



**FCC 47 CFR PART 15 SUBPART B
ICES-003 ISSUE 5**

TEST REPORT

FOR

802.11a/g/n/ac 3X3 WLAN + Bluetooth PCI-E Custom Combination Card

MODEL NUMBER: BCM943602BAED

**FCC ID: QDS-BRCM1088
IC: 4324A-BRCM1088**

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Prepared for
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NVLAP LAB CODE 200065-0

Revision History

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TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	4
2. TEST METHODOLOGY	6
3. FACILITIES AND ACCREDITATION	6
4. CALIBRATION AND UNCERTAINTY	6
4.1. <i>MEASURING INSTRUMENT CALIBRATION</i>	<i>6</i>
4.2. <i>SAMPLE CALCULATION</i>	<i>6</i>
4.3. <i>MEASUREMENT UNCERTAINTY</i>	<i>7</i>
5. EQUIPMENT UNDER TEST	8
5.1. <i>DESCRIPTION OF EUT</i>	<i>8</i>
5.2. <i>TEST CONFIGURATIONS</i>	<i>8</i>
5.3. <i>WORST CASE MODE OF OPERATION</i>	<i>8</i>
5.4. <i>SOFTWARE AND FIRMWARE</i>	<i>8</i>
5.5. <i>MODIFICATIONS</i>	<i>8</i>
5.6. <i>DETAILS OF TESTED SYSTEM</i>	<i>9</i>
6. TEST AND MEASUREMENT EQUIPMENT	11
7. APPLICABLE LIMITS AND TEST RESULTS	12
7.1. <i>RADIATED EMISSIONS</i>	<i>12</i>
7.2. <i>AC MAINS LINE CONDUCTED EMISSIONS</i>	<i>14</i>
8. SETUP PHOTOS	17
8.1. <i>RADIATED EMISSIONS < 1000 MHz – 3 m</i>	<i>17</i>
8.2. <i>AC MAINS LINE CONDUCTED EMISSIONS</i>	<i>18</i>

1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: 802.11a/g/n/ac 3X3 WLAN + Bluetooth PCI-E Custom Combination Card

MODEL: BCM943602BAED

SERIAL NUMBER: 167

DATE TESTED: APRIL 7 to 22, 2015

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 15 SUBPART B	Pass
ICES – 003 ISSUE 5	Pass

UL Verification Services Inc. 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 Verification Services Inc. 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 Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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.

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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.

47173 Benicia Street	47266 Benicia Street
<input checked="" type="checkbox"/> Chamber A	<input type="checkbox"/> Chamber D
<input type="checkbox"/> Chamber B	<input type="checkbox"/> Chamber E
<input type="checkbox"/> Chamber C	<input type="checkbox"/> Chamber F
	<input type="checkbox"/> Chamber G
	<input type="checkbox"/> Chamber H

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

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
Radiated Disturbance, 1 to 6 GHz	± 3.86 dB
Radiated Disturbance, 6 to 18 GHz	± 4.23 dB
Radiated Disturbance, 18 to 26 GHz	± 5.30 dB
Radiated Disturbance, 26 to 40 GHz	± 5.23 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an 8802.11a/g/n/ac 3X3 WLAN + Bluetooth PCI-E Custom Combination Card.

The radio module is manufactured by Broadcom.

5.2. TEST CONFIGURATIONS

EUT Configuration	Description
Typical Configuration	EUT connected to a host laptop via extender board. The laptop used a mouse and router as minimum configuration.

5.3. WORST CASE MODE OF OPERATION

Mode	Description
Radio powered ON	Radio card connected to host PC and powered

5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom, rev.7.35.201.0.

The test utility software used during testing was Broadcom, rev. 7.15RC163.2 (r518356 WLTEST).

5.5. MODIFICATIONS

No modifications were made during testing.

5.6. DETAILS OF TESTED SYSTEM

SUPPORT EQUIPMENT & PERIPHERALS

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	Manufacturer	Model	S/N
Laptop	Lenovo	Lenovo G560	CBU3474487
AC / DC Adapter	Lenovo	PA-1650-56LC	N/A
Ethernet Hub	Netgear	EN106	ENT6A99003602
AC / DC Adapter	Netgear	LPS421-480508EL	N/A
Mouse	Dell	330-9456	N/A
Catalyst PCIe. Board	Enterprises Inc.	NA	NA

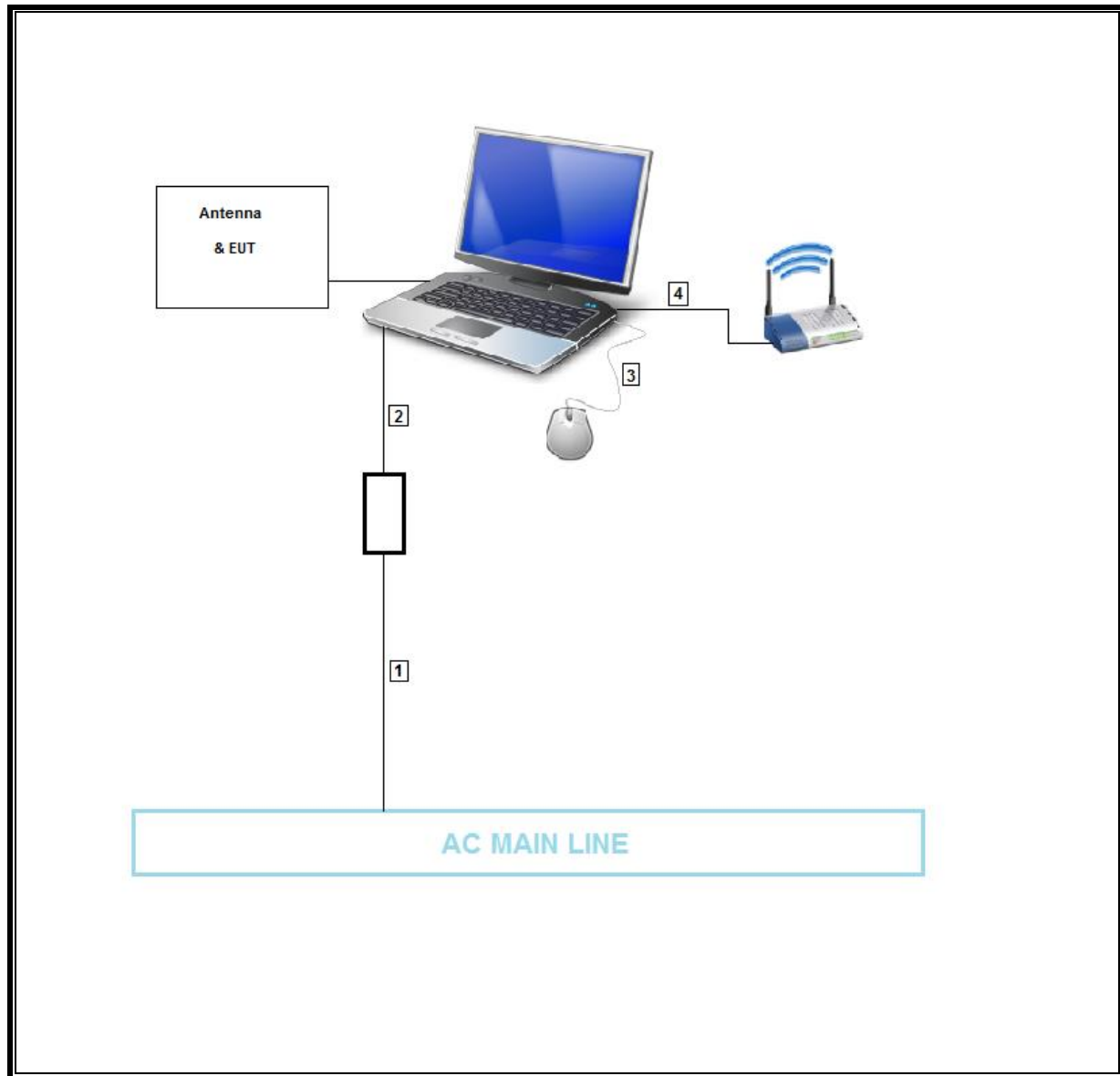
I/O CABLES

Cable No.	Port	No. of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	US115V	Unshielded	1	
2	DC	1	VDC	Unshielded	1.5	Ferrite on laptop end
3	USB	1	Mini-USB	Shielded	2	
4	Ethernet	1	RJ45	Unshielded	2	

TEST SETUP

External antennas were used and the EUT was connected to a laptop computer that was set up in a minimum configuration with a USB mouse and router connected. Test software exercised video and peripherals. Radio was not transmitting.

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	T No.	Cal Date	Cal Due
Radiated Software	UL	UL EMC	Ver 9.5, July 22, 2014		
Line Conducted Software	UL	UL EMC	Ver 9.5, May 17, 2012		
Spectrum Analyzer, 3 Hz-44GHz	Agilent	N9030A	T907	07/05/14	07/05/15
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB1	T243	12/08/14	12/08/15
Preamplifier, 1300 MHz	Agilent / HP	8447D	T10	04/28/14	04/28/15
LISN	Solar	8012-50-R-24-BNC	29	5/7/2014	5/7/2015
EMI Test Receiver, 9KHz to 7GHz	Rohde & Schwarz	ESCI 7	284	09/16/14	09/16/15
LISN	FCC	50/250-25-2	24	01/16/15	01/16/16

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 40 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 μ 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 (WORST-CASE CONFIGURATION)

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T243 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
69.9925	39.8	QP	8.1	-28.4	19.5	40	-21.8	246	159	H
90.01	55.4	QP	7.7	-28.2	34.9	43.52	-9.32	253	186	H
166.5298	53.68	QP	11.9	-27.3	38.28	43.52	-5.24	262	159	H
612.8037	46.6	QP	18.9	-25.2	40.3	46.02	-5.72	209	102	V
612.9541	46.4	QP	18.9	-25.2	40.1	46.02	-5.92	211	103	V
613.0511	46.62	QP	18.9	-25.2	40.32	46.02	-5.7	90	175	H

QP - Quasi-Peak detector

7.2. AC MAINS LINE CONDUCTED EMISSIONS

TEST PROCEDURE

ANSI C63.4

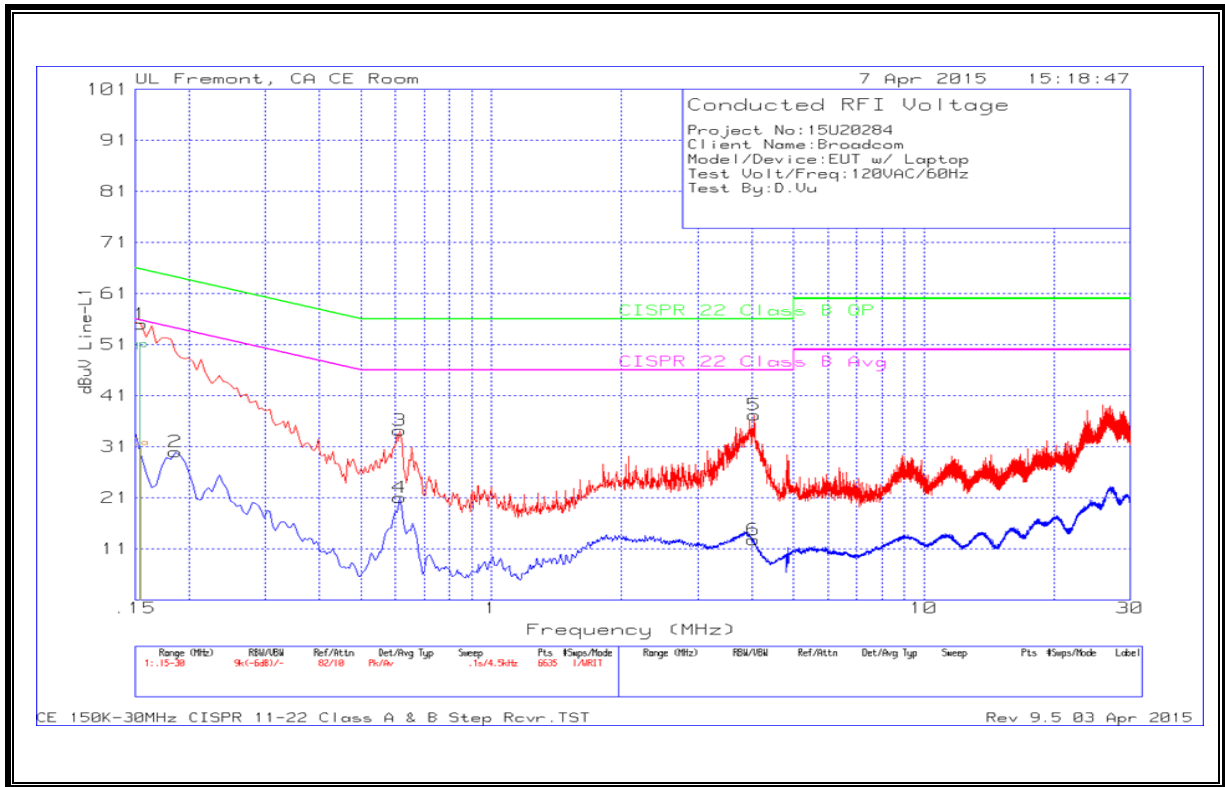
LIMIT

§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 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 band edges.

Frequency range (MHz)	Limits (dB μ 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

LINE 1 RESULTS



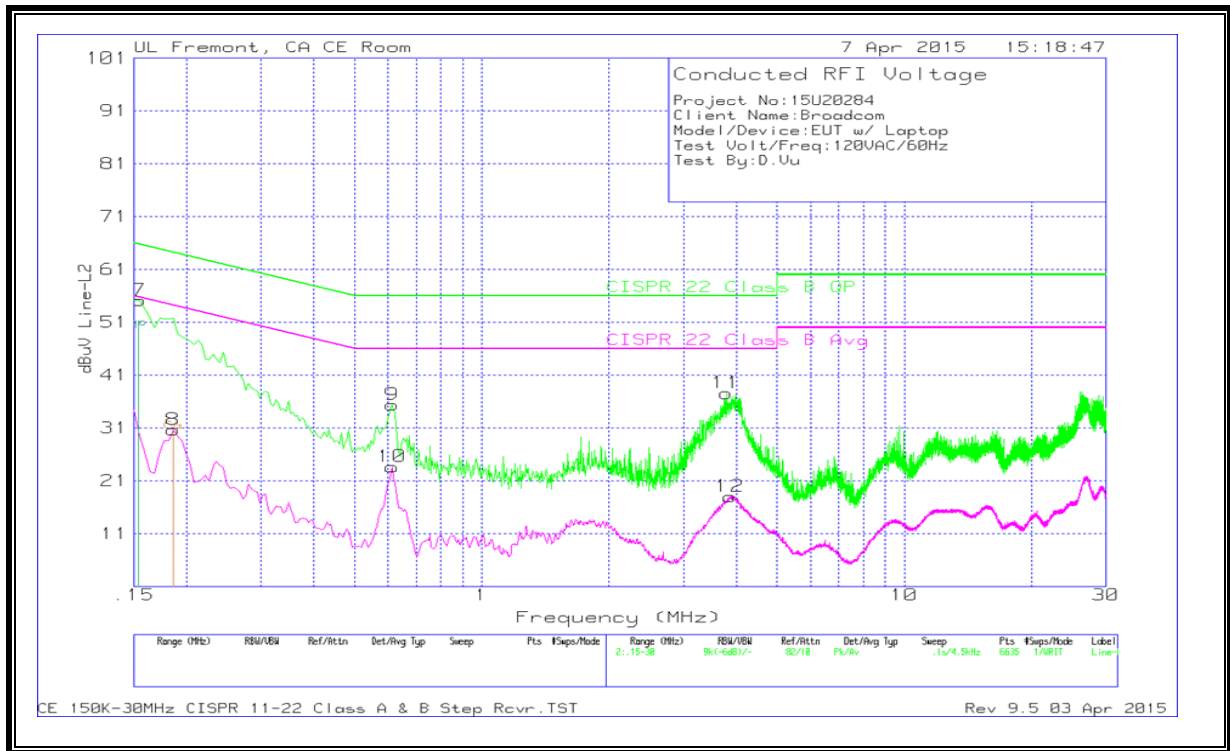
Range 1: Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1	LC Cables 1&3	Corrected Reading dBuV	CISPR 22 Class B QP	Margin (dB)	CISPR 22 Class B Avg	Margin (dB)
1	.1545	53.74	Pk	1.3	0	55.04	64.21	-9.17	-	-
2	.186	29.02	Av	1	0	30.02	-	-	54.21	-24.19
3	.6135	33.92	Pk	.3	0	34.22	56	-21.78	-	-
4	.6135	20.76	Av	.3	0	21.06	-	-	46	-24.94
5	4.056	36.91	Pk	.2	.1	37.21	56	-18.79	-	-
6	4.0335	12.49	Av	.2	.1	12.79	-	-	46	-33.21

Pk - Peak detector

Av - Average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2	LC Cables 2&3	Corrected Reading dBuV	CISPR 22 Class B QP	Margin (dB)	CISPR 22 Class B Avg	Margin (dB)
7	.1545	53.77	Pk	1.4	0	55.17	64.21	-9.04	-	-
8	.186	29.54	Av	1.1	0	30.64	-	-	54.21	-23.57
9	.6135	35.09	Pk	.3	0	35.39	56	-20.61	-	-
10	.6135	23.35	Av	.3	0	23.65	-	-	46	-22.35
11	3.7905	37.3	Pk	.2	.1	37.6	56	-18.4	-	-
12	3.867	17.7	Av	.2	.1	18	-	-	46	-28

Pk - Peak detector

Av - Average detection