



**FCC CFR47 PART 15 SUBPART C  
CERTIFICATION**

**TEST REPORT**

**FOR**

**802.11 a/b/g MINI PCI MODULE**

**MODEL NUMBER: AR5BMB6**

**FCC ID: PPD-AR5BMB6**

**REPORT NUMBER: 05U3230-1**

**ISSUE DATE: MARCH 19, 2005**

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Revision History

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

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## 1. ATTESTATION OF TEST RESULTS

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

**EUT DESCRIPTION:** 802.11 a/b/g MINI PCI MODULE

**MODEL:** AR5BMB6

**SERIAL NUMBER:** 0011F5-3C53C1, 0011F5-007890, MB62-452-L0519

**DATE TESTED:** JANUARY 26 – MARCH 19, 2005

| 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.

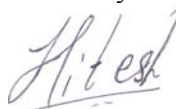
**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions 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:



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EMC SUPERVISOR  
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## 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 a MiniPCI 802.11a/b/g (with TURBO modes) transceiver module.

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<br>(MHz) | Mode          | Output Power<br>(dBm) | Output Power<br>(mW) |
|--------------------------|---------------|-----------------------|----------------------|
| 2412 - 2462              | 802.11b       | 20.16                 | 103.75               |
| 2412 - 2462              | 802.11g       | 27.29                 | 535.80               |
| 2412 - 2462              | 802.11g Turbo | 25.83                 | 382.82               |

5725 to 5850 MHz Authorized Band

| Frequency Range<br>(MHz) | Mode          | Output Power<br>(dBm) | Output Power<br>(mW) |
|--------------------------|---------------|-----------------------|----------------------|
| 5745 - 5825              | 802.11a       | 23.44                 | 220.80               |
| 5760 - 5805              | 802.11a Turbo | 22.41                 | 174.18               |

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

The radio utilizes a WNC W/N-S-1.13-300W- (2-2-1) & 300B-(2-2-1) Omnidirectional antenna, which has a maximum antenna gain of 3.6dBi (Including cable loss) at 2.4GHz band, and gain of 4.8dBi (Including cable loss) at 5.8GHz band. And the radio also utilizes a WNC WN-S-1.37-300W- (2-2-1)&300B-(2-2-1) Omnidirectional antenna, which has a maximum antenna gain of 5.6dBi (Including cable loss) at 5.2GHz band. All other lower gain antennas of the same type that may be used with this module are listed in a separate document.

### **5.4. SOFTWARE AND FIRMWARE**

The EUT driver software installed in the host support equipment during testing was Atheros AR 5002 Anwi Diagnostic Kernal.

The test utility software used during testing was ART, rev. 5.2 Build 55.

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

The worst-case channel is determined as the channel with the highest average output power. The highest measured average output powers were at 2437MHz for g mode and 5320 MHz for a mode

The worst-case data rate for the channel is determined to be 6 Mb/s, based on previous experience with CB62 testing.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| PERIPHERAL SUPPORT EQUIPMENT LIST |              |              |               |
|-----------------------------------|--------------|--------------|---------------|
| Description                       | Manufacturer | Model        | Serial Number |
| Laptop PC                         | IBM          | Thinkpad R40 | FX-28542      |
| AC Adapter                        | IBM          | 08K8204      | 6LV3CD7EN     |
| Laptop PC                         | Dell         | PR04S        | 48Q-0211      |
| AC Adapter                        | Dell         | HP-0Q065B83  | N/A           |

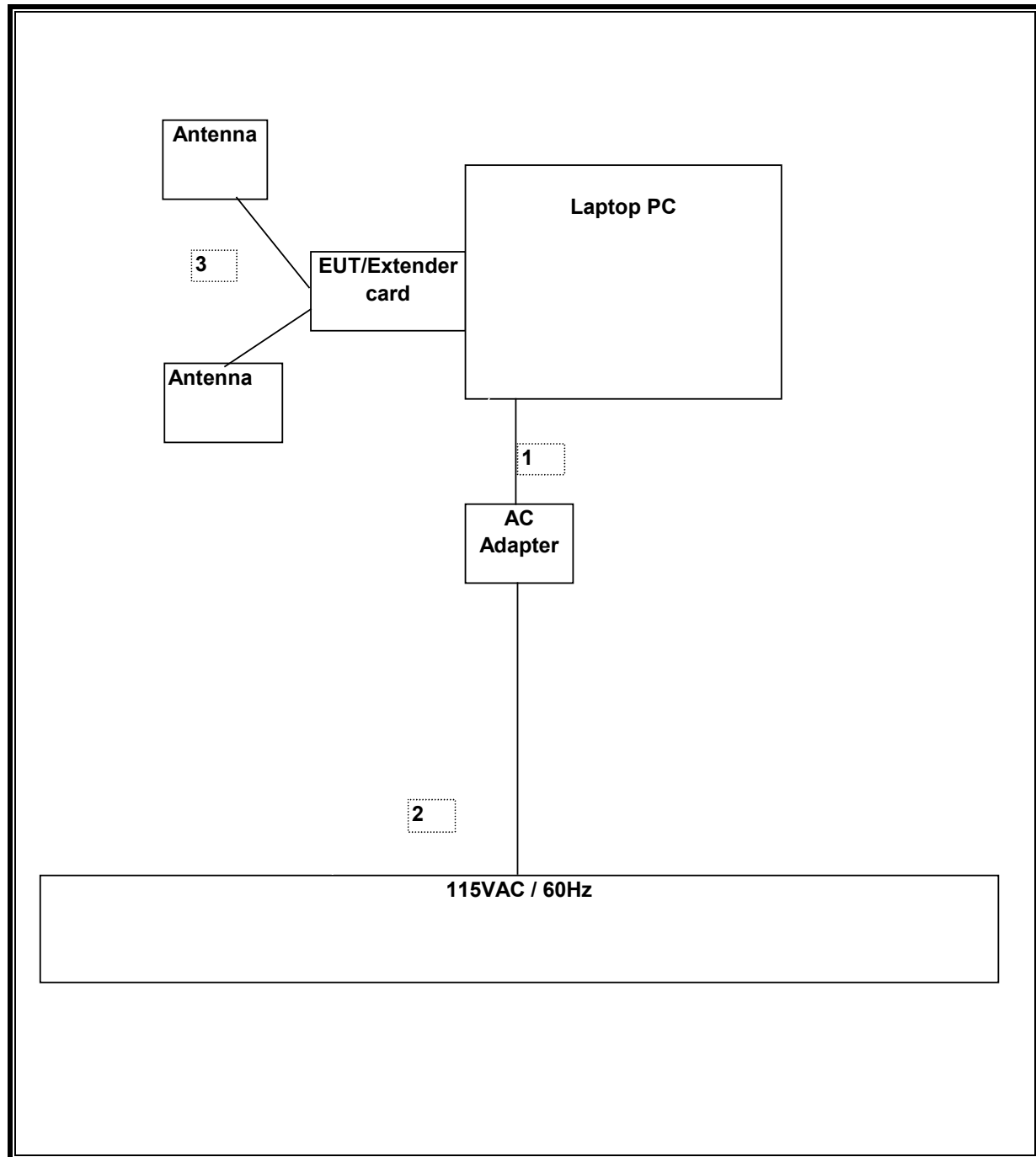
### I/O CABLES

| I/O CABLE LIST |         |                      |                |            |              |
|----------------|---------|----------------------|----------------|------------|--------------|
| Cable No.      | Port    | # of Identical Ports | Connector Type | Cable Type | Cable Length |
| 1              | DC      | 1                    | DC             | Unshielded | 1.8 m        |
| 2              | AC      | 1                    | IEC            | Unshielded | 1.5 m        |
| 3              | Antenna | 2                    | UFL            | Unshielded | .7 m         |

### TEST SETUP

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

**SETUP DIAGRAM FOR TESTS**



## 6. TEST AND MEASUREMENT EQUIPMENT

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

| Description                          | Manufacturer   | Model            | Serial Number | Cal Due    |
|--------------------------------------|----------------|------------------|---------------|------------|
| EMI Test Receiver                    | R & S          | ESHS 20          | 827129/006    | 10/22/2005 |
| Site A Line Stabilizer / Conditioner | Tripplite      | LC-1800a         | A0051681      | CNR        |
| LISN, 10 kHz ~ 30 MHz                | FCC            | LISN-50/250-25-2 | 2023          | 8/30/2005  |
| LISN, 10 kHz ~ 30 MHz                | Solar          | 8012-50-R-24-BNC | 8379443       | 10/21/2005 |
| Spectrum Analyzer                    | HP             | E4446A           | US42510266    | 8/25/2005  |
| Antenna, Horn 1 ~ 18 GHz             | EMCO           | 3117             | 29310         | 9/12/2005  |
| Preamplifier, 1 ~ 26.5 GHz           | HP             | 8449B            | 3008A00369    | 8/17/2005  |
| Temperature / Humidity Chamber       | Thermotron     | SE 600-10-10     | 29800         | 5/13/2005  |
| Peak Power Meter                     | Agilent        | E4416A           | GB41291160    | 2/9/2006   |
| SA Display Section 2                 | HP             | 85662A           | 2816A16696    | 5/24/2005  |
| Quasi-Peak Adaptor                   | HP             | 85650A           | 2811A01155    | 5/24/2005  |
| Spectrum Analyzer                    | HP             | 8568B            |               | 5/25/2005  |
| 30MHz---- 2Ghz                       | Sunol Sciences | JB1 Antenna      | A121003       | 9/22/2005  |
| 4.0 High Pass Filter                 | Micro Tronics  | HPM13351         | 3             | N/A        |
| 2.4 - 2.5 Reject Filter              | Micro Tronics  | BRM50702         | 3             | N/A        |
| 5.75 - 5.8 Reject Filter             | Micro Tronics  | BRC13192         | 2             | N/A        |
| 5.15 - 5.25 Reject Filter            | Micro Tronics  | BRC13190         | 2             | N/A        |

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

### 6.1.1. 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            | 12000                | 500                 | 11500        |
| Low     | 2417            | 12000                | 500                 | 11500        |
| Middle  | 2437            | 12000                | 500                 | 11500        |
| High    | 2457            | 11080                | 500                 | 10580        |
| High    | 2462            | 12500                | 500                 | 12000        |

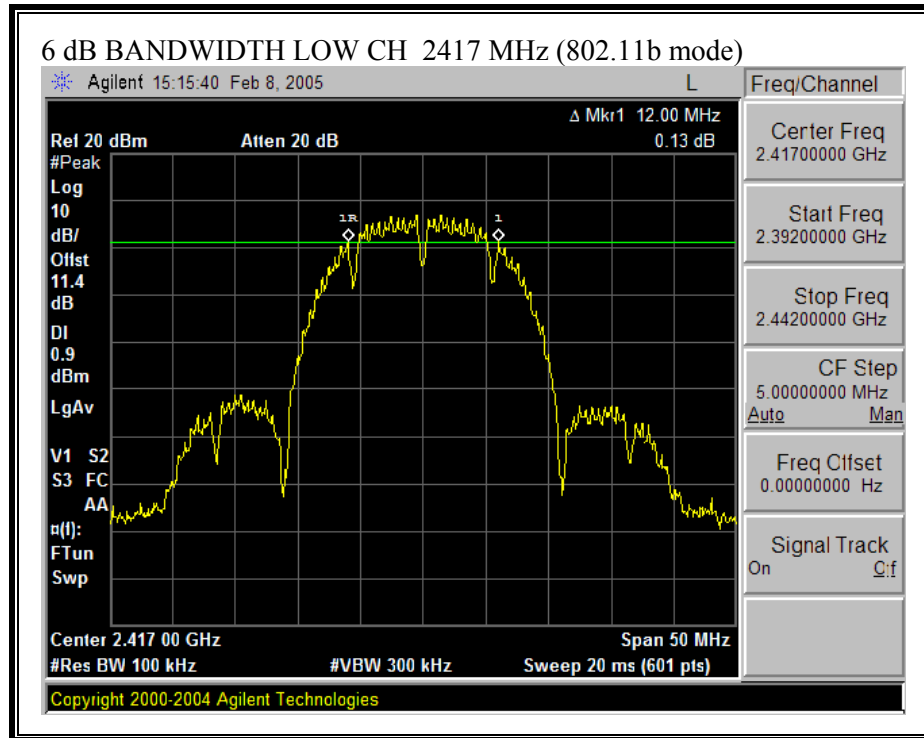
##### 802.11g Mode

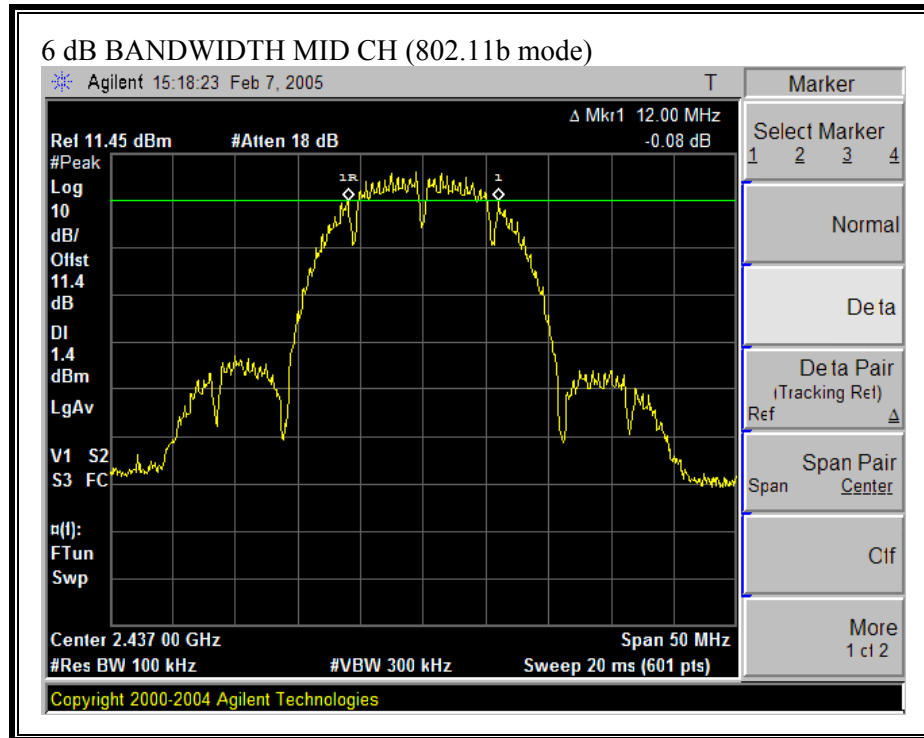
| Channel | Frequency (MHz) | 6 dB Bandwidth (kHz) | Minimum Limit (kHz) | Margin (kHz) |
|---------|-----------------|----------------------|---------------------|--------------|
| Low     | 2412            | 16330                | 500                 | 15830        |
| Low     | 2417            | 16330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

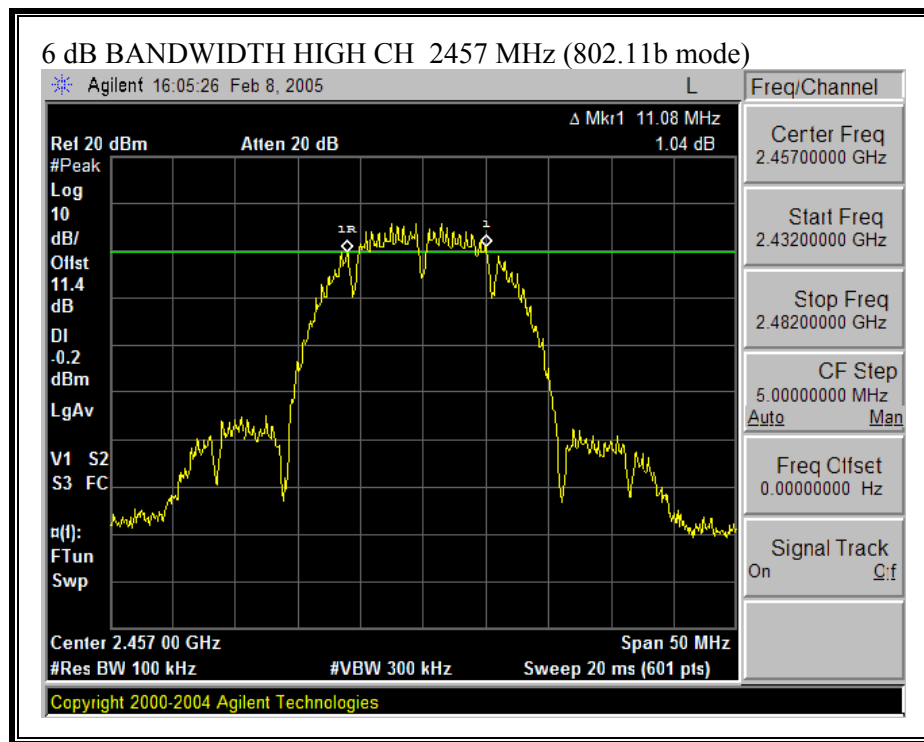
##### 802.11g Turbo Mode

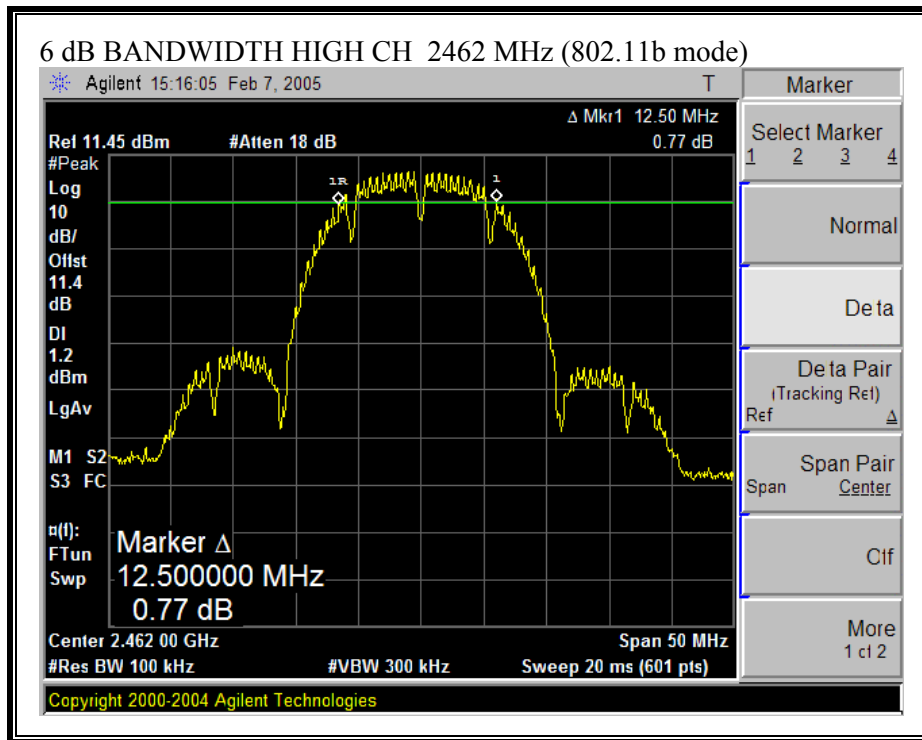
| Channel | Frequency (MHz) | 6 dB Bandwidth (kHz) | Minimum Limit (kHz) | Margin (kHz) |
|---------|-----------------|----------------------|---------------------|--------------|
| Middle  | 2437            | 31330                | 500                 | 30830        |



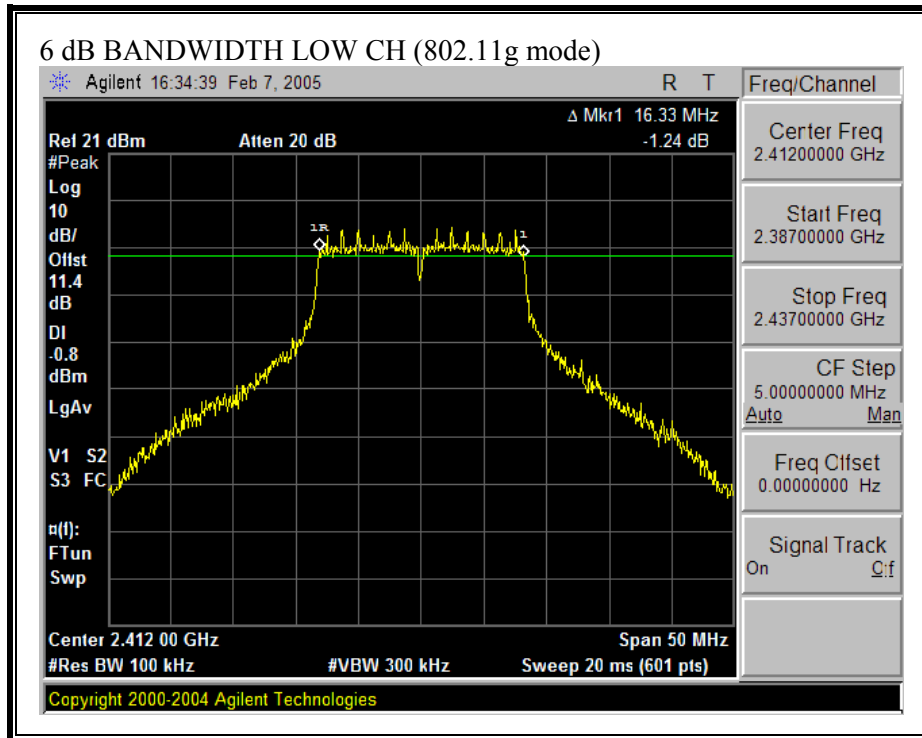


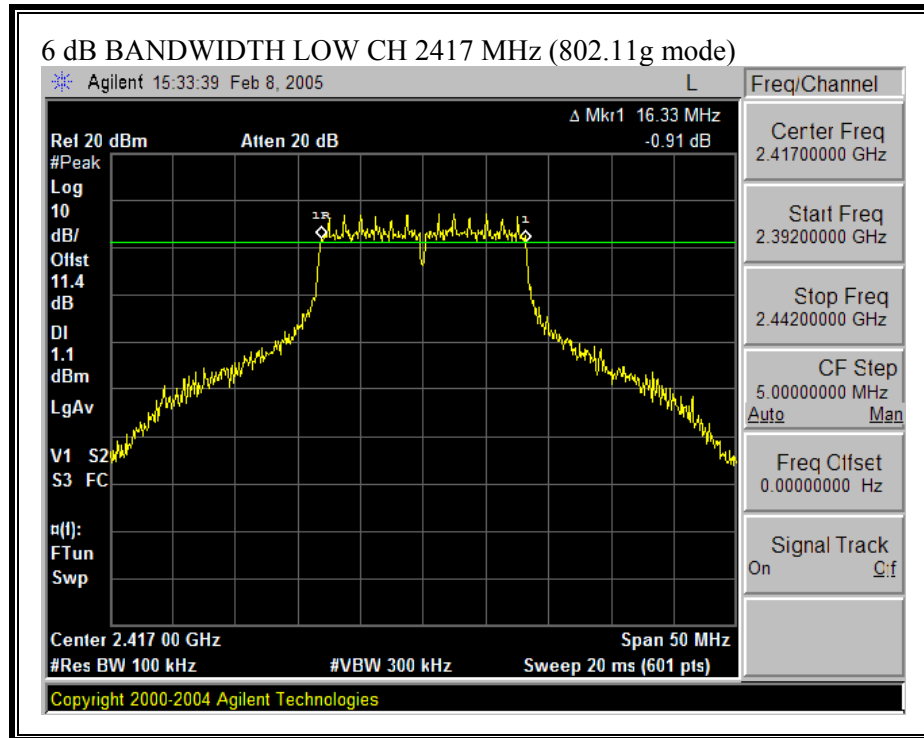


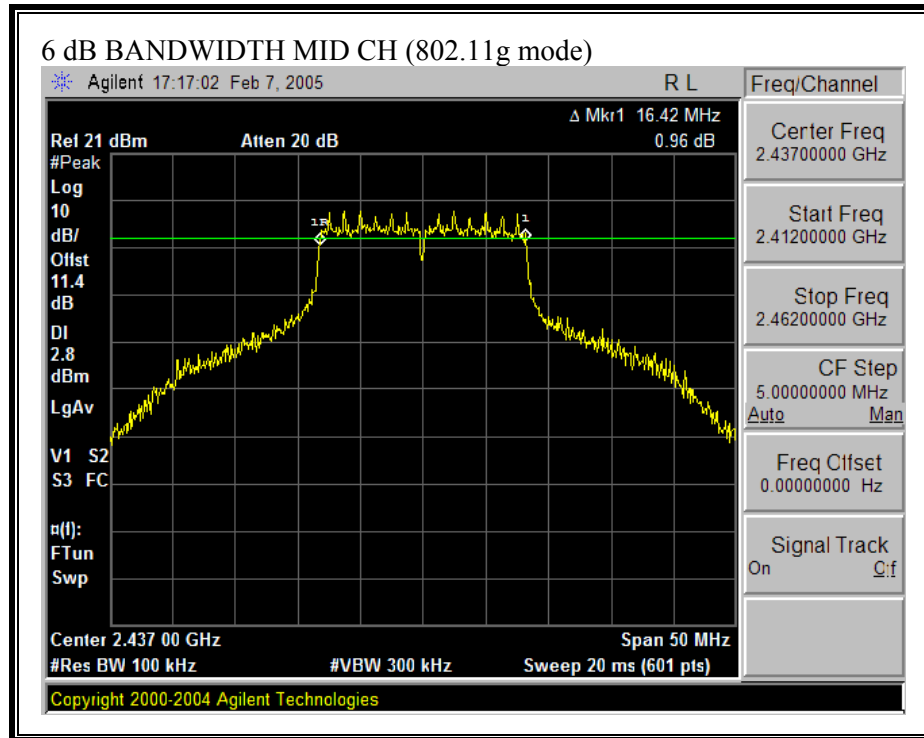


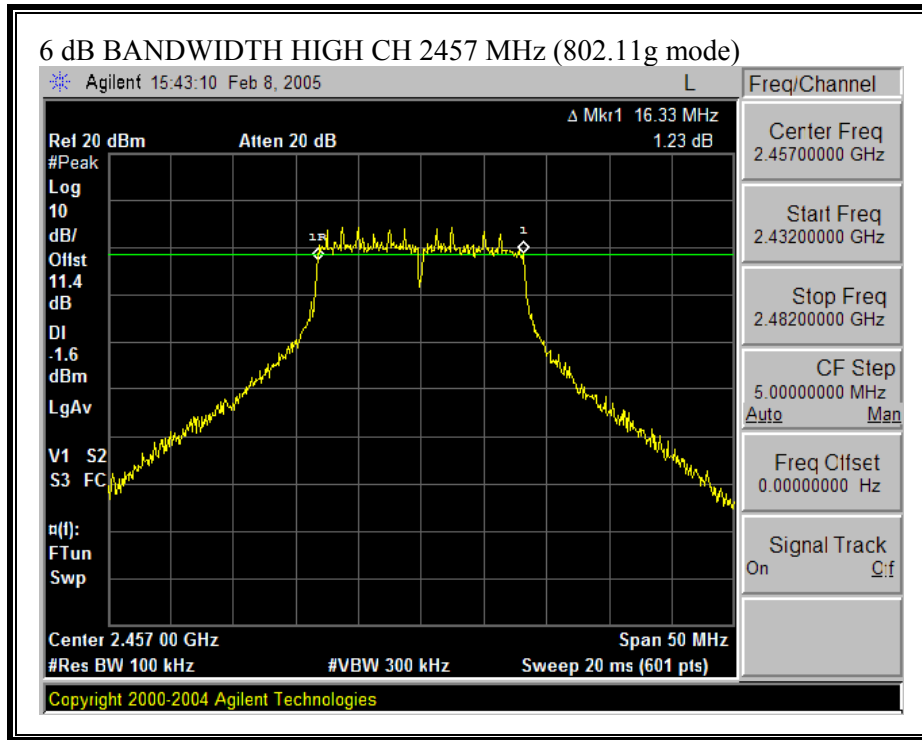


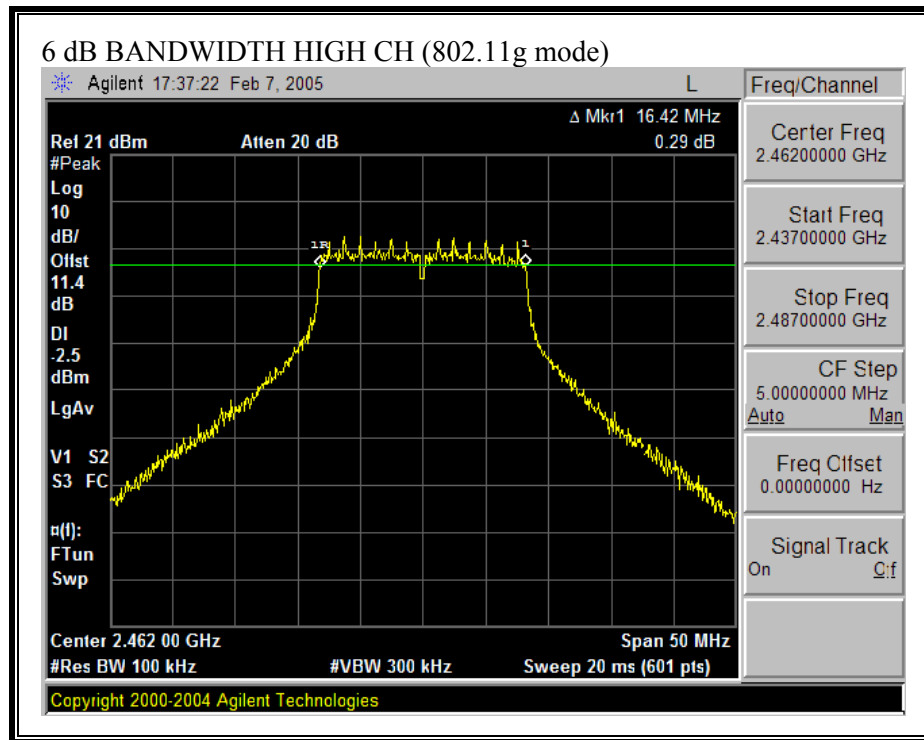
**6 dB BANDWIDTH (802.11g MODE)**



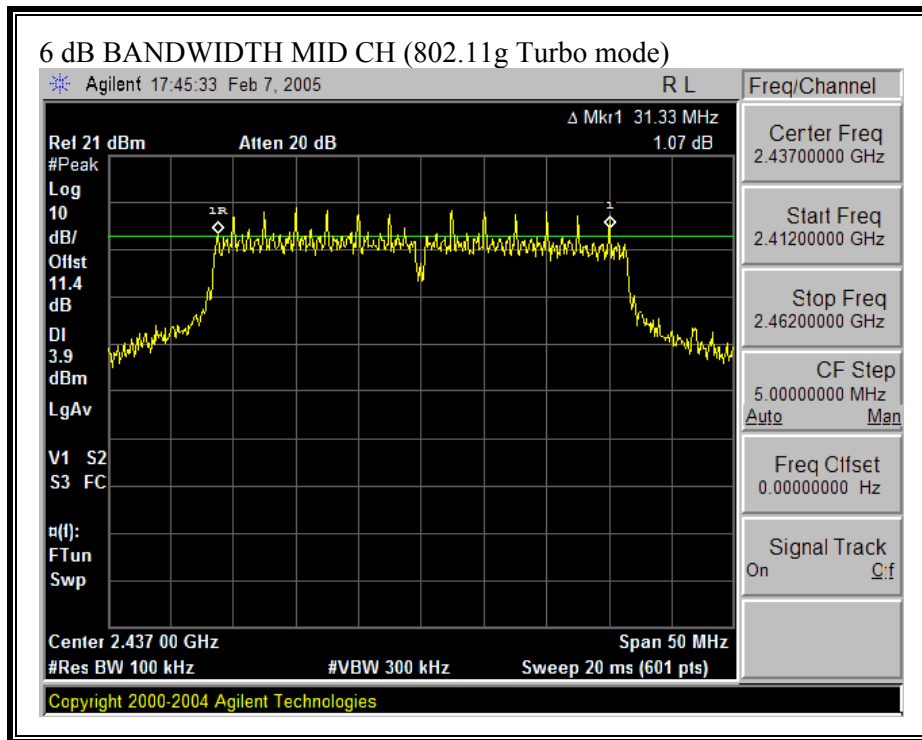








**6 DB BANDWIDTH (802.11g TURBO MODE)**



### 6.1.2. 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<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low     | 2412               | 15.601                 |
| Low     | 2417               | 15.556                 |
| Middle  | 2437               | 15.628                 |
| High    | 2457               | 15.532                 |
| High    | 2462               | 15.522                 |

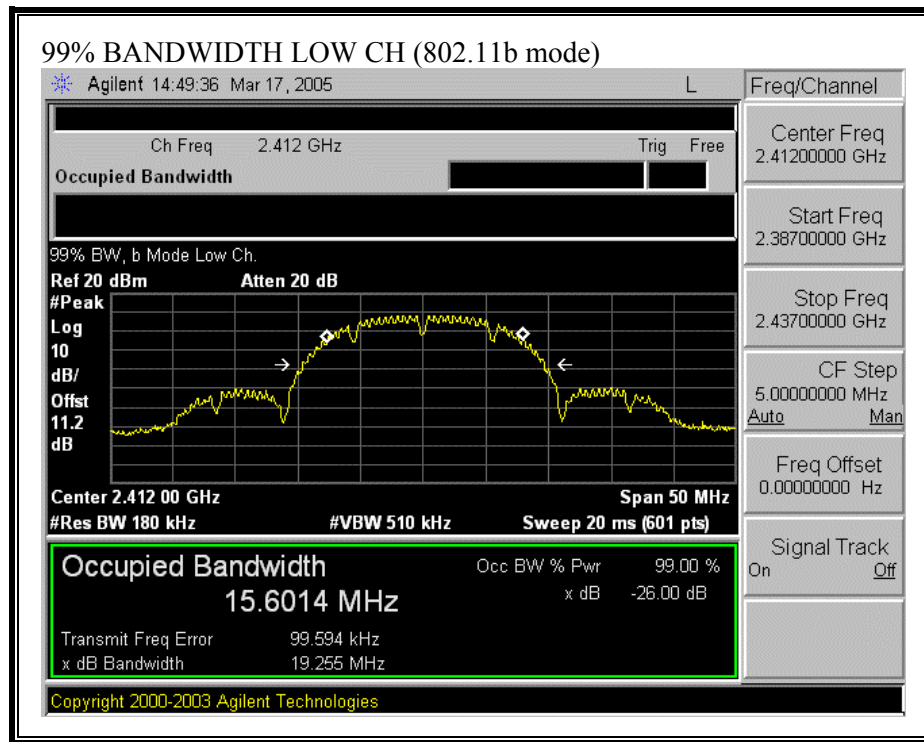
##### 802.11g Mode

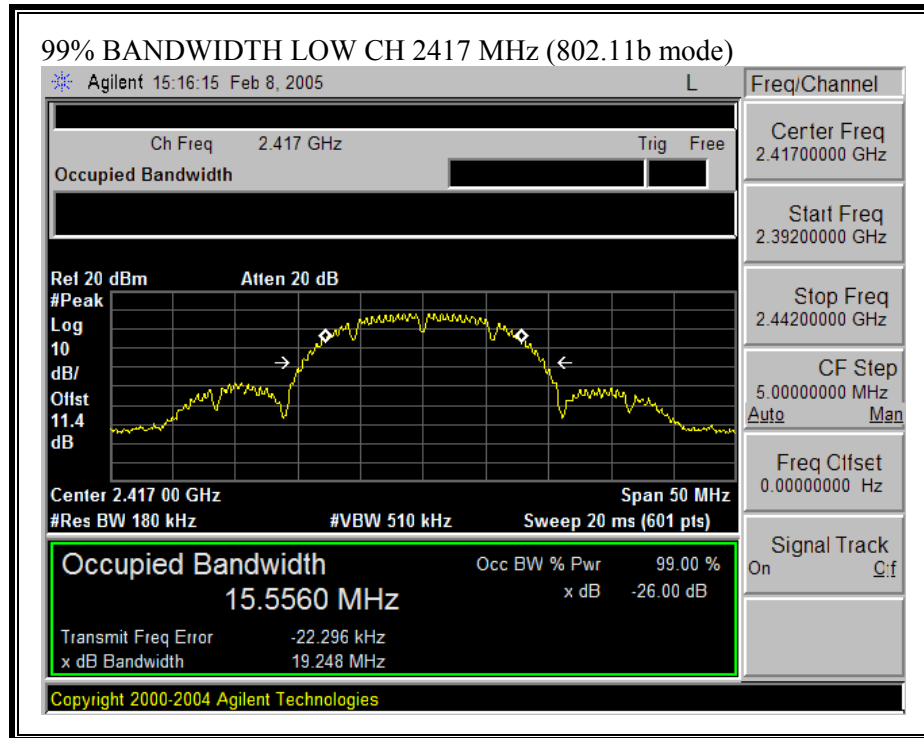
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low     | 2412               | 16.73                  |
| Low     | 2417               | 16.981                 |
| Middle  | 2437               | 16.991                 |
| High    | 2457               | 16.917                 |
| High    | 2462               | 16.742                 |

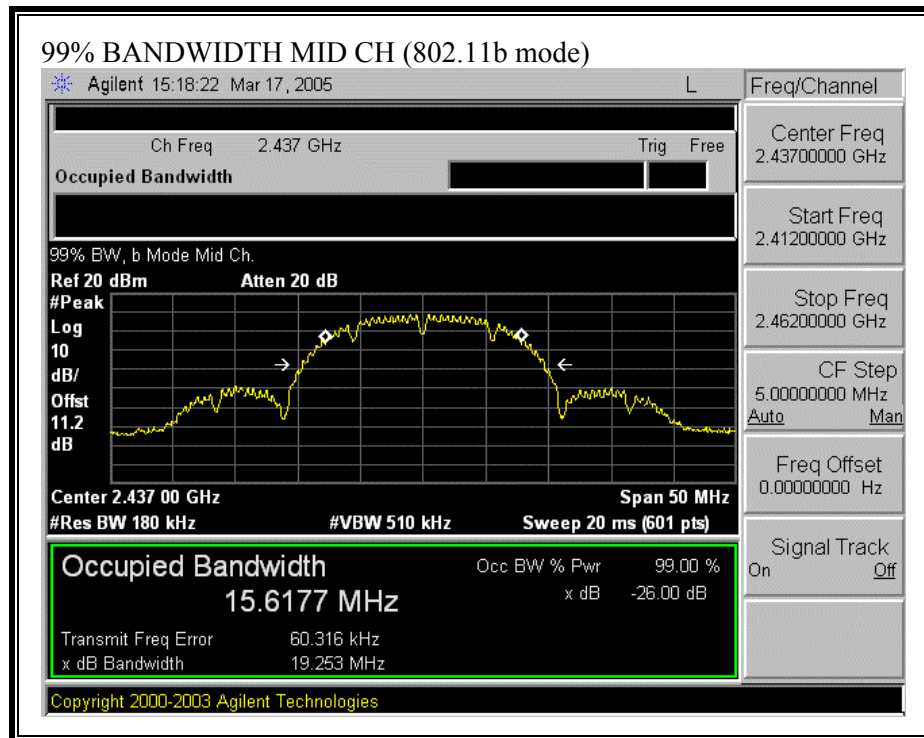
##### 802.11g Turbo Mode

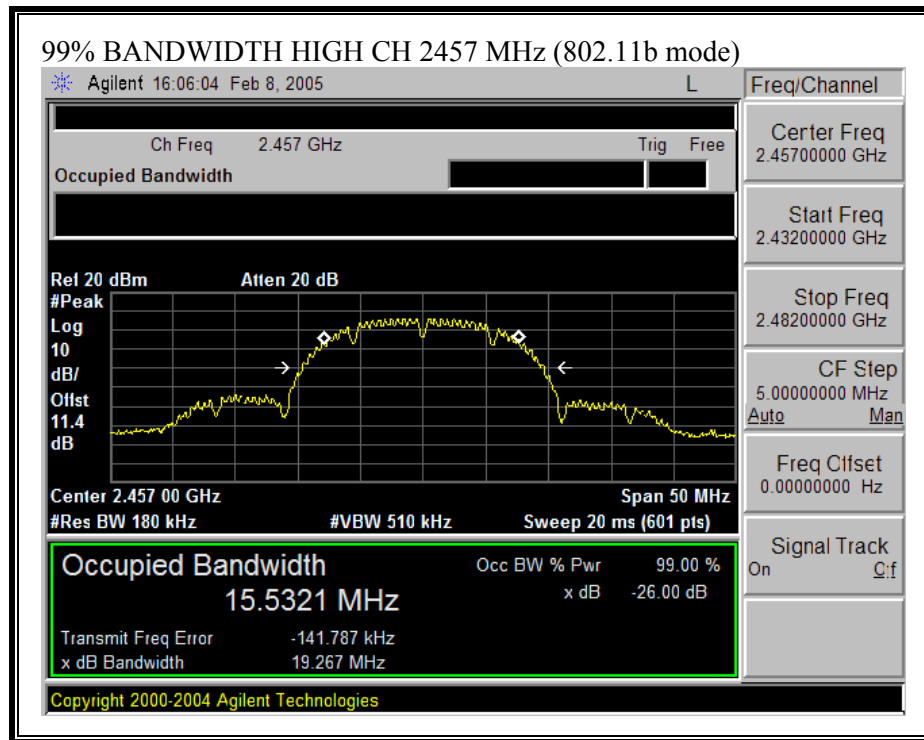
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Middle  | 2437               | 33.258                 |

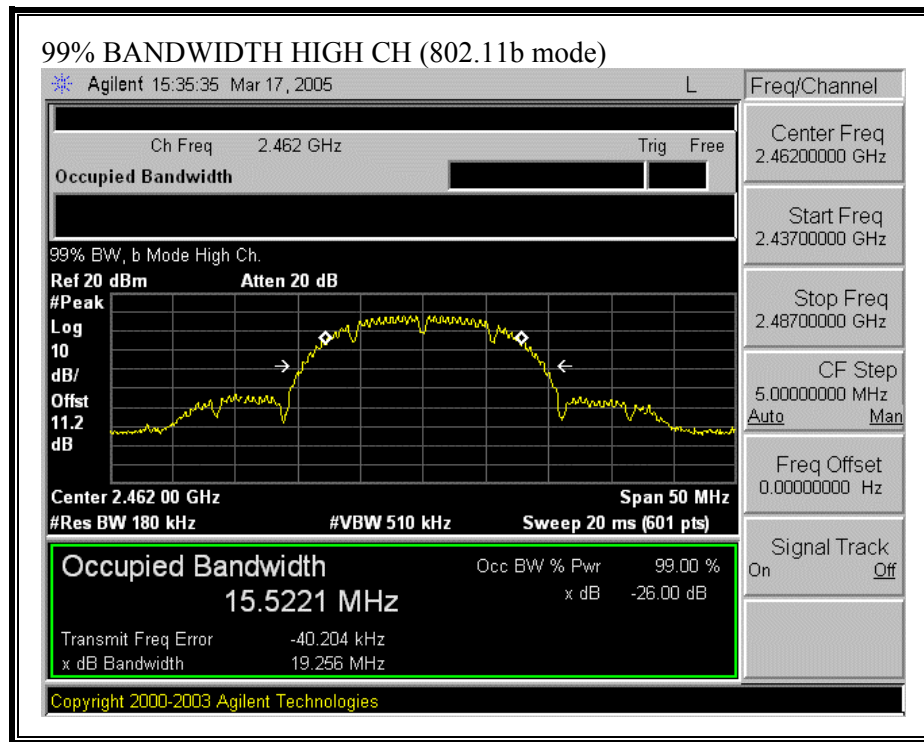
**99% BANDWIDTH (802.11b MODE)**



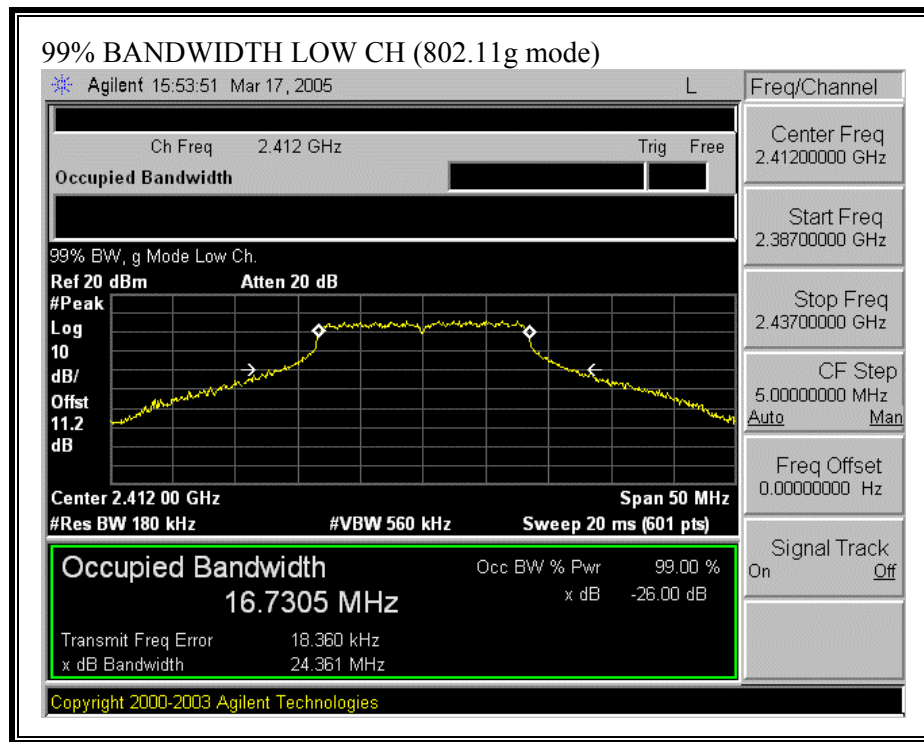


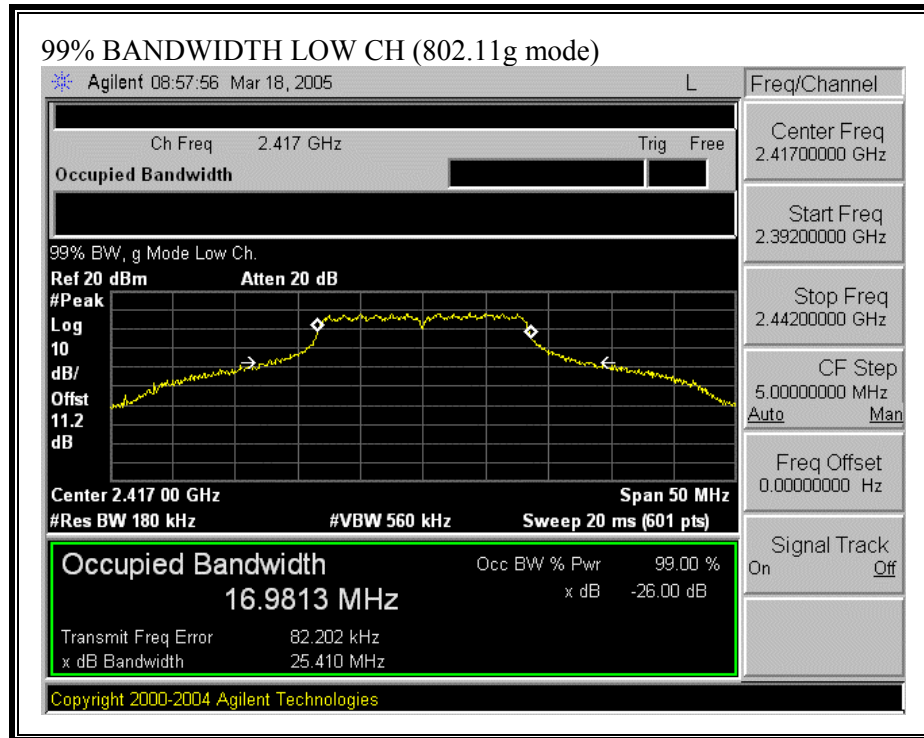


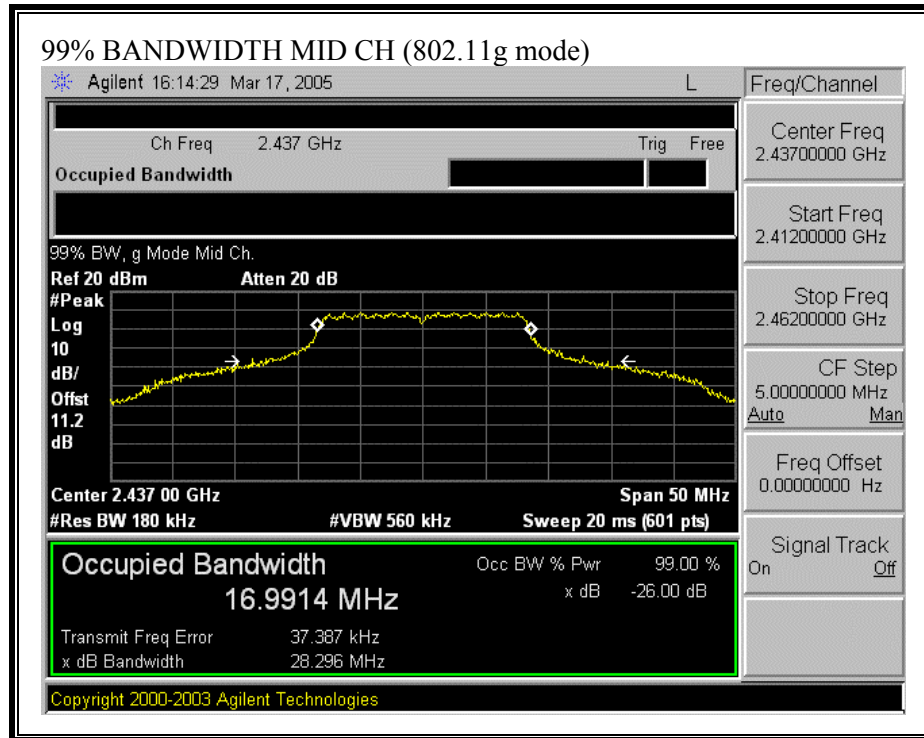


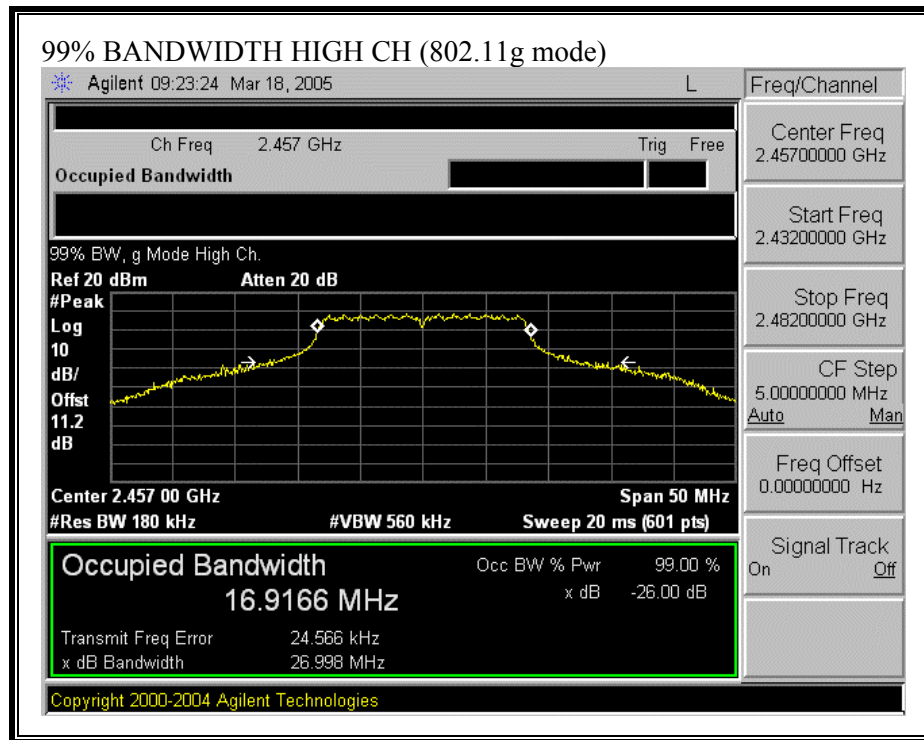


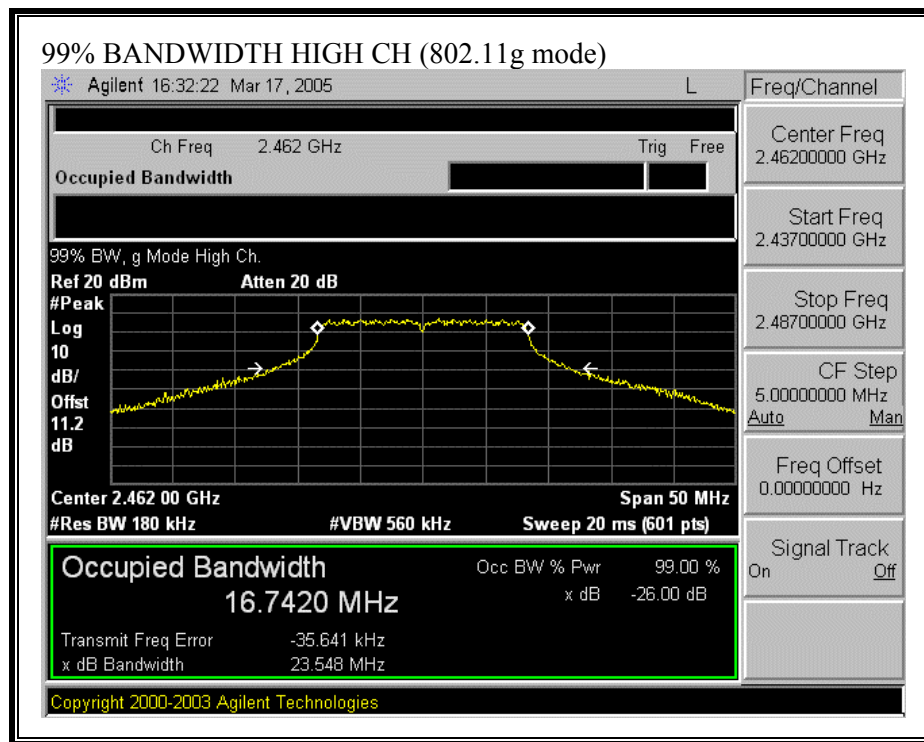
**99% BANDWIDTH (802.11g MODE)**



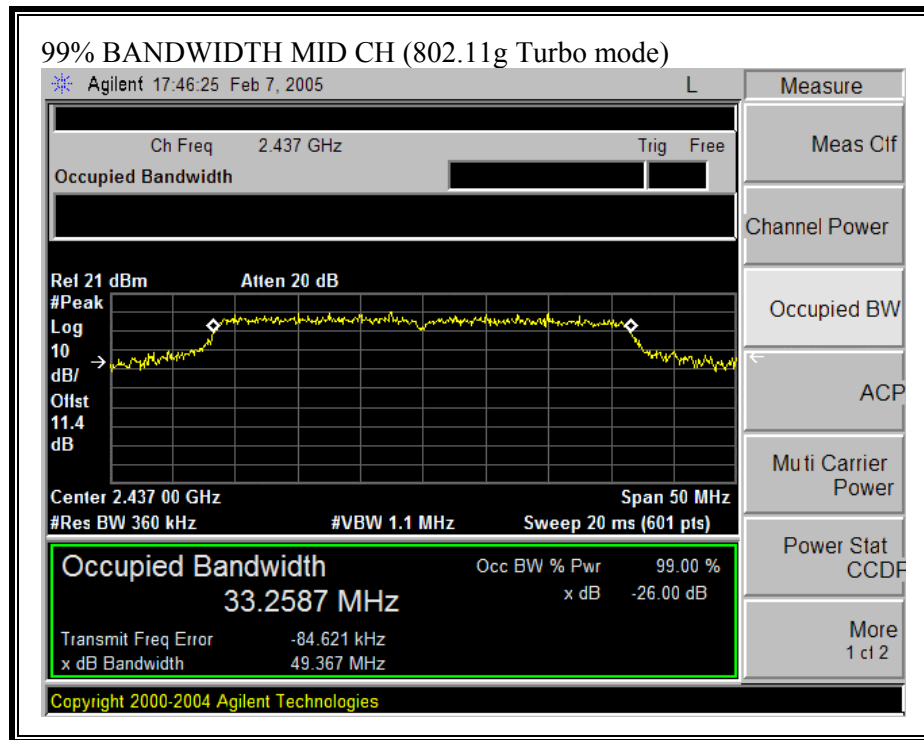








**99% BANDWIDTH (802.11g TURBO MODE)**



### **6.1.3. PEAK OUTPUT POWER**

#### **PEAK POWER LIMIT**

§15.247 (b) The maximum peak output power of the intentional radiator should 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 3.62 dBi for other than fixed, point-to-point operation; therefore the limit is 30 dBm.

No non-compliance noted:

### 802.11b Mode

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>Peak Power<br/>(dBm)</b> | <b>Limit<br/>(dBm)</b> | <b>Margin<br/>(dB)</b> |
|----------------|----------------------------|-----------------------------|------------------------|------------------------|
| Low            | 2412                       | 19.97                       | 30                     | -10.03                 |
| Low            | 2417                       | 19.30                       | 30                     | -10.70                 |
| Middle         | 2437                       | 20.16                       | 30                     | -9.84                  |
| High           | 2457                       | 19.94                       | 30                     | -10.06                 |
| High           | 2462                       | 19.86                       | 30                     | -10.14                 |

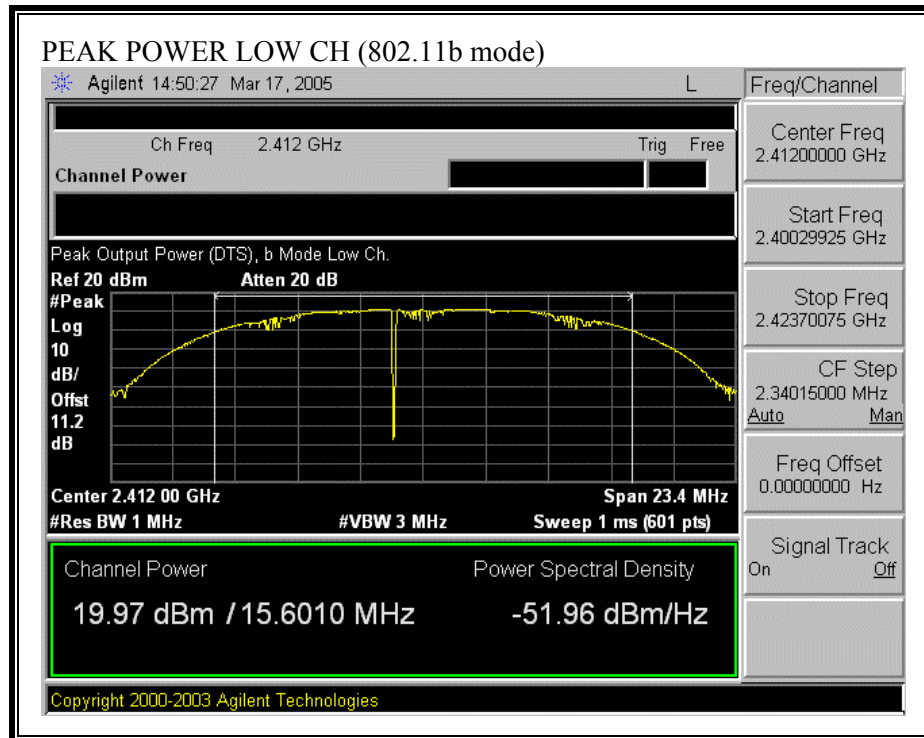
### 802.11g Mode

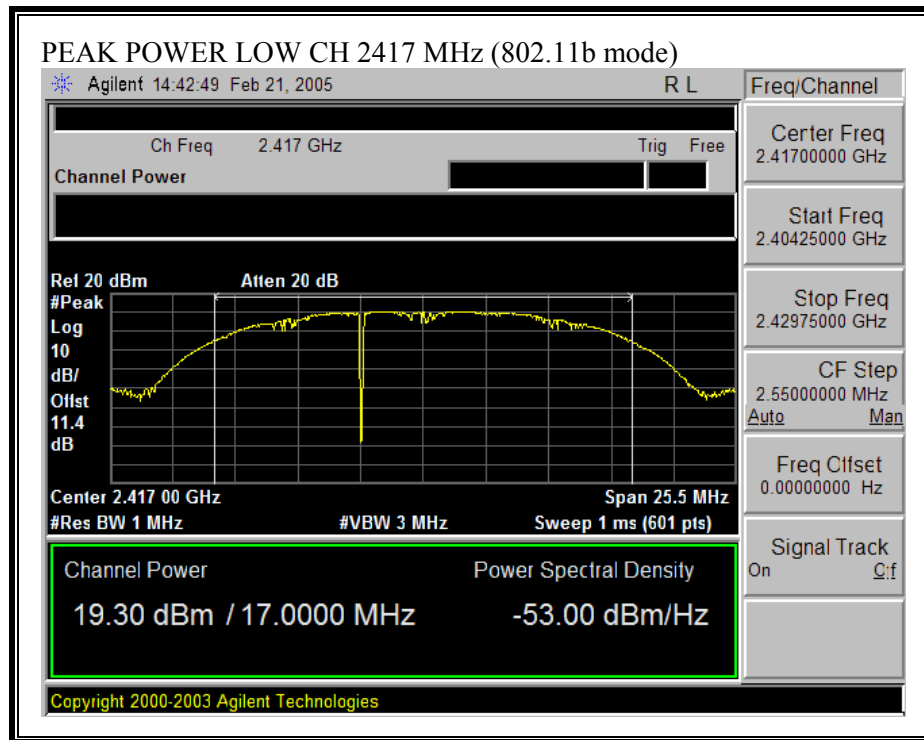
| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>Peak Power<br/>(dBm)</b> | <b>Limit<br/>(dBm)</b> | <b>Margin<br/>(dB)</b> |
|----------------|----------------------------|-----------------------------|------------------------|------------------------|
| Low            | 2412                       | 24.20                       | 30                     | -5.80                  |
| Low            | 2417                       | 26.63                       | 30                     | -3.37                  |
| Middle         | 2437                       | 27.29                       | 30                     | -2.71                  |
| High           | 2457                       | 26.96                       | 30                     | -3.04                  |
| High           | 2462                       | 25.38                       | 30                     | -4.62                  |

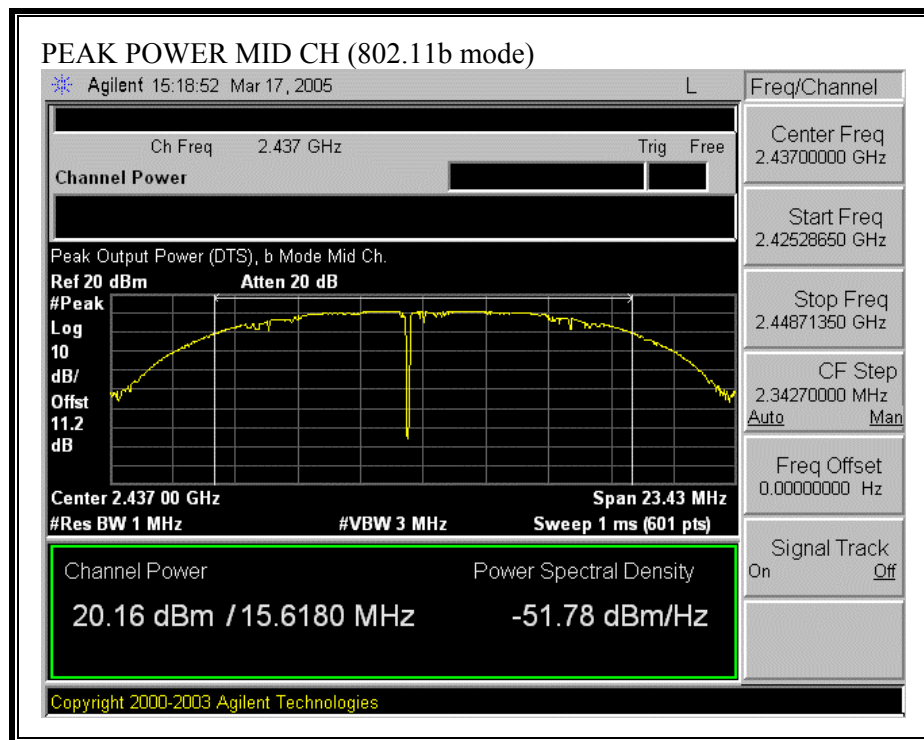
### 802.11g Turbo Mode

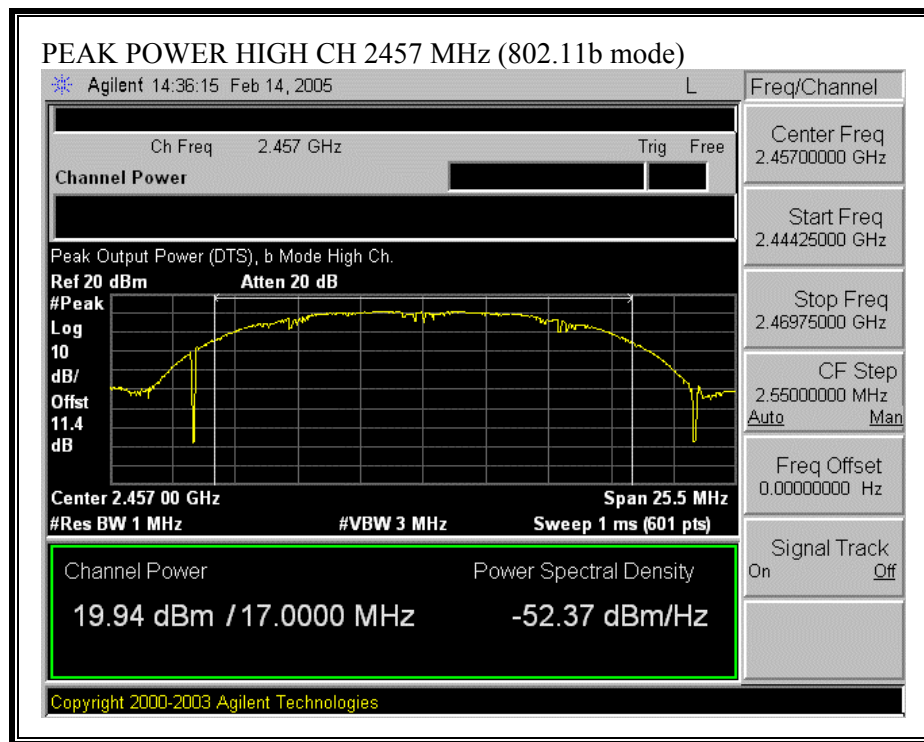
| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>Peak Power<br/>(dBm)</b> | <b>Limit<br/>(dBm)</b> | <b>Margin<br/>(dB)</b> |
|----------------|----------------------------|-----------------------------|------------------------|------------------------|
| Middle         | 2437                       | 25.83                       | 30                     | -4.17                  |

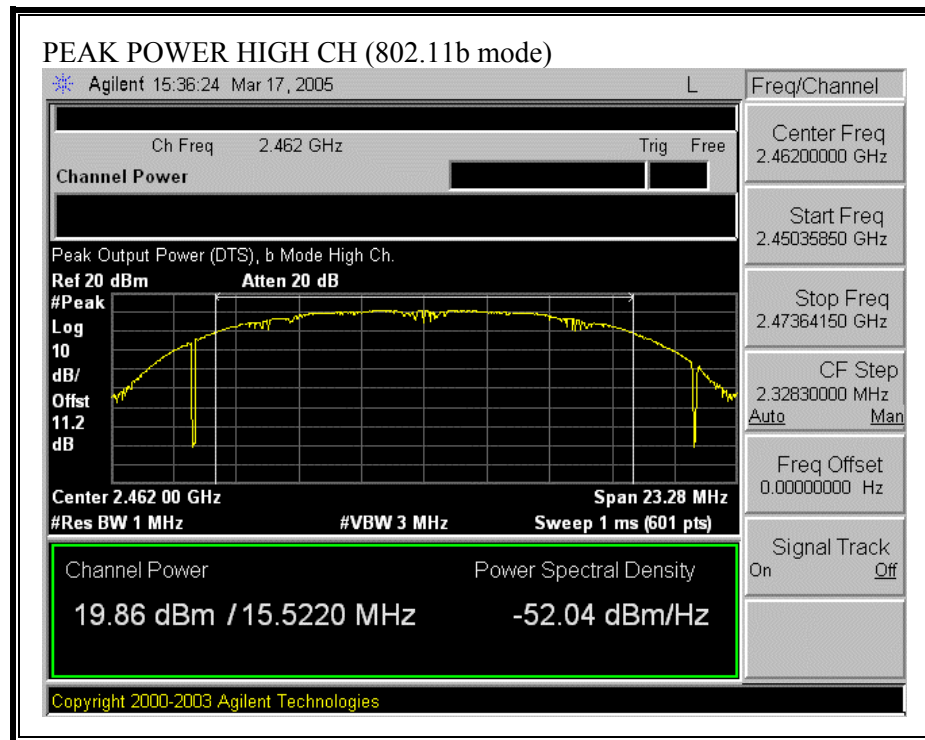
**OUTPUT POWER (802.11b MODE)**



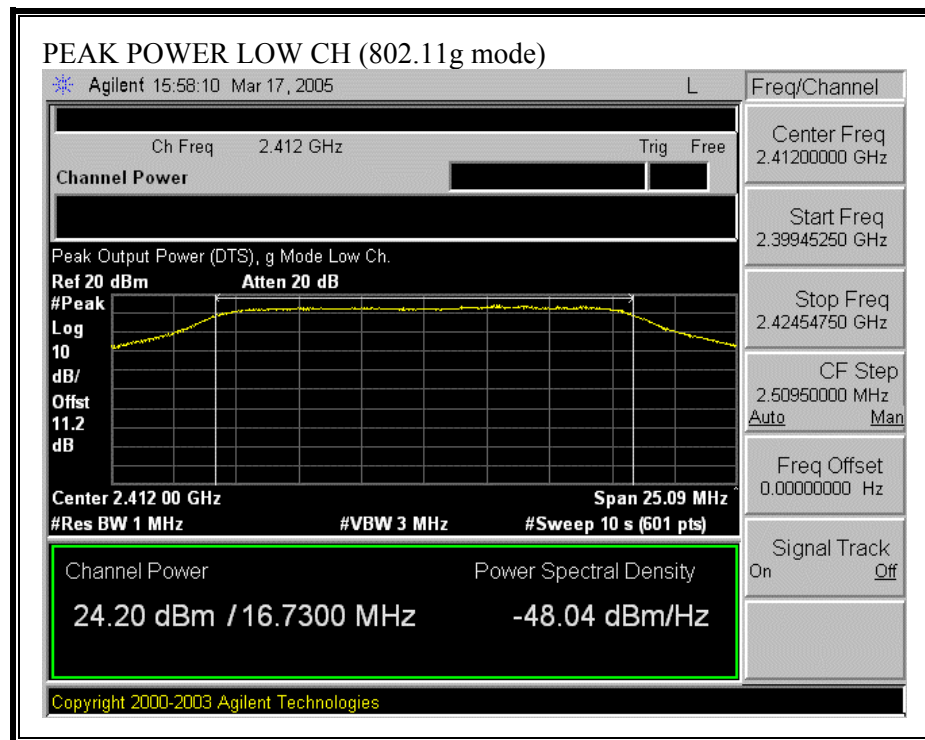


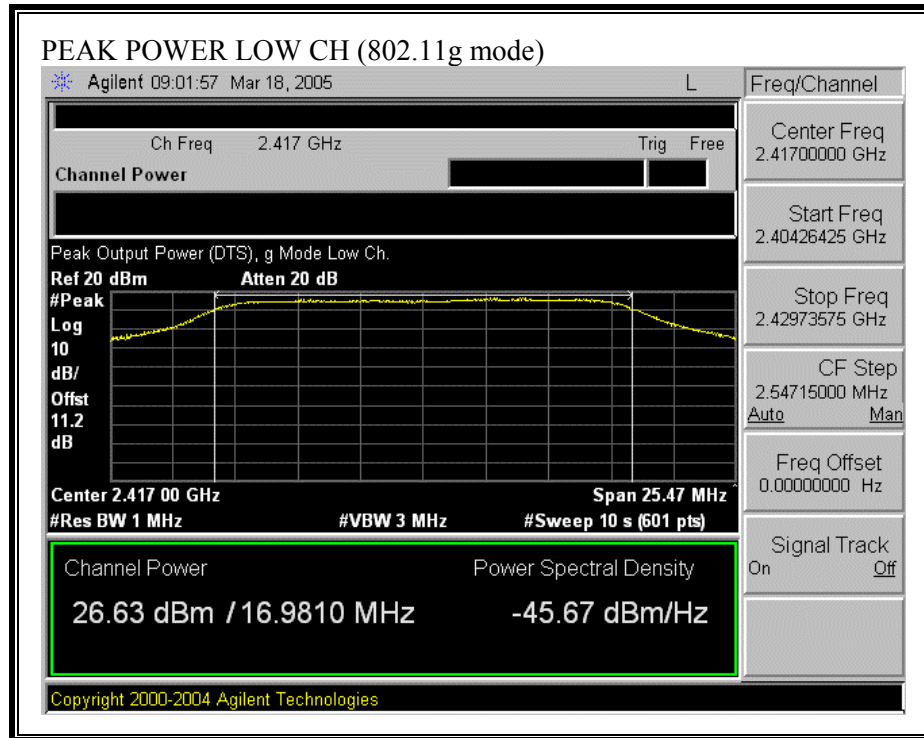


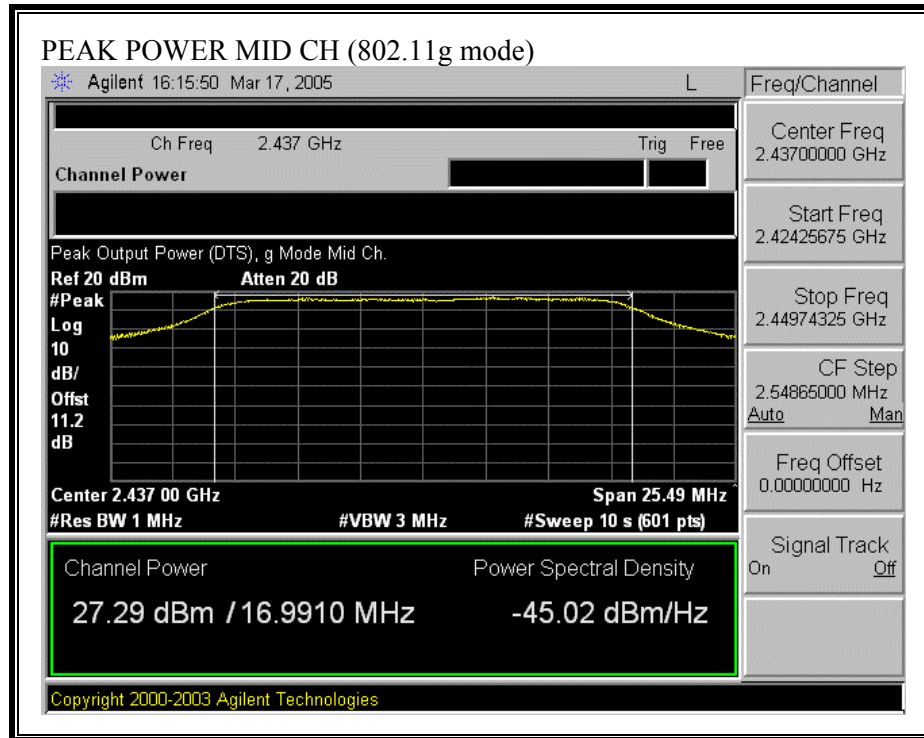


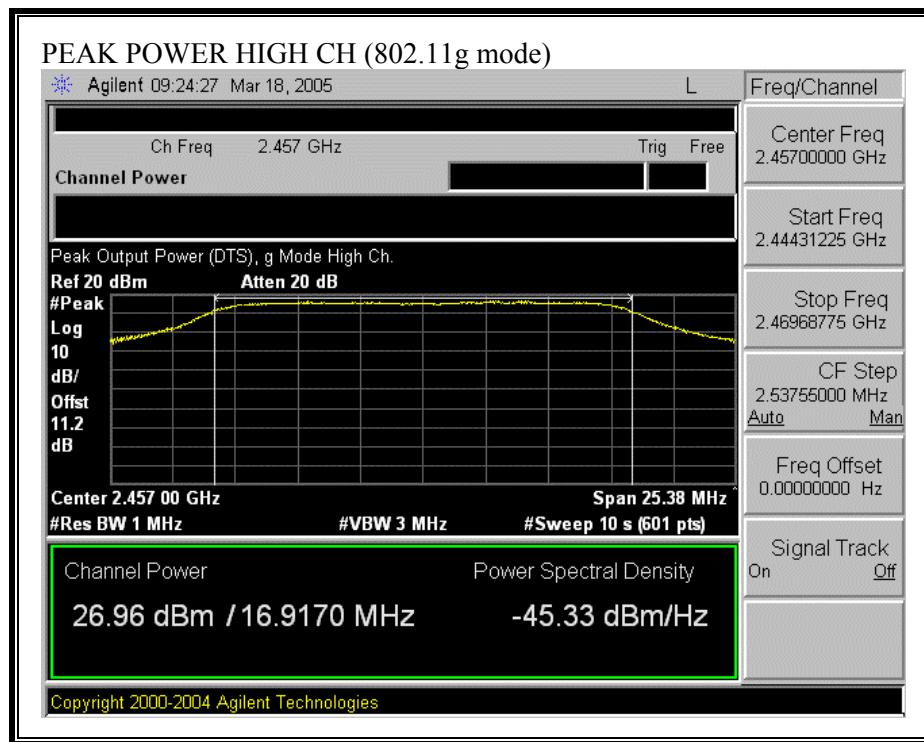


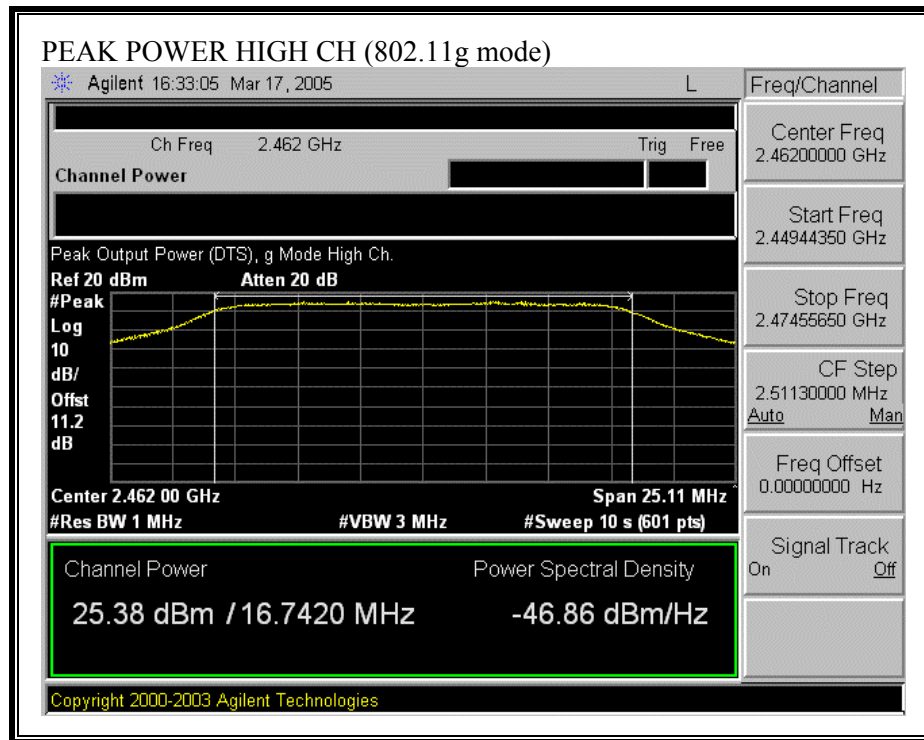
**OUTPUT POWER (802.11g MODE)**



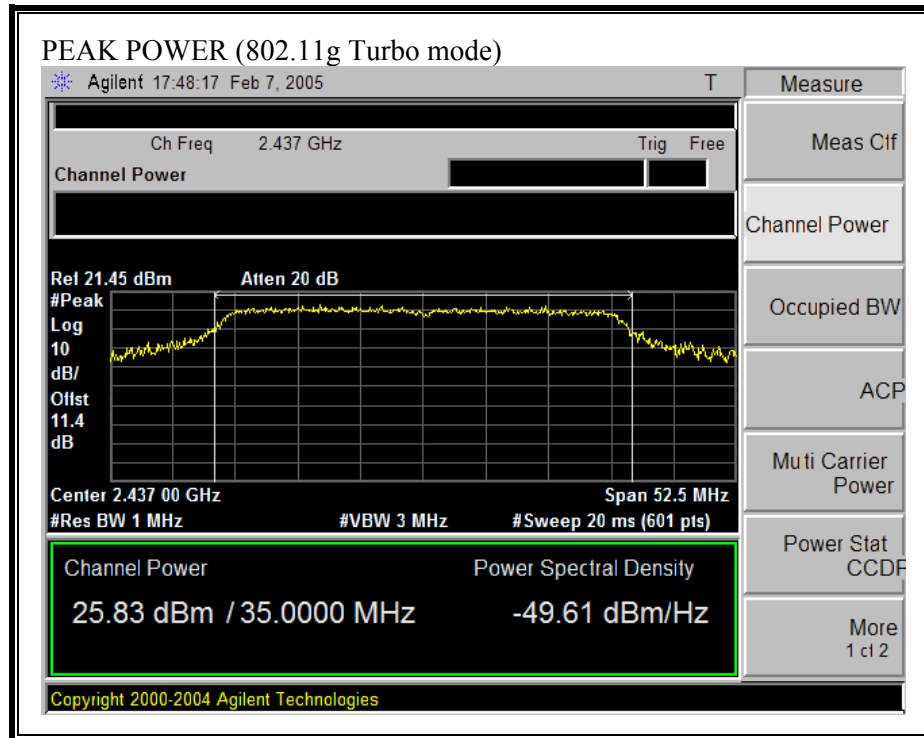








**OUTPUT POWER (802.11g TURBO MODE)**



## 6.1.4. 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<br/>Limit<br/>(mW/cm<sup>2</sup>)</b> | <b>Output<br/>Power<br/>(dBm)</b> | <b>Antenna<br/>Gain<br/>(dBi)</b> | <b>MPE<br/>Distance<br/>(cm)</b> |
|---------------|--------------------------------------------------------|-----------------------------------|-----------------------------------|----------------------------------|
| 802.11b       | 1.0                                                    | 20.16                             | 3.62                              | 4.36                             |
| 802.11g       | 1.0                                                    | 27.29                             | 3.62                              | 9.90                             |
| 802.11g Turbo | 1.0                                                    | 25.83                             | 3.62                              | 8.37                             |

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.

### 6.1.5. 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 11.45 dB (including 10 dB pad and 1.45 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

##### 802.11b Mode

| Channel | Frequency<br>(MHz) | Power<br>(dBm) |
|---------|--------------------|----------------|
| Low     | 2412               | 17.18          |
| Low     | 2417               | 17.35          |
| Middle  | 2437               | 17.88          |
| High    | 2457               | 17.00          |
| High    | 2462               | 17.08          |

##### 802.11g Mode

| Channel | Frequency<br>(MHz) | Power<br>(dBm) |
|---------|--------------------|----------------|
| Low     | 2412               | 15.88          |
| Low     | 2417               | 17.88          |
| Middle  | 2437               | 18.89          |
| High    | 2457               | 18.28          |
| High    | 2462               | 16.78          |

##### 802.11g Turbo Mode

| Channel | Frequency<br>(MHz) | Power<br>(dBm) |
|---------|--------------------|----------------|
| Middle  | 2437               | 19.50          |

## 6.1.6. 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            | -6.61      | 8           | -14.61      |
| Low     | 2417            | -6.03      | 8           | -14.03      |
| Middle  | 2437            | -6.47      | 8           | -14.47      |
| High    | 2457            | -6.50      | 8           | -14.50      |
| High    | 2462            | -6.76      | 8           | -14.76      |

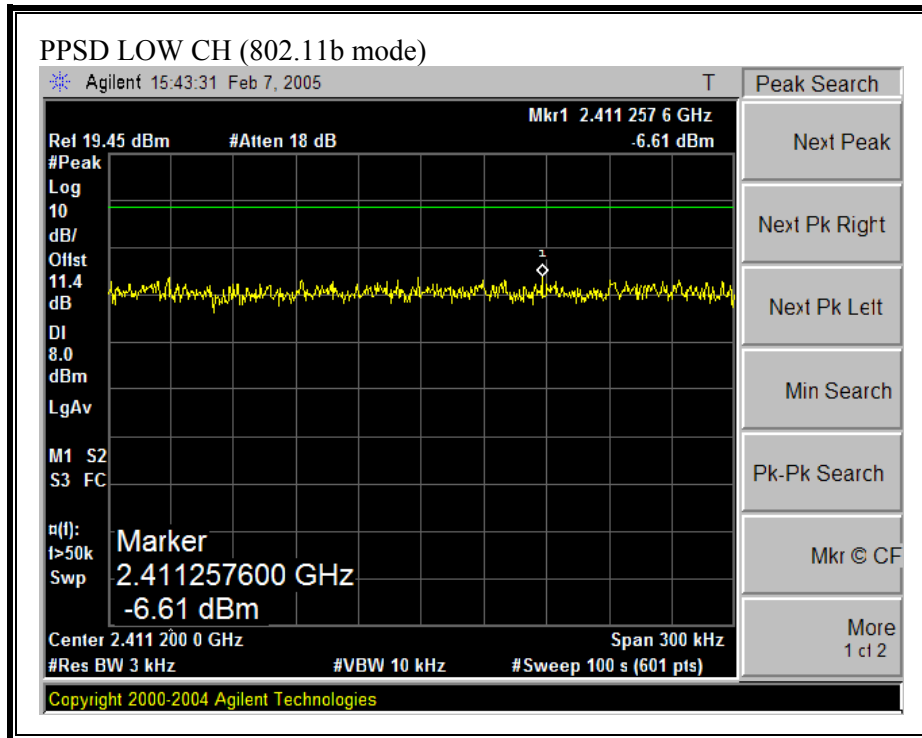
802.11g Mode

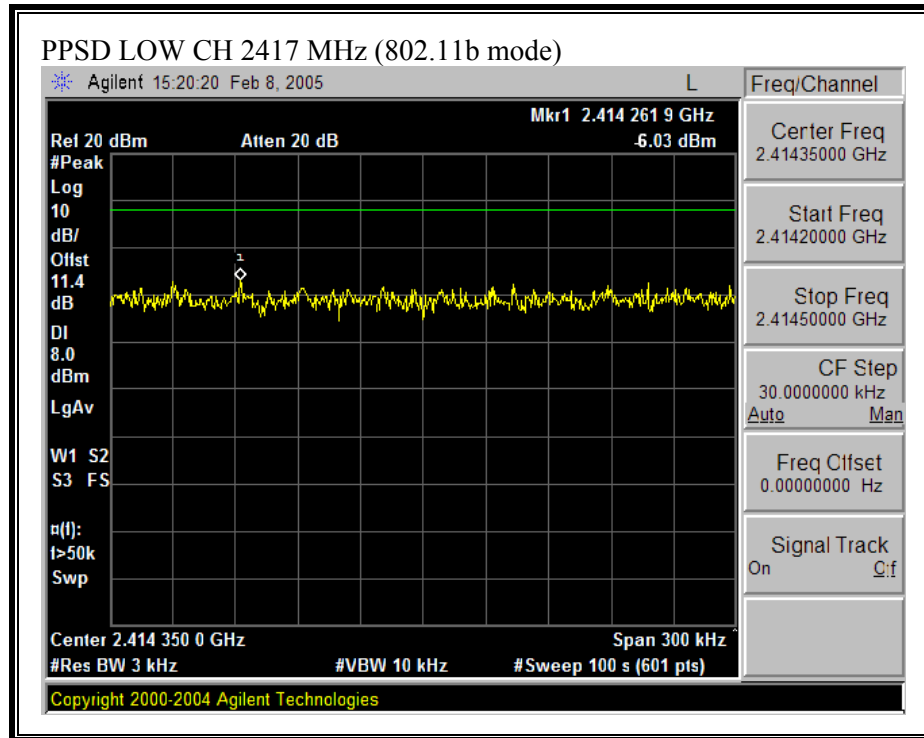
| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|------------|-------------|-------------|
| Low     | 2412            | -8.16      | 8           | -16.16      |
| Low     | 2417            | -6.83      | 8           | -14.83      |
| Middle  | 2437            | -5.61      | 8           | -13.61      |
| High    | 2457            | -5.92      | 8           | -13.92      |
| High    | 2462            | -6.38      | 8           | -14.38      |

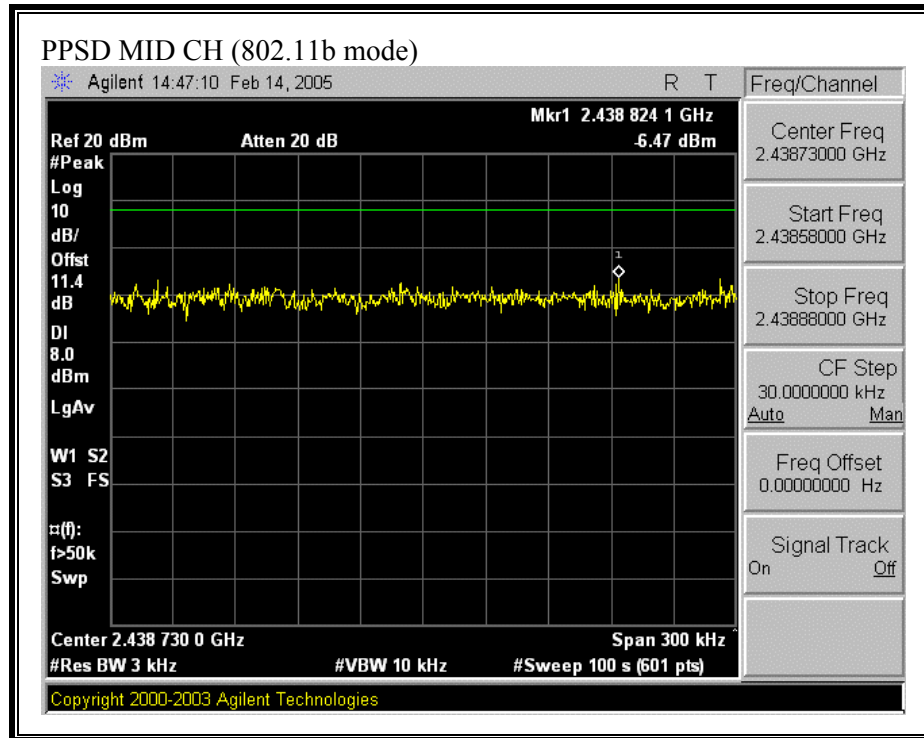
802.11g Turbo Mode

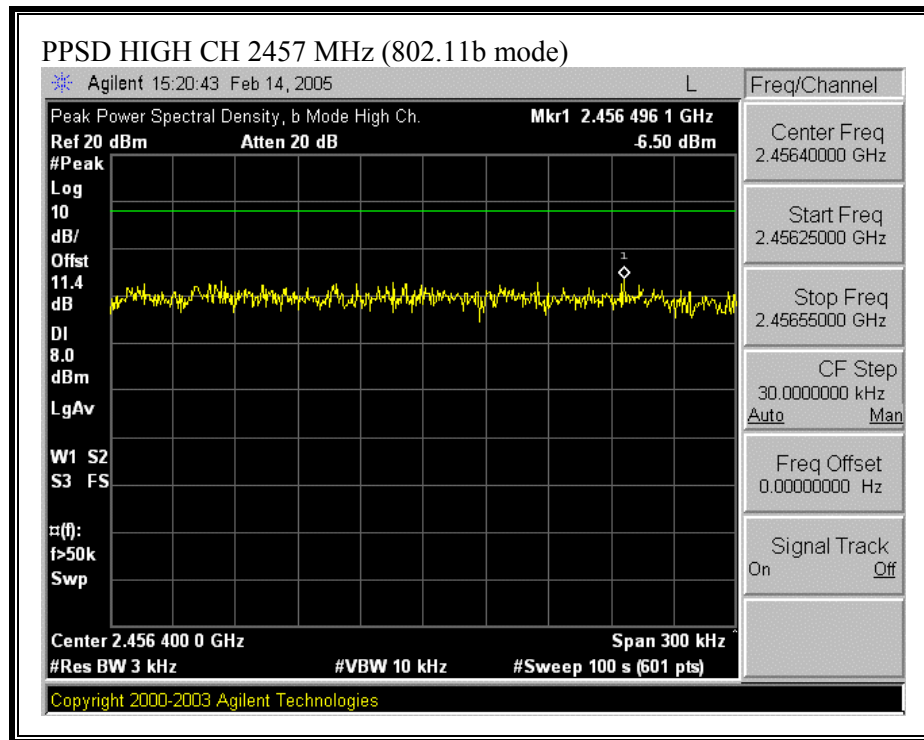
| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|------------|-------------|-------------|
| Middle  | 2437            | -8.69      | 8           | -16.69      |

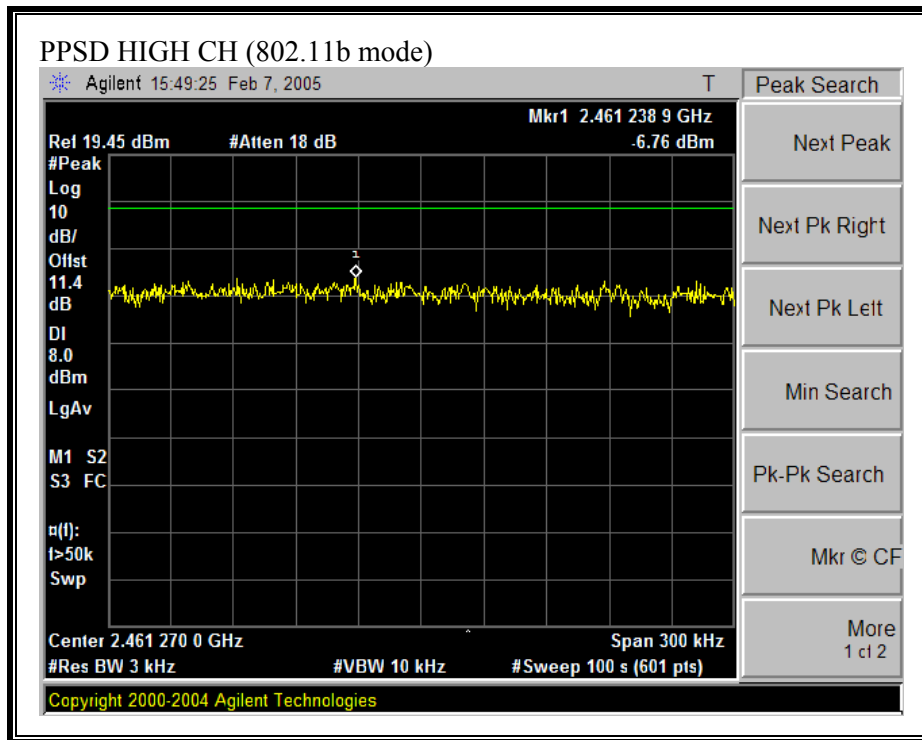
**PEAK POWER SPECTRAL DENSITY (802.11b MODE)**



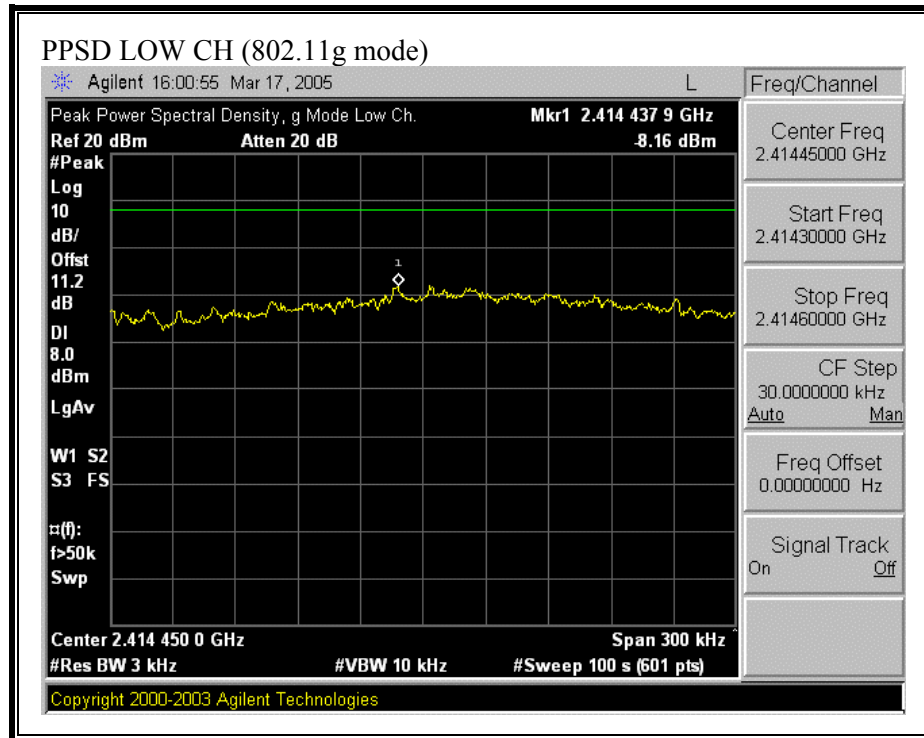


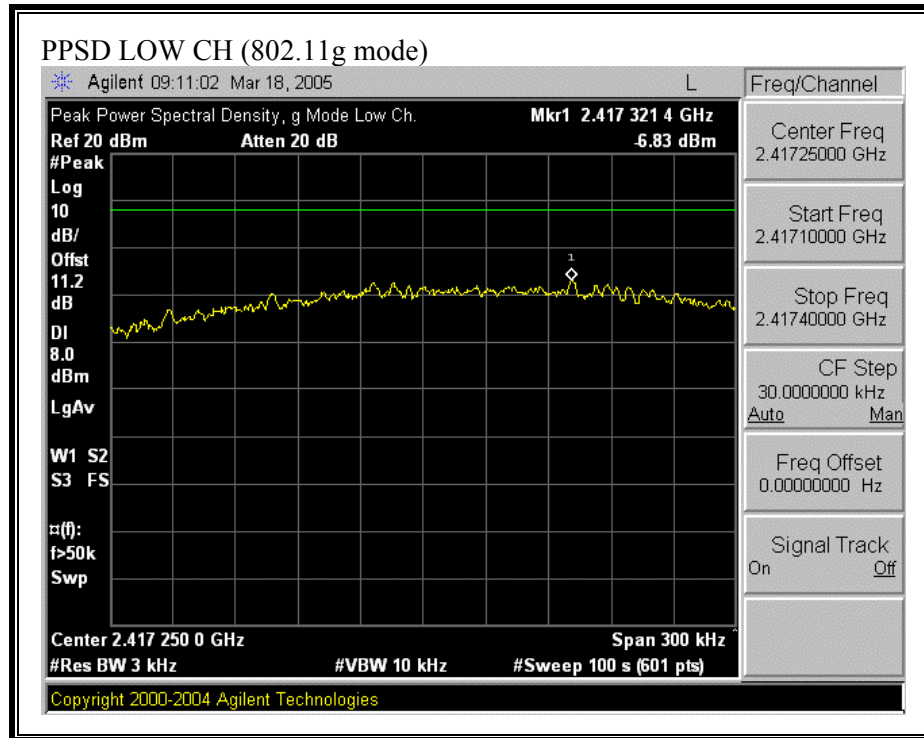


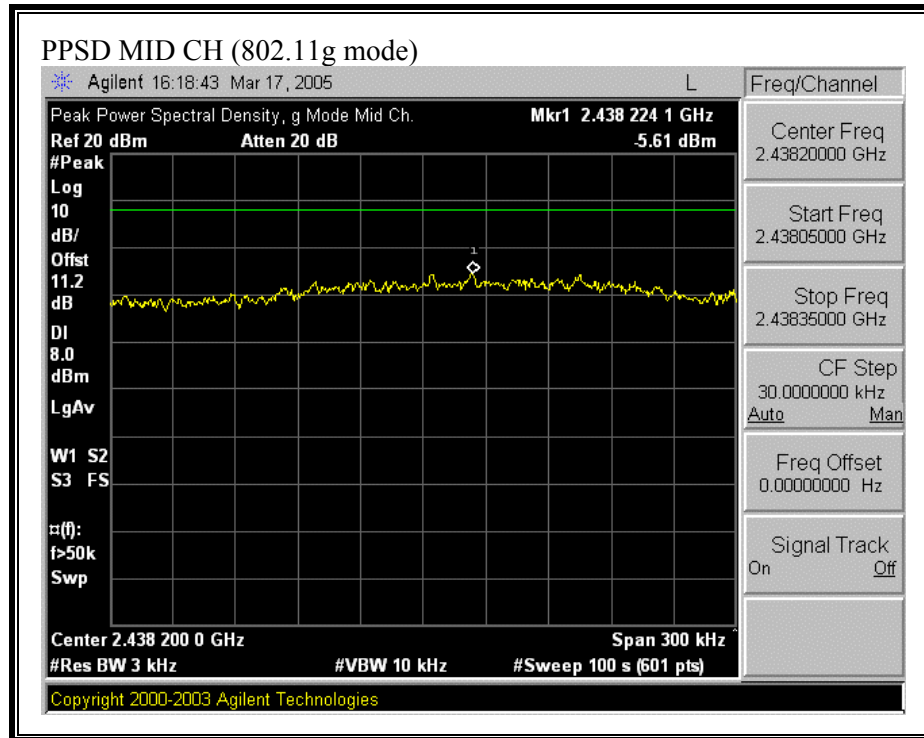


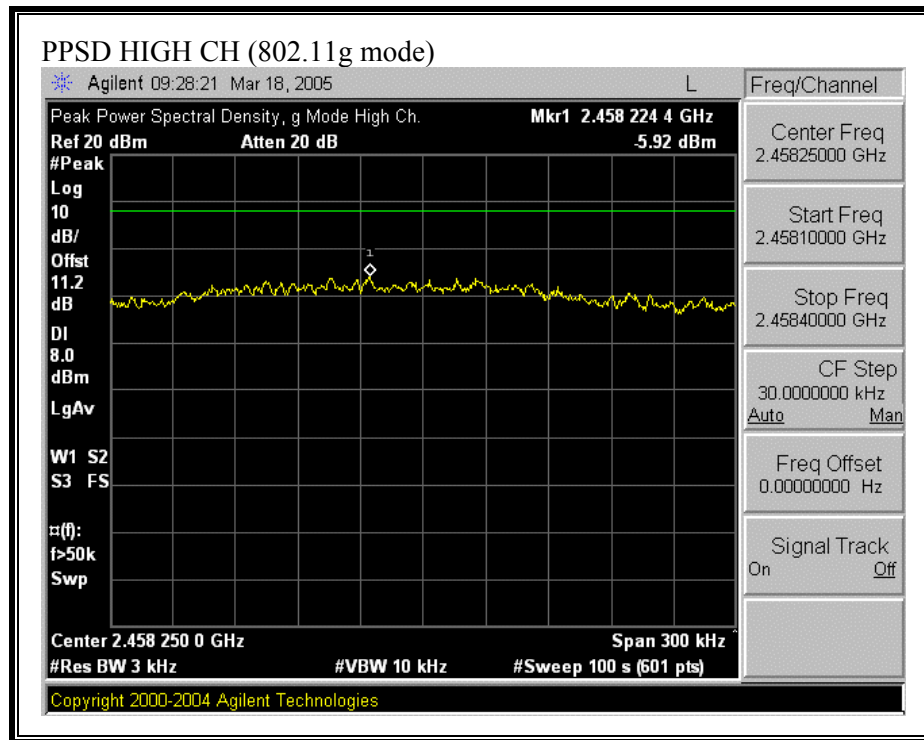


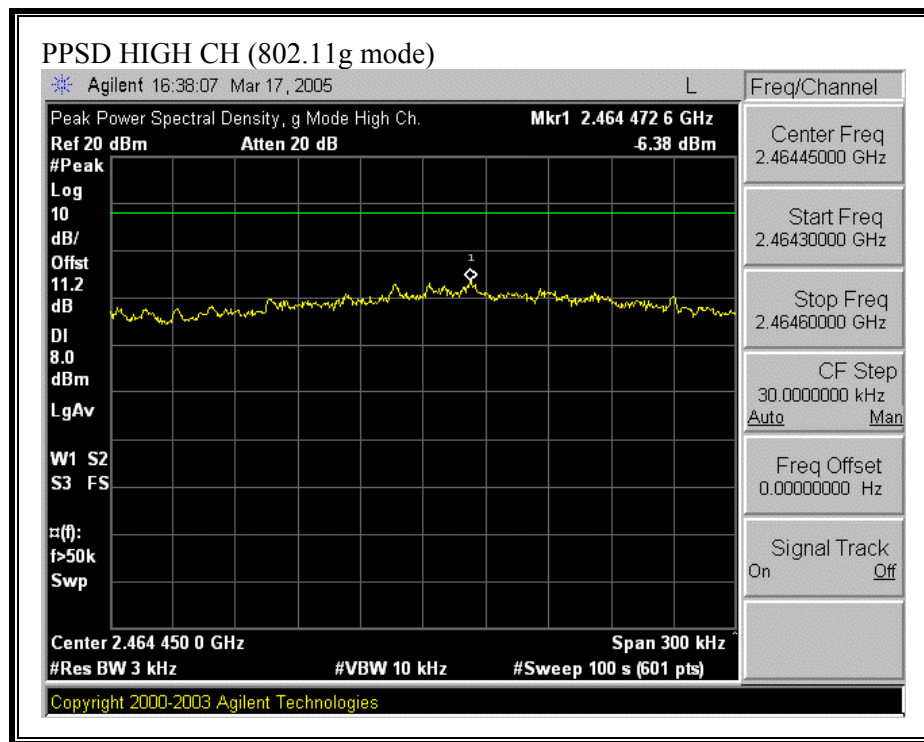
**PEAK POWER SPECTRAL DENSITY (802.11g MODE)**



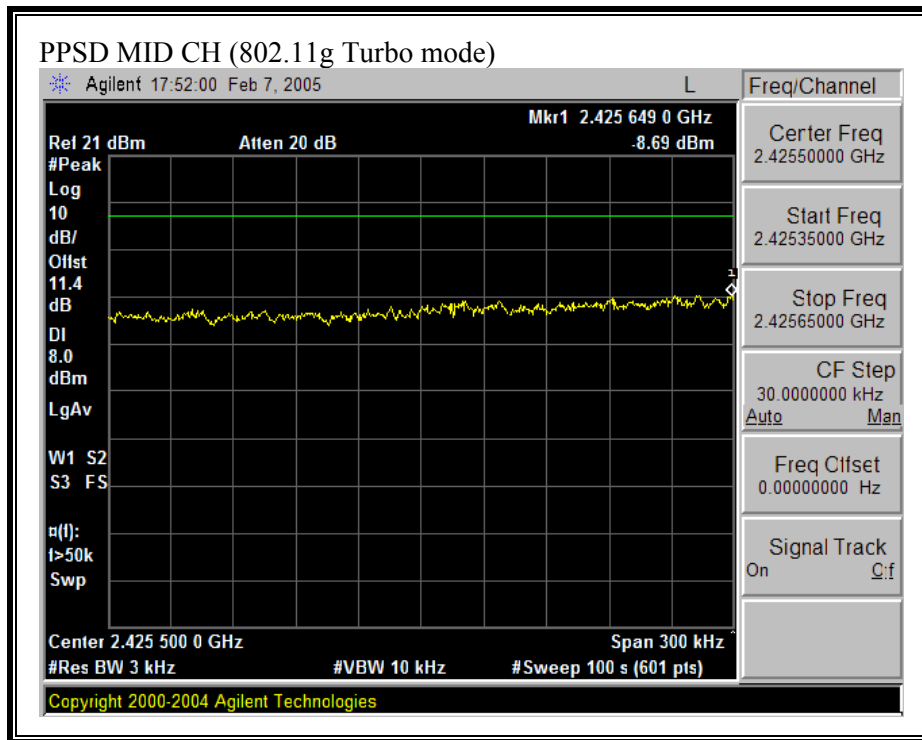








**PEAK POWER SPECTRAL DENSITY (802.11g TURBO MODE)**



### **6.1.7. 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**

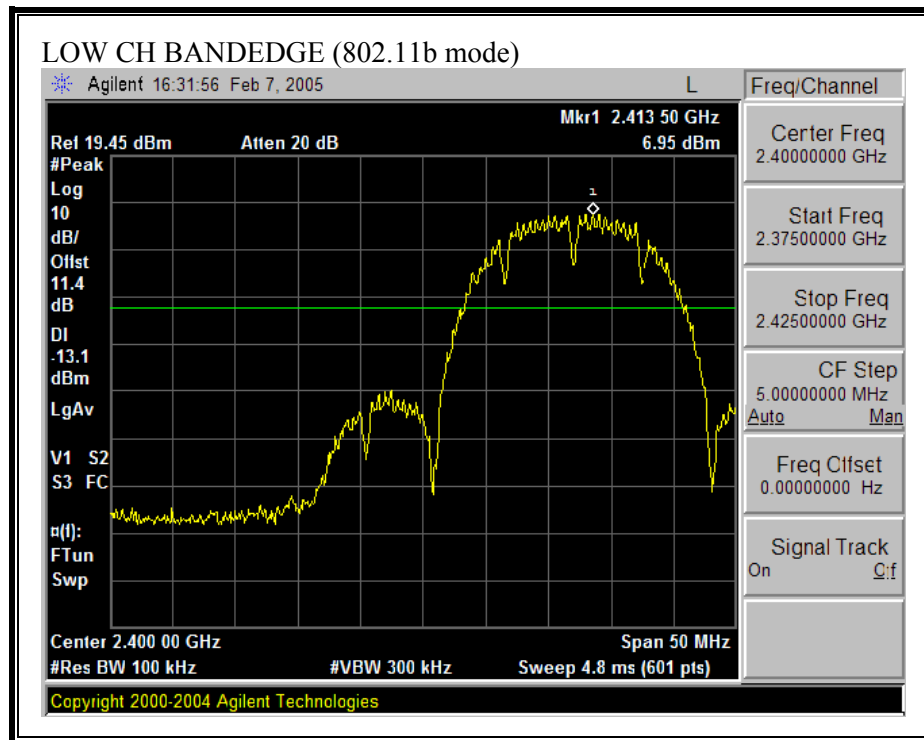
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

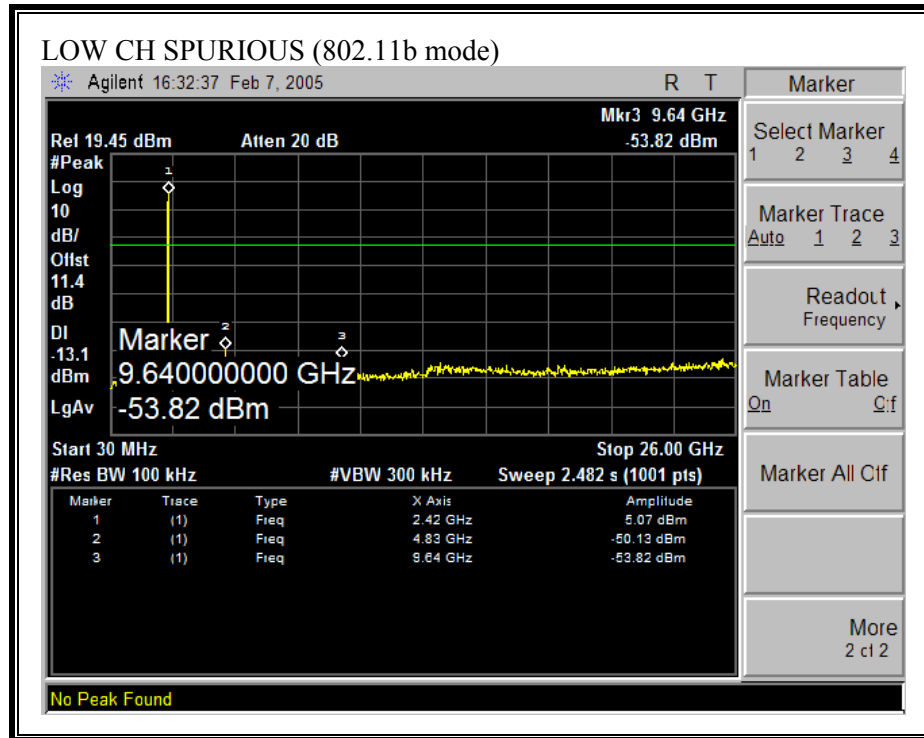
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

#### **RESULTS**

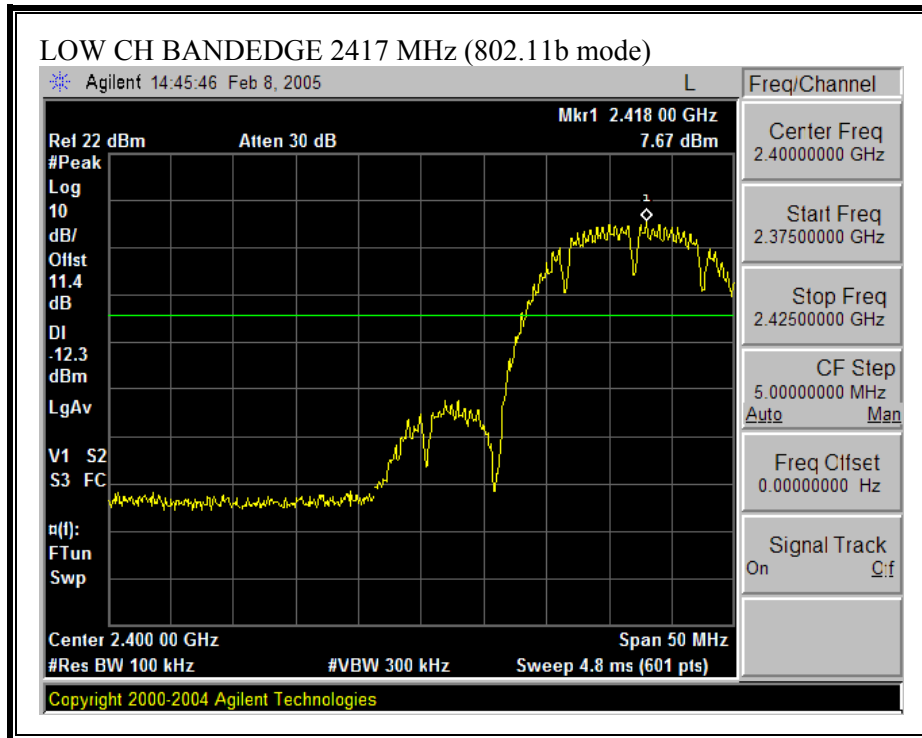
No non-compliance noted:

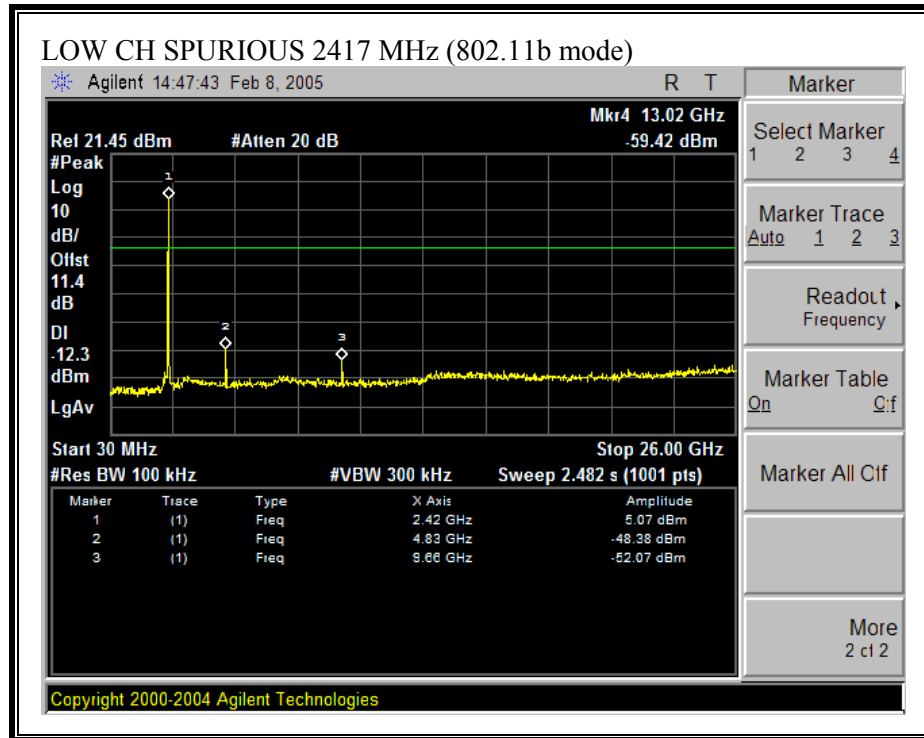
**SPURIOUS EMISSIONS, LOW CHANNEL (802.11b MODE)**



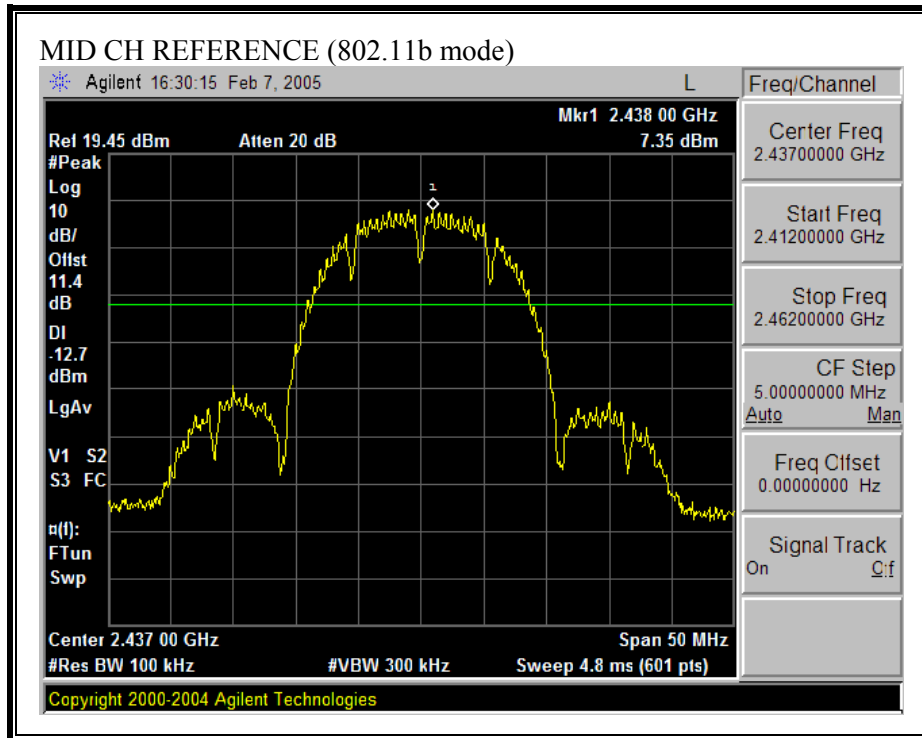


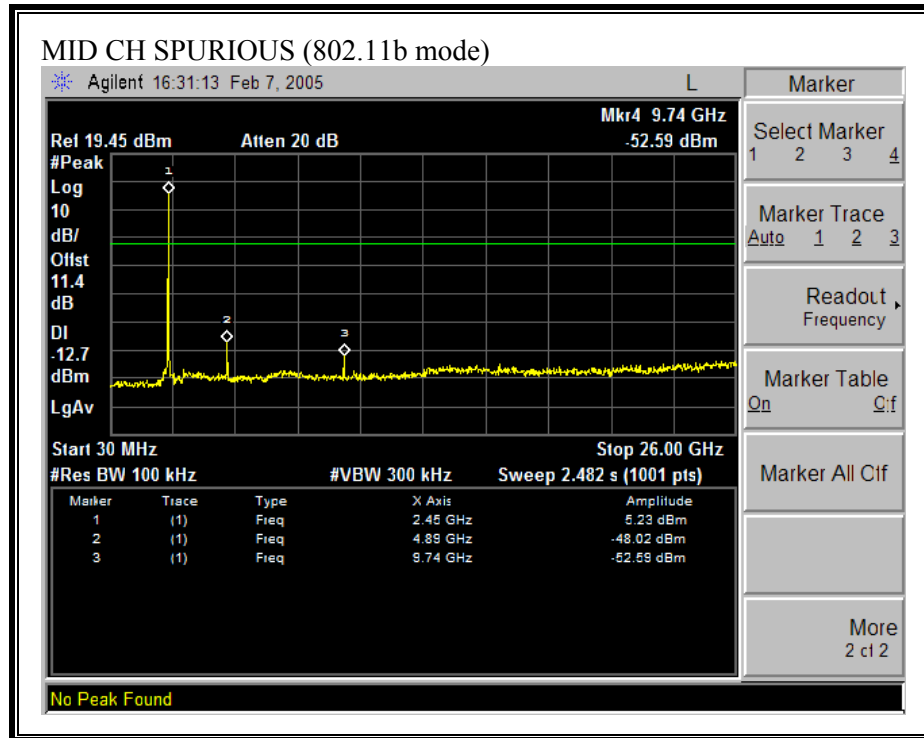
**SPURIOUS EMISSIONS, LOW CHANNEL 2417 MHz (802.11b MODE)**



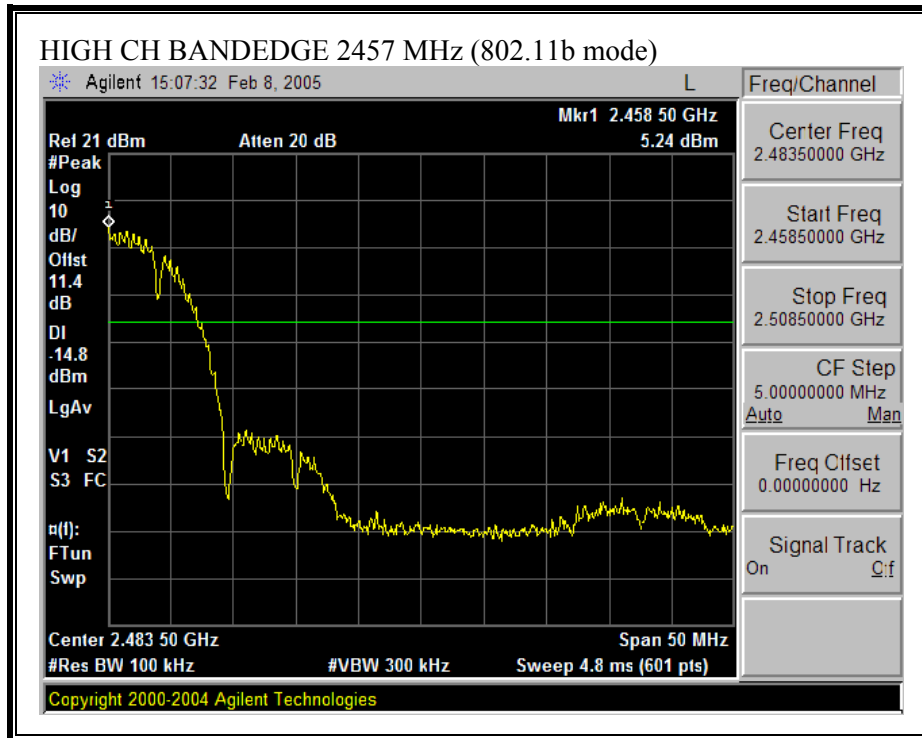


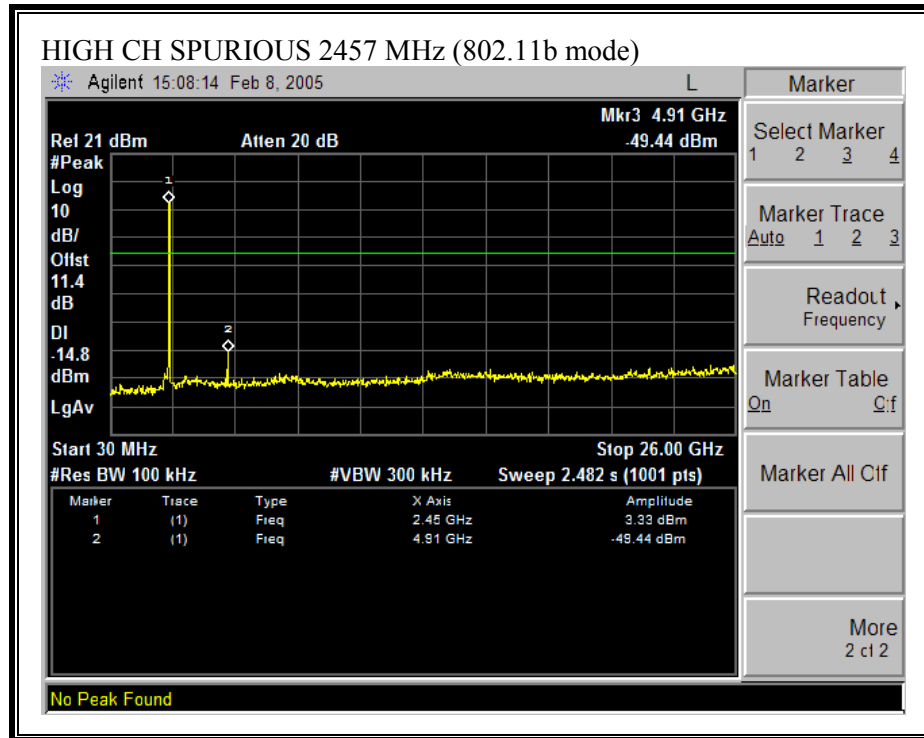
**SPURIOUS EMISSIONS, MID CHANNEL (802.11b MODE)**



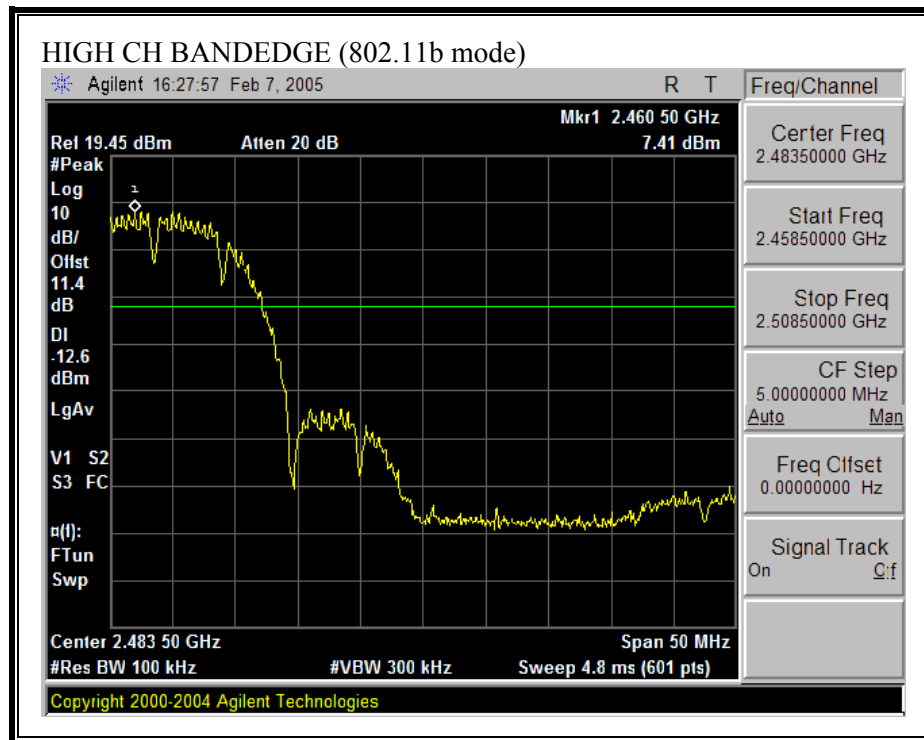


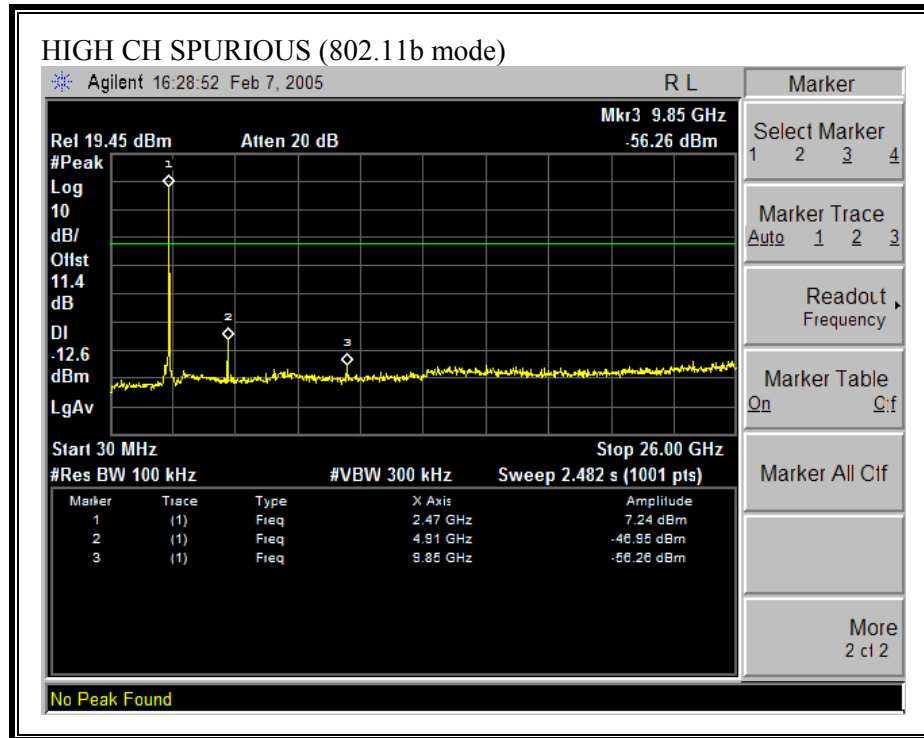
**SPURIOUS EMISSIONS, HIGH CHANNEL 2457 MHz (802.11b MODE)**



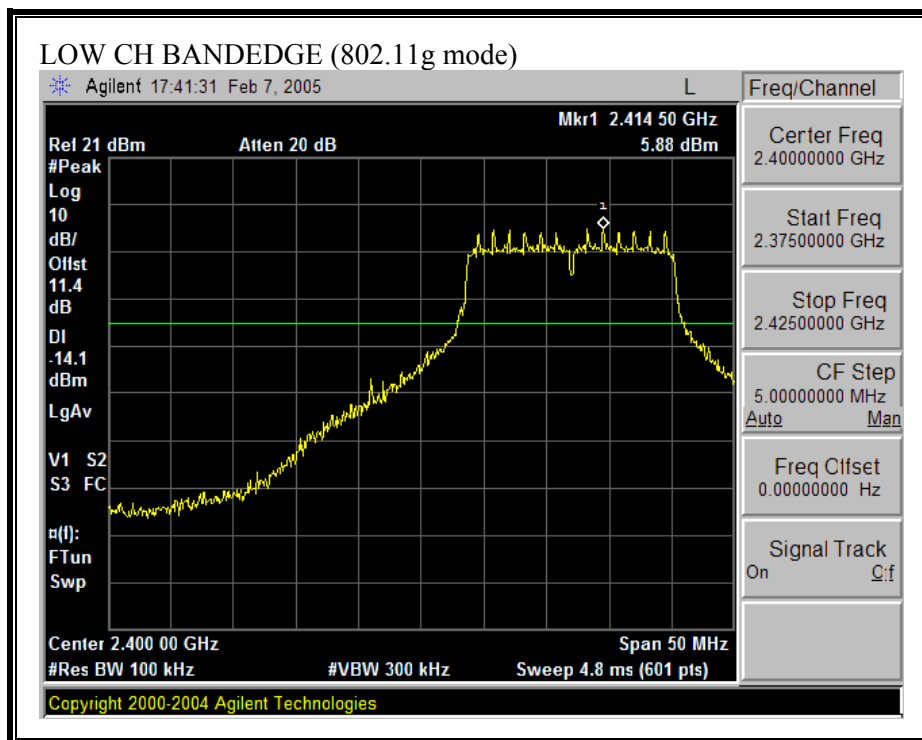


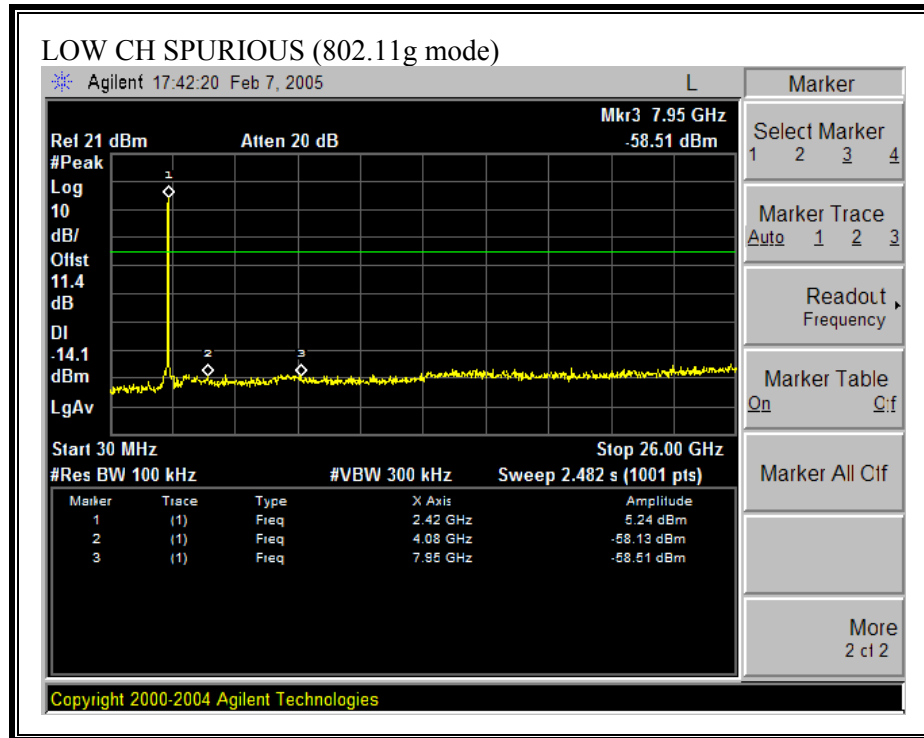
**SPURIOUS EMISSIONS, HIGH CHANNEL (802.11b MODE)**



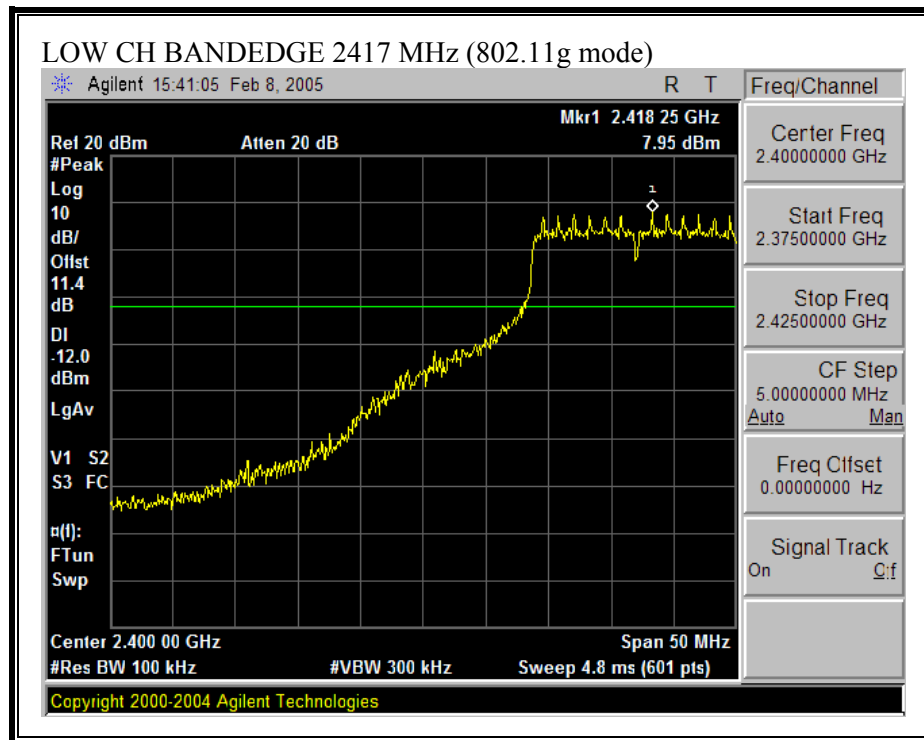


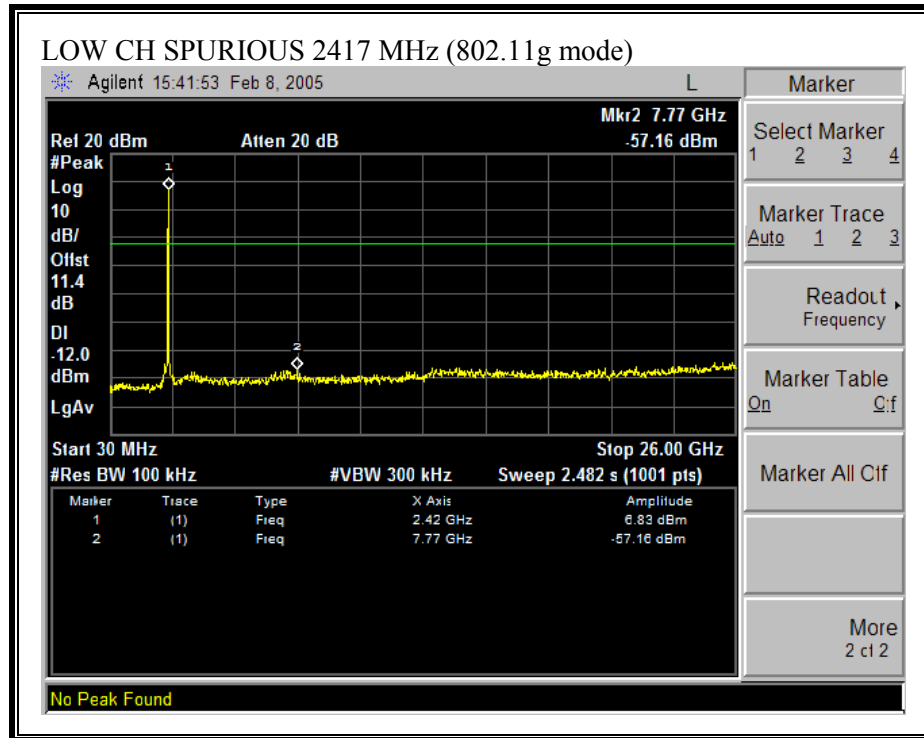
**SPURIOUS EMISSIONS, LOW CHANNEL (802.11g MODE)**



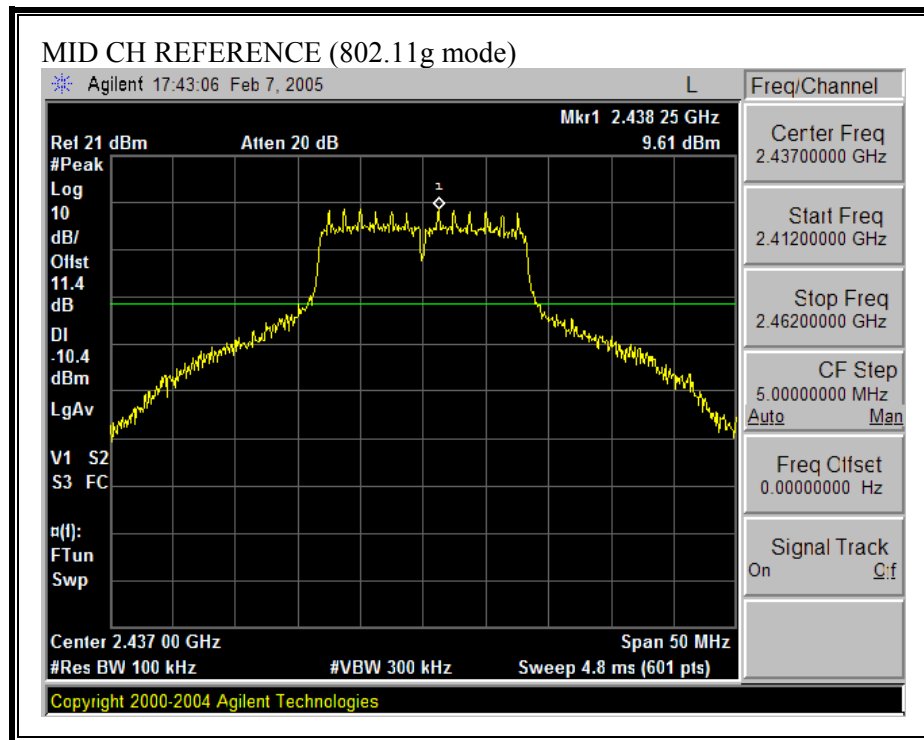


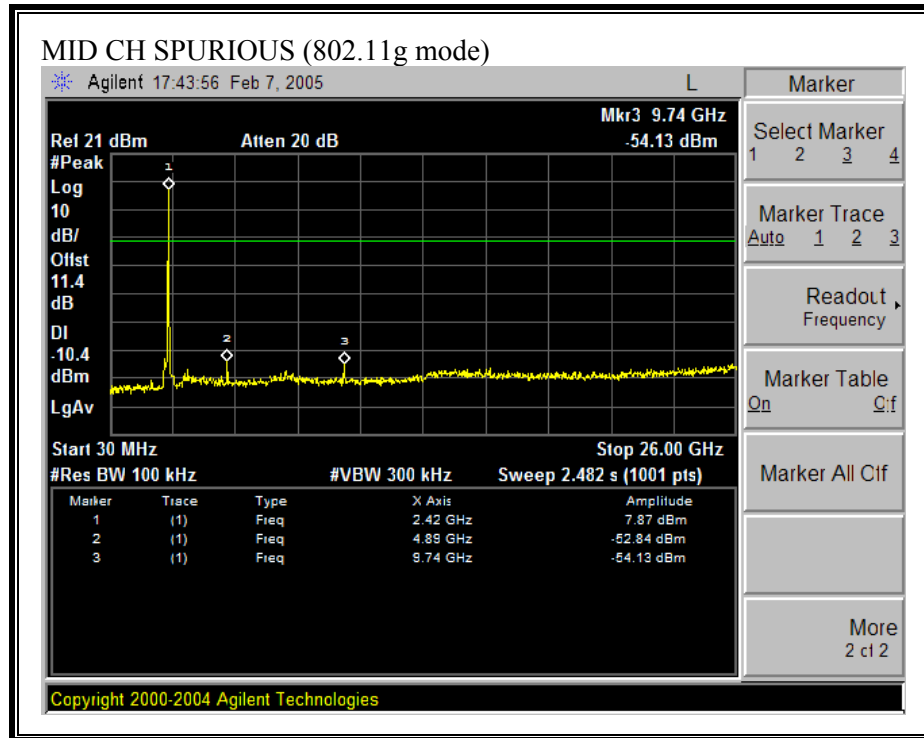
**SPURIOUS EMISSIONS, LOW CHANNEL 2417 MHz (802.11g MODE)**



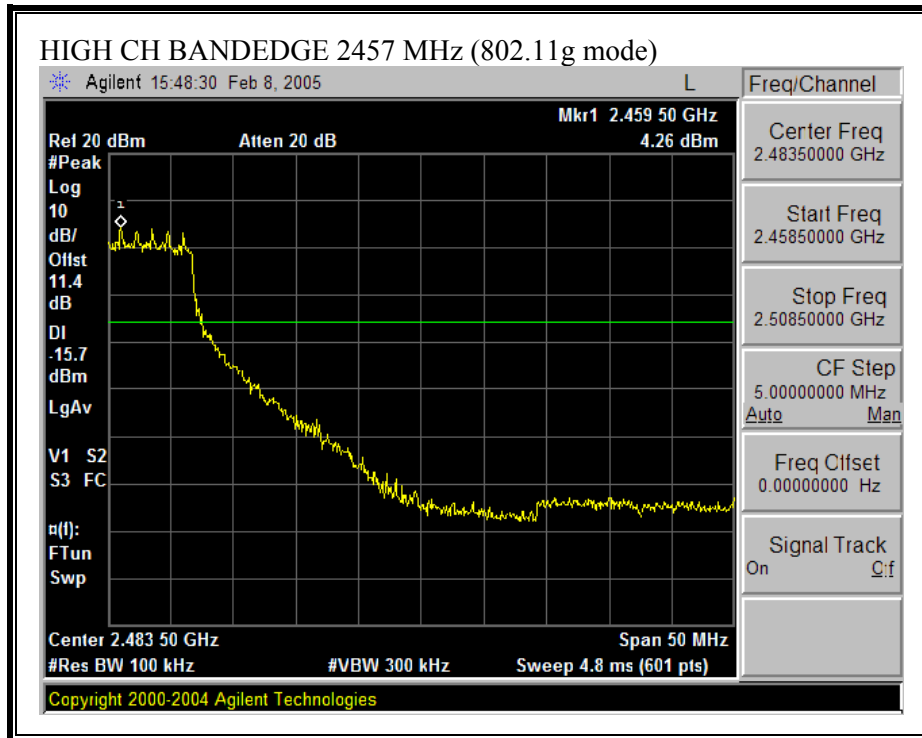


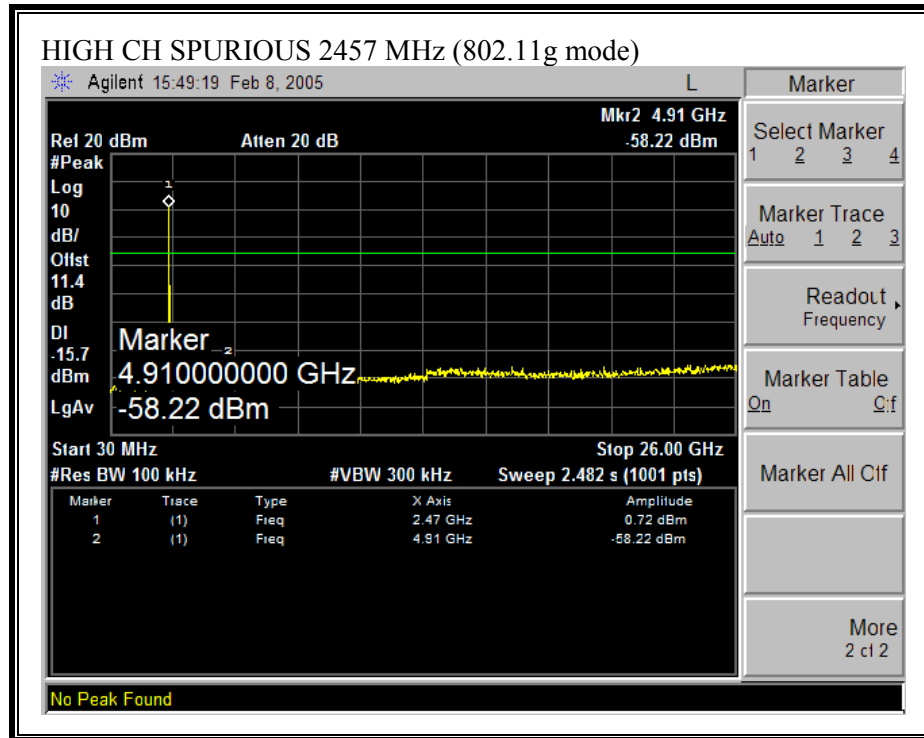
**SPURIOUS EMISSIONS, MID CHANNEL (802.11g MODE)**



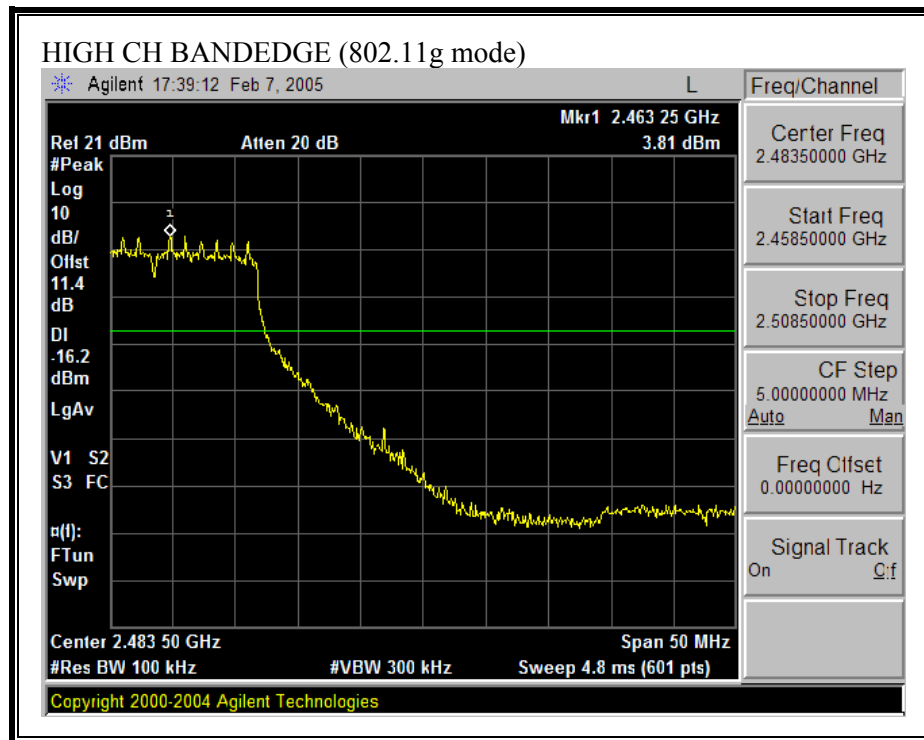


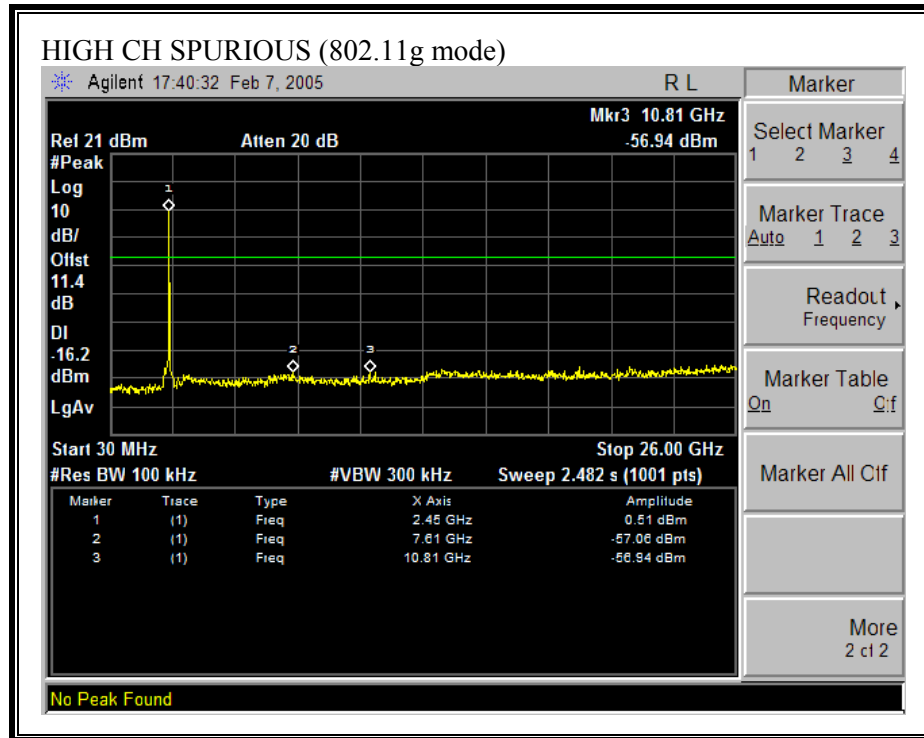
**SPURIOUS EMISSIONS, HIGH CHANNEL 2457 MHz (802.11g MODE)**



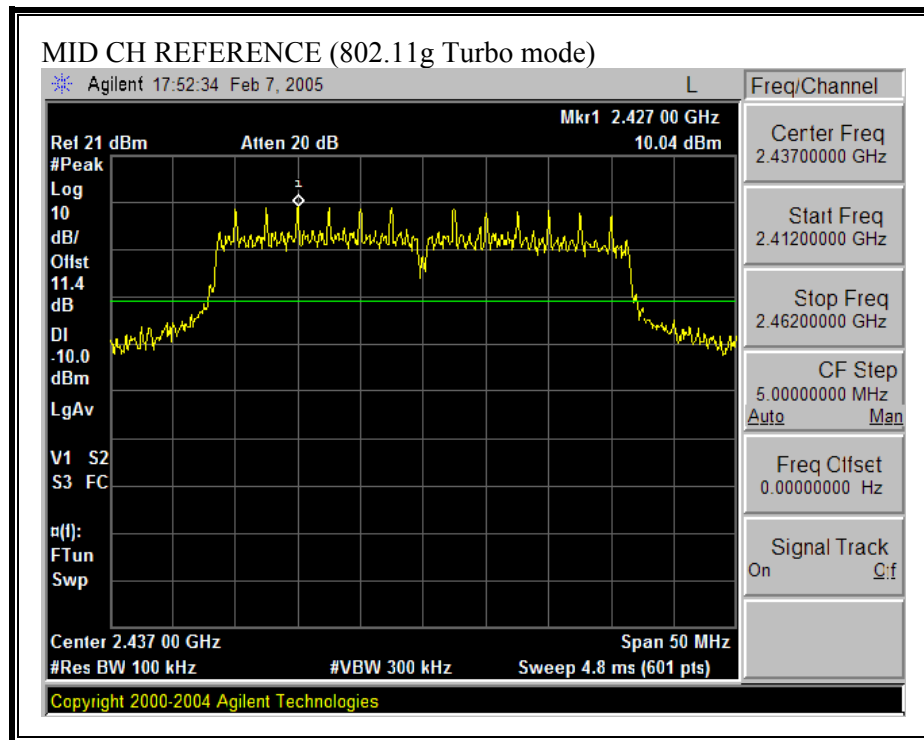


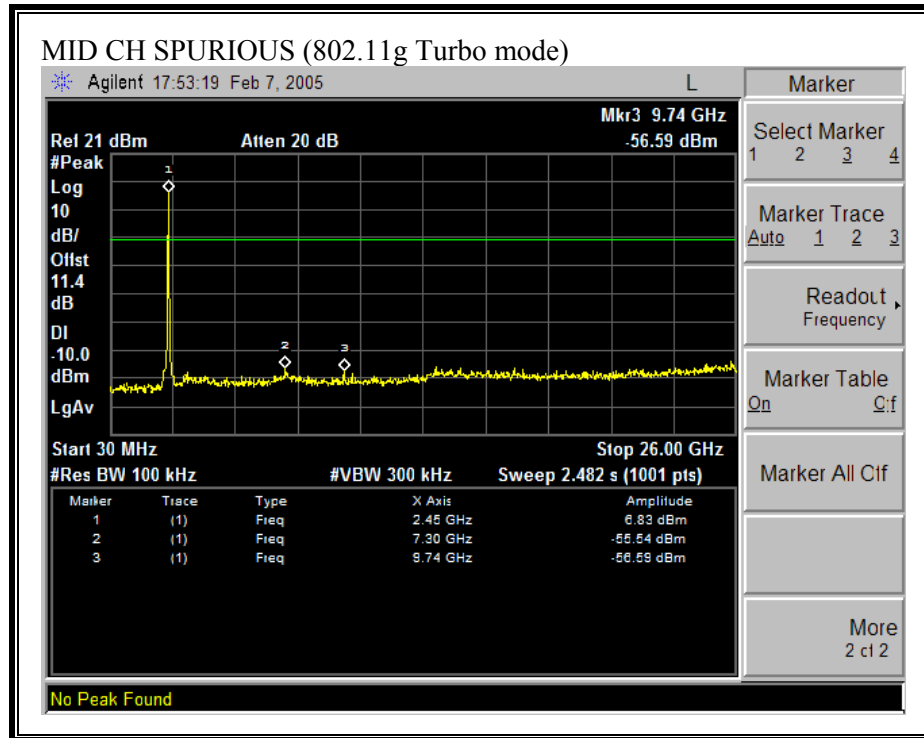
**SPURIOUS EMISSIONS, HIGH CHANNEL (802.11g MODE)**





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





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

### 6.2.1. 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:

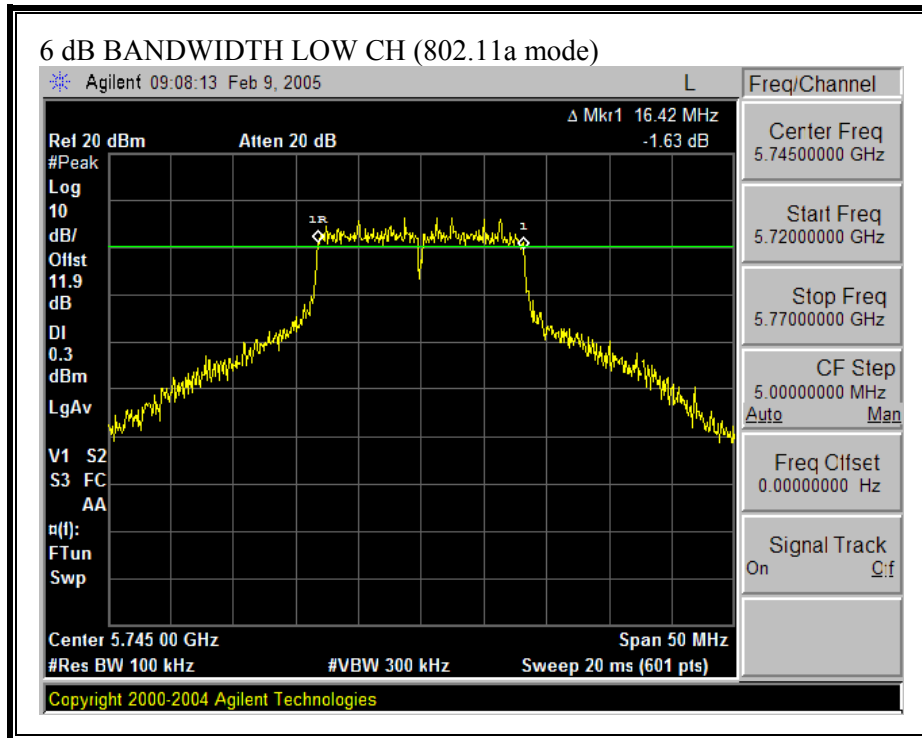
##### 802.11a Mode

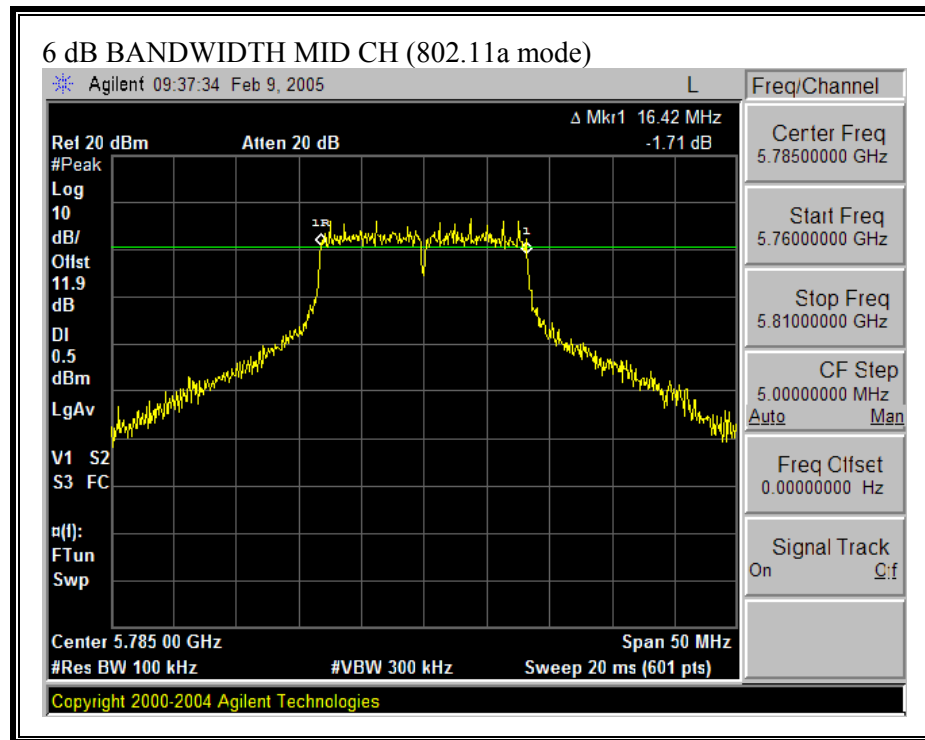
| Channel | Frequency (MHz) | 6 dB Bandwidth (kHz) | Minimum Limit (kHz) | Margin (kHz) |
|---------|-----------------|----------------------|---------------------|--------------|
| Low     | 5745            | 16420                | 500                 | 15920        |
| Middle  | 5785            | 16420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

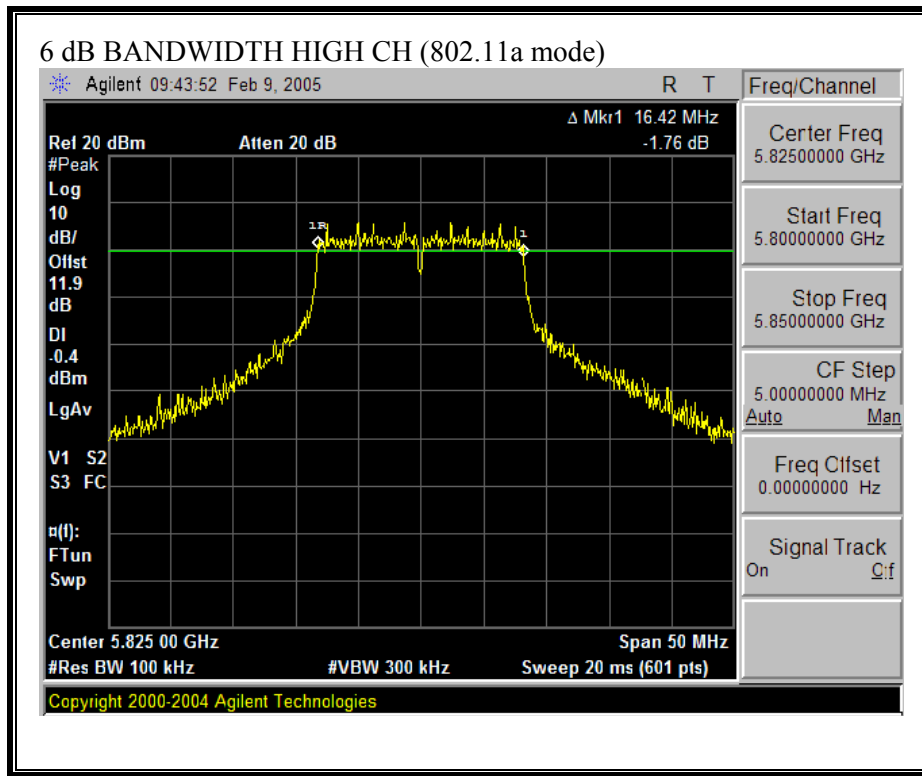
##### 802.11a Turbo Mode

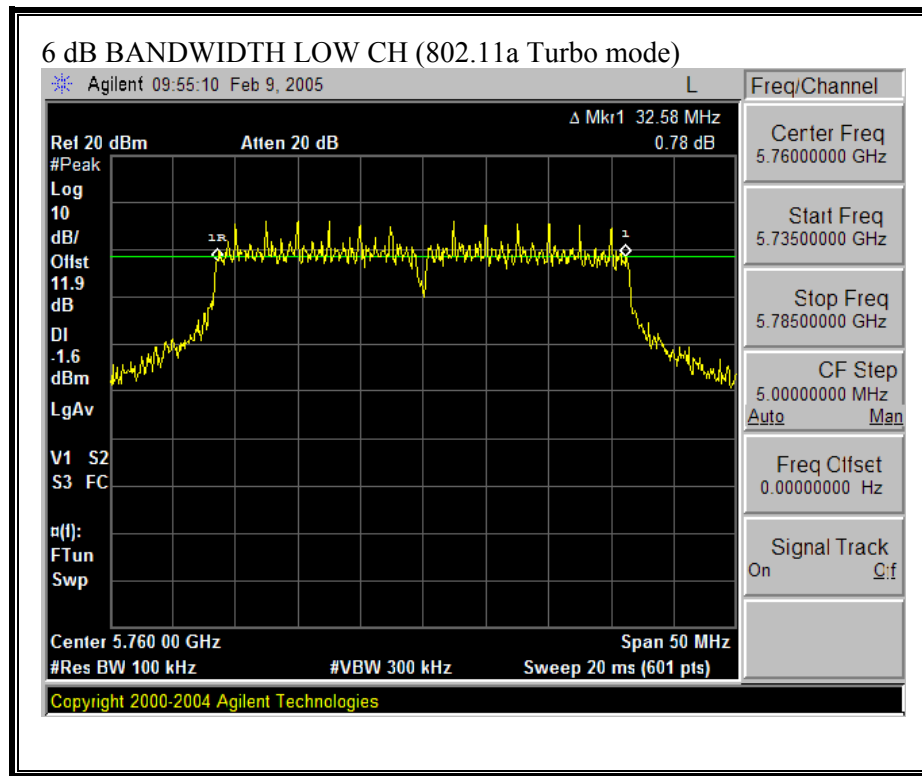
| Channel | Frequency (MHz) | 6 dB Bandwidth (kHz) | Minimum Limit (kHz) | Margin (kHz) |
|---------|-----------------|----------------------|---------------------|--------------|
| Low     | 5760            | 32580                | 500                 | 32080        |
| High    | 5805            | 32500                | 500                 | 32000        |

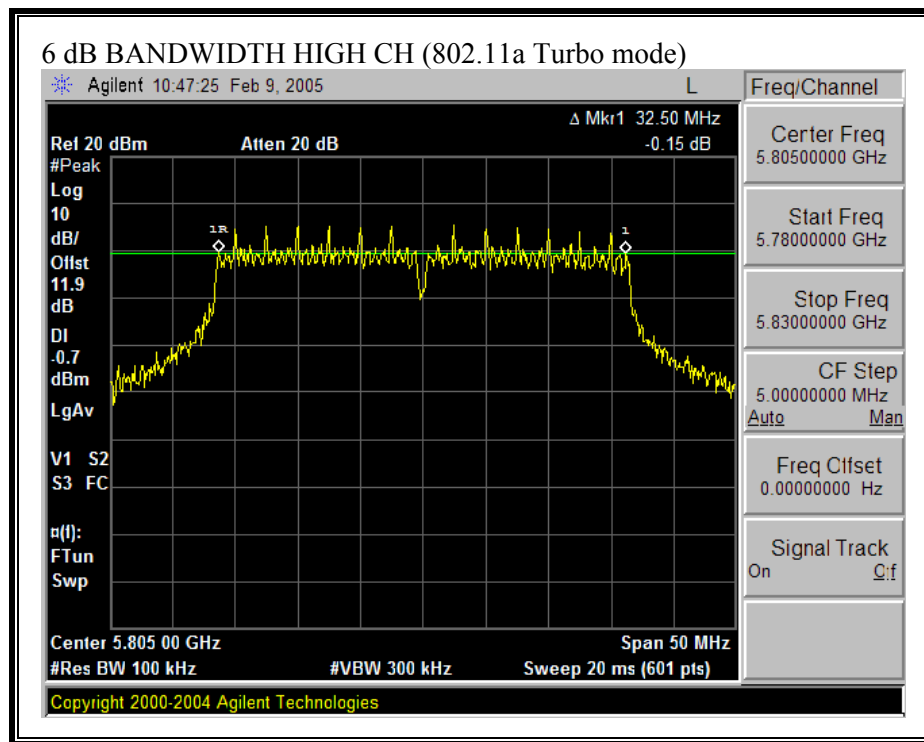
**6 dB BANDWIDTH (802.11a MODE)**











### 6.2.2. 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:

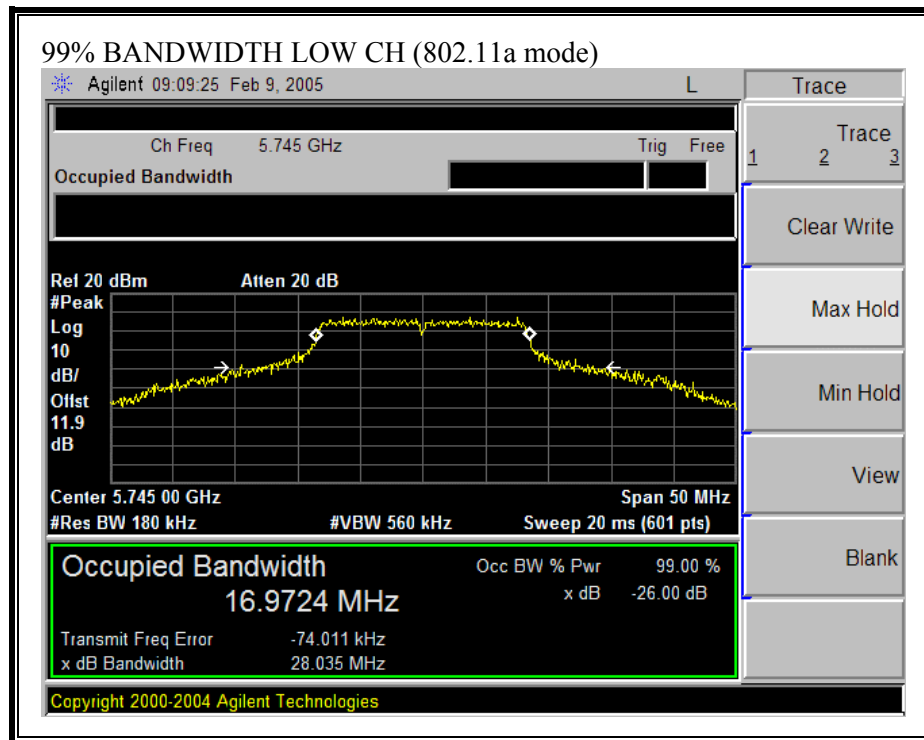
##### 802.11a Mode

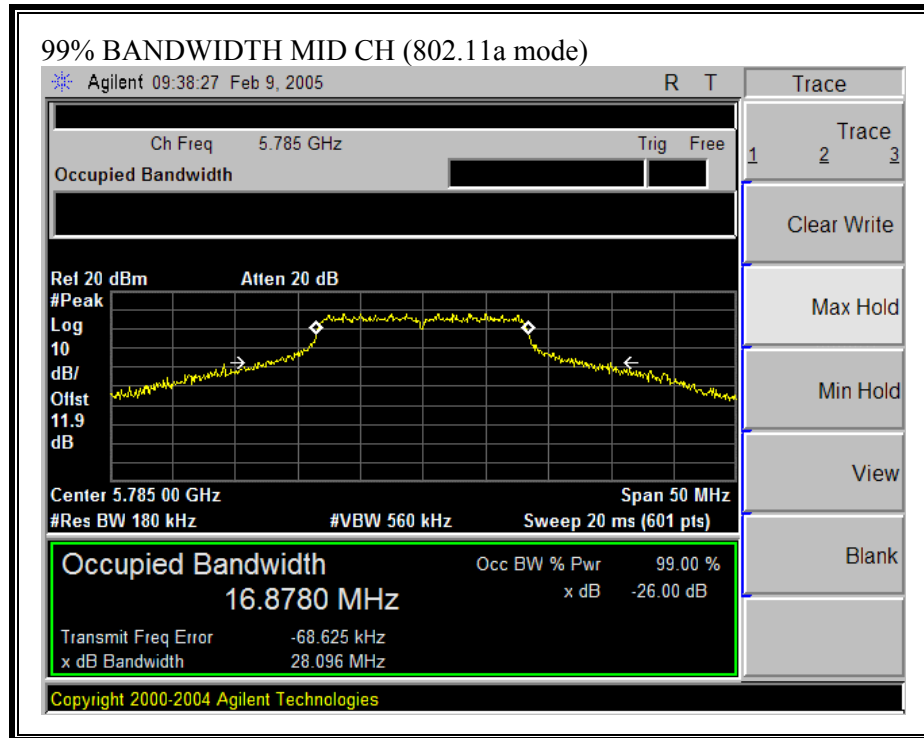
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low     | 5745               | 16.9724                |
| Middle  | 5785               | 16.878                 |
| High    | 5825               | 16.8921                |

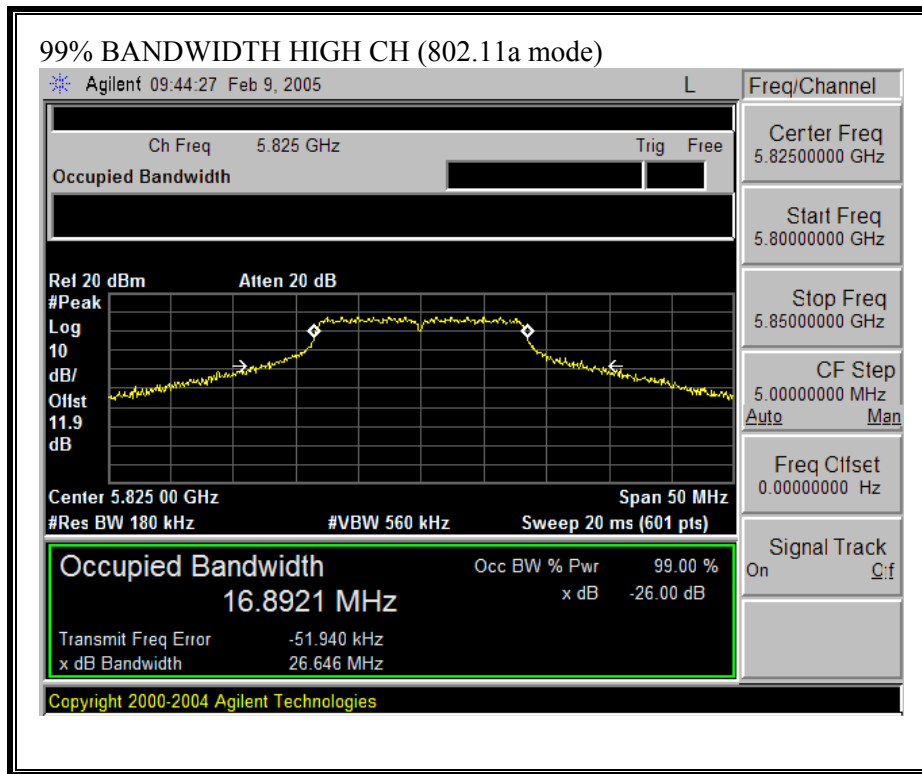
##### 802.11a Turbo Mode

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low     | 5760               | 33.4093                |
| High    | 5805               | 33.3282                |

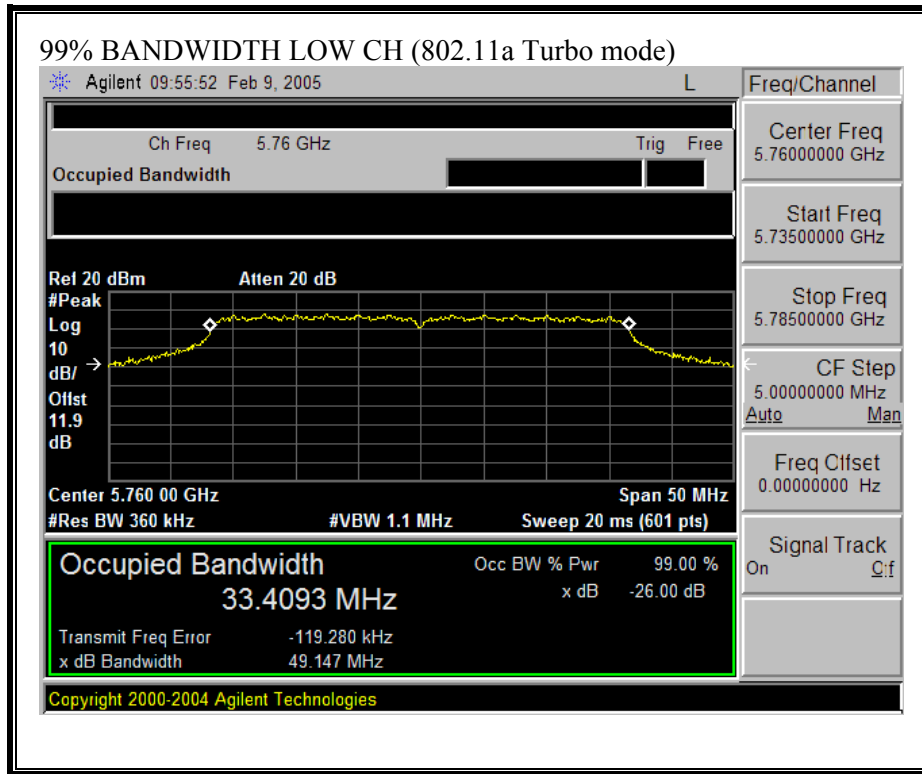
**99% BANDWIDTH (802.11a MODE)**

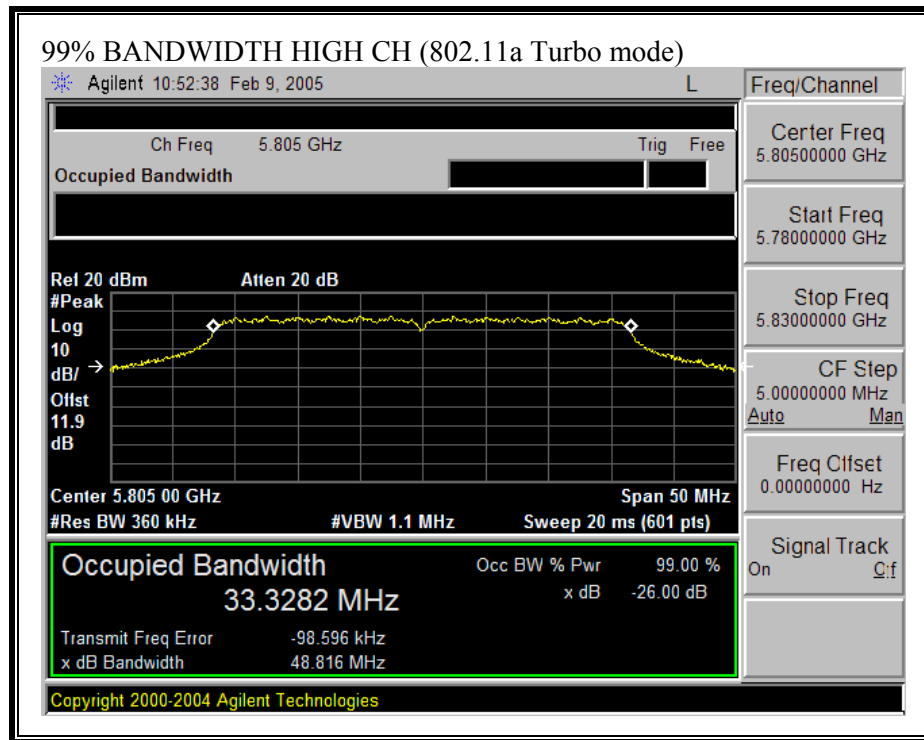






**99% BANDWIDTH (802.11a TURBO MODE)**





### **6.2.3. 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 4.76 dBi for other than fixed, point-to-point operations, therefore the limit is 30 dBm.

No non-compliance noted:

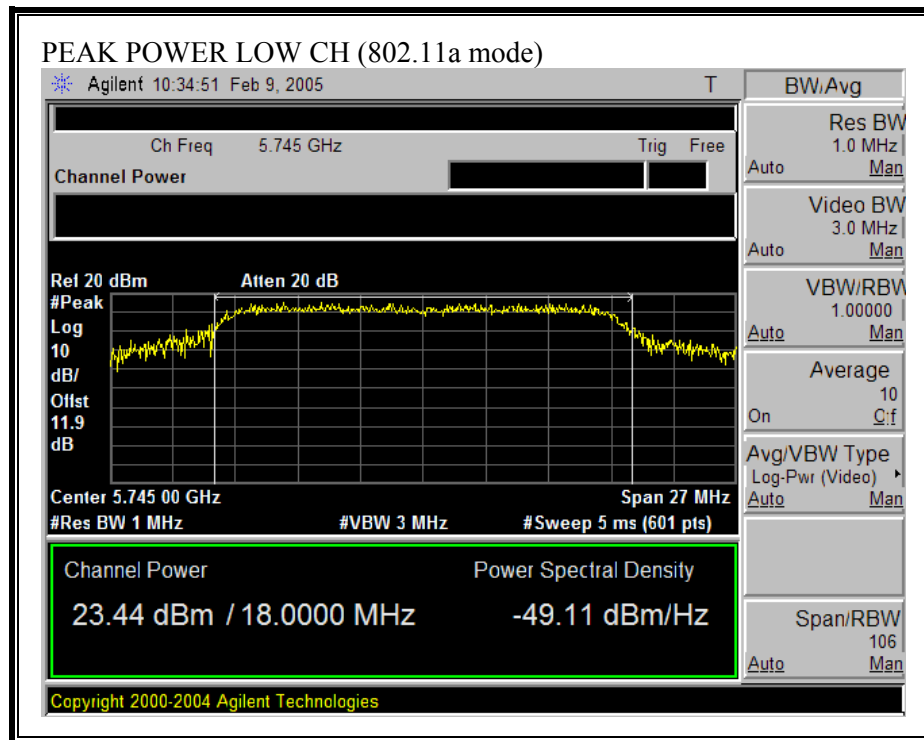
### 802.11a Mode

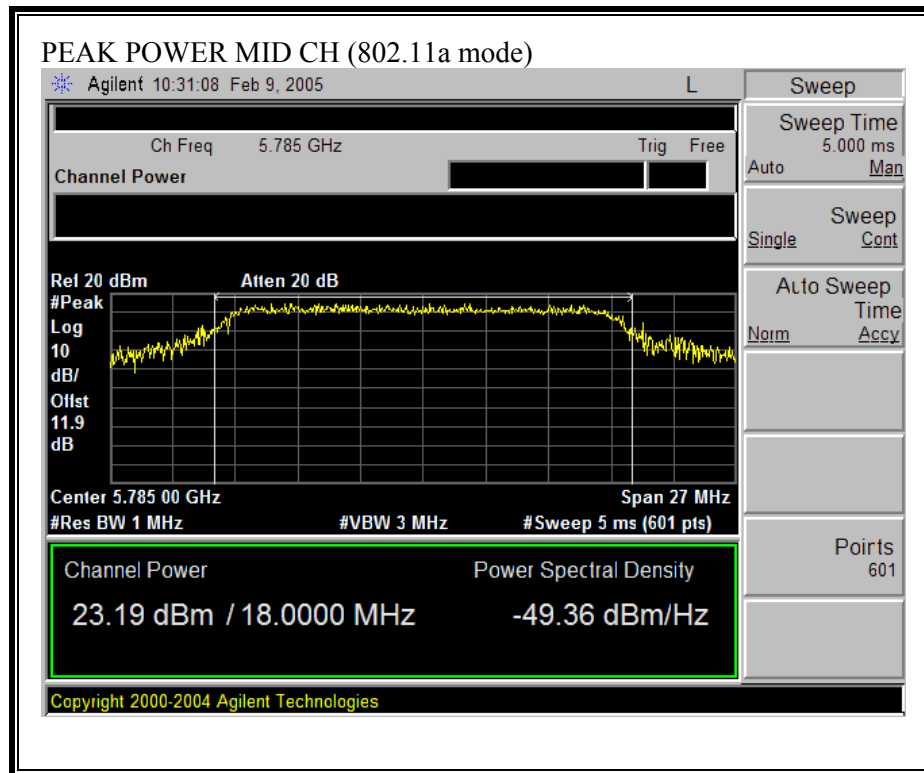
| Channel | Frequency<br>(MHz) | Peak Power<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|---------------------|----------------|----------------|
| Low     | 5745               | 23.44               | 30             | -6.56          |
| Middle  | 5785               | 23.19               | 30             | -6.81          |
| High    | 5825               | 22.94               | 30             | -7.06          |

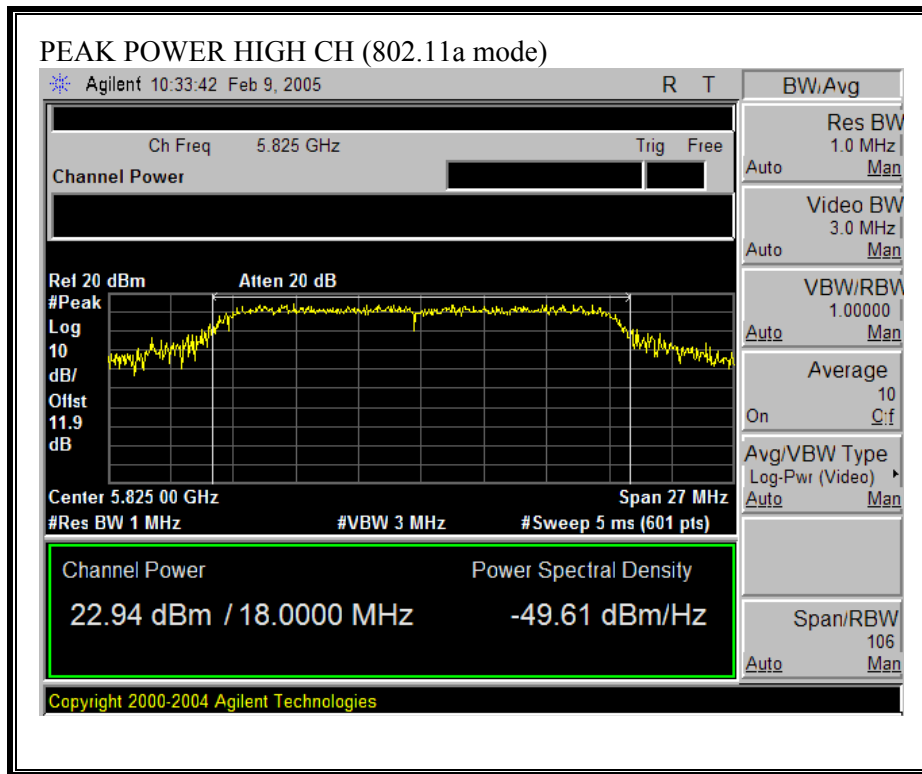
### 802.11a Turbo Mode

| Channel | Frequency<br>(MHz) | Peak Power<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|---------------------|----------------|----------------|
| Low     | 5760               | 22.41               | 30             | -7.59          |
| High    | 5805               | 21.93               | 30             | -8.07          |

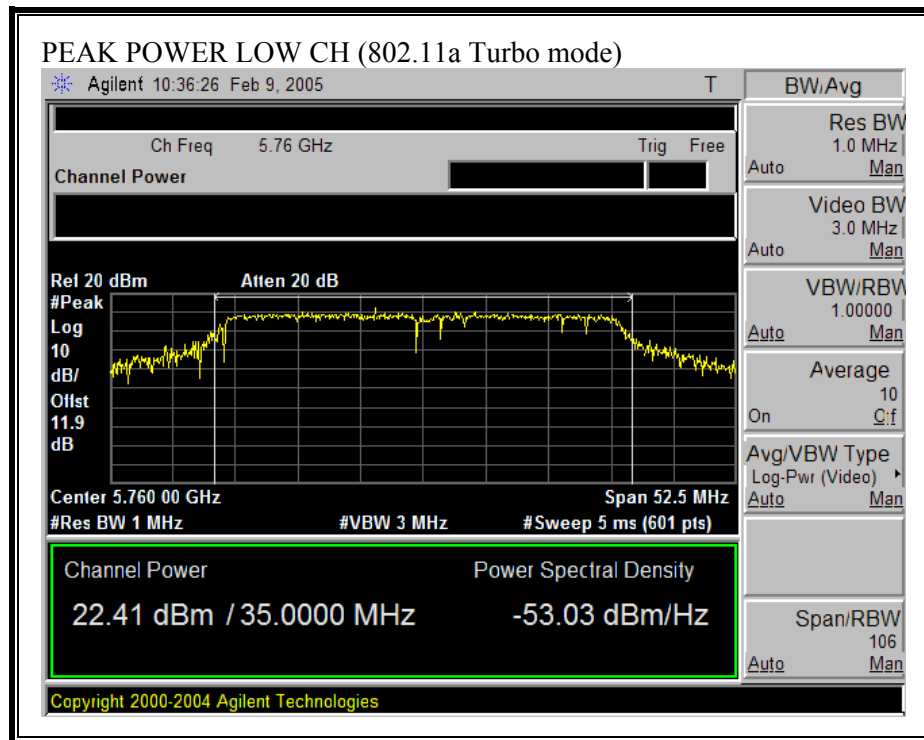
**OUTPUT POWER (802.11a MODE)**

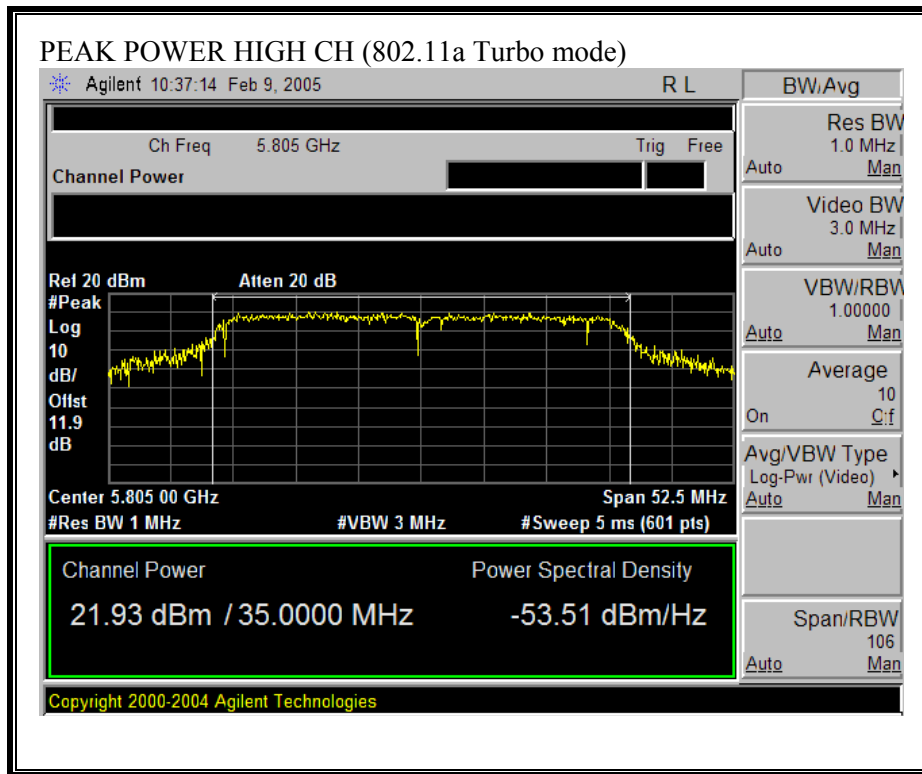






**OUTPUT POWER (802.11a TURBO MODE)**





## 6.2.4. 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<br/>Limit<br/>(mW/cm<sup>2</sup>)</b> | <b>Output<br/>Power<br/>(dBm)</b> | <b>Antenna<br/>Gain<br/>(dBi)</b> | <b>MPE<br/>Distance<br/>(cm)</b> |
|---------------|--------------------------------------------------------|-----------------------------------|-----------------------------------|----------------------------------|
| 802.11a       | 1.0                                                    | 23.44                             | 4.76                              | 7.25                             |
| 802.11a Turbo | 1.0                                                    | 22.41                             | 4.76                              | 6.44                             |

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.

## 6.2.5. 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 11.92 dB (including 10 dB pad and 1.92 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### 802.11a Mode

| Channel | Frequency<br>(MHz) | Average Power<br>(dBm) |
|---------|--------------------|------------------------|
| Low     | 5745               | 17.30                  |
| Middle  | 5785               | 17.30                  |
| High    | 5825               | 17.50                  |

#### 802.11a Turbo Mode

| Channel | Frequency<br>(MHz) | Average Power<br>(dBm) |
|---------|--------------------|------------------------|
| Low     | 5760               | 17.30                  |
| High    | 5805               | 17.00                  |

## 6.2.6. 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:

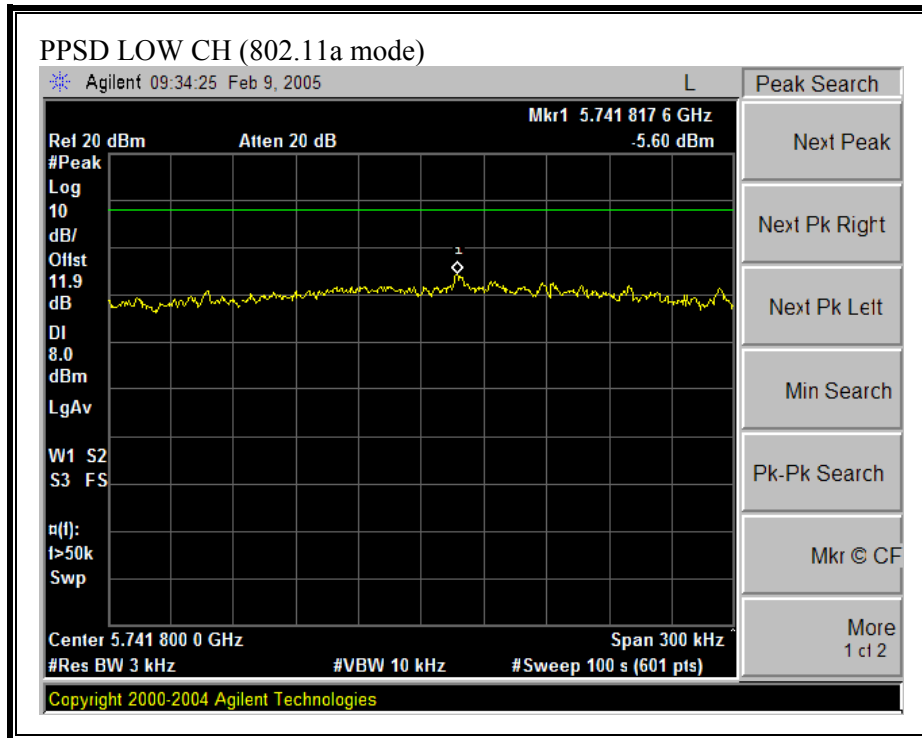
#### 802.11a Mode

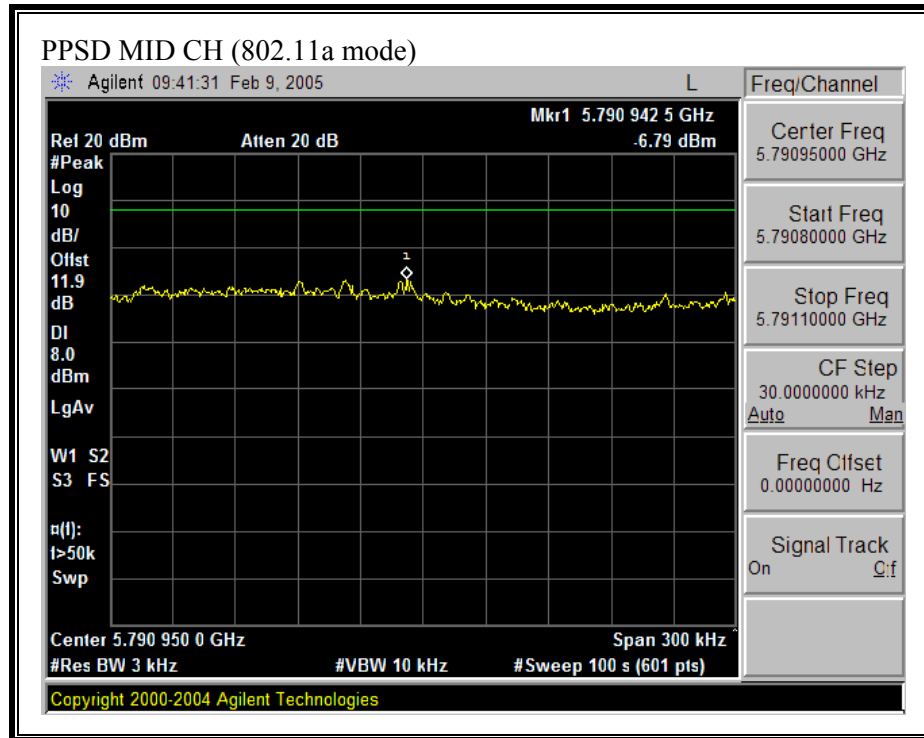
| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|------------|-------------|-------------|
| Low     | 5745            | -5.60      | 8           | -13.60      |
| Middle  | 5785            | -6.79      | 8           | -14.79      |
| High    | 5825            | -6.60      | 8           | -14.60      |

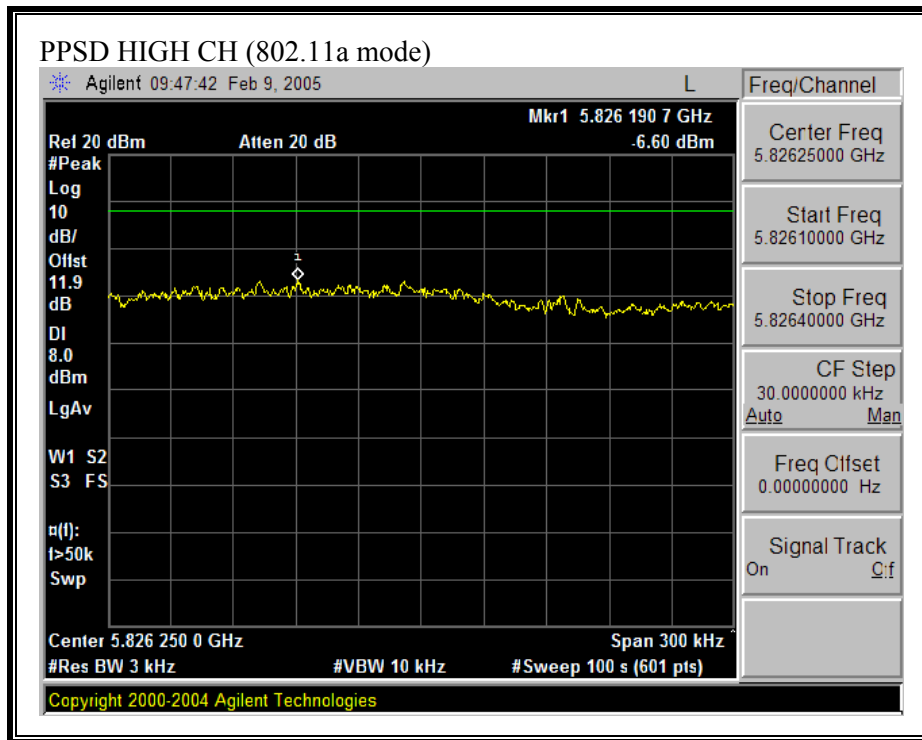
#### 802.11a Turbo Mode

| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|------------|-------------|-------------|
| Low     | 5760            | -8.05      | 8           | -16.05      |
| High    | 5805            | -9.63      | 8           | -17.63      |

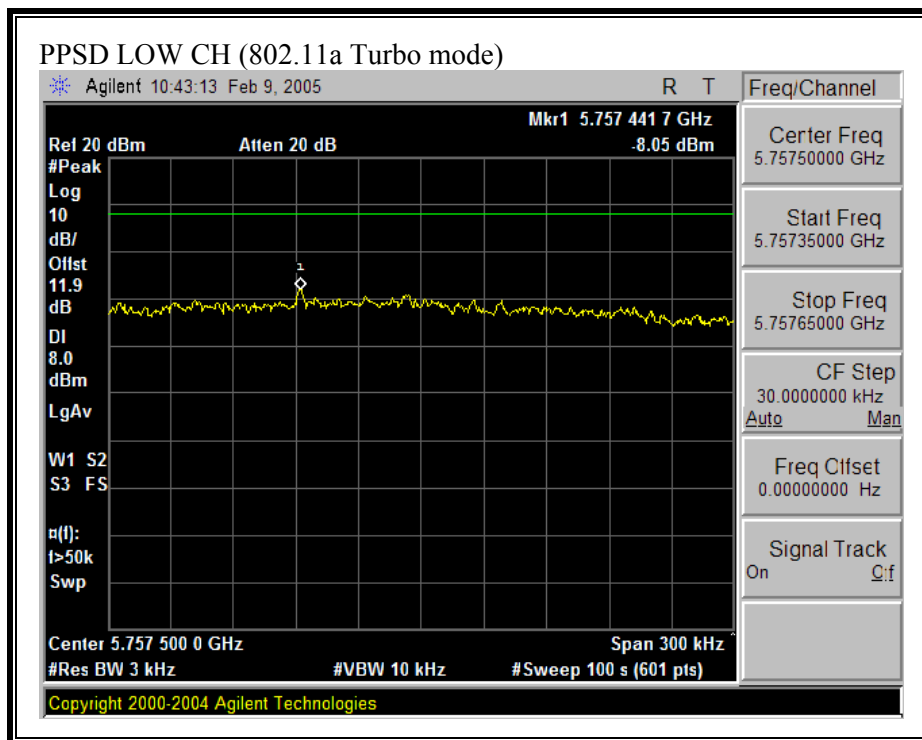
**PEAK POWER SPECTRAL DENSITY (802.11a MODE)**

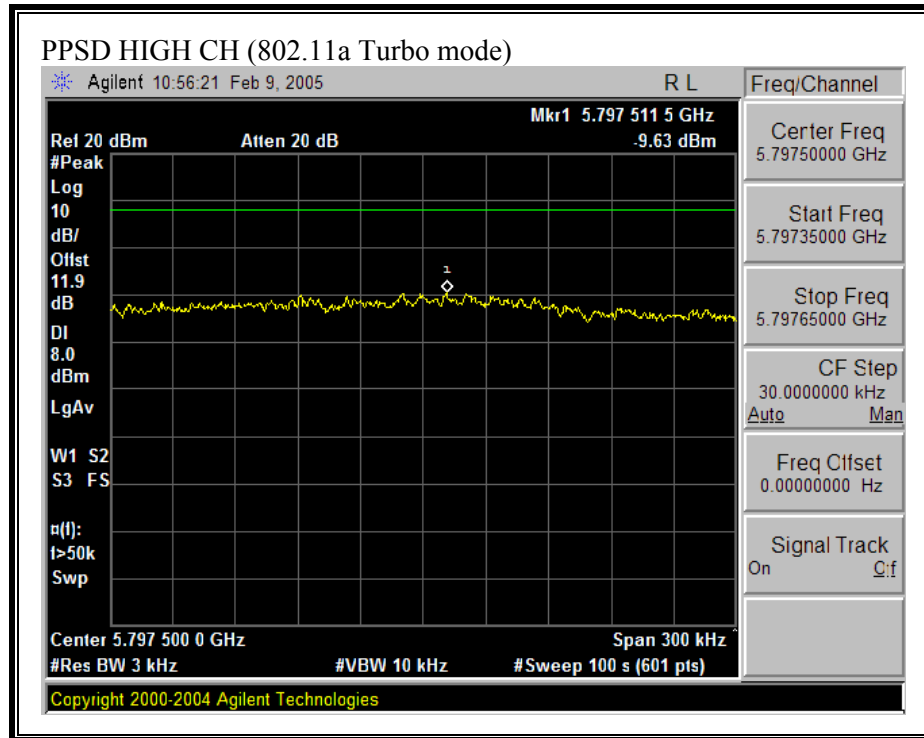






**PEAK POWER SPECTRAL DENSITY (802.11a TURBO MODE)**





## **6.2.7. 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**

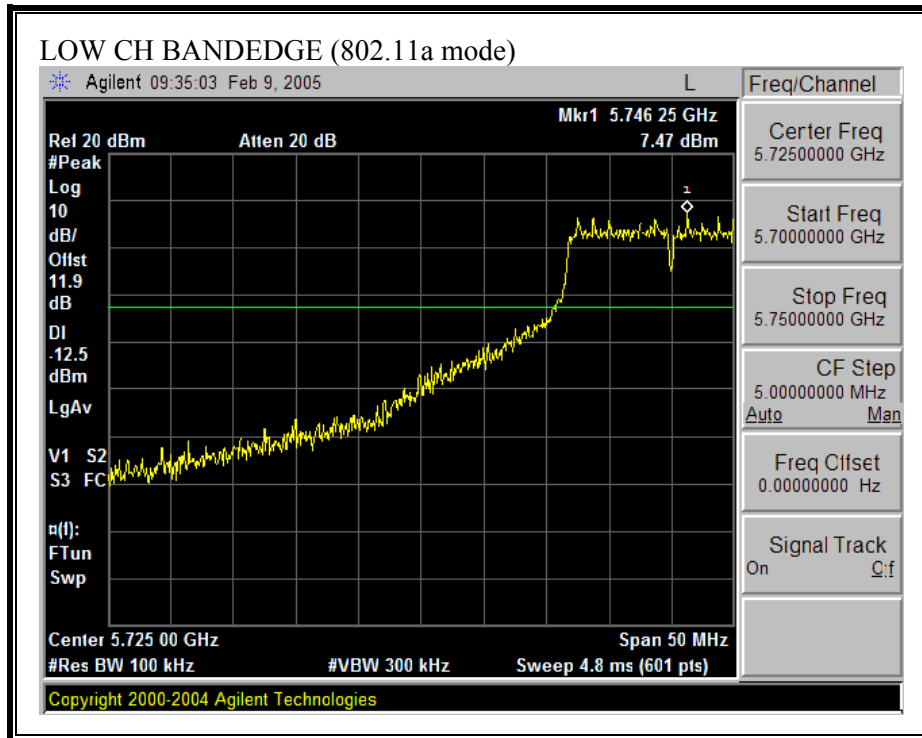
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

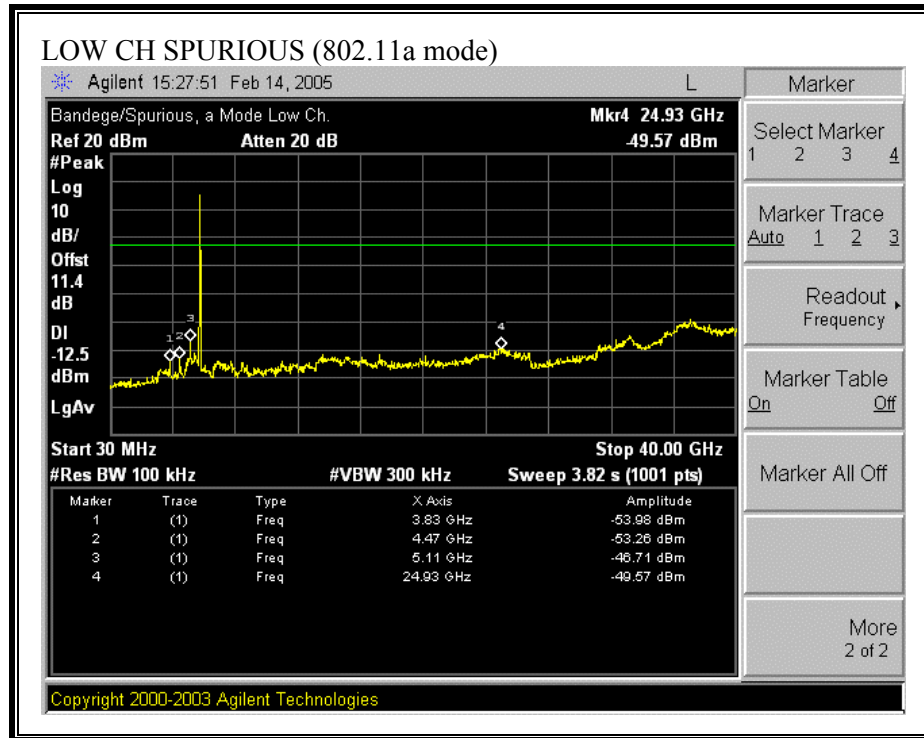
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

### **RESULTS**

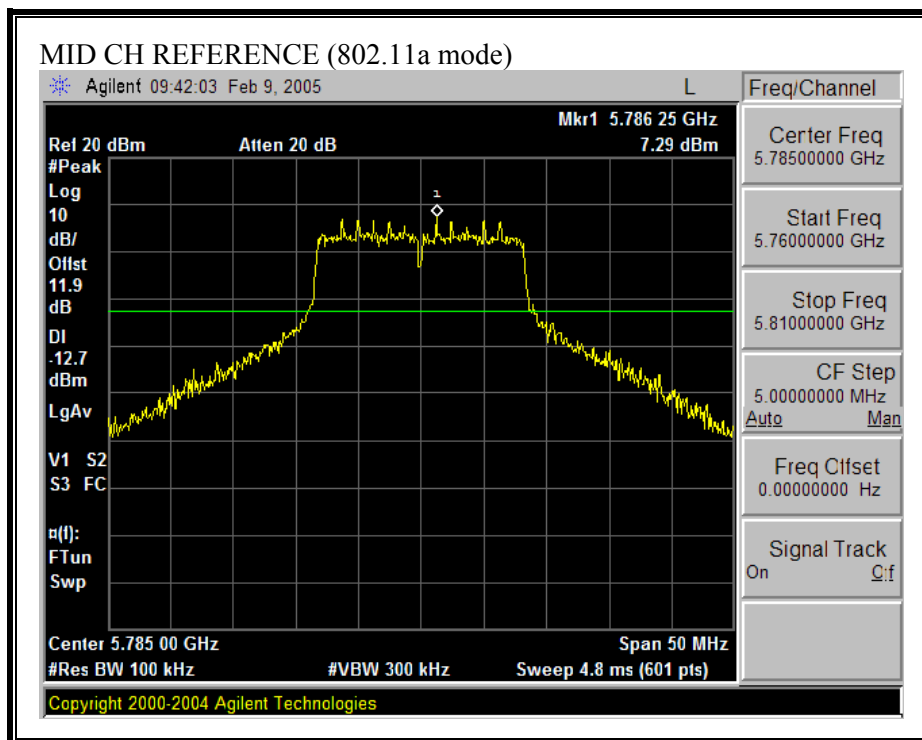
No non-compliance noted:

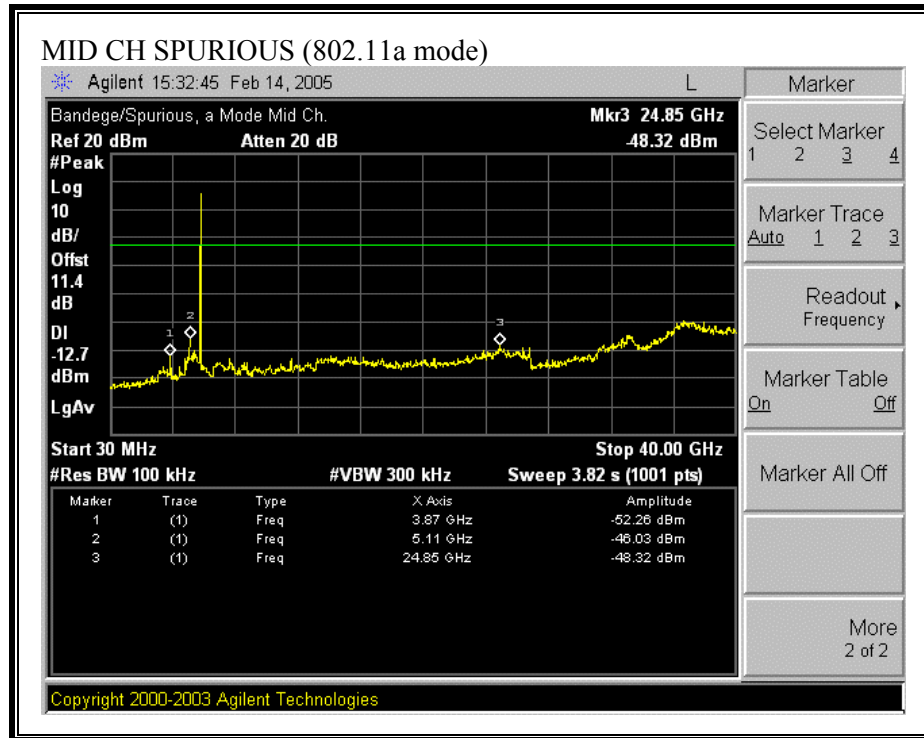
**SPURIOUS EMISSIONS, LOW CHANNEL (802.11a MODE)**



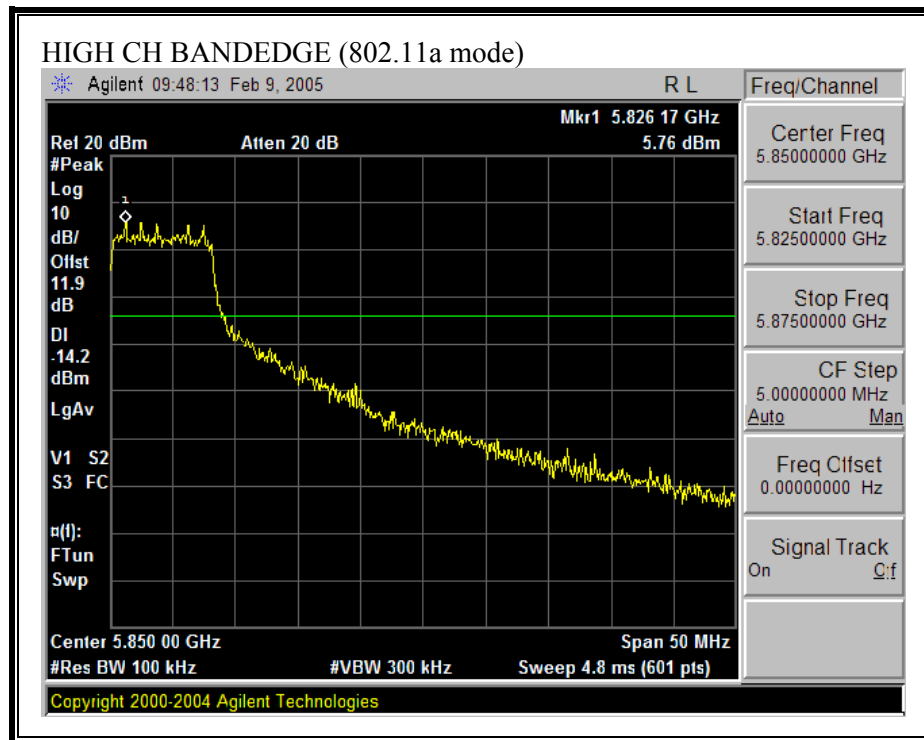


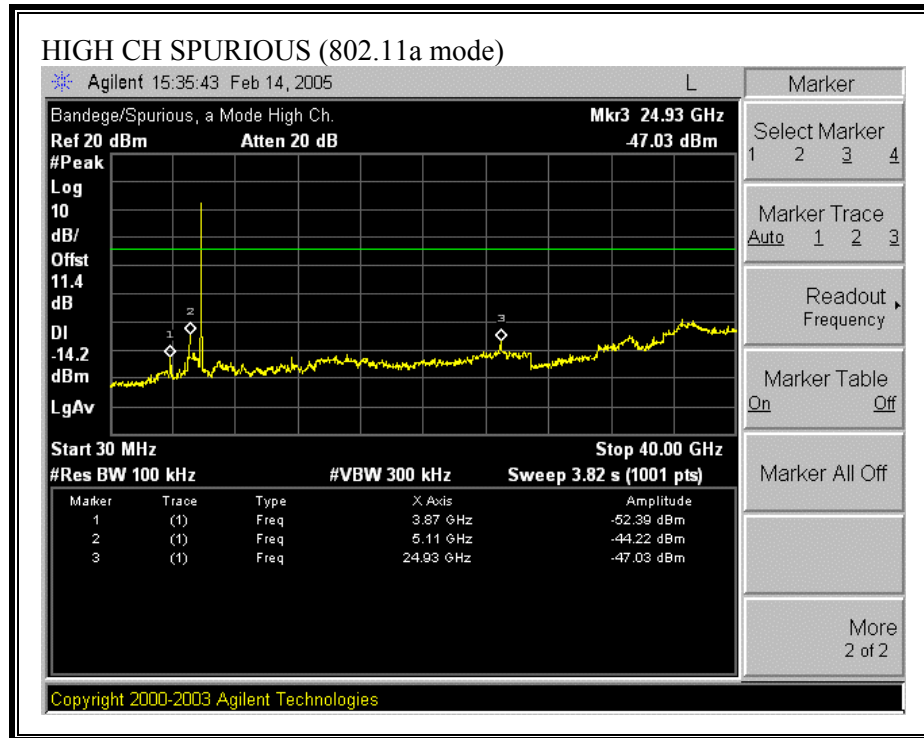
**SPURIOUS EMISSIONS, MID CHANNEL (802.11a MODE)**



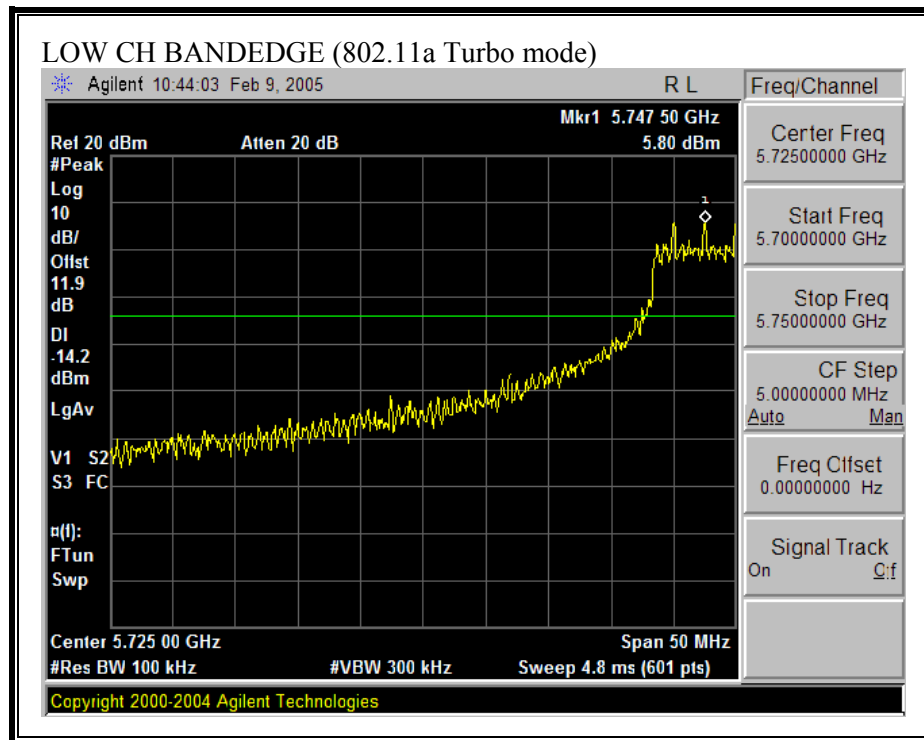


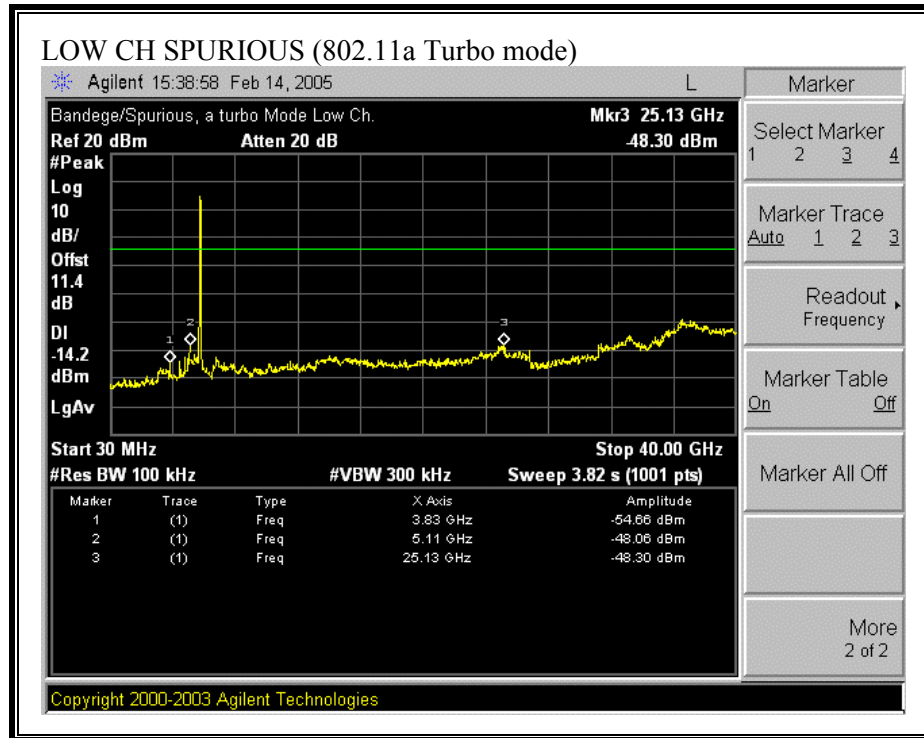
**SPURIOUS EMISSIONS, HIGH CHANNEL (802.11a MODE)**



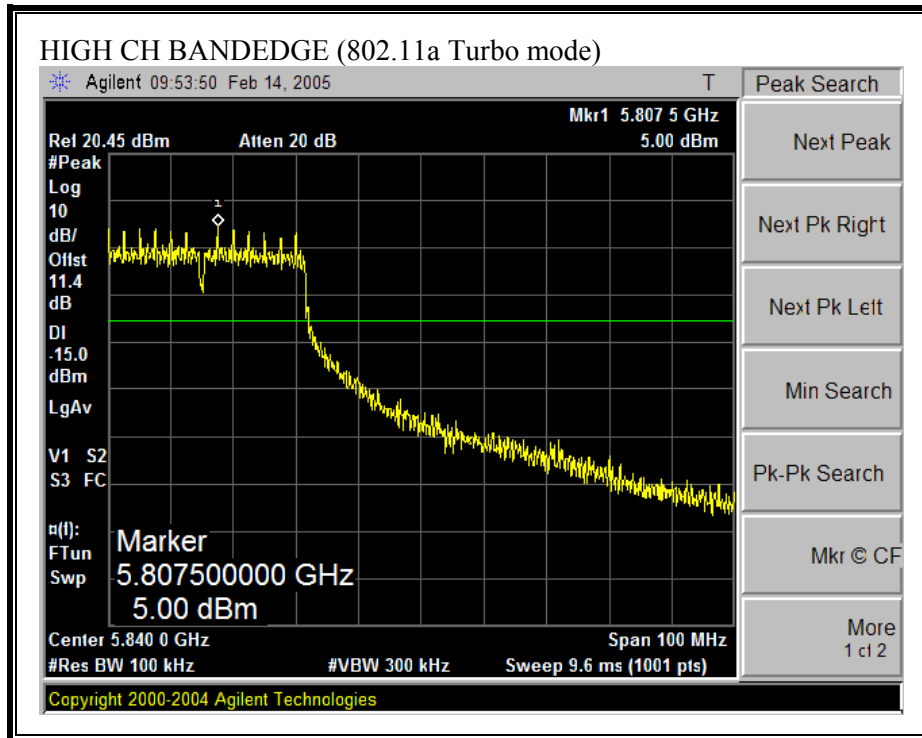


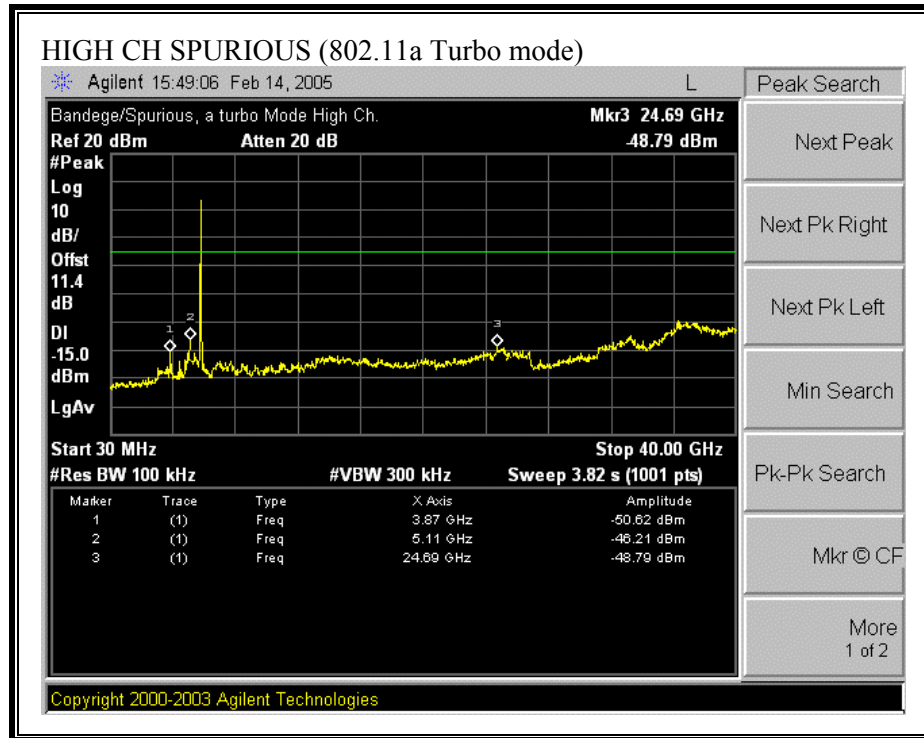
**SPURIOUS EMISSIONS, LOW CHANNEL (802.11a TURBO MODE)**





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





### 6.3. RADIATED EMISSIONS

#### 6.3.1. 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<br>(MHz) | Field Strength<br>(microvolts/meter) | Measurement Distance<br>(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.

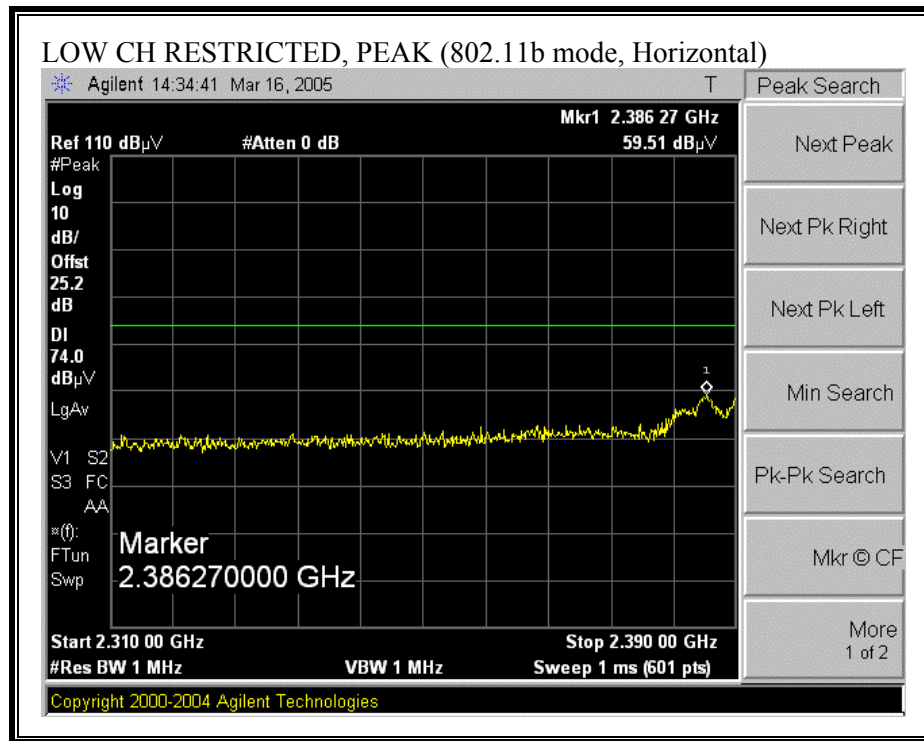
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

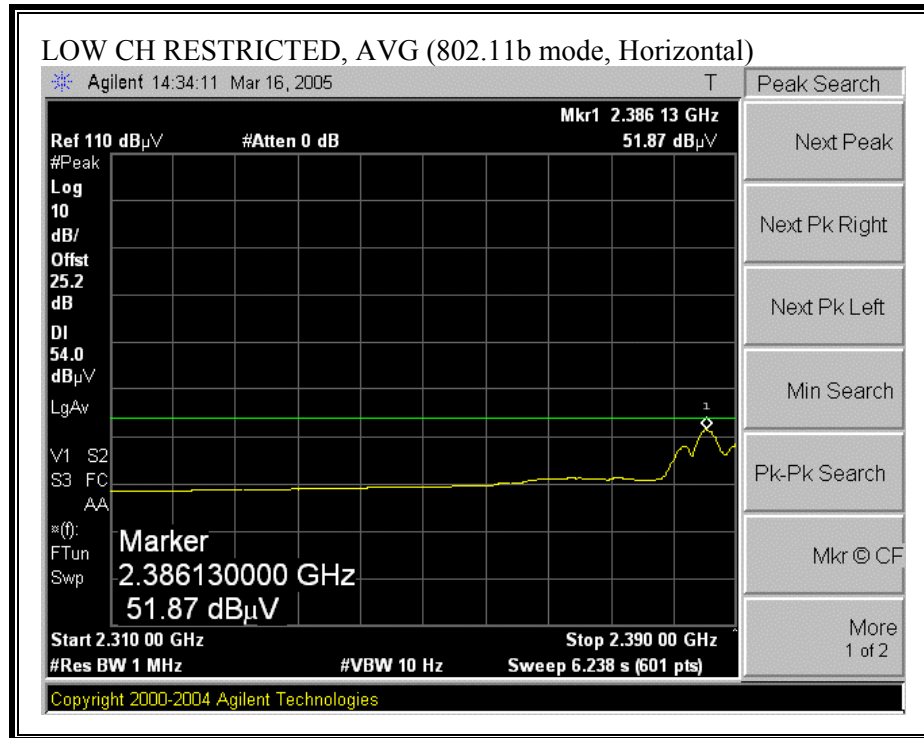
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each 5 GHz band.

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.

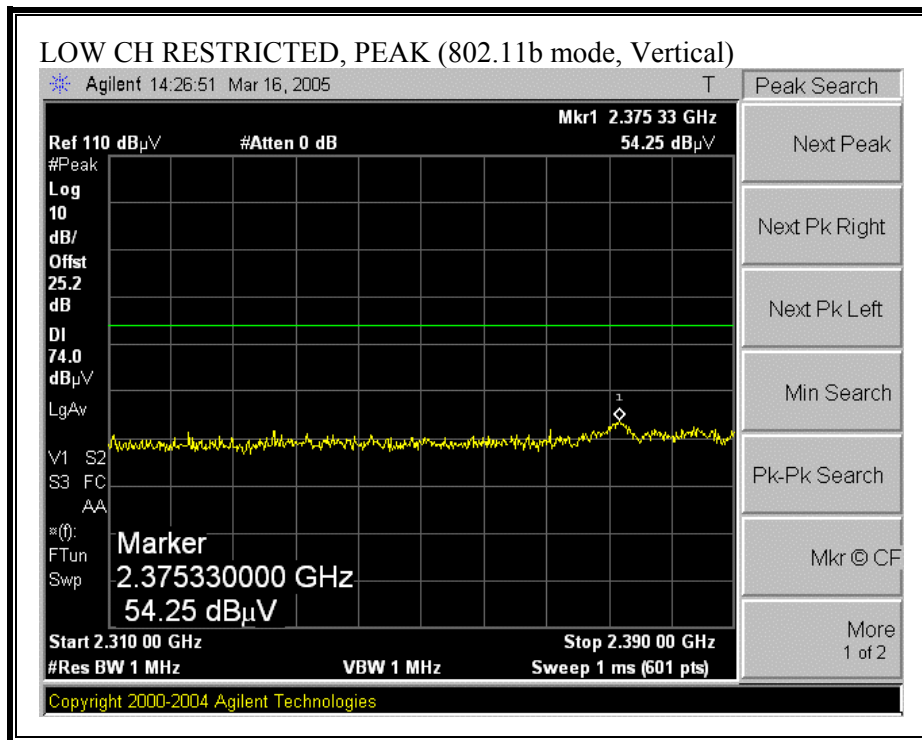
### 6.3.2. TRANSMITTER ABOVE 1 GHz FOR 2400 TO 2483.5 MHz BAND

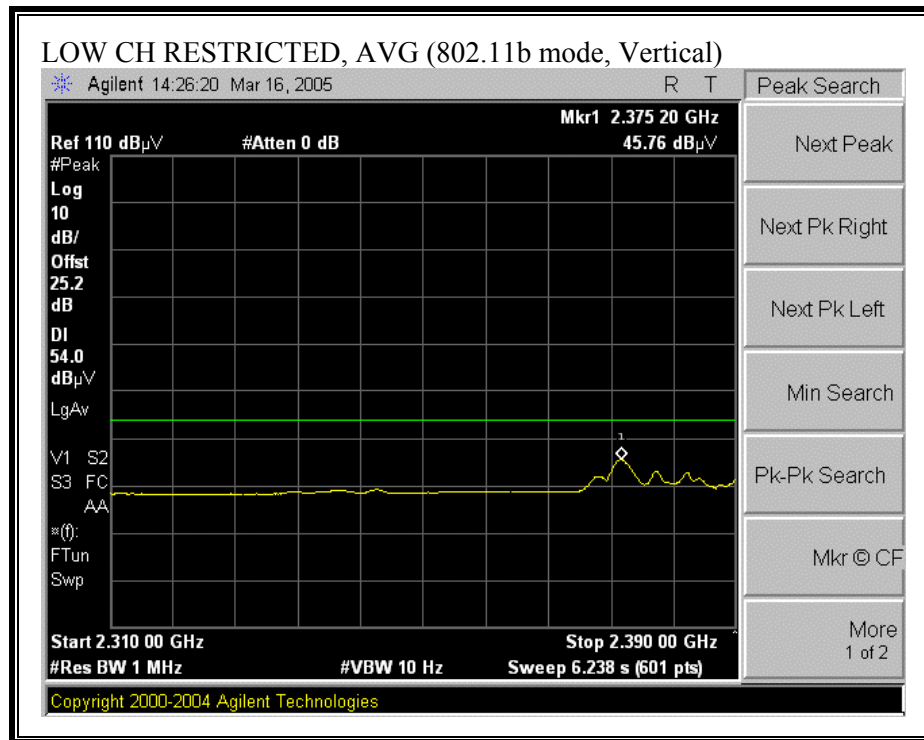
#### RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, HORIZONTAL)



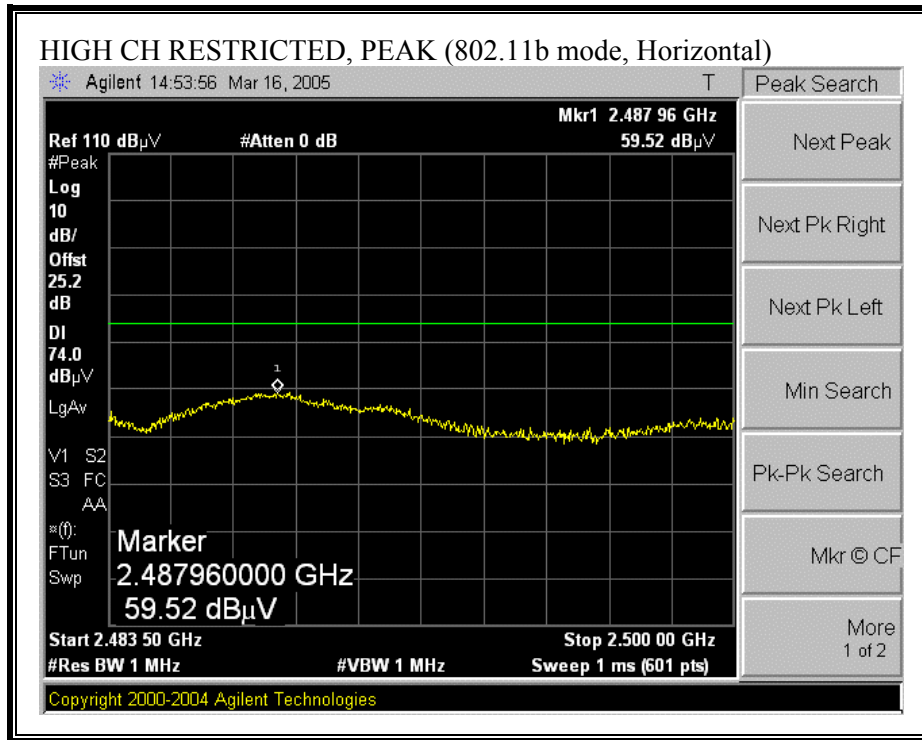


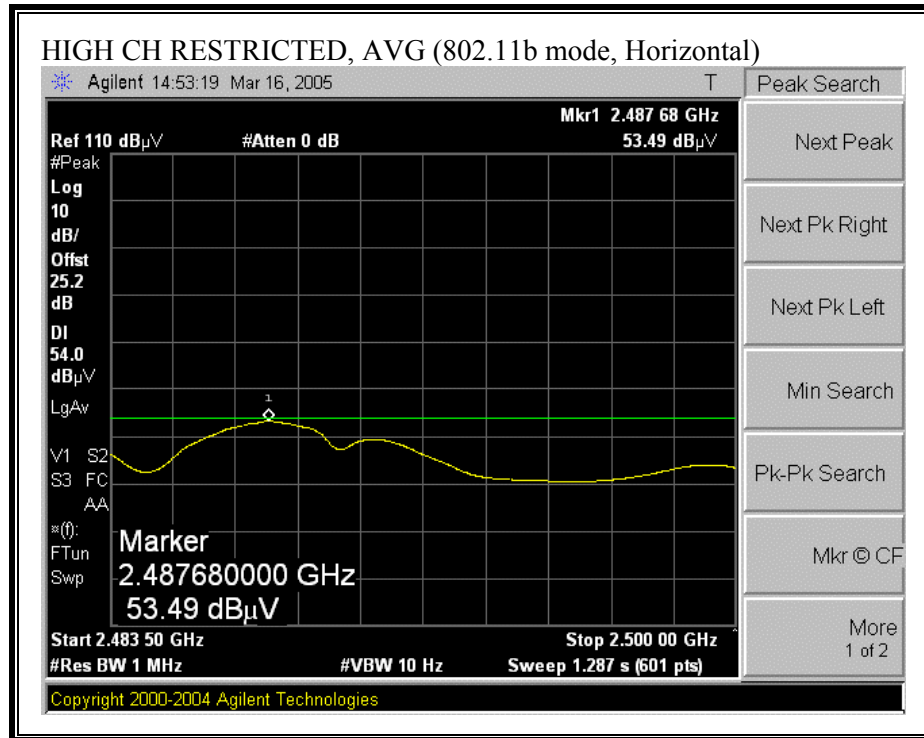
**RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, VERTICAL)**



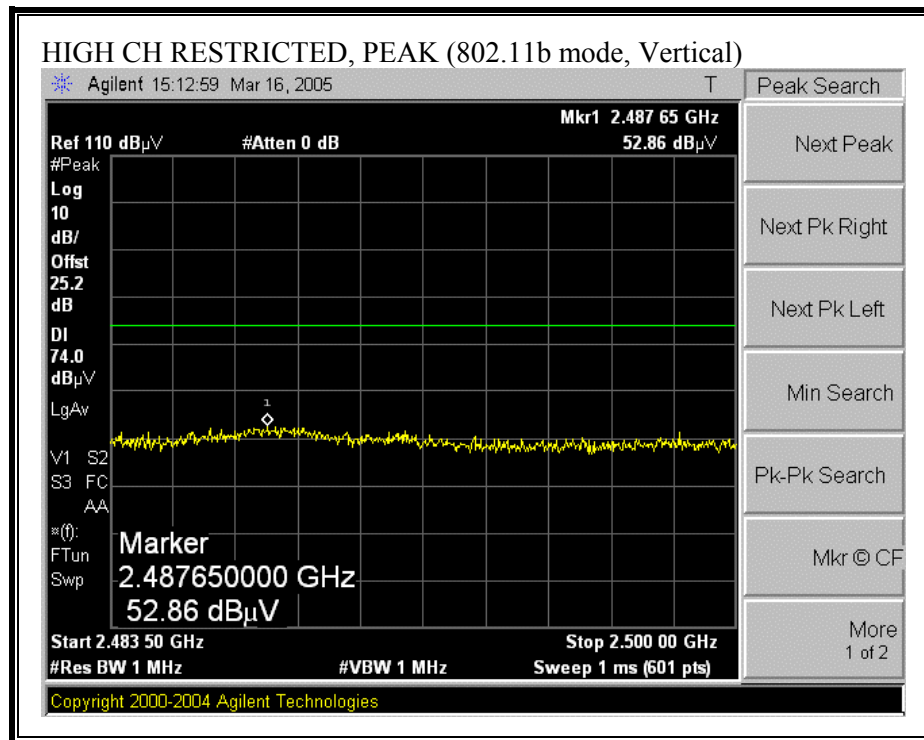


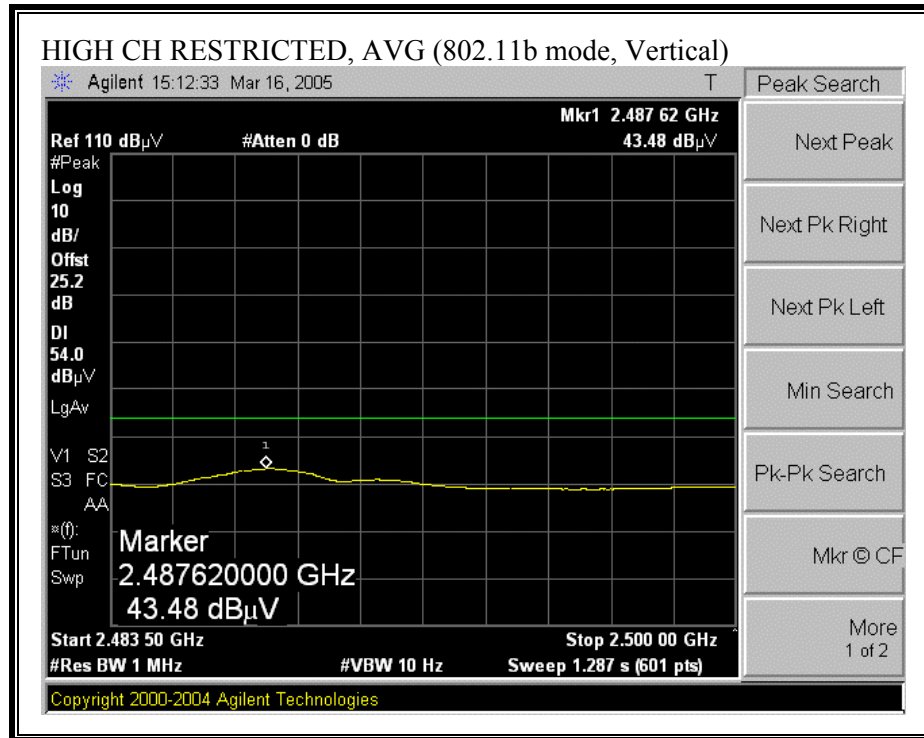
**RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, HORIZONTAL)**





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



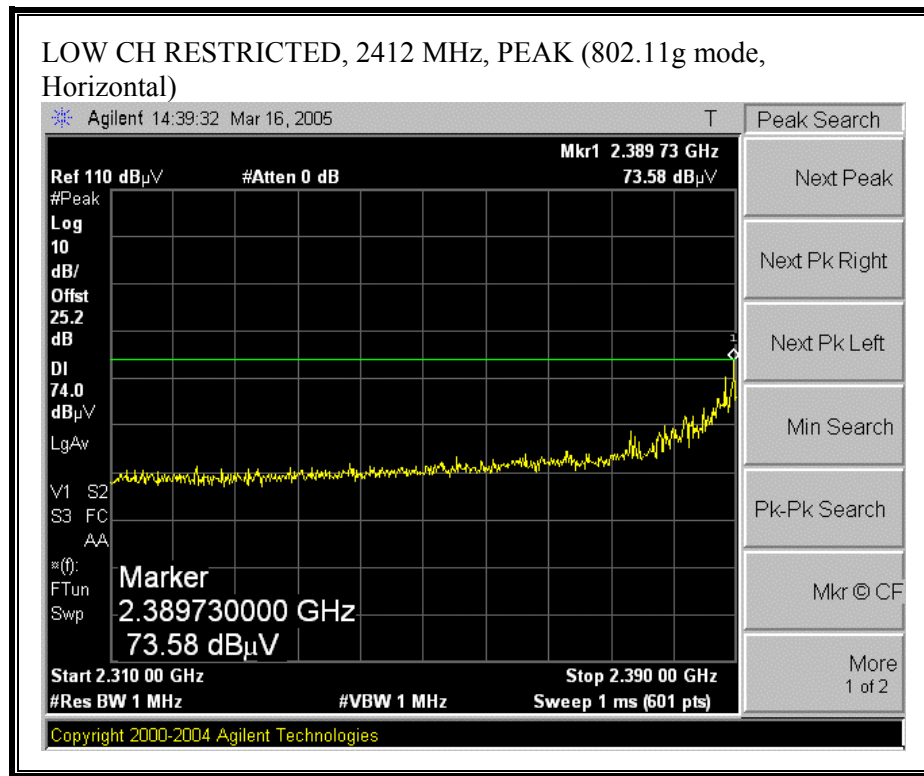


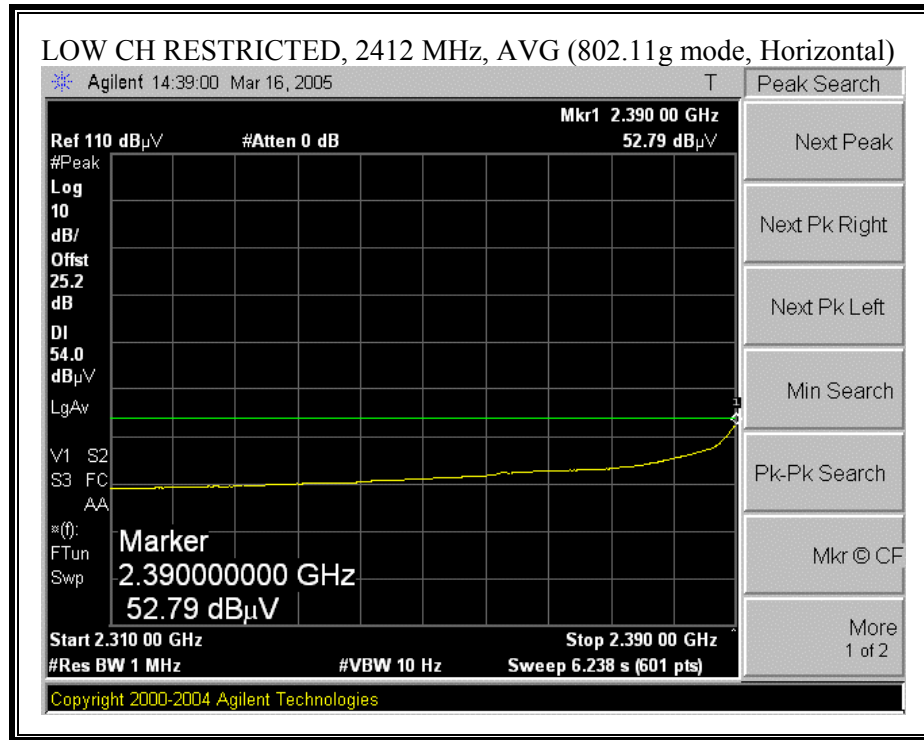
[illegible]

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

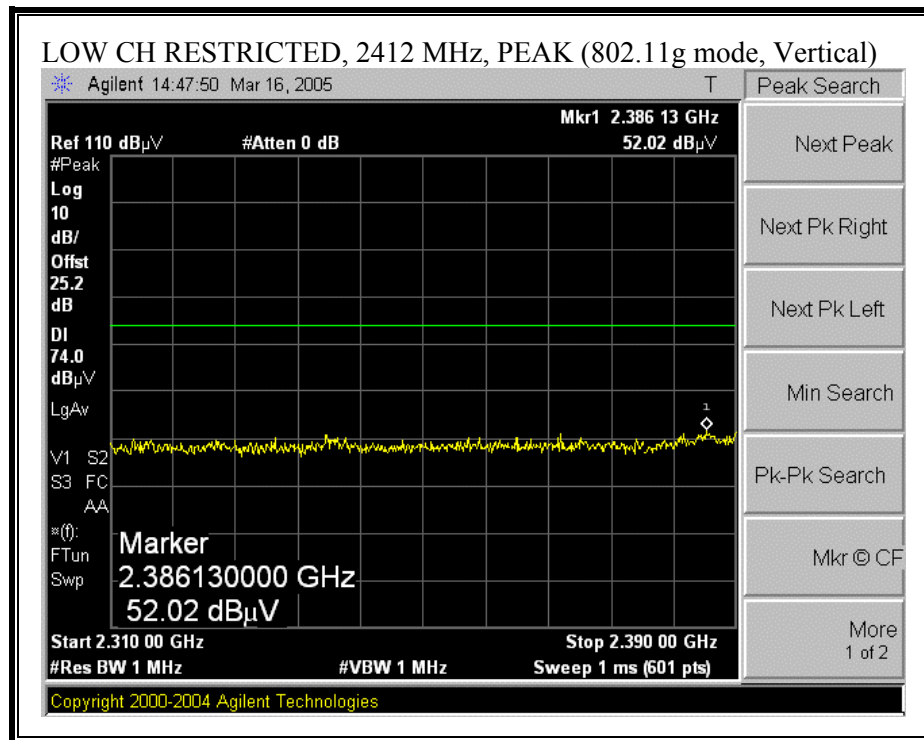
| 01/27/05 <b>High Frequency Measurement</b><br>Compliance Certification Services, Morgan Hill Open Field Site                                                                                                                                                                                                                                                                                                                                      |          |                                                           |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------------------------------------------------------|----------------|--------------------------|-------|--------------------------|-----------|------------------------------------------|-------------|------------|---------------|----------------|-----------|----------------------------------------------------|-------------|
| <b>Test Engr:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 |          | HITESH H. SOLANKI                                         |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
| <b>Project #:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 |          | 05U3230-1                                                 |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
| <b>Company:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   |          | ATHEROS COMMUNICATION, INC.                               |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
| <b>EUT Descr.:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                |          | MiniPCI 802.11 a/b/g TRANSCEIVER - 802.11 a/g TURBO MODES |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
| <b>EUT M/N:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   |          | AR5BMB6                                                   |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
| <b>Test Target:</b>                                                                                                                                                                                                                                                                                                                                                                                                                               |          | FCC CLASS B                                               |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
| <b>Mode Oper:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 |          | TRANSMIT ONLY; (ON SPECIFIED CHANNELS) 11b MODE           |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
| <b>Test Equipment:</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |          |                                                           |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
| EMCO Horn 1-18GHz<br>T60; S/N: 2238 @3m                                                                                                                                                                                                                                                                                                                                                                                                           |          | Pre-amplifier 1-26GHz<br>T86 Miteq 924341                 |                | Pre-amplifier 26-40GHz   |       | Horn > 18GHz             |           |                                          |             |            |               |                |           |                                                    |             |
| Hi Frequency Cables                                                                                                                                                                                                                                                                                                                                                                                                                               |          |                                                           |                | HPF                      |       | Reject Filter            |           | <b>Peak Measurements</b><br>RBW=VBW=1MHz |             |            |               |                |           |                                                    |             |
| 2 foot cable<br>4_Hitesh                                                                                                                                                                                                                                                                                                                                                                                                                          |          |                                                           |                | 3 foot cable<br>4_Hitesh |       | 4 foot cable<br>4_Hitesh |           | 12 foot cable<br>12_Hitesh               |             | HPF_4.0GHz |               | R_001          |           | <b>Average Measurements</b><br>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>LOW CHANNEL 2417 MHz</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |          |                                                           |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
| 4.834                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.0      | 52.7                                                      | 46.2           | 33.0                     | 4.5   | -44.0                    | 0.0       | 0.6                                      | 46.7        | 40.2       | 74            | 54             | -27.3     | -13.8                                              | V           |
| 7.251                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.0      | 51.2                                                      | 39.0           | 35.8                     | 6.2   | -45.0                    | 0.0       | 0.6                                      | 48.8        | 36.6       | 74            | 54             | -25.2     | -17.4                                              | V           |
| 9.668                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.0      | 52.4                                                      | 48.3           | 38.2                     | 7.7   | -43.4                    | 0.0       | 0.8                                      | 55.7        | 51.6       | 74            | 54             | -18.3     | -2.4                                               | V           |
| <b>HIGH CHANNEL 2457 MHz</b>                                                                                                                                                                                                                                                                                                                                                                                                                      |          |                                                           |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
| 4.914                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.0      | 55.8                                                      | 51.3           | 33.0                     | 4.5   | -44.2                    | 0.0       | 0.6                                      | 49.8        | 45.3       | 74            | 54             | -24.2     | -8.7                                               | V           |
| 7.371                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.0      | 50.1                                                      | 38.4           | 36.0                     | 6.2   | -45.0                    | 0.0       | 0.6                                      | 48.0        | 36.3       | 74            | 54             | -26.0     | -17.7                                              | V           |
| 9.828                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.0      | 48.3                                                      | 39.2           | 38.3                     | 7.7   | -43.3                    | 0.0       | 0.8                                      | 51.9        | 42.8       | 74            | 54             | -22.1     | -11.2                                              | V           |
| <b>LOW CHANNEL 2417 MHz</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |          |                                                           |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
| 4.834                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.0      | 62.6                                                      | 59.4           | 33.0                     | 4.5   | -44.0                    | 0.0       | 0.6                                      | 56.7        | 53.4       | 74            | 54             | -17.3     | -0.6                                               | H           |
| 7.251                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.0      | 52.3                                                      | 40.2           | 35.8                     | 6.2   | -45.0                    | 0.0       | 0.6                                      | 49.9        | 37.8       | 74            | 54             | -24.1     | -16.2                                              | H           |
| 9.668                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.0      | 54.0                                                      | 50.0           | 38.2                     | 7.7   | -43.4                    | 0.0       | 0.8                                      | 57.3        | 53.3       | 74            | 54             | -16.7     | -0.7                                               | H           |
| <b>HIGH CHANNEL 2457 MHz</b>                                                                                                                                                                                                                                                                                                                                                                                                                      |          |                                                           |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |
| 4.914                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.0      | 62.2                                                      | 59.5           | 33.0                     | 4.5   | -44.2                    | 0.0       | 0.6                                      | 56.2        | 53.5       | 74            | 54             | -17.8     | -0.5                                               | H           |
| 7.371                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.0      | 50.2                                                      | 39.6           | 36.0                     | 6.2   | -45.0                    | 0.0       | 0.6                                      | 48.1        | 37.5       | 74            | 54             | -25.9     | -16.5                                              | H           |
| 9.828                                                                                                                                                                                                                                                                                                                                                                                                                                             | 3.0      | 49.8                                                      | 45.2           | 38.3                     | 7.7   | -43.3                    | 0.0       | 0.8                                      | 53.4        | 48.8       | 74            | 54             | -20.6     | -5.2                                               | H           |
| f Measurement Frequency      Amp Preamp Gain      Avg Lim Average Field Strength Limit<br>Dist Distance to Antenna      D Corr Distance Correct to 3 meters      Pk Lim Peak Field Strength Limit<br>Read Analyzer Reading      Avg Average Field Strength @ 3 m      Avg Mar Margin vs. Average Limit<br>AF Antenna Factor      Peak Calculated Peak Field Strength      Pk Mar Margin vs. Peak Limit<br>CL Cable Loss      HPF High Pass Filter |          |                                                           |                |                          |       |                          |           |                                          |             |            |               |                |           |                                                    |             |

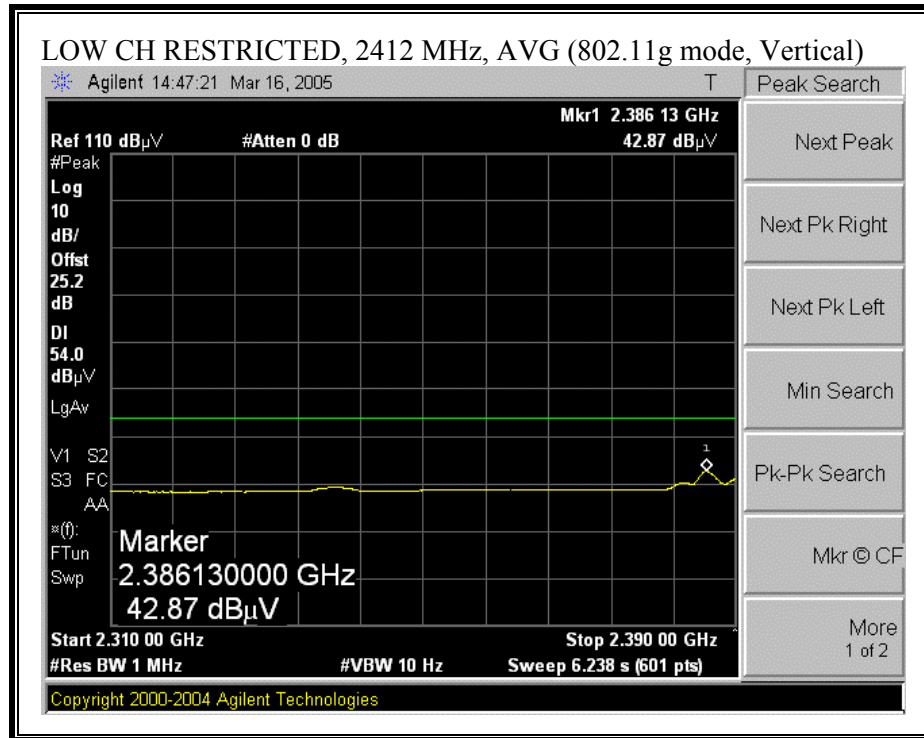
**RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, 2412 MHz, HORIZONTAL)**



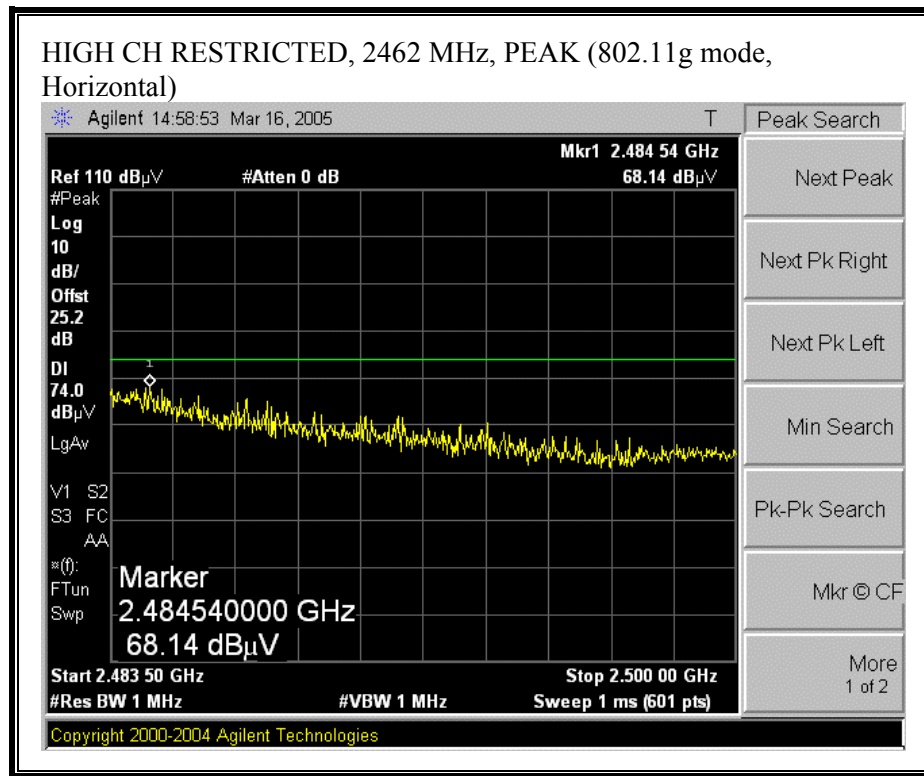


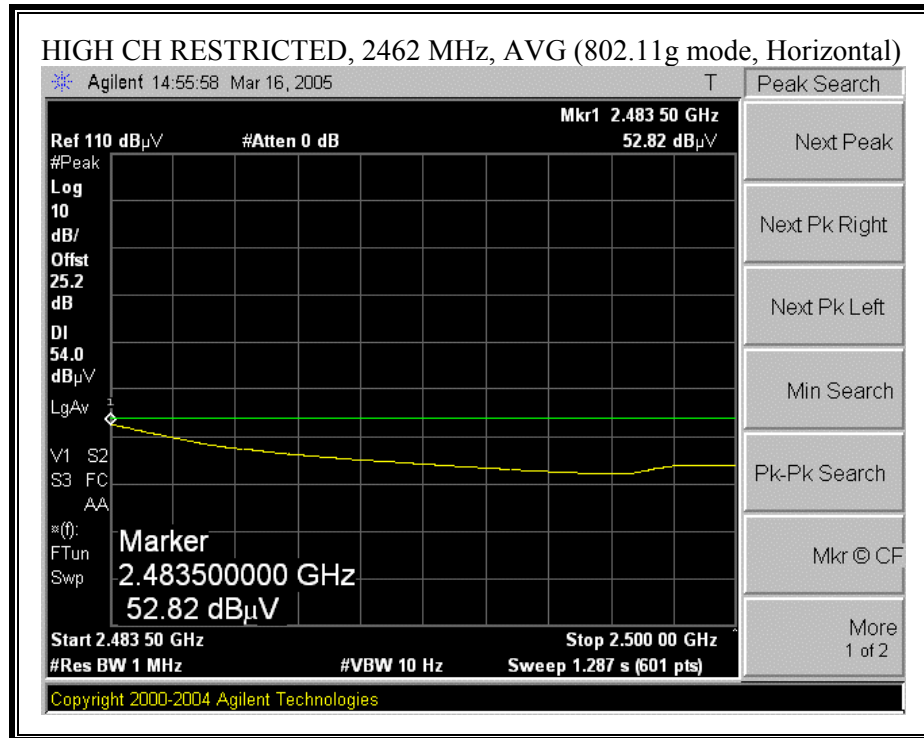
**RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, 2412 MHz, VERTICAL)**



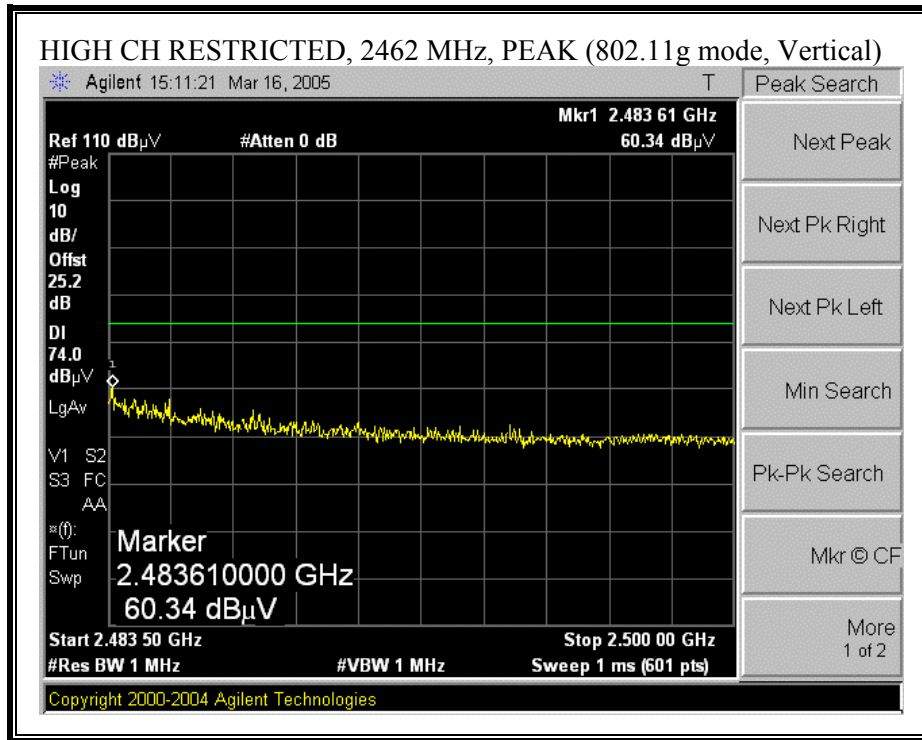


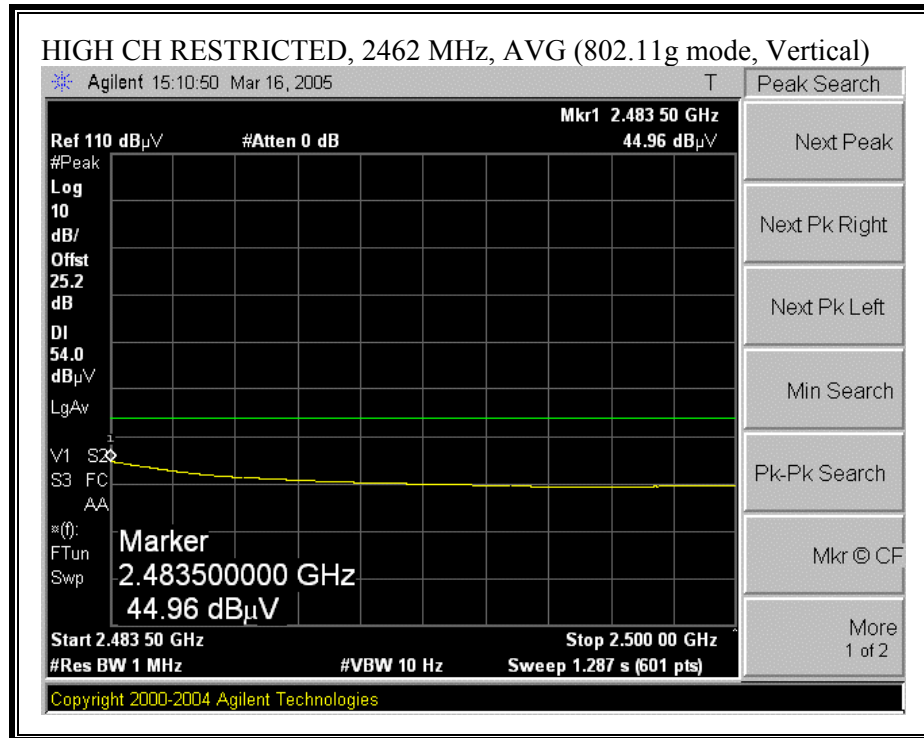
**RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, 2462 MHz, HORIZONTAL)**



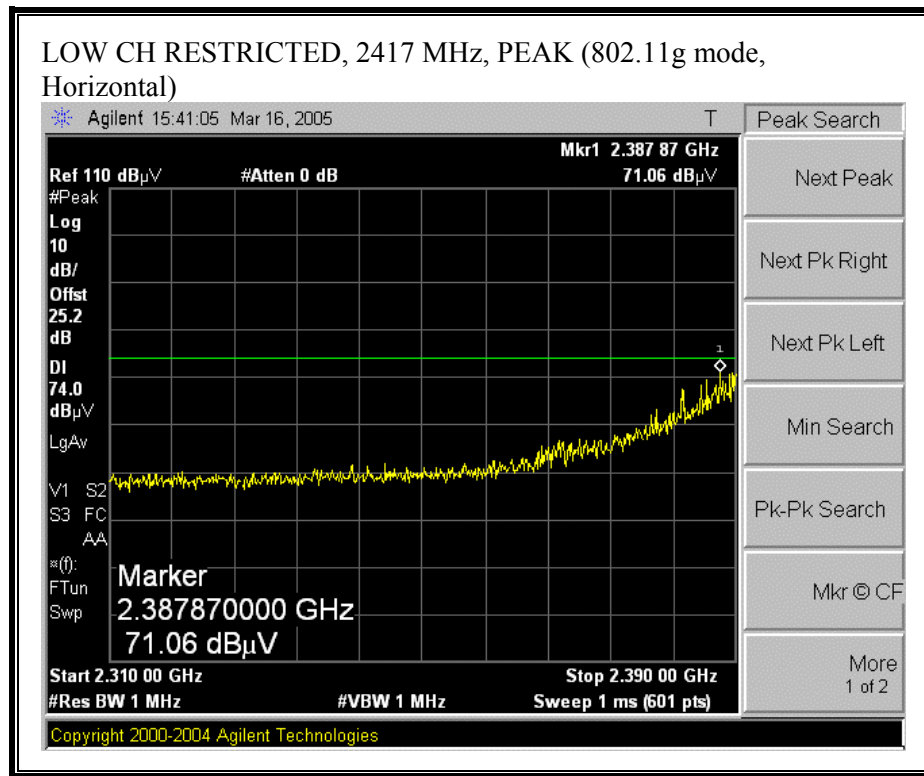


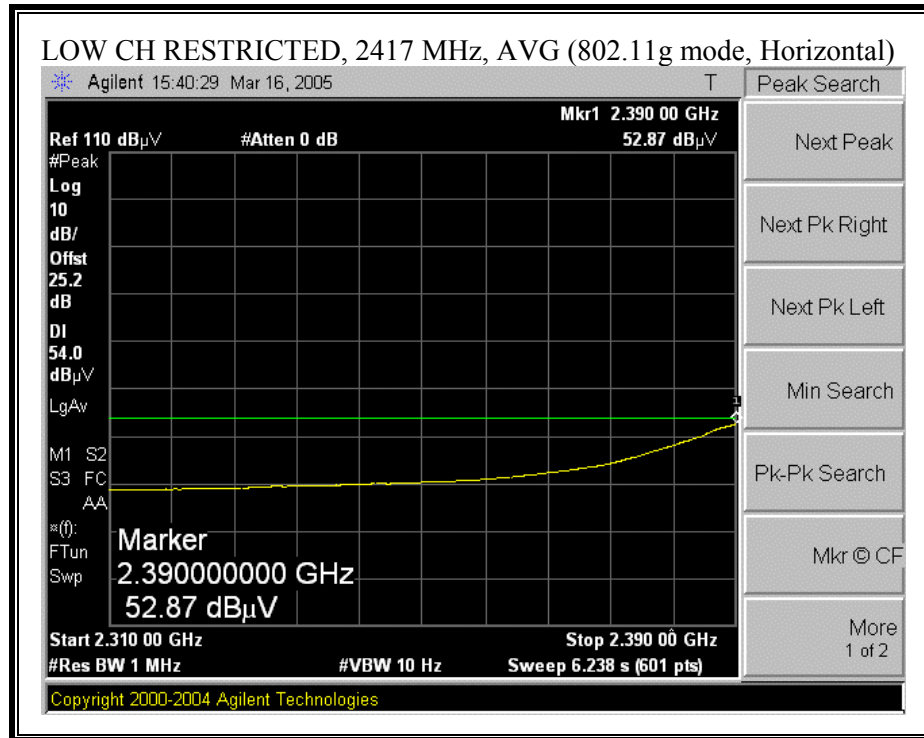
**RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, 2462 MHz, VERTICAL)**



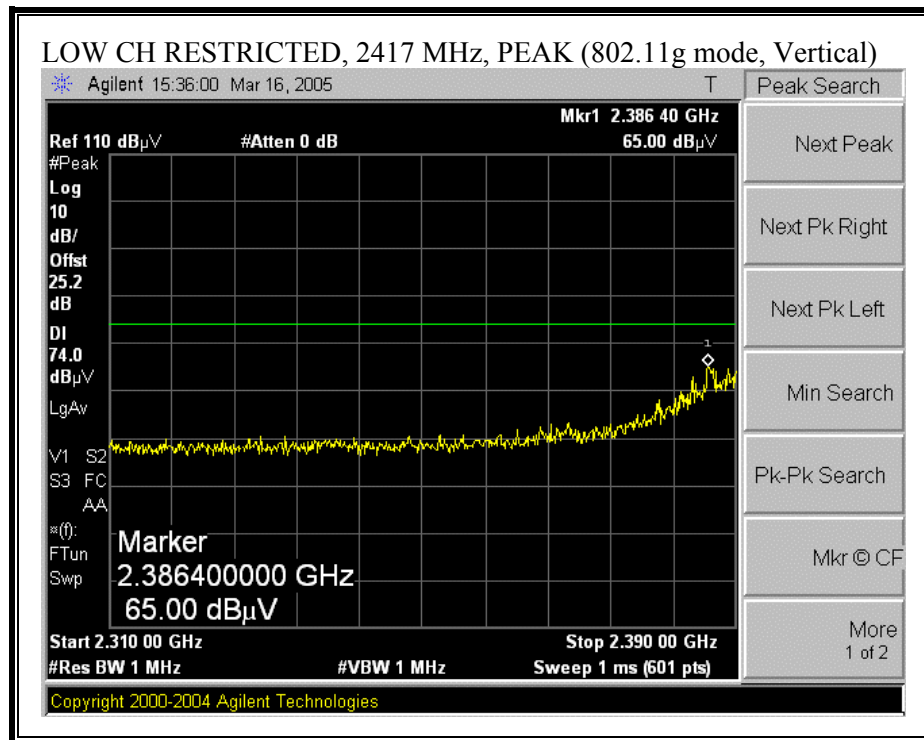


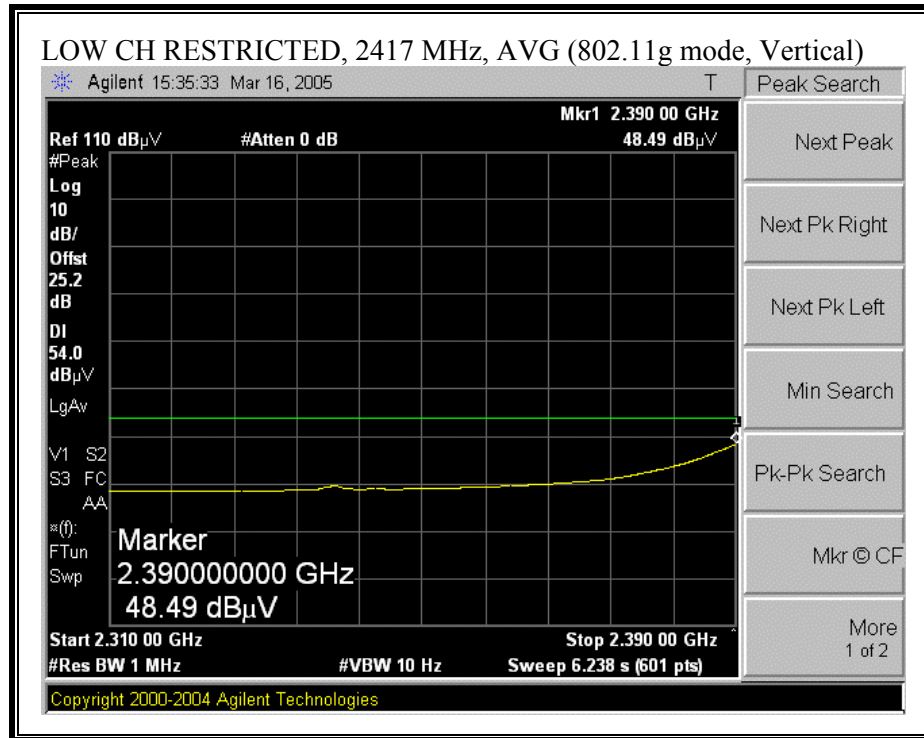
**RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, 2417 MHz, HORIZONTAL)**



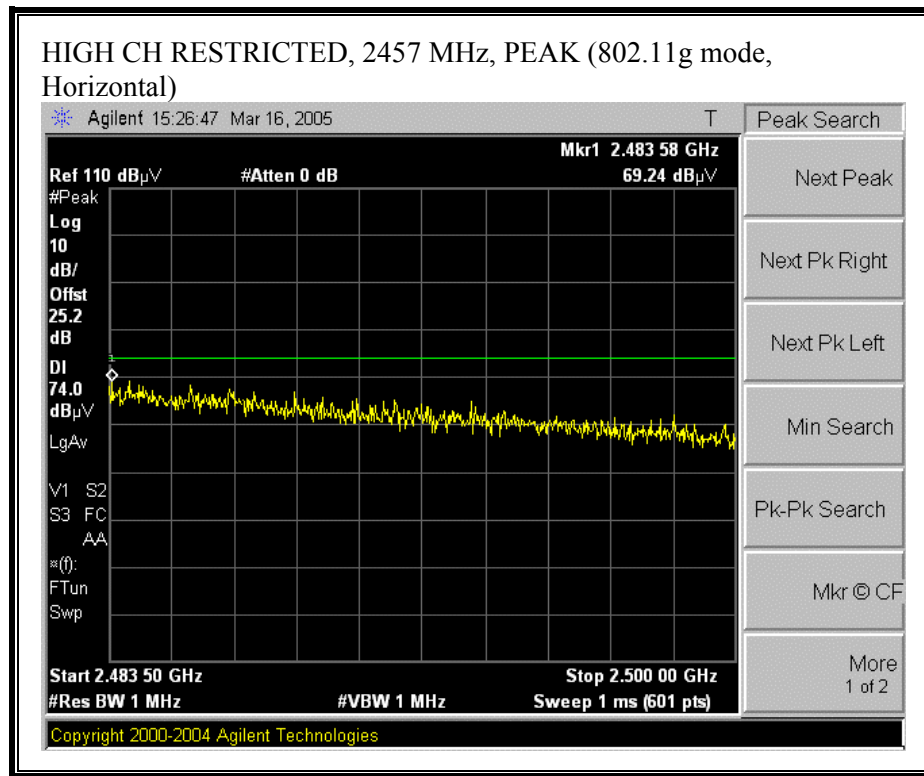


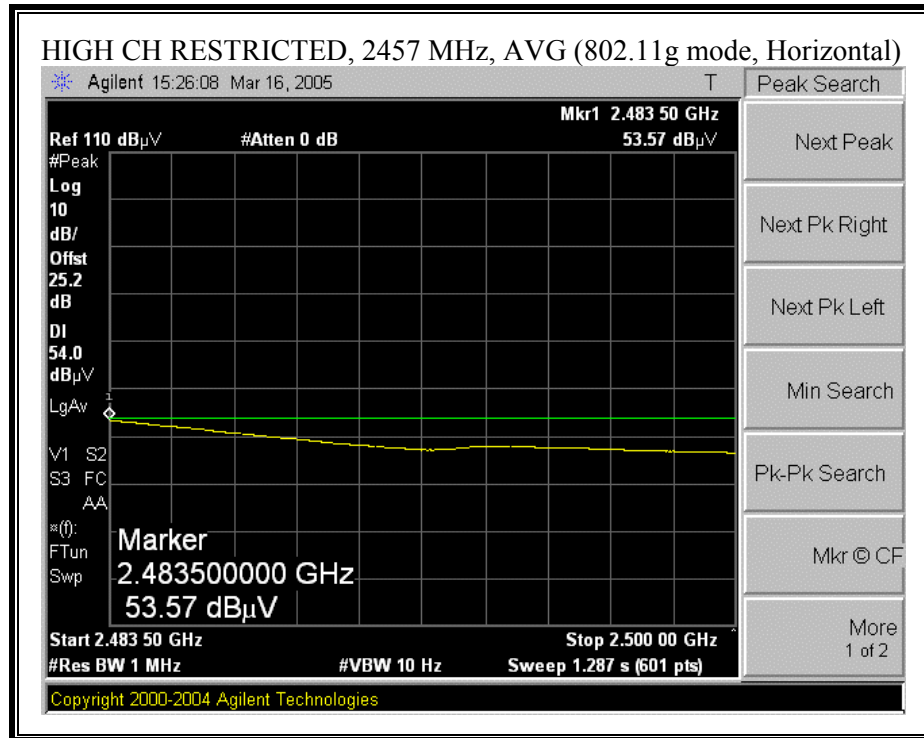
**RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, 2417 MHz, VERTICAL)**



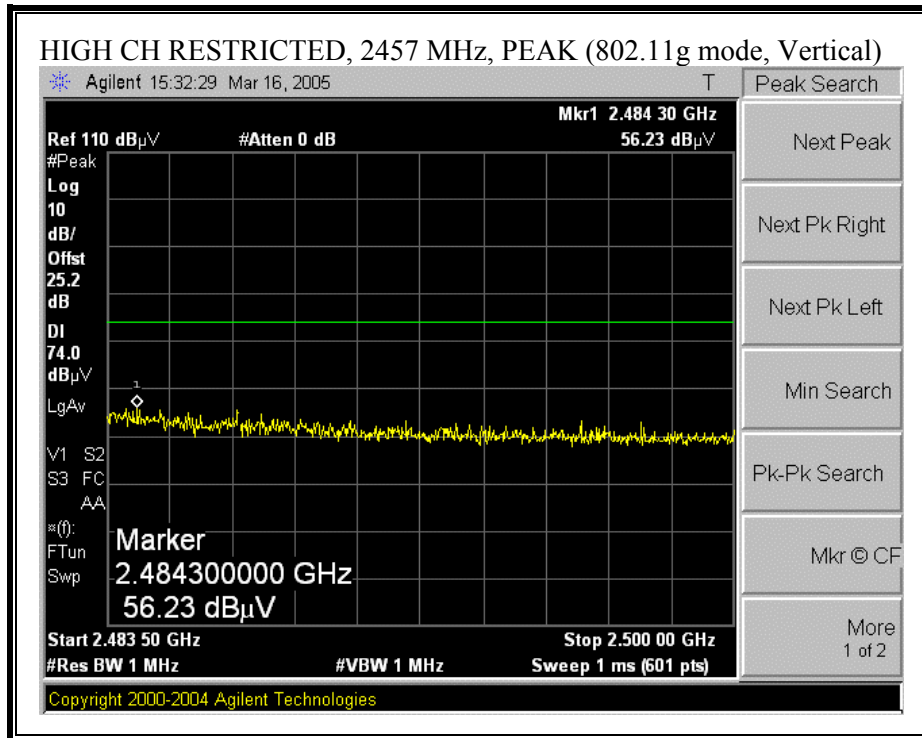


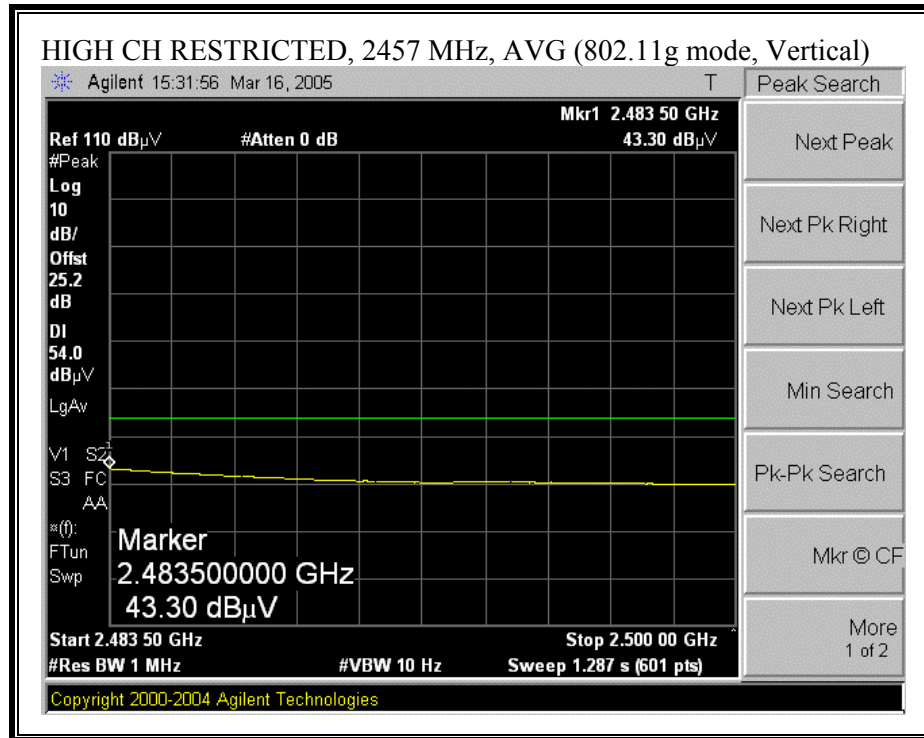
**RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, 2457 MHz, HORIZONTAL)**





**RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, 2457 MHz, VERTICAL)**











[illegible]

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

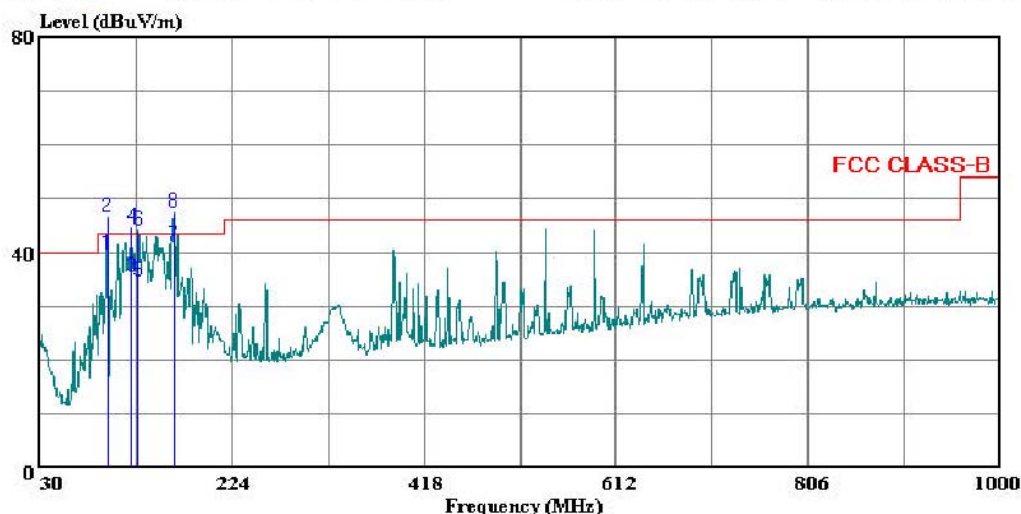
#### SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

##### HORIZONTAL PLOT



561F Monterey Road  
Morgan Hill, CA 95037  
Tel: (408) 463-0888  
Fax: (408) 463-0885

Data#: 18 File#: 05u3230 B.EMI Date: 02-17-2005 Time: 12:53:27



(Auxil ATC)

Trace: 15

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL  
Test Operator: : David Garcia  
Project #: : 05U3230-1  
Company: : Atheros  
EUT: : 802.11a/b/g/turbo mini PCI card  
Model No: : AR5BMB6  
Configuration: : EUT/Extender card/Laptop  
Target of Test: : FCC Part 15.247  
Mode of Operation: Tx, Frame Mode

Page: 1

# HORIZONTAL DATA

|     | Freq    | Read<br>Level | Factor | Level  | Limit<br>Line | Over<br>Limit | Remark |
|-----|---------|---------------|--------|--------|---------------|---------------|--------|
|     | MHz     | dBuV          | dB     | dBuV/m | dBuV/m        | dB            |        |
| 1   | 97.900  | 56.60         | -16.97 | 39.63  | 43.50         | -3.87         | Q-P    |
| 2 * | 97.900  | 63.50         | -16.97 | 46.53  | 43.50         | 3.03          | Peak   |
| 3   | 122.150 | 48.00         | -12.63 | 35.37  | 43.50         | -8.13         | Q-P    |
| 4 * | 122.150 | 57.20         | -12.63 | 44.57  | 43.50         | 1.07          | Peak   |
| 5   | 128.940 | 47.20         | -12.64 | 34.56  | 43.50         | -8.94         | Q-P    |
| 6 * | 128.940 | 56.70         | -12.64 | 44.06  | 43.50         | 0.56          | Peak   |
| 7   | 164.830 | 55.40         | -14.11 | 41.29  | 43.50         | -2.21         | Q-P    |
| 8 * | 164.830 | 61.40         | -14.11 | 47.29  | 43.50         | 3.79          | Peak   |

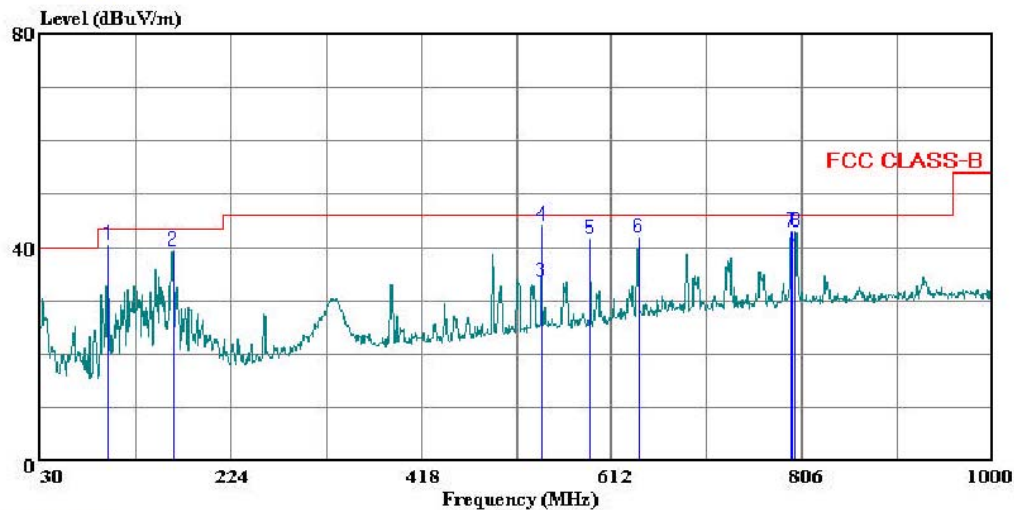
**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**

VERTICAL PLOT



561F Monterey Road  
Morgan Hill, CA 95037  
Tel: (408) 463-0888  
Fax: (408) 463-0885

Data#: 23 File#: 05u3230 B.EMI Date: 02-17-2005 Time: 13:18:31



(Audix ATC)

Trace: 19

Ref Trace:

Condition: FCC CLASS-B VERTICAL  
Test Operator: : David Garcia  
Project #: : 05U3230-1  
Company: : Atheros  
EUT: : 802.11a/b/g/turbo mini PCI card  
Model No: : AR5BMB6  
Configuration: : EUT/Extender card/Laptop  
Target of Test: : FCC Part 15.247  
Mode of Operation: Tx, Frame Mode

VERTICAL DATA

|   | Freq    | Read<br>Level | Factor | Level  | Limit<br>Line | Over<br>Limit | Remark |
|---|---------|---------------|--------|--------|---------------|---------------|--------|
|   | MHz     | dBuV          | dB     | dBuV/m | dBuV/m        | dB            |        |
| 1 | 98.870  | 57.20         | -16.71 | 40.49  | 43.50         | -3.01         | Peak   |
| 2 | 164.830 | 53.50         | -14.11 | 39.39  | 43.50         | -4.11         | Peak   |
| 3 | 540.220 | 40.00         | -6.57  | 33.43  | 46.00         | -12.57        | QP     |
| 4 | 540.220 | 50.74         | -6.61  | 44.13  | 46.00         | -1.87         | Peak   |
| 5 | 589.690 | 47.10         | -5.65  | 41.45  | 46.00         | -4.55         | Peak   |
| 6 | 639.160 | 46.40         | -4.56  | 41.84  | 46.00         | -4.16         | Peak   |
| 7 | 795.330 | 44.70         | -1.87  | 42.83  | 46.00         | -3.17         | Peak   |
| 8 | 799.210 | 44.70         | -1.80  | 42.90  | 46.00         | -3.10         | Peak   |

## 6.4. 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.

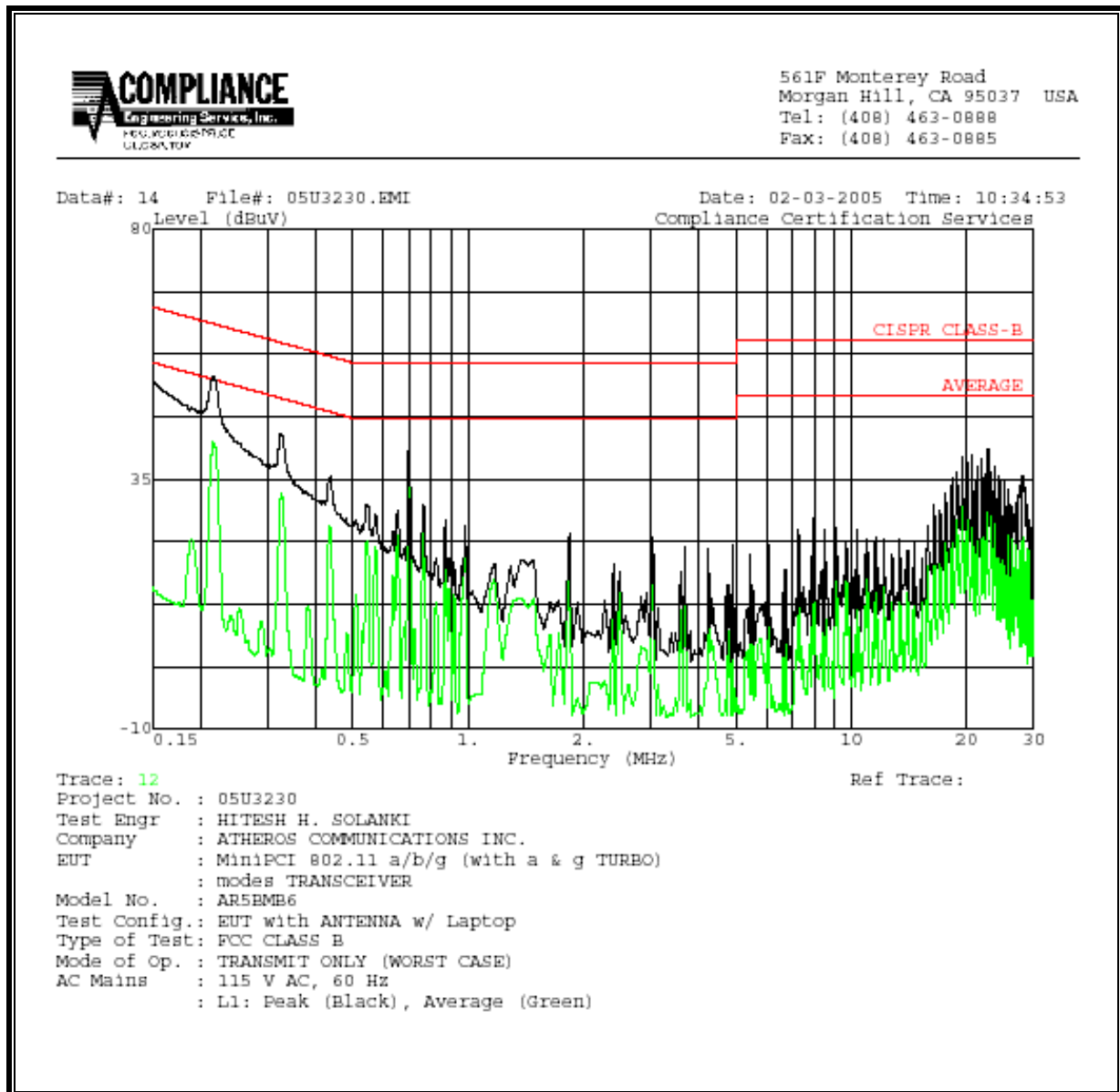
### RESULTS

No non-compliance noted:

# **6 WORST EMISSIONS**

| CONDUCTED EMISSIONS DATA (115VAC 60Hz) |           |           |           |       |       |       |         |         |         |
|----------------------------------------|-----------|-----------|-----------|-------|-------|-------|---------|---------|---------|
| Freq.                                  | Reading   |           |           | Closs | Limit | EN_B  | Margin  |         | Remark  |
| (MHz)                                  | PK (dBuV) | QP (dBuV) | AV (dBuV) | (dB)  | QP    | AV    | QP (dB) | AV (dB) | L1 / L2 |
| 0.22                                   | 53.56     | --        | 41.57     | 0.00  | 63.01 | 53.01 | -9.45   | -11.44  | L1      |
| 0.70                                   | 40.92     | --        | 40.25     | 0.00  | 56.00 | 46.00 | -15.08  | -5.75   | L1      |
| 22.78                                  | 40.56     | --        | 34.69     | 0.00  | 60.00 | 50.00 | -19.44  | -15.31  | L1      |
| 0.22                                   | 52.97     | --        | 41.03     | 0.00  | 62.97 | 52.97 | -10.00  | -11.94  | L2      |
| 0.70                                   | 40.48     | --        | 39.68     | 0.00  | 56.00 | 46.00 | -15.52  | -6.32   | L2      |
| 20.70                                  | 34.04     | --        | 28.94     | 0.00  | 60.00 | 50.00 | -25.96  | -21.06  | L2      |
| 6 Worst Data                           |           |           |           |       |       |       |         |         |         |

## LINE 1 RESULTS



## LINE 2 RESULTS

