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## FCC PART 15.249 TEST REPORT

### UNLICENSED INTENTIONAL RADIATOR

<b>Applicant</b>	ENO SCIENTIFIC LLC
<b>Address</b>	1606 FAUCETTE MILL ROAD HILLSBOROUGH NC 27278 USA
<b>FCC ID</b>	2ACL9WS310
<b>Model Number</b>	WELL WATCH 310
<b>Product Description</b>	WATER WELL LEVEL MONITOR
<b>FCC Standard Applied</b>	47 CFR §15.249
<b>Date Sample Received</b>	11/17/2014
<b>Date Tested</b>	12/2/2014
<b>Tested By</b>	Sid Sanders
<b>Approved By</b>	Cory Leverett
<b>Report Number</b>	2087AUT14TestReport.docx
<b>Test Results</b>	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL

<p>THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.</p>
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## GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

## Summary

The device under test does:

- ☒ fulfill the general approval requirements as identified in this test report  
☐ not fulfill the general approval requirements as identified in this test report

## Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025: 2005 requirements.

I attest that the necessary measurements were made, under my supervision, at:

Timco Engineering Inc.  
849 NW State Road 45  
Newberry, FL 32669

**Authorized Signatory Name:**



**Project Manager:**

**Date: 12/2/2014**

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## GENERAL INFORMATION

### EUT Specification

The test results relate only to the items tested.			
<b>Applicable Standard</b>	Part 15.249		
<b>EUT Description</b>	WATER WELL LEVEL MONITOR		
<b>FCC ID</b>	2ACL9WS310		
<b>Model Number</b>	WELL WATCH 310		
<b>Operating Frequency</b>	TX: 2405-2480.7MHz	RX: Same	
<b>Test Frequencies</b>	2405.0, 2440.7, 2480.7MHz		
<b>EUT Power Source</b>	<input checked="" type="checkbox"/> 110–120Vac/50– 60Hz		
	<input type="checkbox"/> DC Power		
	<input type="checkbox"/> Battery Operated Exclusively		
<b>Test Item</b>	<input type="checkbox"/> Prototype	<input checked="" type="checkbox"/> Pre-Production	<input type="checkbox"/> Production
<b>Type of Equipment</b>	<input type="checkbox"/> Fixed	<input type="checkbox"/> Mobile	<input type="checkbox"/> Portable
<b>Antenna Connector</b>	FCC Rules require that the antenna connector be unique.		
<b>Test Facility</b>	Timco Engineering Inc. located at 849 NW State Road 45 Newberry, FL 32669 USA.		
<b>Conditions in the Test laboratory</b>	Temperature: 24-26°C Relative humidity: 50-65%		
<b>Test Exercise</b>	The TEST SW allowed the EUT was placed in either CW or Data transmission mode of operation.		
<b>Revision History of EUT</b>	New		

### Test Supporting Equipment

Supporting Device	Manufacturer	Model / FCC ID	Serial Number
N/A			

### TEST RESULTS SUMMARY

Specification – Rules Part No.	RESULTS – Pass/Fail/NA
FCC Rule 15.249 Fundamental	PASS
FCC Rule 15.249 Harmonics & Spurious	PASS
Occupied Bandwidth	PASS
Bandedge	PASS
Power Line Emissions 15.207	PASS

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## TEST PROCEDURES

**Radiation Interference:** ANSI C63.4-2003 using a spectrum analyzer, a preselector, a quasi-peak adapter, and an appropriate antenna. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The resolution bandwidth was 100 kHz with an appropriate sweep speed and the video bandwidth was 300 kHz up to 1 GHz and 1 MHz with a video BW of 3 MHz above 1 GHz. When an emission was found, the table was rotated to produce the maximum signal strength. The antenna was placed in both the horizontal and vertical planes and the worst case emissions were reported. The spectrum was searched to at least the tenth (10) harmonic of the fundamental.

**Formula Of Conversion Factors:** The field strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dBuV) to the antenna correction factor supplied by the antenna manufacturer. The antenna correction factors are stated in terms of dB. The gain of the preselector was accounted for in the spectrum analyzer meter reading.

Example:

Freq (MHz)	Meter Reading	+ ACF	+ CL	= FS
33	20 dBuV	+ 10.36 dB	+ 0.5	= 30.86 dBuV/m @ 3m

**Power Line Conducted Interference:** The procedure used was ANSI C63.4-2003 using a 50uH LISN. Both lines were observed. The bandwidth of the spectrum analyzer was 10kHz with an appropriate sweep speed. The spectrum was scanned from 0.15 to 30 MHz.

**Occupied Bandwidth:** A small sample of the transmitter output was fed into the spectrum analyzer and the attached plot was printed. The vertical scale is set to -10 dBm per division.

**ANSI C63.4-2003 10.1 Measurement Procedures:** The EUT was placed on a table 80 cm high and with dimensions of 1m by 1.5m. The EUT was placed in the center of the table (1.5m side). The table used for radiated measurements is capable of continuous rotation.

When an emission was found, the table was rotated to produce the maximum signal strength. At this point, the antenna was raised and lowered from 1m to 4m. The antenna was placed in both the horizontal and vertical planes. Emissions attenuated more than 20 dB below the permissible value are not reported.

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## RADIATION INTERFERENCE

Rules Part No.: 15.249, 15.209

### Requirements:

Frequency	Limits
Part 15.209	
9 to 490 kHz	2400/F (kHz) $\mu\text{V/m}$ @ 300 meters
490 to 1705 kHz	24000/F (kHz) $\mu\text{V/m}$ @ 30 meters
1705 kHz to 30 MHz	29.54 dB $\mu\text{V/m}$ @ 30 meters
30 – 88	40.0 dB $\mu\text{V/m}$ @ 3 meters
80 – 216	43.5 dB $\mu\text{V/m}$ @ 3 meters
216 – 960	46.0 dB $\mu\text{V/m}$ @ 3 meters
Above 960	54.0 dB $\mu\text{V/m}$ @ 3 meters
Part 15.249	
Fundamental 902 – 928 MHz	94.0 dB $\mu\text{V/m}$ @ 3 meters
Fundamental 2.4 – 2.4835 GHz	94.0 dB $\mu\text{V/m}$ @ 3 meters
Harmonics	54.0 dB $\mu\text{V/m}$ @ 3 meters

Tuned Freq. MHz	Emission Frequency MHz	Meter Reading dBuV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBuV/m	Margin dB
2,405.0	2,405.00	41.9	V	3.18	32.49	77.57	16.43
2,405.0	2,405.00	42.5	H	3.18	32.49	78.17	15.83
2,405.0	4,810.00	-12.9	H	4.91	34.10	26.11	27.90
2,405.0	4,810.00	-11.0	V	4.91	34.10	28.01	26.00
2,405.0	7,215.00	-12.4	V	5.73	35.81	29.14	24.86
2,405.0	7,215.00	-9.6	H	5.73	35.81	31.94	22.06
2,405.0	9,620.00	-12.1	V	6.79	36.77	31.46	22.54
2,405.0	9,620.00	-9.9	H	6.79	36.77	33.66	20.34
2,405.0	12,025.00	-13.0	H	7.82	39.12	33.94	20.06
2,405.0	12,025.00	-11.9	V	7.82	39.12	35.04	18.96
2,405.0	12,025.00	-11.9	V	7.82	39.12	35.04	18.96
2,405.0	14,430.00	-8.9	H	9.07	39.86	40.03	13.97
2,405.0	14,430.00	-8.8	V	9.07	39.86	40.13	13.87
2,405.0	16,835.00	-11.2	H	10.20	41.27	40.27	13.73
2,405.0	16,835.00	-10.0	V	10.20	41.27	41.47	12.53

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## RADIATION INTERFERENCE

Rules Part No.: 15.249, 15.209

Tuned Freq. MHz	Emission Frequency MHz	Meter Reading dBuV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBuV/m	Margin dB
2,440.7	2,440.70	29.7	V	3.21	32.57	65.48	28.52
2,440.7	2,440.70	31.3	H	3.21	32.57	67.08	26.92
2,440.7	4,881.40	-4.7	H	4.94	34.10	34.34	19.66
2,440.7	4,881.40	-4.6	V	4.94	34.10	34.44	19.56
2,440.7	7,322.10	-8.9	V	5.79	35.77	32.66	21.34
2,440.7	7,322.10	-8.5	H	5.79	35.77	33.06	20.94
2,440.7	9,762.80	-5.3	H	6.83	36.97	38.50	15.50
2,440.7	9,762.80	-5.3	V	6.83	36.97	38.50	15.50
2,440.7	12,203.50	-1.6	H	7.94	39.22	45.56	8.44
2,440.7	12,203.50	-1.5	V	7.94	39.22	45.66	8.34
2,440.7	14,644.30	-1.6	H	9.16	40.00	47.56	6.44
2,440.7	14,644.30	-1.4	V	9.16	40.00	47.76	6.24
2,440.7	17,085.00	-0.6	V	10.33	41.18	50.91	3.09
2,440.7	17,085.00	-0.4	H	10.33	41.18	51.11	2.89
2,480.7	2,480.70	43.4	V	3.24	32.66	79.30	14.70
2,480.7	2,480.70	44.2	H	3.24	32.66	80.10	13.90
2,480.7	4,961.40	-0.6	H	4.98	34.10	38.48	15.52
2,480.7	4,961.40	-0.5	V	4.98	34.10	38.58	15.42
2,480.7	7,442.10	-5.9	H	5.87	35.72	35.69	18.31
2,480.7	7,442.10	-5.5	V	5.87	35.72	36.09	17.91
2,480.7	9,922.80	-4.6	V	6.88	37.19	39.47	14.53
2,480.7	9,922.80	-4.4	H	6.88	37.19	39.67	14.33
2,480.7	12,403.50	1.4	V	8.08	39.34	48.82	5.18
2,480.7	12,403.50	1.6	H	8.08	39.34	49.02	4.98
2,480.7	14,884.20	-3.0	H	9.25	40.00	46.25	7.75
2,480.7	14,884.20	-3.0	V	9.25	40.00	46.25	7.75
2,480.7	17,364.90	-3.0	V	10.41	41.13	48.54	5.46
2,480.7	17,364.90	-2.9	H	10.41	41.13	48.64	5.36

## RESULTS: MEETS REQUIREMENTS

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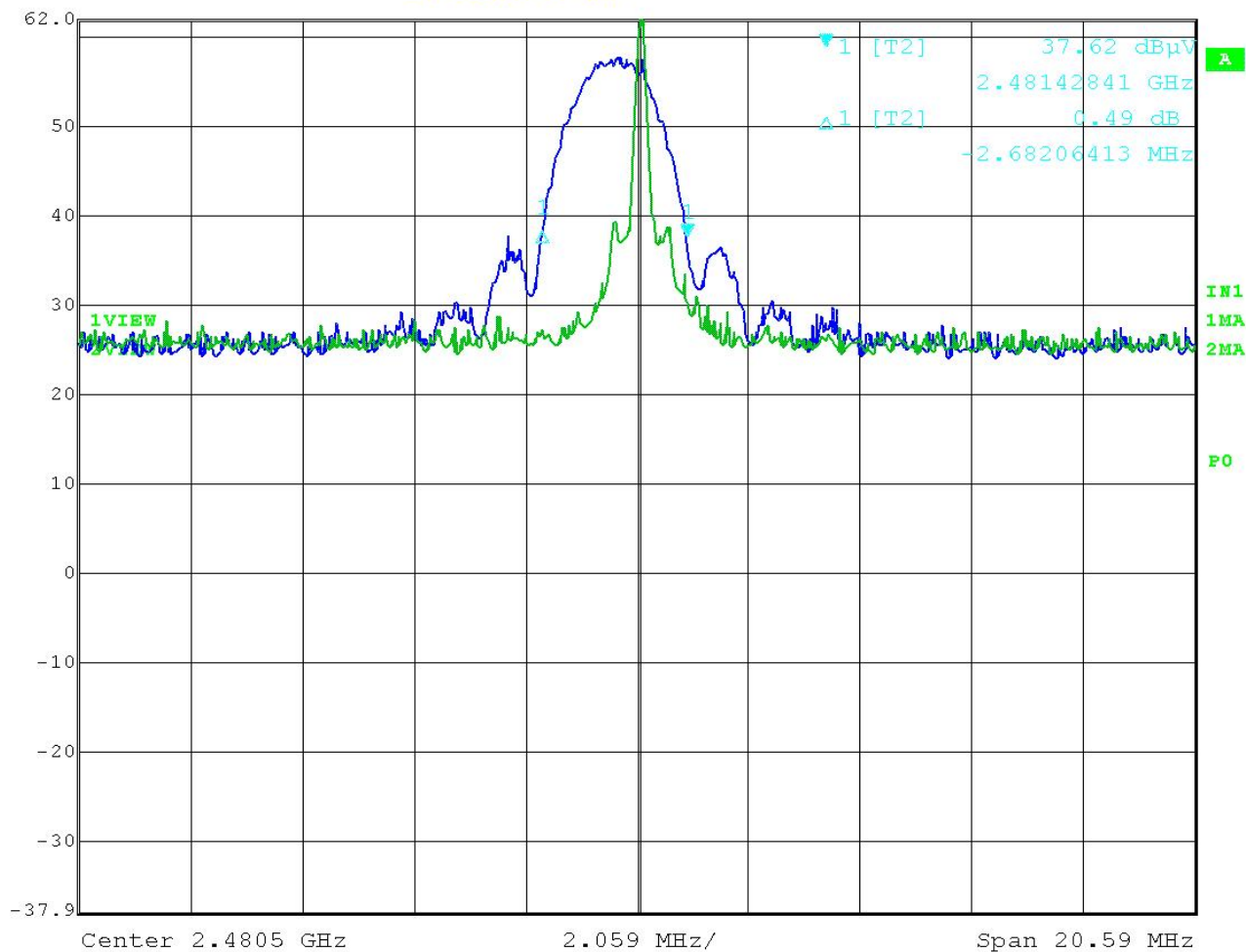
## OCCUPIED BANDWIDTH & Bandedge:

Rules Part No.: 15.249 (d)

**Requirements:** The field strength of any emissions appearing outside the bandedges and up to 10 kHz above and below the band edges shall be attenuated at least 50 dB below the level of the carrier or to the general limits of 15.249.

### Test Data:

	Marker 1 [T2]	RBW	100 kHz	RF Att	10 dB
Ref Lvl	37.62 dBμV	VBW	100 kHz		
62.1 dBμV	2.48142841 GHz	SWT	5.5 ms	Unit	dBμV



Date: 2.DEC.2014 16:44:07

**Results: 20dB Bandwidth is 2.68MHz**

**Results: Meets Requirement**

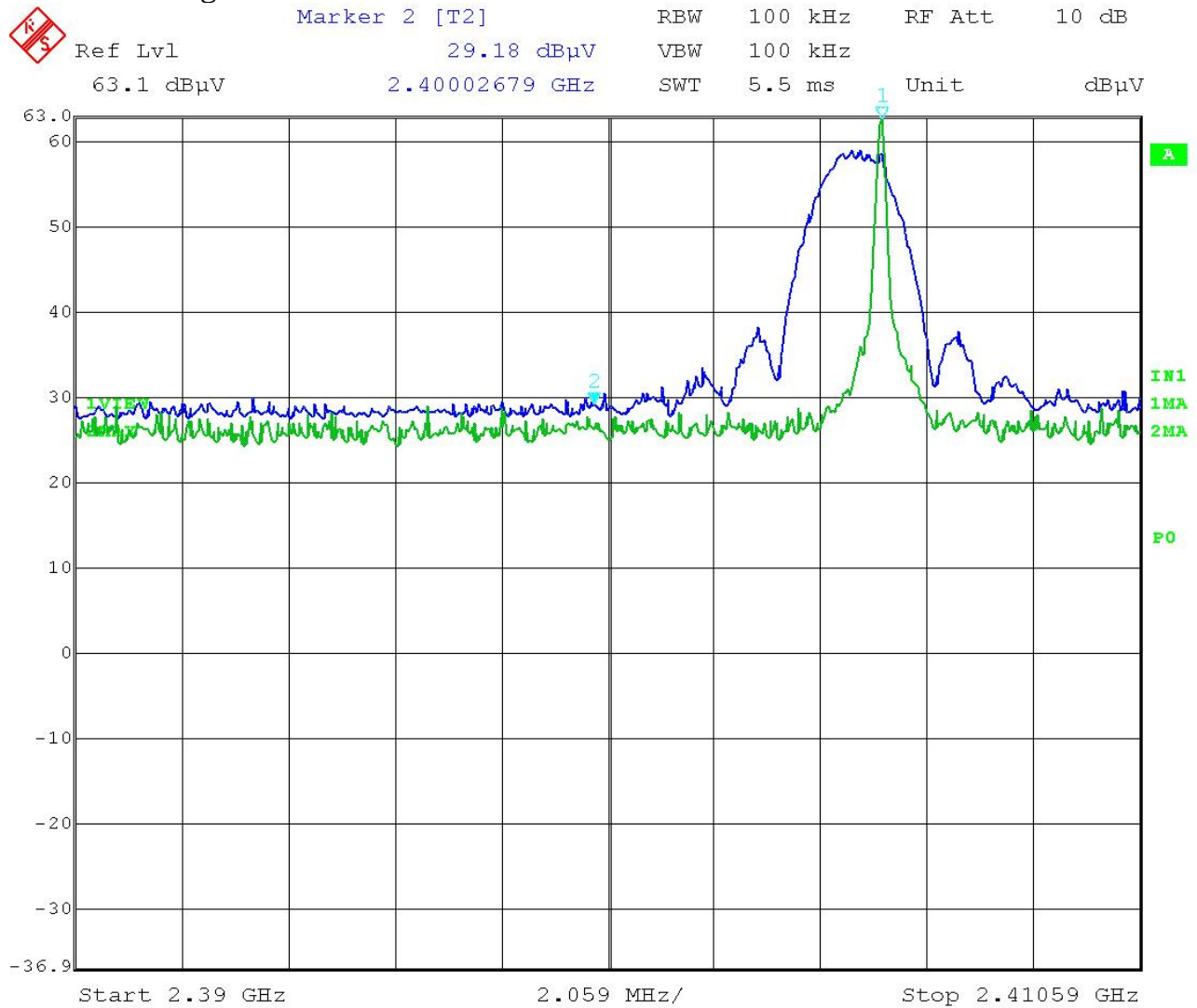
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## OCCUPIED BANDWIDTH & Bandedge:

### Lower Bandedge:



Date: 2.DEC.2014 16:26:40

**Results: The level at 2400MHz was 46.57dBuV/m and meets the Requirements.**

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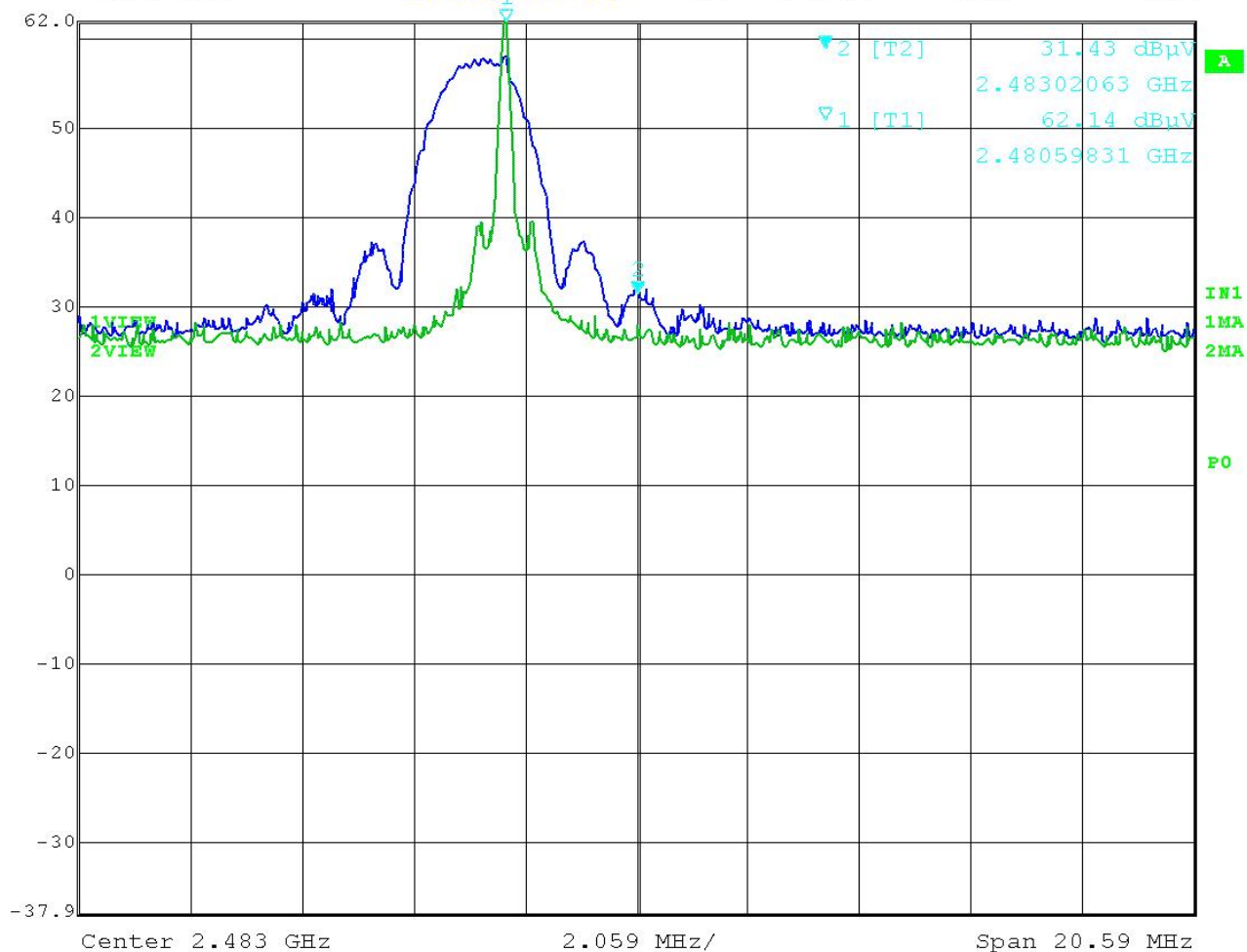
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## OCCUPIED BANDWIDTH & Bandedge:

### Upper Bandedge:


 Marker 2 [T2] RBW 100 kHz RF Att 10 dB  
 Ref Lvl 31.43 dBμV VBW 100 kHz  
 62.1 dBμV 2.48302063 GHz SWT 5.5 ms Unit dBμV



Date: 2.DEC.2014 16:34:53

**Requirement at 2483.5MHz is 54dBuV/m**

**Results: Meets requirements,  $80.1 - 30.0 = 50.1\text{dBuV/m}$ .**

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## POWER LINE CONDUCTED INTERFERENCE

**Rules Part No.:** 15.207

**Requirements:**

Frequency (MHz)	Quasi Peak Limits (dBuV)	Average Limits (dBuV)
0.15 – 0.5	66 – 56	56 – 46
0.5 – 5.0	56	46
5.0 – 30	60	50

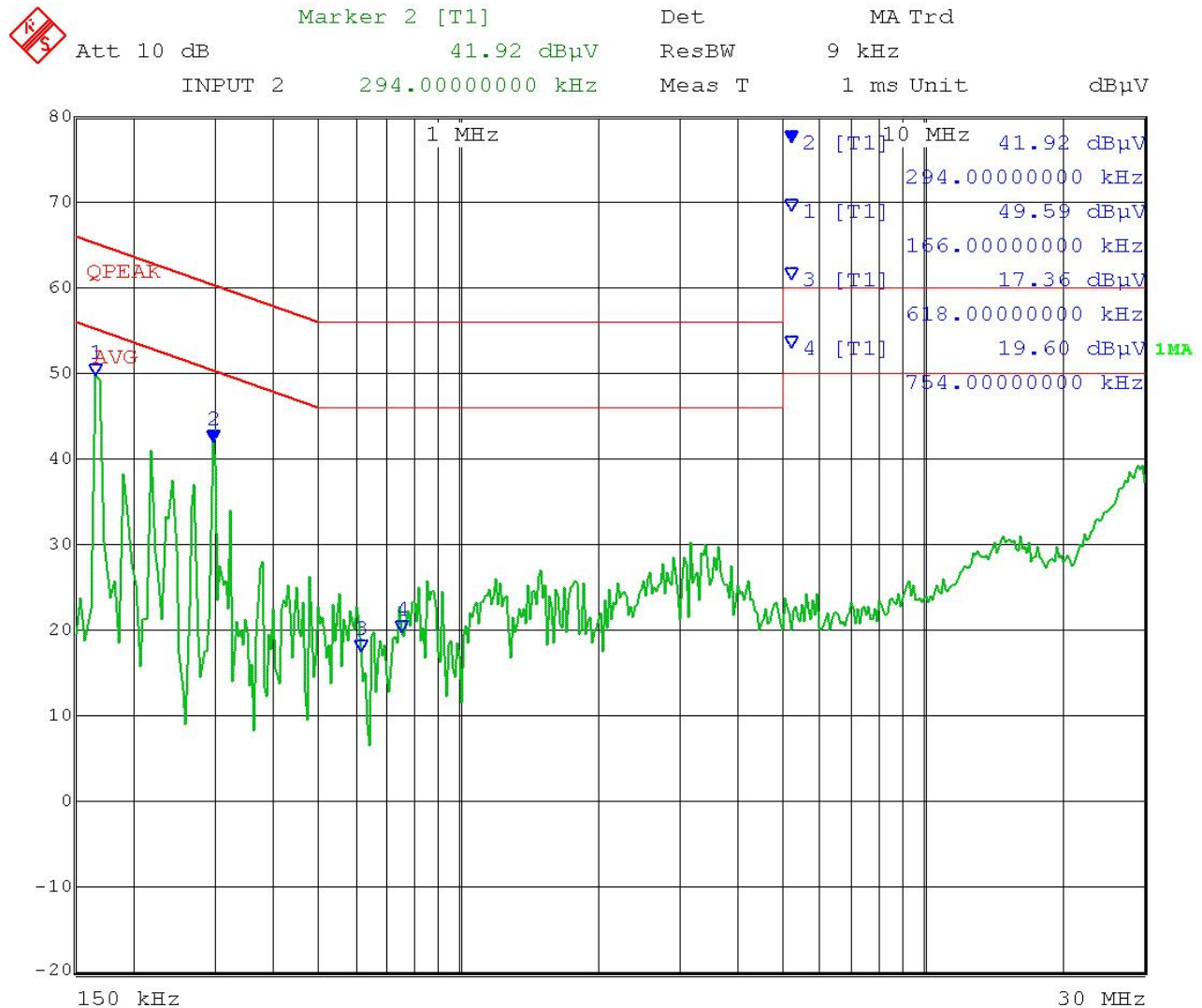
**Test Data:** The attached graphs represent the emissions read for power line conducted for this device. Both lines were observed.

**Rules Part No.:** See Plots below.

# POWER LINE CONDUCTED INTERFERENCE

Rules Part No.: 15.207

## POWERLINE CONDUCTED PLOT - LINE 1



Date: 1.DEC.2014 15:54:53

APPLICANT: ENO SCIENTIFIC LLC

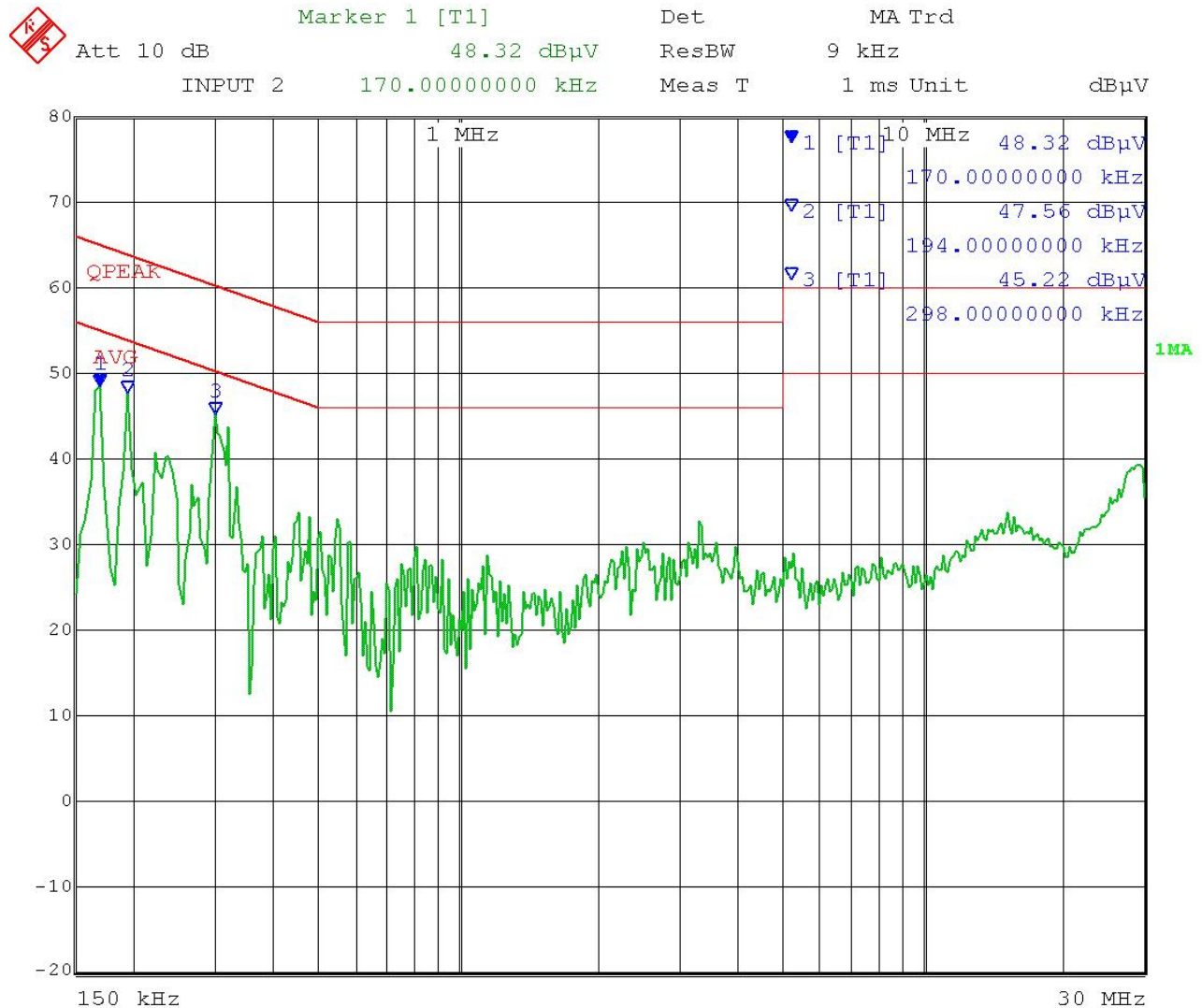
FCC ID: 2ACL9WS310

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## POWER LINE CONDUCTED INTERFERENCE

Rules Part No.: 15.207 Neutral

### POWERLINE CONDUCTED PLOT - LINE 2



Date: 1.DEC.2014 16:00:11

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## EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Antenna: Biconnical Chamber	Eaton Chamber	94455-1	1057	06/14/13	06/14/15
Antenna: Log-Periodic Chamber	Eaton	96005	1243	05/31/13	05/31/15
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	12/31/13	12/31/15
Antenna: Double-Ridged Horn/ETS Horn 1	ETS-Lindgren Chamber	3117	00035923	06/13/14	06/13/16
EMI Test Receiver R & S ESIB 40 Screen Room	Rohde & Schwarz	ESIB 40	100274	08/12/14	08/12/16

### \*EMI RECEIVER SOFTWARE VERSION

\*EMI Test Receiver Firmware Version: 4.73 Service Pack 1

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