

Certification Test Report

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IC: 8797A-AFK41B1

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

ACS Report Number: 17-0061.W06.1B

Manufacturer: iKeyless, LLC
Model: 300-0482

Test Begin Date: February 2, 2017
Test End Date: February 3, 2017

Report Issue Date: April 10, 2017



For Scope of Accreditation Under Certificate Number: AT-2021

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, NIST, 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 for certification.

1.2 Product description

The 300-0482 is a 315MHz, ASK modulation, remote keyless entry FOB.

Technical Information:

Detail	Description
Frequency Range	315 MHz
Number of Channels	1
Modulation Format	ASK (Manchester Encoded)
Operating Voltage	3 Vdc (CR1620 coin cell)
Antenna Type / Gain	Loop Antenna / -13dBi gain

Manufacturer Information:

iKeyless, LLC
828 E. Market St.
Louisville, KY 40206

Test Sample Serial Number(s): ACS#1 (Continuous Mode), ACS#2 (Normal Mode)

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

1.3 Test Methodology and Considerations

All modes of operation, including all available data rates, were evaluated. The data presented in this report represents the worst case where applicable.

For Radiated Emissions, the EUT was programmed to generate a continuously modulated signal. The EUT was evaluated in three orthogonal orientations. See test setup photos for more information.

For RF bandwidth and timing parameter testing, the EUT was programmed for normal operation. The EUT was evaluated with a near field probe to facilitate coupling to the test equipment.

The EUT is a battery powered device with no provisions for connection to the public utilities, therefore power line conducted emissions was not performed.

Software power setting during test: Power setting not controlled by software

2 TEST FACILITIES

2.1 Location

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

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the ANSI-ASQ National Accreditation Board/ANAB accreditation program, and has been issued certificate number AT-2021 in recognition of this accreditation. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 391271

ISED Canada Lab Code: IC 4175A

VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm 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 3/4" stainless steel braided cable.

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 range. 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 during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases 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:

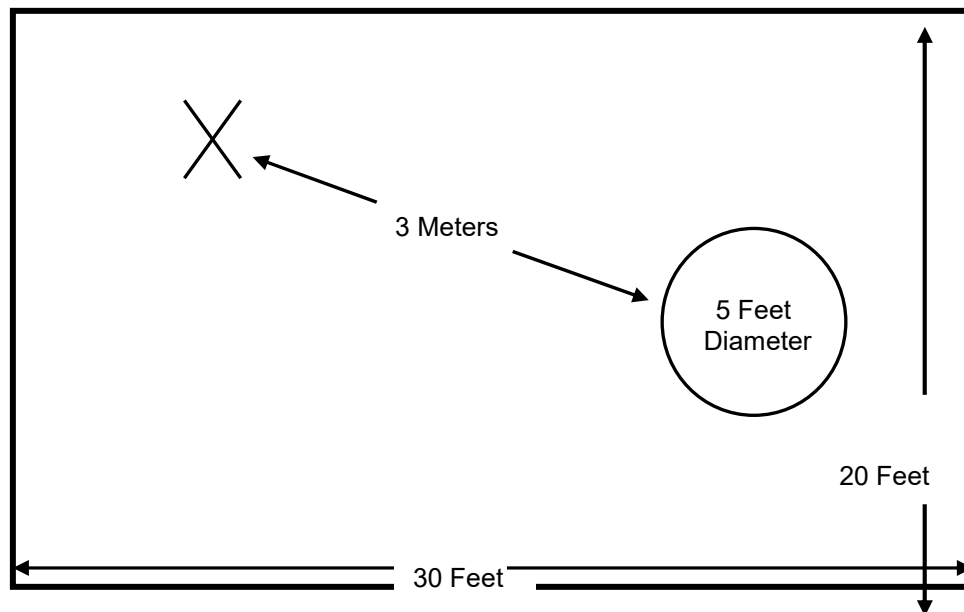


Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. 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 during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room 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. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

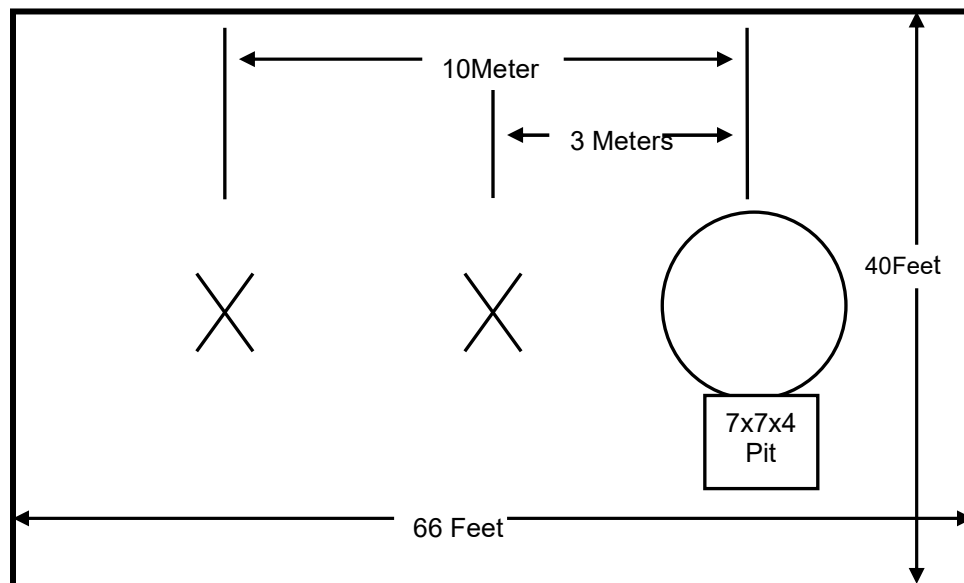


Figure 2.3-2: Open Area Test Site

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 8' solid aluminum horizontal ground reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

A diagram of the room is shown below in figure 4.1.3-1:

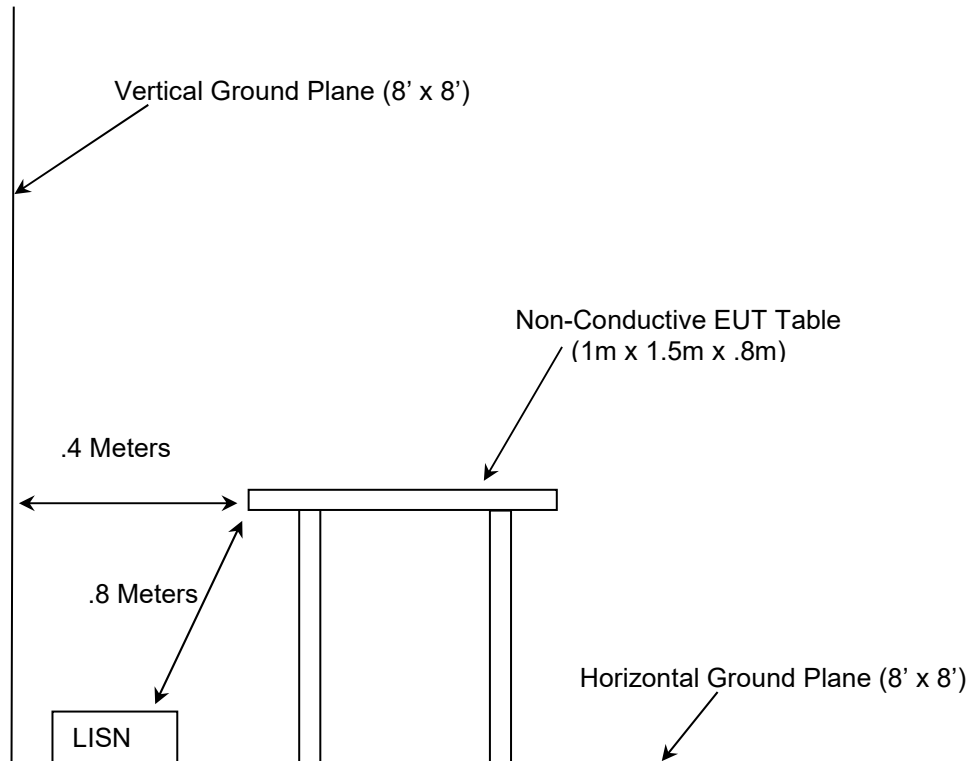


Figure 2.4-1: AC Mains Conducted EMI Site

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 9 kHz 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, 2017
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2017
- ❖ Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-210 – Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 9, August 2016
- ❖ Innovation, Science and Economic Development 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
30	Spectrum Technologies	DRH-0118	Antennas	970102	4/30/2015	4/30/2017
40	EMCO	3104	Antennas	3211	6/8/2016	6/8/2018
73	Agilent	8447D	Amplifiers	2727A05624	7/21/2016	7/21/2017
167	ACS	Chamber EMI Cable Set	Cable Set	167	9/30/2016	9/30/2017
338	Hewlett Packard	8449B	Amplifiers	3008A01111	8/21/2015	8/21/2017
412	Electro Metrics	LPA-25	Antennas	1241	8/8/2016	8/8/2018
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	10/27/2016	10/27/2017
616	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	N/A	9/2/2016	9/2/2017
622	Rohde & Schwarz	FSV40	Analyzers	101338	7/15/2016	7/15/2018
628	EMCO	6502	Antennas	9407-2877	2/11/2016	2/11/2018
676	Florida RF Labs	SMS-290AW-480.0-SMS	Cables	MFR2Y194	11/4/2016	11/4/2017
RE135	Rohde & Schwarz	FSP30	Spectrum Analyzers	835618/031	10/31/2016	10/31/2017

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
The EUT is a battery operated equipment therefore no ancillary or support equipment was utilized. The EUT was tested stand-alone.				

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
The EUT is a battery operated equipment therefore no ancillary or support equipment was utilized. The EUT was tested stand-alone.				

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

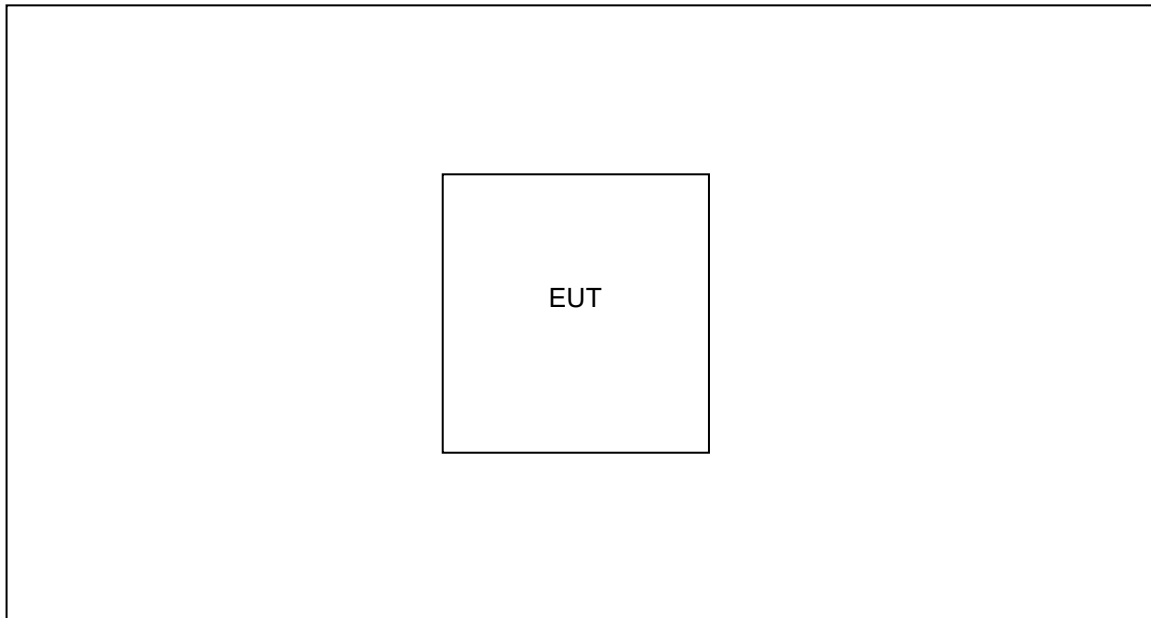


Figure 6-1: EUT Test Setup

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: Part 15.203

The antenna is a PCB Printed Loop antenna and is non-detachable without compromising the device, therefore satisfying Part 15.203. The antenna gain is -13dBi.

7.2 Power Line Conducted Emissions – FCC: Part 15.207; ISED Canada: RSS-GEN 8.8

7.2.1 Measurement Procedure

The EUT is a battery powered device with no provisions for connection to the public utilities, therefore power line conducted emissions was not performed.

7.3 Periodic Operation – FCC: Part 15.231(a); ISED Canada: RSS-210 A.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 with a > 5 second sweep time.

7.3.2 Test Results

The transmitter ceased operation 573.33ms after being manually activated. The results are shown in Figure 7.3.2-1.

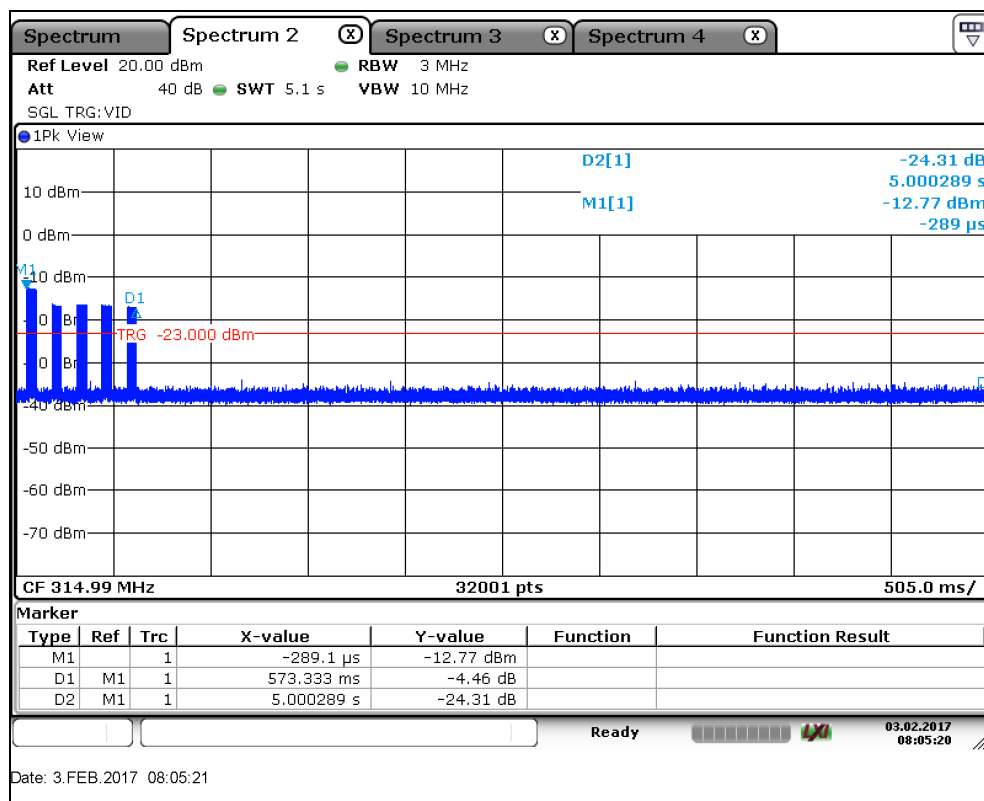


Figure 7.3.2-1: TX Hold Time

7.4 Occupied Bandwidth – FCC: Part 15.231(c); ISED Canada: RSS-210 A.1.3, RSS-GEN 6.6

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.

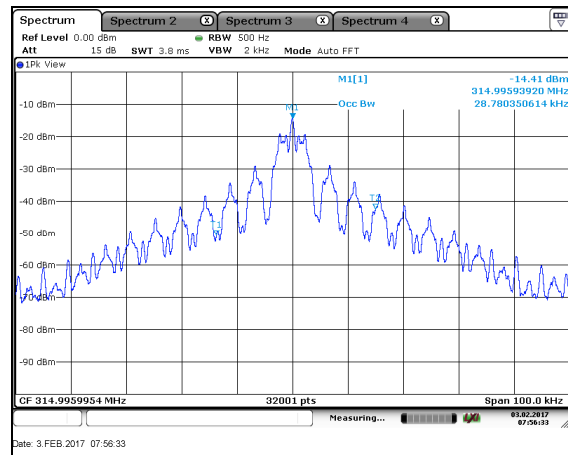
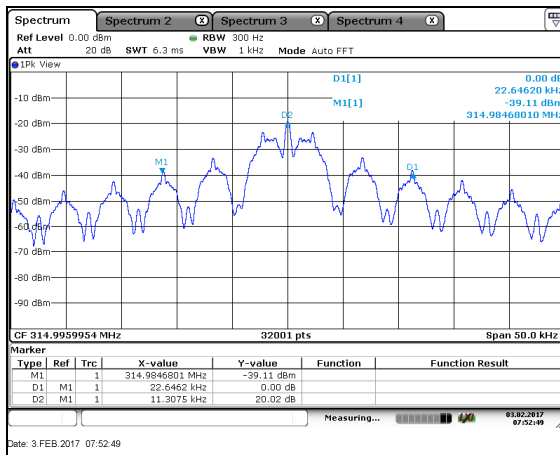
The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set to 1% to 5% of the occupied bandwidth. The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

7.4.2 Test Results

0.25% of the 315 MHz center frequency is equivalent to 787.5 kHz. Therefore the 20 dB and 99% bandwidths of the emission is less than 0.25% of the center frequency. The results are shown in Table 7.4.2-1 and Figures 7.4.2-1 to 7.4.2-4.

Table 7.4.2-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
315	22.646	28.780



7.5 Radiated Emissions – FCC: Part 15.231(b); ISED Canada: RSS-210 A.1.2

7.5.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 5 GHz, 10 times the highest fundamental frequency.

Measurements below 30 MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. The EUT was rotated 360° to maximize each emission. The magnetic loop receiving antenna was positioned with its lowest point 1 meter above the ground. The loop antenna was aligned along the site axis, orthogonal to the site axis, and ground-parallel to the site axis.

The spectrum analyzer's resolution and video bandwidths were set to 200 Hz and 1000 Hz respectively for frequencies below 150 kHz and 9 kHz and 30 kHz respectively for frequencies above 150 kHz and below 30 MHz.

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

An average detector was used for all measurement. The peak emissions were also compared to a limit corresponding to 20 dB above the maximum permitted average limit according to Part 15.35. The final measurements were then corrected by antenna correction factors and cable loss for comparison to the limits. Further, compliance with the provisions of Part 15.205 was demonstrated using the measurement instrumentation specified in that section where applicable.

7.5.2 Duty Cycle Correction

For average radiated measurements, the measured level was reduced by a factor 11.44 dB to account for the duty cycle of the EUT. The worst case duty cycle was determined to be 26.805%. The duty cycle correction factor is determined using the formula: $20\log(26.805/100) = -11.44$ dB. Determination of the duty cycle correction is included in the plots and justification below.

Period (T) = 100 ms

Number Pulses (N1) = 120

Pulse Width (T1) = 0.223375 ms

$(N1 \cdot T1)/T = ((120 \cdot 0.223375) / 100) = 0.26805$

$20 \cdot \text{Log}(0.26805) = -11.44$ dB Average Correction Factor

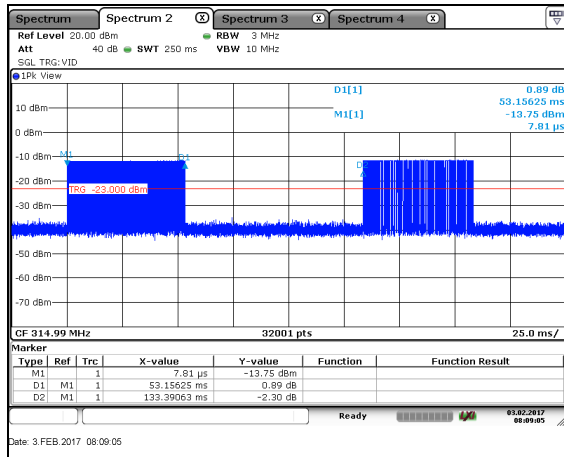


Figure 7.5.2-1: Duty Cycle

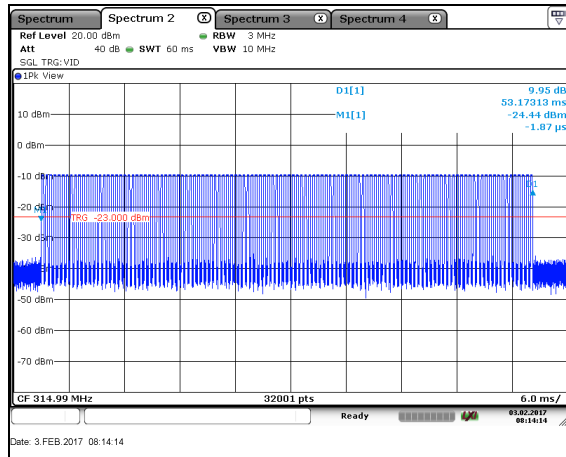


Figure 7.5.2-2: Duty Cycle

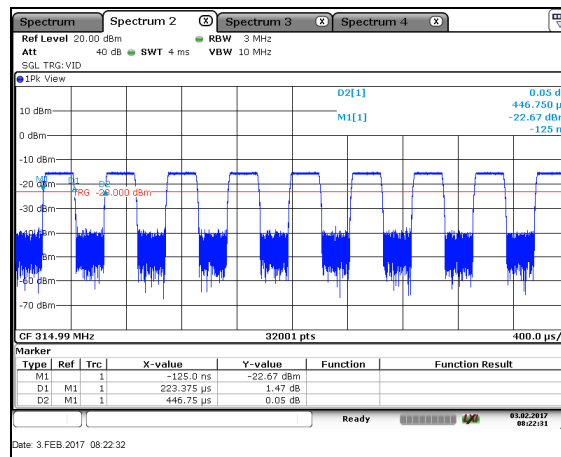


Figure 7.5.2-3: Duty Cycle – Pulse Width

7.5.3 Test Results

Radiated spurious emissions are reported in Table 7.5.3-1 through Table 7.5.3-3. Emissions not reported were below the noise floor of the measurement system.

Table 7.5.3-1: Radiated Emissions – XPOS

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Emission										
315	86.08	86.08	H	-8.20	77.88	66.44	95.6	75.6	17.7	9.2
315	87.76	87.76	V	-8.20	79.56	68.12	95.6	75.6	16.0	7.5
Spurious Emissions										
630	41.13	41.13	H	-2.20	38.93	27.49	75.6	55.6	36.7	28.1
630	39.95	39.95	V	-2.20	37.75	26.31	75.6	55.6	37.9	29.3
945	26.82	26.82	H	3.30	30.12	18.68	75.6	55.6	45.5	36.9
945	30.51	30.51	V	3.30	33.81	22.37	75.6	55.6	41.8	33.2
1260	48.09	48.09	H	-11.67	36.42	24.99	75.6	55.6	39.2	30.6
1260	44.08	44.08	V	-11.67	32.41	20.98	75.6	55.6	43.2	34.6
1575	44.88	44.88	H	-9.85	35.03	23.59	74.0	54.0	39.0	30.4
1575	46.63	46.63	V	-9.85	36.78	25.34	74.0	54.0	37.2	28.7
1890	50.03	50.03	H	-7.96	42.07	30.63	75.6	55.6	33.5	25.0
1890	58.17	58.17	V	-7.96	50.21	38.77	75.6	55.6	25.4	16.8
2205	54.84	54.84	H	-6.30	48.54	37.10	74.0	54.0	25.5	16.9
2205	60.47	60.47	V	-6.30	54.17	42.73	74.0	54.0	19.8	11.3
2520	54.69	54.69	H	-4.81	49.88	38.45	75.6	55.6	25.7	17.2
2520	60.84	60.84	V	-4.81	56.03	44.60	75.6	55.6	19.6	11.0
2835	69.02	69.02	H	-3.90	65.12	53.69	74.0	54.0	8.9	0.3
2835	60.50	60.50	V	-3.90	56.60	45.17	74.0	54.0	17.4	8.8
3150	57.65	57.65	H	-2.93	54.72	43.28	75.6	55.6	20.9	12.3
3150	57.22	57.22	V	-2.93	54.29	42.85	75.6	55.6	21.3	12.8

Table 7.5.3-2: Radiated Emissions – YPOS

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Emission										
315	88.28	88.28	H	-8.20	80.08	68.64	95.6	75.6	15.5	7.0
315	91.01	91.01	V	-8.20	82.81	71.37	95.6	75.6	12.8	4.2
Spurious Emissions										
630	42.39	42.39	H	-2.20	40.19	28.75	75.6	55.6	35.4	26.9
630	43.75	43.75	V	-2.20	41.55	30.11	75.6	55.6	34.1	25.5
945	32.77	32.77	H	3.30	36.07	24.63	75.6	55.6	39.5	31.0
945	27.33	27.33	V	3.30	30.63	19.19	75.6	55.6	45.0	36.4
1260	44.47	44.47	H	-11.67	32.80	21.37	75.6	55.6	42.8	34.3
1260	48.37	48.37	V	-11.67	36.70	25.27	75.6	55.6	38.9	30.4
1575	46.60	46.60	H	-9.85	36.75	25.31	74.0	54.0	37.3	28.7
1575	46.63	46.63	V	-9.85	36.78	25.34	74.0	54.0	37.2	28.7
1890	59.56	59.59	H	-7.96	51.60	40.19	75.6	55.6	24.0	15.4
1890	52.19	52.19	V	-7.96	44.23	32.79	75.6	55.6	31.4	22.8
2205	61.18	61.18	H	-6.30	54.88	43.44	74.0	54.0	19.1	10.6
2205	53.86	53.86	V	-6.30	47.56	36.12	74.0	54.0	26.4	17.9
2520	53.67	53.67	H	-4.81	48.86	37.43	75.6	55.6	26.7	18.2
2520	54.68	54.68	V	-4.81	49.87	38.44	75.6	55.6	25.7	17.2
2835	54.25	54.25	H	-3.90	50.35	38.92	74.0	54.0	23.6	15.1
2835	54.94	54.94	V	-3.90	51.04	39.61	74.0	54.0	23.0	14.4
3150	53.59	53.59	H	-2.93	50.66	39.22	75.6	55.6	24.9	16.4
3150	55.01	55.01	V	-2.93	52.08	40.64	75.6	55.6	23.5	15.0

Table 7.5.3-3: Radiated Emissions – ZPOS

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Emission										
315	90.78	90.78	H	-8.20	82.58	71.14	95.6	75.6	13.0	4.5
315	72.41	72.41	V	-8.20	64.21	52.77	95.6	75.6	31.4	22.8
Spurious Emissions										
630	44.80	44.80	H	-2.20	42.60	31.16	75.6	55.6	33.0	24.5
630	36.49	36.49	V	-2.20	34.29	22.85	75.6	55.6	41.3	32.8
945	29.72	29.72	H	3.30	33.02	21.58	75.6	55.6	42.6	34.0
945	24.90	24.90	V	3.30	28.20	16.76	75.6	55.6	47.4	38.9
1260	50.54	50.54	H	-11.67	38.87	27.44	75.6	55.6	36.7	28.2
1260	50.73	50.73	V	-11.67	39.06	27.63	75.6	55.6	36.5	28.0
1575	50.59	50.59	H	-9.85	40.74	29.30	74.0	54.0	33.3	24.7
1575	49.50	49.50	V	-9.85	39.65	28.21	74.0	54.0	34.4	25.8
1890	57.39	57.39	H	-7.96	49.43	37.99	75.6	55.6	26.2	17.6
1890	52.37	52.37	V	-7.96	44.41	32.97	75.6	55.6	31.2	22.6
2205	58.71	58.71	H	-6.30	52.41	40.97	74.0	54.0	21.6	13.0
2205	54.09	54.09	V	-6.30	47.79	36.35	74.0	54.0	26.2	17.6
2520	48.98	48.98	H	-4.81	44.17	32.74	75.6	55.6	31.4	22.9
2520	48.55	48.55	V	-4.81	43.74	32.31	75.6	55.6	31.9	23.3
2835	66.92	66.92	H	-3.90	63.02	51.59	74.0	54.0	11.0	2.4
2835	62.78	62.78	V	-3.90	58.88	47.45	74.0	54.0	15.1	6.6
3150	59.89	59.89	H	-2.93	56.96	45.52	75.6	55.6	18.6	10.1
3150	57.06	57.06	V	-2.93	54.13	42.69	75.6	55.6	21.5	12.9

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: Peak – Fundamental Frequency – XPOS

Corrected Level: $86.08 - 8.20 = 77.88\text{dBuV}$

Margin: $95.6\text{dBuV} - 77.88\text{dBuV} = 17.7\text{dB}$

Example Calculation: Average – Fundamental Frequency – XPOS

Corrected Level: $86.08 - 8.20 - 11.44 = 66.44\text{dBuV}$

Margin: $75.6\text{dBuV} - 66.44\text{dBuV} = 9.2\text{dB}$

8 CONCLUSION

In the opinion of ACS, Inc. the 300-0482 manufactured by iKeyless, LLC met the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-210.

END REPORT