FCC CFR47 CLASS II PERMISSIVE CHANGE CERTIFICATION TEST REPORT

FOR

AR5BXB6 802.11abg PCI Express Module

MODEL NUMBER: AR5BXB6

FCC ID: PPD-AR5BXB6-M

REPORT NUMBER: 05U3787-2

ISSUE DATE: DECEMBER 19, 2005

Prepared for
ATHEROS COMMUNICATIONS INC.
5480 GREAT AMERICA PARKWAY
SANTA CLARA, CA 95054
U.S.A.

Prepared by
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LAB CODE:200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
A	12/19/05	Initial Issue	DG

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ATHEROS COMMUNICATIONS INC.
5480 GREAT AMERICA PARKWAY
SANTA CLARA, CA 95054

EUT DESCRIPTION: AR5BXB6 802.11abg PCI Express Module

MODEL: AR5BXB6

SERIAL NUMBER: **6F54500CMU4FE**

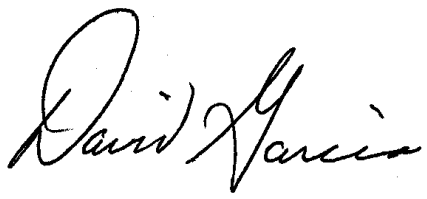
DATE TESTED: DECEMBER 2 - DECEMBER 14, 2005

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

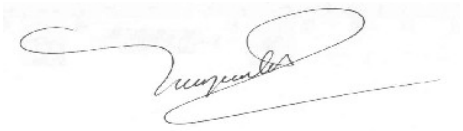
Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

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:



DAVID GARCIA
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES



WILLIAM ZHUANG
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 802.11 a/b/g transceiver.

The radio module is manufactured by Atheros Communications Inc..

5.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

Added new antenna model:

Tyco P/N: 631-0153 12-5, inverted F type.

Full antenna details are included in a separate exhibit.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes two dual band inverted F antennas on a flexible substrate for diversity, each with a maximum gain of 4.06 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Devlib Revision 5.3, rev. Build #15.

The EUT driver software installed in the Apple 15" PowerBook equipment during testing was Apple80211, rev. 12_5_05. The serial number of the PowerBook is SW854600JUNO.

The test utility software used during testing was moma, rev. M35aFred_12_5_05.

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 5260 MHz .

The worst-case data rate for this channel is determined to be 6 Mb/s, based on previous experience with AR5BXB6 WLAN product design architectures.

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop PC	Apple	PowerBook	SW854600JUNO	DOC
AC Adapter	Delta	ADP90UBC	MV54207YSCN	N/A

I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	1	AC	Unshielded	1.7	
2	DC	1	DC	Shielded	1.7	

TEST SETUP

The EUT is installed in a host laptop computer via its internal Mini PCIe slot during the tests. Test software exercised the radio card.

SETUP DIAGRAM FOR TESTS

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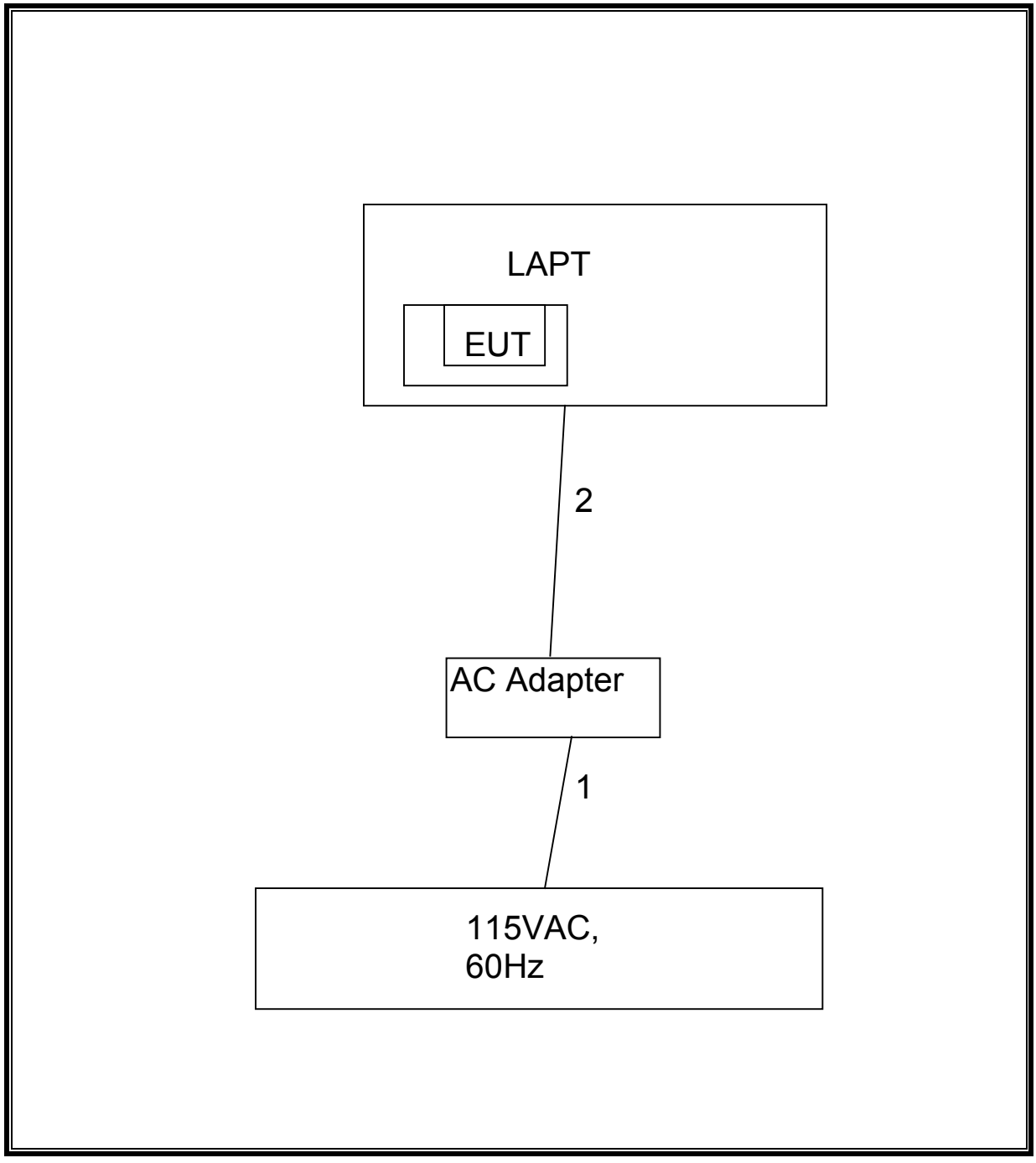


SETUP FOR DIGITAL DEVICE TESTS

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop PC	Apple	PowerBook	SW854600JUNO	DOC
AC Adapter	Delta	ADP90UBC	MV54207YSCN	N/A
Mouse	Apple	M5769	VJ5250Q5BNWDA	DOC
Keyboard	Apple	A1048	KY5230SCEQL3B	DOC
Combo Headphone/Microphone	Radio Shack	33-1187	N/A	N/A
IPod Mini	Apple	A1015	JQ4104QHPFW	DOC
IPod 20 GB	Apple	A1059	JQ436KK6PS9	DOC
Display Monitor	Apple	M6496	CY9374AZGZC	DOC

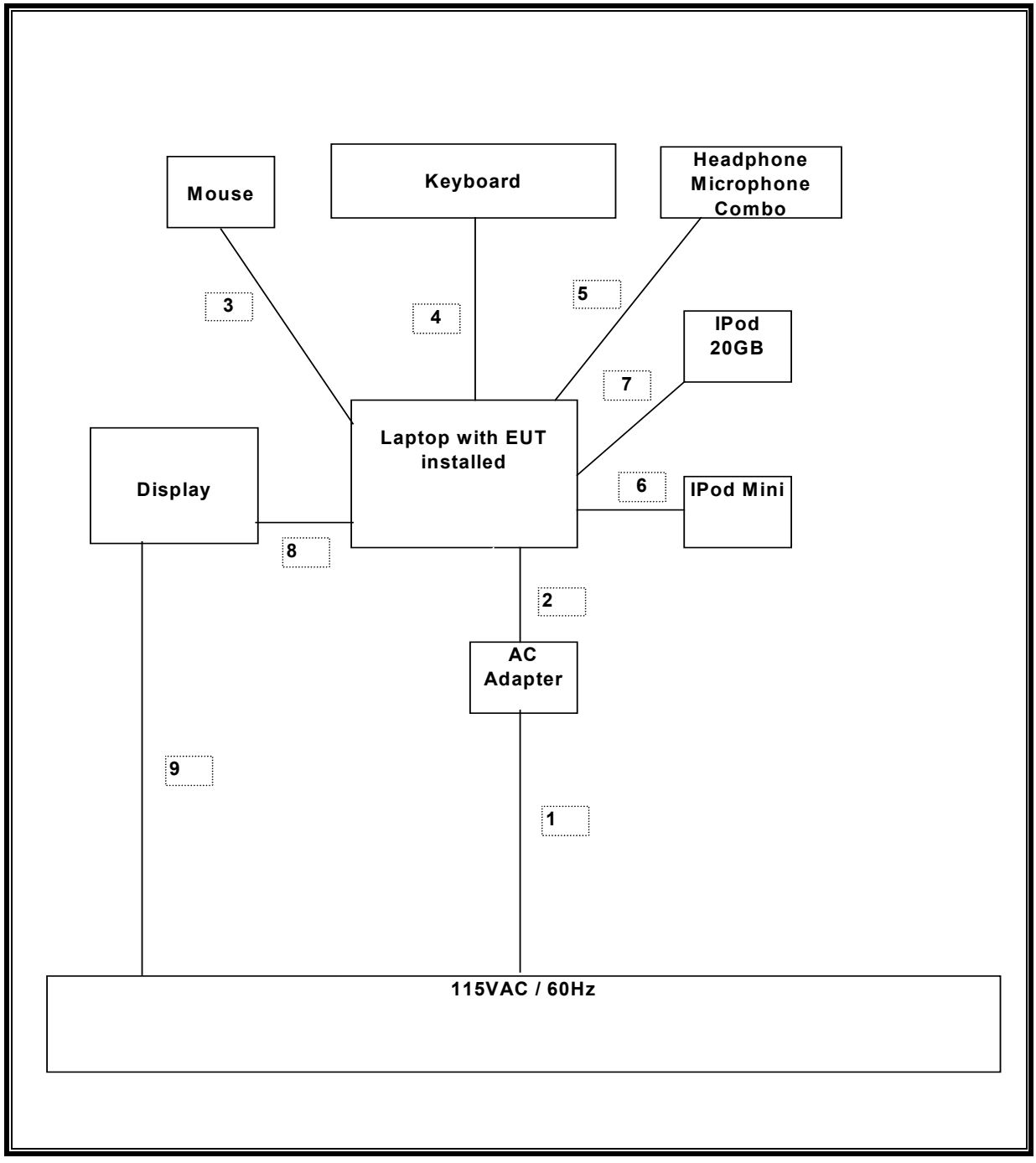
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	1	AC	Unshielded	1.7	
2	DC	1	DC	Shielded	1.7	
3	USB	1	USB	Shielded	0.75	Mouse
4	USB	1	USB	Shielded	0.85	Keyboard
5	Audio	1	Audio Jack	Shielded	2.5	Headphone/Microphone
6	USB	1	USB	Shielded	1.1	IPod Mini
7	USB	1	USB	Shielded	1.1	IPod 20GB
8	Video	1	RGB	Shielded w/Ferrite	1.75	Display
9	AC	1	AC	Shielded	1.75	Display

TEST SETUP

The EUT is installed in a host laptop computer via its internal Mini PCIe slot during the tests. Test software exercised the radio card.

SETUP DIAGRAM FOR DIGITAL DEVICE 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**
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent	E4446A	US42070220	1/1/2006
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	6717	4/22/2006
Preamplifier 1-26.5 GHz	HP	8449B	3008A00931	6/24/2006
Preamplifier, 1 ~ 26.5 GHz	HP	8449B	3008A00369	8/17/2006
Spectrum Analyzer, 26.5 GHz	HP	8593EM	3710A00205	1/6/2006
Preamplifier	HP	8447D	1937A02062	1/7/2006
Antenna, Bilog 30MHz ~ 2Ghz	Sunol Sciences	JB1	A121003	3/3/2006

6.1.1. PEAK POWER

LIMIT

§15.407 (a) (1) For the band 5.15-5.25 GHz, the peak transmit power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. 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.

§15.407 (a) (1) For the band 5.25-5.35 GHz, the peak transmit power over the frequency band of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. 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.

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

No non-compliance noted:

Limit in 5150 to 5250 MHz Band

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	34	19.31	4.06	17.00

Limit in 5250 to 5350 MHz Band

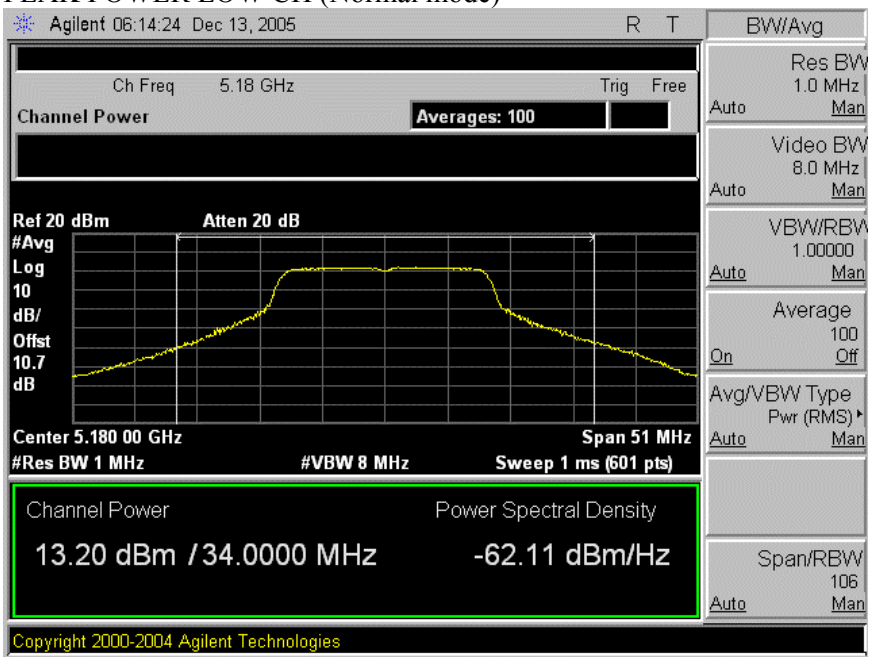
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Mid	5260	24	34	26.31	4.06	24.00
High	5320	24	34	26.31	4.06	24.00

Results

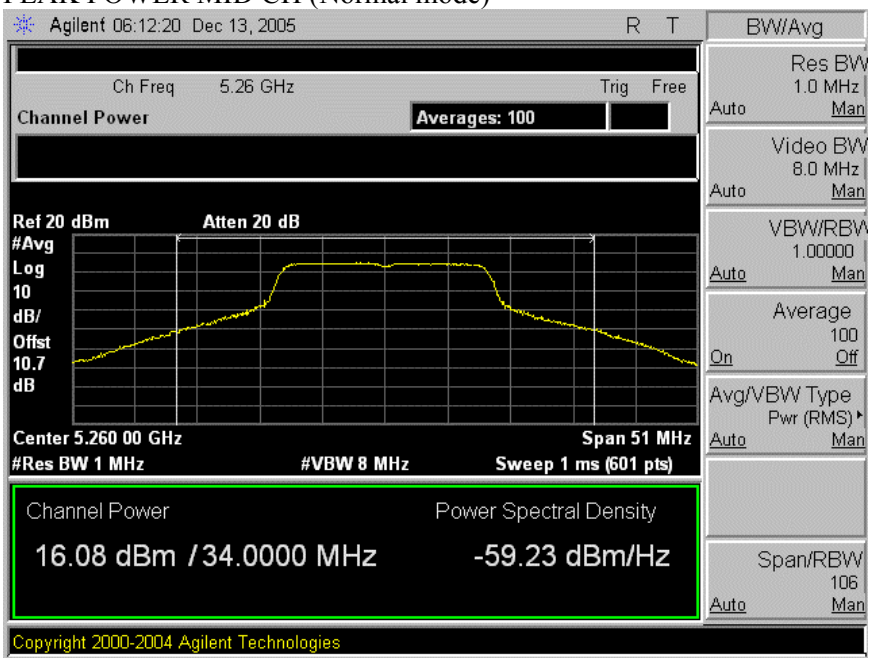
Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	13.20	17.00	-3.80
Mid	5260	16.08	24.00	-7.92
High	5320	14.26	24.00	-9.74

PEAK POWER (NORMAL MODE)

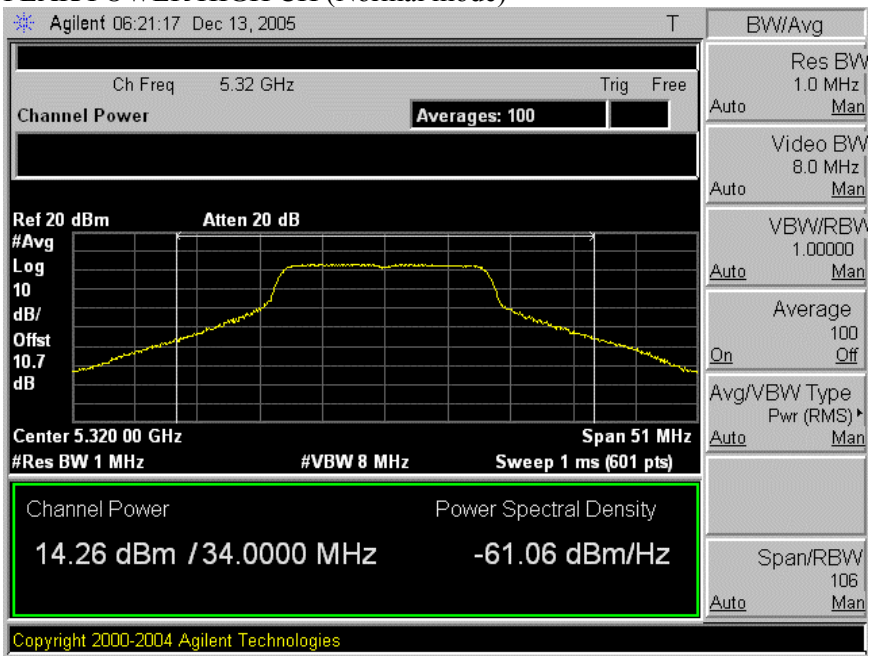
PEAK POWER LOW CH (Normal mode)



PEAK POWER MID CH (Normal mode)



PEAK POWER HIGH CH (Normal mode)



6.1.2. 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.

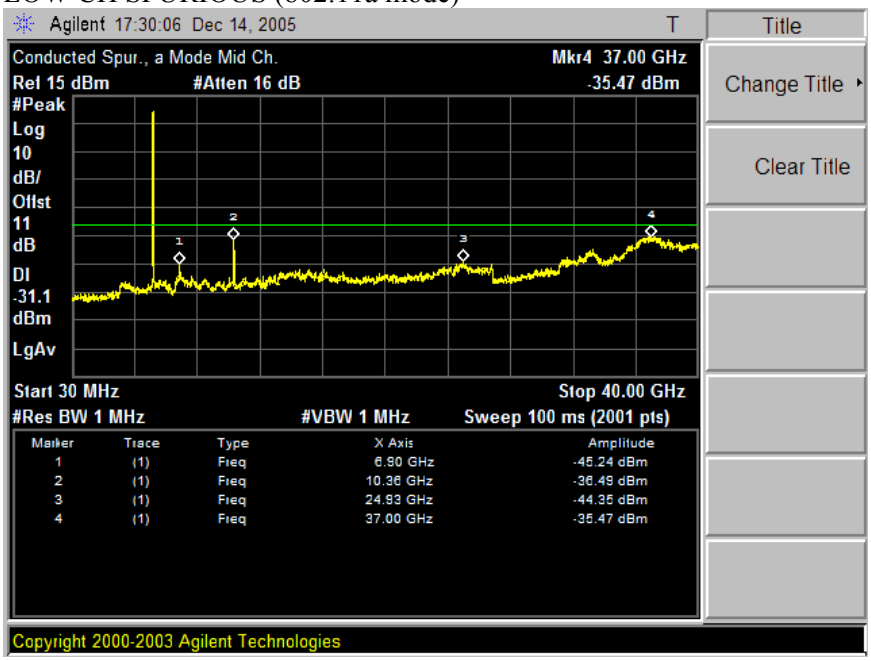
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

RESULTS

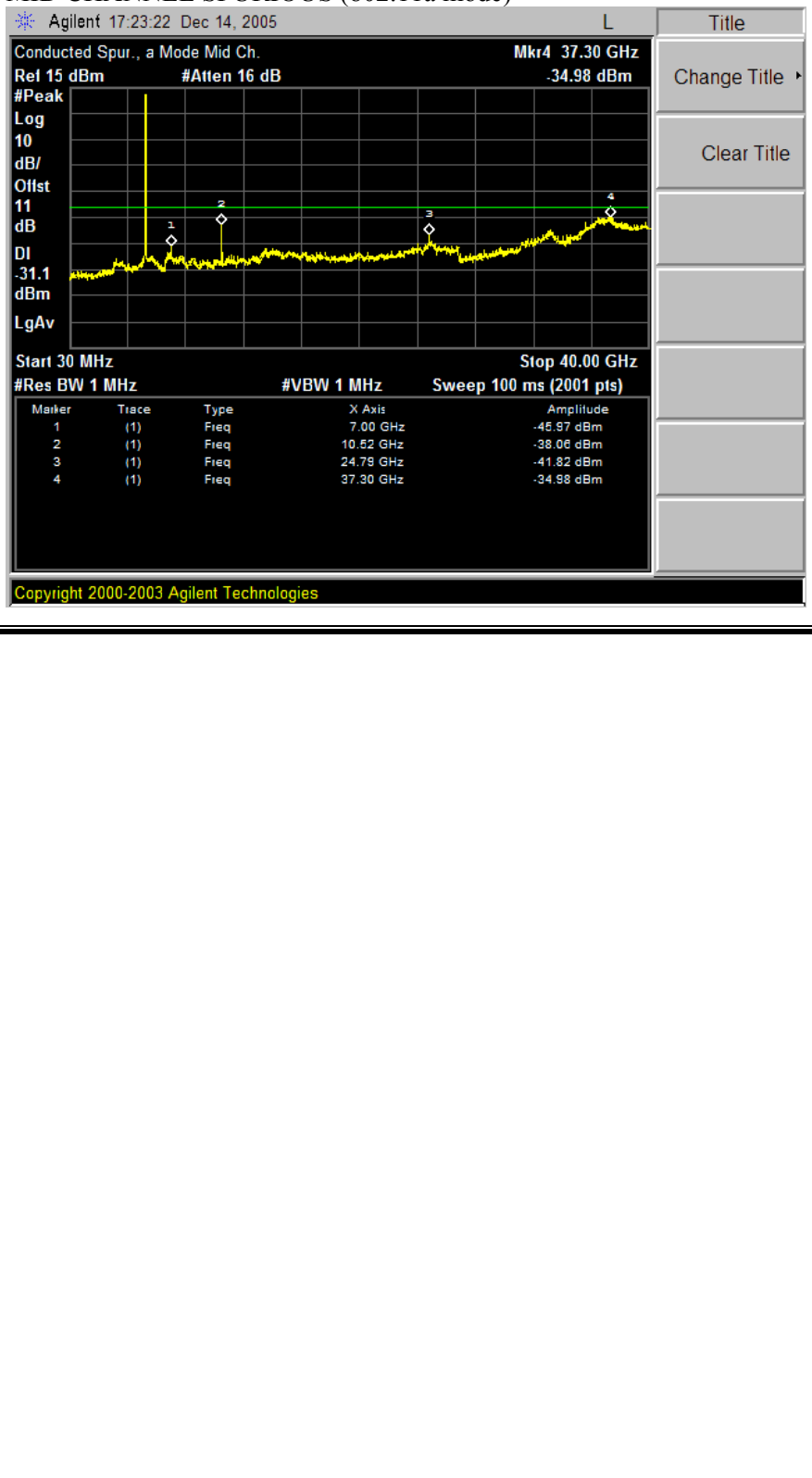
No non-compliance noted:

SPURIOUS EMISSIONS (802.11a MODE)

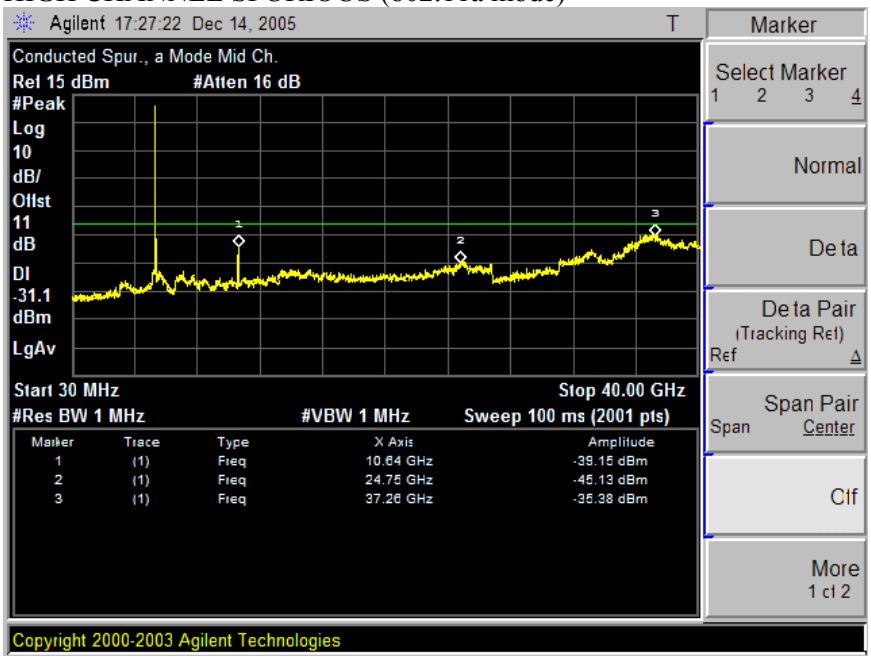
LOW CH SPURIOUS (802.11a mode)



MID CHANNEL SPURIOUS (802.11a mode)



HIGH CHANNEL SPURIOUS (802.11a mode)



6.2. RADIATED EMISSIONS

6.2.1. 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.

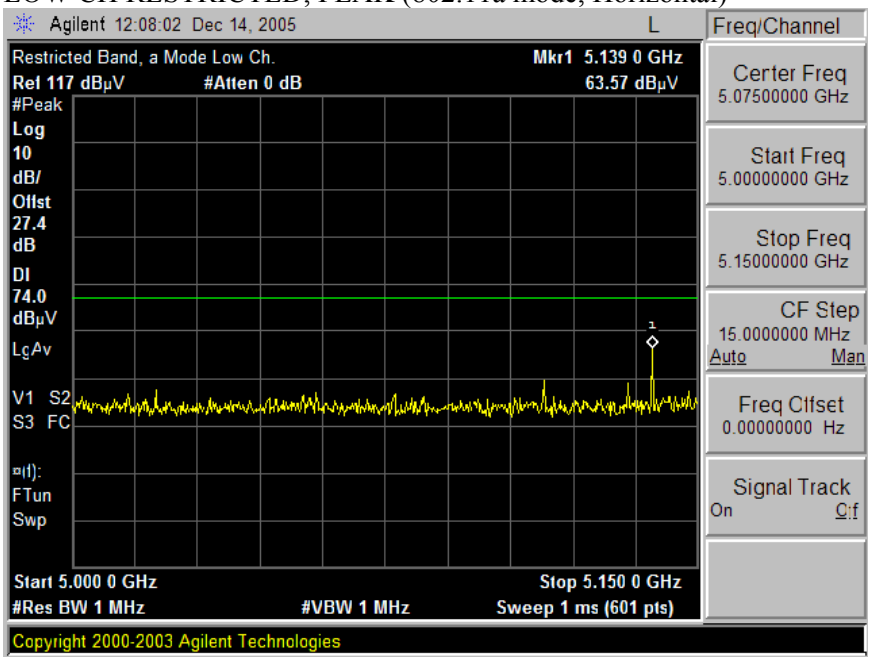
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each band.

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.

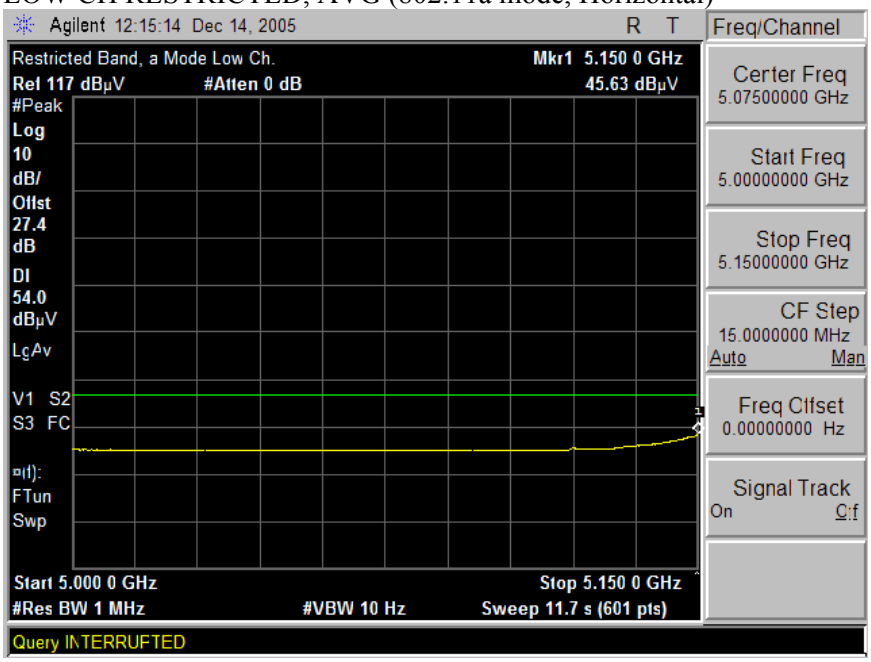
6.2.2. TRANSMITTER ABOVE 1 GHZ FOR 5150 TO 5350 MHz BAND

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

LOW CH RESTRICTED, PEAK (802.11a mode, Horizontal)

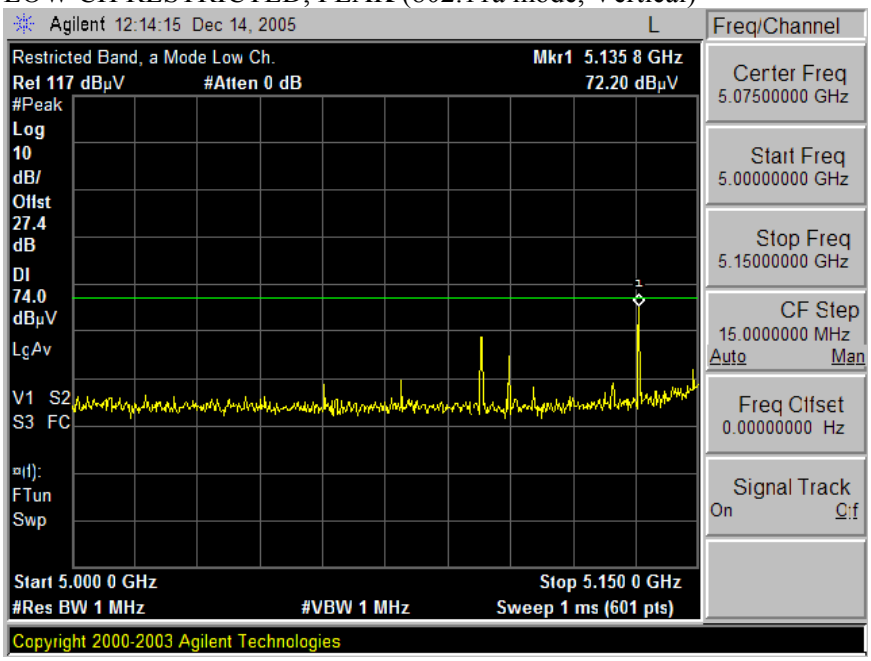


LOW CH RESTRICTED, AVG (802.11a mode, Horizontal)

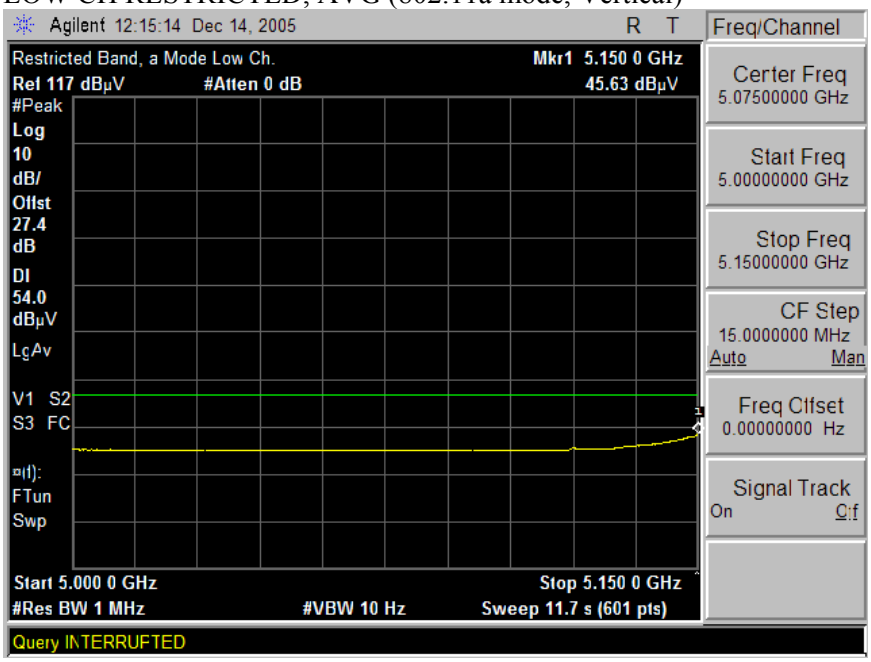


RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, VERTICAL)

LOW CH RESTRICTED, PEAK (802.11a mode, Vertical)

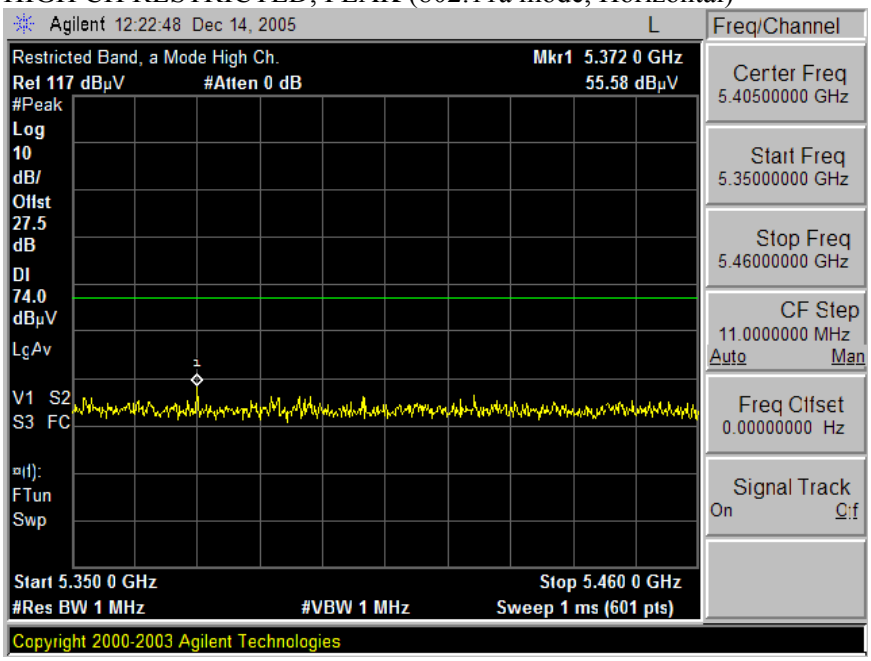


LOW CH RESTRICTED, AVG (802.11a mode, Vertical)

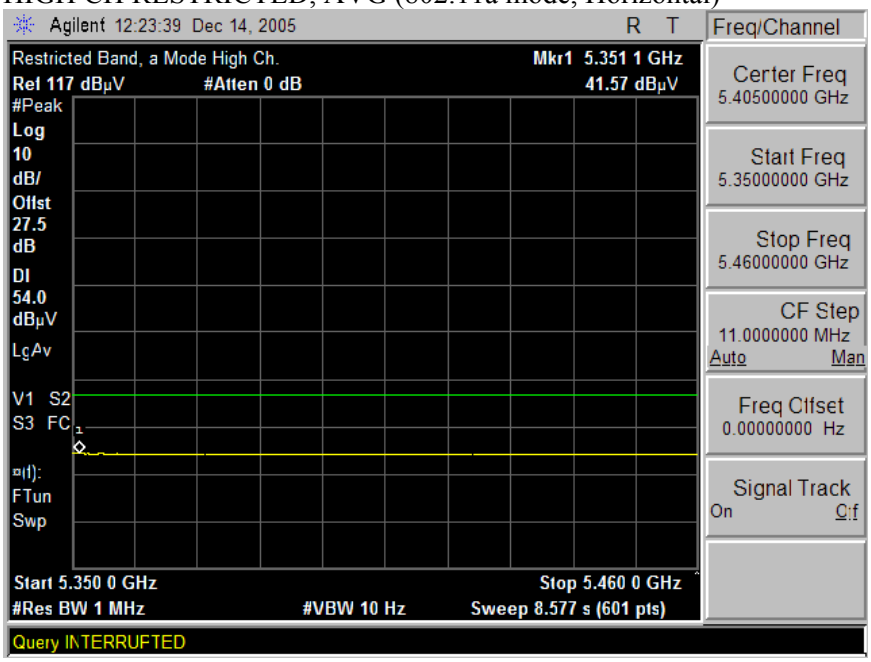


RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, HORIZONTAL)

HIGH CH RESTRICTED, PEAK (802.11a mode, Horizontal)

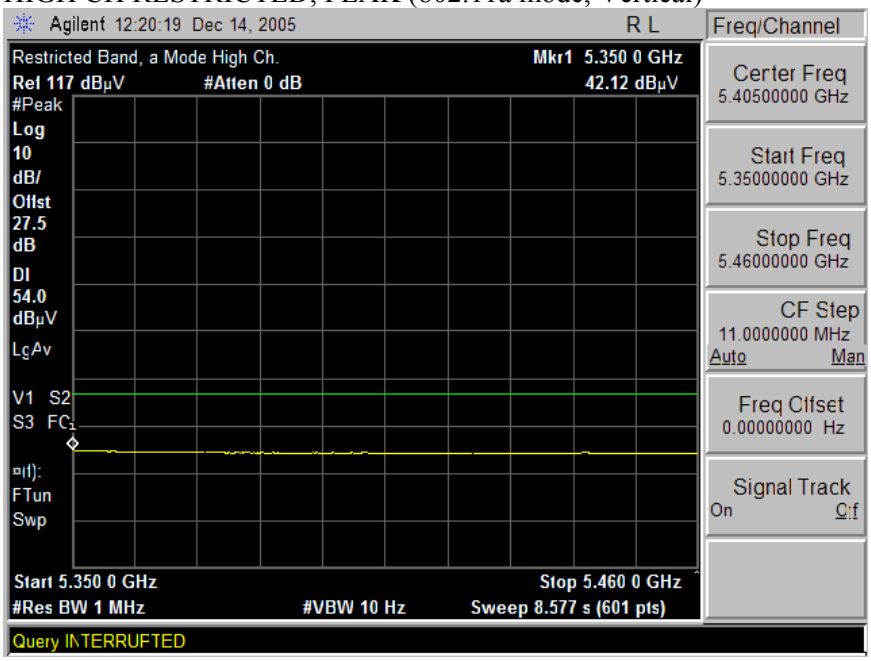


HIGH CH RESTRICTED, AVG (802.11a mode, Horizontal)

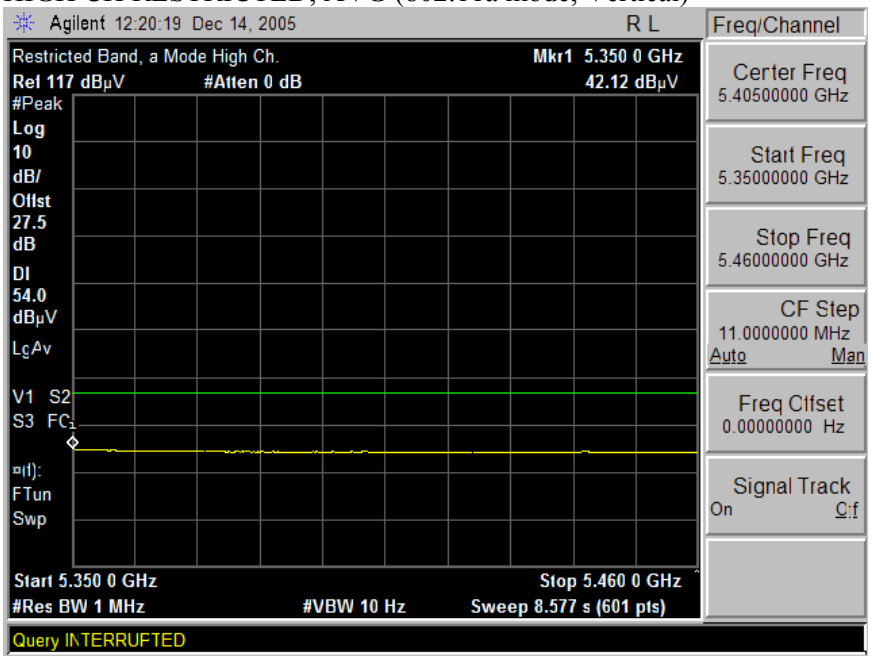


RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, VERTICAL)

HIGH CH RESTRICTED, PEAK (802.11a mode, Vertical)



HIGH CH RESTRICTED, AVG (802.11a mode, Vertical)



HARMONICS AND SPURIOUS EMISSIONS (802.11a MODE)

12/14/05 High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: Vien Tran
Project #:05U3787
Company:Apple Computers Inc.
EUT Descrip.:802.11 abg WLAN Mini Card in 1 Apple Laptop with 1 Antenna Type
EUT M/N:AR5BXB6
Test Target:FCC 15.407
Mode Oper:Tx On_11a 5.2 GHz

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T145 Agilent 3008A005(		T39-T88 ARA 18-40GHz & Mixer > 40GHz	FCC 15.205

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
	Vien 187215002	Vien 197209005	HPF_7.6GHz	R_001

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

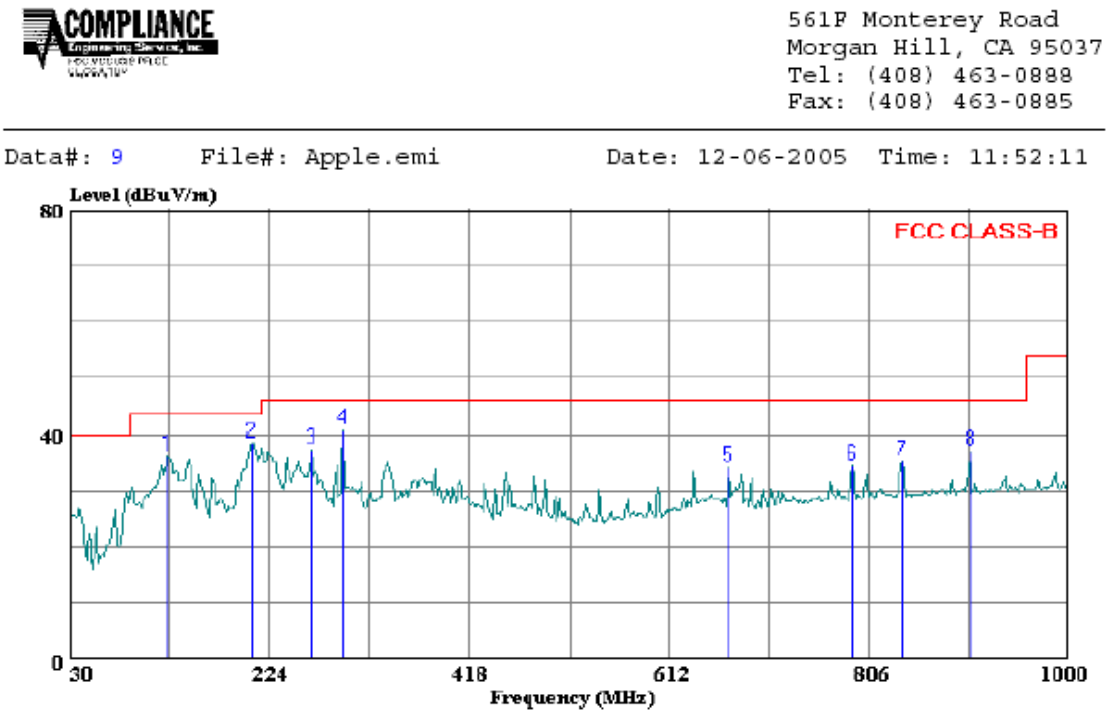
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Ch, 5180MHz Average=13.2dBm															
15.540	3.0	46.2	33.6	39.6	5.8	-32.3	0.0	0.7	60.0	47.4	74	54	-14.0	-6.6	V
15.540	3.0	45.1	33.2	39.6	5.8	-32.3	0.0	0.7	58.9	47.0	74	54	-15.1	-7.0	H
Mid ch, 5260MHz Average=16.1dBm															
15.780	3.0	46.1	33.6	39.2	5.8	-32.2	0.0	0.7	59.6	47.1	74	54	-14.4	-6.9	V
15.780	3.0	45.0	33.4	39.2	5.8	-32.2	0.0	0.7	58.5	46.9	74	54	-15.5	-7.1	H
High Ch, 5320MHz Average=14dBm															
10.640	3.0	51.3	38.8	38.0	4.8	-34.2	0.0	0.8	60.5	48.0	74	54	-13.5	-6.0	V
15.960	3.0	45.0	33.3	38.9	5.9	-32.2	0.0	0.7	58.2	46.5	74	54	-15.8	-7.5	V
10.640	3.0	44.3	32.5	38.0	4.8	-34.2	0.0	0.8	53.5	41.7	74	54	-20.5	-12.3	H
15.960	3.0	43.6	33.4	38.9	5.9	-32.2	0.0	0.7	56.8	46.6	74	54	-17.2	-7.4	H
	Note: No other emissions were detected above the system noise floor.														

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		

6.2.3. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

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

HORIZONTAL PLOT



HORIZONTAL DATA

Page: 1

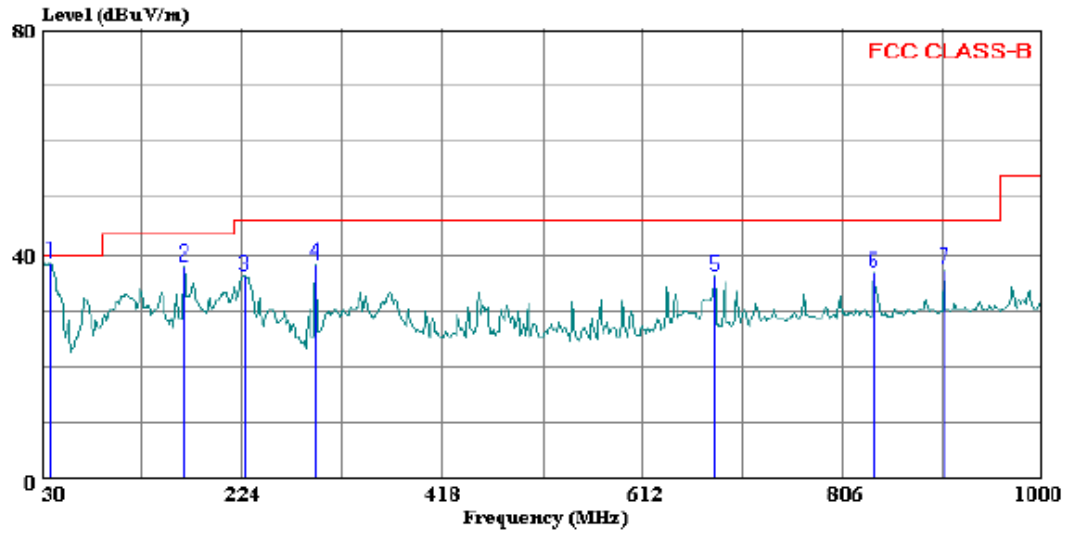
	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	125.060	48.92	-12.55	36.38	43.50	-7.13	Peak
2	207.510	52.55	-14.11	38.44	43.50	-5.06	Peak
3	264.740	50.52	-13.21	37.32	46.00	-8.68	Peak
4	295.780	52.75	-12.05	40.70	46.00	-5.30	Peak
5	669.230	38.19	-3.80	34.39	46.00	-11.61	Peak
6	790.480	36.65	-1.95	34.70	46.00	-11.30	Peak
7	838.980	37.07	-1.53	35.54	46.00	-10.46	Peak
8	904.940	38.08	-0.95	37.13	46.00	-8.87	Peak

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#: 7 File#: Apple.emi Date: 12-06-2005 Time: 11:45:32



(Audix ATC)

Trace: 6 Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator: : William Zhuang
Project #: : 05U3787
Company: : Apple Computers Inc.
EUT: : 802.11abg WLAN Mini Card In 1 Apple's
: Laptop with 1 Antenna Type
Model No.: : AR5BXB6
Configuration : EUT with support equipment
Mode of operation: a Mode worst case
Target of Test : FCC CLASS B

VERTICAL DATA

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	38.730	50.23	-11.81	38.42	40.00	-1.58	Peak
2	167.740	52.08	-14.20	37.88	43.50	-5.62	Peak
3	226.910	50.86	-14.71	36.15	46.00	-9.85	Peak
4	295.780	50.14	-12.05	38.09	46.00	-7.91	Peak
5	681.840	39.72	-3.45	36.27	46.00	-9.73	Peak
6	837.040	38.42	-1.53	36.89	46.00	-9.11	Peak
7	904.940	38.41	-0.95	37.46	46.00	-8.54	Peak