Testing Tomorrow's Technology

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 15.231, Periodic Operation in the band 40.66 MHz to 40.70 MHz and above 70 MHz
And
Innovation, Science, and Economic Development Canada Certification Per
ICRSS-Gen General Requirements for Radio Apparatus
And
RSS-210 License-Exempt Radio Apparatus: Category I Equipment

For the

Cognosos, Inc.

Model: PCA-10017

UST Project: 21-0414b
Issue Date: February 23, 2022

Number of Pages in this report: 21

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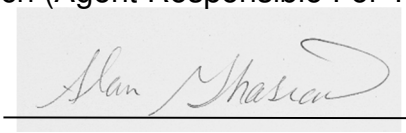
Testing Tomorrow's Technology

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: February 23, 2022

NVLAP TESTING

NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

Company Name:	Cognosos, Inc
Address:	1100 Spring St. NW #300A Atlanta, GA 30309
Model:	PCA-10017
FCC ID:	2AKFQ10017
IC:	22165-10017
Date:	February 23, 2022

This report concerns (check one): ☒ Original ☐ Class II Permissive Change

Equipment type: 433-435 MHz UHF transceiver

Technical Information:

Radio Technology:	
Frequency of Operation (MHz):	433.164- 435.324
Output Power:	79.26 dBuV/m @ 3m
Type of Modulation:	2-GFSK
Data/Bit Rate (M)bps:	100 bps
Antenna Gain (dB):	-0.65
Software used to program EUT:	Cognosos Telluride
EUT firmware:	vaha0.4.0
Power setting:	power set to “4”

Report prepared by:

US Tech

3505 Francis Circle Alpharetta, GA 30004

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1. General Information

This report is prepared as a means of presenting test data to be used by a Telecom Certification Body in determination of whether this product is permitted for unlicensed dissemination to the general public according to the Innovation, Science, and Economic Development Canada and FCC Rules and Regulations for RF Devices Intentional Radiators.

1.1 Product Description

The Cognosos PCA-10017 is a small battery powered 433 MHz UHF transceiver with integrated motion detector and GPS receiver. The EUT also includes a Bluetooth 5 transceiver. The module will be installed into Cognosos enclosures and sold as GPS tracking devices when used by Cognosos customers with proper infrastructure installed. Examples of the host products are the Cognosos models: RT-250 and RT-260 devices.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on January 20, 2022 in good operating condition.

1.3 Related Submittal(s)/Grant(s)

The EUT is subject to the following FCC Equipment Authorizations:

a) Certification of the EUT as an intentional transmitter under Part 15 Subpart C, paragraph 15.231 (this test report)
b) Certification of the EUT as an intentional transmitter under Part 15 Subpart C, paragraph 15.249, UST# 21-0414a
c) Verification of the EUT under Part 15 Subpart B (SDoC), UST # 21-0414c

2. Tests and Measurements

2.1 Configuration of Tested System

The Test sample was tested per *ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* to show compliance to CFR 47, Part 15.231.

All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was set to 3 times the resolution bandwidth or off throughout the evaluation process. There were no interconnecting cables to manipulate in an attempt to maximize emissions; however, the physical position of the EUT was varied through the three mutually exclusive orthogonal planes in an attempt to maximize the emissions. The worst case position is the position used for final measurements and is gathered in this test report. A block diagram of the tested system is shown in Figure 1.

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 186022. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1 and is also a NVLAP accredited test lab; lab code 200162-0.

2.3 Test Equipment

Table 1. EUT and Peripherals

MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID:	CABLES P/D
Radio Module/ Cognosos, Inc. (EUT)	PCA-10017	Engineering Sample	Pending: 2AKFQ10017 22165-10017	P
MANUFACTURER	**MODEL NUMBER**	**SERIAL NUMBER**	**FCC/IC ID:**	**CABLES P/D**
DC Bench top power supply/ Tek Power	HY1803D	1072531	None	P

S= Shielded, U=Unshielded, P= Power line, D= Data line

Table 2. Test Instruments

TEST INSTRUMENT	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	AGILENT	E4407B	US41442935	9/2/2022
SPECTRUM ANALYZER	ADVANTEST	U3772	1806001039	10/28/2022 EXTENDED
LOOP ANTENNA	EMCO	6502	9810-3246	4/6/2022 2 YR.
BICONNICAL ANTENNA	EMCO	3110B	9306-1708	8/17/2023 2 YR.
LOG PERIODIC ANTENNA	EMCO	3146	9110-3236	12/13/2023 2 YR.
HORN ANTENNA	AH SYSTEMS	SAS-571	HA102	2/28/2022 2 YR.
PREAMP 100 KHZ TO 1.3 GHZ	HEWLETT-PACKARD	8447D	1937A02980	6/9/2022
PREAMP 1.0 GHZ TO 26.0 GHZ	HEWLETT-PACKARD	8449B	3008A00914	8/27/2022
LISN X 2	SOLAR ELECTRONICS	9247-50-TS-50-N	955824 AND 955825	6/9/2022
HIGH PASS FILTER	MICROWAVE CIRCUITS	H3R020G2	001DC9528	7/16/2022

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

2.4 EUT Antenna Description (FCC Sec. 15.203, RSS-Gen 6.7)

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.

The Cognosos Inc., Model PCA-10017 Incorporates the antennas detailed in Table 3.

Table 3. Antenna Description

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB	TYPE OF CONNECTOR
None	Cognosos, Inc.	PCB trace antenna	433MHz Meandered Trace	-0.65	trace
None	Cognosos, Inc.	PCB trace antenna	2.4GHz Inverted F	4.68	trace
None	Cognosos, Inc.	PCB trace antenna	1575.42MHz Inverted F	-1.08	trace

2.5 Modifications to Equipment

No modifications were needed to bring the EUT into compliance with the FCC Part or IC RSS requirements.

2.6 Test Procedure

The EUT was configured as shown in the following block diagram(s) and photograph(s). The sample was tested per ANSI C63.10:2013. Conducted and radiated emissions data were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz depending on the frequency range of testing, 150 kHz-30 MHz or 30 MHz to 1000 MHz, respectively. All measurements are peak unless stated otherwise. The video filter on the spectrum analyzer was OFF or set to 3x 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 varied through the three mutually exclusive orthogonal planes in an attempt to maximize the emissions. The final setup description is found in the test section of this report.

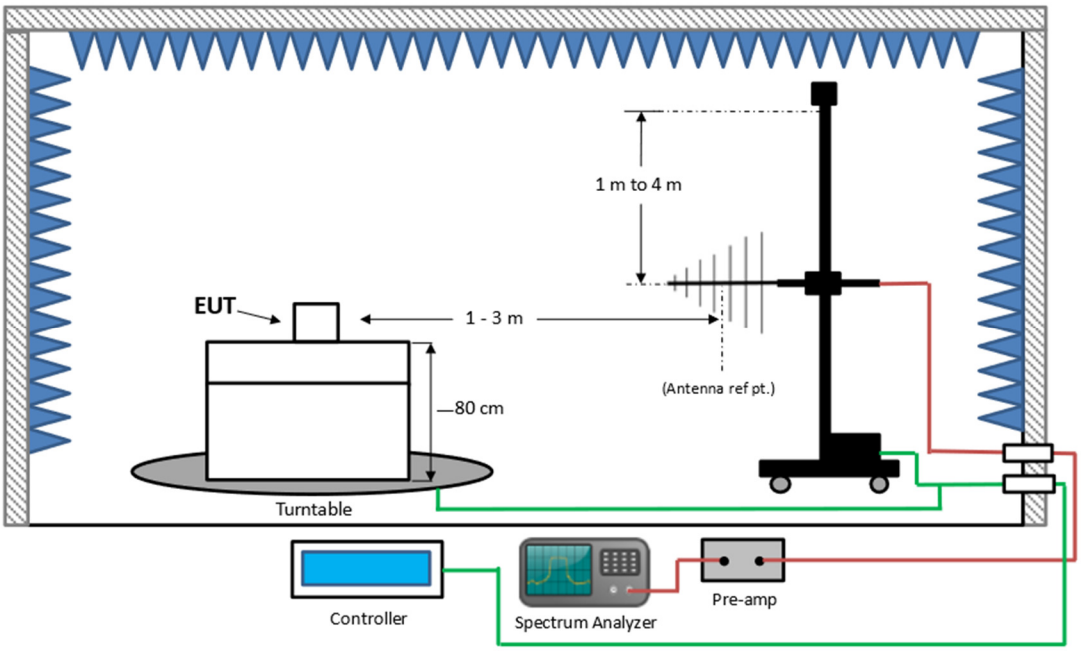

Figure 1. Block Diagram of Test Configuration

2.7 Compliance to CFR 15.231(a), RSS-210, A.1.1(a) Transmitter Activation/Deactivation

According to CFR 15.231(a) The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz . Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

The transmitter is not a manually operated transmitter.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

The transmitter is classified as an automatically activated transmitter and the transmitter does comply with transmissions ceasing after 5 seconds. See Figure 2 below.

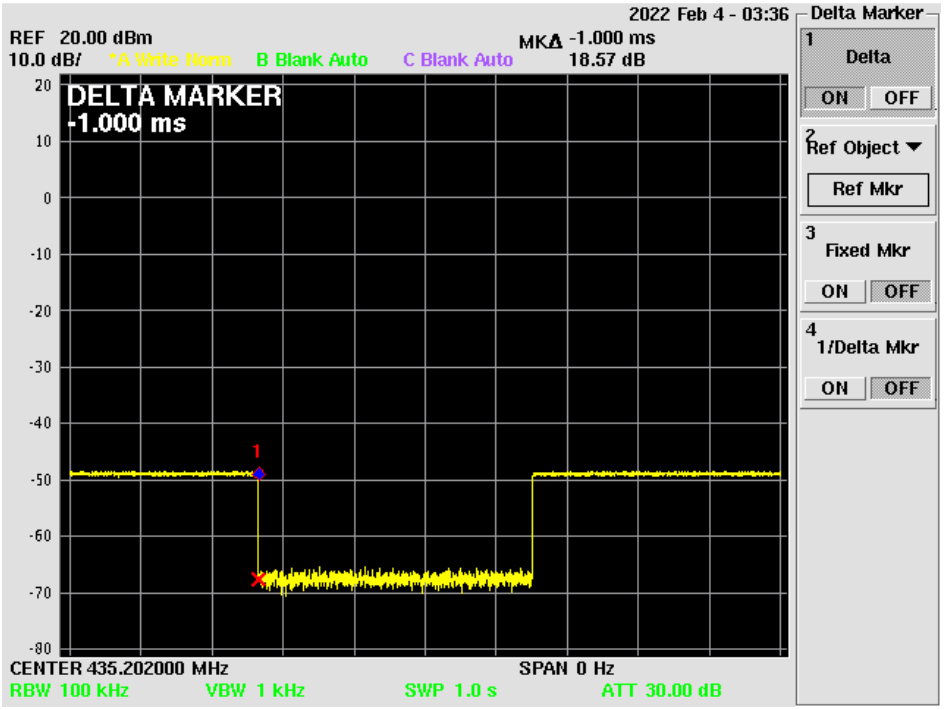

Figure 2. Deactivation per 15.231(a)(1), RSS-210, A.1.1(a)

Note 1: The EUT deactivates within 5 seconds.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, Including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

This does not apply; the transmitter does not have periodic transmissions at pre-determined intervals, and does not have polling or supervision transmissions to determine system integrity.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

This does not apply; the transmitter is not employed for radio control purposes during emergencies.

(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may Include data.

This does not apply; the transmitter is not used for security systems.

2.8 Field Strength of Fundamental (47 CFR 15.231(b), RSS-210, A.1.2(b))

The results of the measurements for peak fundamental emissions are given in Table 4. The EUT emissions measurement was started by setting up the 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's 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 signal is detected, raise and lower the antenna to maximize the signal.

When the signal has been maximized, the antenna height is fixed the turn-table is rotated through 360 degrees to further maximize the signal.

When all signals have been maximized for antenna height and direction, the EUT is carefully maneuvered in each of the three mutually exclusive orthogonal planes while observing the same Max-hold/free-running SA display indication. When the EUT position is found that further maximizes the signal, record the antenna height, rotation orientation, EUT orthogonal position and signal strength on the data sheet for that particular frequency.

Next, the measurement antenna is re-oriented to a Horizontal polarization at 1 meter height and the process described above is repeated. All signals within 6 dB of the limit are recorded.

Finally, the collected data is input into the calculation spread sheet. The spread sheet is designed to calculate for the true value that is collected. The spread sheet takes into account the SA reading, the antenna correction factor, cable losses and duty cycle factors. See the data tables herein.

2.9 Limits for Operation in the Band above 70 MHz (CFR15.231 (b), RSS-210, A.1.2(b))

This limit versus frequency table is as follows (test distance = 3.0 meters):

Fundamental Frequency (MHz)	Limit Fundamental (Average) uV/m	Limit Harmonics and other spurious (Average) uV/m
260 to 470	3750 to 12500*, 1	375 to 1250*,2
* Linear Interpolations		

Note: formula 1: $limit_1 = E = 41.667F - 7083.5$
2: $limit_2 = E = 4.1667F - 708.35$
E= Electric field strength
F= fundamental frequency in MHz

The frequency spectrum above the fundamental to its 10th harmonic was examined and measured for signals falling into the restricted bands of 15.205. If average emissions measurements are employed, the provisions in 15.35 for averaging pulsed emissions and for limiting peak emissions were applied. Spurious and harmonics signals meet the requirements of the above table or the requirements of 15.209, whichever requirement permits higher field strength.

Table 4. Intentional Radiated Emissions Peak Measurements

Tested By:	Test: Part 15C, Para 15.231				Client: Cognosos Inc.		
IC	Project: 21-0414				Model: PCA-10017		
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**PK Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detection Method**
CH0							
433.20	62.94	16.42	79.36	100.8	3m./HORZ	21.5	**PK**
866.20	28.38	-4.88	23.50	80.8	3m./HORZ	57.3	**PK**
1299.30	61.4	-13.21	48.19	80.8	3m./HORZ	32.6	**PK**
CH20							
435.32	61.58	16.42	79.26	100.8	3m./HORZ	22.8	**PK**
870.65	28.48	-4.30	24.18	80.8	3m./HORZ	56.6	**PK**
1306.00	62.42	-13.32	49.10	80.8	3.0m./HORZ	31.7	**PK**
No other emissions found less than 20 dB from the applicable limit.							

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (~) Measurements taken at 1 meter were extrapolated to 3 meter using a factor of (-9.5 dB).

Sample Calculation at 433.20:

Magnitude of Measured Frequency	62.94	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	16.42	dB/m
Corrected Result	79.36	dBuV/m

Test Date: January 24, 2022
Tested By

Signature: Ian Charboneau Name: Ian Charboneau

Table 5. Intentional Radiated Emissions Average Measurements

Tested By:	Test: Part 15B, Para 15.231			Client: Cognosos Inc.			
IC	Project: 21-0414			Model: PCA-10017			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB/m)**	**Corrected Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**Detection Method**
CH0							
433.20	62.35	16.42	78.77	80.8	3m./HORZ	2.1	**AVG**
866.20	14.17	-4.88	9.29	60.8	3m./HORZ	51.5	**AVG**
1299.30	36.50	-13.21	23.18	60.8	3m./HORZ	37.6	**AVG**
CH20							
435.32	60.14	16.42	76.56	80.8	3m./HORZ	4.2	**AVG**
870.65	14.44	-4.30	10.14	60.8	3m./HORZ	50.7	**AVG**
1306.00	36.5	-13.32	41.46	60.8	3m./HORZ	37.6	**AVG**
No other emissions found less than 20 dB from the applicable limit.							

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 20 dB relaxation for peak measurements of CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. (~) Measurements taken at 1 meter were extrapolated to 3 meter using a factor of (-9.5 dB).

Sample Calculation at 433.20:

Magnitude of Measured Frequency	62.35	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	16.42	dB/m
Corrected Result	78.77	dBuV/m

Test Date: January 24, 2022
Tested By

Signature: Ian Charboneau Name: Ian Charboneau

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2.10 Power Line Conducted Emissions and Radiated Spurious Emissions (CFR 15.207, 15.209, RSS-Gen 8.8, 8.9)

The EUT was placed in a state representative of how the device will function under normal operation. The radiated spurious emissions were measured over the frequency range of 9 KHz to 30MHz and 30 MHz to the 10th harmonic of the fundamental frequency of the intentional transmitter. The test results are shown below.

Table 6. Conducted Emissions, 9 kHz - 30 MHz

9 kHz to 30 MHz, 15.207 limits							
Test: Radiated Emissions				**Client:** Cognosos Inc.			
Project: 22-0414				**Model:** PCA-10017			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**QP Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
Phase							
0.1903	33.43	0.08	33.51	54.0	m./meters.	20.5	**PK**
0.9000	28.75	0.59	29.34	46.0	m./meters.	16.7	**PK**
1.1866	28.04	0.87	28.91	46.0	m./meters.	17.1	**PK**
6.6833	34.79	0.34	35.13	50.0	m./meters.	14.9	**PK**
13.366	42.04	0.88	42.92	50.0	m./meters.	7.1	**PK**
20.03	33.93	0.88	34.81	50.0	m./meters.	15.2	**PK**
Neutral							
0.1792	29.79	0.13	29.92	54.0	m./meters.	24.6	**PK**
0.7483	28.42	0.51	28.93	46.0	m./meters.	17.1	**PK**
1.6730	27.75	0.61	28.36	46.0	m./meters.	17.6	**PK**
6.6916	35.21	0.47	35.68	50.0	m./meters.	14.3	**PK**
13.366	42.48	1.24	43.72	50.0	m./meters.	6.3	**PK**
20.033	34.22	1.46	35.68	50.0	m./meters.	14.3	**PK**

Sample Calculation at 0.1903 MHz:

Magnitude of Measured Frequency	33.43	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	0.08	dB/m
Corrected Result	33.51	dBuV/m

Test Date: January 28, 2022
Tested By

Signature:  Name: Ian Charboneau

Table 7. Radiated Emissions, 9 kHz - 30 MHz

9 kHz to 30 MHz, 15.209 limits							
Test: Radiated Emissions				**Client:** Cognosos Inc.			
Project: 21-0414				**Model:** PCA-10017			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**QP Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
Loop X position							
0.0090	50.29	13.75	64.04	127.9	m./meters.	63.9	**PK**
0.1500	46.54	12.42	58.96	104.1	m./meters.	45.1	**PK**
0.5200	37.71	11.94	49.65	73.0	m./meters.	23.3	**PK**
2.7000	32.34	11.66	44.00	69.5	m./meters.	25.5	**PK**
Loop Y position							
0.0090	49.30	13.75	63.05	129.3	m./meters.	66.3	**PK**
0.1500	46.37	12.42	58.79	104.1	m./meters.	45.3	**PK**
0.5400	38.90	11.94	50.84	73.0	m./meters.	22.1	**PK**
7.1800	31.73	11.26	42.99	69.5	m./meters.	26.6	**PK**
Loop Z position							
0.0120	49.04	13.75	62.79	125.7	m./meters.	62.9	**PK**
0.1500	47.55	12.42	59.97	104.1	m./meters.	44.1	**PK**
0.6800	37.75	11.92	49.67	71.0	m./meters.	21.3	**PK**
2.3700	29.09	11.65	40.74	69.5	m./meters.	28.8	**PK**

Sample Calculation at 0.009 MHz:

Magnitude of Measured Frequency	50.29	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	13.75	dB/m
Corrected Result	64.04	dBuV/m

Test Date: January 31, 2020
Tested By

Signature:  Name: Ian Charboneau

Table 8. Radiated Emissions other than Fundamental & Harmonics

Above 30 MHz, 15.209 Limits							
Test: Radiated Emissions				**Client:** Cognosos Inc.			
Project: 21-0414				**Model:** PCA-10017			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**QP Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
35.40	42.84	-14.27	28.57	40.0	3m/VERT	11.4	**PK**
97.14	41.63	-16.74	24.89	43.5	3m/HORZ	18.6	**PK**
182.77	41.61	-12.93	28.68	43.5	3m/VERT	14.8	**PK**
199.15	40.61	-11.97	28.64	43.5	3m/HORZ	14.9	**PK**
394.28	41.24	-12.07	29.17	46.0	3m/VERT	16.8	**PK**
443.66	41.63	-10.99	30.64	46.0	3m/HORZ	15.4	**PK**
597.08	41.95	-9.04	32.91	46.0	3m/VERT	13.1	**PK**
896.36	41.61	-5.61	36.00	46.0	3m/HORZ	10.0	**PK**
995.96	41.74	-6.79	34.95	54.0	3m/VERT	19.1	**PK**
2655.00	52.99	-8.69	44.30	54.0	3m/VERT	9.7	**PK**

Sample Calculation at 35.40 MHz:

Magnitude of Measured Frequency	42.84	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	-14.27	dB/m
Corrected Result	28.57	dBuV/m

Test Date: January 26, 2022
Tested By

Signature:  Name: Ian Charboneau

2.12 Bandwidth of Fundamental (CFR15.231(c), RSS-210, A.1.3)

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz Bandwidth is determined by those frequencies that are at least 20 dB down on either side of the center frequency of the pulse.

Bandwidth of Fundamental= 0.0025 x 434,244,000.00 = 1.085 MHz

The WORST CASE measured bandwidth is 33.5 kHz, well within the limit. See the figure below.

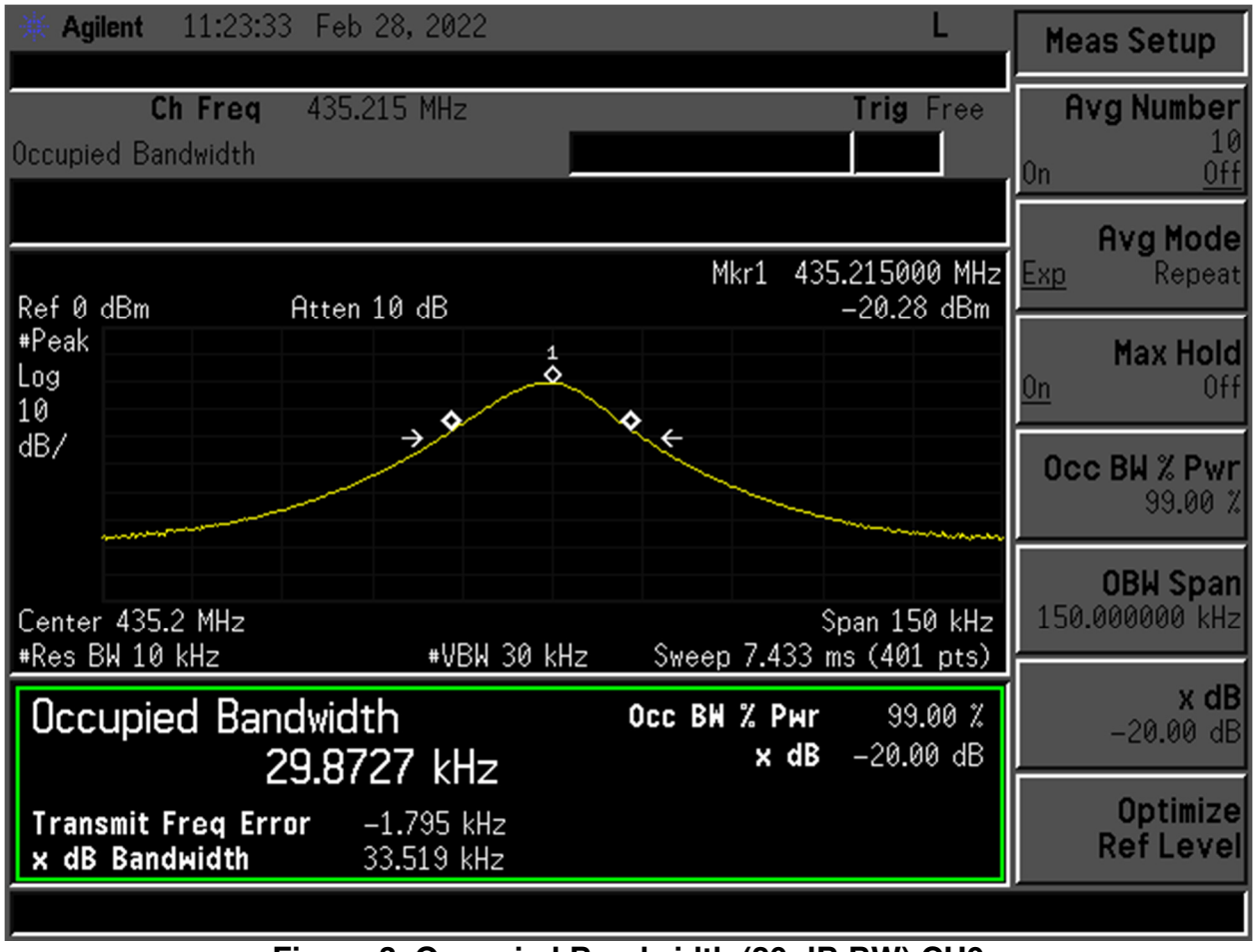

Figure 3. Occupied Bandwidth (20 dB BW) CH0

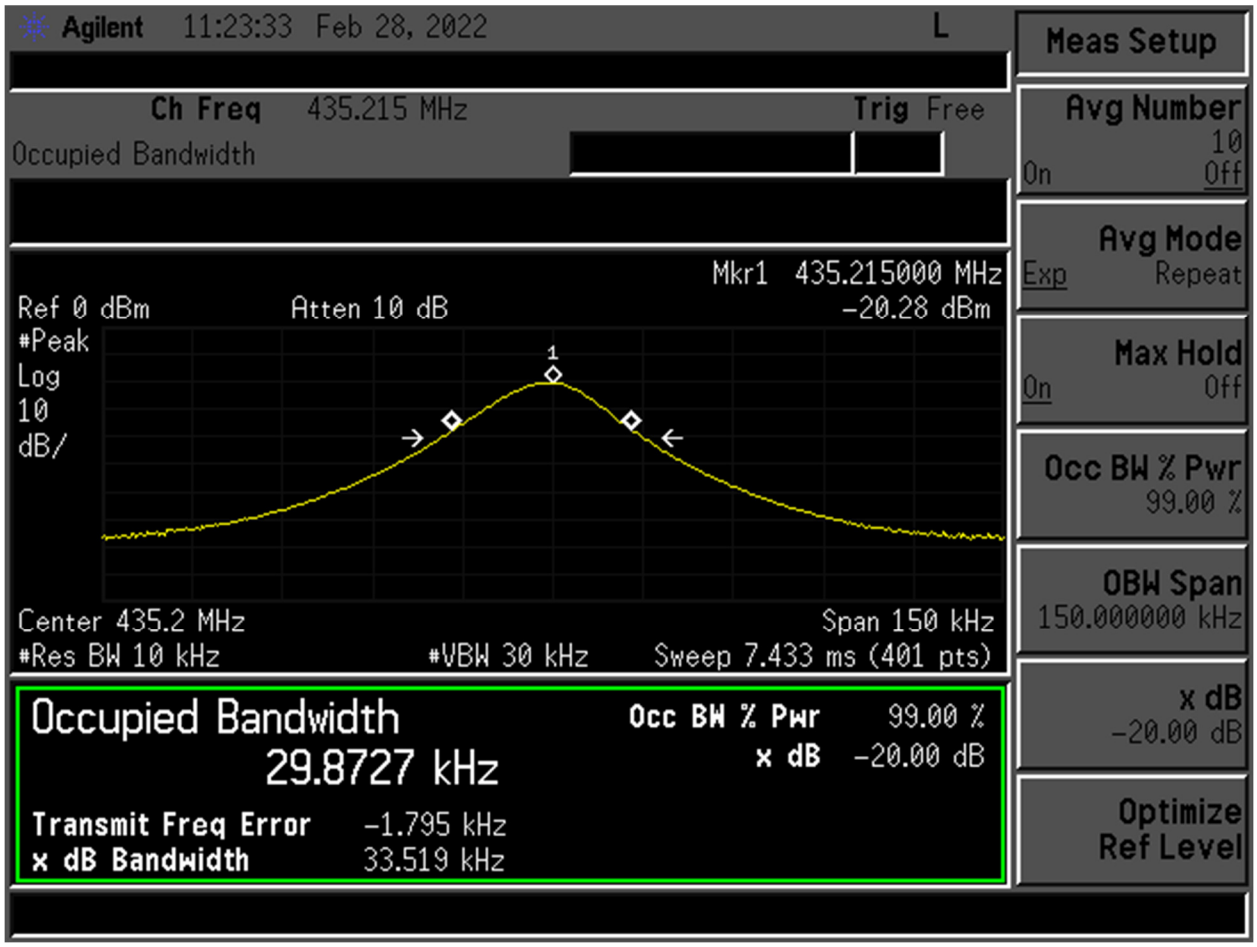

Figure 4. Occupied Bandwidth (20 dB BW) CH19

2.13 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4-2: 2011. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.13.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ± 2.85 dB.

2.13.2 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 ± 5.40 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 ± 5.19 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ± 5.08 dB.