RHEIN TECH LABORATORIES, INC.

Engineering Solutions & Electromagnetic Compatibility Services

FCC Part 15.247 Test Data

EUT: 2.4 GHz Panel 55-0082-06 Rev B

for

Resolution Products LLC
1402 Heggen Street
Hudson, WI 54016
Contact: Dan Mondor

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

RTL Test Engineer: Dan Baltzell

RTL Project/Report Number: 2017184

March 2, 2018

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from, the applicable parts of FCC Part 2, FCC Part 15 and ANSI C63.10.

Signature: _____ Date: March 2, 2018

Typed/Printed Name: Desmond A. Fraser Position: President

These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANAB. Refer to certificate and scope of accreditation AT-1445.

Testing Represented in Report

15.247
The data and limits presented in this report are for radiated emissions per 15.247 which references 15.35(b), and peak limiting for restricted bands per 15.209(e), 15.205, which again references 15.35(b)(2), as procured by Resolution Products LLC. Average data presented in this report is calculated from a duty cycle correction (12.4 dB). Data is also presented for spurious, non-harmonic radiated emissions per 15.209.

15.207 digital emissions, mains conducted.

The Equipment Under Test (EUT) was the 2.4 GHz Panel 55-0082-06 Rev B (RTL Bar Code 22670 and 22672) with AC Adapter AMS177-1202000SU-T

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

Inverted F Antenna Peak Measurements

2.405 GHz

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
2405.0	Peak	86.3	25.4	111.7	145.2	-33.5	Pass
4810.0	Peak	22.6	0.4	23.0	74.0	-51.0	Pass
12025.0	Peak	14.3	44.0	58.3	74.0	-15.7	Pass
19240.0	Peak	6.2	52.9	59.1	74.0	-14.9	Pass

2.44 GHz

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
2440.0	Peak	87.9	25.5	113.4	145.2	-31.8	Pass
4880.0	Peak	21.4	33.6	55.0	74.0	-19.0	Pass
7320.0	Peak	19.0	35.7	54.7	74.0	-19.3	Pass
12200.0	Peak	2.5	44.0	46.5	74.0	-27.5	Pass
19520.0	Peak	7.4	53.0	60.4	74.0	-13.6	Pass

2.475 GHz

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
2475.0	Peak	87.8	25.7	113.5	74.0	-12.0	Pass
4950.0	Peak	21.7	33.7	55.4	74.0	-18.6	Pass
7425.0	Peak	18.8	35.8	54.6	74.0	-19.4	Pass
12375.0	Peak	13.5	44.0	57.5	74.0	-16.5	Pass
19800.0	Peak	3.1	53.2	56.3	74.0	-17.7	Pass
22275.0	Peak	6.3	54.2	60.5	74.0	-13.5	Pass

Inverted F Antenna Average Measurements

2.405 GHz

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
2405.0	Average	73.8	25.4	99.3	125.2	-25.9	Pass
4810.0	Average	10.1	0.4	10.6	54.0	-43.4	Pass
12025.0	Average	1.8	44.0	45.9	54.0	-8.1	Pass
19240.0	Average	-6.3	52.9	46.7	54.0	-7.3	Pass

2.44 GHz

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
2440.0	Average	75.2	25.5	100.8	125.2	-24.4	Pass
4880.0	Average	2.8	33.6	36.5	54.0	-17.5	Pass
7320.0	Average	-0.6	35.7	35.2	54.0	-18.8	Pass
12200.0	Average	-22.7	44.0	21.4	54.0	-32.6	Pass
19520.0	Average	-15.6	53.0	37.5	54.0	-16.5	Pass

2.475 GHz

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
2475.0	Average	74.7	25.7	100.5	125.2	-24.7	Pass
4950.0	Average	3.3	33.7	37.1	54.0	-16.9	Pass
7425.0	Average	-0.7	35.8	35.2	54.0	-18.8	Pass
12375.0	Average	-9.8	44.0	34.3	54.0	-19.7	Pass
19800.0	Average	-22.4	53.2	30.9	54.0	-23.1	Pass
22275.0	Average	-17.5	54.2	36.8	54.0	-17.2	Pass

Fractal Antenna Peak Measurements

2.405 GHz

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
2405.0	Peak	84.6	25.4	110.0	145.2	-35.2	Pass
4810.0	Peak	23.4	0.4	23.8	74.0	-50.2	Pass
12025.0	Peak	2.9	44.0	46.9	74.0	-27.1	Pass
19240.0	Peak	13.1	52.9	66.0	74.0	-8.0	Pass

2.44 GHz

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
2440.0	Peak	85.0	25.5	110.5	145.2	-34.7	Pass
4880.0	Peak	22.3	33.6	55.9	74.0	-18.1	Pass
7320.0	Peak	24.8	35.7	60.5	74.0	-13.5	Pass
12200.0	Peak	11.1	44.0	55.1	74.0	-18.9	Pass
19520.0	Peak	12.1	53.0	65.1	74.0	-8.9	Pass

2.475 GHz

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
2475.0	Peak	86.2	25.7	111.9	145.2	-33.3	Pass
4950.0	Peak	20.9	33.7	54.6	74.0	-19.4	Pass
7425.0	Peak	20.4	35.8	56.2	74.0	-17.8	Pass
12375.0	Peak	4.1	44.0	48.1	74.0	-25.9	Pass
19800.0	Peak	5.1	53.2	58.3	74.0	-15.7	Pass
22275.0	Peak	4.1	54.2	58.3	74.0	-15.7	Pass

Fractal Antenna Average Measurements

2.405 GHz

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
2405.0	Average	72.1	25.4	97.6	125.2	-27.6	Pass
4810.0	Average	10.9	0.4	11.4	54.0	-42.6	Pass
12025.0	Average	-9.6	44.0	34.5	54.0	-19.5	Pass
19240.0	Average	0.6	52.9	53.6	54.0	-0.4	Pass

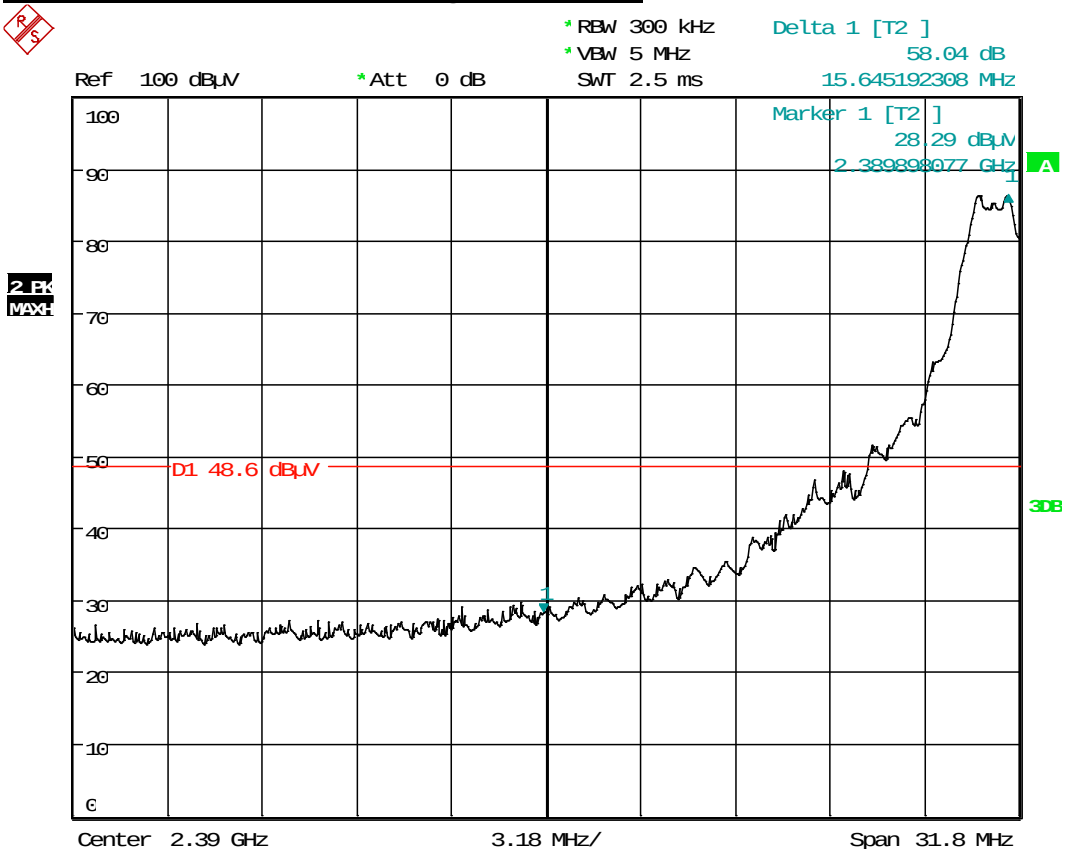
2.44 GHz

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
2440.0	Average	72.5	25.5	98.1	125.2	-27.1	Pass
4880.0	Average	9.8	33.6	43.5	54.0	-10.5	Pass
7320.0	Average	12.3	35.7	48.1	54.0	-5.9	Pass
12200.0	Average	-1.4	44.0	42.7	54.0	-11.3	Pass
19520.0	Average	-0.4	53.0	52.7	54.0	-1.3	Pass

2.475 GHz

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
2475.0	Average	73.7	25.7	99.5	125.2	-25.7	Pass
4950.0	Average	8.4	33.7	42.2	54.0	-11.8	Pass
7425.0	Average	7.9	35.8	43.8	54.0	-10.2	Pass
12375.0	Average	-8.4	44.0	35.7	54.0	-18.3	Pass
19800.0	Average	-7.4	53.2	45.9	54.0	-8.1	Pass
22275.0	Average	-8.4	54.2	45.9	54.0	-8.1	Pass

Inverted F Antenna Lower Band Edge Test Results



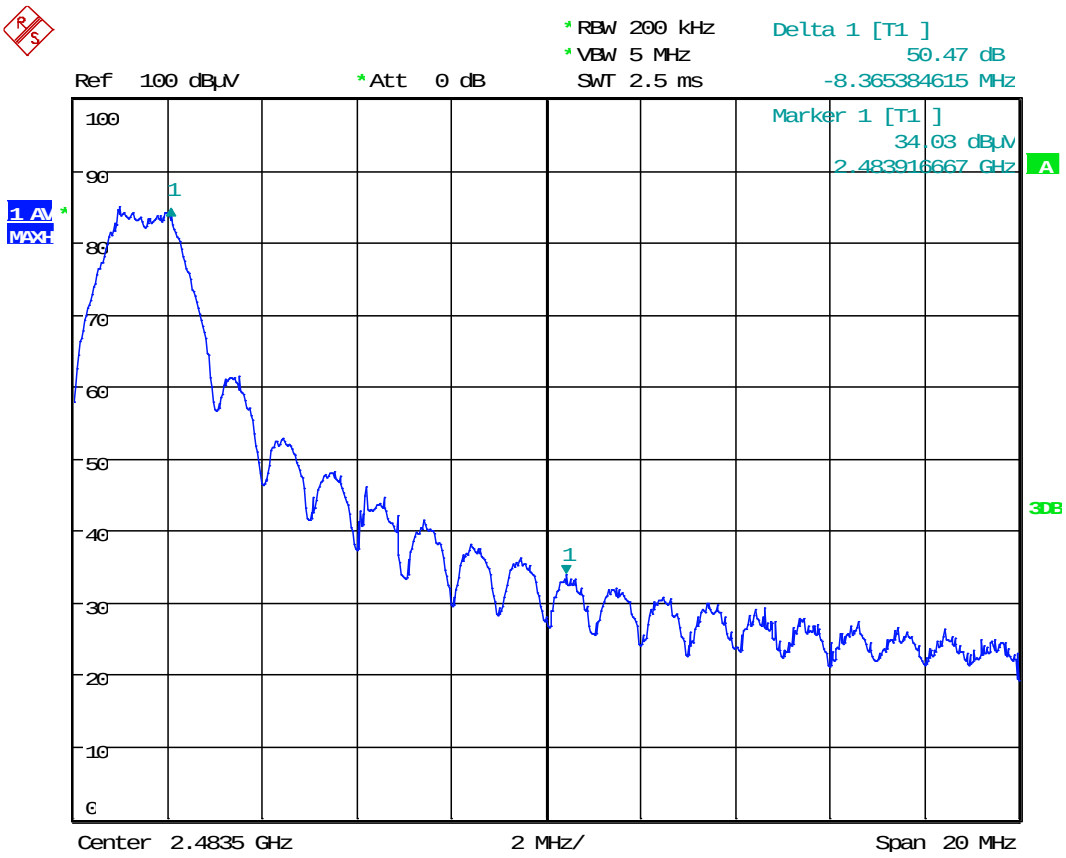
Date: 29.SEP.2017 07:54:27

99.3 dBµV/m is the field strength measurement, from which the delta measurement of 58.0 dB is subtracted, resulting in a level of 41.3 dB. This level has a margin of 12.7 dB below the limit of 54.0 dBuV/m.

Calculation: 99.3 dBµV/m - 58.0 - 54.0 dBµV/m = -12.7 dB

Peak Field Strength of Lower Band Edge (1 MHz RBW/3 MHz VBW) = 111.7 dBµV/m
Average Field Strength of Lower Band Edge (1 MHz RBW/3 MHz VBW) = 99.3 dBµV/m
Delta measurement = 58.0 dB

Inverted F Antenna Upper Band Edge Test Results



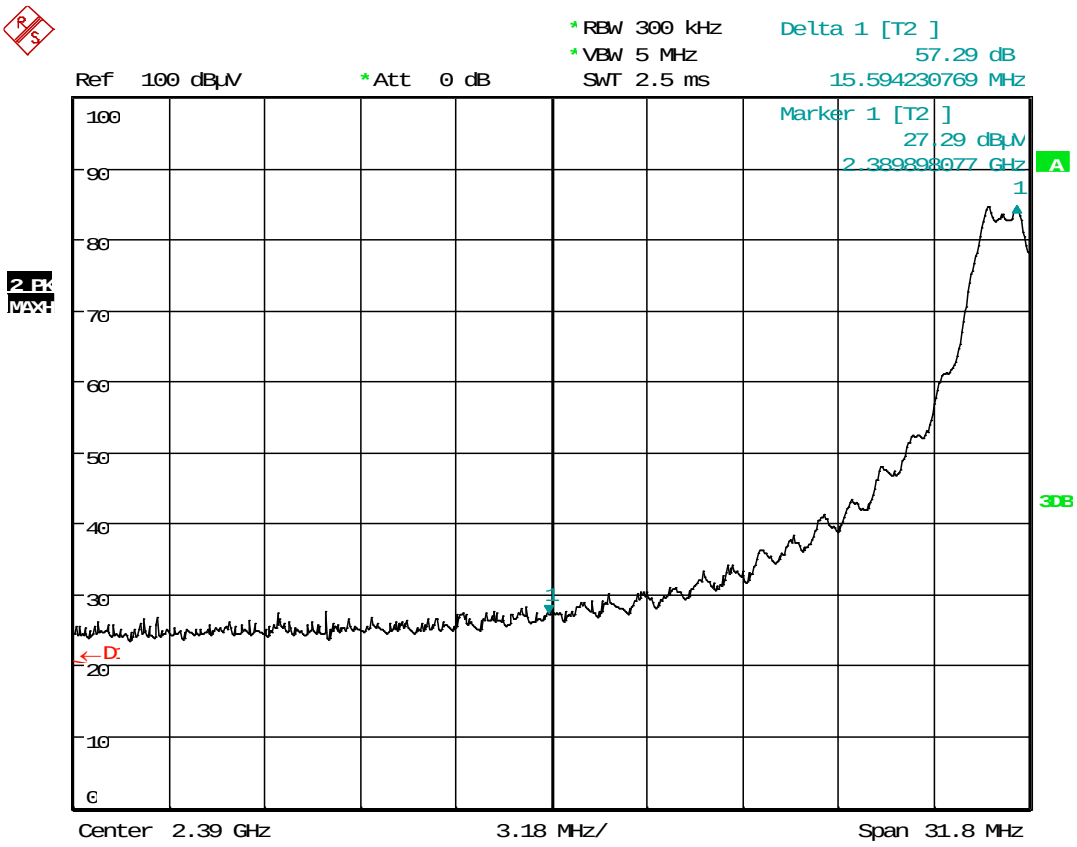
Date: 29.SEP.2017 13:46:27

100.4 dBµV/m is the field strength measurement, from which the delta measurement of 50.5 dB is subtracted, resulting in a level of 49.9 dB. This level has a margin of 4.1 dB below the limit of 54.0 dBuV/m.

Calculation: 100.4 dBµV/m - 50.5 - 54.0 dBµV/m = -4.1 dB

Peak Field Strength of Upper Band Edge (1 MHz RBW/3 MHz VBW) = 113.5 dBµV/m
Average Field Strength of Upper Band Edge (1 MHz RBW/3 MHz VBW) = 100.4 dBµV/m
Delta measurement = 50.5 dB

Fractal Antenna Lower Band Edge Test Results



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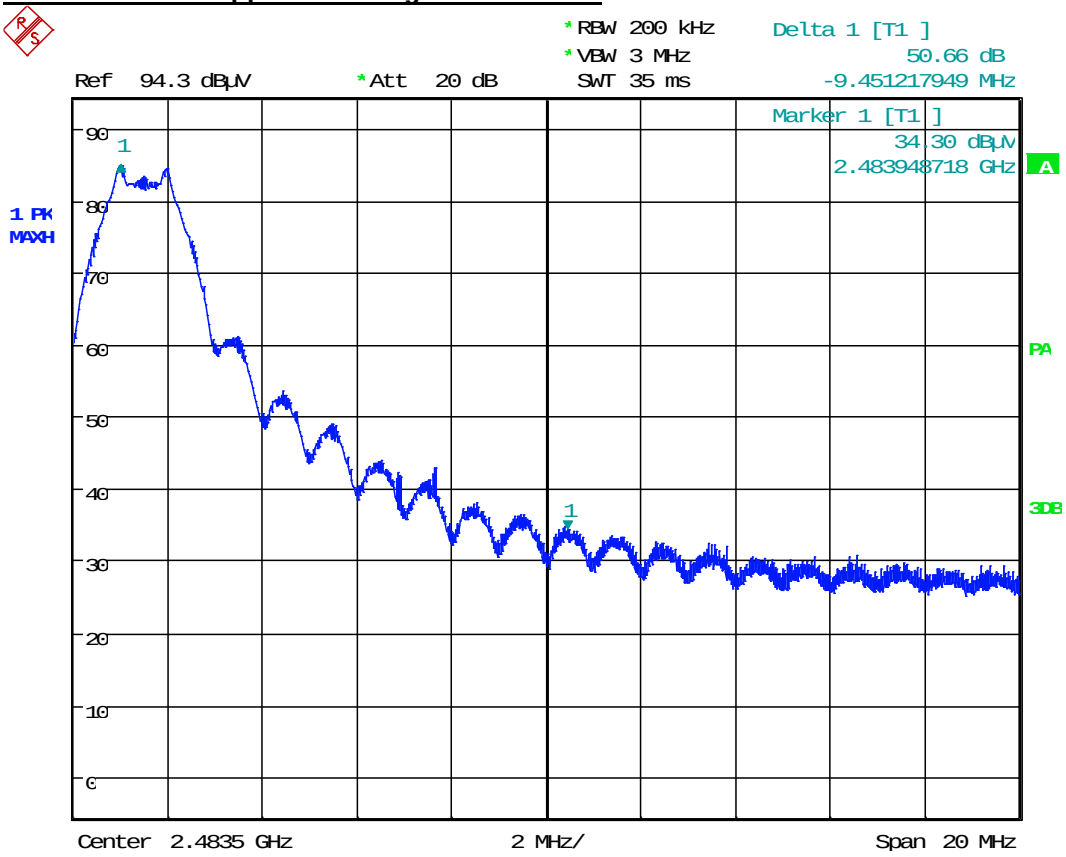
97.6 dBµV/m is the field strength measurement, from which the delta measurement of 57.3 dB is subtracted, resulting in a level of 40.3 dB. This level has a margin of 13.7 dB below the limit of 54.0 dBuV/m.

Calculation: 97.6 dBµV/m - 57.3 - 54.0 dBµV/m = -13.7 dB

Peak Field Strength of Lower Band Edge (1 MHz RBW/3 MHz VBW) = 110.0 dBµV/m
Average Field Strength of Lower Band Edge (Peak-duty cycle (12.4 dB) = 97.6 dBµV/m
Delta measurement = 57.3 dB

Fractal Antenna Upper Band Edge Test Results



Date: 9.OCT.2017 10:39:30

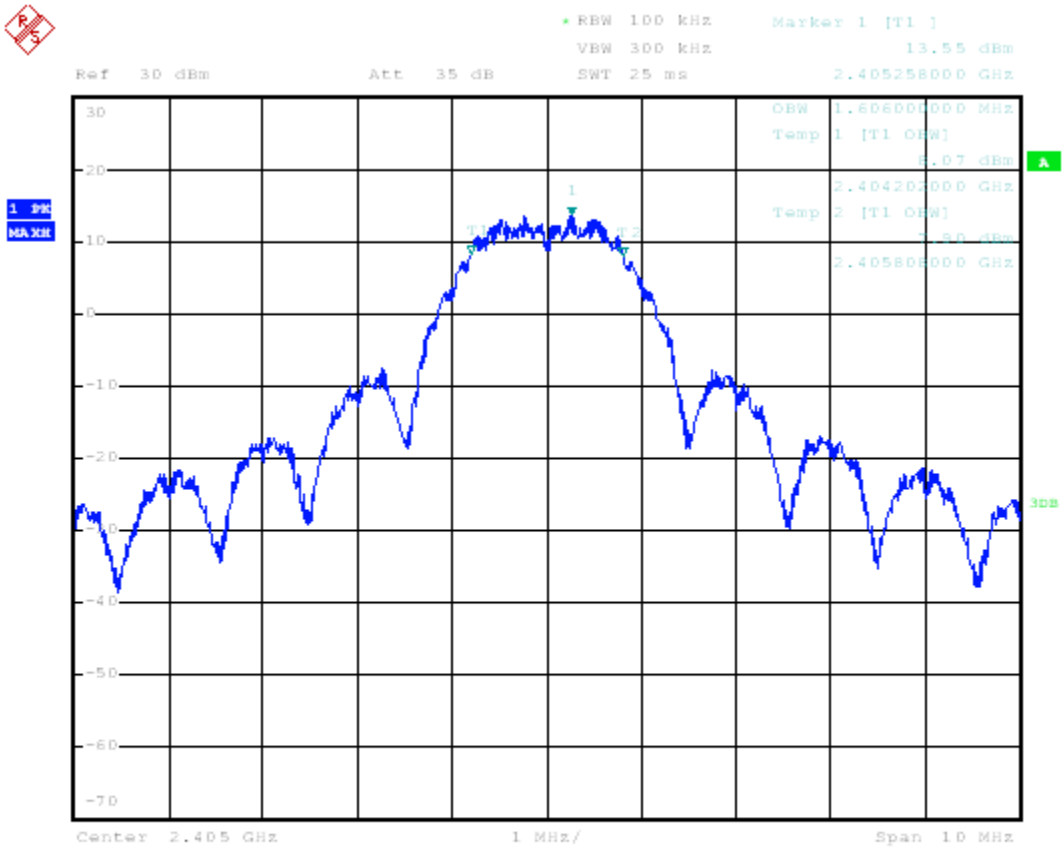
99.5 dBµV/m is the field strength measurement, from which the delta measurement of 50.7 dB is subtracted, resulting in a level of 48.8 dB. This level has a margin of 5.2 dB below the limit of 54.0 dBuV/m.

Calculation: 99.5 dBµV/m - 50.7 - 54.0 dBµV/m = -5.2 dB

Peak Field Strength of Upper Band Edge (1 MHz RBW/3 MHz VBW) = 111.9 dBµV/m
Average Field Strength of Upper Band Edge (1 MHz RBW/3 MHz VBW) = 99.5 dBµV/m
Delta measurement = 50.7 dB

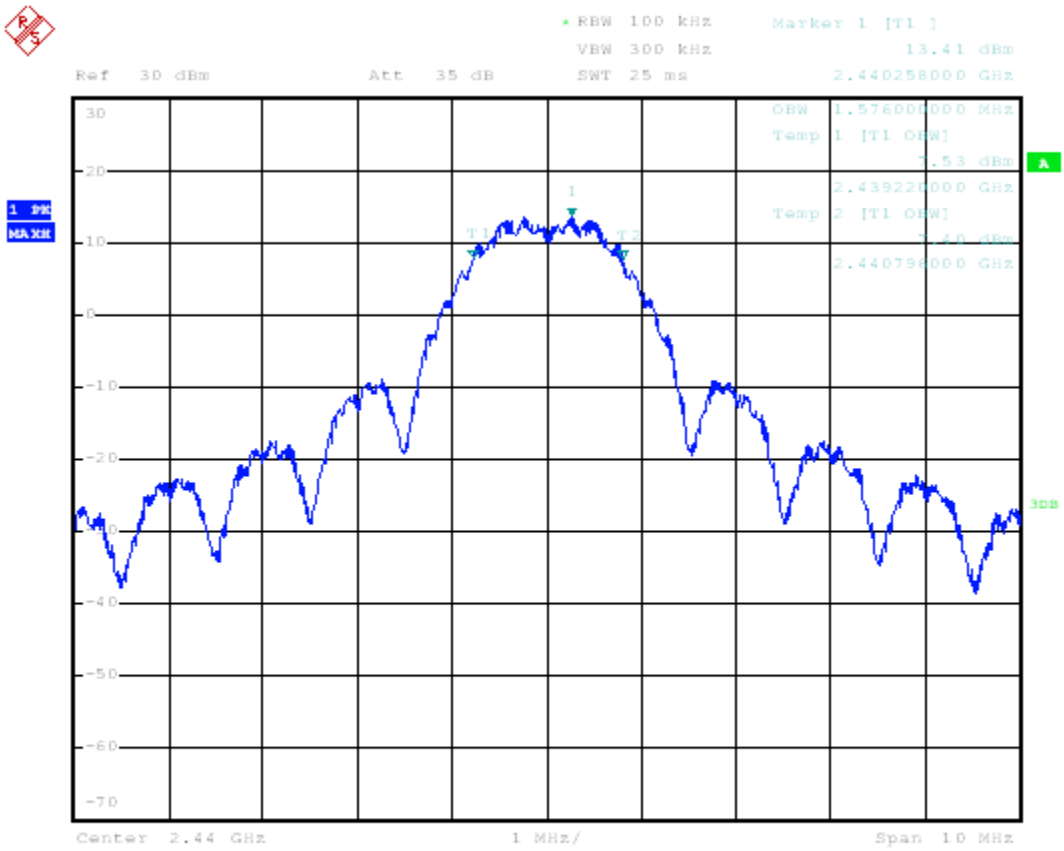
6 dB Bandwidths

2405 MHz, 1.606 MHz



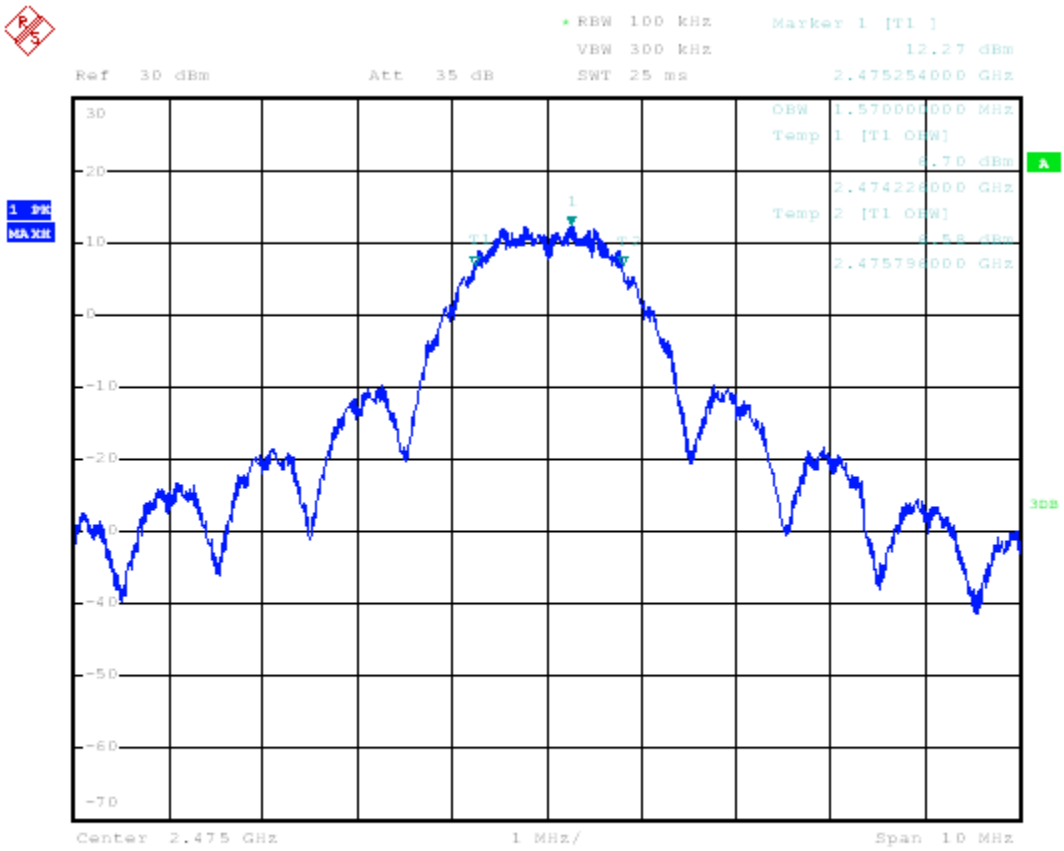
Date: 30.OCT.2017 13:16:07

2440 MHz, 1.576 MHz



Date: 30.OCT.2017 13:10:13

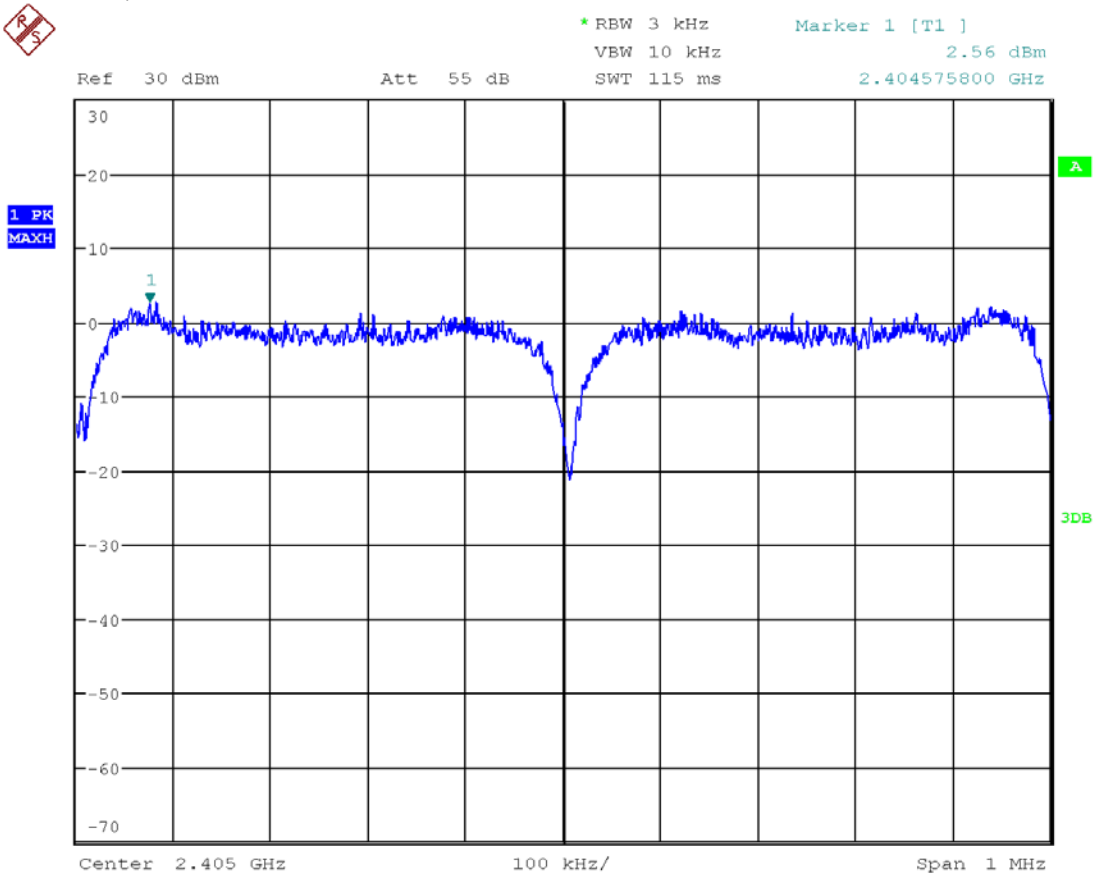
2475 MHz, 1.570 MHz



Date: 30.OCT.2017 12:12:35

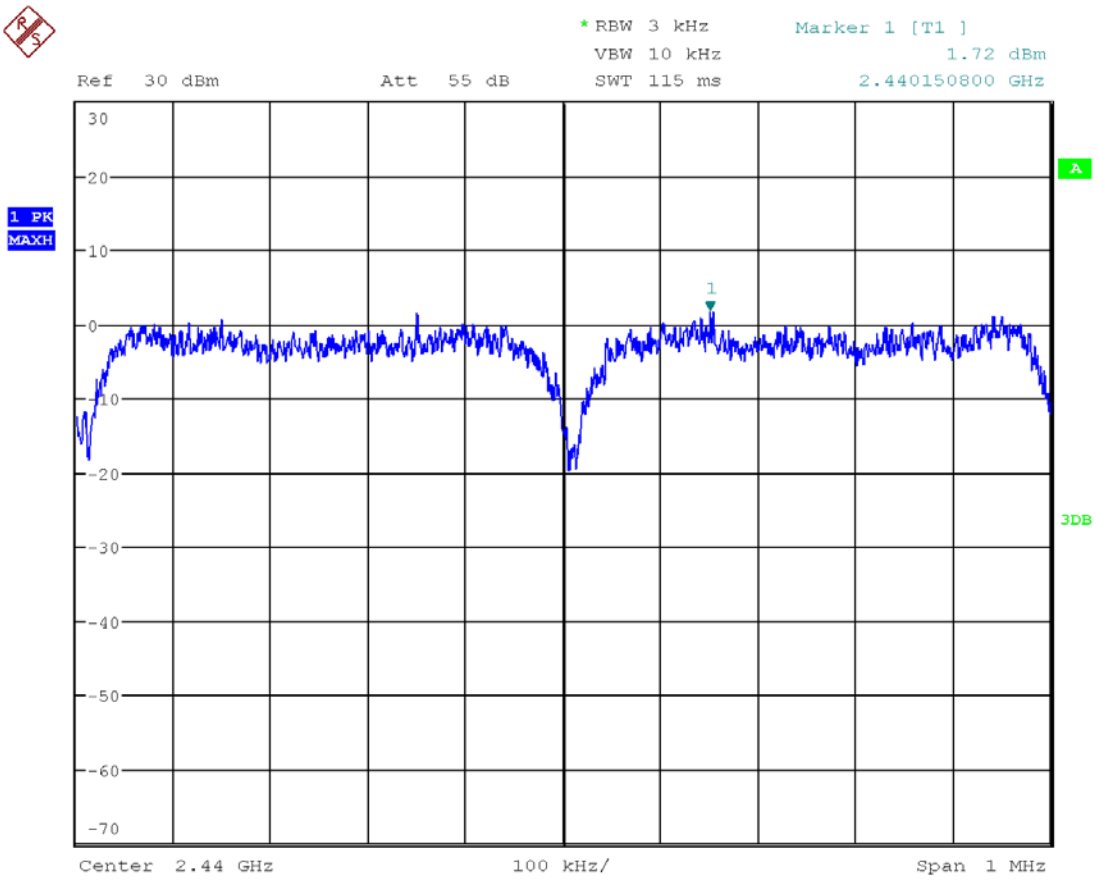
Power Spectral Density

2405 MHz, 2.6 dBm



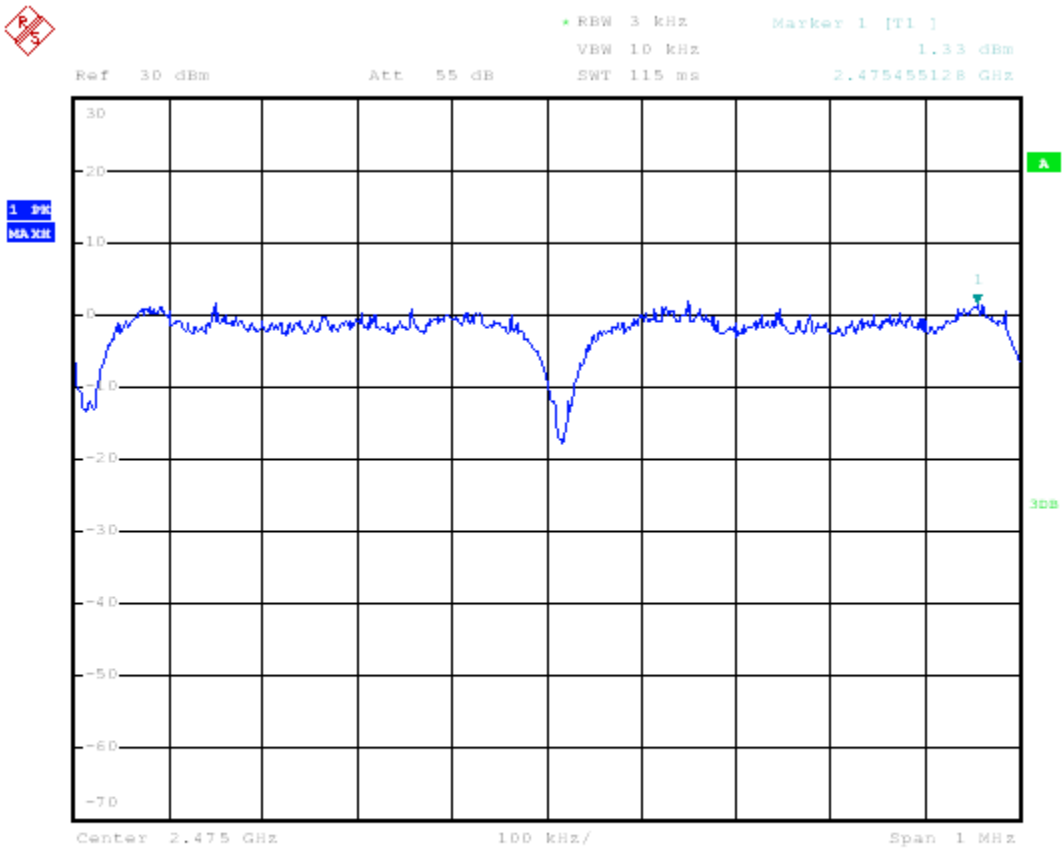
Date: 30.OCT.2017 13:45:35

2440 MHz, 1.7 dBm



Date: 30.OCT.2017 13:46:58

2475 MHz, 1.3 dBm



15.209 Unintentional Emissions

Quasi-Peak

Frequency (MHz)	Analyzer Reading (dBuV)	Site Correction (dB/m)	Corrected Analyzer (dBuV/m)	Limit (dBuV/m)	Margin (dB)
31.711	21.6	16.5	38.2	40.0	-1.8
35.522	20.6	14.2	34.8	40.0	-5.2
53.547	17.4	7.5	24.9	40.0	-15.1
69.918	18.9	7.8	26.7	40.0	-13.3
83.954	11.9	7.7	19.6	40.0	-20.4
87.514	15.1	7.8	22.9	40.0	-17.1
95.843	19.1	8.5	27.6	43.5	-15.9
113.561	14.7	9.1	23.8	43.5	-19.7
137.843	17.9	9.2	27.1	43.5	-16.4
162.331	15.4	11.4	26.7	43.5	-16.8
169.331	15.5	10.9	26.5	43.5	-17.0
190.896	25.7	11.1	36.8	43.5	-6.7
230.281	14.1	12.8	26.9	46.0	-19.1
249.743	16.0	14.0	30.0	46.0	-16.0
274.871	12.6	14.6	27.1	46.0	-18.9
294.333	11.4	14.8	26.2	46.0	-19.8
339.245	14.0	16.4	30.4	46.0	-15.6
375.166	11.3	17.9	29.1	46.0	-16.9
494.200	11.7	20.5	32.2	46.0	-13.8

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

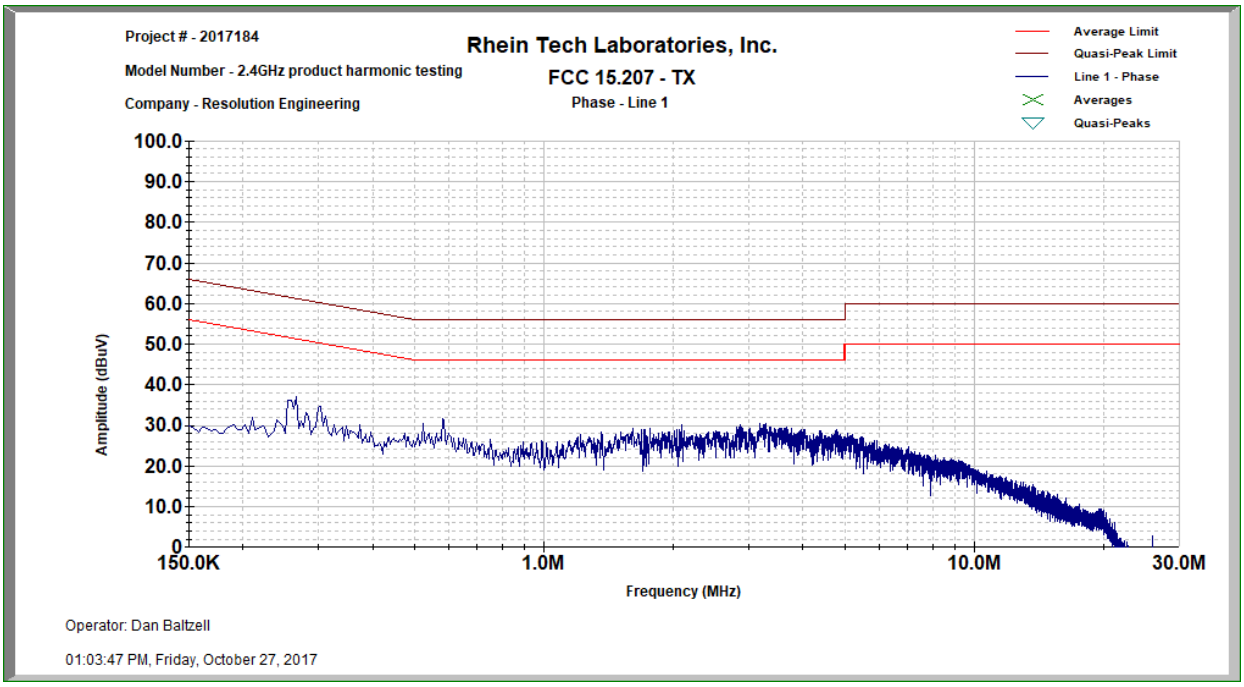
RTL Bar Code	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	3/22/18
901592	Insulated Wire Inc.	KPS-1503-3600-KPR	SMK RF Cables 20'	NA	8/18/18
900791	Chase	CBL6111B	Bilog antenna (30 MHz – 2000 MHz)	N/A	10/4/20
901669	ETS-Lindgren	3142E	Biconilog Antenna (30 MHz – 6000 MHz)	00166065	02/16/18
900772	EMCO	3161-02	Horn Antenna 2 - 4 GHz	9804-1044	4/9/18
900323	EMCO	3160-07	Horn Antenna 8.2-12.4 GHz	9605-1054	4/9/18
900356	EMCO	3160-08	Horn Antenna 12.4-18 GHz	9607-1044	4/9/18
901218	EMCO	3160-09	Horn Antenna (18-26.5 GHz)	960281-003	4/14/18

Test Personnel:

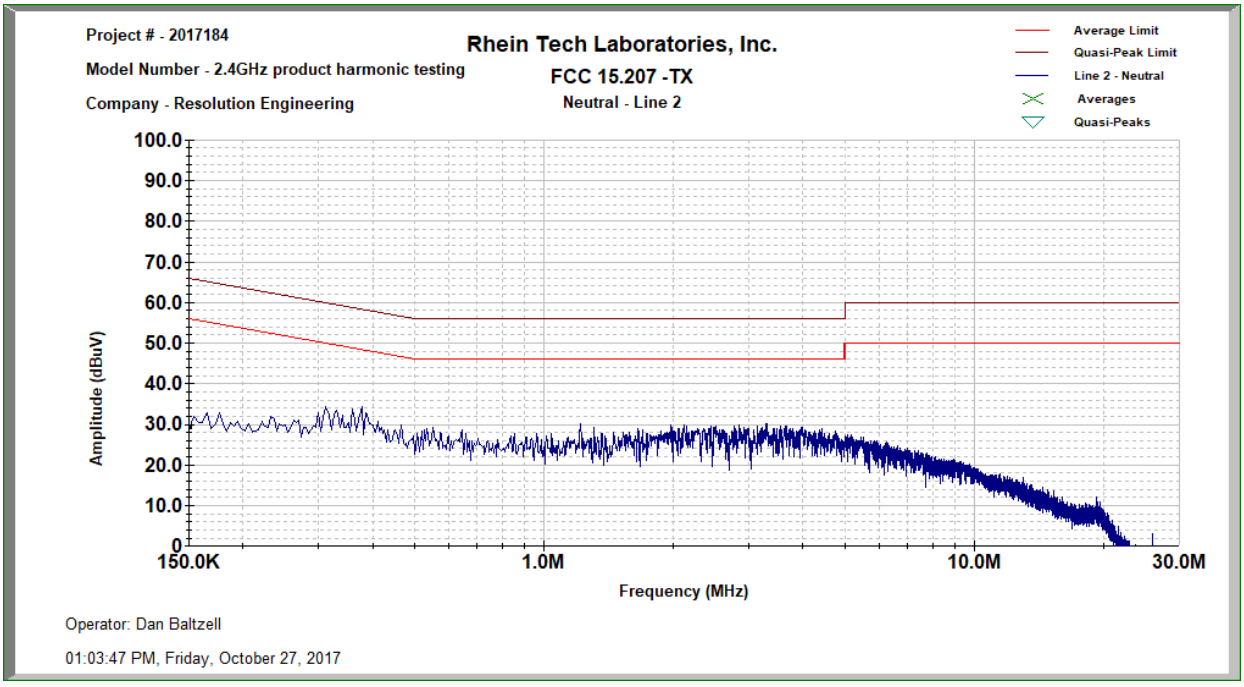
Dan Baltzell		September 15, 2017 to October 27, 2017
Test Engineer	Signature	Date of Test

15.207 Conducted Line Emissions Test Data – FCC Limits

Phase



Neutral



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

Barcode	Manufacturer	Model	Part Type	Serial Number	Calibration Due
Conducted Emissions					
901581	Rohde & Schwarz	FSU	Spectrum Analyzer	1166.1660.50	3/22/18
901083	AFJ International	LS16	16A LISN (110 V)	16010020080	4/18/18
900729	Solar	8130	Filter	947306	4/24/20
N/A	Quantum Change	Tile!	Test software	4.0.A.8	N/A

Test Personnel:

Dan Baltzell		October 27, 2017
Test Engineer	Signature	Date Of Test