



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

FOR

802.11ag /DRAFT 802.11n WIRELESS LAN PCI-E MINI CARD

MODEL NUMBER: BCM94321MC

FCC ID: QDS-BRCM1022

REPORT NUMBER: 07U11296-2

ISSUE DATE: OCTOBER 2, 2007

Prepared for
**BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086, USA**

Prepared by
**COMPLIANCE CERTIFICATION SERVICES
47173 BENICIA STREET
FREMONT, CA 94538, USA
TEL: (510) 771-1000
FAX: (510) 661-0888**



NVLAP LAB CODE 200065-0

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	10/02/07	Initial Issue	Hsin Fu Shih

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086, USA

EUT DESCRIPTION: 802.11ag /DRAFT 802.11n WIRELESS LAN PCI-E MINI CARD

MODEL: BCM94321MC

SERIAL NUMBER: CN-0SE2C2-70166-77L-001M

DATE TESTED: SEPTEMBER 24 – 25, 2007

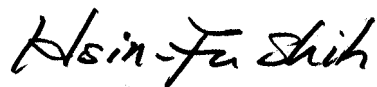
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 15 SUBPART E	NO NON-COMPLIANCE NOTED

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.

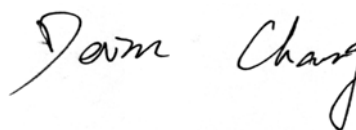
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. 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:



HSIN FU SHIH
ENGINEERING SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES



DEVIN CHANG
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, FCC CFR 47 Part 15 and

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, 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
Radiated Emission, Above 2000 MHz	+/- 43 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 802.11n MIMO transceiver chipset. The chipset is installed on a Mini PCI-E card, model number BCM94321MC.

The radio module is manufactured by Broadcom Corp.

5.2. CLASS II PERMISSIVE CHANGE DESCRIPTION

Add portable platform, Dell PP29L (Spears) and PP28L (Hawke)

The antennas used on Dell PP29L (Spears) and PP28L (Hawke) are the same type as WNC 81.ED415.002 and Hitachi HFT17-DL03, which are already certified in previous filing for FCC ID: QDS-BRCM1022, and have lower gains.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The EUT has 2 Tx/Rx antennas that are automatically selected for use as per the MCS index and STF mode selections. Preliminary testing was performed on all antennas to determine the worst case final testing was performed on the worst case (Aux antenna - Spear Acon for 2.4 GHz & Spear WNC for 5GHz).

Antenna gain list:

Frequency band	Antenna	Hawke (PP28L)		Spears (PP29L)	
		Max gain (dBi)		Max gain (dBi)	
		ACON	WNC	ACON	WNC
2.4GHz	Main	2.3	2.24	-0.3	0.44
	Aux	0	1.62	3.1	2.92
5.8GHz	Main	-1.4	1.03	0	1.11
	Aux	0.1	-0.1	-0.4	0.87
5.2GHz	Main	-1.8	1.89	-0.5	1.49
	Aux	-0.3	-0.13	-0.7	0.06

5.4. SOFTWARE AND FIRMWARE

The EUT was tested in the following manner:

- “epi_tcp.exe” was used to transmit UDP packets to a broadcast IP address (192.168.66.255) – i.e. no ACK required. This test mode sends a continuous packetized data stream with duty cycles that vary dependant upon data rate/MCS Index selected.
- “wl_ampdu” and “frameburst” were enabled to ensure worst case data packet transfer and duty cycle.
 - Worst case packet length have also been used to ensure max duty cycle.

5.5. WORST-CASE CONFIGURATION AND MODE

Operating modes were changed directly in software with no other changes to the set up. Power levels were verified across all the MCS Index at the start of test and as required throughout testing.

Prior to each test a power meter was used to tune the gated average power within a Tx packet. The channel gates on the meter were set to ensure that, at the time of recording, only packet power was captured without including duty cycle off time.

Power was tuned for different modes, channels and antennas based on the power tuning table contained in the Operational Description submitted under the same filing.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop PC	Dell	Inspiron 1526	CN-0SE2C2-70166-77L-001M	DOC
AC Adapter	Dell	DA65NS0-00	CF745	DOC

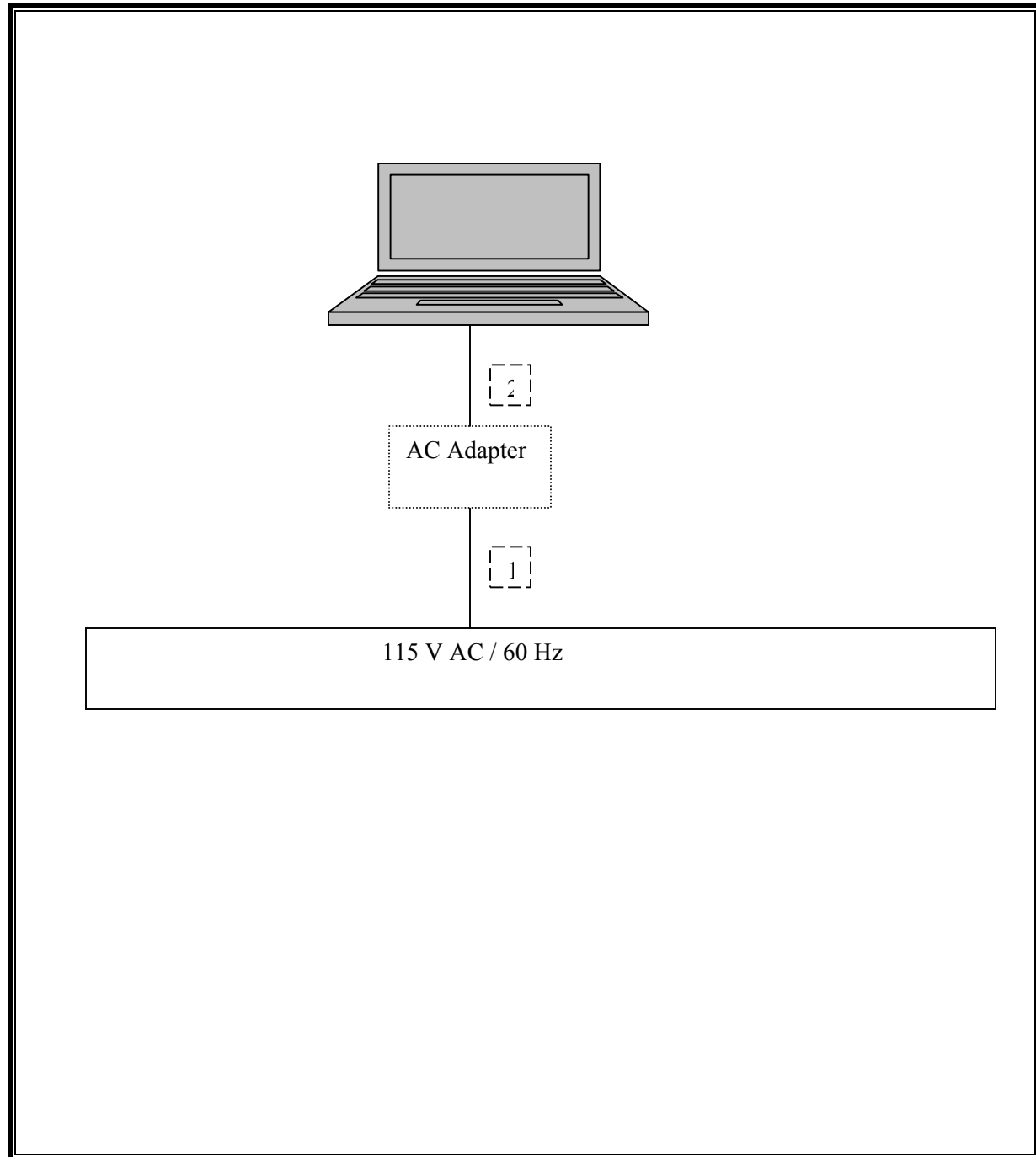
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	AC	Unshielded	0.8 m	N/A
2	DC	1	DC	Unshielded	1.8 m	N/A

TEST SETUP

The EUT is installed in a host laptop computer. 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	S/N	Cal Due
EMI Test Receiver	R & S	ESHS 20	827129/006	1/27/08
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	10/15/07
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	10/15/07
SA RF Section, 1.5 GHz	Agilent / HP	85680B	2814A04227	1/7/08
SA Display Section 2	Agilent / HP	85662A	2816A16696	4/7/08
Quasi-Peak Adaptor	Agilent / HP	85650A	3145A01654	1/21/08
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00931	8/3/08
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	4/15/08
Antenna, Bilog 30 MHz ~ 2 Ghz	Sunol Sciences	JB1	A121003	10/13/07
Preamp 30-1000MHz	Sonoma	310N	185623	1/20/08
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	MY43360112	8/7/08
Peak Power Meter	Agilent	E4416A	GB41291160	12/2/07
Peak / Average Power Sensor	Agilent	E9327A	US40440755	12/2/07
2.4-2.5 GHz Reject Filter	Micro-Tronics	BRM50702	1	CNR

7. LIMITS AND RESULTS

7.1. RADIATED EMISSIONS

7.1.1. 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.

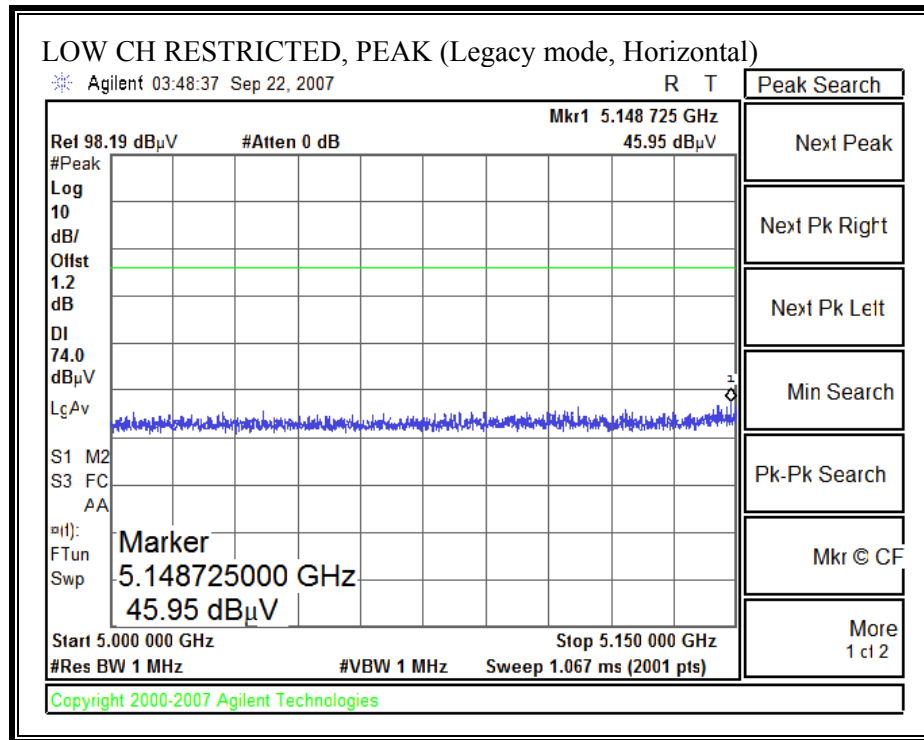
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each 5 GHz band.

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.

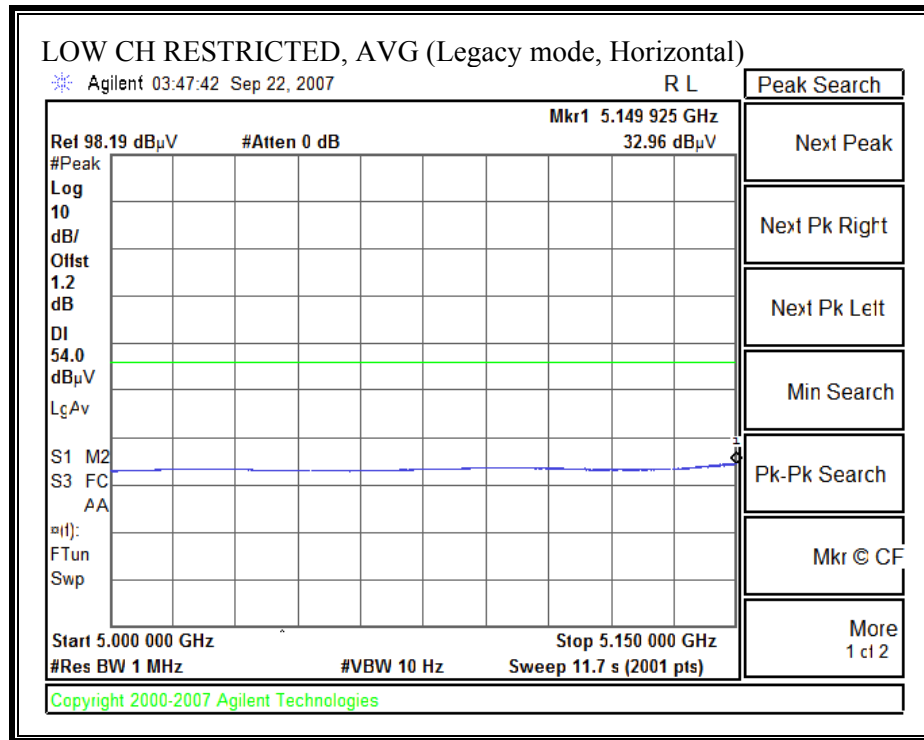
7.1.2. TRANSMITTER ABOVE 1 GHz FOR 5150 TO 5350 MHz BAND

RESTRICTED BANDEDGE (Legacy MODE, LOW CHANNEL, 5180MHz, HORIZONTAL)

Antenna - Spear WNC Aux Antenna

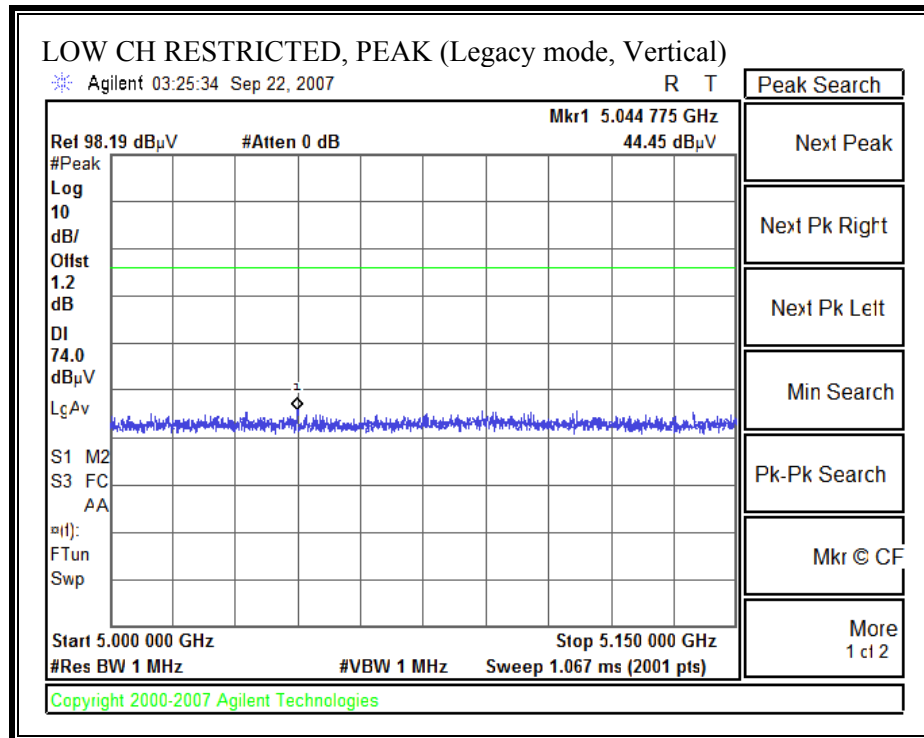


Antenna - Spear WNC Aux Antenna

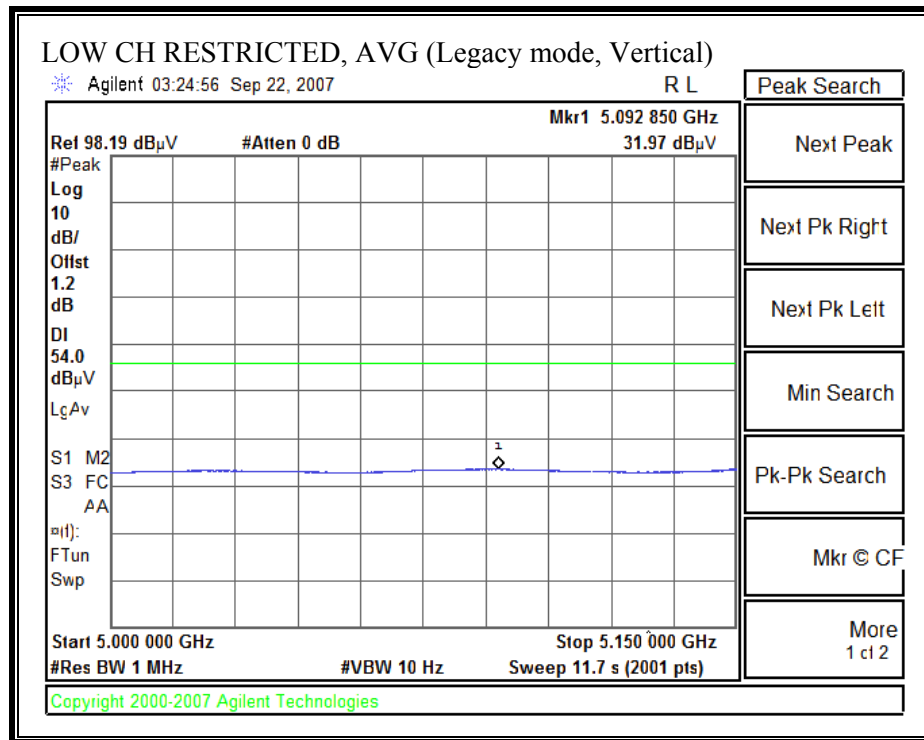


RESTRICTED BANDEDGE (Legacy MODE, LOW CHANNEL, 5180MHz, VERTICAL)

Antenna - Spear WNC Aux Antenna

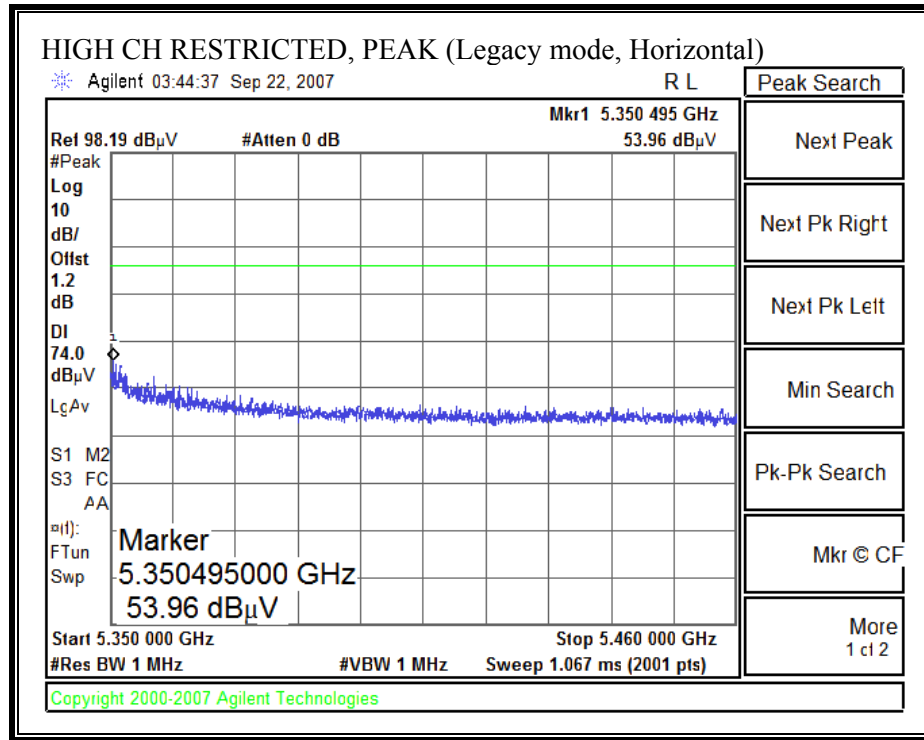


Antenna - Spear WNC Aux Antenna

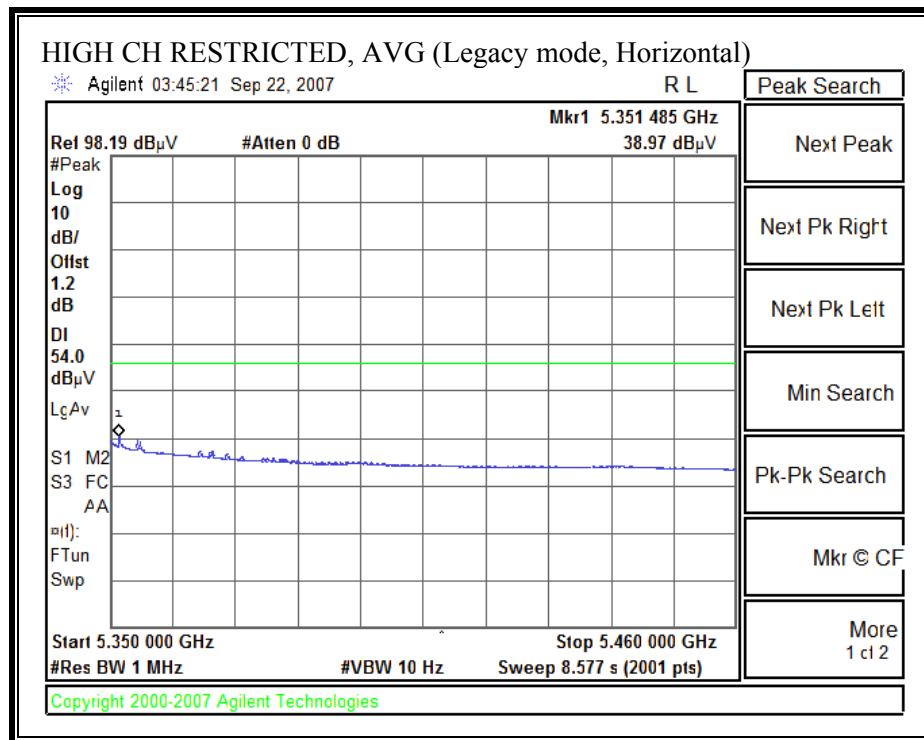


RESTRICTED BANDEDGE (Legacy MODE, HIGH CHANNEL, 5320MHZ, HORIZONTAL)

Antenna - Spear WNC Aux Antenna

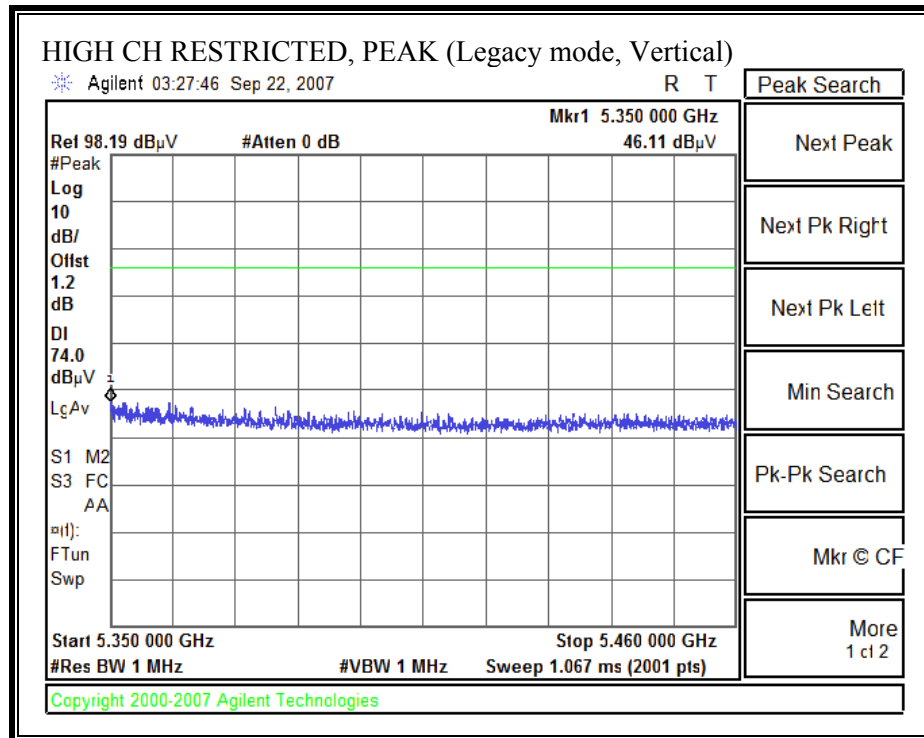


Antenna - Spear WNC Aux Antenna

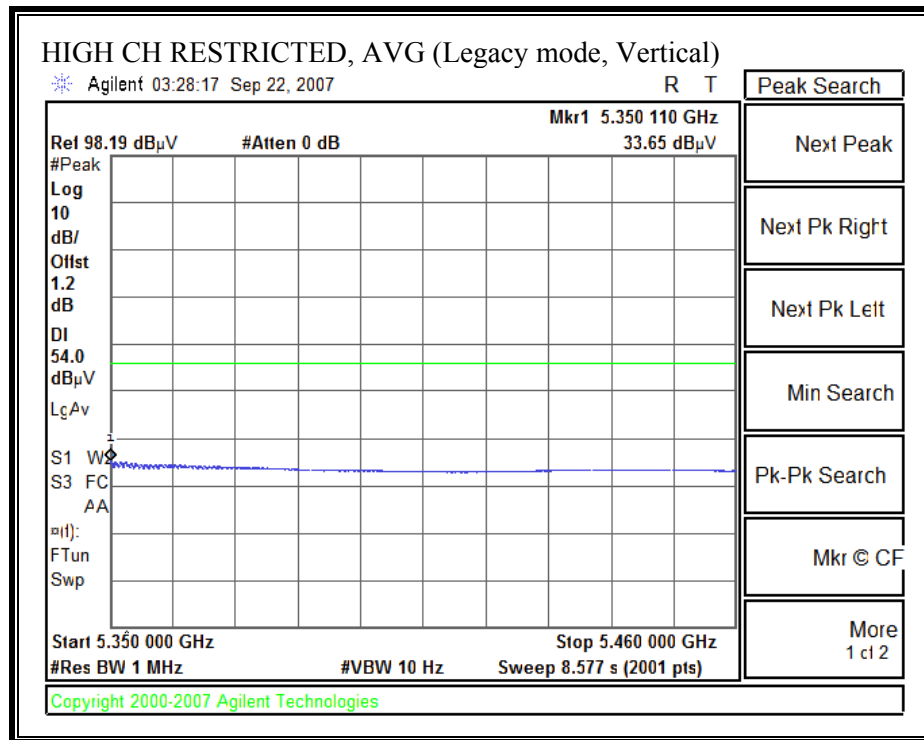


RESTRICTED BANDEDGE (Legacy MODE, HIGH CHANNEL, 5320MHz, VERTICAL)

Antenna - Spear WNC Aux Antenna



Antenna - Spear WNC Aux Antenna



HARMONICS AND SPURIOUS EMISSIONS (A MODE, Aux Antenna)

High Frequency Measurement																
Compliance Certification Services, Fremont 5m Chamber																
Company: Broadcom																
Project #: 07U11296																
Date: 09/24/07																
Test Engineer: Devin Chang																
Configuration: EUT only																
Mode: Tx Mid Channel																
Model: BCM94321MC-C2PC																
Test Equipment:																
Horn 1-18GHz		Pre-amplifier 1-26GHz		Pre-amplifier 26-40GHz		Horn > 18GHz		Limit								
T120; S/N: 29310 @3m		T145 Agilent 3008A005						FCC 15.209								
Hi Frequency Cables																
2 foot cable		3 foot cable		12 foot cable		HPF		Reject Filter		Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz						
Frank 177079007		Gordon 177080004														
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
MID CH (5260MHz)																
10.520	3.0	47.9	32.1	37.5	2.4	-34.4	0.0	0.0	53.3	37.6	74	54	-20.7	-16.4	V	
10.520	3.0	53.0	30.3	37.5	2.4	-34.4	0.0	0.0	58.4	35.7	74	54	-15.6	-18.3	H	
Rev. 4.12.7																
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												

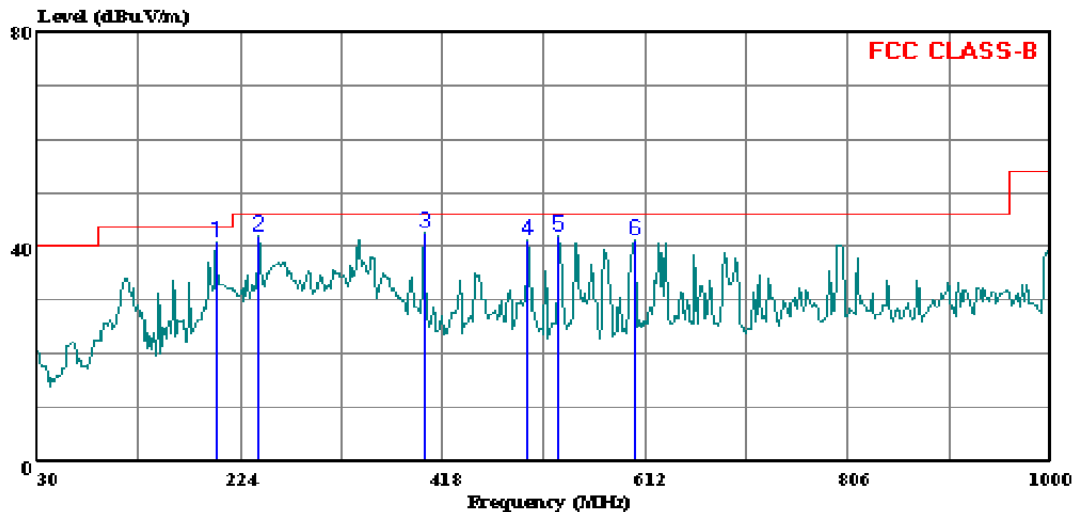
7.1.3. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz (5GHz Band, WORST-CASE CONFIGURATION, HORIZONTAL)



Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 2 File#: 07U11296.EMI Date: 09-24-2007 Time: 20:32:43



Trace: 1

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Ninous Davoudi
Project #: 07U11296
Company: Broadcom Corporation
Configuration: EUT with WNC Antenna
Mode : a mode 5200MHz band ch 52 Tx
Target: FCC Class B

Page: 1

	Freq	Read		Limit	Over	
	MHz	Level	Factor	Level	Line	Limit Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB
1	201.690	57.98	-17.19	40.79	43.50	-2.71 Peak
2	242.430	59.89	-18.02	41.87	46.00	-4.13 Peak
3	400.540	56.06	-13.46	42.60	46.00	-3.40 Peak
4	499.480	52.39	-11.33	41.06	46.00	-4.94 Peak
5	528.580	52.95	-10.88	42.07	46.00	-3.93 Peak
6	601.330	51.14	-9.76	41.38	46.00	-4.62 Peak

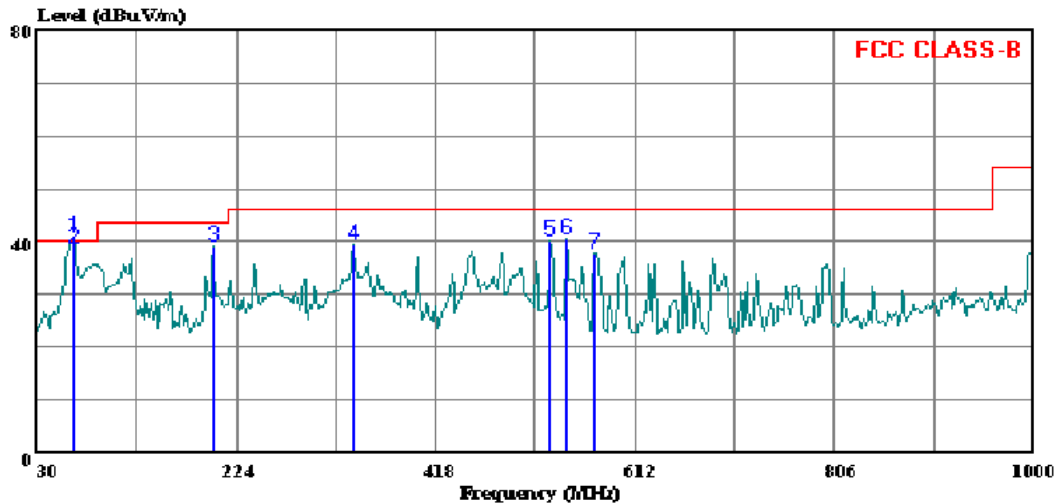
SPURIOUS EMISSIONS 30 TO 1000 MHz (5GHz Band, WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL PLOT



Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 5 File#: 07U11296.EMI Date: 09-24-2007 Time: 20:49:20



Trace: 3

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Ninous Davoudi
Project #: 07U11296
Company: Broadcom Corporation
Configuration: EUT with WNC Antenna
Mode : a mode 5200MHz band ch 52 Tx
Target: FCC Class B

Page: 1

		Read		Limit	Over	
	Freq	Level	Factor	Level	Line	Limit Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB
1 *	65.890	63.59	-22.66	40.93	40.00	0.93 Peak
2	65.890	61.44	-22.66	38.78	40.00	-1.22 QP
3	201.690	56.24	-17.19	39.05	43.50	-4.45 Peak
4	337.490	54.32	-14.80	39.52	46.00	-6.48 Peak
5	528.580	51.14	-10.88	40.26	46.00	-5.74 Peak
6	546.040	51.03	-10.48	40.55	46.00	-5.45 Peak
7	572.230	48.10	-10.20	37.90	46.00	-8.10 Peak

7.2. 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.

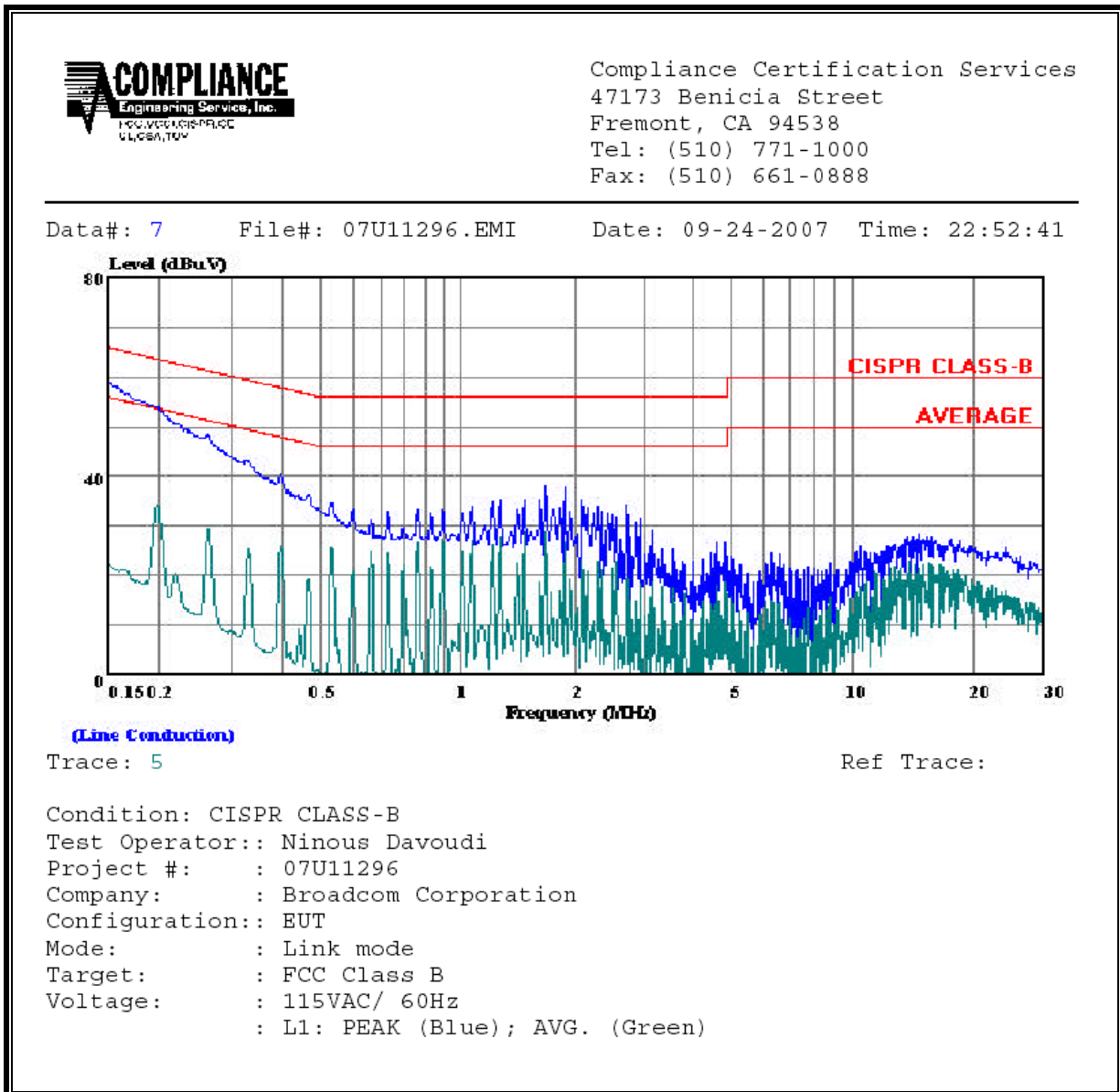
RESULTS

No non-compliance noted:

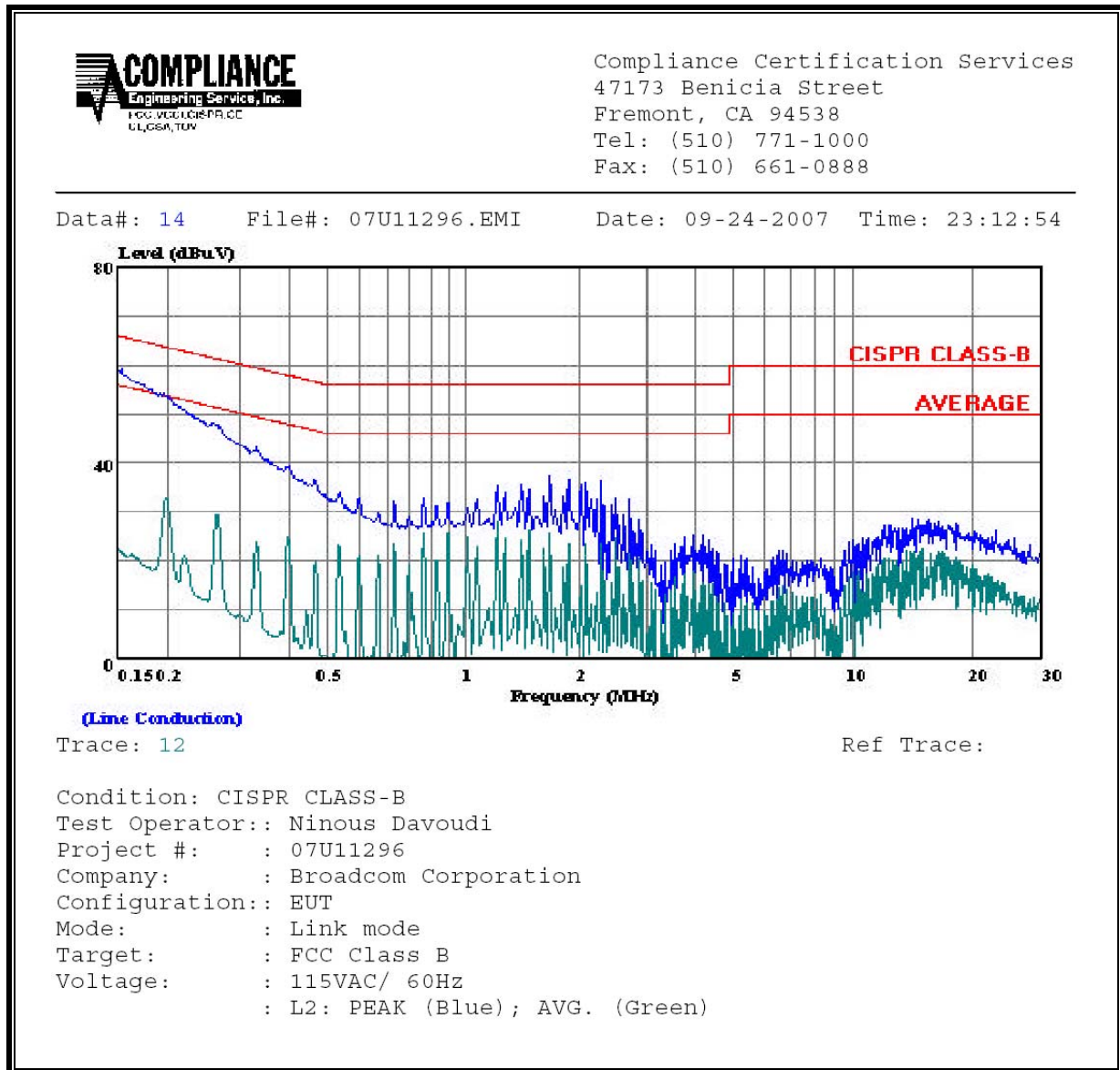
6 WORST EMISSIONS (5GHz Band)

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Class	Limit	EN_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.15	59.04	--	21.72	0.00	65.89	55.89	-6.85	-34.17	L1
1.78	38.02	--	28.59	0.00	56.00	46.00	-17.98	-17.41	L1
1.99	37.80	--	26.67	0.00	56.00	46.00	-18.20	-19.33	L1
0.15	59.06	--	21.98	0.00	65.84	55.84	-6.78	-33.86	L2
1.78	37.48	--	25.52	0.00	56.00	46.00	-18.52	-20.48	L2
2.40	36.36	--	24.09	0.00	56.00	46.00	-19.64	-21.91	L2
6 Worst Data									

LINE 1 RESULTS



LINE 2 RESULTS



8. SETUP PHOTOS

RADIATED RF MEASUREMENT SETUP



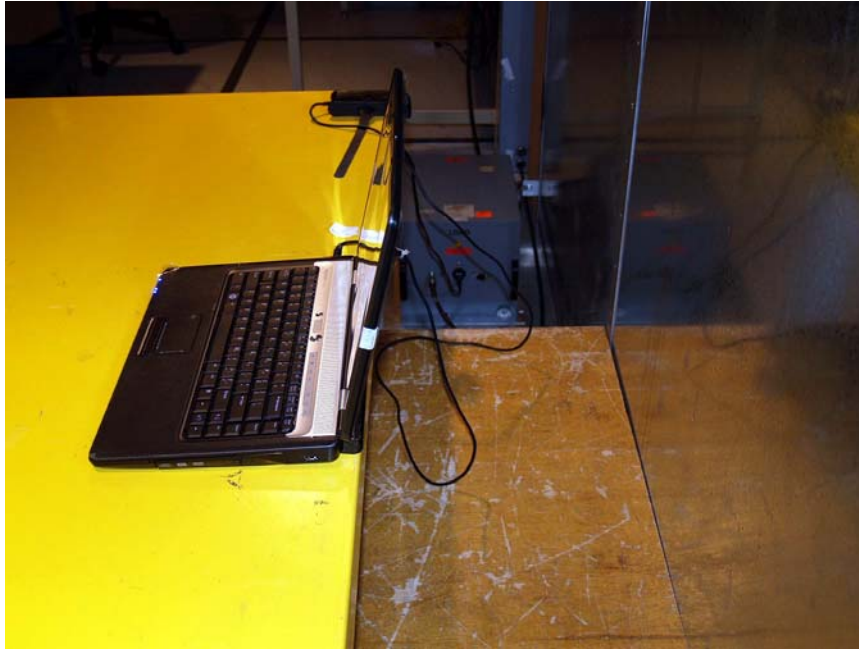
RADIATED BACK PHOTO



POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP



LINE CONDUCTED BACK PHOTO



END OF REPORT