

FCC CFR47 PART 15 SUBPART C CLASS 2 PERMISSIVE CHANGE TEST REPORT

FOR

PCI EXPRESS 802.11 B/G TRANSCEIVER

MODEL NUMBER: AR5BXB61

FCC ID: PPD-AR5BXB61

REPORT NUMBER: 06U10440-1

ISSUE DATE: AUGUST 10, 2006

Prepared for

ATHEROS COMMUNICATIONS, INC. 5480 GREAT AMERICA PARKWAY SANTA CLARA, CA 95054, USA

Prepared by

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Revision History

	Issue		
Rev.	Date	Revisions	Revised By
	8/10/06	Initial Issue	A. Ilarina

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ATHEROS COMMUNICATIONS, INC.

5480 Great America Parkway Santa Clara, CA 95054, USA

EUT DESCRIPTION: PCI EXPRESS 802.11 B/G TRANSCEIVER

MODEL: AR5BXB61

SERIAL NUMBER: 141773121 0000360 R01

DATE TESTED: JULY 31-AUGUST 10, 2006

APPLICABLE STANDARDS

STANDARD TEST RESULTS

FCC PART 15 SUBPART C NO NON-COMPLIANCE NOTED

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

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By: Tested By:

ALVIN ILARINA EMC SUPERVISOR

COMPLIANCE CERTIFICATION SERVICES

CHIN PANG EMC ENGINEER

Chin Pany

COMPLIANCE CERTIFICATION SERVICES

DATE: AUGUST 10 2006

2. TEST METHODOLOGY

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

3. FACILITIES AND ACCREDITATION

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

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. **MEASUREMENT UNCERTAINTY**

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

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

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

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an 802.11b/g transceiver.

The radio module is manufactured by Atheros Communications, Inc.

5.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

Two sets of Integrated Omnidirectional PIFA antennas are added; each set consists of two antennas (Main and Aux) for diversity.

HonHai set WDANSCMS6003-1F and WDANSCMS6004-1F has a peak gain of 1.22dBi (antenna set number 3710).

HonHai set WDANSCMS7001-DF and WDANSCMS7002-DF has a peak gain of 1.08dBi (antenna set number 3720).

The 802.11g Turbo mode is not supported by radio modules incorporating these additional antennas; this change is accomplished by a firmware change using identical hardware.

5.3. SOFTWARE AND FIRMWARE

The EUT driver software installed in the host support equipment during testing was Atheros Radio Test, Revision 5.3 Build #11.

The test utility software used during testing was ART-V5 3 b11.

5.4. WORST-CASE CONFIGURATION AND MODE

The worst-case data rate for this channel is determined to be 1 Mb/s for the 802.11b mode and 6 Mbs for the 802.11g mode.

Thus all emissions tests were made in the 802.11b mode at 1 Mb/s and 802.11g mode at 6Mb/s, using the highest gain (1.22 dBi) antenna set.

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5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST						
Description Manufacturer Model Serial Number FCC ID						
Laptop	IBM	Thinkpad	ZZ-27004	DoC		
AC Adapter	IBM	08K8202	NA	DoC		

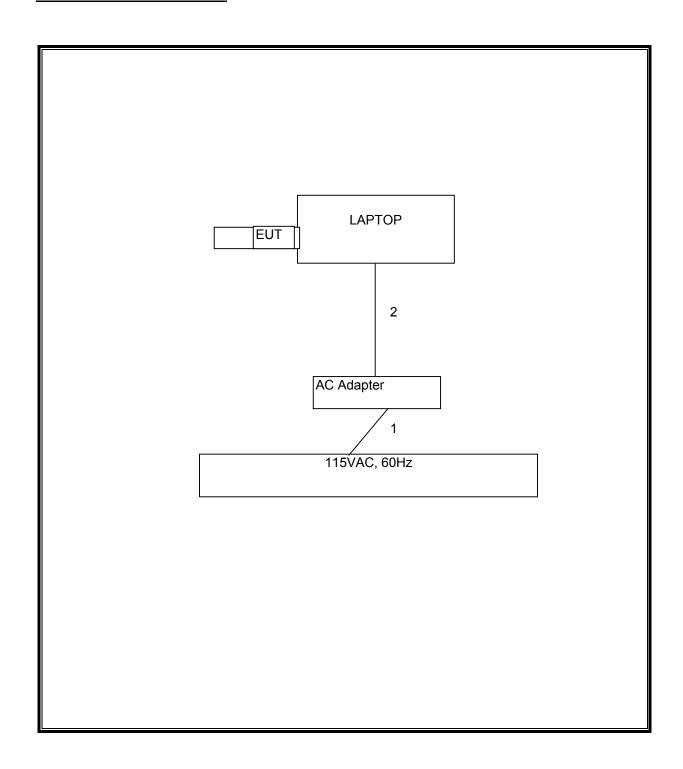
I/O CABLES

	I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks	
1	AC	1	US 115V	Un-shielded	2m	No	
2	DC	1	DC	Un-shielded	1m	No	

TEST SETUP

The EUT was tested with a host laptop computer connected via an express-card extension board. Test s/w exercised the radio card.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

TEST EQUIPMENT LIST						
Description	Manufacturer	Model	Serial Number	Cal Due		
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	US42510266	10/19/2006		
4.0 GHz Highpass Filter	Micro-Tronics	HPM13351	2	CNR		
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	6717	4/22/2007		
EMI Receiver, 9 kHz ~ 2.9 GHz	Agilent / HP	8542E	3942A00286	2/4/2007		
RF Filter Section	Agilent / HP	85420E	3705A00256	2/4/2007		
Antenna, Bilog 30 MHz ~ 2 Ghz	Sunol Sciences	JB1	A121003	9/3/2006		
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00931	9/24/2006		

7. LIMITS AND RESULTS

7.1.1. 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/cm²)	Averaging time (minutes)				
(A) Limits for Occupational/Controlled Exposures								
0.3-3.0 3.0-30 30-300 300-1500 1500-100,000	614 1842/f 61.4	1.63 4.89# 0.163	*(100) *(900/f²) 1.0 f/300 5	6 6 6 6				
(B) Limits	for General Populati	on/Uncontrolled Exp	posure					
0.3–1.34	614 824/f	1.63 2.19/f	*(100) *(180/f²)	30 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/cm²)	Averaging time (minutes)
30–300 300–1500 1500–100,000	27.5	0.073	0.2 f/1500 1.0	30 30 30

f = frequency in MHz

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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.

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:

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

$$d (cm) = 100 * d (m)$$

yields

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

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

where

d = distance in cm

P = Power in mW

G = Numeric antenna gain

 $S = Power Density in mW/cm^2$

Substituting the logarithmic form of power and gain using:

$$P(mW) = 10 ^ (P(dBm) / 10)$$
 and

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

yields

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

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

 $S = Power Density Limit in mW/cm^2$

Rearranging terms to calculate the power density at a specific distance yields

$$S = 0.0795 * 10 ^ ((P + G) / 10) / (d^2)$$

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LIMITS

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

RESULTS

No non-compliance noted:

Mode	MPE	Output	Antenna	Power
	Distance	Power	Gain	Density
	(cm)	(dBm)	(dBi)	(mW/cm^2)
802.11b	20.0	23.95	1.22	0.07
802.11g	20.0	26.70	1.22	0.12

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.

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7.2. RADIATED EMISSIONS

7.2.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS

LIMITS

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

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

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

§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.

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² Above 38 6

§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)
20.00	100 **	2
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

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

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

TEST PROCEDURE

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

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

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

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

The 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.

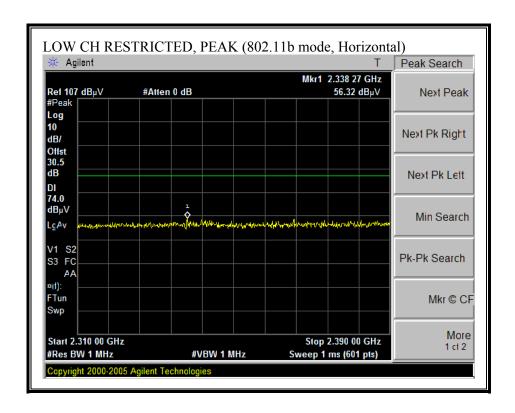
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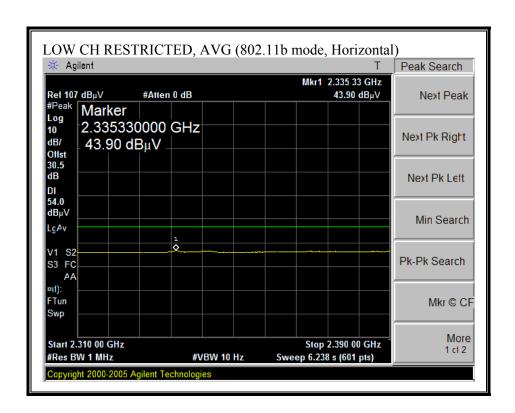
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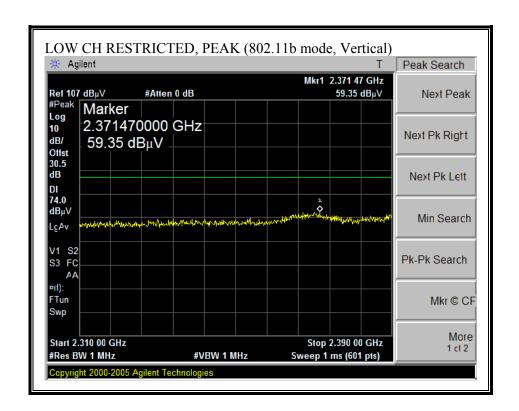
7.2.2. TRANSMITTER ABOVE 1 GHz FOR 2400 TO 2483.5 MHz BAND

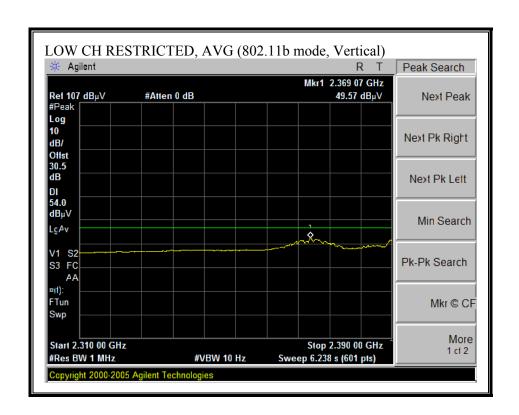
RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, HORIZONTAL)



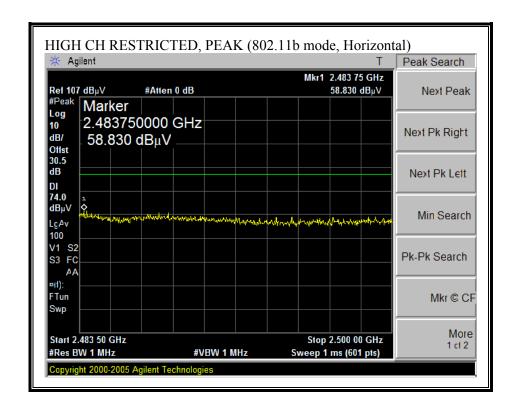


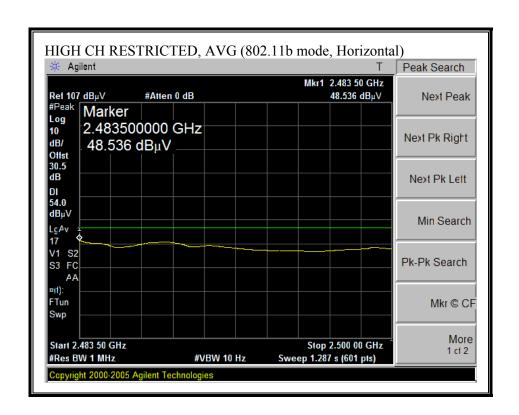
RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, VERTICAL)



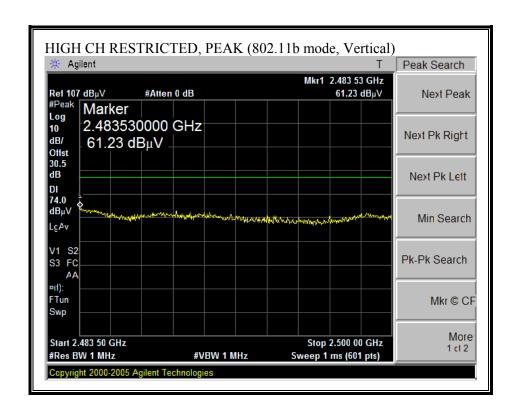


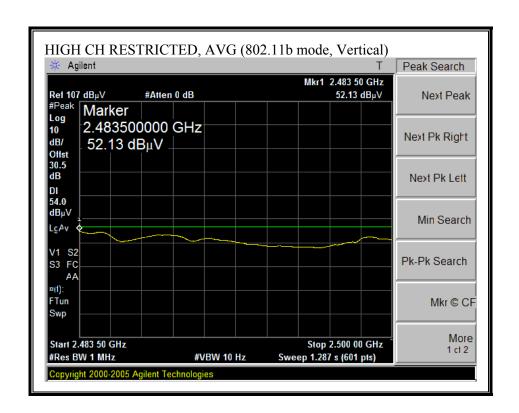
RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, HORIZONTAL)



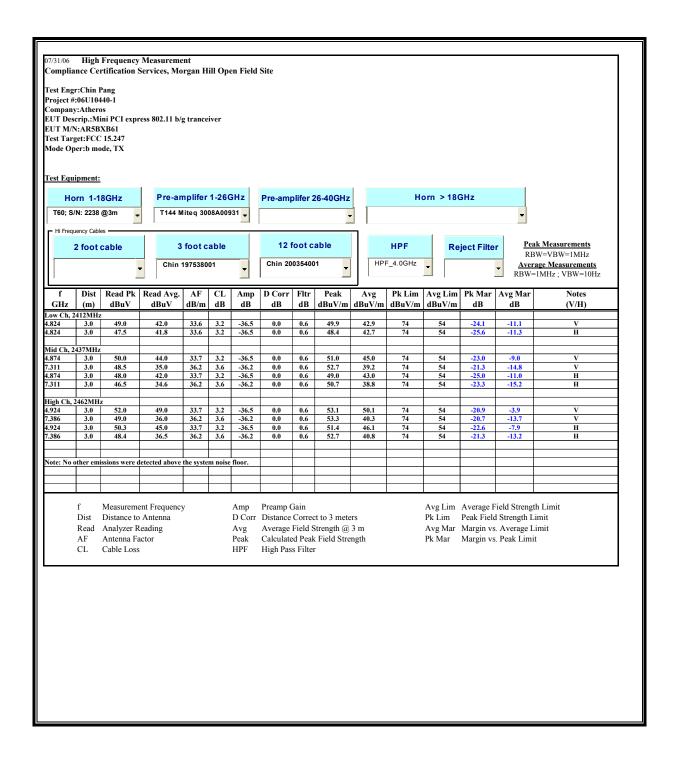


RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, VERTICAL)

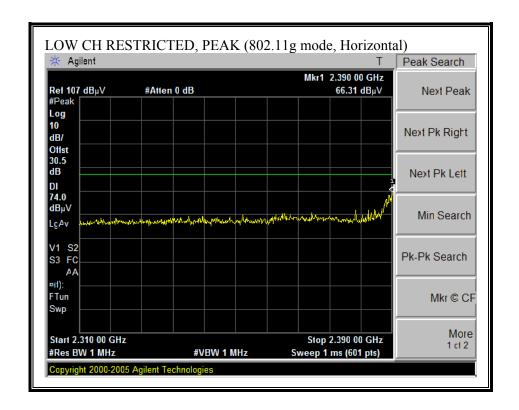


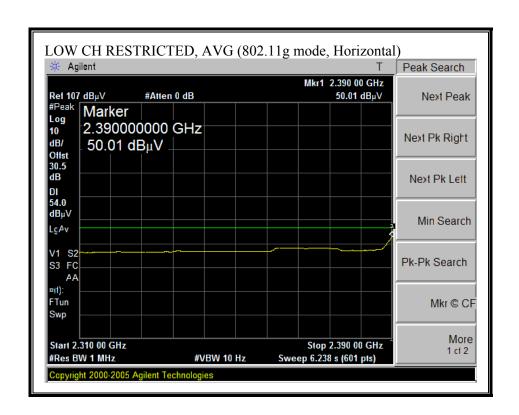


HARMONICS AND SPURIOUS EMISSIONS (b MODE)

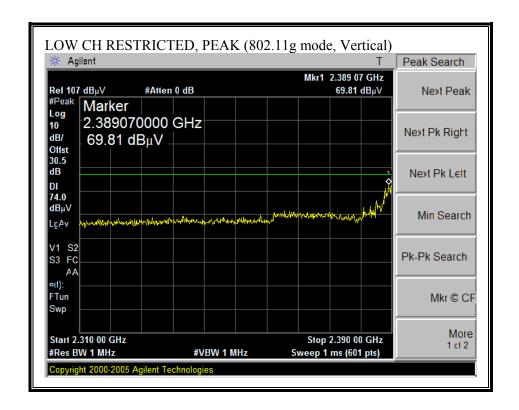


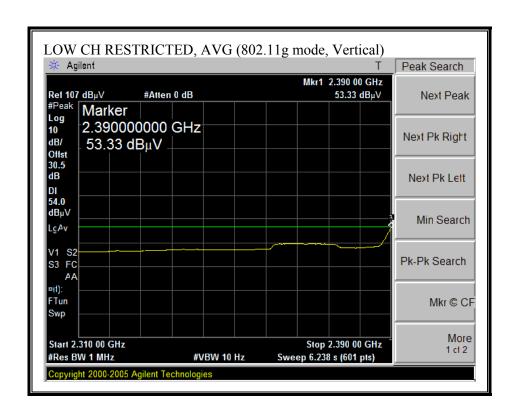
RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, HORIZONTAL)



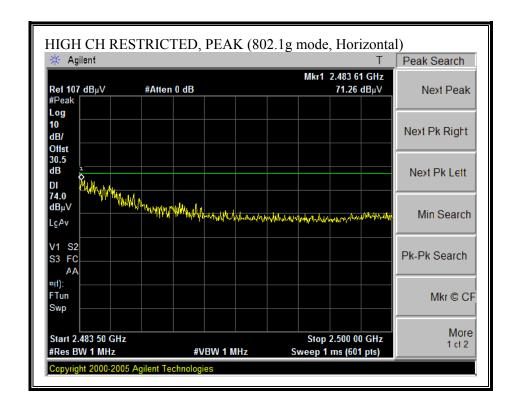


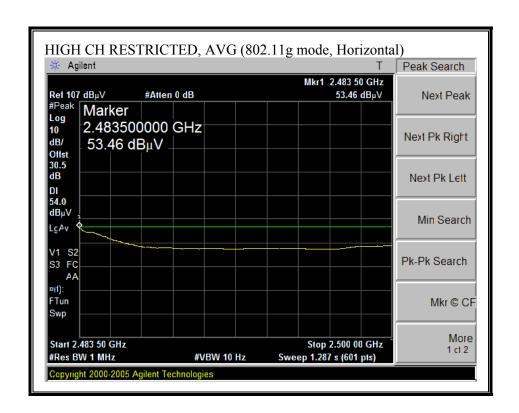
RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, VERTICAL)



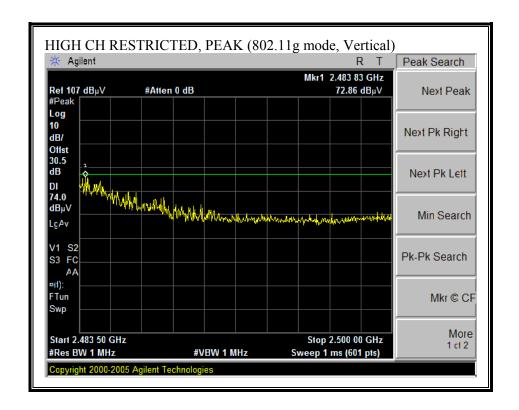


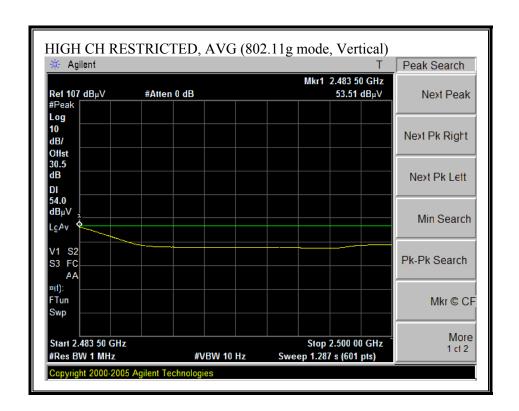
RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, HORIZONTAL)



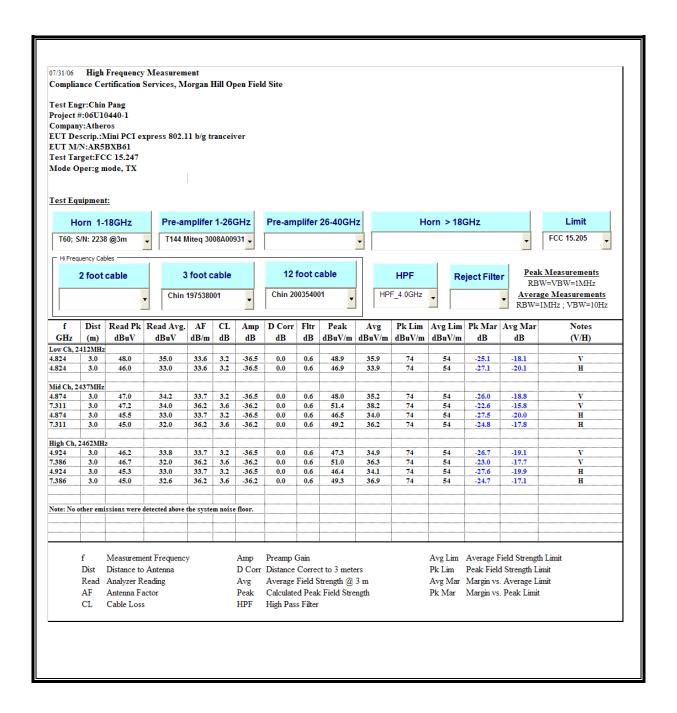


RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS (g MODE)



7.2.3. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

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

Condition: FCC CLASS-B HORIZONTAL
Test Operator: : Chin Pang
Company: : Atheros
Project #: : 06U10440
Configuration: : EUT/Laptop

Mode of Operation: TX Model: : XB61

HORIZONTAL DATA

Serial Number: : 141773121-0000360-R01

Test Target : FCC Class B

							Page:	т
	Read			Limit	Over			
Prog	Loszoll	Factor	Lowel	Line	Limit	Domark		

	Freq	Level	Factor	Level	Line	Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	324.880	18.88	16.28	35.16	46.00	-10.84	Peak
2	334.580	18.62	16.53	35.15	46.00	-10.85	Peak
3	366.590	20.04	17.31	37.35	46.00	-8.65	Peak
4	390.840	20.80	17.83	38.63	46.00	-7.37	Peak
5	500.450	20.15	20.23	40.38	46.00	-5.62	Peak
6	599.390	17.22	21.48	38.70	46.00	-7.30	Peak

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

VERTICAL DATA

Condition: FCC CLASS-B VERTICAL Test Operator: : Chin Pang Company: : Atheros
Project #: : 06U10440
Configuration: : EUT/Laptop

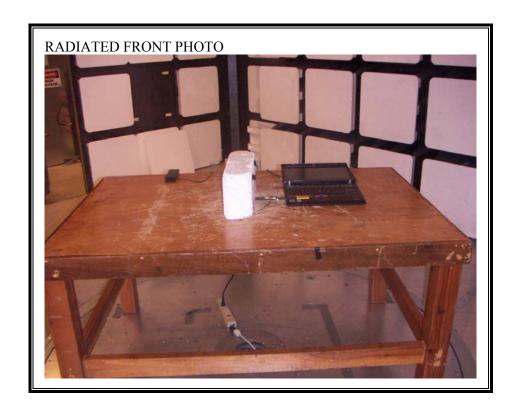
Mode of Operation: TX Model: : XB61 Serial Number: : 141773121-0000360-R01 Test Target : FCC Class B

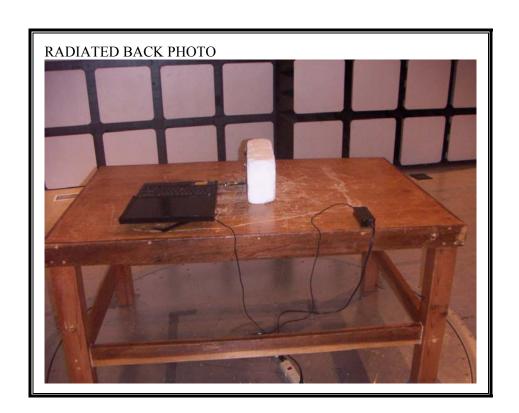
Page: 1 Limit Over Read

	Freq	Level	Factor	Level	Line	Limit	Remark
	MHz	dBuV	dB	dBuV/m	$\overline{\mathtt{dBuV/m}}$	dB	
1	48.430	24.63	10.29	34.92	40.00	-5.08	Peak
2	300.630	19.70	15.67	35.37	46.00	-10.63	Peak
3	376.290	17.60	17.53	35.13	46.00	-10.87	Peak
4	390.840	17.97	17.83	35.80	46.00	-10.20	Peak
5	489.780	14.86	20.05	34.91	46.00	-11.09	Peak
6	798.240	13.16	24.53	37.69	46.00	-8.31	Peak

8. SETUP PHOTOS

RADIATED RF MEASUREMENT SETUP





END OF REPORT