Certification Test Report

FCC ID: 2ADCB-RMODIT
IC: 6715C-RMODIT

FCC Rule Part: 15.247
ISED Canada Radio Standards Specification: RSS-247

Report Number: AT72160386-2P1

Manufacturer: Acuity Brands Lighting, Inc.
Model: RMODIT

Test Begin Date: June 15, 2020
Test End Date: June 22, 2020

Report Issue Date: October 12, 2020

FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: 2955.09

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Prepared By:

Jeremy Pickens
Senior Wireless Engineer
TÜV SÜD America Inc.

Reviewed by:

Ryan McGann
Senior Wireless Engineer
TÜV SÜD America Inc.

This report contains 20 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-247 Certification for a Class II Permissive Change.

The purpose of this permissive change is to add a new antenna and host device for the 2.4GHz and 900MHz radios.

1.2 Applicant Information

Acuity Brands Lighting, Inc.
One Lithonia Way
Conyers, GA 30012

1.3 Product Description

The RMODIT RF Module is a device designed to solder directly to another PCB using castellated edges. The product is intended to allow a variety of Acuity Brands devices to communicate in a wireless network. This can either be done by using an external host processor, or by using the processor on the module.

There are two radios on the module. One radio is a 2.4GHz Bluetooth Radio. The other radio is a proprietary 904-926MHz (915MHz) Implementation. The 904MHz-926MHz radio is 100kbps O-QPSK DSSS 8 symbols/bit. These radios are capable of transmitting and receiving at the same time.

This report documents the 904 – 926MHz transmitter only. The 2.4GHz transmitter evaluation is documented in a separate report.

Technical Information:

Detail	Description
Frequency Range	904 – 926 MHz
Number of Channels	12
Modulation Format	O-QPSK
Data Rates	100kbps
Operating Voltage	4.5Vdc Batteries (Host)
Antenna Type(s) / Gain(s)	PCB Flex Antenna: 0.8dBi

Test Sample Serial Number: Sample PDT1 #2

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.4 Test Methodology and Considerations

All modes of operation, including all available data rates, were evaluated. The data presented in this report represents the worst case where applicable.

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was Y-orientation. The EUT was programmed to generate a continuously modulated signal on each channel evaluated.

Power line conducted emissions was not applicable as the device is battery-powered with no facility to connect to the AC mains.

For RF Conducted power measurements, the EUT was coupled to the measurement equipment via a SMA coaxial pigtail. For testing, the EUT was programmed to generate a continuously modulated signal on each channel evaluated.

This device contains two independent radios which can transmit simultaneously. Radiated inter-modulation testing was performed for the combination of simultaneous transmissions and found to comply.

Software power setting during test: 200

2 TEST FACILITIES

2.1 Location

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

TÜV SÜD America, Inc.
5945 Cabot Pkwy, Suite 100
Alpharetta, GA 30005
Phone: (678) 341-5900

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 in recognition of this accreditation.

Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scopes of accreditation.

The Semi-Anechoic Chamber Test Sites and Conducted Emissions Sites have been fully described, submitted to, and accepted by the FCC, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Designation Accreditation Number:	US1233
FCC Test Site Registration Number:	967699
ISED Canada Lab Code:	23932
VCCI Member Number:	1831
• VCCI Registration Number	A-0295

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site – Chamber A

The Semi-Anechoic Chamber Test Site consists of a 20’ x 30’ x 18’ shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 5’ in diameter and is located 5’6” from the back wall of the chamber. The chamber is grounded via 1 - 8’ copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted EMCO Model 1060 installed in an all steel frame. The table is remotely operated from inside the control room located 25’ from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3’ x 6’ x 4’ deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4” PVC chase from the turntable to the pit that allows for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit, so cables can be supplied to the EUT from the pit.

The chamber rear wall is covered with a mixture of Siepel pyramidal absorber. The side walls of the chamber are partially covered with Siepel pyramidal absorber.

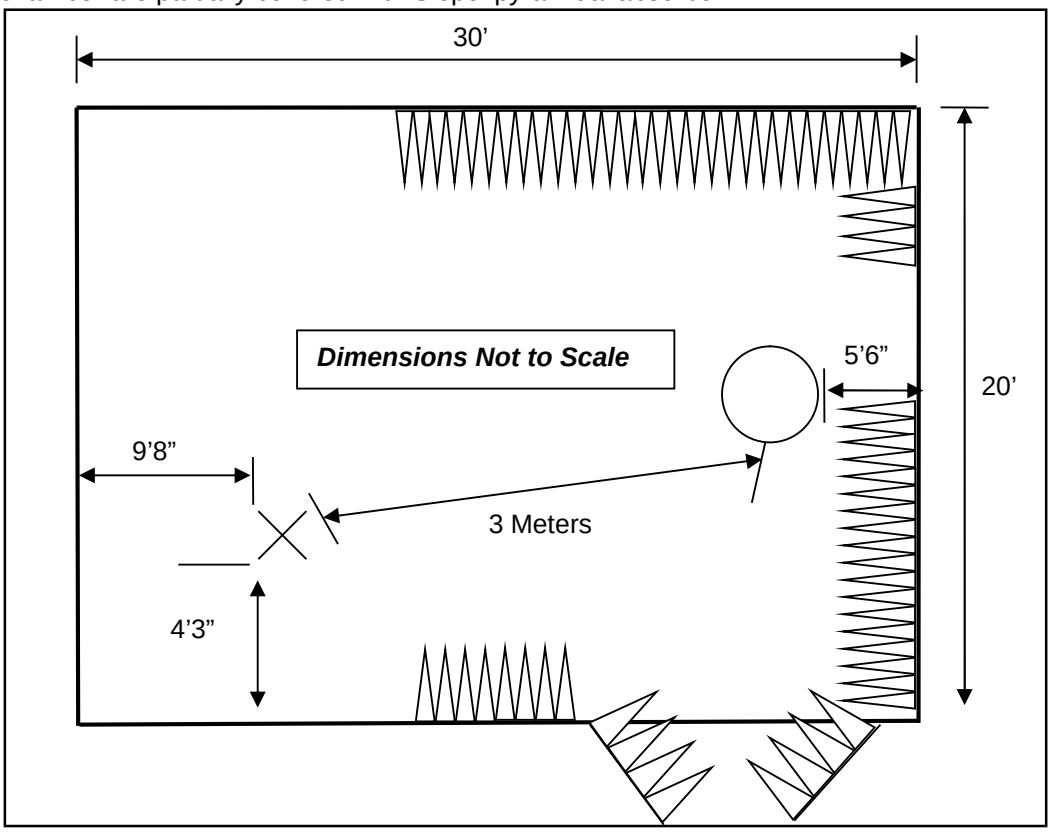


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site – Chamber A

2.3.2 Semi-Anechoic Chamber Test Site – Chamber B

The Semi-Anechoic Chamber Test Site consists of a 20'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170 and installed off the center axis is located 5'6" from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.

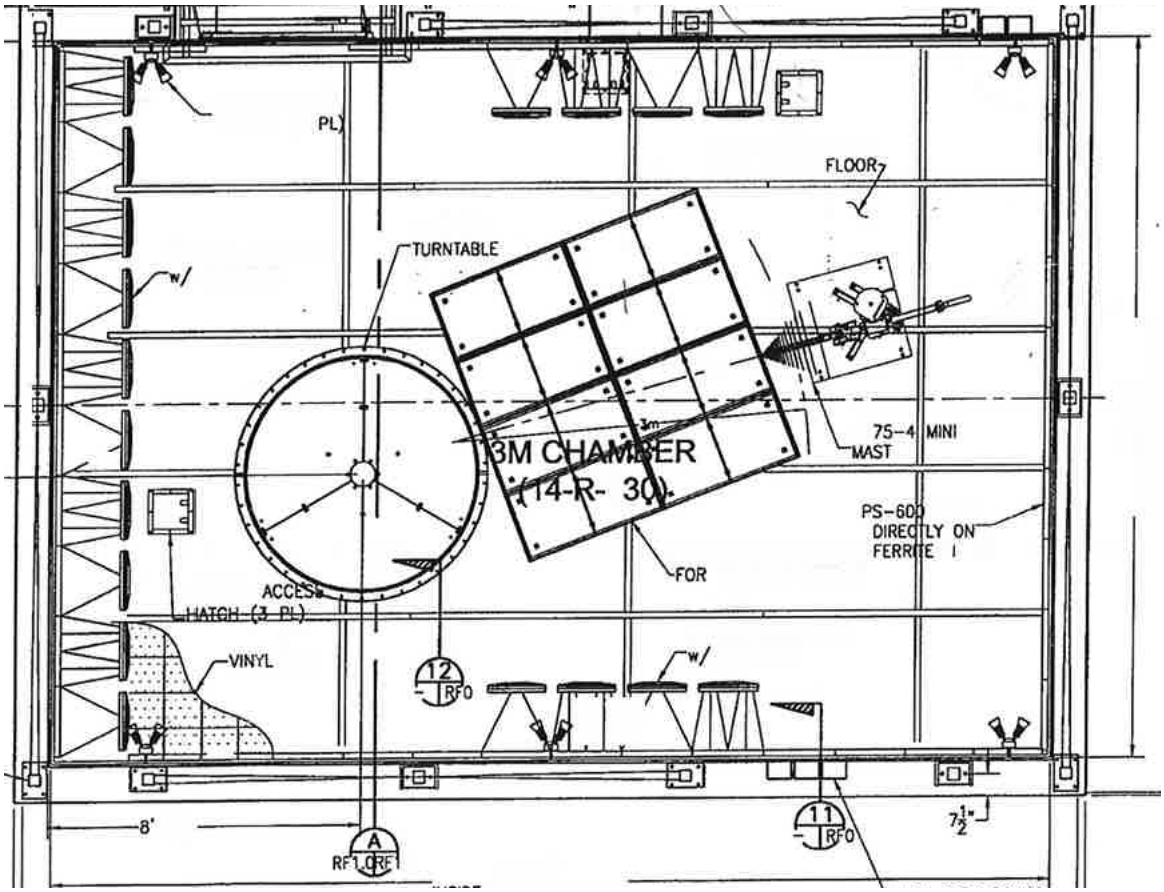


Figure 2.3.2-1: Semi-Anechoic Chamber Test Site – Chamber B

2.4 Conducted Emissions Test Site Description

2.4.1 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main EMC lab. It consists of a 12' x 10' horizontal coupling plane (HCP) as well as a 12'x8' vertical coupling plane (VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via by screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

The HCP and VCP are electrically bonded together using 1"x1" angled aluminum secured with screws.

The site is of sufficient size to test tabletop and floor standing equipment in accordance with section 6.1.4 of ANSI C63.10.

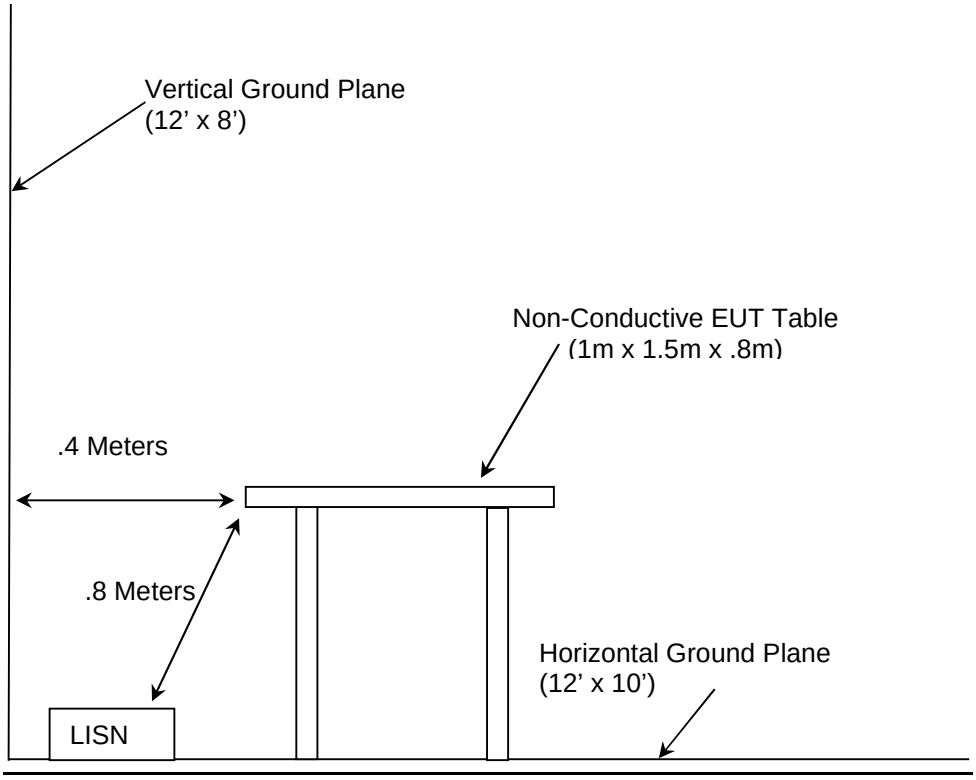


Figure 2.4.1-1: AC Mains Conducted EMI Site

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, 2020
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2020
- FCC KDB 558074 D01 DTS Meas Guidance v05r02 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, April 2, 2019
- ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017.
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, April 2018 + Amendment 1, March 2019

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

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
22	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A00526	07/11/2018	07/11/2020
30	Spectrum Technologies	DRH-0118	1-18GHz Horn Antenna	970102	05/29/2019	05/29/2021
267	Hewlett Packard	N1911A	Power Meter	MY45100129	07/26/2019	07/26/2021
268	Hewlett Packard	N1921A	Power Sensor	MY45240184	07/26/2019	07/26/2021
321	Hewlett Packard	HPC 8447D	Low Freq. Pre-Amp	1937A02809	09/12/2019	09/12/2020
337	Microwave Circuits	H1G513G1	Microwave Bandpass Filter	282706	6/7/2020	6/7/2021
628	EMCO	6502	Active Loop Antenna 10kHz-30MHz	9407-2877	02/11/2019	11/02/2021
651	Rohde & Schwarz	TS-PR26	18GHz to 26.5GHz Pre-Amplifier	100023	07/10/2019	07/10/2020
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	4/2/2020	4/2/2021
851	TUV ATLANTA	FMC0101951-100CM	ASAC Cable Set Consisting of 566, 619, and 564	N/A	10/01/2019	10/01/2020
852	Teseq	CBL 6112D	Bilog Antenna; Attenuator	51617	10/15/2018	10/15/2020

NOTE: All test equipment was used only during active calibration cycles.

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	Sensor	Acuity Brands Lighting	RMODIT	Sample PDT1 #2

Table 5-2: Cable Description

Item	Cable Type	Length	Shield	Termination
The device was battery-powered with no interface cabling				

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

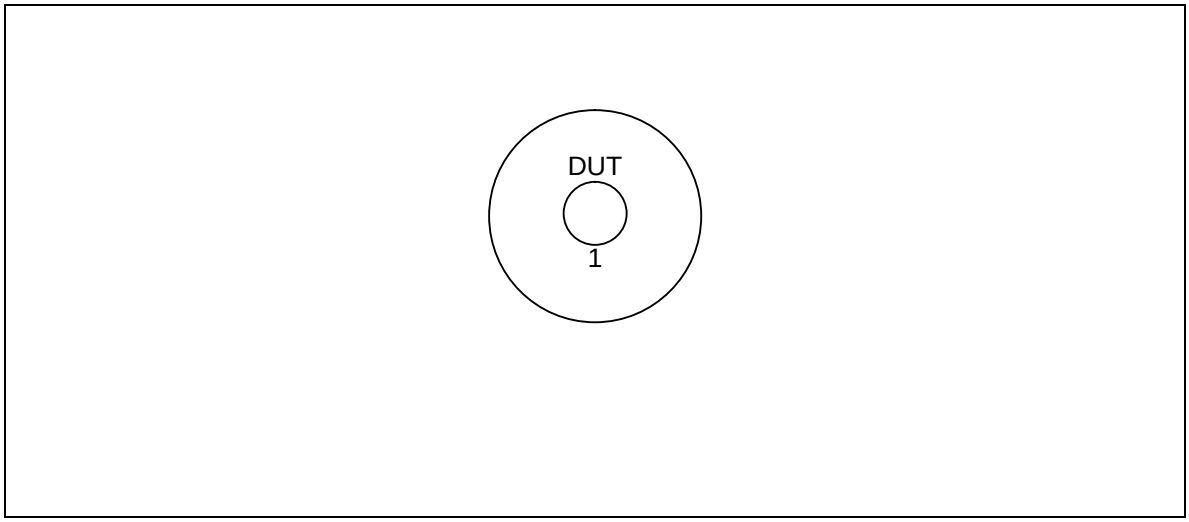


Figure 6-1: Test Setup Block Diagram

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 RMODIT couples to the PCB flex antenna via a U.FL connector which meets the unique antenna connector requirements in 15.203. The antenna has 0.8dBi gain in the 900MHz band.

7.2 Power Line Conducted Emissions – FCC: Section 15.207; ISED Canada: RSS-Gen 8.8

7.2.1 Measurement Procedure

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

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

7.2.2 Measurement Results

AC power line conducted emissions testing was not required as the host is battery-powered with no facility for connection to the AC mains.

7.3 Fundamental Emission Output Power – FCC: Section 15.247(b)(3); ISED Canada: RSS-247 5.4(d)

7.3.1 Measurement Procedure

The maximum conducted output power was measured in accordance with FCC KDB 558074 D01 DTS Meas Guidance utilizing the PKPM1 procedure. The RF output of the equipment under test was directly connected to the input of the power meter applying suitable attenuation.

7.3.2 Measurement Results

Performed by: Jeremy Pickens

Table 7.3.2-1: Maximum Conducted Peak Output Power

Frequency (MHz)	Level (dBm)
904	19.35
914	19.24
926	19.24

7.4 Emission Levels

7.4.1 Emissions into Restricted Frequency Bands – FCC: Sections 15.205, 15.209; ISED Canada: RSS-Gen 8.9 / 8.10

7.4.1.1 Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 9 kHz to 10 GHz, 10 times the highest fundamental frequency.

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. For frequencies above 1000 MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209. Emissions not reported were below the noise floor of the measurement system. Peak data below 30MHz was more than 20dB below the applicable limits.

7.4.1.2 Duty Cycle Correction Factor

For average radiated measurements, using a 30.48% duty cycle, the measured level was reduced by a factor of 10.32dB. The duty cycle correction factor is determined using the formula: 20 x log (30.48/100) = -10.32dB.

The duty cycle for the RMODIT is hardwired to the device and limited by the software of the radio device, therefore the duty cycle is not accessible by the end user. A detailed analysis of the duty cycle timing is provided in the Theory of Operations accompanying the application of the original certification.

7.4.1.3 Measurement Results

Performed by: Jeremy Pickens

Table 7.4.1.3-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBµV/m)		Limit (dBµV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Lowest Channel										
2712	45.20	33.50	H	4.10	49.30	27.28	74.0	54.0	24.7	26.7
2712	46.80	36.40	V	4.10	50.90	30.18	74.0	54.0	23.1	23.8
3616	48.40	38.40	H	7.13	55.53	35.21	74.0	54.0	18.5	18.8
3616	50.50	41.30	V	7.13	57.63	38.11	74.0	54.0	16.4	15.9
Middle Channel										
2742	45.00	33.00	H	4.29	49.29	26.97	74.0	54.0	24.7	27.0
2742	48.70	39.10	V	4.29	52.99	33.07	74.0	54.0	21.0	20.9
3656	49.90	41.00	H	7.25	57.15	37.94	74.0	54.0	16.8	16.1
3656	54.80	47.40	V	7.25	62.05	44.34	74.0	54.0	11.9	9.7
4570	43.70	30.40	H	10.08	53.78	30.16	74.0	54.0	20.2	23.8
4570	44.1	30.6	V	10.08	54.18	30.36	74.0	54.0	19.8	23.6
Highest Channel										
2778	44.9	32.1	H	4.53	49.43	26.31	74.0	54.0	24.6	27.7
2778	49.6	39.8	V	4.53	54.13	34.01	74.0	54.0	19.9	20.0
3704	49.6	40.1	H	7.41	57.01	37.19	74.0	54.0	17.0	16.8
3704	54.4	46.9	V	7.41	61.81	43.99	74.0	54.0	12.2	10.0
4630	43.8	31.1	H	10.14	53.94	30.92	74.0	54.0	20.1	23.1
4630	44.4	32	V	10.14	54.54	31.82	74.0	54.0	19.5	22.2

7.4.1.4 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 – Middle Channel – 3656MHz

Corrected Level: 54.8 + 7.25 = 62.05dBuV/m
Margin: 74dBuV/m – 62.05dBuV/m = 11.9dB

Example Calculation: Average – Middle Channel – 3656MHz

Corrected Level: 47.4 + 7.25 – 10.32 = 44.34dBuV
Margin: 54dBuV – 44.34dBuV = 9.7dB

8 ESTIMATION OF MEASUREMENT UNCERTAINTY

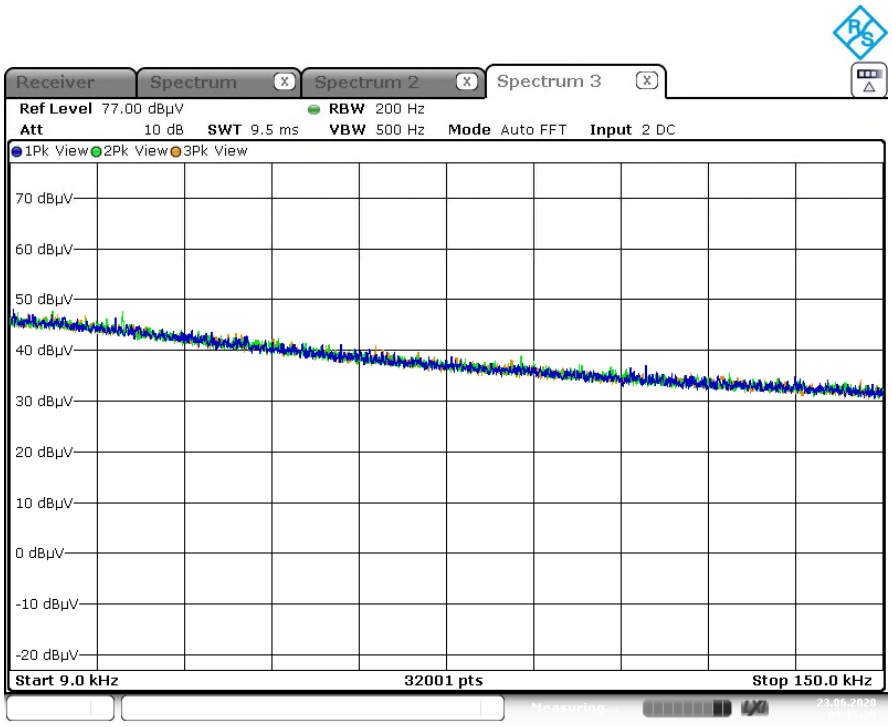
The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

Parameter	U_{lab}
Occupied Channel Bandwidth	± 0.009 %
RF Conducted Output Power	± 0.349 dB
Power Spectral Density	± 0.372 dB
Antenna Port Conducted Emissions	± 1.264 dB
Radiated Emissions ≤ 1 GHz	± 5.814 dB
Radiated Emissions > 1 GHz	± 4.318 dB
Temperature	± 0.860 °C
Radio Frequency	± 2.832 x 10^{-8}
AC Power Line Conducted Emissions	± 3.360 dB

9 CONCLUSION

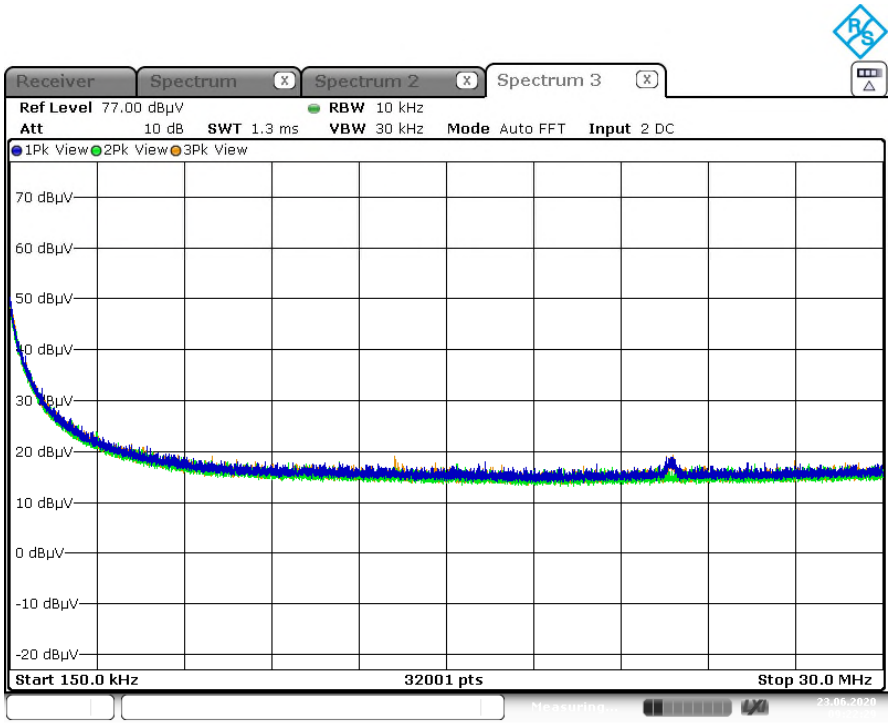
In the opinion of TÜV SÜD America, Inc. the RMODIT, manufactured by Acuity Brands Lighting, Inc. meets the requirements of FCC Part 15 subpart C and ISED Canada's Radio Standards Specification RSS-247 for Class II Permissive Change for the tests documented in this test report.

Appendix A: Plots



Date: 23.JUN.2020 09:15:21

Figure A-1: 9kHz-150kHz1GHz – Radiated Emissions



Date: 23.JUN.2020 09:22:29

Figure A-2: 150kHz-30MHz1GHz – Radiated Emissions

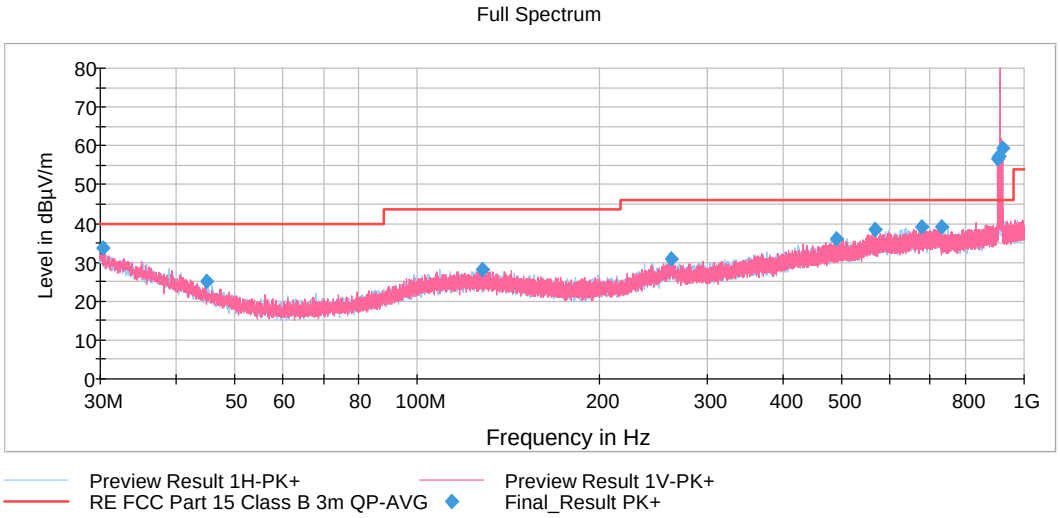


Figure A-3: 30MHz-1GHz – Radiated Emissions

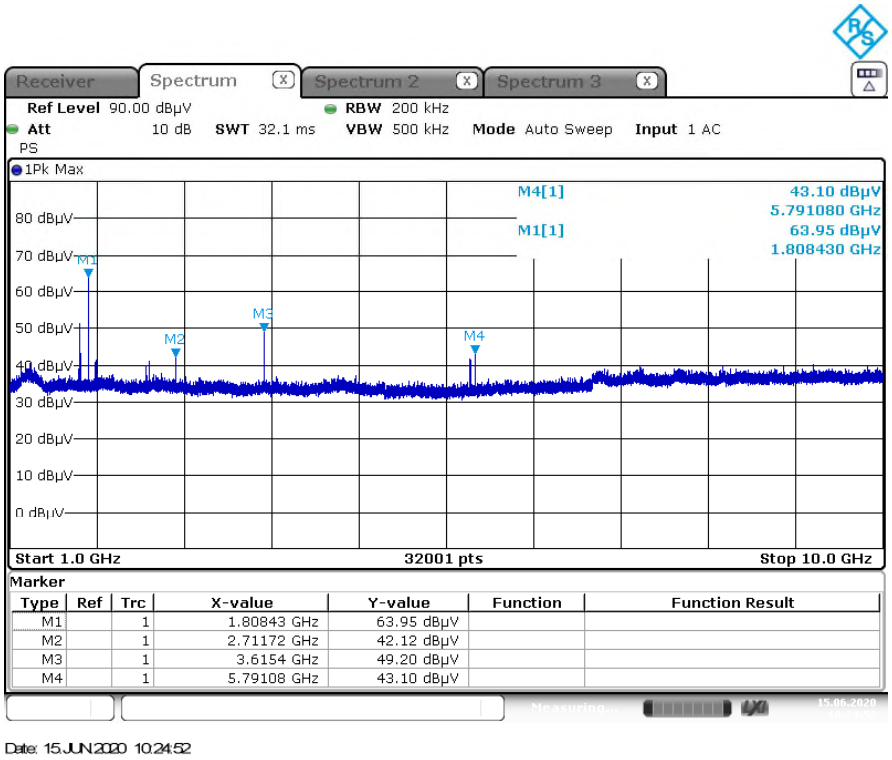


Figure A-4: 1GHz-10GHz – Radiated Emissions

END REPORT