# FCC CFR47 PART 15 SUBPART E CERTIFICATION

# TEST REPORT

# FOR

# 802.11A/G PCI ADAPTER

**MODEL NUMBER: AIR-PI21AG-A-K9**

**FCC ID: LDK102051**

**REPORT NUMBER: 03U2286-2**

**ISSUE DATE: OCTOBER 30, 2003**

*Prepared for*
**CISCO SYSTEMS, INC.**
**170 WEST TASMAN**
**SAN JOSE, CA 95134**
**USA**

*Prepared by*
**COMPLIANCE CERTIFICATION SERVICES**
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# 1. TEST RESULT CERTIFICATION

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

**EUT DESCRIPTION:** 802.11A/G PCI ADAPTER

**MODEL:** AIR-PI21AG-A-K9

**DATE TESTED:** OCTOBER 6 - OCTOBER 30, 2003

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

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

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

**Note:** The 5.2 GHz band is applicable to this report; other bands of operation (2.4 and 5.8 GHz) are documented in a separate report.

Approved & Released For CCS By:

MICHAEL HECKROTTE
CHIEF ENGINEER
COMPLIANCE CERTIFICATION SERVICES

Tested By:

CHIN PANG
EMC TECHNICIAN
COMPLIANCE CERTIFICATION SERVICES

# 2. EUT DESCRIPTION

The EUT is an 802.11a/b/g transceiver on a PCI card.

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

| Mode | Output Power (dBm) | Output Power (mW) |
|---|---|---|
| 802.11a Normal | 15.05 | 31.99 |

The radio utilizes a single flying lead straight antenna, with a maximum assembly (including cable) gain of 0.93 dBi in the 5.2 GHz band.

# 3. TEST METHODOLOGY

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

# 4. FACILITIES AND ACCREDITATION

The open area test sites and conducted 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.

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**LAB CODE:200065-0**

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

# 5. CALIBRATION AND UNCERTAINTY

## 5.1. MEASURING INSTRUMENT CALIBRATION

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

## 5.2. MEASUREMENT UNCERTAINTY

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

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

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

## 5.3. TEST AND MEASUREMENT EQUIPMENT

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

| TEST AND MEASUREMENT EQUIPMENT LIST | | | | |
|---|---|---|---|---|
| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Due Date |
| EMI Test Receiver | R & S | ESHS 20 | 827129/006 | 4/18/04 |
| LISN 10 KHz-30MHz | FCC | 50/250-25-2 | 114 | 11/6/03 |
| Line Filter | Lindgren | LMF-3489 | 497 | NCR |
| LISN 10 KHz-30MHz | Solar | 8012-50-R-24-BNC | 837990 | 11/6/03 |
| Bilog Antenna | AR | LPB-25201A | 1185 | 3/6/04 |
| EMI Receiver | HP | 8542E | 3942A00280 | 11/20/03 |
| RF Filter Section | HP | 85420E | 3705A00256 | 11/20/03 |
| Pre-Amplifier, 1-26GHz | Miteq | NSP2600-SP | 924342 | 4/15/04 |
| PSA Spectrum Analyzer | Agilent | E4446A | NA | 1/23/04 |
| Horn | EMCO | 3115 | 2238 | 2/4/04 |
| 7.6GHz HPF | Microwave | HP7600-9SS | NA | NCR |
| | | | | |

# 6. SETUP OF EQUIPMENT UNDER TEST

## SUPPORT EQUIPMENT

| PERIPHERAL SUPPORT EQUIPMENT LIST | | | | |
|---|---|---|---|---|
| Device Type | Manufacturer | Model | Serial Number | FCC ID |
| Monitor | Dell | M780 | 5322DE20E049 | DoC |
| Keyboard | Dell | SK-8110 | NA | DoC |
| Mouse | Dell | M-SAW34 | LZA30519730 | DZL211029 |
| PC | Dell | DHP | J4V181S | DoC |

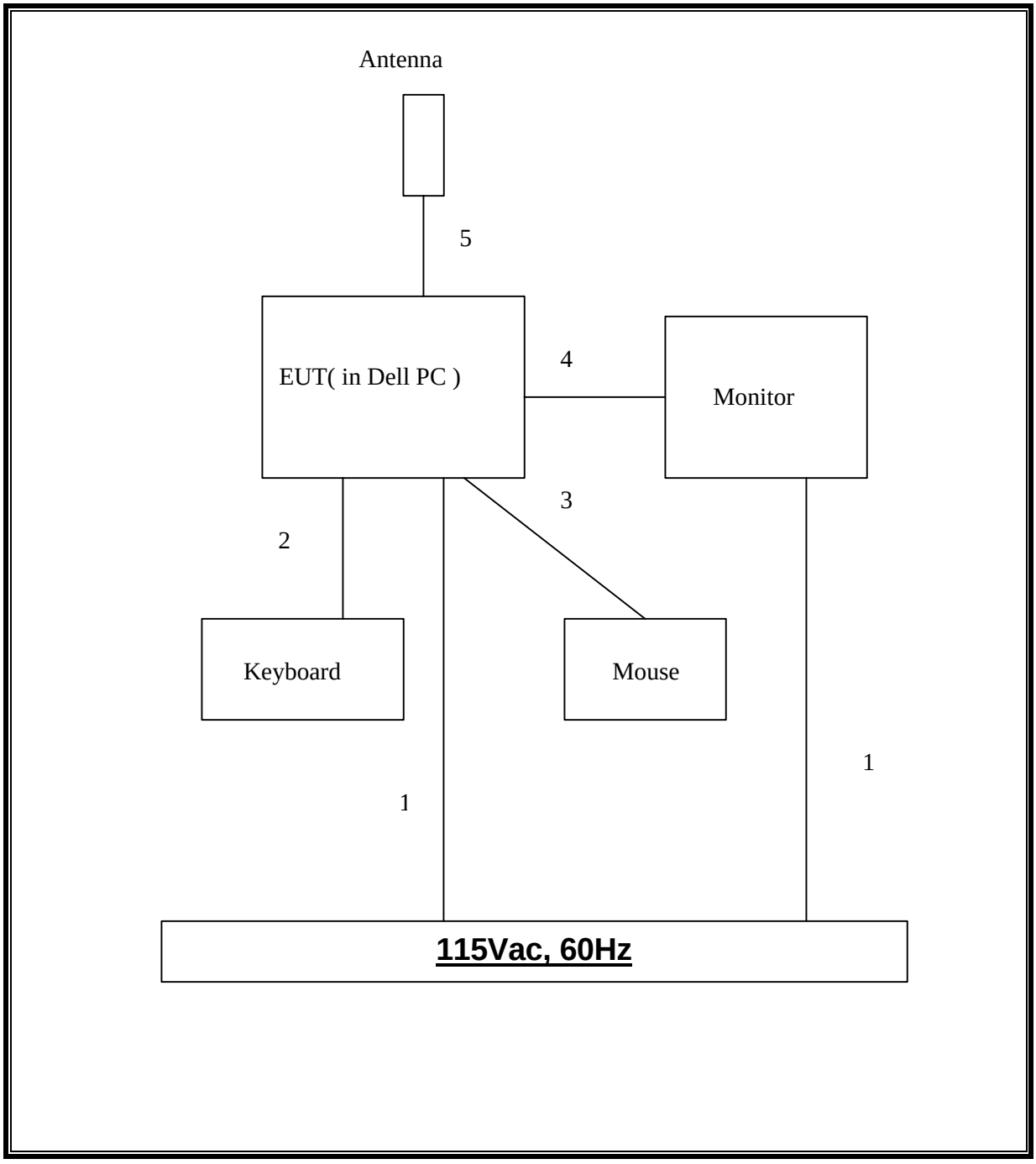
## I/O CABLES

| Cable No. | Port | # of Identical Ports | Connector Type | Cable Type | Cable Length | Remarks |
|---|---|---|---|---|---|---|
| 1 | AC | 2 | AC | Un-Shielded | 2m | Bundled cable for LC test |
| 2 | KB | 1 | PS/2 | Un-Shielded | 2m | NA |
| 3 | Mouse | 1 | PS/2 | Un-Shielded | 2m | NA |
| 4 | Video | 1 | DB15 | Shielded | 1m | One Torroid on each end |
| 5 | Antenna | 1 | Antenna | Un-Shielded | 1m | NA |

## TEST SETUP

The EUT is installed in a host Desktop computer during the tests. Test software exercised the radio card.

**SETUP DIAGRAM FOR TESTS**



## SETUP INFORMATION FOR DIGITAL DEVICE TESTS

### SUPPORT EQUIPMENT

| PERIPHERAL SUPPORT EQUIPMENT LIST | | | | |
|---|---|---|---|---|
| Device Type | Manufacturer | Model | Serial Number | FCC ID |
| Monitor | Dell | M780 | 5322DE20E049 | DoC |
| Keyboard | Dell | SK-8110 | NA | DoC |
| Mouse | Dell | M-SAW34 | LZA30519730 | DZL211029 |
| PC | Dell | DHP | J4V181S | DoC |
| Modem | ACEEX | 1414 | 9013540 | 1FAXDM1414 |
| Printer | HP | 2225C | 2541S41679 | BS46XU2225C |

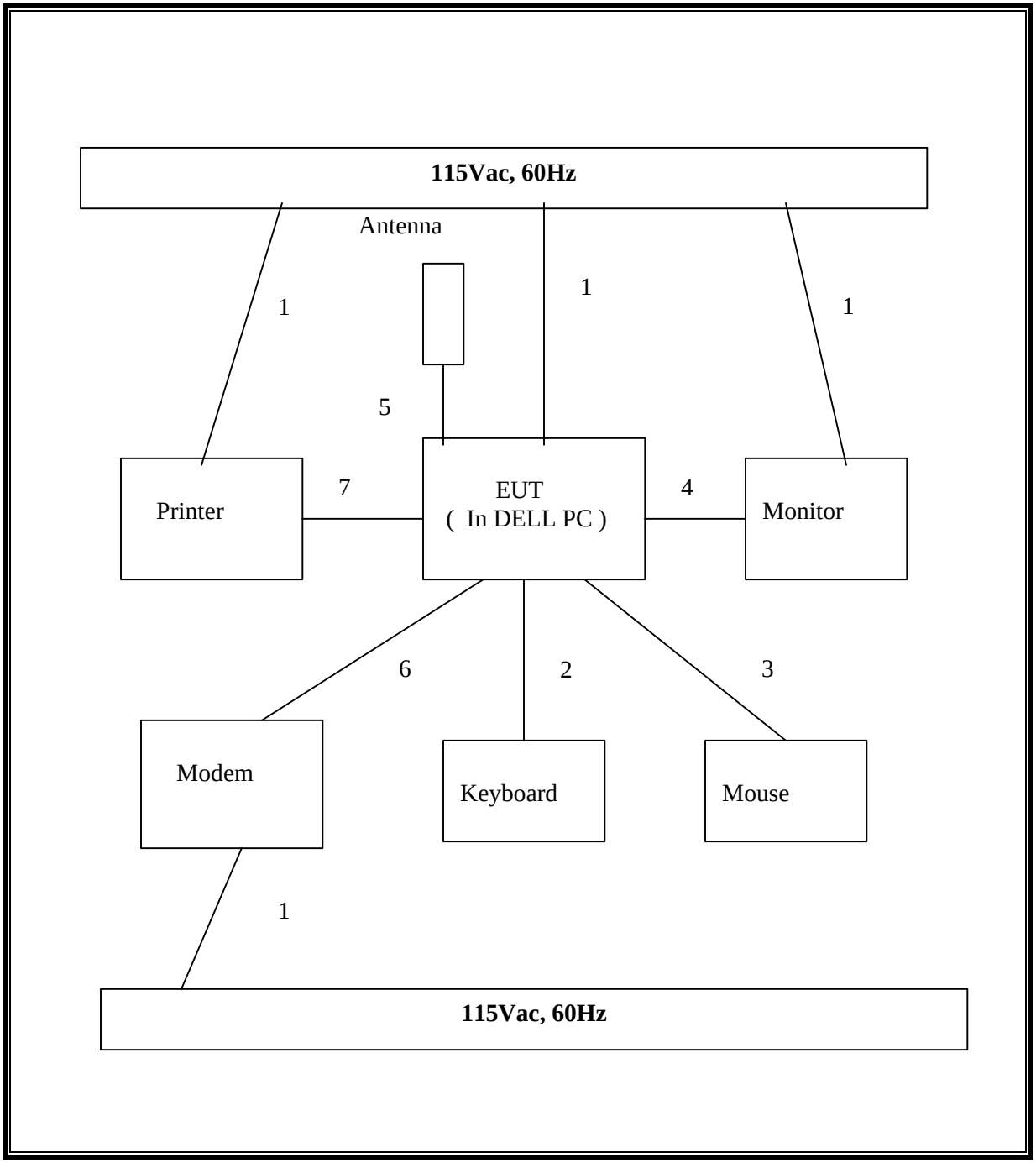
### I/O CABLES

| Cable No. | Port | # of Identical Ports | Connector Type | Cable Type | Cable Length | Remarks |
|---|---|---|---|---|---|---|
| 1 | AC | 4 | AC | Un-Shielded | 2m | Bundled cable for LC test |
| 2 | KB | 1 | PS/2 | Un-Shielded | 2m | NA |
| 3 | Mouse | 1 | PS/2 | Un-Shielded | 2m | NA |
| 4 | Video | 1 | DB15 | Shielded | 1m | One Torroid on each end |
| 5 | Antenna | 1 | Antenna | Un-Shielded | 1m | NA |
| 6 | Serial | 1 | DB9 | Un-Shielded | 1m | NA |
| 7 | Parallel | 1 | DB25 | Shielded | 2m | NA |

### TEST SETUP

The EUT is installed in a host computer during the tests. Test software exercised the host computer and radio card.

**SETUP DIAGRAM FOR DIGITAL DEVICE TESTS**



# 7. APPLICABLE LIMITS AND TEST RESULTS

## 7.1. EMISSION BANDWIDTH

**LIMIT**

None; for reporting purposes only.

§15.403 (c) Emission bandwidth. For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolutions bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1% to 3% of the 26 dB bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled.

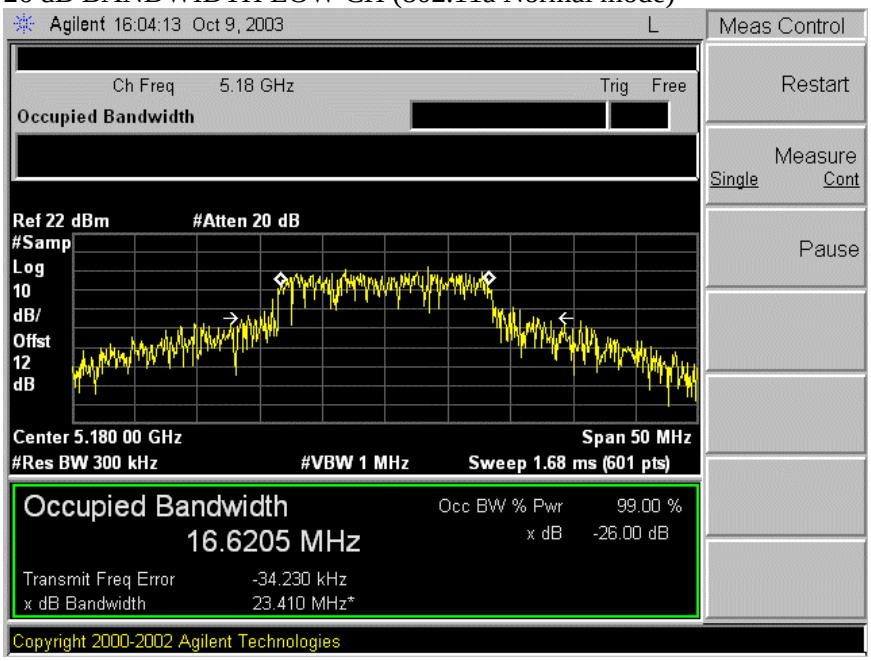
**RESULTS**

Normal Mode

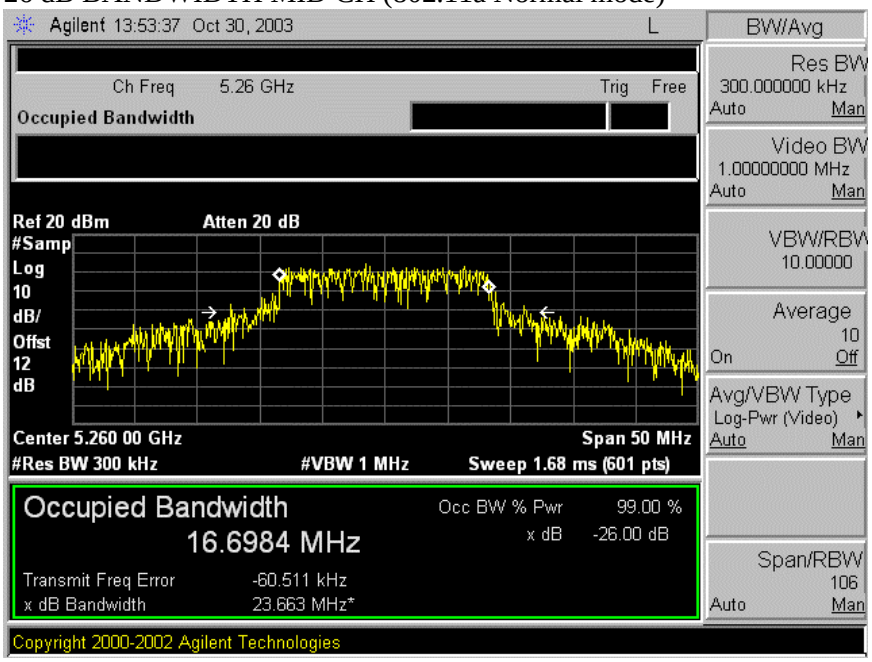
| Channel | Frequency (MHz) | B (MHz) | 10 Log B (dB) |
|---|---|---|---|
| Low | 5180 | 23.41 | 13.69 |
| Middle | 5260 | 23.66 | 13.74 |
| High | 5320 | 23.80 | 13.77 |

## 26 dB EMISSION BANDWIDTH (802.11a NORMAL MODE)

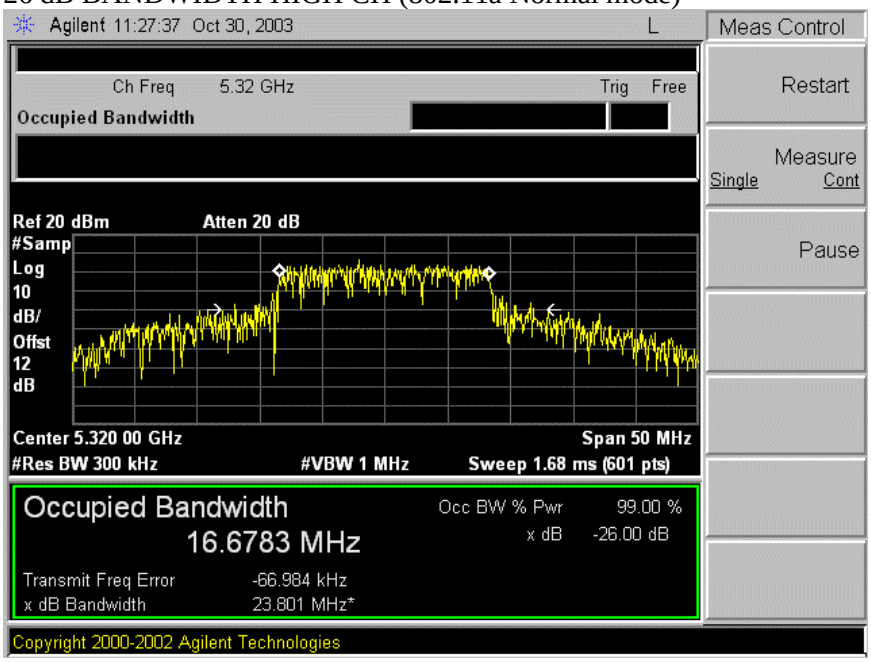
26 dB BANDWIDTH LOW CH (802.11a Normal mode)



26 dB BANDWIDTH MID CH (802.11a Normal mode)



26 dB BANDWIDTH HIGH CH (802.11a Normal mode)



## 7.2. PEAK POWER

**LIMIT**

§15.407 (a) (1) For the band 5.15-5.25 GHz, the peak transmit power over the frequency band of operation shall not exceed the lesser of 50 mW (17 dBm) or 4 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 4 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.407 (a) (1) For the band 5.25-5.35 GHz, the peak transmit power over the frequency band of operation shall not exceed the lesser of 250 mW (24 dBm) or 11 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 11 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**TEST PROCEDURE**

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

The transmitter output operates continuously therefore Method # 1 is used.

## LIMITS AND RESULTS

No non-compliance noted:

Limit in 5150 to 5250 MHz Band

| Mode | Frequency (MHz) | Fixed Limit (dBm) | B (MHz) | 4 + 10 Log B Limit (dBm) | Excess Antenna Gain (dB) | Limit (dBm) |
|---|---|---|---|---|---|---|
| Normal | 5180 | 17 | 23.41 | 17.69 | 0.00 | 17.00 |

Limit in 5250 to 5350 MHz Band

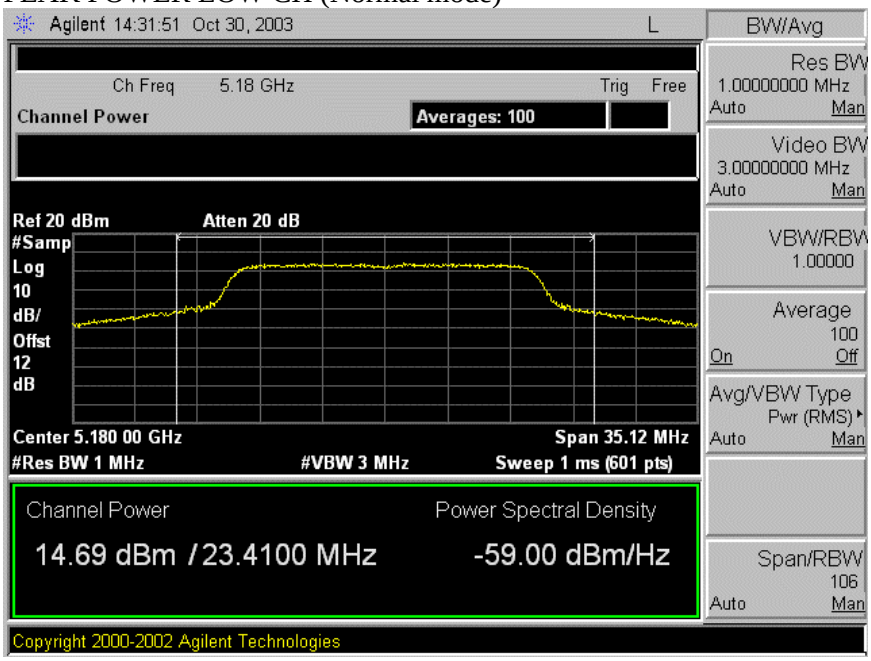
| Mode | Frequency (MHz) | Fixed Limit (dBm) | B (MHz) | 11 + 10 Log B Limit (dBm) | Excess Antenna Gain (dB) | Limit (dBm) |
|---|---|---|---|---|---|---|
| Normal | 5260 | 24 | 23.66 | 24.74 | 0.00 | 24.00 |
| Normal | 5320 | 24 | 23.80 | 24.77 | 0.00 | 24.00 |

Normal Mode Results

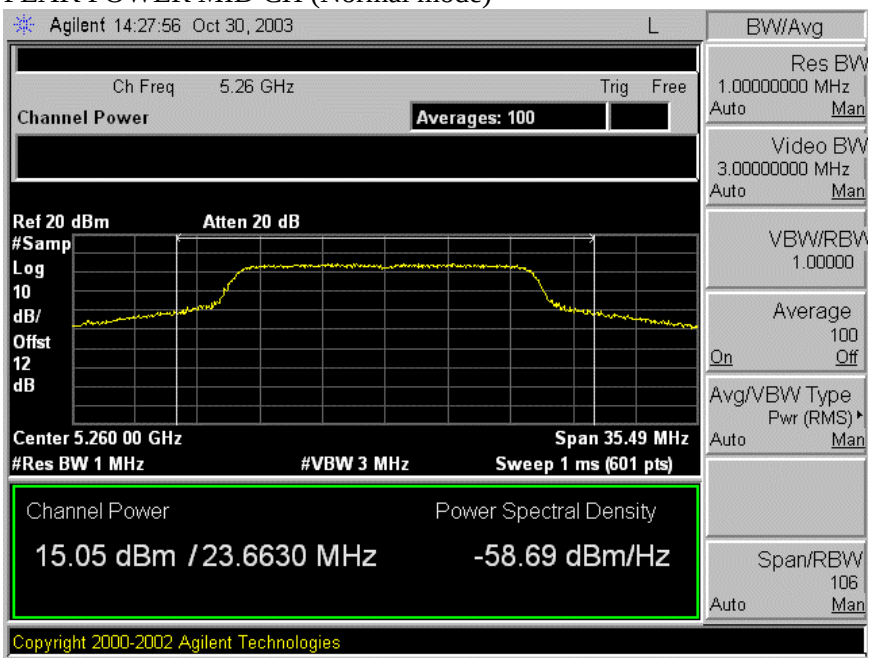
| Channel | Frequency (MHz) | Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 5180 | 14.69 | 17.00 | -2.31 |
| Middle | 5260 | 15.05 | 24.00 | -8.95 |
| High | 5320 | 14.99 | 24.00 | -9.01 |

**PEAK POWER (NORMAL MODE)**

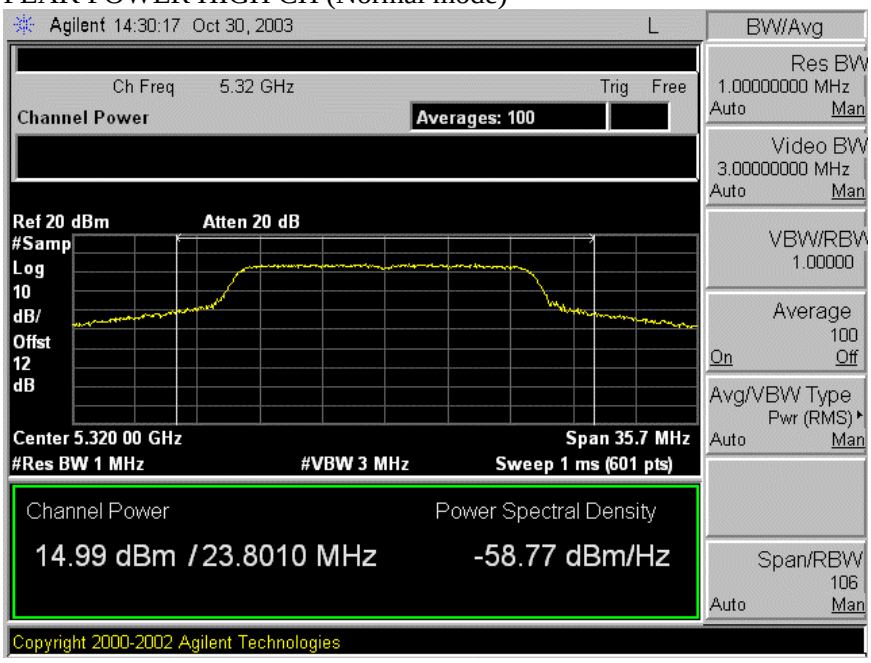
PEAK POWER LOW CH (Normal mode)



PEAK POWER MID CH (Normal mode)



PEAK POWER HIGH CH (Normal mode)



## 7.3. MAXIMUM PERMISSIBLE EXPOSURE

**LIMITS**

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

**CALCULATIONS**

Given

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

and

$S = E \wedge 2 / 3770$

where

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

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

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

Changing to units of mW and cm, using:

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

yields

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

where

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

Substituting the logarithmic form of power and gain using:

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

yields

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

where

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

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

## LIMITS

S = 1.0 mW / cm^2 from 1.1310 Table 1

## RESULTS

No non-compliance noted:

| Power Density Limit (mW/cm^2) | Output Power (dBm) | Antenna Gain (dBi) | MPE Distance (cm) |
|---|---|---|---|
| 1.0 | 15.05 | 0.93 | 1.78 |

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

## 7.4. AVERAGE POWER

**AVERAGE POWER LIMIT**

None; for reporting purposes only.

**TEST PROCEDURE**

The transmitter output is connected to a power meter.

**RESULTS**

No non-compliance noted:

The cable assembly insertion loss of 12 dB (including 10 dB pad and 2 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Normal Mode

| Channel | Frequency (MHz) | Average Power (dBm) |
|---|---|---|
| Low | 5180 | 14.82 |
| Middle | 5260 | 15.07 |
| High | 5320 | 14.83 |

## 7.5. PEAK POWER SPECTRAL DENSITY

**LIMIT**

§15.407 (a) (1) For the band 5.15-5.25 GHz, the peak transmit power over the frequency band of operation shall not exceed the lesser of 50 mW (17 dBm) or 4 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 4 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.407 (a) (1) For the band 5.25-5.35 GHz, the peak transmit power over the frequency band of operation shall not exceed the lesser of 250 mW (24 dBm) or 11 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 11 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain = 0.93 dBi, therefore there is no reduction due to antenna gain.

**TEST PROCEDURE**

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

**RESULTS**

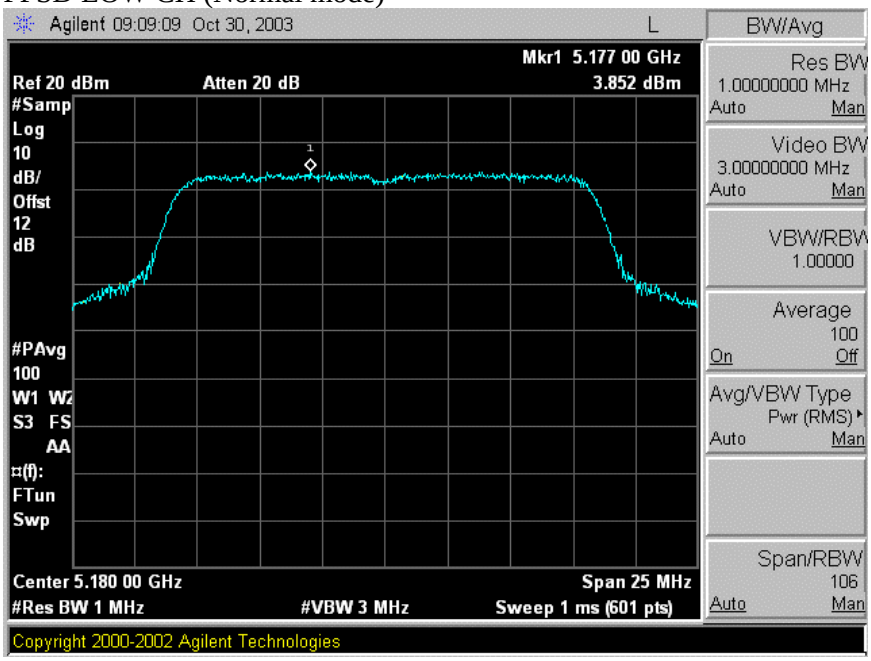
No non-compliance noted:

Normal Mode

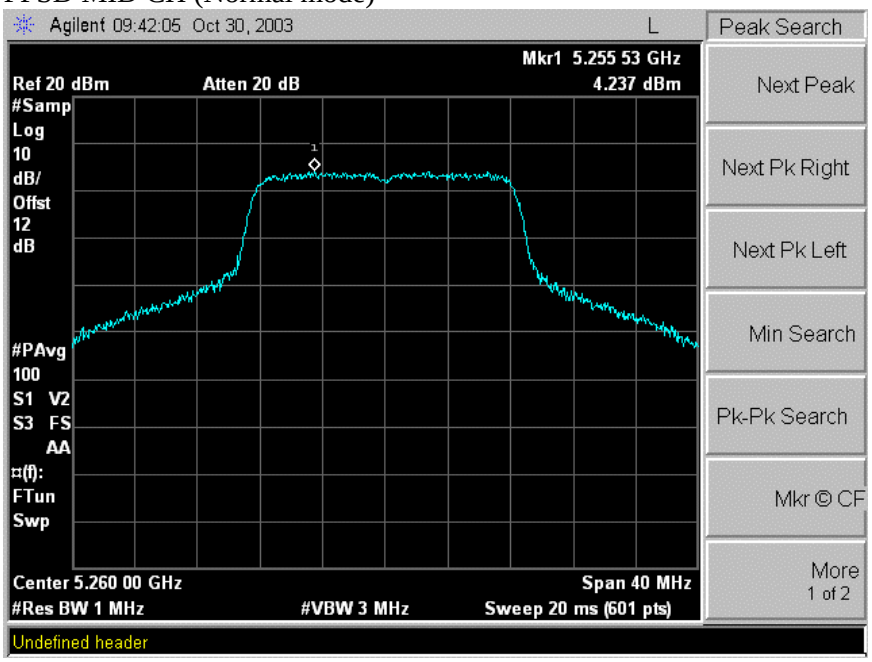
| Channel | Frequency (MHz) | PPSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 5180 | 3.85 | 4.00 | -0.15 |
| Middle | 5260 | 4.24 | 11.00 | -6.76 |
| High | 5320 | 4.22 | 11.00 | -6.78 |

## PEAK POWER SPECTRAL DENSITY (NORMAL MODE)

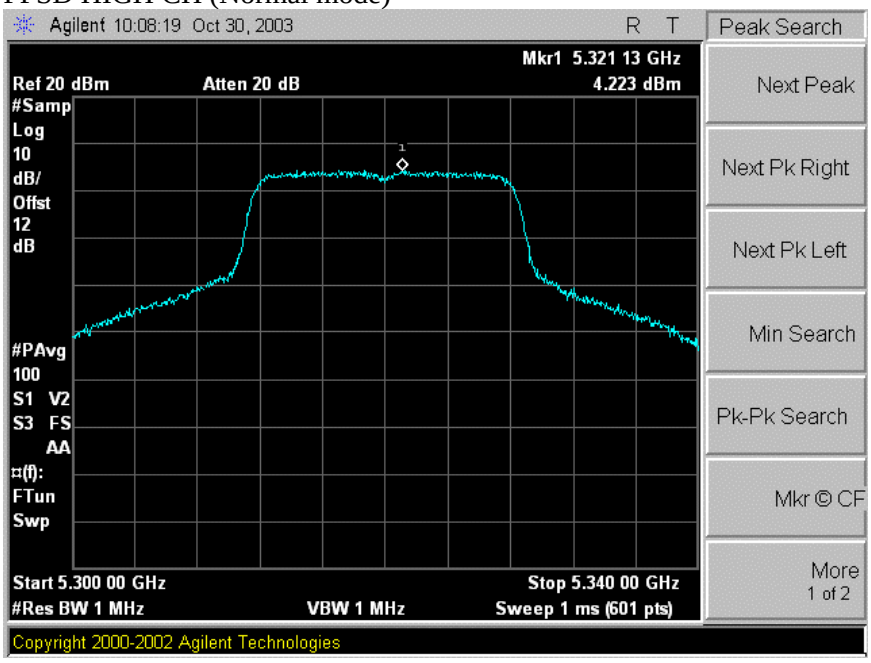
PPSD LOW CH (Normal mode)



PPSD MID CH (Normal mode)



PPSD HIGH CH (Normal mode)



## 7.6. PEAK EXCURSION

**LIMIT**

§15.407 (a) (6) The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

**TEST PROCEDURE**

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

**RESULTS**

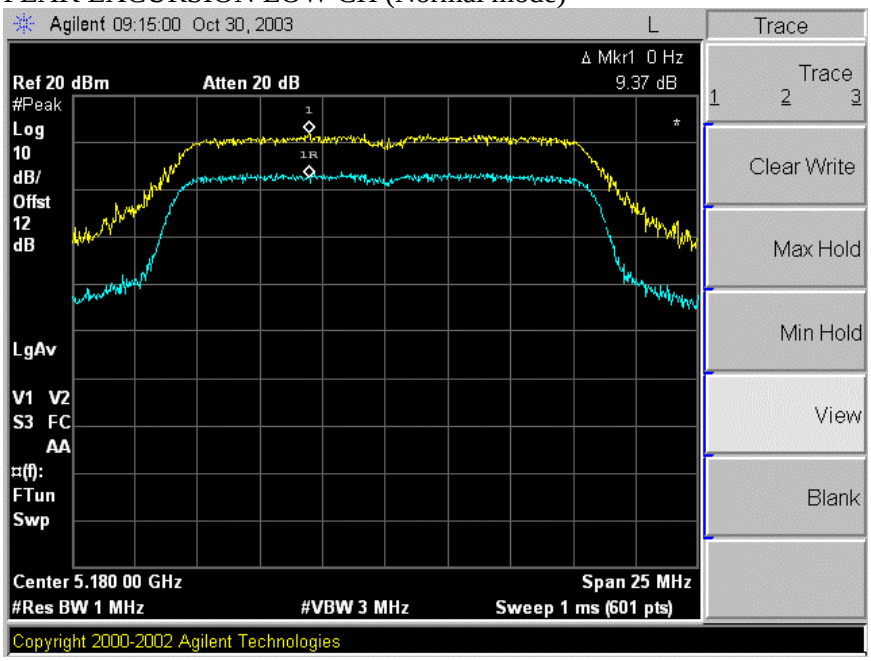
No non-compliance noted:

Normal Mode

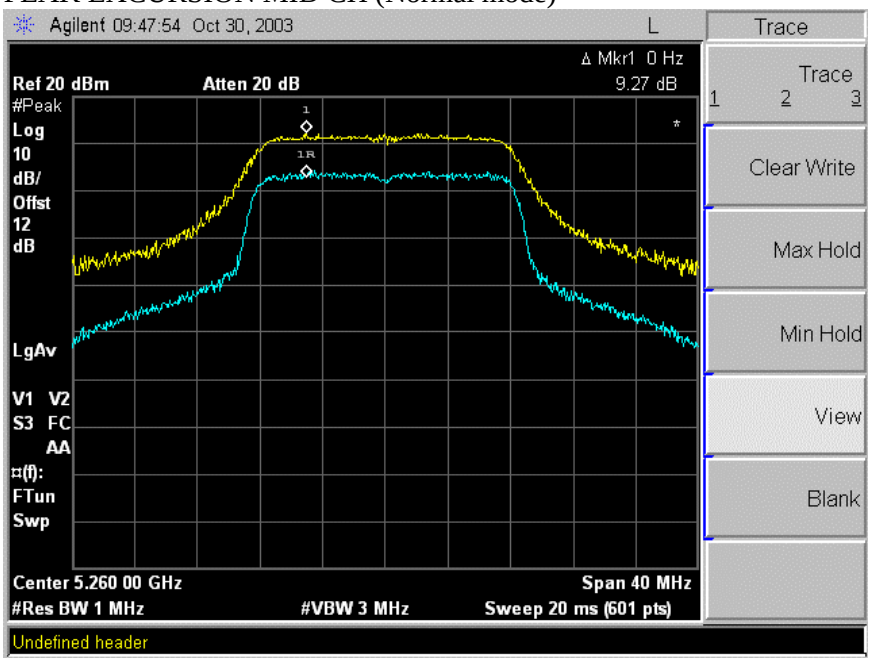
| Channel | Frequency (MHz) | Peak Excursion (dB) | Limit (dB) | Margin (dB) |
|---|---|---|---|---|
| Low | 5180 | 9.37 | 13 | -3.63 |
| Middle | 5260 | 9.27 | 13 | -3.73 |
| High | 5320 | 8.77 | 13 | -4.23 |

**PEAK EXCURSION (NORMAL MODE)**

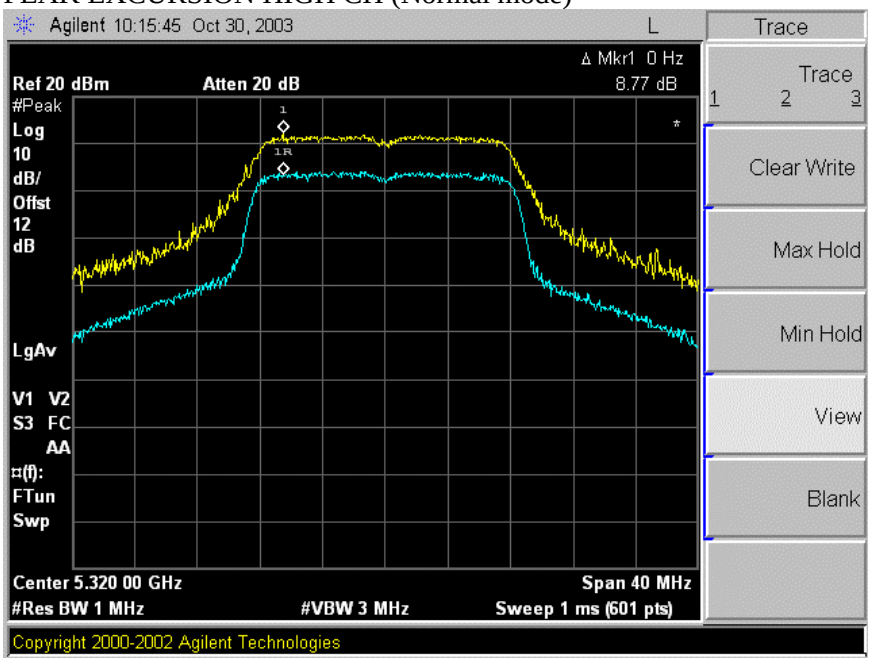
PEAK EXCURSION LOW CH (Normal mode)



PEAK EXCURSION MID CH (Normal mode)



PEAK EXCURSION HIGH CH (Normal mode)



## 7.7. CONDUCTED SPURIOUS EMISSIONS

**LIMITS**

§15.407 (b) (1 & 2) For transmitters operating in the 5.15-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27dBm / MHz.

**TEST PROCEDURE**

Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements are made.

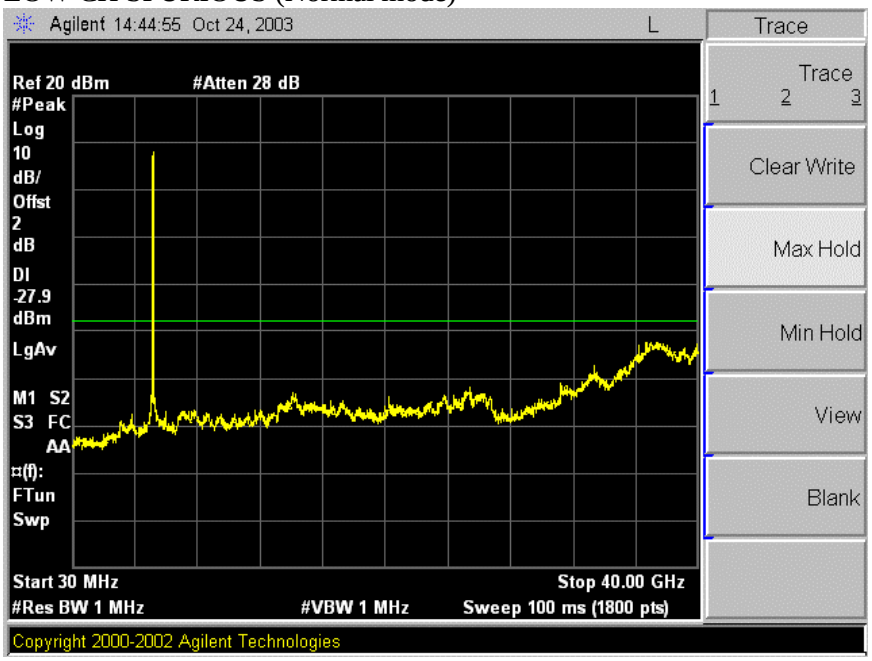
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

**RESULTS**

No non-compliance noted:

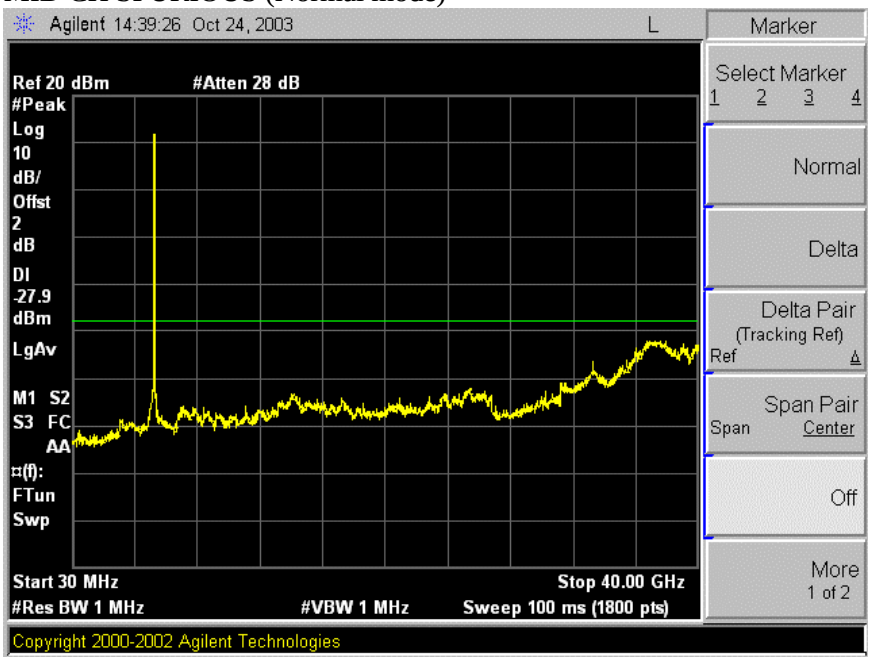
**SPURIOUS EMISSIONS, LOW CHANNEL (NORMAL MODE)**

LOW CH SPURIOUS (Normal mode)



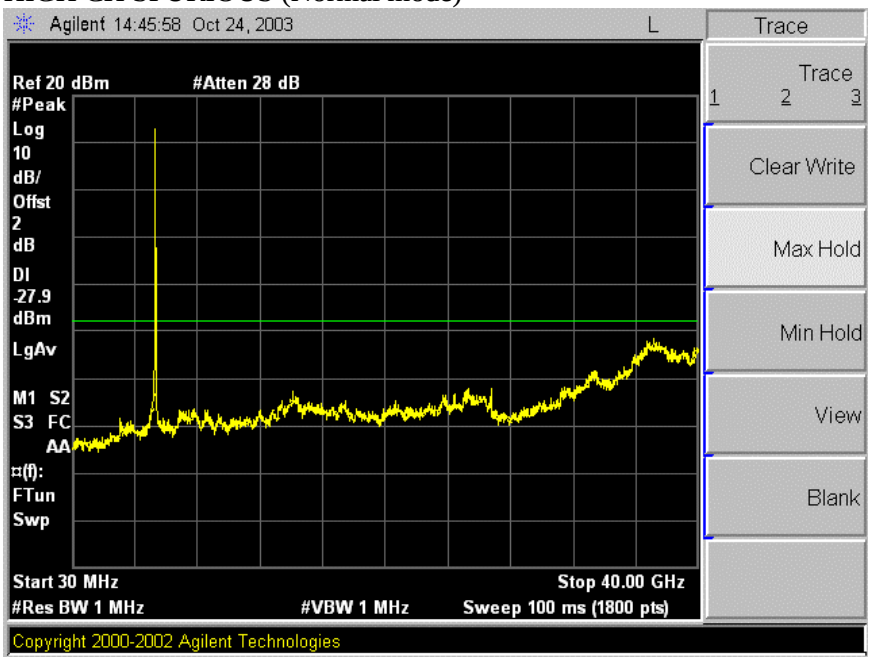
**SPURIOUS EMISSIONS, MID CHANNEL (NORMAL MODE)**

MID CH SPURIOUS (Normal mode)



**SPURIOUS EMISSIONS, HIGH CHANNEL (NORMAL MODE)**

HIGH CH SPURIOUS (Normal mode)



# 7.8. RADIATED EMISSIONS

## 7.8.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS

**LIMITS**

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

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| [1]0.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614 | 5.35 - 5.46 |
| 2.1735 - 2.1905 | 16.80425 - 16.80475 | 960 - 1240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1300 - 1427 | 8.025 - 8.5 |
| 4.17725 - 4.17775 | 37.5 - 38.25 | 1435 - 1626.5 | 9.0 - 9.2 |
| 4.20725 - 4.20775 | 73 - 74.6 | 1645.5 - 1646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1660 - 1710 | 10.6 - 12.7 |
| 6.26775 - 6.26825 | 108 - 121.94 | 1718.8 - 1722.2 | 13.25 - 13.4 |
| 6.31175 - 6.31225 | 123 - 138 | 2200 - 2300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2310 - 2390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.52475 - 156.52525 | 2483.5 - 2500 | 17.7 - 21.4 |
| 8.37625 - 8.38675 | 156.7 - 156.9 | 2655 - 2900 | 22.01 - 23.12 |
| 8.41425 - 8.41475 | 162.0125 - 167.17 | 3260 - 3267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 167.72 - 173.2 | 3332 - 3339 | 31.2 - 31.8 |
| 12.51975 - 12.52025 | 240 - 285 | 3345.8 - 3358 | 36.43 - 36.5 |
| 12.57675 - 12.57725 | 322 - 335.4 | 3600 - 4400 | ([2]) |
| 13.36 - 13.41 | | | |

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2] Above 38.6

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 30 - 88 | 100 ** | 3 |
| 88 - 216 | 150 ** | 3 |
| 216 - 960 | 200 ** | 3 |
| Above 960 | 500 | 3 |

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

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

## TEST PROCEDURE

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

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

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

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

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

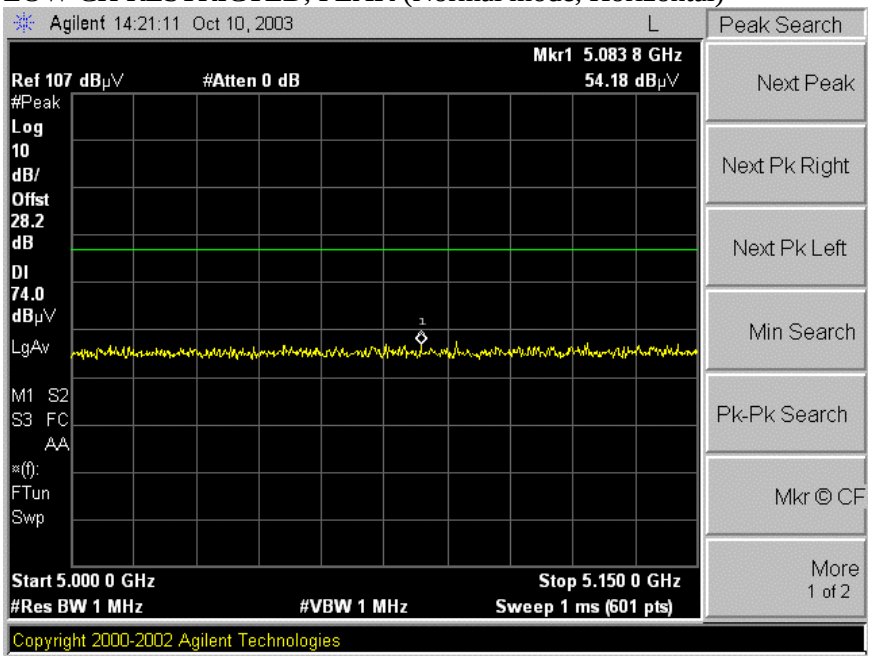
## RESULTS

No non-compliance noted:

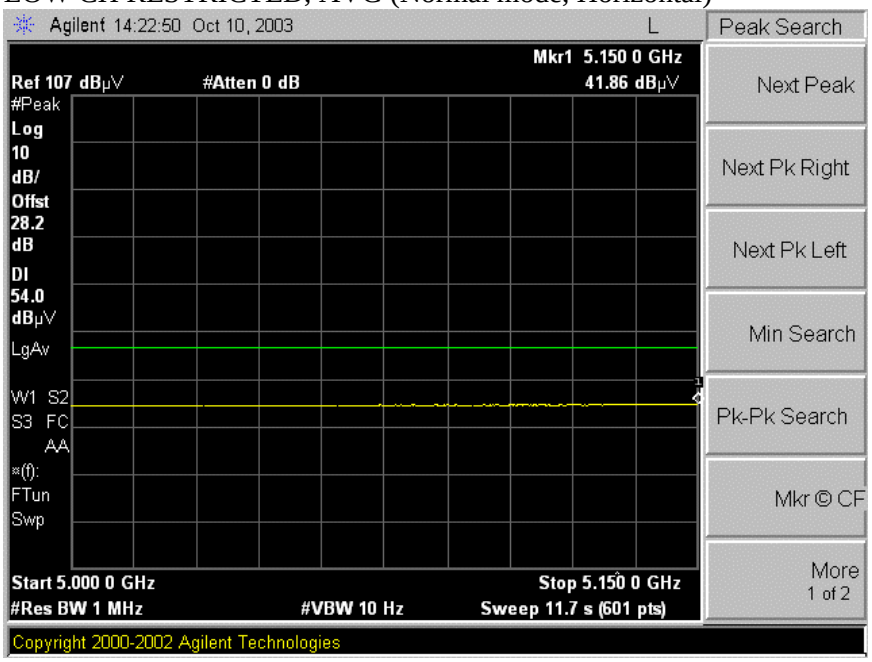
## 7.8.2. TRANSMITTER RADIATED EMISSIONS ABOVE 1 GHZ

**RESTRICTED BANDEDGE (NORMAL MODE, LOW CHANNEL, HORIZONTAL)**

LOW CH RESTRICTED, PEAK (Normal mode, Horizontal)

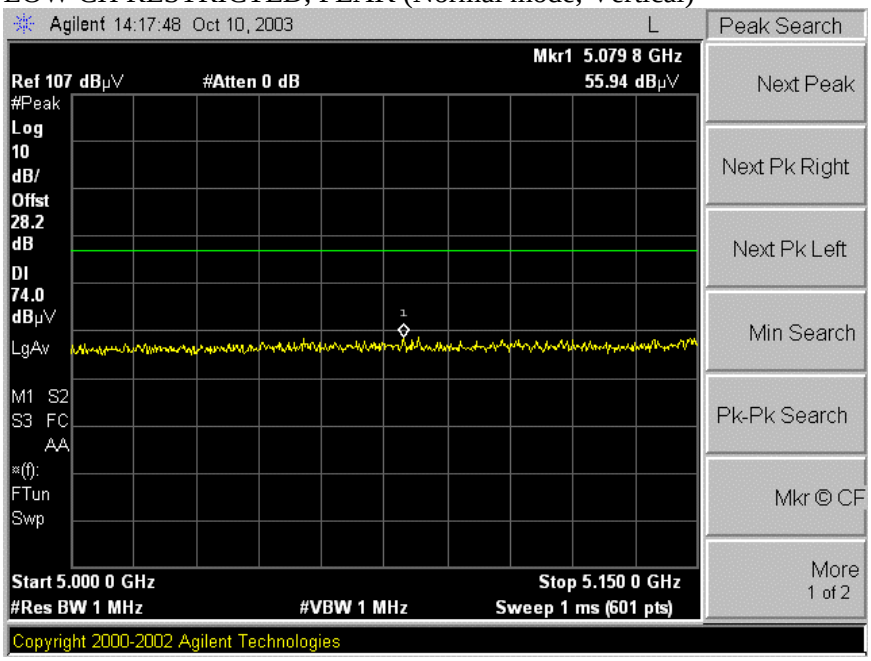


LOW CH RESTRICTED, AVG (Normal mode, Horizontal)

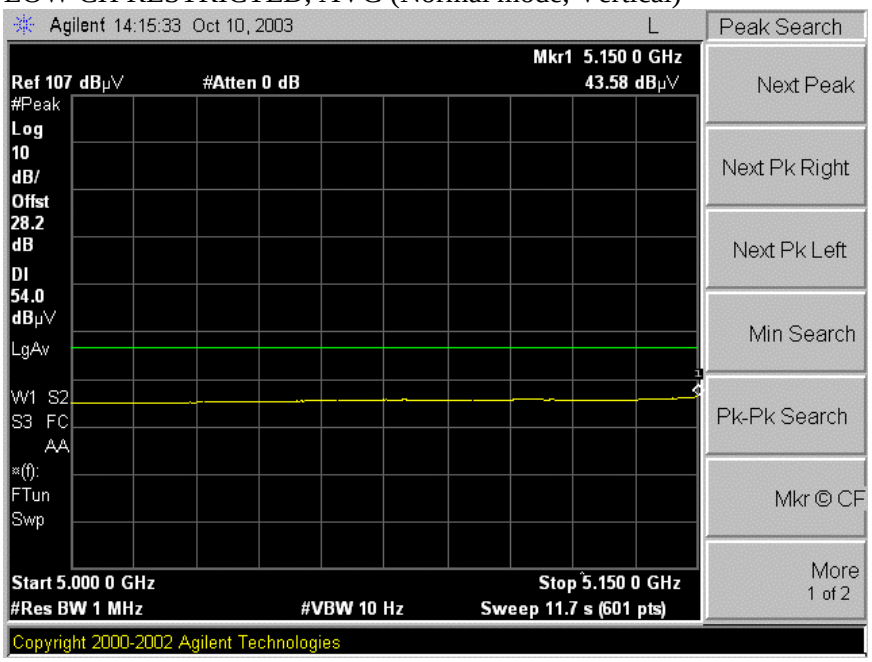


**RESTRICTED BANDEDGE (NORMAL MODE, LOW CHANNEL, VERTICAL)**

LOW CH RESTRICTED, PEAK (Normal mode, Vertical)

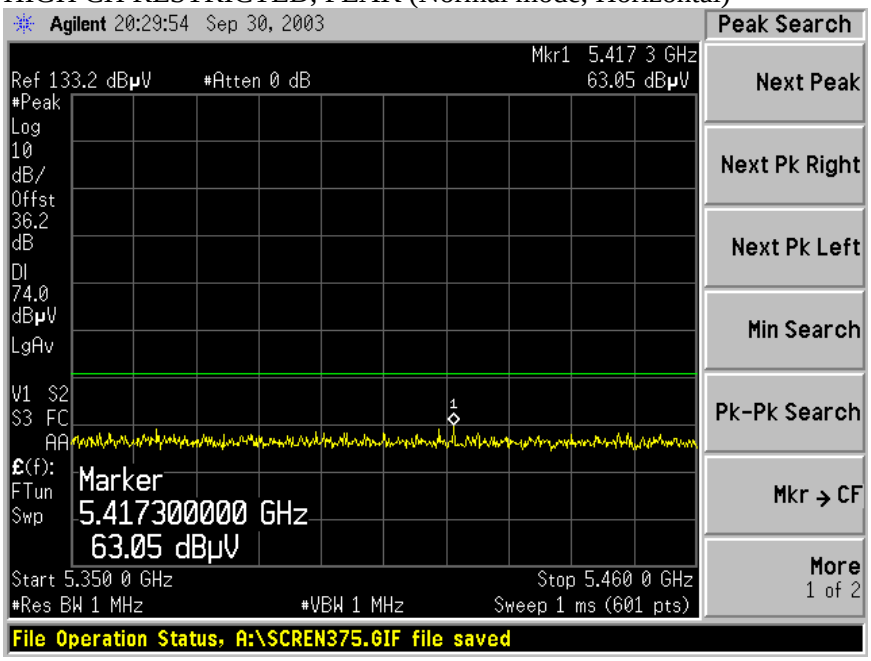


LOW CH RESTRICTED, AVG (Normal mode, Vertical)

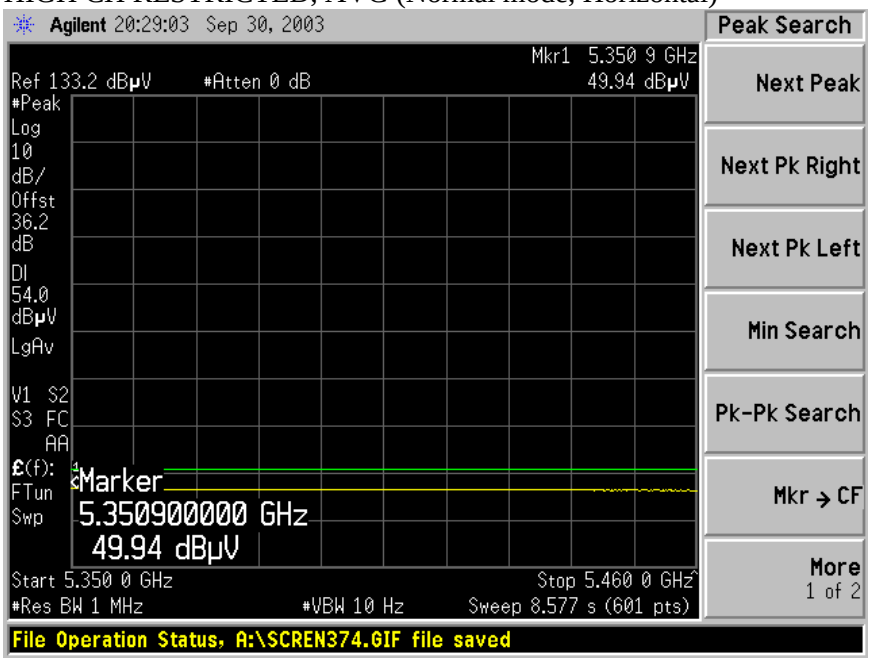


**RESTRICTED BANDEDGE (NORMAL MODE, HIGH CHANNEL, HORIZONTAL)**

HIGH CH RESTRICTED, PEAK (Normal mode, Horizontal)

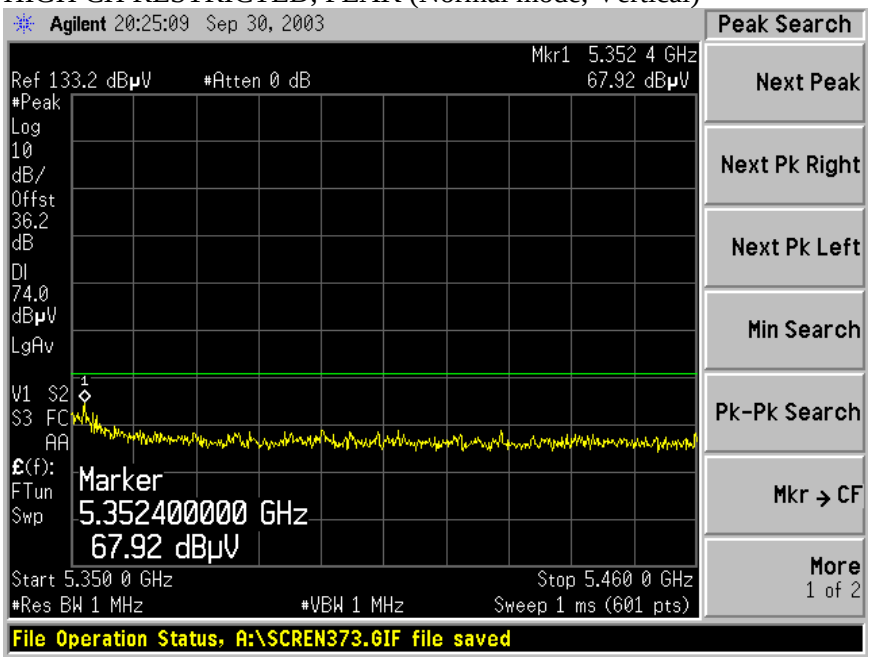


HIGH CH RESTRICTED, AVG (Normal mode, Horizontal)

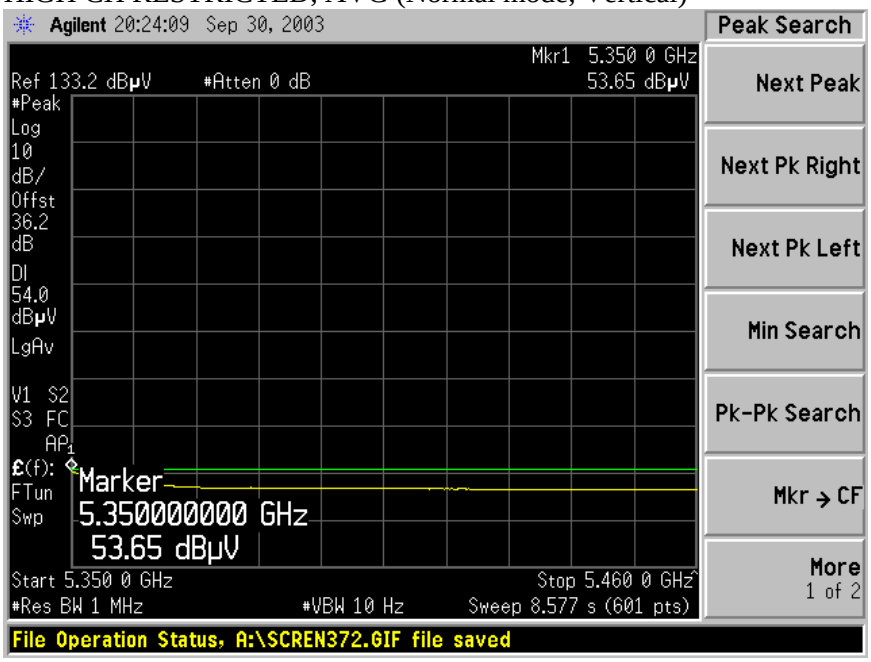


**RESTRICTED BANDEDGE (NORMAL MODE, HIGH CHANNEL, VERTICAL)**

HIGH CH RESTRICTED, PEAK (Normal mode, Vertical)



HIGH CH RESTRICTED, AVG (Normal mode, Vertical)



## HARMONICS AND SPURIOUS EMISSIONS (NORMAL MODE, L M & H CHANNEL)

10/07/03 **High Frequency Measurement**
**Compliance Certification Services, Morgan Hill Open Field Site**

**Test Engr:Chin Pang**
**Project #:03u2286-1**
**Company:Ambit Microsystem Corporation**
**EUT Descrip.:802.11 a/b/g Comb Module PCI**
**EUT M/N: TBD**
**Test Target:FCC 15.407**
**Mode Oper:Tx**

**Test Equipment:**

| EMCO Horn 1-18GHz | Pre-amplifer 1-26GHz | Spectrum Analyzer | Horn > 18GHz |
|---|---|---|---|
| T60; S/N: 2238 @3m | T87 Miteq 924342 | Agilent E4446A Analyzer | |

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

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

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

11a, UNII WLAN

| f GHz | Dist feet | Read Pk dBuV | Read Avg. dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | HPF | Peak dBuV/m | Avg dBuV/m | Pk Lim dBuV/m | Avg Lim dBuV/m | Pk Mar dB | Avg Mar dB | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Transmitting at low ch,** | | | | | | | | | | | | | | | |
| 10.360 | 9.8 | 48.4 | 36.7 | 38.3 | 6.5 | -41.6 | 0.0 | 1.0 | 52.5 | 40.8 | 74.0 | 54.0 | -21.5 | -13.2 | V |
| 15.540 | 9.8 | 50.9 | 39.6 | 39.4 | 8.1 | -45.5 | 0.0 | 1.0 | 53.8 | 42.5 | 74.0 | 54.0 | -20.2 | -11.5 | V |
| 10.360 | 9.8 | 47.7 | 35.5 | 38.3 | 6.5 | -41.6 | 0.0 | 1.0 | 51.8 | 39.6 | 74.0 | 54.0 | -22.2 | -14.4 | H |
| 15.540 | 9.8 | 49.7 | 39.2 | 39.4 | 8.1 | -45.5 | 0.0 | 1.0 | 52.6 | 42.1 | 74.0 | 54.0 | -21.4 | -11.9 | H |
| | | | | | | | | | | | | | | | |
| **Transmitting at mid ch** | | | | | | | | | | | | | | | |
| 10.520 | 9.8 | 50.4 | 38.0 | 38.2 | 6.6 | -41.4 | 0.0 | 1.0 | 54.7 | 42.3 | 74.0 | 54.0 | -19.3 | -11.7 | V |
| 15.780 | 9.8 | 52.8 | 38.5 | 38.7 | 8.2 | -45.6 | 0.0 | 1.0 | 55.1 | 40.8 | 74.0 | 54.0 | -18.9 | -13.2 | V |
| 10.520 | 9.8 | 51.3 | 39.5 | 38.2 | 6.6 | -41.4 | 0.0 | 1.0 | 55.6 | 43.8 | 74.0 | 54.0 | -18.4 | -10.2 | H |
| 15.780 | 9.8 | 53.5 | 41.1 | 38.7 | 8.2 | -45.6 | 0.0 | 1.0 | 55.8 | 43.4 | 74.0 | 54.0 | -18.2 | -10.6 | H |
| | | | | | | | | | | | | | | | |
| **Transmitting at high ch** | | | | | | | | | | | | | | | |
| 10.640 | 9.8 | 48.5 | 37.0 | 38.2 | 6.6 | -41.3 | 0.0 | 1.0 | 53.0 | 41.5 | 74.0 | 54.0 | -21.0 | -12.5 | V |
| 15.960 | 9.8 | 50.3 | 38.0 | 36.3 | 8.2 | -45.7 | 0.0 | 1.0 | 50.1 | 37.8 | 74.0 | 54.0 | -23.9 | -16.2 | V |
| 10.640 | 9.8 | 46.0 | 36.0 | 38.2 | 6.6 | -41.3 | 0.0 | 1.0 | 50.5 | 40.5 | 74.0 | 54.0 | -23.5 | -13.5 | H |
| 15.960 | 9.8 | 47.0 | 36.3 | 38.3 | 8.2 | -45.7 | 0.0 | 1.0 | 48.8 | 38.1 | 74.0 | 54.0 | -25.2 | -15.9 | H |
| | | | | | | | | | | | | | | | |

No other emissions were detected above system noise.

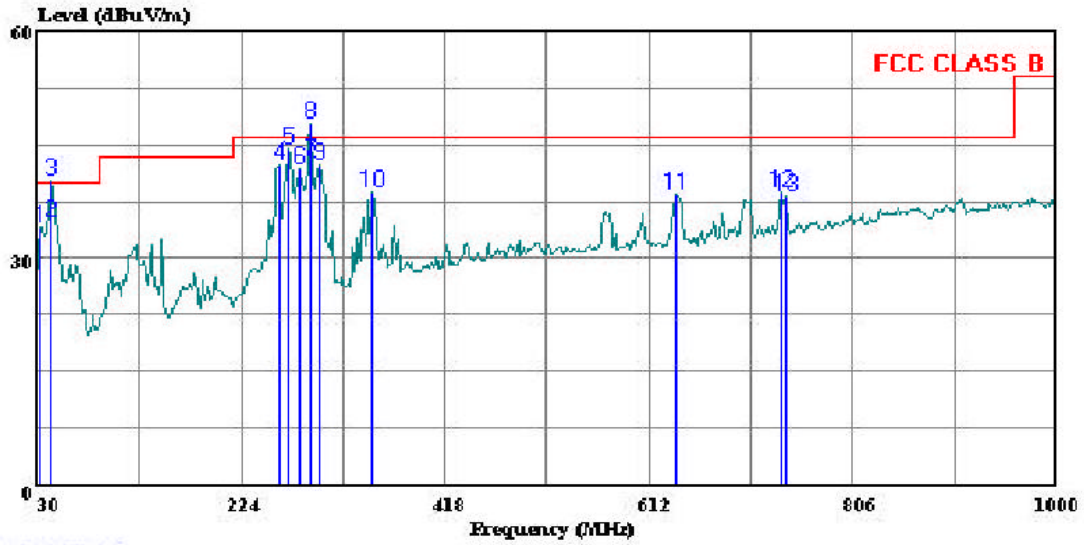
| | | | | | |
|---|---|---|---|---|---|
| f | Measurement Frequency | Amp | Preamp Gain | Avg Lim | Average Field Strength Limit |
| Dist | Distance to Antenna | D Corr | Distance Correct to 3 meters | Pk Lim | Peak Field Strength Limit |
| Read | Analyzer Reading | Avg | Average Field Strength @ 3 m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

## 7.8.3. WORST-CASE RADIATED EMISSIONS BELOW 1 GHZ

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

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

Data#: 4 File#: 100103.EMI Date: 10-01-2003 Time: 10:44:31




(Audix ATC)
Trace: 1 Ref Trace:

Condition: FCC CLASS B 3m CHAMBER 030306 1185 HORIZONTAL
Test Eng: : NEELESH RAJ
Project #: : 03U2286
Company: : AMBIT MICROSYSTEMS CORP.
EUT: : 802.11 A/B/G PCI
Model No: : KITTY HAWK
Configuration: : EUT/ANTENNA/PC/MONITOR/KYB/MOUSE/PRINTER
: MODEM
Target of Test: : FCC
Mode of Operation: TX (WORST CASE)

Page: 1

| | | Freq | Read Level | Probe Factor | Cable Loss | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dB | dBuV/m | dBuV/m | dB | |
| 1 | | 31.940 | 16.55 | 16.97 | 0.56 | 34.08 | 40.00 | -5.92 | Peak |
| 2 | | 43.580 | 18.22 | 16.05 | 0.64 | 34.92 | 40.00 | -5.08 | QP |
| 3 | * | 43.580 | 23.35 | 16.14 | 0.64 | 40.13 | 40.00 | 0.13 | Peak |
| 4 | | 259.890 | 28.83 | 11.82 | 1.59 | 42.24 | 46.00 | -3.76 | Peak |
| 5 | | 269.590 | 30.99 | 11.88 | 1.61 | 44.48 | 46.00 | -1.52 | Peak |
| 6 | | 279.290 | 28.16 | 11.94 | 1.64 | 41.74 | 46.00 | -4.26 | Peak |
| 7 | | 288.990 | 29.13 | 11.99 | 1.67 | 42.79 | 46.00 | -3.21 | QP |

Data#: 4 File#: 100103.EMI Date: 10-01-2003 Time: 10:44:31

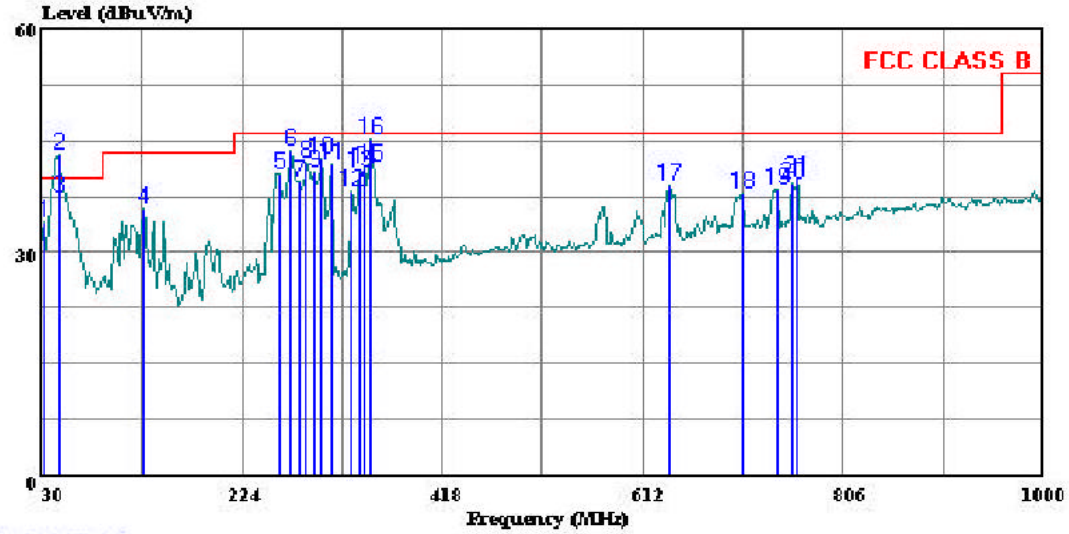
Page: 2

| | | Freq | Read Level | Probe Factor | Cable Loss | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dB | dBuV/m | dBuV/m | dB | |
| 8 | * | 288.990 | 34.21 | 12.00 | 1.66 | 47.87 | 46.00 | 1.87 | Peak |
| 9 | | 298.690 | 28.57 | 12.05 | 1.73 | 42.35 | 46.00 | -3.65 | Peak |
| 10 | | 349.130 | 23.53 | 13.31 | 1.87 | 38.71 | 46.00 | -7.29 | Peak |
| 11 | | 638.190 | 17.83 | 18.03 | 2.65 | 38.51 | 46.00 | -7.49 | Peak |
| 12 | | 737.130 | 16.77 | 19.04 | 2.91 | 38.72 | 46.00 | -7.28 | Peak |
| 13 | | 741.980 | 16.27 | 19.11 | 2.90 | 38.28 | 46.00 | -7.72 | Peak |

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

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

Data#: 4 File#: 100103.emi Date: 10-01-2003 Time: 11:23:27




Trace: 1 Ref Trace:

Condition: FCC CLASS B 3m CHAMBER 030306 1185 VERTICAL
Test Eng: : NEELESH RAJ
Project #: : 03U2286
Company: : AMBIT MICROSYSTEMS CORP.
EUT: : 802.11 A/B/G PCI
Model No: : KITTY HAWK
Configuration: : EUT/ANTENNA/PC/MONITOR/KYB/MOUSE/PRINTER
: MODEM
Target of Test: : FCC
Mode of Operation: TX (WORST CASE)

| | | Freq | Read Level | Probe Factor | Cable Loss | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dB | dBuV/m | dBuV/m | dB | |
| 1 | | 31.940 | 16.55 | 16.97 | 0.56 | 34.08 | 40.00 | -5.92 | Peak |
| 2 | * | 46.490 | 26.44 | 15.91 | 0.65 | 43.01 | 40.00 | 3.01 | Peak |
| 3 | | 46.490 | 21.11 | 15.57 | 0.66 | 37.34 | 40.00 | -2.66 | QP |
| 4 | | 128.940 | 24.92 | 9.79 | 1.05 | 35.76 | 43.50 | -7.75 | Peak |
| 5 | | 259.890 | 27.22 | 11.82 | 1.59 | 40.63 | 46.00 | -5.37 | Peak |
| 6 | | 271.530 | 30.07 | 11.89 | 1.61 | 43.57 | 46.00 | -2.43 | Peak |
| 7 | | 279.290 | 25.86 | 11.94 | 1.64 | 39.44 | 46.00 | -6.56 | Peak |

Data#: 4 File#: 100103.emi Date: 10-01-2003 Time: 11:23:27



| | | Freq | Read Level | Probe Factor | Cable Loss | Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dB | dBuV/m | dBuV/m | dB | |
| 8 | | 286.080 | 28.49 | 11.98 | 1.69 | 42.16 | 46.00 | -3.84 | Peak |
| 9 | | 293.840 | 26.97 | 12.03 | 1.71 | 40.71 | 46.00 | -5.29 | Peak |
| 10 | | 300.630 | 28.70 | 12.06 | 1.71 | 42.47 | 46.00 | -3.53 | Peak |
| 11 | | 310.330 | 27.65 | 12.32 | 1.78 | 41.75 | 46.00 | -4.25 | Peak |
| 12 | | 329.730 | 23.47 | 12.85 | 1.83 | 38.15 | 46.00 | -7.85 | Peak |
| 13 | | 337.490 | 25.92 | 13.02 | 1.85 | 40.79 | 46.00 | -5.21 | Peak |
| 14 | | 342.340 | 26.19 | 13.14 | 1.85 | 41.18 | 46.00 | -4.82 | Peak |
| 15 | | 349.130 | 26.54 | 13.28 | 1.86 | 41.68 | 46.00 | -4.32 | QP |
| 16 | | 349.130 | 30.01 | 13.31 | 1.87 | 45.19 | 46.00 | -0.81 | Peak |
| 17 | | 638.190 | 18.21 | 18.03 | 2.65 | 38.89 | 46.00 | -7.11 | Peak |
| 18 | | 708.030 | 16.62 | 18.67 | 2.75 | 38.04 | 46.00 | -7.96 | Peak |
| 19 | | 741.980 | 16.34 | 19.11 | 2.90 | 38.35 | 46.00 | -7.65 | Peak |
| 20 | | 756.530 | 16.96 | 19.28 | 2.92 | 39.16 | 46.00 | -6.84 | Peak |
| 21 | | 761.380 | 17.72 | 19.34 | 2.92 | 39.98 | 46.00 | -6.02 | Peak |

## 7.8.4. 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 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

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

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

* Decreases with the logarithm of the frequency.

**TEST PROCEDURE**

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

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

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

**RESULTS**

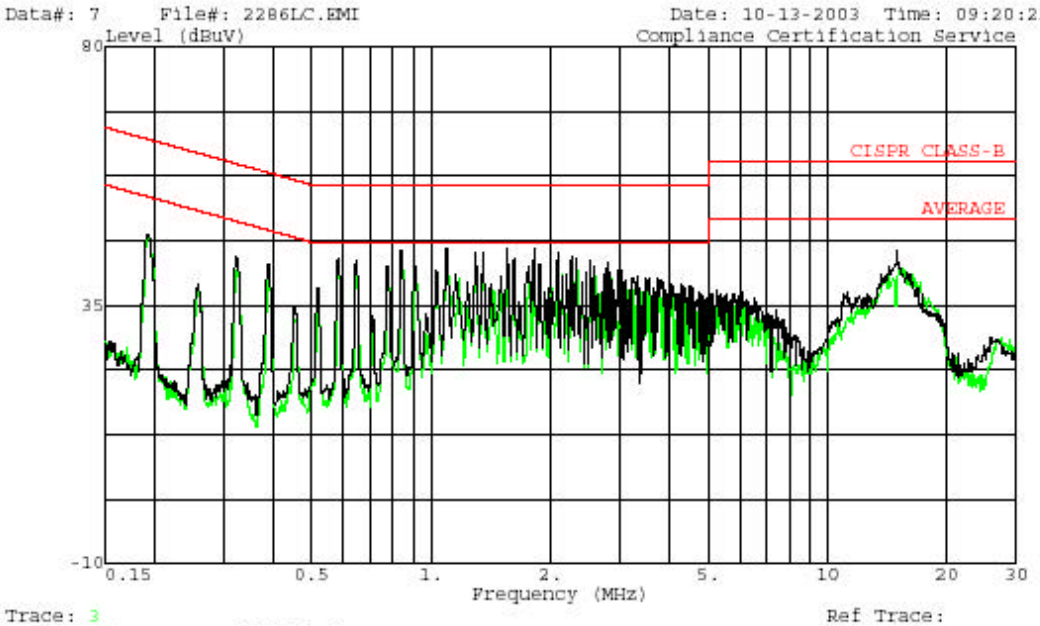
No non-compliance noted:

## 6 WORST EMISSIONS

| CONDUCTED EMISSIONS DATA (115VAC 60Hz) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Freq. | Reading | | | Closs | Limit | EN_B | Margin | | Remark |
| (MHz) | PK (dBuV) | QP (dBuV) | AV (dBuV) | (dB) | QP | AV | QP (dB) | AV (dB) | L1 / L2 |
| 0.84 | 42.32 | -- | -- | 0.00 | 56.00 | 46.00 | -13.68 | -3.68 | L1 |
| 1.09 | 43.52 | -- | -- | 0.00 | 56.00 | 46.00 | -12.48 | -2.48 | L1 |
| 2.31 | 43.00 | -- | -- | 0.00 | 56.00 | 46.00 | -13.00 | -3.00 | L1 |
| 0.84 | 44.46 | -- | -- | 0.00 | 56.00 | 46.00 | -11.54 | -1.54 | L2 |
| 1.09 | 45.04 | -- | -- | 0.00 | 56.00 | 46.00 | -10.96 | -0.96 | L2 |
| 1.82 | 44.74 | -- | -- | 0.00 | 56.00 | 46.00 | -11.26 | -1.26 | L2 |
| 6 Worst Data | | | | | | | | | |

**LINE 1 AND LINE 2 RESULTS**

561F Monterey Road,
San Jose, CA 95037 USA
Tel: (408) 463-0885
Fax: (408) 463-0888




Trace: 3 Ref Trace:
Project # : 03u2286-1
Test Operator : Chin Pang
Company : Ambit Microsystems Corporation
EUT : 802.11 a/b/g Combo Module PCI
Model : TBD
Configuration : EUT/Support Euipment
Mode of Operation: Tx ( Worse Case )
Target of Test : FCC Class B
Voltage : 115 VAC, 60 Hz
: L1: Peak ( Green ), L2: Peak ( Black )

# 8. SETUP PHOTOS

**ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP**

ANTENNA PORT CONDUCTED PHOTO

## RADIATED RF MEASUREMENT SETUP

RADIATED FRONT PHOTO

RADIATED BACK PHOTO

## POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP

LINE CONDUCTED FRONT PHOTO

LINE CONDUCTED BACK PHOTO

# END OF REPORT