



**FCC CFR47 PART 15 SUBPART E  
CERTIFICATION**

**TEST REPORT**

**FOR**

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

**MODEL NUMBER: AR5BMB-44**

**FCC ID: PPD-AR5BMB-00044**

**REPORT NUMBER: 04U2552-2**

**ISSUE DATE: APRIL 30, 2004**

*Prepared for*  
**ATHEROS COMMUNICATIONS, INC.  
529 ALMANOR AVENUE  
SUNNYVALE  
CA 94085, USA**

*Prepared by*  
**COMPLIANCE CERTIFICATION SERVICES  
561F MONTEREY ROAD,  
MORGAN HILL, CA 95037, USA  
TEL: (408) 463-0885  
FAX: (408) 463-0888**



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## 1. TEST RESULT CERTIFICATION

**COMPANY NAME:** ATHEROS COMMUNICATIONS, INC.  
529 ALMANOR AVENUE  
SUNNYVALE, CA 94085, USA

**EUT DESCRIPTION:** 802.11a/b/g Mini PCI module

**MODEL:** AR5BMB-44

**DATE TESTED:** FEBRUARY 24 – APRIL 1, 2004

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:

Tested By:



MIKE HECKROTTE  
ENGINEERING MANAGER  
COMPLIANCE CERTIFICATION SERVICES

YAN ZHENG  
EMC ENGINEER  
COMPLIANCE CERTIFICATION SERVICES

## 2. EUT DESCRIPTION

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

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

Frequency Band (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5180 - 5250	802.11a	14.83	30.41
5200 - 5250	802.11a Turbo	16.64	46.13
5250 - 5320	802.11a	17.98	62.81
5250 - 5290	802.11a Turbo	17.27	53.33

The radio utilizes two film antennas for diversity (main and auxiliary). The Tyco model TIAN01 has a maximum gain of 4.66 dBi, without cable loss, in the 5.2 GHz band.

The Hitachi HTL008 and HTL017 antennas have a lower gain in the 5.2 GHz band, compared to the TIAN01.

Two TIAN01 antennas were utilized during final compliance tests.

Supplemental radiated emissions measurements were made with two HTL017 antennas.

### 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
Spectrum Analyzer	Agilent	E4446A	MY43360112	1/13/2005
Peak Power Meter	Agilent	E4416A	GB41291160	11/7/2004
Peak / Average Power Sensor	Agilent	E9327A	US40440755	11/7/2004
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	2/4/2005
Antenna, Horn 18 ~ 26 GHz	ARA	SWH-28	1007	2/24/2005
Antenna, Horn 26 ~ 40 GHz	ARA	MWH-2640/B	1029	12/3/2004
PreAmplifier 1-26GHz	MITEQ	NSP2600-SP	924341	4/25/2004
PreAmplifier 26-40 GHz	MITEQ	NSP4000-SP2	924343	6/1/2004
7.6GHz High Pass Filter	Micro-tronics	HPM13195	SN-002	N/A
4.0GHz High Pass Filter	Micro-tronics	HPM13351	SN-001	N/A
EMI Receiver, 9 kHz ~ 2.9 GHz	HP	8542E	3942A00286	11/20/2004
RF Filter Section	HP	85420E	3705A00256	11/20/2004
Antenna, Bicon/Log, 30 ~ 2000 MHz	Sunol Sciences	JB1	A121003	12/22/2004
LISN, 10 kHz ~ 30 MHz	FCC	50/250-25-2	114	10/13/2004
Line Filter	Lindgren	LMF-3489	497	CNR
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	10/13/2004

## 6. SETUP OF EQUIPMENT UNDER TEST

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
LAPTOP	DEL	PP01L	DS/N CN-04P240-48643-2BK-4144	DOC
AC ADAPTER	DELL	AA20031	DS/N CN-09364U-16291-2A9-01LG	DOC
CARDBUS ADAPTER	STELLCOM	STCBMP13	SN-022	DOC

### I/O CABLES

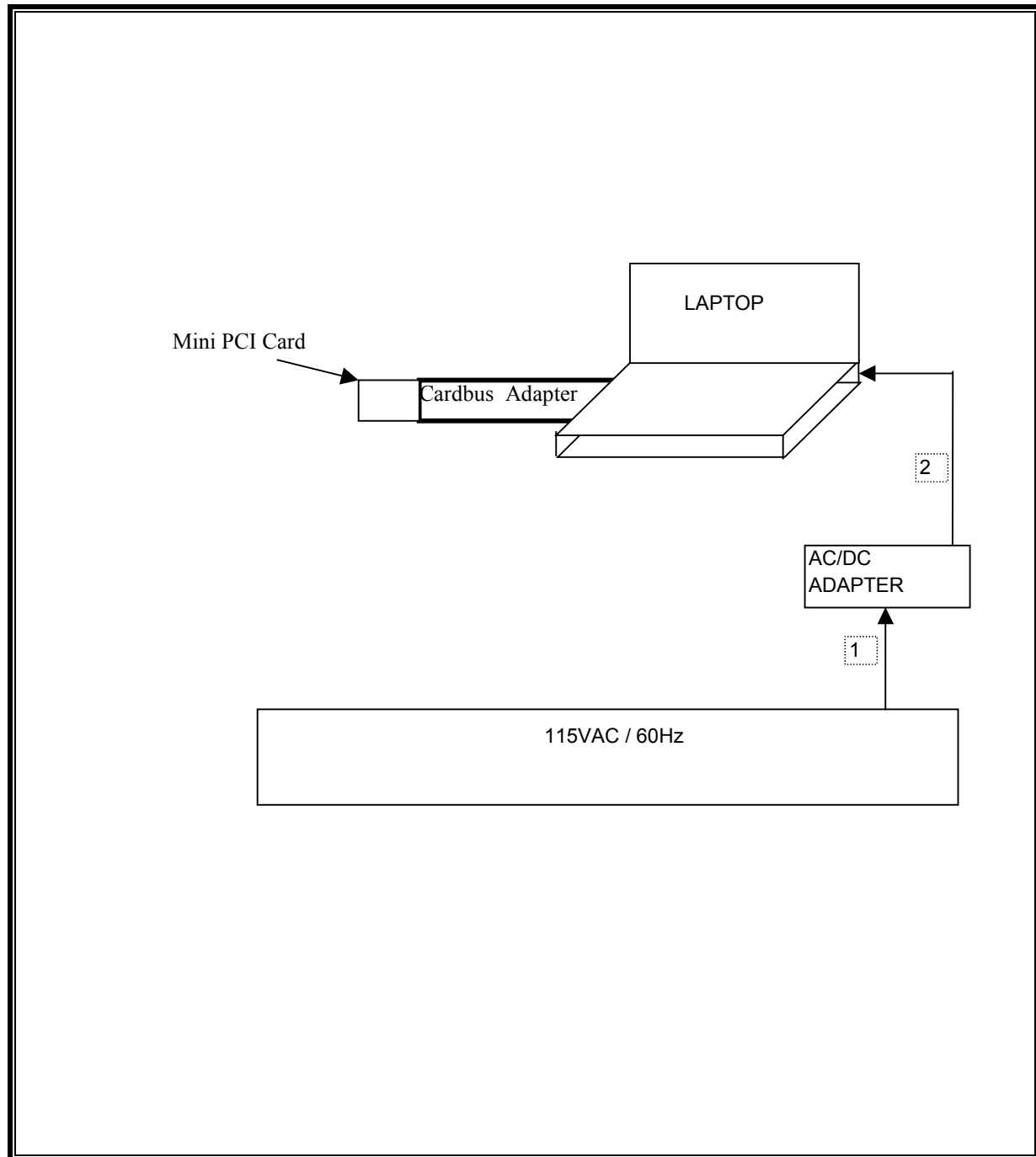
I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	2	US115	UNSHIELDED	2m	NO
2	DC	1	DC	UNSHIELDED	2m	NO

### 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**



## 7. APPLICABLE LIMITS AND TEST RESULTS

### 7.1. EMISSION BANDWIDTH

#### LIMIT

§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

No non-compliance noted:

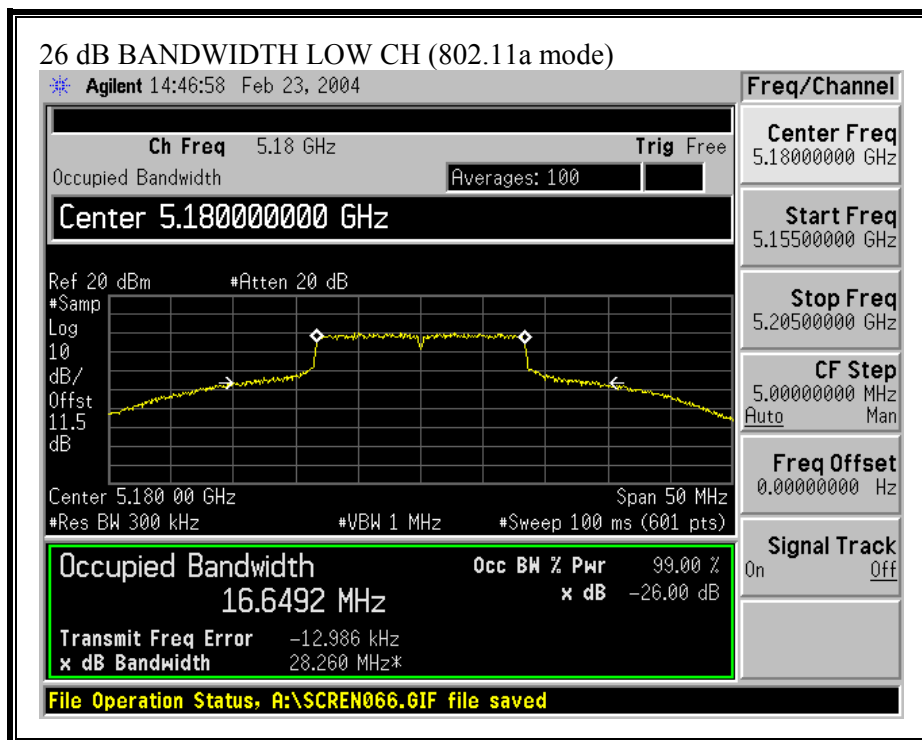
##### 802.11a Mode

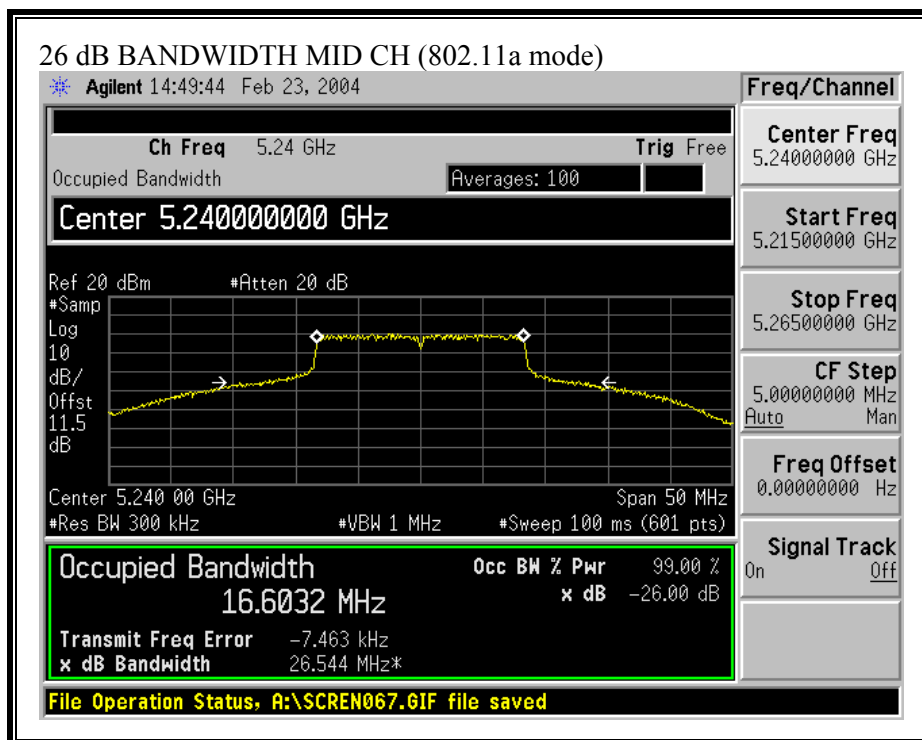
Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5180	28.26	14.51
Middle	5240	26.54	14.24
Middle	5260	24.29	13.85
High	5320	22.94	13.61

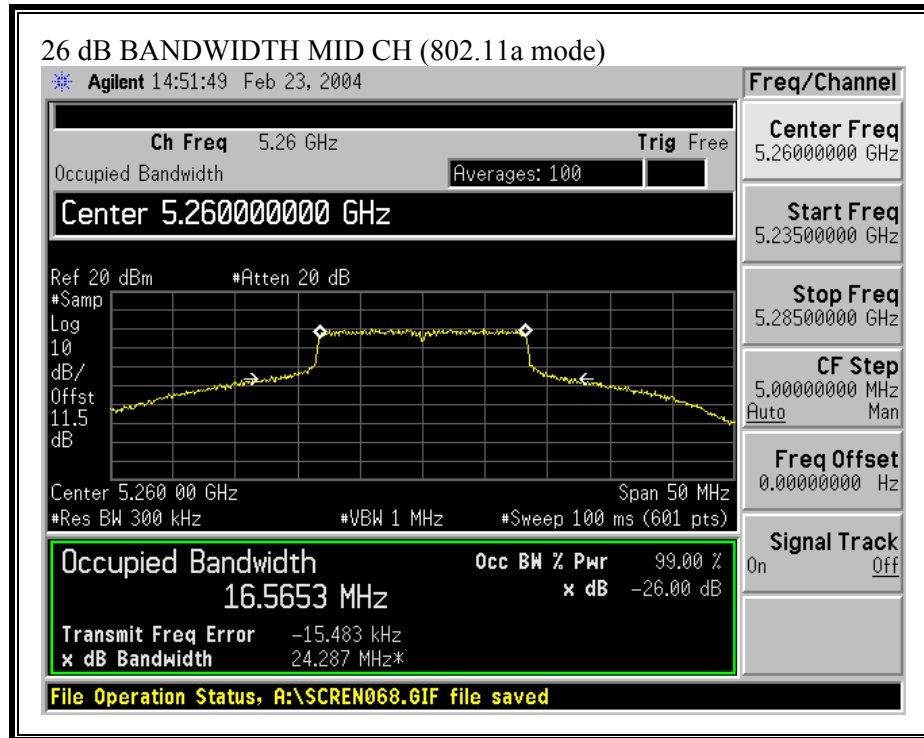
##### 802.11a Turbo Mode

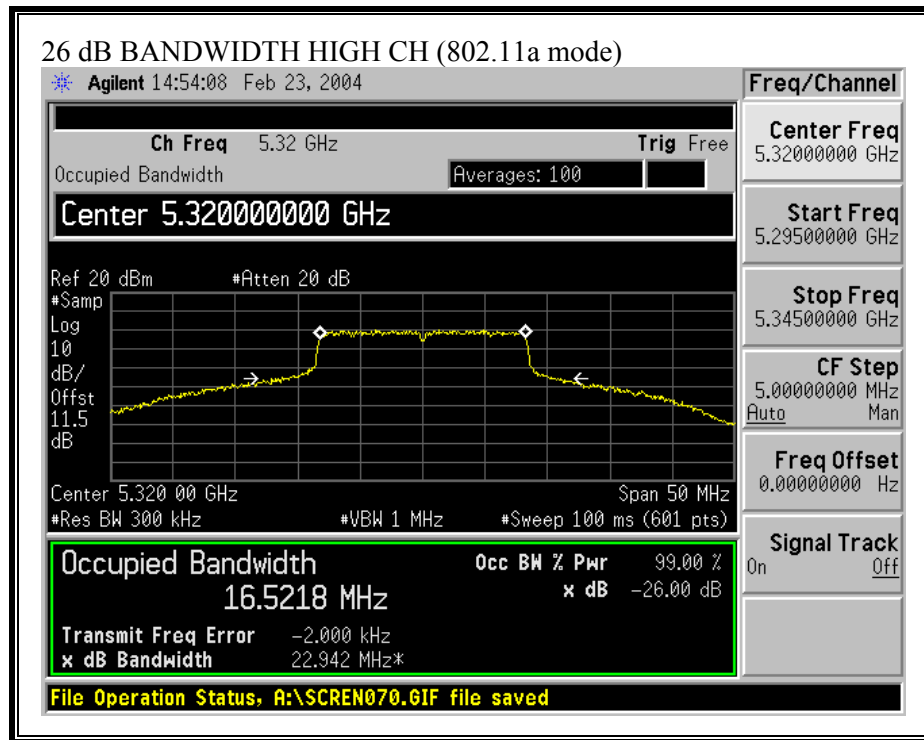
Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5200	55.67	17.46
Middle	5250	52.08	17.17
High	5290	46.30	16.66

**26 dB EMISSION BANDWIDTH (802.11a MODE)**

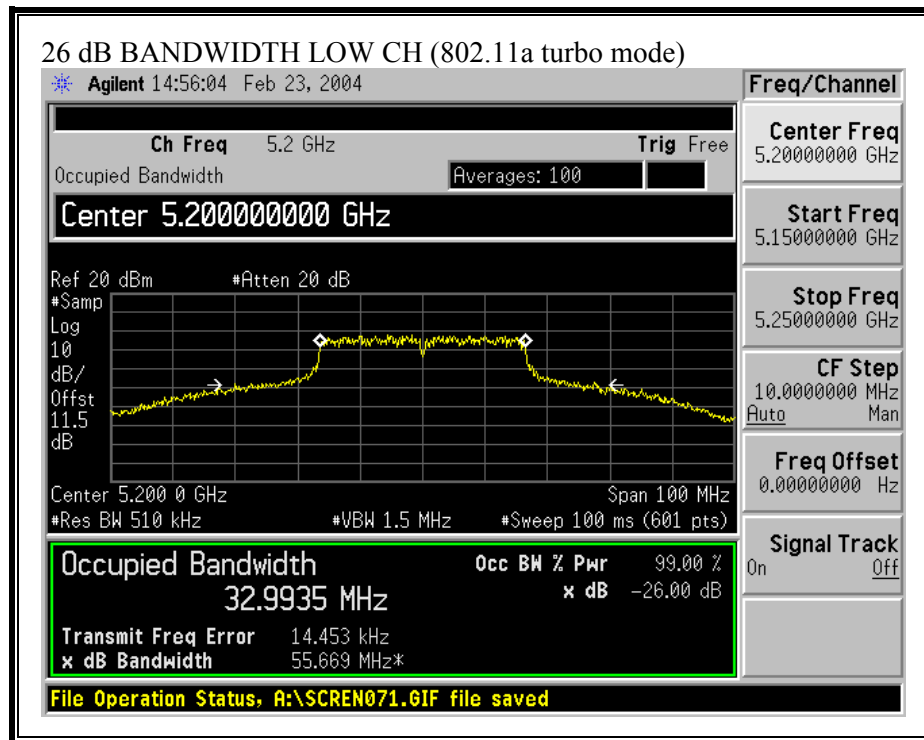


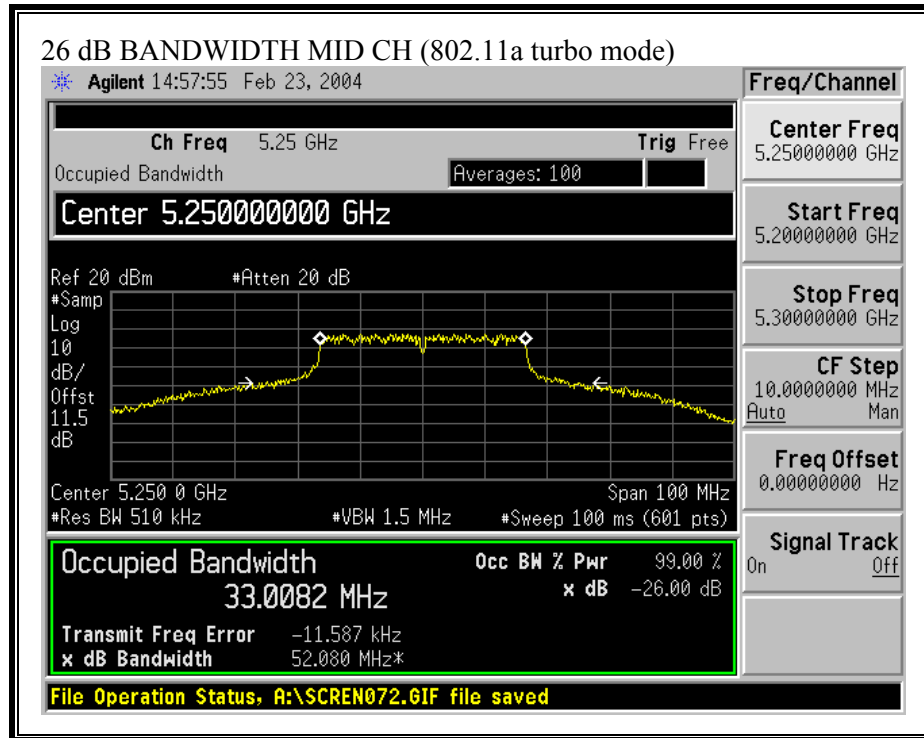




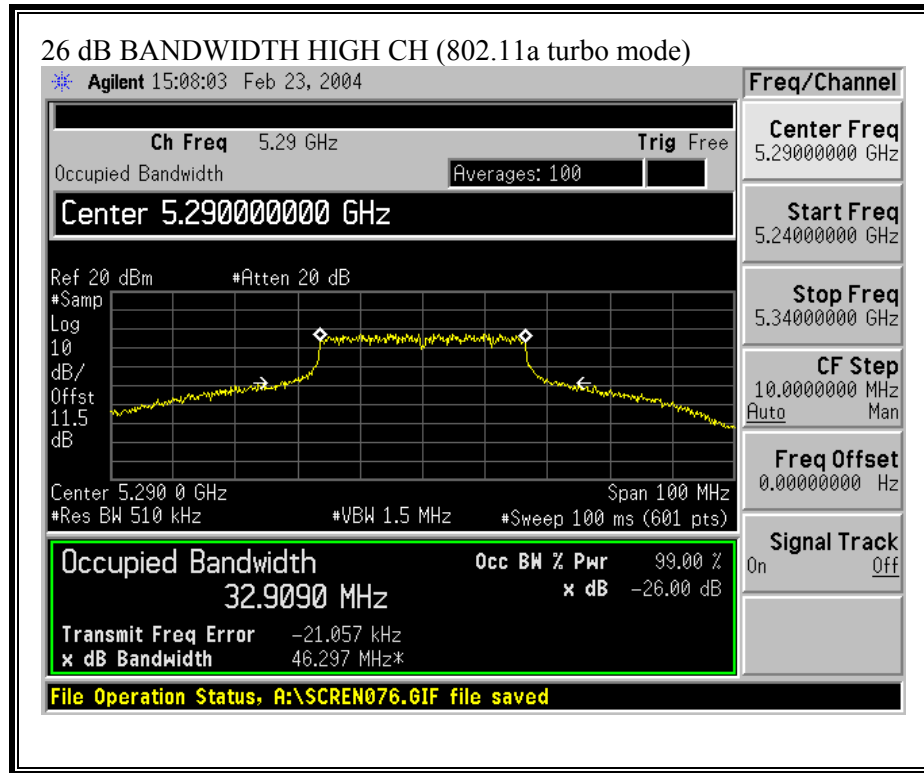


**26 dB EMISSION BANDWIDTH (802.11a TURBO MODE)**









## **7.2. PEAK POWER**

### **LIMIT**

§15.407 (a) (2) For the 5.25–5.35 GHz and 5.47–5.725 GHz bands, the peak transmit power over the frequency band of operation shall not exceed the lesser of 250 mW (24 dBm) or  $11 \text{ dBm} + 10 \log B$ , 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.

### **EIRP LIMIT**

None; for reporting purposes only.

### **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 5.2GHz BAND**

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)	Antenna Gain (dBi)	Limit (dBm)
802.11a	5180	17	28.26	18.51	4.66	17.00
802.11a	5240	17	26.54	18.24	4.66	17.00
Turbo	5200	17	55.67	21.46	4.66	17.00
Turbo	5250	17	52.08	21.17	4.66	17.00

Limit in 5250 to 5350 MHz Band

Mode	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
802.11a	5260	24	24.29	24.85	4.66	24.00
802.11a	5320	24	22.94	24.61	4.66	24.00
Turbo	5290	24	46.3	27.66	4.66	24.00

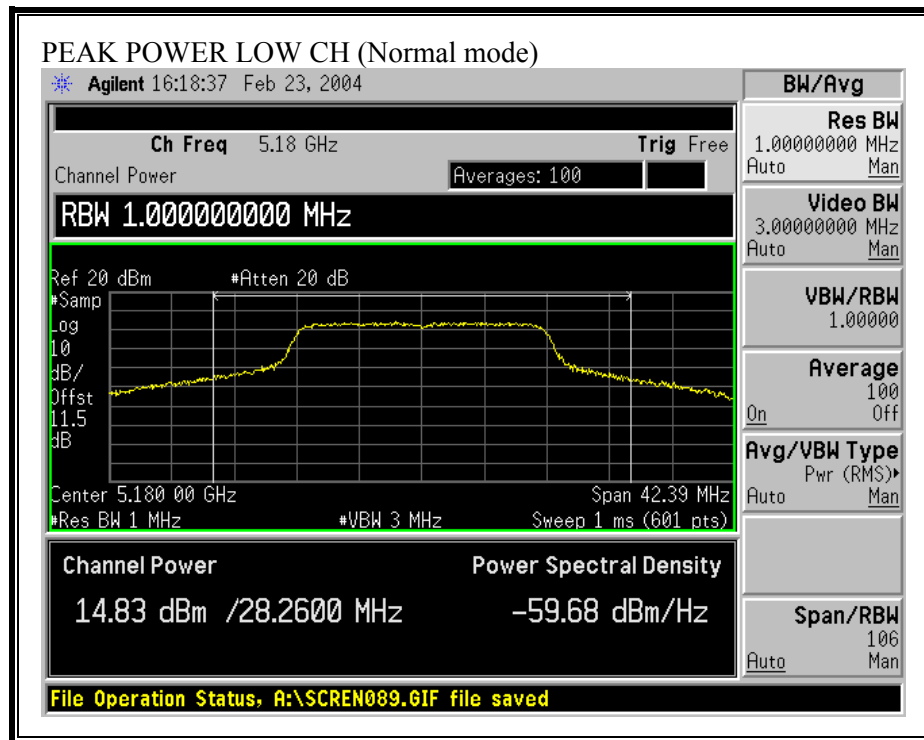
802.11a mode Results

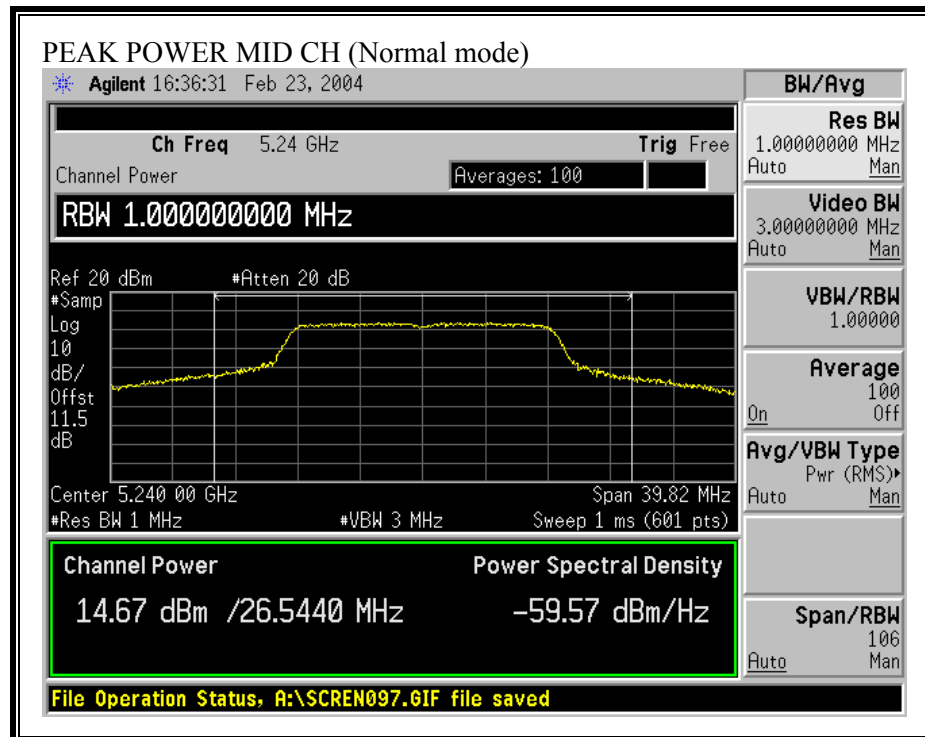
Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	14.83	17.00	-2.17
Middle	5240	14.67	17.00	-2.33
Middle	5260	17.66	24.00	-6.34
High	5320	17.98	24.00	-6.02

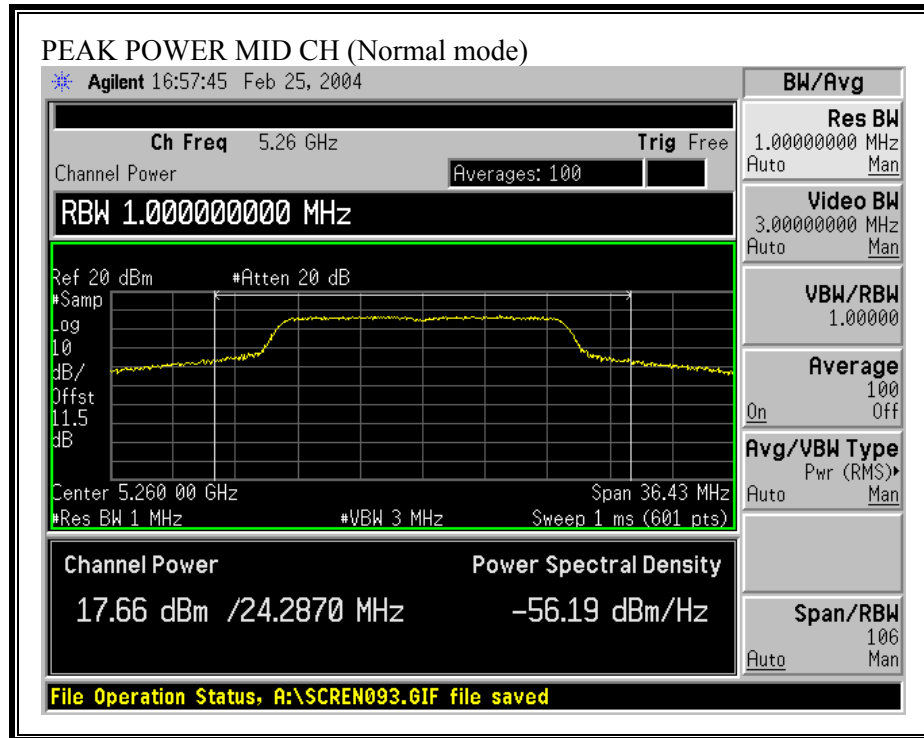
802.11a Turbo mode Results

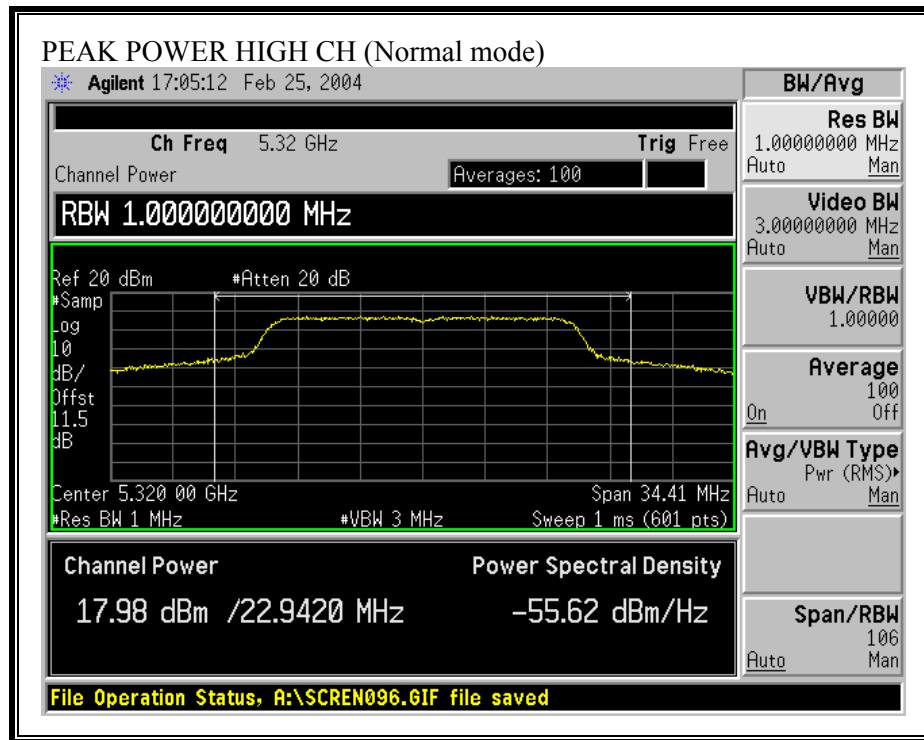
Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5200	16.64	17.00	-0.36
Middle	5250	16.81	17.00	-0.19
High	5290	17.27	24.00	-6.73

**PEAK POWER (NORMAL MODE)**

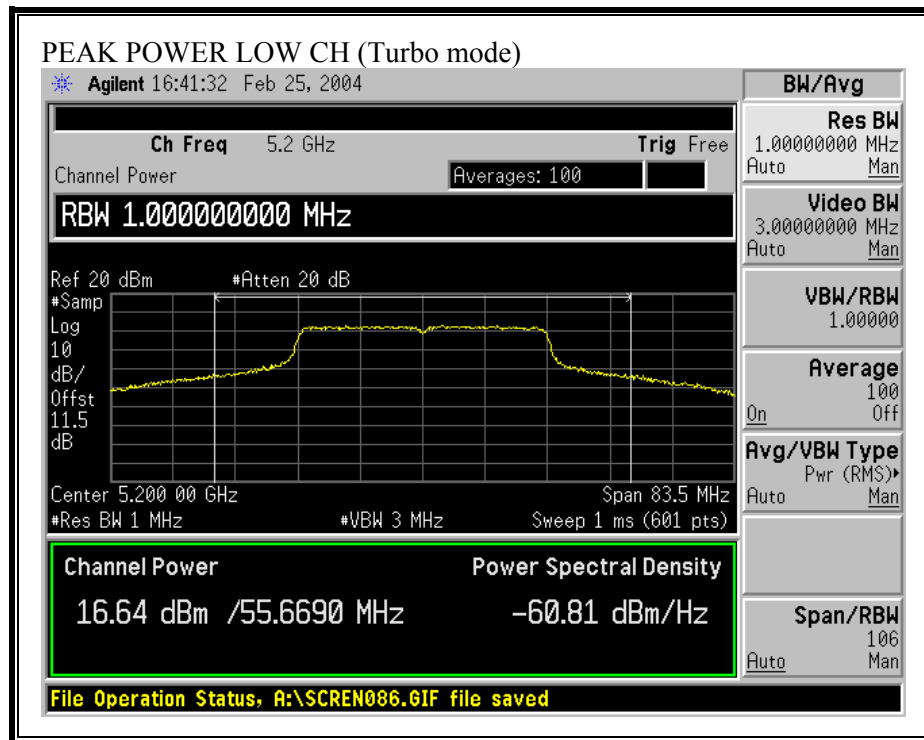




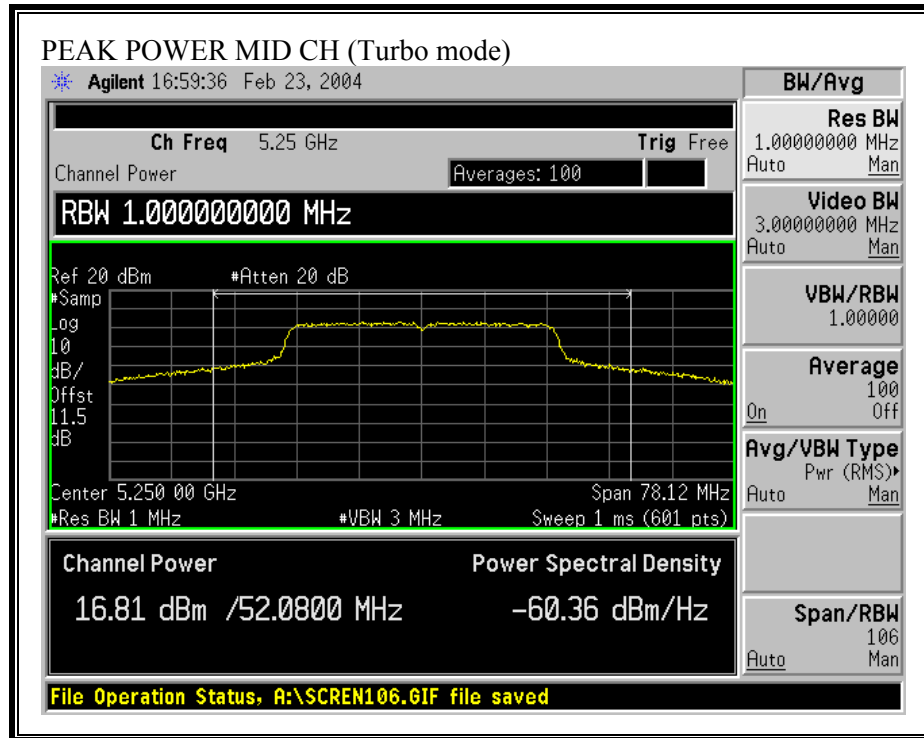


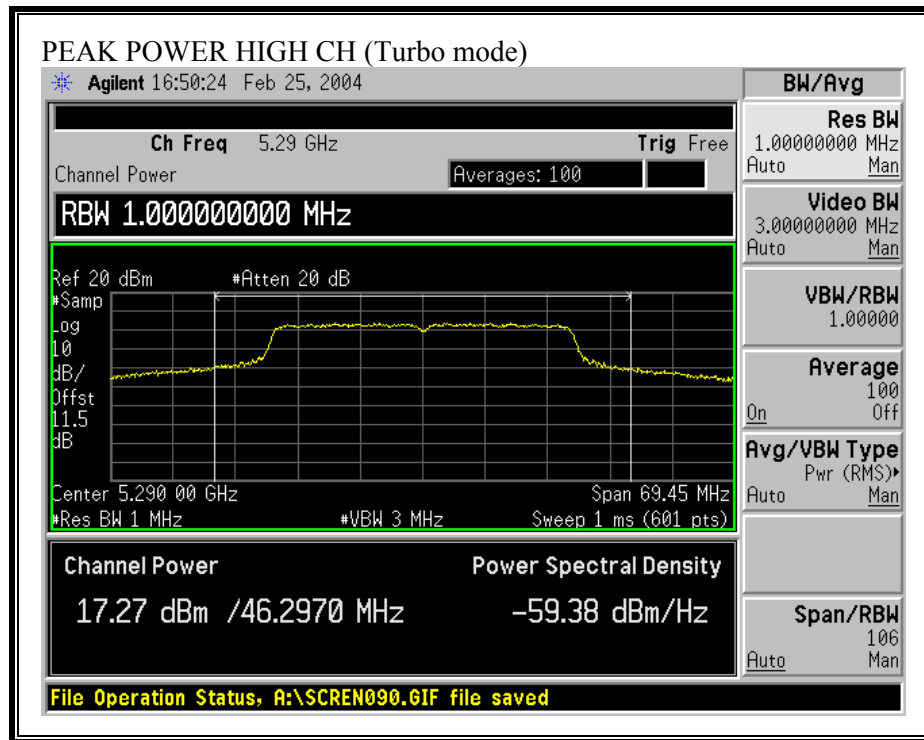


**PEAK POWER (TURBO MODE)**









### 7.3. MAXIMUM PERMISSIBLE EXPOSURE

#### LIMITS

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0 .....	614	1.63	*(100)	6
3.0–30 .....	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300 .....	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34 .....	614	1.63	*(100)	30
1.34–30 .....	824/f	2.19/f	*(180/f <sup>2</sup> )	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
30–300 .....	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

## **CALCULATIONS**

Given

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

and

$$S = E^2 / 3770$$

where

E = Field Strength in Volts/meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power Density in milliwatts/square centimeter

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

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

Changing to units of Power to mW and Distance to cm, using:

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

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

yields

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

$$d = 0.282 * \sqrt{(P * G / S)}$$

where

d = distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power Density in mW/cm<sup>2</sup>

Substituting the logarithmic form of power and gain using:

$$P \text{ (mW)} = 10^{(P \text{ (dBm)} / 10)} \text{ and}$$

$$G \text{ (numeric)} = 10^{(G \text{ (dBi)} / 10)}$$

yields

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

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm<sup>2</sup>

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

## **LIMITS**

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

## **RESULTS**

No non-compliance noted:

<b>Mode</b>	<b>Power Density Limit (mW/cm<sup>2</sup>)</b>	<b>Output Power (dBm)</b>	<b>Antenna Gain (dBi)</b>	<b>MPE Distance (cm)</b>
802.11a, 5.2 Lower Band	1.0	14.83	4.66	2.66
802.11a Turbo, 5.2 Lower Band	1.0	16.64	4.66	3.28
802.11a, 5.2 Upper Band	1.0	17.98	4.66	3.82
802.11a Turbo, 5.2 Upper Band	1.0	17.27	4.66	3.52

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 11.6 dB (including 10 dB pad and 1.6 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### 802.11a Mode, 5.2 Band

Channel	Frequency (MHz)	Average Power (dBm)
Low	5180	15.20
Middle	5240	14.80
Middle	5260	17.10
High	5320	17.10

#### 802.11a Turbo Mode, 5.2 Band

Channel	Frequency (MHz)	Average Power (dBm)
Low	5200	16.20
Middle	5250	17.20
High	5290	16.80

## 7.5. PEAK POWER SPECTRAL DENSITY

### LIMIT

§15.407 (a) (2) For the 5.25–5.35 GHz and 5.47–5.725 GHz bands, the peak transmit power over the frequency band of operation shall not exceed the lesser of 250 mW (24 dBm) or  $11 \text{ dBm} + 10 \log B$ , 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 gains are 4.66dBi for 5.2GHz band and 4.86dBi for 5.5GHz band, 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:

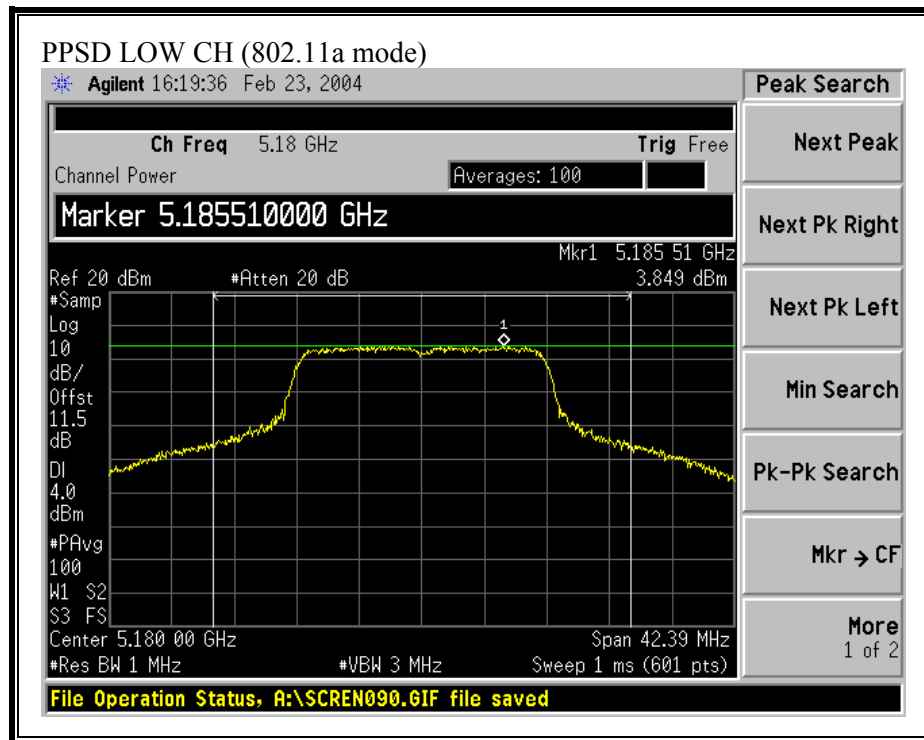
802.11a Mode, 5.2GHz band

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5180	3.85	4.00	-0.15
Middle	5240	3.79	4.00	-0.21
Middle	5260	7.15	11.00	-3.85
High	5320	7.13	11.00	-3.87

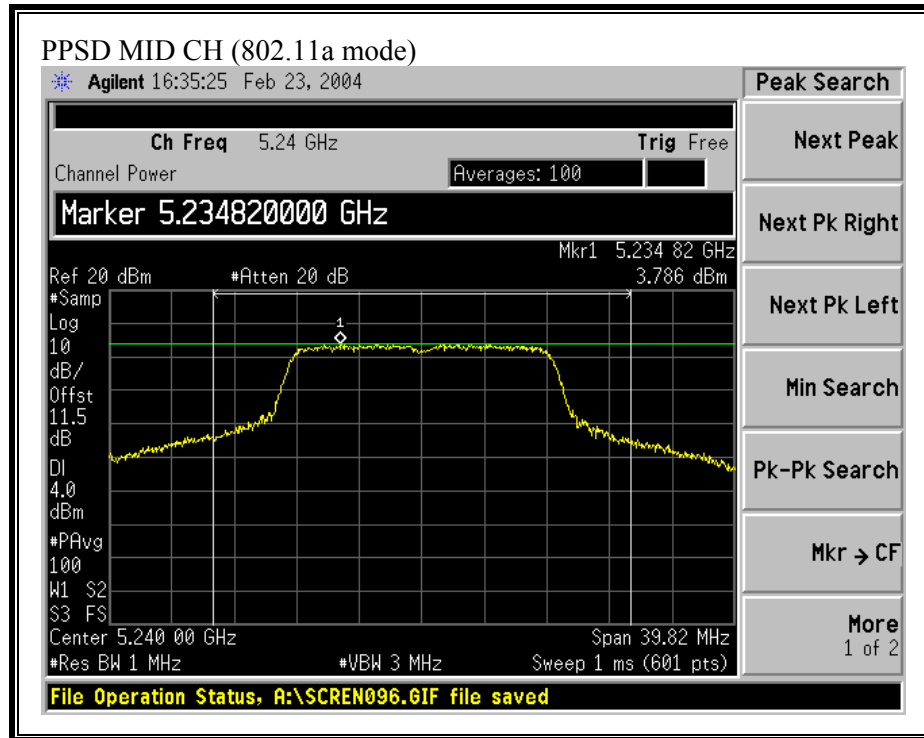
802.11a Turbo Mode, 5.2GHz band

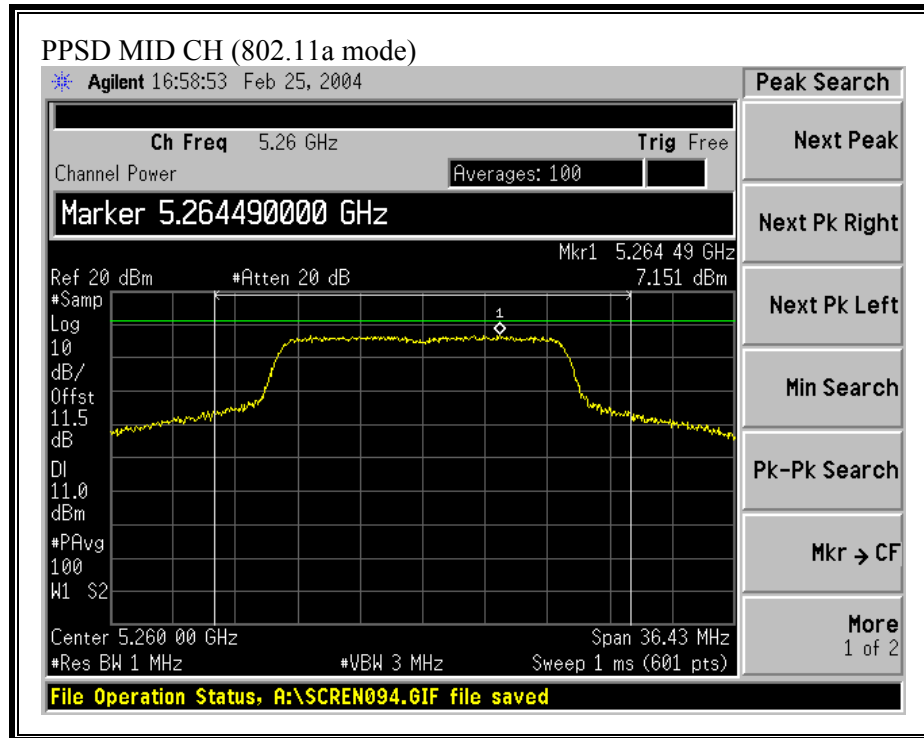
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5200	2.89	4.00	-1.11
Middle	5250	3.05	4.00	-0.95
High	5290	3.74	11.00	-7.26

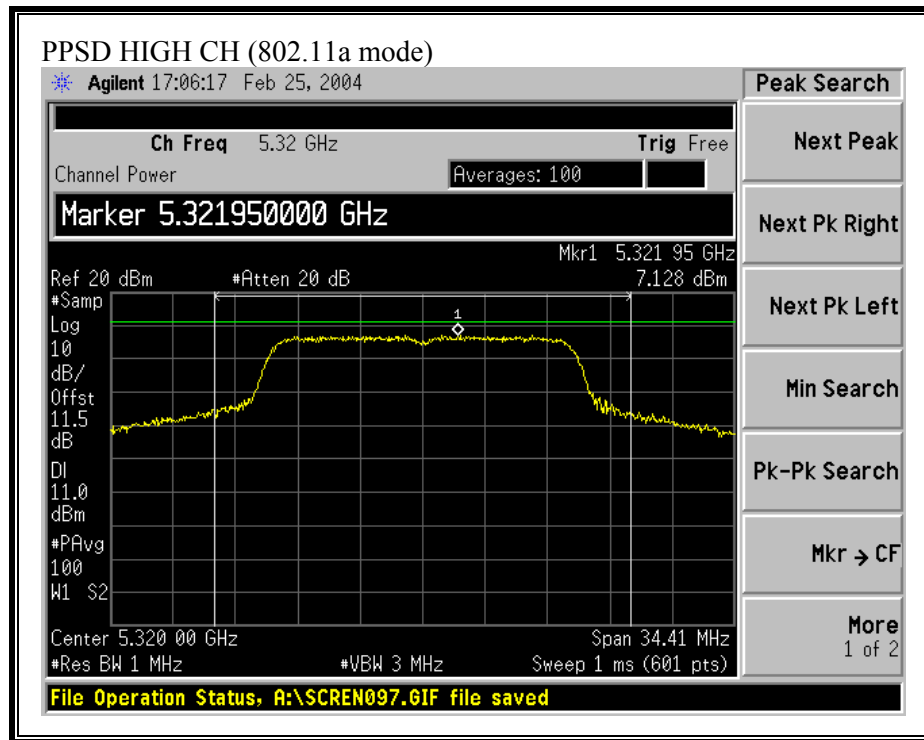
**PEAK POWER SPECTRAL DENSITY (802.11a MODE)**



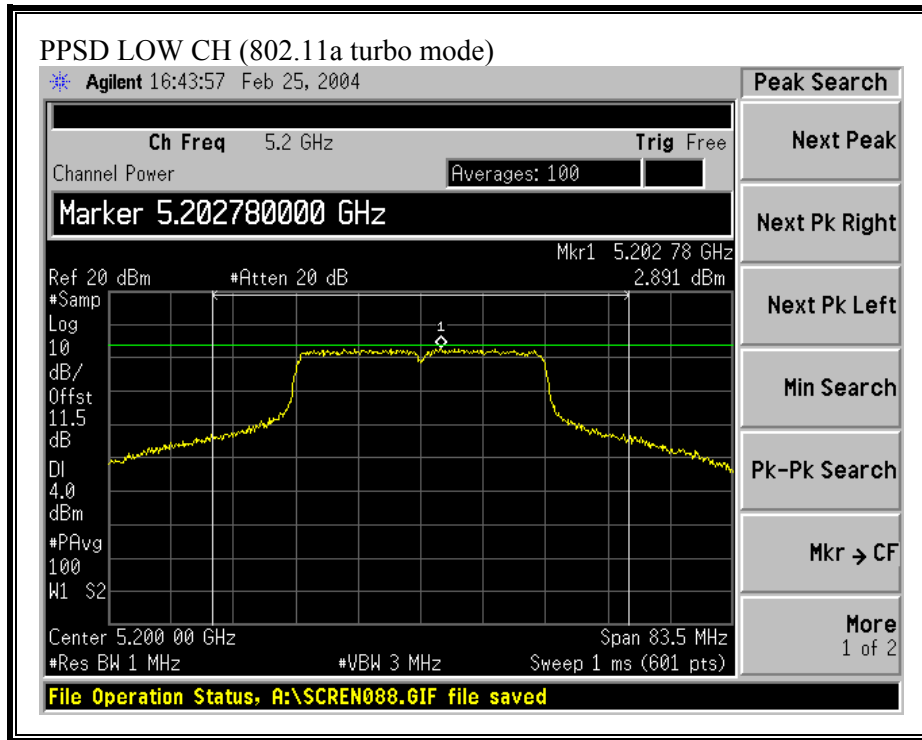


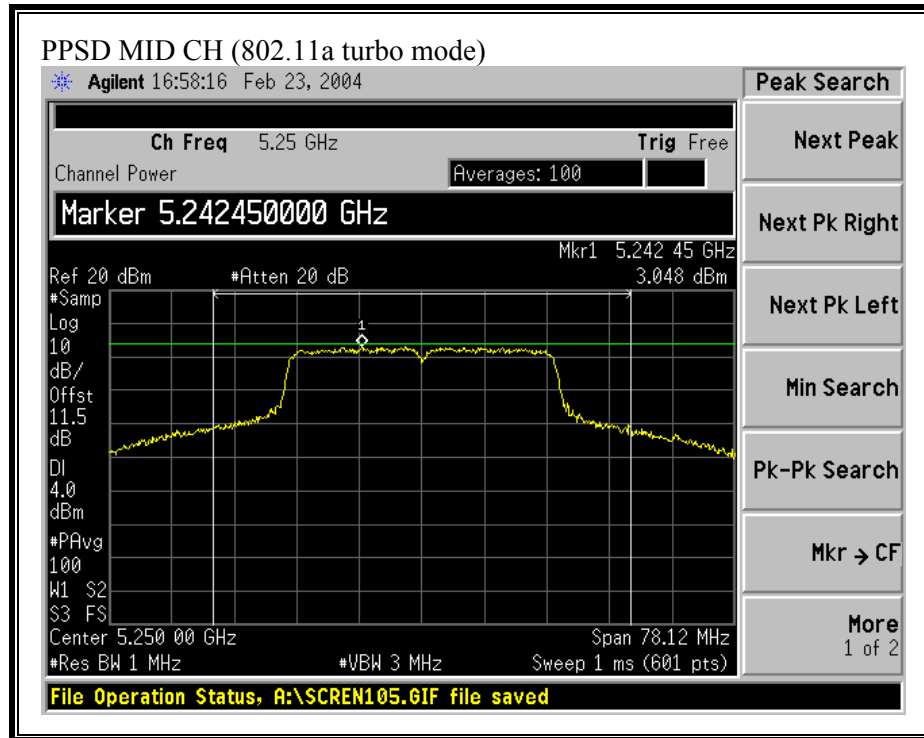


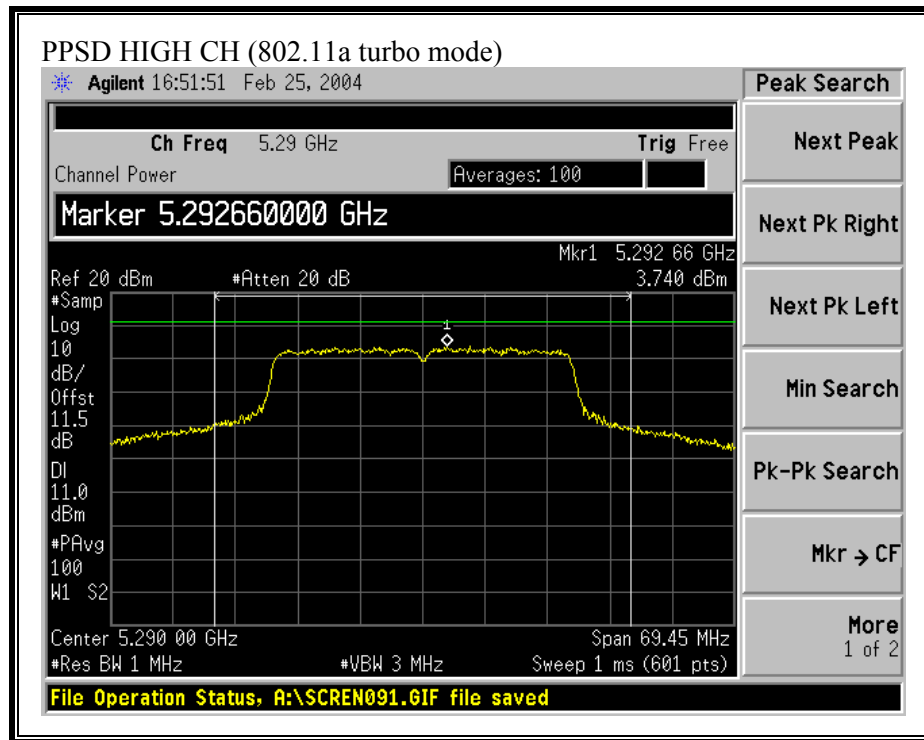




**PEAK POWER SPECTRAL DENSITY (802.11a TURBO MODE)**







## 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:

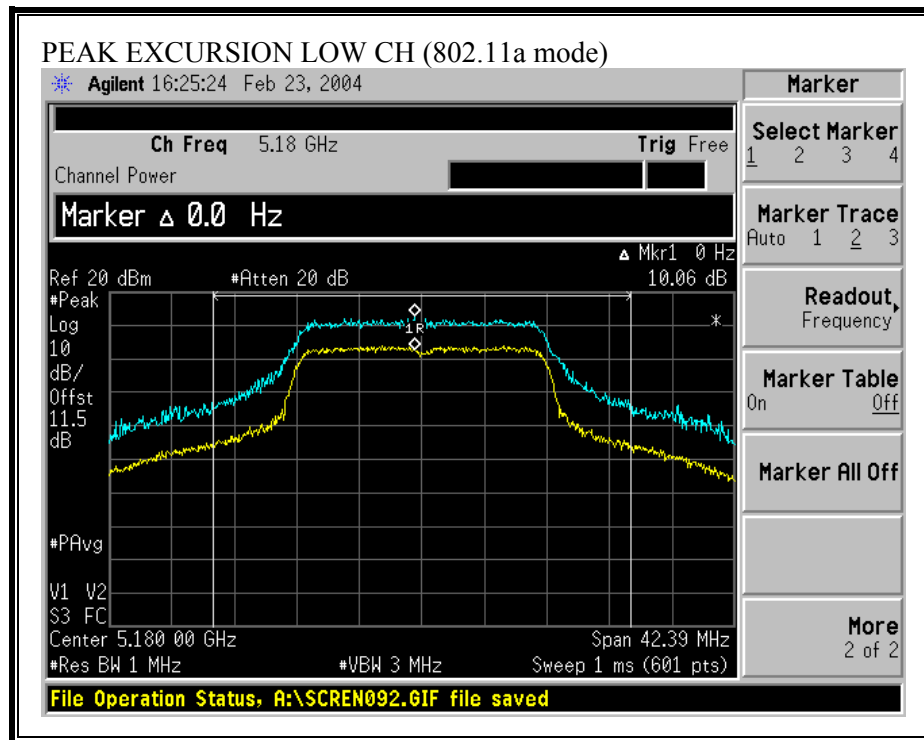
#### 802.11a Mode

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	10.06	13	-2.94
Middle	5240	9.19	13	-3.81
Middle	5260	9.18	13	-3.82
High	5320	8.92	13	-4.08

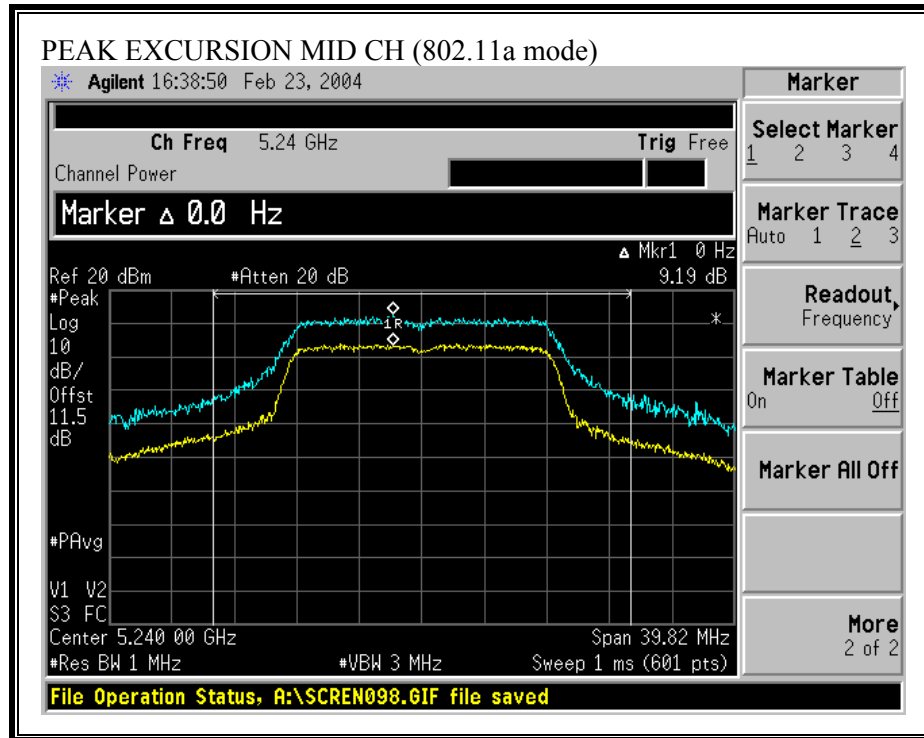
#### 802.11a Turbo Mode, 5.2GHz band

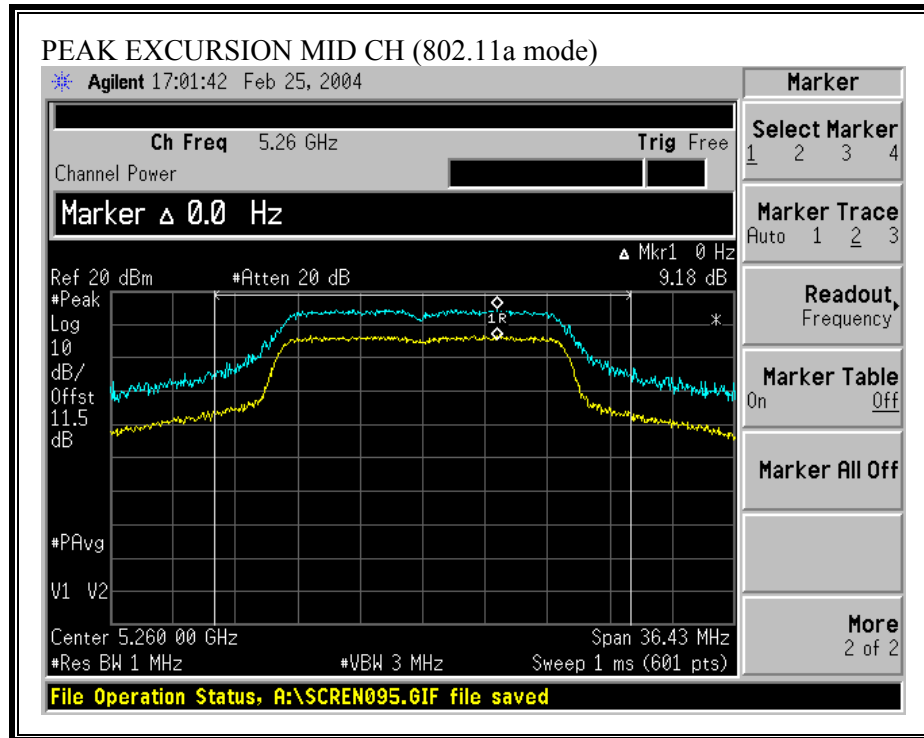
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5200	8.26	13	-4.74
Middle	5250	8.67	13	-4.33
High	5290	7.89	13	-5.11

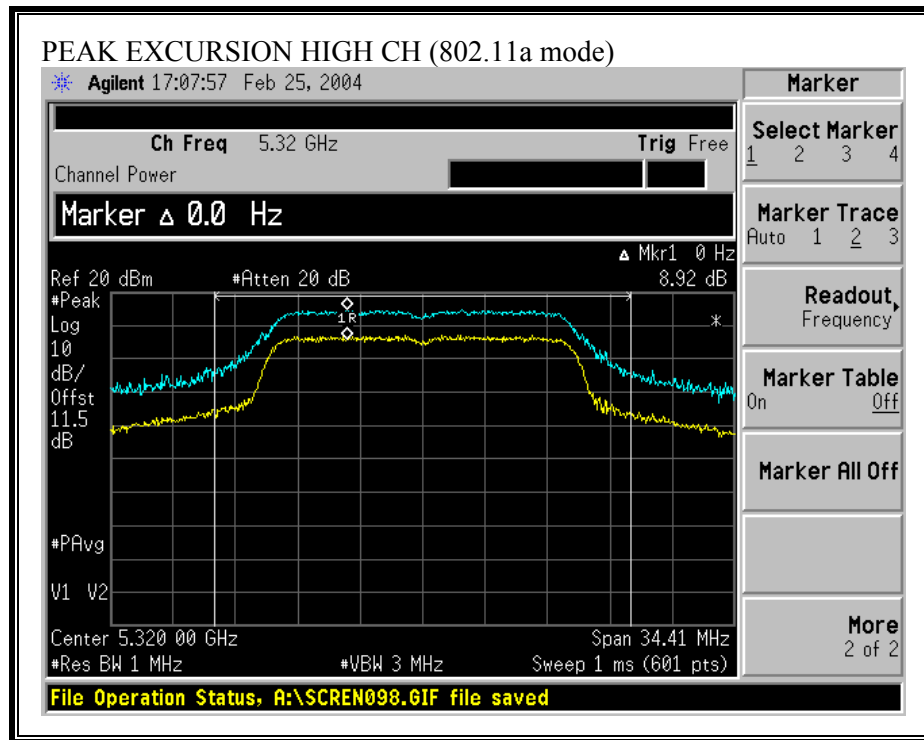
**PEAK EXCURSION (802.11a MODE)**



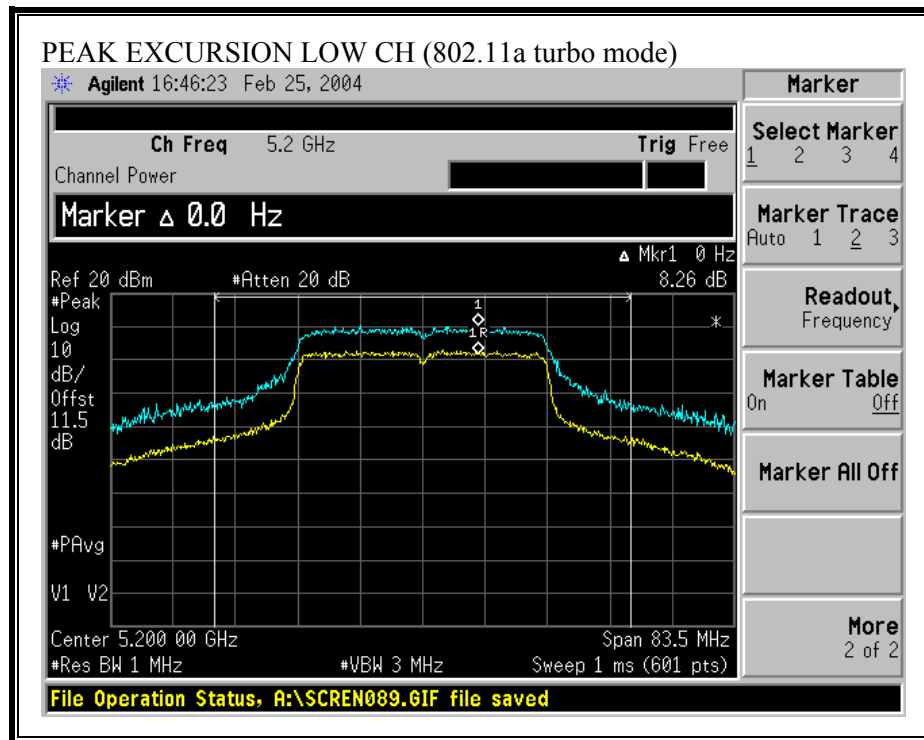


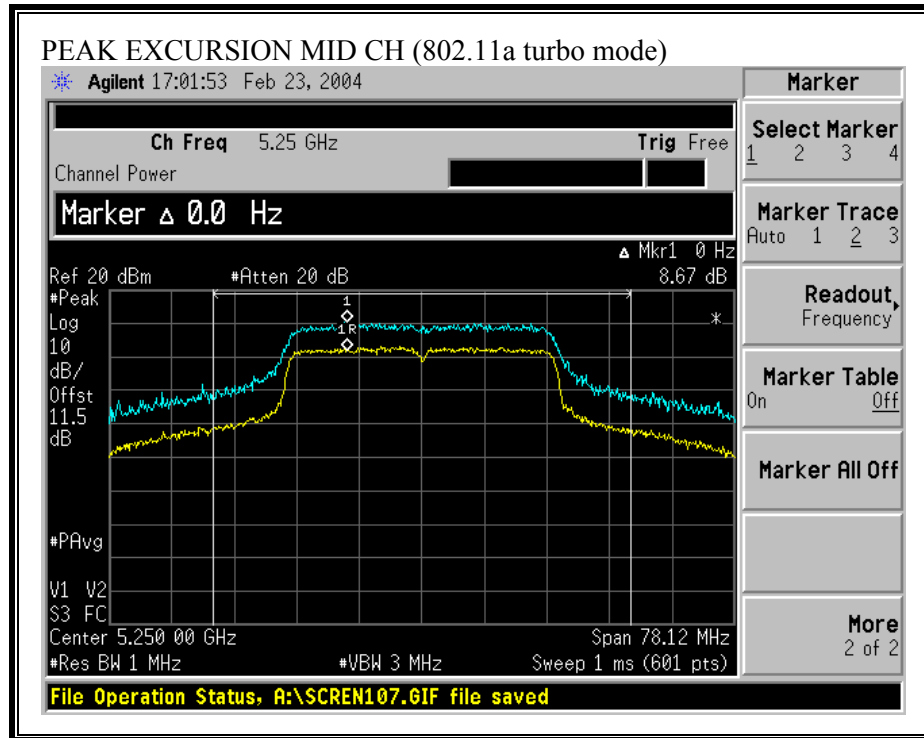


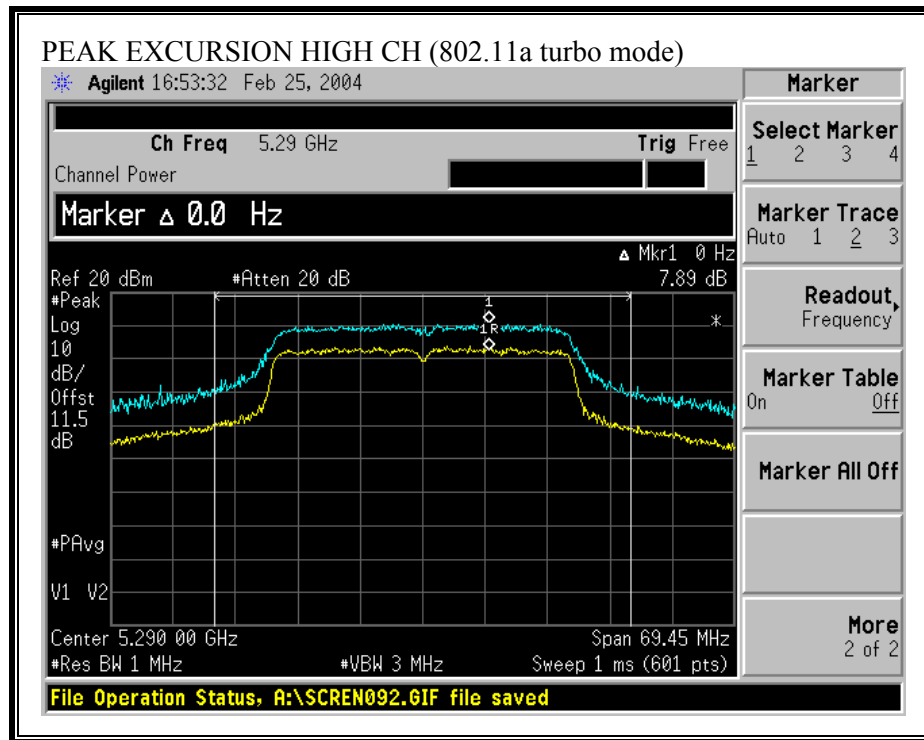




**PEAK EXCURSION (802.11a TURBO MODE)**







## **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.

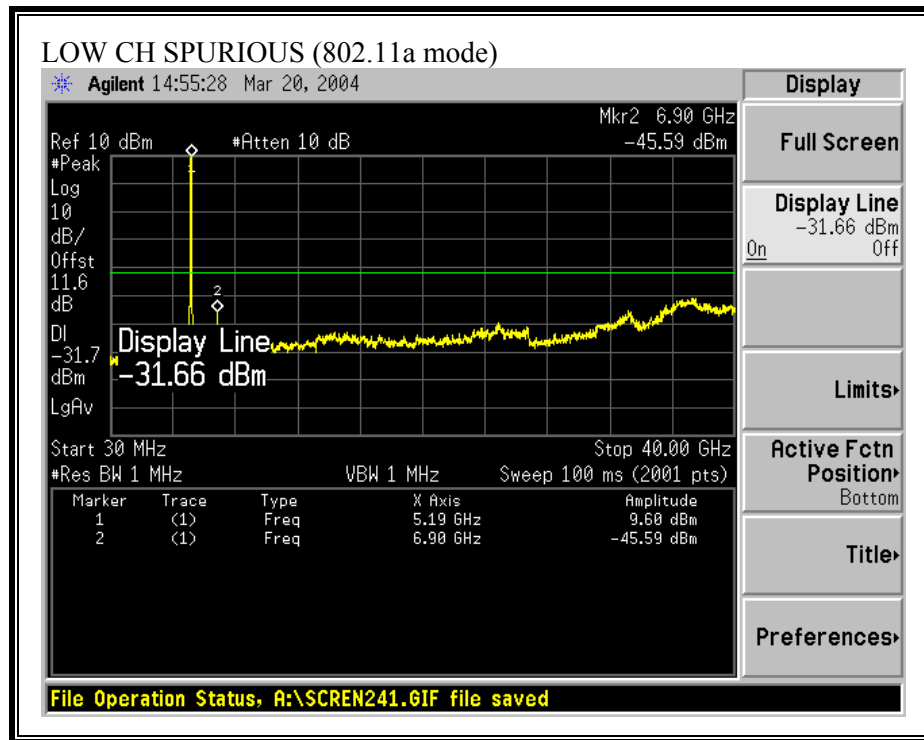
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

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

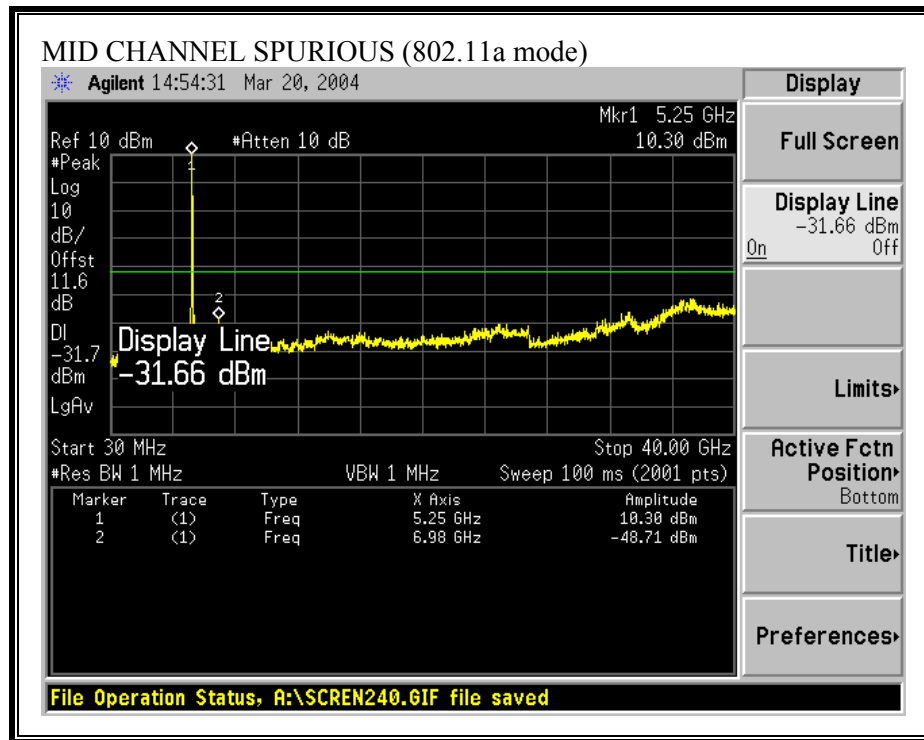
### **RESULTS**

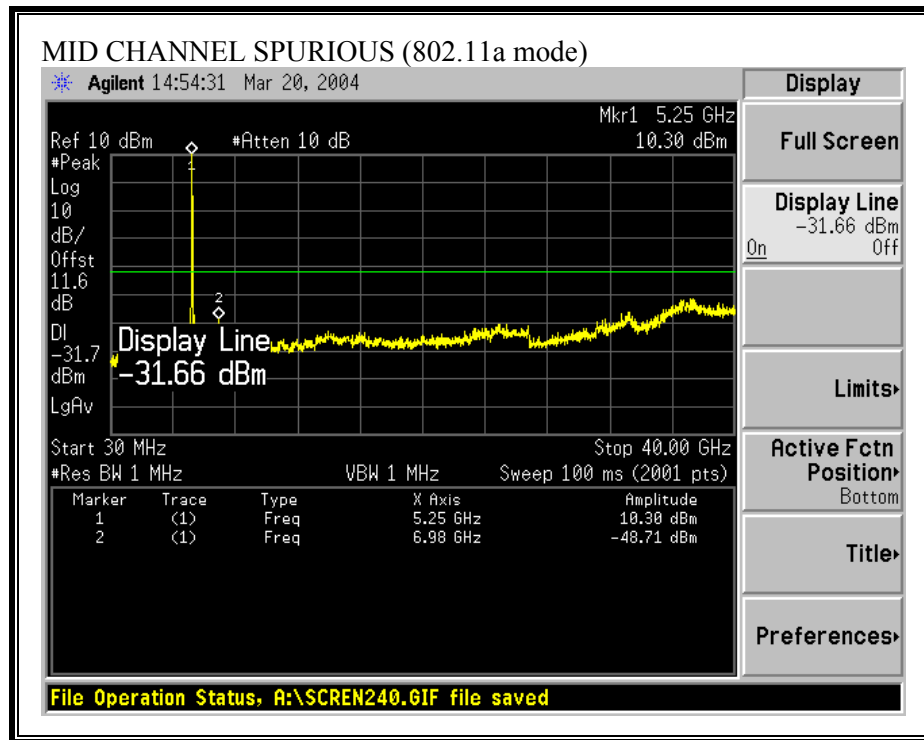
No non-compliance noted:

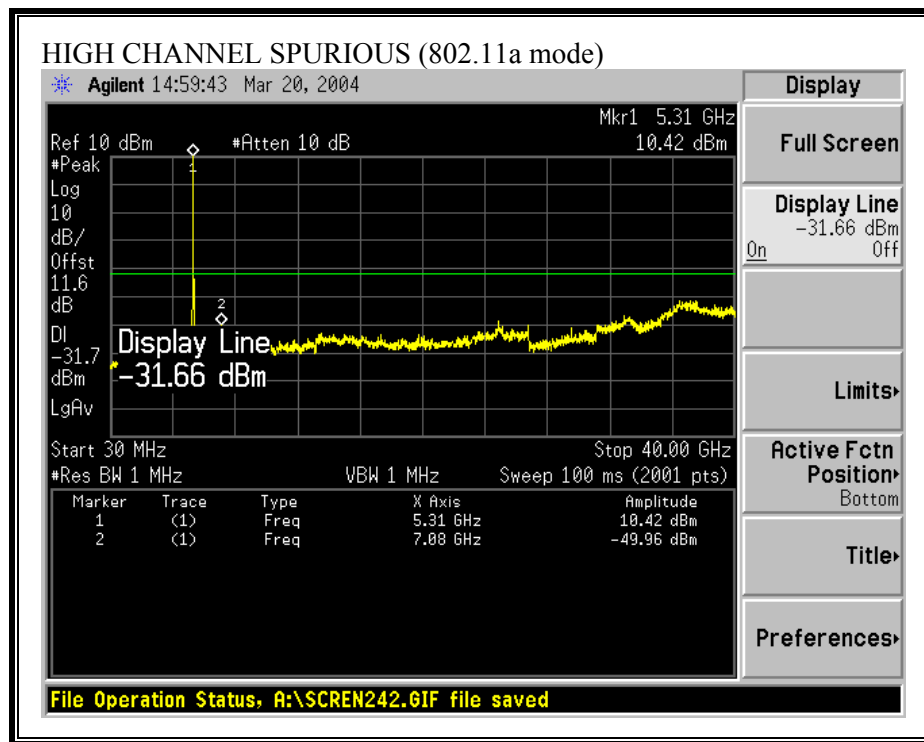
**SPURIOUS EMISSIONS (802.11a MODE)**



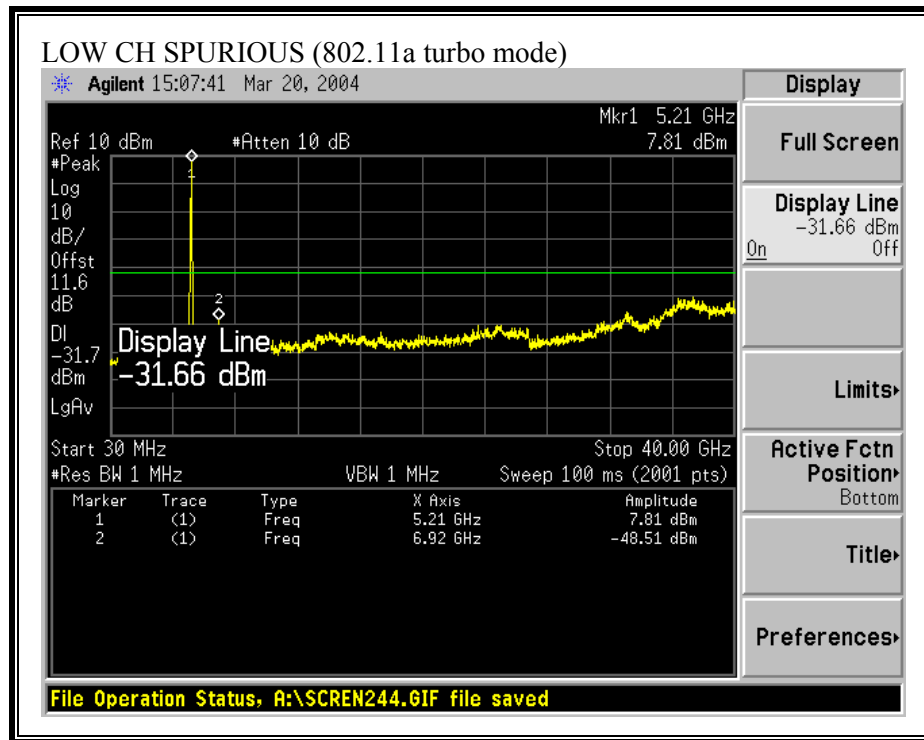


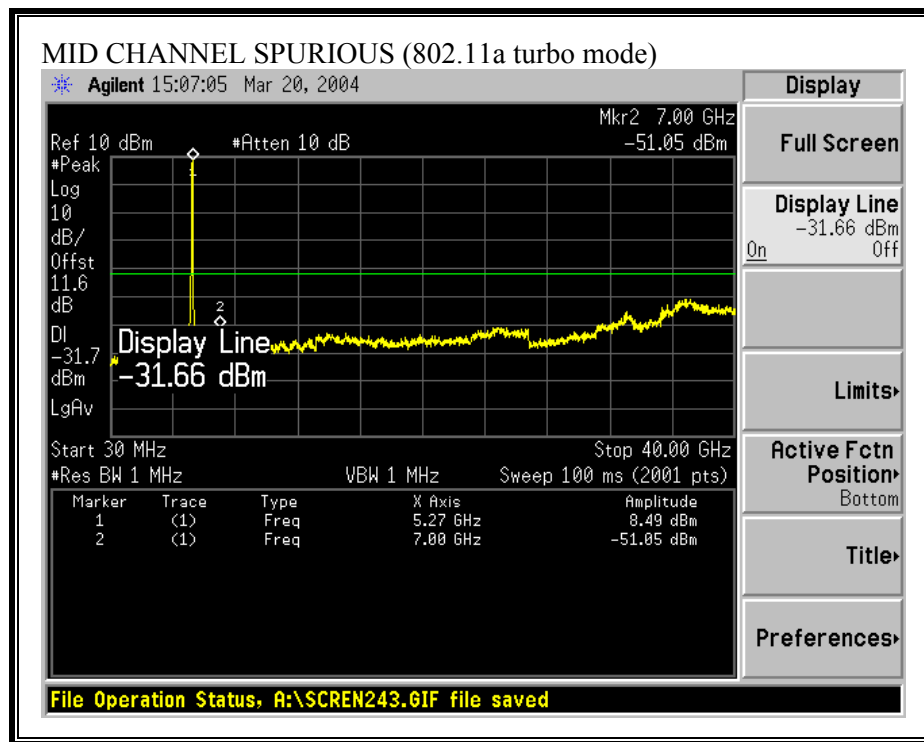


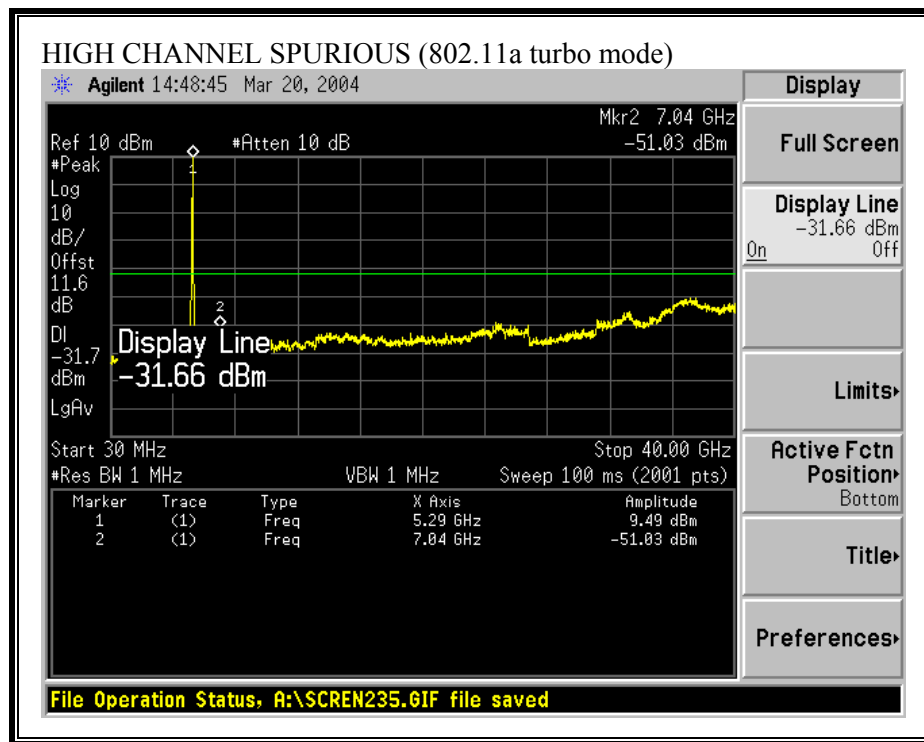




**SPURIOUS EMISSIONS (802.11a TURBO MODE)**







## 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 (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.

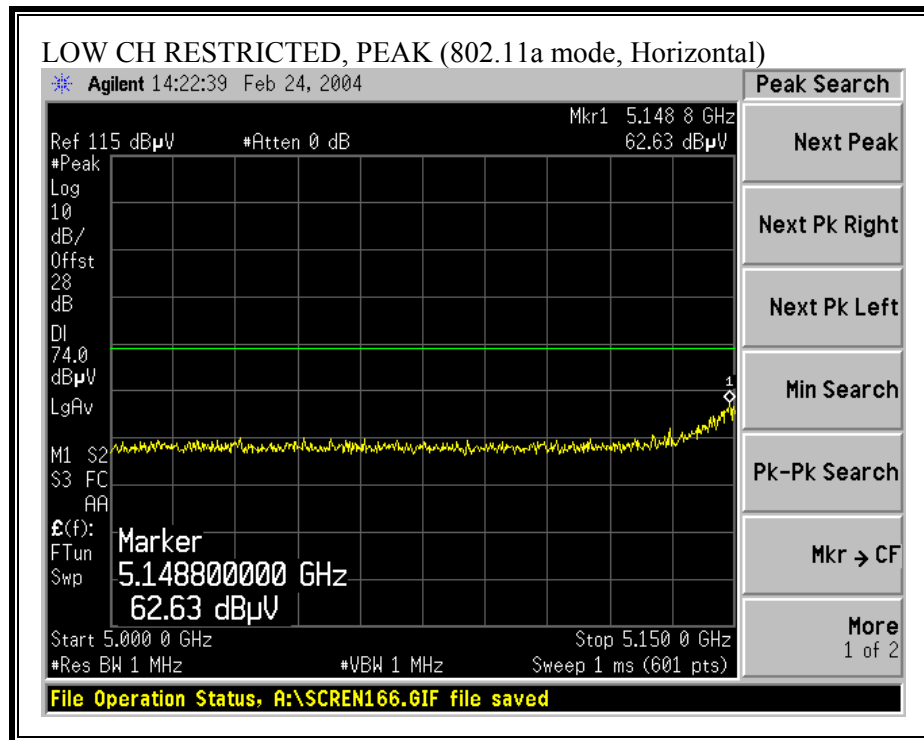
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

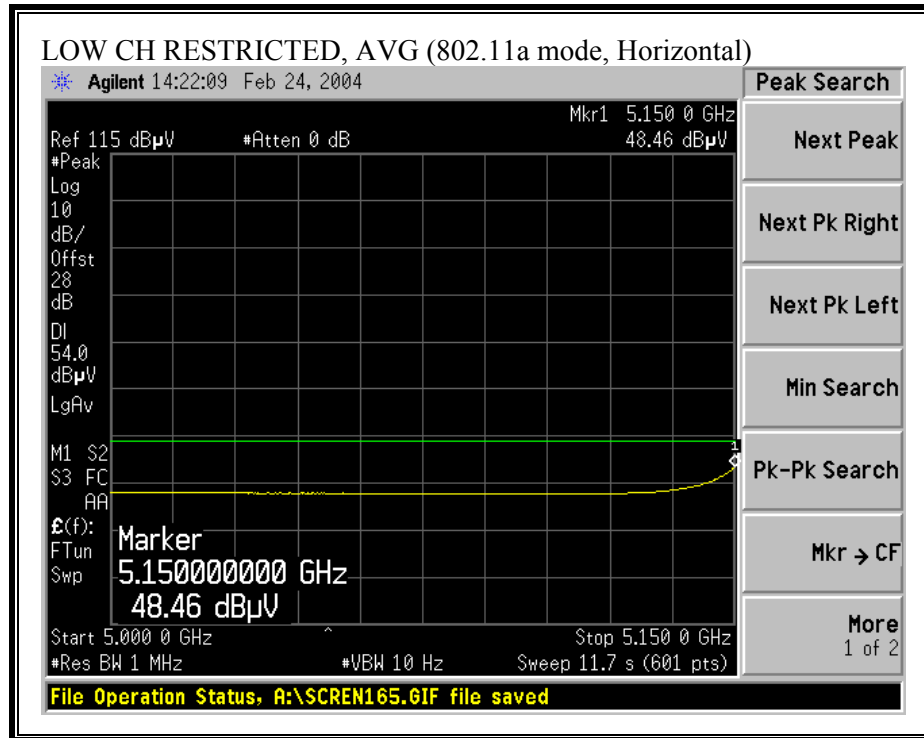
## **RESULTS**

No non-compliance noted:

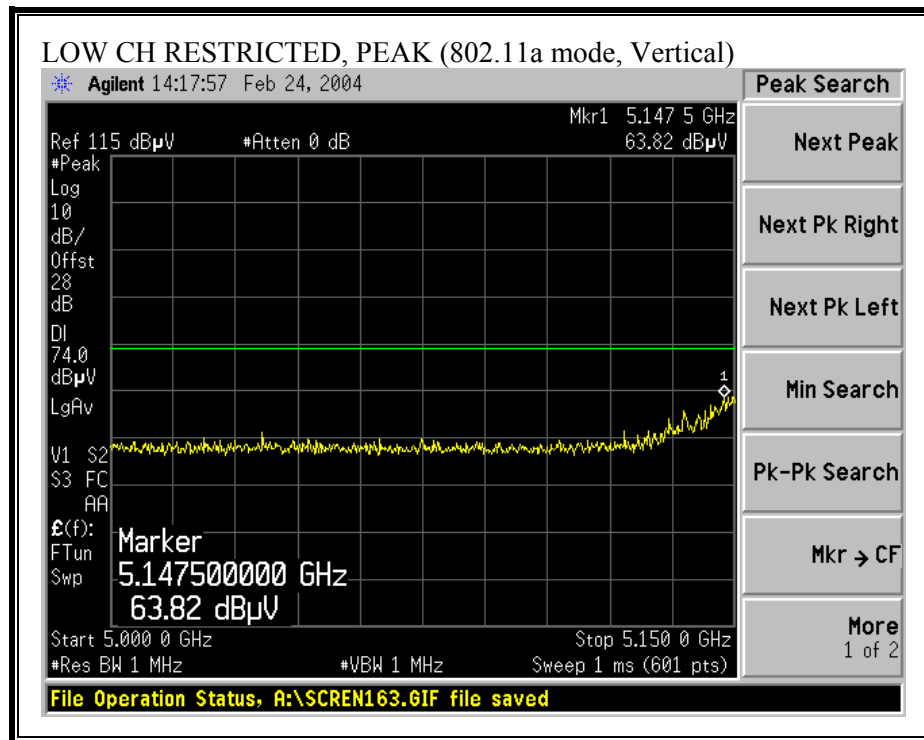
## 7.8.2. TRANSMITTER RADIATED EMISSIONS ABOVE 1 GHZ WITH HIGHEST GAIN ANTENNA (TIAN01)

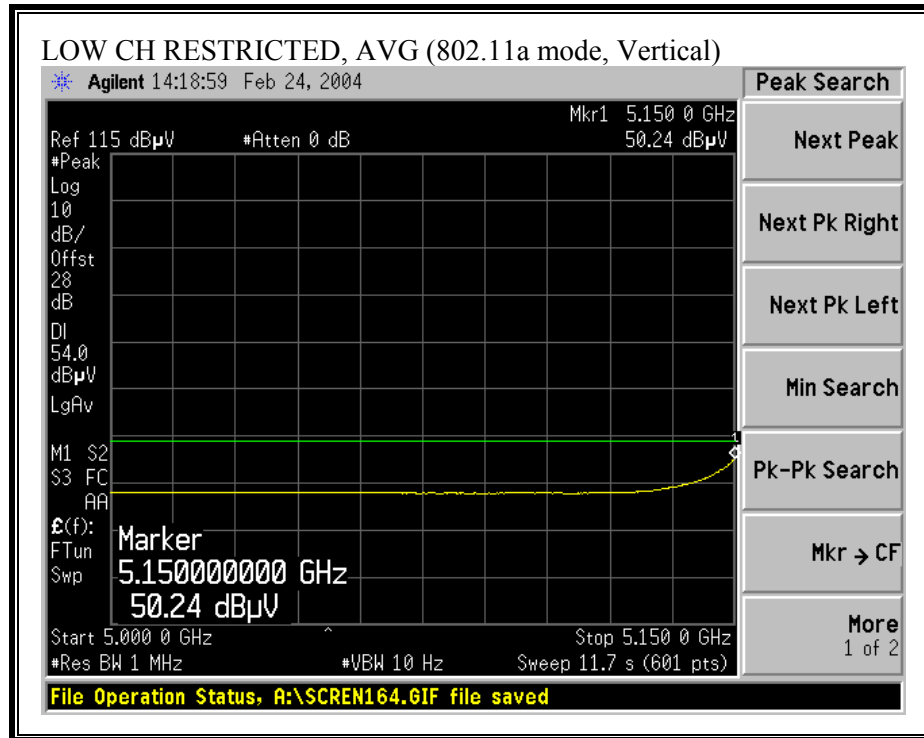
### RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, HORIZONTAL)



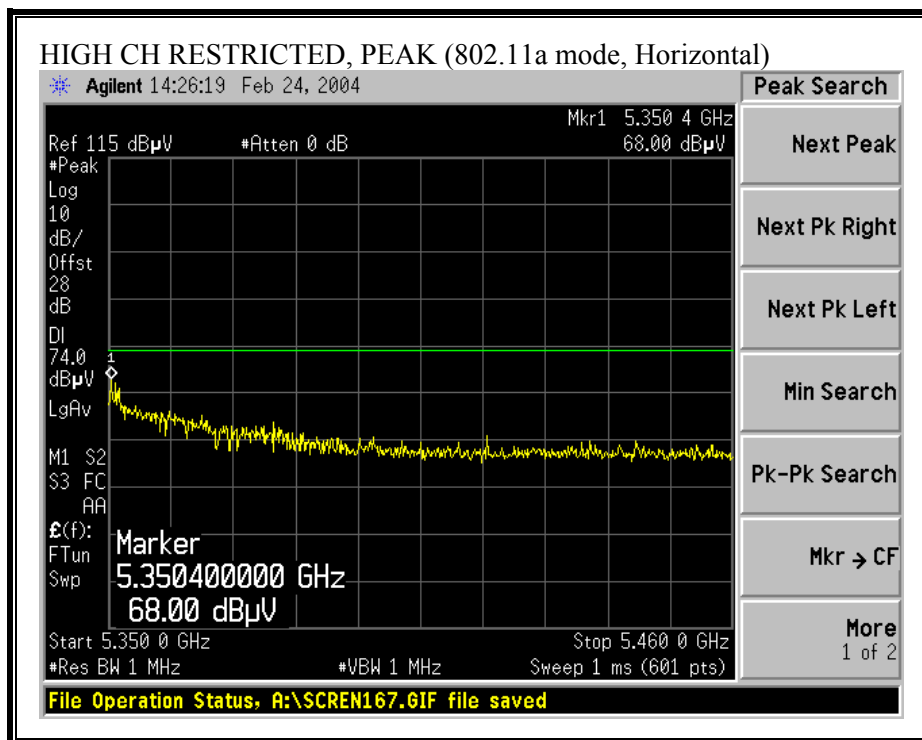


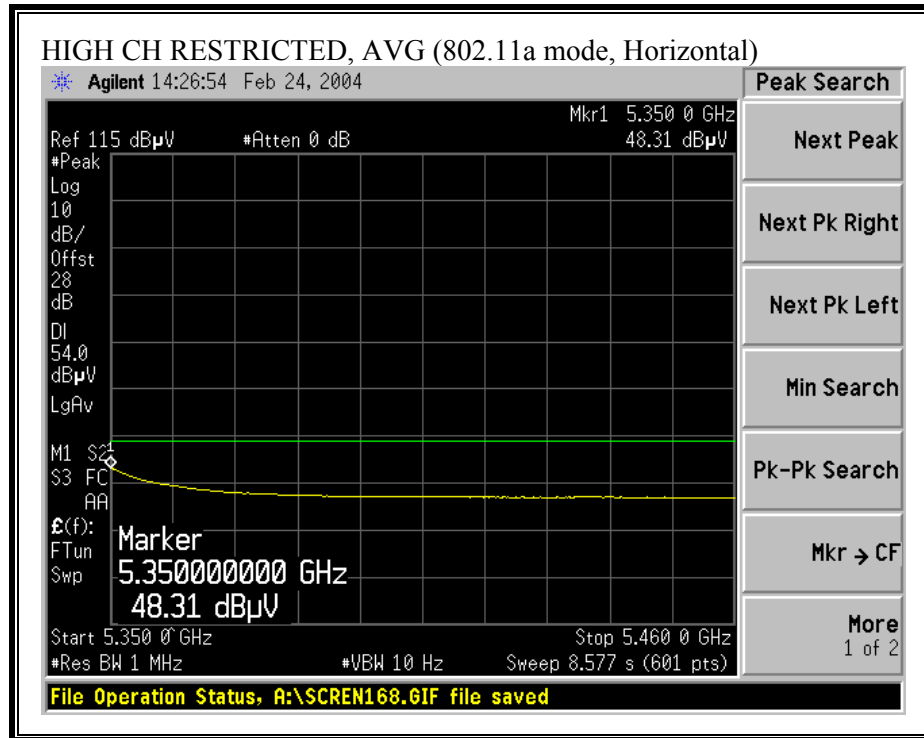
**RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, VERTICAL)**



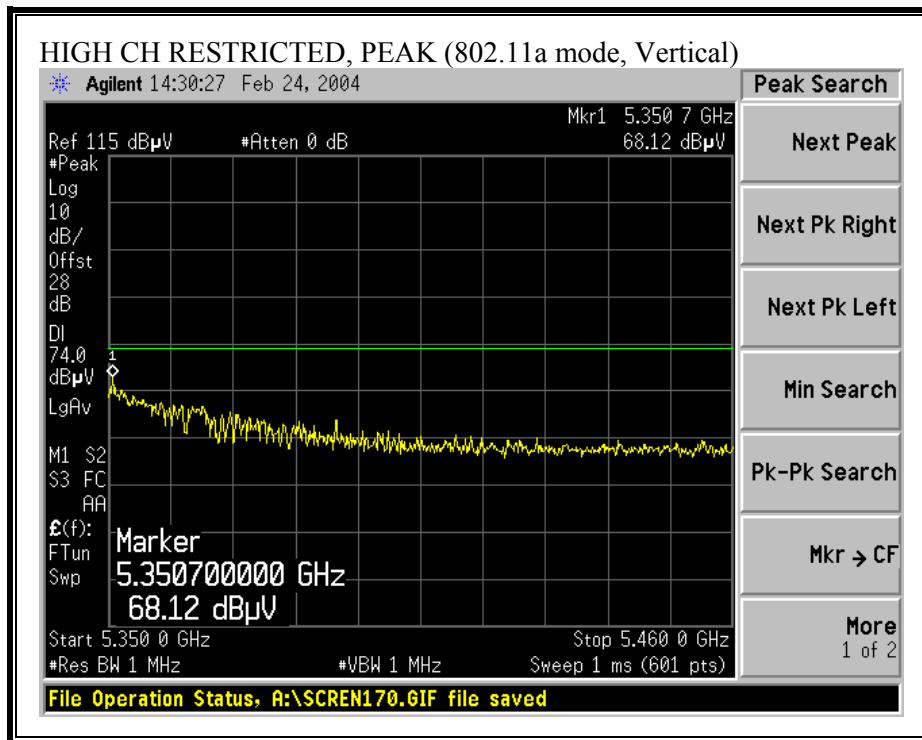


**RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, HORIZONTAL)**

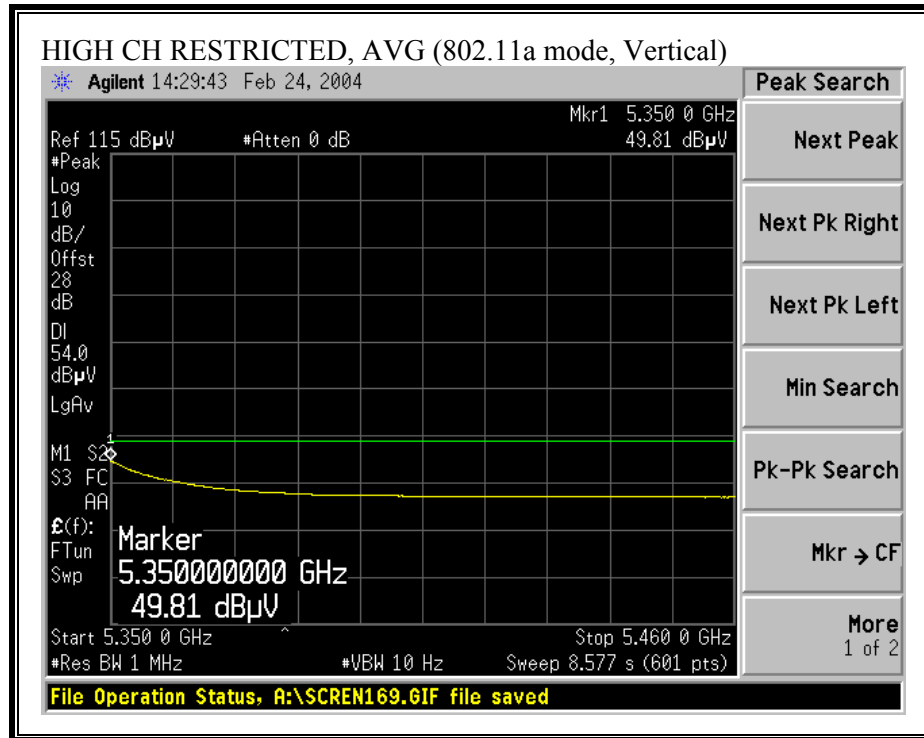




**RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, VERTICAL)**



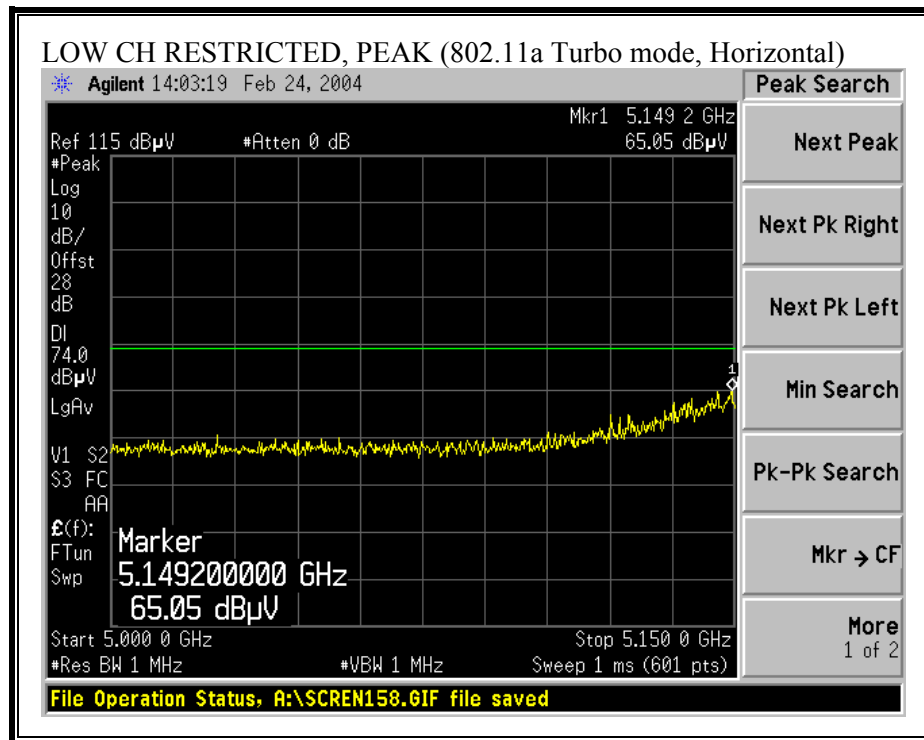


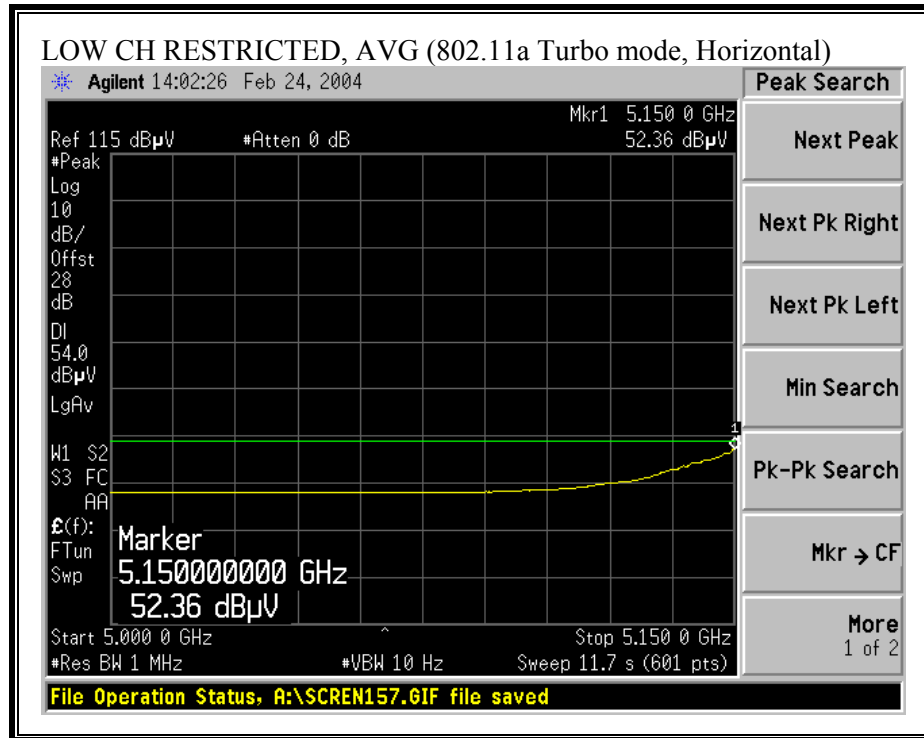


### HARMONICS AND SPURIOUS EMISSIONS (802.11a MODE)

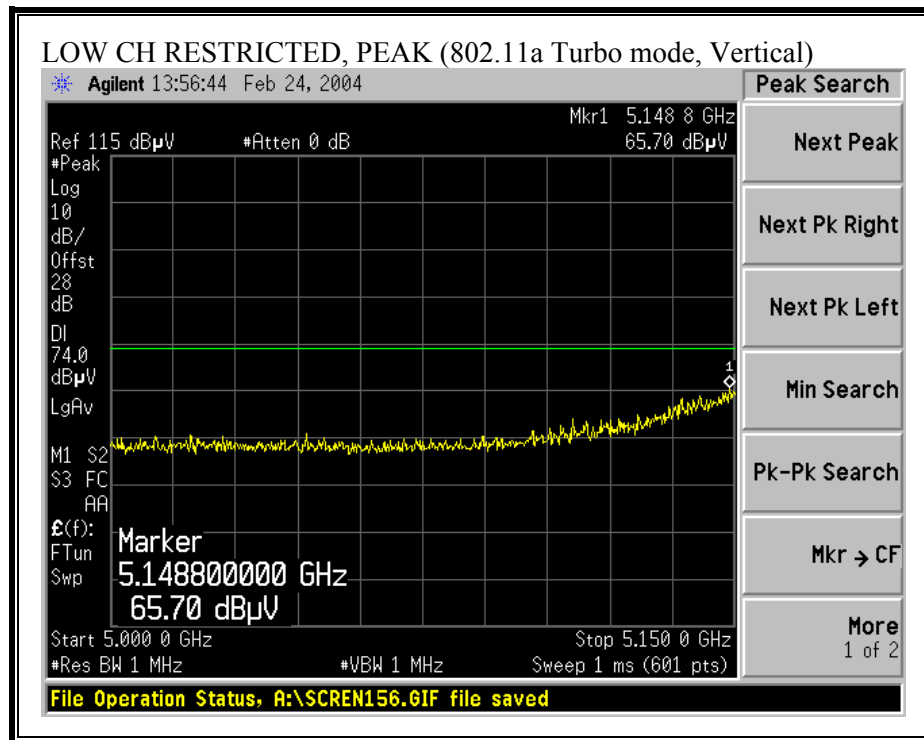
03/11/04 <b>High Frequency Measurement</b> <b>Compliance Certification Services, Morgan Hill Open Field Site</b>																
<b>Test Engr:</b> David Garcia <b>Project #:</b> 04U2552 <b>Company:</b> Atheros <b>EUT Descrip.:</b> Mini PCI card module <b>EUT M/N:</b> MB44 #3323 <b>Test Target:</b> 5.3 GHz band w/TIAN antenna <b>Mode Oper:</b> transmitting, L,M,H																
<b>Test Equipment:</b>																
EMCO Horn 1-18GHz T73; S/N: 6717 @3m		Spectrum Analyzer Agilent E4446A Analyzer		Pre-amplifier 1-26GHz T87 Miteq 924342		Pre-amplifier 26-40GHz		Horn > 18GHz								
Hi Frequency Cables <input checked="" type="checkbox"/> (2 ft) <input type="checkbox"/> (2.0 ft) <input type="checkbox"/> (3 ft) <input checked="" type="checkbox"/> (12 ft)				Limit FCC 15.205		Peak Measurements: 1 MHz Resolution Bandwidth 1MHz Video Bandwidth				Average Measurements: 1 MHz Resolution Bandwidth 10Hz Video Bandwidth						
f GHz	Dist feet	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	HPF	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes	
<b>11a 5180 Channel</b>																
15.540	9.8	57.5	45.4	39.2	5.8	-45.5	0.0	1.0	57.9	45.8	74.0	54.0	-16.1	-8.2	V	
15.540	9.8	53.1	42.0	39.2	5.8	-45.5	0.0	1.0	53.5	42.4	74.0	54.0	-20.5	-11.6	H	
<b>11a 5240 Channel</b>																
15.720	9.8	60.2	48.3	38.8	5.8	-45.6	0.0	1.0	60.2	48.3	74.0	54.0	-13.8	-5.7	V	
15.720	9.8	55.3	42.9	38.8	5.8	-45.6	0.0	1.0	55.3	42.9	74.0	54.0	-18.7	-11.1	H	
<b>11a 5260 Channel</b>																
15.780	9.8	63.5	51.7	38.6	5.8	-45.6	0.0	1.0	63.3	51.5	74.0	54.0	-10.7	-2.5	V	
15.780	9.8	55.0	44.0	38.6	5.8	-45.6	0.0	1.0	54.8	43.8	74.0	54.0	-19.2	-10.2	H	
<b>11a 5320 Channel</b>																
10.640	9.8	59.4	47.7	38.3	4.5	-41.3	0.0	1.0	61.9	50.2	74.0	54.0	-12.1	-3.8	V	
10.640	9.8	51.3	40.1	38.3	4.5	-41.3	0.0	1.0	53.8	42.6	74.0	54.0	-20.2	-11.4	H	
15.960	9.8	65.2	53.2	38.2	5.9	-45.7	0.0	1.0	64.6	52.6	74.0	54.0	-9.4	-1.4	V	
15.960	9.8	59.9	47.1	38.2	5.9	-45.7	0.0	1.0	59.3	46.5	74.0	54.0	-14.7	-7.5	H	
H																
f	Measurement Frequency			Amp	Preamp Gain			Avg Lim	Average Field Strength Limit							
Dist	Distance to Antenna			D Corr	Distance Correct to 3 meters			Pk Lim	Peak Field Strength Limit							
Read	Analyzer Reading			Avg	Average Field Strength @ 3 m			Avg Mar	Margin vs. Average Limit							
AF	Antenna Factor			Peak	Calculated Peak Field Strength			Pk Mar	Margin vs. Peak Limit							
CL	Cable Loss			HPF	High Pass Filter											

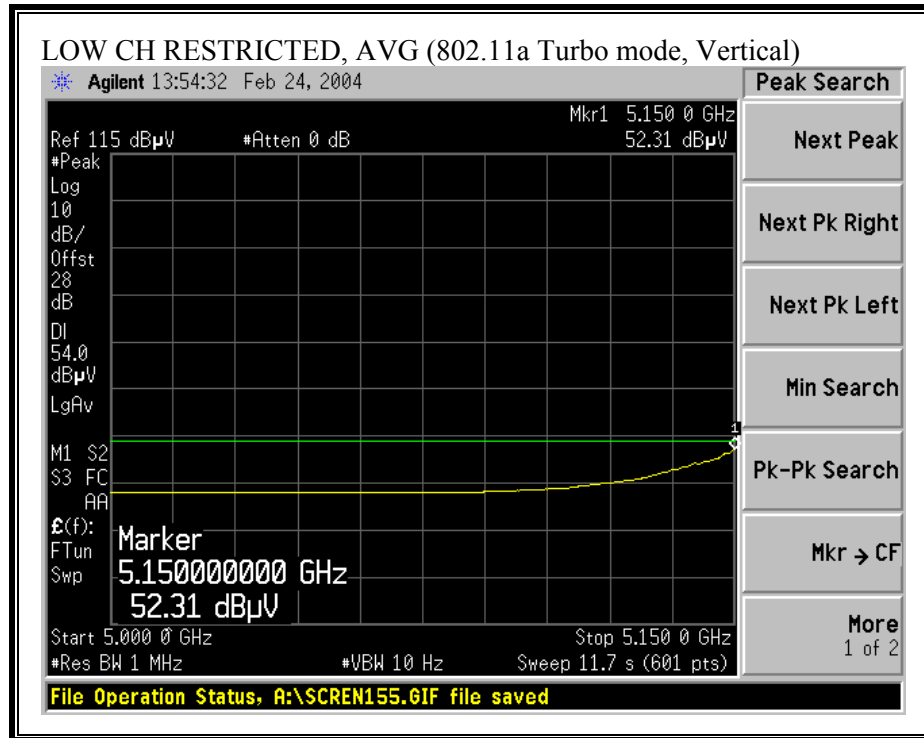
**RESTRICTED BANDEDGE (802.11a TURBO MODE, LOW CHANNEL, HORIZONTAL)**



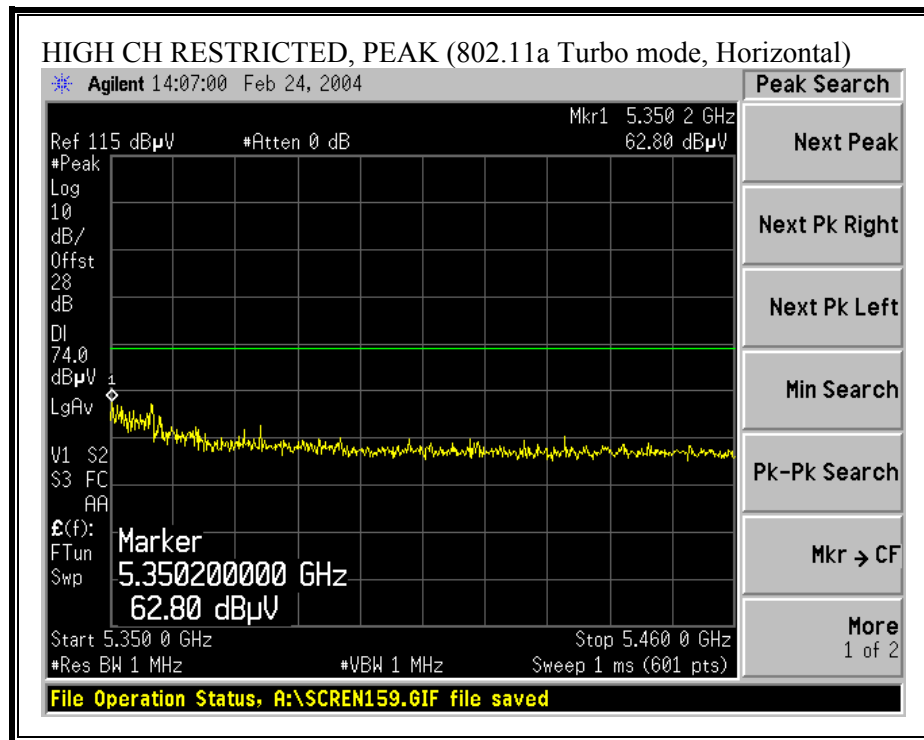


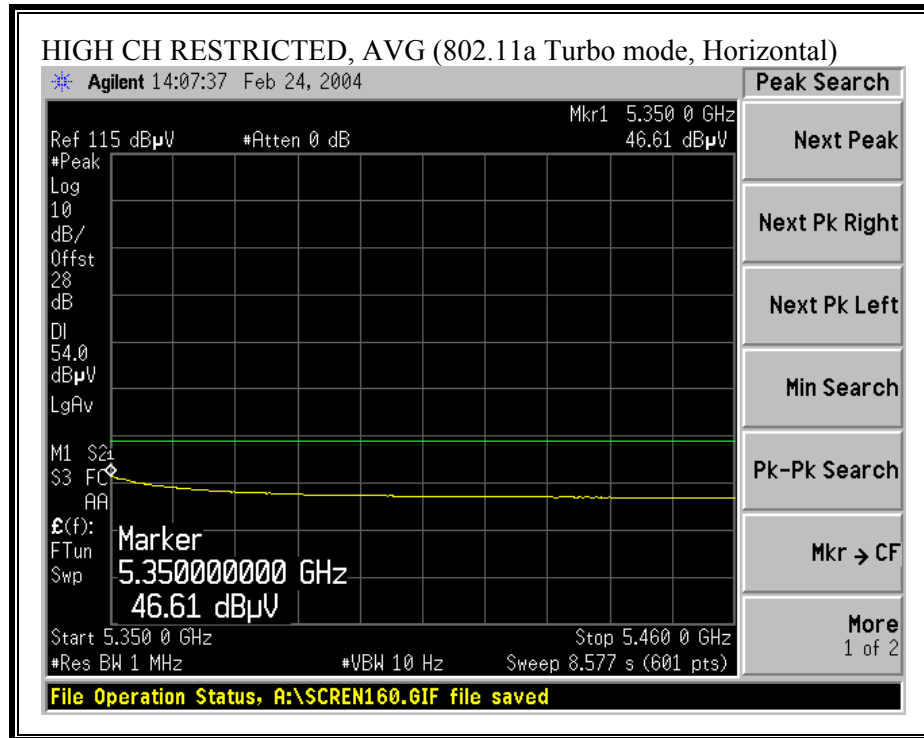
**RESTRICTED BANDEDGE (802.11a TURBO MODE, LOW CHANNEL, VERTICAL)**





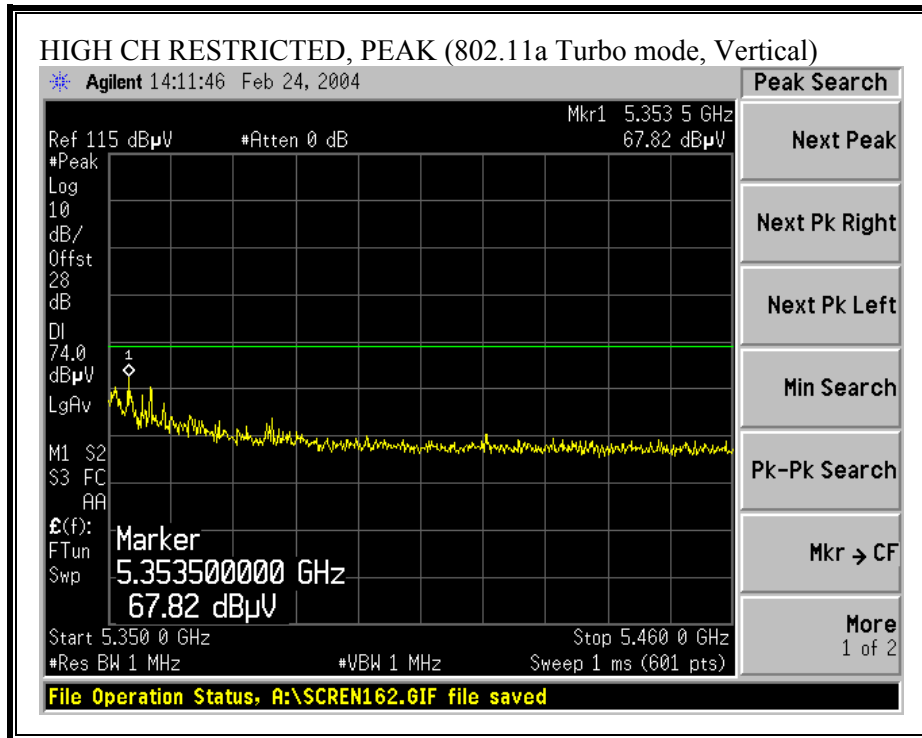
**RESTRICTED BANDEDGE (802.11a TURBO MODE, HIGH CHANNEL, HORIZONTAL)**

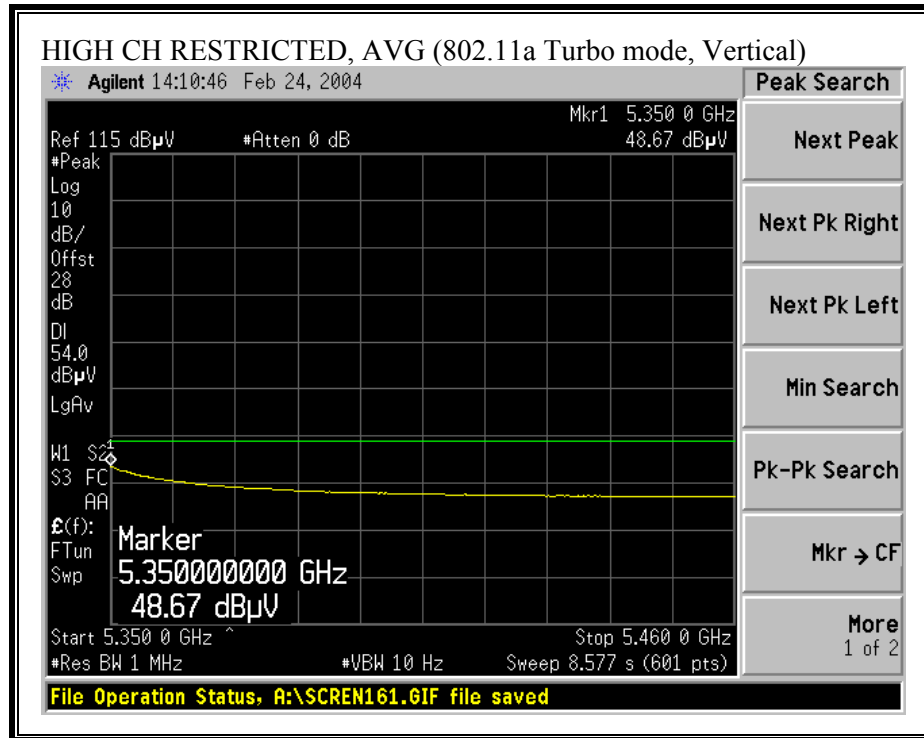






**RESTRICTED BANDEDGE (802.11a TURBO MODE, HIGH CHANNEL, VERTICAL)**



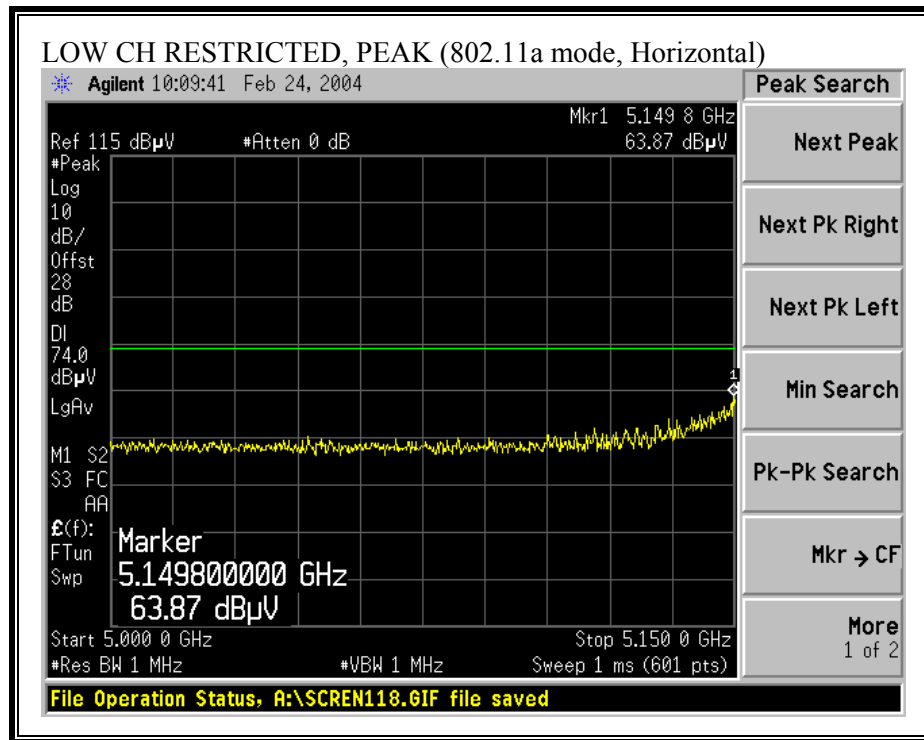


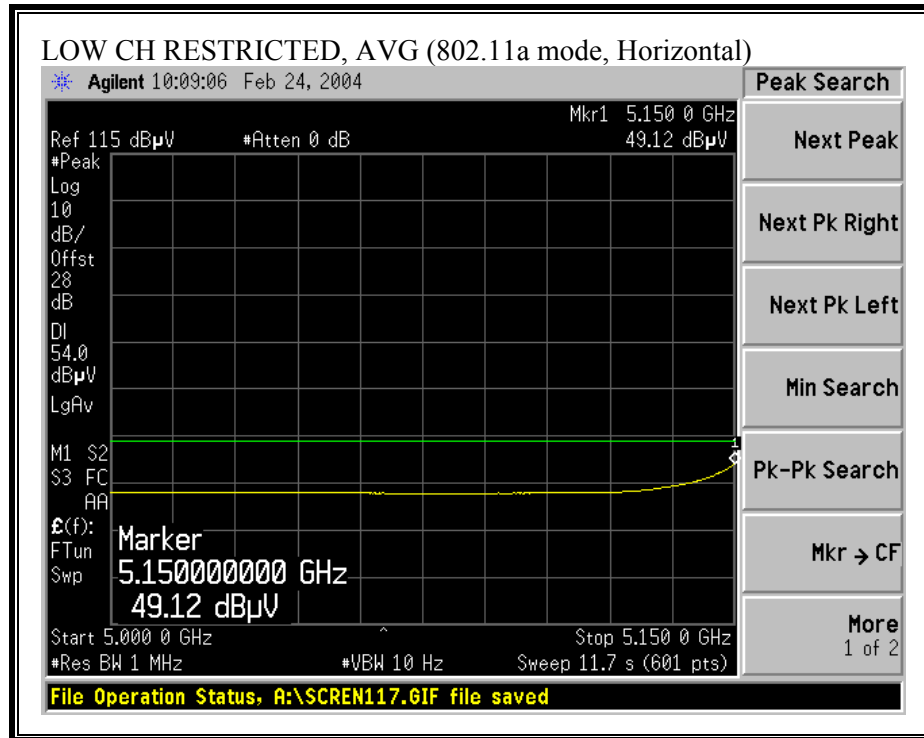
**HARMONICS AND SPURIOUS EMISSIONS 802.11a (TURBO MODE)**

03/11/04 <b>High Frequency Measurement</b> <b>Compliance Certification Services, Morgan Hill Open Field Site</b>																
<b>Test Engr:</b> David Garcia <b>Project #:</b> 04U2552 <b>Company:</b> Atheros <b>EUT Descrip.:</b> Mini PCI card module <b>EUT M/N:</b> MB44 #3323 <b>Test Target:</b> 5.3 GHz band w/TIAN antenna <b>Mode Oper:</b> transmitting, turbo mode.																
<b>Test Equipment:</b>																
<b>EMCO Horn 1-18GHz</b> T73; S/N: 6717 @3m				<b>Spectrum Analyzer</b> Agilent E4446A Analyzer				<b>Pre-amplifier 1-26GHz</b> T87 Miteq 924342				<b>Pre-amplifier 26-40GHz</b>				<b>Horn &gt; 18GHz</b>
<b>Hi Frequency Cables</b> <input checked="" type="checkbox"/> (2 ft) <input type="checkbox"/> (2.0 ft) <input type="checkbox"/> (3 ft) <input checked="" type="checkbox"/> (12 ft)				<b>Limit</b> FCC 15.205				<b>Peak Measurements:</b> 1 MHz Resolution Bandwidth 1MHz Video Bandwidth				<b>Average Measurements:</b> 1 MHz Resolution Bandwidth 10Hz Video Bandwidth				
f GHz	Dist feet	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	HPF	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes	
<b>LOW</b>																
15.600	9.8	59.5	46.7	39.1	5.8	-45.5	0.0	1.0	59.8	47.0	74.0	54.0	-14.2	-7.0	V	
15.600	9.8	53.8	41.5	39.1	5.8	-45.5	0.0	1.0	54.1	41.8	74.0	54.0	-19.9	-12.2	H	
<b>MID</b>																
15.750	9.8	60.7	49.4	38.7	5.8	-45.6	0.0	1.0	60.6	49.3	74.0	54.0	-13.4	-4.7	V	
15.750	9.8	56.6	44.0	38.7	5.8	-45.6	0.0	1.0	56.5	43.9	74.0	54.0	-17.5	-10.1	H	
<b>HIGH</b>																
15.870	9.8	63.0	50.2	38.4	5.9	-45.6	0.0	1.0	62.6	49.8	74.0	54.0	-11.4	-4.2	V	
15.870	9.8	58.1	46.3	38.4	5.9	-45.6	0.0	1.0	57.7	45.9	74.0	54.0	-16.3	-8.1	H	
f	Measurement Frequency			Amp	Preamp Gain			Avg Lim	Average Field Strength Limit							
Dist	Distance to Antenna			D Corr	Distance Correct to 3 meters			Pk Lim	Peak Field Strength Limit							
Read	Analyzer Reading			Avg	Average Field Strength @ 3 m			Avg Mar	Margin vs. Average Limit							
AF	Antenna Factor			Peak	Calculated Peak Field Strength			Pk Mar	Margin vs. Peak Limit							
CL	Cable Loss			HPF	High Pass Filter											

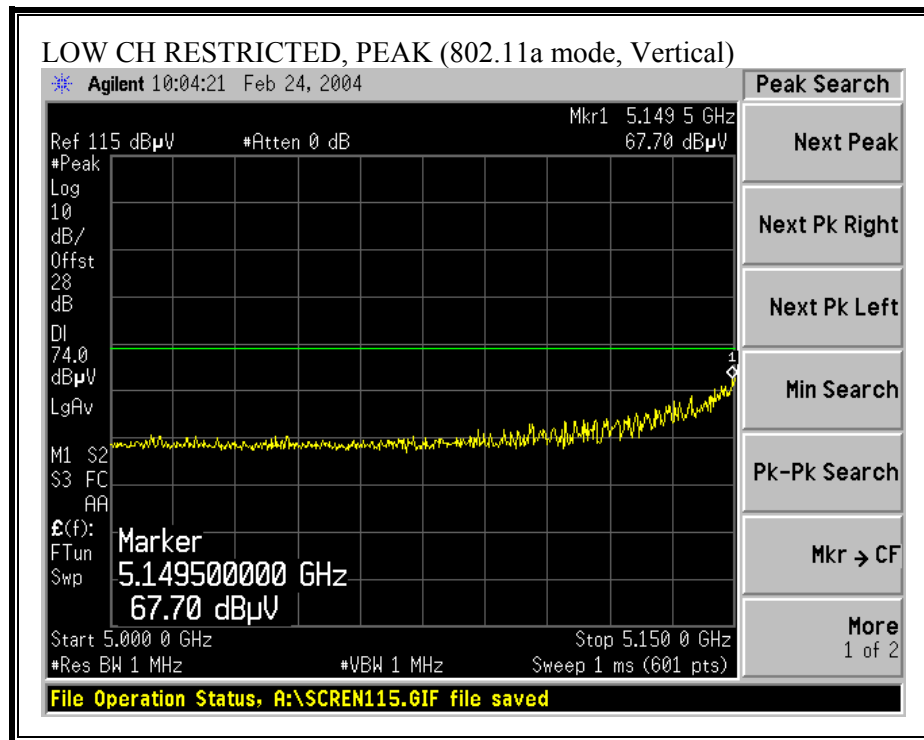
### 7.8.3. SUPPLEMENTAL TRANSMITTER RADIATED EMISSIONS ABOVE 1 GHZ WITH LOWER GAIN ANTENNA (HTL017)

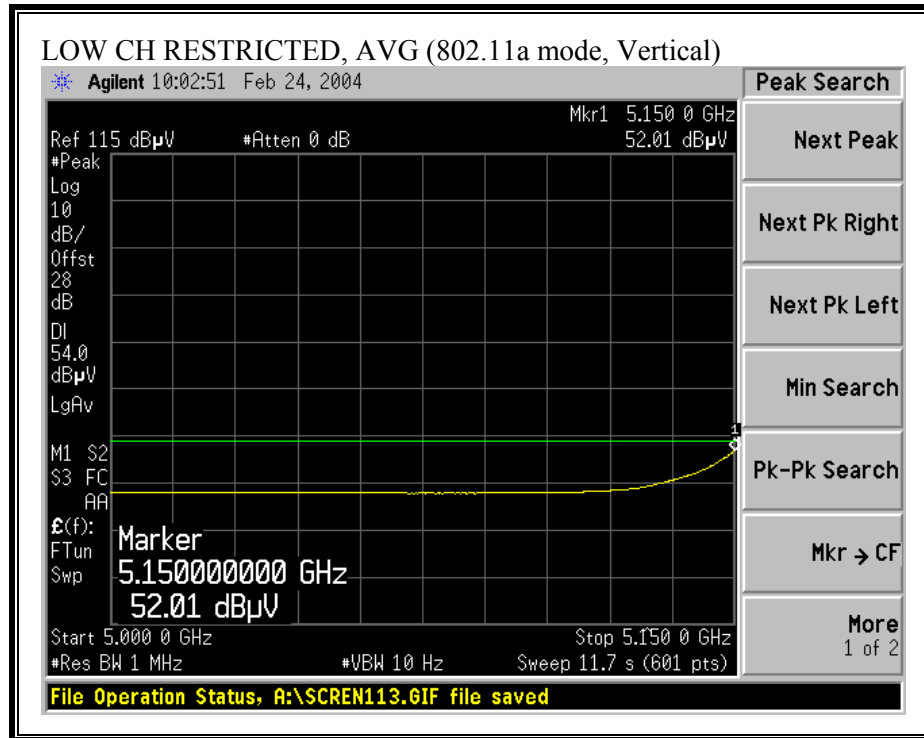
#### RESTRICTED BANDEGE (802.11a MODE, LOW CHANNEL, HORIZONTAL)



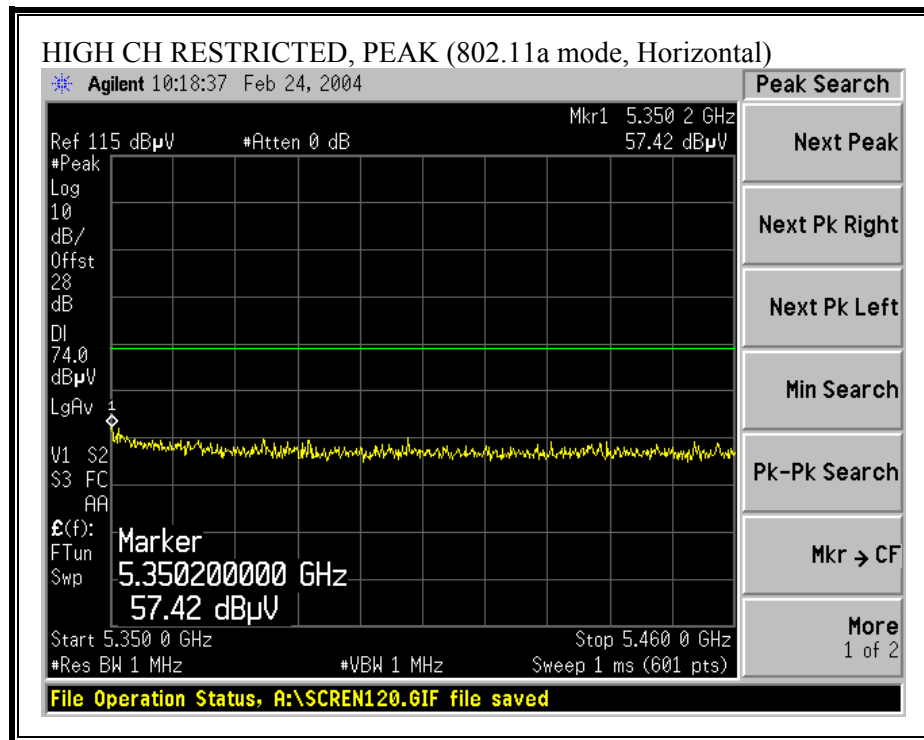


**RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, VERTICAL)**

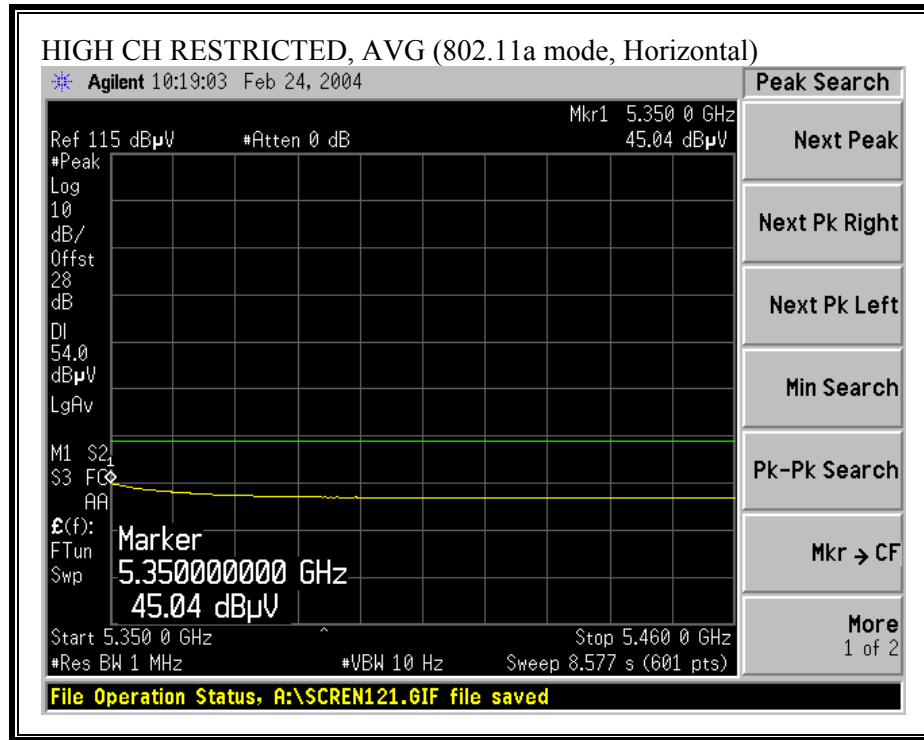




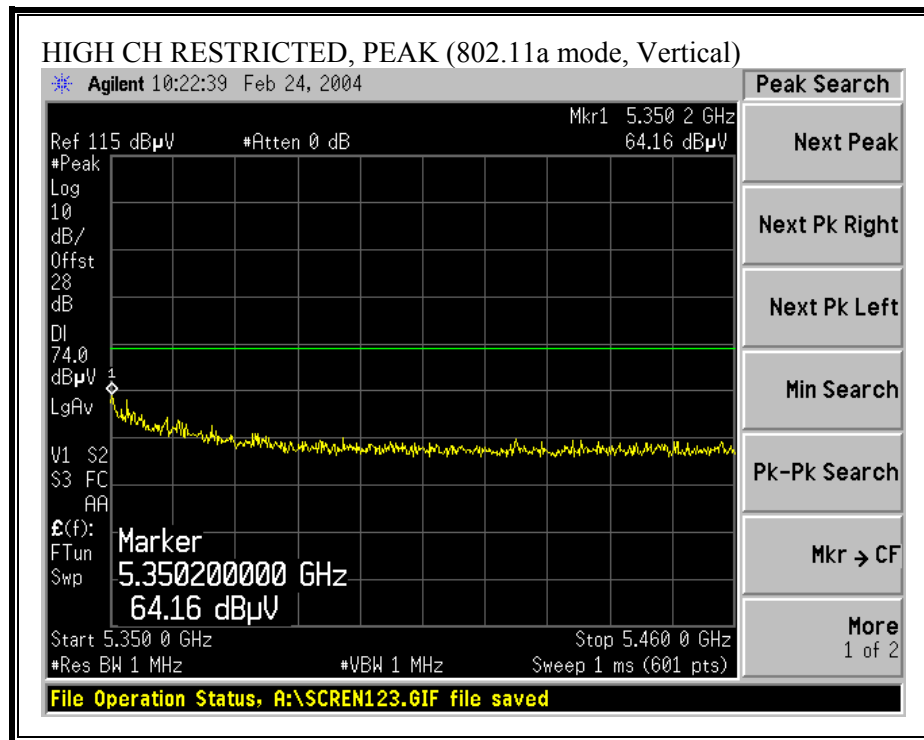
**RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, HORIZONTAL)**

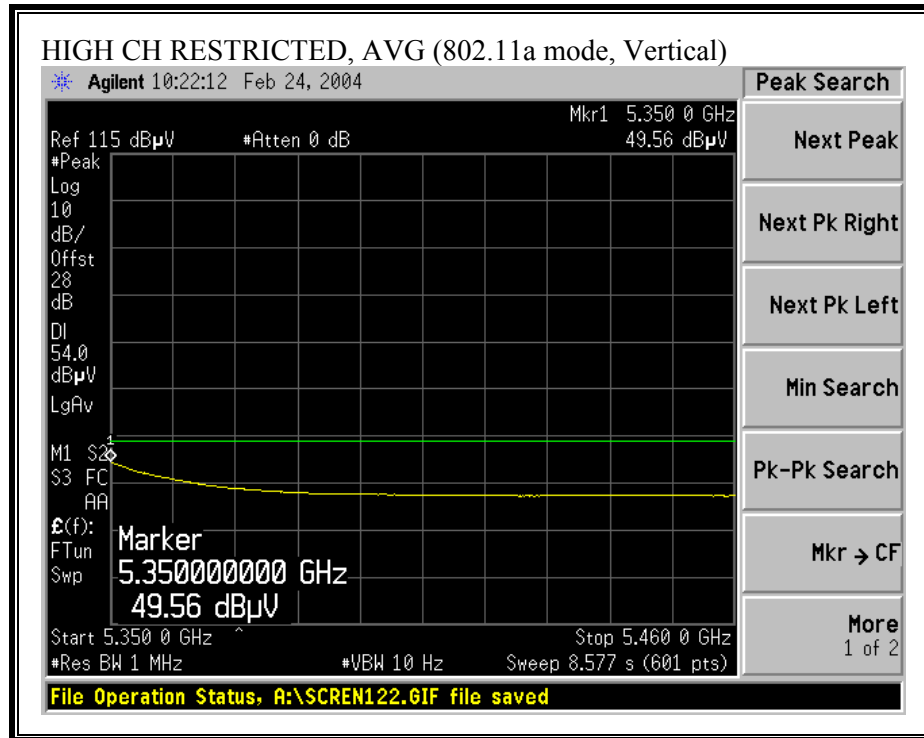






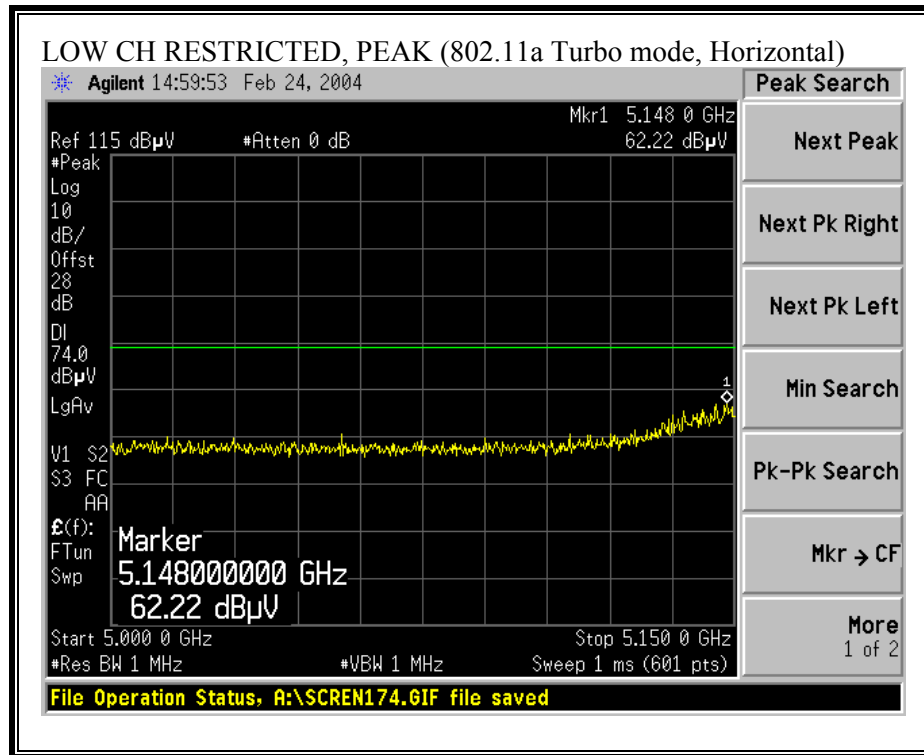
**RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, VERTICAL)**

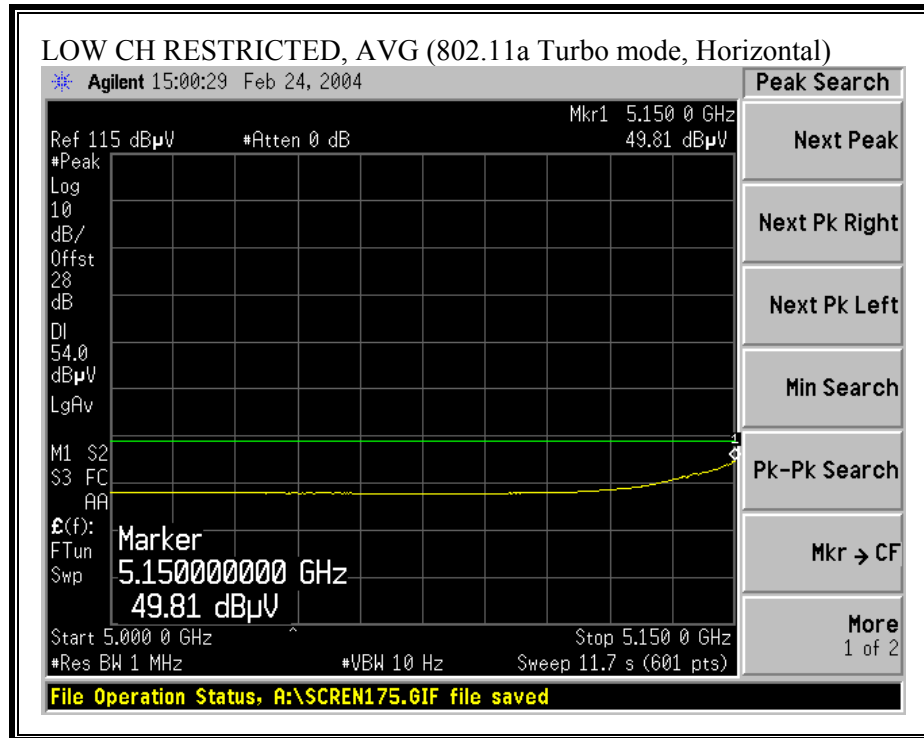




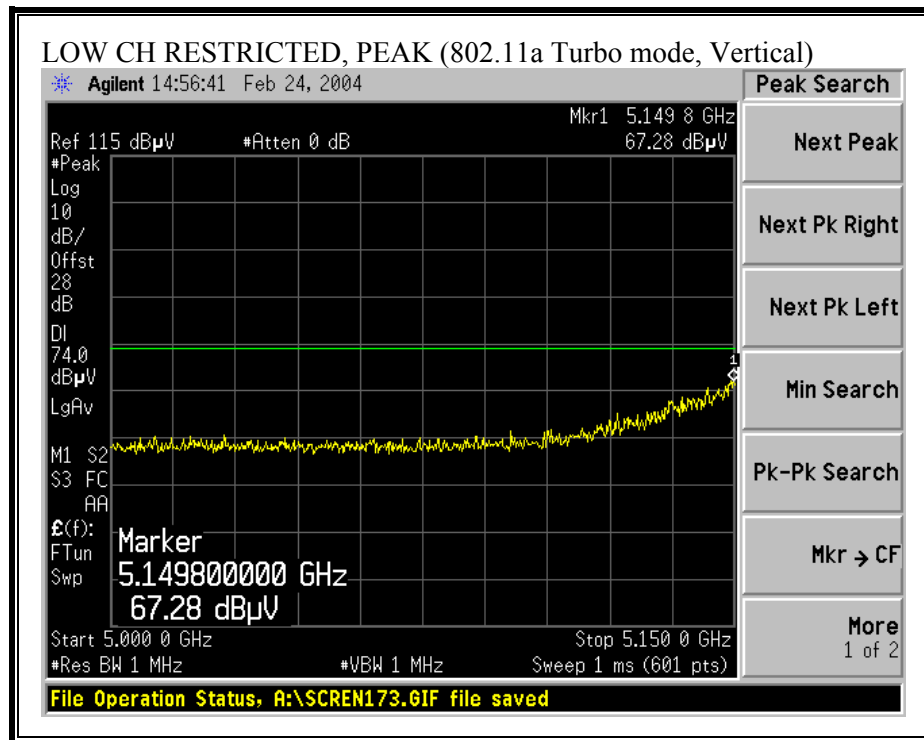


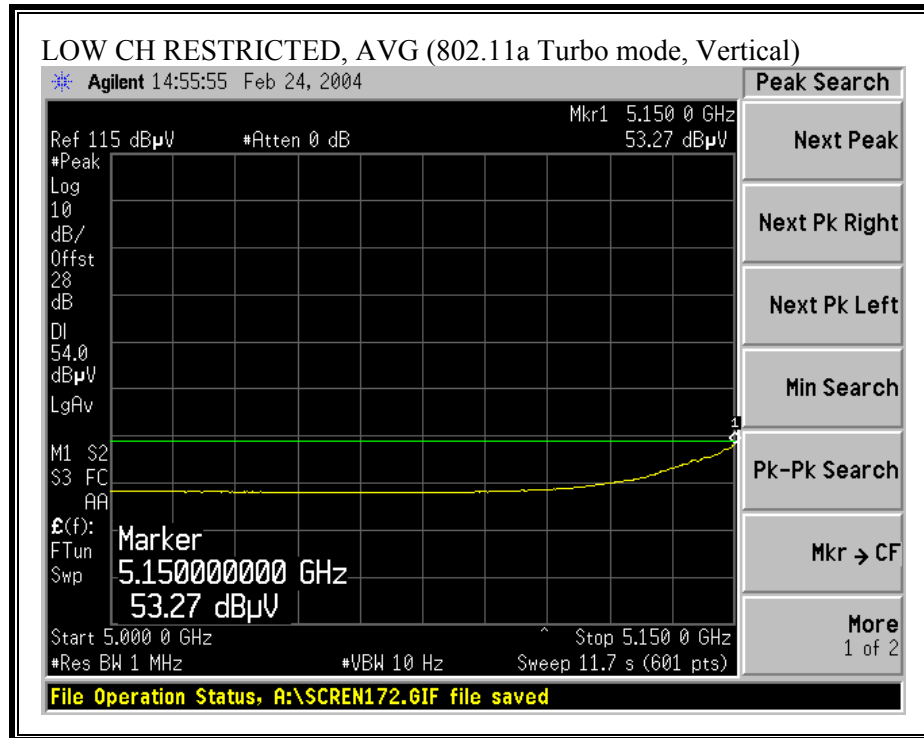
**RESTRICTED BANDEDGE (802.11a TURBO MODE, LOW CHANNEL, HORIZONTAL)**





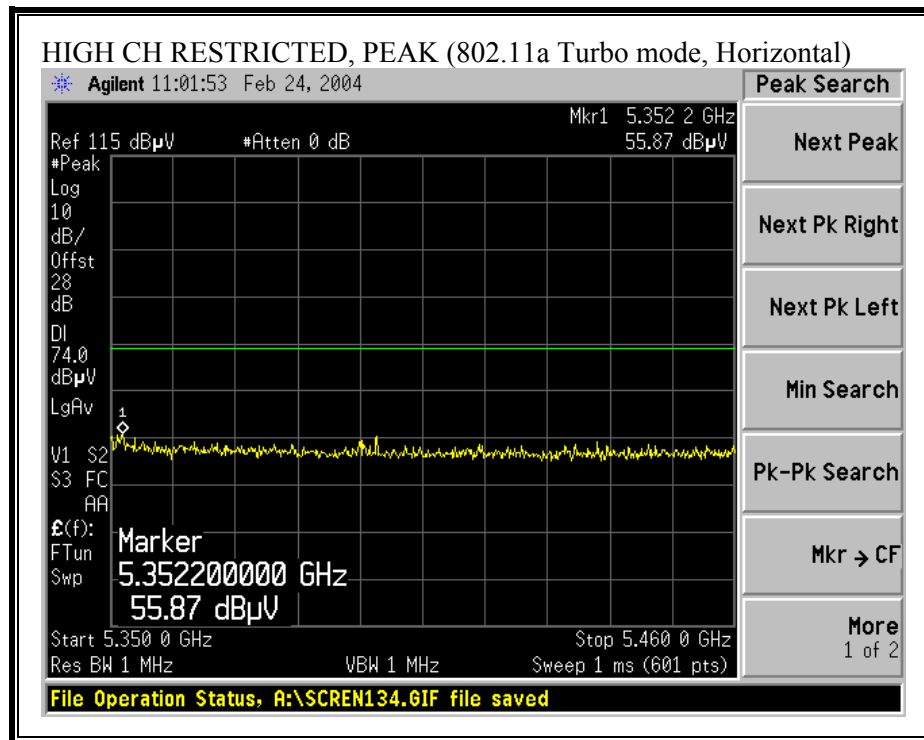
**RESTRICTED BANDEDGE (802.11a TURBO MODE, LOW CHANNEL, VERTICAL)**

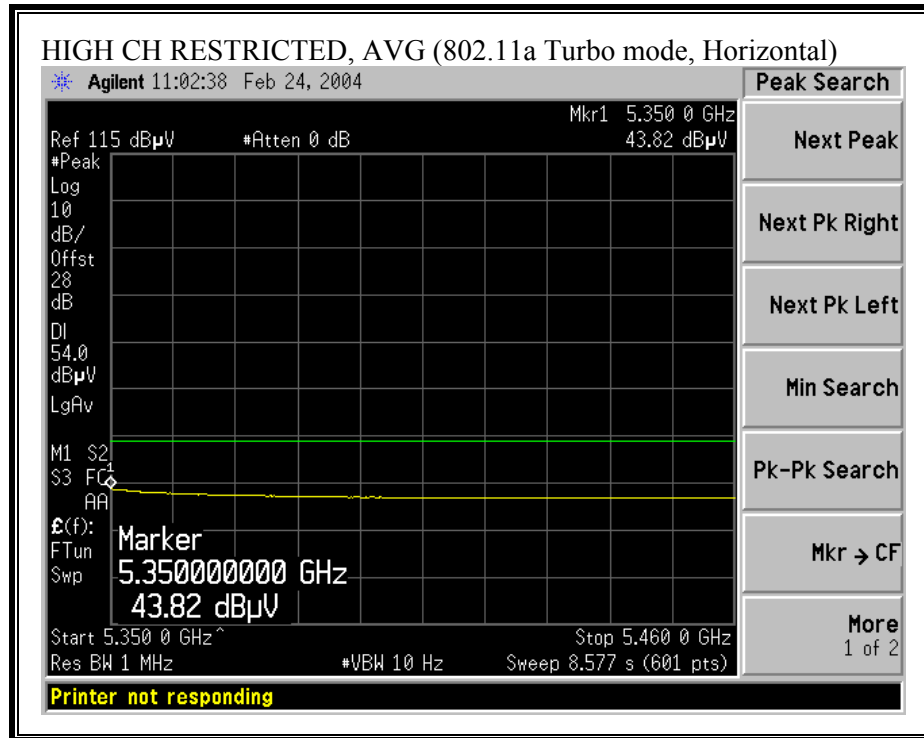




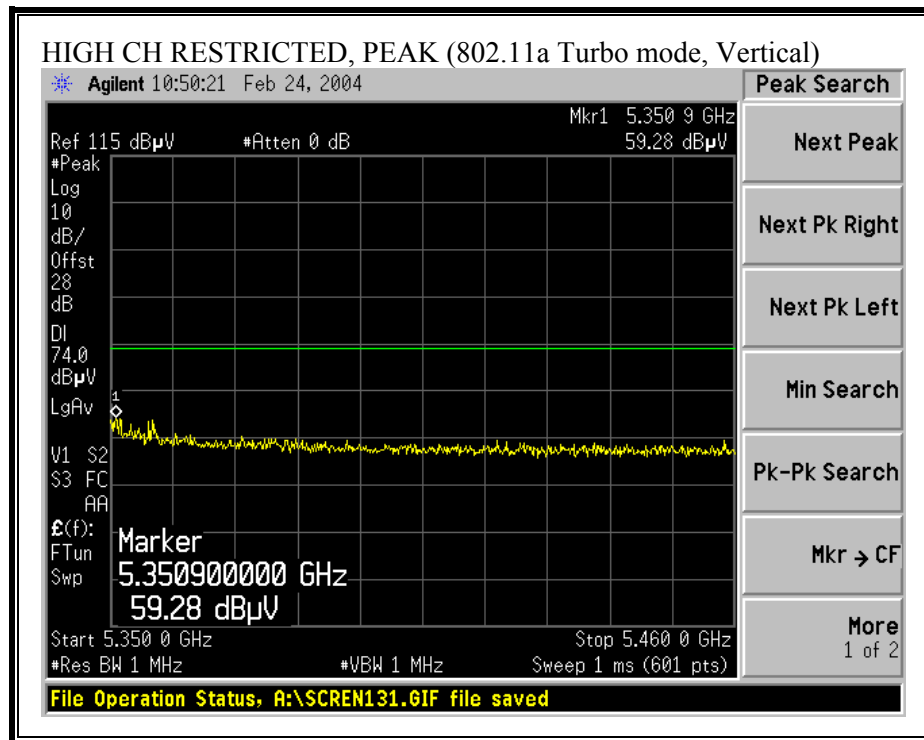


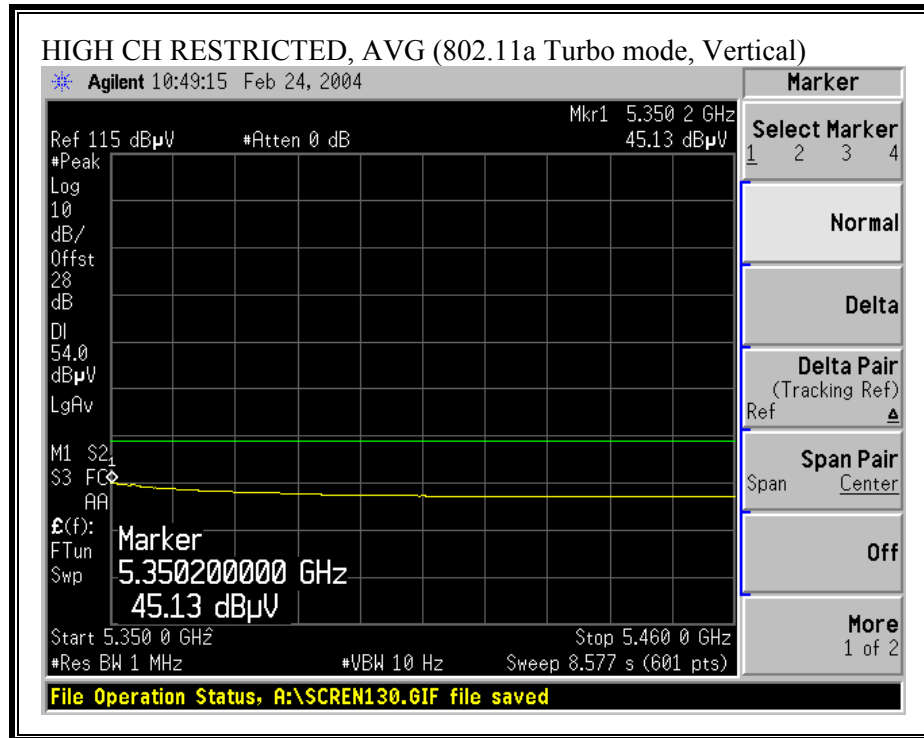
**RESTRICTED BANDEDGE (802.11a TURBO MODE, HIGH CHANNEL, HORIZONTAL)**





**RESTRICTED BANDEDGE (802.11a TURBO MODE, HIGH CHANNEL, VERTICAL)**



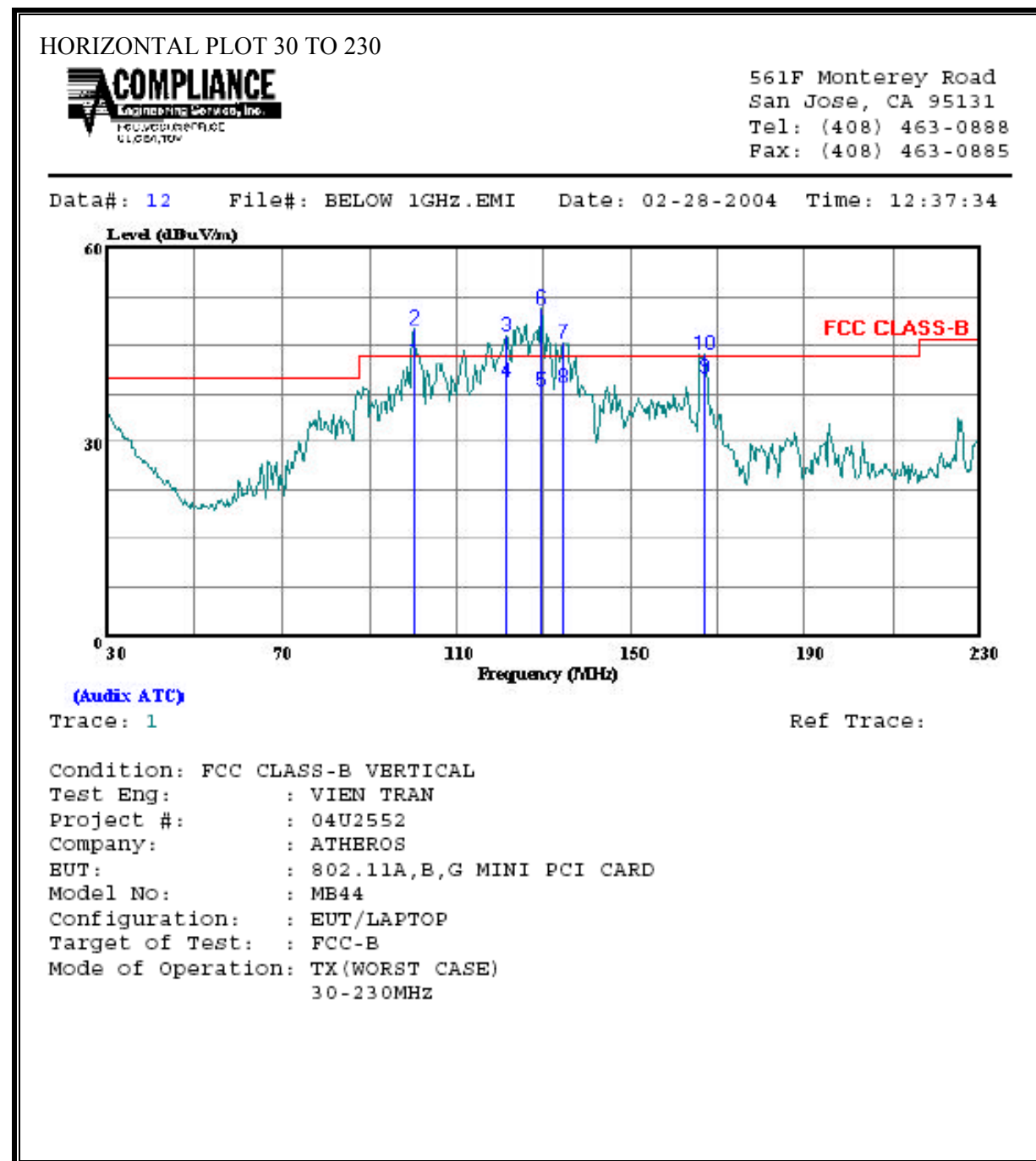


**HARMONICS AND SPURIOUS EMISSIONS 802.11a (TURBO MODE)**

02/24/04 <b>High Frequency Measurement</b> <b>Compliance Certification Services, Morgan Hill Open Field Site</b>															
<b>Test Engr:</b> Yan Zheng <b>Project #:</b> 04U2552 <b>Company:</b> Atheros <b>EUT Descrip.:</b> 802.11 a/b/g Mini PCI card <b>EUT M/N:</b> MB44 <b>Test Target:</b> FCC Class B <b>Mode Oper:</b> Transmit, 5.2GHz, Turbo Mode															
<b>Test Equipment:</b>															
EMCO Horn 1-18GHz T60; S/N: 2238 @3m		Spectrum Analyzer Agilent E4446A Analyzer		Pre-amplifier 1-26GHz T86 Miteq 924341		Pre-amplifier 26-40GHz		Horn > 18GHz							
<input type="checkbox"/> (2 ft) <input type="checkbox"/> (2 ~ 3 ft) <input checked="" type="checkbox"/> (4 ~ 6 ft) <input checked="" type="checkbox"/> (12 ft)				Limit FCC 15.205		Peak Measurements: 1 MHz Resolution Bandwidth 1MHz Video Bandwidth				Average Measurements: 1 MHz Resolution Bandwidth 10Hz Video Bandwidth					
f GHz	Dist feet	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	HPF	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes
Turbo mode mode															
channel 5200MHz															
10.400	9.8	51.5	38.4	38.3	7.7	-44.5	0.0	1.0	53.9	40.8	74.0	54.0	-20.1	-13.2	V
15.600	9.8	58.6	45.6	39.2	8.9	-48.3	0.0	1.0	59.4	46.4	74.0	54.0	-14.6	-7.6	V
10.400	9.8	52.9	40.6	38.3	7.7	-44.5	0.0	1.0	55.3	43.0	74.0	54.0	-18.7	-11.0	H
15.600	9.8	55.2	43.4	39.2	8.9	-48.3	0.0	1.0	56.0	44.2	74.0	54.0	-18.0	-9.8	H
channel 5250MHz															
10.500	9.8	52.3	39.4	38.2	7.7	-44.4	0.0	1.0	54.9	42.0	74.0	54.0	-19.1	-12.0	V
15.750	9.8	60.4	47.4	38.8	8.9	-48.3	0.0	1.0	60.8	47.8	74.0	54.0	-13.2	-6.2	V
10.500	9.8	52.3	40.5	38.2	7.7	-44.4	0.0	1.0	54.9	43.1	74.0	54.0	-19.1	-10.9	H
15.750	9.8	57.2	44.8	38.8	8.9	-48.3	0.0	1.0	57.6	45.2	74.0	54.0	-16.4	-8.8	H
channel 5290MHz															
10.580	9.8	52.2	39.6	38.2	7.8	-44.3	0.0	1.0	54.8	42.2	74.0	54.0	-19.2	-11.8	V
15.870	9.8	63.7	51.3	38.5	9.0	-48.3	0.0	1.0	63.8	51.4	74.0	54.0	-10.2	-2.6	V
10.580	9.8	50.5	39.6	38.2	7.8	-44.3	0.0	1.0	53.1	42.2	74.0	54.0	-20.9	-11.8	H
15.870	9.8	64.4	52.2	38.5	9.0	-48.3	0.0	1.0	64.5	52.3	74.0	54.0	-9.5	-1.7	H
No spurious emissions above the system noise floor were detected above 17 GHz.															
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								

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

### SPURIOUS EMISSIONS 30 TO 230 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)



HORIZONTAL DATA 30 TO 230

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	100.400	QP	31.80	10.59	42.39	43.50	-1.11
2 *	100.400	Peak	37.04	10.59	47.63	43.50	4.13
3 *	121.400	Peak	31.30	15.09	46.39	43.50	2.89
4	121.400	QP	24.50	15.09	39.59	43.50	-3.92
5	129.400	QP	22.40	15.55	37.95	43.50	-5.55
6 *	129.400	Peak	35.01	15.54	50.55	43.50	7.05
7 *	134.400	Peak	29.94	15.43	45.37	43.50	1.87
8	134.400	QP	23.00	15.43	38.43	43.50	-5.07
9	166.800	QP	26.40	13.62	40.02	43.50	-3.48
10 *	166.800	Peak	29.95	13.61	43.56	43.50	0.06

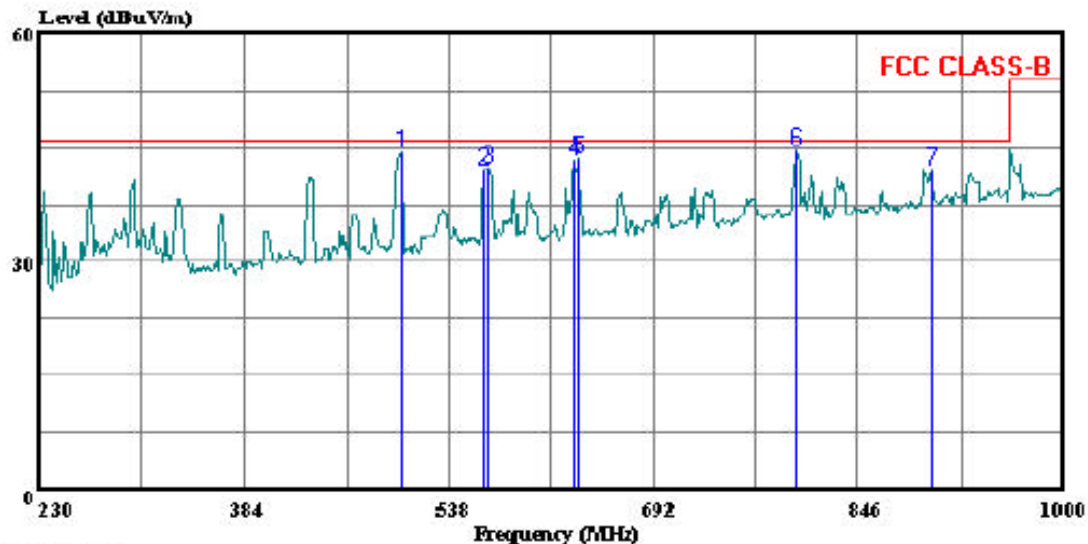
**SPURIOUS EMISSIONS 230 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)**

HORIZONTAL PLOT 230 TO 1000



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

Data#: 5 File#: BELOW 1GHZ.EMI Date: 02-28-2004 Time: 11:03:59



(Audix ATC)

Trace: 4

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL  
Test Eng: : VIEN TRAN  
Project #: : 04U2552  
Company: : ATHEROS  
EUT: : 802.11A,B,G MINI PCI CARD  
Model No: : MB44  
Configuration: : EUT/LAPTOP  
Target of Test: : FCC-B  
Mode of Operation: TX(WORST CASE)\_230-1000MHz



HORIZONTAL DATA 230 TO 1000

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	502.580	Peak	23.67	20.63	44.30	46.00	-1.70
2	564.180	Peak	20.76	21.44	42.20	46.00	-3.80
3	568.030	Peak	20.78	21.59	42.37	46.00	-3.63
4	631.940	Peak	20.87	22.41	43.28	46.00	-2.72
5	635.790	Peak	21.00	22.53	43.53	46.00	-2.47
6	799.030	Peak	19.70	25.01	44.71	46.00	-1.29
7	901.440	Peak	15.98	26.20	42.18	46.00	-3.83

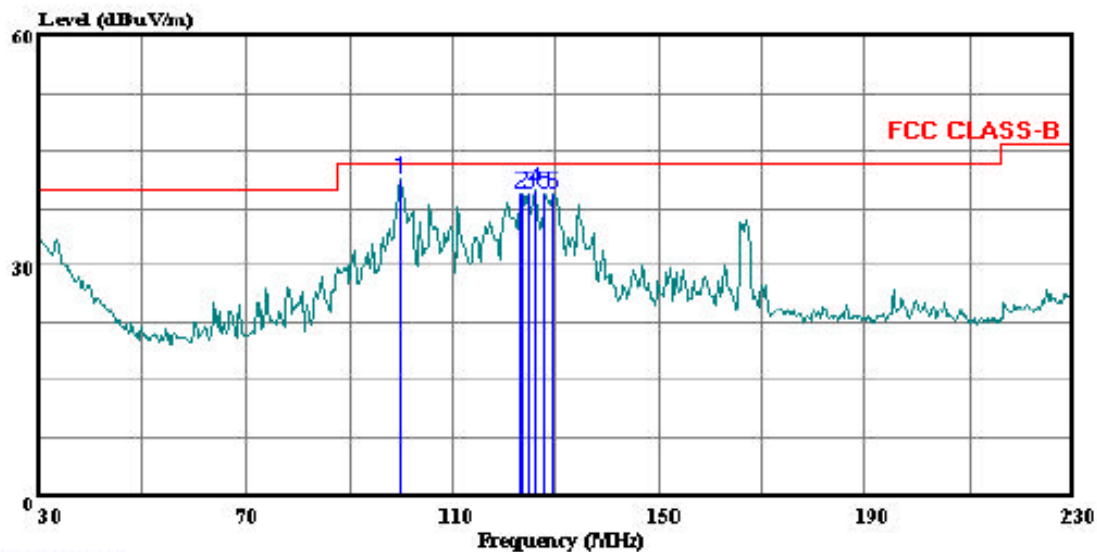
**SPURIOUS EMISSIONS 30 TO 230 MHz (WORST-CASE CONFIGURATION, VERTICAL)**

VERTICAL PLOT 30 TO 230



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

Data#: 7 File#: BELOW 1GHz.EMI Date: 02-28-2004 Time: 11:11:07



(Audix ATC)

Trace: 6

Ref Trace:

Condition: FCC CLASS-B VERTICAL  
Test Eng: : VIEN TRAN  
Project #: : 04U2552  
Company: : ATHEROS  
EUT: : 802.11A,B,G MINI PCI CARD  
Model No: : MB44  
Configuration: : EUT/LAPTOP  
Target of Test: : FCC-B  
Mode of Operation: TX(WORST CASE)  
: 30-230MHZ

VERTICAL DATA 30 TO 230

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	99.800	Peak	30.76	10.41	41.17	43.50	-2.33
2	123.400	Peak	24.24	15.31	39.55	43.50	-3.95
3	124.400	Peak	24.01	15.41	39.42	43.50	-4.08
4	125.800	Peak	24.63	15.48	40.11	43.50	-3.39
5	127.800	Peak	24.07	15.51	39.58	43.50	-3.92
6	129.400	Peak	23.92	15.54	39.46	43.50	-4.04

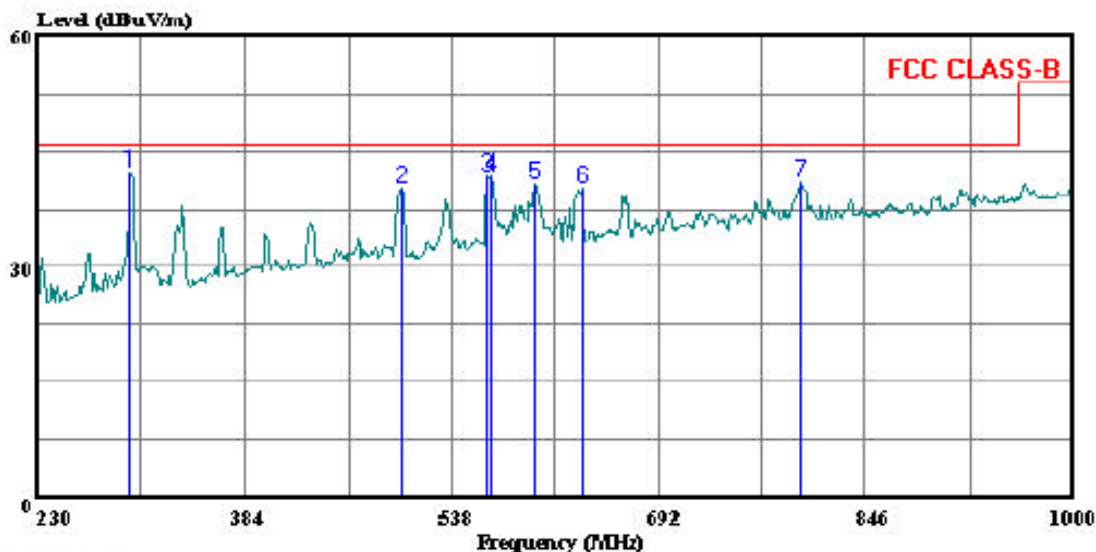
**SPURIOUS EMISSIONS 230 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**

VERTICAL PLOT 230 TO 1000



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

Data#: 9 File#: BELOW 1GHz.EMI Date: 02-28-2004 Time: 11:30:26



(Auxiliary ATC)

Trace: 8

Ref Trace:

Condition: FCC CLASS-B VERTICAL  
Test Eng: : VIEN TRAN  
Project #: : 04U2552  
Company: : ATHEROS  
EUT: : 802.11A,B,G MINI PCI CARD  
Model No: : MB44  
Configuration: : EUT/LAPTOP  
Target of Test: : FCC-B  
Mode of Operation: TX(WORST CASE)  
: 230-1000MHZ

VERTICAL DATA 230 TO 1000

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	298.530	Peak	26.42	15.91	42.33	46.00	-3.68
2	501.040	Peak	19.72	20.61	40.32	46.00	-5.68
3	564.180	Peak	20.41	21.44	41.85	46.00	-4.15
4	568.030	Peak	20.22	21.59	41.81	46.00	-4.19
5	598.830	Peak	18.84	21.93	40.77	46.00	-5.24
6	635.790	Peak	17.84	22.53	40.37	46.00	-5.63
7	797.490	Peak	15.96	24.99	40.95	46.00	-5.05

## 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.

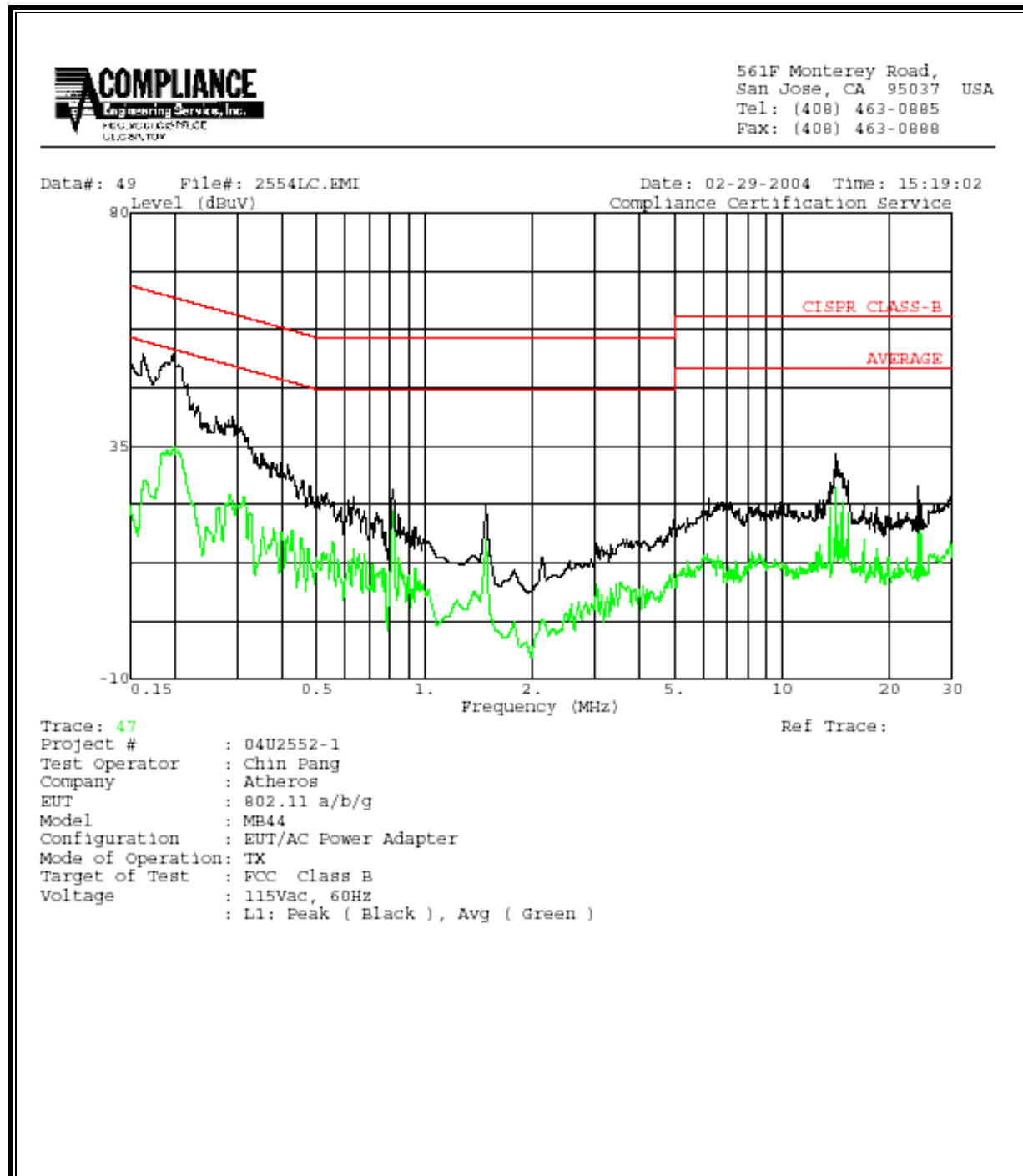
### RESULTS

No non-compliance noted:

# **6 WORST EMISSIONS**

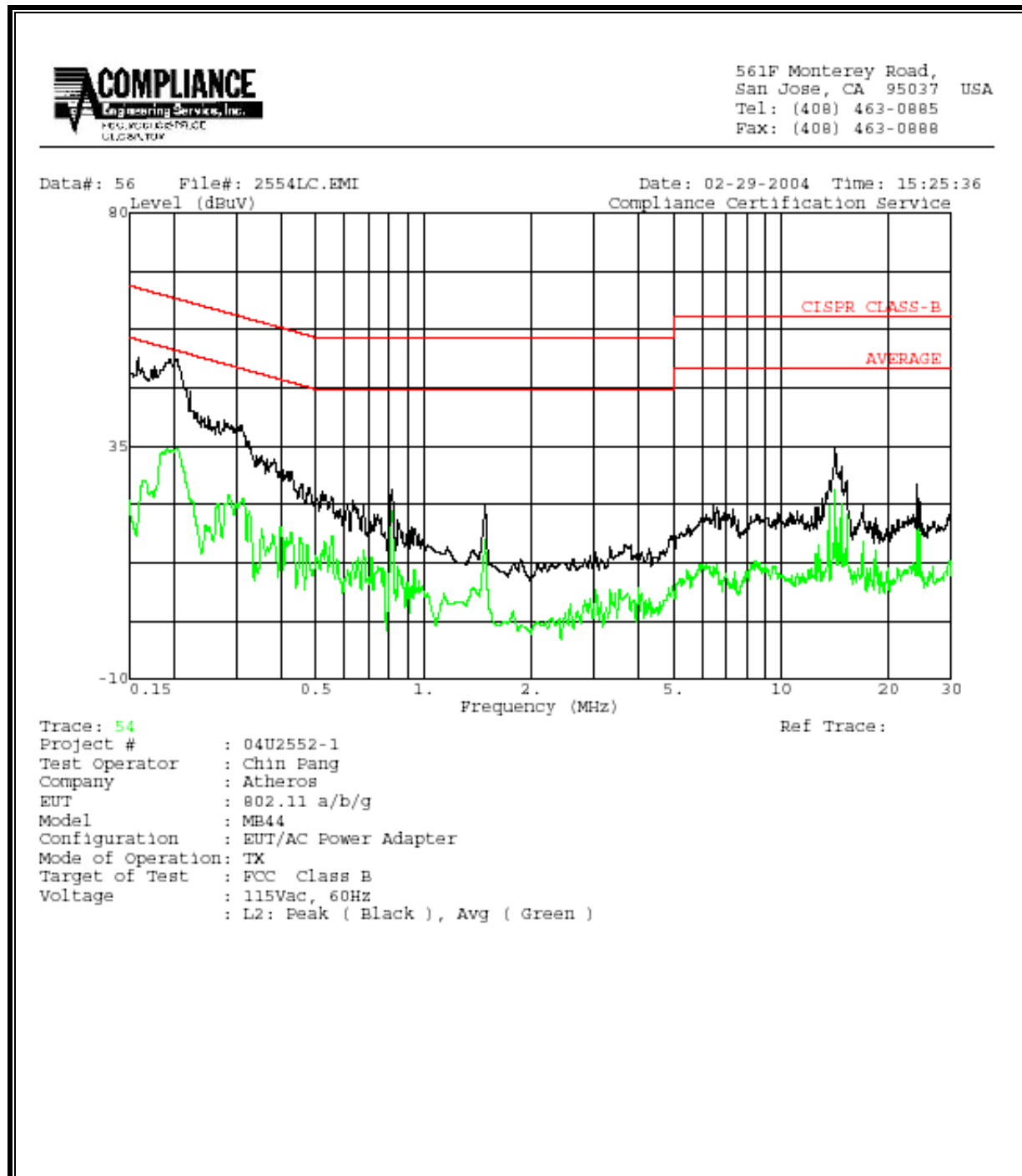
CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.16	53.05	--	28.17	0.00	65.60	55.60	-12.55	-27.43	L1
0.20	52.83	--	34.79	0.00	64.63	54.63	-11.80	-19.84	L1
14.36	34.61	--	27.21	0.00	60.00	50.00	-25.39	-22.79	L1
0.16	52.13	--	28.51	0.00	65.71	55.71	-13.58	-27.20	L2
0.20	52.50	--	35.02	0.00	64.51	54.51	-12.01	-19.49	L2
14.21	35.40	--	27.36	0.00	60.00	50.00	-24.60	-22.64	L2
6 Worst Data									

## LINE 1 RESULTS





## LINE 2 RESULTS

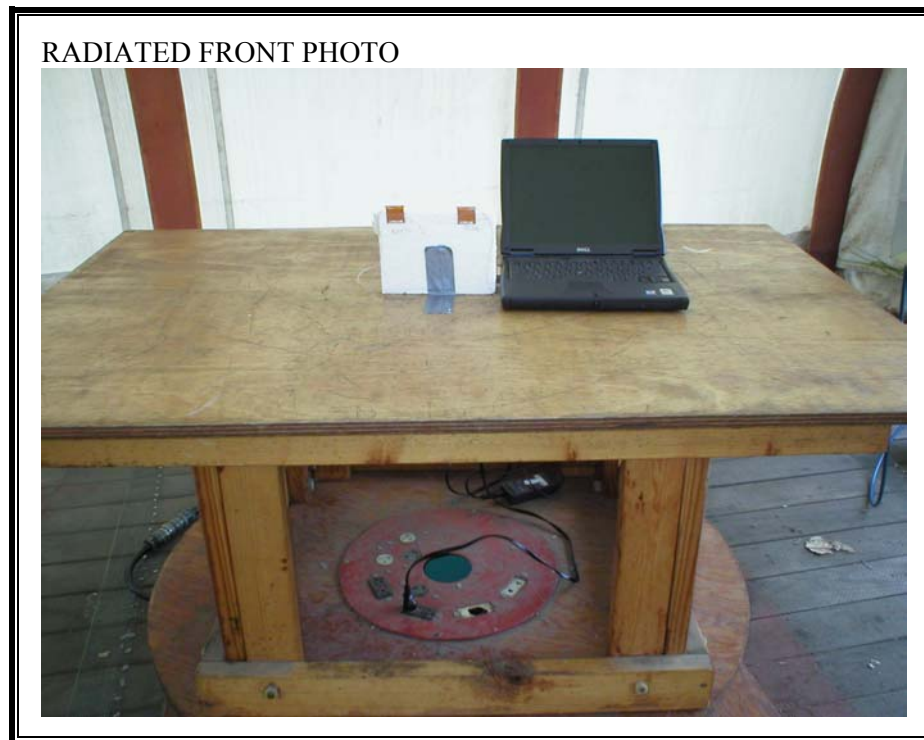


## 8. SETUP PHOTOS

### ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP



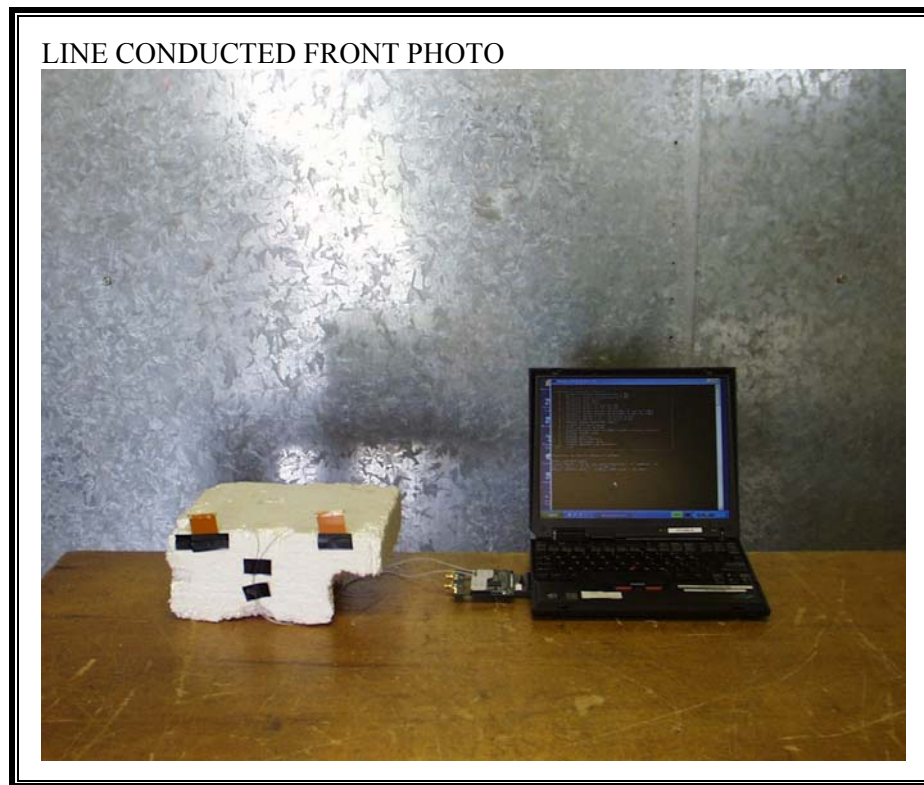
**RADIATED RF MEASUREMENT SETUP**



RADIATED BACK PHOTO



**POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP**



LINE CONDUCTED BACK PHOTO



**END OF REPORT**