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# **TEST REPORT**

Application No.:	HKEM2307000601PF			
Applicant:	ECOLAB Inc.			
Address of Applicant:	FCC: 1 Ecolab Place, St Paul, Minnesota, United States, 55102			
	IC: Ecolab Schuman Center-F6, 655 Lone Oak Drive, Eagan, MN United States, 55121			
Equipment Under Test (EUT)	:			
EUT Name:	HHCM915 BDG2450 ASSY			
Model No.:	53005389			
FCC:	Z9O-53005389			
IC:	10060A-53005389			
HVIN:	53005389			
Standard(s) :	47 CFR Part 15, Subpart C 15.249			
	RSS-210 Issue 10 December 2019			
	RSS-Gen Issue 5, April 2018			
Date of Receipt:	2023-07-18			
Date of Test:	2023-07-18 to 2023-07-25			
Date of Issue:	2023-07-25			
Test Result:	The submitted sample was found to comply with the test requirement			

#### Law Man Kit EMC Manager

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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.

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Revision Record					
Revision No.	Date	Report superseded	Remark		

Authorized for issue by:		
	) AR	
	Chan Chun Lok /Project Engineer	Date: 2023-07-25
	Lais	
	Law Man Kit	
	/Reviewer	Date: 2023-07-25



# 2 Test Summary

IC

Radio Spectrum Technical Requirement				
Item Standard Method Requirement Resu				
Antenna Requirement	RSS-210 Issue 10 December 2019	N/A	RSS-Gen Section 6.8	Pass

Radio Spectrum Matter Part					
Item	Standard	Standard Method		Result	
99% Bandwidth	RSS-210 Issue 10 December 2019	RSS-Gen Section 6.7	RSS-Gen Section 6.7	Pass	
Field Strength of the Fundamental Signal	RSS-210 Issue 10 December 2019	ANSI C63.10 (2013) Section 6.5&6.6	RSS-210 B10 (a)	Pass	
Radiated Emissions in the Restricted Bands	RSS-210 Issue 10 December 2019	ANSI C63.10 (2013) Section 6.4&6.5&6.6	RSS-Gen Section 8.9 & 8.10	Pass	
Radiated Emissions	RSS-210 Issue 10 December 2019	ANSI C63.10 (2013) Section 6.4&6.5&6.6	RSS-Gen Section 8.9 & RSS-210 B10 (b)	Pass	

Note: Frequency stability requested in RSS GEN Section 8.1.1 has been complied since the result of band edge can demonstrate.

#### FCC

Radio Spectrum Technical Requirement				
Item Standard Method Requirement Re				Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.249	N/A	47 CFR Part 15, Subpart C 15.203	Pass

Radio Spectrum Matter Part					
Item	Standard	Method	Requirement	Result	
20dB Bandwidth	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.9	47 CFR Part 15, Subpart C 15.215	Pass	
Field Strength of the Fundamental Signal	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.5&6.6	47 CFR Part 15, Subpart C 15.249(a)	Pass	
Radiated Emissions in the Restricted Bands	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.4&6.5&6.6	47 CFR Part 15, Subpart C 15.205 & 15.249(d) & 15.209	Pass	
Radiated Emissions	47 CFR Part 15, Subpart C 15.249	ANSI C63.10 (2013) Section 6.4&6.5&6.6	47 CFR Part 15, Subpart C 15.209 & 15.249 (a),(d)	Pass	

# Declaration of EUT Family Grouping: N/A



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#### Abbreviation:

- Tx: In this whole report Tx (or tx) means Transmitter.
- Rx: In this whole report Rx (or rx) means Receiver.
- RF: In this whole report RF means Radiated Frequency.
- CH: In this whole report CH means channel.
- Volt: In this whole report Volt means Voltage.
- Temp: In this whole report Temp means Temperature.
- Humid: In this whole report Humid means humidity.
- Press: In this whole report Press means Pressure.
- N/A: In this whole report not application.



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# 4 General Information

# 4.1 Details of E.U.T.

Power supply:	DC 3 V ('CR2450' size battery x 1)
Test voltage:	DC 3 V
Cable:	N/A
Antenna Gain:	-1.0 dBi
Antenna Type:	Chip Antenna
Channel Separation:	N/A
Modulation Type:	2-FSK
Number of Channels:	1
Operation Frequency:	917MHz
Hardware Version:	A
Firmware Version:	2.06
Serial No.:	A1

Frequency Lists:

Channel	Frequency (MHz)
1	917

The frequencies under test are bolded.

# 4.2 Description of Support Units

The EUT has been tested as an independent unit.



## 4.3 Measurement Uncertainty

#### RF

No.	Item	Measurement Uncertainty
1	Radio Frequency	± 7.25 x 10 <sup>-8</sup>
2	Duty cycle	± 0.37%
3	Occupied Bandwidth	± 3%
4	RF conducted power (30MHz-40GHz)	1.5dB
5	RF power density	1.5dB
6	Conducted Spurious emissions	1.5dB
		4.7dB (30MHz-1GHz)
7	RF Radiated power &	4.7dB (1GHz-6GHz)
1	Radiated Spurious emission test	4.7dB (6GHz-18GHz)
		5.7dB (18GHz-40GHz)
8	Temperature test	± 1 ℃
9	Humidity test	± 3%
10	Supply voltages	± 1.5%
11	Time	± 3%

Remark:

The U<sub>lab</sub> (lab Uncertainty) is less than U<sub>cispr</sub> (CISPR Uncertainty), so the test results

- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;

According to decision rule based on Clause 4.2 of CISPR 16-4-2, the EUT complied with the standards specified above.



# 4.4 Test Location

All tests were performed at:

SGS Hong Kong Limited

Unit 2 and 3, G/F, Block A, Po Lung Centre,

11 Wang Chiu Road, Kowloon Bay, Kowloon, Hong Kong

Tel: +852 2305 2570 Fax: +852 2756 4480

No tests were sub-contracted.

## 4.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

## IAS Accreditation (Lab Code: TL-817)

SGS Hong Kong Limited has met the requirements of AC89, IAS Accreditation Criteria for Testing Laboratories, and has demonstrated compliance with ISO/IEC Standard 17025:2017, General requirements for the competence of testing and calibration laboratories. This organization is accredited to provide the services specified in the scope of accreditation maintained on the IAS website (www.iasonline.org).

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

## • FCC Recognized Accredited Test Firm(CAB Registration No.: 514599)

SGS Hong Kong Limited has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: HK0015, Test Firm Registration Number: 514599.

#### Industry Canada (Site Registration No.: 26103; CAB Identifier No.: HK0015)

SGS Hong Kong Limited has been recognized by Department of Innovation, Science and Economic Development (ISED) Canada as a wireless testing laboratory. The acceptance letter from the ISED is maintained in our files. CAB Identifier No: HK0015, Site Registration Number: 26103.

## 4.6 Deviation from Standards

None

## 4.7 Abnormalities from Standard Conditions

None



# 5 Equipment List

adiated Emissions which fall in the restricted bands, Radiated Spurious Emissions					
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
3m Semi-Anechoic Chamber	ChamPro	N/A	E229	2022/08/09	2023/08/08
Coaxial Cable	SGS	N/A	E167	2023/07/15	2024/07/14
EMI Test Receiver 9kHz to 7GHz	Rohde & Schwarz	ESR7 / 102298	E314	2023/06/29	2024/06/28
EMC32 Test software	Rohde & Schwarz	Version 10	N/A	N/A	N/A
Signal and Spectrum Analyzer 2Hz - 26.5GHz	Rohde & Schwarz	FSW26	E296	2022/08/17	2023/08/16
Preamplifier 33dB, 1 - 18GHz	Schwarzbeck	BBV9718	E214	2023/04/09	2024/04/08
RF cable SMA to SMA 10000mm	HUBER+SUHNER	SF104- 26.5/2*11SMA 45	E207	2022/09/17	2023/09/16
Boresight Mast Controller	ChamPro	AM-BS-4500-E	E237	N/A	N/A
Turntable with Controller	ChamPro	EM1000	E238	N/A	N/A
Band Reject Filter 2.4 -2.5GHz	MICRO-TRONICS	BRM50702	E324	2022/09/17	2023/09/16

General used equipment						
Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date	
Digital temperature & humidity data logger	SATO	SK-L200TH II	E232	2022/08/16	2023/08/15	
Electronic Digital Thermometer with Hygrometer	nil	2074/2075	E159	2022/08/16	2023/08/15	
Barometer with digital thermometer	SATO	7612-00	E218	2023/03/29	2024/03/28	
Conditional Chamber	Zhong Zhi Testing Instruments	CZ-E-608D	E216	2022/08/17	2023/08/16	



# 6 Radio Spectrum Technical Requirement

## 6.1 Antenna Requirement

## 6.1.1 Test Requirement:

RSS-Gen Section 6.8, 47 CFR Part 15, Subpart C 15.203 Limit:

#### 15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

#### 6.1.2 Conclusion

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently

attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.



#### EUT Antenna:

The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 1 dBi.



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# 7 Radio Spectrum Matter Test Results

# 7.1 99% Bandwidth

Test Requirement	RSS-Gen Section 6.7
Test Method:	RSS-Gen Section 6.7
Measurement Distance:	3m
Limit:	N/A

# 7.1.1 E.U.T. Operation

Operating Environment:Temperature:26.7 °CHumidity:53.8 % RH

Test mode: a: TX mode\_Keep the EUT in transmitting with modulation mode

# 7.1.2 Test Setup Diagram



# Ground Reference Plane

## 7.1.3 Measurement Procedure and Data

The detailed test method see: RSS-Gen Section 6.7 The detailed test data see: Appendix RSS 210 FCC 15.249



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# 7.2 20dB Bandwidth

Test Requirement	47 CFR Part 15, Subpart C 15.215
Test Method:	ANSI C63.10 (2013) Section 6.9
Measurement Distance:	3m
Limit:	N/A

## 7.2.1 E.U.T. Operation

Operating Environment:

Temperature:27.7 °CHumidity:53.8 % RH:Test mode:a: TX mode\_Keep the EUT in transmitting with modulation mode

## 7.2.2 Test Setup Diagram



# **Ground Reference Plane**

## 7.2.3 Measurement Procedure and Data

The detailed test method see: ANSI C63.10 (2013) Section 6.9 The detailed test data see: Appendix RSS 210 FCC 15.249



# 7.3 Field Strength of the Fundamental Signal

Test Requirement	RSS-210 B10 (a)
	47 CFR Part 15, Subpart C 15.249(a)
Test Method:	ANSI C63.10 (2013) Section 6.5&6.6
Measurement Distance:	3m
Limit:	

Fundamental frequency(MHz)	Field strength of fundamental(millivolts/meter)	Field strength of harmonics(microvolts/meter)
902-928	50	500
2400-2483.5	50	500
5725-5875	50	500
24000-24250	250	2500

Remark: The frequencies above 1000MHz are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

For fundamental frequency in "902-928MHz", the field strength of fundamental is based on Quasi-Peak.



#### 7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 26.6 °C Humidity: 54.7 % RH

Test mode: a: TX mode Keep the EUT in transmitting with modulation mode

## 7.3.2 Test Setup Diagram



30MHz-1GHz

Above 1GHz

:

#### 7.3.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.

i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

The detailed test method see: ANSI C63.10 (2013) Section 6.5&6.6 The detailed test data see: Appendix RSS 210 FCC 15.249



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# 7.4 Radiated Emissions in the Restricted Bands

Test Requirement	RSS-Gen Section 8.9 & 8.10
	47 CFR Part 15, Subpart C 15.205 & 15.249(d) & 15.209
Test Method:	ANSI C63.10 (2013) Section 6.4&6.5&6.6
Measurement Distance:	3m
Limit:	

Frequency	Limit (dBuV/m@3m)	Remark			
30MHz-88MHz	40.0	Quasi-peak Value			
88MHz-216MHz	43.5	Quasi-peak Value			
216MHz-960MHz	46.0	Quasi-peak Value			
960MHz-1GHz	54.0	Quasi-peak Value			
Above 1GHz	54.0	Average Value			
Above 1GHz	74.0	Peak Value			
Emission radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.					



#### 7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 27.7 °C Humidity: 53.8 % RH

Test mode: a: TX mode Keep the EUT in transmitting with modulation mode

## 7.4.2 Test Setup Diagram



30MHz-1GHz

Above 1GHz

:

#### 7.4.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.

i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor



Frequency Antenna		Emission Le	vel (dBµV/m)	Limit (d	Limit (dBµV/m)	
(MHz)	Polarization	Peak	Average	Peak	Average	nesuit
614.000	Н	34.5	16.0	74.0	54.0	Pass
960.500	Н	39.5	20.5	74.0	54.0	Pass
614.000	V	34.6	16.0	74.0	54.0	Pass
960.500	V	39.6	20.5	74.0	54.0	Pass



# 7.5 Radiated Emissions

Test Requirement	RSS-Gen Section 8.9 & RSS-210 B10 (b)
	47 CFR Part 15, Subpart C 15.209 & 15.249 (a),(d)
Test Method:	ANSI C63.10 (2013) Section 6.4&6.5&6.6
Measurement Distance:	3m
Limit:	

Frequency(MHz)	Field strength (microvolts/meter)	Limit (dBuV/m)	Detector	Measurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	-	300
0.490-1.705	24000/F(kHz)	-	-	30
1.705-30	30	-	-	30
30-88	100	40.0	QP	3
88-216	150	43.5	QP	3
216-960	200	46.0	QP	3
960-1000	500	54.0	QP	3
Above 1000	500	54.0	AV	3



:

#### 7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 26.6 °C Humidity: 53.8 % RH

Test mode: a: TX mode Keep the EUT in transmitting with modulation mode

## 7.5.2 Test Setup Diagram



#### 7.5.3 Measurement Procedure and Data

For testing performed with the loop antenna, the center of the loop was positioned 1 m above the ground and positioned with its plane vertical at the specified distance from the EUT. During testing the loop was rotated about its vertical axis for maximum response at each azimuth and also investigated with the loop positioned in the horizontal plane. Only the worst position of vertical was shown in the report.



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#### Radiated emission below 1GHz

Mode:a; Polarization:Horizontal



Frequency	QuasiPeak	Pol.	Corr.	Margin	Limit	Booult
(MHz)	(dBµV/m)		(dB/m)	(dB)	(dBµV/m)	nesuit
45.962500	13.7	Н	14.2	26.4	40.0	Pass
143.741071	13.2	Н	13.9	30.4	43.5	Pass
337.487500	15.7	н	15.9	30.3	46.0	Pass
479.837500	19.9	Н	20.0	26.1	46.0	Pass
673.583929	23.4	н	22.9	22.6	46.0	Pass
858.207143	26.1	Н	25.4	19.9	46.0	Pass



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#### Mode:a; Polarization:Vertical



Frequency	QuasiPeak	Pol.	Corr.	Margin	Limit	Decult
(MHz)	(dBµV/m)		(dB/m)	(dB)	(dBµV/m)	Result
32.451786	17.1	v	13.0	22.9	40.0	Pass
166.235714	13.7	v	14.4	29.8	43.5	Pass
593.773214	22.4	v	22.0	23.7	46.0	Pass
718.573214	24.3	v	23.6	21.7	46.0	Pass
828.191071	25.8	v	25.2	20.2	46.0	Pass
895.605357	26.5	v	25.7	19.5	46.0	Pass

Remark: Only the worst case is shown.



# Above 1GHz

Frequency	Antenna	Emission Level (dBµV/m)		Limit (d	Bemark	
(MHz)	Polarizatio n	Peak	Average	Peak	Average	nomun
1834.000	Н	25.7	9.4	74.0	54.0	PASS
2751.000	Н	28.7	15.2	74.0	54.0	PASS
3668.000	Н	27.4	13.7	74.0	54.0	PASS
1834.000	V	27.7	9.6	74.0	54.0	PASS
2751.000	V	28.1	15.5	74.0	54.0	PASS
3668.000	V	27.7	13.8	74.0	54.0	PASS



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#### Photographs 8

# 8.1 EUT Constructional Details (EUT Photos)

Refer to the appendices external, internal and setup photos.



# 9 Appendix RSS 210 FCC 15.249

# 9.1 99% Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
917.000000	0.077068	N/A	N/A	916.979383	917.056451





# 9.2 20dB Bandwidth

DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
917.000000	0.052770	N/A	N/A	916.995060	917.047830



# 9.3 Field Strength of the Fundamental Signal

Frequency	Antenna	Emission Level (dBµV/m)		Limit (d	Remark	
(MHz)	Polarization	Peak	Average	Peak	Average	
917.000000	Н	63.8	60.0	114.0	94.0	PASS
917.000000	V	51.5	48.4	114.0	94.0	PASS

- End of the Report -