# 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					

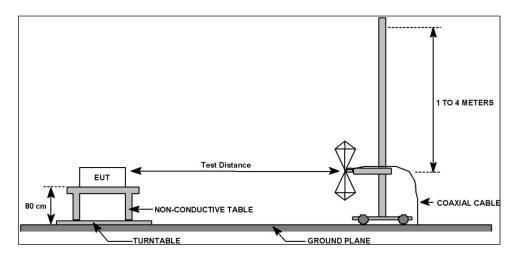
This report supplements test report 15590.

## 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	∕II, Inc.			
Test Metho	d:					ent of Radio-Noise Emissions from Low-Voltage Electrical and 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 Emissio Limits								ed Emissions		
Section:		15.209	15.209							
Test Date(s	):	12/4/	2015			EUT Serial #	<b>‡</b> :	0		
Customer:		Pruf I	Energy	Controls		EUT Part #:		<b>PCBBad</b>	lge Antenna	
Project Nur	nber:	17687	7-15			Test Techni		Eric Lifs	•	
Purchase O	rder #:	NA				Supervisor:		Lisa Arn		
Equip. Und	er Test:	PEC9	15V10	with PCBB	adge	Witness' Na	ame:	JD Holla	and	
	F	Radiat	ed Em	issions Tes	t Results Data	Sheet			Page: 1	of 1
EUT Line Voltage: 3.3 VDC					EUT Pow	er Frequen	су:	0 N/A		
Antenna Orientation:				Vertic	al	Freque	ency Range:		30MHz to	1GHz
	EUT N	1ode d	of Ope	eration:				Receiv	<i>r</i> e	
Frequency Measured (MHz)	Test Distance (Meters)	El Dired (Deg	tion	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Le (dBμV/		Test Result
640.527	10	14	17	2.28	Quasi-peak	21.9	20.393	35.6	-15.2	Pass
771.206	10	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	35.6	-9.3	Pass
Radiated 30MHz-10 70 1	ional Testing, Emissions, 10m Di GHz Vertical Polarity	stance					— Que	si-peak Lim rected Quas k Limit Lev rected Peak ified Low-Pi RF Verificat	t Level -peak Reading t Value Value Fr QP Reading PROPES on Limit	SSIDNAL
Bay 30 1 20 1 10 10 10 10 10 10 10 10 10 10 10 10	Pric Lifsey	and the state of t	Kernelderst Hiller	100M	Freq	uency	eiter de soude enlevier	UT: PEC915V	10 with PCBBadge	1G
	Run02 MiddleChan F AM, Friday, December	•	Badge.til		e: Receive continuous er: 3.3 VDC annel			roject Number: lient: Pruf Ener	17687-15 gy Controls (Birkeland)	

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

Antenna 3										
				Profess	sional Te	sting, EN	∕II, Inc.			
Test Method:  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)								•		
In accordance with: FCC Part 15.209 - Code of Federal Regulations Part 47, Sub- Limits								entional R	adiators, Radiate	ed Emissions
Section:		15.209								
Test Date(s	):	12/4/2	015			EUT Serial #	<b>‡</b> :	0		
Customer:		Pruf En	ergy	Controls		EUT Part #:		PCBBadg	ge Antenna	
Project Nui	nber:	17687-	15			Test Techni	cian:	Eric Lifse	:y	
Purchase O	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			Page: 1	of 1
EUT Line Voltage: 3.3				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	e	
Frequency Measured (MHz)	Test Distance (Meters)	EUT Directi (Degre	on	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBµV)	Corrected Level (dBµV/m)	Limit Lev (dBµV/n		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 1 60 1	-	stance ity Measured E	ēmissio ns	100M	Frequencies	iency	Ver X LPI	UT: PEC915V10	With PCBBadge	SIONAL N 6
	Run02 'MiddleChan'F AM, Friday, December	04,2015		EUT Powe Middle cha	:: Receive continuous r: 3.3 VDC nnel	alaute nos-	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 kH					•		
In accorda	nce with:	FCC Pa Limits	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	
Radiated 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

Antenna 3												
				Profess	sional Te	sting, EN	∕II, Inc					
Test Method:					ds of Measurer e Range of 9 kH					•		1
n accordance v	with:	FCC Par	rt 15.2	09 - Code of F	ederal Regulat	ions Part 47, S	Subpart C -	Intentio	nal Radia	tors, Radiat	ed Emiss	ions
Section:		15.209										
Test Date(s):	<u>'</u>	12/4/	2015			EUT Serial	<b>‡</b> :	O				
Customer:		_		Controls		EUT Part #:				Antenna		
Project Numbe	r:	17687	-15			Test Techni	ician:	Eric	Lifsey			
Purchase Orde		NA				Supervisor:			Arndt			
Equip. Under T	est:	PEC91	.5V10	with PCBB	adge	Witness' N	ame:	JD H	olland			
	R	adiate	d Em	issions Test	Results Data	Sheet			Pag	ge: 1	of	1
EUT Line \	Voltage:		3.	3 VDC		EUT Pow	er Freque	ency:	0	N/A		
Antenna Or	ientatio	n:		Horizon	ıtal	Frequ	ency Rang	ge:		Above 1	GHz	
	EUT M	lode o	f Ope	ration:				Red	eive			
Measured Di	Test stance leters)	EU Direct	tion	Antenna Height (Meters)	Detector Function	Recorded Amplitude (dBμV)	Corrected Level (dBµV/m	Limit	t Level IV/m)	Margin (dB)	Test R	esult
1831.18	3	17	7	1	Average	35.1	25.247	5	4.0	-28.7	Pa	SS
2742.11	3	28	9	1	Average	34.5	26.647	5	4.0	-27.3	Pa	SS
3654.44	3	16	1	1	Average	34.7	28.631	5	4.0	-25.3	Pa	SS
4571.08	3	20	7	1	Average	33.2	29.177	5	4.0	-24.8	Pa	SS
Professional Radiated Emissi 1-18GHz Horizont 90 80 80 40 40	ions, 3m Dist	ance						Average Li Corrected Peak Limit Corrected	Average Re Level		SIONAL	
30 20 1G Operator: Eric Lifs 17687 RERun02	•	Xspurious T	Badgetil	EUT Mode	Freq:: Receive continuous	uency			7 015V10 with	_	56	÷
11:38:45 AM,Fri		•	-		r: 3.3 VDC			-		trols (Birkeland)		
			> 1GI	ız Horizont	al Antenna P	olarity Mea	sured Em	issions				

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

Test Date(s): 12/4/2015 EUT Serial #: 0  Pur Finerry Controls EUT Part #: ANT-916-PML Antenna Project Number: 17687-15 Test Technician: Fric 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 1  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 Measured Distance Direction (Meters) (Degrees) (De	Antenna 4	ļ													
Electronic Equipment in the Range of 9 kHz to 40 GHz" (incorporated by reference, see §15.38).   FCC Part 15.209 - Code of Federal Regulations Part 47, Subpart C - Intentional Radiators, Radiated Emissions Limits   Enteropy					Pro	fess	sional Te	sting, EN	VII, Inc.						
Section: 15.209  Frequency Test Direction: Vertical Frequency Range: 30MHz to 1GHz  Frequency Measured Distance Direction (Meters) (Meters) (Meters) (Degrees) (Meters) (Meters) (1.33 1.9 Quasi-peak 21.2 (2.6.304 35.6 -9.3 Pass 911.391 1.0 186 1.75 Quasi-peak 21.2 (2.6.161 35.6 -9.4 Pass 94.195.8 Pd. Firisr, December 43.015 Projects Name 2000 Projects N	Test Metho	od:										•		rical and	
Test Date(s): 12/4/2015 EUT Serial #: 0  Pur Finerry Controls EUT Part #: ANT-916-PML Antenna Project Number: 17687-15 Test Technician: Fric 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 1  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 Measured Distance Direction (Meters) (Degrees) (De	In accordan	ice with:		rt 15.2	09 - Coo	de of F	ederal Regulat	ions Part 47, S	Subpart C - Int	ention	al Radia	itors, Rad	liate	d Emiss	ions
Project Number:   Pruf Energy Controls   EUT Part #:   ANT-916-PML Antenna Project Number:   17687-15   Test Technician:   Eric Lifsey   Durchase Order #:   NA   Supervisor:   Lisa Armdt   Durchase Order #:   Durchase Order #:   Na   Supervisor:   Lisa Armdt   Durchase Order #:   Na   Durchase Order #:   Na   Order   Durchase Order #:   Na   Order	Section:		15.209	)											
Test	Test Date(s	s):	12/4/	2015				EUT Serial	<b>#</b> :	0					
Supervisor:   Lisa Arnot   Page: 1   Of 1	Customer:		_		Contr	ols				_		∕IL Ante	nna	1	
Radiated Emissions Test Results Data Sheet   Page: 1 of 1				<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 A	ANT-9	16-PML	Witness' N	ame:	JD Ho	olland				
EUT Mode of Operation:   Receive		F	Radiate	ed Em	issions	Test	Results Data	Sheet			Pag	ge:	1	of	1
Frequency   Test   EUT   Antenna   Detector   Height   Glapu/m   (Meters)   Detector   (Meters)   Detector   (Meters)	EUT Li	ne Voltage		3.	.3 \	VDC		<b>EUT Pow</b>	er Frequen	су:	0	N	/A		
Test   Distance   Direction   Height   Detector   Height   (Meters)   Direction   Height   Height   Height   Detector   Height	Antenna	Orientatio	n:		V	/ertica	al	Freque	ency Range:			30MHz	to	1GHz	
Measured (MHz)   Distance (MHz)   Dis		EUT N	/lode o	of Ope	ration	:		-		Rec	eive				
885.882 10 133 1.9 Quasi-peak 21.4 25.996 35.6 -9.6 Pass 911.391 10 186 1.75 Quasi-peak 21.2 26.304 35.6 -9.3 Pass 947.655 10 182 3.99 Quasi-peak 21 26.161 35.6 -9.4 Pass Pass 947.655 10 182 3.99 Quasi-peak 21 26.161 35.6 -9.4 Pass Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz-Vertral Pointry Measured Emissions 70 Corrected Peak Value PRI Verification Limit Professional PRI Verification Limit Professional Price Pric		Distance	Direc	tion	Heig	ht		Amplitude	Level			_		Test Re	esults
911.391 10 186 1.75 Quasi-peak 21.2 26.304 35.6 -9.3 Pass 947.655 10 182 3.99 Quasi-peak 21 26.161 35.6 -9.4 Pass  Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Vertial Pointry Measured Emissions  70	628.483	10	25	0	3.8	34	Quasi-peak	22	20.249	35	5.6	-15.4	1	Pas	SS
Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1cHzVertkalPolarity Measured Emissions  70 60 60 60 70 70 70 70 70 70 70 70 70 70 70 70 70	885.882	10	13	3	1.9	9	Quasi-peak	21.4	25.996	35	5.6	-9.6		Pas	SS
Professional Testing, EMI, Inc Radiated Emissions, 10m Distance 30MHz-1GHz Vertical Polarity Measured Emissions  70  60  70  60  70  70  60  70  70  60  70  7	911.391	10	18	6	1.7	'5	Quasi-peak	21.2	26.304	35	5.6	-9.3		Pas	SS
Operator: Eric Lifsey 17687 RERun04 MiddleChan RX spurious'ANT-916-PML18 04:19:58 PM, Friday, December 04, 2015  180  190  100  100  100  100  100  100	947.655	10	18	2	3.9	9	Quasi-peak	21	26.161	35	5.6	-9.4		Pas	SS
30M 100M 100M EUT: PEC915V10 with ANT-916-PML 17687 RERun04 MiddleChan RX spurious ANT-916-PML EUT Power: 3.3 VDC Middle channel Client: Pruf Energy Controls (Birkeland)	Radiated 30MHz-10 60	Emissions, 10m Di	istance						— Qu	asi-peak I rected Q k Limit I rected P jified Loy RE Verifi	imit Levuusi-peak Level Level eak Value PRF OP cation Lin	-    -	OFES		
30M 100M 1G Operator: Eric Lifsey Frequency EUT: PEC915V10 with ANT-916-PML 17687 RETun04 MiddleChan RX spurious ANT-916-PMLtil 04:19:58 PM, Friday, December 04, 2015 EUT Power: 3.3 VDC Middle channel Client: Pruf Energy Controls (Birkeland)	\$www.y	4/hmyth/phathadadhaddhrayada	ونمو فلما النور	الفنداد ا	ارزين المالعة			Address of the last of the las	The second secon			-		-	
Operator: Eric Lifsey     Frequency     EUT: PEC915V10 with ANT-916-PML       17687'RERun04'MiddleChan'RXspurious'ANT-916-PMLtil     EUT Mode: Receive continuous     Project Number: 17687-15       04:19:58 PM, Friday, December 04, 2015     EUT Power: 3.3 VDC Middle channel     Client: Pruf Energy Controls (Birkeland)	0.		Albert	AVAINA NAME OF THE OWNER, NAME OF THE OWNER,	· · · · · · · · · · · · · · · · · · ·		*1*** df								
PIRIUR CHRIIIIC	Operator: 17687 RET	Run04'MiddleChan'I	-	ANT-916-	PML.til E	UT Mode UT Power	: Receive continuous :: 3.3 VDC	uency	P	roject Num	ber: 17687	-15		1G	
≤ 1GHz Vertical Antenna Polarity Measured Emissions		,, ,	,				-				. 01 - 31		7		

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 for the showing the state of the st	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-	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	су:	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	tari ya ka a a a a a a a a a a a a a a a a a	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

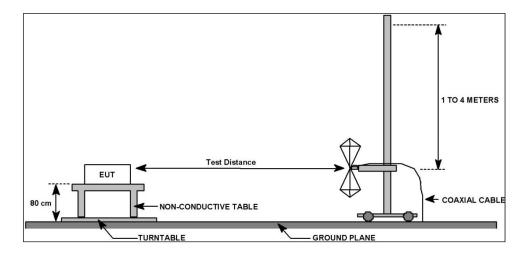
Antenna 4											
				Profess	ional Te	sting, EN	VII, Inc.				
Test Method	<b>:</b>				ds of Measurer Range of 9 kH					•	
In accordanc	e with:	FCC Pa Limits	rt 15.2	09 - Code of F	ederal Regulat	ions Part 47, S	Subpart C - Int	tentiona	al Radia	tors, Radiate	ed Emissions
Section:		15.209	)								
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 American	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

Antenna 3									·
			Profes	sional Te	sting, EN	VII, Inc.			
Test Metho	d:			ds of Measurer e Range of 9 kH				•	
In accordan	ce with:	FCC Part 15.2 Limits	209 - Code of	Federal Regulat	ions Part 47, S	Subpart C - Int	tentional Radi	ators, Radiate	ed Emissions
Section:		15.209							
Test Date(s	):	12/4/2015			EUT Serial	#:	0		
Customer:		<b>Pruf Energy</b>	y Controls		EUT Part #:		PCBBadge .	Antenna	
Project Nur	nber:	17687-15			Test Techni	ician:	Eric Lifsey		
Purchase O	rder #:	NA			Supervisor:		Lisa Arndt		
Equip. Und	er Test:	PEC915V10	with PCBB	adge	Witness' N	ame:	JD Holland		
	F	Radiated Em	nissions Test	Results Data	Sheet		Pa	ge: 1	of 1
EUT Li	ne Voltage:	: 3	.3 VDC		EUT Pow	ver Frequen	icy:	0 N/A	
Antenna	Orientatio	n:	Vertic	al	Frequ	ency Range	:	30MHz to	1GHz
	EUT N	Node 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
32.5312	10	148	3.4	Quasi-peak	23.8	12.301	29.5	-17.2	Pass
258.334	10	357	2.04	Quasi-peak	22.1	11.817	35.6	-23.8	Pass
420.398	10	138	1.25	Quasi-peak	22.2	15.977	35.6	-19.6	Pass
812.21	10	315	2.28	Quasi-peak	21.4	23.233	35.6	-12.4	Pass
878.437	10	289	3.43	Quasi-peak	31.9	36.042	70.0	-34.0	Pass
951.549	10	164	3.48	Quasi-peak	26.2	31.416	70.0	-38.6	Pass
Radiated 30MHz-10 1100   1100	Emissions, 10m Di	stance				— Qu — Qu — Pei — Qu — Ye — Qu — Ye — X — Ye — X — X — X — X — X — X — X — X — X —	asi-peak Limit Levreted Quasi-peak Limit Level. As Limit Level.	PReadin PROFES	SIONAL
	Eric Lifsey Run01 BMT Spurious AM, Friday, December		EUTPowe	Freq e: Transmit continuous er: 3.3 VDC or 3 Channels	uency	P	EUT: PEC915V10 with Project Number: 1768' Client: Pruf Energy Co	7-15	1G

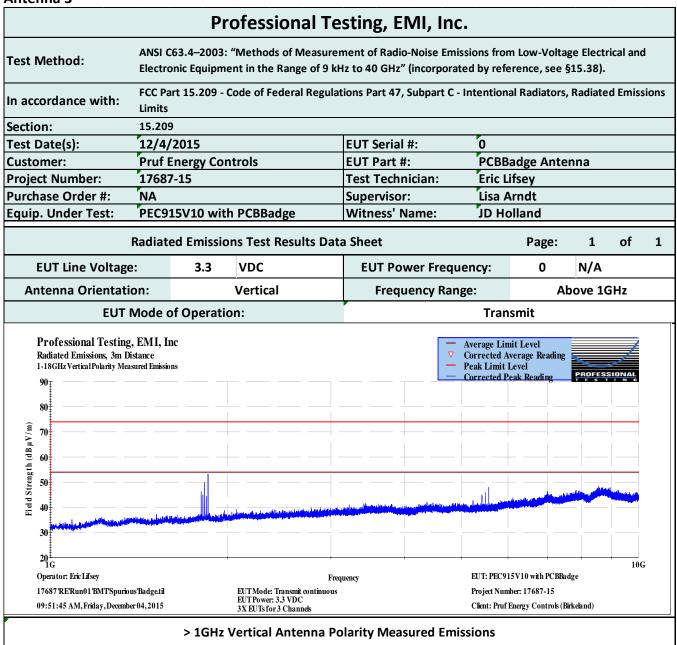
≤ 1GHz Vertical Antenna Polarity Measured Emissions

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

Antenna 3						<u> </u>						
			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 PCBB	adge	Witness' N	ame:	JD Holland					
	R	Radiated Em	issions Test	Results Data	Sheet		Pa	ge: 1	of 1			
EUT Li	ne Voltage:	3.	.3 VDC		EUT Pow	er Frequen	cy: (	N/A				
Antenna Orientation: Horizontal Frequency Range: 30MHz to 1GHz												
EUT Mode of Operation: Transmit												
Frequency Measured (MHz)	Test Distance (Meters)	Function (dBuV/m) (dB)										
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	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	0	EUTPowe	Frequent Continuous r: 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

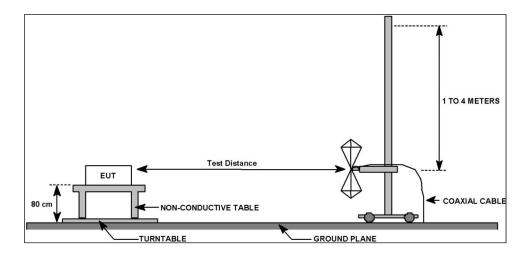
		Pr	ofessional T	esting, El	VII, Inc.					
Test Method:			"Methods of Measur ent in the Range of 9					•	ical and	d
n accordance with:	FCC Pa	rt 15.209 -	Code of Federal Regu	lations Part 47,	Subpart C - Int	entiona	Radiators,	, Radiate	d Emiss	sion
Section:	15.209	)								
Test Date(s):	12/4/	2015		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	Frequ	ency Range:		Al	bove 10	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							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	ļ								
			Profes	sional Te	sting, El	VII, Inc.			
Test Metho	od:			ds of Measurer e Range of 9 kH				•	
In accorda	nce with:	FCC Part 15.2 Limits	209 - Code of	Federal Regulat	ions Part 47,	Subpart C - Int	entional Radi	ators, Radiate	ed Emissions
Section:		15.209			1				
Test Date(s	s):	12/4/2015			EUT Serial		0		
Customer:		Pruf Energ	y Controls		EUT Part #:		ANT-916-PI	ML Antenna	a
Project Nu		17687-15			Test Techn		Eric Lifsey		
Purchase C		NA			Supervisor		Lisa Arndt		
Equip. Und	ler Test:	PEC915V10	) with ANT-9	916-PML	Witness' N	ame:	JD Holland		
	F	Radiated Em	nissions Test	t Results Data	a Sheet		Pa	ge: 1	of 1
EUT L	ine Voltage	: 3	.3 VDC		EUT Pow	er Frequen	cy: (	N/A	
Antenn	a Orientatio	n:	Vertic	al	Frequ	ency Range:	;	30MHz to	1GHz
	EUT N	Node 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
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	sional Testing, Emissions, 10m D GHz Vertical Polarity	istance				— Qu — Coi — Pe: — Coi V Ver	asi-peak Limit Ley rrected Quasi-peak ak Limit Leyel rrected Peak Valu ified Low-PRF QI RF-Verification Li	Readin	SIONAL
Field Strength (dB µV/m) 300 00 00 00 00 00 00 00 00 00 00 00 00 0	X								××
20 20 10 30M Operator:	Eric Lifsey	and the state of t	100M	Freq	uency	×	UT: PEC915V10 with	ANT-916-PML	1G
	Run03 BMTSpurious PM, Friday, December		EUTPowe	e: Transmit continuous er: 3.3 VDC for 3 Channels			roject Number: 17687 lient: Pruf Energy Co		

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 branch and water 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 state of the	
30	de the constitution of the second		Alexand II and the second seco					
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 state of the state of the state of the state of			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

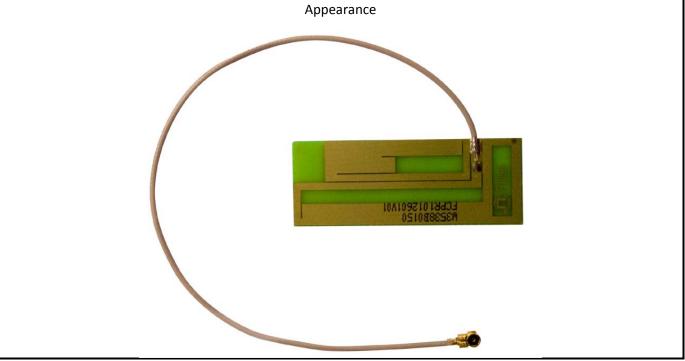
A direct examination of the antenna construction is performed and compared to rule criteria that prevent wireless device antennas from being modified by end users in ways that would void their authorization to use the device. Note that this device is supplied as a modular unit.

## 5.2 Criteria

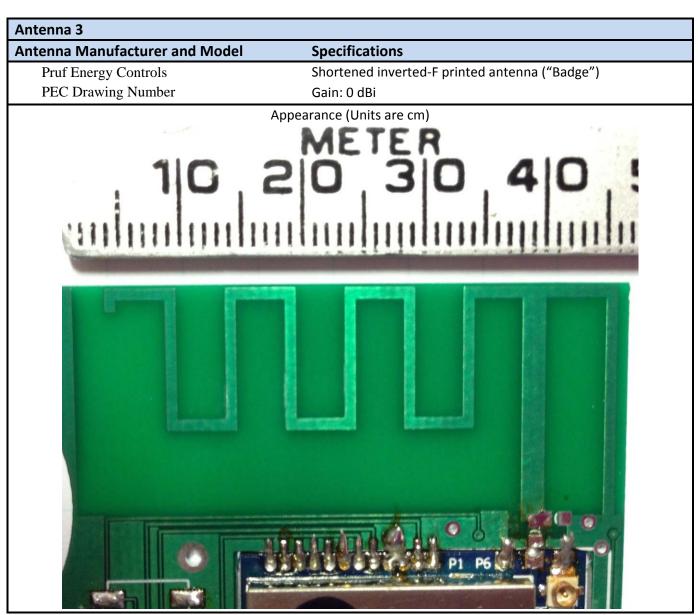
47 CFR (USA) // IC (Canada)								
Section Reference	Parameter	Date(s)						
15.203 // RSS-Gen 8.3	Antenna Construction	9 Dec 2015						

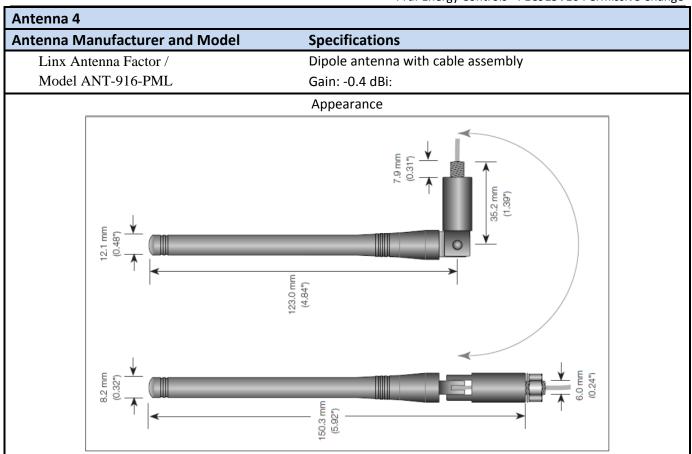
## 5.3 Results

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) 0,5 (min)	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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