# Certification Test Report

**FCC ID: Z9O-92053026**
**IC: 10060A-92053026**

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

**Report Number: BO72131442.300**

Manufacturer: Ecolab Inc.
Model(s): 92053026

Test Begin Date: **October 10, 2017**
Test End Date: **November 3, 2017**

Report Issue Date: November 17, 2017

FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER AT-1533

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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**TÜV SÜD America, Inc.**



**This report contains 21 pages**

# TABLE OF CONTENTS

# 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 92053026 is a NXA HHCM touch free dispenser beacon. The device includes three radios operating at 125 kHz, 433.9 MHz and 2405 MHz, respectively. This test report documents the compliance of the 433.9 MHz radio.

Technical Details
Frequency of Operation: 433.9 MHz
Number of Channels: 1
Modulation: FSK
Data Rate: 250 kbps
Antenna / Gain: Helical Antenna, 1.9 dBi
Input Voltage: 3 VDC (Size AA battery)

Test Sample Serial Number(s): 15001FC9 (radiated emissions), 15001FCF Timing Measurements

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

## 1.4 Test Methodology and Considerations

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 EUT was evaluated for radiated emissions for the 433.9 MHz transmitter inside the Nexa Classic and the Nexa Compact dispensers in the orientation of typical installation. The device was pre-configured to the maximum RF output power setting for the evaluation.

The timing parameters were measured via RF coupling to a spectrum analyzer using a near field probe.

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 comply with the requirements of FCC Section 15.209 and ISED Canada RSS-Gen. The

evaluation of the 125 kHz and 2405 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:

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

## 2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. 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 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:

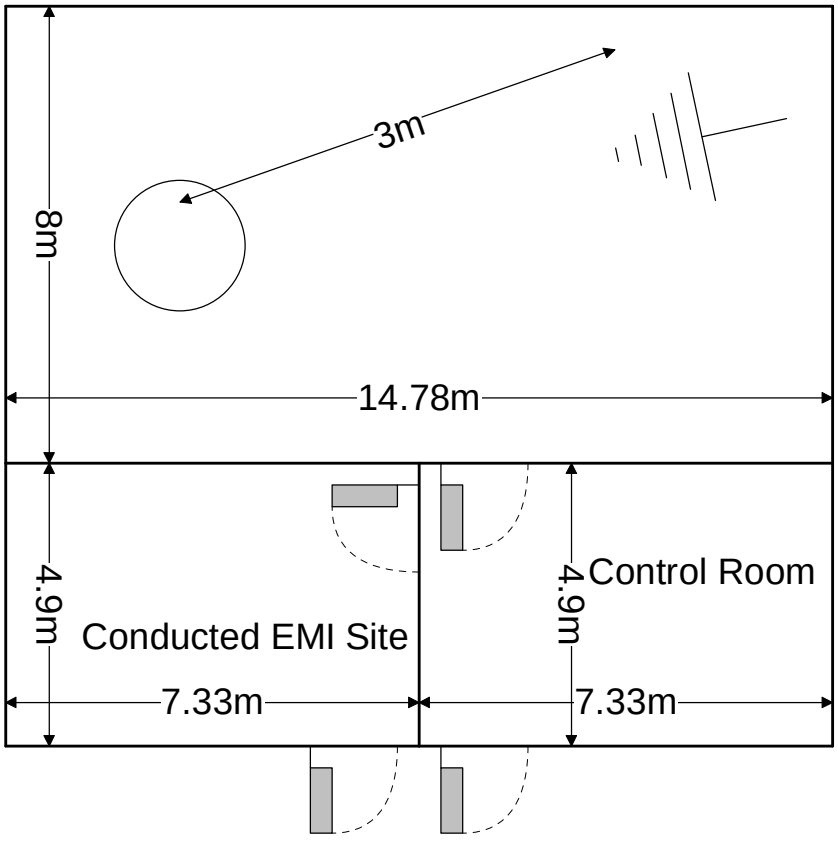


**Figure 2.3.1-1: Semi-Anechoic Chamber Test Site**

### 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:

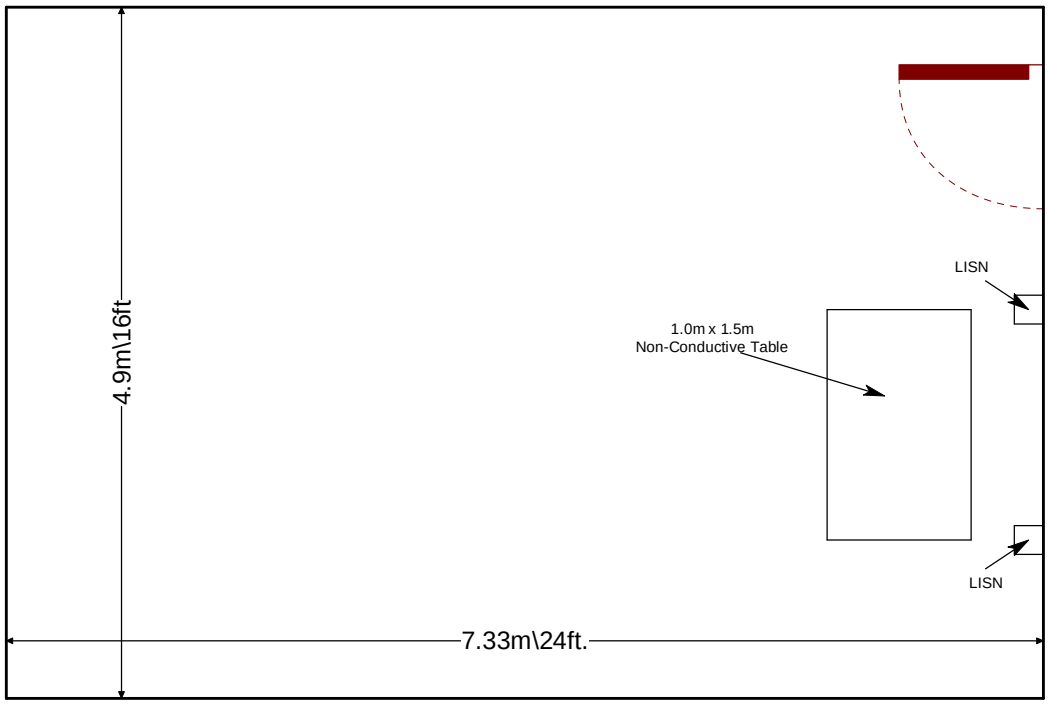


**Figure 2.3.2-1: AC Mains Conducted EMI Site**

## 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, 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 |
|---|---|---|---|---|---|---|
| 283 | Rohde & Schwarz | FSP40 | Spectrum Analyzers | 1000033 | 7/21/2016 | 7/21/2018 |
| 479 | Electro-Metrics | ALP-70 | Antennas | 158 | 12/3/2015 | 12/3/2017 |
| 523 | Agilent | E7405 | Spectrum Analyzers | MY45103293 | 12/9/2016 | 12/9/2018 |
| 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 | 4/7/2017 | 4/7/2019 |
| 2011 | Hewlett-Packard | HP 8447D | Amplifiers | 2443A03952 | 10/27/2017 | 10/27/2018 |
| 2073 | Mini Circuits | NHP-800 | Filter | 10247 | 12/1/2016 | 12/1/2017 |
| 2086 | Merrimac | FAN-6-10K | Attenuators | 23148-83-1 | 10/27/2017 | 10/27/2018 |
| 2089 | Agilent Technologies, Inc. | 83017A | Amplifiers | 3123A00214 | 12/2/2016 | 12/2/2017 |
| 2094 | Mini Circuits | SHP-1000+ | Filter | R UU27401137 | 2/27/2017 | 2/27/2018 |
| 2095 | ETS Lindgren | TILE4! - Version 4.2.A | Software | 85242 | NCR | NCR |
| 2121 | ACS Boca | Radiated Cable Set | Cable Set | 2121 | 7/31/2017 | 7/31/2018 |
| NBLE03366 | Agilent | E4440A | Spectrum Analyzer | MY42510427 | 10/24/2017 | 10/24/2018 |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**Notes:**

- NCR=No Calibration Required
- The assets calibration cycle information is provided to cover the entire test period. The assets were only used during the active period of the calibration cycle.

## 5 SUPPORT EQUIPMENT

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

| Item # | Type Device | Manufacturer | Model/Part # | Serial # |
|---|---|---|---|---|
| 1 | EUT | Ecolab Inc. | 92053026 | 15001FC9 |
| 2 | Classic Dispenser | Ecolab Inc. | 92021188 | N/A |
| | Compact Dispenser | Ecolab Inc. | 92021184 | N/A |

**Table 5-2: Cable Description**

| Cable # | Cable Type | Length | Shield | Termination |
|---|---|---|---|---|
| A | The EUT is a plug-in device into a specific host equipment with no provision for additional connection to accessory equipment. | | | |

## 6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

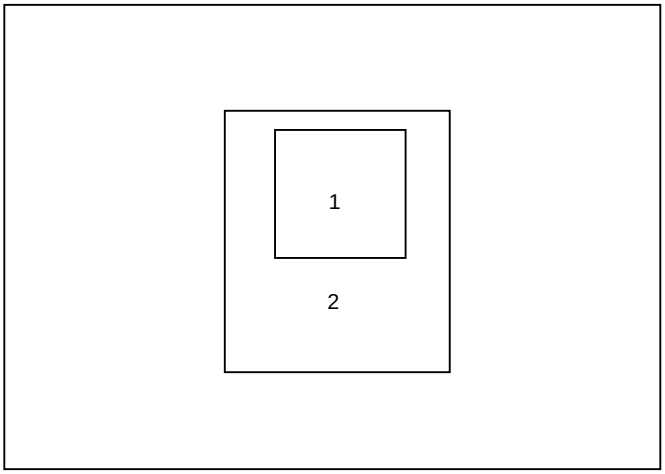


**Figure 6-1: EUT Test Setup**

# 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

For the 433.9 MHz radio, EUT uses an internal 1.9 dBi helical antenna that is directly soldered to the PCB. The antenna is not removable and meets the FCC 15.203 requirements.

## 7.2 20dB / 99% Bandwidth: FCC: Section 15.231(c); ISED Canada: RSS-210 A.1.3

### 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 20-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. The RBW was set from 1% to 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

0.25% of the 433.9 MHz center frequency is equivalent to 1.08 MHz. Therefore the 20 dB and 99% bandwidths of the emission are less than 0.25% of the center frequency.

Performed by: Thierry Jean-Charles

**Table 7.2.2-1: 20dB / 99% Bandwidth**

| Frequency [MHz] | 20dB Bandwidth [kHz] | 99% Bandwidth [kHz] |
|---|---|---|
| 433.9 | 522.42 | 515.8496 |

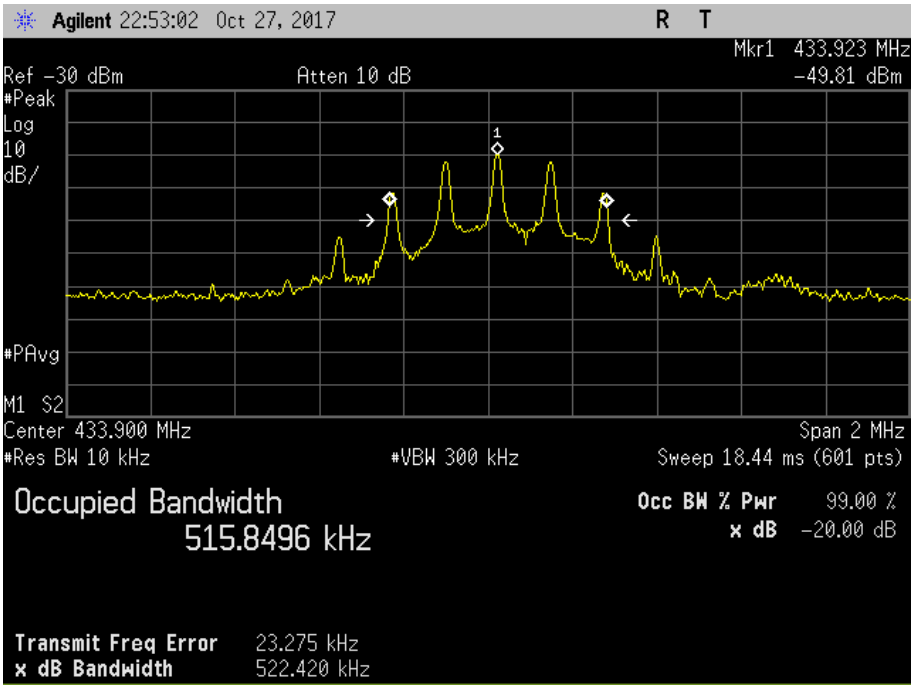


**Figure 7.2.2-1: 20dB / 99% BW**

## 7.3 Radiated Spurious Emissions – FCC: Section 15.231(b); ISED Canada: RSS-210 A.1.2

### 7.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 4.5 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 15.205 was demonstrated using the measurement instrumentation specified in that section where applicable.

### 7.3.2 Duty Cycle Correction

A Duty Cycle Correction of 1.312% corresponding to 20*log(1.312/100) = -37.64 dB was applied to the average measurements for the corrected average results. The justification of the duty cycle is provided in the equipment's theory of operation document.

### 7.3.3 Measurement Results

Performed by: Thierry Jean-Charles, Jean Rene

Radiated spurious emissions found in the band of 9 kHz to 4.5 GHz are reported in Table 7.3.3-1 below.

**Table 7.3.3-1: Radiated Spurious Emissions Tabulated Data – Nexa Classic Dispenser**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | avg | (H/V) | (dB) | pk | avg | pk | avg | pk | avg |
| **Fundamental Frequency** | | | | | | | | | | |
| **433.9** | 78.39 | 77.95 | H | -9.66 | 68.73 | 30.65 | 100.8 | 80.8 | 32.1 | 50.1 |
| **433.9** | 84.44 | 83.93 | V | -9.66 | 74.78 | 36.63 | 100.8 | 80.8 | 26.0 | 44.2 |
| **Spurious Emissions** | | | | | | | | | | |
| **867.8** | 37.56 | 34.24 | H | -0.97 | 36.59 | -4.37 | 80.8 | 60.8 | 44.2 | 65.2 |
| **867.8** | 39.91 | 37.63 | V | -0.97 | 38.94 | -0.98 | 80.8 | 60.8 | 41.9 | 61.8 |
| **1301.7** | 59.03 | 53.84 | H | -10.99 | 48.04 | 5.21 | 74 | 54 | 26.0 | 48.8 |
| **1301.7** | 61.13 | 56.65 | V | -10.99 | 50.14 | 8.02 | 74 | 54 | 23.9 | 46.0 |
| **1735.6** | 49.47 | 36.71 | H | -7.99 | 41.48 | -8.93 | 80.8 | 60.8 | 39.3 | 69.7 |
| **1735.6** | 49.50 | 36.66 | V | -7.99 | 41.51 | -8.98 | 80.8 | 60.8 | 39.3 | 69.8 |
| **2169.5** | 54.48 | 45.82 | H | -5.40 | 49.08 | 2.78 | 80.8 | 60.8 | 31.7 | 58.0 |
| **2169.5** | 55.92 | 47.66 | V | -5.40 | 50.52 | 4.62 | 80.8 | 60.8 | 30.3 | 56.2 |
| **2603.4** | 48.07 | 35.24 | H | -3.47 | 44.60 | -5.87 | 80.8 | 60.8 | 36.2 | 66.7 |
| **2603.4** | 49.62 | 37.30 | V | -3.47 | 46.15 | -3.81 | 80.8 | 60.8 | 34.7 | 64.6 |
| **3037.3** | 49.84 | 38.56 | H | -1.37 | 48.47 | -0.46 | 80.8 | 60.8 | 32.3 | 61.3 |
| **3037.3** | 47.72 | 35.16 | V | -1.37 | 46.35 | -3.86 | 80.8 | 60.8 | 34.5 | 64.7 |
| **3471.2** | 45.91 | 32.25 | H | 0.13 | 46.04 | -5.26 | 80.8 | 60.8 | 34.8 | 66.1 |
| **3471.2** | 44.81 | 31.50 | V | 0.13 | 44.94 | -6.01 | 80.8 | 60.8 | 35.9 | 66.8 |
| **3905.1** | 52.41 | 41.64 | H | 1.90 | 54.31 | 5.89 | 74 | 54 | 19.7 | 48.1 |
| **3905.1** | 51.69 | 40.53 | V | 1.90 | 53.59 | 4.78 | 74 | 54 | 20.4 | 49.2 |
| **4339** | 44.25 | 30.98 | H | 3.05 | 47.30 | -3.61 | 74 | 54 | 26.7 | 57.6 |
| **4339** | 44.23 | 30.94 | V | 3.05 | 47.28 | -3.65 | 74 | 54 | 26.7 | 57.6 |

**Notes:**

- The fundamental emissions were measured using RBW = 1 MHz which is greater than the measured occupied bandwidth.
- A duty cycle correction factor of -37.64 dB was applied to the average measurements for the spurious emissions.

**Table 7.3.3-2: Radiated Spurious Emissions Tabulated Data - Nexa Compact Dispenser**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | avg | (H/V) | (dB) | pk | avg | pk | avg | pk | avg |
| **Fundamental Frequency** | | | | | | | | | | |
| **433.9** | 79.31 | 78.92 | H | -9.66 | 69.65 | 31.62 | 100.8 | 80.8 | 31.1 | 49.2 |
| **433.9** | 85.62 | 85.15 | V | -9.66 | 75.96 | 37.85 | 100.8 | 80.8 | 24.8 | 42.9 |
| **Spurious Emissions** | | | | | | | | | | |
| **867.8** | 37.64 | 34.14 | H | -0.97 | 36.67 | -4.47 | 80.8 | 60.8 | 44.1 | 65.3 |
| **867.8** | 39.93 | 37.17 | V | -0.97 | 38.96 | -1.44 | 80.8 | 60.8 | 41.8 | 62.2 |
| **1301.7** | 60.27 | 55.46 | H | -10.99 | 49.28 | 6.83 | 74 | 54 | 24.7 | 47.2 |
| **1301.7** | 62.32 | 57.34 | V | -10.99 | 51.33 | 8.71 | 74 | 54 | 22.7 | 45.3 |
| **1735.6** | 49.66 | 36.51 | H | -7.99 | 41.67 | -9.13 | 80.8 | 60.8 | 39.1 | 69.9 |
| **1735.6** | 49.89 | 36.16 | V | -7.99 | 41.90 | -9.48 | 80.8 | 60.8 | 38.9 | 70.3 |
| **2169.5** | 54.82 | 45.63 | H | -5.40 | 49.42 | 2.59 | 80.8 | 60.8 | 31.4 | 58.2 |
| **2169.5** | 56.12 | 48.20 | V | -5.40 | 50.72 | 5.16 | 80.8 | 60.8 | 30.1 | 55.6 |
| **2603.4** | 48.35 | 35.34 | H | -3.47 | 44.88 | -5.77 | 80.8 | 60.8 | 35.9 | 66.6 |
| **2603.4** | 49.53 | 37.68 | V | -3.47 | 46.06 | -3.43 | 80.8 | 60.8 | 34.7 | 64.2 |
| **3037.3** | 49.05 | 37.72 | H | -1.37 | 47.68 | -1.30 | 80.8 | 60.8 | 33.1 | 62.1 |
| **3037.3** | 48.04 | 35.50 | V | -1.37 | 46.67 | -3.52 | 80.8 | 60.8 | 34.1 | 64.3 |
| **3471.2** | 45.77 | 31.47 | H | 0.13 | 45.90 | -6.04 | 80.8 | 60.8 | 34.9 | 66.8 |
| **3471.2** | 45.14 | 31.26 | V | 0.13 | 45.27 | -6.25 | 80.8 | 60.8 | 35.5 | 67.1 |
| **3905.1** | 51.90 | 40.78 | H | 1.90 | 53.80 | 5.03 | 74 | 54 | 20.2 | 49.0 |
| **3905.1** | 52.13 | 41.19 | V | 1.90 | 54.03 | 5.44 | 74 | 54 | 20.0 | 48.6 |
| **4339** | 43.83 | 30.91 | H | 3.05 | 46.88 | -3.68 | 74 | 54 | 27.1 | 57.7 |
| **4339** | 44.42 | 31.17 | V | 3.05 | 47.47 | -3.42 | 74 | 54 | 26.5 | 57.4 |

**Notes:**

- The fundamental emissions were measured using RBW = 1 MHz which is greater than the measured occupied bandwidth.
- A duty cycle correction factor of -37.64 dB was applied to the average measurements for the spurious emissions.

### 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: 59.03 + (-10.99) = 48.04 dBµV/m
Margin: 74 dBµV/m – 48.04 dBµV/m = 26.0 dB

**Example Calculation: Average**
Corrected Level: 53.84 + (-10.99) – 37.64= 5.21 dBµV/m
Margin: 54 dBµV – 5.21 dBµV/m = 48.8 dB

## 7.4 Periodic Operation – FCC: CFR 47 15.231(a); ISED Canada: RSS-210 A.1.1

### 7.4.1 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 automatically as well as manually and was evaluated using a spectrum analyzer at zero span.

### 7.4.2 Test Results

Performed by: Thierry Jean-Charles

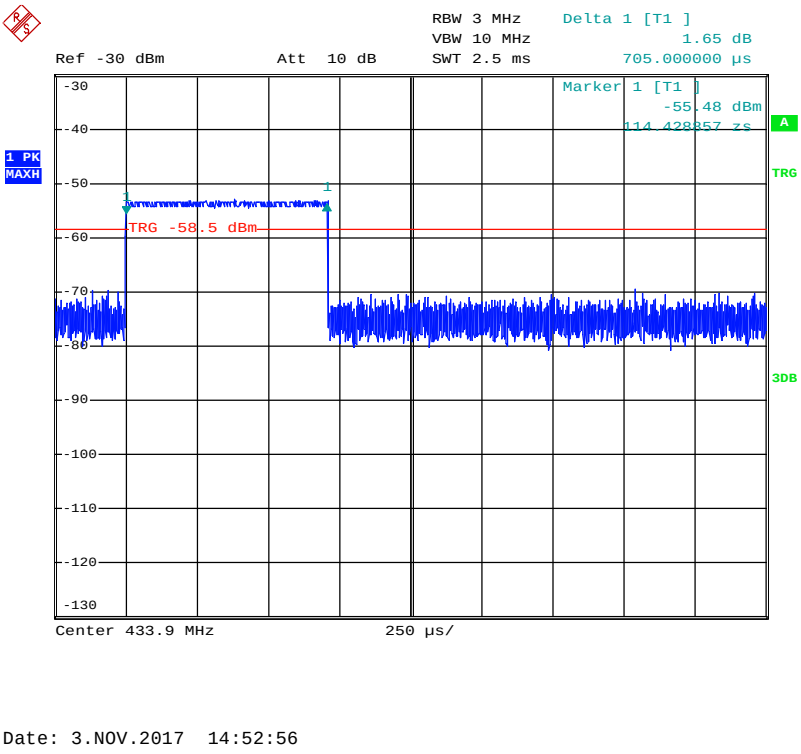


**Figure 7.4.2-1: Periodic Operation – 2.5 Milliseconds – Automatic Operation**

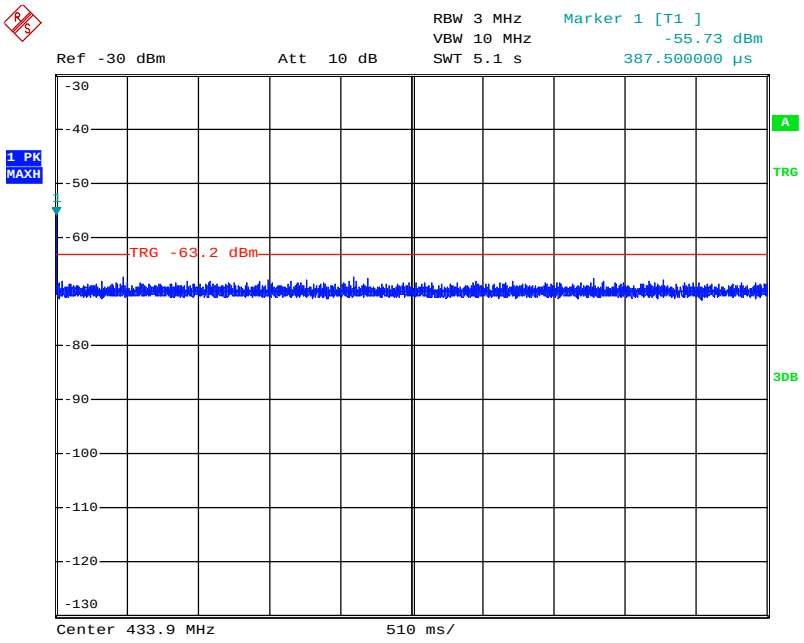


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**Figure 7.4.2-2: Periodic Operation – 5 Seconds – Automatic Operation**

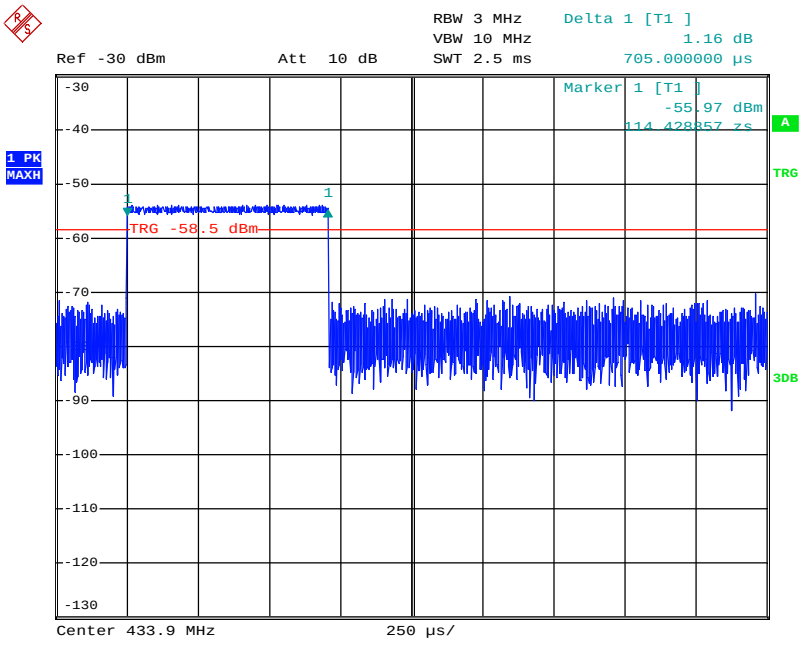


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**Figure 7.4.2-3: Periodic Operation – 2.5 Milliseconds – Soap Switch Down**

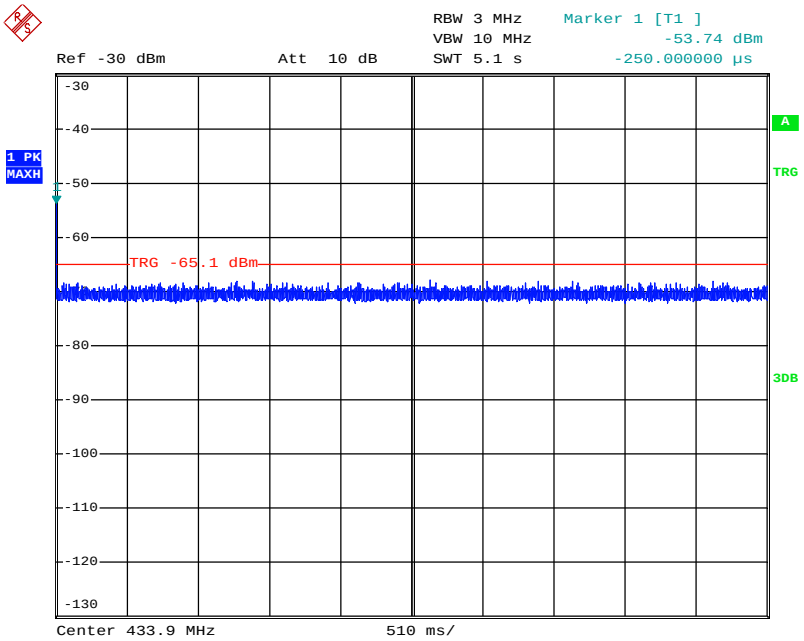


**Figure 7.4.2-4: Periodic Operation – 5 Seconds – Soap Switch Down**

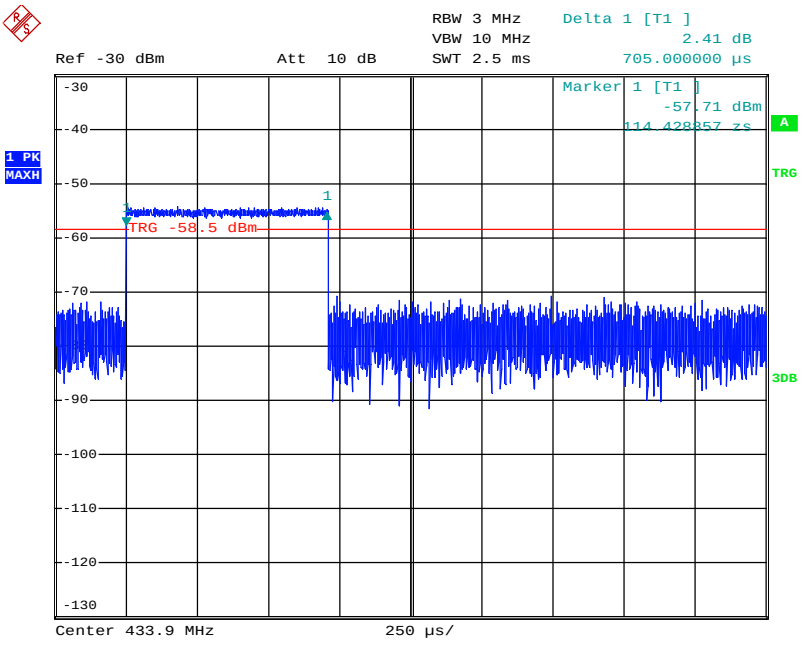


**Figure 7.4.2-5: Periodic Operation – 2.5 Milliseconds – Soap Switch Released**

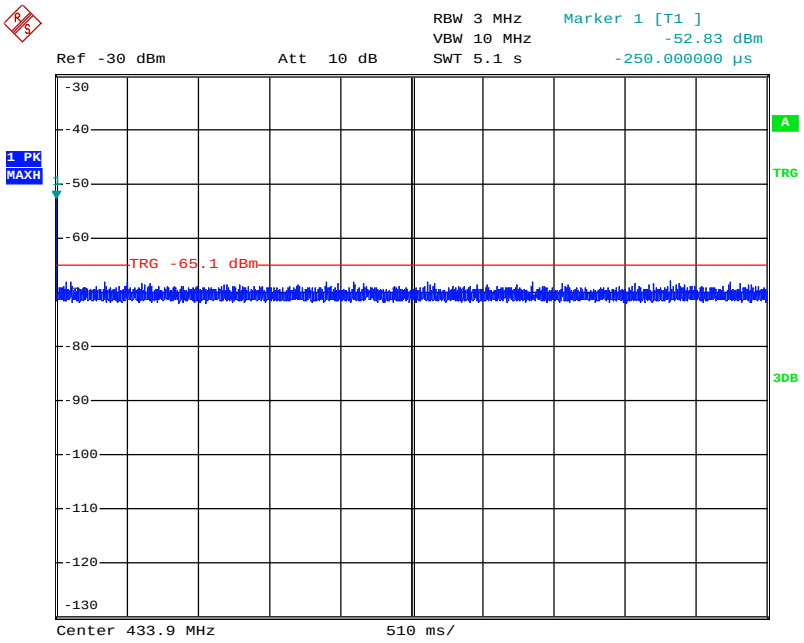


**Figure 7.4.2-6: Periodic Operation – 5 Seconds – Soap Switch Released**

## 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 92053026, 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