



Canada

EMC & RF Test Report

As per

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

Unlicensed Intentional Radiators
DTS System
on the

ECB601/ECB501

Issued by:

TÜV SÜD Canada Inc.
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Testing produced for

Prepared by:

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Sr. Project Engineer
Reviewed by

ecobee

See Appendix A for full client &
EUT details.

Scott Drysdale,
Reginal Manager,
EMC



Registration #
6844A-3



Testing Laboratory
Certificate #2955.02



Registration #
CA6844



Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

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Client	Ecobee Inc.	
Product	ECB601/ECB501	
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 **Ecobee Inc.'s** Model: **ECB601/ECB501 (Sub-Gig FHSS Transmitter)** and is herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against 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. The purpose of this report is to verify that the EUT is still in compliance with the rules after a C2PC. Refer to the original test report, TÜV SÜD Canada Report # **7169010244RE-001 (DSS – SubGig(FHSS))** 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.


Client	Ecobee Inc.	
Product	ECB601/ECB501	
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:	ECB601/ECB501
FCC Certification #, FCC ID:	WR955470766937
Industry Canada Certification #, IC:	7981A-55470766937
EUT passed all tests performed	Yes
Tests conducted by	Min Xie
Report reviewed by	Scott Drysdale


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

Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.207 RSS-GEN (Table 3)	Power Line Conducted Emissions	QuasiPeak Average	Pass
FCC 15.209 RSS-GEN (Table 4)	Spurious Radiated Emissions	QuasiPeak Average	Pass
Overall Result			Pass

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 '*'.

Client	Ecobee Inc.	
Product	ECB601/ECB501	
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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 # **7169010244RE-001 (DSS – SubGig(FHSS))** for full testing and test results.

As per the manufacturer, the new sample is electrically the same to the sample previously tested. No transmitter components were replaced with parts of same dimension and electrical characteristics. 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
- Restricted band Band Edge measurements
- Power line conducted emission

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Sample Calculation(s)

Radiated Emission Test

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

E-Field Level = 50dB μ V + 10dB/m + 2dB – 20dB

E-Field Level = 42dB μ V/m

Margin = Limit – E-Field Level

Margin = 50dB μ V/m – 42dB μ V/m

Margin = 8.0 dB (pass)

Power Line Conducted Emission Test

E-Field Level = Received Signal + Attenuation Factor + Cable Loss + LISN Factor


E-Field Level = 50dB μ V + 10dB + 2.5dB + 0.5dB

E-Field Level = 63dB μ V

Margin = Limit – E-Field Level


Margin = 73dB μ V – 63dB μ V

Margin = 10.0 dB (pass)

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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
CISPR 32:2012	Electromagnetic Compatibility of Multimedia Equipment – Emission Requirements
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 7 2020	Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
RSS-GEN Issue 5: 2018+A1:2019+A2:2021	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

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Document Revision Status

Revision	Date	Description	Initials
000	2023-05-26	Initial Release	MX

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Product	ECB601/ECB501	
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

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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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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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)
2023-02-28	Spurious Emissions	MX	21.5	19.9	100.6
2023-03-01	Spurious Emissions	MX	20.8	20.8	101.2
2023-03-01	Power Line Conducted Emissions	MX	20.8	20.8	101.2

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Detailed Test Results Section

Client	Ecobee Inc.	
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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 FCC KDB 558074 Section 12.2 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).

All unintentional emissions must also meet the ‘Spurious Conducted Emissions’ requirements of -30 dBc or greater. See also ‘Antenna Spurious Conducted Emissions’ for further details.


Frequency	Field Strength Limit ($\mu\text{V/m}$)	Field Strength at 3m (dB $\mu\text{V/m}$)
0.009 MHz – 0.490 MHz	2400/F(kHz) ^a (at 300m)	128.5 to 93.8 ^a
0.490 MHz – 1.705 MHz	24000/F(kHz) ^a (at 30m)	73.8 to 63.0 ^a
1.705 MHz – 30 MHz	30 ^a (at 30m)	69.5 ^a
30 MHz – 88 MHz	100 ^a (at 3m)	40.0 ^a
88 MHz – 216 MHz	150 ^a (at 3m)	43.5 ^a
216 MHz – 960 MHz	200 ^a (at 3m)	46.0 ^a
Above 960 MHz	500 ^a (at 3m)	54.0 ^a
Above 1000 MHz	500 ^b (at 3m)	54.0 ^b
Above 1000 MHz	5 mV/m ^c (at 3m)	74.0 ^c

^aLimit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1

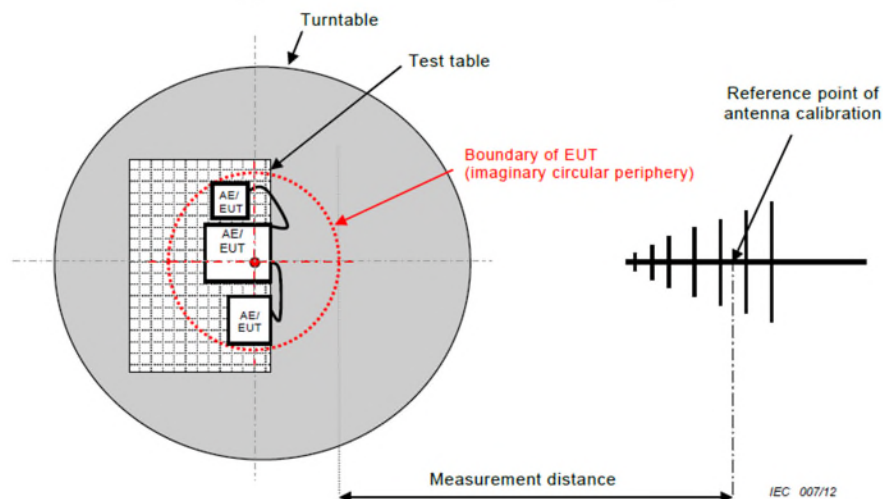
^bLimit is with 1 MHz measurement bandwidth and using an Average detector

^cLimit 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.

Client	Ecobee Inc.	
Product	ECB601/ECB501	
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 $\pm 5.67\text{dB}$ for 30MHz – 1GHz and $\pm 4.58\text{dB}$ 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 10th harmonic (a minimum of 24.835 GHz).

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.

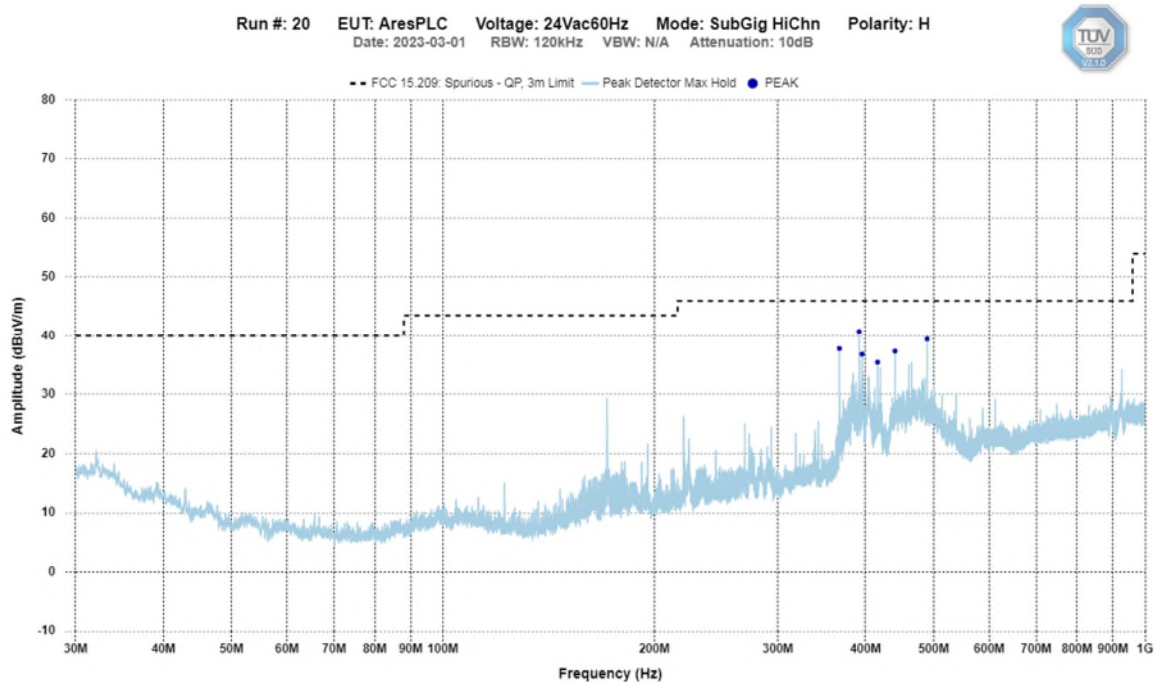
Peak output power for low, middle, and high channels were checked. The worst case was used for the spurious emissions.


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Band-edge measurement graphs are shown for illustration purposes. See final measurement section for all measurements.

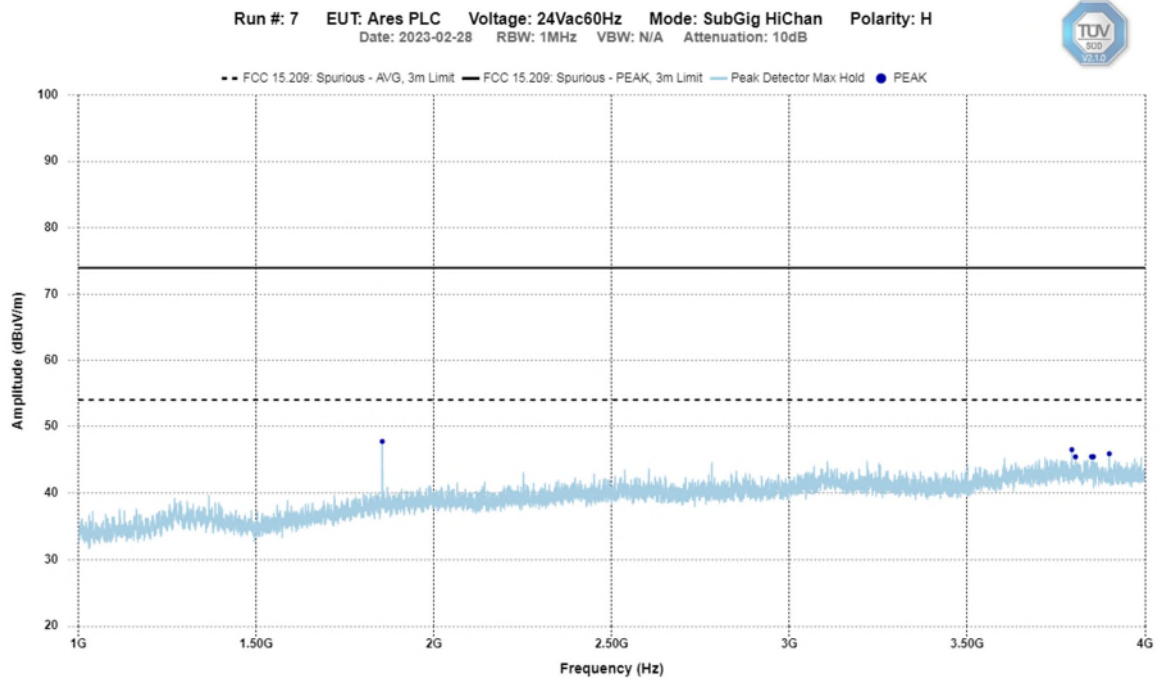
Spurious Emissions


High Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



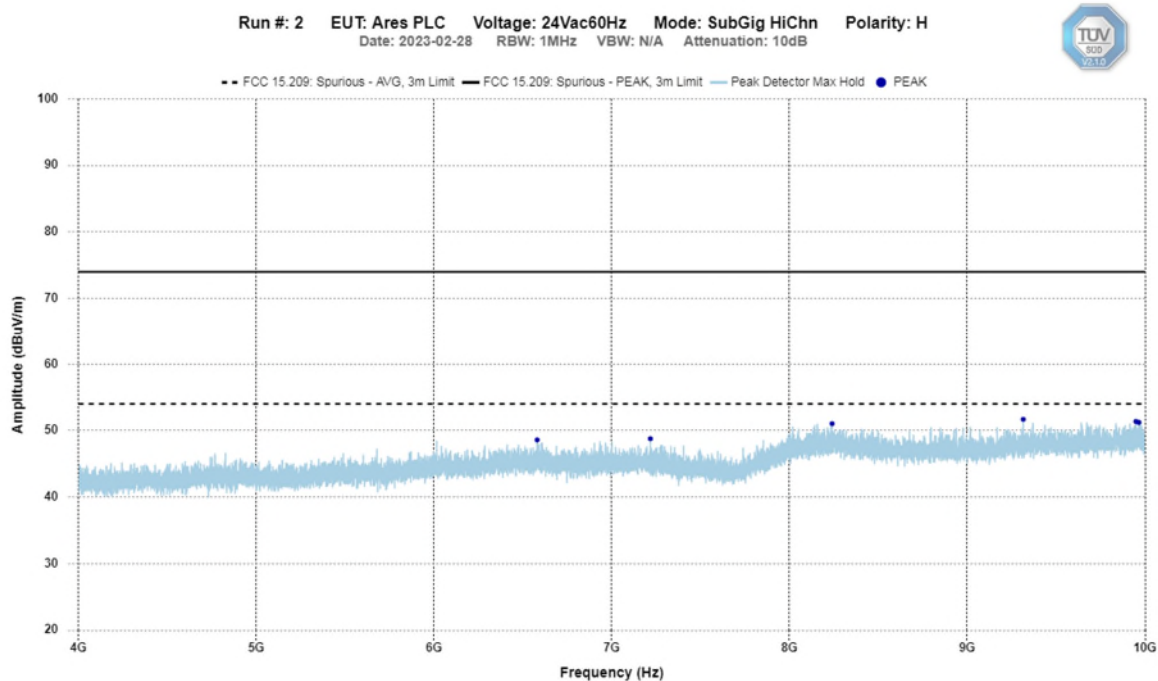
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High Channel – 1 GHz – 4 GHz Horizontal - Peak Emission Graph



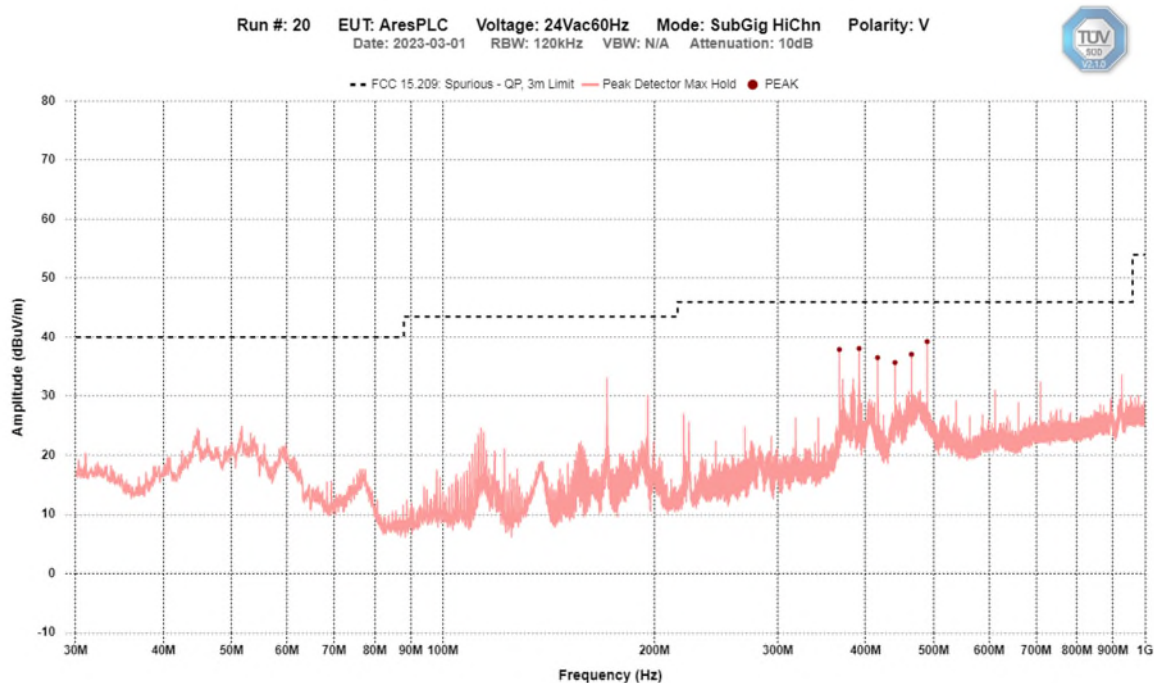
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High Channel – 4 GHz – 10 GHz Horizontal - Peak Emission Graph



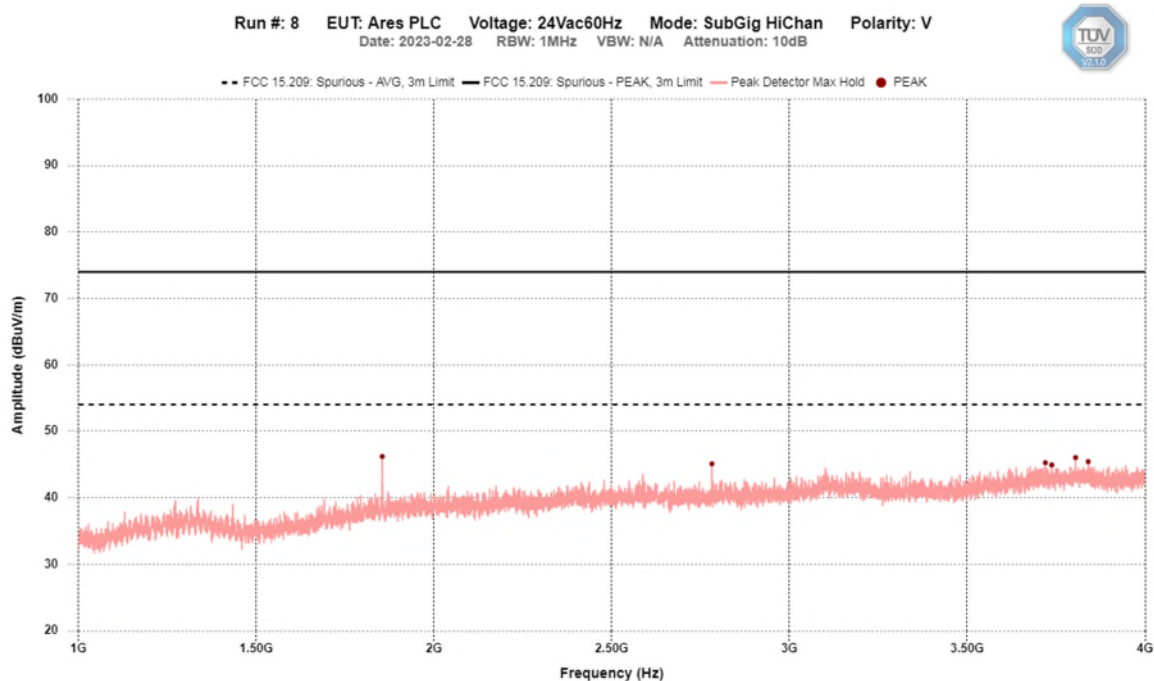
Client	Ecobee Inc.	 Canada
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel – 30 MHz – 1 GHz Vertical - Peak Emission Graph



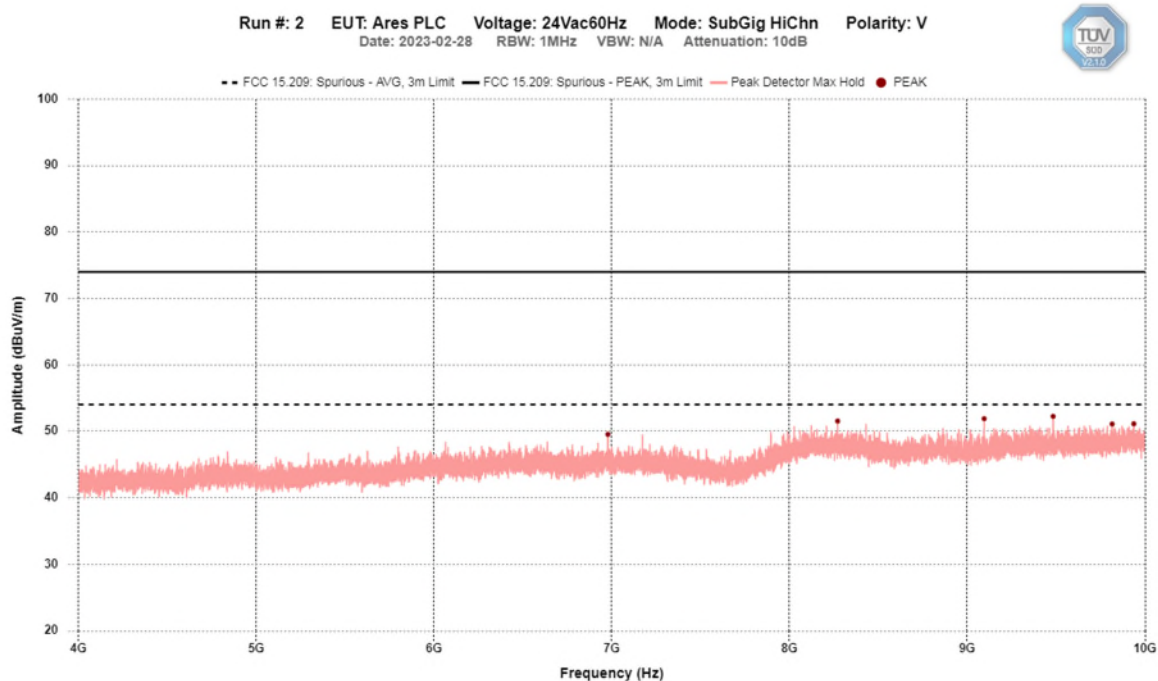
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Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


High Channel – 1 GHz – 4 GHz Vertical - Peak Emission Graph



Client	Ecobee Inc.	 Canada
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High Channel – 4 GHz – 10 GHz Vertical - Peak Emission Graph



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

Final Measurements and Results


The EUT passed. Low, middle, and high bands were measured.

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. Emissions outside the restricted bands were measured for informational purposes.

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.

Superius Emission Measurement table

EUT Name		ECB601				
Limit		FCC 15.209, Spurious				
Power Supply		24Vac60Hz				
Frequency (Hz)	Detector	Correction Factor (dB)	Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dB)	Test Result
Horizontal						
391.71M	QP	-9.3	39.9	46.0	6.1	Pass
489.63M	QP	-6.6	38.6	46.0	7.4	Pass
367.23M	PEAK	-9.7	37.8	46.0	8.2	Pass
440.67M	PEAK	-8.9	37.4	46.0	8.6	Pass
395.55M	PEAK	-9.2	36.9	46.0	9.1	Pass
416.19M	PEAK	-9.4	35.5	46.0	10.5	Pass
1.855G	PEAK	-0.9	47.8	54.0	6.2	Pass
Vertical						
489.63M	QP	-6.6	38.6	46.0	7.4	Pass
391.71M	PEAK	-9.3	38.1	46.0	7.9	Pass
367.23M	PEAK	-9.7	37.9	46.0	8.1	Pass
465.15M	PEAK	-7.5	37.1	46.0	8.9	Pass
416.19M	PEAK	-9.4	36.5	46.0	9.5	Pass
440.67M	PEAK	-8.9	35.7	46.0	10.3	Pass
1.855G	PEAK	-0.9	46.2	54.0	7.8	Pass

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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
BiLog Antenna	3142-C	ETS-Lindgren	Dec. 7, 2022	Dec. 7, 2024	GEMC 8
Horn Antenna 2 – 18 GHz	WBH218HN	Q-par	Jun. 8, 2022	Jun. 8, 2024	GEMC 6375
Horn Antenna 1 – 18 GHz	3117	ETS-Lindgren	Mar. 11, 2022	Mar. 11, 2024	GEMC 340
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
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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Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

Limits and Method

The limits are as defined in 47 CFR FCC Part 15 Section 15.207


Method is as defined in ANSI C63.4

Average Limits		Quasi-Peak Limits	
150 kHz – 500 kHz	56 to 46* dB μ V	150 kHz – 500 kHz	66 to 56* dB μ V
500 kHz – 5 MHz	46 dB μ V	500 kHz – 5 MHz	56 dB μ V
5 MHz – 30 MHz	50 dB μ V	5 MHz – 30 MHz	60 dB μ V

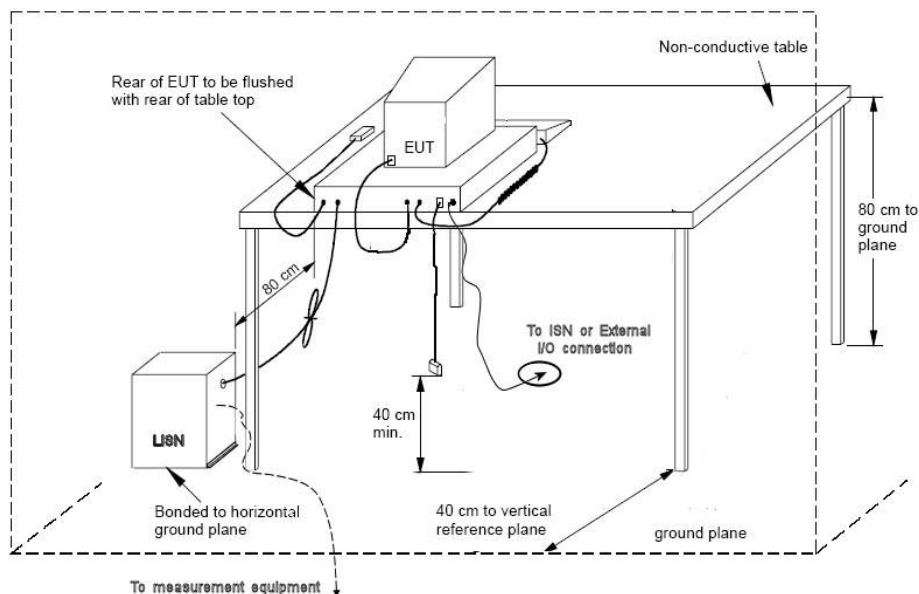
* Decreases linearly with the logarithm of the frequency

Both Quasi-Peak and Average limits are applicable and each is specified as being measured with a resolution bandwidth of 9 kHz. For Quasi-Peak, a video bandwidth at least three times greater than the resolution bandwidth is used.

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

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Typical Setup Diagram




Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is $\pm 2.27\text{dB}$ with a 'k=2' coverage factor and a 95% confidence level.

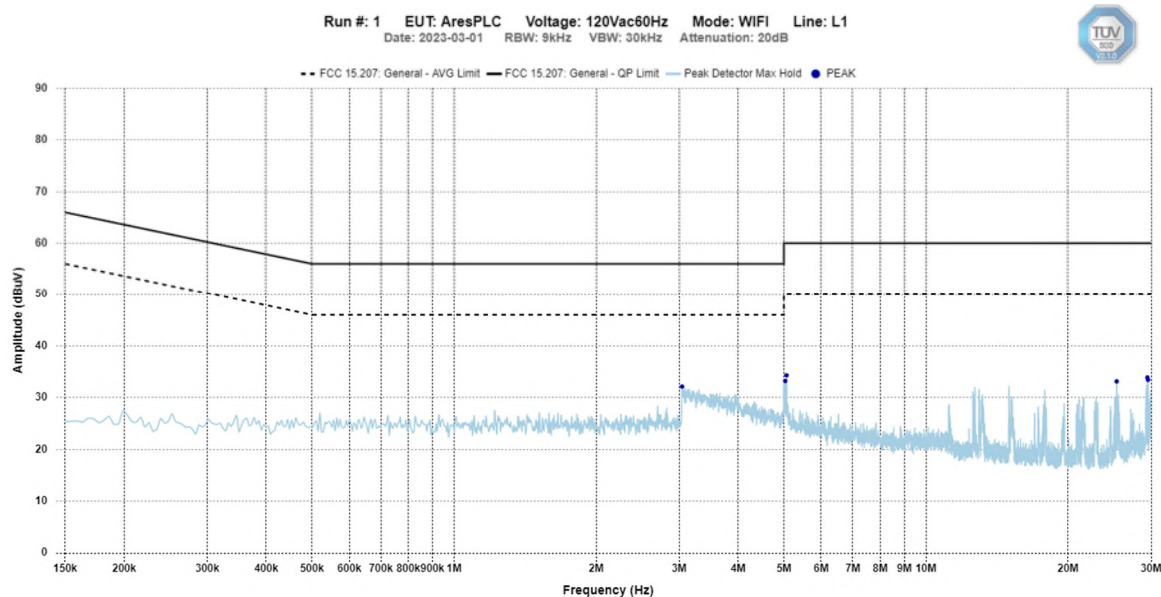
Preliminary Graphs

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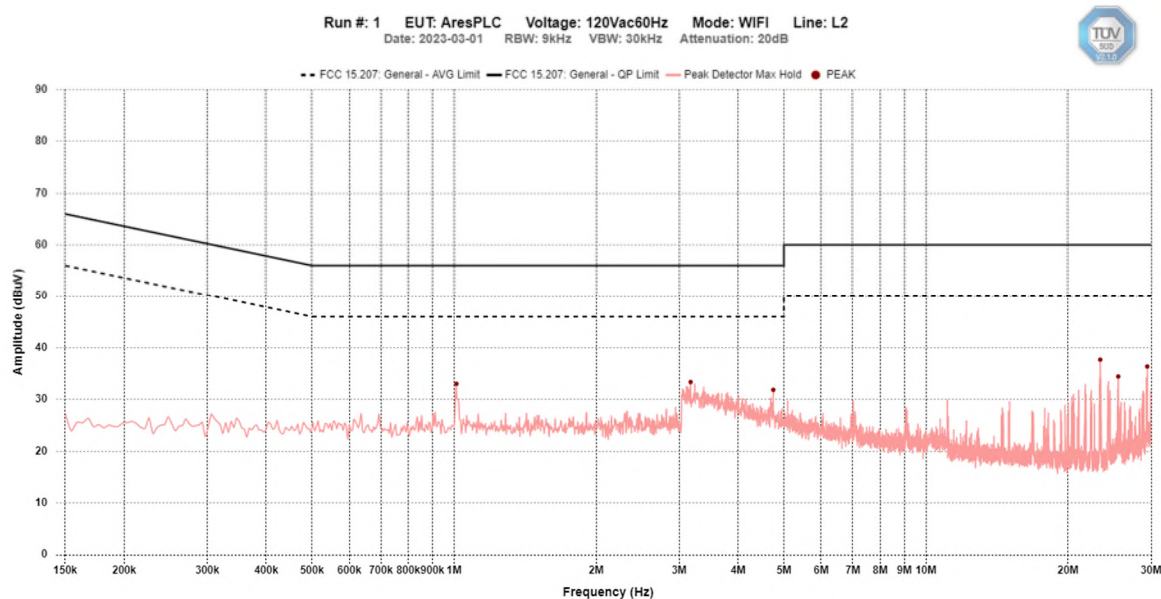
Client	Ecobee Inc.	
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ECB601

Line 1 (L1) – 120Vac 60Hz



Line 2 (L2) – 120Vac 60Hz



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Final Measurements

Average and Quasi-Peak Emissions Table

Limit		FCC 15.207, General						
Power Supply		120Vac60Hz						
Frequency (Hz)	Detector	Correction Factor (dB)	Level (dBuV)	QP Limit (dBuV)	AVG Limit (dBuV)	QP Margin (dB)	AVG Margin (dB)	Test Result
Line 1								
3.0432M	PEAK	10.2	32.1	56.0	46.0	23.9	13.9	Pass
5.0656M	PEAK	10.3	34.3	60.0	50.0	25.7	15.7	Pass
29.4677M	PEAK	11.4	33.9	60.0	50.0	26.1	16.1	Pass
29.5612M	PEAK	11.4	33.4	60.0	50.0	26.6	16.6	Pass
5.0344M	PEAK	10.3	33.2	60.0	50.0	26.8	16.8	Pass
25.365M	PEAK	11.1	33.1	60.0	50.0	26.9	16.9	Pass
Line 2								
23.4139M	PEAK	10.9	37.7	60.0	50.0	22.3	12.3	Pass
3.1724M	PEAK	10.2	33.4	56.0	46.0	22.6	12.6	Pass
1.012M	PEAK	10.2	33.0	56.0	46.0	23.0	13.0	Pass
29.4499M	PEAK	11.1	36.4	60.0	50.0	23.6	13.6	Pass
4.7493M	PEAK	10.3	31.8	56.0	46.0	24.2	14.2	Pass
25.5655M	PEAK	10.9	34.4	60.0	50.0	25.6	15.6	Pass


Note:

Peak = Peak measurement

AVG = Average measurement

QP = Quasi-Peak measurement


See 'Appendix B – EUT, Peripherals and Test Setup Photos' for photos showing the test set-up for the highest line conducted emission

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Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	Feb. 17, 2023	Feb. 17, 2025	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	Feb. 23, 2023	Feb. 23, 2025	GEMC 303
RF Cable 3m	LMR-400-3M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 276
Attenuator 10 dB	6N10W-10	Inmet	NCR	NCR	GEMC 348
Emissions Software	V2.1.0	TUV SUD Canada, Inc.	NCR	NCR	GEMC 361

FCC_ICES003_CE_Rev1

Client	Ecobee Inc.	 Canada
Product	ECB601/ECB501	
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Appendix A – EUT Summary

Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

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	416-809-2405
Email	johnr@ecobee.com
EUT Details	
EUT Name	ECB601/ECB501
FCC ID	WR955470766937
IC	7981A-55470766937
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) and FHSS transmitters and a 902 – 928 MHz FHSS/Hybrid transmitter. 5150-5250 MHz and 5725-5850 MHz UNII 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 DTS and FHSS 902 – 928 MHz FHSS/Hybrid 5150-5250 MHz and 5725-5850 MHz UNII transmitter.
Antenna	Flexible 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, FSK, etc
EUT Configuration	Test software was configured to transmit continuously at 100% duty cycle and to control

Client	Ecobee Inc.	 Canada
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

	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’.

Client	Ecobee Inc.	 Canada
Product	ECB601/ECB501	
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Appendix B – EUT and Test Setup Photos

Refer to the files separate from this test report