



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

CERTIFICATION TEST REPORT

FOR

802.11A/B/G/N WLAN + BLUETOOTH PCI-E MINI CARD

MODEL NUMBER: BCM943224PCIEBT2

FCC ID: QDS-BRCM1052

IC: 4324A-BRCM1052

REPORT NUMBER: 11U13702-1

ISSUE DATE: MARCH 4, 2011

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Revision History

Rev.	Issue Date	Revisions	Revised By
--	03/04/10	Initial Issue	T. Chan

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: 802.11a/b/g/n WLAN+ BLUETOOTH PCI-E MINICARD

MODEL: BCM943224PCIEBT2

SERIAL NUMBER: C8Y1061

DATE TESTED: MARCH 2 - 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, Inc. (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:



THANH NGUYEN
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:

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

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 WLAN transceiver module with 2.1 + EDR and V4.0 + LE modes. The radio module is manufactured by Broadcom.

5.2. MAXIMUM OUTPUT POWER

For Low Energy (LE) mode, the transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	Low Energy (LE)	-2.38	0.58

5.3. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

The major change filed under this application is:

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 a built in antenna with a maximum gain of 4.97dBi.

5.5. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom, rev. 5.5.0.5300. The test utility software used during testing was Bluetool, rev. 3.54.164.0 and 1.3.5.3.

5.6. WORST-CASE CONFIGURATIONS

The worst-case data rate for each mode is determined to be as follows, based on preliminary tests of the chipset utilized in this radio.

For Low Energy mode, since it is adding mode therefore full testing are performed. All final tests were made at 1 Mb/s.

For 8PSK, the spot checks were performed in band edge with high channel and harmonic with low, mid, and high channels. All tests were made at 3 Mb/s.

For radiated emissions below 1 GHz the worst-case configuration is determined to be the mode and channel with the highest output power.

5.7. DESCRIPTION OF TEST SETUP

NORMAL TX

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Lenovo	4446-38U	R8-CAD03 09/09	DoC
AC Adapter	Lenovo	PA-1650-56LC	11S36001651ZZ40008KCM8	N/A
Adapter Board	Broadcom	BCM943224PCIEBT2AD	1340562	N/A

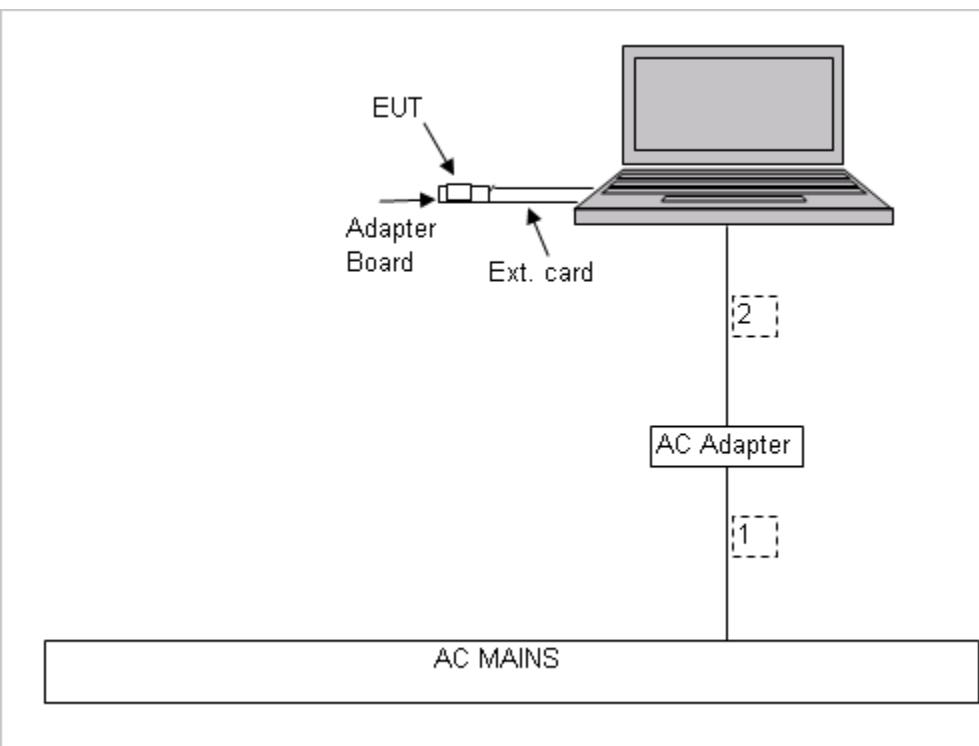
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	AC	Unshielded	1.8m	N/A
2	DC	1	DC	Unshielded	1.8m	Ferrite at laptop's end

TEST SETUP

The EUT is inserted to a host laptop computer via an extended adaptor board during the test. Test software exercised the radio card.

SETUP DIAGRAM FOR TEST



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
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01171	01/14/09	07/14/11
Antenna, Horn, 18 GHz	EMCO	3115	C00872	01/29/09	07/29/11
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	01/29/09	07/29/11
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00778	01/06/10	01/26/12
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	02/04/09	08/04/11
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00996	04/29/10	10/29/11
Peak Power Meter	Agilent / HP	E9327A	C00964	01/07/10	12/04/11
Peak Power Sensor	Agilent / HP	E4416A	C00963	12/04/09	12/04/11
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	01/00/00	CNR
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-	N02481	11/05/09	11/05/11
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/06/09	05/06/11

7. ANTENNA PORT TEST RESULTS

7.1. LE (LOW ENERGY) MODULATION

7.1.1. 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

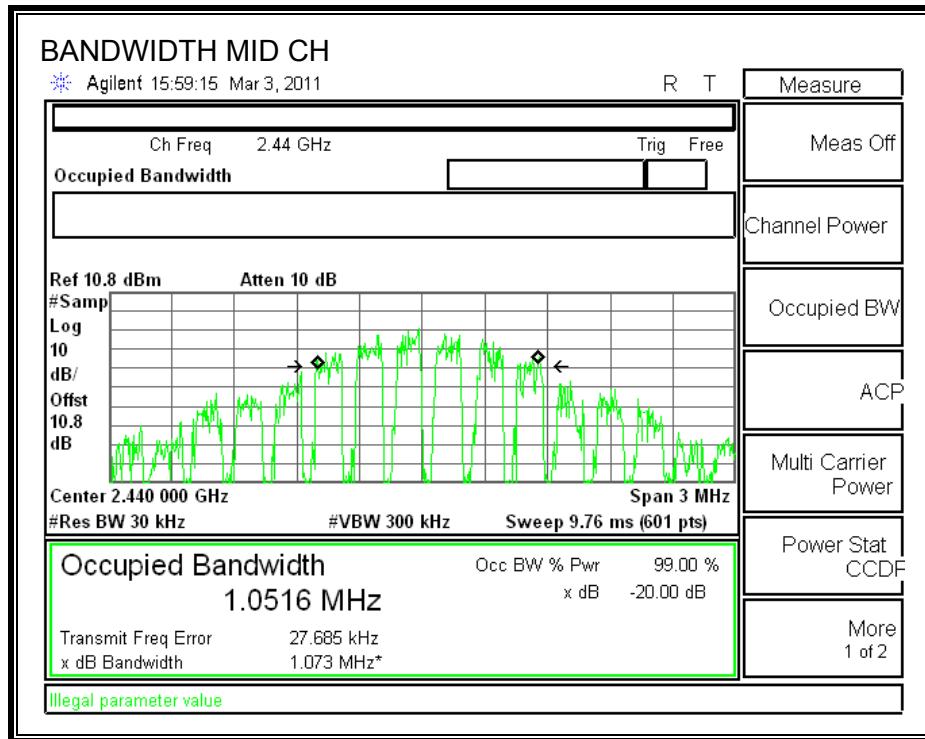
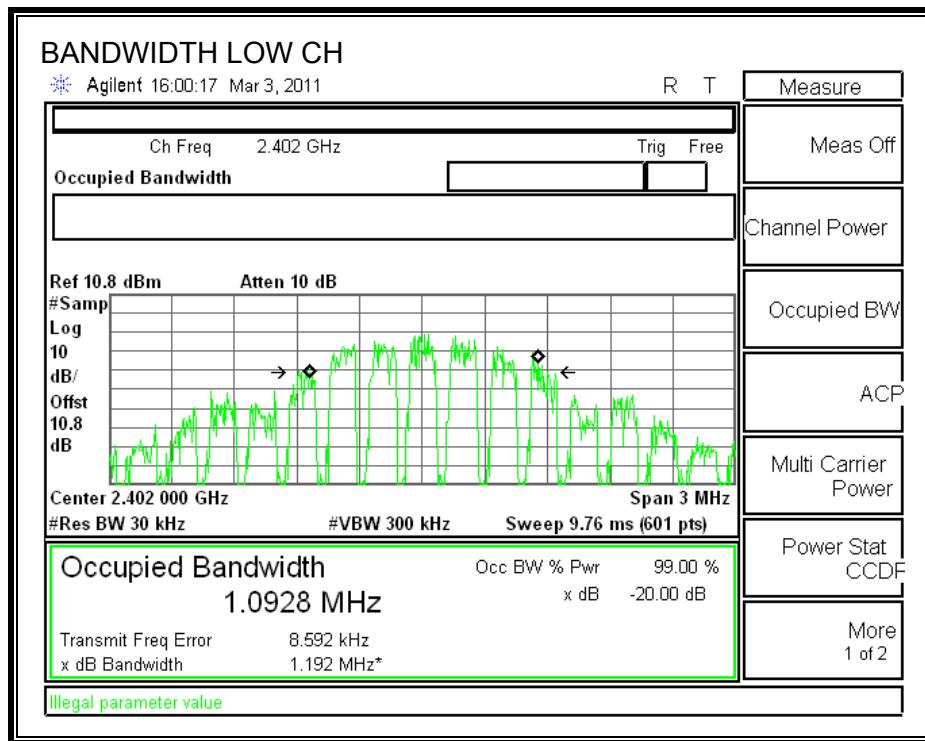
TEST PROCEDURE

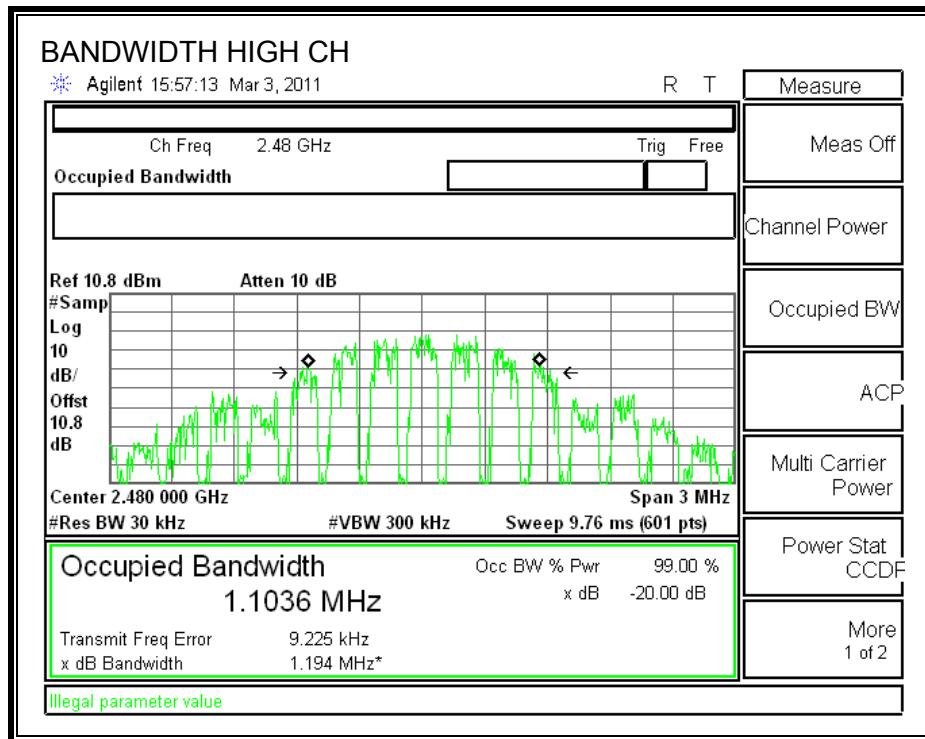
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 99% bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0928
Middle	2440	1.0516
High	2480	1.1036

99% BANDWIDTH





7.1.2. 20dB BANDWIDTH

LIMIT

None; for reporting purposes only.

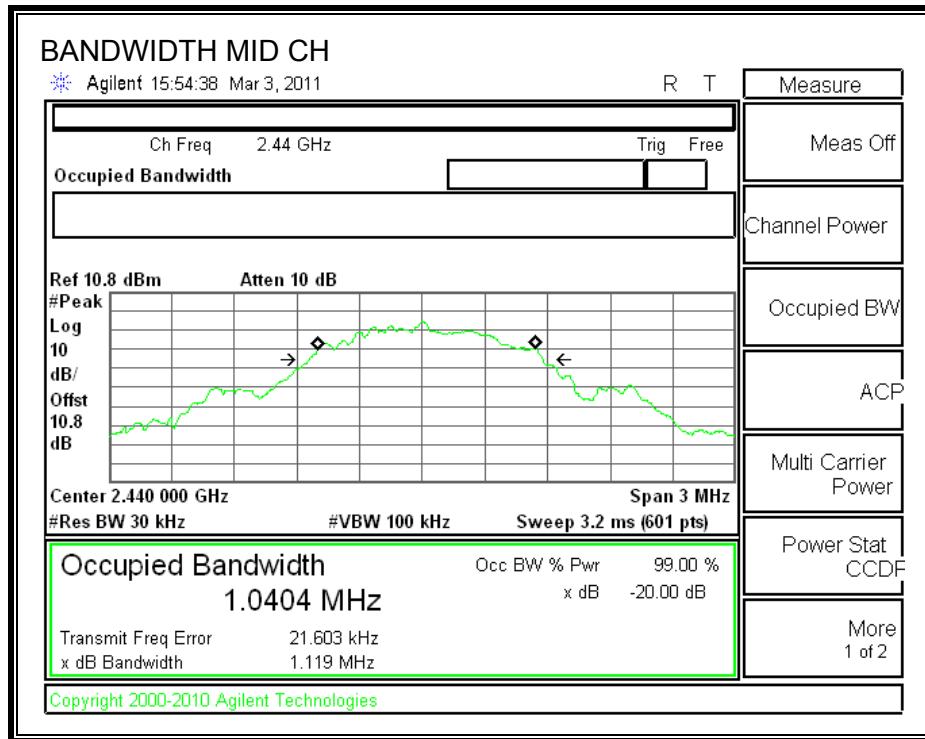
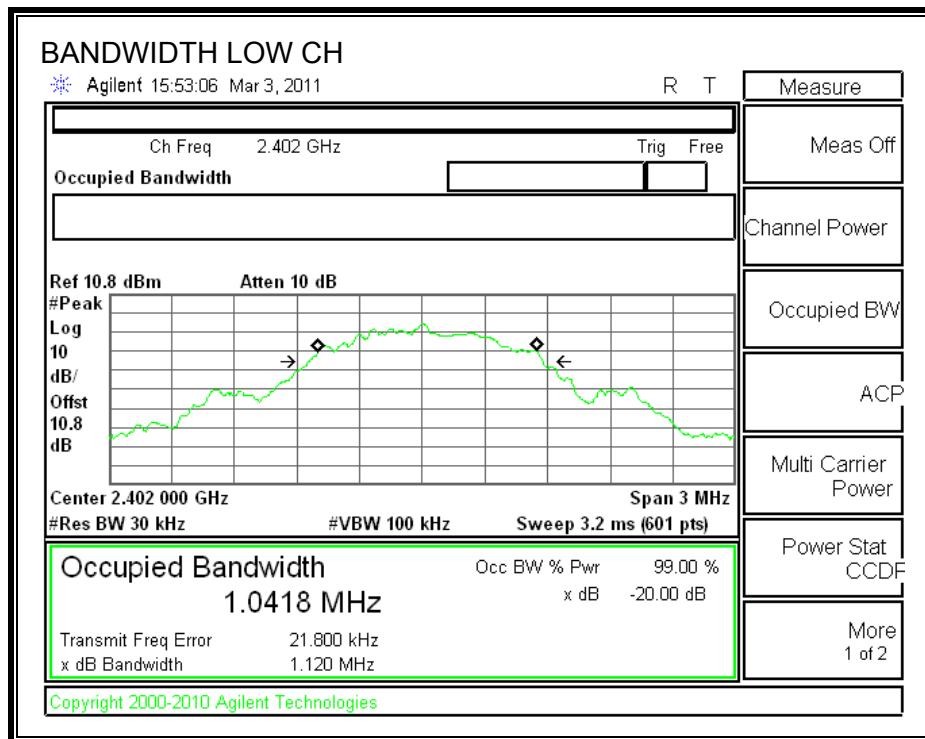
TEST PROCEDURE

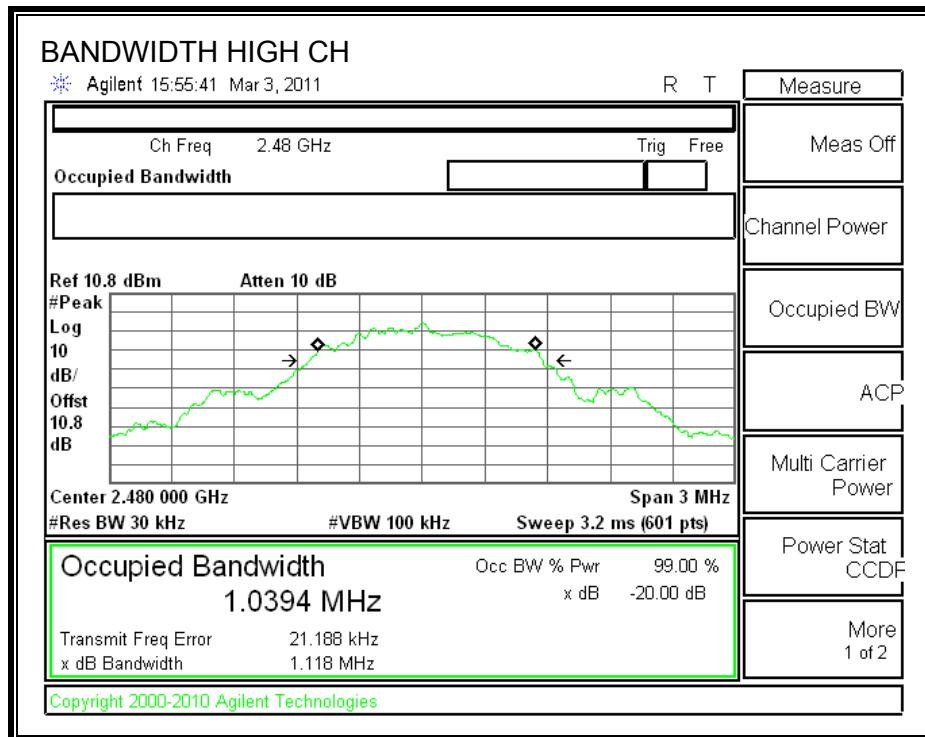
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2402	1.120
Middle	2440	1.119
High	2480	1.118

20 dB BANDWIDTH





7.1.3. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-210 A8.1 (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

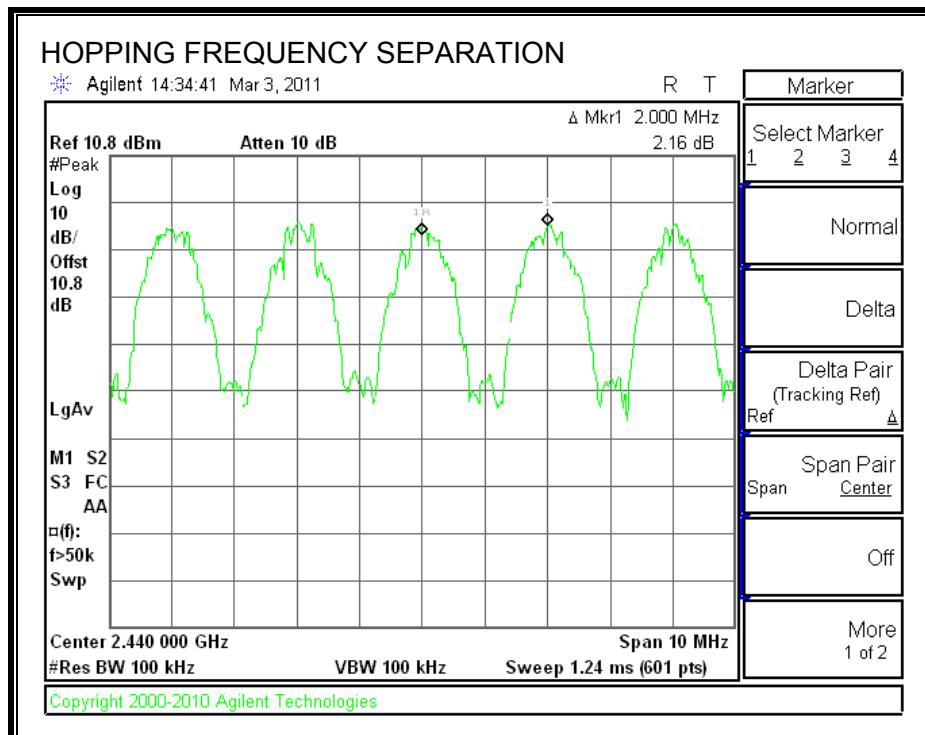
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

TEST PROCEDURE

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

RESULTS

HOPPING FREQUENCY SEPARATION



7.1.4. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

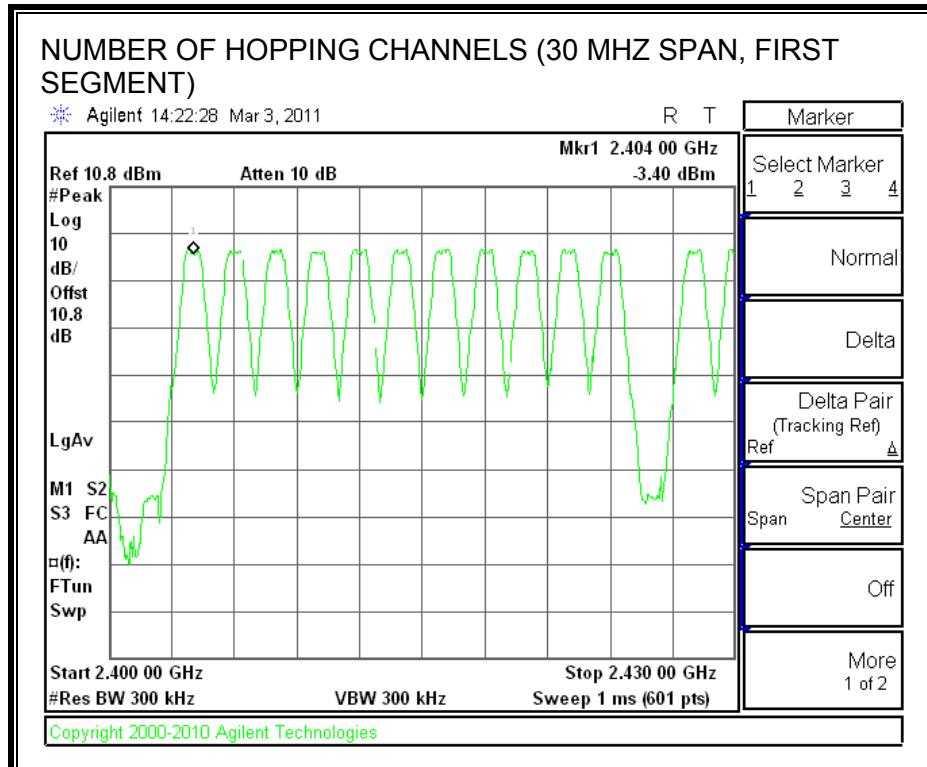
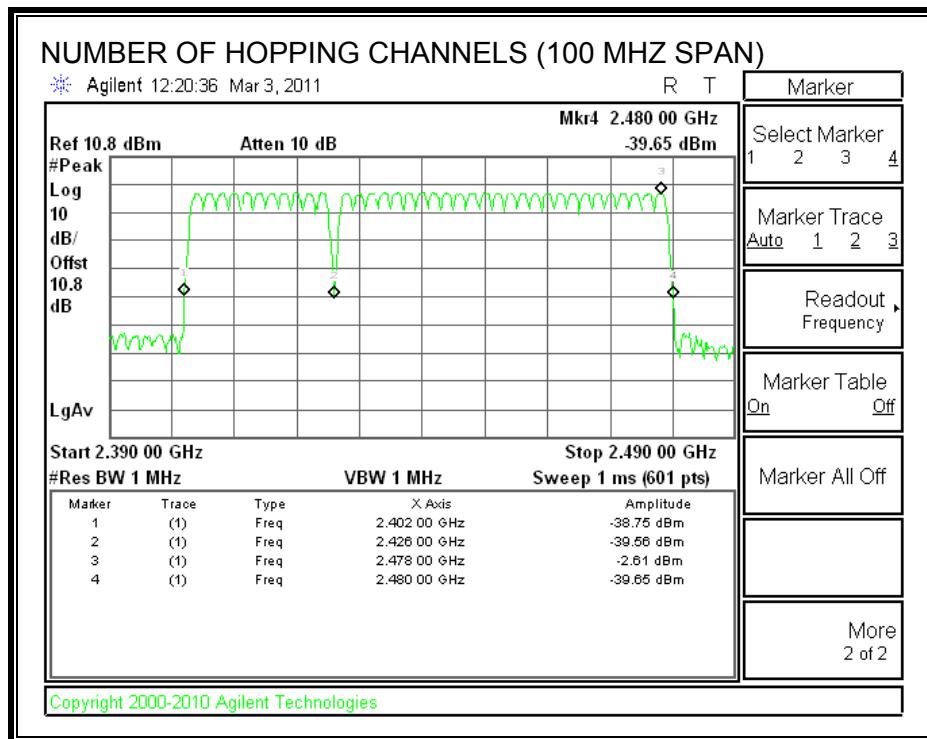
TEST PROCEDURE

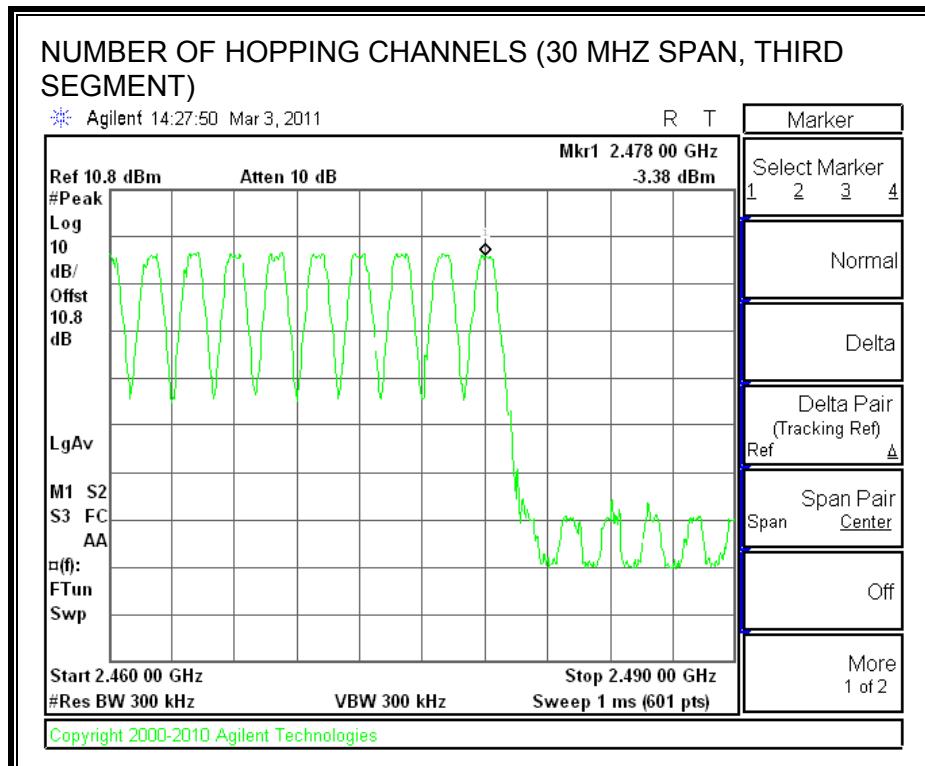
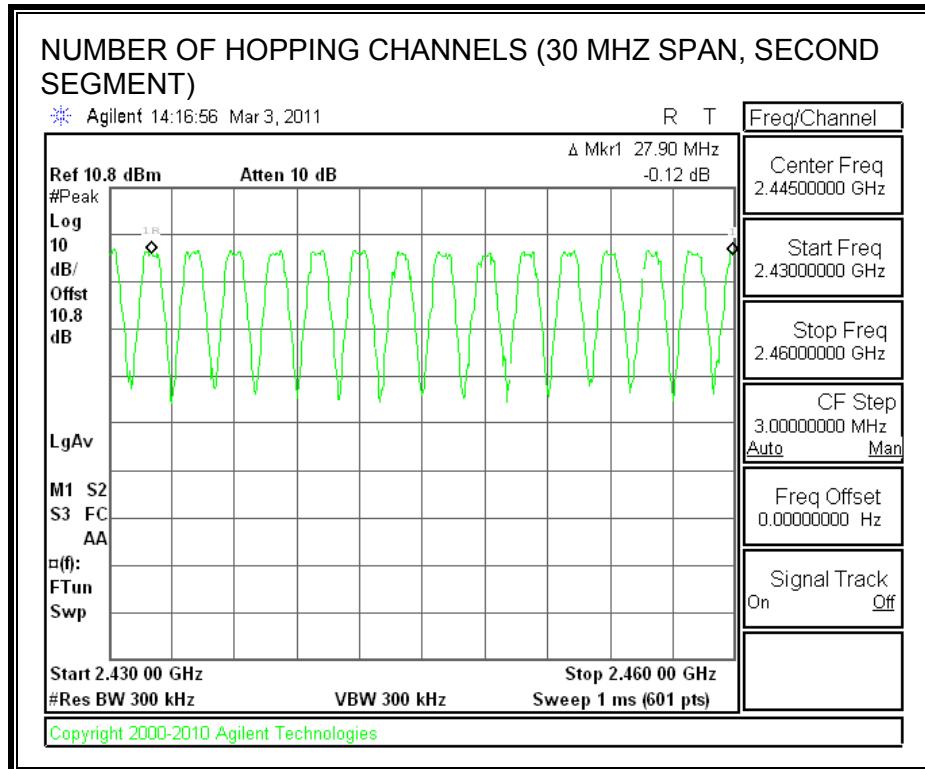
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Please see advertising channels for 2402, 2428, and 2480MHz explanation in separated document.

NUMBER OF HOPPING CHANNELS





7.1.5. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

TEST PROCEDURE

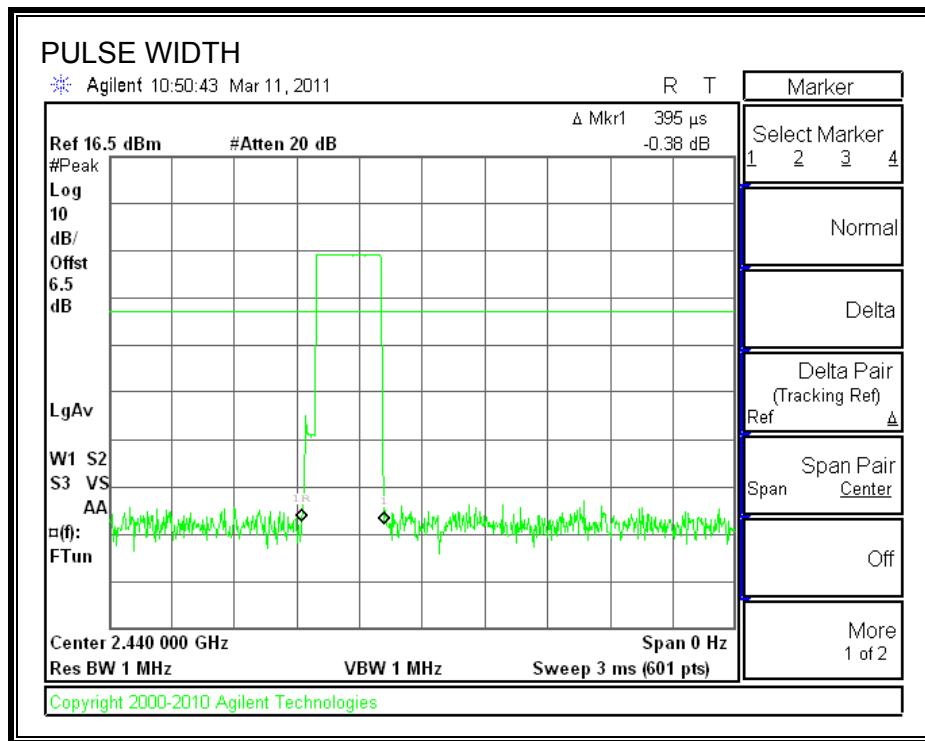
The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 1.60 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 1.60 second period (40 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 1.60 \text{ s}) * \text{pulse width}$.

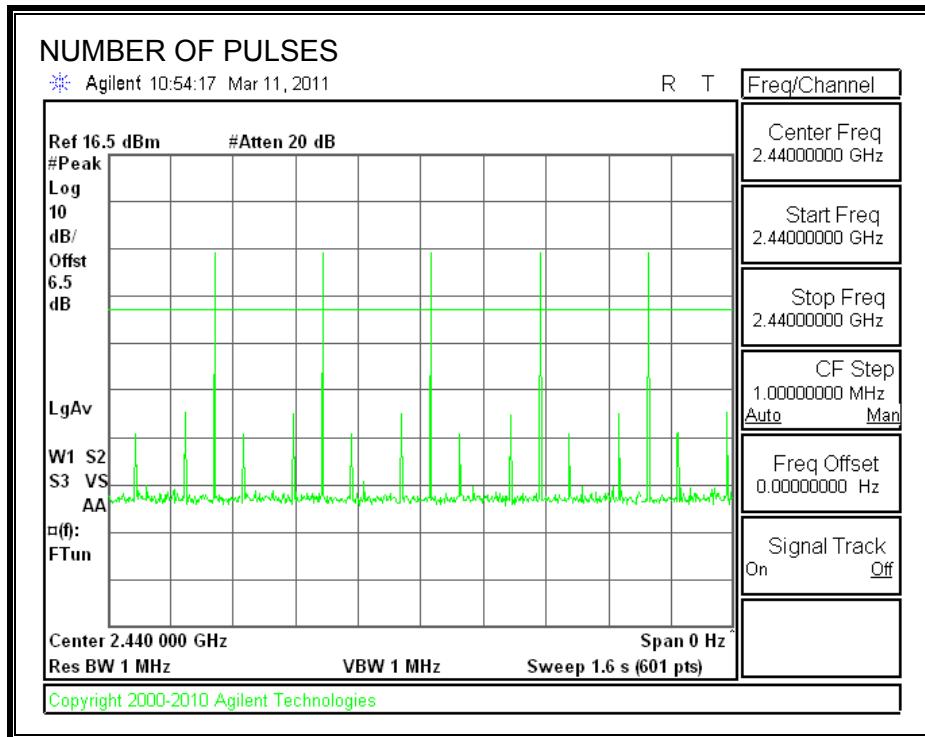
RESULTS

Pulse Width (msec)	Number of Pulses in 1.60 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
0.395	5	0.020	0.4	0.380

PULSE WIDTH



NUMBER OF PULSES IN 1.60 SECOND OBSERVATION PERIOD



7.1.6. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-210 Issue 7 Clause A8.4

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

Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

TEST PROCEDURE

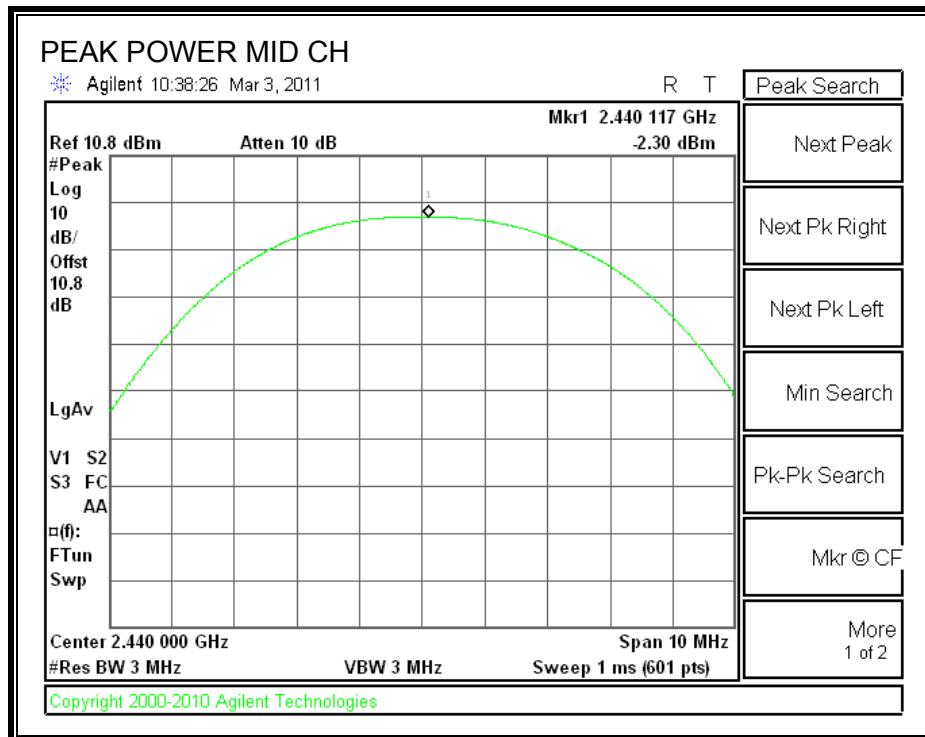
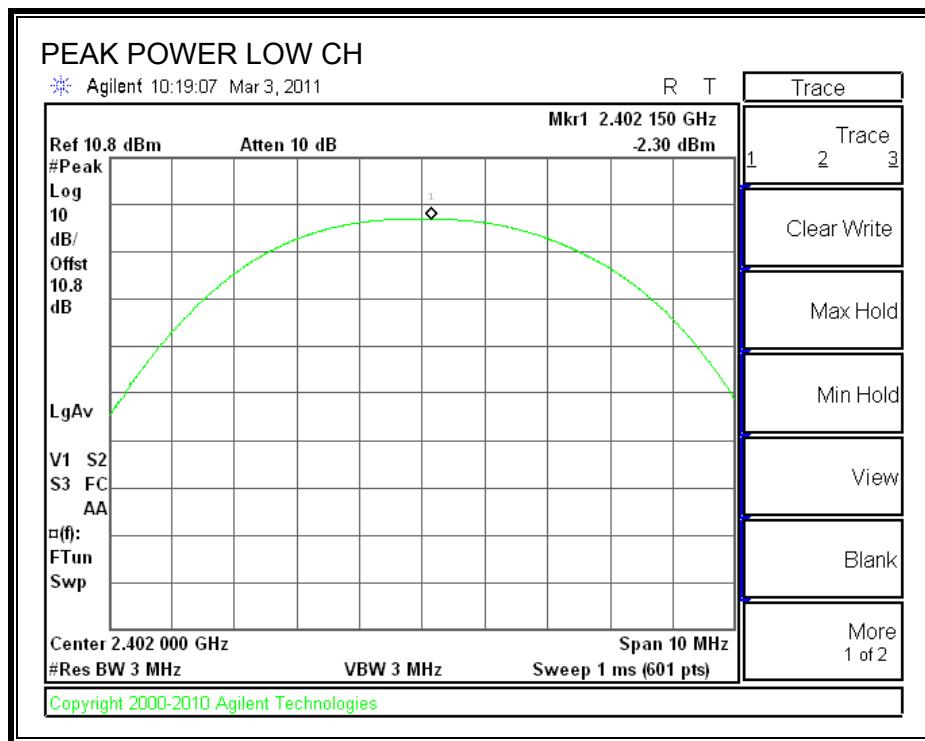
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

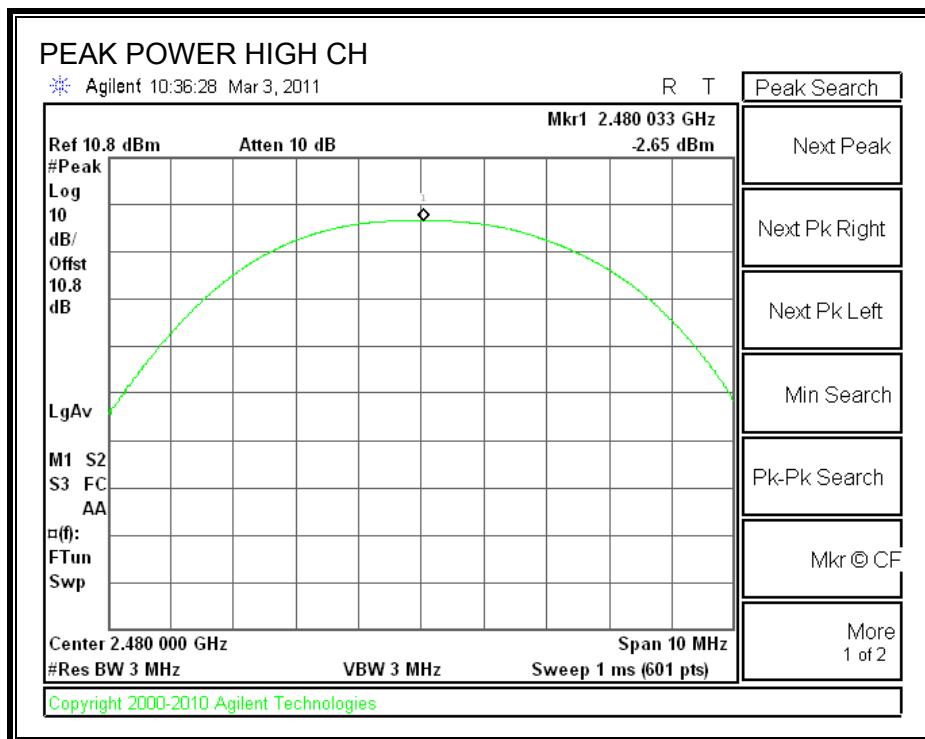
RESULTS

LE MODE

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-2.30	30	-32.30
Middle	2440	-2.30	30	-32.30
High	2480	-2.65	30	-32.65

LE MODE





7.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

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.

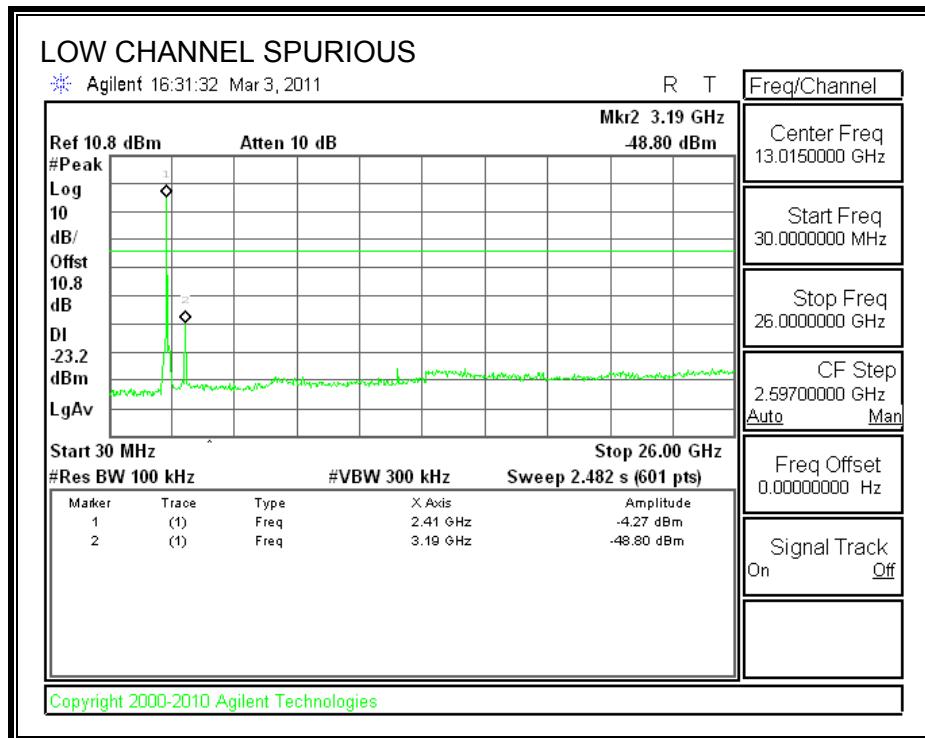
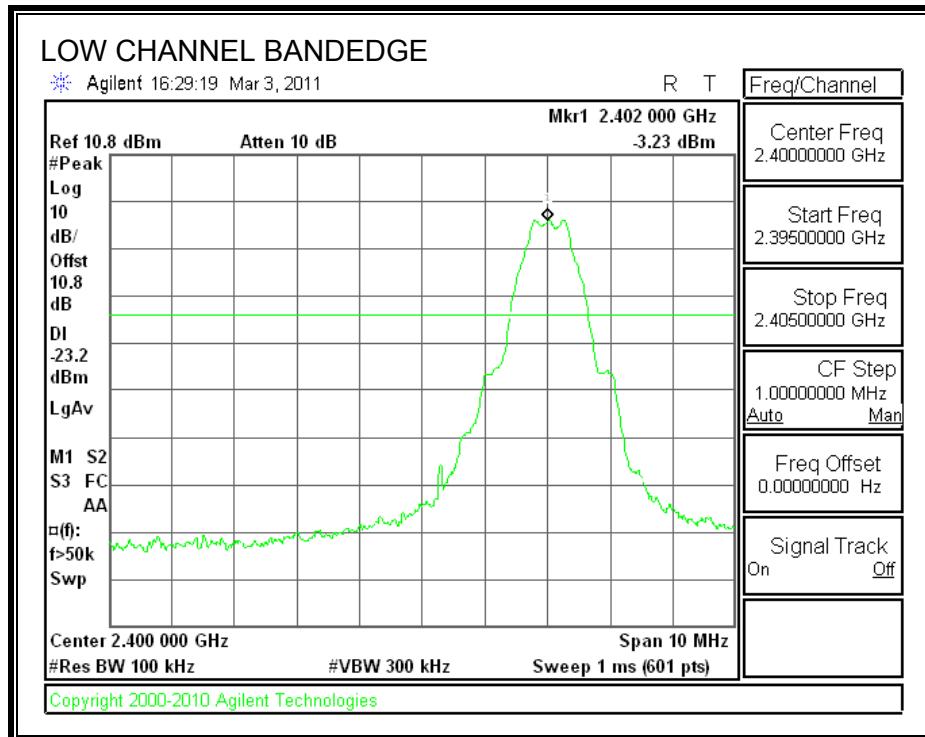
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The band edges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

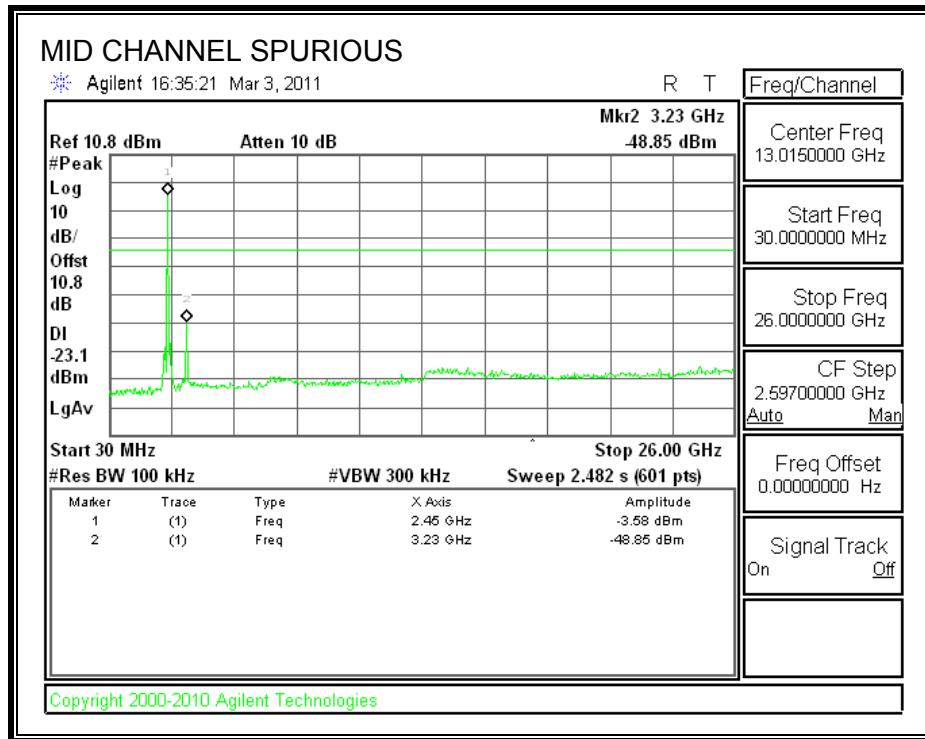
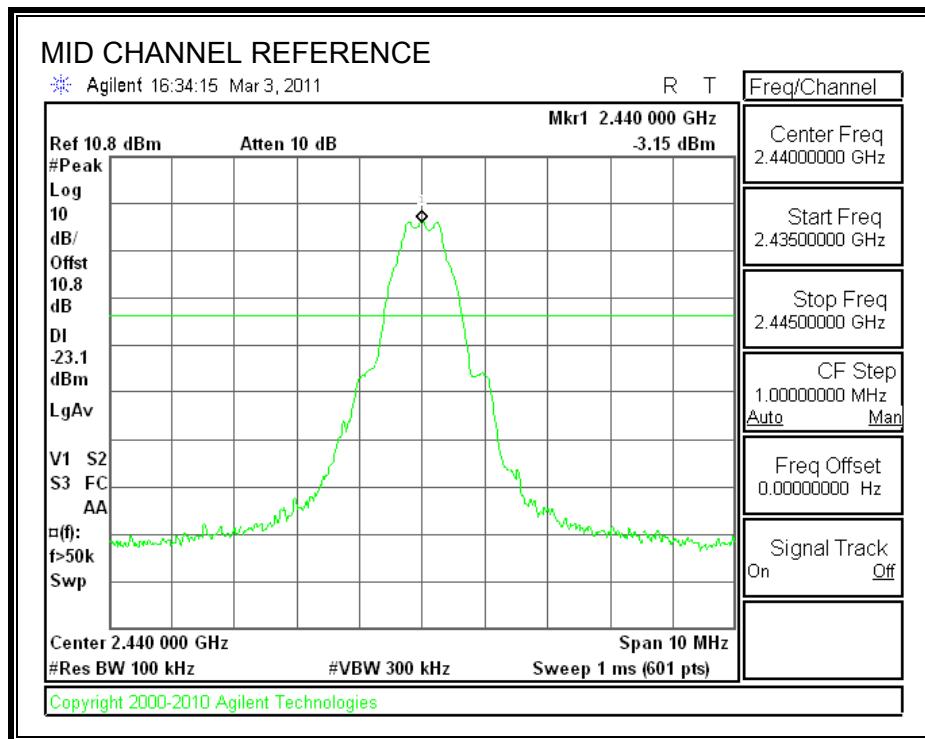
RESULTS

LE MODE

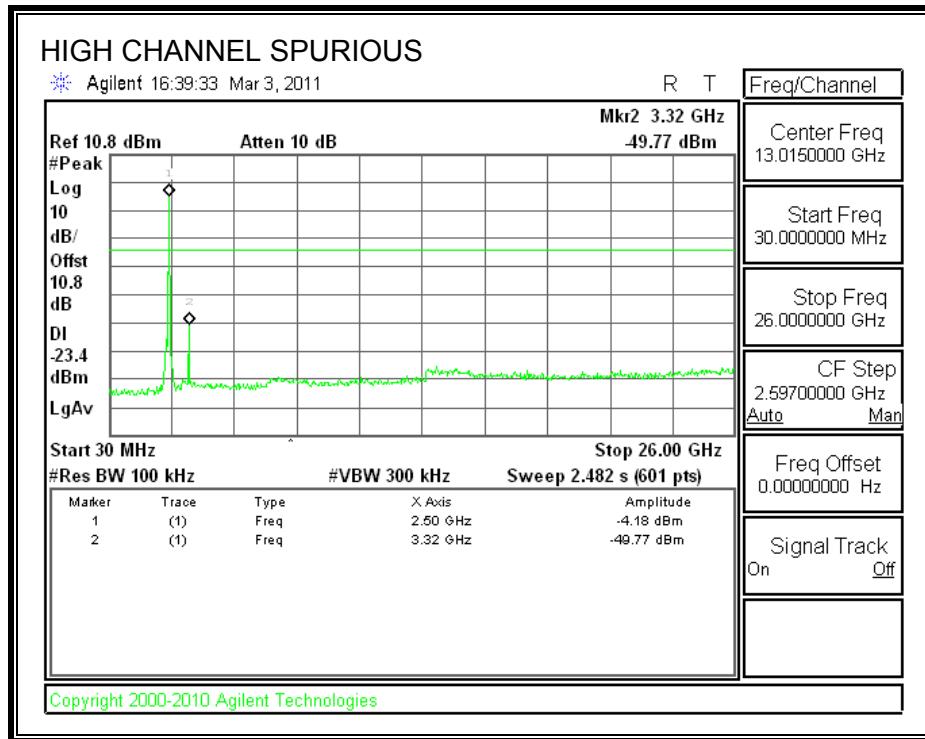
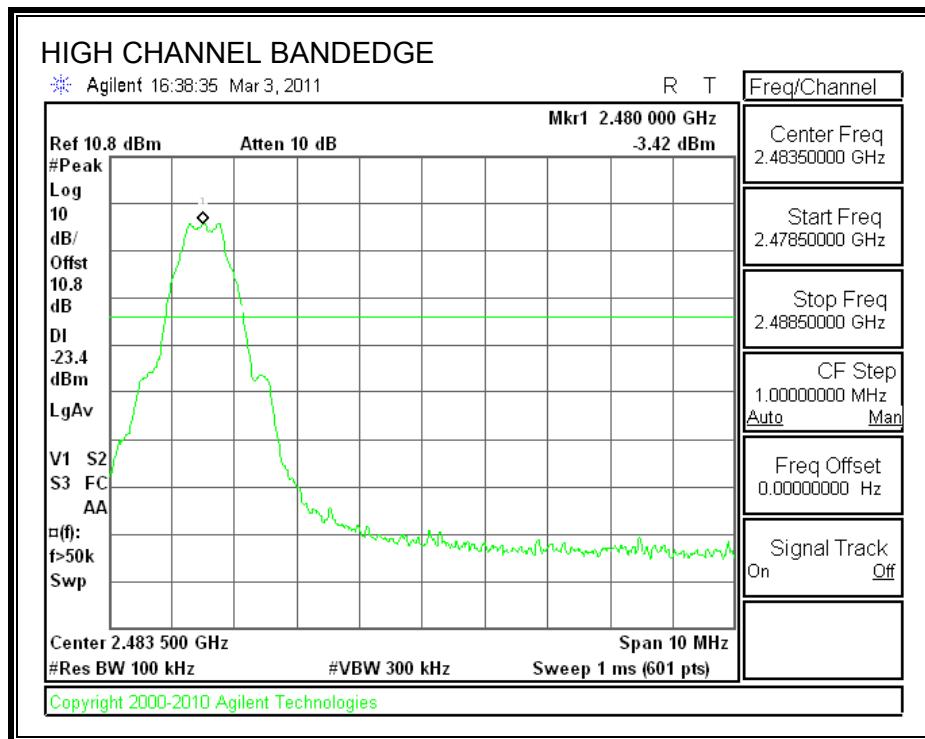
SPURIOUS EMISSIONS, LOW CHANNEL



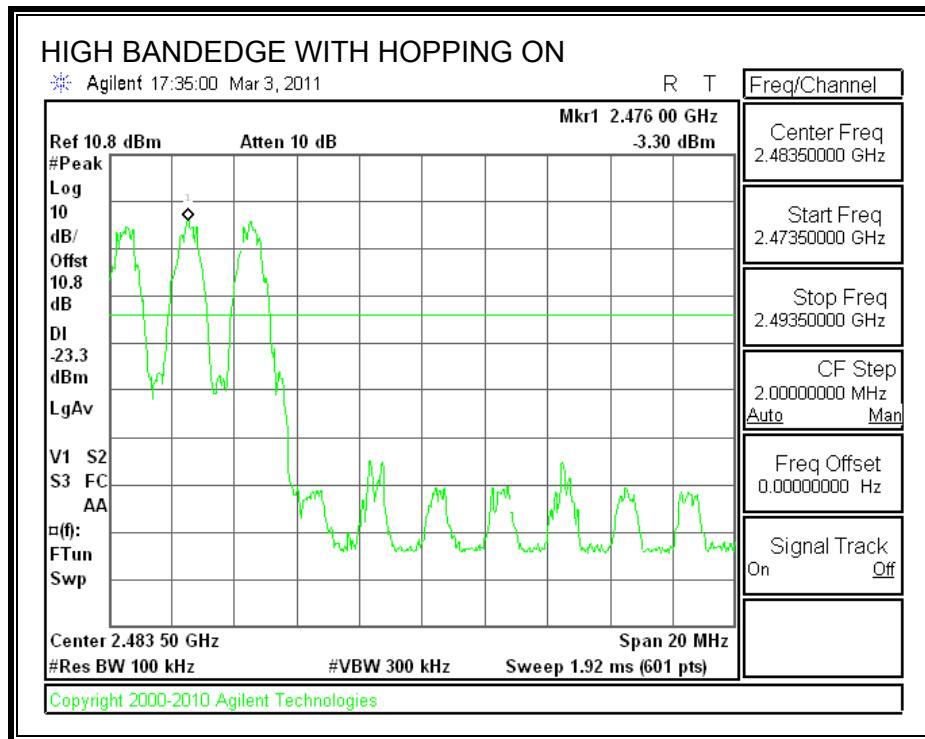
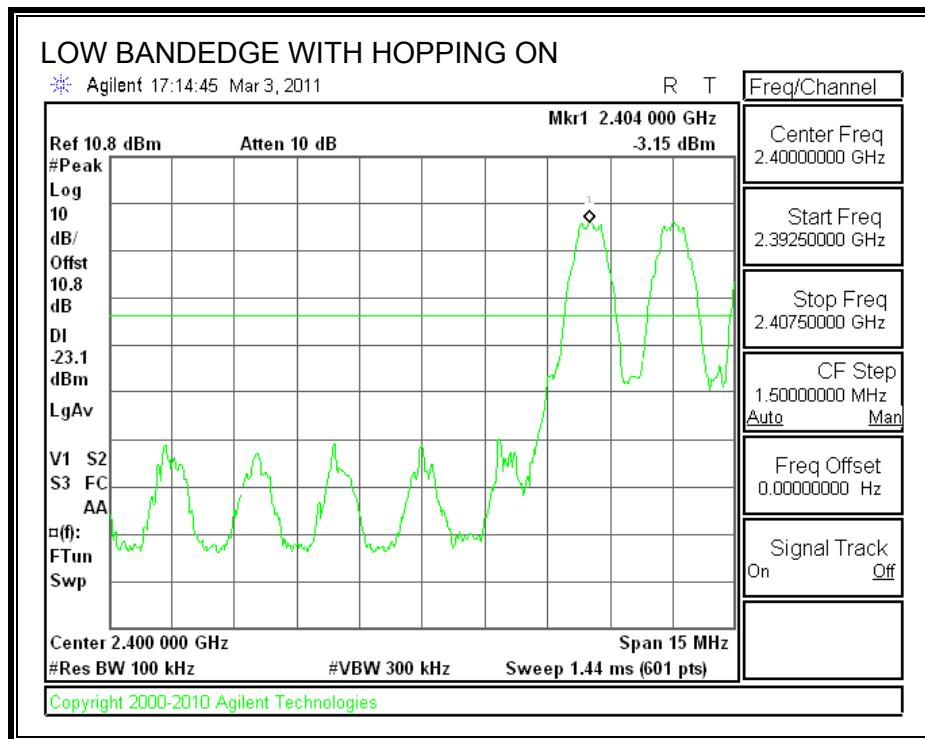
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL

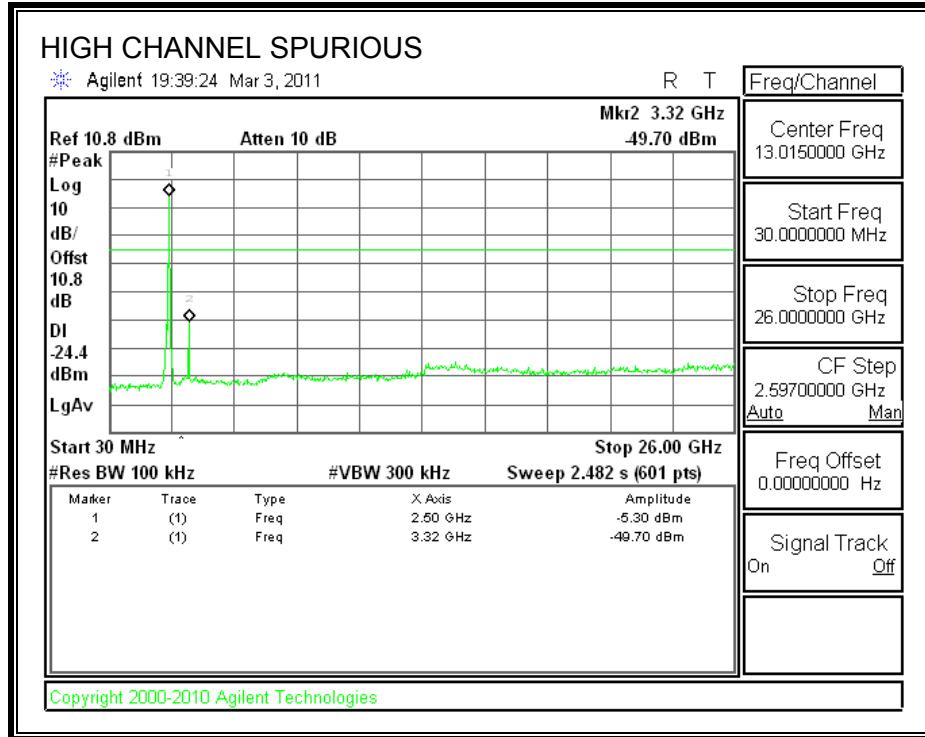
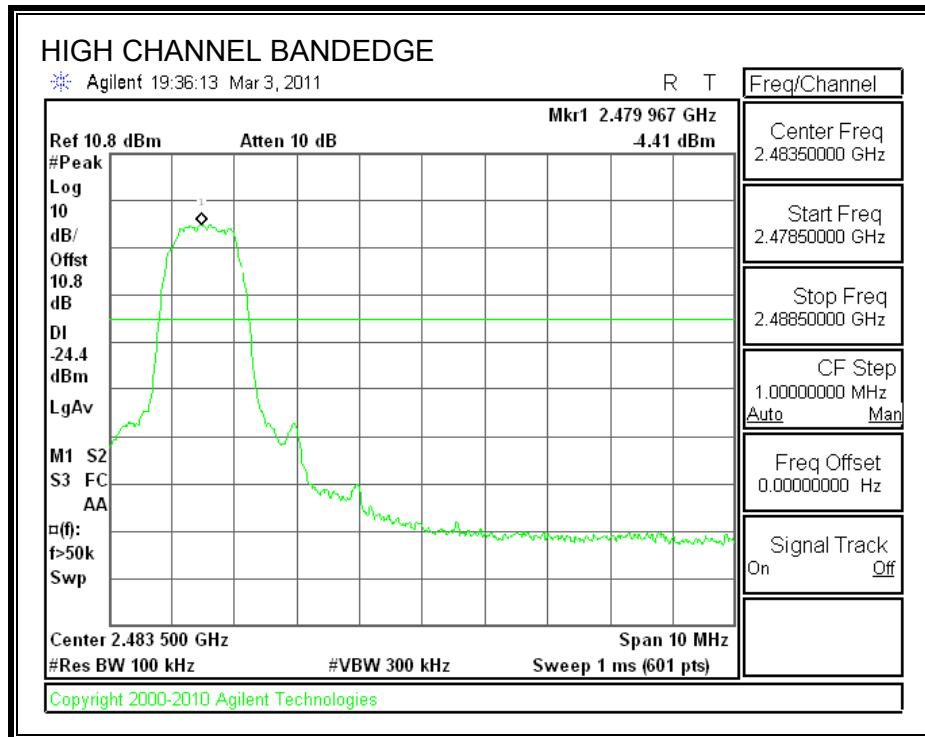


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



8PSK MODE

SPURIOUS EMISSIONS, HIGH CHANNEL



8. RADIATED TEST RESULTS

8.1. 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.

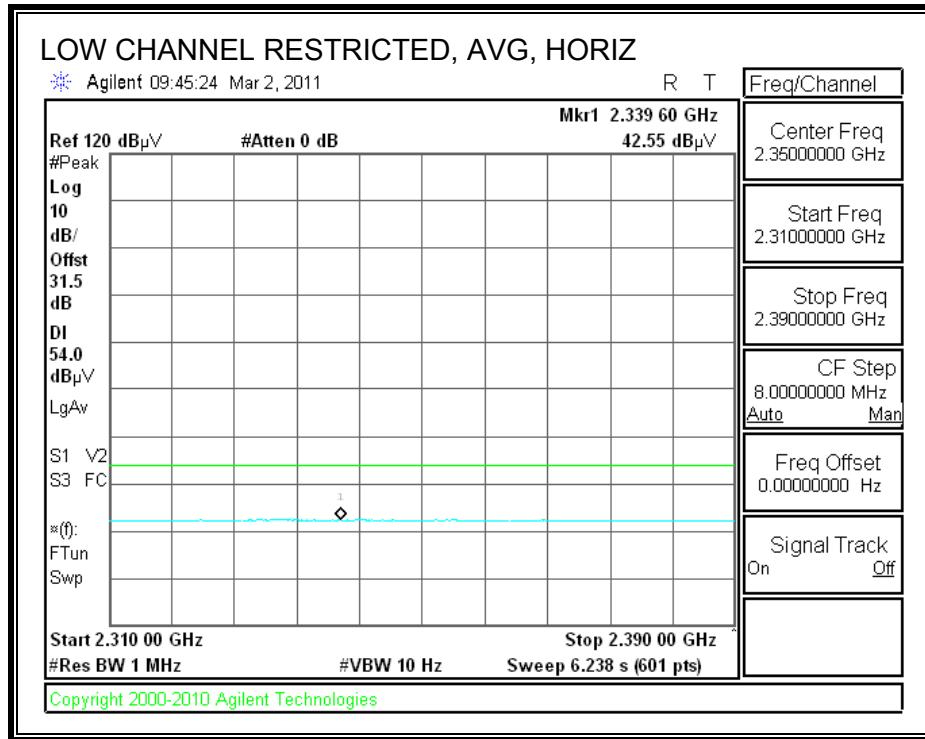
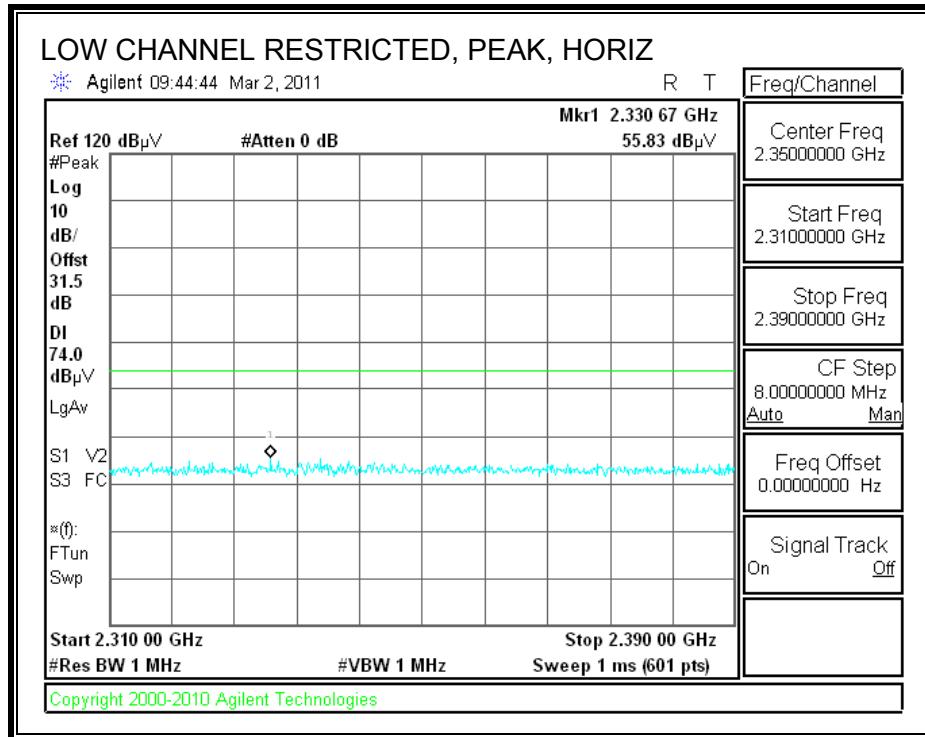
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

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.

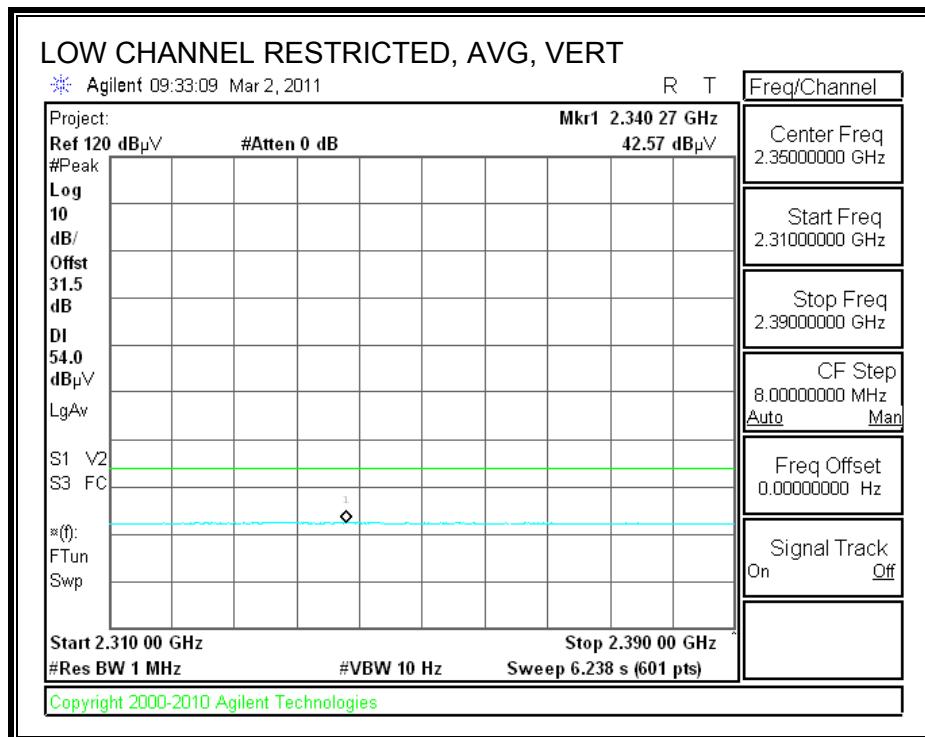
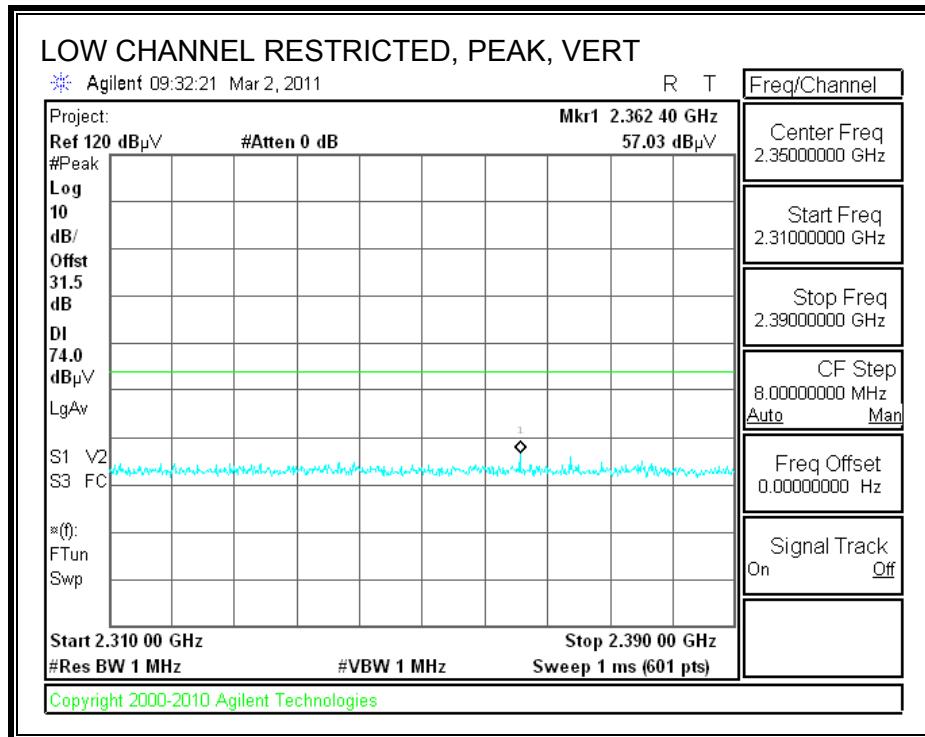
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.1.1. LE MODULATION

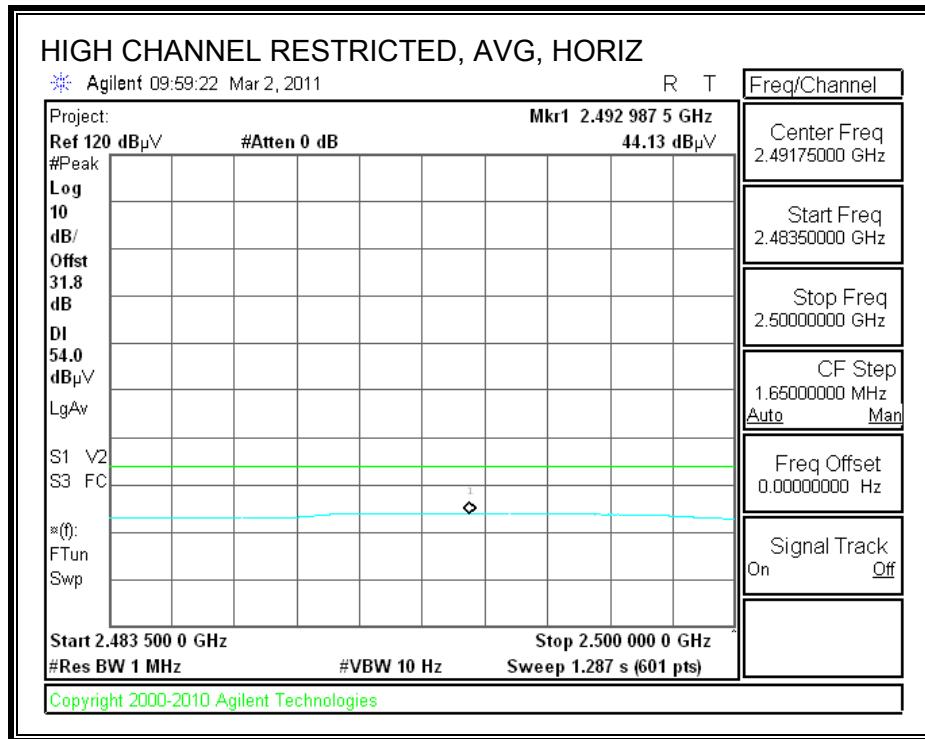
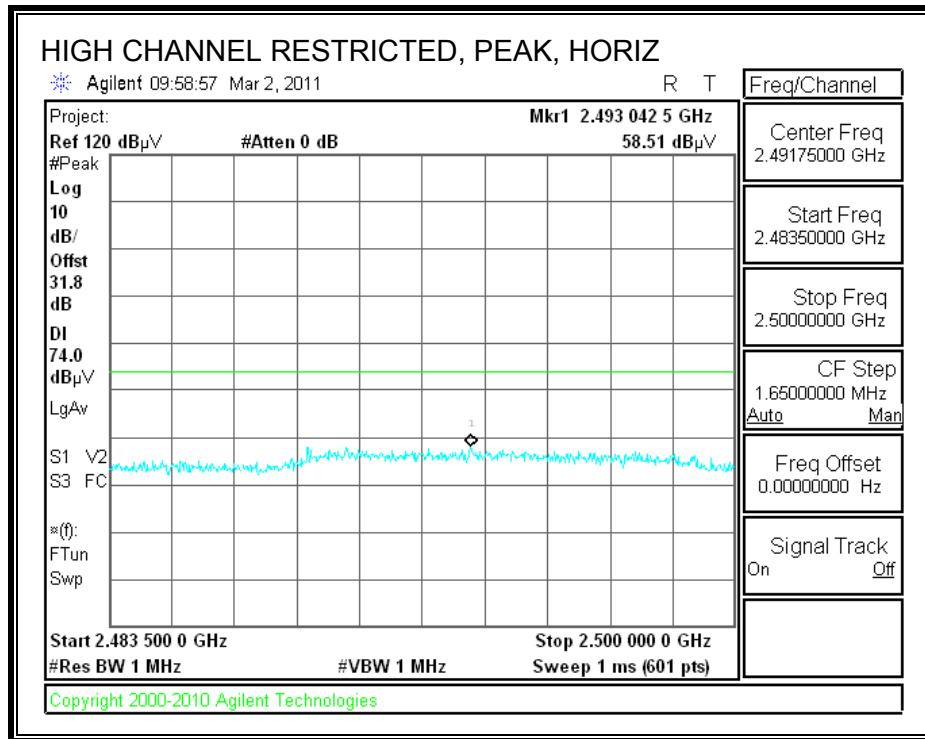
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



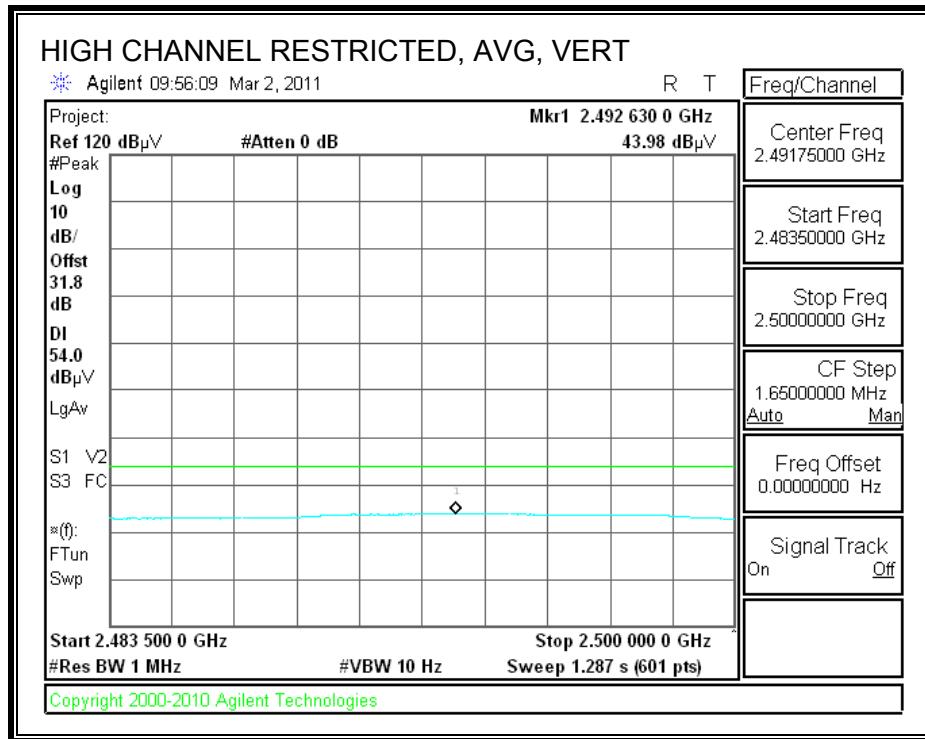
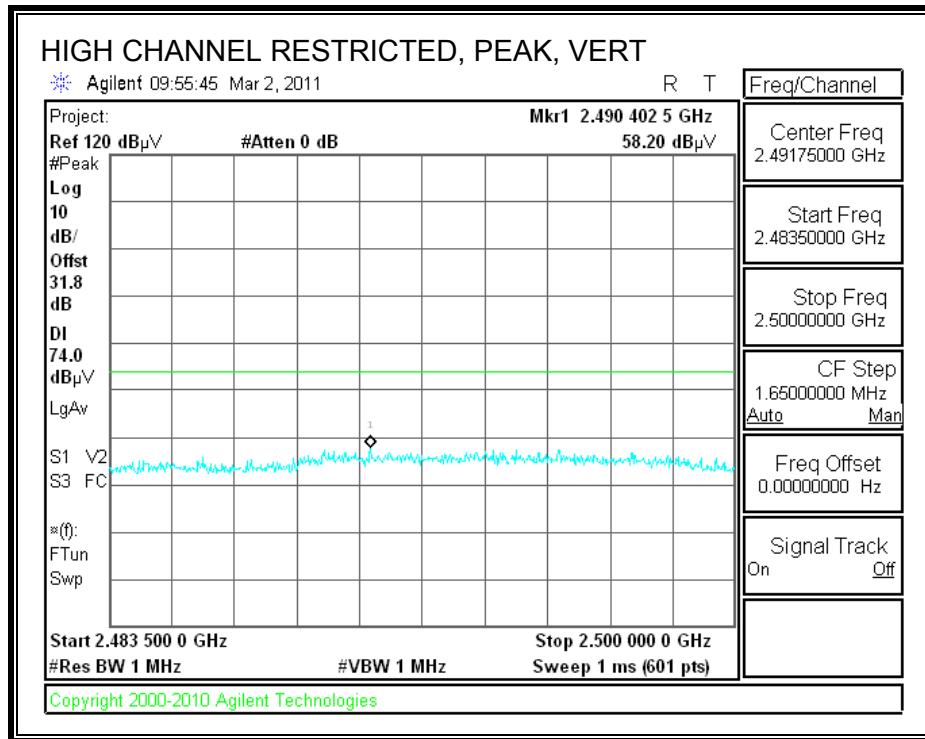
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

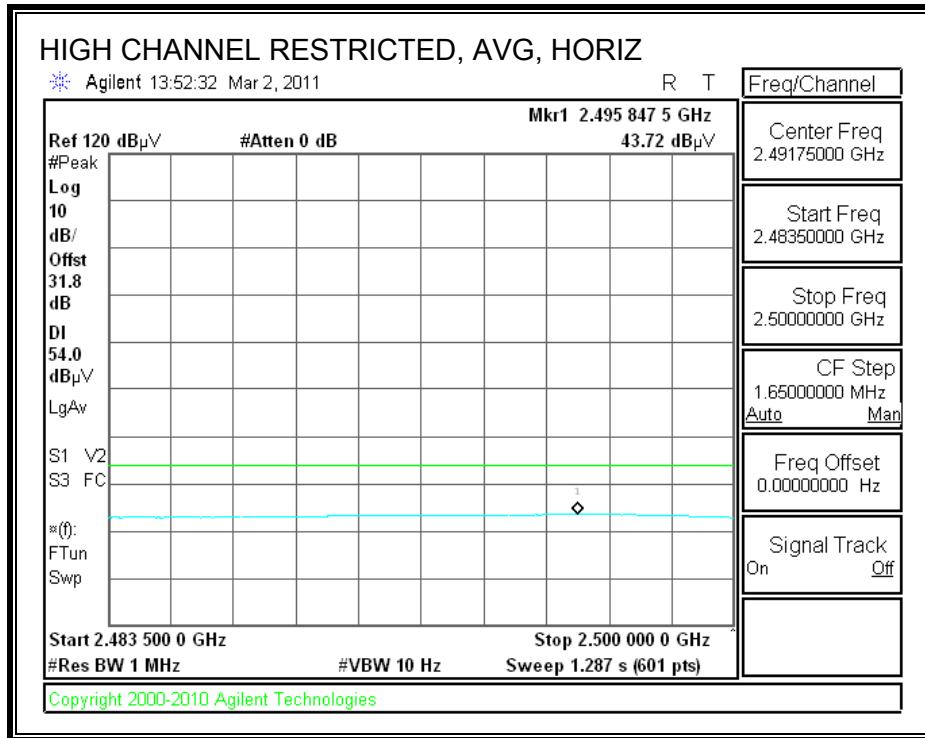
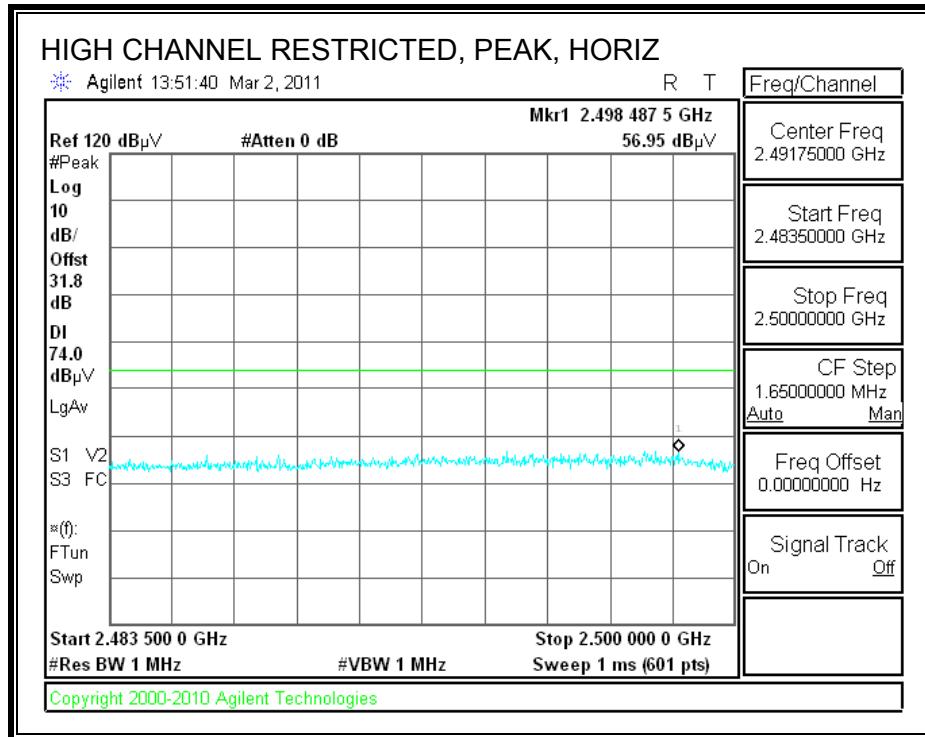


HARMONICS AND SPURIOUS EMISSIONS

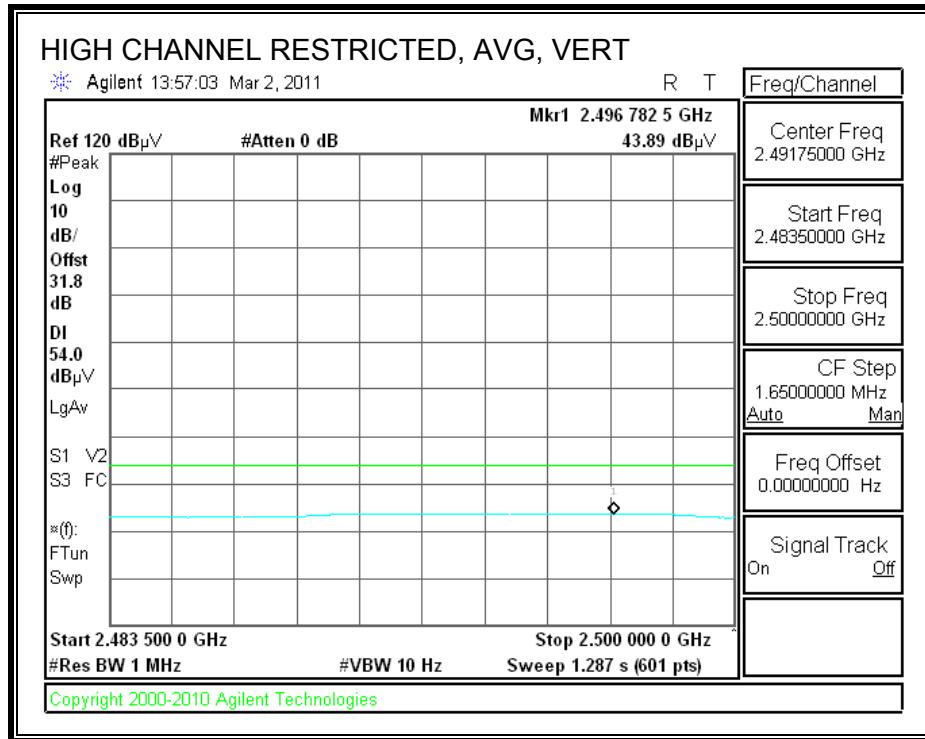
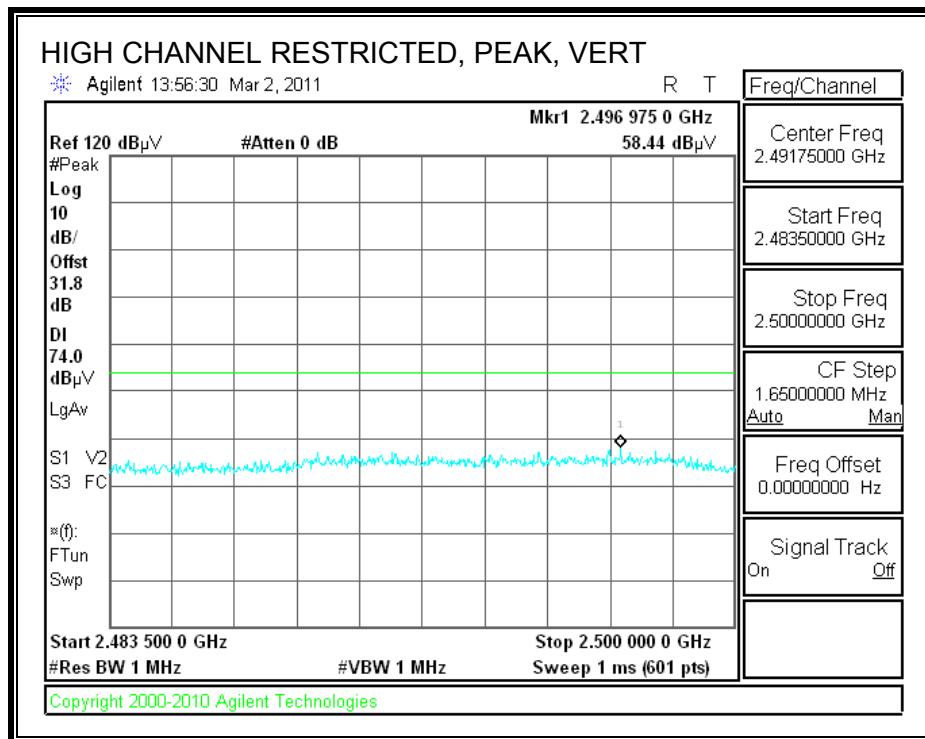
Compliance Certification Services, Fremont 5m Chamber																	
Company:		BroadCom Corporation															
Project #:		11U3702															
Date:		3/2/2011															
Test Engineer:		Thanh Nguyen															
Configuration:		EUT, Antenna, support Laptop															
Mode:		Transmit LE Mode															
Test Equipment:																	
Horn 1-18GHz		Pre-amplifier 1-26GHz		Pre-amplifier 26-40GHz		Horn > 18GHz		Limit									
T60; S/N: 2238 @3m		T34 HP 8449B						FCC 15.209									
Hi Frequency Cables																	
3' cable 22807700		12' cable 22807600		20' cable 22807500		HPF		Reject Filter		Peak Measurements							
3' cable 22807700		12' cable 22807600		20' cable 22807500				R_001		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)		
Harmonics Spurious																	
Low Ch 2402MHz																	
4.804	3.0	39.8	24.6	32.7	5.8	-34.8	0.0	0.0	43.4	28.2	74	54	-30.6	-25.8	V		
Mid Ch 2440MHz																	
4.880	3.0	38.1	24.8	32.7	5.8	-34.8	0.0	0.0	41.9	28.5	74	54	-32.1	-25.5	V		
High Ch 2480MHz																	
4.960	3.0	39.4	24.2	32.8	5.9	-34.8	0.0	0.0	43.2	28.1	74	54	-30.8	-25.9	V		
7.440	3.0	40.2	23.9	35.6	7.3	-34.1	0.0	0.0	49.0	32.8	74	54	-25.0	-21.2	Noise floor		
4.960	3.0	36.8	23.8	32.8	5.9	-34.8	0.0	0.0	40.7	27.7	74	54	-33.3	-26.3	H		
7.440	3.0	35.7	23.1	35.6	7.3	-34.1	0.0	0.0	44.6	32.0	74	54	-29.4	-22.0	Noise floor		
Spurious Emissions																	
1.332	3.0	57.6	52.3	25.6	2.8	-37.8	0.0	0.0	48.1	42.8	74	54	-25.9	-11.2	V		
1.495	3.0	56.9	34.6	26.1	2.9	-37.6	0.0	0.0	48.4	26.1	74	54	-25.6	-27.9	V		
1.867	3.0	49.6	40.8	27.4	3.3	-37.1	0.0	0.0	43.2	34.4	74	54	-30.8	-19.6	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												

8.1.2. 8PSK MODULATION

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber																																																																																																																																																																																																																																																																																																																																																																																																
<p>Company: BroadCom Corporation Project #: 11U13702 Date: 3/2/2011 Test Engineer: Thanh Nguyen Configuration: EUT, Antenna, support Laptop Mode: Transmit 8PSK Mode</p> <p>Test Equipment:</p> <table border="1"> <tr> <td>Horn 1-18GHz</td> <td>Pre-amplifier 1-26GHz</td> <td>Pre-amplifier 26-40GHz</td> <td colspan="4">Horn > 18GHz</td> <td>Limit</td> </tr> <tr> <td>T60: S/N: 2238 @3m</td> <td>T34 HP 8449B</td> <td></td> <td colspan="4"></td> <td>FCC 15.209</td> </tr> <tr> <td colspan="15">Hi Frequency Cables</td> </tr> <tr> <td>3' cable 22807700</td> <td>12' cable 22807600</td> <td>20' cable 22807500</td> <td colspan="4">HPF</td> <td>Reject Filter</td> <td colspan="4">Peak Measurements RBW=VBW=1MHz</td> </tr> <tr> <td>3' cable 22807700</td> <td>12' cable 22807600</td> <td>20' cable 22807500</td> <td colspan="4"></td> <td>R_001</td> <td colspan="4">Average Measurements RBW=1MHz, VBW=10Hz</td> </tr> <tr> <th>f GHz</th> <th>Dist (m)</th> <th>Read Pk dBuV</th> <th>Read Avg dBuV</th> <th>AF dB/m</th> <th>CL dB</th> <th>Amp dB</th> <th>D Corr dB</th> <th>Fltr dB</th> <th>Peak dBuV/m</th> <th>Avg dBuV/m</th> <th>Pk Lim dBuV/m</th> <th>Avg Lim dBuV/m</th> <th>Pk Mar dB</th> <th>Avg Mar dB</th> <th>Notes (V/H)</th> </tr> <tr> <td colspan="15">Harmonics Spurious</td> </tr> <tr> <td colspan="15">Low Ch 2402MHz</td> </tr> <tr> <td>4.804</td> <td>3.0</td> <td>38.0</td> <td>24.3</td> <td>32.7</td> <td>5.8</td> <td>-34.8</td> <td>0.0</td> <td>0.0</td> <td>41.6</td> <td>27.9</td> <td>74</td> <td>54</td> <td>32.4</td> <td>-26.1</td> <td>V</td> </tr> <tr> <td>7.206</td> <td>3.0</td> <td>36.9</td> <td>23.2</td> <td>35.4</td> <td>7.2</td> <td>-34.2</td> <td>0.0</td> <td>0.0</td> <td>45.3</td> <td>31.6</td> <td>74</td> <td>54</td> <td>28.7</td> <td>-22.4</td> <td>V</td> </tr> <tr> <td>4.804</td> <td>3.0</td> <td>38.4</td> <td>24.3</td> <td>32.7</td> <td>5.8</td> <td>-34.8</td> <td>0.0</td> <td>0.0</td> <td>42.0</td> <td>27.9</td> <td>74</td> <td>54</td> <td>32.0</td> <td>-26.1</td> <td>H/noise floor</td> </tr> <tr> <td colspan="15">Mid Ch 2440MHz</td> </tr> <tr> <td>4.880</td> <td>3.0</td> <td>38.0</td> <td>23.7</td> <td>32.7</td> <td>5.8</td> <td>-34.8</td> <td>0.0</td> <td>0.0</td> <td>41.8</td> <td>27.5</td> <td>74</td> <td>54</td> <td>32.2</td> <td>-26.5</td> <td>V</td> </tr> <tr> <td>7.320</td> <td>3.0</td> <td>37.0</td> <td>23.7</td> <td>35.5</td> <td>7.3</td> <td>-34.1</td> <td>0.0</td> <td>0.0</td> <td>45.7</td> <td>32.4</td> <td>74</td> <td>54</td> <td>28.3</td> <td>-21.6</td> <td>Noise floor</td> </tr> <tr> <td colspan="15">High Ch 2480MHz</td> </tr> <tr> <td>4.960</td> <td>3.0</td> <td>37.8</td> <td>24.0</td> <td>32.8</td> <td>5.9</td> <td>-34.8</td> <td>0.0</td> <td>0.0</td> <td>41.7</td> <td>27.9</td> <td>74</td> <td>54</td> <td>32.3</td> <td>-26.1</td> <td>V</td> </tr> <tr> <td>7.440</td> <td>3.0</td> <td>36.8</td> <td>23.0</td> <td>35.6</td> <td>7.3</td> <td>-34.1</td> <td>0.0</td> <td>0.0</td> <td>45.6</td> <td>31.9</td> <td>74</td> <td>54</td> <td>28.4</td> <td>-22.1</td> <td>Noise floor</td> </tr> <tr> <td>4.960</td> <td>3.0</td> <td>38.1</td> <td>24.0</td> <td>32.8</td> <td>5.9</td> <td>-34.8</td> <td>0.0</td> <td>0.0</td> <td>41.9</td> <td>27.8</td> <td>74</td> <td>54</td> <td>32.1</td> <td>-26.2</td> <td>H</td> </tr> <tr> <td>7.440</td> <td>3.0</td> <td>37.0</td> <td>23.0</td> <td>35.6</td> <td>7.3</td> <td>-34.1</td> <td>0.0</td> <td>0.0</td> <td>45.9</td> <td>31.9</td> <td>74</td> <td>54</td> <td>28.1</td> <td>-22.1</td> <td>Noise floor</td> </tr> <tr> <td colspan="15">Spurious Emissions</td> </tr> <tr> <td>1.200</td> <td>3.0</td> <td>57.9</td> <td>51.4</td> <td>25.1</td> <td>2.6</td> <td>-38.0</td> <td>0.0</td> <td>0.0</td> <td>47.7</td> <td>41.1</td> <td>74</td> <td>54</td> <td>26.3</td> <td>-12.9</td> <td>V</td> </tr> <tr> <td>1.333</td> <td>3.0</td> <td>57.6</td> <td>50.8</td> <td>25.6</td> <td>2.8</td> <td>-37.8</td> <td>0.0</td> <td>0.0</td> <td>48.1</td> <td>41.3</td> <td>74</td> <td>54</td> <td>25.9</td> <td>-12.7</td> <td>V</td> </tr> <tr> <td>1.493</td> <td>3.0</td> <td>56.1</td> <td>52.6</td> <td>26.1</td> <td>2.9</td> <td>-37.6</td> <td>0.0</td> <td>0.0</td> <td>47.6</td> <td>24.1</td> <td>74</td> <td>54</td> <td>26.4</td> <td>-29.9</td> <td>V</td> </tr> <tr> <td>1.797</td> <td>3.0</td> <td>50.4</td> <td>40.8</td> <td>27.1</td> <td>3.2</td> <td>-37.2</td> <td>0.0</td> <td>0.0</td> <td>43.6</td> <td>34.0</td> <td>74</td> <td>54</td> <td>30.4</td> <td>-20.0</td> <td>V</td> </tr> <tr> <td>1.134</td> <td>3.0</td> <td>46.3</td> <td>38.6</td> <td>24.9</td> <td>2.5</td> <td>-38.1</td> <td>0.0</td> <td>0.0</td> <td>35.7</td> <td>27.9</td> <td>74</td> <td>54</td> <td>38.3</td> <td>-26.1</td> <td>H</td> </tr> </table>															Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz				Limit	T60: S/N: 2238 @3m	T34 HP 8449B						FCC 15.209	Hi Frequency Cables															3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF				Reject Filter	Peak Measurements RBW=VBW=1MHz				3' cable 22807700	12' cable 22807600	20' cable 22807500					R_001	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)	Harmonics Spurious															Low Ch 2402MHz															4.804	3.0	38.0	24.3	32.7	5.8	-34.8	0.0	0.0	41.6	27.9	74	54	32.4	-26.1	V	7.206	3.0	36.9	23.2	35.4	7.2	-34.2	0.0	0.0	45.3	31.6	74	54	28.7	-22.4	V	4.804	3.0	38.4	24.3	32.7	5.8	-34.8	0.0	0.0	42.0	27.9	74	54	32.0	-26.1	H/noise floor	Mid Ch 2440MHz															4.880	3.0	38.0	23.7	32.7	5.8	-34.8	0.0	0.0	41.8	27.5	74	54	32.2	-26.5	V	7.320	3.0	37.0	23.7	35.5	7.3	-34.1	0.0	0.0	45.7	32.4	74	54	28.3	-21.6	Noise floor	High Ch 2480MHz															4.960	3.0	37.8	24.0	32.8	5.9	-34.8	0.0	0.0	41.7	27.9	74	54	32.3	-26.1	V	7.440	3.0	36.8	23.0	35.6	7.3	-34.1	0.0	0.0	45.6	31.9	74	54	28.4	-22.1	Noise floor	4.960	3.0	38.1	24.0	32.8	5.9	-34.8	0.0	0.0	41.9	27.8	74	54	32.1	-26.2	H	7.440	3.0	37.0	23.0	35.6	7.3	-34.1	0.0	0.0	45.9	31.9	74	54	28.1	-22.1	Noise floor	Spurious Emissions															1.200	3.0	57.9	51.4	25.1	2.6	-38.0	0.0	0.0	47.7	41.1	74	54	26.3	-12.9	V	1.333	3.0	57.6	50.8	25.6	2.8	-37.8	0.0	0.0	48.1	41.3	74	54	25.9	-12.7	V	1.493	3.0	56.1	52.6	26.1	2.9	-37.6	0.0	0.0	47.6	24.1	74	54	26.4	-29.9	V	1.797	3.0	50.4	40.8	27.1	3.2	-37.2	0.0	0.0	43.6	34.0	74	54	30.4	-20.0	V	1.134	3.0	46.3	38.6	24.9	2.5	-38.1	0.0	0.0	35.7	27.9	74	54	38.3	-26.1	H
Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz				Limit																																																																																																																																																																																																																																																																																																																																																																																									
T60: S/N: 2238 @3m	T34 HP 8449B						FCC 15.209																																																																																																																																																																																																																																																																																																																																																																																									
Hi Frequency Cables																																																																																																																																																																																																																																																																																																																																																																																																
3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF				Reject Filter	Peak Measurements RBW=VBW=1MHz																																																																																																																																																																																																																																																																																																																																																																																								
3' cable 22807700	12' cable 22807600	20' cable 22807500					R_001	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)																																																																																																																																																																																																																																																																																																																																																																																	
Harmonics Spurious																																																																																																																																																																																																																																																																																																																																																																																																
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4.804	3.0	38.0	24.3	32.7	5.8	-34.8	0.0	0.0	41.6	27.9	74	54	32.4	-26.1	V																																																																																																																																																																																																																																																																																																																																																																																	
7.206	3.0	36.9	23.2	35.4	7.2	-34.2	0.0	0.0	45.3	31.6	74	54	28.7	-22.4	V																																																																																																																																																																																																																																																																																																																																																																																	
4.804	3.0	38.4	24.3	32.7	5.8	-34.8	0.0	0.0	42.0	27.9	74	54	32.0	-26.1	H/noise floor																																																																																																																																																																																																																																																																																																																																																																																	
Mid Ch 2440MHz																																																																																																																																																																																																																																																																																																																																																																																																
4.880	3.0	38.0	23.7	32.7	5.8	-34.8	0.0	0.0	41.8	27.5	74	54	32.2	-26.5	V																																																																																																																																																																																																																																																																																																																																																																																	
7.320	3.0	37.0	23.7	35.5	7.3	-34.1	0.0	0.0	45.7	32.4	74	54	28.3	-21.6	Noise floor																																																																																																																																																																																																																																																																																																																																																																																	
High Ch 2480MHz																																																																																																																																																																																																																																																																																																																																																																																																
4.960	3.0	37.8	24.0	32.8	5.9	-34.8	0.0	0.0	41.7	27.9	74	54	32.3	-26.1	V																																																																																																																																																																																																																																																																																																																																																																																	
7.440	3.0	36.8	23.0	35.6	7.3	-34.1	0.0	0.0	45.6	31.9	74	54	28.4	-22.1	Noise floor																																																																																																																																																																																																																																																																																																																																																																																	
4.960	3.0	38.1	24.0	32.8	5.9	-34.8	0.0	0.0	41.9	27.8	74	54	32.1	-26.2	H																																																																																																																																																																																																																																																																																																																																																																																	
7.440	3.0	37.0	23.0	35.6	7.3	-34.1	0.0	0.0	45.9	31.9	74	54	28.1	-22.1	Noise floor																																																																																																																																																																																																																																																																																																																																																																																	
Spurious Emissions																																																																																																																																																																																																																																																																																																																																																																																																
1.200	3.0	57.9	51.4	25.1	2.6	-38.0	0.0	0.0	47.7	41.1	74	54	26.3	-12.9	V																																																																																																																																																																																																																																																																																																																																																																																	
1.333	3.0	57.6	50.8	25.6	2.8	-37.8	0.0	0.0	48.1	41.3	74	54	25.9	-12.7	V																																																																																																																																																																																																																																																																																																																																																																																	
1.493	3.0	56.1	52.6	26.1	2.9	-37.6	0.0	0.0	47.6	24.1	74	54	26.4	-29.9	V																																																																																																																																																																																																																																																																																																																																																																																	
1.797	3.0	50.4	40.8	27.1	3.2	-37.2	0.0	0.0	43.6	34.0	74	54	30.4	-20.0	V																																																																																																																																																																																																																																																																																																																																																																																	
1.134	3.0	46.3	38.6	24.9	2.5	-38.1	0.0	0.0	35.7	27.9	74	54	38.3	-26.1	H																																																																																																																																																																																																																																																																																																																																																																																	

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. RECEIVER ABOVE 1 GHz

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber															
Company: BroadCom Corporation Project #: 11U3702 Date: 3/2/2011 Test Engineer: Thanh Nguyen Configuration: EUT, Antenna, support Laptop Mode: Receive LE Mode															
<u>Test Equipment:</u>															
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit			
T60; S/N: 2238 @3m			T34 HP 8449B									RX RSS 210			
Hi Frequency Cables															
3' cable 22807700			12' cable 22807600			20' cable 22807500			HPF			Reject Filter			Peak Measurements RBW=VBW=1MHz
3' cable 22807700			12' cable 22807600			20' cable 22807500						R_001			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)
Spurious Emissions															
Low Ch															
1.200	3.0	56.1	51.8	25.1	2.6	-38.0	0.0	0.0	45.8	41.5	74	54	-28.2	-12.5	V
1.493	3.0	55.9	38.7	26.1	2.9	-37.6	0.0	0.0	47.4	30.2	74	54	-26.6	-23.8	V
1.867	3.0	53.0	43.9	27.4	3.3	-37.1	0.0	0.0	46.6	37.5	74	54	-27.4	-16.5	V
1.500	3.0	50.6	32.6	26.1	2.9	-37.6	0.0	0.0	42.1	24.1	74	54	-31.9	-29.9	H
Mid Ch															
1.100	3.0	57.1	46.0	24.8	2.5	-38.1	0.0	0.0	46.3	35.2	74	54	-27.7	-18.8	V
1.200	3.0	55.7	49.4	25.1	2.6	-38.0	0.0	0.0	45.5	39.1	74	54	-28.5	-14.9	V
1.867	3.0	55.1	46.8	27.4	3.3	-37.1	0.0	0.0	48.7	40.4	74	54	-25.3	-13.6	V
2.095	3.0	51.7	31.3	27.9	3.5	-36.7	0.0	0.0	46.4	25.9	74	54	-27.6	-28.1	H
High Ch															
1.192	3.0	56.5	49.3	25.1	2.6	-38.0	0.0	0.0	46.2	39.0	74	54	-27.8	-15.0	V
1.500	3.0	55.5	48.3	26.1	2.9	-37.6	0.0	0.0	47.0	39.8	74	54	-27.0	-14.2	V
2.133	3.0	49.3	36.2	27.9	3.6	-36.7	0.0	0.0	44.1	30.9	74	54	-29.9	-23.1	V
1.000	3.0	52.6	33.3	24.5	2.4	-38.3	0.0	0.0	41.2	21.8	74	54	-32.8	-32.2	H
Rev. 07.22.09															
f Measurement Frequency Dist Distance to Antenna Read Analyzer Reading AF Antenna Factor CL Cable Loss					Amp Preamp Gain D Corr Distance Correct to 3 meters Avg Average Field Strength @ 3 m Peak Calculated Peak Field Strength HPF High Pass Filter					Avg Lim Average Field Strength Limit Pk Lim Peak Field Strength Limit Avg Mar Margin vs. Average Limit Pk Mar Margin vs. Peak Limit					

8.3. WORST-CASE BELOW 1 GHz

HORIZONTAL AND VERTICAL DATA

30-1000MHz Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Thanh Nguyen
Date: 03/02/11
Project #: 11U13702
Company: BroadCom Corporation
Test Target: FCC 15.247
Mode Oper: Transmit worst case

f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		
Read	Analyzer Reading	Filter	Filter Insert Loss		
AF	Antenna Factor	Corr.	Calculated Field Strength		
CL	Cable Loss	Limit	Field Strength Limit		

f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Pad dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant. High cm	Table Angle Degree	Notes
Worst case															
230.648	3.0	50.3	11.8	1.3	27.4	0.0	0.0	36.0	46.0	-10.0	V	P	100.0	0 - 360	
298.811	3.0	46.4	13.5	1.5	27.4	0.0	0.0	33.9	46.0	-12.1	V	P	100.0	0 - 360	
369.254	3.0	46.9	14.5	1.7	27.8	0.0	0.0	35.3	46.0	-10.7	V	P	100.0	0 - 360	
461.298	3.0	42.1	16.1	1.9	28.4	0.0	0.0	31.8	46.0	-14.2	V	P	100.0	0 - 360	
692.067	3.0	38.2	18.9	2.4	28.5	0.0	0.0	30.9	46.0	-15.1	V	P	100.0	0 - 360	
897.276	3.0	39.2	22.0	2.7	27.9	0.0	0.0	36.1	46.0	-9.9	V	P	100.0	0 - 360	
240.099	3.0	55.8	11.8	1.3	27.4	0.0	0.0	41.5	46.0	-4.5	H	P	100.0	0 - 360	
322.692	3.0	53.4	13.8	1.5	27.5	0.0	0.0	41.3	46.0	-4.7	H	P	100.0	0 - 360	
369.014	3.0	52.8	14.5	1.7	27.8	0.0	0.0	41.2	46.0	-4.8	H	P	100.0	0 - 360	
503.9	3.0	43.3	16.9	2.0	28.6	0.0	0.0	33.6	46.0	-12.4	H	P	100.0	0 - 360	
900.156	3.0	36.3	22.1	2.7	27.9	0.0	0.0	33.3	46.0	-12.7	H	P	100.0	0 - 360	

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

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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 receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

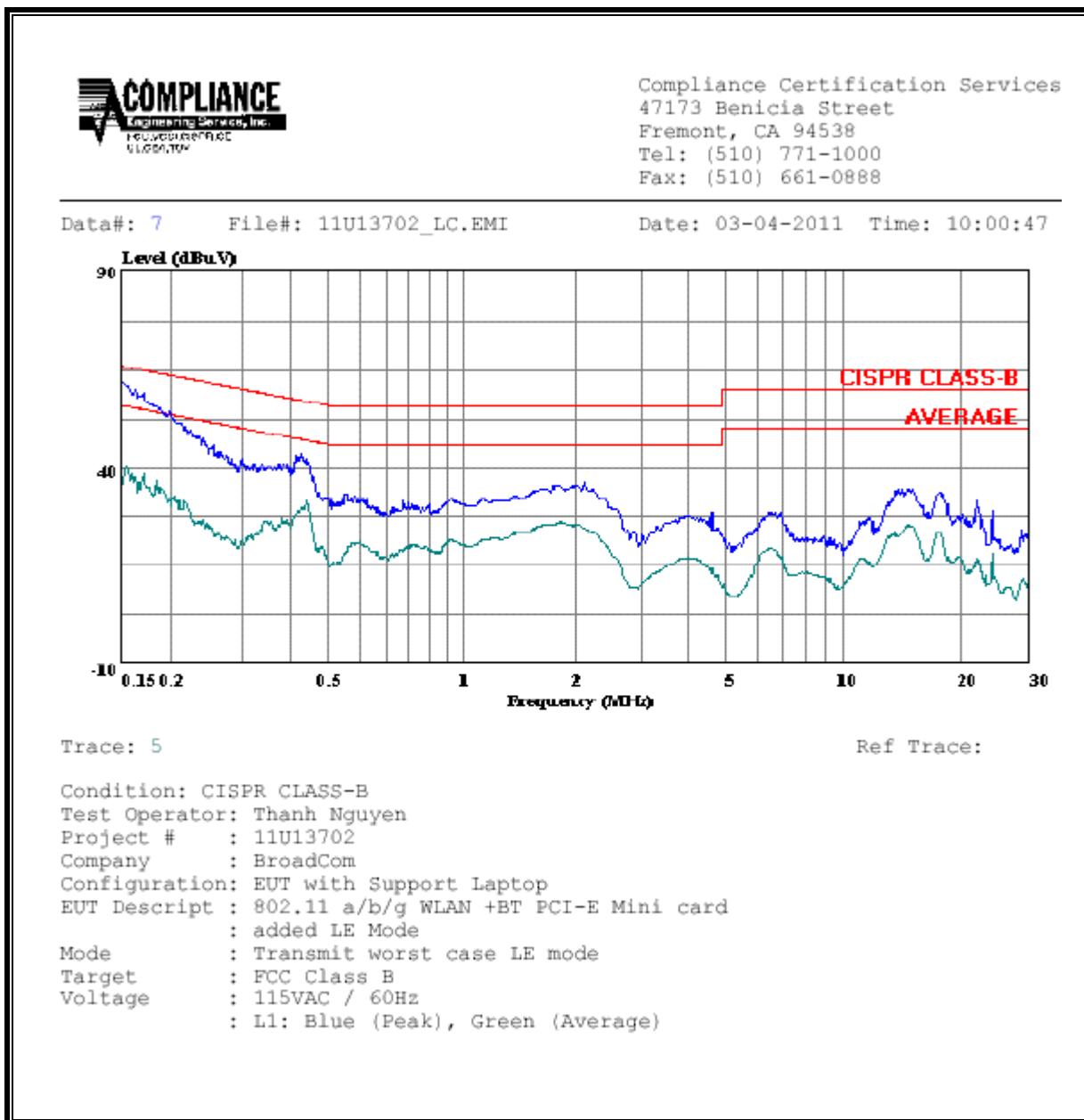
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

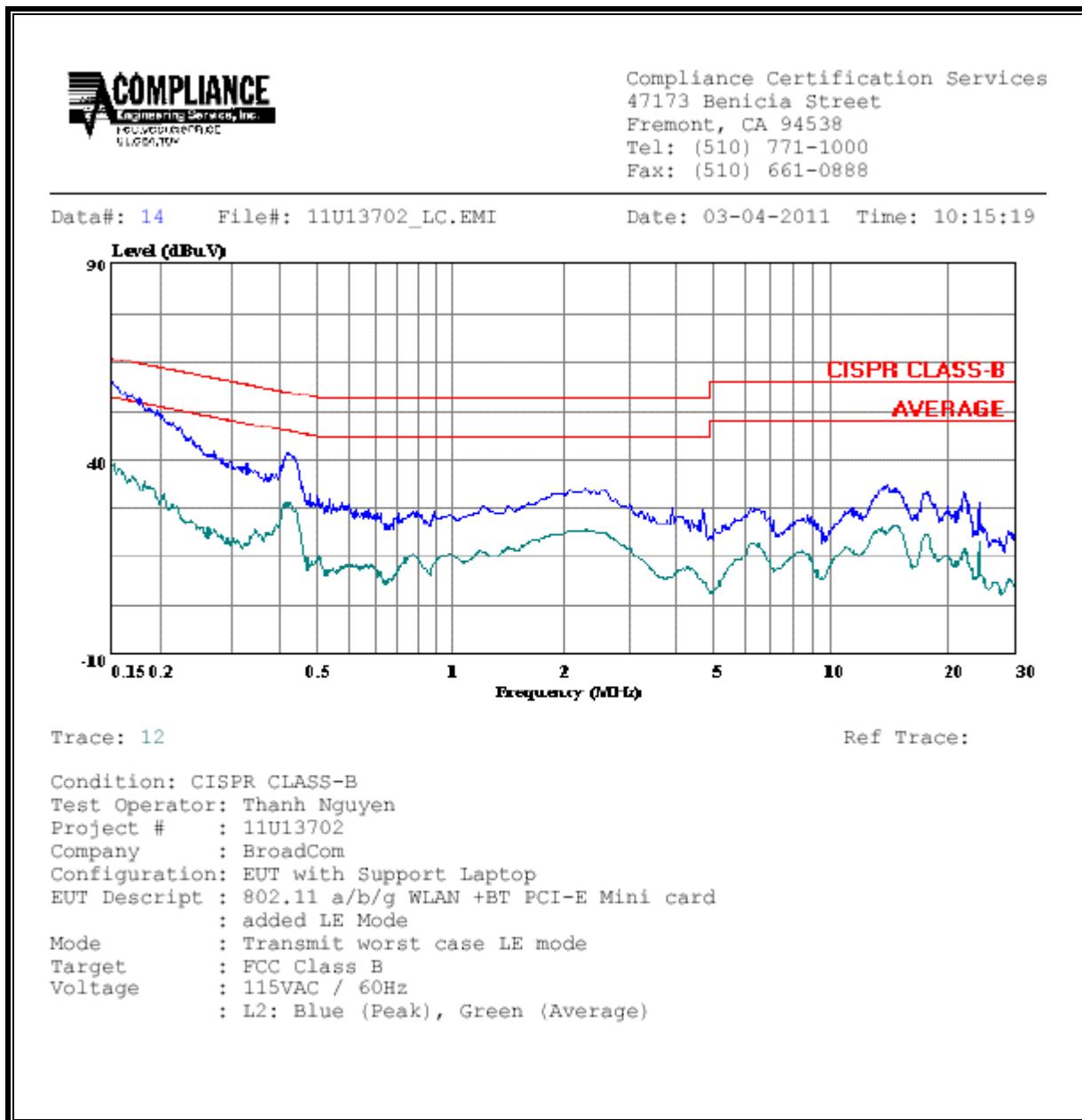
6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq. (MHz)	Reading			Closs (dB)	Limit	EN_B	Margin		Remark
	PK (dBuV)	QP (dBuV)	AV (dBuV)				QP (dB)	AV (dB)	
0.15	61.85	--	40.78	0.00	66.00	56.00	-4.15	-15.22	L1
0.43	43.54	--	31.58	0.00	57.33	47.33	-13.79	-15.75	L1
2.22	36.20	--	26.26	0.00	56.00	46.00	-19.80	-19.74	L1
0.15	60.15	--	38.71	0.00	66.00	56.00	-5.85	-17.29	L2
0.42	41.87	--	28.83	0.00	57.47	47.47	-15.60	-18.64	L2
2.40	32.67	--	21.86	0.00	56.00	46.00	-23.33	-24.14	L2
6 Worst Data									

LINE 1 RESULTS



LINE 2 RESULTS



10. MAXIMUM PERMISSIBLE EXPOSURE

FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m ²)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	280/ <i>f</i>	2.19/ <i>f</i>		6
10–30	28	2.19/ <i>f</i>		6
30–300	28	0.073	2*	6
300–1 500	1.585 <i>f</i> ^{0.5}	0.0042 <i>f</i> ^{0.5}	<i>f</i> /150	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	616 000 / <i>f</i> ^{1.2}
150 000–300 000	0.158 <i>f</i> ^{0.5}	4.21 × 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 × 10 ⁻⁵ <i>f</i>	616 000 / <i>f</i> ^{1.2}

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes:

1. Frequency, *f*, is in MHz.
2. A power density of 10 W/m² is equivalent to 1 mW/cm².
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

EQUATIONS

Power density is given by:

$$S = \text{EIRP} / (4 * \pi * D^2)$$

where

S = Power density in W/m²

EIRP = Equivalent Isotropic Radiated Power in W

D = Separation distance in m

Power density in units of W/m² is converted to units of mW/cm² by dividing by 10.

Distance is given by:

$$D = \text{SQRT} (\text{EIRP} / (4 * \pi * S))$$

where

D = Separation distance in m

EIRP = Equivalent Isotropic Radiated Power in W

S = Power density in W/m²

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm²

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m²

RESULTS

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m ²)	FCC Power Density (mW/cm ²)
2.4 GHz	LE	0.20	-2.30	4.97	0.00	0.000