



**FCC CFR47 PART 15 SUBPART C  
CERTIFICATION**

**TEST REPORT**

**FOR**

**PACKETWAVE POINT TO POINT**

**MODEL NUMBER: PW210, PW220, PW230**

**FCC ID: PS6R3003-A1**

**REPORT NUMBER: 04U2749-1**

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## TABLE OF CONTENTS

|                                                         |           |
|---------------------------------------------------------|-----------|
| <b>1. TEST RESULT CERTIFICATION.....</b>                | <b>3</b>  |
| <b>2. EUT DESCRIPTION.....</b>                          | <b>4</b>  |
| <b>3. TEST METHODOLOGY .....</b>                        | <b>5</b>  |
| <b>4. FACILITIES AND ACCREDITATION .....</b>            | <b>5</b>  |
| <b>5. CALIBRATION AND UNCERTAINTY.....</b>              | <b>6</b>  |
| 5.1. MEASURING INSTRUMENT CALIBRATION.....              | 6         |
| 5.2. MEASUREMENT UNCERTAINTY.....                       | 6         |
| 5.3. TEST AND MEASUREMENT EQUIPMENT.....                | 7         |
| <b>6. SETUP OF EQUIPMENT UNDER TEST.....</b>            | <b>8</b>  |
| <b>7. APPLICABLE LIMITS AND TEST RESULTS .....</b>      | <b>10</b> |
| 7.1. 6 dB BANDWIDTH.....                                | 10        |
| 7.2. 99% BANDWIDTH.....                                 | 14        |
| 7.3. PEAK OUTPUT POWER.....                             | 18        |
| 7.4. MAXIMUM PERMISSIBLE EXPOSURE .....                 | 23        |
| 7.5. AVERAGE POWER.....                                 | 26        |
| 7.6. PEAK POWER SPECTRAL DENSITY .....                  | 27        |
| 7.7. CONDUCTED SPURIOUS EMISSIONS.....                  | 31        |
| 7.8. RADIATED EMISSIONS.....                            | 38        |
| 7.8.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS .....    | 38        |
| 7.8.2. TRANSMITTER RADIATED EMISSIONS ABOVE 1 GHZ ..... | 41        |
| 7.8.3. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz.....   | 42        |
| 7.9. POWERLINE CONDUCTED EMISSIONS .....                | 43        |
| <b>8. SETUP PHOTOS.....</b>                             | <b>47</b> |

## 1. TEST RESULT CERTIFICATION

**COMPANY NAME:** APERTO NETWORKS  
1637 S. MAIN STREET  
MILPITAS CA.95035, USA

**EUT DESCRIPTION:** PACKETWAVE POINT TO MULTIPOINT

**MODEL NAME:** PW210, PW220, PW230

**MODEL DIFFERENCE:** The three models are identical to each other except that they have different software features inside, which allow the products to be configured as VLAN or just a HUB.

**DATE TESTED:** DECEMBER 03-JULY 28, 2004

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

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

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

Approved & Released For CCS By:

Tested By:



THU CHAN  
EMC SUPERVISOR  
COMPLIANCE CERTIFICATION SERVICES

CHIN PANG  
EMC TECHNICIAN  
COMPLIANCE CERTIFICATION SERVICES

## 2. EUT DESCRIPTION

The EUT is a point to point Broadband Wireless subscribe device, with a maximum antenna gain of 18dBi in the 5.8 GHz band

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

| Frequency Band<br>(MHz) | Mode    | Output Power<br>(dBm) | Output Power<br>(mW) |
|-------------------------|---------|-----------------------|----------------------|
| 5728 - 5847             | 802.11a | 27.52                 | 564.94               |

### 3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4/2001, FCC CFR 47 Part 2 and FCC CFR 47 Part 15.

### 4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.



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

## 5. CALIBRATION AND UNCERTAINTY

### 5.1. MEASURING INSTRUMENT CALIBRATION

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

### 5.2. MEASUREMENT UNCERTAINTY

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

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

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

### 5.3. TEST AND MEASUREMENT EQUIPMENT

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

| TEST EQUIPMENT LIST           |              |                  |               |           |
|-------------------------------|--------------|------------------|---------------|-----------|
| Description                   | Manufacturer | Model            | Serial Number | Cal Due   |
| Amplifier, 2-8GHz             | HP           | 11975A           | 2517A01067    | 1/16/2005 |
| Quasi-Peak Adapter            | HP           | 85650A           | 3145A01654    | 11/1/04   |
| SA Display Section 1          | HP           | 85662A           | 3026A19146    | 2/2/05    |
| SA RF Section, 22 GHz         | HP           | 85660B           | 3014A06685    | 11/1/04   |
| Antenna, Horn 1-18GHz         | EMCO         | 3115             | 6717          | 2/4/05    |
| Amplifier, 1-26GHz            | Miteq        | NSP2600-SP       | 924341        | 4/25/05   |
| Antenna, Horn 18-26GHz        | ARA          | MWH-1826/B       | 1013          | 2/2/05    |
| HPF 7.6-18GHz                 | Micro-Tronic | HPM13195         | 1             | CNR       |
| Harmonic Mixer, 26.5 ~ 40 GHz | HP           | 11970A           | 3008A04190    | 10/14/05  |
| Peak Power Meter              | Agilent      | E4416A           | GB41291160    | 11/7/04   |
| Site C Antenna, Biconial      | Eaton        | 94455-1          | 1214          | 3/6/05    |
| Site C Antenna, Log Periodic  | EMCO         | 3146             | 9107-3163     | 3/6/05    |
| Site C Preamplifier, 1300MHz  | HP           | 8447D            | 2944A06550    | 8/18/04   |
| EMI Test Receiver             | R & S        | ESHS 20          | 827129/006    | 7/22/05   |
| Line Filter                   | Lindgren     | LMF-3489         | 497           | CNR       |
| LISN, 10 kHz ~ 30 MHz         | FCC          | LISN-50/250-25-2 | 2023          | 10/13/04  |

## 6. SETUP OF EQUIPMENT UNDER TEST

### SUPPORT EQUIPMENT

| PERIPHERAL SUPPORT EQUIPMENT LIST |              |                 |               |        |
|-----------------------------------|--------------|-----------------|---------------|--------|
| Description                       | Manufacturer | Model           | Serial Number | FCC ID |
| Laptop                            | Toshiba      | Satellite       | NA            | DoC    |
| Radio                             | Aperto       | PWPR5800-01     | 3007          | NA     |
| AC Adapter                        | Toshiba      | NA              | NA            | NA     |
| Radio                             | Aperto       | Packetwave 760R | NA            | NA     |
| AC Adapter                        | Aperto       | HASU11          | NA            | DoC    |
| POE                               | NA           | NA              | NA            | NA     |

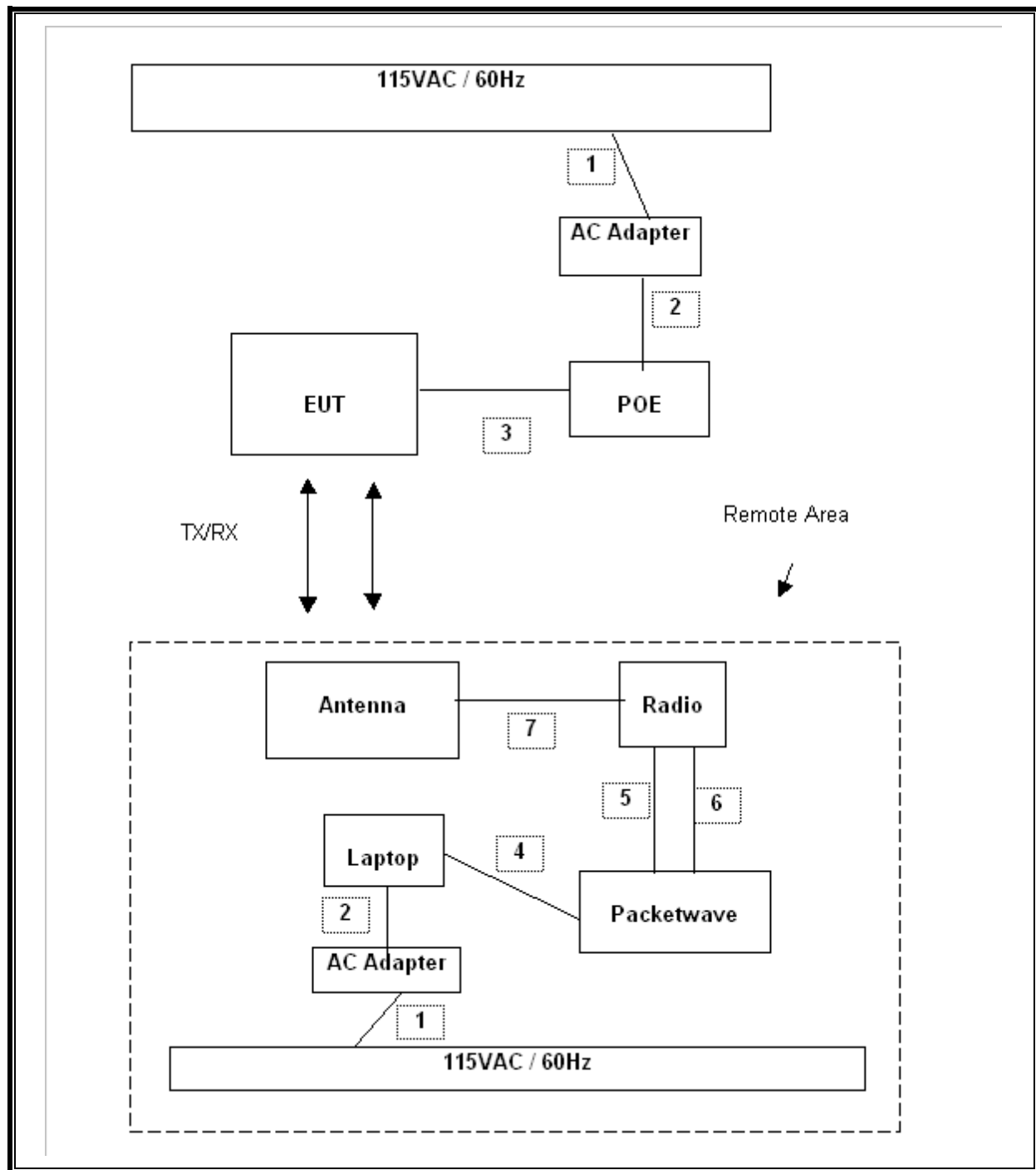
### I/O CABLES

| I/O CABLE LIST |      |                      |                |            |              |         |
|----------------|------|----------------------|----------------|------------|--------------|---------|
| Cable No.      | Port | # of Identical Ports | Connector Type | Cable Type | Cable Length | Remarks |
| AC             | 1    | US 115V              | Un-shielded    | 2m         | No           | No      |
| DC             | 2    | DC                   | Un-shielded    | 1m         | No           | No      |
| POE            | 1    | RJ45                 | Un-shielded    | 1m         | Yes          | No      |
| Serial         | 1    | DB9                  | Un-shielded    | 5m         | Yes          | No      |
| Radio          | 1    | Coax                 | Shielded       | 1m         | Yes          | No      |
| Radio IF       | 1    | RJ45                 | Un-shielded    | 2m         | Yes          | No      |
| Antenna        | 1    | Coax                 | Un-shielded    | 1m         | Yes          | No      |

### TEST SETUP

The EUT is stand-alone unit via POE adapter. Test software exercised between the EUT & support radio antennas

**SETUP DIAGRAM FOR TESTS**



## 7. APPLICABLE LIMITS AND TEST RESULTS

### 7.1. 6 dB BANDWIDTH

#### LIMIT

§15.247 (a) (2) For direct sequence systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

#### TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

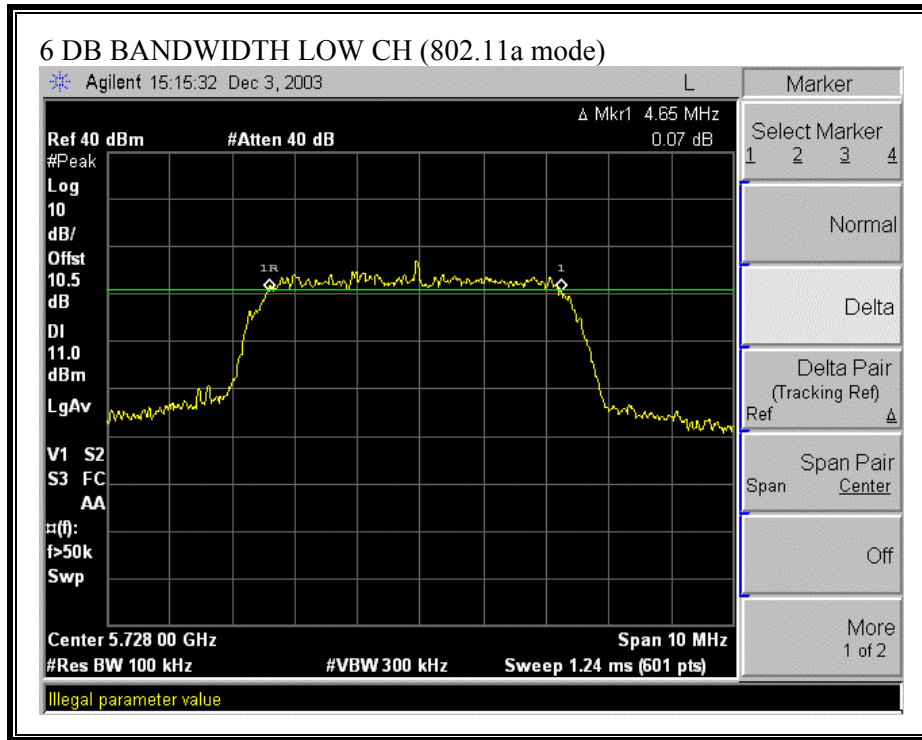
#### 5.8 GHz BAND RESULTS

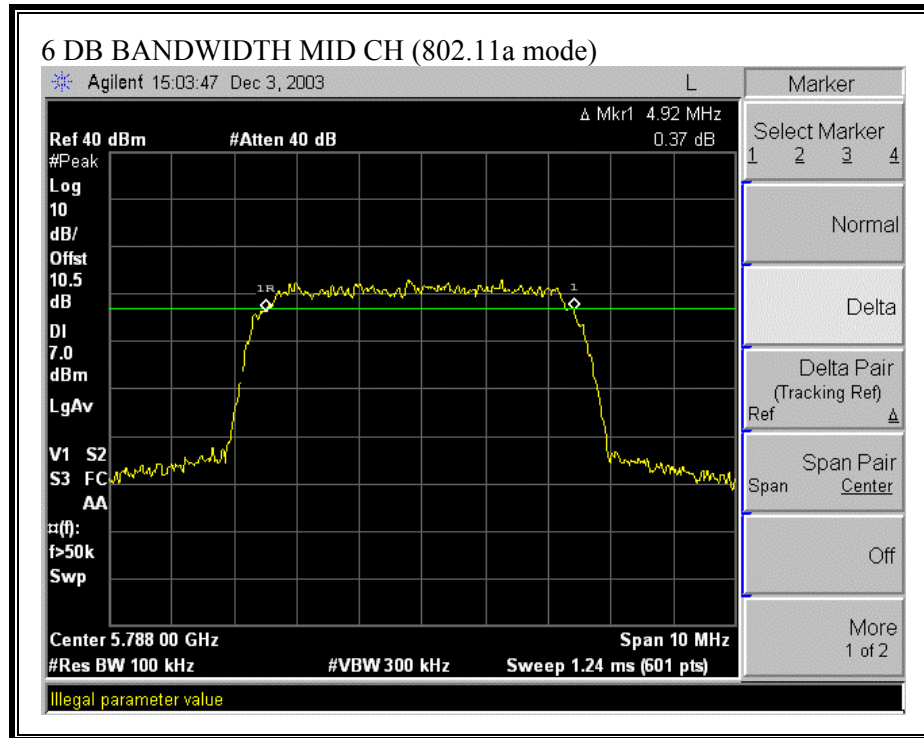
No non-compliance noted:

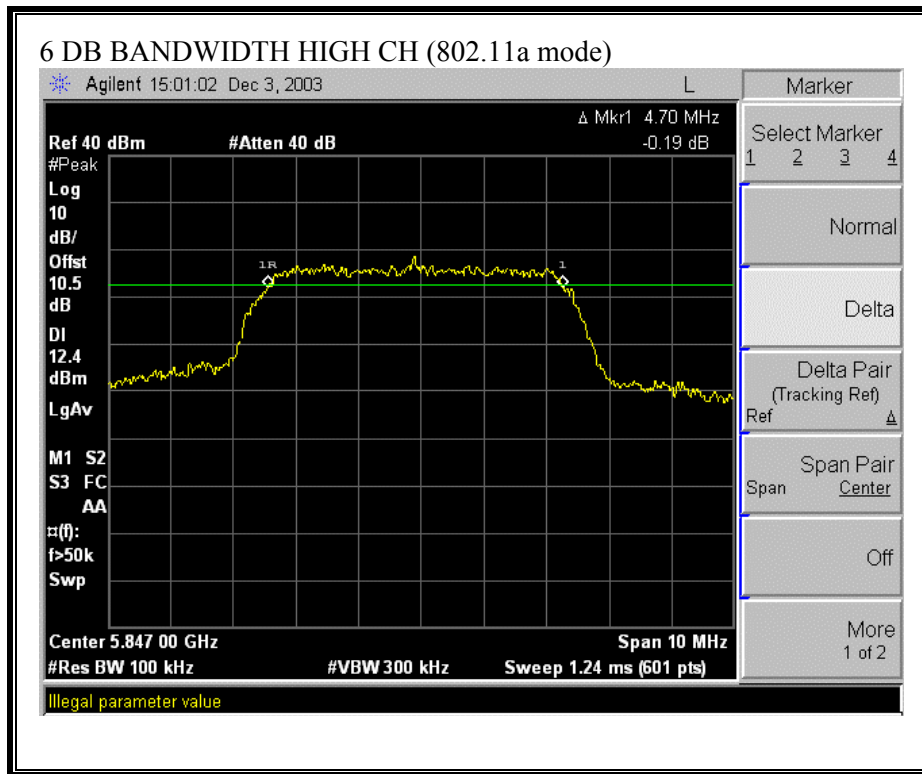
#### 802.11a Mode

| Channel | Frequency<br>(MHz) | 6 dB Bandwidth<br>(kHz) | Minimum Limit<br>(kHz) | Margin<br>(kHz) |
|---------|--------------------|-------------------------|------------------------|-----------------|
| Low     | 5728               | 4650                    | 500                    | 4150            |
| Middle  | 5788               | 4920                    | 500                    | 4420            |
| High    | 5847               | 4700                    | 500                    | 4200            |

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







## 7.2. 99% BANDWIDTH

### LIMIT

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

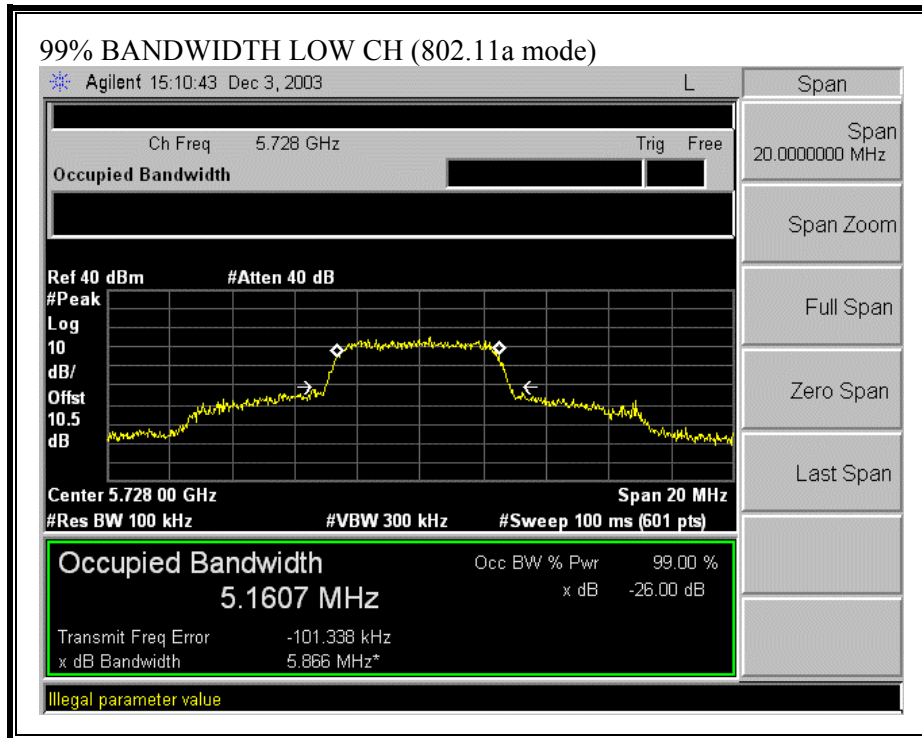
### 5.8 GHz BAND RESULTS

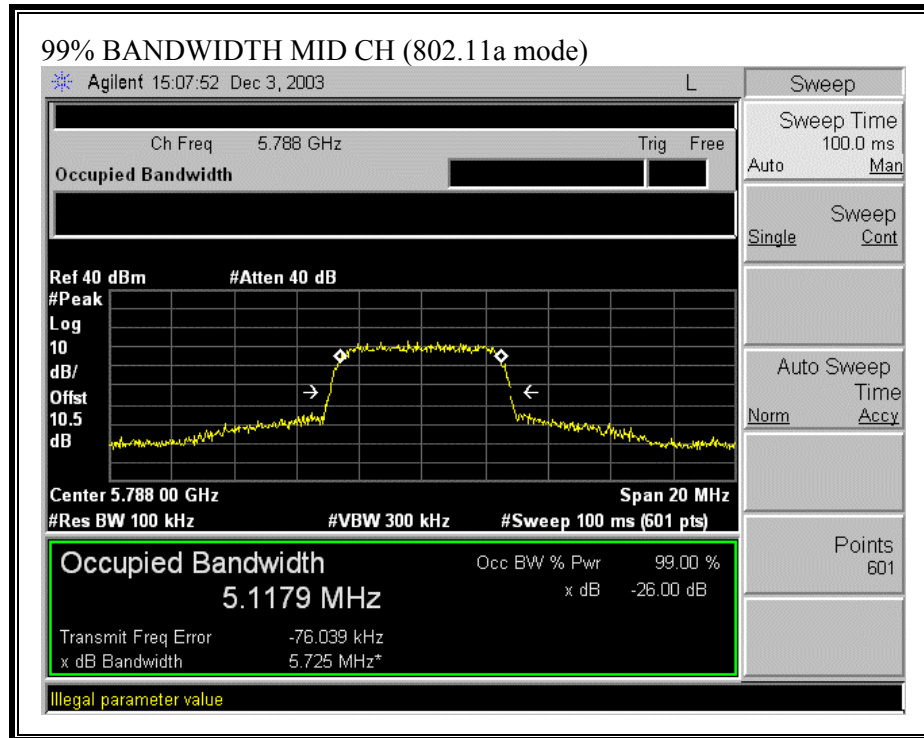
No non-compliance noted:

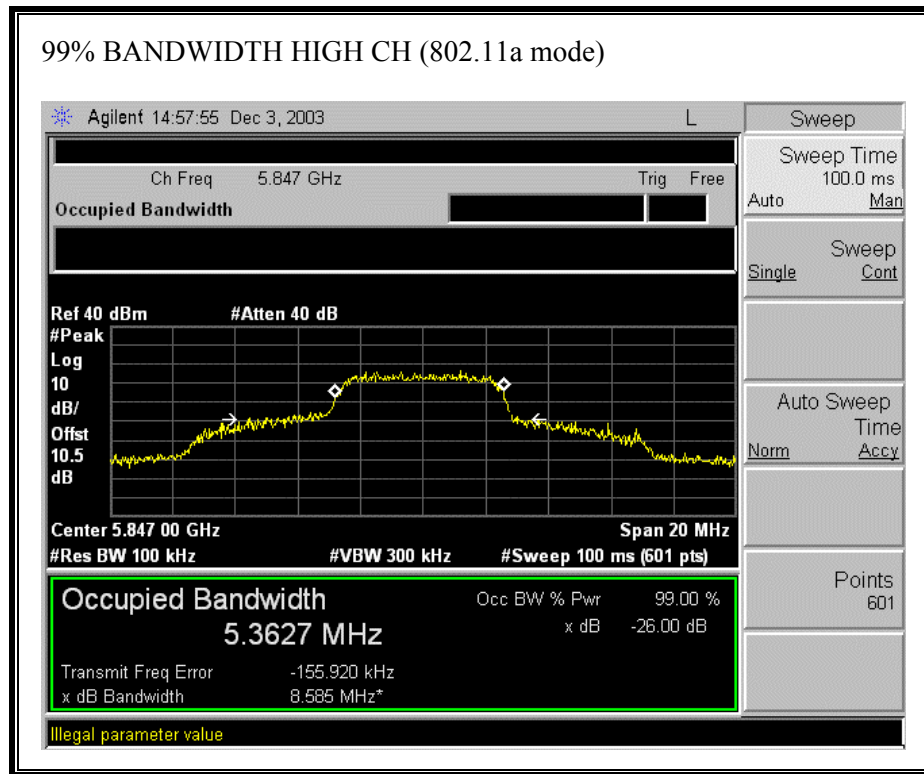
#### 802.11a Mode

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low     | 5728               | 5.1607                 |
| Middle  | 5788               | 5.1179                 |
| High    | 5847               | 5.3627                 |

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







### **7.3. 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.

(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.

The maximum antenna gain is 18dBi and point-to-point, therefore only the limit is 30dBm on the antenna port.

#### **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.

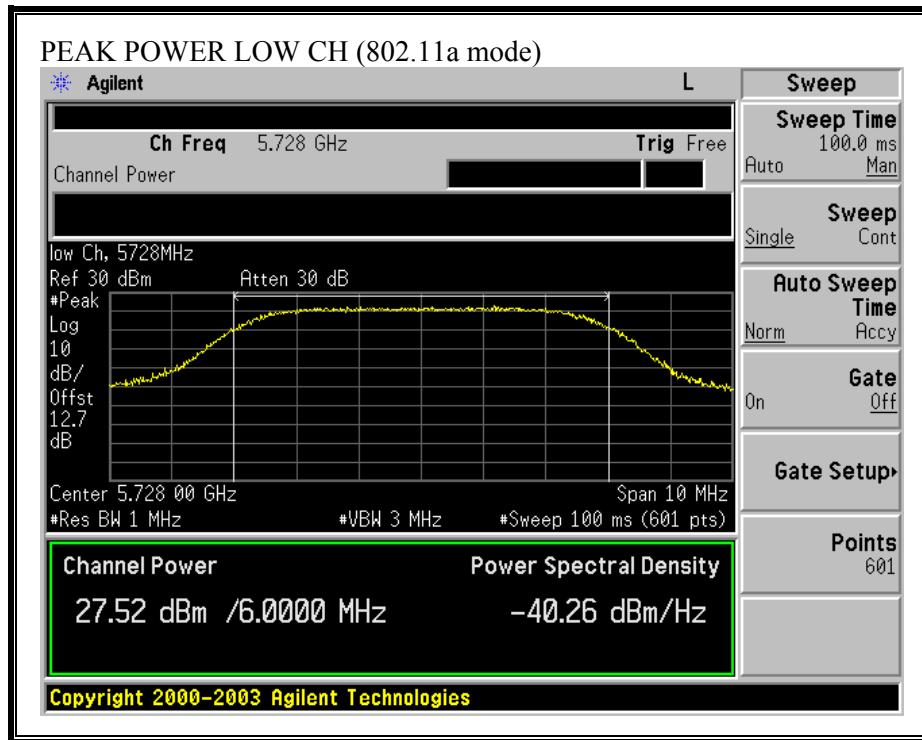
## **5.8 GHZ BAND RESULTS**

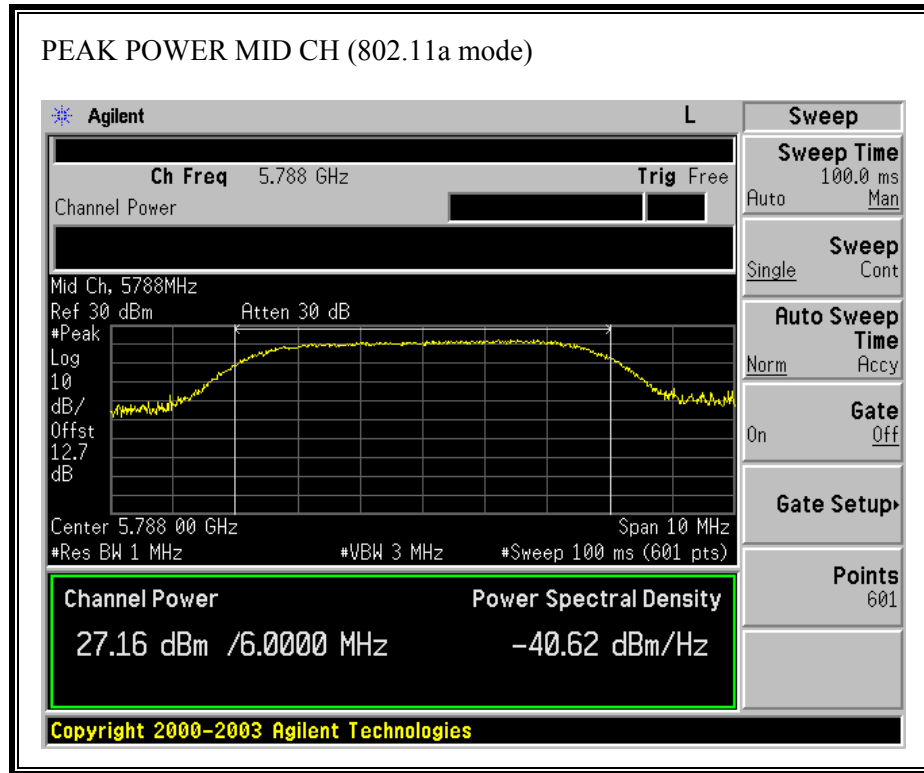
No non-compliance noted:

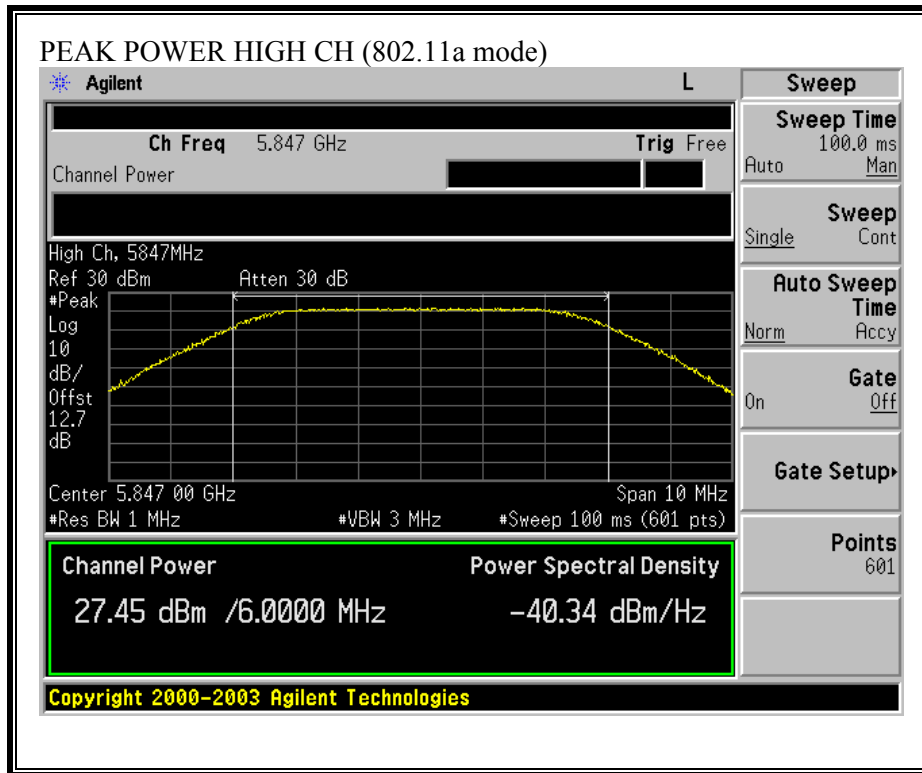
802.11a Mode

| <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            | 5728                       | 27.52                       | 30                     | -2.48                  |
| Middle         | 5788                       | 27.16                       | 30                     | -2.84                  |
| High           | 5847                       | 27.45                       | 30                     | -2.55                  |

**OUTPUT POWER (802.11a MODE)**







## 7.4. 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),  $S = 1.0 \text{ mW/cm}^2$

## **5.8 GHz BAND 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                                                    | 27.52                             | 18.00                             | 53.24                            |

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.

## 7.5. AVERAGE POWER

### AVERAGE POWER LIMIT

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to a power meter.

### 5.8 GHZ BAND RESULTS

No non-compliance noted:

The cable assembly insertion loss of 11.7 dB (including 10 dB pad and 1.7 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     | 5728               | 22.24                  |
| Middle  | 5788               | 20.00                  |
| High    | 5847               | 23.62                  |

## 7.6. 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.

:

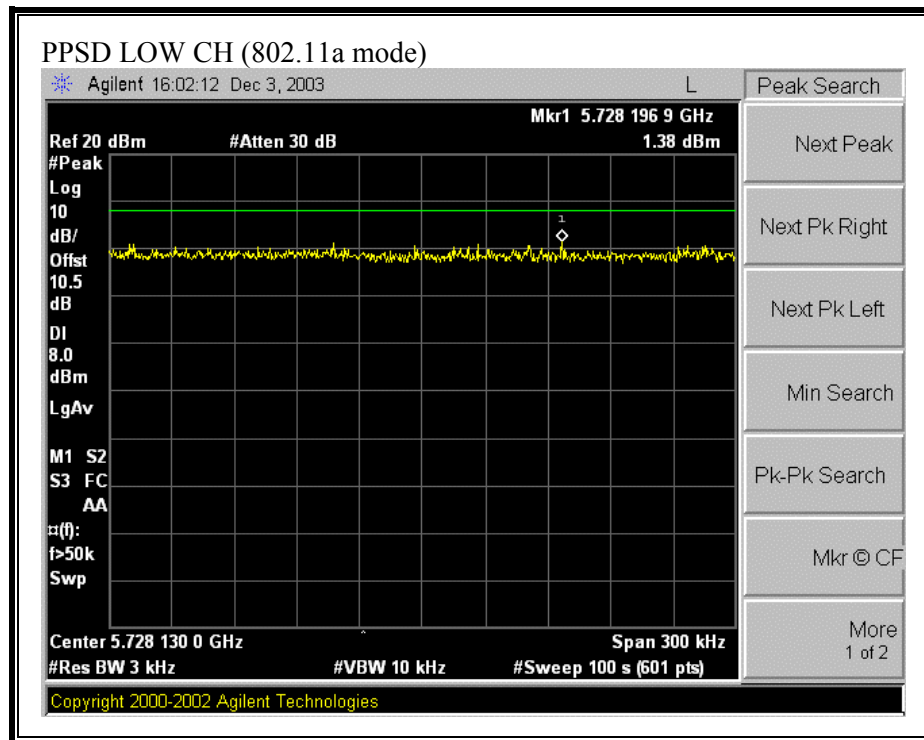
### 5.8 GHz BAND RESULTS

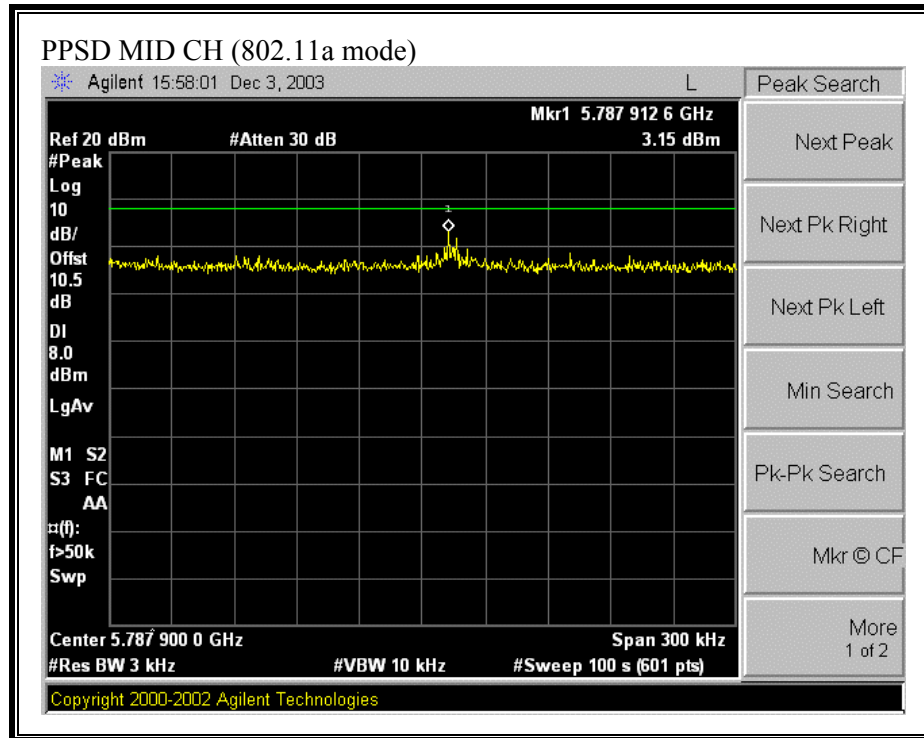
No non-compliance noted:

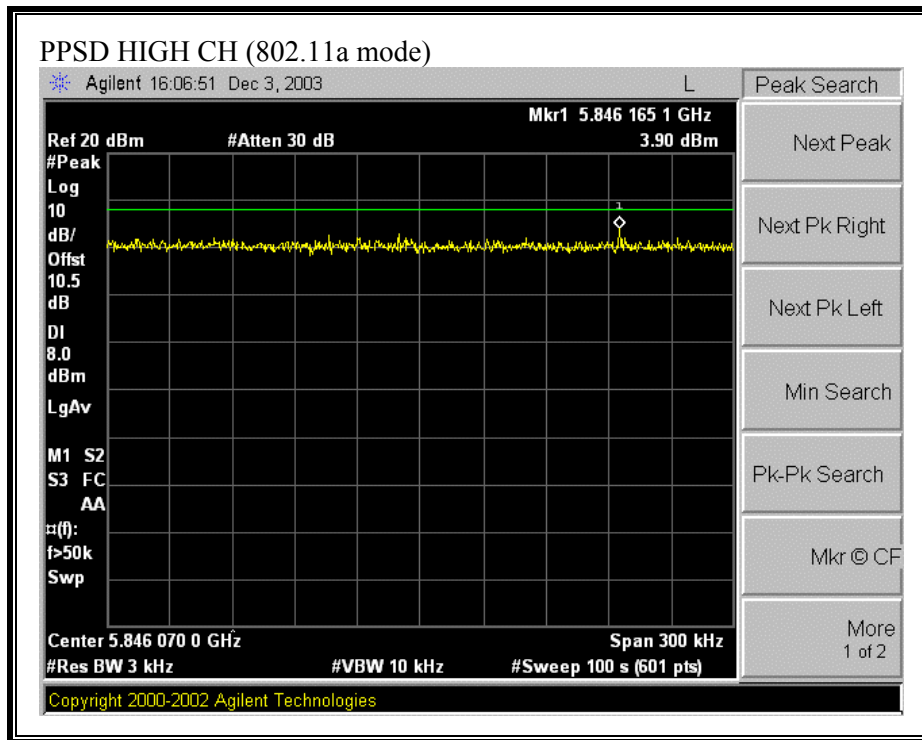
### 802.11a Mode

| Channel | Frequency<br>(MHz) | PPSD<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|---------------|----------------|----------------|
| Low     | 5728               | 1.38          | 8              | -6.62          |
| Middle  | 5788               | 3.15          | 8              | -4.85          |
| High    | 5847               | 3.90          | 8              | -4.10          |

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







## **7.7. 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.

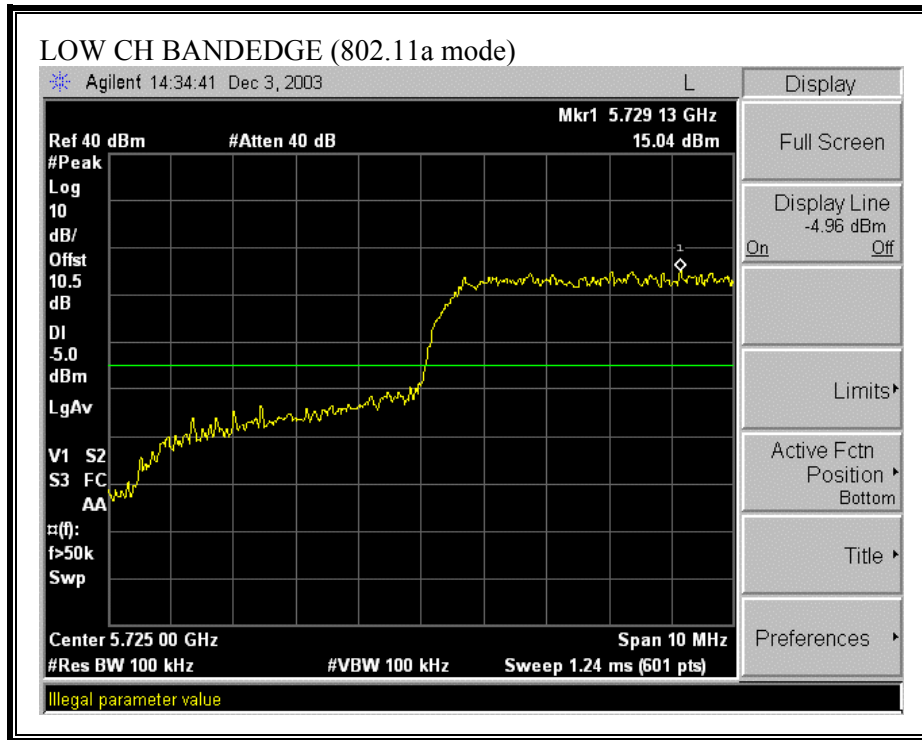
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

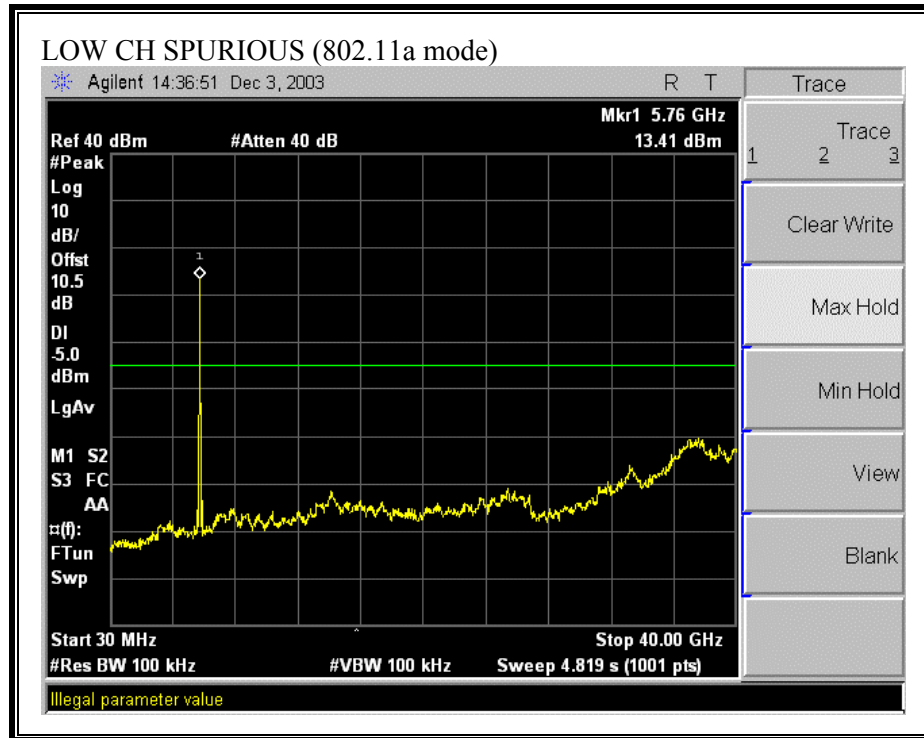
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 5.8 GHz band.

### **RESULTS**

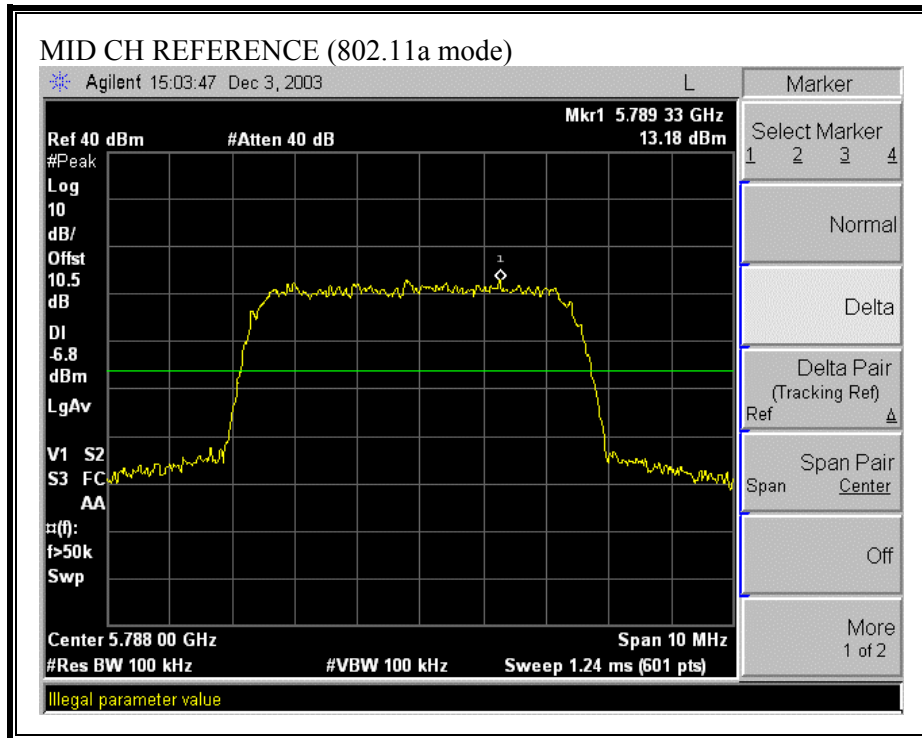
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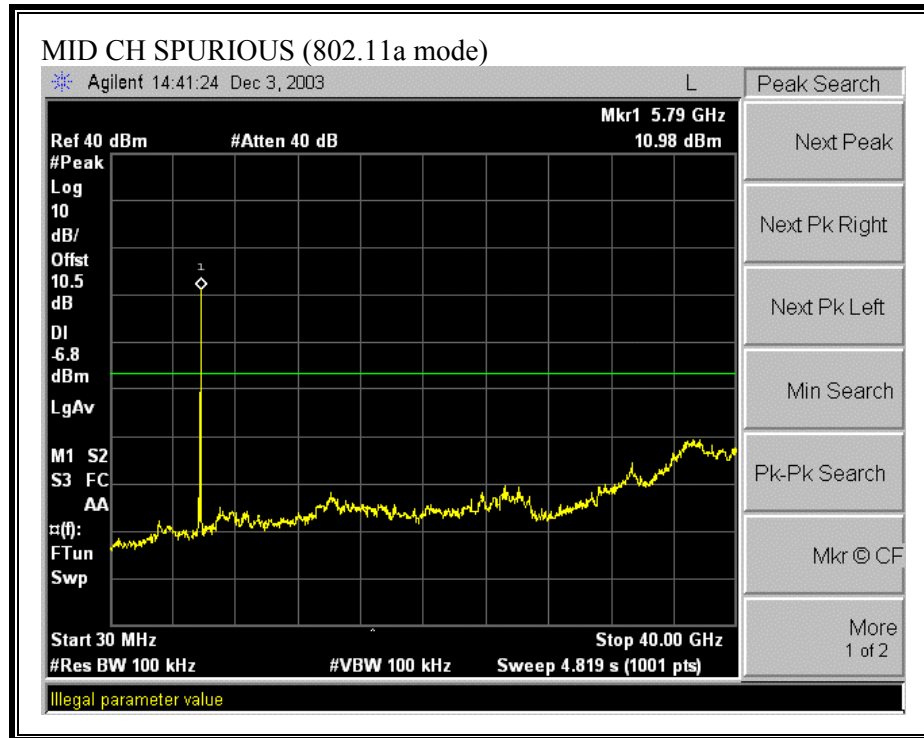
**SPURIOUS EMISSIONS, LOW CHANNEL (802.11a MODE)**



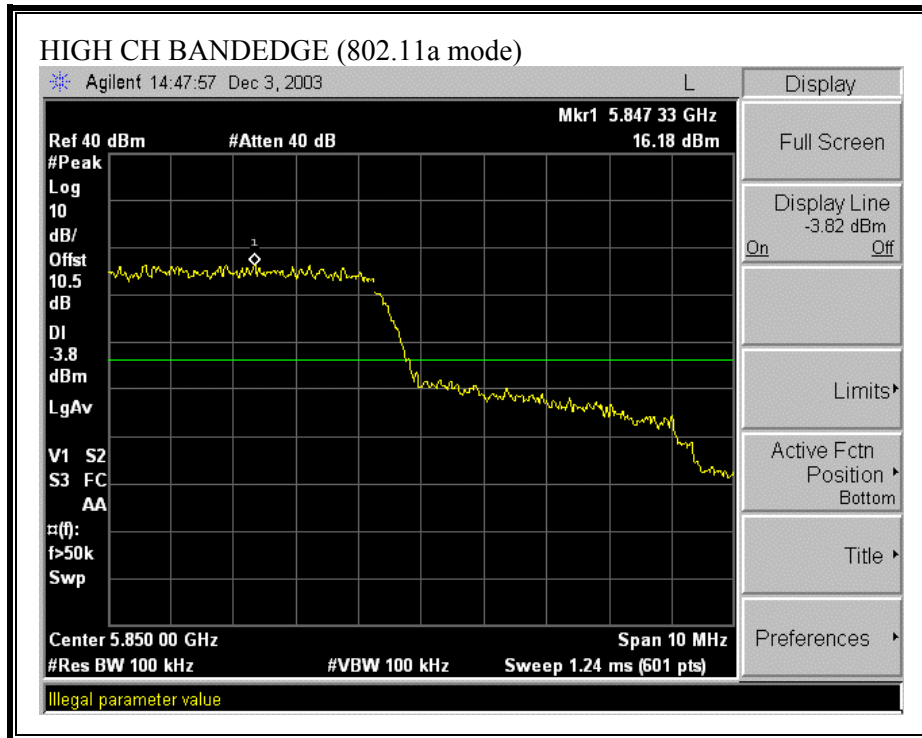


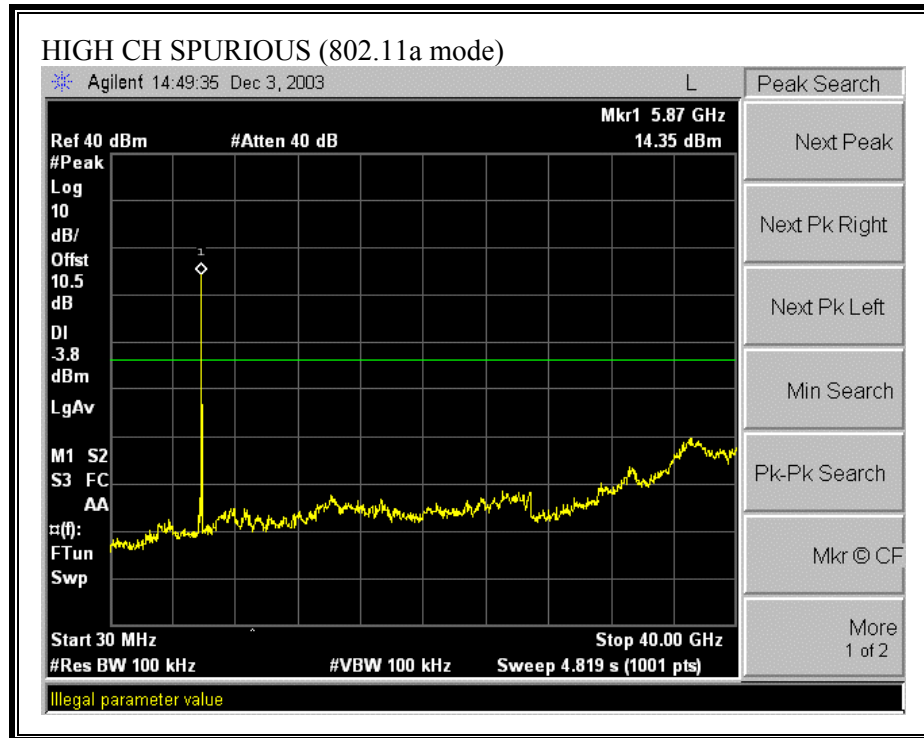
**SPURIOUS EMISSIONS, MID CHANNEL (802.11a MODE)**





**SPURIOUS EMISSIONS, HIGH CHANNEL (802.11a 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       |
| <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 of 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 of the 5.8 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.

## **RESULTS**

No non-compliance noted:

## 7.8.2. TRANSMITTER RADIATED EMISSIONS ABOVE 1 GHZ

### HARMONICS AND SPURIOUS EMISSIONS (a MODE)

07/28/04 High Frequency Measurement

Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: Chin Pang

Project #:04U2749-1

Company: Aperto

EUT Descrip.: Packetwave point to point

EUT M/N: PW210, PW220, PW30

Test Target: FCC 15.247

Mode Oper: Tx

Test Equipment:

| EMCO Horn 1-18GHz  | Pre-amplifier 1-26GHz | Spectrum Analyzer       | Horn > 18GHz | Limit      |
|--------------------|-----------------------|-------------------------|--------------|------------|
| T73; S/N: 6717 @3m | T86 Miteq 924341      | Agilent E4446A Analyzer |              | FCC 15.209 |

Hi Frequency Cables

|                                 |                                                |                                     |                                             |
|---------------------------------|------------------------------------------------|-------------------------------------|---------------------------------------------|
| <input type="checkbox"/> (2 ft) | <input checked="" type="checkbox"/> (2 ~ 3 ft) | <input type="checkbox"/> (4 ~ 6 ft) | <input checked="" type="checkbox"/> (12 ft) |
|---------------------------------|------------------------------------------------|-------------------------------------|---------------------------------------------|

Peak Measurements: 1 MHz Resolution Bandwidth  
1 MHz Video Bandwidth

Average Measurements: 1 MHz Resolution Bandwidth  
10 Hz Video Bandwidth

| f<br>GHz                                  | Dist<br>feet | Read Pk<br>dBuV | Read Avg.<br>dBuV | AF<br>dB/m | CL<br>dB | Amp<br>dB | D Corr<br>dB | HPF | Peak<br>dBuV/m | Avg<br>dBuV/m | Pk Lim<br>dBuV/m | Avg Lim<br>dBuV/m | Pk Mar<br>dB | Avg Mar<br>dB | Notes          |
|-------------------------------------------|--------------|-----------------|-------------------|------------|----------|-----------|--------------|-----|----------------|---------------|------------------|-------------------|--------------|---------------|----------------|
| Low Ch, 5728MHz                           |              |                 |                   |            |          |           |              |     |                |               |                  |                   |              |               |                |
| 11.450                                    | 9.8          | 50.5            | 37.3              | 38.7       | 4.7      | -44.5     | 0.0          | 1.0 | 50.3           | 37.1          | 74.0             | 54.0              | -23.7        | -16.9         | V              |
| 17.184                                    | 9.8          | 50.6            | 37.5              | 41.2       | 6.0      | -48.5     | 0.0          | 1.0 | 50.3           | 37.2          | 74.0             | 54.0              | -23.7        | -16.8         | V, noise floor |
| 11.450                                    | 9.8          | 51.2            | 37.7              | 38.7       | 4.7      | -44.5     | 0.0          | 1.0 | 51.0           | 37.5          | 74.0             | 54.0              | -23.0        | -16.5         | H              |
| 17.184                                    | 9.8          | 52.0            | 38.0              | 41.2       | 6.0      | -48.5     | 0.0          | 1.0 | 51.7           | 37.7          | 74.0             | 54.0              | -22.3        | -16.3         | H, noise floor |
| Mid Ch, 5788MHz                           |              |                 |                   |            |          |           |              |     |                |               |                  |                   |              |               |                |
| 11.569                                    | 9.8          | 48.2            | 37.1              | 38.8       | 4.7      | -44.7     | 0.0          | 1.0 | 48.0           | 36.9          | 74.0             | 54.0              | -26.0        | -17.1         | V              |
| 17.364                                    | 9.8          | 50.2            | 39.5              | 42.3       | 6.1      | -48.3     | 0.0          | 1.0 | 51.2           | 40.5          | 74.0             | 54.0              | -22.8        | -13.5         | V, noise floor |
| 11.569                                    | 9.8          | 49.5            | 37.3              | 38.8       | 4.7      | -44.7     | 0.0          | 1.0 | 49.3           | 37.1          | 74.0             | 54.0              | -24.7        | -16.9         | H              |
| 17.569                                    | 9.8          | 50.9            | 39.6              | 43.5       | 6.1      | -48.1     | 0.0          | 1.0 | 53.5           | 42.2          | 74.0             | 54.0              | -20.5        | -11.8         | H, noise floor |
| High Ch, 5847MHz                          |              |                 |                   |            |          |           |              |     |                |               |                  |                   |              |               |                |
| 11.694                                    | 9.8          | 49.7            | 37.4              | 38.9       | 4.7      | -44.9     | 0.0          | 1.0 | 49.4           | 37.1          | 74.0             | 54.0              | -24.6        | -16.9         | V              |
| 17.576                                    | 9.8          | 48.0            | 37.1              | 43.6       | 6.1      | -48.0     | 0.0          | 1.0 | 50.7           | 39.7          | 74.0             | 54.0              | -23.3        | -14.3         | V, noise floor |
| 11.694                                    | 9.8          | 50.1            | 37.4              | 38.9       | 4.7      | -44.9     | 0.0          | 1.0 | 49.8           | 37.1          | 74.0             | 54.0              | -24.2        | -16.9         | H              |
| 17.576                                    | 9.8          | 49.0            | 37.3              | 43.6       | 6.1      | -48.0     | 0.0          | 1.0 | 51.6           | 39.9          | 74.0             | 54.0              | -22.4        | -14.1         | H, noise floor |
| Note: No emissions were found up to 40GHz |              |                 |                   |            |          |           |              |     |                |               |                  |                   |              |               |                |

|      |                       |        |                                |         |                              |
|------|-----------------------|--------|--------------------------------|---------|------------------------------|
| 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)

| RADIATED EMISSION DATA                                                                                                                                                                                                        |         |       |       |         |          |                                                                                                                                      |        |       |       |         |         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------|-------|---------|----------|--------------------------------------------------------------------------------------------------------------------------------------|--------|-------|-------|---------|---------|
|                                                                                                                                              |         |       |       |         |          | <b>Project #:</b> 04u2749-1<br><b>Report #:</b> 040727C1<br><b>Date &amp; Time:</b> 07/27/04 10:09 AM<br><b>Test Engr:</b> Chin Pang |        |       |       |         |         |
| FCC, VCCI, CISPR, CE, AUSTEL, NZ<br>UL, CSA, TUV, BSMI, DHHS, NVLAP<br><br>561F MONTEREY ROAD, SAN JOSE, CA 95037-9001<br>PHONE: (408) 463-0885 FAX: (408) 463-0888                                                           |         |       |       |         |          |                                                                                                                                      |        |       |       |         |         |
| <b>Company:</b> Aperto Networks<br><b>EUT Description:</b> 5GHZ Broadband Wireless Point to Point<br><b>Test Configuration :</b> EUT/Support Equipment<br><b>Type of Test:</b> FCC Class B<br><b>Mode of Operation:</b> Tx/Rx |         |       |       |         |          |                                                                                                                                      |        |       |       |         |         |
| <a href="#" style="background-color: #e0ffff; padding: 2px 10px; text-decoration: none;">&lt;&lt; Main Sheet</a>                                                                                                              |         |       |       |         |          |                                                                                                                                      |        |       |       |         |         |
| Freq.                                                                                                                                                                                                                         | Reading | AF    | Closs | Pre-amp | Level    | Limit                                                                                                                                | Margin | Pol   | Az    | Height  | Mark    |
| (MHz)                                                                                                                                                                                                                         | (dBuV)  | (dB)  | (dB)  | (dB)    | (dBuV/m) | FCC_B                                                                                                                                | (dB)   | (H/V) | (Deg) | (Meter) | (P/Q/A) |
| 533.33                                                                                                                                                                                                                        | 50.96   | 18.45 | 3.75  | 27.70   | 45.46    | 46.00                                                                                                                                | -0.54  | 3mV   | 0.00  | 2.00    | QP      |
| 533.33                                                                                                                                                                                                                        | 50.30   | 18.45 | 3.75  | 27.70   | 44.80    | 46.00                                                                                                                                | -1.20  | 3mH   | 0.00  | 3.00    | QP      |
| 266.66                                                                                                                                                                                                                        | 55.10   | 13.58 | 2.53  | 26.46   | 44.75    | 46.00                                                                                                                                | -1.25  | 3mH   | 0.00  | 1.50    | P       |
| 800.00                                                                                                                                                                                                                        | 45.60   | 21.76 | 4.69  | 27.43   | 44.62    | 46.00                                                                                                                                | -1.38  | 3mV   | 0.00  | 1.00    | P       |
| 800.00                                                                                                                                                                                                                        | 44.80   | 21.76 | 4.69  | 27.43   | 43.82    | 46.00                                                                                                                                | -2.18  | 3mH   | 0.00  | 1.50    | QP      |
| 400.00                                                                                                                                                                                                                        | 51.30   | 16.25 | 3.17  | 27.13   | 43.59    | 46.00                                                                                                                                | -2.41  | 3mH   | 0.00  | 2.00    | P       |
| 6 Worst Data                                                                                                                                                                                                                  |         |       |       |         |          |                                                                                                                                      |        |       |       |         |         |

## 7.9. 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.

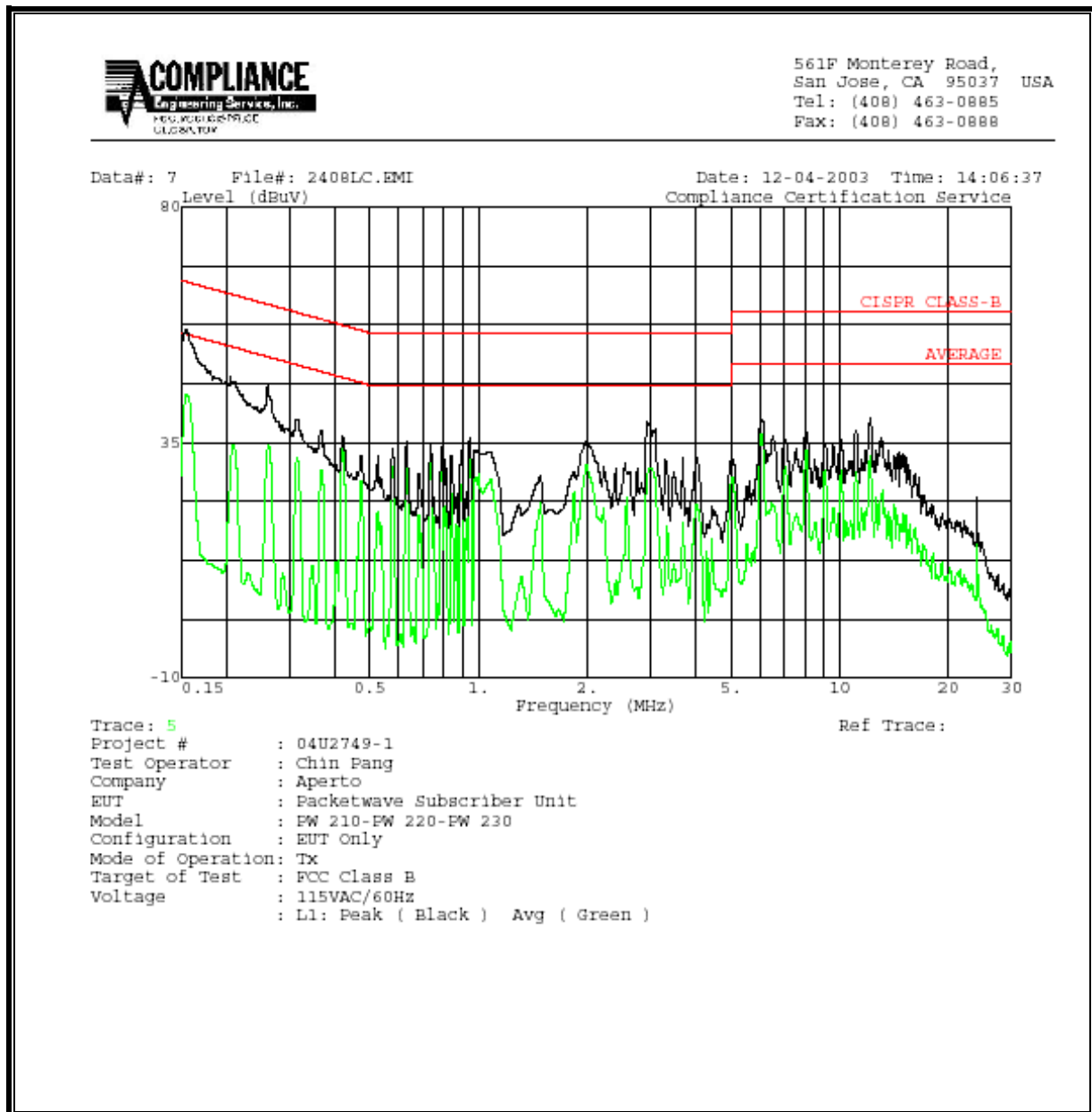
### RESULTS

No non-compliance noted:

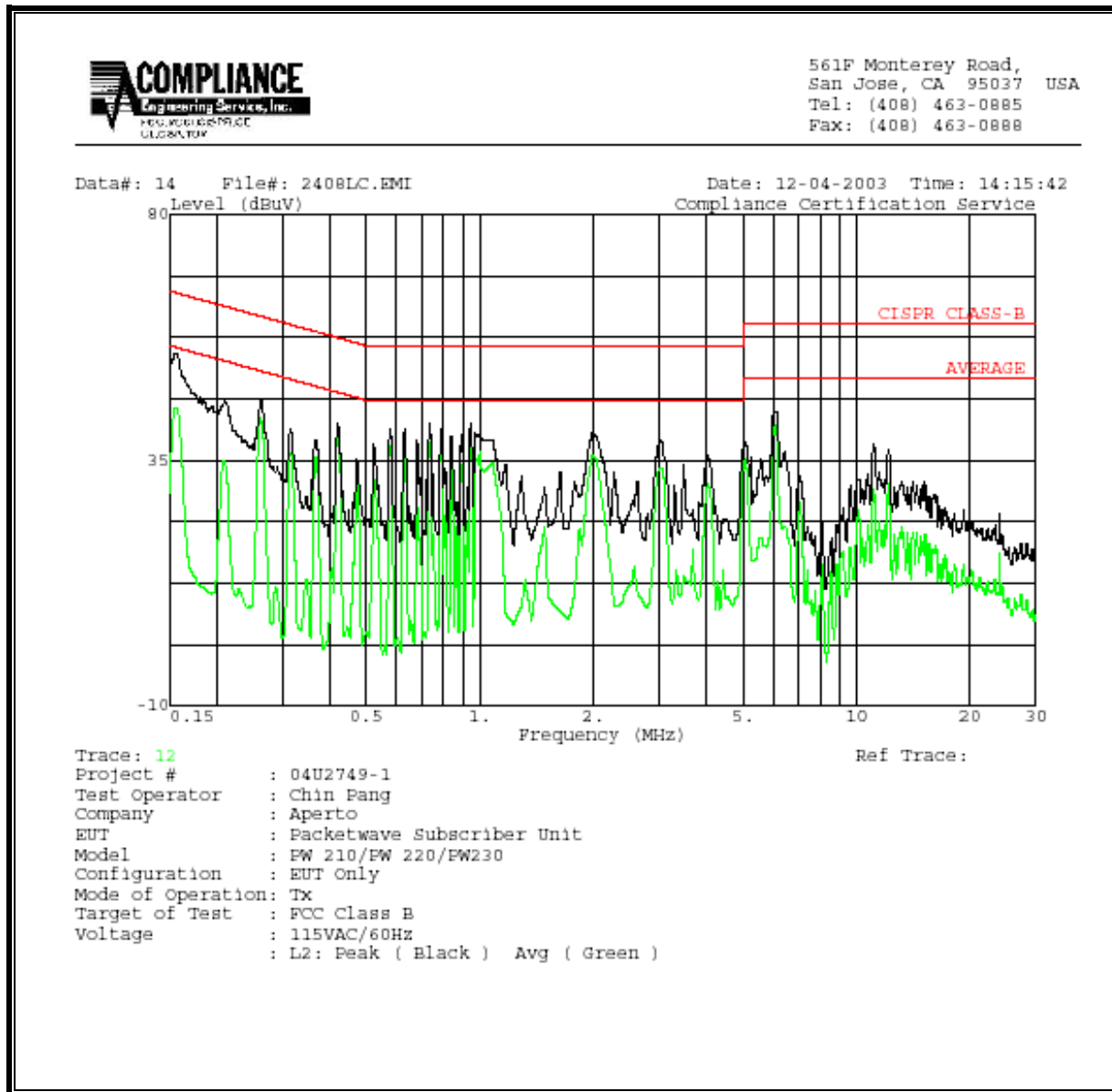
# **6 WORST EMISSIONS**

| 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 |
| 0.16                                   | 57.27     | --        | 44.11     | 0.00  | 65.71 | 55.71 | -8.44   | -11.60  | L1      |
| 0.26                                   | 46.26     | --        | 34.67     | 0.00  | 62.86 | 52.86 | -16.60  | -18.19  | L1      |
| 2.92                                   | 39.00     | --        | 31.20     | 0.00  | 56.00 | 46.00 | -17.00  | -14.80  | L1      |
| 0.16                                   | 55.66     | --        | 45.28     | 0.00  | 65.71 | 55.71 | -10.05  | -10.43  | L2      |
| 0.73                                   | 41.46     | --        | 39.21     | 0.00  | 56.00 | 46.00 | -14.54  | -6.79   | L2      |
| 6.06                                   | 44.95     | --        | 42.10     | 0.00  | 60.00 | 50.00 | -15.05  | -7.90   | L2      |
| 6 Worst Data                           |           |           |           |       |       |       |         |         |         |

## LINE 1 RESULTS

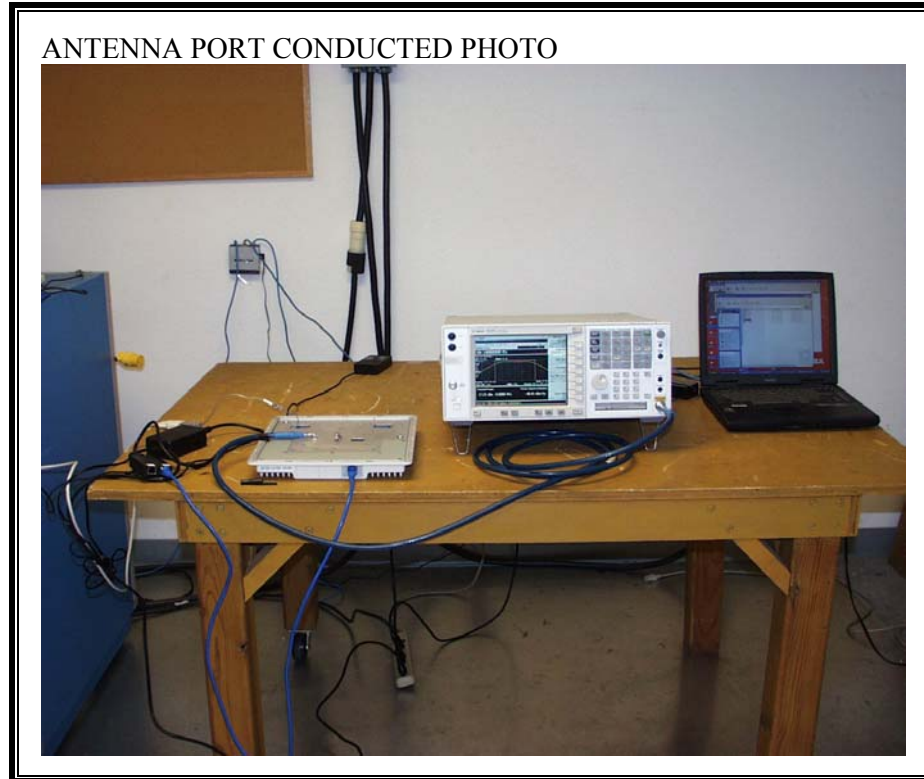


**LINE 2 RESULTS**



## 8. SETUP PHOTOS

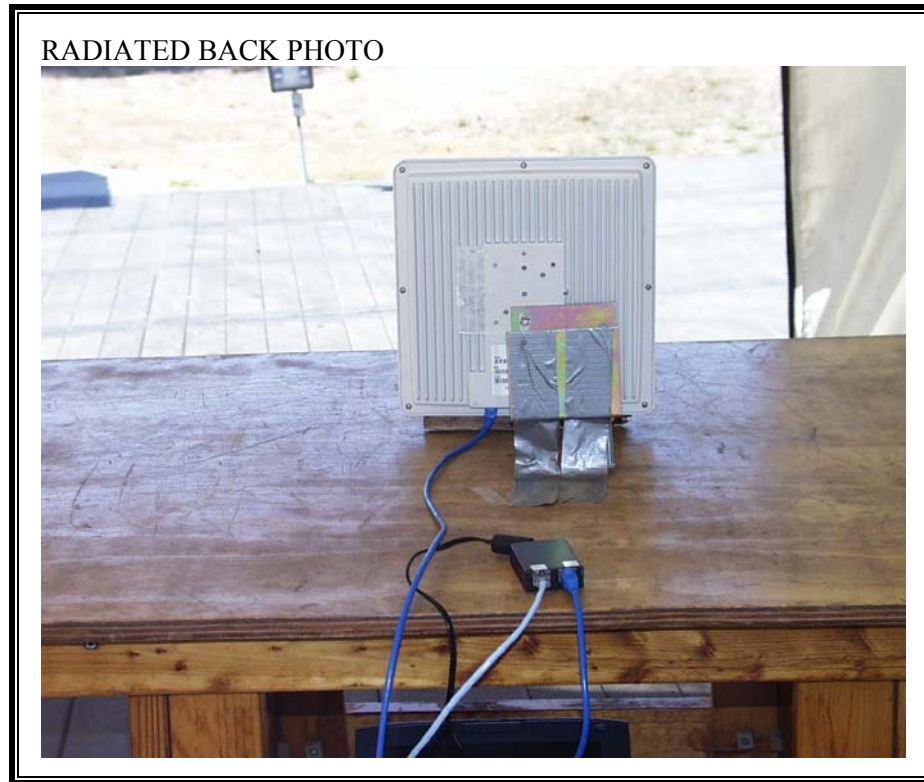
### ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP



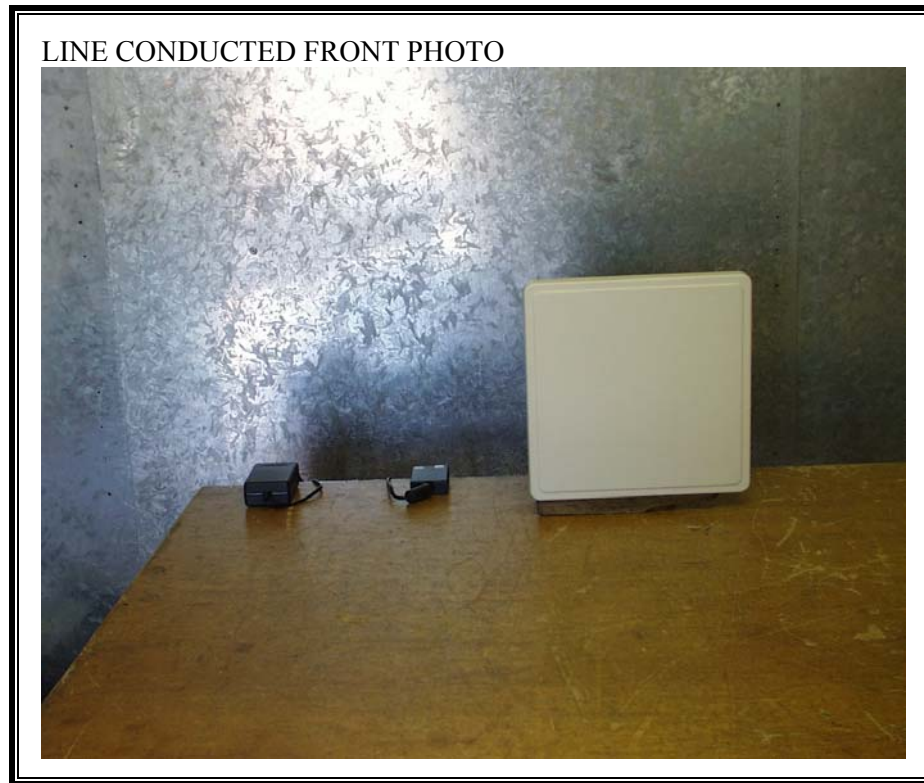
**RADIATED RF MEASUREMENT SETUP**

RADIATED FRONT PHOTO





**POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP**



LINE CONDUCTED BACK PHOTO



**END OF REPORT**