



# **CERTIFICATION TEST REPORT**

**Report Number. :** 11974648-E2V3

**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 18 SUBPART C

**Date Of Issue:**  
FEBUARY 27, 2018

**Prepared by:**  
UL Verification Services Inc.  
47173 Benicia Street  
Fremont, CA 94538, U.S.A.  
TEL: (510) 771-1000  
FAX: (510) 661-0888



Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
V1	01/03/18	Initial Issue	Dan Corona
V2	01/05/18	Updated Section 5.1 & 5.2	Dan Corona
V3	02/27/18	Updated FCC ID from 2ADNG-MS300a to 2ADNG-MS300A, Cover Page and 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:** December 07– December 14, 2017

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC 47 CFR PART 18 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:

Prepared By:



DAN CORONIA  
OPERATIONS LEADER  
UL VERIFICATION SERVICES INC.

ERIC YU  
TEST ENGINEER  
UL VERIFICATION SERVICES INC.

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC / OST MP-5, "FCC Methods of Measurements of Radio Noise Emissions from Industrial, Scientific, and Medical Equipment."

## 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
<input type="checkbox"/> Chamber A(IC: 2324B-1)	<input type="checkbox"/> Chamber D(IC: 22541-1)
<input checked="" type="checkbox"/> Chamber B(IC: 2324B-2)	<input type="checkbox"/> Chamber E(IC: 22541-2)
<input type="checkbox"/> Chamber C(IC: 2324B-3)	<input type="checkbox"/> Chamber F(IC: 22541-3)
	<input type="checkbox"/> Chamber G(IC: 22541-4)
	<input type="checkbox"/> 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. Chambers A through C is covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-3, respectively. Chambers D through H are covered under Industry Canada company address code 22541 with site numbers 22541 -1 through 22541-5, respectively.

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 ISM portion of the EUT.

### 5.2. OPERATING FREQUENCY AND POWER

The EUT receives CW RF energy from the MS-300 WPT charger at a frequency of 913 MHz, within the tolerance of the ISM Frequency of 915 +/- 13MHz. The received power is 0.3 Watts.

### 5.3. 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.

## 5.4. CONFIGURATIONS INVESTIGATED

Configuration	Description
Charging Mode	EUT receives 913 MHz RF energy from MS-300

## 5.5. MODIFICATIONS

No modifications were made during testing.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/DC Adapter	Delta Elect. Inc.	MDS-090AAS15 B	861W321001P	N/A
Wireless Charger	Energous	MS-300	MS3000-WN003	Proposed: 2ADNG-MS300
Watch	Fitbit	FB402	N/A	XRAB402

### I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC Power	1	3-Prong	Unshielded	1	N/A
2	DC	1	4 pin Din	Unshielded	1.2	N/A
3	USB	1	USB	Unshielded	0.25	N/A

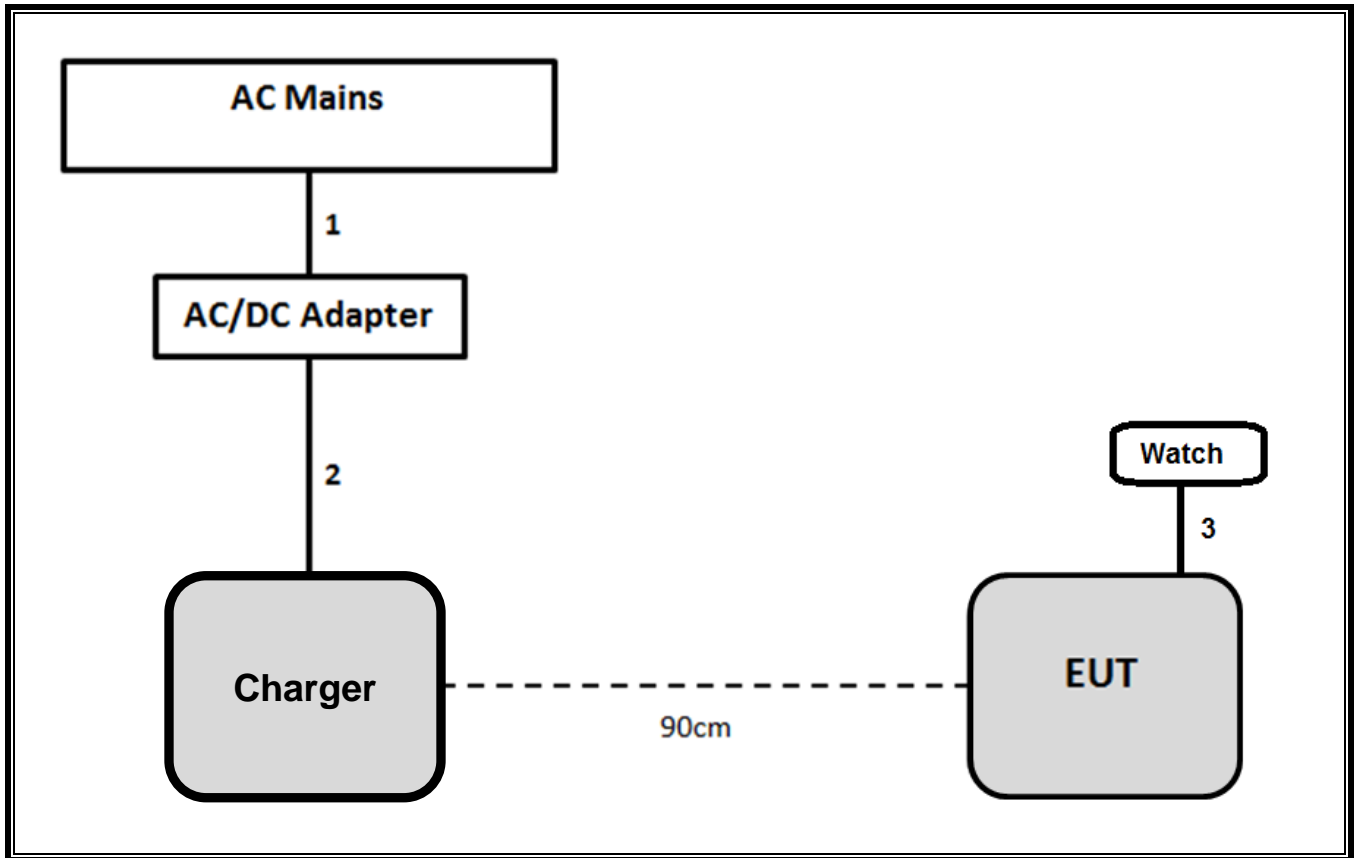
### TEST SETUP

The EUT receives RF energy from the WPT charger, converts to DC power and charges the watch via a USB cable.

**NOTE:** Preliminary testing identified the location of the client device that created the highest emissions was with the client located 90cm from, and at 90 degrees to, the charger.



**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	SUNOL SCIENCES	JB3	T899	06/15/2018
Antenna, Broadband Hybrid, 30MHz to 2000MHz	SUNOL SCIENCES	JB1	T130	10/16/2018
Antenna, Active Loop 9kHz-30MHz	ETS-LINDGREN	6502	T1683	02/17/2018
Antenna, Horn 1-18GHz	ETS-LINDGREN	3117	T863	06/09/2018
Amplifier, 1 to 18 GHz	MITEQ	AMF-4D-01000800-25-S-42	T493	06/23/2018
Amplifier, 30MHz – 1GHz, 32dB	Agilent	8447D	T10	02/15/2018
High Pass Filter, 1GHz	MICRO-TRONICS	HPM50114	T1852	07/16/2018
Band Reject Filter, 902 - 928MHz	MICRO-TRONICS	BRC50722	T1846	07/15/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	T1466	04/11/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	T907	01/23/2018
LISN	FISCHER	FCC-LISN-50/250-25-2-01	T1310	06/15/2018
EMI Receiver	Rohde & Schwarz	ESR-EMI	T1436	01/06/2018

Test Software List			
Description	Manufacturer	Model	Version
Radiated Software	UL	UL EMC	Ver 9.5, Apr 26, 2016
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015

## 7. APPLICABLE LIMITS AND TEST RESULTS

### 7.1. RADIATED EMISSIONS

#### LIMIT

§18.301 Operating frequencies

The EUT operates at 913 MHz, within the tolerance of the ISM Frequency of 915 +/- 13MHz.

§18.305 Field Strength Limits

§18.305 (b) The field strength levels of emissions which lie outside the bands specified in §18.301, unless otherwise indicated, shall not exceed the following:

Equipment	Operating frequency	RF Power generated by equipment (watts)	Field strength limit (uV/m)	Distance (meters)
Any type unless otherwise specified (miscellaneous)	Any ISM frequency	Below 500	25	300
		500 or more	$25 \times \text{SQRT}(\text{power}/500)$	<sup>1</sup> 300

<sup>1</sup>Field strength may not exceed 10µV/m at 1600 meters. Consumer equipment operating below 1000 MHz is not permitted the increase in field strength otherwise permitted here for power over 500 watts.

The RF Power generated by the equipment is below 500 W therefore the field strength limit is 25uV/m at 300 m.

#### TEST PROCEDURE

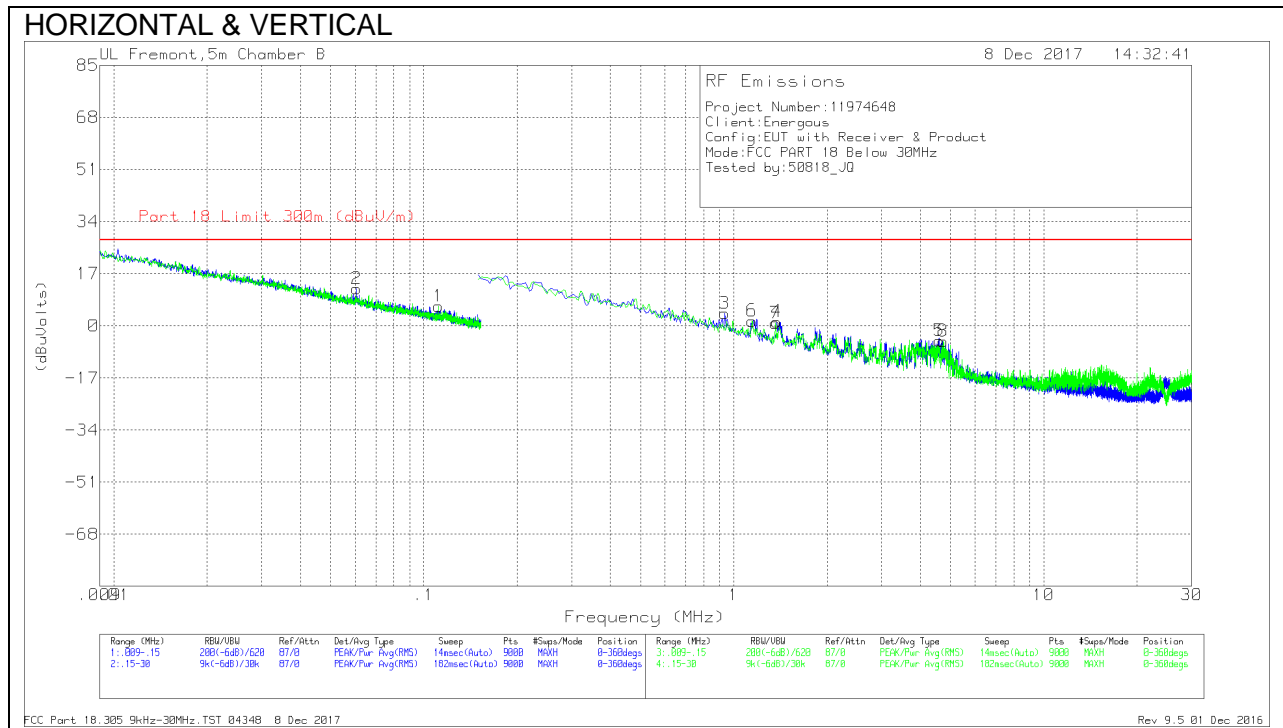
FCC / OST MP-5

The frequency range was investigated from 9 kHz to 10 GHz.

#### RESULTS

No non-compliance noted:

### 7.1.1. SPURIOUS EMISSIONS 9 kHz - 30 MHz



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

#### Trace Markers Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Part 18 Limit 300m (dBuV/m)	Margin (dB)	Azimuth (Degs)
2	.06073	39.59	Pk	11.1	1.4	-40	12.09	28	-15.91	0-360
1	.11153	34.04	Pk	10.9	1.4	-40	6.34	28	-21.66	0-360
3	.93613	31.8	Pk	10.7	1.5	-40	4	28	-24	0-360
6	1.14676	29.36	Pk	10.7	1.5	-40	1.56	28	-26.44	0-360
7	1.36402	28.61	Pk	10.7	1.5	-40	.81	28	-27.19	0-360
4	1.37397	29.17	Pk	10.7	1.5	-40	1.37	28	-26.63	0-360
5	4.59478	22.72	Pk	10.9	1.5	-40	-4.88	28	-32.88	0-360
8	4.73078	22.55	Pk	10.9	1.5	-40	-5.05	28	-33.05	0-360

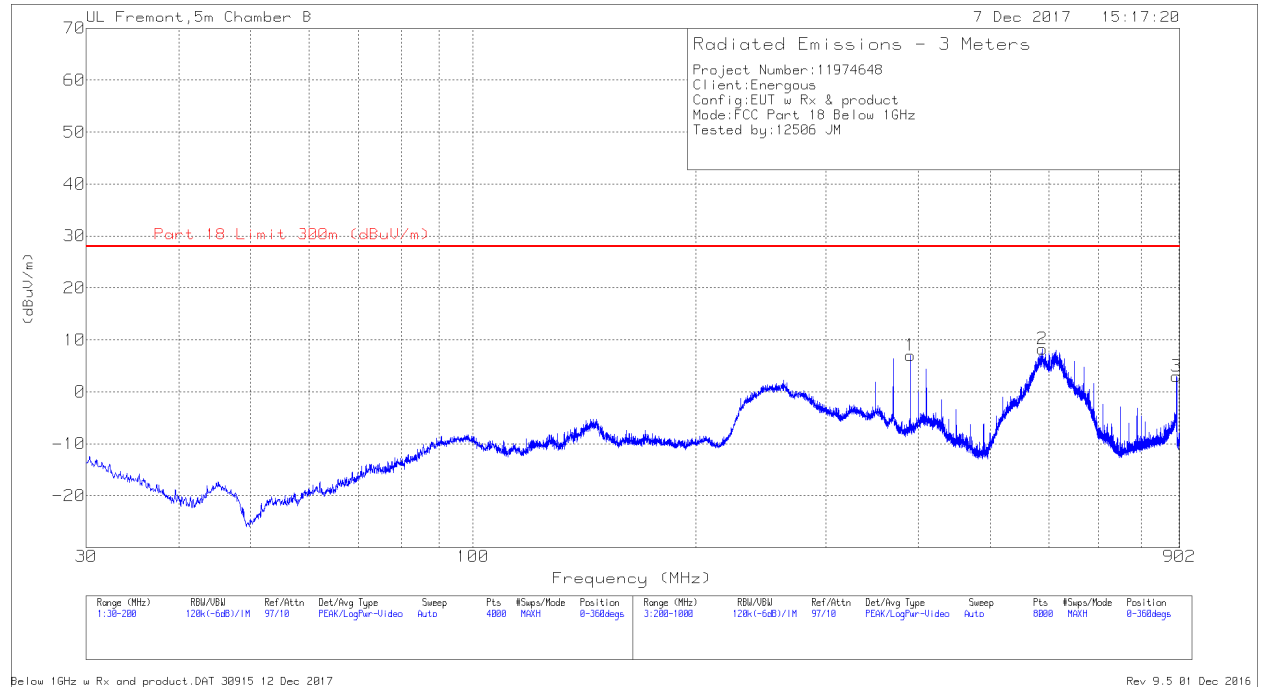
Pk - Peak detector

Note: Distance factor from 3m to 300m = 20log (3/300) = -40dB

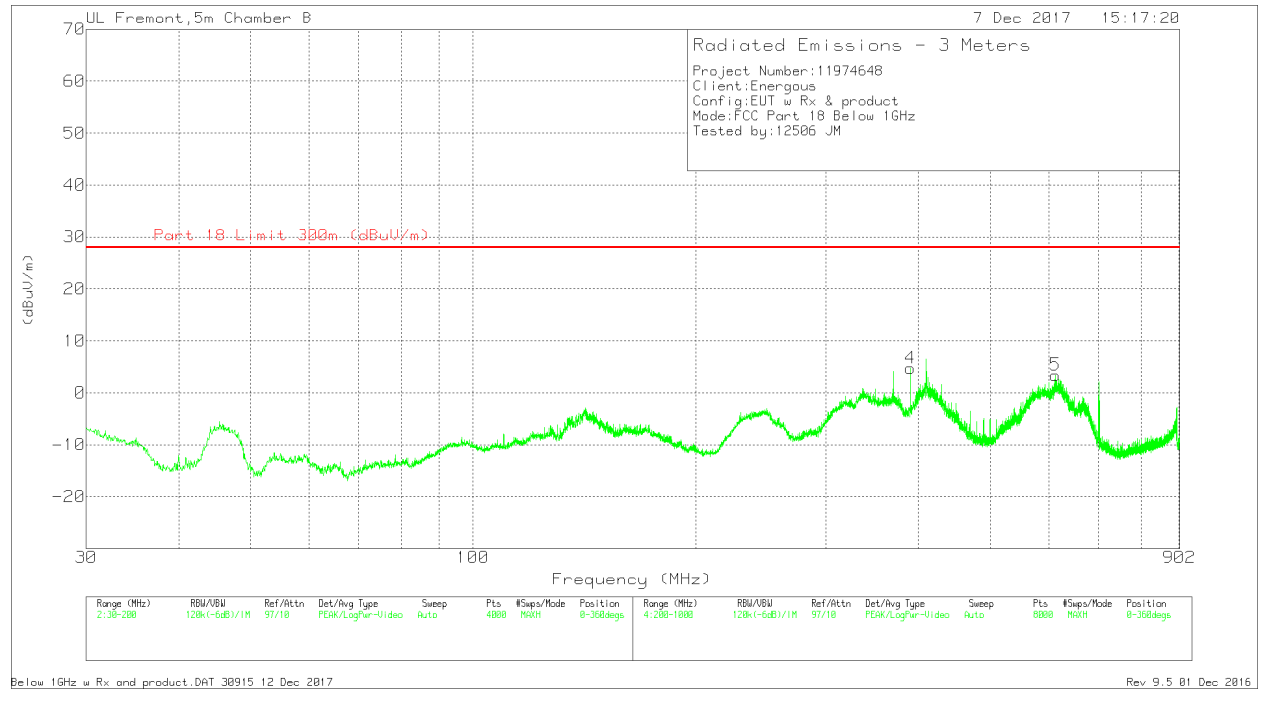
### 7.1.2. SPURIOUS EMISSIONS 30 - 1000 MHz

#### Spurious Emissions 30 – 1000 MHz With A Notch Filter

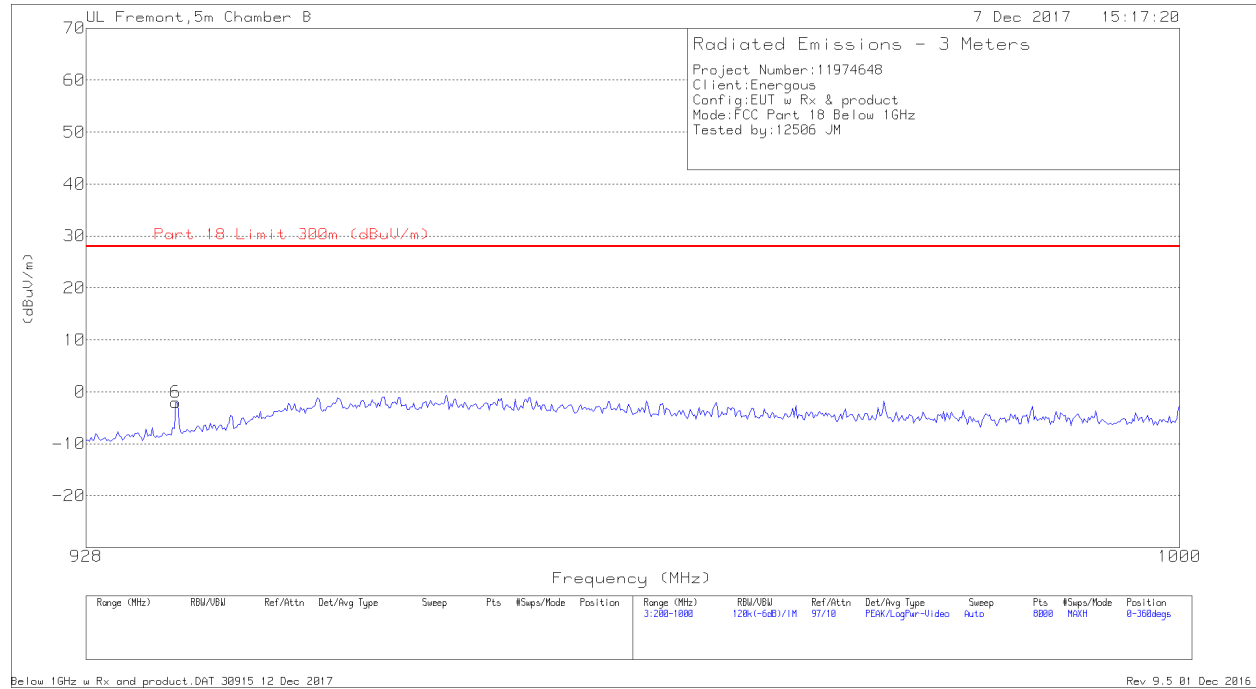
##### 30MHz – 902MHz HORIZONTAL



##### 30MHz – 902MHz VERTICAL



### 928MHz – 1000MHz HORIZONTAL



### 928MHz – 1000MHz VERTICAL



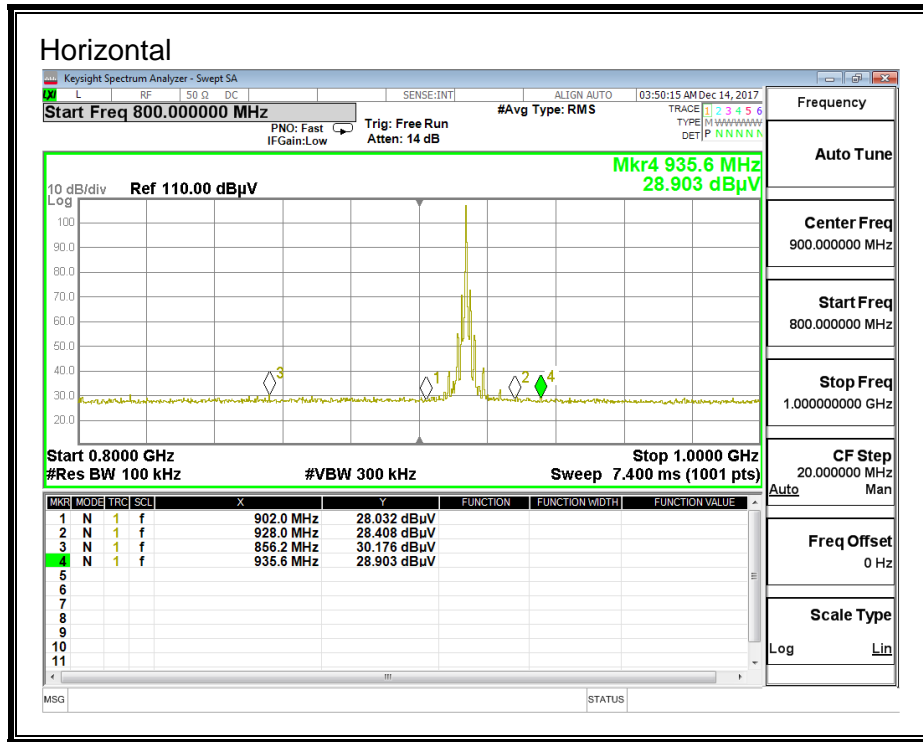
Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T899 (dB/m)	Amp/Cbl (dB)	Fitr (dB)	Dist Corr (dB)	Corrected Reading (dBuV/m)	Part 18 Limit 300m (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
5	612.9537	46.01	Pk	22.9	-25.5	.35	-40	3.76	28	-24.24	0-360	101	V
7	970.5002	30.89	Pk	26.7	-23.1	.45	-40	-5.06	28	-33.06	0-360	101	V
1	390.0247	53.71	Pk	19.2	-25.9	.23	-40	7.24	28	-20.76	0-360	200	H
4	390.0247	51.43	Pk	19.2	-25.9	.23	-40	4.96	28	-23.04	0-360	101	V
2	588.6505	51.55	Pk	22.3	-25.6	.32	-40	8.57	28	-19.43	0-360	101	H
3	893.6902	40.48	Pk	26	-23.5	4.0	-40	6.98	28	-21.02	0-360	101	H
6	933.6954	34.24	Pk	26.9	-23.2	10	-40	7.94	28	-20.06	0-360	200	H

Pk - Peak detector

Note: Distance factor from 3m to 300m =  $20\log(3/300) = -40\text{dB}$

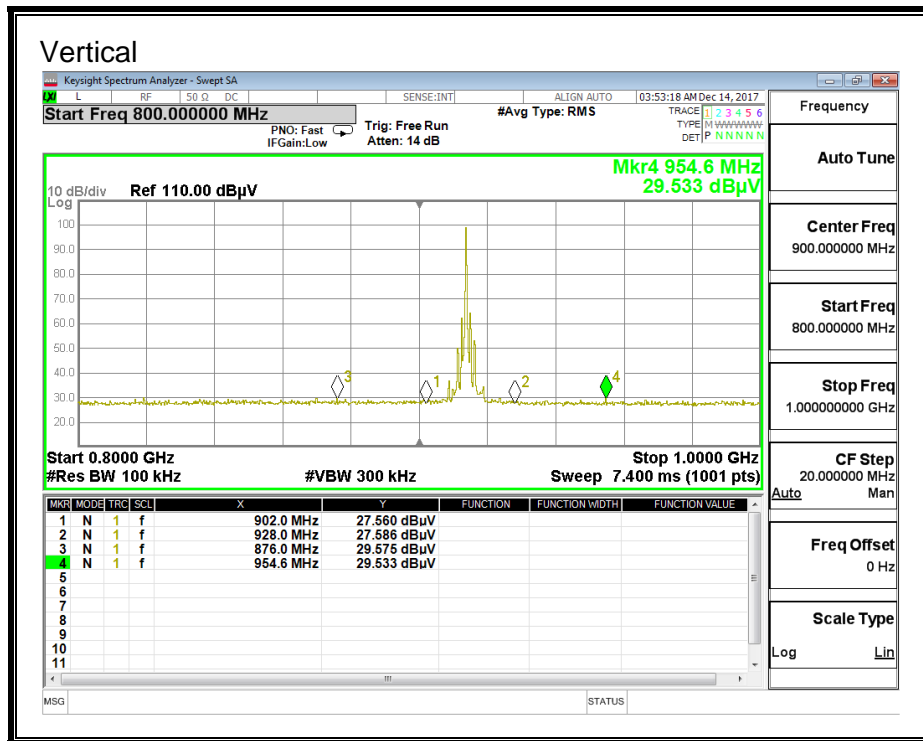
**Spurious Emissions 800 – 1000 MHz Without A Notch Filter**



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Dist Corr (dB)	Corrected Reading (dBuV/m)	FCC PART18 300m LIMIT (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	856.2	30.176	Pk	26.8	-40	16.976	28	-11.024	114	136	H
4	935.6	28.903	Pk	27.5	-40	16.403	28	-11.597	114	136	H

Note: Distance factor from 3m to 300m =  $20\log(3/300) = -40\text{dB}$



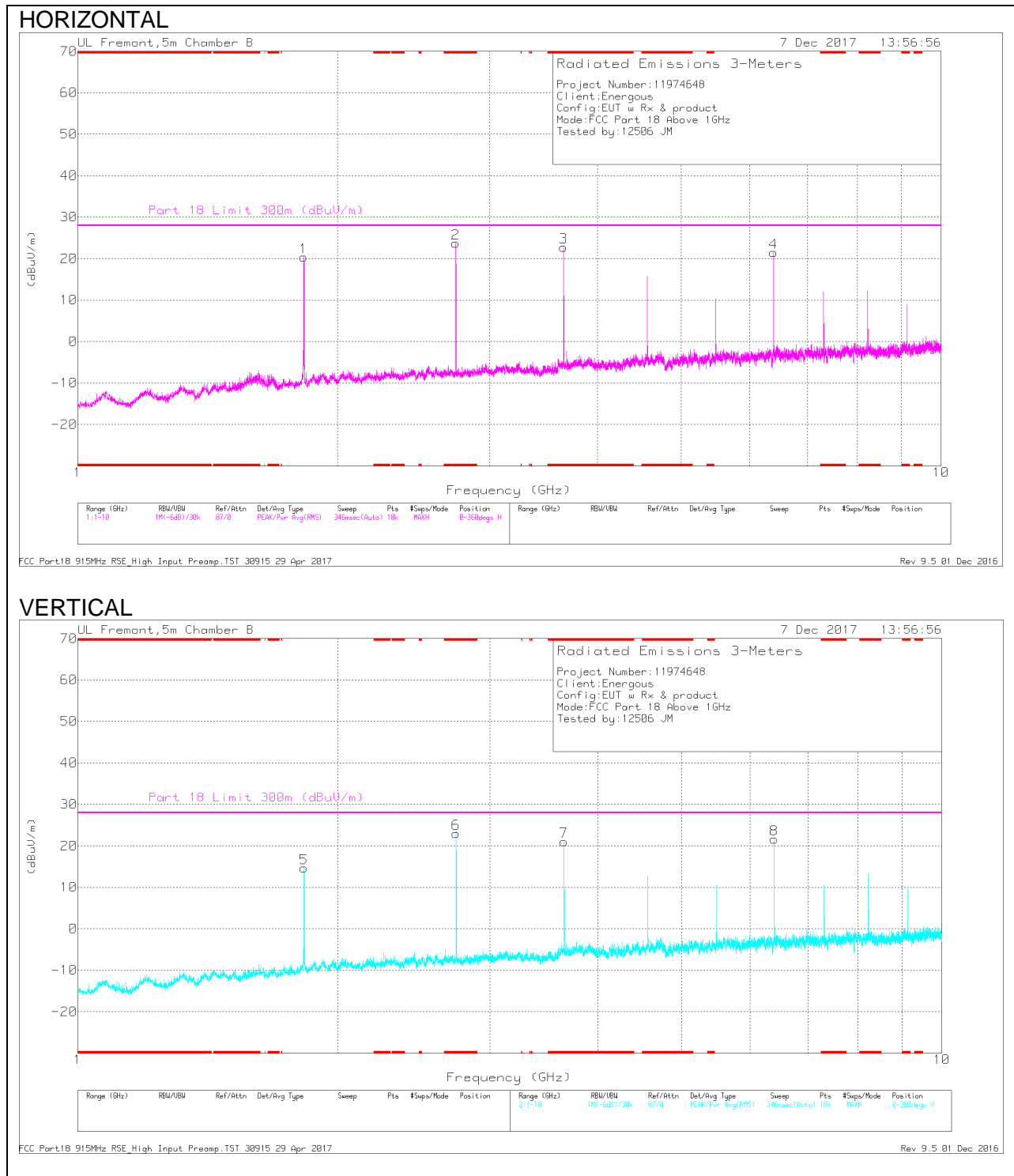


Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Dist Corr (dB)	Corrected Reading (dBuV/m)	FCC PART18 300m LIMIT (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	876.0	29.575	Pk	26.9	-40	16.475	28	-11.525	208	157	V
4	954.6	29.533	Pk	27.8	-40	17.333	28	-10.667	208	157	V

Note: Distance factor from 3m to 300m =  $20\log(3/300) = -40\text{dB}$

<b>TEST ENGINEER:</b>	43573	<b>Date:</b>	12/13/17	<b>Test Site:</b>	Chamber A
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### 7.1.3. SPURIOUS EMISSIONS 1 - 10 GHz



Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl (dB)	Fitr (dB)	Dist Corr (dB)	Corrected Reading (dBuV/m)	Part 18 Limit 300m (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.741	62.85	ADR	32.3	-32.2	.5	-40	23.45	28	-4.55	216	107	H
* 3.655	53.01	ADR	33.2	-31	.5	-40	15.71	28	-12.29	262	105	H
* 2.741	59.01	ADR	32.3	-32.2	.5	-40	19.61	28	-8.39	61	103	V
* 3.655	55.57	ADR	33.2	-31	.5	-40	18.27	28	-9.73	180	102	V
1.827	62.06	ADR	30.5	-33.2	.5	-40	19.86	28	-8.14	239	155	H
1.827	57.13	ADR	30.5	-33.2	.5	-40	14.93	28	-13.07	141	103	V
6.396	50.64	ADR	35.7	-29	.5	-40	17.84	28	-10.16	337	104	H
6.396	52.92	ADR	35.7	-29	.5	-40	20.12	28	-7.88	135	193	V

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

ADR - U-NII AD primary method, RMS average

Note:

For pre-scans 1 – 10 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 average measurements where the values are represented in the Radiated Emissions table.

Distance factor from 3m to 300m =  $20\log(3/300) = -40\text{dB}$

## 7.2. AC MAINS LINE CONDUCTED EMISSIONS

### LIMIT

§ 18.307 For the following equipment, when designed to be connected to the public utility (AC) power line the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies shall not exceed the limits in the following table. Compliance with the provisions of this paragraph shall be based on the measurements of the radio frequency voltage between each power line and ground at the power terminal using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN).

§ 18.307 (b) All other Part 18 consumer devices:

Frequency range (MHz)	Limits (dB $\mu$ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

\* Decreases with the logarithm of the frequency.

### TEST PROCEDURE

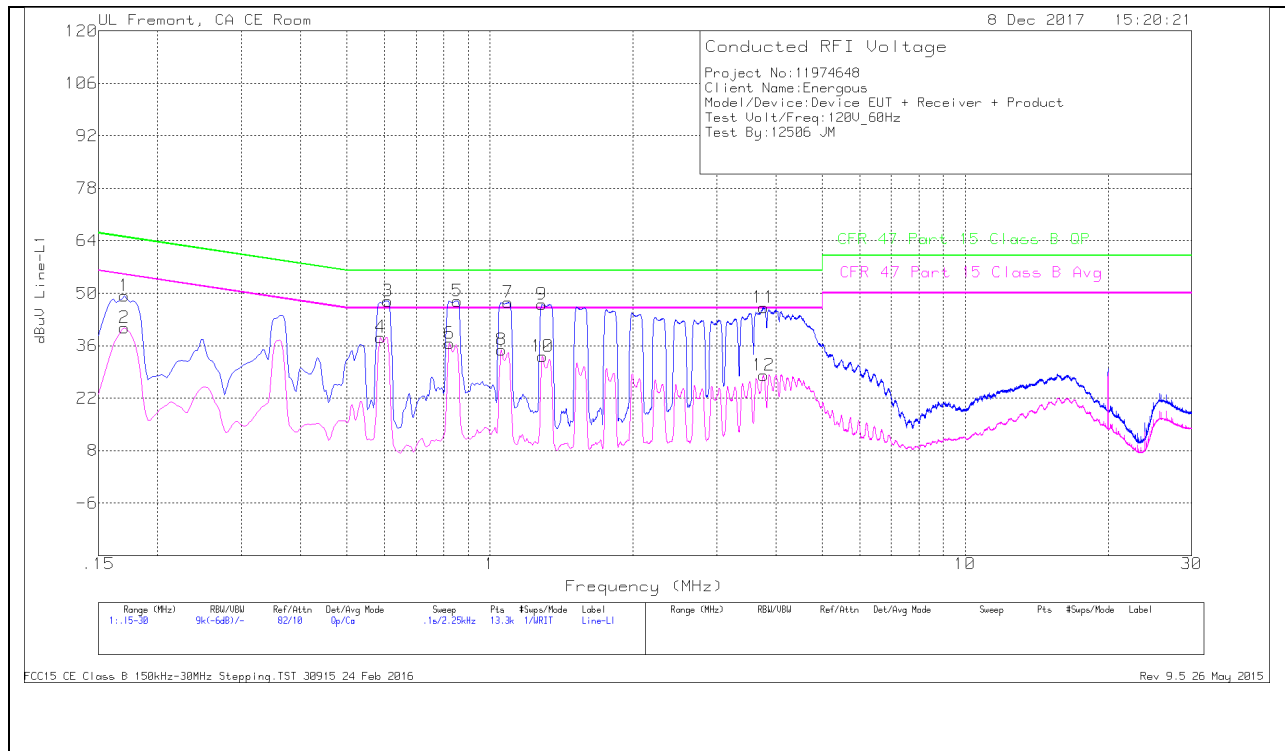
FCC / OST MP-5

### RESULTS

No non-compliance noted:

NOTE: AC conducted emissions for non-wireless charging of the MS-300a is covered under the associated Part 15.247 report for this product.

### LINE 1 PLOT



### LINE 1 RESULTS

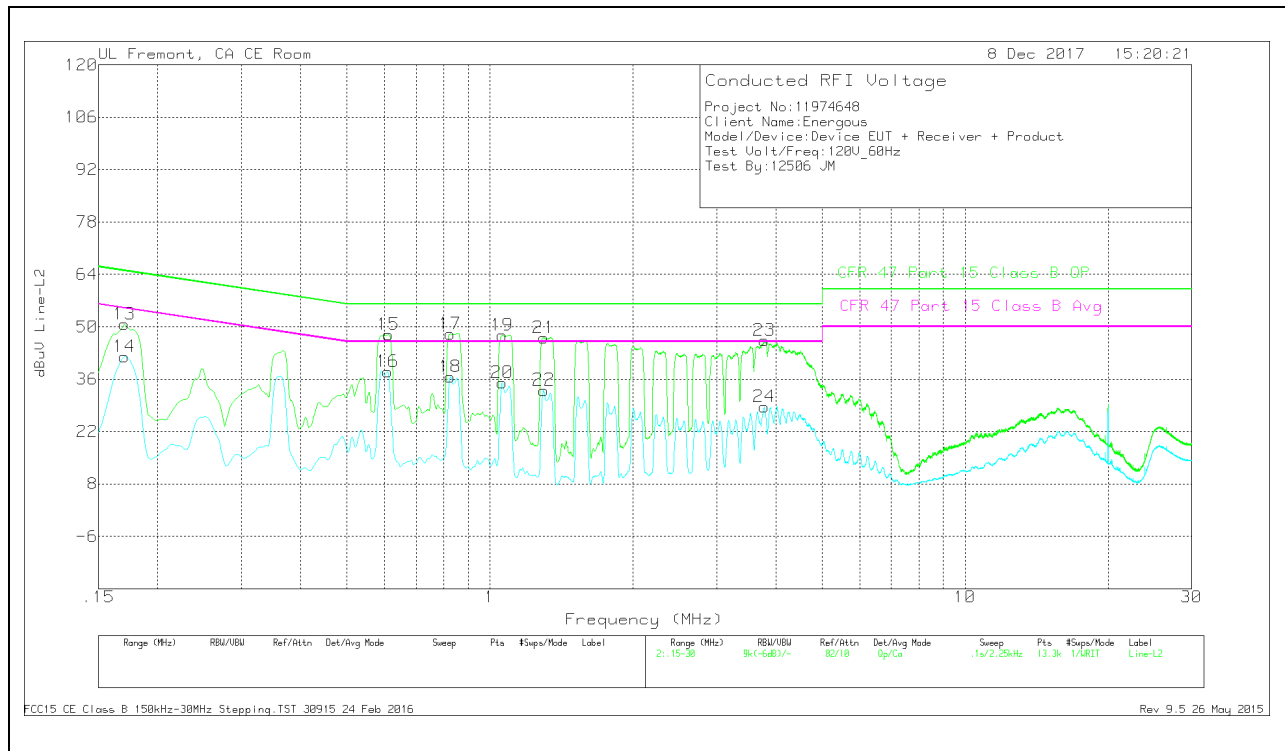
#### Trace Markers

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	.17025	39.2	Qp	0	0	10.1	49.3	64.95	-15.65	-	-
2	.17025	30.75	Ca	0	0	10.1	40.85	-	-	54.95	-14.1
3	.609	37.87	Qp	0	0	10.1	47.97	56	-8.03	-	-
4	.58875	28.16	Ca	0	0	10.1	38.26	-	-	46	-7.74
5	.85425	37.88	Qp	0	0	10.1	47.98	56	-8.02	-	-
6	.82275	26.48	Ca	0	0	10.1	36.58	-	-	46	-9.42
7	1.09275	37.3	Qp	0	.1	10.1	47.5	56	-8.5	-	-
8	1.05675	24.65	Ca	0	.1	10.1	34.85	-	-	46	-11.15
9	1.2885	36.81	Qp	0	.1	10.1	47.01	56	-8.99	-	-
10	1.29075	22.92	Ca	0	.1	10.1	33.12	-	-	46	-12.88
11	3.7635	35.85	Qp	0	.1	10.2	46.15	56	-9.85	-	-
12	3.7635	17.74	Ca	0	.1	10.2	28.04	-	-	46	-17.96

Qp - Quasi-Peak detector  
 Ca - CISPR average detection

### LINE 2 PLOT



### LINE 2 RESULTS

#### Trace Markers

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)
13	.17025	40.57	Qp	0	0	10.1	50.67	64.95	-14.28	-	-
14	.17025	31.97	Ca	0	0	10.1	42.07	-	-	54.95	-12.88
15	.61125	37.79	Qp	0	0	10.1	47.89	56	-8.11	-	-
16	.609	27.85	Ca	0	0	10.1	37.95	-	-	46	-8.05
17	.82612	37.97	Qp	0	0	10.1	48.07	56	-7.93	-	-
18	.825	26.58	Ca	0	0	10.1	36.68	-	-	46	-9.32
19	1.06125	37.53	Qp	0	.1	10.1	47.73	56	-8.27	-	-
20	1.06125	24.8	Ca	0	.1	10.1	35	-	-	46	-11
21	1.2975	36.91	Qp	0	.1	10.1	47.11	56	-8.89	-	-
22	1.2975	22.85	Ca	0	.1	10.1	33.05	-	-	46	-12.95
23	3.77925	36.05	Qp	0	.1	10.2	46.35	56	-9.65	-	-
24	3.77925	18.31	Ca	0	.1	10.2	28.61	-	-	46	-17.39

Qp - Quasi-Peak detector  
 Ca - CISPR average detection