OPERATION MANUAL

for

LL-230
LOADLOGGER

DIGITAL RECORDING AMMETER

Rochester Instrument Systems, Inc.
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Rochester, NY 14605

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OMISSIONS

All information contained in this document is believed to be accurate but RiS will not be responsible for any omissions or inaccuracies which may later become apparent.

MODIFICATIONS

The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes from the information contained in this manual.

WARRANTY

RiS warrants its products to be free from defect of design, workmanship, and material under normal use and service for a period of 1 year after date of shipment. RiS agrees to repair or replace free of charge any defective units which are returned to the factory, shipping prepaid, within the warranty period. The warranty does not cover products defective due to misuse, negligence, or accident.

ROCHESTER INSTRUMENT SYSTEMS, INC.
255 North Union St.
Rochester, N.Y. 14605
Tel: (716) 263-7700
FAX (716) 262-4777

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1.0 INTRODUCTION

The LOADLOGGER Model LL-230 Digital Recording Ammeter is an electronic battery-powered device which is used to measure and record currents carried by single or three-phase distribution lines for purposes such as distribution planning, monitoring, or troubleshooting. The LL-230 can be installed on live distribution lines up to 69kV line-to-line using a live-line stick. The data may be monitored at the installation for short periods of time by use of the LL-234 Display Module. Recorded data can be transferred via the LL-233 Computer Interface Adapter to a computer utilizing the LoadSmart software program for storage and subsequent analysis. The LL-230 is totally electronic and is designed to operate under severe weather conditions.

The model number designation for LOADLOGGER related products is as follows:

MODEL	DESCRIPTION
LL-230	Loadlogger, Single
LL-231	Loadlogger, Starter Kit
LL-232	Loadlogger, 3-Phase Kit
LL-233	Computer Interface Adapter
LL-234	LCD Display Module
LL-235	Loadlogger, Carrying Case
LoadSmart	Software Program

2.0 OPERATING INSTRUCTIONS

The LL-230 Logger/recorder records data by sampling the current sensed by the current transformer every 16 seconds as determined by a crystal-controlled clock, averaging these measurements over the duration of a recording interval, and storing the averages in a non-volatile memory. The Logger has two recording modes: ROLLING and HOLD. The recording mode and recording interval duration is selected when the unit is initialized using the computer software.

ROLLING MODE
In the ROLLING (or continuous) mode, newly recorded data overwrites the oldest data. When the data is transferred to a computer, the entire memory contents are transferred. In this mode, the clock in the Logger does not need to be set unless the time intervals need to be synchronized to a time standard or other Loggers.

HOLD MODE
In the HOLD mode, the Logger records data until the memory is full. When the memory is full, no more data is stored and the clock in the Logger ceases to advance (for this reason it is important to set the clock in the Logger/ recorder). The time, date and data are preserved until the memory contents are transferred to a computer and the Logger is re-initialized. Only the data that has been recorded since initialization will be transferred resulting in shorter data transfers and smaller data files than for ROLLING mode recording.

RECORDING INTERVAL
In both recording modes, one of three recording interval times can be selected: 1, 5, or 15 minutes. This is the length of time over which the current samples are averaged.

The recording mode and interval settings in the Logger can be checked at any time using the LL-234 Display Module. Refer to the section on using the LOADLOGGER with the Display Module for information.

2.1 Checking and Changing the Battery

2.1.1 Computer Interface Adapter (CIA) LL-233

There are three versions of the CIA: the LL-233 AC/DC powered unit, the battery or DC-only powered unit, and the AC-only powered unit. Each utilizes a different battery check method. Use the method suited to your CIA version as follows.

a. AC/DC-Powered

The AC/DC-powered Model LL-233 CIA is provided with an AC adapter which may be plugged into a connector on the right edge of the CIA and also to a source of 120VAC, 60Hz. This adapter does NOT charge the DC battery during AC operation. This version of the CIA has a battery low-voltage detection capability. The CTS "handshake" line is "tied" to the circuitry which monitors the battery voltage in the recorder. This line is checked before and during any data transfer. If the CTS line drops out, the user is prompted with an error message whether to continue with the transfer or not. Since the data in the recorder may be valid even with a marginal battery condition, this will allow transfer of the data. Power during this time is provided by the interface, not the recorder internal batteries. The AC/DC-powered CIA also has a red LED labeled LL-233 BATTERY LOW to indicate the status of the CIA battery. If the 9-volt battery in the CIA is low, this LED will light continuously.

To replace the battery in the CIA, remove the four (4) slotted screws at the corners of the bottom cover using a screw driver. Separate the cover from the box carefully and unsnap the battery contact clip. Replace the faulty/discharged battery and reconnect the contact clip. Place the bottom cover on the box carefully to ensure no wires are pinched and replace the four cover screws.

b. Battery-Powered

The battery-powered CIA has one green LED to indicate the status of the Logger battery whether it's the original Lithium or an alkaline replacement. When a Logger with a sufficient battery is connected to the CIA, the green LED on the CIA front panel will illuminate. If the LED does not illuminate, then the battery is NOT sufficient and should be replaced. However, the green LED will not come on if the battery inside the CIA has expired. If it is suspected that the Logger has a good battery but that is not indicated by the LED illuminating, the CIA battery may have expired. The CIA battery can be checked by using a Logger having a known good battery. If you are unsure, simply replace the CIA's battery with a known good 9-volt alkaline battery and recheck the Logger battery condition.

c. AC Powered

The original CIAs were designed for a 9-volt alkaline battery check utilizing a summer and winter voltage check circuit due to the temperature sensitivity of the alkaline battery. The 7.2-volt Lithium battery now provided is less sensitive to temperature and is verified by the summer voltage LED (6.95V). On newer versions of the AC powered interface the LED previously labeled "SUMMER USE" has been changed to "LITHIUM" and the "WINTER USE" LED to "ALKALINE". If the LITHIUM LED (or SUMMER USE LED if you have the older model) turns off when the CIA is connected to the Logger, then the battery is sufficient for a full recording period. If the LED remains ON, then the battery is NOT sufficient and should be replaced. The "ALKALINE" (or "WINTER USE") LED is non-operative on Lithium powered Loggers and will always be on. On the LITHIUM and ALKALINE labeled models, the LED when illuminated, indicates that the respective battery is adequate for a full recording period.

2.1.2 LoadLogger LL-230

The LOADLOGGER is a battery-operated device. The units are originally furnished with a long-life Lithium battery pack with a nominal voltage of 7.2 volts. LOADLOGGERS can be powered by a 9-volt alkaline battery also if a replacement is necessary. The life of the alkaline battery will be significantly shorter than that of the Lithium battery.

The battery condition can be checked in the unit via the Computer Interface Adapter (CIA). The CIA must be powered for this check. An LED on the CIA face indicates CIA battery strength. Battery strength for the Logger is indicated on the computer screen depending on the type of CIA in use.

To replace the battery in the Logger, loosen the four slotted screws on the corners of the cover using a screwdriver (9/64" Allen wrench used on earlier models). Unsnap the battery connector clip. The Lithium battery pack is mounted on a small PC board and screwed to the lid. Remove the screws and take the whole board out. Install a new Lithium board by mounting it in the same place on the lid. If you wish to replace the battery pack with a 9-volt alkaline battery, slide the battery into the clip on the battery board. In earlier units, fasten the connector and slide the battery into the slot cut-out in the PC board. Ensure that no wires are pinched when replacing the lid. Be certain the lid is securely tightened to prevent water leakage.

On later models, (serial numbers starting with A and above), it is recommended that you replace the O-ring gasket (RiS Part no. 0630-578) with a new one, using caution to seat the gasket in the groove of the enclosure. Replace the lid and lightly snug all four screws in a diagonal pattern, then continue to fully tighten the screws to approximately 28 (+/- 2) inch-pounds torque.

IMPORTANT

Always replace the side connector cap securely to ensure watertight integrity of the LoadLogger.

CAUTION

Whenever the battery connector is disconnected for any reason, including battery installation, the unit should be connected to the computer interface at the time the battery is reconnected. This will assure the circuitry is "jump started" by the CIA power supply (or alkaline battery) so the Lithium battery does not drain itself during start-up.

Always re-initialize Logger set-up and clock time after battery installation as these may have been corrupted when the unit was not powered.

2.2 Initialization

The LOADLOGGER or recorder has three parameters that can be set:

- Time and date (real-time clock)
- Recording mode
- Recording interval

The real-time clock consists of 6 counters. They keep track of the month, day, year, hour, minutes and seconds. All but the seconds counter are programmable. The seconds counter is reset to zero whenever the time is reprogrammed.

There are two recording modes: ROLLING and HOLD. In ROLLING mode the newest data overwrites the oldest. In HOLD mode when the memory is full, recording is terminated and the real-time clock ceases to advance.

There are three recording intervals to select from: 1, 5, or 15 minutes.

These parameters can be programmed automatically using the LoadSmart software written for Windows™-compatible computers and are described further in the LoadSmart Instruction Manual.

2.3 Installation and Removal

WARNING

Potentially lethal voltages may be present in the circuits being measured. Installation and removal of this instrument must be accomplished by qualified persons only. When working on live equipment, take all normal safety precautions appropriate for the equipment and voltage level involved.

To install the LOADLOGGER on a distribution line, first attach it to a live-line stick. Using the live-line stick, clamp the unit on a straight section of conductor, keeping it at least 1.5 feet (0.46m) away from other conductors carrying currents comparable to the one being measured. Avoid placing it within 5 feet (1.52m) of conductors carrying high currents that may introduce errors. If this is not possible, follow the arrangement shown in figure 1 to keep errors at a minimum. In most cases, however, the mounting orientation is not too critical as long as the nearest

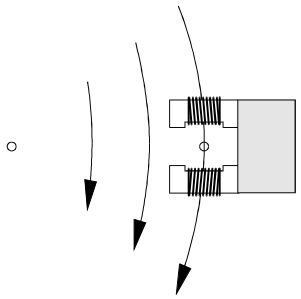
adjacent conductor is more than 5 feet (1.52m) away as shown in figure 2. The Logger is removed from the line by using a live-line stick.

To measure currents in conductors whose diameter is smaller than the minimum range of the clamp (conductors less than 0.4 inches (10.2mm) in diameter), a neoprene adapter or spacer is supplied. This removable adapter is mounted at the stationary part of the clamp.

When using the Logger on high voltage copper conductors, some corrosion may occur due to leakage currents flowing through the clamp to ground. To prevent this, coat the contact surfaces with corrosion inhibiting compound.

As part of the installation and removal procedure, record the location and serial number of each unit as well as the approximate installation and removal times since these may be required by the data processing program.

Figure 1 Mounting Position



I<-- Feet -->I

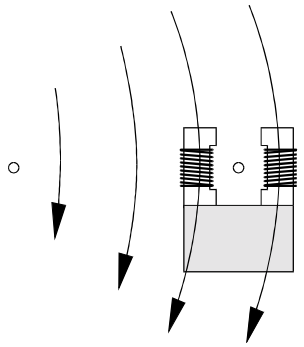
	Amperes				
Feet	<I	I	2i	5i	10i
10	*	*	*	*	*
5	*	*	*	*	*
2	*	*	*	*	*
1	*	*	*	*	*
0.5	<2%	2%	4%	10%	46%

* means less than 0.5% error

The preceding table shows typical percent of reading error with the gap of the LOADLOGGER oriented to face an adjacent conductor separated by a certain

distance and carrying a current whose magnitude is a factor of the current “I” being measured.

Figure 2 Alternate Mounting Position



I<-- Feet -->I

	Amperes				
Feet	<I	I	2i	5i	10i
10	*	*	*	*	*
5	*	*	*	1%	4%
2	<1%	1%	2%	5%	12%
1	<3%	3%	5%	12%	24%
0.5	<6%	6%	12%	29%	60%

* means less than 0.5% error

The preceding table shows typical percent of reading error with the gap of the LOADLOGGER facing 90 degrees with respect to an adjacent conductor, separated by a certain distance and carrying a current whose magnitude is a factor of the current “I” being measured.

2.4 Transferring and Processing Logger Data

Data can be withdrawn from the Logger and transferred to a computer by means of the Computer Interface Adapter (CIA). The output, coded in ASCII, consists of a header containing an identification number (the number stamped on the nameplate) and the Logger's time and date followed by the recorded line current data in reverse chronological order. The recorded data can then be displayed and analyzed by the computer.

Disconnect the Logger from the CIA after completion of data transfer to optimize CIA battery life, and to allow the LoadLogger clock to continue.

2.5 Using the LOADLOGGER with the Display Module

The LCD display module can be connected to the Logger at its serial interface connector to provide an initial display of the recording settings followed by a display (updated every three seconds) of the current flowing in the monitored conductor. The Logger with the display module attached is mounted on a conductor in the same manner as without the display. The one-inch high digits are large enough to be easily read from the ground when the Logger is mounted.

When the display module is first connected, it usually displays "888" for a period lasting up to 16 seconds. If the display was disconnected for more than 16 seconds it will first display the recording parameters as follows; First a number, "XXY", will be displayed where XX is the recording interval 01, 05 or 15 minutes. If the Logger is set to HOLD recording mode, a dash ("-") will be displayed, otherwise Y will be blank (ROLLING mode). The next number to be displayed is "ZZY" where ZZ is the elapsed time of the present recording interval. For a recording interval of 15 minutes this number can range from 0 to 14, for a recording interval of 05 minutes from 0 to 4 and 00 for a interval of one minute. If the Logger is in HOLD recording mode and the memory is full, a dash ("-") will be shown in digit Y. If the memory is not full, this digit will be blank. After these two initial displays, the instantaneous current will be displayed. The three decimal points flash at approximately three-second intervals indicating that a display update is taking place. An update does not take place, however, when the unit is performing its normal 16-second current sample even though the decimals will flash. Use of the display does not affect the normal recording operation of the LOADLOGGER.

The display takes its power from the Logger's battery, and since it uses significantly more power than the Logger itself, it can drain the battery in a short period of time (36hrs). For this reason, the display module should not be left connected for long periods.

3.0 MAINTENANCE

The Model LL-230 LOADLOGGER has two adjustment potentiometers. There is a scale adjustment potentiometer located near where the leads from the current transducer are connected onto the circuit board. The other potentiometer is for zero offset adjustment. These potentiometers are factory set and DO NOT require any periodic adjustment due to the use of stable temperature-compensated components in the Logger circuitry. If a field adjustment is to be carried out however, use the following procedure.

o Zero Offset Adjust

Perform the following away from any magnetic fields. Connect the display module to the Logger. If the display does not already read greater than one, adjust the display until it does read greater than one. Make note of the direction the potentiometer is turned in the next step. Bring the level down, so that the display alternates between 0 and 1. Now continue to turn the potentiometer in the same direction two full turns.

o Scale Calibration

Construct a 10ft by 5ft (3.05m by 1.52m) loop of 1.0inch (25.4mm) diameter conductor (or the size of conductor that will be used most often) that can carry 500 amperes. Mount the Logger, oriented as shown in figure 1, in the center of one of the longer sides of the loop. Pass a 500 Ampere current through the loop and adjust the potentiometer until the display reads 500.

4.0 SPECIFICATIONS

4.1 LL-230 LOADLOGGER

Method of Mounting:	Clamp-on, to be applied with a live-line "Grip-All Clampstick".
Conductor Size:	0.2 to 1.093 inch (5.1 to 27.8mm) diam. (795 MCM max.). Neoprene adapter used for conductor diameter of 0.2 to 0.4 inch (5.1 to 10.2mm).
Maximum Conductor Voltage:	Tested to 69 kV line-to-line
Frequency:	45-65 Hz
Current Range:	0-1000 A
Overload:	Maximum current for no damage: 50,000 A for 1 second, 2,000 A indefinitely.
Nature of Recorded Data:	Data stored is average current for each 1, 5, or 15 minute period based on samples taken every 16 seconds.
Data Output:	Serial, RS232, 9600 baud using special computer interface.
Data Transfer Time:	Up to 45 seconds
Visual Display:	3-digit LCD display module mounted on Logger displays record parameters and present current being measured.
Battery Type:	Lithium battery pack (Life - One year min.). Can be supplemented with a 9-volt alkaline battery.
Battery Check Level:	Factory set 6.95V (Monitored by LL-233 Interface)

Memory Size:	8 kbytes Avg. Intvl Storage 15 Min. 60 Days 5 Min. 20 Days 1 Min. 4 Days
Resolution:	1 A
Accuracy:*	Error is <5% of indication ±1A.
Timing:	Real-time clock derived from quartz crystal oscillator. Maximum time error is one minute per 2 weeks over specified temp. range.
Operating Temp. Range:	-40°C to +55°C (-40°F to 131°F)
Weight:	5.0 lbs.(2.27kg)
Dimensions:	7.5L x 4.8W x 8H inches (190.5 x 114.3 x 203.2mm)

4.2 LL-233 Computer Interface Adapter

Power Supply:	Internal 9-volt alkaline battery or 9VDC, 200ma external power.
Maximum Data Rate:	9600 baud
Computer Connector:	Standard 25-pin D-type female connector. Connects to computer's serial port (COM 1 or COM 2).
Battery Check Level:	Factory set 7.3V
Dimensions:	4.8L x 2.4W x 1.25H inches (121.9 x 61.0 x 31.8mm).

* The accuracy specifications apply to a properly installed and oriented unit with adjacent conductors more than 1.5 feet (0.46m) away and carrying less than ten times the current in the conductor being measured.

4.3 LL-234 Display Module

Display Type:	Liquid Crystal Display, 1 inch (25.4mm) high digits.
Update Frequency:	Display is updated every 3 seconds. Decimal points flash to indicate update has occurred.
Mounting:	Attaches to Logger at the serial line interface connector.
Power Supply:	5V, 300 uA; powered directly from the Logger's internal battery.
Operating Temp. Range:	-30^{o}C to +40^{o}C (-22^{o}F to 104^{o}F)
Dimensions:	4.75L x 2.6W x 1.4H inches (120.7 x 66 x 35.6mm).