

FCC 47 CFR PART 15 SUBPART C INDUSTRY CANADA RSS 210

CERTIFICATION TEST REPORT

FOR

WIRELESS SENSOR

MODEL NUMBER: WST-712

FCC ID: XQC-WST712 IC: 9863B-WST712

REPORT NUMBER: 15U21269 REVISION B

ISSUE DATE: AUGUST 3, 2015

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

Prepared by

UL VERIFICATION SERVICES INC. 47173 BENICIA STREET FREMONT, CA 94538, U.S.A. TEL: (510) 771-1000 FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	lssue Date	Revisions	Revised By
	7/21/15	Initial Issue	P. Zhang
А	8/3/15	Update page 5, 20dB OBW, page 23, page 28	P. Zhang
В	8/3/15	Update page 21, OBW test procedure	P. Zhang

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	ECOLINK INTELLIGENT TECHNOLOGY, INC. 2055 CORTE DEL NOGAL CARLSBAD, CA, 92011, U.S.A			
EUT DESCRIPTION: WIRELESS SENSOR				
MODEL:	WST-712			
SERIAL NUMBER: NON-SERIALIZED PRODUCTION UNIT.				
DATE TESTED:	JULY 18-19, 2015			
	APPLICABLE STANDARDS			
ST	ANDARD	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 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:

PENG ZHANG PROJECT LEAD UL Verification Services Inc.

Tested By:

Rally Mame

R.ALEGRE LAB ENGINEER UL Verification Services Inc.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013 for IC and ANSI C63.10-2009 for FCC, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 4, and RSS-210 Issue 8.

Deviation -Radiated spurious emission above 1GHz EUT height is 1.5m not 0.8m.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

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
Chamber A	Chamber D
🛛 Chamber B	Chamber E
Chamber C	Chamber F

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <u>http://ts.nist.gov/standards/scopes/2000650.htm</u>.

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

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4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	±3.52 dB
Radiated Disturbance, 30 to 18000 MHz	±4.94 dB

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

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Wireless Sensor.

5.2. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an PCB loop antenna, with a maximum gain of -15 dBi.

5.3. SOFTWARE AND FIRMWARE

The typical factory firmware installed in the EUT during testing was ESW1098-02-A01.HEX

The firmware installed in the EUT to allow continuous transmit during testing was CEILING_v1.00.HEX

5.4. WORST-CASE CONFIGURATION AND MODE

The EUT was investigated in each of its three orthogonal axes. All radiated testing was performed in the worse-case axis, which was found to be the "X-axis". See photos for details.

5.5. MODIFICATIONS

No modifications were made during testing.

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5.1. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

NONE

I/O CABLES

NONE

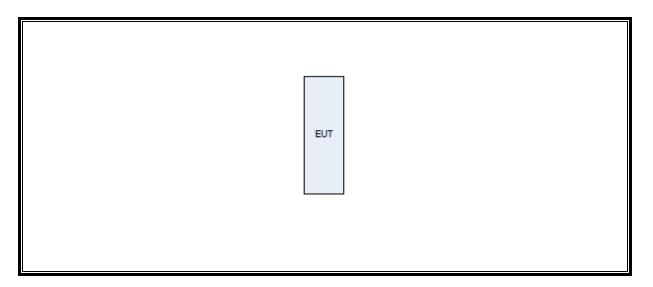
TEST SETUP

The EUT is a stand-alone device, which operated on a button push.

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SETUP DIAGRAM FOR TESTS



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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, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB1	C01171	02/13/16	
Antenna, Horn, 18GHz	EMCO	3115	C00783	10/25/15	
Antenna, Horn, 25.5 GHz	ARA	MWH-1826/B	C00980	11/14/15	
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	01/28/16	
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	10/22/15	
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	12/20/15	
CBT Bluetooth Tester	R & S	CBT	None	07/12/16	
Peak Power Meter	Agilent / HP	E4416A	C00963	12/13/15	
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/13/15	
LISN, 30 MHz	FCC	50/250-25-2	C00626	01/14/16	
Reject Filter, 2.4GHz	Micro-Tronics	BRM50702	N02684	CNR	
ESA-E Spectrum Analyzer, 9kHz-26.5	Agilent / HP	E4407B	C01098	04/04/16	
GHz					
Antenna, Loop, 30 MHz	EMCO	6502	C00593	02/20/16	

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7. ANTENNA PORT TEST RESULTS

7.1. 20 dB AND 99% BW

<u>LIMITS</u>

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

ANSI C63.10

The transmitter output is connected to the spectrum analyzer.

20dB Bandwidth: The RBW is set to 1% to 5% of OBW. The VBW is set to 3 times the RBW. The sweep time is coupled. Bandwidth is determined at the points 20 dB down from the modulated carrier.

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.

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RESULTS

No non-compliance noted:

20dB Bandwidth

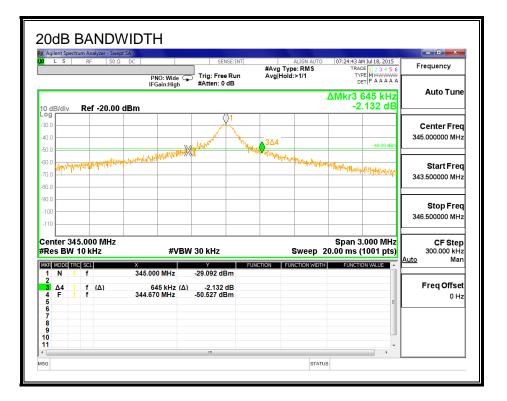
Frequency 20dB Bandwidth		Limit	Margin
(MHz)	(kHz)	(kHz)	(kHz)
345	645	862.5	-217.5

99% Bandwidth

Frequency 99% Bandwidth		Limit	Margin
(MHz)	(kHz)	(kHz)	(kHz)
345	645.25	862.5	-217.25

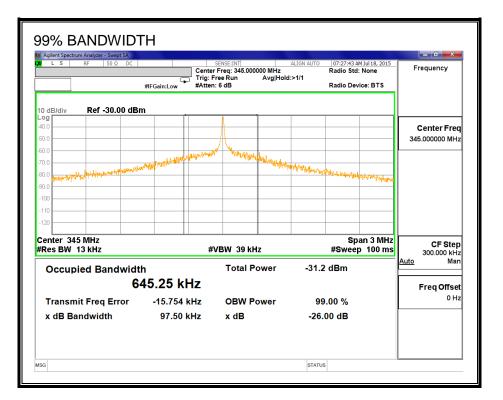
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20dB BANDWIDTH



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99% BANDWIDTH



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7.2. DUTY CYCLE

<u>LIMITS</u>

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 connected to a spectrum analyzer or radiated field strength. The RBW is set to 1MHz and the VBW is set to 1MHz. 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

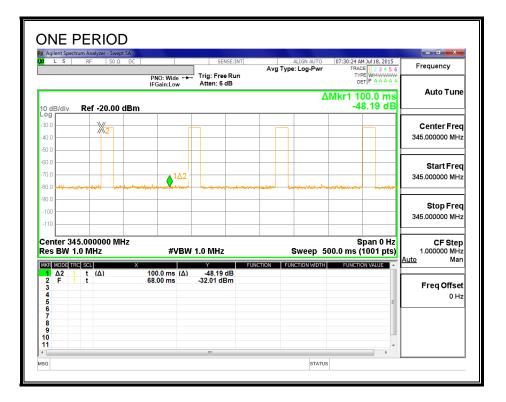
RESULTS

No non-compliance noted:

One	Long Pulse	# of	Short	# of	Duty	20*Log
Period	Width	Long	Width	Short	Cycle	Duty Cycle
(ms)	(ms)	Pulses	(ms)	Pulses		(dB)
100	0.28	11	0.14	42	0.090	-20.95

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ONE PERIOD



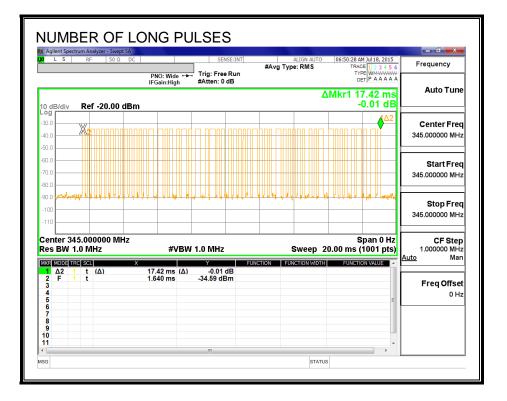
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LONG PULSE WIDTH



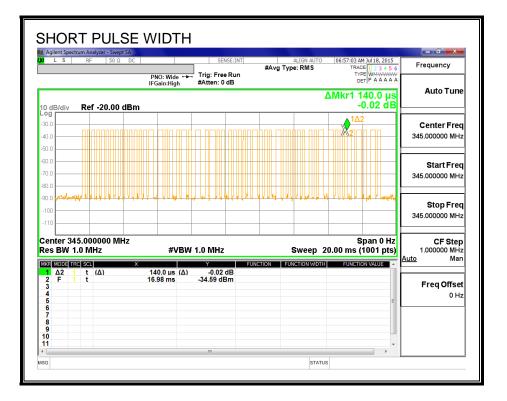
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NUMBER OF LONG PULSES



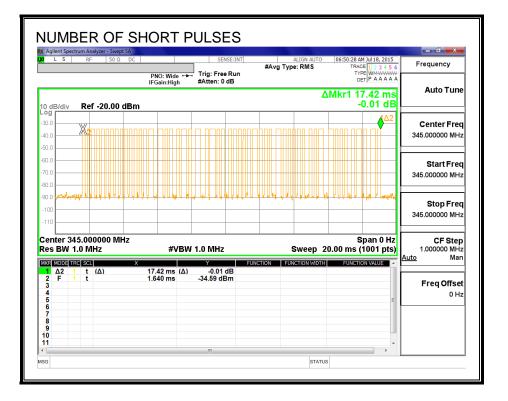
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SHORT PULSE WIDTH



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NUMBER OF SHORT PULSES



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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 1 MHz and the VBW is set to 3 MHz. The sweep time is set to 10 seconds and the span is set to 0 Hz.

RESULTS

No non-compliance noted:



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8. RADIATED EMISSION TEST RESULTS 8.1. TX RADIATED SPURIOUS EMISSION

<u>LIMITS</u>

FCC §15.231 (b) IC A1.1.2

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

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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	Field Strength	Measurement Distance
(MHz)	(microvolts/meter)	(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.

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TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz and 150 cm for above 1GHz. 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 measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

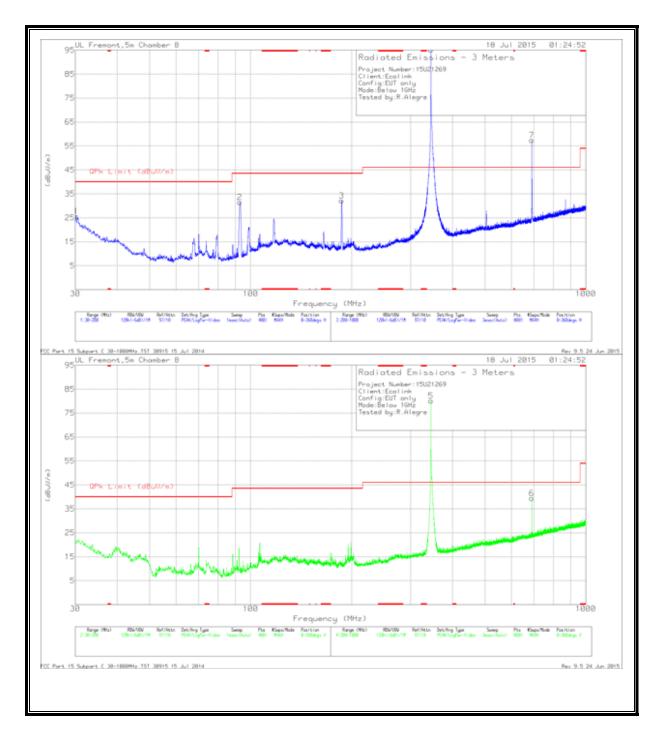
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

RESULTS

No non-compliance noted:

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



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Radiated Emissions

Trace Markers

Trace Markers

Marker	Frequency (MHz)	Meter Reading	Det	AF T243 (dB/m)	Amp/Cbl (dB)	Corrected Reading	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
		(dBuV)				(dBuV/m)					
1	30.17	33.97	Pk	20.6	-28.8	25.77	40	-14.23	0-360	199	Н
2	92.9213	51.3	Pk	8.3	-28	31.6	43.52	-11.92	0-360	399	н
3	187.0375	47.91	Pk	11.3	-27	32.21	43.52	-11.31	0-360	399	н
4	345	106.7	Pk	14.2	-25.7	95.2			0-360	101	н
5	345	91.7	Pk	14.2	-25.7	80.2			0-360	299	V
7	690	61.92	Pk	20.1	-24.5	57.52			0-360	101	н
6	690	43.82	Pk	20.1	-24.5	39.42	46.02	-6.6	0-360	101	V

Pk - Peak detector

Radiated Emissions

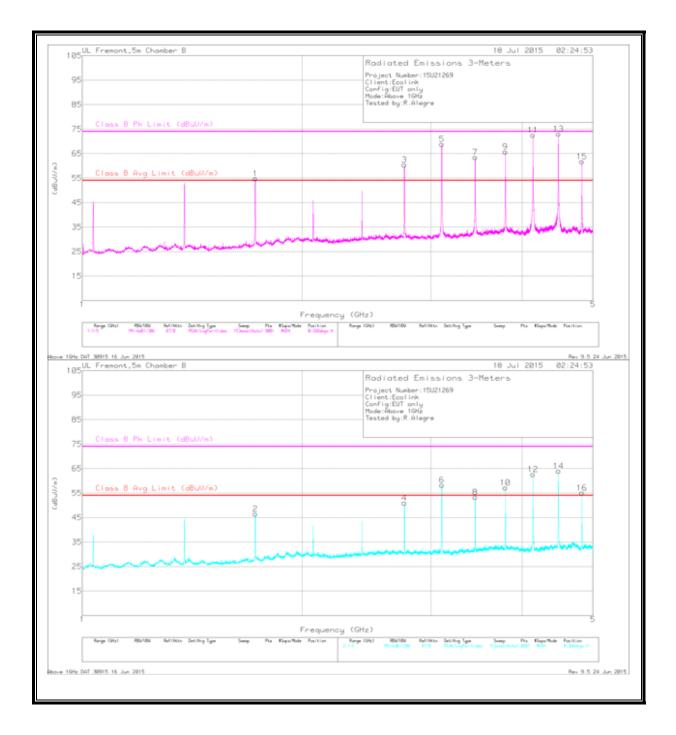
Frequency	Meter	Det	AF T243	Amp/Cbl	Corrected	Limit	Margin	Azimuth	Height	Polarity
(MHz)	Reading		(dB/m)	(dB)	Reading	(dBuV/m)	(dB)	(Degs)	(cm)	
	(dBuV)				(dBuV/m)					
345	91.61	Pk	14.2	-25.7	80.11	97.26	-17.15	28	305	V
345		Av			59.16	77.26	-18.1	28	305	V
345.0005	106.65	Pk	14.2	-25.7	95.15	97.26	-2.11	290	101	Н
345.0043		Av			74.2	77.26	-3.06	290	101	Н
690	61.81	Pk	20.1	-24.5	57.41	77.26	-19.85	288	102	Н
690		Av			36.46	57.26	-20.8	288	102	Н
690	43.99	Pk	20.1	-24.5	39.59	77.26	-37.67	202	101	V
690		Av			18.64	57.26	-38.62	202	101	V

Note: average reading = peak reading + DCCF

* 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 Refer to section 7.2 for duty cycle factor calculation(-20.95dB)

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HARMONICS AND TX SPURIOUS EMISSIONS ABOVE 1GHz



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Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Port 1 Factors	Corrected Avg Reading (dBuV/m)	Class B Avg Limit (dBuV/m)	Margin (dB)	Corrected Peak Reading (dBuV/m)	Class B Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.725	60.28	Pk	30	-32.6	36.73	57.26	-20.53	57.68	77.26	-19.58	196	223	н
1.725	51.39	Pk	30	-32.6	27.84	57.26	-29.42	48.79	77.26	-28.47	239	369	V
2.76	60.34	Pk	32.6	-31.6	40.39	54	-13.61	61.34	74	-12.66	182	103	Н
2.76	52.76	Pk	32.6	-31.6	32.81	54	-21.19	53.76	74	-20.24	36	148	V
3.105	69.18	Pk	32.7	-30.9	50.03	57.26	-7.23	70.98	77.26	-6.28	355	325	н
3.105	57.99	Pk	32.7	-30.9	38.84	57.26	-18.42	59.79	77.26	-17.47	51	105	V
3.45	63.24	Pk	33.3	-31.1	44.49	57.26	-12.77	65.44	77.26	-11.82	334	114	н
3.45	60.58	Pk	33.3	-31.1	41.83	57.26	-15.43	62.78	77.26	-14.48	292	368	V
3.795	65.14	Pk	33.3	-30.6	46.89	54	-7.11	67.84	74	-6.16	330	140	н
3.795	62.79	Pk	33.3	-30.6	44.54	54	-9.46	65.49	74	-8.51	285	386	V
4.14	71.82	Pk	33.3	-30.4	53.77	54	-0.23	73.72	74	-0.28	138	119	н
4.14	68.91	Pk	33.3	-30.4	50.86	54	-3.14	71.81	74	-2.19	275	398	V
4.485	71.65	Pk	34	-30.2	54.5	57.26	-2.76	75.45	77.26	-1.81	155	101	н
4.485	65.9	Pk	34	-30.2	48.75	57.26	-8.51	69.7	77.26	-7.56	196	387	V
4.83	60.61	Pk	34.3	-29.5	44.46	54	-9.54	65.41	74	-8.59	311	102	н
4.83	57.03	Pk	34.3	-29.5	40.88	54	-13.12	61.83	74	-12.17	202	393	V

* 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

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BELOW 30MHz

FCC Part 15, Subpart B & C

3 Meter Distance Measurement At Open Field

Company: Ecolink Project #: 15U21269 EUT configuration #: EUT ONLY Cont. TX. Mode of operation: 9KHz-30MHz Tester: R.A Date: 7/18/15

Frequency	PK	QP	AV	AF	Distance	Distance	PK Corrected	AV Corrected				AV Margin	Notes
(MHz)	(dBu/V)	(dBu/V)	(dBuV)	dB/m	(m)	Correction (dB)	Reading (dBuV/m)	Reading (dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	
Loop Antenn	a Face O	n:											
0.02	60.975		53.91	13.8	3	-80.00	-5.22	-12.29	61.58	41.58	-66.8	-53.9	
0.05	52.66		45.16	11.3	3	-80.00	-16.04	-23.54	53.62	33.62	-69.7	-57.2	
0.22	13.067		11.45	10.8	3	-80.00	-56.13	-57.75	40.76	20.76	-96.9	-78.5	
1.47	14.5	8.698		10.75	3	-40.00	-20.56		24.26		-44.8		
15.064	15.064	8.992		10.59	3	-40.00	-20.41		29.54		-50.0		
23.73	13.593	8.096		9.429	3	-40.00	-22.48		29.54		-52.0		
Loop Antenn	a Face O	ff:											
0.02	60.122		54.11	13.8	3	-80.00	-6.08	-12.09	61.58	41.58	-67.7	-53.7	
0.05	50.36		45.34	11.3	3	-80.00	-18.34	-23.36	53.62	33.62	-72.0	-57.0	
0.22	14.086		10.65	10.8	3	-80.00	-55.11	-58.55	40.76	20.76	-95.9	-79.3	
1.47	14.59	8.954		10.75	3	-40.00	-20.30		24.26		-44.6		
15.064	15.21	9.236		10.59	3	-40.00	-20.17		29.54		-49.7		
23.73	13.456	7.981		9.429	3	-40.00	-22.59		29.54		-52.1		

* No more emissions were found up to 30MHz

Note: The emission limits are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 10000Mhz. Radiated emission limits in these three bands are based on measurements employing an average detector.

P.K. = Peak

Q.P. = Quasi Peak Readings

A.F. = Antenna factor

Below 150kHz => RBW=VBW=200 or 300Hz Above 150kHz =>RBW=VBW=9 or 10kHz (Average => VBW=10Hz)

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