Certification Test Report

FCC ID: X32-NSSSG010
IC: 8797A-NSSSG010

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

Report Number: AT72140495-1C0

Manufacturer: iKeyless, LLC
Model: NSSSL-G010

Test Begin Date: June 26, 2018
Test End Date: June 27, 2018

Report Issue Date: July 19, 2018

For Scope of Accreditation Under Certificate Number: 2955.09

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

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This report contains 18 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 NSSSL-G010 is a 433.92MHz, FSK modulation, remote keyless entry FOB.

Technical Information:

Detail	Description
Frequency Range	433.92 MHz
Number of Channels	1
Modulation Format	FSK
Operating Voltage	3 Vdc (CR1620 coin cell)
Antenna Type / Gain	Loop Antenna / -8 dBi

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

Test Sample Serial Number(s): #1 (FCC Test Code), #2 (FCC Test Code), #3 (Production Code)

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: Not set in software

2 TEST FACILITIES

2.1 Location

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

TÜV SÜD America, Inc.
5945 Cabot Pkwy, Suite 100
Alpharetta, GA 30005
Phone: (678) 341-5900

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 in recognition of this accreditation.

Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scopes of accreditation.

The Semi-Anechoic Chamber Test Sites and Conducted Emissions Sites 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:	967699
ISED Canada Lab Code:	23932
VCCI Member Number:	1831
• VCCI Registration Number	A-0295

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'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170, and installed off the center axis is located 5'6" 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 shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.

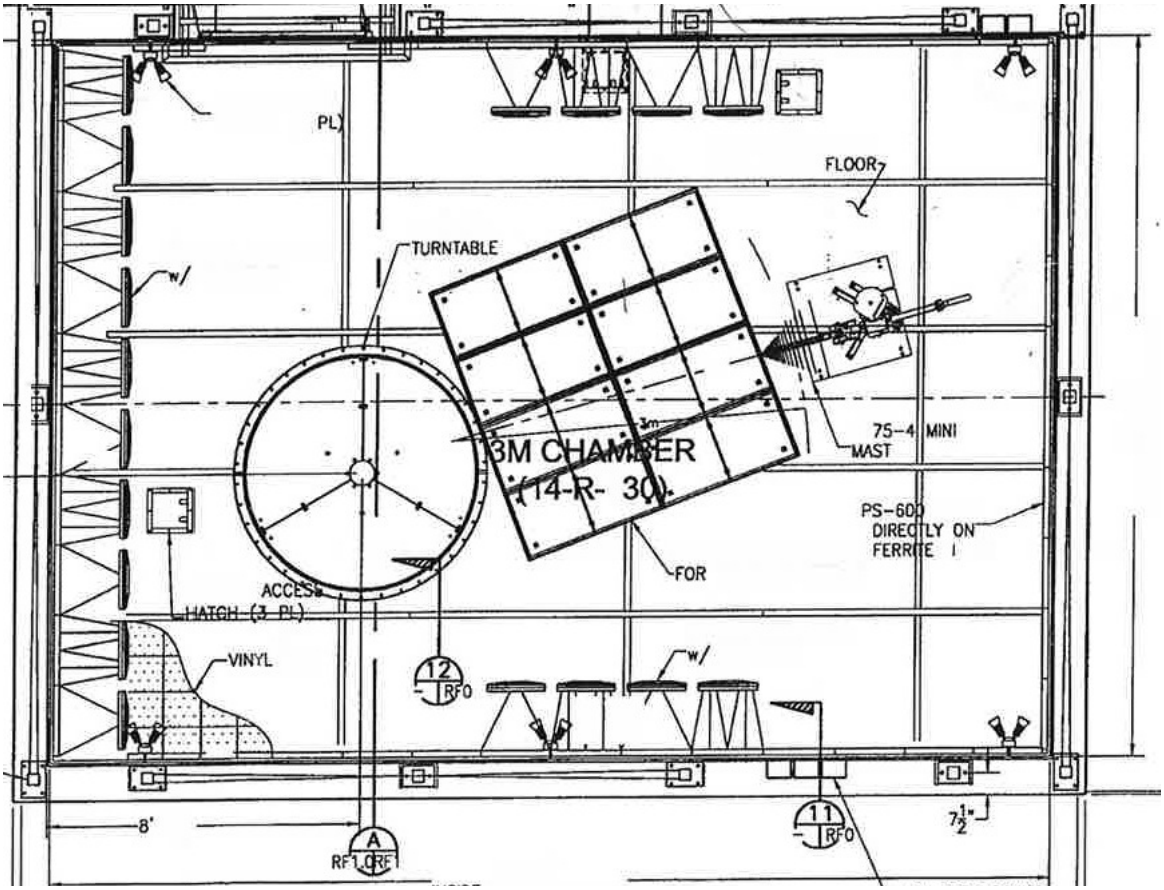

Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.4 Conducted Emissions Test Site Description

2.4.1 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main EMC lab. It consists of a 12' x 10' horizontal coupling plane(HCP) as well as a 12'x8' vertical coupling plane(VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via by screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

The HCP and VCP are electrically bonded together using 1"x1" angled aluminum secured with screws.

The site is of sufficient size to test table top and floor standing equipment in accordance with ANSI C63.10.

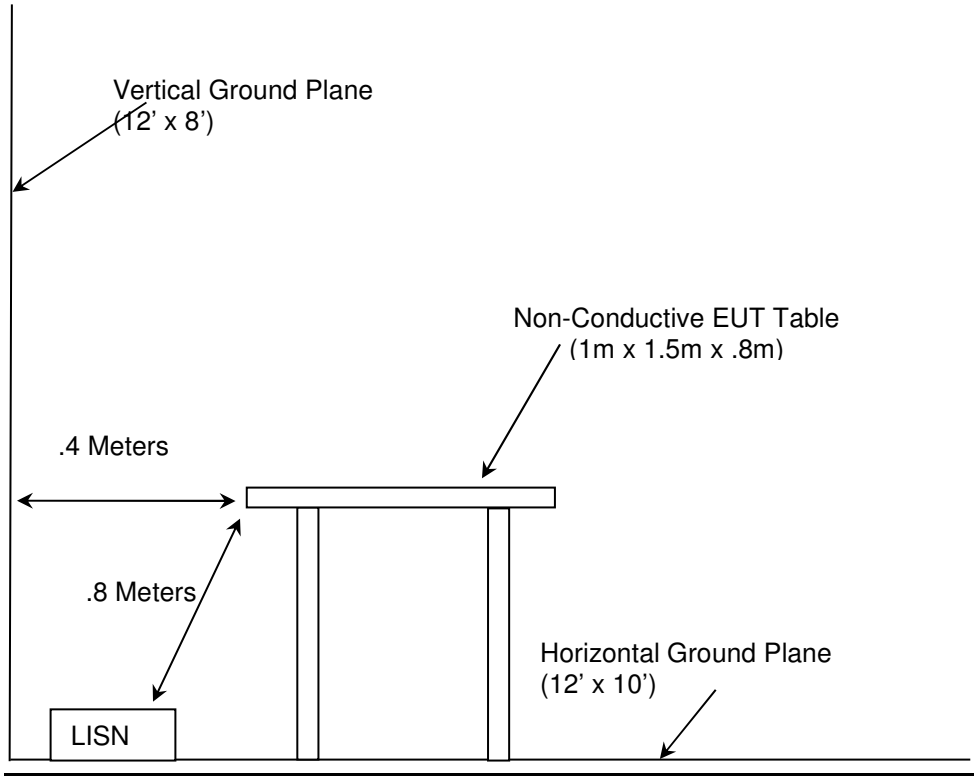

Figure 2.4.2: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- 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, 2018
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2018
- 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 5, April 2018.

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

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
30	Spectrum Technologies	DRH-0118	1-18GHz Horn Antenna	970102	05/09/2017	05/09/2019
213	TEC	PA 102	Amplifier	44927	07/24/2017	07/24/2018
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/11/2017	07/11/2019
412	Electro Metrics	LPA-25	Log Periodic Antenna	1241	08/08/2016	08/08/2018
622	Rohde & Schwarz	FSV40 (v3.40)	FSV Signal Analyzer 10Hz to 40GHz	101338	07/15/2016	07/15/2018
731	EMCO	3104	Bicon Antenna	2659	11/09/2016	11/09/2018
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	10/31/2017	10/31/2018
836	ETS Lindgren	SAC Cable Set	SAC Cable Set includes 620, 837, 838	N/A	05/01/2018	05/01/2019

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

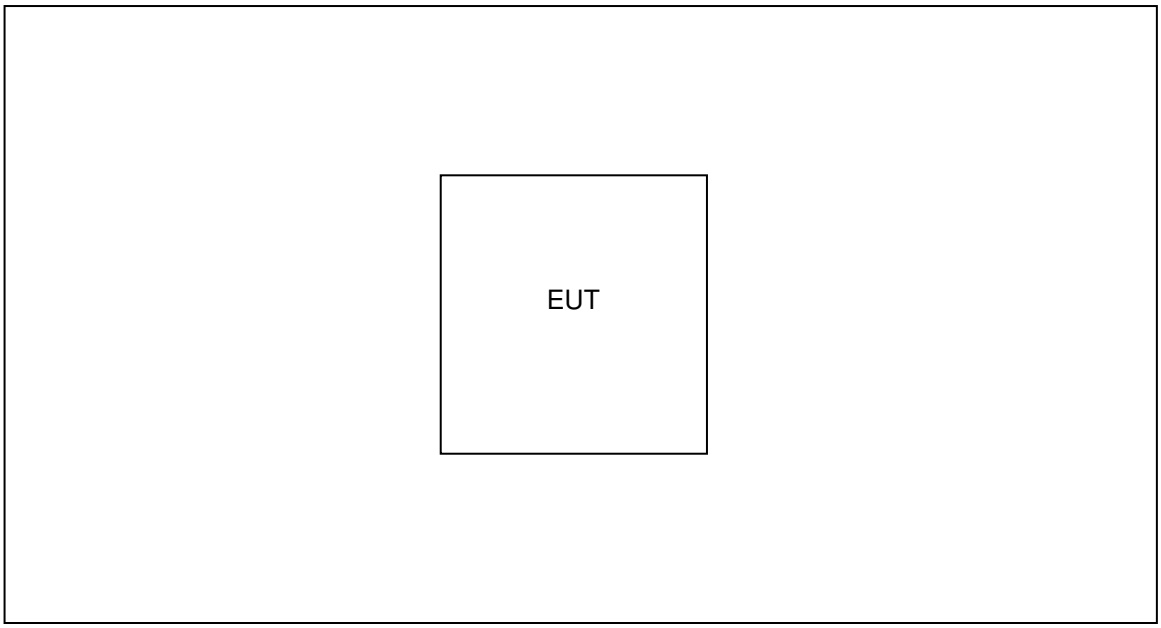

Figure 6-1: EUT Test Setup

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 -8 dBi.

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

Performed by: Jeremy Pickens

The transmitter ceased operation after 5 transmission strings or 434 ms after being manually activated and released. The results are shown in Figures 7.3.2-1 through 7.3.2-3.

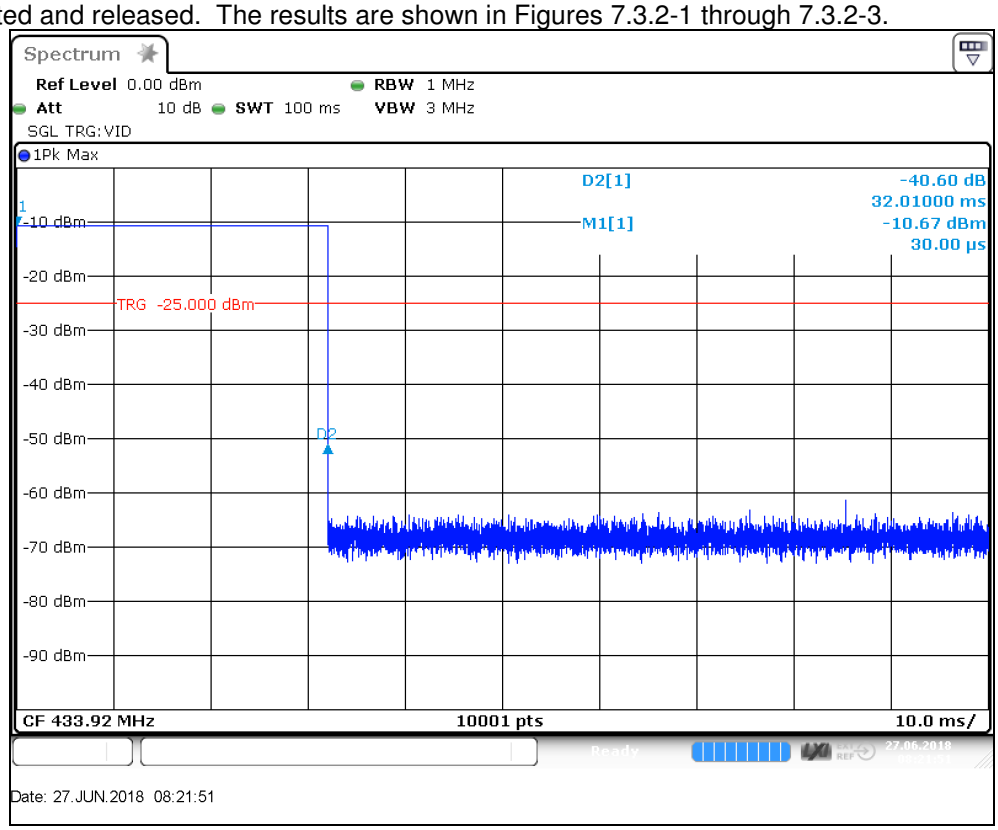

Figure 7.3.2-1: 100ms Transmit Period (Single Pulse)

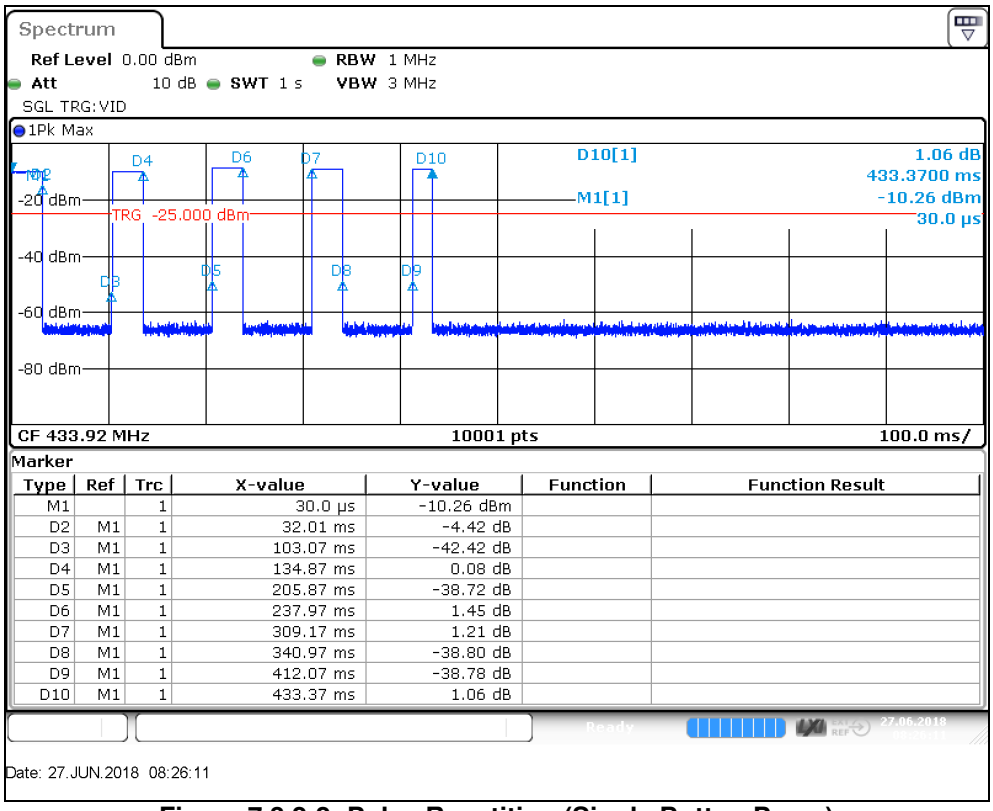

Figure 7.3.2-2: Pulse Repetition (Single Button Press)

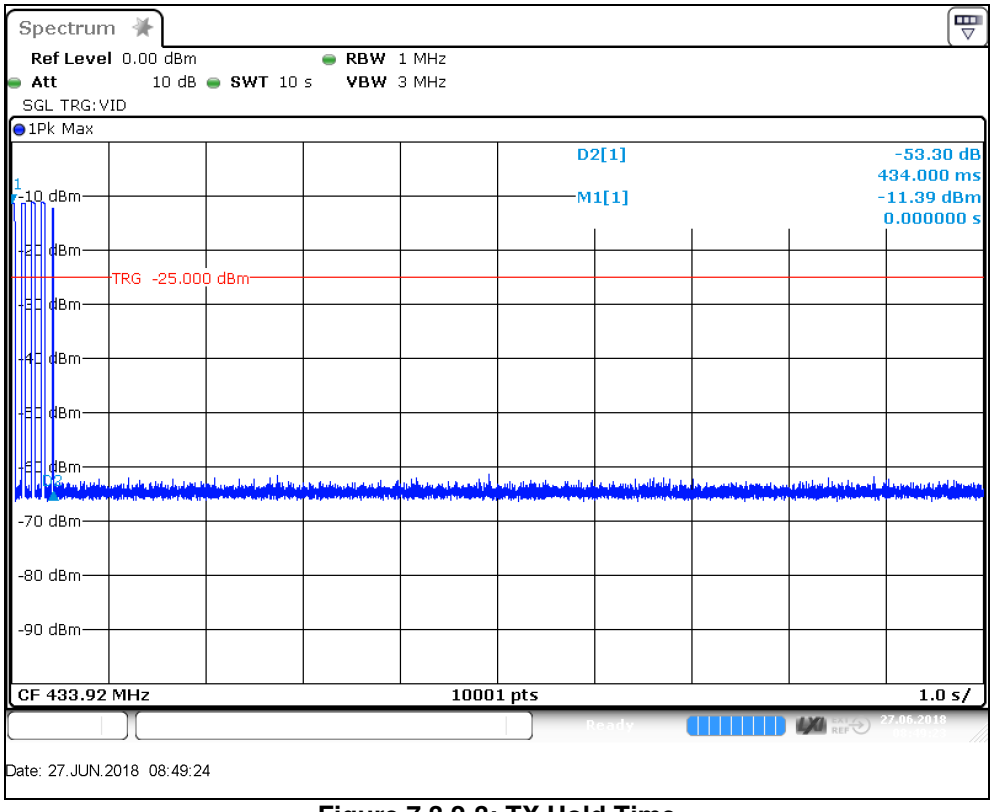

Figure 7.3.2-3: TX Hold Time

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 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

Performed by: Jeremy Pickens

0.25% of the 433.92 MHz center frequency is equivalent to 1084.8 kHz. Therefore the 20 dB and 99% bandwidths of the emission 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

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
433.92	85.88	106.88

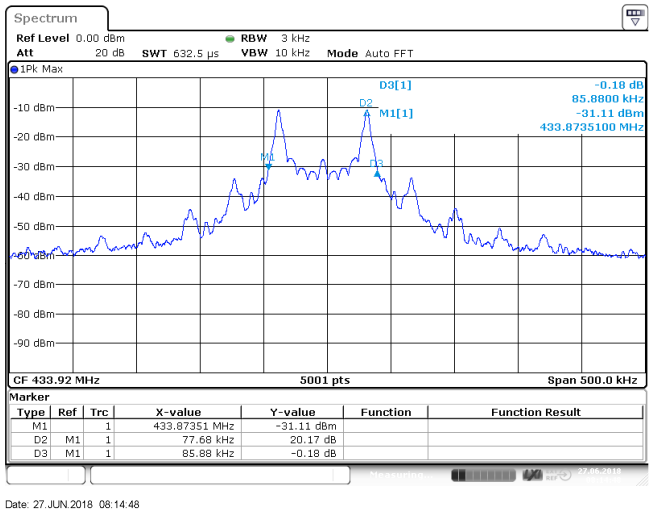

Figure 7.4.2-1: 20 dB Bandwidth

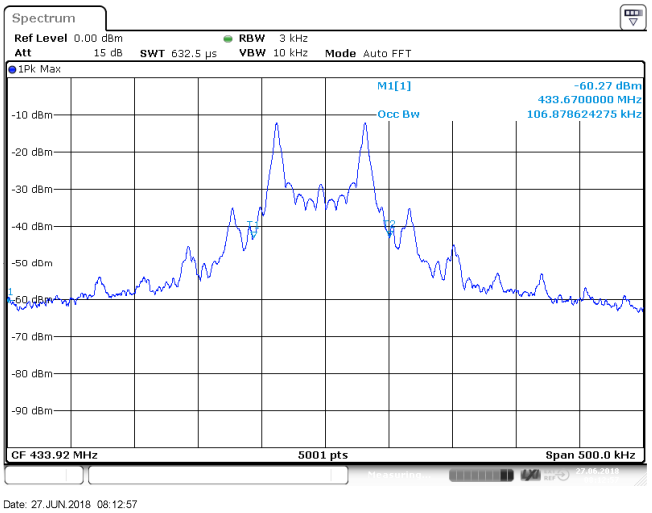

Figure 7.4.2-2: 99% Bandwidth

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 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.

The peak emissions were compared to a limit corresponding to 20 dB above the maximum permitted average limit according to Part 15.35. The peak emissions were corrected by the duty cycle of the transmitter in a normal operational mode and compared to the average limit. 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

Performed by: Jeremy Pickens

For average radiated measurements, the measured level was reduced by a factor 9.89 dB to account for the duty cycle of the EUT. The worst-case duty cycle was determined to be 32.02%. The duty cycle correction factor is determined using the formula: 20log (32.02/100) = - 9.89 dB. Determination of the duty cycle correction is included in the plots and justification below. The on time for the transmission sequence was calculated by capturing the trace data and using an Excel spreadsheet. For this device, there was no off time within the "pulse train," and the repetition rate was >100ms; therefore, the 32.02ms pulse was divided by 100ms to determine the duty cycle. Detailed calculations below:

Period (T) = 100 ms
On Time (ms) = 32.02
Off Time (ms) = 66.98
DC = 32.02 / 100 = 0.3202
20*Log(0.3202) = -9.89 dB Average Correction Factor

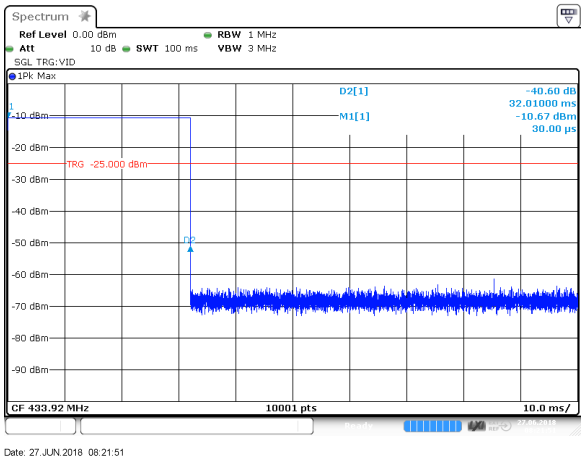

Figure 7.5.2-1: Duty Cycle (100ms)

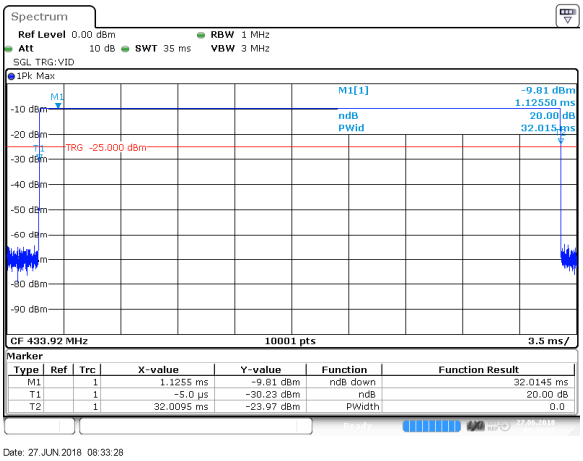

Figure 7.5.2-2: Duty Cycle (Pulse Width)

7.5.3 Test Results

Performed by: Tyler Leeson

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	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Emission										
433.92	95.38	95.38	H	-8.35	87.03	77.13	100.8	80.8	13.8	3.7
433.92	94.87	94.87	V	-8.35	86.52	76.62	100.8	80.8	14.3	4.2
Spurious Emissions										
867.84	47.14	47.14	H	-0.73	46.41	36.51	80.8	60.8	34.4	24.3
867.84	37.68	37.68	V	-0.73	36.95	27.05	80.8	60.8	43.9	33.8
1301.76	52.35	52.35	H	-11.06	41.29	31.39	74.0	54.0	32.7	22.6
1301.76	54.37	54.37	V	-11.06	43.31	33.41	74.0	54.0	30.7	20.6
1735.68	53.83	53.83	H	-8.29	45.54	35.65	80.8	60.8	35.3	25.2
1735.68	51.63	51.63	V	-8.29	43.34	33.45	80.8	60.8	37.5	27.4
2169.6	52.79	52.79	H	-5.77	47.02	37.13	80.8	60.8	33.8	23.7
2169.6	50.91	50.91	V	-5.77	45.14	35.25	80.8	60.8	35.7	25.6
2603.52	51.35	51.35	H	-4.03	47.32	37.43	80.8	60.8	33.5	23.4
2603.52	52.15	52.15	V	-4.03	48.12	38.23	80.8	60.8	32.7	22.6
3037.44	55.15	55.15	H	-2.41	52.74	42.85	80.8	60.8	28.1	18.0
3037.44	52.63	52.63	V	-2.41	50.22	40.33	80.8	60.8	30.6	20.5
3471.36	54.26	54.26	H	-0.87	53.39	43.49	80.8	60.8	27.4	17.3
3471.36	56.55	56.55	V	-0.87	55.68	45.78	80.8	60.8	25.1	15.0
3905.28	48.74	48.74	H	0.49	49.23	39.33	74.0	54.0	24.8	14.7
3905.28	47.58	47.58	V	0.49	48.07	38.17	74.0	54.0	25.9	15.8
4339.2	50.15	50.15	H	0.93	51.08	41.19	74.0	54.0	22.9	12.8
4339.2	49.53	49.53	V	0.93	50.46	40.57	74.0	54.0	23.5	13.4

Table 7.5.3-2: Radiated Emissions – YPOS

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Emission										
433.92	87.63	87.63	H	-8.35	79.28	69.38	100.8	80.8	21.5	11.4
433.92	97.28	97.28	V	-8.35	88.93	79.03	100.8	80.8	11.9	1.8
Spurious Emissions										
867.84	45.55	45.55	H	-0.73	44.82	34.92	80.8	60.8	36.0	25.9
867.84	58.74	58.74	V	-0.73	58.01	48.11	80.8	60.8	22.8	12.7
1301.76	51.46	51.46	H	-11.06	40.40	30.50	74.0	54.0	33.6	23.5
1301.76	57.15	57.15	V	-11.06	46.09	36.19	74.0	54.0	27.9	17.8
1735.68	52.87	52.87	H	-8.29	44.58	34.69	80.8	60.8	36.2	26.1
1735.68	55.12	55.12	V	-8.29	46.83	36.94	80.8	60.8	34.0	23.9
2169.6	51.64	51.64	H	-5.77	45.87	35.98	80.8	60.8	34.9	24.8
2169.6	53.45	53.45	V	-5.77	47.68	37.79	80.8	60.8	33.1	23.0
2603.52	50.57	50.57	H	-4.03	46.54	36.65	80.8	60.8	34.3	24.2
2603.52	50.53	50.53	V	-4.03	46.50	36.61	80.8	60.8	34.3	24.2
3037.44	50.34	50.34	H	-2.41	47.93	38.04	80.8	60.8	32.9	22.8
3037.44	54.16	54.16	V	-2.41	51.75	41.86	80.8	60.8	29.0	19.0
3471.36	56.57	56.57	H	-0.87	55.70	45.80	80.8	60.8	25.1	15.0
3471.36	55.14	55.14	V	-0.87	54.27	44.37	80.8	60.8	26.5	16.5
3905.28	47.33	47.33	H	0.49	47.82	37.92	74.0	54.0	26.2	16.1
3905.28	47.15	47.15	V	0.49	47.64	37.74	74.0	54.0	26.4	16.3
4339.2	46.95	46.95	H	0.93	47.88	37.99	74.0	54.0	26.1	16.0
4339.2	50.65	50.65	V	0.93	51.58	41.69	74.0	54.0	22.4	12.3

Table 7.5.3-3: Radiated Emissions – ZPOS

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Emission										
433.92	97.47	97.47	H	-8.35	89.12	79.22	100.8	80.8	11.7	1.6
433.92	85.94	85.94	V	-8.35	77.59	67.69	100.8	80.8	23.2	13.1
Spurious Emissions										
867.84	59.07	59.07	H	-0.73	58.34	48.44	80.8	60.8	22.5	12.4
867.84	38.60	38.60	V	-0.73	37.87	27.97	80.8	60.8	42.9	32.9
1301.76	54.47	54.47	H	-11.06	43.41	33.51	74.0	54.0	30.6	20.5
1301.76	50.42	50.42	V	-11.06	39.36	29.46	74.0	54.0	34.6	24.5
1735.68	52.22	52.22	H	-8.29	43.93	34.04	80.8	60.8	36.9	26.8
1735.68	52.04	52.04	V	-8.29	43.75	33.86	80.8	60.8	37.0	27.0
2169.6	51.47	51.47	H	-5.77	45.70	35.81	80.8	60.8	35.1	25.0
2169.6	49.34	49.34	V	-5.77	43.57	33.68	80.8	60.8	37.2	27.1
2603.52	52.40	52.40	H	-4.03	48.37	38.48	80.8	60.8	32.4	22.4
2603.52	51.79	51.79	V	-4.03	47.76	37.87	80.8	60.8	33.0	23.0
3037.44	54.73	54.73	H	-2.41	52.32	42.43	80.8	60.8	28.5	18.4
3037.44	52.17	52.17	V	-2.41	49.76	39.87	80.8	60.8	31.0	21.0
3471.36	57.12	57.12	H	-0.87	56.25	46.35	80.8	60.8	24.6	14.5
3471.36	52.96	52.96	V	-0.87	52.09	42.19	80.8	60.8	28.7	18.6
3905.28	48.20	48.20	H	0.49	48.69	38.79	74.0	54.0	25.3	15.2
3905.28	47.93	47.93	V	0.49	48.42	38.52	74.0	54.0	25.6	15.5
4339.2	50.19	50.19	H	0.93	51.12	41.23	74.0	54.0	22.9	12.8
4339.2	48.85	48.85	V	0.93	49.78	39.89	74.0	54.0	24.2	14.1

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: 95.38 - 8.35 = 87.03dBuV
Margin: 100.8dBuV – 87.03dBuV = 13.8dB

Example Calculation: Average – Fundamental Frequency – XPOS
Corrected Level: 95.38 - 8.35 - 9.89 = 77.13dBuV
Margin: 80.8dBuV – 77.13dBuV = 3.7dB

8 ESTIMATION OF MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

Table 8-1: Estimation of Measurement Uncertainty

Parameter	U_{lab}
Occupied Channel Bandwidth	± 0.009 %
RF Conducted Output Power	± 0.349 dB
Power Spectral Density	± 0.372 dB
Antenna Port Conducted Emissions	± 1.264 dB
Radiated Emissions ≤ 1 GHz	± 5.814 dB
Radiated Emissions > 1 GHz	± 4.318 dB
Temperature	± 0.860 °C
Radio Frequency	± 2.832 x 10^{-8}
AC Power Line Conducted Emissions	± 3.360 dB

9 CONCLUSION

In the opinion of TÜV SÜD America Inc. the NSSSL-G010 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 for the tests documented herein.

END REPORT