



**FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8**

**BLUETOOTH LOW ENERGY
CERTIFICATION TEST REPORT**

FOR

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

MODEL NUMBER: BCM94360CD

**FCC ID: QDS-BRCM1070
IC: 4324A-BRCM1070**

REPORT NUMBER: 12U14669-3

ISSUE DATE: FEBRUARY 04, 2013

Prepared for

**BROADCOM CORPORATION
190 MATHILDA PLACE
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	02/04/13	Initial Issue	F. Ibrahim

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1. ATTESTATION OF TEST RESULTS

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

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

MODEL: BCM94360CD

SERIAL NUMBER: 1626297

DATE TESTED: DECEMBER 26, 2012 - JANUARY 04, 2013

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

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

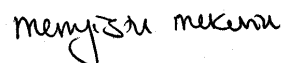
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this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

Approved & Released For UL CCS By:



FRANK IBRAHIM
WiSE PROJECT LEAD
UL CCS

Tested By:



MENGISTU MEKURIA
EMC ENGINEER
UL CCS

2. TEST METHODOLOGY

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

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

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/g/n/ac WLAN + Bluetooth PCI-E Custom Combination Card.

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	Bluetooth Low Energy (BLE)	4.51	2.82

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes the following BT antennas:

- Amphenol/ Molex BT antenna, with a maximum gain of 4.8 dBi.
- Amphenol/ Molex BT antenna, with a maximum gain of 3.29 dBi

The 4.8 dBi BT antenna was selected for the testing as worst-case with higher gain.

5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom, rev. 6.30.118.23.

The test utility software used during testing was Broadcom Bluetool, rev. 1.4.2.6.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The EUT was tested as an external module installed in a test jig board connected to a host Laptop PC. The EUT was oriented in a flat orientation, similar to the orientation it would have in real installations; see setup photos for details.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	HP	DV6000	CNF7120G34	DoC
AC Adapter	HP	PA-1900-08R1	599830ALLUB6N1	N/A
Adapter Board	Broadcom	BCM94331CSAD	1514447	N/A

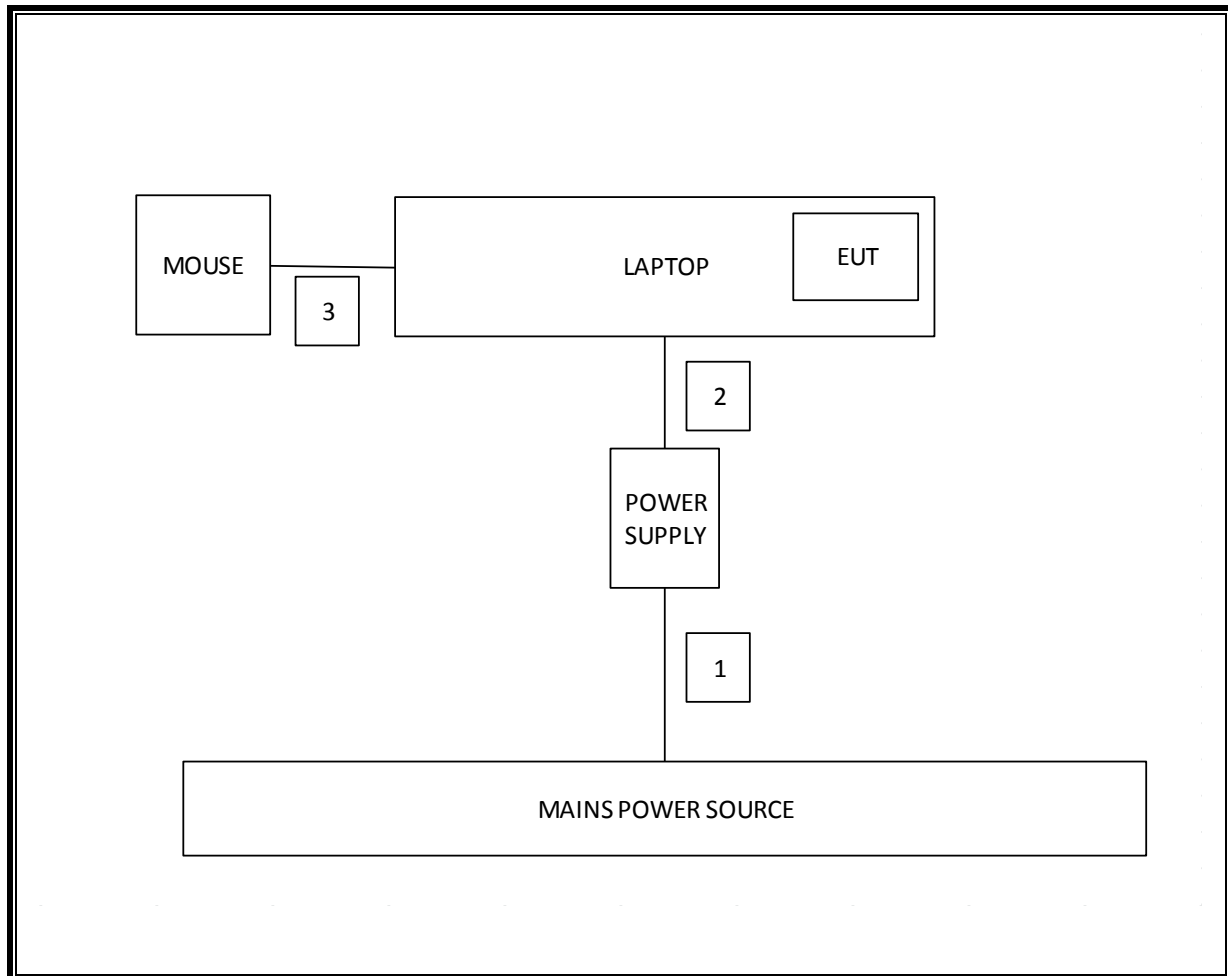
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	US 115V	Un-Shielded	1m	NA
2	DC	1	DC	Un-Shielded	1.8m	NA
2	USB	1	USB	Shielded	1.8m	NA

TEST SETUP

The EUT is attached to a jig board which is installed in the PCMCIA slot of a host laptop computer during the tests. Test software exercised the radio card.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List				
Description	Manufacturer	Model	Asset	Cal Due
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01176	12/13/13
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	10/21/13
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/08/13
Antenna, Horn, 18 GHz	EMCO	3115	C00945	11/12/13
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	11/14/13
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	C00981	06/14/13
Antenna, Bilog, 30MHz-1 GHz	Sunol Sciences	JB1		02/07/13
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	10/19/13
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	08/02/13
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	12/30/13
P-Series single channel Power Meter	Agilent / HP	N1911A		07/27/13
Peak / Average Power Sensor	Agilent / HP	E9323A		07/26/13
LISN, 30 MHz	FCC	50/250-25-2	C00626	01/13/14

7. ANTENNA PORT TEST RESULTS

7.1. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01 v02, Section 7.0.

Output Power: KDB 558074 D01 v02, Section 8.1.1.

Power Spectral Density: KDB 558074 D01 v02, Sections 9.1.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v02, Sections 10.1.

Out-of-band emissions in restricted bands: KDB 558074 D01 v02, Sections 10.2.1.

7.2. 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.

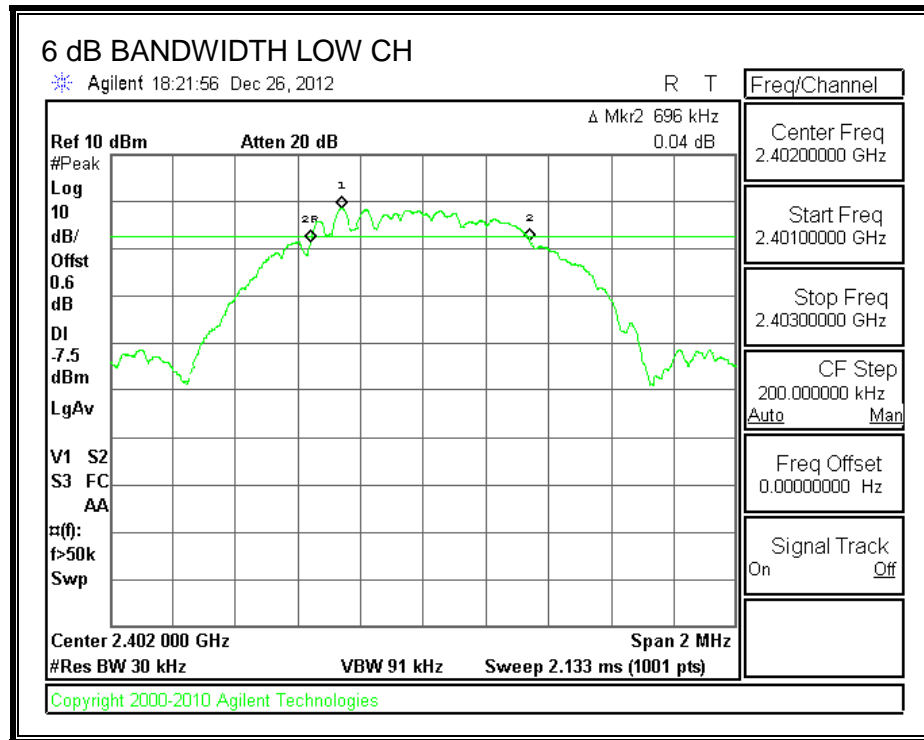
TEST PROCEDURE

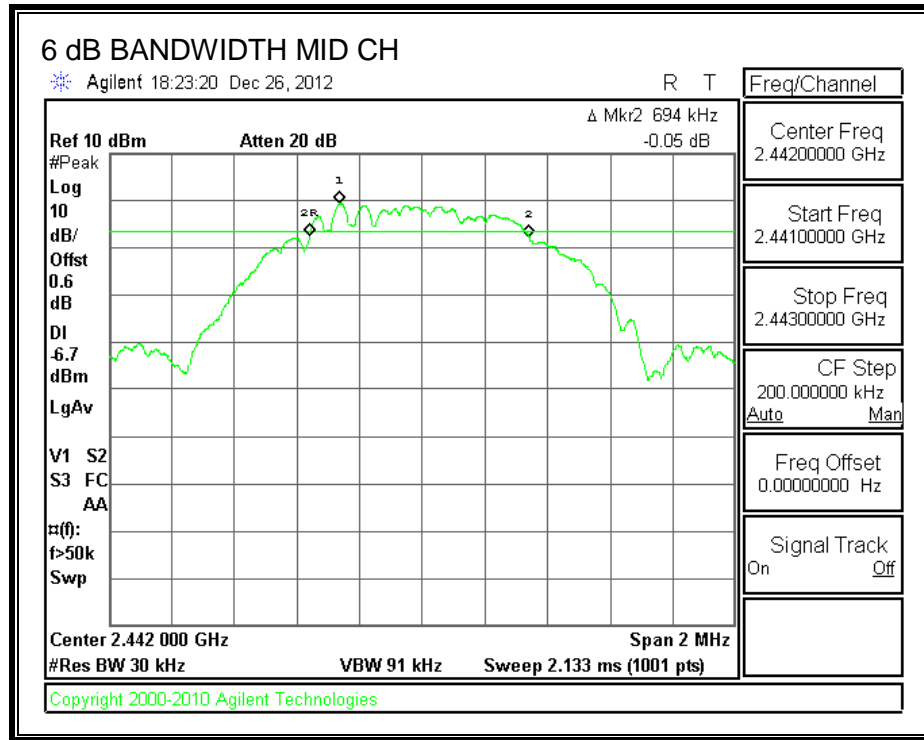
KDB 558074 D01 v02 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247".

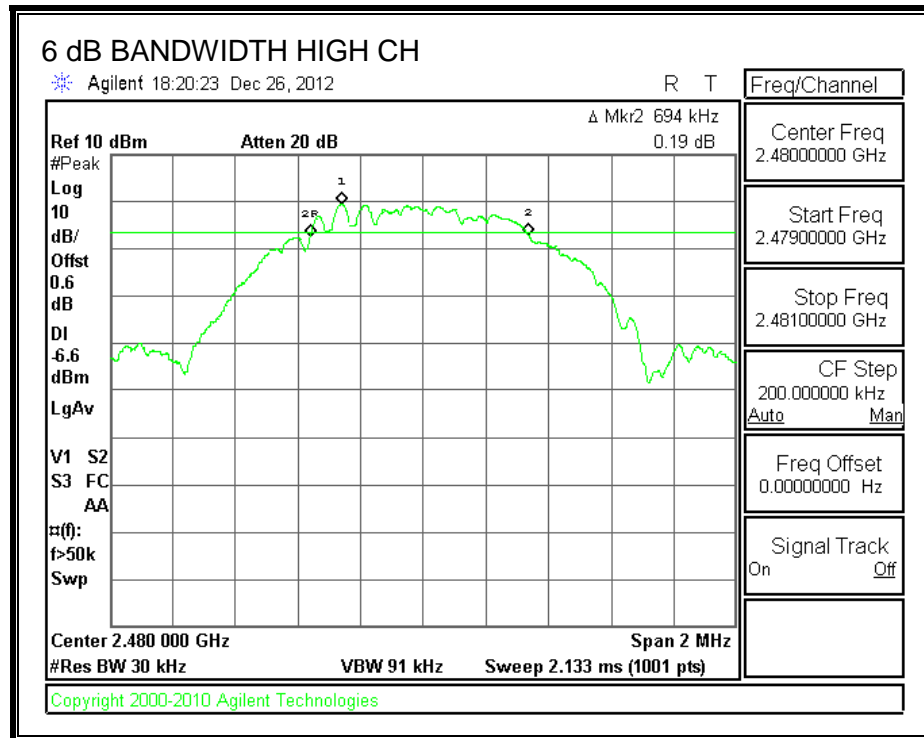
RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.696	0.5
Middle	2442	0.694	0.5
High	2480	0.694	0.5

6 dB BANDWIDTH







7.3. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

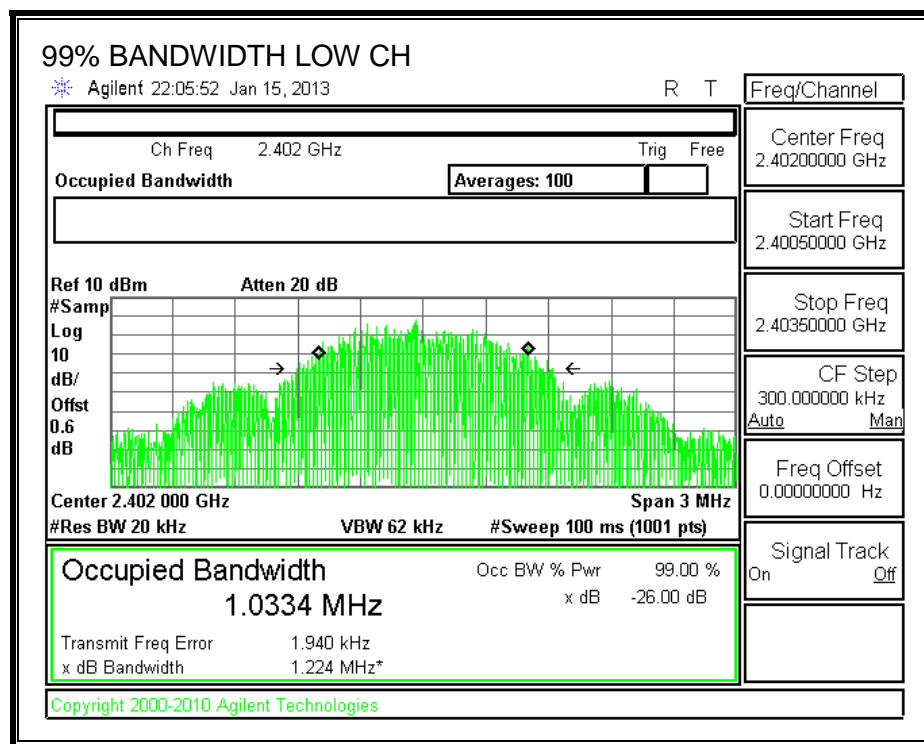
TEST PROCEDURE

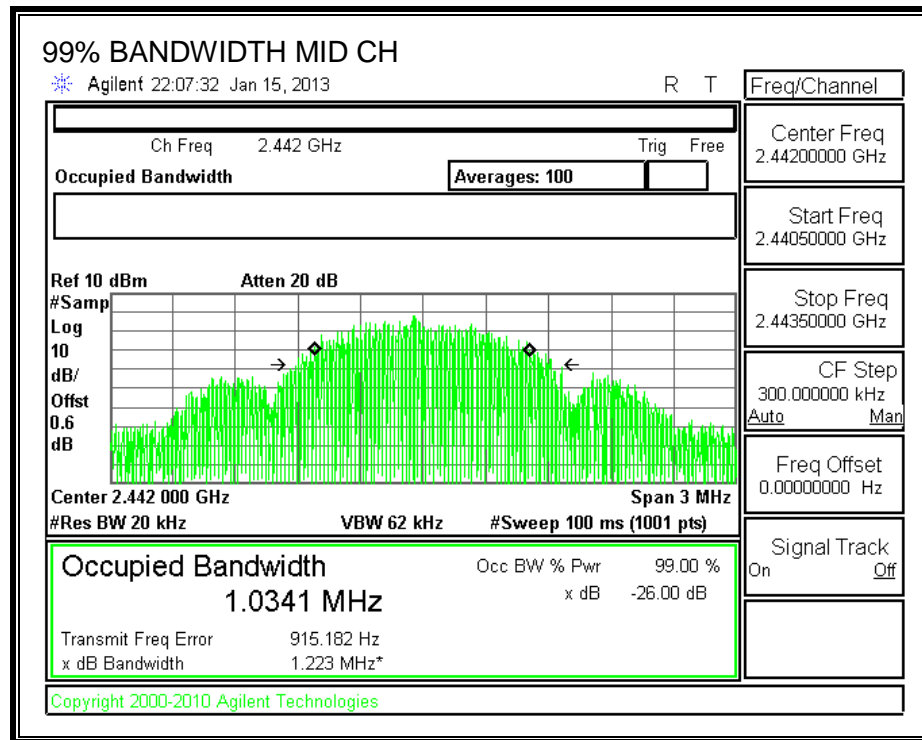
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

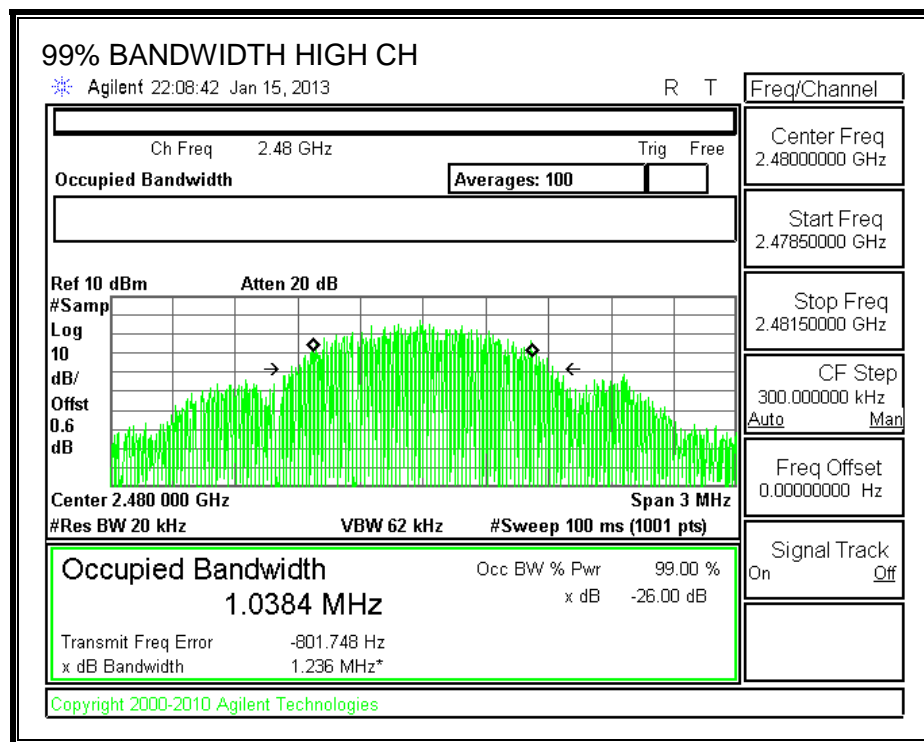
RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0334
Middle	2442	1.0341
High	2480	1.0384

99% BANDWIDTH







7.4. 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.

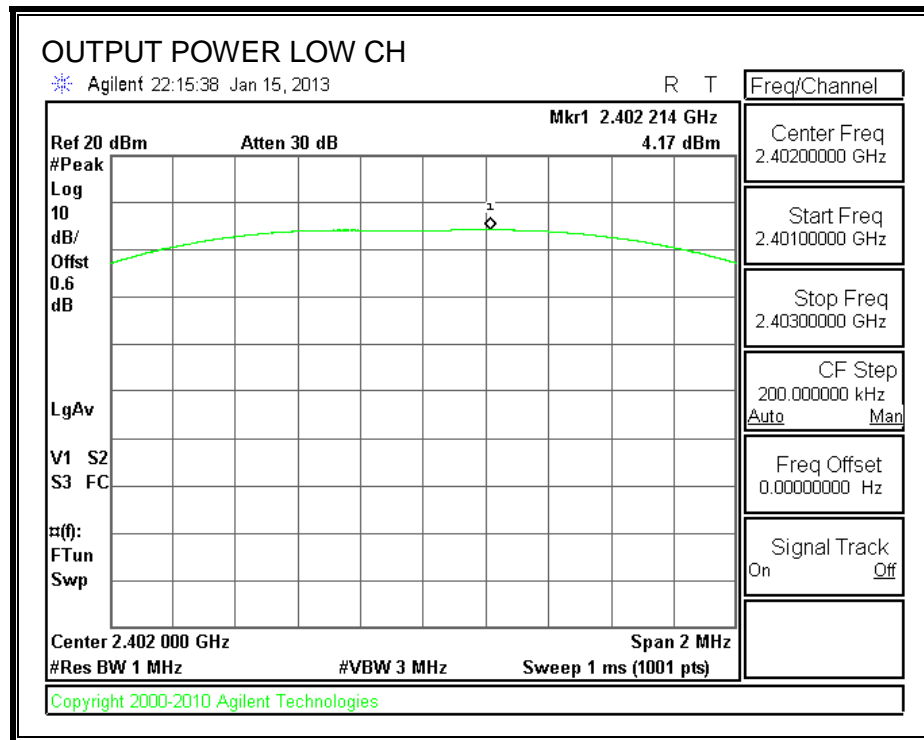
TEST PROCEDURE

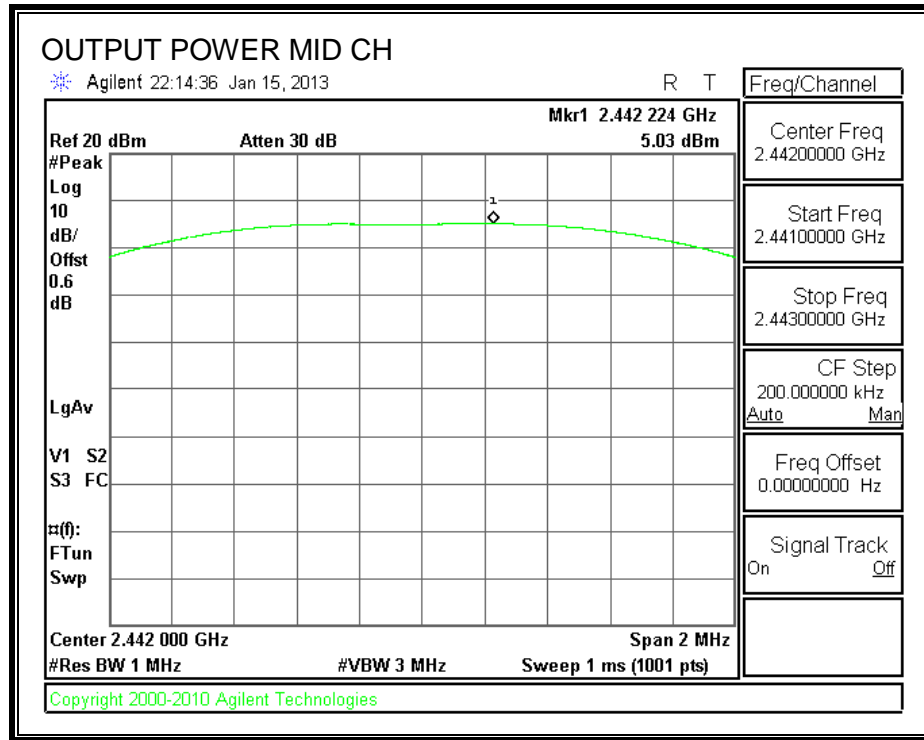
KDB 558074 D01 v02 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247".

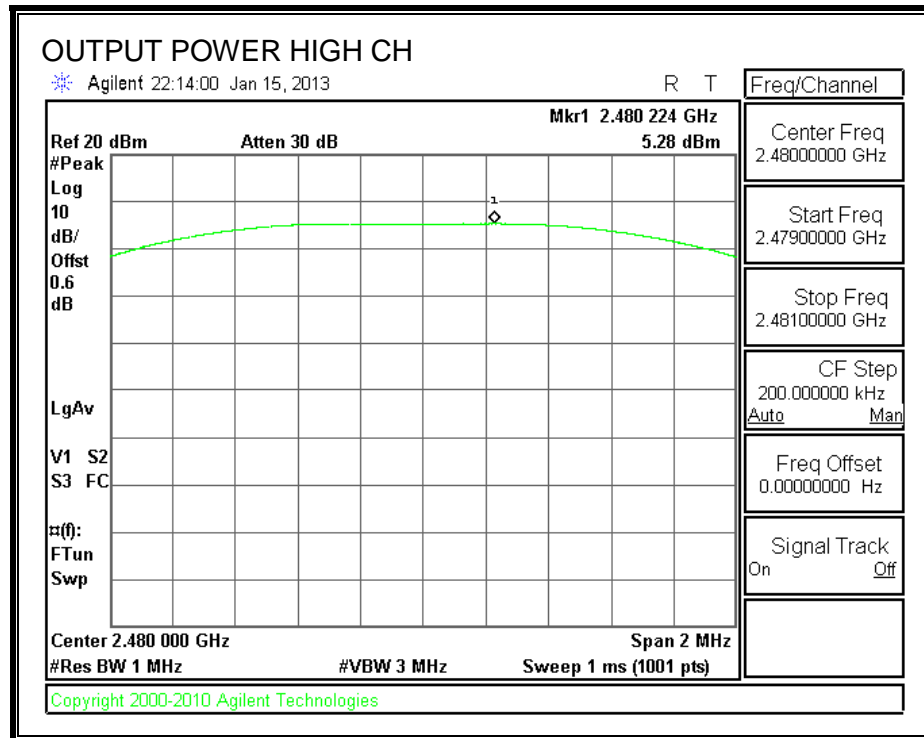
RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	4.17	30	-25.83
Middle	2442	5.03	30	-24.97
High	2480	5.28	30	-24.72

OUTPUT POWER







7.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

KDB 558074 D01 v02 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247".

RESULTS

The cable assembly insertion loss of 0.6 dB (cable loss) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	3.24
Middle	2442	4.02
High	2480	4.13

7.6. 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.

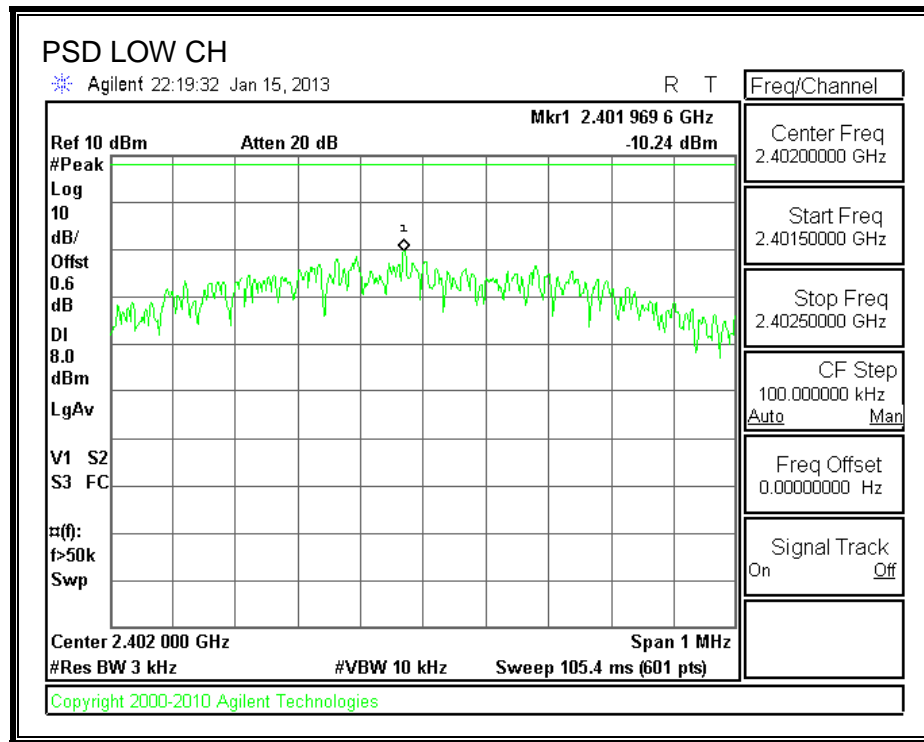
TEST PROCEDURE

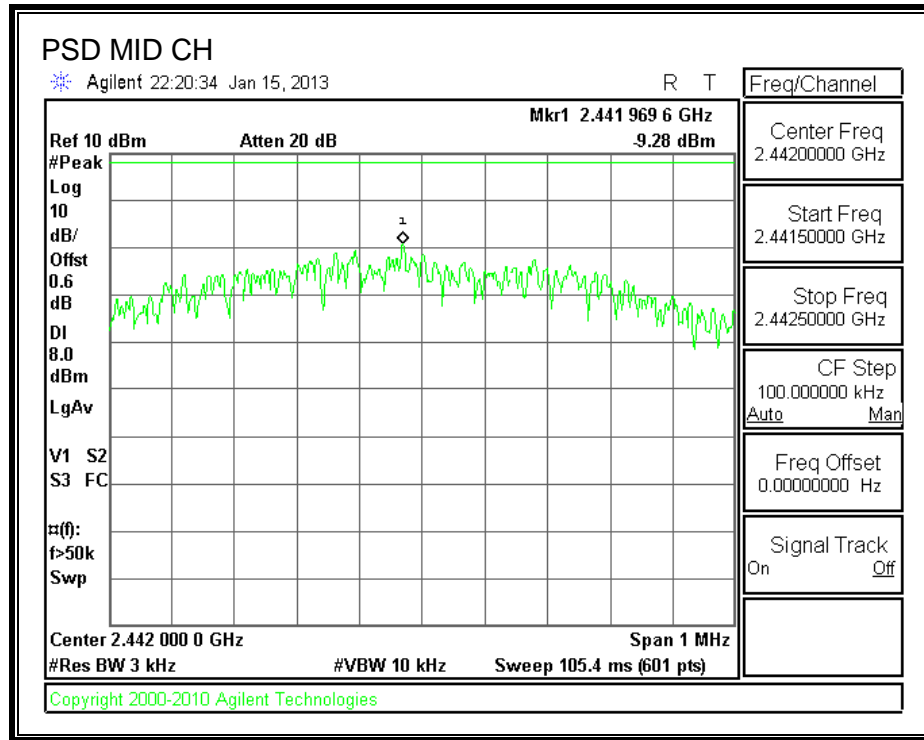
KDB 558074 D01 v02 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247.

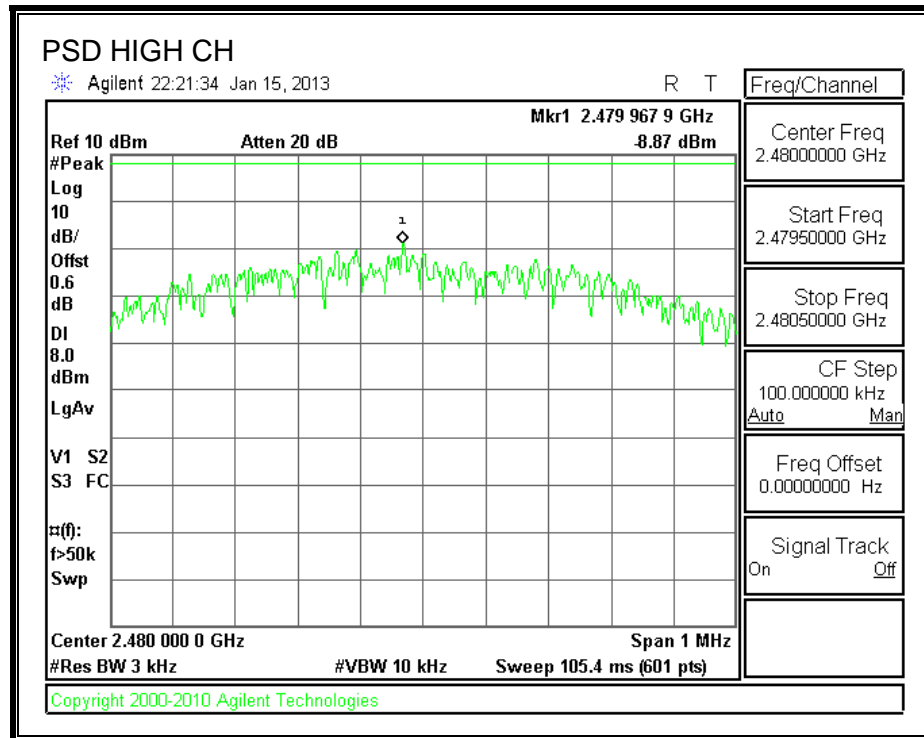
RESULTS

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-10.24	8	-18.24
Middle	2442	-9.28	8	-17.28
High	2480	-8.87	8	-16.87

POWER SPECTRAL DENSITY







7.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

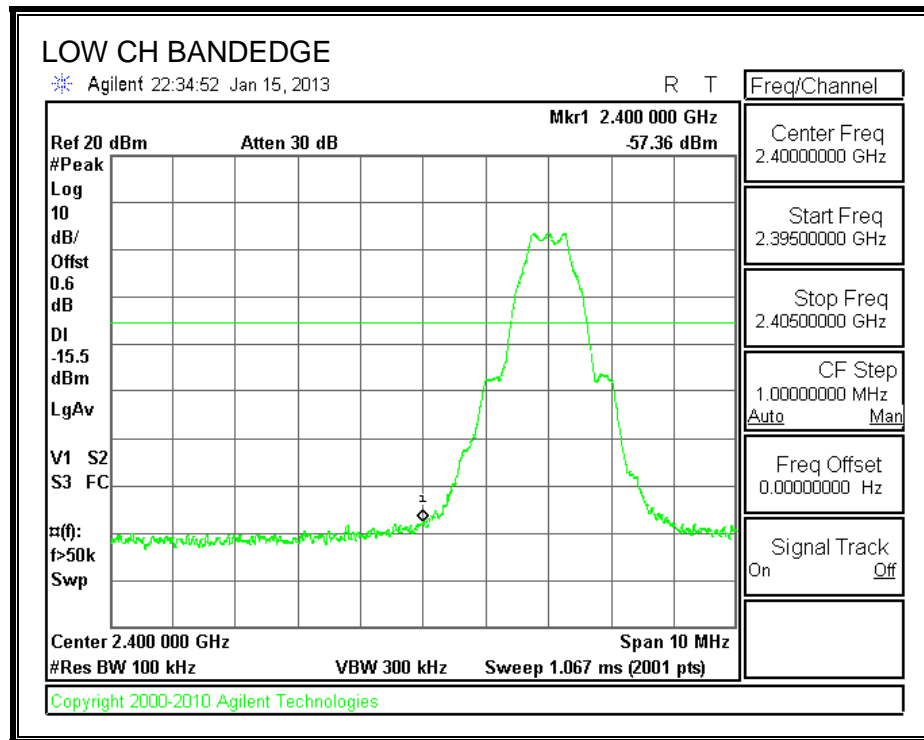
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

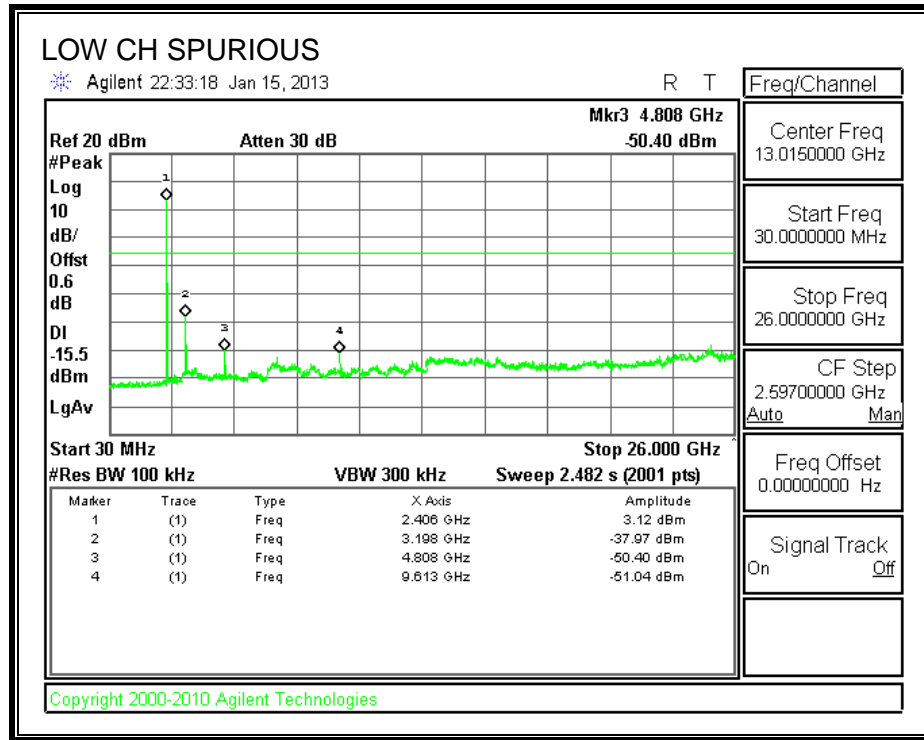
TEST PROCEDURE

KDB 558074 D01 v02 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247".

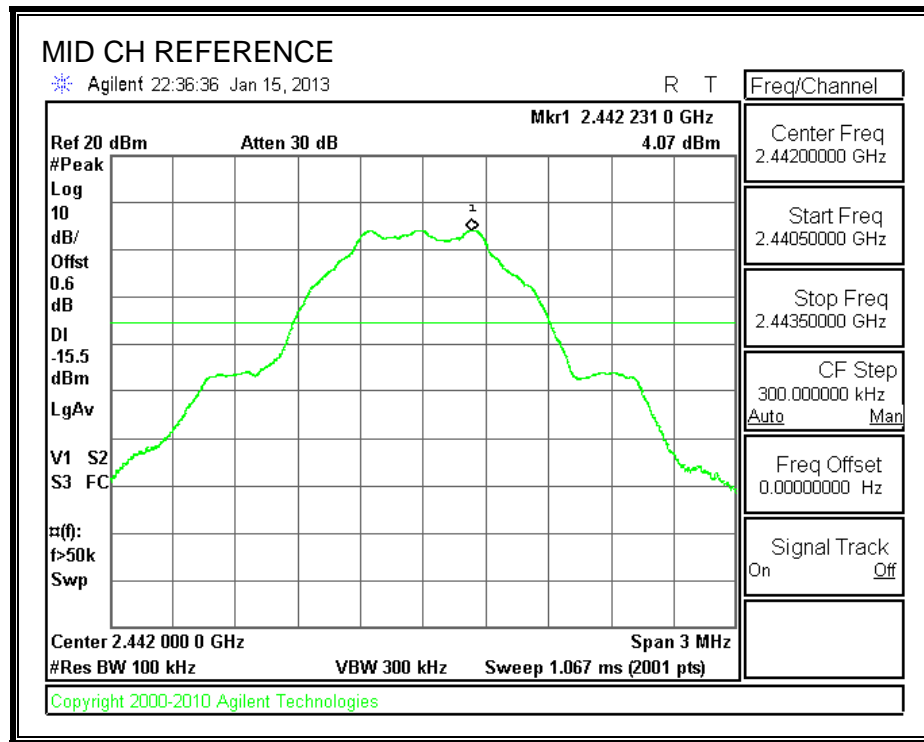
RESULTS

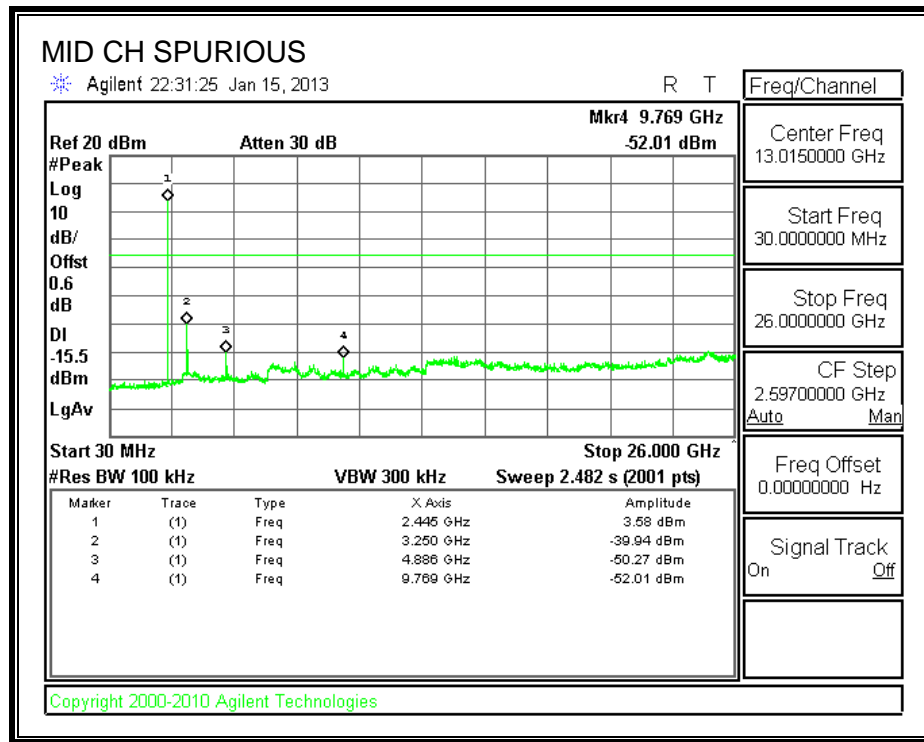
SPURIOUS EMISSIONS, LOW CHANNEL



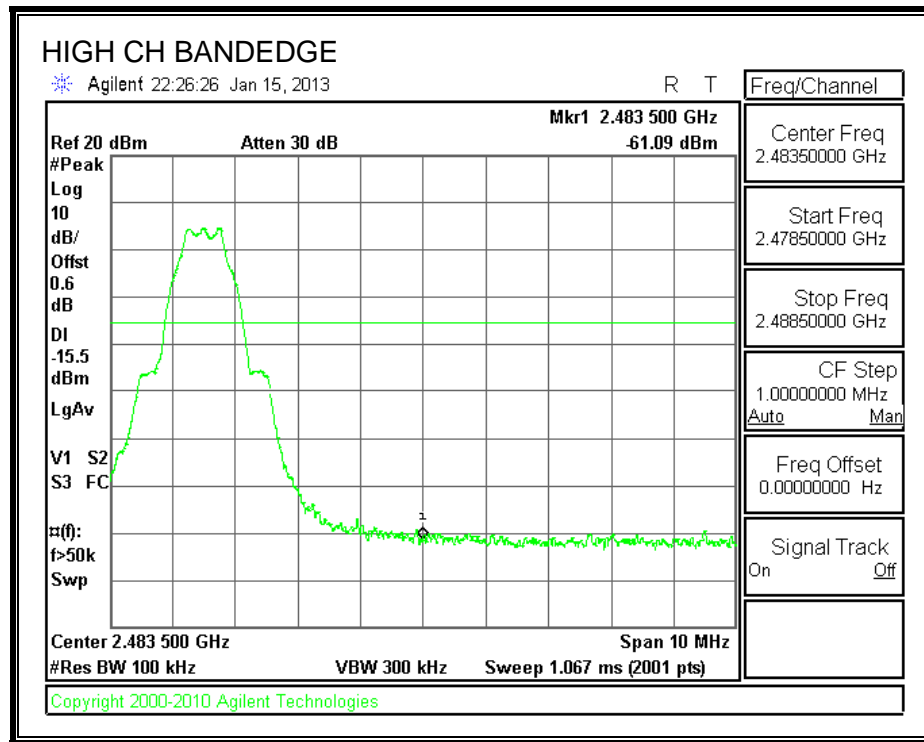


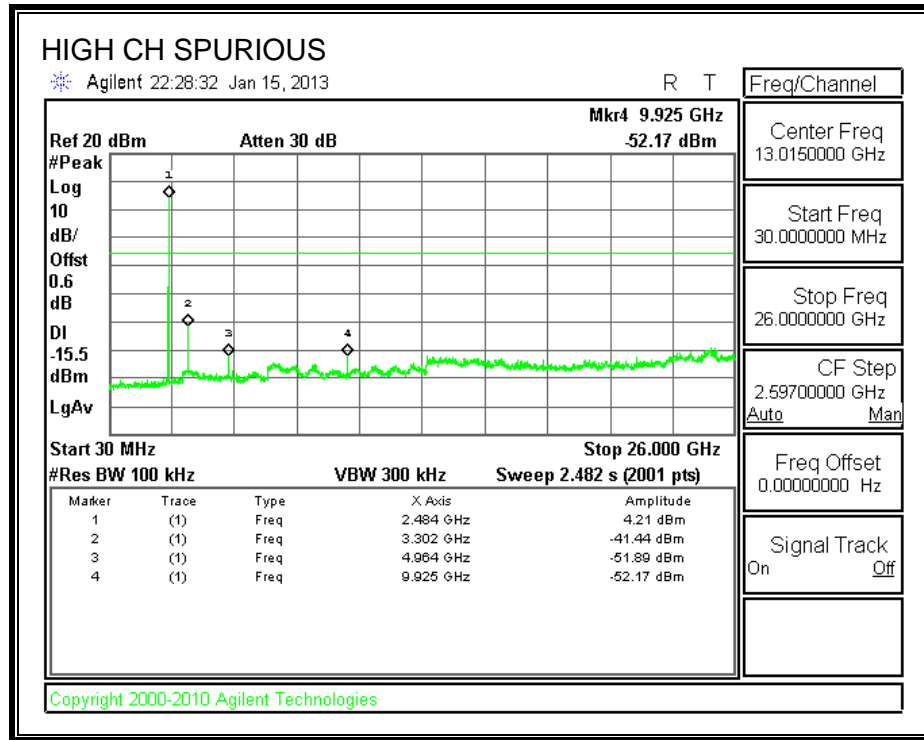
SPURIOUS EMISSIONS, MID CHANNEL





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

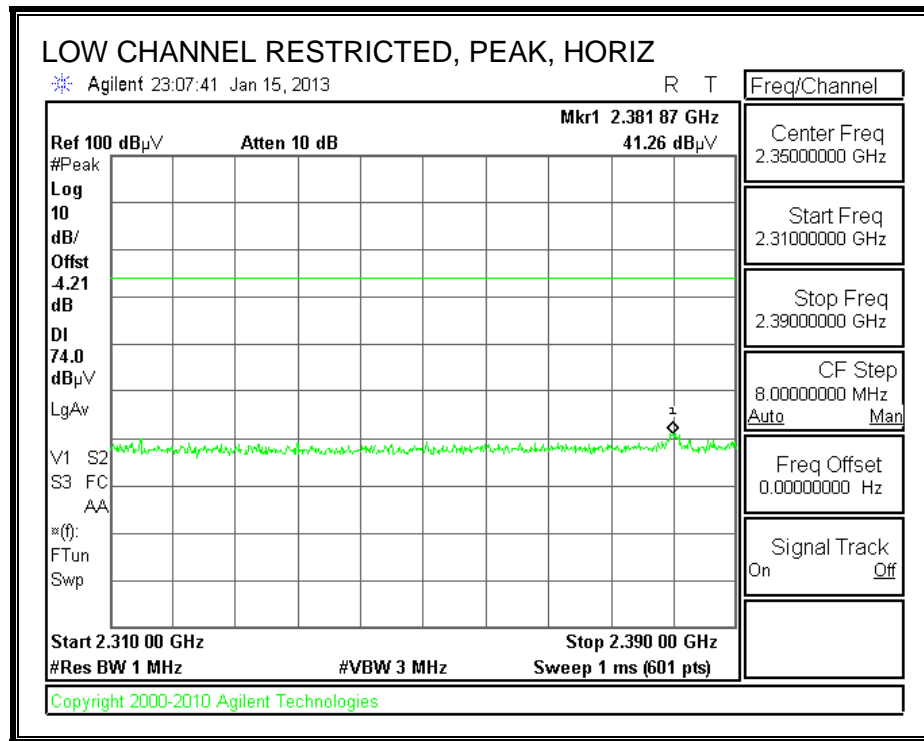
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

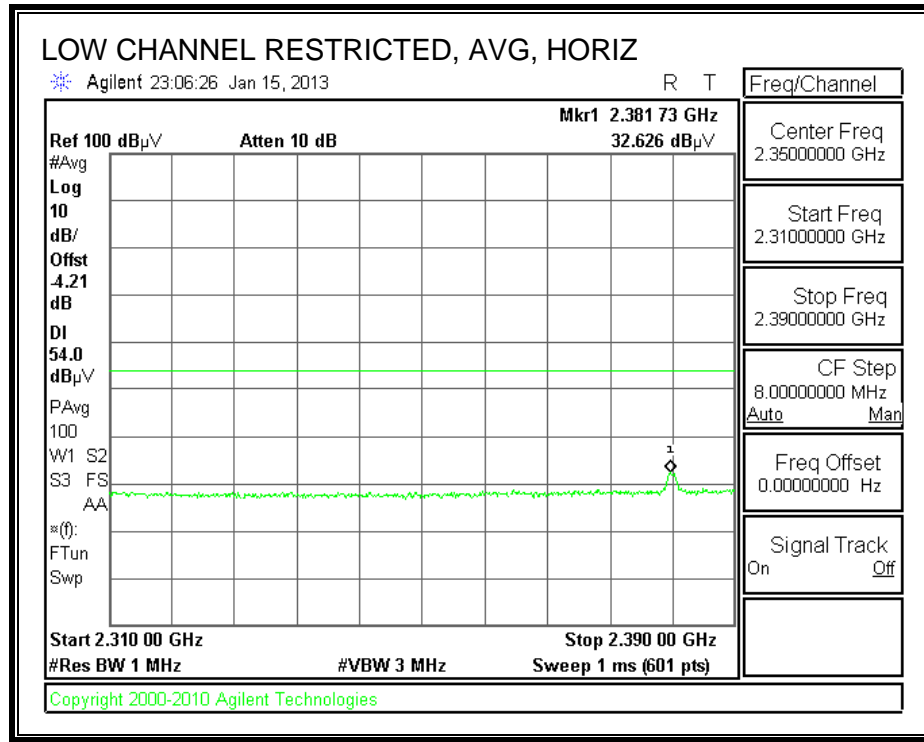
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

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

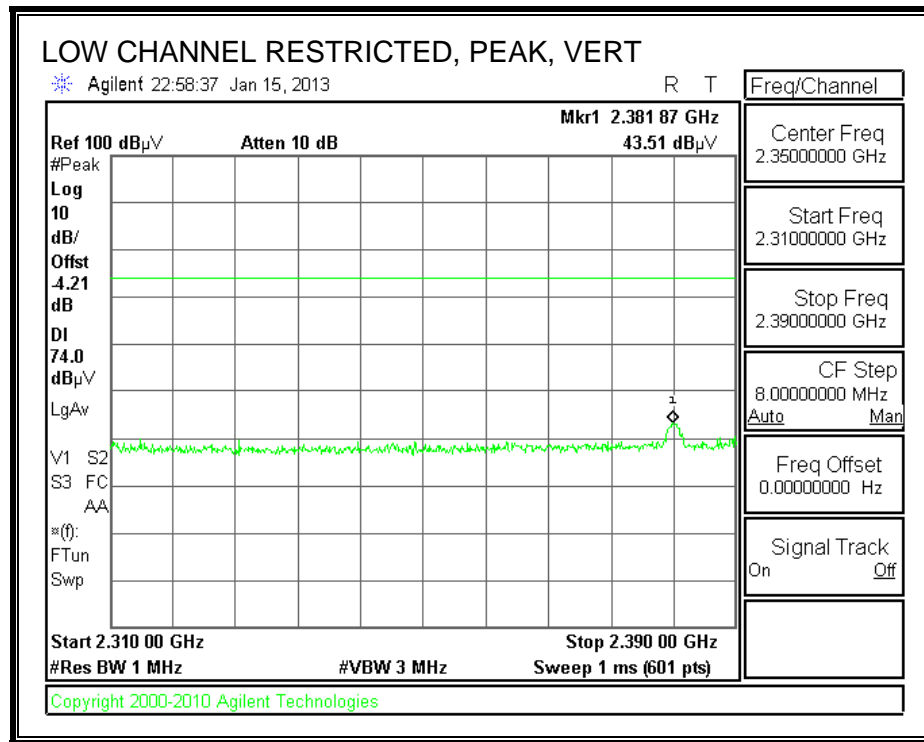
8.2. TX ABOVE 1 GHz

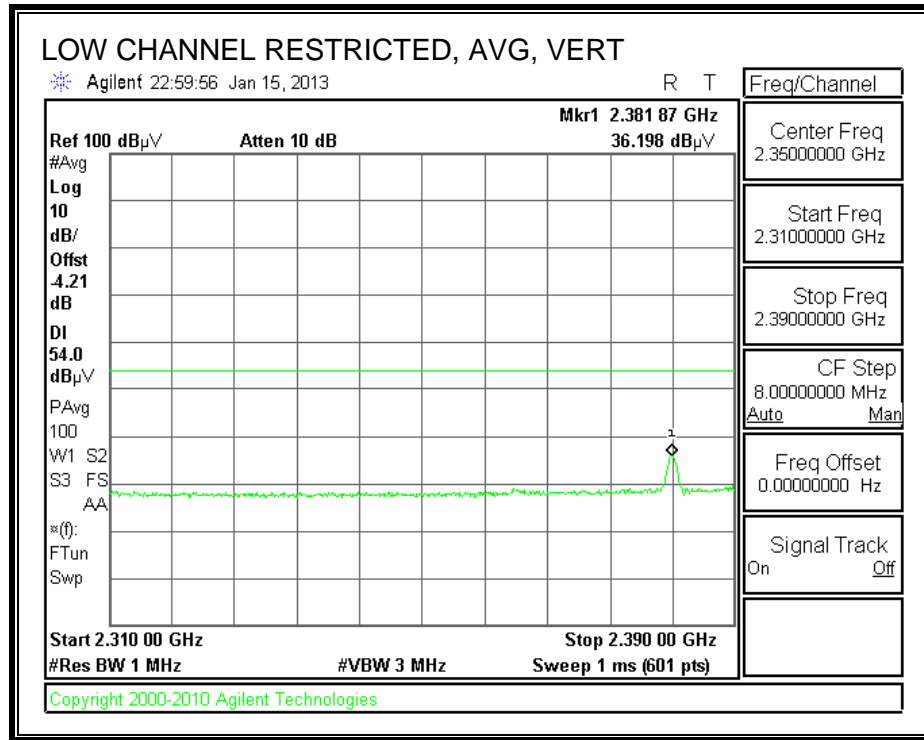
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



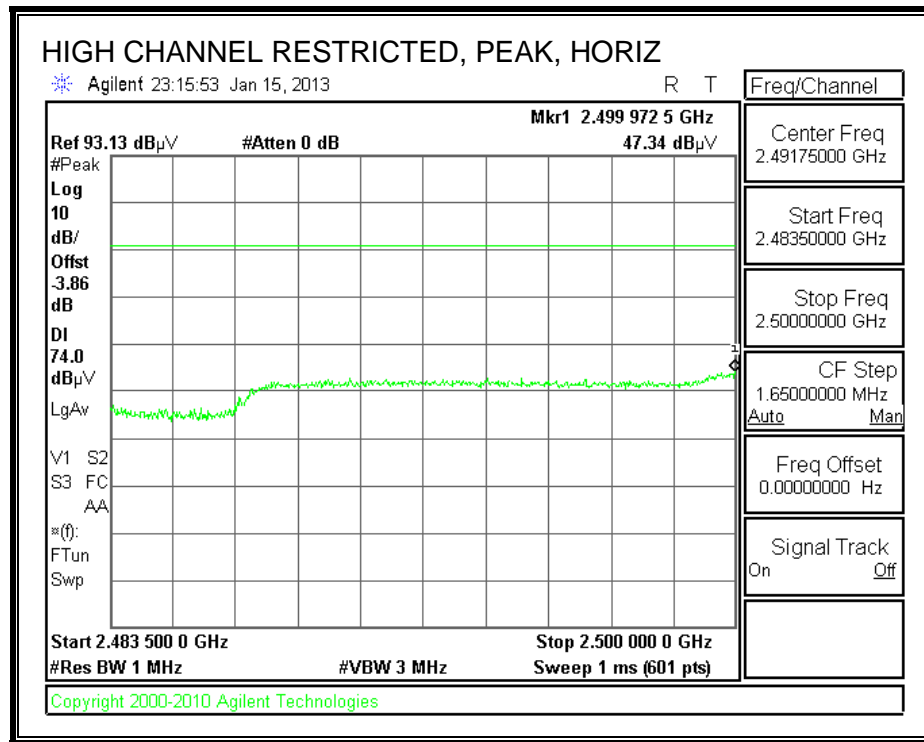


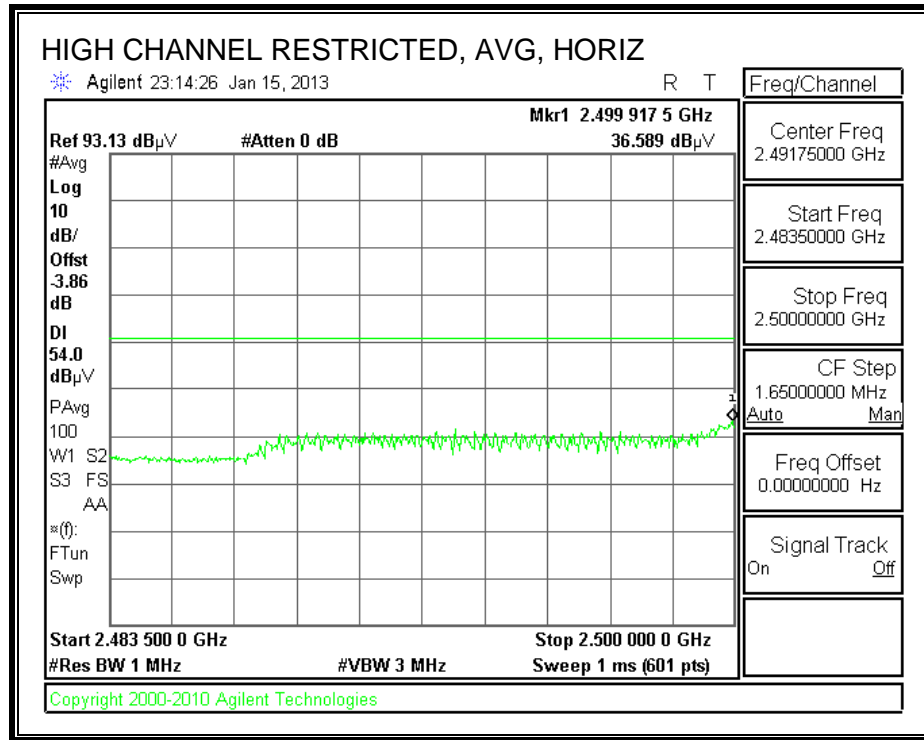
RESTRICTED BANEDGE (LOW CHANNEL, VERTICAL)



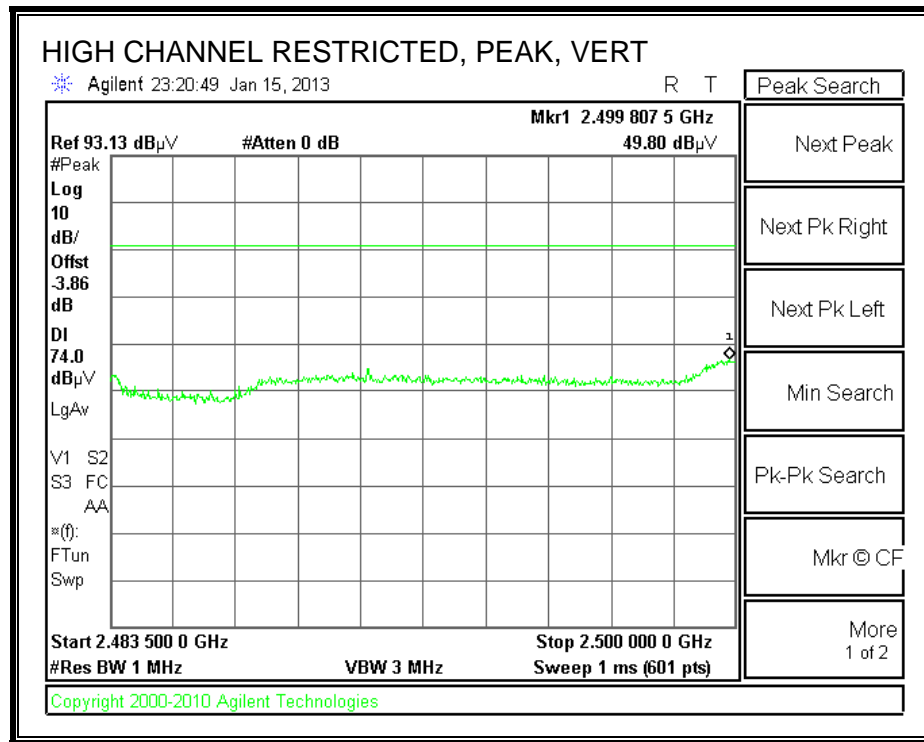


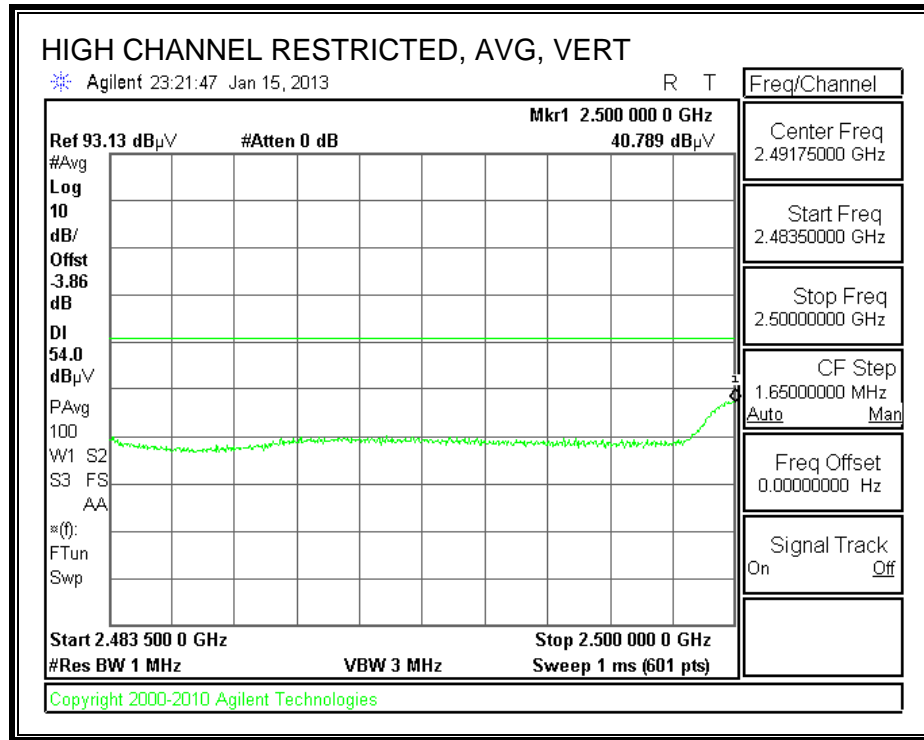
RESTRICTED BANEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 3m Chamber

Company: BROADCOM
Project #: 12U14665
Date: 1/4/2013
Test Engineer: MENGISTU MEKURIA
Configuration: EUT WITH SUPPORT LAPTOP AND EXTERNAL ANTENNA
Mode: TX MODE, BTLE

Test Equipment:

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B	T88 Miteq 26-40GHz	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		R_001	

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	41.2	29.8	33.1	6.8	-34.1	0.0	0.0	47.0	35.6	74	54	-27.0	-18.4	V
4.804	3.0	43.1	32.2	33.1	6.8	-34.1	0.0	0.0	48.9	38.0	74	54	-25.1	-16.0	H
Mid Channel (2442 MHz)															
4.884	3.0	40.4	28.5	33.2	6.8	-34.0	0.0	0.0	46.4	34.5	74	54	-27.6	-19.5	V
7.326	3.0	36.0	23.6	36.3	9.1	-33.1	0.0	0.0	48.3	35.9	74	54	-25.7	-18.1	V
4.884	3.0	41.2	30.3	33.2	6.8	-34.0	0.0	0.0	47.1	36.2	74	54	-26.9	-17.8	H
7.326	3.0	36.7	23.5	36.3	9.1	-33.1	0.0	0.0	49.0	35.8	74	54	-25.0	-18.2	H
High Channel (2480 MHz)															
4.960	3.0	39.2	27.9	33.2	6.9	-34.0	0.0	0.0	45.3	34.0	74	54	-28.7	-20.0	V
7.440	3.0	36.1	23.6	36.5	9.1	-33.0	0.0	0.0	48.7	36.1	74	54	-25.3	-17.9	V
4.960	3.0	38.5	26.7	33.2	6.9	-34.0	0.0	0.0	44.5	32.8	74	54	-29.5	-21.2	H
7.440	3.0	36.1	22.6	36.5	9.1	-33.0	0.0	0.0	48.6	35.1	74	54	-25.4	-18.9	H

Rev. 11.10.11

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	

8.3. WORST-CASE BELOW 1 GHz

HORIZONTAL AND VERTICAL DATA

Project No:12U14669										
Client Name:Broadcom										
Model / Device:BCM94360CD										
Config / Other:EUT With Support Board & Laptop										
Test By:M. Mekuria										
Horizontal 30 - 1000MHz										
Marker No.	Test Frequency	Meter Reading	Detector	25MHz-1GHz ChmbrA Amplified.TX (dB)	T243 Sunol Bilog.TXT (dB)	dBuV/m	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
1	32.7138	47.11	PK	-27.6	19.2	38.71	40	-1.29	100	Horz
2	102.3042	57.38	PK	-26.9	10.9	41.38	43.5	-2.12	100	Horz
3	215.8973	55.88	PK	-26.2	10.5	40.18	43.5	-3.32	100	Horz
4	481.8525	50.35	PK	-25	17.3	42.65	46	-3.35	100	Horz
Vertical 30 - 1000MHz										
Marker No.	Test Frequency	Meter Reading	Detector	25MHz-1GHz ChmbrA Amplified.TX (dB)	T243 Sunol Bilog.TXT (dB)	dBuV/m	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
5	36.0092	37.91	PK	-27.5	16.9	27.31	40	-12.69	400	Vert
6	100.7534	51.7	PK	-26.9	10.4	35.2	43.5	-8.3	300	Vert
7	167.8237	47.87	PK	-26.4	11.7	33.17	43.5	-10.33	200	Vert
8	234.8941	53.7	PK	-26	11.2	38.9	46	-7.1	100	Vert

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.

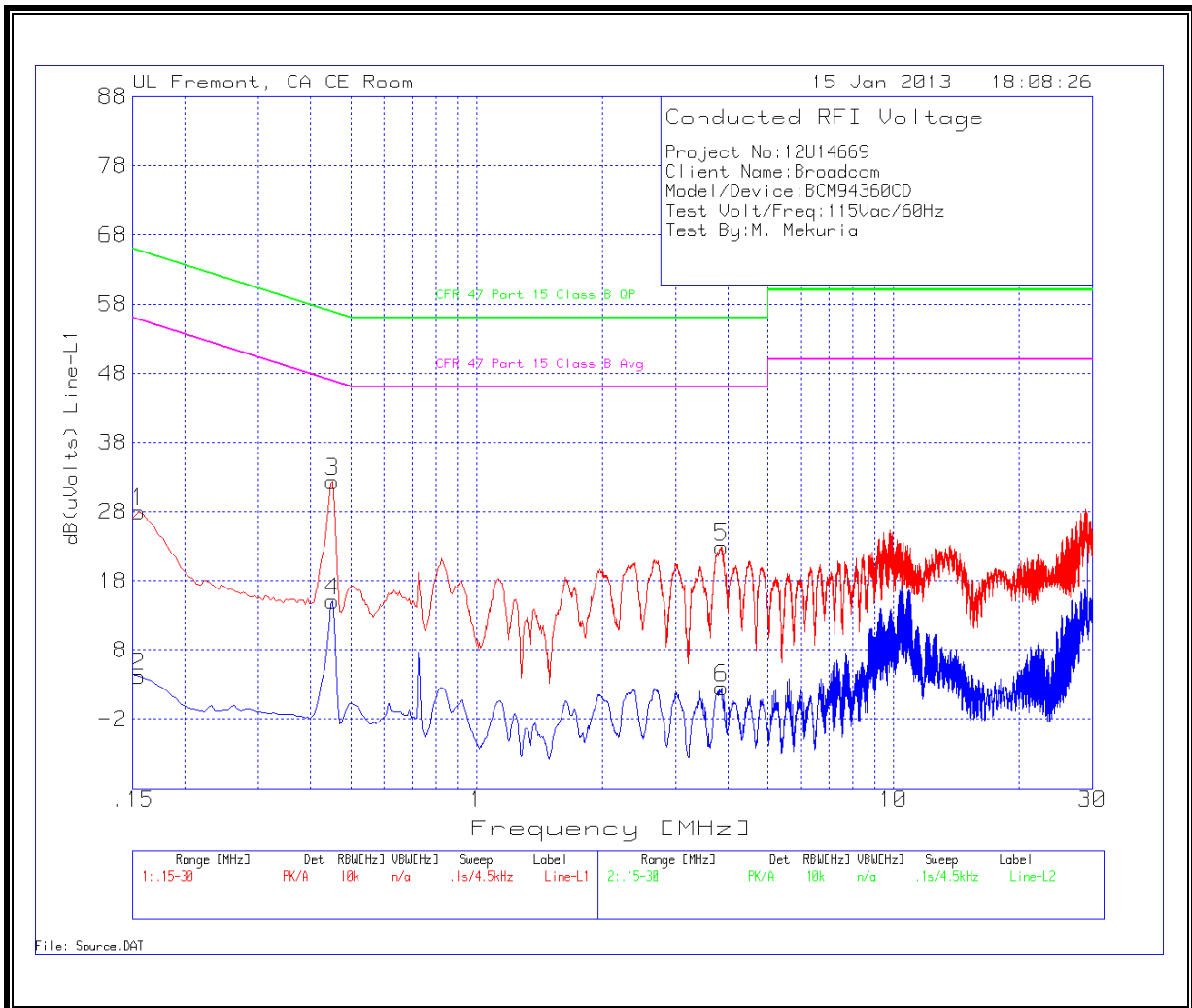
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

6 WORST EMISSIONS

Project No:12U14669									
Client Name:Broadcom									
Model/Device:BCM94360CD									
Test Volt/Freq:115Vac/60Hz									
Test By:M. Mekuria									
Line-L1 .15 - 30MHz									
Test Frequency	Meter Reading	Detector	T24 IL L1.TXT (dB)	LC Cables 1&3.TXT (dB)	dB(uVolts)	CFR 47 Part 15 Class B QP	Margin	CFR 47 Part 15 Class B Avg	Margin
0.1545	27.91	PK	0.1	0	28.01	65.8	-37.79	-	-
0.1545	4.13	Av	0.1	0	4.23	-	-	55.8	-51.57
0.4515	32.2	PK	0.1	0	32.3	56.8	-24.5	-	-
0.4515	15.02	Av	0.1	0	15.12	-	-	46.8	-31.68
3.867	22.7	PK	0.1	0.1	22.9	56	-33.1	-	-
3.867	2.39	Av	0.1	0.1	2.59	-	-	46	-43.41
Line-L2 .15 - 30MHz									
Test Frequency	Meter Reading	Detector	T24 IL L2.TXT (dB)	LC Cables 2&3.TXT (dB)	dB(uVolts)	CFR 47 Part 15 Class B QP	Margin	CFR 47 Part 15 Class B Avg	Margin
0.1545	27.77	PK	0.1	0	27.87	65.8	-37.93	-	-
0.1545	4.7	Av	0.1	0	4.8	-	-	55.8	-51
0.4515	32	PK	0.1	0	32.1	56.8	-24.7	-	-
0.4515	14.88	Av	0.1	0	14.98	-	-	46.8	-31.82
3.867	23.48	PK	0.1	0.1	23.68	56	-32.32	-	-
3.867	3.14	Av	0.1	0.1	3.34	-	-	46	-42.66

LINE 1 RESULTS



LINE 2 RESULTS

