FCC Part 15.249 & IC RSS-210 Certification Application Report for Limited Modular Approval Report

Test Lab:	Applicant:
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	Ikusi – Angel Iglesias Phone: +34 943 448800 Paseo Miramon 170 20009 San Sebastian SPAIN Contact: Borja Pérez Domínguez

FCC ID: **IC:**	PVTTR800CE-EMB 4166A-TR800CEEMB	**Test Report Date**	October 19, 2011
Platform	N/A	**RTL Work Order Number**	2011148DXX
Model #	TR800CE-EMB	**RTL Quote Number**	QRTL11-213A
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		
IC Rule Part(s)	RSS-210 Issue 8: Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment		

Frequency Range (MHz)	**Output Power (W)**	**Frequency Tolerance**	**Emission Designator**
902.5 – 927.45	N/A	N/A	11K6F1D

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, ANSI C63.4, and IC RSS-210.

Signature: _____ Date: October 19, 2011

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

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

Table Index

Figure Index

Plot Index

Appendix Index

Photograph Index

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.

IC RSS-210 Section A2.9: 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.

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 LIMITED MODULAR APPROVAL application for IKUSI Model TR800CE-EMB, FCC ID: PVTTR800CE-EMB, IC: 4166A-TR800CEEMB.

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 902.5 MHz, mid channel at 915.7 MHz, and high channel at 927.45 MHz, were tested and investigated from 9 kHz to 10 GHz. Data for all three channels is presented in this report. The test results relate only to the item that was tested.

Three antennas were tested with the EUT; only one antenna is in place at a given time, and the antenna both transmits and receives.

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
RSS-Gen ICES-003	Receiver/Digital Emissions	Pass

2.4 Test System Details

The test sample was received on September 19, 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 Module	IKUSI	TR800CE-EMB	N/A	PVTTR800CE-EMB	N/A	20279
Host	IKUSI	TM70/1.21	09110507	N/A	N/A	20280
Battery	IKUSI	BT06K	N/A	N/A	N/A	20284
Battery	IKUSI	BT06K	N/A	N/A	N/A	20285

2.5 Configuration of Tested System

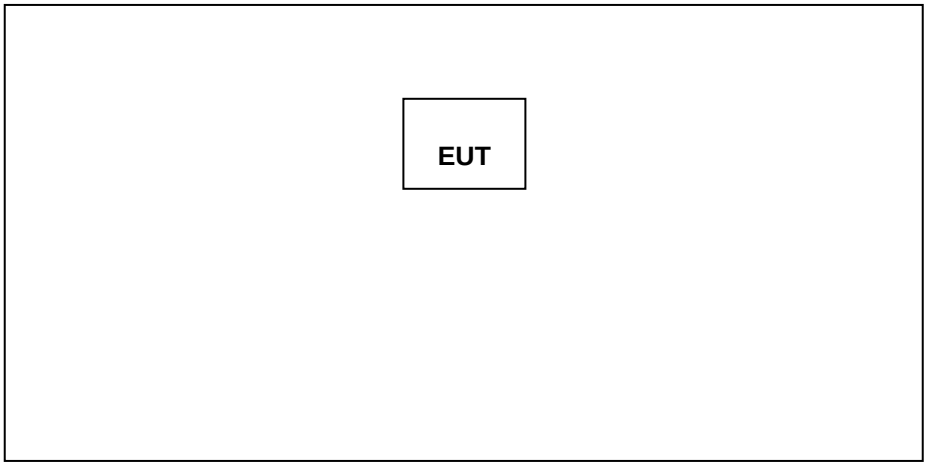


Figure 2-1: Worst Case Configuration of System under Test

3 Conducted AC Emissions – FCC 15.207 & IC RSS-Gen

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).

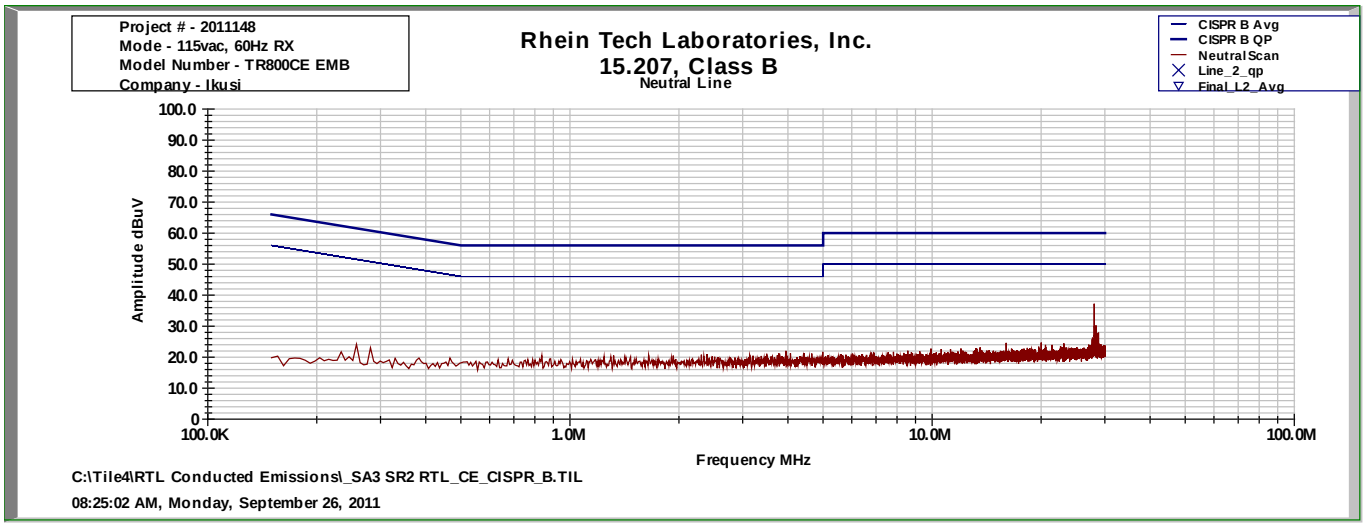
The analyzer's 6 dB bandwidth was set to 9 kHz. Video filter less than 10 times the resolution bandwidth is not used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. 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

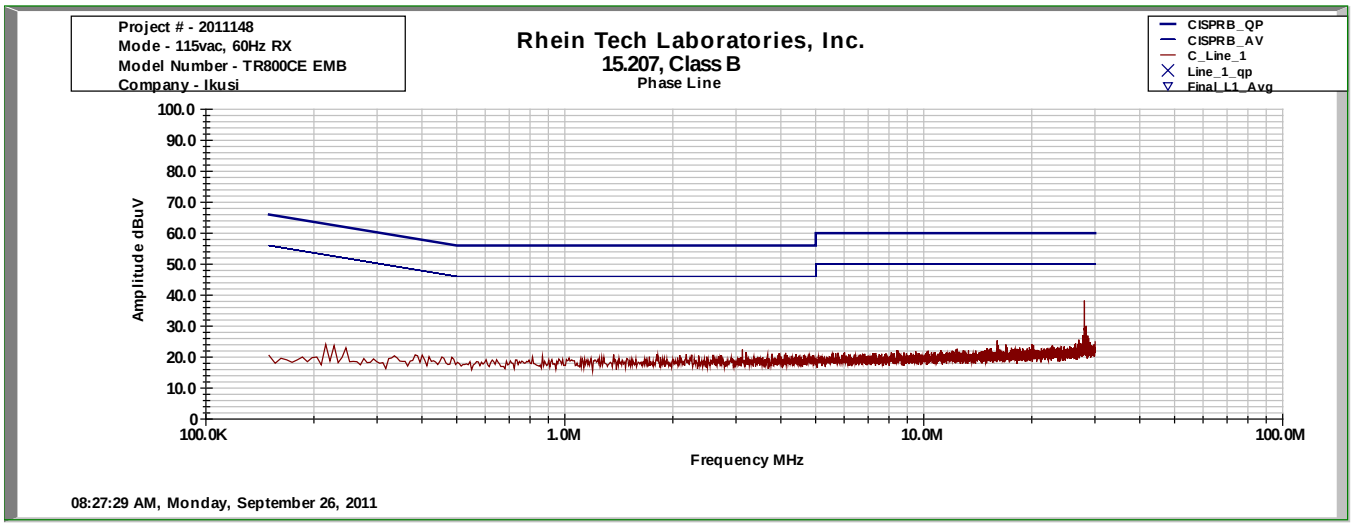
Line-Conducted Emissions		
	Limit (dBµV)	
Frequency (MHz)	**Quasi-Peak**	**Average**
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5.00	56	46
5.00 to 30.00	60	50

3.3 Conducted AC Emissions Test Data

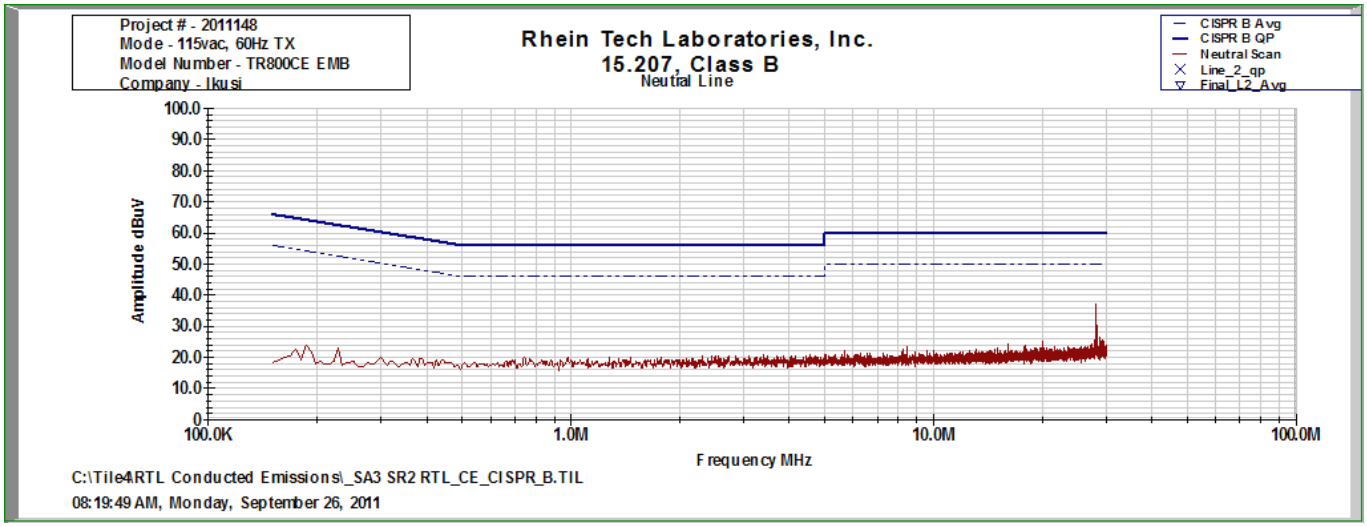
Plot 3-1: Conducted AC Emissions; Neutral; Receive Mode



Plot 3-2: Conducted AC Emissions; Phase; Receive Mode



Plot 3-3: Conducted AC Emissions; Neutral; Transmit Mode



Plot 3-4: Conducted AC Emissions; Phase; Transmit Mode

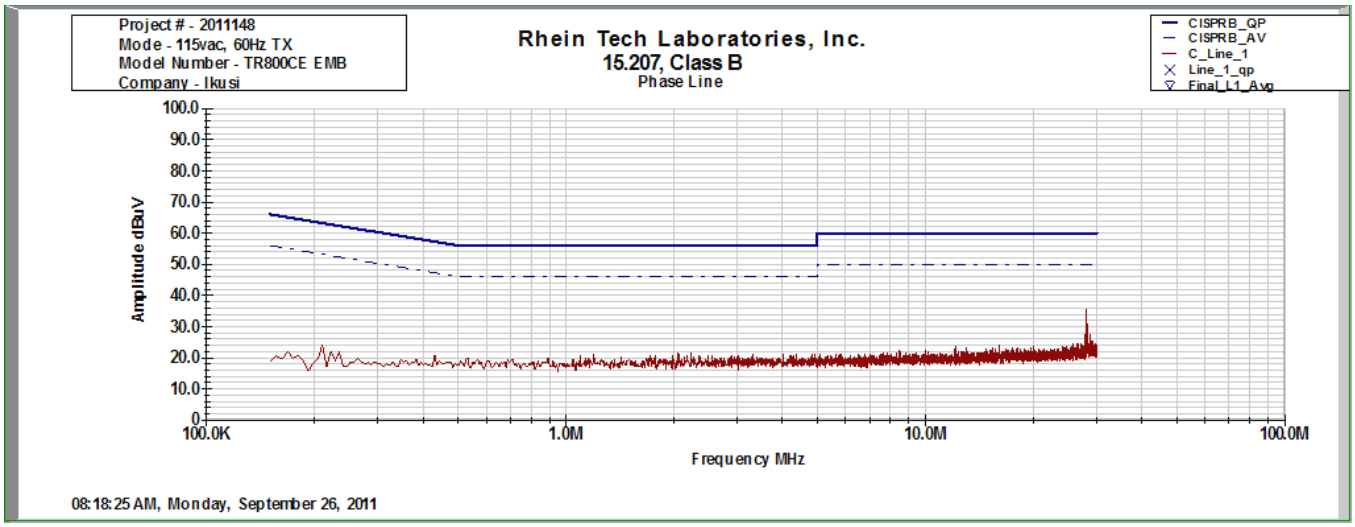


Table 3-1: Conducted Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900968	Hewlett Packard	8567A	Spectrum Analyzer (100 Hz - .15 GHz)	2602A00160	11/17/12
900970	Hewlett Packard	85662A	Spectrum Analyzer Display Section	2542A11239	11/17/12
900339	Hewlett Packard	85650A	Quasi-Peak Adapter	2521A00743	11/17/12
900728	Solar	8130	Filter	947306	2/22/12
901083	AFJ International	LS16/110VAC	16A LISN	16010020080	12/1/12
N/A	Rhein Tech Laboratories, Inc.	Automated Emission Tester	Emissions Testing Software	Rev. 14.0.2	N/A
N/A	Quantum Change	Tile!	Test Software	4.0.A.8	N/A

Test Personnel:

Jon Wilson		September 26, 2011
Test Engineer	Signature	Date of Test

4 Duty Cycle Calculation - FCC 15.35(c)

Worst-case on time in 100 ms is 56.5 ms (100 ms – 43.5 ms). Therefore, the duty cycle correction is as follows:

20 log (46.2/100) = -6.7 dB

Plot 4-1: On time in 100 ms

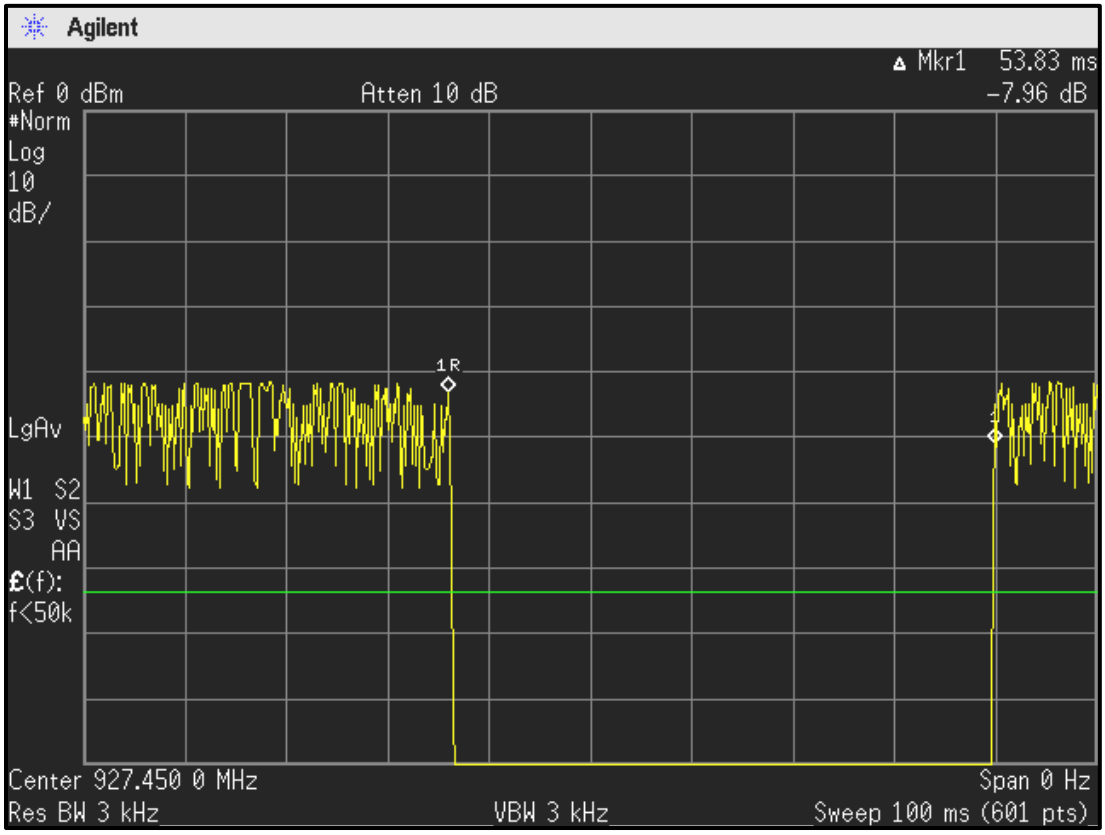


Table 4-1: Duty Cycle Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	4/08/12

Test Personnel:

Daniel Baltzell		October 6, 2011
Test Engineer	Signature	Date of Test

5 Radiated Emission Limits Fundamental Emissions – FCC 15.249 & IC RSS-210 A2.9

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 measurements were taken at 3 m and are compared to the quasi-peak limit.

5.2 Radiated Emission Limits Test Data

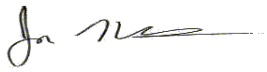
Table 5-1: Radiated Emissions Fundamental Emissions

Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dBm)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
902.500	Pk	54.1	37.4	91.5	94.0	-2.5
915.700	Pk	51.2	38.2	89.4	94.0	-4.6
927.450	Pk	53.0	38.5	91.5	94.0	-2.5

Table 5-2: Radiated Emissions Fundamental 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:

Jon Wilson		September 26-27, 2011
Test Engineer	Signature	Dates of Tests

6 Radiated Spurious/Harmonics – FCC 15.249 & IC RSS-210 A2.9

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.

6.2 Radiated Emissions Test Data

Table 6-1: Radiated Emissions/Harmonics - 902.500 MHz

Frequency (MHz)	Peak Analyzer Reading (dBuV)	Site Correction Factor (dBm)	Peak Level Corrected (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)	Duty Cycle Correction (dB)	Calculated Average Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
1805.0	30.6	29.4	60.0	74.0	-14.0	-6.7	53.3	54.0	-0.7
3610.0	53.1	-6.7	46.4	74.0	-27.6	-6.7	39.7	54.0	-14.3
6317.5	45.3	0.3	45.6	74.0	-28.4	-6.7	38.9	54.0	-15.1
7220.0	49.2	2.4	51.6	74.0	-22.4	-6.7	44.9	54.0	-9.1
8122.5	47.2	8.8	56.0	74.0	-18.0	-6.7	49.3	54.0	-4.7
9025.0	37.3	9.0	46.3	74.0	-27.7	-6.7	39.6	54.0	-14.4

Table 6-2: Radiated Emissions/Harmonics - 915.700 MHz

Frequency (MHz)	Peak Analyzer Reading (dBuV)	Site Correction Factor (dBm)	Peak Level Corrected (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)	Duty Cycle Correction (dB)	Calculated Average Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
1831.4	26.9	31.0	57.9	74.0	-16.1	-6.7	51.2	54.0	-2.8
2747.1	54.9	-7.9	47.0	74.0	-27.0	-6.7	40.3	54.0	-13.7
6409.9	47.0	0.6	47.6	74.0	-26.4	-6.7	40.9	54.0	-13.1
7325.6	51.0	1.8	52.8	74.0	-21.2	-6.7	46.1	54.0	-7.9
8241.3	42.0	8.9	50.9	74.0	-23.1	-6.7	44.2	54.0	-9.8
9157.0	36.6	9.9	46.5	74.0	-27.5	-6.7	39.8	54.0	-14.2

Table 6-3: Radiated Emissions/Harmonics - 927.450 MHz

Frequency (MHz)	Peak Analyzer Reading (dBuV)	Site Correction Factor (dBm)	Peak Level Corrected (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)	Duty Cycle Correction (dB)	Calculated Average Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
1854.9	27.5	30.3	57.8	74.0	-16.2	-6.7	51.1	54.0	-2.9
2782.4	55.5	-8.3	47.2	74.0	-26.8	-6.7	40.5	54.0	-13.5
6492.2	49.8	0.4	50.2	74.0	-23.8	-6.7	43.5	54.0	-10.5
7419.6	51.7	2.4	54.1	74.0	-19.9	-6.7	47.4	54.0	-6.6
8347.1	43.5	9.2	52.7	74.0	-21.3	-6.7	46.0	54.0	-8.0
9274.5	37.9	10.1	48.0	74.0	-26.0	-6.7	41.3	54.0	-12.7

Table 6-4: Radiated Emissions of Harmonics Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900905	Rhein Tech 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

7 Receiver Spurious Emissions – FCC 15B & IC RSS-Gen 4.10

7.1 Receiver Spurious Emissions Limits/Test Procedure

7.1.1 Site and Test Description

Before final radiated emissions measurements were made on the OATS, the EUT was scanned indoors at both one and three meter distances. This was done in order to determine its emission spectrum signal. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emission measurements on the OATS, at each frequency, in order to ensure that maximum emission amplitudes were measured. Final radiated emissions measurements were made on the OATS at a distance of 3 meters. The EUT was placed on a non-conductive turntable. At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emissions maximum levels. Measurements were taken using both horizontal and vertical antenna polarization. The spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the quasi-peak detection mode. No video filter less than 10 times the resolution bandwidth was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

7.1.2 Test Limits

FCC Class B Radiated Emissions	
Frequency (MHz)	**At 3m (dBμV/m)**
30-88	40.0
88-216	43.5
216-960	46.0
>960	54.0

7.1.3 Radiated Emissions Test Data

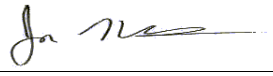
Table 7-1: Radiated Emissions Test Data

Temperature: 73°F Humidity: 100%										
Emission Frequency (MHz)	**Test Detector**	**Antenna Polarity (H/V)**	**Turntable Azimuth (deg)**	**Antenna Height (m)**	**Analyzer Reading (dBuV)**	**Site Correction Factor (dB/m)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Pass/ Fail**
57.920	Qp	V	15	1.0	41.2	-22.9	18.3	40.0	-21.7	Pass
247.250	Qp	H	45	2.0	37.1	-15.8	21.3	46.0	-24.7	Pass
248.850	Qp	H	45	2.5	38.4	-15.6	22.8	46.0	-23.2	Pass
470.000	Qp	H	90	2.5	38.5	-9.2	29.3	46.0	-16.7	Pass
543.750	Qp	V	90	1.0	38.1	-5.9	32.2	46.0	-13.8	Pass
599.080	Qp	V	180	1.0	36.9	-6.8	30.1	46.0	-15.9	Pass
635.920	Qp	V	165	1.0	36.7	-5.0	31.7	46.0	-14.3	Pass
801.790	Qp	H	90	1.0	30.6	-4.2	26.4	46.0	-19.6	Pass

Table 7-2: Radiated Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900905	Rhein Tech 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:

Jon Wilson		September 26, 2011
Test Engineer	Signature	Date of Test

8 Occupied Bandwidth - RSS-Gen 4.6.1

8.1 Modulated Bandwidth Test Procedure

The 99% emission bandwidth was measured using a 50-ohm spectrum analyzer with the resolution bandwidth set at 300 Hz, and the video bandwidth set at 1 kHz.

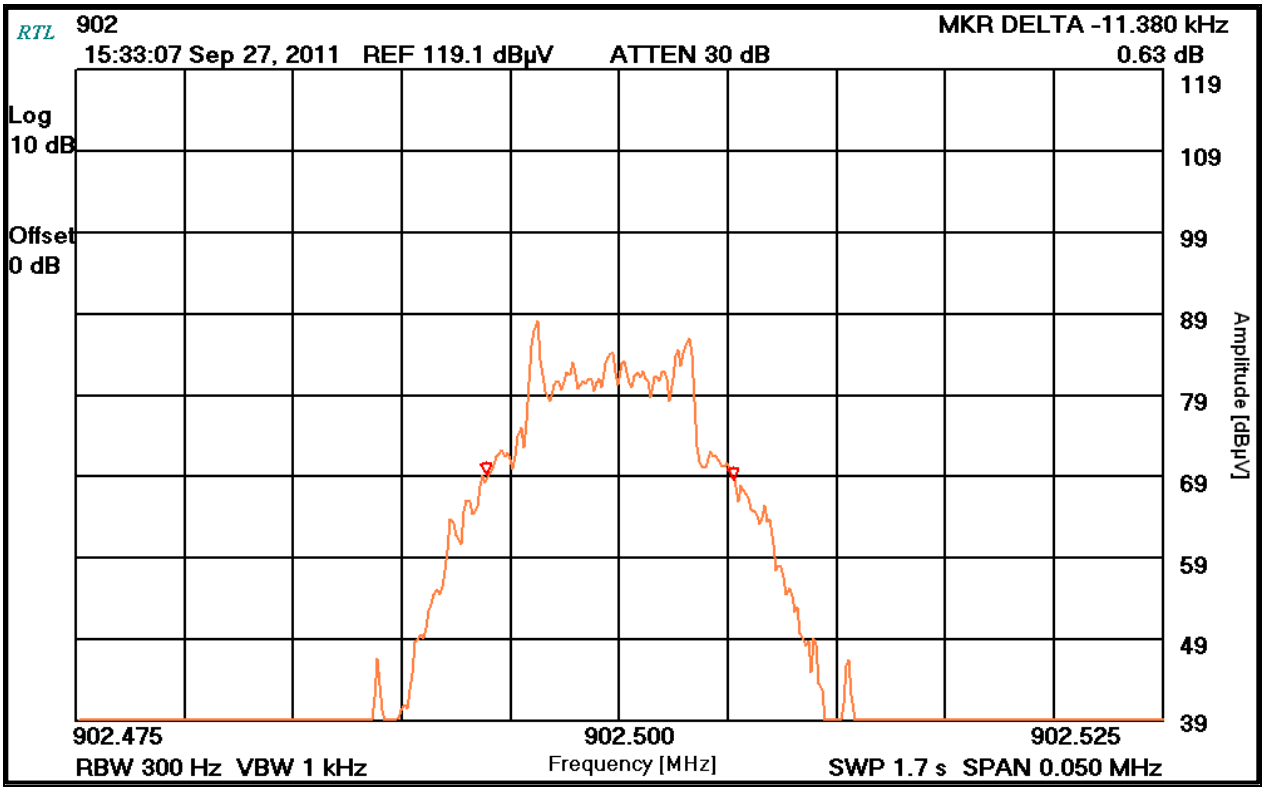
8.2 Modulated Bandwidth Test Data

Table 8-1: Minimum 20 dB Modulated Bandwidths

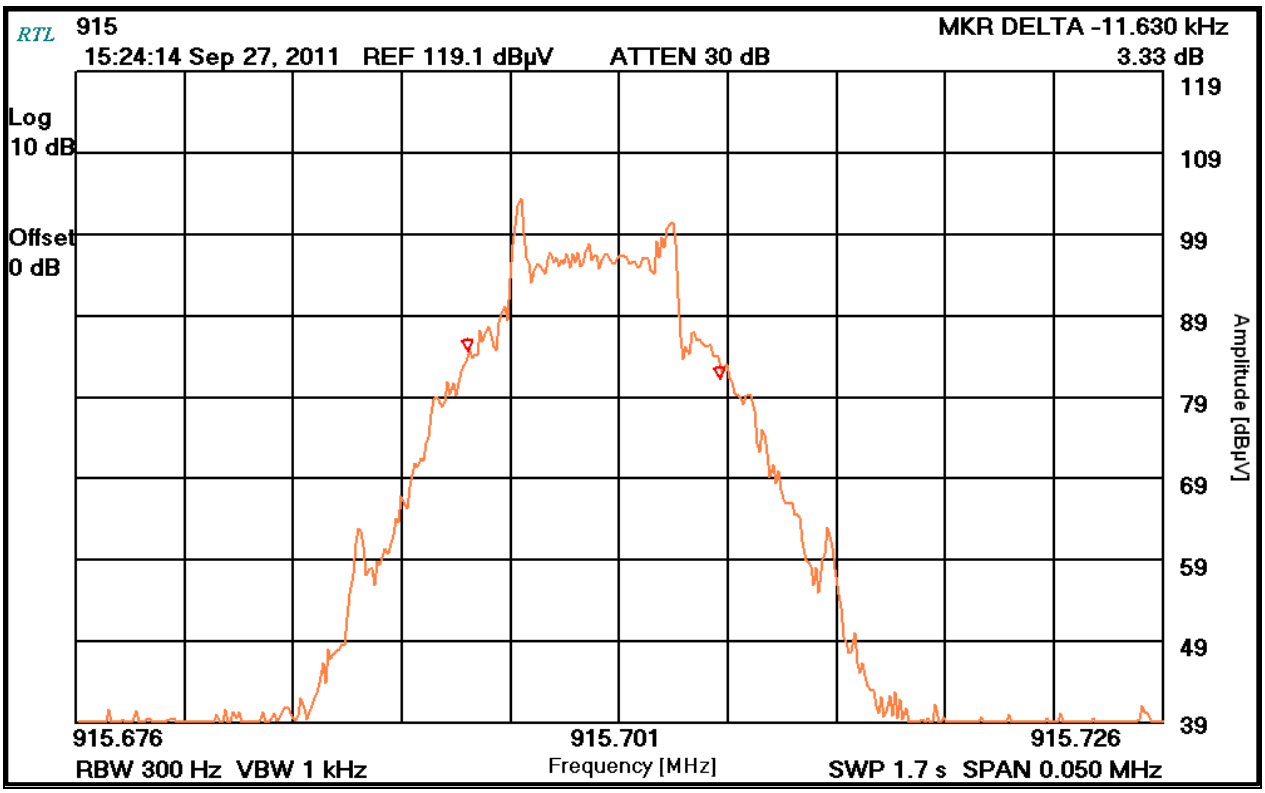
Frequency (MHz)	99% Bandwidth (kHz)
902.5	11.4
915.7	11.6
927.45	11.4

Occupied Bandwidth Plots

Plot 8-1: Occupied Bandwidth - Low Channel



Plot 8-2: Occupied Bandwidth - Middle Channel



Plot 8-3: Occupied Bandwidth - High Channel

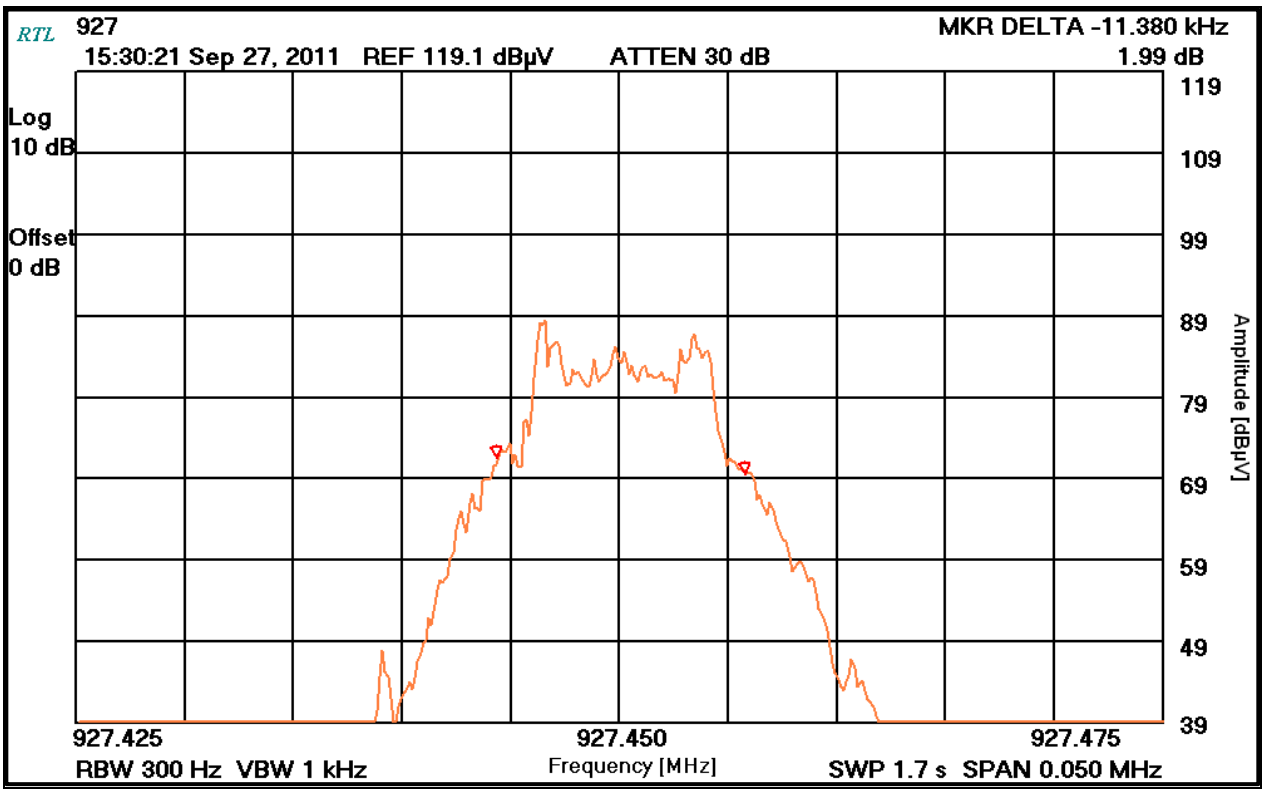


Table 8-2: Occupied Bandwidth Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
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

Test Personnel:

Jon Wilson		September 27, 2011
Test Engineer	Signature	Date of Test

9 Conclusion

The data in this measurement report shows that IKUSI Model TR800CE-EMB; FCC ID: PVTTR800CE-EMB, and IC: 4166A-TR800CEEMB, complies with all the applicable requirements of Parts 2 and 15 of the FCC Rules, and Industry Canada RSS-210 and RSS-Gen, for Limited Modular Approval.