FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8

BLUETOOTH LOW ENERGY CERTIFICATION TEST REPORT

FOR

BROADCOM BLUETOOTH MODULE

MODEL NUMBER: BCM20732S

FCC ID: QDS-BRCM1078
IC: 4324A-BRCM1078

REPORT NUMBER: 13U15716-1, Revision C

ISSUE DATE: NOVEMBER 05, 2013

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

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

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	09/30/2013	Initial Issue	G. Quizon
A	10/11/2013	Revised 8.2 with correct standard reference.	G. Quizon
B	11/04/2013	Added 8.4 and 8.5 – Tx BE, Spurious and Harmonics (without shielding)	G. Quizon
C	11/05/2013	Section 8 – Remove radiated BE, Tx Spurious and Harmonics	G. Quizon

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS 4

2. TEST METHODOLOGY 5

3. FACILITIES AND ACCREDITATION 5

4. CALIBRATION AND UNCERTAINTY 5

4.1. MEASURING INSTRUMENT CALIBRATION 5

4.2. SAMPLE CALCULATION 5

4.3. MEASUREMENT UNCERTAINTY 6

5. EQUIPMENT UNDER TEST 6

5.1. DESCRIPTION OF EUT 6

5.2. MAXIMUM OUTPUT POWER 6

5.3. DESCRIPTION OF AVAILABLE ANTENNAS 6

5.4. SOFTWARE AND FIRMWARE 6

5.5. WORST-CASE CONFIGURATION AND MODE 7

5.6. DESCRIPTION OF TEST SETUP 8

6. TEST AND MEASUREMENT EQUIPMENT 10

7. ANTENNA PORT TEST RESULTS 11

7.1. DUTY CYCLE 11

7.2. 6 dB BANDWIDTH 13

7.3. 99% BANDWIDTH 16

7.4. OUTPUT POWER 19

7.5. AVERAGE POWER 22

7.6. POWER SPECTRAL DENSITY 23

7.7. CONDUCTED SPURIOUS EMISSIONS 26

8. RADIATED TEST RESULTS 30

8.1. LIMITS AND PROCEDURE 30

8.2. WORST-CASE BELOW 1 GHz 31

8.3. TX ABOVE 1 GHz FOR BLUETOOTH LOW ENERGY MODE 33

8.4. WORST-CASE BELOW 1 GHz 43

9. AC POWER LINE CONDUCTED EMISSIONS 45

10. SETUP PHOTOS 49

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: BROADCOM BLUETOOTH MODULE

MODEL: BCM20732S

SERIAL NUMBER: 5 (Radiated) & 52 (Conducted)

DATE TESTED: September 25 to 30, 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 Verification Services Inc. 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 Verification Services Inc. 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 Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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 Verification Services Inc. By:

GEORGE QUIZON
EMC PROJECT LEAD
UL Verification Services Inc.

Tested By:

Joey Gomez
EMC ENGINEER
UL Verification Services Inc.

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

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.

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☒ Chamber A	☐ Chamber D
☐ Chamber B	☐ Chamber E
☐ Chamber C	☒ Chamber F

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

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 BLE module.

The radio module is manufactured by Broadcom Corporation.

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	BLE	2.60	1.82

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an internal PCB antenna, with a maximum gain of -1.5 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was FTDI ver 2.8.14.0,

The test utility software used during testing was Broadcom Bluetool ver 1.7.4.1

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

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 fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List			
Description	**Manufacturer**	**Model**	**Serial Number**
Laptop	HP	Elitebook 2730p	2CE8487ZMT
AC Power Adapter	HP	PPP012L-S	W97920EBMW7SXN
Laptop	HP	Elitebook 2730p	2CE9192V86
AC Power Adapter	HP	PPP009H	W978B0HA9W787I
Interface Board	Broadcom	20732TAG	1746861
Interface Board	Broadcom	20732TAG	1746888

I/O CABLES

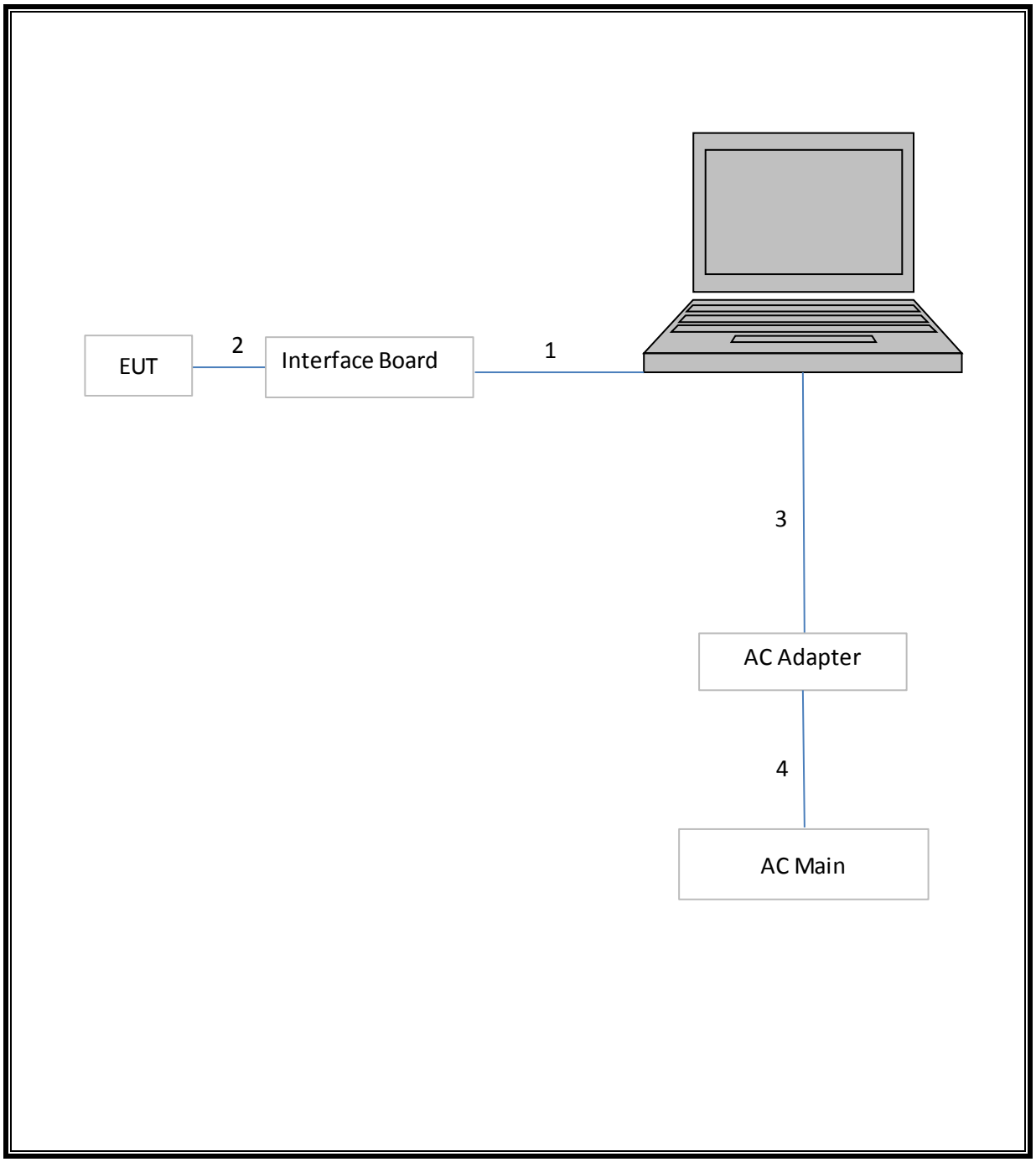
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)
1	USB	1	USB	Unshielded	1.8m
2	JTAG	1	JTAG	Unshielded	0.3m
3	DC	1	DC	Unshielded	1.5m
4	AC	1	US 115V	Shielded	1.5m

TEST SETUP

The EUT is connected to an interface board via JTAG cables. The interface board is connected via USB to a laptop.

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

SETUP DIAGRAM FOR TESTS



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

6. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment List					
Description	**Manufacturer**	**Model**	**Asset**	**Cal Date**	**Cal Due**
Spectrum Analyzer, 44GHz	Agilent	E446A	C00986	04/01/13	04/01/14
Spectrum Analyzer, 26.5GHz	Agilent	E440A	C001176	12/13/12	12/13/14
Attenuator/Switch Driver	Agilent	11713A	F00203	CNR	CNR
Attenuator/Switch Driver	Agilent	11713A	F00202	CNR	CNR
Peak Power Meter	Agilent	N1911A	F00021	04/03/13	04/03/14
Peak and Average Power Sensor	Agilent	E9323A	F00163	04/03/13	04/03/14
Antenna, Bilog, 30MHz-1GHz	Sunol	JB1	C01016	08/22/13	08/22/14
Antenna, Horn, 18GHz	ETS	3117	C01005	03/20/13	03/20/14
Antenna, Horn, 18GHz	ETS	3117	C01022	2/21/2013	2/21/2014
Antenna, Horn,18- 26 GHz	ARA	MWH-1826/B	C00946	11/12/12	11/12/13
PreAmplifer 1300MHz	Agilent	8447D	C00885	01/16/13	01/16/14
PreAmplifer 1-18GHz	Miteq	T742	F00354	08/24/13	08/24/14
RF Preamplifier, 1GHz - 18GHz	Miteq	T739	F00351	06/27/13	06/27/14
High Pass Filter	Mictro-Tronics	HPM17543	F00182	04/13/13	04/13/14
Low Pass Filter	Mictro-Tronics	LPS17541	F00175	08/24/13	08/24/14
EMI Test Receiver	R&S	ESHS20	N02396	08/15/13	08/15/14
LISN, 10kHz-30MHz	Solar	8012-50-R-24-BNC	N02481	05/09/13	05/09/14

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7. ANTENNA PORT TEST RESULTS

7.1. DUTY CYCLE

LIMITS

None; for reporting purposes only.

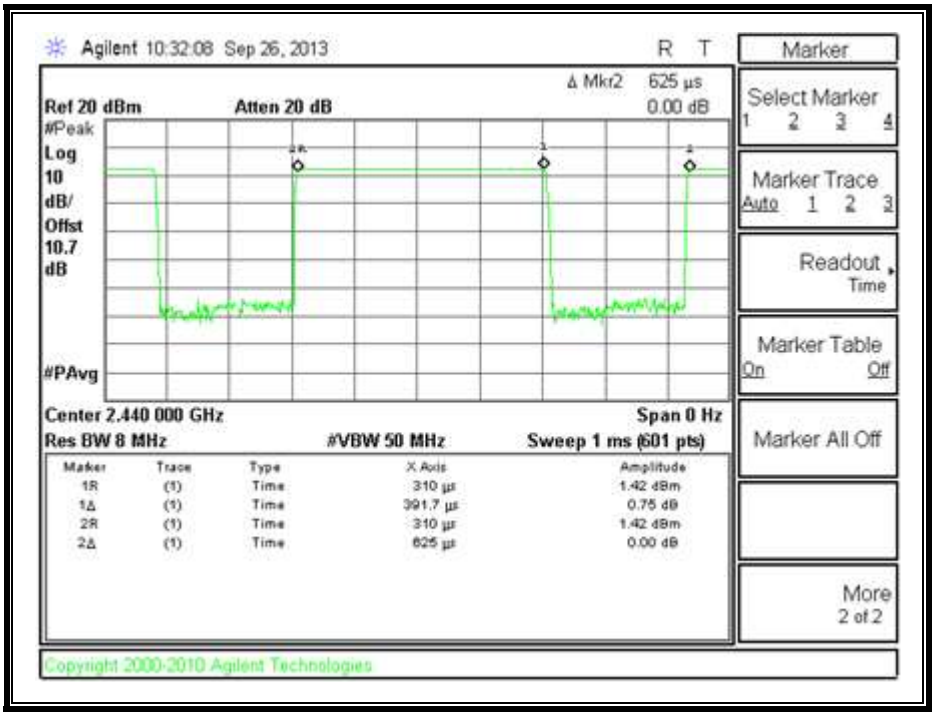
PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
BLE	391.700	625.000	0.627	62.67%	2.03	0.003

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

DUTY CYCLE PLOTS



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

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

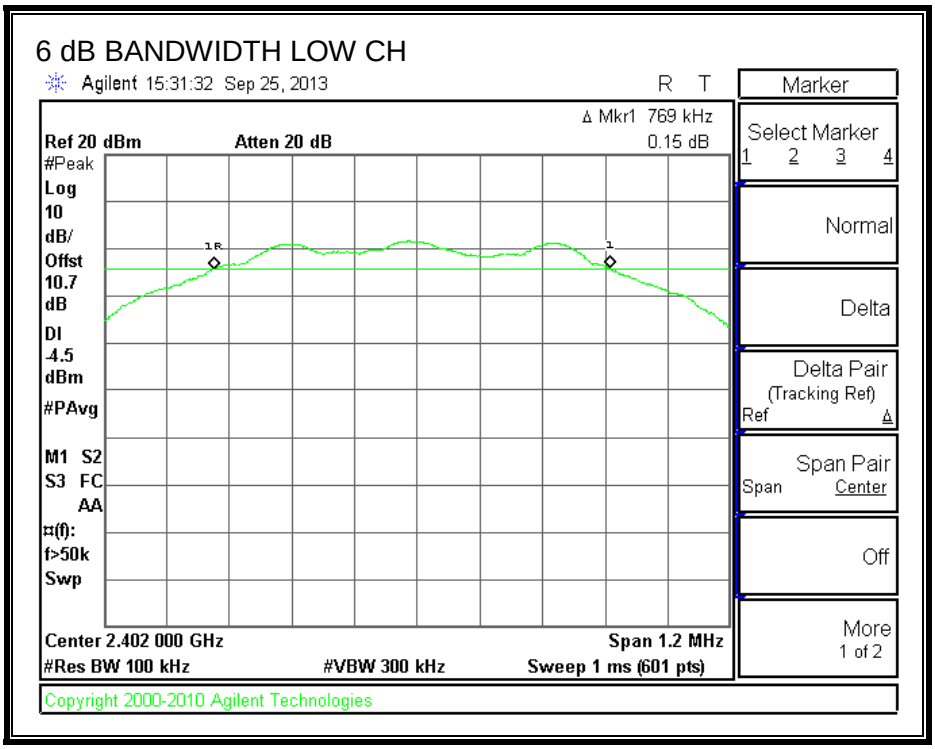
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

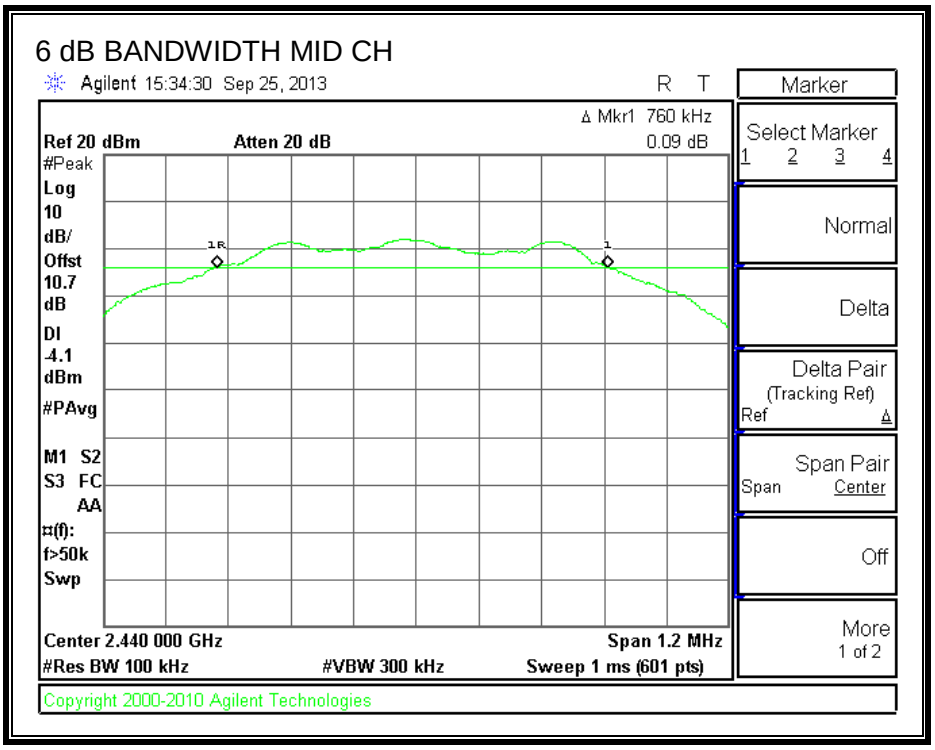
RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.769	0.5
Middle	2440	0.760	0.5
High	2480	0.761	0.5

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

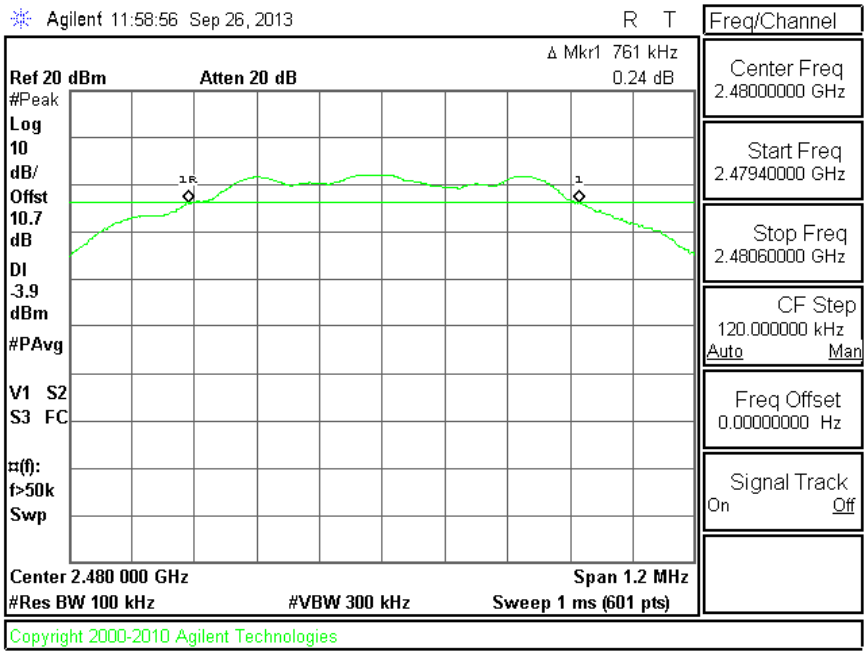
6 dB BANDWIDTH





This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

6 dB BANDWIDTH HIGH CH



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.3. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

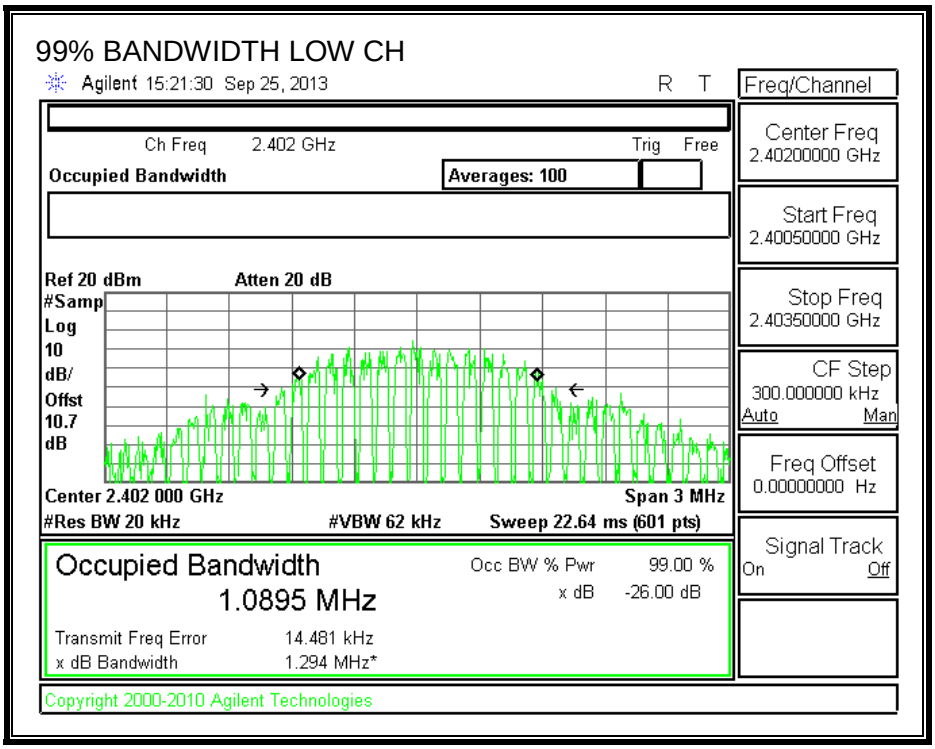
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

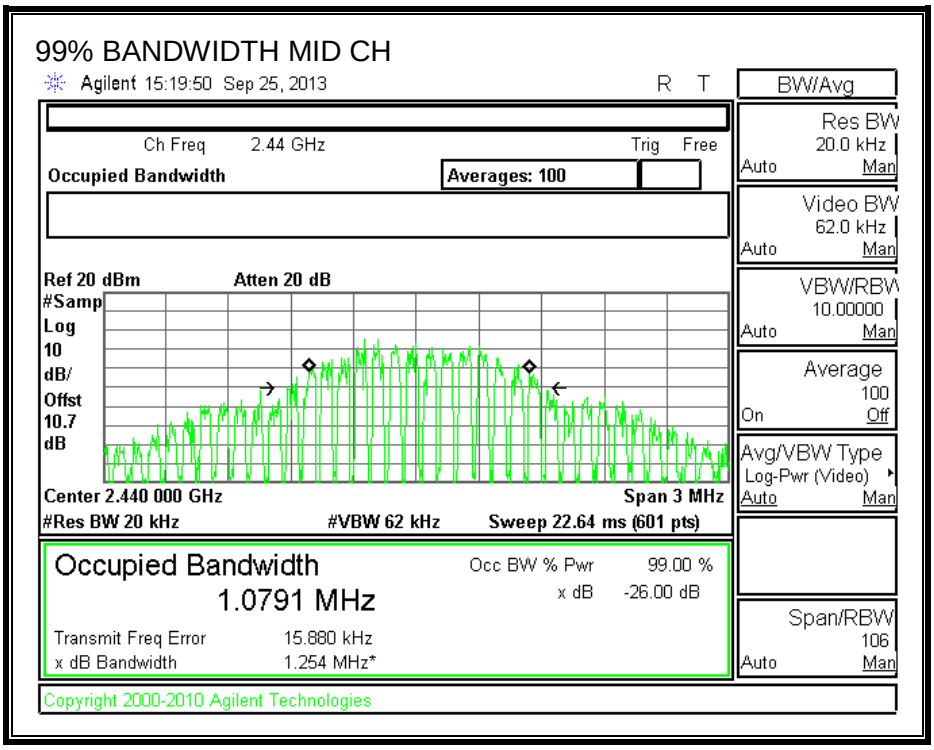
RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0895
Middle	2440	1.0791
High	2480	1.0613

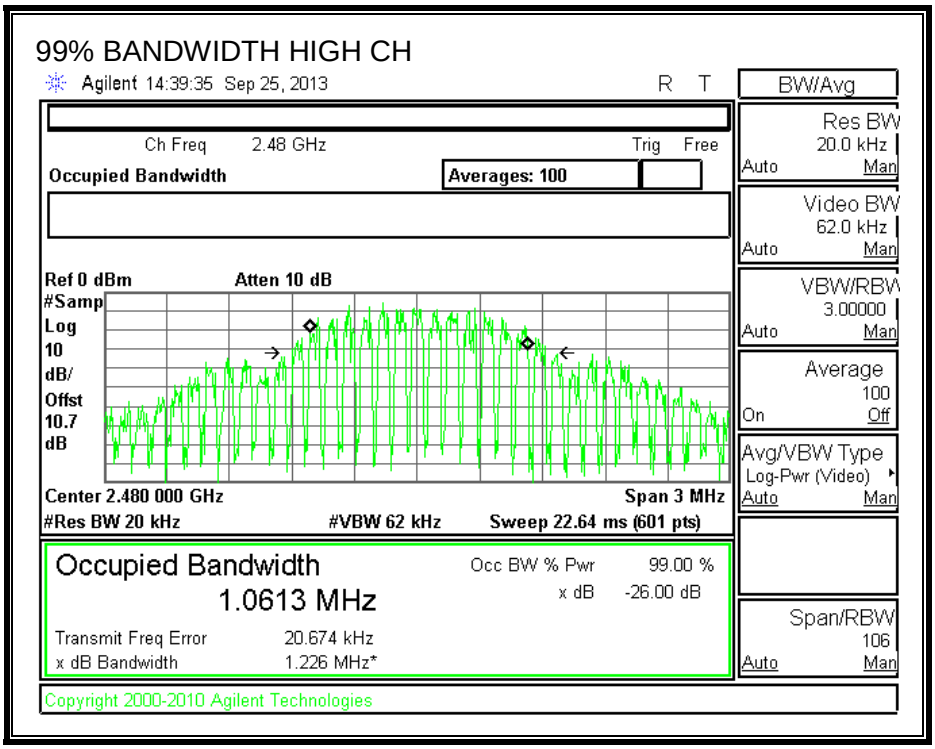
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

99% BANDWIDTH





This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.4. OUTPUT POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

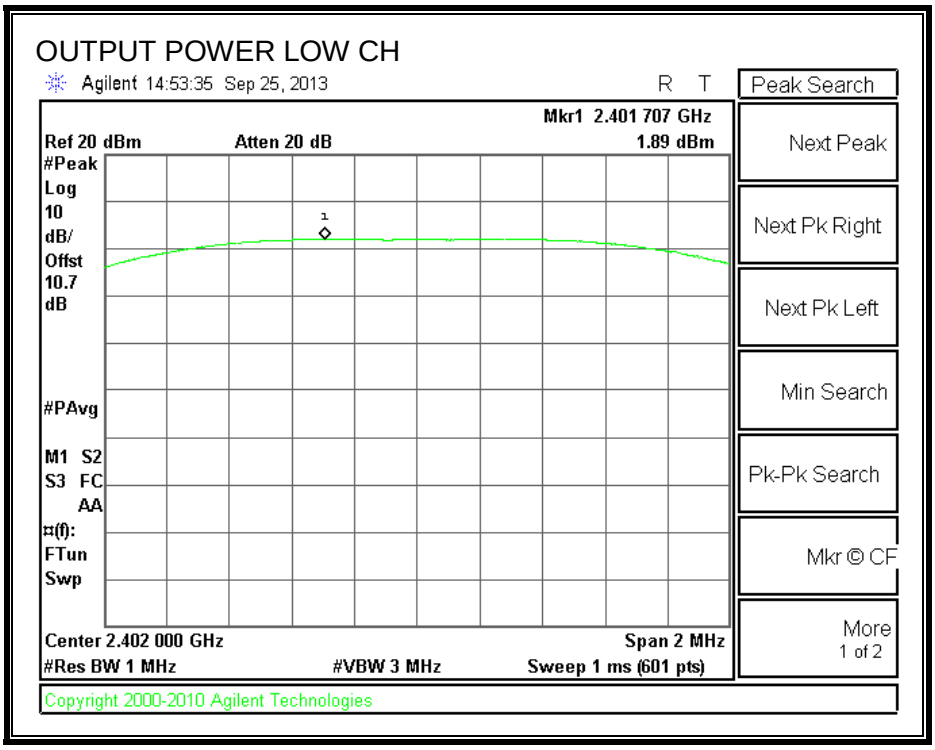
The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

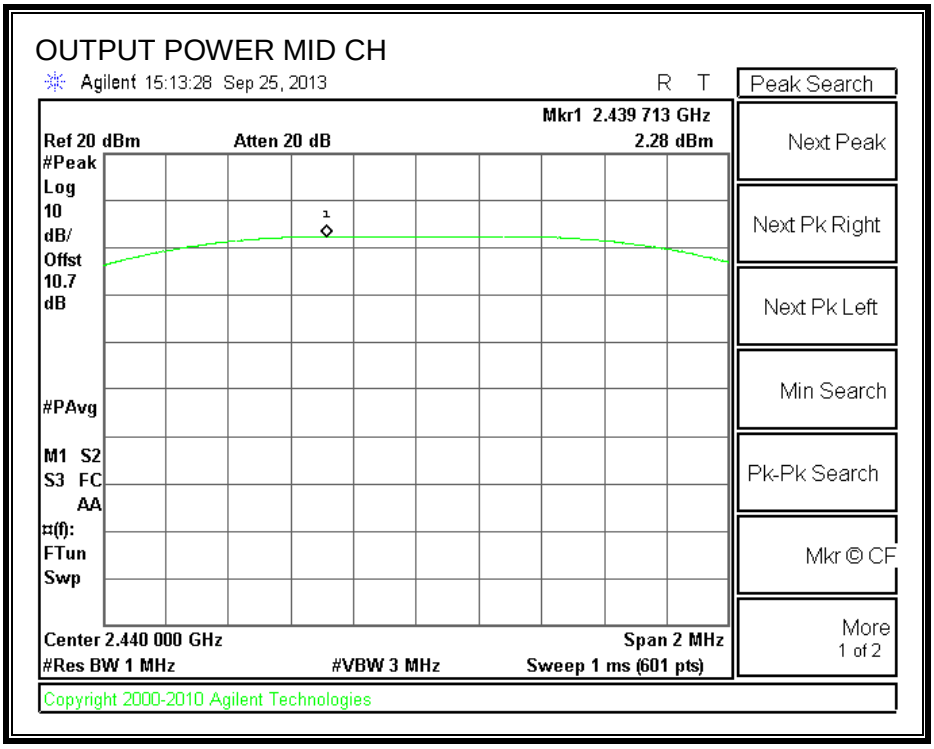
RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	1.89	30	-28.11
Middle	2440	2.28	30	-27.72
High	2480	2.60	30	-27.40

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

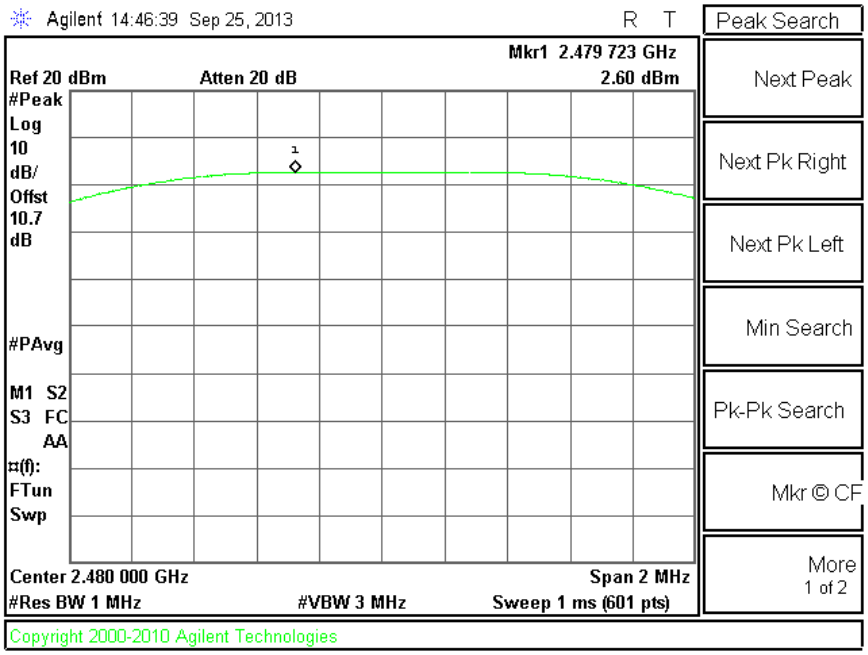
OUTPUT POWER





This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

OUTPUT POWER HIGH CH



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 10.7 dB (including 10 dB pad and 0.7 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	1.2
Middle	2440	1.8
High	2480	2.3

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

7.6. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

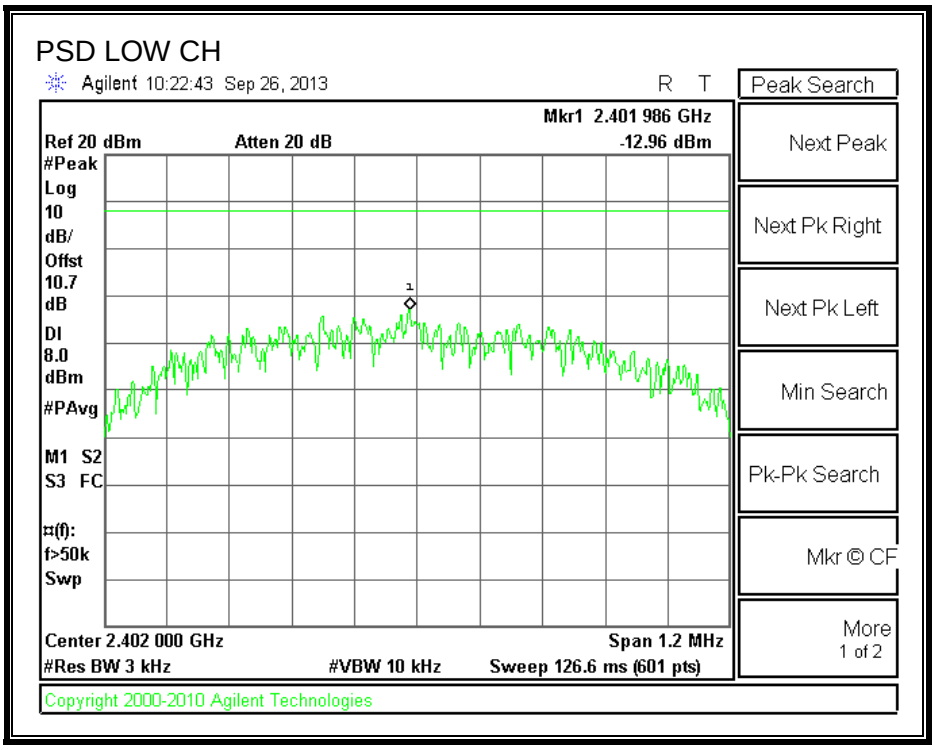
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

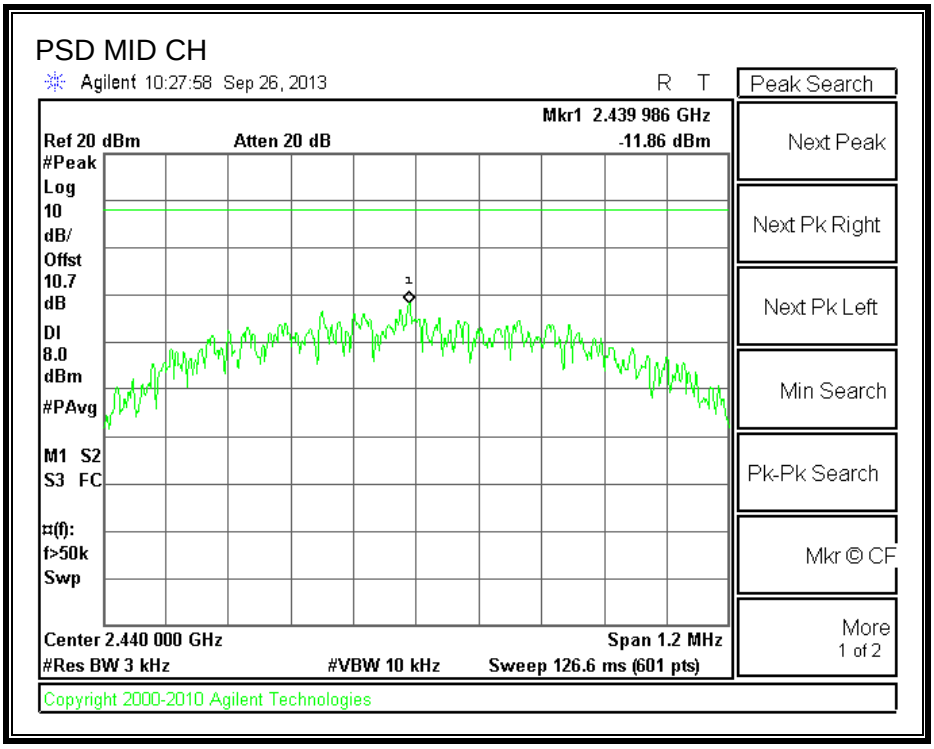
RESULTS

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-12.96	8	-20.96
Middle	2440	-11.86	8	-19.86
High	2480	-11.51	8	-19.51

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

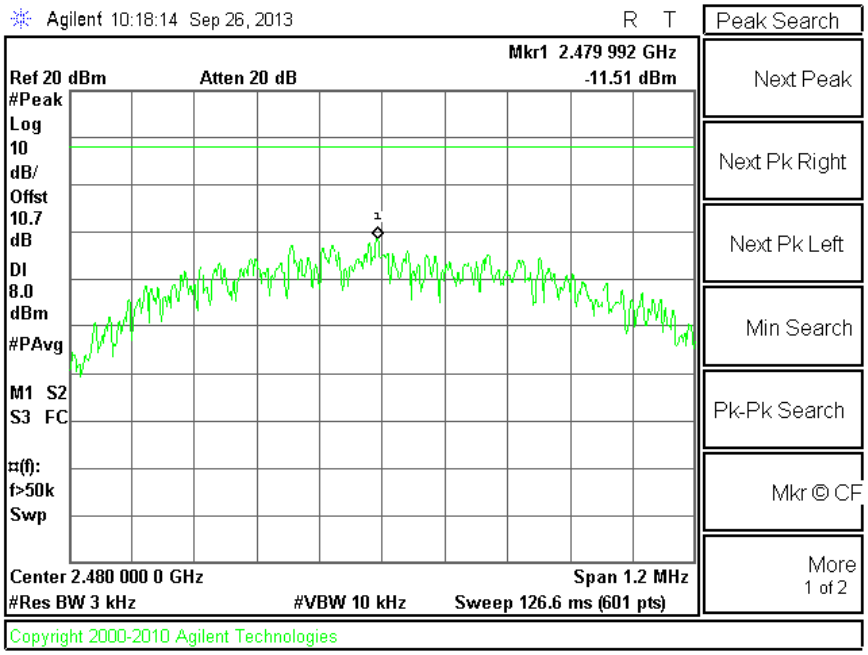
POWER SPECTRAL DENSITY





This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

PSD HIGH CH



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

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

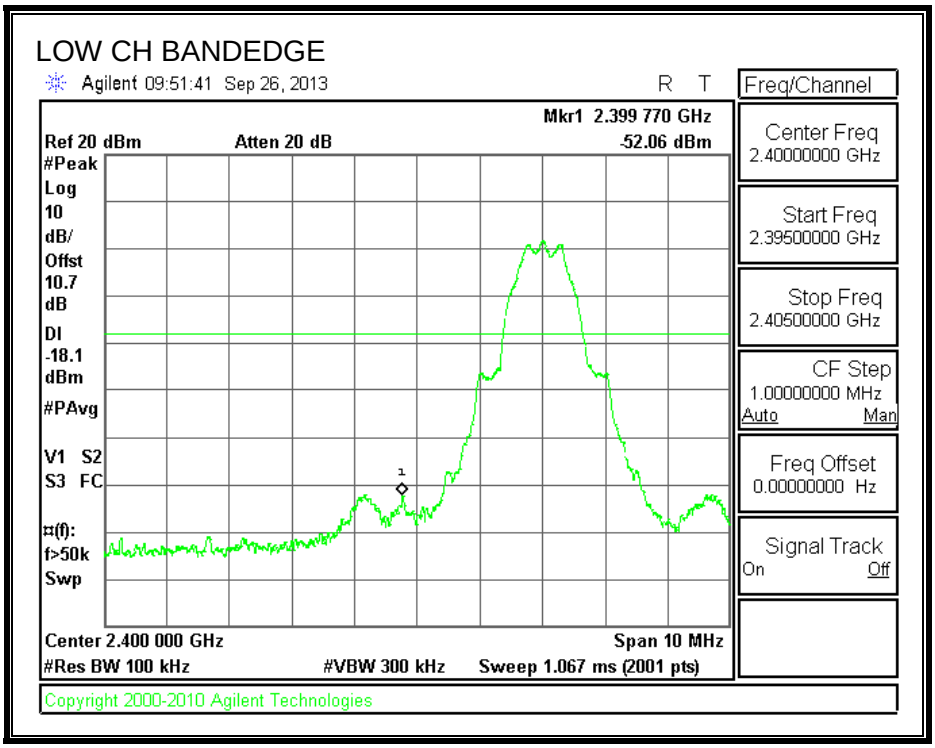
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

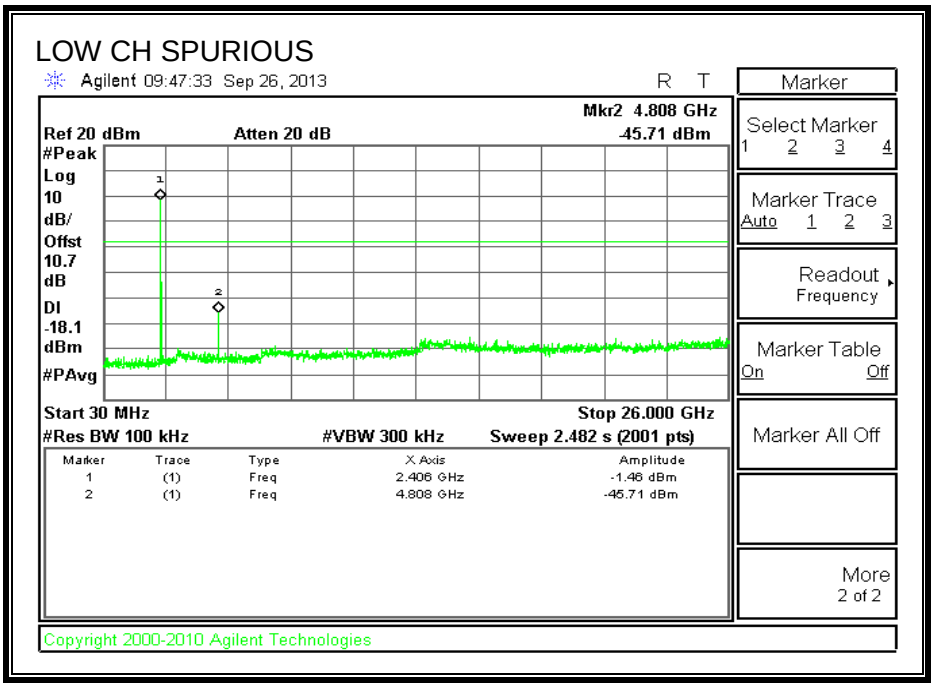
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

RESULTS

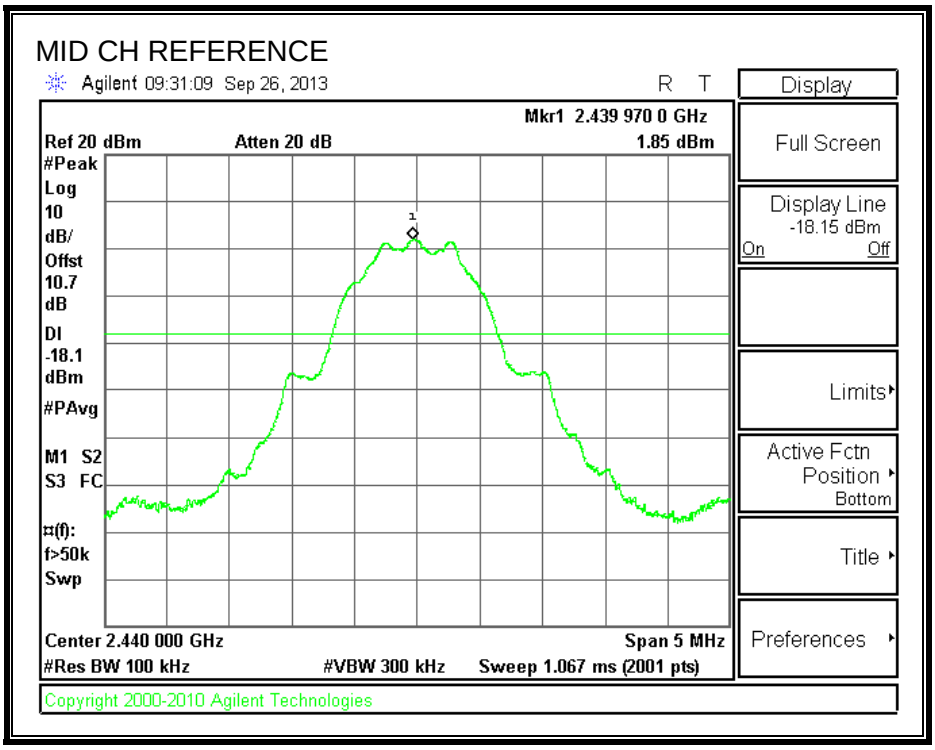
SPURIOUS EMISSIONS, LOW CHANNEL

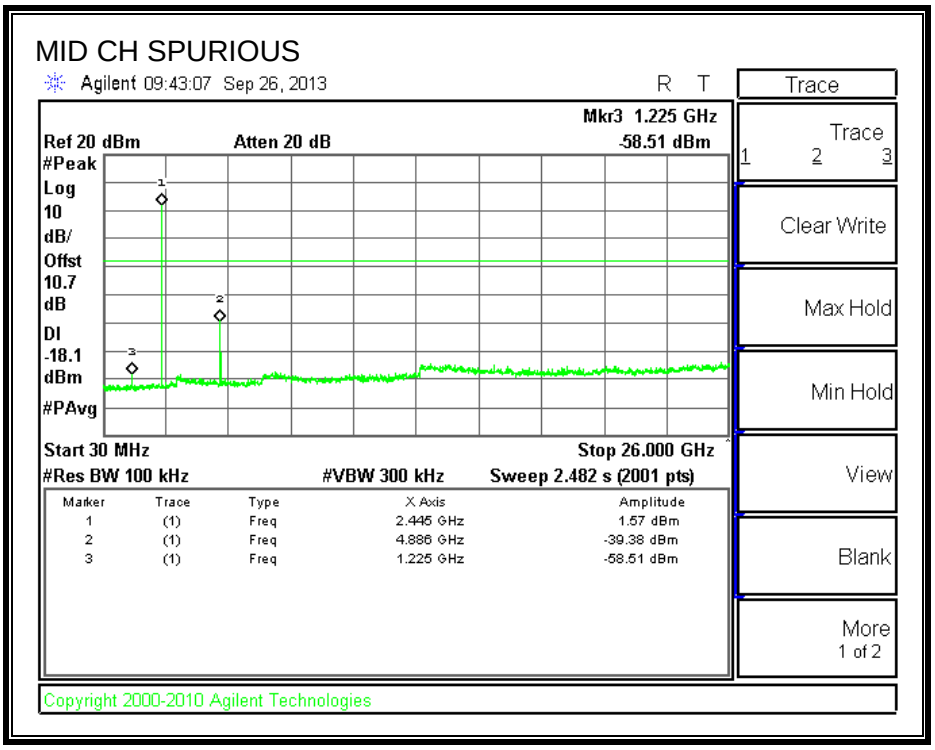




This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

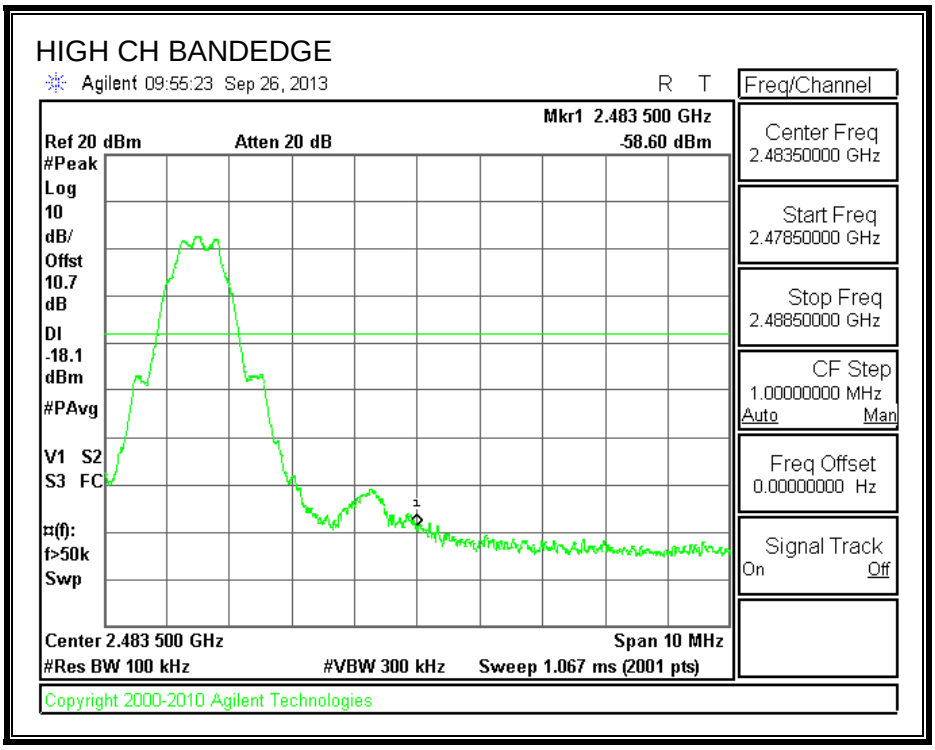
SPURIOUS EMISSIONS, MID CHANNEL

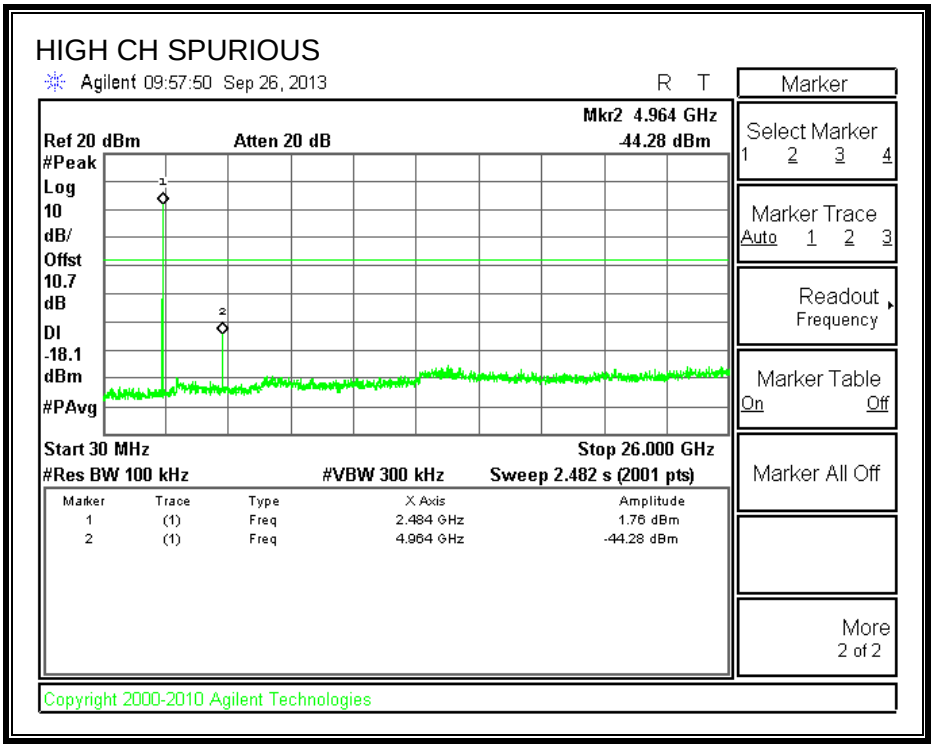




This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

SPURIOUS EMISSIONS, HIGH CHANNEL





This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

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 C63.10. 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 3 MHz for peak and 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.

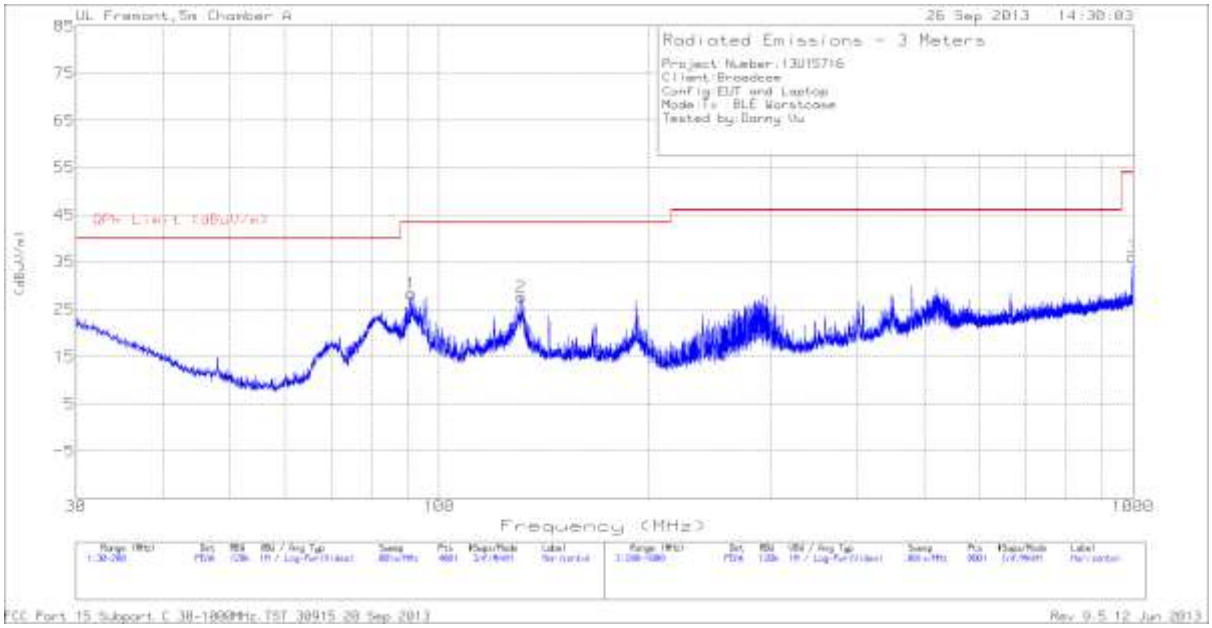
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

8.2. WORST-CASE BELOW 1 GHz

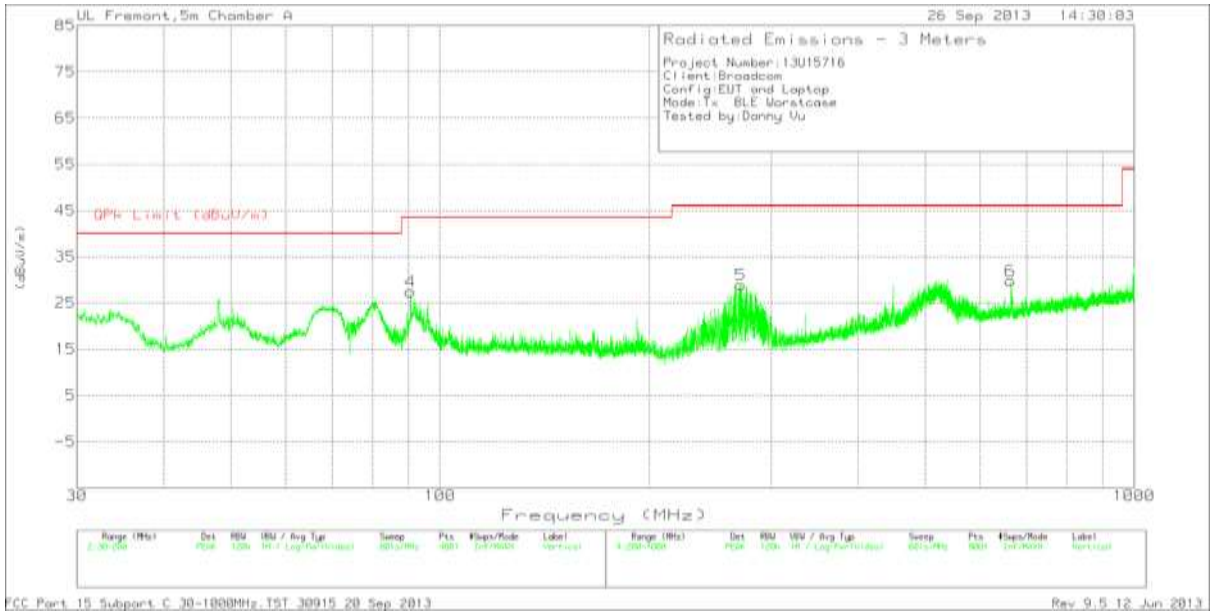
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT



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

VERTICAL PLOT



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

HORIZONTAL AND VERTICAL DATA

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T477 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	912425	47.35	PK	8	-27	28.35	43.52	-15.17	0-360	300	H
2	131405	40.88	PK	13.5	-26.7	27.68	43.52	-15.84	0-360	200	H
4	90.7325	46.57	PK	7.9	-27	27.47	43.52	-16.05	0-360	100	V
3	998.8	36.07	PK	22.7	-22.6	36.17	53.97	-17.8	0-360	200	H
5	2711	41.73	PK	12.9	-25.7	28.93	46.02	-17.09	0-360	200	V
6	663.6	33.37	PK	19.3	-22.9	29.77	46.02	-16.25	0-360	200	V

PK - Peak detector

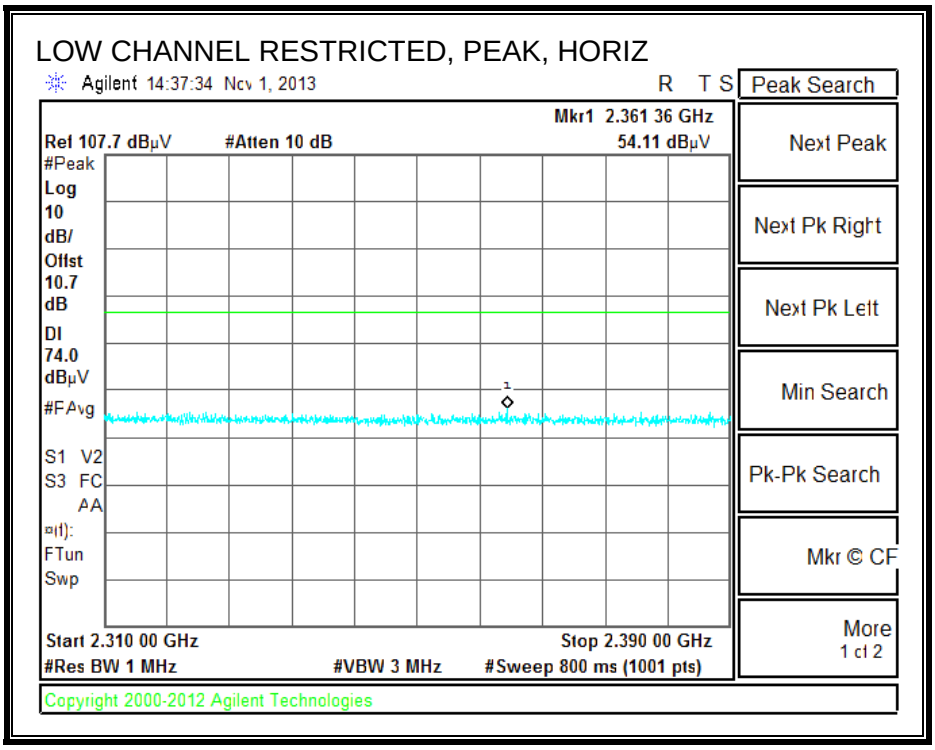
FCC Part 15 Subpart C 30-1000MHz.TST 30915 20 Sep 2013 Rev 9.5 12 Jun 2013

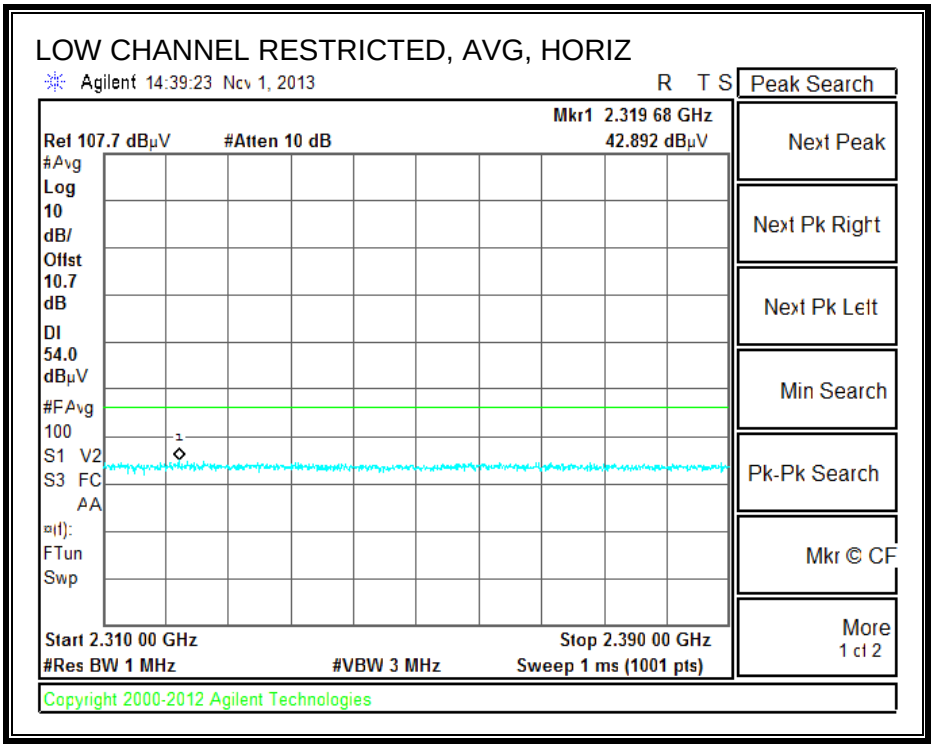
UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701I
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

8.3. TX ABOVE 1 GHz FOR BLUETOOTH LOW ENERGY MODE

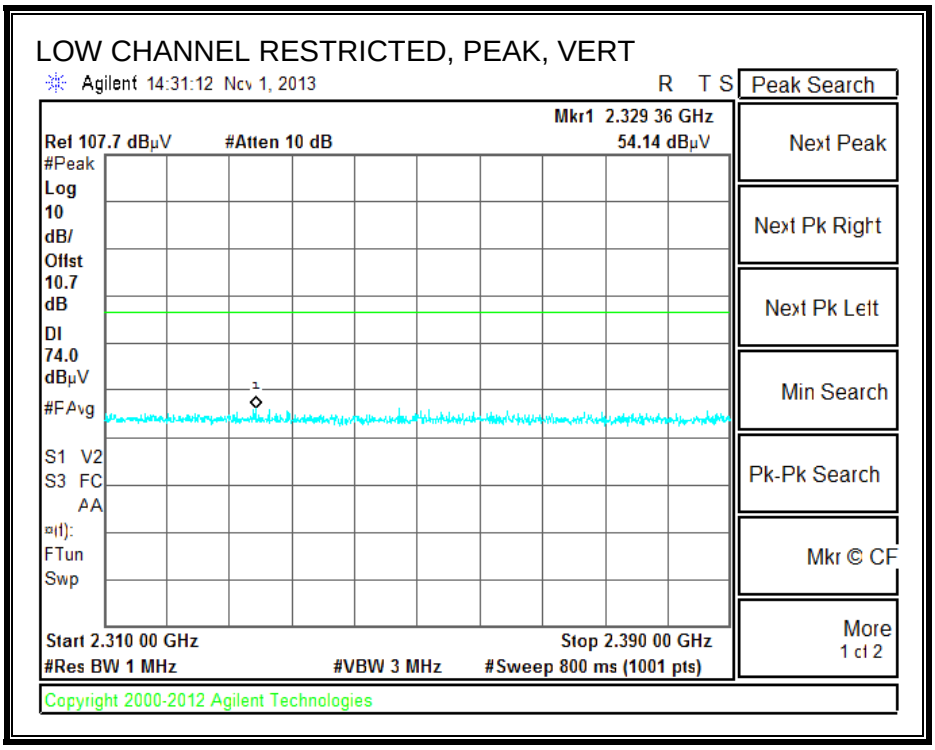
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

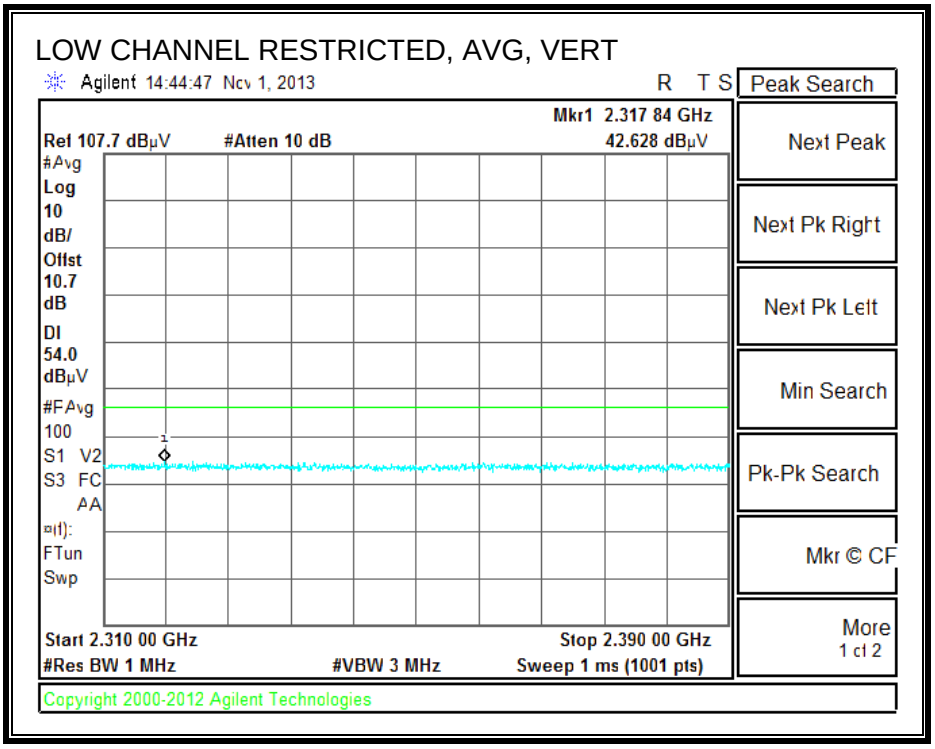




This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

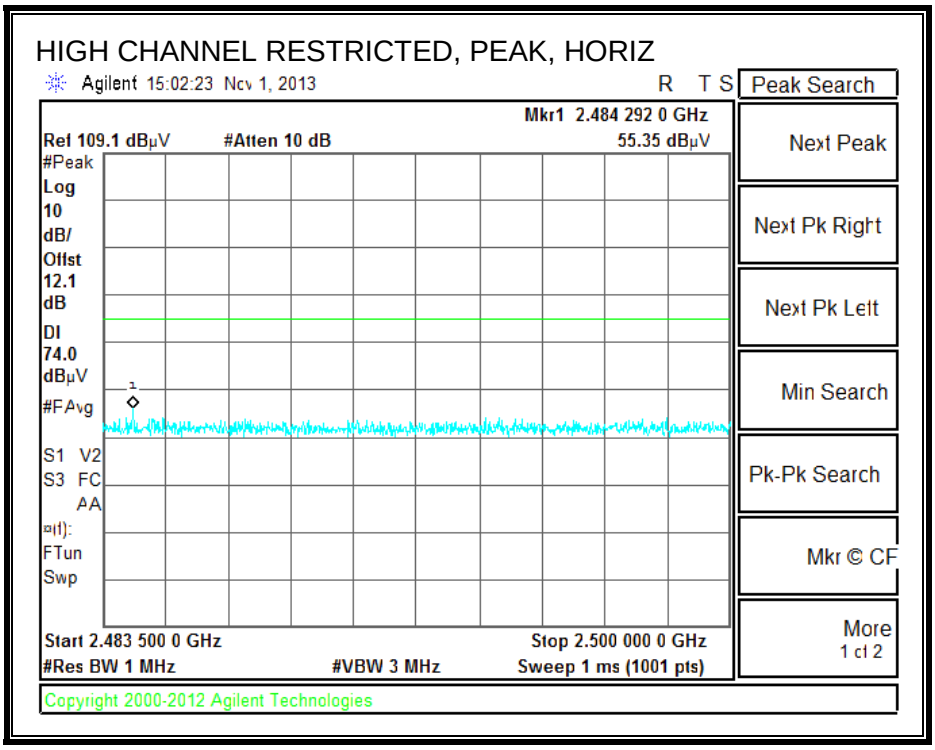
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

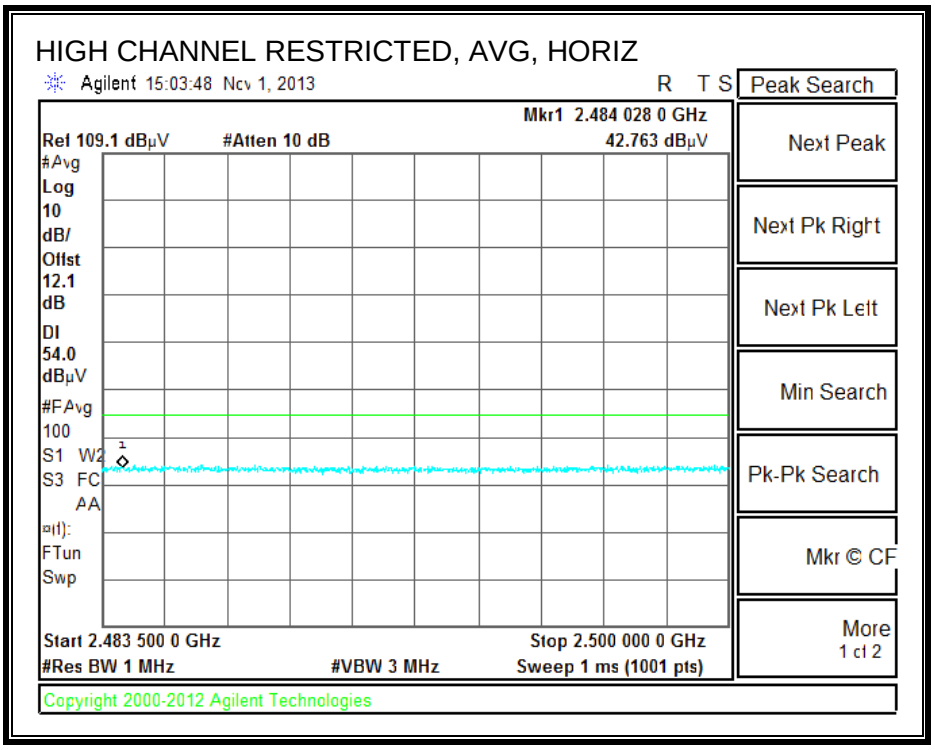




This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

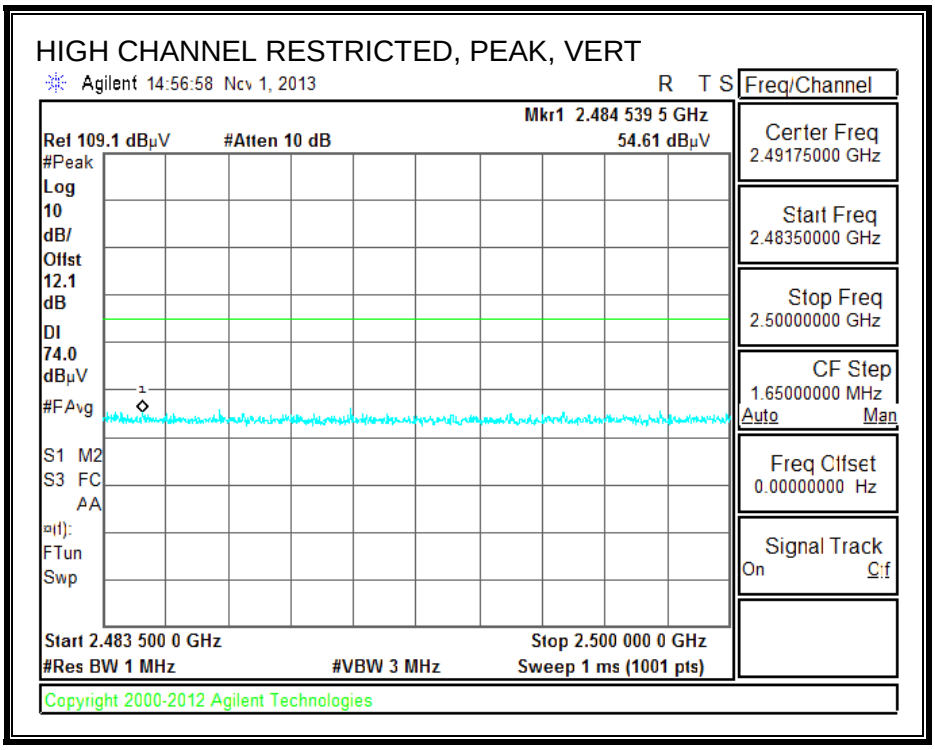
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

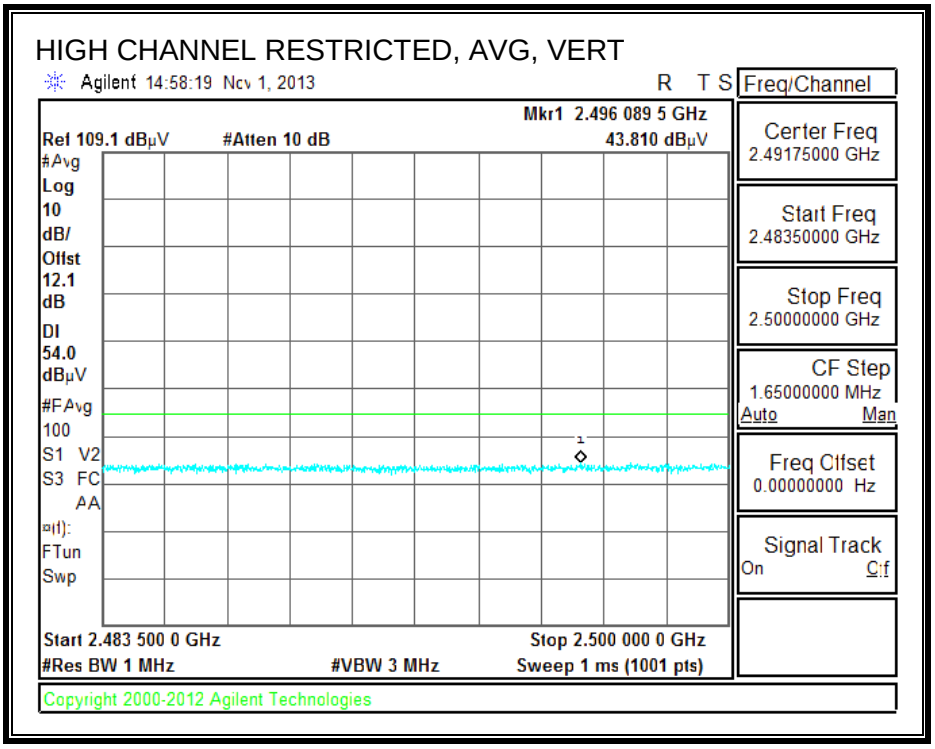




This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

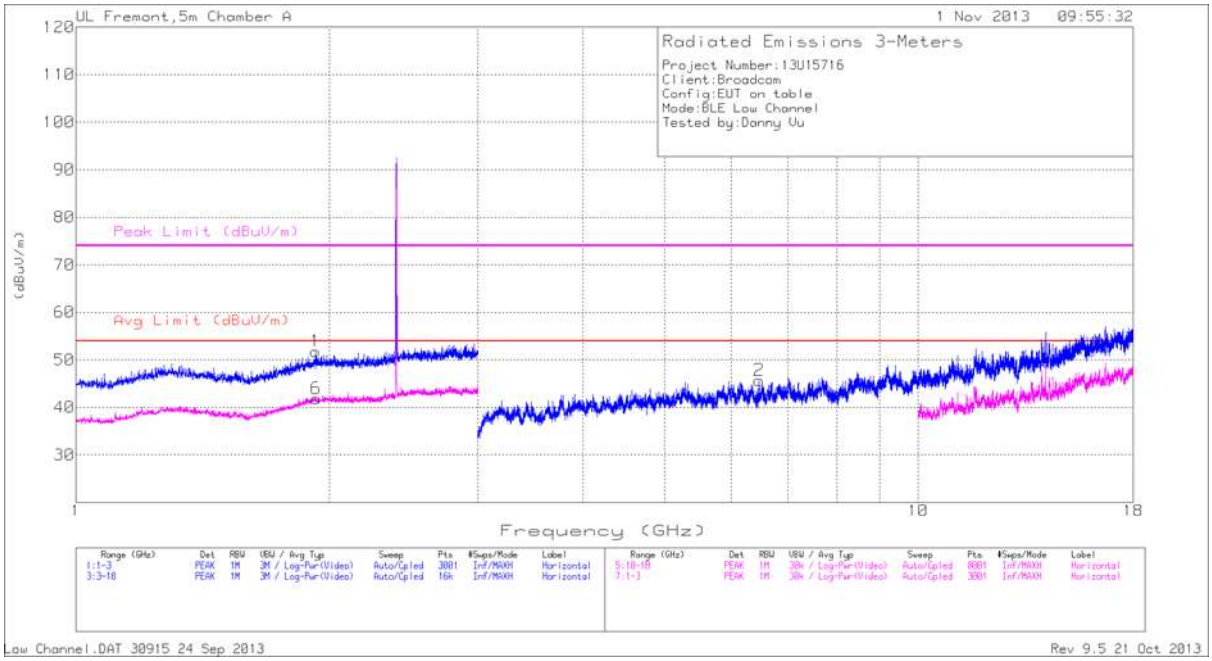




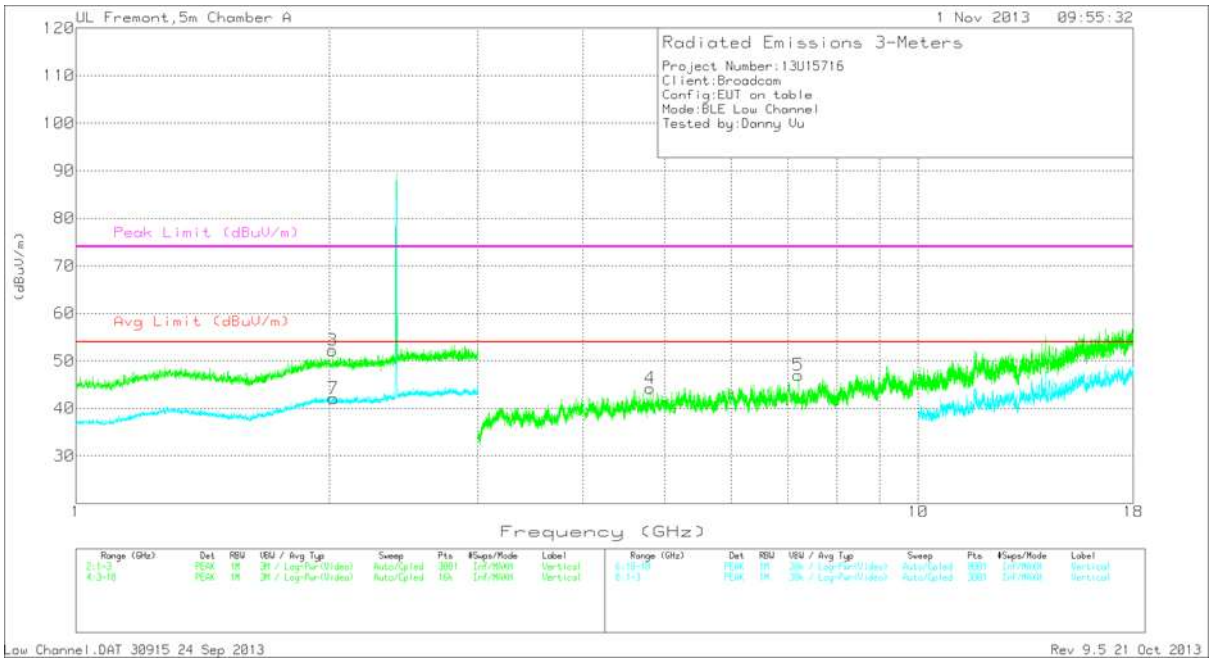
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

LOW CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Flt r/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.925	43.89	PK	31.8	-23.9	51.79	-	-	74	-22.21	0-360	200	H
3	2.017	44.01	PK	31.8	-23.6	52.21	-	-	74	-21.79	0-360	100	V
2	6.474	38.25	PK	35.5	-28.1	45.65	53.97	-8.32	74	-28.35	0-360	100	H
4	4.804	37.58	PK	33.9	-27.3	44.18	53.97	-9.79	74	-29.82	0-360	200	V
5	7.205	38.49	PK	35.4	-26.9	46.99	53.97	-6.98	74	-27.01	0-360	200	V
6	1.929	33.84	Avg	31.8	-23.8	41.84	53.97	-12.13	74	-32.16	0-360	100	H
7	2.021	33.78	Avg	31.8	-23.5	42.08	53.97	-11.89	74	-31.92	0-360	200	V

PK - Peak detector

Avg - Video bandwidth < Resolution bandwidth

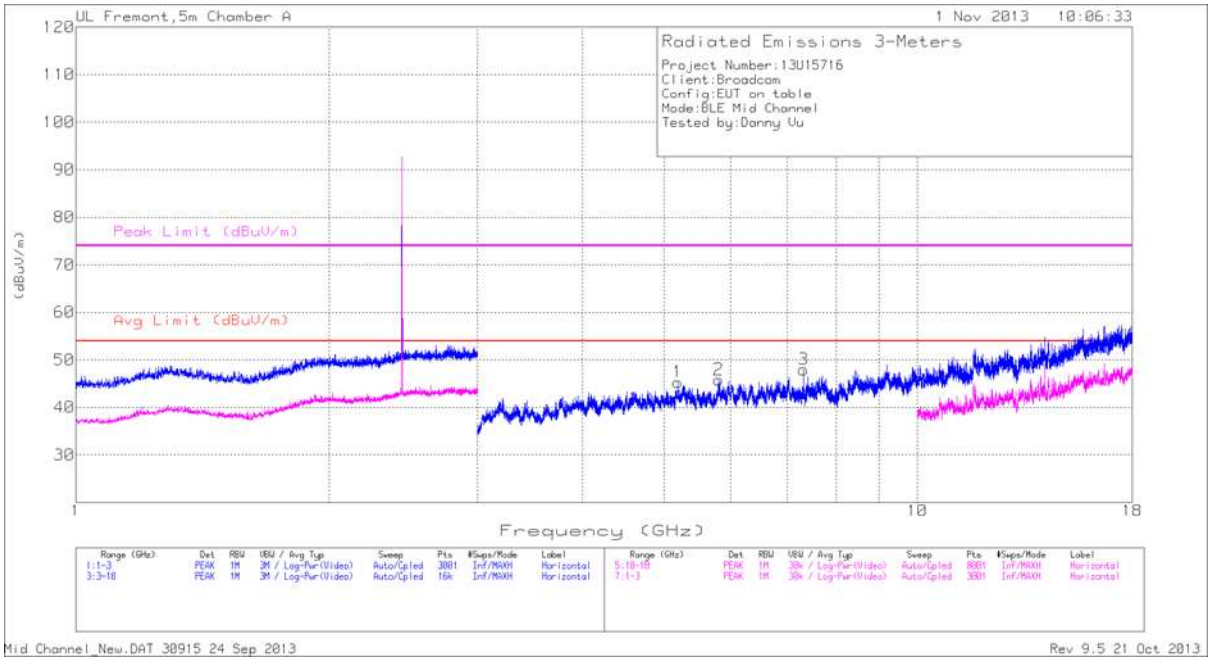
FCC Part15 Subpart C 2400MHz Spurious Emissions with Average Scan.TST 30915 24 Sep 2013 Rev 9.5 21 Oct 2013

Note: No other radiated emissions were found above system noise floor from 18 to 26GHz.

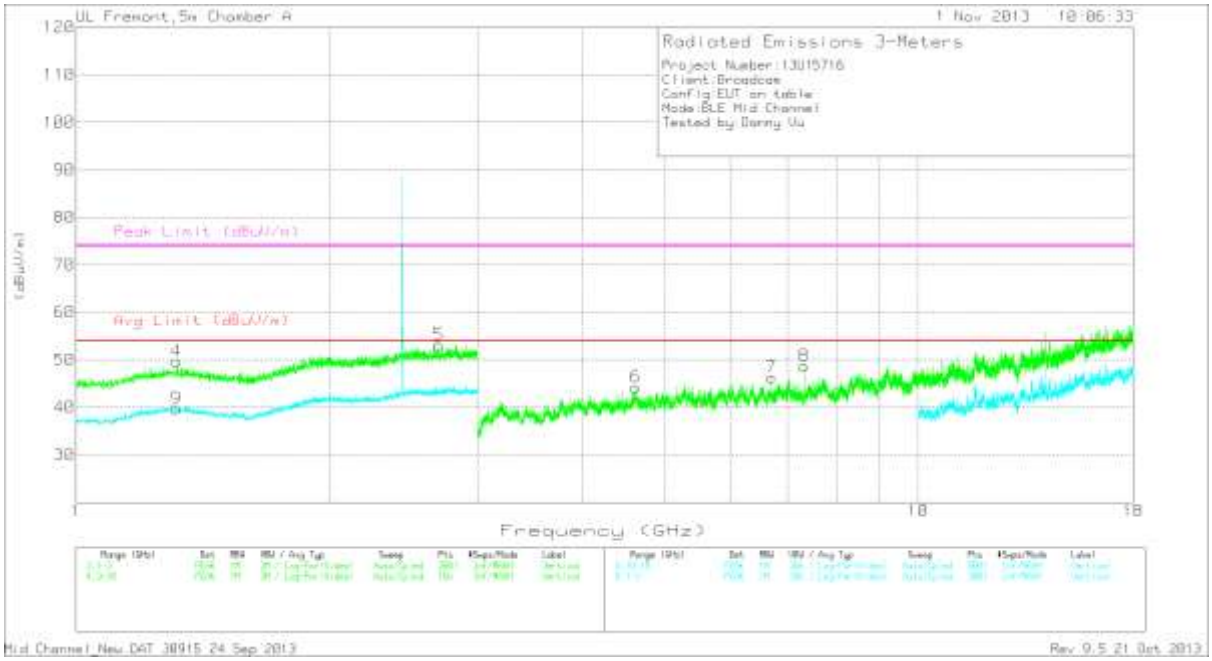
UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701I
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL



Note: No other radiated emissions were found above system noise floor from 18 to 26GHz

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

MID CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
9	1.315	34.63	Avg	30.2	-25.1	39.73	53.97	-14.24	74	-34.27	0-360	200	V
4	1.316	44.6	PK	30.2	-25.1	49.7	-	-	74	-24.3	0-360	100	V
5	2.697	42.86	PK	32.7	-22.4	53.16	-	-	74	-20.84	0-360	100	V
1	5.19	38.11	PK	34.2	-27	45.31	53.97	-8.66	74	-28.69	0-360	100	H
2	5.808	38.97	PK	34.8	-28	45.77	53.97	-8.2	74	-28.23	0-360	100	H
3	7.321	37.77	PK	35.3	-25.1	47.97	53.97	-6	74	-26.03	0-360	200	H
6	4.62	38.14	PK	33.9	-27.8	44.24	53.97	-9.73	74	-29.76	0-360	200	V
7	6.698	37.46	PK	35.4	-26.5	46.36	53.97	-7.61	74	-27.64	0-360	100	V
8	7.32	38.53	PK	35.3	-25.1	48.73	53.97	-5.24	74	-25.27	0-360	100	V

PK - Peak detector

Avg - Video bandwidth < Resolution bandwidth

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2.69	31.92	MAv1	32.7	-22.4	42.22	53.97	-11.75	74	-31.78	23	125	V
7.32	30	MAv1	35.3	-25.1	40.2	53.97	-13.77	74	-33.8	233	128	V

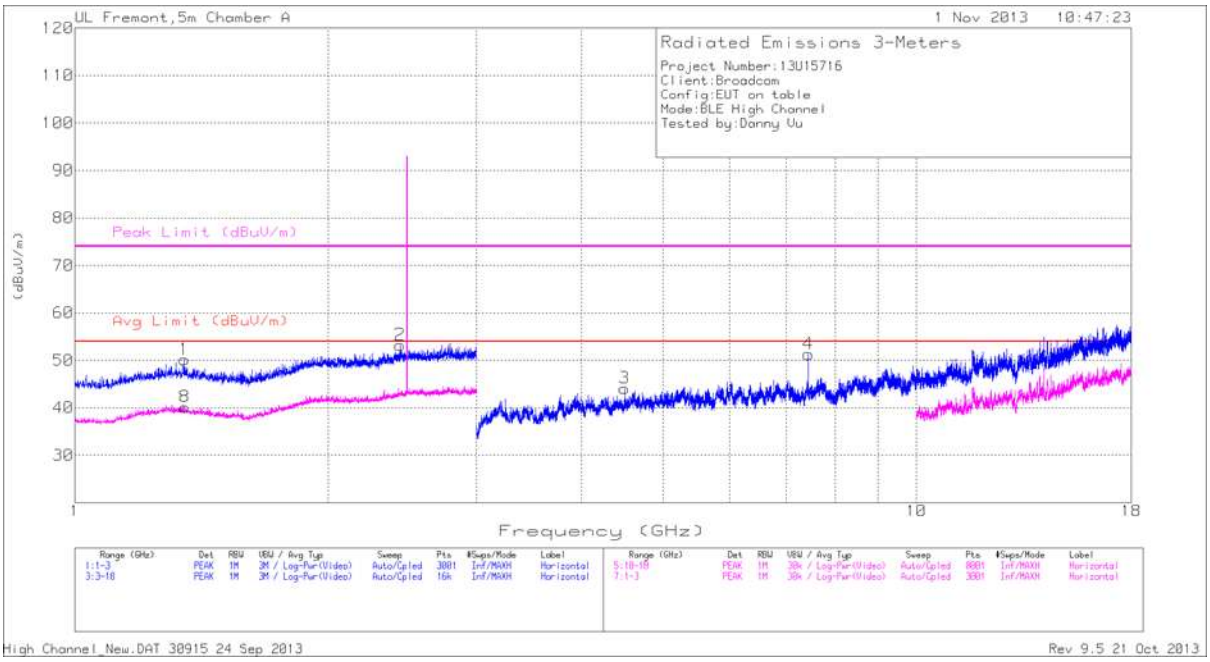
MAv1 - KDB558074 Option 1 Maximum RMS Average

Mid Channel_New.DAT 30915 24 Sep 2013 Rev 9.5 21 Oct 2013

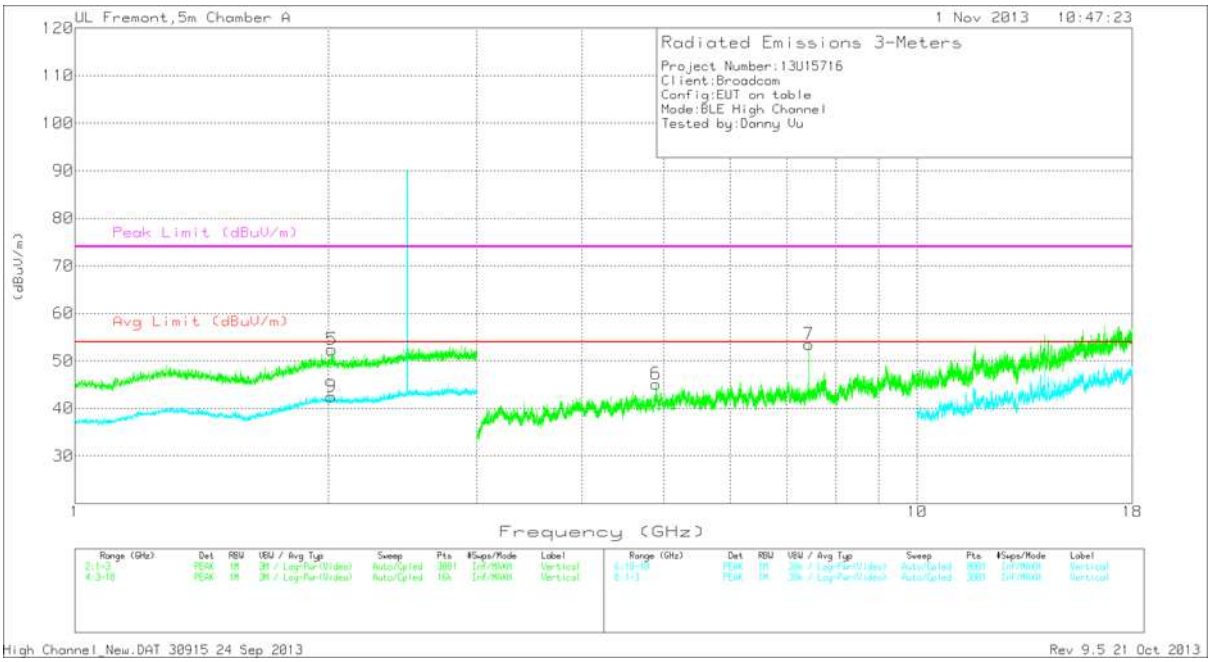
w/ DCCF: 42.22 dBuV/m + 2.03 = 44.25 dBuV/m – 53.97 dBuV/m = - 9.72 dB
w/ DCCF: 40.2 dBuV/m + 2.03 = 42.23 dBuV/m – 53.97 dBuV/m = - 11.74 dB

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701I
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

HIGH CHANNEL DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Flt r/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
8	1.351	35.14	Avg	30	-25	40.14	53.97	-13.83	74	-33.86	0-360	200	H
9	2.015	34.21	Avg	31.9	-23.6	42.51	54.97	-12.46	74	-31.49	0-360	100	V
1	1.349	45.08	PK	30.1	-25	50.18	-	-	74	-23.82	0-360	200	H
2	2.435	43.59	PK	32.3	-22.7	53.19	53.97	-0.78	74	-20.81	0-360	100	H
5	2.018	44.18	PK	31.8	-23.6	52.38	-	-	74	-21.62	0-360	200	V
3	4.499	38.51	PK	33.8	-28.2	44.11	53.97	-9.86	74	-29.89	0-360	100	H
4	7.441	41.9	PK	35.4	-26	51.3	53.97	-2.67	74	-22.7	0-360	200	H
6	4.897	37.83	PK	34	-26.7	45.13	53.97	-8.84	74	-28.87	0-360	100	V
7	7.44	43.95	PK	35.4	-25.9	53.45	53.97	-0.52	74	-20.55	0-360	100	V

PK - Peak detector

Avg - Video bandwidth < Resolution bandwidth

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Flt r/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2.437	32.45	MAv1	32.3	-22.8	41.95	53.97	-12.02	74	-32.05	83	260	H
7.44	26.3	MAv1	35.4	-25.9	35.8	53.97	-18.17	74	-38.2	243	366	H
7.44	28.42	MAv1	35.4	-25.9	37.92	53.97	-16.05	74	-36.08	201	121	V

MAv1 - KDB558074 Option 1 Maximum RMS Average

High Channel_New.DAT 30915 24 Sep 2013 Rev 9.5 21 Oct 2013

w/ DCCF: 41.95 dBuV/m + 2.03 = 43.98 dBuV/m – 53.97 dBuV/m = - 9.99 dB
w/ DCCF: 35.8 dBuV/m + 2.03 = 37.83 dBuV/m – 53.97 dBuV/m = - 16.14 dB
w/ DCCF: 37.92 dBuV/m + 2.03 = 39.95 dBuV/m – 53.97 dBuV/m = - 14.02 dB

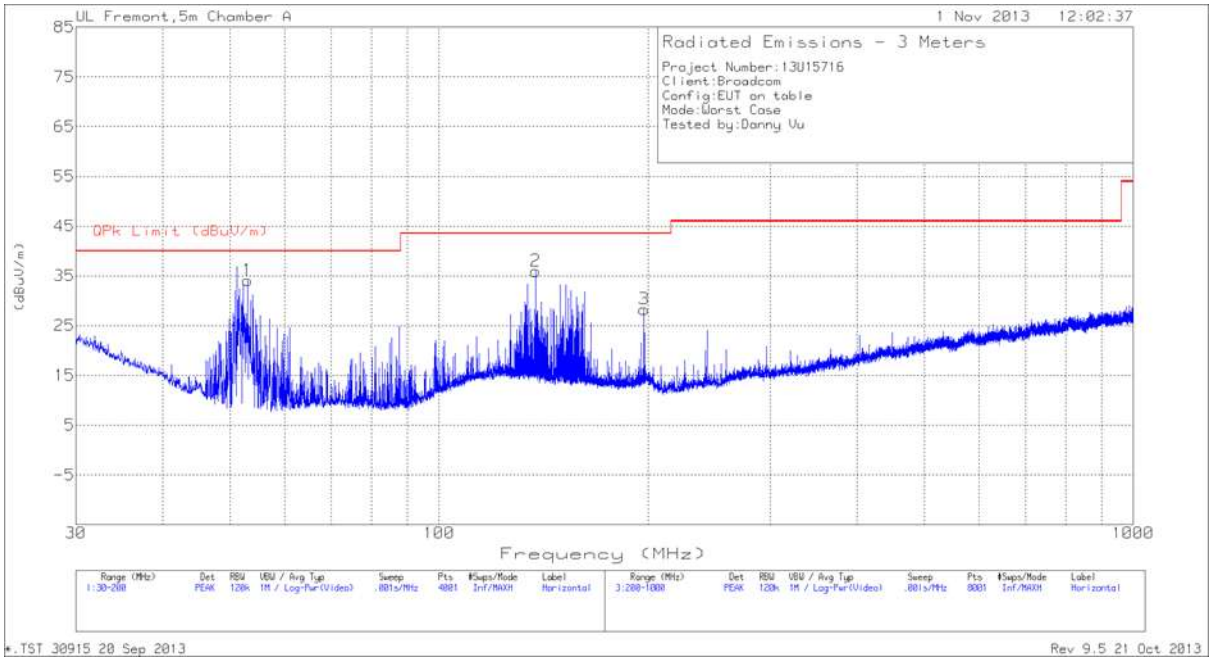
Note: No other radiated emissions were found above system noise floor from 18 to 26GHz

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

8.4. WORST-CASE BELOW 1 GHz

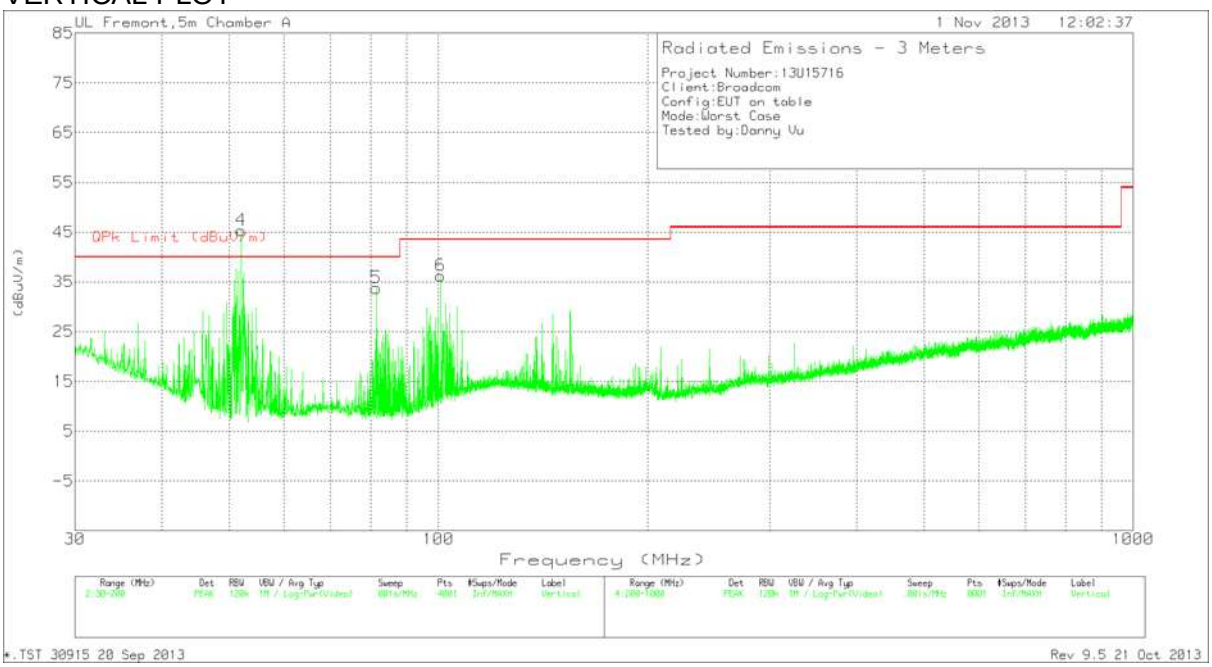
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT



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

VERTICAL PLOT



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

HORIZONTAL AND VERTICAL DATA

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T477 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	53.035	54.3	PK	7.2	-27.4	34.1	40	-5.9	0-360	400	H
2	137.78	49.64	PK	12.9	-26.6	35.94	43.52	-7.58	0-360	200	H
3	197.45	42.4	PK	12	-26.1	28.3	43.52	-15.22	0-360	100	H
4*	52.015	65.55	PK	7.2	-27.4	45.35	40	5.35	0-360	100	V
5	813825	53.17	PK	7.6	-27	33.77	40	-6.23	0-360	100	V
6	100.805	52.66	PK	10.5	-26.9	36.26	43.52	-7.26	0-360	100	V

Note: * Spike verified due to external Power Supply

PK - Peak detector

Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T477 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
52.015	18.74	PK	7.2	-27.4	3146	40	-1146	360	261	V

PK - Peak detector

Below 1GHz_New.DAT 30915 20 Sep 2013 Rev 9.5 21 Oct 2013

UL VERIFICATION SERVICES INC.
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888

FORM NO: CCSUP4701I

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

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

ANSI C63.4

RESULTS

This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

6 WORST EMISSIONS

Line-L1 .15 - 30MHz

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1 (dB)	LC Cables 1&3 (dB)	Corrected Reading	CISPR 11/22 Class B Quasi-	Margin to Limit (dB)	CISPR 11/22 Class B	Margin to Limit (dB)
1	0.456	48.93	PK	0.1	0	49.03	56.8	-7.77	-	-
2	0.456	42.2	Av	0.1	0	42.3	-	-	46.8	-4.5
3	1.248	35.33	PK	0.1	0	35.43	56	-20.57	-	-
4	1.248	24.69	Av	0.1	0	24.79	-	-	46	-21.21
5	13.1595	25.74	PK	0.2	0.2	26.14	60	-33.86	-	-
6	13.1595	14.9	Av	0.2	0.2	15.3	-	-	50	-34.7

Line-L2 .15 - 30MHz

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2 (dB)	LC Cables 2&3 (dB)	Corrected Reading dB(uVolts)	CISPR 11/22 Class B Quasi-peak	Margin to Limit (dB)	CISPR 11/22 Class B Average	Margin to Limit (dB)
7	0.456	48.43	PK	0.1	0	48.53	56.8	-8.27	-	-
8	0.456	42.1	Av	0.1	0	42.2	-	-	46.8	-4.6
9	0.7755	35.1	PK	0.1	0	35.2	56	-20.8	-	-
10	0.7755	26.08	Av	0.1	0	26.18	-	-	46	-19.82
11	15.6165	23.98	PK	0.2	0.2	24.38	60	-35.62	-	-
12	15.6165	16.66	Av	0.2	0.2	17.06	-	-	50	-32.94

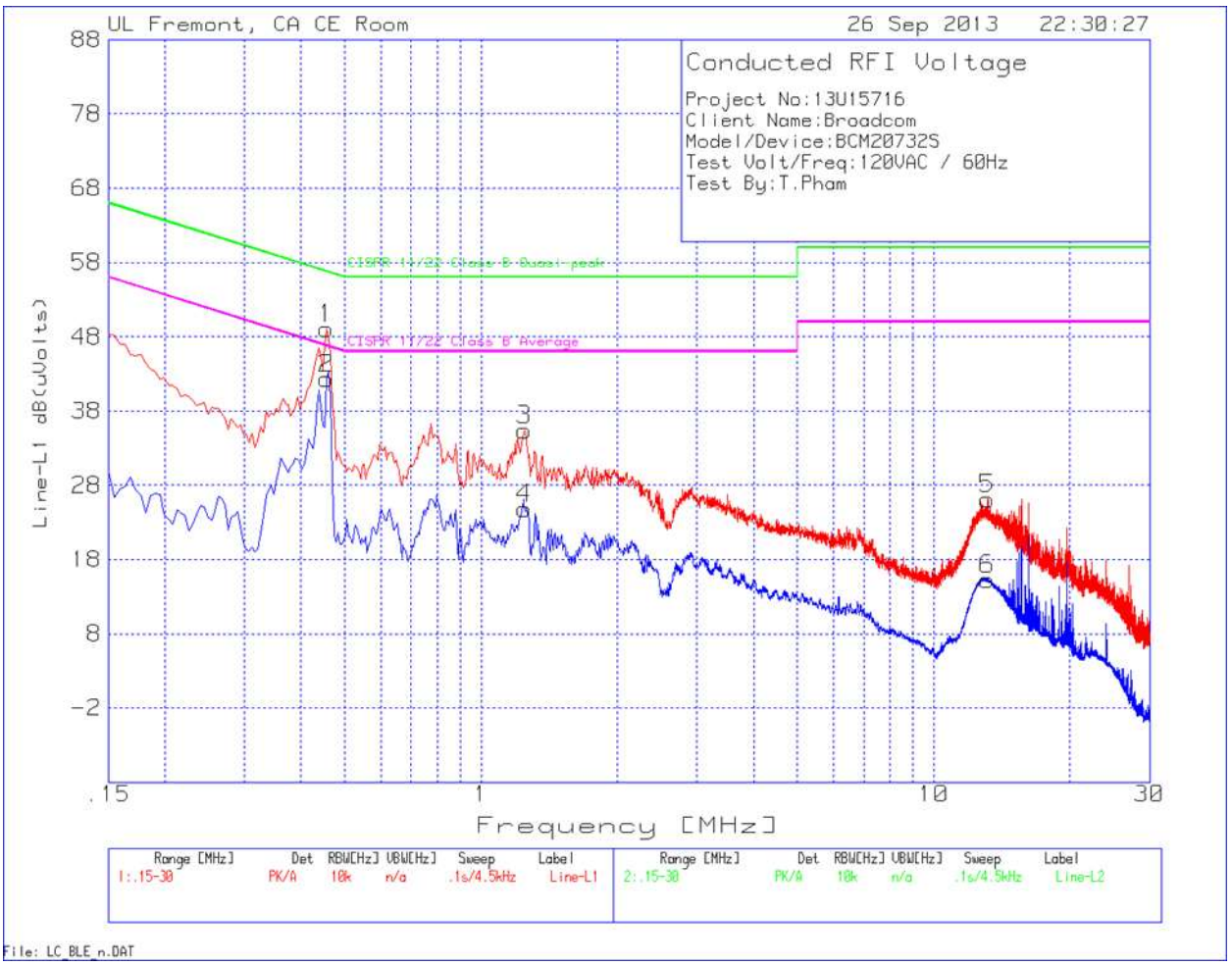
PK - Peak detector

Av - average detection

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701I
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888

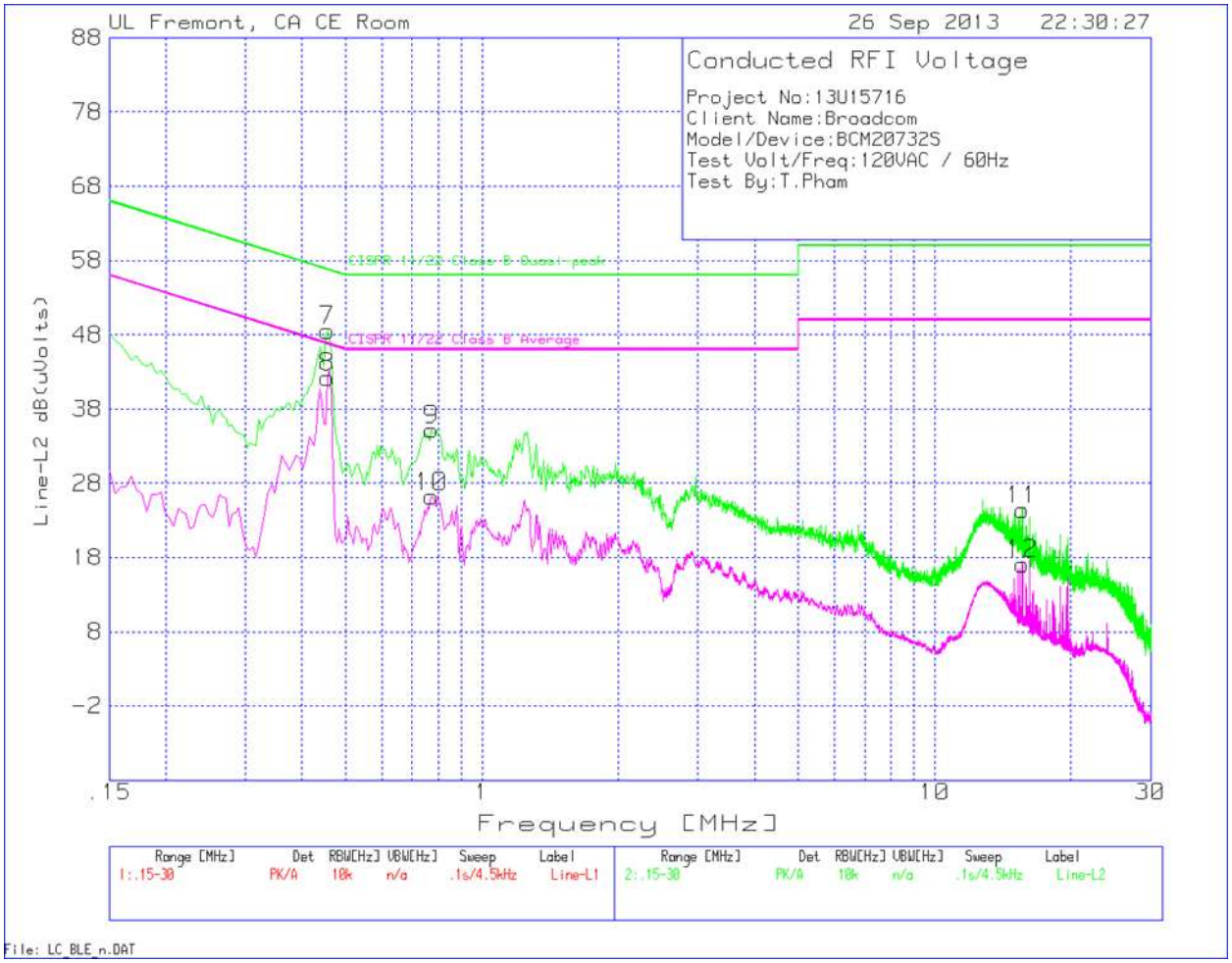
This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

LINE 1 RESULTS



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.

LINE 2 RESULTS



This report shall not be reproduced except in full, without the written approval of UL Verification Services Inc.