



**FCC 47 CFR PART 15 SUBPART B**

**CERTIFICATION TEST REPORT**

**FOR**

**802.11a/b/g/n WLAN + Bluetooth PCI-E Custom Combination Card**

**MODEL NUMBER: BCM94331CSAX**

**FCC ID: QDS-BRCM1062**

**IC: 4324A- BRCM1062**

**REPORT NUMBER: 11U14154-11**

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*Prepared for*

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**NVLAP LAB CODE 200065-0**

Revision History

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** BROADCOM CORPORATION  
190 MATHILDA PLACE  
SUNNYVALE, CA 94086, U.S.A.

**EUT DESCRIPTION:** 802.11a/b/g/n WLAN + Bluetooth PCI-E Custom  
Combination Card

**MODEL:** BCM94331CSAX

**SERIAL NUMBER:** C861475004BDNP604

**DATE TESTED:** JANUARY 05 -17, 2012

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 15 SUBPART B	Pass

Compliance Certification Services (UL CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. 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 UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For UL CCS By:

Tested By:



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STEVE LEITNER  
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## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2009.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL 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. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 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/n WLAN + Bluetooth PCI-E Custom Combination Card.

The radio module is manufactured by Broadcom.

#### GENERAL INFORMATION

Power Requirements	5 Vdc
List of frequencies generated or used by the EUT	20 MHz

### 5.2. TEST CONFIGURATION

EUT Configuration	Description
Typical Configuration	EUT installed inside a laptop computer (Mac Book) and the laptop connected with a USB mouse, a USB printer and a Headset as minimum configuration.

### 5.3. MODE(S) OF OPERATION

Mode	Description
EMC Test and TX	All I/O ports activated, scrolling "H" pattern on the laptop screen, TX on.

### 5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom, rev. 5.106.98.42.

The test utility software used during testing was BCM Internal, rev. 5.106.RC98.42.

### 5.5. MODIFICATIONS

No modifications were made during testing.

## 5.6. DETAILS OF TESTED SYSTEM

### SUPPORT EQUIPMENT & PERIPHERALS

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufactu	Model	Serial Number	FCC ID
Laptop	Apple	Mac Book A1370	C02GT12HDJYD	DoC
AC Adapter	Apple	A1374	N/A	N/A
USB Printer	HP	DeskJet 812C	CN 01A1R23Q	N/A
AC Adapter	HP	C 6049-60014	B9L18B	N/A
USB Mouse	Microsoft	X802382-003 P1D 56180	613	N/A
Headphone	N/A	LT-100	CCS 01595	N/A

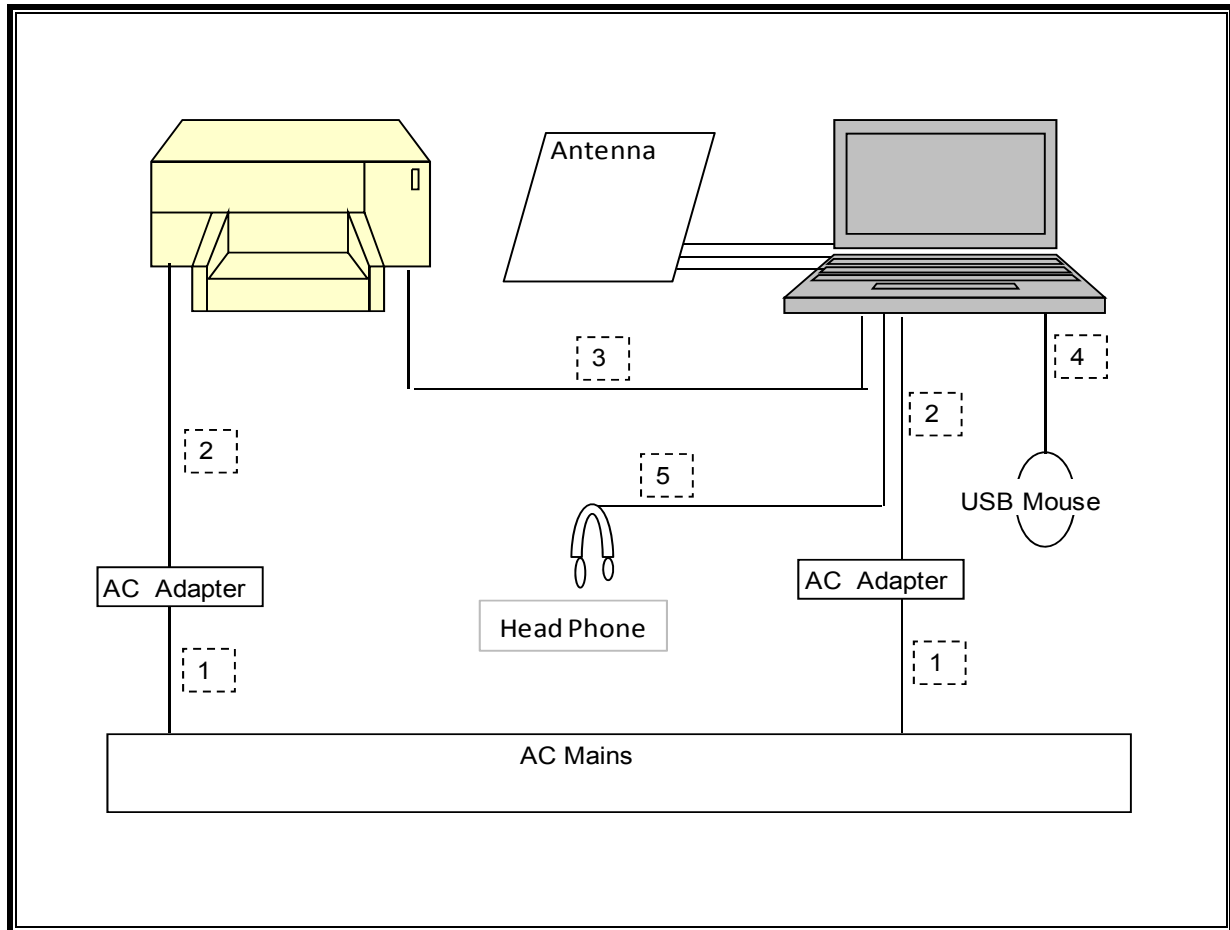
### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	2	US 115V	Unshielded	1.5 m	
2	DC	2	Barrel	Unshielded	1.5 m	
3	USB printer	1	USB	Shielded	2.0 m	Printer
4	USB Mouse	1	USB	Shielded	1.0 m	Mouse
5	USB Headphone	1	USB	Shielded	2.5 m	Headphone

### TEST SETUP

The EUT was installed in the base of a laptop computer that was set up in a minimum configuration with a USB mouse, a USB printer and a headset. Test software exercised the radio card. The bottom cover was removed from the computer throughout the testing.

**TEST SETUP DIAGRAM**





## 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	Asset	Cal Date	Cal Due
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	1000741	07/06/11	07/06/12
LISN, 30 MHz	FCC	50/250-25-2	C00626	11/17/11	11/17/12
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01159	09/02/11	12/02/12
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01171	07/16/11	07/16/12
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00558	12/30/11	12/30/12

## 7. APPLICABLE LIMITS AND TEST RESULTS

### 7.1. RADIATED EMISSIONS

#### TEST PROCEDURE

ANSI C63.4

The highest clock frequency generated or used in the EUT for the digital portion was 20 MHz; therefore the frequency range was investigated from 30 MHz to 1000 MHz.

#### LIMIT

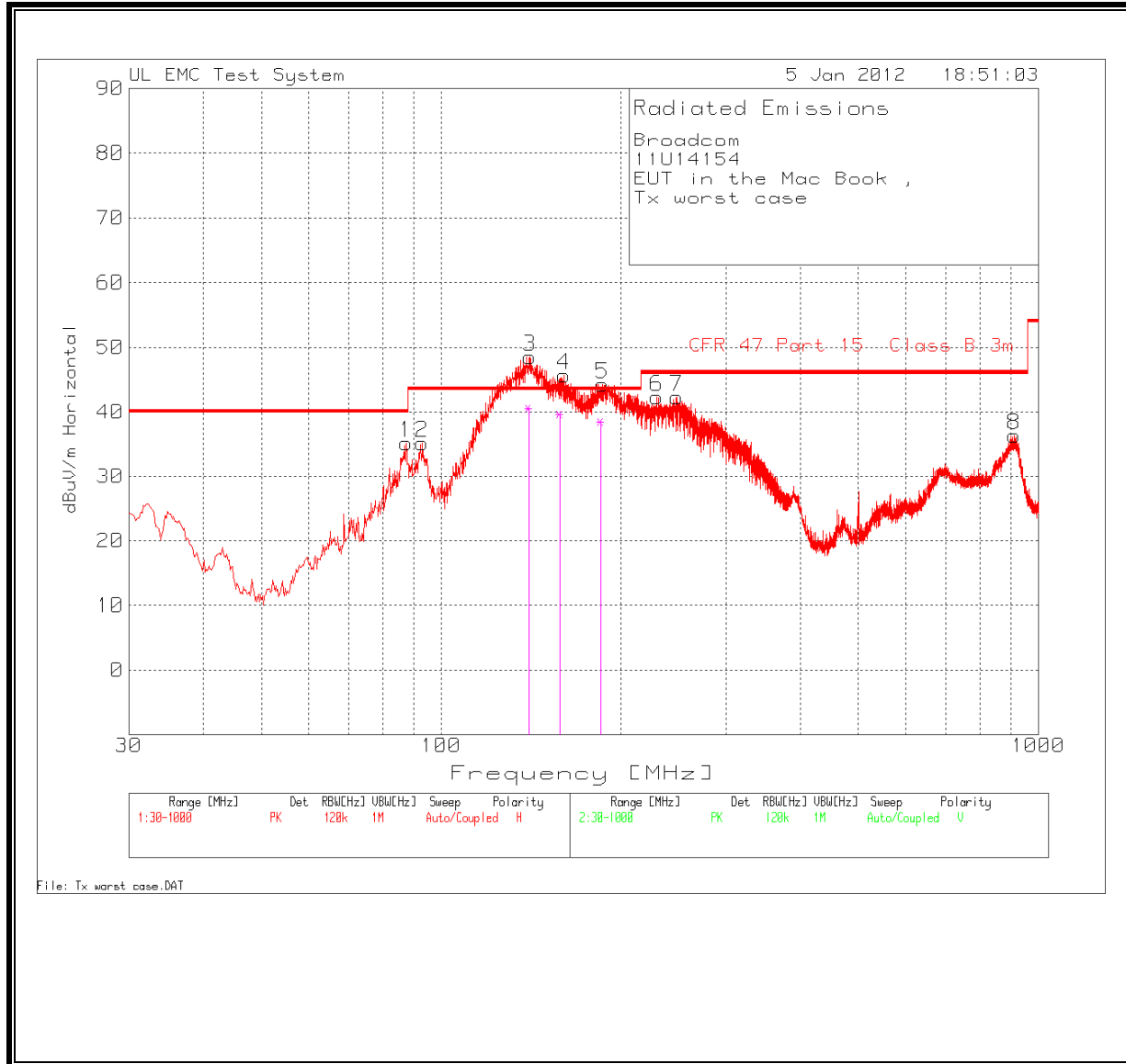
§15.109 (a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Limits for radiated disturbance of Class B ITE at measuring distance of 3 m	
Frequency range (MHz)	Quasi-peak limits (dB $\mu$ V/m)
30 to 88	40
88 to 216	43.5
216 to 960	46
Above 960 MHz	54

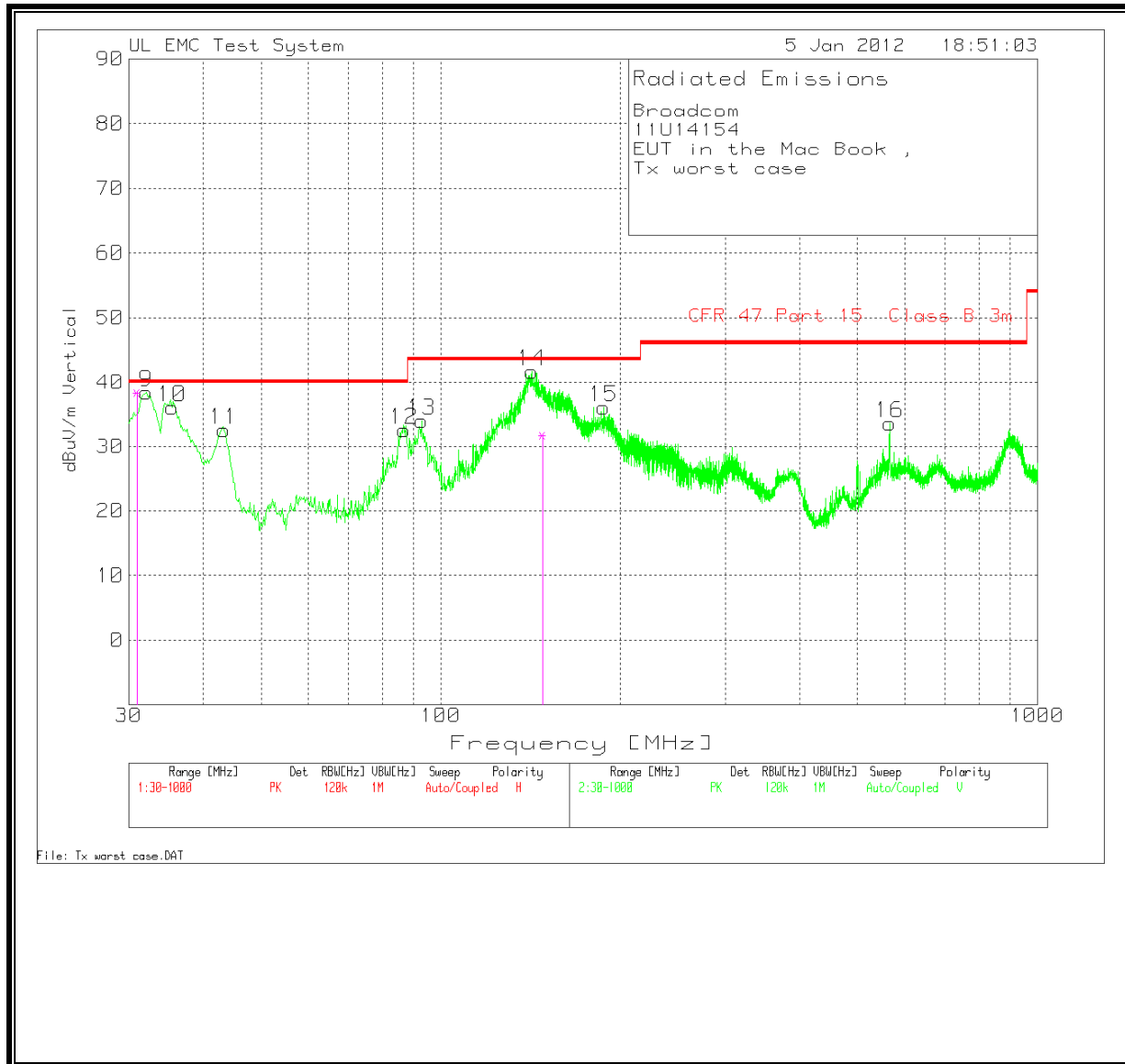
Note: The lower limit shall apply at the transition frequency.

**RESULTS**

**RADIATED EMISSIONS 30 TO 1000 MHz - HORIZONTAL**



**RADIATED EMISSIONS 30 TO 1000 MHz - VERTICAL**



**HORIZONTAL AND VERTICAL DATA**

Company: **Broadcom**  
 Project No.: **11U14154**  
 Test Date: **1/5/2012**  
 Test Setup: **EUT in the MacBook**  
 Mode: **Tx worst case**

Test Frequency	Meter Reading	Detector	Amp [dB]	T130 Bilog Factors [dB]	Corrected dBuV/m	Class B 3m limit	QP Margin	Height [cm]	Polarity	Note
87.3781	54.75	PK	-27.0	7.5	35.25	40	-4.75	251	Horz	
92.9996	54.18	PK	-26.9	7.9	35.18	43.5	-8.32	251	Horz	
140.8793	61.9	PK	-26.4	13.1	48.6	43.5	5.10	251	Horz	
140.2957	53.92	QP	-26.5	13.1	40.52	43.5	-2.98	245	Horz	
160.6515	58.82	PK	-26.2	13.1	45.72	43.5	2.22	176	Horz	
158.2391	52.74	QP	-26.2	13.1	39.64	43.5	-3.86	181	Horz	
186.6267	59.1	PK	-25.9	11.1	44.30	43.5	0.80	176	Horz	
185.3917	53.38	QP	-26.0	11.1	38.48	43.5	-5.02	115	Horz	
229.8541	56.19	PK	-25.6	11.8	42.39	46	-3.61	100	Horz	
248.4632	55.98	PK	-25.4	11.8	42.38	46	-3.62	100	Horz	
911.6067	38.09	PK	-23.9	22.2	36.39	46	-9.61	100	Horz	
959.6803	40.66	PK	-24.3	22.2	38.56	46	-7.44	109	Horz	
32.1323	46.92	PK	-27.5	19.0	38.42	40	-1.58	101	Vert	Noise from MacBook
31.0368	46.39	QP	-27.5	19.5	38.39	40	-1.61	107	Vert	Noise from MacBook
35.4277	46.42	PK	-27.5	17.2	36.12	40	-3.88	101	Vert	
43.3753	47.71	PK	-27.4	12.3	32.61	40	-7.39	101	Vert	
86.9904	52.2	PK	-27.0	7.5	32.7	40	-7.30	176	Vert	
92.8058	53.11	PK	-26.9	7.9	34.11	43.5	-9.39	176	Vert	
142.2362	55.06	PK	-26.4	13.0	41.66	43.5	-1.84	251	Vert	
148.3681	45.5	QP	-26.4	12.7	31.8	43.5	-11.70	250	Vert	
187.5959	50.99	PK	-25.9	11.1	36.19	43.5	-7.31	176	Vert	
566.3689	41.57	PK	-25.8	17.9	33.67	46	-12.33	101	Vert	

PK - Peak detector  
 QP - Quasi-Peak detector

## 7.2. AC MAINS LINE CONDUCTED EMISSIONS

### TEST PROCEDURE

ANSI C63.4

### LIMIT

§15.107 (a) Except for Class A digital devices, for equipment 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  $\mu$ 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 band edges.

Frequency range (MHz)	Limits (dB $\mu$ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

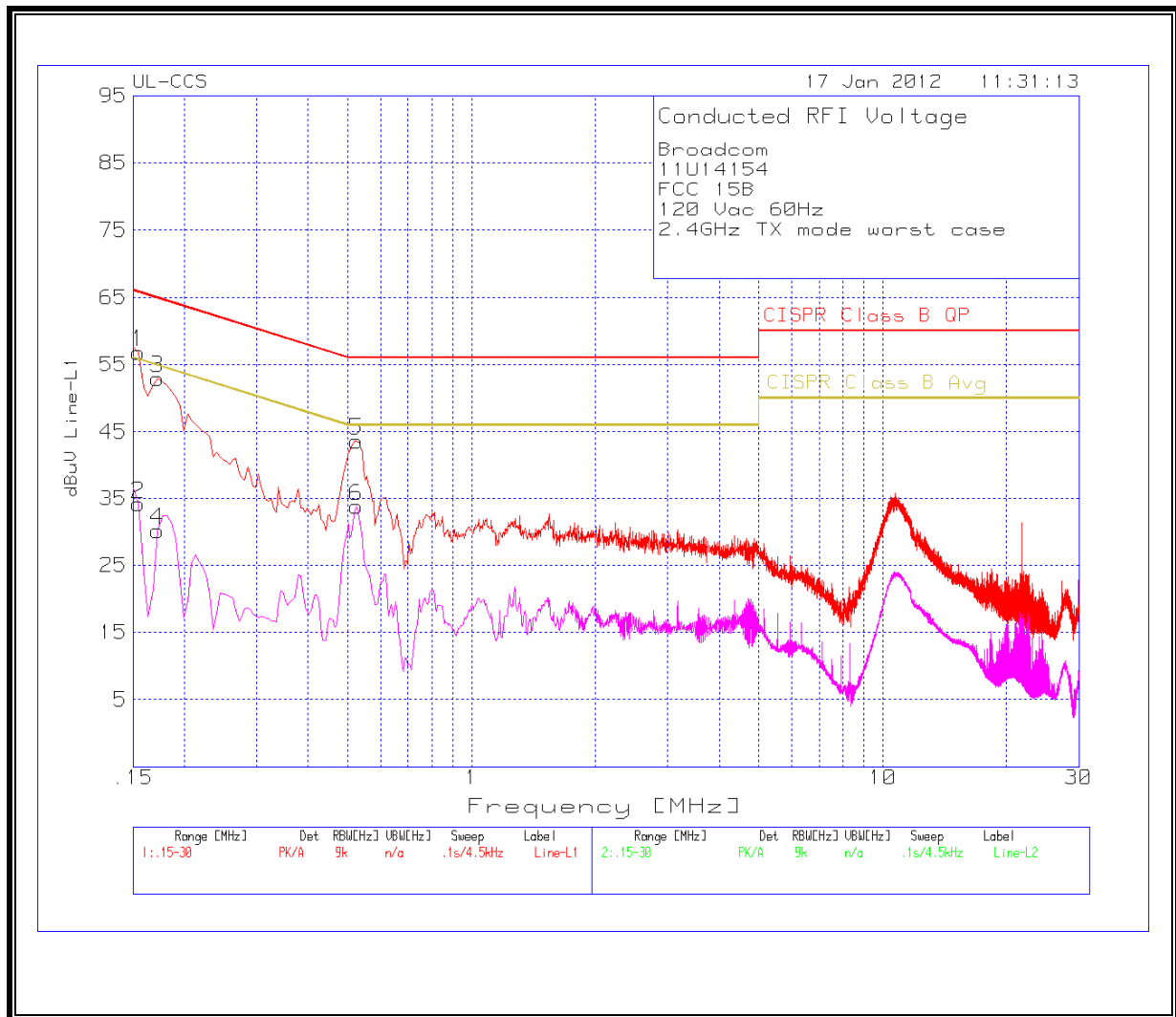
Notes:  
1. The lower limit shall apply at the transition frequencies  
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

**RESULTS**

**6 WORST EMISSIONS**

HORIZONTAL AND VERTICAL DATA									
Broadcom									
11U14154									
EUT inside the Macbook Air									
Tx worst case									
Test Frequency	Meter Reading	Detector	T24 LISN [dB]	Cables [dB]	Corrected dBuV	CISPR Class B QP limit	QP Margin	CISPR Class B Av limit	Av Margin
Line-L1 .15 - 30MHz									
0.15	57.88	PK	0.1	0	57.98	66	-8.02	-	-
0.15	36.86	Av	0.1	0	36.96	-	-	56	-19.04
0.528	41.72	PK	0.1	0	41.82	56	-14.18	-	-
0.528	30.73	Av	0.1	0	30.83	-	-	46	-15.17
1.581	31.05	PK	0.1	0.1	31.25	56	-24.75	-	-
1.581	18.77	Av	0.1	0.1	18.97	-	-	46	-27.03
Line-L2 .15 - 30MHz									
0.15	57.24	PK	0.1	0	57.34	66	-8.66	-	-
0.15	38.03	Av	0.1	0	38.13	-	-	56	-17.87
0.528	41.41	PK	0.1	0	41.51	56	-14.49	-	-
0.528	31.06	Av	0.1	0	31.16	-	-	46	-14.84
10.7475	32.65	PK	0.2	0.2	33.05	60	-26.95	-	-
10.7475	20.46	Av	0.2	0.2	20.86	-	-	50	-29.14
PK - Peak detector									
QP - Quasi-Peak detector									
Av - Average detector									

**LINE 1 RESULTS**





**LINE 2 RESULTS**

