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Project Number: 99-343

Prepared for:

**LESTER ELECTRICAL, INC.**  
625 West A Street  
Lincoln, Nebraska 68522-1794

By

Professional Testing (EMI), Inc.  
1601 FM 1460, Suite B  
Round Rock, Texas 78664

March 1999

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**TYPE CERTIFICATION**  
**Electromagnetic Interference**  
**Test Report**

**LESTER ELECTRICAL, INC.**  
**DATA COLLECTION MODULE**  
**(Intentional Radiator Portion)**

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*THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF PROFESSIONAL TESTING (EMI), INC.*



## Certificate of Compliance

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Applicant: Lester Electrical, Inc.  
Applicant's Address: 625 West A Street  
Lincoln, Nebraska 68522  
Model: Data Collection Module  
Serial Number: N/A  
Project Number: 99-343  
Test Dates: March 4, 1999

I, Jeffrey A. Lenk, for Professional Testing (EMI), Inc., being familiar with the FCC rules and test procedures have reviewed the test setup, measured data and this report. I believe them to be true and accurate.

The **Lester Electrical, Inc. Data Collection Module** was tested to and found to be in compliance with FCC Part 15 Subpart C for an Intentional Radiator.

The highest emissions generated by the above equipment are listed below:

	<u>Frequency (MHz)</u>	<u>Level (dB<math>\mu</math>V/m)</u>	<u>Limit (dB<math>\mu</math>V/m)</u>	<u>Margin (dB)</u>
Fundamental	916.5	81.6	93.9	-12.3
Spurious	1832.9	62.2	63.5	-1.3

### Occupied Bandwidth

Record Only Per 47 CFR 15 - Widest OCBW: 100.4 kHz

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Jeffrey A. Lenk  
President

This report has been reviewed and accepted by Lester Electrical, Inc. The undersigned is responsible for ensuring that the **Data Collection Module** will continue to comply with the FCC rules.

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## 1.0 EUT Description

The Equipment Under Test (EUT) is the **Lester Electrical, Inc., Data Collection Module**. The Data Collection Module is used for gathering battery performance and vehicle utilization data. The EUT operates in the 902 - 928 MHz band and is designed for compliance with 47 CFR 15.249 of the FCC rules. Specific test requirements for this device include the following:

47 CFR 15.249	Fundamental Transmit Power
47 CFR 15.249 & 15.205	Spurious Radiated Power
47 CFR 15.249 & 2.989	Occupied Bandwidth (2.989 used as Procedural Reference)
47 CFR 15.203	Antenna Requirement

**The system tested consisted of the following:**

<u>Manufacturer &amp; Model</u>	<u>Serial #</u>	<u>FCC ID #</u>	<u>Description</u>
Lester Electrical, Inc. Data Collection Module	N/A	OBH21820	Data Collection System

## 1.1 EUT Operation

The **Data Collection Module** was tested with the wireless link active and fully modulated. Setup and operational modes cover worst case configuration and operational modes for the device.

## 2.0 Electromagnetic Emissions Testing

Professional Testing (EMI), Inc. (PTI), follows the guidelines of NIST for all uncertainty calculations, estimates and expressions thereof for EMC testing.

Radiated emission measurements were made of the Fundamental and Spurious Emission levels for the **Data Collection Module**. Measurements of the occupied bandwidth were also made for the equipment.

Measurements of the maximum emission levels for the fundamental and the spurious/harmonic emissions of the **Data Collection Module** were made at the Professional Testing "Open Field" Site 3, located in Marble Falls, Texas to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

Tests of the fundamental for the device were performed to determine the worst case polarization of the devices. The fundamental emissions of the device were measured with the antennas of the devices vertical and horizontal to the ground plane.

## 2.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a motorized turntable which allows 360 degree rotation. For measurements of the fundamental signal, a measurement antenna was positioned at a distance of 3 meters as measured from the closest point of the EUT. For spurious/harmonic measurements above 1GHz, the measurement antenna was placed 1 meter from the EUT. The radiated emissions were maximized by configuring the EUT, by rotating the EUT, and by raising and lowering the antenna from 1 to 4 meters.

A Spectrum Analyzer with peak detection was used to find the maximums of the radiated emissions during the variability testing. A drawing showing the test setup is given as Figure 1.

## 2.2 Test Criteria

The FCC Part 15.249 radiated limits are given below for an intentional radiator operating in the 902 to 928 MHz band. The reference distance for each limit is also shown in this table.

Signal Type	Test Distance (Meters)	Field Strength	
		( $\mu$ V/m)	(dB $\mu$ V/m)
Fundamental	3	50,000	93.9
Spurious/Harmonics	3	500	53.9
Spurious/Harmonics	1	1500	63.5

In addition to these requirements, the EUT must meet the restricted emission band requirements of §15.205. For this frequency range, the unintentional radiated emission limits of §15.249 for a 902 to 928 MHz radiator and the restricted band limits of §15.205 are identical. Measurements of the harmonic were performed to the 10<sup>th</sup> harmonic of the fundamental.

## 2.3 Test Results

The radiated test data is included as Appendix B. The emissions were maximized at each frequency and the highest emissions identified were measured using peak detection. The radiated emissions generated by the **Data Collection Module** are below the FCC Part 15.249 maximum emission criteria.

## 3.0 Occupied Bandwidth Measurements

Measurements of the occupied bandwidth for the fundamental signals of the of the **Data Collection Module** were made at the Professional Testing's Round Rock, Texas laboratory. All measurements were made in a controlled indoor environment in a configuration which did not present measurement distortion or ambient interference.

## 3.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the floor. The table was rotated to an angle which presented the highest signal level. The occupied bandwidth was also measured on the device. Peak detection was used for all tests. The occupied bandwidth was based on a 26 dB criteria (26 dB down either side of the emission from the nominal center of the emission). A drawing showing the test setup is given as Figure 1.

### 3.2 Test Criteria

While the FCC rules do not state a specific limit of occupied bandwidth for 47 CFR 15.249 devices, submission of the emission bandwidth is normally required during the Certification procedure. The only implication regarding an occupied bandwidth requirement is that the emission cannot exceed 80% of the band authorized under §15.249 (902 to 928 MHz for this device).

Measurement of the occupied bandwidth was performed to verify that the emission bandwidth did not change beyond what is typically seen for data collection module. The typical occupied bandwidth for the module is 100 kHz.

Data from these tests was also used to verify compliance with the main frequency range requirement of §15.249. For this device, the lowest allowed center frequency of the intended emission is 902 MHz and the highest allowed center frequency of the intended emission is 928 MHz.

### 3.3 Test Results

The occupied bandwidth test data is included in Appendix C. The occupied bandwidth for the fundamental frequency (916.5 MHz) is 100.4 kHz. The figure is typical for the data collection module.

The intended center frequency for the EUT was centered at 916.5 MHz. The center frequency is within the allowed band. The fundamental signal generated by **Data Collection Module** is within the band allowed under FCC Part 15.249 emission band criteria.

## 4.0 Antenna Requirement

An analysis of the **Data Collection Module** was performed to determine compliance with Section 15.203 of the Rules. This section requires specific handling and control of antennas used for devices subject to regulation under the Intentional Radiator portions of Part 15.

### 4.1 Evaluation Procedure

The structure and application of the **Data Collection Module** were analyzed with respect to the rules. The antenna for this unit is an internal antenna which is soldered onto the main board and is not accessible by the user and an auxiliary antenna port is not present.

### 4.2 Evaluation Criteria

Section 15.203 of the rules states that the subject device must meet at least one of the following criteria:

- (a) Antenna be permanently attached to the unit.
- (b) Antenna must use a unique type of connector to attach to the EUT.
- (c) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

#### 4.3 Evaluation Results

The **Data Collection Module** meets the criteria of this rule by virtue of having an internal antenna permanently attached to the unit. The EUT is therefore compliant with §15.203.

#### 5.0 Modifications to Equipment

There were no modifications made on the **Data Collection Module** during the performance of the test program in order to meet the FCC criteria.

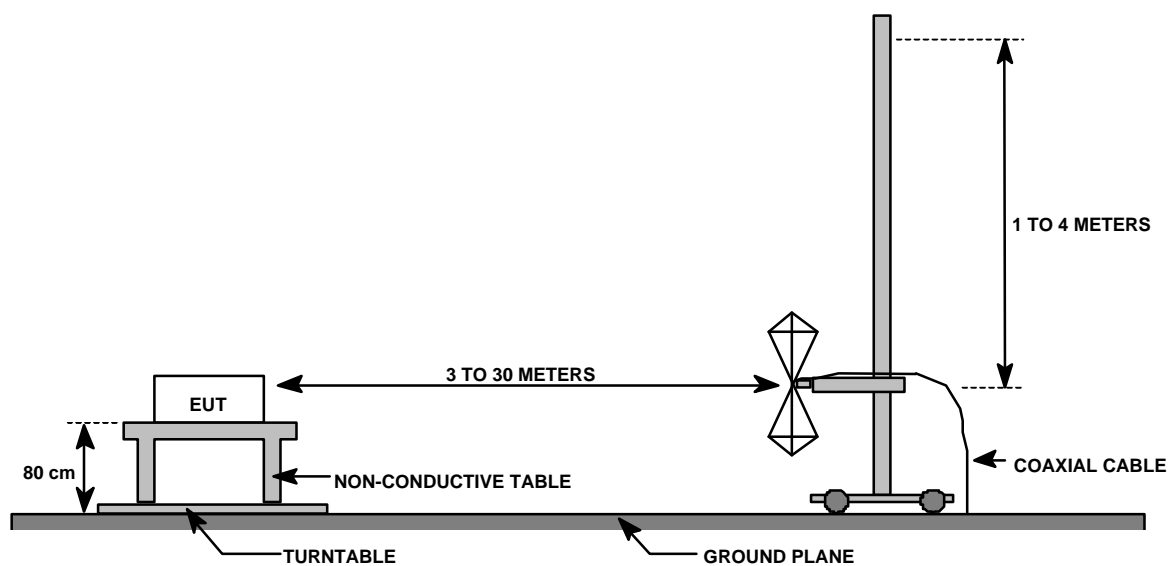
#### 6.0 List of Test Equipment

A list of the test equipment utilized to perform the testing is given below. The date of calibration is given for each.

##### Electromagnetic Emissions Test Equipment

<u>Device</u>	<u>Description</u>	<u>Date Last Calibrated</u>	<u>Calibration Due</u>
HP 8566B	Spectrum Analyzer	09/22/97	09/22/98
HP 85650A	Quasi Peak Adapter	09/22/97	09/22/98
HP 8447	Preamp	05/22/98	05/22/99
EMCO 3108	Biconical Antenna	05/22/98	05/22/99
EMCO 3106	Log Antenna	05/22/98	05/22/99
EMCO 3115	Microwave Antenna	05/22/98	05/22/99
MITEQ	Preamp	05/22/98	05/22/99
AFS4-00101800-40-10P-N			

**FIGURE 1: Radiated Emissions Test Setup**







# Fundamental Radiated Data Sheet

## Lester Electrical, Inc. Data Collection Module

SERIAL #: N/A  
DATE: 03/04/99  
PROJECT #: 99-343

MEASUREMENT DISTANCE (m): 3  
DETECTOR FUNCTION: Peak

### *EUT Horizontal, Antenna Horizontal*

Freq. (MHz)	EUT Dir. (Deg.)	Antenna Height (Meter)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
916.5	225.0	1.0	55.8	22.9	2.9	81.6	93.9	-12.3

### *EUT Vertical, Antenna Horizontal*

Freq. (MHz)	EUT Dir. (Deg.)	Antenna Height (Meter)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
916.5	0.0	1.0	53.9	22.9	2.9	79.7	93.9	-14.2

### *EUT Horizontal, Antenna Vertical*

Freq. (MHz)	EUT Dir. (Deg.)	Antenna Height (Meter)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
916.5	75.0	1.0	52.1	22.9	2.9	77.9	93.9	-16.0

### *EUT Vertical, Antenna Vertical*

Freq. (MHz)	EUT Dir. (Deg.)	Antenna Height (Meter)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
916.5	135.0	1.0	54.3	22.9	2.9	80.1	93.9	-13.8

*Corrected Level = Recorded Level + Antenna Factor + Cable Loss*

COMMENT #1:

COMMENT #2:

TEST ENGINEER: \_\_\_\_\_ APPROVED BY: \_\_\_\_\_  
Larry Zhou Jeffery Lenk



## Spurious Radiated Data Sheet

### Lester Electrical, Inc. Data Collection Module

SERIAL #: N/A  
DATE: 03/04/99  
PROJECT #: 99-343

MEASUREMENT DISTANCE (m): 1  
ANTENNA POLARIZATION: Horizontal  
DETECTOR FUNCTION: Peak

Freq. (MHz)	EUT Dir. (Deg.)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1832.9	90.0	34.9	25.9	1.4	62.2	63.5	-1.3
2749.4	185.0	22.5	26.7	1.6	50.8	63.5	-12.7
3665.8	185.0	15.9	31.1	2.2	49.2	63.5	-14.3
4582.3	185.0	25.4	32.4	3.4	61.2	63.5	-2.3
5498.7	185.0	16.9	34.9	3.8	55.6	63.5	-7.9
6415.2	185.0	14.9	34.3	3.6	52.8	63.5	-10.7
7331.7	185.0	14.8	37.1	3.4	55.3	63.5	-8.2
8248.1	185.0	5.4	36.5	4.0	45.9	63.5	-17.6
10081.0	185.0	3.2	37.4	2.8	43.4	63.5	-20.1

*Corrected Level = Recorded Level + Antenna Factor + Cable Loss*

COMMENT #1: EUT Horizontal.

COMMENT #2: Antenna Elevation optimized at 1 meter.

COMMENT #3: All signals measured above the fundamental are ambients.

TEST ENGINEER: \_\_\_\_\_ APPROVED BY: \_\_\_\_\_  
Larry Zhou Jeffrey Lenk

## Spurious Radiated Data Sheet

### Lester Electrical, Inc. Data Collection Module

SERIAL #: N/A  
DATE: 03/04/99  
PROJECT #: 99-343

MEASUREMENT DISTANCE (m): 1  
ANTENNA POLARIZATION: Vertical  
DETECTOR FUNCTION: Peak

Freq. (MHz)	EUT Dir. (Deg.)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1832.9	90.0	31.2	25.9	1.4	58.5	63.5	-5.0
2749.4	90.0	28.3	26.7	1.6	56.6	63.5	-6.9
3665.8	90.0	18.2	31.1	2.2	51.5	63.5	-12.0
4582.3	90.0	23.0	32.4	3.4	58.8	63.5	-4.7
5498.7	90.0	18.1	34.9	3.8	56.8	63.5	-6.7
6415.2	90.0	17.1	34.3	3.6	55.0	63.5	-8.5
7331.7	90.0	13.0	37.1	3.4	53.5	63.5	-10.0
8248.1	90.0	6.3	36.5	4.0	46.8	63.5	-16.7
10081.0	90.0	8.4	37.4	2.8	48.6	63.5	-14.9

*Corrected Level = Recorded Level + Antenna Factor + Cable Loss*

COMMENT #1: EUT Horizontal.

COMMENT #2: Antenna Elevation optimized at 1 meter.

COMMENT #3: All signals measured above the fundamental are ambients.

TEST ENGINEER: \_\_\_\_\_ APPROVED BY: \_\_\_\_\_  
Larry Zhou Jeffery Lenk

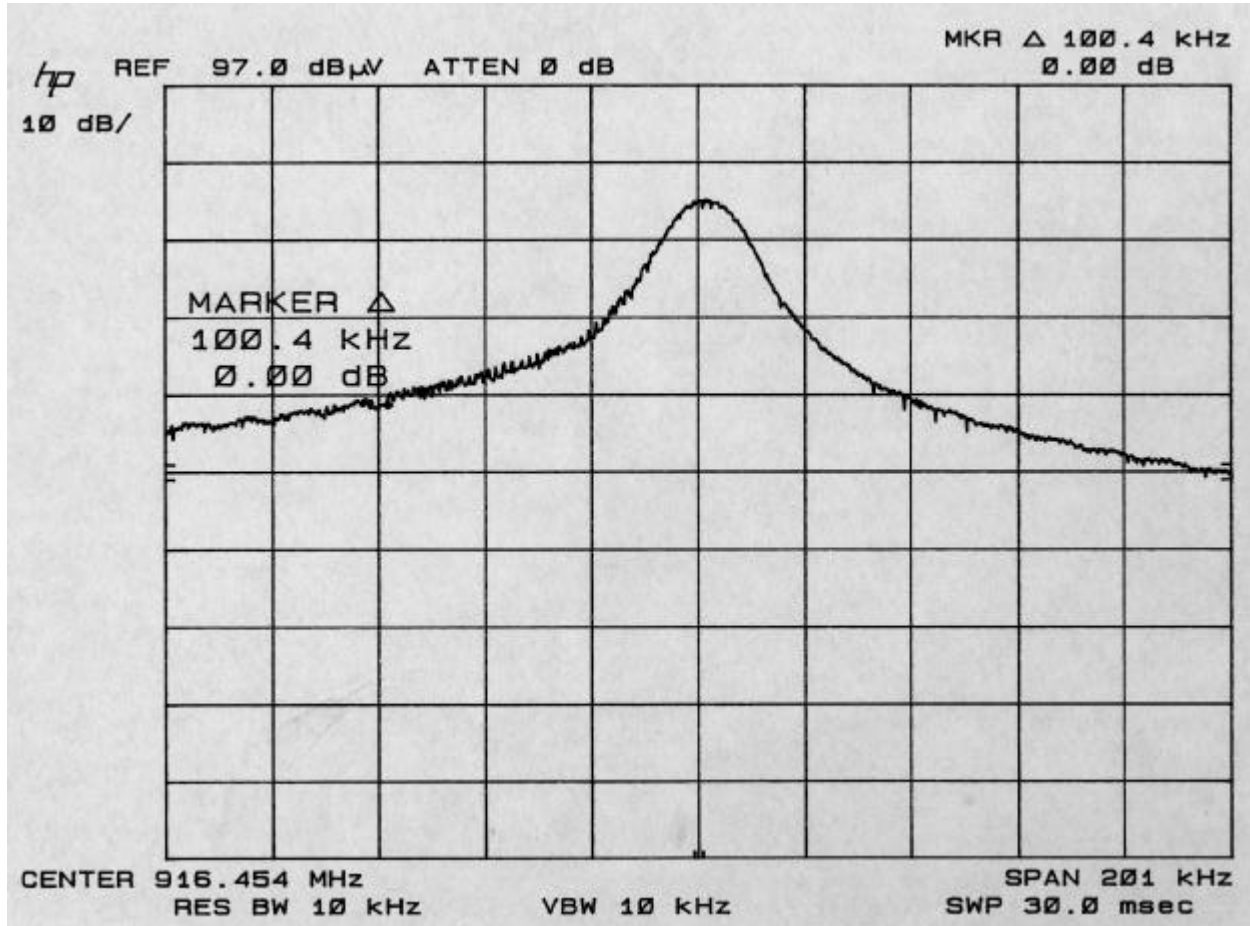


# Occupied Bandwidth Datasheet

## Data Collection Module

SERIAL #: N/A  
DATE: 03/04/99  
PROJECT #: 99-343

MEASUREMENT DISTANCE (m): 0.5  
ANTENNA POLARIZATION: Horizontal  
DETECTOR FUNCTION: Peak



COMMENT #1: 26dB Bandwidth = 100.4 kHz

COMMENT #2:

TEST ENGINEER: \_\_\_\_\_ APPROVED BY: \_\_\_\_\_  
Larry Zhou Jeffery Lenk