

Certification Test Report

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IC: 10060A-FAS154302

FCC Rule Part: 15.249
IC Radio Standards Specification: RSS-210

ACS Report Number: 16-2065.W06.3A

Manufacturer: Ecolab Inc.
Model(s): FAS1543-02

Test Begin Date: November 14, 2016
Test End Date: December 6, 2016

Report Issue Date: February 6, 2017



FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

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This report contains 14 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 Manufacturer Information:

Ecolab, Inc.
370 Wabasha St N
St. Paul, MN 55102

1.3 Product description

The Ecolab Inc. model FAS1543-02 is an installation and maintenance tool for the Patient Safeguard System (PSS) which is a wireless hand hygiene reminder system used in a healthcare facility. The device includes three distinct transceivers operating at 125 kHz, 433.9 MHz and 2.4 GHz, respectively. This test report documents the compliance of the 2405 MHz radio.

Technical Details

Frequency of Operation: 2405 MHz

Number of Channels: 1

Modulation: GFSK

Data Rate: 2 Mbps

Antenna / Gain: Inverted-F PCB antenna / 6.3 dBi

Input Voltage: 3 VDC (Size AA Battery)

Test Sample Serial Number(s): ACS#1

Test Sample Condition: The device was provided in good operating condition without any noticeable physical defects.

1.4 Test Methodology and Considerations

The EUT was evaluated for radiated emissions for the 2405 MHz transmitter in multiple orientations. The EUT was tested standalone per the manufacturer as of typical use. The peripheral test port is only active in the peripheral test and 125 kHz TX modes and is not loaded in the other modes of operation. The RF output power setting of the device was not configurable and was not provided for the evaluation. The device is battery operated only without any provision for connection to the AC mains. The device is exempted from the power line conducted emissions requirements.

The 125 kHz transmitter does not transmit simultaneously with the 433 MHz and 2405 MHz co-located transmitters. The evaluation for intermodulation products was only performed for the 433 MHz and 2405 MHz radios transmitting simultaneously. All intermodulation products were found to be in compliance to the requirements of FCC Section 15.209 and ISSED Canada RSS-Gen. The evaluation of the 125 kHz and 433.9 MHz transceivers as well as the assessment to the unintentional emissions requirements are documented in separate test reports.

2 TEST FACILITIES

2.1 Location

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

Advanced Compliance Solutions, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
www.acstestlab.com

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-1533 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 Test Firm Registration #: 475089
ISED Canada Lab Code: 4175C

2.3 Radiated & Conducted Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl flooring.

The turntable is driven by pneumatic motor, which is capable of supporting a 2000 lb. load. The turntable is flush with the chamber floor which it is connected to, around its circumference, with a continuous metallic loaded spring. An EMCO Model 1060 Multi-device Controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

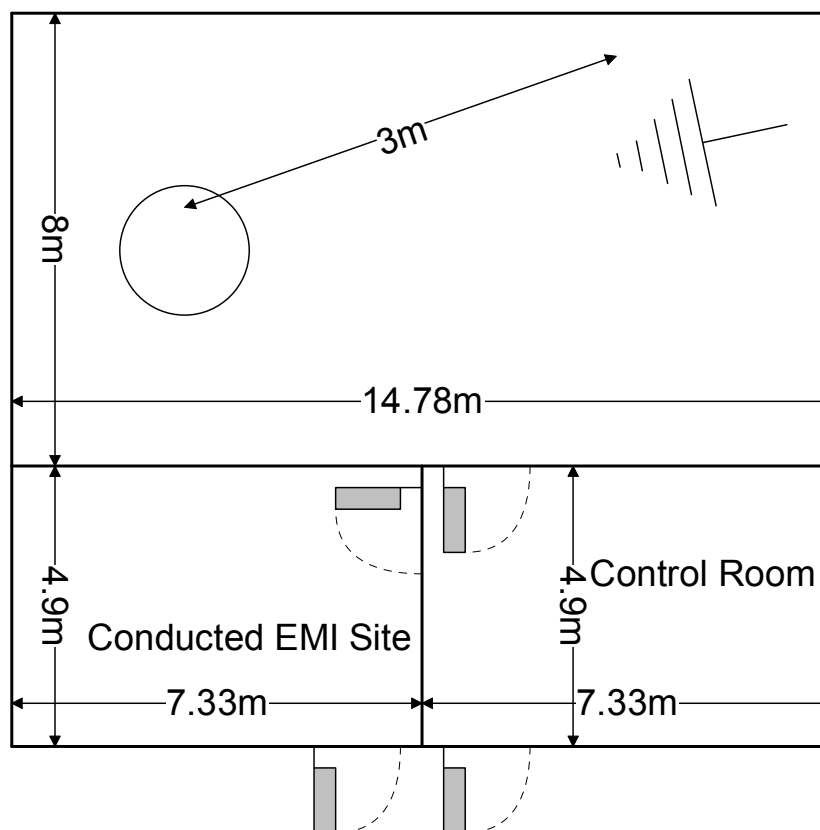


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m³. The power line conducted emission site includes two LISNs: a Solar Model 8028-50 50 Ω /50 μ H and an EMCO Model 3825/2R, which are installed as shown in the figure below. For evaluations requiring 230 V, 50 Hz AC input, a Polarad LISN (S/N 879341/048) is used in conjunction with a California Instruments signal generator Model 2001RP-OP1.

A diagram of the room is shown below in figure 2.3.2-1:

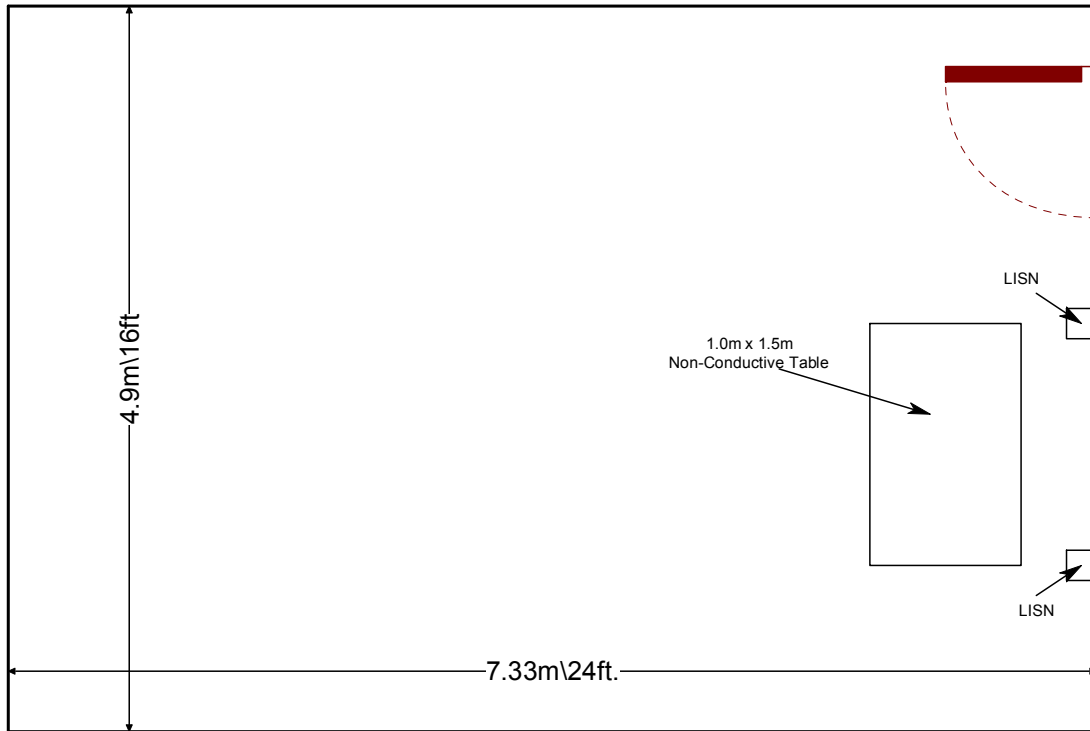


Figure 2.3.2-1: AC Mains Conducted EMI Site

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, 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-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, November 2014.
- ❖ Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-210 - Licence-Exempt Radio Apparatus: Category I Equipment, Issue 9 August 2016.

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
78	EMCO	6502	Antennas	9104-2608	5/11/2016	5/11/2018
282	Microwave Circuits	H2G020G4	Filters	74541	5/25/2016	5/25/2017
523	Agilent	E7405	Spectrum Analyzers	MY45103293	12/26/2014	12/26/2016
653	Suhner	SF-102A	Cables	0944/2A	9/6/2016	9/6/2017
2002	EMCO	3108	Antennas	2147	11/19/2015	11/19/2017
2004	EMCO	3146	Antennas	1385	11/19/2015	11/19/2017
2006	EMCO	3115	Antennas	2573	4/14/2015	4/14/2017
2008	COM-Power	AH-826	Antennas	81009	NCR	NCR
2011	Hewlett-Packard	HP 8447D	Amplifiers	2443A03952	11/2/2016	11/2/2017
2082	Teledyne Storm Products	90-010-048	Cables	2082	4/21/2016	4/21/2017
2086	Merrimac	FAN-6-10K	Attenuators	23148-83-1	11/2/2016	11/2/2017
2089	Agilent Technologies, Inc.	83017A	Amplifiers	3123A00214	12/9/2015	12/9/2016
2095	ETS Lindgren	TILE4! - Version 4.2.A	Software	85242	NCR	NCR
2121	ACS Boca	Radiated Cable Set	Cable Set	2121	8/1/2016	8/1/2017

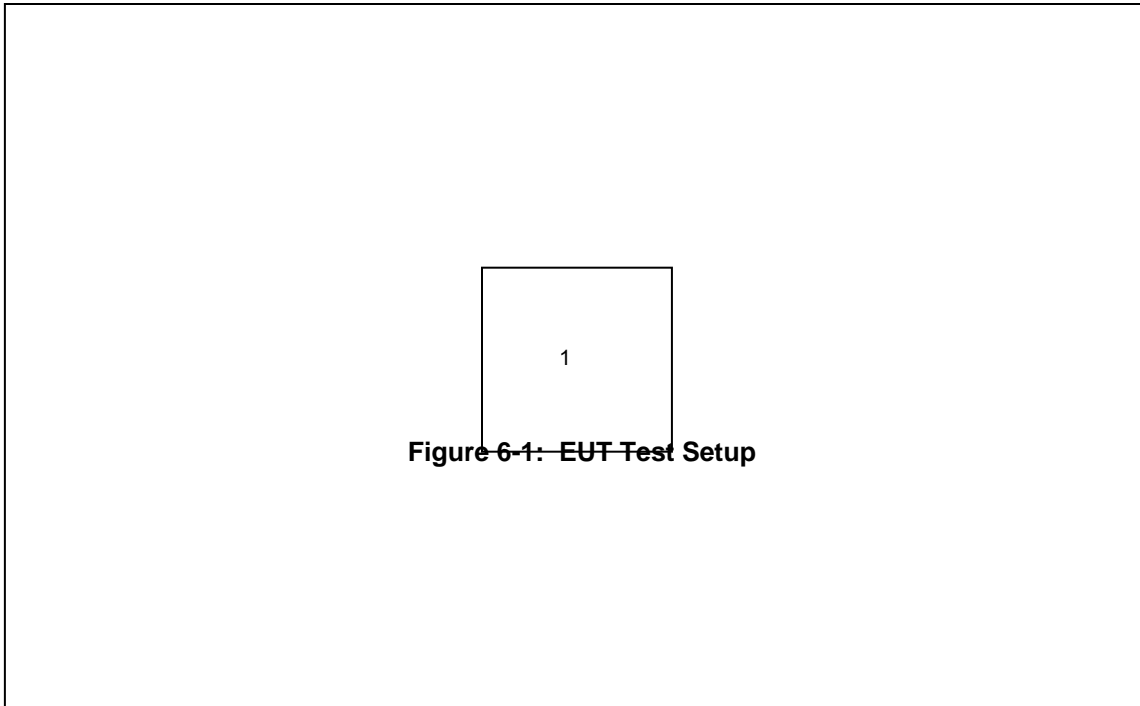
NCR=No Calibration Required

5 SUPPORT EQUIPMENT**Table 5-1: EUT and Support Equipment**

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Ecolab Inc.	FAS1543-02	ACS#1

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
	The device was tested standalone as the peripheral test connector is not active in the 2405 MHz configuration			

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: Section 15.203

The device uses an internal 6.3 dBi PCB inverted-F antenna that is etched to the PCB. The antenna is not detachable thus meeting the requirements of FCC Section 15.203.

7.2 20dB / 99% Bandwidth – FCC: Section 15.215; ISED Canada RSS-Gen 6.6

7.2.1 Measurement Procedure

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.

The spectrum analyzer span was set to 2 to 5 times the estimated bandwidth of the emission. The RBW was set from 1% to 5% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. The “N dB” function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission, including the emissions skirts using a peak detector. The RBW was set from 1% and 5% of the estimated bandwidth. The occupied 99% bandwidth was measured by using a delta marker at the lower and upper frequencies leading to 0.5% of the total power with a sample detector.

7.2.2 Measurement Results

Results are shown below:

Table 7.2.2-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
2405	2419	2550

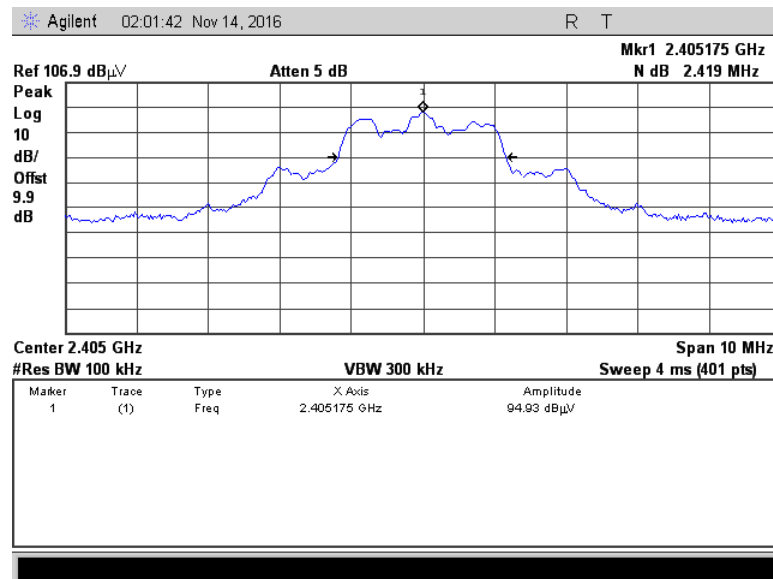


Figure 7.2.2-1: 20dB BW

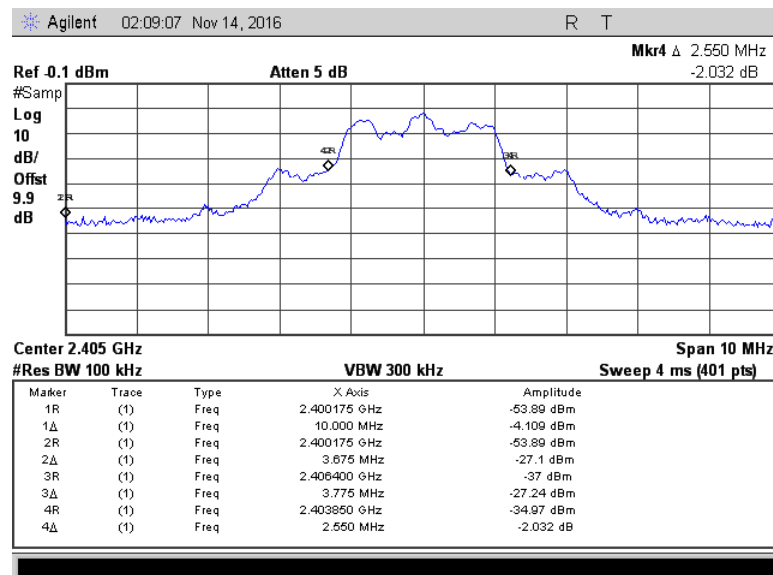


Figure 7.2.2-2: 99% OBW

7.3 Radiated Spurious Emissions – FCC: Section 15.249(a); ISED Canada: RSS-210 B.10**7.3.1 Measurement Procedure**

Radiated emissions tests were made over the frequency range of 9 kHz to 26 GHz, 10 times the highest fundamental frequency.

For measurements below 30 MHz, the receive antenna height was set to 1m and the EUT was rotated through 360 degrees. The resolution bandwidth was set to 200 Hz below 150 kHz and to 9 kHz above 150 kHz.

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 below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements made with RBW and VBW of 1 MHz and 3MHz respectively.

7.3.2 Duty Cycle Correction

The unit was continuously pulsing. A Duty Cycle Correction of 0.72% corresponding to -42.85 dB was applied to the peak measurements for the average results. The justification of the duty cycle is provided in the equipment's theory of operation document.

7.3.3 Measurement Results

Radiated spurious emissions found in the band of 9 kHz to 26GHz are reported in the Table below.

Table 7.3.3-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	avg			pk	avg	pk	avg		
Flat										
Fundamental Frequency										
2405	97.52	97.52	H	-5.28	92.24	49.39	114	94	21.8	44.6
2405	84.40	84.40	V	-5.28	79.12	36.27	114	94	34.9	57.7
Spurious Emissions										
2390.07	66.62	66.62	H	-5.35	61.27	18.42	74	54	12.7	35.6
2388.29	66.04	66.04	H	-5.36	60.68	17.83	74	54	13.3	36.2
2389.93	58.40	58.40	V	-5.35	53.05	10.20	74	54	21.0	43.8
2420.40	66.10	66.10	H	-5.20	60.90	18.04	74	54	13.1	36.0
2421.93	64.76	64.76	H	-5.19	59.57	16.71	74	54	14.4	37.3
2420.14	58.24	58.24	V	-5.20	53.04	10.18	74	54	21.0	43.8
4810	43.91	30.97	H	3.19	47.10	-8.69	74	54	26.9	62.7
4810	43.90	30.91	V	3.19	47.09	-8.75	74	54	26.9	62.8
Standing										
Fundamental Frequency										
2405	88.93	88.93	H	-5.28	83.65	40.80	114	94	30.3	53.2
2405	93.14	93.14	V	-5.28	87.86	45.01	114	94	26.1	49.0
Spurious Emissions										
2388.34	62.59	62.59	V	-5.36	57.23	14.38	74	54	16.8	39.6
2390.01	63.80	63.80	V	-5.35	58.45	15.60	74	54	15.6	38.4
2388.34	61.63	61.63	H	-5.36	56.27	13.42	74	54	17.7	40.6
2389.84	60.62	60.92	H	-5.35	55.27	12.72	74	54	18.7	41.3
2420.43	61.21	61.21	H	-5.20	56.01	13.15	74	54	18.0	40.8
2421.99	59.81	59.81	H	-5.19	54.62	11.76	74	54	19.4	42.2
2420.53	63.06	63.06	V	-5.20	57.86	15.01	74	54	16.1	39.0
2421.83	61.89	61.89	V	-5.20	56.69	13.84	74	54	17.3	40.2
4810	44.52	31.37	H	3.19	47.71	-8.29	74	54	26.3	62.3
4810	44.23	31.00	V	3.19	47.42	-8.66	74	54	26.6	62.7
Side										
Fundamental Frequency										
2405	94.17	94.17	H	-5.28	88.89	46.04	114	94	25.1	48.0
2405	89.91	89.91	V	-5.28	84.63	41.78	114	94	29.4	52.2
Spurious Emissions										
2388.39	64.30	64.30	H	-5.36	58.94	16.09	74	54	15.1	37.9
2389.91	65.21	65.21	H	-5.35	59.86	17.01	74	54	14.1	37.0
2388.40	61.33	61.16	V	-5.36	55.97	12.95	74	54	18.0	41.1
2389.94	62.27	62.27	V	-5.35	56.92	14.07	74	54	17.1	39.9
2420.40	64.39	64.39	H	-5.20	59.19	16.33	74	54	14.8	37.7
2422.03	63.62	63.62	H	-5.19	58.43	15.57	74	54	15.6	38.4
2420.33	61.50	61.50	V	-5.20	56.30	13.44	74	54	17.7	40.6
2422.03	60.39	60.39	V	-5.19	55.20	12.34	74	54	18.8	41.7
4810	44.96	32.10	H	3.19	48.15	-7.56	74	54	25.9	61.6
4810	44.05	30.99	V	3.19	47.24	-8.67	74	54	26.8	62.7

Notes:

- The fundamental frequencies were measured using RBW = 3 MHz.
- A -42.85 dB correction factor was applied on the peak levels for the corrected average measurements.
- All emissions above 4810 MHz were attenuated below the limits and the noise floor of the measurement equipment.

7.3.4 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

Corrected Level: $66.62 + (5.35) = 61.27 \text{ dB}\mu\text{V/m}$

Margin: $74\text{dB}\mu\text{V/m} - 61.27 \text{ dB}\mu\text{V/m} = 12.7 \text{ dB}$

Example Calculation: Average

Corrected Level: $66.62 + (5.35) - 42.85 = 18.42 \text{ dB}\mu\text{V/m}$

Margin: $54\text{dB}\mu\text{V} - 18.42 \text{ dB}\mu\text{V/m} = 35.6 \text{ dB}$

8 CONCLUSION

In the opinion of ACS, Inc. the FAS1543-02, manufactured by Ecolab Inc. meets the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-210.

END REPORT