
Project Number: 01076-10

Prepared for:

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TYPE CERTIFICATION TEST REPORT

DATA COLLECTION MODULE

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1. EUT Description

The Equipment Under Test (EUT) is the **Lester Electrical, Inc., Data Collection Module**. The **Data Collection Module** is used together with a Universal Transceiver Module attached to a base station and Temperature Sensor Units 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.

The data collection Module consists of a DC to DC converter power supply, microprocessor and RF transceiver constructed entirely of surface mount components attached to a 2.4" X 2.4" PC board. It is a battery-powered device that gathers battery performance data from the battery to which it is attached. The device operates at a frequency of 916.5 MHz and employs on-off keying as the modulation method. It has a typical output power of 0 dBm and a maximum power of 5 dBm. Data is Manchester encoded and transmitted at an approximate rate of 12Khz. The device operates autonomously and transmits a 200 millisecond burst of data once every 5 to 8 minutes.

Specific test requirements for this device include the following:

47 CFR 15.249	Fundamental Transmit Power
47 CFR 15.249	Spurious Radiated Power
& 15.205	
47 CFR 15.249	Occupied Bandwidth
15.231 & 2.989	(2.989 used as Procedural Reference)
47 CFR 15.203	Antenna Requirement

The system tested consisted of the following:

Manufacturer & Model	FCC ID #	Description
Lester Electrical, Inc.	OBH22240	Data Collection Module

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. Radiated 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 Round Rock, 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	Field Strength		
		Meters	$\mu\text{V/m}$	dB $\mu\text{V/m}$
Fundamental	3		50,000	93.9
Spurious/Harmonics	3		500	53.9
Spurious/Harmonics	1		1,500	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 10th 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. 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

1. The EUT was placed on a non-conductive table 0.8 meters above the floor. The table was rotated to an angle that presented the highest signal level.
2. The Spectrum Analyzer was set to a resolution bandwidth of 100 kHz. Peak detection was used for all tests. The display was set with the maximum amplitude near the displayed center frequency and with a display width sufficient to view the occupied bandwidth.
3. The occupied bandwidth was measured based on a 20 dB criteria (20 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 120 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. 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 permanently attached and internal to the unit 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 professional 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 antenna permanently attached and internal to the unit. The EUT is therefore compliant with §15.203.

5. 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. 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		
Device Description	Date Last Calibration	Date Calibrated Due
Advantest R3265 Spectrum Analyzer	11/5/00	11/5/01
Tektronix 2706 Preselector	11/5/00	11/5/01
HP 8447E Preamp	11/11/99	11/11/00
Compliance Design B-100 Biconical Antenna	11/5/00	11/5/01
EMCO 3146 Log Antenna	12/21/99	12/21/00
EMCO 3115 Microwave Antenna	5/21/00	5/21/01
MITEQ Preamp 1-20 GHz	5/10/00	5/10/01

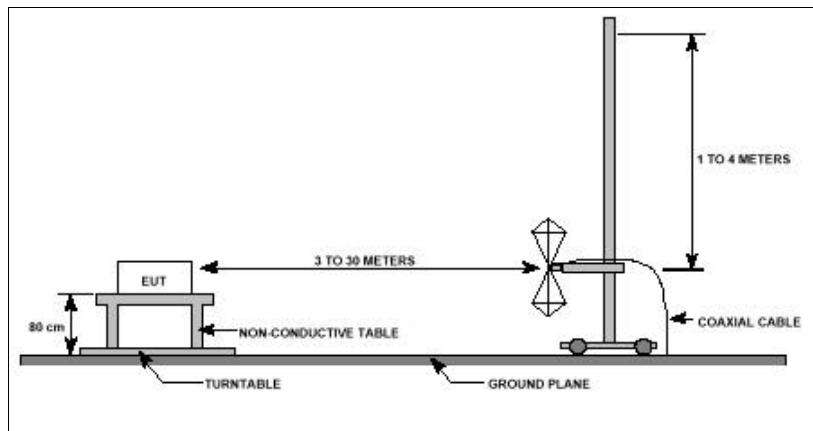


FIGURE 1: Radiated Emissions Test Setup

7. Appendix A: Fundamental Radiated Emissions Data

Grantee: Lester Electrical, Inc.
Model: Data Collection Module
M/N: OBH 22240
S/N: 001
Project: 01076-10

Date: 8/14/00
Measurement Distance (m): 3
Detector Function: Quasi-Peak

Antenna Polarization - Vertical

Frequency	EUT Dir.	Ant. Height	Rec. Level	Ant. Factor	Cable Loss	Corrected Level	Limit	Margin
MHz	Deg.	m	dB $\ddot{\text{V}}$	dB/m	dB	dB $\ddot{\text{V}}/\text{m}$	dB $\ddot{\text{V}}/\text{m}$	dB
916.565	305	2.1	57.3	21.7	9.0	88.0	93.9	5.9

Antenna Polarization - Horizontal

Frequency	EUT Dir.	Ant. Height	Rec. Level	Ant. Factor	Cable Loss	Corrected Level	Limit	Margin
MHz	Deg.	m	dB $\ddot{\text{V}}$	dB/m	dB	dB $\ddot{\text{V}}/\text{m}$	dB $\ddot{\text{V}}/\text{m}$	dB
916.565	355	1.5	59.4	21.7	9.0	90.1	93.9	3.8

8. Appendix B: Spurious Radiated Emissions

Grantee: Lester Electrical, Inc.
Model: Data Collection Module
M/N: OBH 22240
S/N: 001
Project: 01076-10

Date: 8/14/00
Measurement Distance (m): 1
Detector Function: Peak

Antenna Polarization - Horizontal

Frequency	EUT Dir.	Rec. Level	Ant. Factor	Amp Gain	Cable Loss	Corrected Level	Limit	Margin
MHz	Deg.	dB $\ddot{\text{V}}$	dB/m	dB	dB	dB $\ddot{\text{V}}/\text{m}$	dB $\ddot{\text{V}}/\text{m}$	dB
1833.2	0	32.2	27.3	-23.4	1.5	37.6	53.9	6.8
2749.6	0	26.6	29.9	-20.0	1.9	38.4	53.9	6.0

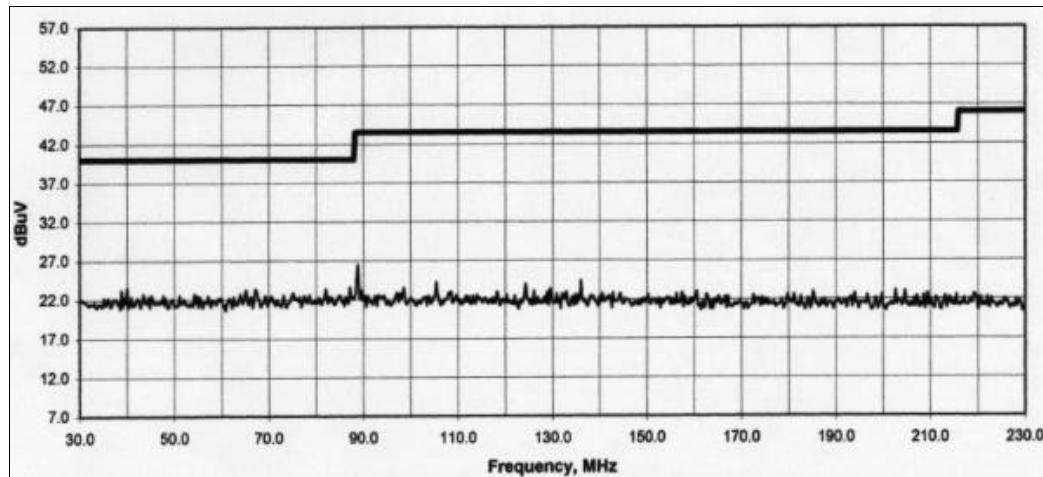
Date: 8/14/00
Measurement Distance (m): 1
Detector Function: Peak

Antenna Polarization - Vertical

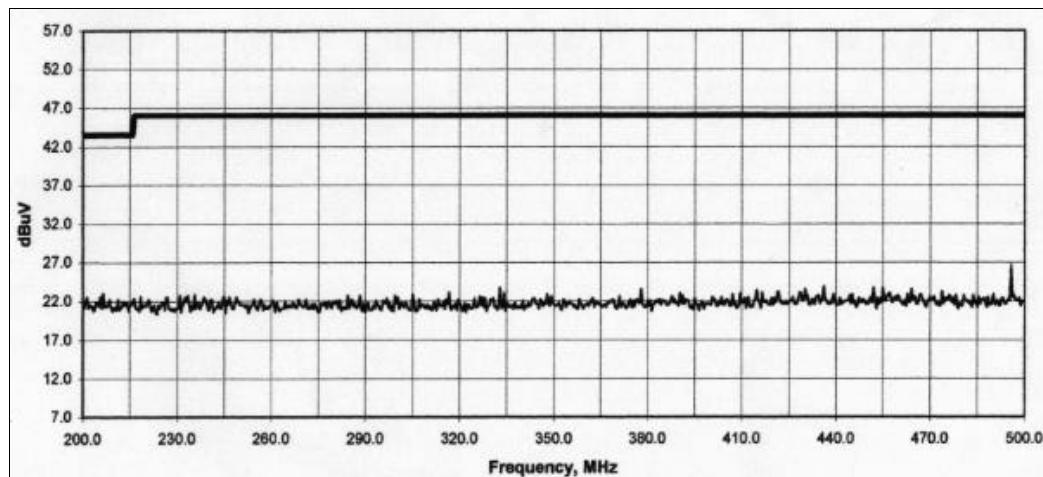
Frequency	EUT Dir.	Rec. Level	Ant. Factor	Amp Gain	Cable Loss	Corrected Level	Limit	Margin
MHz	Deg.	dB $\ddot{\text{V}}$	dB/m	dB	dB	dB $\ddot{\text{V}}/\text{m}$	dB $\ddot{\text{V}}/\text{m}$	dB
1833.2	0	32.5	27.3	-23.4	1.5	37.9	53.9	6.5
2749.6	0	25.8	29.9	-20.0	1.9	37.6	53.9	6.8

NOTE: 9.5 dB was subtracted from the corrected level in order to properly compare the 1 m reading with the 3 m limit.

8.1. Pre-Scan Graphs



FCC 15.109(a): Radiated, 3M, Class B Limit
100 kHz RBW, Peak Detection, 50 ms Sweep



FCC 15.109(a): Radiated, 3M, Class B Limit
100 kHz RBW, Peak Detection, 60 ms Sweep

9. Appendix C: Occupied Bandwidth

Grantee: Lester Electrical, Inc.
Model: Data Collection Module
M/N: OBH 22240
S/N: 001
Project: 01076-10

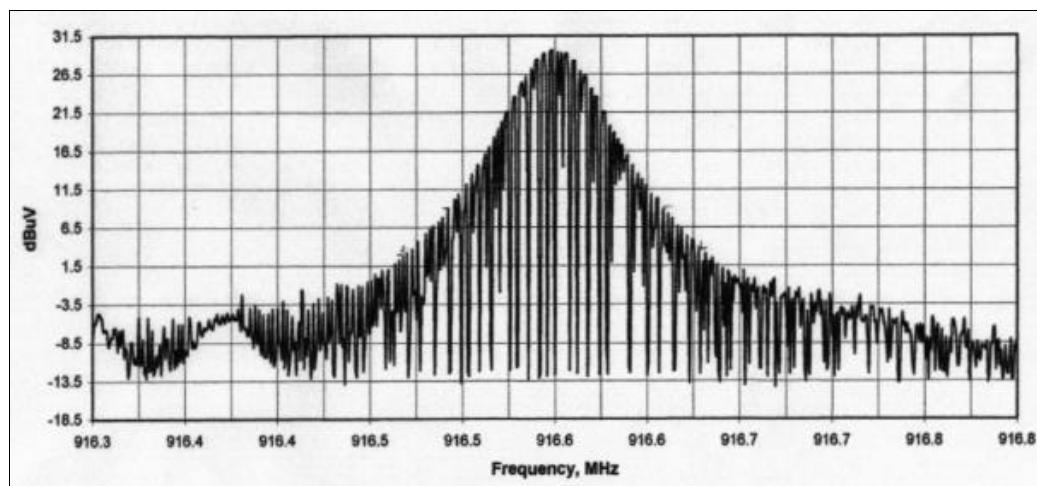
Date: 8/15/00

Resolution Bandwidth: 30 kHz

Detection Function: Peak

Sweep Time: 50 mS

20 dB Bandwidth: 120 kHz



30 kHz RBW, Peak Detection, 50 ms Sweep