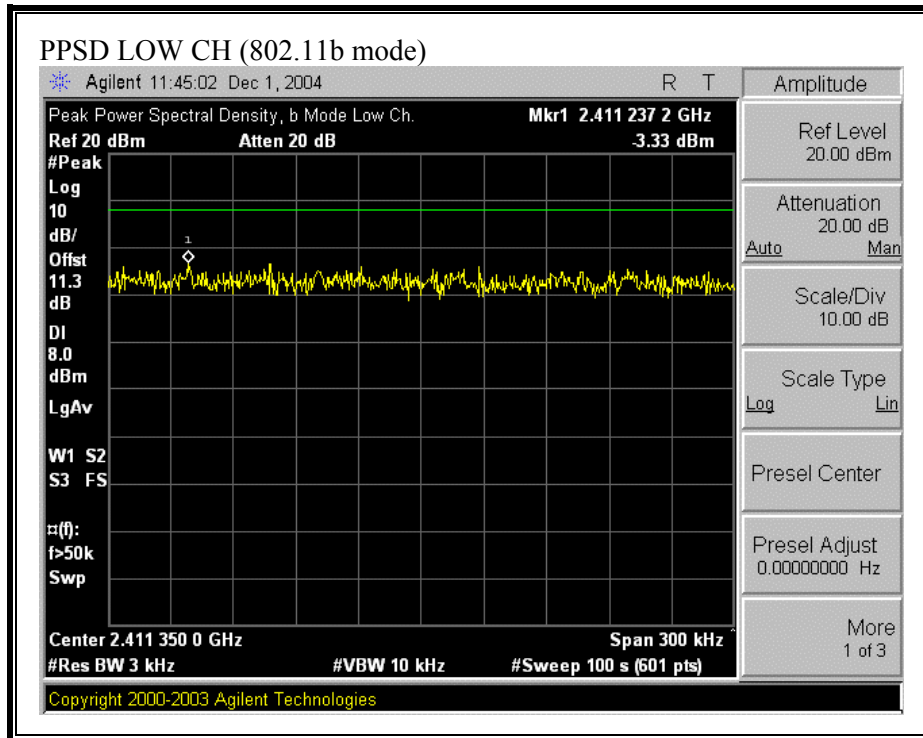
802.11g Mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-5.07	8	-13.07
Low	2417	-4.93	8	-12.93
Middle	2437	-3.82	8	-11.82
High	2457	-7.03	8	-15.03
High	2462	-5.38	8	-13.38

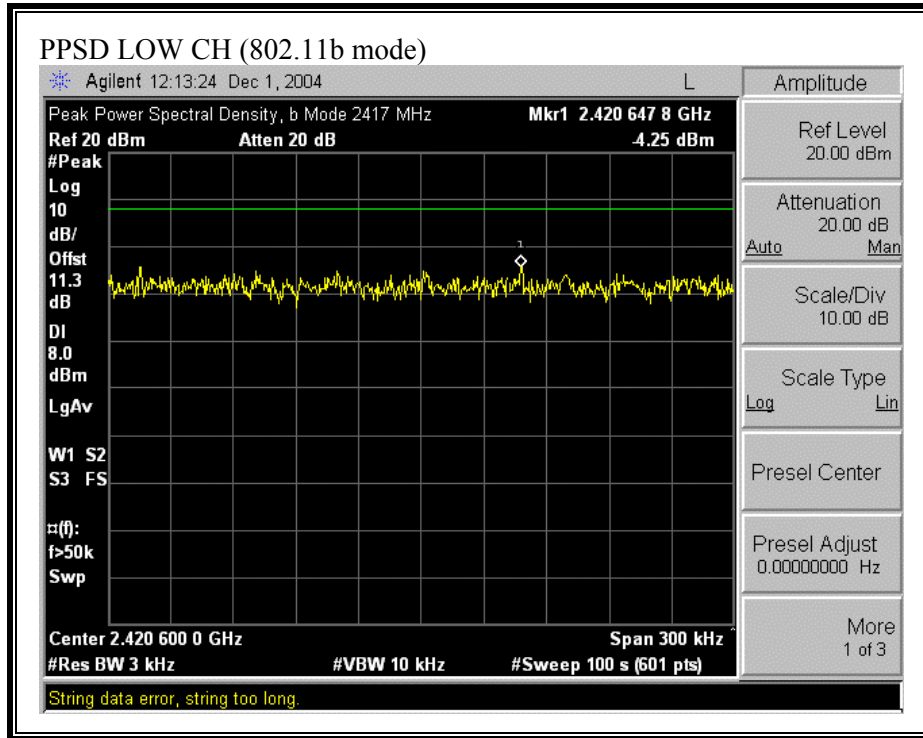
802.11g Turbo Mode

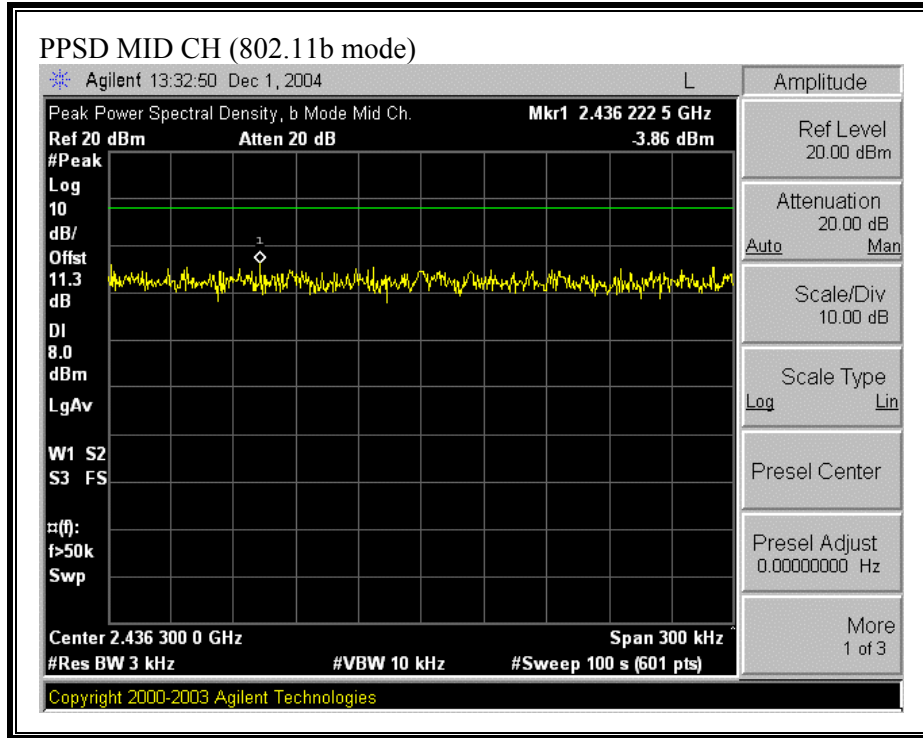
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Middle	2437	-9.44	8	-17.44

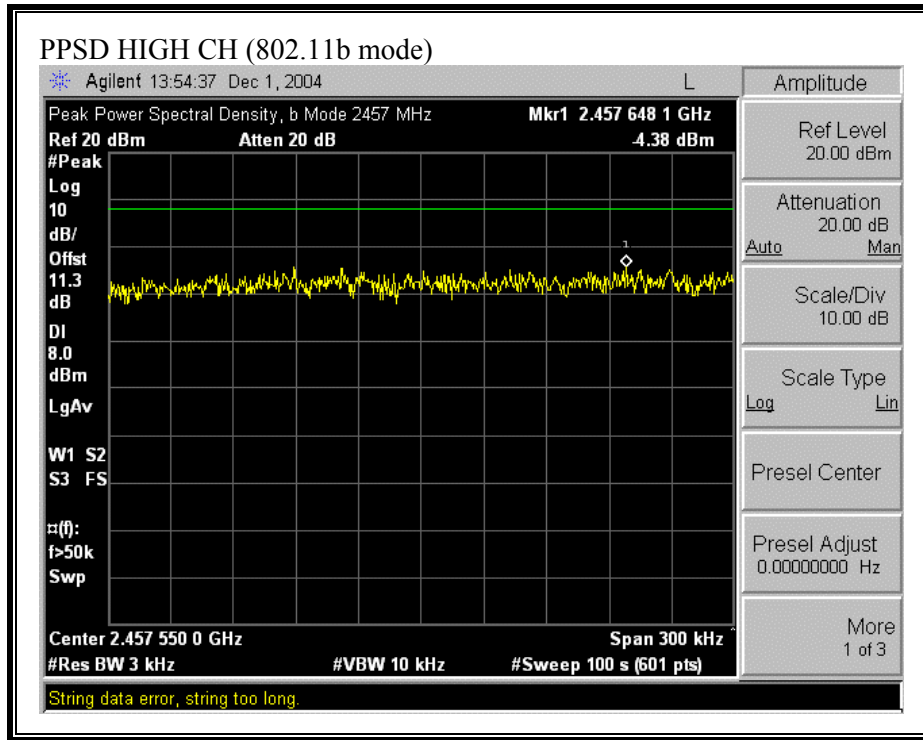
**PEAK POWER SPECTRAL DENSITY (802.11b MODE)**

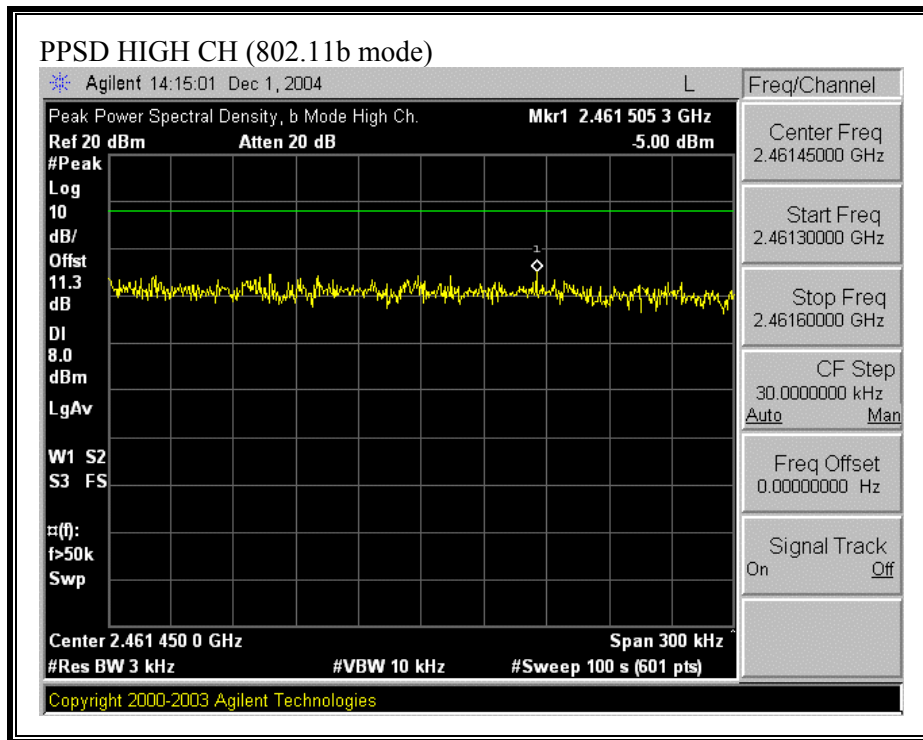




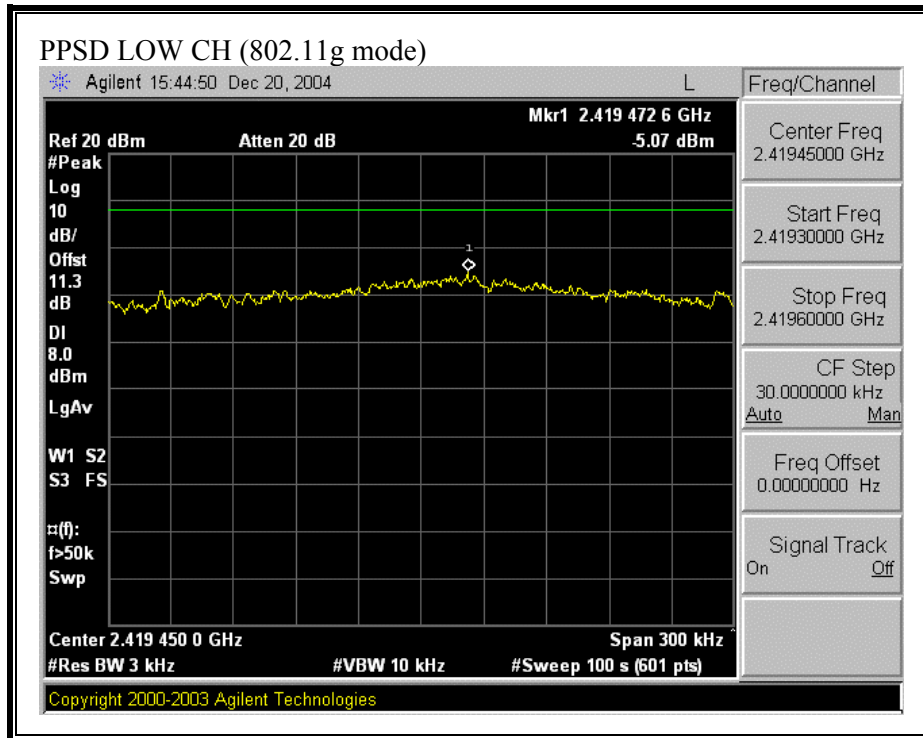


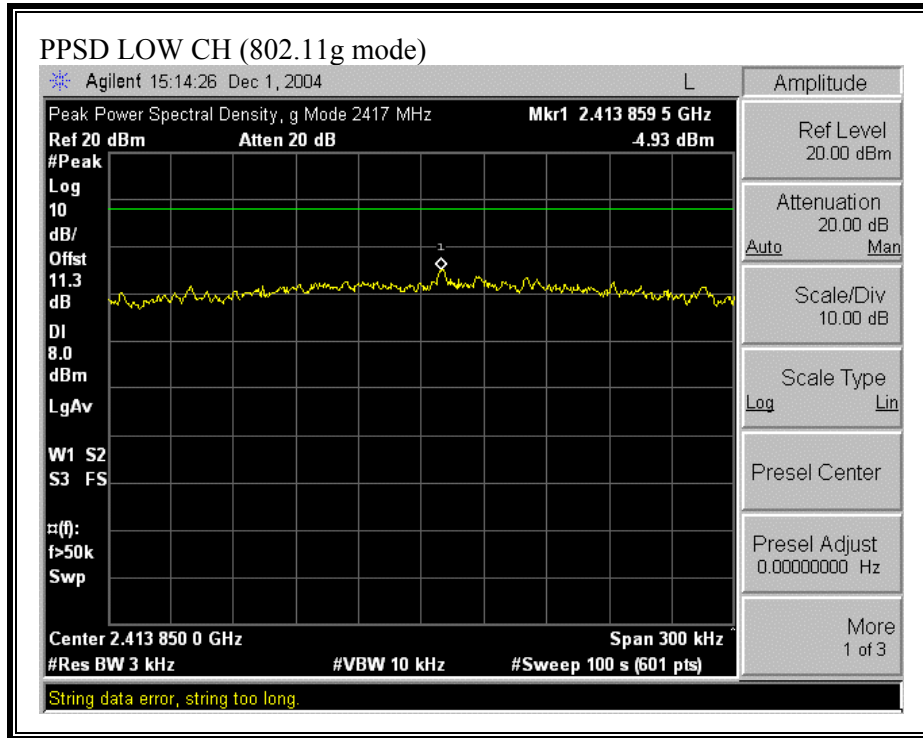


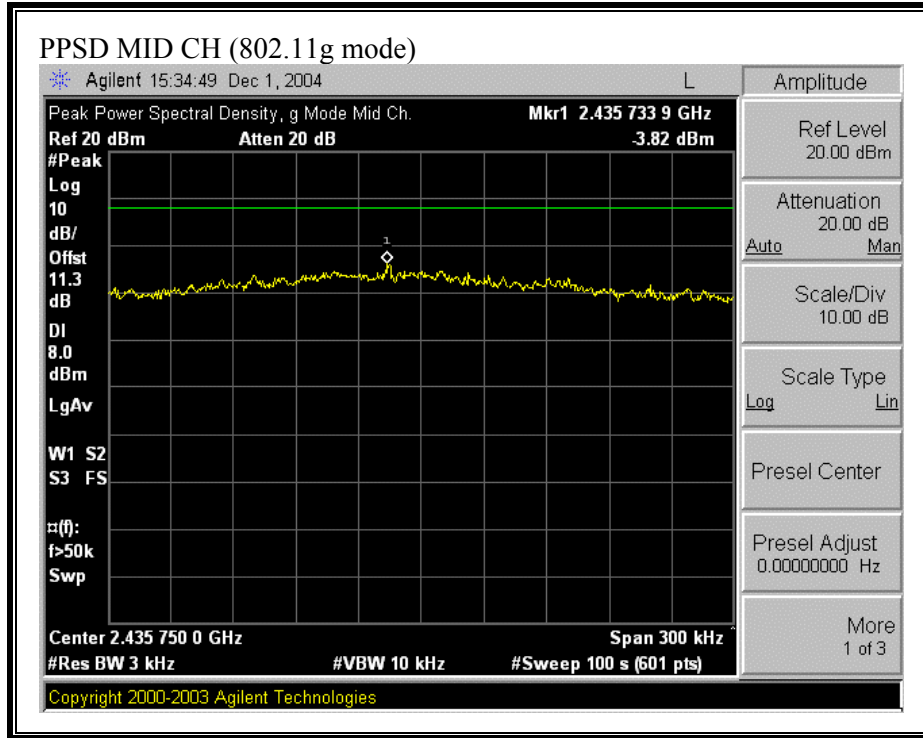


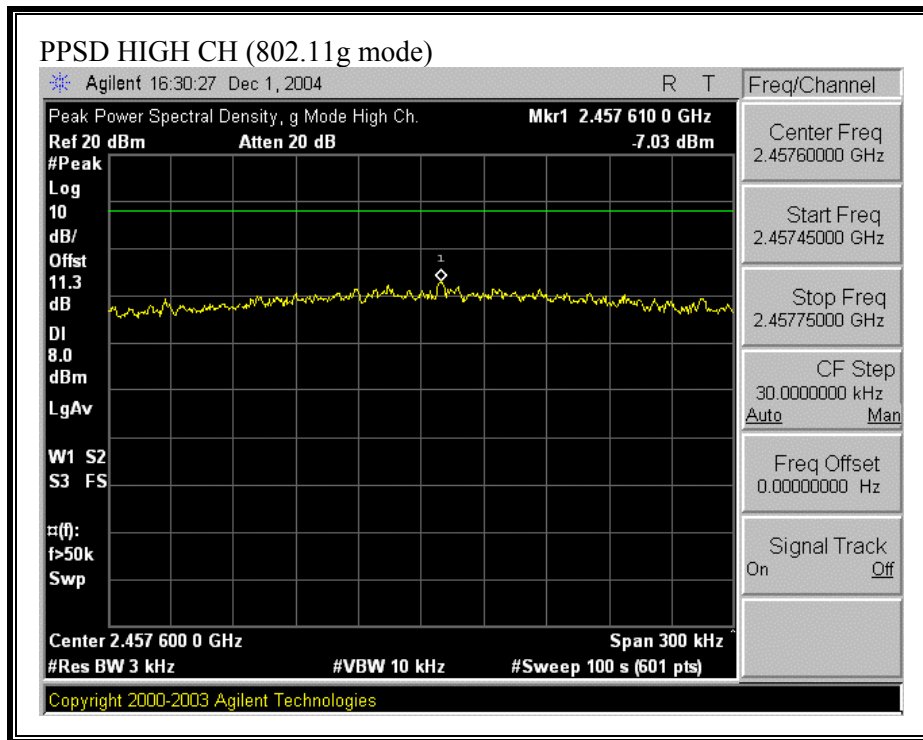


**PEAK POWER SPECTRAL DENSITY (802.11g MODE)**

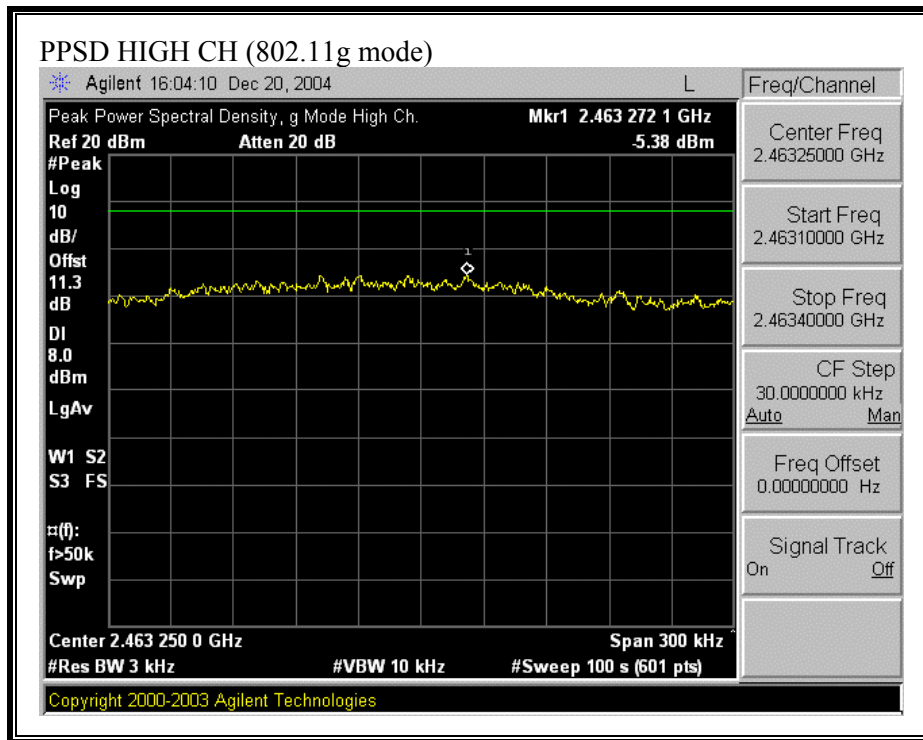




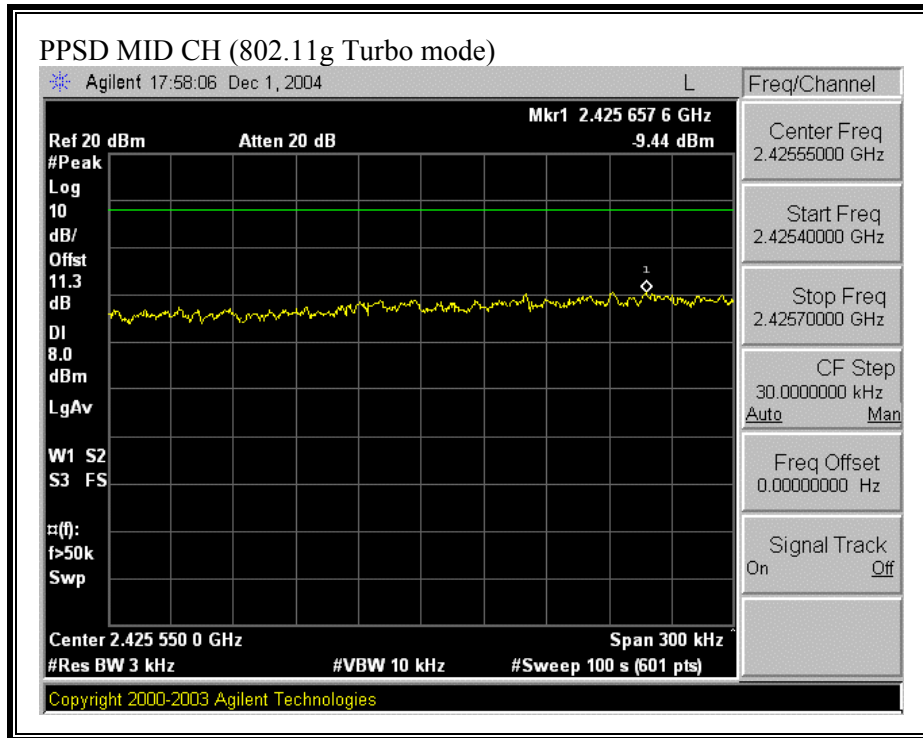








**PEAK POWER SPECTRAL DENSITY (802.11g TURBO MODE)**



## 7.1.7. 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

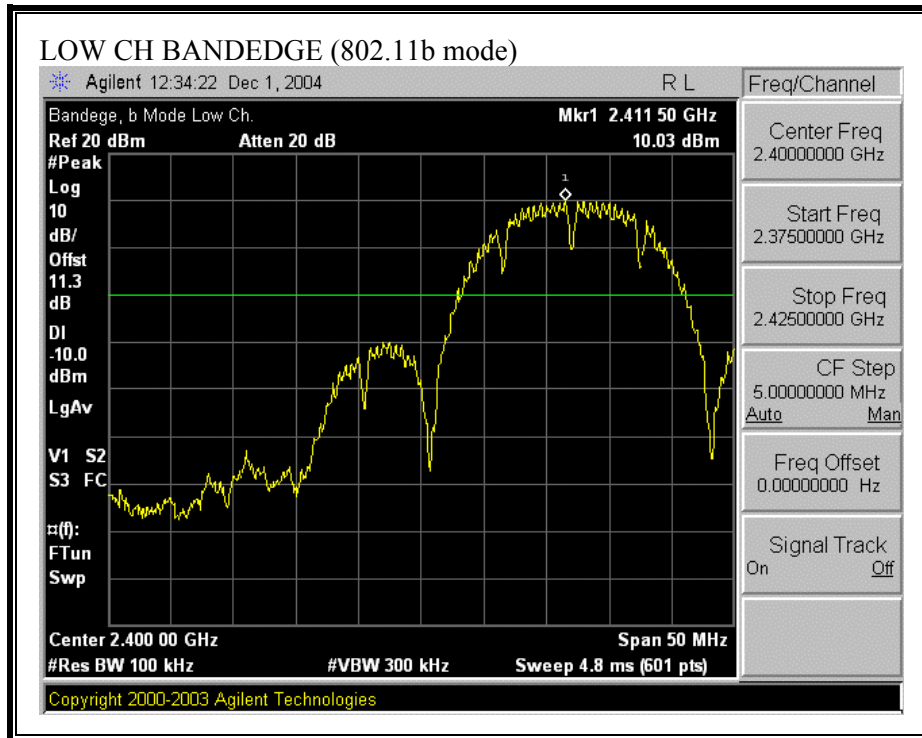
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

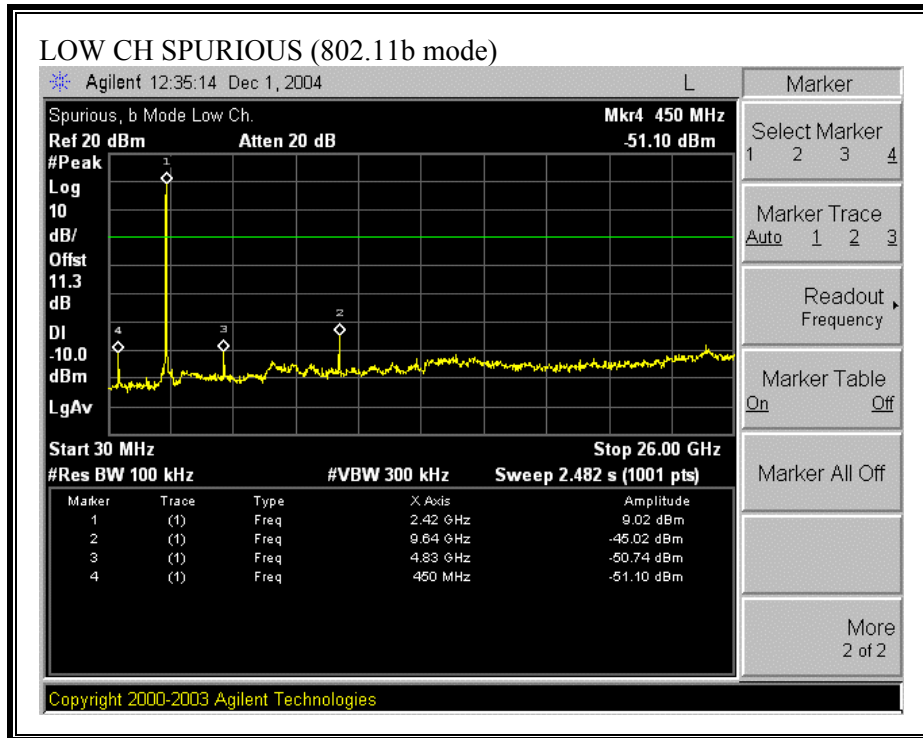
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

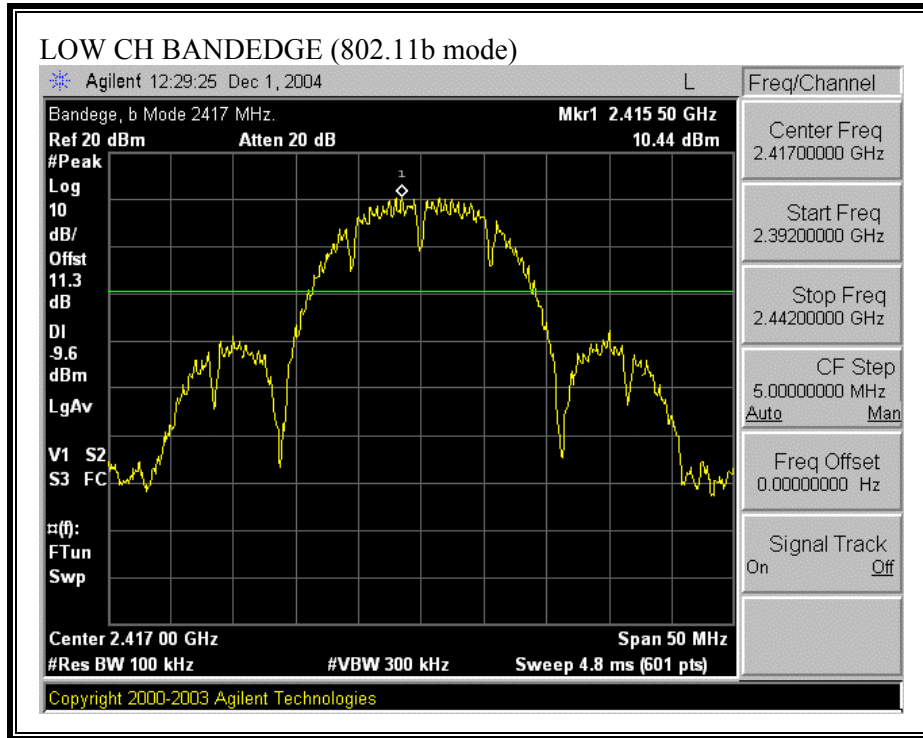
### RESULTS

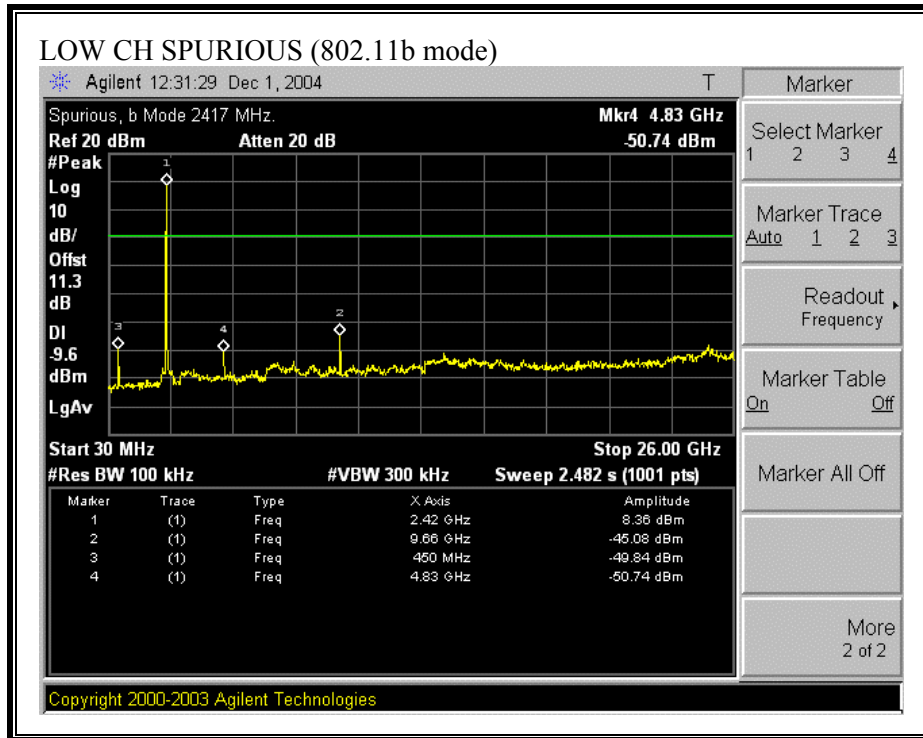
No non-compliance noted:

**SPURIOUS EMISSIONS, LOW CHANNEL (802.11b MODE)**

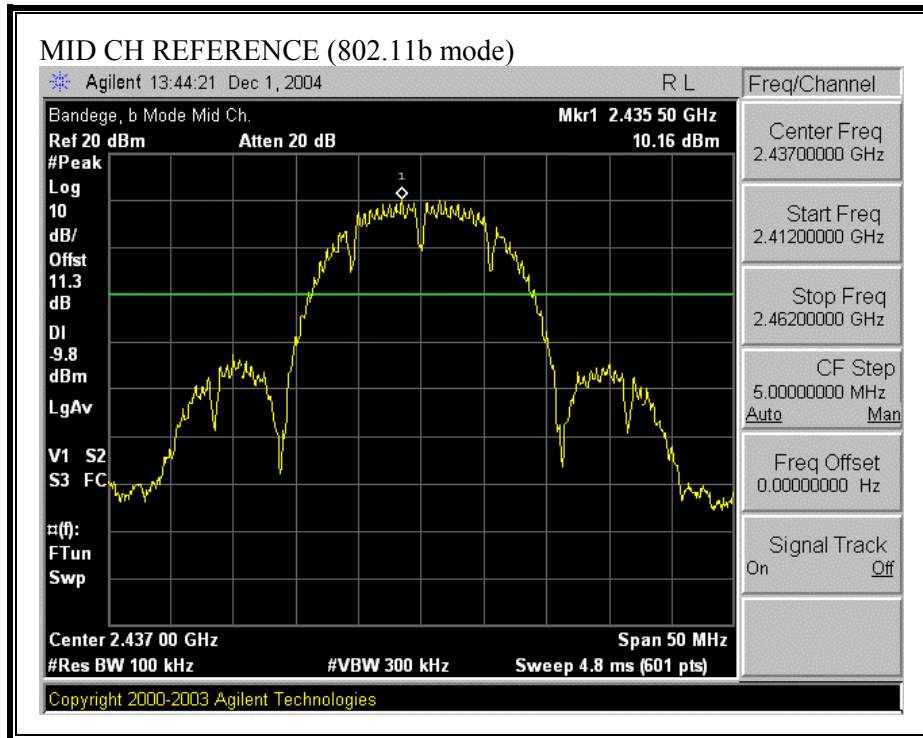




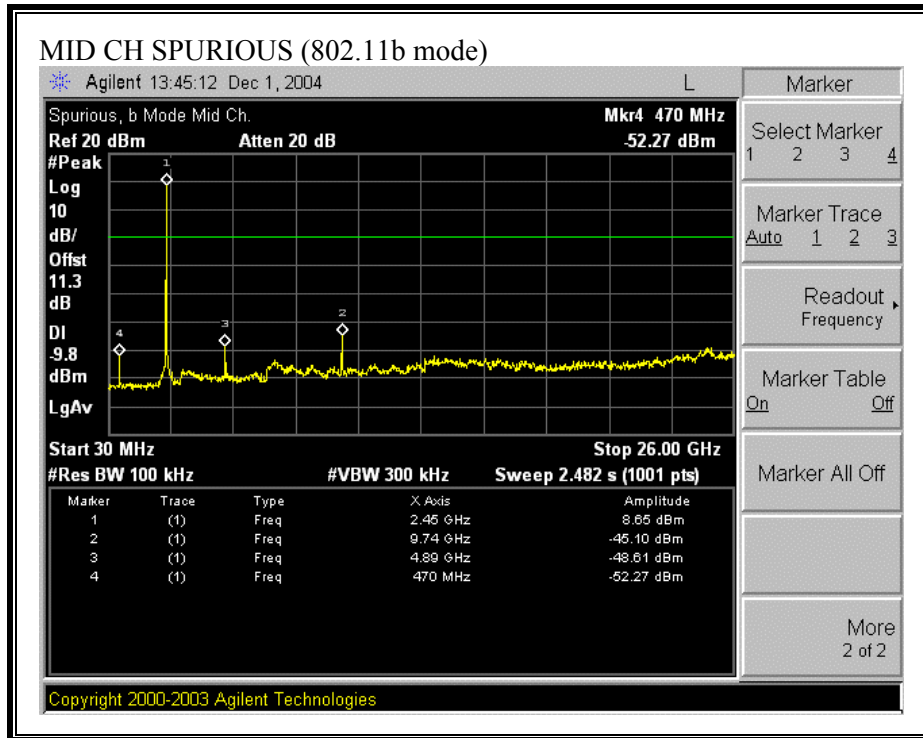




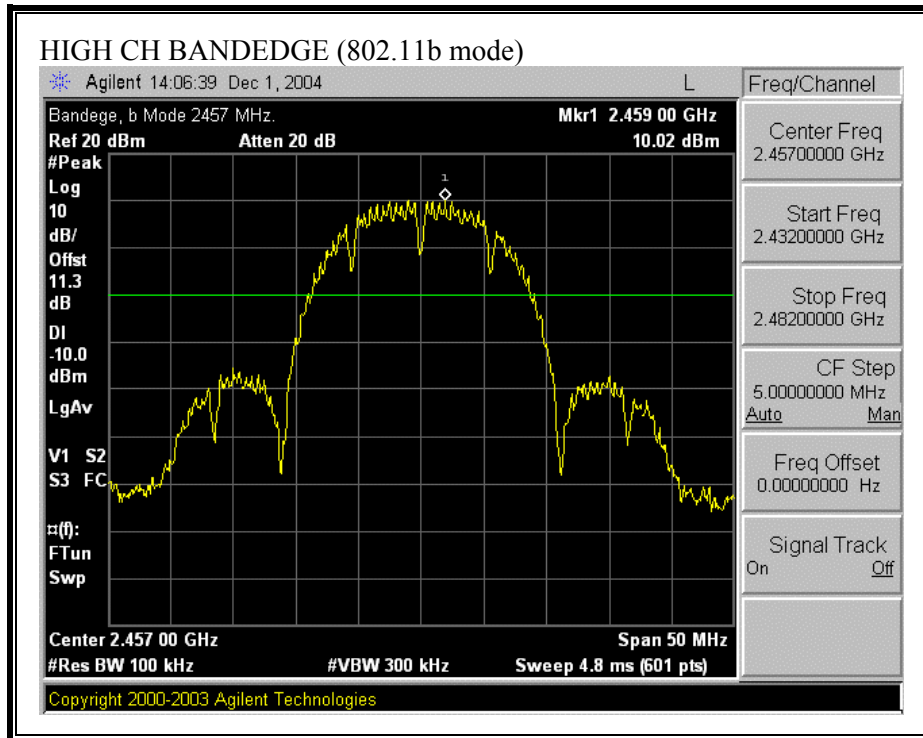
**SPURIOUS EMISSIONS, MID CHANNEL (802.11b MODE)**

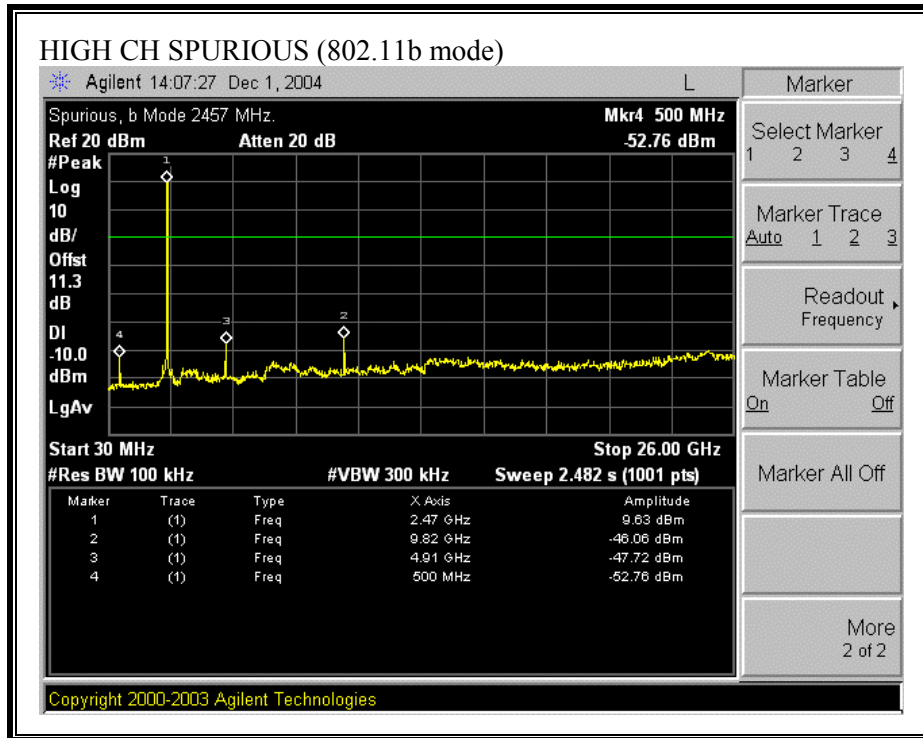


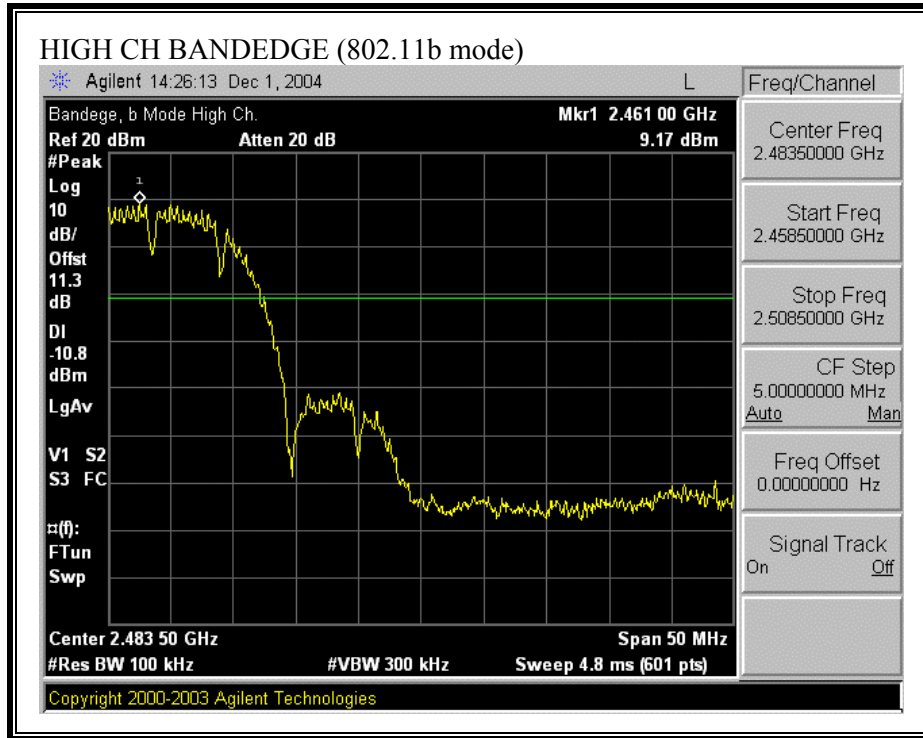


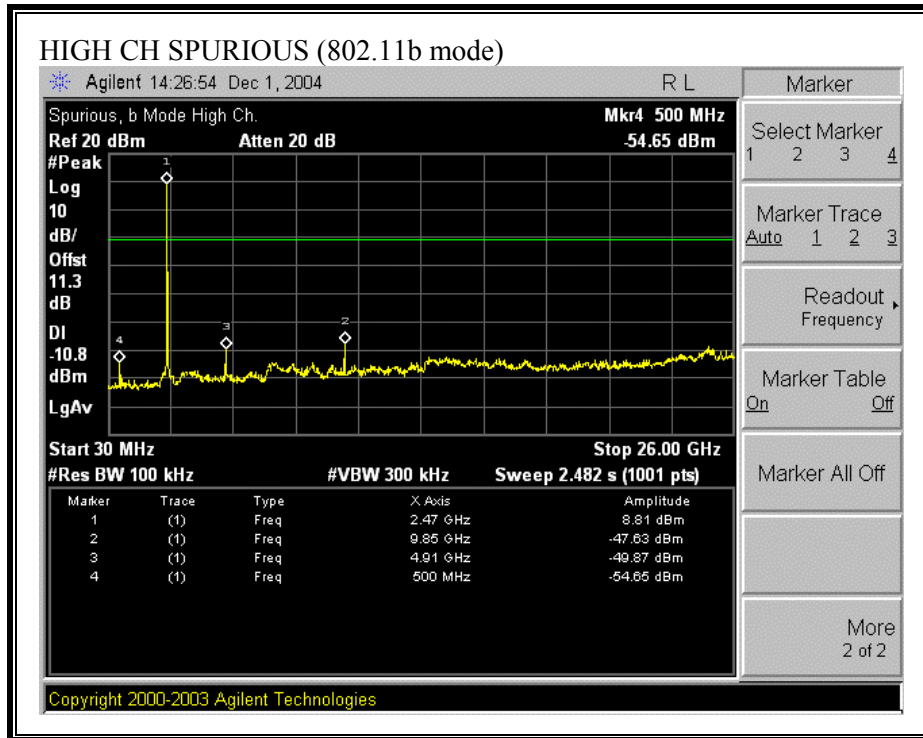


**SPURIOUS EMISSIONS, HIGH CHANNEL (802.11b MODE)**

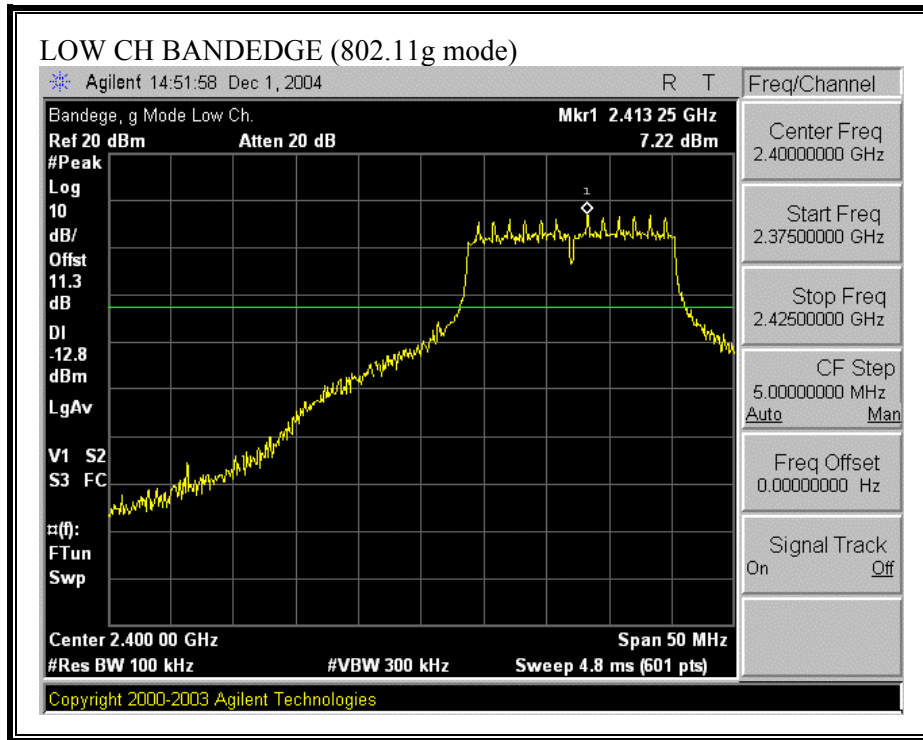


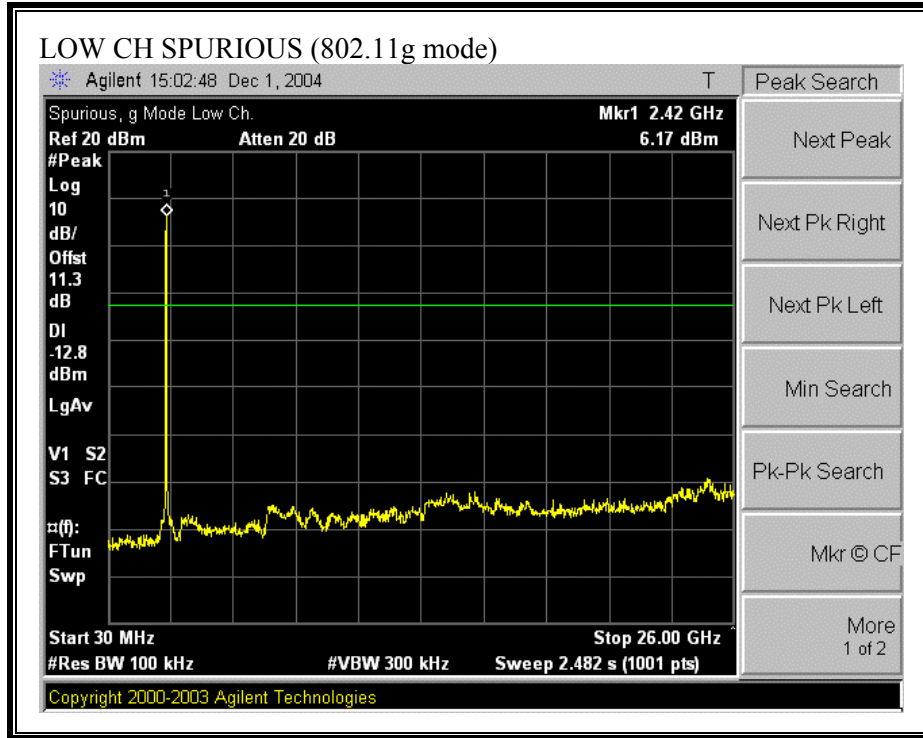


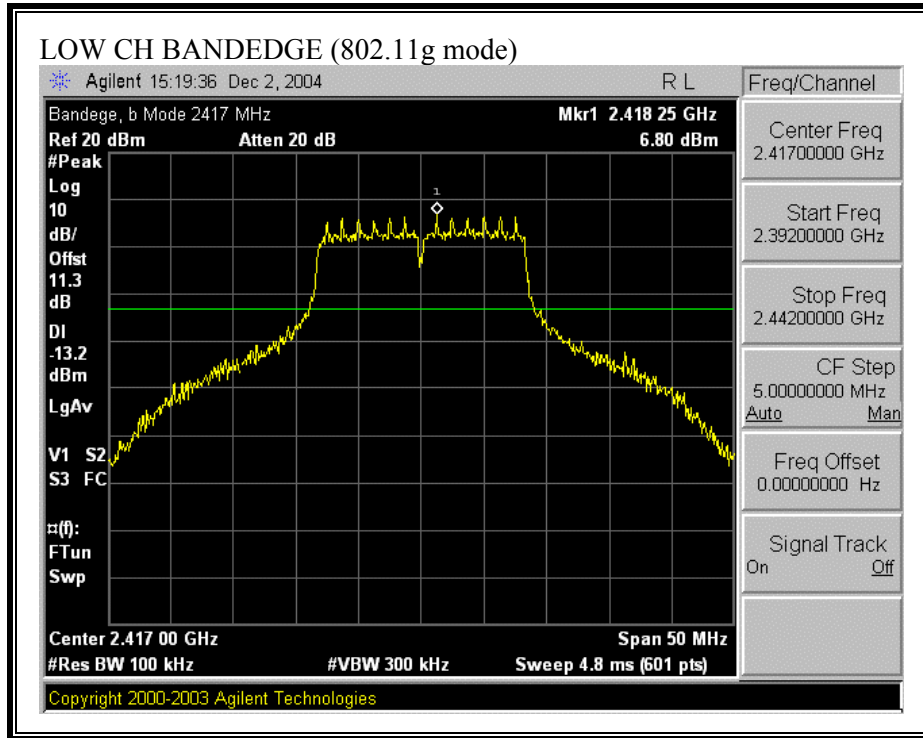




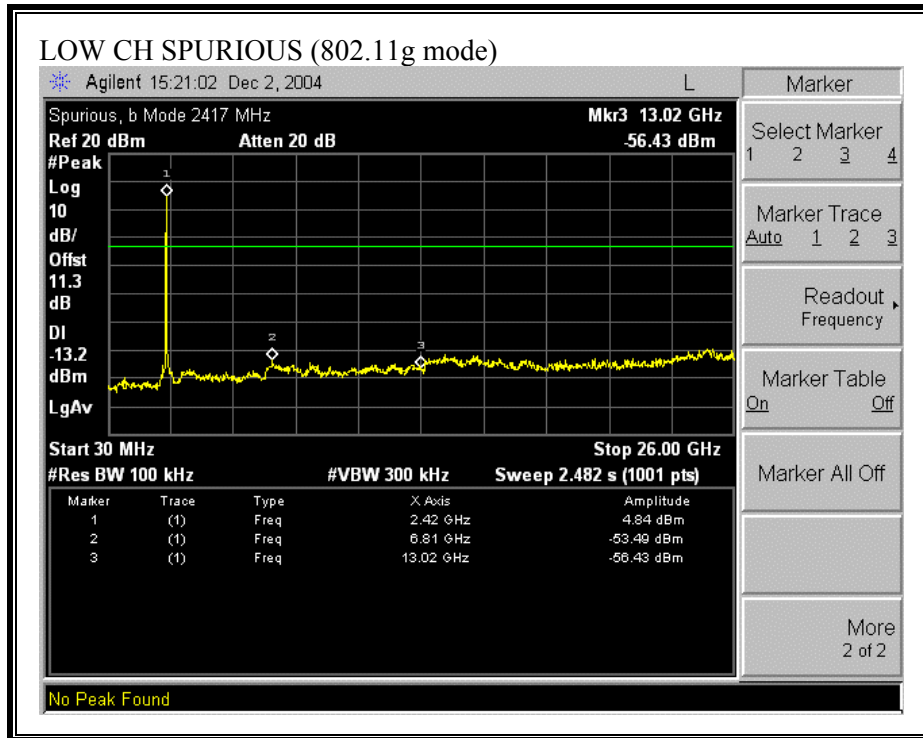
**SPURIOUS EMISSIONS, LOW CHANNEL (802.11g MODE)**



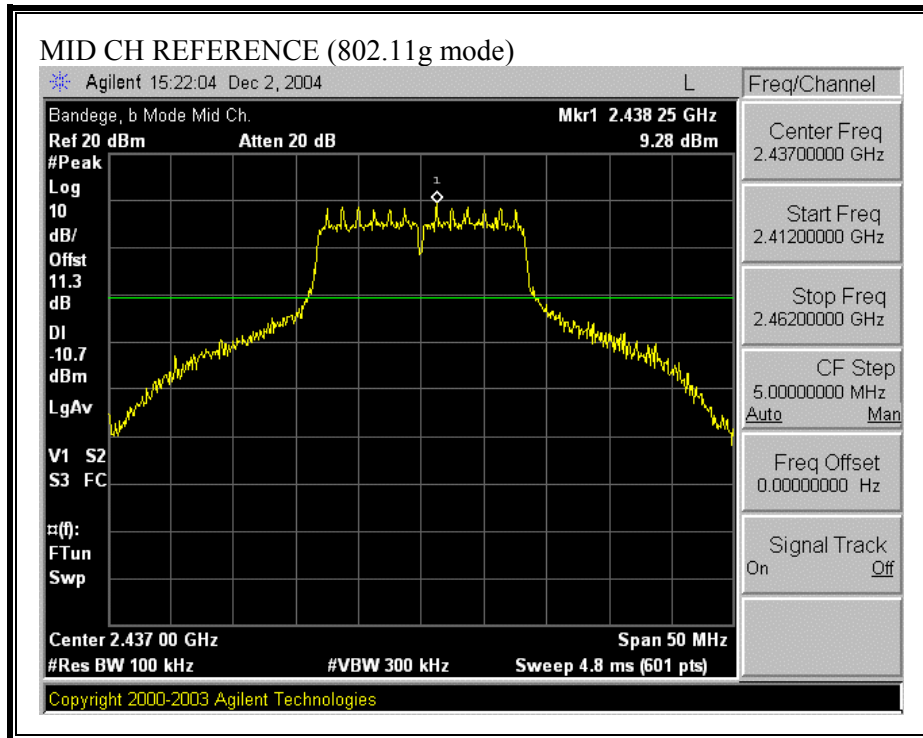


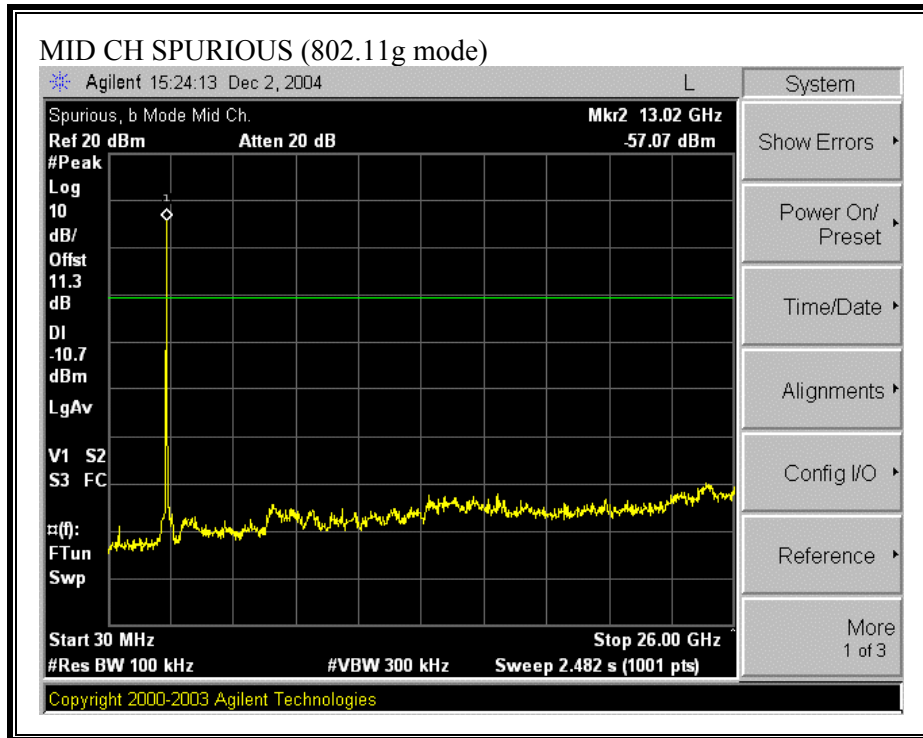




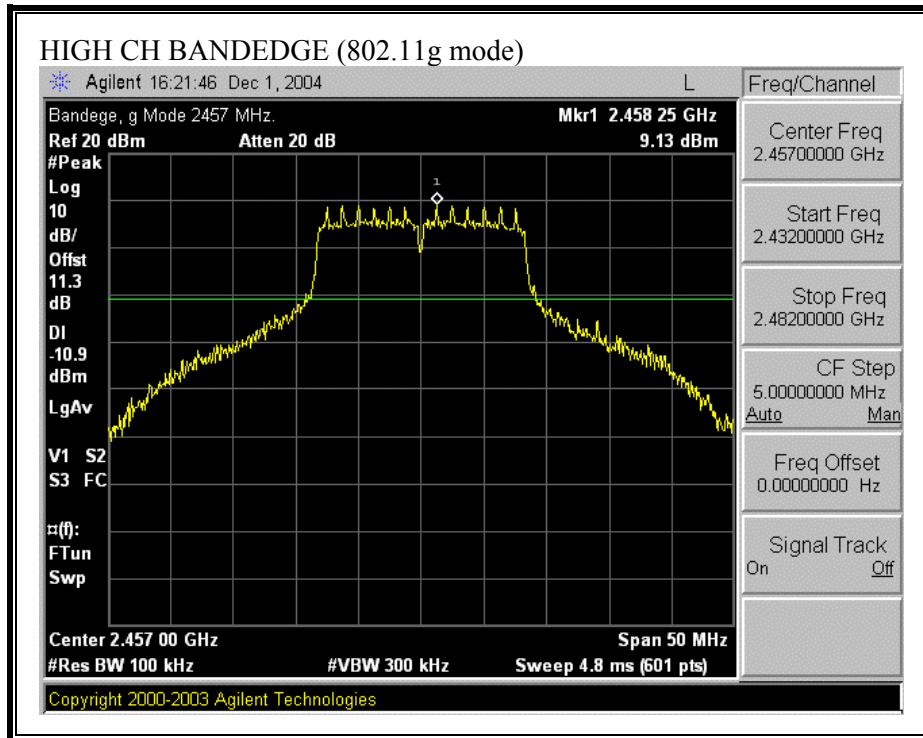


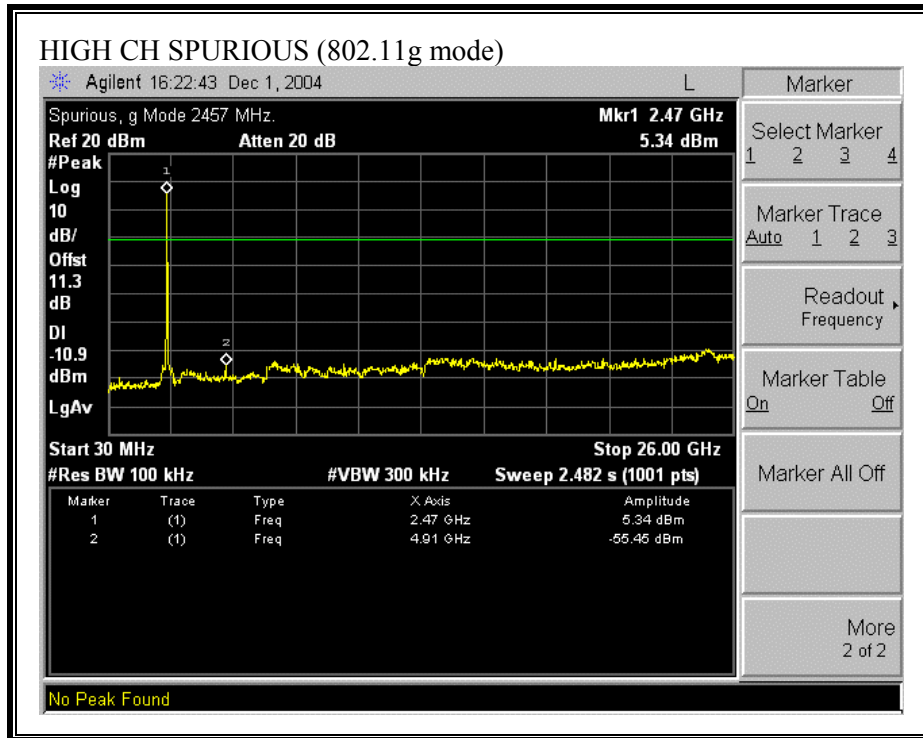
**SPURIOUS EMISSIONS, MID CHANNEL (802.11g MODE)**

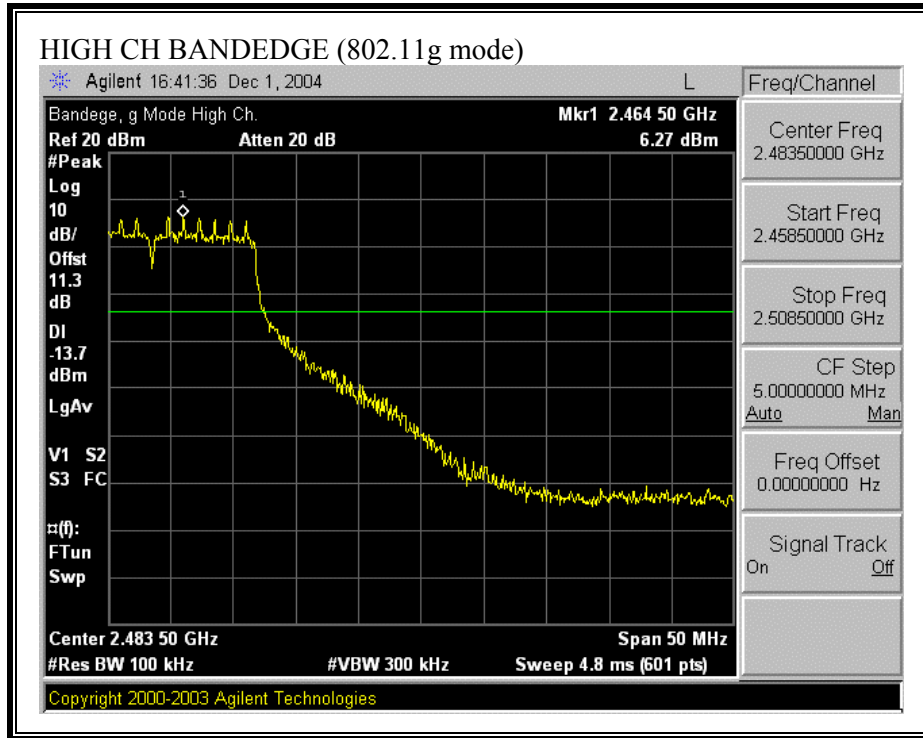


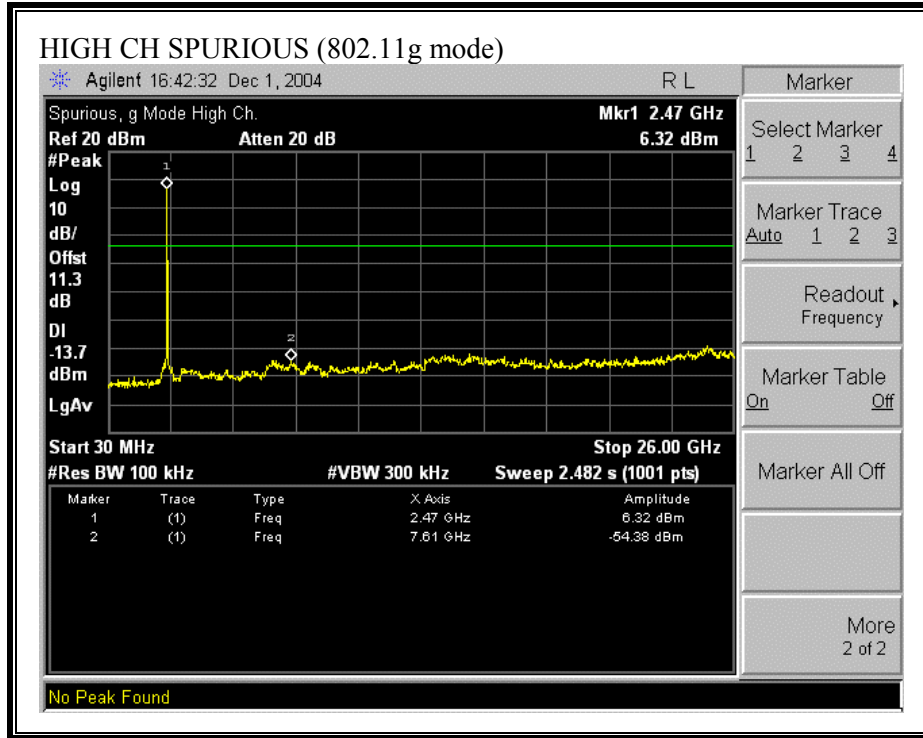


**SPURIOUS EMISSIONS, HIGH CHANNEL (802.11g MODE)**

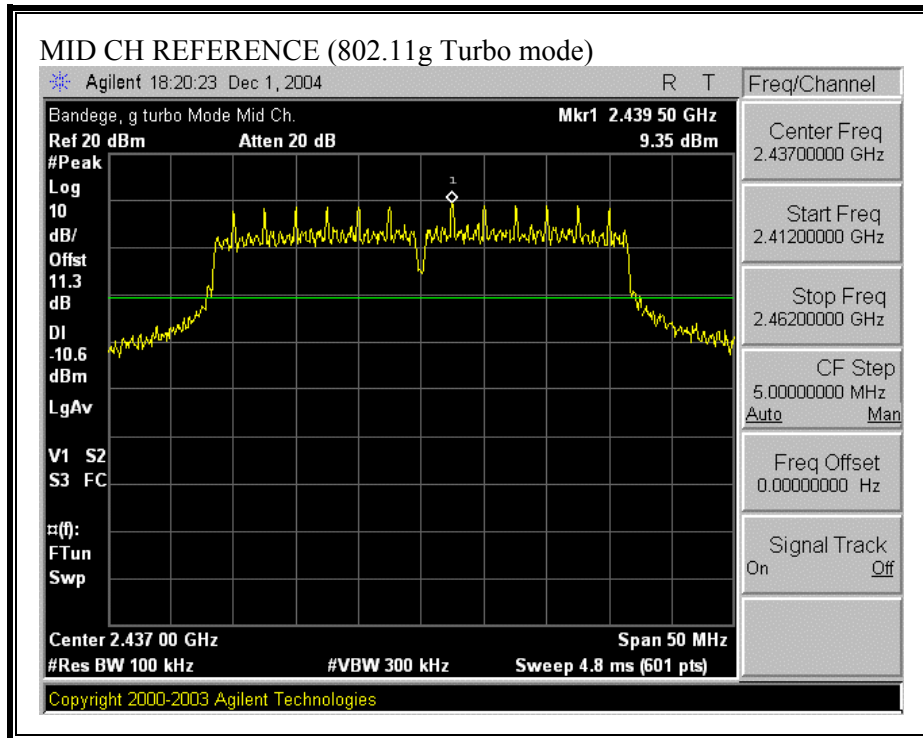




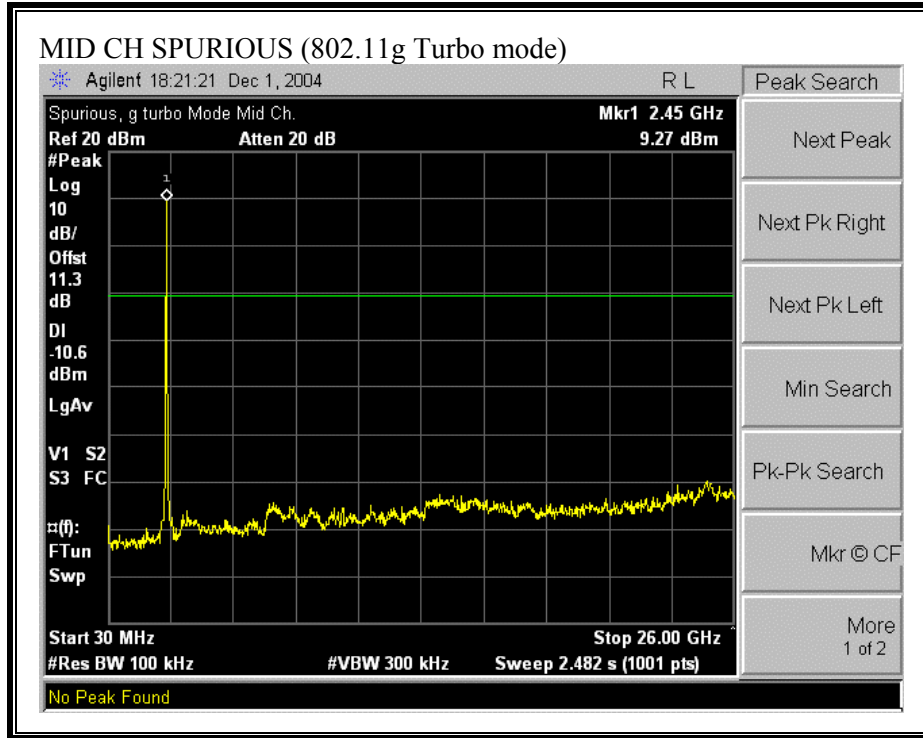




**SPURIOUS EMISSIONS, MID CHANNEL (802.11g TURBO MODE)**







## 7.2. CHANNEL TESTS FOR THE 5725 TO 5850 MHz BAND

### 7.2.1. 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 300 kHz. The sweep time is coupled.

#### RESULTS

No non-compliance noted:

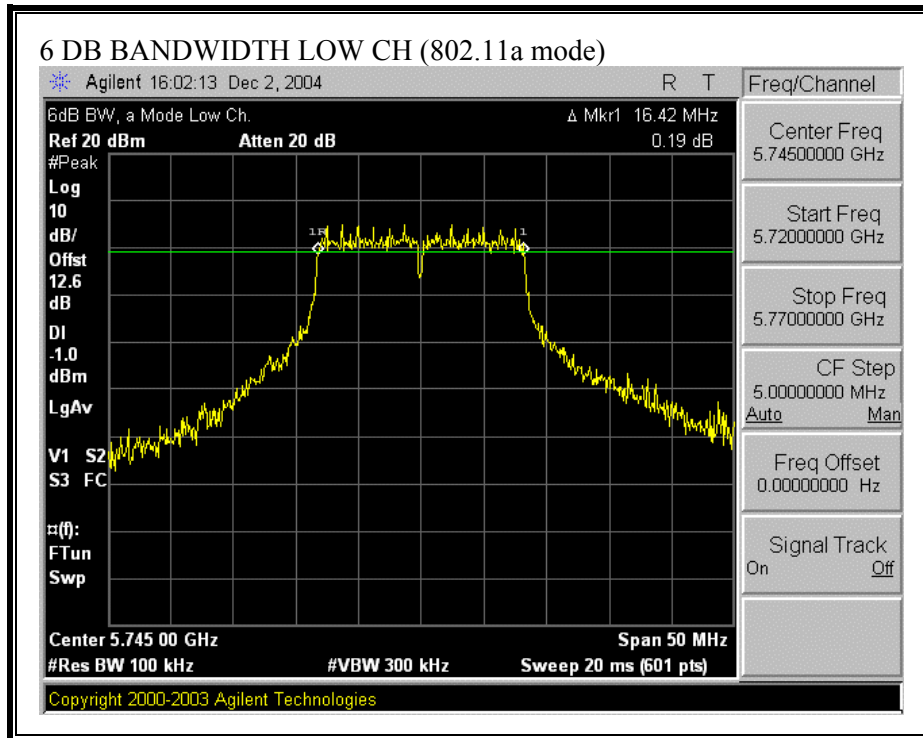
##### 802.11a Mode

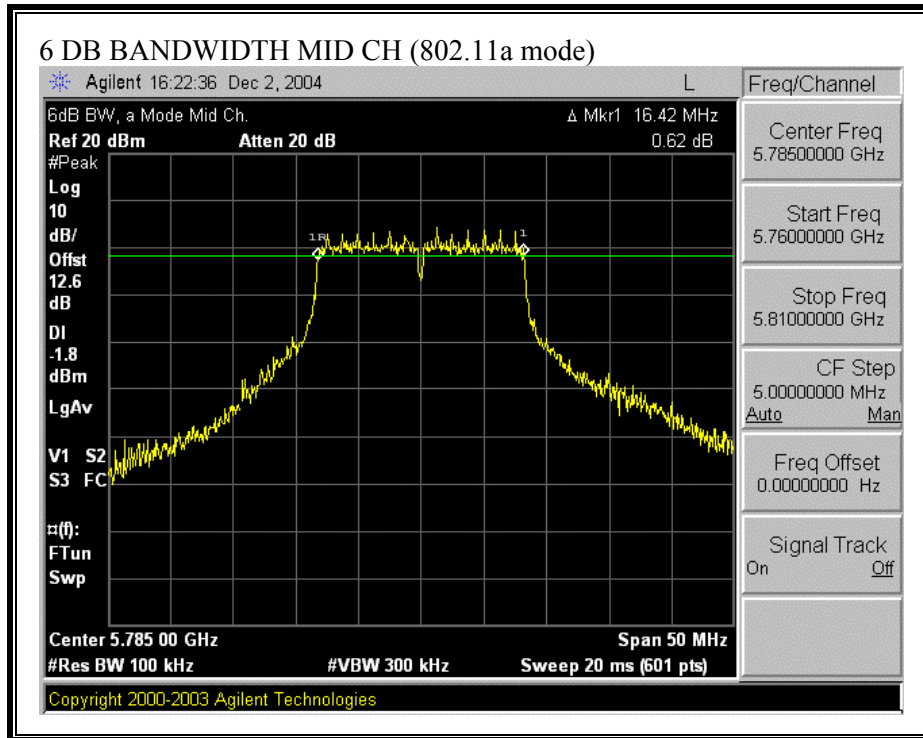
Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Low	5745	16420	500	15920
Middle	5785	16420	500	15920
High	5825	16420	500	15920

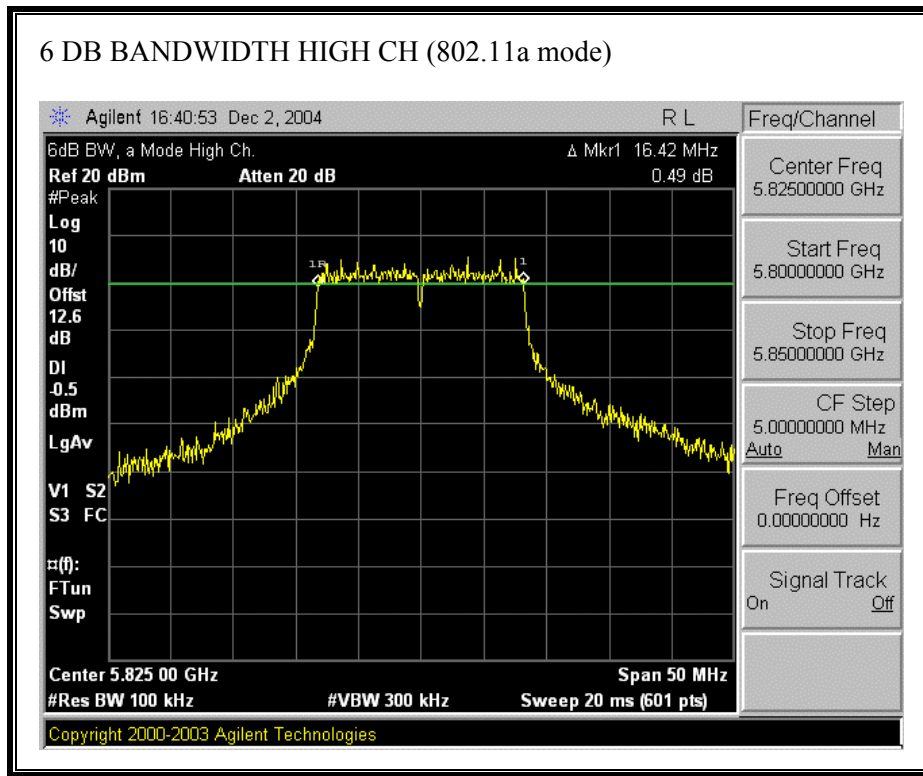
##### 802.11a Turbo Mode

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Low	5760	32580	500	32080
High	5805	32580	500	32080

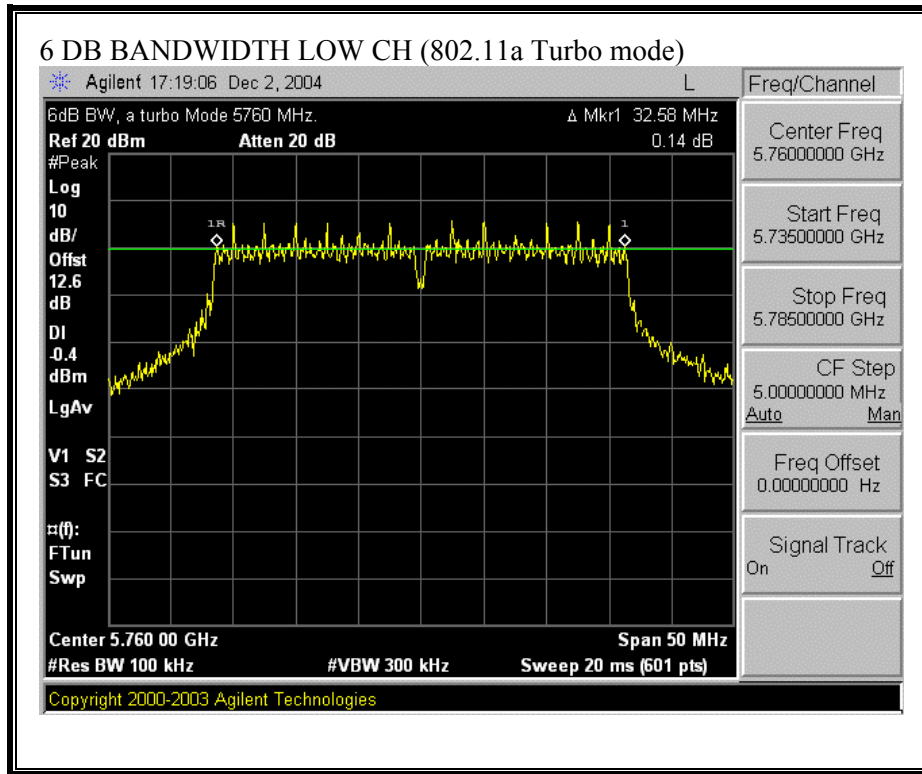
**6 DB BANDWIDTH (802.11a MODE)**

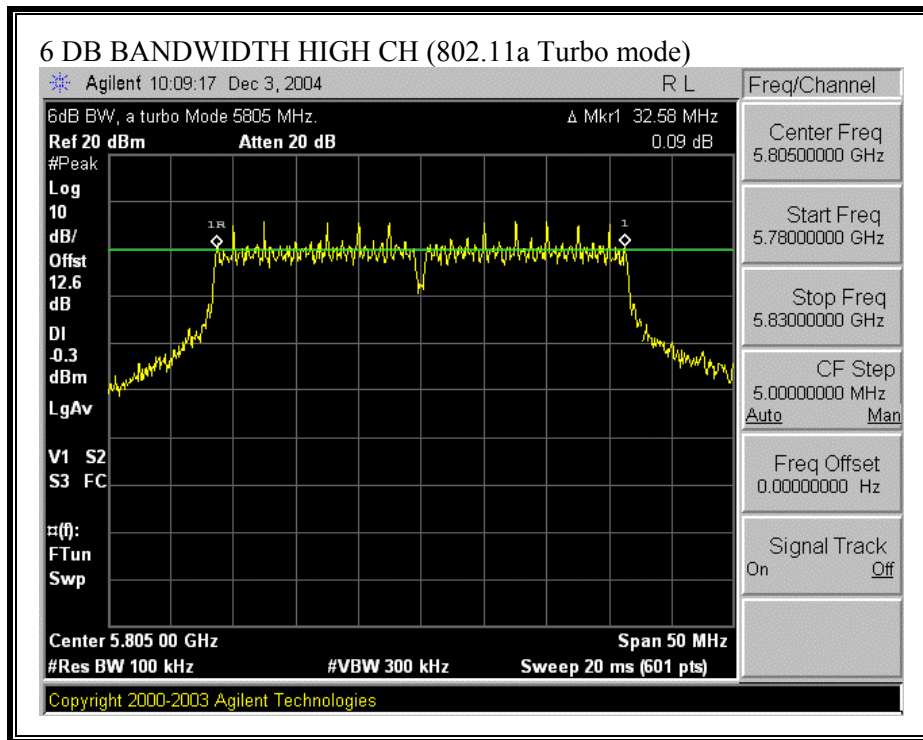






**6 DB BANDWIDTH (802.11a TURBO MODE)**





## 7.2.2. 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:

#### 802.11a Mode

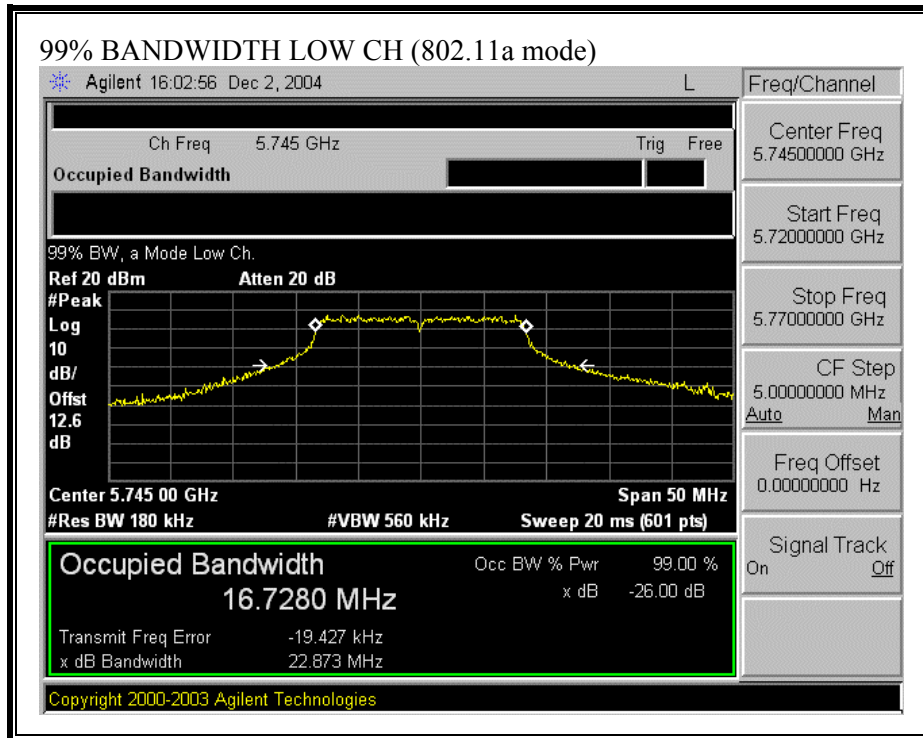
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5745	16.728
Middle	5785	16.6995
High	5825	16.7966

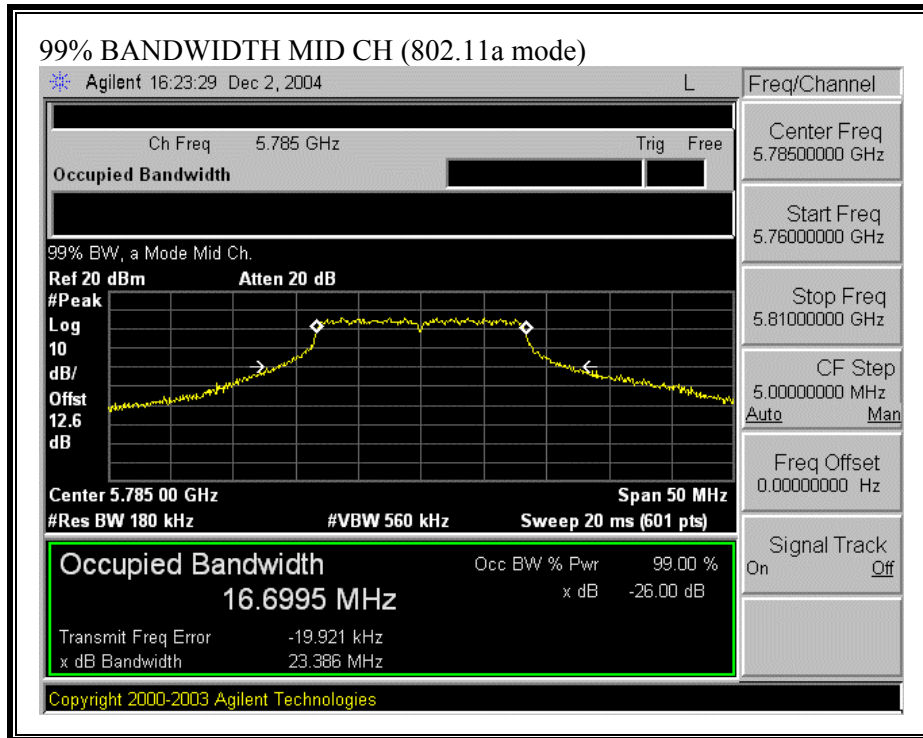
#### 802.11a Turbo Mode

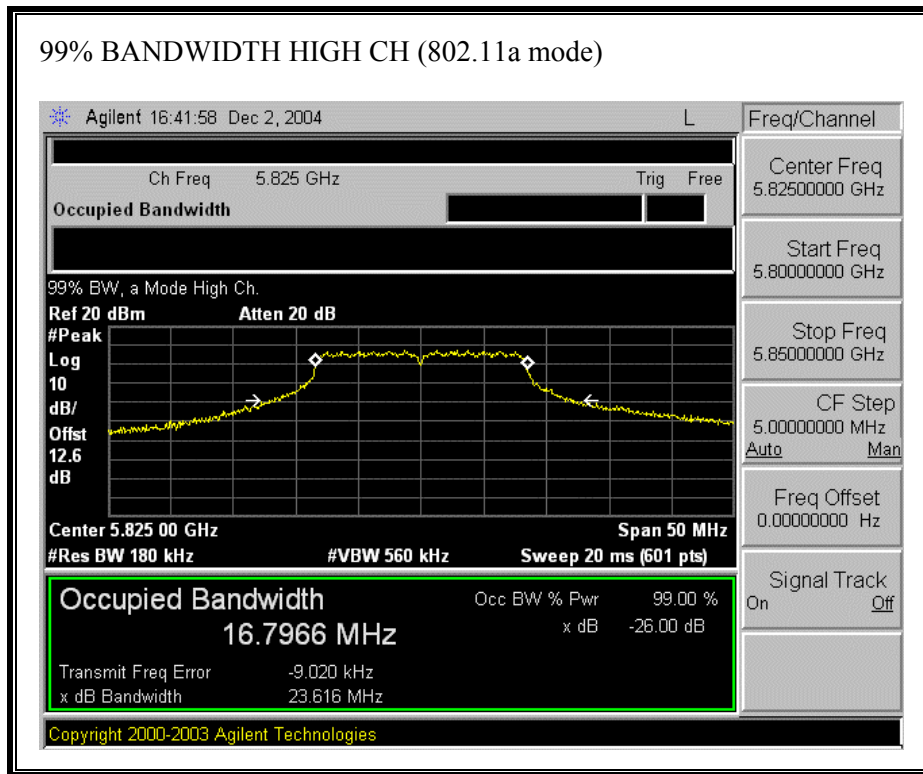
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5760	33.2901
High	5805	33.3751



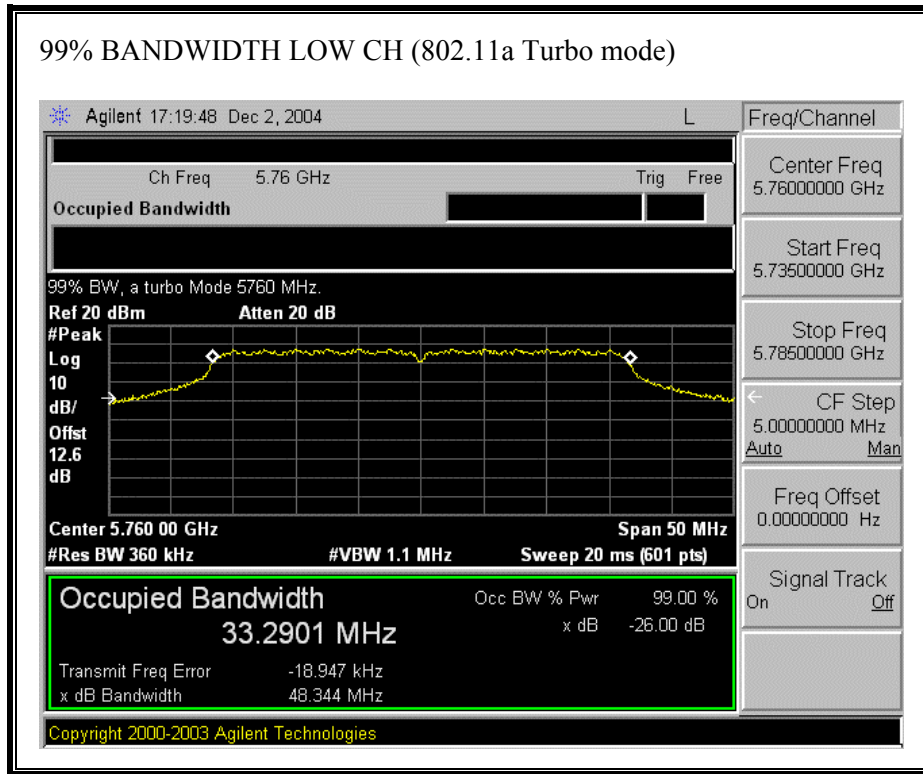
**99% BANDWIDTH (802.11a MODE)**

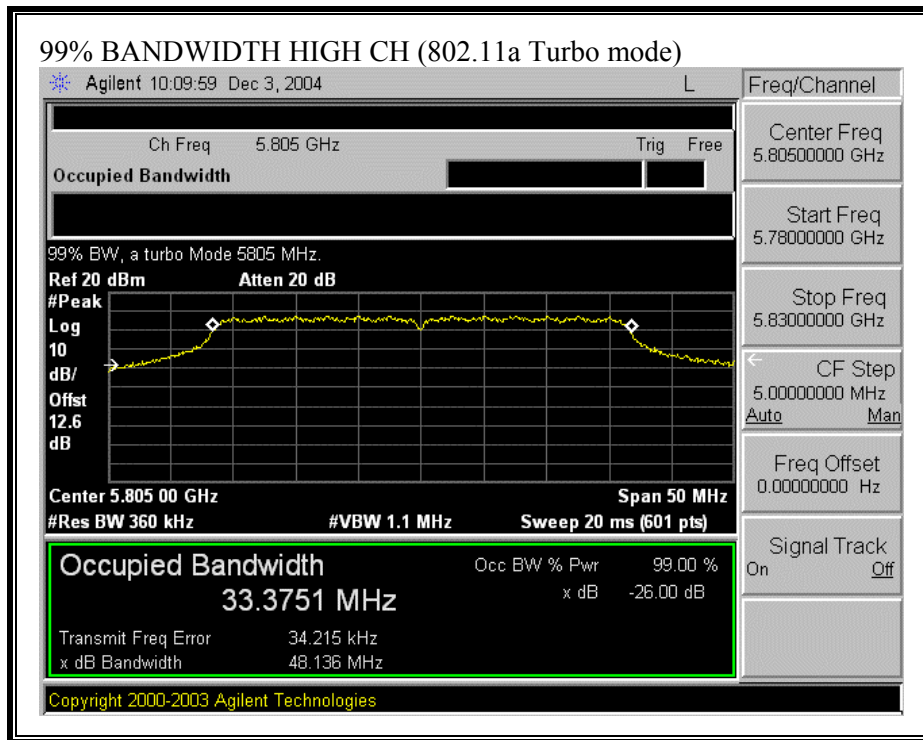






**99% BANDWIDTH (802.11a TURBO MODE)**





### **7.2.3. 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.

§15.247 (b) (4) (ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

#### **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 maximum antenna gain is 0 dBi for other than fixed, point-to-point operations, therefore the limit is 30 dBm.

No non-compliance noted:

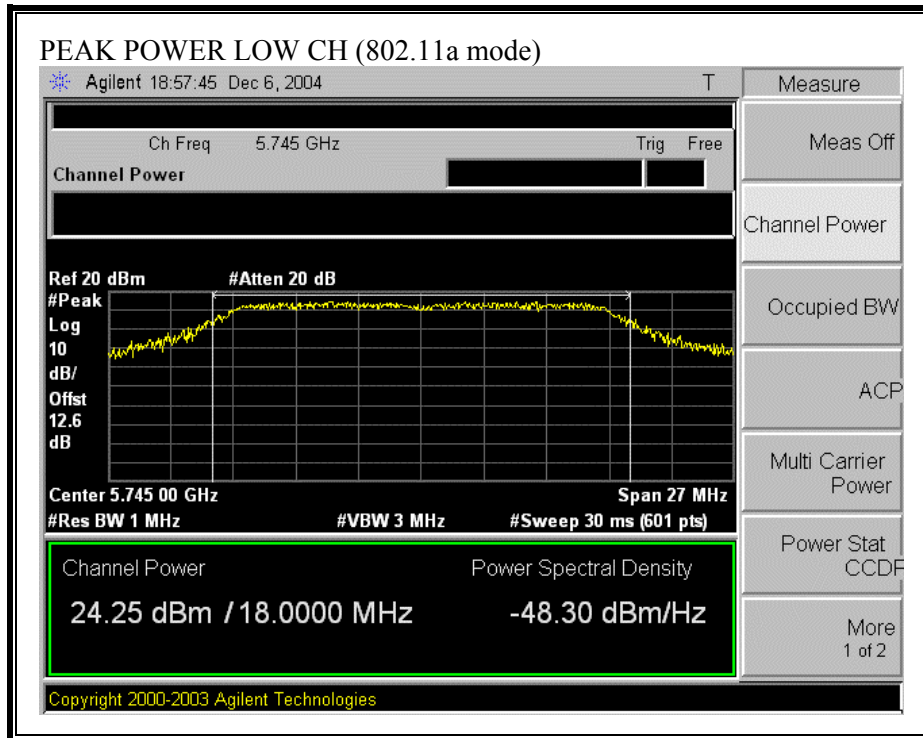
### 802.11a Mode

<b>Channel</b>	<b>Frequency (MHz)</b>	<b>Peak Power (dBm)</b>	<b>Limit (dBm)</b>	<b>Margin (dB)</b>
Low	5745	24.25	30	-5.75
Middle	5785	24.30	30	-5.70
High	5825	24.44	30	-5.56

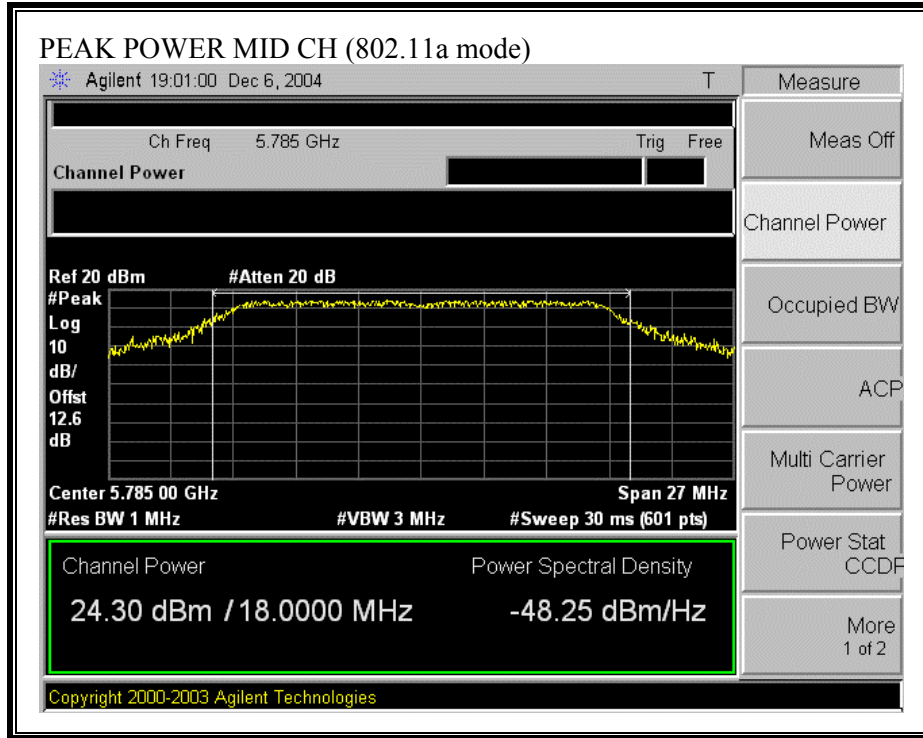
### 802.11a Turbo Mode

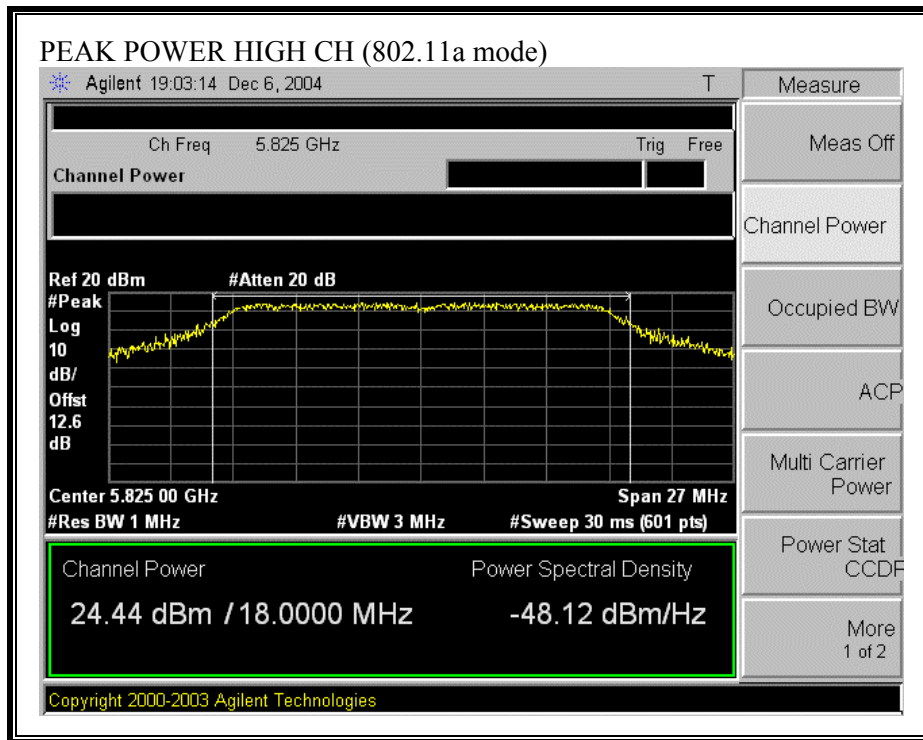
<b>Channel</b>	<b>Frequency (MHz)</b>	<b>Peak Power (dBm)</b>	<b>Limit (dBm)</b>	<b>Margin (dB)</b>
Low	5760	23.35	30	-6.65
High	5805	23.64	30	-6.36

**OUTPUT POWER (802.11a MODE)**

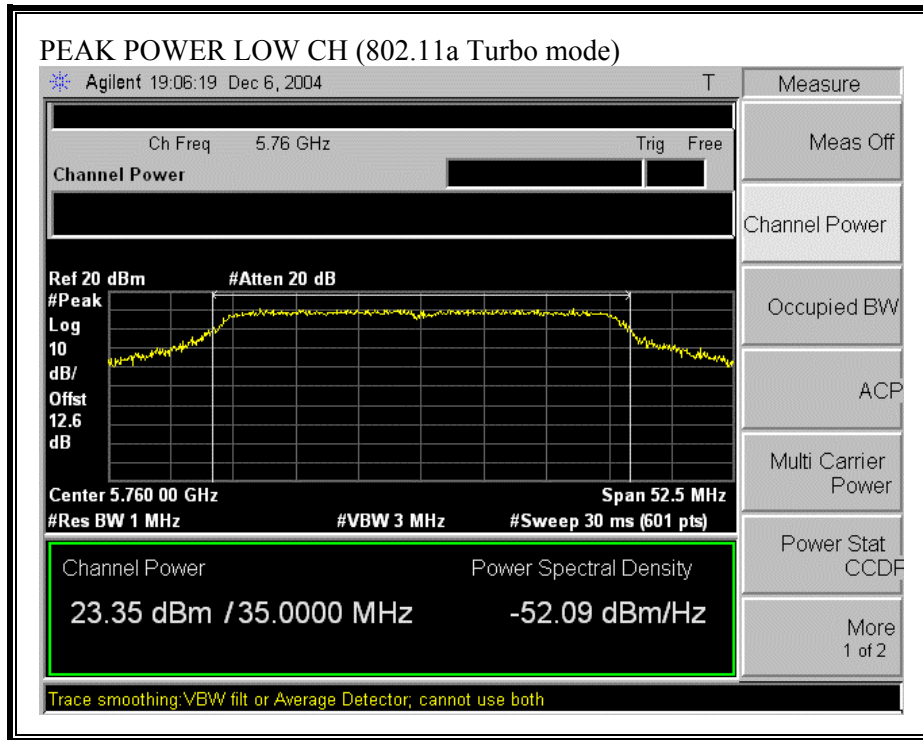


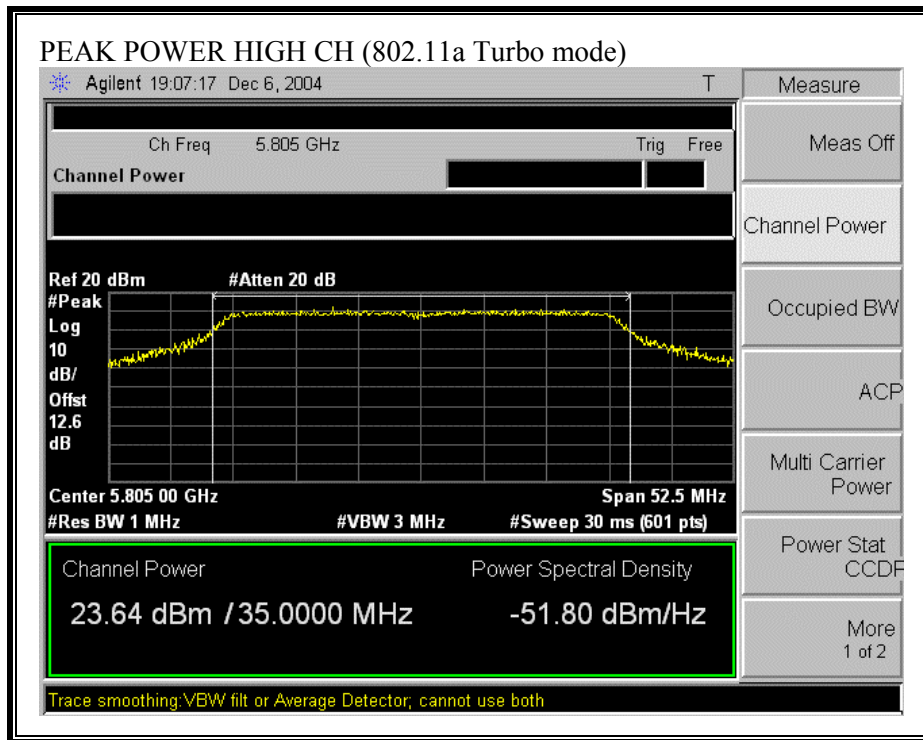






**OUTPUT POWER (802.11a TURBO MODE)**





## 7.2.4. 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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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/cm<sup>2</sup>

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/cm<sup>2</sup>

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

**LIMITS**

From §1.1310 Table 1 (B),  $S = 1.0 \text{ mW/cm}^2$

**RESULTS**

No non-compliance noted:

<b>Mode</b>	<b>Power Density Limit (mW/cm<sup>2</sup>)</b>	<b>Output Power (dBm)</b>	<b>Antenna Gain (dBi)</b>	<b>MPE Distance (cm)</b>
802.11a	1.0	24.44	0.00	4.70
802.11a Turbo	1.0	23.64	0.00	4.29

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.

## 7.2.5. 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 12.6 dB (including 10 dB pad and 2.6 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### 802.11a Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	5745	17.0
Middle	5785	17.1
High	5825	17.0

#### 802.11a Turbo Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	5760	16.7
High	5805	17



## 7.2.6. 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:

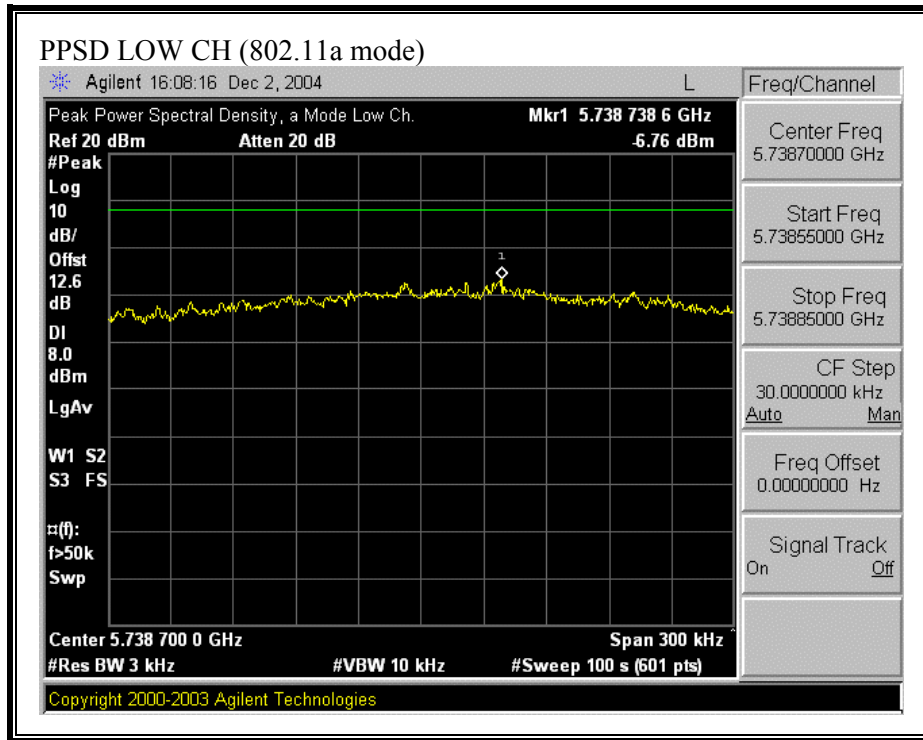
#### 802.11a Mode

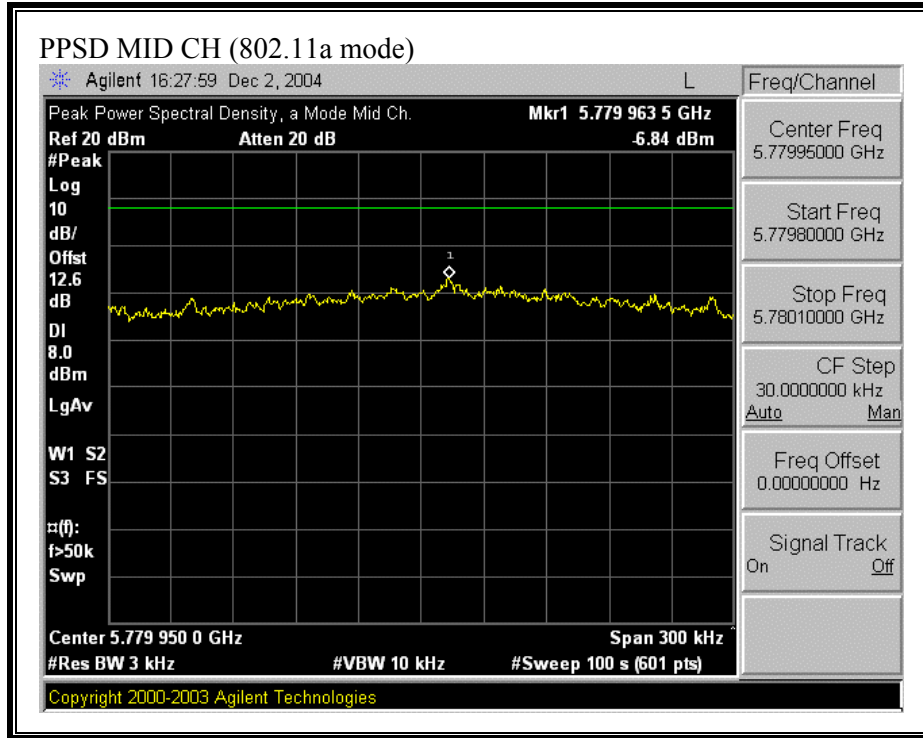
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5745	-6.76	8	-14.76
Middle	5785	-6.84	8	-14.84
High	5825	-7.57	8	-15.57

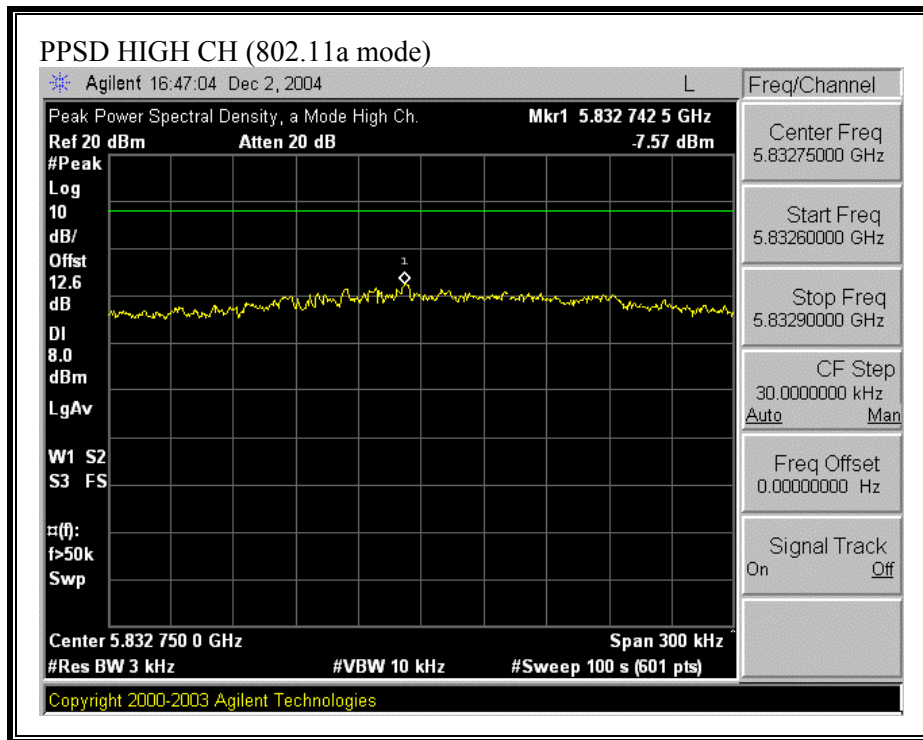
#### 802.11a Turbo Mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5760	-8.21	8	-16.21
High	5805	-9.16	8	-17.16

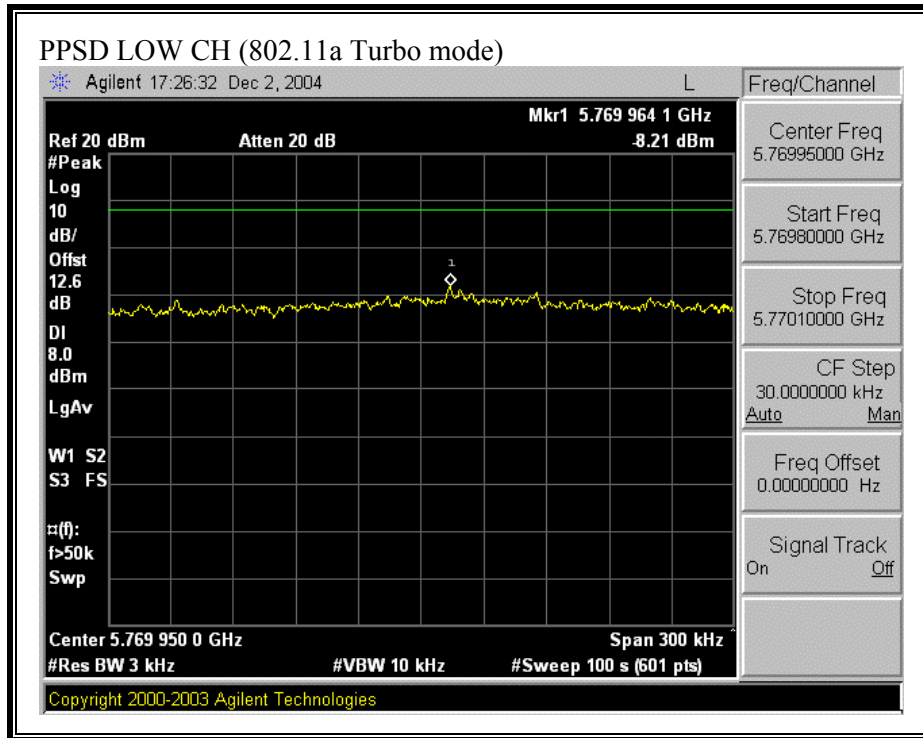
**PEAK POWER SPECTRAL DENSITY (802.11a MODE)**

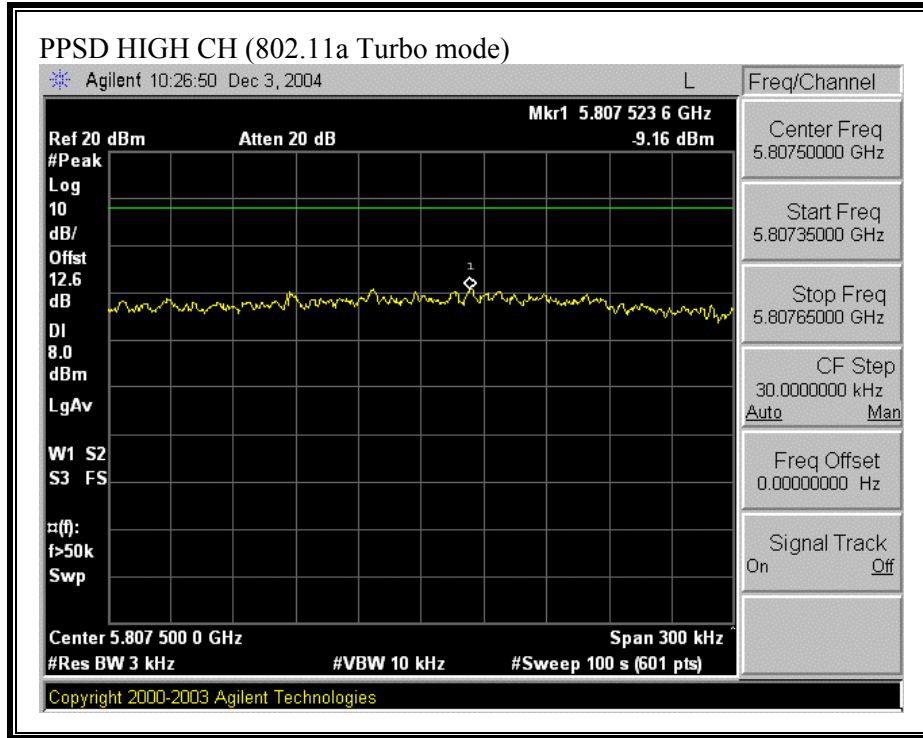






**PEAK POWER SPECTRAL DENSITY (802.11a TURBO MODE)**





## 7.2.7. 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

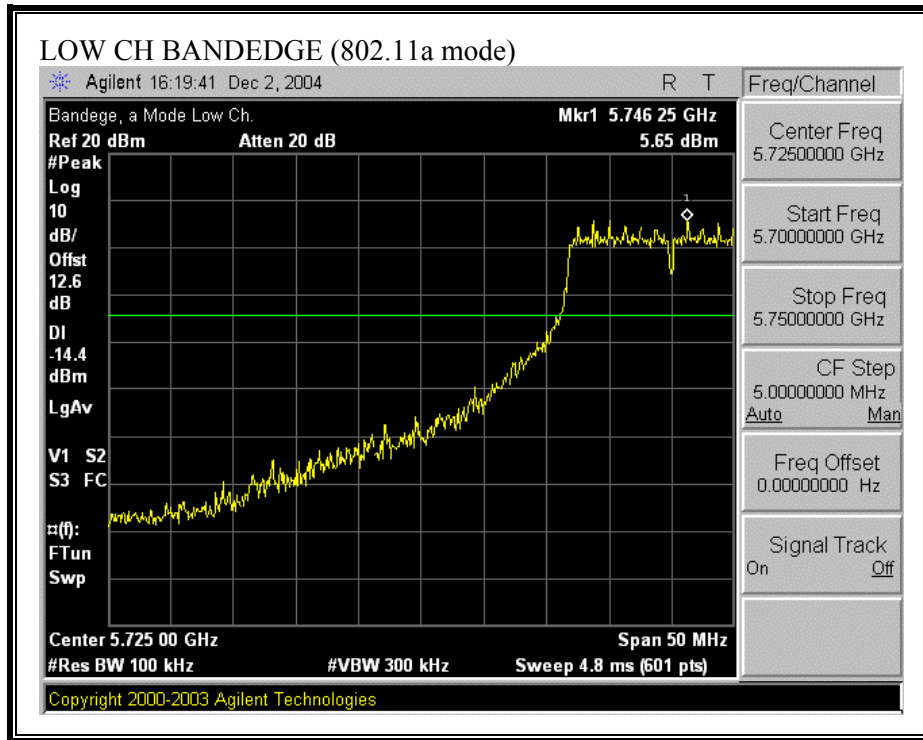
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

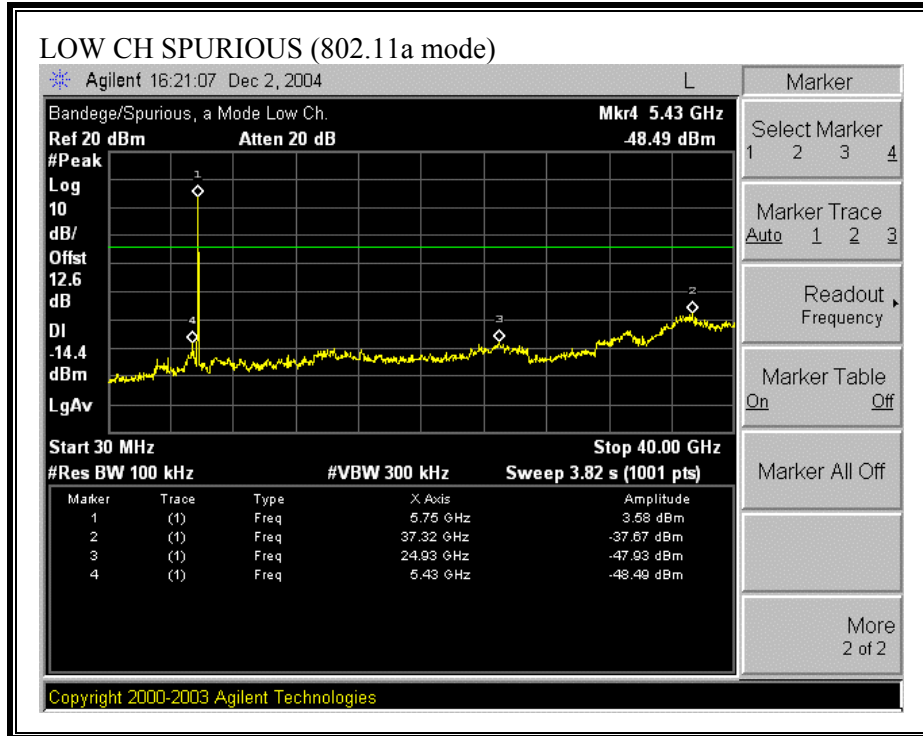
### RESULTS

No non-compliance noted:

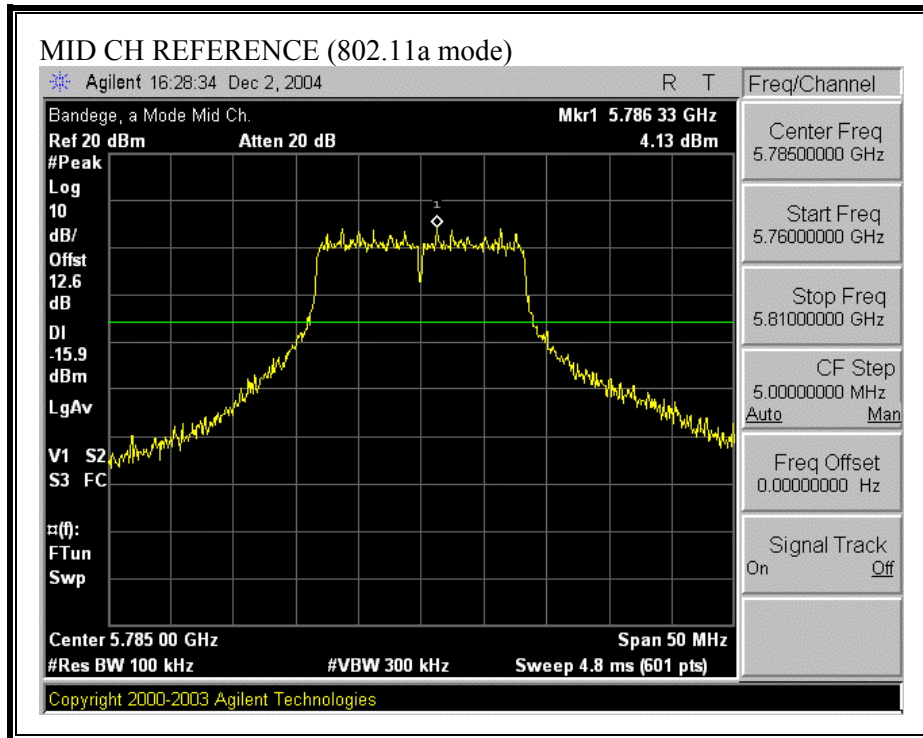
**SPURIOUS EMISSIONS, LOW CHANNEL (802.11a MODE)**

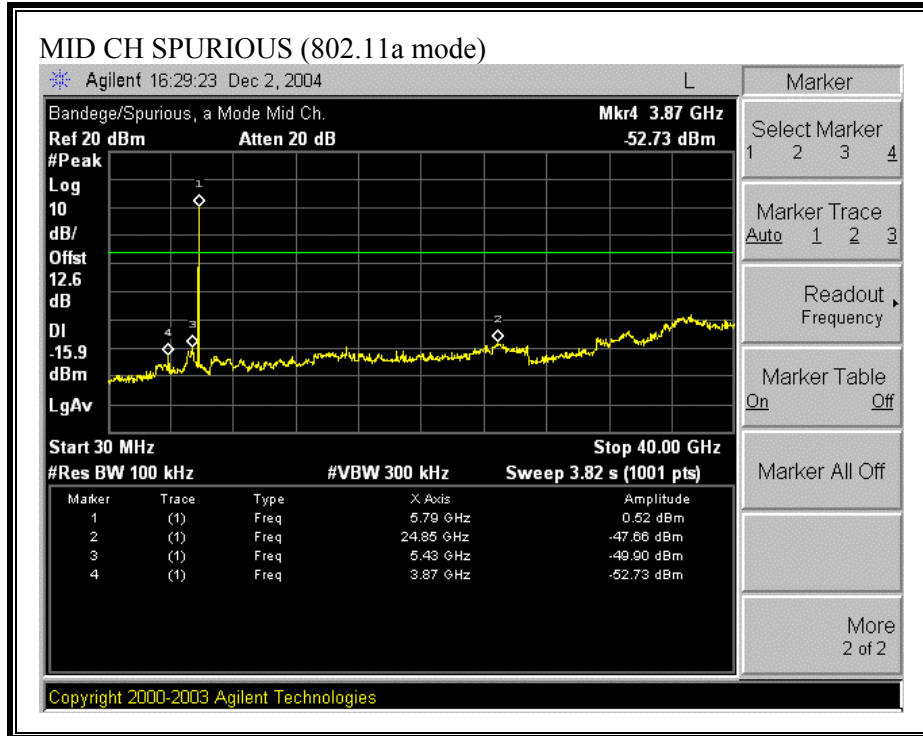




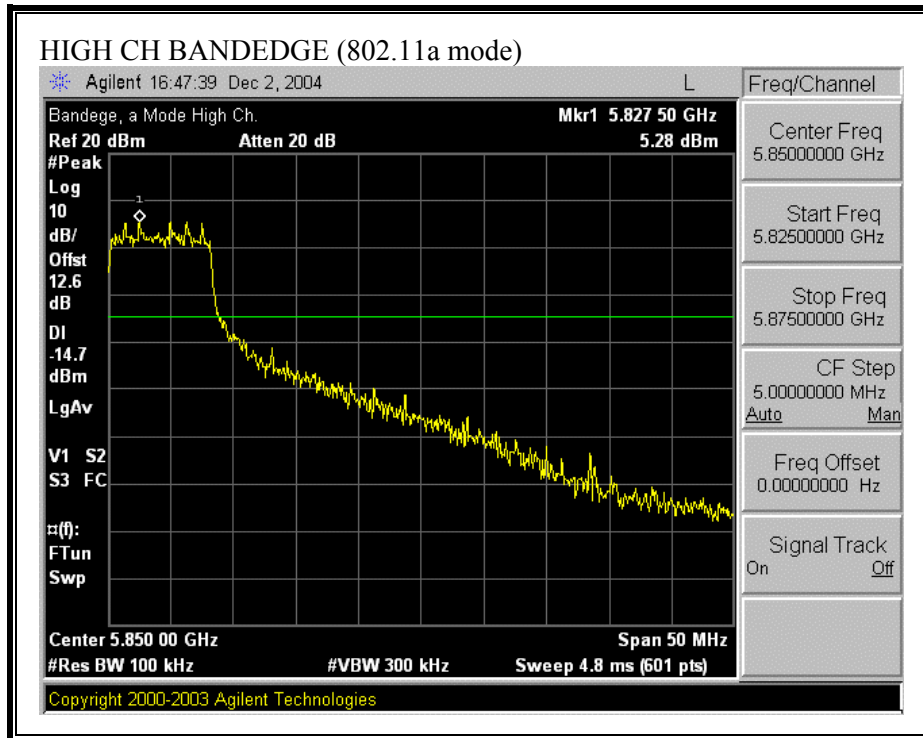


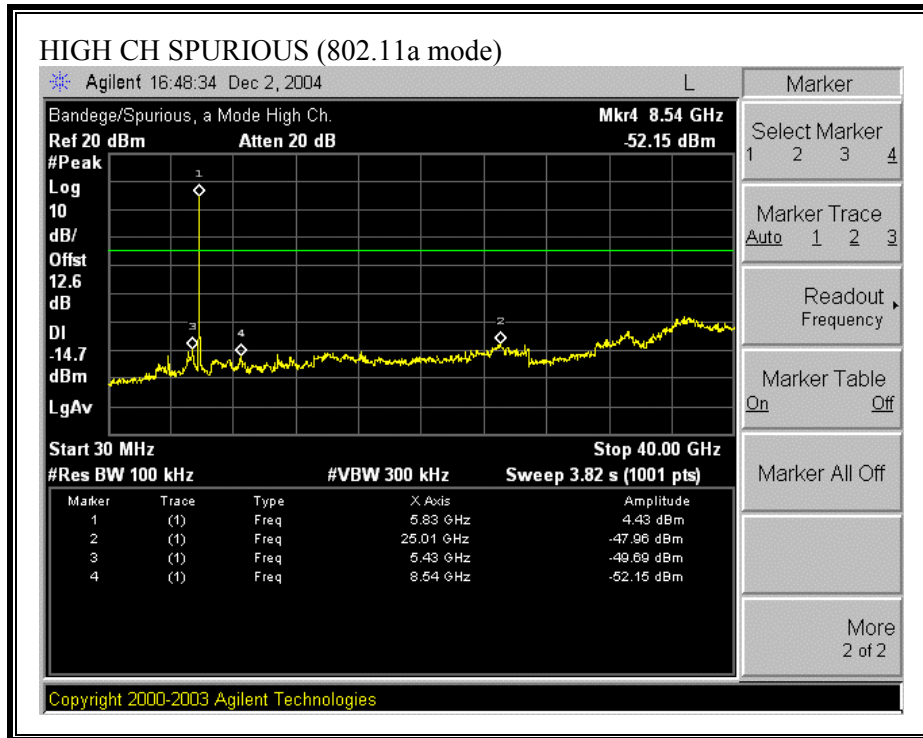
**SPURIOUS EMISSIONS, MID CHANNEL (802.11a MODE)**



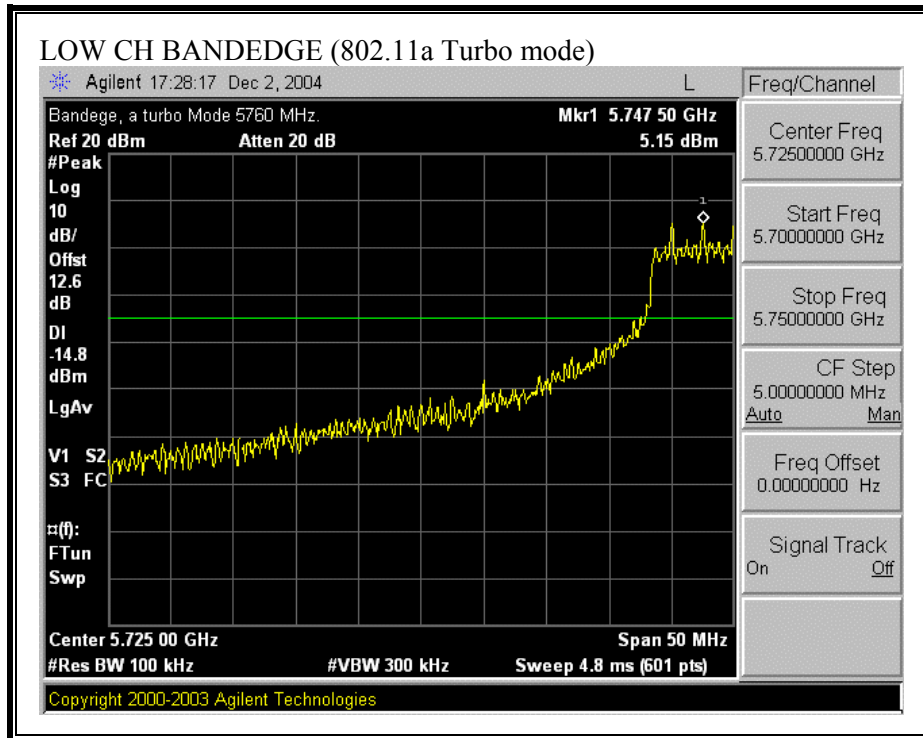


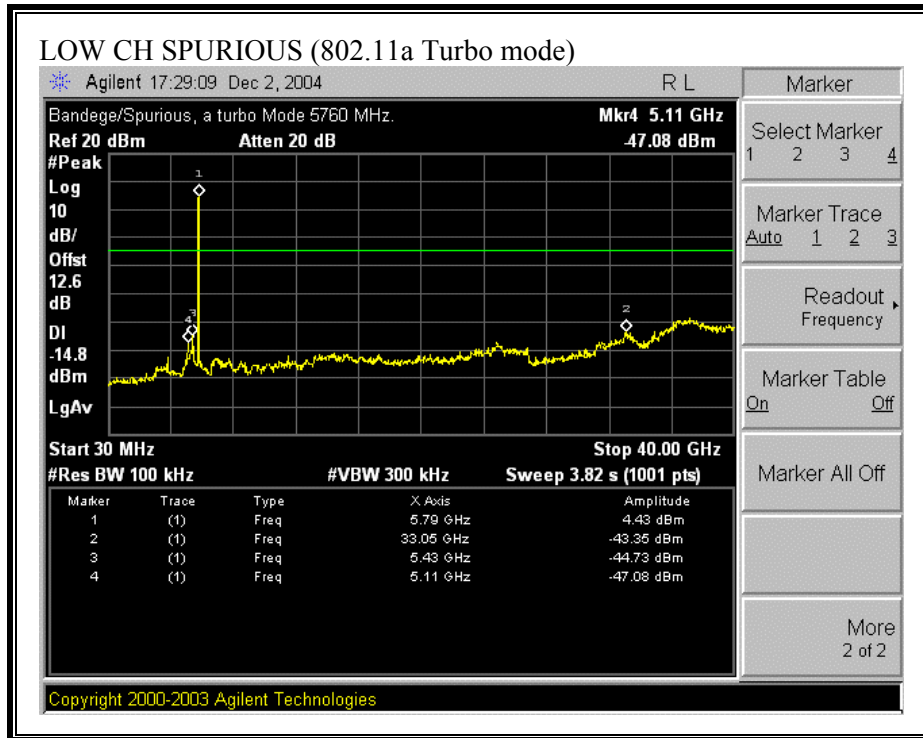
**SPURIOUS EMISSIONS, HIGH CHANNEL (802.11a MODE)**



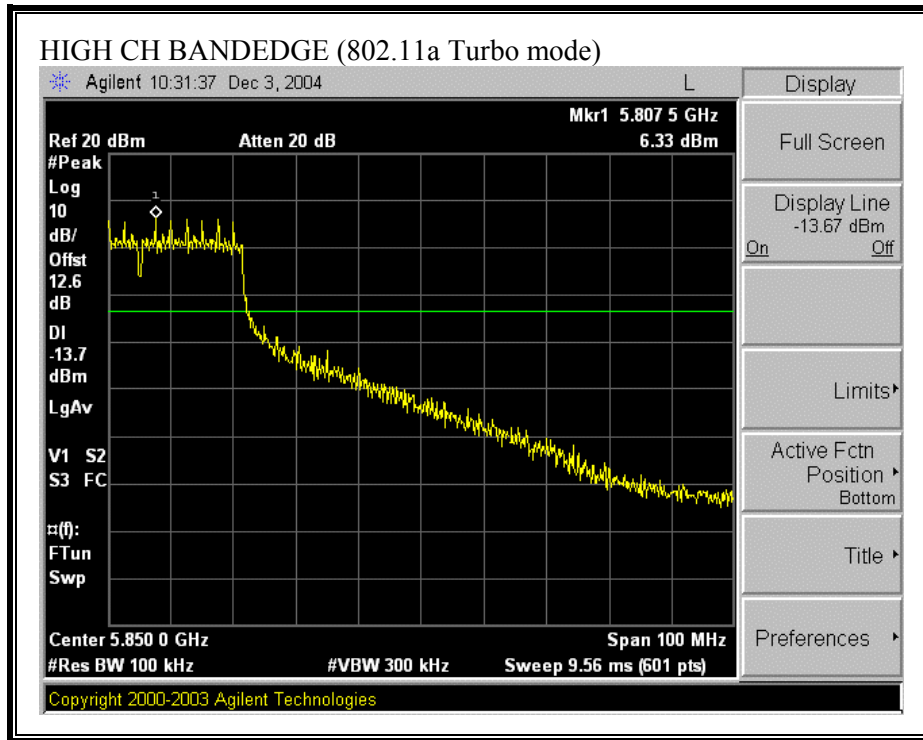


**SPURIOUS EMISSIONS, LOW CHANNEL (802.11a TURBO MODE)**

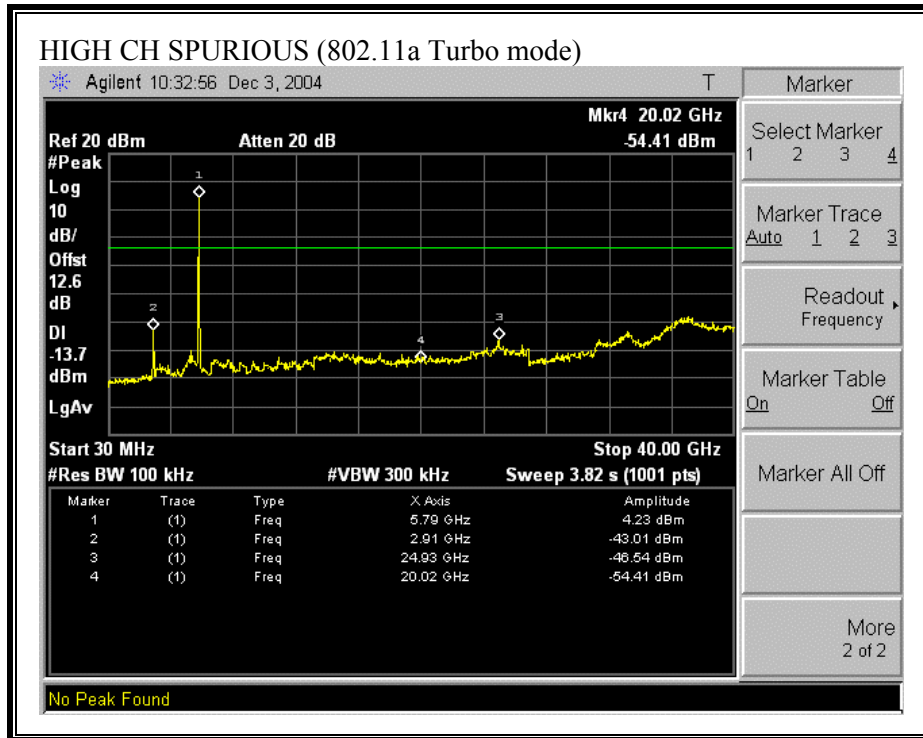




**SPURIOUS EMISSIONS, HIGH CHANNEL (802.11a TURBO MODE)**







### 7.3. RADIATED EMISSIONS

#### 7.3.1. 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
<sup>1</sup> 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	( <sup>2</sup> )
13.36 - 13.41			

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> 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.

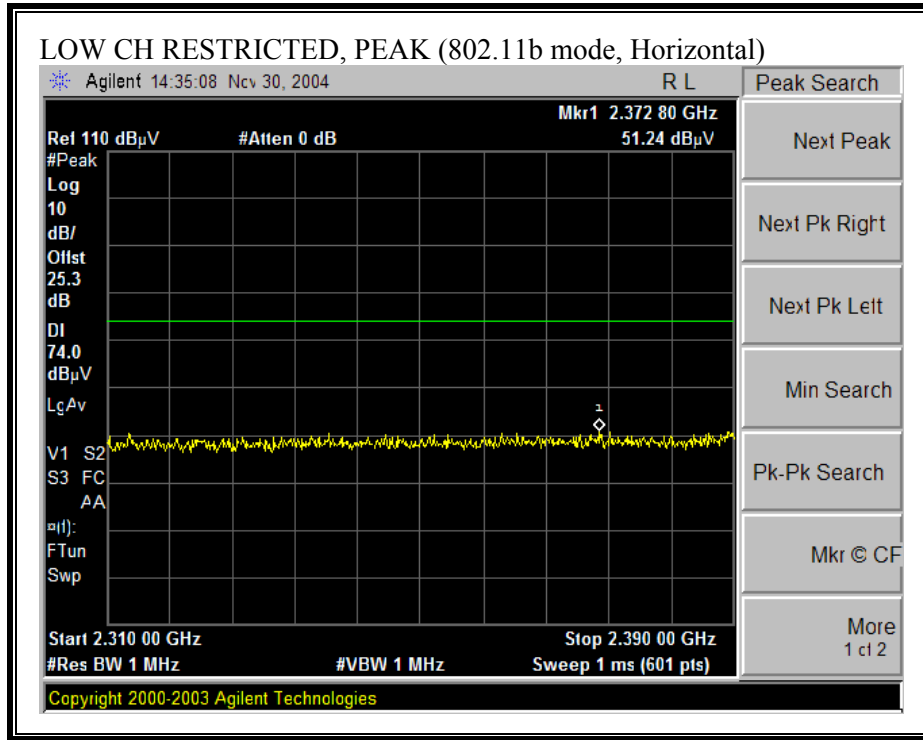
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

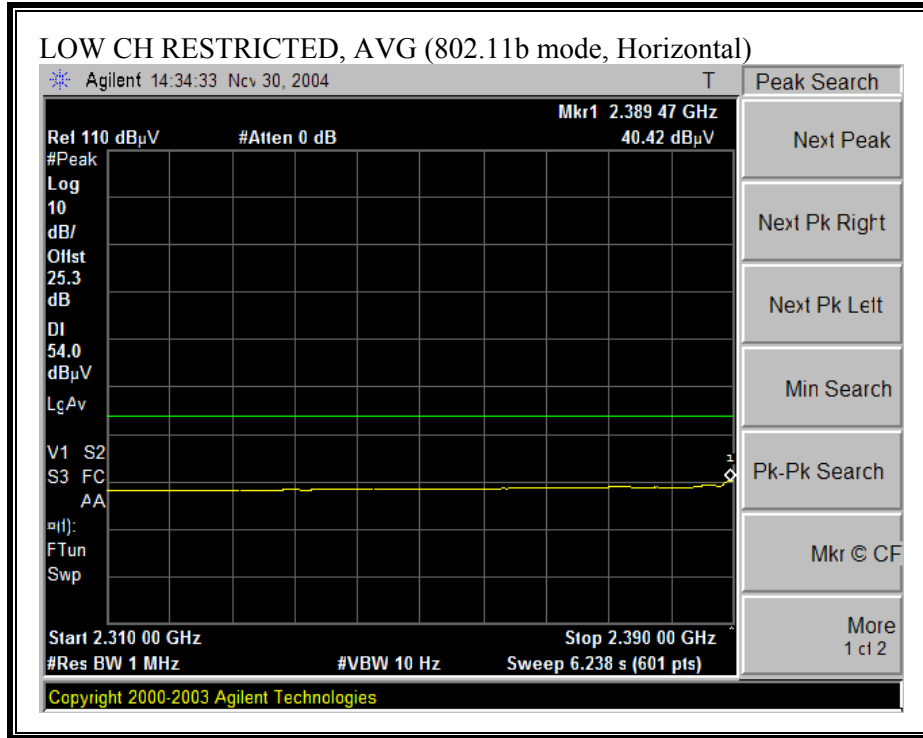
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each 5 GHz band.

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.

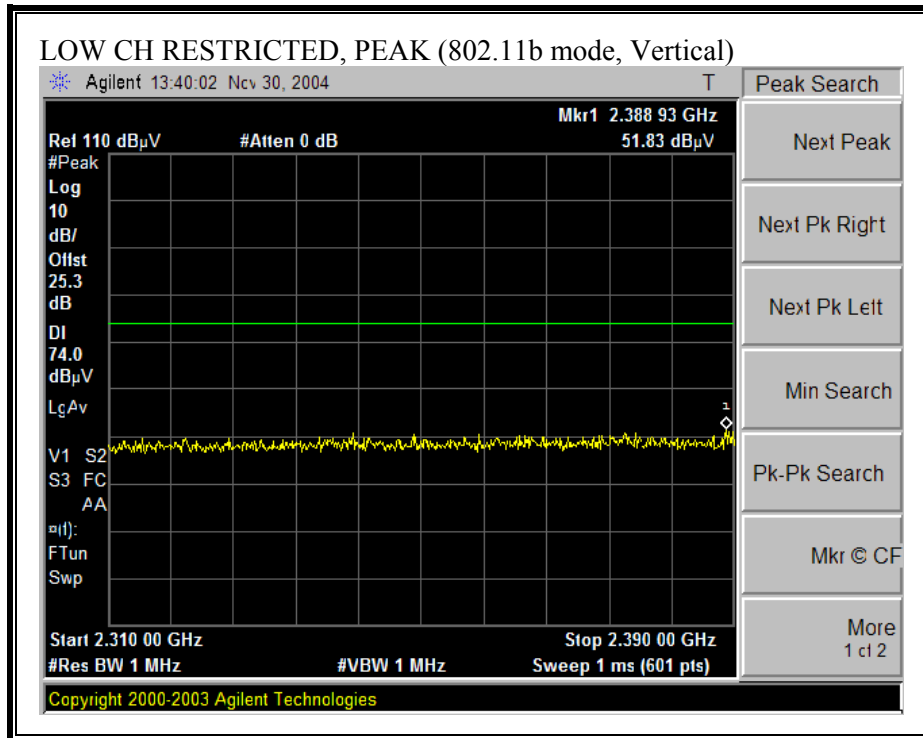
### 7.3.2. TRANSMITTER ABOVE 1 GHz FOR 2400 TO 2483.5 MHz BAND

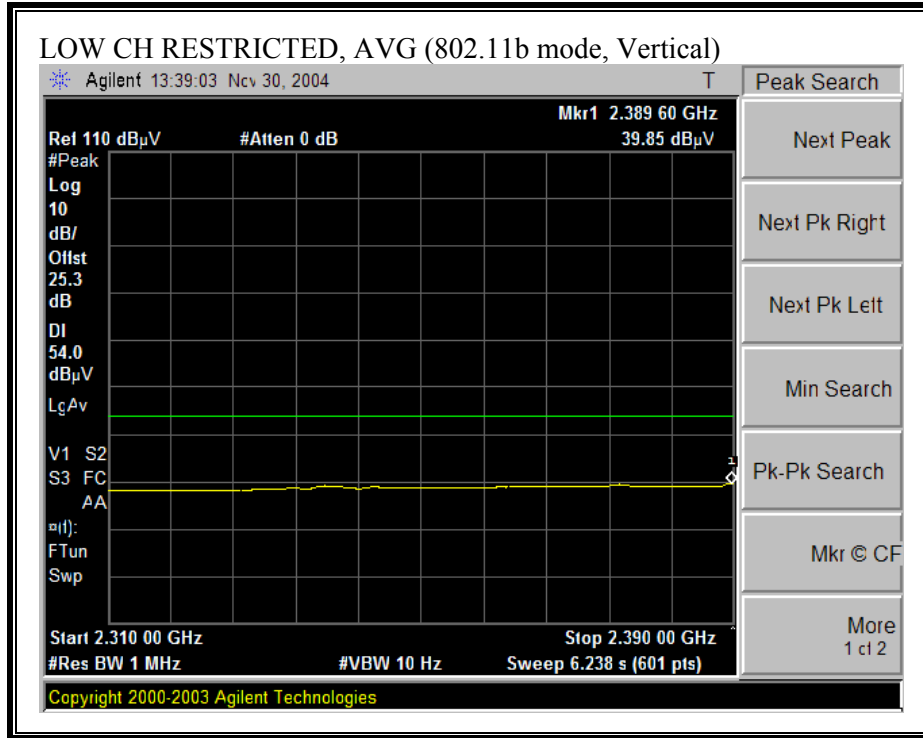
#### RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, HORIZONTAL)





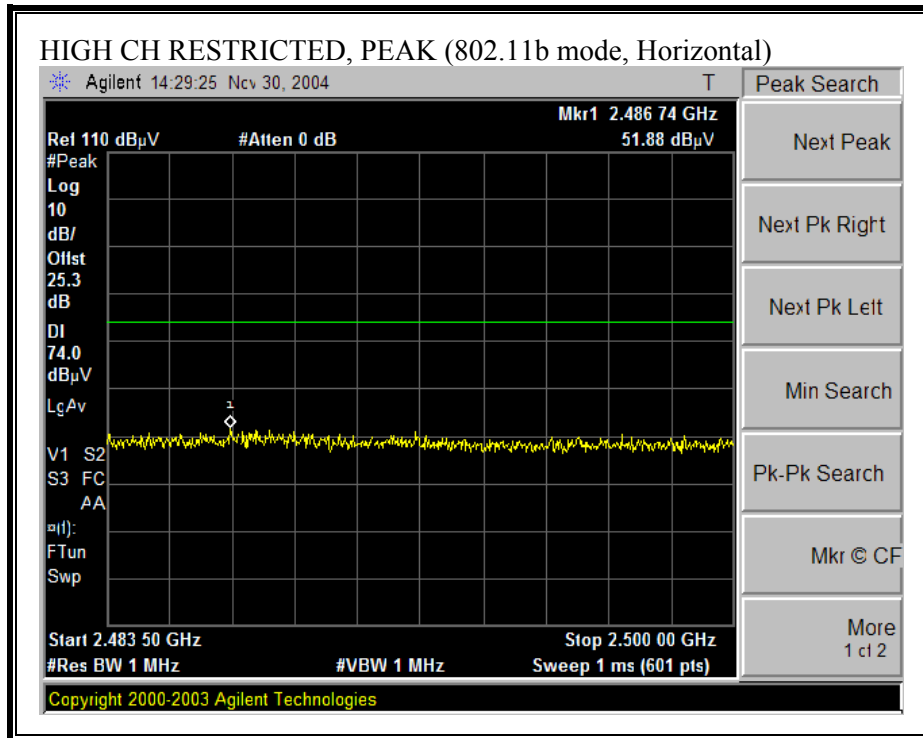
**RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, VERTICAL)**





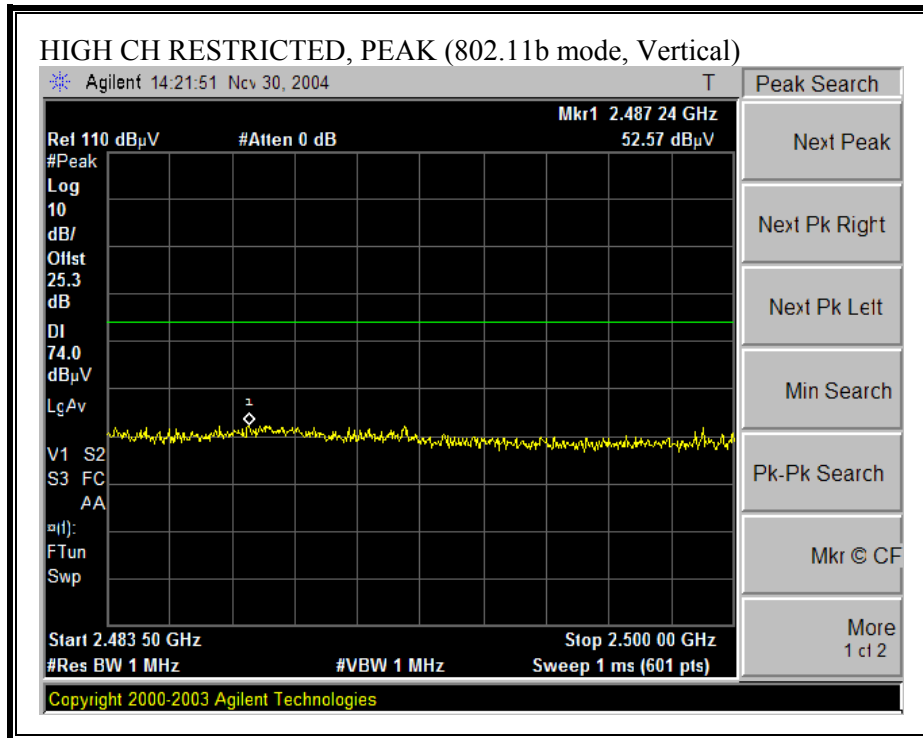


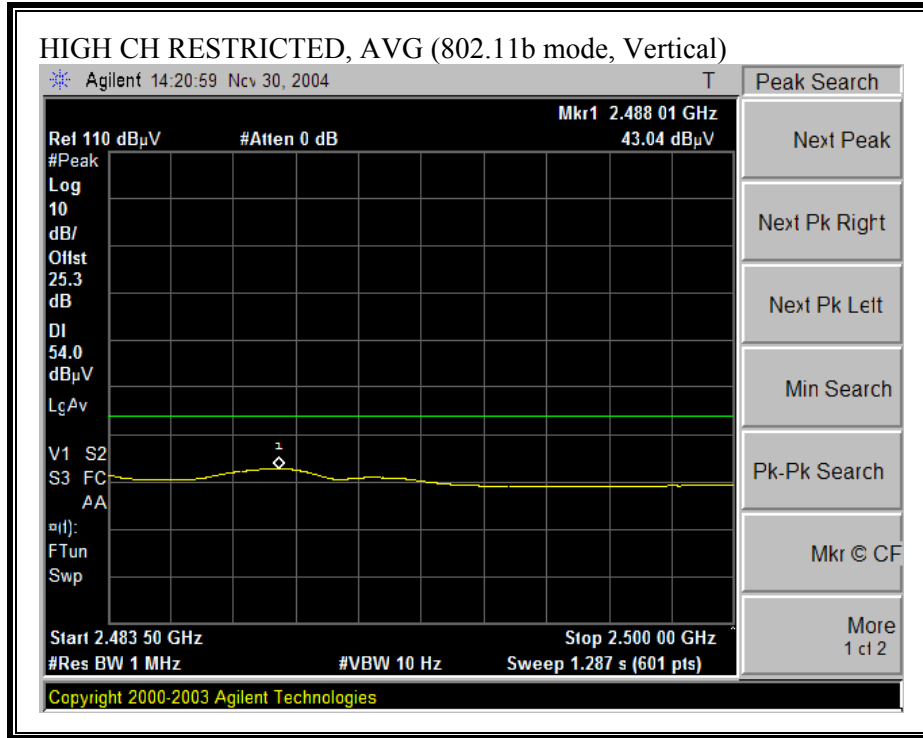
**RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, HORIZONTAL)**





**RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, VERTICAL)**





**HARMONICS AND SPURIOUS EMISSIONS (b MODE)**

11/30/04 **High Frequency Measurement**  
 Compliance Certification Services, Morgan Hill Open Field Site

**Test Engr:** David Garcia  
**Project #:** 04U3043-1  
**Company:** Atheros  
**EUT Descrip.:** 802.11a/b/g cardbus card with turbo mode  
**EUT M/N:** AR5BCB  
**Test Target:** FCC 15.247  
**Mode Oper:** 11b mode Transmitting

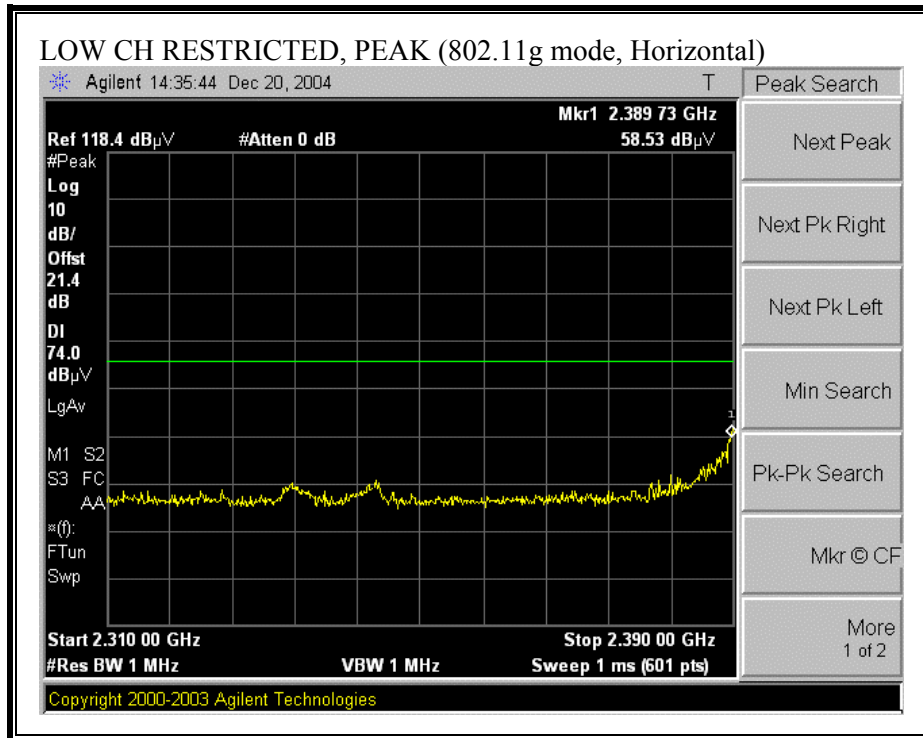
**Test Equipment:**

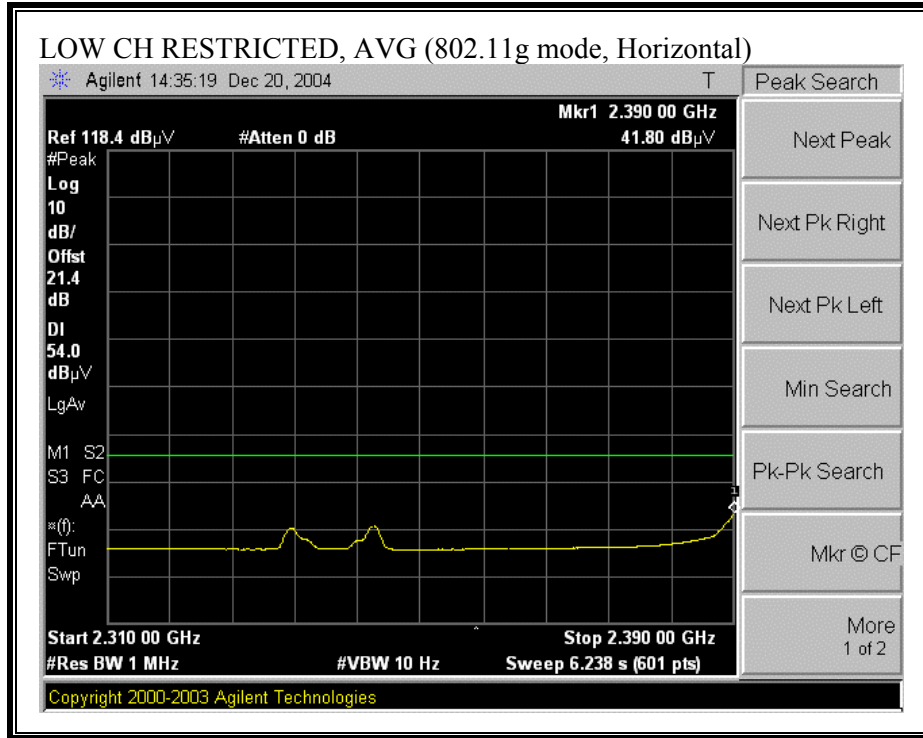
EMCO Horn 1-18GHz: T120; S/N: 29310 @3m  
 Pre-amplifier 1-26GHz: T63 Miteq 646456  
 Pre-amplifier 26-40GHz:   
 Horn > 18GHz:   
 Hi Frequency Cables: 2 foot cable, 3 foot cable (3\_David), 4 foot cable, 12 foot cable (12\_Yan)  
 HPF: HPF\_4.0GHz  
 Reject Filter:   
**Peak Measurements** RBW=VBW=1MHz  
**Average Measurements** RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>2412 Channel</b>															
4.824	3.0	51.6	47.1	33.6	4.6	-35.5	0.0	0.6	54.9	50.4	74	54	-19.1	-3.6	V
4.824	3.0	51.7	47.6	33.6	4.6	-35.5	0.0	0.6	55.0	50.9	74	54	-19.0	-3.1	H
<b>2417 Channel</b>															
4.834	3.0	50.0	45.9	33.6	4.6	-35.5	0.0	0.6	53.3	49.2	74	54	-20.7	-4.8	V
4.834	3.0	51.3	46.7	33.6	4.6	-35.5	0.0	0.6	54.6	50.0	74	54	-19.4	-4.0	H
<b>2437 Channel</b>															
4.874	3.0	48.9	45.0	33.7	4.6	-35.5	0.0	0.6	52.3	48.4	74	54	-21.7	-5.6	V
4.874	3.0	49.9	45.3	33.7	4.6	-35.5	0.0	0.6	53.3	48.7	74	54	-20.7	-5.3	H
<b>2457 Channel</b>															
4.914	3.0	53.6	49.6	33.7	4.7	-35.5	0.0	0.6	57.1	53.1	74	54	-16.9	-0.9	V
4.914	3.0	53.1	50.4	33.7	4.7	-35.5	0.0	0.6	56.6	53.9	74	54	-17.4	-0.1	H, ART=19.5
<b>2462 Channel</b>															
4.924	3.0	50.9	47.9	33.7	4.7	-35.5	0.0	0.6	54.4	51.4	74	54	-19.6	-2.6	V
4.924	3.0	53.6	49.7	33.7	4.7	-35.5	0.0	0.6	57.1	53.2	74	54	-16.9	-0.8	H, ART=19
No further emissions were detected.															

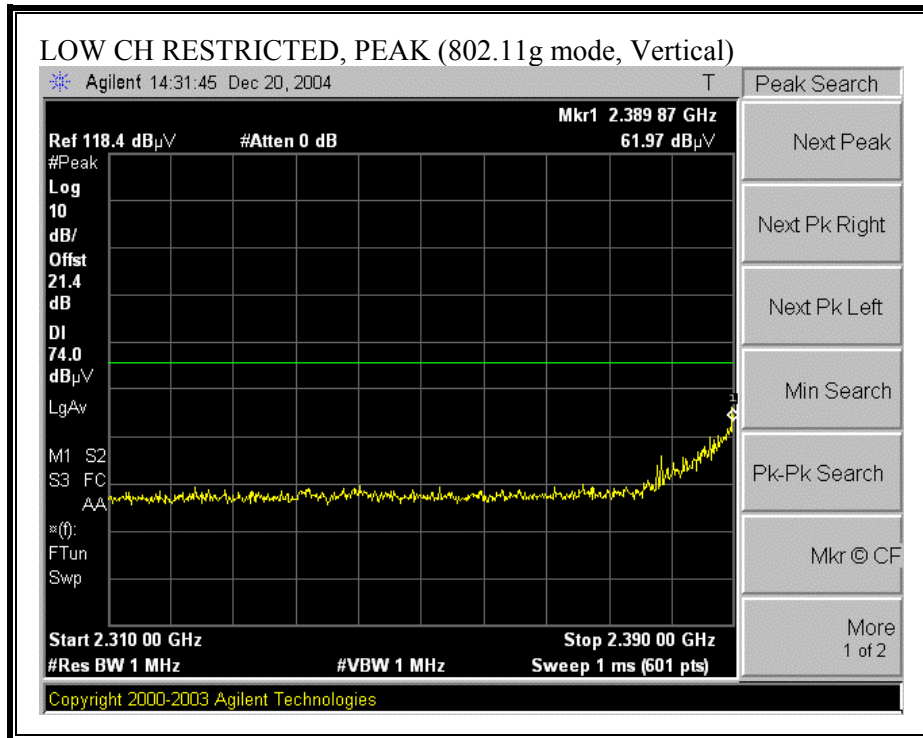
f Measurement Frequency      Amp Preamp Gain      Avg Lim Average Field Strength Limit  
 Dist Distance to Antenna      D Corr Distance Correct to 3 meters      Pk Lim Peak Field Strength Limit  
 Read Analyzer Reading      Avg Average Field Strength @ 3 m      Avg Mar Margin vs. Average Limit  
 AF 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)**

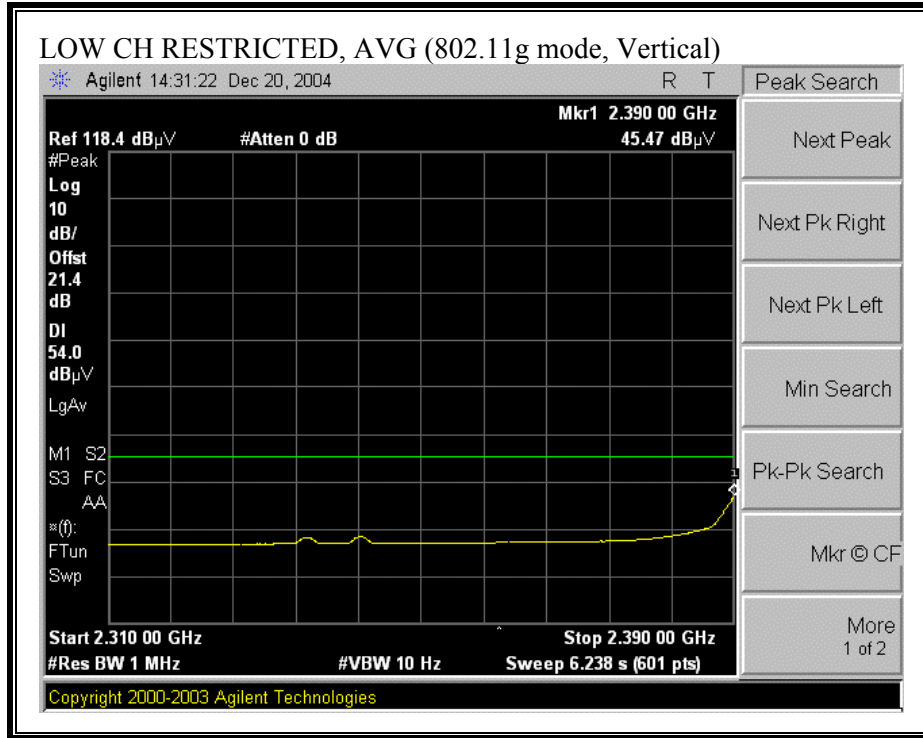




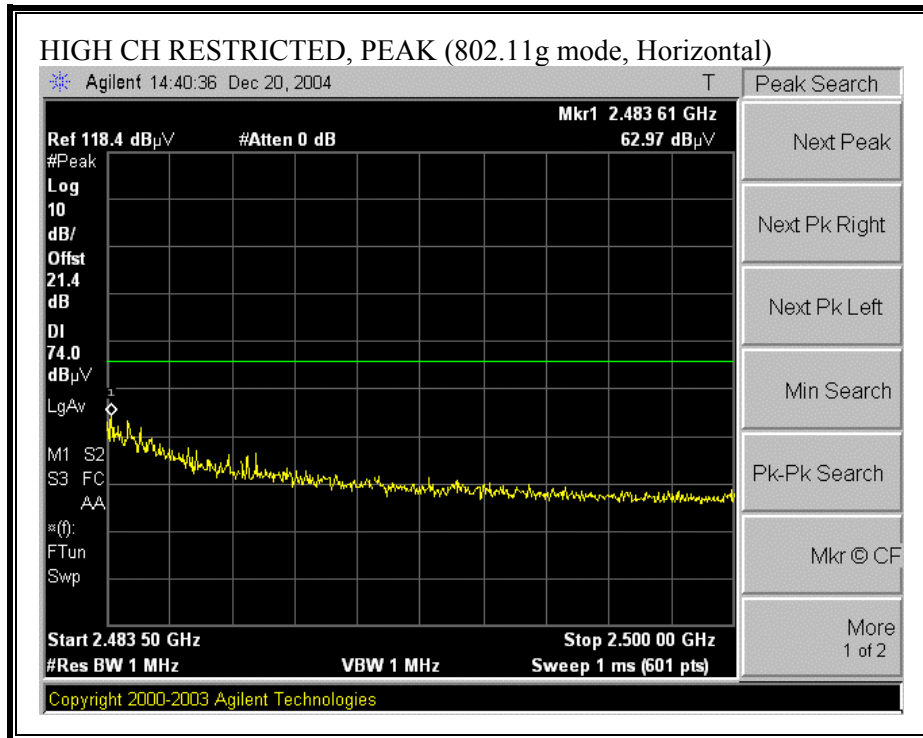
**RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, VERTICAL)**

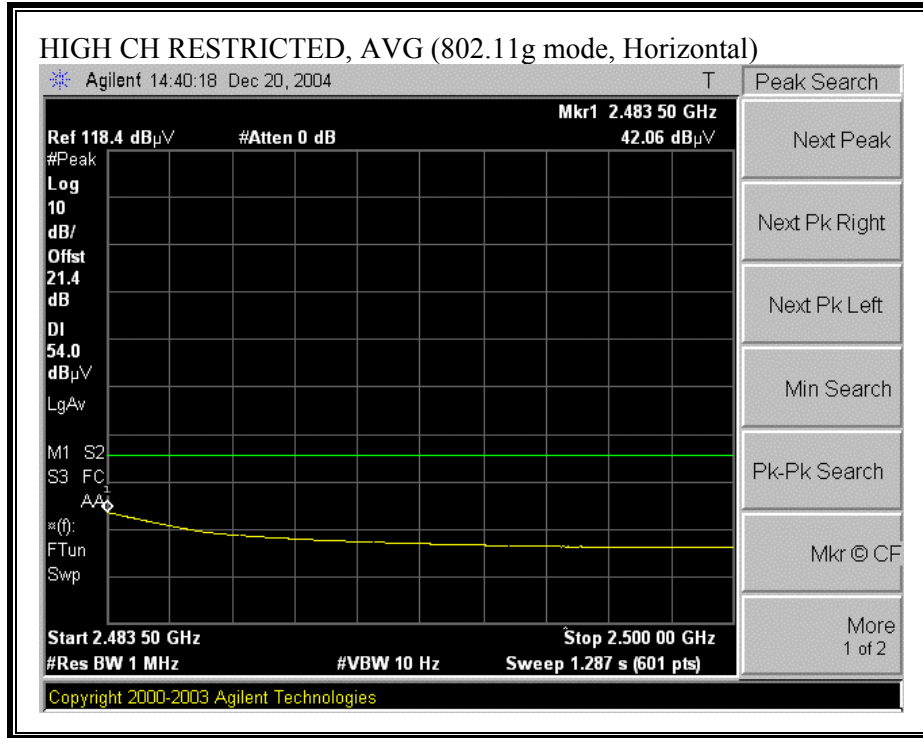




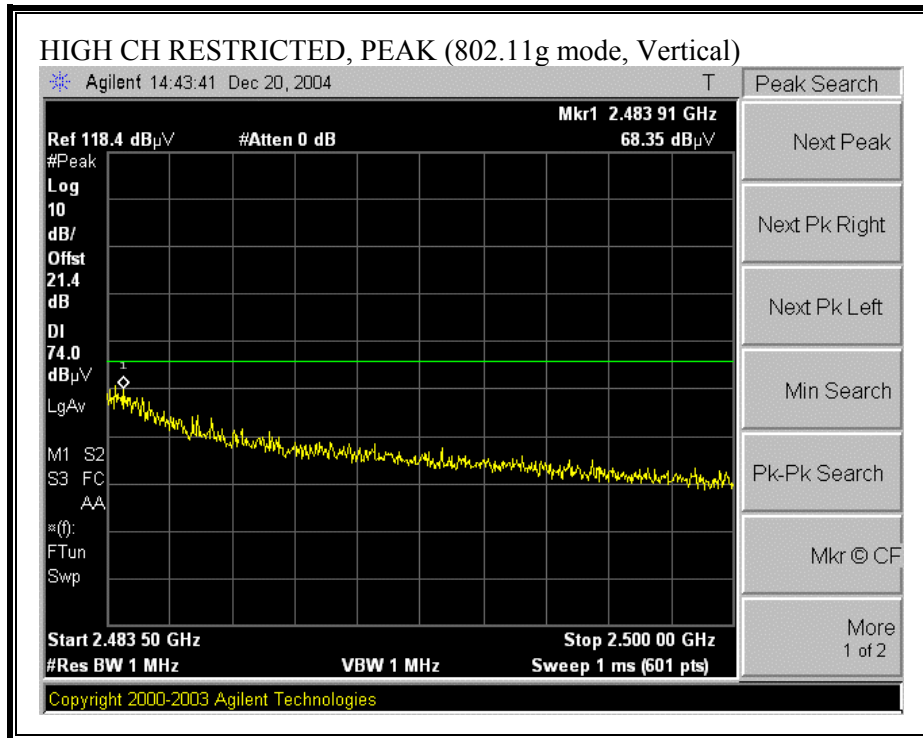


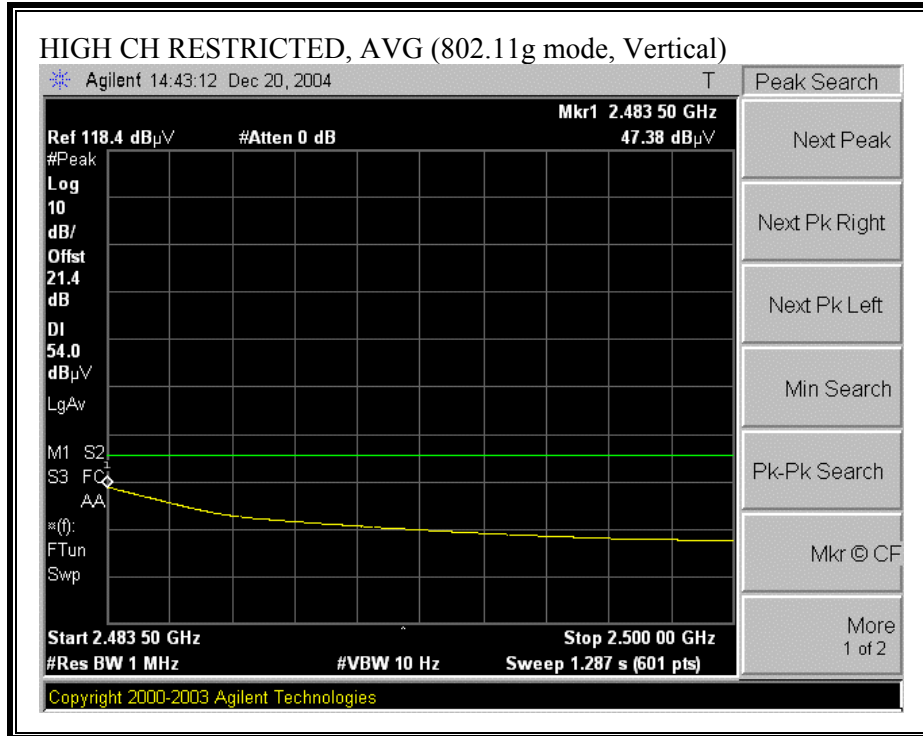
**RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, HORIZONTAL)**





**RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, VERTICAL)**





**HARMONICS AND SPURIOUS EMISSIONS (g MODE AND g TURBO MODE)**

11/30/04 **High Frequency Measurement**  
 Compliance Certification Services, Morgan Hill Open Field Site

**Test Engr:** David Garcia  
**Project #:** 04U3043-1  
**Company:** Atheros  
**EUT Descrip.:** 802.11a/b/g cardbus card with turbo mode  
**EUT M/N:** AR5BCB  
**Test Target:** FCC 15.247  
**Mode Oper:** 11g mode Transmitting

**Test Equipment:**

EMCO Horn 1-18GHz: T120; S/N: 29310 @3m  
 Pre-amplifier 1-26GHz: T63 Miteq 646456  
 Pre-amplifier 26-40GHz:   
 Horn > 18GHz:   
 Hi Frequency Cables: 2 foot cable, 3 foot cable (3\_David), 4 foot cable, 12 foot cable (12\_Yan)  
 HPF: HPF\_4.0GHz  
 Reject Filter:   
**Peak Measurements**  
 RBW=VBW=1MHz  
**Average Measurements**  
 RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>2412 Channel</b>															
4.824	3.0	47.9	36.5	33.6	4.6	-35.5	0.0	0.6	51.2	39.8	74	54	-22.8	-14.2	V
4.824	3.0	49.4	36.7	33.6	4.6	-35.5	0.0	0.6	52.7	40.0	74	54	-21.3	-14.0	H
<b>2417 Channel</b>															
4.834	3.0	47.3	35.7	33.6	4.6	-35.5	0.0	0.6	50.6	39.0	74	54	-23.4	-15.0	V
4.834	3.0	47.8	36.5	33.6	4.6	-35.5	0.0	0.6	51.1	39.8	74	54	-22.9	-14.2	H
<b>2437 Channel</b>															
4.874	3.0	50.9	37.6	33.7	4.6	-35.5	0.0	0.6	54.3	41.0	74	54	-19.7	-13.0	V
4.874	3.0	48.2	36.9	33.7	4.6	-35.5	0.0	0.6	51.6	40.3	74	54	-22.4	-13.7	H
<b>2457 Channel</b>															
4.914	3.0	56.9	41.4	33.7	4.7	-35.5	0.0	0.6	60.4	44.9	74	54	-13.6	-9.1	V
7.371	3.0	51.5	40.6	35.6	5.8	-34.8	0.0	0.6	58.7	47.8	74	54	-15.3	-6.2	H
<b>2462 Channel</b>															
4.924	3.0	53.4	39.6	33.7	4.7	-35.5	0.0	0.6	56.9	43.1	74	54	-17.1	-10.9	V
4.924	3.0			33.7	4.7	-35.5	0.0	0.6	3.5	3.5	74	54	-70.5	-50.5	H
<b>2437 Channel Turbo Mode</b>															
4.874	3.0	47.8	35.5	33.7	4.6	-35.5	0.0	0.6	51.2	38.9	74	54	-22.8	-15.1	H
4.874	3.0	47.6	35.5	33.7	4.6	-35.5	0.0	0.6	51.0	38.9	74	54	-23.0	-15.1	H
No further emissions were detected.															

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

### 7.3.3. TRANSMITTER ABOVE 1 GHz FOR 5725 TO 5850 MHz BAND

#### HARMONICS AND SPURIOUS EMISSIONS (802.11a MODE)

12/01/04 **High Frequency Measurement**  
 Compliance Certification Services, Morgan Hill Open Field Site

**Test Engr:** David Garcia  
**Project #:** 04U3043-1  
**Company:** Atheros  
**EUT Descrip.:** 802.11a/b/g cardbus card with turbo mode  
**EUT M/N:** AR5BCB  
**Test Target:** FCC 15.247  
**Mode Oper:** 11a 5.8 GHz band, Transmitting

**Test Equipment:**

<b>EMCO Horn 1-18GHz</b> T120; S/N: 29310 @3m	<b>Pre-amplifier 1-26GHz</b> T63 Miteq 646456	<b>Pre-amplifier 26-40GHz</b>	<b>Horn &gt; 18GHz</b> T39; ARA 18-26GHz; S/N:1013
<b>Hi Frequency Cables</b>			
<b>2 foot cable</b>	<b>3 foot cable</b> 3_David	<b>4 foot cable</b>	<b>12 foot cable</b> 12_Yan
<b>HPF</b> HPF_ 2.7GHz		<b>Reject Filter</b> R_001	

**Peak Measurements**  
RBW=VBW=1MHz

**Average Measurements**  
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>5745 Channel</b>															
11.490	3.0	47.8	38.2	38.4	7.9	-34.3	0.0	0.8	60.6	51.0	74	54	-13.4	-3.0	V
11.490	3.0	46.8	35.0	38.4	7.9	-34.3	0.0	0.8	59.6	47.8	74	54	-14.4	-6.2	H
<b>5785 Channel</b>															
11.570	3.0	49.9	38.9	38.5	7.9	-34.4	0.0	0.8	62.8	51.8	74	54	-11.2	-2.2	V
11.570	3.0	45.5	35.1	38.5	7.9	-34.4	0.0	0.8	58.4	48.0	74	54	-15.6	-6.0	H
<b>5825 Channel</b>															
11.650	3.0	51.8	38.8	38.7	8.0	-34.5	0.0	0.8	64.8	51.8	74	54	-9.2	-2.2	V
11.650	3.0	47.3	35.7	38.7	8.0	-34.5	0.0	0.8	60.3	48.7	74	54	-13.7	-5.3	H
No further emissions were detected.															

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		

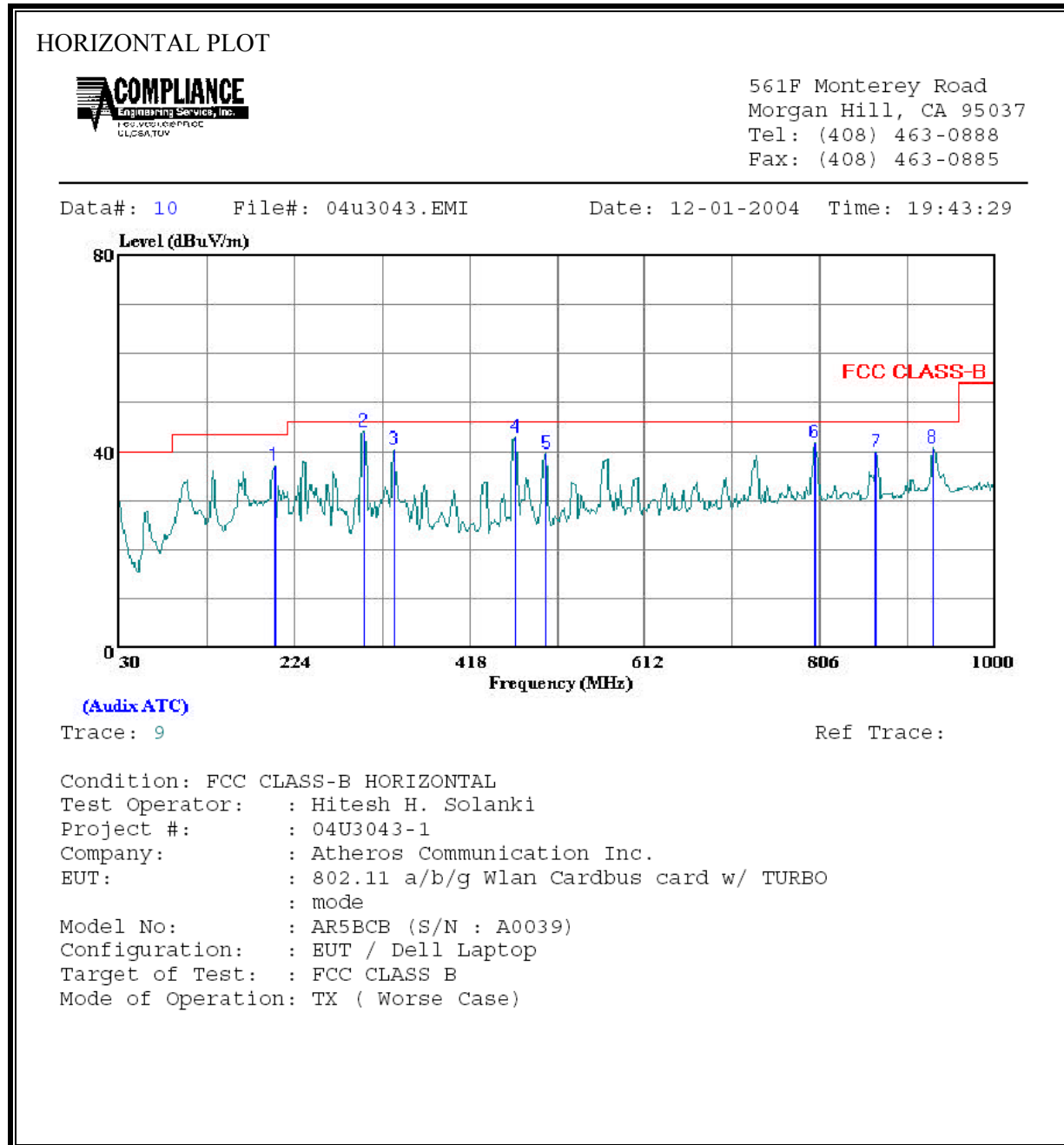
**HARMONICS AND SPURIOUS EMISSIONS (802.11a TURBO MODE)**

12/01/04 <b>High Frequency Measurement</b> Compliance Certification Services, Morgan Hill Open Field Site  <b>Test Engr:</b> David Garcia <b>Project #:</b> 04U3043-1 <b>Company:</b> Atheros <b>EUT Descrip.:</b> 802.11a/b/g cardbus card with turbo mode <b>EUT M/N:</b> AR5BCB <b>Test Target:</b> FCC 15.247 <b>Mode Oper:</b> 11a 5.8 GHz band, Turbo mode, Transmitting  <b>Test Equipment:</b>																	
EMCO Horn 1-18GHz		Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz									
T120; S/N: 29310 @3m		T63 Miteq 646456						T39; ARA 18-26GHz; S/N:1013									
Hi Frequency Cables																	
2 foot cable		3 foot cable		4 foot cable		12 foot cable			HPF		Reject Filter						
		3_David				12_Yan			HPF_2.7GHz		R_001						
<b>Peak Measurements</b> RBW=VBW=1MHz  <b>Average Measurements</b> RBW=1MHz ; VBW=10Hz																	
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)		
<b>S760 Channel</b>																	
11.520	3.0	47.8	35.9	38.5	7.9	-34.3	0.0	0.8	60.6	48.7	74	54	-13.4	-5.3	V		
11.520	3.0	45.5	34.7	38.5	7.9	-34.3	0.0	0.8	58.3	47.5	74	54	-15.7	-6.5	H		
<b>S805 Channel</b>																	
11.610	3.0	48.8	37.2	38.6	8.0	-34.4	0.0	0.8	61.7	50.1	74	54	-12.3	-3.9	V		
11.610	3.0	45.4	35.0	38.6	8.0	-34.4	0.0	0.8	58.3	47.9	74	54	-15.7	-6.1	H		
No further emissions were detected.																	
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																	



### 7.3.4. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

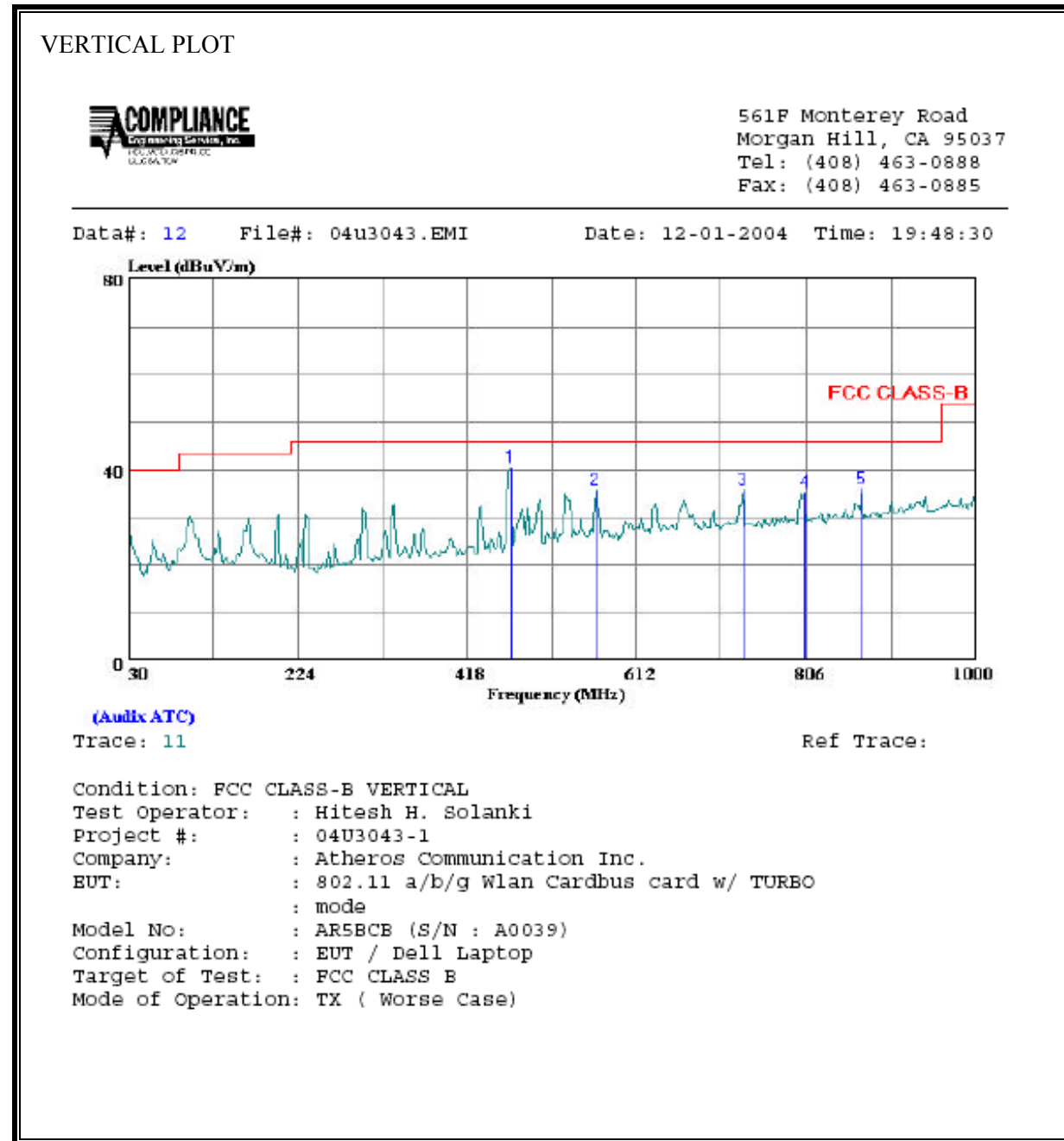
#### SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)



HORIZONTAL DATA

	Freq	Remark	Read Level	Level	Factor	Limit Line	Over Limit
	MHz		dBuV	dBuV/m	dB	dBuV/m	dB
1	201.690	Peak	49.89	37.17	-12.73	43.50	-6.33
2	300.630	Peak	54.32	44.02	-10.30	46.00	-1.98
3	334.580	Peak	50.30	40.52	-9.78	46.00	-5.48
4	468.440	Peak	50.26	42.84	-7.42	46.00	-3.16
5	502.390	Peak	46.54	39.69	-6.85	46.00	-6.31
6	800.180	Peak	44.06	41.71	-2.35	46.00	-4.29
7	868.080	Peak	41.19	39.75	-1.44	46.00	-6.25
8	931.130	Peak	40.99	40.80	-0.19	46.00	-5.20

**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**



VERTICAL DATA

	Freq	Remark	Read Level	Level	Factor	Limit Line	Over Limit
	MHz		dBuV	dBuV/m	dB	dBuV/m	dB
1	468.440	Peak	47.94	40.52	-7.42	46.00	-5.48
2	565.440	Peak	41.85	35.80	-6.05	46.00	-10.20
3	735.190	Peak	38.84	35.67	-3.17	46.00	-10.33
4	803.090	Peak	37.36	35.07	-2.29	46.00	-10.93
5	868.080	Peak	37.56	36.12	-1.44	46.00	-9.88

## 7.4. 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  $\mu$ H/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.

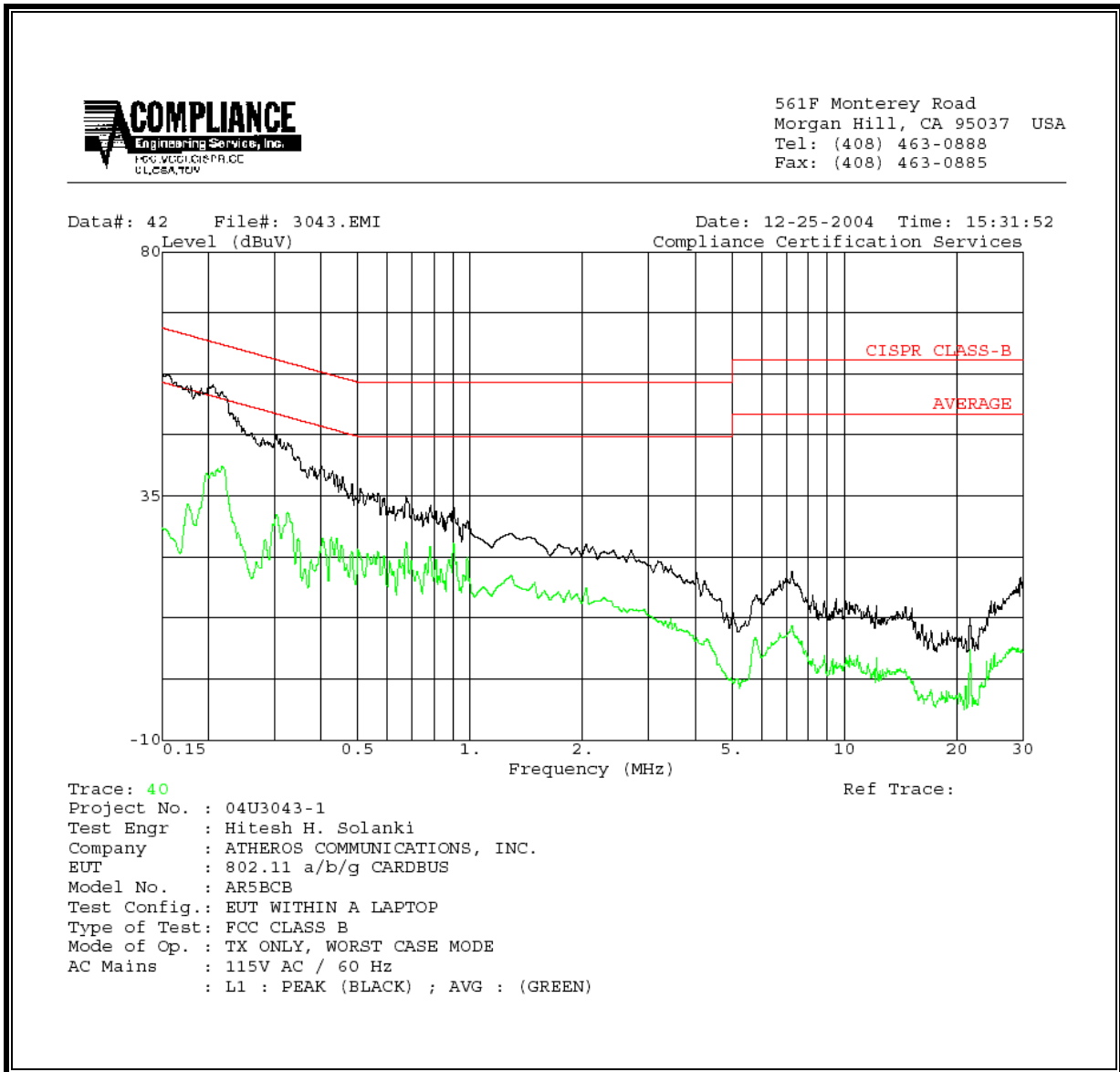
### RESULTS

No non-compliance noted:

**6 WORST EMISSIONS**

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	IC B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.15	61.40	--	38.50	0.00	66.00	56.00	-4.60	-17.50	L1
0.68	37.22	--	30.53	0.00	56.00	46.00	-18.78	-15.47	L1
8.24	36.76	--	26.84	0.00	60.00	50.00	-23.24	-23.16	L1
0.15	57.38	--	39.81	0.00	66.00	56.00	-8.62	-16.19	L2
0.68	35.04	--	26.48	0.00	56.00	46.00	-20.96	-19.52	L2
7.25	21.18	--	10.02	0.00	60.00	50.00	-38.82	-39.98	L2
6 Worst Data									

**LINE 1 RESULTS**



**LINE 2 RESULTS**

