TEST REPORT

Report Number. : 13119172-E2V1

Applicant	:	ENERGOUS CORPORATION 3590 NORTH FIRST STREET SAN JOSE, CA 95134, U.S.A.
Model	:	MS-550
FCC ID	:	2ADNG-MS550
EUT Description	:	OVER-THE-AIR, DISTANCE CHARGING TRANSMITTER
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C

Date Of Issue:
December 18, 2019

Prepared by:
UL Verification Services Inc.
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NVLAP Lab code: 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	12/18/2019	Initial Issue	--

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ENERGOUS CORPORATION
3590 NORTH FIRST STREET
SAN JOSE, CA 95134, U.S.A.

EUT DESCRIPTION: OVER-THE-AIR, DISTANCE CHARGING TRANSMITTER

MODEL NUMBER: MS-550

SERIAL NUMBER: 2032 (RADIATED); 2011 (CONDUCTED)

DATE TESTED: NOVEMBER 25, 2019 TO NOVEMBER 26, 2019

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. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

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, or any agency of the Federal Government.

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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, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, 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	47658 Kato Road
☐ Chamber A	☐ Chamber D	☐ Chamber I
☐ Chamber B	☐ Chamber E	☐ Chamber J
☐ Chamber C	☐ Chamber F	☒ Chamber K
	☐ Chamber G	☐ Chamber L
	☐ Chamber H	☐ Chamber M

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code: 2324A.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0

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

RADIATED EMISSIONS

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

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

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	3.39 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.07 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.52 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.24 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.37 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.17 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an over-the-air, distance charging transmitter. Wireless power transfer is only transmitting a continuous carrier wave signal at 917.5 MHz frequency single channel when client device is positioned within the charging zone. The charging zone of the EUT is up to 40cm for client device placed in front of the EUT. EUT can only charge one client device at a time. The EUT uses BLE to pair with the client device.

This report documents test results of the Bluetooth Low Energy radio portion of the wireless charger.

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	-3.57	0.44

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Peak Gain (dBi)
2.4	2.72

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Version: 4.0.1.255

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 EUT is a tabletop device and it has two ports, one is the USB type C port for power only, second port is for command line interface control, end user will not have access to it. Therefore, all final radiated testing was performed with the EUT in tabletop orientation powered by AC/DC adapter via USB cable.

Worst-case data rate as provided by the client was:
BLE: 1 Mbps.

BLE and WPT bands operate simultaneously, simultaneous operation results are documented in UL document 13119172-E1V1 WPT report.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID/ DoC**
EUT AC/DC Adapter	Anker	PD 30	AFZFD51915301545	DoC
Laptop	Dell	Latitude E7470	3F94RC2	DoC
Laptop AC/DC adapter	Dell	LA65NM130	CN-03NKWD-72438-38D-0F54-A00	DoC

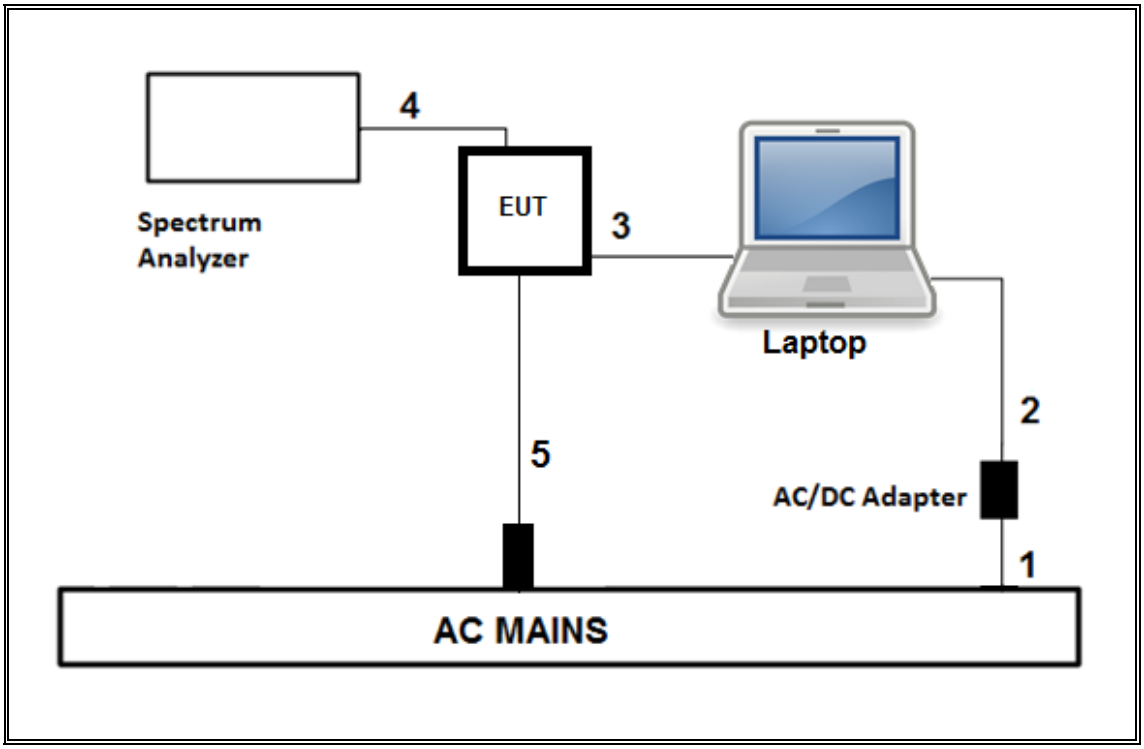
I/O CABLES (RF CONDUCTED TEST)						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	AC	1	AC	Unshielded	1	AC Mains to AC/DC Adapter
2	DC	1	DC	Unshielded	1.5	AC/DC Adapter to Laptop
3	USB	1	UART	Unshielded	1.5	EUT to Laptop
4	Antenna	1	SMA	Unshielded	0.5	To spectrum analyzer
5	USB	1	USB Type C	Shielded	1	EUT to AC/DC adapter

I/O CABLES (RF RADIATED TEST)						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	USB	1	USB Type C	Shielded	1	EUT to AC/DC adapter

TEST SETUP-CONDUCTED TEST

The EUT was connected to the test laptop via USB cable. Test software exercised the EUT.

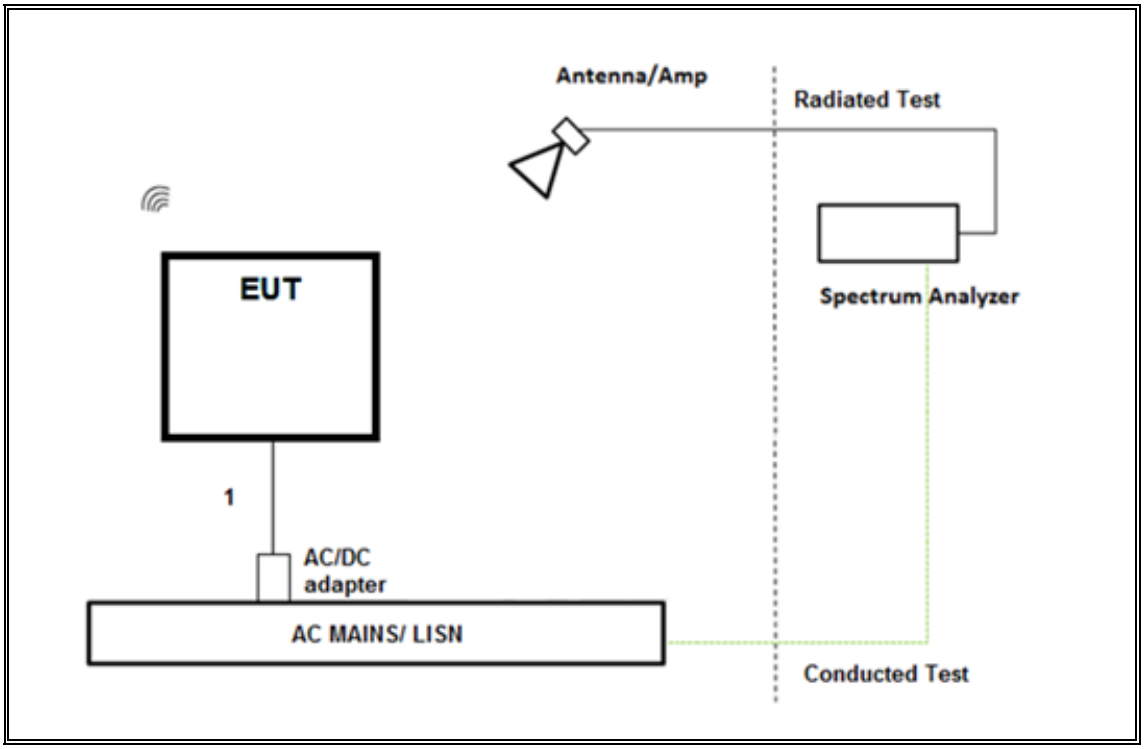
SETUP DIAGRAM



TEST SETUP- RADIATED TEST / AC LINE CONDUCTED TEST

The EUT was powered by an AC/DC adapter via 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, Active Loop 9KHz to 30MHz	COM-POWER	AL-130R	PRE0165308	04/11/2020
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	EMC4294	06/14/2020
Amplifier, 1 to 18GHz, 35dB	AMPLICAL	AMP1G18-35	T1569	05/04/2020
Amplifier, 9KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	PRE0186650	12/13/2019
Antenna, BroadBand Hybrid, 30MHz to 3GHz	Sunol Sciences Corp.	JB3	PRE0181574	10/24/2020
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179372	10/14/2020
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	T447	08/13/2020
Pre-Amp, 18-26.5GHz	Amplical	AMP18G26.5-60	PRE0181238	05/01/2020
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	T1450	01/23/2020
Power Meter, P-series single channel	Keysight	N1911A	T1262	01/31/2020
Power Sensor, P-series, 50MHz to 18GHz, Wideband	Keysight	N1921A	T1227	02/05/2020
AC Line Conducted				
EMI Receiver	Rohde & Schwarz	ESR	T1436	02/14/2020
LISN for Conducted Emissions CISPR-16	FCC INC.	FCC LISN 50/250	T1310	01/24/2020
UL AUTOMATION SOFTWARE				
Radiated Software	UL	UL EMC	Ver 9.5, Sept 24, 2019 and Ver 9.5,Oct 21, 2019	
Antenna Port Software	UL	UL RF	Ver 2019.11.13	
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

7. MEASUREMENT METHODS

6 dB BW: ANSI C63.10 Subclause -11.8.1

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

Output Power: ANSI C63.10 Subclause-11.9.1.3 PKPM1 Peak power meter method

Average Power: ANSI C63.10 Subclause -11.9.2.3.2Method AVGPM-G (Measurement using a gated RF average-reading power meter)

PSD: ANSI C63.10 Subclause -11.10.2 Method PKPSD (peak PSD)

Radiated emissions non-restricted frequency bands: ANSI C63.10 Subclause -11.11

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1

Conducted emissions in restricted frequency bands: ANSI C63.10 Subclause -11.12.2

Band-edge: ANSI C63.10 Subclause -11.13.3.4 Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction

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

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

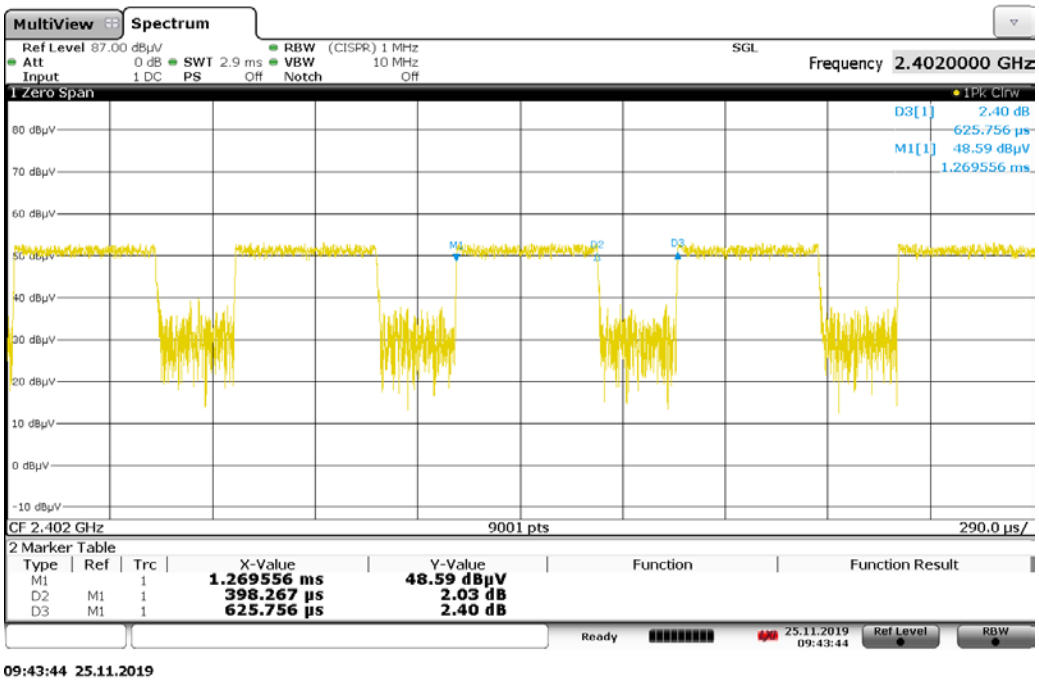
KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
2.4GHz Band					
BLE 1Mbps	0.40	0.63	0.636	63.65%	1.96

DUTY CYCLE PLOTS

Tester ID:	19498 ER



DUTY CYCLE BLE 1Mbps

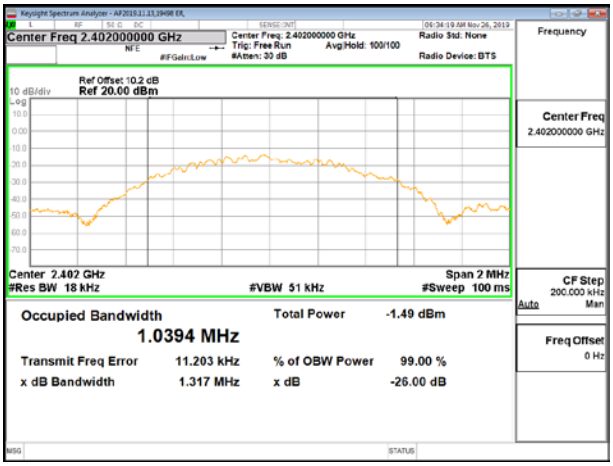
8.2. 99% BANDWIDTH

LIMITS

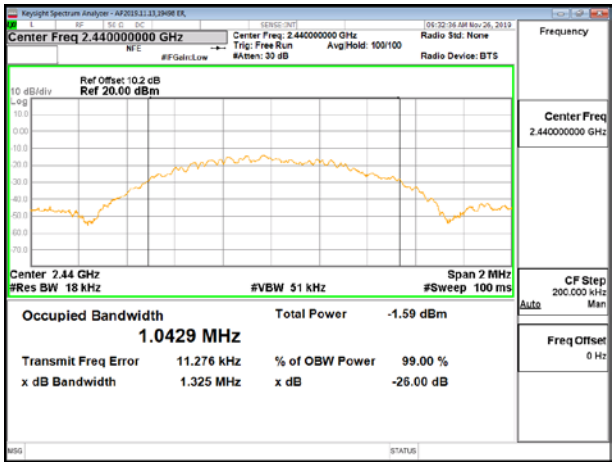
None; for reporting purposes only.

RESULTS

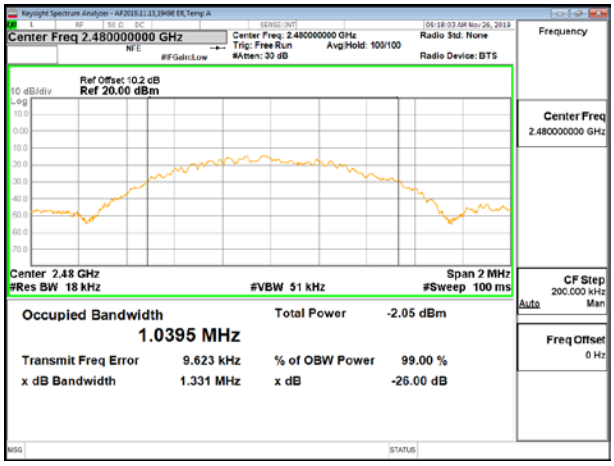
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0394
Middle	2440	1.0429
High	2480	1.0395



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.3. 6 dB BANDWIDTH

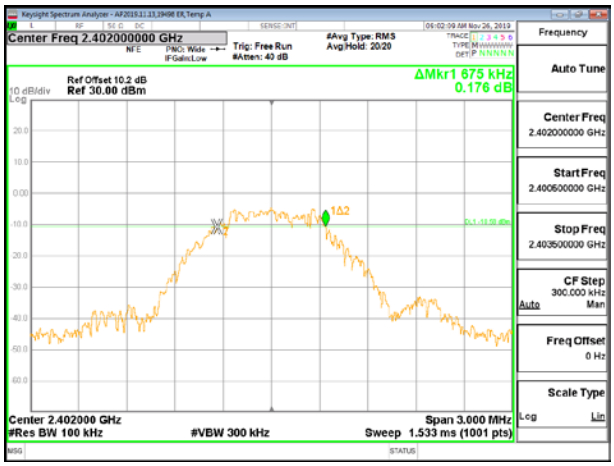
LIMITS

FCC §15.247 (a) (2)

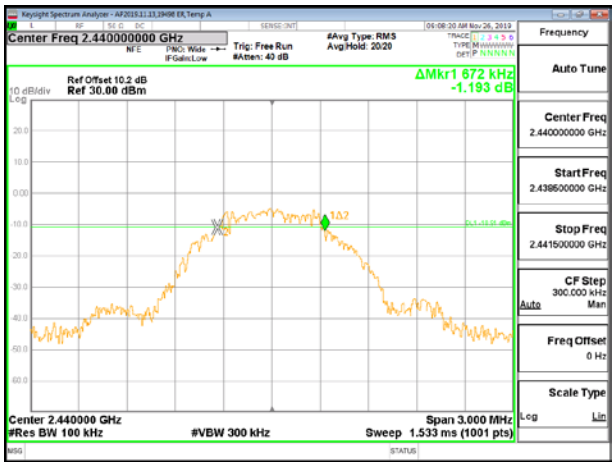
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

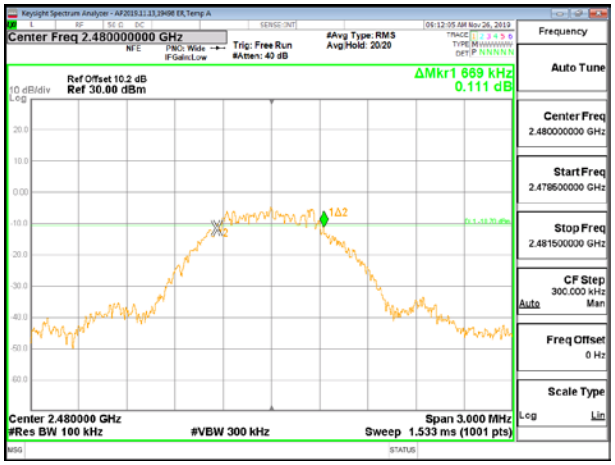
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.675	0.5
Middle	2440	0.672	0.5
High	2480	0.669	0.5



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)

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.

RESULTS

Tested By:	19498 ER
Date:	11/26/2019

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-3.57	30	-33.570
Middle	2440	-4.19	30	-34.190
High	2480	-4.16	30	-34.160

8.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter. Average power measurement is the average during the ON time of the transmission

RESULTS

Tested By:	19498 ER
Date:	11/26/2019

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	-4.05
Middle	2440	-4.61
High	2480	-4.68

8.6. POWER SPECTRAL DENSITY

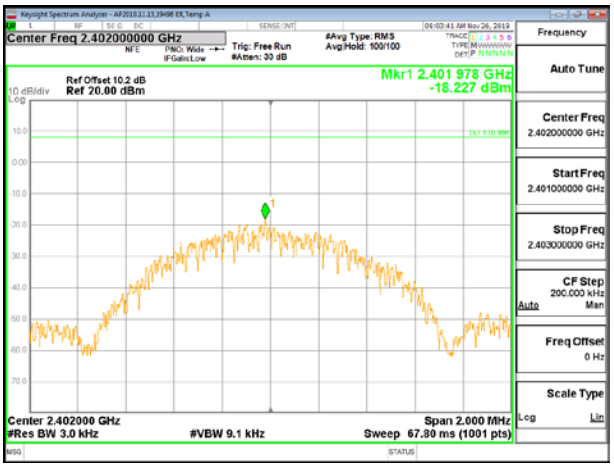
LIMITS

FCC §15.247 (e)

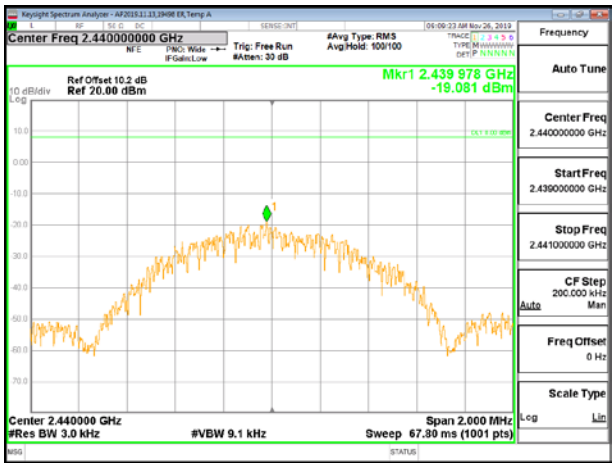
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

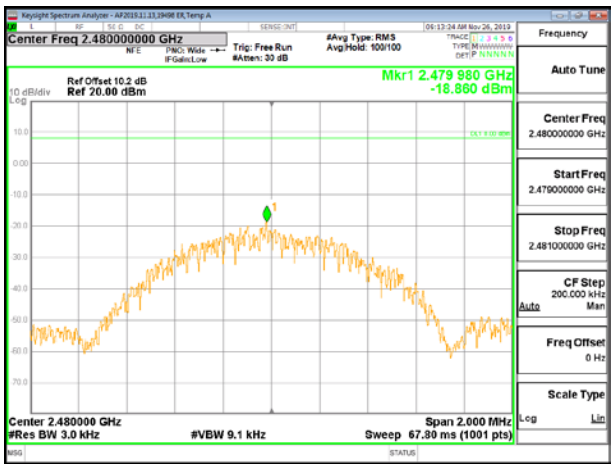
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-18.23	8	-26.23
Middle	2440	-19.08	8	-27.08
High	2480	-18.86	8	-26.86



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

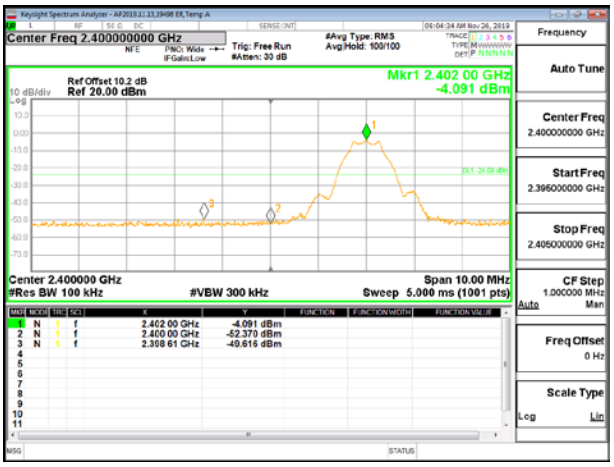
8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

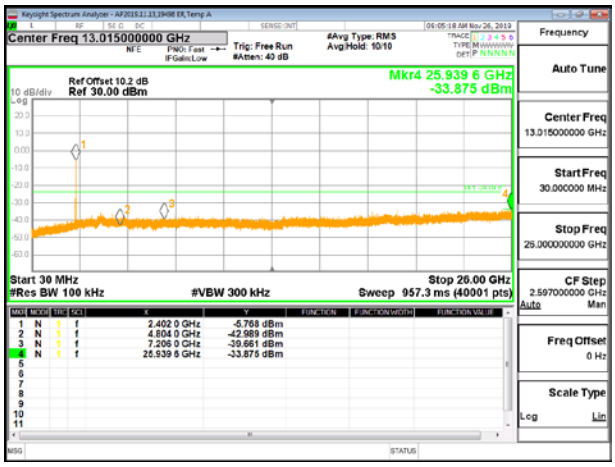
FCC §15.247 (d)

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

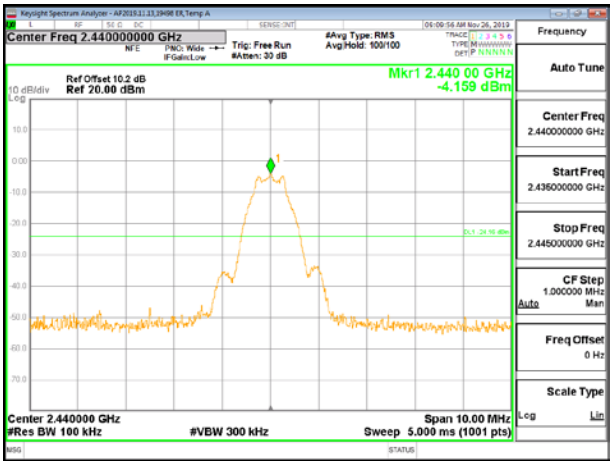
RESULTS



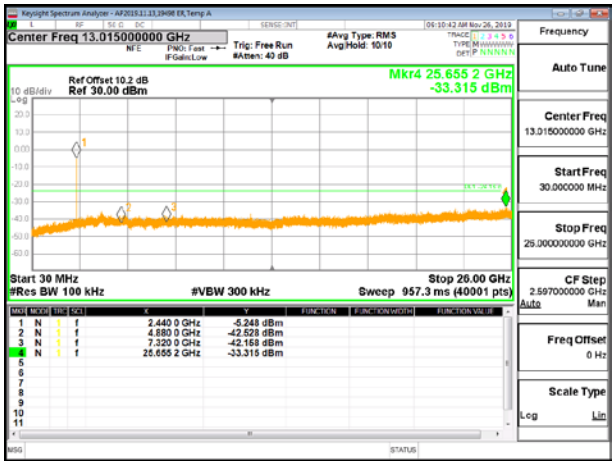
LOW CHANNEL BANDEDGE



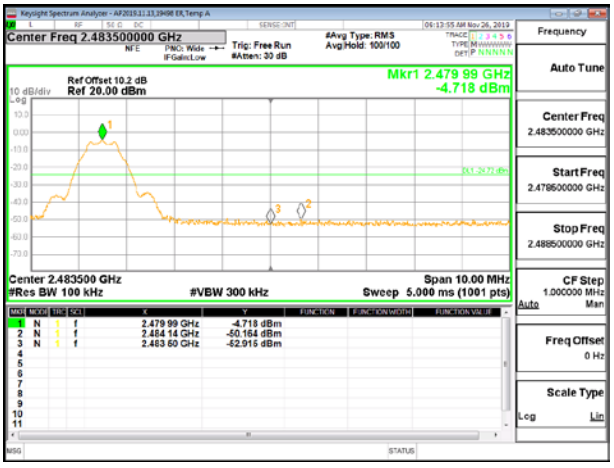
OUT-OF-BAND LOW CHANNEL



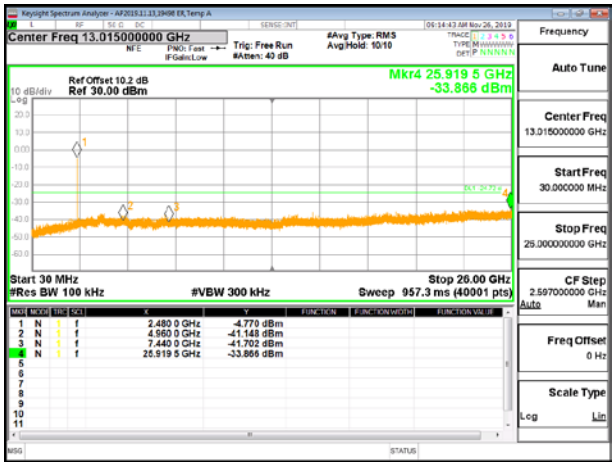
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

RSS-GEN, Section 8.9 and 8.10.

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) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

Tested in accordance with ANSI C63.10-2013

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 1 GHz. 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 1 GHz and above 18 GHz 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.

For below 30 MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore final testing was performed on these two orientations only.

KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

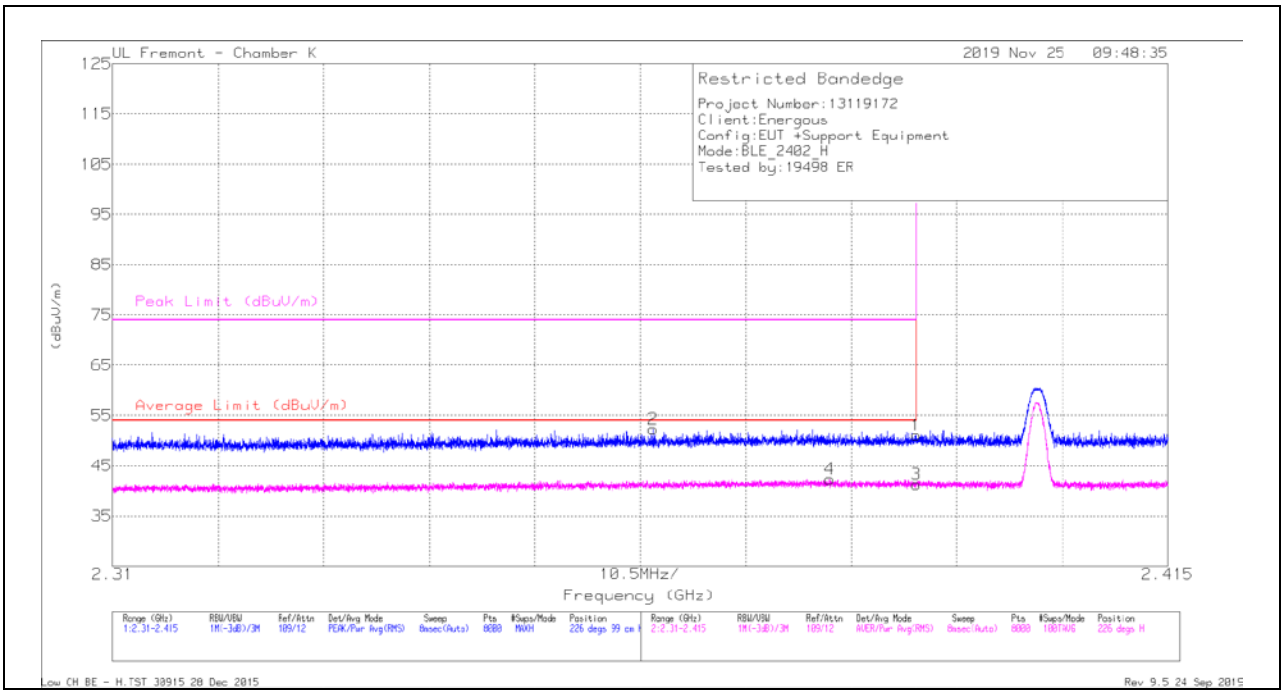
Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

9.2. TRANSMITTER ABOVE 1 GHz

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT

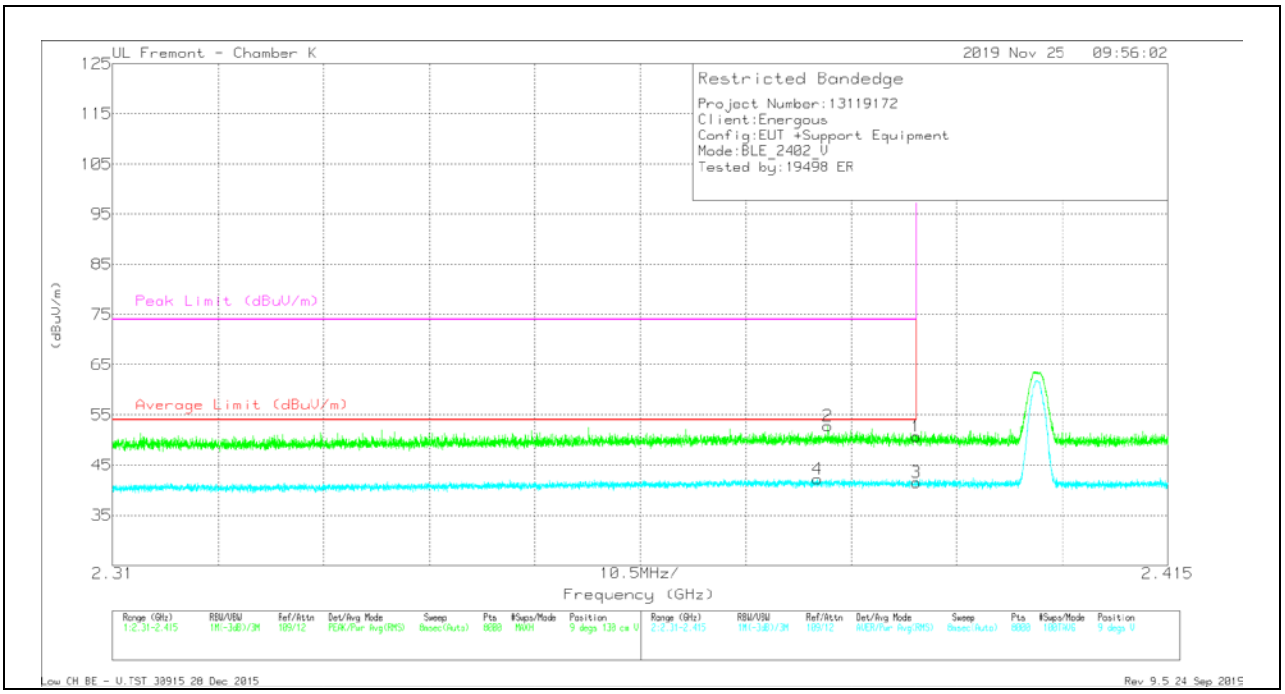


Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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	* 2.39	33.28	Pk	31.9	-14.1	0	51.08	-	-	74	-22.92	226	99	H
2	* 2.36381	34.84	Pk	31.8	-14.3	0	52.34	-	-	74	-21.66	226	99	H
3	* 2.39	21.61	RMS	31.9	-14.1	1.96	41.37	54	-12.63	-	-	226	99	H
4	* 2.38138	22.68	RMS	31.9	-14.2	1.96	42.34	54	-11.66	-	-	226	99	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
RMS - RMS detection

VERTICAL RESULT



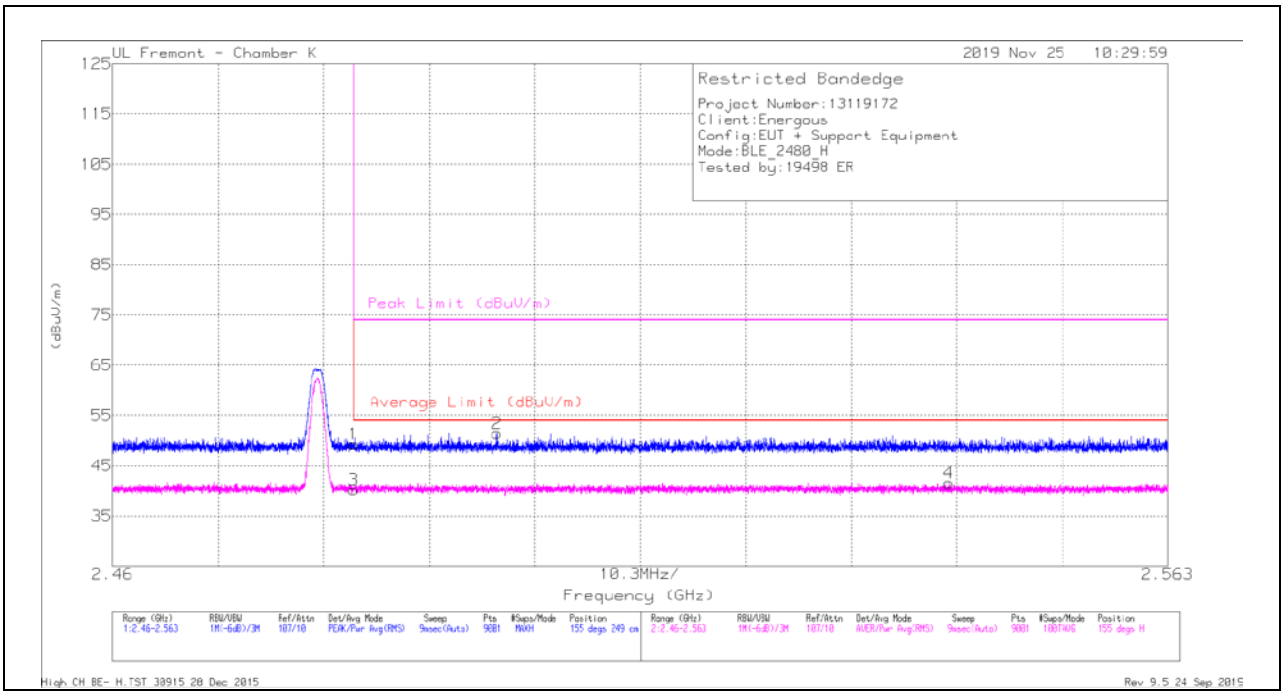
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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	* 2.39	32.93	Pk	31.9	-14.1	0	50.73	-	-	74	-23.27	9	130	V
2	* 2.38121	35.02	Pk	31.9	-14.1	0	52.82	-	-	74	-21.18	9	130	V
3	* 2.39	21.76	RMS	31.9	-14.1	1.96	41.52	54	-12.48	-	-	9	130	V
4	* 2.38015	22.49	RMS	31.9	-14.1	1.96	42.25	54	-11.75	-	-	9	130	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
RMS - RMS detection

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT

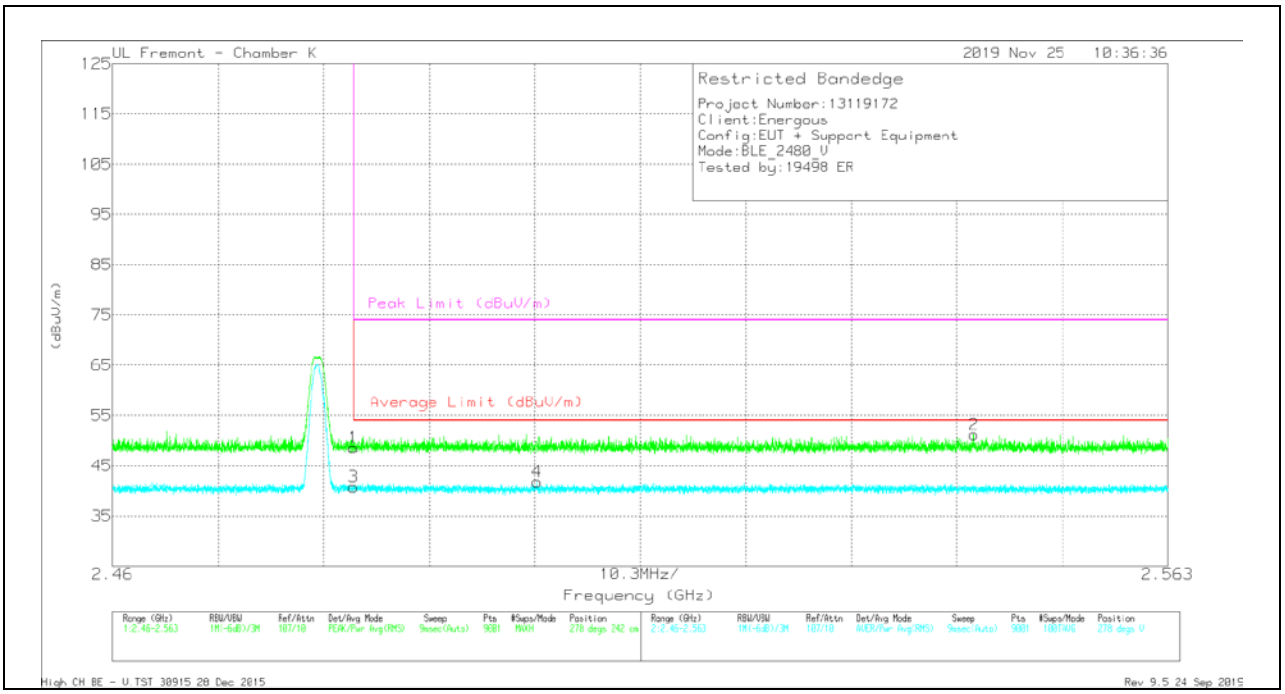


Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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	* 2.48351	41.57	Pk	32.5	-24.8	0	49.27	-	-	74	-24.73	155	249	H
2	* 2.49751	43.83	Pk	32.4	-24.8	0	51.43	-	-	74	-22.57	155	249	H
3	* 2.48351	30.5	RMS	32.5	-24.8	1.96	40.16	54	-13.84	-	-	155	249	H
4	2.54166	32.03	RMS	32.4	-24.8	1.96	41.59	54	-12.41	-	-	155	249	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
RMS - RMS detection

VERTICAL RESULT



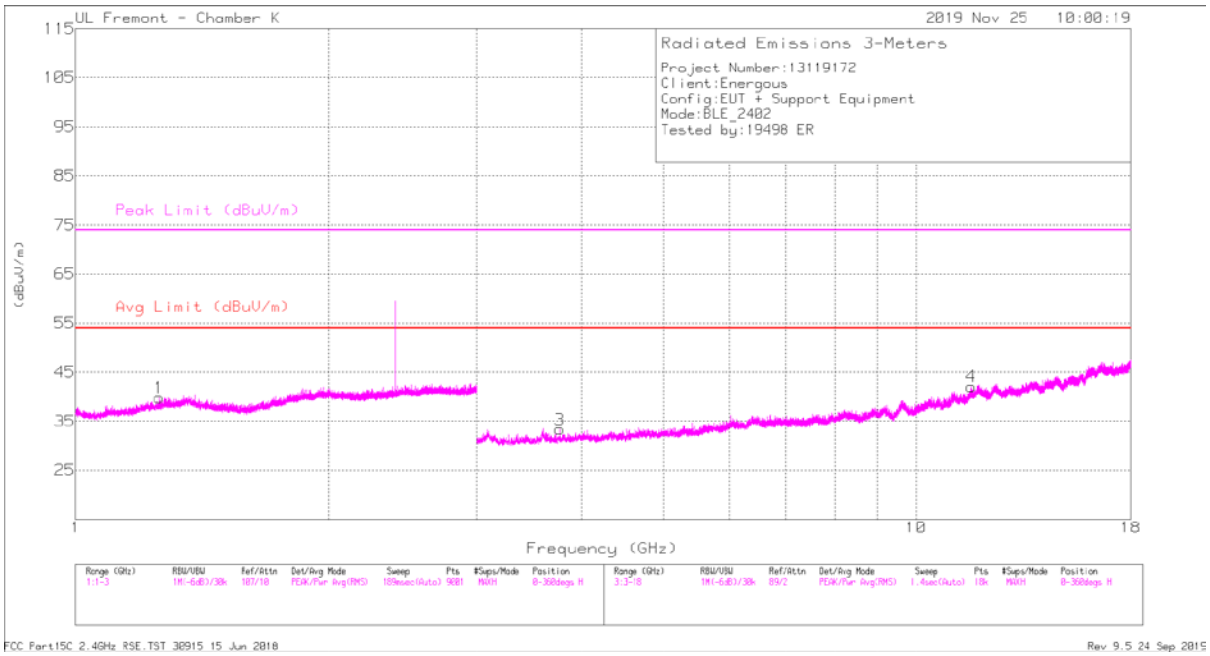
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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	* 2.48351	40.92	Pk	32.5	-24.8	0	48.62	-	-	74	-25.38	278	242	V
2	2.54407	43.64	Pk	32.4	-24.8	0	51.24	-	-	74	-22.76	278	242	V
3	* 2.48351	31.12	RMS	32.5	-24.8	1.96	40.78	54	-13.22	-	-	278	242	V
4	2.50146	32.16	RMS	32.4	-24.7	1.96	41.82	54	-12.18	-	-	278	242	V

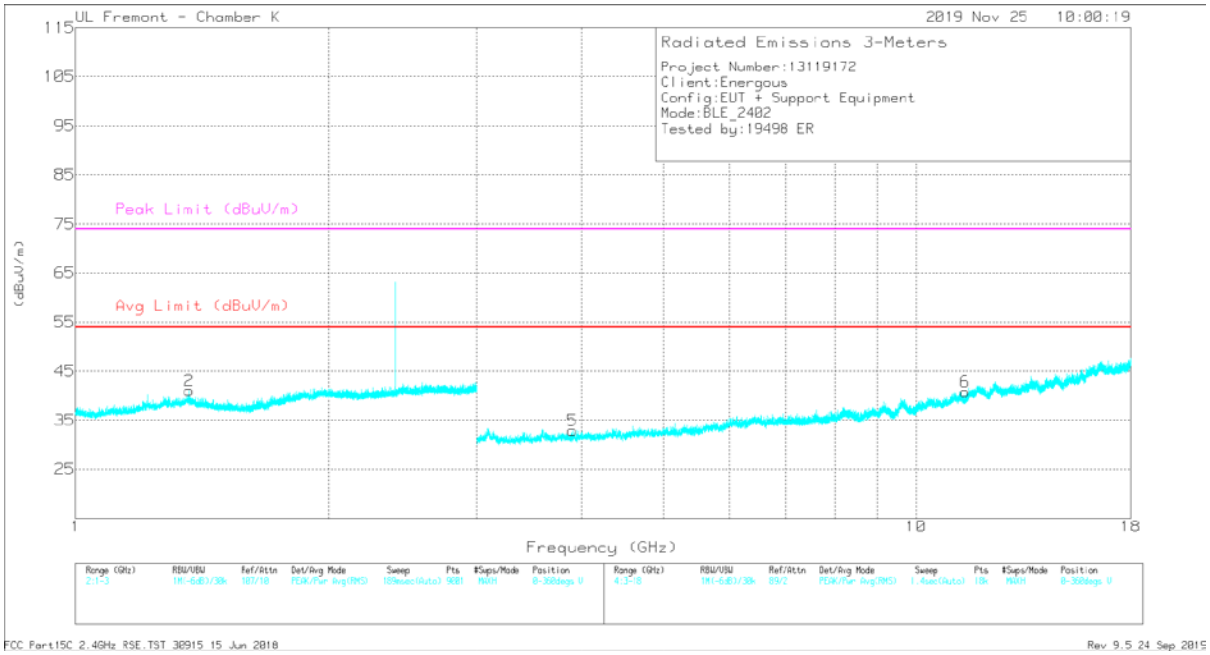
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
RMS - RMS detection

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



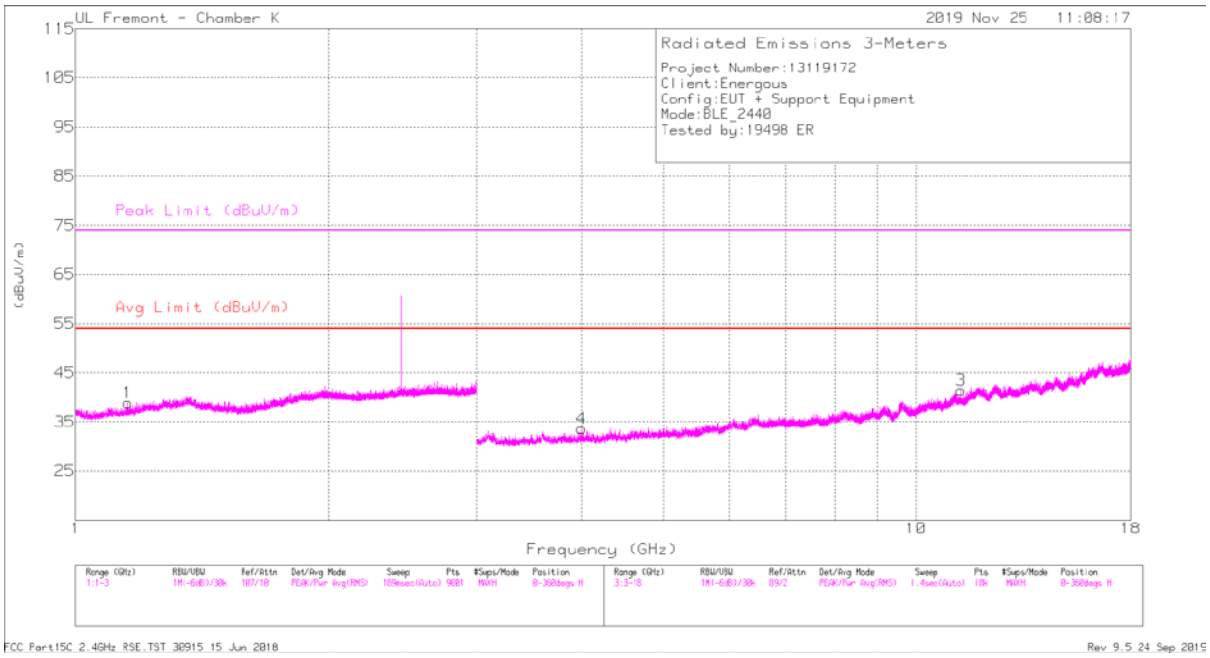
VERTICAL

RADIATED EMISSIONS

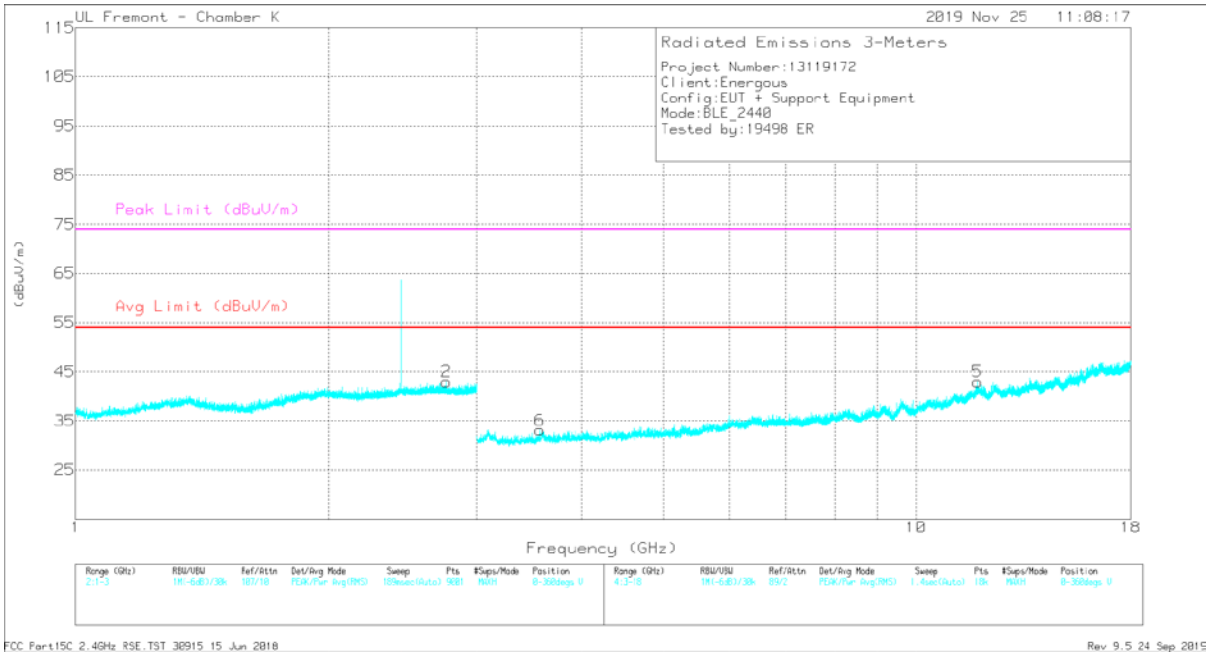
Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.25826	41.5	PK2	28.9	-23.9	0	46.5	-	-	74	-27.5	27	248	H
* 1.25835	31.46	MAv1	28.9	-23.9	1.96	38.42	54	-15.58	-	-	27	248	H
* 1.3637	41.27	PK2	29.6	-23.8	0	47.07	-	-	74	-26.93	123	171	V
* 1.36561	31.8	MAv1	29.6	-23.8	1.96	39.56	54	-14.44	-	-	123	171	V
* 3.76747	39.18	PK2	33.2	-31.7	0	40.68	-	-	74	-33.32	50	225	H
* 3.76621	28.02	MAv1	33.2	-31.7	1.96	31.48	54	-22.52	-	-	50	225	H
* 11.62846	30.55	PK2	38.5	-20.4	0	48.65	-	-	74	-25.35	50	134	H
* 11.63165	20.19	MAv1	38.5	-20.3	1.96	40.35	54	-13.65	-	-	50	134	H
* 3.90174	37.78	PK2	33.4	-31.7	0	39.48	-	-	74	-34.52	185	317	V
* 3.90104	27.86	MAv1	33.4	-31.7	1.96	31.52	54	-22.48	-	-	185	317	V
* 11.43879	30.97	PK2	38.2	-20.7	0	48.47	-	-	74	-25.53	271	279	V
* 11.43839	20.58	MAv1	38.2	-20.7	1.96	40.04	54	-13.96	-	-	271	279	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

MID CHANNEL RESULTS



HORIZONTAL



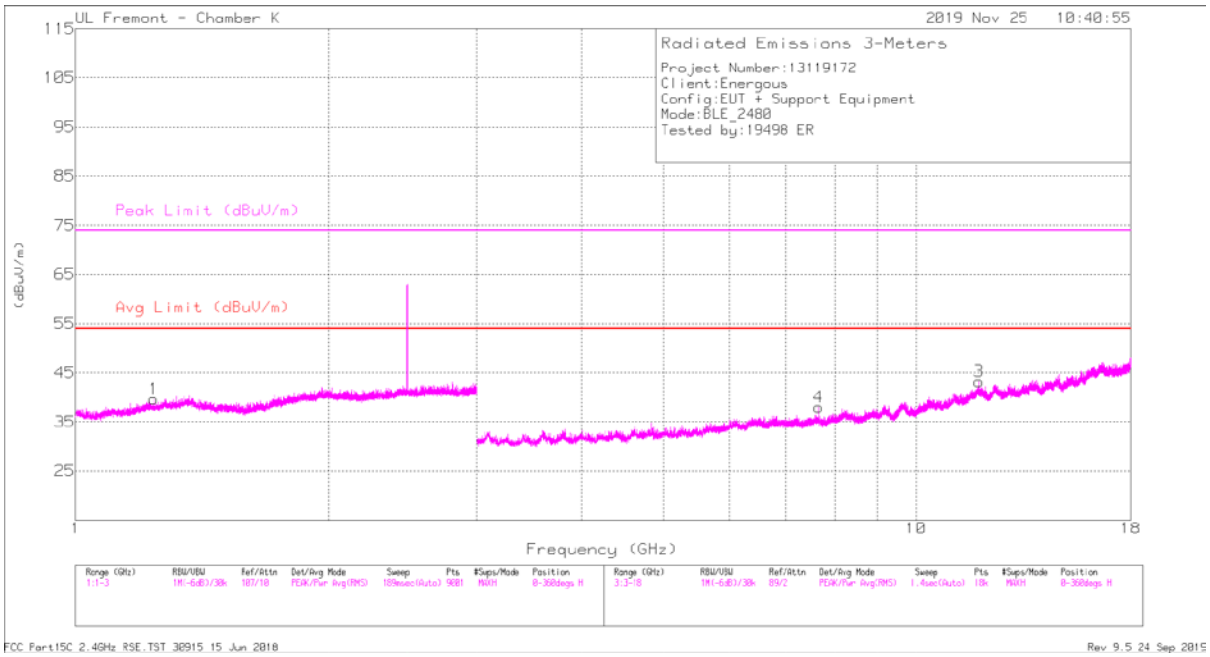
VERTICAL

RADIATED EMISSIONS

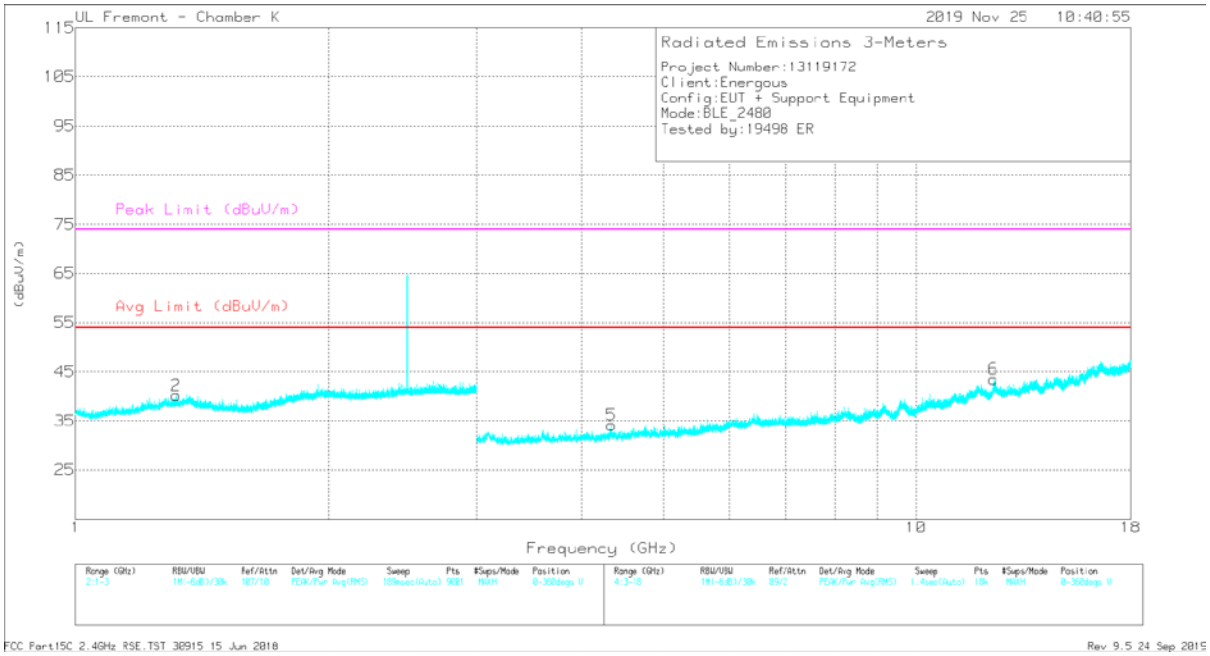
Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.15133	41.8	PK2	27.6	-23.8	0	45.6	-	-	74	-28.4	161	147	H
* 1.15221	31.27	MAv1	27.6	-23.9	1.96	36.93	54	-17.07	-	-	161	147	H
* 2.75844	41.65	PK2	32.5	-24.5	0	49.65	-	-	74	-24.35	298	264	V
* 2.75935	31.48	MAv1	32.5	-24.5	1.96	41.44	54	-12.56	-	-	298	264	V
* 11.31069	29.71	PK2	38.1	-21	0	46.81	-	-	74	-27.19	140	168	H
* 11.30926	20.32	MAv1	38.1	-21	1.96	39.38	54	-14.62	-	-	140	168	H
* 4.00265	37.55	PK2	33.4	-31.4	0	39.55	-	-	74	-34.45	51	129	H
* 4.00158	28.04	MAv1	33.4	-31.4	1.96	32	54	-22	-	-	51	129	H
* 11.83705	29.87	PK2	38.7	-19.7	0	48.87	-	-	74	-25.13	149	161	V
* 11.83875	20.42	MAv1	38.7	-19.7	1.96	41.38	54	-12.62	-	-	149	161	V
* 3.56417	37.92	PK2	33.2	-32.3	0	38.82	-	-	74	-35.18	283	321	V
* 3.56266	28.46	MAv1	33.2	-32.3	1.96	31.32	54	-22.68	-	-	283	321	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

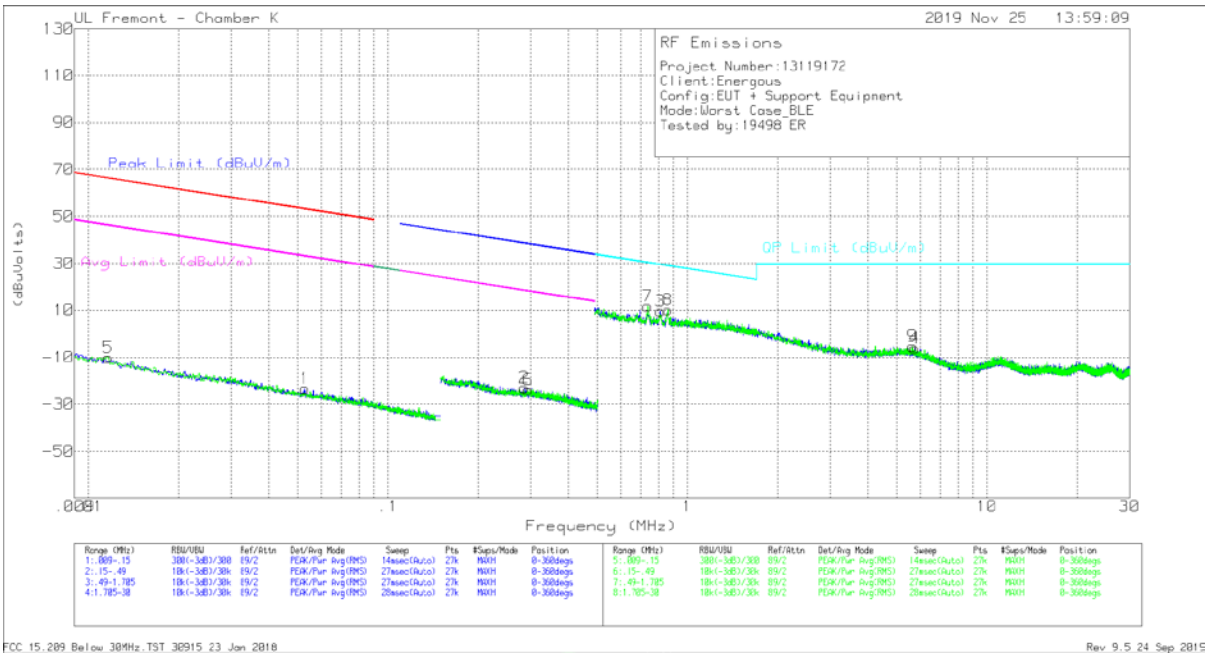
RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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
* 1.23951	42.39	PK2	28.6	-23.9	0	47.09	-	-	74	-26.91	11	239	H
* 1.24066	31.51	MAv1	28.6	-23.9	1.96	38.17	54	-15.83	-	-	11	239	H
* 1.31621	41.65	PK2	29	-23.8	0	46.85	-	-	74	-27.15	205	209	V
* 1.31756	31.41	MAv1	29	-23.9	1.96	38.47	54	-15.53	-	-	205	209	V
* 11.86914	30.35	PK2	38.7	-19.9	0	49.15	-	-	74	-24.85	297	159	H
* 11.87141	20.55	MAv1	38.7	-19.9	1.96	41.31	54	-12.69	-	-	297	159	H
* 7.6582	33.99	PK2	35.8	-25.7	0	44.09	-	-	74	-29.91	248	111	H
* 7.65938	23.43	MAv1	35.8	-25.7	1.96	35.49	54	-18.51	-	-	248	111	H
* 4.34141	37.75	PK2	33.5	-31.1	0	40.15	-	-	74	-33.85	107	273	V
* 4.34208	27.93	MAv1	33.5	-31.1	1.96	32.29	54	-21.71	-	-	107	273	V
* 12.3621	29.46	PK2	39	-20.1	0	48.36	-	-	74	-25.64	37	226	V
* 12.36046	20.48	MAv1	39	-20.1	1.96	41.34	54	-12.66	-	-	37	226	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

9.3. WORST CASE BELOW 30 MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



ANTENNA- TWO ORIENTATIONS FACE ON/FACE OFF

Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cables (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.05292	42.33	Pk	14.4	0	-80	-23.27	53.11	-76.38	33.11	-56.38	0-360
2	.28595	43.05	Pk	13.9	.1	-80	-22.95	38.49	-61.44	18.49	38.49	0-360
5	.01166	54.5	Pk	15.3	0	-80	-10.2	66.25	-76.45	46.25	-56.45	0-360
6	.29346	42.27	Pk	13.9	.1	-80	-23.73	38.26	-61.99	18.26	-41.99	0-360

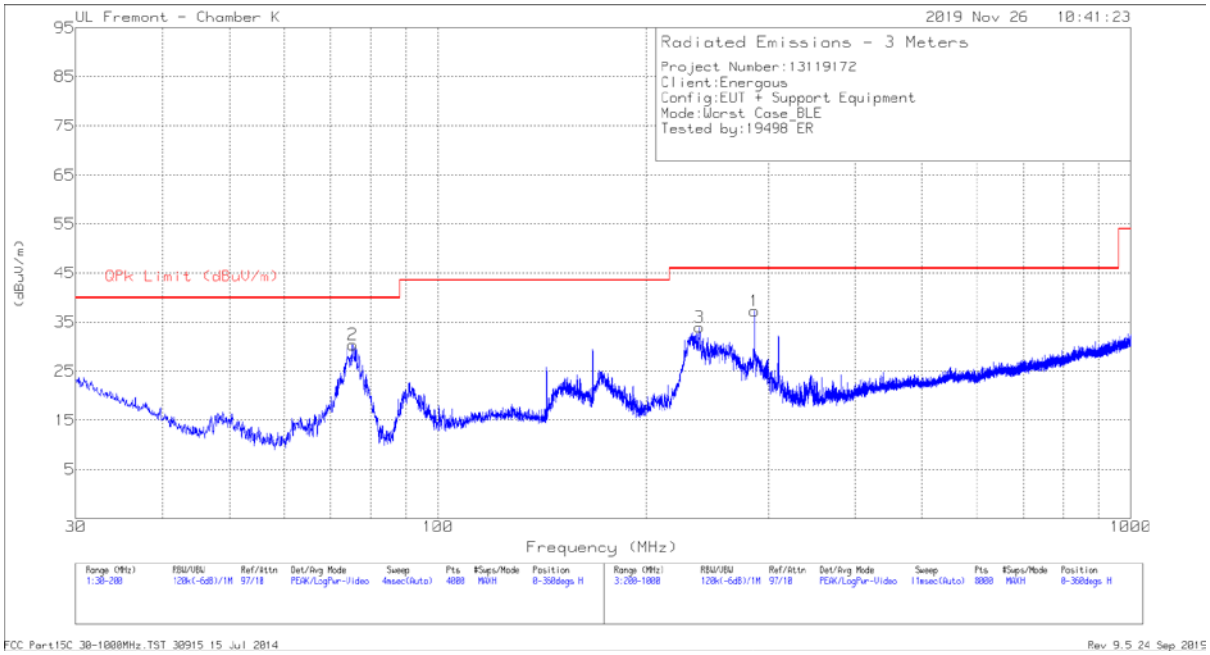
Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cables (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
3	.81186	35.54	Pk	14.1	.1	-40	9.74	29.43	-19.69	0-360
4	5.74085	18.62	Pk	14.9	.3	-40	-6.18	29.5	-35.68	0-360
7	.7391	37.67	Pk	14.1	.1	-40	11.87	30.24	-18.37	0-360
8	.8628	35.86	Pk	14.2	.1	-40	10.16	28.9	-18.74	0-360
9	5.67168	19.47	Pk	14.9	.3	-40	-5.33	29.5	-34.83	0-360

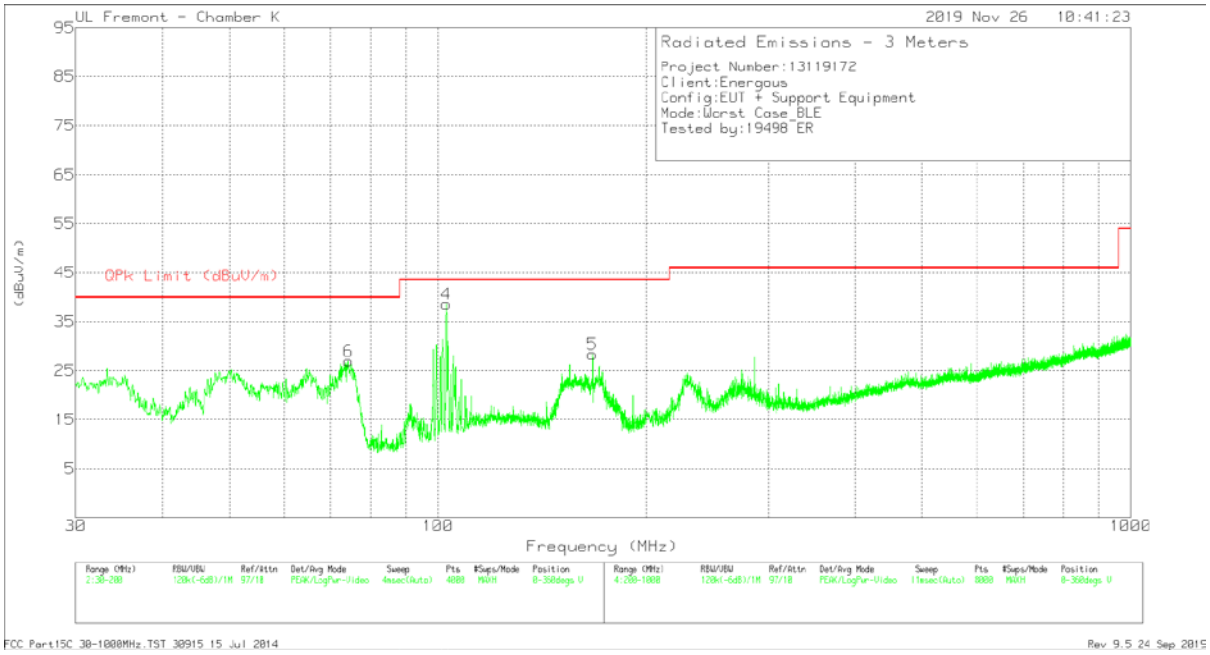
Pk - Peak detector

9.4. WORST CASE BELOW 1 GHZ

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



HORIZONTAL



VERTICAL

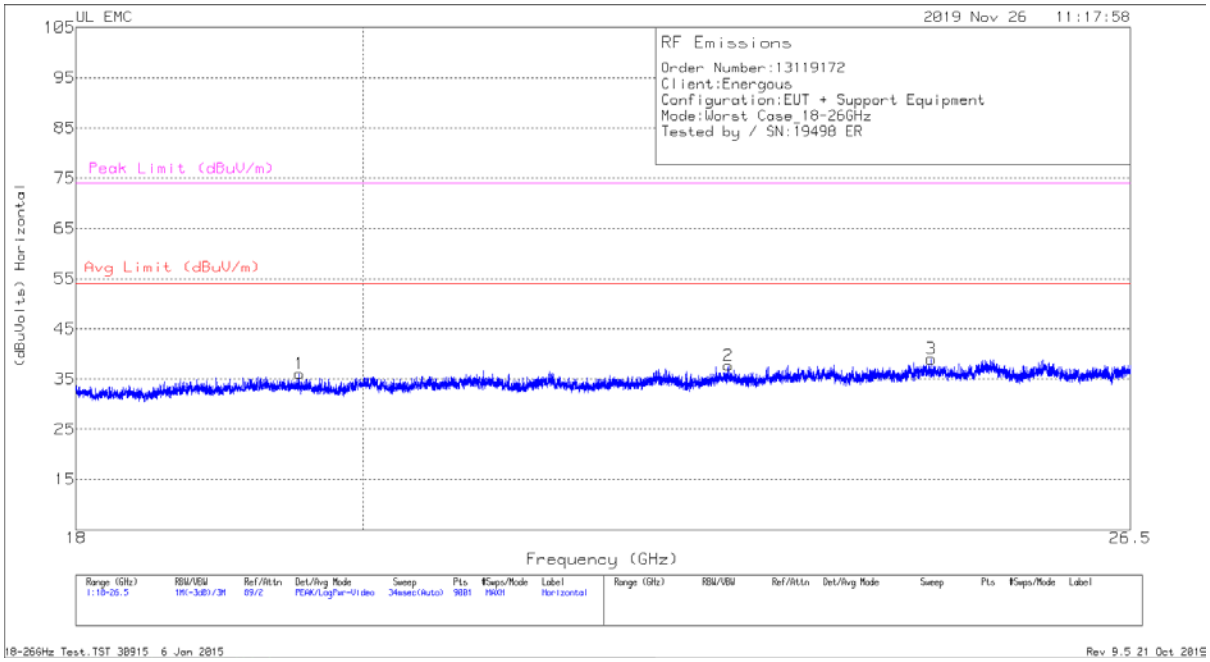
Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181574 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	286.5112	48.07	Pk	19.1	-29.9	37.27	46.02	-8.75	0-360	100	H
2	75.3592	47.63	Pk	13.9	-31.1	30.43	40	-9.57	0-360	299	H
3	238.705	46.69	Pk	17.4	-30.1	33.99	46.02	-12.03	0-360	100	H
4	102.8639	52.47	Pk	17	-30.9	38.57	43.52	-4.95	0-360	100	V
	103.2515	21.99	Qp	17.1	-30.9	8.19	43.52	-35.33	356	352	V
5	167.2255	41.06	Pk	17.8	-30.5	28.36	43.52	-15.16	0-360	100	V
6	* 74.2965	44	Pk	14	-31.1	26.9	40	-13.1	0-360	100	V

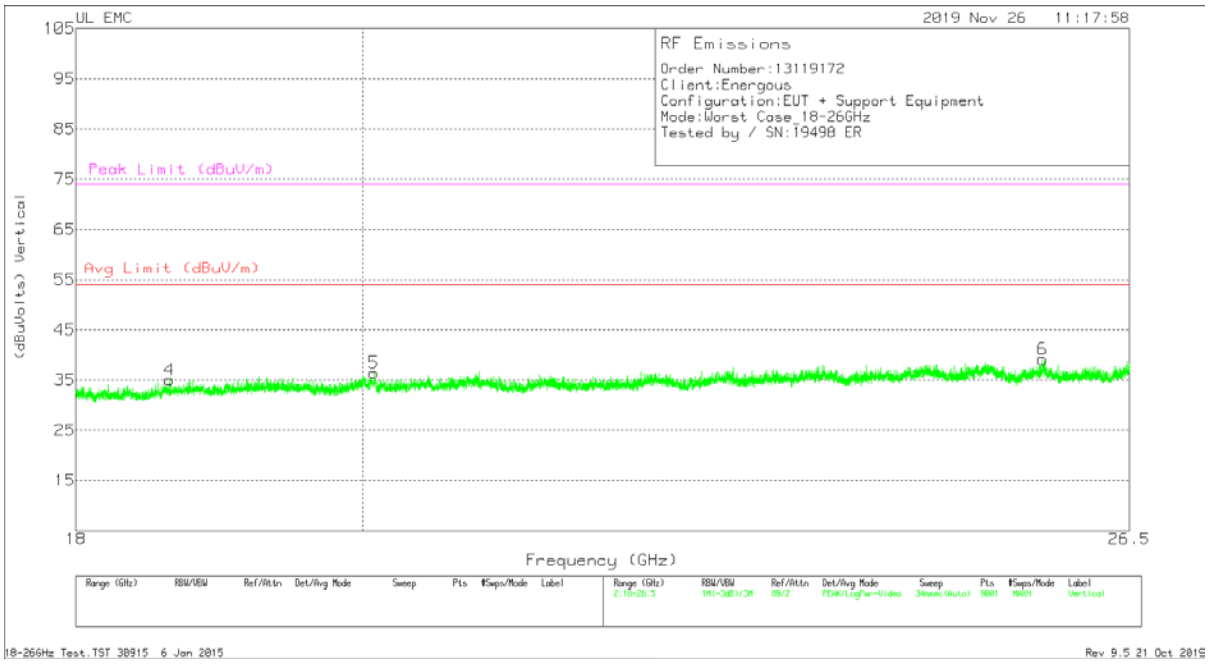
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
Qp - Quasi-Peak detector

9.5. WORST CASE 18-26 GHZ

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



HORIZONTAL



VERTICAL

18 – 26GHz Data

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T447 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	19.53661	70.07	Pk	32.8	-57.3	-9.5	36.07	54	-17.93	74	-37.93
2	22.86672	70.93	Pk	33.7	-57.4	-9.5	37.73	54	-16.27	74	-36.27
3	24.63189	70.12	Pk	34.4	-56	-9.5	39.02	54	-14.98	74	-34.98
4	18.629	70.85	Pk	32.4	-58.7	-9.5	35.05	54	-18.95	74	-38.95
5	20.07967	69.43	Pk	32.9	-56.4	-9.5	36.43	54	-17.57	74	-37.57
6	25.66605	69.07	Pk	34.4	-54.8	-9.5	39.17	54	-14.83	74	-34.83

Pk - Peak detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	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

Tested in accordance with ANSI C63.10-2013

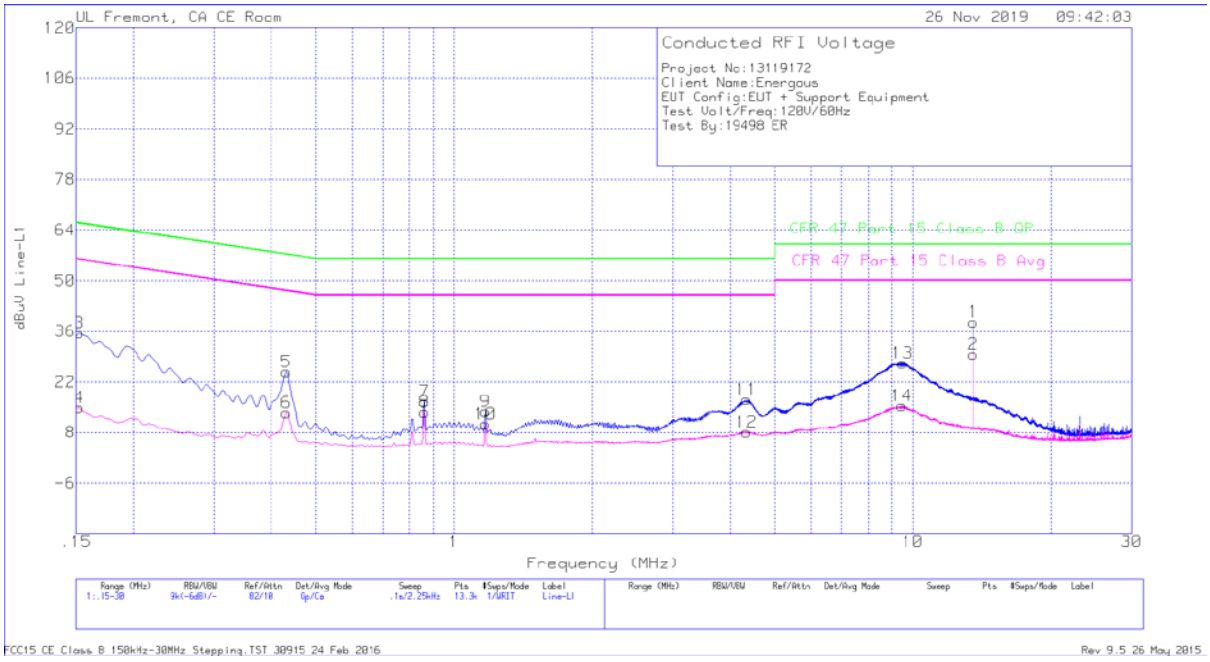
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

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

LINE 1 RESULTS

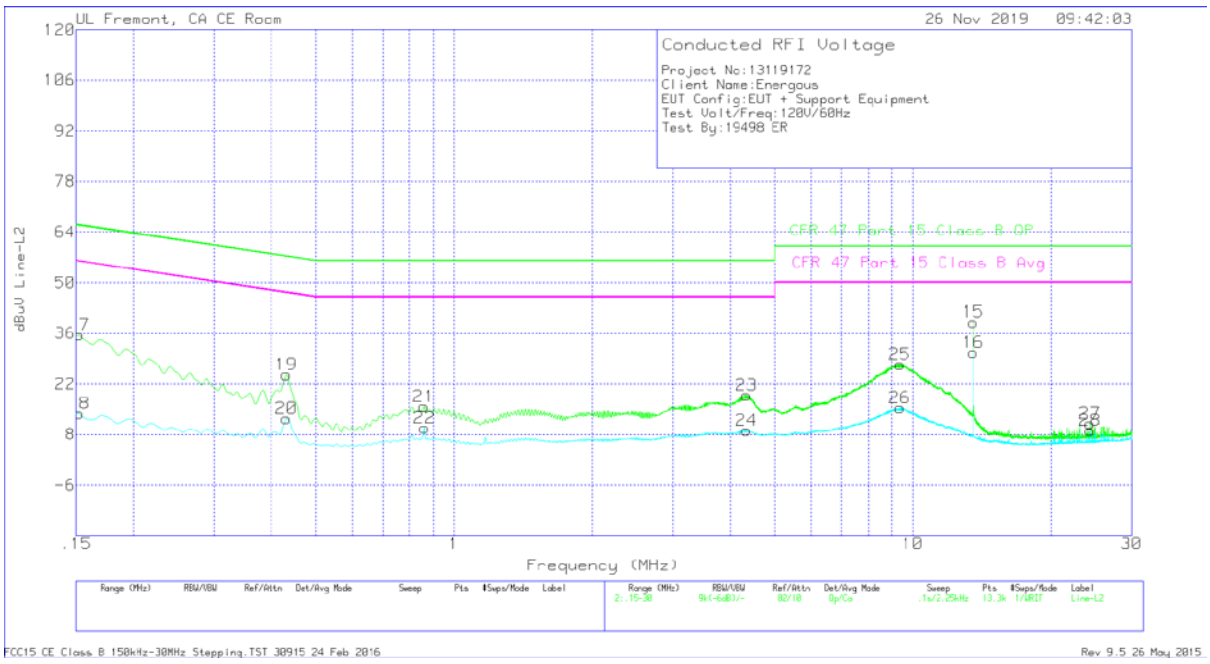


Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
1	13.56	28.11	Qp	.1	.2	10.2	38.61	60	-21.39	-	-
2	13.56	19.18	Ca	.1	.2	10.2	29.68	-	-	50	-20.32
3	.15225	25.35	Qp	.1	0	10.1	35.55	65.88	-30.33	-	-
4	.15225	4.61	Ca	.1	0	10.1	14.81	-	-	55.88	-41.07
5	.43125	14.66	Qp	0	0	10.1	24.76	57.23	-32.47	-	-
6	.43125	3.32	Ca	0	0	10.1	13.42	-	-	47.23	-33.81
7	.861	6.47	Qp	0	0	10.1	16.57	56	-39.43	-	-
8	.861	3.53	Ca	0	0	10.1	13.63	-	-	46	-32.37
9	1.16925	3.62	Qp	0	.1	10.1	13.82	56	-42.18	-	-
10	1.16925	.23	Ca	0	.1	10.1	10.43	-	-	46	-35.57
11	4.3395	6.9	Qp	0	.1	10.1	17.1	56	-38.9	-	-
12	4.3395	-2.12	Ca	0	.1	10.1	8.08	-	-	46	-37.92
13	9.501	16.88	Qp	0	.2	10.2	27.28	60	-32.72	-	-
14	9.45375	4.96	Ca	0	.2	10.2	15.36	-	-	50	-34.64

Qp - Quasi-Peak detector
Ca - CISPR average detection

Note: Marker # 1, 2, 13.56MHz is an ambient signal.

LINE 2 RESULTS



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 B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
15	13.56	28.63	Qp	.1	.2	10.2	39.13	60	-20.87	-	-
16	13.56	20.25	Ca	.1	.2	10.2	30.75	-	-	50	-19.25
17	.15225	25.34	Qp	.1	0	10.1	35.54	65.88	-30.34	-	-
18	.15225	3.7	Ca	.1	0	10.1	13.9	-	-	55.88	-41.98
19	.43125	14.44	Qp	0	0	10.1	24.54	57.23	-32.69	-	-
20	.43125	2.39	Ca	0	0	10.1	12.49	-	-	47.23	-34.74
21	.85875	5.71	Qp	0	0	10.1	15.81	56	-40.19	-	-
22	.861	-.3	Ca	0	0	10.1	9.8	-	-	46	-36.2
23	4.3395	8.73	Qp	0	.1	10.1	18.93	56	-37.07	-	-
24	4.33725	-1.11	Ca	0	.1	10.1	9.09	-	-	46	-36.91
25	9.384	17.02	Qp	0	.2	10.2	27.42	60	-32.58	-	-
26	9.384	4.97	Ca	0	.2	10.2	15.37	-	-	50	-34.63
27	24.35325	.24	Qp	.1	.3	10.5	11.14	60	-48.86	-	-
28	24.35325	-1.82	Ca	.1	.3	10.5	9.08	-	-	50	-40.92

Qp - Quasi-Peak detector
Ca - CISPR average detection

Note: Marker # 15, 16, 13.56MHz is an ambient signal.