



**FCC CFR47 PART 15 SUBPART C**

**BLUETOOTH LOW ENERGY  
CERTIFICATION TEST REPORT**

**FOR**

**GSM/WCDMA/LTE Phone + Bluetooth & DTS b/g/n**

**MODEL NUMBER: LGL31L, L31L, LG-L31L**

**FCC ID: ZNFL31L**

**REPORT NUMBER: 13U16673-3 REV A**

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**NVLAP LAB CODE 200065-0**

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	1/6/14	Initial Issue	P. Kim
A	1/27/14	Updated antenna information	P. Kim

## TABLE OF CONTENTS

<b>1. ATTESTATION OF TEST RESULTS</b> .....	<b>4</b>
<b>2. TEST METHODOLOGY</b> .....	<b>5</b>
<b>3. FACILITIES AND ACCREDITATION</b> .....	<b>5</b>
<b>4. CALIBRATION AND UNCERTAINTY</b> .....	<b>5</b>
4.1. <i>MEASURING INSTRUMENT CALIBRATION</i> .....	5
4.2. <i>SAMPLE CALCULATION</i> .....	5
4.3. <i>MEASUREMENT UNCERTAINTY</i> .....	5
<b>5. EQUIPMENT UNDER TEST</b> .....	<b>6</b>
5.1. <i>DESCRIPTION OF EUT</i> .....	6
5.2. <i>MAXIMUM OUTPUT POWER</i> .....	6
5.3. <i>DESCRIPTION OF AVAILABLE ANTENNAS</i> .....	6
5.4. <i>WORST-CASE CONFIGURATION AND MODE</i> .....	7
5.5. <i>DESCRIPTION OF TEST SETUP</i> .....	8
<b>6. TEST AND MEASUREMENT EQUIPMENT</b> .....	<b>10</b>
<b>7. SUMMARY</b> .....	<b>11</b>
<b>8. ANTENNA PORT TEST RESULTS</b> .....	<b>11</b>
8.1. <i>6 dB BANDWIDTH</i> .....	12
8.2. <i>99% BANDWIDTH</i> .....	15
8.3. <i>OUTPUT POWER</i> .....	18
8.4. <i>AVERAGE POWER</i> .....	21
8.5. <i>POWER SPECTRAL DENSITY</i> .....	22
8.6. <i>CONDUCTED SPURIOUS EMISSIONS</i> .....	25
<b>9. RADIATED TEST RESULTS</b> .....	<b>29</b>
9.1. <i>LIMITS AND PROCEDURE</i> .....	29
9.2. <i>TRANSMITTER ABOVE 1 GHz</i> .....	30
9.3. <i>WORST-CASE BELOW 1 GHz</i> .....	43
<b>10. AC POWER LINE CONDUCTED EMISSIONS</b> .....	<b>46</b>
<b>11. SETUP PHOTOS</b> .....	<b>50</b>

# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** LG ELECTRONICS MOBILECOMM U.S.A., INC.  
**EUT DESCRIPTION:** GSM/WCDMA/LTE Phone + Bluetooth & DTS b/g/n  
**MODEL:** LGL31L, L31L, LG-L31L  
**SERIAL NUMBER:** 1792208-VS  
**DATE TESTED:** DECEMBER 13 – 30, 2013

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.

Approved & Released For  
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Tested By:



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WiSE PROGRAM MANAGER  
UL Verification Services Inc.

STEVEN TRAN  
WiSE TEST TECHNICIAN  
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.

## 3. FACILITIES AND ACCREDITATION

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

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsenc.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 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 b/g/n

### 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	2.02	1.59

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antenna, with a maximum gain of 0.1dBi.

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#### **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 Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z orientation.

## 5.5. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC Adapter	LG	N/A	N/A	N/A
Earphone	LG	N/A	N/A	N/A

### I/O CABLES

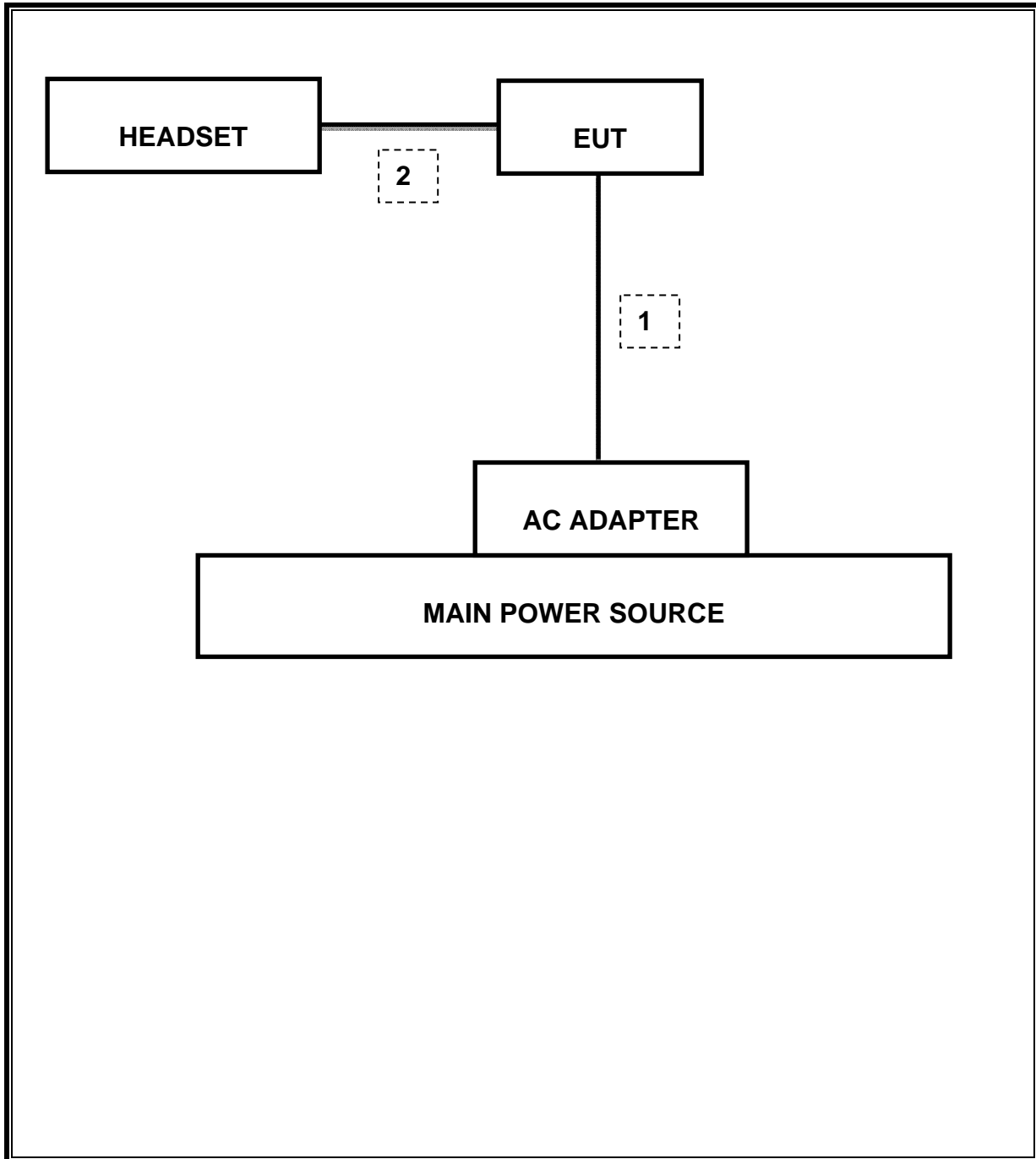
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC Power	1	Mini-USB	Shielded	1.2m	N/A
2	Audio	1	Mini-Jack	Unshielded	1m	N/A

### TEST SETUP

The EUT is continuously communicating to the Bluetooth tester during the tests. 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 Date	Cal Due
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB1	C01171	03/23/13	02/13/14
Antenna, Horn, 18GHz	EMCO	3115	C00783	10/25/13	10/25/14
Antenna, Horn, 25.5 GHz	ARA	MWH-1826/B	C00980	11/14/13	11/14/14
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	01/28/13	01/28/14
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	10/22/13	10/22/14
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	12/20/13	12/20/14
CBT Bluetooth Tester	R & S	CBT	None	07/12/13	07/12/14
Peak Power Meter	Agilent / HP	E4416A	C00963	12/13/13	12/13/14
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/13/13	12/13/14
LISN, 30 MHz	FCC	50/250-25-2	C00626	01/14/13	01/14/14
Reject Filter, 2.4GHz	Micro-Tronics	BRM50702	N02684	CNR	CNR

## 7. SUMMARY

### 8.

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	637.5 kHz
2.1051, 15.247 (d)	RSS-210 A8.5	Band Edge / Conducted Spurious Emission	-20dBc		Pass	-59.12 dBc
15.247	RSS-210 A8.4	TX conducted output power	<30dBm		Pass	2.02 dBm
15.247	RSS-210 A8.2	PSD	<8dBm		Pass	-13.13 dBm
15.207 (a)	RSS-GEN 7.2.2	AC Power Line conducted emissions	Section 10	Radiated	Pass	27.1dBuV(AV)
15.205, 15.209	RSS-210 Clause 2.6, RSS-210 Clause 6	Radiated Spurious Emission	< 54dBuV/m		Pass	43.534 dBuV/m

## ANTENNA PORT TEST RESULTS

### 8.1. 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.

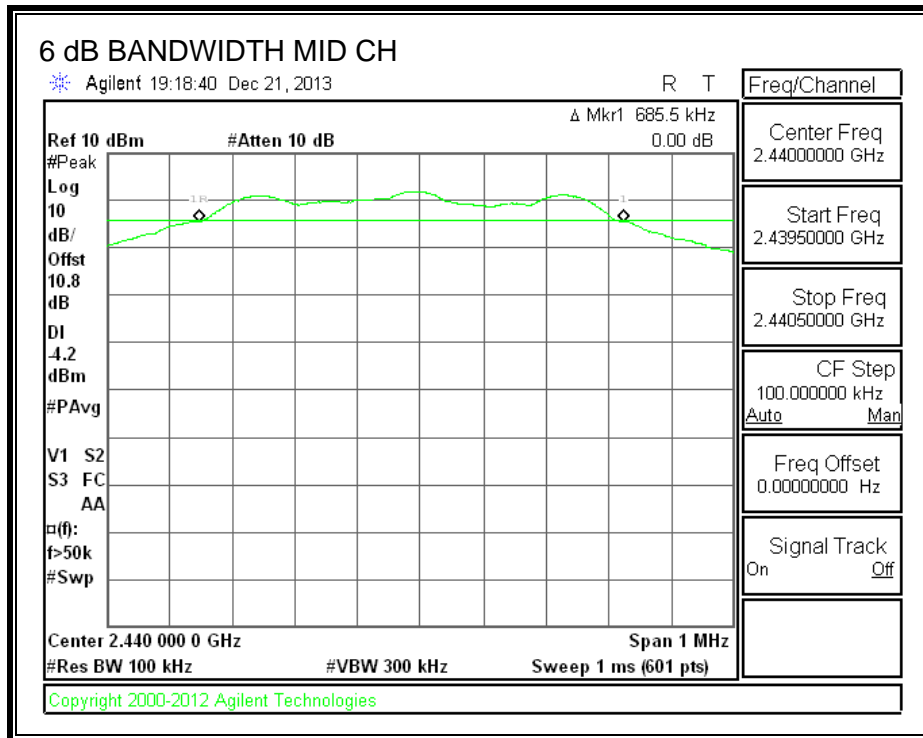
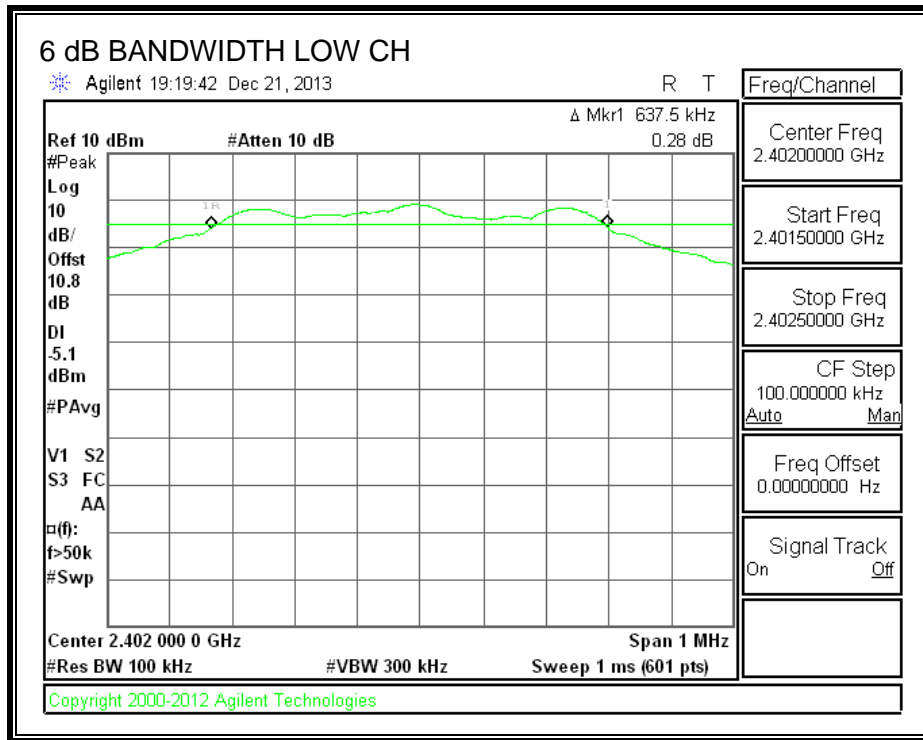
#### TEST PROCEDURE

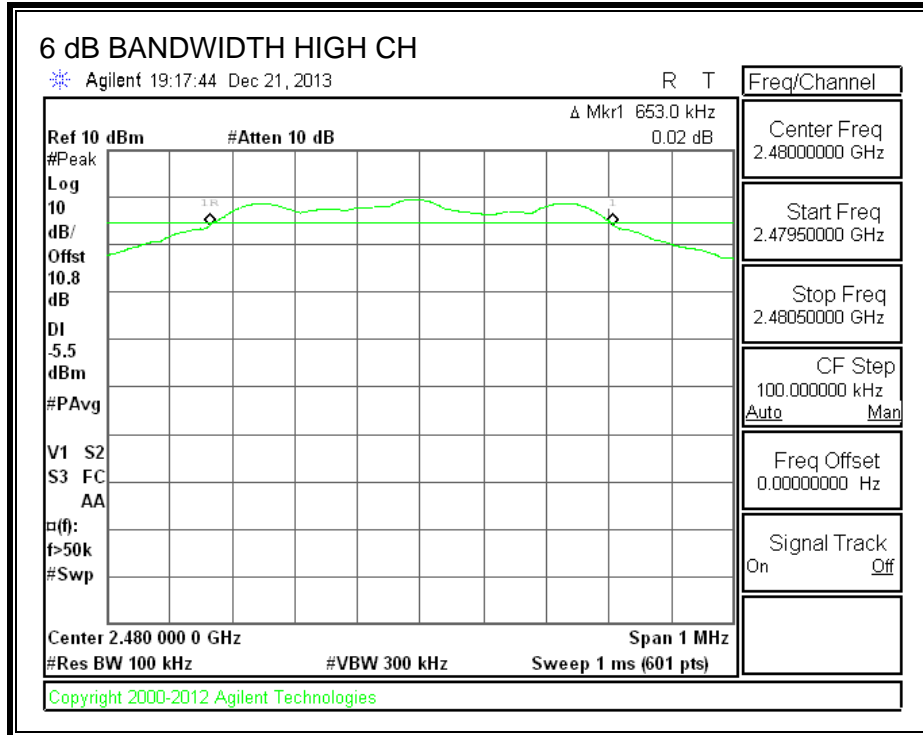
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

#### RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.6375	0.5
Middle	2440	0.6855	0.5
High	2480	0.6530	0.5

**6 dB BANDWIDTH**





## 8.2. 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

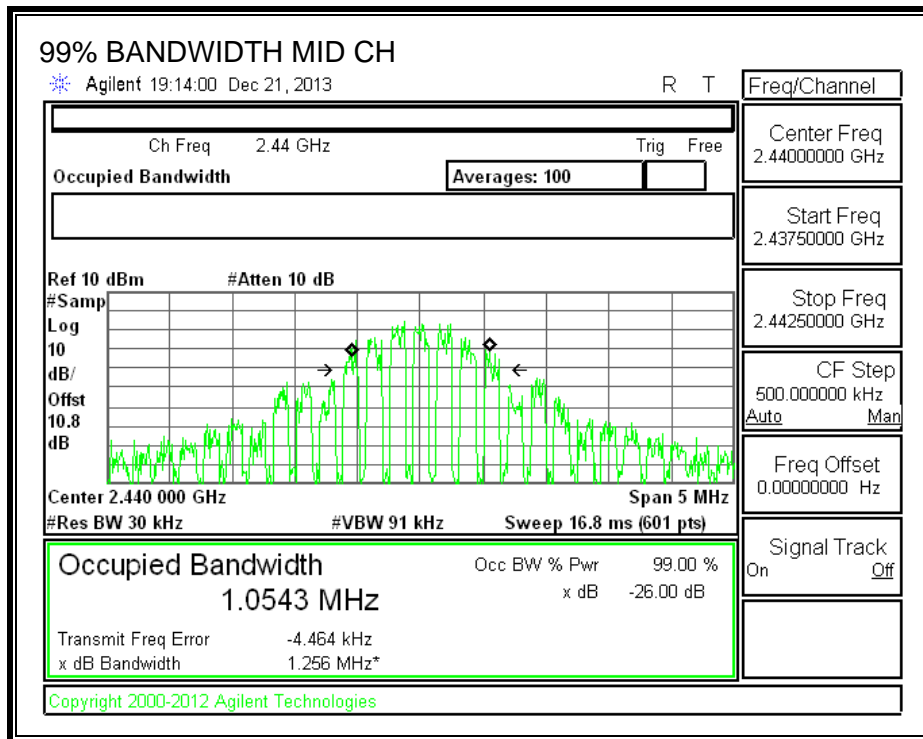
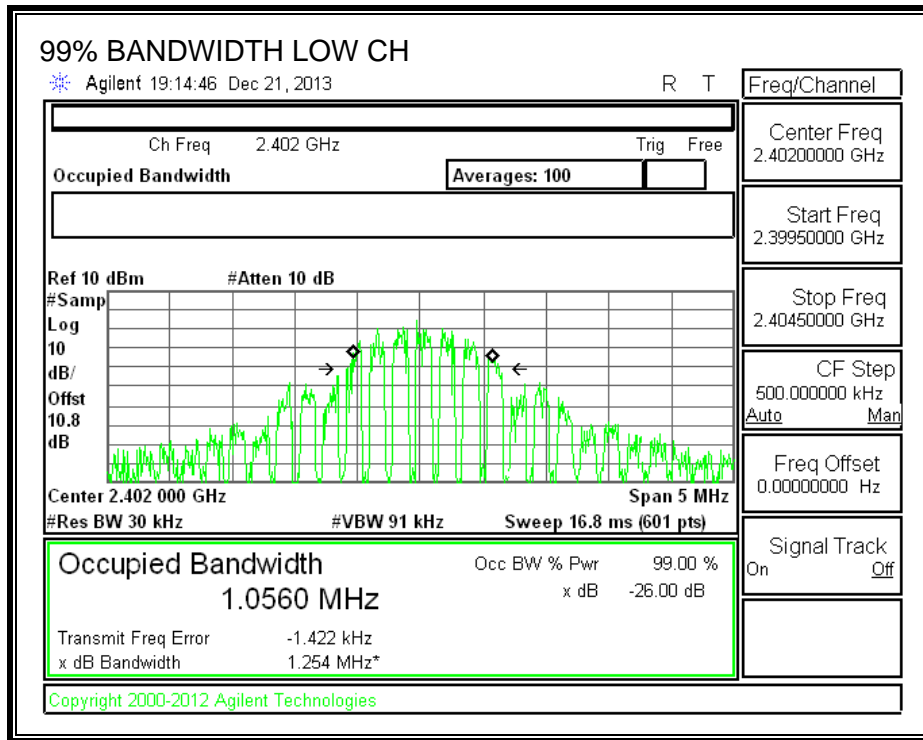
### TEST PROCEDURE

Reference to KDB558074 D01 DTS Meas Guidance v03r01: 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.

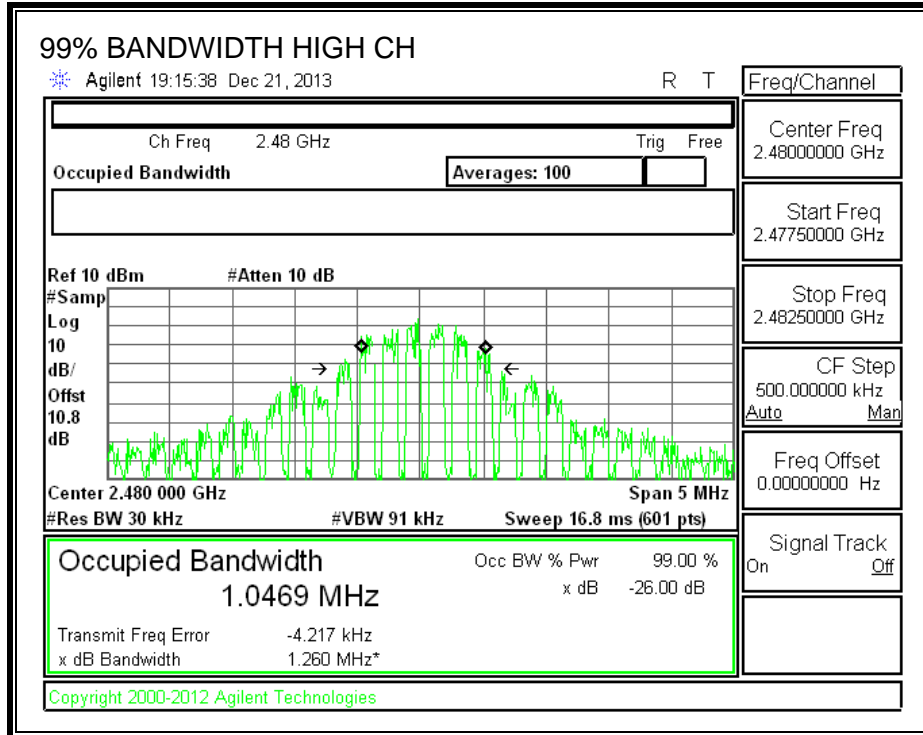
### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0560
Middle	2440	1.0543
High	2480	1.0469

**99% BANDWIDTH**







### 8.3. 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.

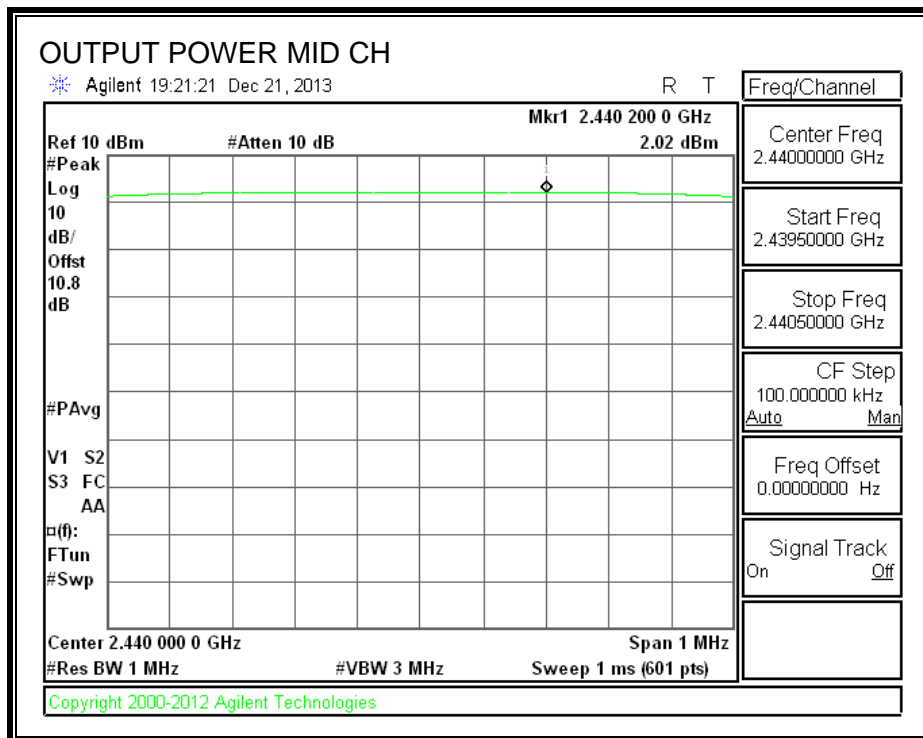
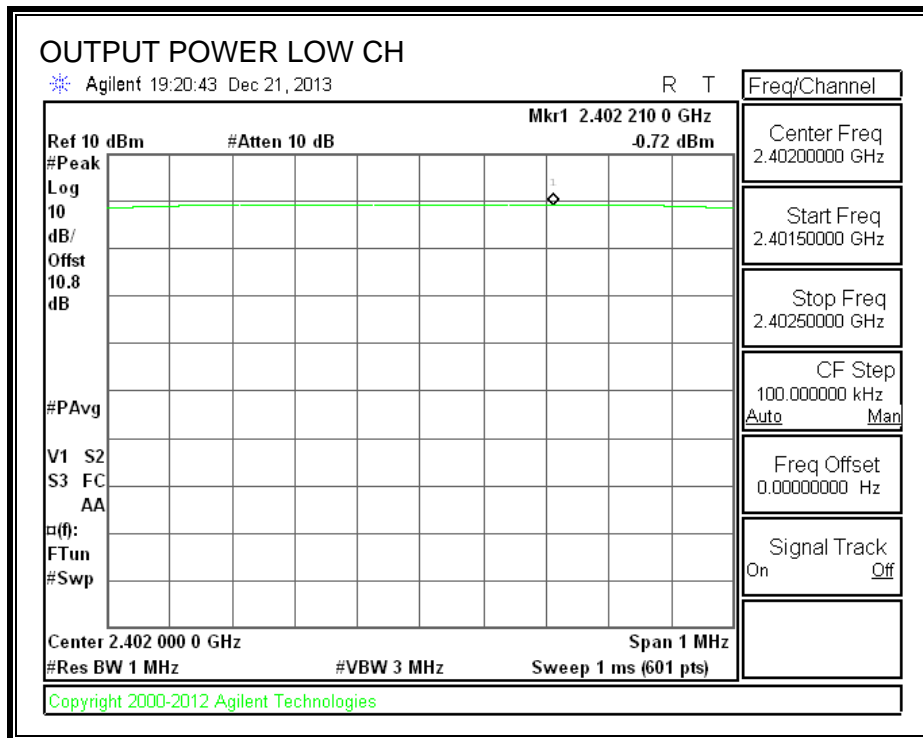
#### TEST PROCEDURE

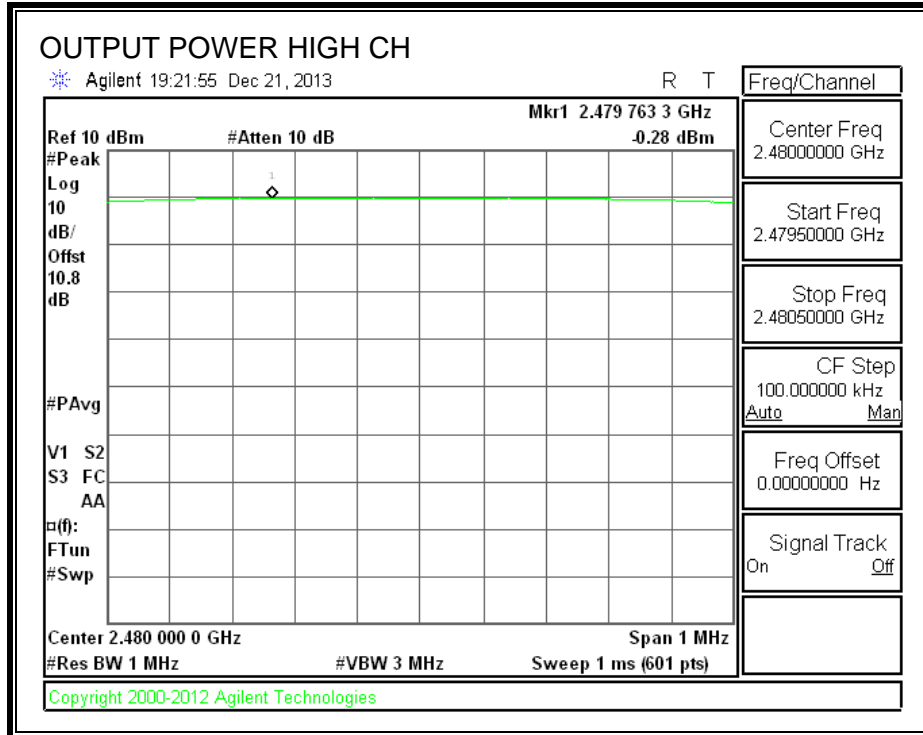
Peak power is measured using KDB558074 D01 DTS Meas Guidance v03r01 April 9, 2013 under section 9.1.1 utilizing spectrum analyzer.

#### RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-0.720	30	-30.720
Middle	2440	2.020	30	-27.980
High	2480	-0.280	30	-30.280

**OUTPUT POWER**





## 8.4. 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 11 dB (including 10 dB pad and 1 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	-1.40
Middle	2440	1.79
High	2480	-0.81

## 8.5. 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.

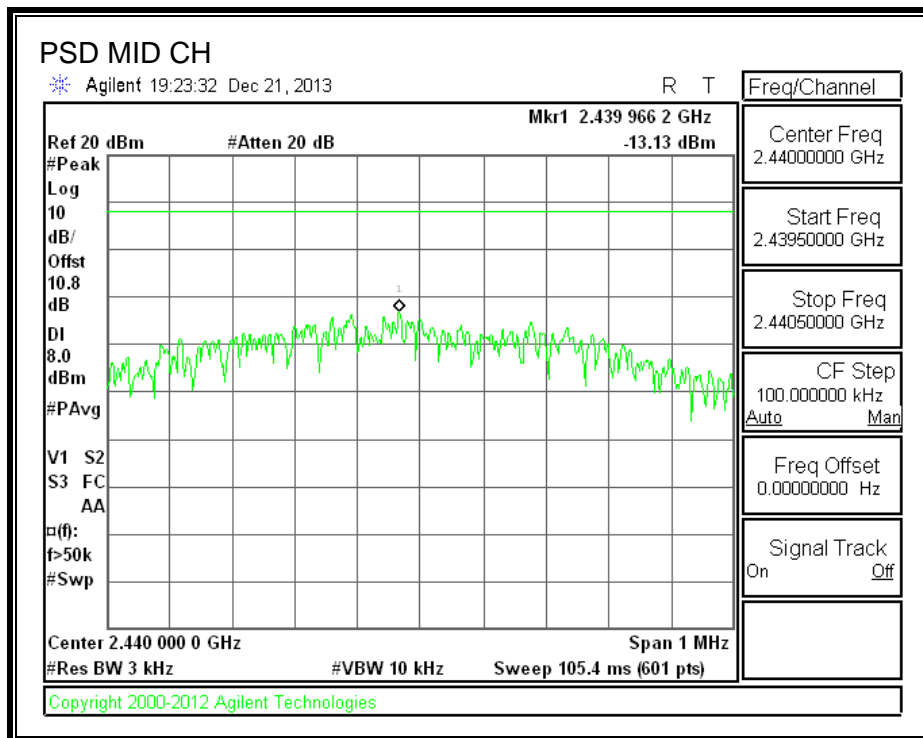
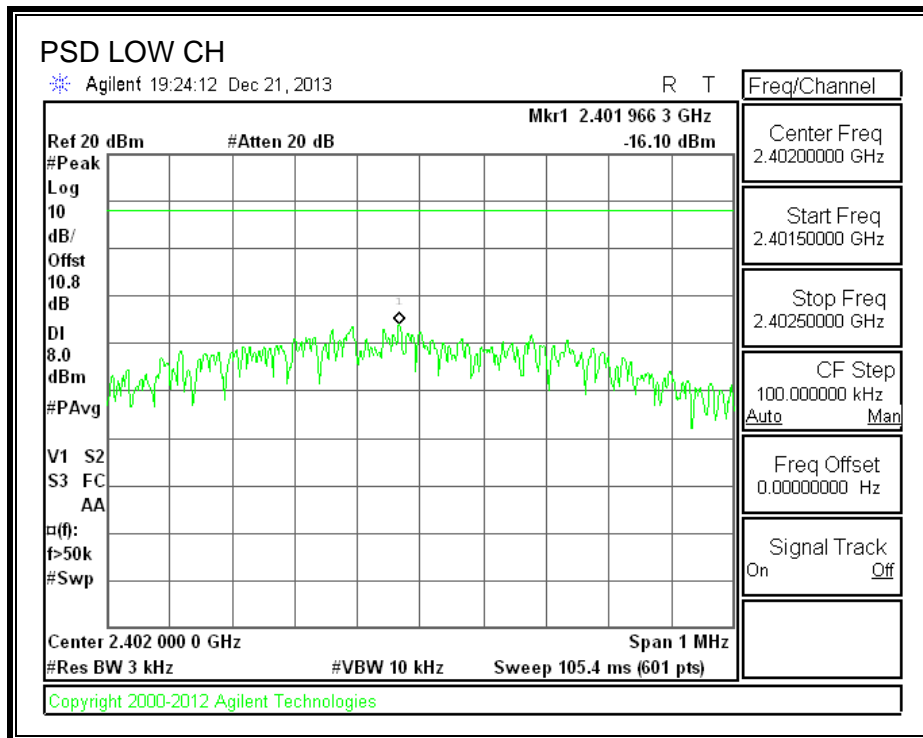
### TEST PROCEDURE

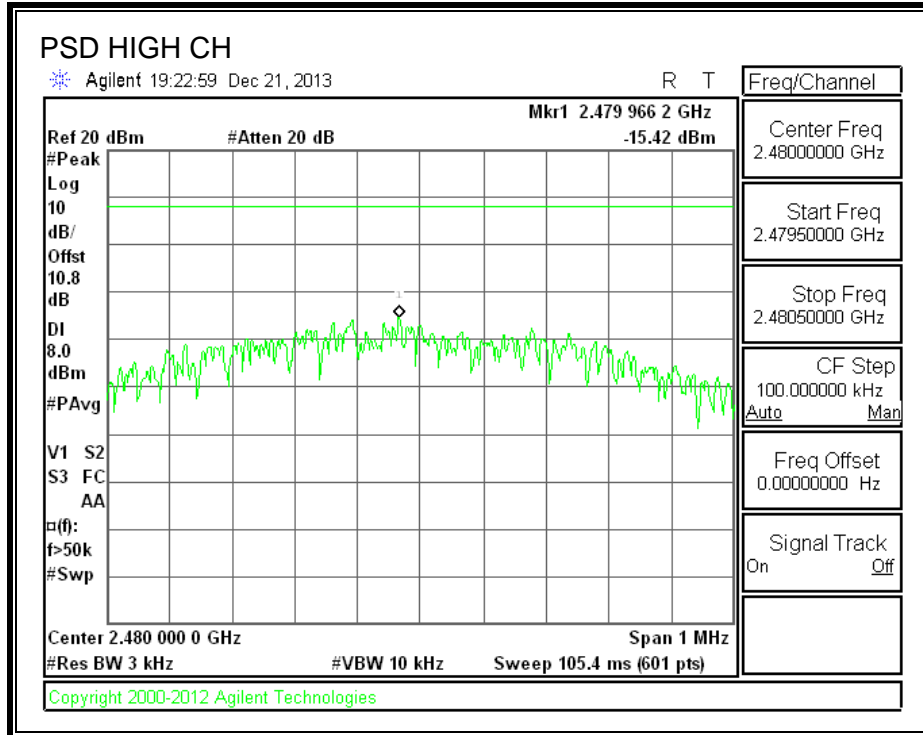
Power Spectral Density was performed utilizing the "Method PKPSD (Peak PSD)" under KDB558074 D01 DTS Meas Guidance v03r01, April 9, 2013

### RESULTS

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-16.10	8	-24.10
Middle	2440	-13.13	8	-21.13
High	2480	-15.42	8	-23.42

**POWER SPECTRAL DENSITY**







## **8.6. 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.

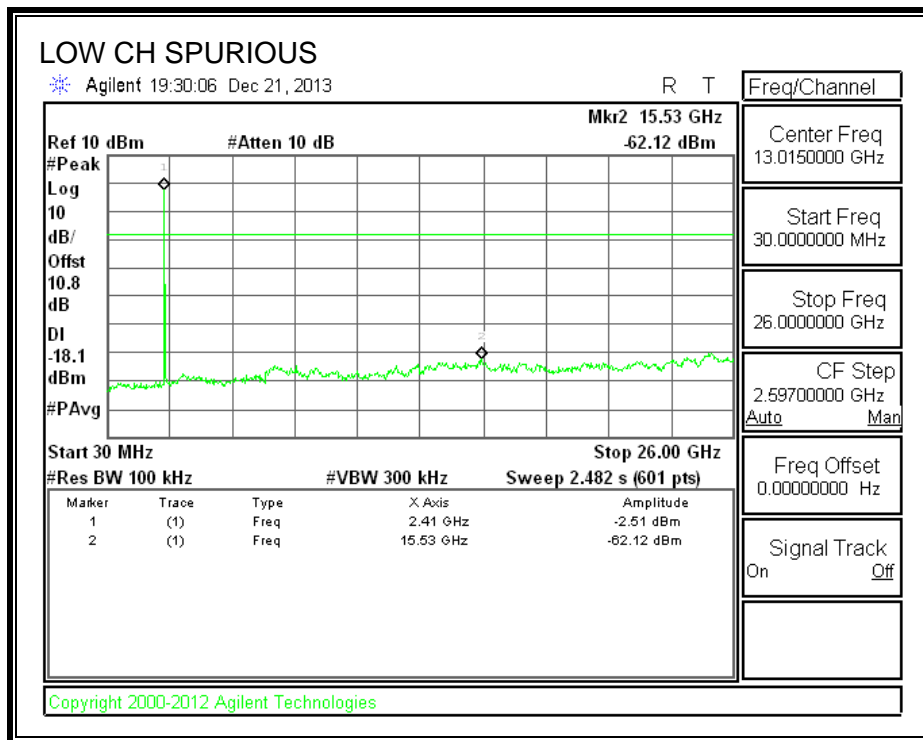
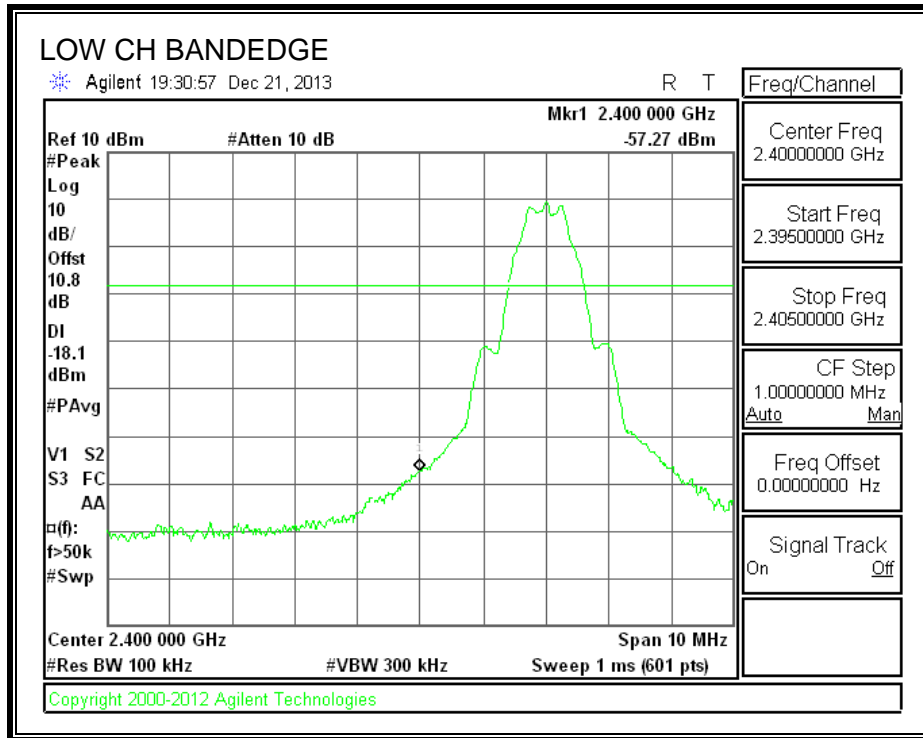
### **TEST PROCEDURE**

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.

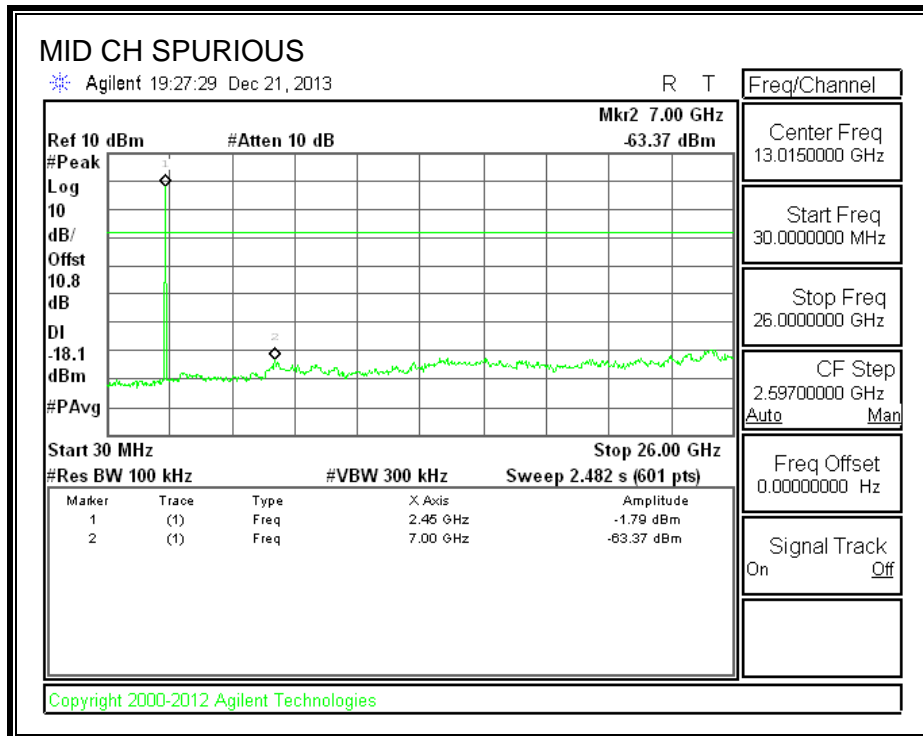
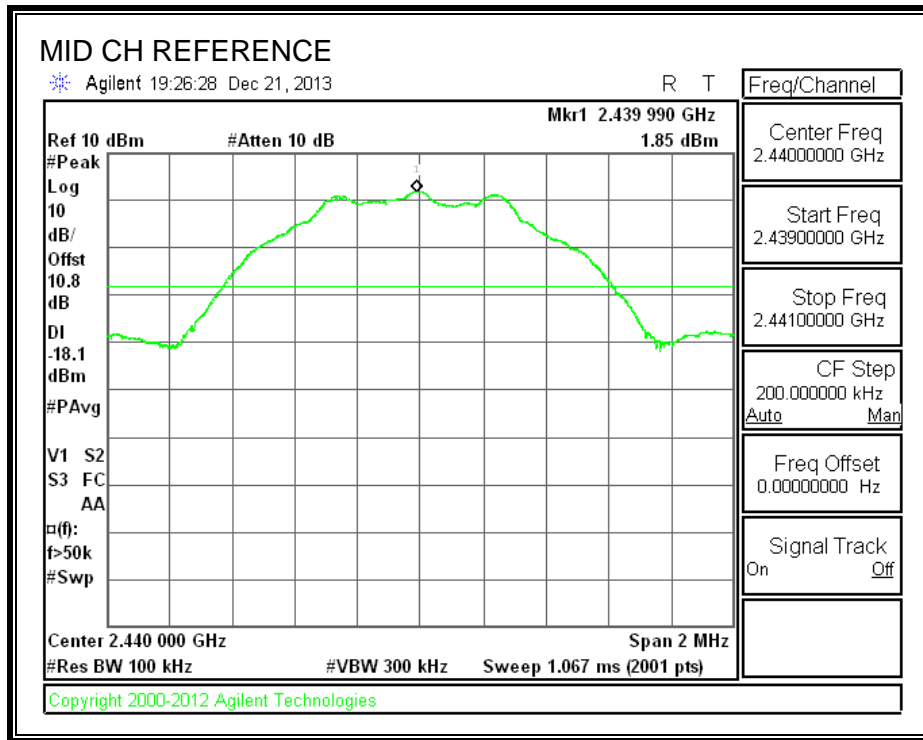
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

**RESULTS**

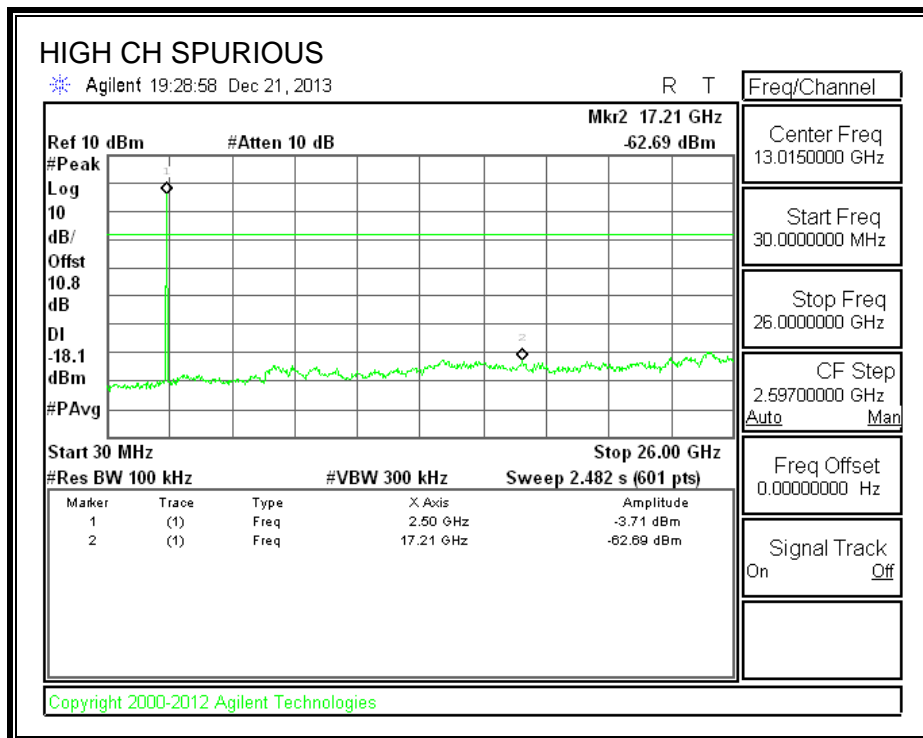
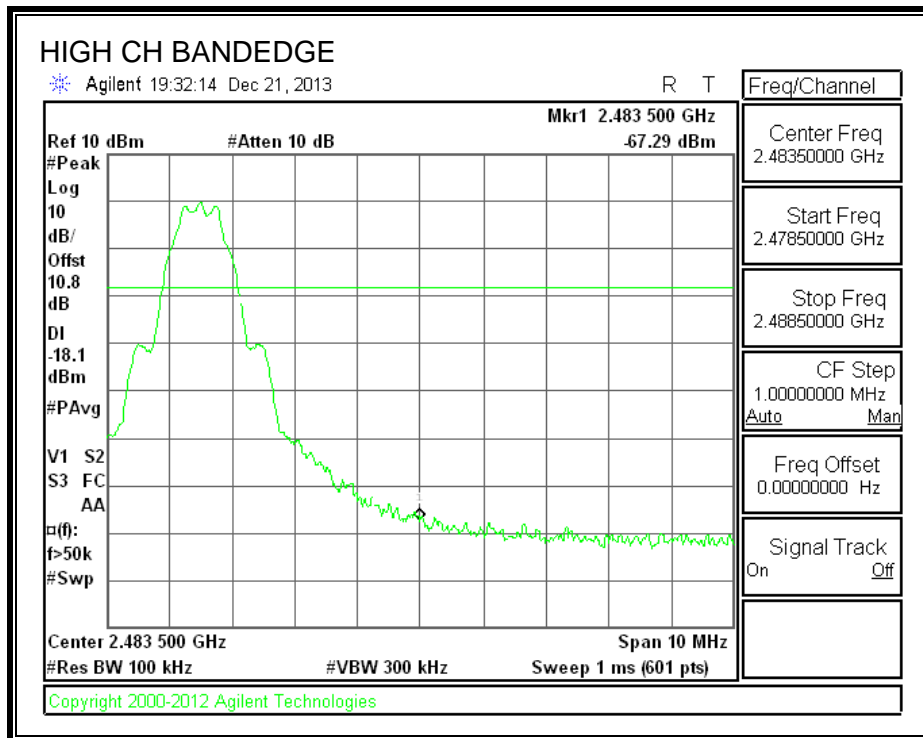
**SPURIOUS EMISSIONS, LOW CHANNEL**



**SPURIOUS EMISSIONS, MID CHANNEL**



**SPURIOUS EMISSIONS, HIGH CHANNEL**



## 9. RADIATED TEST RESULTS

### 9.1. 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 =  $10 \log(1/x) = 2.1 \text{ dB}$

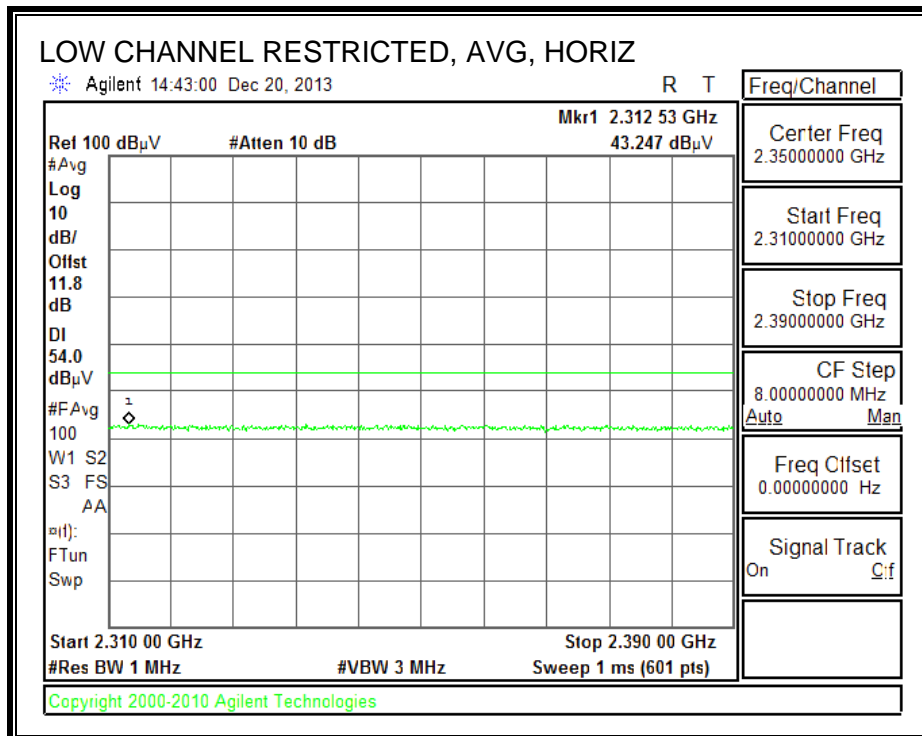
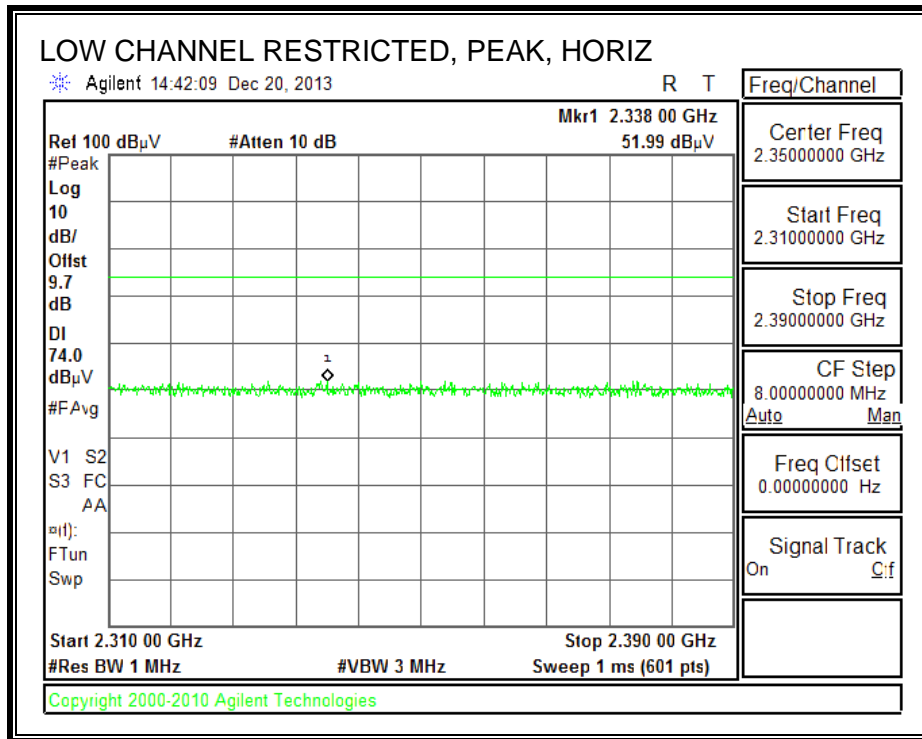
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

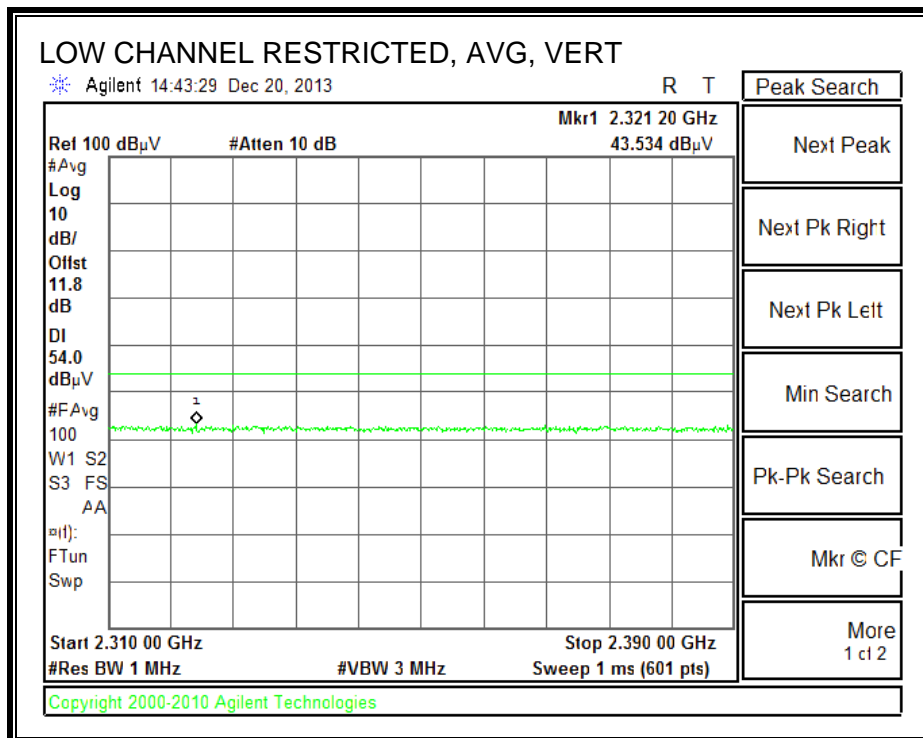
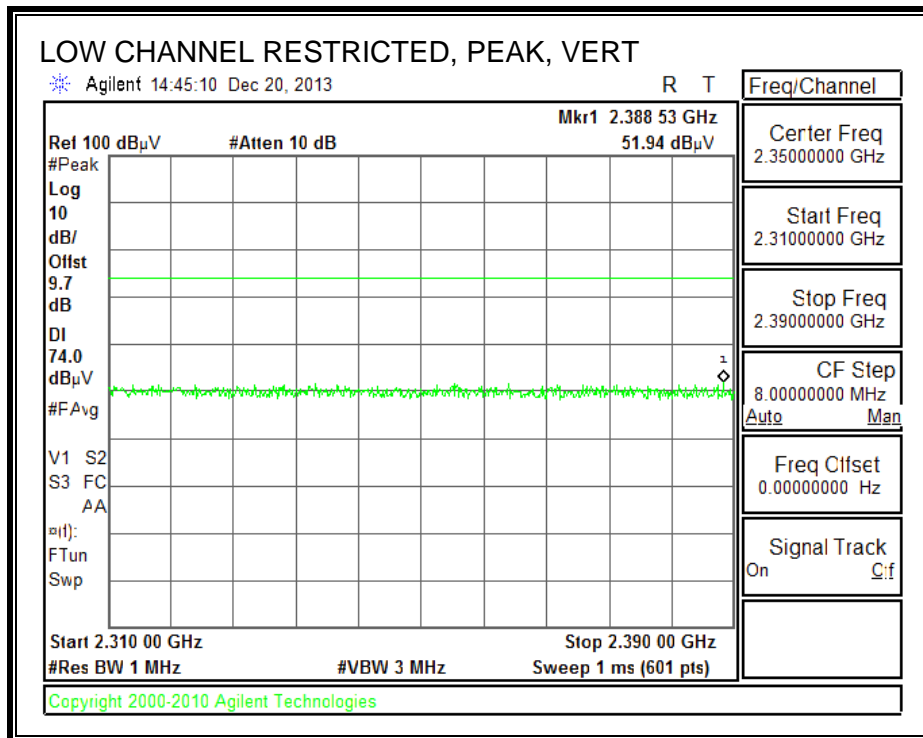
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

## 9.2. TRANSMITTER ABOVE 1 GHz

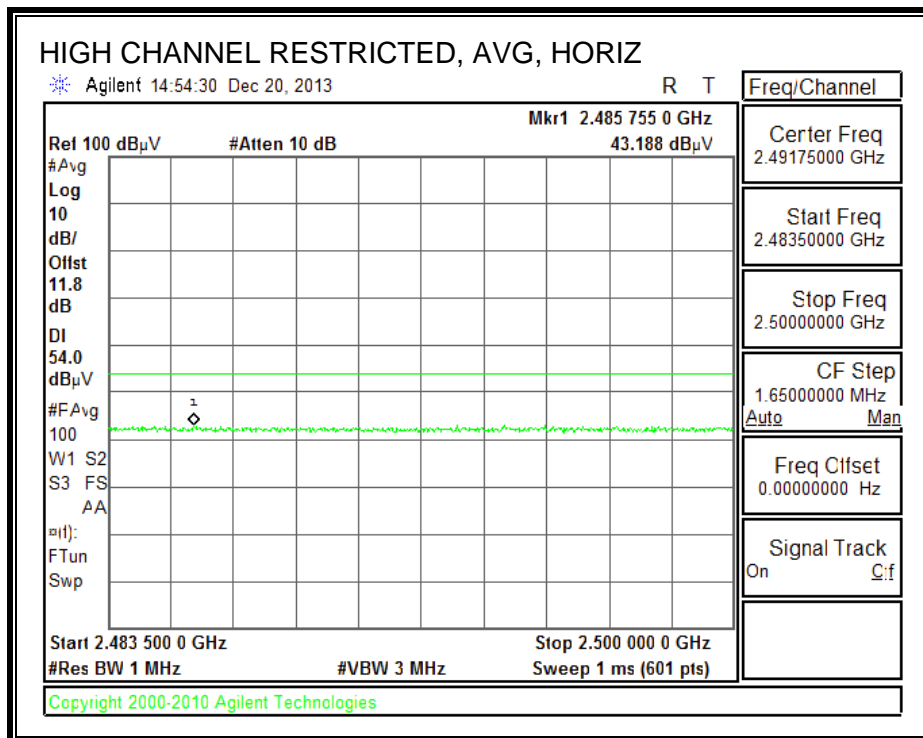
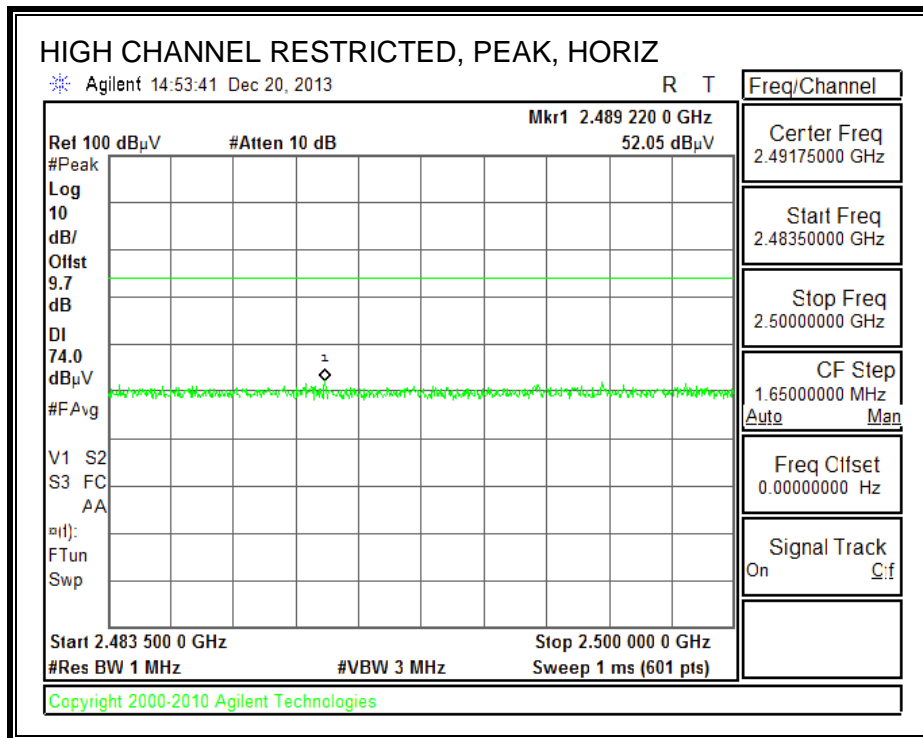
### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

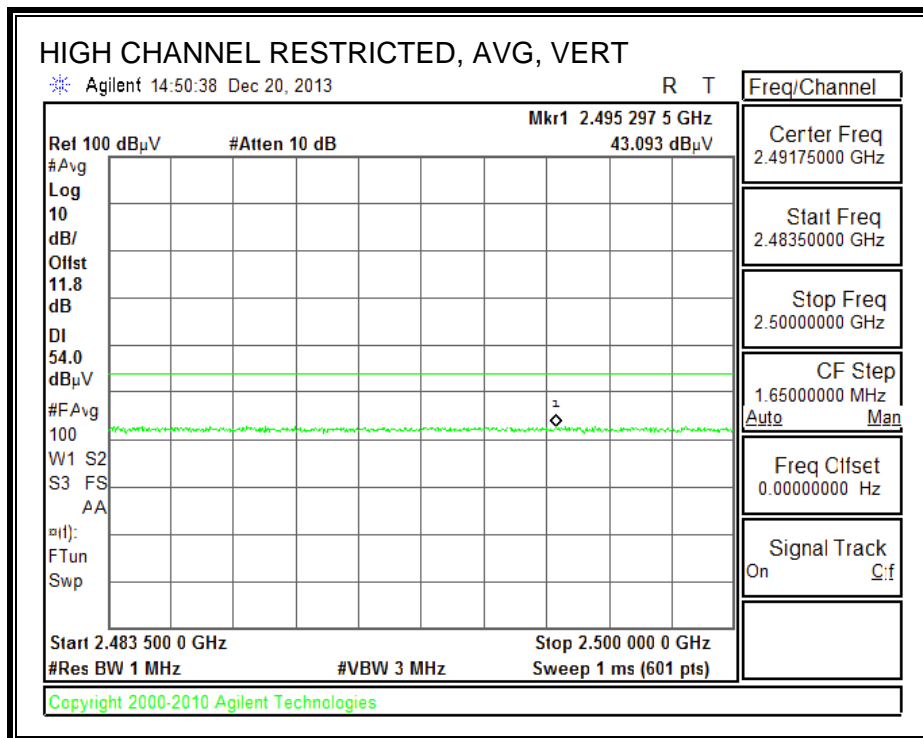
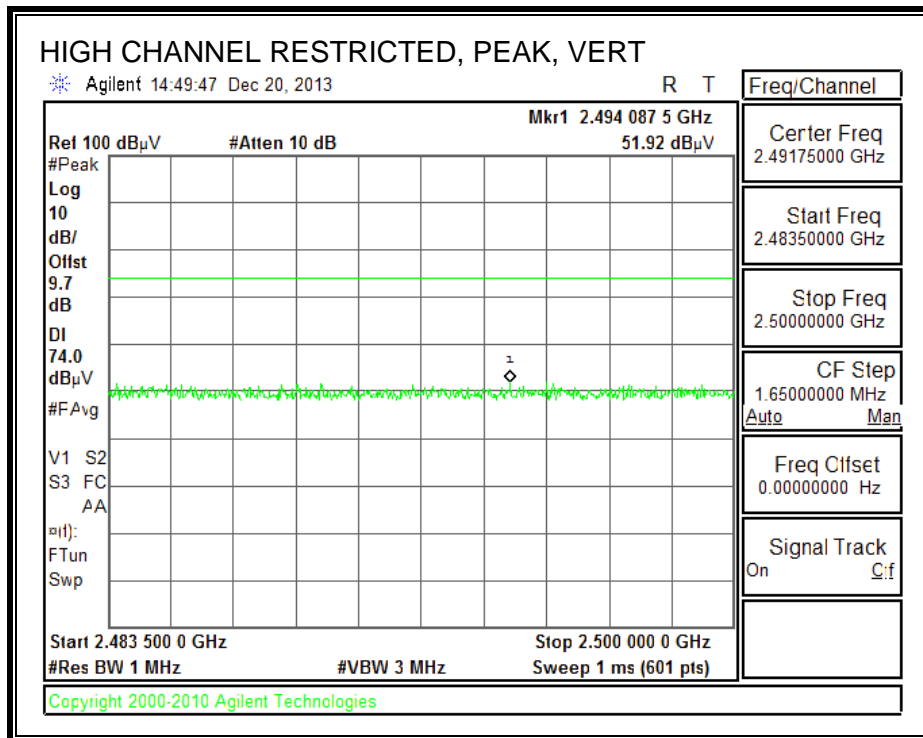


**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



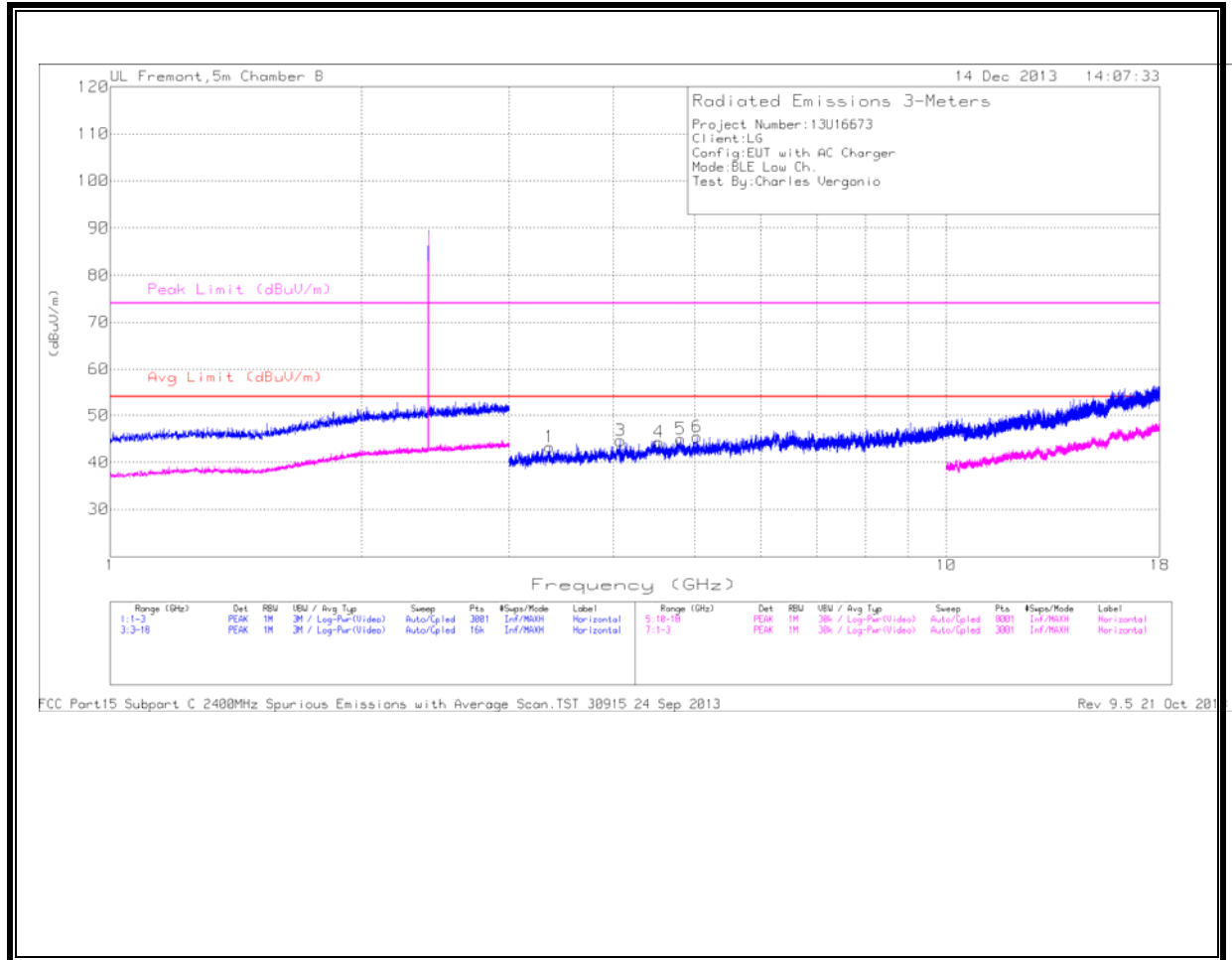


**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



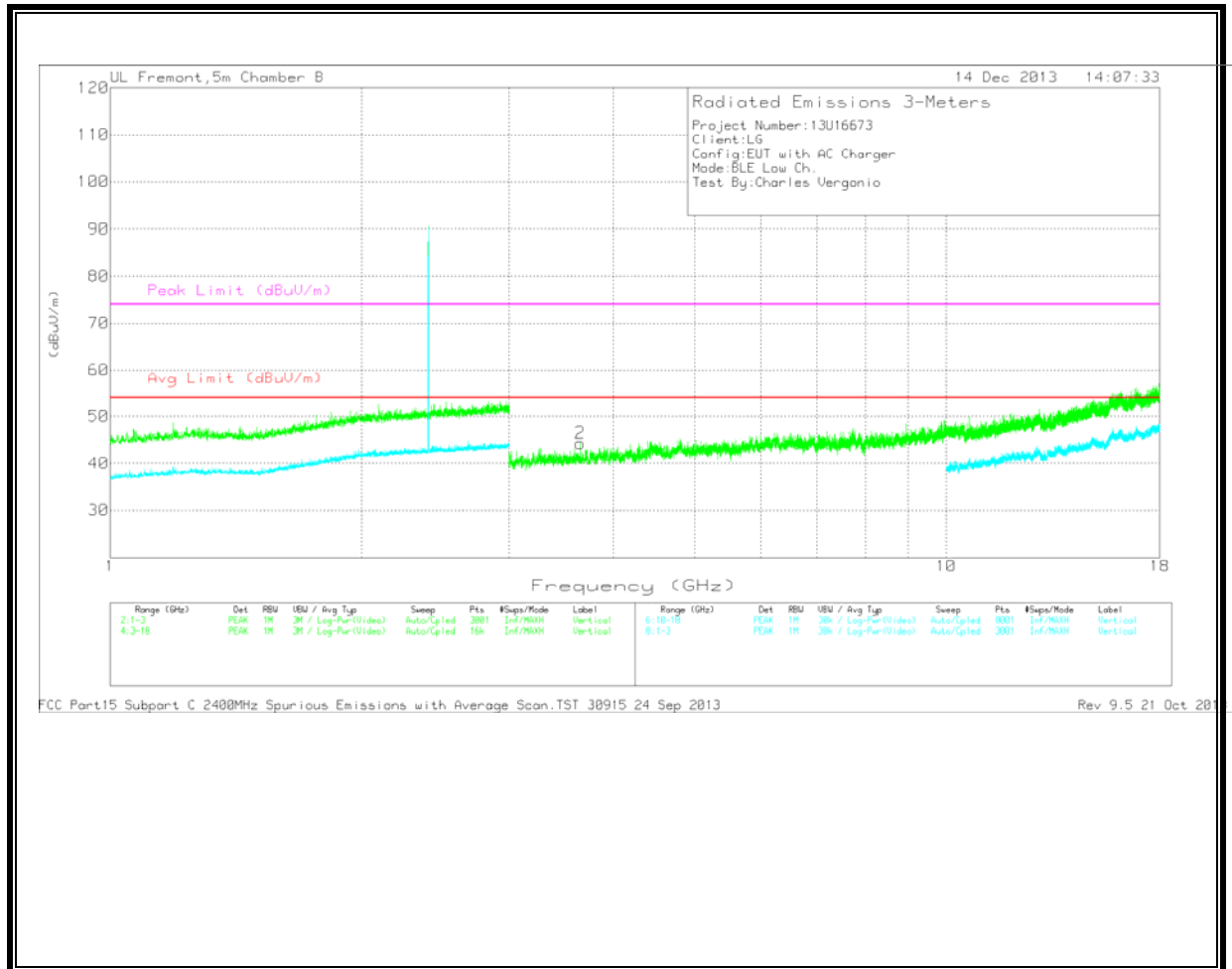
**HARMONICS AND SPURIOUS EMISSIONS**

**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  
 Trace Markers

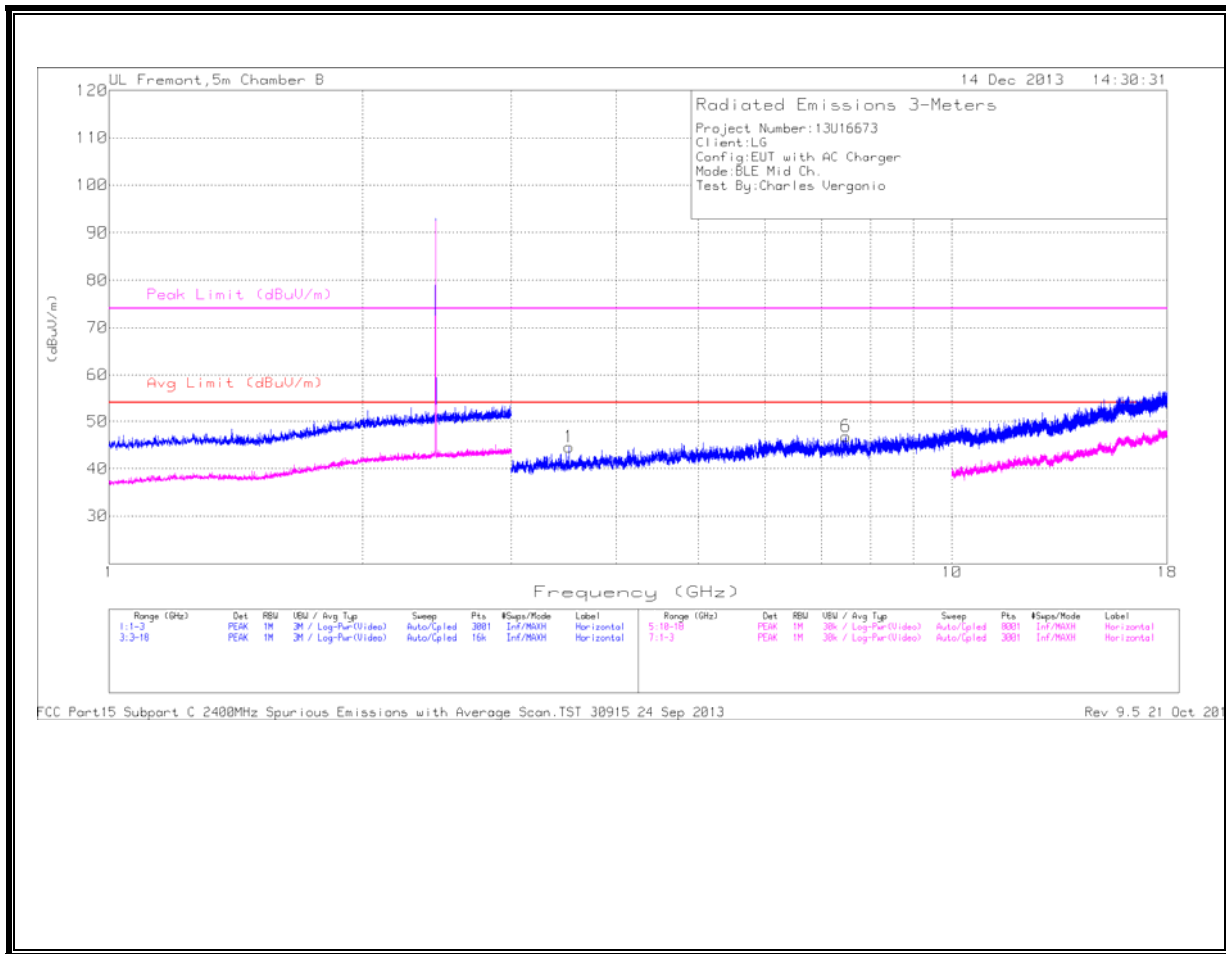
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cb I/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.355	41.32	PK	33.3	-31.4	43.22	53.97	-10.75	74	-30.78	0-360	99	H
2	3.65	41.65	PK	33.6	-31	44.25	53.97	-9.72	74	-29.75	0-360	202	V
3	4.076	41.73	PK	34	-31.1	44.63	53.97	-9.34	74	-29.37	0-360	201	H
4	4.535	39.45	PK	34.5	-29.7	44.25	53.97	-9.72	74	-29.75	0-360	201	H
5	4.814	39.23	PK	34.7	-29	44.93	53.97	-9.04	74	-29.07	0-360	99	H
6	5.033	39.62	PK	34.6	-28.8	45.42	53.97	-8.55	74	-28.58	0-360	99	H

PK - Peak detector

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

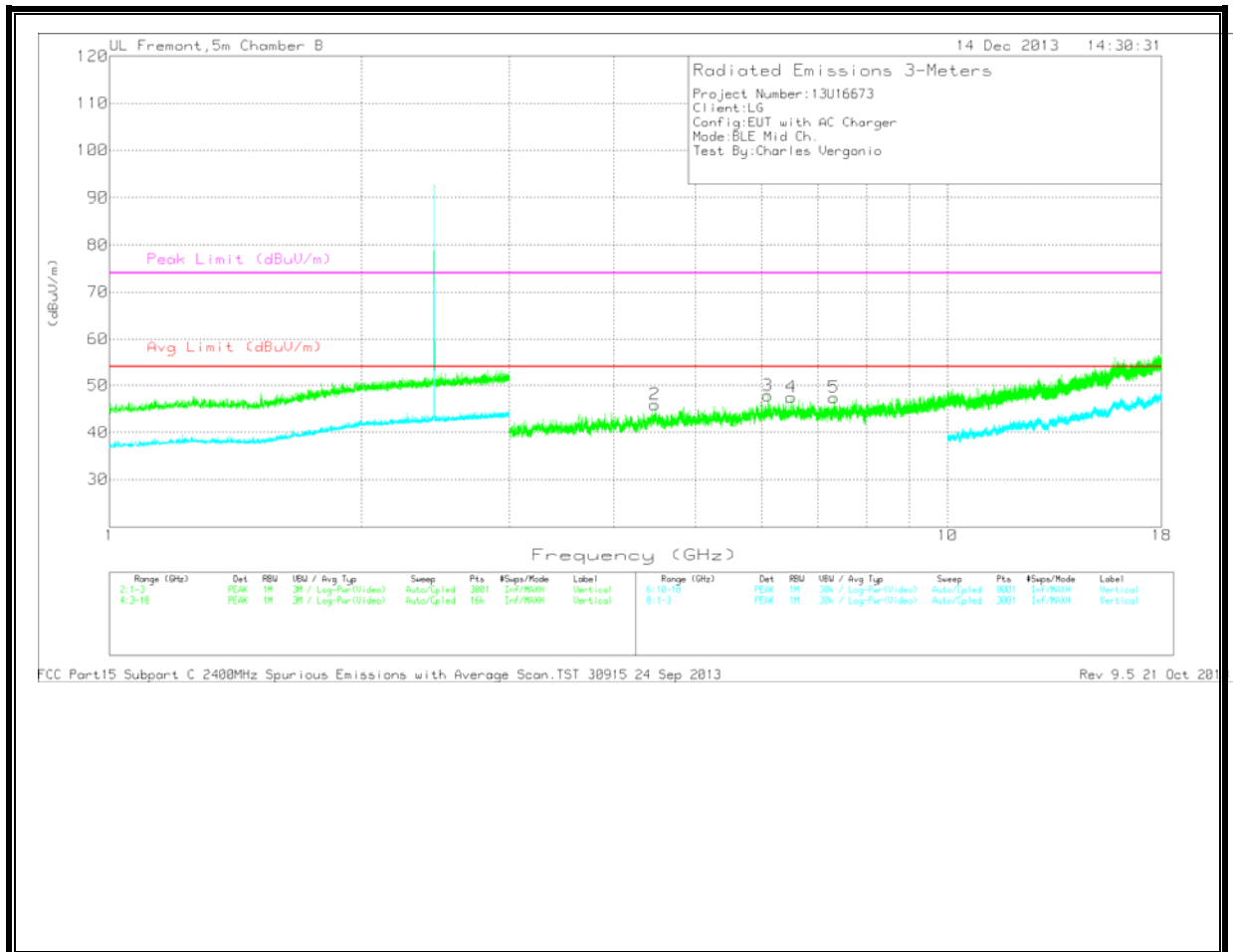
MID CHANNEL

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

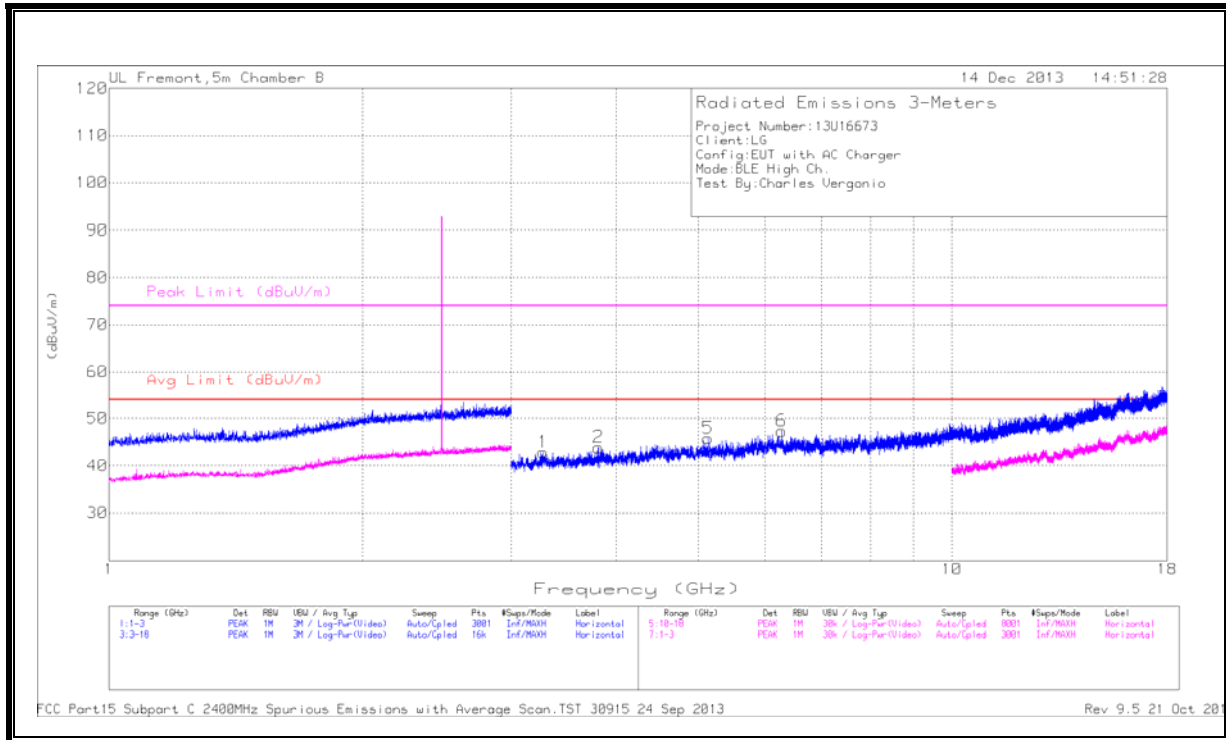
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cb I/Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.516	42.58	PK	33.2	-31.2	44.58	53.97	-9.39	74	-29.42	0-360	99	H
2	4.476	40.52	PK	34.5	-29.1	45.92	53.97	-8.05	74	-28.08	0-360	99	V
3	6.1	41.11	PK	35.9	-29.2	47.81	53.97	-6.16	74	-26.19	0-360	202	V
4	6.511	39.19	PK	35.9	-27.6	47.49	53.97	-6.48	74	-26.51	0-360	99	V
5	7.319	39.18	PK	35.9	-27.7	47.38	53.97	-6.59	74	-26.62	0-360	99	V
6	7.49	37.24	PK	36	-26.4	46.84	53.97	-7.13	74	-27.16	0-360	201	H

PK - Peak detector

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

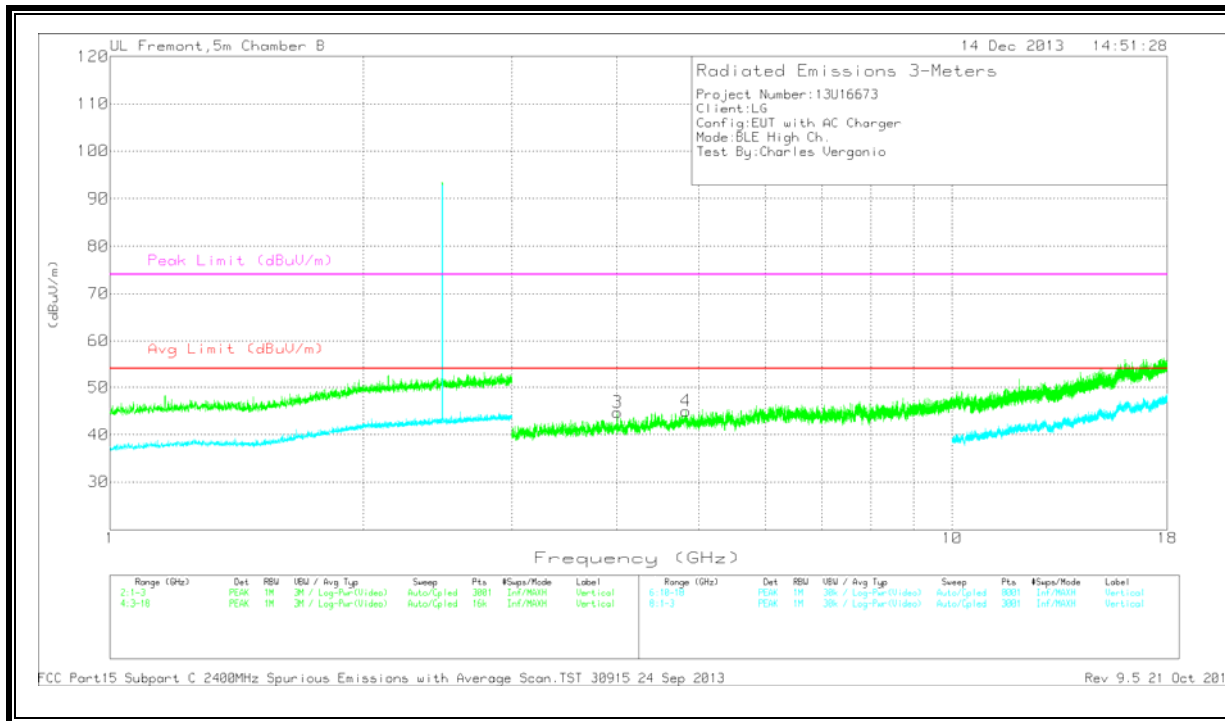
HIGH CHANNEL  
 HORIZONTAL



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  
 Trace Markers

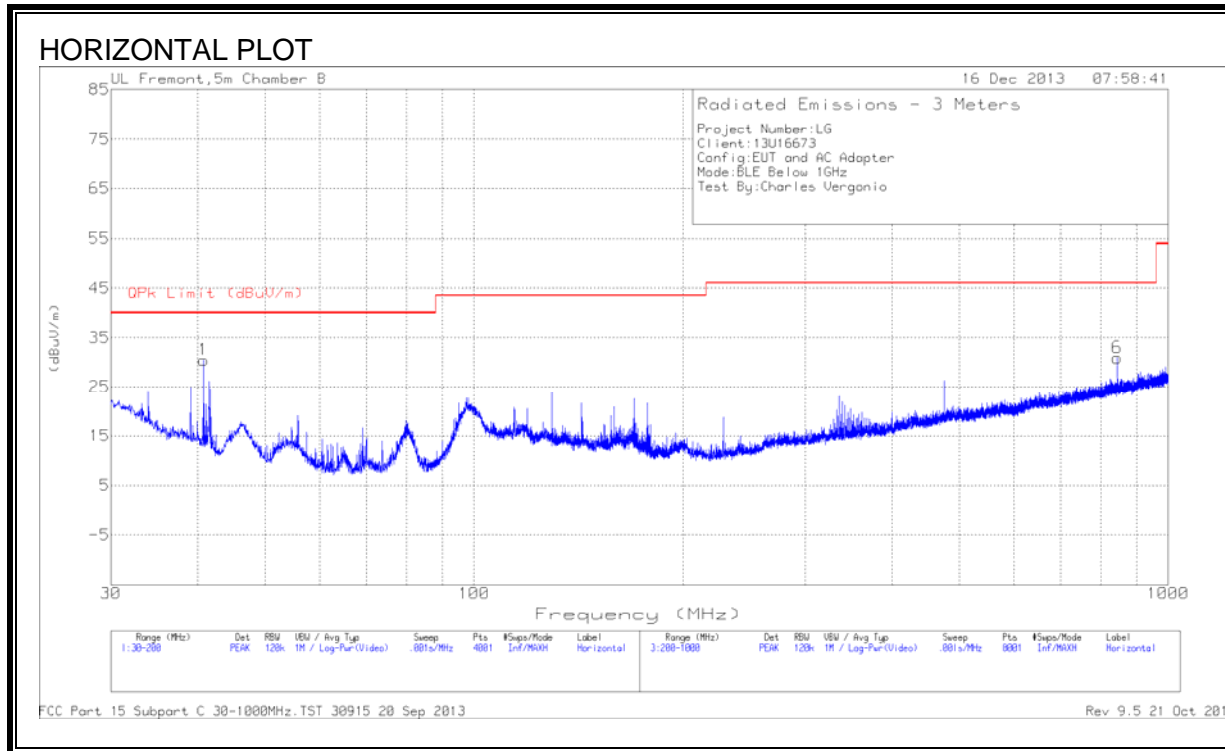
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cb I/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.273	40.92	PK	33.3	-31.4	42.82	53.97	-11.15	74	-31.18	0-360	201	H
2	3.808	40.86	PK	33.8	-30.8	43.86	53.97	-10.11	74	-30.14	0-360	201	H
3	4.005	41.88	PK	33.9	-31.1	44.68	53.97	-9.29	74	-29.32	0-360	99	V
4	4.83	39.75	PK	34.7	-29.5	44.95	53.97	-9.02	74	-29.05	0-360	99	V
5	5.135	40.25	PK	34.8	-29.3	45.75	53.97	-8.22	74	-28.25	0-360	99	H
6	6.279	39.4	PK	36	-28.1	47.3	53.97	-6.67	74	-26.7	0-360	99	H

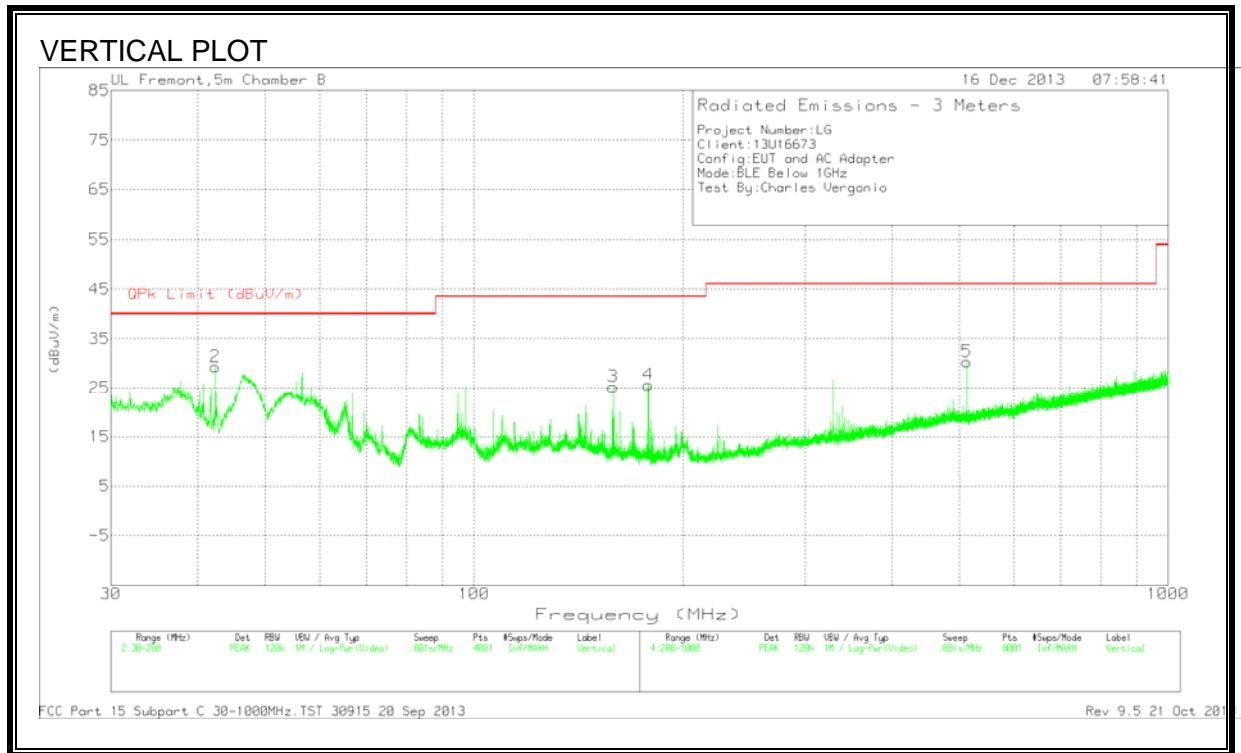
PK - Peak detector

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

### 9.3. WORST-CASE BELOW 1 GHz

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





Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T243 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	40.795	46.3	PK	12.9	-28.7	30.5	40	-9.5	0-360	400	H
2	42.41	46.31	PK	11.7	-28.7	29.31	40	-10.69	0-360	100	V
3	158.6475	40.59	PK	12.1	-27.4	25.29	43.52	-18.23	0-360	100	V
4	178.3675	41.86	PK	11	-27.2	25.66	43.52	-17.86	0-360	100	V
5	512.7	38.54	PK	17.7	-25.9	30.34	46.02	-15.68	0-360	100	V
6	843.9	32.83	PK	21.7	-23.6	30.93	46.02	-15.09	0-360	300	H

PK - Peak detector

FCC Part 15 Subpart C 30-1000MHz.TST 30915 20 Sep 2013 Rev 9.5 21 Oct 2013

## 10. 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 - 2009

### RESULTS

**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 dB(uVolts)	CISPR 11/22 Class B Quasi-peak	Margin to Limit (dB)	CISPR 11/22 Class B Average	Margin to Limit (dB)
3	.3435	40.05	PK	.1	0	40.15	59.1	-18.95	-	-
4	.3435	23.05	Av	.1	0	23.15	-	-	49.1	-25.95
5	1.1895	41.85	PK	.1	.1	42.05	56	-13.95	-	-
6	1.1895	22.41	Av	.1	.1	22.61	-	-	46	-23.39
9	14.5275	39.97	PK	.2	.2	40.37	60	-19.63	-	-
10	14.5275	17.51	Av	.2	.2	17.91	-	-	50	-32.09

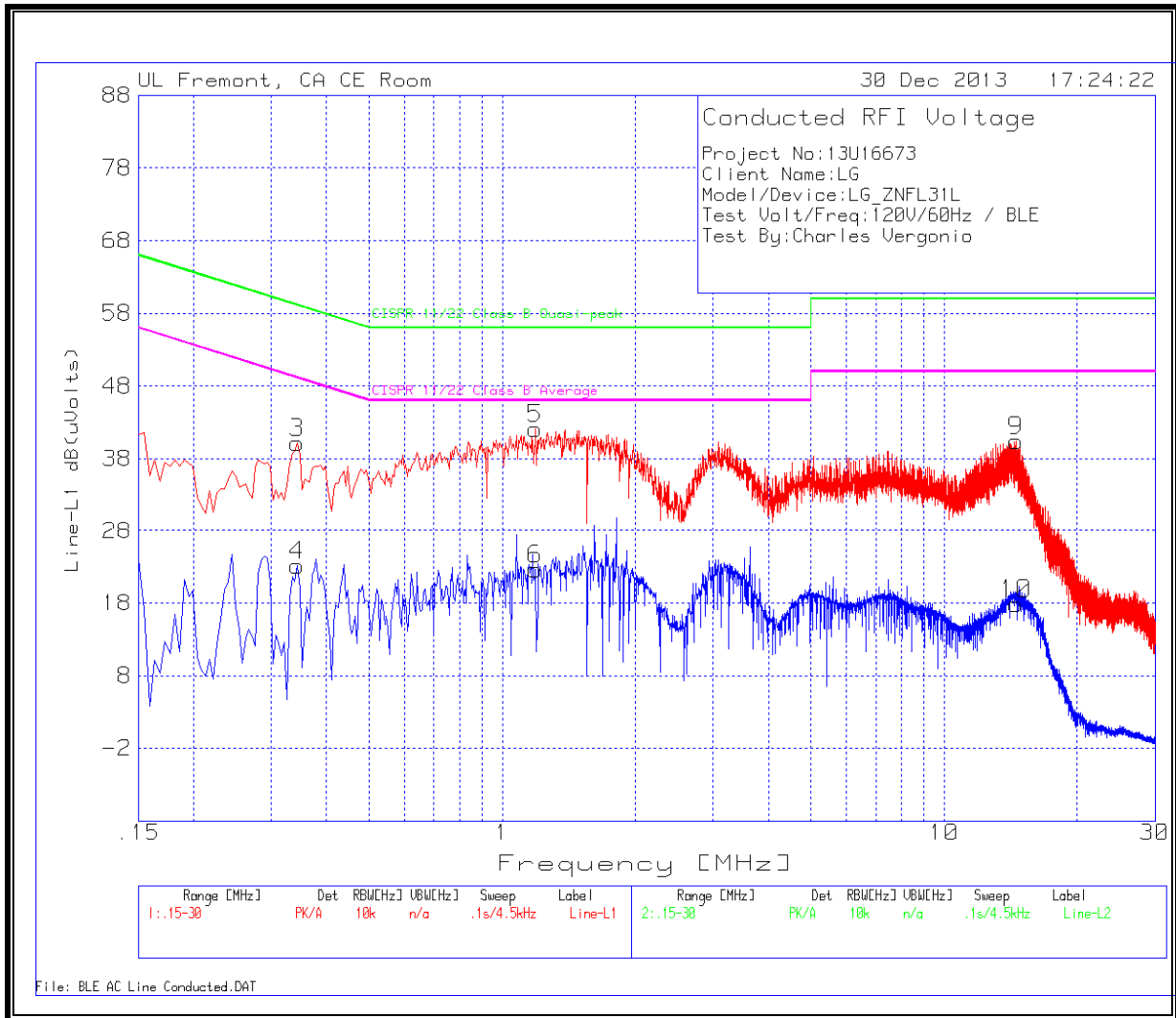
**Line-L2 .15 - 30MHz**

**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)
1	.2895	40.67	PK	.1	0	40.77	60.5	-19.73	-	-
2	.2895	27	Av	.1	0	27.1	-	-	50.5	-23.4
7	3.066	39	PK	.1	.1	39.2	56	-16.8	-	-
8	3.066	20.64	Av	.1	.1	20.84	-	-	46	-25.16
11	16.2285	38.87	PK	.2	.2	39.27	60	-20.73	-	-
12	16.2285	18.34	Av	.2	.2	18.74	-	-	50	-31.26

PK - Peak detector  
 Av - average detection

**LINE 1 RESULTS**





**LINE 2 RESULTS**

