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April 17, 2014

Wayne McVay KeyTrak 200 Quality Circle College Station, Texas 77845 USA

Dear Wayne:

Thank you for allowing Professional Testing (EMI), Inc. an opportunity to perform testing for KeyTrak. Enclosed is the Wireless Certification Report for the ActiveLot. This report can be used to demonstrate compliance with FCC requirements for wireless devices in the United States.

If you have any questions, please contact me.

Sincerely,

Jeffrey A. Lenk

President

Attachment

## Project 15565-15

### **ActiveLot**

## **Wireless Certification Report**

Prepared for:

KeyTrak, Inc.

By

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

April 22, 2014

Reviewed by

Larry Finn
Product Development Engineer

Written by

Eric Lifsey Test Engineer

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## **Revision History**

Revision Number	Description	Date
00	Draft Release	March 7, 2014
01	Revised per Larry Finn comment.	March 25, 2014
02	Revised per client comments.	April 22, 2014

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### **Certificate of Compliance**

Applicant: KeyTrak

Applicant's Address: KeyTrak (Wayne McVay)

200 Quality Circle

College Station, Texas 77845 USA

USA

FCC ID: 2ABY5OBD1

Model: AL OBD MODULE

Project Number: 15565-15

The **AL OBD MODULE** by **KeyTrak** was tested utilizing the following documents and found to be in compliance with the required criteria on the indicated test date.

47 CFR (USA)						
Section Reference	Parameter	Date				
15.247(a)(3)	Conducted Fundamental Power, 1 W	2013-12-18				
15.247(e)	Power Spectral Density	2014-01-10				
15.247(a)(2)	Bandwidth, 6 dB, 20 dB	2013-12-30				
15.203	Antenna Requirements	2014-02-27				
15.209	Harmonic & Spurious Emissions	2014-01-02 thru 03				
2.1091	Maximum Permissible Exposure	2014-02-21				

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

Jeffrey A. Lenk President

This report has been reviewed and accepted by KeyTrak. The undersigned is responsible for ensuring that the AL OBD MODULE by KeyTrak will continue to comply with the applicable rules.

Representative of KeyTrak

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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 the United States.

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 a wireless transmitter that beacons data to a central receiver. This device is used exclusively in vehicles and gets power and data only from the OBD diagnostic connector. It is not a hand-held. The EUT as tested consisted of the following:

**Table 1.2.1: Equipment Under Test** 

Manufacturer	Manufacturer Model		Description	
KeyTrak	AL OBD MODULE	None	Wireless vehicle monitor.	

This device is used in vehicles at the point of sale location or sales lot. The device is composed of a nearly rectangular plastic. Three LED indicators on one edge represent power and activity states.

The antenna is internal to the device on the circuit board. There is no antenna connector. There is only one connector for power and data. The EUT beacons data when the vehicle battery voltage is near 13.8 VDC. Below this voltage the EUT assumes the vehicle is not in motion and beacons far less often.

The EUT measures approximately 8.7 x 5.0 x 2.6 cm. An external view of the EUT is provided below.



Photograph 1.2.1: EUT

### 1.3 EUT Operation

The EUT was exercised in a manner consistent with normal operations at operating voltage 13.8 VDC (active transmit mode) and 12.0 VDC (receive/standby mode).

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The EUT internal software operated the transmitter in a continuous modulated mode.

### 1.4 Modifications to Equipment

No modifications were made to the EUT during the performance of the test program.

### 1.5 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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## 2.0 Applicable Documents and Clauses

This device operates on the 2.4 GHz ISM band, as such 47 CFR and relevant part(s) applies as shown below.

**Table 2.0.1: Applicable Documents** 

Document #	Title/Description		
47 CFR (USA) Part 15 – Section 15.247			
ANSI C63.4 2009	American National Standard for Methods of Measurement of Radio-Noise		
ANSI C05.4 2009	Emissions from Low Voltage Electrical and Electronic Equipment		

**Table 2.0.2: Applicable Clauses** 

Clause Subject	Section References	Required?	Result
Conducted Fundamental Output Power	15.247(a)(3)	Yes	Pass
Occupied Bandwidth, 6 dB, 20 dB	2.1049, 15.247(a)(2)	Yes	Pass
Power Spectral Density	15.247	Yes	Pass
Field Strength of Radiated Spurious/Harmonic Emissions (30 MHz to 25 GHz)	15.247, 15.209	Yes	Pass
Antenna Construction	15.203	Yes	Pass
Maximum Permissible Exposure*	2.1091, FCC OET Bulletin 65	Yes	Pass

<sup>\*</sup>Exposure is reported in a separate document.

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### 3.0 Fundamental Power

#### 3.1 Test Procedure

EUT is placed on a non-conducting table and rotated to record the maximum emission. Bandwidth is first determined to select correct entire bandwidth for power measurement and the fundamental power is measured.

### 3.2 Test Criteria

47 CFR (USA)					
Section Reference	Parameter	Date			
	Fundamental Power				
15.247(a)(3)	Conducted Limit: 1 Watt	2014-02-19			
	Restated as Field Strength 125.2 dBμV/m @ 3 m	2014-02-19			
	Restated as Field Strength 134.7 dBμV/m @ 1 m				

#### 3.3 Test Results

The EUT bandwidth was found to be between 1 MHz and 3 MHz, the measurement resolution bandwidth was set to 3 MHz; video bandwidth was set to 10 MHz. Results are presented below:

Fundamental Power Measured as Field Strength	
Conducted Limit 1 Watt (30 dBm)	
Limit As Field Strength 134.7 dBμV/m @ 1 m	

Note that power on the lowest and highest channels is reduced in the design to insure band edge compliance. Additionally, the intended application must avoid using these channels to meet the range goals.

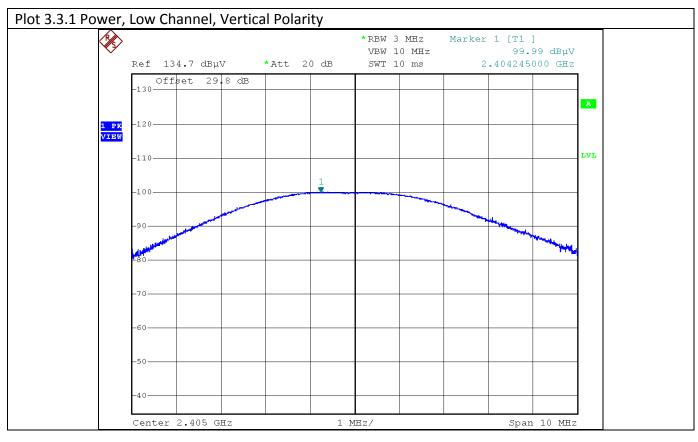
Peak Fundamental Emission, Radiated						
Frequency GHz	Table/ Polarity	Antenna Factor dB	Cable Loss dB	Corrected* Measured Peak Power at 1 m dBµV/m		
2.405	180 / V	28.2	1.6	99.99		
2.440	125 / H	28.2	1.6	122.89		
2.480	180 / V	28.2	1.6	99.08		

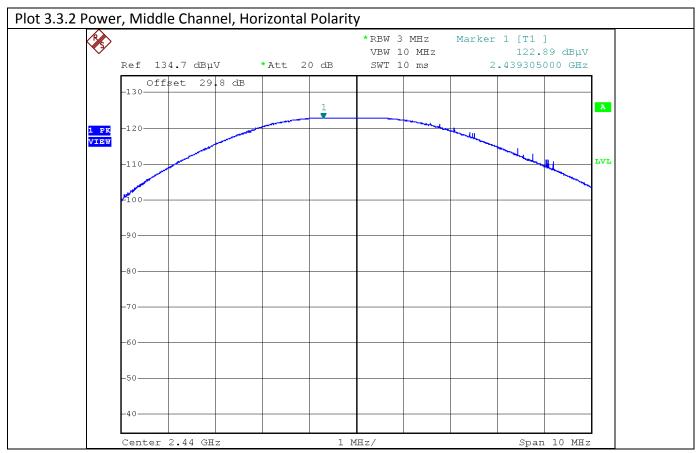
Measured in 3 MHz RBW, 10 MHz VBW. \*Factors were added to spectrum analyzer amplitude offset to obtain a direct corrected measurement.

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

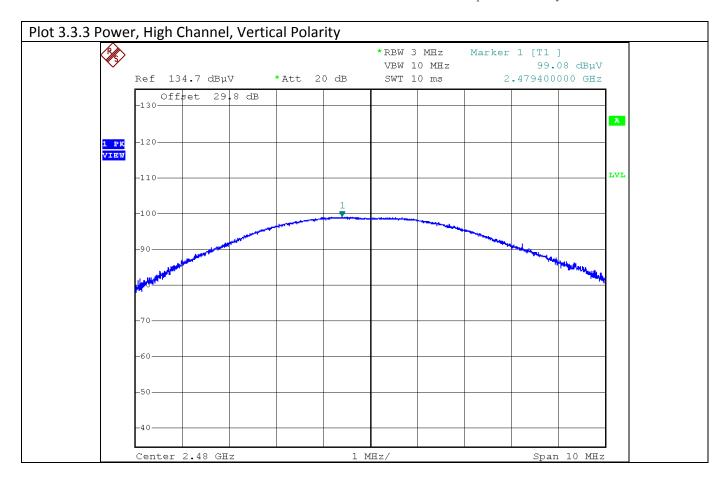
Plotted measurement appears below.

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## 4.0 Power Spectral Density

#### 4.1 Test Procedure

The EUT is placed on a non-conductive table and oriented for maximum signal. A spectrum analyzer is then adjusted to encompass the highest signals and allowed to record in max-hold mode for a time sufficient to capture all transmit products.

### 4.2 Test Criteria

47 CFR (USA)						
Section Reference	Parameter	Date				
	Power Spectral Density					
15 247(a)	·	2014-02-14				
15.247(e)	Restated as Field Strength 103.2 dBμV/m @ 3 m	2014-02-19				
	Restated as Field Strength 112.7 dBμV/m @ 1 m					

### 4.3 Test Results

## Power Spectral Density Conducted Limit 8 dBm, Measured Radiated Limit Restated as Field Strength 112.7 dBμV/m @ 1 m

Frequency GHz	Table/ Polarity	Antenna Factor dB	Cable Loss dB	Corrected* Measured Peak PSD at 1 m dBµV/m
2.440	125 / H	28.2	1.6	110.91

<sup>\*</sup>Factors were added to spectrum analyzer amplitude offset to obtain a direct corrected measurement.

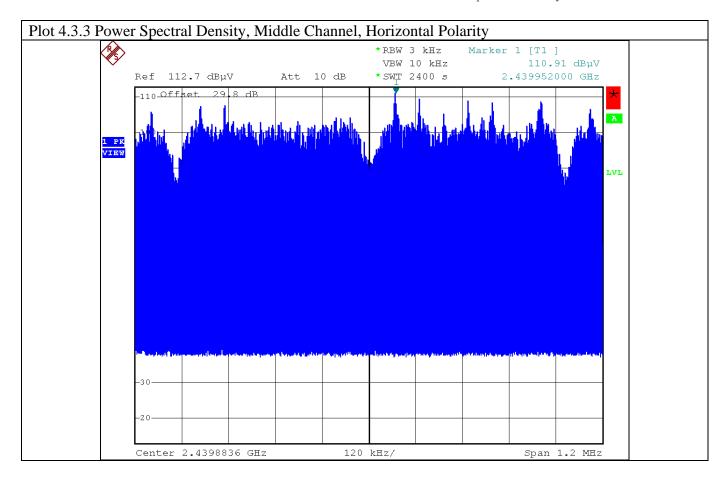
Sweep time 2400 seconds.

Based on peak power measuring more than 10 dB below the power spectral density limit, the measurement of power spectral density is not meaningful for the low and high channels.

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

Plotted measurement appears below.

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## 5.0 Transmitter Duty Cycle

Measurements of transmitter on time and intervals between transmissions were made to determine the duty cycle factor.

#### **5.1** Test Procedure

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

#### 5.2 Test Criteria

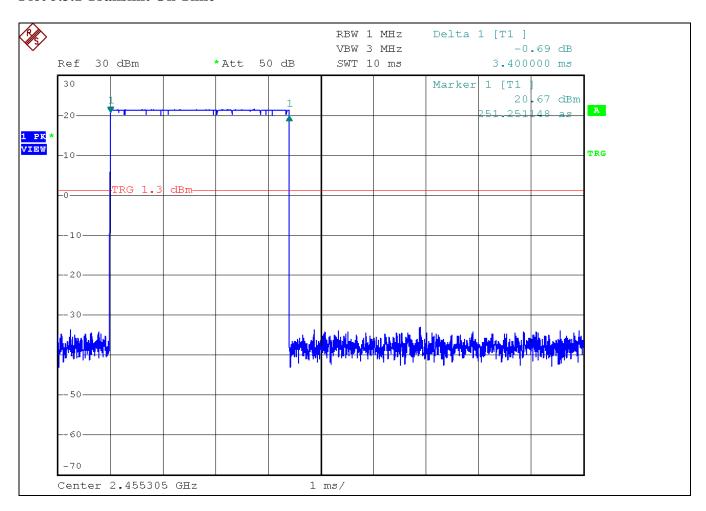
Measurement is based on intervals not to exceed 100 msec. Maximum transmitter on time is divided by the lesser of 100 msec or the actual measured minimum transmitter interval time. The result is converted to dB and applied as needed to peak measurements of transmitter artifacts to determine average power.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

### 5.3 Test Results

Measurements were performed on 2013-10-28 with the results appearing on the following pages.

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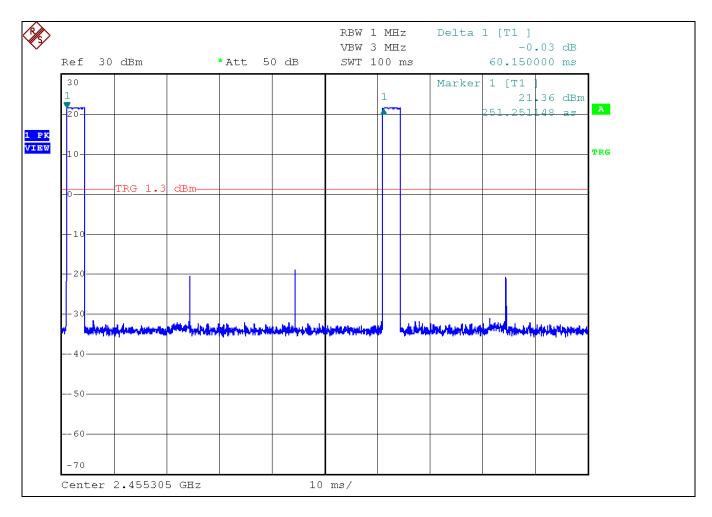
**Plot 5.3.1 Transmit On Time** 



Max hold recording was continued until no further change was observed. Measured maximum transmit time: 3.4 msec.

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**Plot 5.3.2 Transmit Interval Time** 



Measured minimum transmit interval time: 60.15 msec.

**Table 5.3.3 Duty Cycle Factor Result** 

Measured On Time (msec)	Measured Time Interval (msec)	Duty Cycle Factor Calculation	Result (dB)	Duty Cycle Factor Allowed (dB)
3.4	60.15	= 20 * Log <sub>10</sub> ( 3.4 msec / 60.15 msec )	-24.96	-20

The allowed duty cycle factor is applied to out of band spurious and harmonic signals as needed to determine average levels. If applicable, the Result factor above can be applied to exposure calculations.

Factor for exposure calculation:  $10 * Log_{10} (3.4 msec / 60.15 msec) = -12.48 dB$ 

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## 6.0 Occupied Bandwidth

### **6.1** Test Procedure

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

### 6.2 Test Criteria

Section Reference	Parameter	Date(s)
14.247(a)(2), 2.1049	Bandwidth, 6 dB, 20 dB	2014-02-14

### 6.3 Test Results

EUT was found to be in compliance with applicable requirements.

Bandwidth 6 dB Per 15.247	
Minimum 500 kHz	

	Low Channel Measured BW (kHz)	Mid Channel Measured BW (kHz)	High Channel Measured BW (kHz)	Minimum BW (kHz)
ı	1009.5	1197.0	1311.0	1009.5

## Bandwidth 20 dB Measure and Report

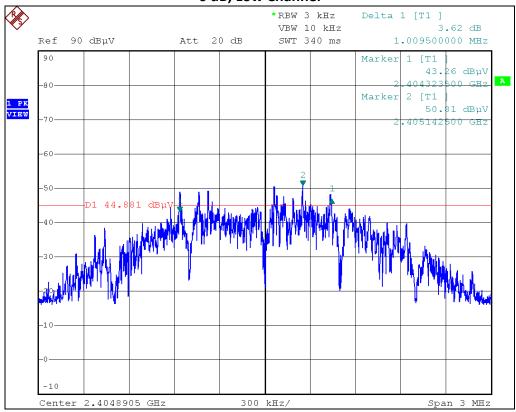
Low Channel	Mid Channel	High Channel	Reported
Measured BW	Measured BW	Measured BW	Maximum BW
(kHz)	(kHz)	(kHz)	(kHz)
2344.5	2082.0	2211.0	2344.5

Plotted measurements appear on the following pages.

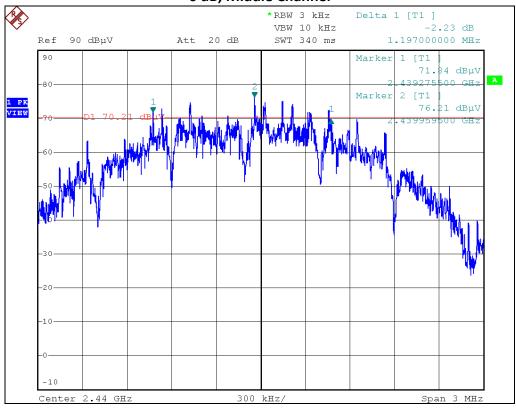
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### 6.3.1 Bandwidth Plots, 6 dB

### 6 dB, Low Channel

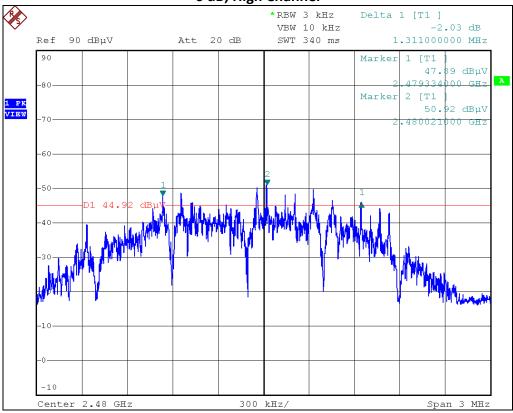


### 6 dB, Middle Channel



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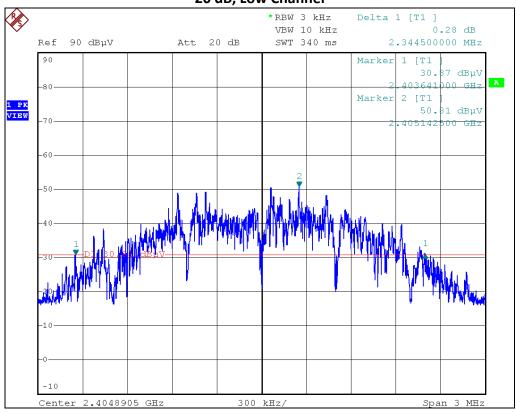
## 6 dB, High Channel



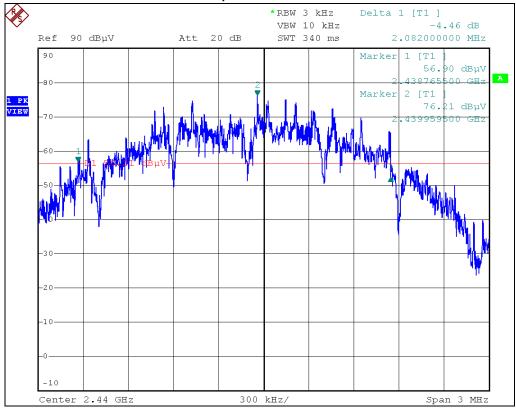
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## 6.3.2 Bandwidth Plots, 20 dB

### 20 dB, Low Channel

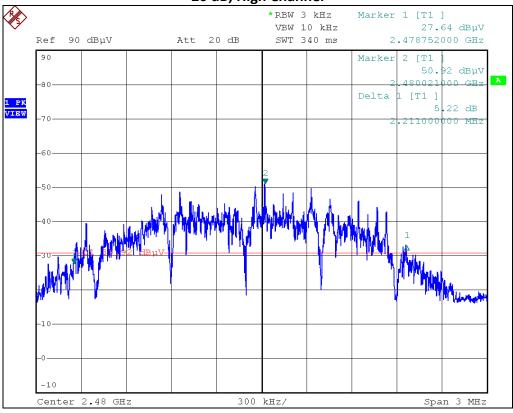


### 20 dB, Middle Channel



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## 20 dB, High Channel



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## 7.0 Band Edge

Measurements of transmitter emissions at the top and bottom band edge.

#### 7.1 Test Procedure

EUT is placed into normal transmit operation on the nearest band edge channel. The spectrum analyzer is centered on the band edge frequency with span sufficient to include the peak of the adjacent fundamental signal. Measurement includes two standard bandwidths from the respective band edge. The relative difference in signal levels from fundamental to strongest signal at the band edge are then determined and compared to limits. If required, the band-edge marker-delta method of C63.4 is utilized.

#### 7.2 Test Criteria

Section Reference	Parameter	Date(s)
15.205, 15.209	Emissions Outside Band	2014-01-14

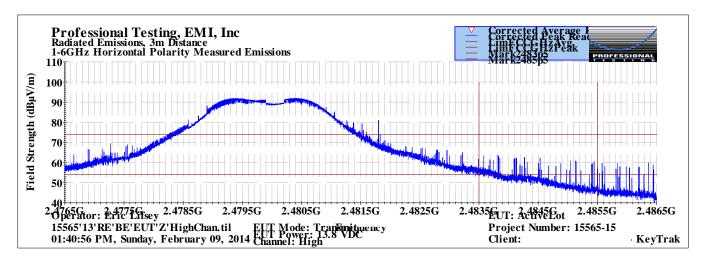
#### 7.3 Test Results

Worse-case margin to limit is in excess of -10 dB on high channel vertical polarity. The EUT satisfied the criteria. Recorded data is presented below.

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## 7.3.1 High Channel Band Edge

Measurements are of peak detection levels and shown for worse-case polarity. The average level would be calculated from peak by applying the duty cycle factor of -20 dB.

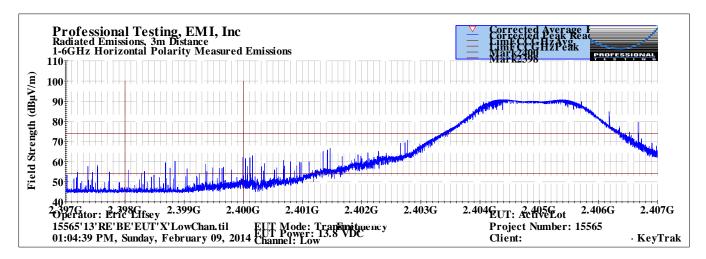


The curves are all under their respective peak limits with 1 MHz RBW and average would be under by an equivalent margin. Consequently the delta procedure is not required.

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### 7.3.2 Low Channel Band Edge

Measurements are of peak detection levels and shown for worse-case polarity. The average level would be calculated from peak by applying the duty cycle factor of -20 dB.



The curves are all under their respective peak limits with 1 MHz RBW and average would be under by an equivalent margin. Consequently the delta procedure is not required.

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## 8.0 Radiated Spurious Emissions Below 1 GHz

Out of band spurious/harmonic emissions measurements were performed on the EUT to determine compliance to 47 CFR, Part 15.

### **8.1** 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 as Figure 6.1.1.

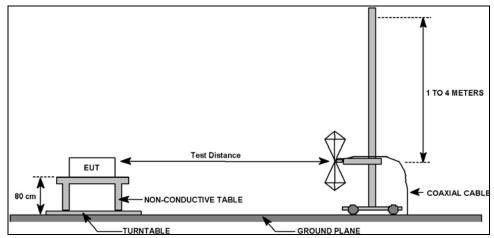


Figure 6.1.1: Field Strength of Spurious Emissions Test Setup

#### 8.2 Test Criteria

Clause Subject	Section Number	Date
Field Strength of Radiated		2014-02-04
Spurious/Harmonic Emissions	15.247, 15.209	2014-02-09
Spurious/Harmonic Emissions		2014-02-23

#### 8.3 Test Results

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

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## 8.3.1 Radiated Spurious Emissions, Receive, Below 1 GHz

			Profes	sional Te	sting, EN	VII, Inc.			
Test Metho	od:			ds of Measurer e Range of 9 kH				_	
In accordar	ice with:	Limits	209 - Code of	Federal Regulat	ions Part 47, S	Subpart C - Int	tentional Radi	ators, Radiato	ed Emissions
Section:		15.209							
Test Date(s	s):	2/23/2014			EUT Serial		None		
Customer:			Reynolds (	KeyTrak)	EUT Part #:		None		
Project Nui		15565-15			Test Techni		Eric Lifsey		
Purchase O		Not Listed			Supervisor:		Rob McCol	lough	
Equip. Und	er Test:	ActiveLot			Witness' N	ame:	None		
	ı	Radiated Em	issions Test	t Results Data	Sheet		Pa	ge: 1	of 1
EUT Li	ne Voltage	: 1	2 VDC		EUT Pow	er Frequen	су:	N/A	
Antenna	Orientation	on:	Vertic	al	Frequ	ency Range:		30MHz to	1GHz
	EUT N	Node of Ope	eration:	1	Powe	ered On, Re	ceive Mode	, Middle Ch	annel
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
59.9962	10	94	3.98	Quasi-peak	36.3	14.984	29.5	-14.5	Pass
138.633	10	275	1.34	Quasi-peak	23.9	3.311	33.1	-29.8	Pass
207.739	10	210	1.45	Quasi-peak	22.4	5.95	33.1	-27.2	Pass
234.454	10	76	2.23	Quasi-peak	22.1	7.389	35.6	-28.2	Pass
698.165	10	195	3.9	Quasi-peak	21.7	17.14	35.6	-18.5	Pass
896.272	10	109	2.71	Quasi-peak	21.3	21.02	35.6	-14.6	Pass
Radiated	sional Testing, Emissions, 10m D GHz Vertical Polarity	istance				<ul> <li>         ∇ Co         Pe     </li> </ul>	asi-peak Limit Le rrected Quasi-pea ak Limit Level rrected Peak Valu	k Readin	SIONAL
Field Strength (d B µ V /m))	al <sub>a</sub> tions.					hda mistrania di basala		The state of the s	
10	and	day and the first and a second	100M	Y	+	· · · · · · · · · · · · · · · · · · ·	TITE A stire Lat OPP		1G
	Eric Lifsey E'022314'RXMode' PM, Sunday, Februar			Freq e: Powered On er: 12.0 VDC	uency	P	UT: ActiveLot OBD roject Number: 15565 lient:	-10 (KeyTrak)	

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			Profes	sional Te	sting, El	VII, Inc.				
Test Metho	od:		–2003: "Metho Equipment in th					•		
n accordai	nce with:	FCC Part 15 Limits	.209 - Code of	Federal Regulat	ions Part 47, S	Subpart C - Int	entional Rad	diators, Radiate	ed Emissions	
Section:		15.209			1					
Test Date(s	s):	2/23/201			EUT Serial		None			
Customer:			& Reynolds (	KeyTrak)	EUT Part #:		None			
Project Nu		15565-15			Test Techn		Eric Lifsey			
Purchase C		Not Liste	<u> </u>		Supervisor:		Rob McCc	llough		
quip. Und	er Test:	ActiveLot			Witness' N	ame:	None			
		Radiated E	missions Test	Results Data	a Sheet		Р	age: 1	of 1	
EUT L	ine Voltage	):	12 VDC		EUT Pow	er Frequen	cy:	- N/A		
Antenna	a Orientati	on:	Horizor	ntal	Frequ	ency Range:	:	30MHz to	1GHz	
	EUT I	Mode of O	peration:		Powe	ered On, Re	ceive Mod	e, Middle Ch	annel	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)		Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Leve (dBµV/m)	0	Test Results	
31.7936	10	214	3.73	Quasi-peak	24.1	12.068	29.5	-17.4	Pass	
183.563	10	237	3.68	Quasi-peak	22.4	4.857	33.1	-28.2	Pass	
209.608	10	264	3.34	Quasi-peak	37.9	21.574	33.1	-11.5	Pass	
232.116	10	251	2.63	Quasi-peak	22.2	7.283	35.6	-28.3	Pass	
756.109	10	354	1.27	Quasi-peak	21.6	18.377	35.6	-17.2	Pass	
928.79	10	119	3.18	Quasi-peak	21.1	21.013	35.6	-14.6	Pass	
Radiated 30MHz-1 60 T	Sional Testing Emissions, 10m I GHz Horizontal Pola	Distance rity Measured Emiss				<ul> <li>         ∇ Coi         <ul> <li>Pes</li> </ul> </li> </ul>	asi-peak Limit I rrected Quasi-pa ak Limit Level rrected Peak Va	ak Readin	SIGNAL	
± !			100M						1G	
0 30M	•		100M							
Operator:	Eric Lifsey RE'022314'RXMod			Freq	uency	E	UT: ActiveLot OBD			

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## 8.3.2 Radiated Spurious Emissions, Transmit, Below 1 GHz

			Profess	sional Te	sting, EN	VII, Inc.			
Test Metho	od:							ow-Voltage Elec nce, see §15.38	
In accorda	nce with:	FCC Part 15.2 Limits	109 - Code of I	Federal Regulat	ions Part 47, S	Subpart C - In	tentional F	Radiators, Radia	ted Emissions
Section:		15.209							
Test Date(s	s):	2/4/2014, 2			EUT Serial		None		
Customer:		Reynolds 8	Reynolds		EUT Part #:		None		
Project Nu		15565-15			Test Techni		7	doutey 2/5, Ei	ric Lifsey 2/9
Purchase C		Not Listed			Supervisor:		_	Collough	
Equip. Und	ler Test:	ActiveLot			Witness' N	ame:	None		
	ı	Radiated Em	issions Test	Results Data	Sheet			Page: 1	of 1
EUT L	ine Voltage	: 13	3.8 VDC		EUT Pow	er Frequen	icy:	- N/A	_
Antenna	a Orientatio	on:	Vertic	al	Frequ	ency Range	•	30MHz to	1GHz
	EUT N	Node of Ope	eration:	ı		Powe	ered On,	Transmit	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Lev		Test Result
32.2043	10	188	3.58	Quasi-peak	23.8	11.58	29.5	-17.9	Pass
60.0058	10	18	2.96	Quasi-peak	32.5	11.13	29.5	-18.4	Pass
205.487	10	220	3.05	Quasi-peak	27.5	10.977	33.1	-22.1	Pass
231.824	10	110	1.47	Quasi-peak	31.8	16.869	35.6	-18.7	Pass
240.079	10	91	1.52	Quasi-peak	33.6	19.305	35.6		Pass
879.264	10	44	3.87	Quasi-peak	21.4	20.572	35.6	-15.0	Pass
Radiated 30MHz - 60 = - ( m / A 1	sional Testing, Emissions, 10m D - 1GHz Vertical F		Emissions			▽ C - Pe	uasi-peak Lim orrected Quas eak Limit Lev orrected Peak	si-peak Readin vel	SSIONAL
Heid Strength (dB)	Makentapa of the land and front had	Mary day day day and d			The state of the s			have reported to the state of t	V

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			Ductos		less Certifica		for the K	eyTrak	AL OB	D MO	DULE
			Protes	sional Te	sting, Ei	vii, inc.					
Test Metho	d:			ds of Measurer e Range of 9 kH					•		d
In accordar	ice with:	FCC Part 15.2 Limits	209 - Code of	Federal Regulat	tions Part 47,	Subpart C - Int	tentional R	adiator	s, Radiate	ed Emis	sions
Section:		15.209					The state of the s				
Test Date(s	):	2/4/2014,	2/9/2014		EUT Serial	#:	None				
Customer:		Reynolds 8	Reynolds		EUT Part #:		None				
Project Nur	nber:	15565-15			Test Techn	ician:	Bob Red	loutey	2/5, Eri	c Lifse	y 2/9
Purchase Order #: Not Listed Supervisor: Rob McCollou							Collou	gh			
Equip. Und	er Test:	ActiveLot			Witness' N	ame:	None				
	F	Radiated Em	issions Test	t Results Data	a Sheet			Page:	1	of	1
EUT Li	ne Voltage:	: 13	3.8 VDC		EUT Pov	ver Frequen	су:	-	N/A		
Antenna Orientation: Horizontal					Frequency Range:			30MHz to 1GHz			
	EUT N	lode of Ope	eration:		Powered On, Transmit						
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBµV/m)	Limit Lev	_	/largin (dB)	Test R	Results
37.6737	10	173	3.01	Quasi-peak	23.5	8.227	29.5		-21.3	Pa	ass
203.402	10	205	3.59	Quasi-peak	34.3	17.647	33.1		-15.5	Pa	ass
207.459	10	155	3.67	Quasi-peak	33.9	17.473	33.1		-15.6	Pa	ass
231.875	10	177	3.94	Quasi-peak	36.3	21.288	35.6		-14.3	Pa	ass
235.901	10	165	2.84	Quasi-peak	36.3	21.701	35.6		-13.9	Pa	ass
240.027	10	171	2.69	Quasi-peak	36.1	21.82	35.6		-13.8	Pa	ass
347.91	10	253	2.22	Quasi-peak	26.6	14.471	35.6		-21.1	Pa	ass
Radiated	cional Testing, Emissions, 10m Di 1GHz Horizontal		ed Emissions			<ul> <li>         ∇ Co         Pe     </li> </ul>	uasi-peak Limi orrected Quasi ak Limit Leve orrected Peak	i-peak Rea el	PROFES	SIONAL	
Field Strength (dBµV/m)					What						

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Frequency EUT Mode: Powered On EUT Power: 13.8VDC 1G

EUT: ActiveLot

Project Number: 15565-10

100M

30M Operator: Bob Redoutey

15565\_2013 Rad Emissions\_ClassB\_020414.til

01:59:14 PM, Tuesday, February 04, 2014

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### 9.0 Radiated Spurious Emissions Above 1 GHz

Out of band spurious/harmonic emissions measurements were performed on the EUT to determine compliance to 47 CFR, Part 15.

#### 9.1 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 are 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 is applicable and duty cycle factor is then applied for average level calculation. Emissions are investigated up to the 10<sup>th</sup> harmonic of the transmitter fundamental.

Non-harmonic spurious emissions must satisfy the average limit and the peak limit (20 dB above average). A diagram showing the test setup is given as Figure 5.1.1.

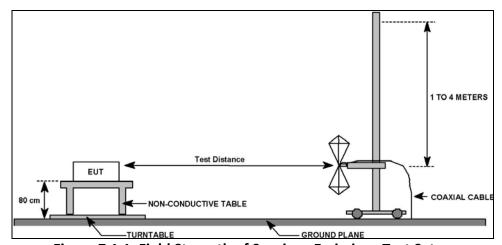


Figure 7.1.1: Field Strength of Spurious Emissions Test Setup

### 9.2 Test Criteria

Clause Subject	Section Number	Date
Field Strength of Radiated	15 247 15 200	2014-01-03
Spurious/Harmonic Emissions	15.247, 15.209	2014-01-03

From timing measurements reported elsewhere in this report, the average level is -20 below the measured peak values. Therefore meeting the peak limit levels also complies with the average levels.

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### 9.3 Test Results

In all cases detector mode is peak, RBW 1 MHz, VBW 3 MHz. The applicable duty cycle factor for averaging is -20 dB. In transmit mode the EUT was transmitting on the indicated channel. All peak emissions can be seen as below the peak limit, meaning the duty cycle factor for averaging places the average also below its respective limit.

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## 9.3.1 Radiated Spurious Emissions, Receive, Middle Channel, 1 GHz to 12 GHz

			Pı	rofes	sional Te	sting, El	VII, Inc.						
Test Me	thod:				ds of Measurer e Range of 9 kH					_		ical and	i
In accord	dance with:	FCC Part Limits	15.209 -	Code of I	Federal Regulat	tions Part 47, S	Subpart C - Int	entiona	al Radia	tors, Ra	diate	d Emiss	ions
Section:		15.209				1							
Test Dat	• •	2/23/2				EUT Serial		None					
Custome		KeyTra				EUT Part #:		None					
	Number:	15565-				Test Techn		Eric Lifsey					
	e Order #:	Not Lis				Supervisor:		Rob McCollough					
Equip. U	Inder Test:	ActiveL	.ot			Witness' N	ame:	None					
		Radiated	d Emissi	ons Test	Results Data	a Sheet			Pag	ge:	1	of	1
EU	T Line Voltage	e:	12	VDC		EUT Pow	er Frequen	су:	-	N	I/A		
Antei	nna Orientati	on:		Vertic	al	Frequ	ency Range:	Above 1GHz			ìΗz		
	EUT	Mode of	Operati	on:		Powe	ered On, Re	ceive N	Mode,	Middle	Cha	nnel	
Frequence Measure (MHz)	ed Distance	EUT Directi (Degre	on F	ntenna leight leters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit (dBµ\		Marg (dB)		Test R	esult
1948.0	2 3	294		0	Average	37.8	27.531	54	.0	-26.4	4	Pa	SS
8787.1	8 3	242		0	Average	27.5	35.865	54	.0	-18.3	1	Pa	SS
11526.	3 3	57		0	Average	26.8	37.957	54	.0	-16.0	0	Pa	SS
Radia	fessional Testing ated Emissions, 3m D GHzVerticalPolarity Mea	stance						erage Lim rrected A ak Limit I rrected Po	verage Re Level		OFESS E S T	IONAL N 6	
1 Strength (dBµV/m)													
				ريز با (الاستاد بالدارد الدارد	John white the local and the same of the s	a para traditional la company de la comp	Aller de la santificación de la control de l		A control of the	VI (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)		7	
S .	mureduly, the day and his too be here added	idden gannidallajdig		hite in the discount like is a	And a share the state of the st	a fina and finite of a second and a second	Ung dayan iya panga pada ka sa kala ka sa kala ka sa ka	or fact the state of the state		VI all tank		7	
30 Heid	rouge of high disk pool his sign by how the legal	ill daying general daybear	T Y	ight of the state of the light of the state	June Manifester	a pay a librarily a	the desired transport of the section of the	of the second second		Y Constitution		Y	
30 20 G			the state of the s	hiteratus de	Januari Maria de La La La Jada de	Hency.	ing from the old stable	HT- Actival	ot OPD	Y	10G	7	ł
30 30 1 G	ners Spirit Spir	EUTY MHz+G	Hztil	EUT Mode	Free: Powered On	quency		UT: ActiveL		10	10G	126	;

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				Wire	less Certifica	ation Report	for the K	KeyTrak	AL OB	D MODUI
			Profess	sional Te	sting, El	MI, Inc.				
Test Metho	d:			ds of Measurer e Range of 9 kH					•	
In accordan	ice with:	FCC Part 15.2 Limits	09 - Code of I	ederal Regulat	tions Part 47,	Subpart C - Int	tentional I	Radiators	s, Radiate	ed Emissions
Section:		15.209								
Test Date(s	):	2/23/2014			EUT Serial	#:	None			
Customer:		Reynolds &	Reynolds (	KeyTrak)	EUT Part #:	<u> </u>	None			
Project Nur	nber:	15565-15			Test Techn	ician:	Eric Lifs	ey		
Purchase O	rder #:	Not Listed			Supervisor		Rob Mc	Colloug	gh	
Equip. Und	er Test:	ActiveLot			Witness' N	ame:	None			
	F	Radiated Em	issions Test	Results Data	a Sheet			Page:	1	of 1
EUT Li	ne Voltage:	ge: 12 VDC EUT Power Frequency: - N/A								
Antenna	Antenna Orientation: Horizontal Frequency Range:					A	bove 1	GHz		
	EUT N	lode of Ope	ration:		Powe	ered On, Re	ceive Mo	ode, Mi	ddle Ch	annel
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBµV/m)	Limit Le	_	argin (dB)	Test Resul
4373.05	3	111	0	Average	33.6	28.576	54.0		-25.4	Pass
8683.06	3	69	0	Average	27.6	35.962	54.0		-18.0	Pass
11970.7	3	51	0	Average	27.3	37.637	54.0		-16.3	Pass
Radiated	iional Testing, Emissions, 3m Dis Iorizontal Polarity Me	tance				<ul> <li>         ∇ Co         Pe     </li> </ul>	erage Limit i rrected Aver ak Limit Lev rrected Peak	age Reading	PROFES	SIONAL

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Frequency

> 1GHz Horizontal Antenna Polarity Measured Emissions

EUT Mode: Powered On EUT Power: 12.0 VDC Center Channel, Receive Mode EUT: ActiveLot OBD

Client:

Project Number: 15565-10

Key Trak)

201G Operator: Eric Lifsey

15565' 13RE' 022314' RXMode' EUT'Y' MHz + GHztil

12:51:17 PM, Sunday, February 23, 2014

## 9.3.2 Radiated Spurious Emissions, Receive, Low & High Channels, 1 GHz to 12 GHz

Two individual EUTs were measured together and operating on the opposite end channels.

	·			Profess	sional Te	sting, EN	VII, Inc.						
Test Metho	d:				ds of Measurer Range of 9 kH					_		ical and	l
In accordan	ce with:	FCC Part :	15.209	9 - Code of F	ederal Regulat	ions Part 47, S	Subpart C - Int	tention	al Radia	tors, Ra	diate	d Emiss	ions
Section:		15.209											
Test Date(s	):	2/23/20	14			EUT Serial	<b>#</b> :	None					
Customer:		KeyTrak				EUT Part #:		None					
Project Nun		15565-1				Test Techni	ician:	Eric L	•				
Purchase O	rder #:	Not List	ed			Supervisor:		Rob I	McColl	ough			
Equip. Und	er Test:	ActiveLo	ot			Witness' Na	ame:	None	1				
	F	Radiated	Emis	sions Test	Results Data	Sheet			Pag	e:	1	of	1
EUT Li	ne Voltage:		12	VDC		EUT Pow	er Frequen	су:	-	١	I/A		
Antenna	Orientatio	n:		Vertica	al	Frequ	ency Range	:		Abov	/e 10	SHz	
	EUT N	/lode of (	Opera	ation:		Powere	d On, Recei	ve Mo	de, Lo	w & Hi	gh C	hanne	ls
Frequency Measured (MHz)	Test Distance (Meters)	EUT Directio (Degree	n	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit (dBµ	Level V/m)	Marg (dB		Test Re	esults
1946.76	3	178		0	Average	38.8	28.547	54	1.0	-25.	4	Pas	SS
8840.62	3	341		0	Average	27.4	35.611	54	1.0	-18.	3	Pas	ss
10282.4	3	168		0	Average	26.6	36.888	54	1.0	-17.	1	Pas	SS
Radiated 1-18GHzV 90 70 80 (m/ Ang p) + 60 4 4 4 5 5 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6	ional Testing, Emissions, 3m Diss ertical Polarity Measu	tance					<ul> <li>         ∇ Co         Pe     </li> </ul>	ak Limit	werage Re		ROFESS	SIONAL	
30 40	and deposite to the second	etil, proposite distribute	<u> </u>		and the state of t	halisa marining a continue parties	Mayori Park and Park			7	10G	12G	
	cric Lifsey E'022314'RXMode'I M, Sunday, February		l	EUT Po wer	Freq : Powered On :: 12.00 VDC ligh Channel Together, I	uency Rec Mode	P	UT: Activel Project Num Client	Lot OBD ber: 15565-	10 KeyTra	nk)		
		>	1GHz		al Antenna P		sured Emis	sions					

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				Wire	less Certifica	ation Report	for the Key	Γrak AL OE	BD MODULE
			Profess	sional Te	sting, El	VII, Inc.			
Test Metho	d:			ds of Measurer Range of 9 kH				•	
In accordan	ce with:	FCC Part 15.2	209 - Code of F	ederal Regulat	ions Part 47, S	Subpart C - Int	entional Radi	ators, Radiat	ed Emissions
Section:		15.209							
Test Date(s	):	2/23/2014			EUT Serial	<b>#:</b>	None		
Customer:		KeyTrak			EUT Part #:		None		
Project Nur	nber:	15565-15			Test Techn	ician:	Eric Lifsey		
Purchase O		Not Listed			Supervisor:		Rob McCol	lough	
Equip. Und	er Test:	ActiveLot			Witness' N	ame:	None		
	F	Radiated Em	issions Test	Results Data	Sheet		Pa	ge: 1	of 1
EUT Li	ne Voltage:	: 1	2 VDC		EUT Pow	ver Frequen	cy:	- N/A	
Antenna	Orientatio	n:	Horizon	tal	Frequ	ency Range:		Above 1	.GHz
	EUT N	lode of Op	eration:		Powere	d On, Recei	ve Mode, Lo	ow & High	Channels
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
6965.14	3	137	0	Average	30.2	33.245	54.0	-20.7	Pass
8837.24	3	328	0	Average	27.5	35.639	54.0	-18.3	Pass
10769.2	3	348	0	Average	27.4	37.391	54.0	-16.6	Pass
11488.9	3	256	0	Average	26.9	38.148	54.0	-15.8	Pass
Radiated 1	ional Testing, Emissions, 3m Diss orizontalPolarity Me	tance				<ul> <li>         ∇ Coi         <ul> <li>Pes</li> </ul> </li> </ul>	erage Limit Level rrected Average I ak Limit Level rrected Peak Rea	Reading	SSIONAL Y I N 6
Special Solution of the state o	Eric Lifsey  EV22314 RXModel	EUTX+ZGHztil		Freq: Powered On	uency		UT: ActiveLot OBD	10G 5-10 KevTrak)	T2G

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> 1GHz Horizontal Antenna Polarity Measured Emissions

## 9.3.3 Radiated Spurious Emissions, Transmit Middle Channel, 1 GHz to 18 GHz

			Profes	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	Federal Regula	tions Part 47, S	Subpart C - Int	entional Radi	ators, Radiat	ed Emissions
Section:		15.209					_		
Test Date(s	s):	2/4/2014			EUT Serial	#:	None		
Customer:		KeyTrak			EUT Part #:		None		
Project Nu		15565-15			Test Techn		Bob Redou	•	
Purchase C		Not Listed			Supervisor		Rob McCol	lough	
Equip. Und	ler Test:	ActiveLot			Witness' N	ame:	None		
	F	Radiated E	missions Test	Results Dat	a Sheet		Pa	ge: 1	of 1
EUT L	ine Voltage	: 1	.3.8 VDC		EUT Pov	ver Frequen	cy:	N/A	
Antenna	a Orientatio	n:	Vertic	al	Frequ	ency Range:		Above 1	GHz
	EUT N	/lode of Op	eration:			Transm	it, Middle (	Channel	_
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 Result
4878.7	3	120	1	peak	56.7	56.7	74.0	-17.3	Pass
7318.2	3	120	1	peak	63.4	63.4	74.0	-10.6	Pass
9761.9	3	120	1	peak	61.4	61.4	74.0	-12.6	Pass
17083	3	120	1	peak	58.8	58.8	74.0	-15.2	Pass
Radiated	sional Testing, Emissions, 3m Dis Vertical Polarity	stance	sions			- Pe	verage Limit Leve prrected Average eak Limit Level prrected Peak Rea	Reading	SSIONAL
	The state of the s								

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				Wire	less Certifica	ation Report	for the Key	Γrak AL OB	D MODULE		
			Profess	sional Te	sting, El	VII, Inc.					
Test Metho	d:			ds of Measurer Range of 9 kH							
In accordan	ce with:	FCC Part 15.2 Limits	209 - Code of I	ederal Regulat	ions Part 47, S	Subpart C - In	tentional Radi	ators, Radiat	ed Emissions		
Section:		15.209									
Test Date(s	):	2/4/2014			<b>EUT Serial</b>	<b>#</b> :	None				
Customer:		KeyTrak			EUT Part #:		None				
Project Nur	nber:	15565-15			Test Techn	ician:	<b>Bob Redou</b>	tey			
<b>Purchase O</b>	rder #:	Not Listed			Supervisor:		Rob McCol	lough			
Equip. Und	er Test:	ActiveLot			Witness' N	ame:	None				
	F	Radiated Em	issions Test	Results Data	a Sheet		Pa	ge: 1	of 1		
EUT Li	ne Voltage	: 13	3.8 VDC		EUT Pow	ver Frequen	icy:	- N/A			
Antenna	Orientatio	n:	Horizor	tal	Frequ	ency Range	ency Range: Above 1GHz				
	EUT N	/lode of Ope	eration:			Transm	nit, Middle (	Channel			
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		
4878.7	3	120	1	peak	62.3	62.3	74.0	-11.7	Pass		
7318.2	3	120	1	peak	68.3	68.3	74.0	-5.7	Pass		
9761.9	3	120	1	peak	56.8	56.8	74.0	-17.2	Pass		
17083	3	120	1	peak	59.1	59.1	74.0	-14.9	Pass		
Radiated 1-18GHz	ional Testing, Emissions, 3m Dis Horizontal Polar	,	ssions			<ul> <li>∇ Co</li> <li>Pe</li> </ul>	reage Limit Level rrected Average F ak Limit Level rrected Peak Read	Reading	SSIONAL SSIONAL		
Field Strength (dBµV/m)											

> 1GHz Horizontal Antenna Polarity Measured Emissions

Frequency EUT Mode: Powered On EUT Power: 13.8VDC Center Channel 10G EUT: ActiveLot

Project Number: 15565-10

18G

20<sup>±</sup> 1G Operator: Bob Redoutey

15565\_2013 Rad Emissions\_ClassB\_020414.til

04:41:21 PM, Tuesday, February 04, 2014

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## 9.3.4 Radiated Spurious Emissions, Transmit Low & High Channel, 1 GHz to 18 GHz

Two individual EUTs were measured together and operating on the opposite end channels.

				Profes	sional Te	sting, El	VII, Inc.				
Test Metho	od:				ods of Measurer he Range of 9 kH					•	
In accordar	nce with:	FCC Par	rt 15.2	09 - Code of	Federal Regulat	ions Part 47,	Subpart C - Int	tention	al Radiato	ors, Radiato	ed Emissions
Section:		15.209	1								
Test Date(s	s):	2/9/2	014			<b>EUT Serial</b>	#:	None			
Customer:		KeyTra	ak			EUT Part #:		None			
Project Nui	mber:	15565	-15			Test Techn	ician:	Eric Li	ifsey 2/	9	
Purchase O	rder #:	Not Li	sted			Supervisor		Rob N	<b>VIcCollo</b>	ugh	
Equip. Und	er Test:	Active	Lot			Witness' N	ame:	None			
	R	Radiate	d Em	issions Te	st Results Data	Sheet			Page	: 1	of 1
EUT Li	ne Voltage:		13	.8 VDC		EUT Pov	ver Frequen	су:	-	N/A	
Antenna	a Orientatio	n:		Verti	cal	Frequ	ency Range	:		Above 1	GHz
	EUT M	/lode o	f Ope	ration:			Transmit	Low 8	& High ር	Channel	
Frequency Measured (MHz)	Test Distance (Meters)	EU Direct	tion	Antenna Height (Meters)	Detector Function	Recorded Corrected Amplitude Level (dBµV) (dBµV/m)		Limit (dBµ\		Margin (dB)	Test Results
4960.5	3	12	0	1	peak	56.3	56.3	74	1.0	-17.7	Pass
Radiated	sional Testing, Emissions, 3m Dis Vertical Polarity	tance		IIS			- Co - Pe	ak Limit	verage Rea		SIONAL
15565'13]	: Eric Lifsey RE'020914'EUT'X-			EUT P	Freq fode: Powered On ower: 13.8VDC d High Channel Toget	uency	I		ımber: 1556	5-10 , (KeyTr	18G

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			_			eless Certifica		for the	KeyT	rak A	L OB	D MOI	DUL
			Pr	otess	sional Te	sting, El	VII, Inc.						
Test Metho	od:				ds of Measurer e Range of 9 kF					_			d
n accordai	nce with:	FCC Part 1 Limits	5.209 - 0	Code of I	ederal Regulat	tions Part 47,	Subpart C - Int	tentiona	al Radia	tors, F	Radiate	ed Emiss	sions
Section:		15.209											
Test Date(s	<u>s):</u>	2/9/2014	4			EUT Serial		None					
Customer:		KeyTrak				EUT Part #:		None					
Project Nu		15565-15				Test Techn	ician:	_	ifsey 2				
Purchase C		Not Liste				Supervisor			<b>AcColl</b>	ough			
Equip. Und	er Test:	ActiveLo	t			Witness' N	ame:	None					
	F	Radiated I	Emissio	ns Test	Results Dat	a Sheet			Pag	e:	1	of	1
EUT L	ine Voltage:	:	13.8	VDC		EUT Pov	ver Frequen	ıcy:	-		N/A		
Antenna Orientation: Horizontal					ntal	Frequ	ency Range	:		Abo	ove 10	GHz	
	EUT N	/lode of O	peratio	n:			Transmit	Low 8	և High	Chan	nel		
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degrees	n He	tenna eight eters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit (dBµ\		Ma (d	_	Test R	esult
Radiated	sional Testing, Emissions, 3m Dis Horizontal Polar	tance	Emissions				<ul> <li>         ∇ Co         Pe     </li> </ul>	verage Lin prrected A eak Limit I prrected P	verage Re Level		PROFESS	SIONAL	
30 20 1G	: Eric Lifsey		a described de la constante de		Freq de: Powered On	uency		EUT: Activ				180	Ţ

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### 9.3.1 Radiated Spurious Emissions, Transmit, 18 GHz to 25 GHz

One emission for the middle channel was found in one polarity as indicated below. No other emissions were found on the low and high channels.

Client:	KeyTrak Rey	ynolds & Rey	nolds		Polarity:	As Shown		Distance:	0.5	meter
Test Date:	February 20,	2014			EUT:	KeyTrak OB	D			
Voltage:	13.8 VDC				Serial #:	EUT Y				
Frequency:	N/A				Project #:	15565				
Technician:	Eric Lifsey				Test Type:	15.	247	D/C Factor:	2	.0
	Correc	ted Level = F	Recorded Lev	el - Amplifier	<sup>-</sup> Gain + Ante	enna Factor +	- Cable Loss	- Duty Cycle	Factor	
Frequency (GHz)	EUT Direction (degrees)	Antenna Elevation (Meters) / Polarity	Recorded Level (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m) less Duty Cycle Factor	Average Limit (dBuV/m)	Margin (dB)	Detector Function
19.52	270	1 / Horiz	71.9	25.4	36.5	3.70	66.7	69.6	-2.9	Average

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## **10.0** Antenna Construction Requirements

The design was investigated for meeting the antenna construction requirements of the applicable rules.

#### 10.1 Procedure

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

### 10.2 Criteria

Clause Subject	Section Number	Date
Antenna Construction	15.203	2014-02-27

#### 10.3 Results

Antenna Manufacturer and Model	Specifications
KeyTrak	
Printed circuit antenna on circuit board.	
Design is an inverted F antenna.	

- The antenna is internal only to the device.
- The antenna is etched on the circuit board.
- There is no antenna connector.

The antenna design meets the requirements of the rules.

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# 11.0 Equipment Lists

## 11.1 Equipment for Spurious Radiated Emissions, 30 MHz to 18 GHz

	1.1	F	200 200 300 300 300 300 300 300 300 300									
		Profes	sional Testing, EMI, Inc.									
Test Metho	a:		nods of Measurement of Radio-Noise		_							
			Equipment in the Range of 9 kHz to									
			of Federal Regulations Part 47, Subpa	art C - Intentional F	Radiators,							
In accordan		ted Emissions Limi	ts									
Section:	15.20		FUT Cardal #	Nama								
Test Date(s) Customer:		2014, 2/9/2014	EUT Serial #: EUT Part #:	None None								
Project Nun	KeyTr nber: 15565		Test Technician:	Bob Redoutey 2/5	Eric Lifeov 2/9							
Purchase O			Supervisor:	Rob McCollough	, Elic Liisey 2/3							
Equip. Unde			Witness' Name:	None								
Equip. Onu	er rest. Active		<u> </u>	None								
Radiated Emissions Test Equipment List												
Til	le! Software Version	on: 4.2.A,	May 23, 2010, 08:38:52 AM									
	Test Profile: Radiated Emissions_Profile Version October 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	7/29/2014							
1890	НР	8447F	Preamp/Amp, 9kHz-1300MHz, 28/25dB	3313A05298	1/22/2015							
1930	Agilent	E4440A-239	Spectrum Analyzer, 3 Hz - 26.5 GHz	MY45304903	7/11/2015							
1926	ETS-Lindgren	3142D	Antenna, Biconilog, 26 MHz - 6 GHz	00135454	7/29/2014							
C027	N/A	RG214	Cable Coax, N-N, 25m	none	9/26/2014							
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							
1325	EMCO	1050	Controller, Antenna Mast	9003-1461	N/A							
1509B	Braden	N/A	TDK 10M Chamber, VSWR > 1 GHz	DAC-012915-005	7/16/2014							
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	9/26/2014							
1780	ETS-Lindgren	3117	Antenna, Double Ridged Guide Horn, 1 - 18 GHz	00110313	1/21/2015							

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## 11.2 Equipment for Spurious Radiated Emissions 18 GHz to 25 GHz

Asset #	Manufacturer	Model #	Description	Calibration Due
0582	EMCO	3115	Ridge Guide Antenna	2014-03-14
1974	Agilent	83017A	Microwave Preamplifier (preamp 1)	2015-02-05
1342	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29
C248	Pasternack		Cable	2014-03-13
1542	AH Systems	SAS-572	Horn Antenna, Standard Gain, 20 dB	Not Required

## 11.3 Equipment for Timings, Bandwidth, Peak Power, and Power Spectral Density

The following equipment was used to measure transmitter timings and bandwidth.

Asset #	Manufacturer	Model #	Description	Calibration Due
0582	EMCO	3115	Ridge Guide Antenna	2014-03-14
1342	Rohde & Schwarz	FSP-30	Spectrum Analyzer	2015-01-29
C248	Pasternack		Cable	2014-03-13

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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 Efflissions	1 to 18 GHz	3 m	5.7

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# **End of Report**

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