



Engineering Solutions & Electromagnetic Compatibility Services

FCC Part 15.249 Test Data

EUT: 2.4 GHz Panel 56-0053-00 Rev G01

for

**Resolution Engineering, Inc.
1402 Heggen Street
Hudson, WI 54016
Contact: Jake Peterson**

**Testing Conducted By
Rhein Tech Laboratories, Inc.
360 Herndon Parkway, Suite 1400
Herndon, VA 20170**

RTL Test Engineer: Jon Wilson

RTL Project/Report Number: 2014154DTS

September 2, 2014

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These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANSI-ASQ National Accreditation Board/ACLASS. Refer to certificate and scope of accreditation AT-1445.

Testing Represented in Report

15.249

The data and limits presented in this report are for radiated emissions per 15.249 which references 15.35(b), and peak limiting for restricted bands per 15.209(e), which again references 15.35(b)(2), as procured by Resolution Engineering. No average data is presented in this report. Data is also presented for spurious, non-harmonic radiated emissions per 15.209.

15.207

Unintentional digital emissions, mains conducted.

The Equipment Under Test (EUT) was the **2.4 GHz Panel 56-0053-00 Rev G01 (RTL Bar Code 21477) with AC Adapter (RTL Bar Code 21476)**.

15.249 Radiated Emissions Test Data – FCC Limits/ 3m Distance

Side Antenna, 2.4 GHz

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
2402.0	Peak	H	82.2	26.0	108.2	114.0	-5.8	Pass
4804.0	Peak	V	64.3	-0.3	64.0	74.0	-10.0	Pass
7206.0	Peak	H	61.8	2.9	64.7	74.0	-9.3	Pass
12010.0	Peak	H	53.6	10.0	63.6	74.0	-10.4	Pass
19216.0	Peak	V	45.6	21.4	67.0	74.0	-7.0	Pass
21618.0	Peak	V	44.9	22.6	67.5	74.0	-6.5	Pass
24020.0	Peak	V	39.9	27.1	67.0	74.0	-7.0	Pass

Bottom Antenna, 2.4 GHz

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
2402.0	Peak	V	83.2	26.0	109.2	114.0	-4.8	Pass
4804.0	Peak	V	63.3	-0.3	63.0	74.0	-11.0	Pass
7206.0	Peak	V	60.3	2.9	63.2	74.0	-10.8	Pass
12010.0	Peak	V	51.8	10.0	61.8	74.0	-12.2	Pass
19216.0	Peak	H	45.7	21.4	67.1	74.0	-6.9	Pass
21618.0	Peak	H	45.0	22.6	67.6	74.0	-6.4	Pass
24020.0	Peak	V	40.0	27.1	67.1	74.0	-6.9	Pass

Side Antenna, 2.44 GHz

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
2440.0	Peak	H	82.1	26.0	108.1	114.0	-5.9	Pass
4880.0	Peak	V	66.5	0.1	66.6	74.0	-7.4	Pass
7320.0	Peak	H	61.3	2.9	64.2	74.0	-9.8	Pass
9760.0	Peak	H	47.2	9.9	57.1	74.0	-16.9	Pass
12200.0	Peak	H	49.7	10.2	59.9	74.0	-14.1	Pass
14640.0	Peak	H	45.2	15.7	60.9	74.0	-13.1	Pass
17080.0	Peak	V	46.1	18.2	64.3	74.0	-9.7	Pass
19520.0	Peak	V	44.9	21.6	66.5	74.0	-7.5	Pass
21960.0	Peak	V	43.8	23.9	67.7	74.0	-6.3	Pass
24400.0	Peak	V	40.2	26.3	66.5	74.0	-7.5	Pass

Bottom Antenna, 2.44 GHz

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
2440.0	Peak	H	82.0	26.0	108.0	114.0	-6.0	Pass
4880.0	Peak	V	66.7	0.1	66.8	74.0	-7.2	Pass
7320.0	Peak	H	59.3	2.9	62.2	74.0	-11.8	Pass
9760.0	Peak	H	48.2	9.9	58.1	74.0	-15.9	Pass
12200.0	Peak	V	49.3	10.2	59.5	74.0	-14.5	Pass
14640.0	Peak	V	45.3	15.7	61.0	74.0	-13.0	Pass
17080.0	Peak	V	46.2	18.2	64.4	74.0	-9.6	Pass
19520.0	Peak	H	45.3	21.6	66.9	74.0	-7.1	Pass
21960.0	Peak	H	44.0	23.9	67.9	74.0	-6.1	Pass
24400.0	Peak	H	40.1	26.3	66.4	74.0	-7.6	Pass

Side Antenna, 2.48 GHz

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
2480.0	Peak	H	79.9	26.0	105.9	114.0	-8.1	Pass
4960.0	Peak	V	61.7	0.0	61.7	74.0	-12.3	Pass
7440.0	Peak	H	57.1	2.9	60.0	74.0	-14.0	Pass
9920.0	Peak	V	46.5	9.0	55.5	74.0	-18.5	Pass
12400.0	Peak	H	48.1	13.5	61.6	74.0	-12.4	Pass
14880.0	Peak	H	44.0	15.8	59.8	74.0	-14.2	Pass
17360.0	Peak	V	46.1	18.7	64.8	74.0	-9.2	Pass
19840.0	Peak	V	45.3	21.9	67.2	74.0	-6.8	Pass
22320.0	Peak	V	39.9	26.0	65.9	74.0	-8.1	Pass
24800.0	Peak	H	40.1	27.6	67.7	74.0	-6.3	Pass

Bottom Antenna, 2.48 GHz

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
2480.0	Peak	H	81.2	26.0	107.2	114.0	-6.8	Pass
4960.0	Peak	H	61.9	0.0	61.9	74.0	-12.1	Pass
7440.0	Peak	H	55.7	2.9	58.6	74.0	-15.4	Pass
9920.0	Peak	V	46.6	9.0	55.6	74.0	-18.4	Pass
12400.0	Peak	H	48.3	13.5	61.8	74.0	-12.2	Pass
14880.0	Peak	H	44.1	15.8	59.9	74.0	-14.1	Pass
17360.0	Peak	H	46.2	18.7	64.9	74.0	-9.1	Pass
19840.0	Peak	V	45.5	21.9	67.4	74.0	-6.6	Pass
22320.0	Peak	V	40.1	26.0	66.1	74.0	-7.9	Pass
24800.0	Peak	V	40.1	27.6	67.7	74.0	-6.3	Pass

FCC/IC Cross Reference

FCC 15.249	RSS-210 Issue 8 A2.9
FCC 15.35(b)	RSS-Gen Issue 3 7.2.3
FCC 15.205	RSS-Gen Issue 3 7.2.2
FCC 15.209	RSS-Gen Issue 3 7.2.5

Non-Harmonic Spurious Emissions

Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
78.550	QP	V	54.7	-20.1	34.6	40.0	-5.4	Pass
88.800	QP	H	43.4	-18.9	24.5	43.5	-19.0	Pass
108.000	QP	V	42.6	-16.6	26.0	43.5	-17.5	Pass
153.520	QP	V	50.7	-18.2	32.5	43.5	-11.0	Pass
277.110	QP	H	36.2	-13.0	23.2	46.0	-22.8	Pass

Test Procedure

Radiated fundamental and spurious emissions were tested at three meters. The EUT was tested in the three orthogonal planes with the receive antenna in both polarities. The emissions were maximized per ANSI C63.4:2003 8.3.1.2; that is, the measurement antenna height was varied between 1 and 4 m, and the EUT was rotated through 360° on a rotating turntable until the maximum emissions were found. Both horizontal and vertical measurement antenna polarizations were used. A resolution bandwidth of 100 kHz was used for frequencies less than 1000 MHz, and a resolution bandwidth of 1 MHz was used for frequencies greater than or equal to 1000 MHz. The video bandwidth was set to a value at least three times greater than the resolution bandwidth.


EUT Disposition

The EUT was adapted to continuously transmit for testing purposes.

Radiated Emissions Test Equipment

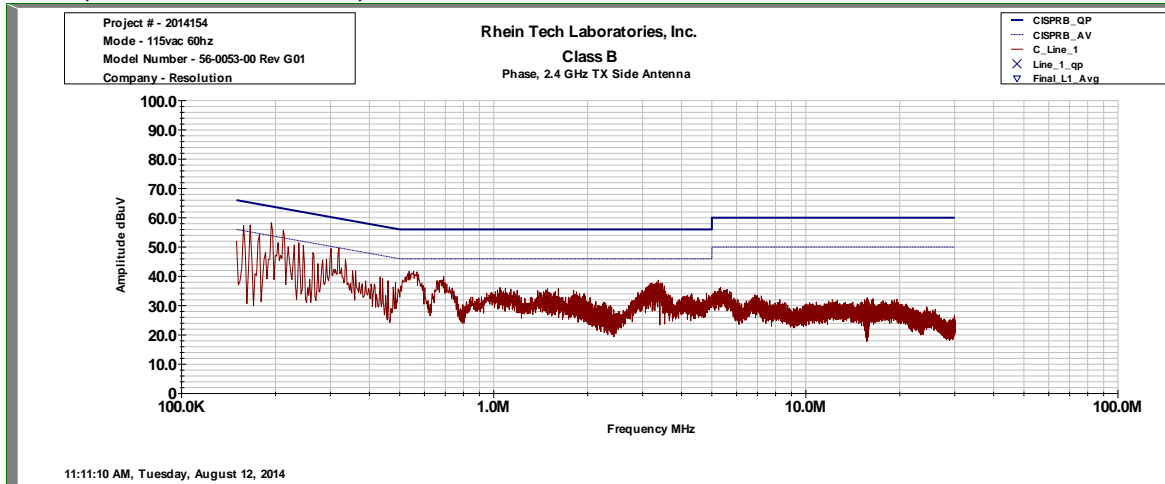
Part	Manufacturer	Model	Serial Number	RTL Bar Code	Calibration Due Date
Amplifier (20 MHz-2 GHz)	Rhein Tech Laboratories, Inc.	PR-1040	900905	900905	9/4/14
Spectrum Analyzer (10 Hz-26.5 GHz)	Agilent	EXA N9010	MY51250846	901583	4/16/15
Bilog Periodic Antenna (25 MHz-2000 MHz)	ARA	LPB-2520	1037	900724	4/19/15
Amplifier (1 GHz-26.5 GHz)	Hewlett Packard	8449B OPT H02	3008A00505	900932	8/27/2014
Horn Antenna (2.0-4.0 GHz)	EMCO	3161-02	9804-1044	900772	4/20/15
Horn Antenna (4.0-8.0 GHz)	EMCO	3161-03	9508-1020	900321	4/20/17
Horn Antenna (8.0-12.4 GHz)	EMCO	3160-07	9605-1054	900323	4/20/17
Horn Antenna (12.4-18.0 GHz)	EMCO	3160-08	9607-1044	900356	4/20/17
Horn Antenna (18.0-26.5 GHz)	EMCO	RA42-K-F-43_C	960281-003	901218	4/20/17
Emissions Testing Software	Rhein Tech Laboratories, Inc.	Automated Emission Tester	Rev. 14.0.2	N/A	N/A

Test Personnel:

Jon Wilson		August 18, 2014
Test Engineer	Signature	Date of Test

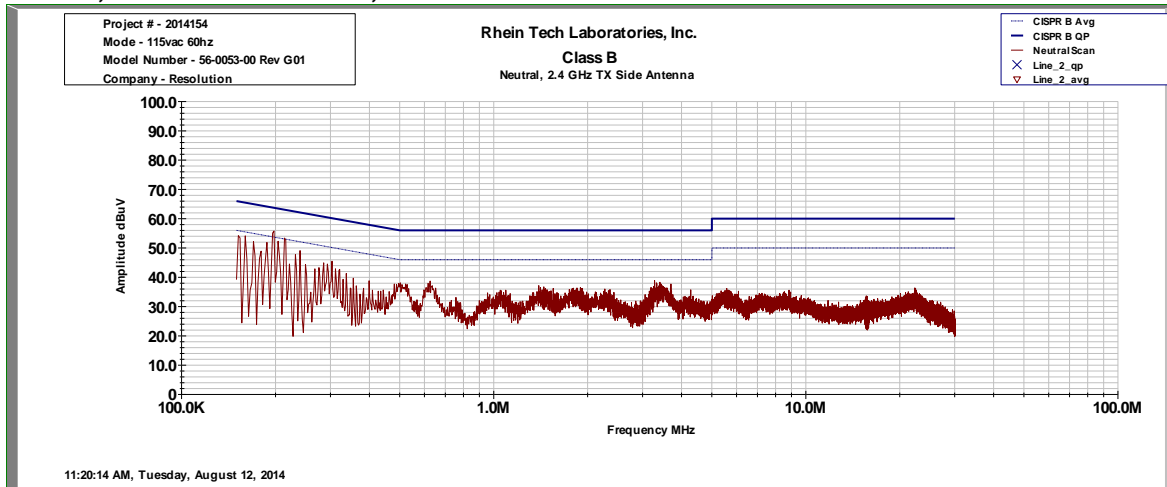
15.207 Conducted Line Emissions Test Data – FCC Limits

Phase, Side Antenna Active, 2.4 GHz



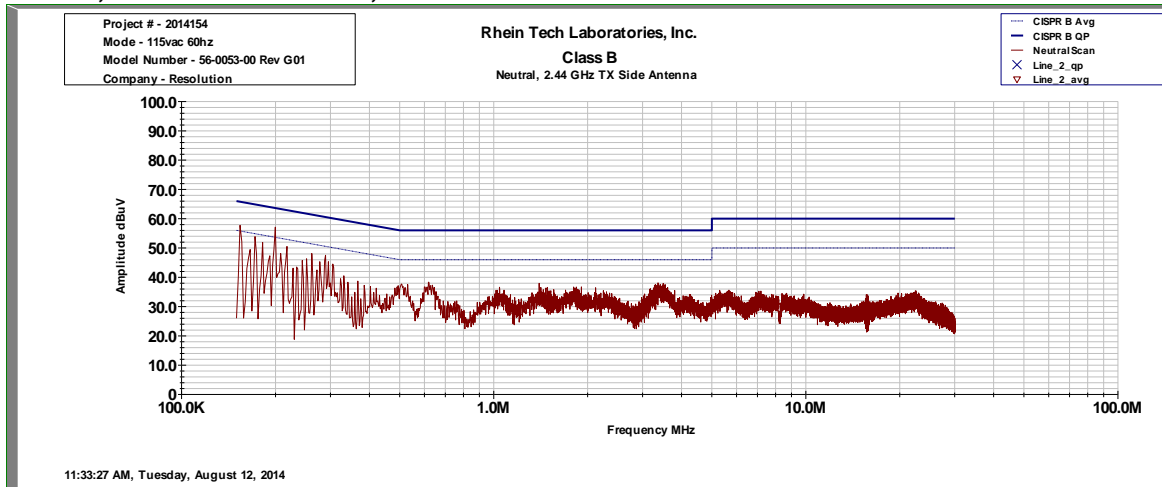
Frequency (MHz)	Detector	Level (dBμV)	Site Correction Factor (dB)	Corrected Level (dBμV)	Limit (dBμV)	Margin (dB)	Pass/Fail
0.157	QP	48.8	0.4	49.2	65.6	-16.4	Pass
0.157	Av	25.9	0.4	26.3	55.6	-29.3	Pass
0.194	QP	55.5	0.4	55.9	63.9	-8.0	Pass
0.194	Av	44.0	0.4	44.4	53.9	-9.5	Pass
0.206	QP	56.5	0.4	56.9	63.4	-6.5	Pass
0.206	Av	44.2	0.4	44.6	53.4	-8.8	Pass
0.313	QP	44.0	0.4	44.0	59.9	-15.9	Pass
0.313	Av	36.9	0.4	37.3	49.9	-12.6	Pass

Neutral, Side Antenna Active, 2.4 GHz



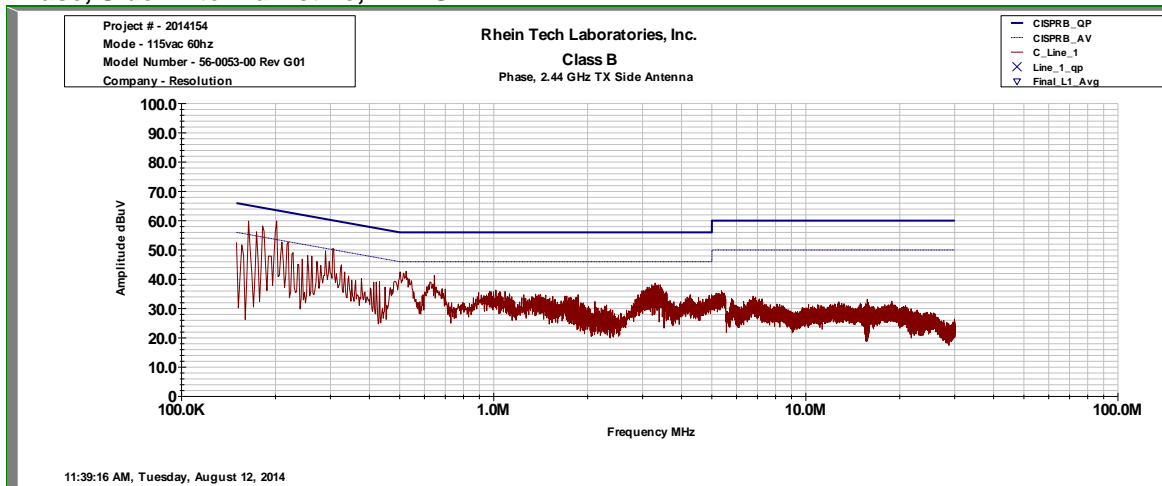
Frequency (MHz)	Detector	Level (dB μ V)	Site Correction Factor (dB)	Corrected Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Pass/Fail
0.159	QP	54.1	0.4	54.5	65.5	-11.0	Pass
0.159	Av	31.7	0.4	32.1	55.5	-23.4	Pass
0.203	QP	57.1	0.4	57.5	63.5	-6.0	Pass
0.203	Av	38.8	0.4	39.2	53.5	-14.3	Pass
0.216	QP	52.4	0.4	52.8	63.0	-10.2	Pass
0.216	Av	33.8	0.4	34.2	53.0	-18.8	Pass

Neutral, Side Antenna Active, 2.44 GHz



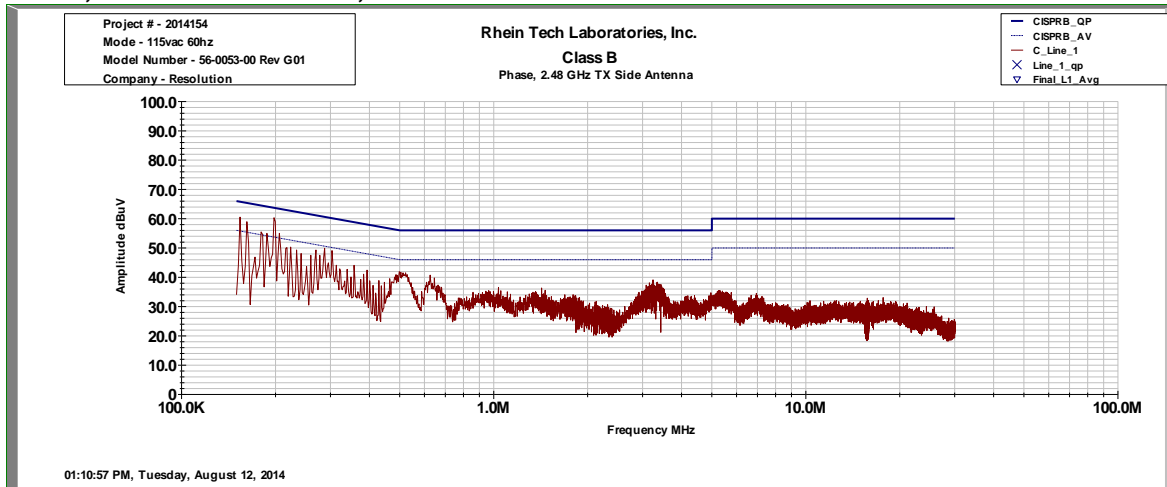
Frequency (MHz)	Detector	Level (dBμV)	Site Correction Factor (dB)	Corrected Level (dBμV)	Limit (dBμV)	Margin (dB)	Pass/Fail
0.154	QP	51.0	0.4	51.4	65.8	-14.4	Pass
0.154	Av	26.4	0.4	26.8	55.8	-29.0	Pass
0.206	QP	56.7	0.4	57.1	63.4	-6.3	Pass
0.206	Av	39.5	0.4	39.9	53.4	-13.5	Pass

Phase, Side Antenna Active, 2.44 GHz



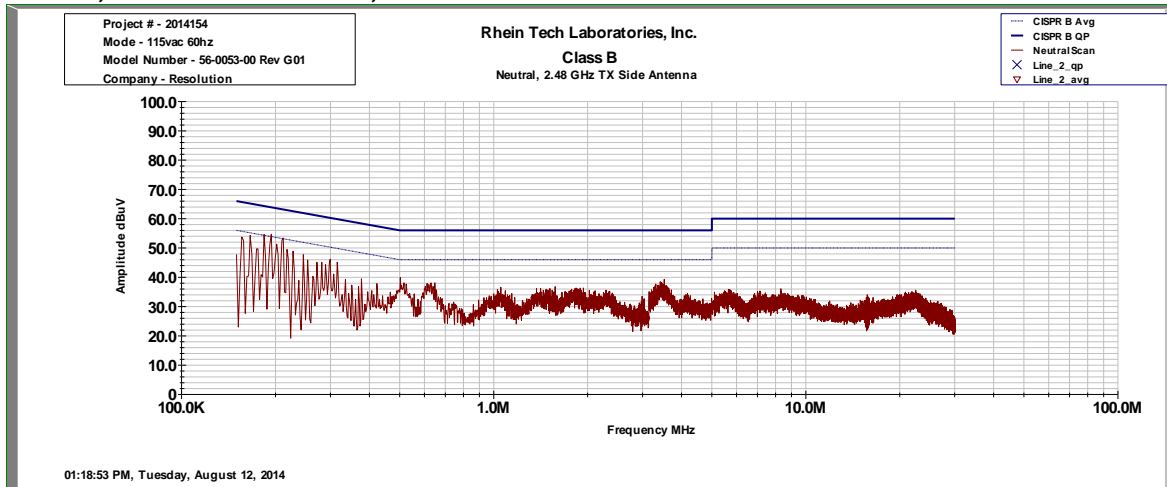
Frequency (MHz)	Detector	Level (dBμV)	Site Correction Factor (dB)	Corrected Level (dBμV)	Limit (dBμV)	Margin (dB)	Pass/Fail
0.167	QP	52.1	0.4	52.5	65.1	-12.6	Pass
0.167	Av	31.2	0.4	31.6	55.1	-23.5	Pass
0.206	QP	58.8	0.4	59.2	63.4	-4.2	Pass
0.206	Av	44.4	0.4	44.8	53.4	-8.6	Pass
0.310	QP	48.4	0.4	48.8	60.0	-11.2	Pass
0.310	Av	35.0	0.4	35.4	50.0	-14.6	Pass

Phase, Side Antenna Active, 2.48 GHz



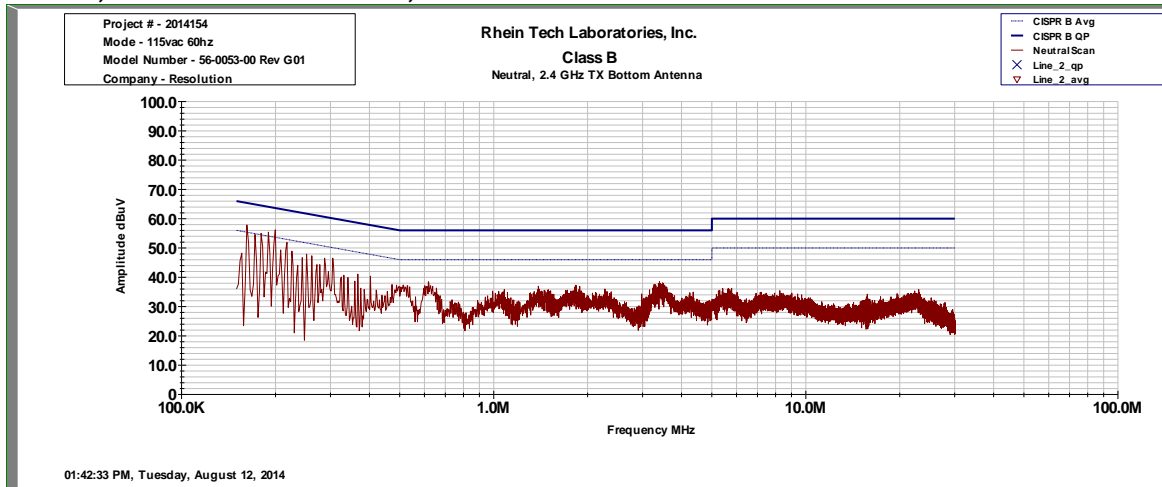
Frequency (MHz)	Detector	Level (dBμV)	Site Correction Factor (dB)	Corrected Level (dBμV)	Limit (dBμV)	Margin (dB)	Pass/Fail
0.154	QP	56.0	0.4	56.4	65.8	-9.4	Pass
0.154	Av	29.1	0.4	29.5	55.8	-26.3	Pass
0.207	QP	56.6	0.4	57.0	63.3	-6.3	Pass
0.207	Av	44.1	0.4	44.5	53.3	-8.8	Pass
0.311	QP	49.1	0.4	49.5	59.9	-10.4	Pass
0.311	Av	36.9	0.4	37.3	49.9	-12.6	Pass

Neutral, Side Antenna Active, 2.48 GHz



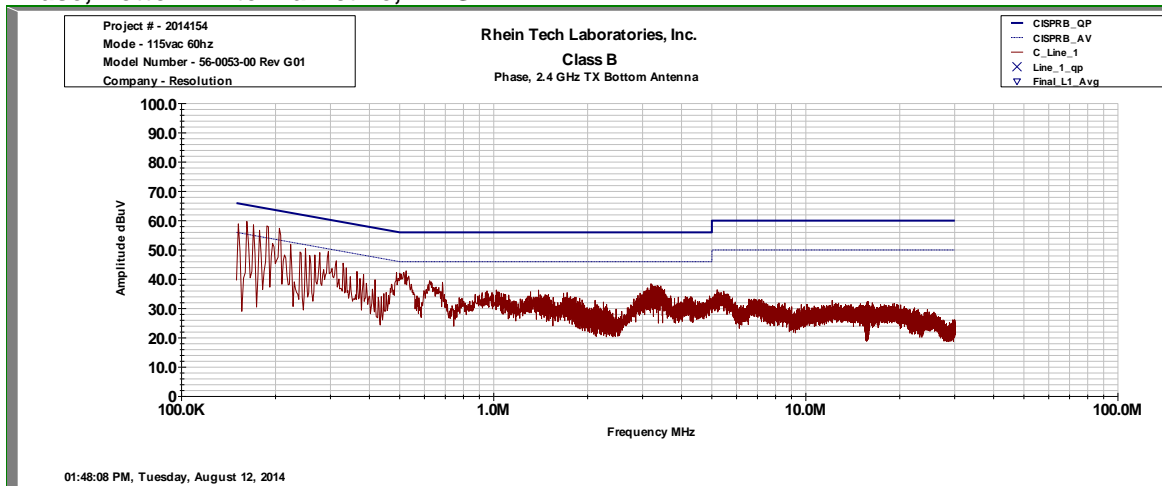
Frequency (MHz)	Detector	Level (dB μ V)	Site Correction Factor (dB)	Corrected Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Pass/Fail
0.154	QP	48.0	0.4	48.4	65.8	-17.4	Pass
0.154	Av	22.1	0.4	22.5	55.8	-33.3	Pass
0.194	QP	53.6	0.4	54.0	63.3	-9.3	Pass
0.194	Av	28.9	0.4	29.3	53.3	-24.0	Pass
0.207	QP	54.6	0.4	55.0	59.9	-4.9	Pass
0.207	Av	36.1	0.4	36.5	49.9	-13.4	Pass

Neutral, Bottom Antenna Active, 2.4 GHz



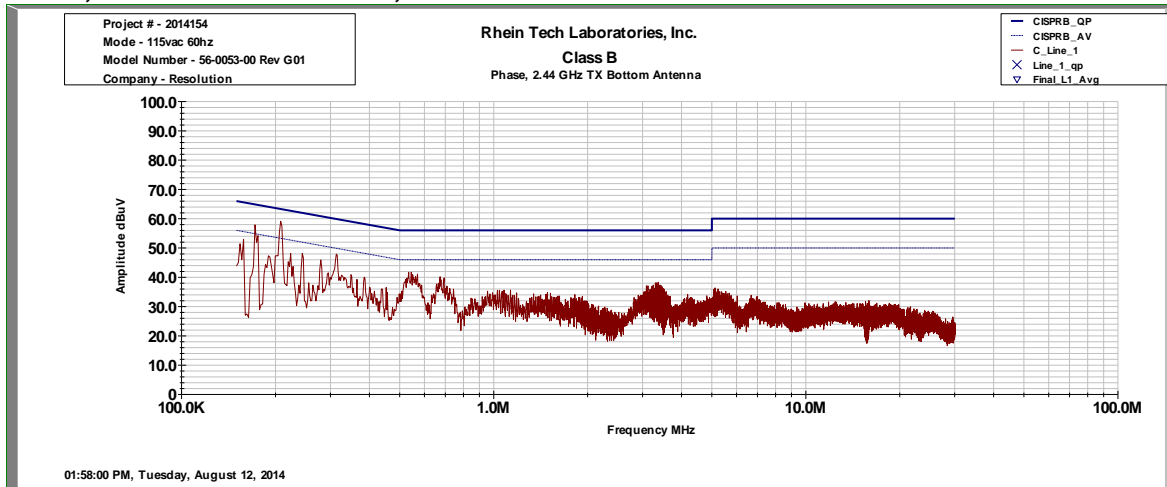
Frequency (MHz)	Detector	Level (dBµV)	Site Correction Factor (dB)	Corrected Level (dBµV)	Limit (dBµV)	Margin (dB)	Pass/Fail
0.169	QP	53.1	0.4	53.5	65.0	-11.5	Pass
0.169	Av	30.5	0.4	30.9	55.0	-24.1	Pass
0.207	QP	55.5	0.4	55.9	63.3	-7.4	Pass
0.207	Av	38.4	0.4	38.8	53.3	-14.5	Pass

Phase, Bottom Antenna Active, 2.4 GHz



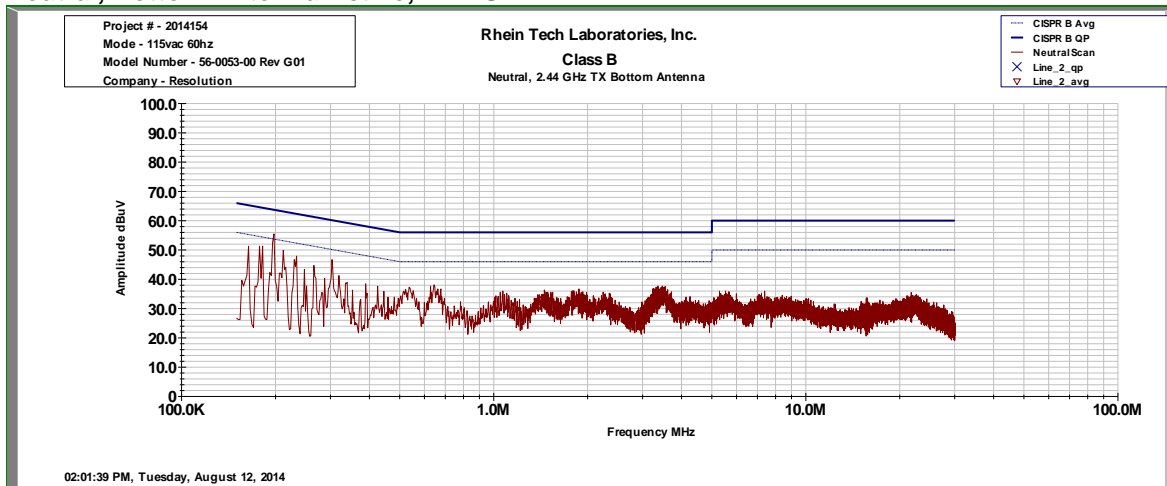
Frequency (MHz)	Detector	Level (dBµV)	Site Correction Factor (dB)	Corrected Level (dBµV)	Limit (dBµV)	Margin (dB)	Pass/Fail
0.169	QP	54.3	0.4	54.7	65.0	-10.3	Pass
0.169	Av	32.3	0.4	32.7	55.0	-22.3	Pass
0.207	QP	55.2	0.4	55.6	63.3	-7.7	Pass
0.207	Av	44.3	0.4	44.7	53.3	-8.6	Pass

Phase, Bottom Antenna Active, 2.44 GHz



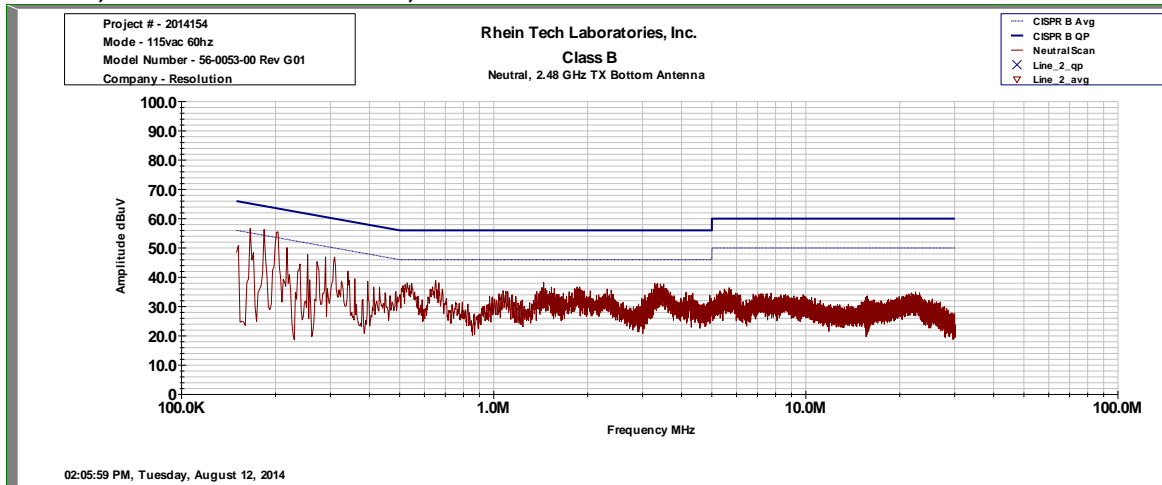
Frequency (MHz)	Detector	Level (dBµV)	Site Correction Factor (dB)	Corrected Level (dBµV)	Limit (dBµV)	Margin (dB)	Pass/Fail
0.169	QP	55.4	0.4	55.8	65.0	-9.2	Pass
0.169	Av	34.0	0.4	34.4	55.0	-20.6	Pass
0.207	QP	58.6	0.4	59.0	63.3	-4.3	Pass
0.207	Av	44.8	0.4	45.2	53.3	-8.1	Pass

Neutral, Bottom Antenna Active, 2.44 GHz



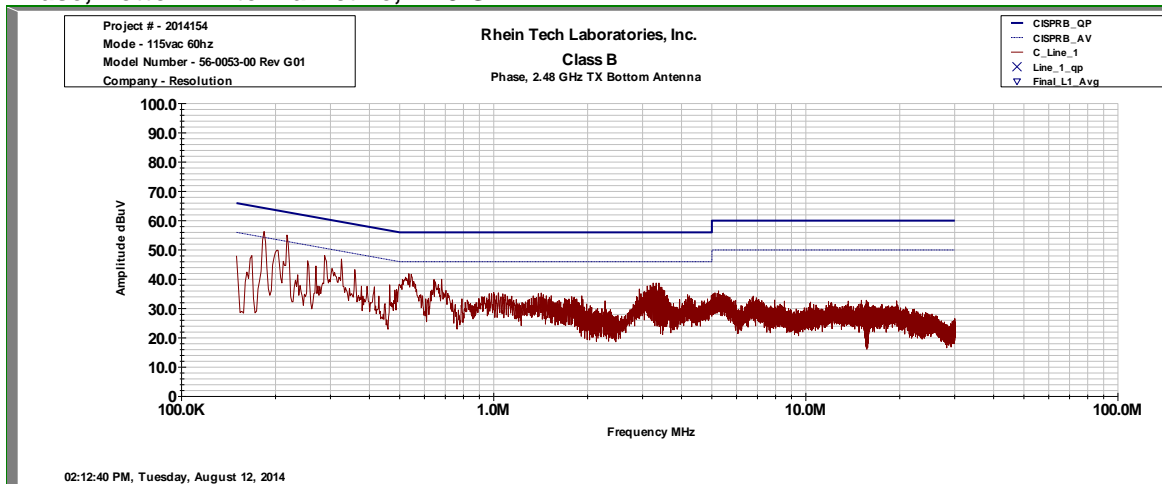
Frequency (MHz)	Detector	Level (dBµV)	Site Correction Factor (dB)	Corrected Level (dBµV)	Limit (dBµV)	Margin (dB)	Pass/Fail
0.207	QP	56.0	0.4	56.4	63.3	-6.9	Pass
0.207	Av	40.3	0.4	40.7	53.3	-12.6	Pass

Neutral, Bottom Antenna Active, 2.48 GHz



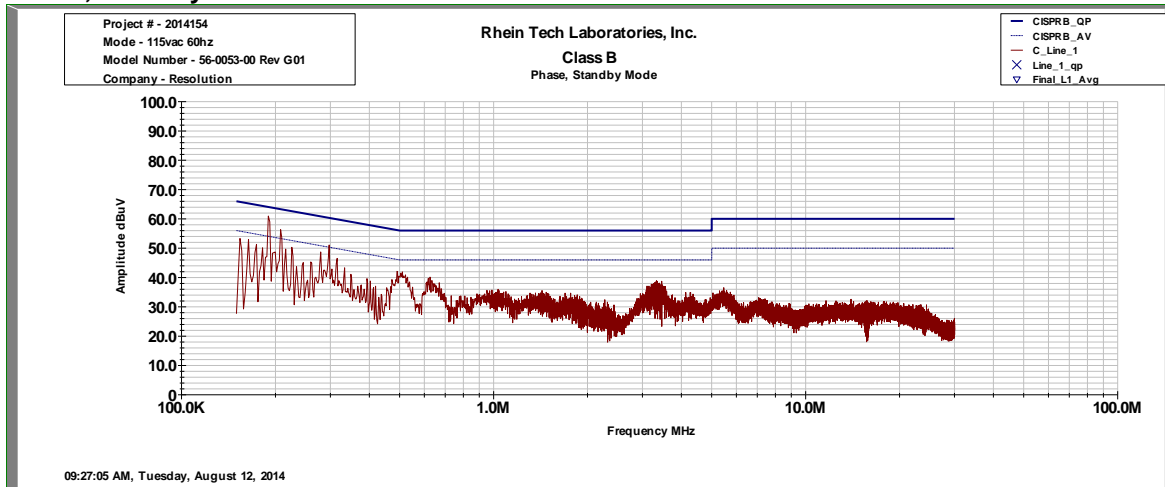
Frequency (MHz)	Detector	Level (dBµV)	Site Correction Factor (dB)	Corrected Level (dBµV)	Limit (dBµV)	Margin (dB)	Pass/Fail
0.169	QP	53.8	0.4	54.2	65.0	-10.8	Pass
0.169	Av	31.1	0.4	31.5	55.0	-23.5	Pass
0.207	QP	55.7	0.4	56.1	63.3	-7.2	Pass
0.207	Av	40.2	0.4	40.6	53.3	-12.7	Pass

Phase, Bottom Antenna Active, 2.48 GHz



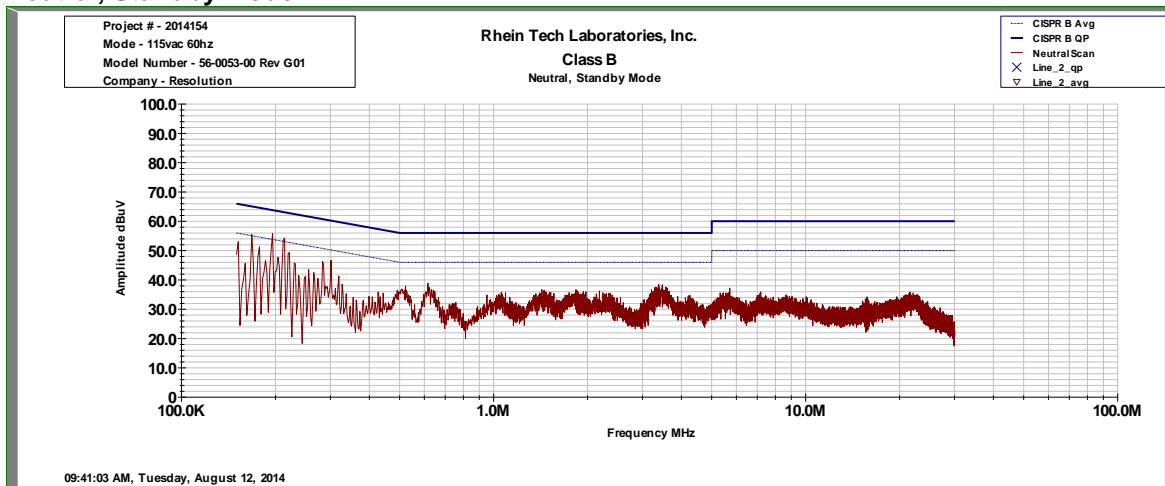
Frequency (MHz)	Detector	Level (dBµV)	Site Correction Factor (dB)	Corrected Level (dBµV)	Limit (dBµV)	Margin (dB)	Pass/Fail
0.169	QP	55.2	0.4	55.6	65.0	-9.4	Pass
0.169	Av	34.6	0.4	35.0	55.0	-20.0	Pass
0.207	QP	60.0	0.4	60.4	63.3	-2.9	Pass
0.207	Av	44.9	0.4	45.3	53.3	-8.0	Pass

Phase, Standby Mode



Frequency (MHz)	Detector	Level (dBµV)	Site Correction Factor (dB)	Corrected Level (dBµV)	Limit (dBµV)	Margin (dB)	Pass/Fail
0.202	QP	52.6	0.4	53.0	63.5	-10.5	Pass
0.202	Av	44.2	0.4	44.6	53.5	-8.9	Pass
0.311	QP	43.4	0.4	43.8	59.9	-16.1	Pass
0.311	Av	37.5	0.4	37.9	49.9	-12.0	Pass

Neutral, Standby Mode



Frequency (MHz)	Detector	Level (dBµV)	Site Correction Factor (dB)	Corrected Level (dBµV)	Limit (dBµV)	Margin (dB)	Pass/Fail
0.204	QP	52.0	0.4	52.4	63.4	-11.0	Pass
0.204	Av	38.3	0.4	38.7	53.4	-14.7	Pass
0.168	QP	45.6	0.4	46.0	65.1	-19.1	Pass
0.168	Av	30.0	0.4	30.4	55.1	-24.7	Pass

Result: Pass

Test Procedure

The power line conducted emission measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was placed on a wooden table. Power was fed to the EUT through a 50-ohm/50 microhenry LISN. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 100 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 100 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The analyzer's 6 dB resolution bandwidth was set to 9 kHz. The video bandwidth was set to a value at least three times greater than the resolution bandwidth. Average measurements are performed in linear mode using a 9 kHz resolution bandwidth and a 1 Hz video bandwidth. The frequency spectrum was scanned from 150 kHz to 30 MHz.


EUT Disposition

The EUT was adapted to continuously transmit for testing purposes.

Conducted Line Emissions Test Equipment

Part Type	Manufacturer	Model	Serial Number	Barcode	Cal Due Date
Conducted Emissions					
Spectrum Analyzer (100 Hz – 22 GHz)	Hewlett Packard	8566B	3138A07771	900930	4/21/2016
Spectrum Analyzer Display Section	Hewlett Packard	85662A	3144A20839	900931	4/21/2016
Quasi-Peak Adapter	Hewlett Packard	85650A	2412A00414	900969	4/21/2016
Filter	Solar	8130	947306	900729	3/26/2015
16A LISN	AFJ International	LS16/110VAC	16010020080	901083	8/27/2014
Test software	Quantum Change	Tile!	4.0.A.8	N/A	N/A

Test Personnel:

Jon Wilson		August 12, 2014
Test Engineer	Signature	Date Of Test

Test Configuration Photographs

Radiated Emissions



Conducted Emissions



EUT Photograph

