



FCC CFR47 CLASS II PERMISSIVE CHANGE
CERTIFICATION
TEST REPORT
FOR

PCI EXPRESS 802.11 A/B/G TRANSCEIVER

MODEL NUMBER: AR5BXB6

FCC ID: PPD-AR5BXB6-M

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Revision History

Rev.	Issue Date	Revisions	Revised By
A	10/21/05	Initial Issue	Thu
A2	10/28/05	Updated antenna info under Section 5.2 Item 6; added Section 7.4	Thu
A3	11/07/05	Corrected typo on power reading in Section 7.1.1.	Thu

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ATHEROS COMMUNICATIONS, INC.
5480 Great America Parkway
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EUT DESCRIPTION: PCI EXPRESS 802.11 A/B/G TRANSCEIVER

MODEL: AR5BXB6

SERIAL NUMBER: 1159P000021

DATE TESTED: OCTOBER 12-16, 2005

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: 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:



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EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES



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2. TEST METHODOLOGY

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

3. FACILITIES AND ACCREDITATION

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

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. MEASUREMENT UNCERTAINTY

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

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

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an 802.11a/b/g transceiver

The radio module is manufactured by Atheros Communications Inc..

5.2. DESCRIPTION OF CLASS II CHANGE

The changes filed under this application include:

1. Added internal shield wall

This change provides a grounded wall within the shield cavity between the Ar5424 device and the 5GHz receiver input to suppress interference from harmonics of the PCI Express bus signals. The PCB design was changed only to open a window in the solder mask material over the ground plane so that the shield can be soldered to the PCB original ground plane during manufacture;

2. Removed eccosorb attached to inside of shield cover above AR5424 I.C. This material previously provided some suppression of the PCI-Express bus harmonic. This is no longer need due to shield wall addition (#1 above);

3. Added R159 51ohm resistor in series with C17 at the terminated input of the LNA;

4. Changed some trace routing in the digital circuits (not RF section) for BT_Active and Rx_Clear signals;

5. Changed reset circuit RC values to 47kohms (R6) and 0.1uF (C1) located in digital section (not RF).

6. Add new antenna models:

Hitachi HTL017 & HFT40

Tyco: TIAN01 & TBN001

WNC: WNC001, 81.EDZ15.001/2, 81.EE115.001-4

Full antenna details are included in separate exhibit.

The highest gain of the new antenna models for 5.2GHz band is: HTL017 with a maximum gain of 3.2 dBi.

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 channel is determined as the channel with the highest output power. The highest measured output power was at 5150 MHz at low channel.

The worst-case data rate for this channel is determined to be 6Mb/s, based on previous experience with WLAN product design architectures.

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

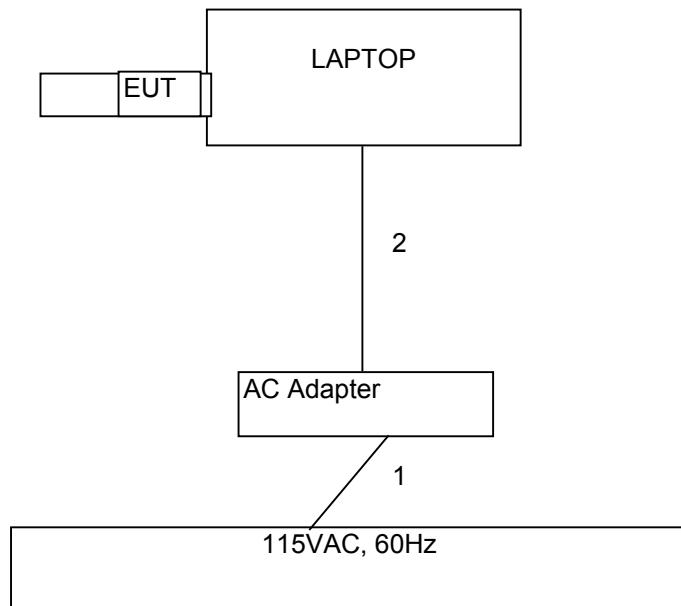
I/O CABLES

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

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
Preamplifier, 1 ~ 26.5 GHz	HP	8449B	3008A00369	8/17/2006
Spectrum Analyzer, 26.5 GHz	HP	8593EM	3710A00205	1/6/2006
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent	E4446A	US42070220	7/29/2006
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	4/22/2006
Antenna, Horn 18 ~ 26 GHz	ARA	MWH-1826/B	1049	9/12/2006
EMI Test Receiver	R & S	ESHS 20	827129/006	6/3/2006
Line Filter	Lindgren	LMF-3489	497	CNR
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	8/30/2006
Antenna, Bilog 30MHz ~ 2Ghz	Solar	JB1	A121003	3/3/2006
EMI Receiver, 9 kHz ~ 2.9 GHz	HP	8542E	3942A00286	3/29/2006
RF Filter Section	HP	85420E	3705A00256	3/29/2006
7.6GHz HPF	MicroTronic	HPM13195	1	CNR
4.0GHz HPF	MicroTronic	HPM13351	3	CNR
Power Meter	R & S	NRVD	DE 12893	10/21/06
Power Sensor, 18 GHz, 300 mW	R&S	NRV-Z51	DE 13013	10/20/06

7. LIMITS AND RESULTS

7.1. CHANNEL TESTS FOR THE 5150 TO 5350 MHz BAND

7.1.1. 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 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

802.11a Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	5180	18.25
Middle	5240	18.35
Middle	5260	18.50
High	5320	18.36

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	(²)
13.36 - 13.41			

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

² Above 38.6

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

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

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

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

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

TEST PROCEDURE

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

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

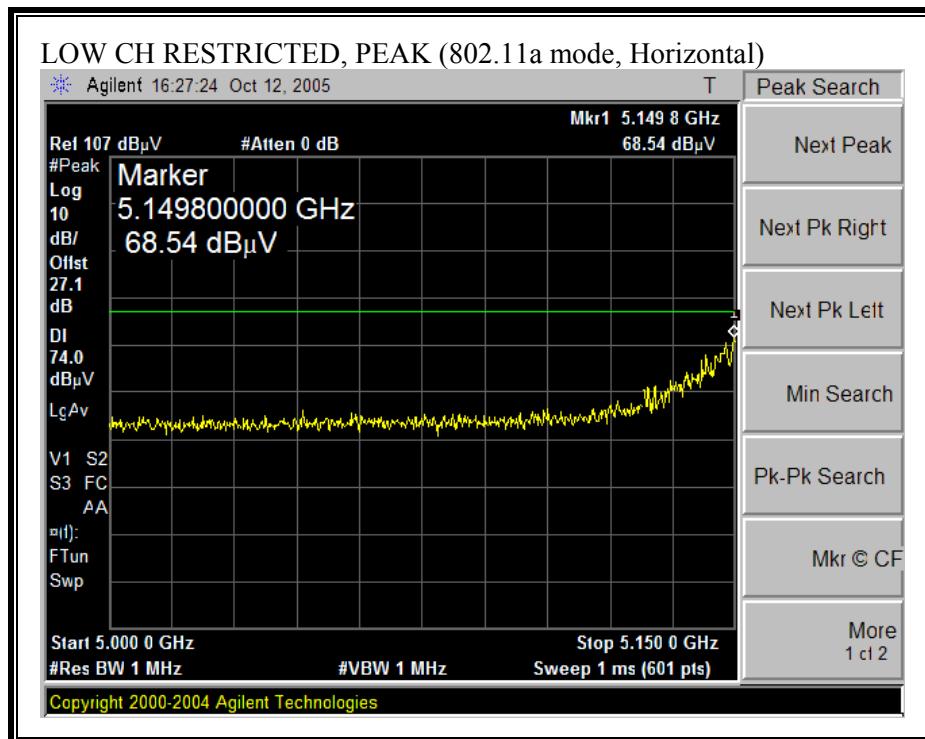
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

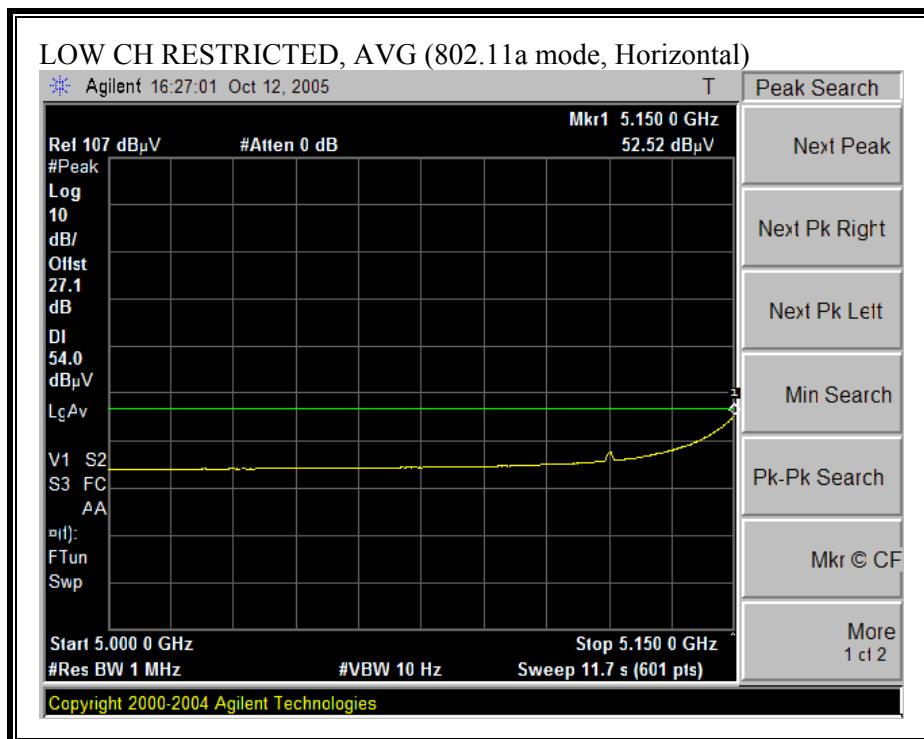
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each band.

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.

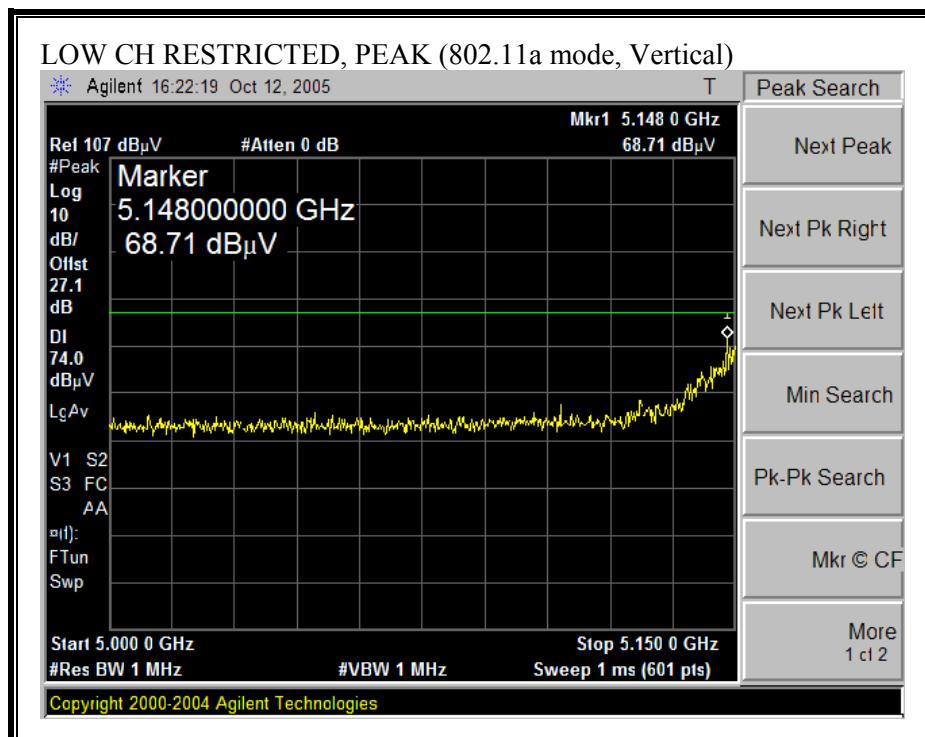
7.2.2. TRANSMITTER ABOVE 1 GHZ FOR 5150 TO 5350 MHz BAND

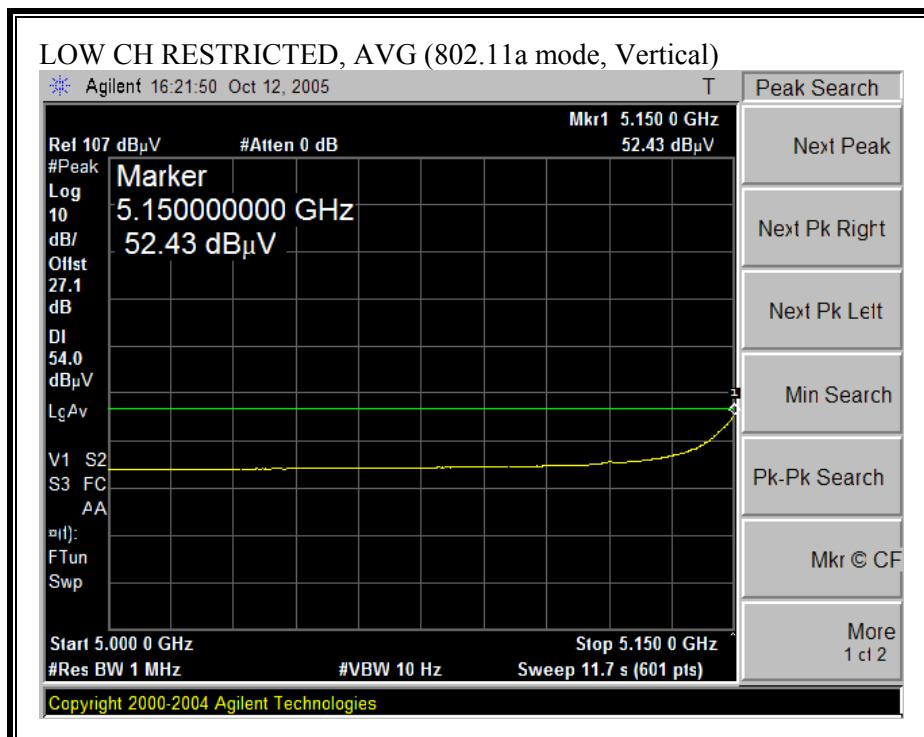
RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, HORIZONTAL)



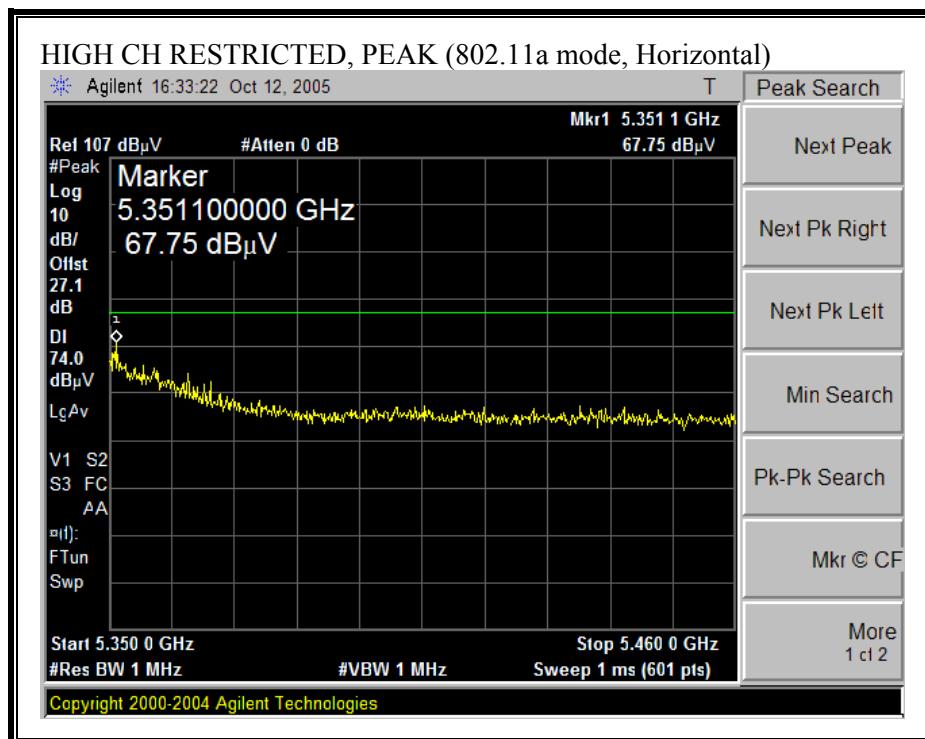


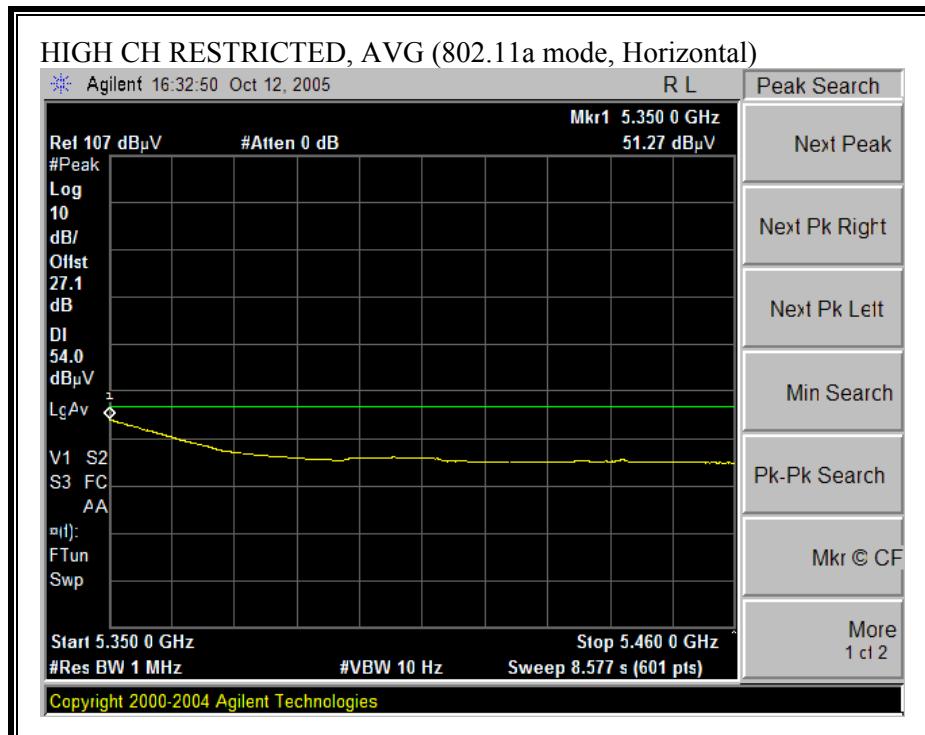
RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, VERTICAL)



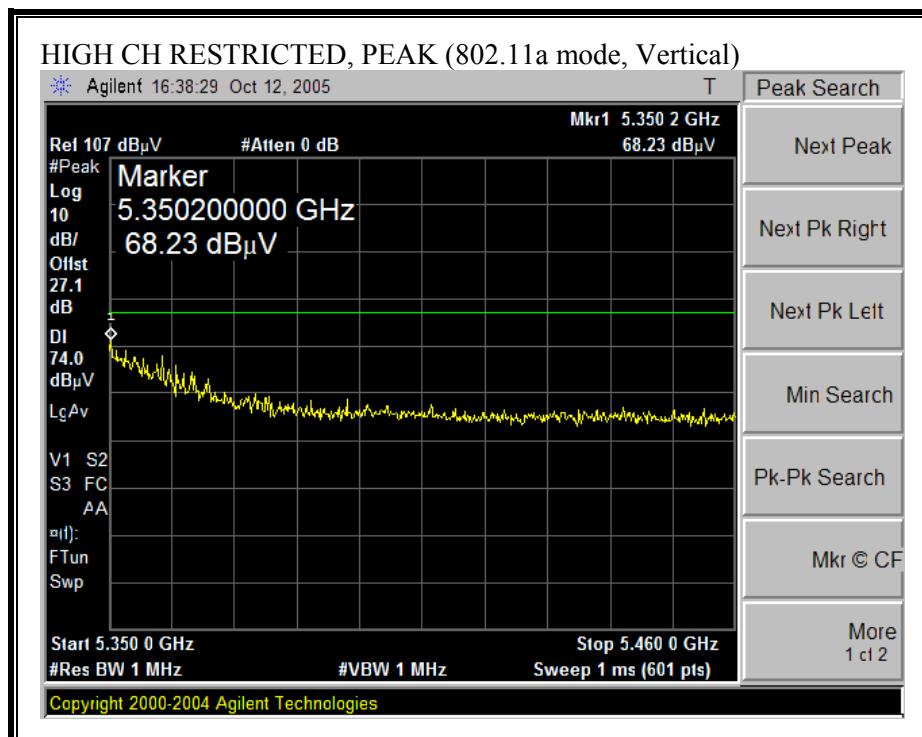


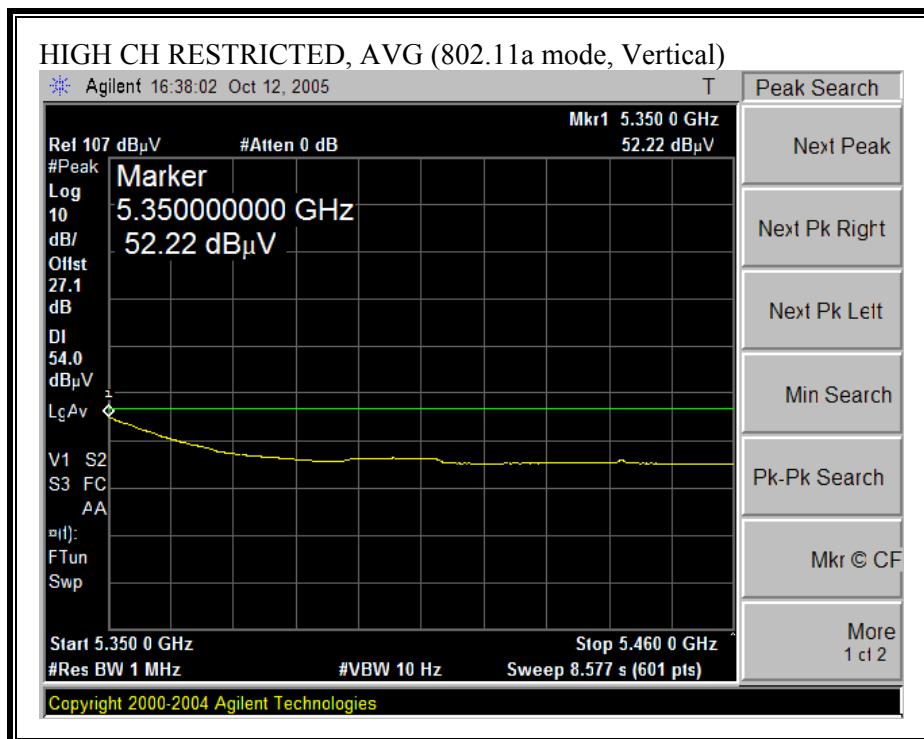
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, HORIZONTAL)





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





HARMONICS AND SPURIOUS EMISSIONS (802.11a MODE)

10/12/05 High Frequency Measurement Compliance Certification Services, Morgan Hill Open Field Site																																																																																																																																																																																																																																																																																					
Test Engr: Chin Pang Project #: 05U3760-1 Company: Atheros Communications, Inc. EUT Descrip.: Mini PCI Express 802.11 a/b/g Transceiver EUT M/N: AR5BXB6 Test Target: FCC 15.407 Mode Oper: TX, 5.2GHz UNNI BAND																																																																																																																																																																																																																																																																																					
Test Equipment:																																																																																																																																																																																																																																																																																					
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7.2.3. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

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

HORIZONTAL DATA

Condition: FCC CLASS-B HORIZONTAL
Test Operator: : Chin Pang
Project #: : 05U3760-1
Company: : Atheros
EUT: : MiniPCI Express 802.11 a/b/g
: Transceiver
Model No. : AR5BXBB6
Configuration : EUT/Laptop
Target of Test : FCC Class B
Mode of Operation: TX (Worst Case)
: 5 GHz Band

Page: 1

Freq	Read		Limit	Over	Limit	Remark
	Level	Factor				
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB
1	119.240	18.23	15.05	33.28	43.50	-10.22 Peak
2	184.230	19.87	12.86	32.73	43.50	-10.77 Peak
3	251.160	15.11	13.93	29.04	46.00	-16.96 Peak
4	506.270	15.10	20.29	35.39	46.00	-10.61 Peak
5	800.180	11.80	24.58	36.38	46.00	-9.62 Peak
6	904.940	16.02	25.99	42.01	46.00	-3.99 Peak

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

VERTICAL DATA

Condition: FCC CLASS-B VERTICAL
Test Operator: : Chin Pang
Project #: : 05U3760-1
Company: : Atheros
EUT: : MiniPCI Express 802.11 a/b/g
: Transceiver
Model No. : AR5BXB6
Configuration : EUT/Laptop
Target of Test : FCC Class B
Mode of Operation: TX (Worst Case)
: 5 GHz Band

Page: 1

Freq	Read		Limit Line	Over Limit	Remark
	Level	Factor			
MHz	dBuV	dB	dBuV/m	dBuV/m	dB
1	130.880	14.16	15.09	29.25	43.50 -14.25 Peak
2	189.080	16.30	12.93	29.23	43.50 -14.27 Peak
3	405.390	16.44	18.18	34.62	46.00 -11.38 Peak
4	507.240	15.22	20.31	35.53	46.00 -10.47 Peak
5	732.280	12.62	23.65	36.27	46.00 -9.73 Peak
6	921.430	12.37	26.12	38.49	46.00 -7.51 Peak

7.3. 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 μ 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.

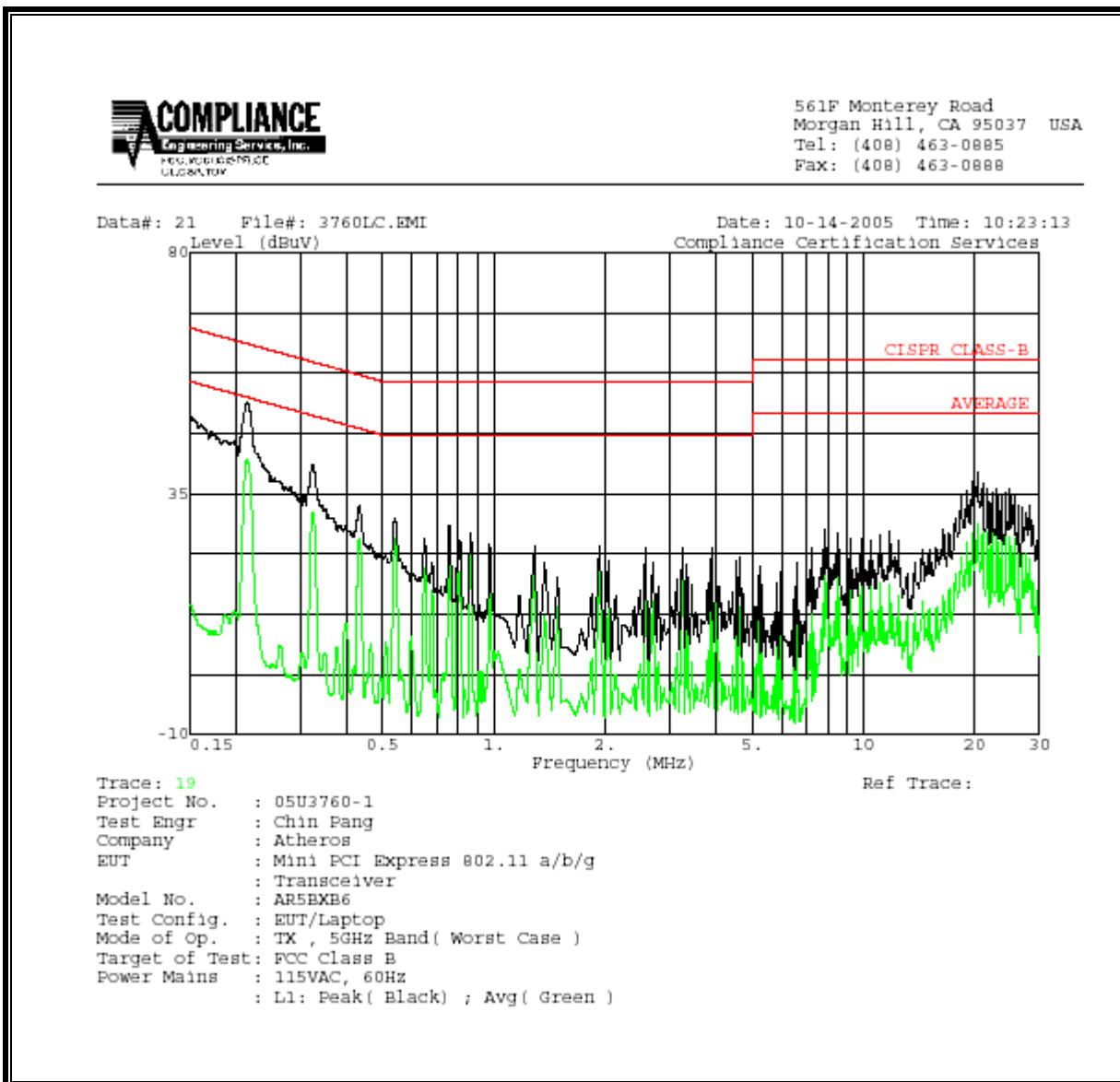
Line conducted data is recorded for both NEUTRAL and HOT lines.

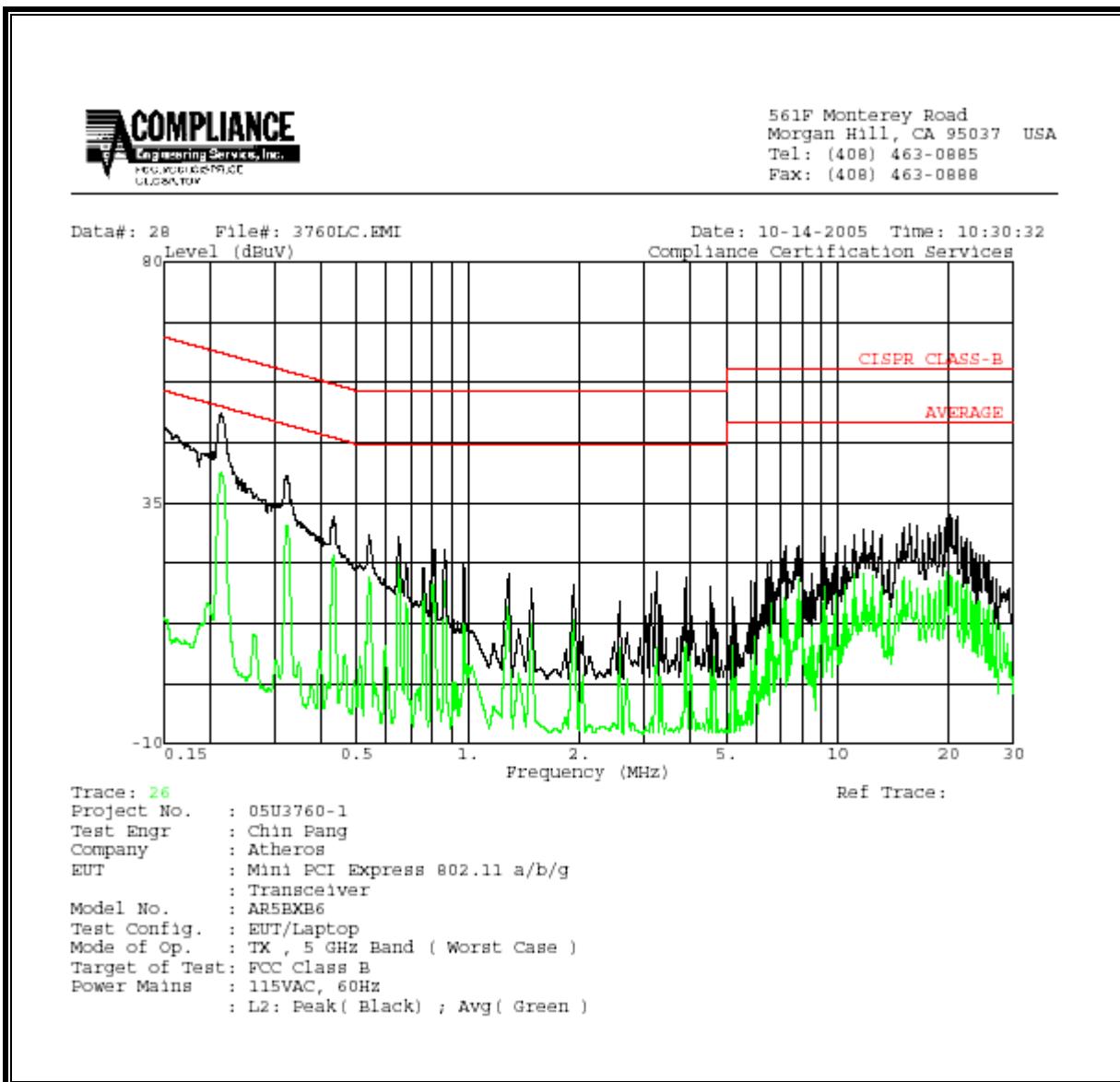
RESULTS

No non-compliance noted:

6 WORST EMISSIONS

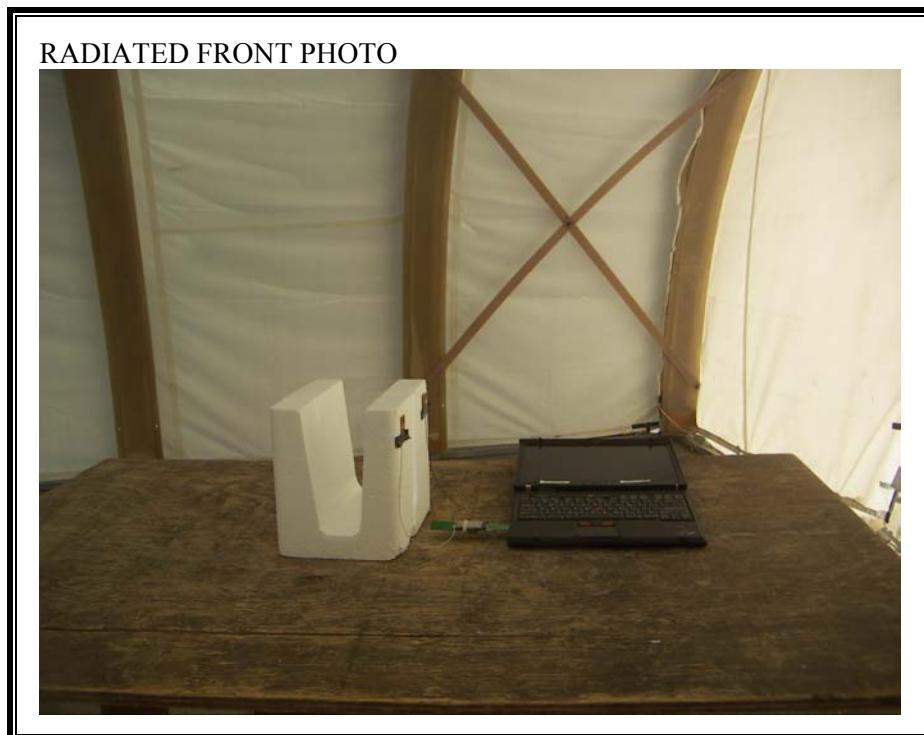
CONDUCTED EMISSIONS DATA (115VAC 60Hz)										
Freq. (MHz)	Reading			Closs (dB)	Limit	EN_B		Margin		Remark
	PK (dBuV)	QP (dBuV)	AV (dBuV)			QP	AV	QP (dB)	AV (dB)	
0.22	52.28	--	41.49	0.00	63.01	53.01	-10.73	-11.52	L1	
0.32	40.48	--	31.37	0.00	59.63	49.63	-19.15	-18.26	L1	
20.38	38.86	--	29.57	0.00	60.00	50.00	-21.14	-20.43	L1	
0.22	51.82	--	40.79	0.00	63.01	53.01	-11.19	-12.22	L2	
0.32	40.22	--	30.65	0.00	59.66	49.66	-19.44	-19.01	L2	
20.27	32.68	--	22.30	0.00	60.00	50.00	-27.32	-27.70	L2	
6 Worst Data										

LINE 1 RESULTS

LINE 2 RESULTS

8. SETUP PHOTOS

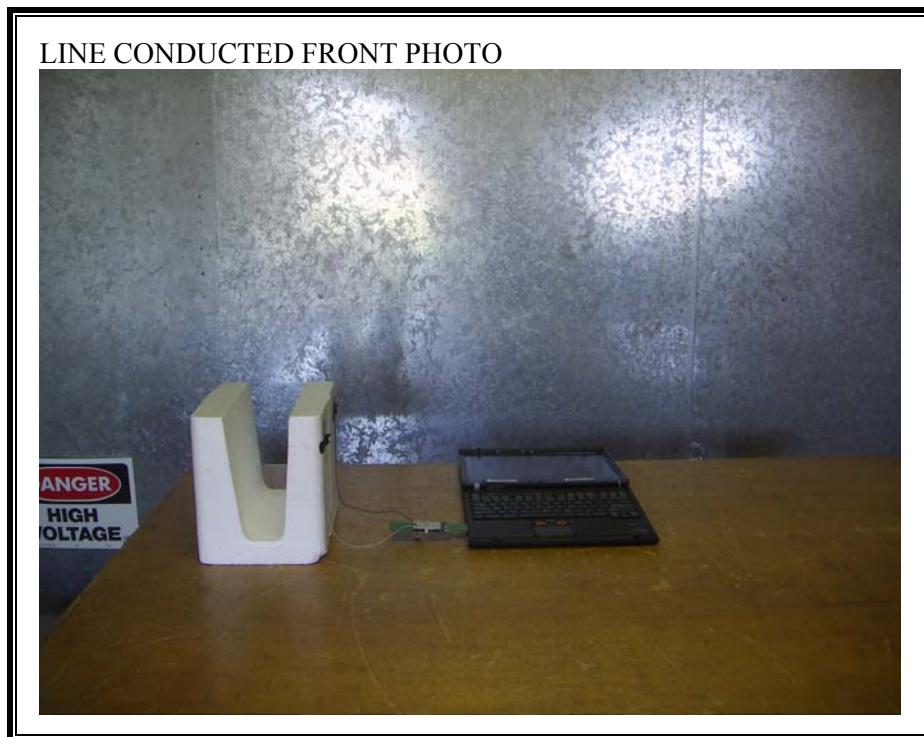
RADIATED RF MEASUREMENT SETUP



RADIATED BACK PHOTO



POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP



LINE CONDUCTED BACK PHOTO



END OF REPORT