

# 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 RS**




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Testing produced for




See Appendix A for full customer & EUT details.



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

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

## Summary

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

EUT FCC Certification #, FCC ID:	WR9EBRSE3
EUT Industry Canada Certification #, IC:	7981A- EBRSE3
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Min Xie


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## ***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	N/A, See Justifications
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
<b>Overall Result</b>			<b>PASS</b>

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 '\*'.

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

For 15.207 power line conducted emissions, the EUT is a battery powered device; thus, this requirement is not applicable.

The unit was tested with a control board which also supply the 3.3VDC for the EUT. A discharged battery was installed in the battery compartment to reflect normal uasage.


For maximum permissible exposure, this device operates at less than 50 mV/m at 3 meters in the 902 – 928 MHz band 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.

Client	<b>Ecobee Inc</b>	
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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 - Aug-19, 2014  
Initial release

Revision 2 - Sept-8, 2014  
Report updated per ACB review.



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## 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 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)
4/24/2014	All	MX	20-24°C	35 - 41%	98 -103kPa

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## Detailed Test Results Section

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

## ***Radiated Emissions of Fundamental***

### **Purpose**

The purpose of this test is to ensure that the RF energy intentionally emitted from the EUT does not exceed the limit listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect other periodic operating devices, and licensed broadcasting devices, and so on, from unwanted interference.


### **Limit(s) and Method**

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

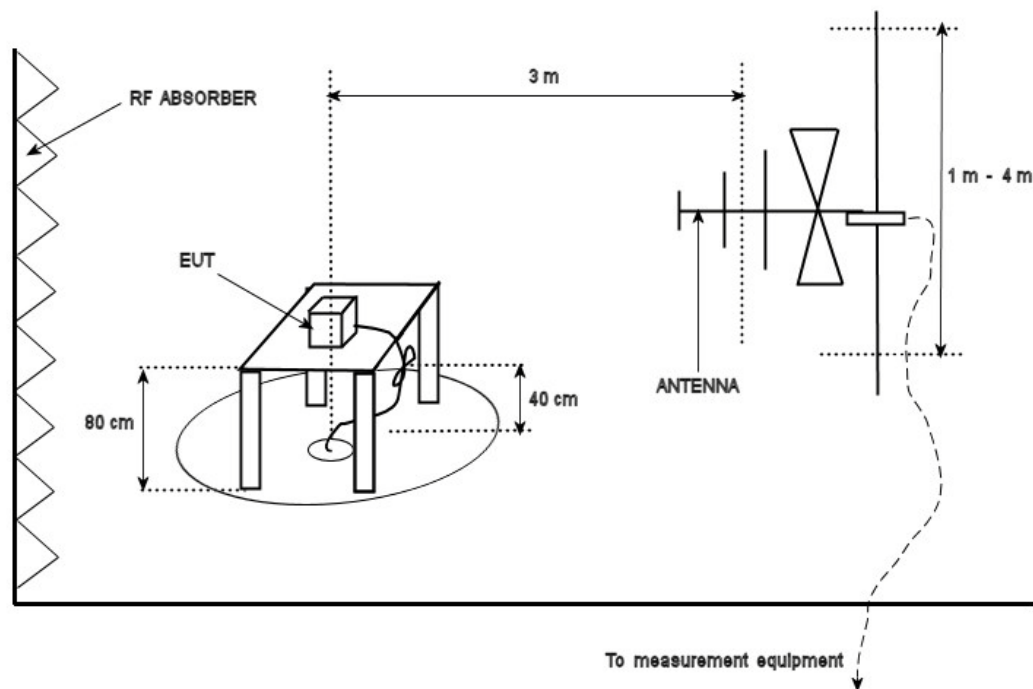
The limits are as specified in FCC Part 15, Section 15.249 (a)

902 MHz to 928 MHz – 50 mV/m (94 dBuV/m)<sup>1</sup> at 3m.

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

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### Typical Radiated Emissions Setup




### Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is  $\pm 4.4$  dB with a 'k=2' coverage factor and a 95% confidence level.

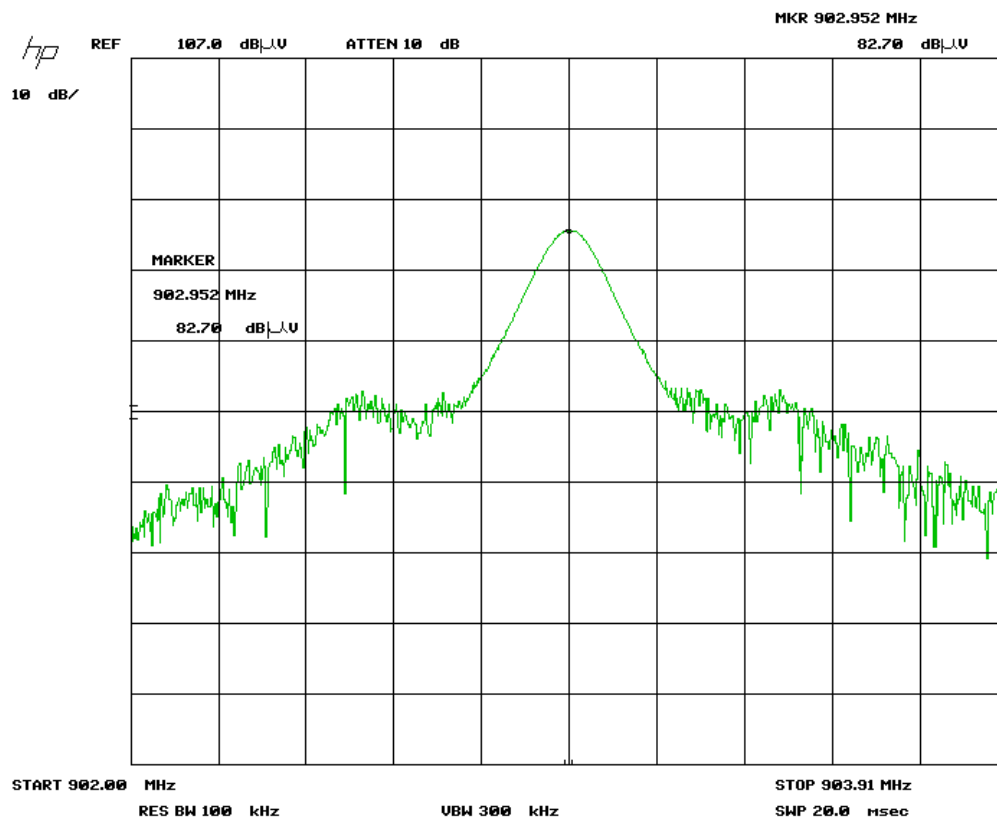
### Preliminary Graphs

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 100 kHz resolution bandwidth, over a full 0-360 rotation and the antenna height was varied from 1 m to 4 m. This peaking process is done as a worst case measurement.


The EUT was mounted in three orthogonal axes to maximize emissions. Worst case results are presented.

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Product	Athena RS	
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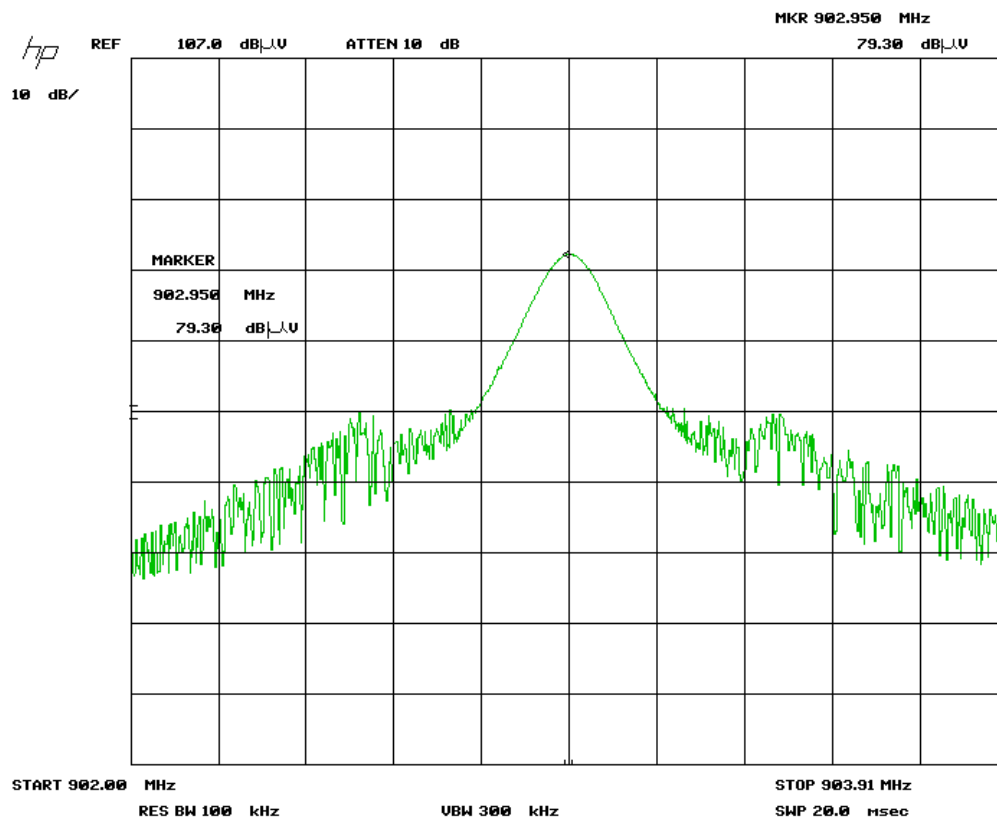
Fundamental – Low Channel  
Horizontal – Peak Emission



Measurements were taken at 3 m measurement distance. Marker readings are raw reading. See Final Measurements section for factor corrected data.


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

Fundamental – Low Channel  
Vertical – Peak Emission

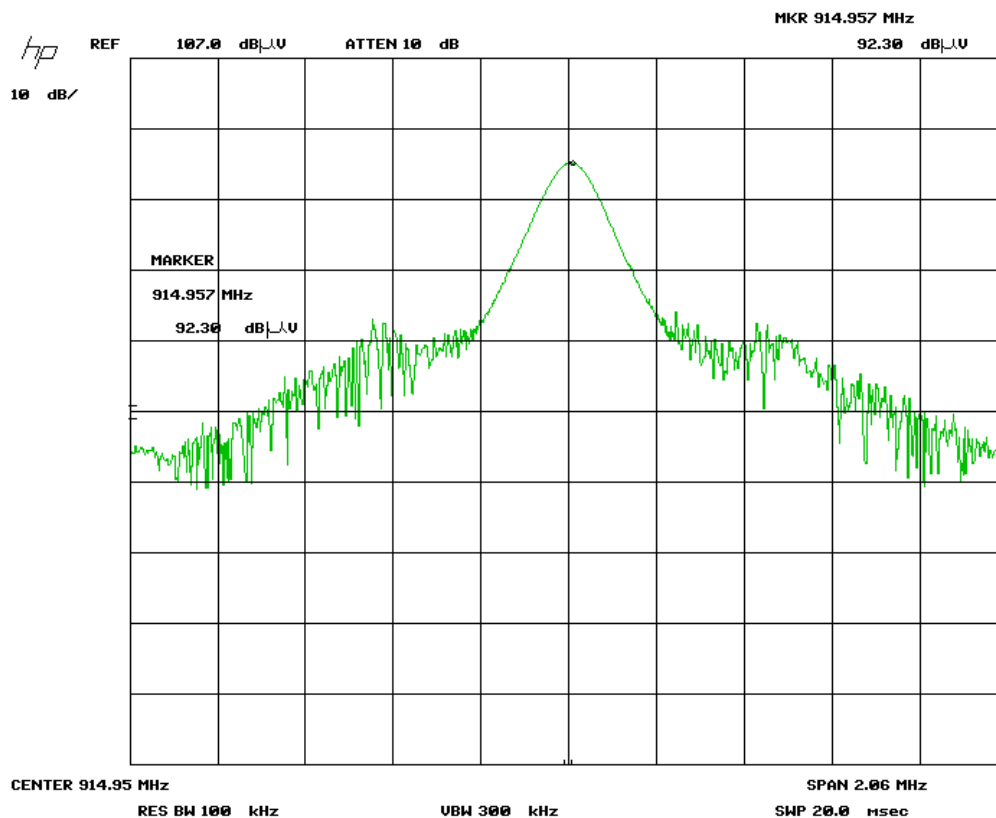


Measurements were taken at 3 m measurement distance. Marker readings are raw reading. See Final Measurements section for factor corrected data.




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

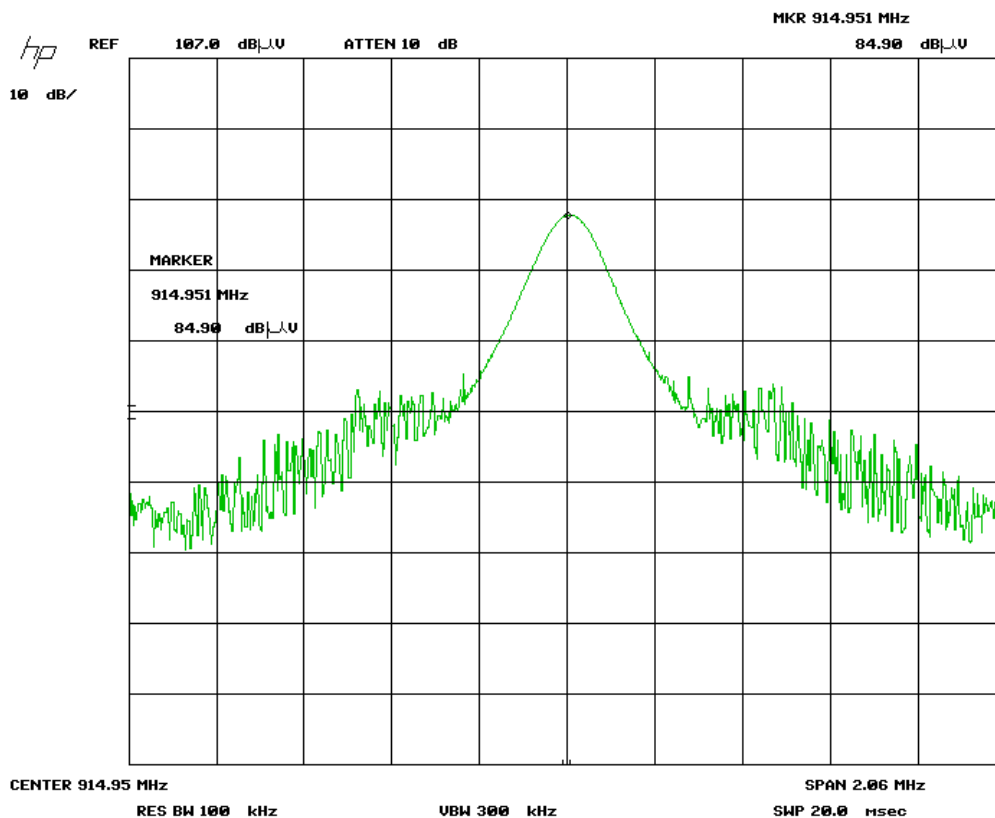
Fundamental – Mid Channel  
Horizontal – Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw reading. See Final Measurements section for factor corrected data.

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

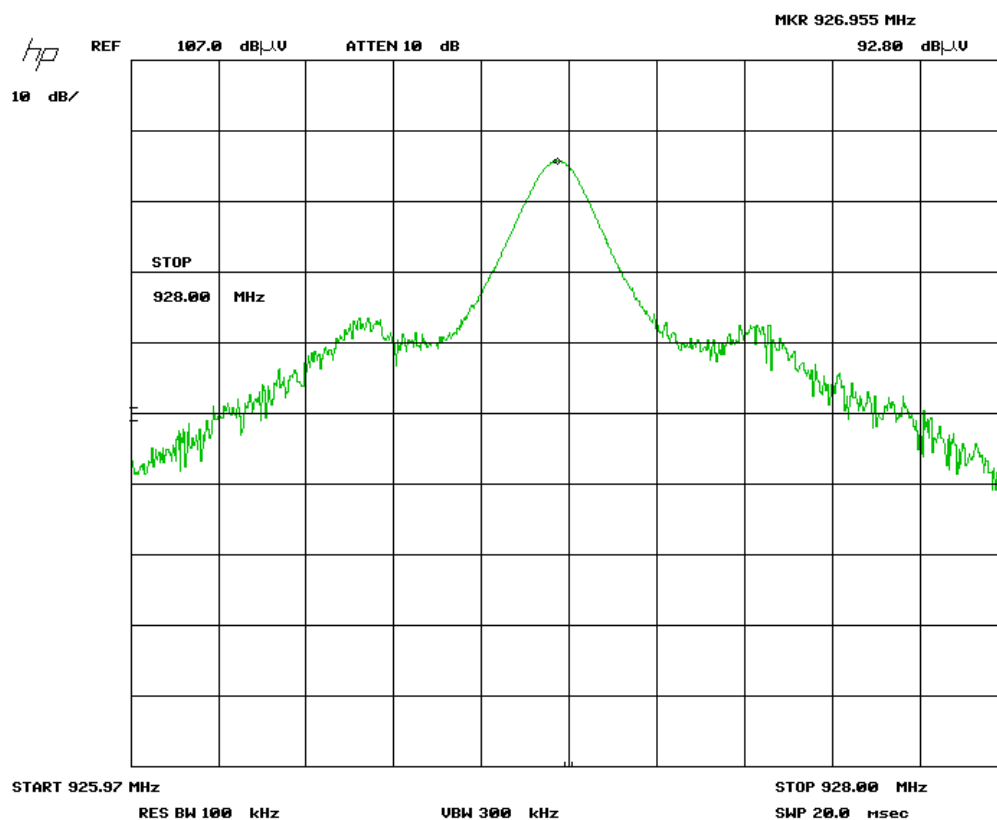
Fundamental – Mid Channel  
Vertical – Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw reading. See Final Measurements section for factor corrected data.

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

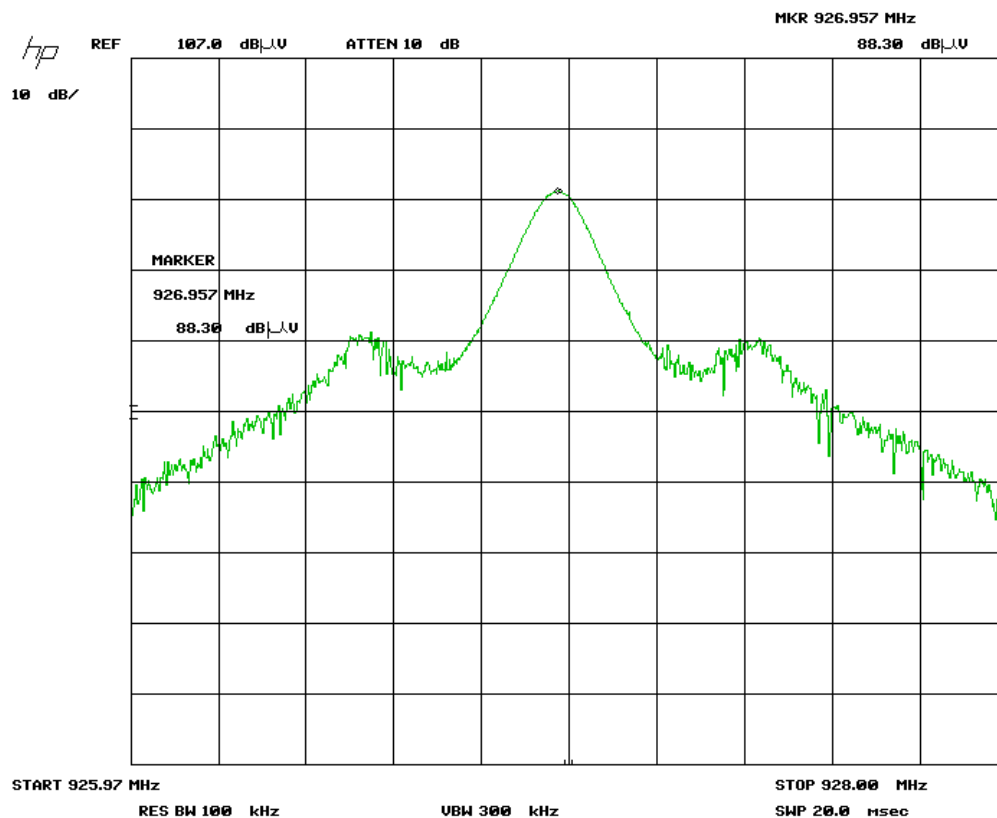
Fundamental – High Channel  
Horizontal – Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw reading. See Final Measurements section for factor corrected data.

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

Fundamental – High Channel  
Vertical – Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw reading. See Final Measurements section for factor corrected data.

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## Final Measurements

Test Frequency (MHz)	Detection mode	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
Low Channel 903 MHz - Y-Axis											
903	Peak	Vert	84.2	22.7	2.4	3.0	28.6	83.7	94.0	10.3	PASS
903	Peak	Horz	79.1	23.8	2.4	3.0	28.6	79.7	94.0	14.3	PASS
Low Channel 903 MHz X-Axis											
903	Peak	Vert	79.3	22.7	2.4	3.0	28.6	78.8	94.0	15.2	PASS
903	Peak	Horz	82.7	23.8	2.4	3.0	28.6	83.3	94.0	10.7	PASS
Low Channel 903 MHz Z-Axis											
903	Peak	Vert	83.9	22.7	2.4	3.0	28.6	83.4	94.0	10.6	PASS
903	Peak	Horz	79.4	23.8	2.4	3.0	28.6	80.0	94.0	14.0	PASS
Mid Channel 915 MHz Y-Axis											
915	Peak	Vert	90.0	22.7	2.4	3.0	28.6	89.5	94.0	4.5	PASS
915	Peak	Horz	85.1	23.8	2.4	3.0	28.6	85.7	94.0	8.3	PASS
Mid Channel 915 MHz X-Axis											
915	Peak	Vert	84.9	22.7	2.4	3.0	28.6	84.4	94.0	9.6	PASS
915	Peak	Horz	92.3	23.8	2.4	3.0	28.6	92.9	94.0	1.1	PASS
Mid Channel 915 MHz Z-Axis											
915	Peak	Vert	90.4	22.7	2.4	3.0	28.6	89.9	94.0	4.1	PASS
915	Peak	Horz	85.2	23.8	2.4	3.0	28.6	85.8	94.0	8.2	PASS
High Channel 927 MHz Y-Axis											
927	Peak	Vert	93.4	22.7	2.4	3.0	28.6	92.9	94.0	1.1	PASS
927	Peak	Horz	87.6	23.8	2.4	3.0	28.6	88.2	94.0	5.8	PASS
High Channel 927 MHz Z-Axis											
927	Peak	Vert	93.2	22.7	2.4	3.0	28.6	92.7	94.0	1.3	PASS
927	Peak	Horz	91.4	23.8	2.4	3.0	28.6	92.0	94.0	2.0	PASS
High Channel 927 MHz X-Axis											
927	Peak	Vert	88.3	22.7	2.4	3.0	28.6	87.8	94.0	6.2	PASS
927	Peak	Horz	92.8	23.8	2.4	3.0	28.6	93.4	94.0	0.6	PASS


**Table 1: Fundamental emissions**

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

## ***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.

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

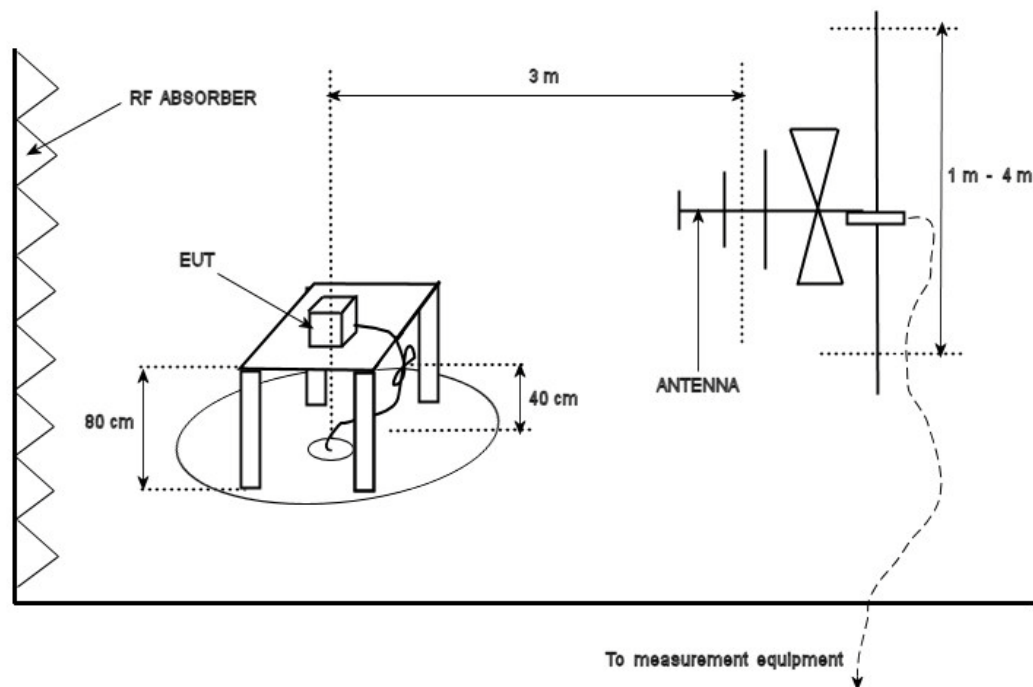
<sup>1</sup>Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1

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

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

Client	Ecobee Inc	
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### Typical Radiated Emissions Setup



### Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is  $\pm 4.4$  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 10<sup>th</sup> harmonic (a minimum of a 10 GHz).

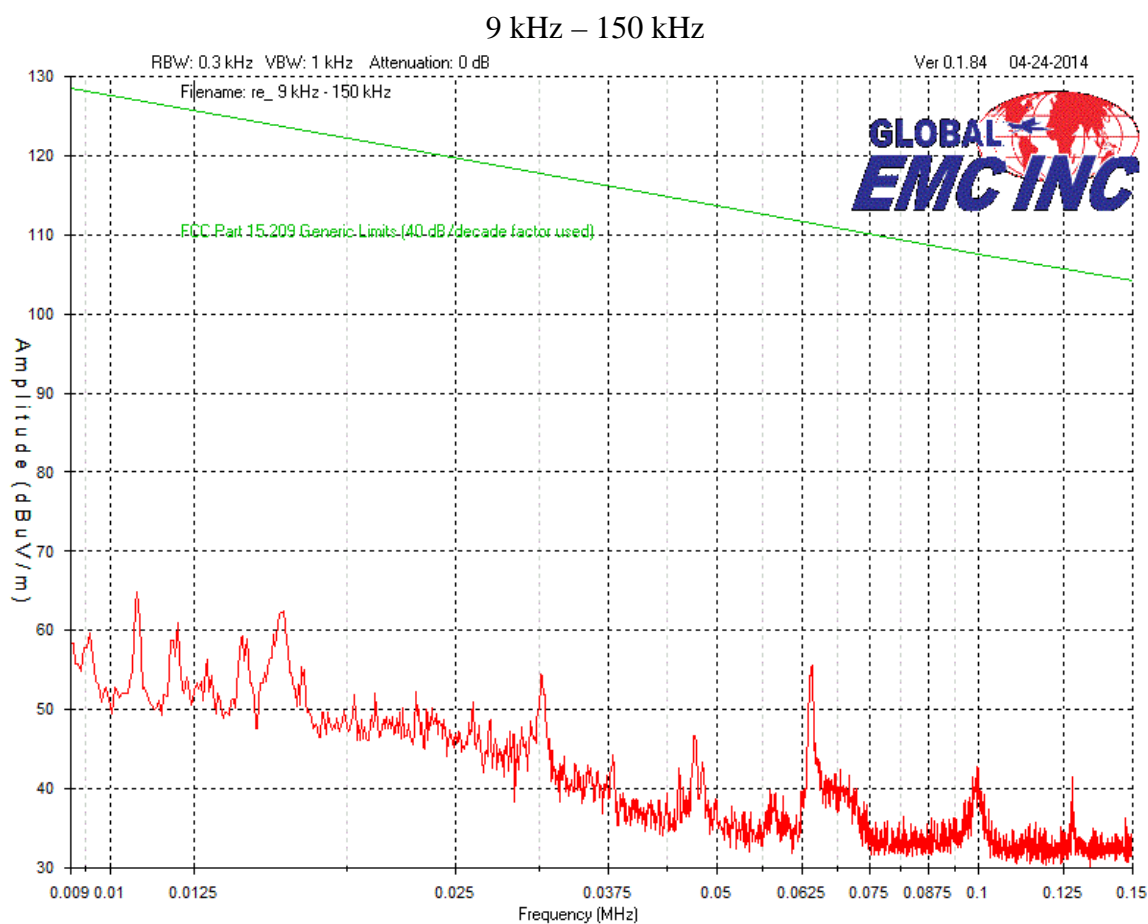
Devices scanned may be scanned at alternate test distances, and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above




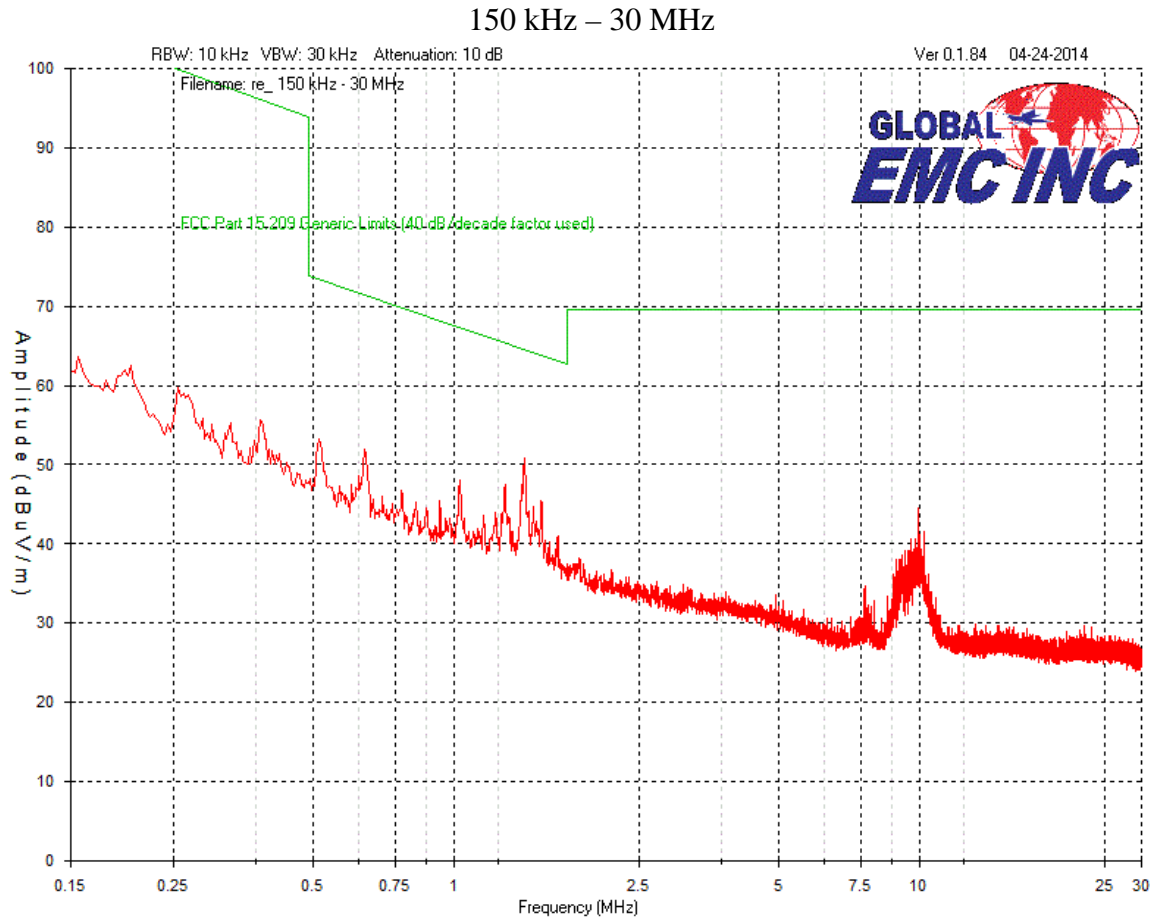
Client	Ecobee Inc	
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30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (3m /1m) is applied.

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

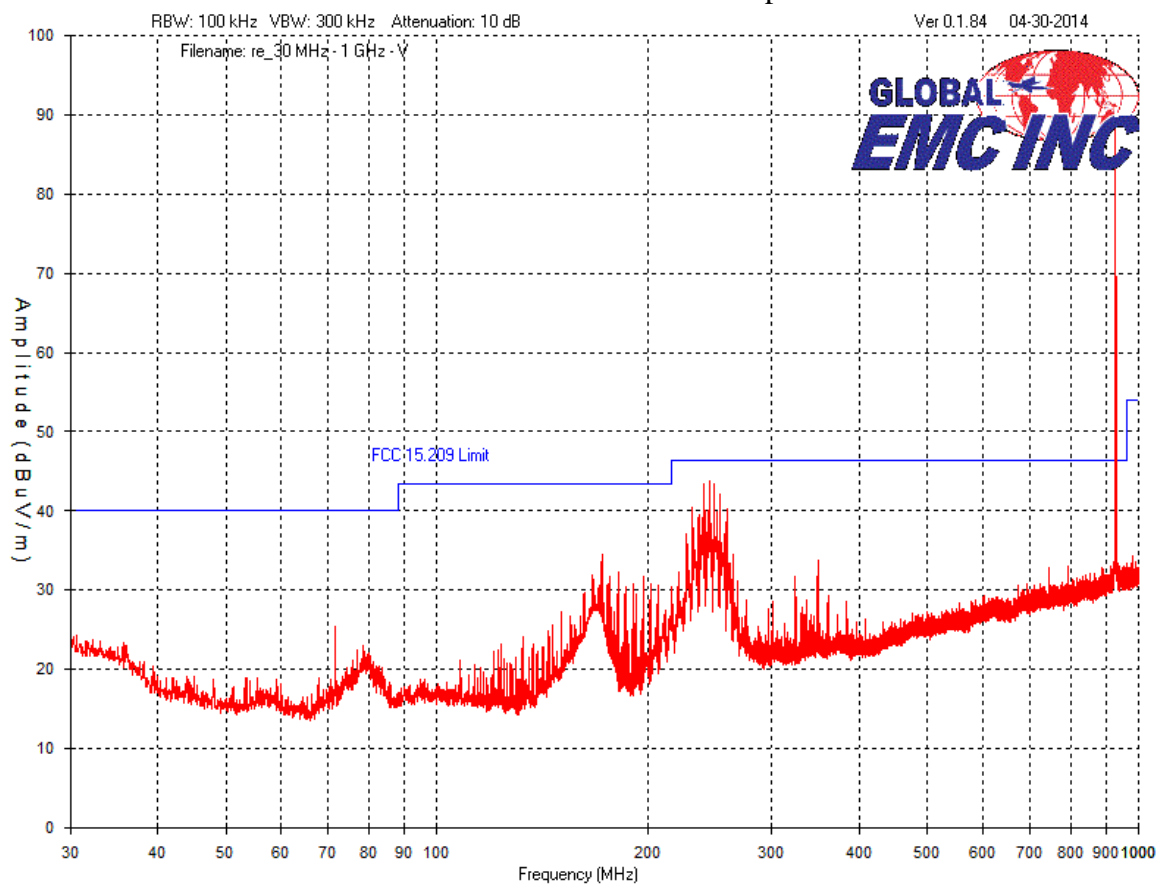


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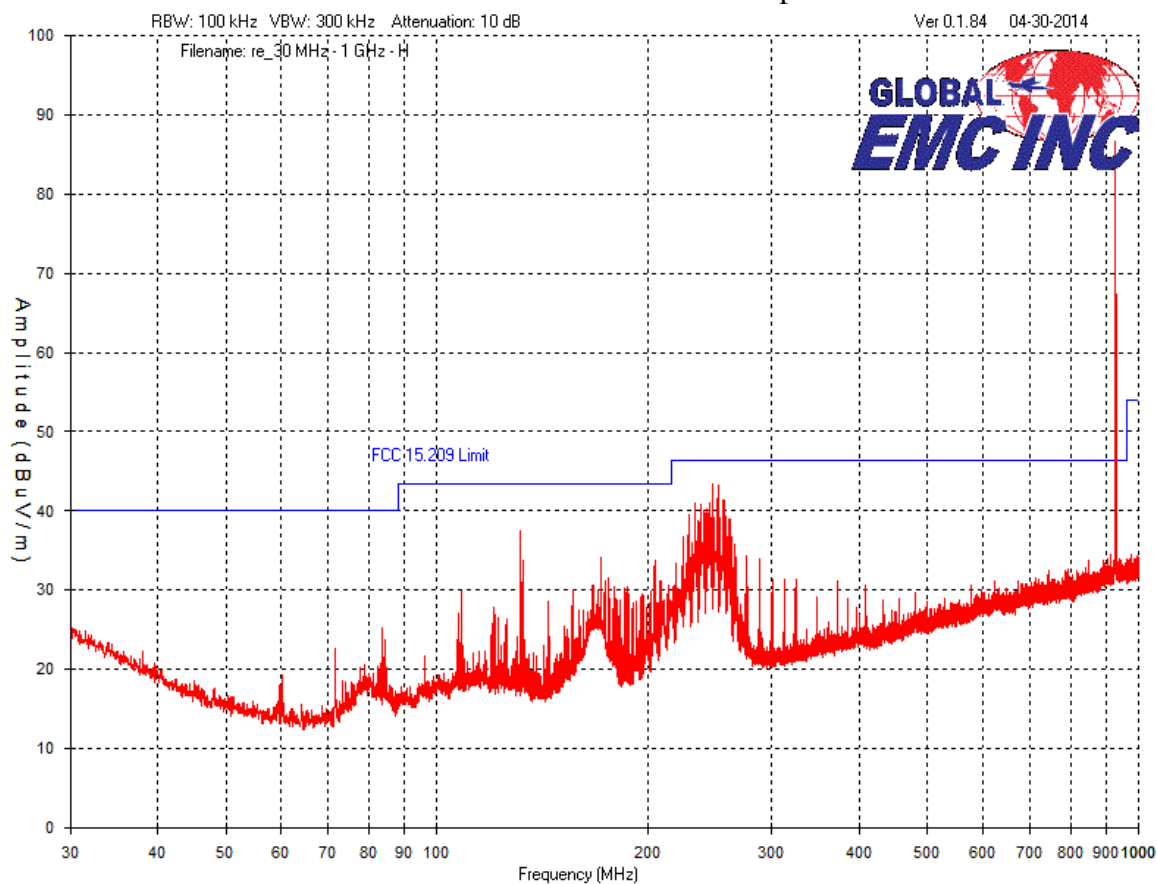
Mid Channel - 30 MHz – 1 GHz  
Vertical – Peak Emission Graph




Note: Emission at 927 MHz is the fundamental frequency of the EUT. See Final Measurements and Results section for numerical results.

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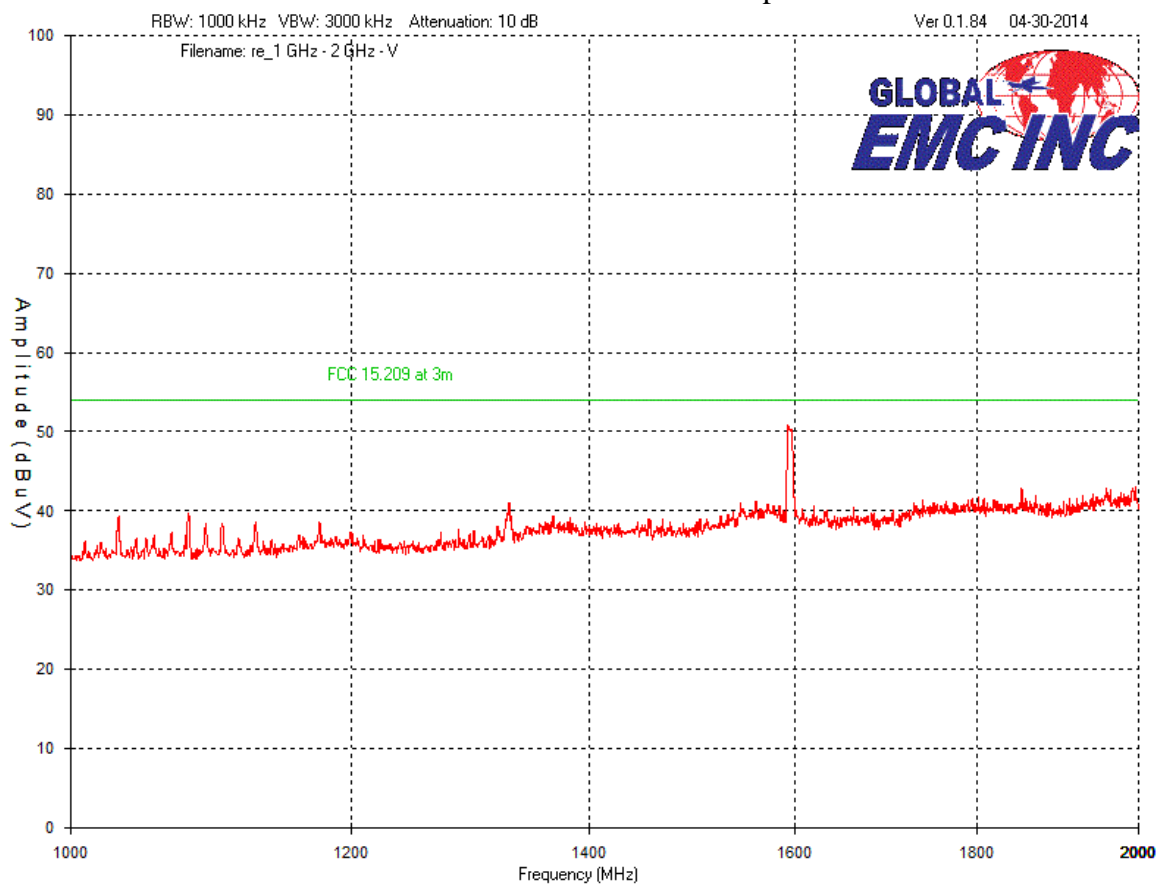
Mid Channel – 30 MHz – 1 GHz  
Horizontal - Peak Emission Graph




Note: Emission at 927 MHz is the fundamental frequency of the EUT. See Final Measurements and Results section for numerical results.

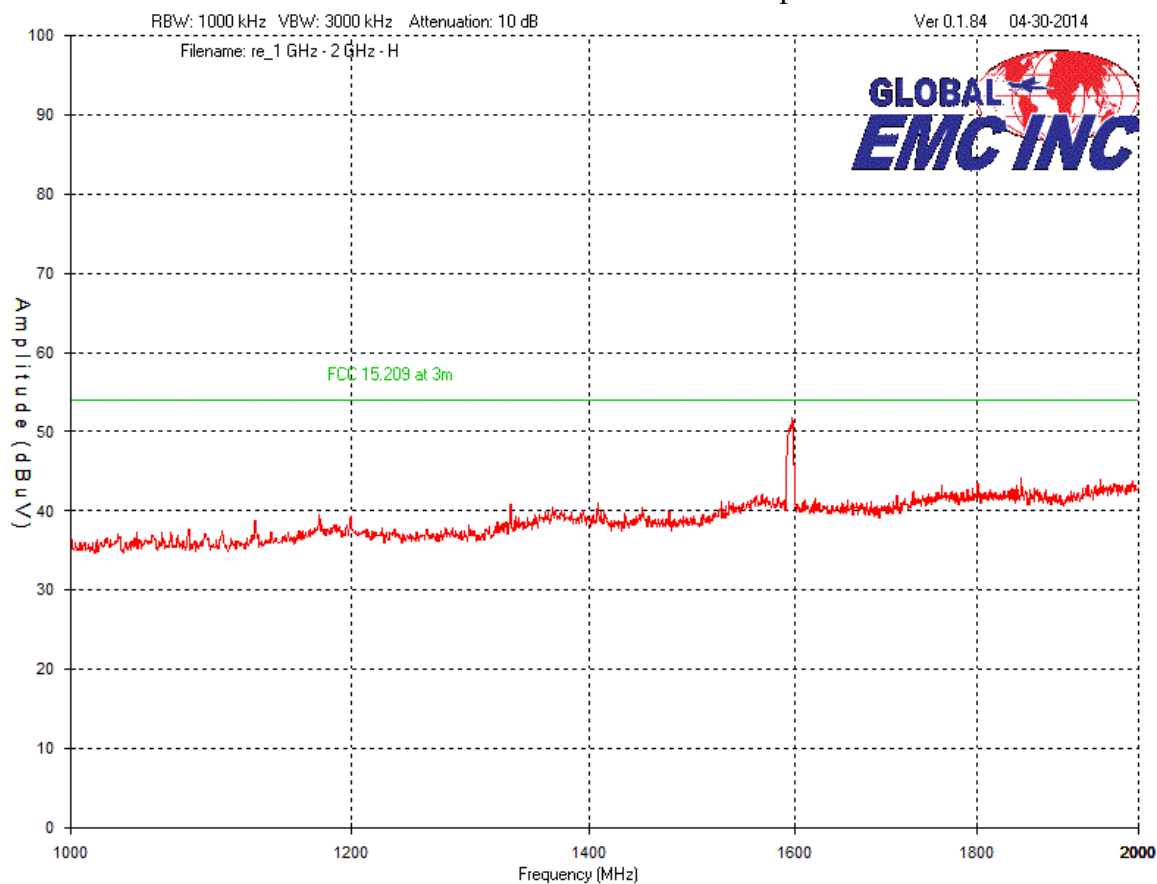
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Mid Channel – 1 GHz – 2 GHz  
Vertical - Peak Emission Graph



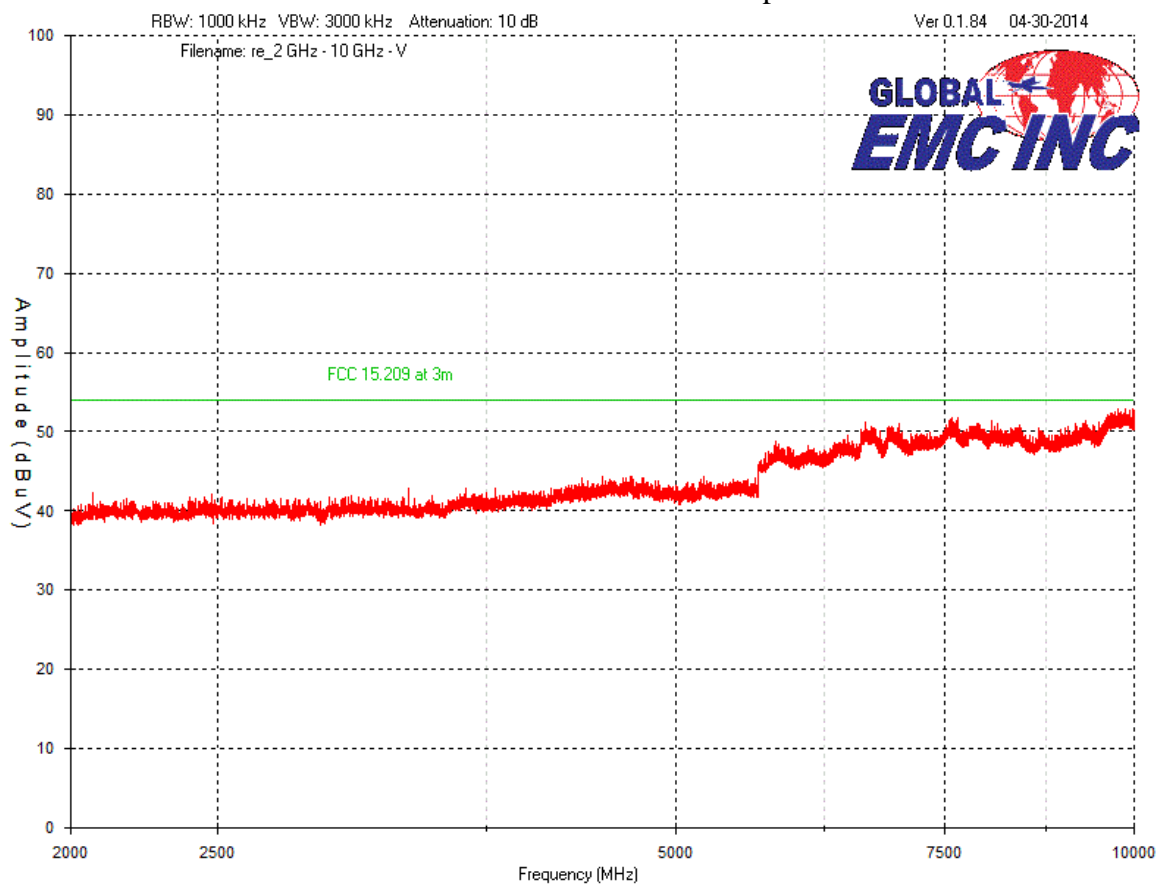
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Mid Channel – 1 GHz – 2 GHz  
Horizontal - Peak Emission Graph



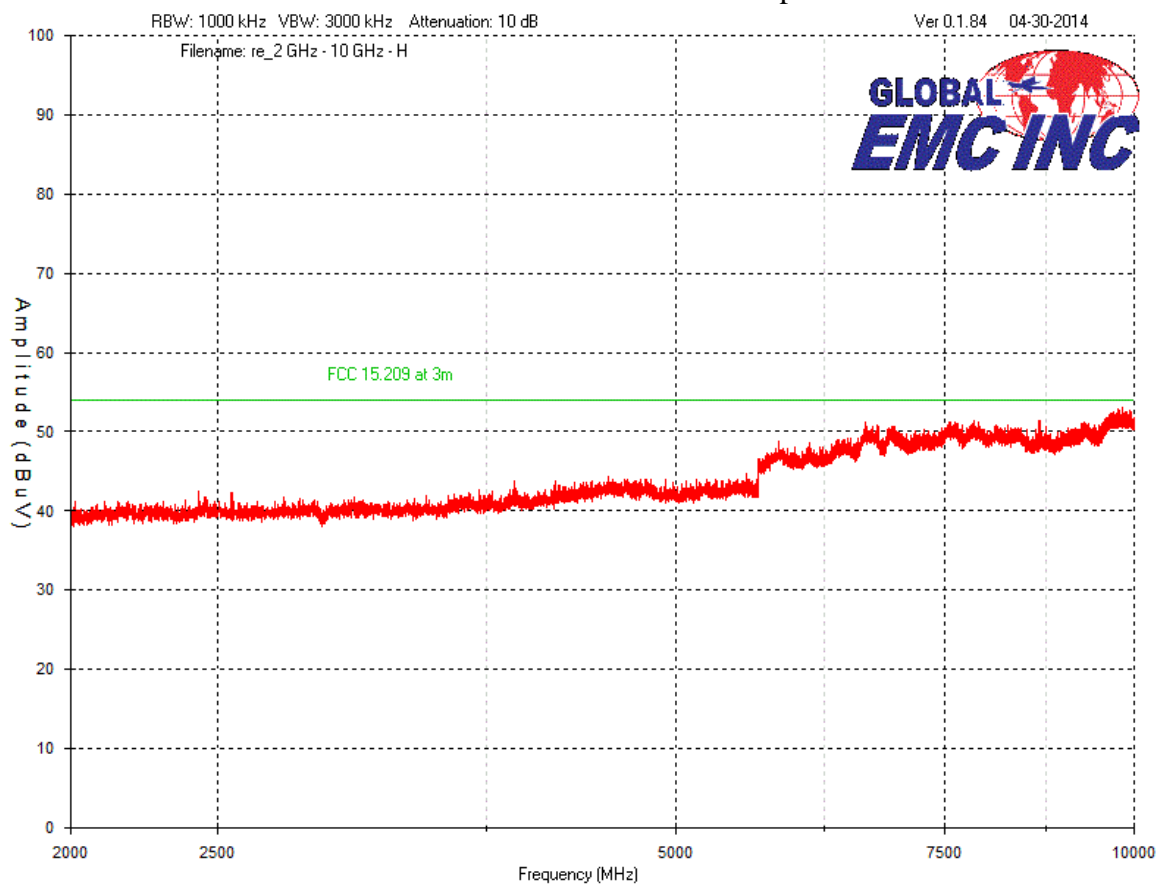
Client	Ecobee Inc	
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Mid Channel – 2 GHz – 10 GHz  
Vertical - Peak Emission Graph




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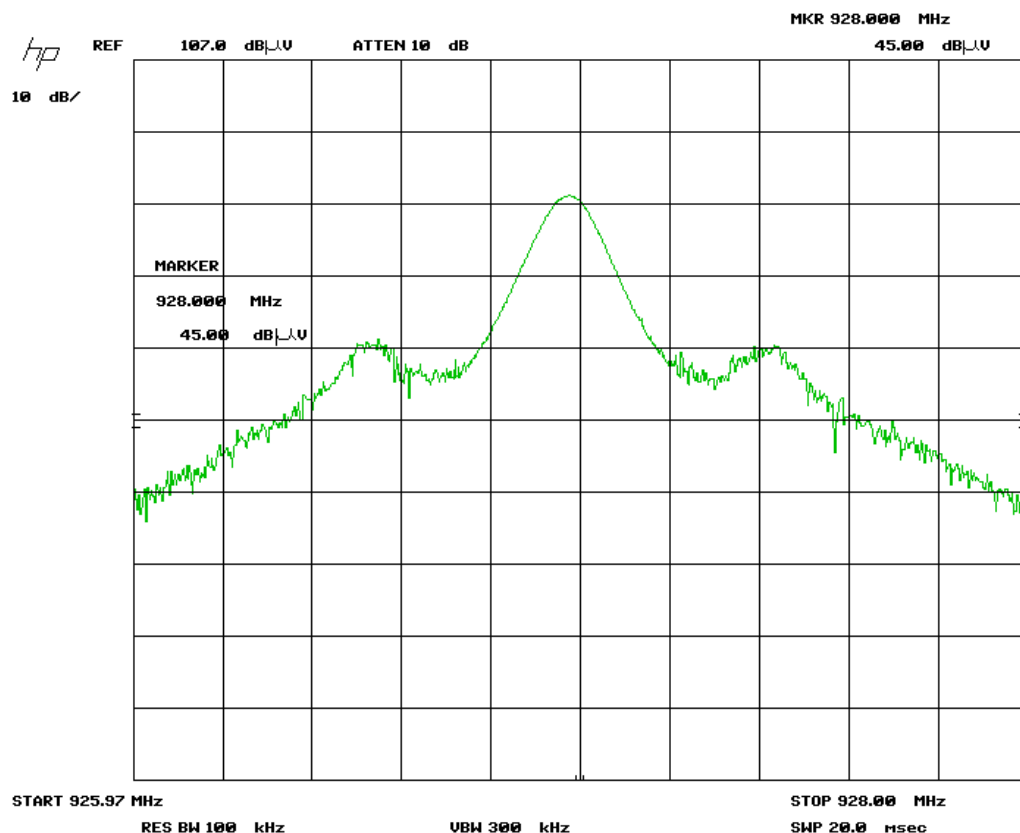
Mid Channel – 2 GHz – 10 GHz  
Horizontal - Peak Emission Graph






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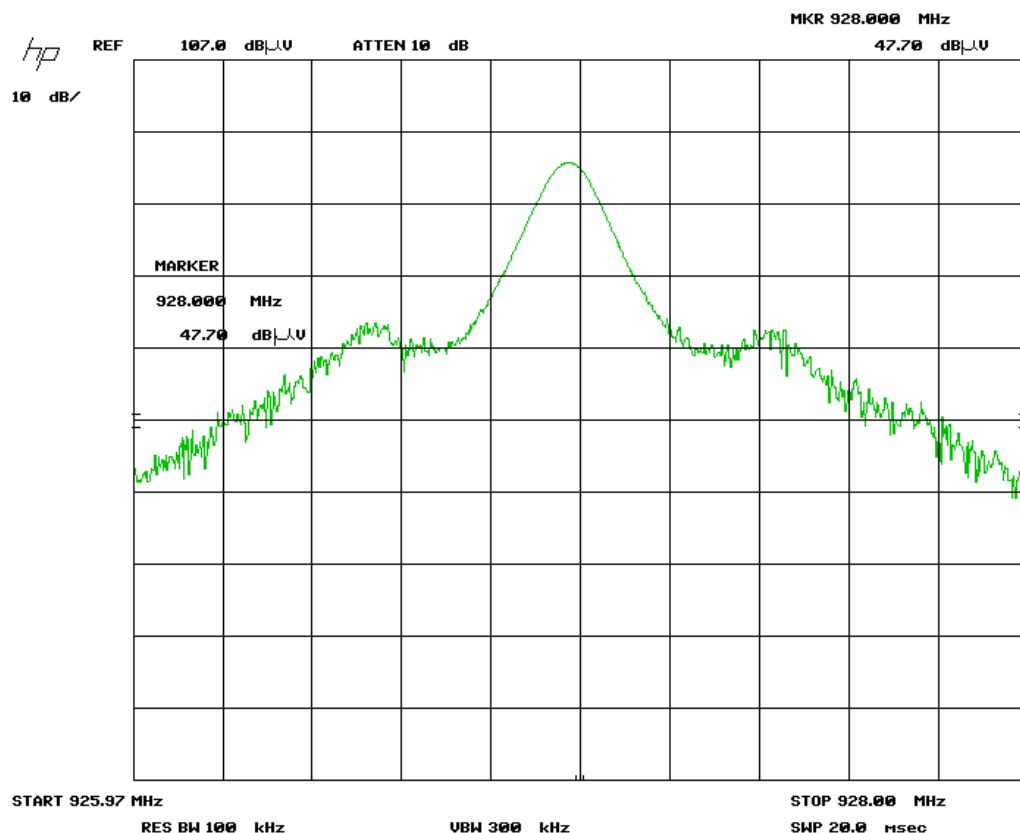
Band Edge – High Channel  
Vertical - Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw data. See Final Measurements and Results section for numerical results.

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

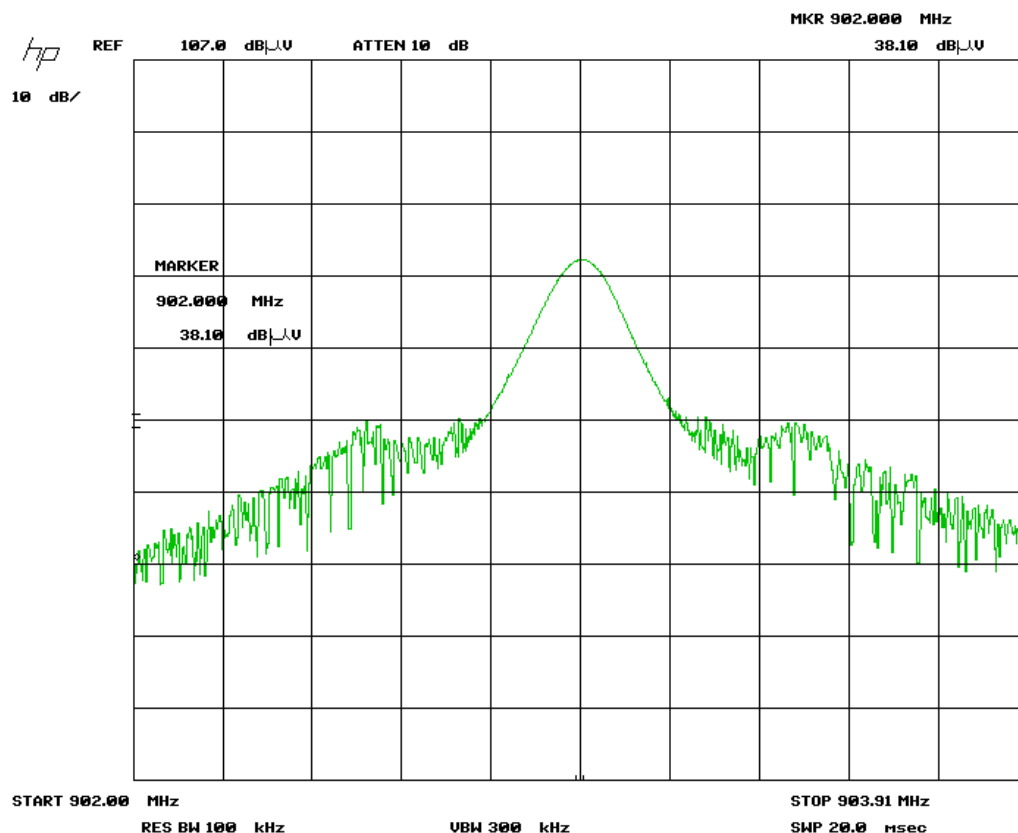
Band Edge – High Channel  
Horizontal - Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw data. See Final Measurements and Results section for numerical results.

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

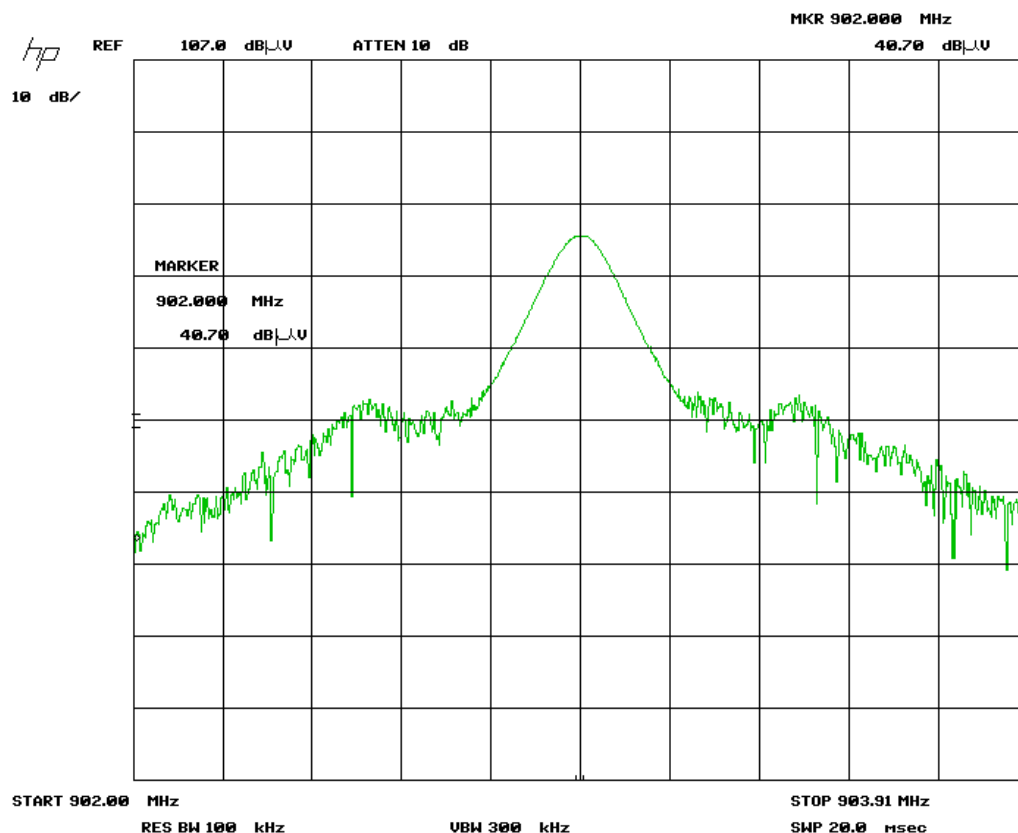
Band Edge – Low Channel  
Vertical - Peak Emission




Measurements were taken at 3 m measurement distance. Marker readings are raw data. See Final Measurements and Results section for numerical results.

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

Band Edge – Low Channel  
Horizontal - Peak Emission



Measurements were taken at 3 m measurement distance. Marker readings are raw data. See Final Measurements and Results section for numerical results.


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

## Final Measurements and Results

The EUT passed the limits.


Product Category		FCC 15.209					
Product		Athena RS					
Supply		Battery, 3.3 VDC					
Vertical Emission Table							
Frequency (MHz)	Detector	Raw (dBuV)	Factors	Level (dBuV)	Limit (dB)	Margin (dB)	Pass/Fail
244.079	Peak	55.9	-12.2	43.7	46	2.3	Pass
248.606	Peak	55.5	-12.1	43.4	46	2.6	Pass
239.423	Peak	55.8	-12.4	43.4	46	2.6	Pass
253.132	Peak	54.3	-12.1	42.2	46	3.8	Pass
230.499	Peak	53.3	-12.8	40.5	46	5.5	Pass
259.276	Peak	52.3	-12.0	40.3	46	5.7	Pass
1593	Peak	56.5	-5.7	50.8	74	23.2	Pass
1593	AVG	36.5	-5.7	30.8	54	23.2	Pass
Horizontal Emission Table							
246.989	Peak	55.6	-12.2	43.4	46	2.6	Pass
251.354	Peak	55.4	-12.1	43.3	46	2.7	Pass
250.61	Peak	53.8	-12.2	41.6	46	4.4	Pass
256.107	Peak	53.3	-12.0	41.3	46	4.7	Pass
256.915	Peak	53.2	-11.9	41.3	46	4.7	Pass
233.28	Peak	53.6	-12.6	41.0	46	5.0	Pass
1597.67	Peak	56.0	-4.3	51.7	74	22.3	Pass
1597.67	AVG	39.6	-4.3	35.3	54	18.7	Pass

**Table 2: Spurious radiated emission**

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

Test Frequency (MHz)	Detection mode	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
Low Channel: 903 MHz - Y-Axis											
902	QP	Vert	28.9	23.8	2.4	3.0	28.6	29.6	46.0	16.4	PASS
902	QP	Horz	24.9	23.8	2.4	3.0	28.6	25.6	46.0	20.4	PASS
Low Channel: 903 MHz Z-Axis											
902	QP	Vert	28.6	23.8	2.4	3.0	28.6	29.3	46.0	16.7	PASS
902	QP	Horz	26.5	23.8	2.4	3.0	28.6	27.2	46.0	18.8	PASS
Low Channel: 903 MHz - X-Axis											
902	QP	Vert	26.7	23.8	2.4	3.0	28.6	27.3	46.0	18.7	PASS
902	QP	Horz	27.9	23.8	2.4	3.0	28.6	28.5	46.0	17.5	PASS
1806	Peak	Vert	47.5	28.3	3.5	0.0	36.3	43.0	74.0	31.0	PASS
1806	Average	Vert	34.2	28.3	3.5	0.0	36.3	29.7	54.0	24.3	PASS
1806	Peak	Horz	47.2	29.9	3.5	0.0	36.3	44.3	74.0	29.7	PASS
1806	Average	Horz	34.4	29.9	3.5	0.0	36.3	31.5	54.0	22.5	PASS
2709	Peak	Vert	41.8	30.9	4.4	0.0	36.1	41.0	74.0	33.0	PASS
2709	Average	Vert	27.8	30.9	4.4	0.0	36.1	27.0	54.0	27.0	PASS
2709	Peak	Horz	42.1	30.9	4.4	0.0	36.1	41.3	74.0	32.7	PASS
2709	Average	Horz	28.1	30.9	4.4	0.0	36.1	27.3	54.0	26.7	PASS
High Channel: 927 MHz Y-Axis											
928	QP	Vert	36.2	23.8	2.4	3.0	28.6	36.8	46.0	9.2	PASS
928	QP	Horz	32.1	23.8	2.4	3.0	28.6	32.7	46.0	13.3	PASS
High Channel: 927 MHz Z-Axis											
928	QP	Vert	36.7	23.8	2.4	3.0	28.6	37.3	46.0	8.7	PASS
928	QP	Horz	35.6	23.8	2.4	3.0	28.6	36.2	46.0	9.8	PASS
High Channel: 927 MHz X-Axis											
928	QP	Vert	33.3	23.8	2.4	3.0	28.6	33.9	46.0	12.1	PASS
928	QP	Horz	34.9	23.8	2.4	3.0	28.6	35.5	46.0	10.5	PASS
1854	Peak	Vert	50.2	28.3	3.5	0.0	36.3	45.7	74.0	28.3	PASS
1854	Average	Vert	43.7	28.3	3.5	0.0	36.3	39.2	54.0	14.8	PASS
1854	Peak	Horz	50.7	29.8	3.5	0.0	36.3	47.7	74.0	26.3	PASS
1854	Average	Horz	44.9	29.8	3.5	0.0	36.3	41.9	54.0	12.1	PASS
2781	Peak	Vert	41.3	30.9	4.4	0.0	36.1	40.5	74.0	33.5	PASS
2781	Average	Vert	28.0	30.9	4.4	0.0	36.1	27.2	54.0	26.9	PASS
2781	Peak	Horz	42.2	30.9	4.4	0.0	36.1	41.4	74.0	32.6	PASS
2781	Average	Horz	27.9	30.9	4.4	0.0	36.1	27.1	54.0	26.9	PASS


**Table 3: Band edge and harmonic measurements**

Client	Ecobee Inc	
Product	Athena RS	
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 RS	
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.

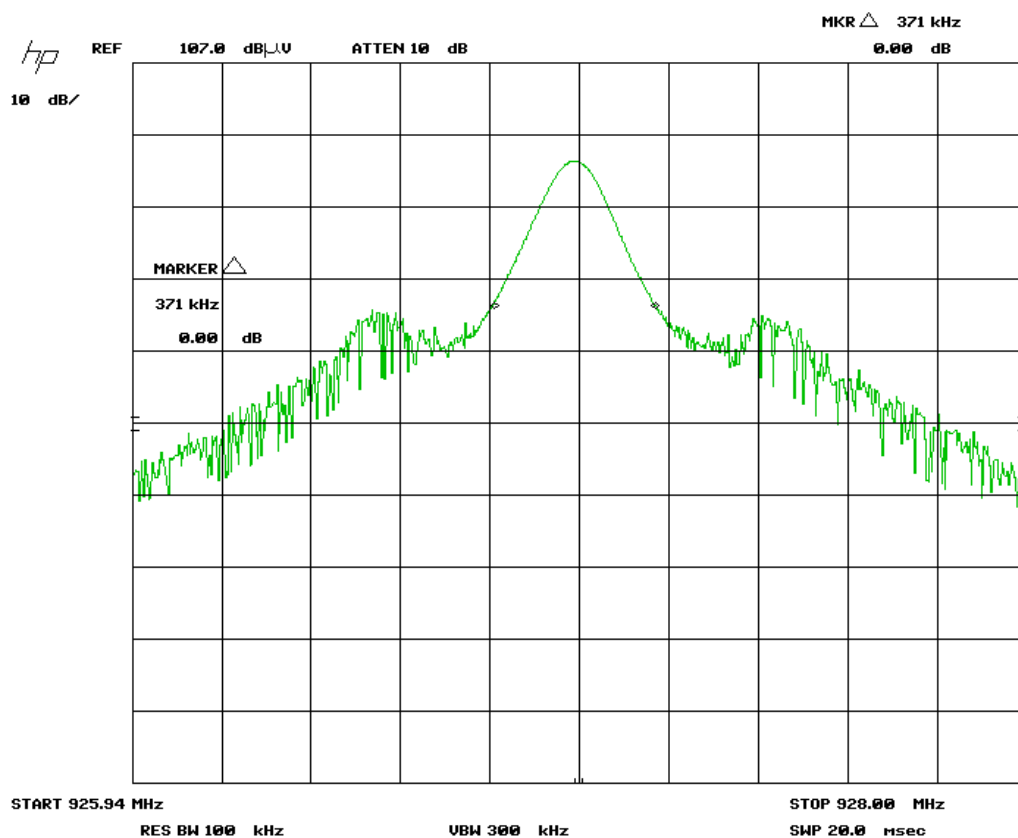
Channel Frequency (MHz)	20dB Measured Bandwidth (kHz)
927	371
915	378
903	368




Client	Ecobee Inc	
Product	Athena RS	
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	<b>Ecobee Inc</b>	
Product	<b>Athena RS</b>	
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 RS	
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  $0.000127 \text{ mW/cm}^2$ , this is significantly under the  $0.618 \text{ mW/cm}^2$  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.

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

$$\text{EIRP} = 93.3 - 95.2$$


$$\text{EIRP} = -1.9 \text{ dBm or } 0.64 \text{ mW}$$

$$P_d = 0.64 \text{ mW} / (4 * \pi * 20\text{cm}^2)$$


$$P_d = 0.64 \text{ mW} / 5026 \text{ cm}^2$$

$$P_d = 0.000127 \text{ mW/cm}^2$$

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

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

## Appendix A – EUT Summary


Client	Ecobee Inc	
Product	Athena RS	
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	<a href="mailto:kashif@ecobee.com">kashif@ecobee.com</a>
EUT Details	
EUT Name (for report title)	Athena RS
EUT Model / SN (if known)	
FCC ID	WR9
Industry Canada #	7981A-
Equipment category	Wireless temperature and room occupancy sensor
EUT is powered using	Battery
Input voltage range(s) (V)	3.3 VDC
Transmits RF energy? (describe)	Yes
Basic EUT functionality description	Ecobee 3 temperature sensor

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	<b>Ecobee Inc</b>	
Product	<b>Athena RS</b>	
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), 0 dBm setting (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.
- The EUT was powered by the debug board. However a battery was install in the battery compartment.

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

## Appendix B – EUT and Test Setup Photographs

Client	<b>Ecobee Inc</b>	
Product	<b>Athena RS</b>	
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: Radiated emission setup – photo 1**



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




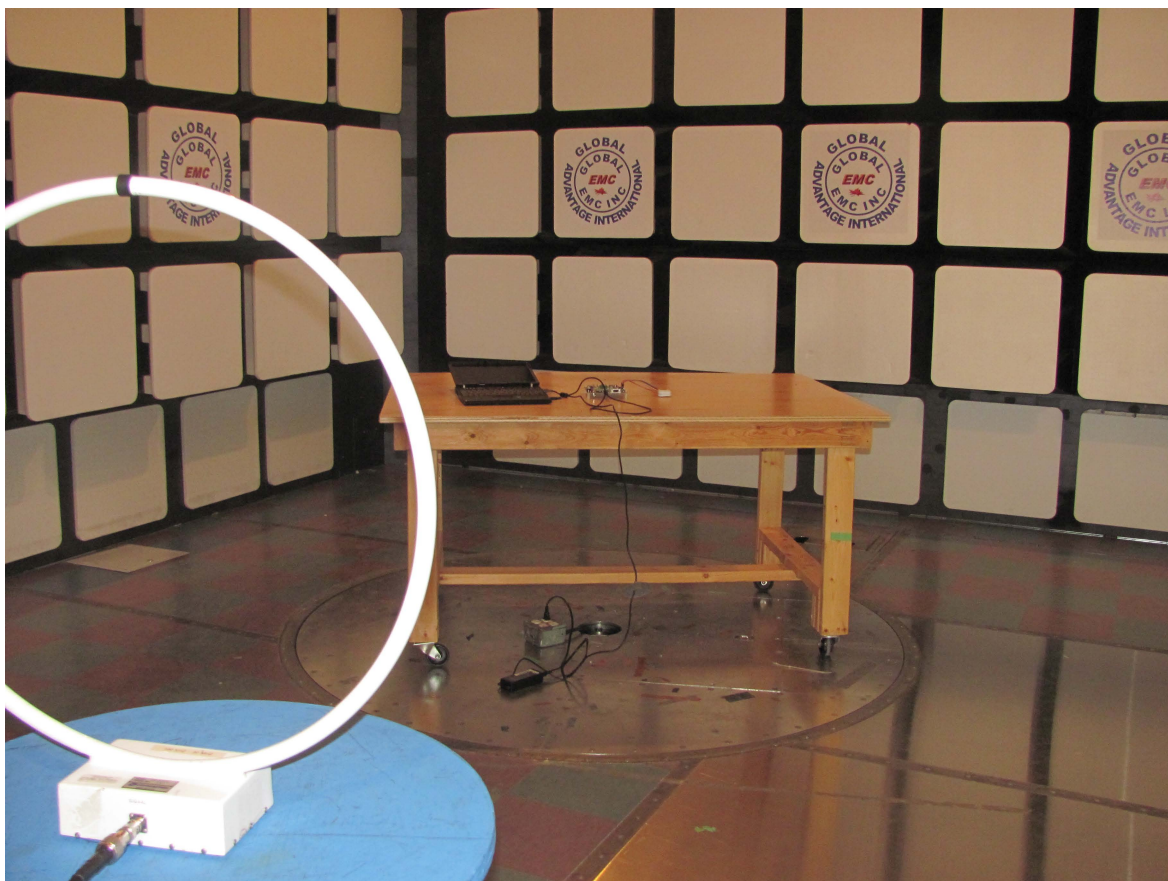
**Illustration 2: Radiated emission setup - photo 2**

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



**Illustration 3: Radiated setup - photo 3**

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



**Illustration 4: Radiated setup - photo 4**