



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 (DTS)

on the

EB-STATE3LT02

Issued by:

TÜV SÜD Canada Inc.
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Testing produced for

ecobee

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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



R-14023, G-20072
C-14498, T-20060



Registration #
CA6844

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

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Client	Ecobee Inc.	
Product	EB-STATE3LT02	
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 # **7169010650RB-000 (DTS)** 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	EB-STATE3LT02	
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	Amir Emami
Reviewed by	Min Xie

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

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

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.205 RSS-GEN (Table 7)	Restricted Bands for Intentional Operation	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 '*'.

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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 # **7169010650RB-000 (DTS)**, for full testing and test results.

The worst-case emission is 802.11n mode. Thus band edge and spurious emission testing was performed with channel 11.

As per the manufacturer, the new sample is electrically the same to the sample previously tested. None 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

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)

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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
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

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Document Revision Status

Revision	Date	Description	Initials
000	May-19, 2022	Initial Release	MX
-	-	-	-

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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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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)
April 25, 2022	Radiated Emissions	AE	22.1	50.4	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 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).

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

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

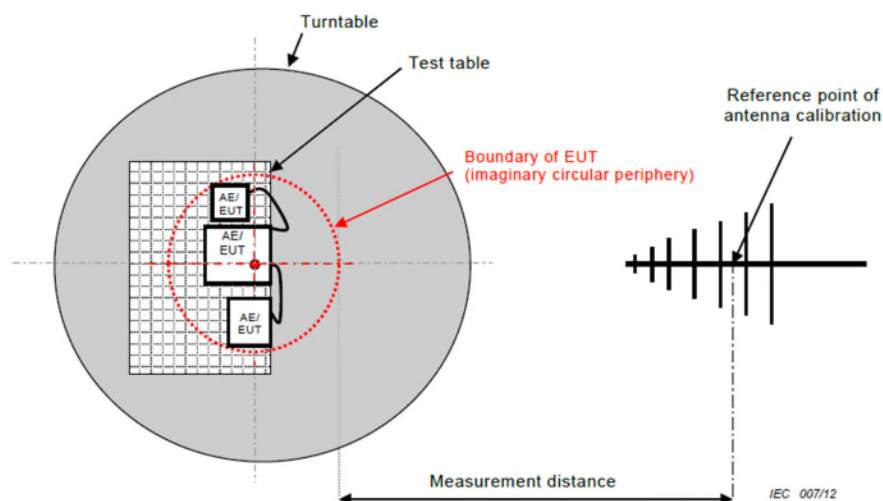
²Limit is with 1 MHz measurement bandwidth and using an Average detector

³Limit 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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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 10th harmonic (a minimum of 24.835 GHz).

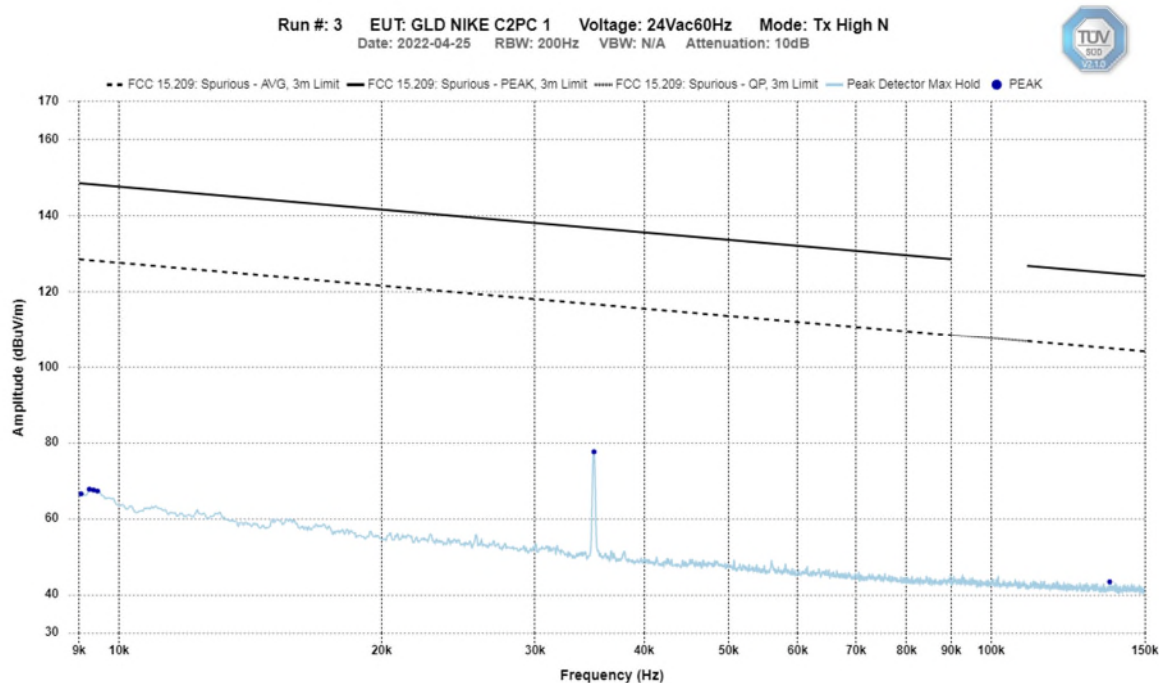
Devices scanned may be scanned at alternate test distances and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m /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

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

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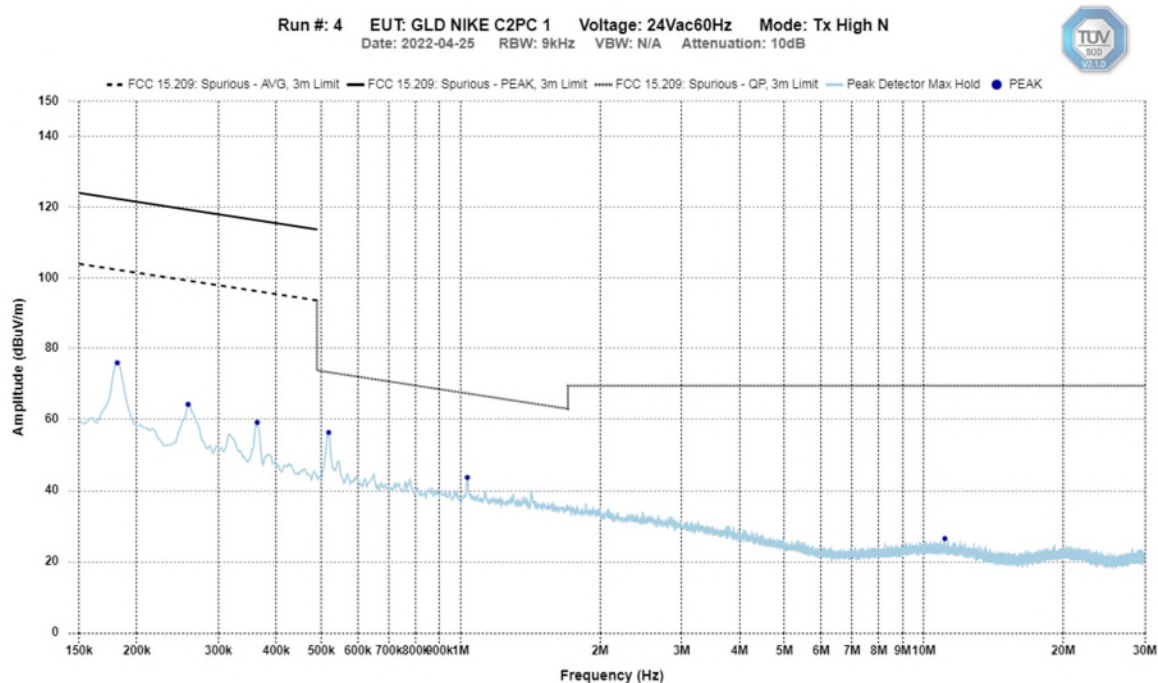
Spurious Emissions

N-Mode, High Channel
9 kHz – 150 kHz
Peak Emission Graph



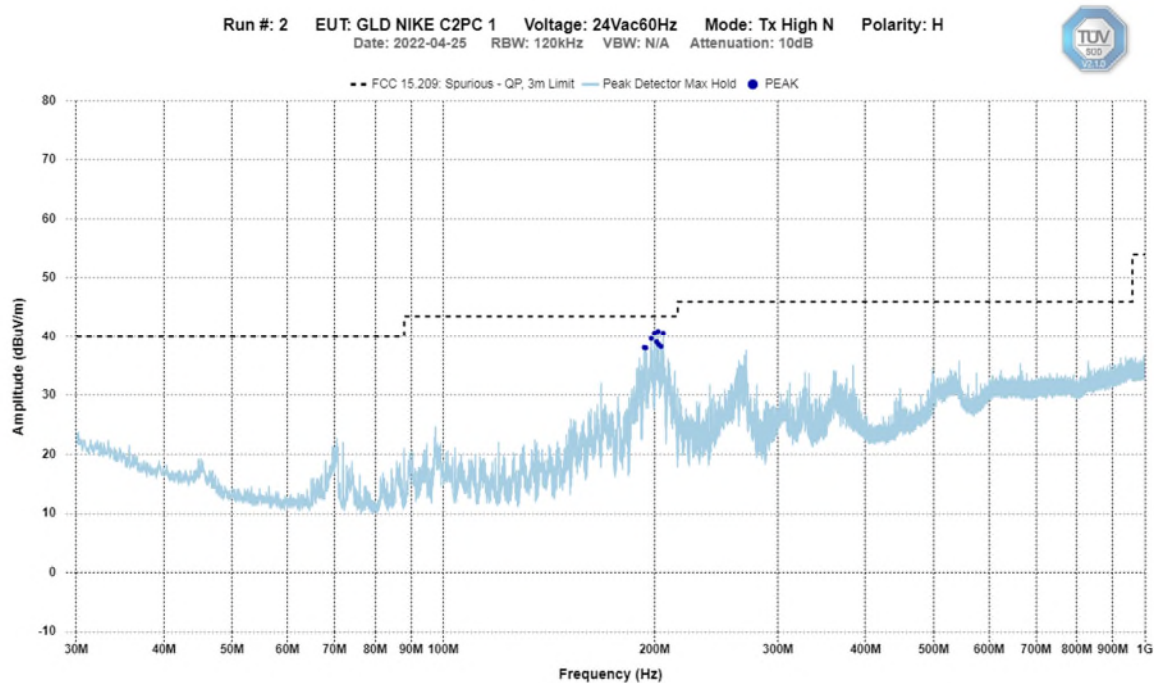
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N-Mode, High Channel
150 kHz – 30 MHz
Peak Emission Graph



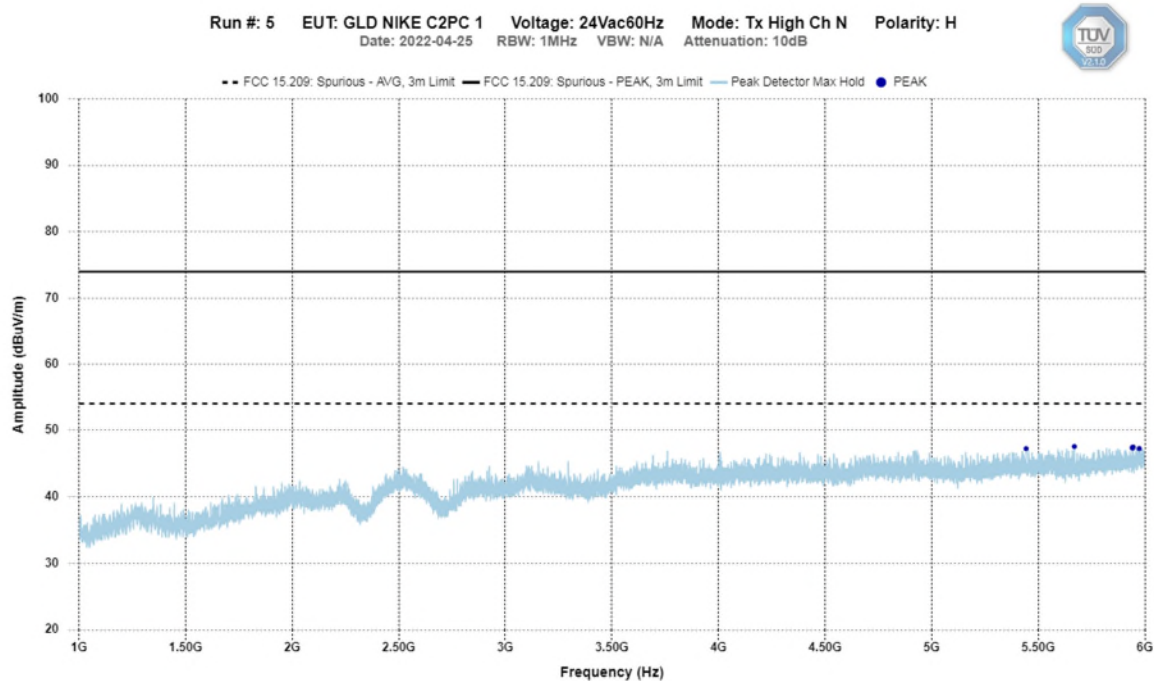
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N-Mode, High Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph



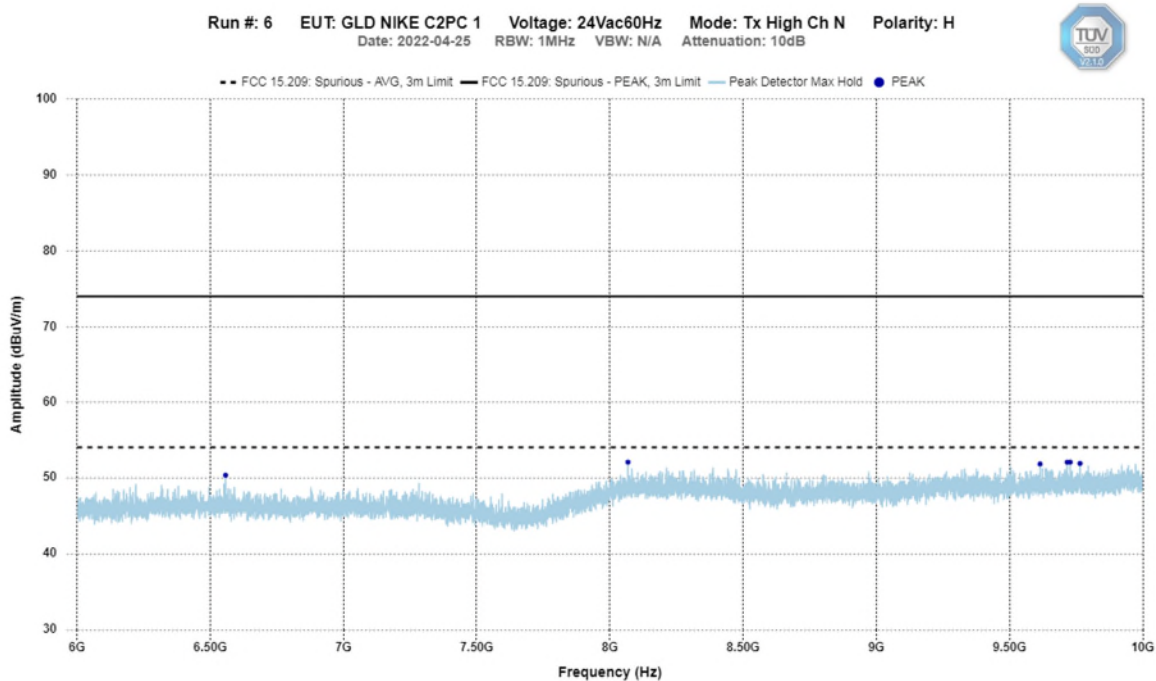
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N-Mode, High Channel – 1 GHz – 6 GHz Horizontal - Peak Emission Graph



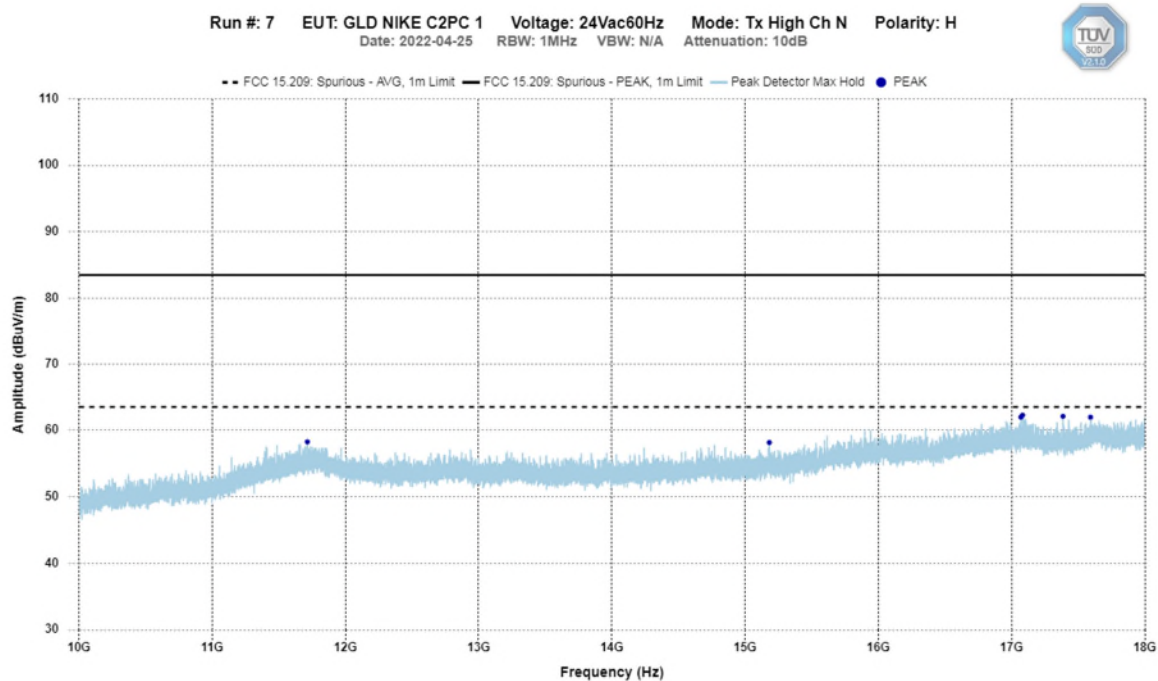
Client	Ecobee Inc.	 Canada
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N-Mode, High Channel – 6 GHz – 10 GHz
Horizontal - Peak Emission Graph



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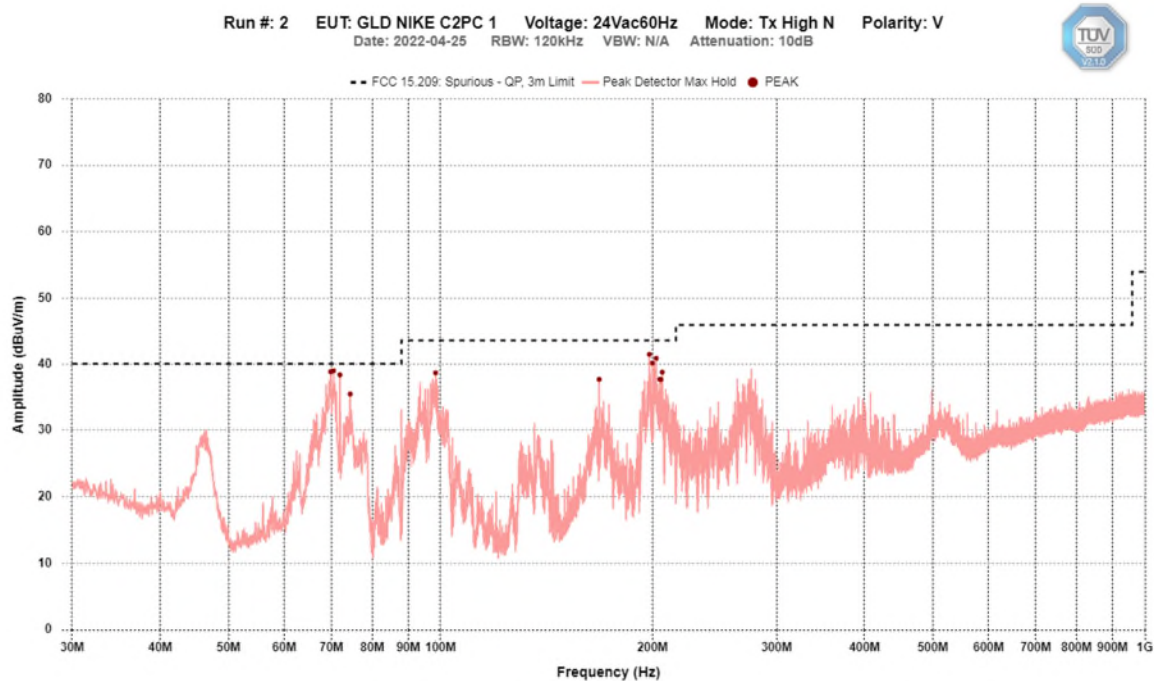
N-Mode, High Channel – 10 GHz – 18 GHz
Horizontal - Peak Emission Graph



Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range and up to 25GHz.

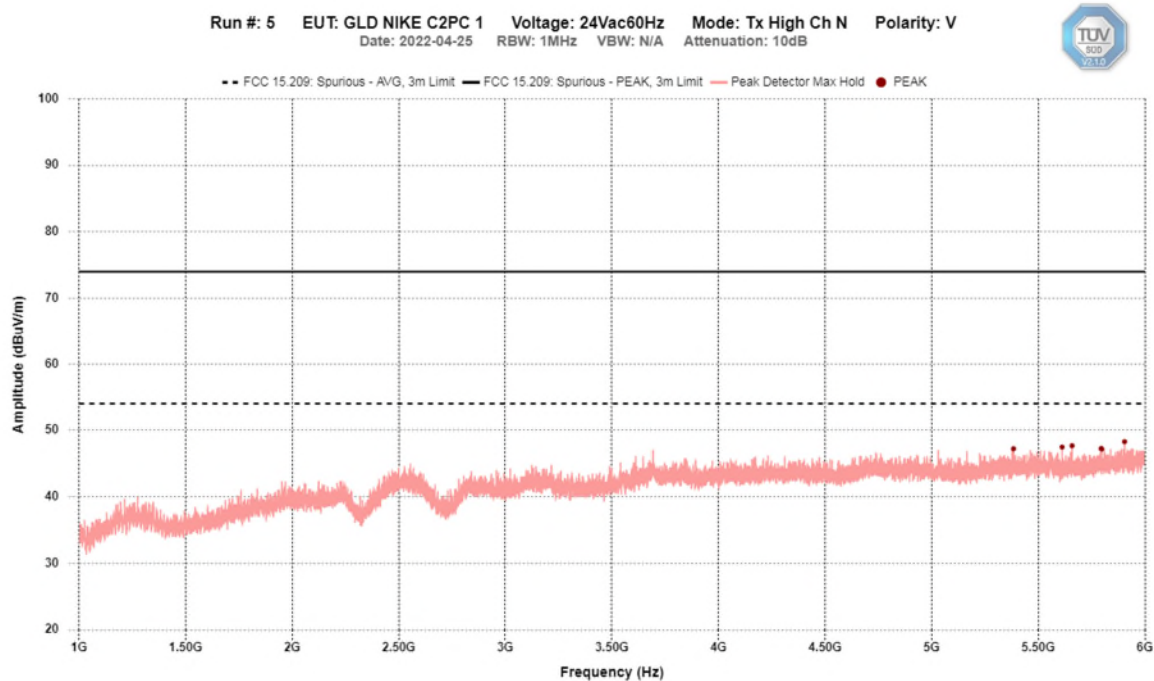
Client	Ecobee Inc.	 Canada
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N-Mode, High Channel – 30 MHz – 1 GHz
Vertical - Peak Emission Graph



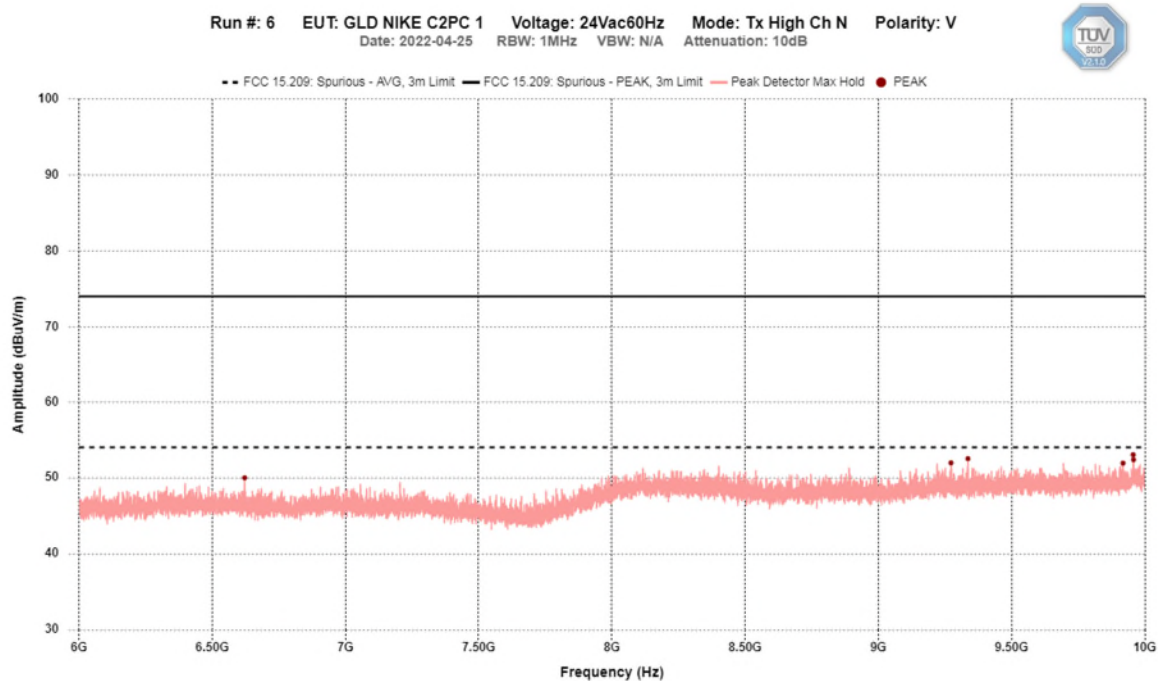
Client	Ecobee Inc.	 Canada
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N-Mode, High Channel – 1 GHz – 6 GHz
Vertical - Peak Emission Graph



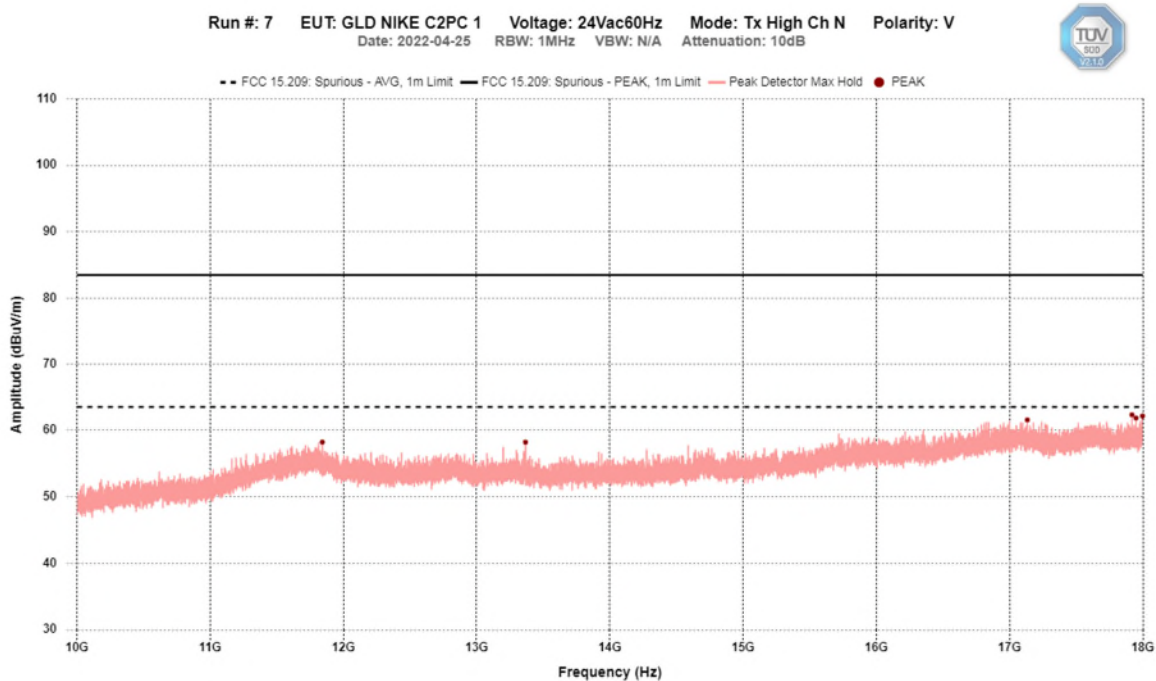
Client	Ecobee Inc.	 Canada
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N-Mode, High Channel – 6 GHz – 10 GHz
Vertical - Peak Emission Graph



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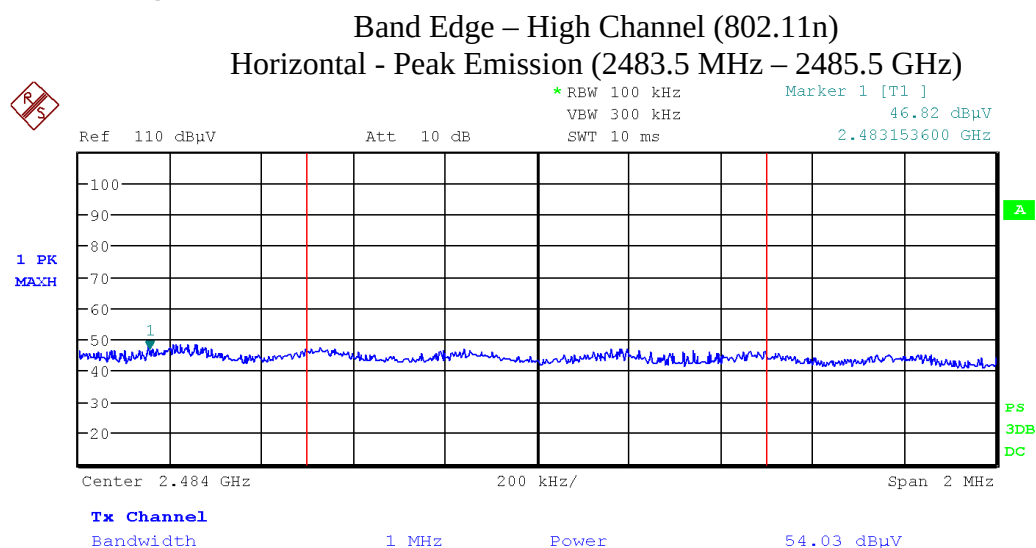
B-Mode, Mid Channel – 10 GHz – 18 GHz
Vertical - Peak Emission Graph



Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range and up to 25GHz.

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Band Edge – N-Mode



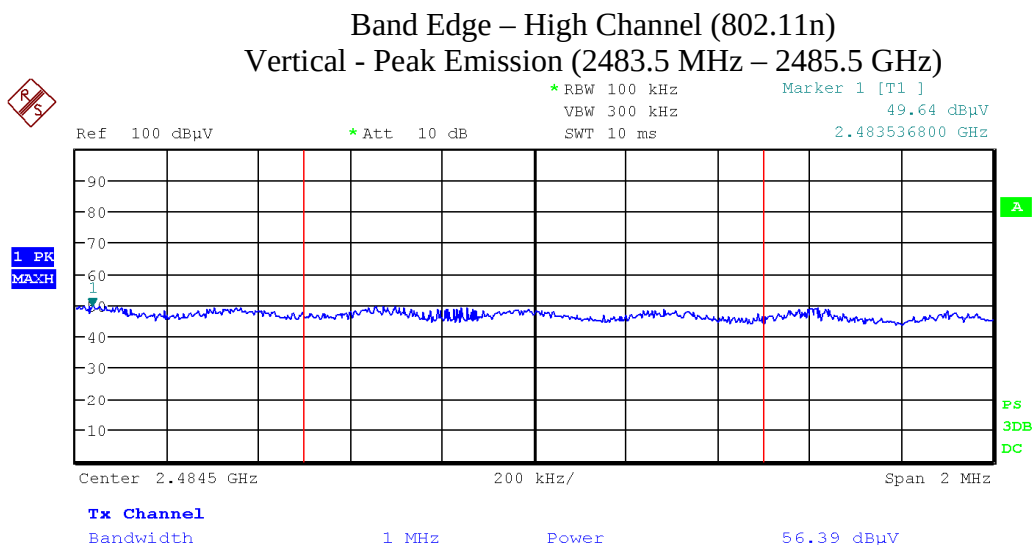
Date: 25.APR.2022 14:35:16

Note: Restricted band Band Edge plot was taken at a 3m measurement distance.

For peak emission appearing within 2 MHz of the Band Edge (2483.5 MHz – 2485.5 MHz), the Integration method was used to perform peak measurement.

The marker shows the raw value. See the Final Measurements and Results section below for correct values.

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Date: 25.APR.2022 14:11:37

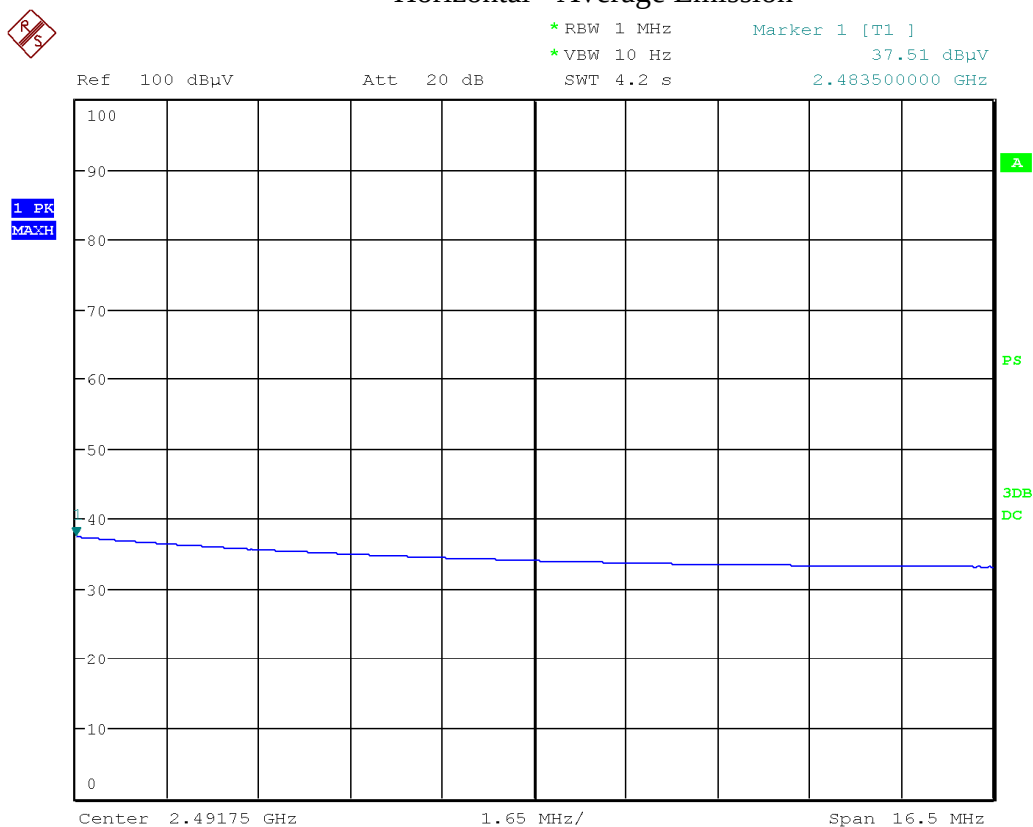
Note: Restricted band Band Edge plot was taken at a 3m measurement distance.

For peak emission appearing within 2 MHz of the Band Edge (2483.5 MHz – 2485.5 MHz), the Integration method was used to perform peak measurement.

The marker shows the raw value. See the Final Measurements and Results section below for correct values.

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Band Edge – High Channel Horizontal - Average Emission

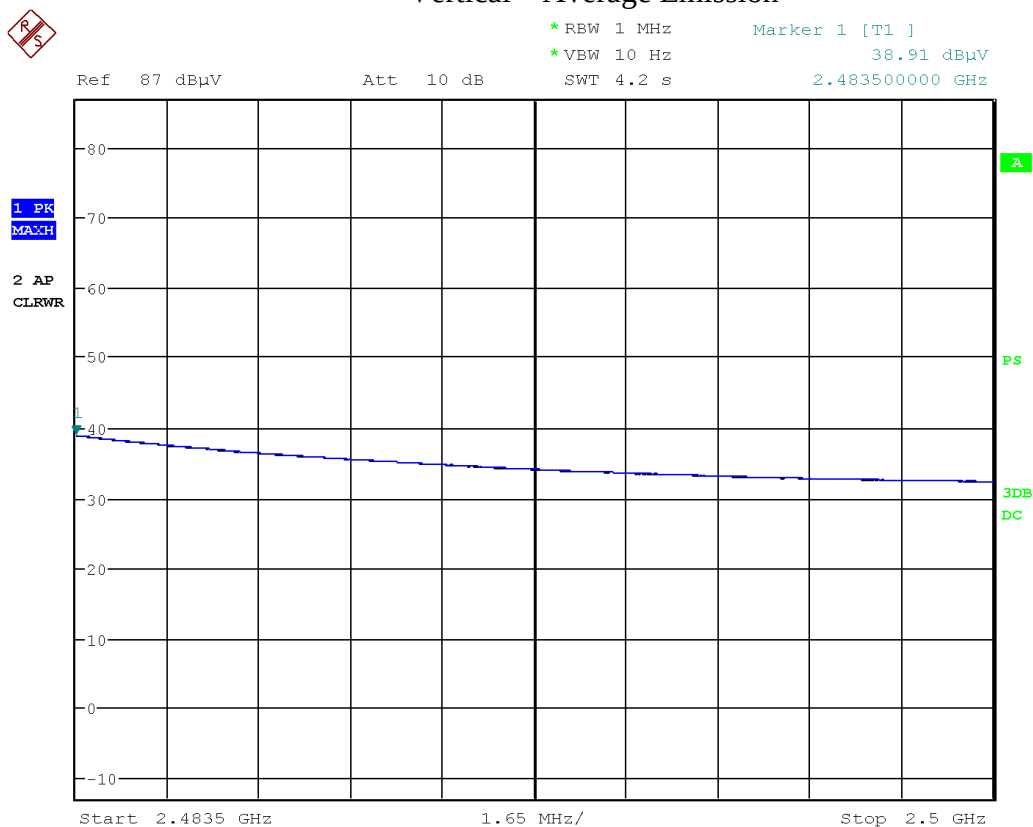


Date: 25.APR.2022 14:41:02

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The marker shows the raw value. See the Final Measurements and Results section below for correct values.

Client	Ecobee Inc.	 Canada
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Band Edge – High Channel Vertical – Average Emission



Date: 25.APR.2022 14:17:03

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The marker shows the raw value. See the Final Measurements and Results section below for correct values.

Client	Ecobee Inc.	 Canada
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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 Mode		Wi-Fi N-Mode				
Power Supply		24Vac60Hz				
Frequency (Hz)	Detector	Correction Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Test Result
Horizontal						
202.47M	QP	-10.6	35.6	43.5	7.9	Pass
200.00M	QP	-10.6	39.5	43.5	4.0	Pass
9.728G	AVG	12.4	38.4	54.0	15.6	Pass
8.068G	AVG	10.9	38.5	54.0	15.5	Pass
6.558G	AVG	8.9	35.3	54.0	18.7	Pass
17.083G	AVG	23.5	48.6	63.5	14.9	Pass
17.386G	AVG	23.1	48.2	63.5	15.3	Pass
17.593G	AVG	23.7	49.0	63.5	14.5	Pass
Vertical						
70.5M	QP	-15.0	32.9	40.0	7.1	Pass
69.87M	QP	-14.9	30.7	40.0	9.3	Pass
72.0M	QP	-15.0	37.1	40.0	2.9	Pass
198.03M	QP	-10.6	36.7	43.5	6.8	Pass
202.47M	QP	-10.6	34.5	43.5	9.0	Pass
74.46M	QP	-15.2	30.3	40.0	9.7	Pass
98.43M	QP	-13.1	33.8	43.5	9.7	Pass
168.03M	QP	-11.3	34.8	43.5	8.7	Pass
9.957G	AVG	12.8	38.7	54.0	15.3	Pass
6.622G	AVG	9.0	35.1	54.0	18.9	Pass
17.919G	AVG	24.0	48.9	63.5	14.6	Pass
17.134G	AVG	23.4	48.5	63.5	15.0	Pass

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Test Frequency (MHz)	Detection Mode	Antenna Polarity (Horz/Vert)	Received Signal (dBμV)	Antenna Factor (dB/m)	Cable Factor (dB)	Attenuator (dB)	Pre-Amp Gain (dB)	Level (dBμV/m)	Emission Limit (dBμV/m)	Margin (dB)	Result
WIFI N - High Channel 20 MHz											
2462	Peak	Horz	94.6	32.3	3.2	10.0	-33.8	106.3			PASS
2462	Avg	Horz	83.1	32.3	3.2	10.0	-33.8	94.8			PASS
2462	Peak	Vert	98.8	32.3	3.2	10.0	-33.8	110.5			PASS
2462	Avg	Vert	86.9	32.3	3.2	10.0	-33.8	98.5			PASS
2483.5	Peak	Horz	54.0	32.2	3.2	10.0	-33.8	65.7	74.0	8.3	PASS
2483.5	Avg	Horz	37.5	32.2	3.2	10.0	-33.8	49.2	54.0	4.8	PASS
2483.6	Peak	Vert	56.4	32.2	3.2	10.0	-33.8	68.1	74.0	5.9	PASS
2483.5	Avg	Vert	38.9	32.2	3.2	10.0	-33.8	50.6	54.0	3.4	PASS

Band-Edge Measurements – N-Mode

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	Nov. 25, 2020	Nov. 25, 2022	GEMC 8
Horn Antenna 1 – 18 GHz	3117	ETS-Lindgren	Mar. 11, 2022	Mar. 11, 2024	GEMC 340
Horn Antenna 18 - 26.5 GHz	SAS-572	A.H. Systems	Dec. 1, 2020	Dec. 1, 2022	GEMC 6371
Attenuator 6 dB	6N5W-06	Inmet	NCR	NCR	GEMC 345
Pre-Amp 9 kHz – 1 GHz	LNA 6901	Teseq	Feb. 12, 2021	Feb. 12, 2023	GEMC 168
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Mar. 11, 2022	Mar. 11, 2024	GEMC 189
Pre-Amp 18 – 40 GHz	PAM-840A	Com-Power Corporation	May 13, 2021	May 13, 2023	GEMC 252
2.4GHz-2.5GHz Notch Filter	BRM50702	Micro-Tronics	NCR	NCR	GEMC 230
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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Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Appendix A – EUT Summary

Client	Ecobee Inc.	
Product	EB-STATE3LT02	
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	416-987-1058
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

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

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	EB-STATE3LT02	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

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	Ecobee Inc.	 Canada
Product	EB-STATE3LT02	
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