



**FCC CFR47 PART 15 SUBPART C
CLASS II PERMISSIVE CHANGE
TEST REPORT**

FOR

MINI PCI 802.11 B/G TRANSCEIVER

MODEL NUMBER: AR5BMB5

FCC ID: PPD-AR5BMB5

REPORT NUMBER: 04U3040-1

ISSUE DATE: NOVEMBER 12, 2004

Prepared for
**ATHEROS COMMUNICATIONS INC.
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SUNNYVALE, CA 94085
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Prepared by
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NVLAP[®]
LAB CODE:200065-0

Revision History

<u>Rev.</u>	<u>Revisions</u>	<u>Revised By</u>
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ATHEROS COMMUNICATIONS INC.
529 ALMANOR AVE.
SUNNYVALE, CA 94085 U.S.A.

EUT DESCRIPTION: MINI PCI 802.11 b/g TRANSCEIVER

MODEL: AR5BMB5

DATE TESTED: OCTOBER 29 – NOVEMBER 9, 2004

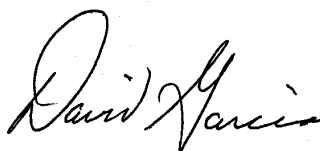
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 15 SUBPART C	NO NON-COMPLIANCE NOTED

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

Note: 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:



YAN ZHENG
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

DAVID GARCIA
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

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 802.11b/g Mini PCI transceiver module, operating in the 2400-2483.5 MHz band.

The purpose of the Class II Permissive Change is to add to the list of antennas that are applicable with the module.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Maximum conducted peak power

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2462	802.11b	22.41	174.18
2412 - 2462	802.11g	22.87	193.64
2437	802.11g Turbo	23.76	237.68

Maximum conducted average power

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2462	802.11b	19.8	95.50
2412 - 2462	802.11g	19.0	79.43
2412 - 2462	802.11g Turbo	19.0	79.43

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes two integrated omni directional antennas for diversity. The following is the list of the antennas to be added to AR5BMB5 Certifications. All the tests have been performed with the highest gain antenna, which is HTL017, manufactured by Hitachi.

Antennas to be Added to AR5BMB5 Certifications

Highest Gain in **Green**

Manufacturer	Antenna Part Number	Antenna Type	<u>Peak Assembly Gain (with Cable Loss) (dBi)</u>	
			<u>Cable Lengths Main/Aux (mm)</u>	<u>Peak Gain in 2.4GHz (dBi)</u>
Hitachi	HTL 017	Integrated Omnidirectional	510/0510	2.2
Hitachi	HTL 008	Integrated Omnidirectional	510/0510	0.2
Hitachi	HTL 004	Integrated Omnidirectional	510/0510	1.5
Tyco/IDAA	TIAN01	Integrated Omnidirectional	510/0510	2.0
Foxconn	EW3	Integrated Omnidirectional	581/650	2.1
Hitachi	HFT24S0	Integrated Omnidirectional	525/670	2.12
Hitachi	HFT23S0	Integrated Omnidirectional	525/670	1.6
Hitachi	HFD-04R	Integrated Omnidirectional	570/680	0.71
SmartAnt	DD0RB1TH102	Integrated Omnidirectional	520/570	0.48
Nissei	1-754-331-11(main), 1-754-331-21 (aux)	Integrated Omnidirectional	630/870	-2.45
Phycomp	XXX17	Integrated Omnidirectional	760/950	0.6
Phycomp	XXX15	Integrated Omnidirectional	590/735	0.6
Wistron	81.ED415.001	Integrated Omnidirectional	465/650	0.52
Wistron	81.EBJ15.003	Integrated Omnidirectional	535/791	2.14
Wistron	81.EBJ15.001	Integrated Omnidirectional	628/493	0.66
Wistron	50.EBQ0X.001	Integrated Omnidirectional	340/355	0.59
Wistron	81.ED415.005	Integrated Omnidirectional	300/300	1.27
Wistron	81.ED415.006	Integrated Omnidirectional	300/300	1.48
Wistron	81.ED415.003	Integrated Omnidirectional	535/791	2.14
Foxocnn	62P4204 (main) / 62P4203 (aux)	Integrated Omnidirectional	740/845	0.99
Hitachi	91P6841 (main) / 91P6840 (aux)	Integrated Omnidirectional	755/580	1.24
Hitachi	91P6812 (main) / 91P6813 (aux)	Integrated Omnidirectional	775/670	1.71
Hitachi	91P6810 (main) / 91P6811 (aux)	Integrated Omnidirectional	750/635	1.84
Nissei	13N5743 (main) / 13N5742 (aux)	Integrated Omnidirectional	488/449	1.67
SmartAnt	RO222-099 (main) / RO222-100 (aux)	Integrated Omnidirectional	570/610	0.87
Nissei	08K4083 (main) / 08K4084 (aux)	Integrated Omnidirectional	394/534	1.28

5.4. SOFTWARE AND FIRMWARE

The test firmware was installed in the EUT during testing.

The test utility software used during testing was “art program” rev. V5_2_b14.

5.5. 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 2412 MHz for b mode.

The worst-case data rate for this channel is determined to be 11 Mb/s, based on previous experience with 802.11b/g WLAN product design architectures.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Dell	PP01L	CN-04P240-48643-2BK-4131	DOC
AC/DC Adapter	Dell	AA2031	CN-09364U-12761-0BP-0QXN	N/A

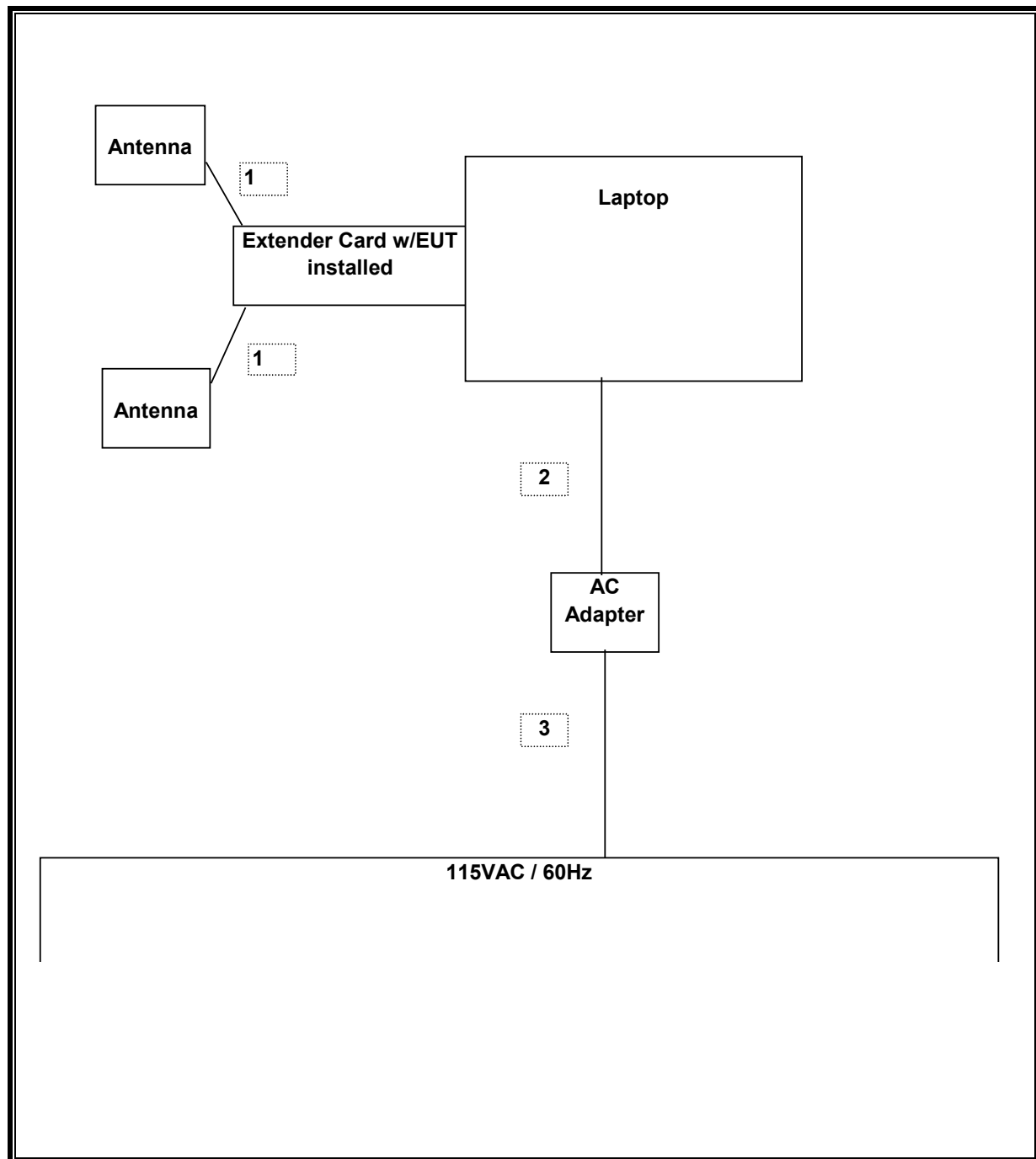
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	Antenna	2		Shielded	.48m	Yes
2	DC	1	DC	Unshielded	1.8m	No
3	AC	1	AC	Unshielded	1.8m	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



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
EMI Test Receiver	R & S	ESHS 20	827129/006	10/22/2005
Site A Line Stabilizer / Conditioner	Tripplite	LC-1800a	A0051681	CNR
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	8/30/2005
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	10/21/2005
Spectrum Analyzer	HP	E4446A	US42510266	8/25/2005
Antenna, Horn 1 ~ 18 GHz	EMCO	3117	29310	9/12/2005
Preamplifier, 1 ~ 26.5 GHz	HP	8449B	3008A00369	8/17/2005
Temperature / Humidity Chamber	Thermotron	SE 600-10-10	29800	5/13/2005
Peak Power Meter	Agilent	E4416A	GB41291160	11/7/2004
Peak / Average Power Sensor	Agilent	E9327A	US40440755	11/7/2004
RF Filter Section	HP	85420E	3705A00256	11/21/2004
EMI Receiver, 9 kHz ~ 2.9 GHz	HP	8542E	3942A00286	11/21/2004
30MHz---- 2Ghz	Sunol Sciences	JB1 Antenna	A121003	12/22/2004
4.0 High Pass Filter	Micro Tronics	HPM13351	3	N/A

7. LIMITS AND RESULTS

7.1. CHANNEL TESTS FOR THE 2400 TO 2483.5 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 11.18 dB (including 10 dB pad and 1.18 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

802.11b Mode

Channel	Frequency (MHz)	Power (dBm)
Low	2412	19.8
Middle	2437	19.5
High	2462	19.1

802.11g Mode

Channel	Frequency (MHz)	Power (dBm)
Low	2412	16.1
Middle	2437	19
High	2462	16.6

802.11g Turbo Mode

Channel	Frequency (MHz)	Power (dBm)
Middle	2437	19

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.

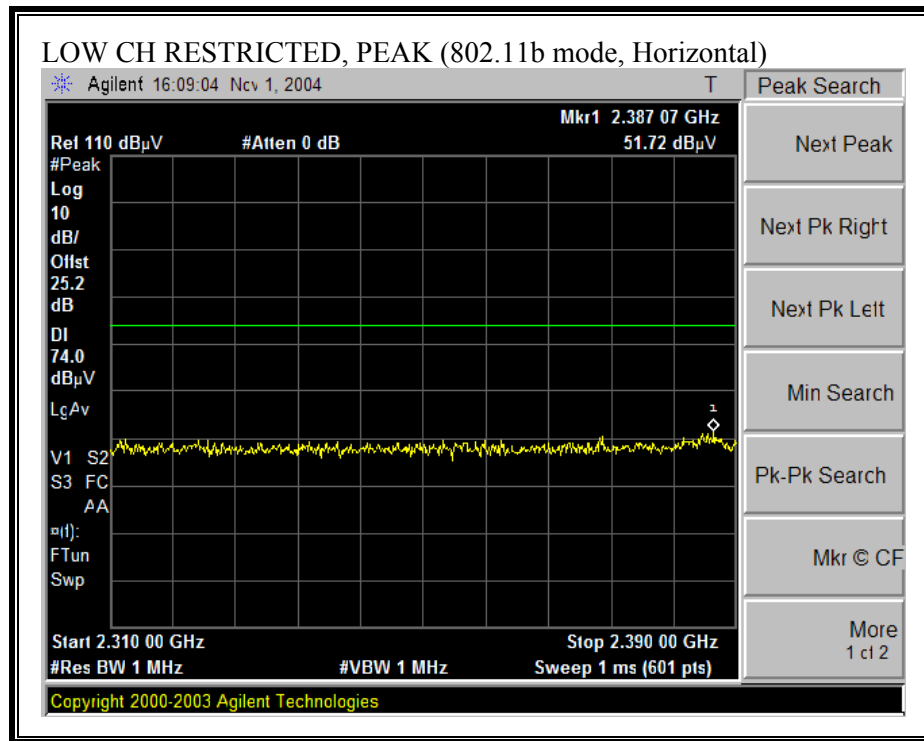
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

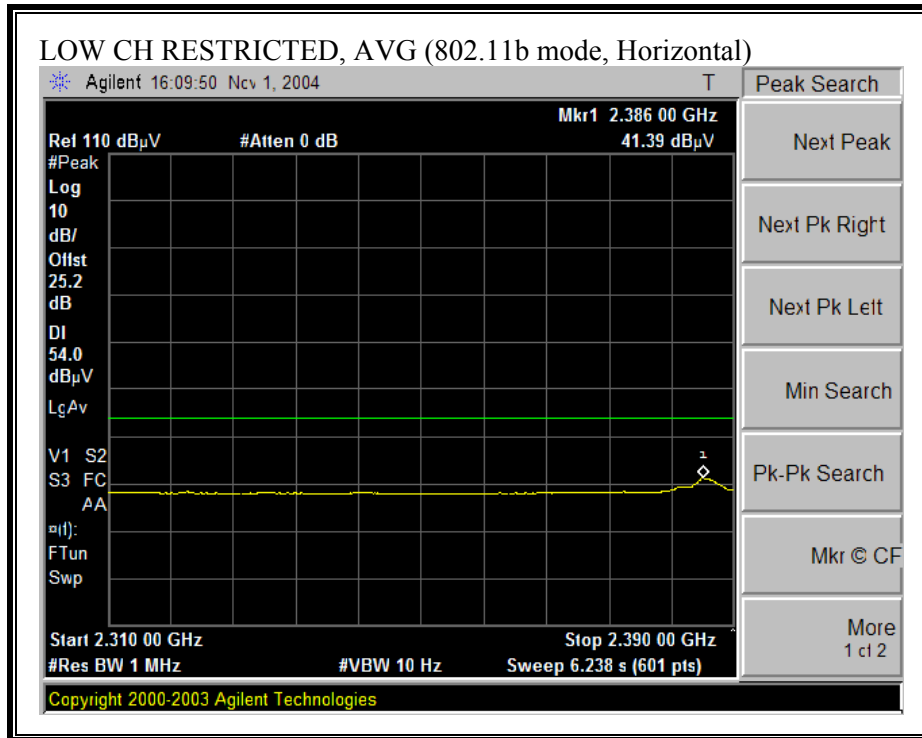
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

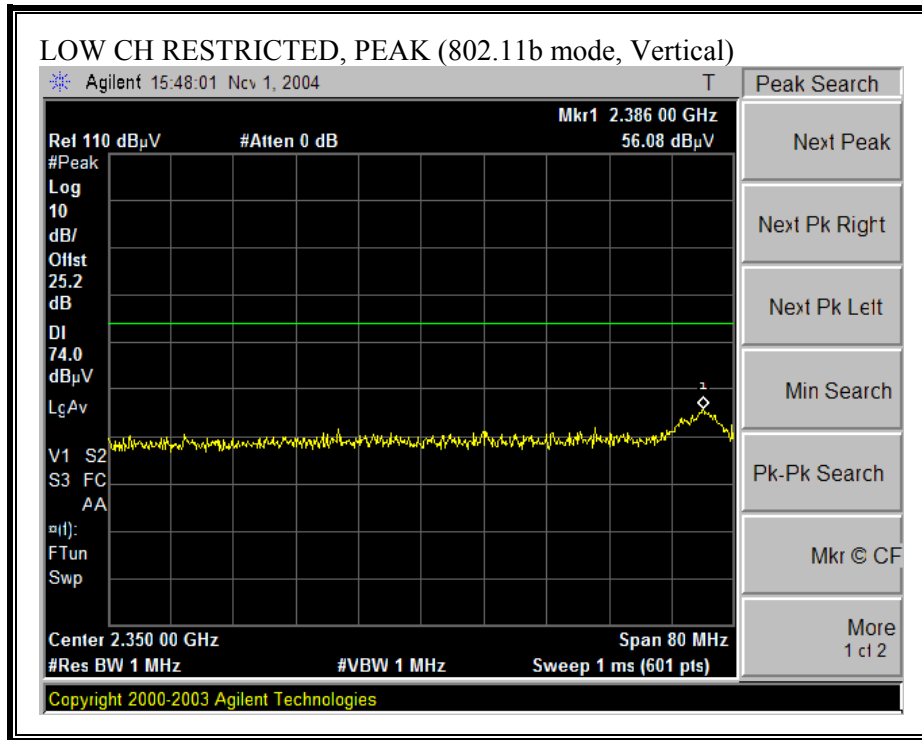
7.2.2. TRANSMITTER ABOVE 1 GHz FOR 2400 TO 2483.5 MHz BAND

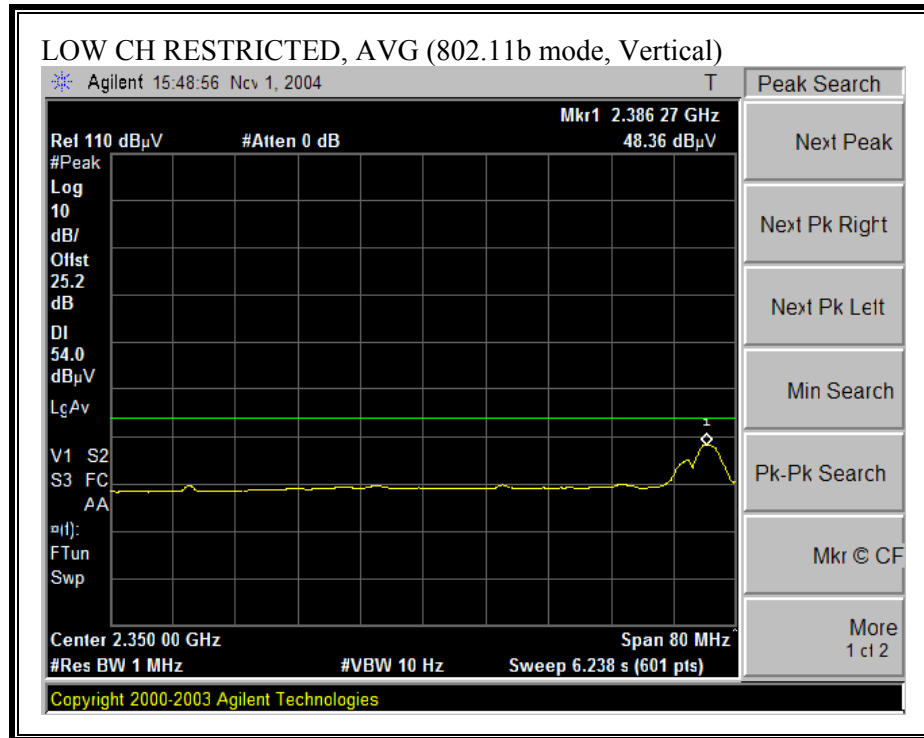
RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, HORIZONTAL)



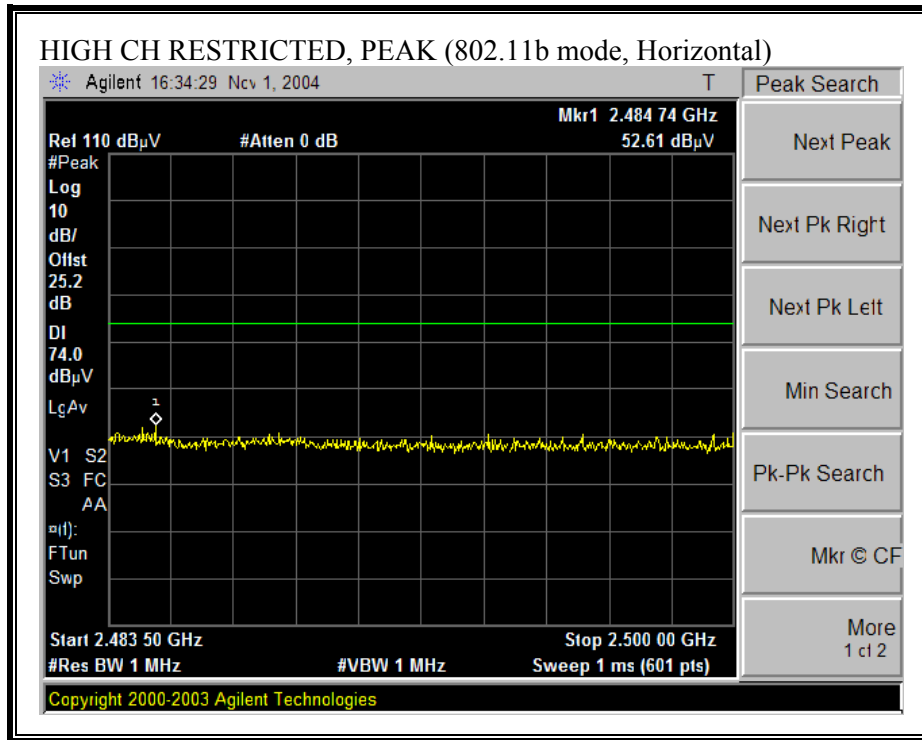


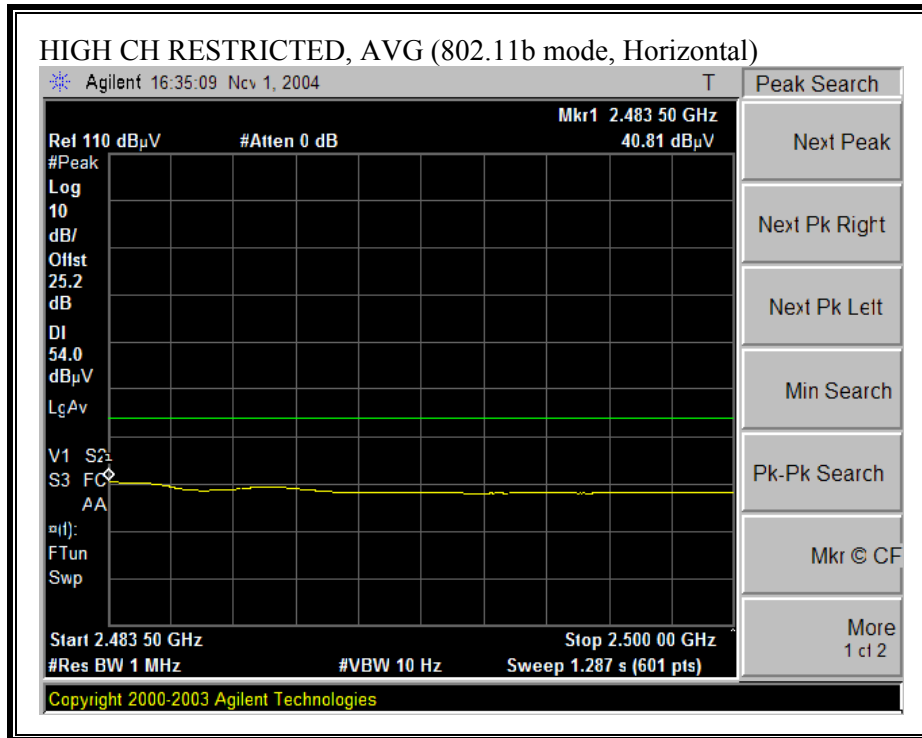
RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, VERTICAL)



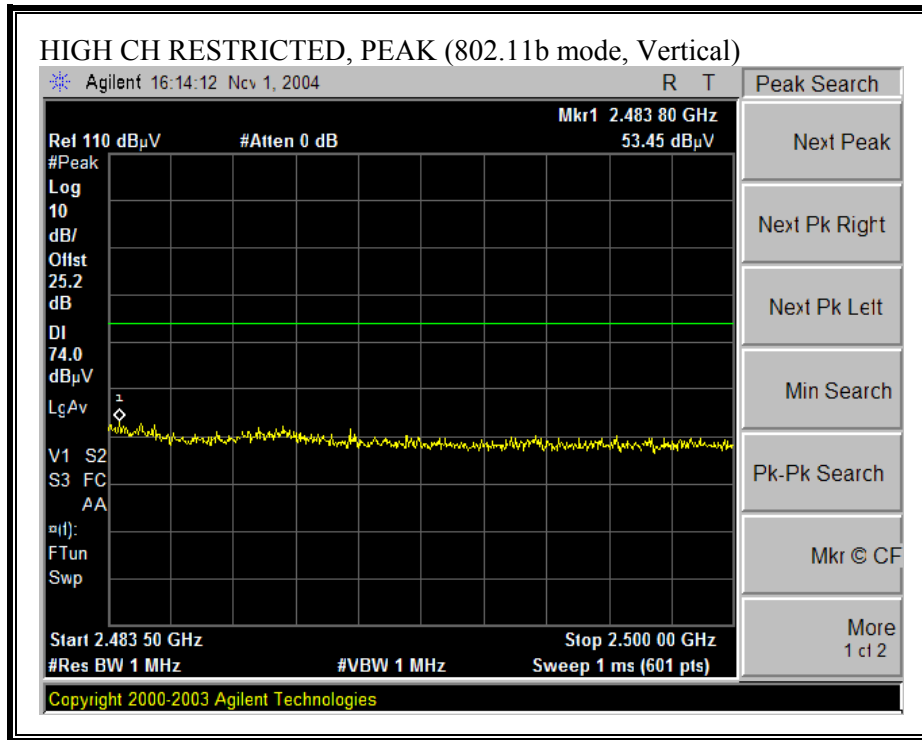


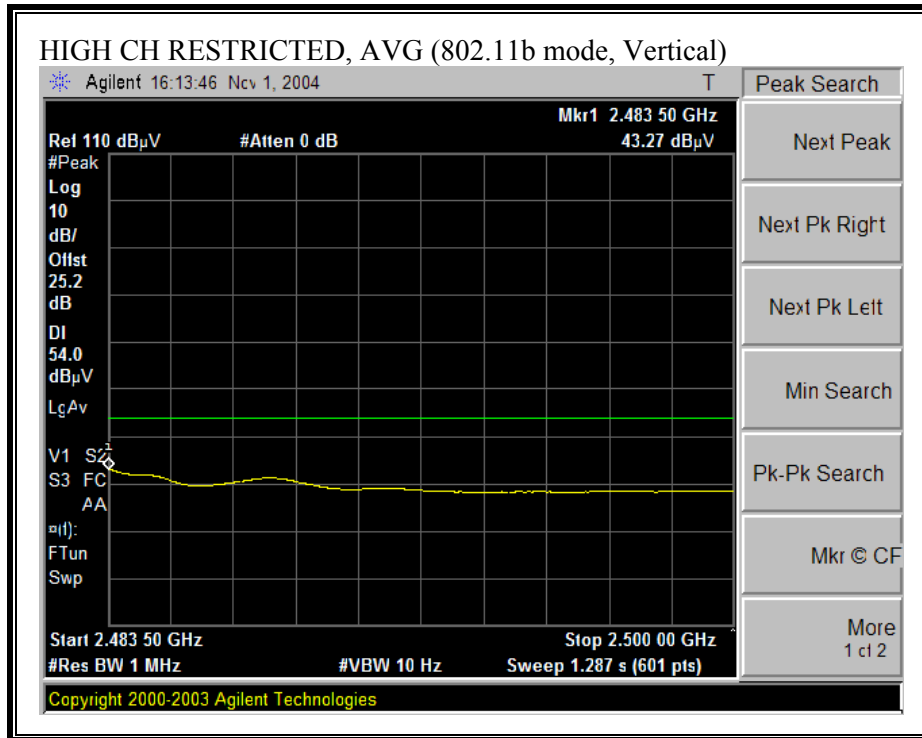
RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, HORIZONTAL)





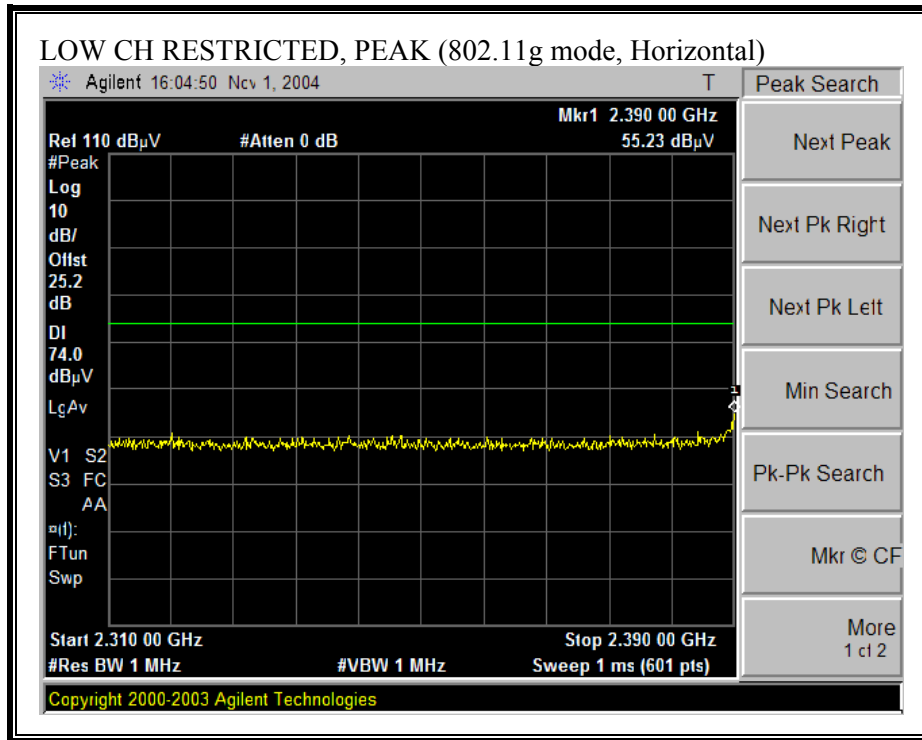
RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, VERTICAL)

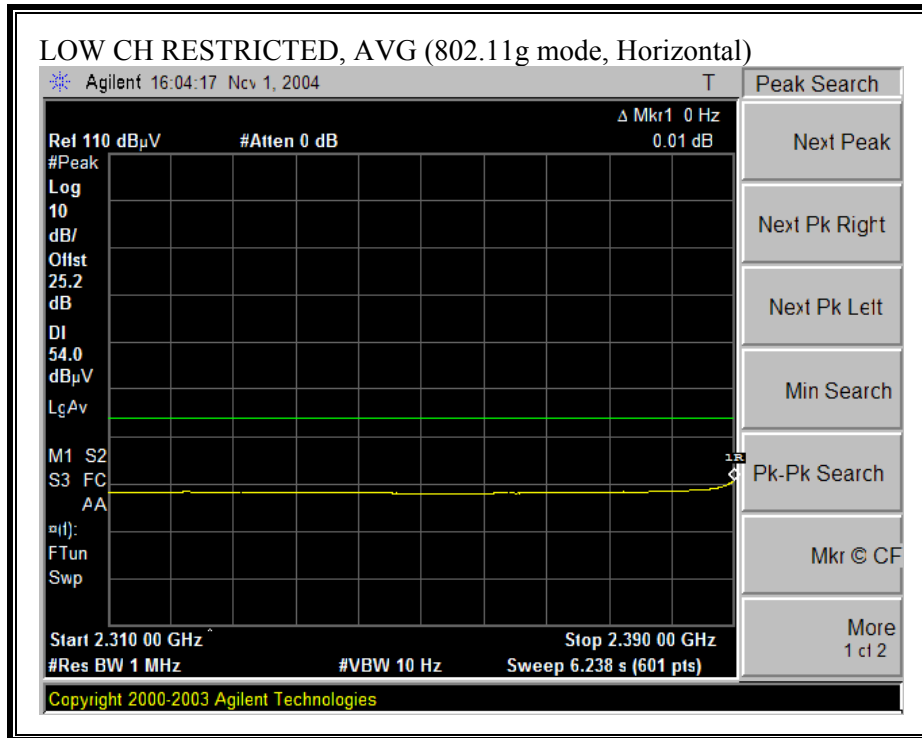




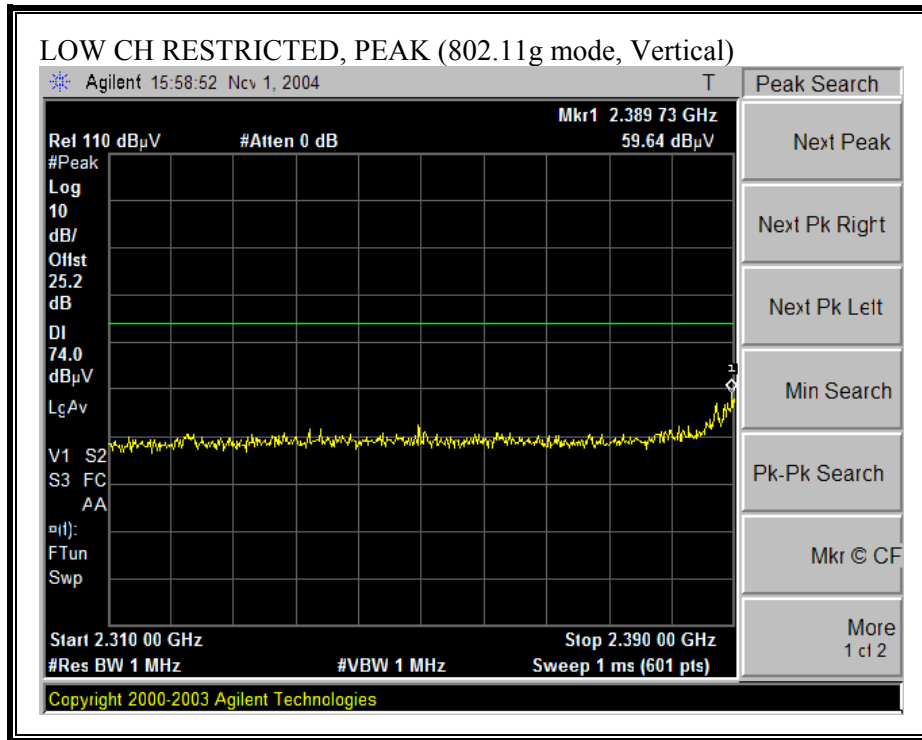
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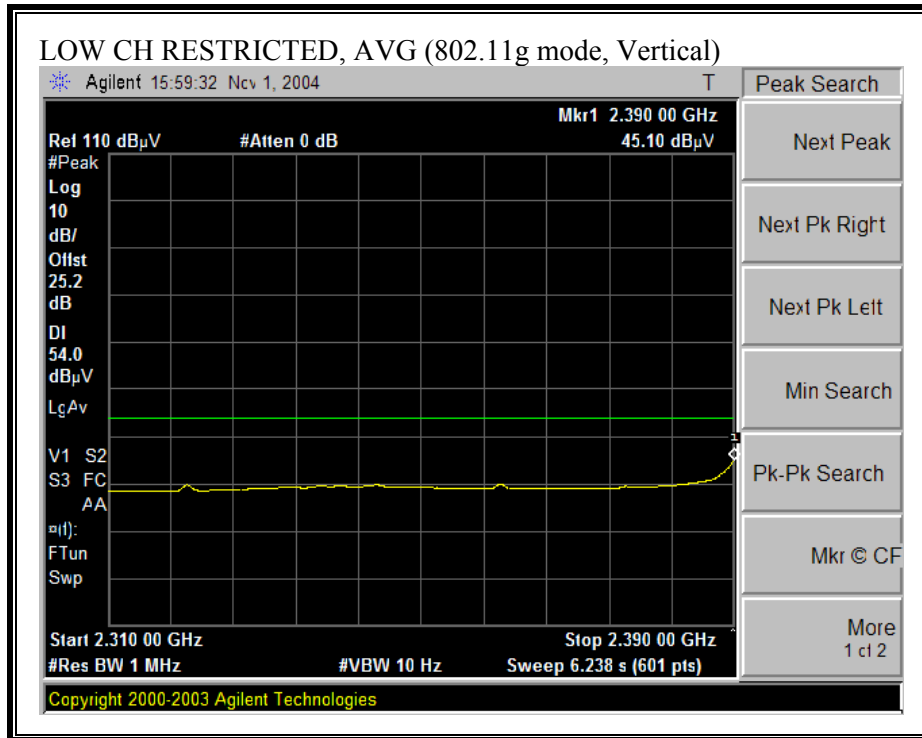
RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, HORIZONTAL)



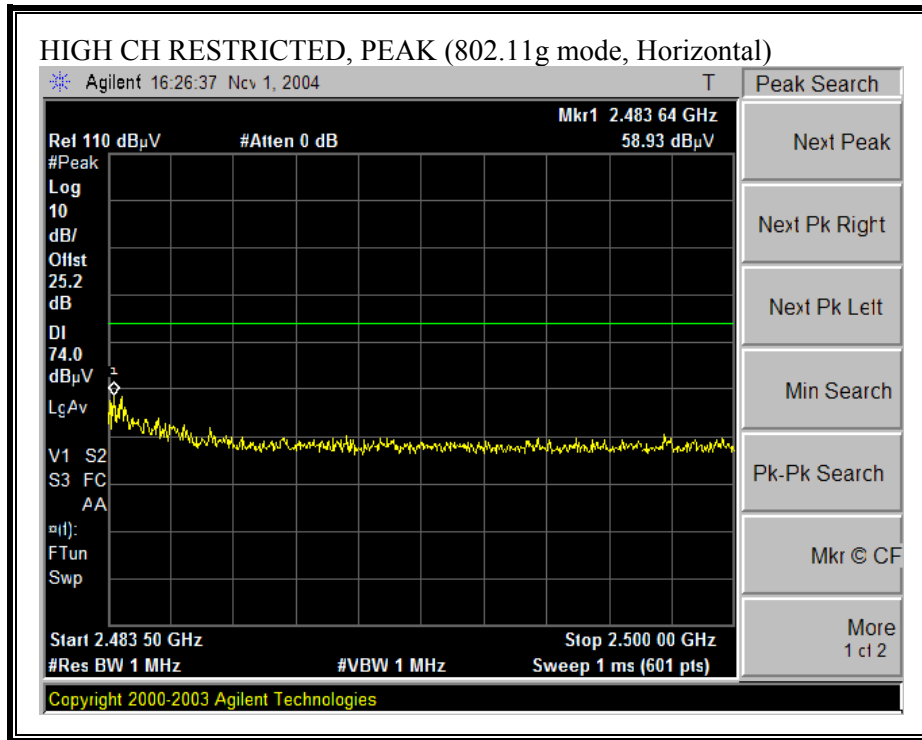


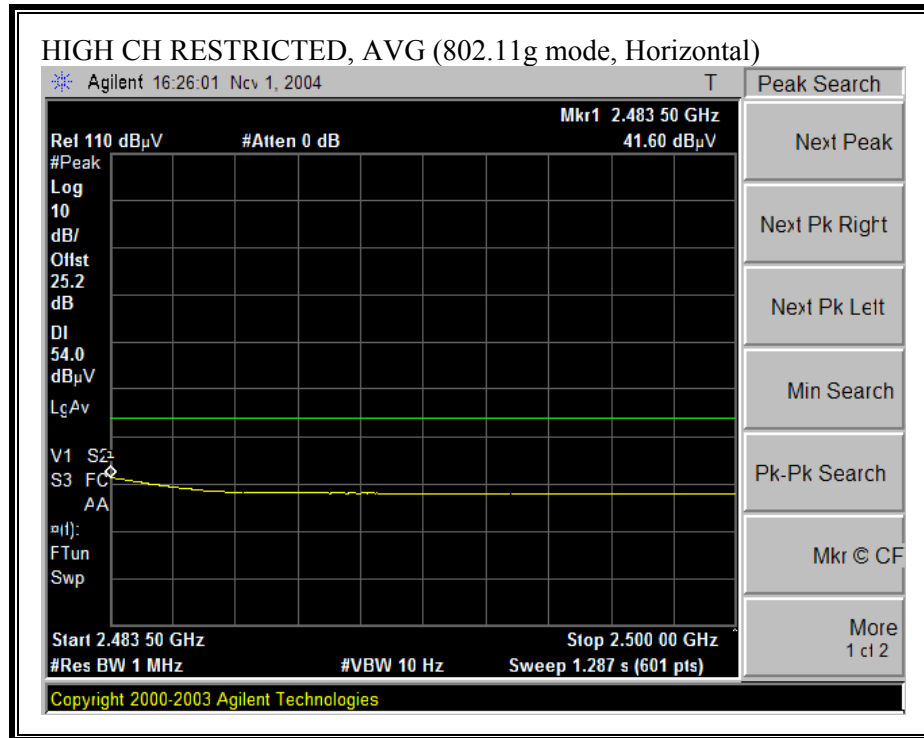
RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, VERTICAL)



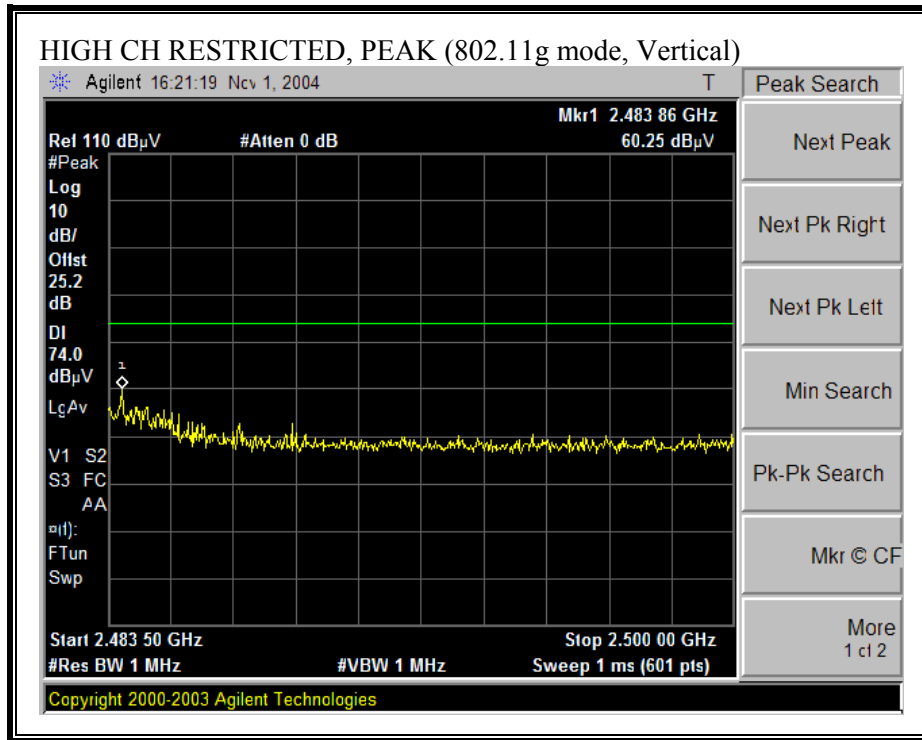


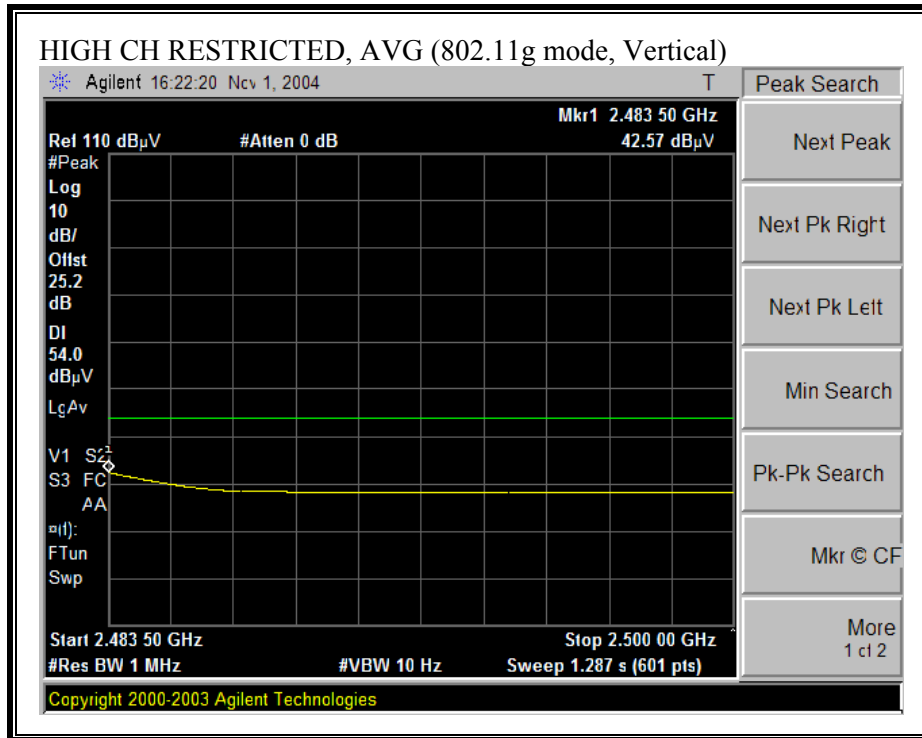
RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, VERTICAL)





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7.2.3. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

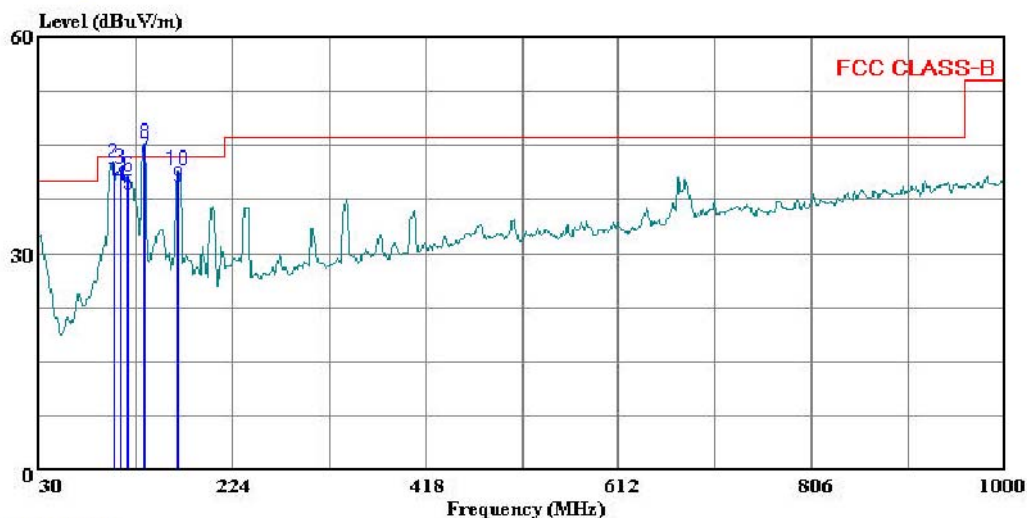
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT



561F Monterey Road
Morgan Hill, CA 95037
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 8 File#: 04U3040-1.EMI Date: 11-09-2004 Time: 16:02:48



(Audix.ATC)

Trace: 5

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator: : David Garcia
Project #: : 04U3040-1
Company: : Atheros
EUT: : 802.11 b/g/g turbo Mini PCI card
Model No: : AR5BMB5
Configuration: : Extender card/laptop/antenna
Target of Test: : FCC Class B
Mode of Operation: 11b 2412 channel

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HORIZONTAL DATA

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	104.690	QP	27.56	12.48	40.04	43.50	-3.46
2	104.690	Peak	30.17	12.48	42.65	43.50	-0.85
3	111.480	Peak	27.72	14.10	41.82	43.50	-1.68
4	111.480	QP	25.42	14.10	39.52	43.50	-3.98
5	119.240	QP	22.95	15.24	38.19	43.50	-5.31
6	119.240	Peak	25.47	15.24	40.71	43.50	-2.79
7	135.730	QP	27.67	15.80	43.47	43.50	-0.03
8 *	135.730	Peak	29.54	15.76	45.30	43.50	1.80
9	169.680	QP	25.34	13.88	39.22	43.50	-4.28
10	169.680	Peak	27.69	13.88	41.57	43.50	-1.93

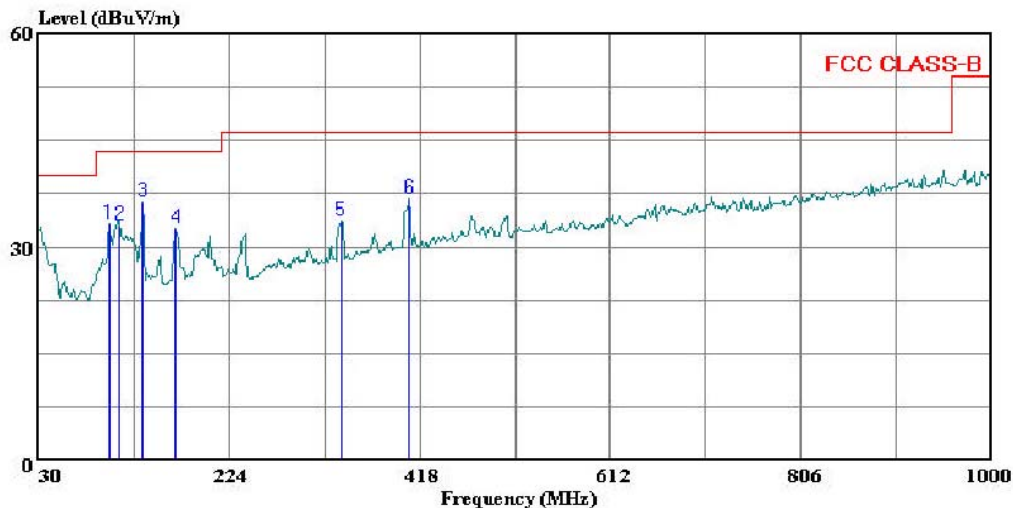
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL PLOT



561F Monterey Road
Morgan Hill, CA 95037
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 12 File#: 04U3040-1.EMI Date: 11-09-2004 Time: 16:13:11



(Audix ATC)

Trace: 11

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator: : David Garcia
Project #: : 04U3040-1
Company: : Atheros
EUT: : 802.11 b/g/g turbo Mini PCI card
Model No: : AR5BMB5
Configuration: : Extender card/laptop/antenna
Target of Test: : FCC Class B
Mode of Operation: 11b 2412 channel

Page: 1

VERTICAL DATA

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	101.780	Peak	21.76	11.38	33.14	43.50	-10.36
2	112.450	Peak	18.84	14.27	33.11	43.50	-10.39
3	135.730	Peak	20.66	15.76	36.42	43.50	-7.08
4	169.680	Peak	18.69	13.88	32.57	43.50	-10.93
5	337.490	Peak	16.60	16.98	33.58	46.00	-12.42
6	407.330	Peak	18.01	18.76	36.77	46.00	-9.23

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.

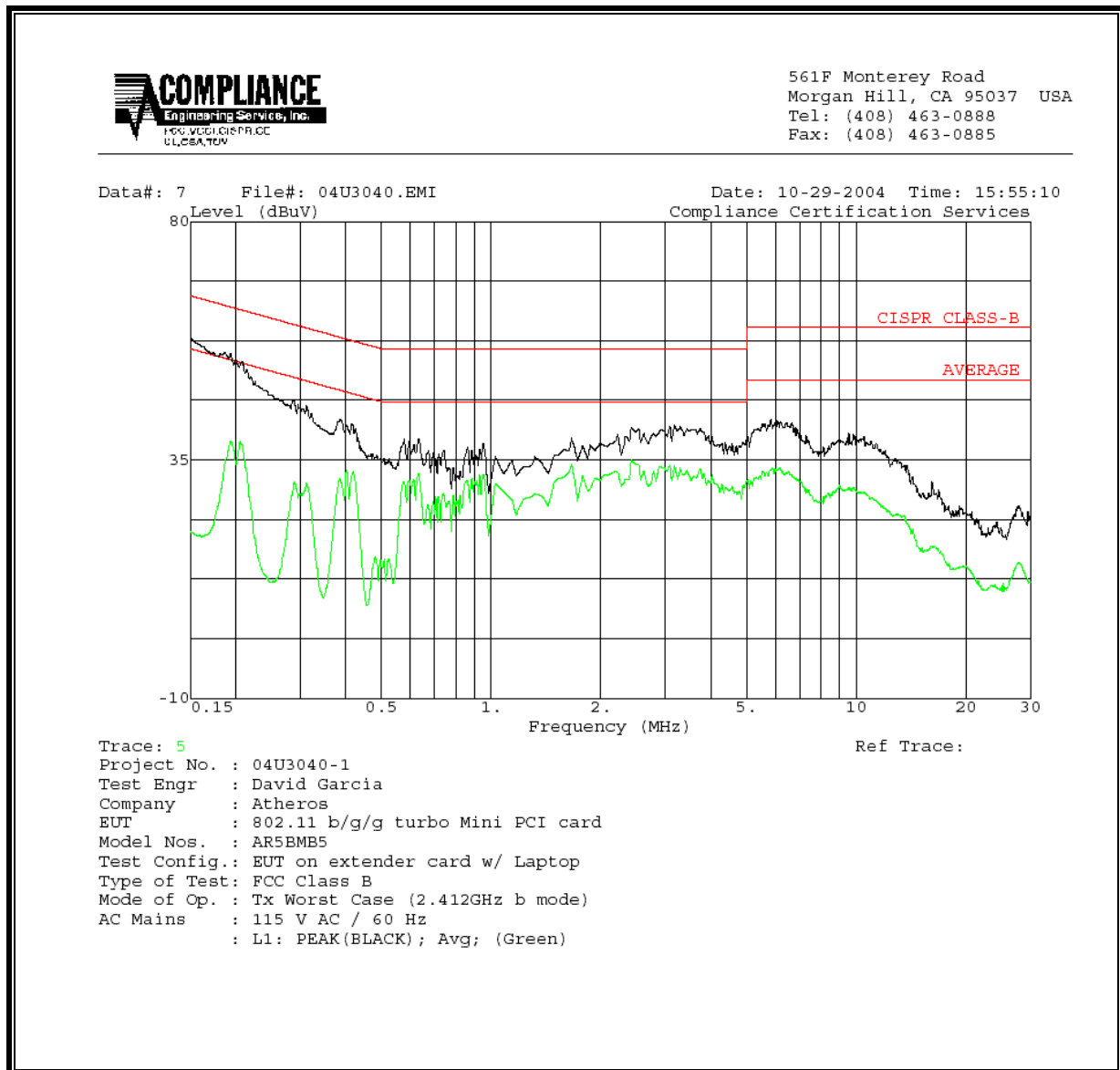
RESULTS

No non-compliance noted:

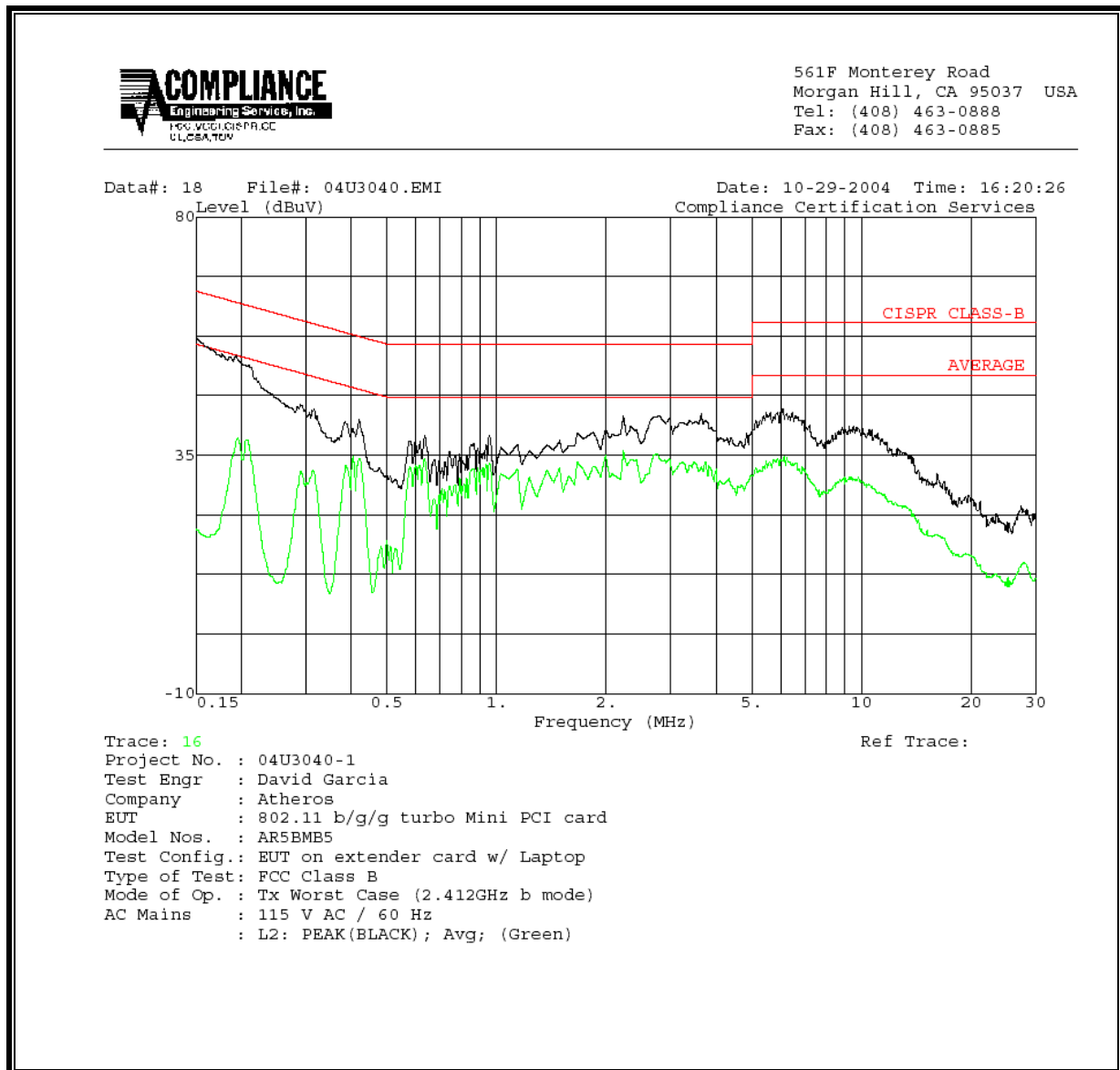
6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.15	58.02	--	24.35	0.00	66.00	56.00	-7.98	-31.65	L1
0.19	55.20	--	38.57	0.00	64.94	54.94	-9.74	-16.37	L1
0.21	53.46	--	30.83	0.00	64.34	54.34	-10.88	-23.51	L1
0.15	57.06	--	22.93	0.00	66.00	56.00	-8.94	-33.07	L2
0.19	53.84	--	38.27	0.00	64.77	54.77	-10.93	-16.50	L2
0.32	43.66	--	32.13	0.00	61.23	51.23	-17.57	-19.10	L2
6 Worst Data									

LINE 1 RESULTS

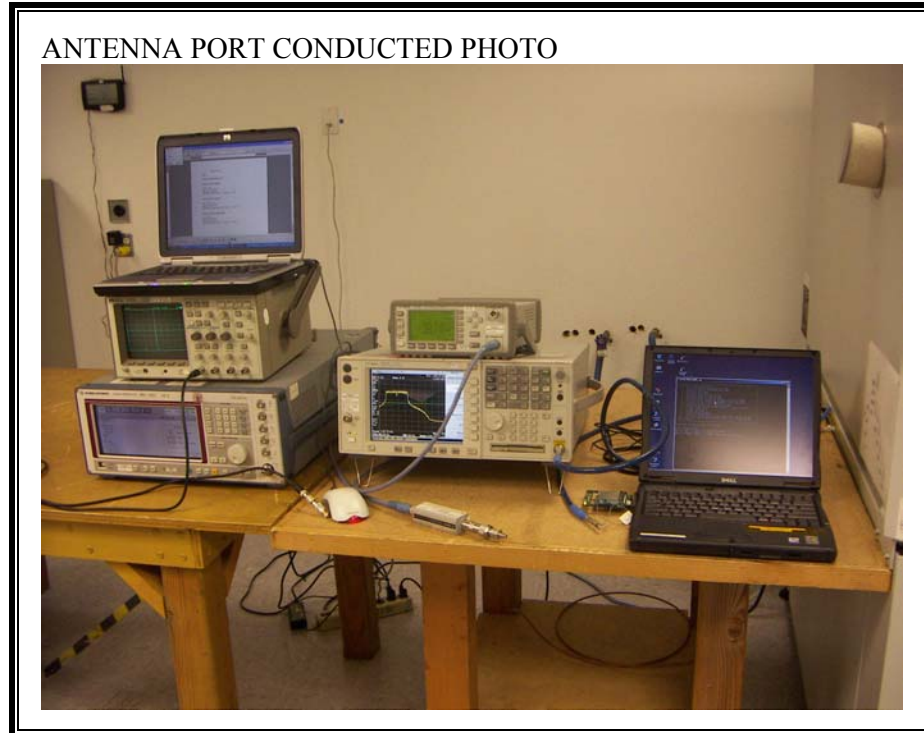


LINE 2 RESULTS



8. SETUP PHOTOS

ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP



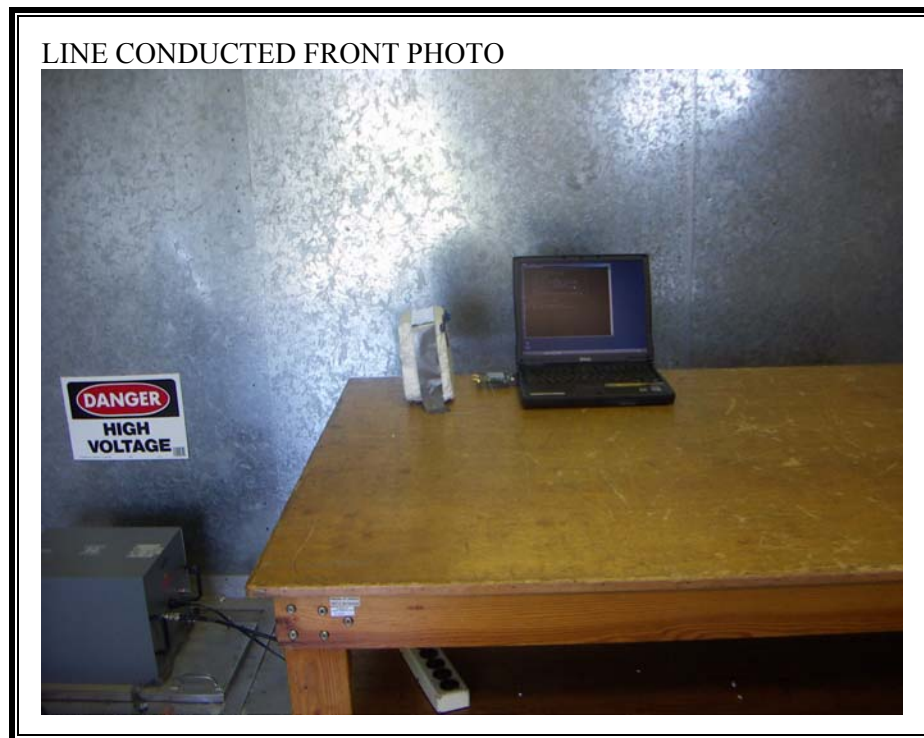
RADIATED RF MEASUREMENT SETUP



RADIATED BACK PHOTO



POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP



LINE CONDUCTED BACK PHOTO



END OF REPORT