TEST REPORT

Report Number: 101262612DEN-001E
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

Report prepared by
Randy Thompson
Senior EMC Project Engineer

Report reviewed by
Mike Spataro
Engineering Team Leader

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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 "CC1101 #0 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
- **Radio #5 (CC1101 #0): 101262612DEN-001E (This report)**
- 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 coved under the laboratories scope.

2 Test Summary

Section	Test Specification	Test Description	Test Date	Result
5	Reference Only	6dB Bandwidth	09/05/2013	N/A Note3
6	FCC 15.249(a)	Radiated Field Strength Emissions – Tx Fundamental	09/05/2013	Pass
7	FCC 15.249(a)(e)	Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)	09/05/2013	Pass
8	FCC 15.209/15.249(d)(e)/15.205	Radiated Tx Spurious Emissions – Including Restricted Band & Band Edge	09/06/2013	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 was 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:	☒ 47 CFR, Part 15C:§15.249 ☐ RSS–210, Issue 8, 2010 ☐ RSS-Gen, Issue 3, 2010 ☒ 47 CFR, Part 15B:§15.107 and §15.109, Class B ☐ Other
Type of radio:	☒ Stand -alone ☐ Module ☐ Hybrid
Date Sample Submitted:	08/11/2013
Test Work Started:	08/14/2013
Test Work Completed:	09/18/2013
Test Sample Conditions:	☐ Damaged ☐ Poor (Usable) ☒ Good

Product Description:	Wireless RF-Enabled Home Automation Hub
Transmitter Type:	☐ FHSS ☒ Digital Modulation ☐ WiFi ☐ Blue Tooth
Operating Frequency Range(s):	Range From 903.0 to 927.0 MHz
Number of Channels:	44
Modulation:	FSK (deviation = 64kHz), Manchester Encoded, 38.4 Kbaud
Emission Designator:	489KF1D
Antenna(s) Info:	Antenna: Type: Ceramic Gain: -1.0 dBi Connector Type: N/A Integral Antenna
Rated Power:	93.11 dBuV @ 3-meters -2.12 dBm .614 mW
Antenna Installation:	☐ User ☐ Professional ☒ Factory
Transmitter power configuration:	☐ Internal battery ☒ 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)

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.

The product is configured with the following discrete radios:

- 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)

Note the radios do not transmit simultaneously and have (1) dedicated antenna/radio.

There are no signal or I/O ports or cables configured on the product.

The product is powered from an external AC Adapter.

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	---	---

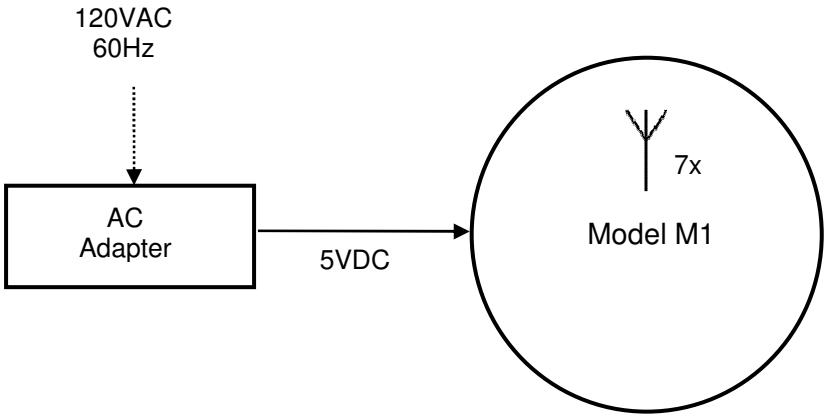
Descriptions of EUT Exercising
☒ Standby/Idle Mode
☒ Continuous transmission, un-modulated carrier (CW)
☒ Continuous transmission, modulated carrier (CW)
☒ Continuous Receive Mode

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.

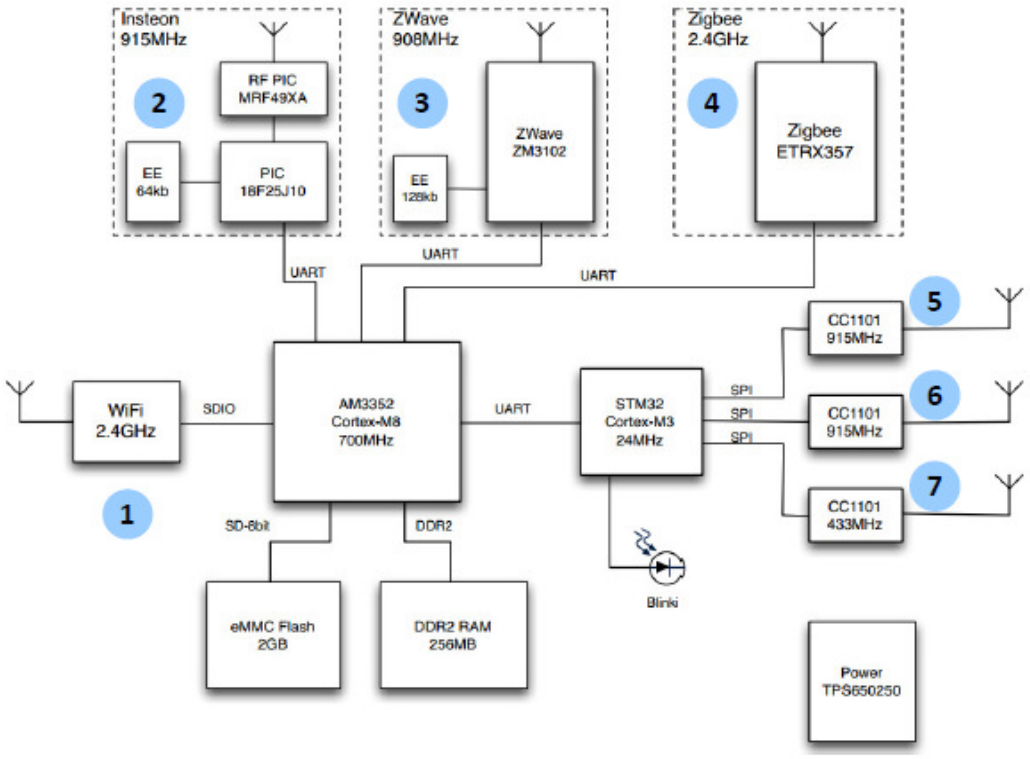
EUT Block Diagram: EMC Perspective



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.

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

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.

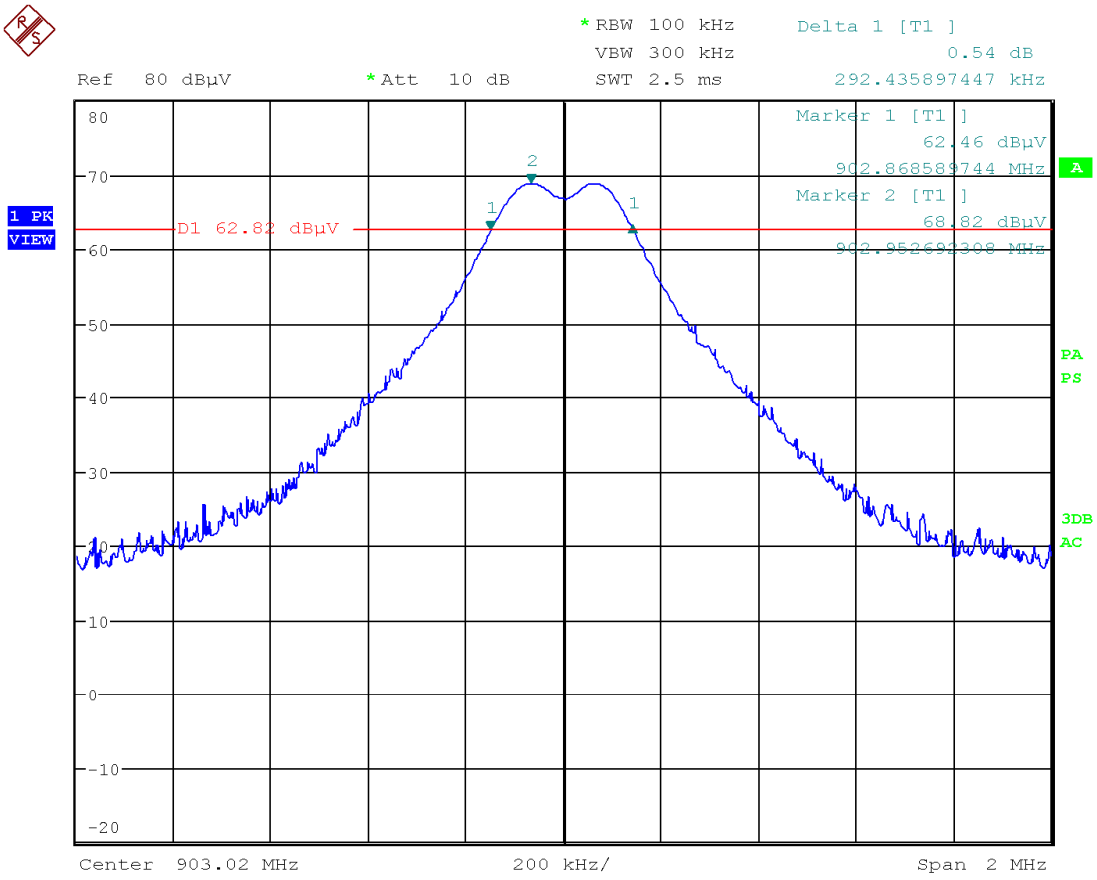
Test Equipment Used:

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:

Not applicable – measurement used for reference only – to determine minimum RBW required for testing fundamental.

Plot: 6dB Bandwidth



Date: 5.SEP.2013 09:21:15

Test Data: Reference Only – To determine RBW required for testing fundamental emissions.

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												
915.001	66.83	**Pk**	2.10	22.40	0.00	91.33	0.00	91.33	H	94.00	- 2.67	0.100
915.001	68.56	**Pk**	2.10	22.40	0.00	93.06	0.00	93.06	H	94.00	- 0.94	0.300
915.001	68.59	**Pk**	2.10	22.40	0.00	93.09	0.00	93.09	H	94.00	- 0.91	0.500

Test Method:

- N/A

Test Summary:

6dB Bandwidth Summary	
Channel/ Mode	**6dB Bandwidth**
915.00 MHz	293 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 taken at 3-meters..
3) For fundamental measurements, a RBW of 500kHz 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)

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:	☒ 902-928MHz ☐ 2400-2483.5MHz ☐ 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**
903.00	93.11	0.00	93.11	50	94	-0.89
Mid Frequency MHz						
915.00	92.90	0.00	92.90	50	94	-1.10
High Frequency MHz						
927.00	92.86	0.00	92.86	50	94	-1.14
RBW:	☐ 100kHz	☐ 300kHz	☒ 500kHz	☐ 1MHz	☐ 3MHz	☐ 10MHz
VBW:	☐ 300kHz	☐ 1MHz	☒ 1MHz	☐ 3 MHz	☐ 10MHz	☐ 10MHz
Antenna Gain:	☒ < 6dBi ☐ >6dBi and = ___ dBi, Output power reduction = ___ dB					

Test Method:

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

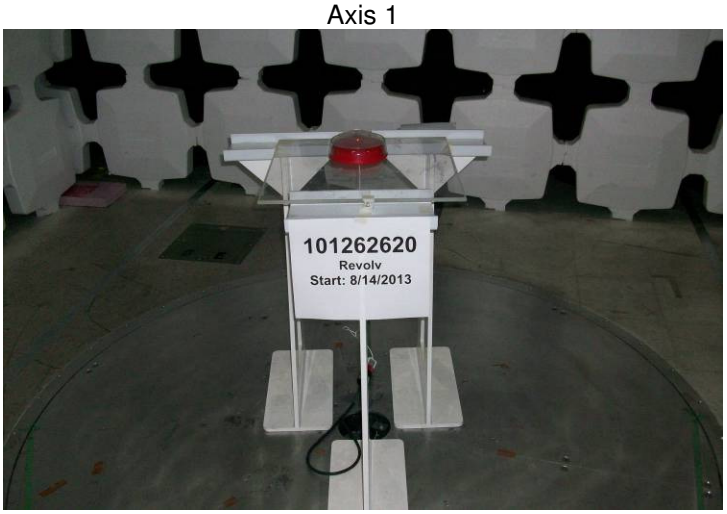
Notes:

1. All Fundamental measurements are radiated field - peak detector, max hold – 500kHz 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 multi-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



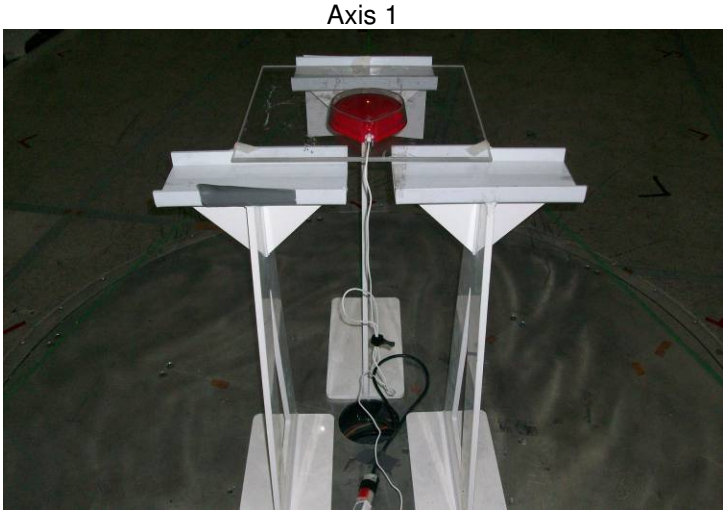
Axis 2

Axis 3

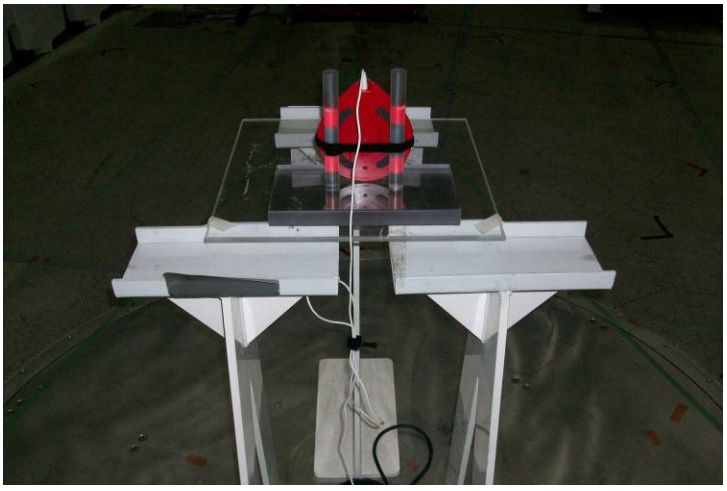
Setup Photographs: Radiated Field Strength Emissions – Tx Fundamental

Test Setup – Rear View

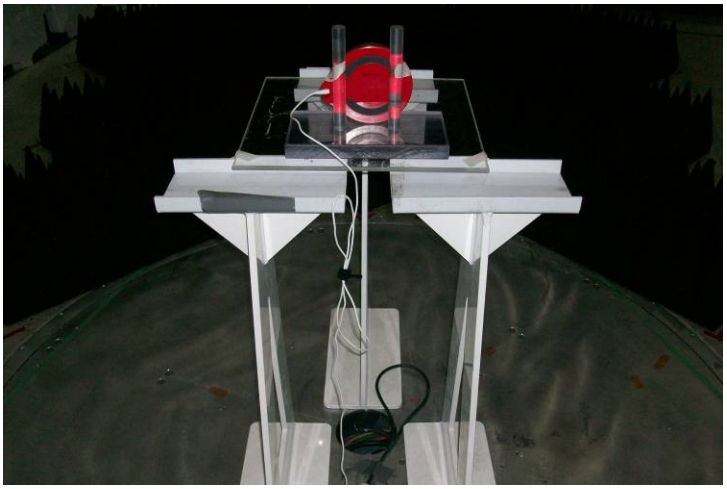
Axis 1



Axis 2



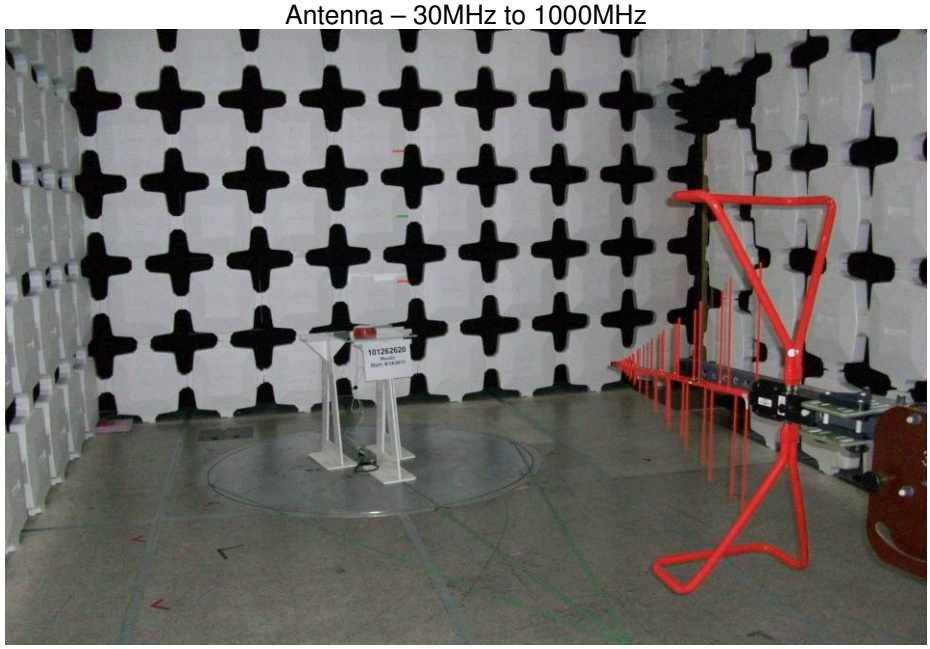
Axis 3



Setup Photographs: Radiated Field Strength Emissions – Tx Fundamental

Test Setup

Antenna – 30MHz to 1000MHz



Test Data: Radiated Field Strength Emissions – Tx Fundamental

Radiated Field Strength – Tx Fundamental

Test Report #:	**G101262612**	Test Area:	CC1 Radiated	Temperature:	23.1 °C
Test Method:	FCC 15.249(a)	Test Date:	05-Sep-2013	Relative Humidity:	33.2 %
EUT Model #:	M1	EUT Power:	120VAC/60Hz	Air Pressure:	82.8 kPa
EUT Serial #:	FCC1				
Manufacturer:	Revolv, Inc.				
EUT Description:	Revolv "Hub" – RF-Enabled Home Automation				
Notes:	Product transmitting continuously – C1101 #0 Radio active – FSK Modulated				
	Radio is multi-channel: Lowest Channel 903MHz, Mid Channel 915MHz, Highest Channel 927MHz				
	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: Not Applicable

No Duty Cycle Correction 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*$\log_{10}$(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 Low Channel														
903.0000	68.61	**Pk**	2.10	22.40	0.00	93.11	0.00	93.11	H	1.00	26.0	94.00	- 0.89	0.500
903.0000	57.66	**Pk**	2.10	22.40	0.00	82.16	0.00	82.16	V	2.70	343.0	94.00	- 11.84	0.500
Fundamental Measurements - Axis 2 - EUT Vertical on Table														
Tx Low Channel														
903.0000	62.10	**Pk**	2.10	22.40	0.00	86.60	0.00	86.60	V	1.20	110.0	94.00	- 7.40	0.500
903.0000	65.44	**Pk**	2.10	22.40	0.00	89.94	0.00	89.94	H	1.37	339.0	94.00	- 4.06	0.500
Fundamental Measurements - Axis 3 - EUT Vertical & Rotated 90 Degrees														
Tx Low Channel														
903.0000	59.26	**Pk**	2.10	22.40	0.00	83.76	0.00	83.76	H	1.55	346.0	94.00	- 10.24	0.500
903.0000	66.36	**Pk**	2.10	22.40	0.00	90.86	0.00	90.86	V	1.17	269.0	94.00	- 3.14	0.500
Fundamental Measurements - Axis 1 - EUT Flat on Table (Horizontal)														
Tx Mid Channel														
915.0500	66.57	**Pk**	2.11	22.40	0.00	91.08	0.00	91.08	V	1.16	257.0	94.00	- 2.92	0.500
915.0500	59.28	**Pk**	2.11	22.40	0.00	83.79	0.00	83.79	H	1.54	8.0	94.00	- 10.21	0.500
Fundamental Measurements - Axis 2 - EUT Vertical on Table														
Tx Mid Channel														

915.0500	64.67	**Pk**	2.11	22.40	0.00	89.18	0.00	89.18	H	1.41	336.0	94.00	- 4.82	0.500
915.0500	62.45	**Pk**	2.11	22.40	0.00	86.96	0.00	86.96	V	1.16	107.0	94.00	- 7.04	0.500
Fundamental Measurements - Axis 3 - EUT Vertical & Rotated 90 Degrees														
Tx Mid Channel														
915.0500	68.39	**Pk**	2.11	22.40	0.00	92.90	0.00	92.90	H	1.00	21.0	94.00	- 1.10	0.500
915.0500	57.74	**Pk**	2.11	22.40	0.00	82.25	0.00	82.25	V	2.74	332.0	94.00	- 11.75	0.500
Fundamental Measurements - Axis 1 - EUT Flat on Table (Horizontal)														
Tx High Channel														
927.0000	68.33	**Pk**	2.13	22.40	0.00	92.86	0.00	92.86	H	1.00	26.0	94.00	- 1.14	0.500
927.0000	58.34	**Pk**	2.13	22.40	0.00	82.87	0.00	82.87	V	2.66	333.0	94.00	- 11.13	0.500
Fundamental Measurements - Axis 2 - EUT Vertical on Table														
Tx HIgh Channel														
927.0000	62.61	**Pk**	2.13	22.40	0.00	87.14	0.00	87.14	V	1.08	58.0	94.00	- 6.86	0.500
927.0000	65.63	**Pk**	2.13	22.40	0.00	90.16	0.00	90.16	H	1.36	344.0	94.00	- 3.84	0.500
Fundamental Measurements - Axis 3 - EUT Vertical & Rotated 90 Degrees														
Tx High Channel														
927.0000	60.78	**Pk**	2.13	22.40	0.00	85.31	0.00	85.31	H	1.54	0.0	94.00	- 8.69	0.500
927.0000	67.07	**Pk**	2.13	22.40	0.00	91.60	0.00	91.60	V	1.17	250.0	94.00	- 2.40	0.500

7 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:	☒ 902-928MHz ☐ 2400-2483.5MHz ☐ 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**
5418.480 (Average)	36.39	0.00	36.39	500	54	-17.61
5418.480 (Peak)	48.95	0.00	48.95	20dB above average	74	-25.05
Mid Harmonic Frequency MHz						
5418.480 (Average)	39.11	0.00	39.11	500	54	-14.89
5418.480 (Peak)	50.53	0.00	50.53	20dB above average	74	-23.47
High Harmonic Frequency MHz						
5562.440 (Average)	38.63	0.00	38.63	500	54	-15.37
5562.440 (Peak)	50.45	0.00	50.45	20dB above average	74	-23.55
RBW:	☐ 100kHz	☐ 300kHz	☐ 500kHz	☒ 1MHz	☐ 3MHz	☐ 10MHz
VBW:	☐ 300kHz	☐ 1MHz	☐ 1MHz	☒ 3 MHz	☐ 10MHz	☐ 10MHz
Antenna Gain:	☒ < 6dBi ☐ >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 valve 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:

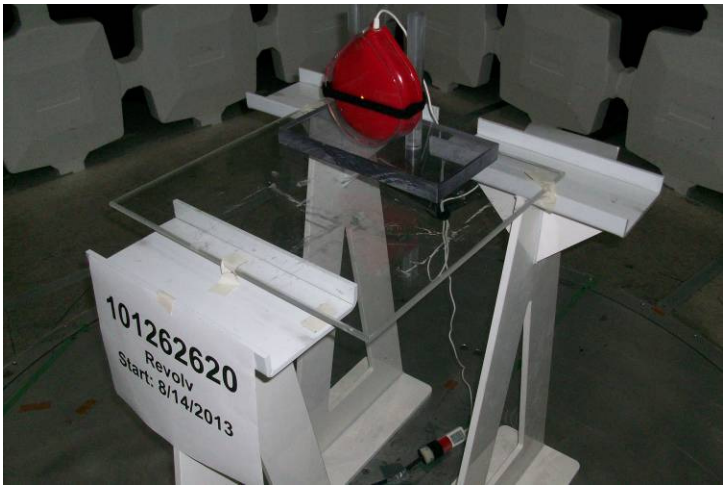
1. All Harmonics of the Fundamental measurements are radiated field – peak/average detector, max hold measurements – 1MHz RBW.
2. The product was tested in (3) axes – refer to section 4 for details.
3. The transmitter is single-channel.
4. Measurements were not adjusted by the allowed duty cycle correction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

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

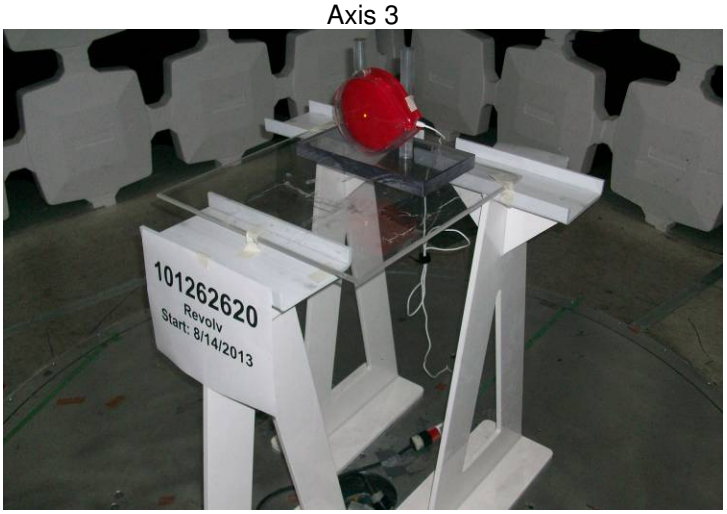
Test Setup – Front View

Axis 1

Axis 2



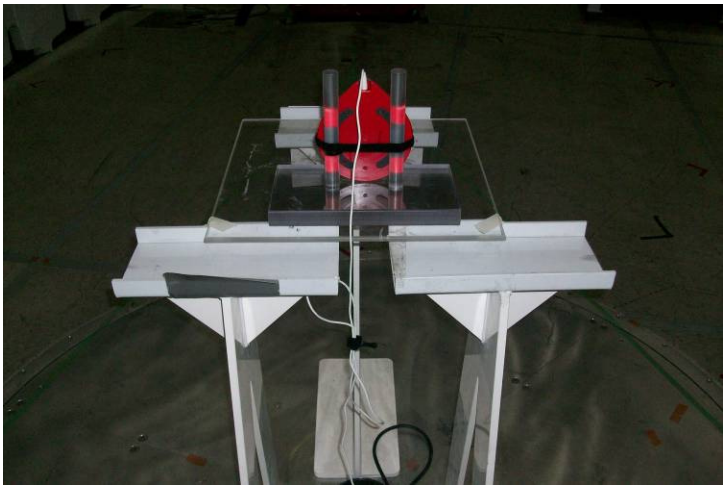
Axis 3



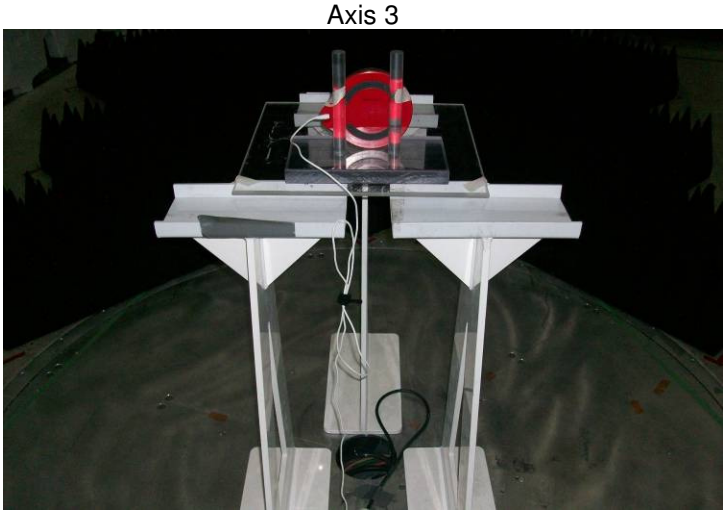
Setup Photographs: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

Test Setup – Rear View
Axis 1

Axis 2



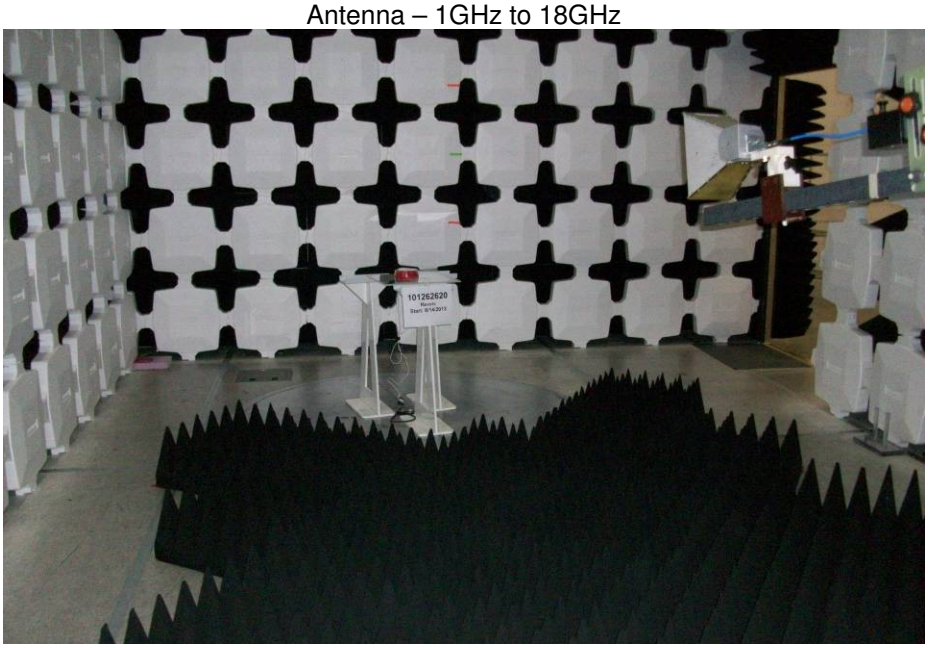
Axis 3



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

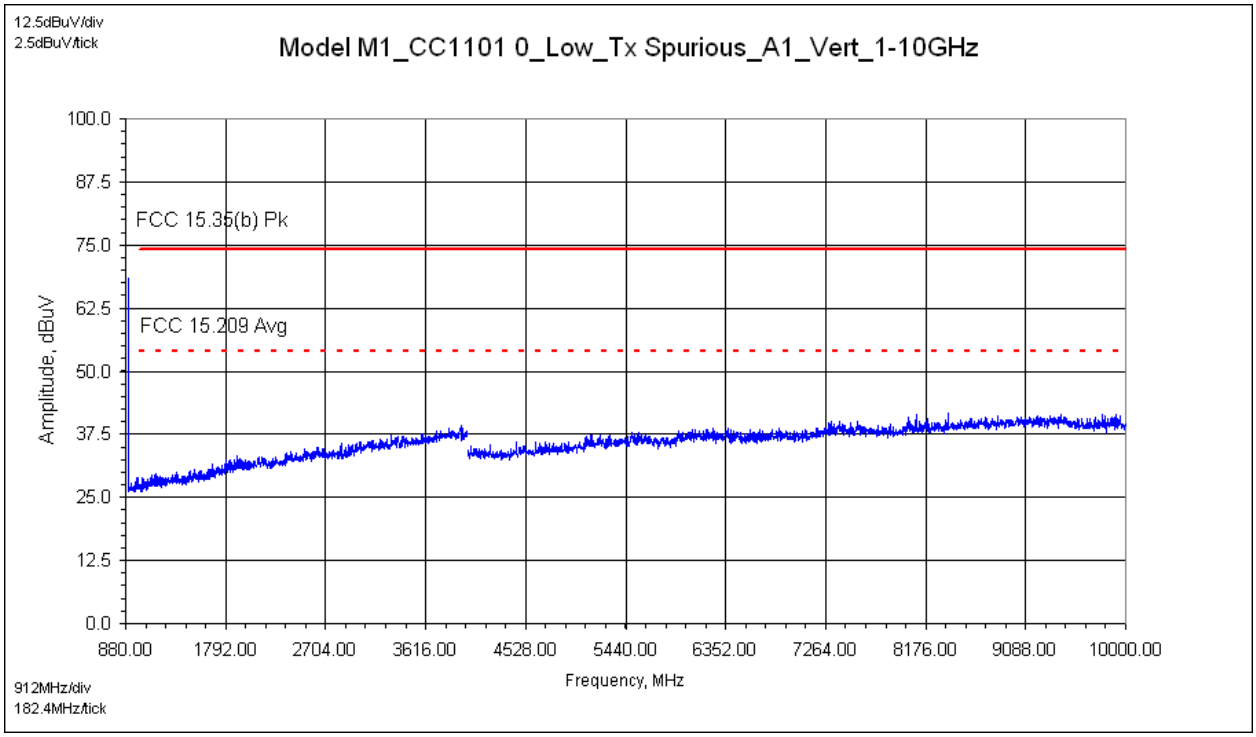
Test Setup

Antenna – 1GHz to 18GHz

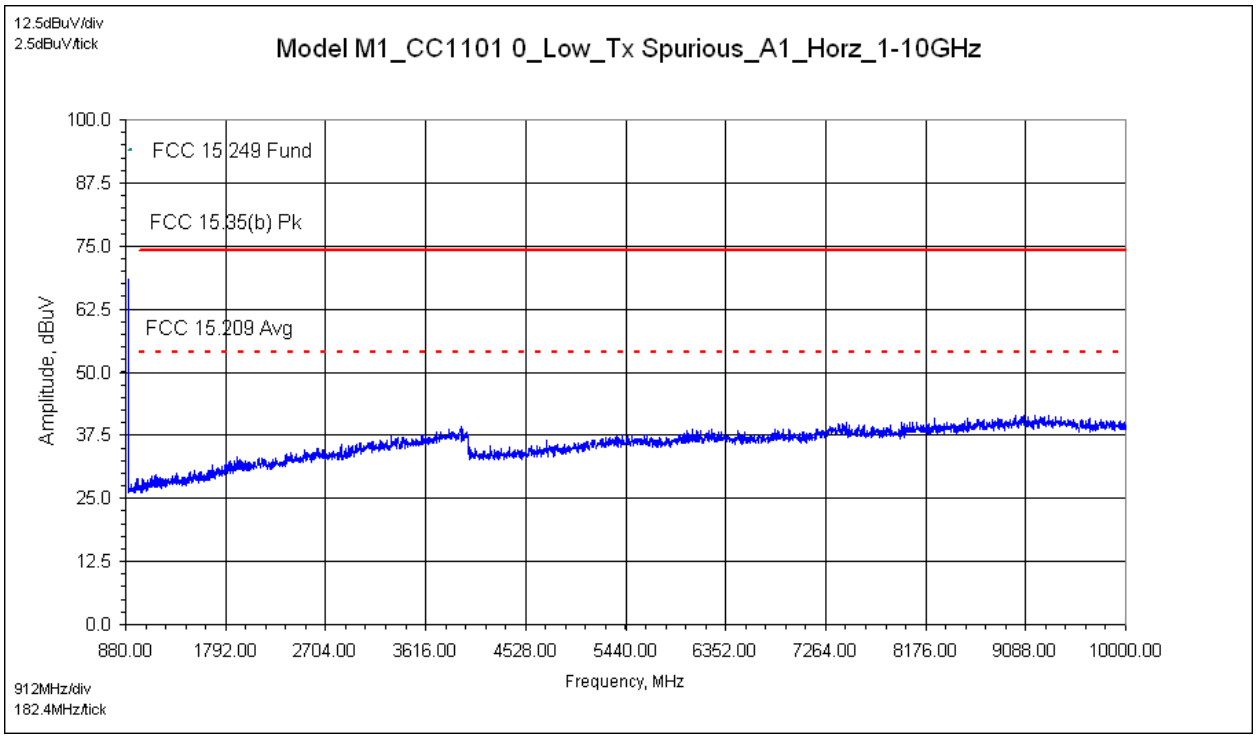


Plots: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

Low Channel: Axis 1 – Vertical

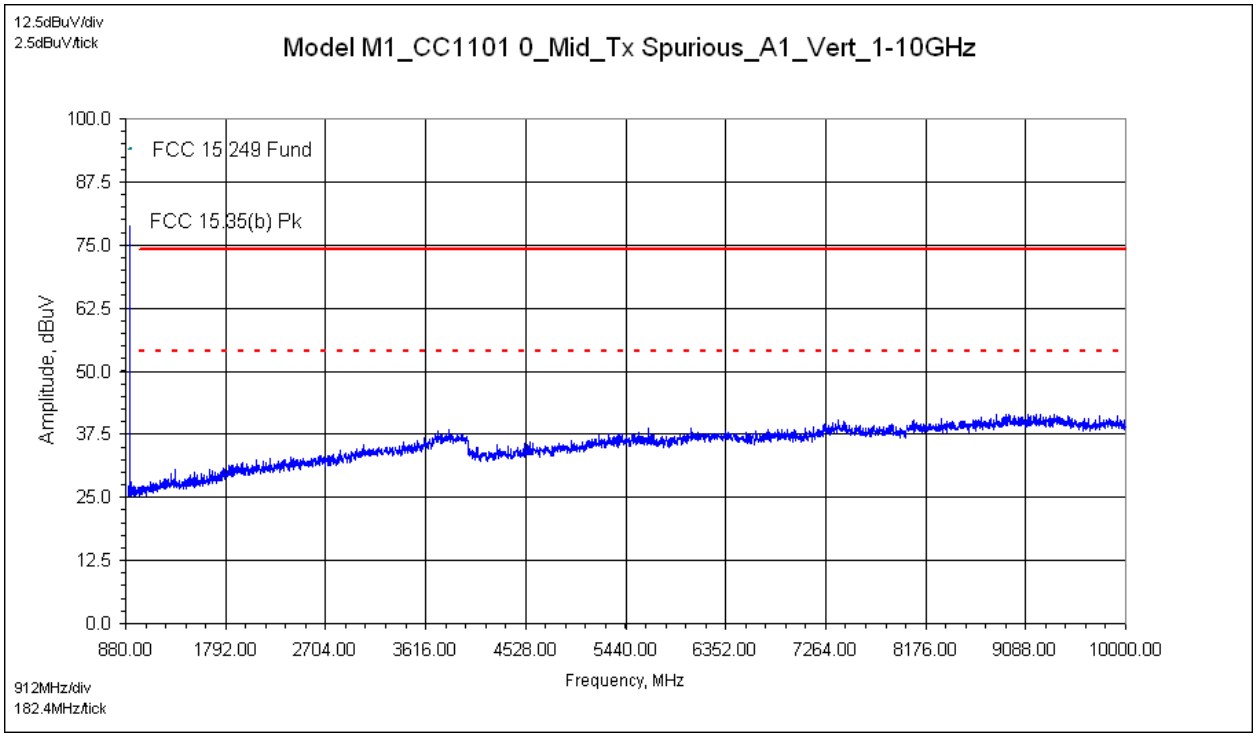


Low Channel: Axis 1 – Horizontal

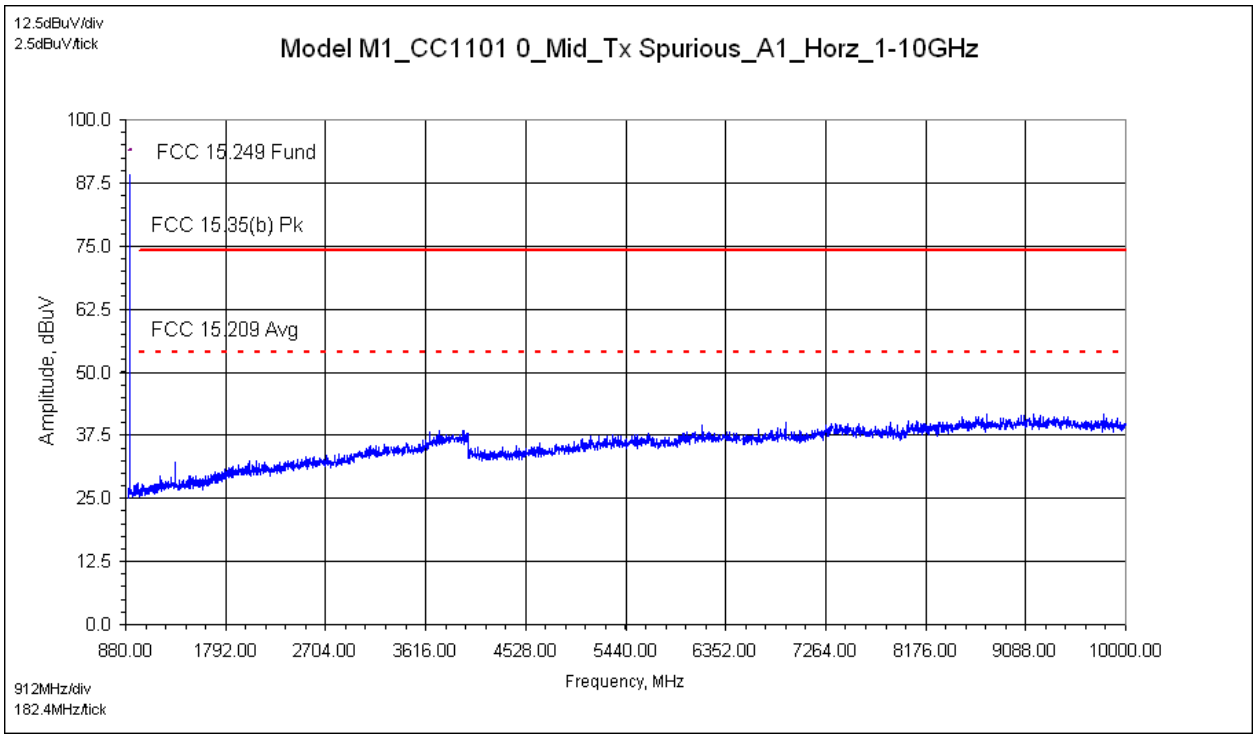


Plots: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

Mid Channel: Axis 1 – Vertical

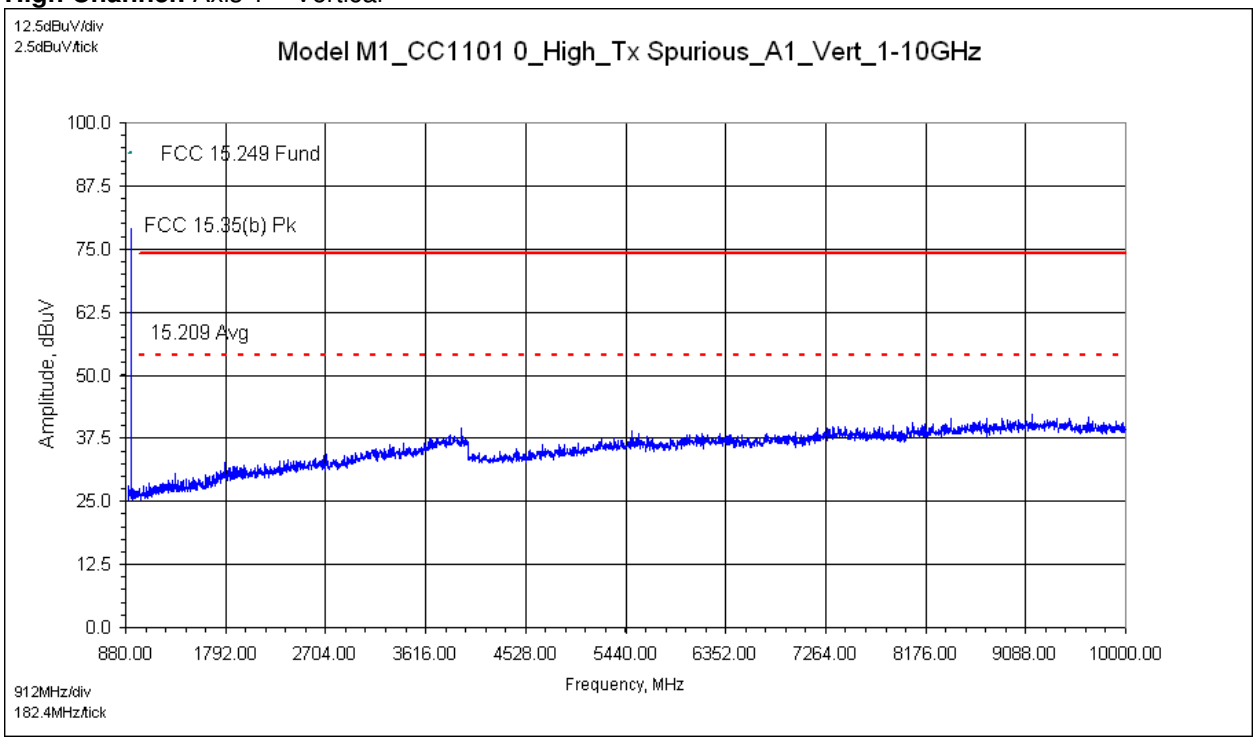


Mid Channel: Axis 1 – Horizontal

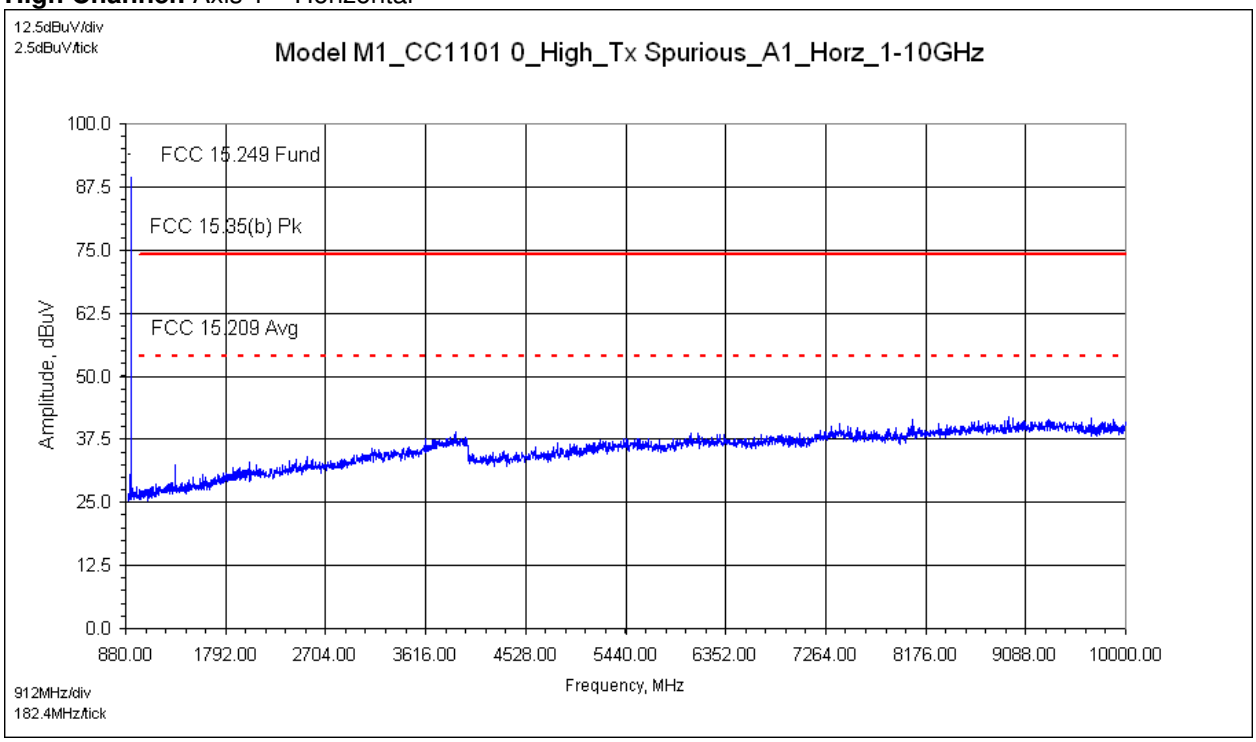


Plots: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

High Channel: Axis 1 – Vertical

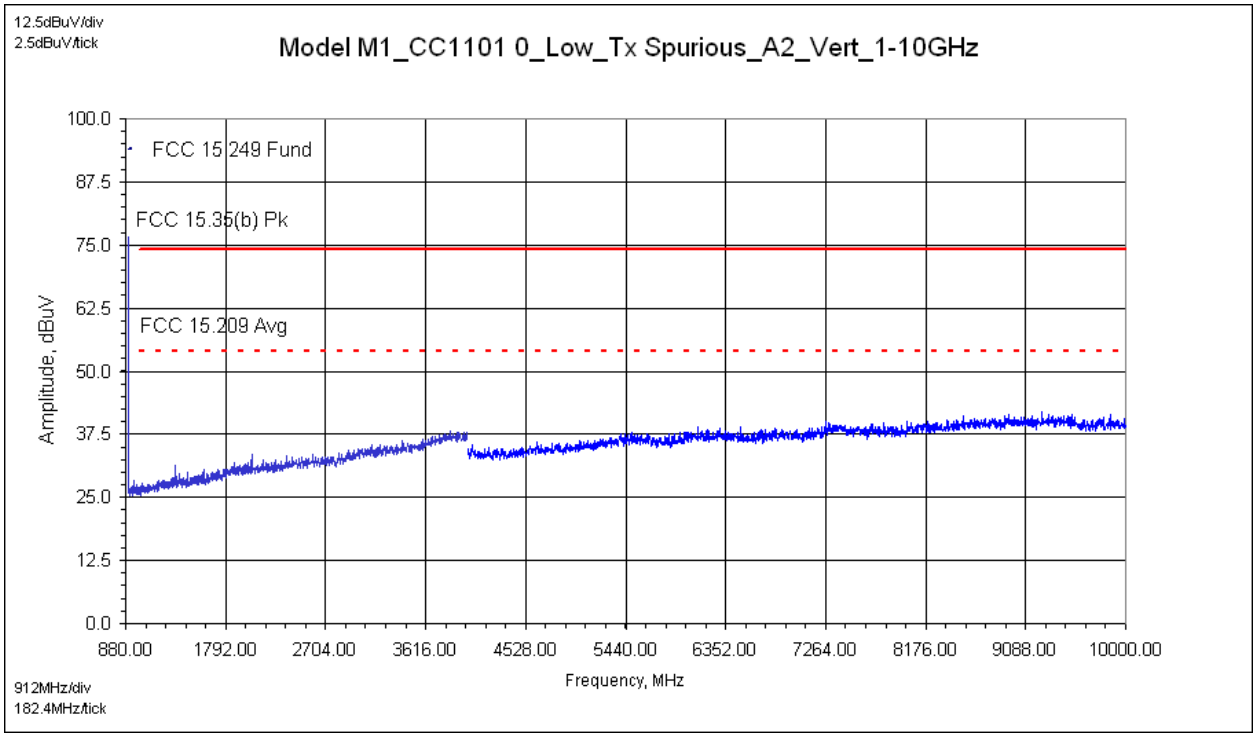


High Channel: Axis 1 – Horizontal

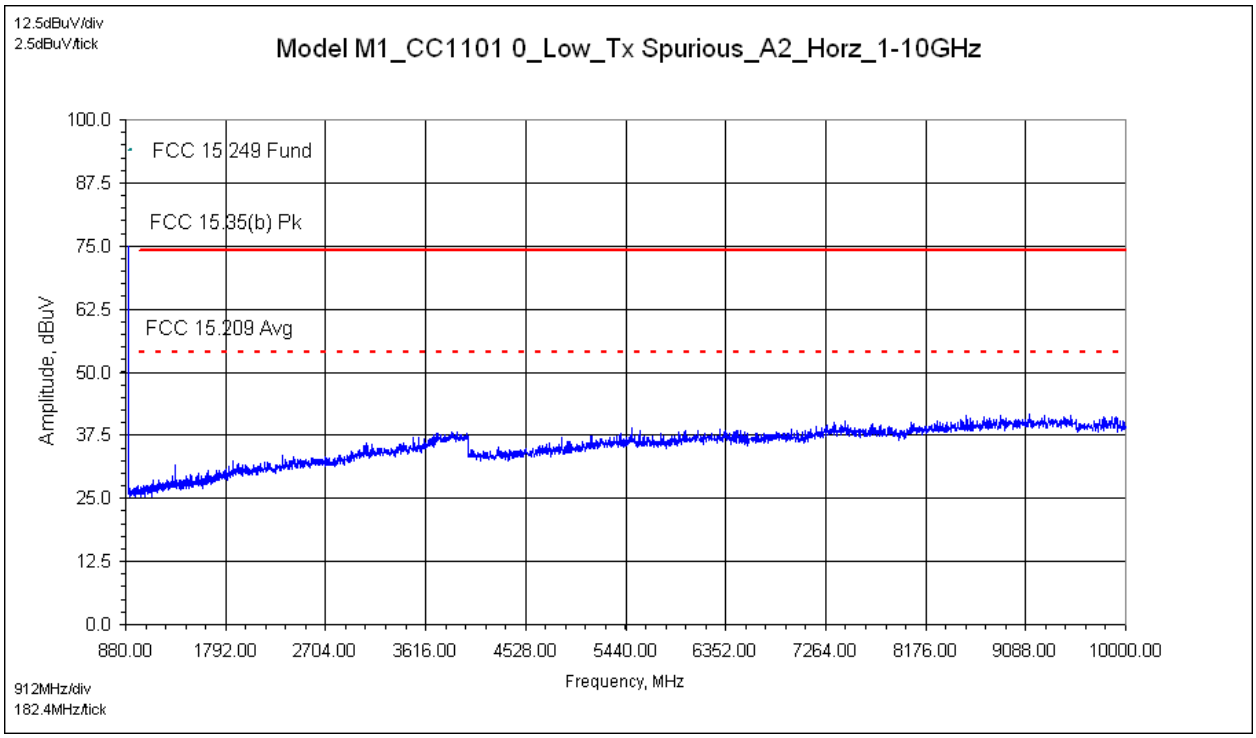


Plots: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

Low Channel: Axis 2 – Vertical

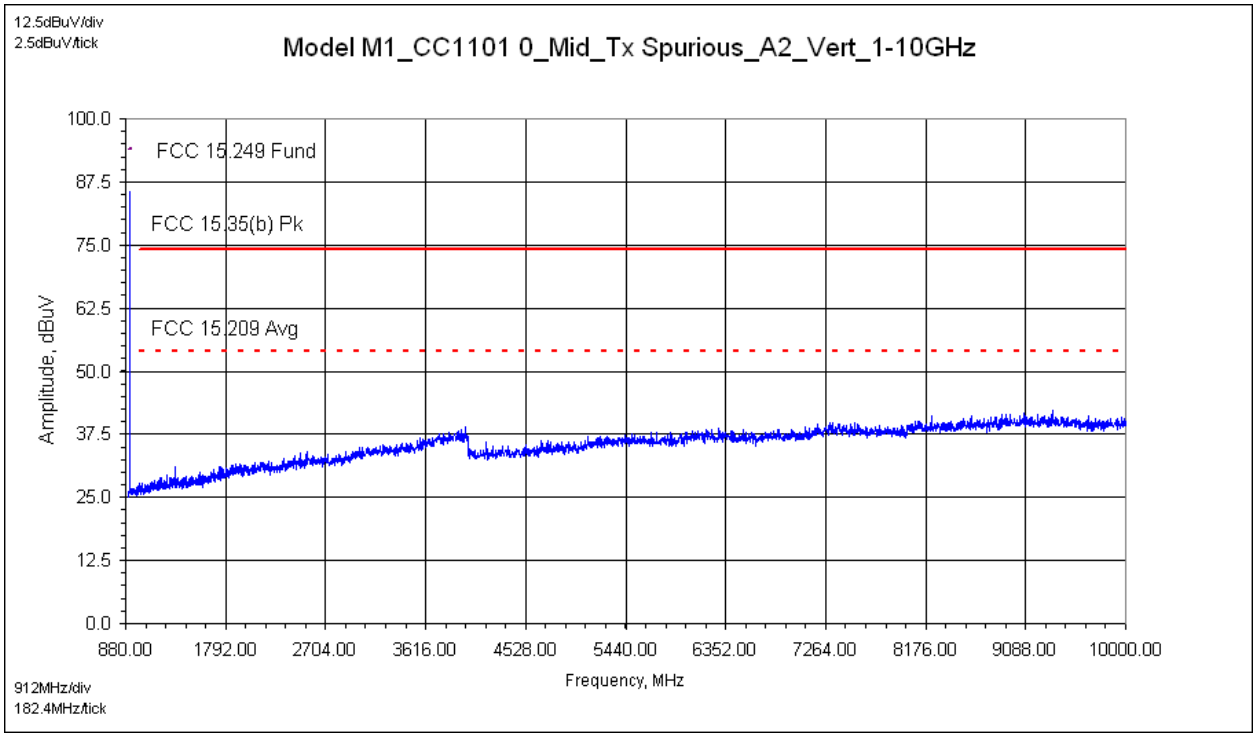


Low Channel: Axis 2 – Horizontal

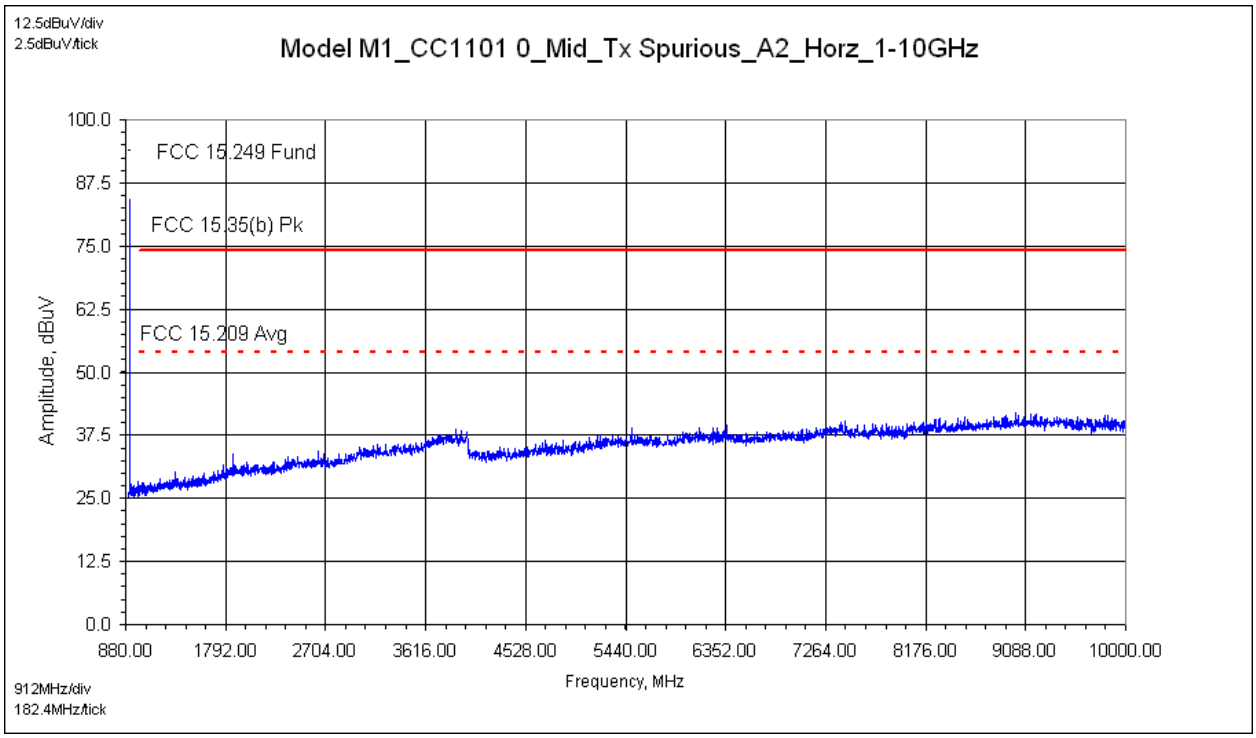


Plots: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

Mid Channel: Axis 2 – Vertical

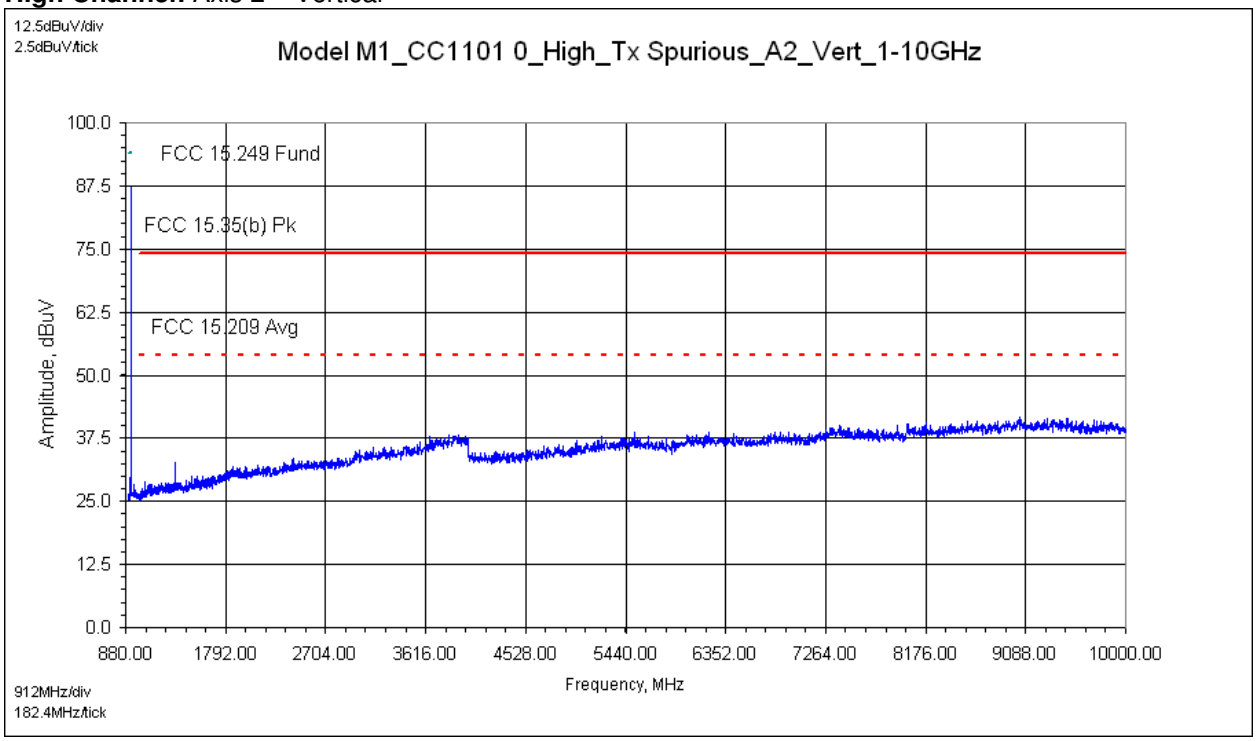


Mid Channel: Axis 2 – Horizontal

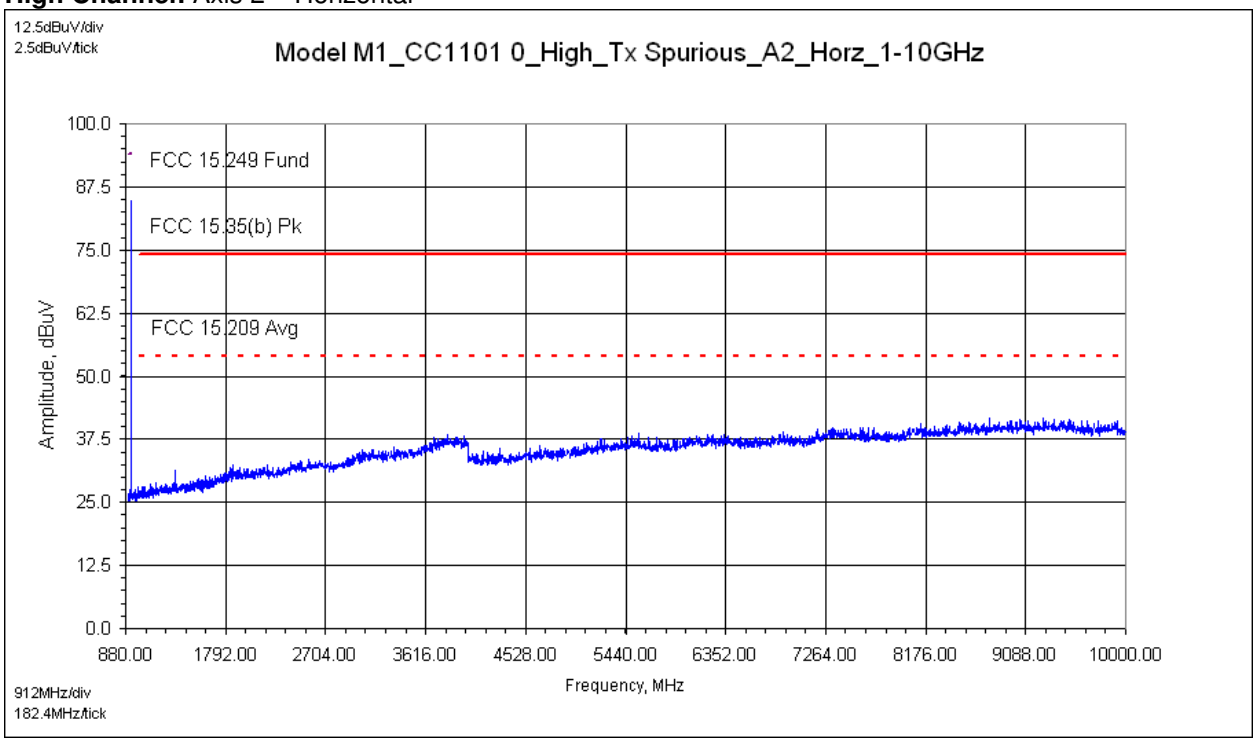


Plots: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

HIgh Channel: Axis 2 – Vertical

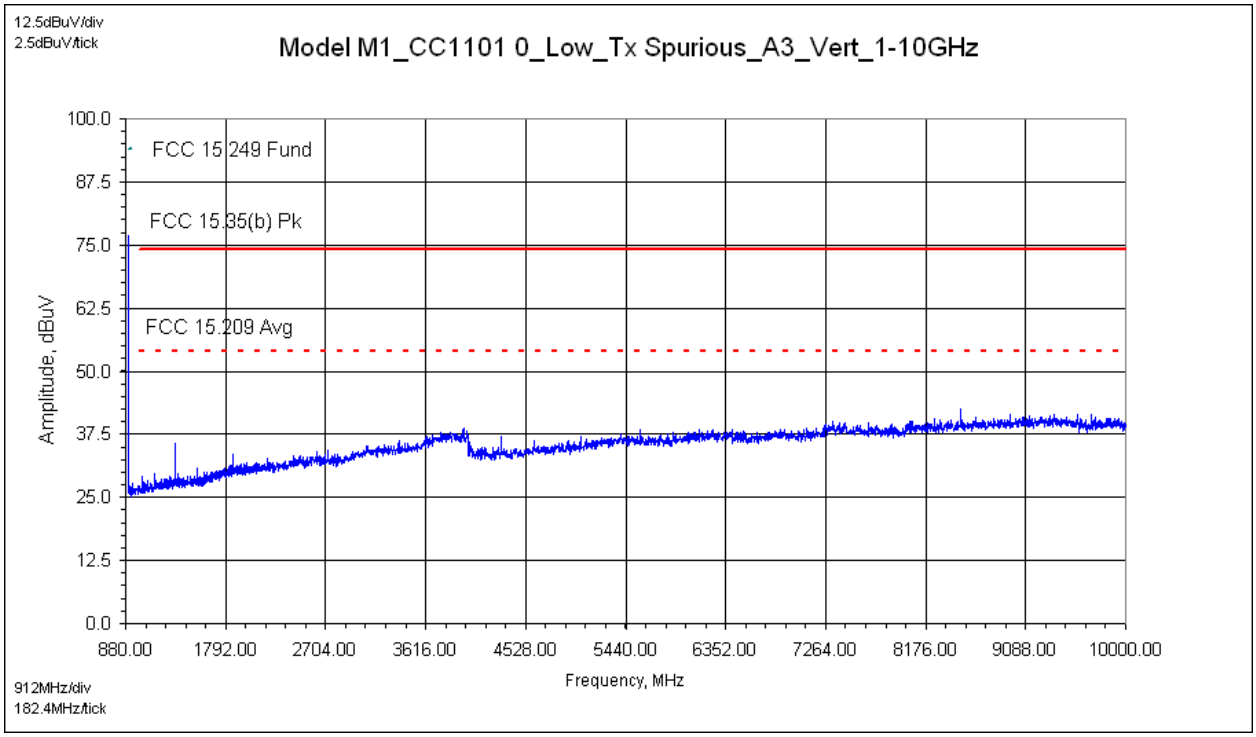


High Channel: Axis 2 – Horizontal

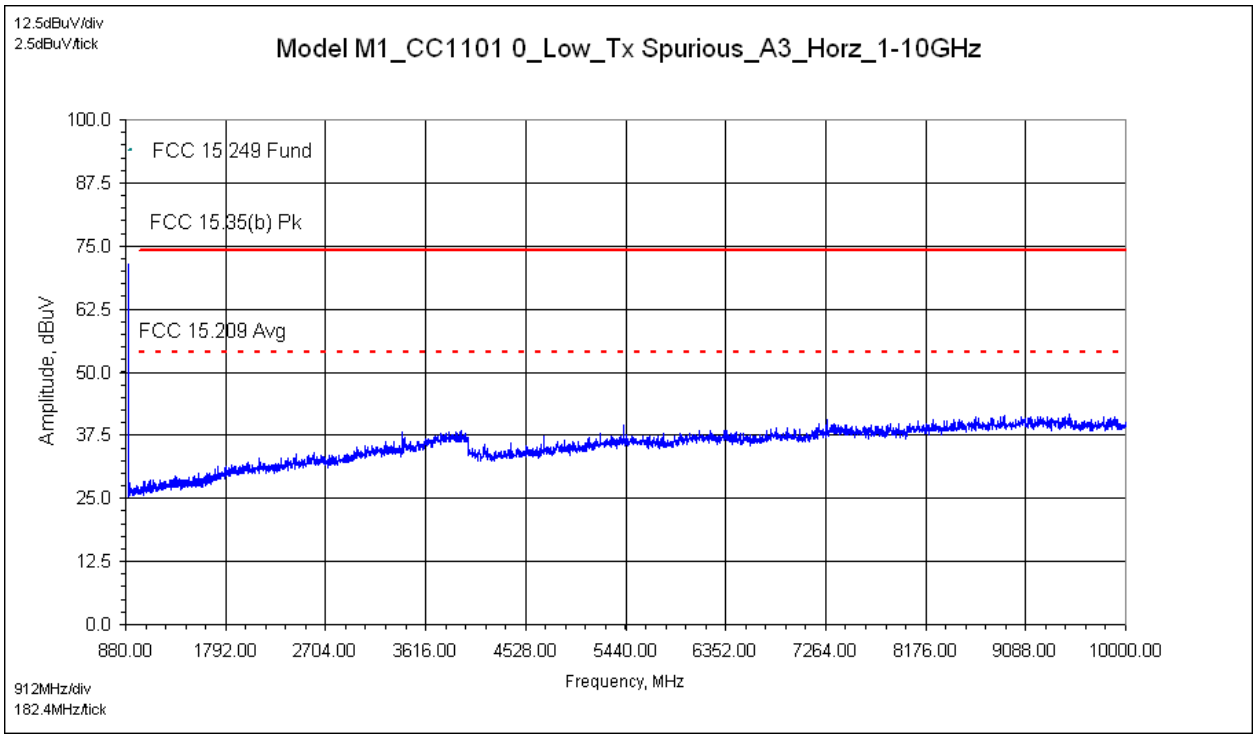


Plots: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

Low Channel: Axis 3 – Vertical

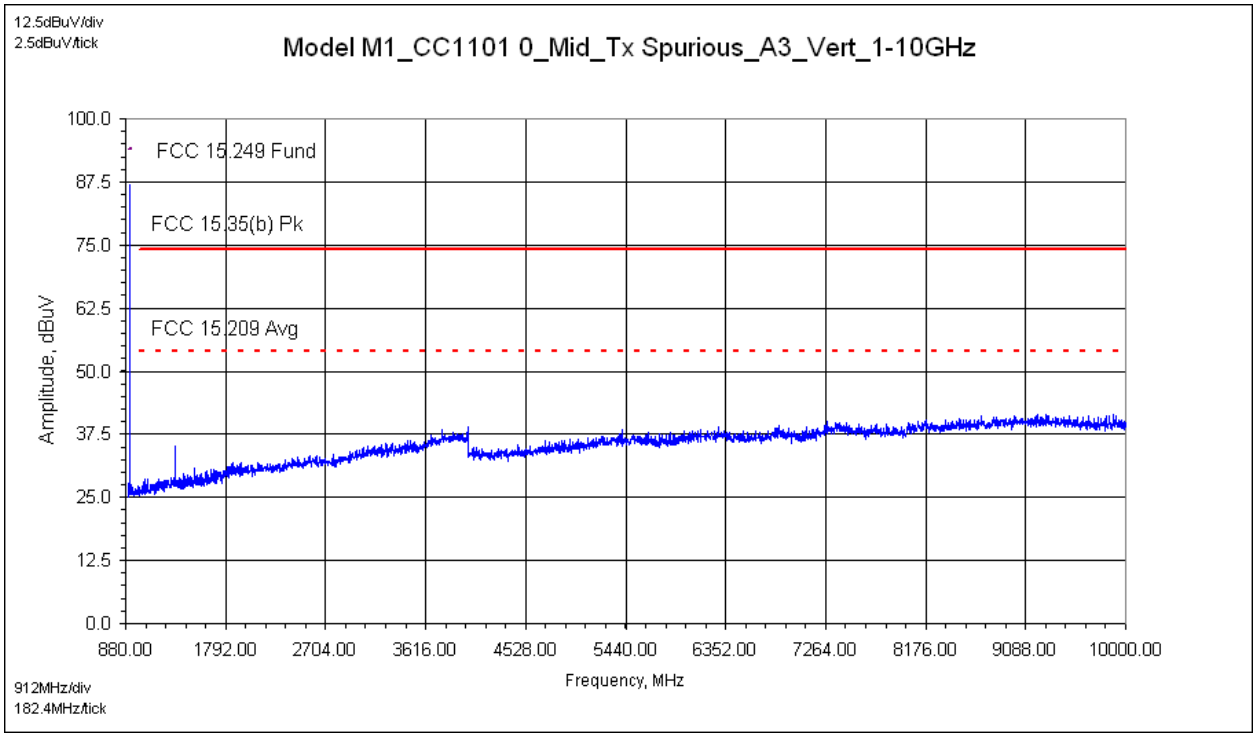


Low Channel: Axis 3 – Horizontal

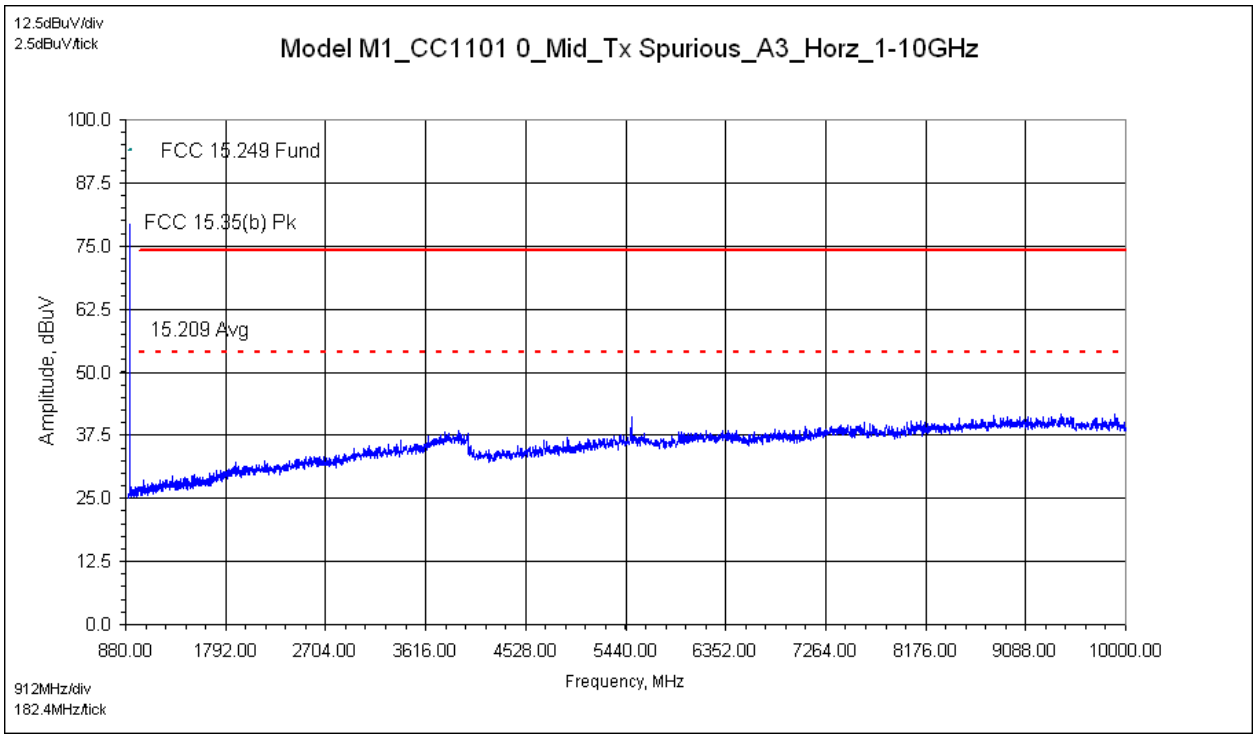


Plots: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

Mid Channel: Axis 3 – Vertical

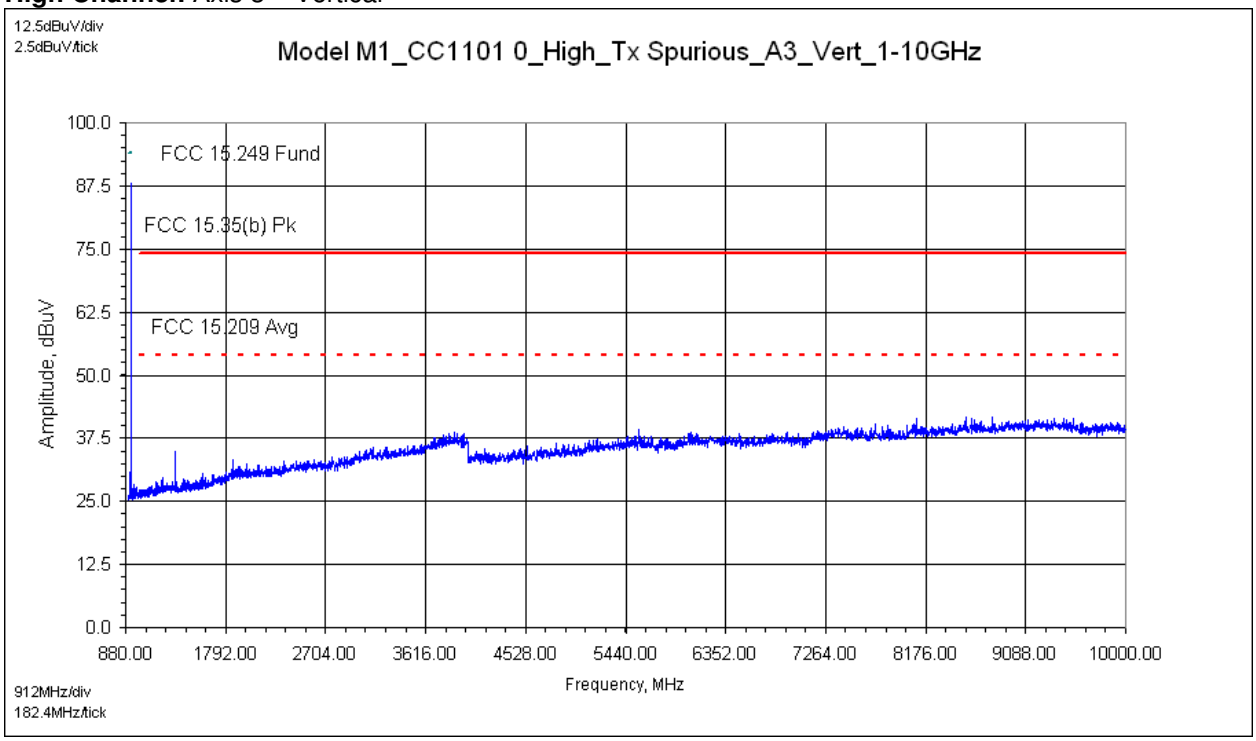


Mid Channel: Axis 3 – Horizontal

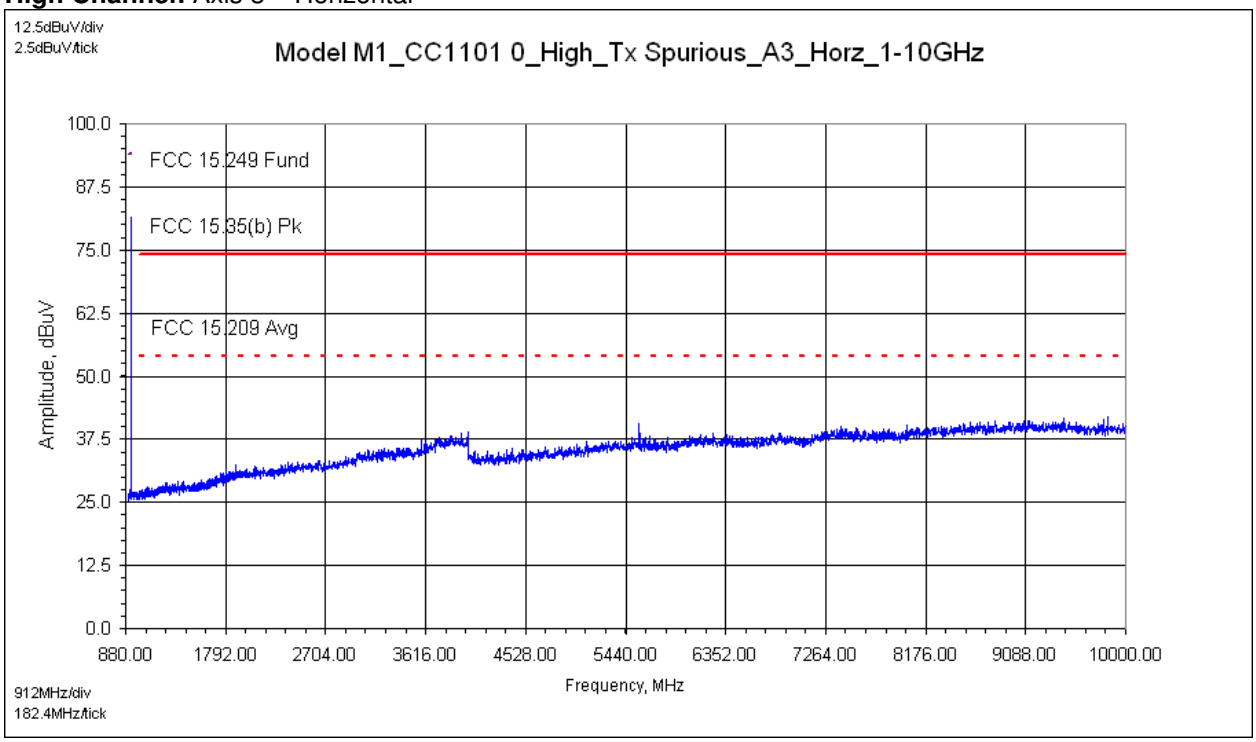


Plots: Radiated Field Strength - Harmonics of the Fundamental (Out-of-Band Emissions)

High Channel: Axis 3 – Vertical



High Channel: Axis 3 – Horizontal



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:	06-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 – C1101 #0 Radio active – FSK Modulated

Radio is multi-channel: Lowest Channel 903.00MHz, Mid Channel 915MHz, Highest Channel 927.00MHz

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 $20*\log_{10}$ (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: Low Channel Axis 1 – Product Flat on Table (Horizontal)														
1806.0000	35.08	**Av**	3.02	26.81	37.06	27.85	0.00	27.85	H	1.00	27.0	54.00	-26.15	1.000
1806.0000	48.68	**Pk**	3.02	26.81	37.06	41.45	0.00	41.45	H	1.00	27.0	74.00	-32.55	1.000
Tx Harmonics 1-8GHz: Low Channel Axis 3 – Product Vertical & rotated 90 degrees														
5418.4800	48.17	**Pk**	5.48	34.25	38.95	48.95	0.00	48.95	H	1.62	115.0	74.00	-25.05	1.000
5418.4800	35.61	**Av**	5.48	34.25	38.95	36.39	0.00	36.39	H	1.62	115.0	54.00	-17.61	1.000
Tx Harmonics 1-8GHz: Mid Channel Axis 3 – Product Vertical & rotated 90 degrees														
5490.4600	49.64	**Pk**	5.52	34.35	38.99	50.53	0.00	50.53	H	1.47	311.0	74.00	-23.47	1.000
5490.4600	38.22	**Av**	5.52	34.35	38.99	39.11	0.00	39.11	H	1.47	311.0	54.00	-14.89	1.000
Tx Harmonics 1-8GHz: High Channel Axis 3 – Product Vertical & Rotated 90 degrees														
5562.4400	49.61	**Pk**	5.55	34.28	38.99	50.45	0.00	50.45	H	1.65	271.0	74.00	-23.55	1.000
5562.4400	37.79	**Av**	5.55	34.28	38.99	38.63	0.00	38.63	H	1.65	271.0	54.00	-15.37	1.000
Tx Harmonics 8-18GHz: No signals found – refer to pre-scans														

Harmonics in Restricted Bands – Reference Only

fundamental			Harmonics							
MHz0	MHz1	MHz2	MHz3	MHz4	MHz5	MHz6	MHz7	MHz8	MHz9	MHz10
903	903.00	1806.00	**2709.00**	**3612.00**	**4515.00**	**5418.00**	6321.00	7224.00	**8127.00**	**9030.00**
915	915.00	1830.00	**2745.00**	**3660.00**	**4575.00**	5490.00	6405.00	**7320.00**	**8235.00**	**9150.00**
927	927.00	1854.00	**2781.00**	**3708.00**	**4635.00**	5562.00	6489.00	**7416.00**	**8343.00**	9270.00

8 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:

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 Tx Spurious Emissions – Including Restricted Band & Band Edge

Tx Spurious Emissions	Radiated Field Strength @ 3-meters					
Frequency Range:	☒ 902-928MHz ☐ 2400-2483.5MHz ☐ 5725-5850MHz					
Worst-case measurement (includes band edge)	**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						
928.010	42.68	0.00	42.68	---	46.02	-3.34
band edge						
RBW:	☒ 120kHz	☐ 300kHz	☐ 500kHz	☐ 1MHz	☐ 3MHz	☐ 10MHz
VBW:	☒ 300kHz	☐ 1MHz	☐ 1MHz	☐ 3 MHz	☐ 10MHz	☐ 10MHz
Antenna Gain:	☒ < 6dBi	☐ >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 valve 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)).

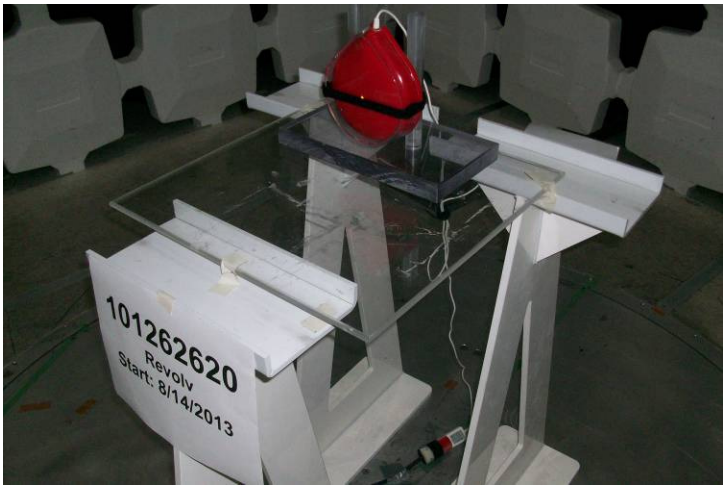
Notes:

1. All Tx Spurious of the Fundamental measurements are radiated field taken at 3-meters.
   30MHz-1000MHz: RBW 120kHz, quasi-peak detector, max hold
   Above 1GHz: RBW 1MHz, average/peak detector, max hold
2. The product was tested in (3) axes – refer to section 4 for details.
3. The transmitter is multi-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.

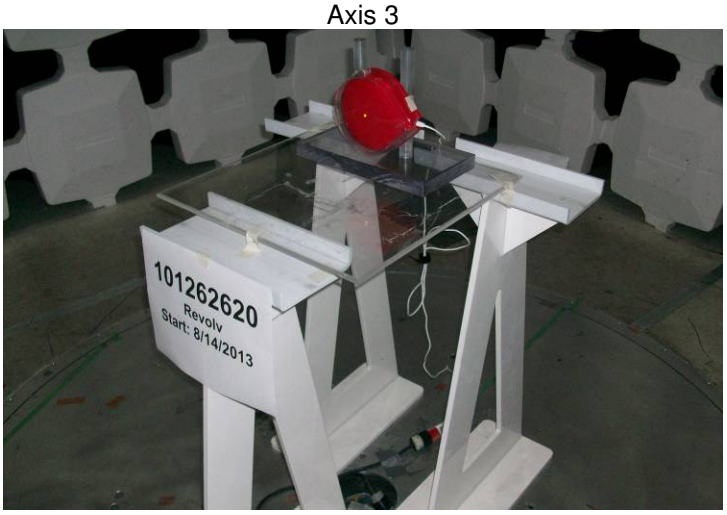
Setup Photographs: Radiated Tx Spurious Emissions – Including Restricted Band & Band Edge

Test Setup – Front View
Axis 1

Axis 2



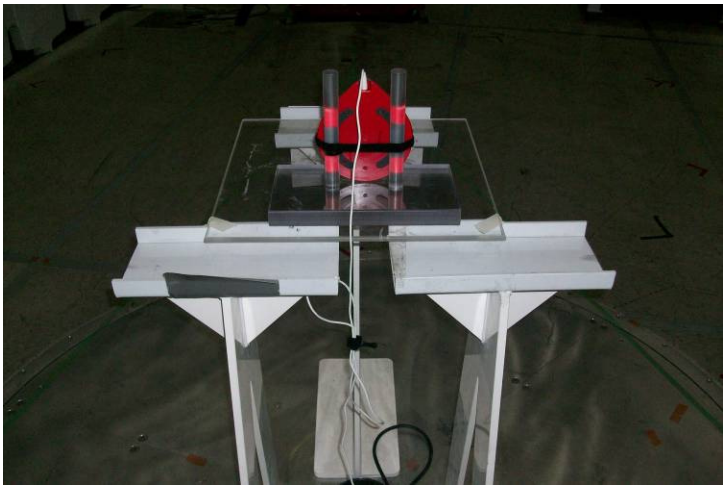
Axis 3



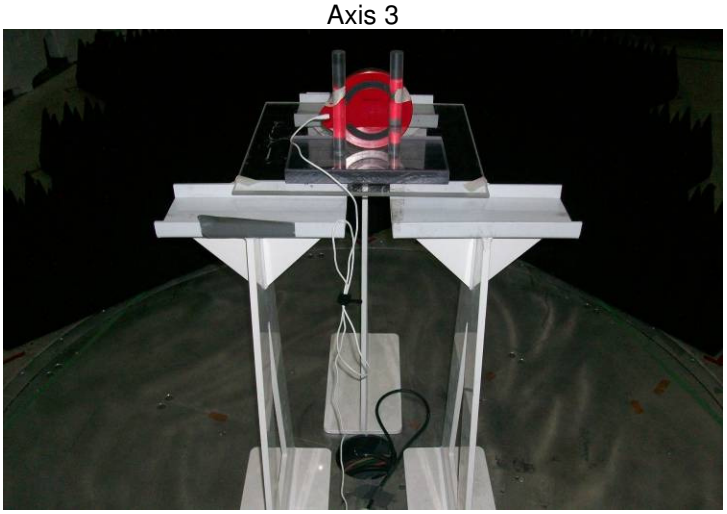
Setup Photographs: Radiated Tx Spurious Emissions – Including Restricted Band & Band Edge

Test Setup – Rear View
Axis 1

Axis 2



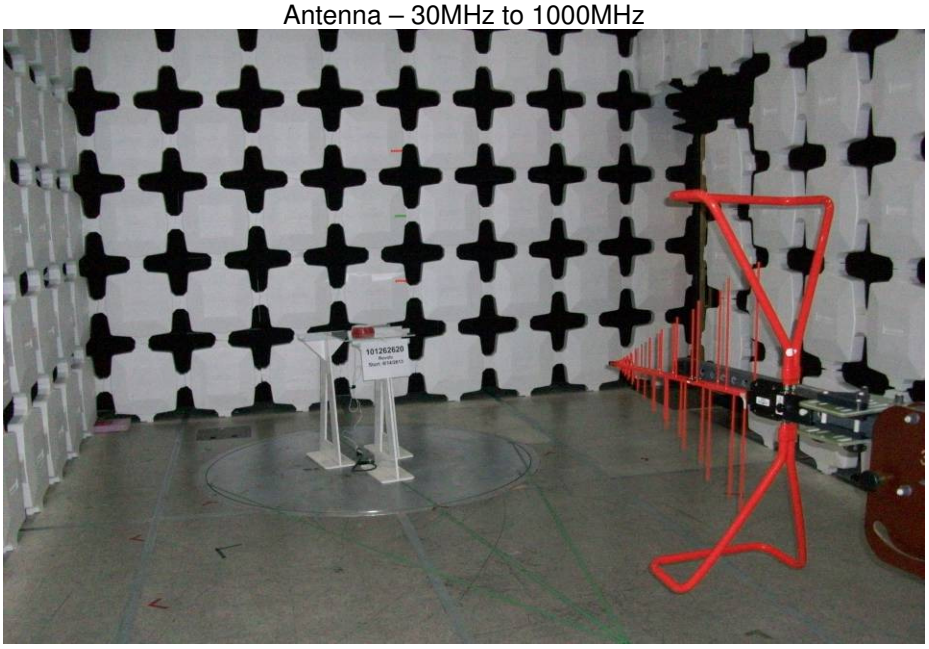
Axis 3



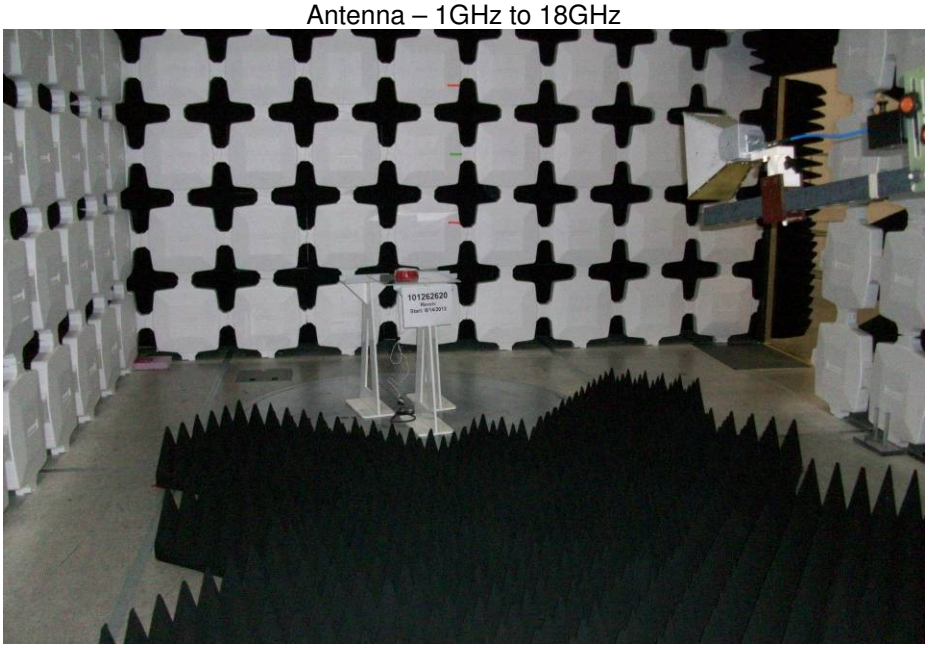
Setup Photographs: Radiated Tx Spurious Emissions – Including Restricted Band & Band Edge

Test Setup

Antenna – 30MHz to 1000MHz

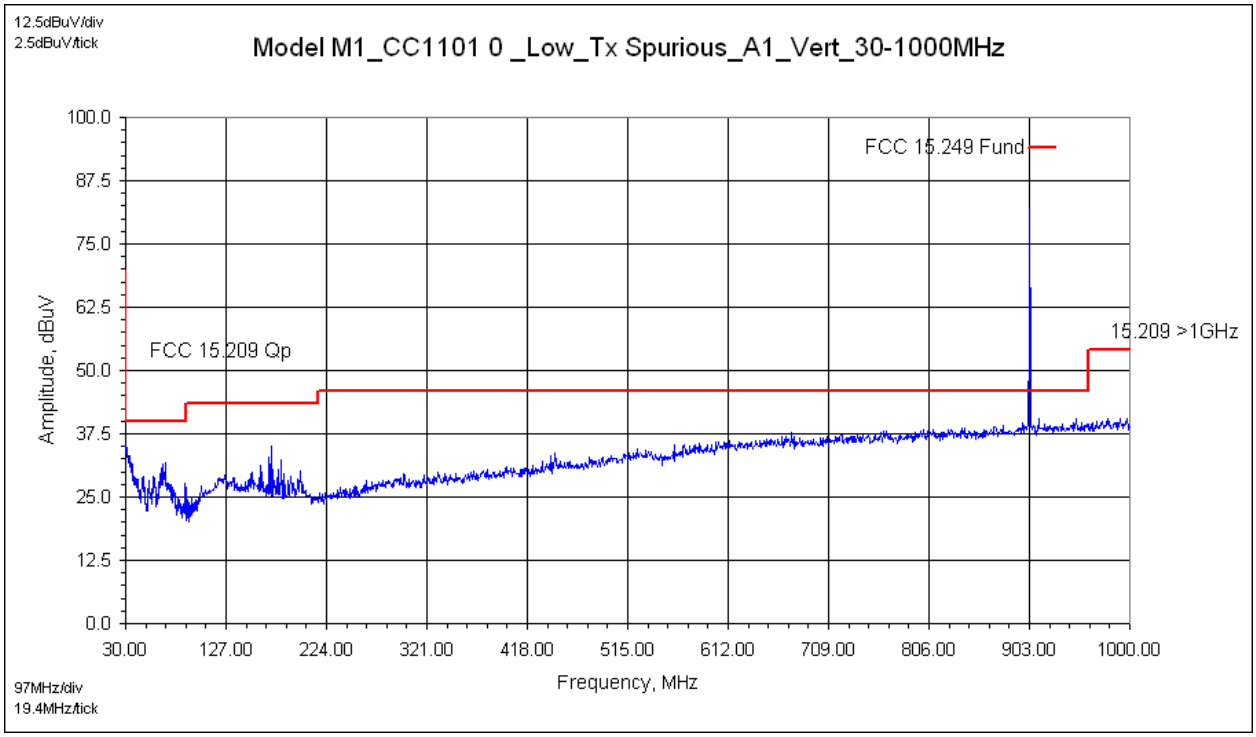


Antenna – 1GHz to 18GHz

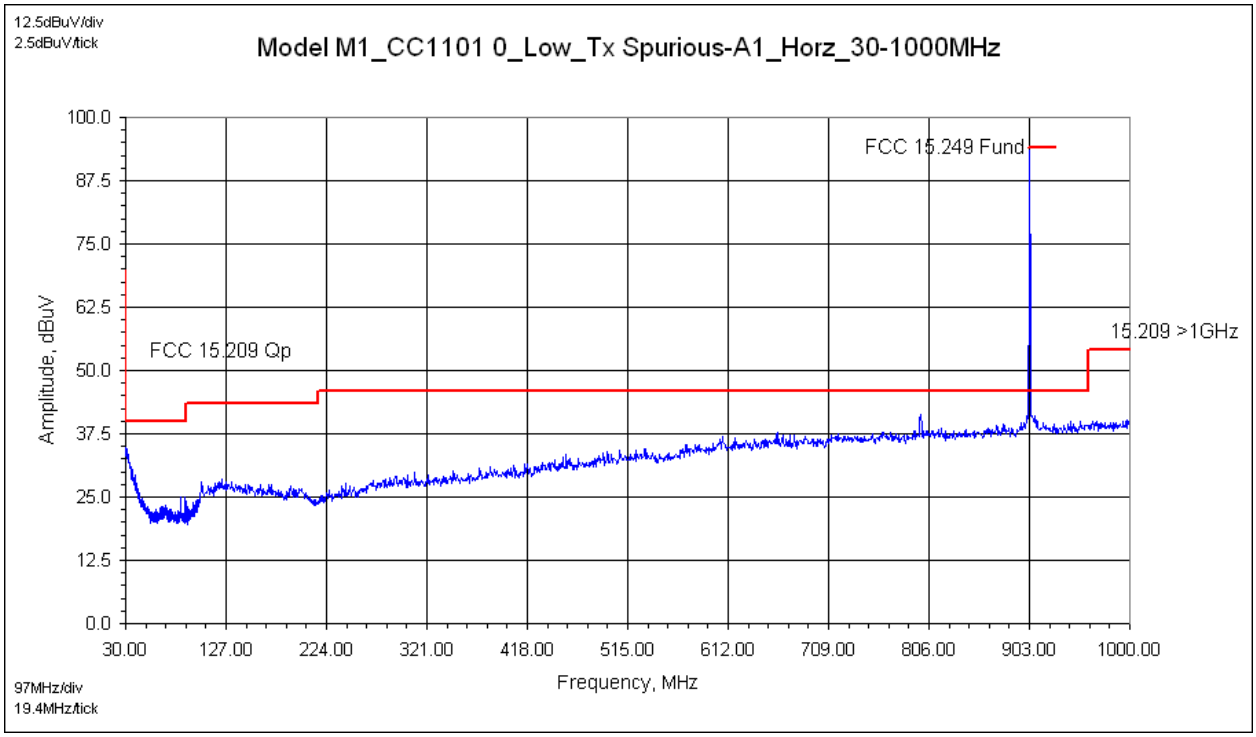


Plots: Tx Spurious Emissions 30-1000MHz

Low Channel: Axis 1 – Vertical

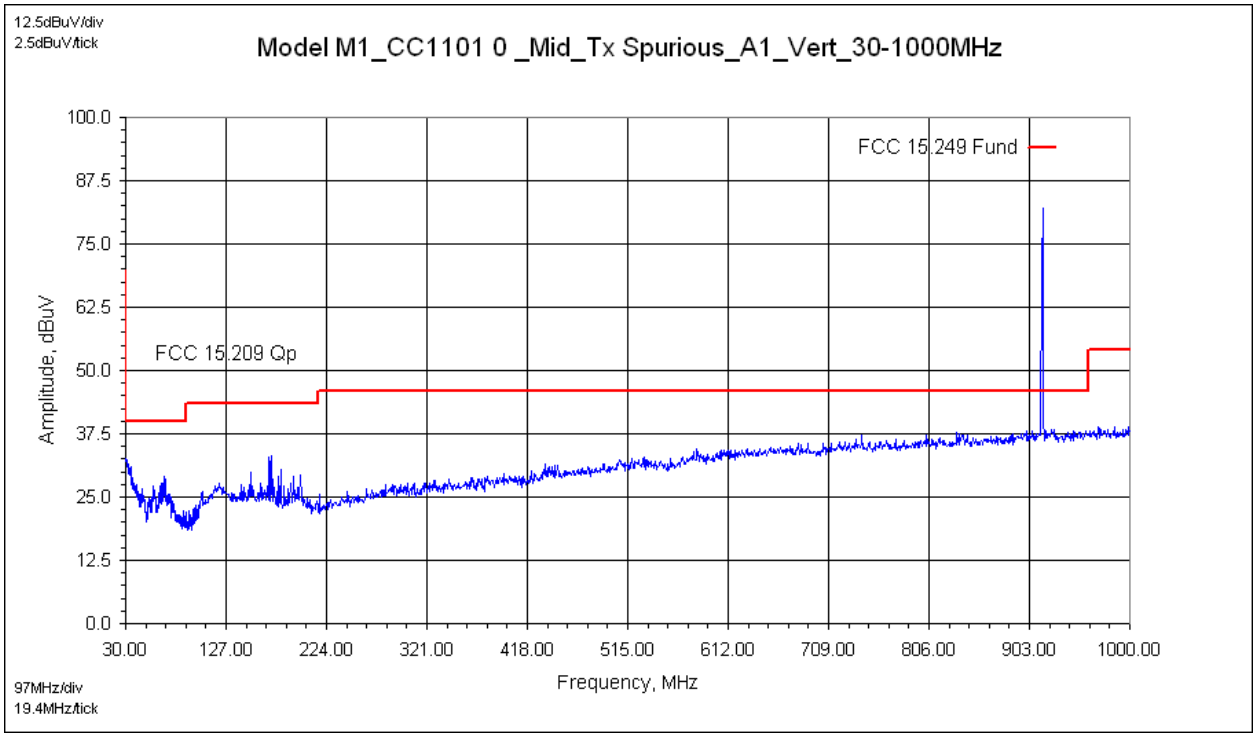


Low Channel: Axis 1 – Horizontal

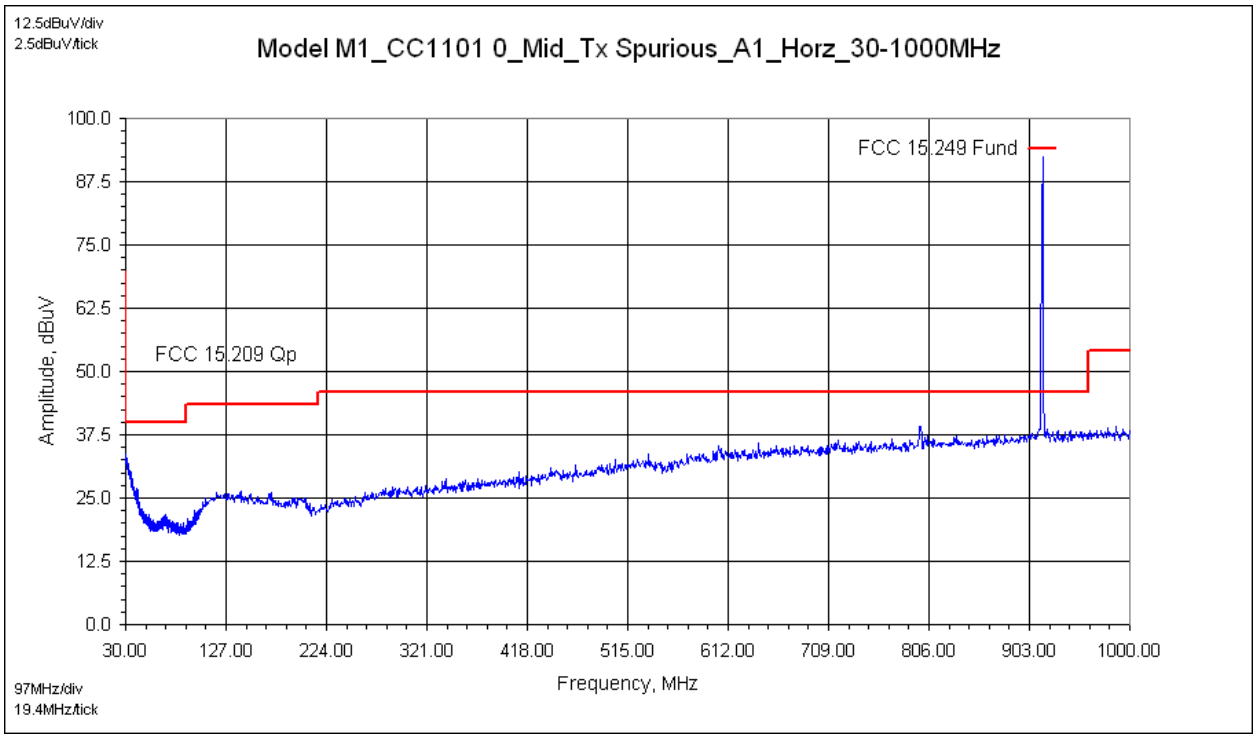


Plots: Tx Spurious Emissions 30-1000MHz

Mid Channel: Axis 1 – Vertical

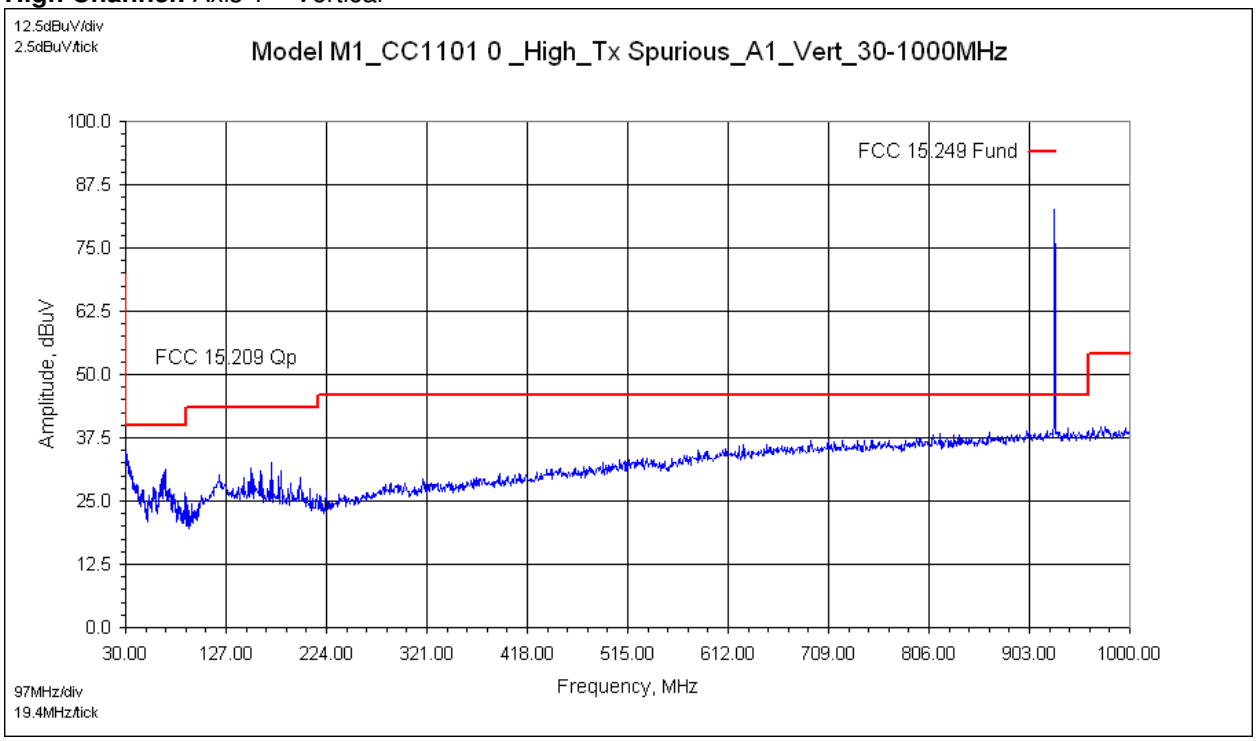


Mid Channel: Axis 1 – Horizontal

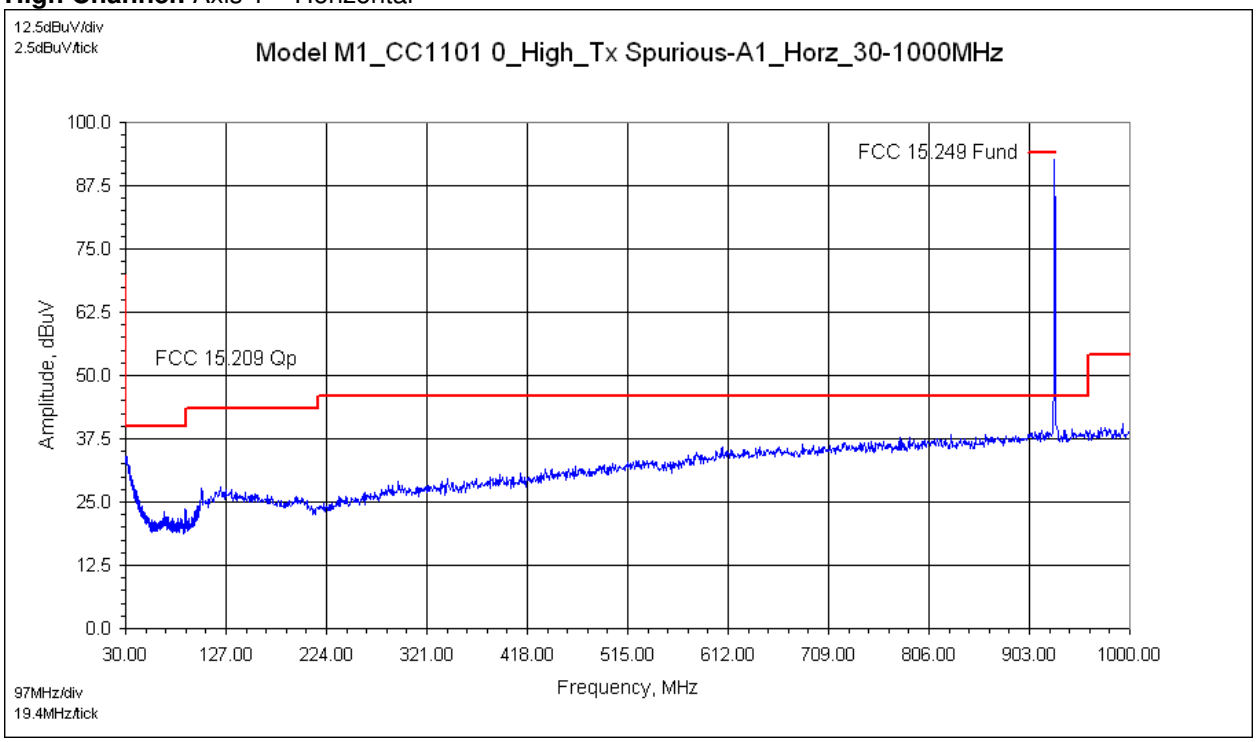


Plots: Tx Spurious Emissions 30-1000MHz

High Channel: Axis 1 – Vertical

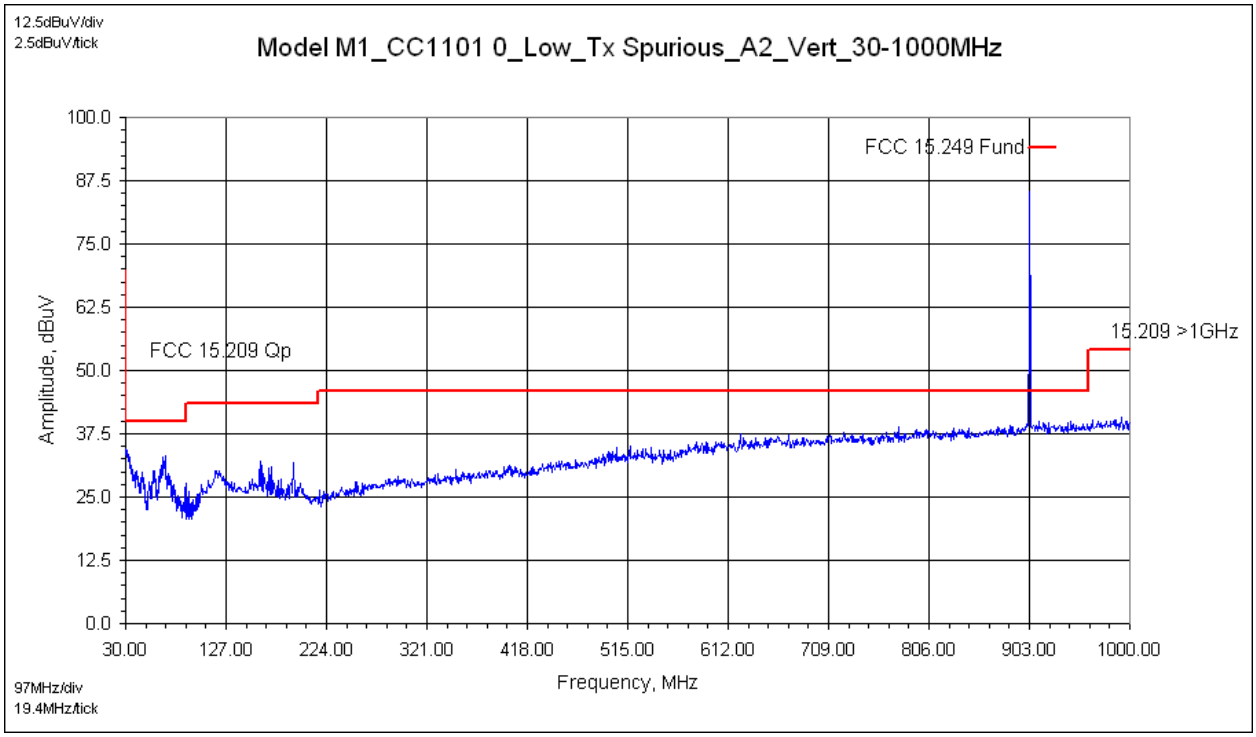


High Channel: Axis 1 – Horizontal

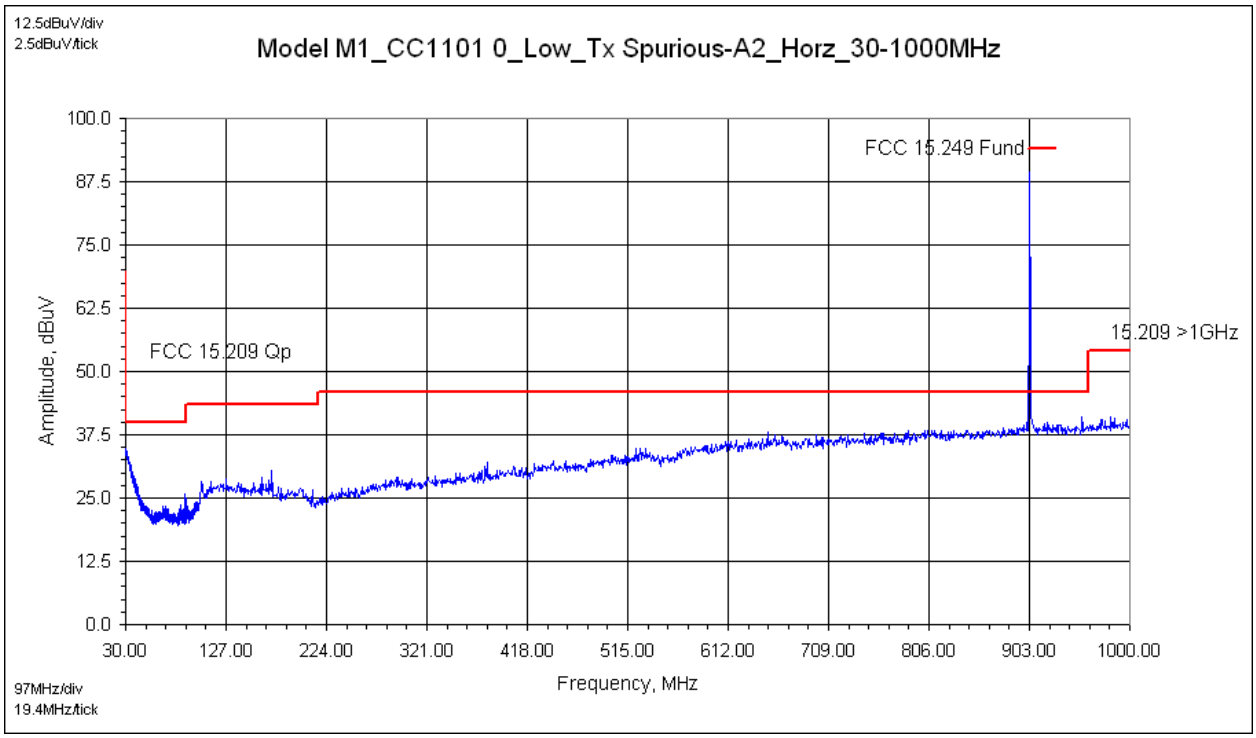


Plots: Tx Spurious Emissions 30-1000MHz

Low Channel: Axis 2 – Vertical

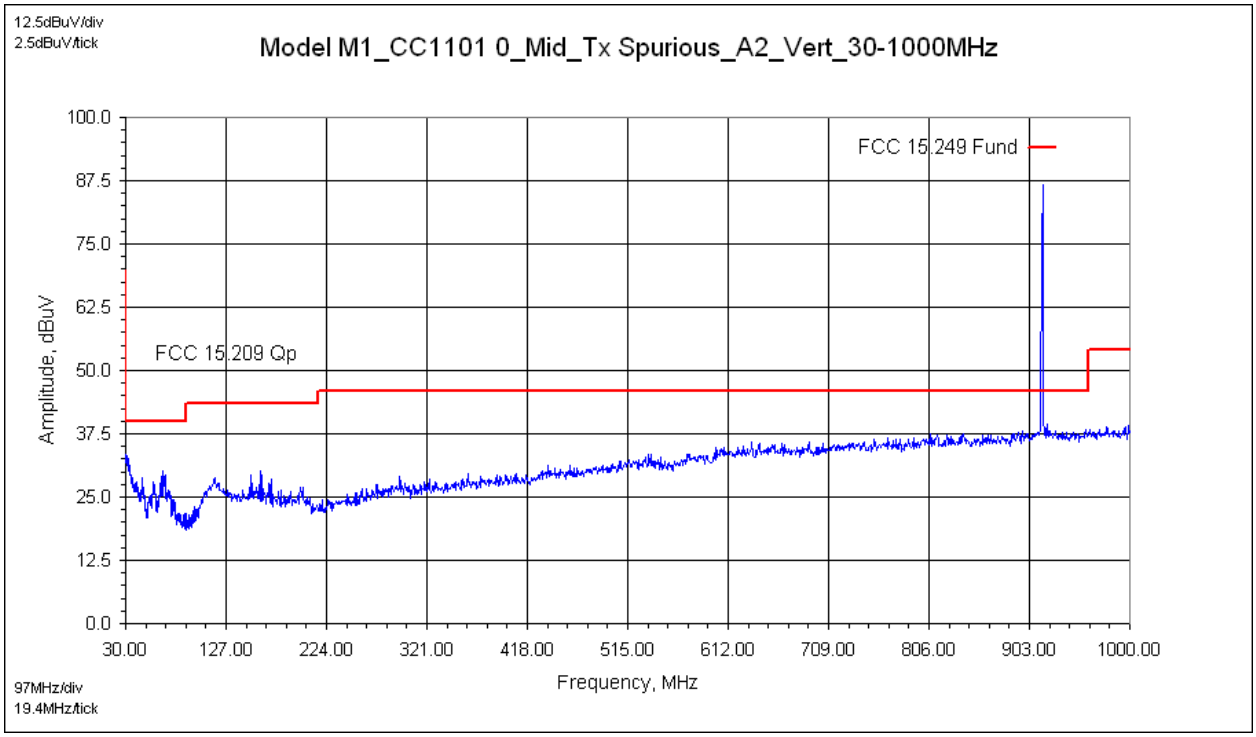


Low Channel: Axis 2 – Horizontal

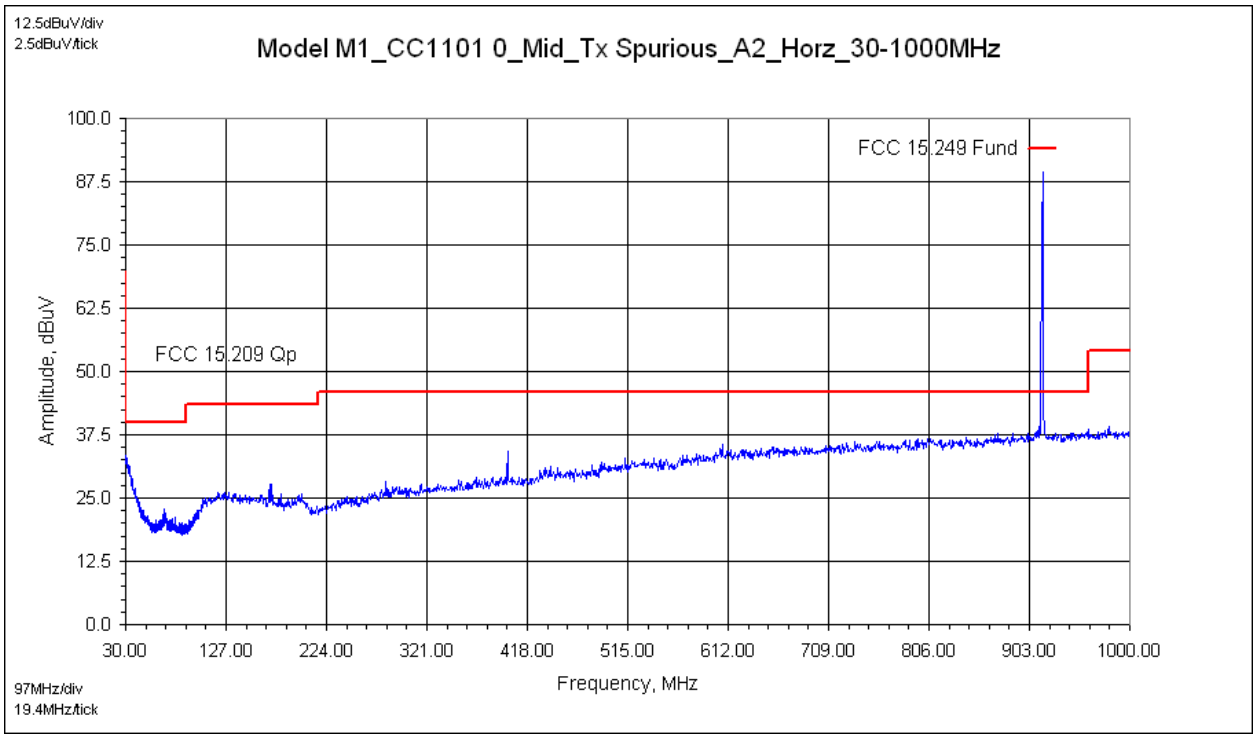


Plots: Tx Spurious Emissions 30-1000MHz

Mid Channel: Axis 2 – Vertical

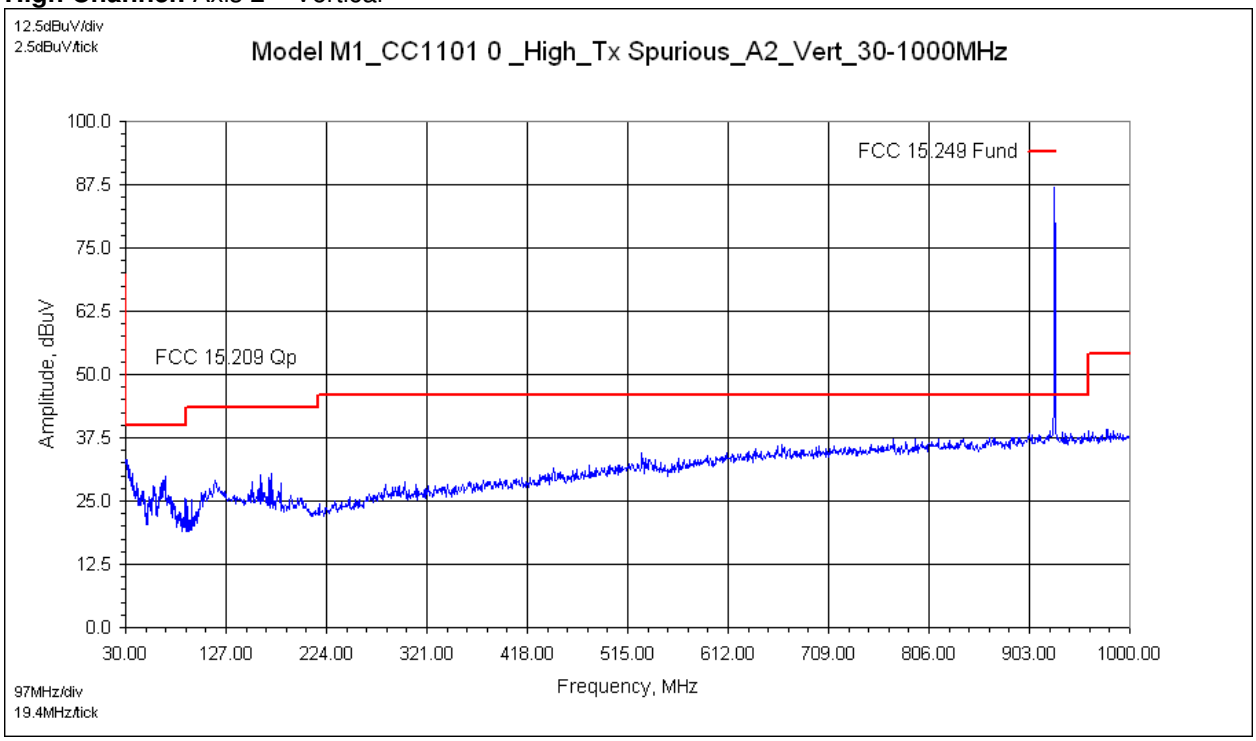


Mid Channel: Axis 2 – Horizontal

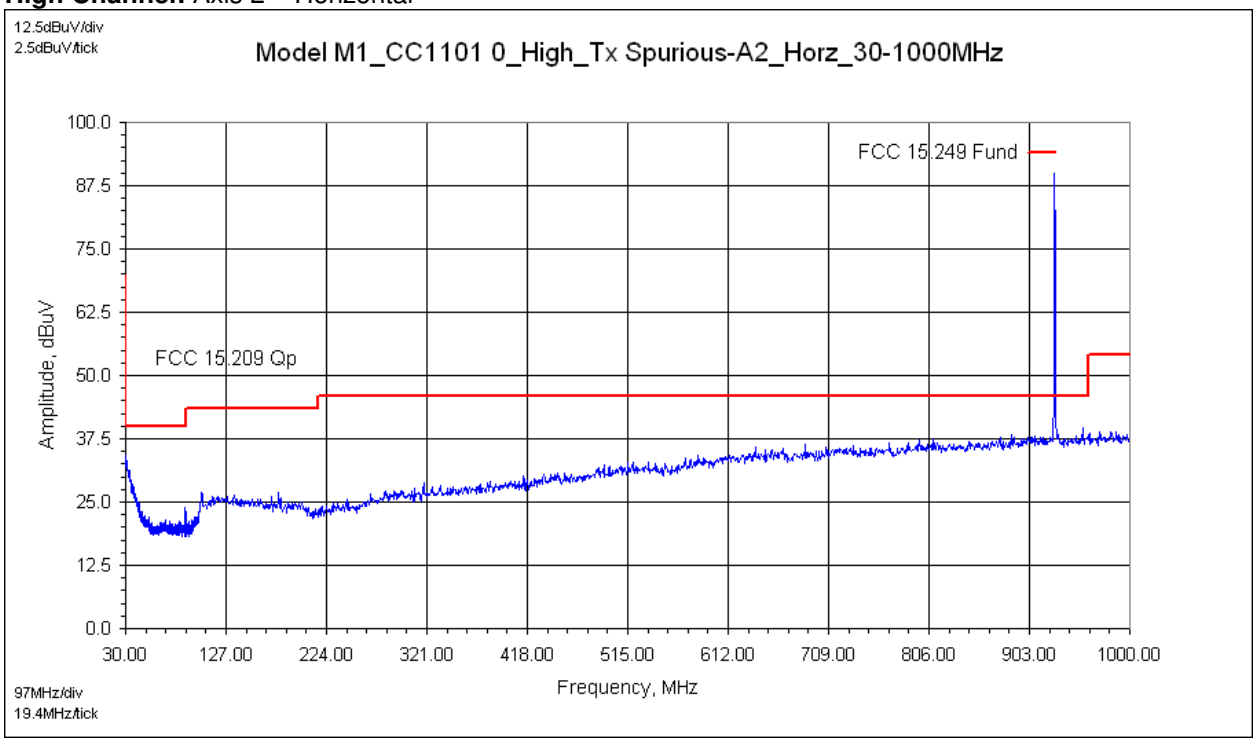


Plots: Tx Spurious Emissions 30-1000MHz

High Channel: Axis 2 – Vertical

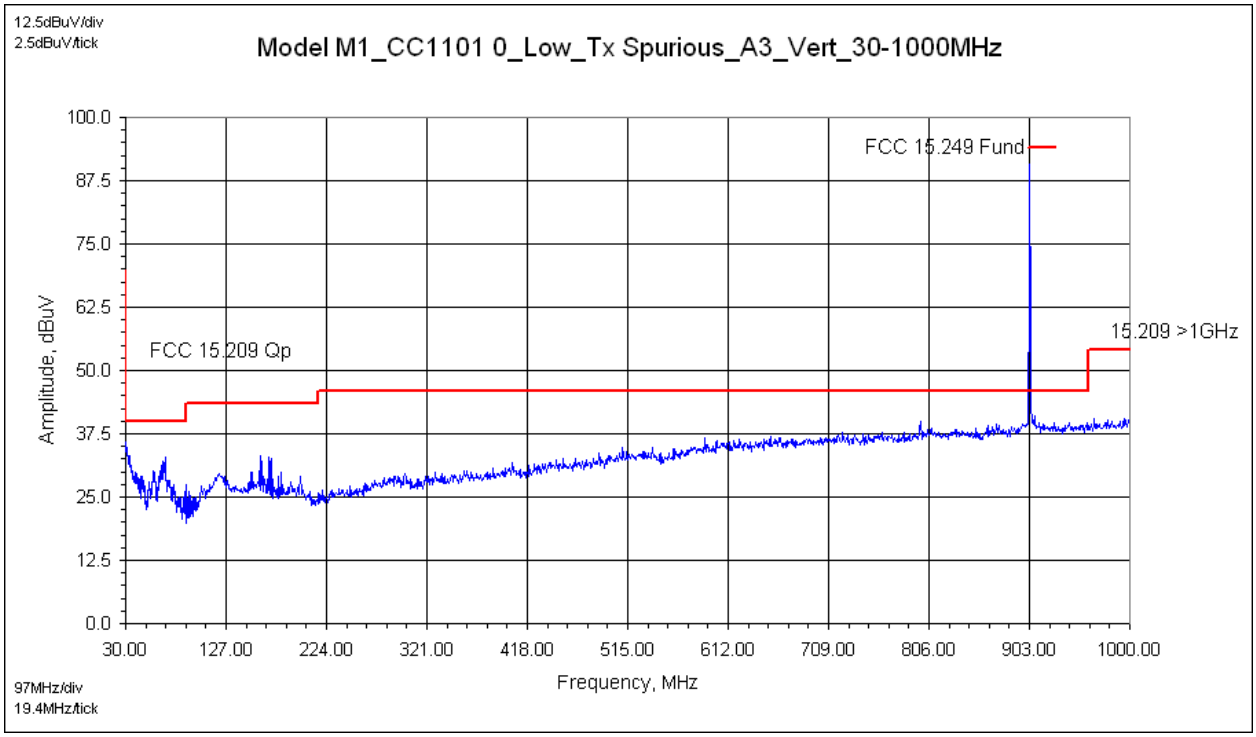


High Channel: Axis 2 – Horizontal

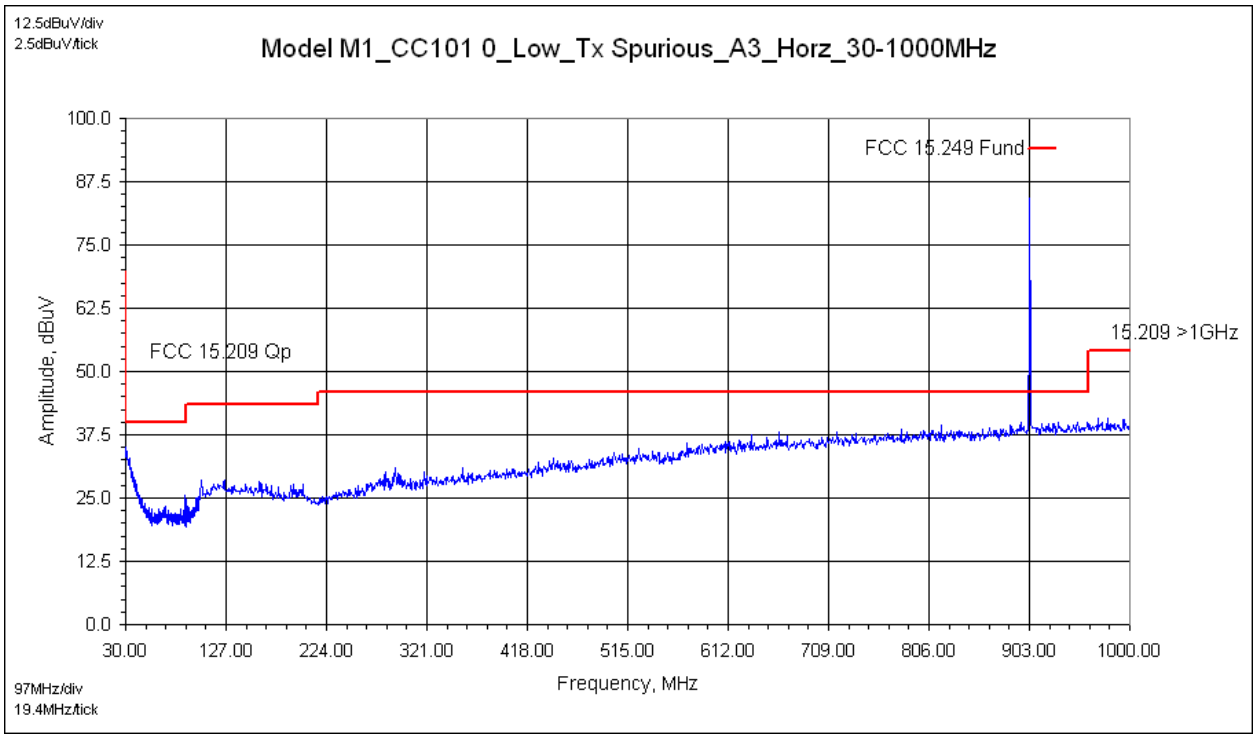


Plots: Tx Spurious Emissions 30-1000MHz

Low Channel: Axis 3 – Vertical

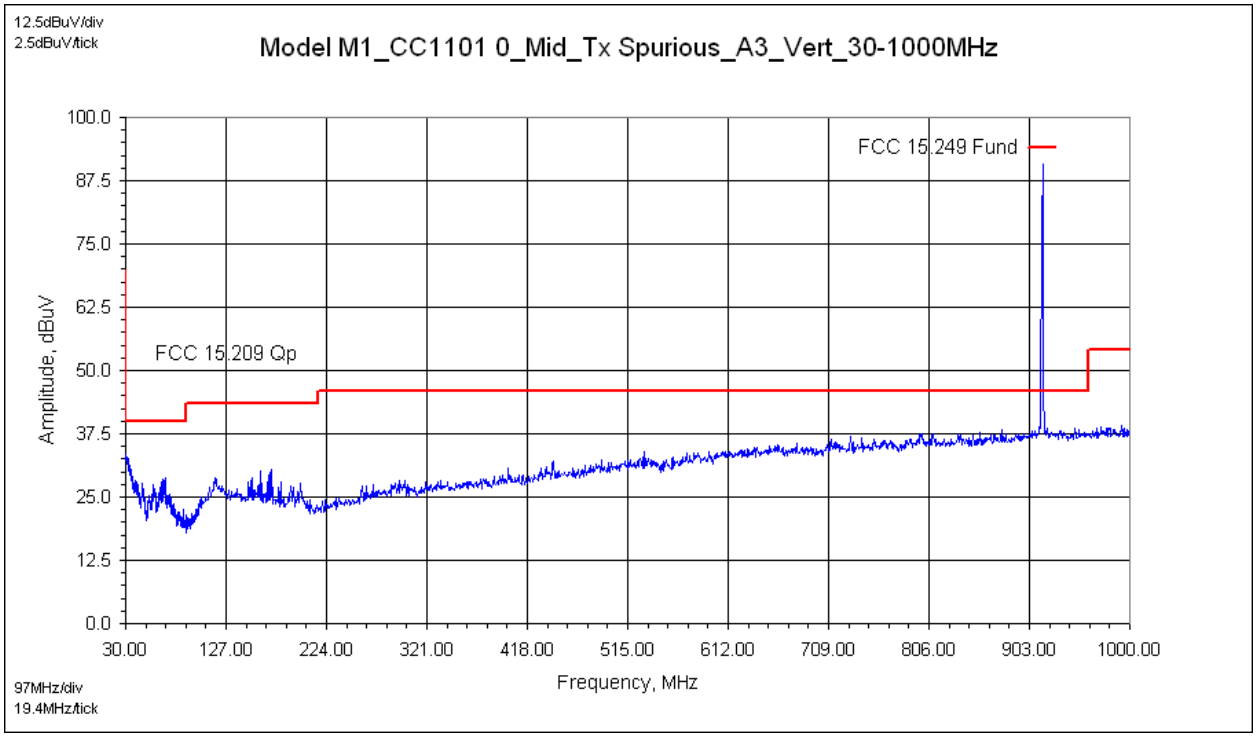


Low Channel: Axis 3 – Horizontal

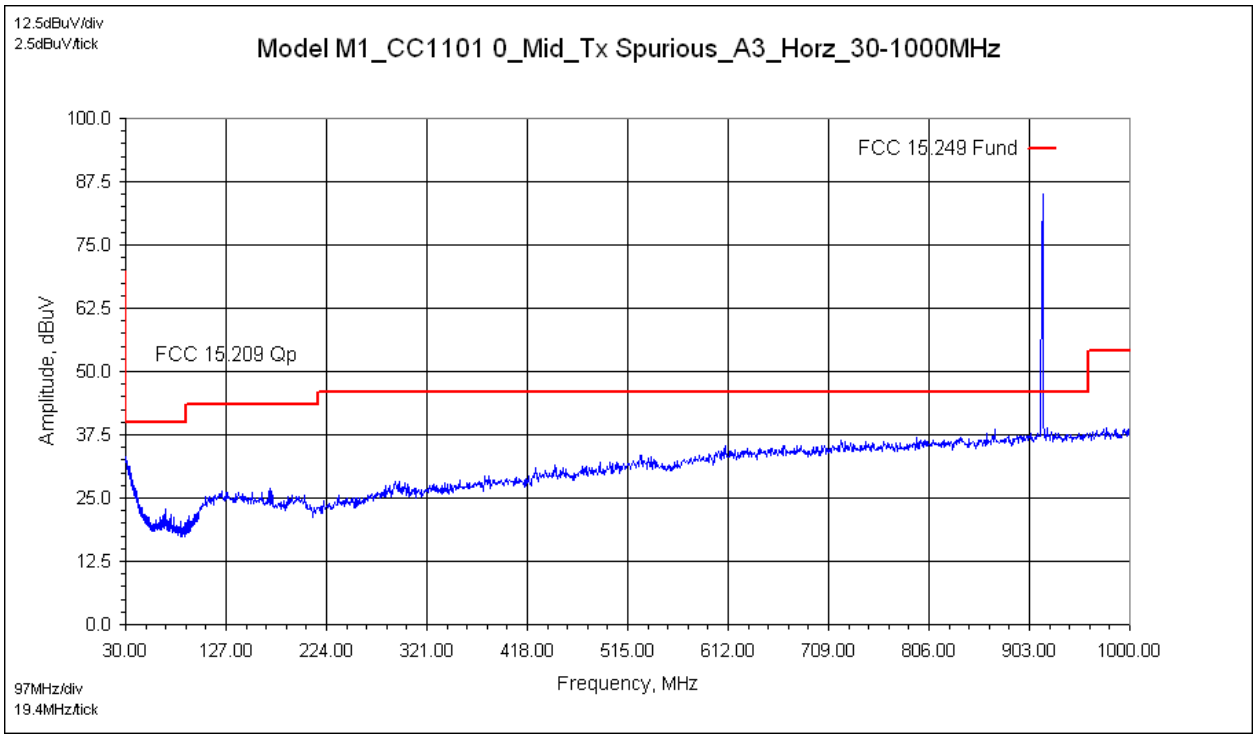


Plots: Tx Spurious Emissions 30-1000MHz

Mid Channel: Axis 3 – Vertical

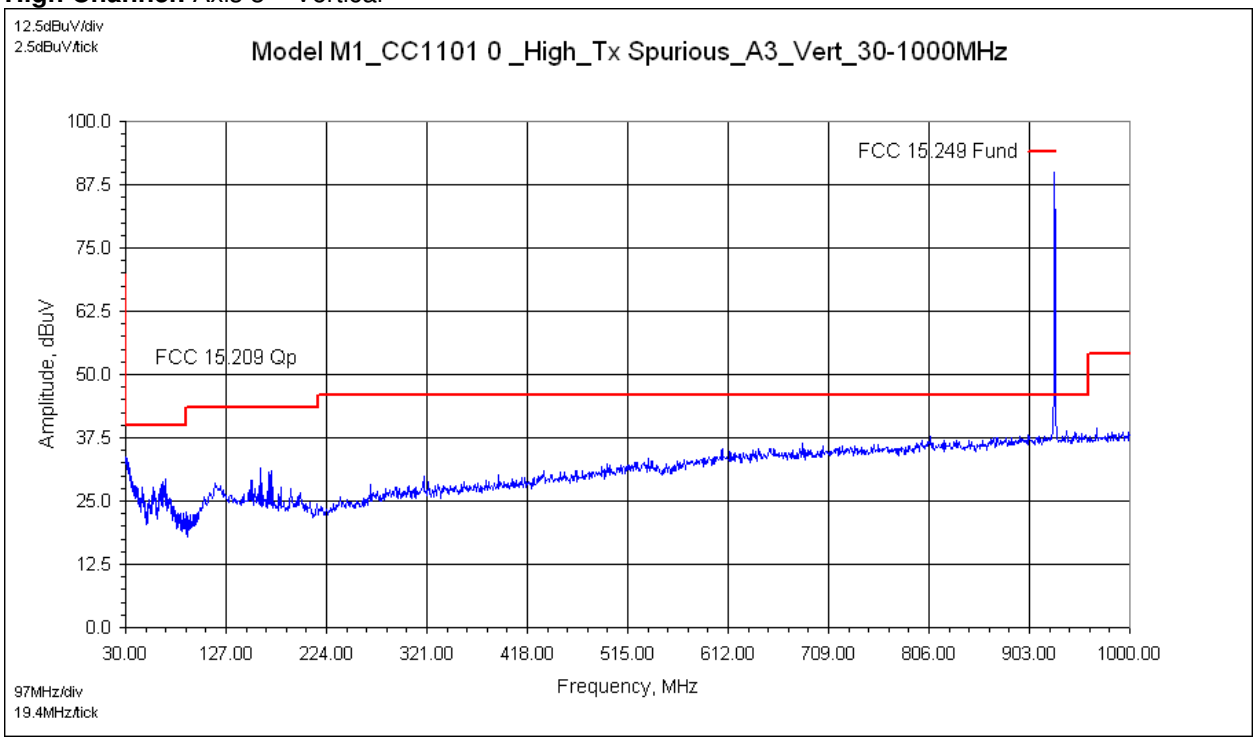


Mid Channel: Axis 3 – Horizontal

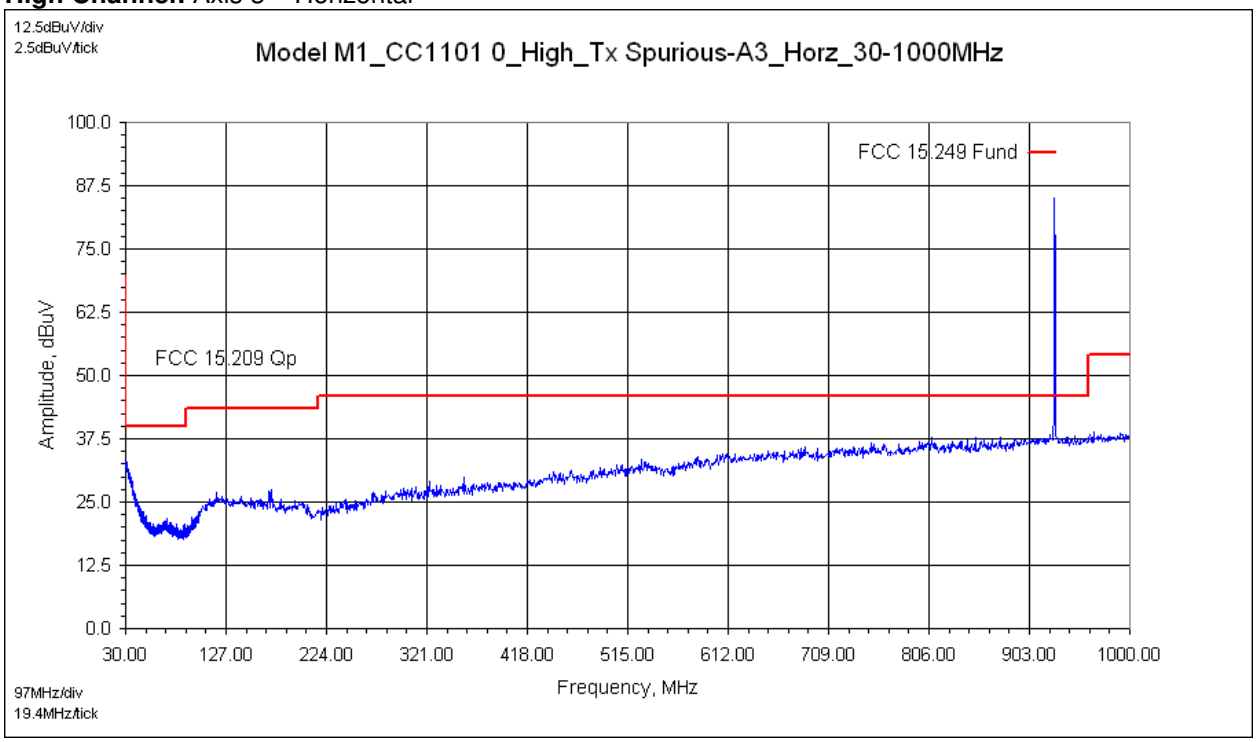


Plots: Tx Spurious Emissions 30-1000MHz

High Channel: Axis 3 – Vertical



High Channel: Axis 3 – Horizontal



Plots: Tx Spurious Emissions 1-10GHz

Plots in the frequency range of 1-10GHz can be found in Section 7 of this report.

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

Tx Spurious (Non-Harmonics) - Radiated Field Measurements

Test Report #:	**G101262612**	Test Area:	CC1 Radiated	Temperature:	22.7 °C
Test Method:	FCC 15.209/205	Test Date:	06-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 – C1101 #0 Radio active – FSK Modulated				
	Radio is a multi-channel: Lowest Channel 903.00MHz, Mid Channel 915.00MHz, Highest Channel 927.00MHz				
	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 $20*\log_{10}$ (duty cycle in 100mS).

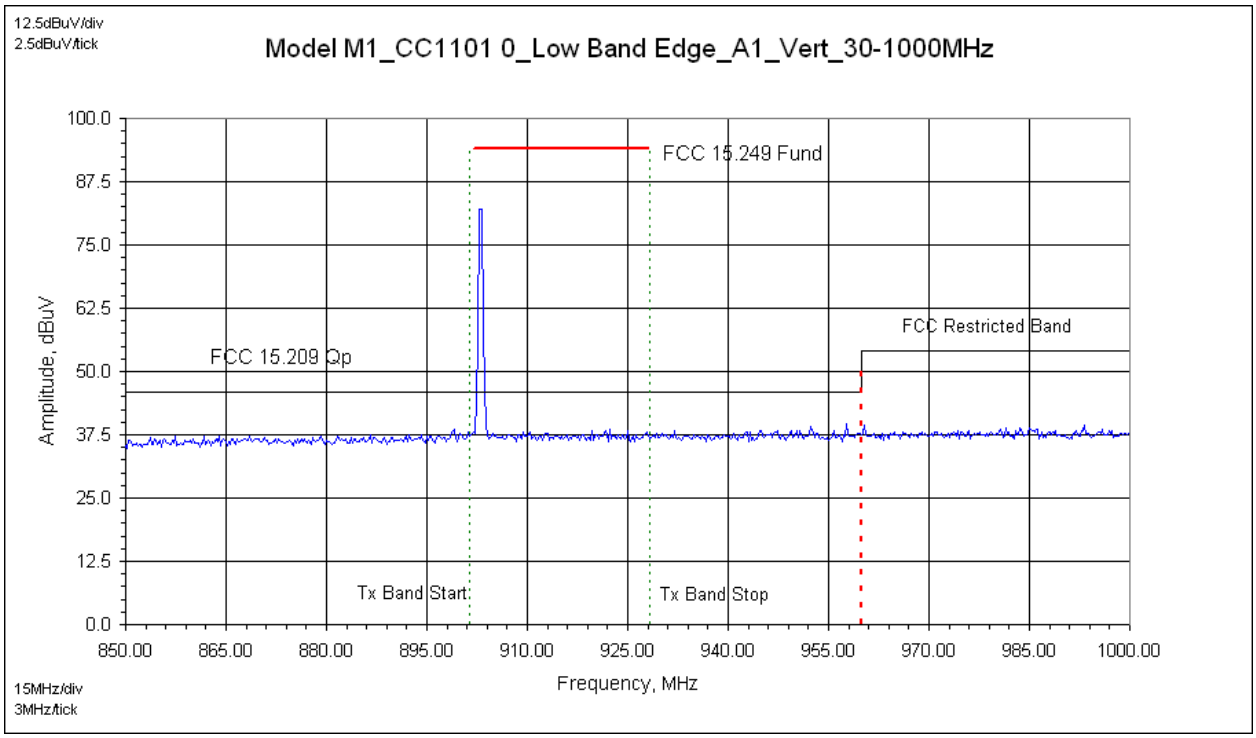
Part 15.249 (a) Limit: Average 500uV/m = 54 dBuV/m / Peak 74 dBuV/m (3-meter test distance)

FREQ	LEVEL	DET	CABLE	Antenna	PREAMP	FINAL	Duty Cycle CF	Duty Cycle Corrected	POL	HGT	AZ	DELTA LIMIT	DELTA2 LIMIT	RBW
MHz	duV/m	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	= [dBuV/m]	- [dB]	Corrected Final = [dBuV/m]	(V/H)	(m)	(DEG)	FCC 15.209	FCC 15.35(b) Pk	(MHz)
Harmonics of the Fundamental Measurements – Radiated Field [dBuV/m]														
Tx Spurious 30MHz to 1000MHz: Low Channel - Worst-Case Axis 1 – Product Flat on Table (Horizontal)														
67.8000	16.27	**Qp**	0.77	8.10	0.00	25.14	0.00	25.14	V	1.00	360.0	- 14.86	NA	0.120
159.9600	18.39	**Qp**	0.85	12.70	0.00	31.94	0.00	31.94	V	1.00	255.0	- 11.58	NA	0.120
169.0800	18.75	**Qp**	0.87	12.29	0.00	31.91	0.00	31.91	V	1.00	238.0	- 11.61	NA	0.120
171.3600	19.38	**Qp**	0.88	12.06	0.00	32.32	0.00	32.32	V	1.00	239.0	- 11.20	NA	0.120
Band Edge Measurements														
902.0000	11.52	**Qp**	2.10	22.40	0.00	36.02	0.00	36.02	H	1.00	25.0	- 10.00	NA	0.120
928.01	18.15	**Qp**	2.13	22.40	0.00	42.68	0.00	42.68	H	1.00	27.0	- 3.34	NA	0.120
928.5000	15.02	**Qp**	2.13	22.40	0.00	39.55	0.00	39.55	H	1.00	28.0	- 6.47	NA	0.120
Tx Spurious 30MHz to 1000MHz: Mid Channel - Axis 1 – Product Flat on Table (Horizontal)														
68.0000	16.84	**Qp**	0.77	8.10	0.00	25.71	0.00	25.71	V	1.00	311.0	- 14.29	NA	0.120
169.1000	18.70	**Qp**	0.87	12.29	0.00	31.86	0.00	31.86	V	1.08	262.0	- 11.66	NA	0.120
171.3800	18.90	**Qp**	0.88	12.06	0.00	31.84	0.00	31.84	V	1.01	317.0	- 11.68	NA	0.120
180.5400	17.32	**Qp**	0.90	11.45	0.00	29.66	0.00	29.66	V	1.09	329.0	- 13.86	NA	0.120
Tx Spurious 30MHz to 1000MHz: High Channel - Axis 1 – Product Flat on Table (Horizontal)														

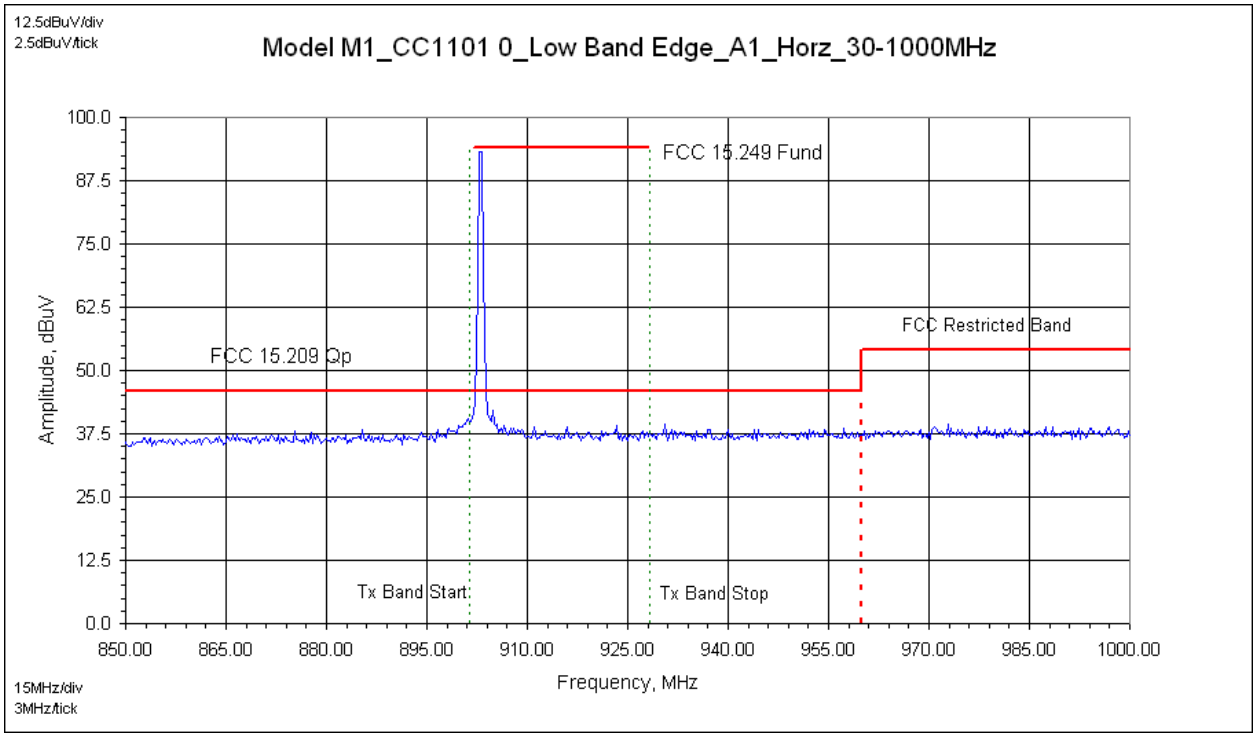
67.9603	17.20	**Qp**	0.77	8.10	0.00	26.07	0.00	26.07	V	1.00	360.0	- 13.93	NA	0.120
169.0900	18.23	**Qp**	0.87	12.29	0.00	31.39	0.00	31.39	V	1.00	31.0	- 12.13	NA	0.120
171.3800	17.70	**Qp**	0.88	12.06	0.00	30.64	0.00	30.64	V	1.00	222.0	- 12.88	NA	0.120
180.5200	18.64	**Qp**	0.90	11.45	0.00	30.98	0.00	30.98	V	1.00	121.0	- 12.54	NA	0.120
Tx Spurious 1-4GHz: Low Channel Axis 1 – Product Flat on Table														
1330.4000	53.89	**Pk**	2.56	25.21	36.87	44.80	0.00	44.80	H	1.02	73.0	NA	- 29.20	1.000
1330.4000	38.67	**Av**	2.56	25.21	36.87	29.58	0.00	29.58	H	1.02	73.0	- 24.42	NA	1.000
1806.0000	48.68	**Pk**	3.02	26.81	37.06	41.45	0.00	41.45	H	1.00	27.0	NA	- 32.55	1.000
1806.0000	35.08	**Av**	3.02	26.81	37.06	27.85	0.00	27.85	H	1.00	27.0	- 26.15	NA	1.000
Tx Spurious 1-4GHz: Low Channel Axis 3 – Product Vertical & rotated 90 degrees														
1330.0000	53.00	**Pk**	2.56	25.21	36.87	43.91	0.00	43.91	V	1.41	241.0	NA	- 30.09	1.000
1330.0000	43.35	**Av**	2.56	25.21	36.87	34.26	0.00	34.26	V	1.41	241.0	- 19.74	NA	1.000
Tx Spurious 1-4GHz: Mid Channel Axis 3 – Product Vertical & rotated 90 degrees														
1329.5987	53.47	**Pk**	2.56	25.21	36.87	44.38	0.00	44.38	V	1.78	210.0	NA	- 29.62	1.000
1329.5987	42.89	**Av**	2.56	25.21	36.87	33.80	0.00	33.80	V	1.78	210.0	- 20.20	NA	1.000
Tx Spurious 1-4GHz: High Channel Axis 3 – Product Vertical & rotated 90 degrees														
1330.0000	56.20	**Pk**	2.56	25.21	36.87	47.11	0.00	47.11	V	1.74	203.0	NA	- 26.89	1.000
1330.0000	43.59	**Av**	2.56	25.21	36.87	34.50	0.00	34.50	V	1.74	203.0	- 19.50	NA	1.000
Tx Harmonics 4-10 GHz: No signals found – refer to pre-scan plots														

Plots: Lower Band Edge

Axis 1 – Vertical

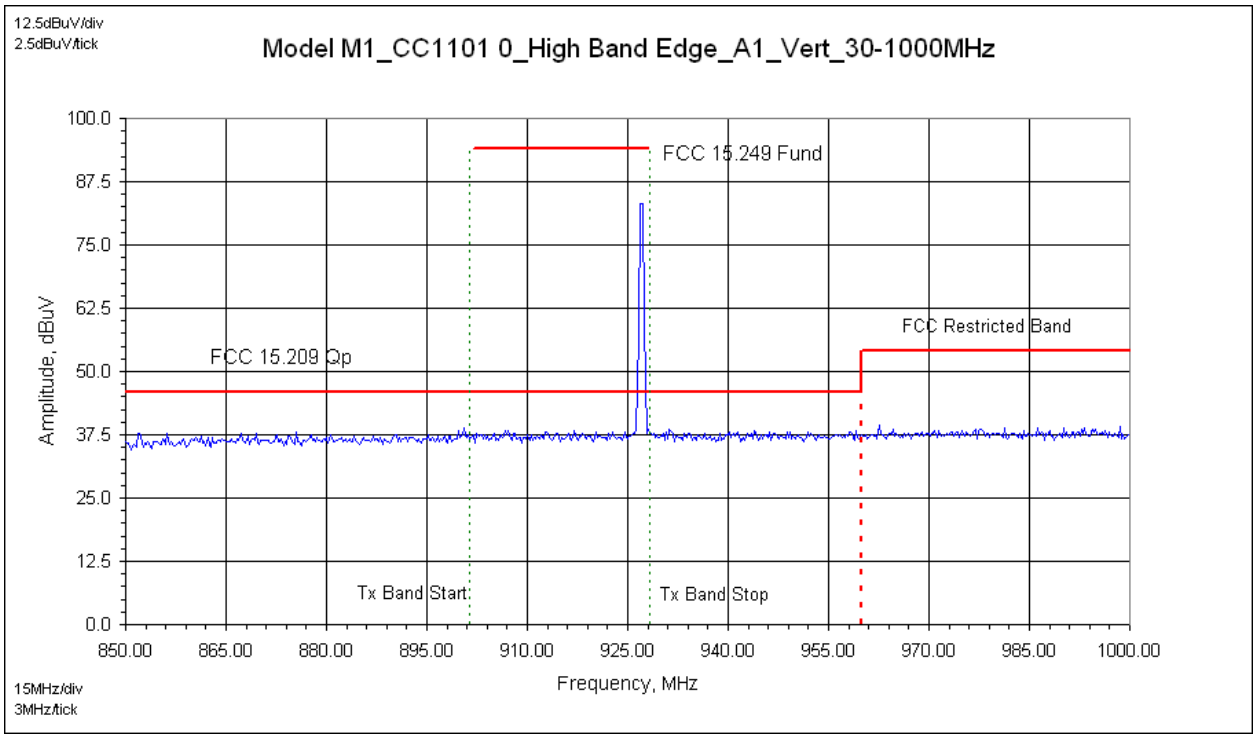


Axis 1 – Horizontal

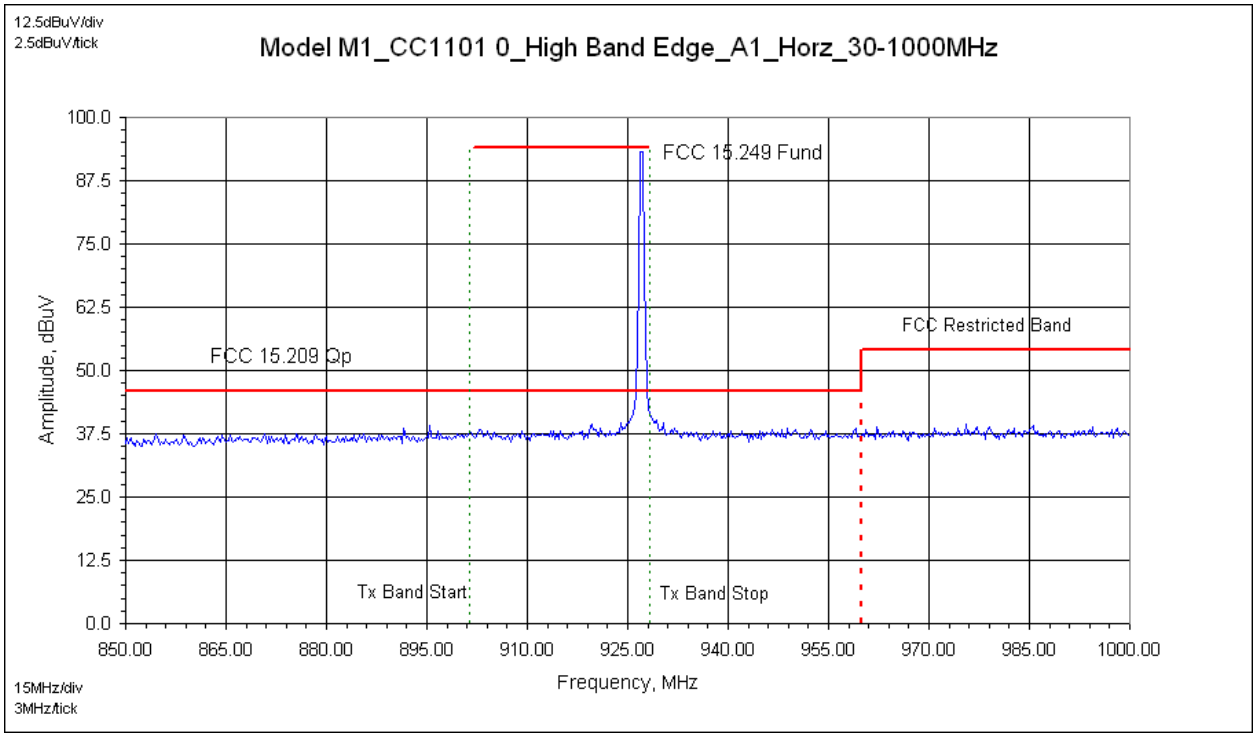


Plots: Upper Band Edge

Axis 1 – Vertical



Axis 1 – Horizontal



9 Occupied Bandwidth (OBW) – Not Applicable

Method:

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

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

Test Requirement/Specification:

When an occupied bandwidth value is not specified in the applicable standard, the transmitted signal bandwidth to be reported is its 99% emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

- IC RSS-GEN, Clause 4.6.1

Test Equipment Used:

Asset ID:	Description:	Manufacturer:	Model:	Serial:	Cal Date	Cal Due

Results:

Not applicable – test not required per FCC standard.

Test Summary:

Occupied Bandwidth (OBW) Summary	
Channel/ Mode	**OBW**

Specification: 99% Power Emission Bandwidth

Test Method:

- **IC RSS-GEN: 2010, Section 4.6.1**
- **ANSI C63.10:2009, Section 6.9.1**

Test Setup Photographs:

Test Data:

10 Requirements for fixed, point-to-point operation – Not Applicable

Method:

The test methods used comply with ANSI C63.4 and CISPR 16. Unless otherwise stated no deviations were made from FCC 15.249 & RSS-210.

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

Test Requirement/Specification:

- FCC 15.249(b)(e)
- RSS-210

Test Equipment Used:

Asset ID	Description	Manufacturer	Model	Serial	Cal Date	Cal Due

Results:

Test not applicable – product is not a fixed, point-to-point system.

Test Summary:

Test Method:

Notes: None

Setup Photographs:

Plots:

Test Data:

Example calculation:

Measured Level	+	Transducer, Cable Loss & Amplifier corrections	=	Corrected Reading	Specification Limit	-	Corrected Reading	=	Delta Specification
(dBµV)		(dB)		(dBµV/m)	(dBµV/m)		(dBµV/m)		
14.0		**14.9**		**28.9**	**40.0**		**28.9**		**-11.1**

11 Duty Cycle Correction Factor – Not Used

No duty cycle correction factor was utilized during this testing – therefore, product duty cycle verification was not applicable.

Method:

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC CFR47 15.35(c) & IC RSS-GEN.

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

Test Requirement/Specification:

Unless otherwise specified, e.g. §15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

Determine the period of the pulse train, T, in mSec and record the results. T is defined as the time from the beginning of one pulse train to the beginning of the next pulse train.
Count the number of different types of pulses, N and record the results.
For each of the different types of pulses, count the number of occurrences within one pulse train.
Use the Duty Cycle Correction Factor, DCCF, from the results table and use it to adjust the field strength measurements recorded for radiated emissions.

- FCC 15.35(c)
- RSS-GEN, Clause 4.5

Test Equipment Used:

Results:

Not applicable

Test Method:

- ANSI C63.10: 2009, Clause 7.5

Test Summary:

Duty Cycle Measurements	

Plots:

Test Data:

Notes: None

12 AC Mains Conducted Emissions – Transmitter

Method:

The test methods used comply with ANSI C63.4 and CISPR 16. Unless otherwise stated no deviations were made from FCC 15.207/RSS-GEN.

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

Test Requirement/Specification:

- FCC 15.207
- RSS-GEN Section 7.2.4 Table 4

The product must pass the AC Conducted average and quasi-peak Limits defined in FCC Part 15.207.

Test Equipment Used:

Asset ID	Description	Manufacture	Model	Serial	Cal Date	Cal Due
DEN-073	EMI Receiver	ROHDE & SCHWARZ	ESU 26	100265	01/23/2013	01/23/2014
18885	Transient Limiter	Hewlett-Packard	11947A	3107A00700	05/05/2013	05/05/2014
18914	Single Phase LISN	EMCO	3816/NM	9408-1003	04/11/2013	04/11/2014
SW-6	Software for Radiated and Conducted emissions.	Intertek	OATS vba	V. 1.0	VBU	VBU

Test Procedure:

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at all frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.
The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.
The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.10.

Results:

The sample tested was found to comply.

Test Summary:

FREQ	LEVEL	DET	CABLE	LISN	PREAMP	ATTEN	FINAL	TEST POINT	DELTA1	DELTA2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	Line 1 Line2 (Neutral)	FCC 15.207 Average	FCC 15.207 Qp	(MHz)
Measured Data – 150kHz to 30MHz (worst-case)											
0.377	24.27	**Av**	0.10	0.03	0.00	9.97	34.37	Line 1	- 13.99	NA	0.009

Test Method:

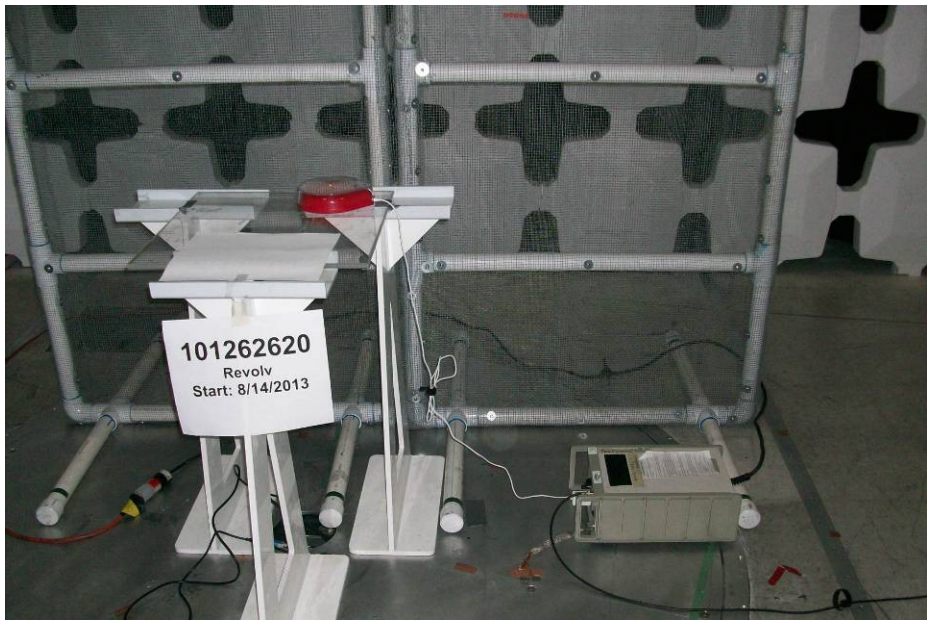
- ANSI C63.10:2009, Section 6.2
- RSS-GEN Section 7.2.4

Notes:

1. All product radios (transmitters) were enabled and continuously transmitting during testing.

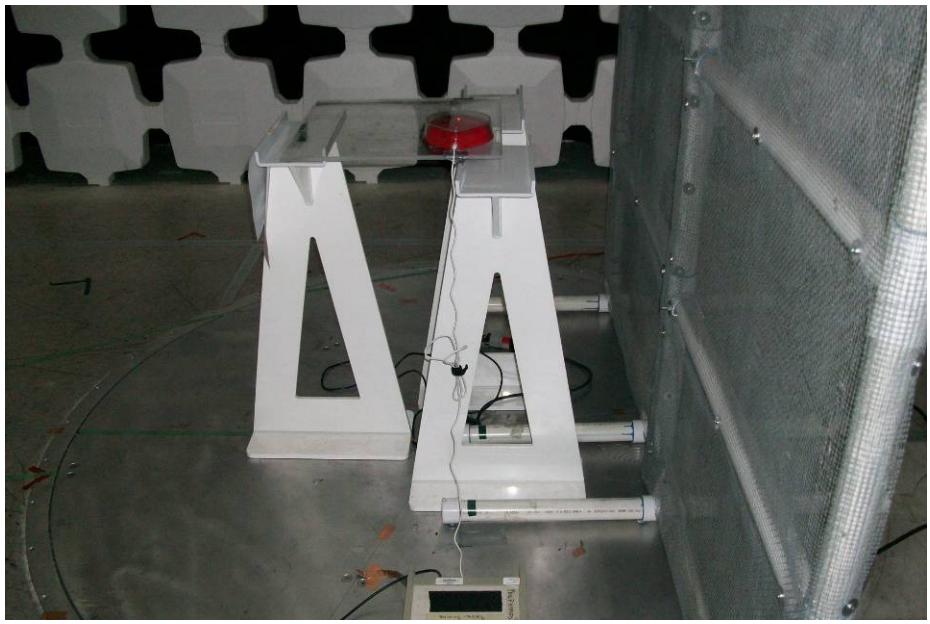
Setup Photographs: AC Mains Conducted Emissions – Transmitter

Test Setup – Front View



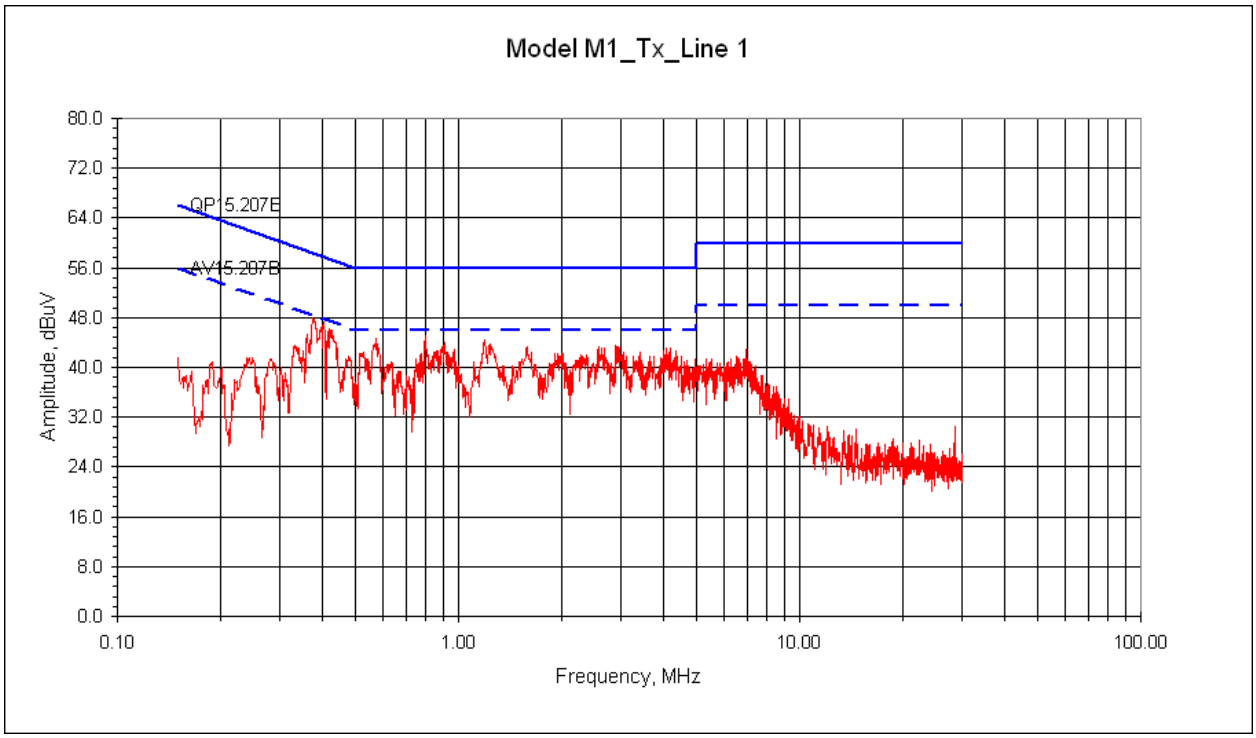
Setup Photographs: AC Mains Conducted Emissions – Transmitter

Test Setup – Rear View

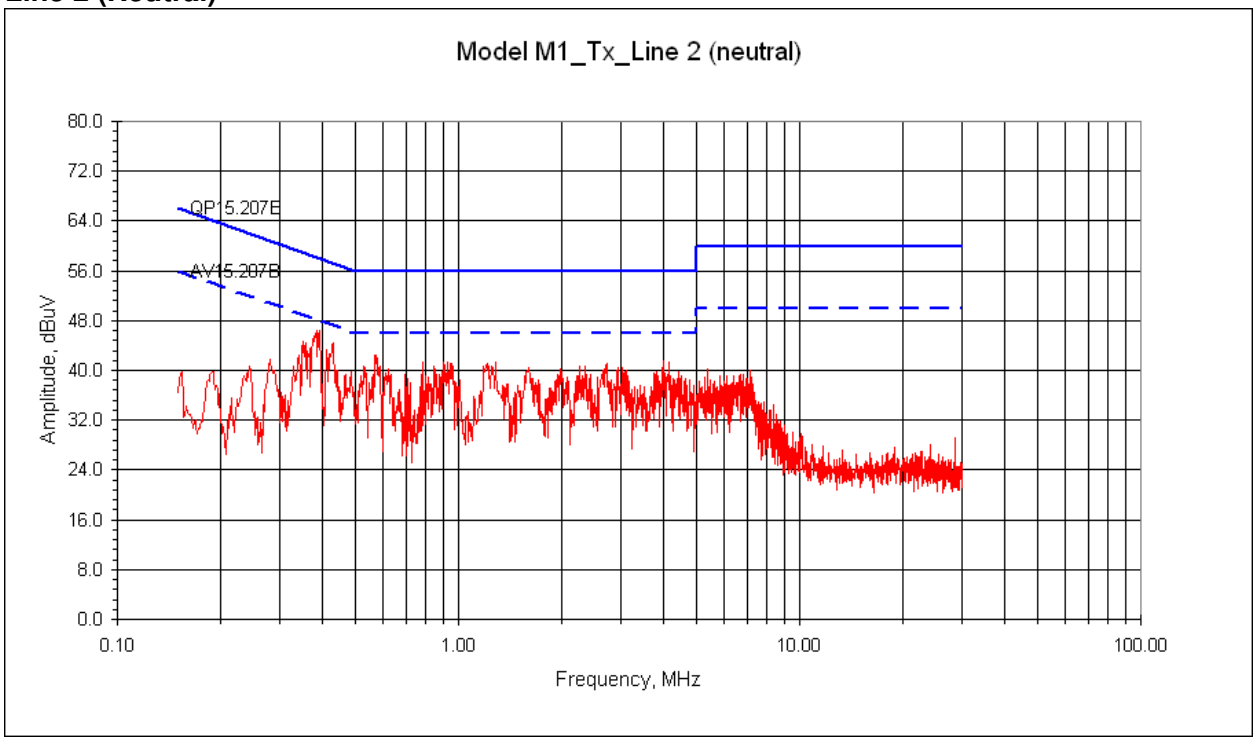


Plots: AC Mains Conducted Emissions - Transmitter

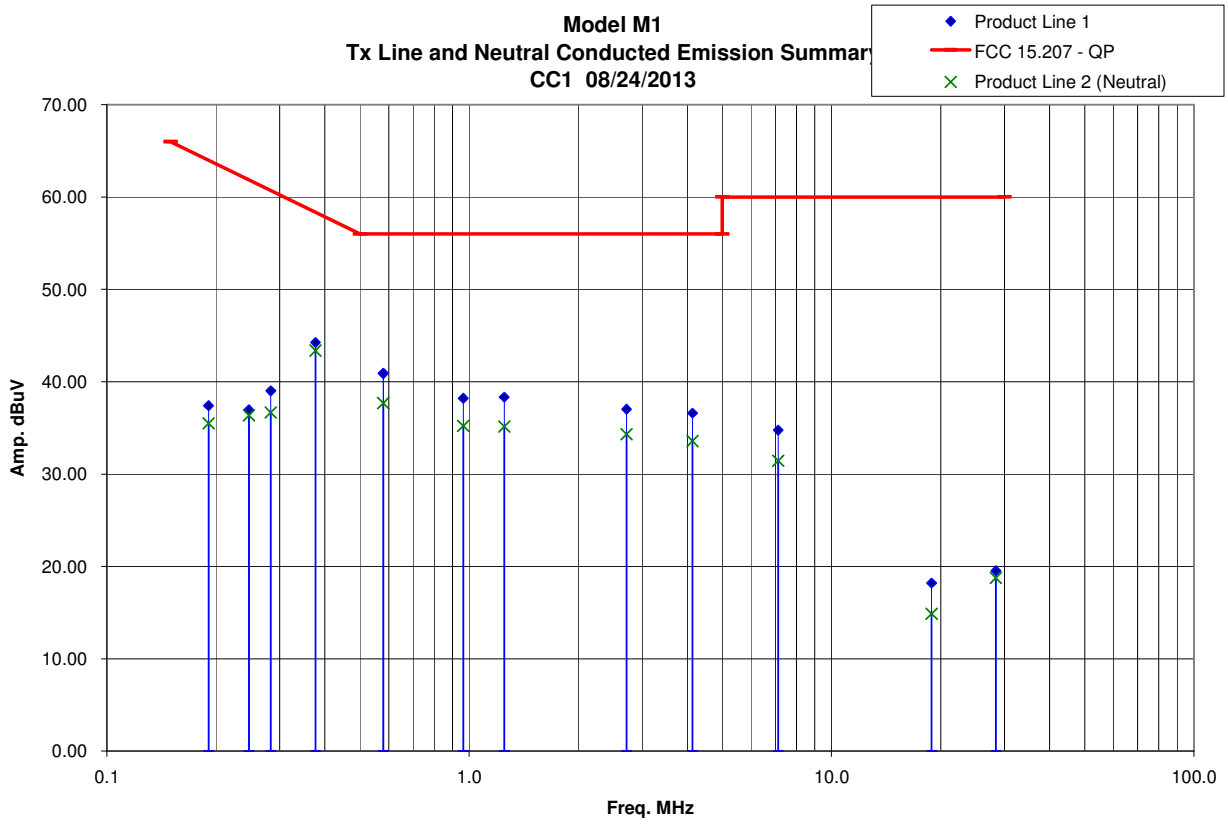
Line 1

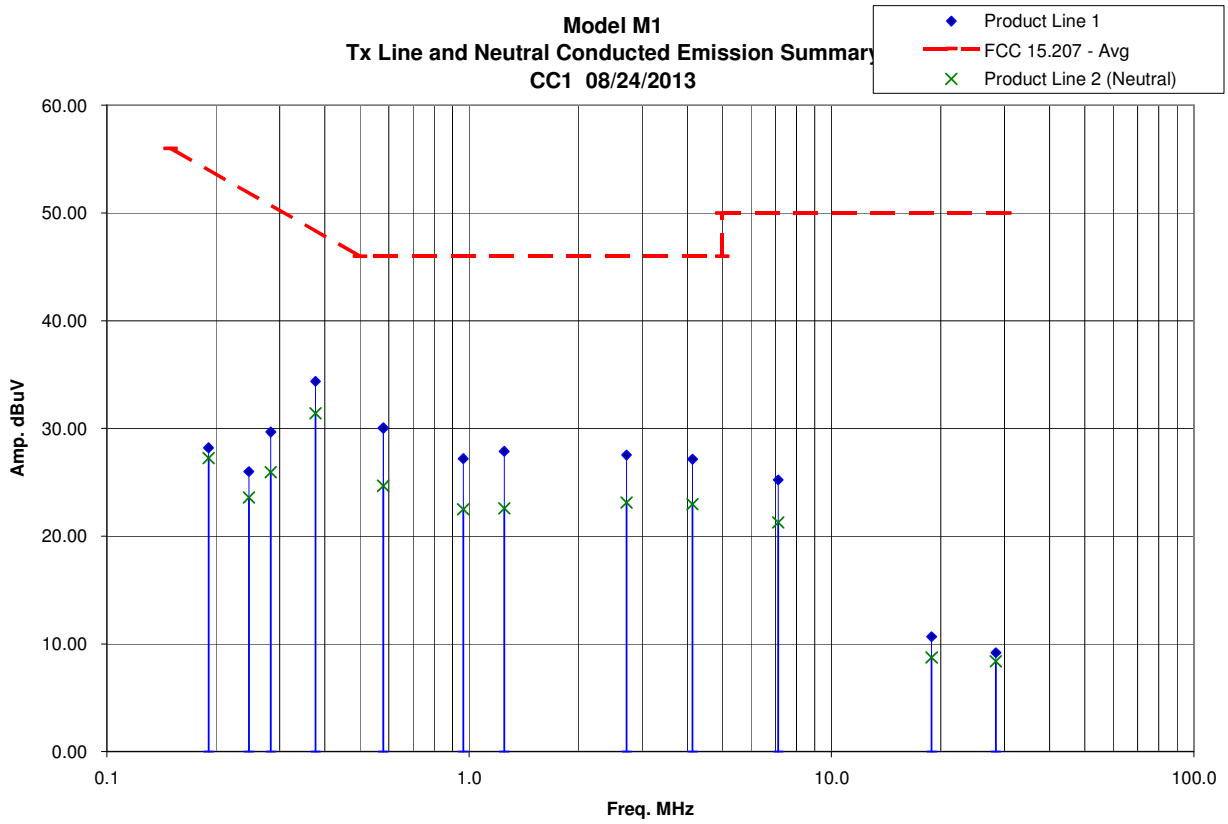


Line 2 (Neutral)



Final Plots: AC Mains Conducted Emissions – Transmitter





Test Data: AC Mains Conducted Emissions – Transmitter

Tx AC Conducted Electromagnetic Emissions

Test Report #:	G101262620	Test Area:	CC1 Conducted		Temperature:	23.5	C
Test Method:	FCC 15.207	Test Date:	24-Aug-2013		Relative Humidity:	22.8	%
EUT Model #:	M1	EUT Power:	**120V/ 60Hz**		Air Pressure:	82.8	kPa
EUT Serial #:	FCC1						
Manufacturer:	Revolv				Level Key		
EUT Description:	Revolv Hub – RF-enabled Home Automation				Pk - Peak	Nb - Narrow Band	
Notes:	AC Adapter: Model UN310-0520				Qp - QuasiPeak	Bb - Broad Band	
	Product tested in Tx mode of operation – all radios active				Av - Average		

FREQ	LEVEL	DET	CABLE	LISN	PREAMP	ATTEN	FINAL	TEST POINT	DELTA1	DELTA2	RBW
MHz	dBuV	Qp Av Pk	+ [dB]	+ [dB/m]	- [dB]	+ [dB]	= [dBuV]	Line 1 Line2 (Neutral)	FCC 15.107 Class B Average	FCC 15.107 Class B Qp	(MHz)
Line 1 Data – 150kHz to 30MHz											
0.191	18.11	**Av**	0.10	0.03	0.00	9.96	28.21	Line 1	- 25.79	NA	0.009
0.191	27.31	**Qp**	0.10	0.03	0.00	9.96	37.41	Line 1	NA	- 26.59	0.009
0.247	15.91	**Av**	0.10	0.03	0.00	9.96	26.00	Line 1	- 25.86	NA	0.009
0.247	26.87	**Qp**	0.10	0.03	0.00	9.96	36.96	Line 1	NA	- 24.90	0.009
0.283	19.57	**Av**	0.10	0.03	0.00	9.97	29.66	Line 1	- 21.05	NA	0.009
0.283	28.92	**Qp**	0.10	0.03	0.00	9.97	39.01	Line 1	NA	- 21.70	0.009
0.377	24.27	**Av**	0.10	0.03	0.00	9.97	34.37	Line 1	- 13.99	NA	0.009
0.377	34.15	**Qp**	0.10	0.03	0.00	9.97	44.25	Line 1	NA	- 14.11	0.009
0.579	19.95	**Av**	0.10	0.02	0.00	9.97	30.05	Line 1	- 15.95	NA	0.009
0.579	19.92	**Av**	0.10	0.02	0.00	9.97	30.02	Line 1	- 15.98	NA	0.009
0.579	30.78	**Qp**	0.10	0.02	0.00	9.97	40.88	Line 1	NA	- 15.12	0.009
0.579	30.83	**Qp**	0.10	0.02	0.00	9.97	40.93	Line 1	NA	- 15.07	0.009
0.963	16.99	**Av**	0.20	0.03	0.00	9.98	27.19	Line 1	- 18.81	NA	0.009
0.963	28.02	**Qp**	0.20	0.03	0.00	9.98	38.22	Line 1	NA	- 17.78	0.009
1.250	17.67	**Av**	0.20	0.03	0.00	9.98	27.88	Line 1	- 18.12	NA	0.009
1.250	28.11	**Qp**	0.20	0.03	0.00	9.98	38.32	Line 1	NA	- 17.68	0.009
2.718	17.31	**Av**	0.20	0.03	0.00	9.98	27.53	Line 1	- 18.47	NA	0.009
2.718	26.80	**Qp**	0.20	0.03	0.00	9.98	37.02	Line 1	NA	- 18.98	0.009
4.135	16.83	**Av**	0.30	0.04	0.00	9.98	27.15	Line 1	- 18.85	NA	0.009
4.135	26.29	**Qp**	0.30	0.04	0.00	9.98	36.61	Line 1	NA	- 19.39	0.009
7.131	14.75	**Av**	0.40	0.07	0.00	9.99	25.21	Line 1	- 24.79	NA	0.009
7.131	24.28	**Qp**	0.40	0.07	0.00	9.99	34.74	Line 1	NA	- 25.26	0.009
18.910	- 0.67	**Av**	1.10	0.20	0.00	10.02	10.65	Line 1	- 39.35	NA	0.009
18.910	6.88	**Qp**	1.10	0.20	0.00	10.02	18.20	Line 1	NA	- 41.80	0.009
28.429	- 2.29	**Av**	1.31	0.12	0.00	10.04	9.18	Line 1	- 40.82	NA	0.009
28.429	8.06	**Qp**	1.31	0.12	0.00	10.04	19.53	Line 1	NA	- 40.47	0.009
Line 2 (Neutral) Data – 150kHz to 30MHz											
0.191	17.15	**Av**	0.10	0.03	0.00	9.96	27.25	Line 2	- 26.75	NA	0.009
0.191	25.38	**Qp**	0.10	0.03	0.00	9.96	35.48	Line 2	NA	- 28.52	0.009

0.247	13.50	Av	0.10	0.03	0.00	9.96	23.59	Line 2	- 28.28	NA	0.009
0.247	26.28	Qp	0.10	0.03	0.00	9.96	36.37	Line 2	NA	- 25.50	0.009
0.283	15.83	Av	0.10	0.03	0.00	9.97	25.92	Line 2	- 24.79	NA	0.009
0.283	26.57	Qp	0.10	0.03	0.00	9.97	36.66	Line 2	NA	- 24.05	0.009
0.377	21.31	Av	0.10	0.02	0.00	9.97	31.40	Line 2	- 16.95	NA	0.009
0.377	33.28	Qp	0.10	0.02	0.00	9.97	43.37	Line 2	NA	- 14.98	0.009
0.579	14.57	Av	0.10	0.02	0.00	9.97	24.67	Line 2	- 21.33	NA	0.009
0.579	27.59	Qp	0.10	0.02	0.00	9.97	37.69	Line 2	NA	- 18.31	0.009
0.963	12.27	Av	0.20	0.02	0.00	9.98	22.47	Line 2	- 23.53	NA	0.009
0.963	25.03	Qp	0.20	0.02	0.00	9.98	35.23	Line 2	NA	- 20.77	0.009
1.250	12.37	Av	0.20	0.03	0.00	9.98	22.58	Line 2	- 23.42	NA	0.009
1.250	24.95	Qp	0.20	0.03	0.00	9.98	35.16	Line 2	NA	- 20.84	0.009
2.718	12.89	Av	0.20	0.03	0.00	9.98	23.10	Line 2	- 22.90	NA	0.009
2.718	24.11	Qp	0.20	0.03	0.00	9.98	34.32	Line 2	NA	- 21.68	0.009
4.135	12.65	Av	0.30	0.03	0.00	9.98	22.97	Line 2	- 23.03	NA	0.009
4.135	23.24	Qp	0.30	0.03	0.00	9.98	33.56	Line 2	NA	- 22.44	0.009
7.131	10.79	Av	0.40	0.07	0.00	9.99	21.25	Line 2	- 28.75	NA	0.009
7.131	20.98	Qp	0.40	0.07	0.00	9.99	31.44	Line 2	NA	- 28.56	0.009
18.910	- 2.59	Av	1.10	0.20	0.00	10.02	8.73	Line 2	- 41.27	NA	0.009
18.910	3.53	Qp	1.10	0.20	0.00	10.02	14.85	Line 2	NA	- 45.15	0.009
28.429	- 3.17	Av	1.31	0.20	0.00	10.04	8.38	Line 2	- 41.62	NA	0.009
28.429	7.20	Qp	1.31	0.20	0.00	10.04	18.75	Line 2	NA	- 41.25	0.009

Example calculation:

Measured Level	+	Transducer, Cable Loss & Amplifier corrections	=	Corrected Reading	Specification Limit	-	Corrected Reading	=	Delta Specification
(dBµV)		(dB)		(dBµV/m)	(dBµV/m)		(dBµV/m)		
14.0		**14.9**		**28.9**	**40.0**		**28.9**		**-11.1**

13 Antenna Requirement

Method

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC CFR47 15.203.

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

Test Requirement/Specification

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

- FCC 15.203

Results:

The product utilizes an integral antenna – not user accessible; therefore, the sample tested was found to comply.

14 RF Exposure Requirements

Method

The test methods used comply with ANSI C63.10. Unless otherwise stated no deviations were made from FCC OET 65 & IC RSS-102.

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

Test Requirement/Specification

- FCC OET Bulletin 65/ KDB 447498
- RSS-102

Results:

The sample tested was found to comply.

Test Data: RF Exposure – MPE

RF Exposure Requirements - MPE

Project #:	**G101262612**	Test Area:	Intertek Louisville
Test Method:	FCC CFR47 Part 1.1310	Test Date:	09/25/2013
EUT Model #:	M1		
EUT Serial #:	FCC1		
Manufacturer:	Revolv, Inc.		
EUT Description:	Wireless RF-enabled Home Automation Hub		
Notes:	CC1101 #0 Radio: 903.0 to 927.0MHz (multi-channel)		

The following limit is from table 1 (B) Limits for General Population/Uncontrolled Exposure in FCC part 1.1310:

Power Density Limit for Frequency Range 300 – 1500 MHz: F(MHz)/1500 mW/cm^2 = 903/1500 = 0.602 mW/cm^2

The following calculation was used to determine compliance to the above limit. The calculation is from FCC OET bulletin 65.

Power Density(S) =PG/4πR^2 or S=EIRP/4πR^2

Where:
S = power density (in appropriate units, e.g. mW/cm²)
P = power input to the antenna (mW).
G = numeric power gain of the antenna in the direction of interest relative to an isotropic radiator.
R = distance to the center of radiation of the antenna (cm)

In this case, 20cm will be used.
==========

CC1101 #0: 903 - 927MHz (Multi-Channel) Radio

Maximum measured radiated field strength at 3-meters = 93.11 dBuV/m

Maximum typical gain declared by the manufacture = -1.0 dBi = 0.794 (numeric gain)

Production Tolerance declared = +/- 0.45dB

Calculated power input to the antenna = Measured Field Strength – Antenna Gain + Production Tolerance

93.11 dBuV/m – (-1.0dBi) + 0.45dB = 94.56 dBuV/m = 0.85727716 mW

Power Density

Power (mW)	Gain (dbi)	Gain numeric	Distance (cm)	Power Density (mW/cm²)
0.85727716	-1.0	0.794	20	0.000135

Therefore: Power Density Margin (Δ Limit) = 0.000135 – 0.602 = -0.6018646 mW/cm^2

To determine what <u>minimum</u> distance the product will satisfy the Power Density Limit:

R(cm) = SQRT[(P*G)/(4*π*S)] = 0.2999436 cm

Therefore: Distance Margin (Δ Limit) = = 0.2999436 cm – 20 cm = -19.7000564 cm

==========

Reference Conversion Equations:

1. Gain numeric = $10^{(dBi/10)}$

2. Gain (dBi) = 10 log(Gain numeric)

3. dBm = dBuV/m – 107 (50 ohm system)

4. dBm to Watts (W) = $10^{((dBm - 30)/10)}$

15 Unintentional Radiated Emissions (Digital Part of Receiver)

Method:

Unless otherwise stated no deviations were made from FCC Part 15.109 – Class B.

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

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
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

Test Requirement:

The product must pass Unintentional Radiated Emissions – Class B.
Unwanted emissions below 1GHz must comply with the general field strength limits defined in FCC Part 15.109, when measured with a quasi-peak detector. Unwanted emissions above 1GHz are measured with an average detector.

Test Procedure:

The Resolution Bandwidth is 120 kHz for frequencies 30 MHz -1000 MHz and 1 MHz for frequencies above 1000 MHz.

The EUT is placed on a plastic turntable that is 80 cm in height. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables are manipulated to produce worst-case emissions. The signal is maximized by rotating the turntable through a 360º rotation. The antenna height is varied from 1-4 meters. Both vertical and horizontal antenna configurations are utilized in the testing.

Radiated emissions are taken at 3-meter antenna-to-product test distance for all measurements.

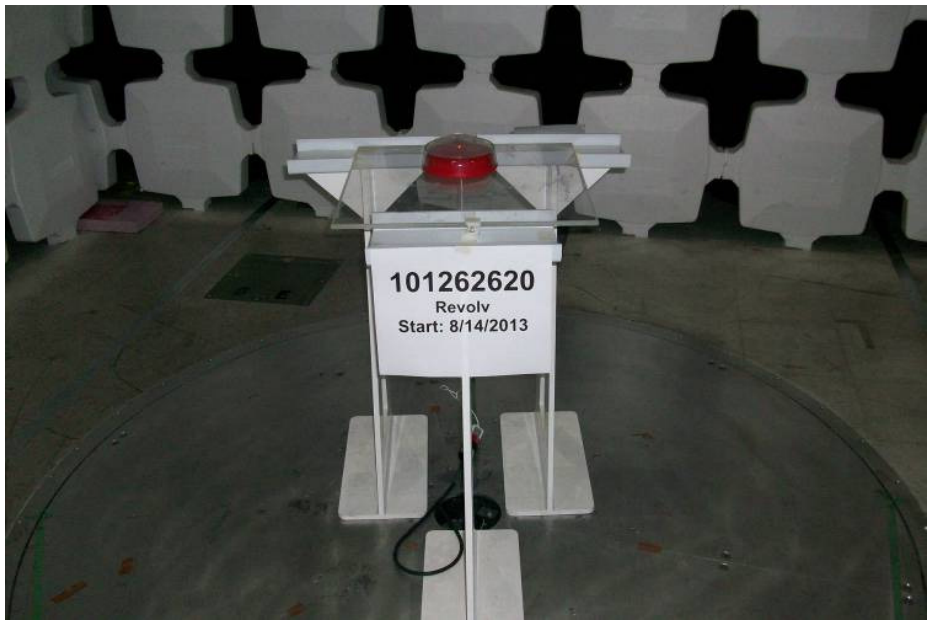
Data is included for the worst-case configuration (the configuration which resulted in the highest emission levels).

Test Results:

The sample tested was found to Comply.

Setup Photographs: Product Axis 1 – Horizontal Position (Product Flat on Table)

Unintentional Radiated Emissions - Test setup (Front View)

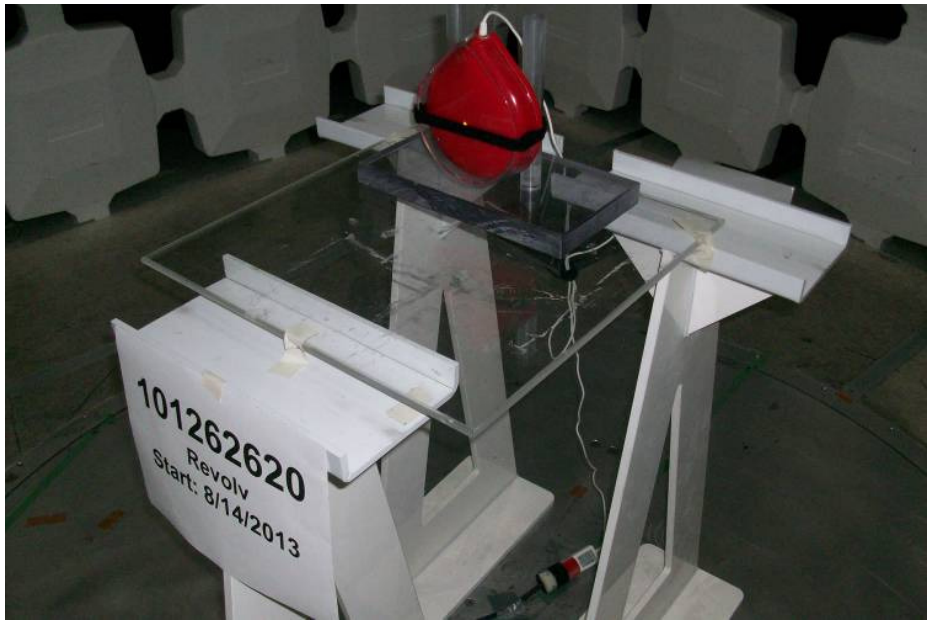


Setup Photographs: Product Axis 1 – Horizontal Position (Product Flat on Table)

Unintentional Radiated Emissions - Test setup (Rear View)

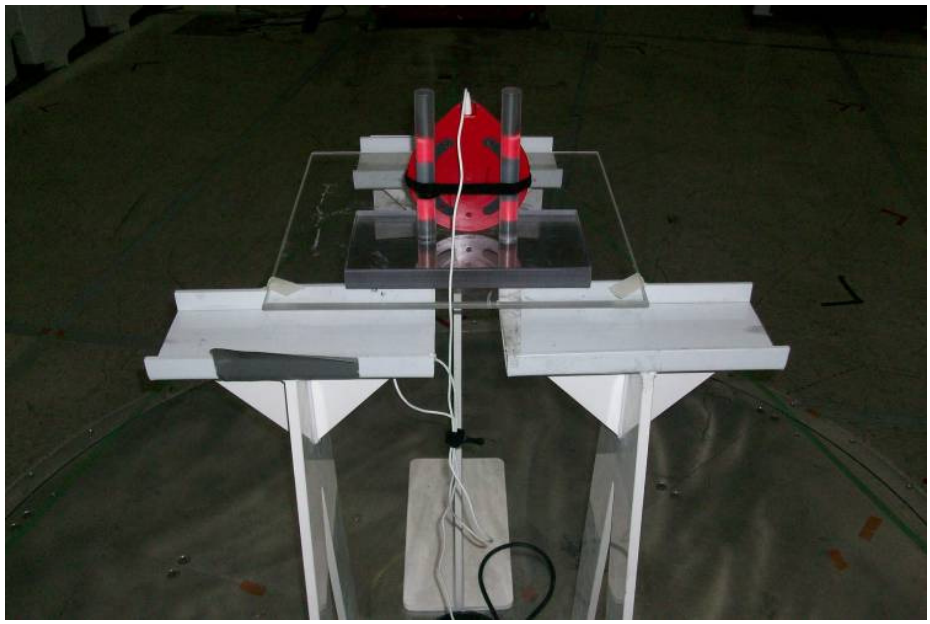
Setup Photographs: Product Axis 2 – Product Vertical on Table (Wall Mount)

Unintentional Radiated Emissions - Test setup (Front View)



Setup Photographs: Product Axis 2 – Product Vertical on Table (Wall Mount)

Unintentional Radiated Emissions - Test setup (Rear View)



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ERROR: stackunderflow
OFFENDING COMMAND: ~

STACK:
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