



FCC CFR47 PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

BLUETOOTH TRANSCEIVER MODULE (LE MODE)

MODEL NUMBER: BCM92070MD_LEN0

FCC ID: QDS-BRCM1046LE

REPORT NUMBER: 11U13947-4

ISSUE DATE: AUGUST 02, 2011

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
--	08/02/11	Initial Issue	T. Chan

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: BLUETOOTH TRANSCEIVER MODULE

MODEL: BCM92070MD_LEN0

SERIAL NUMBER: 39 V005 and V005

DATE TESTED: JULY 21 to 27, 2011

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass

Compliance Certification Services (UL CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For UL CCS By:

Tested By:



THU CHAN
ENGINEERING MANAGER
UL CCS



DAVID GARCIA
EMC ENGINEER
UL CCS

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 15.

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:

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

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 a Bluetooth transceiver module with Low Energy mode.

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)
2402 - 2480	Low Energy (BLE)	1.77	1.50

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a permanently attached PCB antenna, with a maximum peak gain of 0.48 dBi.

5.1. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom Bluetooth Version 5.1.0.1400

The test utility software used during testing was Bluetool, ver. 1.4.6.7.

5.2. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power.

5.3. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	HP	dv6000	CNF6463KP7	DoC
AC Adapter	HP	PPP009S	57BC30AU4Q709M	DoC
Adapter Board	Broadcom	BCM9USB3P3V	1416738	N/A

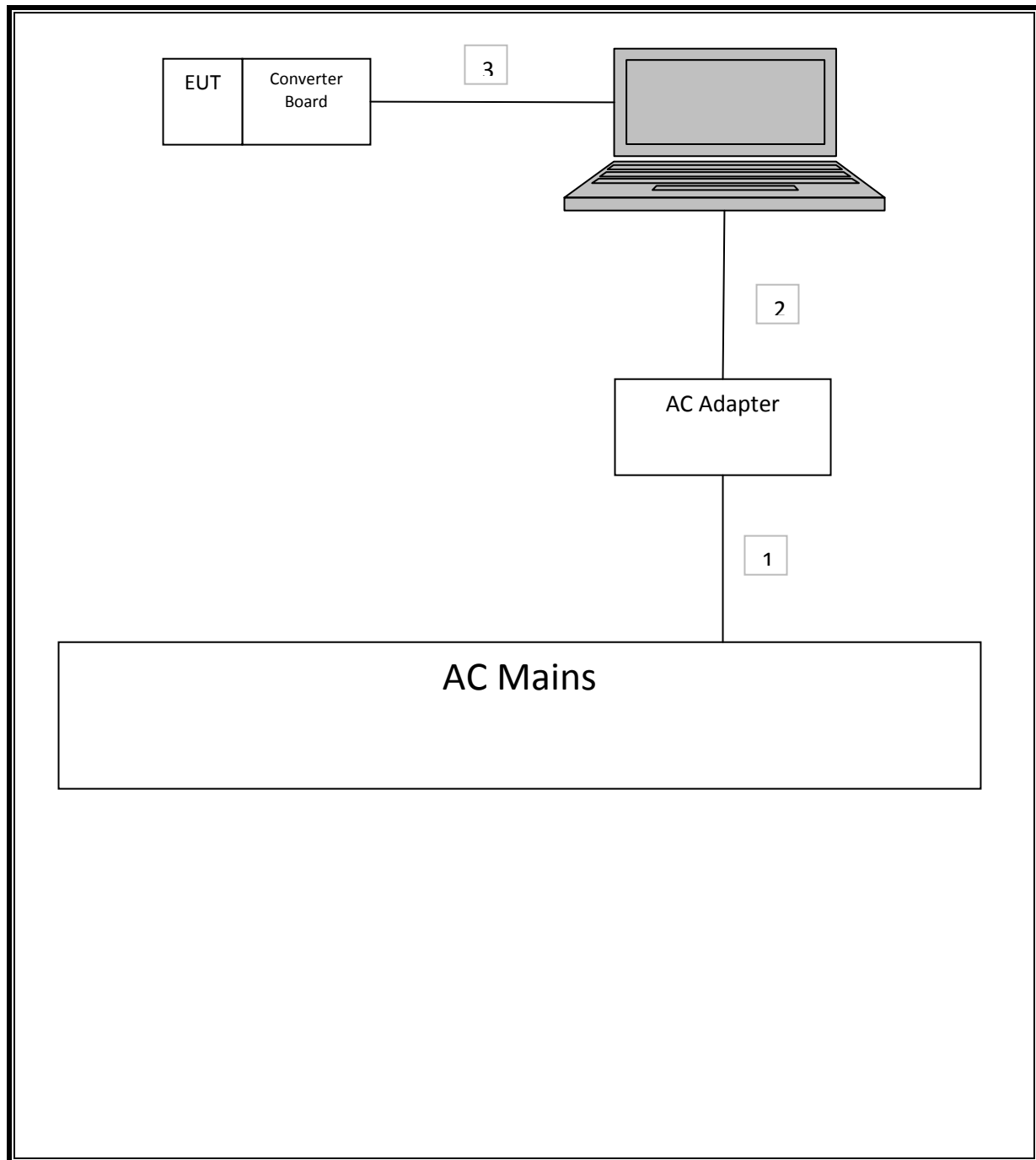
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	AC	Unshielded	1.8m	
2	DC	1	DC	Unshielded	1.8m	
3	USB	1	USB	Shielded	1.5m	Molded ferrite on EUT end

TEST SETUP

The EUT is connected to a host laptop computer via a USB cable and a conversion board during the test. 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
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01176	08/10/11
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01159	05/11/12
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01171	07/16/12
Antenna, Horn, 18 GHz	EMCO	3115	C00872	06/29/12
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00558	01/27/12
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	07/18/12
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	1000741	07/06/12
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	11/10/11
Peak Power Meter	Agilent / HP	E4416A	C00963	03/22/12
Peak Power Sensor	Agilent / HP	E9327A	C00964	04/13/12

7. ANTENNA PORT TEST RESULTS – LE (LOW ENERGY) MODULATION

7.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

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

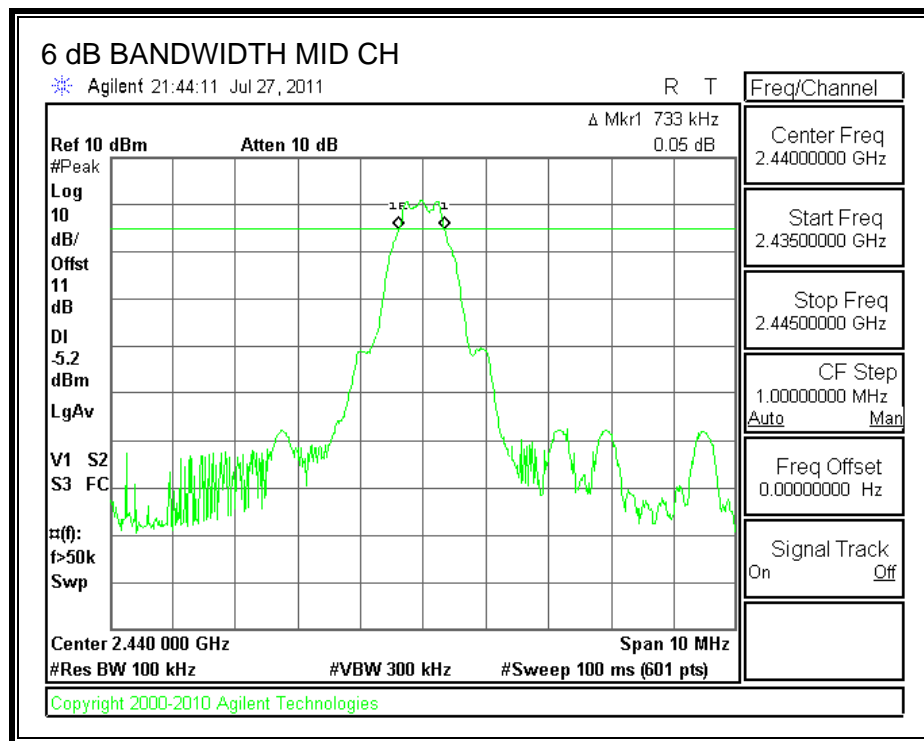
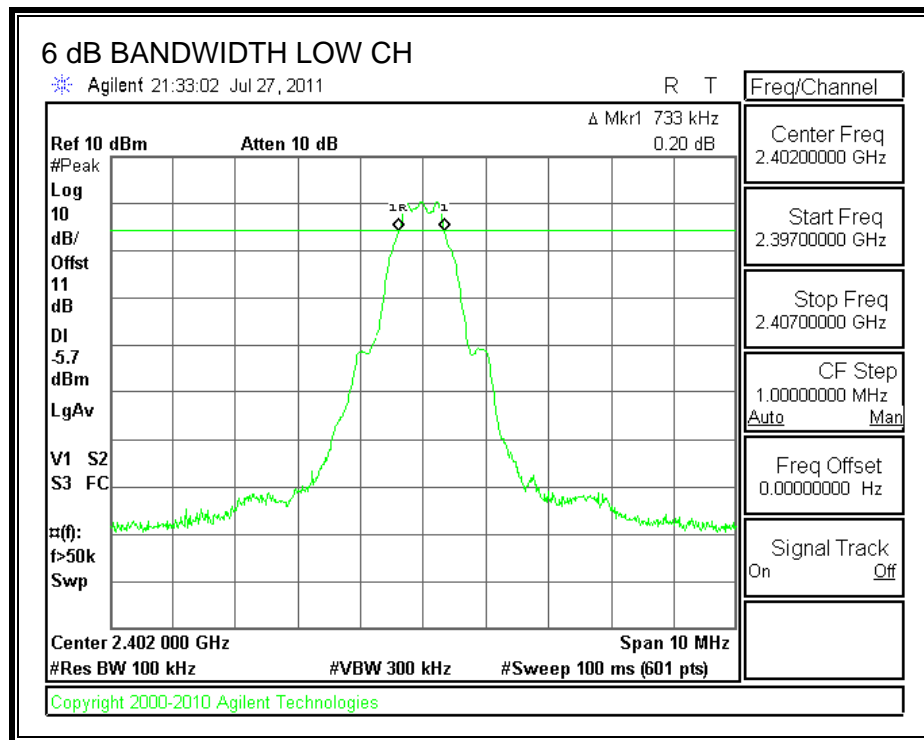
TEST PROCEDURE

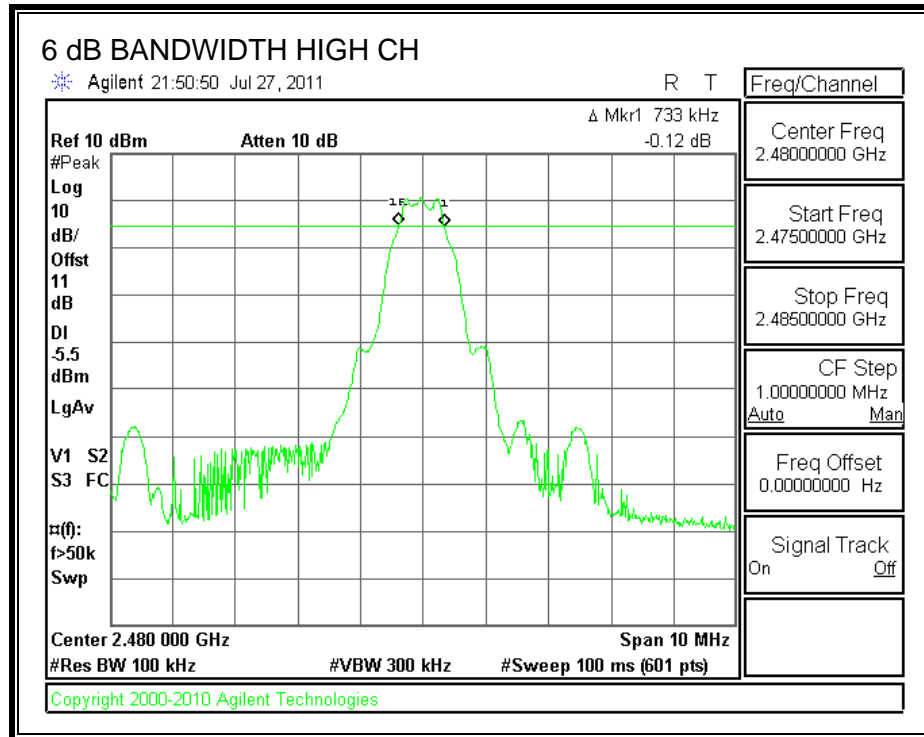
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.733	0.5
Middle	2440	0.733	0.5
High	2480	0.733	0.5

6 dB BANDWIDTH





7.2. OUTPUT POWER

LIMIT

§15.247 (b) (1)

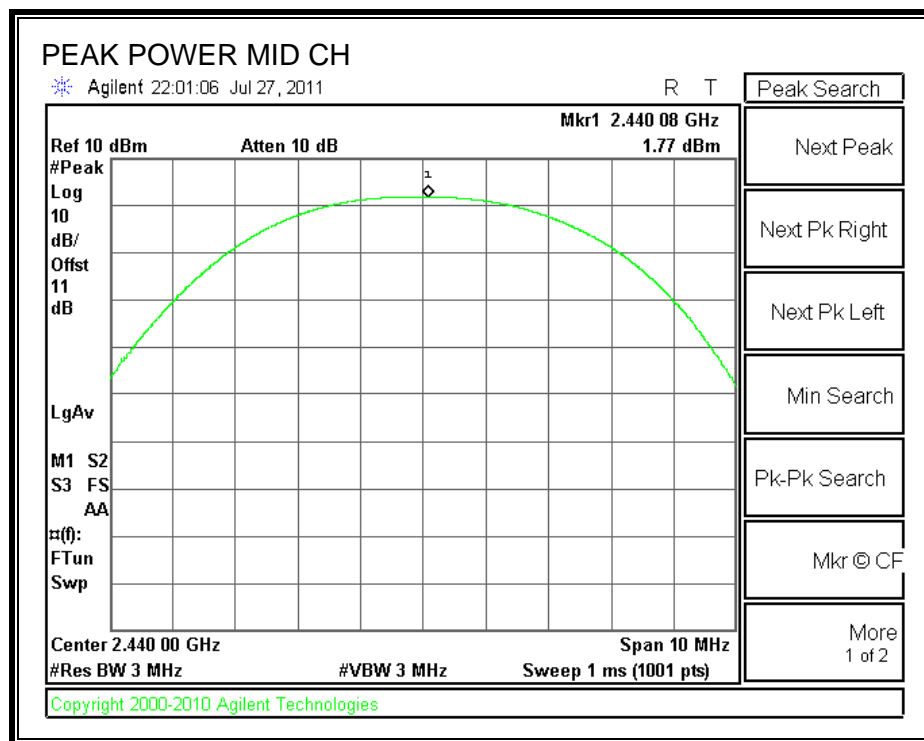
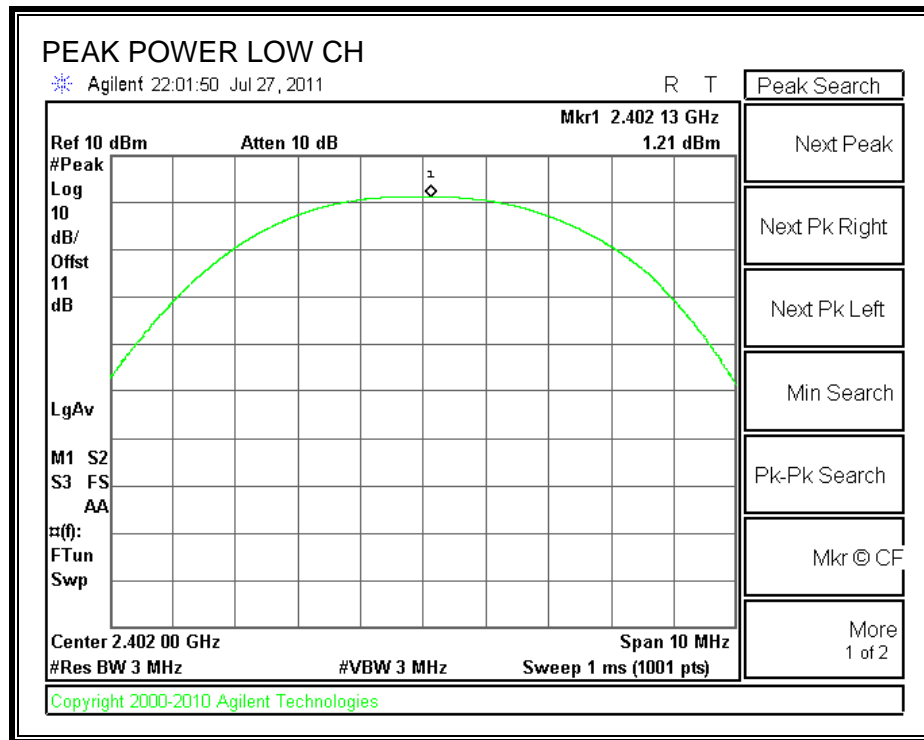
The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

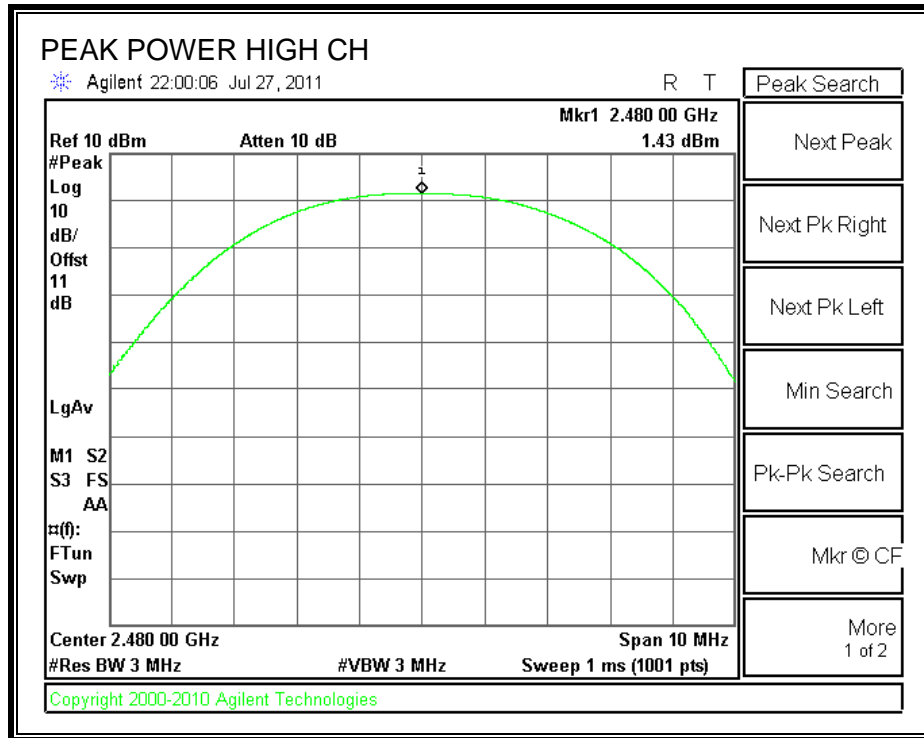
TEST PROCEDURE

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

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	1.21	30	-28.79
Middle	2440	1.77	30	-28.23
High	2480	1.43	30	-28.57





7.3. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

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.

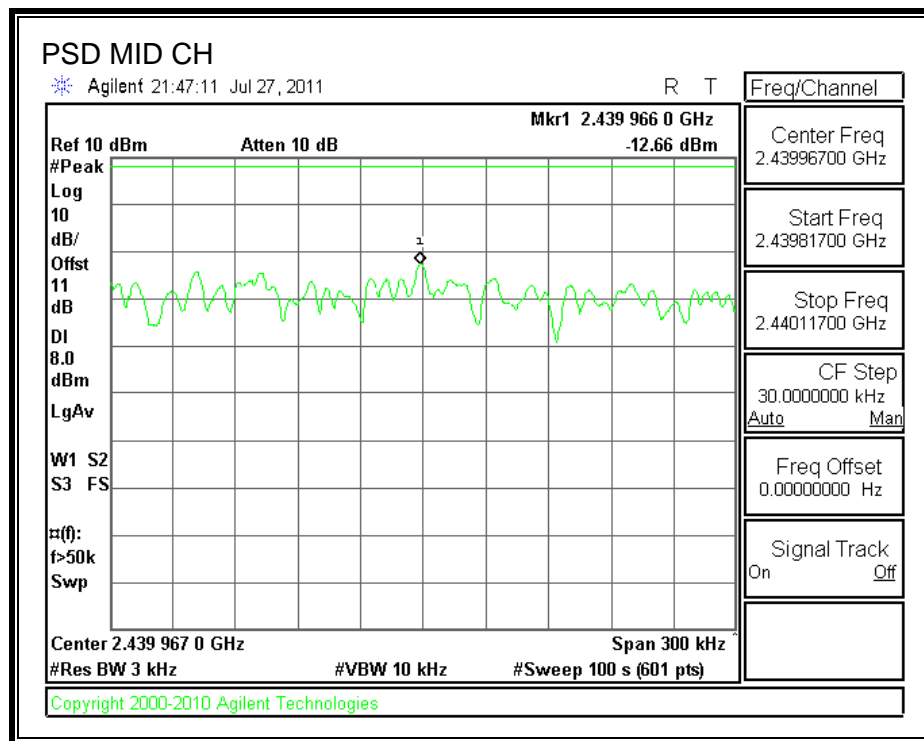
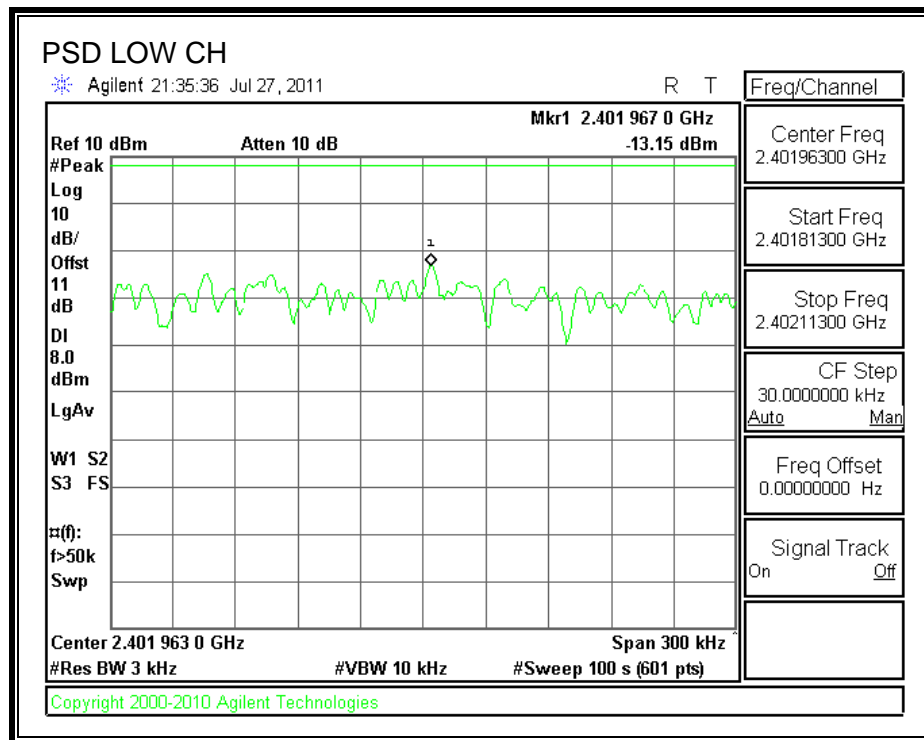
TEST PROCEDURE

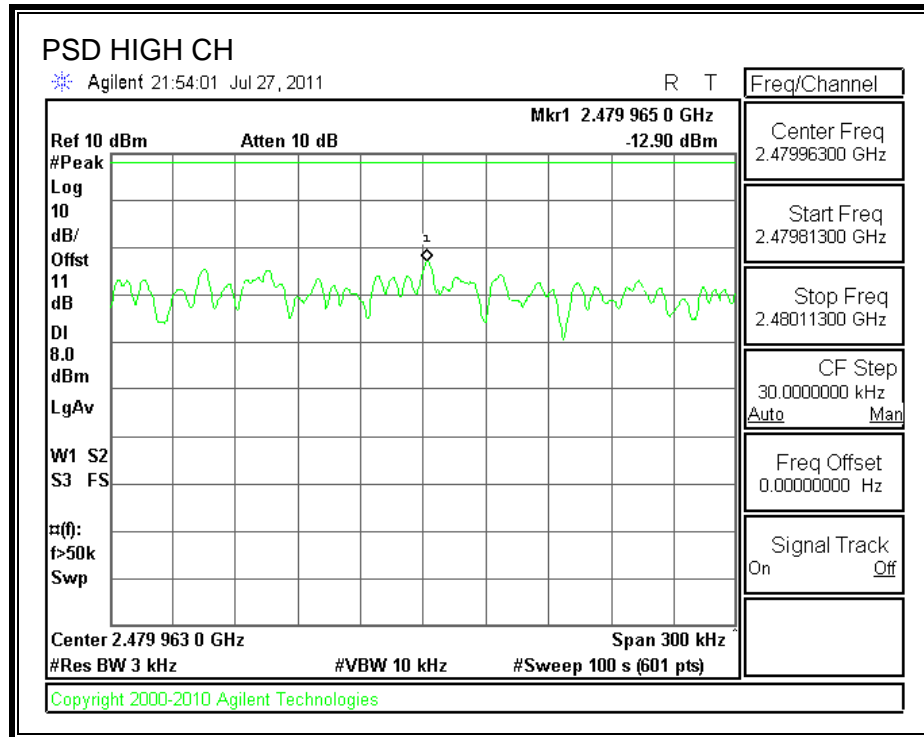
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-13.15	8	-21.15
Middle	2440	-12.66	8	-20.66
High	2480	-12.90	8	-20.90

POWER SPECTRAL DENSITY





7.4. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

Limit = -20 dBc

TEST PROCEDURE

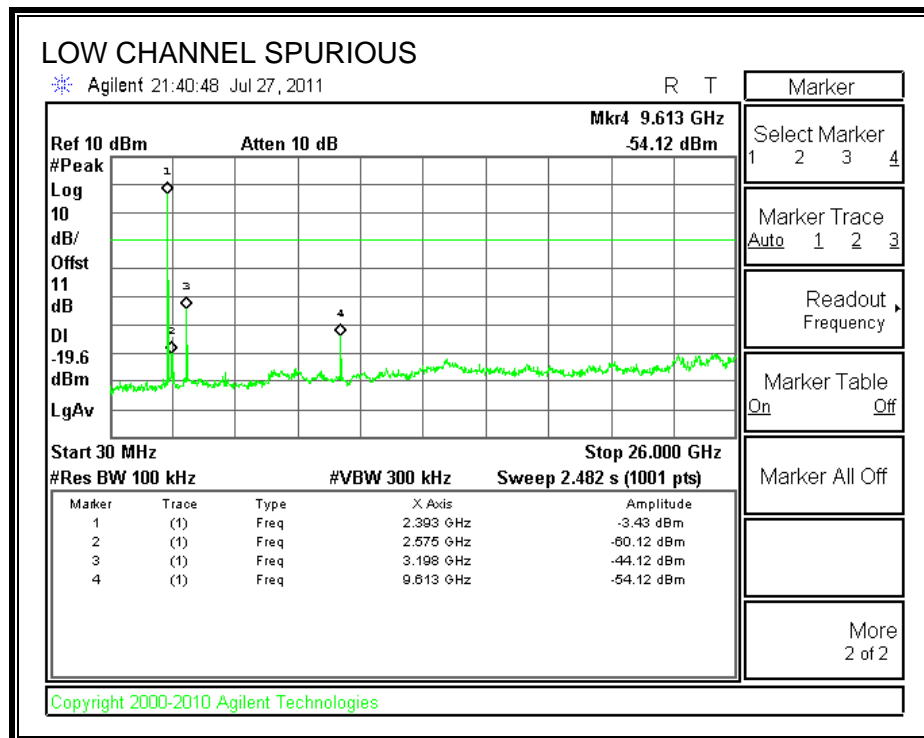
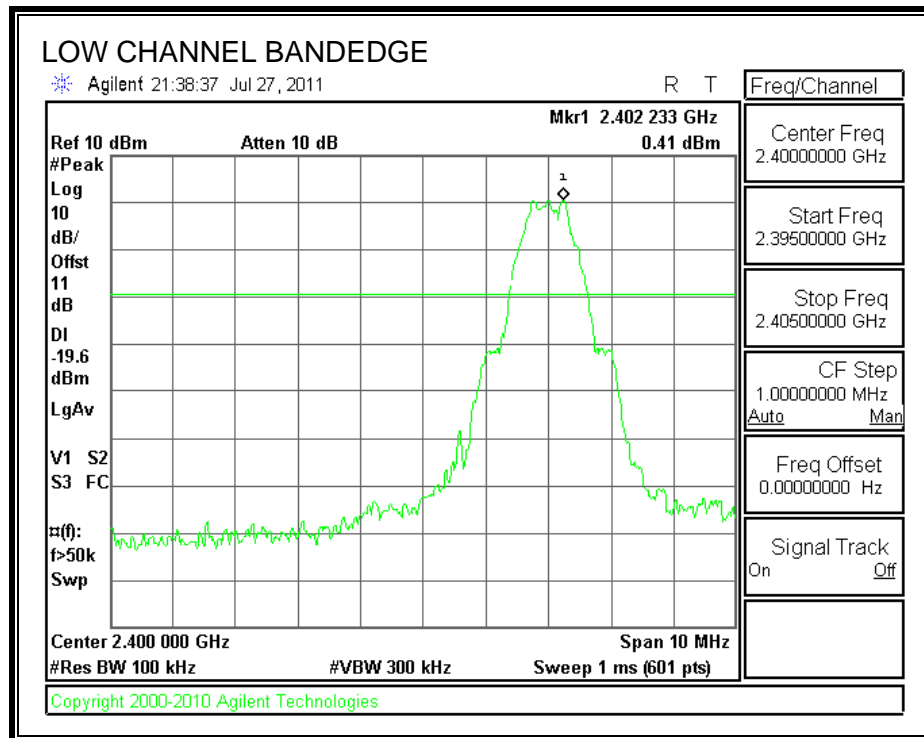
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

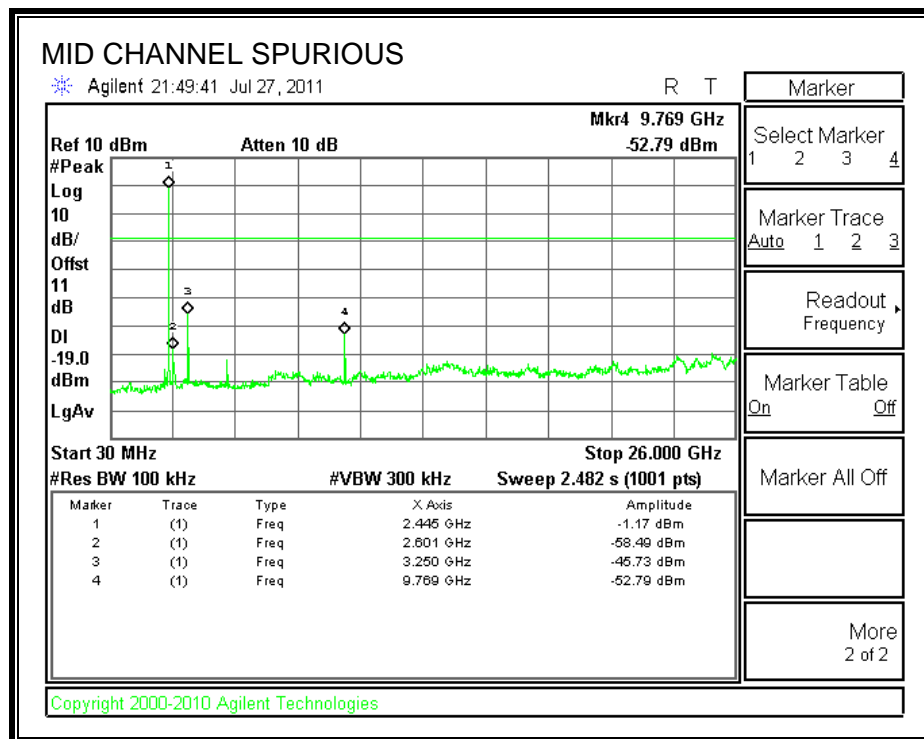
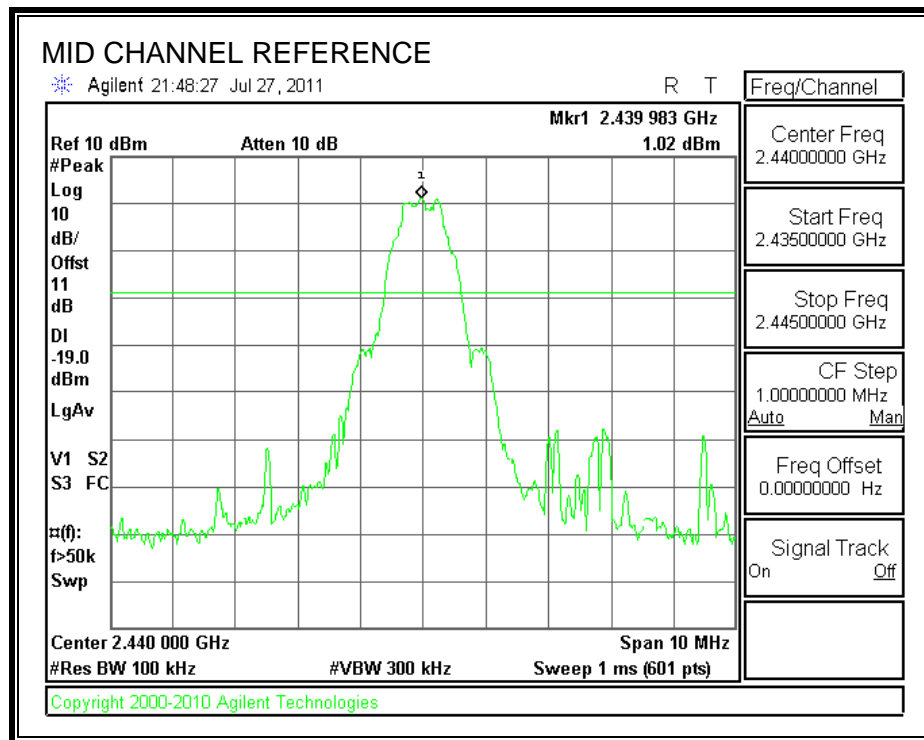
The band edges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

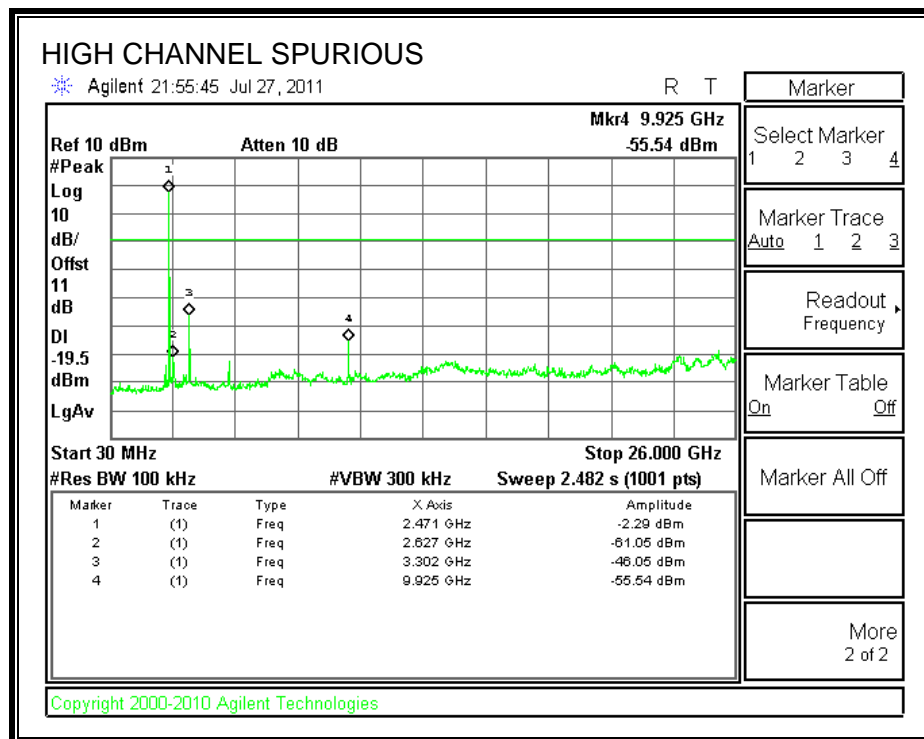
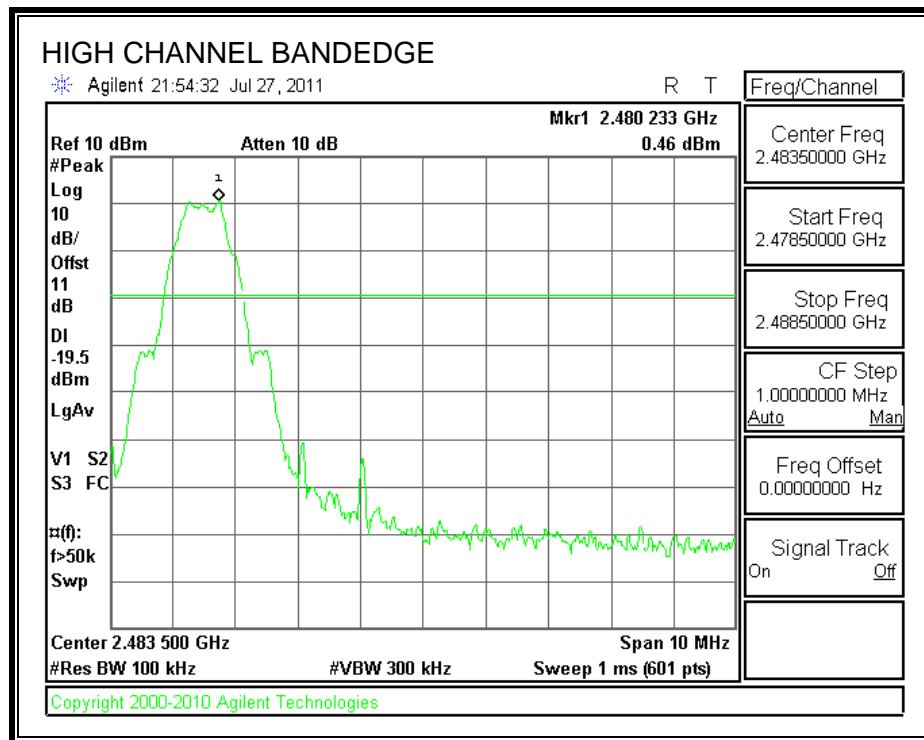
SPURIOUS EMISSIONS, LOW CHANNEL



SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



8. RADIATED TEST RESULTS – LE (LOW ENERGY) MODULATION

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.

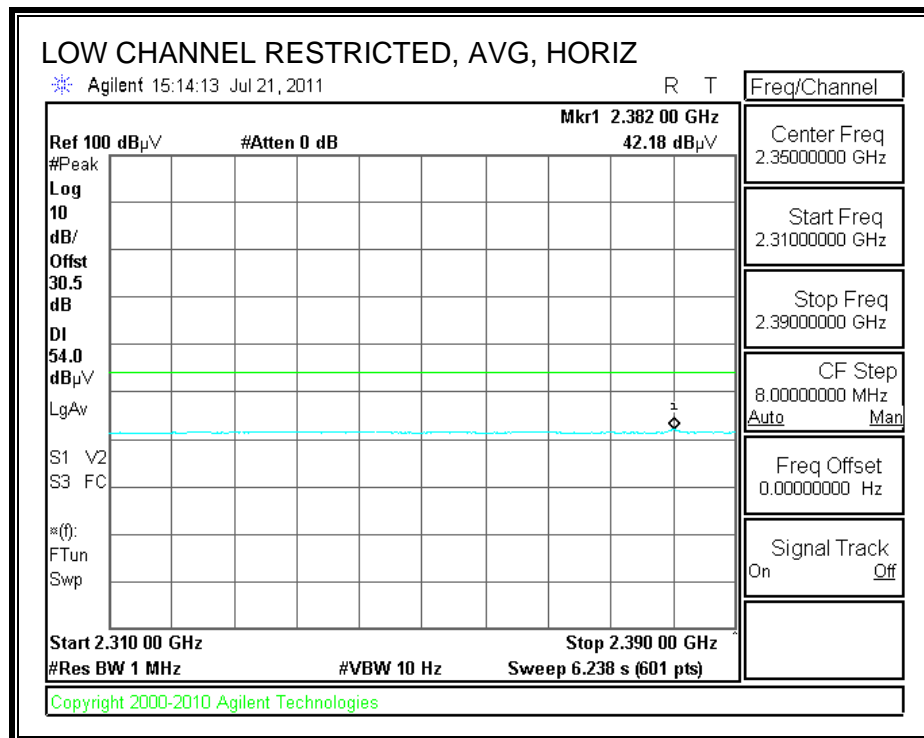
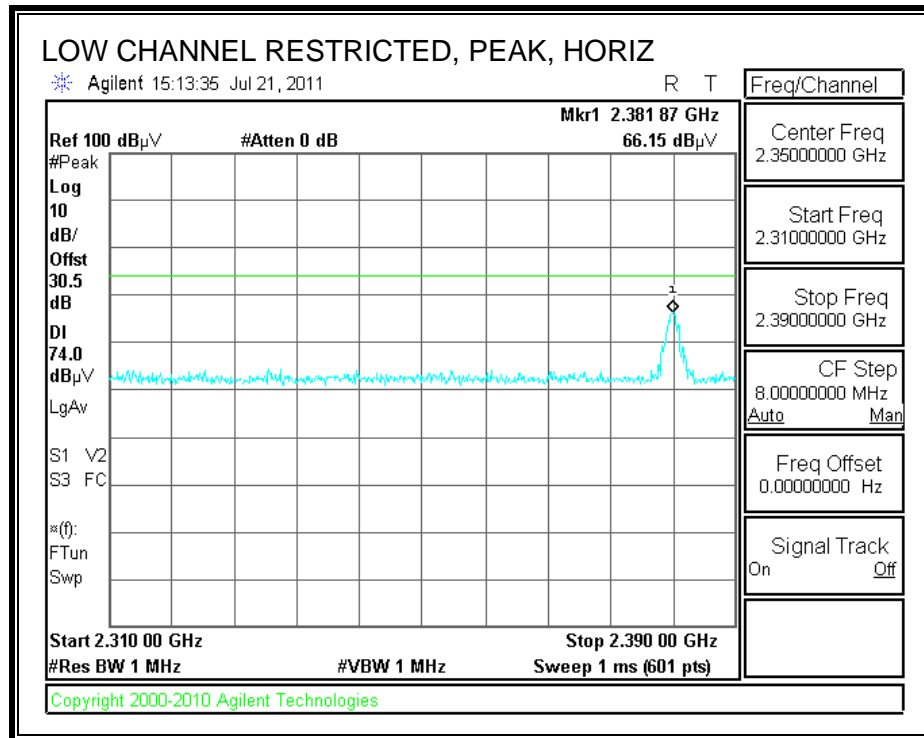
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

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.

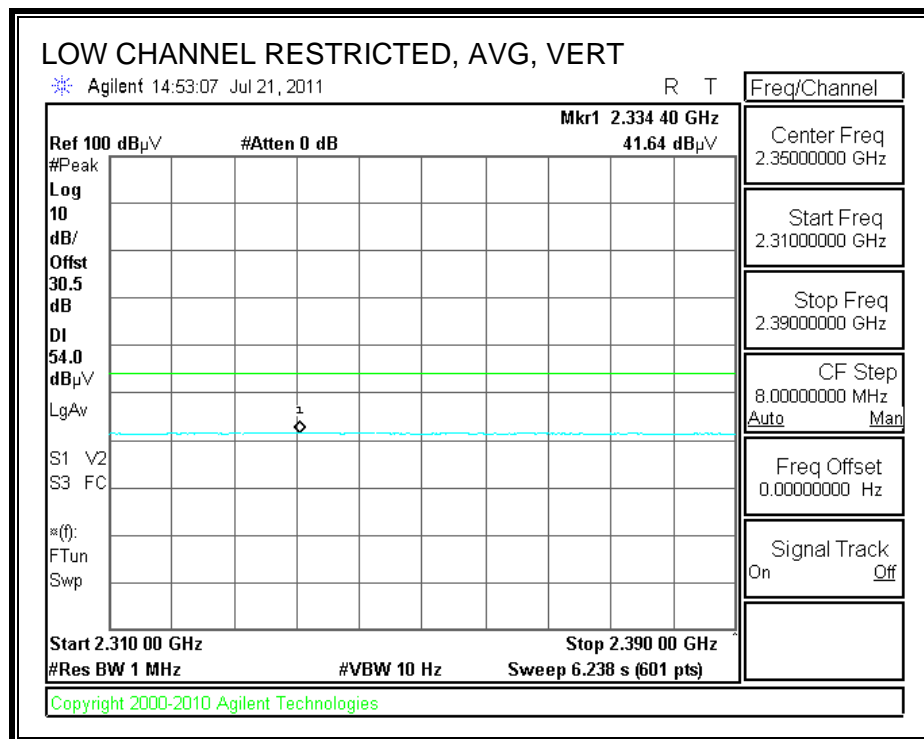
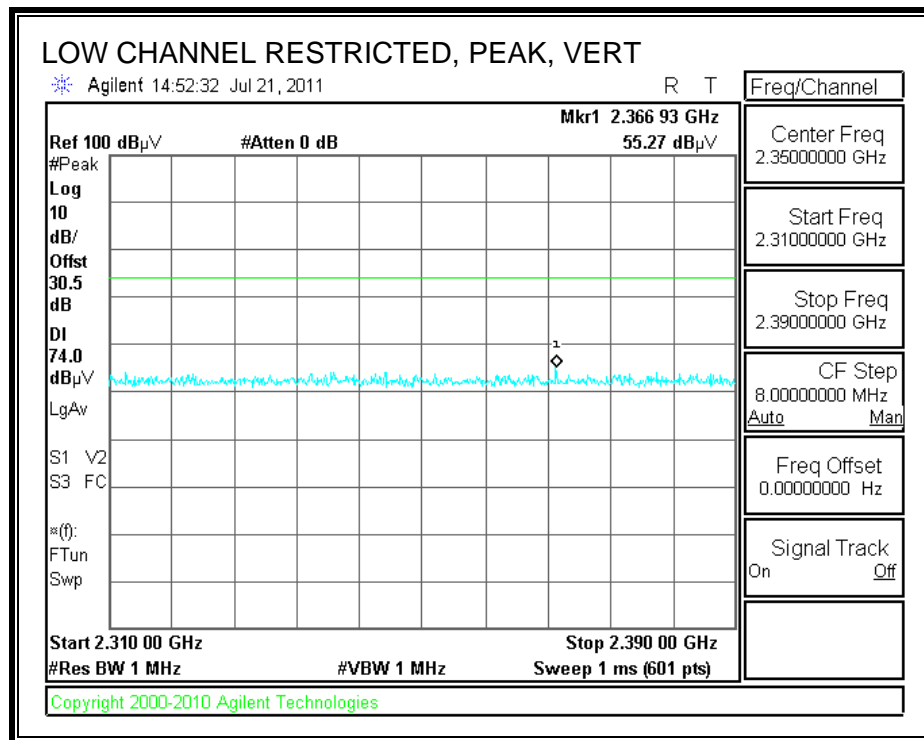
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.1. TRANSMITTER ABOVE 1 GHz

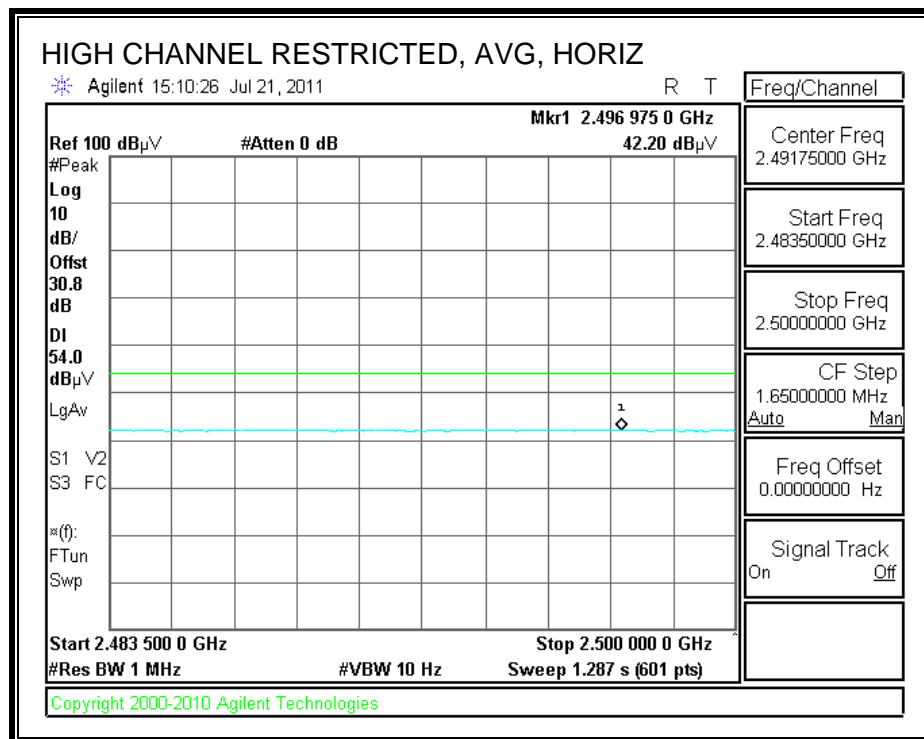
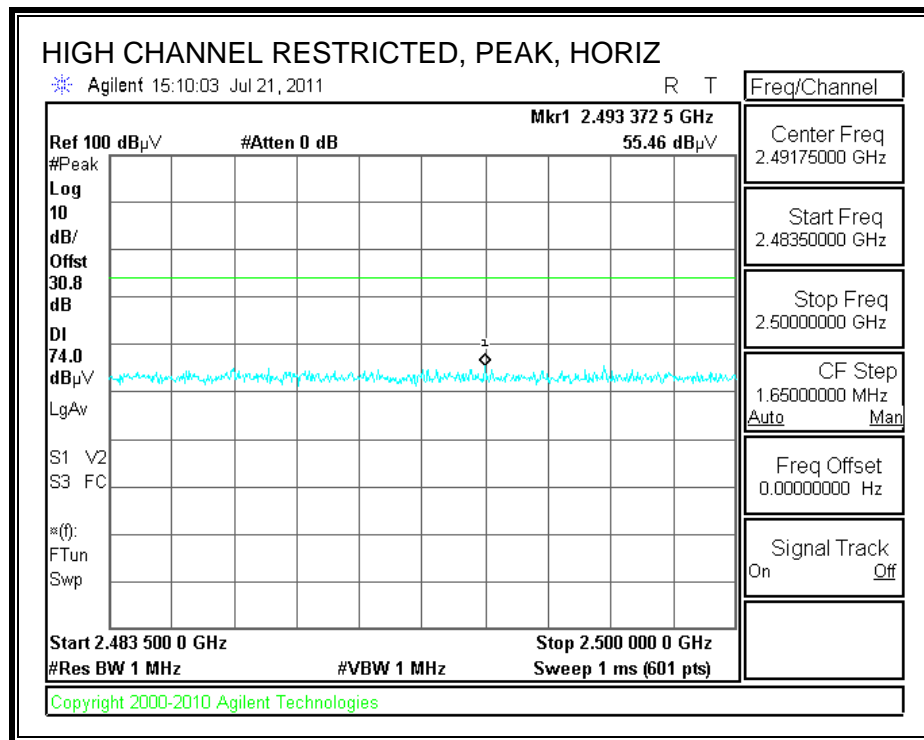
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



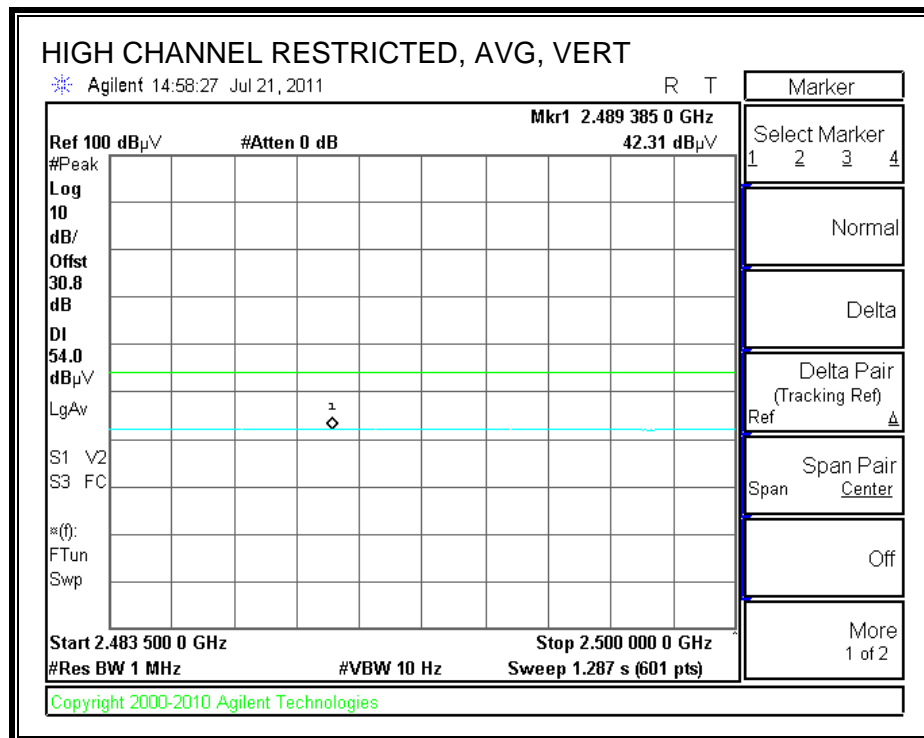
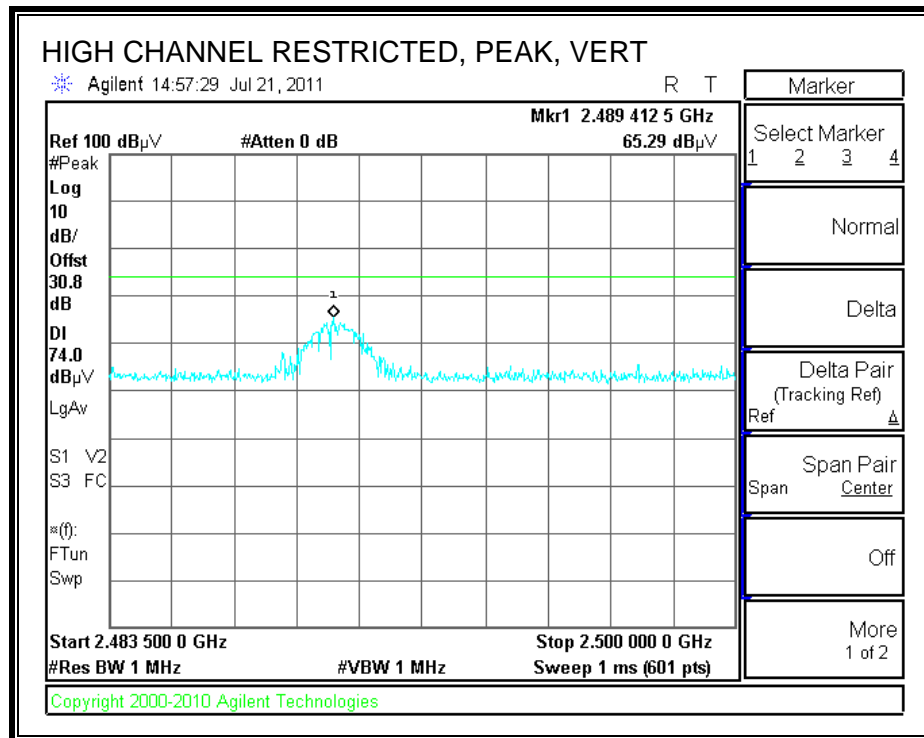
RESTRICTED BANEDGE (LOW CHANNEL, VERTICAL)



RESTRICTED BANEDGE (HIGH CHANNEL, HORIZONTAL)



RESTRICTED BANEDGE (HIGH CHANNEL, VERTICAL)

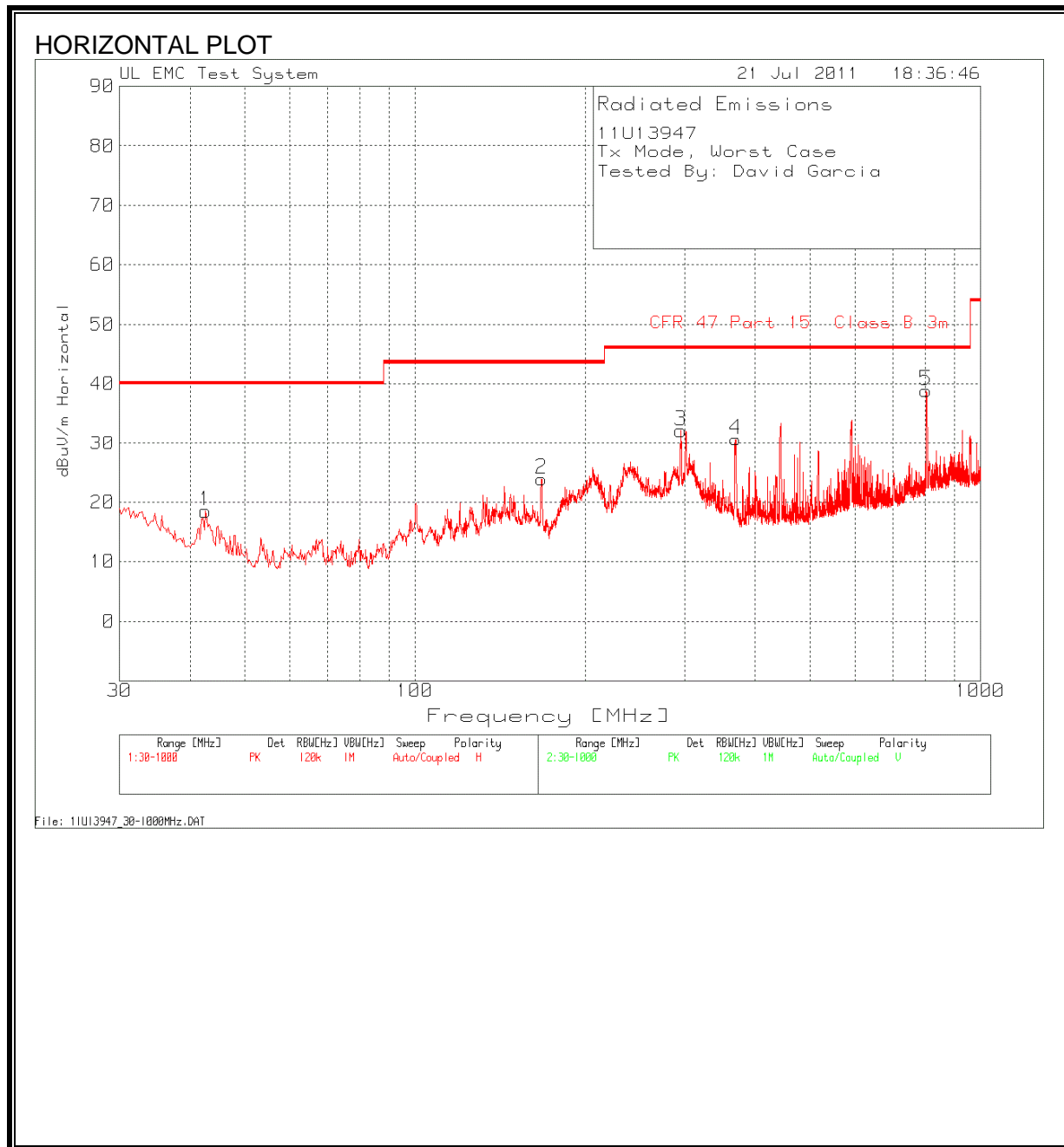


HARMONICS AND SPURIOUS EMISSIONS

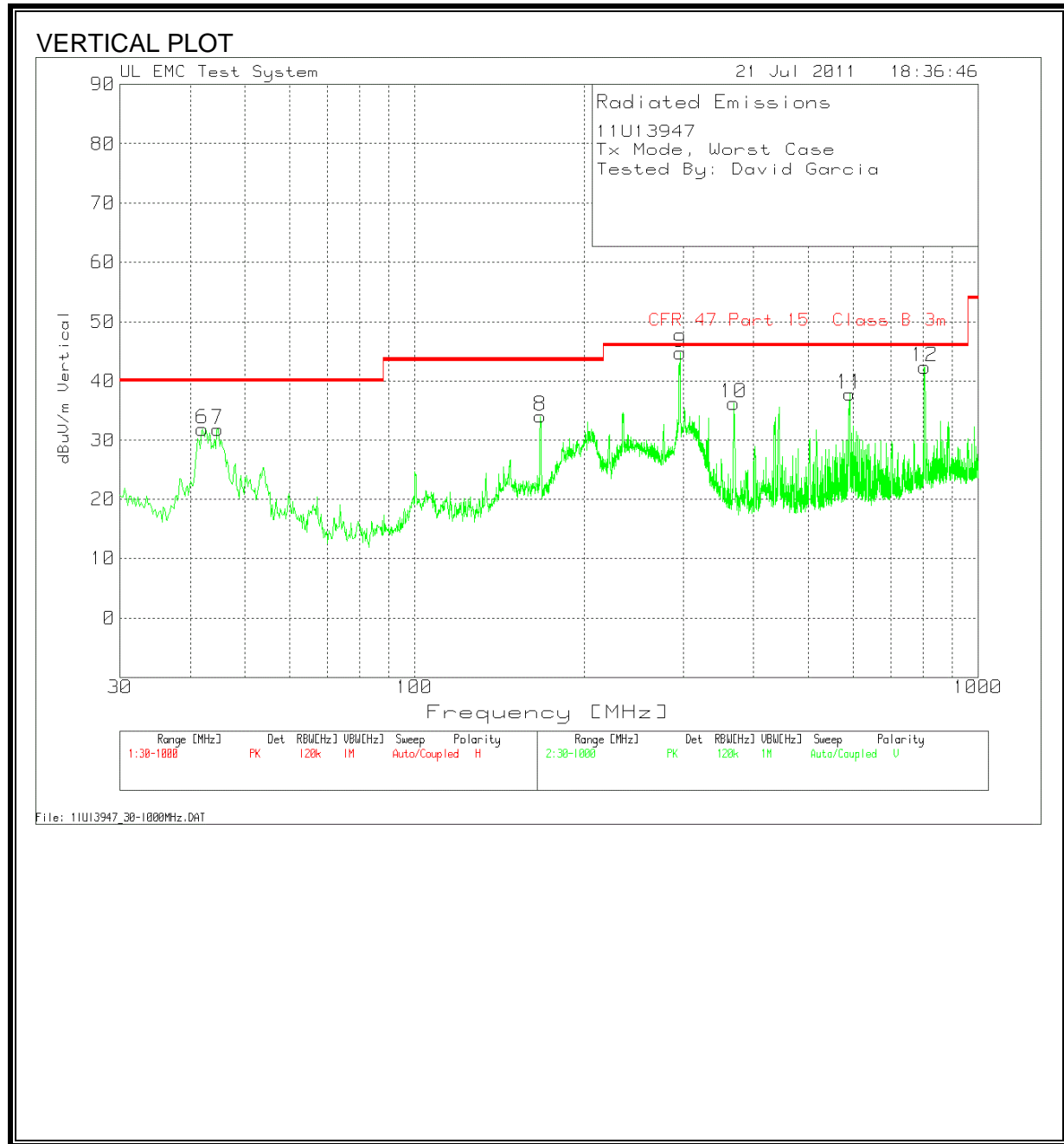
High Frequency Measurement																
Compliance Certification Services, Fremont 3m Chamber																
Company:		Broadcom														
Project #:		11U13947														
Date:		7/21/2011														
Test Engineer:		David Garcia														
Configuration:		EUT, Adapter board, Laptop PC														
Mode:		Tx, BLE														
Test Equipment:																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T60; S/N: 2238 @3m			T34 HP 8449B						T39; ARA 18-26GHz; S/N:1013			FCC 15.209				
Hi Frequency Cables																
3' cable 22807700			12' cable 22807600			20' cable 22807500			HPF			Reject Filter			Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz	
3' cable 22807700			12' cable 22807600			20' cable 22807500			HPF_2.7GHz							
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
Low Channel: 2402 MHz																
4.804	3.0	37.9	27.9	33.9	6.8	-34.1	0.0	0.5	44.9	35.0	74	54	-29.1	-19.0	H	
4.804	3.0	40.2	30.1	33.9	6.8	-34.1	0.0	0.5	47.3	37.1	74	54	-26.7	-16.9	V	
9.608	3.0	34.1	21.3	38.5	9.1	-33.3	0.0	0.7	49.0	36.1	74	54	-25.0	-17.9	V	
Mid Channel: 2440MHz																
4.880	3.0	37.9	27.6	33.9	6.8	-34.0	0.0	0.5	45.2	34.8	74	54	-28.8	-19.2	H	
4.880	3.0	40.6	29.9	33.9	6.8	-34.0	0.0	0.5	47.9	37.1	74	54	-26.1	-16.9	V	
9.764	3.0	34.1	21.9	38.5	9.1	-33.0	0.0	0.7	49.4	37.1	74	54	-24.6	-16.9	V	
High Channel: 2480 MHz																
4.960	3.0	37.5	26.4	34.0	6.9	-34.0	0.0	0.5	44.9	33.8	74	54	-29.1	-20.2	H	
4.960	3.0	40.3	29.8	34.0	6.9	-34.0	0.0	0.5	47.7	37.2	74	54	-26.3	-16.8	V	
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									

8.2. WORST-CASE BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)



SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)



HORIZONTAL AND VERTICAL DATA

Company Name:		Broadcom								
Project Number:		11U13947								
Model Number:		BCM920702MD_REF14L								
Test Date:		7/21/2011								
Test Engineer:		David Garcia								
Mode:		Tx Mode, Worst Case								
Test Frequency MHz	Meter Reading	Detector	3m below 1GHz Cable.TXT [dB]	3m T15 PreAmp below 1GHz.TXT [dB]	3m Bilog T185 below 1GHz.TXT [dB]	dBuV/m	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
42.5999	33.5	PK	0.7	-28.2	12.5	18.5	40	-21.5	251	Horz
167.4361	38.68	PK	1.3	-27.8	11.7	23.88	43.5	-19.62	251	Horz
295.1799	44.33	PK	1.8	-27.3	13.3	32.13	46	-13.87	176	Horz
369.2286	41.85	PK	2	-27.7	14.5	30.65	46	-15.35	251	Horz
802.472	43.07	PK	2.9	-28	20.9	38.87	46	-7.13	101	Horz
42.0184	46.72	PK	0.7	-28.2	12.7	31.92	40	-8.08	99	Vert
44.7322	47.55	PK	0.7	-28.2	11.8	31.85	40	-8.15	99	Vert
167.2422	48.8	PK	1.3	-27.8	11.8	34.1	43.5	-9.4	99	Vert
295.9552	56.87	PK	1.8	-27.3	13.4	44.77	46	-1.23	99	Vert
368.6471	47.5	PK	2	-27.7	14.5	36.3	46	-9.7	251	Vert
591.9564	45.42	PK	2.5	-28.4	18.3	37.82	46	-8.18	99	Vert
804.7982	46.61	PK	2.9	-28	20.9	42.41	46	-3.59	99	Vert

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

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.

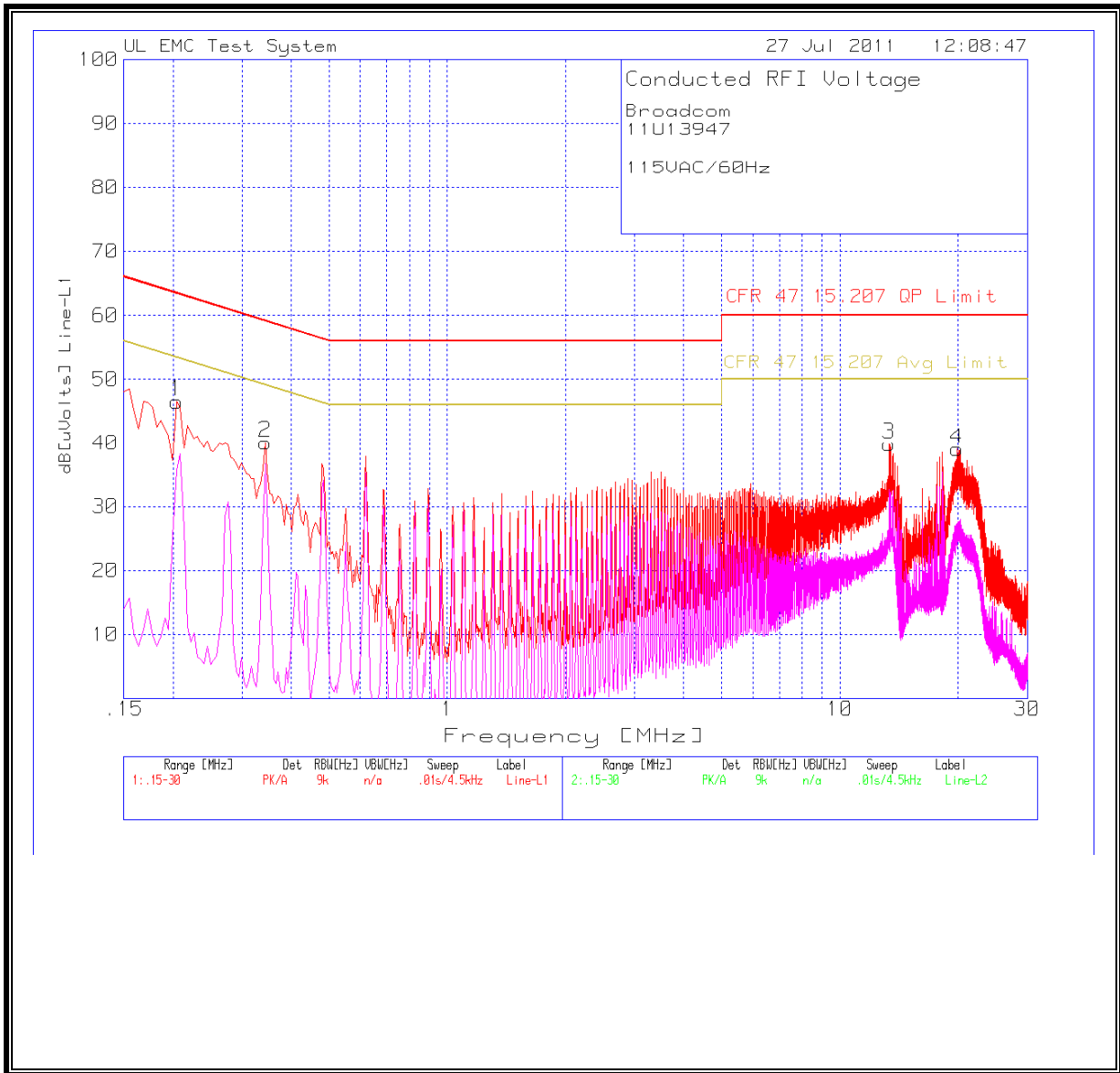
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

6 WORST EMISSIONS

Company Name:	Broadcom								
Project Number:	11U13947								
Model Number:	BCM920702MD_REF14L								
Test Date:	7/21/2011								
Test Engineer:	David Garcia								
Mode:	Tx Mode, Worst Case								
Line-L1 .15 - 30MHz									
Test Frequency	Meter Reading	Detector	LISN [dB]	Conducted Emission Cable [dB]	dB[uVolts]	CFR 47 15.207 QP Limit	Margin	CFR 47 15.207 Avg Limit	Margin
0.204	46.52	PK	0	0	46.52	63.4	-16.88	53.4	-6.88
0.3435	40.03	PK	0	0	40.03	59.1	-19.07	49.1	-9.07
13.3575	39.84	PK	0	0	39.84	60	-20.16	50	-10.16
19.8825	38.97	PK	0	0	38.97	60	-21.03	50	-11.03
Line-L2 .15 - 30MHz									
Test Frequency	Meter Reading	Detector	LISN [dB]	Conducted Emission Cable [dB]	dB[uVolts]	CFR 47 15.207 QP Limit	Margin	CFR 47 15.207 Avg Limit	Margin
0.204	48.38	PK	0	0	48.38	63.4	-15.02	53.4	-5.02
0.618	38.63	PK	0	0	38.63	56	-17.37	46	-7.37
13.479	39.81	PK	0	0	39.81	60	-20.19	50	-10.19
18.2445	40.15	PK	0	0	40.15	60	-19.85	50	-9.85
PK - Peak detector									
QP - Quasi-Peak detector									
LnAv - Linear Average detector									
LgAv - Log Average detector									
Av - Average detector									
CAV - CISPR Average detector									
RMS - RMS detection									
CRMS - CISPR RMS detection									

LINE 1 RESULTS



LINE 2 RESULTS

