Application for Certification

Per

Title 47 USC Part 2, Subpart J, Equipment Authorization Procedures, Paragraph 2.907, Certification and Part 15, Subpart C, Intentional Radiators, Paragraph 15.207, Conducted limits and 209, Radiated emission limits; General requirements

For the

Cognosos, Inc.

Models (HVIN): PCA10015-1, PCA10015-2, PCA10015-3, PCA1005-4
Product Marketing Name (PMN): PCA-10015

UST Project: 18-0167
Issue Date: October 15, 2018

Number of Pages in this report: 17

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I certify that I am authorized to sign for the test facility and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US Tech (Agent Responsible For Test):

By: 

Name: Alan Ghasiani

Title: President – Consulting Engineer

Date: October 15, 2018

TESTING
NVLAP LAB CODE 200162-0

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MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: Cognosos, Inc.

PRODUCT MARKETING NAME: PCA-10015
MODEL(S): PCA10015-1, PCA10015-2, PCA10015-3, PCA10015-4

FCC ID: 2AKFQ10015
IC: 22165-10015

DATE: October 15, 2018

This report concerns (check one): Original grant X
Class II change_____

Equipment type: 433-435 MHz Transmitter Module

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until:_____
date

N.A. agrees to notify the Commission by N.A.
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

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Table of Contents

Paragraph Title Page

List of Figures

Figure **Title** **Page**

List of Tables

Tables **Title** **Page**

1. General Information

The information contained in this report is presented for the FCC Equipment Authorization of Certification of the Equipment under Test (EUT).

1.1 Product Description

The Equipment under Test (EUT) is the Cognosos, Inc. PCA-10015. The EUT is a small battery powered 433 MHz UHF transceiver with an integrated motion detector and GPS receiver. The EUT is a low power device used to create end devices that operate on Cognosos' RadioCloud® radio network. The baseline application for the end products includes asset tracking and other applications across campus-wide facilities.

The EUT module offers several methods of UHF communication:

- Long Range Mode (100 bps GFSK, burst operation)
- High Power Short Range (25.6 kbps GFSK, burst operation)
- Short range (25.6 kbps GFSK continuous operation)

The Long Range Mode (100 bps GFSK) is the mode of operation evaluated in this test report. The other two modes are evaluated in separate test reports.

In addition to the PCA10015-1 device tested, the EUT will be sold with the following hardware variants: PCA10015-2, PCA10015-3, and PCA10015-4. All models are electrically and physically identical except from the orientation of LED's to shine upwards or downwards and the removal of an optional connector. All models use identical radio transceivers, MCU, crystals and PCB.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on June 13, 2018 in good operating condition.

1.3 Related Submittal(s)/Grant(s)

None.

1.4 The EUT is subject to the following authorizations:

a) Certification of the transmitter circuitry.
b) Verification of the non-transmitter circuitry as a Digital Device.

2. Tests and Measurements

2.1 Configuration of Tested System

The Test sample was tested per *ANSI C63.4:2014, Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014) and ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (2013).* Radiated emissions data were taken according to the respective sections of each test standard. All measurements are peak unless stated otherwise.

There were no interconnecting cables to manipulate in an attempt to maximize emissions. The EUT was tested in the position in which it would be mounted in a door, right side up. This is considered the worse case position and used for final measurements. A block diagram of the tested system is shown in Figure 1. All test configuration photographs are shown in the Test Configuration Exhibit.

2.2 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and registered with the FCC, under site registration number US5301. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1. US Tech is also a NVLAP accredited test lab; lab code 200162-0.

2.3 Test Equipment

Table 1. EUT and Peripherals

PERIPHERAL AND MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID and IC Number	CABLES P/D
Tracker/ Cognosos, Inc. (EUT)	PCA10015-1	Engineering Sample	Pending: FCC ID: 2AKFQ10015 IC: 22165-10015	None

P = Power D = data S = Shielded U = Unshielded

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	9/22/2018
SPECTRUM ANALYZER	8593E	HEWLETT PACKARD	3205A60124	10/28/2018
LOOP ANTENNA	6502	EMCO	9810-3246	1/22/2020 2 yr
BICONNICAL ANTENNA	3110B	EMCO	9307-1431	10/23/2019 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	9/21/2018 2 yr.
HORN ANTENNA	3115	EMCO	9107-3723	9/22/2018 2 yr.
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	3/7/2019
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT-PACKARD	3008A00480	12/01/2018
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

Note: The calibration interval of the above test instruments is 12 months unless stated otherwise, and all calibrations are traceable to NIST/USA.

2.4 Modifications to Equipment

No modifications necessary to meet the requirements of this subpart.

2.5 Test Procedure

The EUT was configured as shown in the following block diagram(s) and photograph(s). Conducted and radiated emissions data were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter on the spectrum analyzer was OFF or 3 x the RBW throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions. The EUT was rotated 360 degrees with the turntable to maximize emissions. The physical position of the EUT was the same as would used in normal installation. The final setup description is found in the test section of this report.

2.5.1 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 below.

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

The EUT operates at a single channel therefore only one channel was selected and tested.

2.5.2 Frequency Range of Radiated Emissions (Part 15.33(a)/RSS Gen 4.10)

Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10th harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to the range specified in 2.4.1 above, whichever is the higher range of investigation and according to the table in 47 CFR 15.33(b).

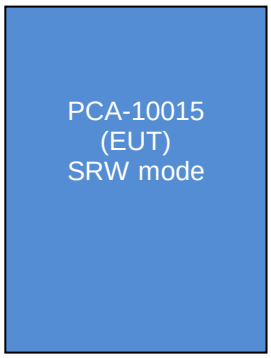

Figure 1. Block Diagram of Test Configuration

2.6 EUT Antenna Description (FCC Sec. 15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

Cognosos, Inc. Model: PCA-10015 transmitter incorporates the following antenna(s) only.

Table 4. Antenna Description

MANUFACTURER	TYPE	MODEL	GAIN dB_i
Cognosos, Inc.	Internal OCB Antenna	None	-5.1

2.7 Field Strength of Fundamental (47 CFR 15.209)

The results of the measurements for peak fundamental emissions are given in the test tables below. The EUT emissions measurement was started by setting up the receiver antenna in the vertical orientation at a distance of 3 meters from the EUT and at a height of 1.0 meters above the ground. The EUT packages' major axis was set normal to the direction of the measuring antenna.

The Spectrum Analyzer (SA) displays were set to: Channel A free-running, Channel B to Max-Hold. Choose a frequency or frequency range and scan it at a coupled rate. When a suspicious signal is found, center the signal on the screen and raise the receive antenna to the 4-meter height while observing the SA display for changes to the max-hold and free-running display. Next, the antenna is lowered to 1 meter height above the ground plane while observing the channel A and B displays. The display having max-hold shows the maximum signal seen across the height range of 1 to 4 meters. The next action is to raise or lower the antenna until the free-running display matches the Max-hold display's magnitude on the SA screen. When this occurs, the signal is maximized for antenna height. Record the antenna height on the data sheet corresponding to the present frequency.

When the antenna height has been maximized, the next step in the measurement process is to maximize the EUT direction with respect to the receiving antenna. Rotate the turn-table through 360 degrees with one SA channel set for max-hold and the other channel in free-run mode. The object is to find that azimuth direction where the free-running indication just matches the greatest max-hold indication. This is the direction where the signal is peaked for azimuth. Record the direction on the data sheet next to the frequency.

Radiated emissions within the band of 9 kHz to 30 MHz were investigated using a calibrated Loop Antenna and per the requirements of ANSI C63.10:2013. The resolution bandwidth was set to 300 Hz between 9 kHz to 150 kHz and 9 kHz up to 30 MHz; the video bandwidth was set to three times the resolution bandwidth.

2.8 Intentional Radiated Emissions, 9 kHz to 30 MHz (47 CFR 15.205, 15.209)

The peak radiated spurious emissions were measured over the frequency range of 9 kHz to 10 times the fundamental frequency, or 30 MHz.

Table 5. Intentional Radiated Emissions (9 kHz to 30 MHz)

9 kHz to 30 MHz, 15.209 limits						
Test: Radiated Emissions				**Client:** Cognosos, Inc.		
Project: 18-0167						
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**QP Limits (dBuV/m)**	**Margin (dB)**	**Detector PK, or AVG**
Loop X Position						
0.01	48.72	15.60	64.32	129.9	65.5	**PK**
0.16	44.72	11.94	56.66	86.8	30.2	**PK**
0.55	34.85	11.82	46.67	85.7	39.0	**PK**
1.71	23.15	11.77	34.92	49.5	14.6	**PK**
Loop Y Position						
0.01	55.43	15.60	71.03	135.2	64.2	**PK**
0.16	46.34	11.94	58.28	87.4	29.1	**PK**
0.52	35.42	11.82	47.24	86.7	39.4	**PK**
1.71	22.80	11.77	34.57	49.5	15.0	**PK**
Loop Z Position						
0.01	46.30	15.60	61.90	133.6	71.7	**PK**
0.16	45.48	11.94	57.42	87.6	30.2	**PK**
0.49	35.13	11.54	46.67	87.6	40.9	**PK**
1.99	23.70	11.77	35.47	49.5	14.1	**PK**

* frequency falls in restricted band of CFR 15.205.

Note (1): limit extrapolated using the factor of 50dB/decade. See Extrapolation Factor Statement attachment for details.

SAMPLE CALCULATIONS: At 0.01 MHz = 48.72 dBuV + (15.60) = 64.32 dBuV

Test Date: July 2, 2018
Tested By
Signature: _____ Name: John Freeman

2.9 Radiator Radiated Emissions (47 CFR 15.33(a); 15.209)

Radiated emissions coming from the EUT in a non-transmit state were evaluated as well as in a continuous transmit state from 9 kHz or the lowest emissions generated by the EUT up to five times the highest clock frequency per Part 15.209.

Measurements made below 30 MHz were recorded using the procedure in section 2.7 and are displayed in Table 5. No other emissions were seen within 20 dB of the limit.

For measurements above 30 MHz the measurements were made with the analyzer's resolution bandwidth set to 120 kHz for measurements made below 1 GHz and 1 MHz for measurements made above 1 GHz. The video bandwidth was set to three times the resolution bandwidth. The test data was maximized for magnitude by rotating the turn-table through 360 degrees and raising and lowering the receiving antenna between 1 to 4 meters in height as a part of the measurement procedure. All measured signals were at least 6 db below the specification limit.

The worst-case radiated emission was 6.0 dB below the limit at 57.9900 MHz. All other radiated emissions were at least 7.4 dB below the FCC Part 15.209 limit. The data is tabulated in the test table below

Table 6. Spurious Radiated Emissions (30 MHz to 1000 MHz)

Spurious Radiated Emissions							
Test By: JF	Test: Part 15B, Para 15.33, 15.209			Client: Cognosos, Inc.			
	Project: 18-0167						
Frequency (MHz)	**Peak Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Peak Corrected Results (dBuV/m)**	**Average Limits (dBuV/m)**	**Application Test Distance/ Polarization**	**Margin (dB)**	**Detector Used**
Measurements were made over the frequency range of 30 MHz to 1 GHz							
Fundamental							
433.10	50.35	-8.61	41.74	46.0	3m.HORZ	4.3	**PK**
433.10	48.11	-8.61	39.50	46.0	3m.HORZ	6.5	**QP**
434.03	48.19	-8.63	39.56	46.0	3m.HORZ	6.4	**PK**
435.32	47.96	-8.63	39.33	46.0	3m.HORZ	6.7	**PK**
Spurious Emissions other than Fundamental							
57.99	50.18	-17.55	32.63	40.0	3m./VERT	7.4	**PK**
102.28	42.05	-15.25	26.80	43.5	3m./VERT	16.7	**PK**
109.28	45.95	-15.64	30.31	43.5	3m./HORZ	13.2	**PK**
57.99	51.03	-17.05	33.98	40.0	3m./HORZ	6.0	**PK**
279.24	31.83	-12.20	19.63	46.0	3m./VERT	26.4	**PK**
971.20	28.40	-0.34	28.06	54.0	3m./VERT	25.9	**PK**
249.48	33.64	-13.36	20.28	46.0	3m./HORZ	25.7	**PK**
966.40	28.90	0.41	29.31	54.0	3m./HORZ	24.7	**PK**

Tested from 30 MHz to 1000 MHz

SAMPLE CALCULATIONS: At 57.99 MHz = 50.18 + (-17.55) = 32.63 dBuV

Test Date: July 2, 2018
Tested By

Signature:  Name: John Freeman

2.10 Power Line Conducted Emissions for Transmitter and Receiver/Digital Apparatus (47 CFR 15.207).

The EUT is battery operated with no means to connect to the AC mains therefore this test is deemed not applicable.

Table 7. Unintentional Powerline Conducted Emissions

Conducted Emissions							
Test By: JF	Test: Part 15.207			Client: Cognosos, Inc.			
	Project: 18-0167						
Frequency (MHz)	**Test Data (dBuV)**	**LISN+CL-PA (dB)**	**Results (dBuV)**	**Limits AVG (dBuV)**	**Application Point**	**Margin (dB)**	**DET P/QP/AVG**
Not applicable; EUT is battery powered only.							

SAMPLE CALCULATIONS: N/A

Test Date: July 2, 2018
Tested By

Signature:  Name: John Freeman

2.11 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.11.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.8 dB.

The EUT is battery operated therefore this test was deemed not applicable.

2.11.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ±5.3 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ±5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±2.45

The data listed in this test report does have sufficient margin to negate the effects of uncertainty, therefore, the EUT unconditionally meets this requirement.