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

CERTIFICATION TEST REPORT

FOR

802.11g/DRAFT 802.11n WLAN PCI-E MINICARD
(Tested inside HP HSTNN-W82C)

MODEL NUMBER: BCM94313HMG2L

FCC ID: QDS-BRCM1050
IC: 4324A-BRCM1050

REPORT NUMBER: 10U13562-1, REVISION C
ISSUE DATE: MARCH 29, 2011

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

Prepared by
COMPLIANCE CERTIFICATION SERVICES (UL CCS)
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
---	3/13/11	Initial Issue	Thu Chan
A	3/18/11	Add IC rules	Thu Chan
B	3/21/11	Updated Antenna Gain With Cable Loss	Thu Chan
C	3/29/11	Added Average Output Power & Updated IC Standards	Thu Chan

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: 802.11g/Draft 802.11n WLAN PCI-E Mini Card
(Tested inside HP HSTNN-W82C)

MODEL: BCM94313HMG2L

SERIAL NUMBER: A209

DATE TESTED: MARCH 11, 2011

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:

THU CHAN
ENGINEERING MANAGER
UL CCS

Tested By:

VIEN TRAN
EMC ENGINEER
UL CCS

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, 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 a Broadcom 802.11g/Draft 802.11n WLAN PCI-E Minicard and installed inside HP HSTNN-W82C.

The radio module is manufactured by Broadcom.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2462	802.11b	19.42	87.50
2412 - 2462	802.11g	24.53	283.79
2412 - 2462	802.11n 20 SISO	Covered by the worst case 802.11g Mode Legacy testing	

5.3. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

The major changes filed under this application are:

Change #1 Adding a portable platform, tablet PC, HP HSTNN-W82C.
Change #2 Reduced output power and frequency channels.

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an 802.11bg WLAN antenna, with a maximum gain of 1.88 at tablet mode.

5.5. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom version 5.60.18.20.

The test utility software used during testing was Broadcom version 5.60.18 TOB.

5.6. NUMBER OF TRANSMIT CHAINS

Selected measurements were performed on the Main and Auxiliary chains for 802.11b/g mode; however only one of these chains will be transmitting at any time.

5.7. WORST-CASE CONFIGURATION AND MODE

Worst-Case data rates were utilized from preliminary testing of the chipset, worst-case data rates used during the testing are as follows:
_802.11b Mode (20 MHz BW operation): 1 Mbps, CCK.
_802.11g Mode (20 MHz BW operation): 6 Mbps, OFDM.

Since the EUT was certified as modular approval with highest antenna gain of 3.9dBi; therefore only the tablet laptop mode was selected to investigate on worst case band and all RF conducted and radiated emission on channel 11.

The tablet laptop was investigated under potable positions (X, Y, and Z) to determine the worst case and the Y-axis position was the worse case to test.

5.8. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMEN

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	HP	OUTFIELD SI_2 SANDY	ABC0490071	DoC
AC Adapter	HP	PPP009D	WBGSV0ACXZOIRL	N/A

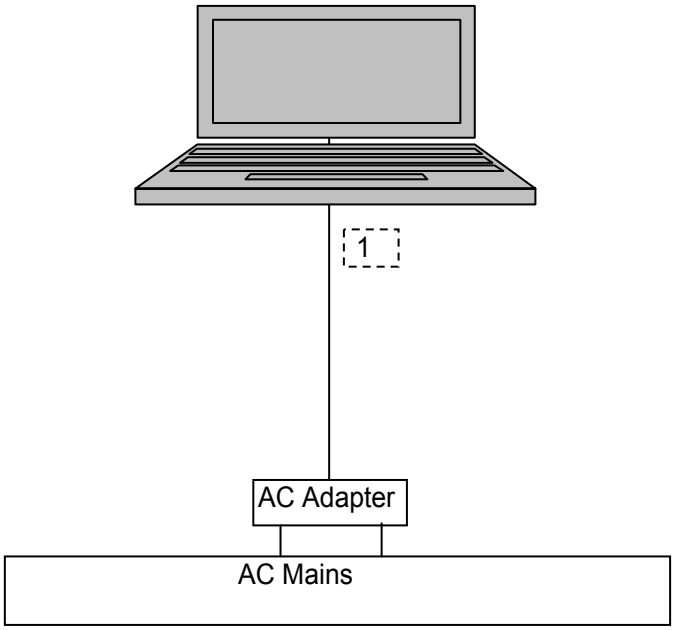
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identica Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	1	DC	Unshielded	1.5m	AC Adapter 100-240VAC

TEST SETUP

The EUT is installed inside a host tablet PC 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 Due**
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01171	07/14/11
Antenna, Horn, 18 GHz	EMCO	3115	C00872	07/29/11
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	07/29/11
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00778	01/27/12
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	08/04/11
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00996	08/10/11
Peak Power Meter	Boonton	4541	C01186	08/11/11
Peak Power Sensor	Boonton	57318	0	07/28/11
Peak Power Meter	Agilent / HP	E9327A	C00964	12/04/11
Peak Power Sensor	Agilent / HP	E4416A	C00963	12/04/11
EMI Receiver, 6.5 GHz	Agilent / HP	8546A	1963	08/19/11
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR

7. ANTENNA PORT TEST RESULTS

7.1. 802.11b MODE IN THE 2.4 GHz BAND (High Channel)

7.1.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

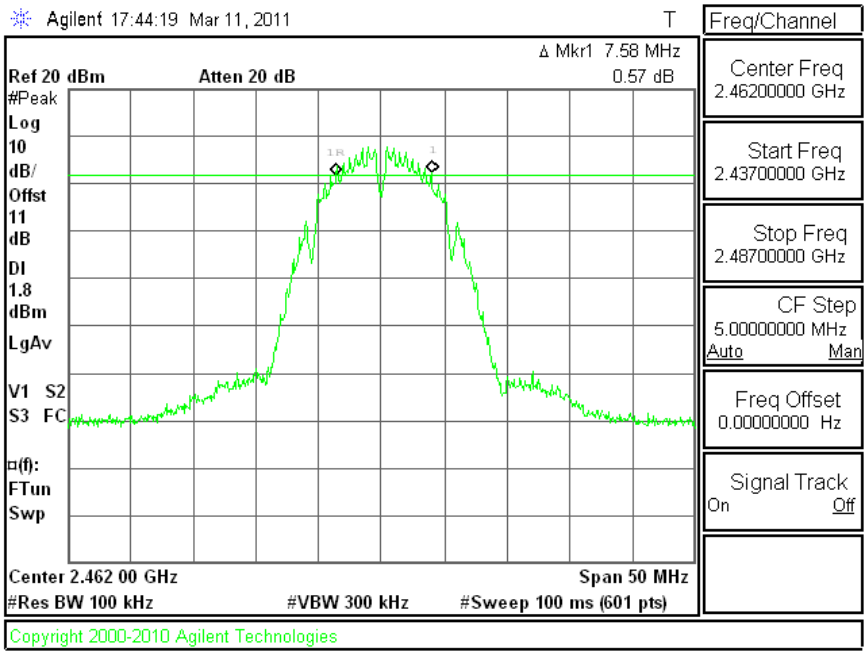
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
High	2462	7.58	0.5

6 dB BANDWIDTH HIGH CH



7.1.2. 99% BANDWIDTH

LIMITS

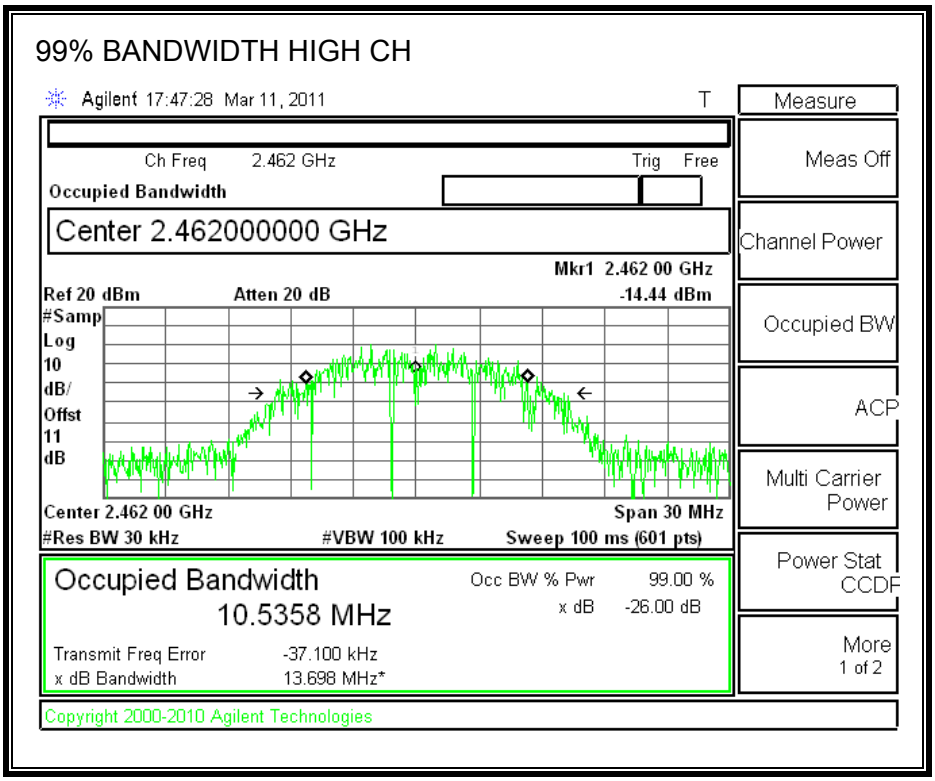
None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
High	2462	10.5358



7.1.3. OUTPUT POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

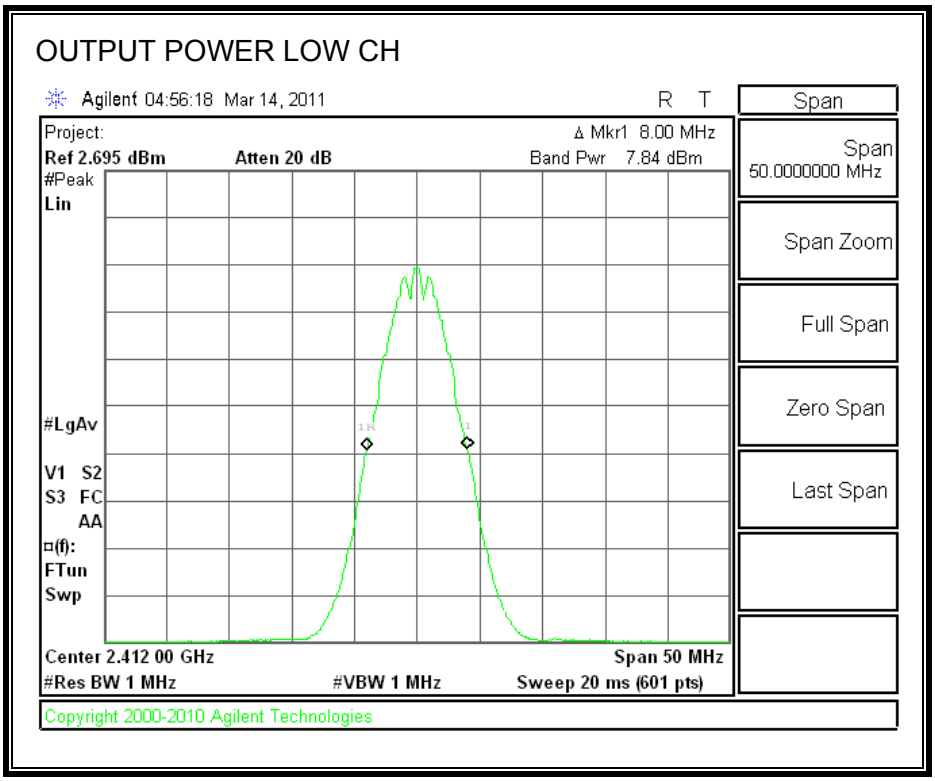
TEST PROCEDURE

Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

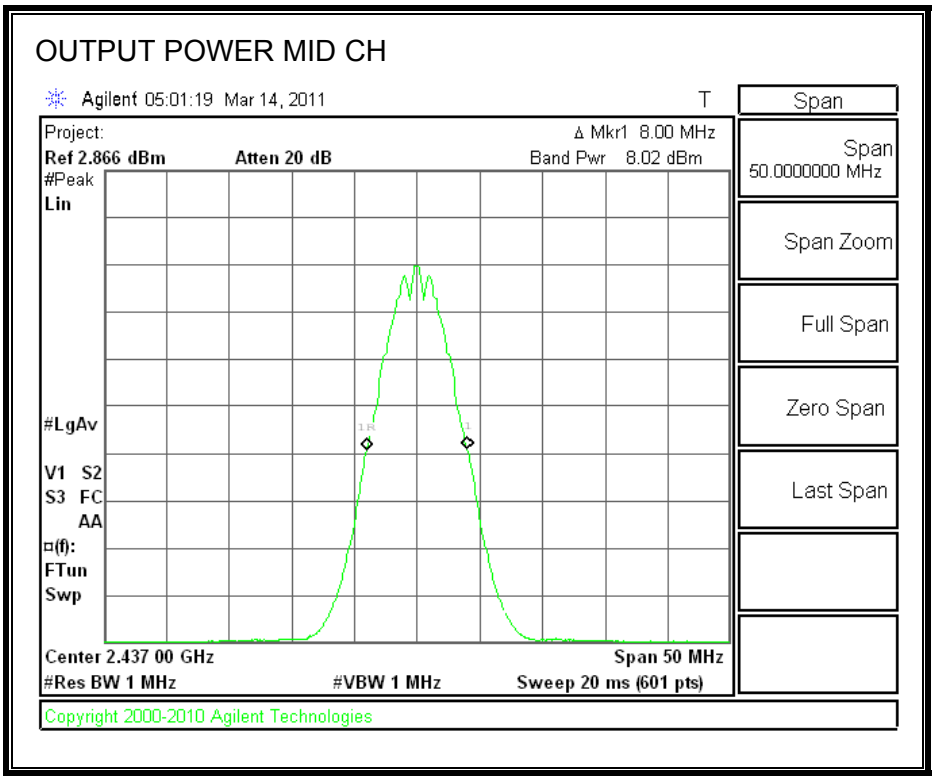
RESULTS

Channel	Frequency (MHz)	Spectrum Analyzer Reading (dBm)	Attenuator and Cable Offset (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	7.84	11	18.84	30	-11.16
Middle	2437	8.02	11	19.02	30	-10.98
High	2462	8.42	11	19.42	30	-10.58

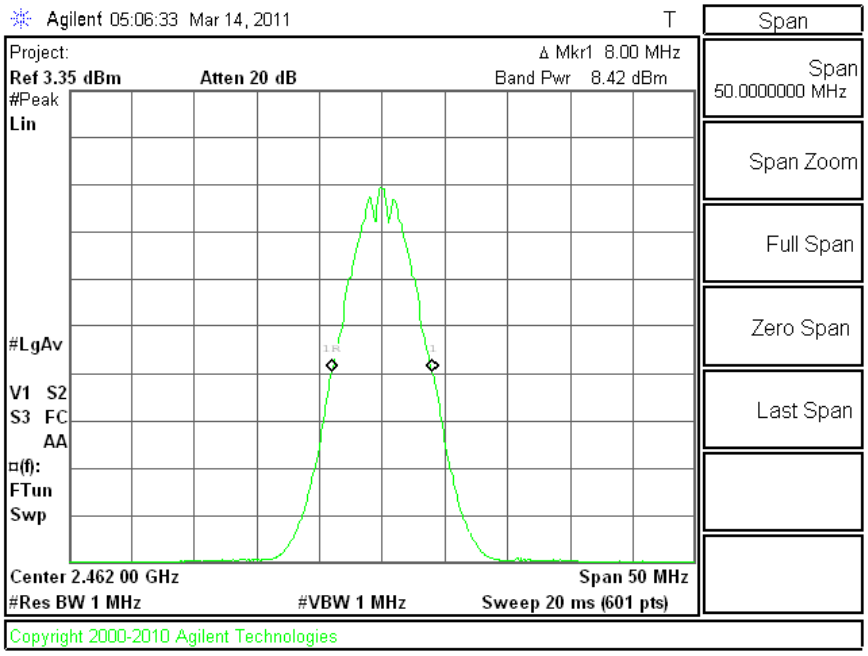
OUTPUT POWER



OUTPUT POWER MID CH



OUTPUT POWER HIGH CH



7.1.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2412	16.03
Middle	2437	16.13
High	2462	16.05

7.1.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

TEST PROCEDURE

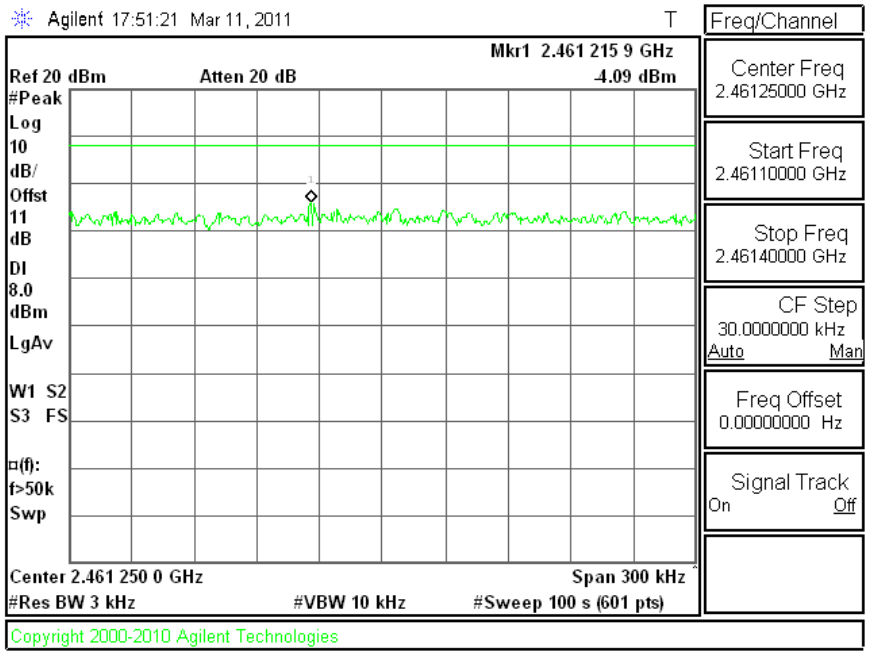
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
High	2462	-4.09	8	-12.09

POWER SPECTRAL DENSITY

PSD HIGH CH



7.1.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

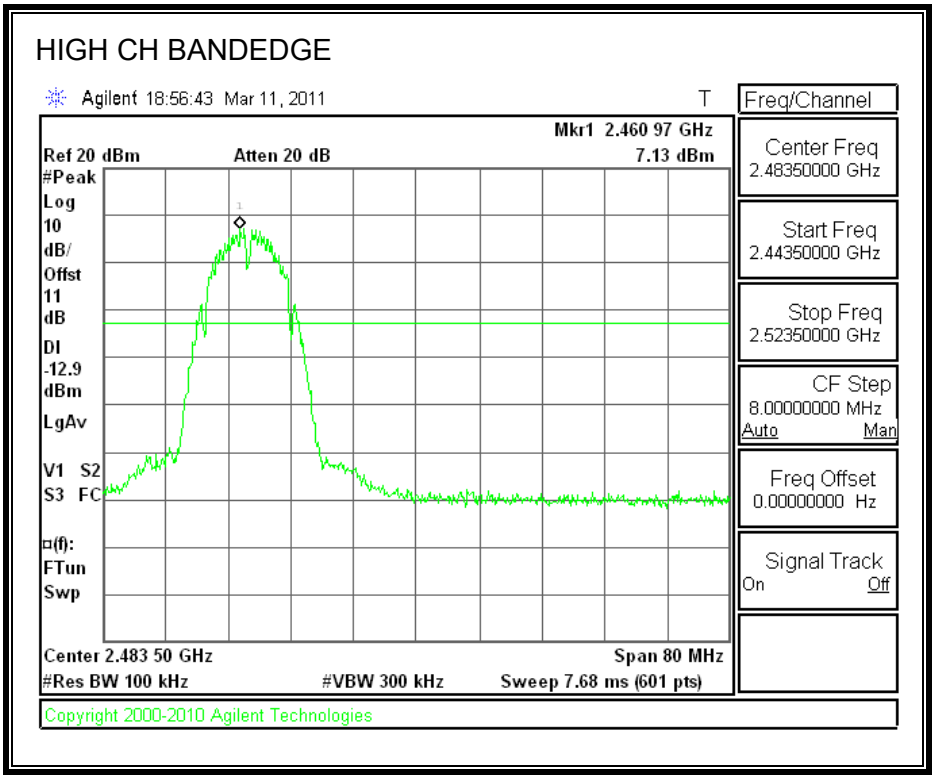
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

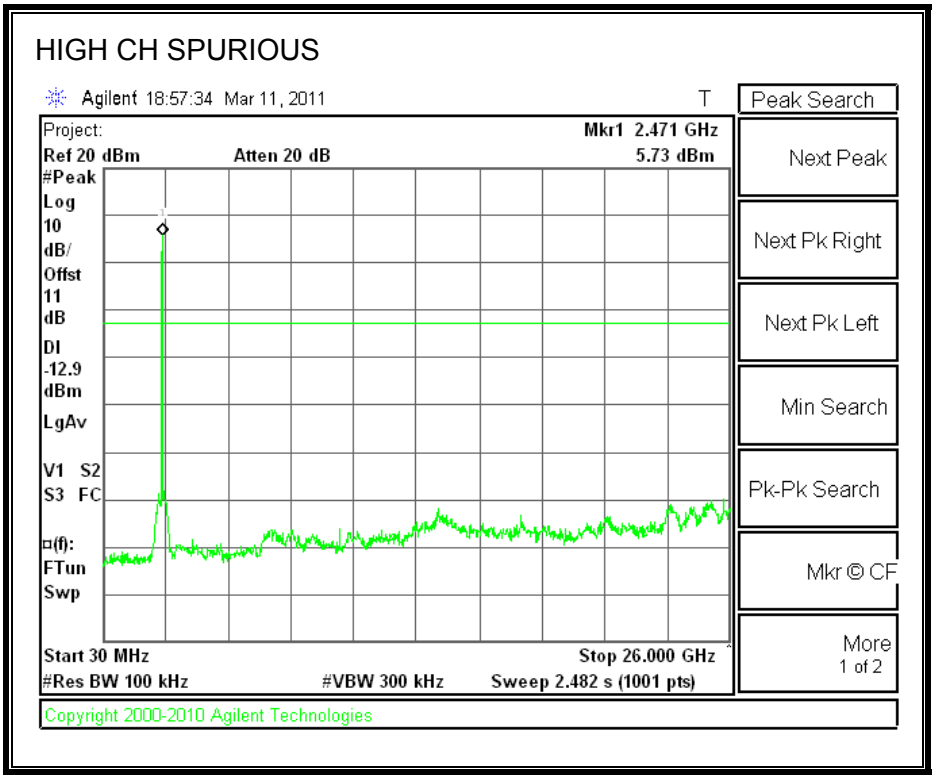
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

SPURIOUS EMISSIONS, HIGH CHANNEL



HIGH CH SPURIOUS



7.2. 802.11g MODE IN THE 2.4 GHz BAND (High Channel)

7.2.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

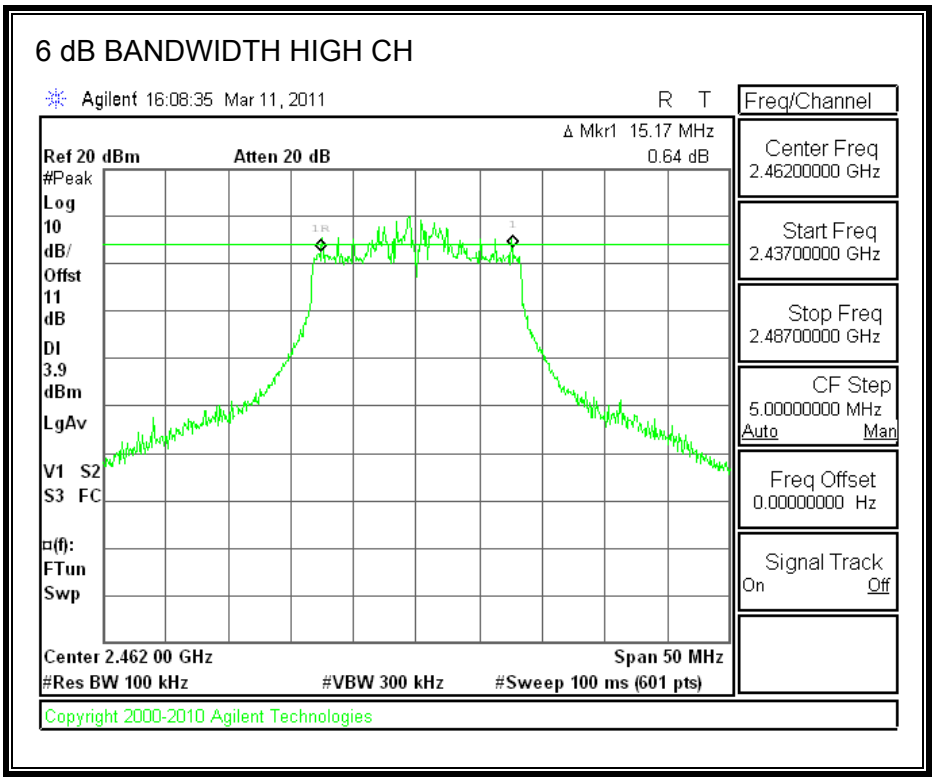
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
High	2462	15.17	0.5

6 dB BANDWIDTH



7.2.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

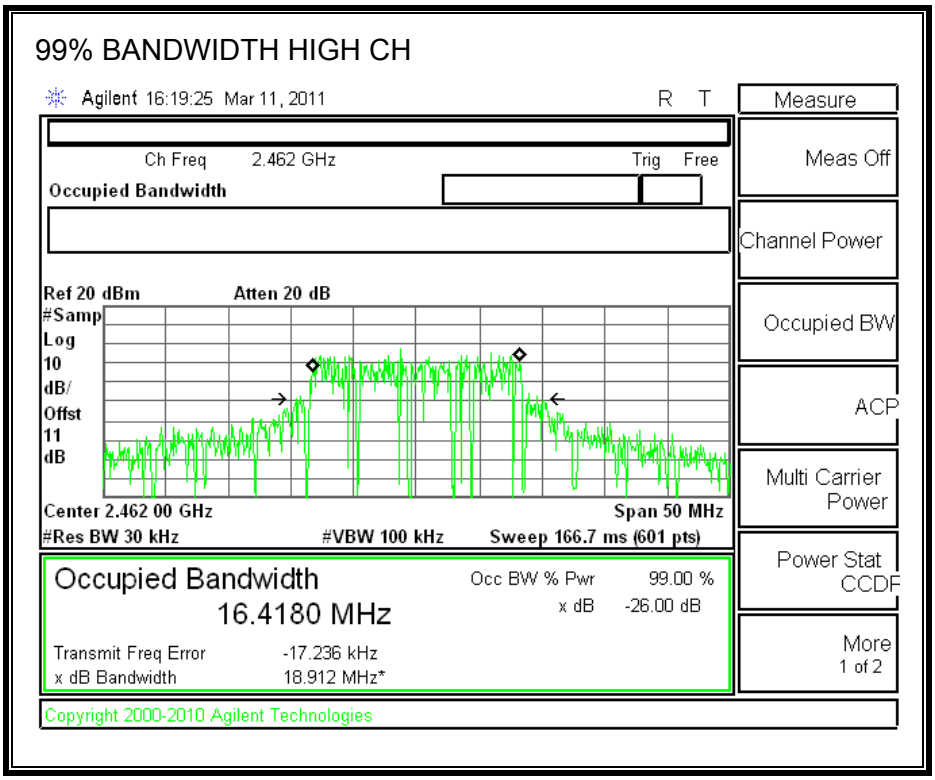
TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
High	2462	16.418

99% BANDWIDTH



7.2.3. OUTPUT POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

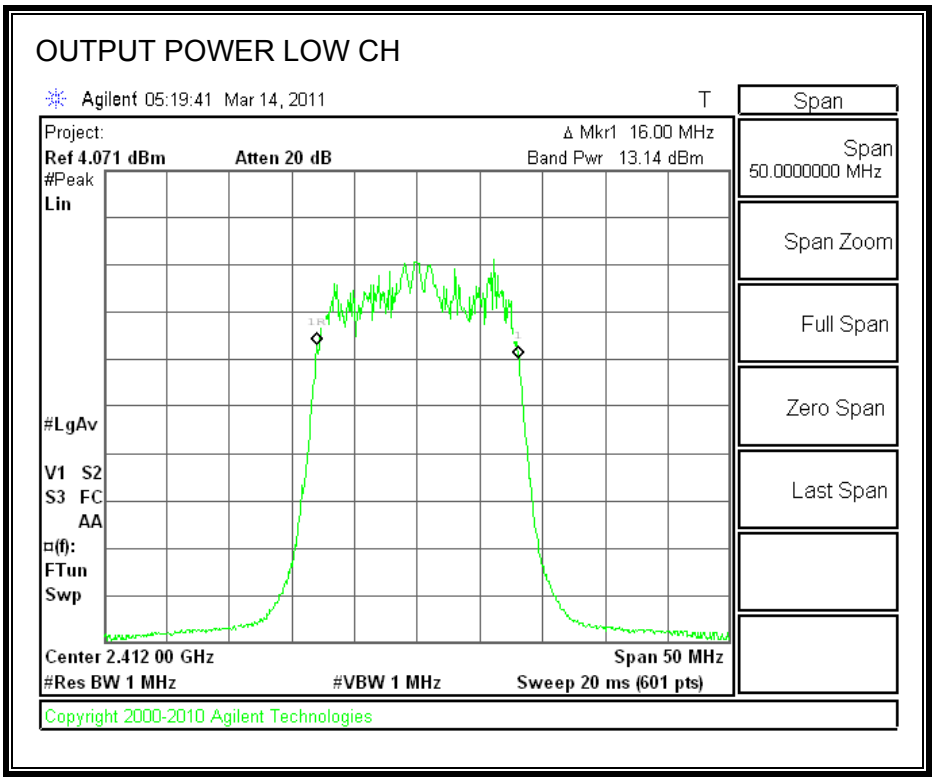
TEST PROCEDURE

Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

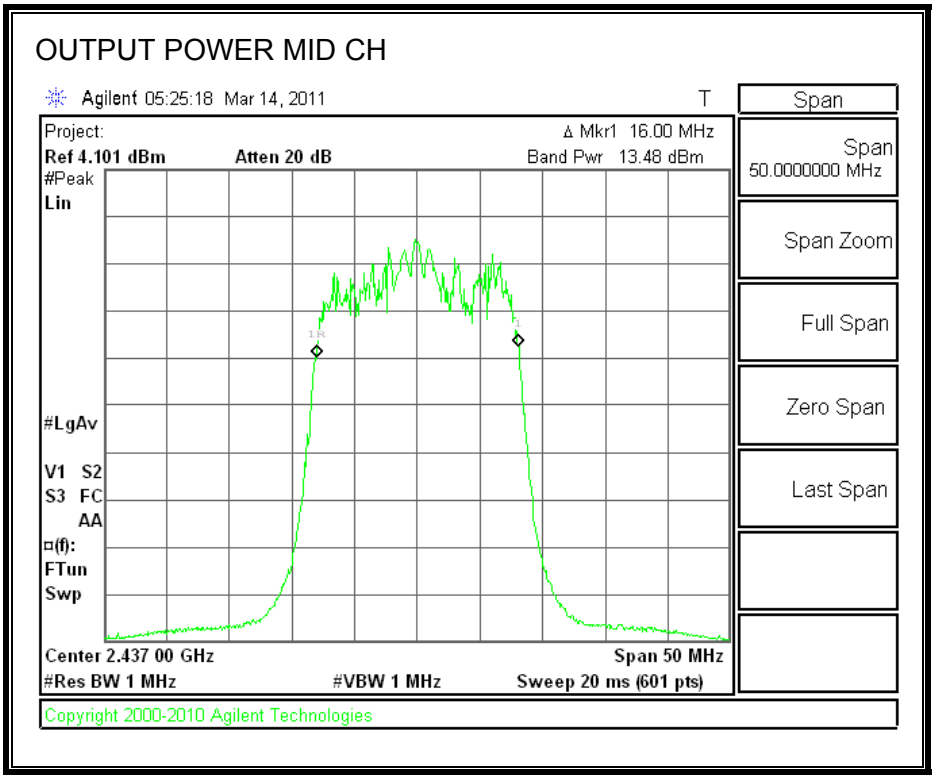
RESULTS

Channel	Frequency (MHz)	Spectrum Analyzer Reading (dBm)	Attenuator and Cable Offset (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	13.14	11	24.14	30	-5.86
Middle	2437	13.48	11	24.48	30	-5.52
High	2462	13.53	11	24.53	30	-5.47

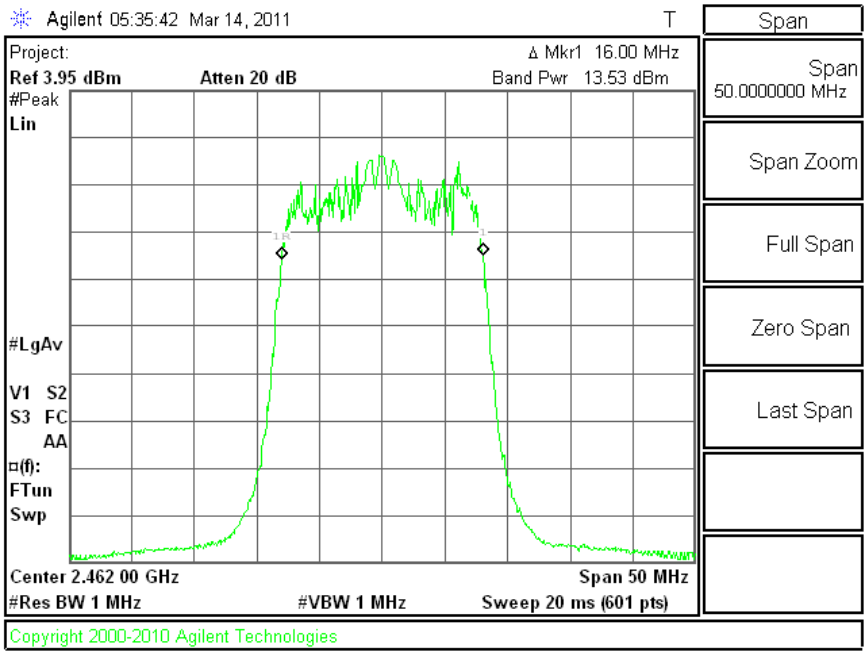
OUTPUT POWER



OUTPUT POWER MID CH



OUTPUT POWER HIGH CH



7.2.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2412	15.94
Middle	2437	16.22
High	2462	15.95

7.2.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

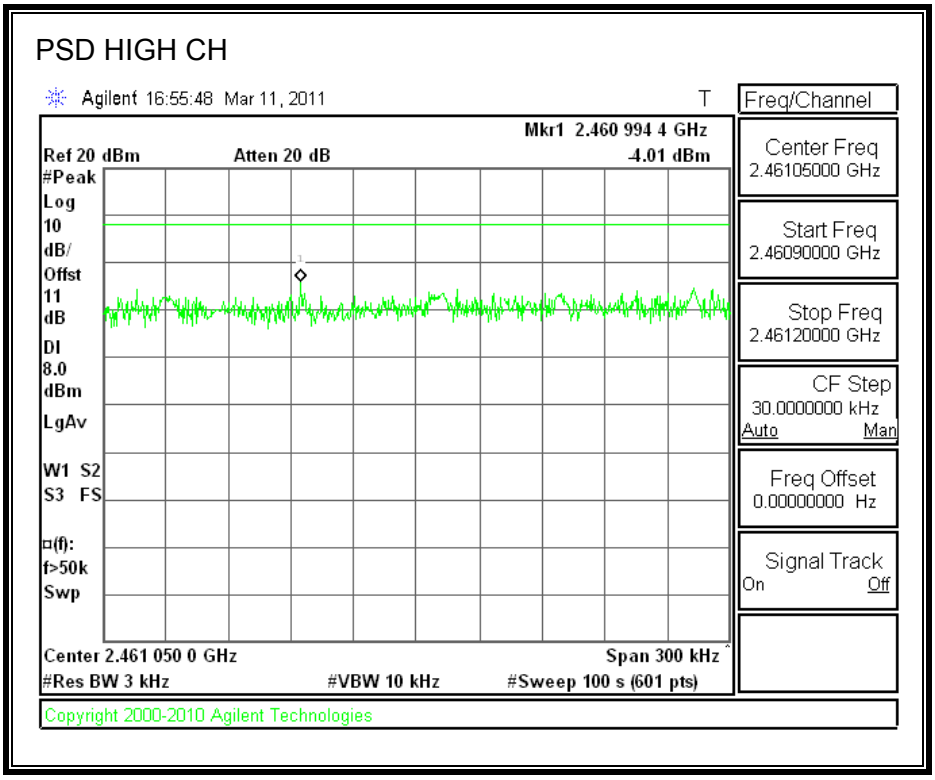
TEST PROCEDURE

Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
High	2462	-4.01	8	-12.01

POWER SPECTRAL DENSITY



7.2.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

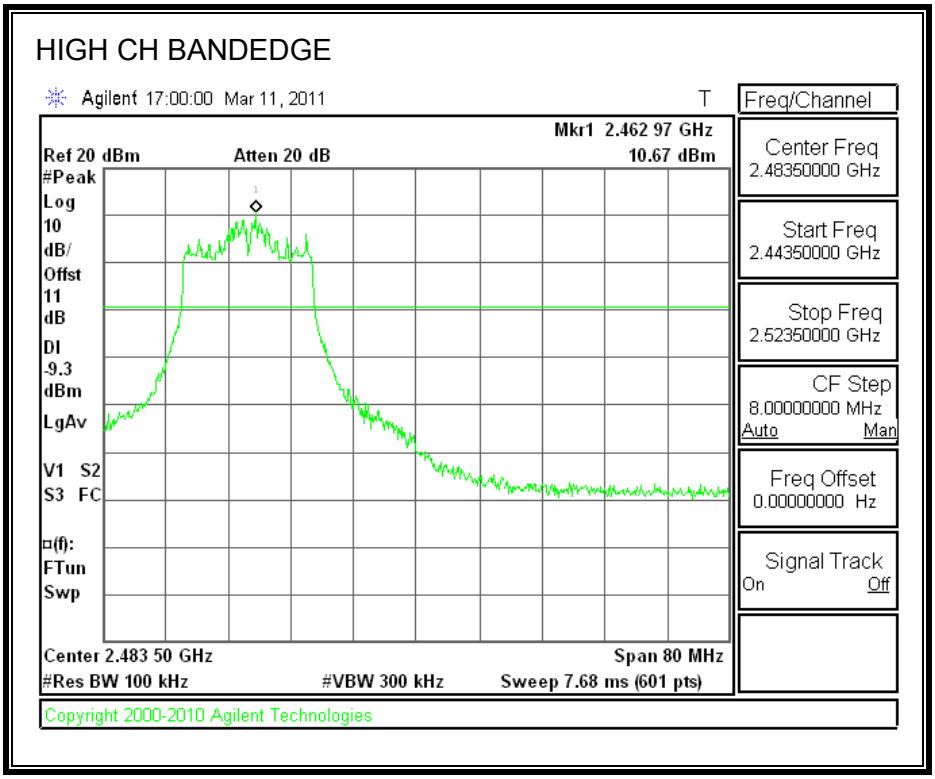
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

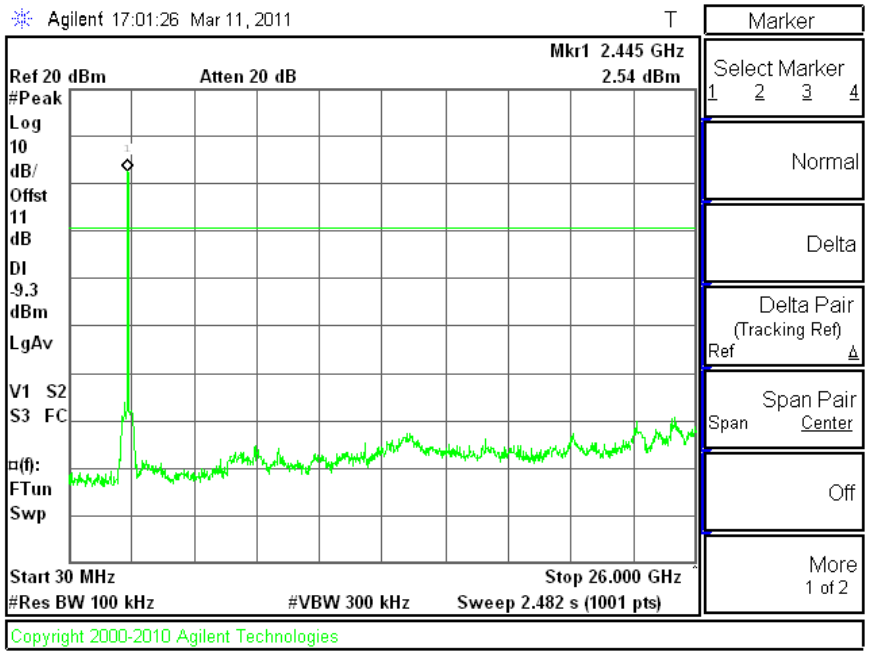
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

SPURIOUS EMISSIONS, HIGH CHANNEL



HIGH CH SPURIOUS



8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

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, and 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.

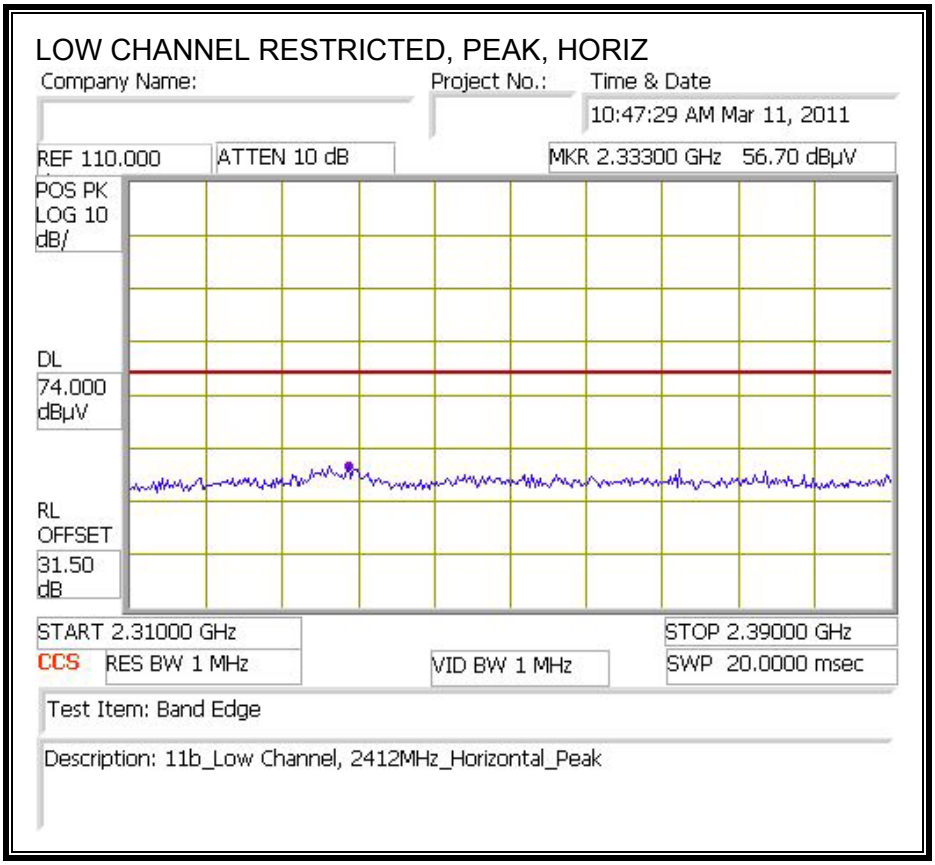
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

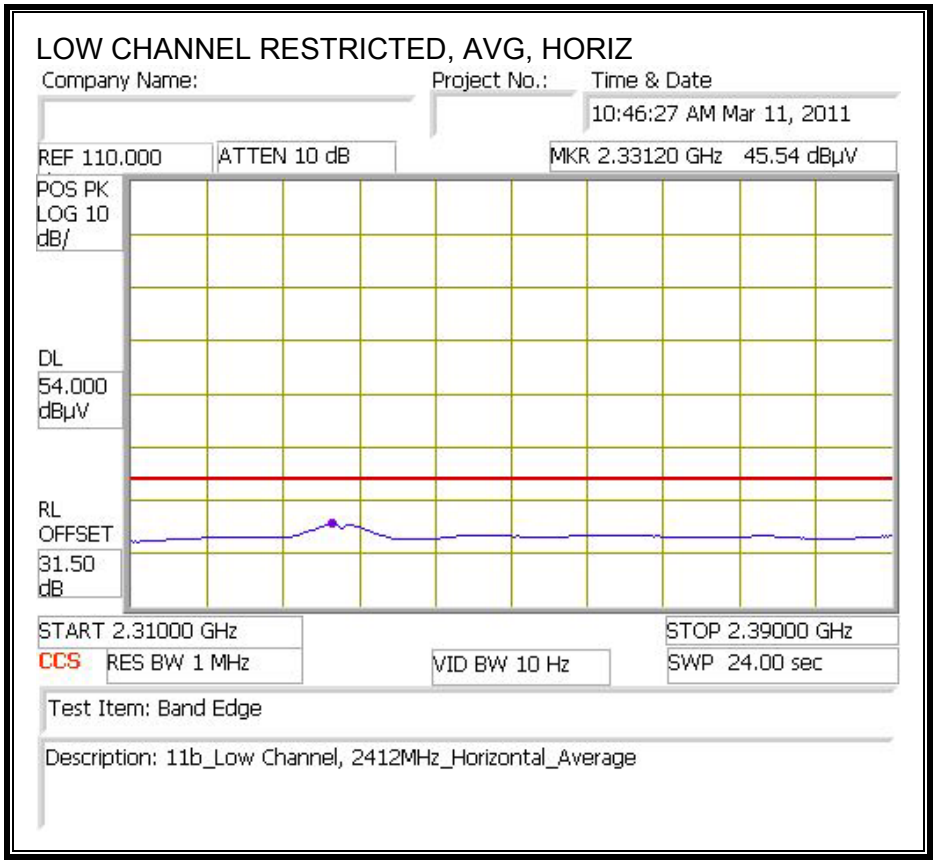
RESULTS

8.2. TRANSMITTER ABOVE 1 GHz

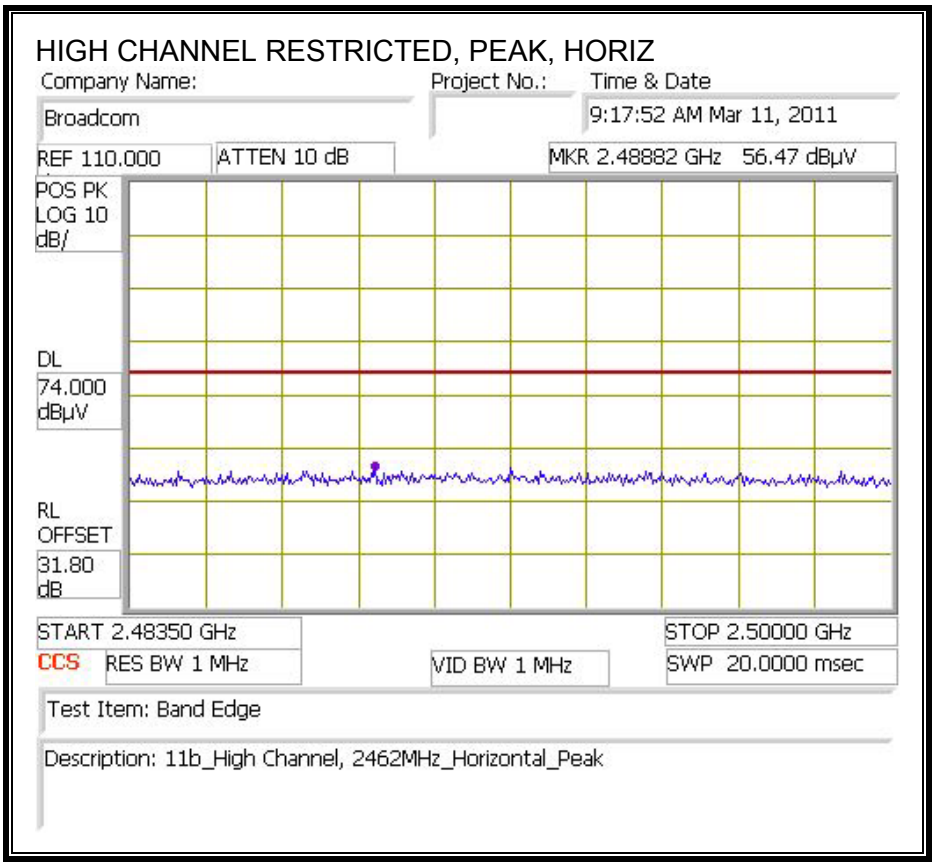
8.2.1. 802.11b MODE

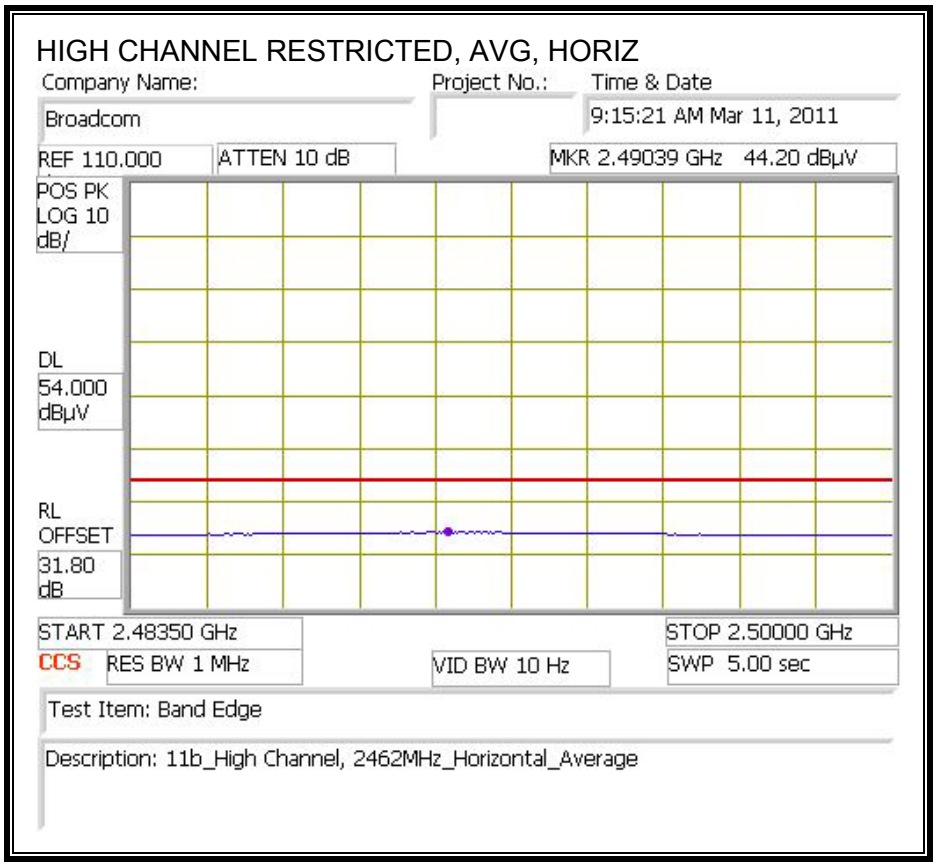
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: BradCom Corporation
Project #: 10U13562
Date: 3/14/2011
Test Engineer: Thanh Nguyen
Configuration: EUT only
Mode: Transmit b Mode

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931			FCC Class B

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

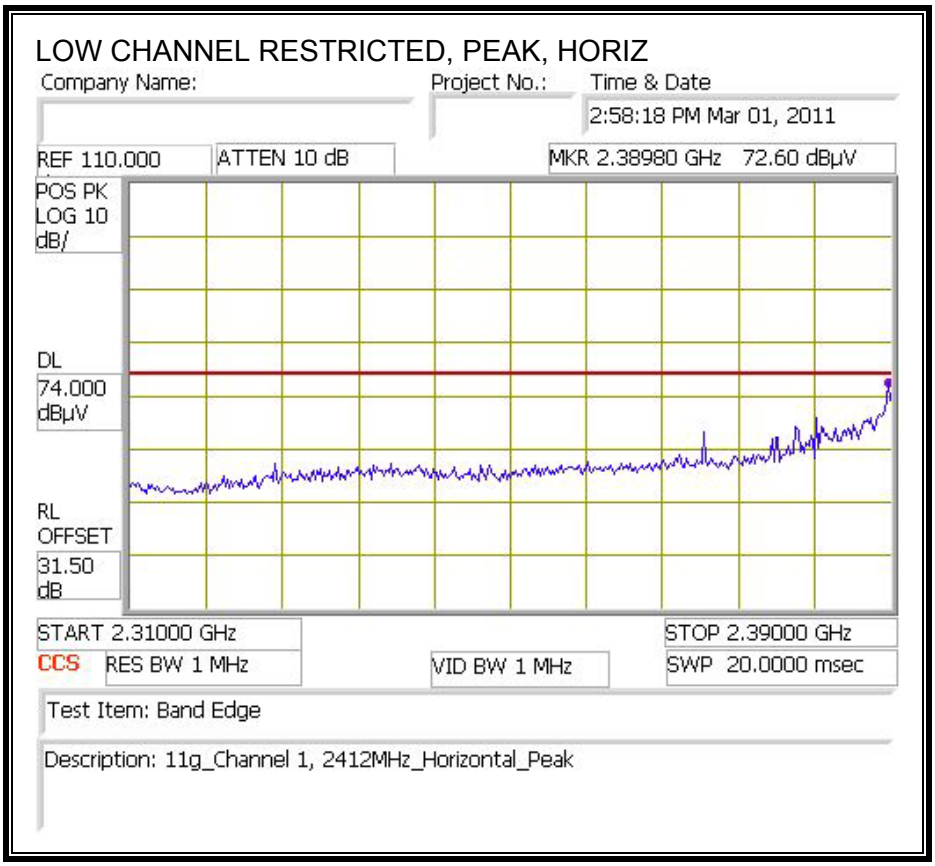
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
High Ch															
4.924	3.0	46.4	36.3	33.1	5.9	-36.5	0.0	0.0	48.9	38.9	74	54	-25.1	-15.1	V
7.386	3.0	51.2	37.3	35.4	7.3	-36.2	0.0	0.0	57.7	43.8	74	54	-16.3	-10.2	V
9.848	3.0	46.1	33.6	37.5	8.7	-37.0	0.0	0.0	55.2	42.7	74	54	-18.8	-11.3	Noise floor
4.924	3.0	49.2	35.2	33.1	5.9	-36.5	0.0	0.0	51.7	37.7	74	54	-22.3	-16.3	H
7.386	3.0	50.3	35.2	35.4	7.3	-36.2	0.0	0.0	56.8	41.7	74	54	-17.2	-12.3	H
9.848	3.0	46.3	33.6	37.5	8.7	-37.0	0.0	0.0	55.4	42.6	74	54	-18.6	-11.4	Noise floor
Spurious Emissions															
2.220	3.0	52.5	39.7	27.8	3.7	-37.7	0.0	0.0	46.2	33.4	74	54	-27.8	-20.6	H
1.994	3.0	53.8	34.6	27.2	3.5	-38.1	0.0	0.0	46.3	27.1	74	54	-27.7	-26.9	V

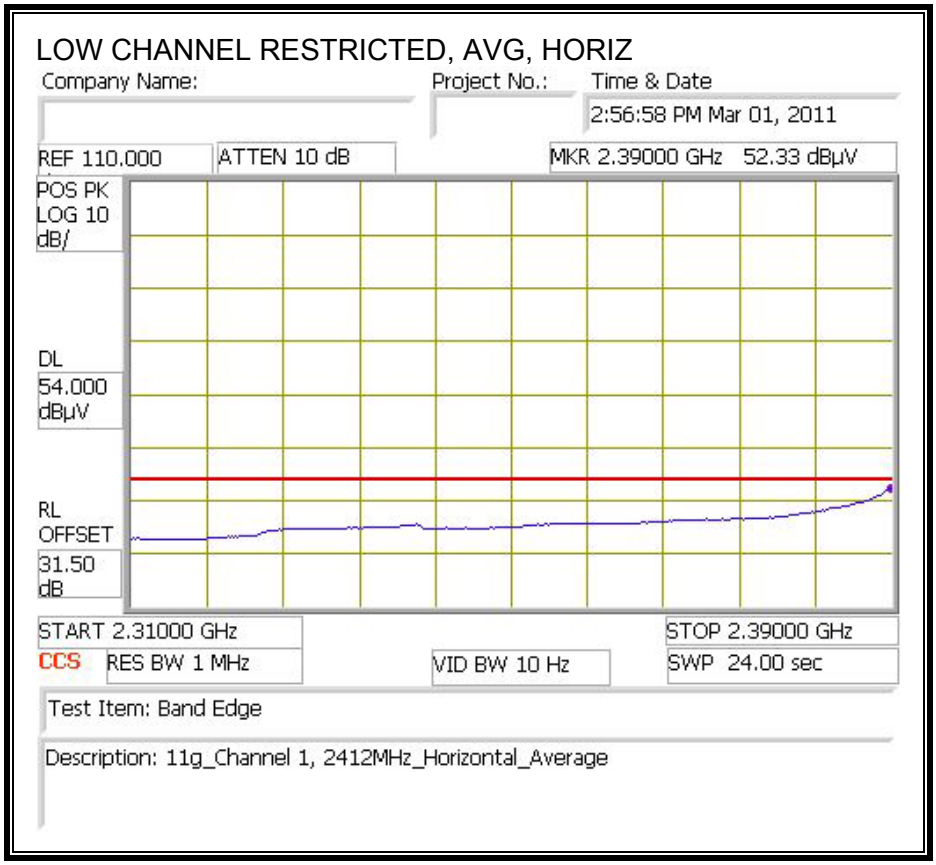
Rev. 07.22.09

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		

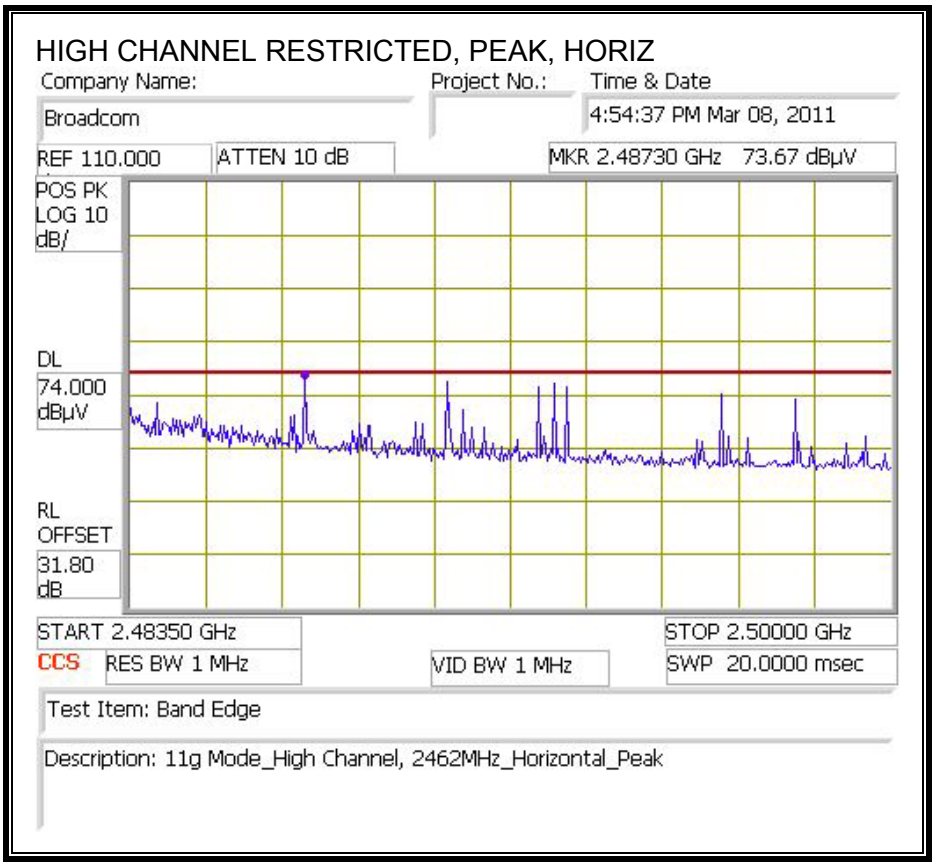
8.2.2. 802.11g MODE

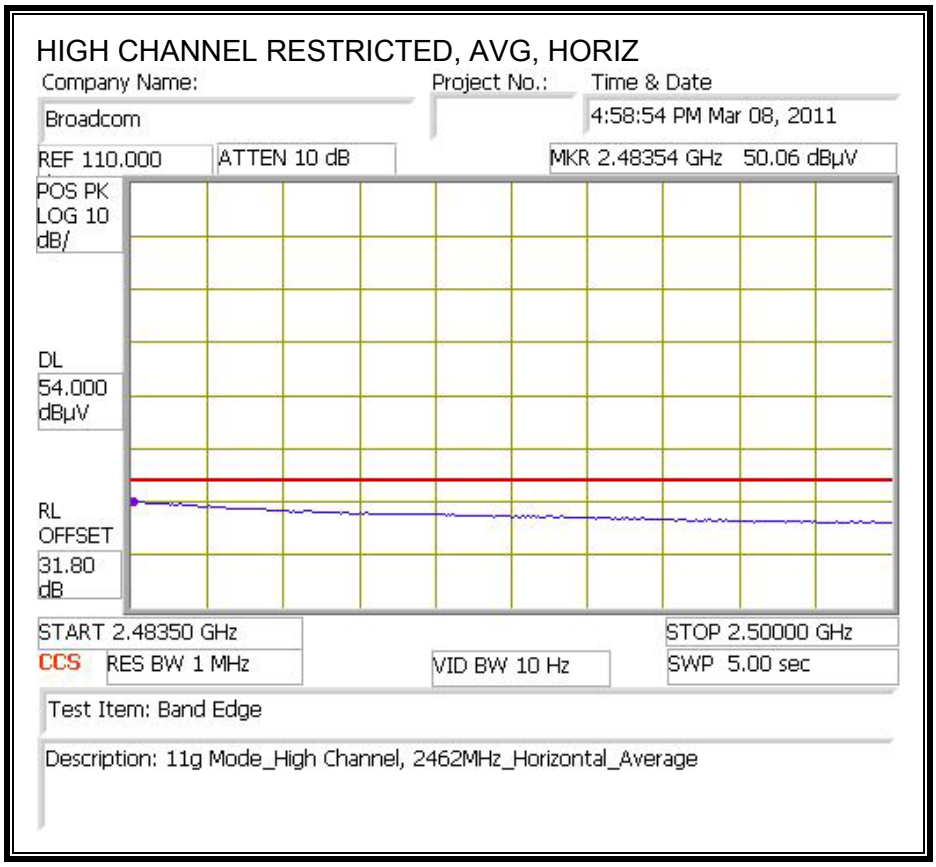
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: BradCom Corporation
Project #: 10U13562
Date: 3/14/2011
Test Engineer: Thanh Nguyen
Configuration: EUT only
Mode: Transmit g Mode

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931			FCC Class B

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)
High Ch															
4.924	3.0	47.3	34.3	33.1	5.9	-36.5	0.0	0.0	49.9	36.8	74	54	-24.1	-17.2	V
7.386	3.0	49.3	36.6	35.4	7.3	-36.2	0.0	0.0	55.8	43.1	74	54	-18.2	-10.9	V
9.848	3.0	46.1	33.5	37.5	8.7	-37.0	0.0	0.0	55.2	42.5	74	54	-18.8	-11.5	Noise floor
4.924	3.0	48.4	36.1	33.1	5.9	-36.5	0.0	0.0	50.9	38.7	74	54	-23.1	-15.3	H
7.386	3.0	49.4	34.3	35.4	7.3	-36.2	0.0	0.0	55.9	40.8	74	54	-18.1	-13.2	H
9.848	3.0	46.3	33.6	37.5	8.7	-37.0	0.0	0.0	55.4	42.6	74	54	-18.6	-11.4	Noise floor
Spurious Emissions															
2.220	3.0	52.5	39.7	27.8	3.7	-37.7	0.0	0.0	46.2	33.4	74	54	-27.8	-20.6	H
1.994	3.0	56.9	33.8	27.2	3.5	-38.1	0.0	0.0	49.5	26.3	74	54	-24.5	-27.7	V

Rev. 07.22.09

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		