



Engineering Solutions & Electromagnetic Compatibility Services

FCC Part 15.249 Certification Application Report for Full Modular Approval

Test Lab: Rhein Tech Laboratories, Inc. Phone: 703-689-0368 360 Herndon Parkway Fax: 703-689-2056 Suite 1400 Web: www.rheintech.com Herndon, VA 20170 Email: atcbinfo@rheintech.com		Applicant: C2 Development, Inc. Phone: 515-233-5105 x101 1606 Golden Aspen Drive, Suite 106 Ames, IA 50010 Contact: Christian Clough	
FCC ID:	ZOM-30000003	Test Report Date	June 28, 2011
Platform	N/A	RTL Work Order Number	2011091
Model #	3000-0003	RTL Quote Number	QRTL10-208
American National Standard Institute	ANSI C63.4-2003: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
FCC Classification	DXX – Part 15 Low Power Communication Device Transmitter		
FCC Rule Part(s)	Part 15.249 (10-01-10): Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz, and 24.0-24.25 GHz		
Frequency Range (MHz)	Output Power (W)	Frequency Tolerance	Emission Designator
2433.585 - 2479.978	N/A	N/A	1M00F2D

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 C63.4.

Signature: 

Date: June 28, 2011

Typed/Printed Name: Desmond A. Fraser

Position: President

This report may not be reproduced, except in full, without the written approval of Rhein Tech Laboratories, Inc. and C2 Development, Inc. The test results relate only to the item(s) tested.

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.

Table of Contents

1	General Information	4
1.1	Scope	4
1.2	Modifications	4
1.3	Test Facility	4
1.4	Related Submittal(s)/Grant(s)	4
2	Test Information	5
2.1	Test Justification	5
2.2	Exercising the EUT	5
2.3	Test Result Summary.....	5
2.4	Test System Details	5
2.5	Configuration of Tested System.....	6
3	Conducted AC Emissions – FCC 15.207.....	7
3.1	Site and Test Description	7
3.2	Test Limits.....	7
3.3	Conducted AC Emissions Test Data.....	8
4	Duty Cycle Correction Calculation	11
5	Radiated Emission Limits Fundamental Emissions – FCC 15.249	13
5.1	Radiated Emission Limits Test Procedure	13
5.2	Radiated Emission Limits Test Data	13
6	Radiated Emission Limits Radiated Harmonics – FCC 15.249	15
6.1	Radiated Emission Limits Test Procedure	15
6.2	Radiated Emissions Test Data.....	15
7	Conclusion	18

Table Index

Table 2-1:	Test Result Summary with FCC Rules and Regulations	5
Table 2-2:	Equipment under Test (EUT)	5
Table 3-1:	Conducted Emissions Test Equipment	10
Table 4-1:	Duty Cycle Test Equipment	12
Table 5-1:	Radiated Emissions Fundamental Emissions - Peak	13
Table 5-2:	Radiated Emissions Fundamental – Calculated Average	13
Table 5-3:	Radiated Emissions Test Equipment	14
Table 6-1:	Radiated Emissions - 2433.585 MHz	15
Table 6-2:	Radiated Emissions - 2457.585 MHz	16
Table 6-3:	Radiated Emissions - 2479.978 MHz	17
Table 6-4:	Radiated Spurious Emissions Test Equipment	18

Figure Index

Figure 2-1:	Worst Case Configuration of System under Test	6
-------------	---	---

Plot Index

Plot 3-1:	Conducted AC Emissions; Neutral (Line 1); Receive Mode	8
Plot 3-2:	Conducted AC Emissions; Hot (Line 2); Receive Mode	8
Plot 3-3:	Conducted AC Emissions; Neutral (Line 1); Transmit Mode	9
Plot 3-4:	Conducted AC Emissions; Hot (Line 2); Transmit Mode	9
Plot 4-1:	Pulse Width (600 us)	11
Plot 4-2:	Number of Pulses/100ms = 6	11

Appendix Index

Appendix A:	FCC Part 1.1307, 1.1310, 2.1091, 2.1093 RF Exposure	19
Appendix B:	FCC/TCB Agency Authorization Letter	20
Appendix C:	FCC Confidentiality Request Letter	21
Appendix D:	DA00-1407 Part 15 Unlicensed Modular Tx Attestation	22
Appendix E:	Label and Label Location	23
Appendix F:	Operational Description	24
Appendix G:	Schematics	25
Appendix H:	Block Diagram	26
Appendix I:	Manual	27
Appendix J:	Test Photographs	28
Appendix K:	External Photographs	32
Appendix L:	Internal Photographs	34

Photograph Index

Photograph 1:	Radiated Emissions - Front View	28
Photograph 2:	Radiated Emissions - Rear View	29
Photograph 3:	Conducted AC Emissions - Front View	30
Photograph 4:	Conducted AC Emissions - Rear View	31

1 General Information

1.1 Scope

FCC Rules Part 15.249: Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz, and 24.0-24.25 GHz.

1.2 Modifications

None

1.3 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at Rhein Tech Laboratories (RTL), 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 2003).

1.4 Related Submittal(s)/Grant(s)

This is an original FULL MODULAR APPROVAL application for C2 Development, Inc. Model: 3000-0003, FCC ID: ZOM-30000003.

2 Test Information

2.1 Test Justification

The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. The low channel at 2433.585 MHz, mid channel at 2457.585 MHz, and high channel at 2479.978 MHz, were tested and investigated from 9 kHz to 25 GHz. Data for all three channels is presented in this report. The test results relate only to the item that was tested.

2.2 Exercising the EUT

The EUT was provided with software to continuously transmit during testing. The carrier was also checked to verify that the information was being transmitted. There were no deviations from the test standard(s) and/or methods. The IF, LO, and up to the 2nd LO, were investigated and tested, and found to be compliant.

2.3 Test Result Summary

Table 2-1: Test Result Summary with FCC Rules and Regulations

Standard	Test	Pass/Fail or N/A
FCC 15.249(a)	Radiated Emissions	Pass
FCC 15.207	AC Line Conducted Emissions	Pass
RSS-Gen	20 dB Bandwidth	N/A

2.4 Test System Details

The test sample was received on June 16, 2011. The FCC Identifiers for all equipment, plus descriptions of all cables used in the tested system, are shown in the table below.

Table 2-2: Equipment under Test (EUT)

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
Transceiver	C2 Development	3000-0003	N/A	ZOM-30000003	N/A	19940
Transceiver	C2 Development	3000-0003	N/A	ZOM-30000003	N/A	19941
AC Adapter	CUI Inc.	HK-H1-A05	0308CLF	N/A	1.8m unshielded with ferrite on connector	19942

2.5 Configuration of Tested System

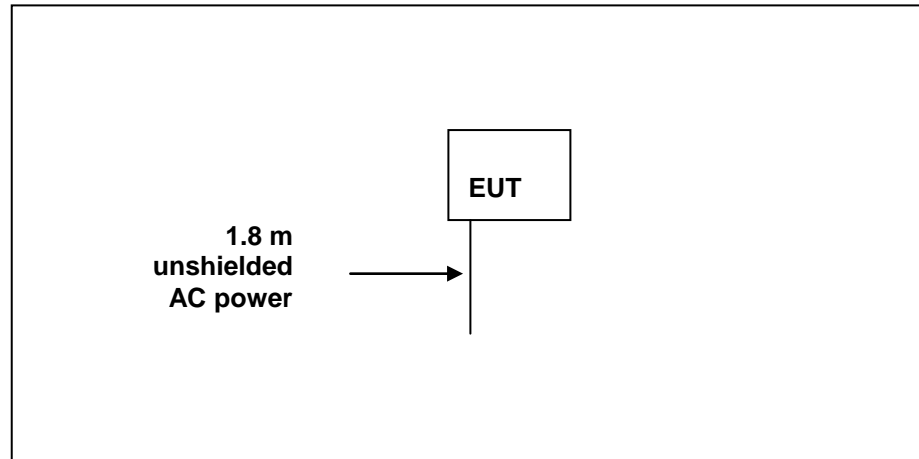


Figure 2-1: Worst Case Configuration of System under Test

3 Conducted AC Emissions – FCC 15.207

3.1 Site and Test Description

The power line conducted emissions measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50-ohm/50 microhenry Line Impedance Stabilization Network (LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the AC line through an isolation transformer. 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).

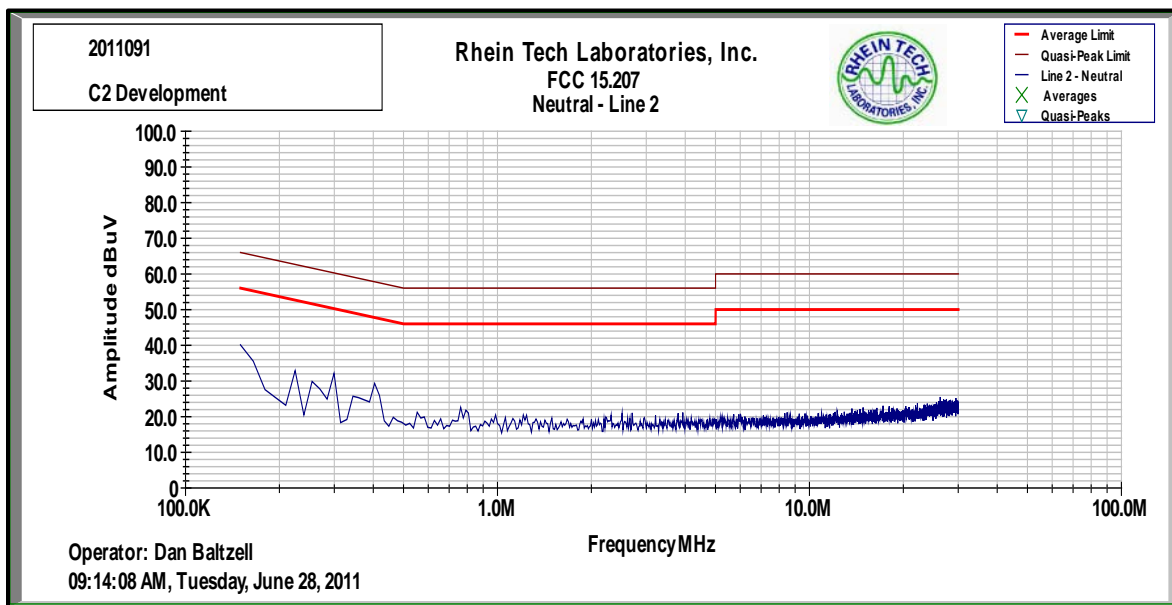
The analyzer's 6 dB bandwidth was set to 9 kHz. Video filter less than 10 times the resolution bandwidth is not used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limits were measured and have been recorded.

3.2 Test Limits

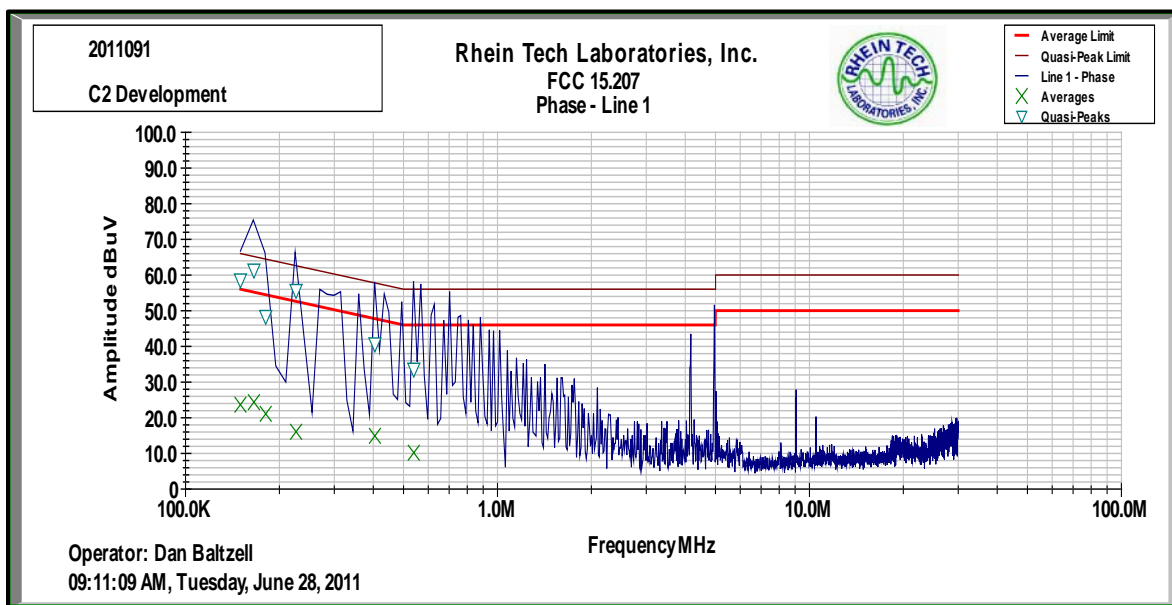
Line-Conducted Emissions		
Limit (dB μ V)		
Frequency (MHz)	Quasi-Peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5.00	56	46
5.00 to 30.00	60	50

3.3 Conducted AC Emissions Test Data

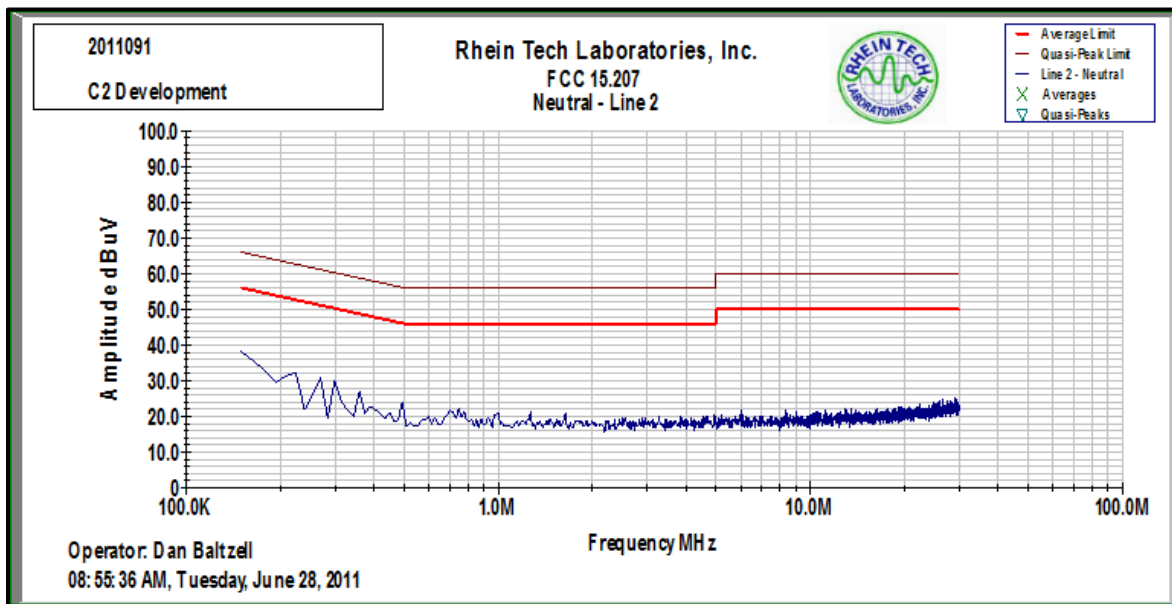
Plot 3-1: Conducted AC Emissions; Neutral (Line 1); Receive Mode



Plot 3-2: Conducted AC Emissions; Hot (Line 2); Receive Mode



Plot 3-3: Conducted AC Emissions; Neutral (Line 1); Transmit Mode



Plot 3-4: Conducted AC Emissions; Hot (Line 2); Transmit Mode

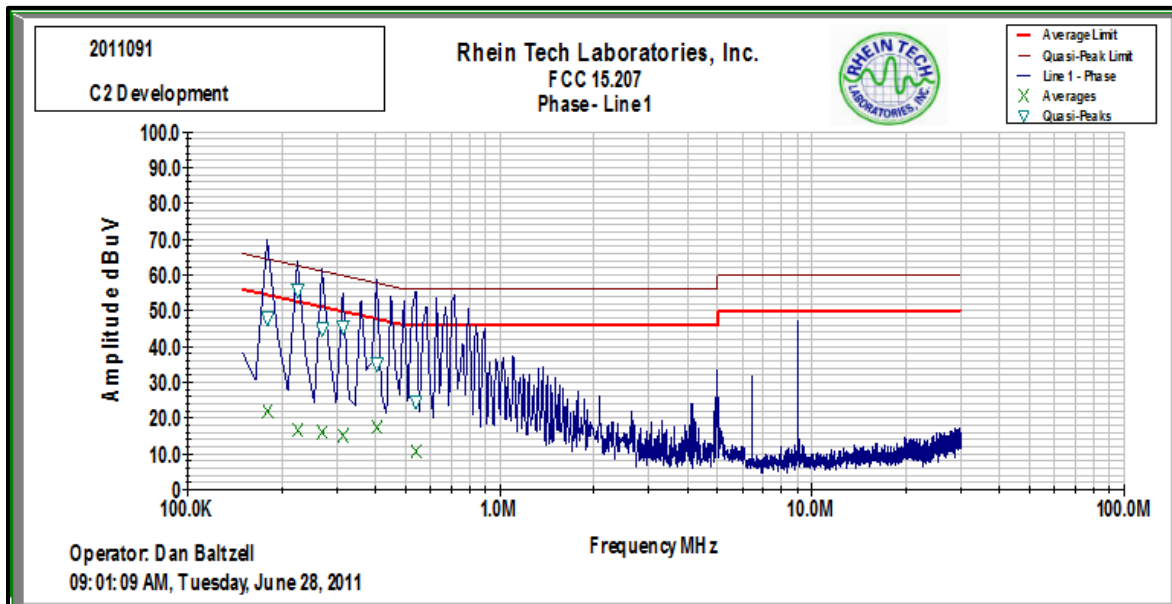
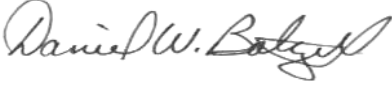


Table 3-1: Conducted Emissions Test Equipment

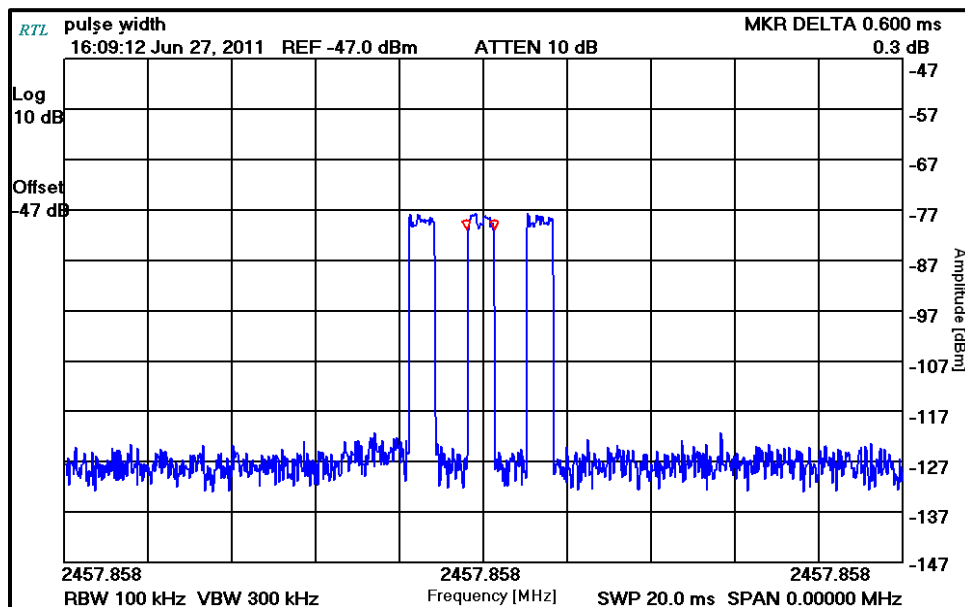
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900968	Hewlett Packard	8567A	Spectrum Analyzer (10 kHz - 1.5 GHz)	2602A00160	10/17/11
900969	Hewlett Packard	85650A	Quasi-Peak Adapter	2412A00414	10/17/11
900970	Hewlett Packard	85662A	Spectrum Analyzer Display	2542A11239	10/17/11
901082	AFJ International	LS16	16A LISN	16010020081	4/13/12

Test Personnel:

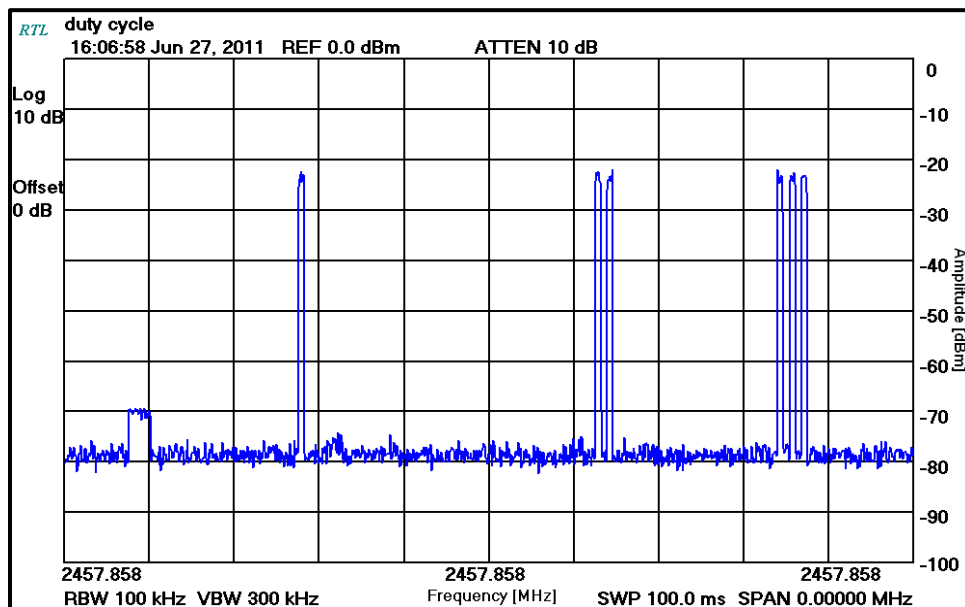
Daniel Baltzell		June 28, 2011
Test Engineer	Signature	Date of Test

4 Duty Cycle Correction Calculation

Plot 4-1: Pulse Width (600 us)



Plot 4-2: Number of Pulses/100ms = 6



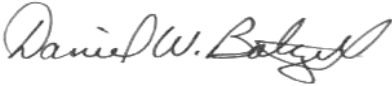
Pulse width = 600 us
 Number of pulses in 100ms= 6
 6 pulses X 0.6ms = 3.6ms total per 100ms

Duty Cycle = $20 \log (3.6/100) = -28.9 \text{ dB}$

Table 4-1: Duty Cycle Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	9/13/11
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	9/13/11

Test Personnel:

Daniel Baltzell		June 27, 2011
Test Engineer	Signature	Date of Test

5 Radiated Emission Limits Fundamental Emissions – FCC 15.249

5.1 Radiated Emission Limits Test Procedure

Radiated emissions of the fundamentals were tested at three meters, and meet the quasi-peak limit of 50 mV/m. The EUT was tested in all three orthogonal planes for the low, mid, and high channels; the worst case emissions are shown. Peak and average measurements were taken and are compared to the average limit, and the average limit plus 20 dB per FCC 15.35(b).

5.2 Radiated Emission Limits Test Data

Table 5-1: Radiated Emissions Fundamental Emissions - Peak

Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dBm)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2433.585	Pk	86.7	10.0	96.7	114.0	-17.3
2457.585	Pk	87.2	10.2	97.4	114.0	-16.6
2479.978	Pk	88.5	10.4	98.9	114.0	-15.1

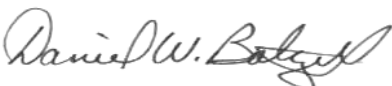
Table 5-2: Radiated Emissions Fundamental – Calculated Average

Frequency (MHz)	Peak Emission Level (dBuV/m)	Duty Cycle Correction (dB)	Average Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2433.585	96.7	-28.9	67.8	94.0	-26.2
2457.585	97.4	-28.9	68.5	94.0	-25.5
2479.978	98.9	-28.9	70.0	94.0	-24.0

Table 5-3: Radiated Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900905	RheinTech Laboratories, Inc.	PR-1040	Amplifier (20 MHz - 2 GHz)	900905	4/10/12
900791	Schaffner Chase	CBL6112	Bilog Periodic Antenna (25 MHz - 2 GHz)	2099	12/12/12
900913	Hewlett Packard	85462A	EMI Receiver RF Section (9 kHz - 6.5 GHz)	3325A00159	6/8/12
900914	Hewlett Packard	85460A	RF Filter Section (100 kHz - 6.5 GHz)	3330A00107	6/8/12
901215	Hewlett Packard	8596EM	Spectrum Analyzer	3826A00144	11/23/11
901364	Rhein Tech Laboratories, Inc.	PR-1042	Amplifier (1 GHz - 26.4 GHz)	1003	3/31/12
900772	EMCO	3161-02	Horn Antenna (2.0 - 4.0 GHz)	9804-1044	6/13/12
900321	EMCO	3161-03	Horn Antenna (4.0 - 8.2 GHz)	9508-1020	6/13/12
900323	EMCO	3160-07	Horn Antenna (8.2 - 12.0 GHz)	9605-1054	6/13/12
N/A	Rhein Tech Laboratories, Inc.	Automated Emission Tester	Emissions Testing Software	Rev. 14.0.2	N/A

Test Personnel:

Daniel Baltzell Test Engineer	 Signature	June 27, 2011 Date of Test
----------------------------------	--	-------------------------------

6 Radiated Emission Limits Radiated Harmonics – FCC 15.249

6.1 Radiated Emission Limits Test Procedure

Radiated emissions of the harmonics were tested at three meters, and meet the requirements of 500 microvolts/meter in average mode, and 20 dB higher in peak mode, per 15.249(e). The EUT was tested in the X-Y, X-Z, and Y-Z orthogonal planes at 3 m.

6.2 Radiated Emissions Test Data

Table 6-1: Radiated Emissions - 2433.585 MHz

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Corrected Peak (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)
4867.170	40.0	14.9	54.9	74.0	-19.1
7300.755	34.9	14.2	49.1	74.0	-24.9
9734.340	34.2	19.0	53.2	74.0	-20.8
12167.925	33.9	17.0	50.9	74.0	-23.1
14601.510	32.8	22.5	55.3	74.0	-18.7
17035.095	32.9	22.8	55.7	74.0	-18.3
19468.680	33.3	32.0	65.3	74.0	-8.7
21902.265	33.2	33.0	66.2	74.0	-7.8
24335.850	32.8	33.9	66.7	74.0	-7.3

Emission Frequency (MHz)	Peak Emission Level (dBuV/m)	Duty Cycle Correction (dB)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)
4867.170	54.9	-28.9	26.0	54.0	-28.0
7300.755	49.1	-28.9	20.2	54.0	-33.8
9734.340	53.2	-28.9	24.3	54.0	-29.7
12167.925	50.9	-28.9	22.0	54.0	-32.0
14601.510	55.3	-28.9	26.4	54.0	-27.6
17035.095	55.7	-28.9	26.8	54.0	-27.2
19468.680	65.3	-28.9	36.4	54.0	-17.6
21902.265	66.2	-28.9	37.3	54.0	-16.7
24335.850	66.7	-28.9	37.8	54.0	-16.2

Table 6-2: Radiated Emissions - 2457.585 MHz

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Corrected Peak (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)
4915.170	38.6	15.1	53.7	74.0	-20.3
7372.755	34.3	14.5	48.8	74.0	-25.2
9830.340	33.5	18.5	52.0	74.0	-22.0
12287.925	33.6	17.4	51.0	74.0	-23.0
14745.510	33.5	22.8	56.3	74.0	-17.7
17203.095	33.2	22.8	56.0	74.0	-18.0
19660.680	32.4	32.1	64.5	74.0	-9.5
22118.265	33.0	33.1	66.1	74.0	-7.9
24575.850	33.3	34.0	67.3	74.0	-6.7

Emission Frequency (MHz)	Peak Emission Level (dBuV/m)	Duty Cycle Correction (dB)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)
4915.170	53.7	-28.9	24.8	54.0	-29.2
7372.755	48.8	-28.9	19.9	54.0	-34.1
9830.340	52.0	-28.9	23.1	54.0	-30.9
12287.925	51.0	-28.9	22.1	54.0	-31.9
14745.510	56.3	-28.9	27.4	54.0	-26.6
17203.095	56.0	-28.9	27.1	54.0	-26.9
19660.680	64.5	-28.9	35.6	54.0	-18.4
22118.265	66.1	-28.9	37.2	54.0	-16.8
24575.850	67.3	-28.9	38.4	54.0	-15.6

Table 6-3: Radiated Emissions - 2479.978 MHz

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Corrected Peak (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)
4959.956	36.7	15.3	52.0	74.0	-22.0
7439.934	34.0	14.8	48.8	74.0	-25.2
9919.912	33.0	18.1	51.1	74.0	-22.9
12399.890	33.4	18.3	51.7	74.0	-22.3
14879.868	34.1	22.9	57.0	74.0	-17.0
17359.846	33.2	23.3	56.5	74.0	-17.5
19839.824	33.3	32.2	65.5	74.0	-8.5
22319.802	33.5	33.2	66.7	74.0	-7.3
24799.780	33.2	34.1	67.3	74.0	-6.7

Emission Frequency (MHz)	Peak Emission Level (dBuV/m)	Duty Cycle Correction (dB)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)
4959.956	36.7	-28.9	23.1	54.0	-30.9
7439.934	34.0	-28.9	19.9	54.0	-34.1
9919.912	33.0	-28.9	22.2	54.0	-31.8
12399.890	33.4	-28.9	22.8	54.0	-31.2
14879.868	34.1	-28.9	28.1	54.0	-25.9
17359.846	33.2	-28.9	27.6	54.0	-26.4
19839.824	33.3	-28.9	36.6	54.0	-17.4
22319.802	33.5	-28.9	37.8	54.0	-16.2
24799.780	33.2	-28.9	38.4	54.0	-15.6

Table 6-4: Radiated Spurious Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900791	Chase	CBL6111B	Bilog Antenna (30 MHz – 2000 MHz)	N/A	1/31/13
900932	Hewlett Packard	8449B OPT H02	Preamplifier (1 - 26.5 GHz)	3008A00505	2/22/12
900933	Hewlett Packard	11975A	Amplifier (2 - 8 GHz)	2304A00348	2/22/12
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	9/13/11
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	9/13/11
901516	Insulated Wire, Inc.	KPS-1503-2400-KPS-09302008	RF cable, 20'	NA	10/19/11
901517	Insulated Wire Inc.	KPS-1503-360-KPS-09302008	RF cable 36"	NA	10/19/11
900878	Rhein Tech Laboratories, Inc.	AM3-1197-0005	3 meter antenna mast, polarizing	Outdoor Range 1	Not Required
901242	Rhein Tech Laboratories, Inc.	WRT-000-0003	Wood rotating table	N/A	Not Required
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	6/14/12
900321	EMCO	3161-03	Horn Antennas (4 – 8 GHz)	9508-1020	6/14/12
900323	EMCO	3160-07	Horn Antennas (8.2 – 12 GHz)	9605-1054	6/14/12
900356	EMCO	3160-08	Horn Antennas (12.4 – 18 GHz)	9607-1044	6/14/12
901218	EMCO	3160-09	Horn Antenna (18-26 GHz)	960281-003	6/19/12
900392	Hewlett Packard	1197OK	Harmonic Mixer (18 - 26 GHz)	3525A00159	11/27/11

7 Conclusion

The data in this measurement report shows that C2 Development, Inc. Model 3000-0003; FCC ID: ZOM-30000003, complies with all the applicable requirements of Parts 2 and 15 of the FCC Rules for FULL MODULAR APPROVAL.