FCC CFR47 PART 15 SUBPART C

BLUETOOTH LOW ENERGY
C2PC CERTIFICATION TEST REPORT

FOR

GSM/WCDMA/LTE Phone + Bluetooth, DTS/UNII a/b/g/n and NFC

MODEL NUMBER: LG-D631, D631, LGD631

FCC ID: ZNFD631

REPORT NUMBER: 14U17500-3

ISSUE DATE: JUNE 14, 2014

Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	06/14/14	Initial Issue	P. Zhang

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	**LG ELECTRONICS MOBILECOMM U.S.A., INC**
EUT DESCRIPTION:	**GSM/WCDMA/LTE Phone + Bluetooth, DTS/UNII a/b/g/n and NFC.**
MODEL:	**LG-D631, D631, LGD631**
SERIAL NUMBER:	**18UL4 (Radiated)**
DATE TESTED:	**MAY 27 – JUNE 11, 2014**

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	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.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15.

3. FACILITIES AND ACCREDITATION

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

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 18000 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 GSM/WCDMA/LTE Phone + Bluetooth, DTS/UNII a/b/g/n and NFC.

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	8.10	6.46

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antenna, with a maximum gain of -8.45 dBi.

5.4. 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.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
AC Adapter	LG ELECTRONICS	MCS-01WD	DB390078751	N/A
Earphone	LG ELECTRONICS	LG-D631	N/A	N/A
PowerMat	DURACELL	KSAP0151800083HU	N/A	N/A
PMA cover	LG ELECTRONICS	N/A	N/A	N/A

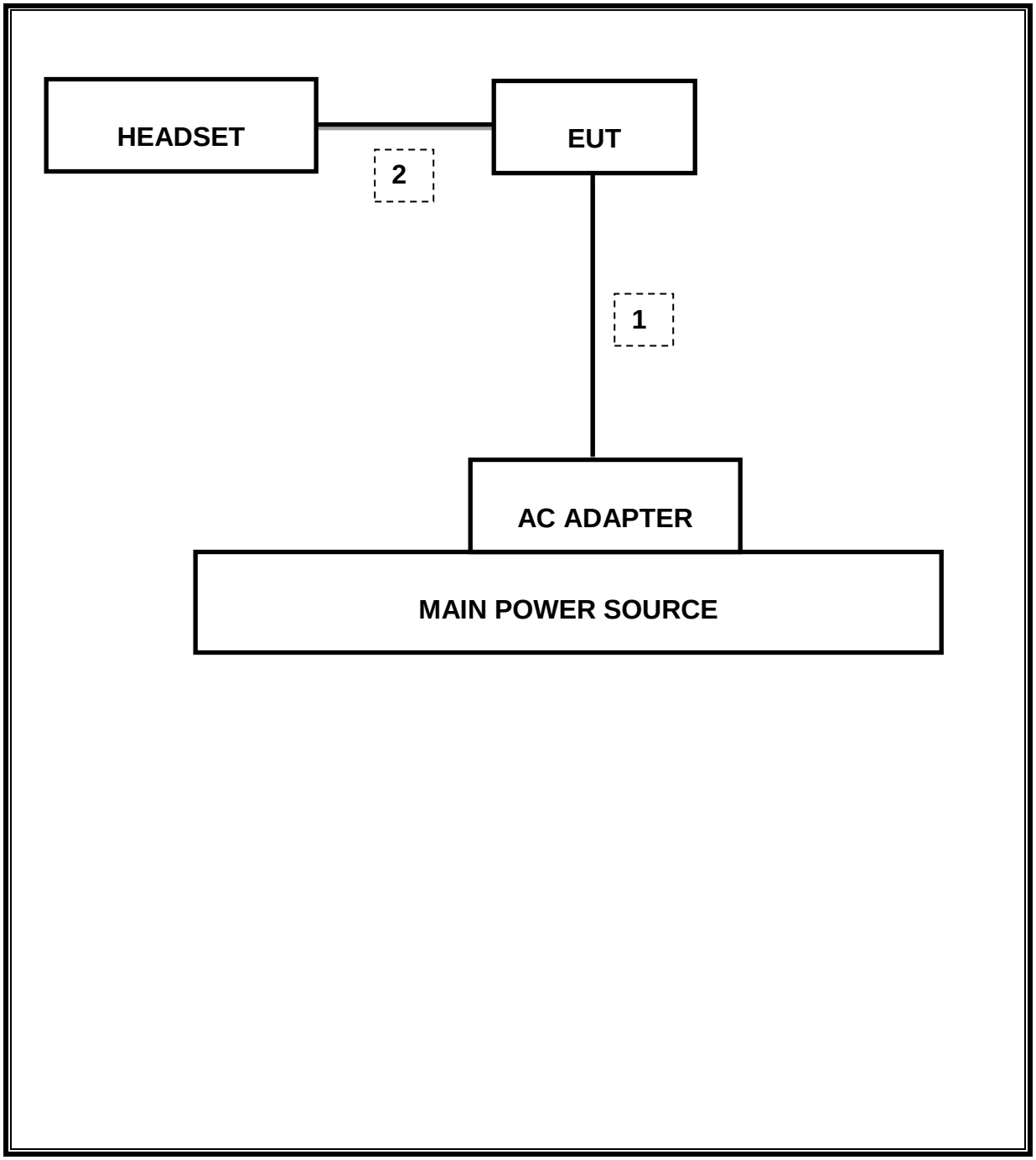
I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	DC Power	1	Mini-USB	Shielded	1.2m	N/A
2	Audio	1	Mini-Jack	Unshielded	1m	N/A

TEST SETUP

EUT was set in the Hidden menu mode to enable BLE communications.

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, 44 GHz	Agilent / HP	E4446A	C00986	4/1/2015
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01179	2/26/2015
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	8/8/2014
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	5/8/2015
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01063	10/22/2014
Antenna, Bilog, 30MHz-1 GHz	Sunol Sciences	JB1	N/A	3/6/2015
Antenna, Horn, 18 GHz	ETS	3117	C01022	2/21/2015
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	12/17/2014
Peak Power Meter	Agilent / HP	E4416A	C00963	12/13/2014
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/13/2014
LISN, 30 MHz	FCC	50/250-25-2	C00626	1/14/2015

7. SUMMARY

FCC Part Section	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Worst Case
15.247 (a)(2)	RSS-210 A8.2(a)	Occupied Band width (6dB)	>500KHz	Conducted	Pass	see original
2.1051, 15.247 (d)	RSS-210 A8.5	Band Edge / Conducted Spurious Emission	-20dBc		Pass	see original
15.247	RSS-210 A8.4	TX conducted output power	<30dBm		Pass	see original
15.247	RSS-210 A8.2	PSD	<8dBm		Pass	see original
15.207 (a)	RSS-GEN 7.2.2	AC Power Line conducted emissions	Section 10	Radiated	Pass	see original
15.205, 15.209	RSS-210 Clause 2.6, RSS-210 Clause 6	Radiated Spurious Emission	< 54dBuV/m		Pass	40.74dBuV/m

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 - 2009. 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.

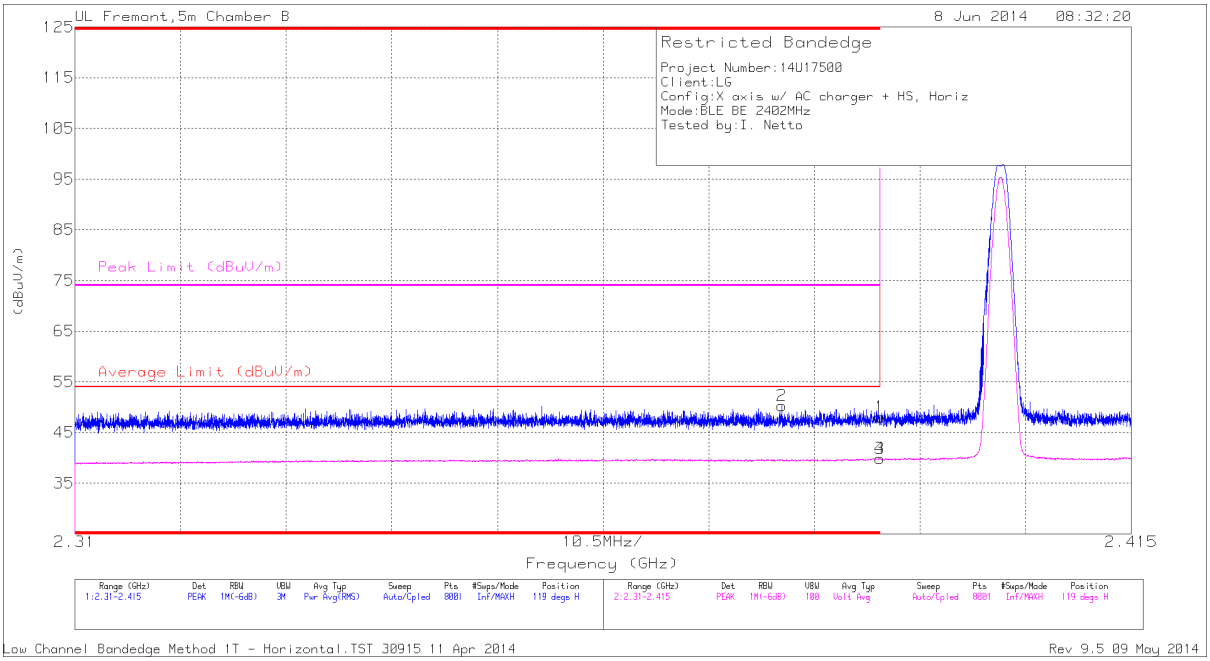
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and add duty cycle factor for average measurements. Duty cycle factor = 10 log (1/x). For this sample: DCF = 10log(1/0.618)=2.08dB (Spectrum Analyzer round it up to 2.1dB)

The spectrum from 1GHz 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.

8.2. TRANSMITTER ABOVE 1 GHz

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

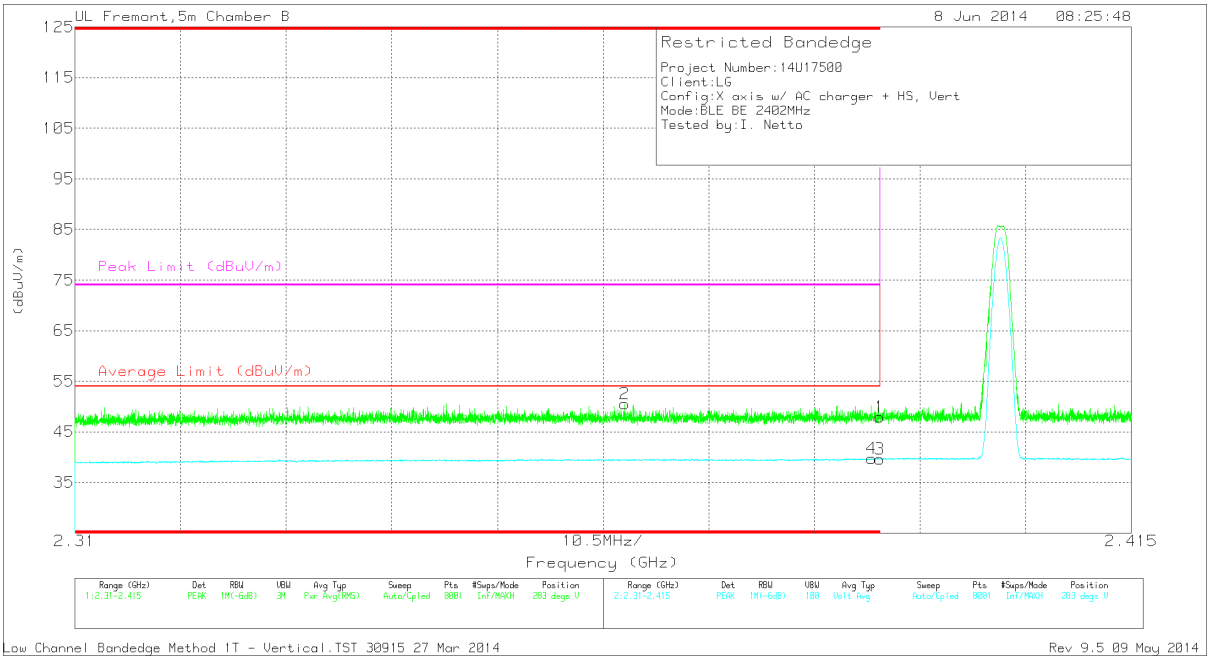


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Flt r/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	38.7	PK	32.1	-22.8	0	48	-	-	74	-26	119	237	H
2	* 2.38	41.23	PK	32	-22.9	0	50.33	-	-	74	-23.67	119	237	H
3	* 2.39	28.43	RMS	32.1	-22.8	2.1	39.83	54	-14.17	-	-	119	237	H
4	* 2.39	28.48	RMS	32.1	-22.8	2.1	39.88	54	-14.12	-	-	119	237	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



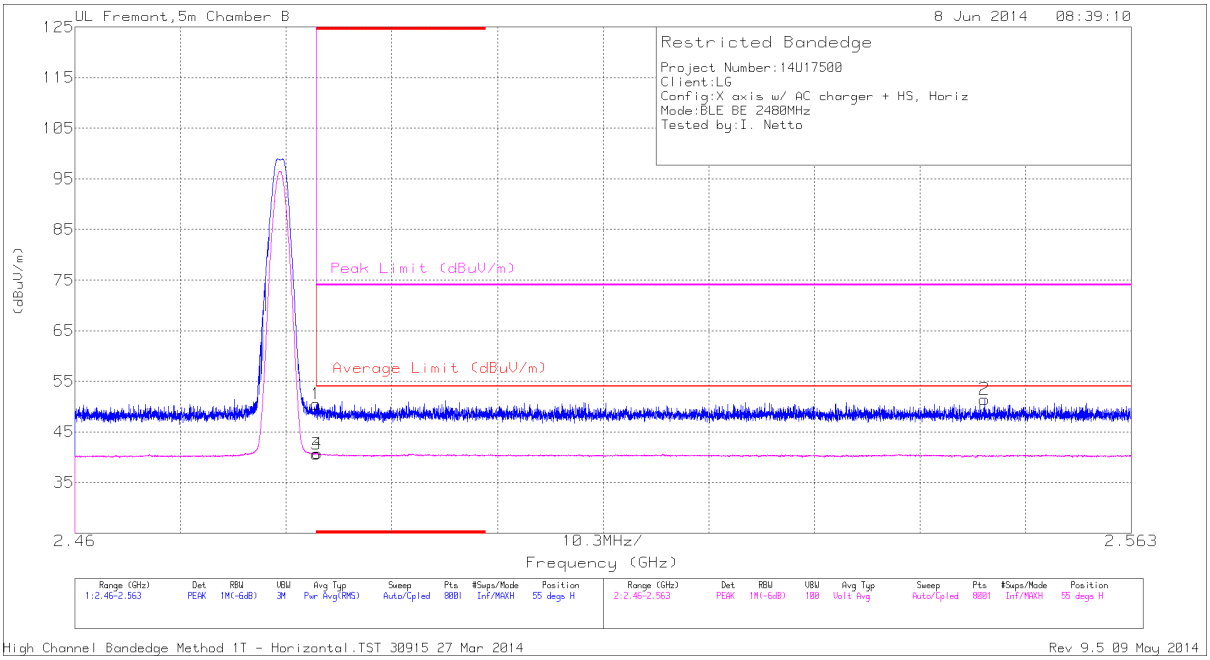
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Flt r/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	38.64	PK	32.1	-22.8	0	47.94	-	-	74	-26.06	283	178	V
2	* 2.365	41.39	PK	32	-22.8	0	50.59	-	-	74	-23.41	283	178	V
3	* 2.39	28.21	RMS	32.1	-22.8	2.1	39.61	54	-14.39	-	-	283	178	V
4	* 2.389	28.35	RMS	32.1	-22.8	2.1	39.75	54	-14.25	-	-	283	178	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

VB1T - FHSS Method: VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



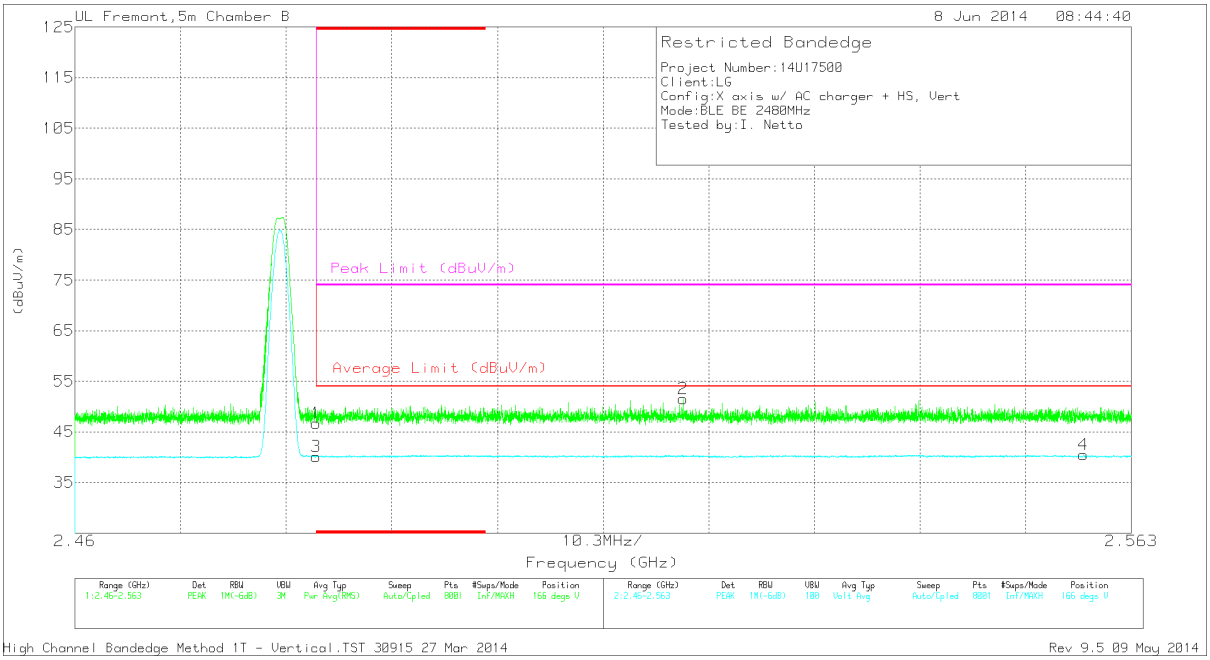
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	40.78	PK	32.4	-22.7	0	50.48	-	-	74	-23.52	55	179	H
3	* 2.484	28.83	RMS	32.4	-22.7	2.1	40.63	54	-13.37	-	-	55	179	H
4	* 2.484	28.94	RMS	32.4	-22.7	2.1	40.74	54	-13.26	-	-	55	179	H
2	2.549	41.57	PK	32.5	-22.6	0	51.47	-	-	74	-22.53	55	179	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

VB1T - FHSS Method: VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



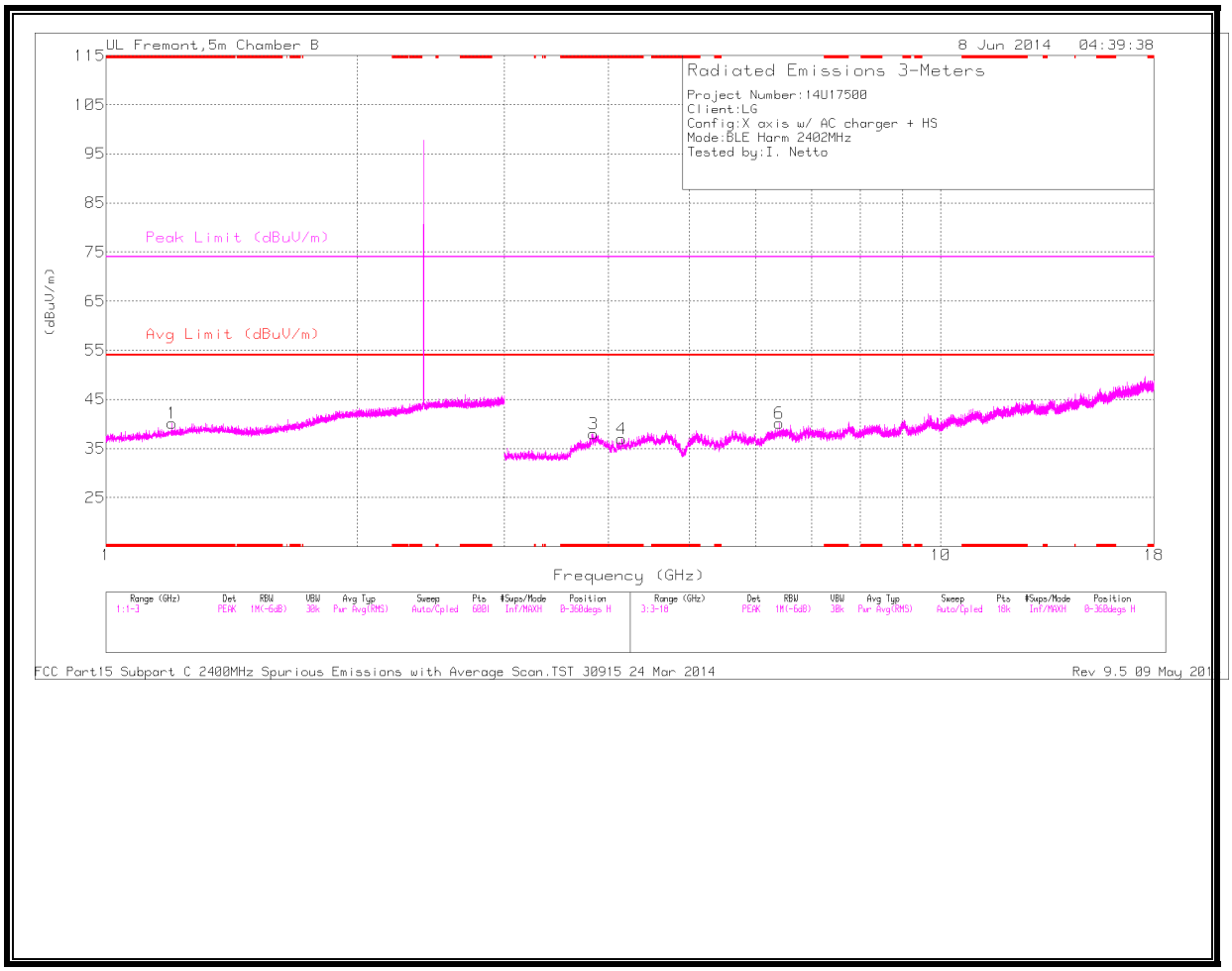
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	37.02	PK	32.4	-22.7	0	46.72	-	-	74	-27.28	166	364	V
3	* 2.484	28.33	RMS	32.4	-22.7	2.1	40.13	54	-13.87	-	-	166	364	V
2	2.519	41.61	PK	32.5	-22.6	0	51.51	-	-	74	-22.49	166	364	V
4	2.558	28.53	RMS	32.5	-22.7	2.1	40.43	54	-13.57	-	-	166	364	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

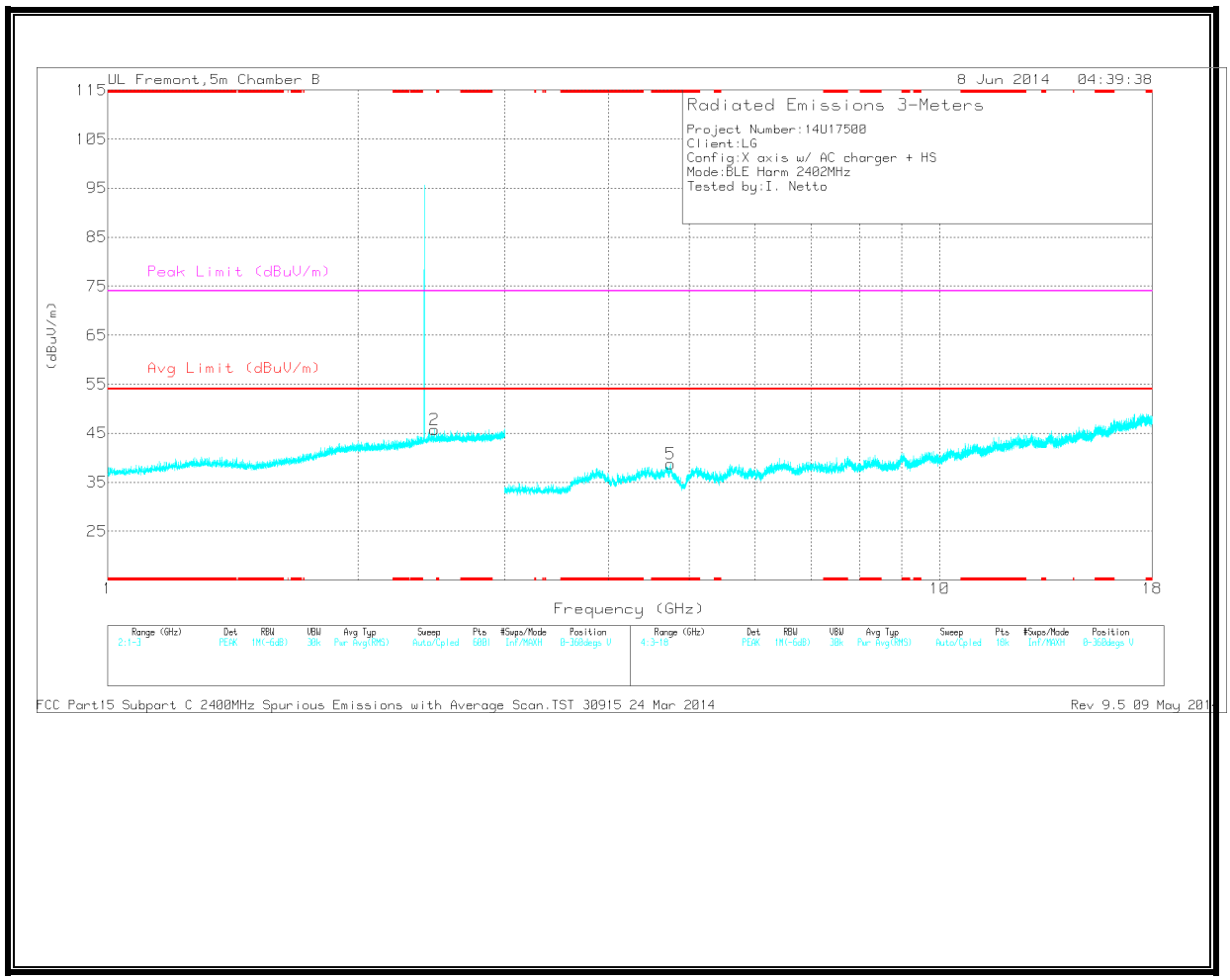
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL
HORIZONTAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

LOW CHANNEL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr /Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.199	36.54	PK	28.2	-24.6	0	40.14	-	-	74	-33.86	0-360	201	H
3	* 3.837	34.69	PK	33.7	-30.4	0	37.99	-	-	74	-36.01	0-360	101	H
4	* 4.142	33.6	PK	33.6	-30.2	0	37	-	-	74	-37	0-360	101	H
5	* 4.744	33.82	PK	34.2	-29.3	0	38.72	-	-	74	-35.28	0-360	101	V
2	2.47	36.06	PK	32.4	-22.7	0	45.76	-	-	-	-	0-360	201	V
6	6.399	33.51	PK	35.6	-29	0	40.11	-	-	-	-	0-360	101	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

Radiated Emissions

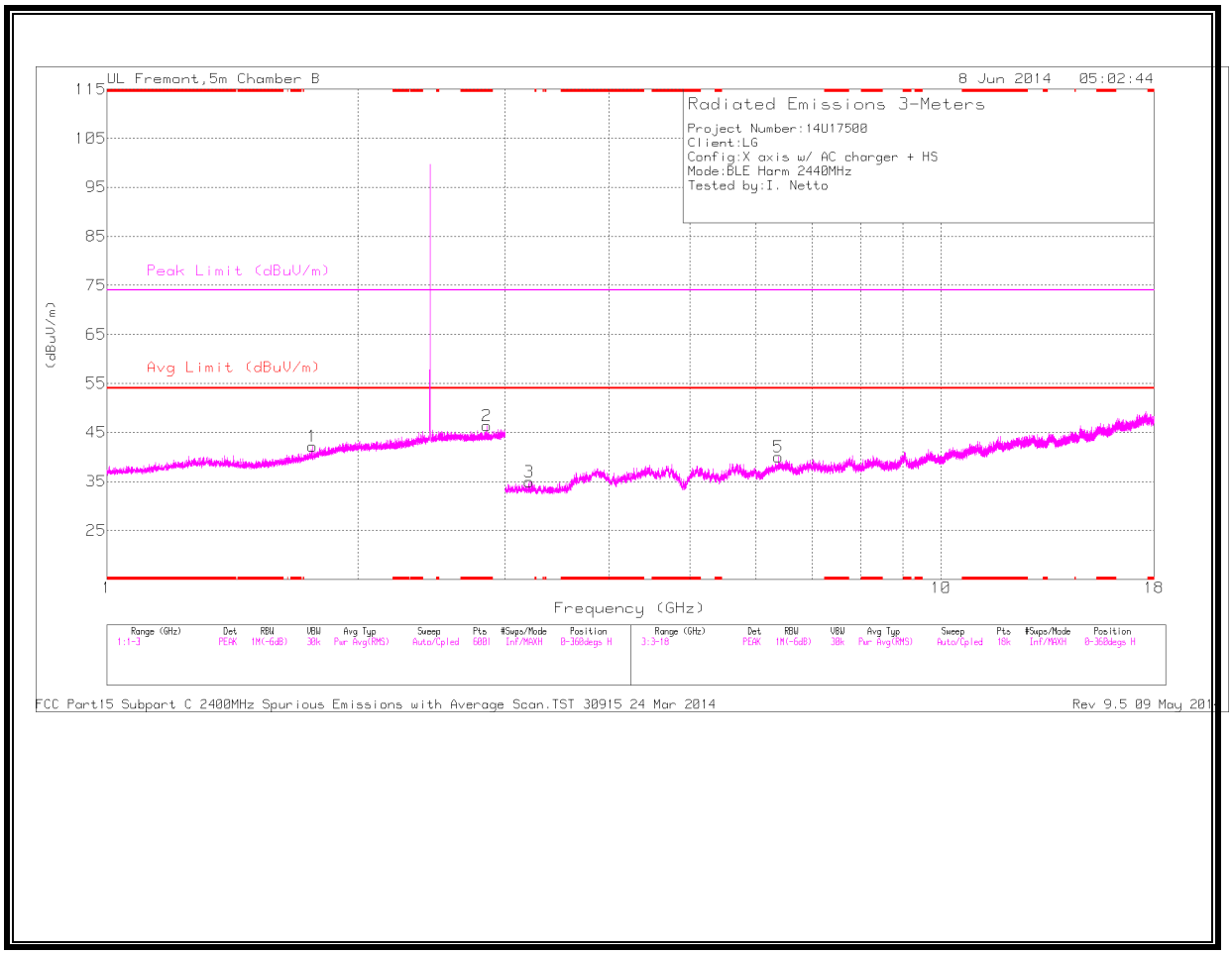
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.198	43.88	PK2	28.2	-24.6	0	47.48	-	-	74	-26.52	1	202	H
* 3.837	41.66	PK2	33.7	-30.3	0	45.06	-	-	74	-28.94	1	102	H
* 4.14	40.96	PK2	33.6	-30.1	0	44.46	-	-	74	-29.54	1	102	H
* 4.746	41.5	PK2	34.2	-29.3	0	46.4	-	-	74	-27.6	1	102	V
2.471	43.25	PK2	32.4	-22.7	0	52.95	-	-	-	-	1	202	V
6.401	40.91	PK2	35.6	-29	0	47.51	-	-	-	-	1	102	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

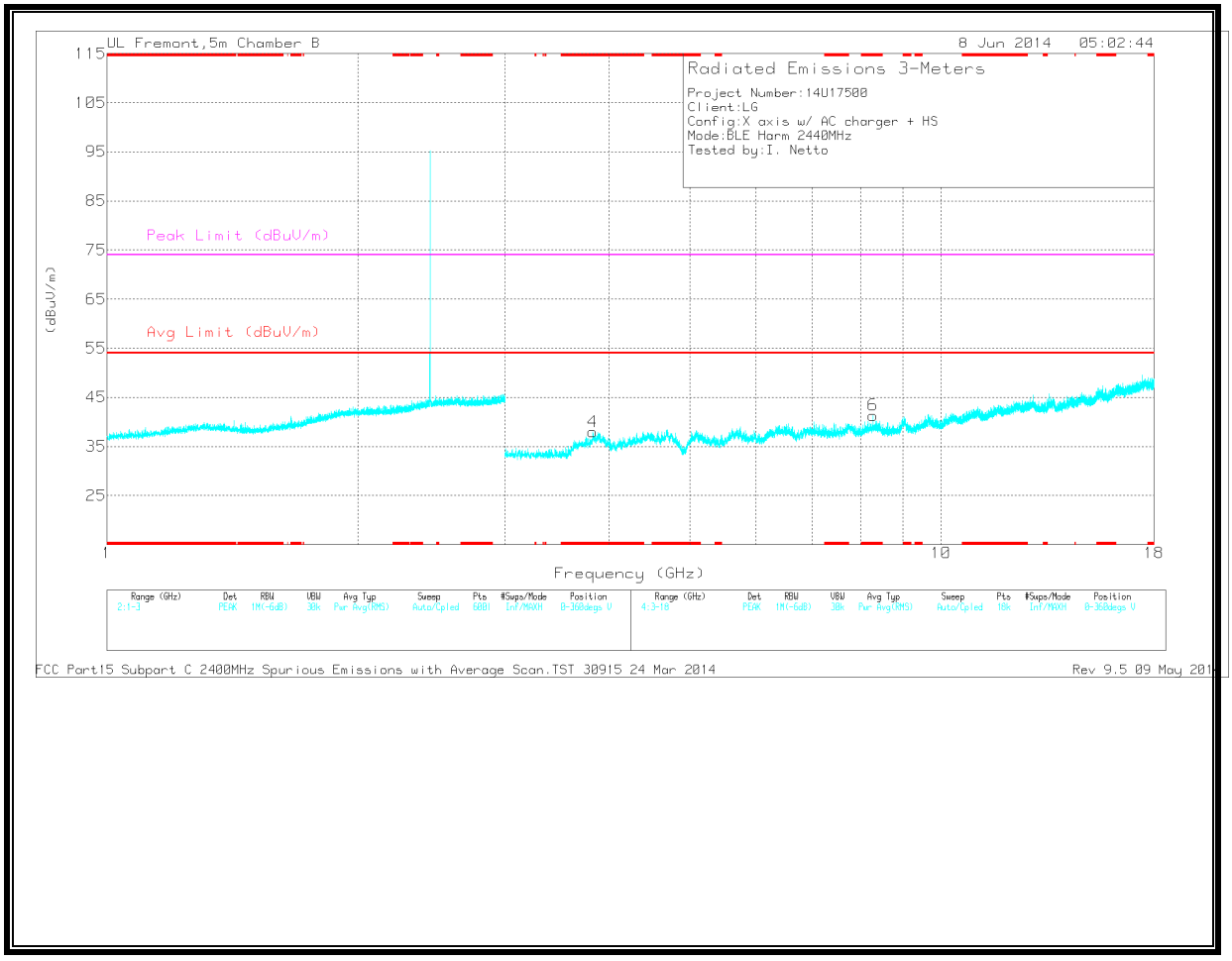
MID CHANNEL

HORIZONTAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

MID CHANNEL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr /Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 2.853	36.12	PK	32.5	-22.2	0	46.42	-	-	74	-27.58	0-360	200	H
4	* 3.824	34.86	PK	33.7	-30.6	0	37.96	-	-	74	-36.04	0-360	201	V
6	* 8.288	31.55	PK	35.7	-25.9	0	41.35	-	-	74	-32.65	0-360	201	V
1	1.762	36.12	PK	29.7	-23.6	0	42.22	-	-	-	-	0-360	102	H
3	3.207	33.21	PK	32.8	-31.1	0	34.91	-	-	-	-	0-360	200	H
5	6.385	33.37	PK	35.6	-29	0	39.97	-	-	-	-	0-360	101	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

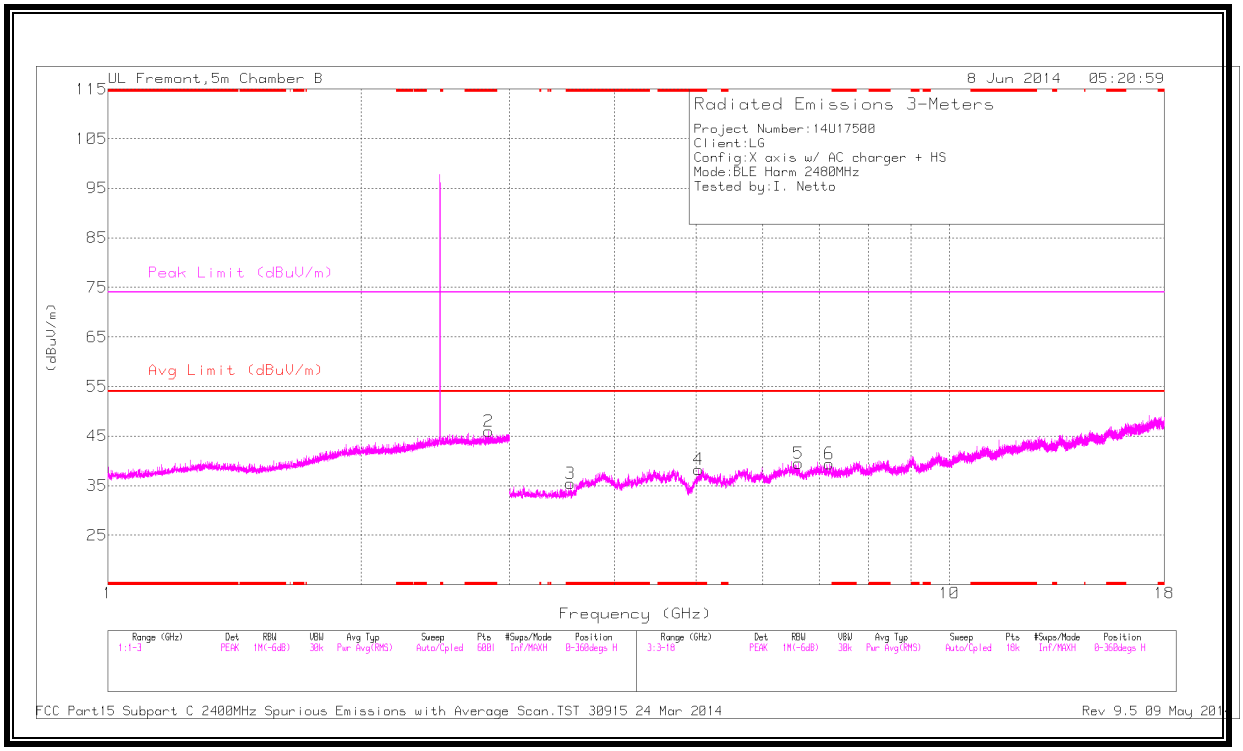
Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.851	42.72	PK2	32.5	-22.2	0	53.02	-	-	74	-20.98	1	201	H
* 3.826	42	PK2	33.7	-30.6	0	45.1	-	-	74	-28.9	1	202	V
* 8.287	37.95	PK2	35.7	-26	0	47.65	-	-	74	-26.35	1	202	V
1.763	42.66	PK2	29.8	-23.6	0	48.86	-	-	-	-	1	101	H
3.207	40.52	PK2	32.8	-31.1	0	42.22	-	-	-	-	1	201	H
6.384	40.44	PK2	35.6	-29	0	47.04	-	-	-	-	1	102	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

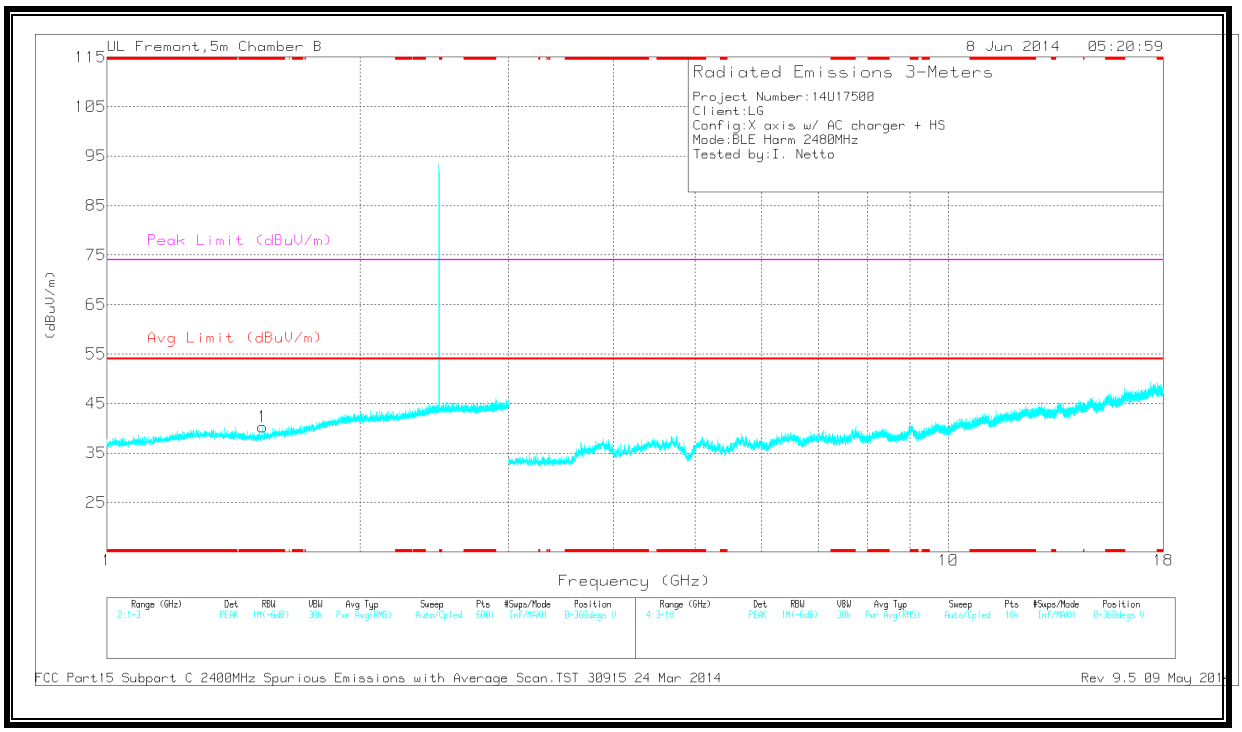
PK2 - KDB558074 Method: Maximum Peak

HIGH CHANNEL
HORIZONTAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

HIGH CHANNEL DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr /Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 2.834	35.83	PK	32.4	-22.3	0	45.93	-	-	74	-28.07	0-360	202	H
1	* 1.531	36.23	PK	28.1	-24.1	0	40.23	-	-	74	-33.77	0-360	201	V
3	* 3.546	33.89	PK	32.9	-31.4	0	35.39	-	-	74	-38.61	0-360	201	H
4	* 5.032	33.2	PK	34.2	-29.1	0	38.3	-	-	74	-35.7	0-360	101	H
5	6.616	31.75	PK	35.7	-28	0	39.45	-	-	-	-	0-360	201	H
6	7.202	31.04	PK	35.5	-27.1	0	39.44	-	-	-	-	0-360	201	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.836	42.58	PK2	32.4	-22.3	0	52.68	-	-	74	-21.32	1	203	H
* 1.532	43.27	PK2	28.1	-24.1	0	47.27	-	-	74	-26.73	1	203	V
* 3.544	41.05	PK2	32.9	-31.4	0	42.55	-	-	74	-31.45	1	203	H
* 5.034	40.18	PK2	34.2	-29.1	0	45.28	-	-	74	-28.72	1	101	H
6.615	38.79	PK2	35.7	-27.9	0	46.59	-	-	-	-	1	202	H
7.201	38.27	PK2	35.5	-27.1	0	46.67	-	-	-	-	1	202	H

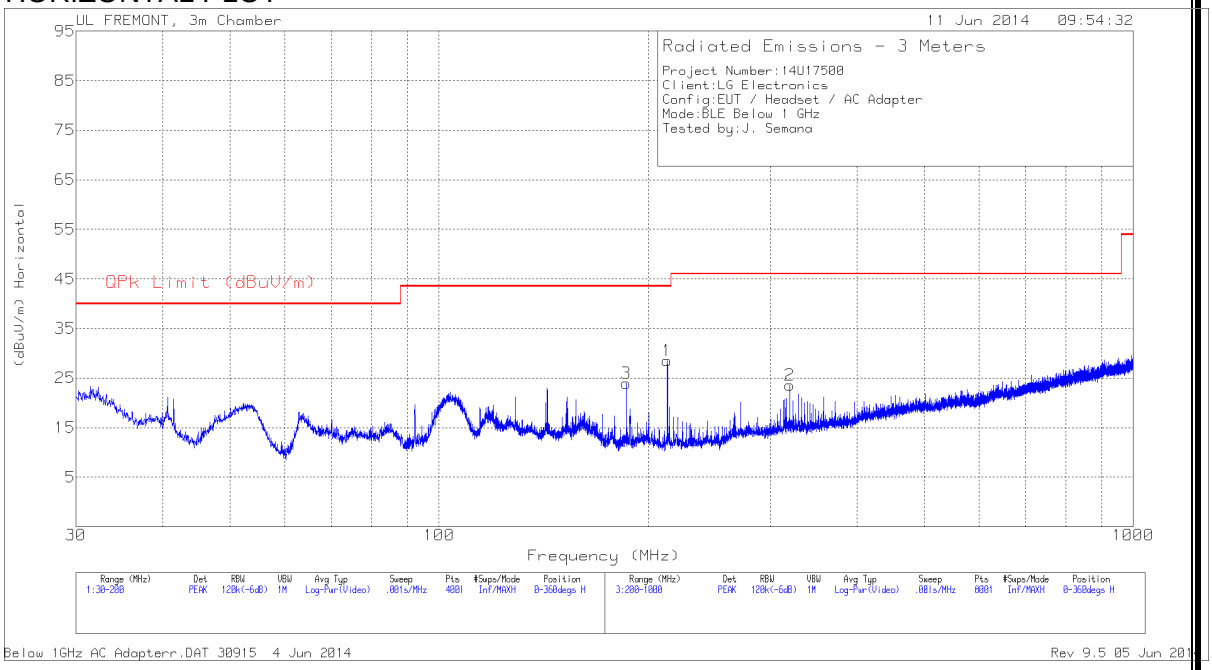
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

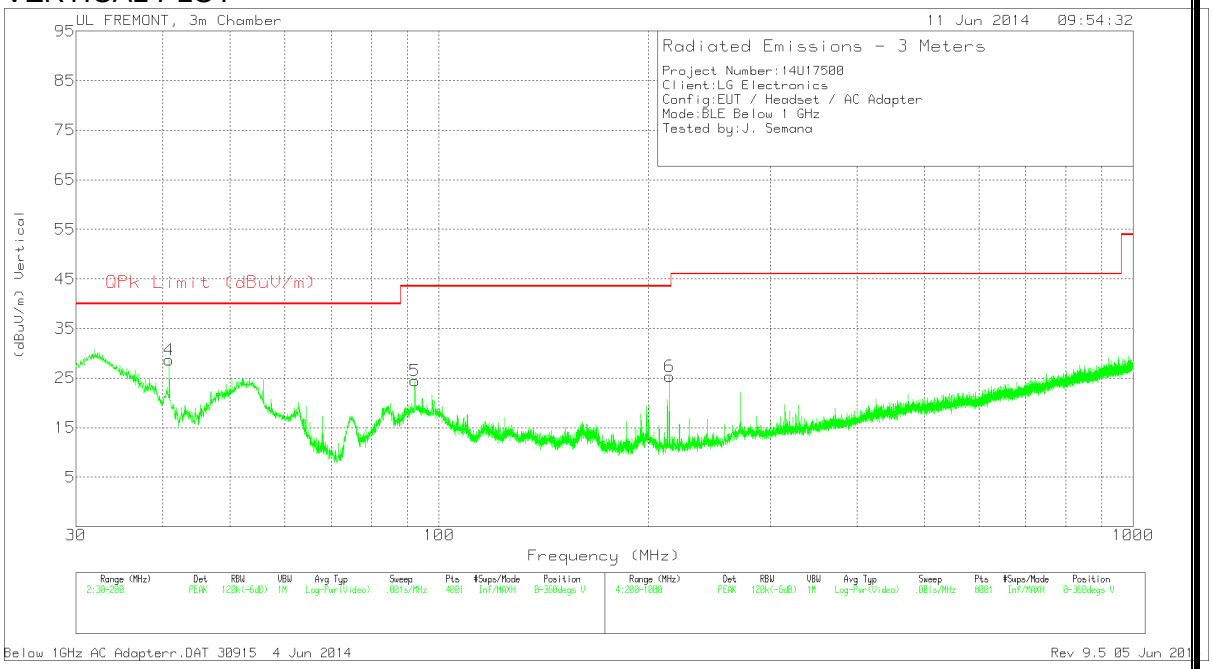
WORST-CASE BELOW 1 GHz

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

HORIZONTAL PLOT



VERTICAL PLOT



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T243 (dB/m)	Amp/Cbl (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	40.88	43.93	PK	13.3	-28.6	0	28.63	40	-11.37	0-360	101	V
5	92.39	44.36	PK	8.2	-28.1	0	24.46	43.52	-19.06	0-360	101	V
3	186.145	40.04	PK	10.9	-27	0	23.94	43.52	-19.58	0-360	100	H
1	213.3	44.77	PK	10.5	-26.8	0	28.47	43.52	-15.05	0-360	101	H
6	214.8	41.58	PK	10.6	-26.8	0	25.38	43.52	-18.14	0-360	200	V
2	320	35.53	PK	13.9	-25.9	0	23.53	46.02	-22.49	0-360	101	H

PK - Peak detector