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December 9, 2014

William Anderson TowMate 15827 Serenity Point Lane Rogers, Arkansas 72756

Mr. Anderson:

Thank you for allowing Professional Testing (EMI), Inc. an opportunity to perform testing for TowMate. Enclosed is the Wireless Certification Report for the 4L-3600-4. This report can be used to demonstrate compliance with the regulatory requirements for wireless devices in North America.

If you have any questions, please contact me.

Sincerely,

Jeffrey A. Lenk President

Attachment

Project 16162-15

Model 4L-3600-4

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

December 9, 2014

Reviewed by

Larry Finn Chief Technology Officer Written by

Eric Lifsey Test Engineer

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Revision History

Revision Number	Description	Date
00	Initial draft.	2014-12-01
01	Final. Revised with client and internal comments.	2014-12-08
02	Final. Revised to remove modular references.	2015-01-09

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1	

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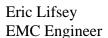
Certificate of Compliance

Applicant	Device & Test Identification	
TowMate (William Anderson)	FCC ID:	UZVTM500
15827 Serenity Point Lane	Industry Canada ID:	Not Applicable
Rogers, Arkansas 72756	Model(s):	4L-3600-4
Certificate Date: December 2, 2014	Laboratory Project ID:	16162-15

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.



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

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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	4L-3600	Sample B Green Dot	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.

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

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.

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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)
	Radiated Output Power, 10,333.33μV/m @ 3 m	
15.231(a) RSS210 A1.1	Restated as 80.28 dBμV/m @ 3 m	2014-11-16
	Or extrapolated as 69.8 dBμV/m @ 10 m	

3.3 Test Results

Table 3.3.1: Field Strength at 10 Meters				
Frequency MHz	Antenna Polarity	Corrected Level (Measured Peak Level) dBµV/m	Detector Mode	
418	V	72.9	Peak	
418	Н	77.1	Peak	

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

Duty cycle is such that the emission average level is calculated as 20 dB below the peak level.

Table 3.3.2: Corrected Field Strength				
Limit At 10 meters dBµV/m (Average Detection)	Corrected Level (Measured Peak Level) dBµV/m	Duty Cycle Factor dB	Corrected Level dBµV/m	Margin dB
69.8	77.1	20	57.1	-12.7

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

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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)
15 224/aV/1\	Mayimum Transmit Time	2014-09-16
15.231(a)(1) RSS210 A1.1.1	Maximum Transmit Time	2014-10-14

4.3 Test Results

Table 4.3.1 Du	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)					
9.0513	91.4438	= 20 * Log ₁₀ (9.0513 msec / 91.4438 msec)	-20.08	-20					

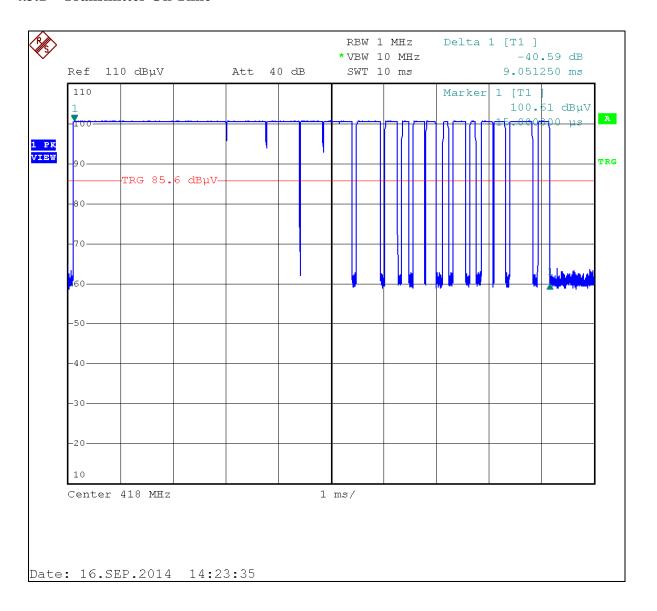
Table 4.3.2 Exp	Table 4.3.2 Exposure Source Duty Cycle Results								
Measured On Time (msec)	Measured Time Interval (msec)	Exposure Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)					
9.0513	91.4438	= 10 * Log ₁₀ (9.0513 msec / 91.4438 msec)	-10.04	-10.04					

Table 4.3.3: Maximum Transmit Shutoff Time, Limit and Measured						
Limit Transmit Time	Maximum Measured Transmit Time					
5 seconds	Immediate cessation as all power is removed, no measurement required.					

See plotted results of duty cycle time appear below.

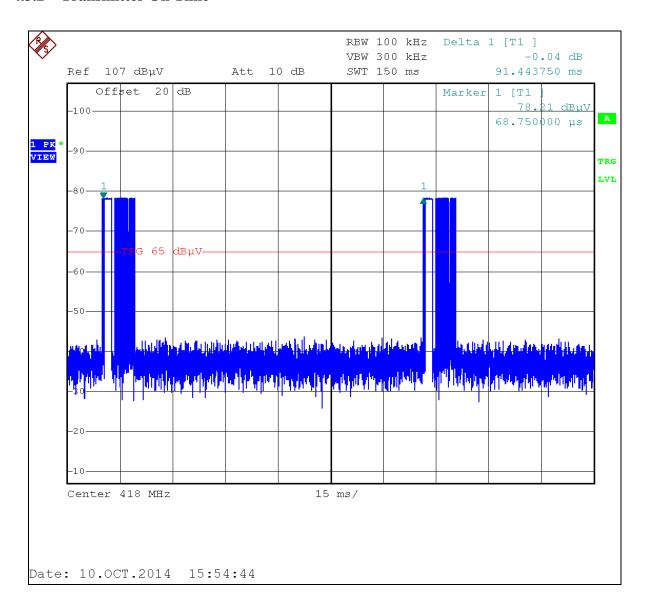
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4.3.1 Transmitter On Time



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4.3.2 Transmitter On Time



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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	2014-09-16

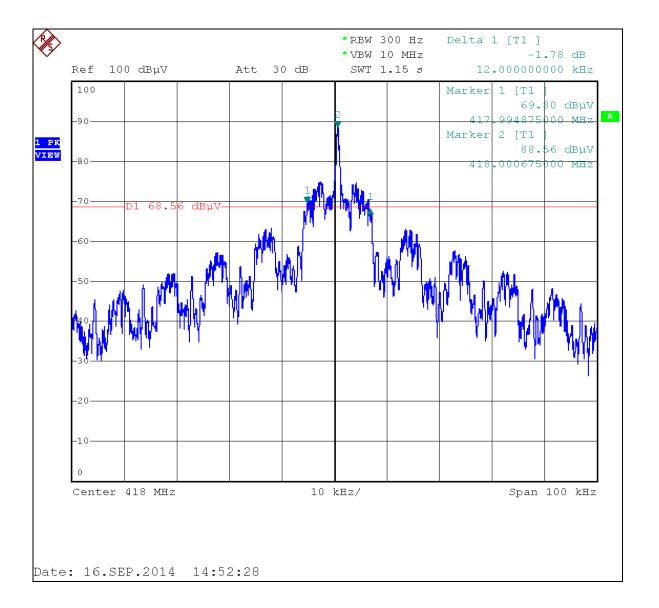
5.3 Test Results

Table 5.3.1: Bandwidth Limit and Measurement					
Limit 15.231(c) 20 dB BW For Fundamental = 418 MHz 0.25% of Fundamental kHz	Measured BW 20 dB kHz				
1045	12.0				

EUT was found to be in compliance with applicable requirements.

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5.3.1 Bandwidth Plot



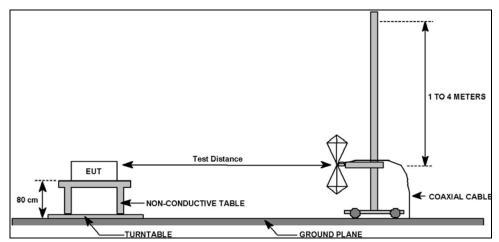
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6.0 Radiated Spurious Emissions Below 1 GHz

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 10 meters 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.



Field Strength of Spurious Emissions Test Setup

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	2014-09-21
15.251(a), 15.209 K55-210 A1.1 Table A	Spurious/Harmonic Emissions	2014-11-16

6.3 Test Results

The fundamental signal also appears in the measurements taken.

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

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6.3.1 Receive Mode, Vertical Polarity

			Profes	sional Te	sting, EN	VII, Inc.			
est Meth	od:							ow-Voltage Elec nce, see §15.38)	
n accorda	nce with:	Limits	209 - Code of I	Federal Regulat	ions Part 47, S	Subpart C - Int	tentional R	adiators, Radiat	ed Emissions
ection:		15.209							
est Date(•	9/21/2014			EUT Serial		None		
ustomer:		4L-Design	Towmate		EUT Part #:		None		
Project Nu		16162-15			Test Techni		Eric Lifse	•	
Purchase (Not Listed			Supervisor:		Lisa Arn	ατ	
quip. Und	ier rest:	4L-3600-4			Witness' N	ame:	None		
			nissions Test	Results Data	1			Page: 1	of 1
	ine Voltage		VDC			er Frequen	•	- N/A	
Antenn	a Orientation		Vertic	al	Frequ	ency Range:		30MHz to	1GHz
	EUT N	/lode of Op	eration:	T		R	Receive IV	lode	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Lev (dBµV/r	-	Test Results
30.3357	10	74	3.78	Quasi-peak	24	12.786	29.5	-16.7	Pass
156.007	10	308	1.79	Quasi-peak	33.5	14.071	33.1	-19.0	Pass
208.018	10	229	1.68	Quasi-peak	35	18.576	33.1	-14.5	Pass
286.007	10	332	1.18	Quasi-peak	32.4	18.504	35.6	-17.1	Pass
897.592	10	351	2.36	Quasi-peak	21.4	21.092	35.6	-14.5	Pass
980.215	10	242	2.96	Quasi-peak	21.1	21.883	43.5	-21.6	Pass
Radiated	ssional Testing, I Emissions, 10m D I GHz V ertical Pola rity	istance				∇ CorPea	asi-peak Limit rected Quasi- ak Limit Leve rected Peak V	peak Readin	SSIONAL , , , , , , ,
Field Strength (d Bµ V/m)									
10 0 30M	handrach albertale de Lochente	terror that his advantage description	100M	The state of the s	A Company of the Comp		and the first		1G
Operator	Eric Lifsey ER un 0 2 'R x M o d e'M H	zCHz til		Freq	lu en cy		UT: Model4L-30 roject Number: 1		
10104 K	Kunva KamoueMH	EG 11EAH		r: 12 VDC		r	roject mamber: 1	0104-13	

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6.3.2 Receive Mode, Horizontal Polarity

				Profess	sional Te	sting, EN	MI, I	nc.					
Test Metho	d:				ds of Measuren e Range of 9 kH						•		
In accordan	ce with:	Limits	15.20	09 - Code of I	ederal Regulat	ions Part 47, S	Subpart	C - Int	entiona	al Radia	ators, Radiate	ed Emissio	ns
Section:		15.209											
Test Date(s):	9/21/2				EUT Serial #			None				
Customer:		_		owmate		EUT Part #:			None	-			
Project Nur		16162-				Test Techni			Eric Li				
Purchase O		Not List				Supervisor:			Lisa A	rnat			
Equip. Und		4L-3600				Witness' Na	ame:		None				
			l Emi	issions Test	Results Data					Pag		of	1
EUT Li	ne Voltage	:	12	2 VDC		EUT Pow	er Fre	quen	су:		N/A		
Antenna Orientation:				Horizor	ital	Freque	ency R	ange:			30MHz to	1GHz	
	EUT	Mode of	Ope	ration:				R	eceive	Mod	e		
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degree	on	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corre Lev (dBµ\	el	Limit (dBµ\		Margin (dB)	Test Res	ults
31.0163	10	83		2.46	Quasi-peak	24.2	12.6	559	29	.5	-16.8	Pass	
208.007	10	243		3.71	Quasi-peak	35.4	18.9	998	33	.1	-14.1	Pass	
286.012	10	251		2.83	Quasi-peak	35.7	21.8	324	35	.6	-13.8	Pass	
299.003	10	230)	2.29	Quasi-peak	35.2	21.7	744	35	.6	-13.9	Pass	
724.303	10	148		1.43	Quasi-peak	21.8	18.0)25	35	.6	-17.6	Pass	
901.847	10	80		2.54	Quasi-peak	21.2	21.0	007	35	.6	-14.6	Pass	
Radiated	ional Testing, Emissions, 10m E GHz Horizontal Pola	istance						CorPea	asi-peak L rrected Q k Limit I rrected Pe	uasi-peak .evel	Reading	SIONAL	
Field Strength (dB yr Vm) 30						 	 			A supplement	h tropped		
10 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	who are not seemed by the world for which the	Wayned Albanda Anglandida	ljadjograficijoj	100M	A CHILDREN TO A CHILDREN TO A CHILDREN	the same of the sa						16	
	Eric Lifsey Run02 'R x Mode'M H 'M, Sunday, Septeml			EUT Mode EUT Powe	: Receive 418 MHz	uency		P	UT: Model4 roject Numl lient: 4L-De	ber: 16162			
VI.17.201	,sanday,septem		≤ 1GF	Iz Horizont	al Antenna P	olarity Mea	sured			asg i Town			

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6.3.3 Transmit Mode, Vertical Polarity

			rtical Polarity								
			Profes	sional Te	sting, El	MI, Inc.					
Test Metho	d:		4–2003: "Metho Equipment in th								d
In accordan	ce with:	FCC Part 1 Limits	.5.209 - Code of	Federal Regula	tions Part 47,	Subpart C - Int	tentional I	Radiators,	Radiate	ed Emis	sions
Section:		15.209									
Test Date(s	:	11/16/2			EUT Serial			B.Green	Dot		
Customer:			n Towmate		EUT Part #:		None				
Project Nun		16162-1			Test Techn		Eric Lifs				
Purchase O		Not Liste			Supervisor		Lisa Arn	ndt			
Equip. Und		4L-3600-			Witness' N	ame:	None				
	R	adiated	Emissions Tes	t Results Dat	a Sheet			Page:	1	of	1
EUT Line Voltage: 12 VDC				EUT Pov	ver Frequen	су:	-	N/A			
Antenna Orientation: Vertical			al	Frequ	ency Range		30N	lHz to	1GHz		
	EUT N	lode of C	Operation:		Tran	smit Mode,	Unmod	ulated, F	und &	Spur	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees	- 0	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBµV/m)	Limit Le	-	argin dB)	Test F	Result
418	10	0	4	Peak	72.9	72.9	89.8	-1	.6.9	Pa	ss
836	10	0	4	Peak	53	53	80.2	-2	7.2	Pa	ass
418	10	0	4	average	72.9	52.9	69.8		.6.9	Pa	ass
836	10	0	4	average	53	33	60.2	-2	27.2	Pa	ass
Radiated 1	ional Testing, Emissions, 10m Di Hz Vertical Pola rity	stance	ons 100M			▽ Cor — Pea	asi-peak Limi rrected Quasi ak Limit Lev rrected Peak	i-peak Readin el		SIONAL	G
30M Operator: F	ric Lifsey		100M	Fre	quency	E	UT: Model4L-3	3600-4		10	j.
	tun04'TxMode'MHz0 M,Sunday,Novemb			e: Transmit, Unmodulate er: 12 VDC GreenDot	ed,418 MHz		roject Number: lient: 4L-Design				

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≤ 1GHz Vertical Antenna Polarity Measured Emissions

6.3.4 Transmit Mode, Horizontal Polarity

			Profess	sional Te	sting, El	VII, Inc.			
Test Metho	od:		-2003: "Metho quipment in th					•	
In accorda	nce with:	FCC Part 15 Limits	.209 - Code of I	ederal Regula	tions Part 47, S	Subpart C - Int	entional Radi	ators, Radiate	ed Emissions
Section:		15.209							
Test Date(s):	11/16/201	L 4		EUT Serial	# :	Sample B.G	ireenDot	
Customer:		4L-Design	Towmate		EUT Part #:		None		
Project Nu	mber:	16162-15			Test Techn	ician:	Eric Lifsey		
Purchase C	Order #:	Not Listed			Supervisor:		Lisa Arndt		
Equip. Und	ler Test:	4L-3600-4			Witness' N	ame:	None		
	F	Radiated Er	missions Test	Results Dat	a Sheet		Pa	ge: 1	of 1
EUT Line Voltage: 12 VDC					EUT Pow	er Frequen	cy:	- N/A	
Antenn	a Orientatio	n:	Horizor	ntal	Frequ	ency Range:	:	30MHz to	1GHz
	EUT N	/lode of Op	eration:		Trans	smit Mode,	Unmodulat	ed, Fund &	Spur
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
418	10	0	4	Peak	77.1	77.1	89.8	-12.7	Pass
836	10	0	4	Peak	64.1	64.1	80.2	-16.1	Pass
418	10	0	4	average	77.1	57.1	69.8	-12.7	Pass
836	10	0	4	average	64.1	44.1	60.2	-16.1	Pass
Radiated 30 MHz - 1 100	sional Testing, Emissions, 10m Di GHz Horizontal Polar	istance	ns			∇ CorPea	asi-peak Limit Lev rrected Quasi-peak ak Limit Level rrected Peak Value	Reading	SIONAL
Field Streng							The same same and bearing		"
20 10	or had properly be a part of the second of t	-yhanking laphaga ya khlanda yazilar	100M	Ned-		Active Management			16
20	Eric Lifsey	mugh sandrings have been properly specified	100M	Fre	quency	,.	UT: Model4L-3600-4		16
20 10 30M Operator:	Eric Lifsey 'Run04'TxMode'MHz	GHz'B-GreenDot.til		: Transmit, Unmodulate	quency	E	UT: Model4L-3600-4		1G

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7.0 Radiated Spurious Emissions Above 1 GHz

7.1 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.

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).

7.2 Test Criteria

Section Number FCC IC		
15.231(a), 15.209 RSS-210 A1.1 Table A	Field Strength of Radiated	2014-09-21
13.231(d), 13.209 K33-210 A1.1 Table A	Spurious/Harmonic Emissions	2014-11-16

7.3 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 (-20 dB) would apply. Therefore, the emissions must remain under the peak limit of 74 dB μ V/m to also satisfy the average limit. All emissions remained under the peak limit.

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

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7.3.1 Receive Mode, Vertical Polarity

			Profess	sional Te	esting, El	VII, Inc.			
Test Metho	d:		–2003: "Metho quipment in the					•	
In accordar	nce with:	FCC Part 15 Limits	entional Radia	ators, Radiat	ed Emissions				
Section:		15.209			1				
Test Date(s):	9/21/201			EUT Serial		None		
Customer:			Towmate		EUT Part #:		None		
Project Nui		16162-15			Test Techn		Eric Lifsey		
Purchase O		Not Listed			Supervisor		Lisa Arndt		
Equip. Und	er Test:	4L-3600-4			Witness' N	ame:	None		
			missions Test	Results Dat			Pag		of 1
EUT Li	ne Voltage	:	12 VDC		EUT Pov	ver Frequen	cy: -	N/A	
Antenna	orientation	n:	Vertic	al	Frequ	ency Range:	ł	Above 1	GHz
	EUT N	/lode of O _l	peration:			R	eceive Mod	e	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)		Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBμV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
1002.02	3	279	1	Average	35	21.362	54.0	-32.6	Pass
1255.42	3	80	1	Average	34.4	22.076	54.0	-31.9	Pass
1672.75	3	330	1	Average	35.4	23.775	54.0	-30.2	Pass
2098.68	3	146	1	Average	35.3	25.732	54.0	-28.2	Pass
2517.84	3	65	1	Average	34.5	25.621	54.0	-28.3	Pass
Radiated 1-18GHzV 90 80 80 0 70 1 70	sional Testing, Emissions, 3m Dis ertical Polarity Meass	tance				∇ CorPea	erage Limit Level rected Average Re ak Limit Level rected Peak Readi		SSIONAL V 1 N 6
Field Strength 6	aran da salah da sala	Andreas and American Action	Altery minds Affine develop	y white of the	skatskaji kirinata ar za diradi	the legislation of the legislati	reggenes klies volum paglajos distributoros.	and the least the Atlanta	nd Apparation of Process
20 ⁷ / _G	7					-			5 G
Operator	Eric Lifsey				equency		UT: Model 4L-3600-4		
16162 RE	Run01'RxMode'GHz PM,Sunday,Septemb		EUT Mode EUT Powe	:: Receive 418 MHz r: 12 VDC			roject Number: 16162 lient: 4L-Design Town		

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

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7.3.2 Receive Mode, Horizontal Polarity

			Profess	sional Te	sting, El	VII, Inc.			
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 Emission in the Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emiss								ed Emissions	
Section: 15.209									
Test Date(s	s):	9/21/2014			EUT Serial		None		
Customer:		4L-Design 1	owmate		EUT Part #		None		
Project Nu		16162-15			Test Techn		Eric Lifsey		
Purchase C		Not Listed			Supervisor		Lisa Arndt		
Equip. Und	ler Test:	4L-3600-4			Witness' N	ame:	None		
	F	Radiated Em	issions Test	Results Data	a Sheet		Pa	ge: 1	of 1
EUT L	ine Voltage	: 1	2 VDC		EUT Pov	ver Frequen	cy:	N/A	
Antenna	a Orientatio	on:	Horizor	ıtal	Frequ	ency Range:		Above 1	GHz
	EUT N	lode of Ope	eration:			R	eceive Mod	е	
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
1001.54	3	181	1	Average	35	21.358	54.0	-32.6	Pass
1254.48	3	166	1	Average	34.4	22.074	54.0	-31.9	Pass
1684.1	3	50	1	Average	35.3	23.814	54.0	-30.1	Pass
2092.18	3	285	1	Average	35.2	25.621	54.0	-28.3	Pass
2508.78	3	209	2	Average	34.5	25.592	54.0	-28.4	Pass
Radiated	sional Testing, Emissions, 3m Dis Horizontal Polarity Mo	tance				∇ CorPea	rage Limit Level rected Average R k Limit Level rected Peak Read	, i	SIONAL
_ 7 0	phinagely angle and deligen above deligately bearing the self	the aligh test to self the							
30	20 7 7								
30 20 G	γ	<u>'</u>	<u> </u>						5 G
Ļ	•			Free	quency	E	UT: Model 4L-3600-4		5 G

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

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7.3.3 Transmit Mode, Vertical Polarity

	Pr	ofessional	l Test	ting, EMI, Ir	ıc.				
Tast Mathad:	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: 15.2	09								
Test Date(s): 9/2:	L/2014		E	UT Serial #:	None				
Customer: 4L-D	esign Towr	mate	E	UT Part #:	None				
Project Number: 1610	62-15		T	est Technician:	Eric Li	fsey			
Purchase Order #: Not	Listed		Sı	upervisor:	Lisa A	rndt			
Equip. Under Test: 4L-3	600-4		V	Vitness' Name:	None				
Radia	ted Emissio	ons Test Results	s Data S	Sheet		Page:	1	of	1
EUT Line Voltage:	12	VDC		EUT Power Free	quency:	-	N/A		
Antenna Orientation:		Vertical		Frequency Range:		Above 1GHz			
EUT Mode	of Operati	on:		Transmit Mode, Unmodulated					
Professional Testing, EMI, Radiated Emissions, 3m Distance 1-18 GHz Vertical Polarity Measured Emis 90 80 80 87 87					 Average Lim Corrected At Peak Limit I Corrected Pe 	erage Reading evel	PROFESS	SIONAL N 6	
To the second of	ing angenius and an	EUT Mode: Transmit, Unit EUT Power: 12 VDC	Frequen	·	EUT: Model-	IL-3600-4 er: 16162-15	and the second	56	
02:33:40 PM, Sunday, September 21,20		Vertical Antenr			Client: 4L-De	sign Tow Mate			

Detector mode peak. Resolution bandwidth 1 MHz. Video bandwidth 3 MHz. (Note that average duty cycle factor is -20 dB and the peaks shown above result in passing averages.)

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7.3.4 Transmit Mode, Horizontal Polarity

			0.000.0	u c.	sting, EMI, In	ic.				
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).								
n accordance with:	FCC Pa Limits	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits								
Section:	15.209)								
Test Date(s):	9/21/	2014			EUT Serial #:	None				
Customer:	4L-De	sign Towr	mate		EUT Part #:	None				
Project Number:	16162	2-15			Test Technician:	Eric Li	fsey			
Purchase Order #:	Not Li	isted			Supervisor:	Lisa A	rndt			
quip. Under Test:	4L-36	00-4			Witness' Name:	None				
	Radiate	ed Emissio	ons Test Resul	lts Data	Sheet		Page:	1	of	1
EUT Line Voltag	e:	12	VDC		EUT Power Freq	juency:	-	N/A		
Antenna Orientat	ion:		Horizontal		Frequency Range:		Α	Above 1GHz		
EUT	Mode o	of Operati	on:		Transmit Mode, Unmodulated					
Professional Testin Radiated Emissions, 3m 1-18 GHz Horizontal Polarity 90 80 70 70 70 70 80 40 40 30	Distance		The second state of the se	and the state of t		- Average Lim Corrected Av Peak Limit I Corrected Pe	verage Reading Level	PROFESS	SIONAL	
20G Operator: Eric Lifsey 16162 'R E'R un 03 'Tx Mode'M 02:33:38 PM, Sunday, Septe			EUT Mode: Transmit, EUT Power: 12 VD C HPF	•	uency 1,418 MHz	-	4L-3600-4 per: 16162-15 esign TowMate		5 G	

Detector mode peak. Resolution bandwidth 1 MHz. Video bandwidth 3 MHz. (Note that average duty cycle factor is -20 dB and the peaks shown above result in passing averages.)

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8.0 Antenna Construction Requirements

8.1 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.

8.2 Criteria

Section Number FCC IC	Clause Subject	Date
15.203 RSS-Gen	Antenna Construction	2014-11-30

8.3 Results

Antenna Manufacturer, Details

Manufactured by:

TowMate

Antenna is a fixed length of insulated wire soldered directly to the circuit board.

No external connector.

The antenna is not subject to user replacement or substitution.

The antenna design satisfies the requirements of the rules.

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9.0 Equipment Lists

9.1 Equipment for Fundamental Power and Spurious Radiated Emissions

7.1 E			Spurious Kaulateu 1					
		Profess	sional Testing, EMI, Inc.					
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,								
In accordan	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, In accordance with: Radiated Emissions Limits							
Section:	15.20	9						
Test Date(s)		2014 - 11/16/2014		None				
Customer:		sign Towmate	EUT Part #:	None				
Project Num			Test Technician:	Eric Lifsey				
Purchase Or Equip. Unde			Supervisor: Witness' Name:	Lisa Arndt None				
Equip. Onde	er rest: 4L-30			None				
			d Emissions Test Equipment List					
Til	e! Software Version	•	May 23, 2010, 08:38:52 AM					
	Test Profile:	Radia	ted Emissions_Profile Version Octob	er 12, 2011				
Asset #	Manufacturer	Model	Equipment Nomenclature	Serial Number	Calibration Due Date			
1509A	Braden	N/A	TDK 10M Chamber, NSA < 1 GHz	DAC-012915-005	11/29/2014			
1890	НР	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	1/22/2015			
1937	Agilent	E4440A	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY44303298	12/2/2015			
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	00135454	12/29/2014			
C027	N/A	RG214	Cable Coax, N-N, 25m	none	10/22/2015			
1327	EMCO	1050	Controller, Antenna Mast	none	N/A			
0942	EMCO	11968D	Turntable, 4ft.	9510-1835	N/A			
1969	НР	11713A	Attenuator/Switch Driver	3748A04113	N/A			
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	11/16/2014			
2004	Miteq	AFS44-00101800- 2S-10P-44	Amplifier, 40dB, .1-18GHz	0	11/19/2014			
C030	N/A	0	Cable Coax, N-N, 30m	none	10/10/2015			
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	00110313	1/21/2015			
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A			

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9.2 Equipment for Timings and Bandwidth

Asset #	Manufacturer	Model #	Description	Calibration Due
1486	EMCO	3147	Log Periodic Antenna	Not Required
1342	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29

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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.

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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
Radiated Ellissions	1 to 18 GHz	3 m	5.7

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End of Report

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