Exhibit 6: Test Report

TEST REPORT FROM:

COMMUNICATION CERTIFICATION LABORATORY
1940 W. Alexander Street
Salt Lake City, Utah
84119-2039

Type of Report: Certification

TEST OF: EMRF900

FCC ID: OOG-EMRF900

To FCC PART 15, Subpart C
Section 15.249

Test Report Serial No: 73-6913

Applicant:

emWare
6322 S. 3000 E.
Suite 250
Salt Lake City, UT 84121

Date of Test: August 18, 1999

Issue Date: August 24, 1999

CERTIFICATION OF ENGINEERING REPORT

This report has been prepared by Communication Certification Laboratory to determine compliance of the device described below with the notification requirements of FCC Part 15, Subpart C Section 15.249. This report may be reproduced in full, partial reproduction may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

- Applicant: emWare
- Manufacturer: emWare
- Trade Name: emWare
- Model Number: EMRF900
- FCC ID: OOG-EMRF900

On this 24th day of August 1999, I, individually, and for Communication Certification Laboratory, certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

Although NVLAP has recognized that the Communication Certification Laboratory EMC testing facilities are in good standing, NVLAP does not endorse the product described in this report.

COMMUNICATION CERTIFICATION LABORATORY

Checked by: William S. Hurst, P.E.
Vice President

Tested by: Roger J. Midgley
EMC Engineering Manager

SECTION 1.0 CLIENT INFORMATION

1.1 Client Information:

Company Name:	emWare 6322 S. 3000 E. Suite 250 Salt Lake City, UT 84121
Contact Name:	Matt S. Martin
Title:	RF Engineer

SECTION 2.0 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of EUT:

Trade Name:	emWare
Model Name or Number:	EMRF900
Serial Number:	N/A
Options Fitted:	N/A
Country of Manufacture:	U.S.A.

2.2 Description of EUT:

The EMRF900 RF Module acts as a passthrough device: accepting data in and passing the same data out. The Module has as onboard voltage regulator and microcontroller. The radio uses FM modulation and operates at 9600 Bps. The data rate can be increased or decreased by changing the firmware. Please note however, that while not affecting RF emissions whatsoever, changing the data rate will directly affect range. For example: if the data rate were increased to 38.4 Kbps, the range would decrease to 600-500 feet line of sight or half the current range. On the other hand, if you were to decrease the data rate to 2400 Kbps, the range would improve. This is solely a function of the receiving code’s ability to decode pulse widths as the radio approaches sensitivity. While the RF emissions remains constant, the wider pulses will expand the capacity of the receiving firmware to decode incoming data.

The radio itself is used as a virtual wire allowing for remote capabilities of devices. The radio is powered from a 9 V battery or a power supply that delivers anywhere from 6 – 15 Volts. The radio has it’s own linear voltage regulator (please see block diagram in Exhibit 4 and schematic in Exhibit 5). Data is accepted into the USART of the microcontroller that buffers the data and Manchester encodes it. The onboard microcontroller in turn modulates the carrier.

The EMRF900 can be configured with two different connector/interface boards. The first one is an emWare connector board part No. 670013-011 and the second is a SDK connector/interface board part No. 67002-003.

The EMRF900 is to be certified as a module; therefore, the following items are applicable:

1. The EMRF900 provides its own RF shielding and does not rely on the host system in which it is installed to provide shielding.

2. The EMRF900 provides buffered modulation and data inputs; therefore, the type of modulation or the data input rate does not affect the RF output power. (See equipment description in section 2.2)
3. The EMRF900 can operate on 6 to 15 VDC provided by the interface board; however, the EMRF900 provides its own power supply regulation that delivers 5 VDC to the transmitter regardless of the input voltage. (See equipment description in section 2.2 and block diagram in Exhibit 4)
4. The EMRF900 complies with Section 15.203. (See Exhibit 12).
5. The EMRF900 was tested as a stand-alone device installed with an interface board to provide DC power and data input during the tests. (See Section 4.2 and Photos in Exhibits 7 and 9).
6. The EMRF900 is labeled with its own FCC ID number and compliance statement. When the EMRF900 is installed inside of a host system and the FCC ID number on the transmitter is not visibly from the outside, a separate label is provided for the outside of the host system listing the transmitters FCC ID number. (See labels in Exhibit 1).
7. The EMRF900's output power is less than 100 mW; therefore, it is not subject to RF exposure limits. (See Exhibit 11)

This application is for the transmitter portion only; the receiver portion was tested and complies with the Verification procedures according to FCC Part 15 Subpart B.

2.3 Modification Incorporated/Special Accessories on EUT:

There were no modifications or special accessories required to comply with the specification.

Signature: ______________________________

Typed Name: Matt S. Martin

Title: RF Engineer

SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES

3.1 Test Specification:

Title: FCC PART 15, Subpart C (47 CFR 15).
Section 15.249

Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz and 24.0-24.25 GHz.

Purpose of Test: The tests were performed to demonstrate Initial compliance.

3.2 Methods & Procedures:

3.2.1 § 15.249

(a) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902 – 902 MHz	50	500
2400 – 2483.5 MHz	50	500
5725 – 5875 MHz	50	500
24.0 – 24.25 GHz	250	2500

(b) Field strength limits are specified at a distance of 3 meters.

(c) 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 § 15.209, whichever is the lesser attenuation.

(d) As shown in § 15.35(b), for frequencies above 1000 MHz, the above 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.

(e) Parties considering the manufacture, importation, marketing or operation of equipment under this section should also not the requirements in § 15.37(d).

3.2.2 § 15.207 Conducted Limits

(a) For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 450 kHz to 30 MHz shall not exceed 250 microvolts. Compliance with the provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

3.3 Test Procedure

The line conducted and radiated emissions testing was performed according to the procedures in ANSI C63.4 (1992). Line conducted and radiated emissions testing was performed at CCL's anechoic chamber located at 1940 W. Alexander Street in Salt Lake City, Utah. This site has been fully described in a report submitted to the FCC, and was accepted in a letter dated March 1, 1999 (31040/SIT).

CCL participates in the National Voluntary Laboratory Accreditation Program (NVLAP) and has been accepted under NVLAP Lab Code:100272-0, which is effective until September 30,1999.

For radiated emissions testing that is performed at distances closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

SECTION 4.0 OPERATION OF EUT DURING TESTING

4.1 Operating Environment:

Power Supply: 9 VDC
AC Mains Frequency: N/A
Current Rating: N/A

4.2 Operating Modes:

Each mode of operation was exercised to produce worst case emissions. The worst case emissions were with the EMRF900 powered up in the transmit mode. The EMRF900 was connected to the SDK interface board that provided DC power and data input to the transmitter. The EMRF900 was tested as a stand-alone configuration.

The EMRF900 can transmit on two channels, 903.0 MHz and 909.0 MHz; therefore, testing was performed with the EMRF900 tuned to both channels.

The EMRF900 operates on 9 VDC supplied via a power adapter; therefore, conducted emissions testing was performed on the AC to DC power adapter.

4.3 EUT Exercise Software:

The EMRF900 used internal firmware to produce the worst case emissions.

SECTION 5.0 SUMMARY OF TEST RESULTS

5.1 FCC PART 15, Subpart C Section 15.249

5.1.1 Summary of Tests:

Section	Test Performed	Frequency Range (MHz)	Result
15.249 (a)	Radiated Emissions – Transmitting at 903.0 MHz	30 to 10,000	Complied
15.249 (a)	Radiated Emissions – Transmitting at 909.0 MHz	30 to 10,000	Complied
15.207	Line Conducted Emissions (Hot Lead to Ground)	0.45 to 30	Complied
15.207	Line Conducted Emissions (Neutral Lead to Ground)	0.45 to 30	Complied

5.2 Result

In the configuration tested, the EUT complied with the requirements of the specification.

SECTION 6.0 MEASUREMENTS, EXAMINATIONS AND DERIVED RESUTLS

6.1 General Comments:

This section contains the test results only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Appendix 1 of this report.

6.2 Test Results:

6.2.1 Radiated Interference Level Data - (Vertical Polarity) (Transmitting at 903.0 MHz)

Frequency MHz	Detector	Receiver Reading dBμV	Correction Factor dB	Field Strength dBμV/m	Limit dBμV/m
734.2	Quasi-Peak	9.9	32.0	41.9	46.0
903.0	Peak	58.2	34.5	92.7	94.0
1806.0	Peak	14.3	31.9	46.2	74.0
1806.0	Average	9.1	31.9	41.0	54.0
2709.0 *	Peak	10.0	36.5	46.5	74.0
2709.0 *	Average	0.4	36.5	36.9	54.0
3612.0 *	Peak	9.3 **	39.8	49.1	74.0
3612.0 *	Average	-0.9 **	39.8	38.9	54.0
4515.0 *	Peak	9.8 **	41.1	50.9	74.0
4515.0 *	Average	-1.8 **	41.1	39.3	54.0
5418.0 *	Peak	9.3 **	45.4	54.7	74.0
5418.0 *	Average	-2.1 **	45.4	43.3	54.0
6321.0	Peak	10.4 **	43.8	54.2	74.0
6321.0	Average	1.1 **	43.8	44.9	54.0
7224.0	Peak	11.6 **	45.3	56.9	74.0
7224.0	Average	1.4 **	45.3	46.7	54.0
8127.0 *	Peak	12.9 **	46.6	59.5	74.0
8127.0 *	Average	1.9 **	46.6	48.5	54.0
9030.0 *	Peak	14.6 **	48.1	62.7	74.0
9030.0 *	Average	3.2 **	48.1	51.3	54.0

Note 1: * Emissions within restricted bands of § 15.205

Note 2: ** No emission detected, noise floor reading from spectrum analyzer

6.2.2 Radiated Interference Level Data - (Horizontal Polarity) (Transmitting at 903.0 MHz)

Frequency MHz	Detector	Receiver Reading dBμV	Correction Factor dB	Field Strength dBμV/m	Limit dBμV/m
734.2	Quasi-Peak	8.9	32.0	40.9	46.0
903.0	Peak	50.8	34.5	85.3	94.0
1806.0	Peak	10.2	31.9	42.1	74.0
1806.0	Average	1.4	31.9	33.3	54.0
2709.0 *	Peak	9.5	36.5	46.0	74.0
2709.0 *	Average	0.5	36.5	37.0	54.0
3612.0 *	Peak	9.3 **	39.8	49.1	74.0
3612.0 *	Average	-0.9 **	39.8	38.9	54.0
4515.0 *	Peak	9.8 **	41.1	50.9	74.0
4515.0 *	Average	-1.8 **	41.1	39.3	54.0
5418.0 *	Peak	9.3 **	45.4	54.7	74.0
5418.0 *	Average	-2.1 **	45.4	43.3	54.0
6321.0	Peak	10.4 **	43.8	54.2	74.0
6321.0	Average	1.1 **	43.8	44.9	54.0
7224.0	Peak	11.6 **	45.3	56.9	74.0
7224.0	Average	1.4 **	45.3	46.7	54.0
8127.0 *	Peak	12.9 **	46.6	59.5	74.0
8127.0 *	Average	1.9 **	46.6	48.5	54.0
9030.0 *	Peak	14.6 **	48.1	62.7	74.0
9030.0 *	Average	3.2 **	48.1	51.3	54.0

Note 1: * Emissions within restricted bands of § 15.205

Note 2: ** No emission detected, noise floor reading from spectrum analyzer

6.2.3 Radiated Interference Level Data - (Vertical Polarity) (Transmitting at 909.0 MHz)

Frequency MHz	Detector	Receiver Reading dBμV	Correction Factor dB	Field Strength dBμV/m	Limit dBμV/m
734.2	Quasi-Peak	9.9	32.0	41.9	46.0
909.0	Peak	58.2	34.5	92.7	94.0
1818.0	Peak	14.8	32.1	46.9	74.0
1818.0	Average	10.1	32.1	42.2	54.0
2727.0 *	Peak	11.1	36.6	47.7	74.0
2727.0 *	Average	-0.2	36.6	36.4	54.0
3636.0 *	Peak	9.3 **	39.8	49.1	74.0
3636.0 *	Average	-0.9 **	39.8	38.9	54.0
4545.0 *	Peak	9.8 **	41.1	50.9	74.0
4545.0 *	Average	-1.8 **	41.1	39.3	54.0
5454.0 *	Peak	9.3 **	45.4	54.7	74.0
5454.0 *	Average	-2.1 **	45.4	43.3	54.0
6363.0	Peak	10.4 **	43.8	54.2	74.0
6363.0	Average	1.1 **	43.8	44.9	54.0
7272.0 *	Peak	11.6 **	45.3	56.9	74.0
7272.0 *	Average	1.4 **	45.3	46.7	54.0
8181.0 *	Peak	12.9 **	46.6	59.5	74.0
8181.0 *	Average	1.9 **	46.6	48.5	54.0
9090.0 *	Peak	14.6 **	48.1	62.7	74.0
9090.0 *	Average	3.2 **	48.1	51.3	54.0

Note 1: * Emissions within restricted bands of § 15.205

Note 2: ** No emission detected, noise floor reading from spectrum analyzer

6.2.4 Radiated Interference Level Data - (Horizontal Polarity) (Transmitting at 909.0 MHz)

Frequency MHz	Detector	Receiver Reading dBμV	Correction Factor dB	Field Strength dBμV/m	Limit dBμV/m
734.2	Quasi-Peak	8.9	32.0	40.9	46.0
909.0	Peak	51.4	34.5	85.9	94.0
1818.0	Peak	10.8	32.1	42.9	74.0
1818.0	Average	4.6	32.1	36.7	54.0
2727.0 *	Peak	10.0	36.6	46.6	74.0
2727.0 *	Average	0.2	36.6	36.8	54.0
3636.0 *	Peak	9.3 **	39.8	49.1	74.0
3636.0 *	Average	-0.9 **	39.8	38.9	54.0
4545.0 *	Peak	9.8 **	41.1	50.9	74.0
4545.0 *	Average	-1.8 **	41.1	39.3	54.0
5454.0 *	Peak	9.3 **	45.4	54.7	74.0
5454.0 *	Average	-2.1 **	45.4	43.3	54.0
6363.0	Peak	10.4 **	43.8	54.2	74.0
6363.0	Average	1.1 **	43.8	44.9	54.0
7272.0 *	Peak	11.6 **	45.3	56.9	74.0
7272.0 *	Average	1.4 **	45.3	46.7	54.0
8181.0 *	Peak	12.9 **	46.6	59.5	74.0
8181.0 *	Average	1.9 **	46.6	48.5	54.0
9090.0 *	Peak	14.6 **	48.1	62.7	74.0
9090.0 *	Average	3.2 **	48.1	51.3	54.0

Note 1: * Emissions within restricted bands of § 15.205

Note 2: ** No emission detected, noise floor reading from spectrum analyzer

6.2.5 Line Conducted Data - (Hot Lead)

Frequency MHz	Detector	Measured Level dBμV	Limit dBμV
0.46	Peak	38.8	48.0
0.80	Peak	36.1	48.0
1.26	Peak	29.6	48.0
2.01	Peak	27.4	48.0
22.44	Peak	20.3	48.0

6.2.6 Line Conducted Data - (Neutral Lead)

Frequency MHz	Detector	Measured Level dBμV	Limit dBμV
0.45	Peak	37.7	48.0
0.87	Peak	33.3	48.0
1.57	Peak	28.5	48.0
1.93	Peak	25.6	48.0
24.47	Peak	19.4	48.0

6.3 Sample Field Strength Calculation:

The field strength is calculated by adding the Correction Factor (Antenna Factor + Cable Factor), to the measured level from the receiver. The receiver amplitude reading is compensated for any amplifier gain. The basic equation with a sample calculation is shown below:

FS = RA + CF Where

FS = Field Strength
RA = Receiver Amplitude Reading (Receiver Reading - Amplifier Gain)
CF = Correction Factor (Antenna Factor + Cable Factor)

Assume a receiver reading of 42.5 dBμV is obtained from the receiver, an amplifier gain of 26.5 dB and a correction factor of 8.5 dB. The field strength is calculated by subtracting the amplifier gain and adding the correction factor, giving a field strength of 24.5 dBμV/m, FS = (42.5 - 26.5) + 8.5 = 24.5 dBμV/m

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT

Radiated Interference Emissions:

The radiated emission from the intentional radiator was measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings. A preamplifier with a fixed gain of 26 dB and a power amplifier with a fixed gain of 22 dB were used to increase the sensitivity of the measuring instrumentation. The quasi-peak adapter uses a bandwidth of 120 kHz, with the spectrum analyzer's resolution bandwidth set at 1 MHz, for readings in the 30 to 1000 MHz frequency range. For peak emissions above 1000 MHz the spectrum analyzer’s resolution bandwidth was set to 1 MHz and the video bandwidth was set to 3 MHz. For average emissions above 1000 MHz the spectrum analyzer’s resolution bandwidth was set to 1 MHz and the video bandwidth was set to 1 Hz.

A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz and a Double Ridge Guide Horn antenna was used to measure the frequency range 1 GHz to 10 GHz, at a distance of 3 meters from the EUT. The readings obtained by these antennas are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors.

The configuration of the intentional radiator was varied to find the maximum radiated emission. The EUT was connected to the peripherals listed in Section 2.4 via the interconnecting cables listed in Section 2.5. These interconnecting cable were manipulated manually by a technician to obtain worst case radiated emissions. The intentional radiator was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there were multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

Desktop intentional radiator is measured on a non-conducting table one meter above the ground plane. The table is placed on a turntable which is level with the ground plane. The turntable has slip rings, which supply AC power to the intentional radiator. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

Type of Equipment	Manufacturer	Model Number	Serial Number
Anechoic Chamber	CCL	N/A	N/A
Test Software	CCL	Radiated Emissions	Revision 1.3
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
Biconilog Antenna	EMCO	3141	1045
Double Ridged Guide Antenna	EMCO	3115	9409-4355
Radiated Emissions Cable Anechoic Chamber	CCL	Cable B	N/A
Pre-Amplifier	Hewlett Packard	8447D	1937A03151
Power-Amplifier	Hewlett Packard	8447E	2434A01975
6 dB Attenuator	Hewlett Packard	8491A	32835

All the equipment listed above is calibrated every 12 months by an independent calibration laboratory or by CCL personal following outlined calibration procedures.

Radiated Emissions Test