

Global EMC Inc. Labs EMC & RF Test Report

As per

RSS 210 Issue 8:2010

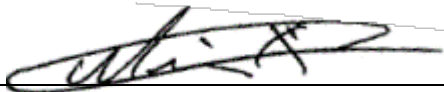
&

FCC Part 15 Subpart C:2014

Unlicensed Intentional Radiators

on the

Athena



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Testing produced for



See Appendix A for full customer & EUT details.





Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

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Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Report Scope

This report addresses the EMC verification testing and test results of Ecobee Inc's Athena, herein referred to as EUT (Equipment Under Test) performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:


RSS 210 Issue 8:2010
FCC Part 15 Subpart C 15:2014

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

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

This report does not imply product endorsement by A2LA or any other accreditation agency, any government, or Global EMC Inc.


Opinions/interpretations expressed in this report, if any, are outside the scope of Global EMC Inc accreditation. Any opinions expressed do not necessarily reflect the opinions of Global EMC Inc, unless otherwise stated.

Client	Ecobee Inc	
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Summary

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

EUT FCC Certification #, FCC ID:	WR9EBSTATZBE3
EUT Industry Canada Certification #, IC:	7981A- EBSTATZBE3
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Min Xie


Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.207	Power line conducted emissions	QuasiPeak Average	Pass
FCC 15.209 RSS-210 (Table 2)	Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.249(a), (c) RSS-210 A2	Power requirement	< 50 mV/m @ 3m	Pass
Overall Result			PASS

All tests were performed by Min Xie.

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	Athena	
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Justifications, Descriptions, or Deviations

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


For the Antenna requirement specified in FCC 15.203 (RSS 210 section 5.5), the unit uses a 0 dBi PCB trace antenna for the 15.249 transmitter. It have less than 6 dBi gain.

For the Restricted Bands of operation, the EUT is designed to only operate between 902 – 928 MHz.

For maximum permissible exposure, this device operates at less than 50 mV/m at 902 – 928 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 follows later in this report.


For the scope of this test report the EUT was mounted in three orthogonal axes to maximize emissions. Worst case results are presented.

The device contains three transmitters; the current 15.247 device operating 802.11B, G, and N protocols, a 15.249 device operation in the 902 MHz to 928 MHz frequency range, and a modularly certified 15.247 2.4 GHz frequency hopping device with FCC ID: W7Z-ZICM357SP2. Antenna co-location testing was performed on the device verify compliance with 15.247(d) radiated emission requirements.

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Applicable Standards, Specifications and Methods

ANSI C63.4:2009	- Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2009	- American national standard for testing unlicensed wireless devices
CFR 47 FCC 15	- Code of Federal Regulations – Radio Frequency Devices
CISPR 22:2008	- Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
ICES-003:2012	- Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
ISO 17025:2005	- General Requirements for the competence of testing and calibration laboratories
RSS-GEN	General Requirements and Information for the Certification of Radio Apparatus
RSS 210:2010	- Issue 8: Spectrum Management and Telecommunications Policy. Radio Standards Specification Low Power License-Exempt Radiocommunication Devices

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Sample calculation(s)


Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)

Margin = 50.5dBuV/m – (50dBuV + 10dB + 2.5dB – 20dB)

Margin = 8.5 dB

Document Revision Status

Revision 1 - May 14, 2014
Initial release

Client	Ecobee Inc	
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Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Definitions and Acronyms

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

AE – Auxillary Equipment.

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

EMC – Electro-Magnetic Compatibility

EMI – Electro-Magnetic Immunity


EUT – Equipment Under Test

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line impedance stabilization network

NCR – No Calibration Required

RF – Radio Frequency


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Testing Facility

Testing for EMC on the EUT was carried out at Global EMC labs in Toronto, Ontario, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog, and Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN.

Calibrations and Accreditations


The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, 377448), Industry Canada (IC, 6844A-3) and VCCI (R-4023, G-506, T-1246, and C-4498). This semi-anechoic chamber complies with the requirements of EN55016-2-3:2006, section 7.5 and the site attenuation requirements of EN55016-1-4. This chamber was additionally 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 Global EMC. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at Global EMC. Global EMC Inc is accredited to ISO 17025 by A2LA with Testing Certificate #2555.01. The laboratories current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

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Testing Environmental Conditions and Dates

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

Date	Test	Init.	Temperature (°C)	Humidity (%)	Pressure (kPa)
2/25/2014 to 4/10/2014	All	MX	20-24°C	35 - 41%	98 -103kPa

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Detailed Test Results Section

Client	Ecobee Inc	
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Radiated Emissions – 15.249

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.

Limit(s) and Method

The method is as defined in ANSI C63.10:2009.


The limits are as defined in FCC Part 15, Section 15.209:

0.009 MHz – 0.490 MHz, 2400/F(kHz) uV/m at 300 m¹
0.490 MHz – 1.705 MHz, 24000/F(kHz) uV/m at 30 m¹
1.705 MHz – 30 MHz, 30 uV/m at 30 m¹
30 MHz – 88 MHz, 100 uV/m (40.0 dBuV/m¹) at 3 m
88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m¹) at 3 m
216 MHz – 960 MHz, 200 uV/m (46.0 dBuV/m¹) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m¹) at 3 m
Above 1000 MHz, 500 uV/m (54 dBuV/m²) at 3m
Above 1000 MHz, 500 uV/m (74 dBuV/m³) at 3m

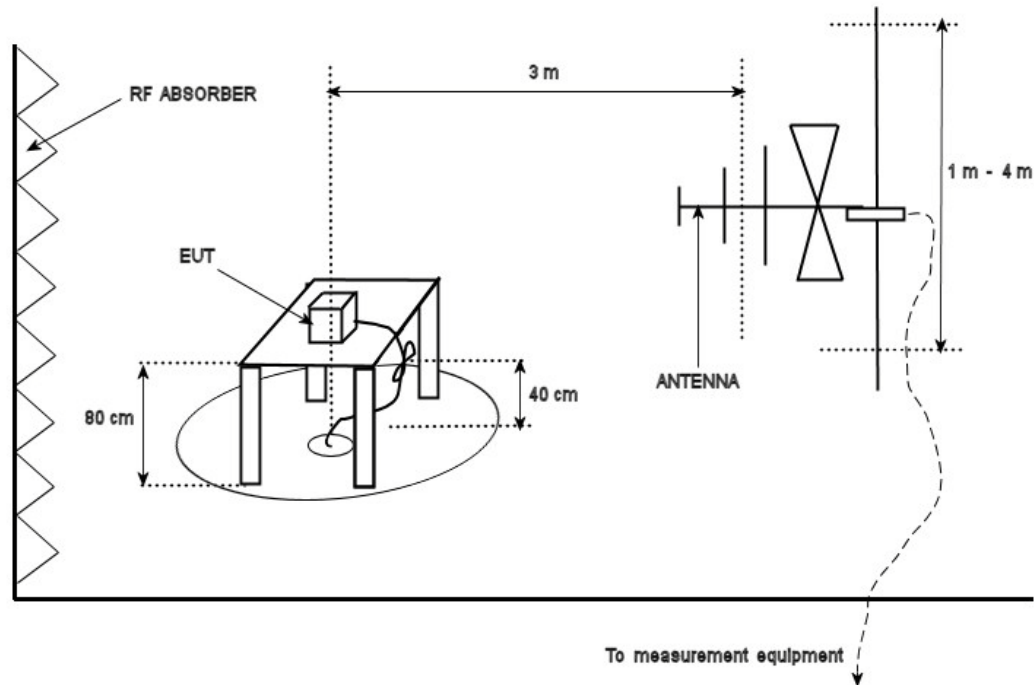
¹Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1

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

³Limit is with 1 MHz measurement bandwidth and using a Peak detector

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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 +/-4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater than the final required detector and over a full 0-360 rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

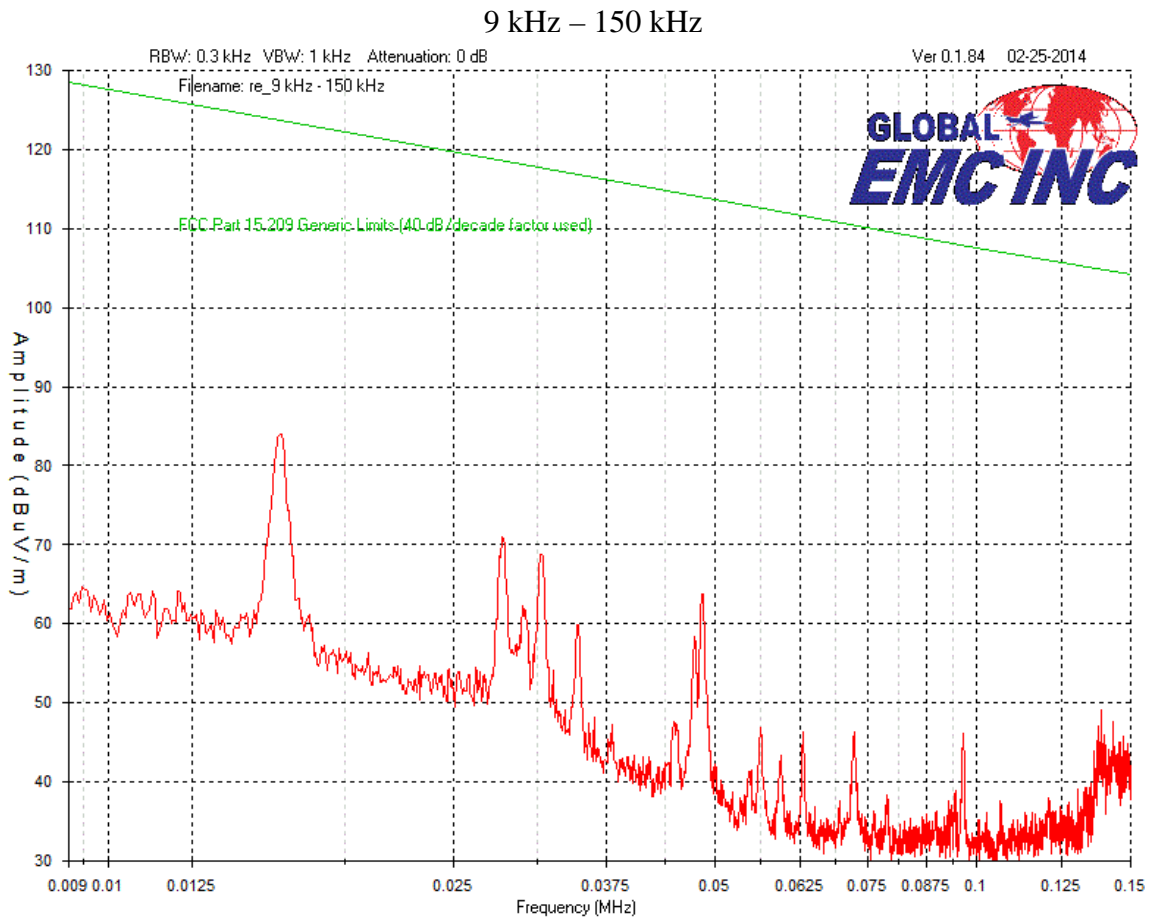
In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic (a minimum of a 10 GHz).


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

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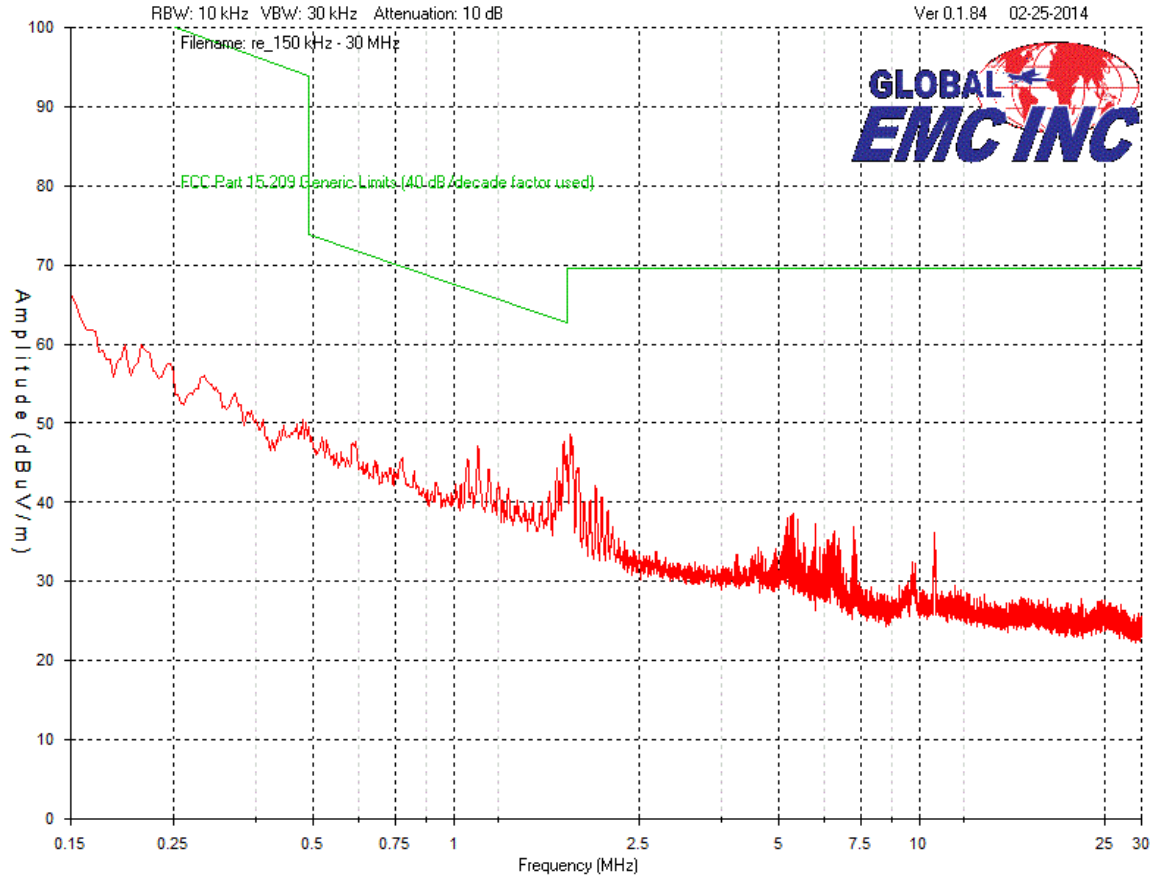
30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (3m /1m) is applied.


Band edge measure graphs were shown for illustrations purpose. See final measurement section for all measurements.



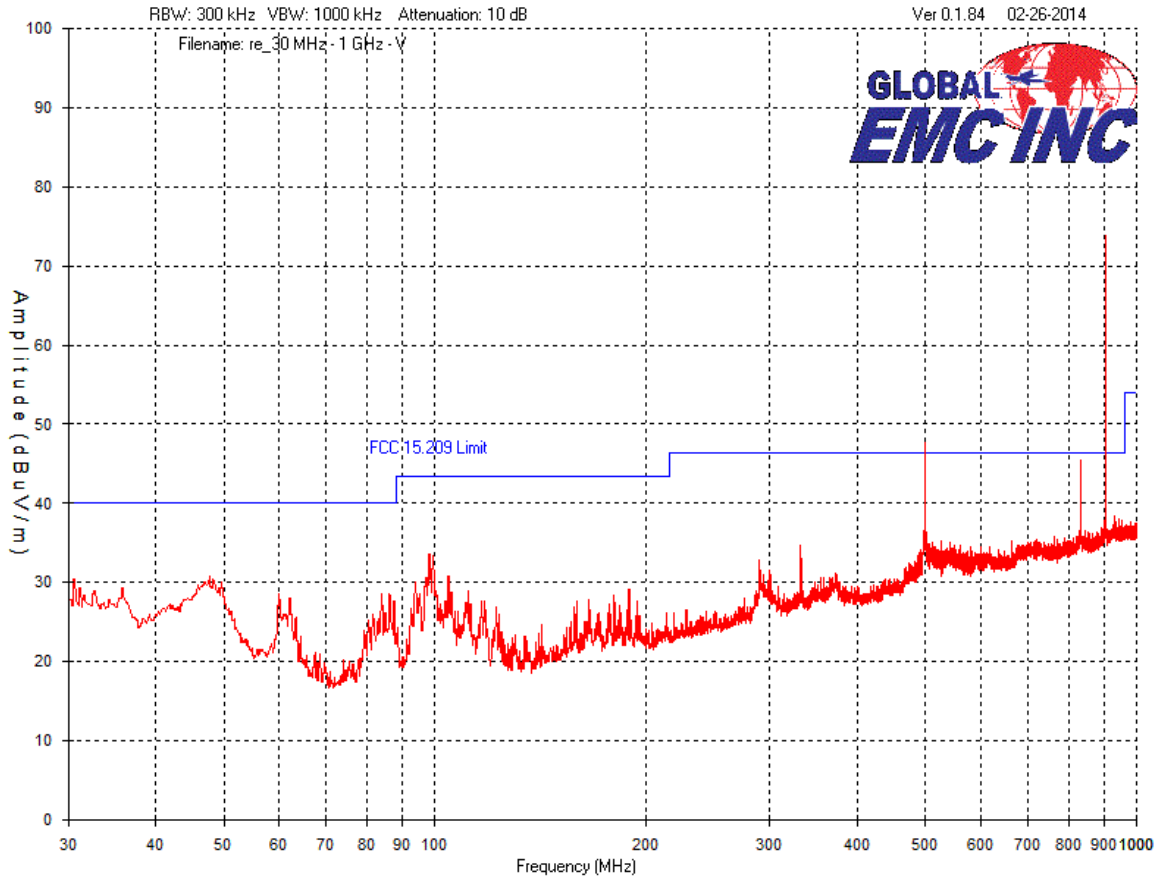
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150 kHz – 30 MHz




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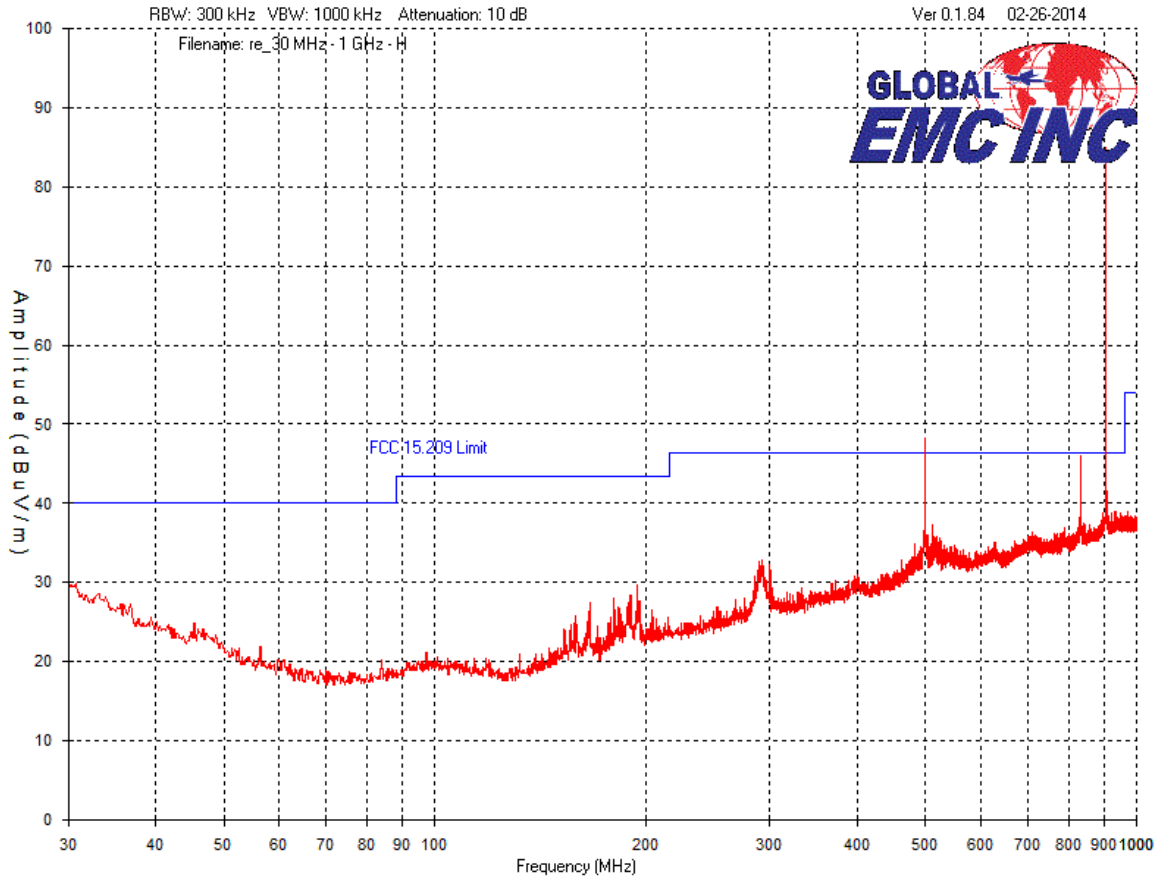
Mid Channel - 30 MHz – 1 GHz
Vertical – Peak Emission Graph




Note: See Final Measurements and Results section on page 33 for quasi peak measurements.

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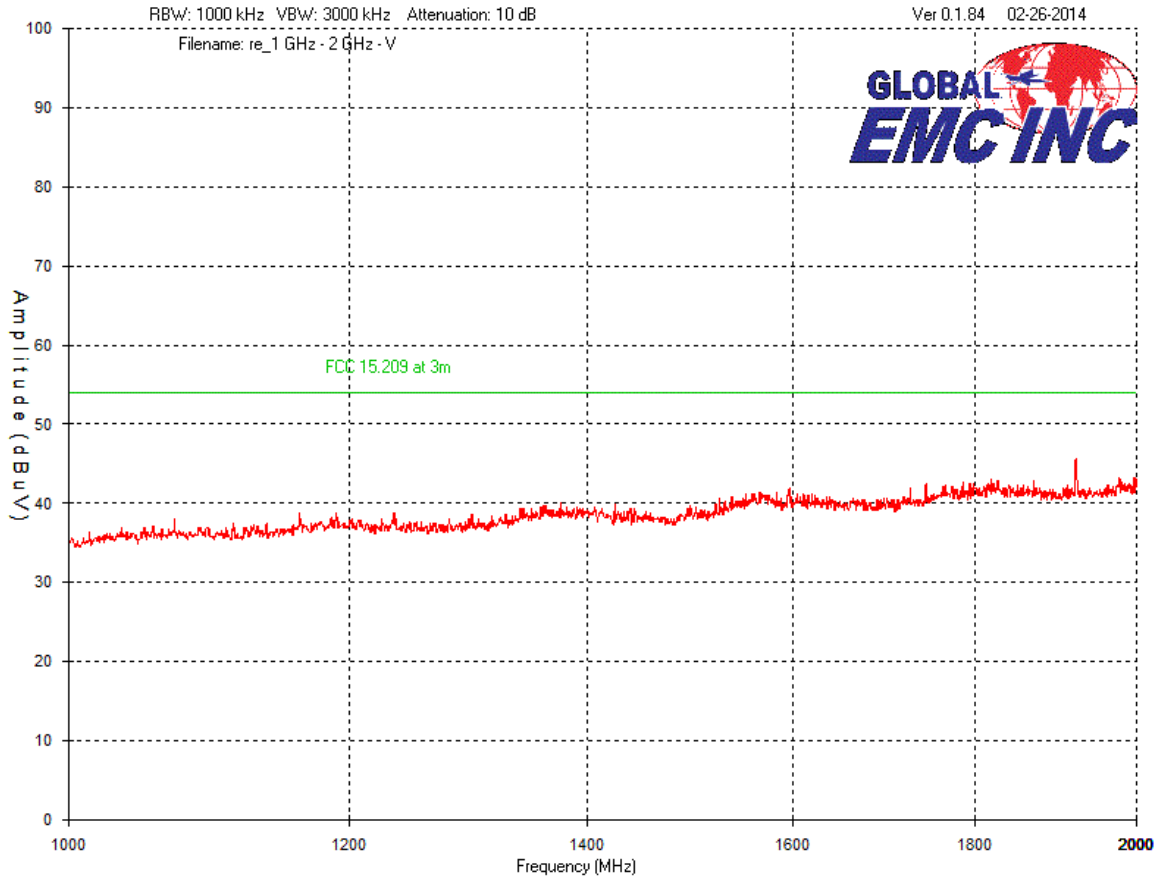
**Mid Channel – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph**




Note: See Final Measurements and Results section on page 33 for quasi peak measurements.

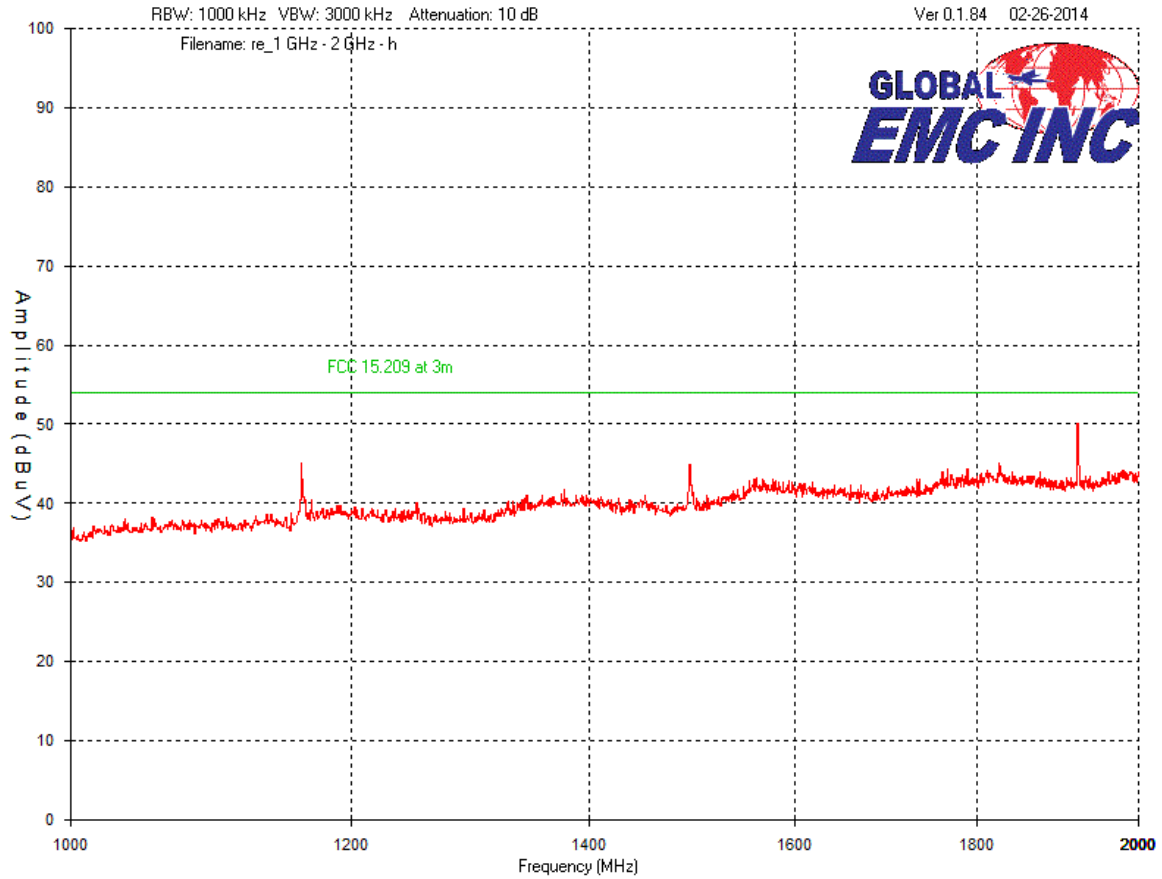
Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Mid Channel – 1 GHz – 2 GHz
Vertical - Peak Emission Graph



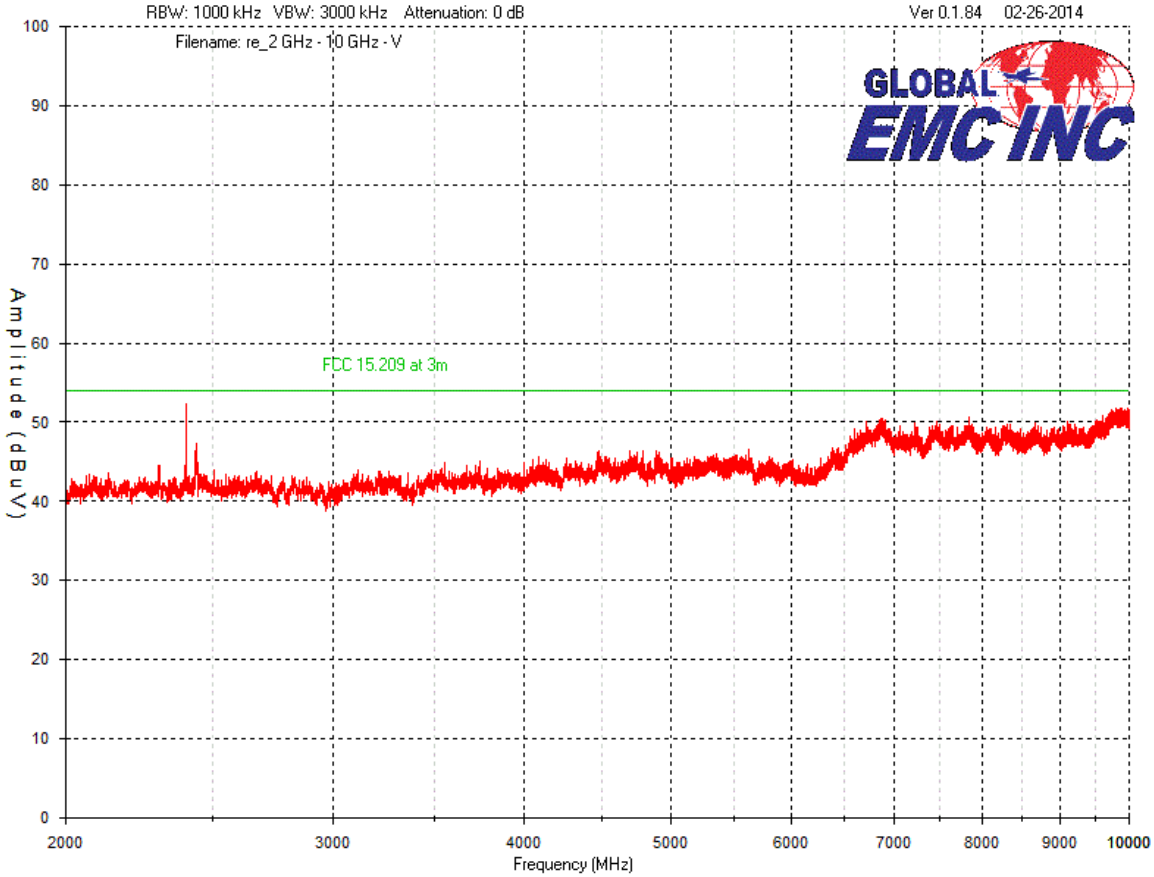
Client	Ecobee Inc	
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Mid Channel – 1 GHz – 2 GHz
Horizontal - Peak Emission Graph



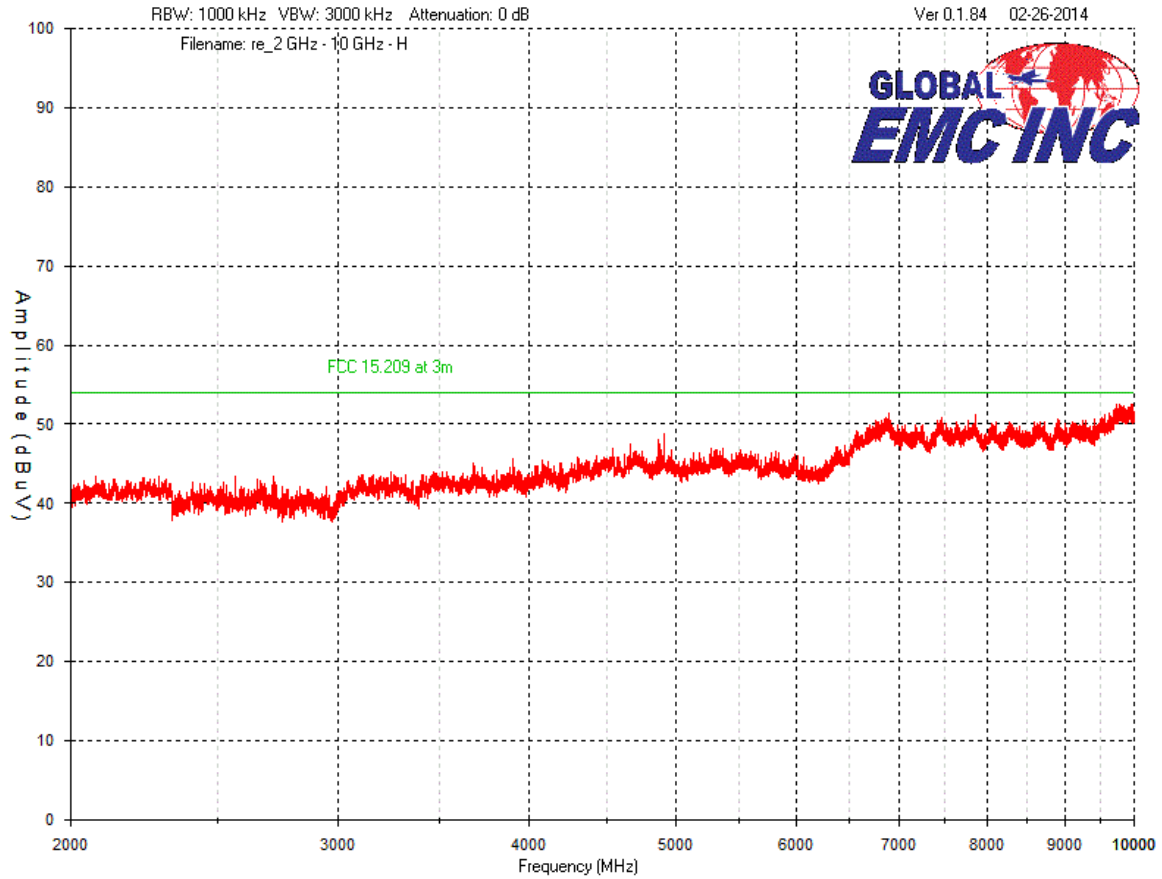
Client	Ecobee Inc	
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Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


Mid Channel – 2 GHz – 10 GHz
Vertical - Peak Emission Graph



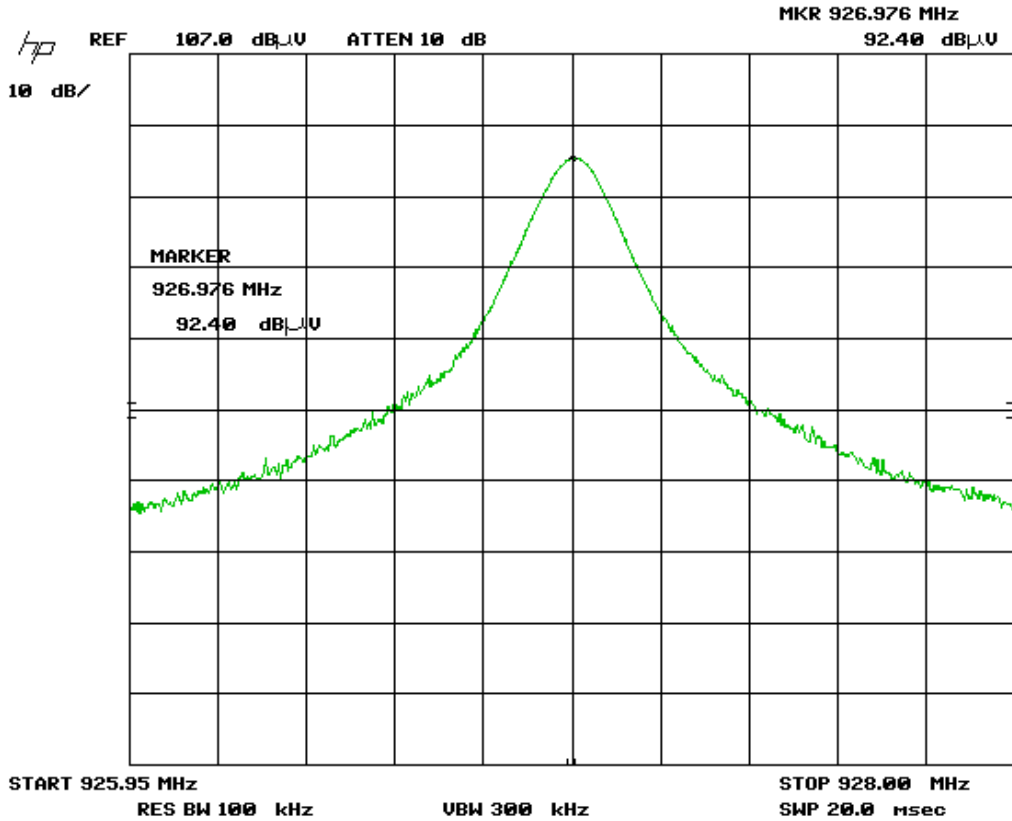
Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Mid Channel – 2 GHz – 10 GHz
Horizontal - Peak Emission Graph




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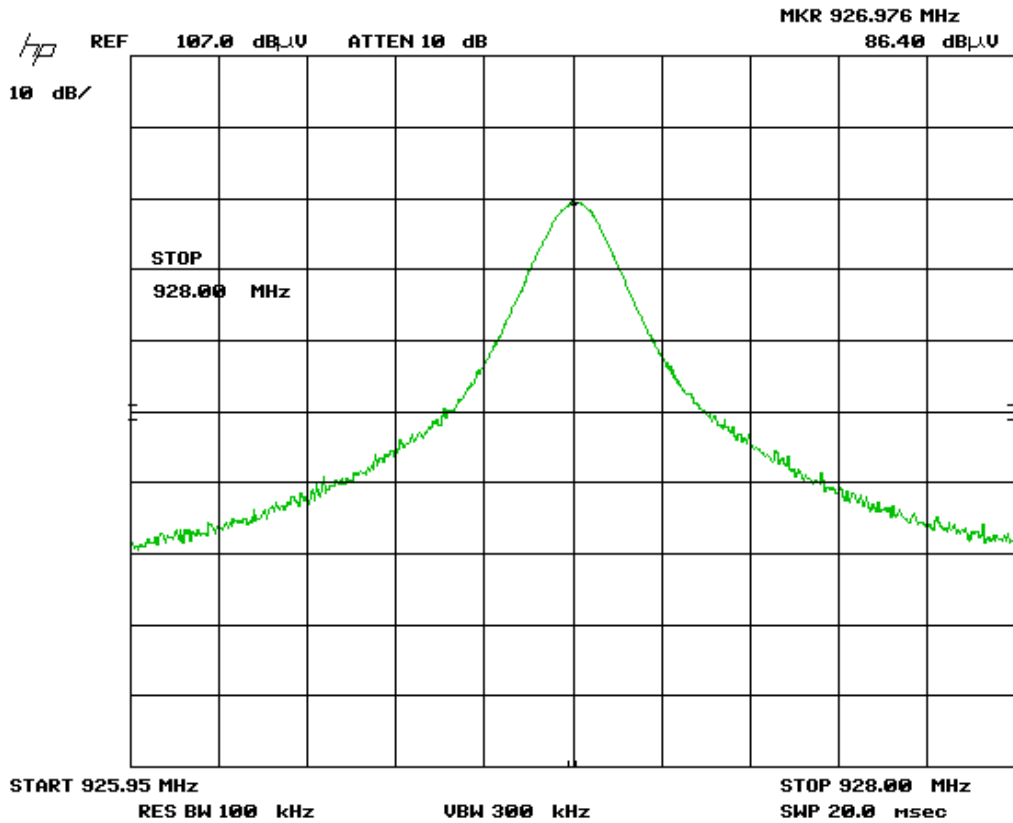
Fundamental - High Channel
Horizontal - Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw data. See table on page 34 for corrected reading.

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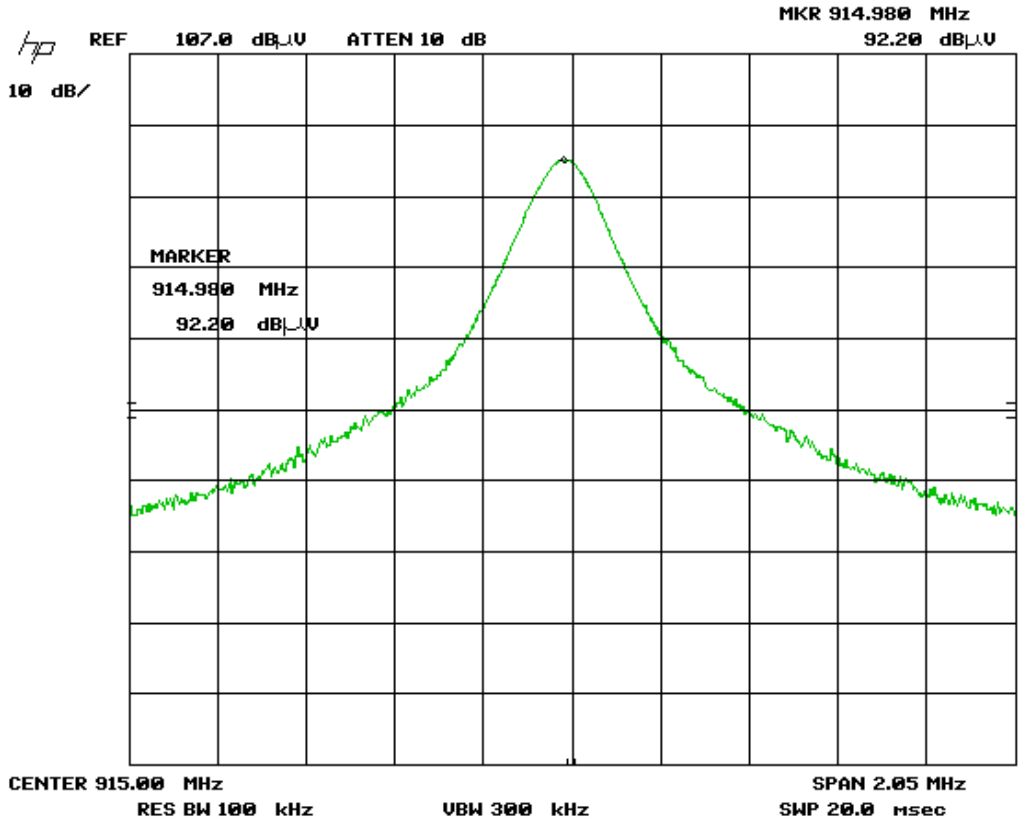
Fundamental - High Channel
Vertical - Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw data. See table on page 34 for corrected reading.

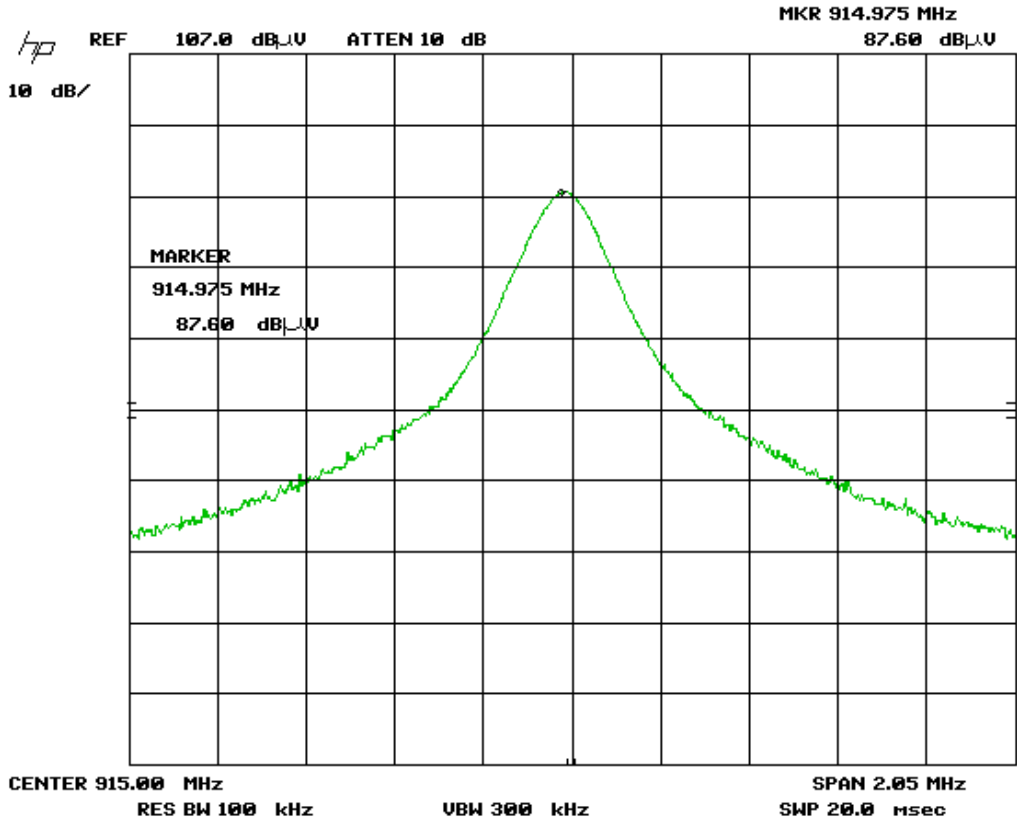
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Fundamental - Mid Channel
Horizontal - Peak Emission




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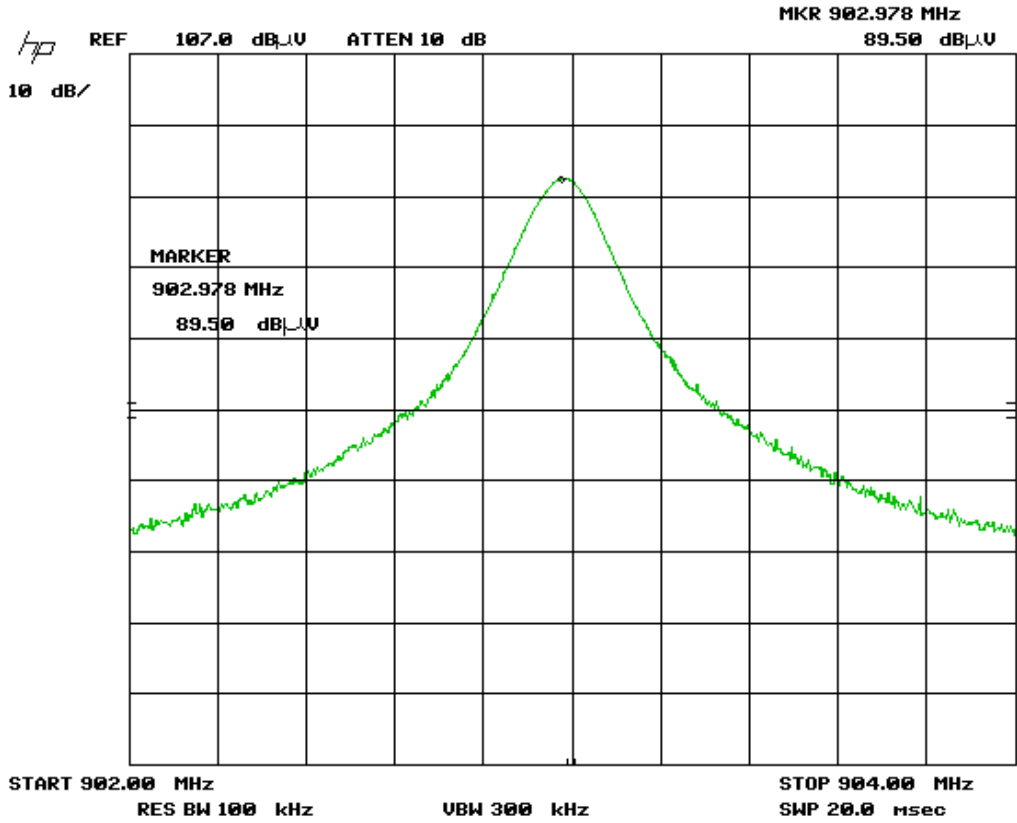
Fundamental - Mid Channel
Vertical - Peak Emission




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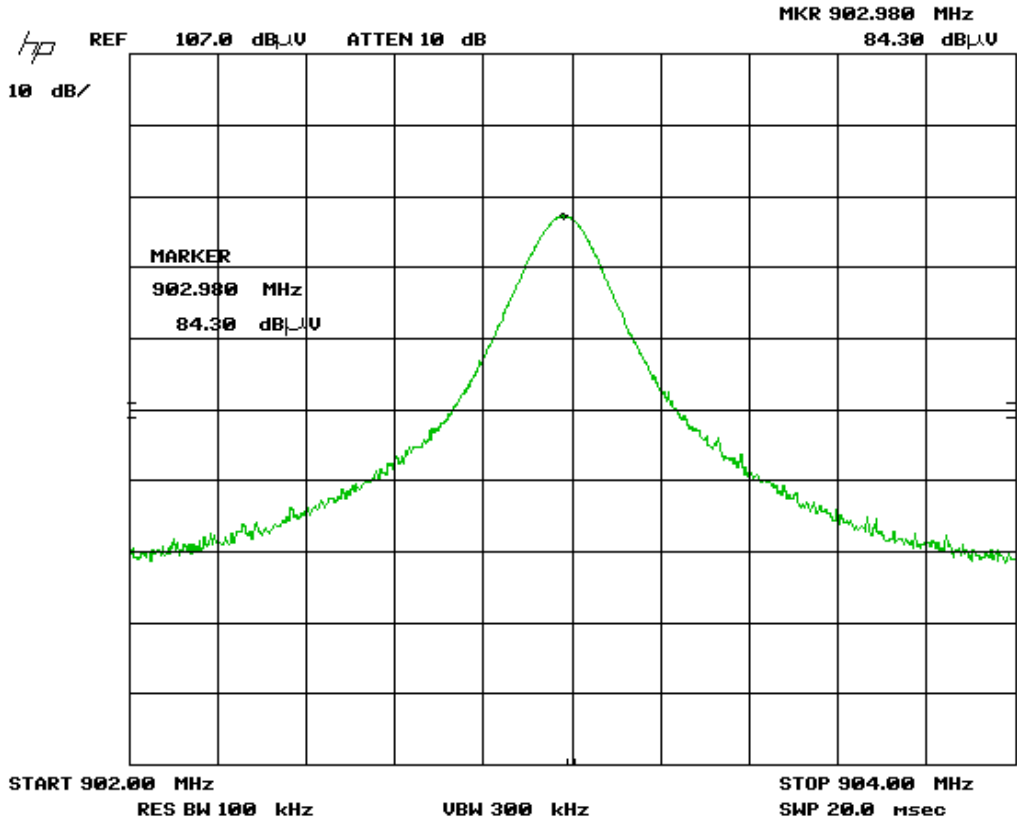
Fundamental - Low Channel
Horizontal - Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw data. See table on page 34 for corrected reading.

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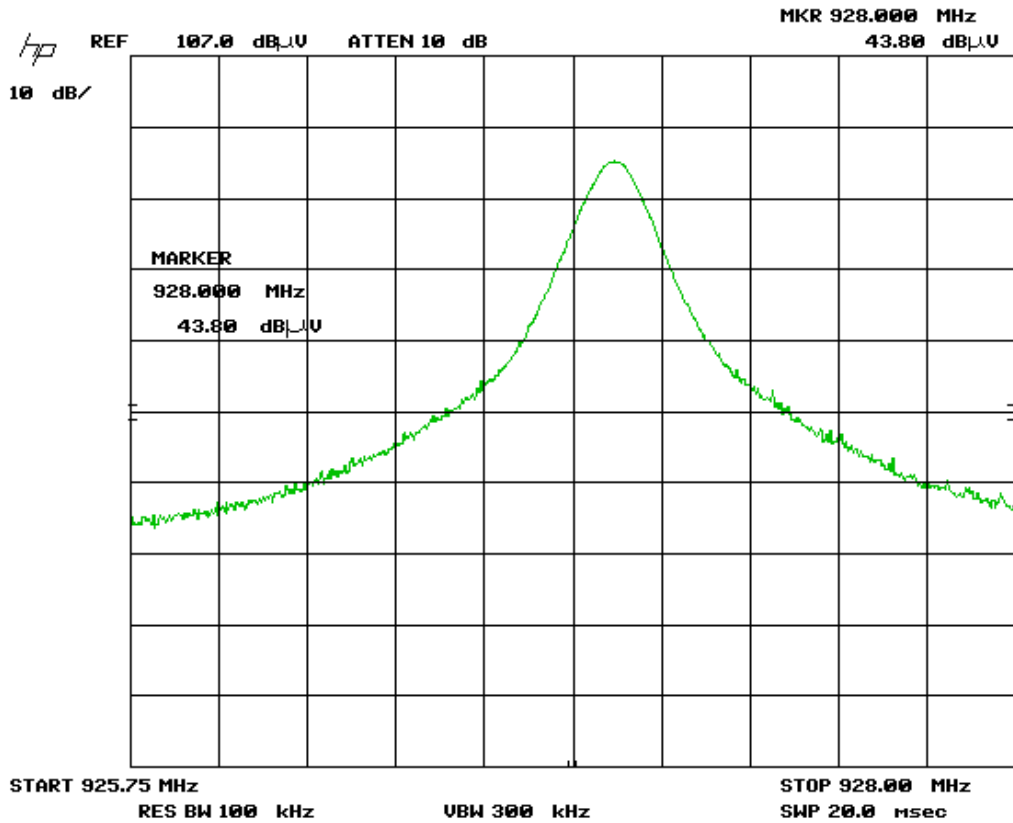
Fundamental - Low Channel
Vertical - Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw data. See table on page 34 for corrected reading.

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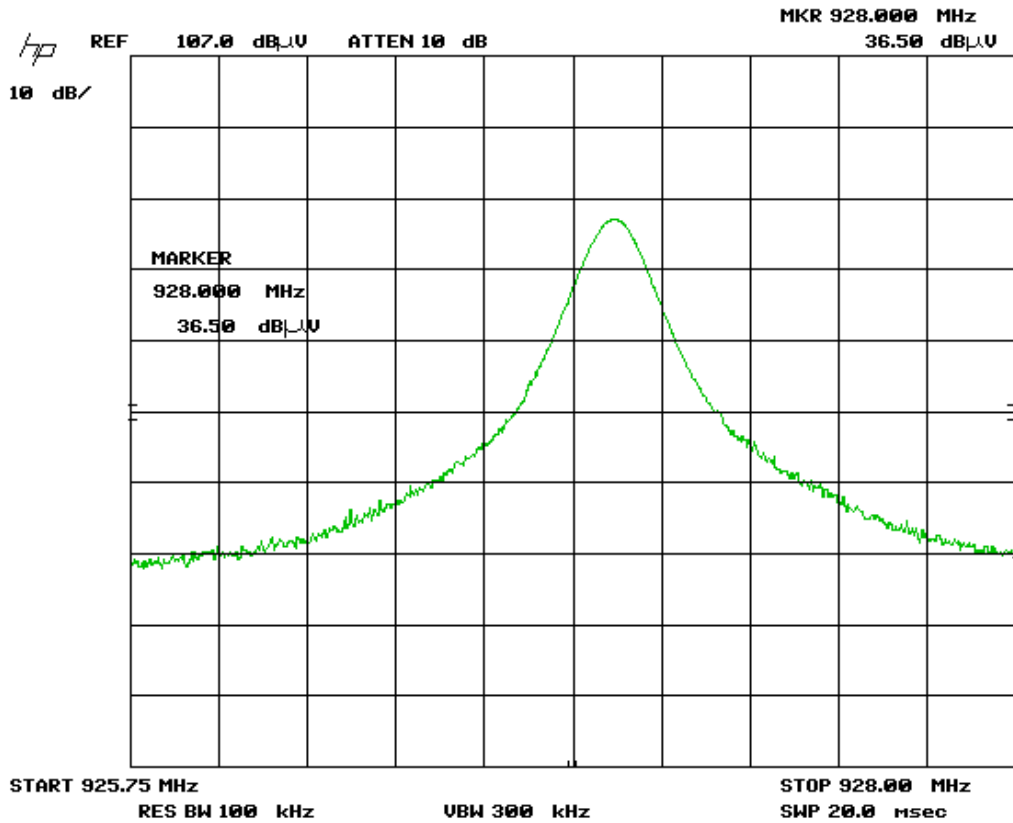
Band Edge – High Channel
Vertical - Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw data. See table on page 34 for corrected reading.

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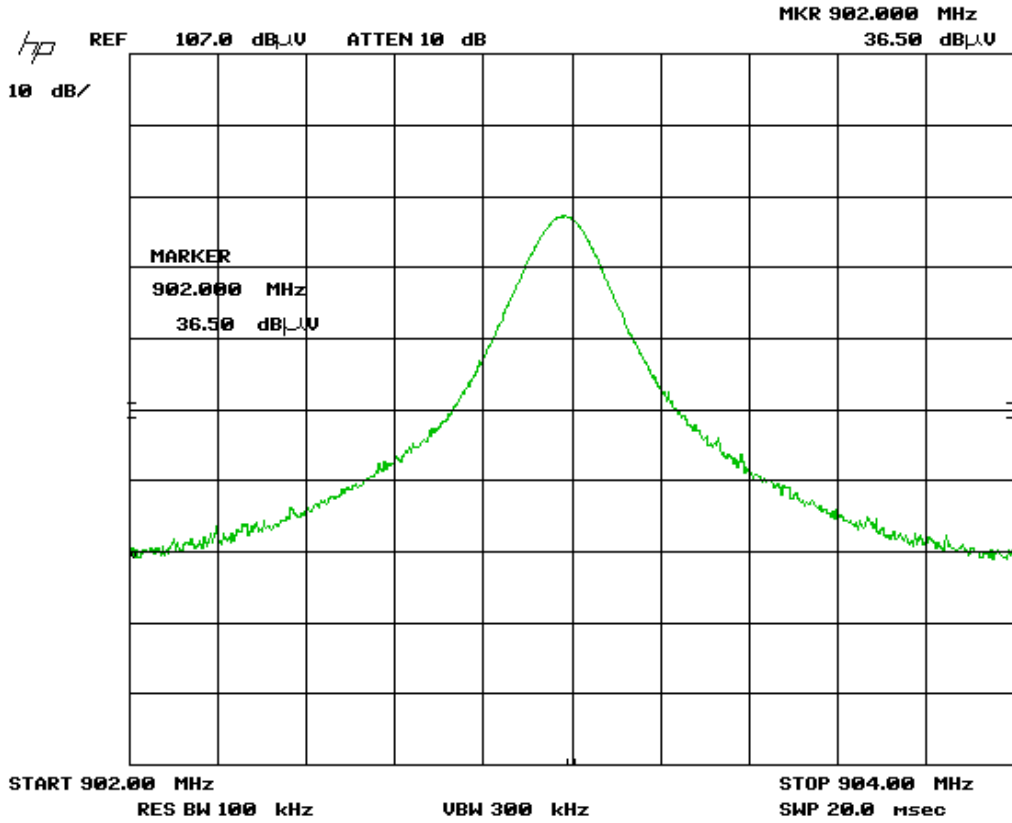
Band Edge – High Channel
Horizontal - Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw data. See table on page 34 for corrected reading.

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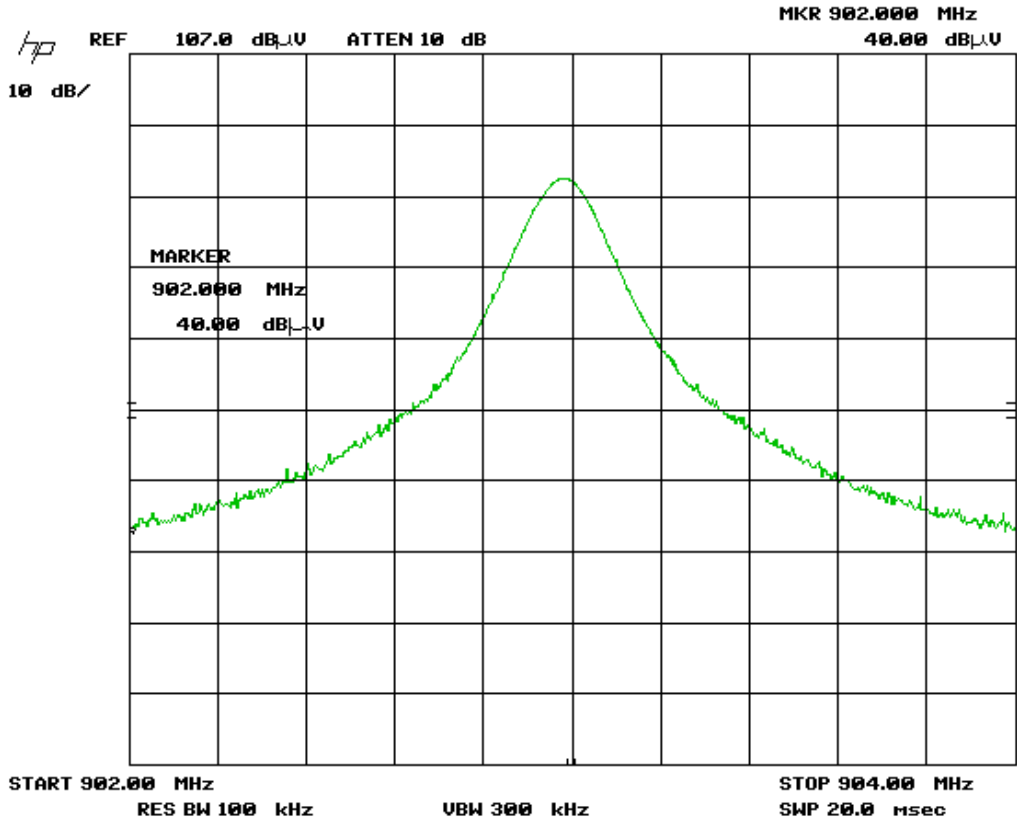
Band Edge – Low Channel
Vertical - Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw data. See table on page 34 for corrected reading.

Client	Ecobee Inc	
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Band Edge – Low Channel
Horizontal - Peak Emission



Measurements were taken at 3 m measurement distance. Marker readings are raw data. See table on page 34 for corrected reading.


Client	Ecobee Inc	
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Final Measurements and Results


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

The device contains three transmitters; the current 15.247 device operating 802.11B, G, and N protocols, a 15.249 device operation in the 902 MHz to 928 MHz frequency range, and a modularly certified 15.247 2.4 GHz frequency hopping device with FCC ID: W7Z-ZICM357SP2. Antenna co-location testing was performed on the device verify compliance with 15.209 radiated emission requirements. The device complies with radiated emission requirements with all three transmitters transmitting at 100% duty cycle and maximum power setting.

Emissions Table - Vertical										
Freq (MHz)	Detector	Raw (dBuV)	Antenna Factor (dB/m)	Attenuator Factor (dB)	Cable RE Factor (dB)	Pre-Amp (dB)	Level (dBuV /m)	Limit (dB)	Margin (dB)	Pass/Fail
498.51	QP	45.4	17.6	3	1.7	-28.9	38.8	46.4	7.6	Pass
830.929	QP	33.7	21.9	3	2.2	-28.8	32	46.4	14.4	Pass
Emissions Table - Horizontal										
498.51	QP	43.2	18	3	1.7	-28.9	37	46.4	9.4	Pass
831.123	QP	31.32	22.8	3	2.2	-28.8	30.52	46.4	15.88	Pass
1922	Peak	53.4	29.5	0	3.4	-36.3	50	54	4	Pass
1162.33	Peak	53.8	25.5	0	2.6	-36.9	45	54	9	Pass

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Project Name / Number		Athena 15.249										
Test Frequency (MHz)	Detection mode (Q-Peak)	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB	Attenuator dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result	
903 MHz - Y-Axis												
903	Peak	Vert	85.4	22.7	2.4	3.0	28.6	85.0	94.0	9.0	PASS	
903	Peak	Horz	87.5	23.8	2.4	3.0	28.6	88.2	94.0	5.8	PASS	
903 MHz X-Axis												
903	Peak	Vert	87.7	22.7	2.4	3.0	28.6	87.3	94.0	6.7	PASS	
903	Peak	Horz	85.4	23.8	2.4	3.0	28.6	86.1	94.0	7.9	PASS	
903 MHz Z-Axis												
903	Peak	Vert	84.3	22.7	2.4	3.0	28.6	83.9	94.0	10.1	PASS	
903	Peak	Horz	89.5	23.8	2.4	3.0	28.6	90.2	94.0	3.8	PASS	
902	Peak	Vert	36.5	23.8	2.4	3.0	28.6	37.2	46.0	8.8	PASS	
902	Peak	Horz	40.0	23.8	2.4	3.0	28.6	40.7	46.0	5.3	PASS	
903 MHz - Y-Axis												
902	Peak	Vert	37.7	22.7	2.4	3.0	28.6	37.3	46.0	8.7	PASS	
902	Peak	Horz	39.0	22.7	2.4	3.0	28.6	38.6	46.0	7.4	PASS	
1806	Peak	Vert	48.9	28.3	3.5	0.0	36.3	44.4	74.0	29.6	PASS	
1806	Average	Vert	37.1	28.3	3.5	0.0	36.3	32.6	54.0	21.4	PASS	
1806	Peak	Horz	49.1	29.4	3.5	0.0	36.3	45.7	74.0	28.3	PASS	
1806	Average	Horz	36.3	29.4	3.5	0.0	36.3	32.9	54.0	21.1	PASS	
2709	Peak	Vert	46.6	30.9	4.4	0.0	36.1	45.7	74.0	28.3	PASS	
2709	Average	Vert	34.2	30.9	4.4	0.0	36.1	33.3	54.0	20.7	PASS	
2709	Peak	Horz	46.1	30.9	4.4	0.0	36.1	45.2	74.0	28.8	PASS	
2709	Average	Horz	37.3	30.9	4.4	0.0	36.1	36.4	54.0	17.6	PASS	
915 MHz Y-Axis												
915	Peak	Vert	85.3	22.7	2.4	3.0	28.6	84.9	94.0	9.1	PASS	
915	Peak	Horz	91.9	23.8	2.4	3.0	28.6	92.6	94.0	1.4	PASS	
915 MHz X-Axis												
915	Peak	Vert	90.1	22.7	2.4	3.0	28.6	89.7	94.0	4.3	PASS	
915	Peak	Horz	83.3	23.8	2.4	3.0	28.6	84.0	94.0	10.0	PASS	
915 MHz Z-Axis												
915	Peak	Vert	87.6	22.7	2.4	3.0	28.6	87.2	94.0	6.8	PASS	
915	Peak	Horz	92.2	23.8	2.4	3.0	28.6	92.9	94.0	1.1	PASS	
927 MHz X-Axis												
927	Peak	Vert	93.0	22.7	2.4	3.0	28.6	92.6	94.0	1.4	PASS	
927	Peak	Horz	84.1	23.8	2.4	3.0	28.6	84.8	94.0	9.2	PASS	
928	Peak	Vert	45.3	22.7	2.4	3.0	28.6	44.9	46.0	1.1	PASS	
928	Peak	Horz	37.6	22.7	2.4	3.0	28.6	37.2	46.0	8.8	PASS	
927 MHz Z-Axis												
927	Peak	Vert	89.6	22.7	2.4	3.0	28.6	89.2	94.0	4.8	PASS	
927	Peak	Horz	90.1	23.8	2.4	3.0	28.6	90.8	94.0	3.2	PASS	
927 MHz Y-Axis												
927	Peak	Vert	86.4	22.7	2.4	3.0	28.6	86.0	94.0	8.0	PASS	
927	Peak	Horz	92.4	23.8	2.4	3.0	28.6	93.1	94.0	0.9	PASS	
928	Peak	Vert	40.5	22.7	2.4	3.0	28.6	40.1	46.0	5.9	PASS	
928	Peak	Horz	43.8	22.7	2.4	3.0	28.6	43.4	46.0	2.6	PASS	
1854	Peak	Vert	48.7	28.3	3.5	0.0	36.3	44.2	74.0	29.8	PASS	
1854	Average	Vert	36.6	28.3	3.5	0.0	36.3	32.1	54.0	22.0	PASS	
1854	Peak	Horz	48.6	29.4	3.5	0.0	36.3	45.2	74.0	28.8	PASS	
1854	Average	Horz	36.2	29.4	3.5	0.0	36.3	32.8	54.0	21.2	PASS	
2781	Peak	Vert	46.6	30.9	4.4	0.0	36.1	45.7	74.0	28.3	PASS	
2781	Average	Vert	34.2	30.9	4.4	0.0	36.1	33.3	54.0	20.7	PASS	
2781	Peak	Horz	46.1	30.9	4.4	0.0	36.1	45.2	74.0	28.8	PASS	
2781	Average	Horz	37.3	30.9	4.4	0.0	36.1	36.4	54.0	17.6	PASS	

Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	2013-01-22	2015-01-22	GEMC169
Quasi Peak Adapter	85650A	HP	2013-01-23	2015-01-23	GEMC170
Loop Antenna	EM 6871	Electro-Metrics	Feb 5, 2013	Feb 5, 2015	GEMC 70
Loop Antenna	EM 6872	Electro-Metrics	Feb 5, 2013	Feb 5, 2015	GEMC 71
BiLog Antenna	3142-C	ETS	Feb 4, 2013	Feb 4, 2015	GEMC 137
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	GEMC 40
9kHz-1GHz, preamp	LNA 6901	Teseq	2013-02-25	2015-02-25	GEMC168
Q-Par 1.5-18 GHz Horn	6878/24	Q-par	8/23/2012	8/23/2014	GEMC 6365
1-26G pre-amp	HP 8449B	HP	8/22/2012	8/22/2014	GEMC 6351
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev1.doc"

Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


20 dB Bandwidth Measurement – 15.249

15.215 c) intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

Test Results

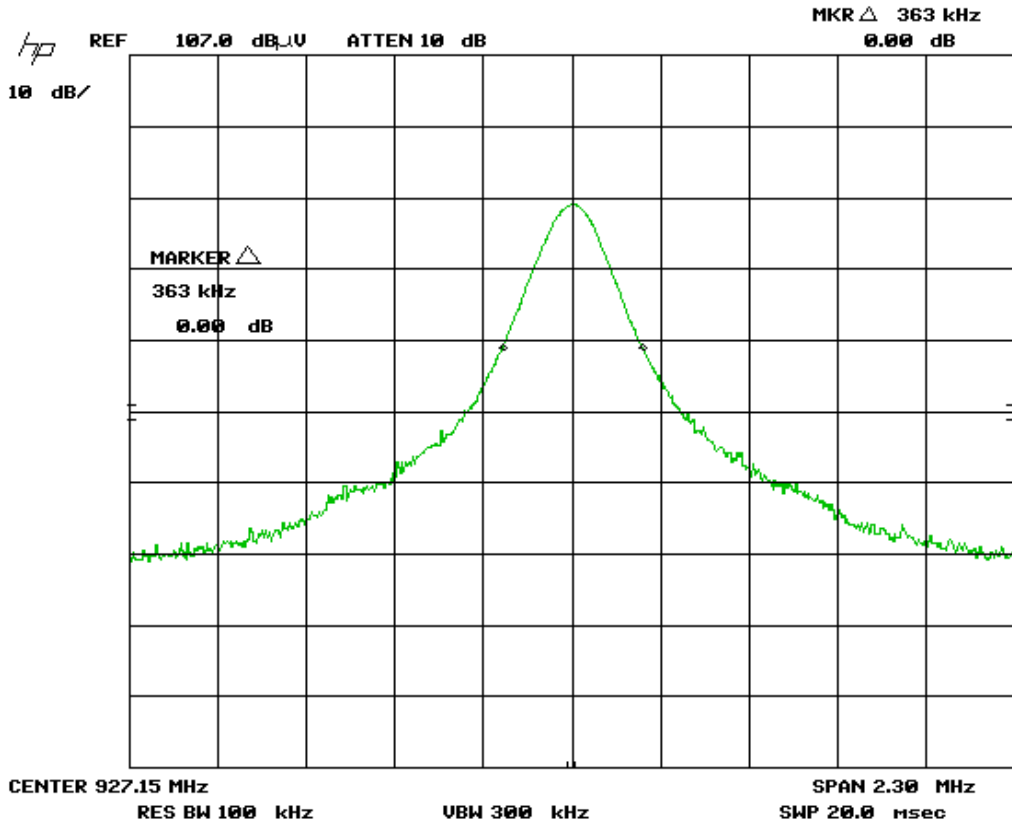
The EUT passed. The 20 dB BW was wholly contained within the 15.249 emission band of 902 - 928 MHz.


Channel Frequency (MHz)	20dB Measured Bandwidth (kHz)
927	363

Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

20 dB Bandwidth measurement graph

The graph below shows the 20 dB bandwidth 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 20 dB bandwidth of a channel during operation of the EUT. This measurement is a peak measurement. Max hold is performed for a duration of not less than 1 minute.




Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Test Equipment

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	2013-01-22	2015-01-22	GEMC169
Quasi Peak Adapter	85650A	HP	2013-01-23	2015-01-23	GEMC170
BiLog Antenna	3142-C	ETS	Feb 4, 2013	Feb 4, 2015	GEMC 137
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	GEMC 40
9kHz-1GHz, preamp	LNA 6901	Teseq	2013-02-25	2015-02-25	GEMC168
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev1.doc"

Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

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 & Method

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


Method is as defined in ANSI C64:2003

Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

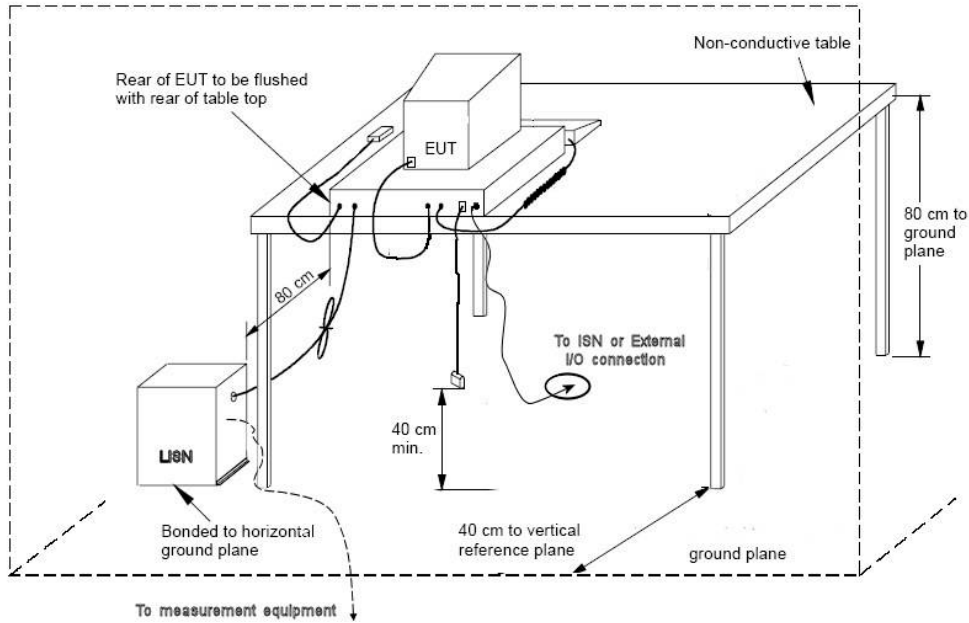
The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth.

Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Typical Setup Diagram




Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ± 3.6 dB with a 'k=2' coverage factor and a 95% confidence level.

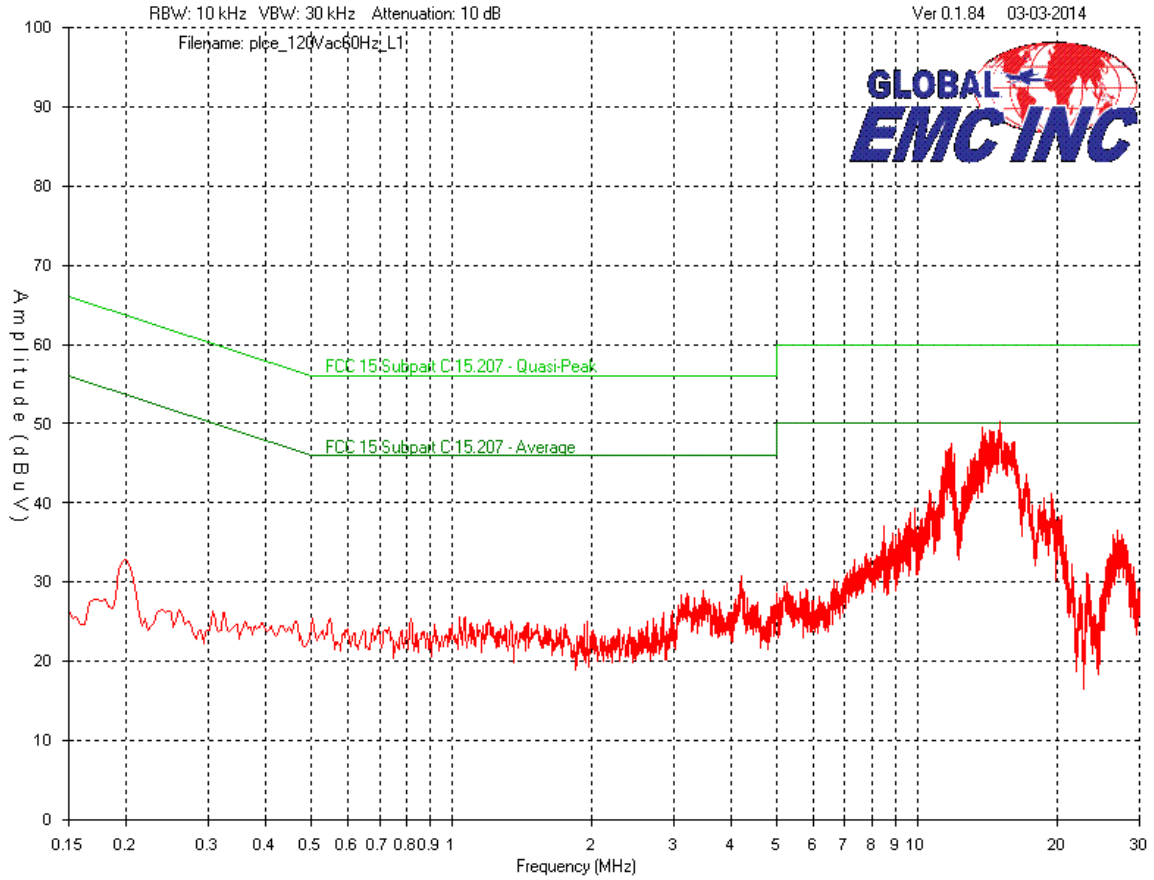
Preliminary Graphs


Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector where applicable, please refer to the table. The graph shown below is a peak measurement graph, measured with a resolution bandwidth greater than or equal to the final required detector. These graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings.

Power line conducted emissions were performed with both transmitters transmitting at 100% duty cycle.

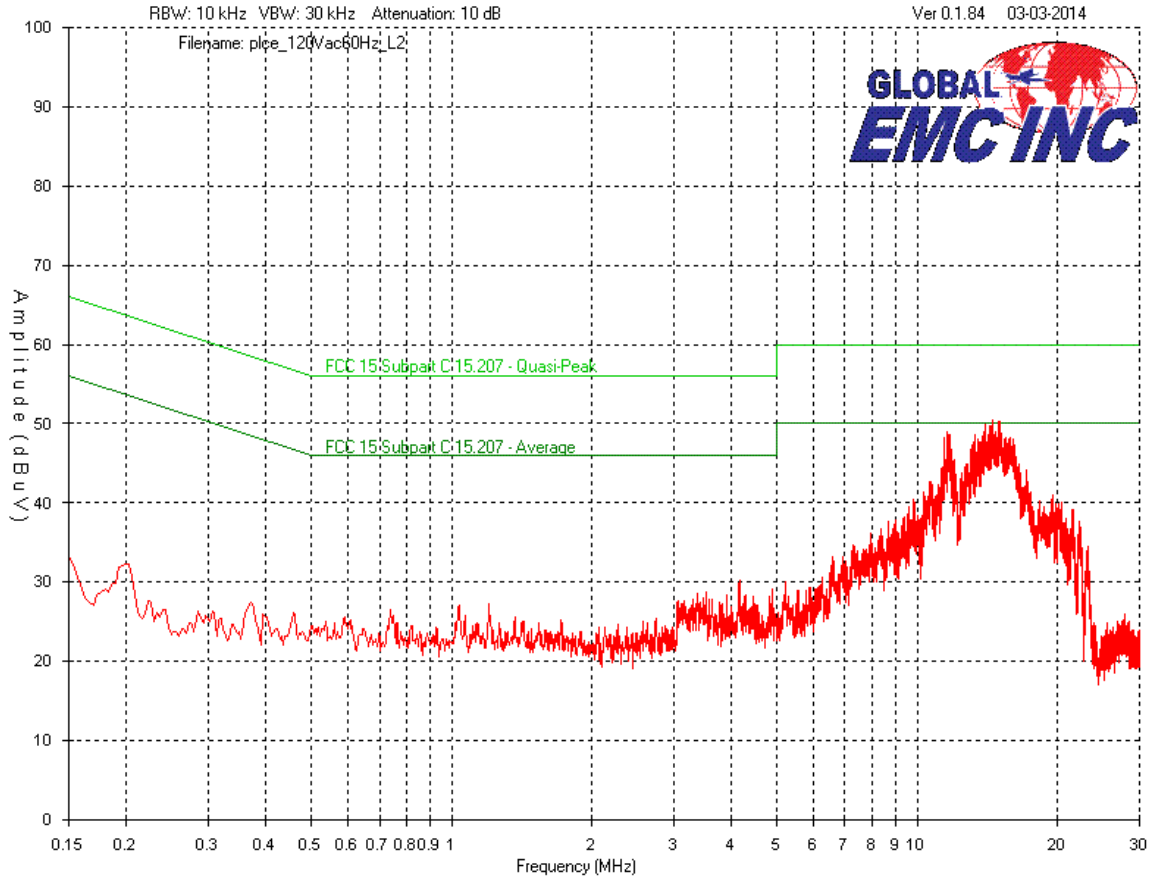
Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	


L1(Line) – 120Vac 60Hz



Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

L2 (Neutral) – 120Vac 60Hz




Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Final Measurements

Product Category		Class B						
Product		Athena						
Supply		120 VAC 60 Hz						
L1 (Line) - Average								
Frequency (MHz)	Raw (dBuV)	Atten Factor (dB)	Cable Loss (dB)	LISN Factor (dB)	Level (dBuV)	Limit (dB)	Margin (dB)	Pass/Fail
15.0517	30.57	10	0.2	0.2	40.97	50	9.03	Pass
13.7988	29.82	10	0.2	0.1	40.12	50	9.88	Pass
14.37	30.57	10	0.2	0.1	40.87	50	9.13	Pass
13.7224	29.17	10	0.2	0.1	39.47	50	10.53	Pass
11.8946	27.47	10	0.2	0.1	37.77	50	12.23	Pass
11.5589	27.12	10	0.2	0.1	37.42	50	12.58	Pass
L2 (Neutral) - Average								
14.5532	31.39	10	0.2	0.2	41.79	50	8.21	Pass
11.6387	29.53	10	0.2	0.1	39.83	50	10.17	Pass
13.97	31.39	10	0.2	0.1	41.69	50	8.31	Pass
11.436	28.23	10	0.2	0.1	38.53	50	11.47	Pass
11.5689	29.32	10	0.2	0.1	39.62	50	10.38	Pass
14.37	31.3	10	0.2	0.1	41.6	50	8.4	Pass

Notes:


1. No peak emissions exceeded power line conducted emission quasi-peak limits; therefore, the unit was deemed to meet power line conducted emission quasi-peak requirements base on peak emissions.
2. Power line conducted emissions was performed on the 24 Vac transformer.
3. See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up for the highest line conducted emission

Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL 6	Rohde & Schwarz	15-Nov-13	15-Nov-15	GEMC 160
LISN	FCC-LISN-50/250-16-2-01	FCC	2013-02-06	2015-02-06	GEMC 65
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Maximum Permissible Exposure

Purpose

The purpose of this test is to ensure that the RF energy intentionally transmitted, in terms of power density emitted from the EUT at a stated operating distance does not exceed the limits listed below as defined in the applicable test standard, as calculated based upon readings obtained during testing. This helps protect human exposure to excessive RF fields.

Limit(s) and Method

The limits, as defined FCC 1.1310 Table 1 (B) limits for general public exposure was applied. The limits for the frequency ranges 300 MHz to 1.5 GHz was applied. The limits are $f/1500 \text{ mW/cm}^2$. The distance used for calculations was 20 cm, as this is the minimum distance an operator will be from the EUT during normal operation, as stated by the manufacturer.

Results

The EUT passed the requirements. The worst case calculated power density was 0.00012 mW/cm^2 , this is significantly under the 0.618 mW/cm^2 requirement.

Calculations

Method 2 (EIRP)
PCB antenna

$$P_d = \text{EIRP} / (4 * \pi * R^2)$$

Where EIRP = equivalent isotropic radiated power
Where R = 20 cm

The EUT have highest output field strength, 93.1 dBuV, at 927 MHz.

$$\text{EIRP} = E(\text{dBuV/m}) - 95.2$$

$$\text{EIRP} = 93.1 - 95.2$$


$$\text{EIRP} = -2.1 \text{ dBm or } 0.61 \text{ mW}$$

$$P_d = 0.61 \text{ mW} / (4 * \pi * 20\text{cm}^2)$$


$$P_d = 0.61 \text{ mW} / 5026 \text{ cm}^2$$

$$P_d = 0.00012 \text{ mW/cm}^2$$

The limit for 927 MHz is $(927/1500) = 0.618 \text{ mW/cm}^2$

Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Appendix A – EUT Summary


Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

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

General EUT Description

Client	
Organization	Ecobee Inc 477 Richmond Street West, Ste 210 Toronto, ON, Canada M5R 3E7
Contact	Kashif Ahmed
Phone	416 987 1048
Email	kashif@ecobee.com
EUT Details	
EUT Name (for report title)	Athena
EUT Model / SN (if known)	Athena module # EB-STATZBe3-01
FCC ID	WR9EBSTATBe3
Industry Canada #	7981A-EBSTATBe3
Equipment category	Wireless thermostat
EUT is powered using	AC
Input voltage range(s) (V)	24 Vac
Frequency range(s) (Hz)	60 Hz
Rated input current (A)	2 A
Number of power supplies in EUT	1
Transmits RF energy? (describe)	Yes
Basic EUT functionality description	Ecobee 3 thermostat (with Zigbee)

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 & Test Setup Photographs’.

Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

EUT Configuration


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

- Wireless were configured to transmit at 100% duty cycle
- The 15.249 902 – 928 MHz transmitter were configure with the following settings:
v25 (25 kHz channel separation frequency), w3 (max power level).


Operational Setup

These devices are required to be attached to the EUT for its normal operation.

- A debug board was connected to the EUT.

Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Appendix B – EUT and Test Setup Photographs

Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

Note: These photos are for information purposes only. Also refer to PDF files that are separate from this test report.



Illustration 1: EUT external front view


Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	



Illustration 2: EUT external rear view


Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	



Illustration 3: Radiated emission setup – photo 1


Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	



Illustration 4: Radiated emission setup - photo 2



Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	



Illustration 5: Radiated setup - photo 3

Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	

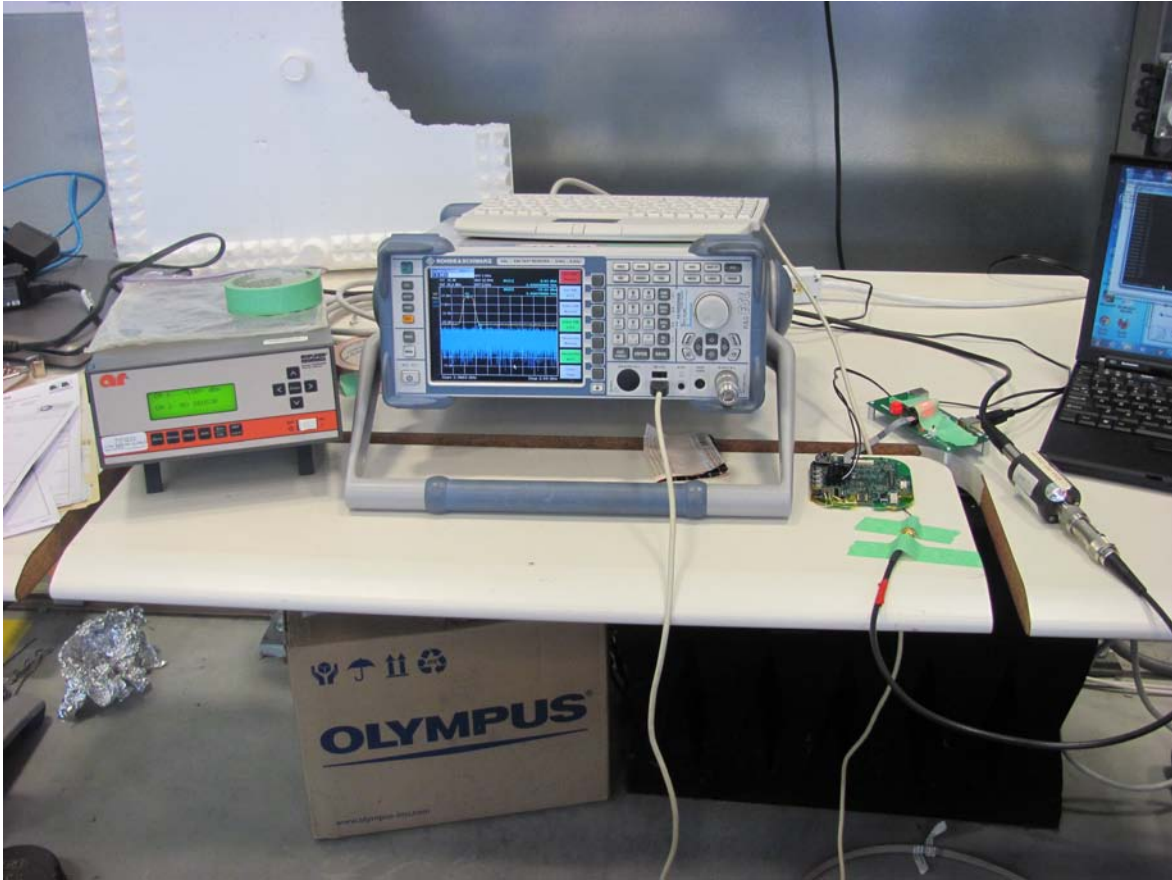


Illustration 6: Antenna conducted emission setup


Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	



Illustration 7: Power line conducted emission setup – photo 1


Client	Ecobee Inc	
Product	Athena	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2014	



Illustration 8: Power line conducted emission – photo 2