



Canada

EMC & RF Test Report

As per

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

Unlicensed Intentional Radiators
FHSS System
on the

ECB601/ECB501

Issued by: **TÜV SÜD Canada Inc.**
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Testing produced for

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ecobee

See Appendix A for full client &
EUT details.

Reviewed by:
Amir Emami,
Project Engineer



Registration #
6844A-3



Testing Laboratory
Certificate #2955.02



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



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 (2.4 GHz 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.

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	Amir Emami


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 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS-GEN (Table 6)	Restricted Bands for Intentional Operation	QuasiPeak Average	Pass
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
FCC 15.247(a)(1) RSS 247 5.1	Channel Separation	> 25 kHz or 20 dB BW	Pass
FCC 15.247(a)(1) RSS 247 5.1	Number of channels	> 15	Pass
FCC 15.247(a)(1)(i) RSS 247 5.1 (3)	Time of occupancy	< 0.4 x N _{ch} Seconds period	Pass
FCC 15.247(b)2 RSS-247 5.4(d)	Max Output Power	< 0.125 Watt	Pass
FCC 15.247(b)4 RSS-247 5.4(d)	Antenna Gain	< 6 dBi	Pass See Justifications
FCC 15.247(d) RSS-247 5.5	Antenna Conducted Spurious	< 20 dBc	Pass
FCC 15.247(h) RSS GEN 247 5.1	FHSS Intelligence	No coordination	Pass See Justification
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:

For the Antenna requirement specified in FCC 15.203 (RSS-247 section 5.4(d)), the unit uses a 1.5 dBi gain flexible PCB antenna which is less than 6 dBi gain.


For the Restricted Bands of operation, the EUT is designed to only operate between 2400 – 2483.5 MHz.

The EUT is not a hybrid system and FCC 15.247 (f) does not apply to it.

The EUT contains a 902 – 928 MHz FHSS/Hybrid transmitter, a 2400 – 2483.5 MHz FHSS transmitter, three 2400 – 2483.5 DTS MHz transmitter, and UNII-1 and UNII-3 transmitters. Antenna co-location testing is applicable and documented in a test report.

For maximum permissible exposure, this device operates at less than 1 Watt at 2400 – 2483.5 MHz and is designed to operate greater than 20 cm from any personnel during normal operation. No testing is required, however worst-case calculated exposure compliance was shown in the RF Exposure exhibits.

This FHSS report documents the 2.4 GHz IEEE 802.15.1, complaint transceiver.

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

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)

Client	Ecobee Inc.	
Product	ECB601/ECB501	
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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
- SCFR 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

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

Document Revision Status

Revision	Date	Description	Initials
000	2022-04-24	Initial Release	MX
001	2022-05-03	Updated Appendix A and added antenna gain.	MX

Client	Ecobee Inc.	
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.


Client	Ecobee Inc.	
Product	ECB601/ECB501	
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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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Product	ECB601/ECB501	
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)
2021-09-21	Radiated Emissions	MX	24.3	59.4	101.8
2021-09-30	Radiated Emissions	MX	22.2	37	102.2
2021-10-06	Antenna Conducted Emissions	MX	23.5	54.1	102.7
2021-10-01	Power Line Conducted Emissions	MX	23.2	39.8	102.2

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

Detailed Test Results Section

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

Emission Bandwidth

Purpose

The purpose of this test is to ensure that the upper and lower frequency limits of the transmitter 99% emission power bandwidth remain within the operating frequency limits at all times.

Limits and Method

The method is given in ANSI C63.10 Section 6.9.3 and RSS-GEN 6.7.


The 99% and 20dB bandwidth shall always remain within the operating frequency band. This should be measured with a RBW in the range of 1% to 5% of the occupied bandwidth and a VBW of approximately three times RBW.

Results

The EUT passed. The 99% bandwidth was measured using the 99% bandwidth function of the spectrum analyzer.

1 MBPS			
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.128	0.93
Mid	2440	1.006	0.92
High	2480	0.994	0.92

2 MBPS			
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.128	1.19
Mid	2440	1.320	1.19
High	2480	1.327	1.19

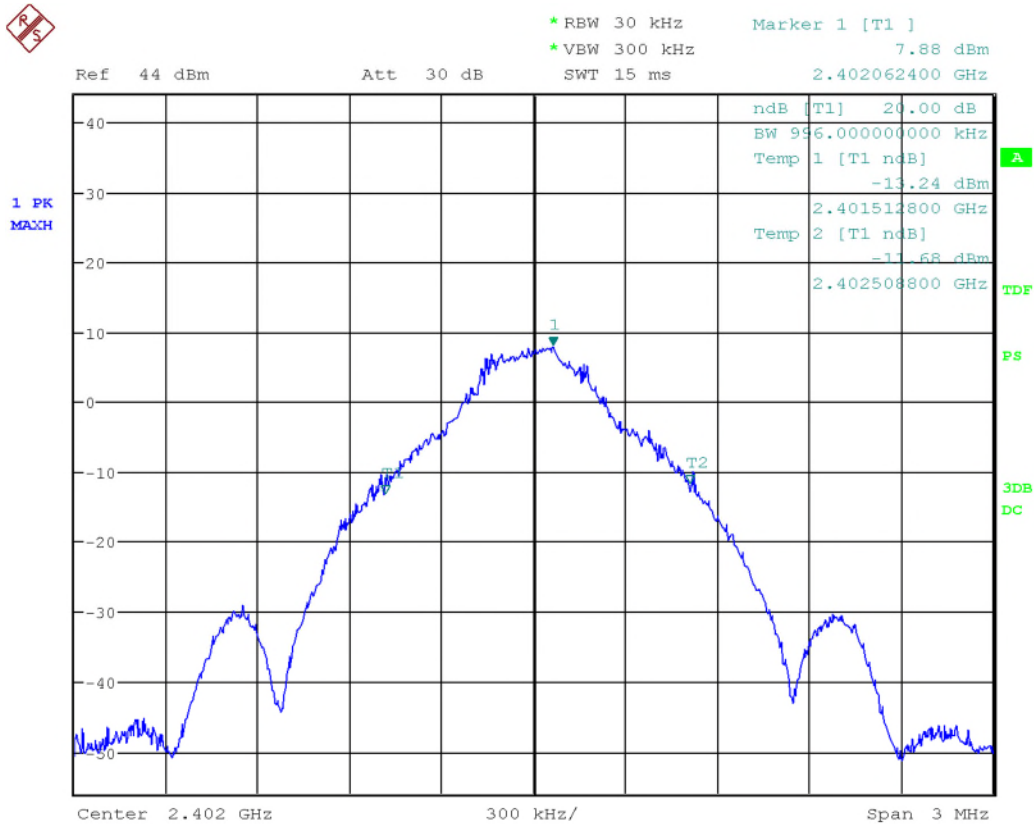
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Graphs


The graphs shown below show the 20 dB Bandwidth and the OBW of the device during antenna conducted measurement operation of the EUT. This is measured by a max hold on the spectrum analyzer.

1 MBPS

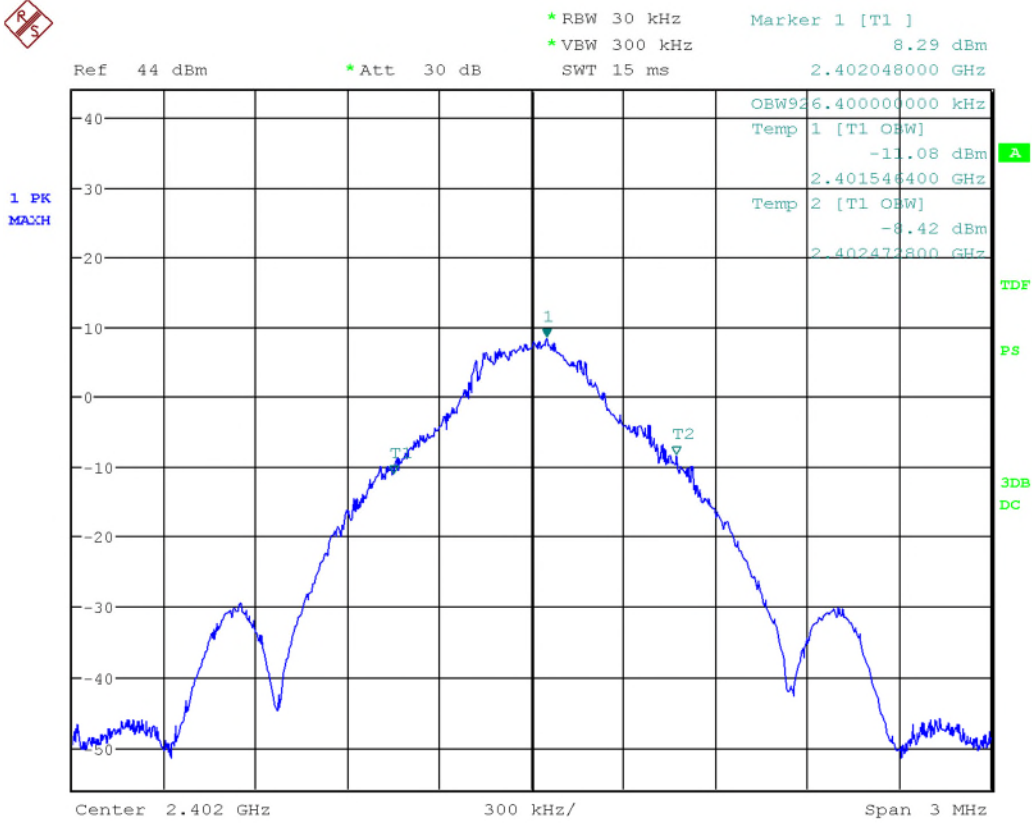
20dB Bandwidth Low Channel




Date: 6.OCT.2021 18:30:59

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

**99% Bandwidth
Low Channel**

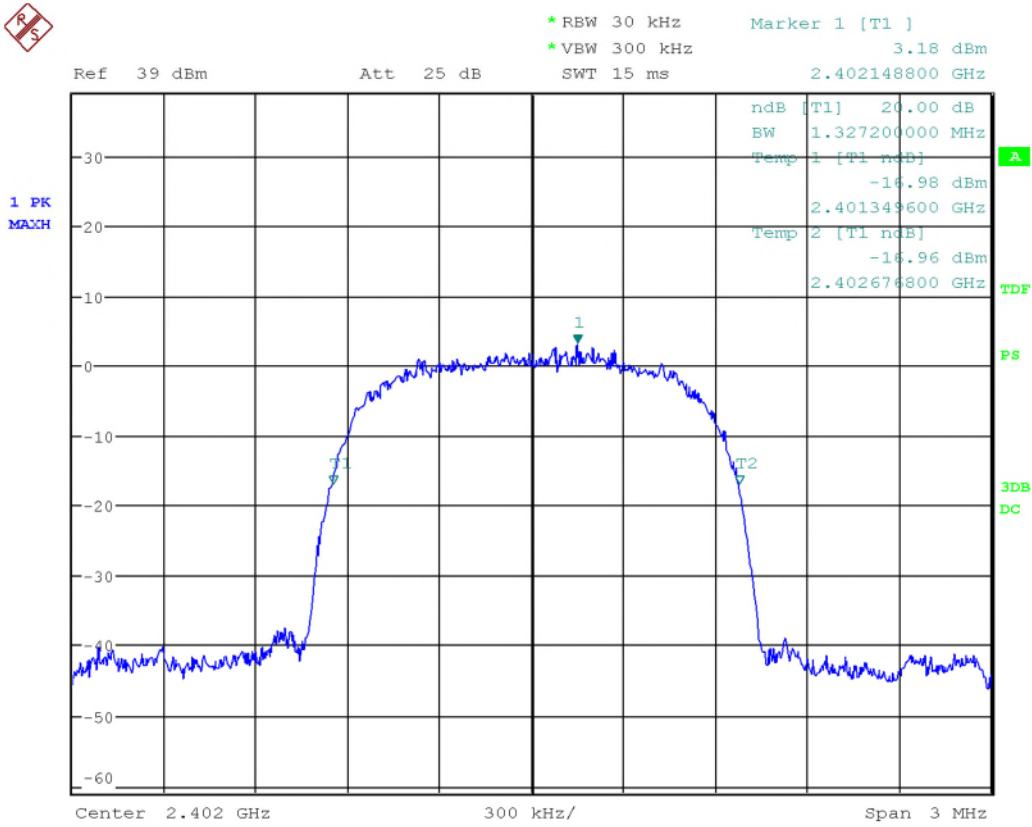


Date: 6.OCT.2021 18:30:42


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

2 MBPS

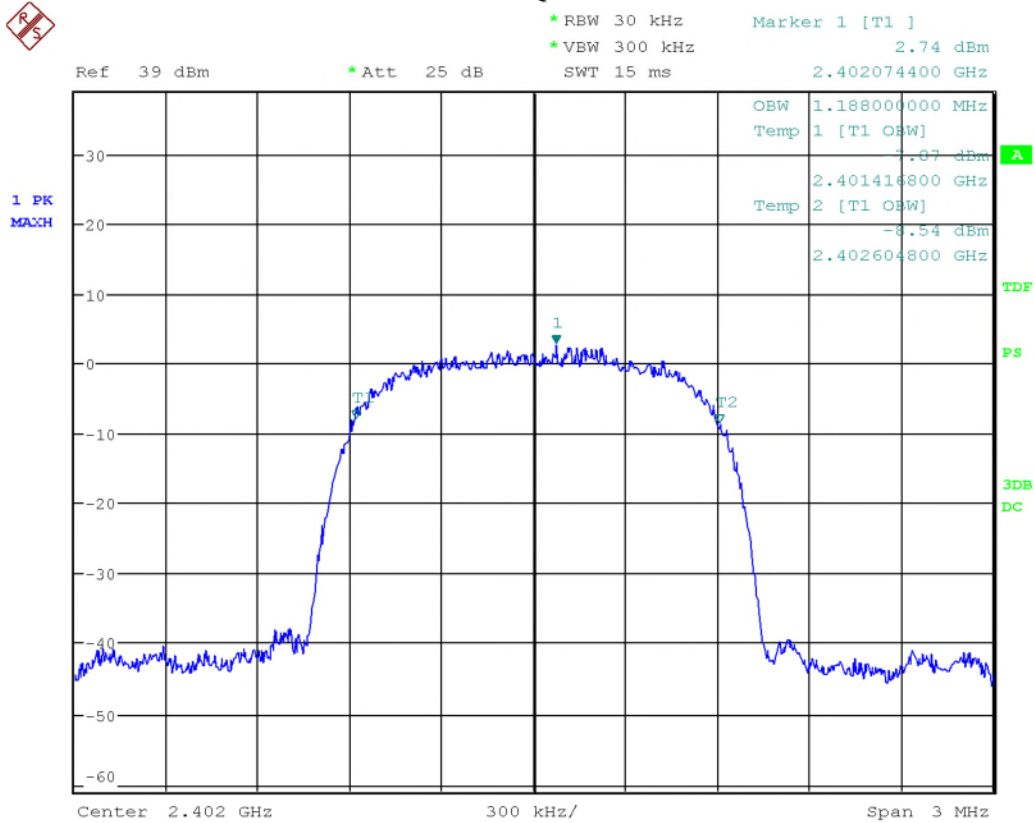
20dB Bandwidth Low Channel



Date: 6.OCT.2021 18:55:32

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

99% Bandwidth High Channel




Date: 6.OCT.2021 18:55:15

Note: See 'Appendix B – EUT & Test Setup Photos' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Attenuator 10 dB	8493B	Agilent	Oct 4, 2021	Oct 4, 2022	GEMC133

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

Number of Hopping Frequencies

Purpose

The purpose of this test is to ensure that the RF energy of frequency hopping systems is sufficiently spread over a spectrum and that the radio energy is not overly dense. This limit helps allow for other spread spectrum devices to co-exist in the same frequency spectrum. This also helps prevent corruption of data by ensuring adequate channel separation to distinguish the reception of the intended information.


Limits and method

The limits are as defined in 47 CFR FCC Part 15 Section 15.247(a)(1) and RSS 247 Section 5.1. The test method is a defined in ANSI C63.10.

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

Results

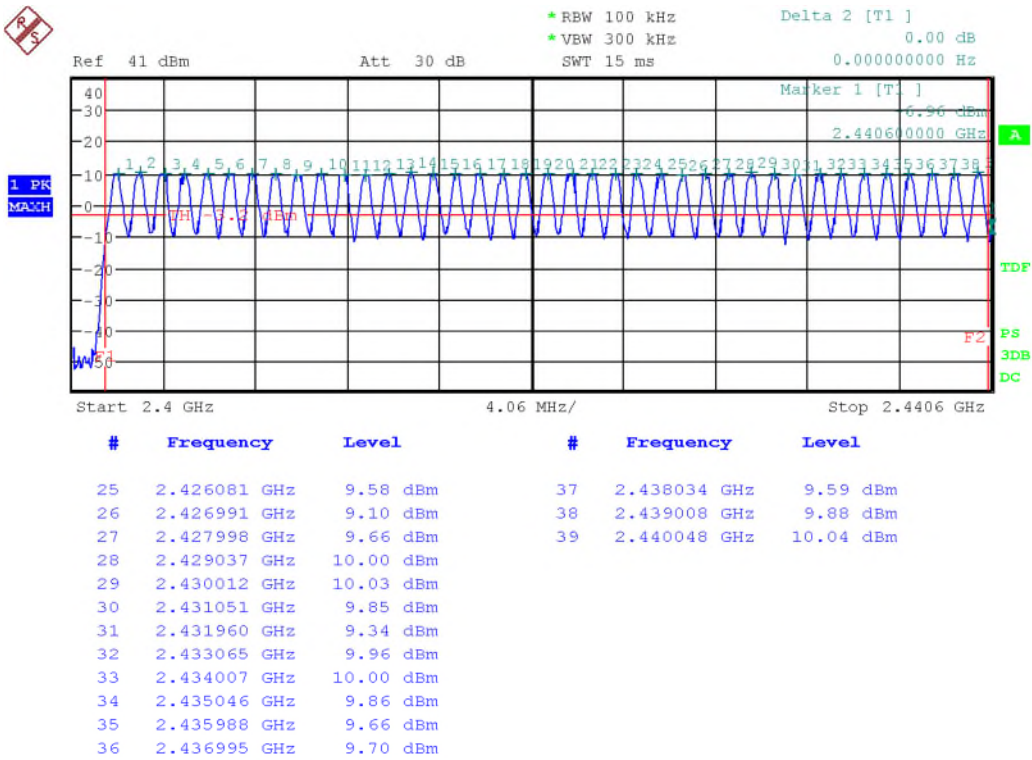
The EUT passed the requirements of the number of channels. The number of channels the device occupies is 79, (39+40) channels in the allocation band of 2.4 to 2.4835 GHz.

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

Graph(s)


The graphs shown below shows the number of occupied channels during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the channel spacing of the signal being measured. This measurement is a peak measurement. Max hold is performed for a duration of not less than 10 minutes, or as sufficient to capture the channels occupied.

Graph 1 of 2 (39 channels)

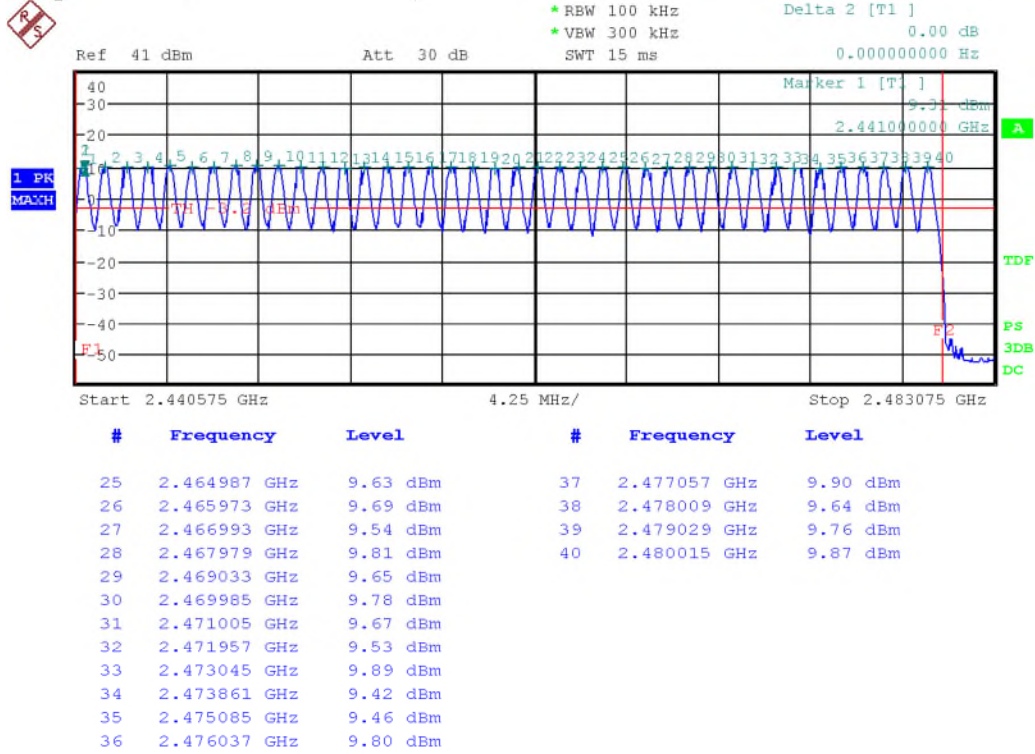


Date: 6.OCT.2021 19:39:57

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

Graph 2 of 2 (40 more channels)




Date: 6.OCT.2021 19:37:01

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Attenuator 10 dB	8493B	Agilent	Oct 4, 2021	Oct 4, 2022	GEMC133

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

Carrier Frequency Separation

Purpose

The purpose of this test is to ensure that the RF energy of frequency hopping systems is sufficiently spread over a spectrum and that the radio energy is not overly dense. This limit helps allow for other spread spectrum devices to co-exist in the same frequency spectrum. This also helps prevent corruption of data by ensuring adequate channel separation to distinguish the reception of the intended information.

Limits and method


The limits are as defined in 47 CFR FCC Part 15 Section 15.247(a)(1) and RSS 247 Section 5.1. The test method is a defined in ANSI C63.10.

902 to 928 MHz	$P_{\max\text{-pk}} \leq 1 \text{ W}$ $\Delta f \geq \text{MAX} \{25 \text{ kHz}, BW_{20\text{dB}}\}$ $BW_{20\text{dB}} \leq 250 \text{ kHz}$	$P_{\max\text{-pk}} \leq 0.25 \text{ W}$ $\Delta f \geq \text{MAX} \{25 \text{ kHz}, BW_{20\text{dB}}\}$ $250 \text{ kHz} \leq BW_{20\text{dB}} \leq 500 \text{ kHz}$
2400 to 2483.5 MHz	$P_{\max\text{-pk}} \leq 1 \text{ W}$ $\Delta f \geq \text{MAX} \{25 \text{ kHz}, BW_{20\text{dB}}\}$ Max. $BW_{20\text{dB}}$ not specified	$P_{\max\text{-pk}} \leq 0.125 \text{ W}$ $\Delta f \geq [\text{MAX} \{25 \text{ kHz}, \frac{2}{3}BW_{20\text{dB}}\}]$ OR $\text{MAX} \{25 \text{ kHz}, BW_{20\text{dB}}\}$ Max. $BW_{20\text{dB}}$ not specified
5275 to 5850 MHz	$P_{\max\text{-pk}} \leq 1 \text{ W}$ $\Delta f \geq \text{MAX} \{25 \text{ kHz}, BW_{20\text{dB}}\}$ $BW_{20\text{dB}} \leq 1 \text{ MHz}$	

Note 1: The maximum power of the transmitter is less than 10 mW. The $P_{\max\text{-pk}} \leq 0.125 \text{ W}$ limit applies to the FHSS. The greater of the two-thirds of the 20 dB BW or 25 kHz are the applicable limit. The largest 20 dB BW of the system was measured to be 1.33 MHz, so a limit of 0.88 MHz applies.

Results

The EUT passed the requirements of channel carrier spacing exceeding the measured 20 dB BW of the EUT. The device had a channel spacing of at least 1.00 MHz.

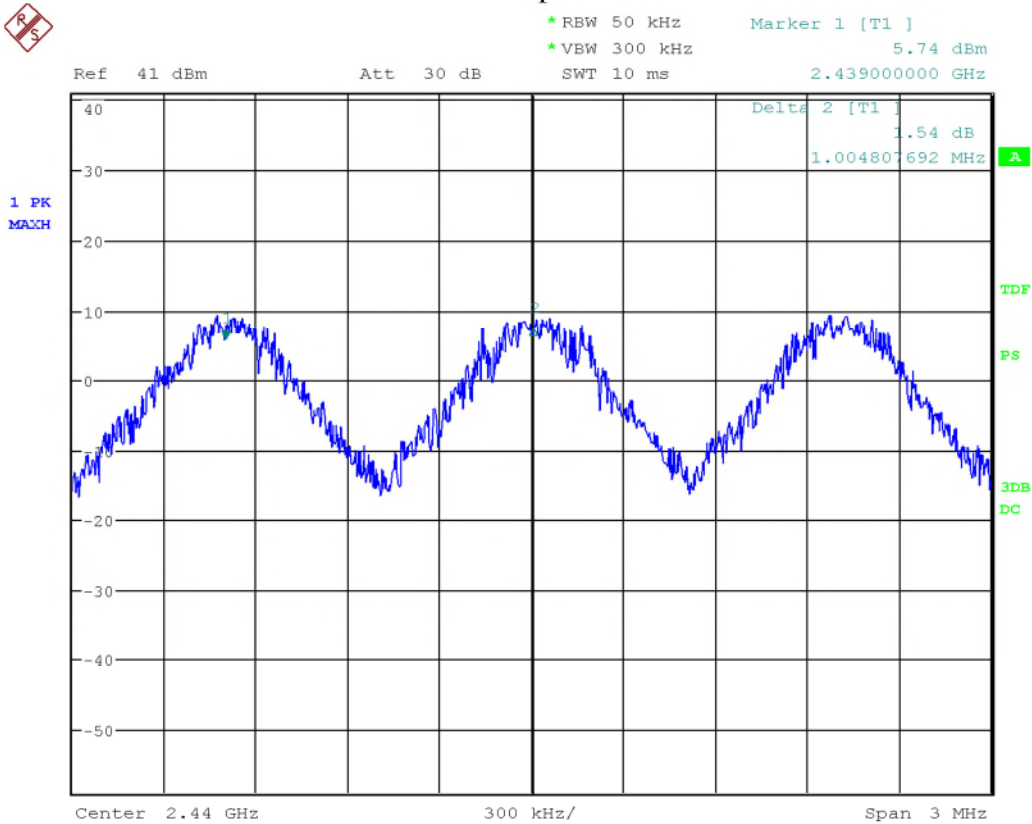
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Graph(s)

The graphs shown below shows the channel spacing during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the channel spacing of the signal being measured. This measurement is a peak measurement. Max hold is performed for a duration of not less than 1 minute, as the device is stepping through its hopping table.


1 MBPS

Channel Separation: 1.00 MHz



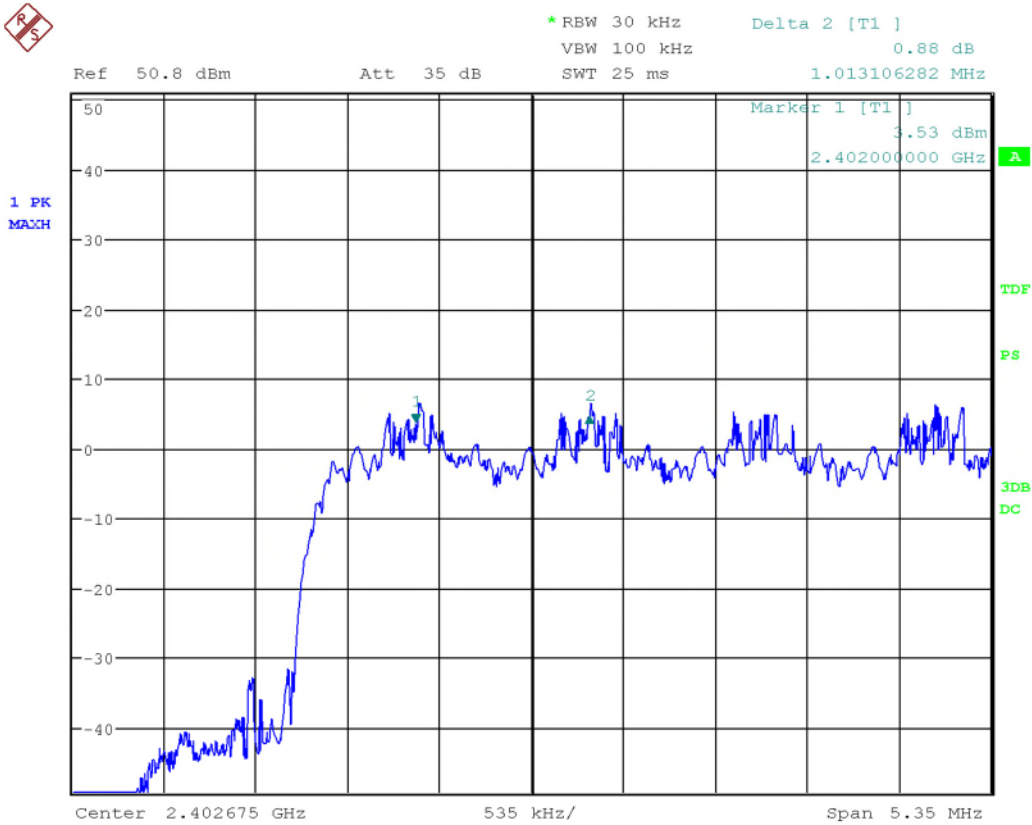
Date: 6.OCT.2021 19:07:13

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


2 MBPS

Channel Separation: 1.01 MHz




Date: 7.OCT.2021 10:26:07

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

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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	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Attenuator 10 dB	8493B	Agilent	Oct 4, 2021	Oct 4, 2022	GEMC133

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

Time of Occupancy

Purpose

The purpose of this test is to ensure that the RF energy of frequency hopping systems is hopping at a minimum defined rate. This helps ensure sufficient time off to enable other frequency hopping devices to co-operate within this allocated band.

Limits

The limits are as defined in 47 CFR FCC Part 15 Section 15.247(a)(1) and RSS 247 Section 5.1. The test method is a defined in ANSI C63.10.

902 to 928 MHz	$P_{\max\text{-pk}} \leq 1 \text{ W}$ $BW_{20\text{dB}} \leq 250 \text{ kHz}$ $t_{\text{ch}} \leq 0.4 \text{ s for } T = 20 \text{ s}$	$P_{\max\text{-pk}} \leq 0.25 \text{ W}$ $250 \text{ kHz} \leq BW_{20\text{dB}} \leq 500 \text{ kHz}$ $t_{\text{ch}} \leq 0.4 \text{ s for } T = 10 \text{ s}$
2400 to 2483.5 MHz	$P_{\max\text{-pk}} \leq 1 \text{ W}$ $N_{\text{ch}} \geq 75$ $t_{\text{ch}} \leq 0.4 \text{ s for } T = 0.4 N_{\text{ch}} \text{ s}$	$P_{\max\text{-pk}} \leq 0.125 \text{ W}$ $N_{\text{ch}} \geq 15$ $t_{\text{ch}} \leq 0.4 \text{ s for } T = 0.4 N_{\text{ch}} \text{ s}$
5275 to 5850 MHz	$P_{\max\text{-pk}} \leq 1 \text{ W}$ $t_{\text{ch}} \leq 0.4 \text{ s for } T = 30 \text{ s}$	


Results

The EUT passed the requirements.

Notes:

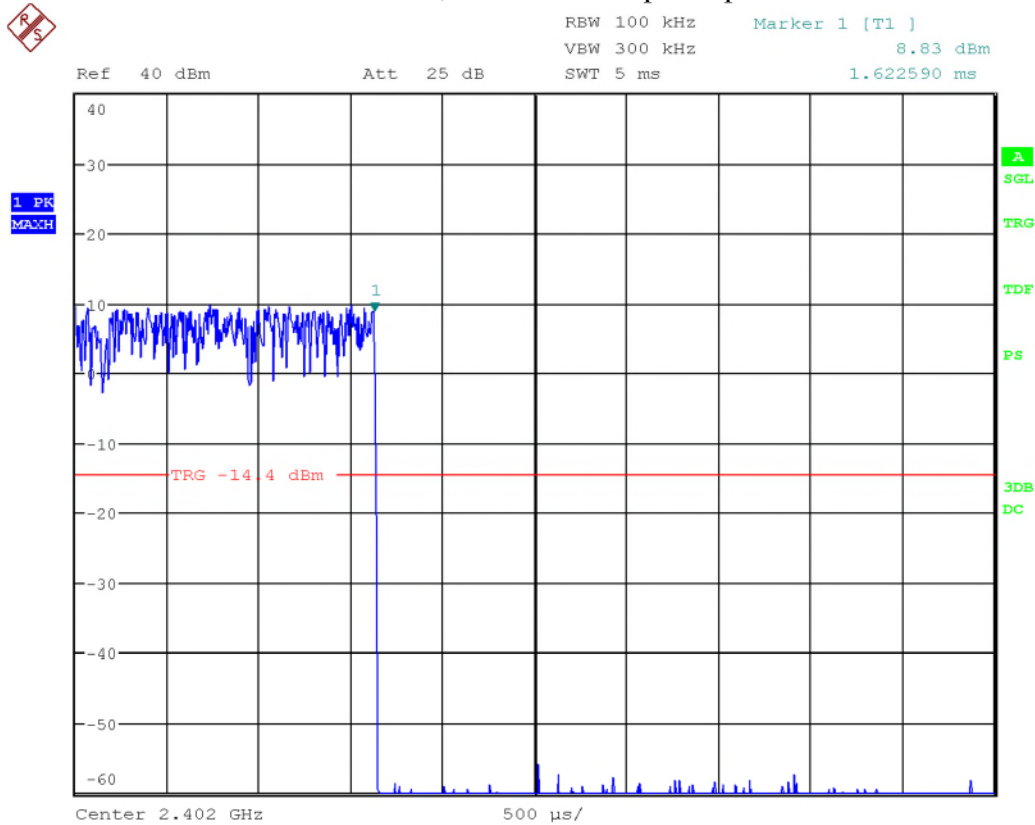
1. In normal mode, hopping rate is 1600 hops/s with 6 slots in 79 hopping channels. With channel hopping rate (1600/6/79) in an Observation Time (0.4 x 79) seconds. The number of hops per Observation Time is (1600/6/79) x (0.4 x 79) = 106.67 hops.
2. In AFH mode, hopping rate is 800 hops/s with 6 slots in 20 hopping channels. With channel hopping rate of (800/6/20) in an Observation Time (0.4 x 20) seconds. The number of hops per Observation Time is (800/6/20) x (0.4 x 20) = 53.33 hops.
3. The average Channel Occupancy Time = number of hops per Observation Time x package transmit time per hop

The EUT has an average occupancy of 106.67 x 1.6 = 0.17 s for normal mode and 53.33 * 1.6 = 0.09 s for AFH mode within 0.4 s. This is under the 0.4 sec limit.


Client	Ecobee Inc.	
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Graph(s)

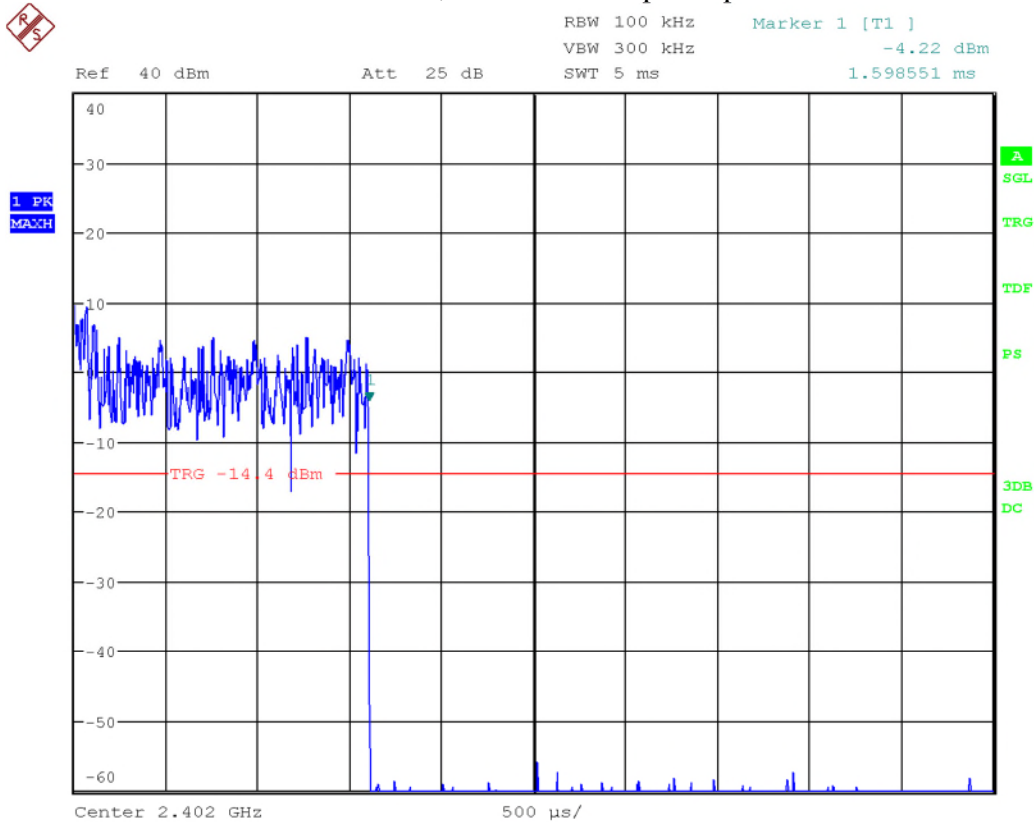
1 MBPS, Transmit time per hop: 1.63 ms



Date: 7.OCT.2021 10:30:11

Client	Ecobee Inc.	 Canada
Product	ECB601/ECB501	
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2 MBPS, Transmit time per hop: 1.60 ms




Date: 7.OCT.2021 10:29:11

Note: See ‘Appendix B – EUT & Test Setup Photographs’ for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Attenuator 10 dB	8493B	Agilent	Oct 4, 2021	Oct 4, 2022	GEMC133

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

Maximum Peak Envelope Conducted Power - FHSS

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 a defined in ANSI C63.10.


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 maximum peak power measured was 9.97 dBm (9.93 mW).

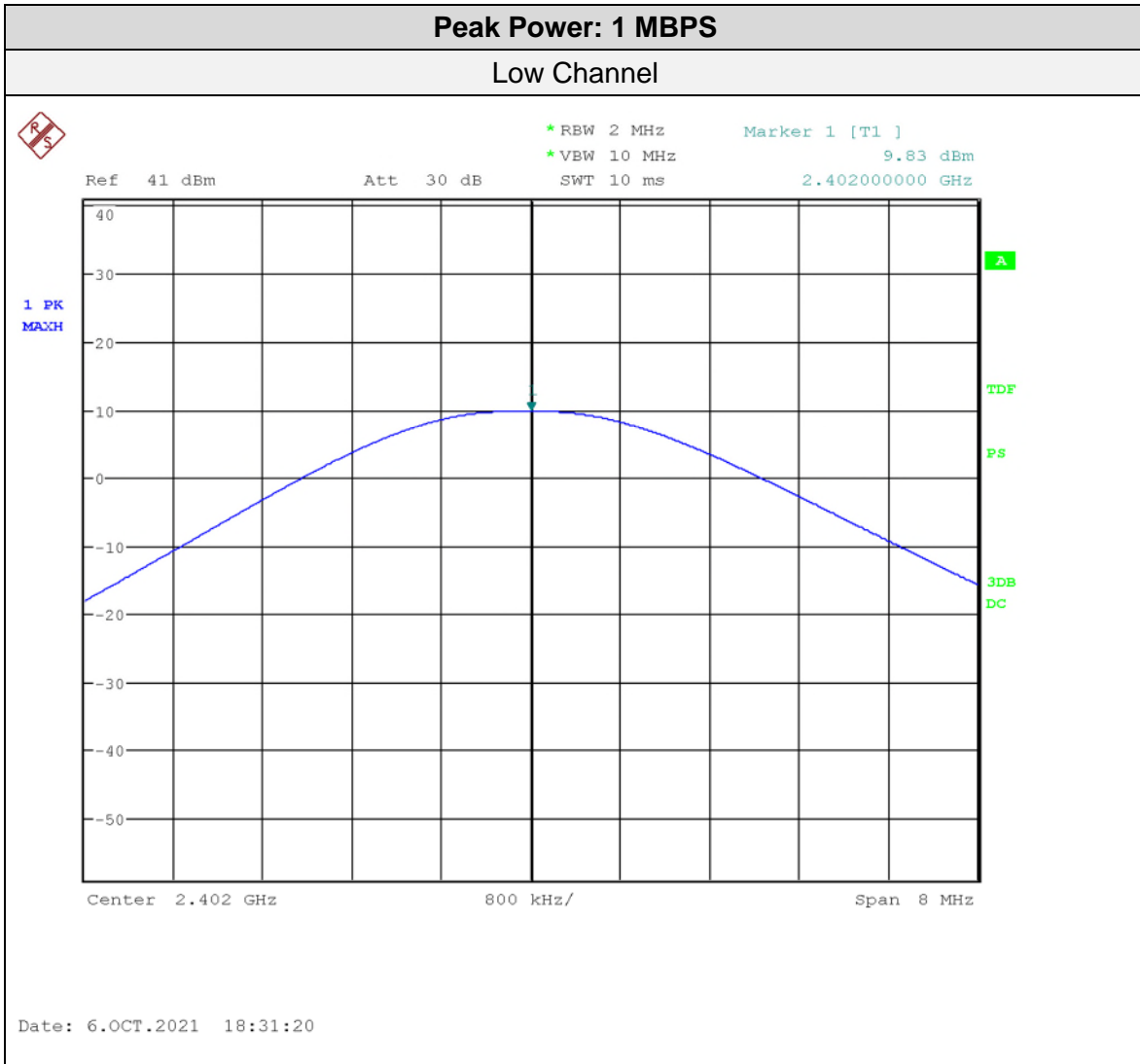
1 MBPS					
Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power (mW)	Limit (mW)	Pass/Fail
Low	2402	9.83	9.62	125 mW	Pass
Mid	2440	9.97	9.93	125 mW	Pass
High	2480	9.78	9.51	125 mW	Pass


2 MBPS					
Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power (mW)	Limit (mW)	Pass/Fail
Low	2402	9.56	9.04	125 mW	Pass
Mid	2440	9.74	9.42	125 mW	Pass
High	2480	9.51	8.93	125 mW	Pass

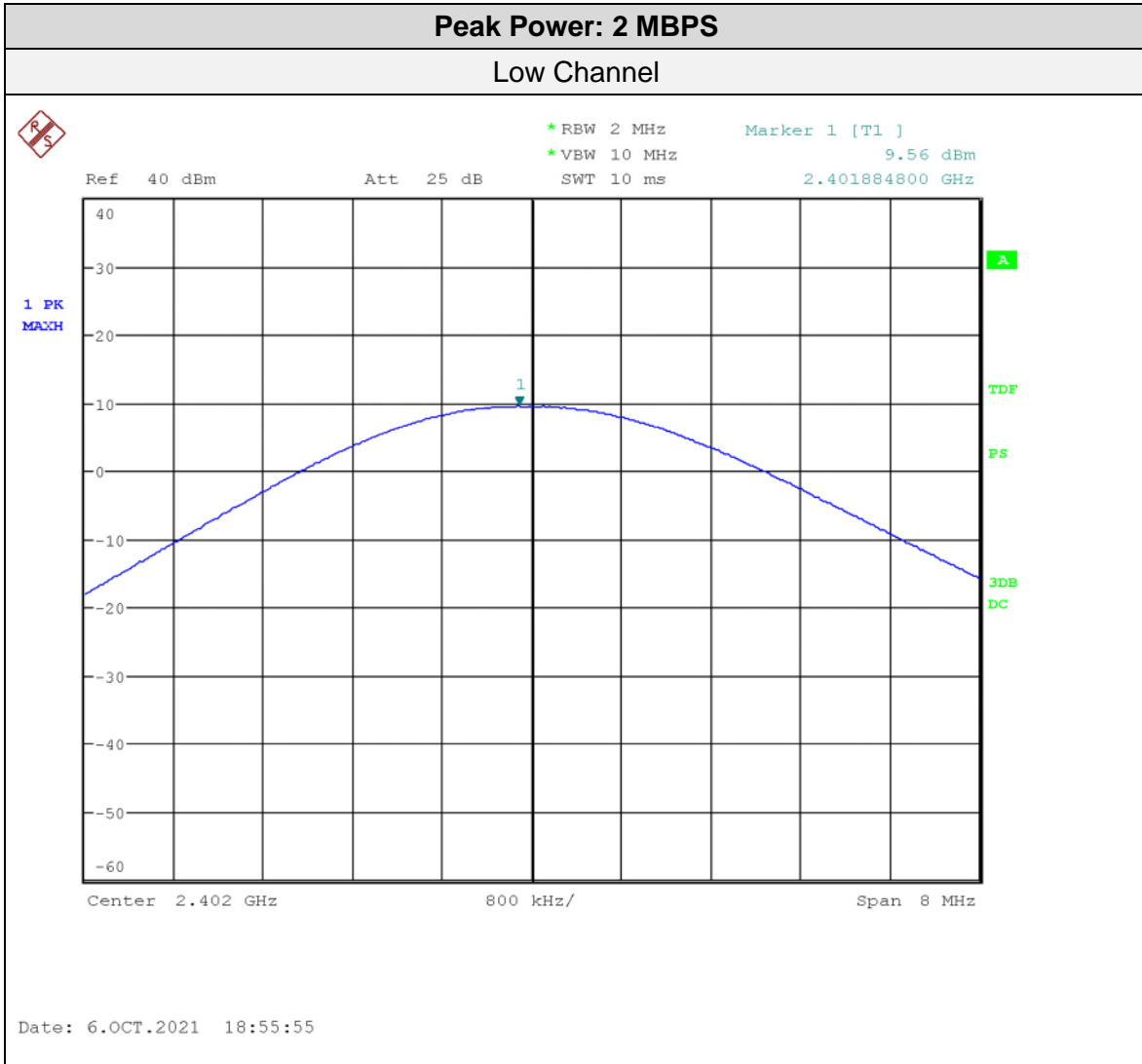
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Measurement(s)

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




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



Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Attenuator 10 dB	8493B	Agilent	Oct 4, 2021	Oct 4, 2022	GEMC133

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

Antenna Spurious Conducted Emissions

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element at frequencies outside of the authorized spectrum does not exceed the limits specified. This ensures that the only the intended signal is delivered to the radiating element.


Limits and Method

The limits are defined in 15.247(d) and RSS-247 5.5. In any 100 kHz band, the peak spurious harmonics emissions must be at least 20 dB below the fundamental. Spurious Conducted emissions are to be evaluated up to the 10th harmonic. This -20 dBc requirement also applies at the ‘band edge’.

The method is given in FCC KDB 558074 Section 11 and ANSI C63.10.

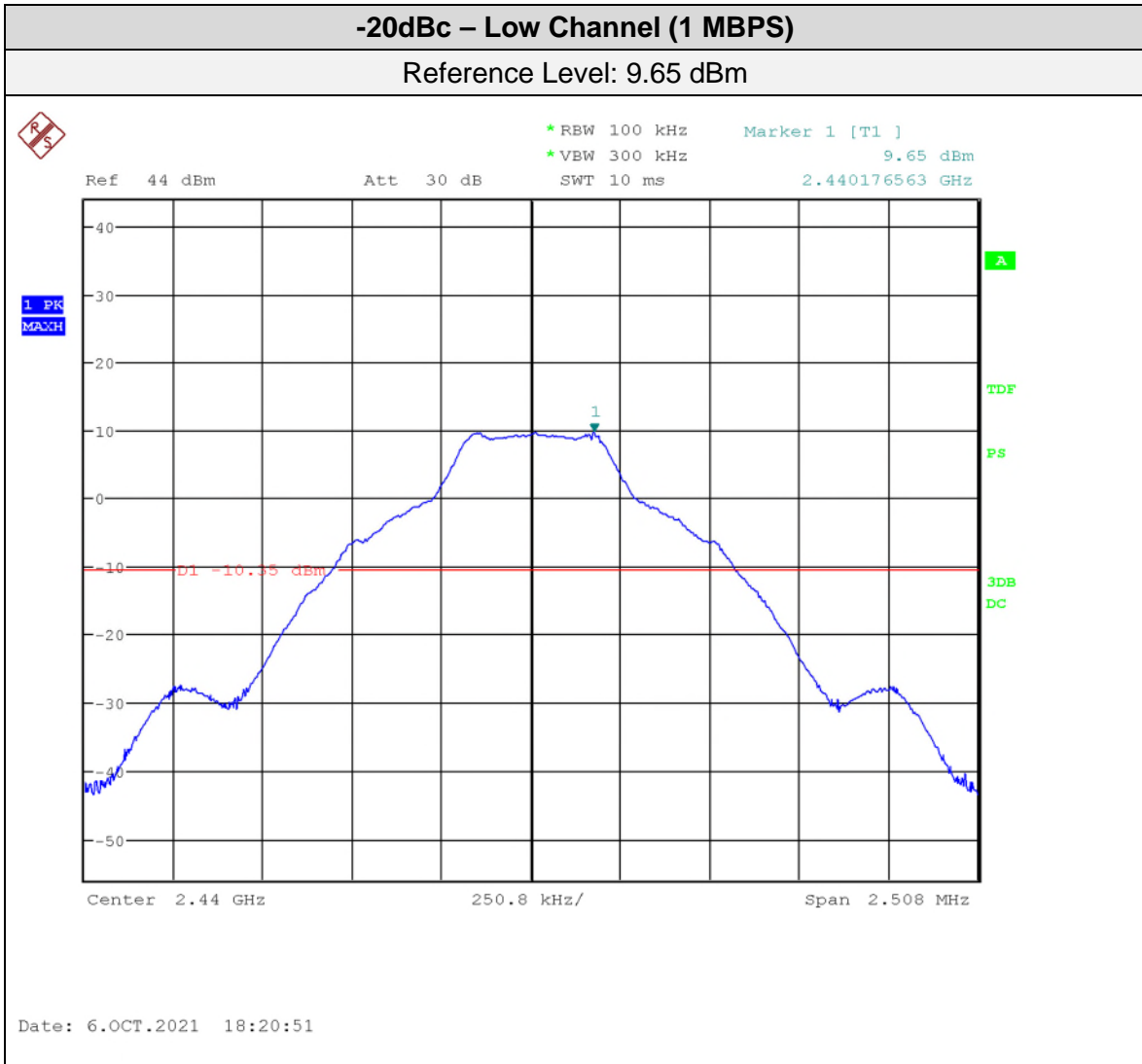
Results


The EUT passed. Low, middle and high bands were measured. The worst case is presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band and for the higher band edge at 2.4835 GHz in the high band. Band edge testing was performed with the transmitter in hopping mode and with hopping mode turned off.

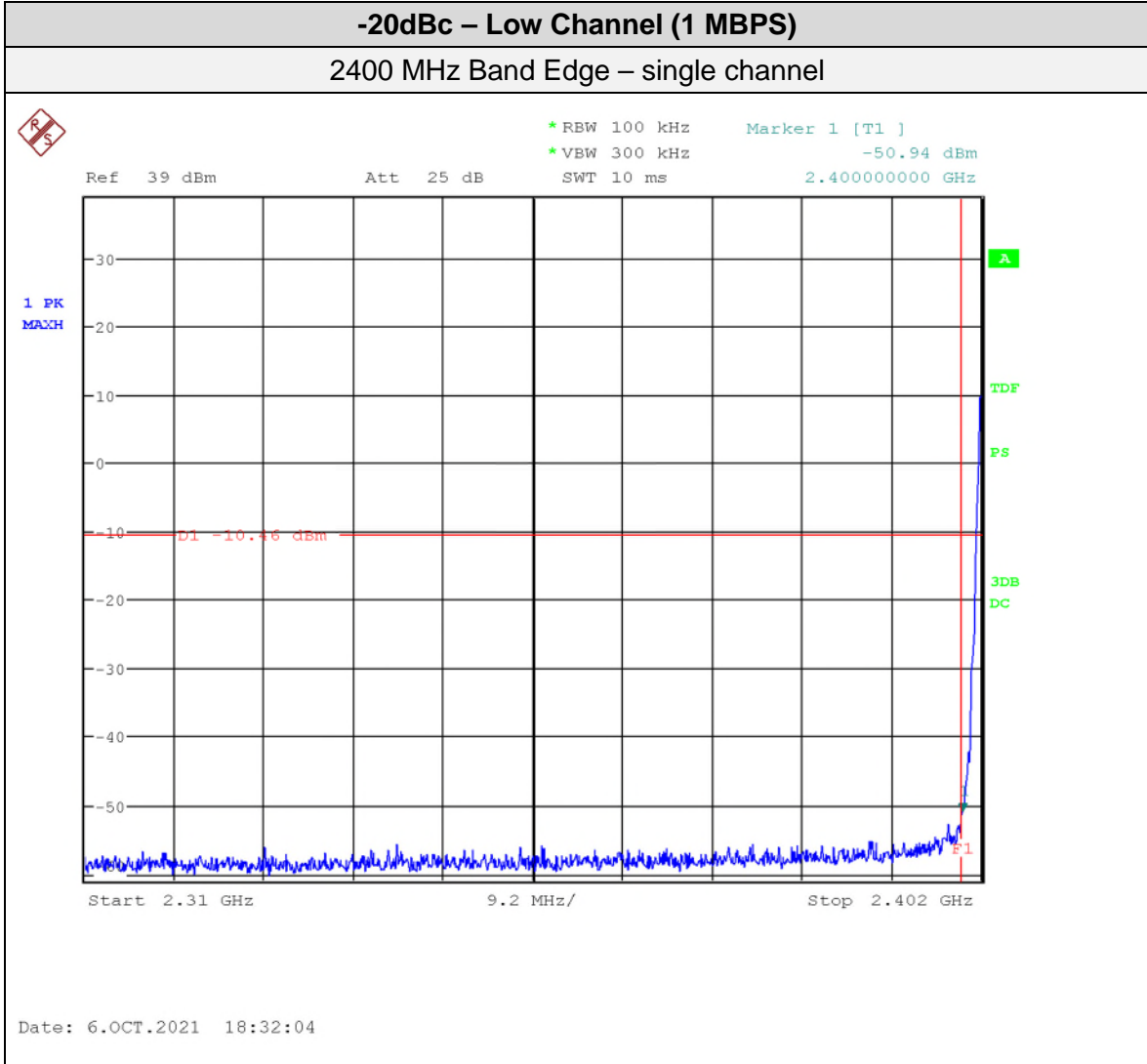
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Graphs

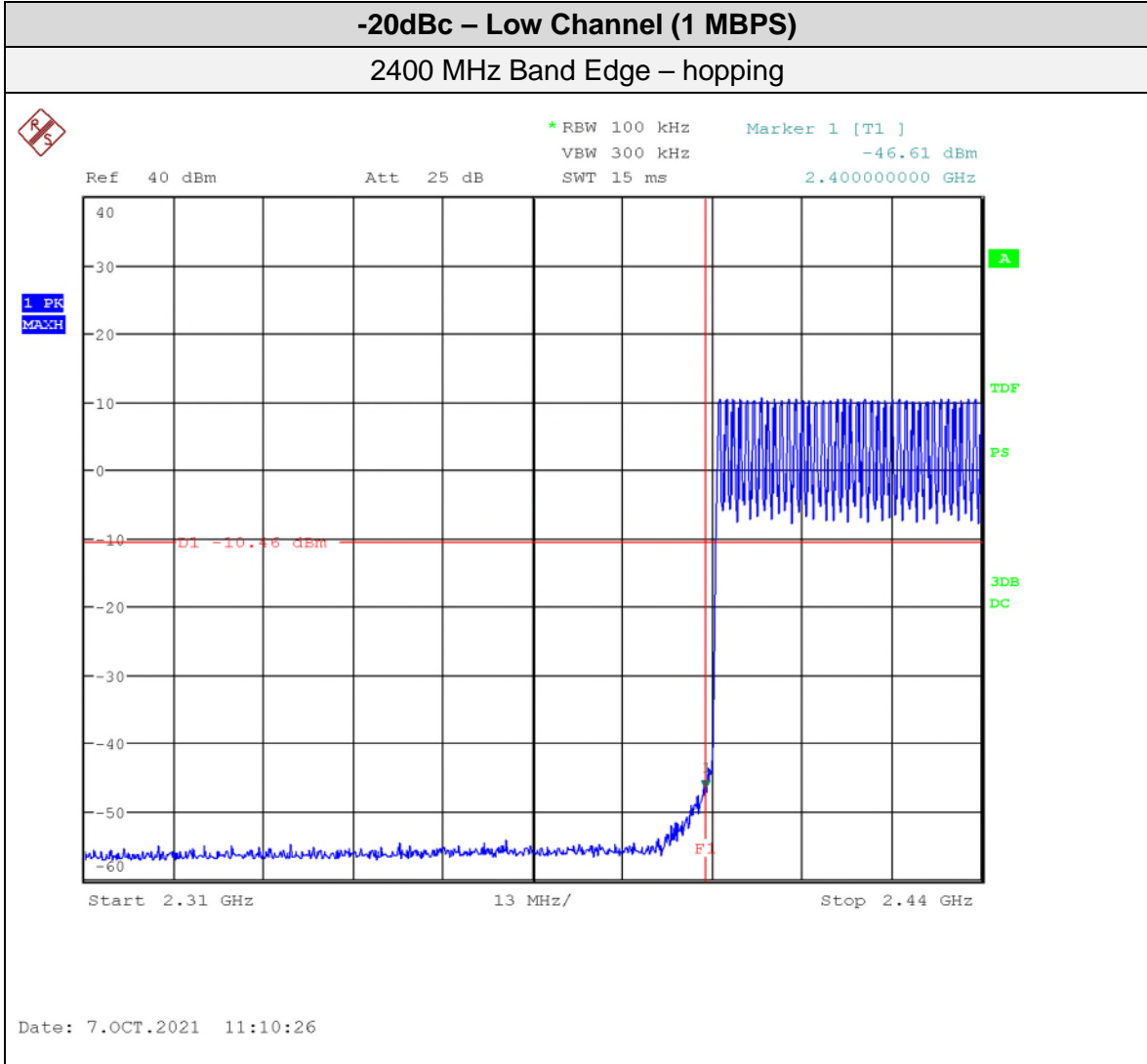
The graphs shown below show the power output of the device during the conducted measurement operation of the EUT.




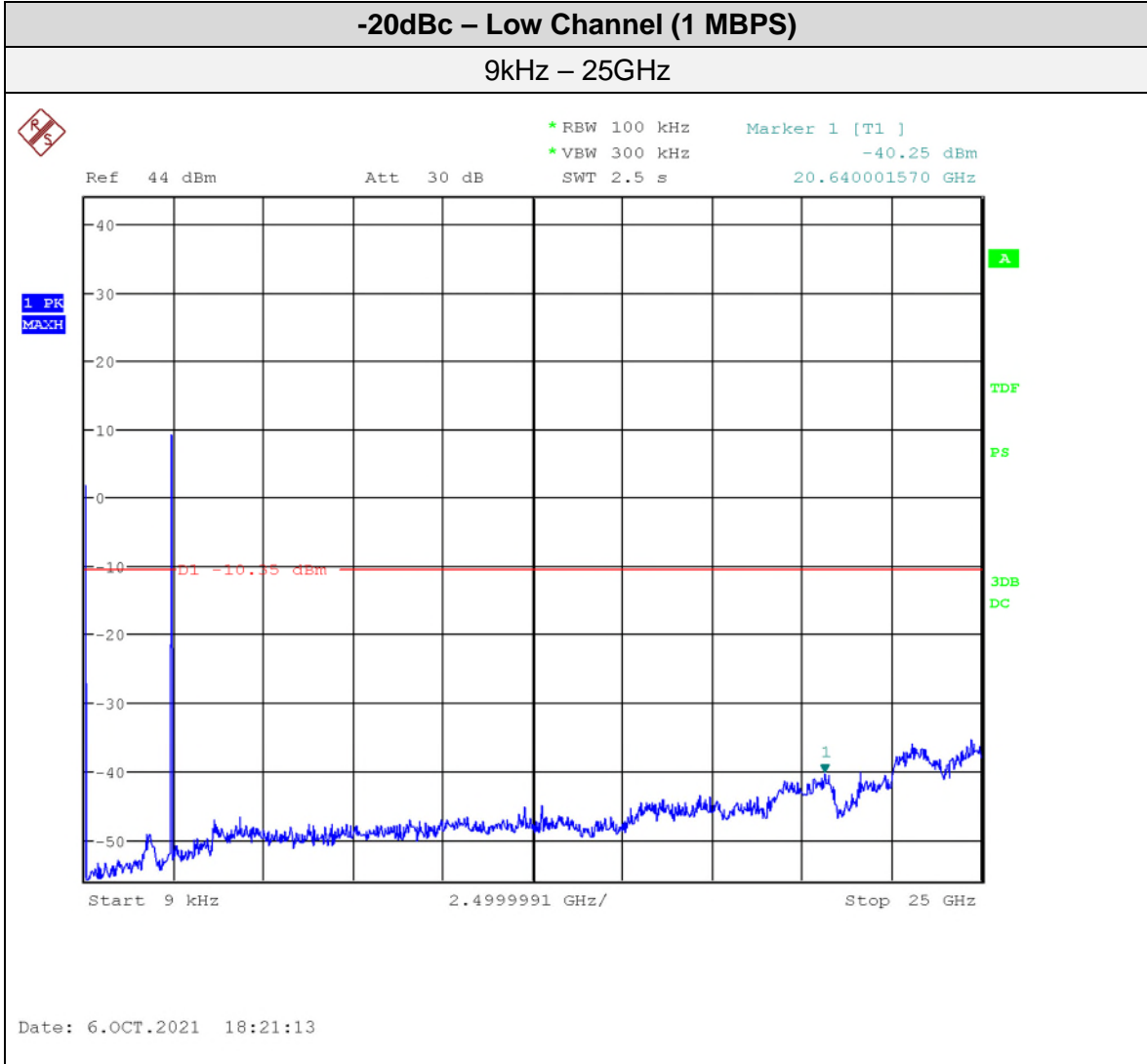
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




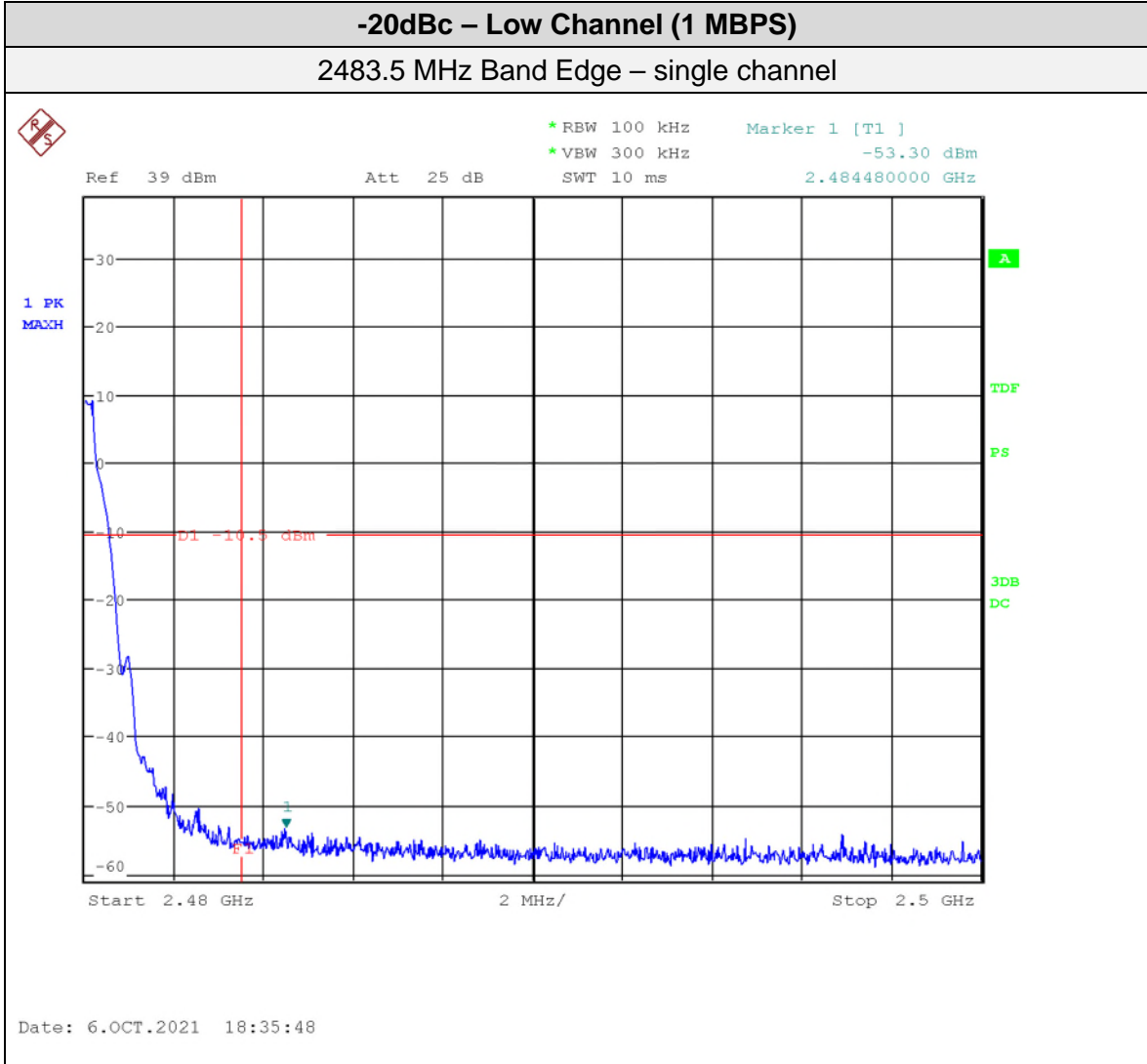
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




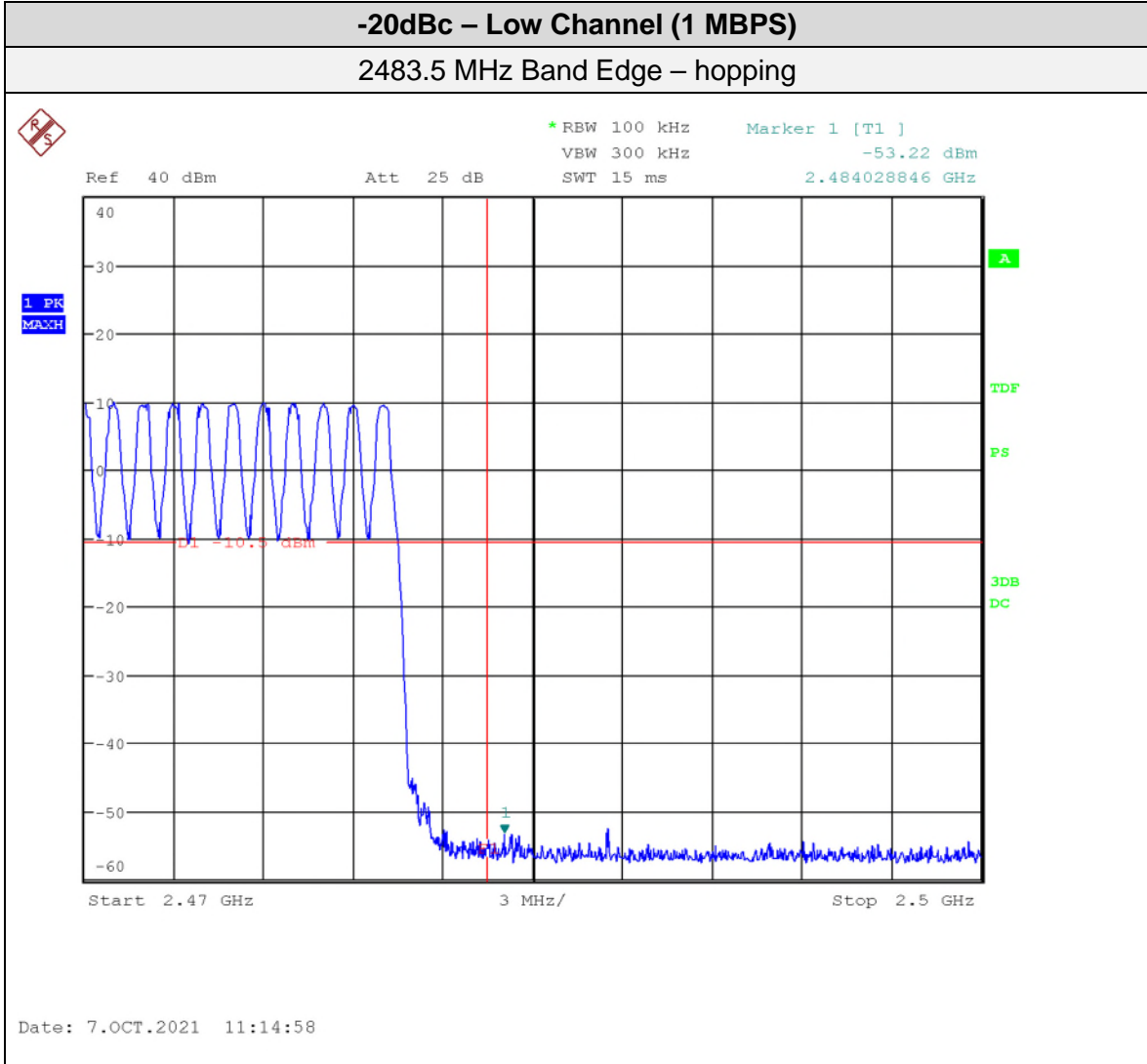
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




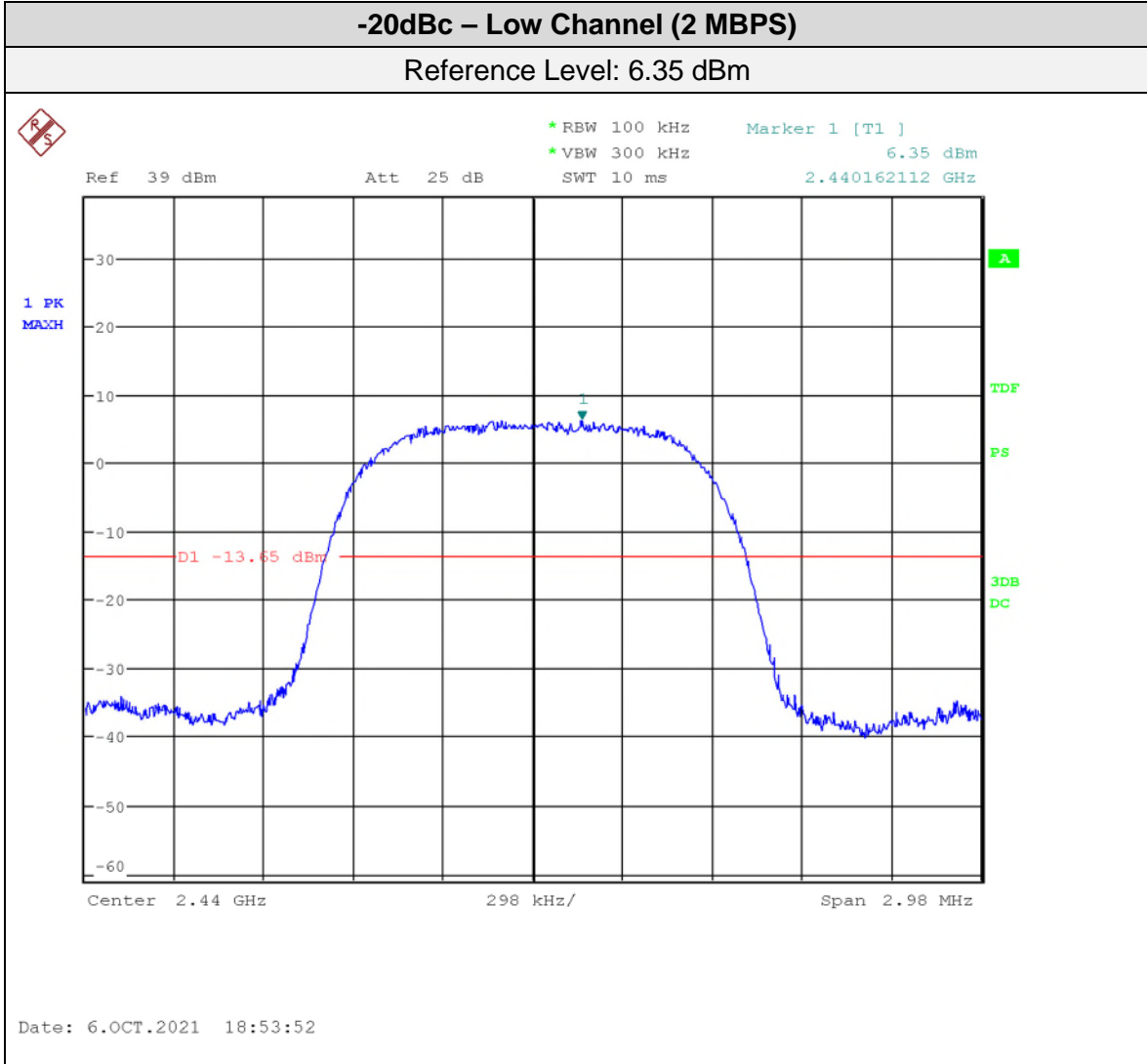
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




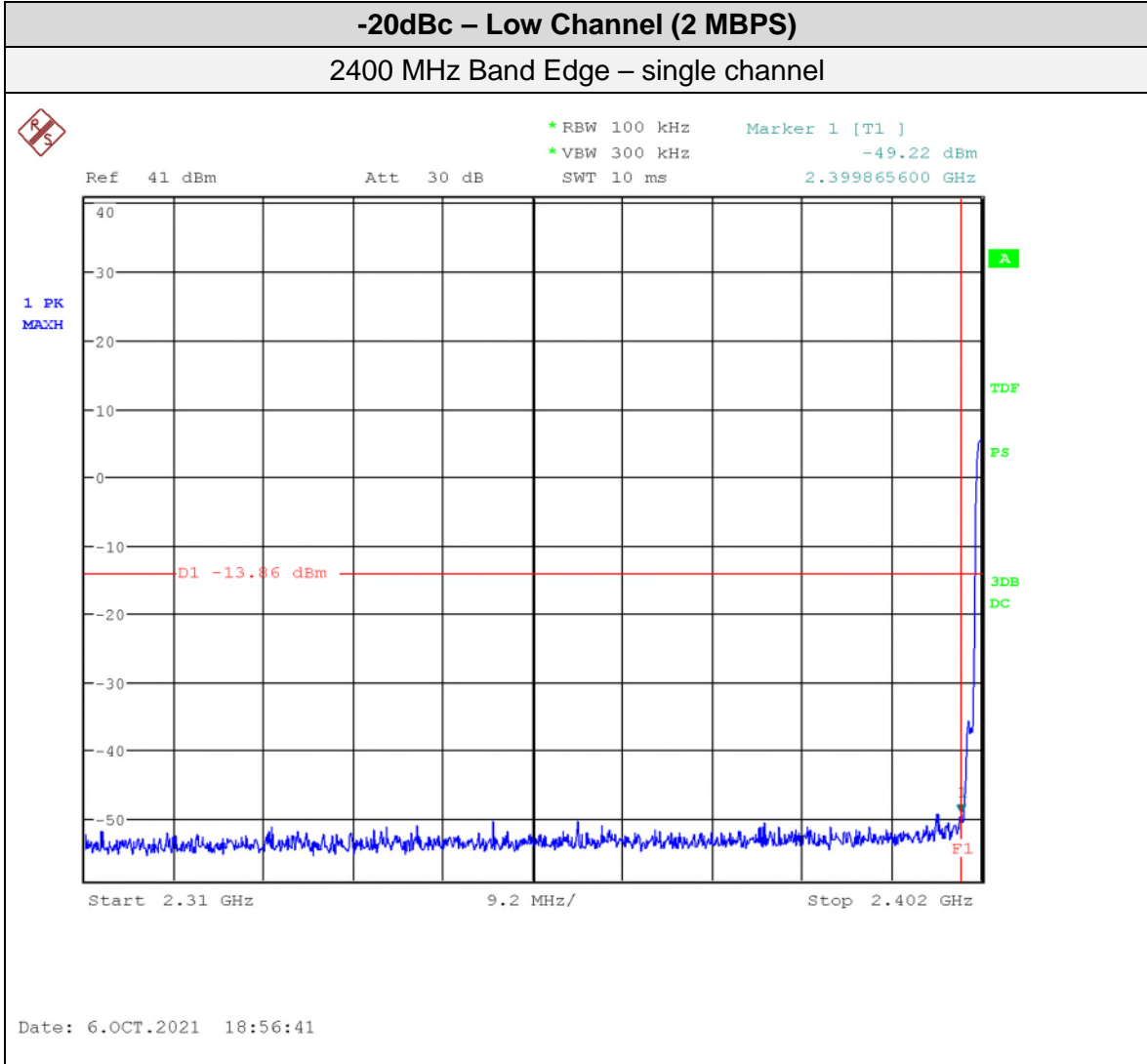
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




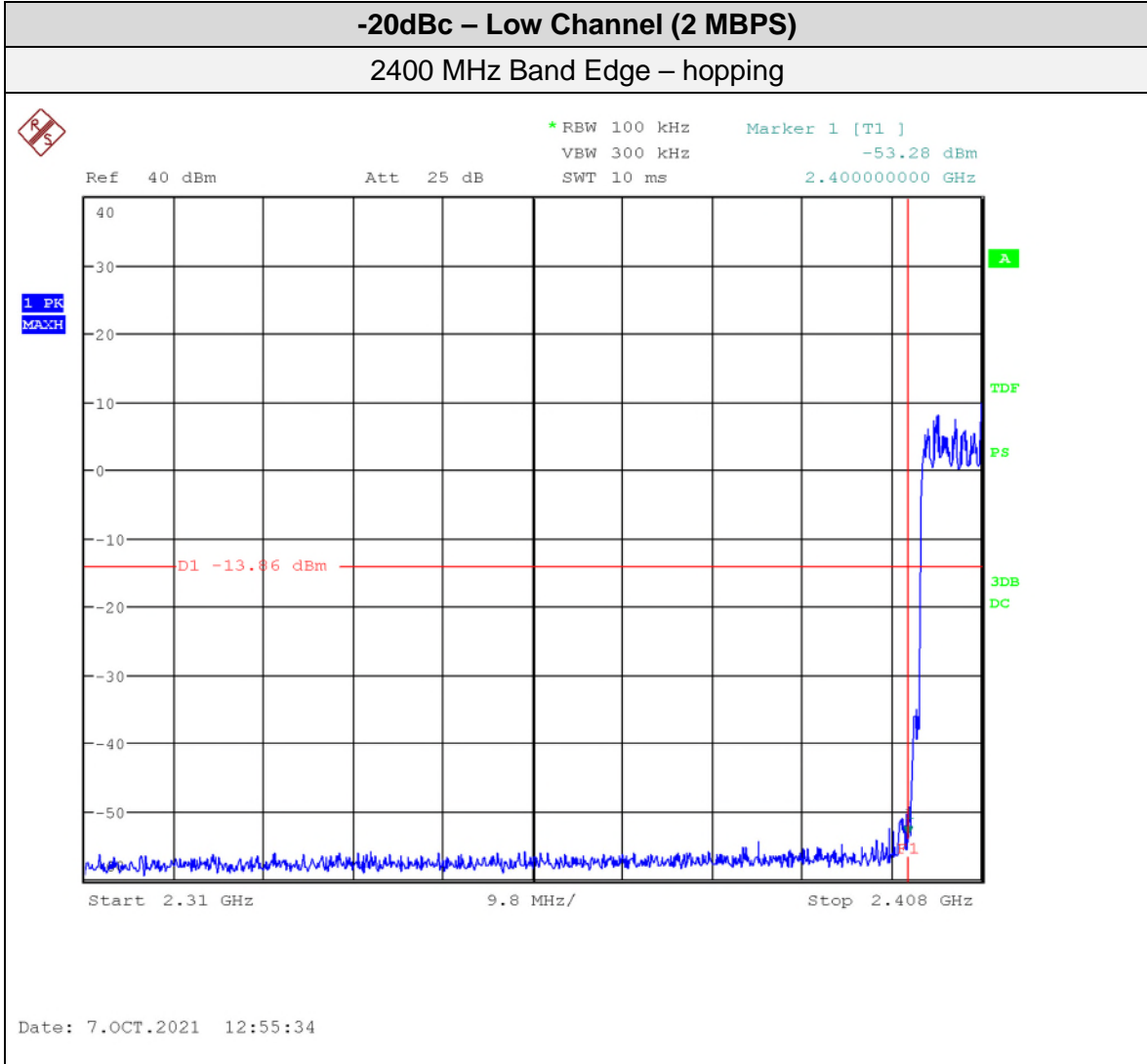
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




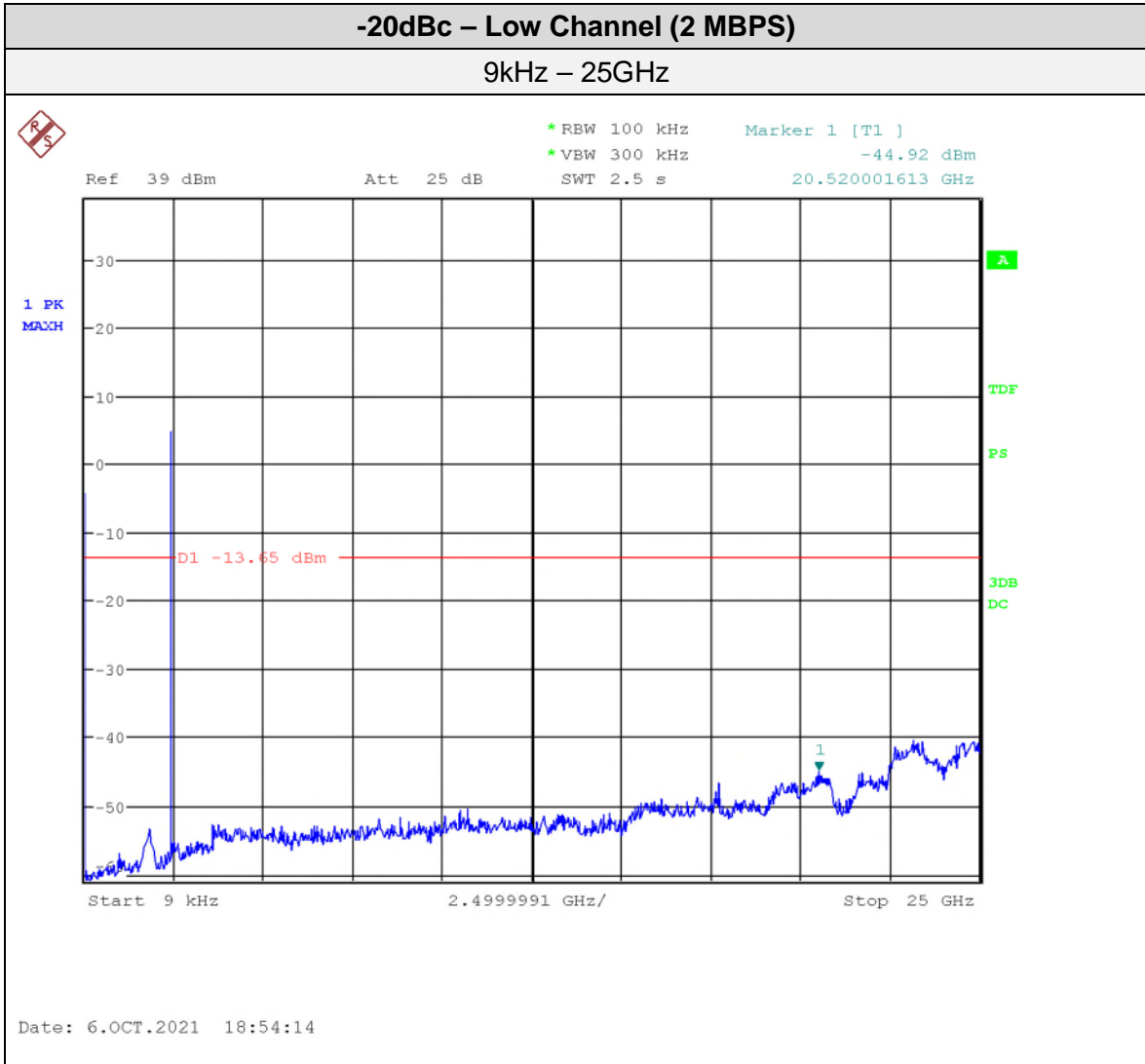
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




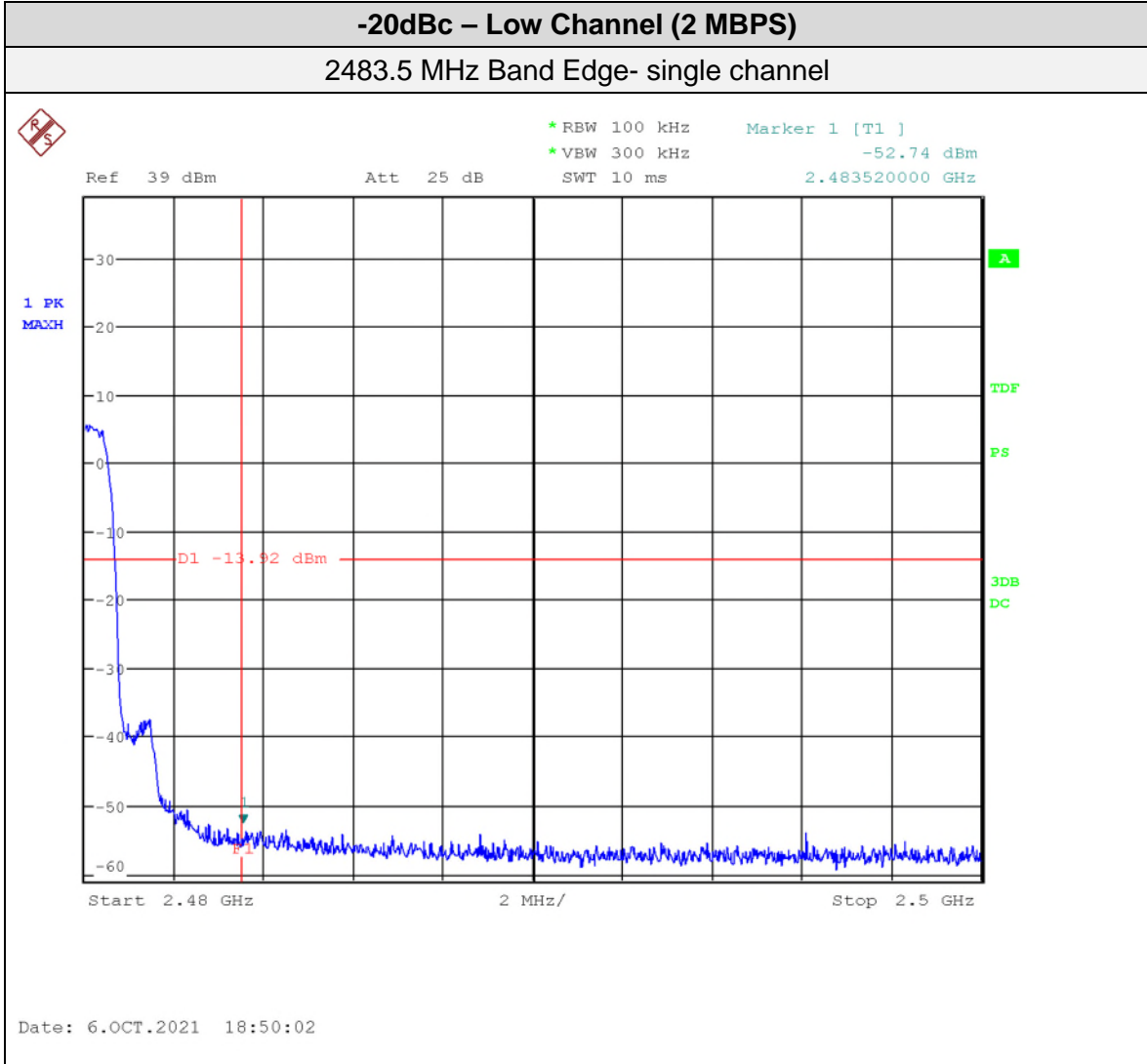
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	




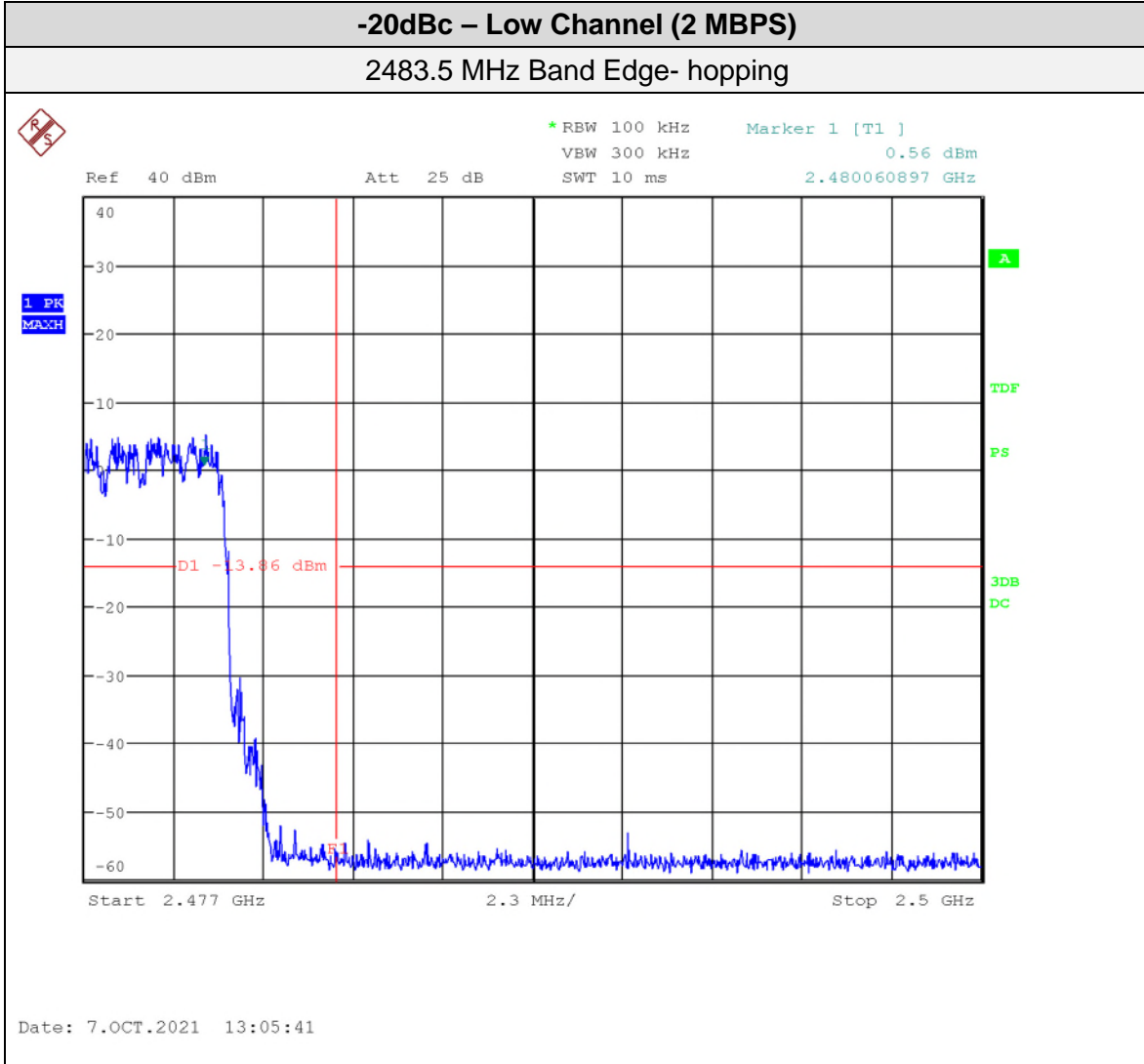
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	



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




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



See 'Appendix B – EUT and Test Setup Photos' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU 40	Rohde & Schwarz	Jan. 15, 2020	Jan. 15, 2022	GEMC 233
Attenuator 10 dB	8493B	Agilent	Oct 4, 2021	Oct 4, 2022	GEMC133

Client	Ecobee Inc.	
Product	ECB601/ECB501	
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 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 ($\text{dB}\mu\text{V/m}$)
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

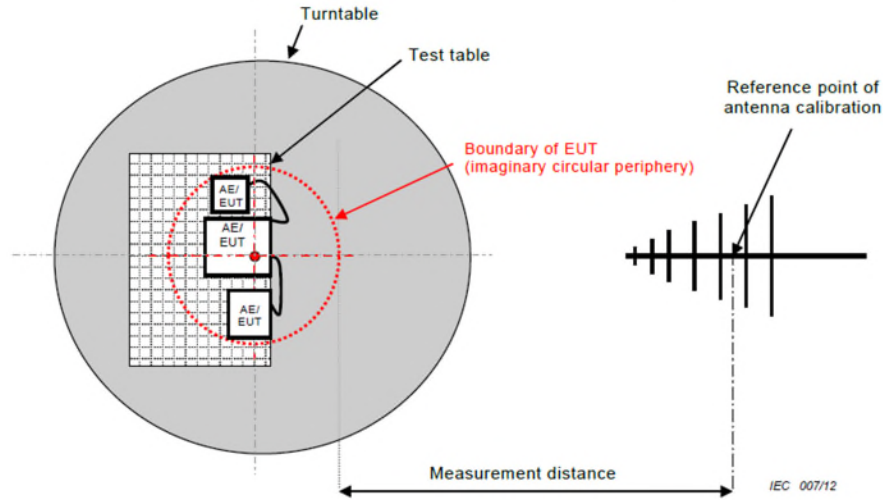
^bLimit is with 1 MHz measurement bandwidth and using an Average detector

^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.

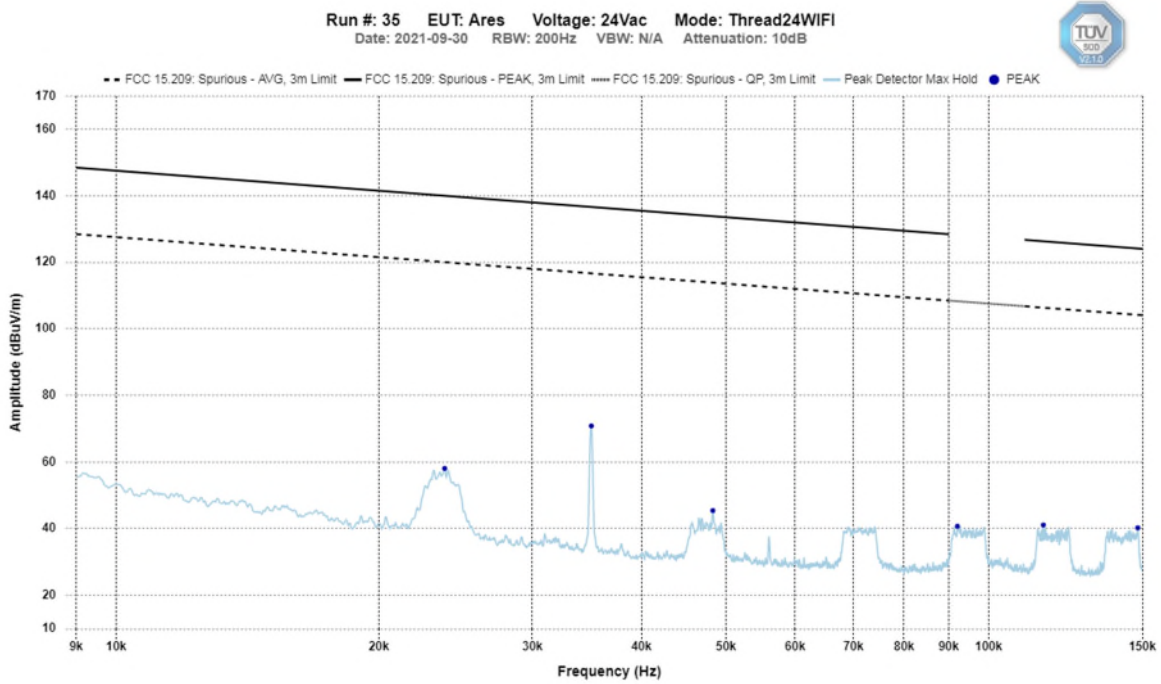
Peak output power for low, middle, and high channels were checked. The worst case was used for the spurious emissions.


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

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

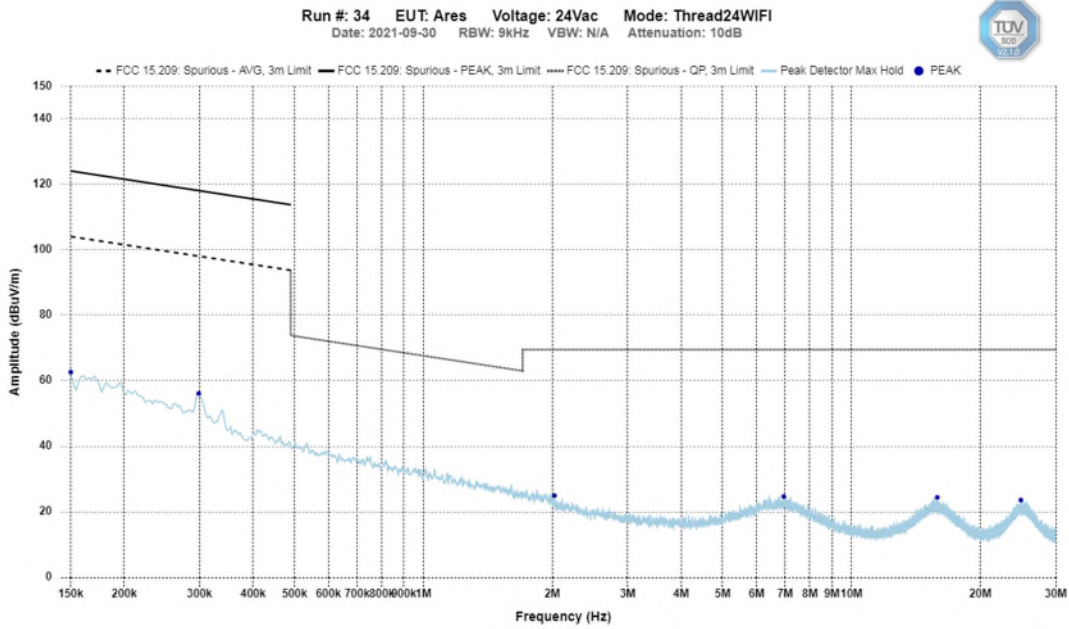
Spurious Emissions

Mid Channel 9 kHz – 150 kHz Peak Emission Graph

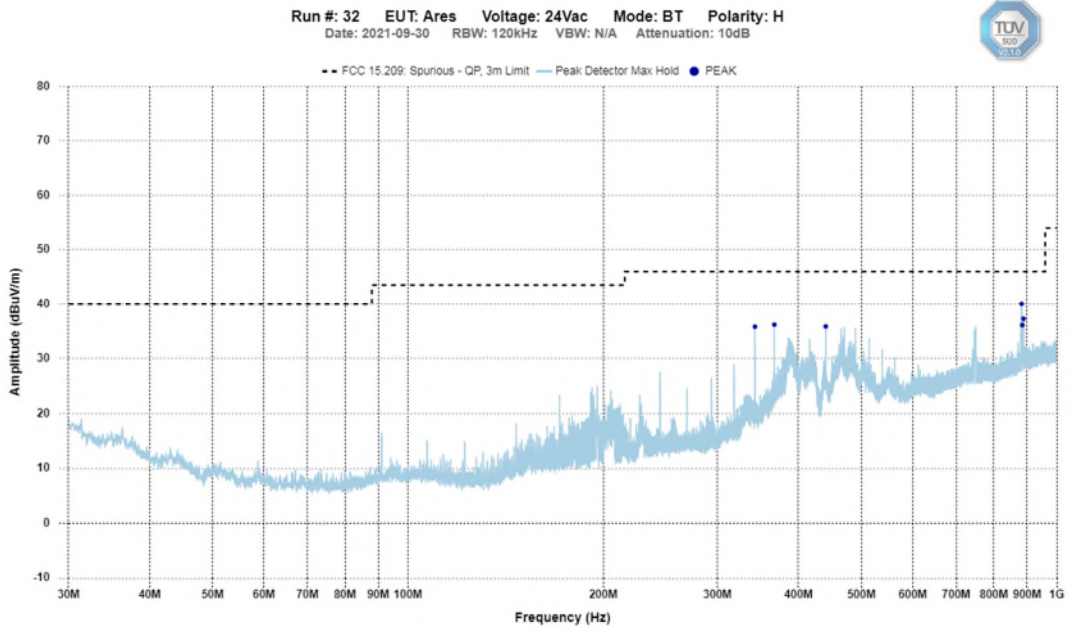



Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Mid Channel 150 kHz – 30 MHz Peak Emission Graph

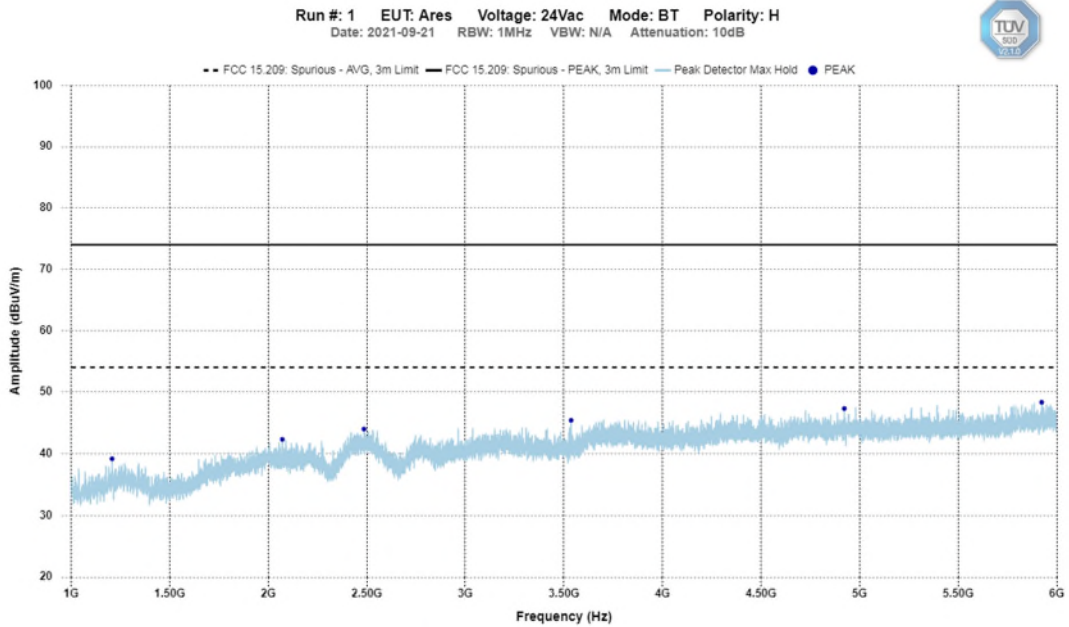


Mid Channel – 30 MHz – 1 GHz Horizontal - Peak Emission Graph

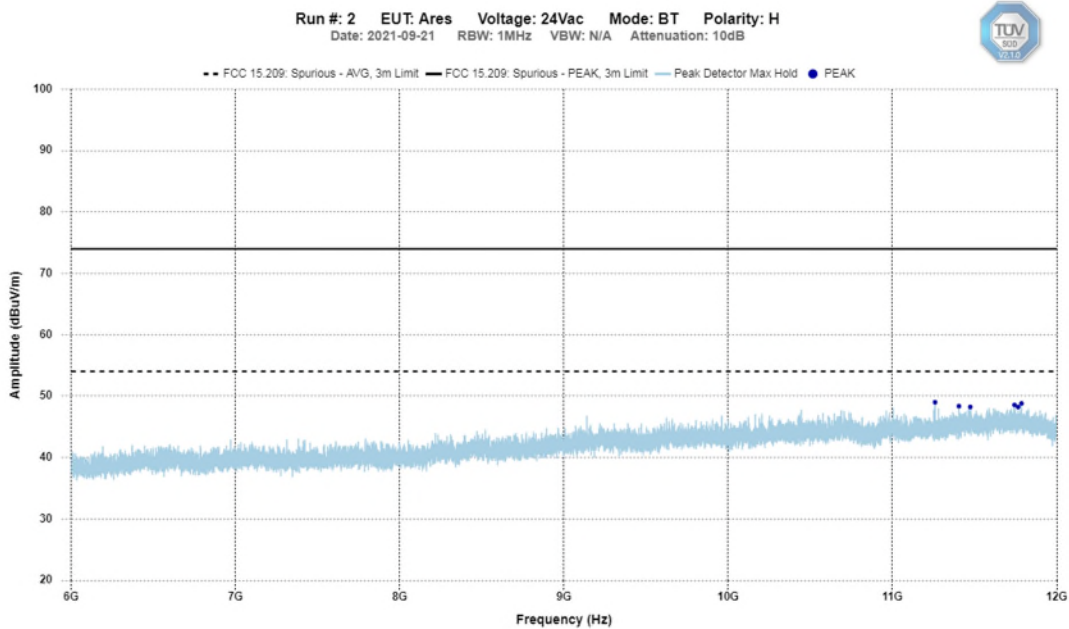



Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	

Mid Channel – 1 GHz – 6 GHz Horizontal - Peak Emission Graph

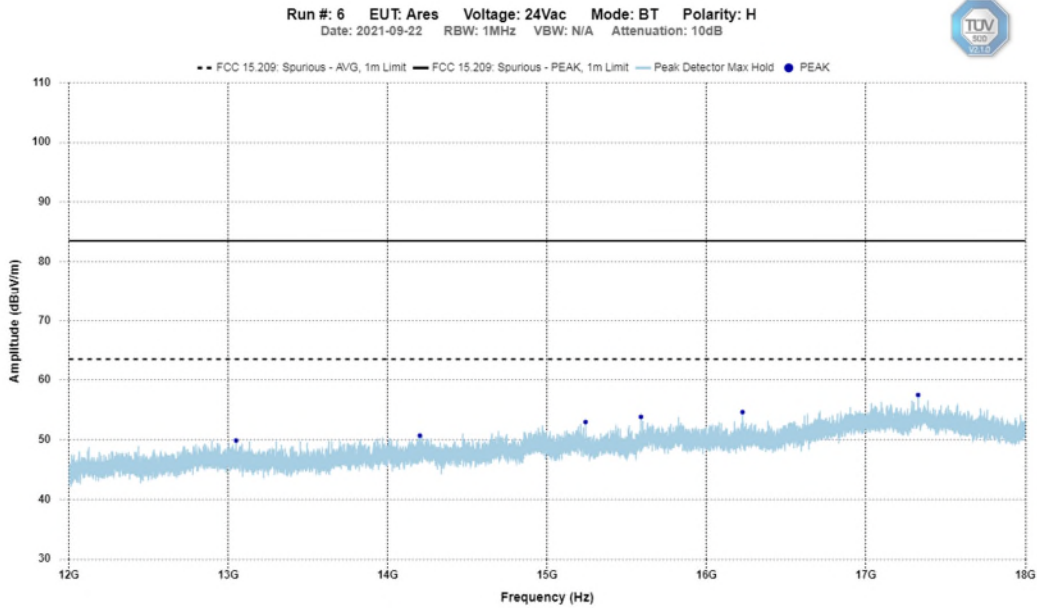


Mid Channel – 6 GHz – 12 GHz Horizontal - Peak Emission Graph

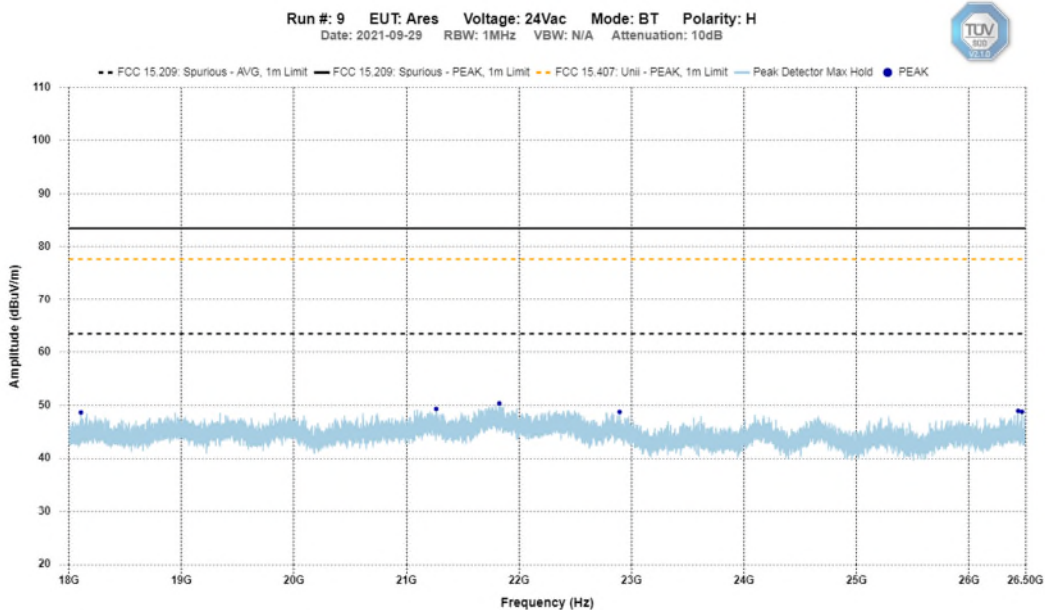


Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Mid Channel – 12 GHz – 18 GHz Horizontal - Peak Emission Graph



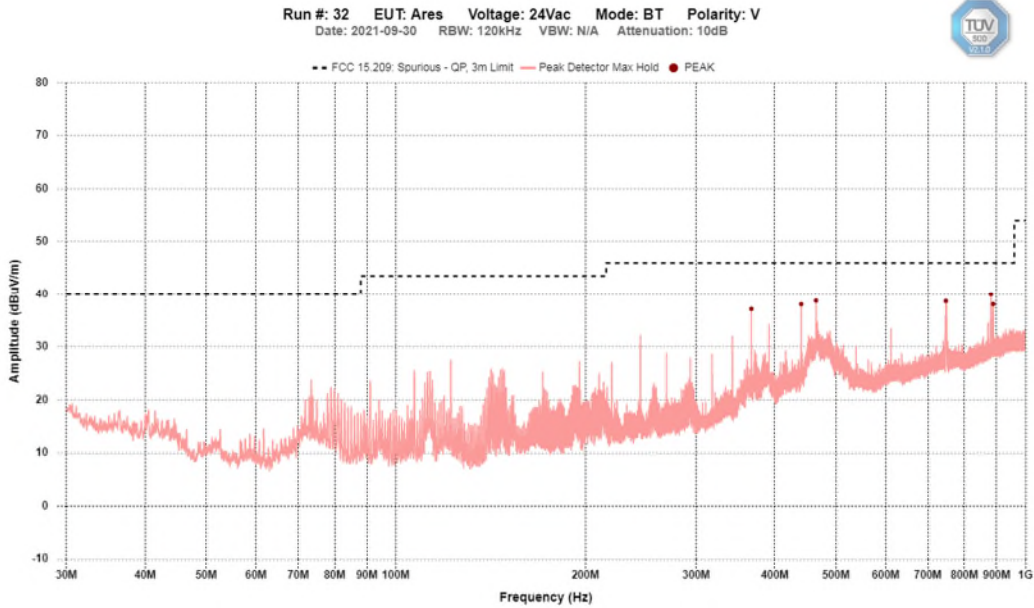
Mid Channel – 18 GHz – 25 GHz Horizontal - Peak Emission Graph



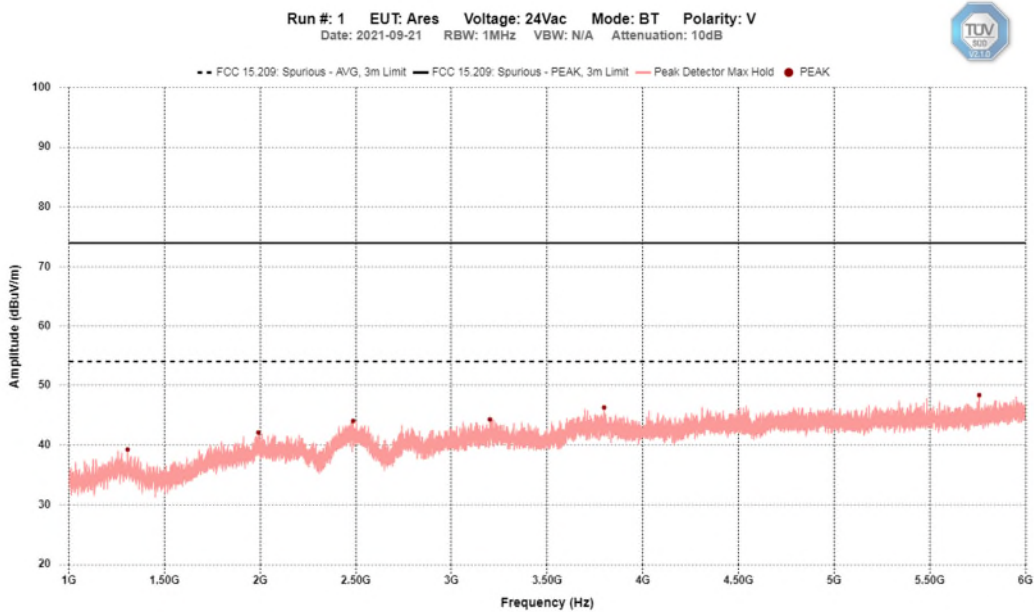
12 – 26 GHz plot were taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.


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

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

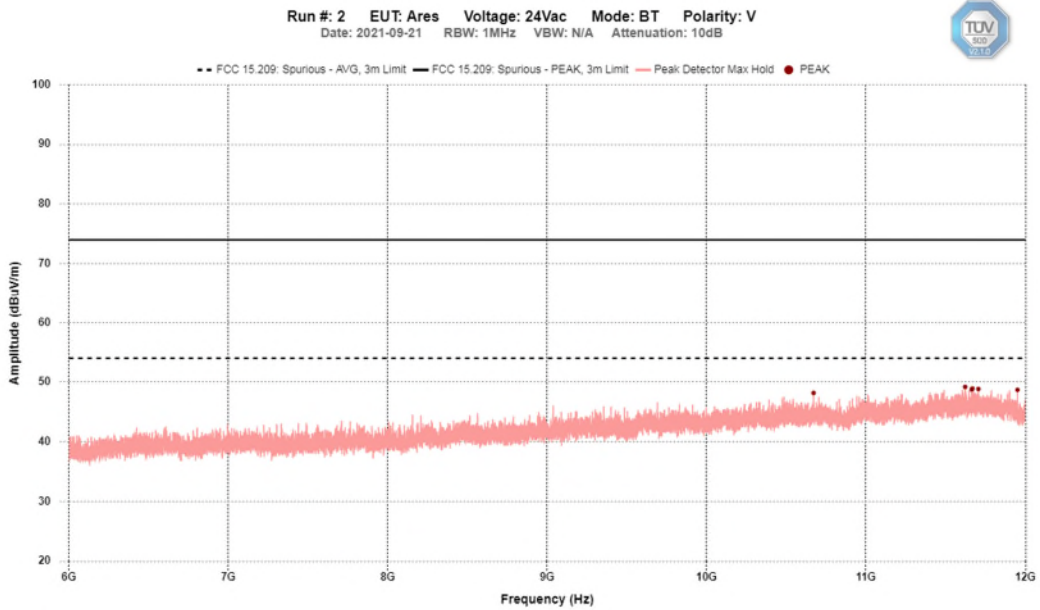


Mid Channel – 1 GHz – 6 GHz
Vertical - Peak Emission Graph

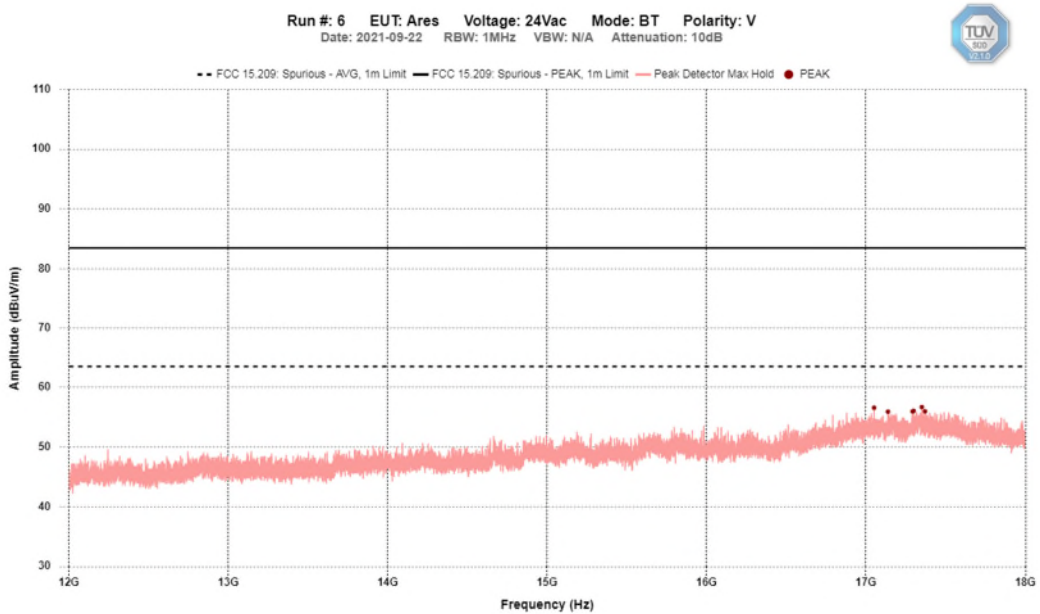


Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


Mid Channel – 6 GHz – 12 GHz
Vertical - Peak Emission Graph



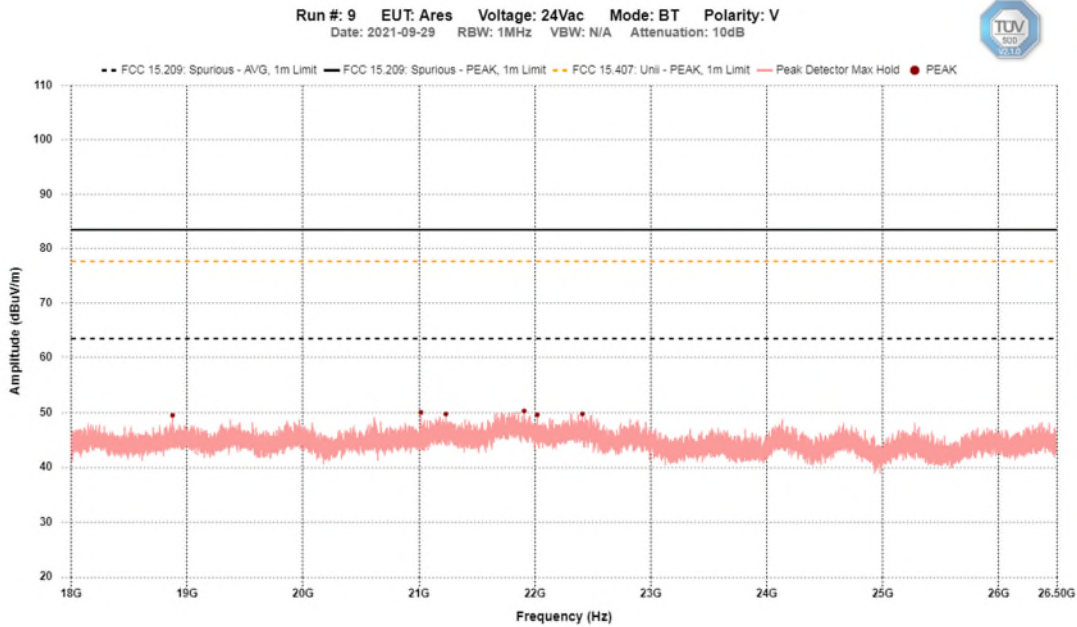
Mid Channel – 12 GHz – 18 GHz
Vertical - Peak Emission Graph



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


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

**Mid Channel – 18 GHz – 25 GHz
Vertical - Peak Emission Graph**



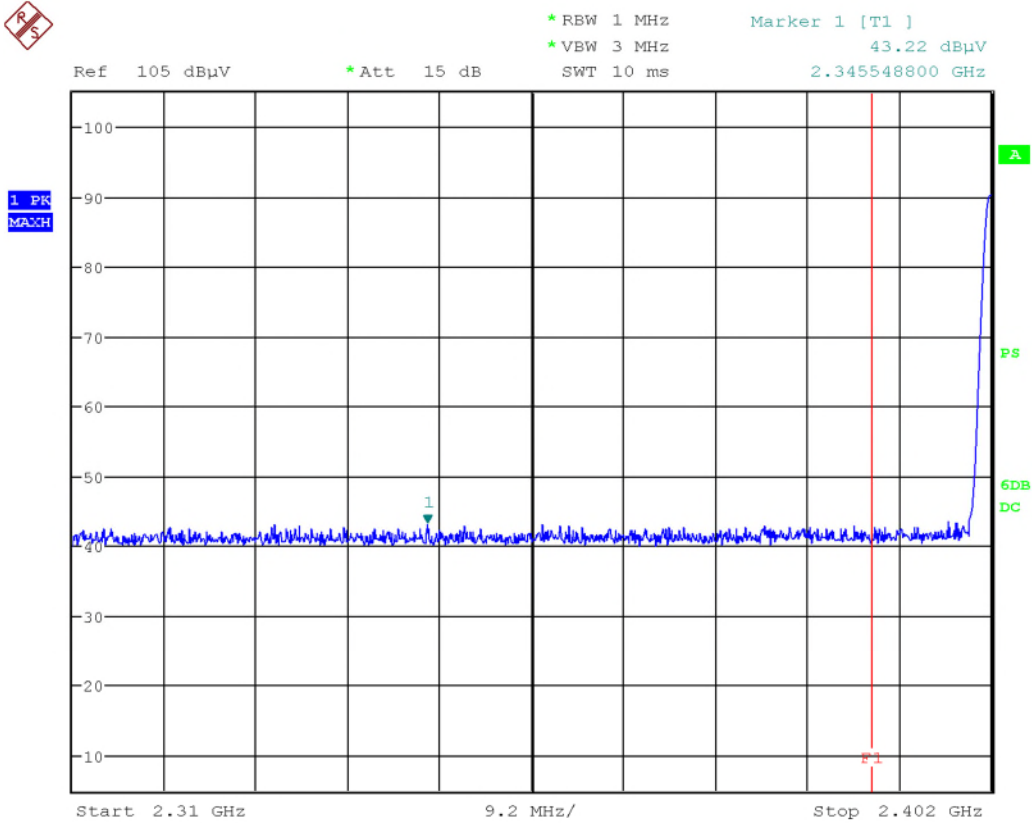
Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

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


Band Edges – 1 MBPS

Band Edge – Low Channel Horizontal - Peak Emission

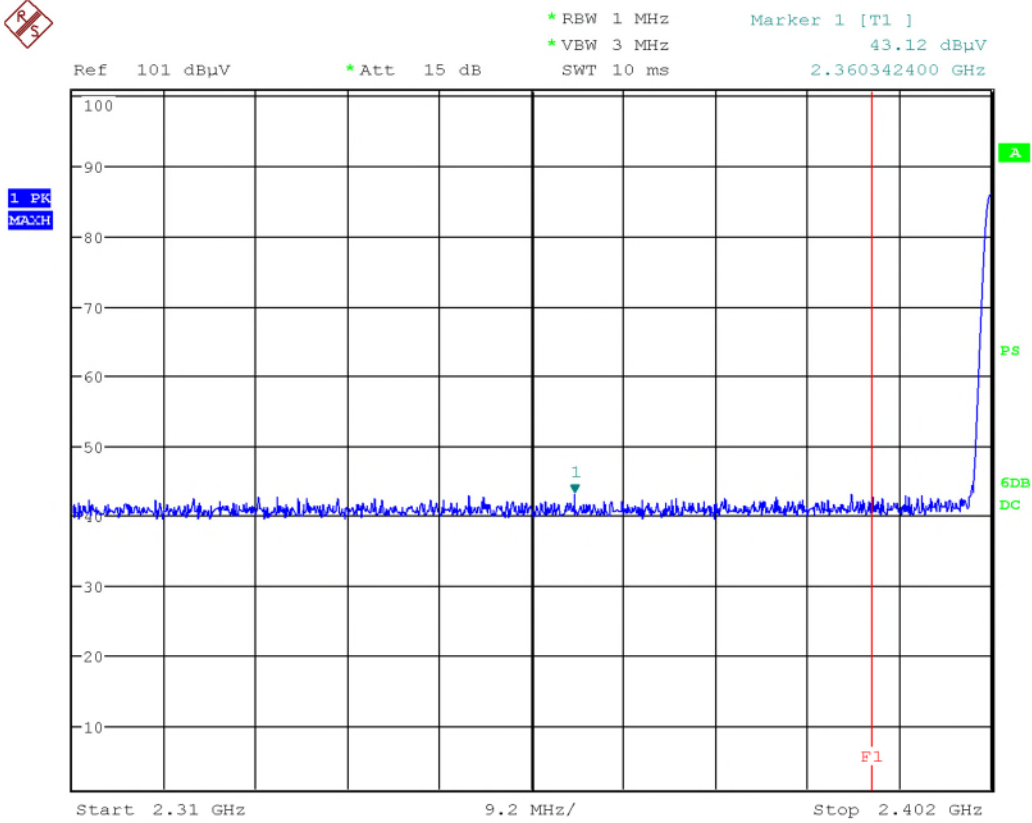


Date: 21.SEP.2021 16:08:33

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

**Band Edge – Low Channel
Vertical - Peak Emission**

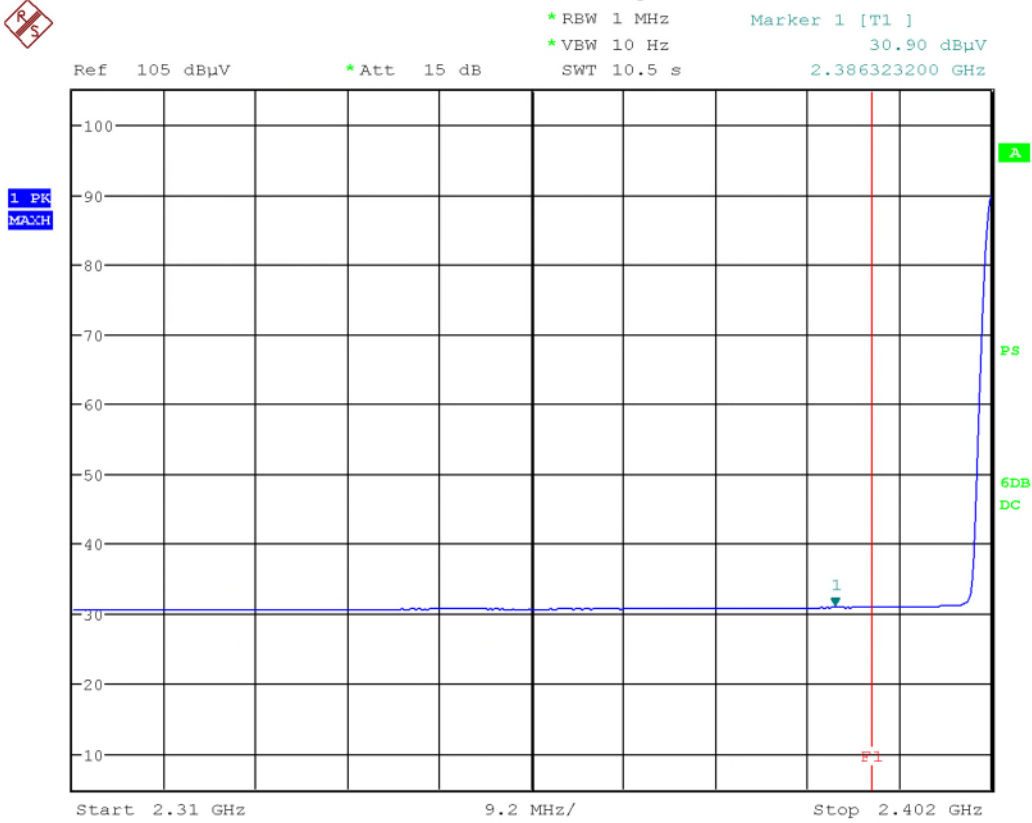


Date: 21.SEP.2021 16:18:21

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

Band Edge – Low Channel
Horizontal - Average Emission

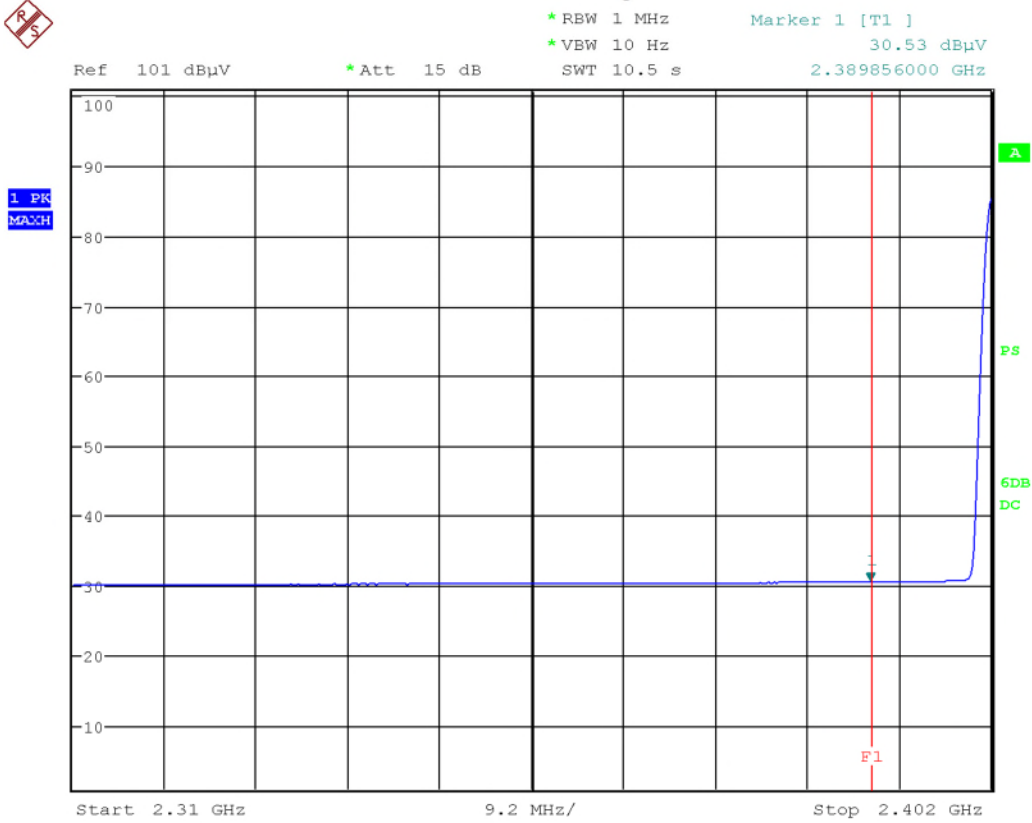


Date: 21.SEP.2021 16:09:15

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

**Band Edge – Low Channel
Vertical – Average Emission**

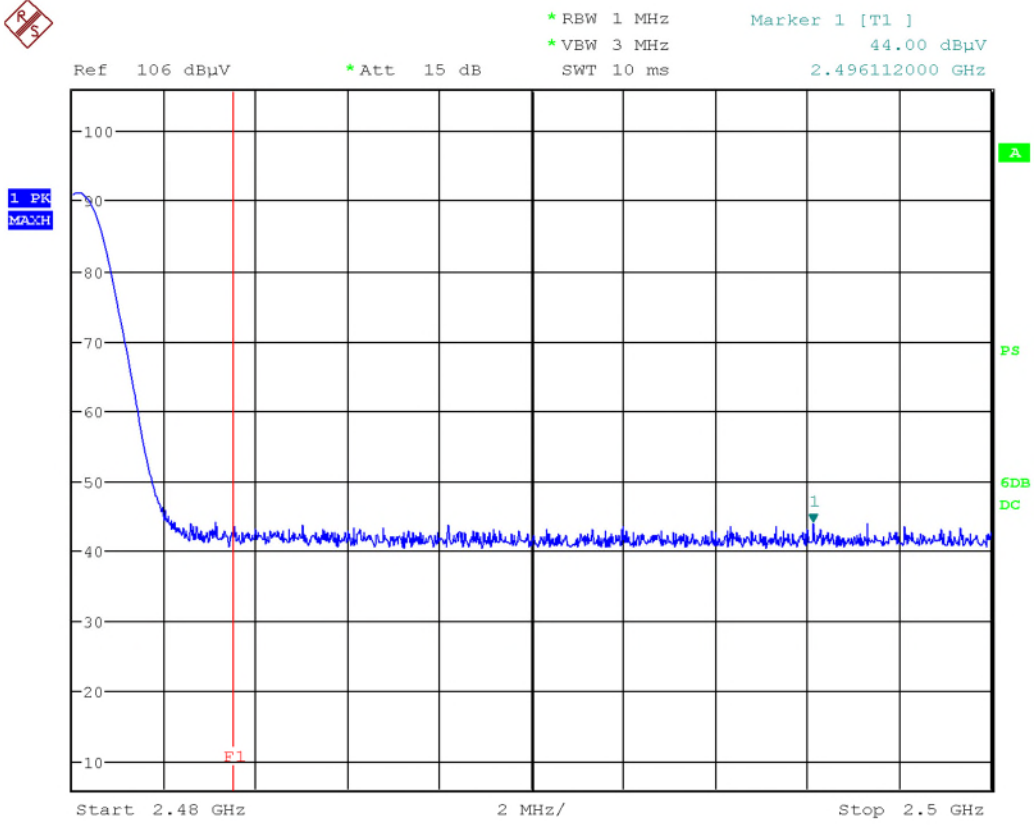


Date: 21.SEP.2021 16:19:03

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


**Band Edge – High Channel
Horizontal - Peak Emission**



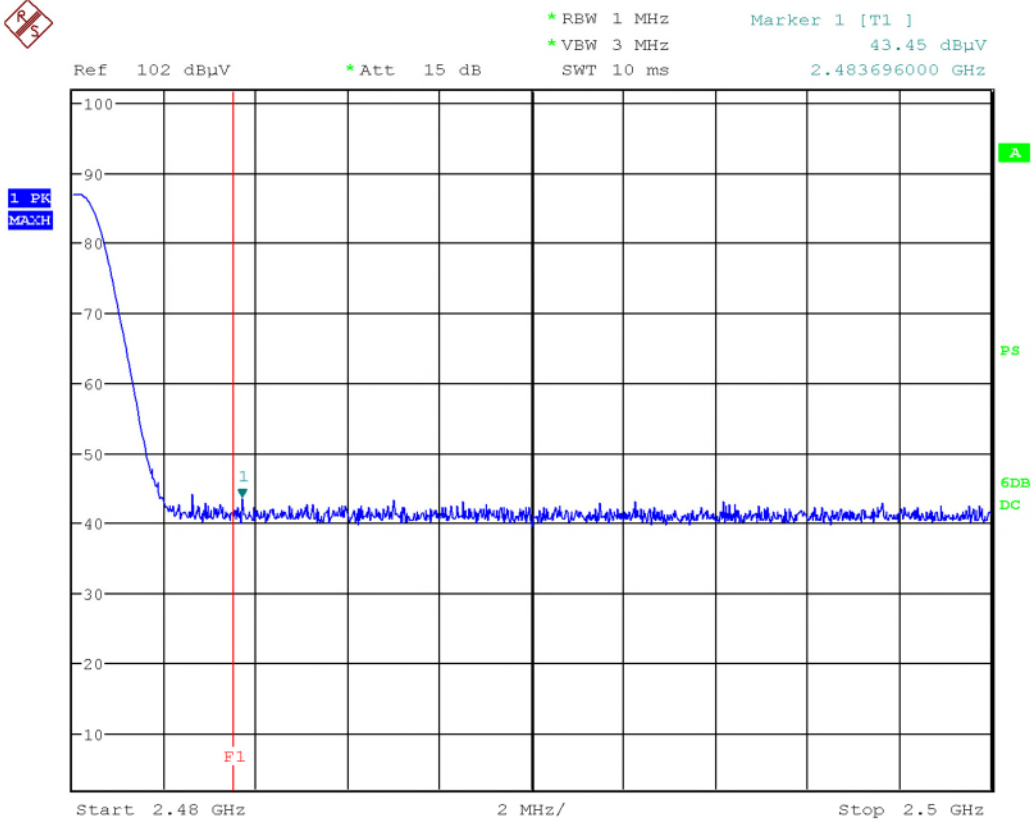
Date: 21.SEP.2021 16:32:40

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.

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

**Band Edge – High Channel
Vertical - Peak Emission**

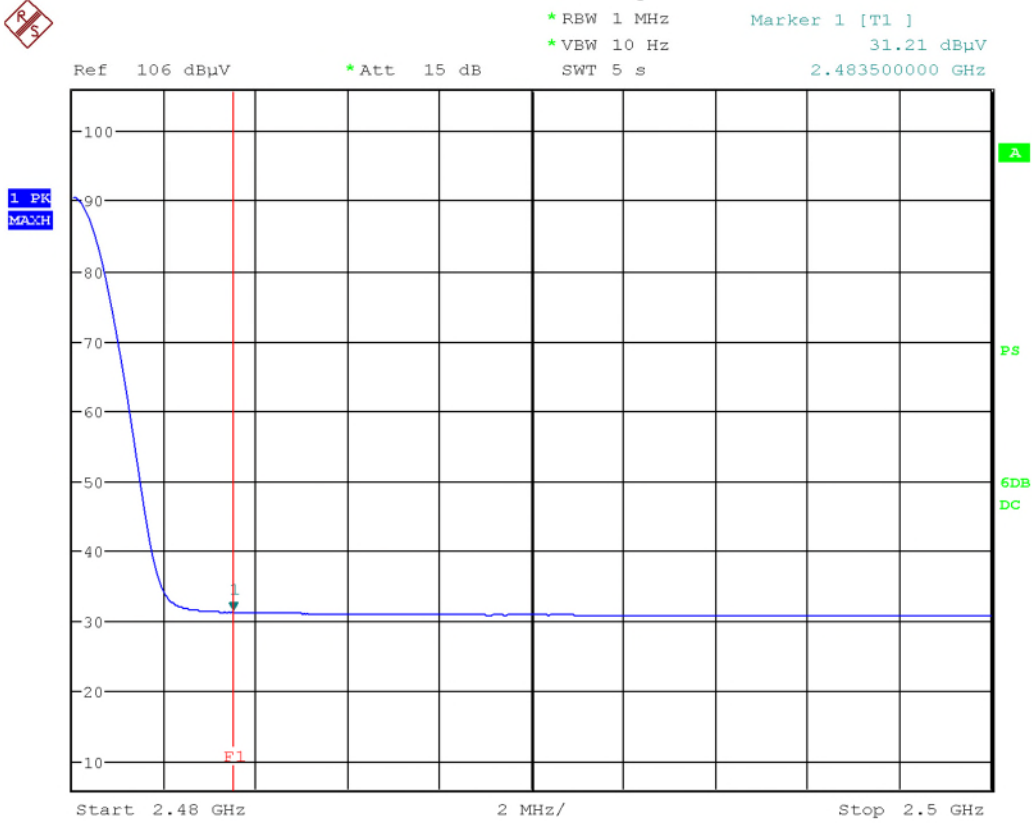


Date: 21.SEP.2021 16:28:43

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

**Band Edge – High Channel
Horizontal - Average Emission**

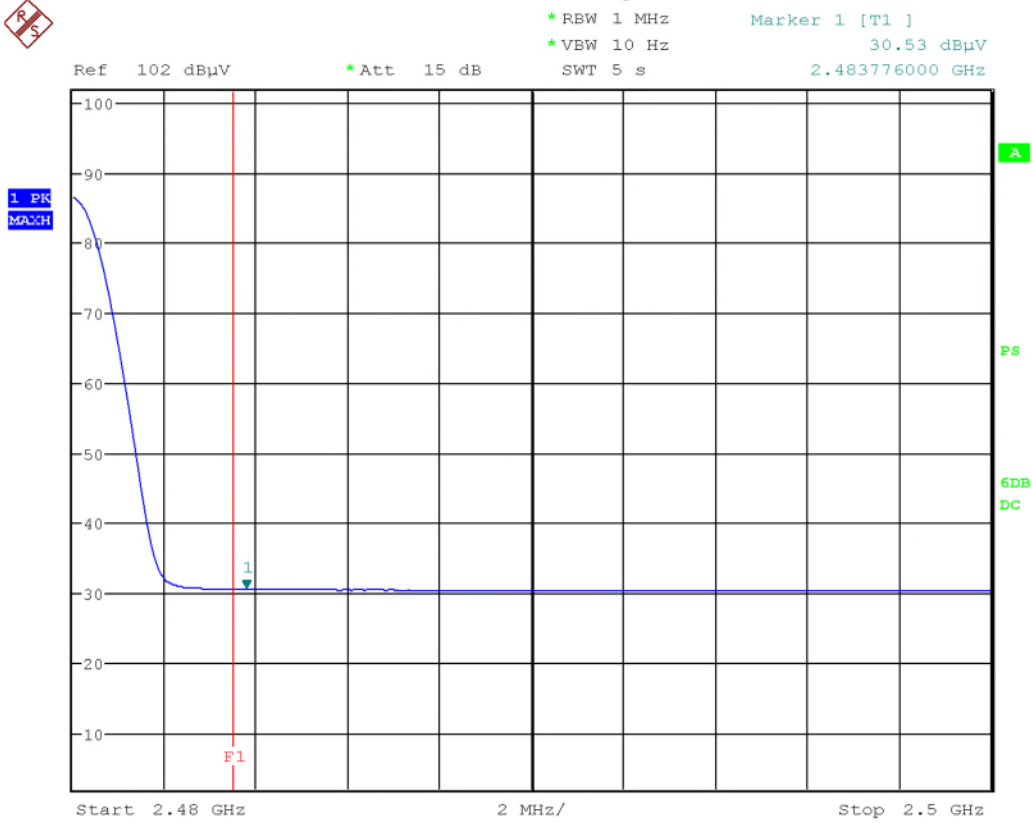


Date: 21.SEP.2021 16:33:02

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

**Band Edge – High Channel
Vertical – Average Emission**



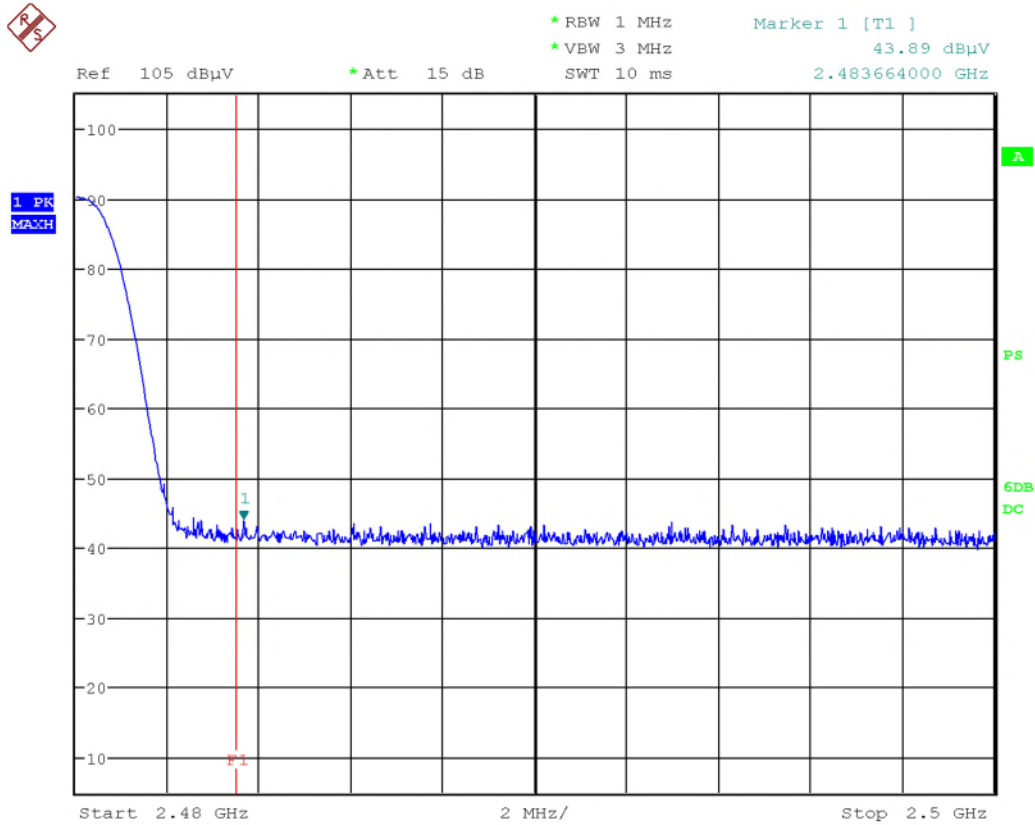
Date: 21.SEP.2021 16:29:05

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


Band Edges – 2 MBPS

Band Edge – High Channel Horizontal - Peak Emission

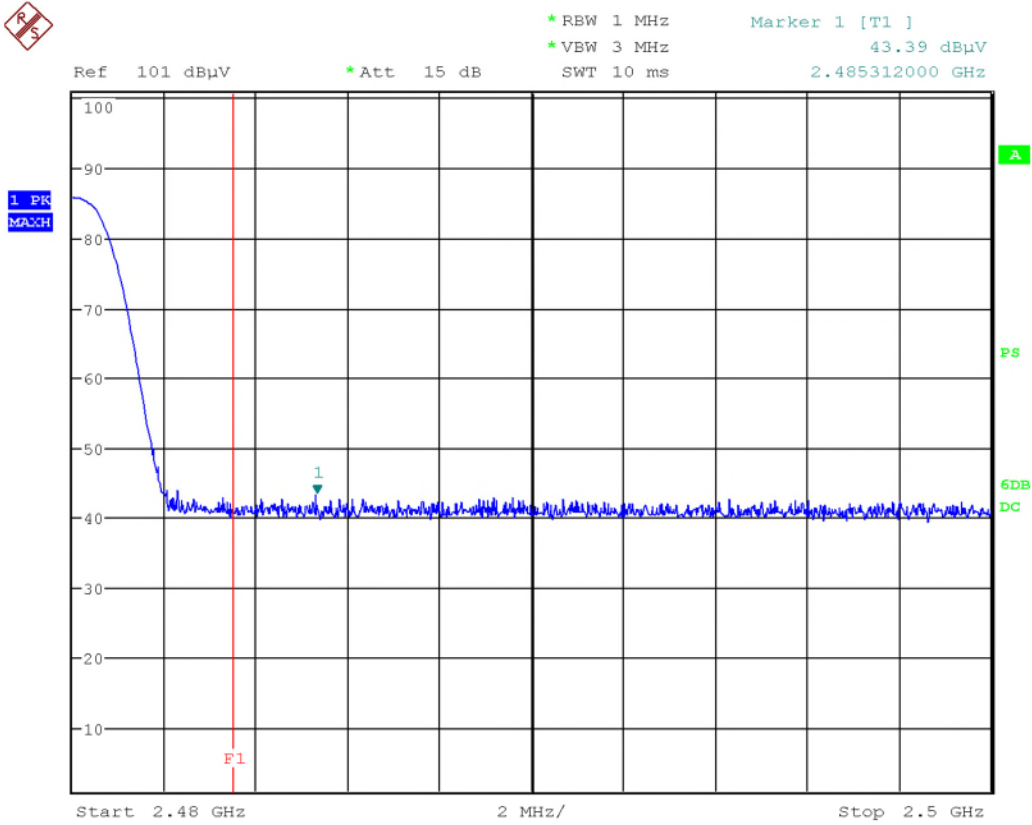


Date: 21.SEP.2021 16:37:07

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

**Band Edge – High Channel
Vertical - Peak Emission**

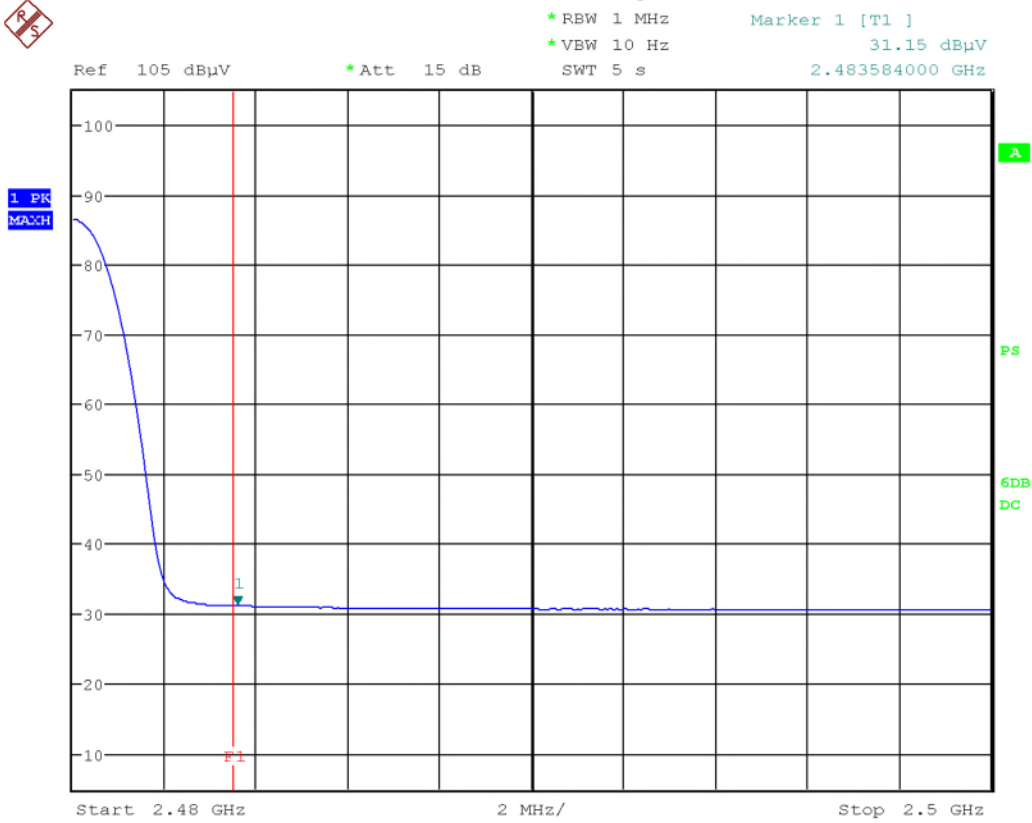


Date: 21.SEP.2021 16:40:13

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

**Band Edge – High Channel
Horizontal - Average Emission**

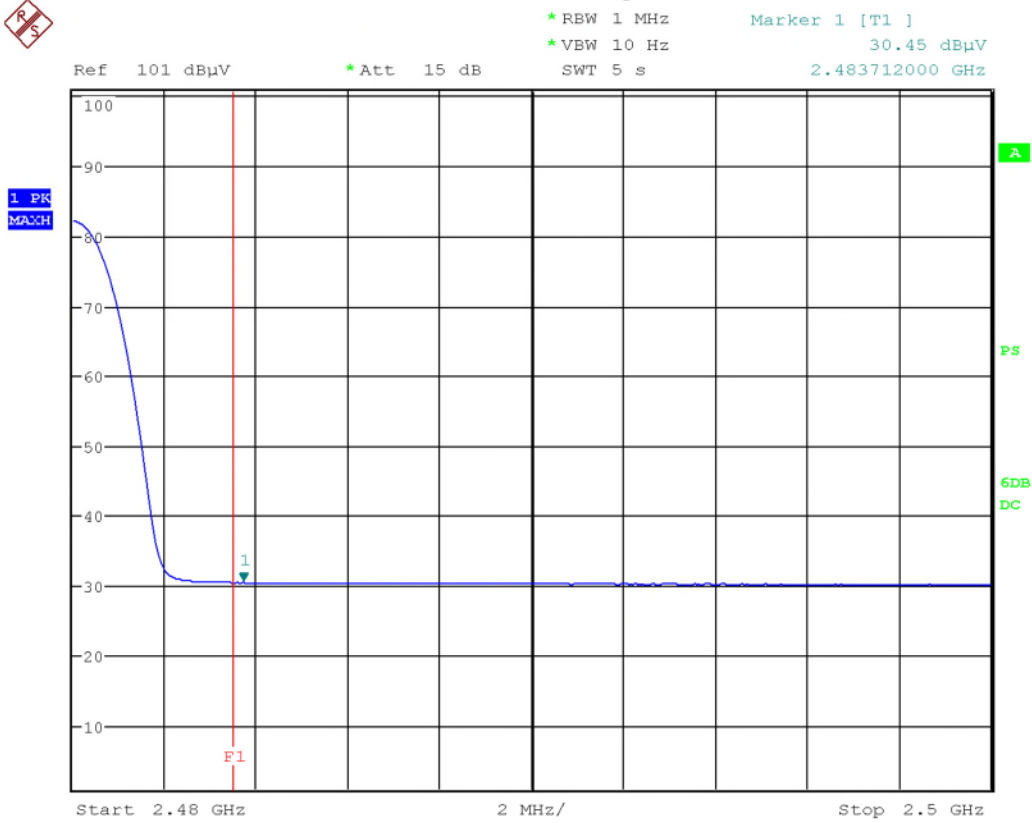


Date: 21.SEP.2021 16:37:29

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

**Band Edge – High Channel
Vertical – Average Emission**



Date: 21.SEP.2021 16:40:35

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.	
Product	ECB601/ECB501	
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.

Frequency (Hz)	Detector	Correction Factor (dB)	Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dB)	Test Result
Horizontal						
883.29M	PEAK	4.3	40.1	46.0	5.9	Pass
889.17M	PEAK	4.5	37.3	46.0	8.7	Pass
367.2M	PEAK	-8.5	36.2	46.0	9.8	Pass
885.33M	PEAK	4.3	36.1	46.0	9.9	Pass
440.67M	PEAK	-7.4	35.9	46.0	10.1	Pass
342.75M	PEAK	-10.1	35.8	46.0	10.2	Pass
Vertical						
882.15M	PEAK	4.3	40.0	46.0	6.0	Pass
465.15M	PEAK	-5.9	38.8	46.0	7.2	Pass
747.96M	PEAK	1.5	38.7	46.0	7.3	Pass
889.2M	PEAK	4.5	38.1	46.0	7.9	Pass
440.67M	PEAK	-7.4	38.1	46.0	7.9	Pass
367.23M	PEAK	-8.5	37.2	46.0	8.8	Pass


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

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
Low Channel											
1 MBPS											
2402	Peak	Horz	90.3	32.0	3.2	10.0	-34.0	101.5			PASS
2402	Avg	Horz	89.8	32.0	3.2	10.0	-34.0	101.0			PASS
2402	Peak	Vert	85.9	32.0	3.2	10.0	-34.0	97.1			PASS
2402	Avg	Vert	85.5	32.0	3.2	10.0	-34.0	96.7			PASS
2345.5	Peak	Horz	43.2	31.9	3.2	10.0	-34.2	54.1	74.0	19.9	PASS
2386.3	Avg	Horz	30.9	32.0	3.2	10.0	-34.1	42.0	54.0	12.0	PASS
2360.3	Peak	Vert	43.1	31.9	3.2	10.0	-34.1	54.1	74.0	19.9	PASS
2389.9	Avg	Vert	30.5	32.0	3.2	10.0	-34.1	41.6	54.0	12.4	PASS
2492.4	Peak	Horz	43.2	32.2	3.2	10.0	-33.7	54.9	74.0	19.1	PASS
2487.8	Avg	Horz	30.0	32.2	3.2	10.0	-33.8	41.7	54.0	12.3	PASS
2487.7	Peak	Vert	43.6	32.2	3.2	10.0	-33.8	55.3	74.0	18.7	PASS
2484.5	Avg	Vert	30.1	32.2	3.2	10.0	-33.8	41.8	54.0	12.2	PASS
Mid Channel											
1 MBPS											
2440	Peak	Horz	90.1	32.2	3.2	10.0	-33.9	101.6			PASS
2440	Avg	Horz	86.5	32.2	3.2	10.0	-33.9	98.1			PASS
2440	Peak	Vert	84.9	32.2	3.2	10.0	-33.9	96.5			PASS
2440	Avg	Vert	81.3	32.2	3.2	10.0	-33.9	92.9			PASS
High Channel											
1 MBPS											
2480	Peak	Horz	91.2	32.2	3.2	10.0	-33.8	102.9			PASS
2480	Avg	Horz	90.7	32.2	3.2	10.0	-33.8	102.4			PASS
2480	Peak	Vert	87.0	32.2	3.2	10.0	-33.8	98.7			PASS
2480	Avg	Vert	86.5	32.2	3.2	10.0	-33.8	98.2			PASS
2375.9	Peak	Horz	42.7	32.0	3.2	10.0	-34.1	53.8	74.0	20.2	PASS
2388.5	Avg	Horz	30.3	32.0	3.2	10.0	-34.1	41.4	54.0	12.6	PASS
2385.1	Peak	Vert	42.8	32.0	3.2	10.0	-34.1	53.9	74.0	20.1	PASS
2389.6	Avg	Vert	30.0	32.0	3.2	10.0	-34.1	41.1	54.0	12.9	PASS
2496.1	Peak	Horz	44.0	32.2	3.2	10.0	-33.7	55.7	74.0	18.3	PASS
2483.5	Avg	Horz	31.2	32.2	3.2	10.0	-33.8	42.9	54.0	11.1	PASS
2483.7	Peak	Vert	43.5	32.2	3.2	10.0	-33.8	55.1	74.0	18.9	PASS
2483.8	Avg	Vert	30.5	32.2	3.2	10.0	-33.8	42.2	54.0	11.8	PASS
4960	Peak	Horz	40.5	34.1	4.5	0.0	-32.5	46.6	74.0	27.4	PASS
4960	Avg	Horz	27.3	34.1	4.5	0.0	-32.5	33.4	54.0	20.6	PASS
4960	Peak	Vert	40.8	34.1	4.5	0.0	-32.5	46.9	74.0	27.1	PASS
4960	Avg	Vert	27.3	34.1	4.5	0.0	-32.5	33.4	54.0	20.6	PASS
7440	Peak	Horz	39.9	35.7	6.0	0.0	-33.1	48.5	74.0	25.5	PASS
7440	Avg	Horz	27.3	35.7	6.0	0.0	-33.1	35.9	54.0	18.1	PASS
7440	Peak	Vert	39.9	35.7	6.0	0.0	-33.1	48.5	74.0	25.5	PASS
7440	Avg	Vert	27.3	35.7	6.0	0.0	-33.1	35.9	54.0	18.1	PASS
High Channel											
2 MBPS											
2480	Peak	Horz	90.3	32.2	3.2	10.0	-33.8	102.0			PASS
2480	Avg	Horz	86.5	32.2	3.2	10.0	-33.8	98.2			PASS
2480	Peak	Vert	86.0	32.2	3.2	10.0	-33.8	97.6			PASS
2480	Avg	Vert	82.2	32.2	3.2	10.0	-33.8	93.9			PASS
2379.6	Peak	Horz	43.3	32.0	3.2	10.0	-34.1	54.3	74.0	19.7	PASS
2388.4	Avg	Horz	30.3	32.0	3.2	10.0	-34.1	41.4	54.0	12.6	PASS
2378	Peak	Vert	42.6	32.0	3.2	10.0	-34.1	53.7	74.0	20.3	PASS
2385.5	Avg	Vert	30.3	32.0	3.2	10.0	-34.1	41.4	54.0	12.6	PASS
2483.7	Peak	Horz	43.9	32.2	3.2	10.0	-33.8	55.6	74.0	18.4	PASS
2483.6	Avg	Horz	31.1	32.2	3.2	10.0	-33.8	42.8	54.0	11.2	PASS
2485.3	Peak	Vert	43.4	32.2	3.2	10.0	-33.8	55.1	74.0	18.9	PASS
2483.7	Avg	Vert	30.5	32.2	3.2	10.0	-33.8	42.1	54.0	11.9	PASS

Client	Ecobee Inc.	
Product	ECB601/ECB501	
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	Jan. 15, 2020	Jan. 15, 2022	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 2 – 18 GHz	WBH218HN	Q-par	Apr. 1, 2020	Apr. 1, 2022	GEMC 6375
Horn Antenna 1 – 18 GHz	3117	ETS-Lindgren	Feb. 17, 2020	Feb. 17, 2022	GEMC 340
Horn Antenna 18 - 26.5 GHz	SAS-572	A.H. Systems	Dec. 1, 2020	Dec. 1, 2022	GEMC 6371
Attenuator 6 dB	612-6-1	Meca Electronics, Inc	NCR	NCR	GEMC 286
Attenuator 10 dB	8493B	Agilent	Oct 4, 2021	Oct 4, 2022	GEMC133
Pre-Amp 9 kHz – 1 GHz	CPA9230	Chase	May 22, 2020	May 22, 2022	GEMC 301
Pre-Amp 1 – 26.5 GHz	HP 8449B	HP	Dec. 20, 2019	Dec. 20, 2021	GEMC 189
2.4GHz-2.5GHz Notch Filter	BRM50702	Micro-Tronics	NCR	NCR	GEMC 230
4GHz HPF	11SH10-4000/T12000	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

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

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

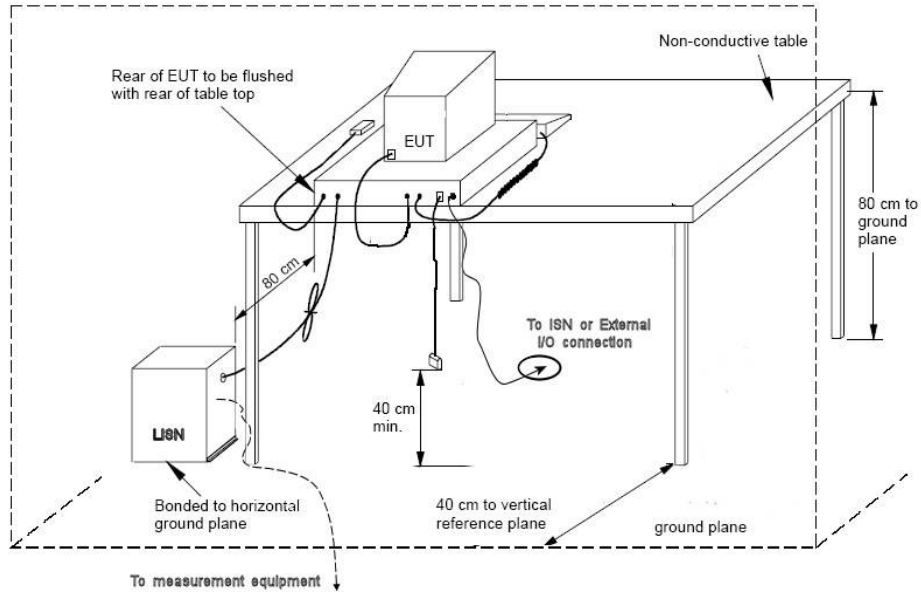
* Decreases linearly with the logarithm of the frequency

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.

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

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.

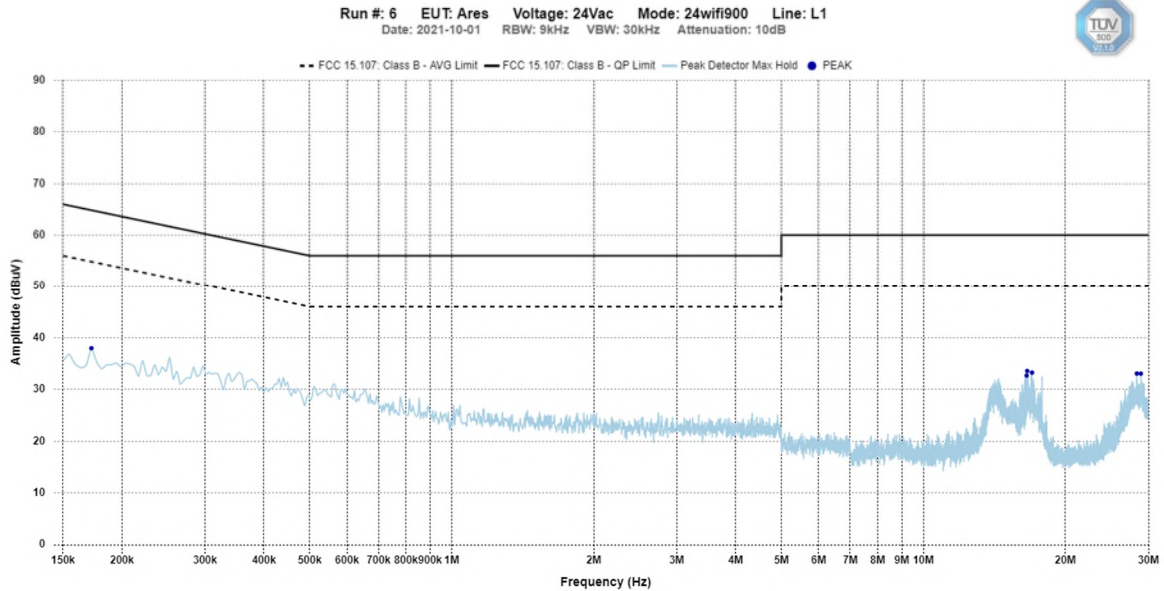
Preliminary Graphs

The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector. 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.

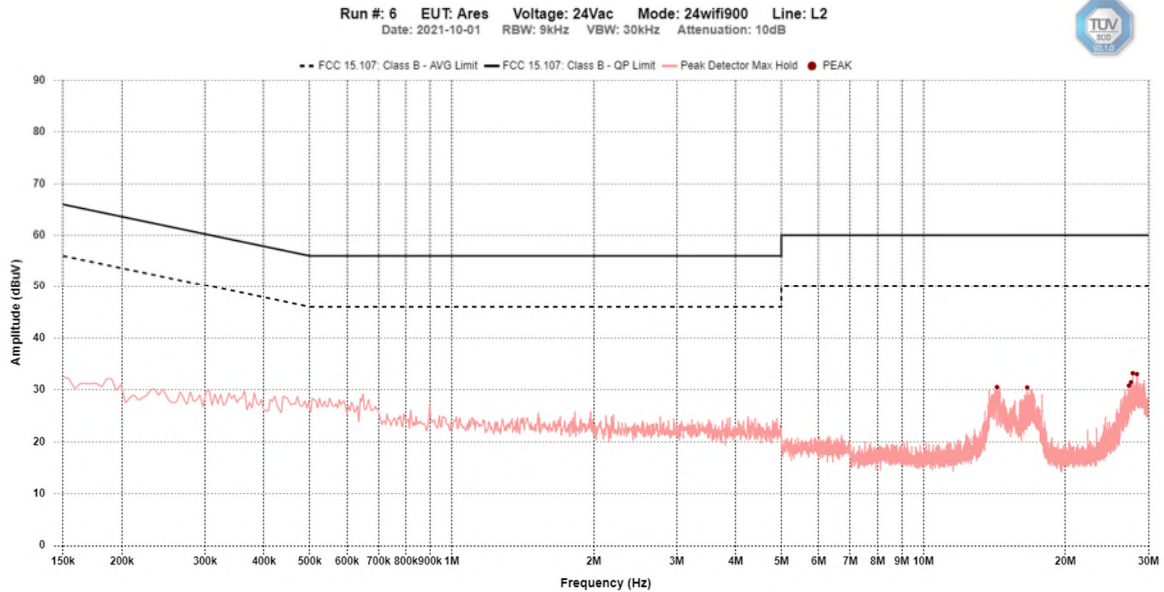
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


ECB601

Line 1 (L1) – 120Vac 60Hz



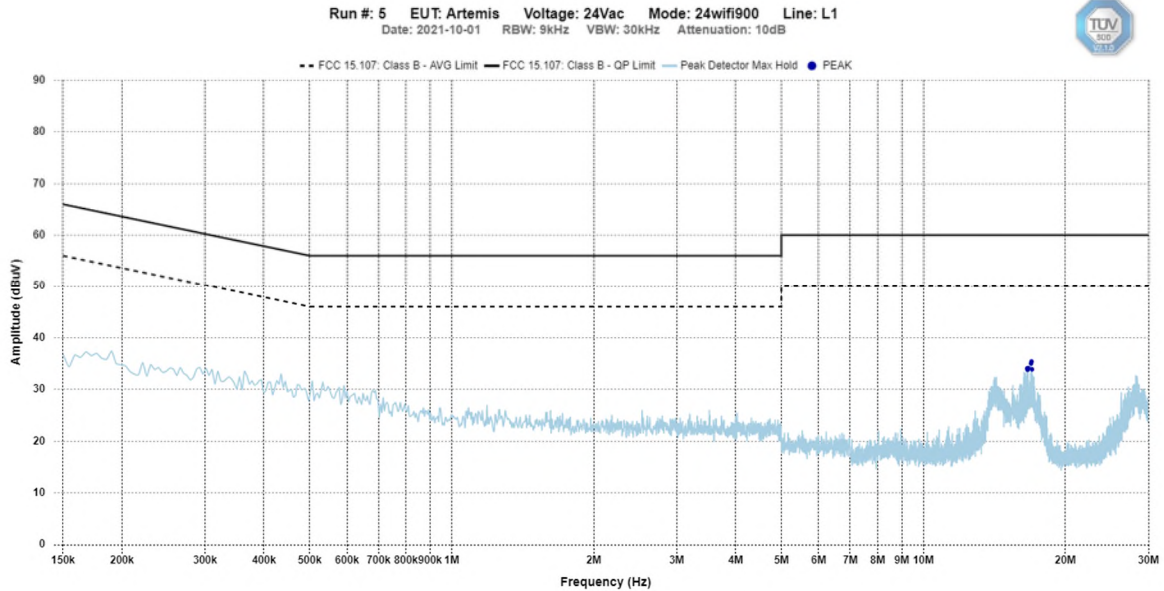
Line 2 (L2) – 120Vac 60Hz



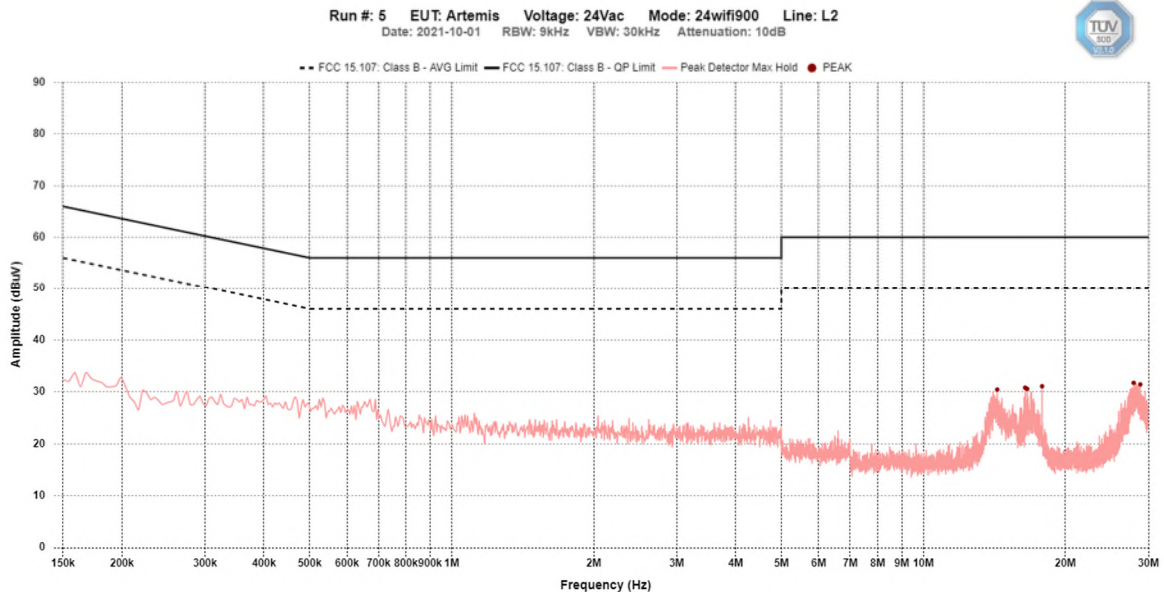
Client	Ecobee Inc.	
Product	ECB601/ECB501	
Standard(s)	RSS 247 Issue 2:2017 FCC Part 15 Subpart 15.247	


ECB501

Line 1 (L1) – 120Vac 60Hz



Line 2 (L2) – 120Vac 60Hz



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

Final Measurements

EUT Name		EB601						
Limit		FCC 15.109						
Power Supply		120Vac 60Hz						
Frequency (Hz)	Detector	Correction Factor (dB)	Level (dBuV)	QP Limit (dBuV)	AVG Limit (dBuV)	QP Margin (dB)	AVG Margin (dB)	Test Result
Line 1								
16.603M	PEAK	10.4	33.6	60.0	50.0	26.4	16.4	Pass
17.0M	PEAK	10.5	33.2	60.0	50.0	26.8	16.8	Pass
172.276k	PEAK	10.1	38.0	65.4	55.4	27.4	17.4	Pass
28.36M	PEAK	10.9	33.1	60.0	50.0	26.9	16.9	Pass
28.922M	PEAK	10.9	33.0	60.0	50.0	27.0	17.0	Pass
16.559M	PEAK	10.4	32.7	60.0	50.0	27.3	17.3	Pass
Line 2								
27.804M	PEAK	10.8	33.2	60.0	50.0	26.8	16.8	Pass
28.365M	PEAK	10.9	33.0	60.0	50.0	27.0	17.0	Pass
27.559M	PEAK	10.8	31.5	60.0	50.0	28.5	18.5	Pass
27.282M	PEAK	10.8	30.8	60.0	50.0	29.2	19.2	Pass
14.327M	PEAK	10.4	30.5	60.0	50.0	29.5	19.5	Pass
16.603M	PEAK	10.4	30.5	60.0	50.0	29.5	19.5	Pass

Average and Quasi-Peak Emissions Table


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

Client	Ecobee Inc.	
Product	ECB601/ECB501	
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	ESL 6	Rohde & Schwarz	Feb. 25, 2019	Feb. 25, 2021	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	Jan. 16, 2020	Jan. 16, 2022	GEMC 302
RF Cable 3m	LMR-400-3M-50Ω-MN-MN	LexTec	NCR	NCR	GEMC 276
Attenuator 10 dB	6N10W-10	Inmet	NCR	NCR	GEMC 350
Emissions Software	0.1.99	TUV SUD Canada, Inc.	NCR	NCR	GEMC 58

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


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.	
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.	
Product	ECB601/ECB501	
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