



CERTIFICATION TEST REPORT

Report Number. : 11717038-E1V2

Applicant : ENERGOUS CORPORATION
3590 NORTH FIRST STREET
SAN JOSE, CA 95134 USA

Model : MS-300a

FCC ID : 2ADNG-MS300a

EUT Description : WPT CLIENT DEVICE WITH BLE

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C

Date Of Issue:

January 05, 2018

Prepared by:

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Revision History

Rev.	Issue Date	Revisions	Revised By
V1	01/03/18	Initial Issue	Dan Corona
V2	01/05/18	Updated Section 8.2, list model number in the header	Dan Corona

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Energous Corporation
3590 North First Street
San Jose, CA 95134 USA

EUT DESCRIPTION: WPT Client Device with BLE

MODEL: MS-300a

SERIAL NUMBER: DD0372062004

DATE TESTED: NOVEMBER 22-29, 2017

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

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:



DAN CORONIA
OPERATIONS LEADER
UL VERIFICATION SERVICES INC.

Prepared By:



ERIC YU
TEST ENGINEER
UL VERIFICATION SERVICES INC.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, KDB 558074 D01 v04, ANSI C63.10-2013.

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 (IC:2324B-1)	☐	Chamber D (IC:22541-1)
☐	Chamber B (IC:2324B-2)	☐	Chamber E (IC:22541-2)
☐	Chamber C (IC:2324B-3)	☐	Chamber F (IC:22541-3)
		☐	Chamber G (IC:22541-4)
		☐	Chamber H (IC:22541-5)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

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:

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

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The MS-300a is a wireless power transfer (WPT) client device designed for use with MS-300 wireless charging system that delivers RF energy to a Client Device seeking to be charged when positioned within the Charging Zone. The MS-300 transfers RF energy to the MS-300a at a frequency of 913 MHz; the system does not transmit information at this frequency. Data communication, for example for the authentication of client devices, is performed through standard 2.4 GHz Bluetooth LE protocols.

The MS-300 / MS-300a fall under FCC Part 18.107(c) it because they are designed to generate and use RF energy locally to charge domestic consumer electronic devices. The MS-300 transfers RF energy from the front of the transmitter and creates a pocket around the authenticated Client Device (MS-300a) that will be charged. The MS-300a uses this energy to charge internal batteries. The system is intended to be used by the general public in a residential or office environment.

The MS-300a can be charged at any point within the Charging Zone of the MS-300 if three conditions are met; all self-checks passed, the device is determined to be positioned in the Charging Zone, and the device is receiving sufficient power to charge. Full details related to the MS-300 WPT charger are provided in the filing for the device under FCC ID 2ADNG-MS300.

This report covers the Bluetooth Low Energy portion of the EUT.

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	-1.55	0.70

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Gain (dBi)
2402-2480	-2.63

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 3.0.2.79

The software installed in the EUT during testing was Windows Command Prompt / eCLI

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated band edge, harmonics, and spurious emissions from 1 GHz to 18GHz were performed with the EUT was set to transmit at the Low/Middle/High channels.

Radiated emission below 30MHz, below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT was 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, and it was determined that X-Axis orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X-Axis orientation.

Worst-case data rates as provided by the applicant are:

BLE: 1 Mbps.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	DELL	M4800	N/A	N/A
AC/DC Adapter	DELL	LA130PM121	N/A	N/A
Debug Board	Energous	N/A	011-0415	N/A

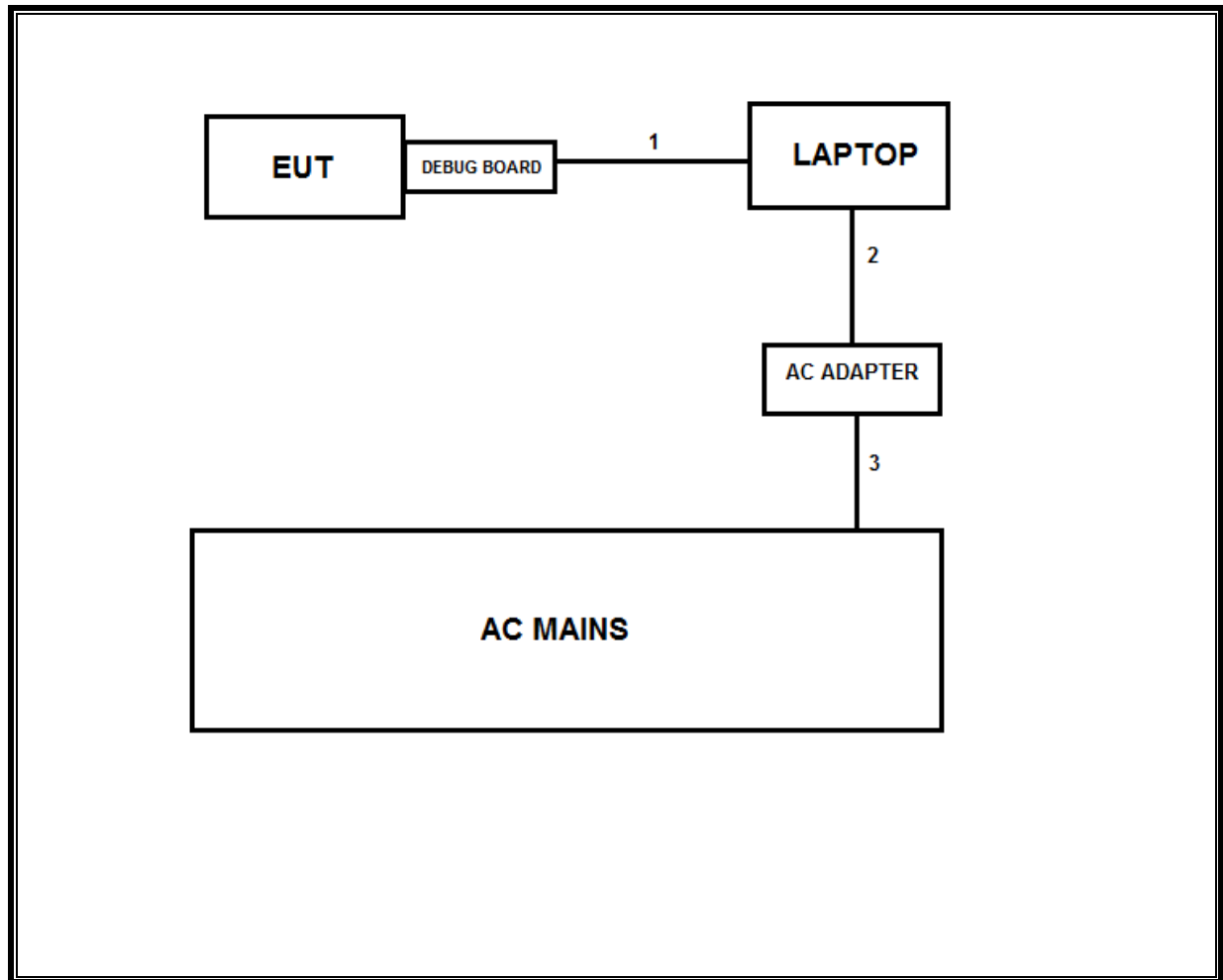
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	USB	1	USB	Unshielded	1	Debug Board to Laptop
2	DC Power	1	DC	Unshielded	1	
3	AC Power	1	AC	Unshielded	1	

TEST SETUP

The EUT is connected to the test laptop through USB cable. Test software exercised the EUT.

SETUP DIAGRAM



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
Antenna, Broadband Hybrid, 30MHz to 2000MHz w/4dB Pad	Sunol Sciences Corp.	JB1	T130	10/16/2018
Antenna, Active Loop 9kHz-30MHz	COM-POWER	AL-130R	T1866	10/10/2018
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T862	06/09/2018
Antenna, Horn 18-26.5GHz	ARA	MWH-1826/B	T89	05/26/2018
Power Meter, P-series single channel	Agilent (Keysight) Technologies	N1911A	T1264	07/08/2018
Power Sensor, P – series, 50MHz to 18GHz, Wideband	Agilent (Keysight) Technologies	N1921A	T413	06/20/2018
Amplifier, 1-26.5GHz	Agilent (Keysight) Technologies	8449B	T404	07/05/2018
Amplifier, 10kHz-1GHz	Agilent (Keysight) Technologies	8447D	T15	08/26/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1466	04/11/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1454	12/15/2018
LISN	FISCHER	FCC-LISN-50/250-25-2-01	T1310	01/17/2018
Receiver, 10kHz-7GHz	ROHDE & SCHWARZ	ESR	T1436	01/06/2018

Test Software List			
Description	Manufacturer	Model	Version
Radiated Software	UL	UL EMC	Ver 9.5, Dec 01, 2016
Conducted Emissions Software	UL	UL EMC	Ver 9.5, May 26, 2015
Antenna Port Software	UL	UL RF	Ver 6.0, Jan 19, 2017

7. ANTENNA PORT TEST RESULTS

7.1. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01 v04, Section 8.1.

Output Power: KDB 558074 D01 v04, Section 9.1.1.

Power Spectral Density: KDB 558074 D01 v04, Section 10.2.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v04, Section 11.0.

Out-of-band emissions in restricted bands: KDB 558074 D01 v04, Section 12.1.

Band-edge: KDB 558074 D01 v04, Section 12.1.

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

7.2. ON TIME, DUTY CYCLE

LIMITS

None; for reporting purposes only.

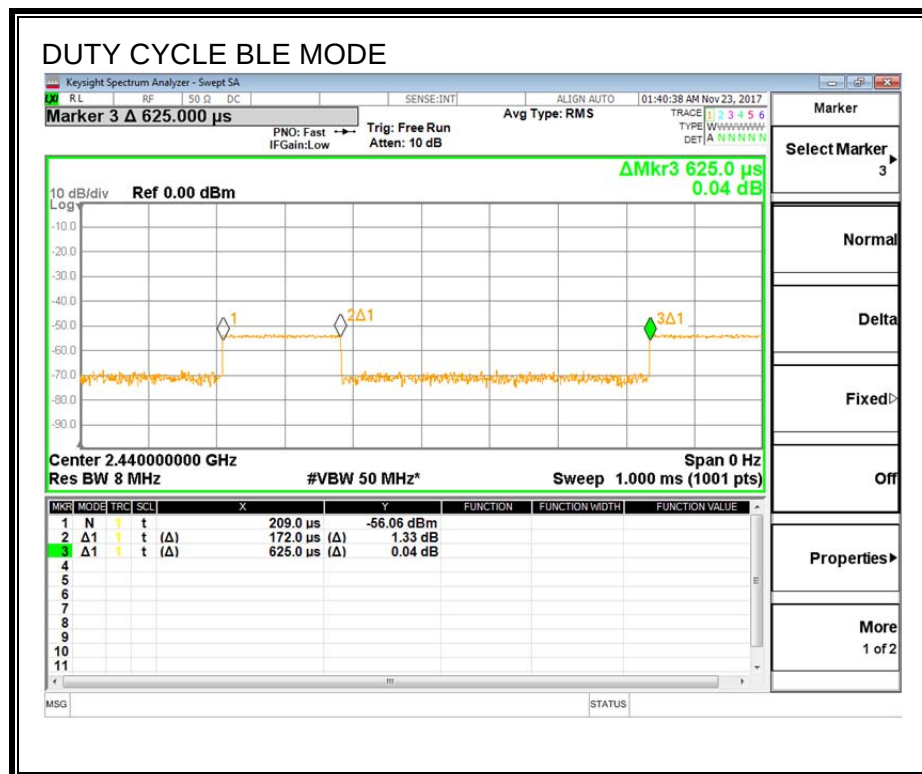
PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (khz)
BLE	0.172	0.625	0.275	27.52%	5.60	5.814

DUTY CYCLE PLOTS



7.3.1. 6 dB BANDWIDTH

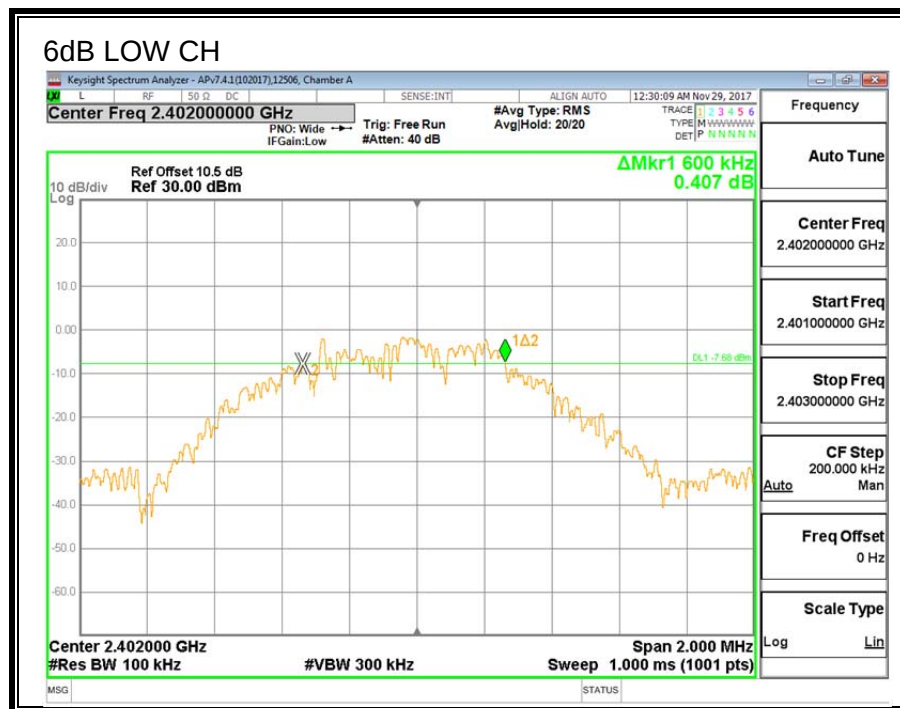
LIMITS

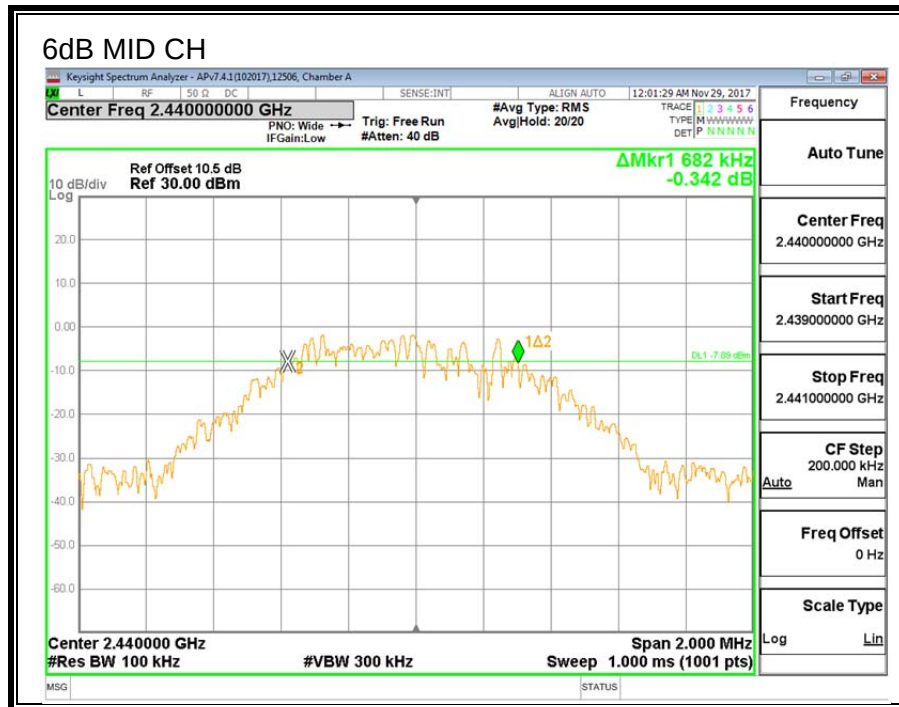
FCC §15.247 (a) (2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

Channel	Frequency	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.600	0.5
Middle	2440	0.682	0.5
High	2480	0.608	0.5





7.3.2. 99% BANDWIDTH

LIMITS

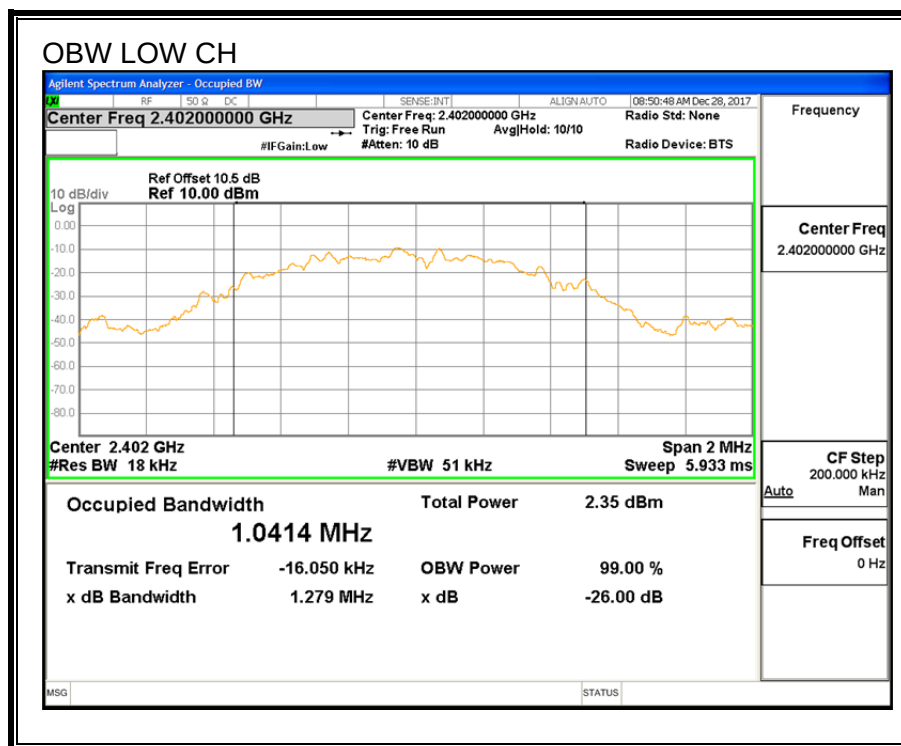
None; for reporting purposes only.

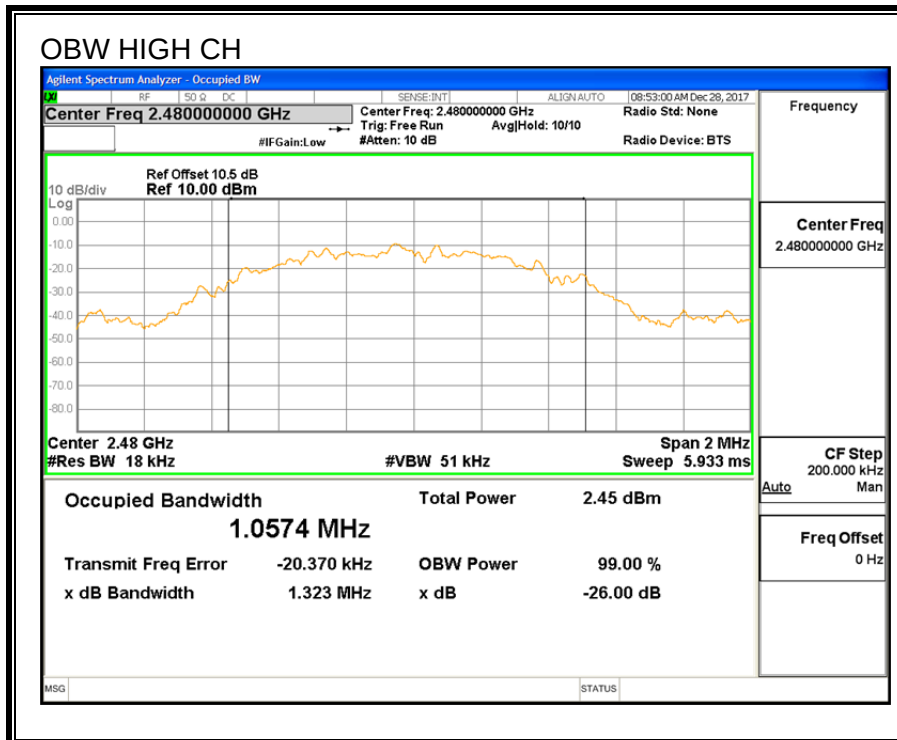
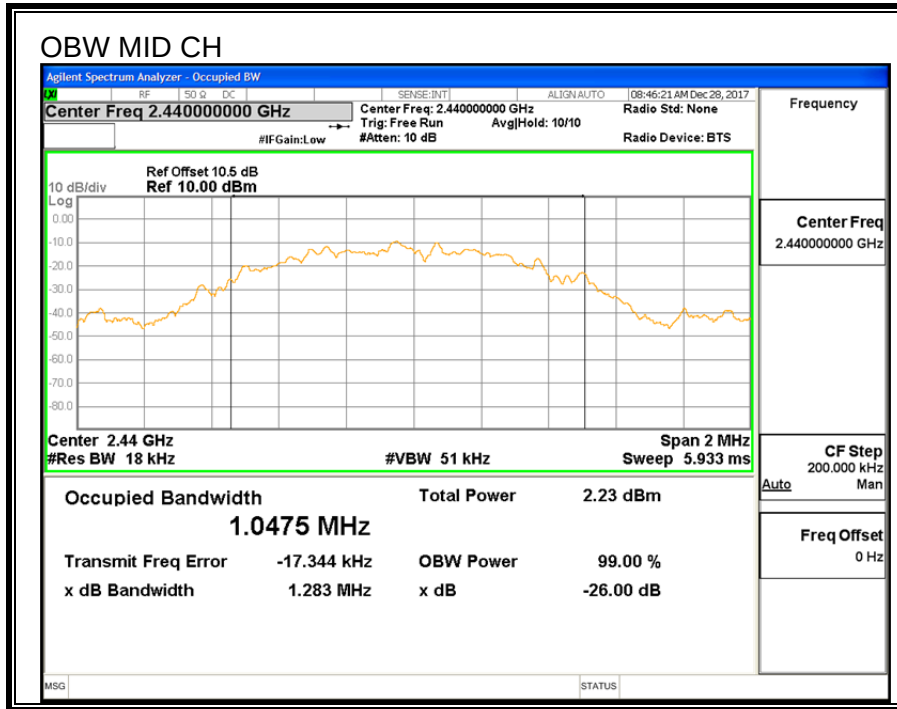
Test Procedure

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	1.0414
Middle	2440	1.0475
High	2480	1.0574





7.3.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.5 dB (consisting of 10 dB pad and 0.5 dB cable) is entered as an offset in the power meter to enable direct reading of the power. The power meter is gated to measure average power during the ON time of the transmitter.

RESULTS

Channel	Frequency (MHz)	AV Power (dBm)
Low	2402	-1.93
Middle	2440	-1.93
High	2480	-1.97

TEST ENGINEER:	12506	Date:	11/27/17
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7.3.4. OUTPUT POWER

LIMITS

FCC §15.247 (b)

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

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.5 dB (consisting of 10 dB pad and 0.5 dB cable) is entered as an offset in the power meter to enable direct reading of the power. The power meter is gated to measure peak power during the ON time of the transmitter.

RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-1.58	30	-31.58
Middle	2440	-1.55	30	-31.55
High	2480	-1.62	30	-31.62

TEST ENGINEER:	12506	Date:	11/27/17
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7.3.5. POWER SPECTRAL DENSITY

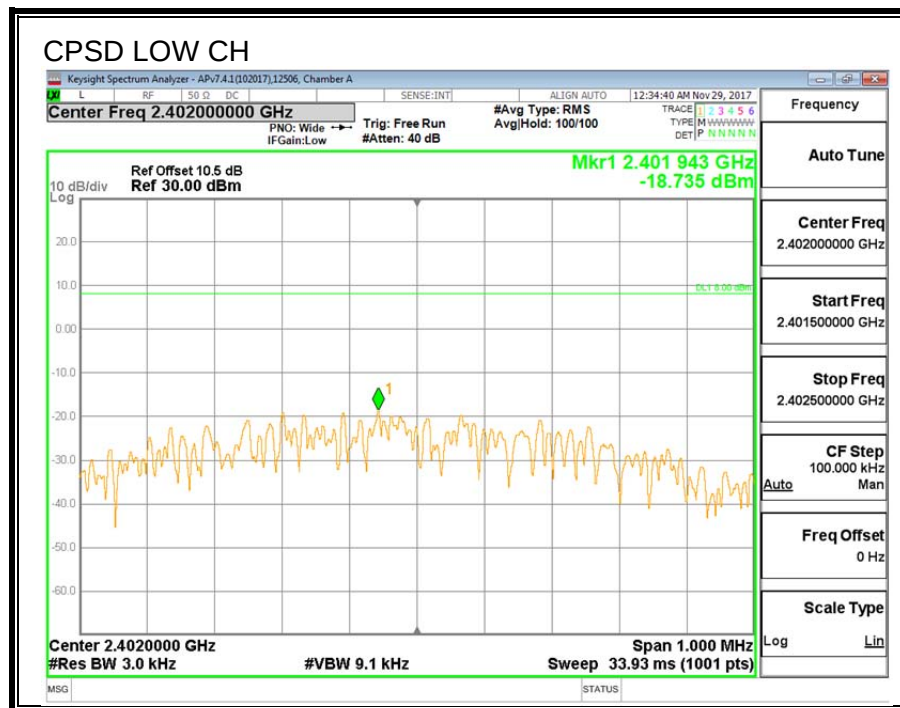
LIMITS

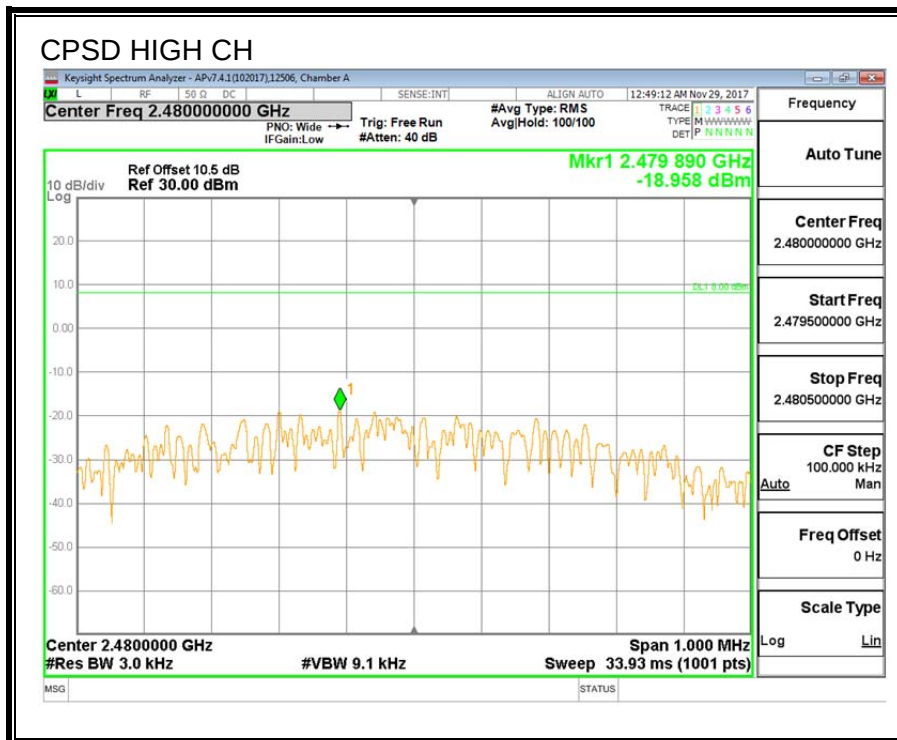
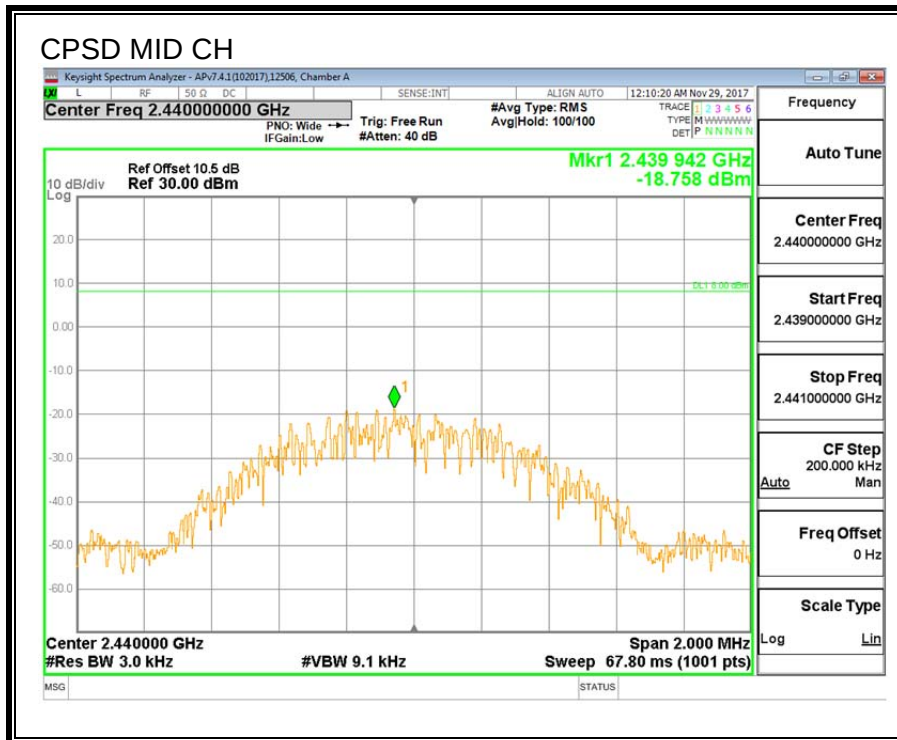
FCC §15.247 (e)

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	-18.735	8	-26.735
Middle	2440	-18.758	8	-26.758
High	2480	-18.958	8	-26.958





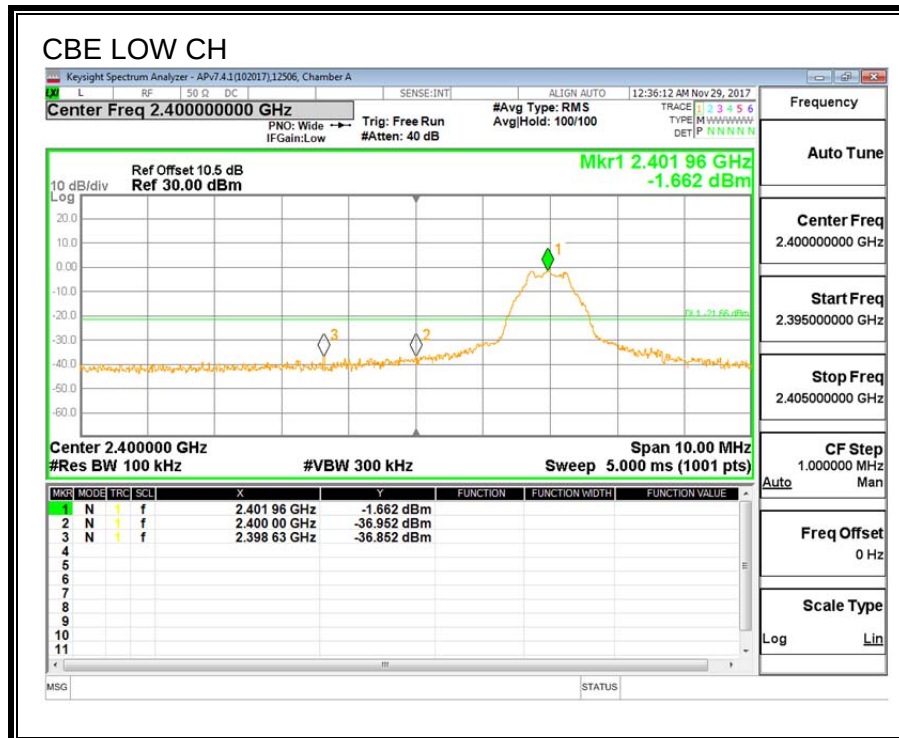
7.3.6. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

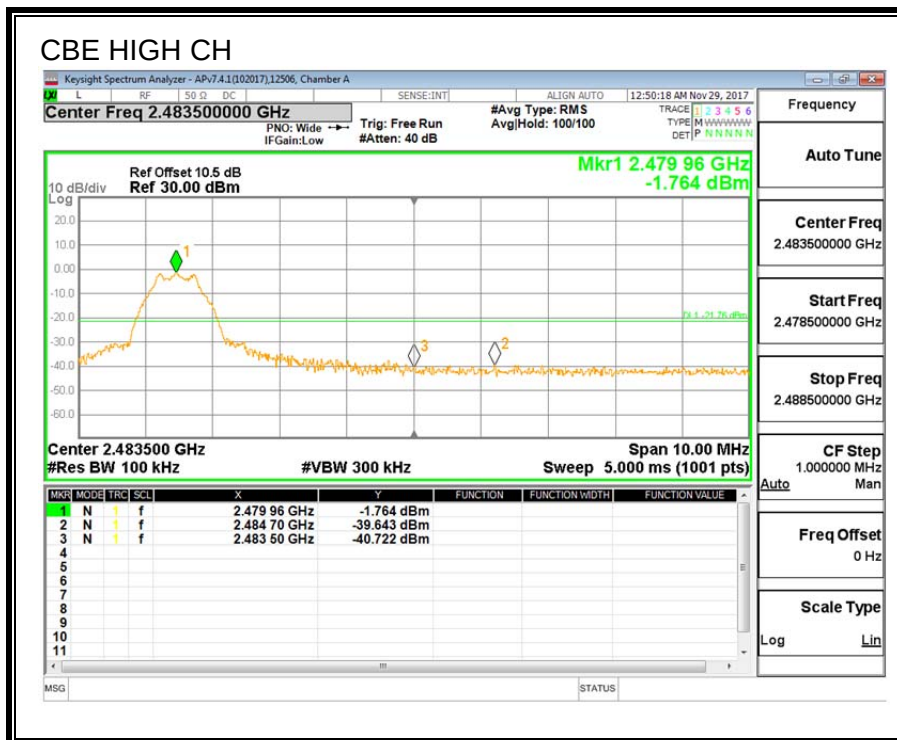
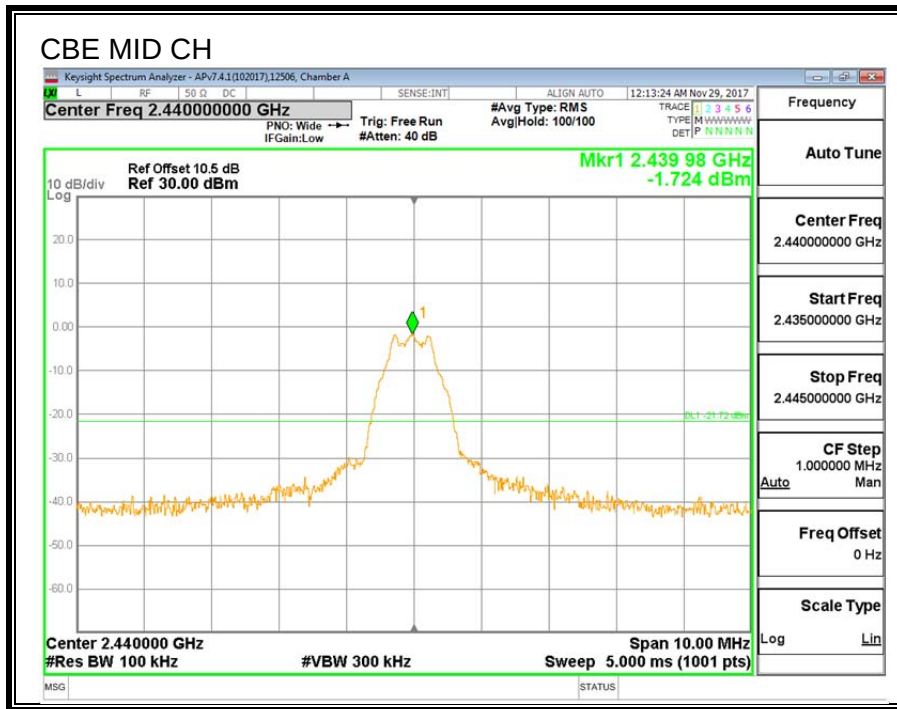
LIMITS

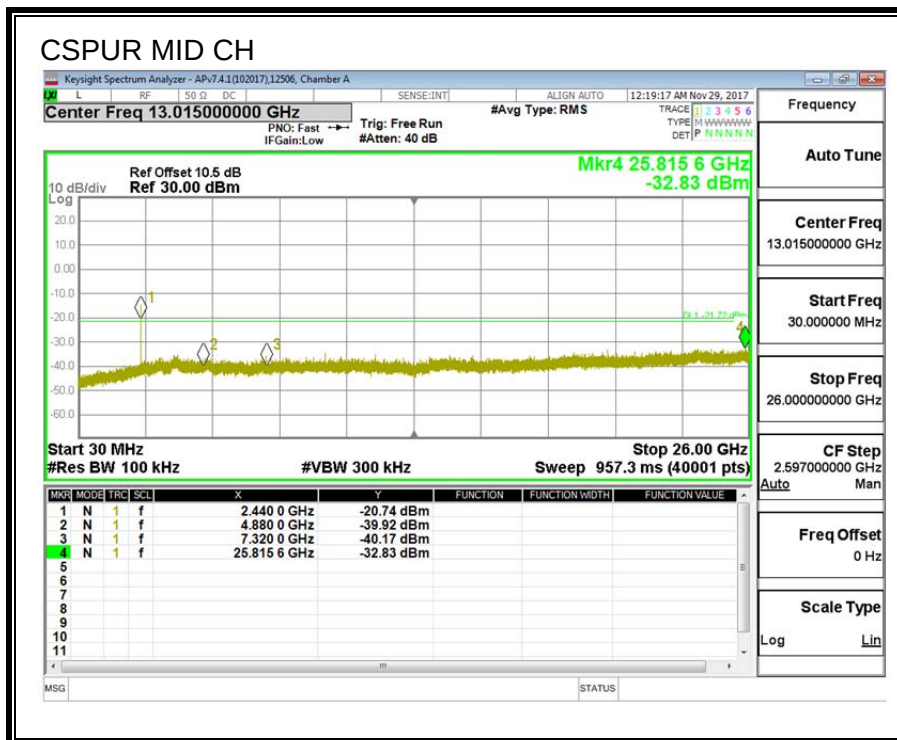
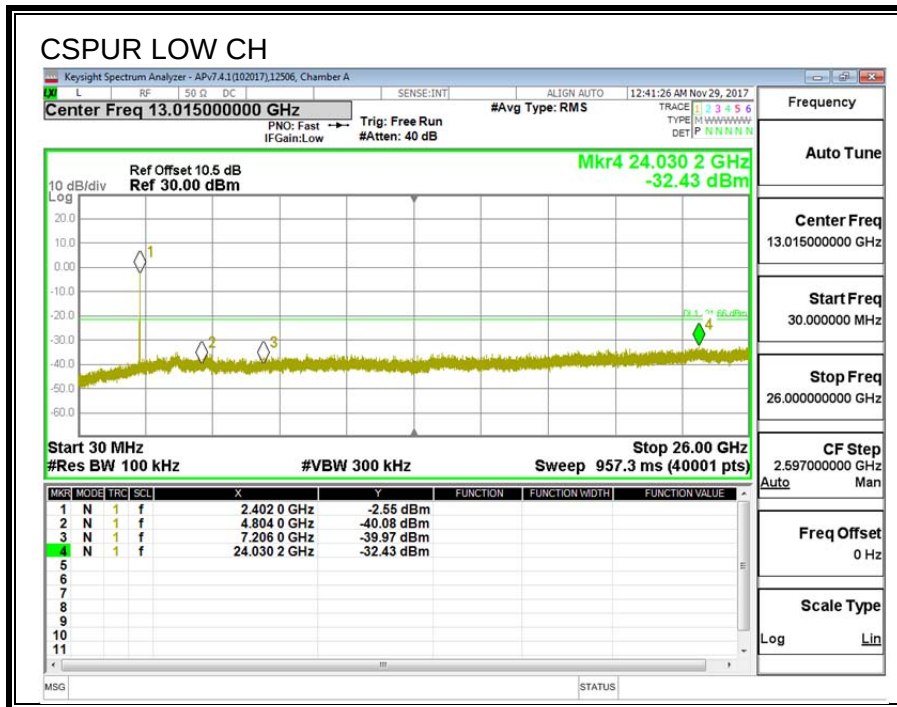
FCC §15.247 (d)

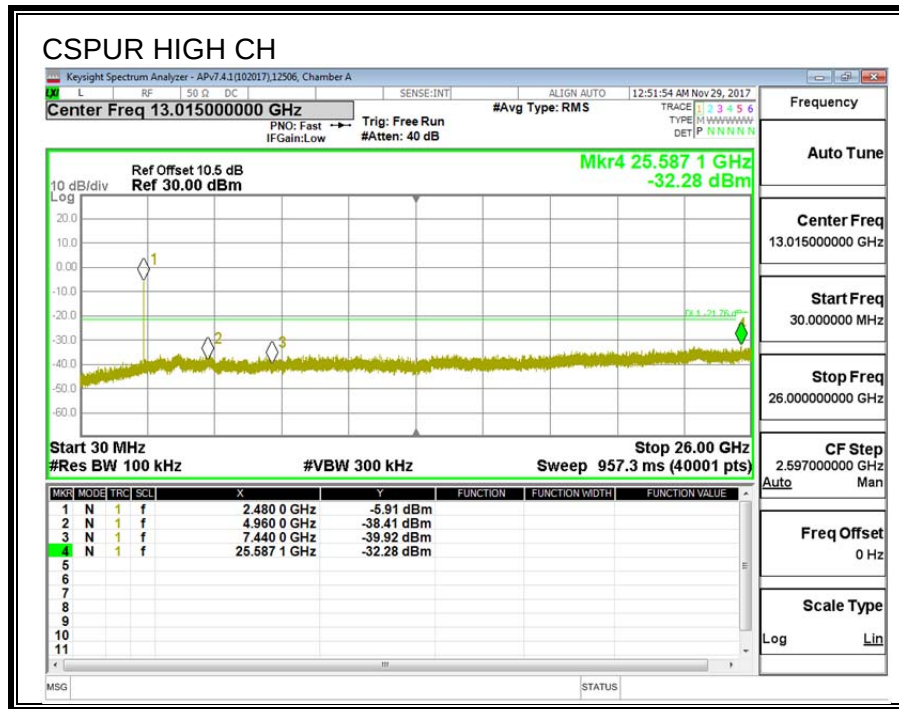
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

RESULTS









8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300m	-
0.490-1.705	24000/F(kHz) @ 30m	-
1.705-30.0	30 @ 30m	-
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 for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. 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.

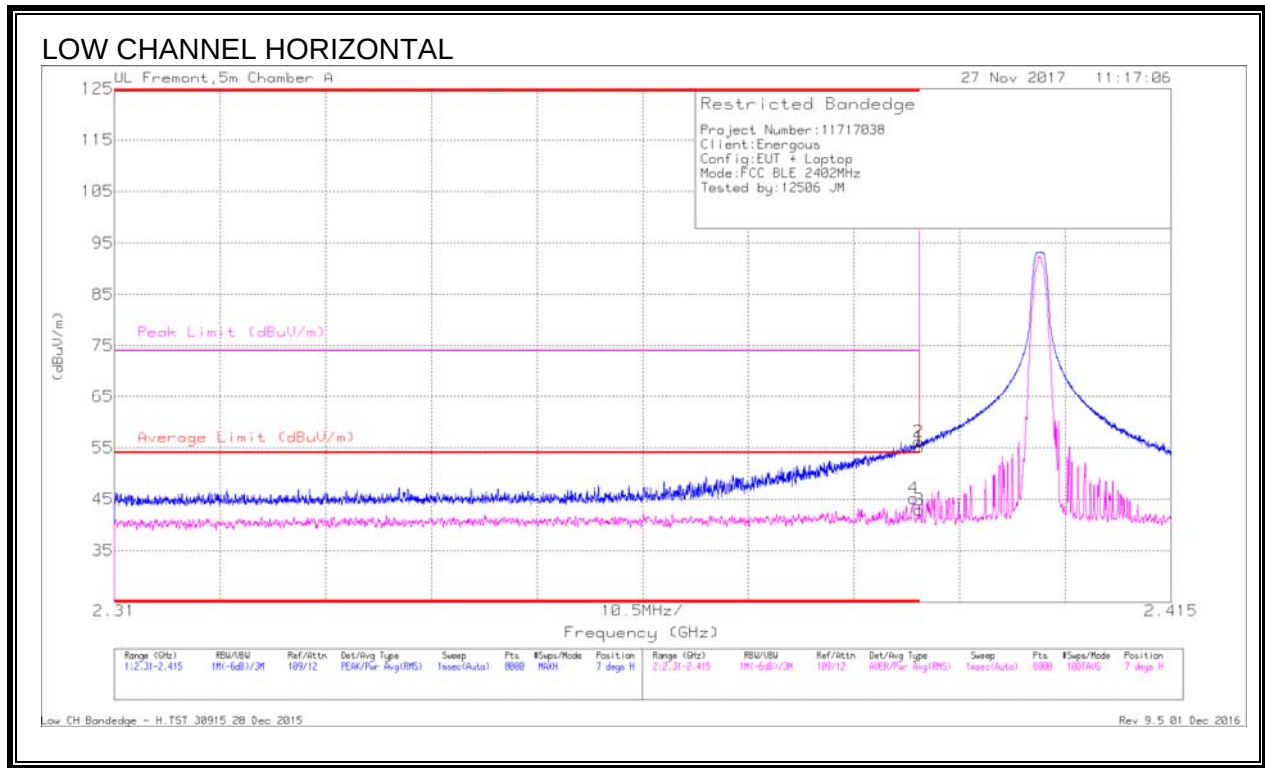
For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

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. RESTRICTED BANDEDGE (LOW CHANNEL)



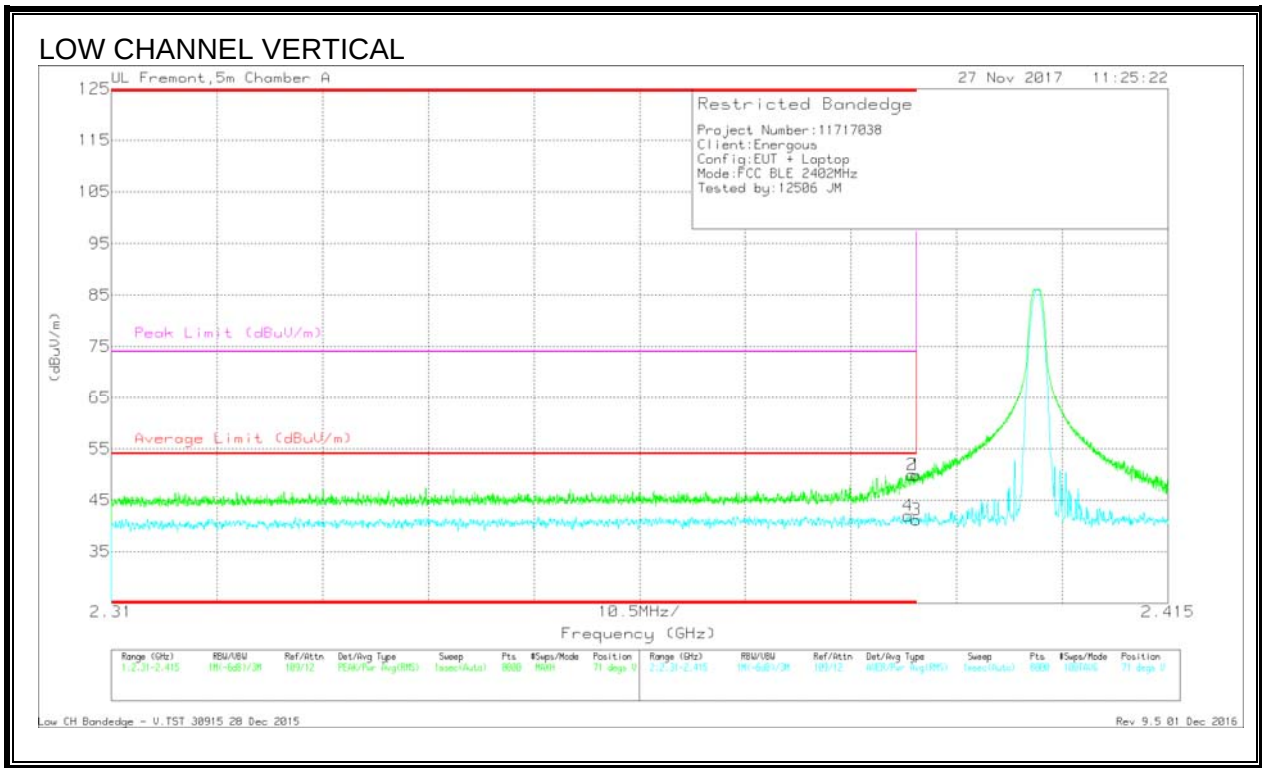
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Af T862 (dB/m)	Amp/Ch/Filt/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Asimuth (Degs)	Height (cm)	Polarity
1	* 2.39	46.49	Pk	31.8	-23.2	0	55.09	-	-	74	-18.91	7	111	H
2	* 2.39	47.6	Pk	31.8	-23.2	0	56.2	-	-	74	-17.8	7	111	H
3	* 2.39	28.69	RMS	31.8	-23.2	5.6	42.89	54	-11.11	-	-	7	111	H
4	* 2.389	30.96	RMS	31.8	-23.2	5.6	45.16	54	-8.84	-	-	7	111	H

* - indicates frequency in CFR47 Pt 15 - Restricted Band

Pk - Peak detector

RMS - RMS detection



Trace Markers

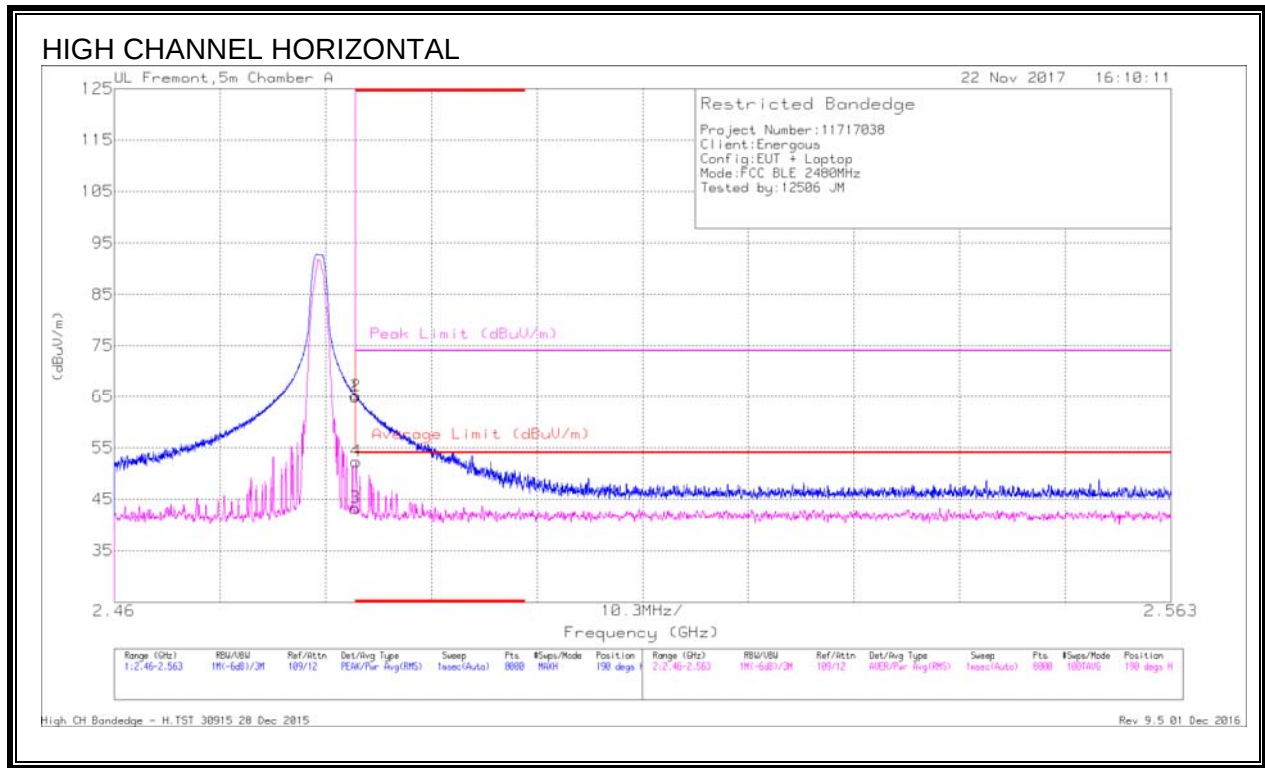
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 1862 (dB/m)	Amp/Cb/Ftr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.3	PK	31.8	-23.2	0	49.9	-	-	74	-24.1	71	363	V
2	* 2.39	41.32	PK	31.8	-23.2	0	49.92	-	-	74	-24.08	71	363	V
3	* 2.39	26.99	RMS	31.8	-23.2	5.6	41.19	54	-12.81	-	-	71	363	V
4	* 2.389	27.78	RMS	31.8	-23.2	5.6	41.98	54	-12.02	-	-	71	363	V

* - indicates frequency in CFR47 Pt 15 - Restricted Band

PK - Peak detector

RMS - RMS detection

8.3. AUTHORIZED BANDEDGE (HIGH CHANNEL)



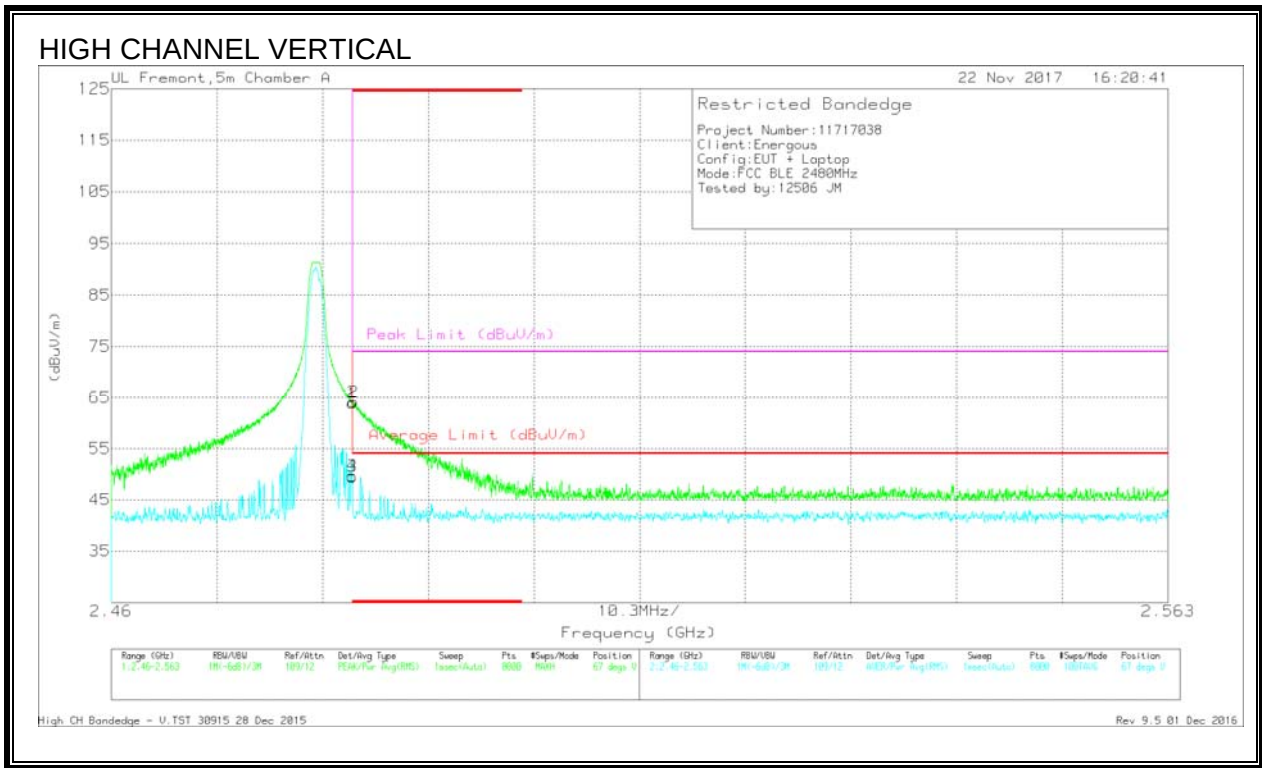
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	Af T862 (dB/m)	Amp/Ch/Filt/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Asimuth (Degs)	Height (cm)	Polarity
1	* 2.484	55.75	Pk	32.3	-23.1	0	64.95	-	-	74	-9.05	190	124	H
2	* 2.484	56.04	Pk	32.3	-23.1	0	65.24	-	-	74	-8.76	190	124	H
3	* 2.484	28.5	RMS	32.3	-23.1	5.6	43.3	54	-10.7	-	-	190	124	H
4	* 2.484	37.54	RMS	32.3	-23.1	5.6	52.34	54	-1.66	-	-	190	124	H

* - indicates frequency in CFR47 Pt 15 - Restricted Band

Pk - Peak detector

RMS - RMS detection



Trace Markers

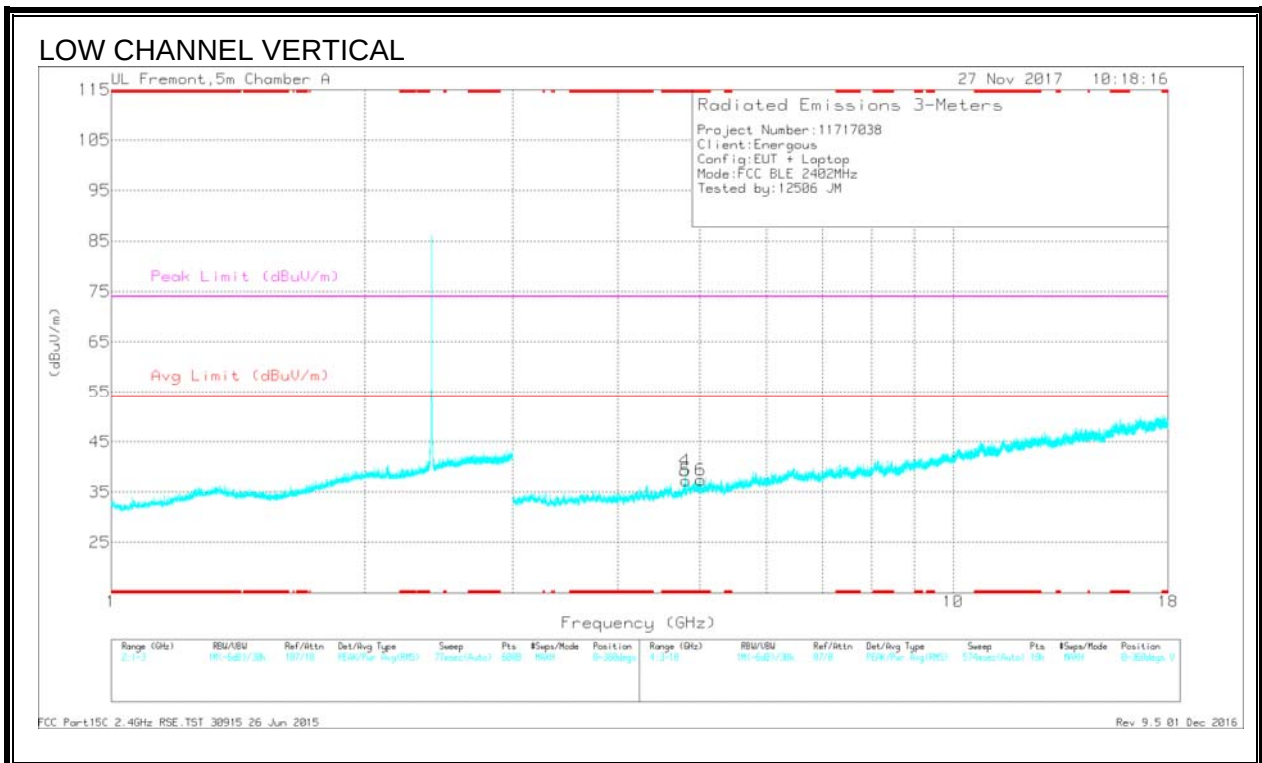
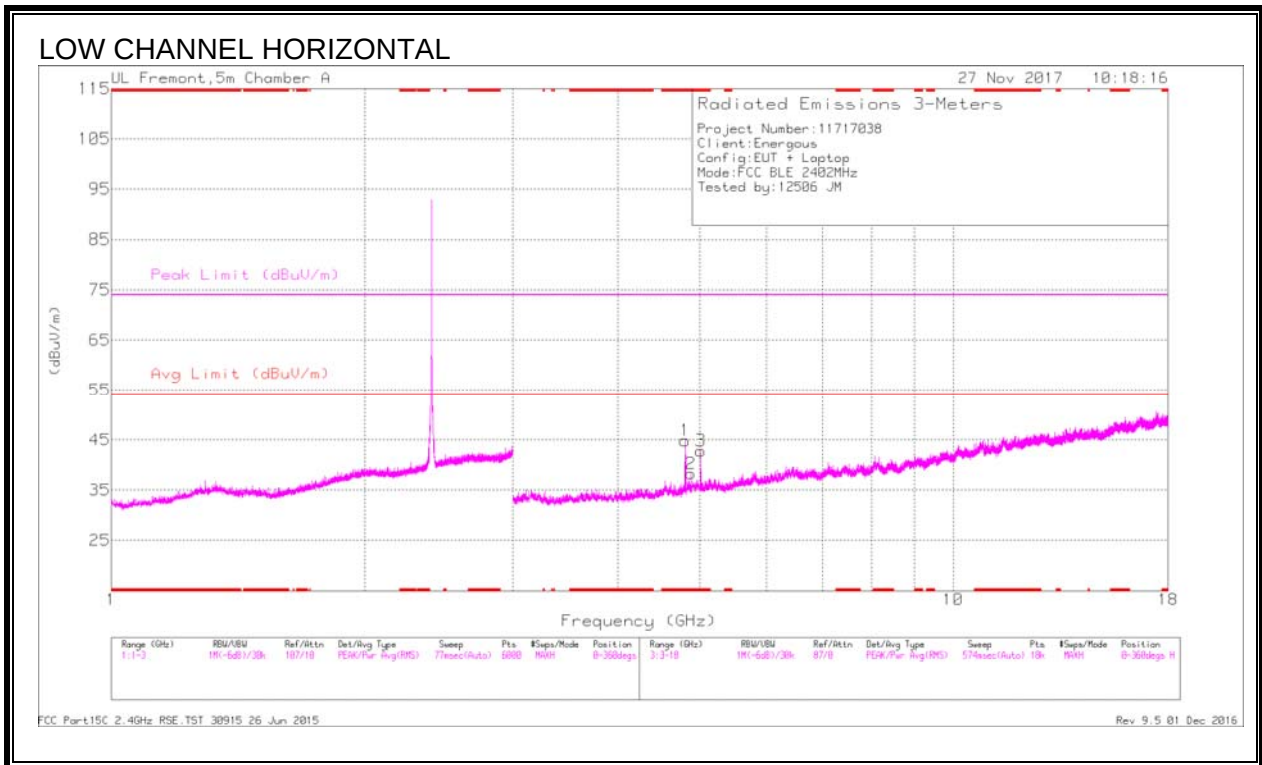
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF 1862 (dB/m)	Amp/Ch/Filt/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Altitude (Degs)	Height (cm)	Polarity
1	* 2.484	54.68	PK	32.3	-23.1	0	63.88	-	-	74	-10.12	67	388	V
2	* 2.484	54.94	PK	32.3	-23.1	0	64.14	-	-	74	-9.86	67	388	V
3	* 2.484	34.75	RMS	32.3	-23.1	5.6	49.55	54	-4.45	-	-	67	388	V
4	* 2.484	34.86	RMS	32.3	-23.1	5.6	49.66	54	-4.34	-	-	67	388	V

* - indicates frequency in CFR47 Pt 15 - Restricted Band

PK - Peak detector

RMS - RMS detection

8.4. HARMONICS AND SPURIOUS EMISSIONS 1 TO 18 GHz



Radiated Emissions

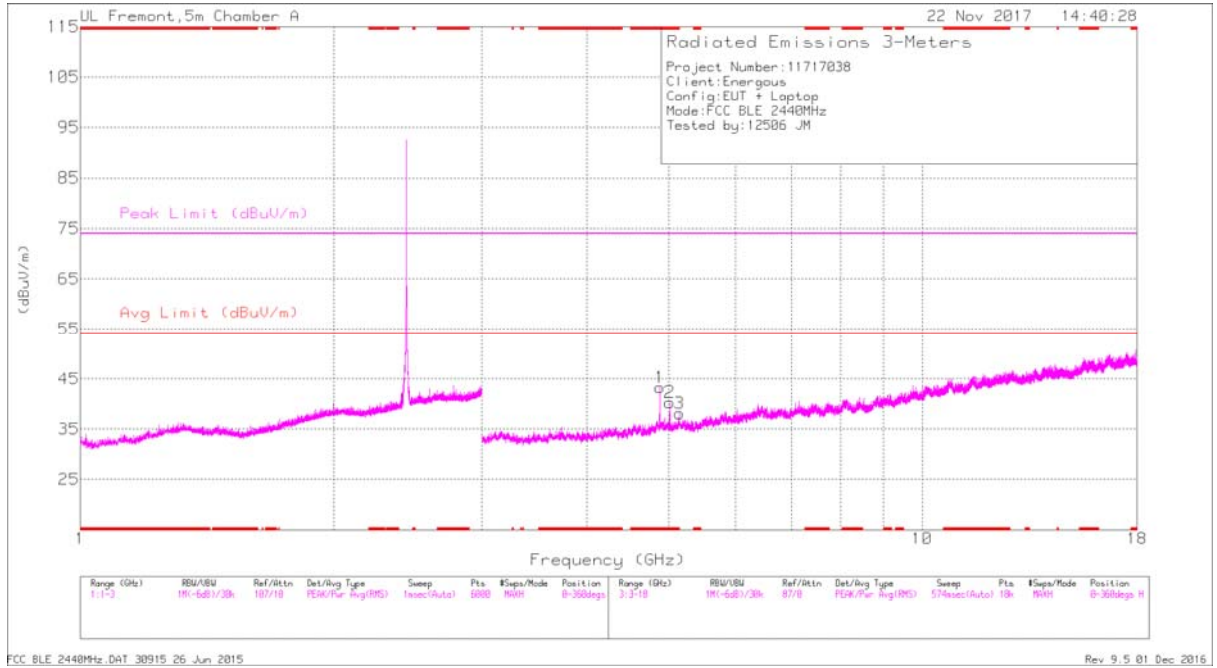
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Cbl/Filtr/ Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 4.804	41.88	PK2	34.2	-27.7	0	48.38	-	-	74	-25.62	3	124	H
* 4.804	31.93	MAV1	34.2	-27.7	5.6	44.03	54	-9.97	-	-	3	124	H
* 4.881	36.74	PK2	34.1	-27.3	0	43.54	-	-	74	-30.46	218	385	H
* 4.882	24.23	MAV1	34.1	-27.3	5.6	36.63	54	-17.37	-	-	218	385	H
* 5.014	41.87	PK2	34.3	-28.4	0	47.77	-	-	74	-26.23	351	114	H
* 5.014	25.78	MAV1	34.3	-28.4	5.6	37.28	54	-16.72	-	-	351	114	H
* 4.803	38	PK2	34.2	-27.7	0	44.5	-	-	74	-29.5	176	105	V
* 4.804	26.75	MAV1	34.2	-27.7	5.6	38.85	54	-15.15	-	-	176	105	V
* 4.815	35.79	PK2	34.2	-27.6	0	42.39	-	-	74	-31.61	172	254	V
* 4.814	23.82	MAV1	34.2	-27.6	5.6	36.02	54	-17.98	-	-	172	254	V
* 5.015	37.44	PK2	34.3	-28.4	0	43.34	-	-	74	-30.66	341	392	V
* 5.015	25.07	MAV1	34.3	-28.4	5.6	36.57	54	-17.43	-	-	341	392	V

* - indicates frequency in CFR47 Pt 15 - Restricted Band

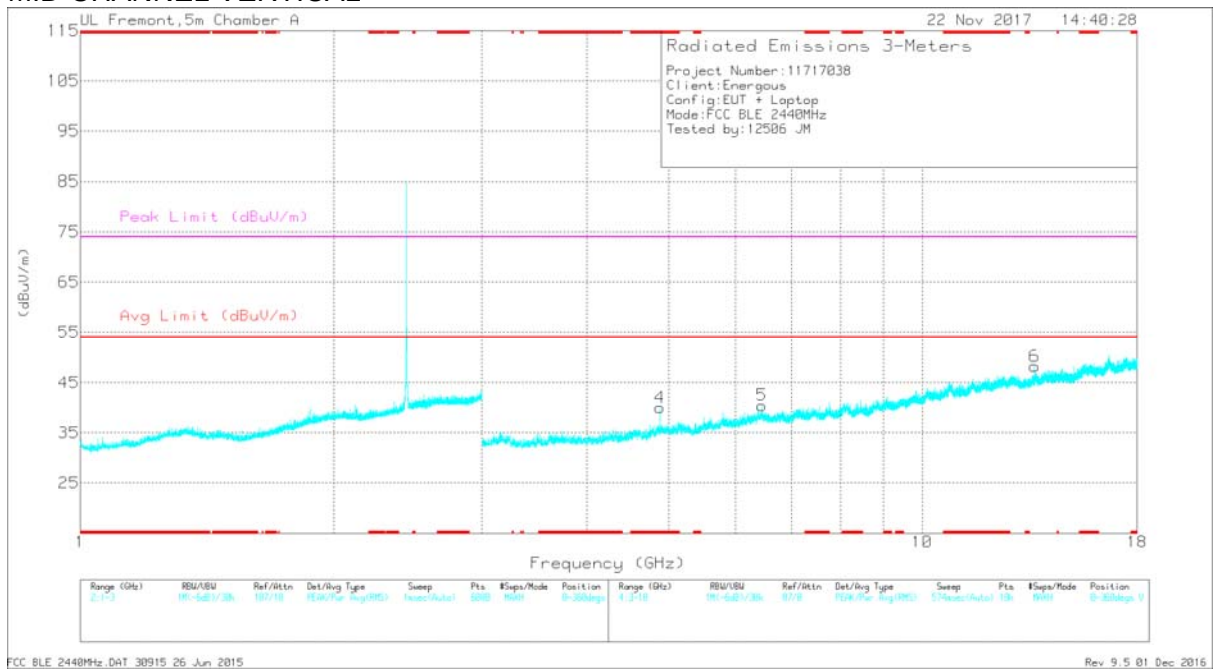
PK2 - KDB558074 Method: Maximum Peak

MAV1 - KDB558074 Option 1 Maximum RMS Average

MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL



Radiated Emissions

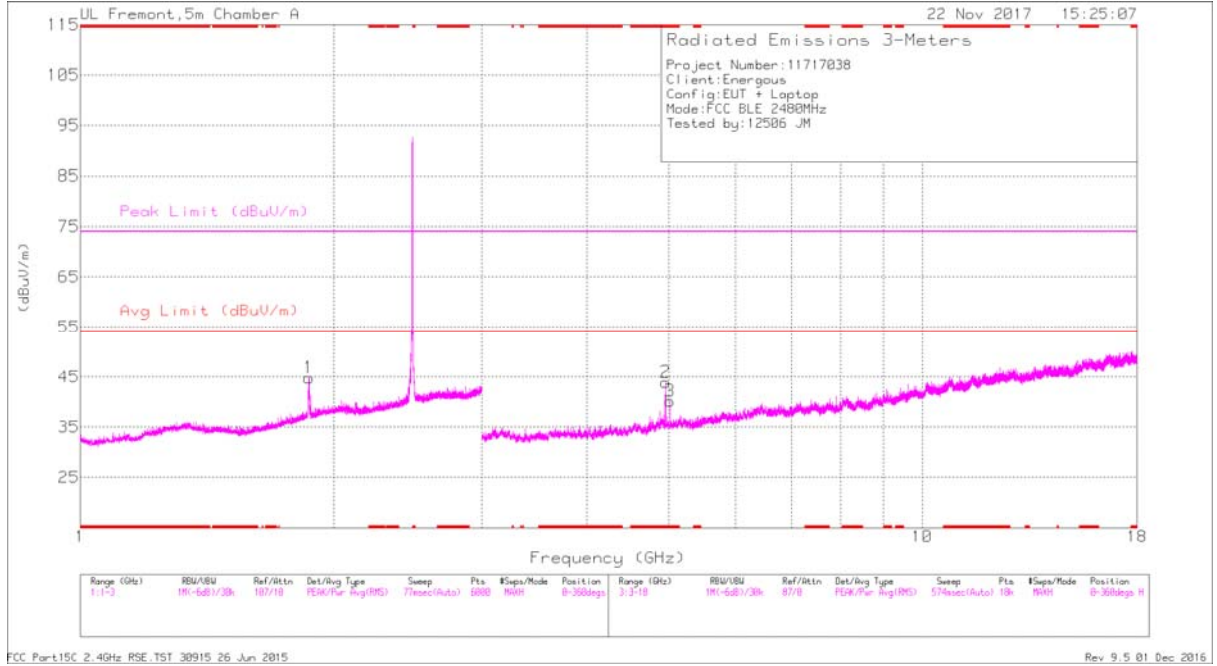
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Cbl/Filtr/ Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 4.879	41.94	PK2	34.1	-27.3	0	48.74	-	-	74	-25.26	265	101	H
* 4.88	32.66	MAv1	34.1	-27.3	5.6	45.06	54	-8.94	-	-	265	101	H
* 5.014	41.1	PK2	34.3	-28.4	0	47	-	-	74	-27	230	133	H
* 5.015	25.38	MAv1	34.3	-28.4	5.6	36.88	54	-17.12	-	-	230	133	H
* 4.88	38.69	PK2	34.1	-27.3	0	45.49	-	-	74	-28.51	352	101	V
* 4.88	26.89	MAv1	34.1	-27.3	5.6	39.29	54	-14.71	-	-	352	101	V
5.151	36.88	PK2	34.4	-26.7	0	44.58	-	-	-	-	132	194	H
6.448	33.55	PK2	35.8	-23.8	0	45.55	-	-	-	-	153	206	V
13.602	32.99	PK2	39.2	-18.8	0	53.39	-	-	-	-	334	105	V

* - indicates frequency in CFR47 Pt 15 - Restricted Band

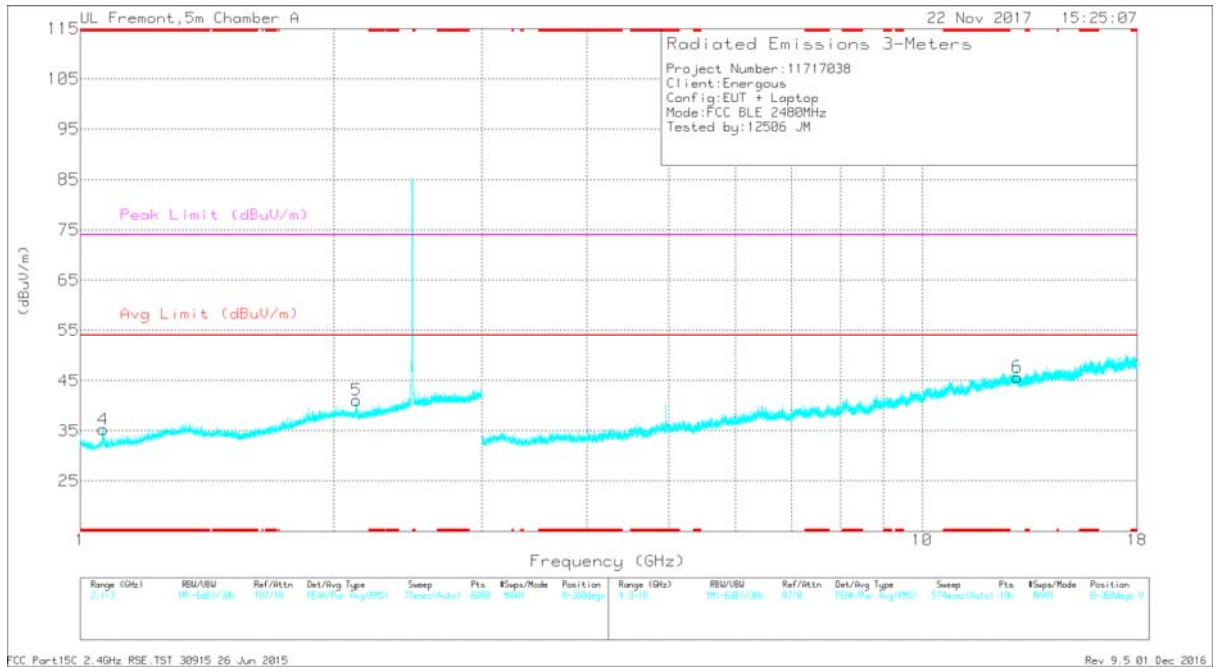
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Ch/Filt/ 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
* 1.065	37.84	PK2	27.3	-23.9	0	41.24	-	-	74	-32.76	128	369	V
* 1.063	24.37	MAv1	27.3	-23.9	5.6	33.37	54	-20.63	-	-	128	369	V
* 4.96	43.05	PK2	34.2	-27.9	0	49.35	-	-	74	-24.65	267	119	H
* 4.96	32.93	MAv1	34.2	-27.9	5.6	44.83	54	-9.17	-	-	267	119	H
* 5.016	41.23	PK2	34.3	-28.4	0	47.13	-	-	74	-26.87	255	135	H
* 5.016	25.39	MAv1	34.3	-28.4	5.6	36.89	54	-17.11	-	-	255	135	H
1.868	36.28	PK2	31	-23.2	0	44.08	-	-	-	-	36	270	H
2.13	40.71	PK2	31.1	-23.3	0	48.51	-	-	-	-	181	102	V
12.979	19.67	MAv1	39.3	-18.6	5.6	45.97	-	-	-	-	5	113	V
12.98	31.51	PK2	39.3	-18.6	0	52.21	-	-	-	-	5	113	V

* - indicates frequency in CFR47 Pt 15 - Restricted Band

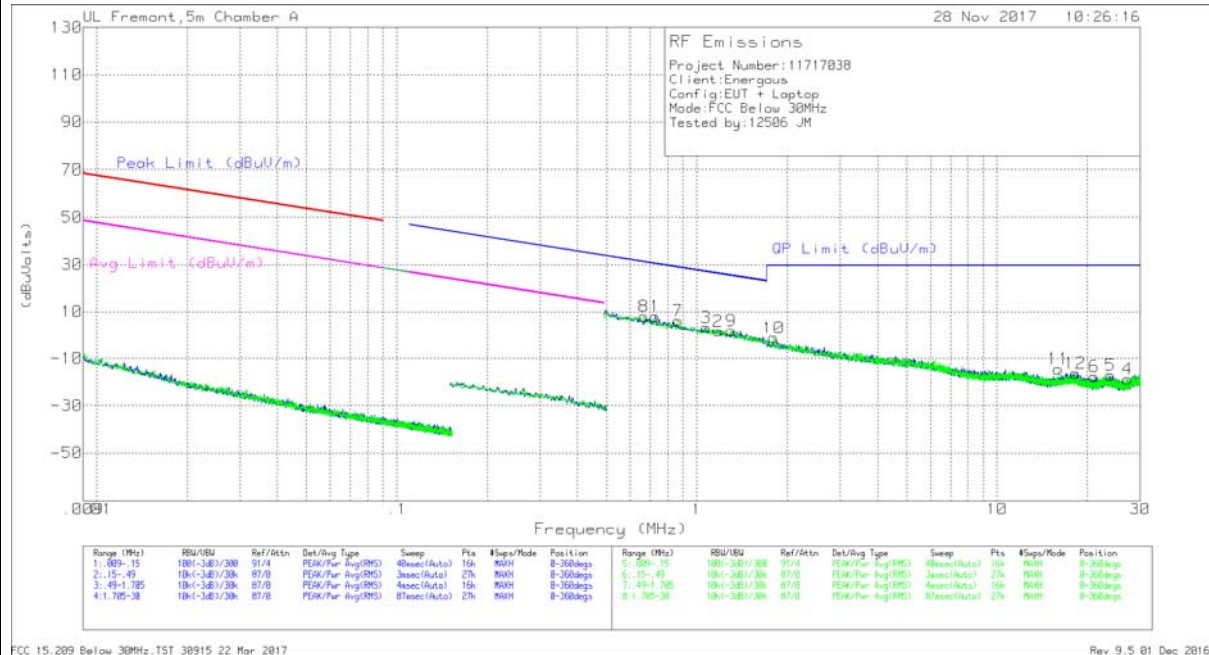
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

8.5. WORST-CASE BELOW 30 MHz

SPURIOUS EMISSIONS BELOW 30MHz (WORST-CASE CONFIGURATION)

FACE ON AND FACE OFF PLOTS



NOTE: KDB 414788 OATS and Chamber Correlation Justification

- Based on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.
- OATs and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

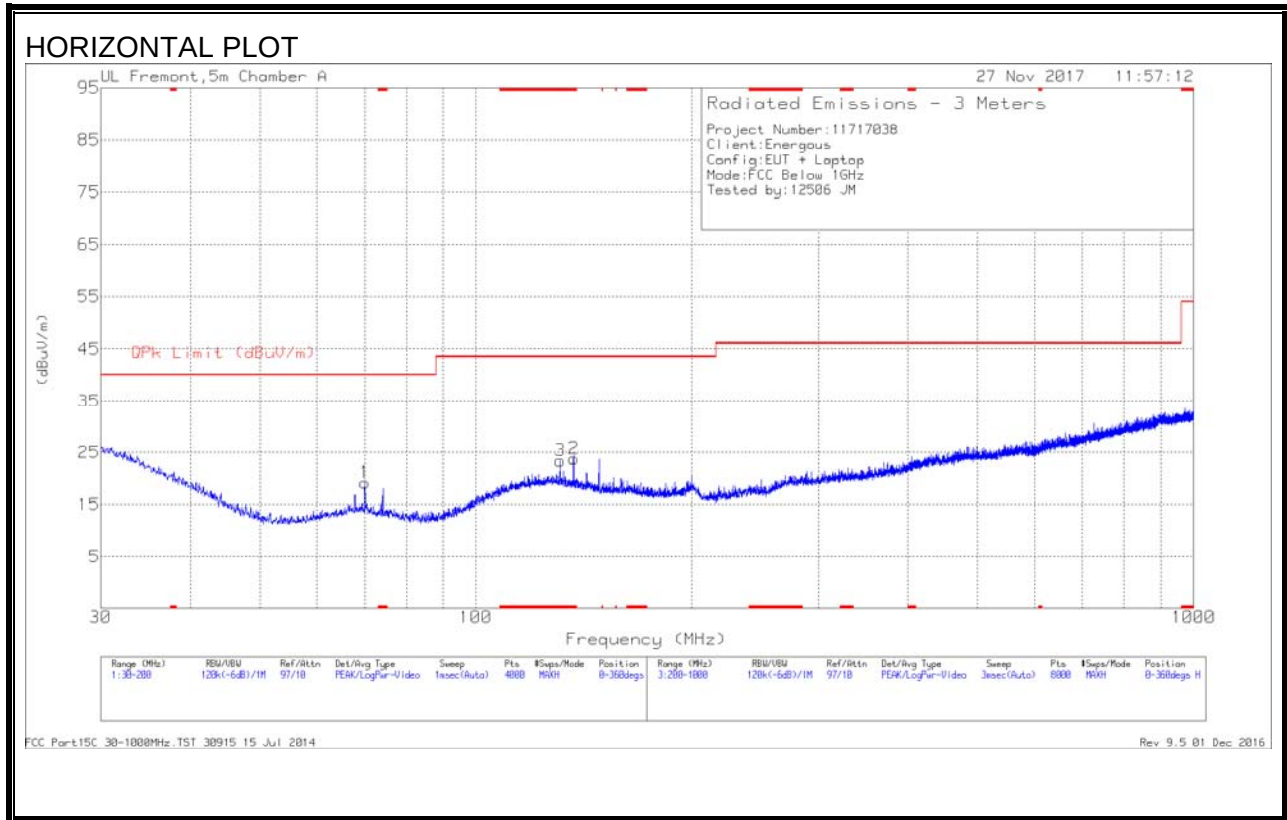
Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cbl (dB)	Dist Corr 30m	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
8	.66712	36.27	Pk	11.6	.1	-40	7.97	31.13	-23.16	0-360
1	.72765	36.5	Pk	11.6	.1	-40	8.2	30.38	-22.18	0-360
7	.86373	34.59	Pk	11.6	.1	-40	6.29	28.89	-22.6	0-360
3	1.07178	31.55	Pk	11.6	.2	-40	3.35	27.02	-23.67	0-360
2	1.17476	29.85	Pk	11.6	.2	-40	1.65	26.23	-24.58	0-360
9	1.30423	30.05	Pk	11.6	.2	-40	1.85	25.32	-23.47	0-360
10	1.80299	26.79	Pk	11.7	.2	-40	-1.31	29.5	-30.81	0-360
11	15.98819	14.59	Pk	10.2	.6	-40	-14.61	29.5	-44.11	0-360
12	18.22043	13.12	Pk	9.9	.6	-40	-16.38	29.5	-45.88	0-360
6	21.06051	12.04	Pk	9.6	.7	-40	-17.66	29.5	-47.16	0-360
5	23.88592	12.95	Pk	9.2	.7	-40	-17.15	29.5	-46.65	0-360
4	27.19603	11.72	Pk	8.8	.8	-40	-18.68	29.5	-48.18	0-360

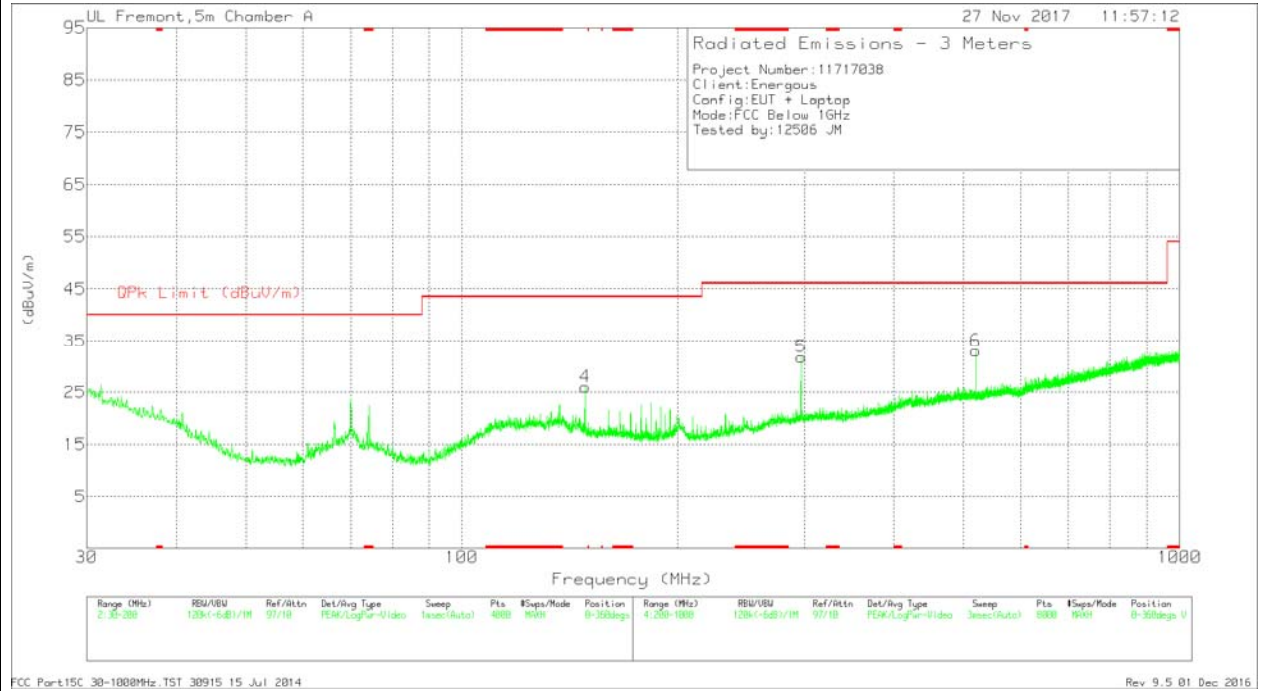
Pk - Peak detector

8.6. WORST-CASE BELOW 1 GHz

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



VERTICAL PLOT



DATA

Trace Markers

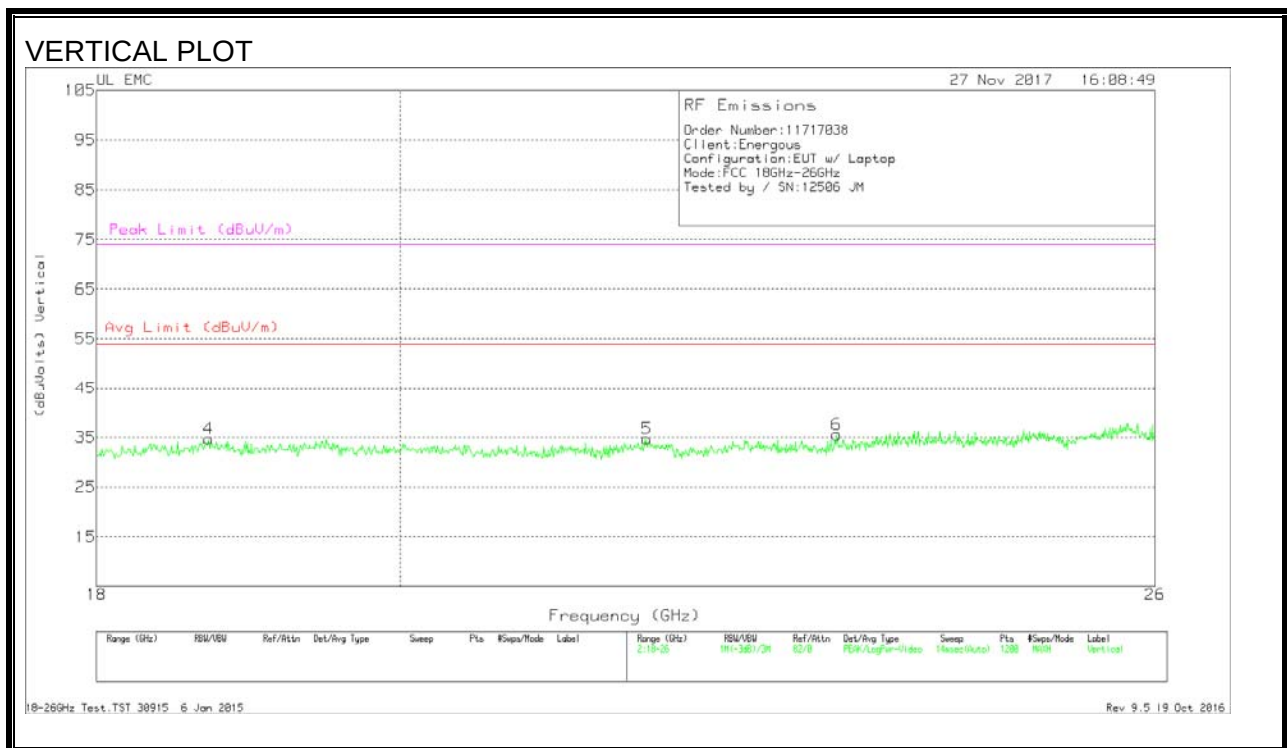
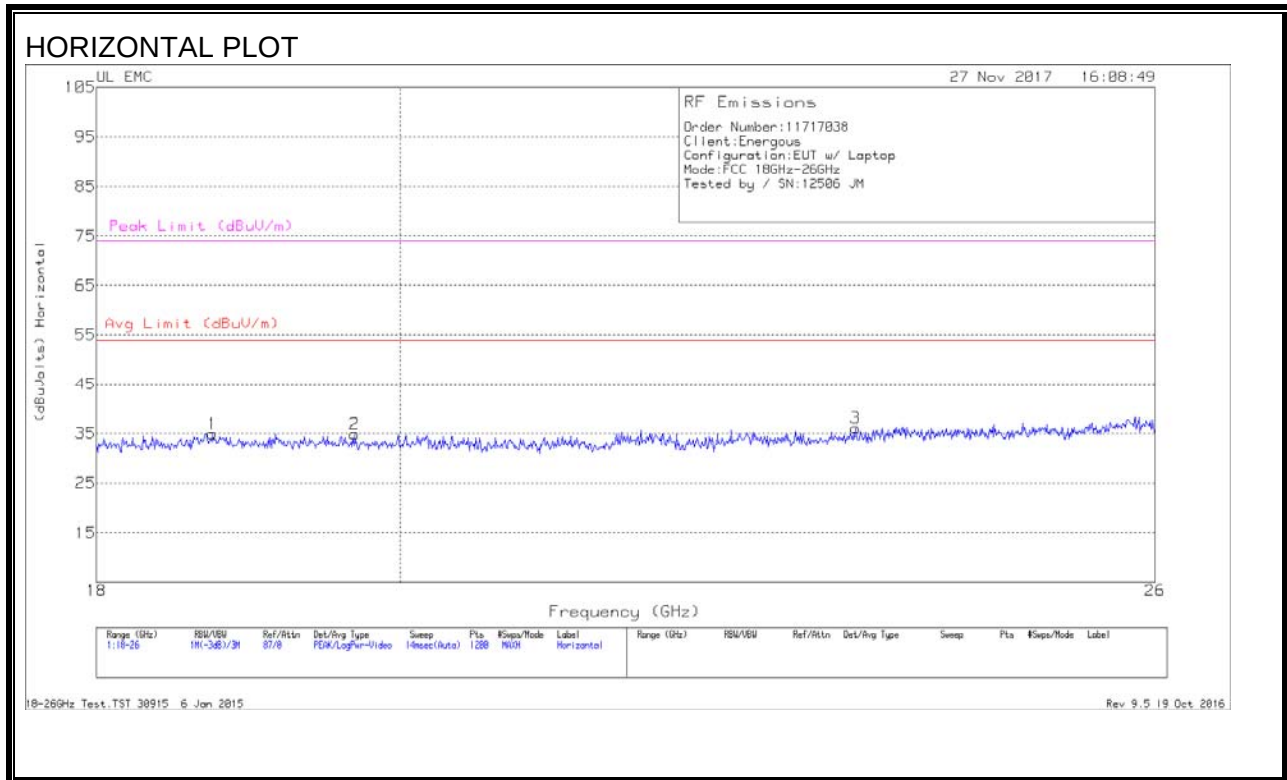
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	DC Corr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 136.9152	32.39	Pk	17.4	-26	0	23.79	43.52	-19.73	0-360	200	H
3	* 131.0061	31.51	Pk	17.9	-26	0	23.41	43.52	-20.11	0-360	300	H
1	70.0454	33.81	Pk	12.1	-26.7	0	19.21	40	-20.79	0-360	100	H
4	148.4782	35.35	Pk	16.6	-25.9	0	26.05	43.52	-17.47	0-360	100	V
5	297.0126	39.13	Pk	17.3	-24.6	0	31.83	46.02	-14.19	0-360	300	V
6	519.7416	36.64	Pk	21.7	-25.3	0	33.04	46.02	-12.98	0-360	200	V

* - indicates frequency in CFR47 Pt 15 - Restricted Band

Pk - Peak detector

8.7. WORST-CASE ABOVE 18 GHz

SPURIOUS EMISSIONS 18 TO 26 GHz (WORST-CASE CONFIGURATION)



Data

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T89 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	18.741	36.4	Pk	32.6	-24.6	-9.5	34.9	54	-19.1	74	-39.1
2	19.688	36.94	Pk	32.5	-25.1	-9.5	34.84	54	-19.16	74	-39.16
3	23.431	36.67	Pk	33.3	-24.4	-9.5	36.07	54	-17.93	74	-37.93
4	18.714	36.32	Pk	32.5	-24.6	-9.5	34.72	54	-19.28	74	-39.28
5	21.79	35.7	Pk	33.3	-24.8	-9.5	34.7	54	-19.3	74	-39.3
6	23.278	36.27	Pk	33.5	-24.7	-9.5	35.57	54	-18.43	74	-38.43

Pk - Peak detector

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	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 C63.10.

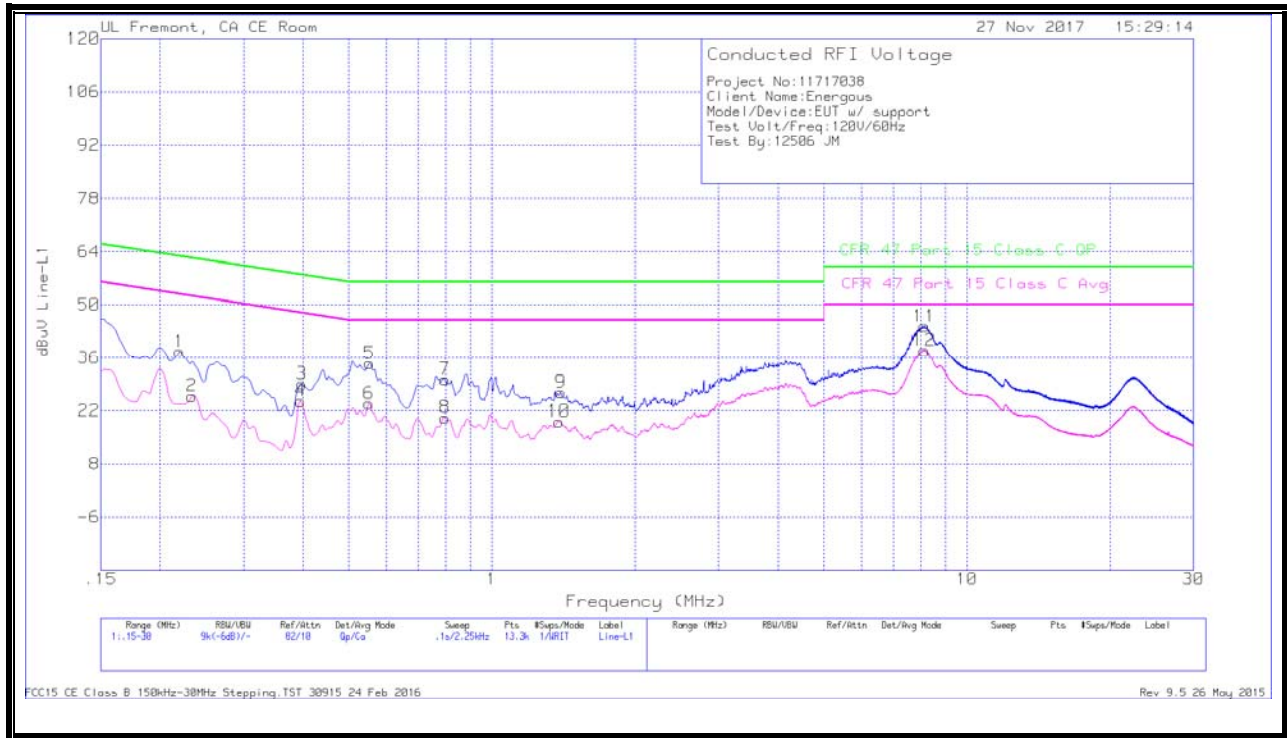
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

RESULTS

9.1. EUT POWERED BY HOST PC VIA USB CABLE

LINE 1 RESULTS



WORST EMISSIONS

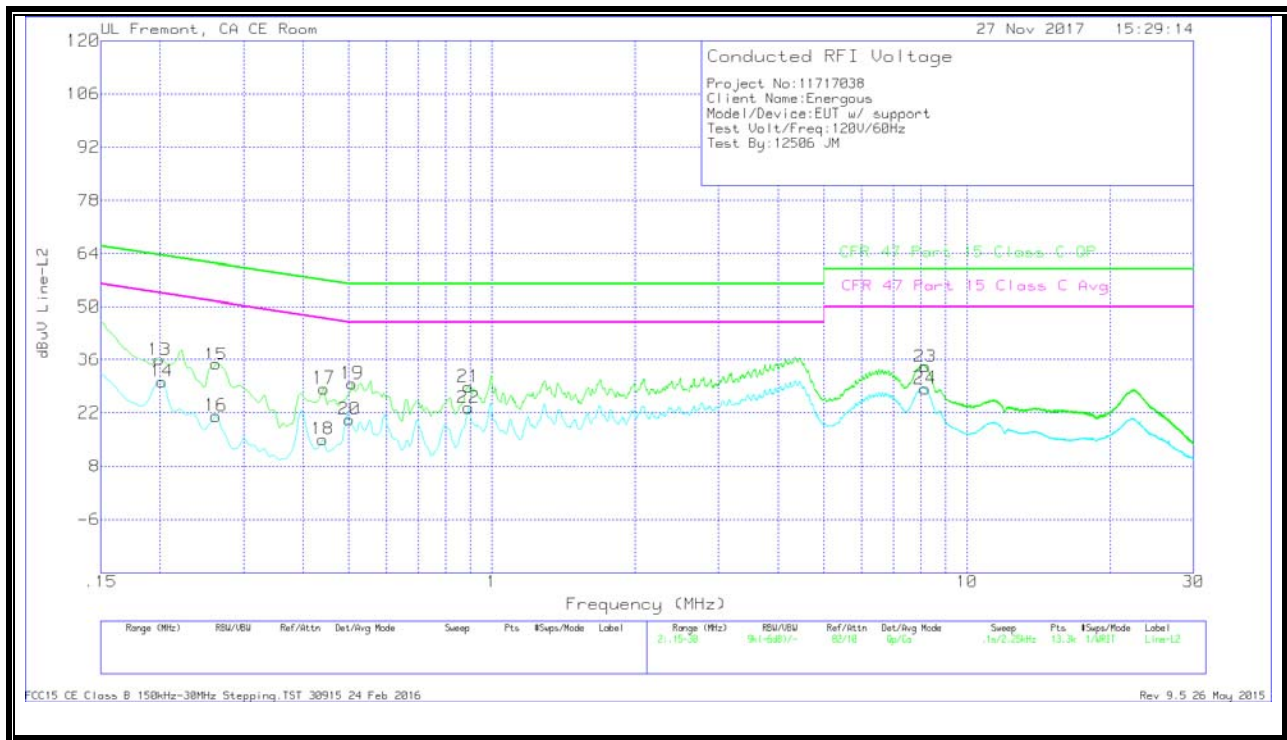
Range 1: Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class C QP	QP Margin (dB)	CFR 47 Part 15 Class C Avg	Av(CISPR)Margin (dB)
1	.21975	27.55	Qp	0	0	10.1	37.65	62.83	-25.18	-	-
2	.23325	15.71	Ca	0	0	10.1	25.81	-	-	52.33	-26.52
3	.3975	18.89	Qp	0	0	10.1	28.99	57.91	-28.92	-	-
4	.39525	14.36	Ca	0	0	10.1	24.46	-	-	47.95	-23.49
5	.55275	24.4	Qp	0	0	10.1	34.5	56	-21.5	-	-
6	.5505	13.72	Ca	0	0	10.1	23.82	-	-	46	-22.18
7	.79575	20.1	Qp	0	0	10.1	30.2	56	-25.8	-	-
8	.79575	10.03	Ca	0	0	10.1	20.13	-	-	46	-25.87
9	1.3965	16.59	Qp	0	.1	10.1	26.79	56	-29.21	-	-
10	1.383	8.91	Ca	0	.1	10.1	19.11	-	-	46	-26.89
11	8.13525	33.93	Qp	0	.2	10.2	44.33	60	-15.67	-	-
12	8.13525	27.57	Ca	0	.2	10.2	37.97	-	-	50	-12.03

Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 2 RESULTS



WORST EMISSIONS

Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class C QP	QP Margin (dB)	CFR 47 Part 15 Class C Avg	Av(CISPR)M argin (dB)
13	.1995	25.97	Qp	0	0	10.1	36.07	63.63	-27.56	-	-
14	.20175	20.08	Ca	0	0	10.1	30.18	-	-	53.54	-23.36
15	.2625	24.64	Qp	0	0	10.1	34.74	61.35	-26.61	-	-
16	.2625	11.05	Ca	0	0	10.1	21.15	-	-	51.35	-30.2
17	.4425	18.24	Qp	0	0	10.1	28.34	57.01	-28.67	-	-
18	.44025	4.92	Ca	0	0	10.1	15.02	-	-	47.06	-32.04
19	.50775	19.51	Qp	0	0	10.1	29.61	56	-26.39	-	-
20	.501	10.13	Ca	0	0	10.1	20.23	-	-	46	-25.77
21	.8925	18.67	Qp	0	0	10.1	28.77	56	-27.23	-	-
22	.8925	13.17	Ca	0	0	10.1	23.27	-	-	46	-22.73
23	8.17125	23.75	Qp	0	.2	10.2	34.15	60	-25.85	-	-
24	8.16225	17.92	Ca	0	.2	10.2	28.32	-	-	50	-21.68

Qp - Quasi-Peak detector

Ca - CISPR average detection