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FCC PART 15.249 TEST REPORT

UNLICENSED INTENTIONAL RADIATOR

Applicant	ENO SCIENTIFIC LLC
Address	1606 FAUCETTE MILL ROAD
	HILLSBOROUGH NC 27278 USA
FCC ID	2ACL9WS600A
Model Number	WELL WATCH 600
Product Description	ZIGBEE TRANSMITTER
FCC Standard Applied	47 CFR §15.249
Date Sample Received	6/23/2014
Date Tested	6/27/2014
Tested By	Jian Huang
Approved By	Sid Sanders
Report Number	1065AUT14TestReport.docx
Test Results	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL
WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.

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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: _____

Jian Huang
Project Manager

Date: 2 July 2014

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GENERAL INFORMATION

EUT Specification

The test results relate only to the items tested.			
Applicable Standard	Part 15.249		
EUT Description	ZIGBEE TRANSMITTER		
FCC ID	2ACL9WS600A		
Model Number	WELL WATCH 600		
Operating Frequency	TX: 2405-2483 MHZ	RX: Same	
No. of Channels	15		
Modulations	None		
EUT Power Source	<input checked="" type="checkbox"/> 110–120Vac/50– 60Hz		
	<input type="checkbox"/> DC Power		
	<input type="checkbox"/> Battery Operated Exclusively		
Test Item	<input type="checkbox"/> Prototype	<input checked="" type="checkbox"/> Pre-Production	<input type="checkbox"/> Production
Type of Equipment	<input type="checkbox"/> Fixed	<input type="checkbox"/> Mobile	<input checked="" type="checkbox"/> Portable
Antenna Connector	Antenna if permanent Attached		
Test Facility	Timco Engineering Inc. located at 849 NW State Road 45 Newberry, FL 32669 USA.		
Conditions in the Test laboratory	Temperature: 26°C		
	Relative humidity: 50%		
Test Exercise	The EUT was placed in continuous transmit mode of operation.		
Revision History of EUT	None		

Test Supporting Equipment

Supporting Device	Manufacturer	Model / FCC ID	Serial Number
None			

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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.

TEST RESULTS SUMMARY

Specification	RESULTS
FCC Rules Part.	Pass/Fail/NA
FCC Rule 15.249 Fundamental	Pass
FCC Rule 15.249 Harmonics & Spurious	Pass
Bandedge	Pass
Power Line Emissions 15.207	Pass

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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

Test Data:

Tuned Frequency 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	42.3	V	3.18	32.49	77.97	16.03
2,405.0	2,405.00	49.6	H	3.18	32.49	85.27	8.73
2,405.0	4,810.00	5.9	H	4.91	34.10	44.91	9.10
2,405.0	4,810.00	7.1	V	4.91	34.10	46.11	7.90
2,405.0	7,215.00	4.8	H	5.73	35.81	46.34	7.66
2,405.0	7,215.00	5.9	V	5.73	35.81	47.44	6.56
2,405.0	9,620.00	4.0	V	6.79	36.77	47.56	6.44
2,405.0	9,620.00	5.0	H	6.79	36.77	48.56	5.44
2,440.0	2,440.00	43.6	V	3.21	32.57	79.38	14.62
2,440.0	2,440.00	47.3	H	3.21	32.57	83.08	10.92
2,440.0	4,880.00	5.3	V	4.94	34.10	44.34	9.66
2,440.0	4,880.00	5.5	H	4.94	34.10	44.54	9.46
2,440.0	7,320.00	5.5	V	5.79	35.77	47.06	6.94
2,440.0	7,320.00	6.0	H	5.79	35.77	47.56	6.44
2,440.0	9,760.00	3.9	H	6.83	36.96	47.69	6.31
2,440.0	9,760.00	3.9	V	6.83	36.96	47.69	6.31
2,480.0	2,480.00	46.6	H	3.24	32.66	82.50	11.50
2,480.0	2,480.00	46.8	V	3.24	32.66	82.70	11.30
2,480.0	4,960.00	5.1	V	4.98	34.10	44.18	9.82
2,480.0	4,960.00	5.8	H	4.98	34.10	44.88	9.12
2,480.0	7,440.00	5.4	V	5.86	35.72	46.98	7.02
2,480.0	7,440.00	6.5	H	5.86	35.72	48.08	5.92
2,480.0	9,920.00	2.4	V	6.88	37.19	46.47	7.53
2,480.0	9,920.00	3.9	H	6.88	37.19	47.97	6.03

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Results: Meets Requirements

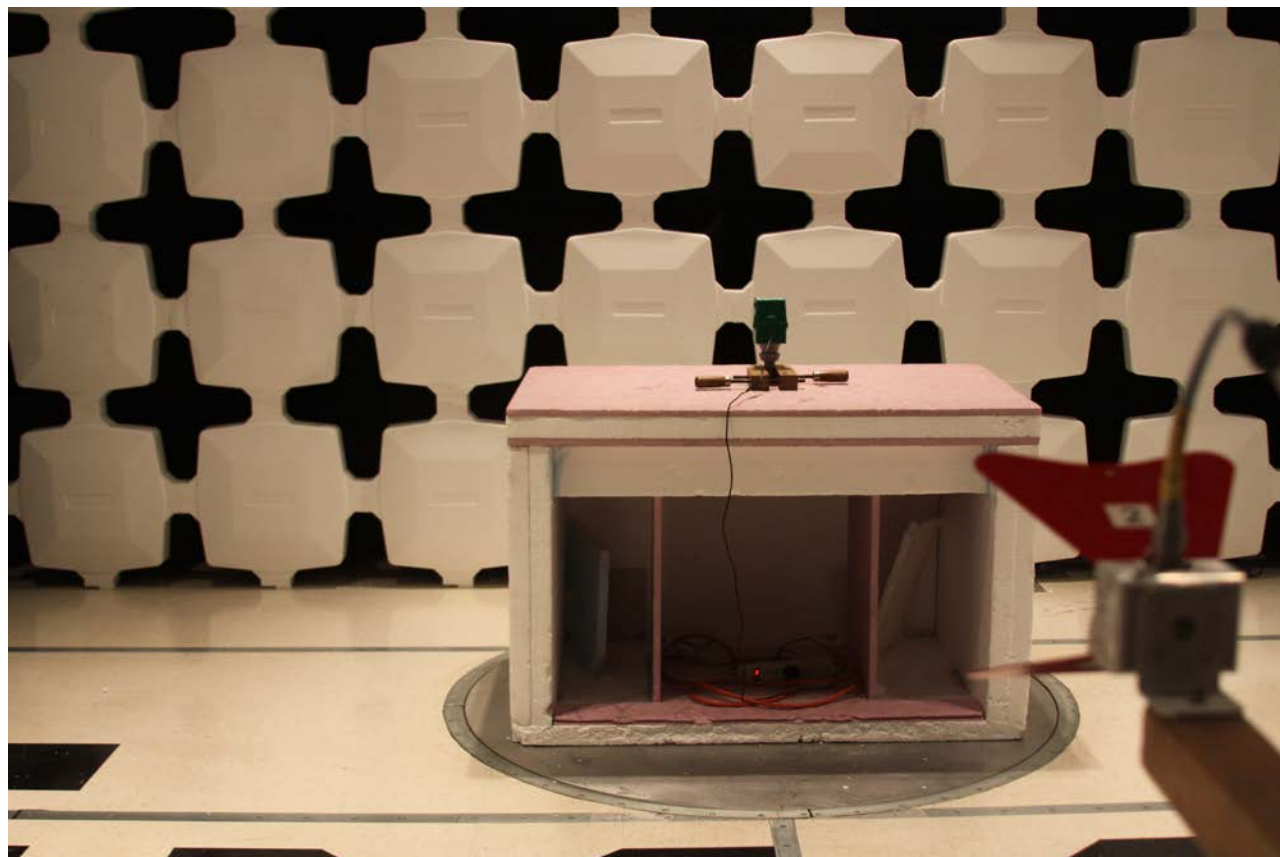
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RADIATION INTERFERENCE TEST SET-UP PHOTOS



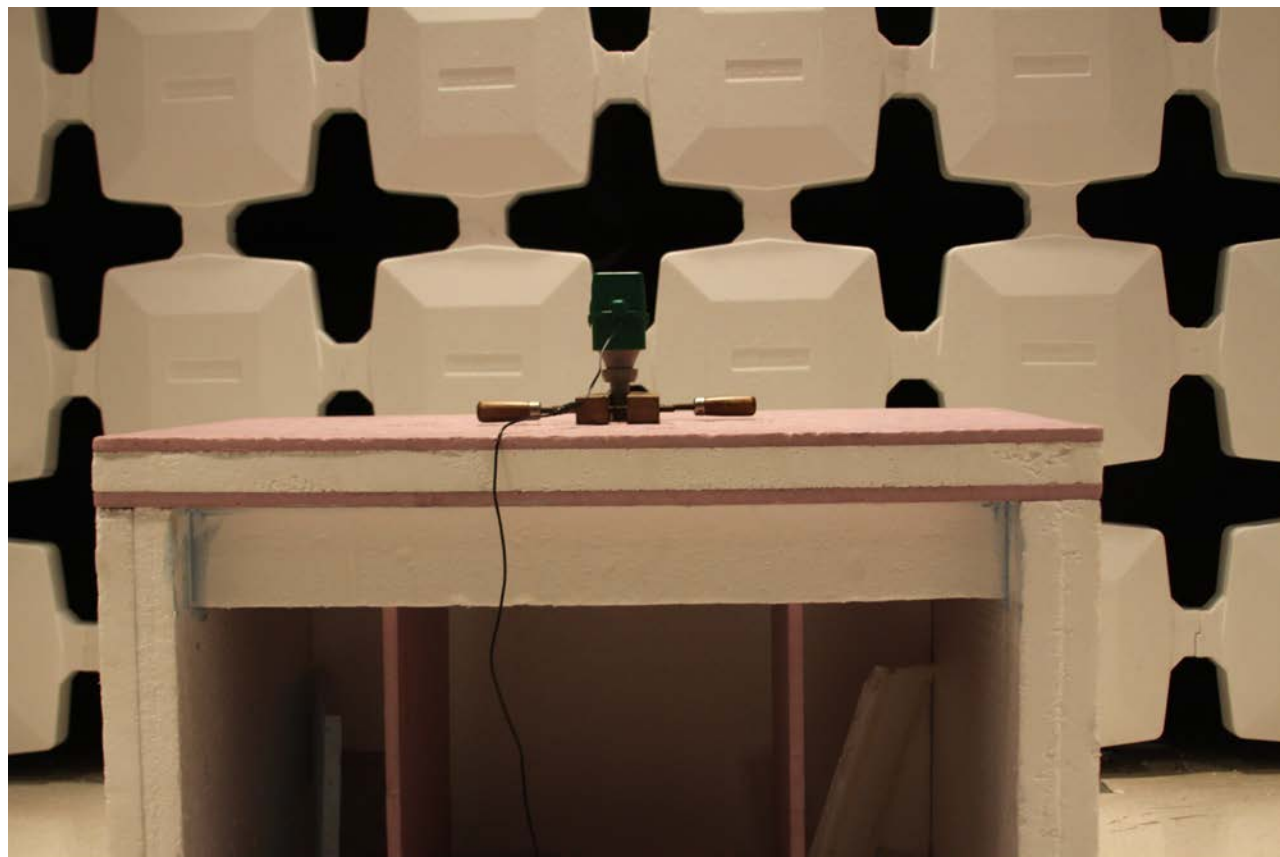
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RADIATION INTERFERENCE TEST SET-UP PHOTOS



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POWER LINE CONDUCTED INTERFERENCE

Rule Part No. 15.207

Requirements:

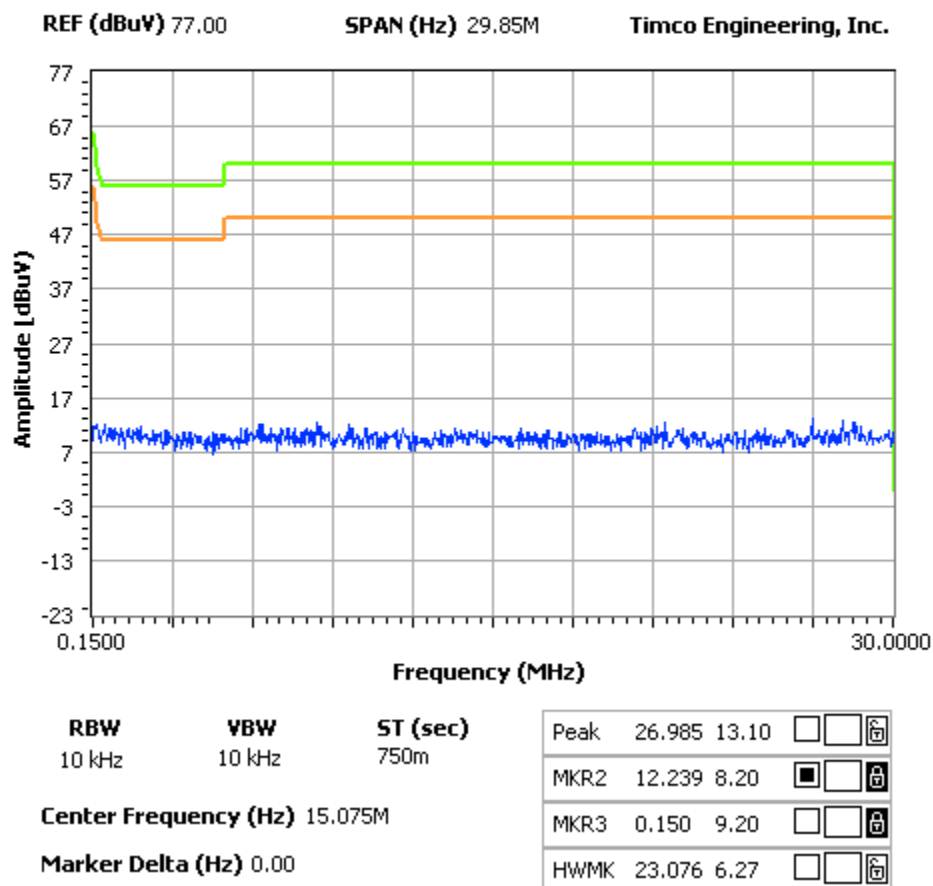
Frequency (MHz)	Quasi Peak Limits (dBμV)	Average Limits (dBμV)
0.15 – 0.5	66 – 56 *	56 – 46 *
0.5 – 5.0	56	46
5.0 – 30	60	50

* Decrease with logarithm of frequency

Line #1

NOTES:

FCC 15.107 Mask Class B



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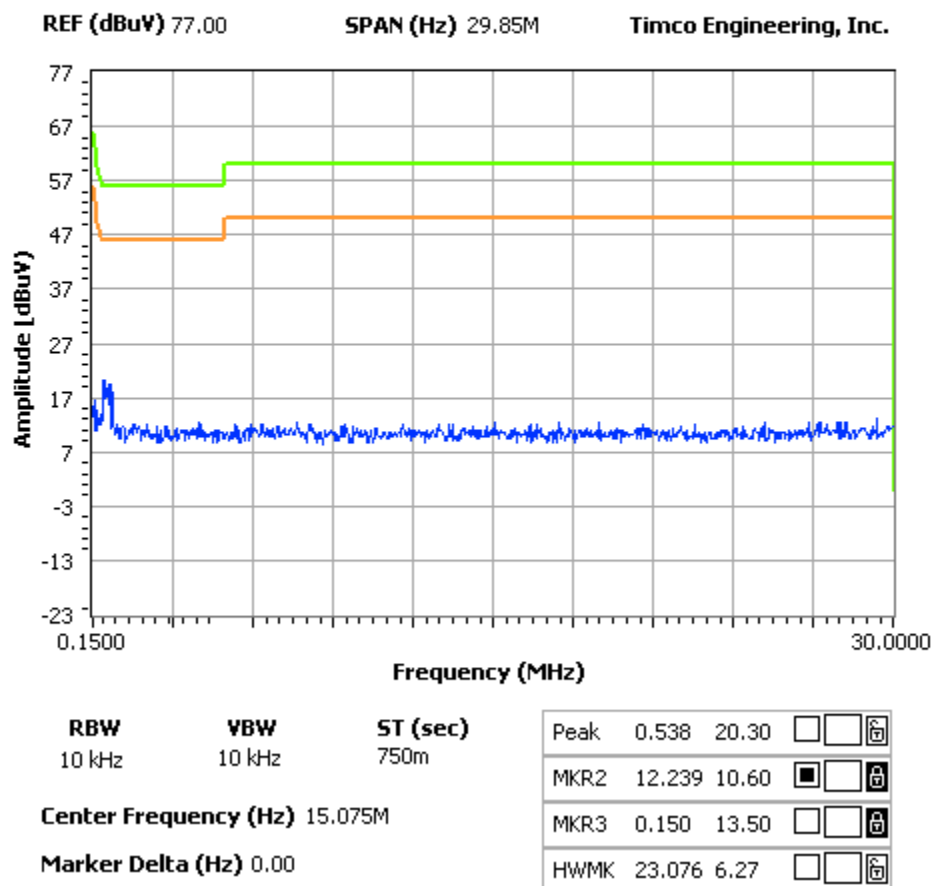
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POWER LINE CONDUCTED INTERFERENCE: (Cont.)

Line #2

NOTES:

FCC 15.107 Mask Class B



Results: Meets Requirement

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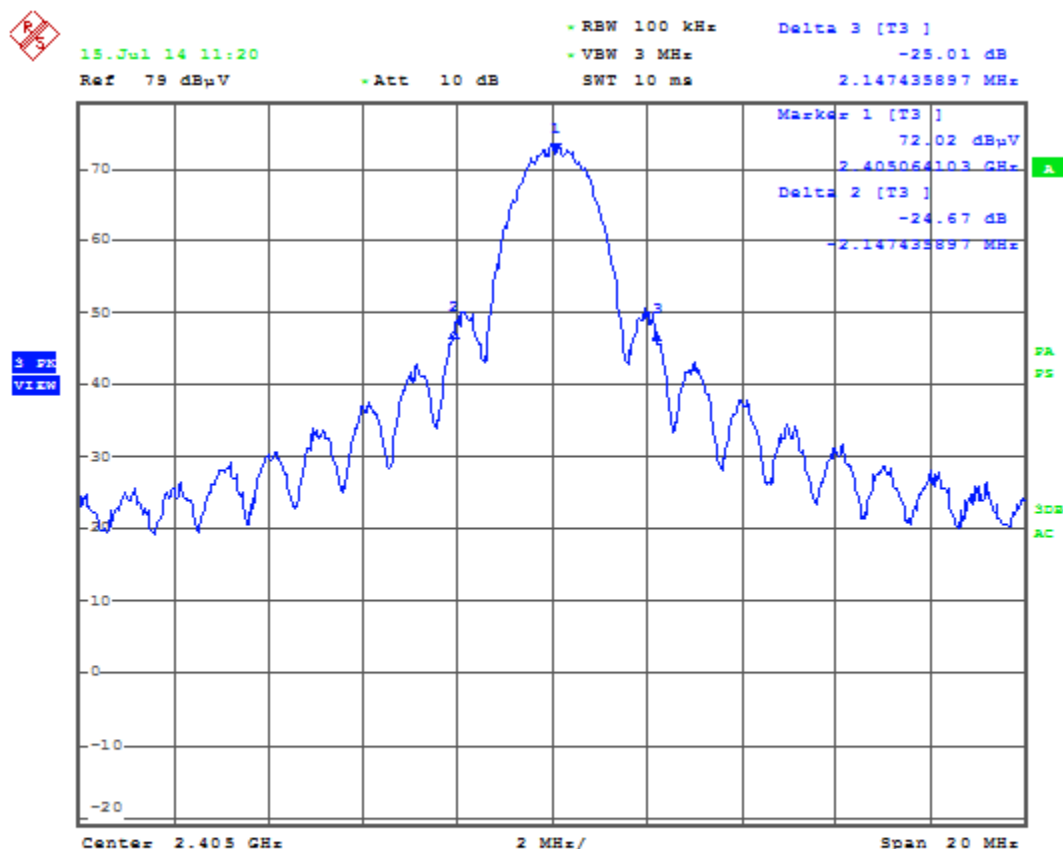
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OCCUPIED BANDWIDTH

Rules Part No.: 15.249 (d)

Requirements: The field strength of any emissions appearing outside the band edges 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:



Date: 15 JUL 2014 11:20:23

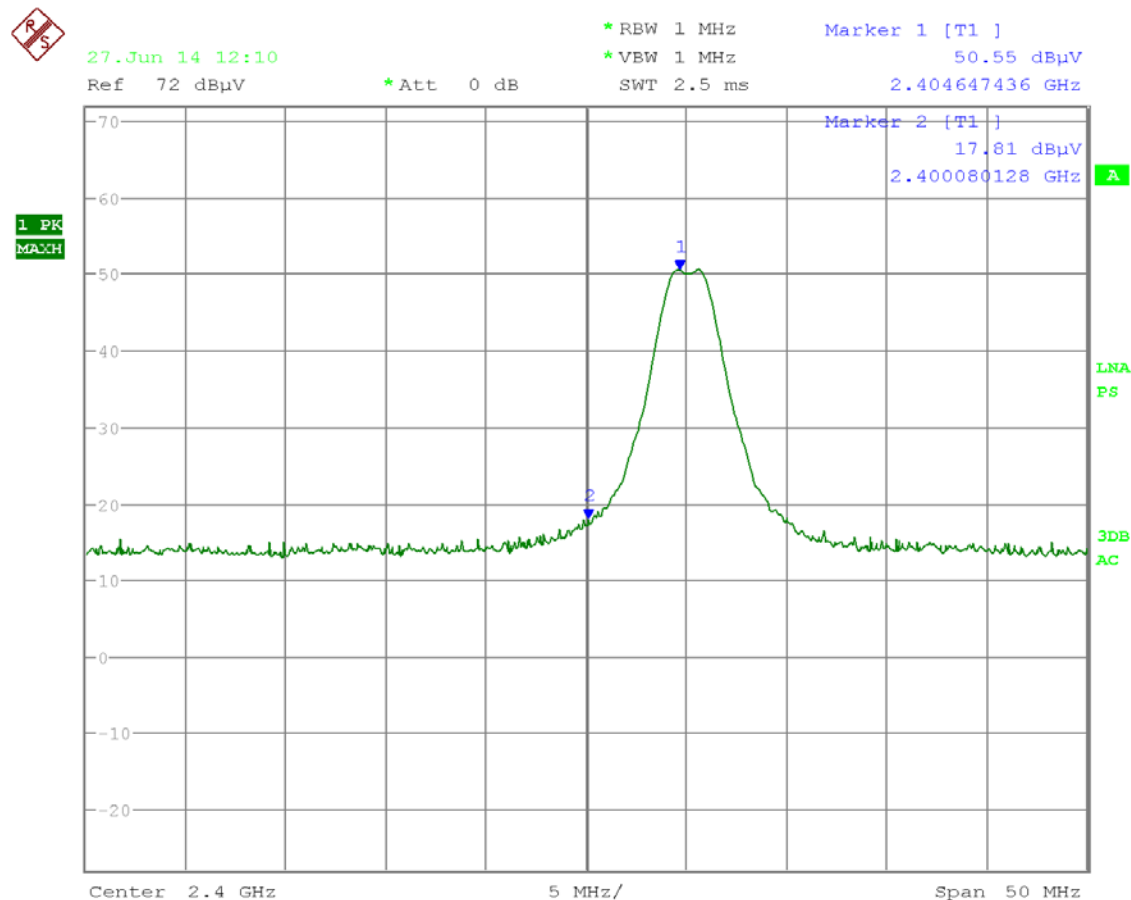
APPLICANT: ENO SCIENTIFIC LLC
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BAND EDGE COMPLIANCE LOWER EDGE:

Rules Part No.: 15.249 (d)

Requirements: 40 dBc or in the case of restricted bands 54 dBuV/m.

Test Data:



Date: 27.JUN.2014 12:10:39

Results: FS Reading at lowest Frequency –Difference to bandedge=Level at bandedge.
 $85.27 - (50.55 - 17.81) = 52.49 \text{ dBuV/m}$

MEETS REQUIREMENT

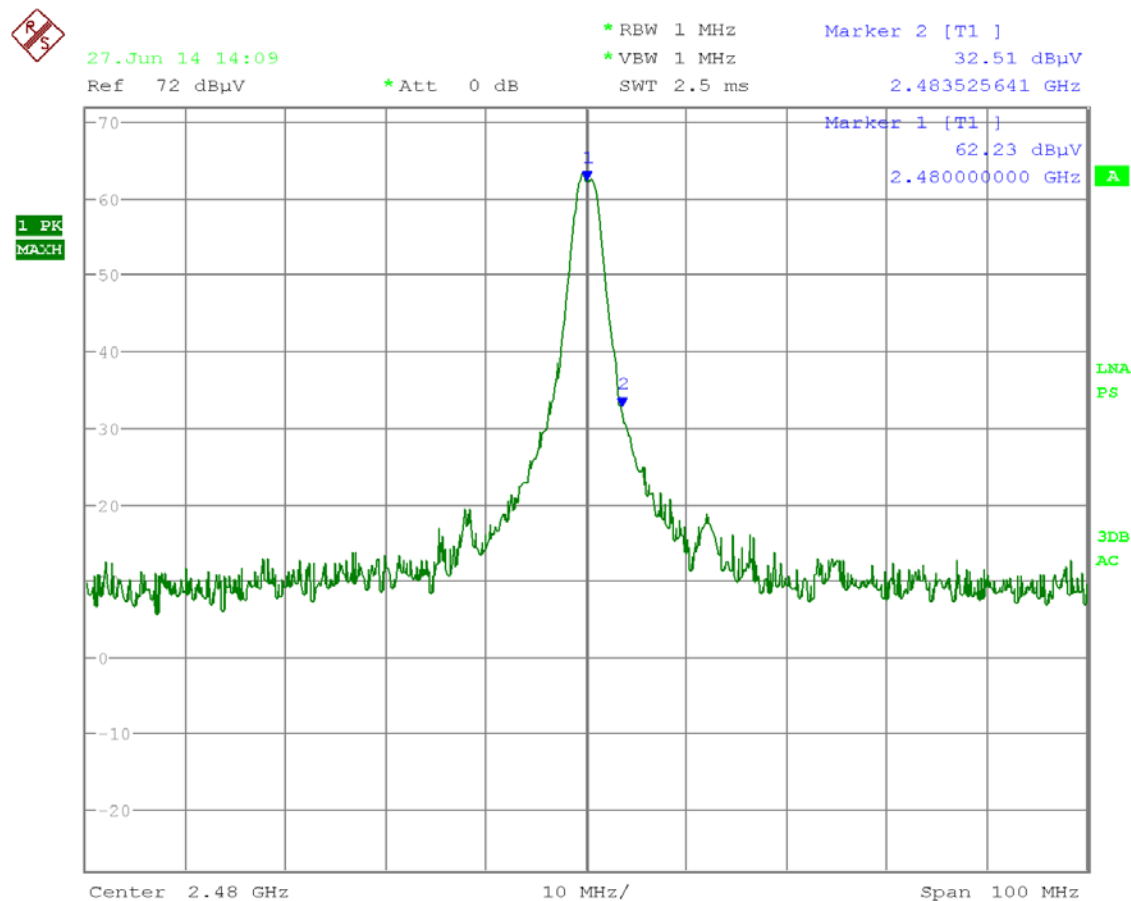
APPLICANT: ENO SCIENTIFIC LLC
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BAND EDGE COMPLIANCE UPPER BANDEDGE

Rules Part No.: 15.249 (d)

Requirements: 40 dBc or in the case of restricted bands 54 dBuV/m.

Test Data:



Date: 27.JUN.2014 14:09:08

Results: FS Reading at lowest Frequency –Difference to bandedge=Level at bandedge.
 $82.7 - (62.23 - 32.51) = 52.98 \text{ dBuV/m}$

MEETS REQUIREMENT

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EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	12/31/13	12/31/15
Coaxial Cable - Chamber 3 cable set	SemiFlex	NA	Chamber 3PC Set	1/13/14	1/13/16
Antenna-Active Loop	ETS-Lindgren	6502	00062529	10/09/2013	10/09/2015
Antenna: Biconnical	Eaton	94455-1	1057	06/14/13	06/14/15
Antenna: Log-Periodic	Eaton	96005	1243	05/31/13	05/31/15
EMI Test *Receiver*	Rhode & Schwarz	ESU 40	100320	03/21/15	03/21/17
Coaxial Cable #65	General Cable Co.	E9917 RG233/U	Timco #65	06/26/13	06/26/15
LISN	Electro-Metrics	FCC-25/2	2512	06/05/13	06/05/15

*EMI Test Receiver Firmware Version: 4.73 Service Pack 1