

Report on the FCC and ISED Testing of the

Cooper Lighting LLC

MTR-H5-B09

In accordance with FCC Rule Part 15.247 & ISED
Radio Standard RSS-247

Prepared for: Cooper Lighting LLC
1121 Hwy 74 S
Peachtree City GA, 30269

FCC ID: 2AKCYLMSWFG IC: 4706A-LMSWFG

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EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC Rule Part 15.247, ISED Radio Standard RSS-247



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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 15.247 and Innovation Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

The test report documents compliance of the 802.11b/g/n Wi-Fi transmitter for a new antenna configuration. There are no RF output power or hardware changes on the product.

1.2 Applicant Information

Cooper Lighting LLC
1121 Hwy 74 S
Peachtree City GA, 30269

1.3 Product Description

The model MTR-H5-B09 is a MultiModem rCell 100 Series Router. The device includes a Cellular, GPS and Wi-Fi radio. The Class 2 Permissive Change applies to the Wi-Fi radio only.

Technical Details

Mode of Operation:	802.11b/g/n
Frequency Range:	2412 MHz - 2462 MHz
Number of Channels:	11
Channel Separation:	5MHz
Modulations:	CCK,DSSS, OFDM
Antenna Type/Gain:	Low Profile Housing PCB Antenna, 4 dBi
Input Power:	9 VDC Power Supply

Model Number: MTR-H5-B09

Test Sample Serial Number(s): 19679560

Test Sample Condition: The EUT was in good operationg condition without any physical damages.

1.4 Test Methodology and Considerations

The EUT was evaluated for radiated and power line conducted emissions when configured with the new antenna configuration using the maximum output power settings defined by the original equipment manufacturer.

The EUT was evaluated using the worst data rate configurations. Per the grantee, the cellular transceiver, Bluetooth radio and GPS transceiver are disabled on the product. Therefore, these antenna ports were not terminated during the evaluation.

Table 1.4-1: IEEE 802.11b/g/n Radio Test Configuration

Mode of Operation	Frequency (MHz)	Channel	Test Software Power Setting	Data Rate Configuration (Mbps)
802.11b	2412	1	12500	1
	2437	6		
	2462	11		
802.11g	2412	1	12500	6
	2437	6		
	2462	11		
802.11n 20 MHz	2412	1	12500	6.5
	2437	6		
	2462	11		

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:

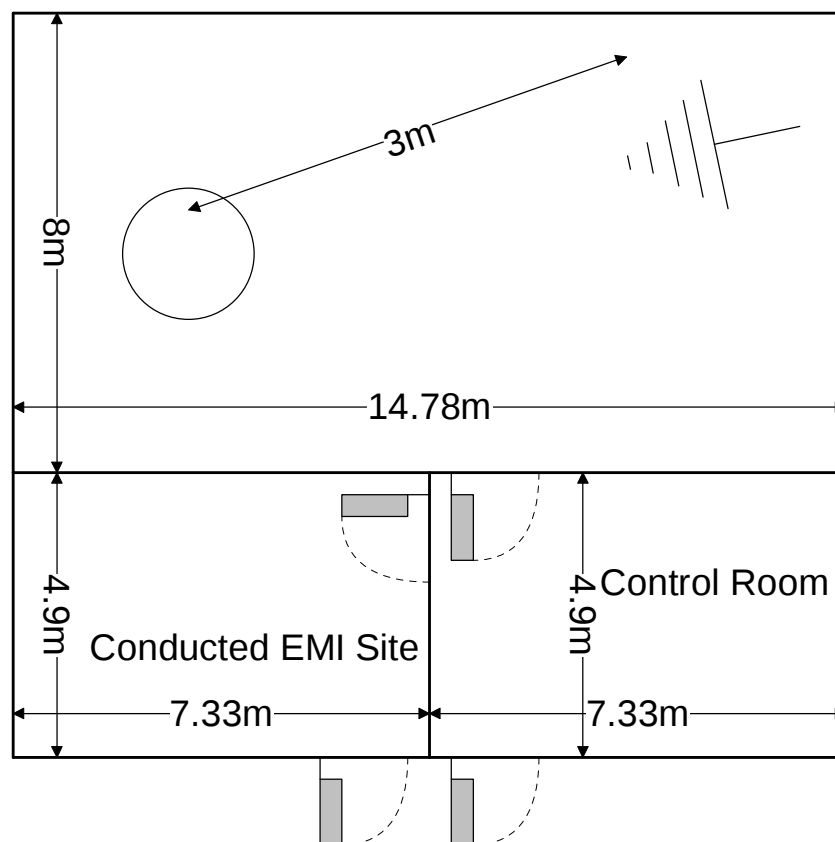


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m³. The power line conducted emission site includes two LISNs: a Solar Model 8028-50 50 Ω /50 μ H 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:

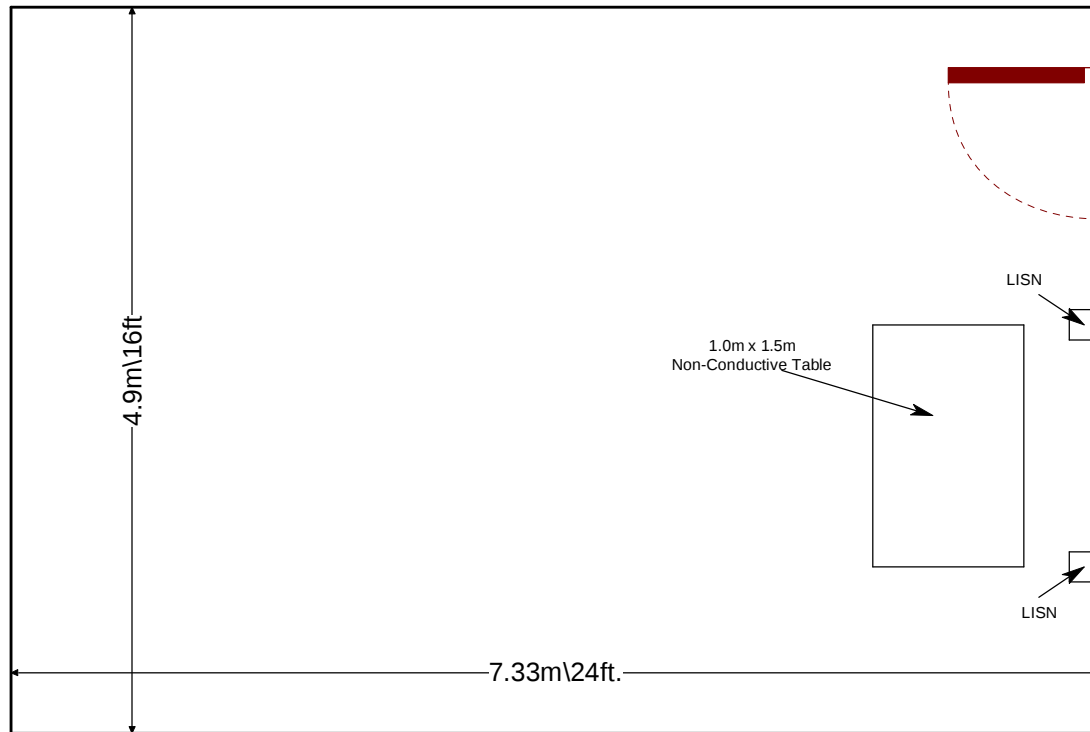


Figure 2.3.2-1: AC Mains Conducted EMI Site

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-247 — Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017.
- ❖ Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, Amendment 1, March 2018.

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 #	Last Calibration Date	Calibration Due Date
BEMC00078	EMCO	6502	Active Loop Antenna	9104-2608	5/9/2018	5/9/2020
BEMC00282	Microwave Circuits	H3G020G4	2-20GHz Band Pass Filter	74541	5/17/2018	5/17/2019
BEMC00523	Agilent	E7405A	9kHz-26.5GHz EMC analyzer/HYZ	MY45103293	12/9/2016	12/9/2018
BEMC00653	Suhner	SF-102A	Cable (40GHz)	0944/2A	10/9/2018	10/9/2019
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
BEMC02006	EMCO	3115	Linear Polarized Horn antenna, 1-18 GHz	2573	4/7/2017	4/7/2019
BEMC02008	COM-power	AH-826	Horn Antenna (18 GHz to 26.5 GHz)	81009	NCR	NCR
BEMC02011	Hewlett-Packard	HP 8447D	100 kHz to 1.3 GHz low noise, high gain amplifier	2443A03952	10/27/2017	10/27/2018
BEMC02022	EMCO	LISN3825/2R	Line Impedance Stabilization Network	1095	9/28/2017	9/28/2019
BEMC02045	ACS Boca	Conducted Cable Set	Consists of cables 2046, 2047, 2062, 2063 and 2065	2045	10/26/2017	10/27/2018
BEMC02086	Merrimac	FAN-6-10K	10dB Attenuator	23148-83-1	10/27/2017	10/27/2018
BEMC02095	ETS Lindgren	TILE4! - Version 4.2.A	Tile Automation Software	85242	NCR	NCR
BEMC02121	Teledyne Storm Products	A81-0303	Radiated Cable Set	2121	7/26/2018	7/26/2019
BEMC02138	Hewlett Packard	8449B	Pre-Amplifier	3008A00320	12/1/2017	12/1/2018
BEMC03004	Teseq	CFL 9206A	Transient Filter Limiter 9kHz - 30MHz	34720	8/10/2018	8/10/2019
TEMC00153	Rhode & Schwarz Vertrieb München	ESH3-Z5	Voltage Network	894785/012	9/27/2017	9/27/2018
TEMC00171	MegaPhase, LLC	1GVT4	4A & 4B Test Cables	NC12-K1K1-59, 394	5/30/2018	5/30/2020

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 – Radiated Emissions

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Multitech	MTR-H5-B09	19679560
2	Antenna	Airgain, Inc.	AP-WiFi	N/A
3	9 VDC Power Supply	Mega Electronics Inc.	FJ-SW0901700N	MJSW0901700N-5448
4	Laptop	Dell	Latitude E7250	3904132400043
5	19.5 DC Power Supply	Dell	LA65NS2-01	CN-06TM1C-72438-54L-8611-A04
6	Mouse	Dell	M-UAV-DEL8	LZ517BJ06KL

Table 5-2: Cable Description – Radiated Emissions

Cable #	Cable Type	Length	Shield	Termination
A	Coaxial	0.58 m	Yes	Antenna to EUT
B	Power	1.53 m	No	Power Supply to EUT
C	Extension Cord	2.7 m	No	Power Supply to AC Mains
D	Ethernet	10 m	No	EUT to Laptop
E	Power	1.8 m	No	Power Supply to EUT
F	Power	0.9m	No	Power Supply to AC Mains
G	USB	1.73m	No	Mouse to Laptop

Table 5-3: Cable Description – Power Line Conducted Emissions

Cable #	Cable Type	Length	Shield	Termination
A	Coaxial	0.58 m	Yes	Antenna to EUT
B	Power	1.53 m	No	Power Supply to EUT
C	Extension Cord	1.87 m	No	Power Supply to AC Mains
D	Ethernet	2.07 m	No	EUT to Laptop
E	Power	1.8 m	No	Power Supply to EUT
F	Power	0.9m	No	Power Supply to AC Mains
G	USB	1.73m	No	Mouse to Laptop

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

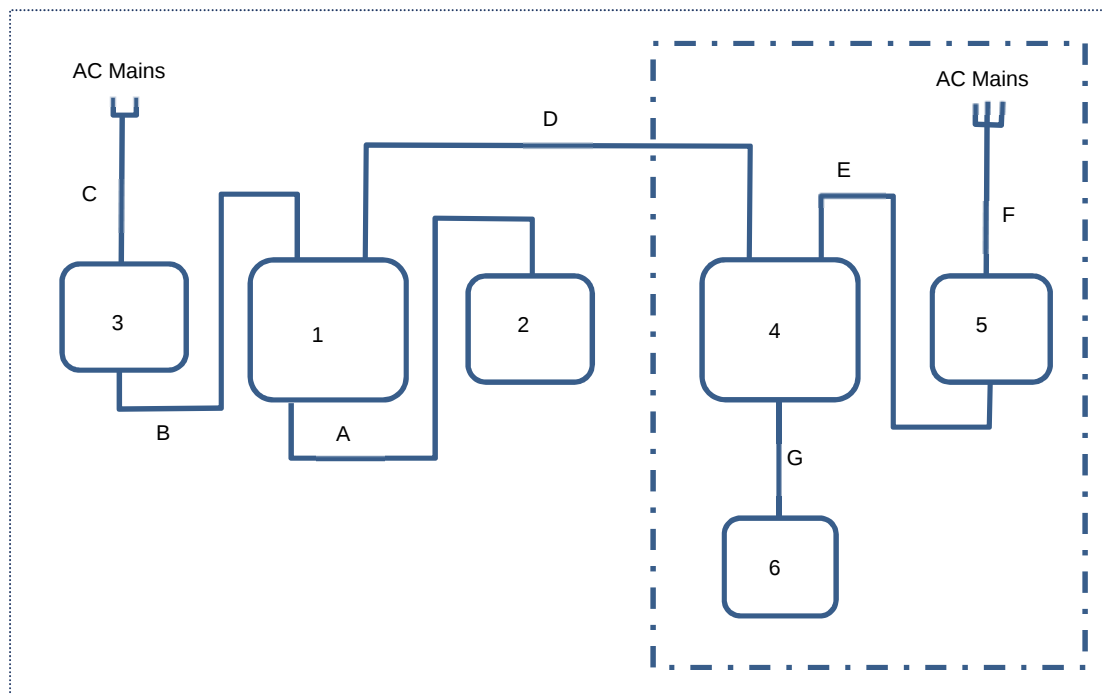


Figure 6-1: EUT and Support Equipment Block Diagram

Note: The equipment within the dotted box was set outside of the test environment during the radiated emission evaluation.

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: August 20, 2018
Test End Date: September 20, 2018

Table 7-1: Summary of Tests

Requirements	FCC Rule Part	ISED Canada	Test Results
Antenna Requirement	FCC: Section 15.203		Pass
Radiated Spurious Emissions into Restricted Frequency Bands	FCC: Sections 15.205, 15.209	ISED Canada: RSS-Gen 8.9, 8.10	Pass
Power Line Conducted Emissions	FCC: Section 15.207	ISED Canada: RSS-Gen 8.8	Pass

7.1 Antenna Requirement – FCC: Section 15.203

The EUT uses a 4 dBi Low Profile Housing PCB WiFi antenna with an RSMA connector. The antenna connector is considered unique and therefore meets the FCC 15.203 test requirements.

7.2 Band-Edge and Spurious Emissions

7.2.1 Radiated Spurious Emissions into Restricted Frequency Bands – FCC: Sections 15.205, 15.209; ISD Canada: RSS-Gen 8.9, 8.10

7.2.1.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 26 GHz, 10 times the highest fundamental frequency. 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.

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

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.

7.2.1.2 Measurement Results

Performed by: Jean Rene, Thierry Jean-Charles

Radiated band-edge and spurious emissions found in the restricted frequency bands of 9 kHz to 26 GHz are reported in the tables below.

Table 7.2.1.2-1: Radiated Spurious Emissions Tabulated Data – 802.11b

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
Low Channel 2412 MHz										
2385	54.13	41.49	H	0.67	54.80	42.16	74.0	54.0	19.2	11.8
2385	57.59	46.01	V	0.67	58.26	46.68	74.0	54.0	15.7	7.3
2390	52.27	40.21	H	0.69	52.96	40.90	74.0	54.0	21.0	13.1
2390	56.98	44.71	V	0.69	57.67	45.40	74.0	54.0	16.3	8.6
4824	38.04	27.23	H	8.12	46.16	35.35	74.0	54.0	27.8	18.7
4824	38.91	28.72	V	8.12	47.03	36.84	74.0	54.0	27.0	17.2
Middle Channel 2437 MHz										
4874	38.28	24.77	H	8.33	46.61	33.10	74.0	54.0	27.4	20.9
4874	37.43	25.35	V	8.33	45.76	33.68	74.0	54.0	28.2	20.3
High Channel 2462 MHz										
2483.5	50.03	39.01	H	0.94	50.97	39.95	74.0	54.0	23.0	14.0
2483.5	51.83	39.34	V	0.94	52.77	40.28	74.0	54.0	21.2	13.7
2490	51.78	36.50	H	0.96	52.74	37.46	74.0	54.0	21.3	16.5
2490	54.60	43.70	V	0.96	55.56	44.66	74.0	54.0	18.4	9.3
4924	37.35	24.19	H	8.54	45.89	32.73	74.0	54.0	28.1	21.3
4924	35.92	24.11	V	8.54	44.46	32.65	74.0	54.0	29.5	21.4

Notes:

All emissions above 4.924 GHz were attenuated below the limits and the noise floor of the measurement equipment.

Table 7.2.1.2-2: Radiated Spurious Emissions Tabulated Data – 802.11g

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
Low Channel 2412 MHz										
2390	65.12	43.73	H	0.69	65.81	44.42	74.0	54.0	8.2	9.6
2390	67.74	47.83	V	0.69	68.43	48.52	74.0	54.0	5.6	5.5
Middle Channel 2437 MHz										
Noise Floor										
High Channel 2462 MHz										
2483.5	60.81	40.49	H	0.94	61.75	41.43	74.0	54.0	12.2	12.6
2483.5	70.40	45.80	V	0.94	71.34	46.74	74.0	54.0	2.7	7.3

Notes:

All emissions above 2.4835 GHz were attenuated below the limits and the noise floor of the measurement equipment.

Table 7.2.1.2-3: Radiated Spurious Emissions Tabulated Data – 802.11n 20 MHz

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
Low Channel 2412 MHz										
2390	65.34	44.87	H	0.69	66.03	45.56	74.0	54.0	8.0	8.4
2390	69.75	49.40	V	0.69	70.44	50.09	74.0	54.0	3.6	3.9
Middle Channel 2437 MHz										
Noise Floor										
High Channel 2462 MHz										
2483.5	62.23	40.89	H	0.94	63.17	41.83	74.0	54.0	10.8	12.2
2483.5	69.16	46.13	V	0.94	70.10	47.07	74.0	54.0	3.9	6.9

Notes:

All emissions above 2.4835 GHz were attenuated below the limits and the noise floor of the measurement equipment.

7.2.2 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: $54.13 + 0.67 = 54.8 \text{ dB}\mu\text{V/m}$

Margin: $74 \text{ dB}\mu\text{V/m} - 54.8 \text{ dB}\mu\text{V/m} = 19.2 \text{ dB}$

Example Calculation: Average

Corrected Level: $41.49 + 0.67 = 42.16 \text{ dB}\mu\text{V/m}$

Margin: $54 \text{ dB}\mu\text{V/m} - 42.16 \text{ dB}\mu\text{V/m} = 11.84 \text{ dB}$

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

7.3.1 Measurement Procedure

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

7.3.2 Measurement Results

Performed by: Thierry Jean-Charles

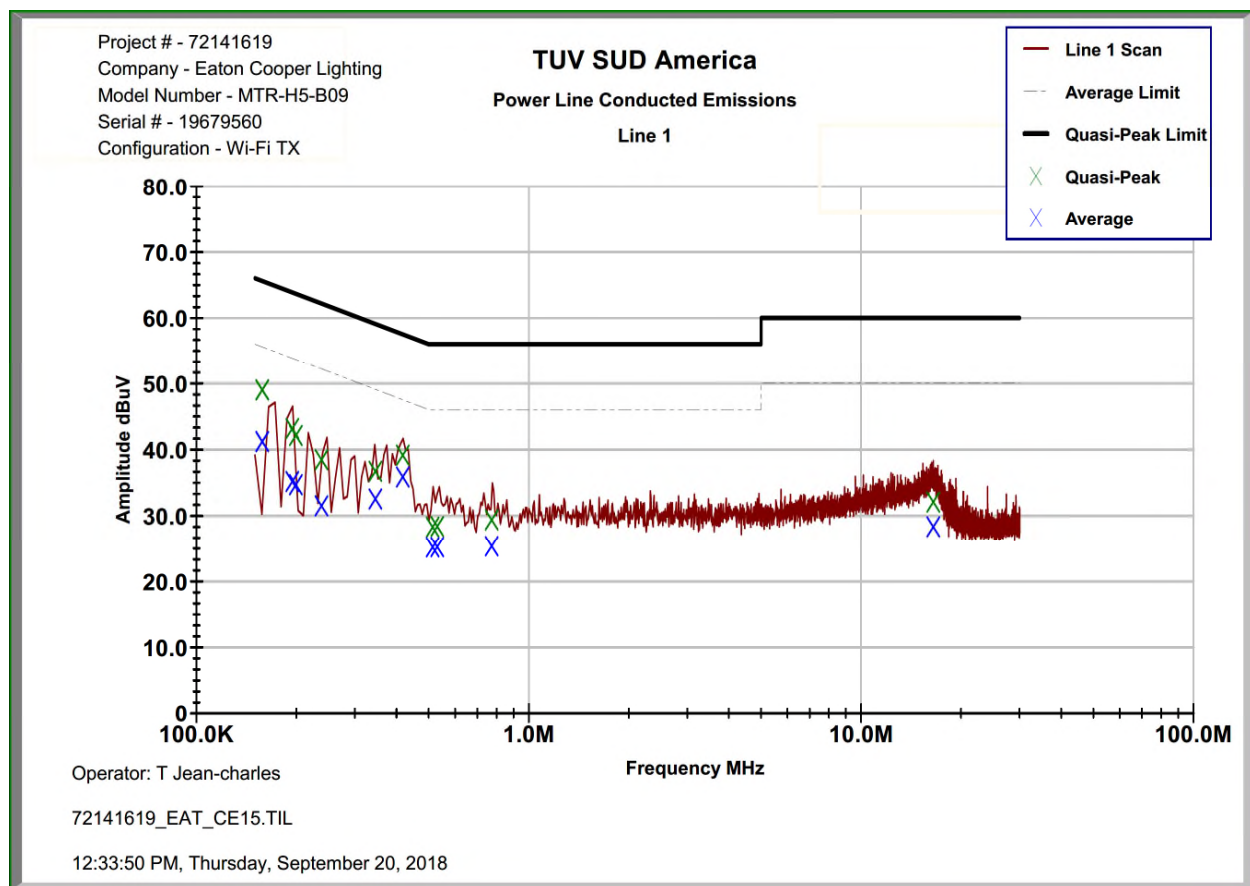


Figure 7.3.2-1: Conducted Emissions Results – Line 1

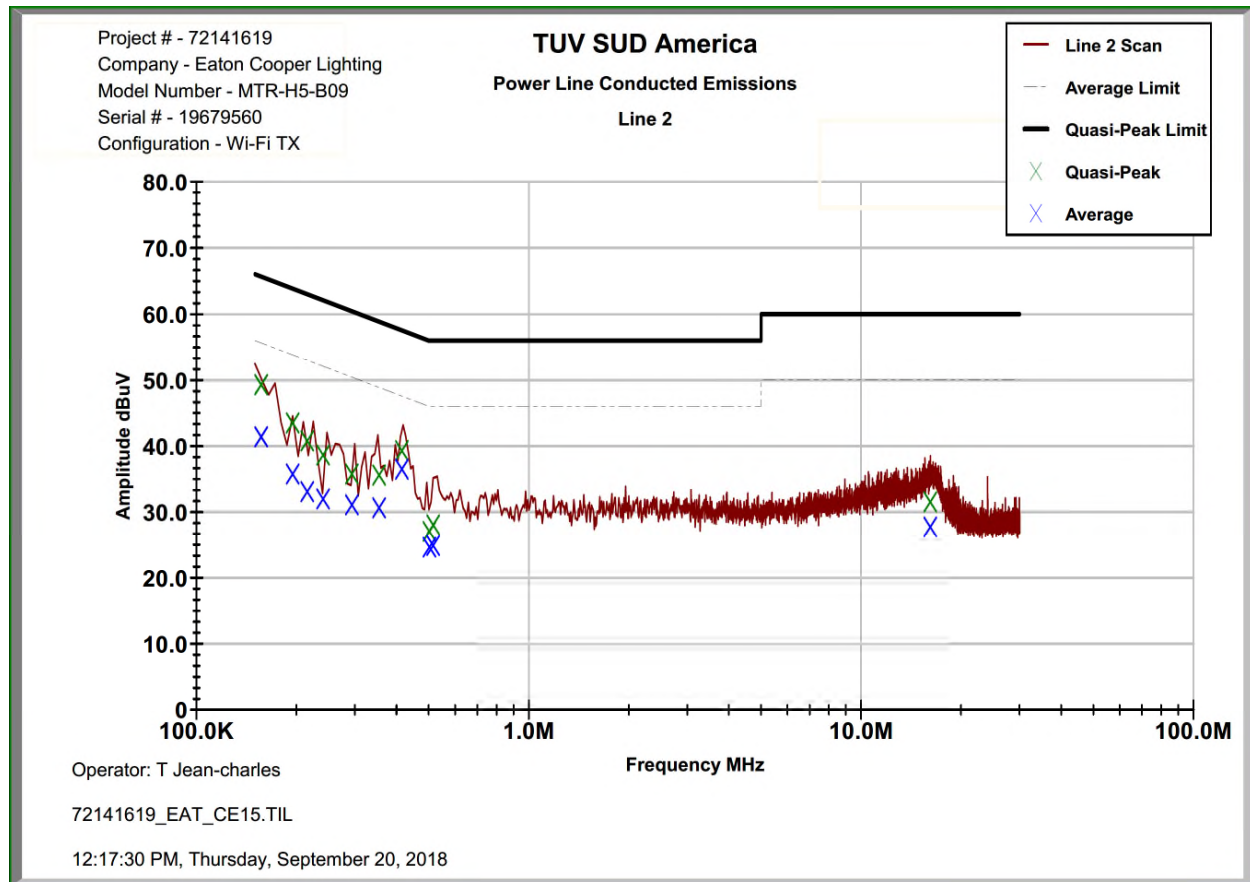


Figure 7.3.2-2: Conducted Emissions Results – Line 2

Table 7.3.2-1: Conducted EMI Results

☒ Line 1
☒ Line 2
☐ Line 3

☐ Line 4

☐ To Ground
☒ Floating

☐ Telecom Port

☒ dBµV
☐ dBµA

Plot Number:

72141619 EAT CE15

Power Supply Description: 9

VDC Mega Electronics, Inc.

Frequency (MHz)	Uncorrected Reading		Total Correction Factor (dB)	Corrected Level		Limit		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
Line 1									
0.157788	38.919	31.149	10.09	49.01	41.24	65.58	55.58	16.6	14.3
0.194324	33.089	25.118	10.09	43.18	35.21	63.85	53.85	20.7	18.6
0.199112	32.028	24.619	10.09	42.12	34.71	63.65	53.65	21.5	18.9
0.237762	28.389	21.461	10.14	38.53	31.60	62.17	52.17	23.6	20.6
0.345574	26.651	22.464	10.16	36.81	32.62	59.07	49.07	22.3	16.4
0.4174	29.066	25.767	10.16	39.23	35.93	57.50	47.50	18.3	11.6
0.51355	18.208	15.118	10.15	28.35	25.26	56.00	46.00	27.6	20.7
0.5302	18.325	15.163	10.15	28.47	25.31	56.00	46.00	27.5	20.7
0.77305	19.281	15.246	10.19	29.47	25.44	56.00	46.00	26.5	20.6
16.4761	20.683	16.925	11.58	32.27	28.51	60.00	50.00	27.7	21.5
Line 2									
0.156609	39.254	31.38	10.14	49.39	41.52	65.64	55.64	16.2	14.1
0.194899	33.469	25.737	10.14	43.61	35.88	63.83	53.83	20.2	17.9
0.215575	30.731	23.063	10.18	40.91	33.25	62.99	52.99	22.1	19.7
0.240413	28.624	21.939	10.19	38.81	32.12	62.08	52.08	23.3	20.0
0.293399	25.7	21.069	10.19	35.89	31.25	60.43	50.43	24.5	19.2
0.354587	25.54	20.605	10.20	35.74	30.80	58.85	48.85	23.1	18.1
0.415249	29.241	26.432	10.20	39.44	36.63	57.54	47.54	18.1	10.9
0.502349	16.983	14.579	10.20	27.18	24.77	56.00	46.00	28.8	21.2
0.515787	17.987	14.846	10.20	28.18	25.04	56.00	46.00	27.8	21.0
16.1462	19.991	16.198	11.45	31.44	27.65	60.00	50.00	28.6	22.4

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	$\pm 0.009 \%$
RF Conducted Output Power	$\pm 1.15 \text{ dB}$
Power Spectral Density	$\pm 1.15 \text{ dB}$
Antenna Port Conducted Emissions	$\pm 1.15 \text{ dB}$
Radiated Emissions $\leq 1\text{GHz}$	$\pm 5.86 \text{ dB}$
Radiated Emissions $> 1\text{GHz}$	$\pm 4.65 \text{ dB}$
Temperature	$\pm 0.860 \text{ }^{\circ}\text{C}$
Radio Frequency	$\pm 2.832 \times 10^{-8}$
AC Power Line Conducted Emissions	$\pm 3.72 \text{ dB}$

9 CONCLUSION

In the opinion of TÜV SÜD America, Inc. the model MTR-H5-B09, manufactured by Cooper Lighting LLC, meets the requirements of FCC Part 15.247 and Industry Canada's Radio Standards Specification RSS-247 for the tests documented herein.

END REPORT