

TEST REPORT

Report Number: 101262612DEN-001D

Project Number: G101262612

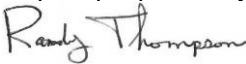
Report Issue Date: 9/30/2013


Product Designation: Model: M1 (Revolv Hub)

Standards: FCC 47 CFR Part 15 Subpart C, 15.249 - Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz

Tested by:
Intertek Testing Services NA, Inc.
1795 Dogwood St. Suite 200
Louisville, CO 80027

Client:
Revolv, Inc.
2060 Broadway, Suite 380
Boulder, CO 80302

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 3.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded **the product tested complies with the requirements of the standard(s) indicated**. The results obtained in this test report pertain only to the item(s) tested.

Test Report Scope

The scope of this report was to qualify the "ZWave Radio" configured within the Revolv Model M1 product. This radio operates within the following Tx Band: 902-928 MHz (ISM)

Refer to the following Intertek Test Reports for the test results of the following radios configured within the Revolv Model M1 product:

- Unintentional Radiated and Conducted Emissions (DoC) 101262612DEN-001A
- Radio #1 (WiFi): 101262612DEN-001B
- Radio #2 (Insteon): 101262612DEN-001C
- **Radio #3 (ZWave): 101262612DEN-001D (This report)**
- Radio #5 (CC1101 #0): 101262612DEN-001E
- Radio #6 (CC1101 #1): 101262612DEN-001F
- Radio #7 (433MHz): 101262612DEN-001G

General Test Methodology

All measurements were performed according to the procedures in the following documents:

- ANSI C63.10:2009 – ANSI Standard for Testing Unlicensed Wireless Devices

Test Facility

Intertek Denver's testing facilities are located at 1795 Dogwood St. Suite 200 Louisville, CO 80027. The testing facility is ISO17025:2005 accredited by A2LA, our lab code is 2506.02, our VCCI registration numbers are. R-1643, C-1752 and T-1558, our FCC designation no. US1121 and our IC lab no. 2042N.

Testing contained in this test report may not be covered under the laboratories scope of accreditation. A note will be placed in the specific test section for testing not covered under the laboratories scope.

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2 Test Summary

Section	Test Specification	Test Description	Test Date	Result
5	Reference Only	6dB Bandwidth	09/03/2013	N/A Note3
6	FCC 15.249(a)	Radiated Field Strength Emissions – Tx Fundamental	09/03/2013	Pass
7	FCC 15.249(a)(e)	Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)	09/03/2013	Pass
8	FCC 15.209/15.249(d)(e)/15.205	Radiated Tx Spurious Emissions – Including Restricted Band & Band Edge	09/04/2013	Pass
9	FCC 15.215(c)	Occupied Bandwidth	---	N/A
10	FCC 15.249(b)	Requirements for Fixed – Point-to-Point Operation	-----	N/A
11	FCC 15.35(c)	Duty Cycle Correction Factor	-----	N/A
12	FCC 15.207	AC Power Transmitter AC Conducted Emissions	08/24/2013	Pass
13	FCC 15.203	Antenna Requirement	09/03/2013	Pass
14	FCC 15.247(b)(5)	RF Exposure Requirements	09/26/2013	Pass
15	FCC 15.109	Receiver/ Digital Device Radiated Emissions	08/14/2013	Pass
16	FCC 15.107	Digital Device AC Conducted Emissions	08/14/2013	Pass

Notes:

- 1) The radio is not a fixed, point-to-point operating system.
- 2) The product is ac-powered utilizing an ac power adapter.
- 3) The 6dB bandwidth was used to determine the minimum RBW used for the fundamental measurement – reference only.

General Radio Test Notes:

- ANSI C63.10, Section 6.3: Testing was performed in 3 different orthogonal axes to determine the worst-case emissions from the device. The worst-case axis and emissions are shown in this report.
- ANSI C63.10, Section 5.13/ FCC CFR Part 15.31(e): For battery-operated equipment, the equipment tests shall be performed using a new battery. For ac-operated equipment, measurements of the fundamental frequency were performed with the supply voltage varied between 85% and 115% of the nominal rated voltage to determine worst-case.
- ANSI C63.10, Section 4.2.3.2/ FCC 15.35: Measurement detector functions and bandwidths utilized in this testing were per the preceding guidelines.
- ANSI C63.10, Section 4.2.3.2.2/ FCC 15.35(b): When an average limit is specified, the peak emission must also be measured to ensure the emissions is less than 20dB above the average limit and/or below the peak limit specified. This report includes both average and peak test data.
- ANSI C63.10, Section 4.2.3.2.4/ FCC 15.35(c): When the field strength (or envelope power) is not constant or when it pulses, and an average detector/limit is specified to be used, a duty cycle correction factor may be utilized to determine the pulsed "average" of the field strength or power. Duty cycle correction was not utilized in this report.
- ANSI C63.10, Section 5.3/ FCC 15.31: All radiated field strength measurements taken at an antenna-to-product test distance of 3-meters.
- ANSI C63.10, Section 5.5, Table 2/ FCC 15.33(a): The frequency range of measurement were per the requirements of the preceding standards. The product was tested from 30MHz to 10GHz.
- ANSI C63.10, Section 6.3.1/ FCC 15.35(b): Measurement bandwidths utilized for fundamental peak emissions were equal to or greater than the 6dB bandwidth of the emission.
- ANSI C63.10, Section 6.3/ FCC 15.31(m): Measurements were taken for at the lowest, near the middle and highest channels of the product tested.

3 Description of Equipment Under Test

Model:	M1
Type of EUT:	Revolv "Hub" – RF-enabled home automation
Serial Number:	FCC1
FCC ID:	2AAITJARVIS1
Industry Canada ID:	N/A
Related Submittal(s) Grants:	W7Z-ZICM357P2 (Zigbee radio)
Company:	Revolv, Inc.
Customer:	Revolv, Inc.
Address:	Revolv, Inc. 2060 Broadway, Suite 380 Boulder, CO 80302
Phone:	(720) 961-5009
Fax:	-----
e-mail:	mbergquist@revolv.com
Test Standards:	<input checked="" type="checkbox"/> 47 CFR, Part 15C:§15.249 <input type="checkbox"/> RSS-210, Issue 8, 2010 <input type="checkbox"/> RSS-Gen, Issue 3, 2010 <input checked="" type="checkbox"/> 47 CFR, Part 15B:§15.107 and §15.109, Class B <input type="checkbox"/> Other
Type of radio:	<input checked="" type="checkbox"/> Stand -alone <input type="checkbox"/> Module <input type="checkbox"/> Hybrid
Date Sample Submitted:	08/11/2013
Test Work Started:	08/14/2013
Test Work Completed:	09/18/2013
Test Sample Conditions:	<input type="checkbox"/> Damaged <input type="checkbox"/> Poor (Usable) <input checked="" type="checkbox"/> Good

Product Description:	Wireless RF-Enabled Home Automation Hub
Transmitter Type:	<input type="checkbox"/> FHSS <input checked="" type="checkbox"/> Digital Modulation <input type="checkbox"/> WiFi <input type="checkbox"/> Blue Tooth
Operating Frequency Range(s):	Range From 908.42 to 908.42 MHz (Single Channel)
Number of Channels:	1
Modulation:	FSK (deviation = 20kHz), Manchester Encoded, 40 Kbaud
Emission Designator:	315KF1D
Antenna(s) Info:	Antenna: Type: Ceramic Gain: -1.0 dBi Connector Type: N/A Integral Antenna
Rated Power:	92.95 dBuV -2.28 dBm .592 mW
Antenna Installation:	<input type="checkbox"/> User <input type="checkbox"/> Professional <input checked="" type="checkbox"/> Factory
Transmitter power configuration:	<input type="checkbox"/> Internal battery <input checked="" type="checkbox"/> External power source
Special Test Arrangement:	Since the product can be mounted in several orientations, the EUT was rotated and tested in three orthogonal axes to determine the maximum emissions
Test Facility Accreditation:	A2LA (Certificate No. 2506.01)
Test Methodology:	Measurements performed according to the procedures in ANSI C63.10-2009 and FCC Publication Number 720338 & 433442

Description of Equipment Under Test (provided by client)
<p>The Revolv "Hub" is designed to link a variety of RF-enabled Home Automation products to a Wi-Fi Local Area Network and through that LAN to the cloud.</p> <p>The product is configured with the following discrete radios:</p> <ul style="list-style-type: none"> ▪ Wi-Fi: 2.4GHz ISM Band (802.11 b/g/n HT20) ▪ Insteon: 915 MHz ISM Band (single channel) ▪ ZWave: 908.42 MHz ISM Band (single channel) ▪ Zigbee: 2.4GHz ISM Band (Certified Module) ▪ CC1101 #0: 903 - 927 MHz ISM Band (multi-channel) ▪ CC1101 #1: 902.6 - 927.4MHz ISM Band (multi-channel) ▪ CC1101 #3: 431 – 437 MHz (control signals – multi-channel) <p>Note the radios do not transmit simultaneously and have (1) dedicated antenna/radio.</p> <p>There are no signal or I/O ports or cables configured on the product.</p> <p>The product is powered from an external AC Adapter.</p>

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Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
AC Adapter Input: 100-240VAC	0.3	50/60	1
AC Adapter Output: 5VDC	2.0	---	---

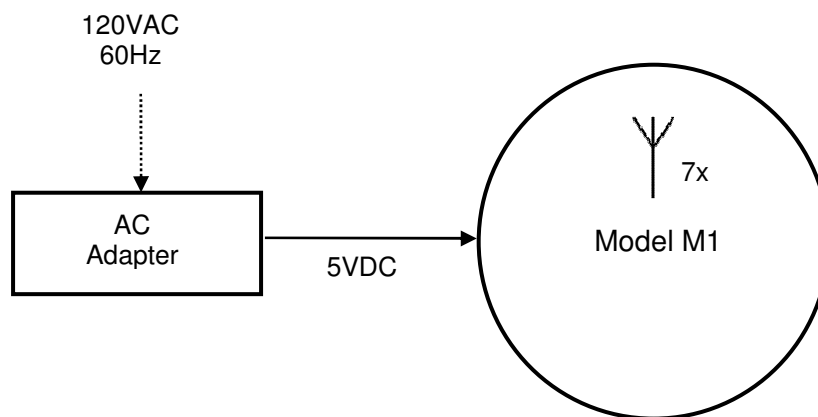
Descriptions of EUT Exercising	
<input checked="" type="checkbox"/>	Standby/Idle Mode
<input checked="" type="checkbox"/>	Continuous transmission, un-modulated carrier (CW)
<input checked="" type="checkbox"/>	Continuous transmission, modulated carrier (CW)
<input checked="" type="checkbox"/>	Continuous Receive Mode

Note: The chosen mode of operation described above is dependent upon the specific test to be performed.

4 System setup including cable interconnection details, support equipment and simplified block diagram

Method:

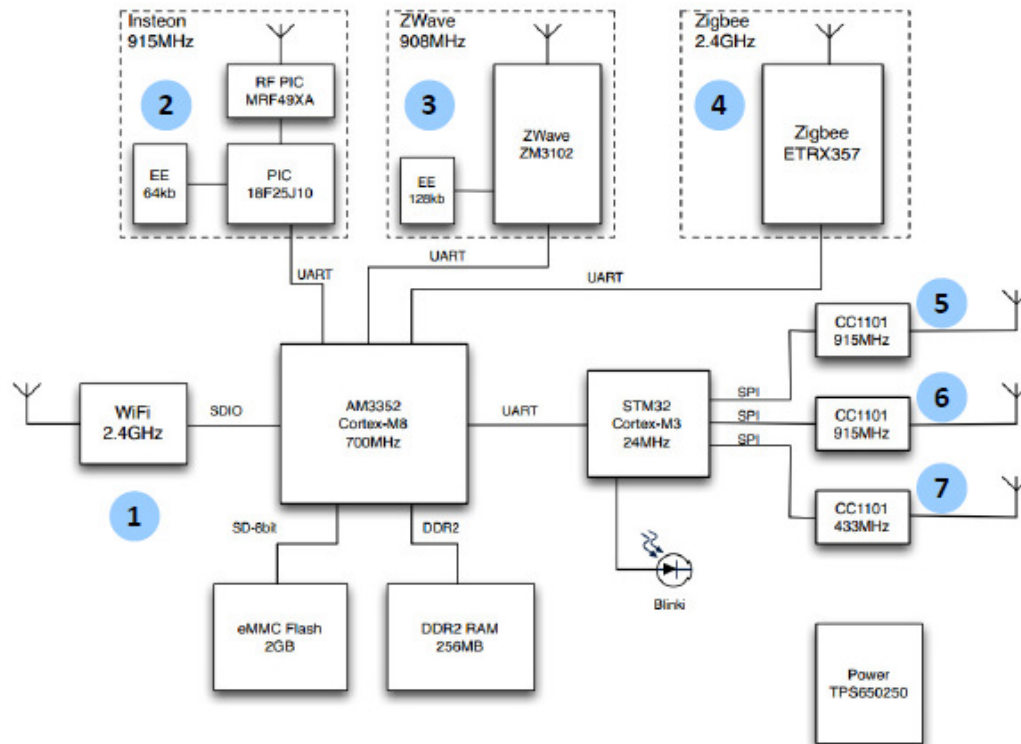
Record the details of EUT cabling, document the support equipment, and show the interconnections in a block diagram.

EUT Block Diagram: EMC Perspective

Note: Dashed lines indicate auxiliary/support equipment

EUT Block Diagram: Detailed

The Hub contains a number of discrete radios as shown in this product block diagram:



Purpose of this document is to describe the Hub and describe each radio to facilitate creation of FCC certification test plan and quotation for testing and TCB service to obtain FCC certification.

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Support Data:

ID	Description/ Function	Shield Type	Length	Connector	Connection	Ferrites
--	----	----	----	----	----	----

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop	HP	---	---

Notes:

- 1) The laptop was utilized only to configure the product during testing (i.e. set channel, modulation, data rates, etc.).
- 2) The product has no signal or I/O cables.

Photograph: Product Tested – Test Axes**Model M1 (Revolv Hub)**

Axis 1 – Product Horizontal (Flat on Table)



Axis 2 – Product Vertical (Wall Mount)



Axis 3 – Product Vertical & Rotated 90 degrees CW



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5 6dB Bandwidth (Reference Only)

Method:

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC 15.249 & IC RSS-210.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

Test Requirement/Specification:

- ANSI C63.10: 2009, Section 6.3.1

Radiated measurements of the fundamental-signal peak field strength shall be made using instrumentation with a bandwidth equal to or greater than the 6 dB bandwidth of the emission.

Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	06/07/2013	06/07/2014
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/15/2012	11/15/2013
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

Results:

Not applicable – measurement used for reference only.

Test Data:

FREQ	LEVEL	DET	CABLE	Antenna	PREAMP	FINAL	POL	HGT	AZ	LIMIT	DELTA LIMIT	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV]	(V/H)	(m)	(DEG)	FCC 15.249(a) 94dBuV/m	FCC 15.249(a)	(MHz)
Measurements to verify the 6dB bandwidth – used to determine the RBW used for measuring fundamental emissions												
908.4168	68.45	Pk	2.10	22.40	0.00	0.00	92.95	H	1.00	231.5	- 1.05	0.120
908.3975	69.06	Pk	2.10	22.40	0.00	0.00	93.56	H	1.00	231.5	- 0.44	0.300
908.3975	69.06	Pk	2.10	22.40	0.00	0.00	93.56	H	1.00	231.5	- 0.44	1.000

Test Method:

- N/A

Test Summary:

6dB Bandwidth Summary	
Channel/ Mode	6dB Bandwidth
908.42 MHz	178 kHz

Specification: Not applicable

Notes:

- 1) Measurements were taken using worst-case modulated (maximum bandwidth) mode, using maximum data packet length.
- 2) All measurements are radiated field strength.
- 3) For fundamental measurements, a RBW of 300kHz will be utilized per the plot and measurements above. No significant increase in field strength was measured when using a higher bandwidth.

Deviations, Additions, or Exclusions: None

6 Radiated Field Strength Emissions – Tx Fundamental

Method:

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC 15.249.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

Test Requirement/Specification:

The maximum Radiated Field Strength shall not exceed 50mV/m.

Fundamental Frequency	Field Strength of Fundamental (mV/m)	Field Strength of Harmonics (uV/m)
902-928 MHz	50 (94dBuV/m)	500 (54dBuV/m)
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

- FCC 15.249(a)
- RSS-210 A2.9(a)

Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	06/07/2013	06/07/2014
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/15/2012	11/15/2013
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

Results:

The sample tested was found to comply.

Test Summary: Radiated Field Strength Emissions – Tx Fundamental

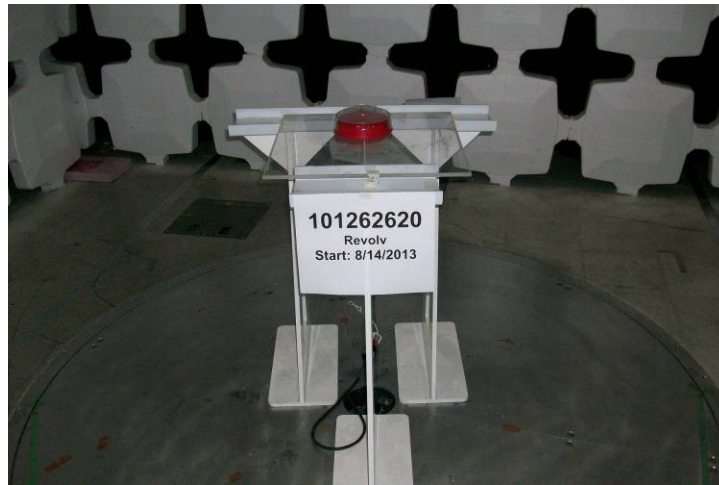
Fundamental	Radiated Field Strength @ 3-meters					
Frequency Range:	<input checked="" type="checkbox"/> 902-928MHz		<input type="checkbox"/> 2400-2483.5MHz		<input type="checkbox"/> 5725-5850MHz	
Low Frequency MHz	Measured Field Strength (dBuV/m)	Duty Cycle Correction Factor (dB)	Final Corrected (dBuV/m)	Standard Limit (mV/m)	Limit (dBuV/m)	Margin dB
---	---	---	---	50	94	---
Mid Frequency MHz						
908.42	92.95	0.00	92.95	50	94	-1.05
High Frequency MHz						
---	---	---	---	50	94	---
RBW: <input type="checkbox"/> 100kHz <input type="checkbox"/> 300kHz <input checked="" type="checkbox"/> 500kHz <input type="checkbox"/> 1MHz <input type="checkbox"/> 3MHz <input type="checkbox"/> 10MHz VBW: <input type="checkbox"/> 300kHz <input type="checkbox"/> 1MHz <input checked="" type="checkbox"/> 1MHz <input type="checkbox"/> 3 MHz <input type="checkbox"/> 10MHz <input type="checkbox"/> 10MHz						
Antenna Gain:	<input checked="" type="checkbox"/> < 6dBi <input type="checkbox"/> >6dBi and = dBi, Output power reduction = dB					

Test Method:

- FCC Publication 720338 & 433442
- ANSI C63.10:2009, Section 6.5

Notes:

1. All Fundamental measurements are radiated field - peak detector, max hold – 300kHz RBW.
2. The measurement bandwidth ≥6dB bandwidth – refer to section 5.
3. Product measured in (3) axes – refer to section 4 for details.
4. The product is a single-channel transmitter.
5. Measurements were not adjusted by the allowed duty cycle correction factor per FCC 15.35/ IC RSS-GEN, Section 4.5 – fundamental frequency is below 1GHz.
6. The limit for RSS-210 is identical to the limit for FCC 15.249.

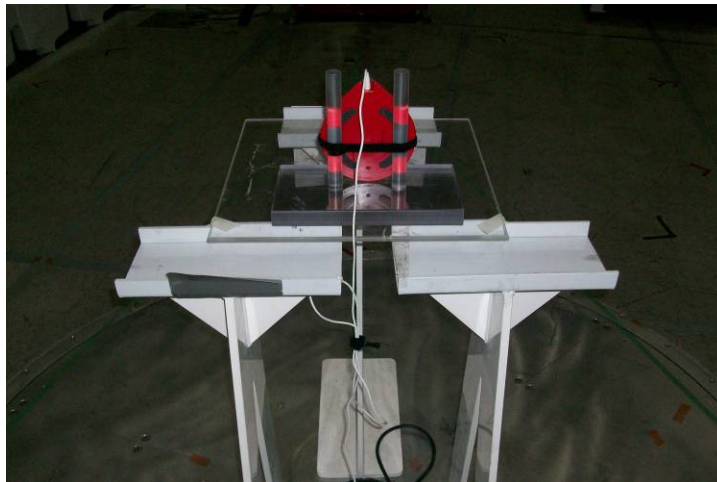
Setup Photographs: Radiated Field Strength Emissions – Tx Fundamental**Test Setup – Front View****Axis 1****Axis 2****Axis 3**

Setup Photographs: Radiated Field Strength Emissions – Tx Fundamental**Test Setup – Rear View**

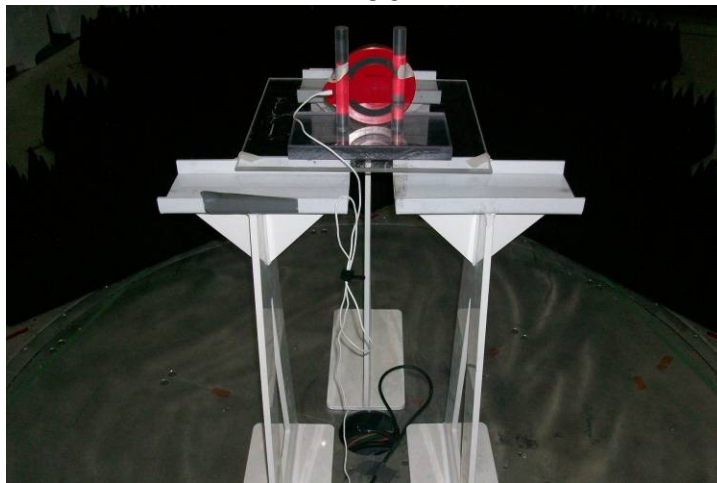
Axis 1



Axis 2



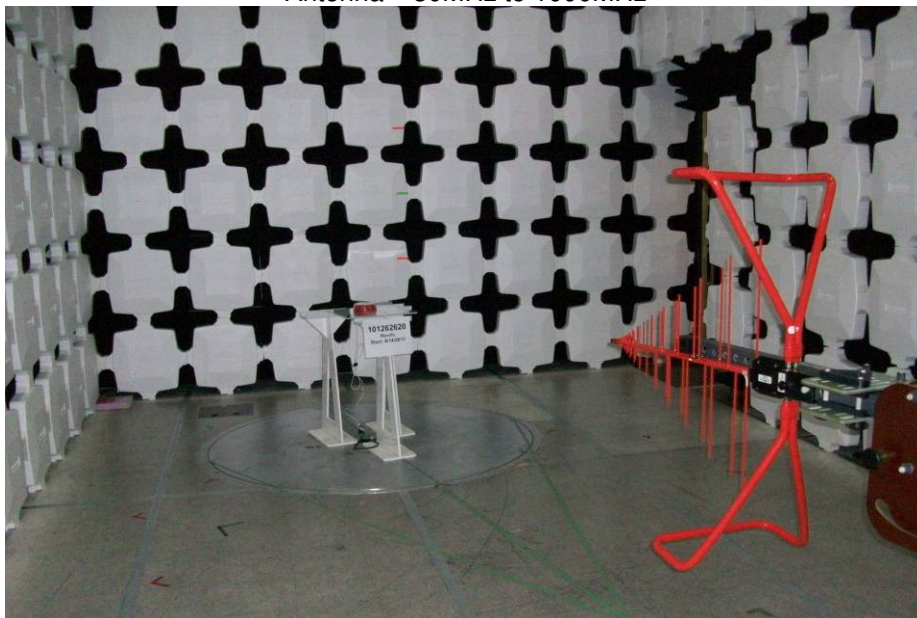
Axis 3



Setup Photographs: Radiated Field Strength Emissions – Tx Fundamental

Test Setup

Antenna – 30MHz to 1000MHz



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Test Data: Radiated Field Strength Emissions – Tx Fundamental

Radiated Field Strength – Tx Fundamental

Test Report #: **G101262612** Test Area: CC1 Radiated Temperature: 22.5 °C
 Test Method: FCC 15.249(a) Test Date: 03-Sep-2013 Relative Humidity: 25.8 %
 EUT Model #: M1 EUT Power: 120VAC/60Hz Air Pressure: 83.1 kPa
 EUT Serial #: FCC1

Manufacturer: <u>Revolv, Inc.</u>	Level Key	
EUT Description: <u>Revolv "Hub" – RF-Enabled Home Automation</u>	Pk – Peak	Nb – Narrow Band
Notes: <u>Product transmitting continuously – ZWave Radio active – FSK Modulated</u>	Qp – QuasiPeak	Bb – Broad Band
<u>Radio is a single channel: 908.42 MHz</u>	Av - Average	
<u>All measurements peak detector – RBW > 6dB BW</u>		

The following Duty Cycle was verified by Intertek: Not Applicable														
Duty Cycle Correction Not Applied														
Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.														
The testing performed in accordance to FCC CFR47 Part 15.249 and delta limits were calculated as follows:														
Final Corrected Peak Measurement – Duty Cycle Correction Factor* = Final Calculated Emission														
The Final Calculated Emission was then compared to the Limits in CFR47 Part 15.249 and the emission/limit delta was calculated.														
DTCF is calculated as follows $20 \cdot \log_{10}(\text{duty cycle in 100ms})$.														
FCC Part 15.249(a) Limit: 50mV/m = 94dBuV/m														
FREQ	LEVEL	DET	CABLE	Antenna	PREAMP	FINAL	Duty Cycle CF	Duty Cycle Corrected	POL	HGT	AZ	LIMIT	DELTA LIMIT	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV]	- [dB]	= [dBuV/m]	(V/H)	(m)	(DEG)	FCC 15.249(a) 94dBuV/m	FCC 15.249(a)	(MHz)
Fundamental Measurements - Axis 1 - EUT Flat on Table (Horizontal)														
Tx Channel														
908.4168	68.45	Pk	2.10	22.40	0.00	92.95	0.00	92.95	H	1.00	222.7	- 1.05	N/A	0.300
908.4168	57.22	Pk	2.10	22.40	0.00	81.72	0.00	81.72	V	2.57	0.1	- 12.28	N/A	0.300
Fundamental Measurements - Axis 2 - EUT Vertical on Table														
Tx Channel														
908.4168	65.80	Pk	2.10	22.40	0.00	90.30	0.00	90.30	V	1.23	79.5	- 3.70	N/A	0.300
908.4168	56.54	Pk	2.10	22.40	0.00	81.04	0.00	81.04	H	1.32	296.4	- 12.96	N/A	0.300
Fundamental Measurements - Axis 3 - EUT Vertical & Rotated 90 Degrees														
Tx Channel														
908.4168	63.46	Pk	2.10	22.40	0.00	87.96	0.00	87.96	H	2.31	141.1	- 6.04	N/A	0.300
908.4168	64.06	Pk	2.10	22.40	0.00	88.56	0.00	88.56	V	1.64	103.1	- 5.44	N/A	0.300

Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

Method:

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC 15.249.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

Test Requirement/Specification

The maximum Radiated Field Strength of the Harmonics of the Fundamental shall not exceed 500uV/m.

Fundamental Frequency	Field Strength of Fundamental (mV/m)	Field Strength of Harmonics (uV/m)
902-928 MHz	50 (94dBuV/m)	500 (54dBuV/m)
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

In addition, as shown in FCC 15.35(b), for frequencies above 1000 MHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

Attenuation below the general limits specified in 15.209(a) is not required.

- FCC 15.249(a)(e)

Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	06/07/2013	06/07/2014
18906	RF Pre-Amp (1-4GHz)	Mini-Circuits Lab	ZHL-42	N052792-2	06/10/2013	06/10/2014
18900	RF Pre-Amplifier (4-8 GHz)	Avantek	AFT97-8434-10F	1007	06/10/2014	06/10/2014
18901	RF Pre-Amp (8-18GHz)	Avantek	AWT-18037	1002	06/10/2013	06/10/2014
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/15/2012	11/15/2013
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/19/2013	03/19/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBU	VBU

Results:

The sample tested was found to comply.

**Test Summary: Radiated Field Strength - Harmonics of the Fundamental
(Out-of-Band Emissions)**

Harmonics of Fundamental	Radiated Field Strength @ 3-meters					
Frequency Range:	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz					
Low Harmonic Frequency MHz	Measured Field Strength (dBuV/m)	Duty Cycle Correction Factor (dB)	Final Corrected (dBuV/m)	Standard Limit (uV/m)	Limit (dBuV/m)	Margin dB
---	---	---	---	500	54	---
---	---	---	---	---	74	---
Mid Harmonic Frequency MHz						
2725.180 (Average)	42.09	0.00	42.09	500	54	-11.91
2725.180 (Peak)	49.10	0.00	49.10	---	74	-24.90
High Harmonic Frequency MHz						
---	---	---	---	500	54	---
---	---	---	---	---	74	---
RBW:	<input type="checkbox"/> 100kHz <input type="checkbox"/> 300kHz <input type="checkbox"/> 500kHz <input checked="" type="checkbox"/> 1MHz <input type="checkbox"/> 3MHz <input type="checkbox"/> 10MHz					
VBW:	<input type="checkbox"/> 300kHz <input type="checkbox"/> 1MHz <input type="checkbox"/> 1MHz <input checked="" type="checkbox"/> 3 MHz <input type="checkbox"/> 10MHz <input type="checkbox"/> 10MHz					
Antenna Gain:	<input checked="" type="checkbox"/> < 6dBi <input type="checkbox"/> >6dBi and = dBi, Output power reduction = dB					

Test Method:

- FCC Publication 720338 & 433442
- ANSI C63.10:2009, Section 6.6

An intentional radiator shall be measured in accordance with 47 CFR 15.31-15.35. The detector functions and measuring bandwidths for these measurements are specified in 15.35. For measurements below 1 GHz, a quasi-peak detector shall be used. However, a peak detector may be used, since the measured value will generally be higher with a peak detector. For measurements above 1 GHz, the limits are in terms of using an instrument with an average detector, unstated otherwise for a specific type of device. For device operating under Section 15.249, the limit is in terms of average with an additional peak limit of 20 dB over the average limit (see 47 CFR 15.249(e)).

Notes:

1. All Harmonics of the Fundamental measurements are radiated field – peak/average detector, max hold measurements – 1MHz RBW.
2. The product was tested in (3) axes – refer to section 4 for details.
3. The transmitter is single-channel.
4. Measurements were not adjusted by the allowed duty cycle correction factor per FCC 15.35/ IC RSS-GEN, Section 4.5.

Setup Photographs: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

Test Setup – Front View

Axis 1



Axis 2



Axis 3

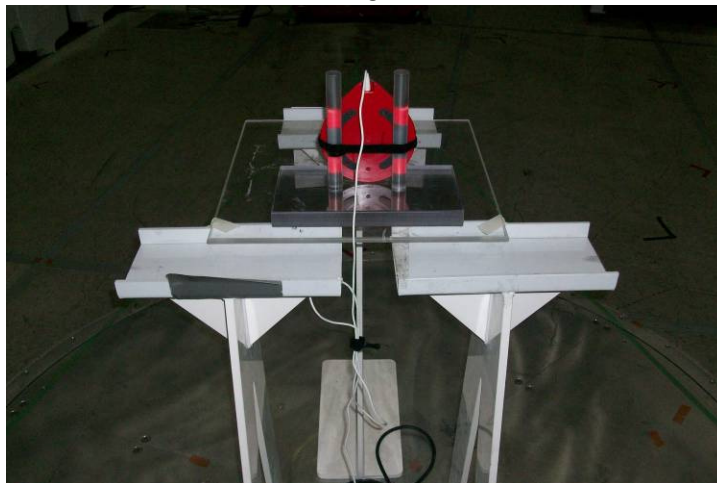


**Setup Photographs: Radiated Field Strength - Harmonics of the Fundamental
(Out-of-Band Emissions)**

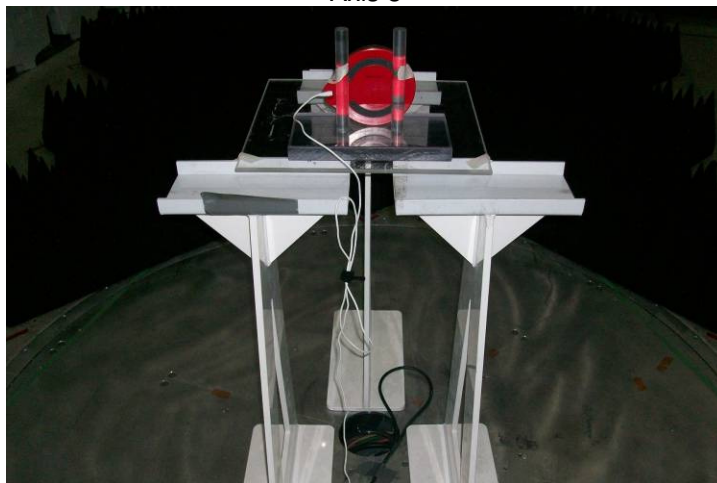
Test Setup – Rear View
Axis 1



Axis 2



Axis 3

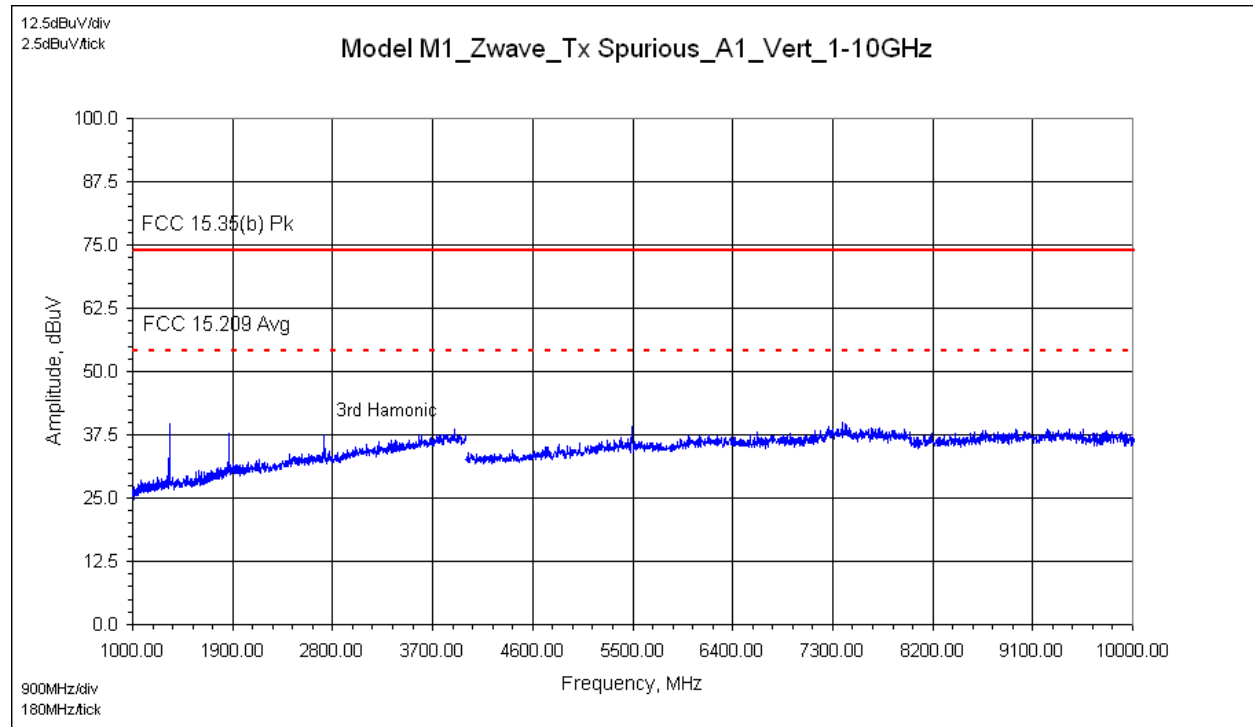
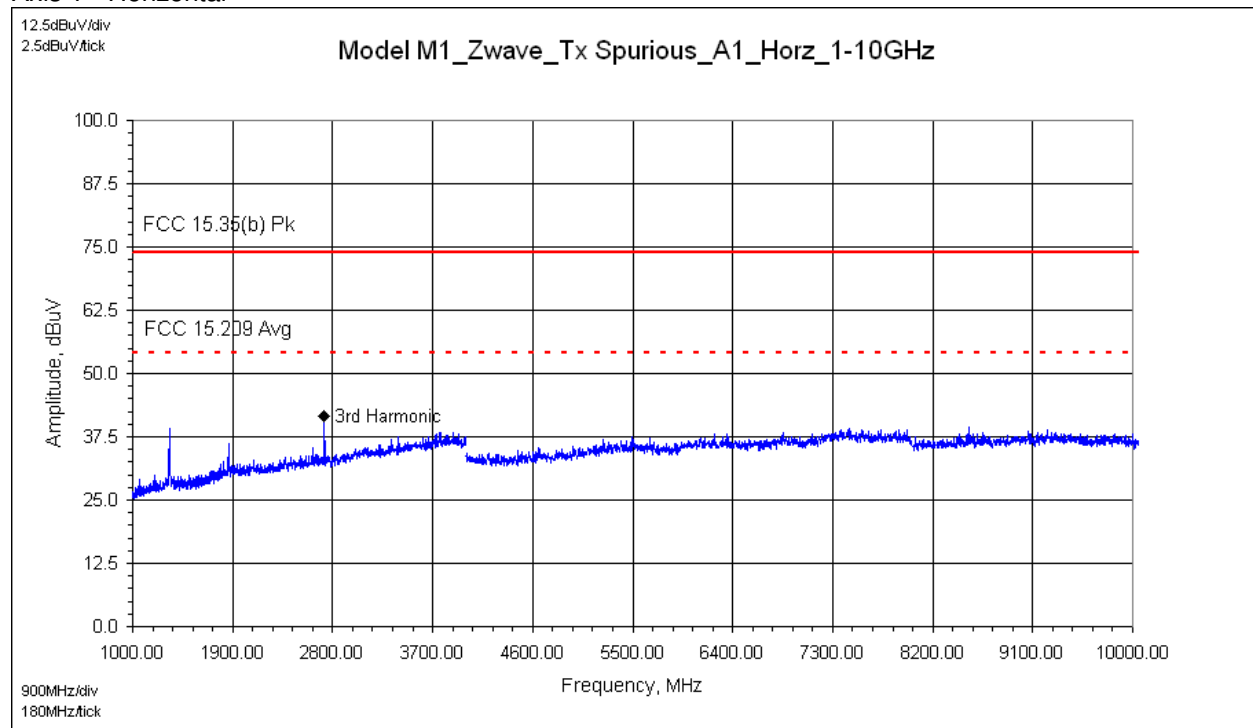


**Setup Photographs: Radiated Field Strength - Harmonics of the Fundamental
(Out-of-Band Emissions)**

Test Setup

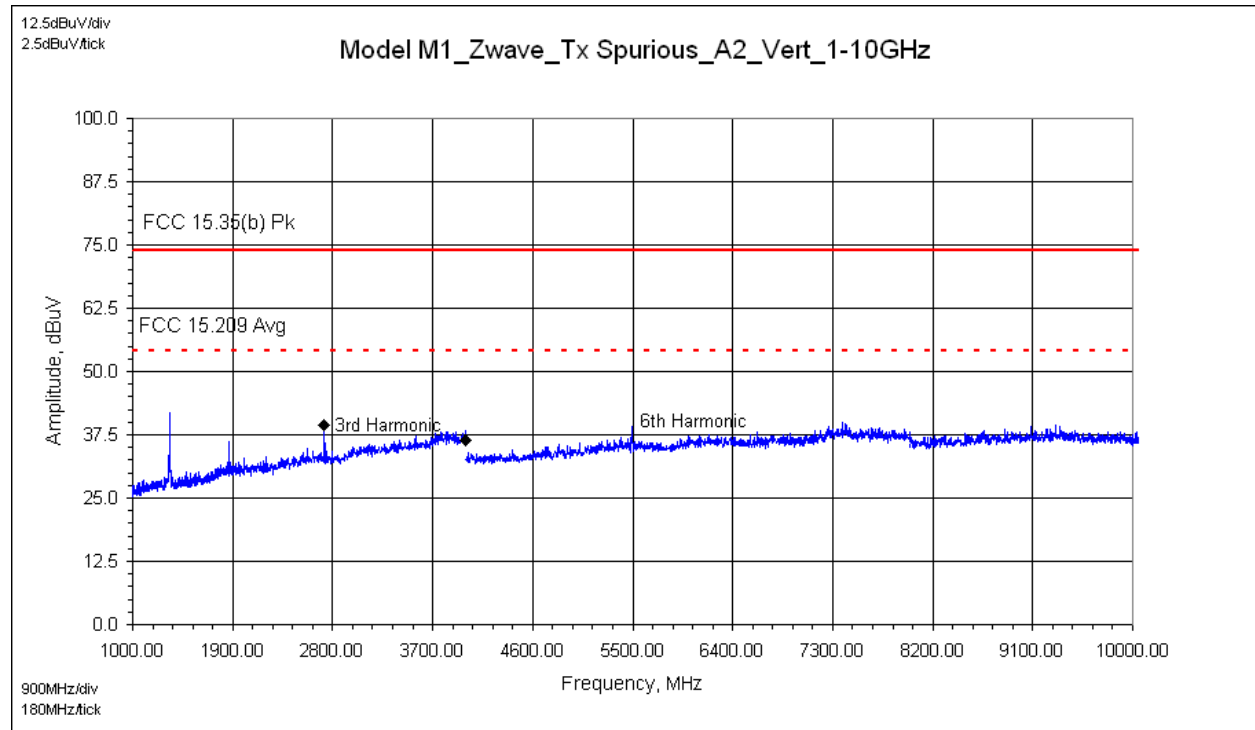
Antenna – 1GHz to 18GHz



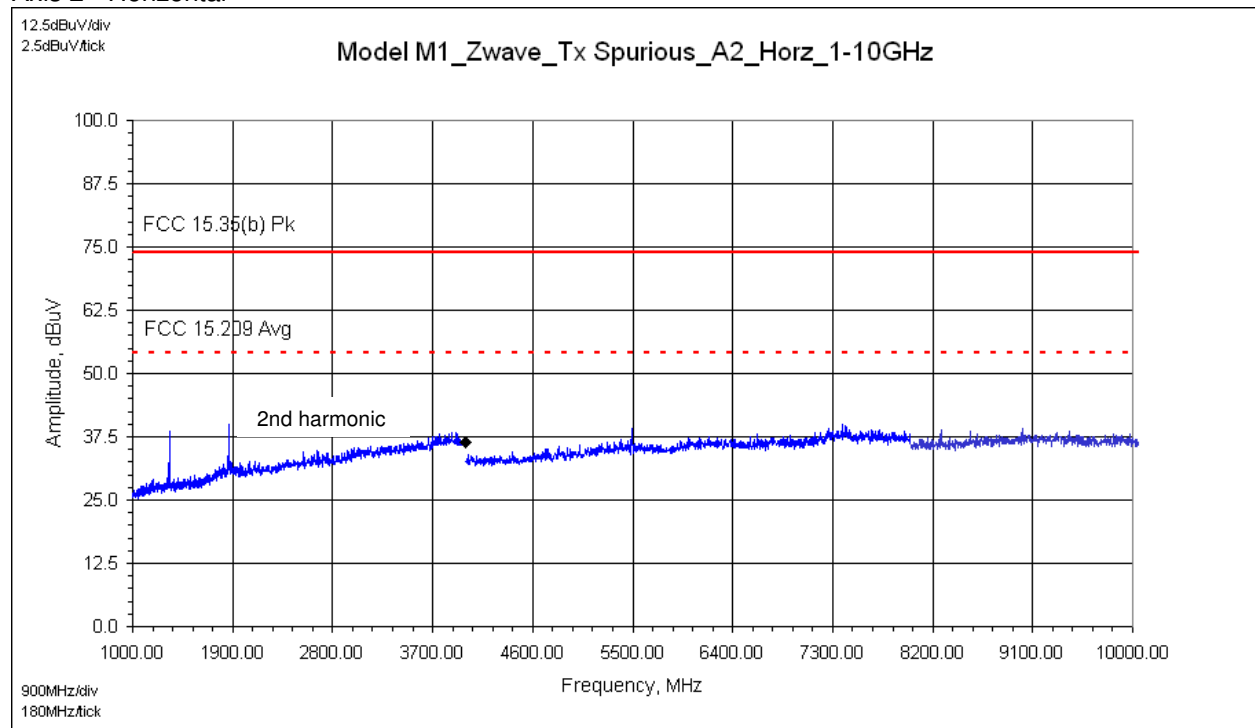
Plots: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)**Axis 1 - Vertical****Axis 1 - Horizontal**

Plots: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

Axis 2 - Vertical

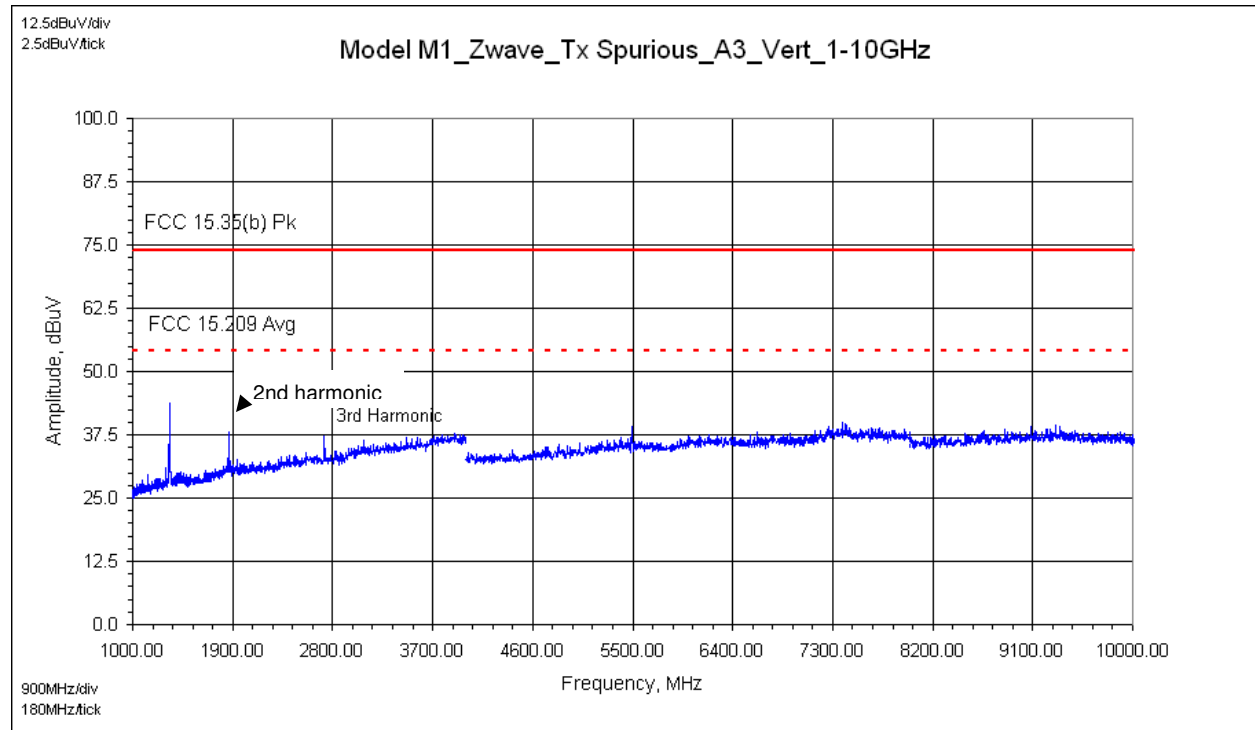


Axis 2 - Horizontal

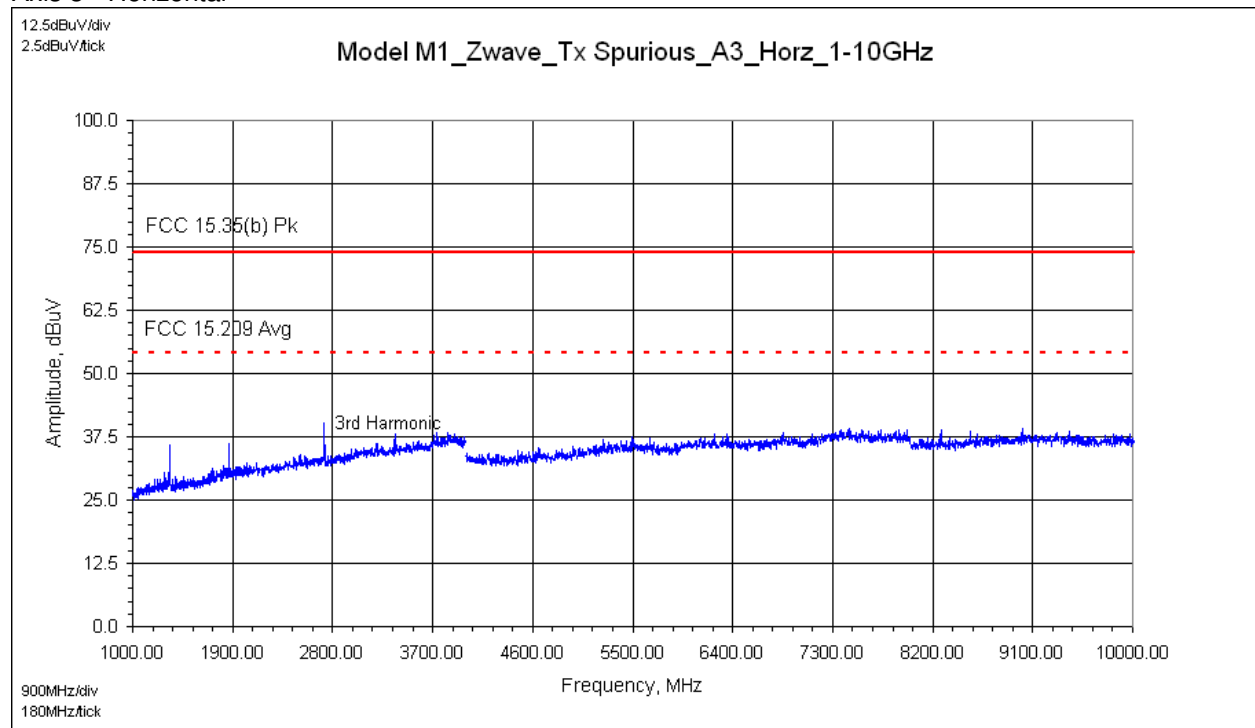


Plots: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

Axis 3 - Vertical



Axis 3 - Horizontal



Intertek

Report Number: 101262612DEN-001D

Issued:9/30/2013

Test Data: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

Harmonics of the Fundamental - Radiated Field Measurements

Test Report #: G101262612	Test Area: CC1 Radiated	Temperature: 22.7 °C
Test Method: FCC 15.249(a)	Test Date: 03-Sep-2013	Relative Humidity: 29.1 %
EUT Model #: M1	EUT Power: 120VAC/60Hz	Air Pressure: 83.1 kPa
EUT Serial #: FCC1		

Manufacturer: Revolv, Inc.

EUT Description: Revolv "Hub" – RF-Enabled Home Automation

Notes: Product transmitting continuously – ZWave Radio active – FSK Modulated

Radio is a single channel: 908.42 MHz

All measurements peak detector – RBW > 6dB BW

Level Key

Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av - Average	

The following Duty Cycle was verified by Intertek: No Duty Cycle Correction was utilized in this test data.

Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.

The testing performed in accordance to FCC CFR47 Part 15.249 and delta limits were calculated as follows:

Final Corrected Peak Measurement – Duty Cycle Correction Factor* = Final Calculated Emission

The Final Calculated Emission was then compared to the Limits in CFR47 Part 15.249 and the emission/limit delta was calculated.

DTCF is calculated as follows $20 \cdot \log_{10}$ (duty cycle in 100mS).

Part 15.249 (a) Limit: Average 500uV/m = 54 dBuV/m / Peak 74 dBuV/m (3-meter test distance)

FREQ	LEVEL	DET	CABLE	Antenna	PREAMP	FINAL	Duty Cycle CF	Duty Cycle Corrected	POL	HGT	AZ	LIMIT	DELTA LIMIT	RBW
MHz	duV/m	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV/m]	- [dB]	Corrected Final = [dBuV/m]	(V/H)	(m)	(DEG)	FCC 15.249(a) FCC 15.35(b)	FCC 15.249(a) FCC 15.35(b)	(MHz)

Harmonics of the Fundamental Measurements – Radiated Field [dBuV/m]

Tx Harmonics 1-8GHz: Axis 1 – Product Flat on Table (Horizontal)

2725.1600	53.20	Pk	3.77	28.98	37.46	48.49	0.00	48.49	H	1.11	85.5	74.00	-25.51	1.000
2725.1600	45.35	Av	3.77	28.98	37.46	40.64	0.00	40.64	H	1.11	85.5	54.00	-13.36	1.000
5450.5200	33.60	Av	5.50	34.30	38.97	34.43	0.00	34.43	H	1.59	161.3	54.00	-19.57	1.000
5450.5200	47.27	Pk	5.50	34.30	38.97	48.10	0.00	48.10	H	1.59	161.3	74.00	-25.90	1.000
5450.5200	33.58	Av	5.50	34.30	38.97	34.41	0.00	34.41	V	1.11	33.1	54.00	-19.59	1.000
5450.5200	47.22	Pk	5.50	34.30	38.97	48.05	0.00	48.05	V	1.11	33.1	74.00	-25.95	1.000

Tx Harmonics 1-8GHz: Axis 2 – Product Vertical on Table

2725.1600	52.76	Pk	3.77	28.98	37.46	48.05	0.00	48.05	V	2.47	221.7	74.00	-25.95	1.000
2725.1600	43.83	Av	3.77	28.98	37.46	39.12	0.00	39.12	V	2.47	221.7	54.00	-14.88	1.000
3659.0000	52.87	Pk	4.16	28.79	36.98	48.84	0.00	48.84	H	1.40	148.0	74.00	-25.16	1.000

Tx Harmonics 1-8GHz: Axis 3 – Product Vertical & Rotated 90 degrees

2725.1800	46.80	Av	3.77	28.98	37.46	42.09	0.00	42.09	H	1.65	37.5	54.00	-11.91	1.000
2725.1800	53.81	Pk	3.77	28.98	37.46	49.10	0.00	49.10	H	1.65	37.5	74.00	-24.90	1.000
2725.1800	42.19	Av	3.77	28.98	37.46	37.48	0.00	37.48	V	1.98	16.5	54.00	-16.52	1.000

Intertek	
Report Number: 101262612DEN-001D	Issued:9/30/2013

2725.1800	51.84	Pk	3.77	28.98	37.46	47.13	0.00	47.13	V	1.98	16.5	74.00	-26.87	1.000
Tx Harmonics 8-18GHz: No signals found – refer to pre-scans														

Harmonics in Restricted Bands – Reference Only

fundamental				Harmonics										
<u>MHz0</u>	<u>MHz1</u>	<u>MHz2</u>	<u>MHz3</u>	<u>MHz4</u>	<u>MHz5</u>	<u>MHz6</u>	<u>MHz7</u>	<u>MHz8</u>	<u>MHz9</u>	<u>MHz10</u>				
908.42	908.42	1816.84	2725.26	3633.68	4542.10	5450.52	6358.94	7267.36	8175.78	9084.20				

Intertek	
Report Number: 101262612DEN-001D	Issued:9/30/2013

7 Radiated Tx Spurious Emissions – Including Restricted Band & Band Edge

Method:

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC 15.249.

This testing was performed at Intertek Denver, located at 1795 Dogwood St. Suite 200, Louisville, CO 80027.

Test Requirement/Specification:

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in FCC 15.209, whichever is the lesser attenuation.

As shown in FCC15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

- FCC 15.249(d)(e)/ 15.205/209

Test Equipment Used:

<u>Asset ID</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial</u>	<u>Cal Date</u>	<u>Cal Due</u>
DEN-073	EMI Receiver (10Hz – 26.5GHz)	RHODE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18912	9 kHz- 1.3GHz Pre Amp	Hewlett-Packard	8447F	3113A05545	06/07/2013	06/07/2014
18906	RF Pre-Amp (1-4GHz)	Mini-Circuits Lab	ZHL-42	N052792-2	06/10/2013	06/10/2014
18900	RF Pre-Amplifier (4-8 GHz)	Avantek	AFT97-8434-10F	1007	06/10/2014	06/10/2014
18901	RF Pre-Amp (8-18GHz)	Avantek	AWT-18037	1002	06/10/2013	06/10/2014
19936	Bilog Antenna 30MHz – 6GHz	Sunol Sciences	JB6	A050707-1	11/15/2012	11/15/2013
18887	Horn Antenna 1-18GHz	EMCO	3115	9205-3886	03/19/2013	03/19/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 3.0	VBV	VBV

Results:

The sample tested was found to comply.

Test Summary: Radiated Tx Spurious Emissions – Including Restricted Band & Band Edge

Tx Spurious Emissions	Radiated Field Strength @ 3-meters					
Frequency Range:	<input checked="" type="checkbox"/> 902-928MHz <input type="checkbox"/> 2400-2483.5MHz <input type="checkbox"/> 5725-5850MHz					
Low Frequency MHz	Measured Field Strength (dBuV/m)	Duty Cycle Correction Factor (dB)	Final Corrected (dBuV/m)	Standard Limit (uV/m)	Limit (dBuV/m)	Margin dB
Frequency MHz						
171.31 Quasi-Peak	33.88	0.00	33.88	---	43.52	-9.64
RBW:	<input checked="" type="checkbox"/> 120kHz <input type="checkbox"/> 300kHz <input type="checkbox"/> 500kHz <input type="checkbox"/> 1MHz <input type="checkbox"/> 3MHz <input type="checkbox"/> 10MHz					
VBW:	<input checked="" type="checkbox"/> 300kHz <input type="checkbox"/> 1MHz <input type="checkbox"/> 1MHz <input type="checkbox"/> 3 MHz <input type="checkbox"/> 10MHz <input type="checkbox"/> 10MHz					
Antenna Gain:	<input checked="" type="checkbox"/> < 6dBi <input type="checkbox"/> >6dBi and = dBi, Output power reduction = dB					

Test Method:

- FCC Publication 720338 & 433442
- ANSI C63.10:2009, Section 6.6

An intentional radiator shall be measured in accordance with 47 CFR 15.31-15.35. The detector functions and measuring bandwidths for these measurements are specified in 15.35. For measurements below 1 GHz, a quasi-peak detector shall be used. However, a peak detector may be used, since the measured value will generally be higher with a peak detector. For measurements above 1 GHz, the limits are in terms of using an instrument with an average detector, unstated otherwise for a specific type of device. For device operating under Section 15.249, the limit is in terms of average with an additional peak limit of 20 dB over the average limit (see 47 CFR 15.249(e)).

Notes:

1. All Tx Spurious of the Fundamental measurements are radiated field – peak/average detector, max hold measurements – 1MHz RBW.
2. The product was tested in (3) axes – refer to section 4 for details.
3. The transmitter is single-channel.
4. Measurements were not adjusted by the allowed duty cycle correction factor per FCC 15.35/ IC RSS-GEN, Section 4.5.
5. The limit for RSS-210 is identical to the limit for FCC 15.249.

Setup Photographs: Radiated Tx Spurious Emissions – Including Restricted Band & Band Edge

Test Setup – Front View
Axis 1



Axis 2



Axis 3

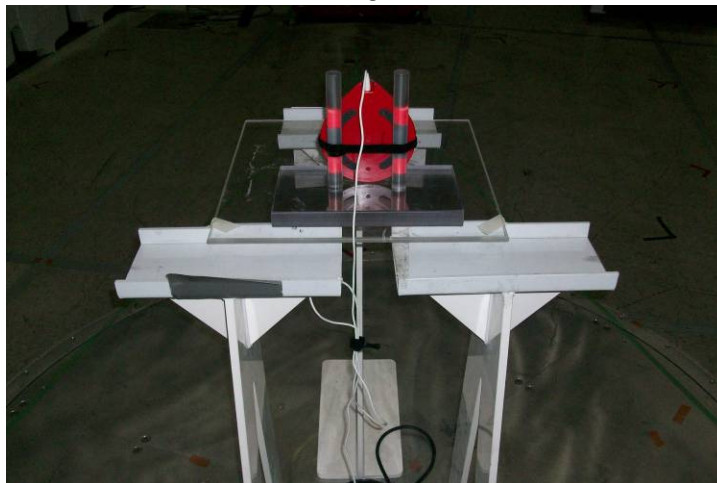


Setup Photographs: Radiated Tx Spurious Emissions – Including Restricted Band & Band Edge

Test Setup – Rear View
Axis 1



Axis 2



ERROR: stackunderflow
OFFENDING COMMAND: ~

STACK: