FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8

CERTIFICATION TEST REPORT

FOR

Shock Sensor

MODEL NUMBER: WST-302

FCC ID: XQC-WST302
IC: 9863B-WST302

REPORT NUMBER: R10744421-Revision A

ISSUE DATE: 2015-11-25

Prepared for
ECOLINK INTELLIGENT TECHNOLOGY
2055 CORTEL DEL NOGAL
CARLSBAD
CA 92011, U.S.A.

Prepared by

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Revision History

NVLAP Lab code: 200246-0

Rev.	Issue Date	Revisions	Revised By
--	2015-11-19	Initial Issue	M.Ferrer
A	2015-11-25	Updated Antenna Gain & Tx Radiated Spurious table on page 22	M.Ferrer

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ECOLINK INTELLIGENT TECHNOLOGY
2055 CORTE DEL NOGAL
CARLSBAD CA, 92011, U.S.A.

EUT DESCRIPTION: WIRELESS SHOCK AND CONTACT SENSOR

MODEL: WST-302

SERIAL NUMBER: 11 FE 15 (Continuous Tx sample);
13 MY 15 & sample ID 2236718 (Factory firmware samples)

DATE TESTED: October 6-13 and 29, 2015

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 15 SUBPART C	Pass
INDUSTRY CANADA RSS-210 Issue 8, Annex 1	Pass
INDUSTRY CANADA RSS-GEN Issue 4	Pass

UL LLC 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 LLC. 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 LLC. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC 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 LLC By:

Mike Ferrer
EMC Program Manager
UL – Consumer Technology Division

Tested & Prepared By:

Mark Nolting
EMC Engineer
UL – Consumer Technology Division

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 4, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Dr., Research Triangle Park, NC 27709, USA and 2800 Suite B Perimeter Park Dr., Morrisville, NC 27560.

12 Laboratory Dr., RTP, NC 27709
☐ Chamber A
☐ Chamber C

2800 Suite B Perimeter Park Dr., Morrisville, NC 27560
☒ Chamber NORTH
☐ Chamber SOUTH

The above onsite chambers are covered under Industry Canada company address code 2180C with site numbers 2180C -1 through 2180C-4, respectively.

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0. The full scope of accreditation can be viewed at http://www.nist.gov/nvlap/.

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:

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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Total RF power, conducted	±0.45 dB
RF power density, conducted	±1.5 dB
Spurious emissions, conducted	±1.46 dB
Radiated Emissions (30-1000 MHz)	+/- 6.04 dB (3m)
Radiated Emissions (1-6 GHz)	+/- 5.96 dB
Radiated Emissions (6-18 GHz)	+/- 6.10 dB
Radiated Emissions (18-26 GHz)	+/- 6.81 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a wireless shock and contact sensor.

5.2. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an internal wire loop antenna soldered to PCB, with a maximum gain of -15 dBi. It is not user replaceable.

5.3. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was ESW1021-02-C01.hex.

The firmware installed in the EUT to allow continuous transmit during testing was ESW1021-02-B01-TEST.hex.

5.4. WORST-CASE CONFIGURATION AND MODE

The EUT was investigated in three orthogonal axes. All radiated testing was performed in the worst-case axis, which was determined to be the Z axis. (See the photos section for details.)

5.5. MODIFICATIONS

No modifications were made during testing.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

None.

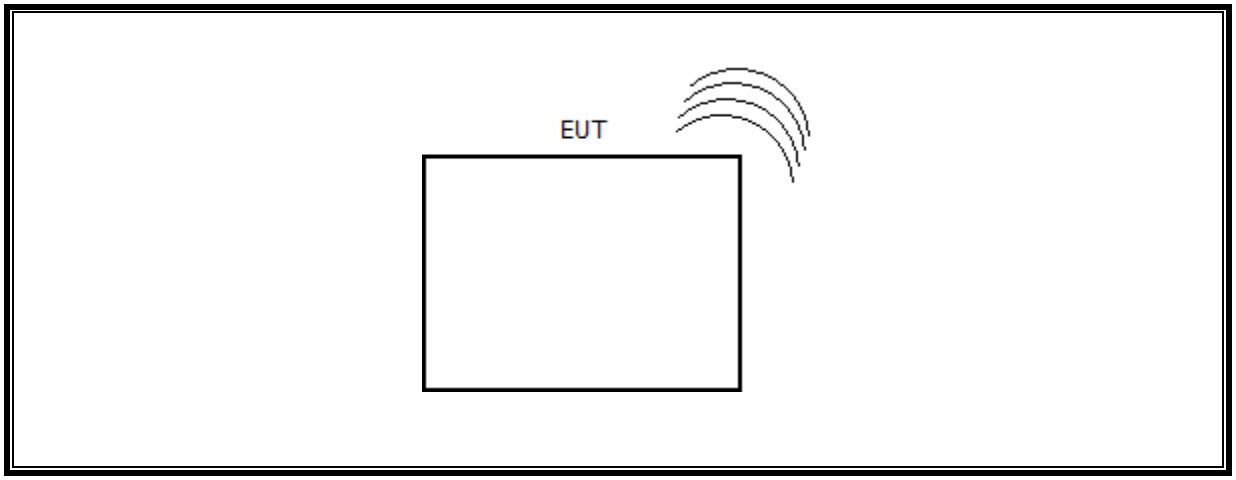
I/O CABLES

None.

TEST SETUP

The EUT is a stand-alone device, which operated as a function of external disturbances. (e.g., shock and contact closure/opening.) The device was placed on a standard test table for fundamental and spurious emissions testing and a cart for all other tests.

SETUP DIAGRAMS FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - North Chamber)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0059	Active Shielded Loop Antenna	EMCO	6502	2015-03-17	2016-03-31
AT0074	Hybrid Broadband Antenna, 30-1000MHz	Sunol Sciences Corp.	JB3	2015-06-10	2016-06-30
AT0069	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2015-02-17	2016-02-29
S-SAC01	Gain-loss string: 0.09-30MHz	Various	Various	2015-10-07	2016-10-31
S-SAC02	Gain-loss string: 30-1000MHz	Various	Various	2015-06-09	2016-06-30
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2015-08-22	2016-08-31
SA0026	Spectrum Analyzer	Agilent	N9030A	2015-03-27	2016-03-31
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
43733	Temp/Humid/Pressure Meter	Cole Parmer	99760-00	2014-03-24	2016-03-24

7. ANTENNA PORT TEST RESULTS

7.1. 20 dB AND 99% BW

LIMITS

FCC §15.231 (c)
The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

IC A1.1.3
For the purpose of Section A1.1, the 99% Bandwidth shall be no wider than 0.25% of the center frequency for devices operating between 70-900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

TEST PROCEDURE

RSS-GEN (Section 6.6)

The transmitter output is coupled to the spectrum analyzer via an antenna connected to the spectrum analyzer.

99% Bandwidth: The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

20dB Bandwidth: The 20dB bandwidth is measured as above using the x dB bandwidth setting of the spectrum analyzer's Occupied BW function.

RESULTS

No non-compliance noted:

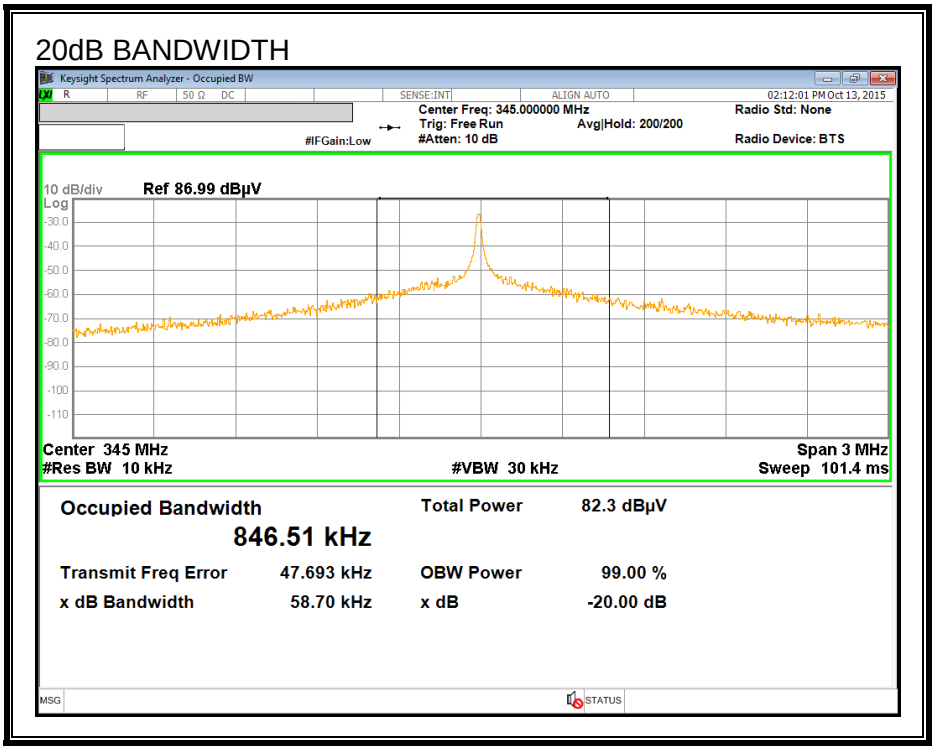
20dB Bandwidth

Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)
345	58.7	862.5	-803.8

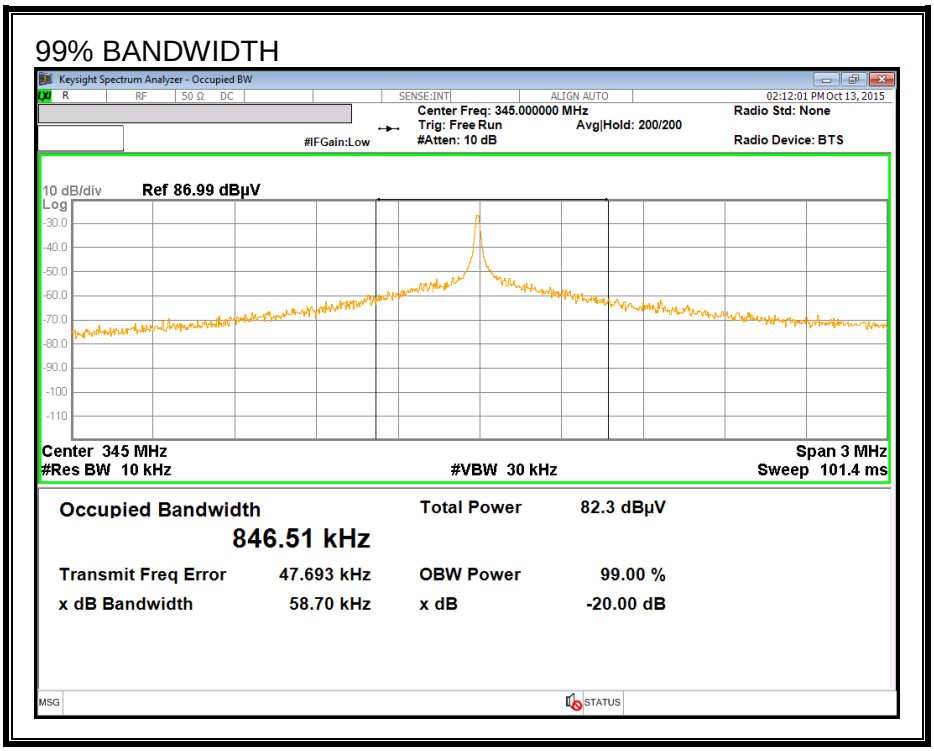
99% Bandwidth

Frequency (MHz)	99% Bandwidth (kHz)	Limit (kHz)	Margin (kHz)
345	846.51	862.5	-15.99

20dB BANDWIDTH



99% BANDWIDTH



7.2. DUTY CYCLE

LIMITS

FCC §15.35 (c)
The measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

TEST PROCEDURE

The transmitter output is coupled to a spectrum analyzer via an antenna connected to the input of the spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled and the span is set to 0 Hz. The number of pulses is measured and calculated in a 100 ms scan.

CALCULATION

Average Reading = Peak Reading (dBuV/m) + 20log (Duty Cycle), Where Duty Cycle is (# of long pulses * long pulse width) + (# of short pulses * short pulse width) / 100 or T

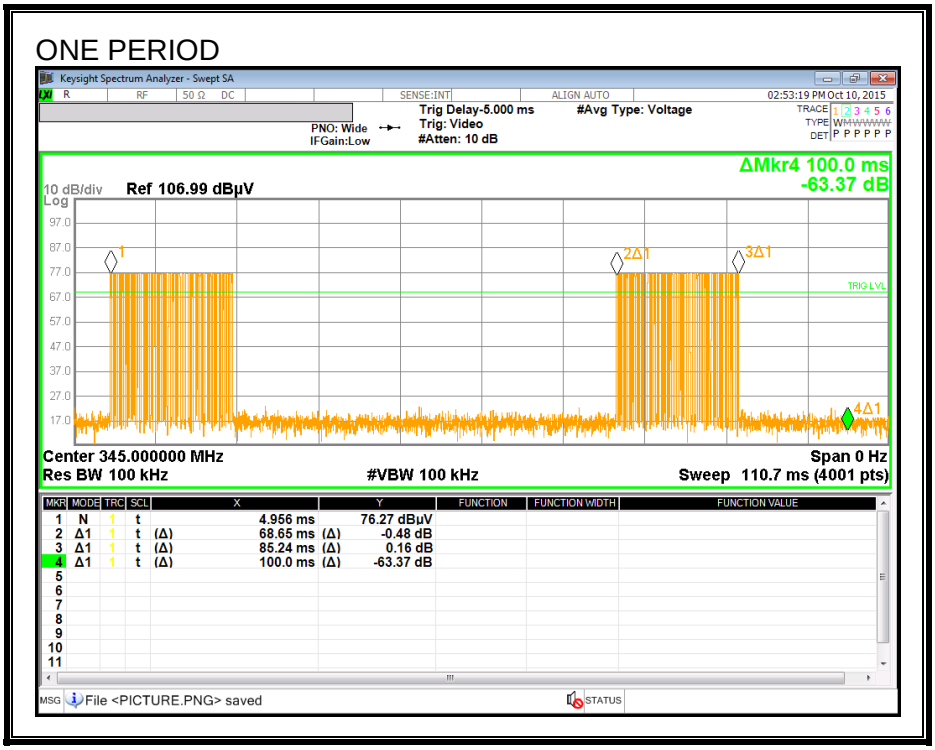
RESULTS

No non-compliance noted:

One Period (ms)	Long Pulse Width (ms)	# of Long Pulses	Short Width (ms)	# of Short Pulses	Duty Cycle	20*Log Duty Cycle (dB)
100	0.2816	22	0.15	84	0.188	-14.5

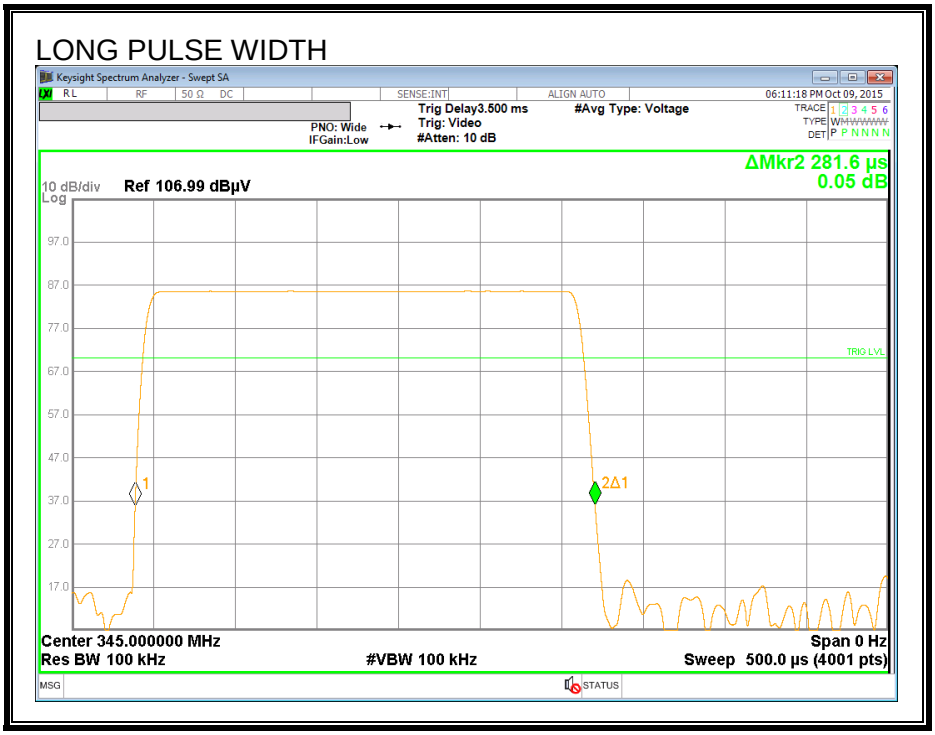
The EUT has four sensors to investigate as follows: (1) shock sensor; (2) contact sensor; (3) cover sensor; (4) reed-relay sensor. Further, the contact, cover, and reed-relay sensors were investigated when opening and closing their respective circuits. Overall, the case where the cover of the device is opened and the two reed-relay cases proved to be worst-case from the stand-point of total ON time. Since these three cases had the same number of wide and narrow pulses but not necessarily the same sequence, only the data for the case of opening the cover is presented here.

ONE PERIOD



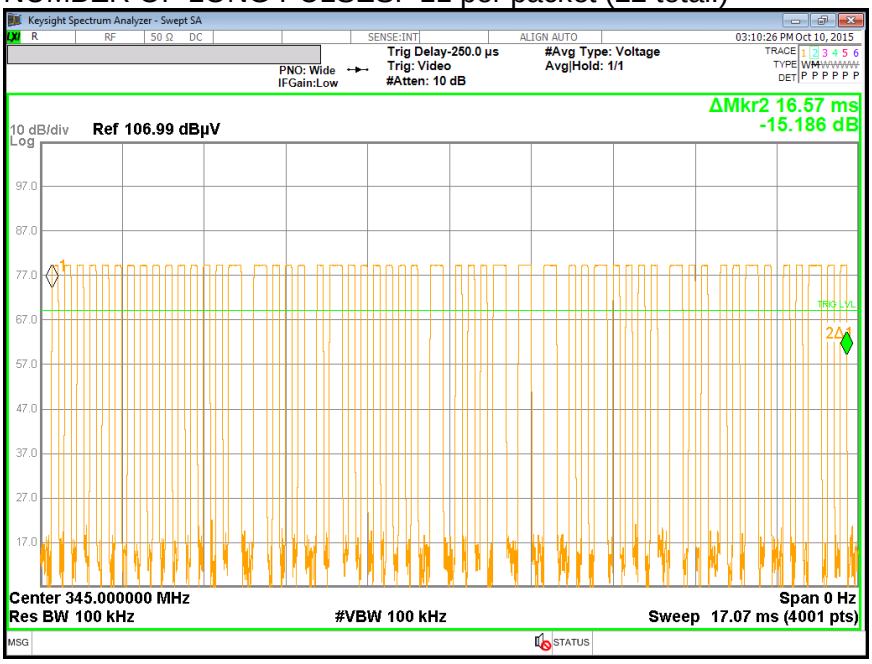
The above shows two packets within a 100ms window. Both packets had the same data pattern. Therefore, what follows represents both. Also, since there were two packets within a 100ms window the pulse count is multiplied by 2.

LONG PULSE WIDTH



NUMBER OF LONG PULSES

NUMBER OF LONG PULSES: 11 per packet (22 total.)

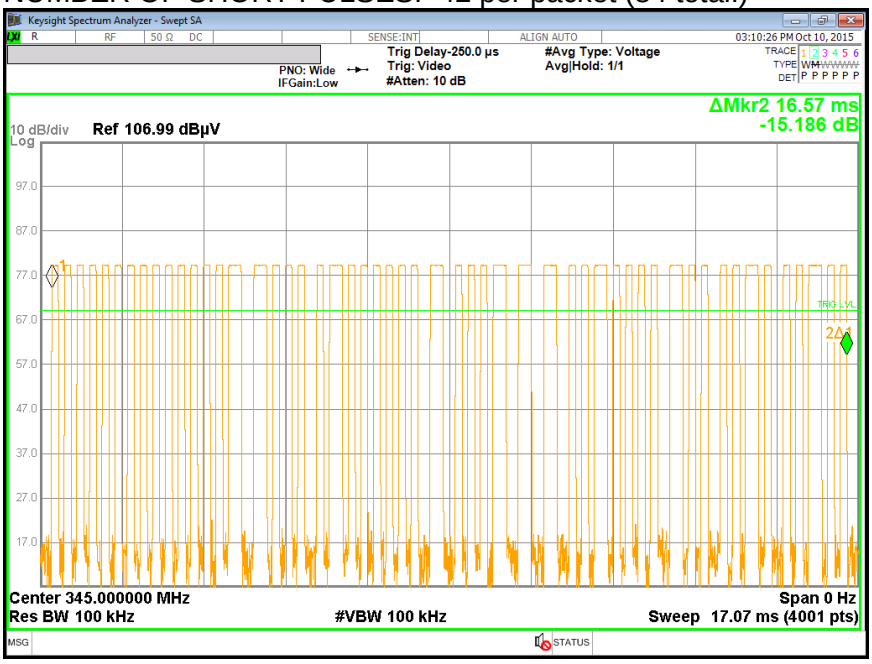


SHORT PULSE WIDTH

SHORT PULSE WIDTH

NUMBER OF SHORT PULSES

NUMBER OF SHORT PULSES: 42 per packet (84 total.)



7.3. TRANSMISSION TIME

LIMITS

FCC §15.231 (a) (2)

IC A1.1.1 (b)

A transmitter activated automatically shall cease transmission within 5 seconds after activation.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer or radiated field strength. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is set to 10 seconds and the span is set to 0 Hz.

RESULTS

No non-compliance noted:

LESS THAN 5 SECONDS

The EUT has four sensors to investigate as follows: (1) shock sensor; (2) contact sensor; (3) cover sensor; (4) reed-relay sensor. Of the four the shock sensor had the longest turn-off time and is presented here.

8. RADIATED EMISSION TEST RESULTS

8.1. TX RADIATED SPURIOUS EMISSION

LIMITS

FCC §15.231 (b)
IC A1.1.2
In addition to the provisions of § 15.205, the field strength of emissions from Intentional radiators operated under this section shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental Frequency (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)
40.66 - 40.70	2,250	225
70 - 130	1,250	125
130 - 174	1,250 to 3,750	125 to 375
174 - 260	3,750	375
260 - 470	3,750 to 12,500	375 to 1,250
Above 470	12,500	1,250

1 Linear interpolation

§15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	([2])
13.36 – 13.41	322 - 335.4		

1 Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
2 Above 38.6

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 88	100 **	3
88 216	150 **	3
216 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 72 MHz, 76 88 MHz, 174 216 MHz or 470 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

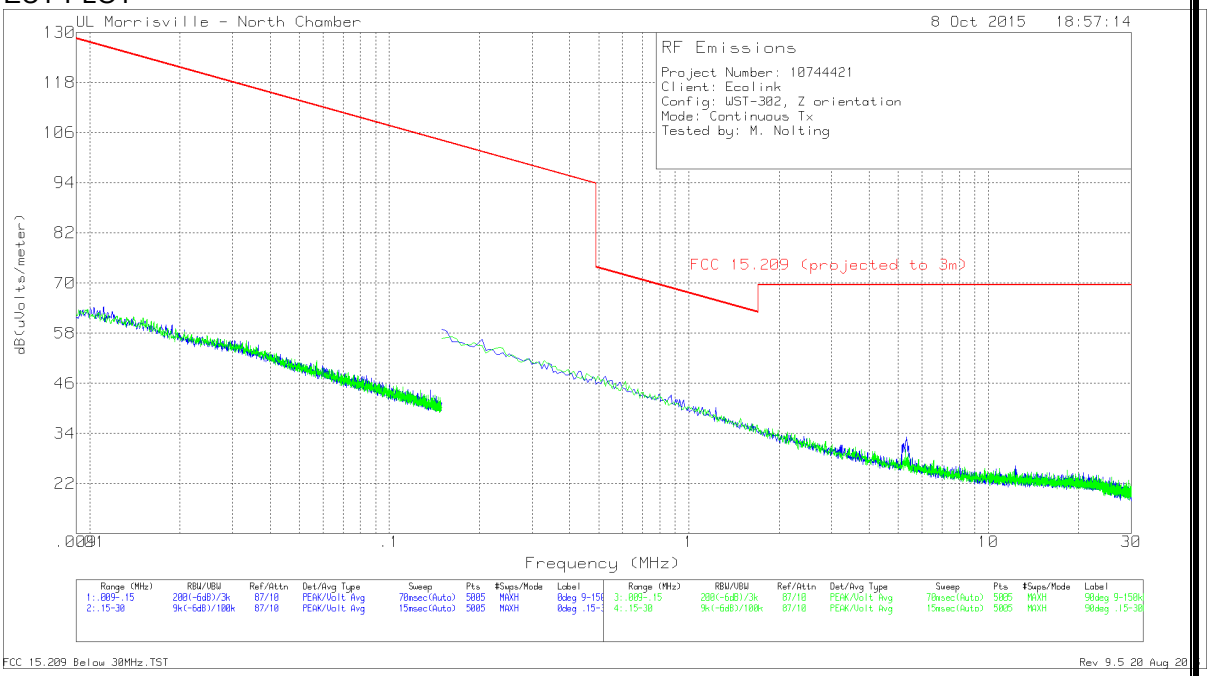
§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

RESULTS

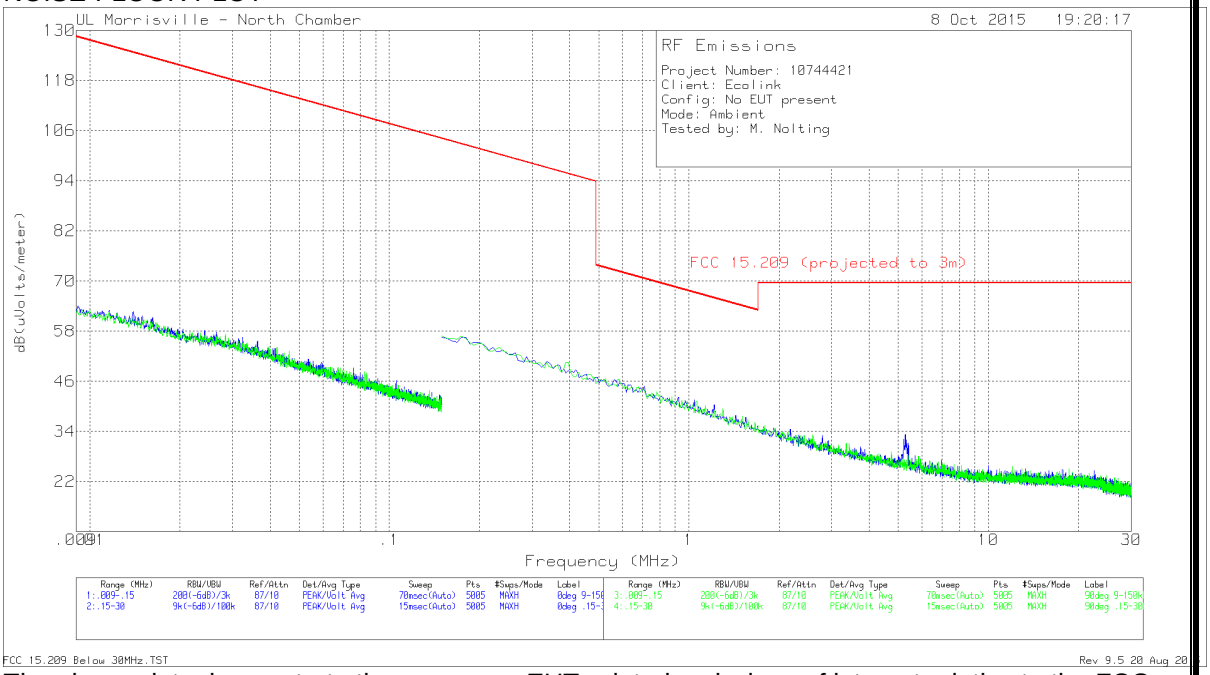
TX SPURIOUS EMISSIONS (0.009-30MHz)

Note: All measurements were made at a test distance of 3 m. The limits in the plots and tabular data are the FCC/IC limits extrapolated from the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to the measurement distance to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40*Log (specification distance / test distance) per FCC 15.31 (f) (2).

EUT PLOT

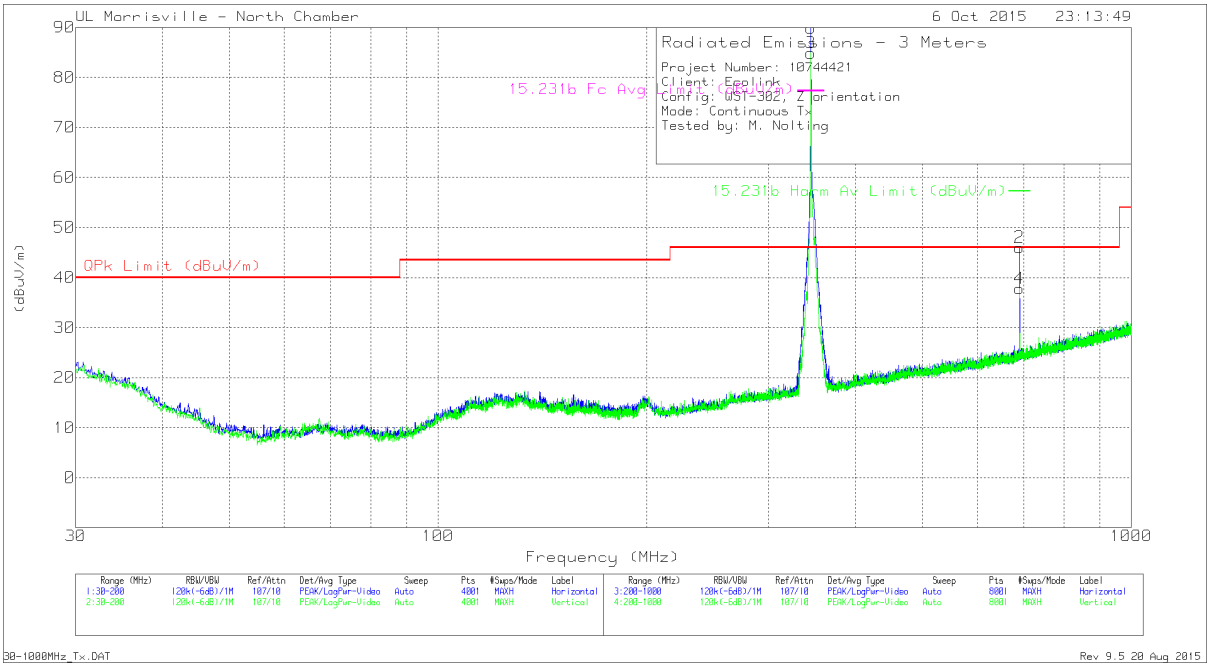


NOISE-FLOOR PLOT



The above plots demonstrate there were no EUT-related emissions of interest relative to the FCC 15.209 limit below 30MHz.

FUNDAMENTAL, HARMONICS AND TX SPURIOUS EMISSION (30 – 1000 MHz)



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF JB3 (dB/m)	Amp/Cbl (dB)	DCCF (dB)	Corrected Reading (dBuV/m)	QPk/Pk Limit (dBuV/m)	QP/Pk Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	345	99.86	Pk	19.1	-29.3	0	89.66	97.26	-7.6	-	-	209	101	H
	345	99.86	Pk	19.1	-29.3	-14.5	75.16	-	-	77.26	-2.1	209	101	H
2	689.985	57.44	Pk	24.7	-28.1	0	54.04	77.26	-23.22	-	-	323	129	H
	689.985	57.44	Pk	24.7	-28.1	-14.5	39.54	-	-	57.26	-17.72	323	129	H
3	345	97.09	Pk	19.1	-29.3	0	86.89	97.26	-10.37	-	-	122	147	V
	345	97.09	Pk	19.1	-29.3	-14.5	72.39	-	-	77.26	-4.87	122	147	V
4	689.9862	48.09	Pk	24.7	-28.1	0	44.69	77.26	-32.57	-	-	96	134	V
	689.9862	48.09	Pk	24.7	-28.1	-14.5	30.19	-	-	57.26	-27.07	96	134	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
30-1000MHz_Tx.DAT
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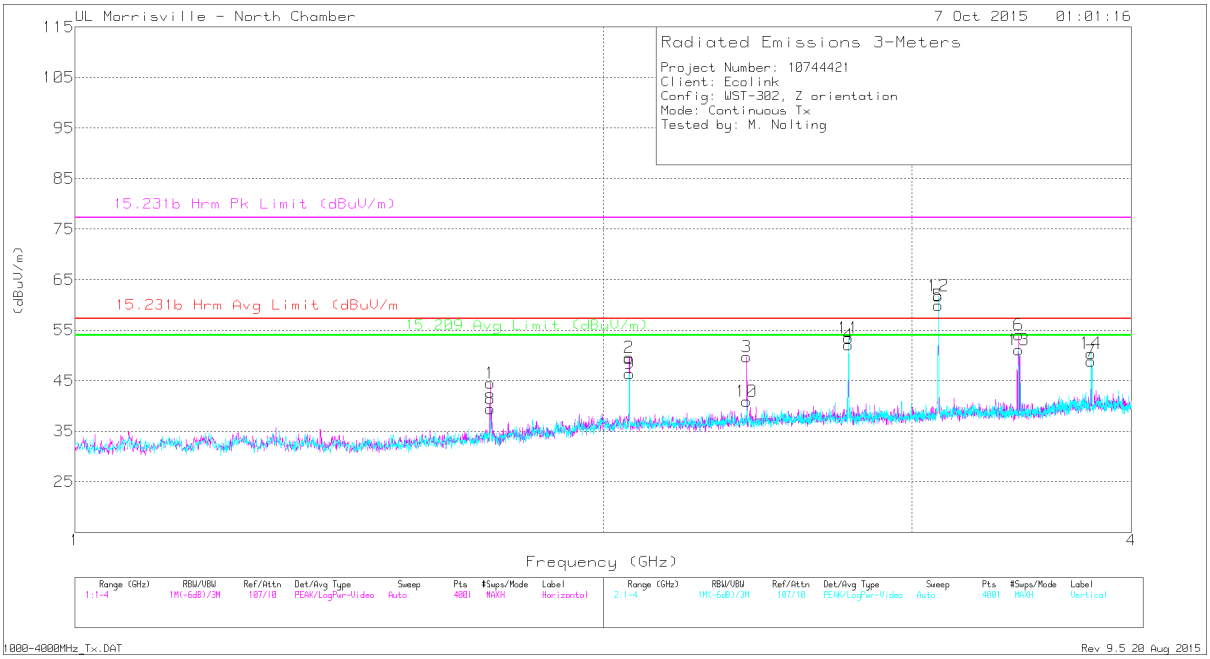
HARMONICS AND TX SPURIOUS EMISSIONS ABOVE 1GHz



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (dB/m)	Amp/Cbl (dB)	DCCF (dB)	Corrected Reading (dBuV/m)	Pk Limit (dBuV/m)	PK Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.725	55.03	Pk	29.3	-36.4	0	47.93	77.26	-29.33	-	-	99	198	H
	1.725	55.03	Pk	29.3	-36.4	-14.5	33.43	-	-	55.26	-21.83	99	198	H
2	2.07	57.03	Pk	31.7	-35.8	0	52.93	77.26	-24.33	-	-	246	105	H
	2.07	57.03	Pk	31.7	-35.8	-14.5	38.43	-	-	55.26	-16.83	246	105	H
3	2.415	57.15	Pk	31.9	-35	0	54.05	77.26	-23.21	-	-	240	102	H
	2.415	57.15	Pk	31.9	-35	-14.5	39.55	-	-	55.26	-15.71	240	102	H
4	* 2.76	58.02	Pk	32.4	-34.7	0	55.72	74	-18.28	-	-	114	174	H
	* 2.76	58.02	Pk	32.4	-34.7	-14.5	41.22	-	-	54	-12.78	114	174	H
5	3.105	64.54	Pk	32.6	-34.3	0	62.84	77.26	-14.42	-	-	346	284	H
	3.105	64.54	Pk	32.6	-34.3	-14.5	48.34	-	-	55.26	-6.92	346	284	H
6	3.449	59.97	Pk	33.1	-34.1	0	58.97	77.26	-18.29	-	-	356	321	H
	3.449	59.97	Pk	33.1	-34.1	-14.5	44.47	-	-	55.26	-10.79	356	321	H
7	* 3.795	52.63	Pk	33.5	-33.9	0	52.23	74	-21.77	-	-	120	110	H
	* 3.795	52.63	Pk	33.5	-33.9	-14.5	37.73	-	-	54	-16.27	120	110	H
8	1.725	52.78	Pk	29.3	-36.4	0	45.68	77.26	-31.58	-	-	159	343	V
	1.725	52.78	Pk	29.3	-36.4	-14.5	31.18	-	-	55.26	-24.08	159	343	V
9	2.07	54.66	Pk	31.7	-35.8	0	50.56	77.26	-26.7	-	-	143	252	V
	2.07	54.66	Pk	31.7	-35.8	-14.5	36.06	-	-	55.26	-19.2	143	252	V
10	2.415	54.09	Pk	31.9	-35	0	50.99	77.26	-26.27	-	-	141	308	V
	2.415	54.09	Pk	31.9	-35	-14.5	36.49	-	-	55.26	-18.77	141	308	V
11	* 2.76	57.15	Pk	32.4	-34.7	0	54.85	74	-19.15	-	-	242	109	V
	* 2.76	57.15	Pk	32.4	-34.7	-14.5	40.35	-	-	54	-13.65	242	109	V
12	3.105	64.76	Pk	32.6	-34.3	0	63.06	77.26	-14.2	-	-	320	286	V
	3.105	64.76	Pk	32.6	-34.3	-14.5	48.56	-	-	55.26	-6.7	320	286	V
13	3.449	58.63	Pk	33.1	-34.1	0	57.63	77.26	-19.63	-	-	352	120	V
	3.449	58.63	Pk	33.1	-34.1	-14.5	43.13	-	-	55.26	-12.13	352	120	V
14	* 3.795	53.55	Pk	33.5	-33.9	0	53.15	74	-20.85	-	-	359	102	V
	* 3.795	53.55	Pk	33.5	-33.9	-14.5	38.65	-	-	54	-15.35	359	102	V

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

Pk - Peak detector

1000-4000MHz_Tx.DAT

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