



FCC CFR47 PART 15 SUBPART C

**BLUETOOTH LOW ENERGY
CERTIFICATION TEST REPORT**

FOR

GLASS

MODEL NUMBER: XEB

FCC ID: A4R-X1

REPORT NUMBER: 13U14955-3, REVISION A

ISSUE DATE: APRIL 12, 2013

Prepared for
GOOGLE INC.
1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW CA, 94043, U.S.A

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



NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	04/05/13	Initial Issue	T. LEE
A	04/12/13	Correction to model on cover page	G. Persons

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	4
TEST METHODOLOGY	5
2. FACILITIES AND ACCREDITATION	5
3. CALIBRATION AND UNCERTAINTY	5
3.1. <i>MEASURING INSTRUMENT CALIBRATION</i>	<i>5</i>
3.2. <i>SAMPLE CALCULATION</i>	<i>5</i>
3.3. <i>MEASUREMENT UNCERTAINTY</i>	<i>5</i>
4. EQUIPMENT UNDER TEST	6
4.1. <i>DESCRIPTION OF EUT</i>	<i>6</i>
4.2. <i>MAXIMUM OUTPUT POWER.....</i>	<i>6</i>
4.3. <i>DESCRIPTION OF CLASS II PERMISSIVE CHANGE</i>	<i>6</i>
4.4. <i>DESCRIPTION OF AVAILABLE ANTENNAS</i>	<i>6</i>
4.5. <i>SOFTWARE AND FIRMWARE.....</i>	<i>6</i>
4.6. <i>WORST-CASE CONFIGURATION AND MODE.....</i>	<i>6</i>
4.7. <i>DESCRIPTION OF TEST SETUP.....</i>	<i>7</i>
5. TEST AND MEASUREMENT EQUIPMENT	9
6. DUTY CYCLE.....	10
7. RADIATED TEST RESULTS.....	11
7.1. <i>LIMITS AND PROCEDURE</i>	<i>11</i>
7.2. <i>TX ABOVE 1 GHz FOR BLUETOOTH LOW ENERGY MODE IN THE 2.4 GHz BAND</i> <i>12</i>	
7.3. <i>WORST-CASE BELOW 1 GHz.....</i>	<i>17</i>
8. AC POWER LINE CONDUCTED EMISSIONS.....	19
9. SETUP PHOTOS.....	23

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: GOOGLE INC.
1600 AMPHITHEATRE PARKWAY
MOUNTAIN VIEW, CA, 94043, U.S.A

EUT DESCRIPTION: GLASS

MODEL: XEB

SERIAL NUMBER: ECABB131105243

DATE TESTED: APRIL 4, 2013

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



Tim Lee
WiSE PROGRAM MANAGER
UL CCS

Tested By:



MONA HUA
EMC ENGINEER
UL CCS

TEST METHODOLOGY

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

2. 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>.

3. CALIBRATION AND UNCERTAINTY

3.1. 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.

3.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

3.3. 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%.

4. EQUIPMENT UNDER TEST

4.1. DESCRIPTION OF EUT

The EUT is a glass providing a heads-up video display. The device incorporates an 802.11 b/g 2.4 GHz WLAN and BT radio. This report covers the Bluetooth Low Energy.

4.2. MAXIMUM OUTPUT POWER

The measured average power values were within ± 0.5 dB of the original values. Refer to original report number "12U14656-4A" for exact output power values and for all antenna port results.

4.3. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

The change filed under this application has the following changes.

The antenna length was increased by 2.5mm.

The Wifi antenna battery pod grounding was changed

4.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a coaxial monopole antenna with a maximum gain of 3.32 dBi.

4.5. SOFTWARE AND FIRMWARE

The firmware/software installed in the EUT during testing was 201303251100.

4.6. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed video playing with audio sound and 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, and Z. It was determined that Z-orientation was the worst-case orientation. Therefore, all final radiated testing was performed with the EUT in Z-orientation operated by AC adapter.

4.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

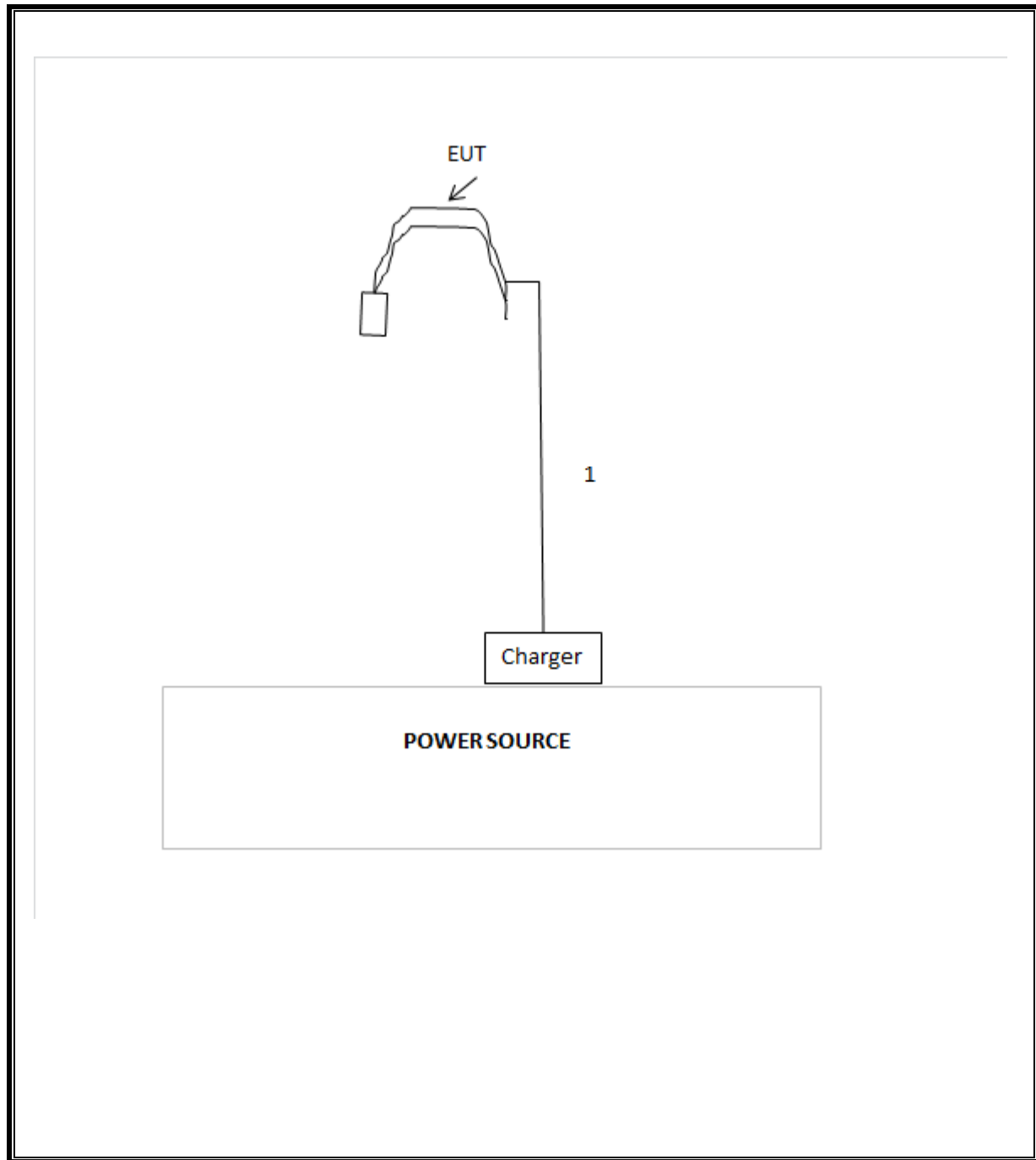
Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC Charger	GOOGLE	10AGE212020	N/A	N/A

I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC	1	USB	Shielded	1.2	No

TEST SETUP

The EUT was at the worst position and connected to the charger played the video script and transmit the worst case BLE mode.

SETUP DIAGRAM FOR TESTS

5. 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, Horn, 18 GHz	EMCO	3115	C00872	09/20/12	09/20/13
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00986	08/22/12	08/22/13
Antenna, Bilog, 30MHz-1 GHz	Sunol Sciences	JB1	C01011	04/23/12	04/23/13
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	11/11/12	11/11/13
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/08/12	08/08/13
LISN, 30 MHz	FCC	50/250-25-2	C00626	01/14/13	01/14/14

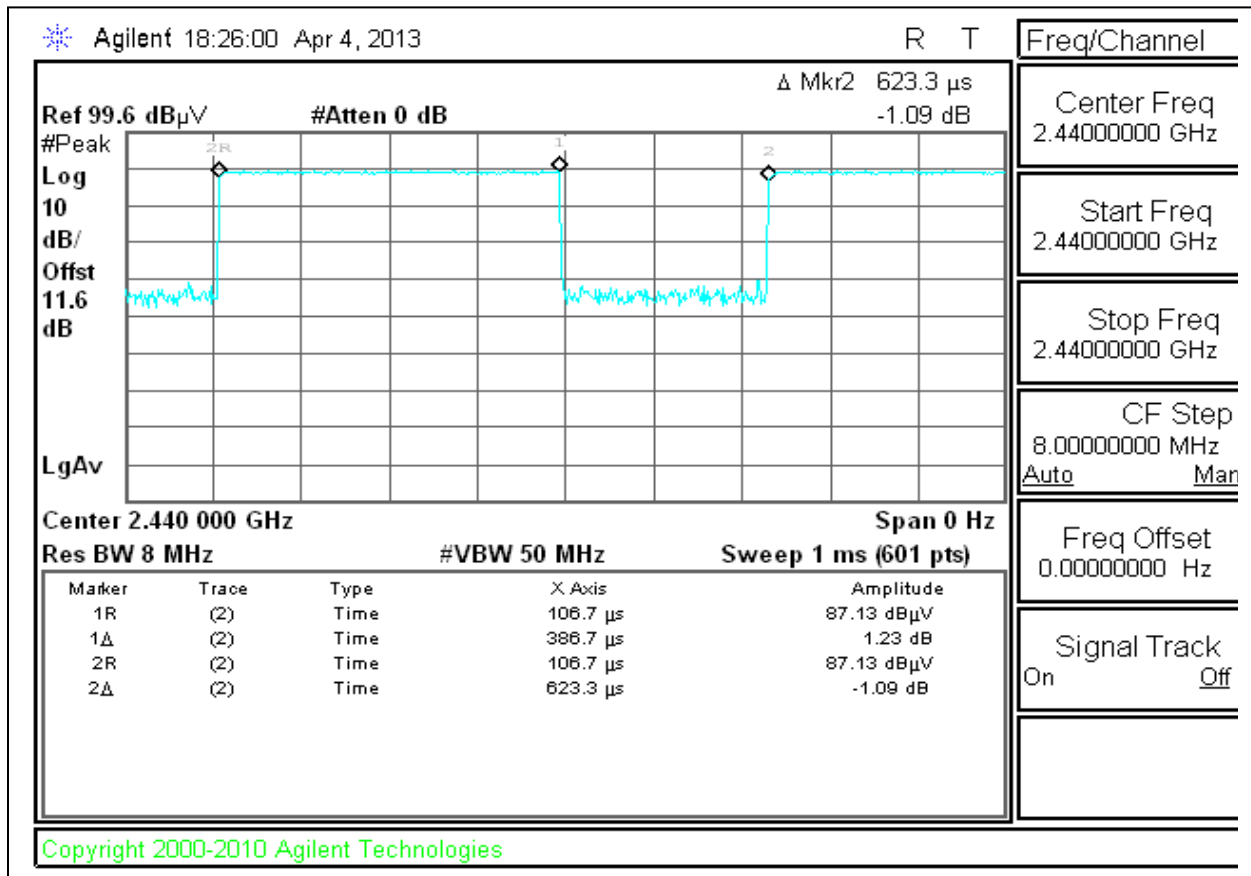
6. DUTY CYCLE

LIMITS

None; for reporting purposes only.

RESULTS

Mode	Tx on (usec)	Tx on + Tx off (usec)	Duty Cycle (%)	Correction Factor (dB)
BLE	386.7	623.3	62.04	2.07



7. RADIATED TEST RESULTS

7.1. 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.

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.

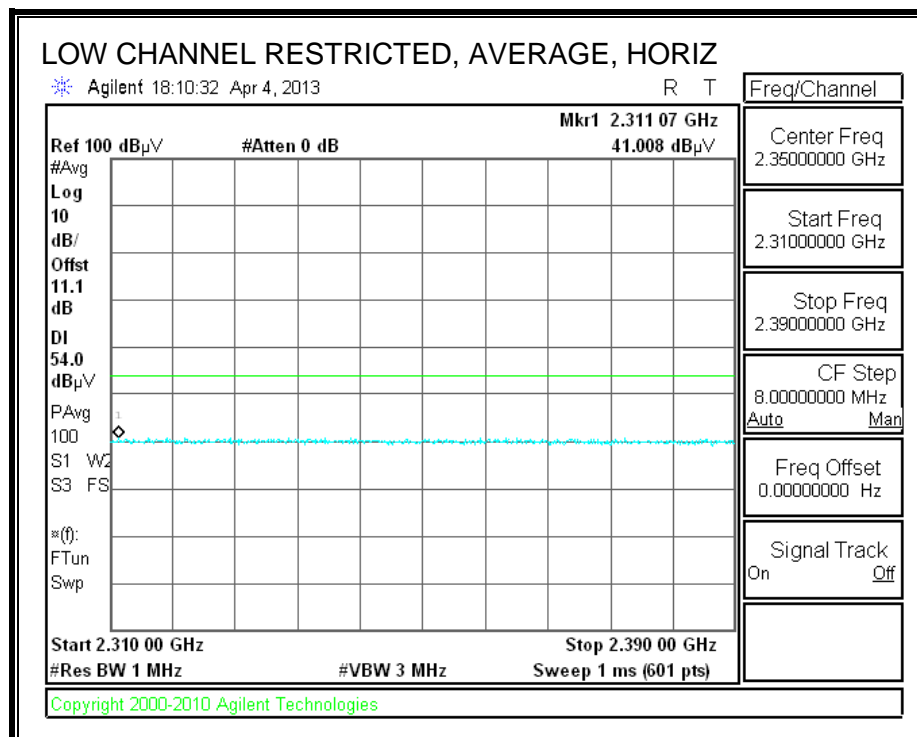
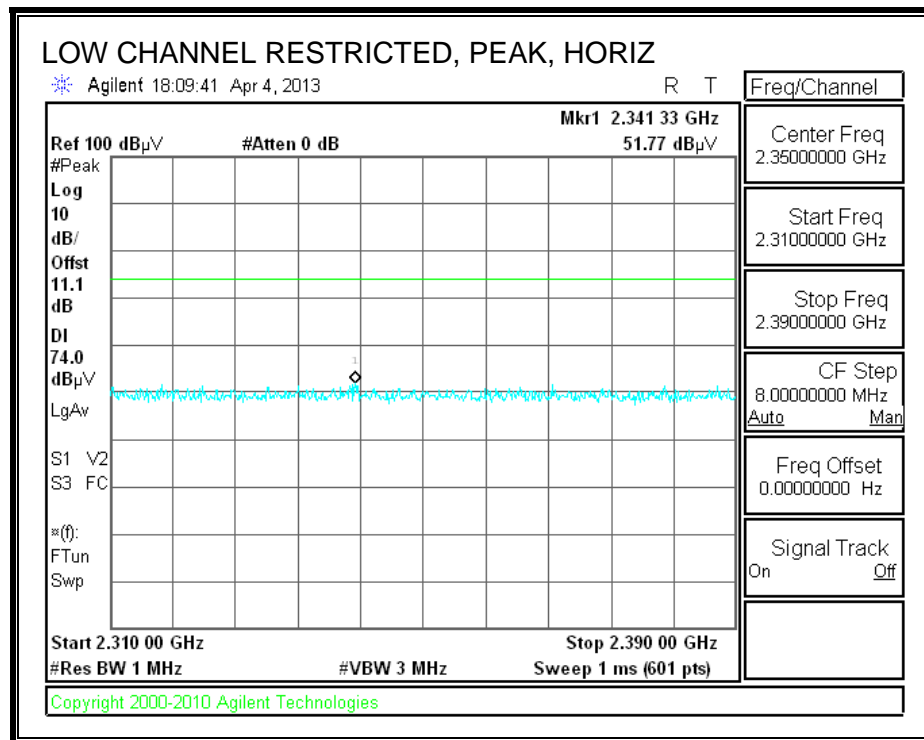
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 1 MHz for peak measurements and as applicable for average measurements.

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.

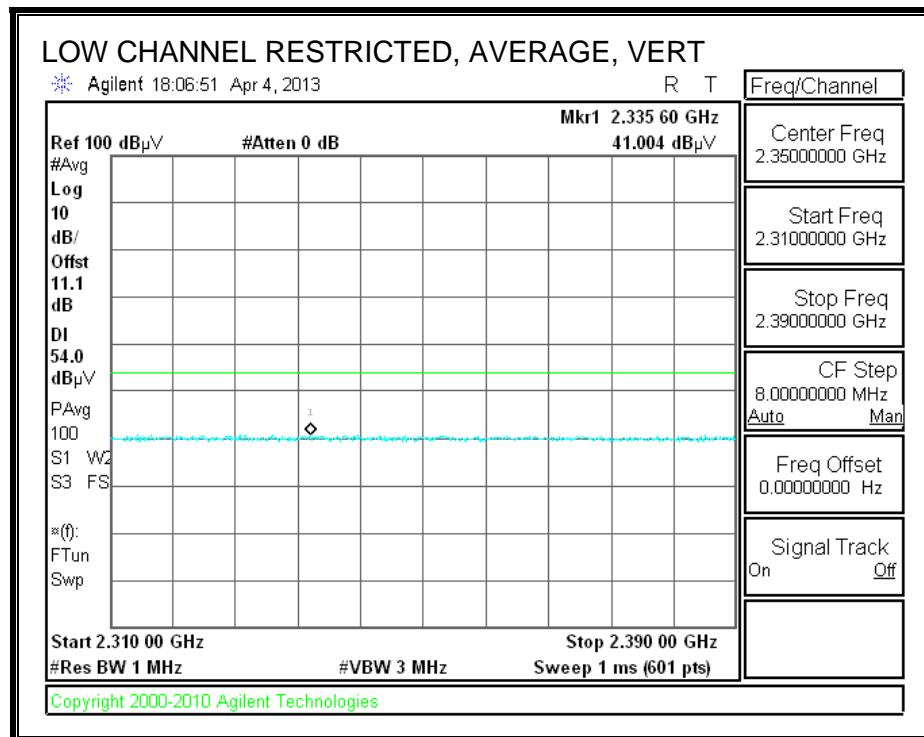
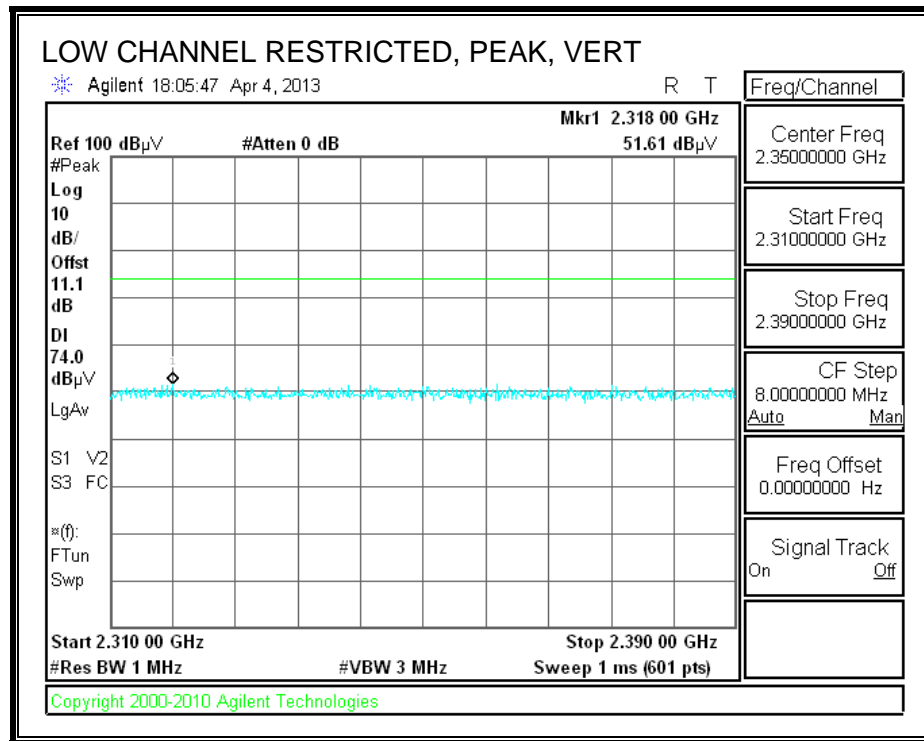
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

7.2. TX ABOVE 1 GHz FOR BLUETOOTH LOW ENERGY MODE IN THE 2.4 GHz BAND

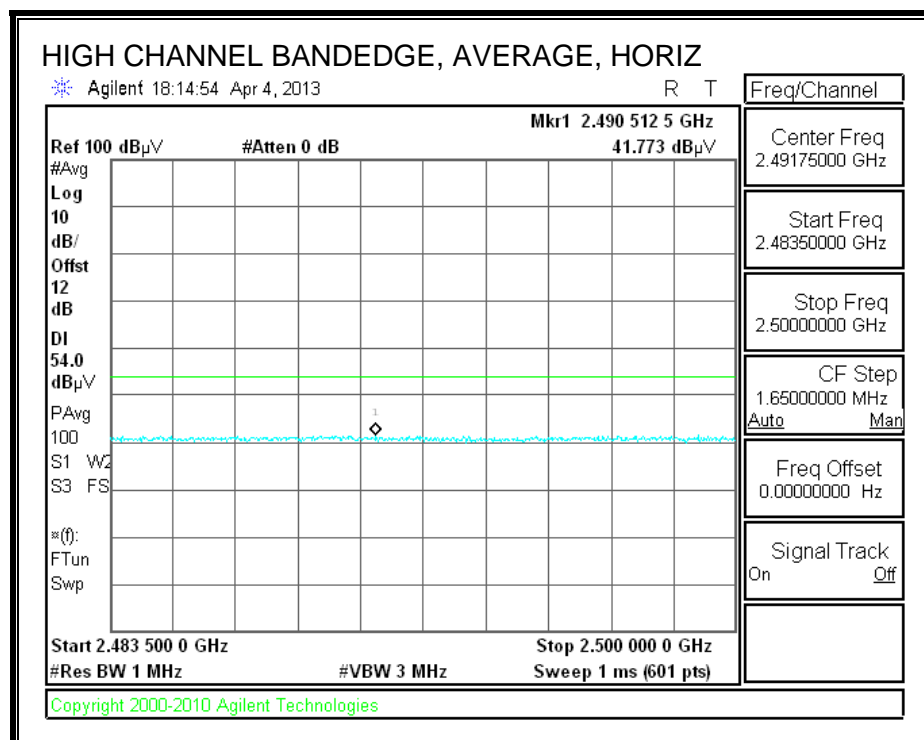
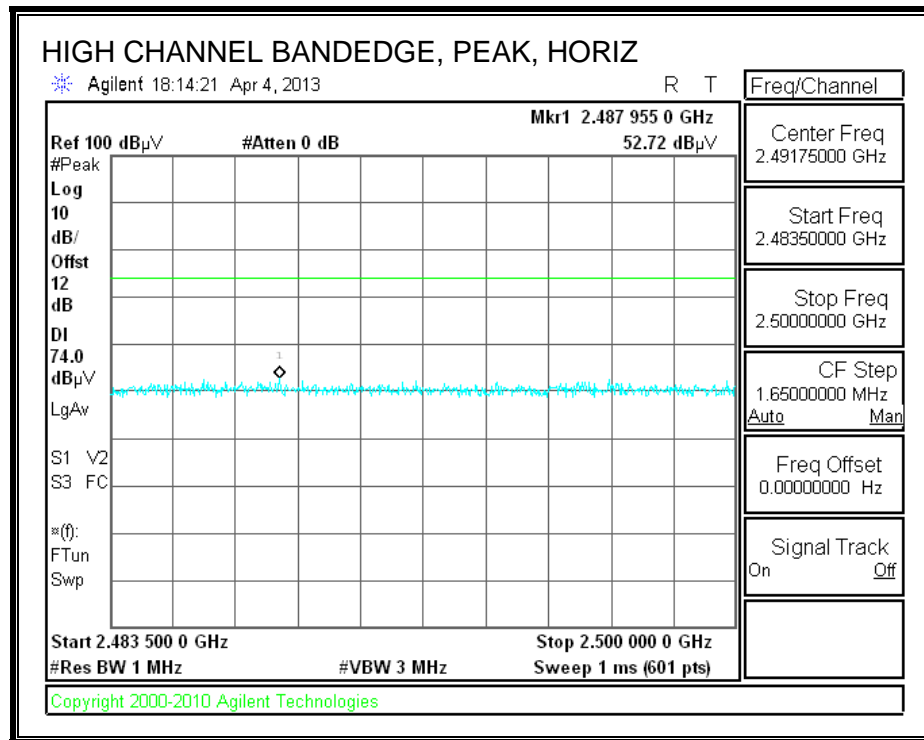
RESTRICTED BANDEDGE (LOW CHANNEL)



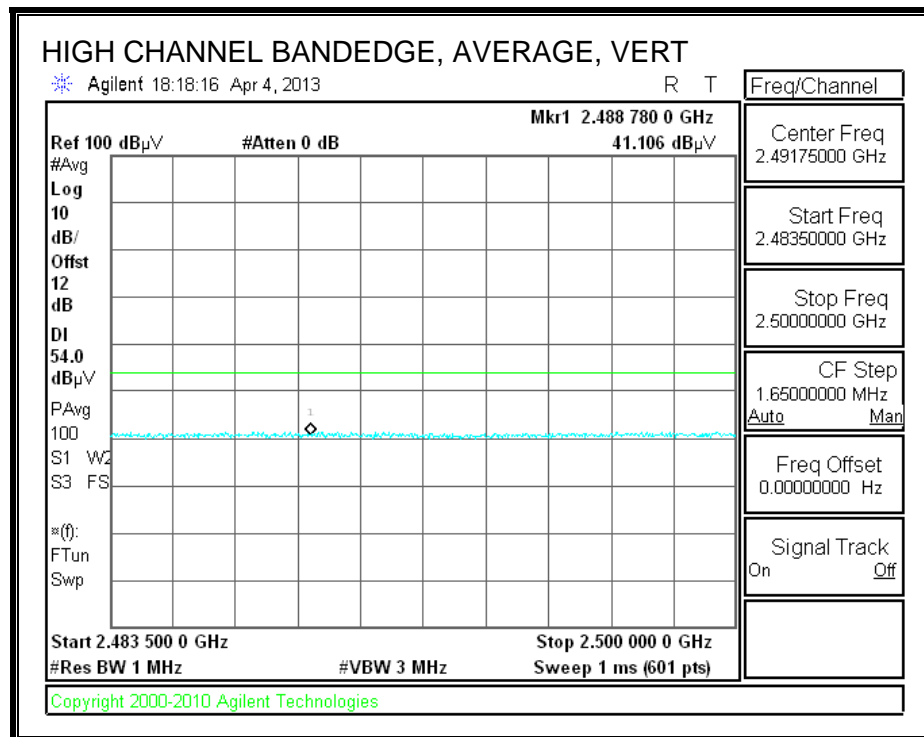
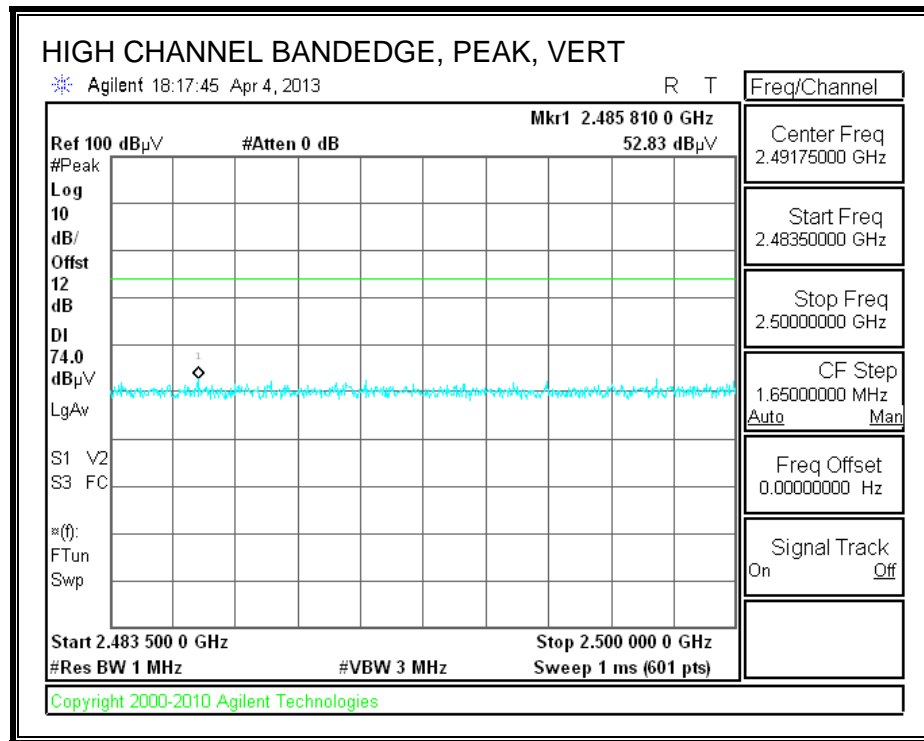
$$\begin{aligned} \text{Actual Average} &= \text{Measured Average} + \text{Correction Factor} \\ &= 41.008 \text{ dBuV} + 2.07 = \mathbf{43.078 \text{ dBuV}} \end{aligned}$$



$$\begin{aligned} \text{Actual Average} &= \text{Measured Average} + \text{Correction Factor} \\ &= 41.004 \text{ dB}\mu\text{V} + 2.07 = \mathbf{43.074 \text{ dB}\mu\text{V}} \end{aligned}$$

RESTRICTED BANDEDGE (HIGH CHANNEL)

$$\begin{aligned} \text{Actual Average} &= \text{Measured Average} + \text{Correction Factor} \\ &= 41.773 \text{ dBuV} + 2.07 = \mathbf{43.843 \text{ dBuV}} \end{aligned}$$



$$\begin{aligned} \text{Actual Average} &= \text{Measured Average} + \text{Correction Factor} \\ &= 41.106 \text{ dB}\mu\text{V} + 2.07 = \mathbf{43.176 \text{ dB}\mu\text{V}} \end{aligned}$$

HARMONICS AND SPURIOUS EMISSIONS**High Frequency Measurement**

Compliance Certification Services, Fremont 5m Chamber

Test Engr: Mona Hua
 Date: 04/04/13
 Project #: 13U14955
 Company: Google
 Test Target: Class 1, EVT-4
 Mode Oper: Tx, BLE

f Measurement Frequency Amp Preamp Gain Average Field Strength Limit
 Dist Distance to Antenna D Corr Distance Correct to 3 meters Peak Field Strength Limit
 Read Analyzer Reading Avg Average Field Strength @ 3 m Margin vs. Average Limit
 AF Antenna Factor Peak Calculated Peak Field Strength Margin vs. Peak Limit
 CL Cable Loss HPF High Pass Filter

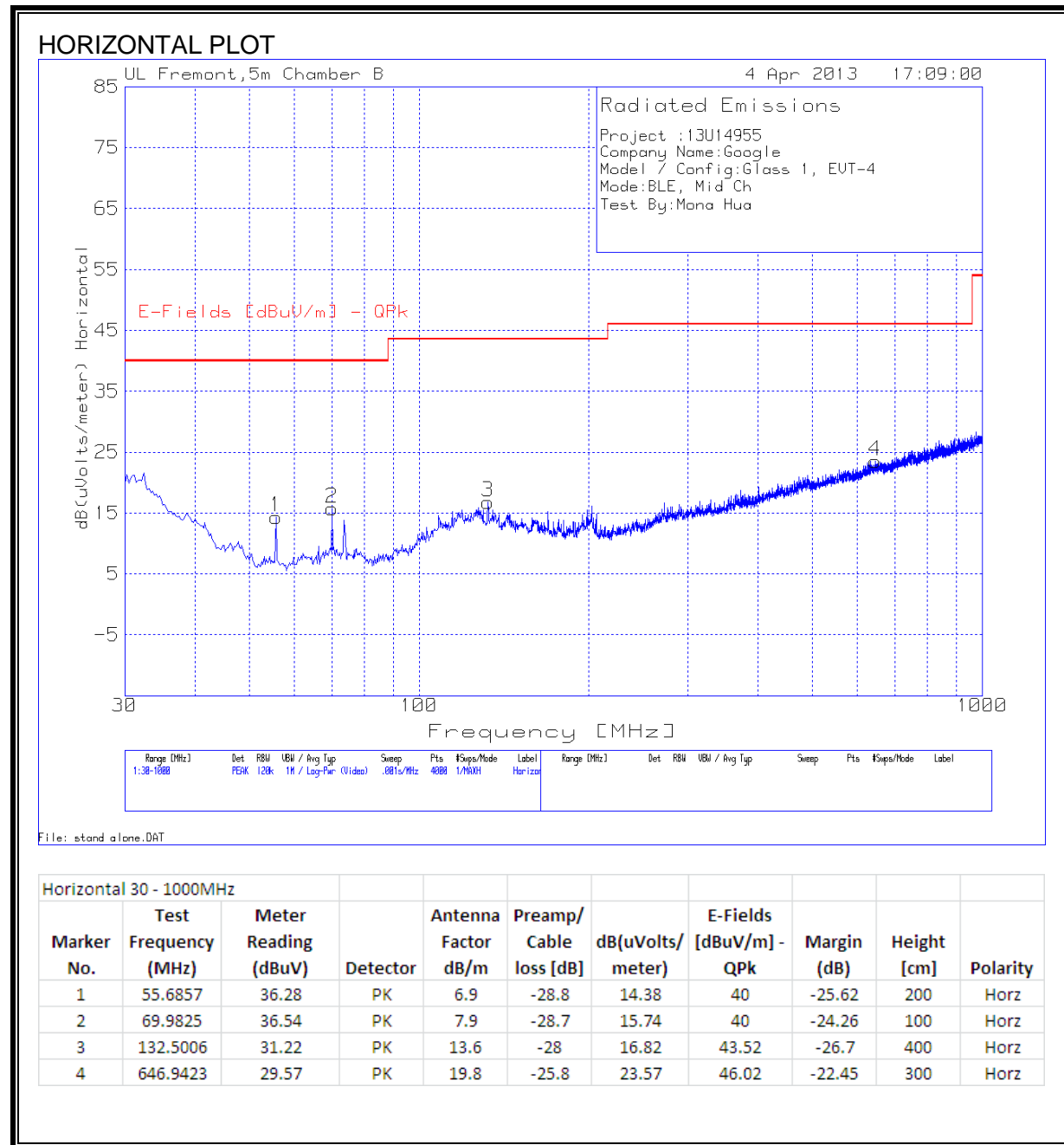
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fitr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
Low Ch (2402 MHz)															
4.804	3.0	37.5	33.1	6.3	-34.8	0.0	0.5	42.6	74.0	-31.4	V	P	136.1	209.4	
4.804	3.0	34.1	33.1	6.3	-34.8	0.0	0.5	39.2	54.0	-14.8	V	A	136.1	209.4	
4.804	3.0	37.6	33.1	6.3	-34.8	0.0	0.5	42.7	74.0	-31.3	H	P	100.3	324.1	
4.804	3.0	34.1	33.1	6.3	-34.8	0.0	0.5	39.1	54.0	-14.9	H	A	100.3	324.1	
Mid Ch (2440 MHz)															
4.880	3.0	37.4	33.1	6.3	-34.8	0.0	0.5	42.5	74.0	-31.5	V	P	163.2	283.5	
4.880	3.0	34.5	33.1	6.3	-34.8	0.0	0.5	39.7	54.0	-14.3	V	A	163.2	283.5	
7.320	3.0	37.4	35.8	8.5	-34.9	0.0	0.5	47.4	74.0	-26.6	V	P	100.2	89.3	
7.320	3.0	32.6	35.8	8.5	-34.9	0.0	0.5	42.5	54.0	-11.5	V	A	100.2	89.3	
4.880	3.0	37.1	33.1	6.3	-34.8	0.0	0.5	42.3	74.0	-31.7	H	P	100.4	33.1	
4.880	3.0	33.9	33.1	6.3	-34.8	0.0	0.5	39.1	54.0	-14.9	H	A	100.4	33.1	
7.320	3.0	36.3	35.8	8.5	-34.9	0.0	0.5	46.3	74.0	-27.7	H	P	104.7	149.1	
7.320	3.0	33.0	35.8	8.5	-34.9	0.0	0.5	42.9	54.0	-11.1	H	A	104.7	149.1	
High Ch (2480 MHz)															
4.960	3.0	38.2	33.2	6.4	-34.8	0.0	0.5	43.5	74.0	-30.5	V	P	100.2	111.8	
4.960	3.0	35.3	33.2	6.4	-34.8	0.0	0.5	40.6	54.0	-13.4	V	A	100.2	111.8	
7.440	3.0	36.1	36.0	8.5	-34.9	0.0	0.5	46.3	74.0	-27.7	V	P	199.2	313.5	
7.440	3.0	32.5	36.0	8.5	-34.9	0.0	0.5	42.7	54.0	-11.3	V	A	199.2	313.5	
4.960	3.0	37.9	33.2	6.4	-34.8	0.0	0.5	43.3	74.0	-30.7	H	P	102.9	163.9	
4.960	3.0	34.2	33.2	6.4	-34.8	0.0	0.5	39.5	54.0	-14.5	H	A	102.9	163.9	
7.440	3.0	36.4	36.0	8.5	-34.9	0.0	0.5	46.6	74.0	-27.4	H	P	101.4	1.2	
7.440	3.0	32.7	36.0	8.5	-34.9	0.0	0.5	42.9	54.0	-11.1	H	A	101.4	1.2	

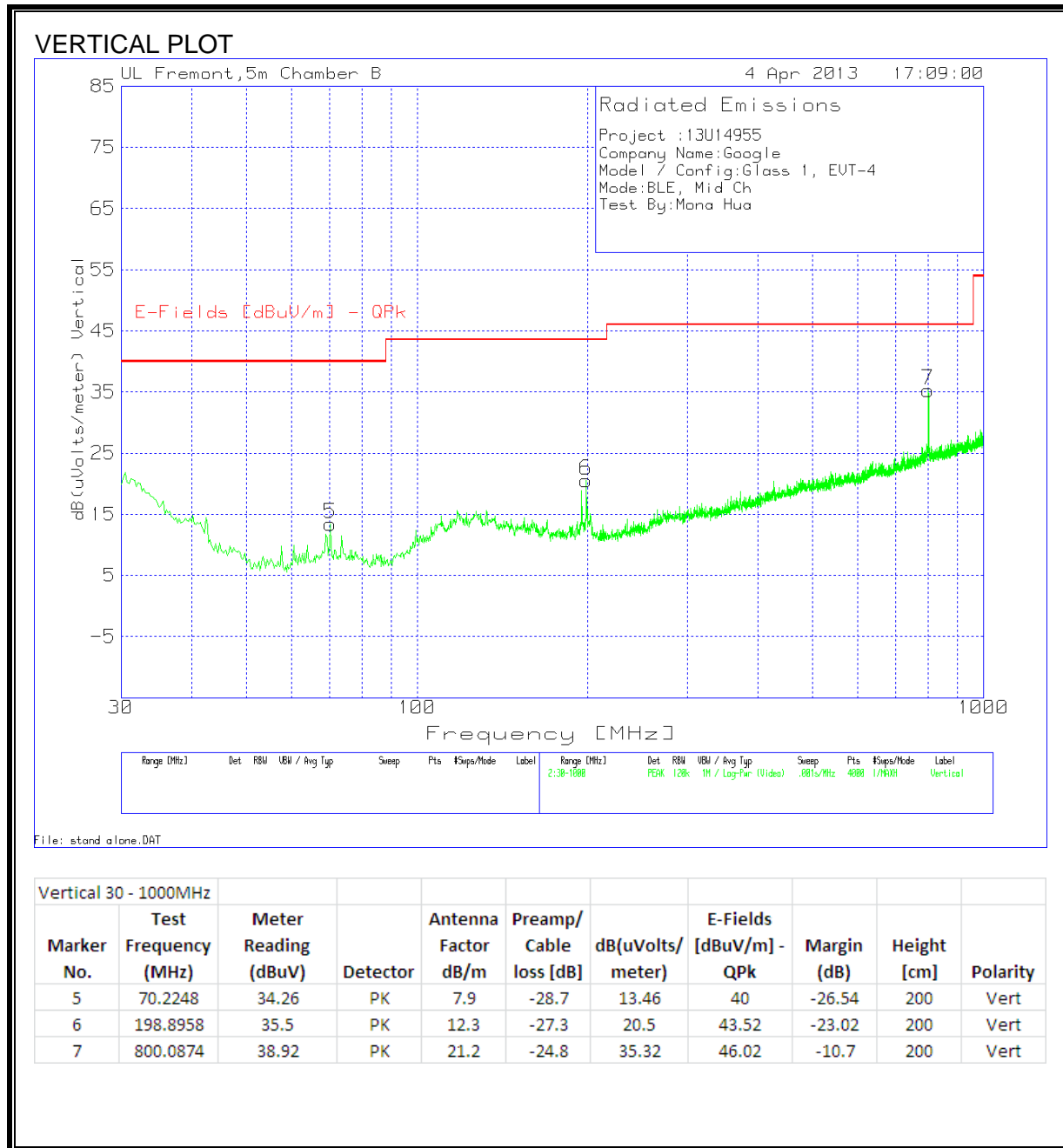
Rev. 4.1.2.7

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

7.3. 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)

8. 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

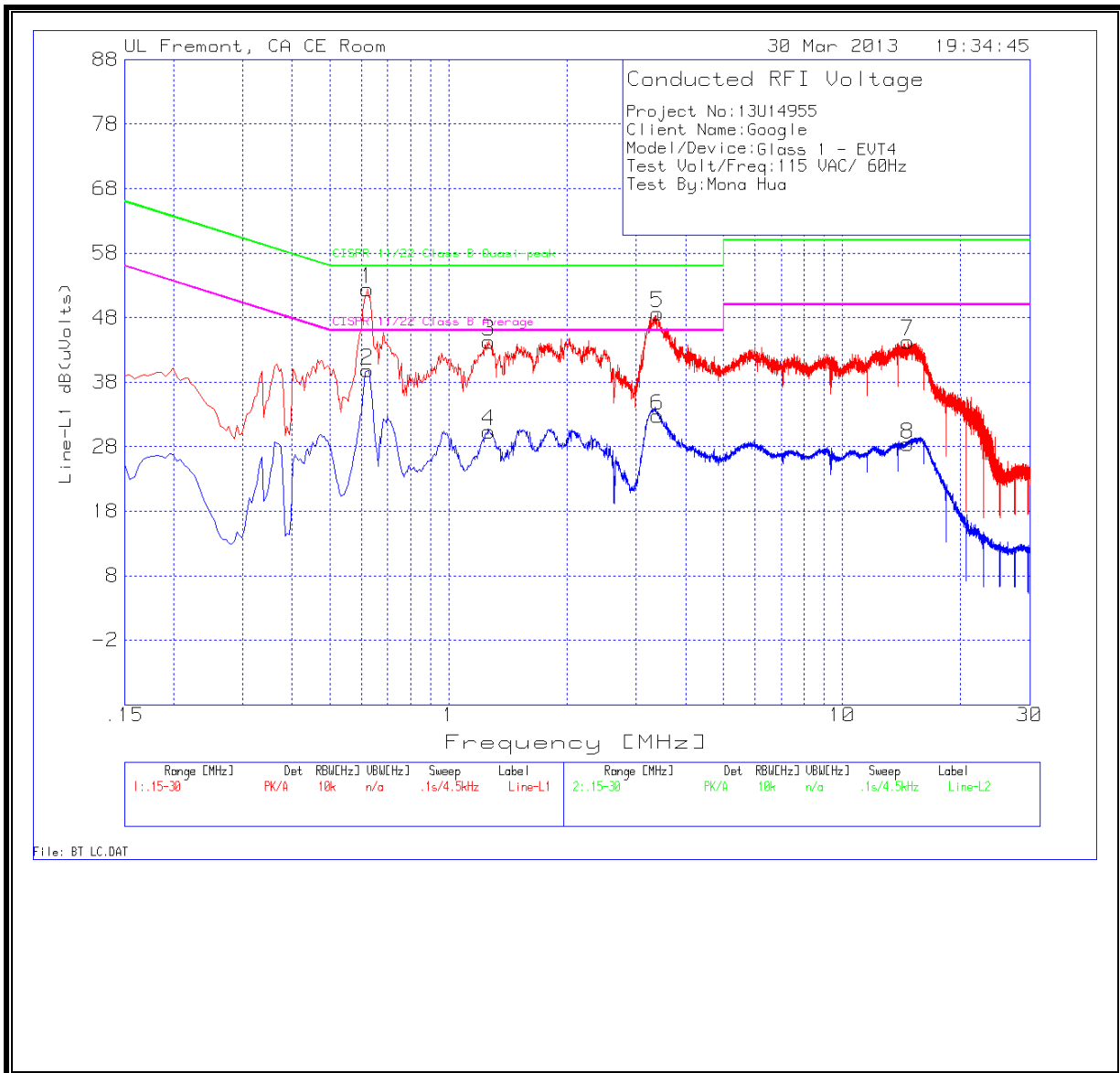
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

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:13U14955									
Client Name:Google									
Model/Device: Glass 1 - EVT4									
Test Volt/Freq:115 VAC/ 60Hz									
Test By:Mona Hua									
Line-L1 .15 - 30MHz									
Test Frequency (MHz)	Meter Reading (dBuV)	Detector	T24 IL L1.TXT (dB)	LC Cables 1&3 (dB)	dB(uVolts)	CISPR 11/22 Class B Quasi-peak	Margin	CISPR 11/22 Class B Average	Margin
0.6225	52.3	PK	0.1	0	52.4	56	-3.6	-	-
0.6225	39.74	Av	0.1	0	39.84	-	-	46	-6.16
1.266	44.1	PK	0.1	0.1	44.3	56	-11.7	-	-
1.266	30.14	Av	0.1	0.1	30.34	-	-	46	-15.66
3.4035	48.53	PK	0.1	0.1	48.73	56	-7.27	-	-
3.4035	32.56	Av	0.1	0.1	32.76	-	-	46	-13.24
14.703	43.84	PK	0.2	0.2	44.24	60	-15.76	-	-
14.703	27.97	Av	0.2	0.2	28.37	-	-	50	-21.63
Line-L2 .15 - 30MHz									
Test Frequency (MHz)	Meter Reading (dBuV)	Detector	T24 IL L1.TXT (dB)	LC Cables 1&3 (dB)	dB(uVolts)	CISPR 11/22 Class B Quasi-peak	Margin	CISPR 11/22 Class B Average	Margin
0.6045	43.19	PK	0.1	0	43.29	56	-12.71	-	-
0.6045	18.81	Av	0.1	0	18.91	-	-	46	-27.09
1.23	34.47	PK	0.1	0.1	34.67	56	-21.33	-	-
1.23	10.67	Av	0.1	0.1	10.87	-	-	46	-35.13
7.0665	39.7	PK	0.1	0.1	39.9	60	-20.1	-	-
7.0665	23.96	Av	0.1	0.1	24.16	-	-	50	-25.84
14.1225	42.01	PK	0.2	0.2	42.41	60	-17.59	-	-
14.1225	25.02	Av	0.2	0.2	25.42	-	-	50	-24.58

LINE 1 RESULTS

LINE 2 RESULTS