FCC and ISED Canada Testing of the

Ecolab Inc.
92053073

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

America

Add value.
Inspire trust.

Prepared for: Ecolab Inc.
1201 Jupiter Park Drive
Jupiter, FL 33458

FCC ID: Z9O-92053073
IC: 10060A-92053073

COMMERCIAL-IN-CONFIDENCE

Document Number: TP72156787.302 | Version Number: 03

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Authorized Signatory	Peter Walsh	2020 -March-16	
Testing	Thierry Jean-Charles	2020-March-16	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

FCC Accreditation Designation Number US1063 Tampa, FL Test Laboratory	Innovation, Science, and Economic Development Canada Accreditation Site Number 2087A-2 Tampa, FL Test Laboratory

EXECUTIVE SUMMARY
Samples of this product were tested and found to be in compliance with 15.209. and ISED Canada's RSS-210.

A2LA Cert. No. 2955.15

TÜV SÜD America
5610 West Sligh Ave., Suite 100
Tampa, FL 33634

Phone: 813-284-2715
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Contents

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	2020-February-27
2	Corrected Grantee Code	2020-March-05
3	Corrected Model Number	2020-March-16

1.2 Introduction

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.

Applicant	Ecolab Inc.
Manufacturer	Ecolab Inc.
Applicant's Email Address	david.snodgrass@ecolab.com
Model Number(s)	92053073
Serial Number(s)	N/A
FCC ID	Z9O-92053073
ISED Certification Number	10060A-92053073
Hardware Version(s)	1
Software Version(s)	1.00
Number of Samples Tested	1
Test Specification/Issue/Date	US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2019 Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-210 — Licence-Exempt Radio Apparatus: Category I Equipment, Issue 10, December 2019
Test Plan/Issue/Date	2020-January-15
Order Number	72156787
Date	2020-January-26
Date of Receipt of EUT	2020-February-13
Start of Test	2020-February-17
Finish of Test	2020-February-24
Name of Engineer(s)	Thierry Jean-Charles, Jean N. Rene
Related Document(s)	ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC Part 15.209 and ISED Canada's RSS-210 is shown below.

Table 1.3-1: Test Result Summary

Test Parameter	Test Plan (Yes/No)	Test Result	FCC 47 CFR Rule Part	ISED Canada's RSS	Test Report Page No
Antenna Requirement	Yes	Pass	15.203, 15.204	-------	10
20 dB Bandwidth	Yes	Pass	15.215(c)	-------	11
99% Bandwidth	Yes	Pass	-------	RSS-GEN 6.6	13
Radiated Field Strength of Fundamental and Spurious Emissions	Yes	Pass	15.209	RSS-210 2.5	15
Power Line Conducted Emissions	Yes	Pass	15.207	RSS-GEN 8.8	20

1.4 Product Information

1.4.1 Technical Description

The EUT, HHCM915 BDG ASSGMT DVC ASSY model 92053073, is used to change the internal configuration of an HCW Badge. The EUT includes a 917 MHz transceiver and a 125 kHz transmitter. The two radios are not capable of transmitting simultaneously. The test report addresses the compliance of the 125 kHz radio.

Technical Details
Mode of Operation: 125 kHz
Frequency Range: 125 kHz
Number of Channels: 1
Channel Separation: N/A
Data Rate: 2.4 kbps
Modulations: OOK
Antenna Type/Gain: Coil Antenna
Input Power: 5 VDC USB

A full description and detailed product specification details are available from the manufacturer.

Table 1.4.1-1 – Cable Descriptions

Cable/Port	Description
USB	1.8 m, Not Shielded, EUT to Laptop
Power	1.8m, Not Shielded, Molded Ferrite, Power Supply to Laptop
Power	0.98 m, Not Shielded, Power Supply to AC Mains

Table 1.4.1-2 – Support Equipment Descriptions

Make/Model	Description
Lenovo / B570	Laptop Computer, SN: WB06182206
Lenovo / CPA-A065	AC/DC Adapter 20V, 3.25 A, SN: 11S36001943ZZ40023J6EC

Declaration of Build Status

EQUIPMENT DESCRIPTION	
Model Name/Number	HHCM915 BDG ASSGMT DVC ASSY
Part Number	92053073
Hardware Version	1
Software Version	1.00
FCC ID (if applicable)	Z9O-92053073
ISED ID (if applicable)	10060A-92053073
Technical Description (Please provide a brief description of the intended use of the equipment)	Used to change the internal configuration of an HCW Badge.

UN-INTENTIONAL RADIATOR	
Highest frequency generated or used in the device or on which the device operates or tunes	917 MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	32.768kHz
Class A Digital Device (Use in commercial, industrial or business environment) ☒ (Used in hospitals, not sure if this is Class A) Class B Digital Device (Use in residential environment only) ☐	

Power Source			
AC	Single Phase	Three Phase	Nominal Voltage
	☐	☐	N/A
External DC	Nominal Voltage		Maximum Current
	5VDC		< 100mA
Battery	Nominal Voltage		Battery Operating End Point Voltage
	N/A		N/A

EXTREME CONDITIONS					
Maximum temperature	+40	°C	Minimum temperature	-0	°C

Ancillaries
Please list all ancillaries which will be used with the device.
USB cable attached to PC or laptop computer.

I hereby declare that the information supplied is correct and complete.

Name: David L. Snodgrass

Position held: Lead Electrical Engineer Date: 02/10/20

1.4.2 Modes of Operation

The EUT was configured to transmit continuously at 125 kHz at 100% duty cycle. The EUT was powered through a laptop computer via USB.

1.4.3 Monitoring of Performance

The EUT was evaluated for radiated, RF conducted and power line conducted emissions.

The radiated emissions evaluation was performed for the EUT in the orientation of typical use.

The bandwidth measurements were performed for the EUT configurated with an RF connector at the antenna port

1.4.4 Performance Criteria

The EUT was evaluated in accordance to FCC Part 15 Supbart C and ISED Canada RSS-210 for the following parameters.

Table 1.4.4 -1: Performance Criteria

Parameter	Requirement
Antenna Requirement	FCC: Section 15.203. 15.204
20 dB Bandwidth	FCC: Section 15.215(c)
99% Bandwidth	ISED Canada: RSS-GEN 6.6
Radiated Field Strength of Fundamental and Spurious Emissions	FCC: Section 15.209; ISED Canada: RSS-210 2.5
Power Line Conducted Emissions	FCC: Section 15.207; ISED Canada: RSS-GEN 8.8

1.5 Deviations from the Standard

The EUT was evaluated without any deviation from the test standards.

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test program. The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted

The equipment was tested as provided without any modifications.

1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Tampa FL Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
DC Powered Operating		
Antenna Requirement	Thierry Jean-Charles	A2LA
20 dB Bandwidth	Thierry Jean-Charles	A2LA
99% Bandwidth	Thierry Jean-Charles	A2LA
Radiated Field Strength of Fundamental and Spurious Emissions	Jean N. Rene	A2LA
Power Line Conducted Emissions	Jean N. Rene	A2LA

Office Address:

TÜV SÜD America, Inc.
5610 W. Sligh Ave, Suite 100
Tampa, FL 33634
USA

2 Test Details

2.1 Antenna Requirements

2.1.1 Specification Reference

FCC: Section 15.203, 15.204

2.1.2 Equipment Under Test and Modification State

SN: N/A

2.1.3 Date of Test

2/18/2020

2.1.4 Test Method

N/A

2.1.5 Environmental Conditions

Ambient Temperature	N/A
Relative Humidity	N/A
Atmospheric Pressure	N/A

2.1.6 Test Results

Limit Clause FCC Sections: 15.203, 15,204

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 EUT uses a coil antenna which is directly soldered to the PCB. The antenna is not removable/replaceable and therefore meets the requirements of FCC Section 15.203.

2.1.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

As this is a visual inspection, no test equipment was used.

2.2 20 dB Bandwidth

2.2.1 Specification Reference

FCC: Section 15.215

2.2.2 Equipment Under Test and Modification State

SN: N/A

2.2.3 Date of Test

2/18/2020

2.2.4 Test Method

The 20 dB bandwidth was measured in accordance with ANSI C63.10 Subclause 6.9.2. The spectrum analyzer span was set between two times and five times the OBW. The RBW of the spectrum analyzer was set to 1% to 5% if the OBW. The VBW was approximately three times RBW. A peak detector was used for the measurements.

2.2.5 Environmental Conditions

Ambient Temperature	24.2°C
Relative Humidity	41.2 %
Atmospheric Pressure	1018.5 mbar

2.2.6 Test Results

DC Powered Operating

Limit Clause FCC Part 15.215

The intentional radiator must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated.

Table 2.2.6-1: 20 dB Bandwidth Test Results

Frequency (kHz)	20 dB Bandwidth (kHz)
125.0	13.830

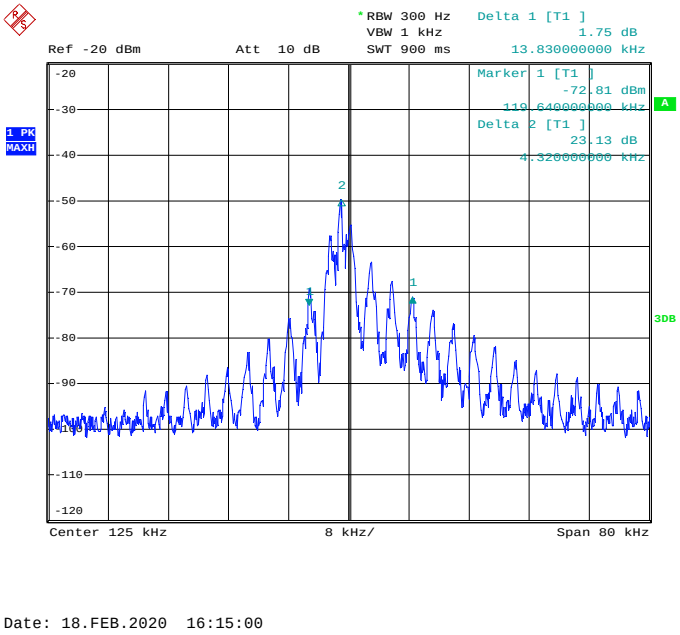

Figure 2.2.6-1: 20 dB Bandwidth Test Results

2.2.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

Instrument	Manufacturer	Type No	TE No	Software / Firmware Revision	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSP40	BEMC00283	4.50 SP5	24	04-Oct-2021
Attenuator 10dB, 2.9 mm-M/F, DC-40GHz 2 W	Aeroflex Inmet	40AH2W-10	BEMC02110	N/A	12	27-Jul-2020
Duratest High Frequency Cable Max. frequency 26.5GHz	Teledyne Storm Products	921-0101-036	BEMC02112	N/A	12	12-Oct-2020
PCB Loop Antenna	FAU EMI R&D Lab	EMI-LOOP	BEMC02141	N/A	N/A	NCR

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable
NCR – No Calibration Required

2.3 99% Bandwidth

2.3.1 Specification Reference

ISED Canada: RSS-GEN 6.6

2.3.2 Equipment Under Test and Modification State

SN: N/A

2.3.3 Date of Test

2/26/2020

2.3.4 Test Method

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission. The RBW was set to 1% to 5% of the approximated bandwidth. The occupied 99% bandwidth was measured by using 99% bandwidth equipment function of the spectrum analyzer using a peak detector.

2.3.5 Environmental Conditions

Ambient Temperature	24.2°C
Relative Humidity	41.2 %
Atmospheric Pressure	1018.5 mbar

2.3.6 Test Results

DC Powered Operating

Limit Clause ISED RSS-GEN 6.6

Table 2.3.6-1: 99% Bandwidth Test Results

Frequency (kHz)	99% Bandwidth (kHz)
125.0	16.850

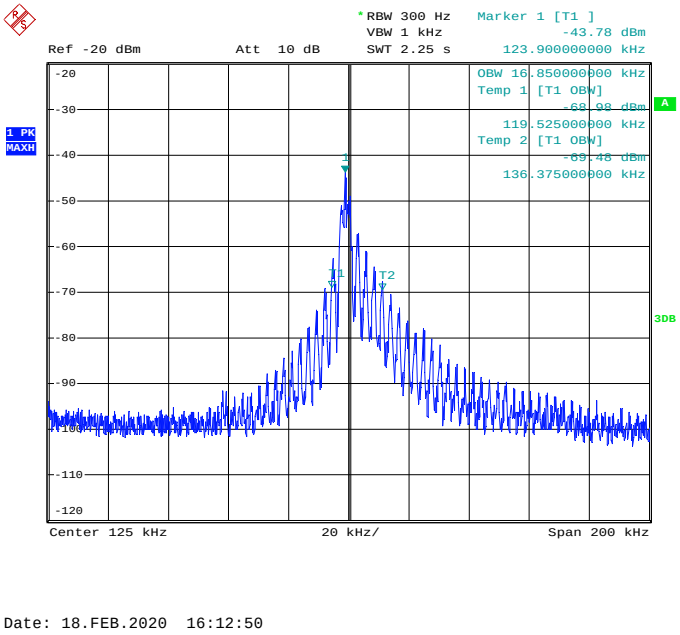

Figure 2.3.6-1: 99% Bandwidth Test Results

2.3.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

Instrument	Manufacturer	Type No	TE No	Software / Firmware Revision	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSP40	BEMC00283	4.50 SP5	24	04-Oct-2021
Attenuator 10dB, 2.9 mm-M/F, DC-40GHz 2 W	Aeroflex Inmet	40AH2W-10	BEMC02110	N/A	12	27-Jul-2020
Duratest High Frequency Cable Max. frequency 26.5GHz	Teledyne Storm Products	921-0101-036	BEMC02112	N/A	12	12-Oct-2020
PCB Loop Antenna	FAU EMI R&D Lab	EMI-LOOP	BEMC02141	N/A	N/A	NCR

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable
NCR – No Calibration Required

2.4 Radiated Field Strength and Spurious Emissions

2.4.1 Specification Reference

FCC Sections: 15.209;
ISED Canada: RSS-210 2.5

2.4.2 Equipment Under Test and Modification State

SN: N/A

2.4.3 Date of Test

2/17/2020 to 2/19/2020

2.4.4 Test Method

Radiated emissions tests were made over the frequency range of 9 kHz to 1 GHz, 10 times the highest fundamental frequency

For measurements below 30 MHz, the receive antenna height was set to 1 m 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. 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 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

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 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 measurements are made with RBW of 1 MHz and VBW of 3 MHz. Average measurements are performed in the linear scale using VBW of 30 Hz.

2.4.5 Duty Cycle Correction

The EUT was configured to transmit at 100% duty cycle during the evaluation. No Duty Cycle Correction Factor was applied to the average measurements for the corrected average results.

2.4.6 Environmental Conditions

Ambient Temperature	24.7 °C
Relative Humidity	40.9 %
Atmospheric Pressure	1019.4 mbar

2.4.7 Test Results

DC Powered Operating

Limit Clause FCC Sections 15.209, ISED Canada: RSS-210 2.5

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.4090-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

Table 2.4.7-1: Radiated Emissions Test Results

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	Pk	QPk/Avg			Pk	QPk/Avg	Pk	QPk/Avg	Pk	QPk/Avg
Fundamental Frequency										
0.125	64.45	56.03	H	14.44	78.89	70.47	125.7	105.7	46.8	35.2
0.125	70.16	63.21	V	14.44	84.60	77.65	125.7	105.7	41.1	28.0
Spurious Emissions below 30 MHz										
0.375	45.59	37.33	V	14.34	59.93	51.67	116.1	96.1	56.2	44.4
Spurious Emissions above 30 MHz										
30.08	-------	2.87	V	25.50	-------	28.37	-------	40	-------	11.6
30.12	-------	2.98	V	25.50	-------	28.48	-------	40	-------	11.5
49.16	-------	13.91	V	15.20	-------	29.11	-------	40	-------	10.9
49.4	-------	14.72	V	15.20	-------	29.92	-------	40	-------	10.1
120.72	-------	12.72	H	19.80	-------	32.52	-------	43.5	-------	11.0
209.48	-------	15.26	H	17.20	-------	32.46	-------	43.5	-------	11.0
209.96	-------	16.16	H	17.10	-------	33.26	-------	43.5	-------	10.2
265.56	-------	19.10	H	21.60	-------	40.70	-------	46	-------	5.3
313.84	-------	15.27	H	22.20	-------	37.47	-------	46	-------	8.5
697.6	-------	0.73	H	28.90	-------	29.63	-------	46	-------	16.4
699.48	-------	0.91	H	29.00	-------	29.91	-------	46	-------	16.1
893.24	-------	6.56	H	31.20	-------	37.76	-------	46	-------	8.2

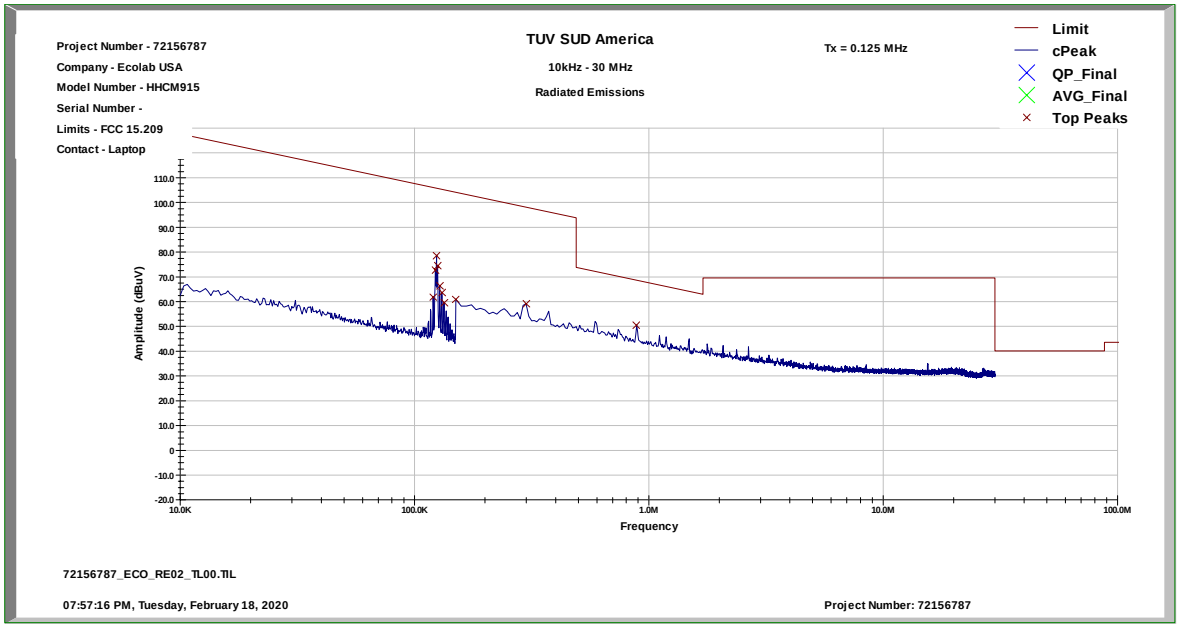

Figure 2.4.7-1: Radiated Emissions 9 kHz – 30 MHz – Vertical Polarization

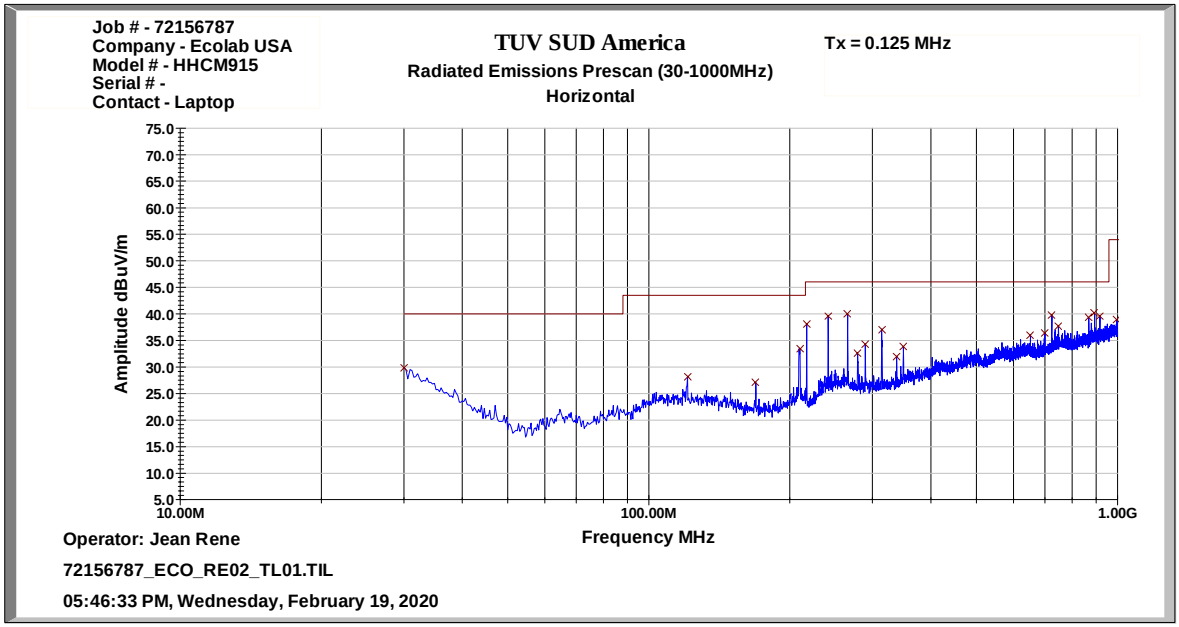

Figure 2.4.7-2: Radiated Emissions 30 MHz – 1 GHz – Horizontal Polarization

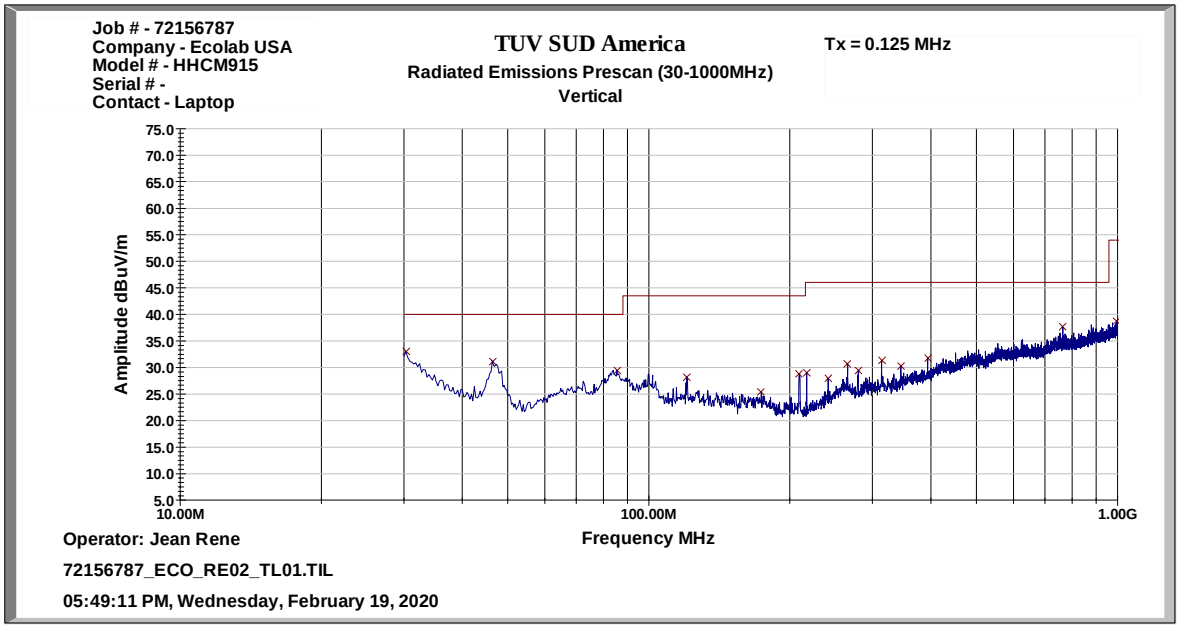

Figure 2.4.7-3: Radiated Emissions 30 MHz – 1 GHz – Vertical Polarization

2.4.8 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: 45.59 + 14.34 = 59.93 dBµV/m
Margin: 116.1 dBµV/m – 59.93 dBµV/m = 56.17 dB

Example Calculation: Average
Corrected Level: 37.33 + 0.69 - 0= 51.67 dBµV/m
Margin: 96.1 dBµV/m – 51.67 dBµV/m = 44.43 dB

2.4.9 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

Instrument	Manufacturer	Type No	TE No	Software / Firmware Revision	Calibration Period (months)	Calibration Due
9kHz-26.5GHz EMC analyzer/HYZ	Agilent	E7405A	BEMC00523	A.14.06	24	27-Nov-2020
Tile Automation Software	ETS Lindgren	TILE4! - Version 4.2.A	BEMC02095	4.2A	N/A	NCR
BI LOG PERIODIC, ANTENNA	Schaffner	CBL6112B	TEMC00005	N/A	24	31-Oct-2021
Loop Antenna	Com Power	AL-130	TEMC00025	N/A	24	26-Sep-2021
EMC Chamber	Panashield	N/A	TEMC00031	N/A	36	28-Jan-2021
Double Ridge Guide Horn	ETS Lindgren	3117	TEMC00061	N/A	24	13-Feb-2020
EMI Test Receiver	Rohde & Schwarz	ESIB 40	TEMC00128	4.35	24	03-Oct-2021
PAM-118A	Com-Power Corporation	PAM-118A	TEMC00160	N/A	12	27-Apr-2020
4A & 4B Test Cables	MegaPhase, LLC	1GVT4	TEMC00171	N/A	24	30-May-2020
Radiated Cable Set 30 MHz - 1 GHz	TUV SUD Tampa	Cable 2	TEMC00179	N/A	12	07-May-2020
Test Software	Rohde & Schwarz	EMC32	TEMC00184	10.50.00	N/A	NCR
Radiated Cable Set 9 kHz - 30 MHz	TUV SUD Tampa	Cable 2	TEMC00186	N/A	12	08-May-2020

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable
NCR – No Calibration Required

2.5 Power Line Conducted Emissions

2.5.1 Specification Reference

FCC: Section 15.207
ISED Canada; RSS-GEN 8.8

2.5.2 Equipment Under Test and Modification State

S/N:N/A

2.5.3 Date of Test

2/19/2020

2.5.4 Test Method

ANSI C63.10 section 6.2 was the guiding document for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

2.5.5 Environmental Conditions

Ambient Temperature	24.4 °C
Relative Humidity	40.8 %
Atmospheric Pressure	1022 mbar

2.5.6 Test Results

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

Table 2.5.6-1: Quasi-Peak Conducted Emissions Test Results

Frequency (MHz)	Quasi-peak (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	51.13	L1	9.9	14.87	66.00
0.357000	31.62	L1	10.0	27.18	58.80
0.465000	32.49	L1	10.0	24.11	56.60
1.293000	24.58	N	10.5	31.42	56.00
3.439500	23.72	N	10.6	32.28	56.00
3.642000	22.92	N	10.6	33.08	56.00
17.425500	30.31	N	11.4	29.69	60.00
21.678000	36.22	N	11.5	23.78	60.00
25.579500	35.44	L1	11.8	24.56	60.00
27.933000	38.92	N	11.7	21.08	60.00

Table 2.5.6-2: Average Conducted Emissions Test Results

Frequency (MHz)	Average (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	35.39	N	10.2	20.61	56.00
0.384000	20.42	N	10.3	27.77	48.19
0.487500	21.96	L1	10.0	24.25	46.21
1.171500	17.02	N	10.5	28.98	46.00
2.107500	18.11	N	10.5	27.89	46.00
2.679000	18.59	N	10.6	27.41	46.00
3.619500	16.80	N	10.6	29.20	46.00
15.445500	24.65	N	11.3	25.35	50.00
27.825000	31.68	N	11.7	18.32	50.00

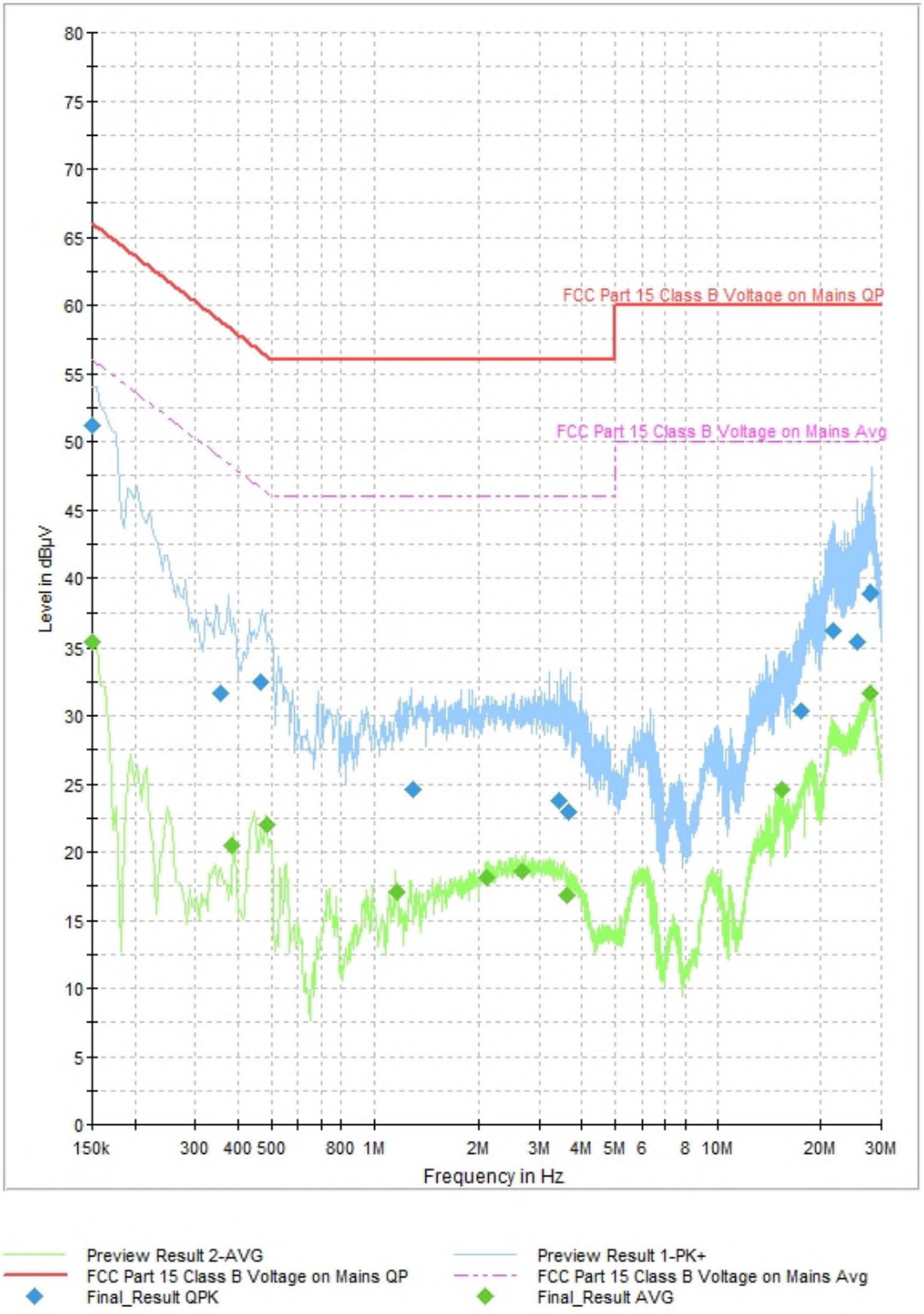

Figure 2.5.6-1: Line and Neutral Conducted Emissions Composite Plot

2.5.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

Instrument	Manufacturer	Type No	TE No	Software / Firmware Revision	Calibration Period (months)	Calibration Due
LISN	Rohde & Schwarz	ESH3-Z5	TEMC00002	N/A	24	30-Sep-2021
EMI Test Receiver	Rohde & Schwarz	ESCS30	TEMC00011	2.3002.0102.36	24	03-Oct-2021
RFI/EMI Shielded Enclosure	UNIVERSAL SHIELDING CORP.	N/A	TEMC00100	N/A	N/A	NCR
Test Software	Rohde & Schwarz	EMC32	TEMC00184	10.50.00	N/A	NCR

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable
NCR – No Calibration Required

3 Test Equipment Information

3.1 General Test Equipment Used

Instrument	Manufacturer	Type No	TE No	Software / Firmware Revision	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSP40	BEMC00283	4.50 SP5	24	04-Oct-2021
9kHz-26.5GHz EMC analyzer/HYZ	Agilent	E7405A	BEMC00523	A.14.06	24	27-Nov-2020
Tile Automation Software	ETS Lindgren	TILE4! - Version 4.2.A	BEMC02095	4.2A	N/A	NCR
Attenuator 10dB, 2.9 mm-M/F, DC-40GHz 2 W	Aeroflex Inmet	40AH2W-10	BEMC02110	N/A	12	27-Jul-2020
Duratest High Frequency Cable Max. frequency 26.5GHz	Teledyne Storm Products	921-0101-036	BEMC02112	N/A	12	12-Oct-2020
PCB Loop Antenna	FAU EMI R&D Lab	EMI-LOOP	BEMC02141	N/A	N/A	NCR
LISN	Rohde & Schwarz	ESH3-Z5	TEMC00002	N/A	24	30-Sep-2021
BI LOG PERIODIC, ANTENNA	Schaffner	CBL6112B	TEMC00005	N/A	24	31-Oct-2021
EMI Test Receiver	Rohde & Schwarz	ESCS30	TEMC00011	2.3002.0102.36	24	03-Oct-2021
Loop Antenna	Com Power	AL-130	TEMC00025	N/A	24	26-Sep-2021
EMC Chamber	Panashield	N/A	TEMC00031	N/A	36	28-Jan-2021
Double Ridge Guide Horn	ETS Lindgren	3117	TEMC00061	N/A	24	13-Feb-2020
RFI/EMI Shielded Enclosure	UNIVERSAL SHIELDING CORP.	N/A	TEMC00100	N/A	N/A	NCR
EMI Test Receiver	Rohde & Schwarz	ESIB 40	TEMC00128	4.35	24	03-Oct-2021
PAM-118A	Com-Power Corporation	PAM-118A	TEMC00160	N/A	12	27-Apr-2020
4A & 4B Test Cables	MegaPhase, LLC	1GVT4	TEMC00171	N/A	24	30-May-2020
Radiated Cable Set 30 MHz - 1 GHz	TUV SUD Tampa	Cable 2	TEMC00179	N/A	12	07-May-2020
Test Software	Rohde & Schwarz	EMC32	TEMC00184	10.50.00	N/A	NCR
Radiated Cable Set 9 kHz - 30 MHz	TUV SUD Tampa	Cable 2	TEMC00186	N/A	12	08-May-2020

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable
NCR – No Calibration Required

4 Diagram of Test Set-ups

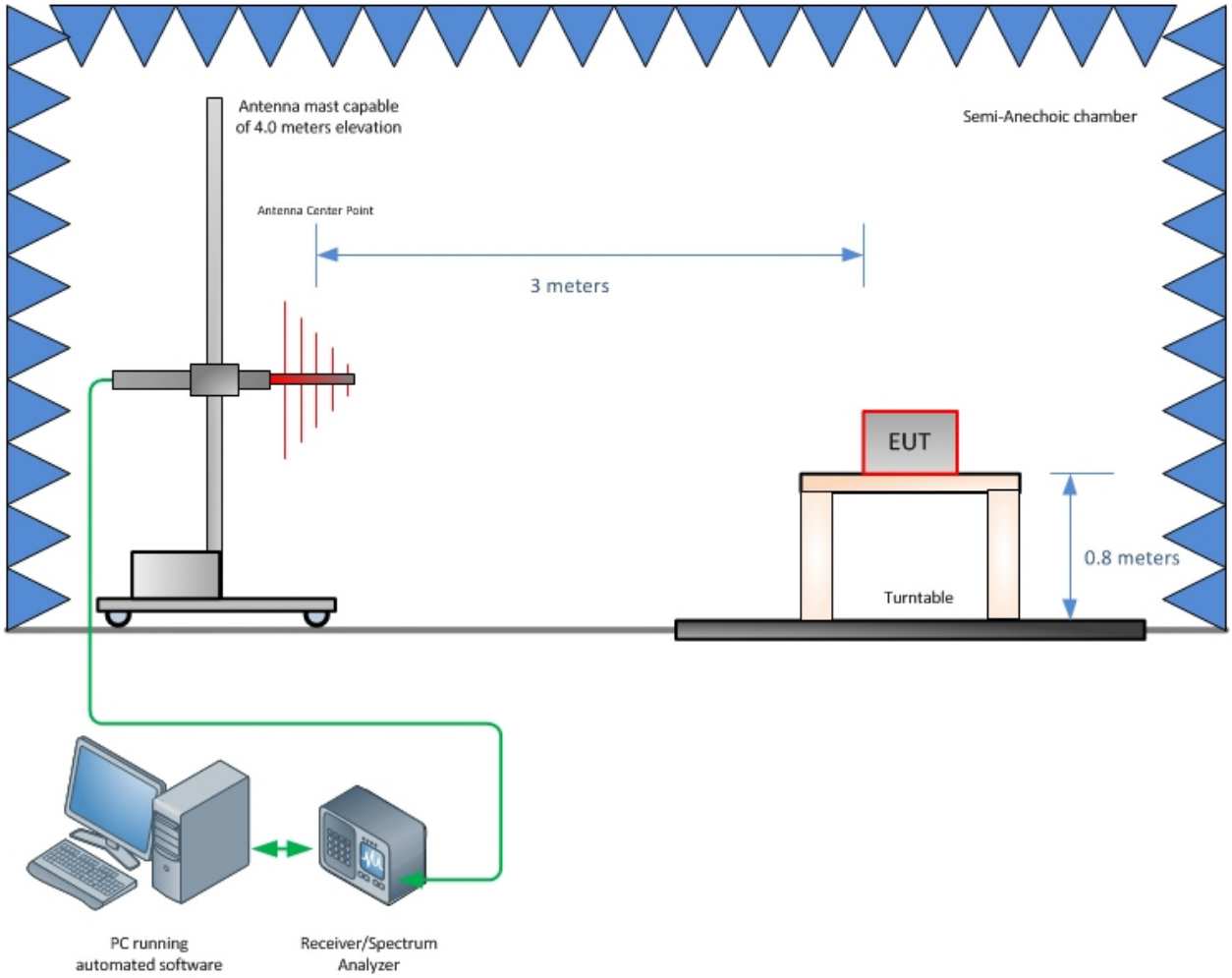

Figure 4-1 - Radiated Emissions Test Setup up to 1 GHz

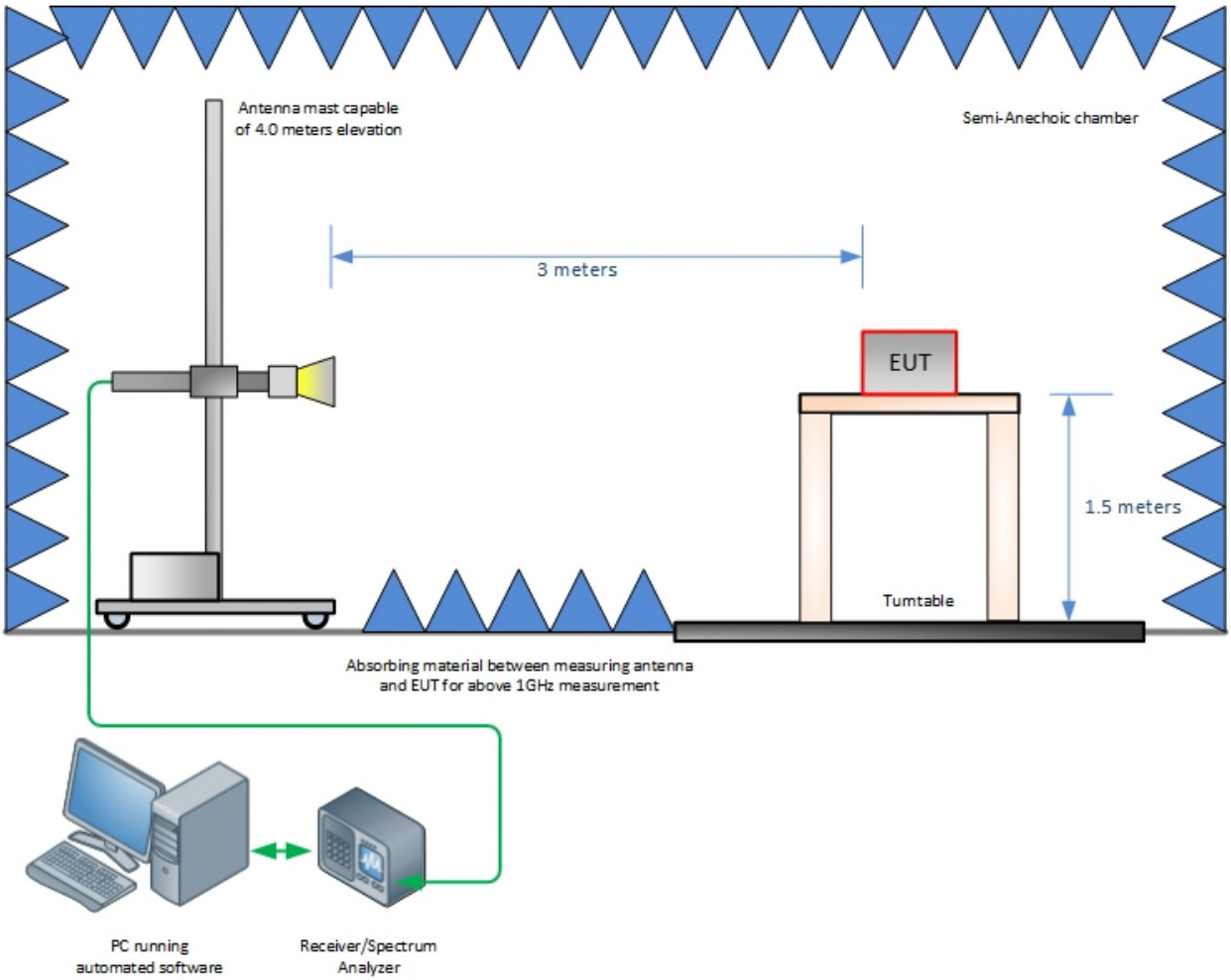

Figure 4-2 - Radiated Emissions Test Setup above 1 GHz

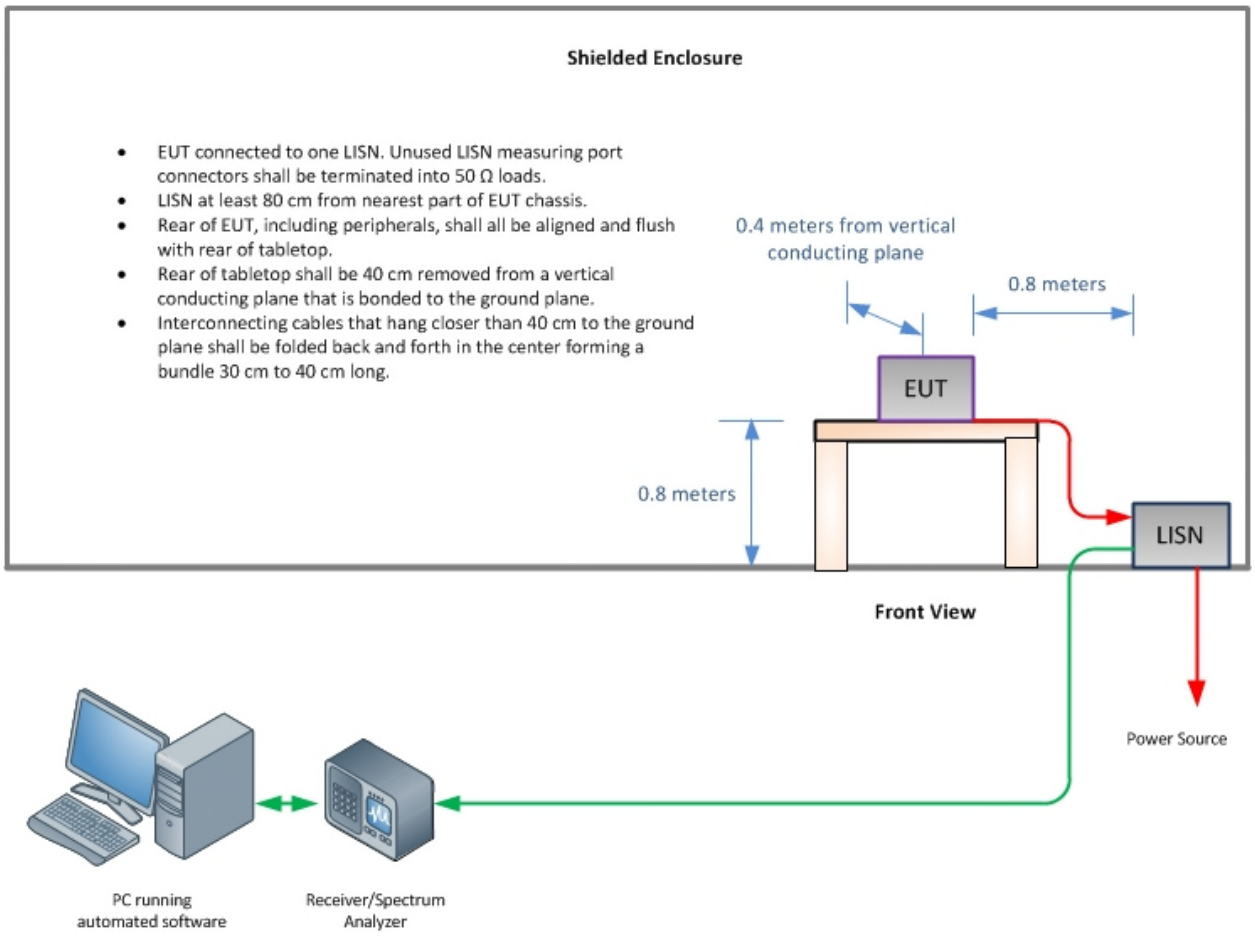

Figure 4-3 – Conducted Emissions Test Setup

5 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Table 5-1 - Values of U_{cispr} and U_{Lab}

Measurement	U_{cispr}	U_{Lab}
Conducted disturbance (mains port) (9 kHz – 150 kHz) (150 kHz – 30 MHz)	 3.8 dB 3.4 dB	 3.71 dB 3.31 dB
Conducted disturbance (telecom port) (150 kHz – 30 MHz 55 dB LCL) (150 kHz – 30 MHz 65 dB LCL) (150 kHz – 30 MHz 75 dB LCL)	 5.0 dB 5.0 dB 5.0 dB	 4.11 dB 4.50 dB 4.94 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1 000 MHz) (1 – 6 GHz) (6-18 GHz)	 6.3 dB 5.2 dB 5.5 dB	 5.85 dB 4.48 dB 4.48 dB

Notes:

U_{cispr} resembles a value of measurement uncertainty for a specific test, which was determined by considering uncertainties associated with the quantities listed in CISPR 16-4-2:2011.

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