Report on the FCC and ISED Testing of the

Ecolab, Inc.
92053071

In accordance with FCC 47 CFR Part 15.209 & ISED Canada's Radio Standards Specifications RSS-210

America

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Prepared for: Ecolab, Inc.
650 Lone Oak Drive
Eagan, MN 55121

FCC ID: Z9O-92053071 IC: 10060A-92053071

COMMERCIAL-IN-CONFIDENCE

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Pete Walsh	**Service Line Manager**	**Authorized Signatory**	06-Dec-2018

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FCC Accreditation Designation Number US1063 Tampa, FL Test Laboratory	Innovation, Science, and Economic Development Canada Accreditation Main Site Number 2087A-2 Tampa, FL Test Laboratory Satellite Site Number: 4175C Boca Raton, FL Test Laboratory

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with FCC Part 15.209, ISED Canada's RSS-210

A2LA Cert. No. 2955.15

ACCREDITATION
Our A2LA Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our A2LA Accreditation.

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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 Section 15.209 and Innovation Science and Economic Development Canada's Radio Standards Specification RSS-210 for the tests documented herein.

1.2 Applicant Information

Ecolab, Inc.
650 Lone Oak Drive
Ecolab Schuman Center
Eagan, MN 55121

1.3 Product Description

The EUT is a hand hygiene compliance monitoring beacon for the Ecolab NEXA manual soap/sanitizer dispenser. The device includes a 900 MHz and a 125 kHz transceiver.

Technical Details

Mode of Operation:	125 kHz transceiver
Frequency Range:	125 kHz
Number of Channels:	1
Channel Separation:	N/A
Data Rate:	1.2 kbps
Modulations:	OOK
Antenna Type/Gain:	Coil Antenna
Input Power:	3 VDC (AA Batteries)

Model Number: 92053071

Test Sample Serial Number(s): 1818-001G-00439E

Test Sample Condition: The test samples were in good operating condition without any physical damages.

1.4 Test Methodology and Considerations

The EUT was evaluated for radiated emissions in the orientation of normal use. The co-located radios are not capable of transmitting simultaneously.The unit is battery operated only without any provision for connection to the AC Mains. The EUT is exempted from the conducted power line emissions requirements. The device was set to the maximum user accessible power levels for testing.

Compliance of the 900 MHz transceivers as well as the unintentional emissions 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:

TÜV SÜD America, Inc.
3998 FAU Blvd, Suite 310
Boca Raton, Florida 33431
Phone: (561) 961-5585
Fax: (561) 961-5587
http://www.tuv-sud-america.com

Innovation, Science and Economic Development Canada Lab Code: 4175C

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by American Association for Laboratory Accreditation (A2LA) and has been issued certificate number 2955.15 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.

Main Site Information:

TÜV SÜD America, Inc.
5610 West Sligh Ave., Suite 100
Tampa, FL 33634
Phone: 813-284-2715
www.tuv-sud-america.com

FCC Designation Number US1063
FCC Test Firm Registration #: 160606
Innovation, Science, and Economic Development Canada Lab Code: 2087A-2

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 can support 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:

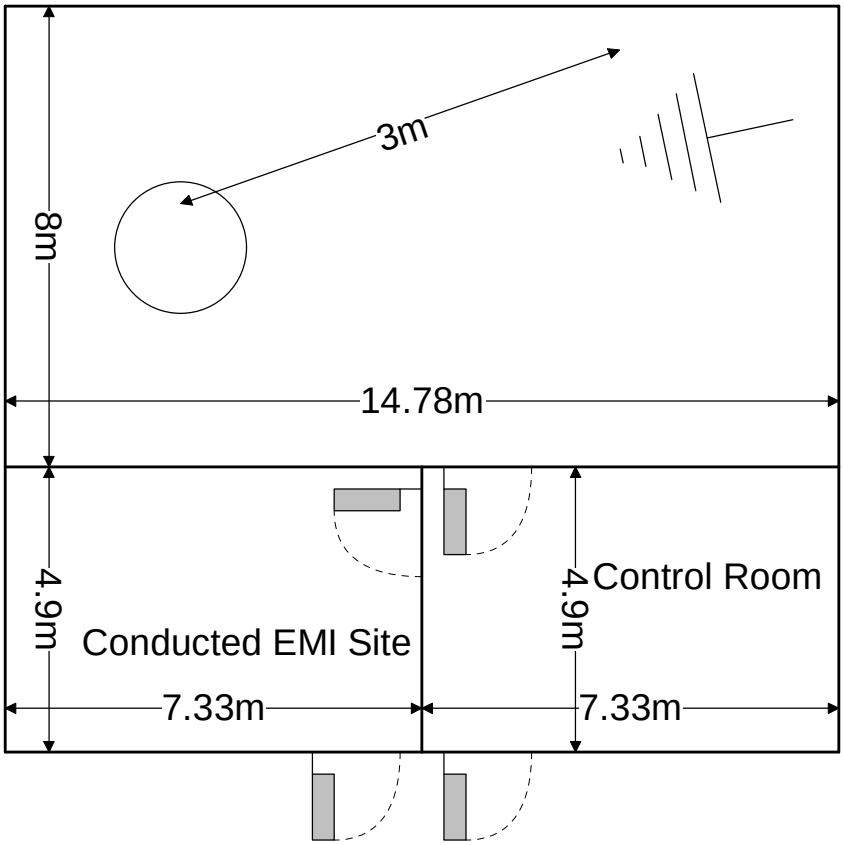

Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m^3. The power line conducted emission site includes two LISNs: a Solar Model 8028-50 50 Ω/50 µH 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:

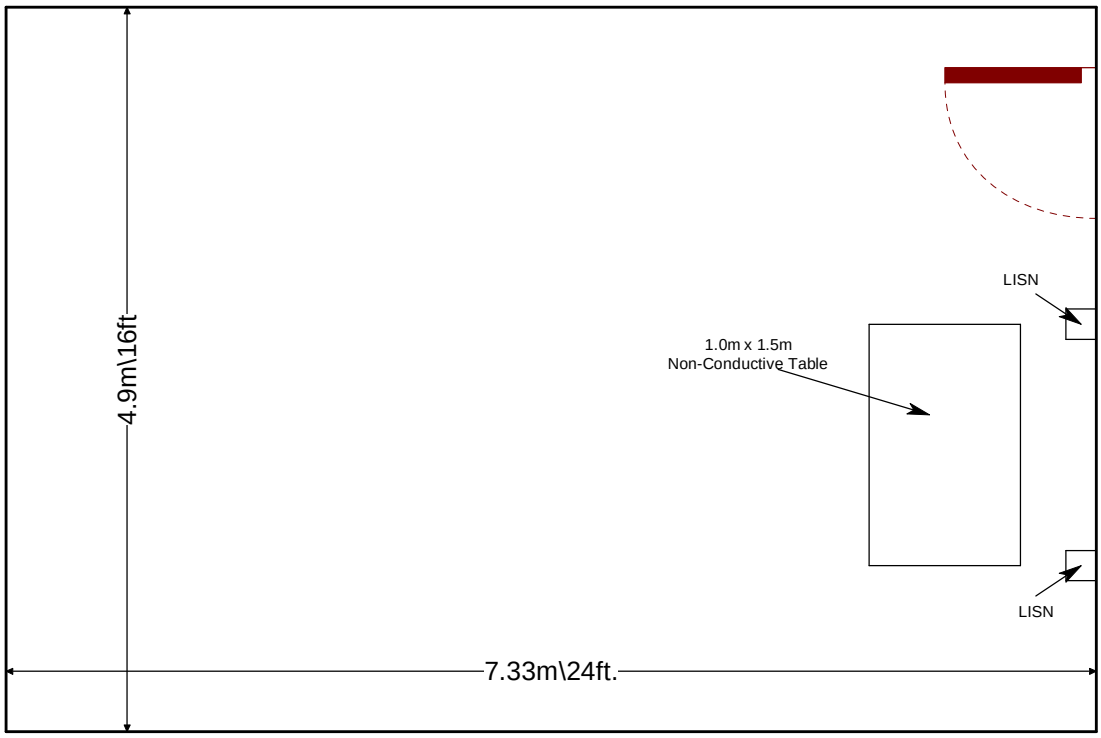

Figure 2.3.2-1: AC Mains Conducted EMI Site

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, 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-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 List

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Calibration Performed Date	Calibration Due Date
BEMC00078	EMCO	6502	Active Loop Antenna	9104-2608	5/9/2018	5/9/2020
BEMC00283	Rohde & Schwarz	FSP40	Spectrum Analyzer	1000033	11/28/2017	11/28/2019
BEMC00523	Agilent	E7405A	9kHz-26.5GHz EMC analyzer/HYZ	MY45103293	12/9/2016	12/9/2018
BEMC02002	EMCO	3108	30 MHz to 200 MHz Biconical Antenna	2147	11/28/2017	11/30/2019
BEMC02004	EMCO	3146	200 MHz to 1 GHz Log Periodic Antenna	1385	12/27/2017	12/27/2019
BEMC02011	Hewlett-Packard	HP 8447D	100 kHz to 1.3 GHz low-noise, high gain amplifier	2443A03952	10/27/2017	10/27/2018
BEMC02095	ETS Lindgren	TILE4! - Version 4.2.A	Tile Automation Software	85242	NCR	NCR
BEMC02110	Aeroflex Inmet	40AH2W-10	Attenuator 10dB, 2.9 mm-M/F, DC-40GHz 2 W	2110	8/5/2018	8/5/2019
BEMC02112	Teledyne Storm Products	921-0101-036	Duratest High Frequency Cable Max. frequency 26.5GHz	12-06-698	10/27/2017	10/27/2018
BEMC02121	Teledyne Storm Products	A81-0303	Radiated Cable Set	2121	7/26/2018	7/26/2019
BEMC02141	FAU EMI R&D Lab	EMI-LOOP	PCB Loop Antenna	EM002	NCR	NCR

Notes:

- **NCR=No Calibration Required**
- **The assets were only used during the active period of the calibration cycle.**

5 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment Description

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Ecolab, Inc.	92053071	1818-001G-00439E

Table 5-2: Cable Description – Radiated Emissions

Cable #	Cable Type	Length	Shield	Termination
	The EUT is standalone only and does not connect to other devices.			

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

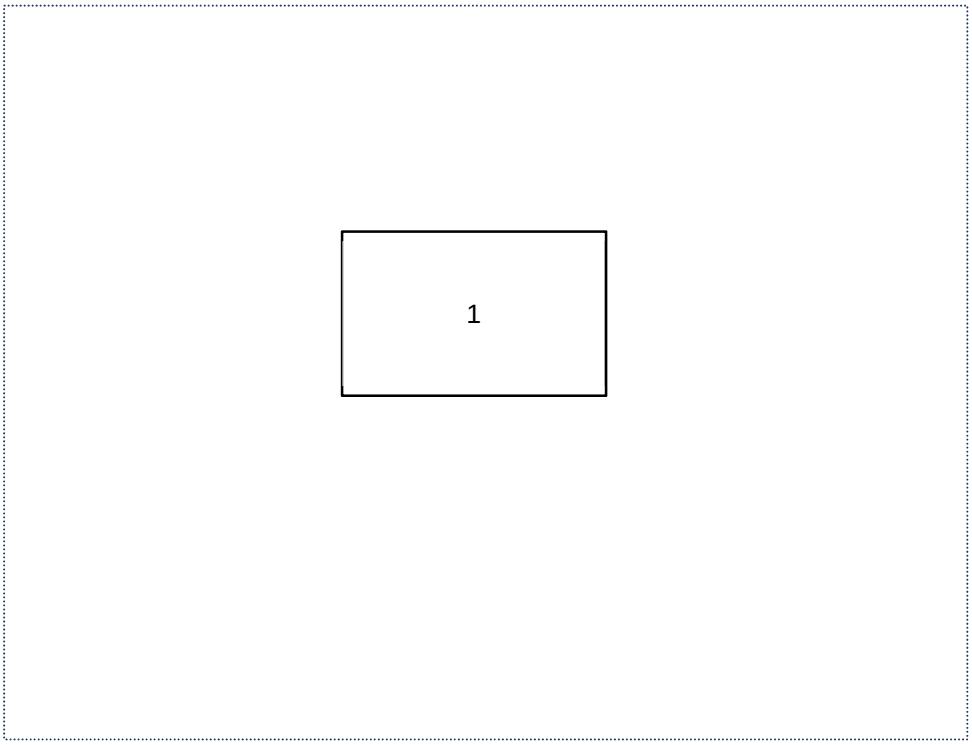

Figure 6-1: EUT and Support Equipment Block Diagram

7 SUMMARY OF TESTS

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

Test Begin Date: October 8, 2018
Test End Date: October 16, 2018

Table 7-1: Summary of Tests

Test Description	FCC 47 CFR Rule Part	ISED Canada RSS Section	Test Results
Antenna Requirements	FCC: Section 15.203		Compliant
20dB / 99% Bandwidth	FCC: Section 15.215	ISED Canada: RSS-Gen 6.6	Compliant
Field Strength of Fundamental and Spurious Emissions	FCC: Sections 15.209	ISED Canada: RSS-210 2.5	Compliant
Power Line Conducted Emissions	FCC: Section 15.207	ISED Canada: RSS-Gen 8.8	N/A

7.1 Antenna Requirement – FCC: Section 15.203

The EUT uses an internal magnetic coil antenna that is soldered to the PCB. The antenna is permanently attached and therefore meet 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 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 marker-delta function of the analyzer, set at 20 dB below the highest peak, 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. The RBW was set from 1% and 5% of the estimated 99% bandwidth. The occupied 99% bandwidth was measured by using the occupied bandwidth function of the spectrum analyzer set to 99% with a peak detector.

7.2.2 Measurement Results

Performed by: Thierry Jean-Charles

Table 7.2.2-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
0.125	11.356	16.509

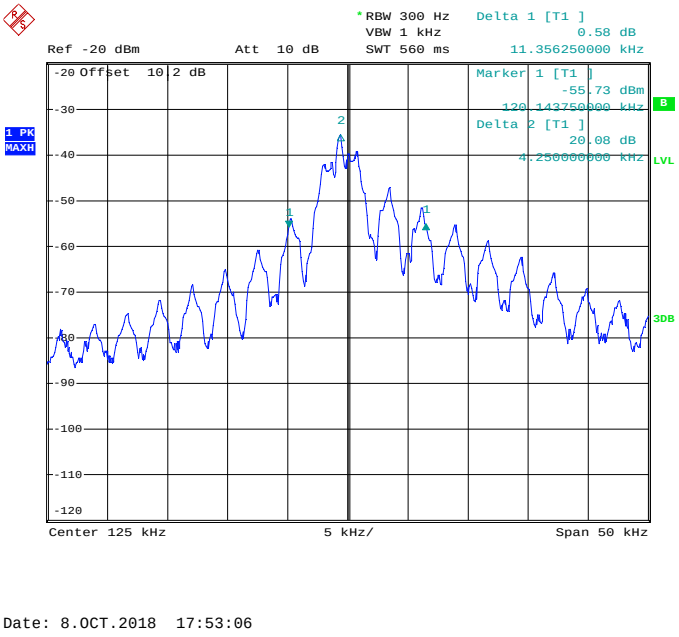

Figure 7.2.2-1: 20dB Occupied Bandwidth

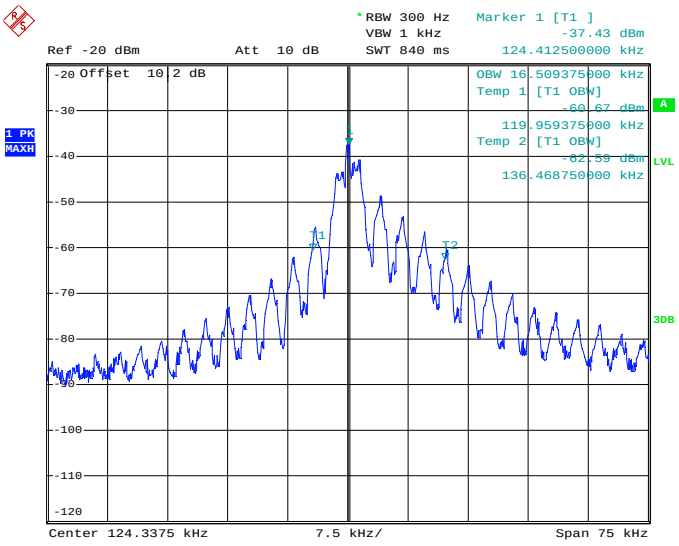

Figure 7.2.2-2: 99% Occupied Bandwidth

7.3 Field Strength of Fundamental and Spurious Emissions – FCC: Section 15.209; ISED Canada: RSS-210 2.5

7.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 1 GHz. Section 15.33(a)(4) specifies, if the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to frequency specified in 15.33(b)(1) for unintentional radiators. The upper frequency range for the digital device is 1000 MHz which greater than the 10th harmonic of the fundamental frequency. The upper frequency range measured was 1000 MHz.

Measurements below 30 MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. The magnetic loop receiving antenna was positioned 1 meter above the ground. The EUT was rotated 360° to maximize each emission. The spectrum analyzer's resolution and video bandwidths were set to 200 Hz and 1000 Hz respectively for frequencies below 150 kHz, and to 9 kHz and 30 kHz respectively for frequencies between 150 kHz and 30 MHz. The fundamental levels were measured using a resolution bandwidth of 30 kHz which is greater than the measured emission bandwidth. For measurements in the frequency bands 9-90 kHz and 110-490 kHz, an average detector was used. When average measurements are specified, the peak emissions were also compared to a limit corresponding to 20 dB above the maximum permitted average limit according to Part 15.35. All other emissions were measured using a Quasi-peak detector. The final measurements were then corrected by antenna correction factors and cable loss for comparison to the limits.

Measurements above 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 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, quasi-peak measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz.

7.3.2 Distance Correction for Measurements below 30 MHz – FCC: Section 15.31

Radiated measurements were performed at a distance closer than 300 meters and 30m as required, according to Part 15.209. Therefore, a correction factor was applied to account for propagation loss at the specified distance. The propagation loss was determined by using the square of an inverse linear distance extrapolation factor (40dB/decade) according to 15.31. A sample calculation of the distance correction factor is shown below for limits expressed at a 300m measurement distance and a 30m measurement distance.

Distance correction factor (300m Specified Test Distance) = 40*Log (Test Distance/300)
= 40*Log (3/300)
= - 80 dB

Distance correction factor (30m Specified Test Distance) = 40*Log (Test Distance/30)
= 40*Log (3/30)
= - 40 dB

7.3.3 Measurement Results

Performed by: Thierry Jean-Charles, Jean Rene

Radiated spurious emissions found in the band of 9 kHz to 1 GHz are reported in the Table below.

Table 7.3.3-1: Radiated Spurious Emissions Tabulated Data

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 Frequency										
0.125	64.48	56.23	V	10.39	74.87	66.62	125.7	105.7	50.8	39.1
0.125	71.68	65.06	H	10.39	82.07	75.45	125.7	105.7	43.6	30.3
Spurious Emissions										
0.375	42.63	31.10	H	10.12	52.75	41.219	116.1	96.1	63.4	54.9
Emissions above 30 MHz										
140.73	---------	24.75	H	-14.31	---------	10.44	--------	43.5	---------	33.1
173.6	---------	25.64	H	-13.55	---------	12.09	--------	43.5	---------	31.4
180.9	---------	24.52	H	-13.20	---------	11.32	--------	43.5	---------	32.2
184.5	---------	24.44	H	-12.89	---------	11.55	--------	43.5	---------	32.0
978.42	---------	22.96	H	-0.50	---------	22.46	--------	54	---------	31.5
928.3	---------	23.34	V	-0.55	---------	22.79	--------	46	---------	23.2

Note:

- **The fundamental emission levels were measured using a RBW = 30 kHz which is greater than the occupied bandwidth of the signal.**
- **The emissions above 30 MHz are generated by the digital portion of the device.**

7.3.4 Sample Calculations

$R_C = R_U + CF_T$

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: 42.63 + 10.12 = 52.75 dBµV/m
Margin: 116.10 dBµV/m – 52.75 dBµV/m = 63.35 dB

Example Calculation: Average
Corrected Level: 31.1 + 10.12 = 41.22 dBµV/m
Margin: 96.10 dBµV/m – 41.22 dBµV/m = 54.88 dB

8 MEASUREMENT UNCERTAINTIES

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: Measurement Uncertainties

Parameter	U_{lab}
Occupied Channel Bandwidth	± 0.009 %
RF Conducted Output Power	± 1.15 dB
Power Spectral Density	± 1.15 dB
Antenna Port Conducted Emissions	± 1.15 dB
Radiated Emissions ≤ 1GHz	± 5.86 dB
Radiated Emissions > 1GHz	± 4.65 dB
Temperature	± 0.860 °C
Radio Frequency	$\pm 2.832 \times 10^{-8}$
AC Power Line Conducted Emissions	±3.72 dB

9 CONCLUSION

In the opinion of TÜV SÜD America, Inc. the model 92053071, manufactured by Ecolab, Inc., meets the requirements of FCC Part 15.209 and Industry Canada's Radio Standards Specification RSS-210 for the tests documented herein.

END REPORT