
Project 17510

Model TM500-315

Wireless Certification Report

Prepared for:

TowMate
15827 Serenity Point Lane
Rogers, Arkansas 72756

By

Professional Testing (EMI), Inc.
1601 North A.W. Grimes Blvd., Suite B
Round Rock, Texas 78665

21 Dec 2015

Reviewed by

A handwritten signature in black ink, appearing to read 'Larry Finn'.

Larry Finn
Chief Technology Officer

Written by

A handwritten signature in black ink, appearing to read 'Eric Lifsey'.

Eric Lifsey
EMC Engineer

Revision History

Revision Number	Description	Date
00	Initial draft.	21 Dec 2015
01	Revised with product details.	21 Dec 2015

Corrections

In all cases where the model appears at 315 MHz Wireless Towlight or similar it represents the model TM500-315.

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Certificate of Compliance

Applicant	Device & Test Identification
TowMate (William Anderson) 15827 Serenity Point Lane Rogers, Arkansas 72756 Certificate Date: 21 Dec 2015	FCC ID: UZVTM315 Industry Canada ID: Not Applicable Model(s): TM500-315 Laboratory Project ID: 17510

The device model(s) listed above were tested utilizing the following documents and found to be in compliance with the required criteria.

47 CFR (USA) Industry Canada RSS-210 & RSS-Gen	
Section Reference FCC IC	Parameter
15.231(a) RSS-210 Is. 8 A1.1, Table A	Fundamental Field Strength
15.231(a) RSS-210 Is. 8 A1.1, Table A	Harmonic & Spurious Emissions
15.231(a)(1) RSS-210 Is. 8 A1.1.1	Maximum Transmit Time
15.231(c) RSS-210 Is. 8 A1.1.3	Bandwidth
15.203 RSS-Gen Is. 3	Antenna Requirements

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above rules and test procedures have reviewed the test setup, measured data, and this report. I believe them to be true and accurate.

Eric Lifsey
EMC Engineer

This report has been reviewed and accepted by the Applicant. The undersigned is responsible for ensuring that this device will continue to comply with the rules listed above.

Representative of Applicant

1.0 Introduction

1.1 Scope

This report describes the extent to which the equipment under test (EUT) conformed to the intentional radiator requirements of North America.

Professional Testing (EMI), Inc., (PTI) follows the guidelines of National Institute of Standards and Technology (NIST) for all uncertainty calculations, estimates, and expressions thereof for electromagnetic compatibility testing. The procedures of ANSI C63.4: 2009 were used for making all radiated enclosure and mains emission measurements.

1.2 EUT Description

This device is part of a wireless extension of the rear signal lights of a towing vehicle. It will be used in multiple products by the manufacturer on a limited-modular basis; it is not intended for sale to other parties.

Table 1.2.1: Equipment Under Test

Manufacturer	Model	Serial #	Description
TowMate	TM500-315	None	Transmitter

The device is composed of an approximately square circuit board 3.3 x 4.3 cm and typically housed in a rigid plastic case or in a plastic connector of the style used to connect a towed vehicle to the towing vehicle. As tested it was circuit board only. The device only transmits when it receives power; it has no receive mode.

In operation the device is activated/powered by the usual rear signal lights from the towing vehicle and transmits this information to a separate device attached to the towed vehicle and replicates the light signals for other traffic to observe. When no vehicle lamps are powered, the transmitter is also not powered.

1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations.

1.4 Modifications to Equipment

The EUT transmit power was reduced, and duty cycle extended, during the performance of the test program.

1.5 Radiated Measurement Calculation

Raw Measured Level + Antenna Factor + Cable Losses – Amplifier Gain = Corrected Level
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When measurement distance differs from the specified limit distance the correct extrapolation factor is applied.

2.0 Applicable Documents and Clauses

Table 2.0.1: Applicable Documents	
Document	Title/Description
47 CFR (USA)	Part 15 – Section 15.231
ANSI C63.4 2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment
RSS-Gen Issue 3	General Requirements and Information for the Certification of Radio Apparatus
RSS-210 Issue 8	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

Table 2.0.2: Applicable Clauses	
47 CFR (USA) Industry Canada RSS-210 & RSS-Gen	
Section Reference FCC IC	Parameter
15.231(a) RSS-210 A1.1, Table A	Fundamental Field Strength
15.231(a) RSS-210 A1.1, Table A	Harmonic & Spurious Emissions
15.231(a)(1) RSS-210 A1.1.1	Maximum Transmit Time
15.231(c) RSS-210 A1.1.3	Bandwidth
15.203 RSS-Gen	Antenna Requirements

Table 2.0.3: Supplemental Statements		
Section Number FCC	Clause Subject	Statement
Section Number IC		
FCC 15.231(a)(3)	Periodic Transmissions	The EUT makes no periodic transmission and is strictly activated by the vehicle lighting/indicator including brake and turn signals. Transmission only occurs while the lights are engaged and ceases immediately when light power is removed.
RSS-210 A1.1.1(c)		

2.1 Test Site

Measurements were made at the PTI semi-anechoic facility designated Site 45 (FCC 459644, IC 3036B-1) in Austin, Texas. The site is registered with the FCC under Section 2.948 and Industry Canada per RSS-GEN, and is subsequently confirmed by laboratory accreditation (NVLAP). The test site is located at 11400 Burnet Road, Austin, Texas 78758, while the main office is located at 1601 North A.W. Grimes Boulevard, Suite B, Round Rock, Texas, 78665.

3.0 Fundamental Field Strength

3.1 Test Procedure

EUT is placed on a non-conductive surface 80 cm above a reference plane and measurements of emissions are made to find maximum emission level.

3.2 Test Criteria

Section Reference FCC IC	Parameter	Date(s)
15.231(a) RSS210 A1.1	Frequency 315.0 MHz Radiated Output Power, 10,333.33 μ V/m @ 3 m Restated as 80.28 dB μ V/m @ 3 m Or extrapolated as 69.8 dB μ V/m @ 10 m	14 Dec 2015

3.3 Test Results

Table 3.3.1: Field Strength at 10 Meters			
Frequency MHz	Antenna Polarity	Corrected Level (Measured Peak Level) dB μ V/m	Detector Mode
315	V	80.94	Peak
315	H	81.40	Peak

Resolution bandwidth 120 kHz. Video bandwidth 120 kHz. Detector mode is peak.

Duty cycle is such that the emission average level is calculated from the duty cycle factor applied to the measured peak level.

Table 3.3.2: Corrected Field Strength				
Limit At 10 meters dB μ V/m (Average Detection)	Maximum Corrected Level (Measured Peak Level) dB μ V/m	Duty Cycle Factor dB	Calculated Average Level dB μ V/m	Margin dB
65.17	81.4	-19.82	61.58	-3.59

The EUT was found to be in compliance with the applicable criteria.

4.0 Transmitter Duty Cycle and Shutoff Time

4.1 Test Procedure

EUT is placed into normal transmit operation to observe and record transmitter time domain performance.

4.2 Test Criteria

Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power. This is not a pass/fail measurement.

Section Reference FCC IC	Parameter	Date(s)
15.231(a)(1) RSS210 A1.1.1	Maximum Transmit Time Duty Cycle	14 Dec 2015

4.3 Test Results

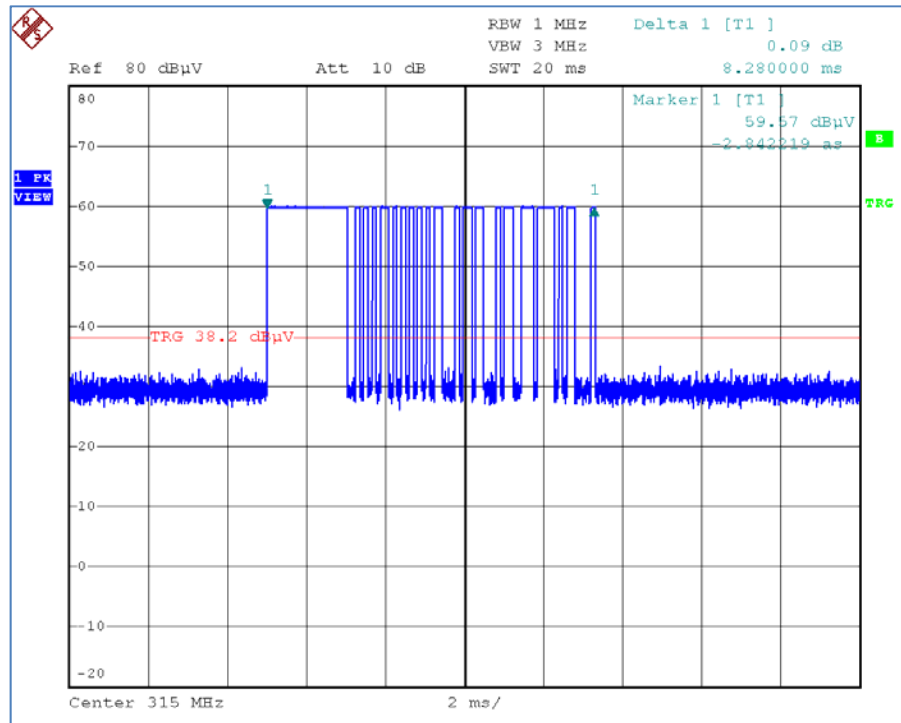
Table 4.3.1 Duty Cycle Results and Average Duty Cycle Factor Result				
Measured On Time (msec)	Measured Time Interval (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
8.28	81.125	$= 20 * \log_{10} (8.28 \text{ msec} / 81.125 \text{ msec})$	-19.82	-19.82

Table 4.3.2 Exposure Source Duty Cycle Results				
Measured On Time (msec)	Measured Time Interval (msec)	Exposure Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
8.28	81.125	$= 10 * \log_{10} (8.28 \text{ msec} / 81.125 \text{ msec})$	-9.91	-9.91

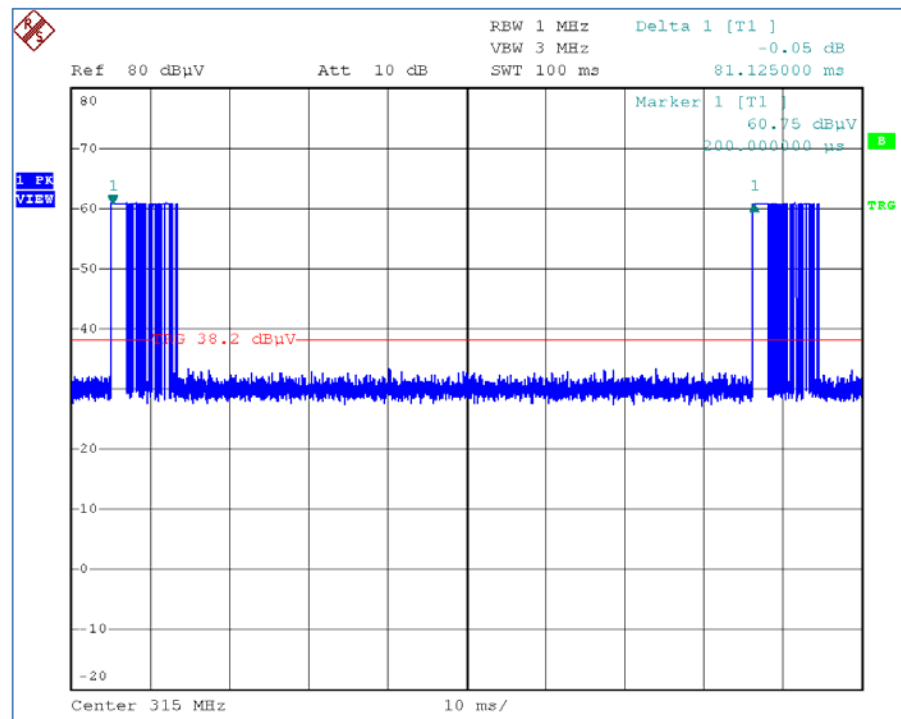
Table 4.3.3: Maximum Transmit Shutoff Time, Limit and Measured	
Limit Transmit Time	Maximum Measured Transmit Time
5 seconds	Transmission ends immediately as all power is removed when all vehicle light signals stop functioning.

See plotted results of duty cycle time appear below.

4.3.1 Transmitter On Time



4.3.2 Transmitter Period



5.0 Occupied Bandwidth

5.1 Test Procedure

The EUT is configured for best signal/power and the bandwidth then is measured. A recording of the results is included.

5.2 Test Criteria

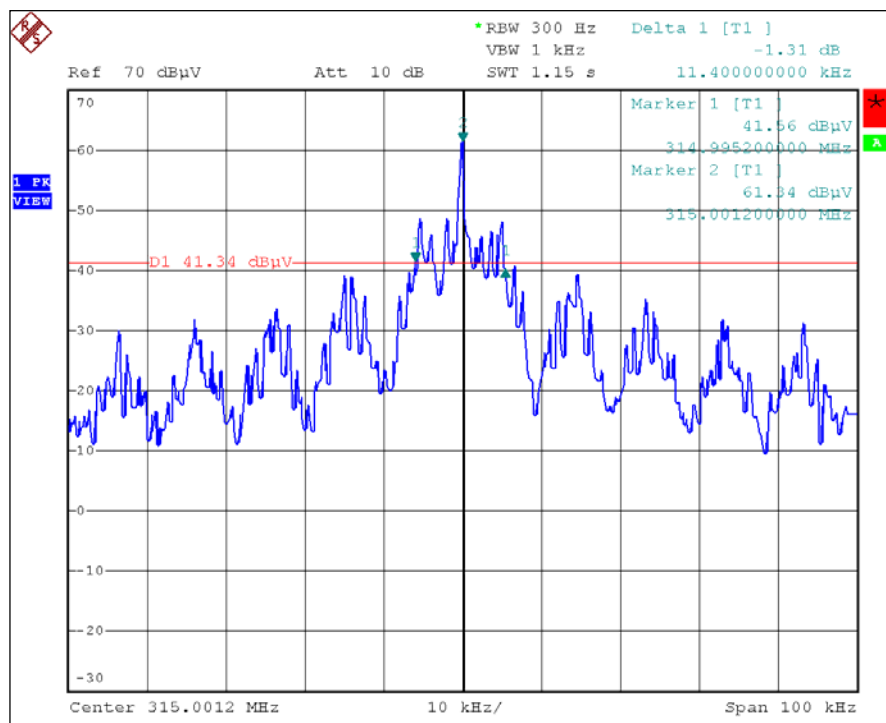
Section Reference FCC IC	Parameter	Date(s)
15.231(c), 2.1049 RSS210 A1.1.3	Bandwidth, 20 dB	15 Dec 2015

5.3 Test Results

Table 5.3.1: Bandwidth Limit and Measurement	
Limit 15.231(c) 20 dB BW For Fundamental = 315 MHz 0.25% of Fundamental kHz	Measured BW 20 dB kHz
$0.0025 \cdot 315.0 = 787.5$	11.4

EUT was found to be in compliance with applicable requirements.

5.3.1 Bandwidth Plot



6.0 Radiated Spurious Emissions

6.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a rotating turntable at a distance of 1 meter from the measurement antenna.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. A diagram showing the test setup is given in the figure below.

Harmonic emissions above 1 GHz peak were measured with peak detection, a resolution bandwidth of 1 MHz, and at a distance of 3 meters. If peak measurements exceeded average limits, the peak limit was applicable and duty cycle factor was then applied for average level calculation. Emissions were investigated up to at least the 10th harmonic of the transmitter fundamental.

Non-harmonic spurious emissions must satisfy the average limit and the peak limit (20 dB above average).

6.2 Test Criteria

Section Number FCC IC	Clause Subject	Date
15.231(a), 15.209 RSS-210 A1.1 Table A	Field Strength of Radiated Spurious/Harmonic Emissions	14 Dec 2015

6.3 Test Results

Emissions were measured in peak detection mode. All recorded emissions were harmonics of the fundamental. For each emission the average duty cycle factor (-19.82 dB) would apply. Therefore, the emissions must remain under the peak limit of 85 dB μ V/m to also satisfy the average limit. All emissions remained under the peak and therefore under the average limits.

The EUT satisfied the criteria. Recorded data is presented below.

6.3.1 Below 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.										
Test Method:		ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).								
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits								
Section:		15.209								
Test Date(s):		12/14/2015			EUT Serial #:		N/A			
Customer:		4L-Design (TowMate)			EUT Part #:		0			
Project Number:		17510-15			Test Technician:		Eric Lifsey			
Purchase Order #:		0			Supervisor:		Lisa Arndt			
Equip. Under Test:		315 MHz Wireless Towlight			Witness' Name:		None			
Radiated Emissions Test Results Data Sheet										Page: 1 of 1
EUT Line Voltage:		14 VDC		EUT Power Frequency:		0 N/A				
Antenna Orientation:		Vertical			Frequency Range:		30MHz to 1GHz			
EUT Mode of Operation:					Transmit					
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results	
30.3142	10	81	3.43	Quasi-peak	24	12.573	29.5	-16.9	Pass	
59.0488	10	11	3.58	Quasi-peak	31.4	13.299	29.5	-16.2	Pass	
630.27	10	144	1.93	Quasi-peak	22.1	20.316	35.6	-15.3	Pass	

Professional Testing, EMI, Inc
Radiated Emissions, 10m Distance
30MHz - 1GHz Vertical Polarity Measured Emissions

Field Strength (dBμV/m)

Frequency

Operator: Eric Lifsey
17510_121415_RE02_Spurious.til
10:22:49 AM, Monday, December 14, 2015

Mode: Transmitting
Power: 14VDC
2.05k

EUT: 315 MHz Towlight
Project Number: 17510-15
Client: TowMate

≤ 1GHz Vertical Antenna Polarity Measured Emissions

Dark red line is average limit of 15.231; green line is peak limit assuming 20 dB duty cycle factor.

6.3.2 Below 1 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.									
Test Method:		ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).							
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits							
Section:		15.209							
Test Date(s):		12/14/2015			EUT Serial #:		N/A		
Customer:		4L-Design (TowMate)			EUT Part #:		0		
Project Number:		17510-15			Test Technician:		Eric Lifsey		
Purchase Order #:		0			Supervisor:		Lisa Arndt		
Equip. Under Test:		315 MHz Wireless Towlight			Witness' Name:		None		
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		14 VDC		EUT Power Frequency:		0		N/A	
Antenna Orientation:		Horizontal		Frequency Range:		30MHz to 1GHz			
EUT Mode of Operation:				Transmit					
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
39.1879	10	33	1.25	Quasi-peak	24	6.898	29.5	-22.6	Pass
58.905	10	326	1.37	Quasi-peak	23.1	5.024	29.5	-24.5	Pass
630.213	10	78	1.53	Quasi-peak	33.8	32.109	35.6	-3.5	Pass

Professional Testing, EMI, Inc
Radiated Emissions, 10m Distance
30MHz - 1GHz Horizontal Polarity Measured Emissions

Operator: Eric Lifsey
17510_121415_RE02_Spurious.til
10:22:49 AM, Monday, December 14, 2015

Mode: Transmitting
Power: 14VDC
2.05k

Quasi-peak Limit Level
Peak Limit Level
Corrected Peak Value
Verified Low-Pk OP Reading
PK Verification Limit
Limit 15.231 Peak

PROFESSIONAL TESTING

EUT: 315 MHz Towlight
Project Number: 17510-15
Client: TowMate

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Dark red line is average limit of 15.231; green line is peak limit assuming 20 dB duty cycle factor.

6.3.3 Above 1 GHz, Vertical Polarity

Professional Testing, EMI, Inc.									
Test Method:		ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).							
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits							
Section:		15.209							
Test Date(s):		12/14/2015			EUT Serial #:		N/A		
Customer:		4L-Design (TowMate)			EUT Part #:		0		
Project Number:		17510-15			Test Technician:		Eric Lifsey		
Purchase Order #:		0			Supervisor:		Lisa Arndt		
Equip. Under Test:		315 MHz Wireless Towlight			Witness' Name:		None		
Radiated Emissions Test Results Data Sheet								Page: 1 of 1	
EUT Line Voltage:		14 VDC		EUT Power Frequency:		0 N/A			
Antenna Orientation:		Vertical			Frequency Range:		Above 1GHz		
EUT Mode of Operation:					Transmit				
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results
1261.76	3	229	1	Peak	44.7	32.604	74.0	-41.4	Pass
1571.47	3	275	1	Peak	44.5	33.557	74.0	-40.4	Pass
1888.84	3	323	1	Peak	43.9	34.481	74.0	-39.5	Pass
1261.76	3	229	1	Average	34.3	22.164	54.0	-31.8	Pass
1571.47	3	275	1	Average	35.6	24.624	54.0	-29.3	Pass
1888.84	3	323	1	Average	34.1	24.719	54.0	-29.2	Pass

Professional Testing, EMI, Inc.
Radiated Emissions, 3m Distance
1-6GHz Vertical Polarity Measured Emissions

Field Strength (dBμV/m)

Frequency

Operator: Eric Lifsey
17510_121415_RE02_Spurious.til
10:34:07 AM, Monday, December 14, 2015

Mode: Transmitting
Power: 14VDC
2.05k

EUT: 315 MHz Towlight
Project Number: 17510-15
Client: TowMate

> 1GHz Vertical Antenna Polarity Measured Emissions

Detector mode peak. Resolution bandwidth 1 MHz. Video bandwidth 3 MHz.

6.3.4 Above 1 GHz, Horizontal Polarity

Professional Testing, EMI, Inc.										
Test Method:		ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).								
In accordance with:		FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits								
Section:		15.209								
Test Date(s):		12/14/2015			EUT Serial #:		N/A			
Customer:		4L-Design (TowMate)			EUT Part #:		0			
Project Number:		17510-15			Test Technician:		Eric Lifsey			
Purchase Order #:		0			Supervisor:		Lisa Arndt			
Equip. Under Test:		315 MHz Wireless Towlight			Witness' Name:		None			
Radiated Emissions Test Results Data Sheet										
										Page: 1 of 1
EUT Line Voltage:		14 VDC		EUT Power Frequency:		0 N/A				
Antenna Orientation:		Horizontal		Frequency Range:		Above 1GHz				
EUT Mode of Operation:				Transmit						
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBμV/m)	Limit Level (dBμV/m)	Margin (dB)	Test Results	
1266.36	3	89	1	Peak	43.9	31.784	74.0	-42.2	Pass	
1572.23	3	272	1	Peak	44.5	33.499	74.0	-40.5	Pass	
1877.58	3	242	1	Peak	42.4	32.906	74.0	-41.1	Pass	
1266.36	3	89	1	Average	33.9	21.789	54.0	-32.2	Pass	
1572.23	3	272	1	Average	35	24.018	54.0	-29.9	Pass	
1877.58	3	242	1	Average	34	24.471	54.0	-29.5	Pass	

Professional Testing, EMI, Inc
Radiated Emissions, 3m Distance
1-6GHz Horizontal Polarity Measured Emissions

Field Strength (dBμV/m)

Frequency

Operator: Eric Lifsey
17510_121415_RE02_Spurious.til
10:34:07 AM, Monday, December 14, 2015

Mode: Transmitting
Power: 14VDC
2.05k

EUT: 315 MHz Towlight
Project Number: 17510-15
Client: TowMate

> 1GHz Horizontal Antenna Polarity Measured Emissions

Detector mode peak. Resolution bandwidth 1 MHz. Video bandwidth 3 MHz.

7.0 Antenna Construction Requirements

7.1 Procedure

A direct examination of the antenna construction is performed and compared to rule criteria that prevents wireless device antennas from being modified by end users in ways that would void their authorization to use the device.

7.2 Criteria

Section Number FCC IC	Clause Subject	Date
15.203 RSS-Gen	Antenna Construction	18 Dec 2015

7.3 Results

Antenna Manufacturer, Details
Manufactured by: TowMate Antenna is a fixed length of insulated wire soldered directly to the circuit board. Length = 23.5 cm No external connector.

The antenna is not subject to user replacement or substitution.

The antenna design satisfies the requirements of the rules.

8.0 Equipment Lists

8.1 Equipment for Fundamental Power and Spurious Radiated Emissions

Professional Testing, EMI, Inc.					
Test Method:		ANSI C63.4-2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators,			
In accordance with:		Radiated Emissions Limits			
Section:		15.209			
Test Date(s):		12/14/2015	EUT Serial #:	N/A	
Customer:		4L-Design (TowMate)	EUT Part #:	0	
Project Number:		17510-15	Test Technician:	Eric Lifsey	
Purchase Order #:		0	Supervisor:	Lisa Arndt	
Equip. Under Test:		315 MHz Wireless Towlight	Witness' Name:	None	
Radiated Emissions Test Equipment List					
Tile! Software Version:		4.2.A, May 23, 2010, 08:38:52 AM			
Test Profile:		2015 Rad Emissions_ClassA - LowPRF_072715.til or 2015 Rad Emissions_ClassB - LowPRF_072715.til			
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	2/5/2016
1890	HP	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	2/6/2016
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303298	1/2/2016
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	135454	1/25/2017
C027D	none	RG214	Cable Coax, N-N, 25m	none	10/1/2016
1327	EMCO	1050	Controller, Antenna Mast	none	N/A
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A
1969	HP	11713A	Attenuator/Switch Driver	3748A04113	N/A
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	3/13/2016
2004	Miteq	AFS44-00101800-2S-10P-44	Amplifier, 40dB, .1-18GHz	0	12/29/2015
C030	none	none	Cable Coax, N-N, 30m	none	10/1/2016
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	110313	2/25/2017

8.2 Equipment for Timings and Bandwidth

Asset #	Manufacturer	Model #	Description	Calibration Due
None	PTI	None	SMA Sleeve Antenna	Not Required
ALN-077	Rohde & Schwarz	FSP-30	Spectrum Analyzer	16 Dec 2016

Appendix: Policy, Rationale, and Evaluation of EMC Measurement Uncertainty

All uncertainty calculations, estimates and expressions thereof shall be in accordance with NIST policy. Since PTI operates in accordance with NIST (NVLAP) Handbook 150-11: 2007, all instrumentation having an effect on the accuracy or validity of tests shall be periodically calibrated or verified traceable to national standards by a competent calibration laboratory. The certificates of calibration or verification on this instrumentation shall include estimates of uncertainty as required by NIST Handbook 150-11.

1. Rationale and Summary of Expanded Uncertainty.

Each piece of instrumentation at PTI that is used in making measurements for determining conformance to a standard (or limit), shall be assessed to evaluate its contribution to the overall uncertainty of the measurement in which it is used. The assessment of each item will be based on either a type A evaluation or a type B evaluation. Most of the evaluations will be type B, since they will be based on the manufacturer's statements or specifications of the calibration tolerances, or uncertainty will be stated along with a brief rationale for the type of evaluation and the resulting stated uncertainties.

The individual uncertainties included in the combined standard uncertainty for a specific test result will depend on the configuration in which the item of instrumentation is used. The combination will always be based on the law of propagation of uncertainty. Any systematic effects will be accommodated by including their uncertainties, in the calculation of the combined standard uncertainty; except that if the direction and amount of the systematic effect cannot be determined and separated from its uncertainty, the whole effect will be treated as uncertainty and combined along with the other elements of the test setup.

Type A evaluations of standard uncertainty will usually be based on calculating the standard deviation of the mean of a series of independent observations, but may be based on a least-squares curve fit or the analysis of variance for unusual situations. Type B evaluations of standard uncertainty will usually be based on manufacturer's specifications, data provided in calibration reports, and experience. The type of probability distribution used (normal, rectangular, a priori, or u-shaped) will be stated for each Type B evaluation.

In the evaluation of the uncertainty of each type of measurement, the uncertainty caused by the operator will be estimated. One notable operator contribution to measurement uncertainty is the manipulation of cables to maximize the measured values of radiated emissions. The operator contribution to measurement uncertainty is evaluated by having several operators independently repeat the same test. This results in a Type A evaluation of operator-contributed measurement uncertainty.

A summary of the expanded uncertainties of PTI measurements is shown as Table 1. These are the worst-case uncertainties considering all operative influence factors.

Table 1: Summary of Measurement Uncertainties for Site 45

Type of Measurement	Frequency Range	Meas. Dist.	Expanded Uncertainty U, dB (k=2)
Mains Conducted Emissions	150 kHz to 30 MHz	N/A	2.9
Telecom Conducted Emissions	150 kHz to 30 MHz	N/A	2.8
Radiated Emissions	30 to 1,000 MHz	10 m	4.8
	1 to 18 GHz	3 m	5.7

End of Report

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