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RADIO FREQUENCY IDENTIFICATION DEVICE
PER FCC PART 15.225
TEST REPORT

Applicant	PLUG AND PLAY ROBOTICS LLC
Address	2901 W. CYPRESS CREEK ROAD SUITE 103 FT. LAUDERDALE FL 33309 USA
FCC ID	2AEZUCLRC66301NH
Model Number	000001
Product Description	RFID LOCKING DEVICE
Date Sample Received	8/25/2015
Date Tested	10/2/2015
Tested By	Tim Royer
Approved By	Cory Leverett
Test Results	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail

Report Number	Version Number	Description	Issue Date
1764YUT15TestReport	Rev1	Initial Issue	9/11/2015
	Rev2	Modified Sample	9/25/2015
	Rev3	Modified Sample	10/5/2015

**THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL
WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.**

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GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

Summary

The device under test does:

- ☒ Fulfill the general approval requirements as identified in this test report
☐ Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025: 2005 requirements.

I attest that the necessary measurements were made, under my supervision, at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669

Authorized Signatory Name:

A handwritten signature in blue ink is written over a circular purple stamp. The stamp contains the text "TIMCO ENGINEERING, INC." around the perimeter and a signature in the center.

Tim Royer
Project Manager

Date: 10/5/2015

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REPORT SUMMARY

Disclaimer	The test result only related to the item tested.
Purpose of Test Report	Shows the EUT in compliance with FCC Pt 15.225 requirements for a 13.110 – 14.010 MHz transmitter.
Applicable Rule(s)	FCC Pt 15.225
Measurement Standard	ANSI C63.4-2009: Radiated Site Validation ANSI C63.10-2013: Measurement Procedures
Related Report	None

TEST ENVIRONMENT

Test Facility	All tests were performed by Timco Engineering Inc. located at 849 NW State Road 45 Newberry, FL 32669 USA.
Test Condition:	Temperature: 26°C Relative humidity: 50%.

TEST SETUP

Test Exercise (e.g. software description, test signal, etc.):	The EUT was placed in continuous transmit mode of operation.
Supporting Peripheral Equipment	I.T.E. Power Supply. Model: CENB1030A0503B01
Deviation to the standard(s)	No deviation was made
Modification to the EUT:	Software and a new Power supply.

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EUT SPECIFICATION

Description	RFID LOCKING DEVICE		
FCC ID	2AEZUCLRC66301NH		
Model Name	000001		
Family Model number	N/A		
EUT Accessories			
EUT Frequency	13.56Mhz		
EUT Power Source	<input checked="" type="checkbox"/> 110–120Vac/50– 60Hz		
	<input type="checkbox"/> DC Power		
	<input type="checkbox"/> Battery Operated Exclusively		
Test Item	<input type="checkbox"/> Prototype	<input checked="" type="checkbox"/> Pre-Production	<input type="checkbox"/> Production
Type of Equipment	<input checked="" type="checkbox"/> Fixed	<input type="checkbox"/> Mobile	<input type="checkbox"/> Portable
Antenna	Integral		

TEST RESULTS SUMMARY

FCC Rule Part No.	Test Item	Result
15.225(a)(b)(c)	Field Strength of Fundamental Emission	Pass
15.225(d)	Field Strength of Radiated Emissions	Pass
15.225(e)	Frequency Tolerance	Pass
15.207	AC Powerline Conducted Emissions	Pass

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TEST PROCEDURES

Power Line Conducted Interference: The procedure used was ANSI C63.4-2009 using a 50uH LISN. The resolution bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

Radiation Interference: The test procedure used was ANSI C63.4-2009 using a Rohde & Schwartz Spectrum Analyzer with a preselector. The bandwidth of the spectrum analyzer was 100 kHz with an appropriate sweep speed. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The resolution bandwidth was 100 kHz and the video bandwidth was 300 kHz.

Formula of Conversion Factors: The field strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dB μ V) to the antenna correction factor supplied by the antenna manufacturer plus the coax loss. The antenna correction factors are stated in terms of dB. The gain of the preselector was accounted for in the spectrum analyzer meter reading.

Example:

Freq MHz	Meter Reading dB μ V	ACF dB/m	Cable Loss dB	Field Strength dB μ V/m @ 3 m
33	20	+10.36	+1.2	31.56

ANSI C63.4-2009 Measurement Procedures: The EUT was placed on a table 80 cm high and with dimensions of 1m by 1.5m. The EUT was placed in the center of the table. The table used for radiated measurements is capable of continuous rotation. The spectrum was scanned from 30 MHz to 10th harmonic of the fundamental.

Peak readings were taken in three (3) orthogonal planes if necessary and the highest readings were converted to average readings based on the duration of "ON" time in 100 mseconds.

When an emission was found, the table was rotated to produce the maximum signal strength. At this point, the antenna was raised and lowered from 1m to 4m. The antenna was placed in both the horizontal and vertical planes.

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Frequency Stability: The test procedure used was ANSI C63.4: 2009. Temperature and voltage tests were performed to verify that the frequency tolerance of the carrier signal remains within the $\pm 0.01\%$ of the operating frequency over a temperature variation of -20°C to $+50^{\circ}\text{C}$ at normal supply voltage and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20°C .

The test was conducted as follows: The transmitter was placed in the temperature chamber at 25°C and allowed to stabilize for one hour. The transmitter was keyed ON for one minute during which time four frequency readings were recorded at 15-second intervals. The worst case number was recorded. The assigned channel frequency was considered to be the reference frequency. The temperature was then reduced to -20°C after which the transmitter was again allowed to stabilize. The transmitter was keyed ON for one minute, and again frequency readings were noted at 15-second intervals. This procedure was repeated in 10°C increments up to $+50^{\circ}\text{C}$.

Readings were also taken at plus and minus 15% of the battery voltage.

RADIATION INTERFERENCE

Rules Part No.: Pt 15.225, Pt 15.209

Requirements:

Fundamental Frequency (MHz)	Field Strength of Fundamental dB μ V/m @ 30 meters	Strength of Fundamental μ V @ 30 meters
13.553 – 13.567	84	15,848
13.410 – 13.553 13.567 – 13.710	50.5	334
13.110 – 13.410 13.710 – 14.010	40.5	106

Fundamental Frequency (MHz)	Field Strength of Harmonics and Spurious Emissions
0.009 – 0.490	2400/F (kHz) μ V/m @ 300 meters
0.490 – 1.705	24000/F (kHz) μ V/m @ 30 meters
1.705 – 30.0	29.54 dB μ V/m @ 30 meters or 69.54 dB μ V/m @ 3 meters
30 – 88	40.00 dB μ V/m @ 3 meters
88 – 216	43.50 dB μ V/m @ 3 meters
216 – 960	46.00 dB μ V/m @ 3 meters
Above 960	54.00 dB μ V/m @ 3 meters

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RADIATION INTERFERENCE

Test Data:

30 Meter extrapolation Table

Measurements below 30MHz using an extrapolation factor of 40 dB/decade

Detector	Ant Polarity	Emission Frequency (MHz)	Measured Level (dBuV)	measured distance (m)	extrapolation distance (m)	extrapolated level (dBuV/m)
Peak	V	13.42	24.89	1	30	-34.19
Peak	V	13.54	46.6	1	30	-12.48
Peak	V	14.2	13.42	1	30	-45.66

Field Strength Table:

Detector	Emission Frequency (MHz)	Meter Reading (dBuV/m)	Ant Polarity	Coax Loss (dB)	Correction Factor (dB)	Field Strength (dBuV/m)	Margin (dB)
Peak	13.54	-12.48	V	0.11	10.56	-1.81	52.31
Peak	41.74	16.80	V	0.26	12.82	29.88	10.12
Peak	50.97	14.33	V	0.34	10.73	25.40	14.60
Peak	68.40	21.44	V	0.43	5.96	27.83	12.17
Peak	72.22	22.71	V	0.45	6.34	29.50	10.50
Peak	135.70	12.60	V	0.68	14.11	27.39	16.11
Peak	135.70	13.81	H	0.68	14.11	28.60	14.90
Peak	141.69	13.54	H	0.70	15.14	29.38	14.12
Peak	162.67	11.01	V	0.76	16.29	28.06	15.44
Peak	162.95	17.88	H	0.76	16.26	34.90	8.60
Peak	189.91	13.40	V	0.83	13.60	27.83	15.67
Peak	189.91	15.75	H	0.83	13.60	30.18	13.32
Peak	94.83	22.01	V	0.56	10.69	33.26	10.24
Peak	94.83	22.98	H	0.56	10.69	34.23	9.27
Peak	108.54	21.02	H	0.60	10.29	31.91	11.59
Peak	122.08	23.72	V	0.64	11.12	35.48	8.02
Peak	149.27	14.50	H	0.72	16.23	31.45	12.05
Peak	176.29	16.45	H	0.79	14.39	31.63	11.87
Peak	189.91	19.85	H	0.83	13.60	34.28	9.22
Peak	216.03	17.55	V	0.88	10.58	29.01	16.99
Peak	216.03	22.70	V	0.88	10.58	34.16	11.84
Peak	352.30	20.30	V	1.22	14.29	35.81	10.19
Quasipeak	352.30	18.65	V	1.22	14.29	34.16	11.84
Peak	379.50	19.50	V	1.33	14.96	35.79	10.21
Peak	379.55	20.57	V	1.33	14.96	36.86	9.14
Peak	406.81	19.92	V	1.42	14.84	36.18	9.82

Note: Emissions attenuated more than 20 dB below the limit are not reported.

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FREQUENCY TOLERANCE

Rules Part No.: Pt 15.225 (e), Pt 2.1055

Requirements: The frequency tolerance shall be maintained within $\pm 0.01\%$ (100PPM) of the operating frequency.

Test Data: The data indicates the EUT passed this specific requirement.

Temperature	Frequency MHz	PPM
25°C (reference)	13.3374933	
-20°C	13.3372668	-16.982
-10°C	13.3376464	11.479
0°C	13.3370837	-30.710
10°C	13.3371737	-23.963
20°C	13.3379817	36.619
30°C	13.3375106	1.297
40°C	13.3381674	50.542
50°C	13.3370904	-30.208
Supply Voltage	Frequency	PPM
-15%	13.3374933	0.000
15%	13.3374933	0.000

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POWER LINE CONDUCTED INTERFERENCE

Rules Part No.: Part 15.107

Requirements:

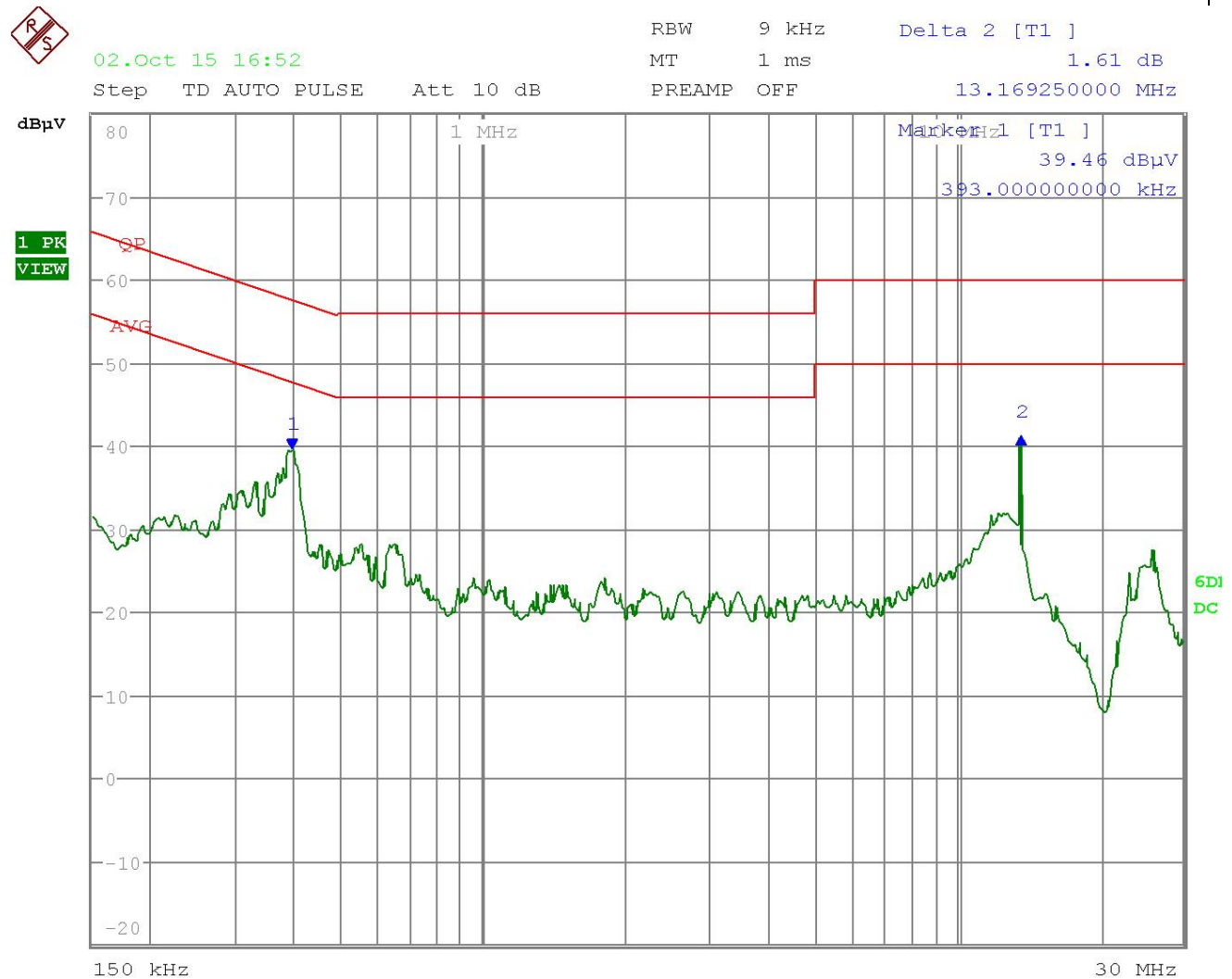
Frequency (MHz)	Quasi Peak Limits (dB μ V)	Average Limits (dB μ V)
0.15 – 0.5	66 – 56 *	56 – 46 *
0.5 – 5.0	56	46
5.0 – 30	60	50
* Decrease with logarithm of frequency		

Test Data: The following plots represent the emissions for power line conducted.
Both lines were observed.

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POWER LINE CONDUCTED INTERFERENCE

POWERLINE CONDUCTED PLOT – LINE 1 PEAK PLOT



Date: 2.OCT.2015 16:52:39

Results Meets Requirements

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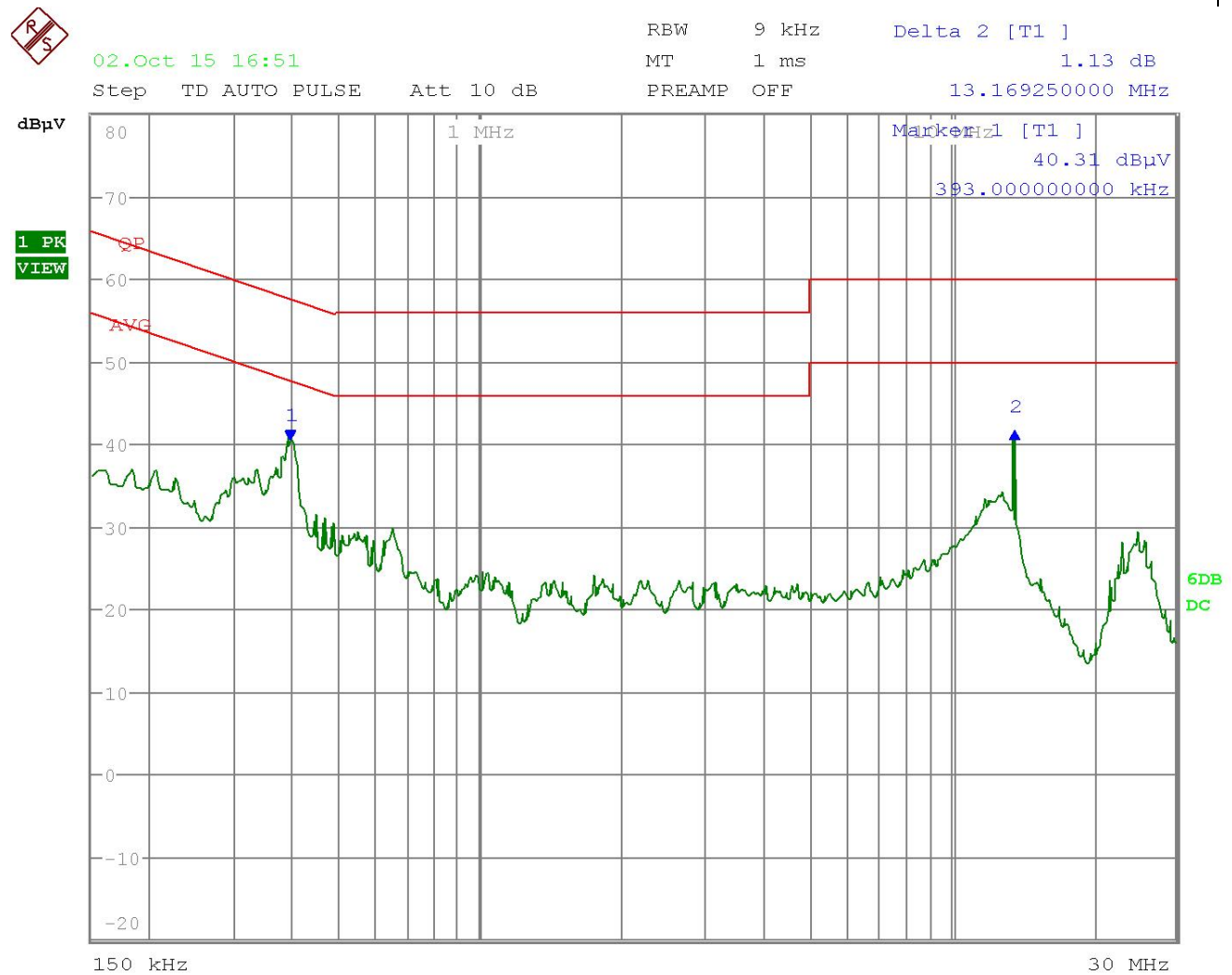
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POWER LINE CONDUCTED INTERFERENCE

POWERLINE CONDUCTED PLOT – LINE 2 PEAK PLOT



Date: 2.OCT.2015 16:51:36

Results Does Meet Requirements

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EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Antenna: Biconnical Chamber	Eaton Chamber	94455-1	1057	06/14/13	12/14/15
Antenna: Log-Periodic Chamber	Eaton	96005	1243	05/31/13	11/30/15
Antenna: Passive Loop	EMC Test Systems	EMCO 6512	9706-1211	07/09/15	07/09/17
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	12/31/13	12/31/15
Anennat: Double-Ridged Horn/ETS Horn 1	ETS-Lindgren Chamber	3117	00035923	06/13/14	06/13/16
EMI Test Receiver R & S ESIB 40 Screen Room	Rohde & Schwarz	ESIB 40	100274	08/12/14	08/12/16
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	03/11/14	03/11/16

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3

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