FCC CERTIFICATION TEST REPORT

for

Logis-Tech, Inc.
5775 Barclay Drive
Suite 4
Alexandria, VA 22315

FCC ID: OVU-LTI-A-0101

March 31, 2000

WLL PROJECT #: 5262X

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STATEMENT OF QUALIFICATIONS

for

Herbert W. Meadows

Washington Laboratories, Ltd.

I hold a Bachelor of Science in Electronics Engineering Technology. I have over three years of EMI testing experience and nine years of RF and microwave testing experience. I am qualified to perform EMC testing to the methods described in this test report. The measurements taken within this report are accurate within my ability to perform the tests and within the tolerance of the measuring instrumentation.

By: Herbert W. Meadows
Herbert W. Meadows
Compliance Engineer

Date: MARCH 31, 2000

FCC CERTIFICATION TEST REPORT

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FCC ID: OVU-LTI-A-0101

1.0 Introduction

This report has been prepared on behalf of Logis-Tech, Inc. to support the attached Application for Equipment Authorization. The test and application are submitted for an Intentional Radiator under Part 15.209 of the FCC Rules and Regulations. The Equipment Under Test was the 132 kHz Transceiver used in an Automated Inventory Maintenance Management System.

All measurements herein were performed according to the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and field Strength Instrumentation. Calibration checks are made periodically to verify proper performance of the measuring instrumentation.

All measurements are performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

All results reported herein relate only to the equipment tested. The measurement uncertainty of the data contained herein is ±2.3 dB. Refer to Appendix A for Statement of Measurement Uncertainty. This report shall not be used to claim product endorsement by NVLAP or any agency of the US Government.

1.1 Summary

The Logis-Tech, Inc. 132 kHz Transceiver, an Automated Inventory Maintenance Management System, complies with the limits for an Intentional Radiator under Part 15.209 of the FCC Rules and Regulations.

2.0 Description of Equipment Under Test (EUT)

The Logis-Tech, Inc. 132 kHz Transceiver (EUT) unit is part of a system used for tracking assets in a controlled area. The overall system is the Automated Inventory and Maintenance Management System (AIMMS). The transceiver consists of a 132 kHz transmitted signal supplied to a portal antenna which is used to activate another transmitter (separate certification, FCC ID: OVU-LTI-A-0100) that is located on the vehicle as the vehicle passes through the doorway. The vehicle transmitter then transmits a fixed length code that is received by the portal antenna and receiver (separate receiver DOC). This received signal then turns on an indicator light and changes a status from “out” to “in” which stops a timer from counting.

The housing in which the 132 kHz transceiver is located is AC powered and contains the digital circuitry necessary for the decoding of the received signal and the network interface.

2.1 On-board Oscillators

The Logis-Tech, Inc. 132 kHz Transceiver contains the following oscillators: 2.4092 MHz and 3.168 MHz

3.0 Test Configuration

To complete the test configuration required by the FCC, the transmitter was powered on and the output was connected to the portal antenna. The portal antenna was tested in all three orthogonal planes. All testing was performed as 120VAC.

The EUT consists of a transceiver and a portal antenna (132 kHz and 315 MHz).

I/O Ports	I/O Cables
Channel A – BNC	Shielded (braid), 3 m, Channel A to Antenna
Channel B – BNC	Shielded (braid), 3 m, Channel B to Termination
Network	Non-shielded, 5 m, Network Connection

3.1 Testing Algorithm

The transmitter was turned on and constantly transmitting. Worst case emissions are recorded in the data tables.

3.2 Conducted Emissions Testing

The EUT was placed on an 80 cm high 1 x 1.5 m non-conductive table above a ground plane. Power to the CPU was provided through a Solar Corporation 50 Ω/50 µH Line Impedance Stabilization Network bonded to a 3 x 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 450 kHz to 30 MHz was measured. The detector function was set to quasi-peak or peak, as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth.

3.3 Radiated Emissions Testing

The EUT was placed on an 80 cm high 1 x 1.5 meters non-conductive motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Biconical, log periodic and loop antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The loop antenna was rotated about its' horizontal and vertical axis to maximize the emissions. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak or peak, as appropriate. For emissions above 30 MHz, the measurement bandwidth on the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth. For emissions below 30 MHz, the measurement bandwidth on the spectrum analyzer system was set to at least 9 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth.

3.3.1 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, it is necessary to account for various calibration factors that are supplied with the antennas and other measurement accessories. These factors are grouped into a composite antenna factor (AFc) and are supplied in the AFc column of Table 2. The AFc in dB/m is algebraically added to the Spectrum Analyzer Voltage in dbμV to obtain the Radiated Electric Field in dBμV/m. This level is then compared with the FCC limit.

Example:

Spectrum Analyzer Voltage:	VdBμV
Composite Antenna Factor:	AFcdB/m
Electric Field:	EdBμV/m = VdBμV + AFcdB/m
To convert to linear units:	EμV/m = antilog (EdBμV/m/20)

Data is recorded in Table 2.

Table 1

FCC 15.207 Conducted Emissions Data

CLIENT: Logis-Tech, Inc.
FCC ID: OVU-LTI-A-0101
DATE: 12/21/99
VOLTAGE: 120VAC
BY: Herb Meadows
JOB #: 5262X

Line 1 - Neutral

Frequency MHz	Voltage (Peak) dBuV	Voltage uV	FCC Limit uV	Margin dB
0.52	41.2	114.8	250	-6.8
0.79	27.6	24.0	250	-20.4
3.95	30.8	34.7	250	-17.2
6.03	29.9	31.3	250	-18.1
11.55	37.0	70.8	250	-11.0
13.85	34.3	51.9	250	-13.7

Line 2 - Phase

Frequency MHz	Voltage (Peak) dBuV	Voltage uV	FCC Limit uV	Margin dB
0.53	43.2	144.5	250	-4.8
0.79	39.0	89.1	250	-9.0
1.05	31.2	36.3	250	-16.8
7.73	29.6	30.2	250	-18.4
13.88	34.4	52.5	250	-13.6
19.60	30.2	32.4	250	-17.8

Table 2

FCC 15.209 3M Radiated Emissions Data

CLIENT: Logis-Tech, Inc.
FCC ID: OVU-LTI-A-0101
DATE: 12/21/99
BY: Herb Meadows
JOB #: 5262X
CONFIGURATION: 6511 Loop Antenna

Freq. kHz	Polarity H/V	Azimuth Degree	Ant Height m	SA Level (QP) dBuV	AFc dB/m	E-Field dBuV/m	E-Field uV/m	Limit uV/m	Margin dB	
132.1	N/A	180.00	1.0	34.1	52.0	86.1	20183.7	181970.0	-19.1	
264.4	N/A	180.00	1.0	-2.8	51.1	48.3	260.0	89125.0	-50.7	
396.1	N/A	180.00	1.0	-6.8	51.0	44.2	162.2	60953.7	-51.5	
528.0	N/A	0.00	1.0	-13.9	50.9	37.0	70.8	4570.9	-36.2	Ambient
657.8	N/A	180.00	1.0	1.5	50.8	52.3	412.1	3630.8	-18.9	
792.0	N/A	0.00	1.0	-5.0	50.7	45.7	192.8	3030.4	-23.9	Ambient

Measurements made from 132kHz to 490kHz were made using an average detector. The limit for measurements made below 30 MHz were extrapolated using the square of an inverse linear distance extrapolation factor; (40 dB/decade).

Table 3

System Under Test

FCC ID: OVU-LTI-A-0101

EUT: Logis-Tech, Inc., 132 kHz Transceiver; P/N: 0101
FCC ID: OVU-LTI-A-0101

Table 4

Interface Cables Used

Shielded and non-shielded I/O cables were used throughout the system under test.

The EUT was powered via a non-shielded AC power cord.

Table 5

Measurement Equipment Used

The following equipment is used to perform measurements:

Hewlett-Packard Spectrum Analyzer: HP8564E
Hewlett-Packard Spectrum Analyzer: HP8568B
Hewlett-Packard Spectrum Analyzer: HP8593A
Hewlett-Packard Quasi-Peak Adapter: HP85650A
Hewlett-Packard Preselector: HP85685A
Hewlett-Packard Preamplifier: HP8449B
Antenna Research Associates, Inc. Biconical Log Periodic Antenna: LPB-2520A (Site 2)
EMCO Loop Antenna: Model 6511
Solar 50 Ω/50 μH Line Impedance Stabilization Network: 8012-50-R-24-BNC
Solar 50 Ω/50 μH Line Impedance Stabilization Network: 8028-50-TS-24-BNC
AH Systems, Inc. Portable Antenna Mast: AMS-4 (Site 2)
AH Systems, Inc. Motorized Turntable (Site 2)
RG-214 semi-rigid coaxial cable
RG-223 double-shielded coaxial cable

Appendix A

Statement of Measurement Uncertainty

For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:
A = Antenna calibration uncertainty, in dB = 2 dB
B = Spectrum Analyzer uncertainty, in dB = 1 dB
C = Site uncertainty, in dB = 4 dB
n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$