FCC 47 CFR PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

Audio Detector

MODEL NUMBER: WST-601

FCC ID: XQC-WST601

REPORT NUMBER: 10400745B

ISSUE DATE: Jun 25, 2015

Prepared for
Ecolink Intelligent Technology
2055 Corte Del Nogal
Carlsbad, CA 92011

Prepared by

UL LLC
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Northbrook, IL 60062
TEL: (847) 272-8800

NVLAP Lab code: 100414-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	05/21/15	Initial Issue	M.Ferrer
B	6/25/15	Update below 30MHz test result; Update page 22, 23, radiated test procedure.	P. Zhang

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Ecolink Intelligent Technology
2055 Corte Del Nogal
Carlsbad, CA 92011

EUT DESCRIPTION: Audio Detector

MODEL: WST-601

SERIAL NUMBER: Prototype

DATE TESTED: January 5, 2015 – Jun 25, 2015

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 15 SUBPART C	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:

BART MUCHA
Staff Engineer
UL LLC

Tested By:

MICHAEL FERRER
Program Manager
UL LLC

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15.

Testing deviation for Radiated Emissions above 1GHz was tested with EUT height at 1.5m.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 333 Pfingsten Road, Northbrook, IL 60062 USA.

UL NBK is accredited by NVLAP, Laboratory Code 100414-0. The full scope of accreditation can be viewed at http://ts.nist.gov/Standards/scopes/1004140.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

Sample Calculations
Radiated Field Strength and Conducted Emissions data contained within this report is calculated on the following basis:
Field Strength (dBuV/m) = Meter Reading (dBuV) + AF (dB/m) - Gain (dB) + Cable Loss (dB)
Conducted Voltage (dBuV) = Meter Reading (dBuV) + Cable Loss (dB) + LISN IL (dB)
Conducted Current (dBuA) = Meter Reading (dBuV) + Cable Loss (dB) - Transducer Factor (dBohms)

4.3. MEASUREMENT UNCERTAINTY

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

Test	Range	Equipment	Uncertainty k=2
Radiated Emissions	30-200MHz	Bicon 10m Horz	4.27dB
Radiated Emissions	30-200MHz	Bicon 10m Vert	4.28dB
Radiated Emissions	200-1000MHz	LogP 10m Horz	3.33dB
Radiated Emissions	200-1000MHz	LogP 10m Vert	3.39dB
Radiated Emissions	30-200MHz	Bicon 3m Horz	3.30dB
Radiated Emissions	30-130MHz	Bicon 3m Vert	4.84dB
Radiated Emissions	130-200MHz	Bicon 3m Vert	4.94dB
Radiated Emissions	200-1000MHz	LogP 3m Horz	3.46dB
Radiated Emissions	200-1000MHz	LogP 3m Vert	4.98dB
Radiated Emissions	1-6GHz	Horn	5.02dB
Radiated Emissions	6-18GHz	Horn	5.34dB
Radiated Emissions	18-26GHz	Horn	6.60dB
Conducted Ant Port	30MHz-26GHz	Spectrum Analyzer	2.94

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Transmitter intended for Security use. Uses 3VDC battery
.

5.2. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a Loop antenna using copper wire, with a maximum gain of -15dBi.

5.3. WORST-CASE CONFIGURATION AND MODE

The worst-case axis was determined as Y-axis with preliminary testing.

5.4. MODIFICATIONS

No modifications were made during testing.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List			
Description	**Manufacturer**	**Model**	**Serial Number**
Audio Detector	Ecolink	WST-601	Prototype

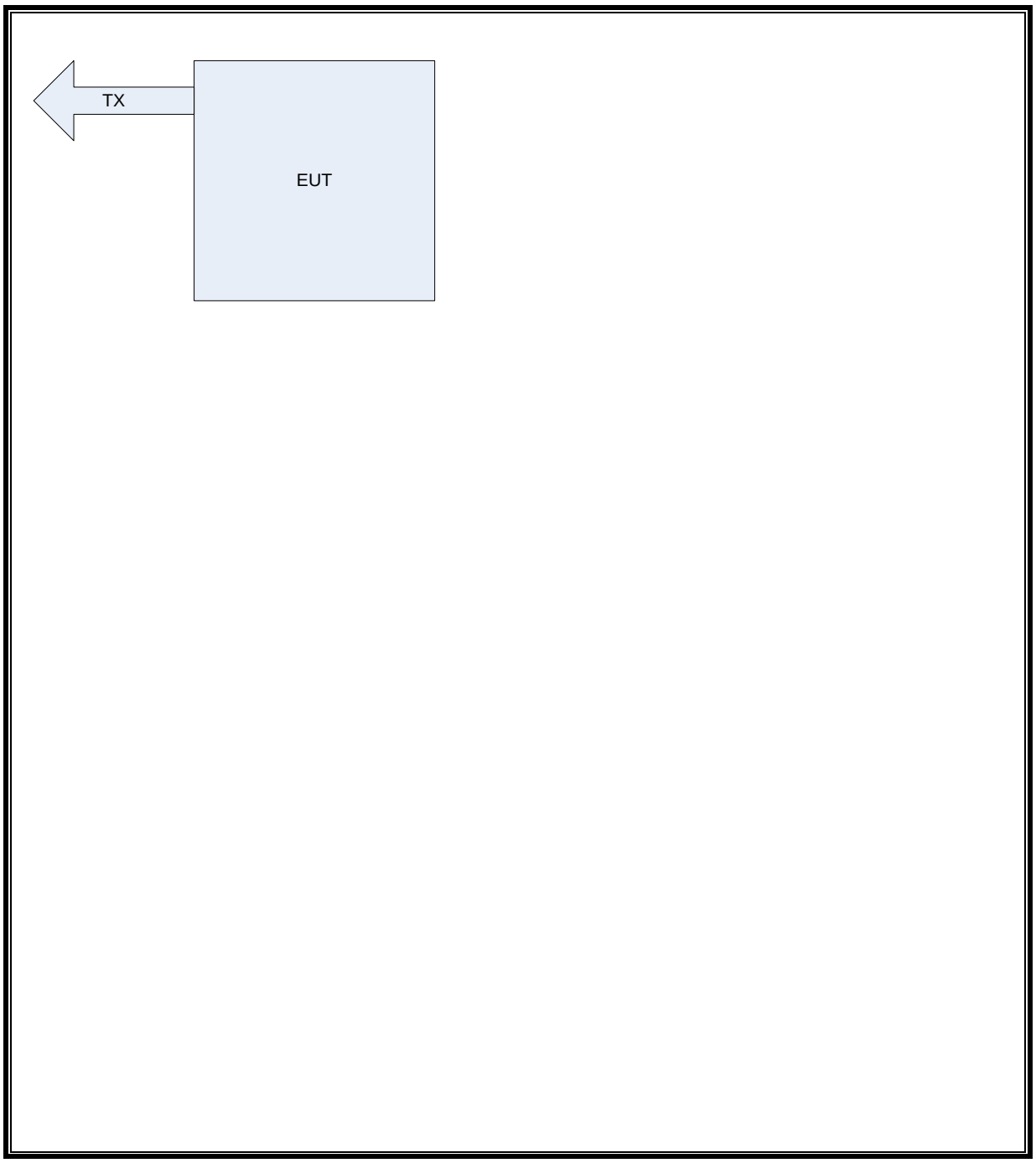
I/O CABLES

None

TEST SETUP

The EUT is a standalone product. 2 samples were provided. 1 programed with continuous transmission and 1 programed as normal use.

SETUP DIAGRAM FOR TESTS



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**	**T No.**	**Cal Date**	**Cal Due**
Radiated Software	UL	UL EMC	Ver 9.5, July 22, 2014		
Conducted Software	UL	UL EMC	Ver 9.5, May 17 2012		
EMI Test Receiver	Rohde & Schwarz	ESCI	EMC4328	20141218	20151231
Bicon Antenna	Chase	VBA6106A	EMC4078	20140401	20150401
Log-P Antenna	Chase	UPA6109	EMC4313	24141119	20151130
Spectrum Analyzer	Rohde & Schwarz	ESU	EMC4323	20141216	20151231
Antenna Array	UL	BOMS	EMC4276	20141201	20151231
EMI Test Receiver	Agilent	N9030A	EMC4360	20141219	20151219

All Radiated Emissions testing was completed prior to April 1, 2015.

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

ANSI C63.4

The transmitter output is connected to the spectrum analyzer.

20dB Bandwidth: The RBW is set to 10 KHz. The VBW is set to 30 KHz. The sweep time is coupled. Bandwidth is determined at the points 20 dB down from the modulated carrier.

RSS-Gen 6.6
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.

RESULTS

No non-compliance noted:

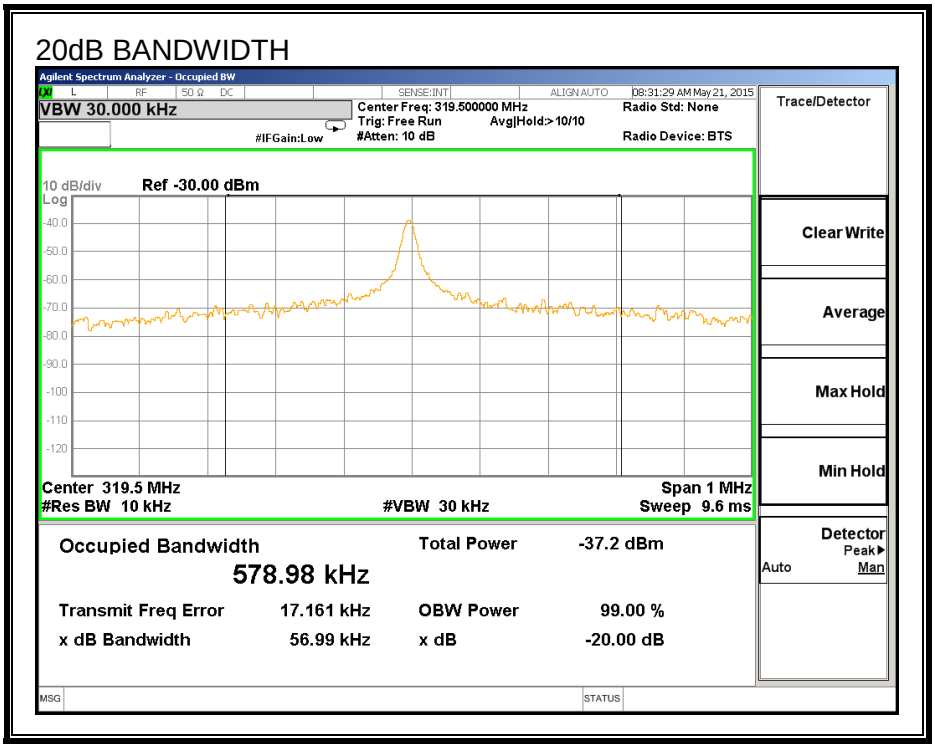
20dB Bandwidth

Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)
319.5	56.99	798.75	-741.76

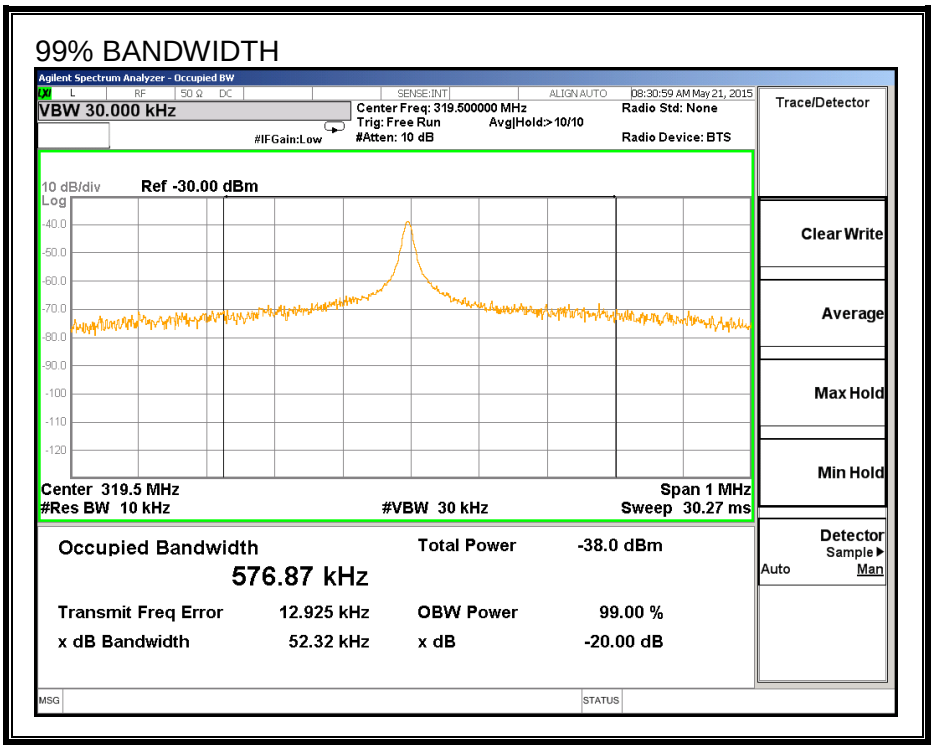
99% Bandwidth

Frequency (MHz)	99% Bandwidth (kHz)	Limit (kHz)	Margin (kHz)
319.5	576.87	798.75	-221.88

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

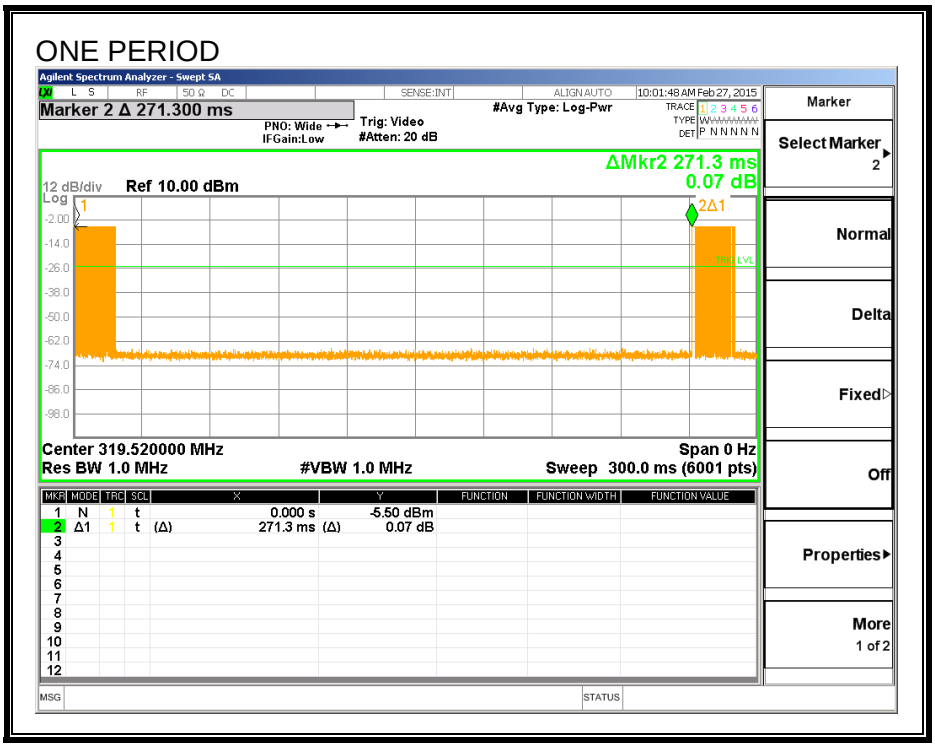
Average Reading = Peak Reading (dBuV/m) + 20log (Duty Cycle), Where Duty Cycle is (# of long pulses * long pulse width) + (# of medium pulses * medium pulse width) + (# of short pulses * short pulse width) / 100 or T

RESULTS

No non-compliance noted:

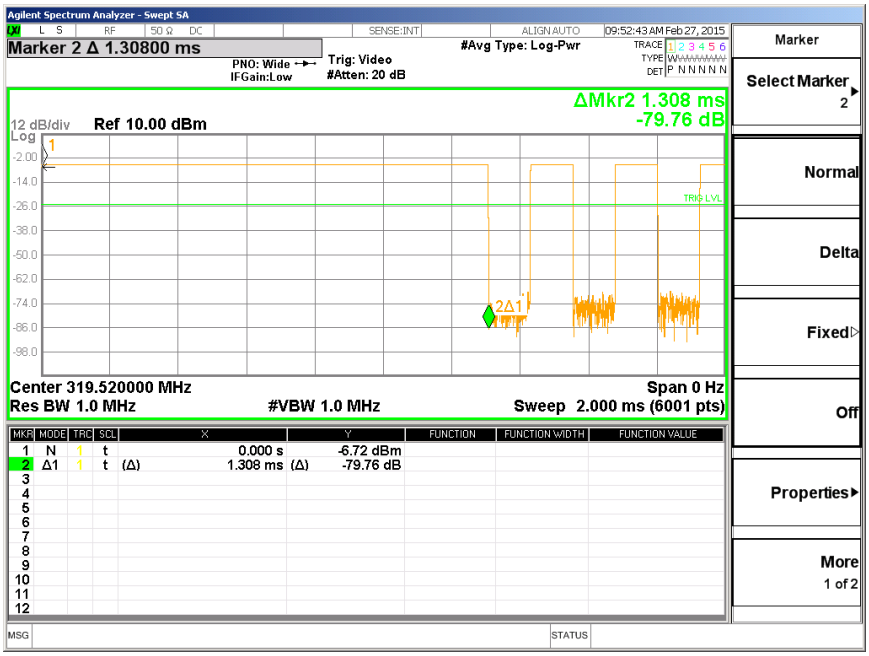
One Period (ms)	Long Width (ms)	# of Long Pulses	Medium Width (ms)	# of Medium Pulses	Short Width (ms)	# of Short Pulses	Duty Cycle	20*Log Duty (dB)
271.3	1.308	1	0.4967	1	0.125	58	0.0905	-20.86

ONE PERIOD

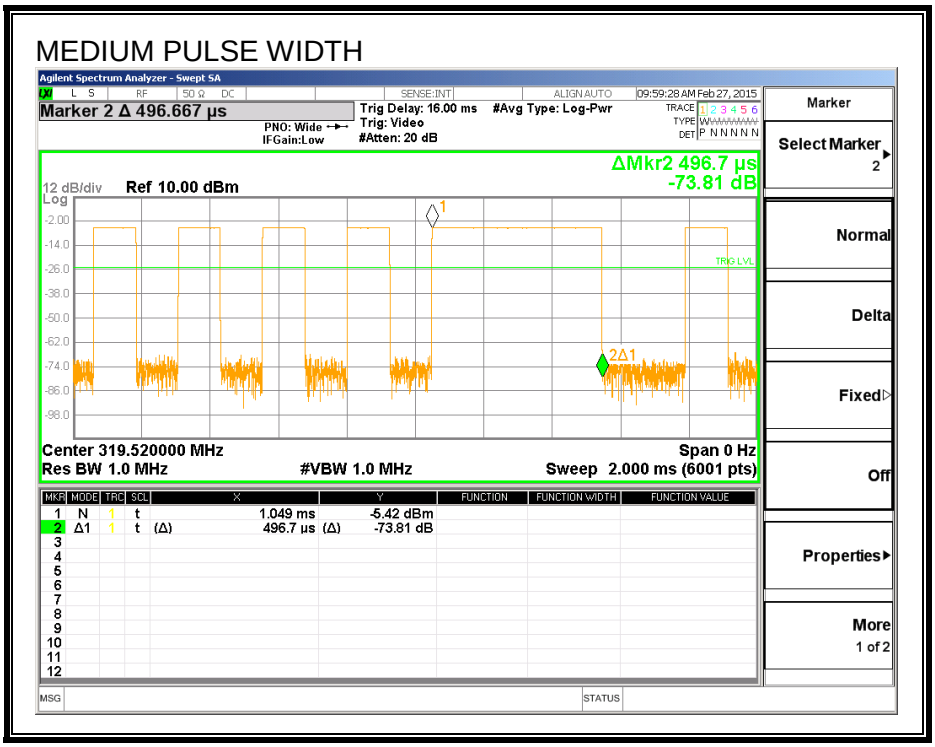


LONG PULSE WIDTH

LONG PULSE WIDTH

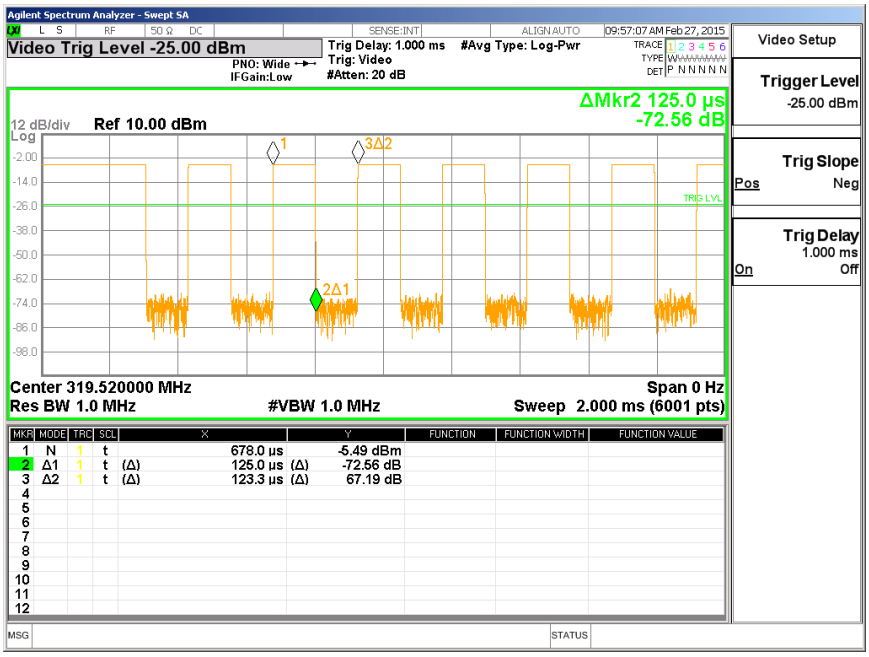


MEDIUM PULSE WIDTH

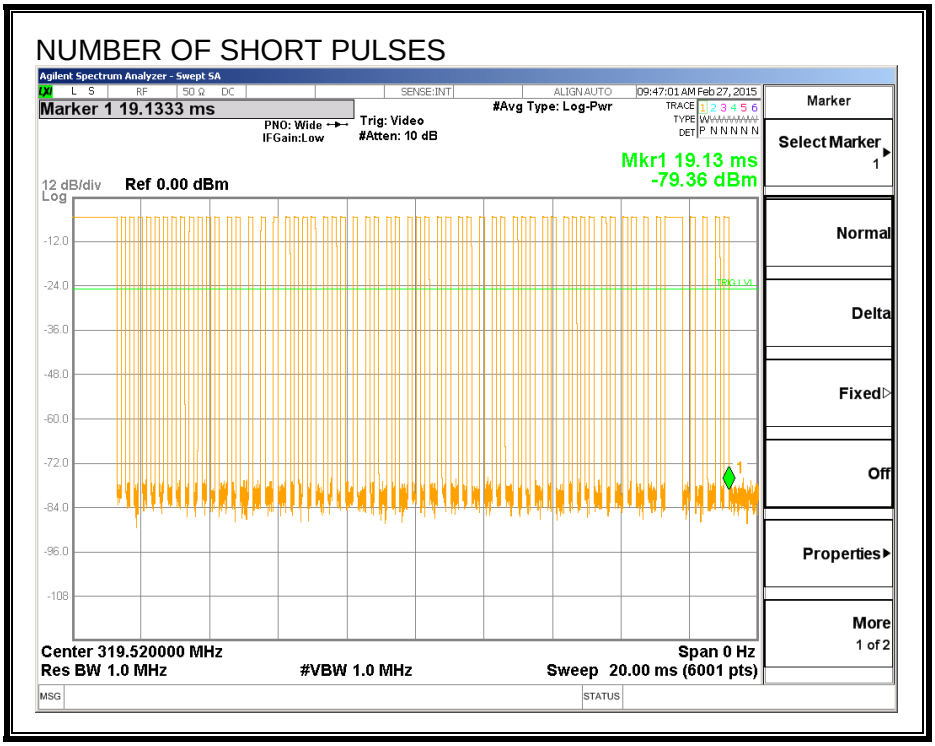


SHORT PULSE WIDTH

SHORT PULSE WIDTH



NUMBER OF SHORT PULSES



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.

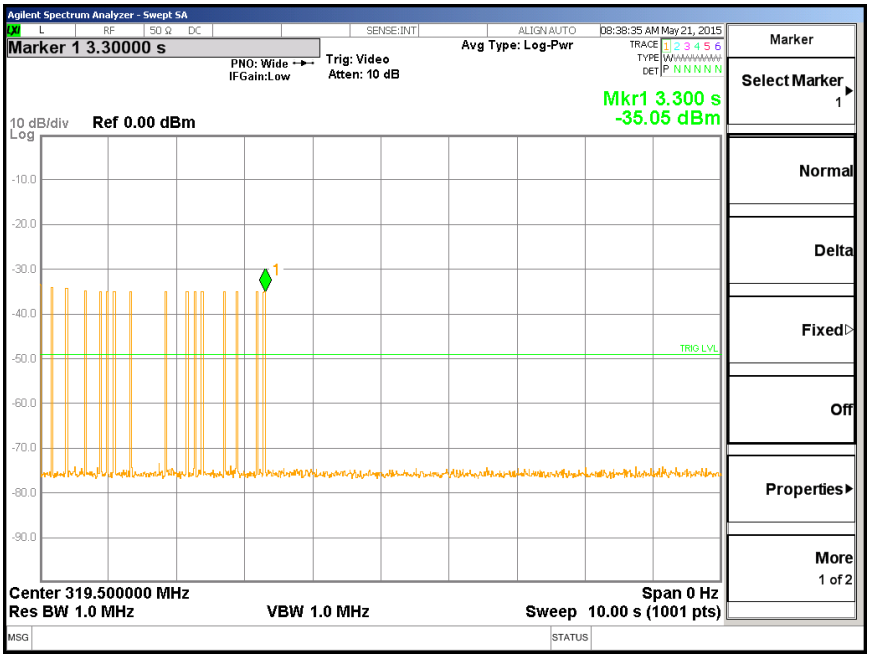
TEST PROCEDURE

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



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)
Fundamental frequency (MHz)	**Field strength of fundamental (microvolts/meter)**	**Field strength of spurious emissions (microvolts/meter)**
40.66-40.70	2,250	225
70-130	1,250	125
130-174	[1]1,250 to 3,750	[1]125 to 375
174-260	3,750	375
260-470	[1]3,750 to 12,500	[1]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)
quency (MHz)	**Field strength (microvolts/meter)**	**Measurement distance (meters)**
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
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.

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. 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 3 MHz for peak measurements and apply DCCF 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:

RESULTS

BELOW 30MHz

FCC Part 15, Subpart B & C **3 Meter Distance Measurement At Open Field**

Company: Ecolink
Project #: 10400745
EUT configuration #: EUT ONLY Cont. TX.
Mode of operation: 9KHz-30MHz
Tester: R. Alegre
Date:

Frequency (MHz)	PK (dBu/V)	QP (dBu/V)	AV (dBuV)	AF dB/m	Distance (m)	Distance Correction (dB)	PK Corrected Reading (dBuV/m)	AV Corrected Reading (dBuV/m)	PK Limit (dBuV/m)	AV Limit (dBuV/m)	PK Margin (dB)	AV Margin (dB)	Notes
Loop Antenna Face On:													
0.03	62.1		56.89	12.97	3	-80.00	-4.93	-10.14	58.06	38.06	-63.0	-48.2	
0.05	59.12		57.13	11.3	3	-80.00	-9.58	-11.57	53.62	33.62	-63.2	-45.2	
0.22	60.45		52.2	10.8	3	-80.00	-8.75	-17.00	40.76	20.76	-49.5	-37.8	
1.05	55.09	48.22		10.71	3	-40.00	18.93		27.18		-8.3		
7.21	59.49	52.65		10.86	3	-40.00	23.51		29.54		-6.0		
15.45	60.89	53.01		10.56	3	-40.00	23.57		29.54		-6.0		
Loop Antenna Face Off:													
0.03	61.3		59.21	12.97	3	-80.00	-5.73	-7.82	58.06	38.06	-63.8	-45.9	
0.05	57.56		55.6	11.3	3	-80.00	-11.14	-13.10	53.62	33.62	-64.8	-46.7	
0.22	59.58		57.6	10.8	3	-80.00	-9.62	-11.60	40.76	20.76	-50.4	-32.4	
1.05	53.57	43.98		10.71	3	-40.00	14.69		27.18		-12.5		
7.21	58.3	51.52		10.86	3	-40.00	22.38		29.54		-7.2		
15.45	58.3	52.26		10.56	3	-40.00	22.82		29.54		-6.7		

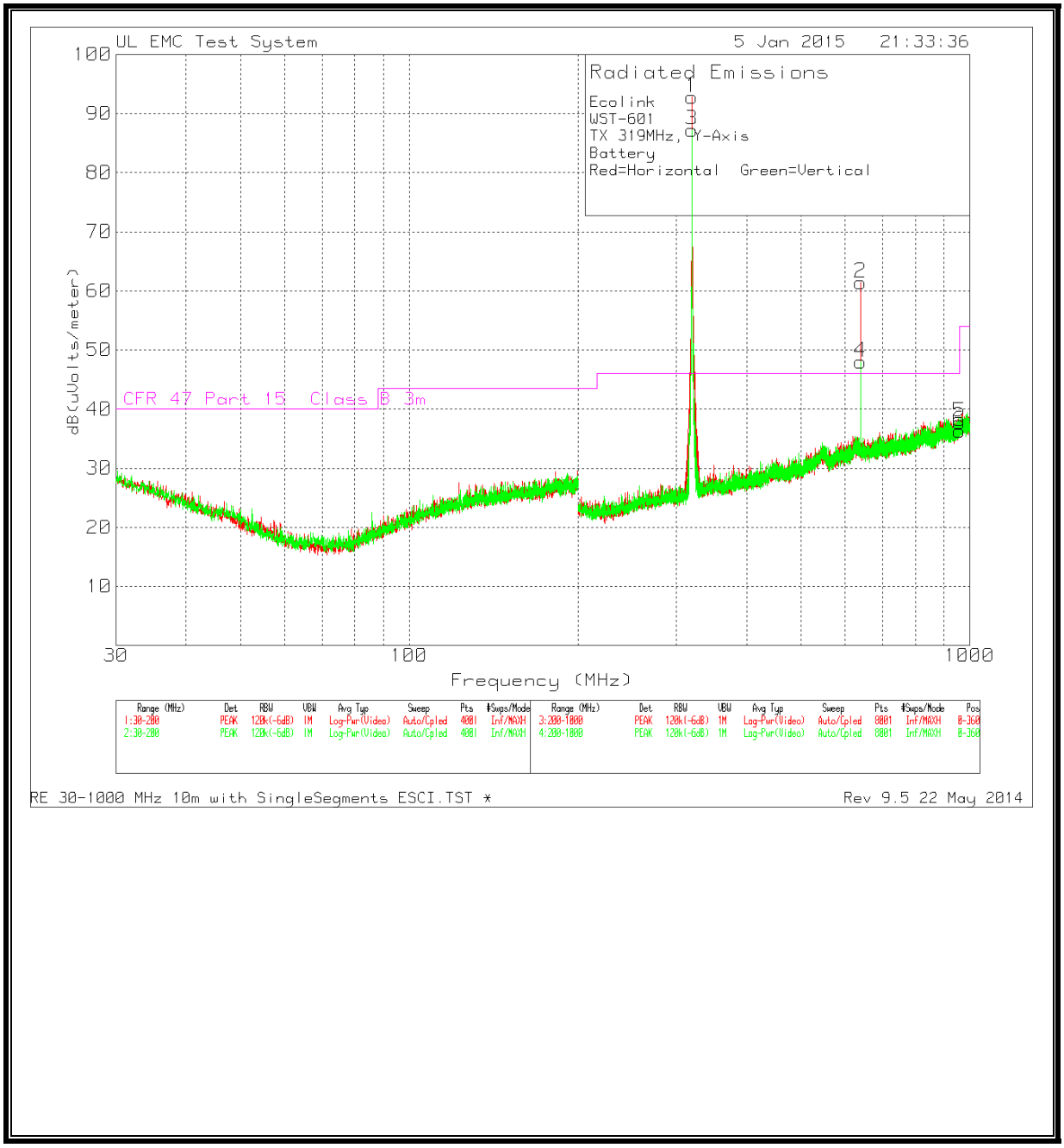
* No more emissions were found up to 30MHz

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 Below 150kHz => RBW=VBW=200 or 300Hz
A.F. = Antenna factor Above 150kHz =>RBW=VBW=9 or 10kHz (Average => VBW=10Hz)

Rev. 060314

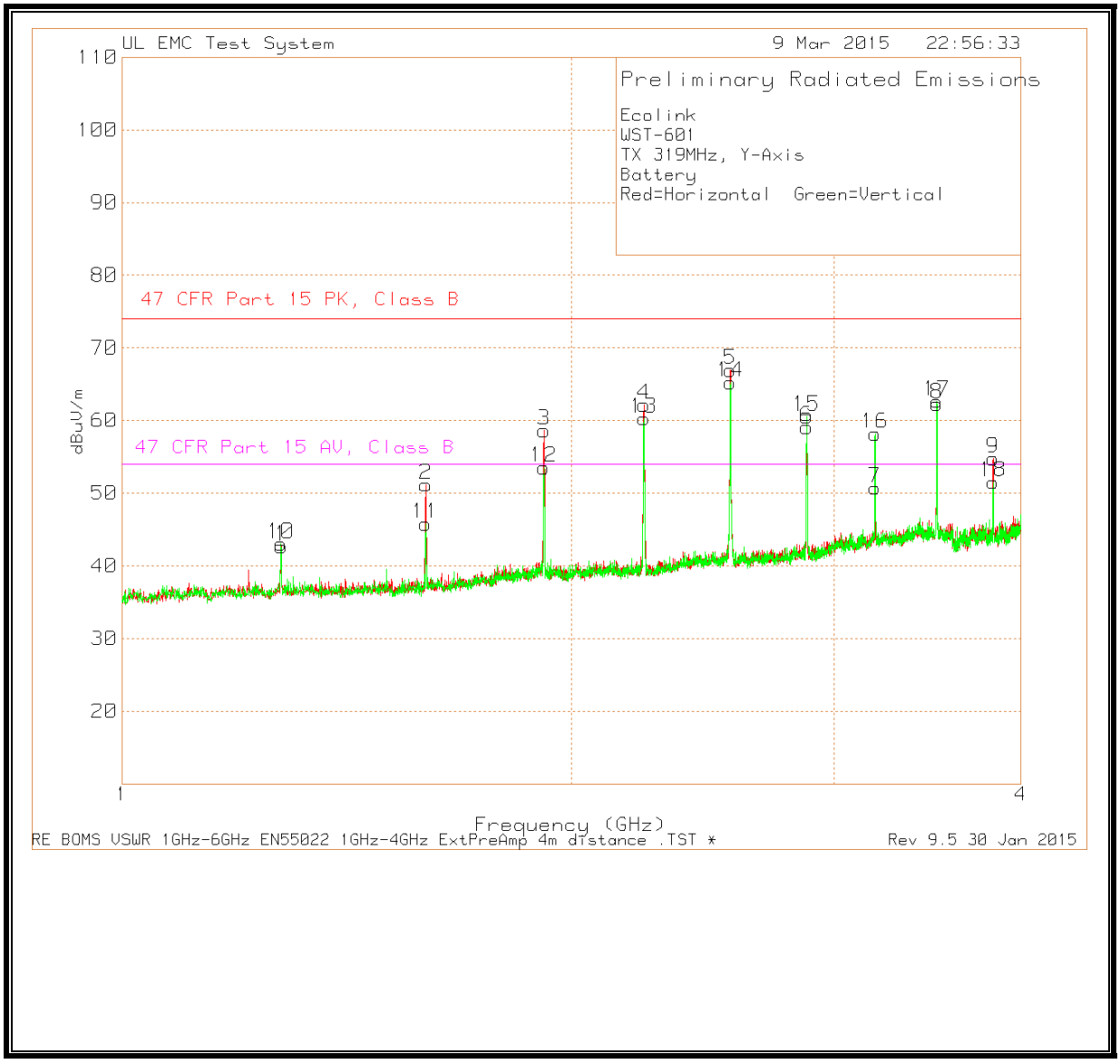
FUNDAMENTAL, HARMONICS AND TX SPURIOUS EMISSION (30 – 1000 MHz)



Ecolink
WST-601
TX 319MHz

Test Frequency (MHz)	Meter Reading (dBuV)	Detector	Antenna Factor dB/m	Cable Factor dB	PK Corrected Reading dB(uVolts /meter)	PK Limit	Margin (dB)	Duty Cycle	AV Corrected Reading dB(uVolts /meter)	AV Limit	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
319.4915	72.32	PK	14.6	8.2	95.12	100.02	-4.9	-20.86	74.26	80.02	-5.76	357	104	H
319.4875	60.39	PK	14.6	8.2	83.19	100.02	-16.83	-20.86	62.33	80.02	-17.69	26	247	V
639.011	26.29	PK	20.7	9.3	56.29	80.02	-23.73	-20.86	35.43	60.02	-24.59	18	140	H
639.041	21.1	PK	20.7	9.3	51.1	80.02	-28.92	-20.86	30.24	60.02	-29.78	106	110	V
958.48	7.5	PK	24.1	10.2	41.8	80.02	-38.22	-20.86	20.94	60.02	-39.08	21	163	H
958.48	4.97	PK	24.1	10.2	39.27	80.02	-40.75	-20.86	18.41	60.02	-41.61	296	115	V

HARMONICS AND TX SPURIOUS EMISSIONS ABOVE 1GHz



Ecolink

WST-601

TX 319MHz, Y-Axis

Battery

Red=Horizontal Green=Vertical

Test Frequency (GHz)	Meter Reading (dBuV)	Detector	Antenna Factor dB/m	Gain/Loss Factor	Corrected Reading dBuV/m	47 CFR Part 15 PK, Class B	Margin (dB)	Duty Cycle	Corrected AV Reading dBuV/m	47 CFR Part 15 AV, Class B	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
2.556	89.59	PK	29.1	-51.4	67.29	74	-6.71	-20.86	46.43	54	-7.57	207	113	H
2.5559	87.88	PK	29.1	-51.4	65.58	74	-8.42	-20.86	44.72	54	-9.28	148	162	V
2.2366	87.62	PK	27.7	-52.01	63.31	74	-10.69	-20.86	42.45	54	-11.55	223	100	H
2.2364	84.21	PK	27.7	-52	59.91	74	-14.09	-20.86	39.05	54	-14.95	162	198	V
2.8754	82	PK	29.3	-50.27	61.03	74	-12.97	-20.86	40.17	54	-13.83	90	125	H
2.8752	80.69	PK	29.3	-50.27	59.72	74	-14.28	-20.86	38.86	54	-15.14	265	156	V
1.9169	84.33	PK	27.6	-53.4	58.53	74	-15.47	-20.86	37.67	54	-16.33	91	110	H
1.9169	79.99	PK	27.6	-53.4	54.19	74	-19.81	-20.86	33.33	54	-20.67	144	173	V
3.1947	73.58	PK	30.9	-50.49	53.99	74	-20.01	-20.86	33.13	54	-20.87	74	100	H
3.195	78.03	PK	30.9	-50.49	58.44	74	-15.56	-20.86	37.58	54	-16.42	115	100	V