Excellence in Compliance Testing

Certification Test Report

FCC ID: X32-ARX11B2
IC: 8797A-ARX11B2

FCC Rule Part: 15.231
ISED Canada Radio Standards Specification: RSS-210

ACS Report Number: 16-3048.W06.1A

Manufacturer: iKeyless, LLC
Model: 300-0388

Test Begin Date: June 27, 2016
Test End Date: June 28, 2016

Report Issue Date: June 30, 2016

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code AT-1921

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

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This report contains 17 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Innovation, Science, and Economic Development Canada's Radio Standards Specification RSS-210.

1.2 Product description

Remote product 300-0388 is an aftermarket replacement keyless entry remote for automobiles. The remote is designed such that it can emulate the functionality of a wide range of existing OEM remotes operating at 433.92MHz with ASK modulation. The emulated remote is configured from a predetermined list of car remotes by the user. The remote features a microcontroller/transmitter, 7 micro-switch dome buttons, and a user LED. The remote electronics are contained inside an ABS plastic shell with a labeled silicon rubber pad over the buttons. The device is powered by a single CR2032 coin cell battery.

Operating Voltage: 3 VDC (CR2032 Battery)
Antenna Type / Gain: Loop / -12.0 dBi

Manufacturer Information:
iKeyless, LLC
828 E Market St
Louisville, KY 40206

Test Sample Serial Number(s): ACS 1 for Radiated Measurements and ACS 2 for Duty Cycle and Bandwidth Measurements

Test Sample Condition: The test sample was provided in working order with no visible defects.

1.3 Test Methodology and Considerations

The EUT is a stand-alone handheld device and was tested in (3) orientations which represent normal intended operation.

The EUT is a battery powered device; therefore AC power line conducted emissions was not performed.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 381-4235

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1921 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

FCC Registered Test Site Number: 637011
ISED Test Site Registration Number: 20446

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 18' x 28' x 18' shielded enclosure. The chamber is lined with Samwha Electronics Co. LTD Ferrite Absorber, model number SFA300 (HSN-1). The ferrite tile is 10cm x 10 cm and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. On top of the ferrite tiles is DMAS HT-45 (Dutch Microwave Absorber Solutions) hybrid absorber on all walls except the wall behind the antenna mast which has a shorter DMAS HT-25 absorber.

The turntable is 1.50m in diameter and is located 150cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using short #6 copper wire. The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the turntable. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane.

Behind the turntable is a 2' x 6' x 1.5' deep shielded pit used for support equipment if necessary. The pit is equipped with 2 - 4" PVC chase from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

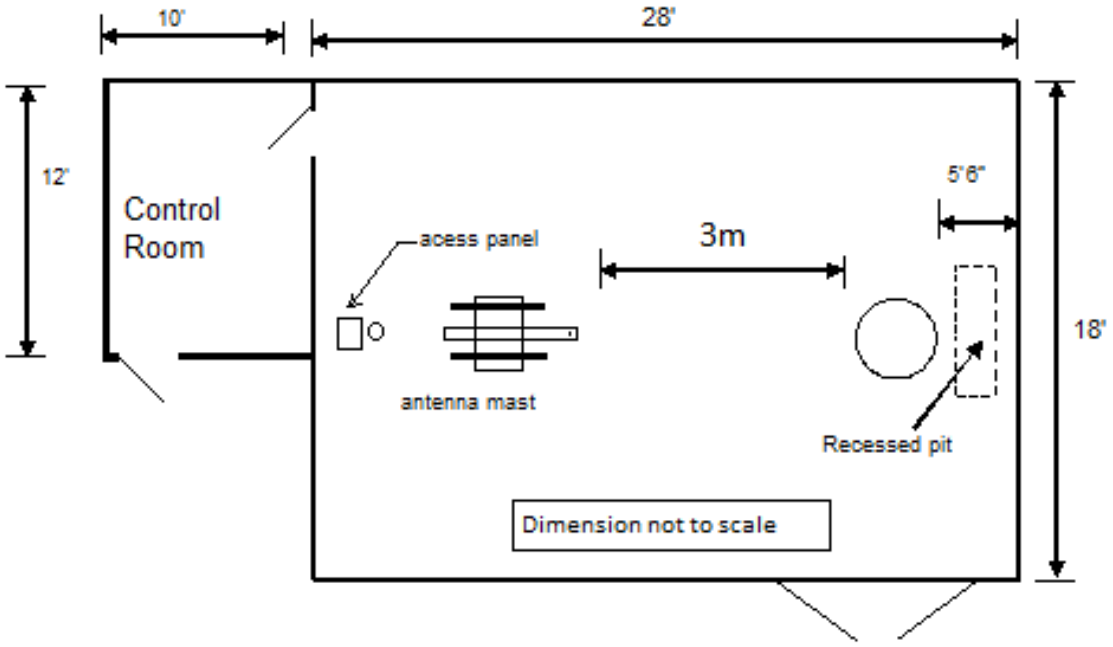

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 10' sheet galvanized steel horizontal ground reference plane (GRP) bonded every 6" to an 8' X 8' aluminum vertical ground plane.

A diagram of the room is shown below in figure 2.4-1:

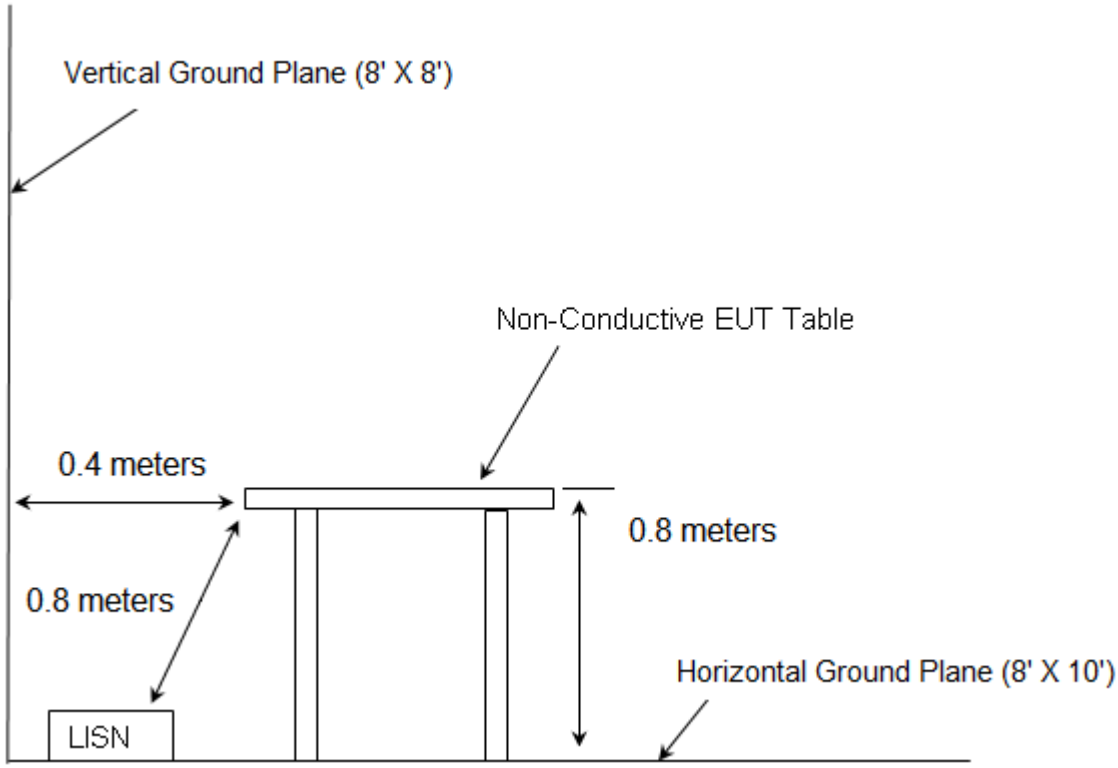

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014 - American National Standard for Methods of Measurement of Radio-Noise Emissions from low-voltage electrical and electronic equipment in the range of 9kHz to 40 GHz.
- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2014
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2014
- ISED Canada Radio Standards Specification: RSS-210 – Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment, Issue 8, December 2010
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, Nov 2014.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
277	Emco	93146	Antennas	9904-5199	9/2/2014	9/2/2016
626	EMCO	3110B	Antennas	9411-1945	2/29/2016	2/28/2017
3002	Rohde & Schwarz	ESU40	Receiver	100346	1/8/2016	1/8/2017
3006	Rohde & Schwarz	TS-PR18	Amplifiers	122006	6/29/2015	6/29/2016
3012	Rohde & Schwarz	EMC32-EB	Software	100731	2/2/2016	8/2/2016
3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	1/26/2016	1/26/2018
3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	12/22/2015	12/22/2016
3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	12/22/2015	12/22/2016
3055	Rohde & Schwarz	3005	Cables	3055	12/30/2015	12/30/2016

NCR = No Calibration Required
Firmware Version: ESU40 is 4.73 SP1
Software Version: EMC32-B is 9.15

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Manufacturer	Equipment Type	Model Number	Serial Number
The EUT operates standalone therefore no support equipment was utilized.				

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

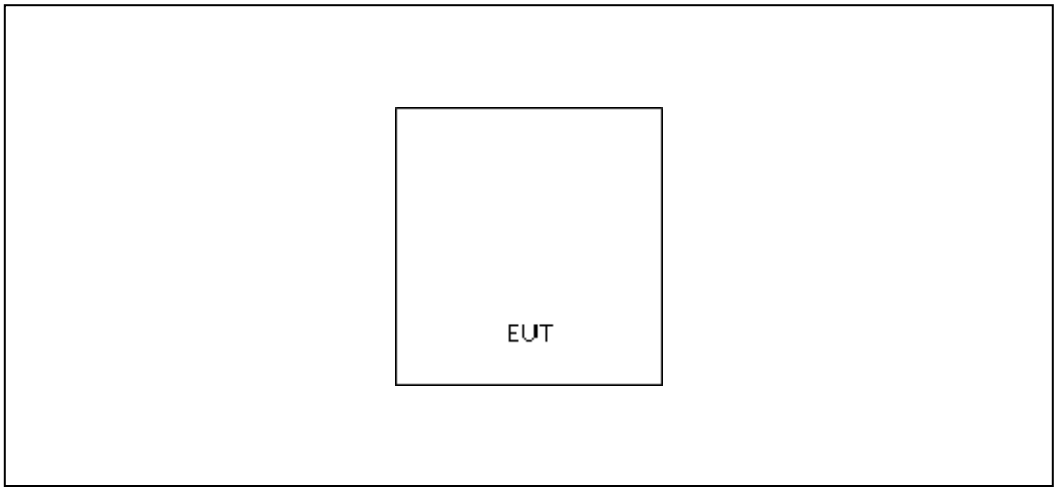

Figure 6-1: EUT Test Setup

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: CFR 47 Part 15.203

The antenna is a loop antenna that is implemented as a copper trace on the PCB, thus satisfying Part 15.203 requirements. The antenna gain is -12.0 dBi.

7.2 AC Power Line Conducted Emissions – FCC: CFR 47 Part 15.207/ISED CANADA: RSS-GEN 8.8

7.2.1 Measurement Procedure

The EUT is battery operated therefore power line conducted emissions is not applicable.

7.3 Periodic Operation – FCC: CFR 47 15.231(a) / ISED CANADA: RSS-210 A1.1.1

7.3.1 Test Methodology

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

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

The transmitter was activated manually and was evaluated using a spectrum analyzer at zero span.

7.3.2 Test Results

The transmitter ceased operation after the next whole packet was sent after being manually activated and deactivated. The results are shown in Figure 7.3.2-1.

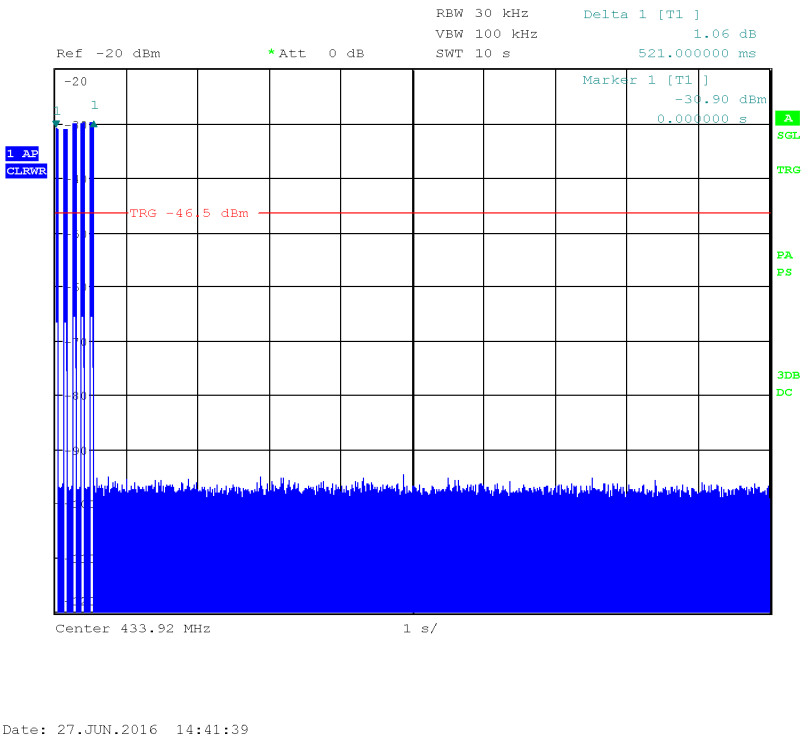

Figure 7.3.2-1: TX Hold Time

7.4 Occupied Bandwidth – FCC: CFR 47 15.231(c)(1) / ISED CANADA: RSS-210 A1.1.3

7.4.1 Test Methodology

The span of the spectrum analyzer display was set between two times and five times the occupied bandwidth (OBW) of the emission. The RBW of the spectrum analyzer was set to approximately 1 % to 5 % of the OBW. The trace was set to max hold with a peak detector active. The Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set to 1% to 5% of the occupied bandwidth. The video bandwidth was set to 3 times the resolution bandwidth. A peak detector was used.

7.4.2 Test Results

0.25% of the 433.92 MHz center frequency is equivalent to 1084.8 kHz. Therefore the 20 dB and 99% bandwidths of the emissions are less than 0.25% of the center frequency. The results are shown in Table 7.4.2-1 and Figures 7.4.2-1 and 7.4.2-2.

Table 7.4.2-1: 20dB / 99% Bandwidth

Modulation	Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
ASK	433.92	24.21	33.35

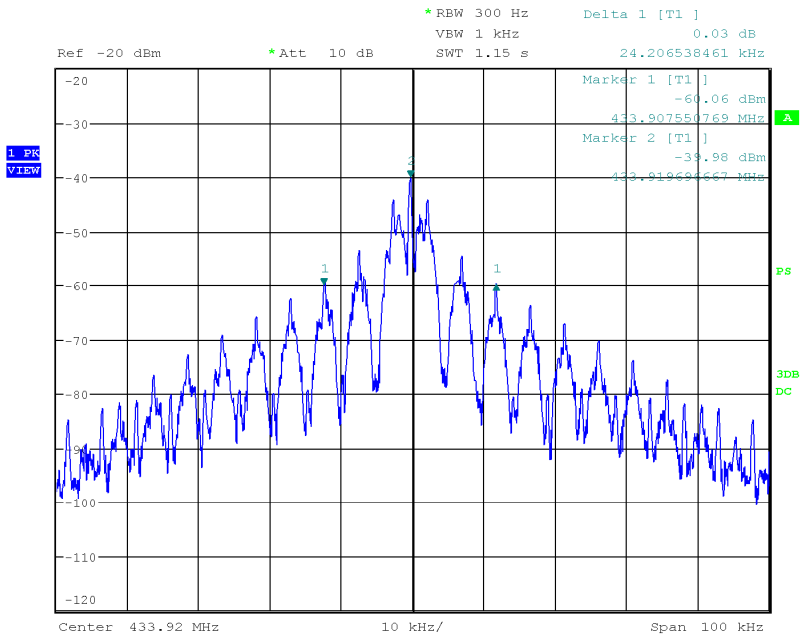

Figure 7.4.2-1: 20 dB Bandwidth

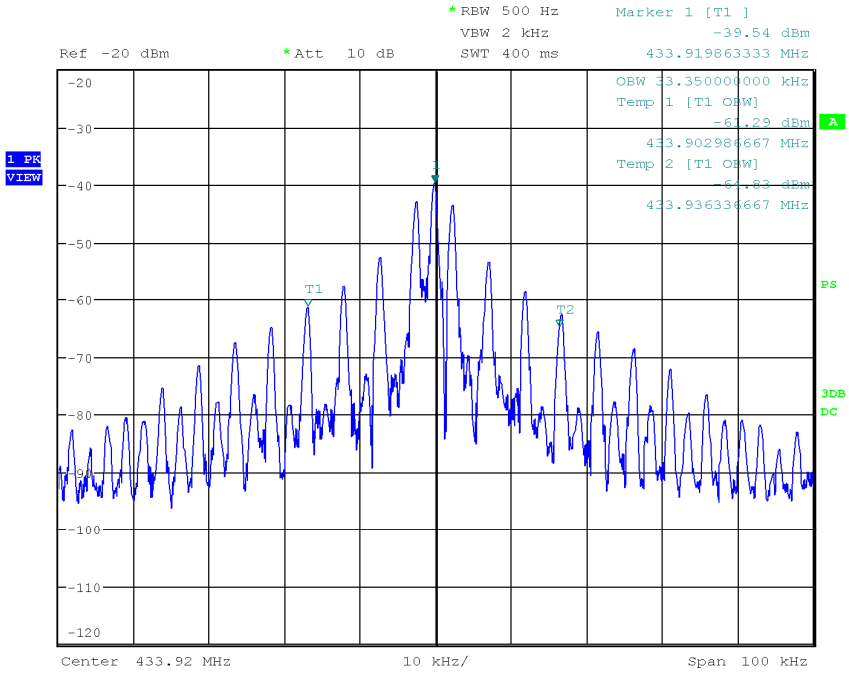

Figure 7.4.2-2: 99% Occupied Bandwidth

7.5 Radiated Emissions – FCC: CFR 47 15.231(b) / ISED CANADA: RSS-210 A1.1.2

7.5.1 Test Methodology

Radiated emissions measurements were made over the frequency range of 9 kHz or the lowest frequency generated to 4.3392GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies between 9 kHz and 150 kHz, measurements were made using a resolution bandwidth (RBW) of 300 Hz and a video bandwidth of 1 kHz. For frequencies between 150 kHz and 30 MHz, measurements were made using a resolution bandwidth (RBW) of 150 kHz and a video bandwidth of 30 kHz. For frequencies between 30 MHz and 1000 MHz, measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz. For frequencies above 1000MHz, measurements were made with RBW of 1 MHz and a VBW of 3 MHz.

Further, compliance with the provisions of 15.205 was demonstrated using the measurement instrumentation specified in that section where applicable.

For ASK modulation the EUT utilized pulsed modulation therefore peak measurements where corrected by the duty cycle for comparison to the average limits.

7.5.2 Duty Cycle Correction

For average radiated measurements, the measured level was reduced by a factor 13.55 dB to account for the duty cycle of the EUT with ASK modulation.

The worst case duty cycle was determined to be 21%. The duty cycle correction factor is determined using the formula: 20log (21/100) = -13.55 dB. Determination of the duty cycle correction is included in the plots and justification below.

ASK Duty Cycle Determination:

Period (T) = 122ms (100ms was used for the duty cycle calculations)
Number Pulses (N1) = 112
Pulse Width (T1) = 0.190ms
(N1*T1)/T = (112*0.190)/100 = 0.21
20*Log(0.21) = -13.55 dB Average Correction Factor (from plots below)

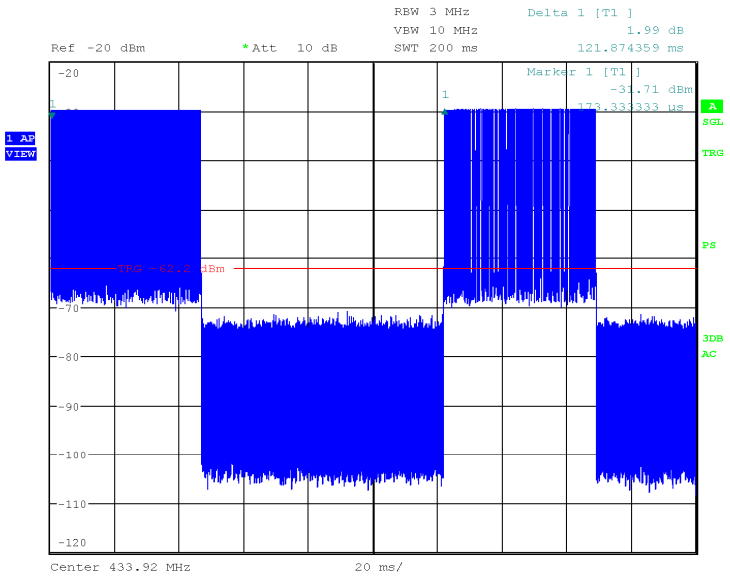

Figure 7.5.2-1: Duty Cycle

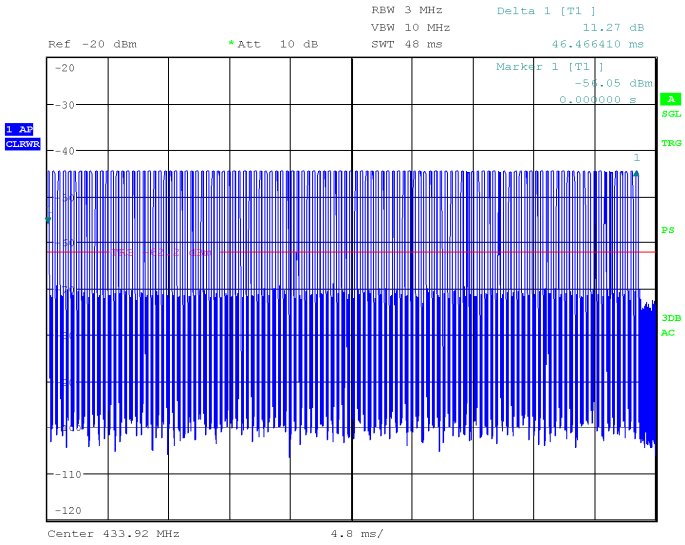

Figure 7.5.2-2: Duty Cycle

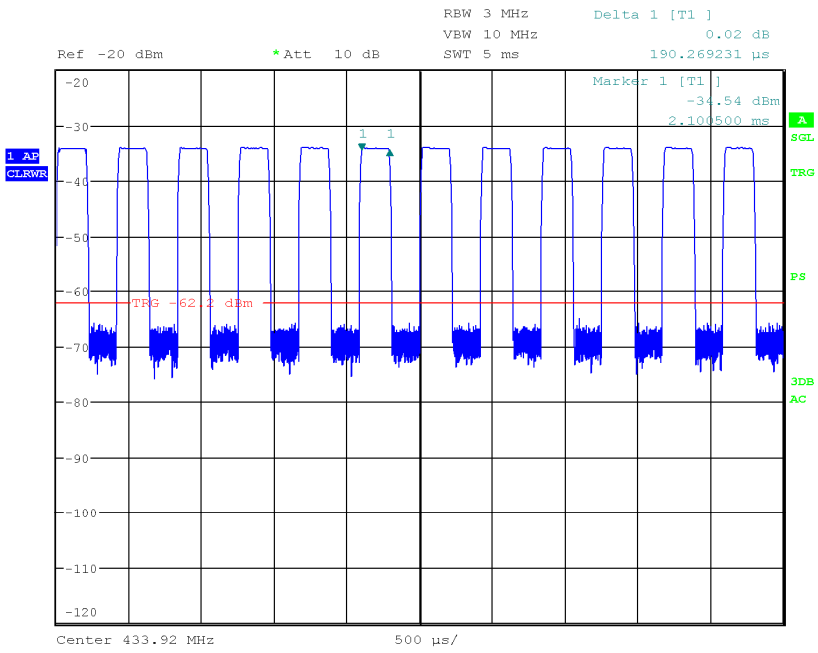

Figure 7.5.2-3: Duty Cycle –Pulse Width (T1)

7.5.3 Test Results

X, Y and Z positions were pre-scanned and Z position was determined to be the worst case. The final measurements are reported in Table 7.5.3-1.

Table 7.5.3-1: Radiated Emissions

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	pk	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Emission										
433.92	65.00	65.00	H	17.48	82.48	68.93	100.8	80.8	18.3	11.9
433.92	72.90	72.90	V	17.48	90.38	76.83	100.8	80.8	10.4	4.0
Spurious Emissions										
867.84	18.80	18.80	H	24.34	43.14	29.59	80.8	60.8	37.7	31.2
867.84	25.60	25.60	V	24.34	49.94	36.39	80.8	60.8	30.9	24.4
1301.76	46.80	46.80	H	-5.22	41.58	28.03	74.0	54.0	32.4	26.0
1301.76	61.90	61.90	V	-5.22	56.68	43.13	74.0	54.0	17.3	10.9
2603.52	52.60	52.60	H	-1.07	51.53	37.98	80.8	60.8	29.3	22.8
2603.52	62.10	62.10	V	-1.07	61.03	47.48	80.8	60.8	19.8	13.3
3037.44	49.30	49.30	H	0.87	50.17	36.61	80.8	60.8	30.6	24.2
3037.44	56.20	56.20	V	0.87	57.07	43.51	80.8	60.8	23.7	17.3
3905.28	57.10	57.10	H	4.54	61.64	48.09	74.0	54.0	12.4	5.9
3905.28	59.80	59.80	V	4.54	64.34	50.79	74.0	54.0	9.7	3.2
4339.2	54.10	54.10	H	5.71	59.81	46.26	74.0	54.0	14.2	7.7
4339.2	56.50	56.50	V	5.71	62.21	48.66	74.0	54.0	11.8	5.3

7.5.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: Fundamental Frequency (X Orientation)

PEAK:
Corrected Level: 18.80 + 24.34 = 43.14dBuV
Margin: 80.8dBuV – 43.14dBuV = 37.7dB

AVERAGE:
Corrected Level: 18.80 + 24.34 - 13.55 = 29.59dBuV
Margin: 60.80dBuV – 29.59dBuV = 31.2dB

8 CONCLUSION

In the opinion of ACS, Inc. the 300-0388 manufactured by iKeyless, LLC meets the requirements of FCC Part 15 subpart C and Innovation, Science, and Economic Development Canada's Radio Standards Specification RSS-210.

END REPORT