# Project 17687-15

## Pruf Energy Controls PEC915V10

## Wireless Certification Report Additional Antennas Permissive Change

Prepared for:

Pruf Energy Controls 100 Research Parkway Suite 2265 Waco, TX 76704

By

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

11 Dec 2015

Reviewed by

Larry Finn Chief Technical Officer Eric Lifsey EMC Engineer

Written by

# **Revision History**

Revision Number	Description	Date
00	Draft for review.	9 Dec 2015
01	Revised per reviewer comments.	11 Dec 2015

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# **Compliance Certificate**

Applicant	Device & Test Identification				
Pruf Energy Controls	FCC ID:	2ACB8-PEC915V10			
100 Research Parkway	Industry Canada ID:	11970A-PEC915V10			
Suite 2265	Model(s):	PEC915V10			
Waco, TX 76704	Part Number(s):	N/A			
Certificate Date: 11 Dec 2015	Laboratory Project ID:	17687-15			

The device named above was tested utilizing the following documents and found to be in compliance with the required criteria:

Standard	Reference	Detail
FCC 47 CFR Part 15 C	15.247	Operation within the bands <u>902-928 MHz</u> , 2400-2483.5 MHz, and 5725-5850 MHz.
FCC 47 CFR Part 15 C	15.209	Radiated emission limits; general requirements.
KDB 558074 D01	DR01	DTS Measurement Guidance v03r02
OET Bulletin 65*	Edition 97-01, and Supplement C, Ed. 01-01	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
RSS-210	Issue 8	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
RSS-Gen	Issue 3	General Requirements and Information for the Certification of Radio Apparatus
RSS-102 Issue 4		Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

<sup>\*</sup>MPE is reported separately from this document. \*\*Corresponding RSS references are listed in the body of the report.

I, Eric Lifsey, for Professional Testing (EMI), Inc., being familiar with the above requirements 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 requirements listed above.

Representative	e 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 the United States and Canada.

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

The EUT as tested consisted of the following module and the #3 and #4 antennas listed. Antennas #1 and #2 were listed in the original module report and are included here to form a complete list.

Table 1.2.1: Equipment Under Test

Manufacturer	Model	Serial #	Description		
Pruf Energy Controls	PEC915V10	none	Wireless transmitter/receiver module for 902 – 928 MHz.		

Table 1.2.2: Complete Antenna List

#	Manufacturer / Model	Туре	Gain dBi	Description
1	Pulse / Model W3538	Printed multiband	2.8	Printed-circuit antenna with cable assembly
2	Pruf Energy Controls	Helical	0.0	Inductively-loaded helical wire
3	Pruf Energy Controls	Short Inverted-F "Badge"	0.0	Printed circuit antenna
4	Linx Antenna Factor / Model ANT-916-PML	Dipole	-0.4	Dipole antenna with cable assembly

The EUT is powered by a 3.3 Volts DC.

## **1.3** EUT Operation

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

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.

#### 1.6 Radiated Measurements

Radiated levels are determined as follows:

## Raw Measured Level + Antenna Factor + Cable Losses - Amplifier Gain = Corrected Level

Additionally, measurement distance extrapolation factors are applied where needed.

## 1.7 Applicable Documents and Clauses

Table 1.7.1: Applicable	Table 1.7.1: Applicable Documents						
Document	Title						
47 CFR	Part 15 – Radio Frequency Devices						
47 CFR	Subpart C -Intentional Radiators						
RSS-247 Issue 1	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-						
N33-247 ISSUE 1	Exempt Local Area Network (LE-LAN) Devices						
RSS-Gen Issue 4	General Requirements and Information for the Certification of Radio Apparatus						
ANCI C62 4 2000	American National Standard for Methods of Measurement of Radio-Noise Emissions						
ANSI C63.4 2009	from Low Voltage Electrical and Electronic Equipment						

Table 1.7.2: Applicable Clauses							
Parameter	FCC Part 15 Rule Paragraphs	IC RSS References					
Transmitter Characteristics	15.247	RSS-247 5.2 (DTS) & 5.4, RSS-Gen					
Spurious Emission	15.247, 15.209, 15.205	RSS-247 5.5, RSS-GEN 4.9, 4.10					
Antenna Requirement	15.203	RSS-Gen 8.3					

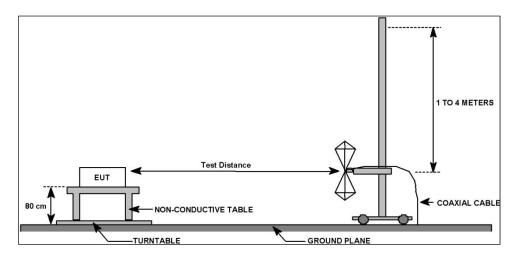
This report supplements test report 15590.

## 2.0 Radiated Spurious Emissions, Receive Mode

#### 2.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate. A diagram showing the test setup appears below.



#### 2.2 Test Criteria

47 CFR (USA) // IC (Canada)							
Section Reference	Parameter	Date(s)					
15.247, 15.209 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Field Strength of Radiated Spurious/Harmonic Emissions Receive Mode	4 Dec 2015					

#### 2.3 Test Results

Emission measurements of receiver spurious were taken for each of the added antennas. The EUT was tuned to the middle channel.

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

Table 2.3.1: Radiated Spurious Emissions, Receive Mode, Below 1 GHz, Vertical Polarity Antenna 3

Antenna 3	<u> </u>												
				Profes	sional Te	sting, EN	VII, Inc.						
Test Metho	est Method:  ANSI C63.4–2003: "Methods of Measu Electronic Equipment in the Range of 9									•			
n accordance with: FCC Part 15.209 - Code of Federal Regularits					Federal Regulat	ions Part 47, S	Subpart C - Int	entiona	l Radia	tors, Radiato	ed Emission		
Section:		15.209	5.209										
Test Date(s	):	12/4/	2015			EUT Serial #	<b>#</b> :	0					
Customer:		Pruf E	Energy	Controls		EUT Part #:		PCBBa	dge A	ntenna			
Project Nur	nber:	17687	7-15			Test Techni		Eric Lif					
Purchase O	rder #:	NA				Supervisor:		Lisa Aı					
Equip. Und	er Test:	PEC9	15V10	with PCBB	adge	Witness' Na	ame:	JD Hol	land				
	F	adiate	ed Em	issions Tes	t Results Data	a Sheet			Pag	e: 1	of 1		
EUT Line Voltage: 3.3 VDC EUT Power F				er Frequen	су:	0	N/A						
Antenna Orientation:				Vertic	al	Freque	ency Range:			30MHz to	1GHz		
	EUT N	1ode c	of Ope	eration:				Rece	ive				
Frequency Measured (MHz)	Test Distance (Meters)	EU Direc (Degr	tion	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit L (dBμV		Margin (dB)	Test Resu		
640.527	10	14	17	2.28	Quasi-peak	21.9	20.393	35.	6	-15.2	Pass		
771.206	10	221		221		1.8	Quasi-peak	21.6	22.614	35.	6	-13.0	Pass
913.271	10	9	6	2.81	Quasi-peak	21.2	26.279 3		6	-9.3	Pass		
Radiated 30MHz-10 70 1	sional Testing, Emissions, 10m Di GHz Vertical Polarity	stance					— Que  □ Que  □ Pea  □ Cor  □ Ver  × LP1	asi-peak Li rected Qu k Limit La rected Pea ified Low- RF Verifie	mit Leve asi-peak evel ak Value PRF QP ation Lin	Readin PROFES	\$SIONAL X		
Bay 30 1 20 1 10 10 10 10 10 10 10 10 10 10 10 10	Dric Lifsey	appendict the second	Arrack Alleran	100M	Freq	uency	EE	UT: PEC915	V10 with I	PCBBadge	1G		
	Run02 'MiddleChan'F AM, Friday, December	-	Badge.til		e: Receive continuous er: 3.3 VDC annel			roject Numb lient: Pruf Er		rols (Birkeland)			

Table 2.3.2: Radiated Spurious Emissions, Receive Mode, Below 1 GHz, Horizontal Polarity Antenna 3

Antenna 3	<u> </u>									
				Profess	sional Te	sting, EN	∕II, Inc.			
Test Metho	est Method:  ANSI C63.4–2003: "Methods of Meas Electronic Equipment in the Range of								•	
In accordance with: FCC Part 15.209 - Code of Federal Reg Limits					ederal Regulat	ions Part 47, S	Subpart C - Int	entional Ra	adiators, Radiate	ed Emissions
Section:		15.209								
Test Date(s	s):	12/4/2	015			EUT Serial #	<b>‡</b> :	0		
Customer:		Pruf En	nergy	Controls		EUT Part #:		PCBBadg	ge Antenna	
Project Nu	mber:	17687-	15			Test Techni	ician:	Eric Lifse	:y	
Purchase C	rder #:	NA				Supervisor:		Lisa Arno	dt	
Equip. Und	er Test:	PEC915	5V10	with PCBB	adge	Witness' Na	ame:	JD Holla	nd	
	F	Radiated	d Emi	issions Test	Results Data	Sheet		l	Page: 1	of 1
EUT Line Voltage: 3.				3 VDC		EUT Pow	er Frequen	су:	0 N/A	
Antenna Orientation:				Horizor	ntal	Freque	ency Range:		30MHz to	1GHz
	EUT N	lode of	Ope	ration:				Receive	2	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Directi (Degre	ion	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Lev (dBµV/m		Test Results
640.516	10	327	,	3.6	Quasi-peak	21.9	20.4	35.6	-15.2	Pass
770.942	10	82		2.96	Quasi-peak	21.6	22.609	35.6	-13.0	Pass
913.401	10	78		3.65	Quasi-peak	21.2	26.247	35.6	-9.4	Pass
Radiated 30MHz-1  70	*	stance ity Measured F	Emissions	100M	Frequence	iency	Ver LPI	UT: PEC915V10	With PCBBadge	SIONAL X
	Run02'MiddleChan'F AM, Friday, December	04,2015		EUT Powe Middle cha	:: Receive continuous r: 3.3 VDC nnel		С		7687-15 y Controls (Birkeland)	

Table 2.3.3: Radiated Spurious Emissions, Receive Mode, Above 1 GHz, Vertical Polarity
Antenna 3

Antenna :	3											
				Profess	sional Te	sting, EN	VII, Inc.					
Test Meth	od:				ds of Measurer e Range of 9 kF					•		
In accorda	nce with:	FCC Pa	rt 15.2	09 - Code of I	ederal Regulat	ions Part 47, S	Subpart C - Int	entiona	al Radia	tors, Radiate	ed Emission	ns
Section:		15.209	)									
Test Date(	s):	12/4/				EUT Serial	<b>#</b> :	0				
Customer:		Pruf E	nergy	Controls		EUT Part #:		_		ntenna		
Project Nu	mber:	17687	<b>'-15</b>			Test Techni	ician:	Eric Li				
Purchase (		NA				Supervisor:		Lisa A				
Equip. Und	der Test:	PEC91	L5V10	with PCBB	adge	Witness' N	ame:	JD Ho	lland			
	F	Radiate	ed Em	issions Test	Results Data	a Sheet			Pag	e: 1	of	1
EUT I	ine Voltage	:	3.	.3 VDC		EUT Pow	er Frequen	cy:	0	N/A		
Antenn	a Orientatio	n:		Vertic	al	Freque	ency Range:			Above 1	GHz	
	EUT N	/lode o	f Ope	eration:				Rece	eive			
Frequency Measured (MHz)	Test Distance (Meters)	EU Direc (Degr	tion	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit I		Margin (dB)	Test Resu	ult
1833.85	3	3	}	1	Average	35.1	25.335	54	.0	-28.6	Pass	
2736.43	3	10	0	1	Average	34.4	26.532	54	.0	-27.4	Pass	
3661.27	3	19	4	1	Average	34.5	28.424	54	.0	-25.5	Pass	
4581.65	3	34	-2	1	Average	33.1	28.995	54	.0	-25.0	Pass	
Radiatec 1-18GHz 90 =	ssional Testing, I Emissions, 3m Dis Vertical Polarity Meass	tance					▽ Cor — Pea	erage Lim Prected Av ak Limit I Prected Pe	verage Rea Level		SIONAL	
_	Eric Lifsey	ligen de la la la de la	Maked to Leave	and the second s		uency		UT: PEC91:		-	5G	
	ERun02'MiddleChanT AM,Friday,December	•		EUT Po we Middle cha	: Receive continuous r: 3.3 VDC nnel		С			15 rols (Birkeland)		_

Table 2.3.4: Radiated Spurious Emissions, Receive Mode, Above 1 GHz, Horizontal Polarity Antenna 3

			Profess	sional Te	sting, EN	∕II, Inc.	•				
Test Method:				ds of Measurer e Range of 9 kF					•		d
n accordance with:	FCC Pa		:09 - Code of I	ederal Regulat	tions Part 47, S	Subpart C - I	ntentio	nal Radia	tors, Radiate	ed Emiss	sions
Section:	15.20	9									
Test Date(s):	12/4	/2015			EUT Serial	<b>‡</b> :	0				
Customer:			Controls		EUT Part #:		PCBI	Badge A	ntenna		
Project Number:	1768	7-15			Test Techni	ician:	Eric	Lifsey			
Purchase Order #:	NA				Supervisor:			Arndt			
Equip. Under Test:	PEC9	15V10	with PCBB	adge	Witness' N	ame:	JD H	olland			
	Radiat	ed Em	issions Test	Results Data	a Sheet			Pag	e: 1	of	1
<b>EUT Line Volta</b>	ge:	3.	.3 VDC		EUT Pow	er Freque	ency:	0	N/A		
Antenna Orienta	tion:		Horizon	ital	Freque	ency Rang	e:		Above 1	GHz	
EU	Γ Mode (	of Ope	eration:				Red	eive			
Frequency Test Measured Distance (MHz) (Meters	e Dire	JT ction rees)	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m	Limit	t Level IV/m)	Margin (dB)	Test R	lesult
1831.18 3	1	.7	1	Average	35.1	25.247	5	4.0	-28.7	Pa	iss
2742.11 3	28	39	1	Average	34.5	26.647	5	4.0	-27.3	Pa	iss
3654.44 3	16	51	1	Average	34.7	28.631	5	4.0	-25.3	Pa	iss
4571.08 3	20	)7	1	Average	33.2	29.177	5	4.0	-24.8	Pa	iss
Professional Test: Radiated Emissions, 3n 1-18GHz Horizontal Polari 90 80 70 40 40 40	Distance						Peak Limit	Average Rea		SIONAL	
30 20 1G Operator: Eric Lifsey			lien silandi kanananana		uency	<u> </u>		7 015V10 with 1	_	5 G	ī
17687 RE'Run02 MiddleC 11:38:45 AM, Friday, Dec	-	'Badge.til		:: Receive continuous r: 3.3 VDC nnel			-	mber: 17687- f Energy Cont	15 rols (Birkeland)		

Table 2.3.5: Radiated Spurious Emissions, Receive Mode, Below 1 GHz, Vertical Polarity Antenna 4

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:  Section:  15.209 - Section:  15.209 - Section:  15.209 - Section:  17687-15 - Set Technician:  For Test Technician:  Fire Lifsey  Purchase Order #:  NA - Supervisor:  Usa Arndt  Equip. Under Test:  PEC915V10 with ANT-916-PML Witness' Name:  JD Holland  Radiated Emissions Test Results Data Sheet  Page:  1 of  EUT Line Voltage:  3.3 VDC - EUT Power Frequency:  O N/A  Antenna Orientation:  Vertical - Frequency Range:  30MHz to 1GHz  Frequency Distance (MHz) (Meters)  (Meters) (Degrees) (Meters)  (Meters) (Meters)  Professional Testing, EMI, Inc Radiated Emissions  Radiated Emissions  Professional Testing, EMI, Inc Radiated Emiscons  Professi	Antenna 4	ļ 													
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					Pro	ofes	sional Te	sting, EN	VII, Inc.						
In accordance with:    Section:   15.209	Test Metho	od:										•		rical and	
Test Date(s):  12/4/2015  EUT Serial #:  ONA  Supervisor:  Usa Arndt  Eut Holder H:  NA  Supervisor:  Usa Arndt  Eut Holder H:  NA  Supervisor:  Usa Arndt  Eut Holder H:  Radiated Emissions Test Results Data Sheet  Page:  1 of  EUT Line Voltage:  3.3 VDC  EUT Power Frequency:  ONA  Antenna Orientation:  Vertical  Frequency Range:  Test  Eut Mode of Operation:  Frequency Test  Measured (Meters)  Oirection (Meters)  (Meters)  Oirection (Meters)	In accordar	ice with:		rt 15.2	09 - C	ode of	Federal Regulat	ions Part 47, S	Subpart C - Int	ention	al Radia	tors, Ra	diate	d Emiss	ions
Customer: Pruf Energy Controls EUT Part #: ANT-916-PML Antenna Project Number: 17687-15 Test Technician: Eric Lifsey Purchase Order #: NA Supervisor: Lisa Arndt Equip. Under Test: PEC915V10 with ANT-916-PML Witness' Name: JD Holland  Radiated Emissions Test Results Data Sheet Page: 1 of  EUT Line Voltage: 3.3 VDC EUT Power Frequency: 0 N/A  Antenna Orientation: Vertical Frequency Range: 30MHz to 1GHz  EUT Mode of Operation: Receive  Frequency Test EUT Antenna Direction (Metars) Direction (Meters) (Mete	Section:		15.209	)											
Project Number: 17687-15 Test Technician: Eric Lifsey Purchase Order #: NA Supervisor: Lisa Arndt Equip. Under Test: PEC915V10 with ANT-916-PML Witness' Name: JD Holland  Radiated Emissions Test Results Data Sheet Page: 1 of  EUT Line Voltage: 3.3 VDC EUT Power Frequency: 0 N/A  Antenna Orientation: Vertical Frequency Range: 30MHz to 1GHz  EUT Mode of Operation: Receive  Frequency Test Distance Distance (Meters) (	Test Date(s	<u>):</u>	12/4/	2015				EUT Serial	<b>#</b> :	0					
Purchase Order #: NA Supervisor: Lisa Arndt Equip. Under Test: PEC915V10 with ANT-916-PML Witness' Name: JD Holland  Radiated Emissions Test Results Data Sheet Page: 1 of EUT Line Voltage: 3.3 VDC EUT Power Frequency: 0 N/A Antenna Orientation: Vertical Frequency Range: 30MHz to 1GHz  EUT Mode of Operation: Receive  Frequency Test EUT Antenna Detector Function (MHz) Distance (MHz) (Degrees) (Meters) Direction (Meters) Distance (Meters) Distance (Meters) Distance (Meters) Direction (Meters) Distance (Meters) Distance (Meters) Direction (Degrees) (Meters) Direction (Meters) Direction (Meters) Direction (Meters) Direction (Meters) Detector Function (Meters) Distance (MHz) Detector Function (Meters) Direction (			_		Cont	trols				_		/L Ante	enna	1	
Radiated Emissions Test Results Data Sheet   Page: 1 of				<b>'-15</b>				Test Techni	ician:	_					
Radiated Emissions Test Results Data Sheet			_					•							
EUT Line Voltage: 3.3   VDC   EUT Power Frequency: 0   N/A	Equip. Und	er Test:	PEC91	L5V10	with	ANT-	916-PML	Witness' N	ame:	JD Ho	lland				
Frequency   Test   EUT   Mode of Operation:   Receive		F	Radiate	ed Em	issior	ns Test	t Results Data	Sheet			Pag	ge:	1	of	1
Frequency   Test   EUT   Antenna   Detector   Recorded   Amplitude   Level   (dBμV/m)	EUT Li	ne Voltage	:	3.	3	VDC		EUT Pow	er Frequen	су:	0	N	I/A		
Test   Measured   Distance   Direction   Height   (Meters)   Detector   Function   Height   (Meters)   Detector   Function   Height   (Meters)   Detector   Function   Height   (Meters)   Detector   Function   (Meters)   Detector   Height   (Meters)   Detector   Function   (Meters)   Detector   Function   (Meters)   Detector   Function   (Meters)   Detector	Antenna	Orientatio	n:			Vertic	al	Frequ	ency Range:	:		30MHz	z to	1GHz	
Masured (Meters)   Direction (Meters)   Detector (Meters)   Eurotion (Meters)   Detector (Meters)   Det		EUT N	/lode o	f Ope	ratio	n:				Rec	eive				
885.882 10 133 1.9 Quasi-peak 21.4 25.996 35.6 -9.6 Pas 911.391 10 186 1.75 Quasi-peak 21.2 26.304 35.6 -9.3 Pas 947.655 10 182 3.99 Quasi-peak 21 26.161 35.6 -9.4 Pas  Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MIL-1 GHz Vertical Polarity Measured Emissions  70  100  Operator: Eric Lifescy 17687 RERum04-MiddleChan RXspurious/ANT-916-PML1 EUT Mode: Receive continuous  Frequency 17687 RERum04-MiddleChan RXspurious/ANT-916-PML1 EUT Mode: Receive continuous	Measured	Distance	Direc	tion	Hei	ight		Amplitude	Level			_		Test Re	esults
911.391 10 186 1.75 Quasi-peak 21.2 26.304 35.6 -9.3 Pas 947.655 10 182 3.99 Quasi-peak 21 26.161 35.6 -9.4 Pas  Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Vertical Polarity Measured Emissions  70  60  100M  Operator: Erk Lifesy  Frequency  17687 RERuno4 Midds Chan RX spurious ANT-916-PMIL.ii  EUT Mode: Receive continuous  Page 1.10  26.304 35.6 -9.3 Pas 26.304 35.6 -9.4 Pas  126.161 35.6 -9.4 Pas  Quasi-peak Limit Level Corrected Quasi-peak Readin Peak Limit Level Corrected Quasi-peak Readin Peak Limit Level Corrected Quasi-peak Readin Peak Limit Level Corrected Peak Value Verified Low-PKY OP Readin Page 1.10  AND Distance Substitution  100M  Departor: Erk Lifesy  Frequency  EUT: PEC915V10 with ANT-916-PMIL Project Number: 17687-15	628.483	10	25	0	3.	84	Quasi-peak	22	20.249	35	5.6	-15.4	4	Pas	SS
Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Vertical Polarity Measured Emissions  To a solution of the professional Testing of the professional Testing of the professional Testing of the professional Testing of the professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Vertical Polarity Measured Emissions  To a solution of the professional Testing of the professional T	885.882	10	13	3	1	.9	Quasi-peak	21.4	25.996	35	5.6	-9.6	ò	Pas	SS
Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Vertkal Polarity Measured Emissions  70  60  60  60  70  70  70  70  70  70	911.391	10	18	6	1.	75	Quasi-peak	21.2	26.304	35	5.6	-9.3	}	Pas	SS
To grade the state of the state	947.655	10	18	2	3.	99	Quasi-peak	21	26.161	35	5.6	-9.4		Pas	SS
1000 Trequency EUT: PEC915V10 with ANT-916-PML 17687 RERun04 Middle Chan RX spurious' ANT-916-PML EUT Mode: Receive continuous Project Number: 17687-15	Radiated 30MHz-10 60 50 1	Emissions, 10m D	istance						— Qu	asi-peak I rected Q k Limit rected P rified Loy RF Verifi	Limit Leve uasi-peak Level eak Value v-PRF OP cation Li		ROFES:		
30M 100M 1G  Operator: Eric Lifsey Frequency EUT: PEC915V10 with ANT-916-PML  17687 RE Run04 Middle Chan RX spurious 'ANT-916-PML til EUT Mode: Receive continuous Project Number: 17687-15	#www.	4N-rayle (Mad)						distance and the state of the s				A A PORT OF THE PROPERTY OF TH		YVV	
Operator: Eric Lifsey Frequency EUT: PEC915V10 with ANT-916-PML  17687 RERun04 MiddleChan RX spurious'ANT-916-PMLtil EUT Mode: Receive continuous Project Number: 17687-15			up de production de la constitución de la constituc	Water Manager	Parlanding to the last of the	Alter Annual Inches		order and the second se							
04:19:58 PM, Friday, December 04, 2015 EUT Power: 3.3 VDC Middle channel Client: Pruf Energy Controls (Birkeland)	Operator: 17687'RE	Run04'MiddleChan'I	-	ANT-916-	PMLtil	EUT Mode EUT Powe	e: Receive continuous er: 3.3 VDC	uency	P	roject Num	ber: 17687	-15		1G	
≤ 1GHz Vertical Antenna Polarity Measured Emissions			•	<i>-</i> 11	2U- 14			Jarity Mass					-		

Table 2.3.6: Radiated Spurious Emissions, Receive Mode, Below 1 GHz, Horizontal Polarity Antenna 4

Antenna 4	ļ								
			Profess	sional Te	sting, EN	VII, Inc.			
Test Metho	od:		3.4–2003: "Metho ic Equipment in th					•	
In accordar	nce with:	FCC Part Limits	15.209 - Code of I	ederal Regulat	ions Part 47, S	Subpart C - Int	entional Rad	iators, Radiate	ed Emissions
Section:		15.209							
Test Date(s	s):	12/4/2	015		EUT Serial	<b>#</b> :	0		
Customer:			ergy Controls		EUT Part #:			ML Antenn	a
Project Nu		17687-1	15		Test Techni		Eric Lifsey		
Purchase C		NA			Supervisor:		Lisa Arndt		
Equip. Und	ler Test:	PEC915	V10 with ANT-9	916-PML	Witness' N	ame:	JD Holland		
	F	Radiated	l Emissions Test	Results Data	Sheet		Pa	ige: 1	of 1
EUT L	ine Voltage		3.3 VDC		EUT Pow	er Frequen	cy:	0 N/A	
Antenna	a Orientatio	n:	Horizor	ntal	Frequ	ency Range:	:	30MHz to	1GHz
	EUT N	lode of	Operation:				Receive		
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degree	on Height	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Level (dBµV/m)	Margin (dB)	Test Results
628.527	10	198	1.25	Quasi-peak	22	20.204	35.6	-15.4	Pass
885.968	10	174	1.13	Quasi-peak	21.4	25.988	35.6	-9.6	Pass
911.195	10	14	2.18	Quasi-peak	21.2	26.3	35.6	-9.3	Pass
947.792	10	63	4	Quasi-peak	21	26.226	35.6	-9.4	Pass
Radiated 30MHz-1 70 60	sional Testing, Emissions, 10m Di GHzHorizontalPolar	stance	Amissions			— Qu	asi-peak Limit Le rected Quasi-pea k Limit Level rected Peak Vali ified Low-PRF ( RF Verification I	vel k Readin P Readir PROFES	SIONAL T N 6
Field Strength (dB µV/m) 30			+ + +			- + - -   - -   -	A state of the sta	X X	×××
10	white we have been about the safely	and the same of th	And the public of the public o	Angle the complete and the place of the plac	to the state of th				
	Eric Lifsey 'Run04'MiddleChan'F PM, Friday, December	•		:: Receive continuous r: 3.3 VDC	uency	P	UT: PEC915V10 wir roject Number: 1768 lient: Pruf Energy Co	7-15	1G

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 2.3.7: Radiated Spurious Emissions, Receive Mode, Above 1 GHz, Vertical Polarity

Antenna 4	<u> </u>											
			Pr	ofes	sional Te	sting, El	MI, Inc.					
Test Metho	od:				ds of Measure e Range of 9 kl					_		
In accorda	nce with:	FCC Part Limits	15.209 -	Code of I	Federal Regula	tions Part 47, S	Subpart C - Int	tentiona	Radiato	ors, Radiat	ed Emissi	ions
Section:		15.209										
Test Date(	s):	12/4/20				EUT Serial		0				
Customer:		Pruf En		ntrols		EUT Part #:				L Antenn	a	
Project Nu		17687-1	.5			Test Techn		Eric Lif				
Purchase C		NA		. ANT (	24.6. DD41	Supervisor		Lisa Ar				
Equip. Und	ier Test:	PEC915	V10 WIT	n ANI-S	916-PML	Witness' N	ame:	JD Hol	ıand			
	F	Radiated	Emissic	ns Test	Results Dat	a Sheet			Page	: 1	of	1
EUT L	ine Voltage		3.3	VDC		EUT Pow	ver Frequen	cy:	0	N/A		
Antenn	a Orientatio	n:		Vertic	al	Frequ	ency Range			Above 1	GHz	
	EUT N	/lode of	Operati	on:				Rece	ive			
Frequency Measured (MHz)	Test Distance (Meters)	EUT Direction (Degree	on H	tenna eight leters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit L (dBµV		Margin (dB)	Test Re	sult
1825.32	3	41		1	Average	35.1	25.281	54.	0	-28.7	Pas	SS.
1927.63	3	151		1	Average	34.1	24.992	54.	0	-29.0	Pas	S
2738.44	3	174		1	Average	34.6	26.679	54.	0	-27.3	Pas	S
3668.77	3	357		1	Average	34.7	28.673	54.	0	-25.3	Pas	S
4570.6	3	3	[	1	Average	33.2	29.169	54.	0	-24.8	Pas	iS
Radiated	sional Testing, Emissions, 3m Dis Vertical Polarity Meass	tance					<ul> <li>∇ Cor</li> <li>— Per</li> </ul>	erage Limi rrected Avo ak Limit Lo rrected Pea	erage Read evel		SSIONAL	
<u> 50+</u>					last, <sub>trans</sub> l <sub>uster</sub> na de tribitant de	and the state of t		almage del stal languagità	into the second	response of the late of	description.	
30 20 1G	Eric Lifsey	ter en la companya de la companya d	hodina dibada		7 7	juency	7	UT: PEC915	V10 21. 43	UT 014 DAM	5 G	

Table 2.3.8: Radiated Spurious Emissions, Receive Mode, Above 1 GHz, Horizontal Polarity Antenna 4

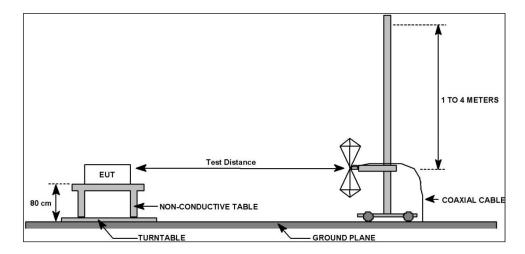
Antenna 4											
				Profess	ional Te	sting, EN	VII, Inc.				
Test Method	<b>:</b>				ds of Measurer Range of 9 kH					•	
In accordanc	e with:	FCC Pa Limits	rt 15.2	09 - Code of F	ederal Regulat	ions Part 47, S	Subpart C - Int	tentiona	al Radia	tors, Radiate	ed Emissions
Section:		15.209	)								
Test Date(s):		12/4/	2015			EUT Serial	#:	0			
Customer:		Pruf E	nergy	Controls		EUT Part #:		ANT-9	916-PN	/IL Antenn	a
Project Num	ber:	17687	<b>'-15</b>			Test Techni	ician:	Eric Li			
Purchase Ord		NA				Supervisor:		Lisa A			
Equip. Unde	r Test:	PEC91	L5V10	with ANT-9	16-PML	Witness' N	ame:	JD Ho	lland		
	R	adiate	ed Em	issions Test	Results Data	a Sheet			Pag	ge: 1	of 1
EUT Lin	e Voltage:		3.	3 VDC		EUT Pow	ver Frequen	су:	0	N/A	
Antenna	Orientatio	n:		Horizon	tal	Frequ	ency Range:	1		Above 1	GHz
	EUT N	lode o	f Ope	ration:				Rece	eive		
Frequency Measured (MHz)	Test Distance (Meters)	EU Direc (Degr	tion	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit   (dBµ\		Margin (dB)	Test Resul
1838.18	3	33	2	1	Average	35.1	25.332	54	.0	-28.6	Pass
2731.77	3	43	3	1	Average	34.7	26.756	54	.0	-27.2	Pass
3653.68	3	23	0	1	Average	34.5	28.446	54	.0	-25.5	Pass
4575.19	3	14	.0	1	Average	33.2	29.106	54	.0	-24.9	Pass
Radiated En 1-18GHz Hor 90 80 (III / 70	onal Testing, missions, 3m Dist izontal Polarity Me	ance					▽ Con — Pea	erage Lim rrected Av ak Limit I rrected Pe	verage Re Level		SIONAL
30 50 50 50 50 50 50 50 50 50 50 50 50 50	c Lifsey	Venurioue'	ANT 916	philipping in Alexandria	Freq: Receive continuous	uency		UT: PEC91		ANT-916-PML	5 G
	,Friday,December(	-		EUT Po wer Middle cha	:: 3.3 VDC		(	Client: Pruf I		trols (Birkeland)	

## 3.0 Radiated Spurious Emissions, Transmit Mode, Antenna 3

#### 3.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate. A diagram showing the test setup appears below.



#### 3.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Field Strength of Radiated Spurious/Harmonic Emissions Transmit Mode	4 Dec 2015

#### 3.3 Test Results

Three EUT and antenna samples were tested simultaneously to cover all three essential channels. Signals appear at wide enough intervals to be easily discerned.

The applicable duty cycle factor for averaging harmonics above 1 GHz is 0 dB. All peak emissions can be seen as falling below the average limit, meaning the average level would also be under the average limit.

Also, certain harmonics, specifically the  $2^{nd}$  harmonic around 1.8 GHz, are outside of the restricted bands; as such the 15.247 -20 dBc criteria applies. Limit shown is conservative estimate using rounded-down to nearest 10 dB point then reduced 20 dB resulting in 70 dB $\mu$ V/m limit.

Table 3.3.1: Radiated Spurious Emissions, TX Mode, Below 1 GHz, Vertical Polarity
Antenna 3

		Profes	sional Te	sting, El	VII, Inc.			
d:							•	
ce with:	FCC Part 15.2 Limits	209 - Code of	Federal Regulat	ions Part 47,	Subpart C - Int	entional Radi	ators, Radiate	ed Emissions
	15.209							
:	12/4/2015			EUT Serial	#:	0		
	<b>Pruf Energy</b>	y Controls		EUT Part #:		<b>PCBBadge</b>	Antenna	
ber:	17687-15			Test Techn	ician:	Eric Lifsey		
der #:	NA			•		Lisa Arndt		
r Test:	PEC915V10	with PCBB	adge	Witness' N	ame:	JD Holland		
R	adiated Em	nissions Test	t Results Data	Sheet		Pa	ge: 1	of 1
ne Voltage:	3	.3 VDC		EUT Pow	ver Frequen	cy:	0 N/A	
Orientatio	n:	Vertic	al	Frequ	ency Range		30MHz to	1GHz
EUT N	lode of Ope	eration:				Transmit		
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 Resul
10	148	3.4	Quasi-peak	23.8	12.301	29.5	-17.2	Pass
10	357	2.04	Quasi-peak	22.1	11.817	35.6	-23.8	Pass
10	138	1.25	Quasi-peak	22.2	15.977	35.6	-19.6	Pass
	315	2.28	Quasi-peak	21.4	23.233	35.6	-12.4	Pass
	289	3.43	Quasi-peak	31.9	36.042	70.0	-34.0	Pass
10	164	3.48	Quasi-peak	26.2	31.416	70.0	-38.6	Pass
missions, 10m Di	stance					asi-peak Limit Le rrefted Quasi-pea ak Limit Level, rrected Peak Valu iffied Low-PRF Q RE-Verification L	PReading PROFES	SIONAL
•	Badgetil		-	uency			Ü	1G
	Test Distance (Meters)  10 10 10 10 10 to no la Testing, missions, 10m Diltz Vertical Polarity	Electronic Equations   Electronic Equations	ANSI C63.4–2003: "Method Electronic Equipment in the Ce with:  FCC Part 15.209 - Code of Limits  15.209  : 12/4/2015	ANSI C63.4–2003: "Methods of Measurer Electronic Equipment in the Range of 9 kHote with:  FCC Part 15.209 - Code of Federal Regulat Limits  15.209 : 12/4/2015  Pruf Energy Controls  Alber: 17687-15  Ider #: NA  Prest: PEC915V10 with PCBBadge  Radiated Emissions Test Results Data  Test: PEC915V10 with PCBBadge  Radiated Emissions Test Results Data  Test Distance (Meters)  Function  Test Direction Height (Meters)  10 148 3.4 Quasi-peak 10 357 2.04 Quasi-peak 10 138 1.25 Quasi-peak 10 138 1.25 Quasi-peak 10 289 3.43 Quasi-peak 10 289 3.43 Quasi-peak 10 164 3.48 Quasi-peak	ANSI C63.4–2003: "Methods of Measurement of Radio- Electronic Equipment in the Range of 9 kHz to 40 GHz"  EVEN WITH:  FCC Part 15.209 - Code of Federal Regulations Part 47, 3 Limits  15.209  EVEN EUT Serial 3  Pruf Energy Controls  BUT Part #3  Buber: 17687-15  Get #: NA  FUT Est: PEC915V10 with PCBBadge  Witness' N  Radiated Emissions Test Results Data Sheet  But Voltage: 3.3 VDC  FUT Pow  Orientation: Vertical  Frequination:  Function  Weters)  Function  (Meters)  10  148  3.4  10  357  2.04  10  315  2.28  10  315  2.28  10  315  2.28  10  315  2.28  10  315  2.28  10  315  2.28  10  315  2.28  10  315  2.28  10  315  2.28  10  315  2.28  10  315  3.43  Quasi-peak  21.4  10  289  3.43  Quasi-peak  21.4  10  164  3.48  Quasi-peak  26.2  Donal Testing, EMI, Inc  missions, 10m Distance  Hz Vertical Polarity Measured Emissions  Frequency  Frequency	Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated to with:  FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intimits  15.209  : 12/4/2015	ANSI C63.4–2003: "Methods of Measurement of Radio-Noise Emissions from Low-Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, the with:  FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiumits  15.209  : 12/4/2015	ANSI C63.4—2003: "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Elect Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).  EVEN WITH SECONDAY SECOND

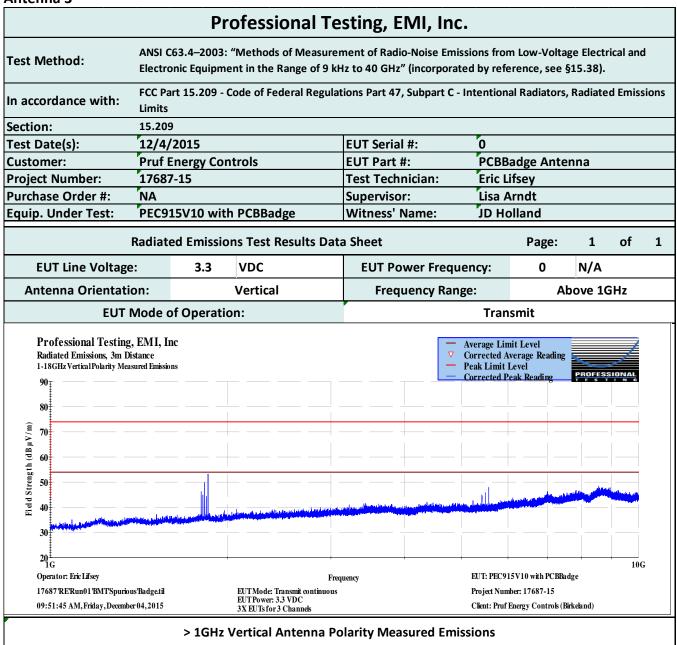
≤ 1GHz Vertical Antenna Polarity Measured Emissions

Table 3.3.2: Radiated Spurious Emissions, TX Mode, Below 1 GHz, Horizontal Polarity Antenna 3

Antenna 5	Intenna 3										
			Profess	sional Te	sting, EN	MI, Inc.					
Test Metho	d:			ds of Measuren e Range of 9 kH				•			
In accordan	ice with:	FCC Part 15.2 Limits	209 - Code of	Federal Regulat	ions Part 47, S	Subpart C - Int	entional Radi	ators, Radiate	ed Emissions		
Section:		15.209									
Test Date(s	):	12/4/2015			EUT Serial	<b>#</b> :	0				
Customer:		Pruf Energy	/ Controls		EUT Part #:		PCBBadge A	Antenna			
Project Nur		17687-15			Test Techni		Eric Lifsey				
Purchase O		NA			Supervisor:		Lisa Arndt				
Equip. Und	er Test:	PEC915V10 with PCBBadge Witness' Name: JD Holland									
Radiated Emissions Test Results Data Sheet Page: 1 of 1											
EUT Li	ne Voltage:	3.	.3 VDC		EUT Pow	er Frequen	cy: (	N/A			
Antenna	tenna Orientation: Horizontal Frequency Range: 30MHz to 1GHz										
EUT Mode of Operation: Transmit											
Frequency Measured (MHz)	Test Distance (Meters)	Function   Galletin   (dBuV/m)   (dB)							Test Results		
34.3375	10	180	1.53	Quasi-peak	23.1	11.602	29.5	-17.9	Pass		
181.968	10	8	1.48	Quasi-peak	27.5	12.416	33.1	-20.7	Pass		
424.818	10	237	1.21	Quasi-peak	22.2	16.091	35.6	-19.5	Pass		
812.069	10	70	1.66	Quasi-peak	21.4	23.246	35.6	-12.4	Pass		
878.453	10	60	1.43	Quasi-peak	24.5	28.651	70.0	-41.3	Pass		
939.554	10	121	3.56	Quasi-peak	28.7	33.818	70.0	-36.2	Pass		
Radiated	ional Testing, Emissions, 10m Di GHz Horizontal Polari	,	s			— Qu ▽ Cor — Pes ▽ Yes × Yes	asi-peak Limit Ley rected Quasi-peak k Limit Level rected Peak Valu ified Low-PRF () R Verification Li	el Readin	SIONAL		
20 10 30M Operator: I	Eric Lifsey Run01 BMT Spurious		EUTPowe	Frequent continuous rr: 3.3 VDC or 3 Channels	uency	P	UT: PEC915V10 with roject Number: 17687 lient: Pruf Energy Coi	-15	1G		

≤ 1GHz Horizontal Antenna Polarity Measured Emissions

Table 3.3.3: Radiated Spurious Emissions, TX Mode, Above 1 GHz, Vertical Polarity Antenna 3



Note that the ~1.8 GHz harmonic emissions appearing above are subject to the 15.247 -20 dBc criteria with a limit of ~95 dB $\mu$ V/m.

Table 3.3.4: Radiated Spurious Emissions, TX Mode, Above 1 GHz, Horizontal Polarity Antenna 3

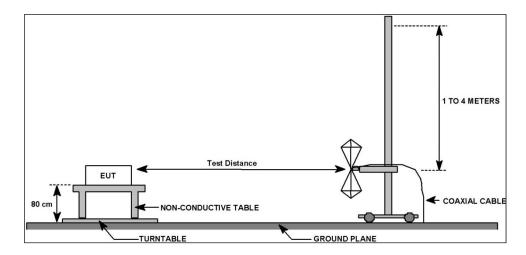
		Pr	ofessional T	esting, El	VII, Inc.					
Test Method:			"Methods of Measur ent in the Range of 9					•	ical and	d
n accordance with:	FCC Pa	rt 15.209 -	Code of Federal Regu	lations Part 47,	Subpart C - Int	entiona	Radiators,	, Radiate	d Emiss	sion
Section:	15.209	)								
Test Date(s):	12/4/	2015		EUT Serial	#:	0				
Customer:	Pruf E	nergy Cor	ntrols	EUT Part #		PCBBa	dge Ante	nna		
Project Number:	17687	7-15		Test Techn	ician:	Eric Lif	sey			
Purchase Order #:	NA			Supervisor	;	Lisa Ar	ndt			
quip. Under Test:	PEC9:	15V10 wit	h PCBBadge	Witness' N	ame:	JD Hol	land			
	Radiate	ed Emissio	ons Test Results Da	ita Sheet			Page:	1	of	1
EUT Line Voltag	ge:	3.3	VDC	EUT Pov	ver Frequen	су:	0	N/A		
Antenna Orienta	tion:		Horizontal	Frequency Range: Abo					Hz	
EUT	Mode o	of Operation	on:			Trans	mit			
Professional Testin Radiated Emissions, 3m 1-18 GHz Horizontal Polarity	Distance				∨ Cor — Pea	rage Limit rected Ave k Limit Le rected Pea	erage Reading evel	PROFESS	IONAL I N 6	
Field Strength (dB µV/m) 60 60 60 60 60 60 60 60 60 60 60 60 60					and the same of th		Mary Processing		The state of the s	
30	teretistis and the state of the		dien der eine die der leiter der eine d							
20 IG Operator: Eric Lifsey 17687 RERun01 BMTSpur 09:51:44 AM, Friday, Decen	-		F EUT Mode: Transmit continuou EUT Power: 3.3 VDC 3X EUTs for 3 Channels	requency is	Pr	oject Numbe	V10 with PCBBaer: 17687-15 ergy Controls (B	ŭ	100	<del>.</del>
			orizontal Antenna							

## 4.0 Radiated Spurious Emissions, Transmit Mode, Antenna 4

#### 4.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The EUT was centered on a rotating turntable. Measurements below 1 GHz were taken at a test distance of 10 meters from the measurement antenna. Above 1 GHz the measurement distance was 3 meters.

Spurious emissions below 1 GHz were measured with quasi-peak detection with a resolution bandwidth of 120 kHz. Above 1 GHz peak measurements were taken and average measured where appropriate. A diagram showing the test setup appears below.



#### 4.2 Test Criteria

47 CFR (USA) // IC (Canada)		
Section Reference	Parameter	Date(s)
15.247, 15.209 // RSS-247 5.5, RSS-Gen 4.9 & 4.10	Field Strength of Radiated Spurious/Harmonic Emissions Transmit Mode	4 Dec 2015

#### 4.3 Test Results

Three EUT and antenna samples were tested simultaneously to cover all three essential channels. Signals appear at wide enough intervals to be easily discerned.

The applicable duty cycle factor for averaging harmonics above 1 GHz is 0 dB. All peak emissions can be seen as falling below the average limit, meaning the average level would also be under the average limit. Also, certain harmonics, specifically the 2<sup>nd</sup> harmonic around 1.8 GHz, are outside of the restricted bands; as such the 15.247 -20 dBc criteria applies.

Table 4.3.1: Radiated Spurious Emissions, TX Mode, Below 1 GHz, Vertical Polarity
Antenna 4

Antenna 4									
			Profes	sional Te	sting, EN	∕II, Inc.			
Test Metho	d:			ds of Measurer e Range of 9 kH				•	
In accordar	ce with:	FCC Part 15.2 Limits	209 - Code of	Federal Regulat	ions Part 47, S	Subpart C - Int	entional Radia	ators, Radiate	ed Emissions
Section:		15.209			1				
Test Date(s	):	12/4/2015			EUT Serial		0		
Customer:		Pruf Energy	/ Controls		EUT Part #:		ANT-916-PI	VIL Antenna	3
Project Nur		17687-15			Test Techni		Eric Lifsey		
Purchase O		NA	••• •••		Supervisor:		Lisa Arndt		
Equip. Und	er Test:	PEC915V10	with ANT-9	916-PML	Witness' N	ame:	JD Holland		
	F	Radiated Em	issions Test	Results Data	a Sheet		Pa	ge: 1	of 1
EUT Li	ne Voltage:	: 3	.3 VDC		EUT Pow	er Frequen	cy: (	N/A	
Antenna	Orientatio	n:	Vertic	al	Frequ	ency Range:		30MHz to	1GHz
	EUT N	lode of Ope	eration:				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
36.2881	10	188	3.04	Quasi-peak	30.6	17.392	29.5	-12.1	Pass
204.514	10	262	2.41	Quasi-peak	22.4	8.101	33.1	-25.0	Pass
335.099	10	305	1.28	Quasi-peak	22.1	12.542	35.6	-23.1	Pass
784.143	10	204	3.16	Quasi-peak	21.5	22.774	35.6	-12.8	Pass
890.293	10	6	3.21	Quasi-peak	52.3	57.169	70.0	-12.8	Pass
939.494	10	20	3.35	Quasi-peak	50.1	55.15	70.0	-14.9	Pass
Radiated 30MHz-10 110	ional Testing, Emissions, 10m Di GHz Vertical Polarity	stance				— Qu — Qu — Pei — Coi × Vei	asi-peak Limit Ley rrefted Quasi-peak & Limit Level rrected Peak Valu rified Low-PRF () RE Verification Li	Readin	SIONAL
Field Strength (dB µV/m 30 70 70 70 70 70 70 70 70 70 7	×				×	×		×	
10 ± 0 ± 0 ± 0 ± 0 ± 0 ± 0 ± 0 ± 0 ± 0 ±	Trio I House	and the state of t	100M			10	TT. DEC015V1021	ANT 016 DMI	1G
	Pric Lifsey Run03 BMT Spurious M, Friday, December		EUTPowe	Freq e: Transmit continuous er: 3.3 VDC or 3 Channels	uency	P	IUT: PEC915V10 with troject Number: 17687 Slient: Pruf Energy Cou	-15	

Table 4.3.2: Radiated Spurious Emissions, TX Mode, Below 1 GHz, Horizontal Polarity
Antenna 4

Antenna 4									
			Profes	sional Te	sting, EN	VII, 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 Emissic Limits							ed Emissions		
Section:	-	15.209							
Test Date(s	):	12/4/2015			EUT Serial		0		
Customer:			gy Controls		EUT Part #:			ML Antenn	a
Project Nur		17687-15			Test Techni		Eric Lifsey		
Purchase O		NA			Supervisor:		Lisa Arndt		
Equip. Und	er Test:	PEC915V1	0 with ANT-	916-PML	Witness' N	ame:	JD Holland		
	F	Radiated E	missions Tes	t Results Data	Sheet		Pa	ge: 1	of 1
EUT Li	ne Voltage	:	3.3 VDC		EUT Pow	er Frequen	cy:	0 N/A	
Antenna	Orientatio	n:	Horizoi	ntal	Frequ	ency Range	•	30MHz to	1GHz
	EUT N	/lode of Op	eration:				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
31.2059	10	174	3.73	Quasi-peak	24.1	12.679	29.5	-16.8	Pass
169.156	10	168	3.55	Quasi-peak	22.6	7.102	33.1	-26.0	Pass
389.971	10	292	2.84	Quasi-peak	28.1	20.554	35.6	-15.0	Pass
841.429	10	77	3.6	Quasi-peak	21.4	23.403	35.6	-12.2	Pass
890.629	10	69	1.23	Quasi-peak	40.1	44.9	70.0	-25.1	Pass
940.244	10	290	1.19	Quasi-peak	39.2	44.319	70.0	-25.7	Pass
Radiated 30MHz-10	ional Testing, Emissions, 10m Di GHzHorizontal Polar	istance	ons			— Qu — Qu — Pe — Co ▽ Ve × LP	asi-peak Limit Le rrected Quasi-pea Ak Limit Level rrected Peak Valu vined Low-PRF O RF Verification I	vel k Readin PROFES	SIONAL
Field Strength (dB µV/m)  70  70  70  70  70  70  70  70  70  7	Water water branches and water	And the second second		×			7		××
0 <sup>±</sup> 30M Operator: 1 17687′RET	Eric Lifsey Run03 'BMT'Spurious	s'ANT-916-PMLtil	100M EUT Mod	e: Transmit continuous	uency		ZUT: PEC915V10 wit		1G
	M, Friday, December		EUTPowe	er: 3.3 VDC for 3 Channels			Client: Pruf Energy Co		
		≤ 10	GHz Horizon	tal Antenna P	olarity Mea	sured Emis	sions		

Table 4.3.3: Radiated Spurious Emissions, TX Mode, Above 1 GHz, Vertical Polarity Antenna 4

		Professional T	esting, EMI, Inc.					
Fest 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 Part 15.209 Limits	9 - Code of Federal Regul	ations Part 47, Subpart C - I	Intentional F	Radiators,	Radiate	d Emiss	sion
Section:	15.209							
Гest Date(s):	12/4/2015		EUT Serial #:	0				
Customer:	Pruf Energy (	Controls	EUT Part #:	ANT-91	6-PML A	ntenna		
Project Number:	17687-15		Test Technician:	Eric Lifs	ey			
Purchase Order #:	NA		Supervisor:	Lisa Arn	dt			
Equip. Under Test:	PEC915V10 v	vith ANT-916-PML	Witness' Name:	JD Holla	and			
	Radiated Emis	sions Test Results Da	ita Sheet		Page:	1	of	1
EUT Line Voltag	ge: 3.3	VDC	EUT Power Freque	ency:	0	N/A		
Antenna Orientat	ion:	Vertical	Frequency Range: Above 1GH			iHz		
EUT	Mode of Opera	ation:		Transm	nit			
Professional Testin Radiated Emissions, 3m 1-18GHz Vertical Polarity M 90 80	Distance			Average Limit I Corrected Avera Peak Limit Lev Corrected Peak	age Reading el	PROFESS T E S T	SIONAL IN 6	
Field Strength (dB μV/m)  20  40  40							1 the strong left	
30	de the constitution of the second		Alexand II a service and the s					
20 <sup>±</sup> 1G Operator: Eric Lifsey	ious'ANT-916-PML.til	FUT Mode: Transmit continuou	requency	EUT: PEC915V1		16-PML	100	}

Table 4.3.4: Radiated Spurious Emissions, TX Mode, Above 1 GHz, Horizontal Polarity Antenna 4

Antenna 4								
	F	Professional T	esting, 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).							
n accordance with:	FCC Part 15.209 Limits	FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits						
Section:	15.209							
Test Date(s):	12/4/2015		EUT Serial #:	O				
Customer:	Pruf Energy C	Controls	EUT Part #:	ANT-9	16-PML A	ntenna		
Project Number:	17687-15		Test Technician:	Eric Lif	fsey			
Purchase Order #:	NA		Supervisor:	Lisa Aı	rndt			
Equip. Under Test:	PEC915V10 w	rith ANT-916-PML	Witness' Name:	JD Hol	lland			
	Radiated Emiss	sions Test Results Da	ata Sheet		Page:	1	of	1
EUT Line Voltage	9: 3.3	VDC	EUT Power Freque	ncy:	0	N/A		
Antenna Orientation	on:	Horizontal	Frequency Range: Above 1GH			Hz		
EUT I	Mode of Opera	ition:		Trans	mit			
Professional Testing Radiated Emissions, 3m Di 1-18GHz Horizontal Polarity M 90 80 80 (E) 70 19 60 19 50 19 40	stance		▽ C — P	eak Limit Lo	erage Reading evel	PROFESS	SIONAL	
99 40		and the second second second second second second			I sales ( I sales )			
30	And the second s							
201 1G Operator: Eric Lifsey 17687/RE'Run03 BMT'Spuriou	ıs'ANT-916-PMLtil	F EUT Mode: Transmit continuou EUT Power: 3,3 VDC	requency	EUT: PEC915 Project Numb	V10 with ANT-9	16-PML	100	G

# **5.0** Antenna Construction Requirements

#### 5.1 Procedure

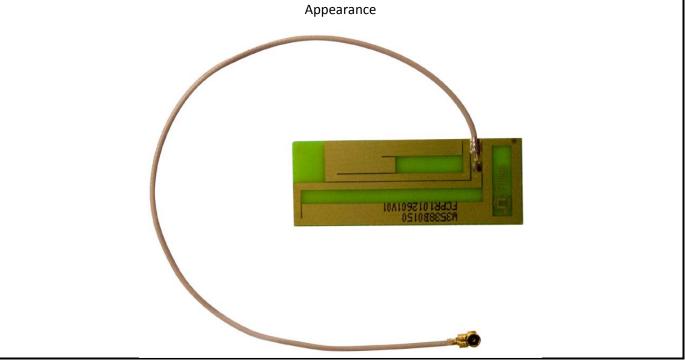
A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users in ways that would void their authorization to use the device. Note that this device is supplied as a modular unit.

## 5.2 Criteria

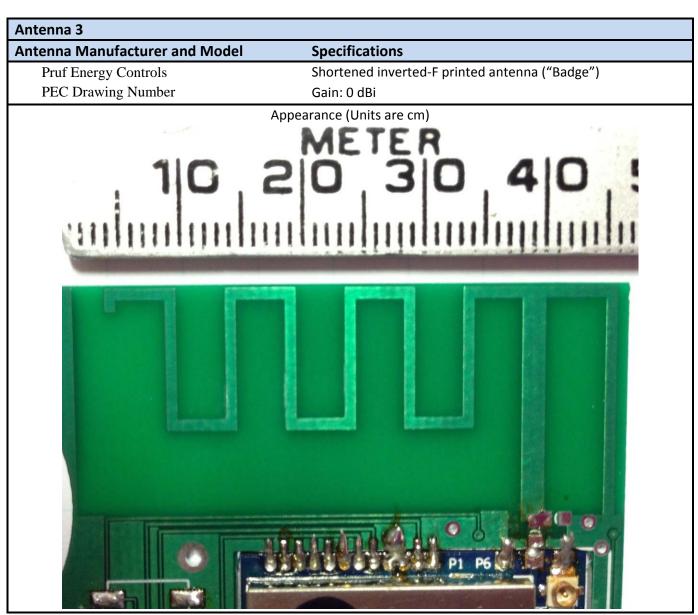
47 CFR (USA) // IC (Canada)								
Section Reference	Parameter	Date(s)						
15.203 // RSS-Gen 8.3	Antenna Construction	9 Dec 2015						

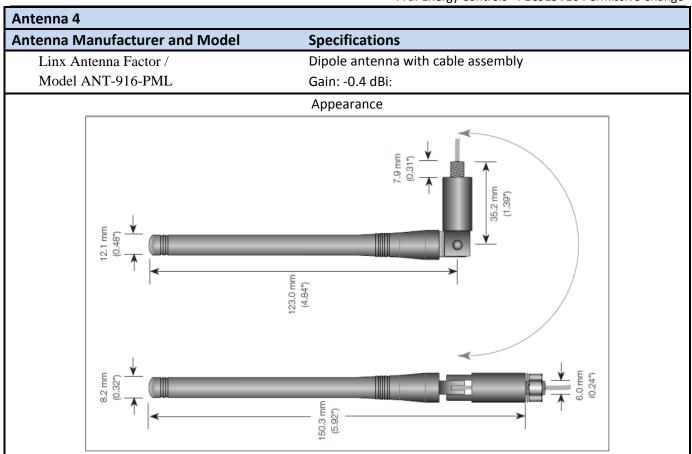
## 5.3 Results

Antenna 1 Antenna Manufacturer and Model Specifications									
Pulse Antenna USA 12220 World Trade D Sand Diego, CA 92128 W3538B0200 / W	rive 3, USA 3538E0200/ W35	•	circuit antenna						
Frequency Range [MHz]	Max Gain [dBi]	Efficiency [%] / [dB]	Return loss min. [dB]	Impedance [Ω]	Operating Temperature [° C]				
	2,8 (peak)	70 / -1,6 (peak) 50 / -3,0 (min)	-6	50	-40 to +85				



Antenna 2	
Antenna Manufacturer and Model	Specifications
Pruf Energy Controls	Helical Style (inductive loaded quarter-wave)
PEC Drawing Number 34915-HELI	Gain: 0 dBi
The blawing Number 34713-11EE	Appearance:
	Appearance
2.967 - 11.12	17.000 - 5.461 - 36.553





- The final integrator is provided a list of antenna types and gains authorized for this device.
- Additional antennas, 3 and 4, are new types with gain of 0 dBi or lower.

The antenna designs above satisfy the requirements of the rules.

#### **6.0 Equipment and Bandwidths**

#### 6.1 **Equipment for Spurious Radiated Emissions**

		Radiate	d Emissions Test Equipment List							
Ti	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	НР	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	RG214 Cable Coax, N-N, 25m		10/1/2016					
1327	EMCO	1050	1050 Controller, Antenna Mast		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					

Horn, 1 - 18 GHz

## 6.2 Measurement Bandwidths, Radiated Emissions

Radiated Emissions Spectrum Analyzer Bandwidth and Measurement Time - Peak Scan									
Frequency Band Start (MHz)	Frequency Band Stop (MHz)	6 dB Bandwidth (kHz)	Number of Ranges Used	Measurement Time per Range					
0.009	0.15	0.3	2	Multiple Sweeps					
0.15	30	9	6	Multiple Sweeps					
30	1000	120	2	Multiple 800 mS Sweeps					
1000	6000	1000	2	Multiple Sweeps					
6000	18000	300	2	Multiple Sweeps					

#### \*Notes:

<sup>1.</sup> The settings above are specifically calculated for the E4440A series of spectrum analyzers, which have 8,000 data points per range.

<sup>2.</sup> The measurement receiver resolution bandwidth setting was 300 Hz for quasi-peak measurements from 9-150 kHz.

<sup>3.</sup> The measurement receiver resolution bandwidth setting was 9 kHz for quasi-peak measurements from 0.15-30 MHz.

<sup>4.</sup> The measurement receiver resolution bandwidth setting was 120 kHz for quasi-peak measurements from 30-1000 MHz.

<sup>5.</sup> The measurement receiver resolution bandwidth setting was 1 MHz for average measurements from 1-18 GHz.

#### 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
Radiated Emissions	1 to 18 GHz	3 m	5.7

# **End of Report**

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