FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8
CLASS II PERMISSIVE CHANGE

CERTIFICATION TEST REPORT

FOR

802.11a/g/n 3x3 MIMO WLAN + BT COMBO PCI-E MINI CARD

MODEL NUMBER: BCM94331PCIEBT4

FCC ID: QDS-BRCM1055
IC: 4324A-BRCM1055

REPORT NUMBER: 11U14192-12

ISSUE DATE: FEBRUARY 24, 2012

Prepared for

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

Prepared by

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	02/24/12	Initial Issue	F. Ibrahim

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	BROADCOM CORPORATION 190 MATHILDA PLACE SUNNYVALE, CA 94086, USA
EUT DESCRIPTION:	802.11a/g/n 3x3 MIMO WLAN + BT Combo PCI-E Mini Card
MODEL:	BCM94331PCIEBT4
SERIAL NUMBER:	C8Y14660004DRK7EZ
DATE TESTED:	FEBRUARY 7-20, 2012

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	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:

FRANK IBRAHIM
EMC SUPERVISOR
UL CCS

Tested By:

DAVID GARCIA
EMC ENGINEER
UL CCS

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

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:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

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/g/n 3x3 MIMO WLAN + BT Combo PCI-E Mini Card with Low Energy mode (LE).

The radio module is manufactured by Broadcom.

5.2. MAXIMUM OUTPUT POWER

The measured average power values were within ± 0.5 dB of the original values. Refer to original report number “10U13492-1A_FCC IC DTS WLAN Report_Revised 012111” for exact output power values and for all antenna port results.

5.3. CLASS II PERMISSIVE CHANGE DESCRIPTION

The Bluetooth Low Energy functionality (BLE) is added to the Bluetooth chipset.
The modified chipset is pin for pin compatible and the BT functionality, the maximum output power and frequencies of operation remain the same as the original approval.

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes three 802.11agn antennas, with a maximum gain as below table;

2x2-ANTENNA

K90	Antenna Gain		Antenna Gain
GHz	Ant 1 dBi	Ant 2 dBi	Combined dBi
5.2	**6.02**	5.96	**9.00**
5.3	**6.80**	6.17	**9.51**
5.6	**7.06**	6.26	**9.69**

3x3-ANTENNA

K90	Antenna Gain			Antenna Gain
GHz	Ant 1 dBi	Ant 2 dBi	Ant 3 dBi	Combined dBi
5.2	**6.02**	5.96	5.50	**10.60**
5.3	**6.80**	6.17	5.59	**10.99**
5.6	**7.06**	6.26	5.97	**11.23**

5.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was WLTEST 5.100 RC98.3, version 5.100.98.17.

The EUT driver software installed during testing was Broadcom, rev. 5.100.98.17
The test utility software used during testing was BCM Internal, rev. 5.100.RC98.3.

5.6. WORST-CASE CONFIGURATION AND MODE

The EUT was tested as an external module installed in a test jig board connected to a host Laptop PC.

Worst-Case data rates were utilized from preliminary testing of the Chipset, worst-case data rates used during the testing are as follows:

All final tests in the 802.11b Legacy mode were made at 1 Mb/s.
All final tests in the 802.11g Legacy mode were made at 6 Mb/s.
All final tests in the 802.11a Legacy mode were made at 6 Mb/s.
All final tests in the 802.11n 20 MHz CDD/SDM mode were made at MCS0.
All final tests in the 802.11n 40 MHz CDD/SDM mode were made at MCS0.

For radiated band edge measurements preliminary testing showed that the worst case was vertical polarization, so final measurements were performed with vertical polarization.

An investigation of the original report “10U13492-1A_FCC IC DTS WLAN Report_Revised 012111” was performed to find worst case radiated emissions data, spot test in this report is performed for those worst-case modes and channels.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop PC	HP	DV6000	CNF6463KP7	DoC
AC Adapter	HP	PA-1650-02H	592C40CRGUBR9B	DoC
Adapter	Catalyst	MINI2EXP	BRCM 2011-05	N/A
Adapter	Broadcom	BCM9433PCIEBT4HAD	1371750	N/A

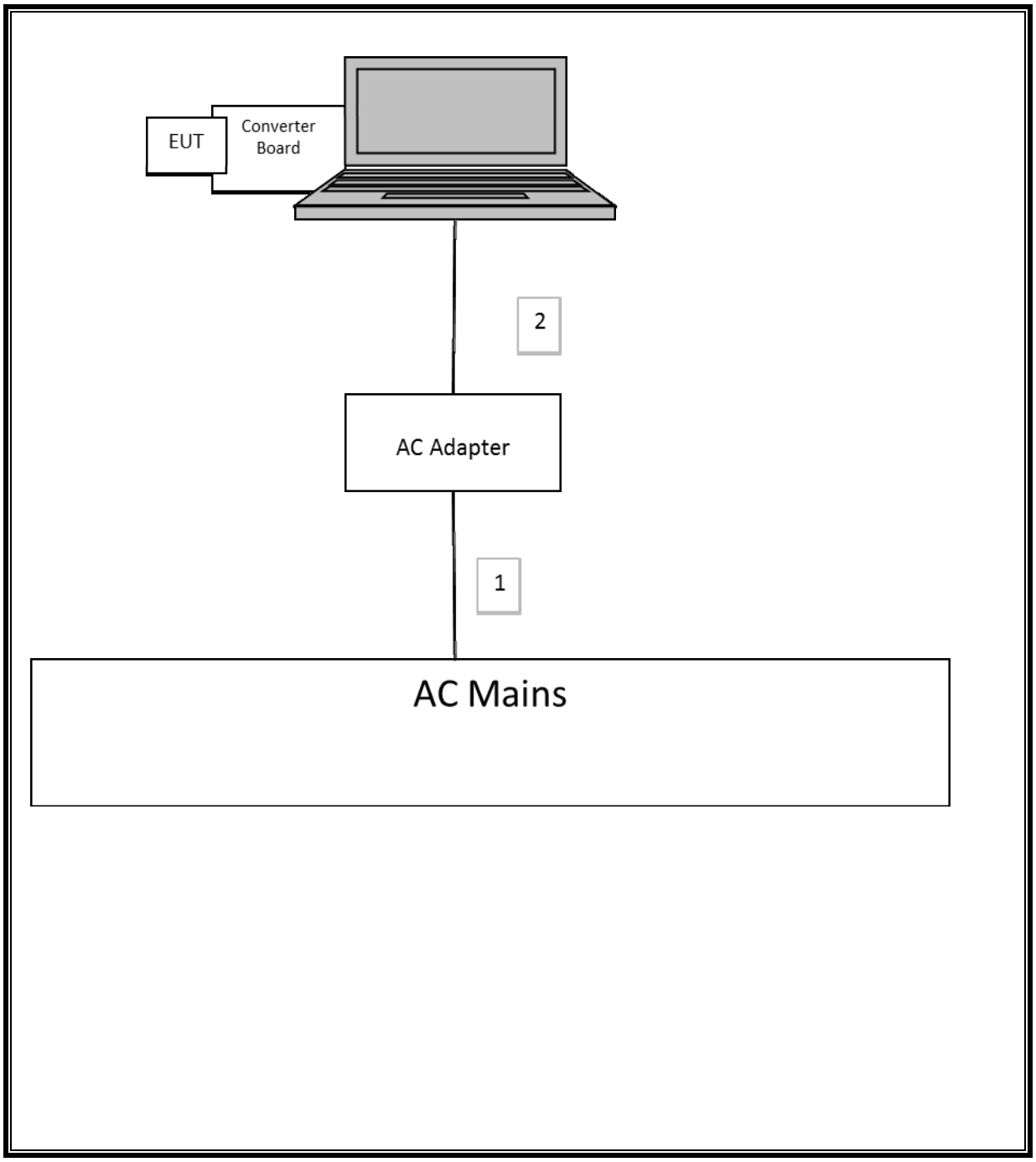
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	1	US 115V	Unshielded	1.5m	N/A
2	DC	1	DC	Unshielded	1.5m	Ferrite at laptop end

TEST SETUP

The EUT is installed in a host laptop computer 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**	**Asset**	**Cal Date**	**Cal Due**
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	09/02/11	09/02/12
ESA Spectrum Analyzer 9kHz-6.7GHz	Agilent / HP	E4404B		01/10/12	01/10/13
Antenna, Horn, 18 GHz	EMCO	3115	C00872	09/20/11	09/20/12
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	07/18/11	07/18/12
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/13/11	12/13/13
Peak Power Meter	Agilent / HP	E4416A	C00963	12/13/11	12/13/13
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	07/28/11	07/28/12
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	C00981	06/14/11	06/14/12
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	08/02/11	08/02/12

7. RADIATED TEST RESULTS

Note: This report only covers radiated portion, refer to original report number "10U13492-1A_FCC IC DTS WLAN Report_Revised 012111" for all antenna port results.

7.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

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.

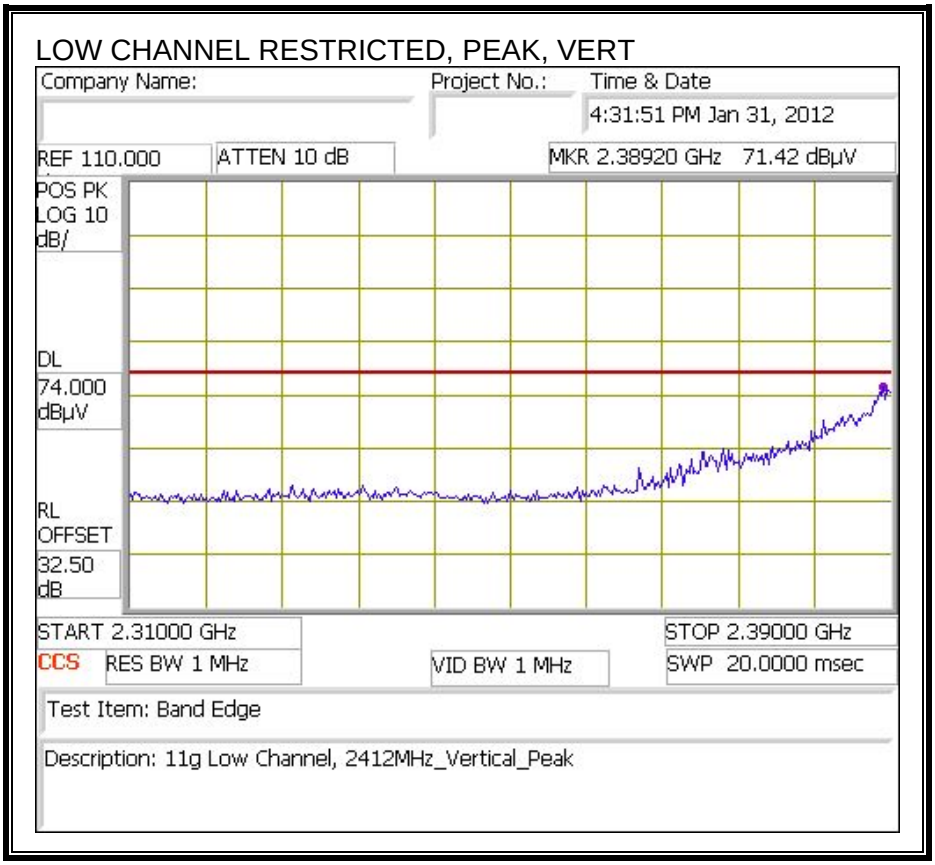
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

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.

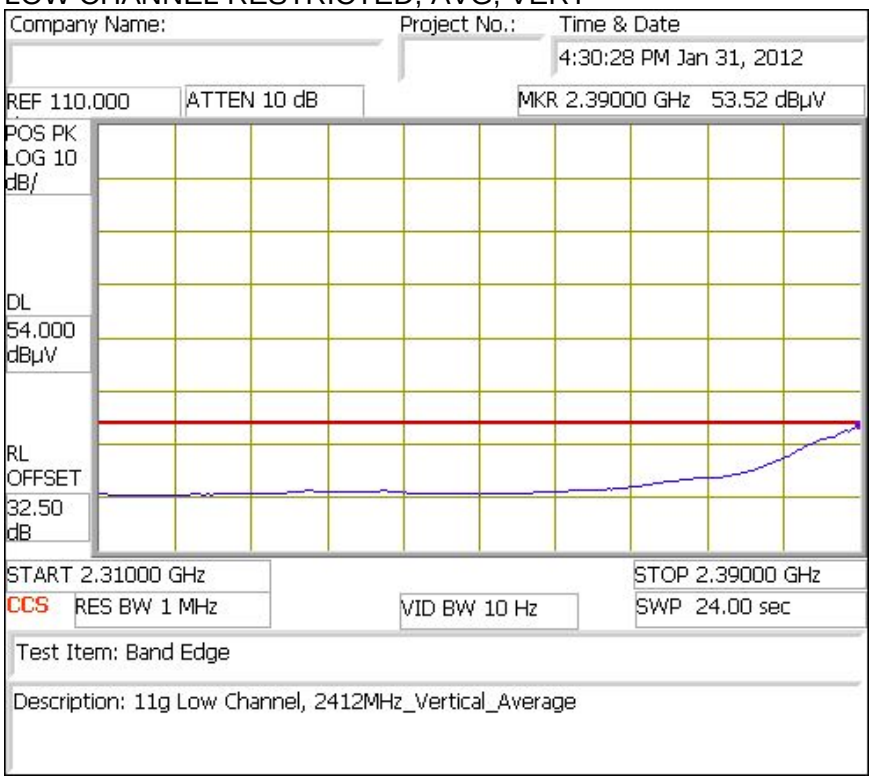
7.2. TRANSMITTER ABOVE 1 GHz

7.2.1. TX ABOVE 1 GHz, 802.11g 1TX, 2.4 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

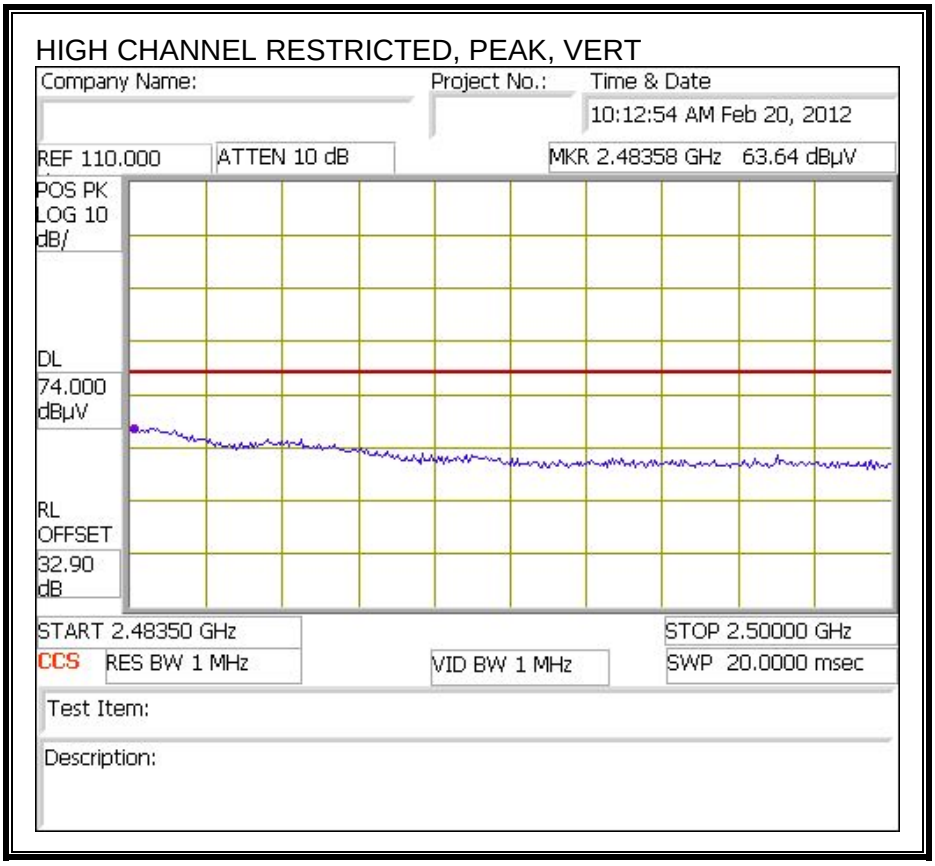


LOW CHANNEL RESTRICTED, AVG, VERT

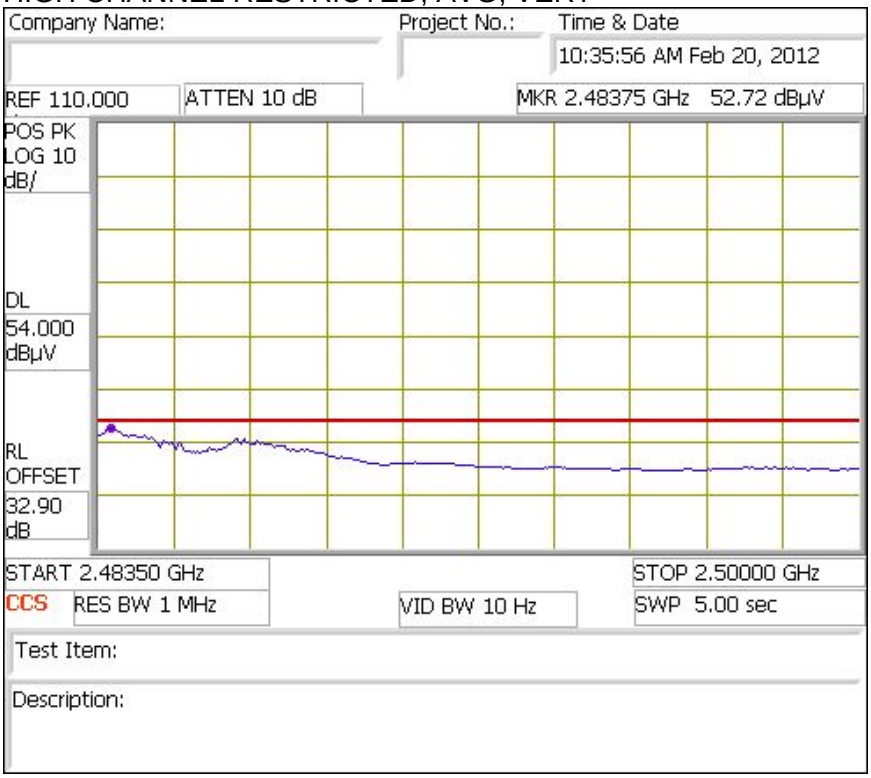


7.2.2. TX ABOVE 1 GHz, 802.11b 3TX, 2.4 GHz BAND, CDD MCS0

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



HIGH CHANNEL RESTRICTED, AVG, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: David Garcia
Date: 02/16/12
Project #: 11U14192
Company: Broadcom
Test Target: 15.247 C2PC
Mode Oper: 11b 3x3 CDD MCS0

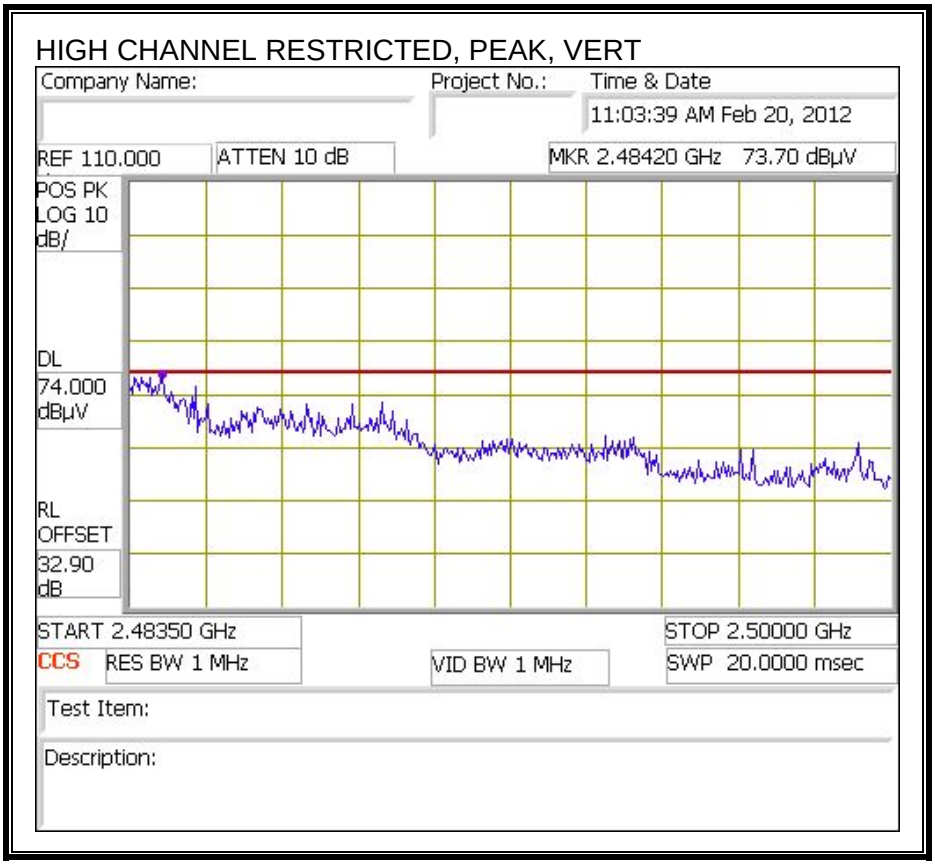
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
11b 3x3 Channel 11: 2462 MHz													s/n: 4DRK7EZ
12.310	3.0	37.2	39.4	12.0	-32.5	0.0	0.0	56.1	74.0	-17.9	V	P	
12.310	3.0	29.4	39.4	12.0	-32.5	0.0	0.0	48.4	54.0	-5.6	V	A	
7.386	3.0	42.6	36.4	9.1	-34.1	0.0	0.0	54.1	74.0	-19.9	V	P	
7.386	3.0	36.6	36.4	9.1	-34.1	0.0	0.0	48.0	54.0	-6.0	V	A	
4.924	3.0	44.0	33.2	6.8	-34.8	0.0	0.0	49.2	74.0	-24.8	V	P	
4.924	3.0	40.2	33.2	6.8	-34.8	0.0	0.0	45.4	54.0	-8.6	V	A	
4.924	3.0	41.4	33.2	6.8	-34.8	0.0	0.0	46.6	74.0	-27.4	H	P	
4.924	3.0	37.2	33.2	6.8	-34.8	0.0	0.0	42.4	54.0	-11.6	H	A	
7.386	3.0	39.6	36.4	9.1	-34.1	0.0	0.0	51.0	74.0	-23.0	H	P	
7.386	3.0	32.9	36.4	9.1	-34.1	0.0	0.0	44.4	54.0	-9.6	H	A	
12.310	3.0	36.8	39.4	12.0	-32.5	0.0	0.0	55.7	74.0	-18.3	H	P	
12.310	3.0	28.6	39.4	12.0	-32.5	0.0	0.0	47.5	54.0	-6.5	H	A	

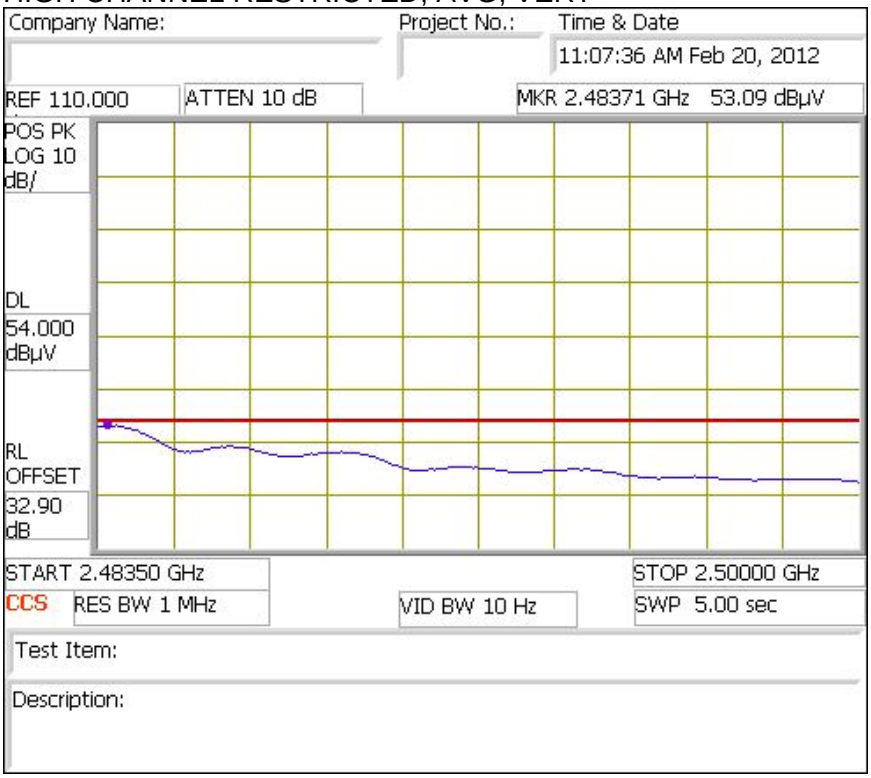
Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

7.2.3. TX ABOVE 1 GHz, 802.11n HT20 3TX, 2.4 GHz BAND, CDD MCS0

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



HIGH CHANNEL RESTRICTED, AVG, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: David Garcia
Date: 02/16/12
Project #: 11U14192
Company: Broadcom
Test Target: 15.247 C2PC
Mode Oper: 11n HT20 3x3 CDD MCS0

f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
11n HT20 3x3 Channel 11: 2462 MHz													s/n: 4DRK7EZ
4.924	3.0	32.9	33.2	6.8	-34.8	0.0	0.0	38.2	54.0	-15.8	V	A	
7.386	3.0	44.5	36.4	9.1	-34.1	0.0	0.0	55.9	74.0	-18.1	V	P	
7.386	3.0	30.7	36.4	9.1	-34.1	0.0	0.0	42.1	54.0	-11.9	V	A	
4.924	3.0	47.4	33.2	6.8	-34.8	0.0	0.0	52.7	74.0	-21.3	V	P	
12.310	3.0	46.2	39.4	12.0	-32.5	0.0	0.0	65.2	74.0	-8.8	V	P	
12.310	3.0	29.6	39.4	12.0	-32.5	0.0	0.0	48.5	54.0	-5.5	V	A	
4.924	3.0	47.2	33.2	6.8	-34.8	0.0	0.0	52.4	74.0	-21.6	H	P	
4.924	3.0	32.1	33.2	6.8	-34.8	0.0	0.0	37.3	54.0	-16.7	H	A	
7.386	3.0	38.6	36.4	9.1	-34.1	0.0	0.0	50.0	74.0	-24.0	H	P	
7.386	3.0	25.6	36.4	9.1	-34.1	0.0	0.0	37.0	54.0	-17.0	H	A	
12.310	3.0	39.0	39.4	12.0	-32.5	0.0	0.0	58.0	74.0	-16.0	H	P	
12.310	3.0	23.9	39.4	12.0	-32.5	0.0	0.0	42.9	54.0	-11.1	H	A	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

7.2.4. TX ABOVE 1 GHz, 802.11n HT20 3TX, 5.8 GHz BAND, CDD MCS0

HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 3m Chamber

Company: Broadcom
Project #: 11U14192
Date: 2/13/2012
Test Engineer: D. Garcia
Configuration: Laptop PC, EUT on Test Board, antenna apparatus
Mode: HT20 3x3 CDD MCS0

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B			FCC 15.205

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		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)
HT20 3x3 CDD MCS0; CH 157 = 5785 MHz															
11.570	3.0	34.5	24.6	38.9	11.3	-32.4	0.0	0.0	52.4	42.4	74	54	-21.6	-11.6	V
11.570	3.0	33.8	24.3	38.9	11.3	-32.4	0.0	0.0	51.7	42.2	74	54	-22.3	-11.8	H

Rev. 07.08.11

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		

7.2.1. TX ABOVE 1 GHz, 802.11n HT40 3TX, 5.8 GHz BAND, CDD MCS0

HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 3m Chamber

Company: Broadcom
Project #: 11U14192
Date: 2/13/2012
Test Engineer: D. Garcia
Configuration: Laptop PC, EUT on Test Board, antenna apparatus
Mode: HT40 3x3 CDD MCS0

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B			FCC 15.205

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		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)
HT40 3x3 CDD MCS0; CH 159 = 5795 MHz															
11.590	3.0	33.8	22.0	39.0	11.3	-32.4	0.0	0.0	51.7	39.9	74	54	-22.3	-14.1	V
11.590	3.0	33.5	21.6	39.0	11.3	-32.4	0.0	0.0	51.4	39.6	74	54	-22.6	-14.4	H

Rev. 07.08.11

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		