



Canada

# EMC & RF Test Report

Class II Permissive Change Results  
based on

## RSS-247 Issue 2:2017 & FCC Part 15 Subpart 15.247

Unlicensed Intentional Radiators (FHSS)

on the

**EB-STATE3LT02**

Issued by:

**TÜV SÜD Canada Inc.**  
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Testing produced for

Prepared by:

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Jadon Bull,  
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See Appendix A for full client &  
EUT details.



Innovation, Science and  
Economic Development Canada


Registration #  
6844A-3



Testing Laboratory  
Certificate #2955.02




Registration #  
CA6844

Client	<b>Ecobee Inc.</b>	
Product	<b>EB-STATE3LT02</b>	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Table of Contents

Table of Contents .....	2
Report Scope .....	3
Summary .....	4
Test Results Summary .....	5
Notes, Justifications, or Deviations .....	6
Sample Calculation(s) .....	6
Applicable Standards, Specifications and Methods .....	7
Document Revision Status .....	8
Definitions and Acronyms .....	9
Testing Facility .....	10
Calibrations and Accreditations .....	10
Testing Environmental Conditions and Dates .....	11
Detailed Test Results Section .....	12
Maximum Conducted Output Power .....	13
Transmitter Spurious Radiated Emissions .....	16
Appendix A – EUT Summary .....	28
Appendix B – EUT and Test Setup Photos .....	31

Client	<b>Ecobee Inc.</b>	
Product	<b>EB-STATE3LT02</b>	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Report Scope

This report addresses the EMC verification testing and test results of the **EB-STATE3LT02** herein referred to as EUT (Equipment Under Test). Testing was performed based on Class II Permissive Changes made to the EUT and using the following standards:


RSS-247 Issue 2:2017

FCC Part 15 Subpart C 15.247

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report. Refer to the original test report, TÜV SÜD Canada Report # **7169010650RA-000 (DSS)** for full testing and test results.

This report does not imply product endorsement by any government, accreditation agency, or TÜV SÜD Canada Inc.

Opinions or interpretations expressed in this report, if any, are outside the scope of TÜV SÜD Canada Inc. accreditations. Any opinions expressed do not necessarily reflect the opinions of TÜV SÜD Canada Inc., unless otherwise stated.


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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Summary

The results contained in this report relate only to the item(s) tested.

EUT:	EB-STATE3LT02
FCC Certification #, FCC ID:	WR9EBSTAT3LT02
Industry Canada Certification #, IC:	7981A-EBSTAT3LT02
EUT passed all tests performed	Yes
Tests conducted by	Min Xie
Reviewed by	Jadon Bull


For testing dates, see "Testing Environmental Conditions and Dates".

Client	<b>Ecobee Inc.</b>	
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.209 RSS-GEN (Table 4)	Spurious Radiated Emissions	QuasiPeak Average	Pass
FCC 15.247(b)(2) RSS-247 5.4(d)	Max Output Power (FHSS)	< 1 Watt	Pass
<b>Overall Result</b>			<b>Pass</b>

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties. A 'PASS' / 'FAIL' grade within measurement uncertainty is marked with a '\*'.

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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

### ***Notes, Justifications, or Deviations***

The following notes, justifications for tests not performed or deviations from the above listed specifications apply:

This report is only an update based on Class II Permissive Changes. Refer to the original test report, TÜV SÜD Canada Report # **7169010650RA-000 (DSS)**, for full testing and test results.

As per the manufacturer, the transmitter in the new sample is electrically the same to the sample previously tested. Non transmitter components were replaced with new parts. The following test was re-evaluated on the EUT to verify if this change did not degrade the radiated data previously reported.

- Spurious radiated emission.
- Output power

### ***Sample Calculation(s)***

#### **Radiated Emission Test**

E-Field Level = Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain


E-Field Level = 50dB $\mu$ V + 10dB/m + 2dB – 20dB

E-Field Level = 42dB $\mu$ V/m

Margin = Limit – E-Field Level


Margin = 50dB $\mu$ V/m – 42dB $\mu$ V/m

Margin = 8.0 dB (pass)

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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Applicable Standards, Specifications and Methods


ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2013	American National Standard For Testing Unlicensed Wireless Devices
CFR 47 FCC 15 Subpart C	Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
FCC KDB 558074: 2019	FCC KDB 558074 Digital Transmission Systems, measurements and procedures
FCC KDB 447498: 2015	RF exposure procedures and equipment authorization policies for mobile and portable devices
ICES-003 Issue 6 2019	Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
RSS-GEN Issue 5 2019	General Requirements and Information for the Certification of Radio Apparatus
RSS-247 Issue 2:2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
ISO 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories

Client	<b>Ecobee Inc.</b>	 Canada
Product	<b>EB-STATE3LT02</b>	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Document Revision Status

Revision	Date	Description	Initials
000	2023-02-21	Initial Release	MX
-	-	-	-



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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Definitions and Acronyms

The following definitions and acronyms are applicable in this report.  
See also ANSI C63.14.

**DTS** – Digital Transmission System  
**FHSS** – Frequency Hopping Spread Spectrum  
**LISN** – Line Impedance Stabilization Network  
**NCR** – No Calibration Required  
**NSA** – Normalized Site Attenuation  
**N/A** – Not Applicable  
**RF** – Radio Frequency

**AE** – Auxiliary Equipment. A digital accessory that feeds data into or receives data from another device (host) that in turn, controls its operation.

**Antenna Port** – Port, other than a broadcast receiver tuner port, for connection of an antenna used for intentional transmission and/or reception of radiated RF energy.


**BW** – Bandwidth. Unless otherwise stated, this refers to the 6 dB bandwidth.

**EMC** – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

**EMI** – Electro-Magnetic Immunity. The ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels.

**EUT** – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.

**ITE** – Information Technology Equipment. Has a primary function of entry, storage, display, retrieval, transmission, processing, switching, or control of data and/or telecommunication messages and which may be equipped with one or more ports typically for information transfer.


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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada testing lab near Toronto, Ontario. The testing lab has calibrated 3m semi-anechoic chambers which allow measurements on a EUT that has a maximum width or length of up to 2m and a height of up to 3m. The testing lab also has a calibrated 10m Open Area Test Site (OATS). The chambers are equipped with a turntable that is capable of testing devices up to 5000lb in weight and are equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. This facility is capable of testing products that are rated for single phase or 3-phase AC input and DC capability is also available. Radiated emission measurements are performed using a BiLog antenna and a Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN and using the vertical ground plane if applicable.

### **Calibrations and Accreditations**


The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, CA6844), Innovation, Science and Economic Development Canada (ISED, 6844A-3) and Voluntary Control Council for Interference (VCCI, R-14023, G-20072, C-14498, and T-20060). This chamber was calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at TÜV SÜD Canada. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at TÜV SÜD Canada. TÜV SÜD Canada Inc. is accredited to ISO 17025 by A2LA with Testing Certificate #2955.02. The laboratory's current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or biennial basis as listed for each respective test.

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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


### ***Testing Environmental Conditions and Dates***

Following environmental conditions were recorded in the facility during time of testing

Date	Test	Initials	Temperature (°C)	Humidity (%)	Pressure (kPa)
2023-01-03	Radiated Emissions	MX	22.6	25.9	100.8
2023-01-04	Antenna conducted Power	MX	22.7	27.3	100.8

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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Detailed Test Results Section

Client	<b>Ecobee Inc.</b>	
Product	<b>EB-STATE3LT02</b>	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Maximum Conducted Output Power

### Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified.

### Limits

The limits are as defined in 47 CFR FCC Part 15 Section 15.247(b) and RSS 247 Section 5.4. The test method is defined in ANSI C63.10 Section 11.12.2.5.1 and 11.9.2.2.2.


902 to 928 MHz	$N_{ch} \geq 50$ $P_{max-pk} \leq 1 \text{ W}$	$25 \leq N_{ch} \leq 50$ $P_{max-pk} \leq 0.25 \text{ W}$
2400 to 2483.5 MHz	$N_{ch} \geq 75$ $P_{max-pk} \leq 1 \text{ W}$	$N_{ch} \geq 15$ $P_{max-pk} \leq 0.125 \text{ W}$
5275 to 5850 MHz	$N_{ch} \geq 75$ $P_{max-pk} \leq 1 \text{ W}$	

### Results

The EUT passed. The FHSS peak power measured was 8.96 dBm (7.87 mW).

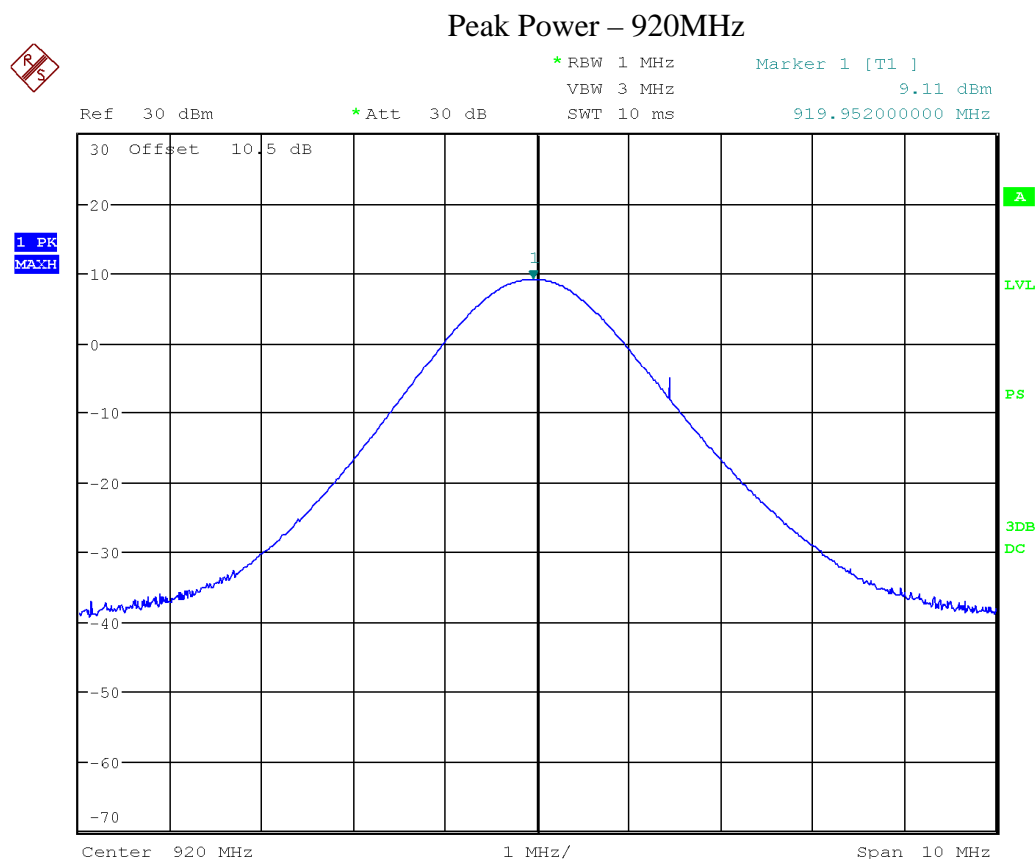
Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power (mW)
Low	920.00	9.11	8.15

Note: The external attenuator and cable loss are accounted for as reference offset in the spectrum analyzer


Client	Ecobee Inc.	 Canada
Product	EB-STATE3LT02	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Graphs

The graphs shown below show the peak power output of the device during the conducted measurement operation of the EUT.




Date: 4.JAN.2023 12:17:32

Client	<b>Ecobee Inc.</b>	 Canada
Product	<b>EB-STATE3LT02</b>	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Feb. 11, 2022	Feb. 11, 2024	GEMC 233
Attenuator 10 dB	8493B	Agilent	NCR	NCR	GEMC133

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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## ***Transmitter Spurious Radiated Emissions***

### **Purpose**

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

### **Limits and Method**

The method is as defined in Section 12.2 of FCC KDB 558074 and ANSI C63.10.

The limits, as defined in 15.247(d) for unintentional radiated emissions, apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

<b>Frequency</b>	<b>Limit</b>
0.009 MHz – 0.490 MHz	2400/F(kHz) uV/m at 300m <sup>1</sup>
0.490 MHz – 1.705 MHz	24000/F(kHz) uV/m at 30m <sup>1</sup>
1.705 MHz – 30 MHz	30 uV/m at 30m <sup>1</sup>
30 MHz – 88 MHz	100 uV/m (40.0 dBuV/m <sup>1</sup> ) at 3m
88 MHz – 216 MHz	150 uV/m (43.5 dBuV/m <sup>1</sup> ) at 3m
216 MHz – 960 MHz	200 uV/m (46.0 dBuV/m <sup>1</sup> ) at 3m
Above 960 MHz	500 uV/m (54.0 dBuV/m <sup>1</sup> ) at 3m
Above 1000 MHz	500 uV/m (54 dBuV/m <sup>2</sup> ) at 3m
Above 1000 MHz	500 uV/m (74 dBuV/m <sup>3</sup> ) at 3m


<sup>1</sup>Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1

<sup>2</sup>Limit is with 1 MHz measurement bandwidth and using an Average detector

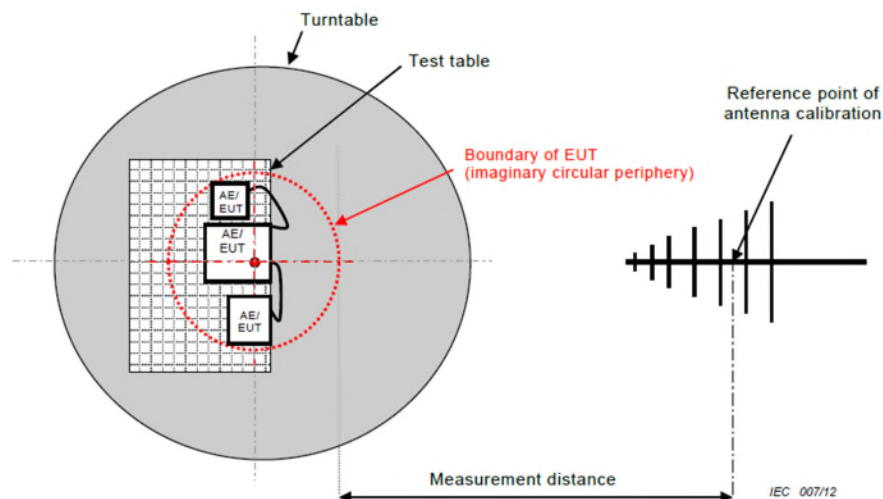
<sup>3</sup>Limit is with 1 MHz measurement bandwidth and using a Peak detector

Based on ANSI C63.4 Section 4.2, if the Peak detector measurements do not exceed the Quasi-Peak limits, where defined, then the EUT is deemed to have passed the requirements.



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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

### Typical Radiated Emissions Setup



### Measurement Uncertainty


The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is  $\pm 4.25\text{dB}$  for 30MHz – 1GHz and  $\pm 4.93\text{dB}$  for 1GHz – 18GHz with a 'k=2' coverage factor and a 95% confidence level.

### Preliminary Graphs

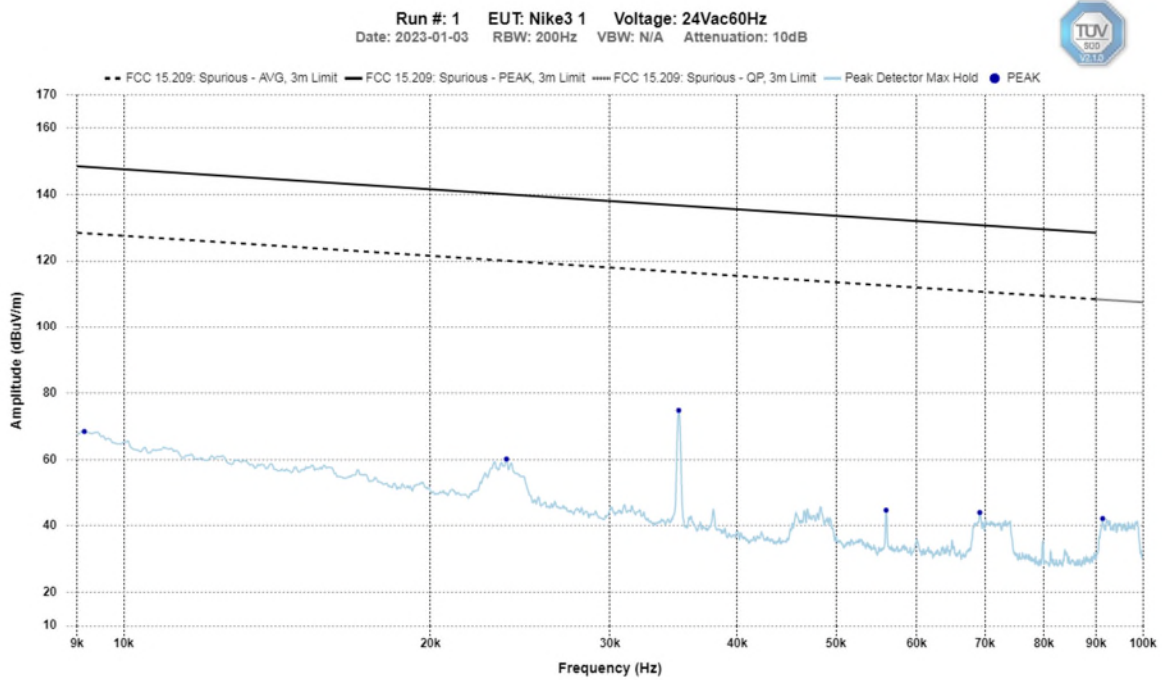
The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector over a full 0-360°. This peaking process is done as a worst case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, please refer to the tables under Final Measurements.


In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10<sup>th</sup> harmonic (a minimum of 9273.5 MHz).

Devices scanned may be scanned at alternate test distances and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m / 3m) is applied.

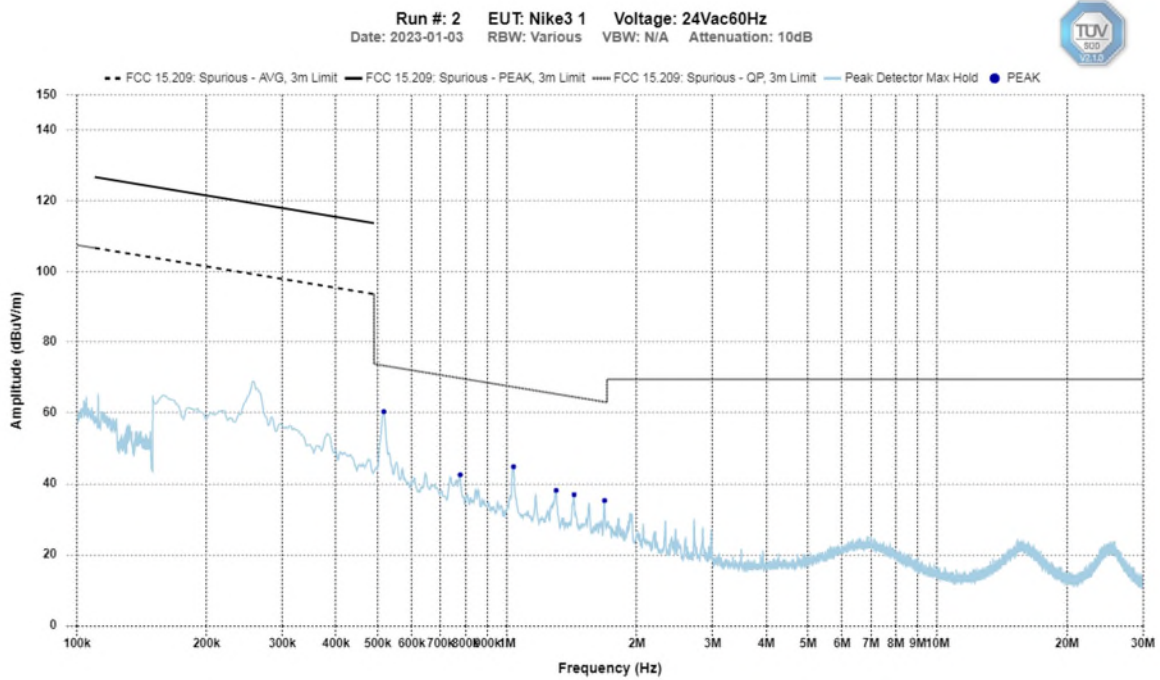
Client	Ecobee Inc.	 Canada
Product	EB-STATE3LT02	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


9 kHz – 100 kHz  
Peak Emission Graph



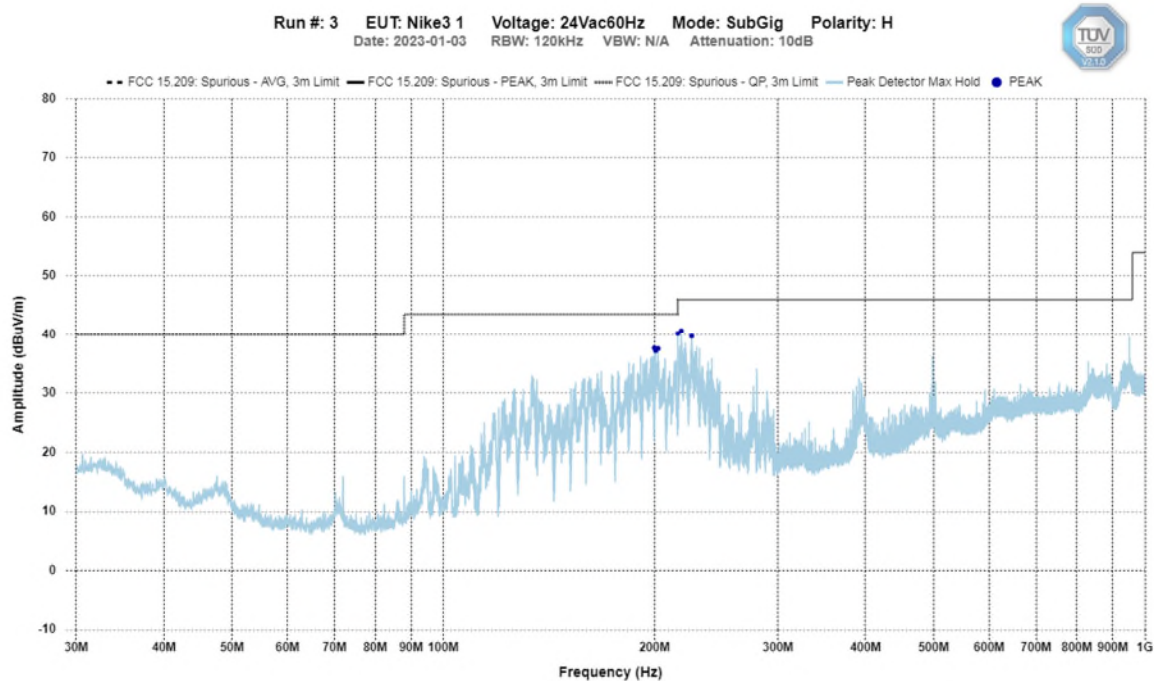
Client	Ecobee Inc.	 Canada
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# 100 kHz – 30 MHz Peak Emission Graph



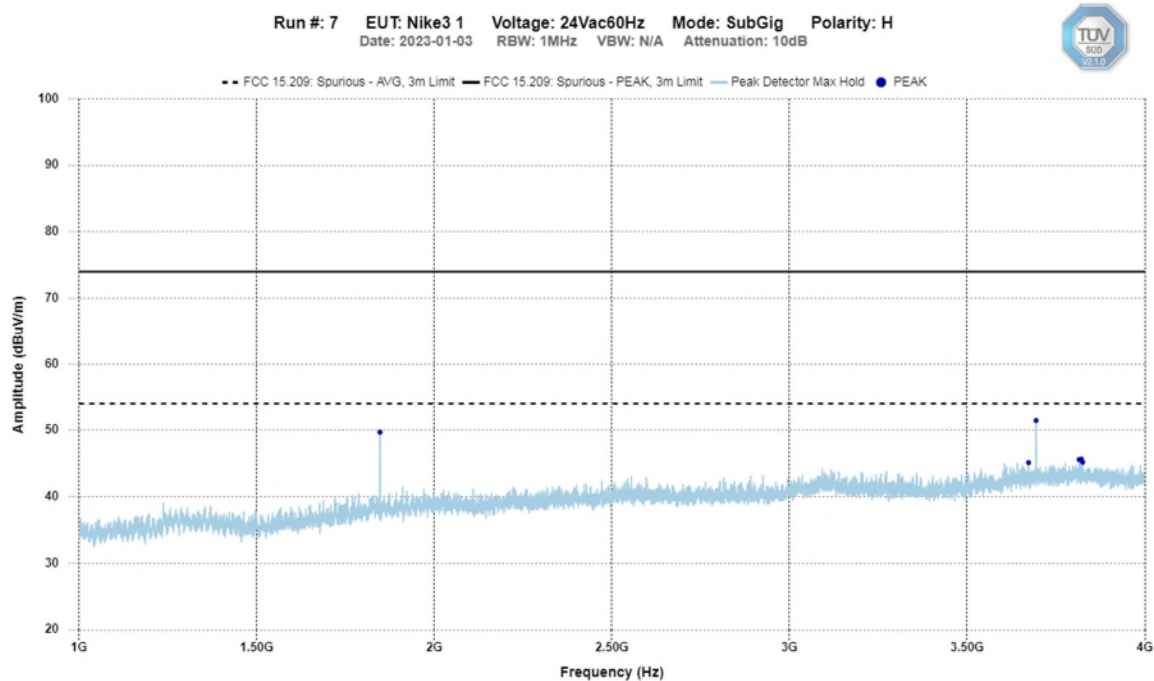
Client	Ecobee Inc.	 Canada
Product	EB-STATE3LT02	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


### 30 MHz – 1 GHz Horizontal - Peak Emission Graph



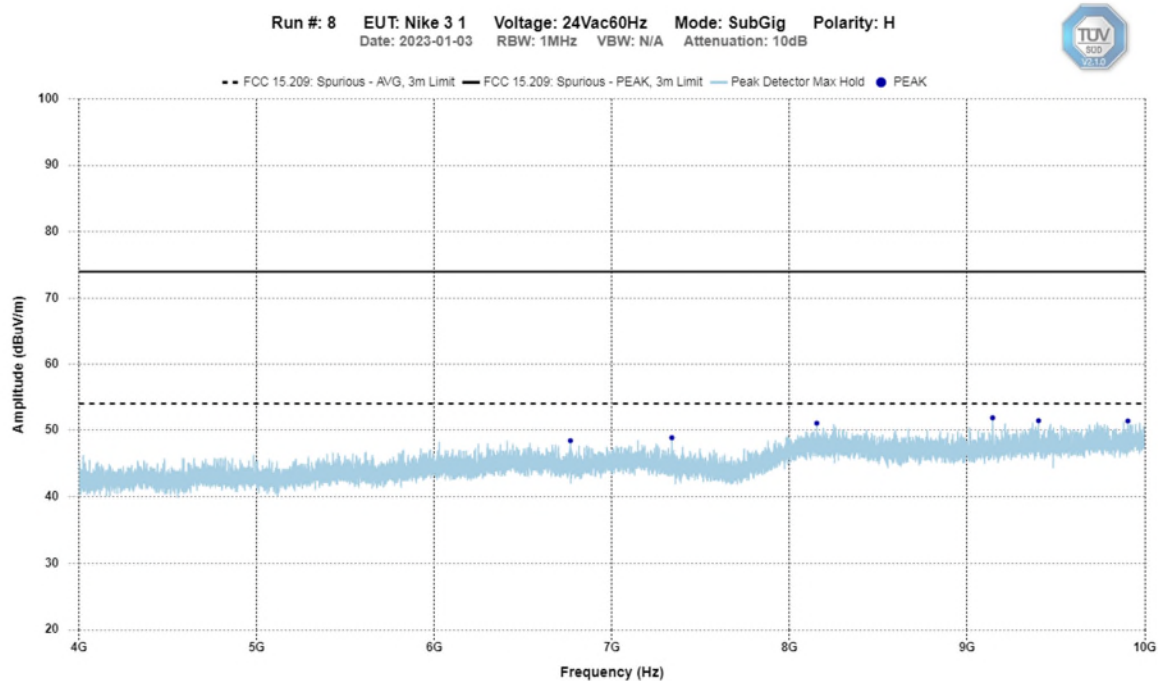
Client	Ecobee Inc.	 Canada
Product	EB-STATE3LT02	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


1 GHz – 4 GHz  
Horizontal - Peak Emission Graph



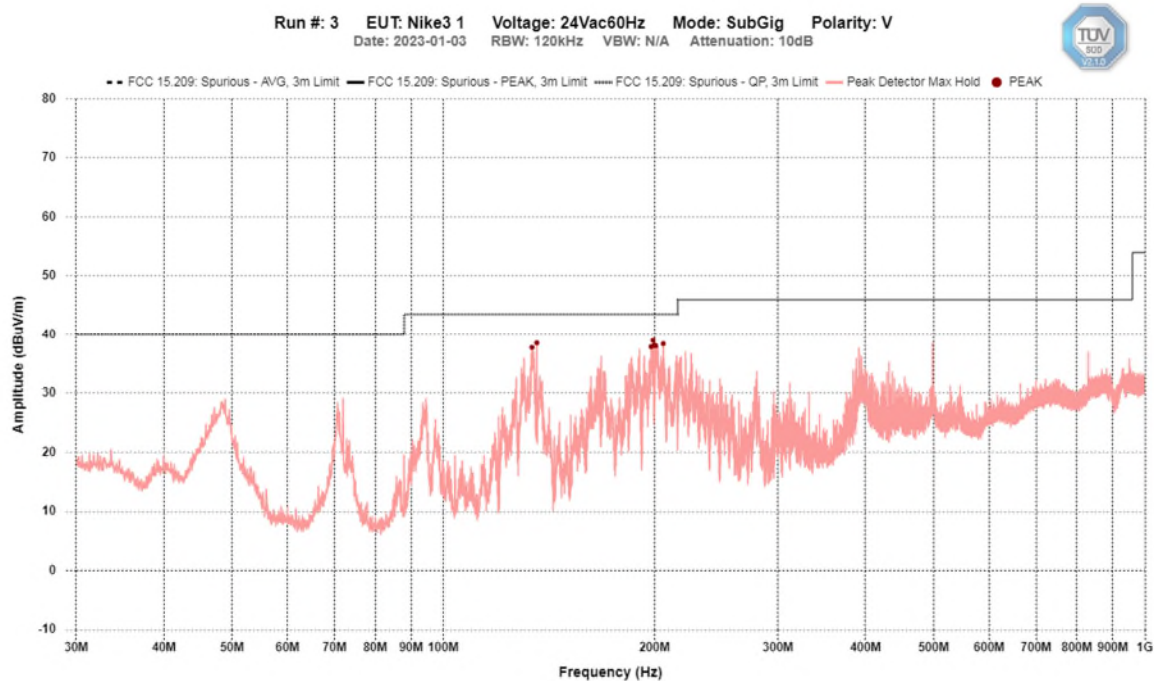
Client	Ecobee Inc.	 Canada
Product	EB-STATE3LT02	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

4 GHz – 10 GHz  
Horizontal - Peak Emission Graph




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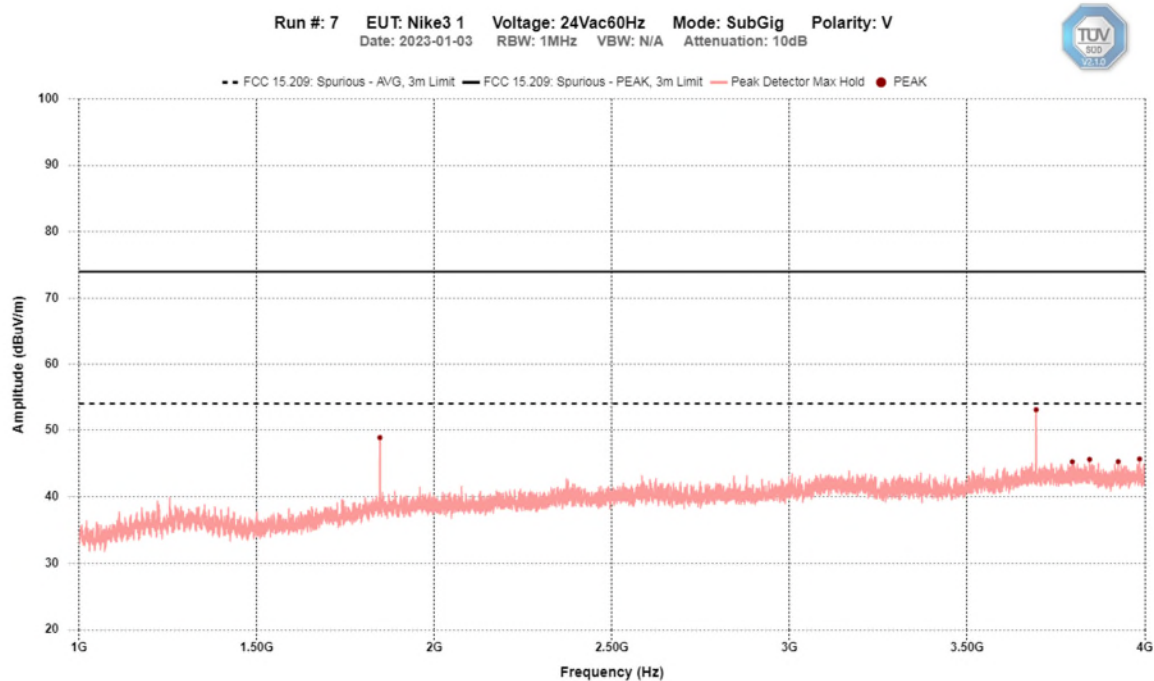
30 MHz – 1 GHz  
Vertical - Peak Emission Graph






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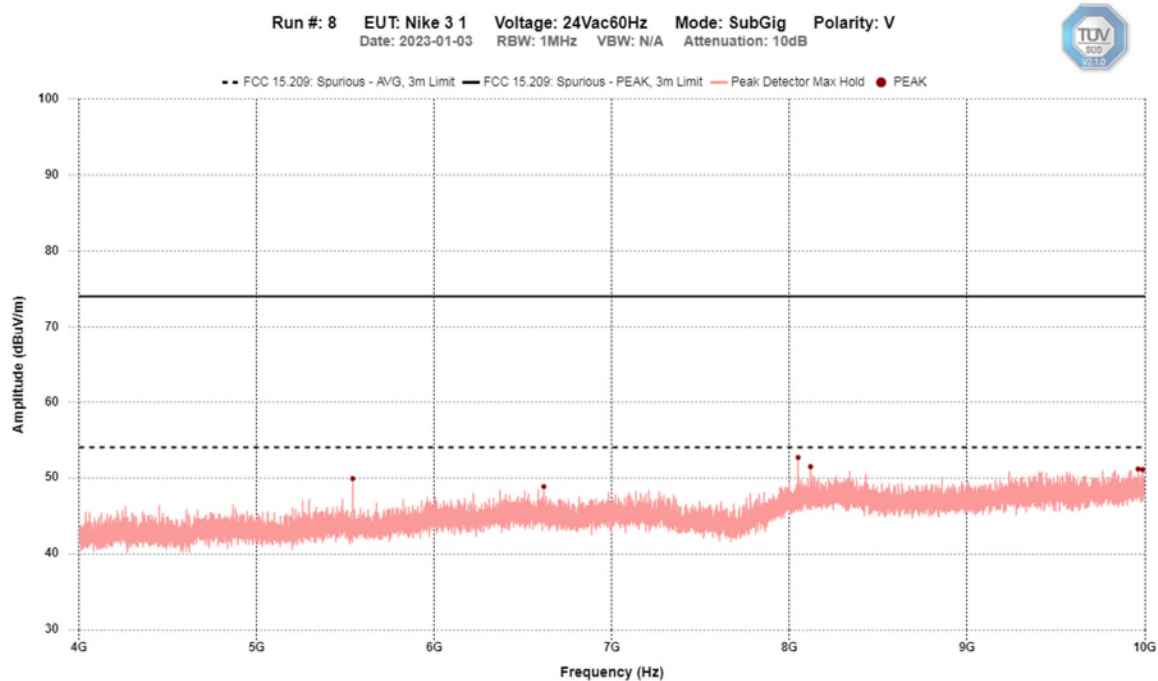
1 GHz – 4 GHz  
Vertical - Peak Emission Graph






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4 GHz – 10 GHz  
Vertical - Peak Emission Graph



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## Final Measurements and Results

The EUT passed.

In accordance with 15.247(d), only frequencies exceeding the 15.209 limit that occur within the bands listed in 15.205 need to be verified with a final detector. Emission outside the restricted bands were measured for information purpose.


The measurements were maximized by rotating the turn table over a full 0-360 rotation and the antenna height was varied from 1 m to 4 m.

Tx Channel		920MHz				
Power Supply		24Vac60Hz				
Frequency (Hz)	Detector	Correction Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Test Result
<b>Horizontal</b>						
218.46M	QP	-14.5	36.7	46.0	9.3	Pass
200.04M	QP	-15.6	35.8	43.5	7.7	Pass
216.03M	PEAK	-14.6	40.2	46.0	5.8	Pass
202.47M	PEAK	-15.5	37.6	43.5	5.9	Pass
226.11M	PEAK	-13.9	39.8	46.0	6.2	Pass
200.88M	PEAK	-15.6	37.2	43.5	6.3	Pass
3.694G	AVG	4.7	49.5	54.0	4.5	Pass
1.847G	AVG	-0.9	48.7	54.0	5.3	Pass
3.694G	PEAK	4.7	51.5	74.0	22.5	Pass
1.847G	PEAK	-0.9	49.7	74.0	24.3	Pass
<b>Vertical</b>						
199.17M	QP	-15.6	31.7	43.5	11.8	Pass
136.02M	QP	-18.9	39.0	43.5	4.5	Pass
200.04M	QP	-15.6	37.7	43.5	5.8	Pass
205.95M	PEAK	-15.2	38.4	43.5	5.1	Pass
200.88M	PEAK	-15.6	38.1	43.5	5.4	Pass
197.91M	PEAK	-15.6	35.0	43.5	8.5	Pass
133.89M	PEAK	-19.1	37.8	43.5	5.7	Pass
3.695G	AVG	4.8	51.5	54.0	2.5	Pass
1.847G	AVG	-0.9	49.9	54.0	4.1	Pass
3.695G	PEAK	4.8	53.1	74.0	20.9	Pass
1.847G	PEAK	-0.9	48.9	74.0	25.1	Pass


Client	<b>Ecobee Inc.</b>	 TUV SUD Canada
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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Feb. 11, 2022	Feb. 11, 2024	GEMC 233
Loop Antenna	EM 6871	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Feb 26, 2021	Feb 26, 2023	GEMC 71
BiLog Antenna	3142-C	ETS-Lindgren	Dec. 22, 2022	Dec. 22, 2024	GEMC 8
Horn Antenna 1 – 18 GHz	3117	ETS-Lindgren	Mar. 11, 2022	Mar. 11, 2024	GEMC 340
Attenuator 6 dB	6N5W-06	Inmet	NCR	NCR	GEMC 345
Pre-Amp 9 kHz – 1 GHz	CPA9230	Chase	Sept. 16, 2022	Sept 16, 2024	GEMC 301
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Mar. 11, 2022	Mar. 11, 2024	GEMC 189
902-928MHz Notch Filter	BRC50722	Micro-Tronics	NCR	NCR	GEMC 186
1.2 GHz High pass filter	5IH30-1078	K & L Microwave	NCR	NCR	GEMC 118
4GHZ-12GHz High Pass filter	11SH10- 4000/T12000- 0/0	K & L Microwave	NCR	NCR	GEMC 119
RF Cable <1GHz	LMR-400	LexTec	NCR	NCR	GEMC 274
RF Cable <1GHz	Sucoflex 104A	Huber+Suhner	NCR	NCR	GEMC 271
RF Cable >1GHz	EMC2	MegaPhase	NCR	NCR	GEMC 369
Emissions Software	V2.1.0	TUV SUD Canada, Inc.	NCR	NCR	GEMC 361

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## Appendix A – EUT Summary

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For further details for filing purposes, refer to filing package.

## General EUT Description

Client	
Organization / Address	Ecobee Inc. 25 Dockside Drive. Suite 700 Toronto, ON. M5A 0B5, Canada
Contact	John Russomanno
Phone	416-987-1058
Email	johnr@ecobee.com
EUT Details	
EUT Name	EB-STATE3LT02
FCC ID	WR9EBSTAT3LT02
IC	7981A- EBSTAT3LT02
Equipment Category	Unlicensed transmitter
Basic EUT Functionality	EUT is a smart thermostat that have a 2400 – 2483.5 MHz DTS (802.11 b/g/n) transmitter and a 902 – 928 MHz FHSS/Hybrid transmitter.
Input Voltage and Frequency	24 Vac 60 Hz
Connectors available on EUT	1 (terminals for HVAC control)
Peripherals Required for Test	120 Vac – 24 Vac step down transformer.
Release type	Final
Intentional Radiator Frequency Range	2400 – 2483.5 MHz for 802.11 b/g/n DTS 902 – 928 MHz FHSS/Hybrid
Antenna	PCB antennas
Type of Transmitter	Hybrid, Frequency Hopping and Digitally Modulated
Modulation	FSK for Sub Gig Various for 2.4 GHz 802.11 b/g/n
EUT Configuration	Test software was configured to transmit continuously at 100% duty cycle and to control hopping through its pseudo random sequence or single channel. Channels tested: Lowest and Highest

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Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see ‘Appendix B – EUT and Test Setup Photos’.

## EUT Configuration


Please see Appendix B for a picture of the unit running in normal conditions.

- The transmitter was configured by client on site and set to transmit at maximum possible duty cycle.

## Operational Setup

Peripheral devices were attached to the EUT for its test operation. However, this report does not represent compliance of these peripheral device(s) in any way.

- A USB to serial cable was connected to the EUT for test mode setting.

Client	<b>Ecobee Inc.</b>	 Canada
Product	<b>EB-STATE3LT02</b>	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

## Appendix B – EUT and Test Setup Photos

Refer to the files separate from this test report