LI-1400
dataLogger

Flexibility
and
Performance
For Your
Data Logging
Applications...

Solar Radiation

Air Temperature

Soil Temperature

Humidity

Dew Point

Rainfall

UW PAR Profiling

LI-COR ®

High accuracy with LI-COR light sensors. Three external light sensor connectors for fast setup.

Two additional current channels, four voltage channels, one pulse counting channel and several regulated and unregulated voltage supplies.

96K Bytes RAM for data storage.

Ergonomic, light weight for hand-held operation as a meter with instantaneous or averaged readout.

RS-232C data output to PC-compatible or Macintosh computers in "spreadsheet-ready" format.

Nine math channels for direct readout of saturation vapor pressure, dew point temperature, vertical light attenuation coefficients (underwater), and more.

Two line LCD display shows sensor instantaneous or logged sensor outputs, stored data, battery voltage and more.

Autoranging electronics with low power consumption.

Easy to use internal software with setup macro libraries to simplify sensor configuration.

Alphanumeric keypad speeds entry of remarks for data identification.

Now the hardest part is deciding what to measure!

Thanks to the new LI-1400 DataLogger, you have the flexibility in one instrument to meet applications that vary from remote environmental data logging in harsh environments, to hand held logging of vertical light attenuation in aquatic systems. By providing both a multichannel data logger and a powerful hand held meter in one package, the LI-1400 DataLogger delivers both value and performance. With simple setup and operation, the hardest thing you'll have to do is to decide which sensors to measure.

SIMPLIFIED DATA LOGGING

Operating the LI-1400 is easy. All functions are selectable from short lists using cursor keys. Commonly used functions like printing and memory management are assigned to a function list on a dedicated key for quick access. Other important functions like instrument setup and data display are also assigned to dedicated keys.

FAST SETUP

Channel setup is simplified by the use of *log routines* that eliminate entering repetitive information. The LI-1400's log routines allow you to enter the logging period, start/stop times and other information in one place, and then apply that log routine to as many channels as required.

Each channel can be individually configured to collect data for logging periods as short as 1 second or as long as 24 hours. Sampling intervals within each logging period are selectable from 1 second to one hour.

For each logging period, data can be integrated or averaged. Alternatively, an instantaneous point reading can be taken at the end of each period. The maximum and minimum readings within the logging period and the time of their occurrence can also be stored.

After software setup, sensors can be quickly connected to clearly marked terminals on the 1400-301 Terminal Block.

MATH FUNCTIONS

Channel setup includes choosing from a list of *math functions* that can be applied to sensor inputs. In addition to sensor input scaling or linearization, several powerful calculations can be performed using *math functions*:

Math Operators $(+, -, \times, \div)$: Used to combine one input with another through channel addition, subtraction, etc. For example, math operators can determine the ratio of two similar sensors in different environmental conditions, like an LI-190SA Quantum Sensor at the water's surface and an LI-192SA Quantum Sensor underwater.

Steinhart-Hart Function: Calculates temperature from thermistor type temperature sensors such as LI-COR air and soil temperature sensors.

Saturation Vapor Pressure: Calculated when temperature is input from an air temperature sensor.

Dew Point Temperature: Calculates the dew point temperature using signals from the 1400-104 Relative Humidity and Air Temperature Sensor (or equivalent).

Natural Log: Multiplies a constant by the natural log of a channel input. When used in conjunction with math operators, this function can be used to calculate the vertical light attenuation coefficient between two underwater quantum sensors submerged at different depths.

Polynomial: A fifth order polynomial is provided for sensor linearization.

Math Libraries: Five math libraries are available to store values for any of the above math functions. For example, if the same linearization polynomial is to be used for several sensor inputs, storing the polynomial in one of the math libraries eliminates re-entering the polynomial for every sensor.

MATH CHANNELS

The logging and calculation capabilities of the LI-1400 are extended by nine math channels. Math channels let you perform additional logging or math routines using any other current, voltage or math channel. For example, if you are logging total daily solar radiation from an LI-200SA Pyranometer sensor connected to current channel #1, you can also log hourly integrations or averages from the same sensor by adding the channel #1 input to a math channel and then setting the log routine on the math channel for hourly integrations. Any of the math operators or math functions described above can be used in the math channels as well.

CIRCUITRY

The LI-1400 uses an autoranging, trans-impedance, chopper stabilized amplifier for high resolution (8 picoamp), high accuracy measurements of LI-COR radiation sensors and other sensors with a current output. The high gain amplifier and unique circuit topology gives an extremely low input impedance (< 0.03 ohm) to current sensors, resulting in excellent linearity. Measurement accuracy is enhanced by performing an auto zero and span before every reading (or once per minute with 1 second sampling rate) using a high precision, low drift reference. A precision sigma-delta analog-to-digital converter allows high speed, low noise measurements to be made.

Highly accurate, single-ended voltage measurements are achieved using a precision instrumentation amplifier. Voltage output transducers with low or high output impedance are accurately measured because of very high amplifier input impedance.

CURRENT CHANNELS

The LI-1400 has unrivaled resolution for LI-COR radiation sensors. Current resolution down to 8 picoamps is available through three sealed BNC connectors and two additional channels on the 1400-301 Terminal Block.

The three BNC current channels are designed for type "SA" radiation sensors like LI-COR's LI-190SA Quantum Sensor, LI-200SA Pyranometer Sensor or LI-210SA Photometric Sensor. LI-COR Type "SZ" radiation sensors, with bare wire leads, are recommended for use with the terminal block.

For other sensors, the LI-1400 can measure current up to ± 250 microamps with very high resolution.

"Data are formatted for easy import into widely used spreadsheet and database software."

VOLTAGE CHANNELS

Four single-ended voltage channels (± 2.5 VDC) provide high input impedance for measuring a wide range of sensors, including LI-COR temperature sensors and humidity sensors. Voltage measurements require the 1400-301 Terminal Block.

The 1400-401 Vented Instrument Enclosure protects the LI-1400 and sensor connections from direct exposure and has provisions for mounting the optional 1400-02 External Battery Pack on the door of the enclosure.

PULSE COUNTING

The LI-1400 has one pulse counting channel for logging total rainfall from LI-COR's 1400-106 Tipping Bucket Rain Gauge (or equivalent). The counter channel can be accessed through the 1400-301 Terminal Block.

ENVIRONMENTAL OPERATION

The LI-1400's rugged, splash resistant case protects it from exposure to the environment. Operating temperatures are from -25 to 55 °C. For operation at remote sites, the 1400-201 Vented Instrument Enclosure is recommended to protect sensor connections from rain water and to shade the LI-1400 from direct sunlight.

The LI-1400 is powered by four "AA" batteries which provide over 60 hours of hand-held, instantaneous operation as a meter. For remote logging applications, the 1400-402 external "D" cell battery pack provides over a year of data logging operation from six batteries. To ensure continuous operation, a low battery warning is displayed when the batteries are depleted; a lithium back-up battery protects the memory while changing batteries.

While logging data, the LI-1400 conserves battery life by operating fully powered only when it must sample a given channel. After sampling channels and storing data (if necessary), the LI-1400 automatically returns to a state of low power consumption.

DATA STORAGE

The LI-1400 has 96K bytes RAM for data storage. The storage capacity is dependent on the software configuration (Table 1).

DATA OUTPUT

Windows 95® communication software is included for:
- Rapid binary data transfer
- ASCII data transfer
- Datalogger configuration changes from the computer.

Stored data can also be transfered to PC-compatible or Macintosh (RS-232C) computers using any terminal program. The LI-1400 data is formatted for easy import into widely used spreadsheet and database software.

Data can be automatically output via the RS-232C port after every logging period. When using short logging periods, this feature allows data capture by a computer with large storage capacity.

HAND-HELD OPERATION

As an autoranging meter, the LI-1400 provides direct read-out for up to three LI-COR radiation sensors without requiring a terminal input block.

LI-190SA Quantum Sensor

The output of a given sensor can be viewed on the LCD display or stored in memory by simply pressing the ENTER key on the keypad (data for all operative channels are stored, along with the time at which the data were logged).

Radiation measurements in water or under changing cloud cover often require an averaged reading of sensor output to obtain the best results. The LI-1400 can display a continuous running average for each sensor. The length of the average is user selectable for each channel. Instantaneous or averaged values for any sensor can also be displayed while the LI-1400 is logging data.

Table 1. Storage Capacity Examples.

Setup Description		Time Till Memory Full
2 channels, 1 hour periods	no max/min	215 days
	with time stamp	77 days
Daily integration and hourly means from a radiation sensor; hourly means of humidity and temperature, daily rain fall.	no max/min	170 days
	with time stamp	53 days
9 channels, 1 hour periods and 9 math channels, 1 hour periods	no max/min	47 days
	with time stamp	10 days

ORDERING INFORMATION

LI-1400 DataLogger. Includes 4 "AA" batteries and Windows 95® communication software. Sensors not included.

1400-301 Standard Terminal Block: Allows connection to two additional current channels, 4 voltage channels, 1 pulse counting channel, two unregulated voltage supplies, and two regulated + 5 volt DC supplies for LI-COR temperature sensor and other sensors requiring a constant voltage input.

1400-301

1400-401 AC Adapter. Requires 120 VAC, 60 Hz. Used for applications where continuous operation is required.

1400-402 External Alkaline Battery Pack. Holds 6 "D" cell batteries for remote logging applications. The 1400-402 has provisions for mounting in the 1400-201 Vented Instrument Enclosure.

1400-320 Storage Case. Foam-lined plastic case for LI-1400, sensors, and accessories.

1400-201 Vented Instrument Enclosure. Wooden enclosure to limit exposure of LI-1400 and sensor connections. Dimensions: 19L x 19W x 56 cm H (7.5" x 7.5" x 22"). Weight: 4.8 kg (10.5 lb). Includes one 1400-310 Mounting Bracket.

1400-310 Mounting Bracket. For mounting the LI-1400 in third-party instrument enclosures, or any other vertical or inclined surface.

SENSORS

Quantum Sensors: LI-190SA Quantum Sensor, LI-190SZ Quantum Sensor, LI-191SA Line Quantum Sensor, LI-192SA Underwater Quantum Sensor, LI-193SA Spherical Quantum Sensor.

Pyranometer Sensors: LI-200SA, LI-200SZ.

Photometric Sensors: LI-210SA, LI-210SZ.

1400-103 Soil Temperature Sensor. 20 foot cable. Accuracy: ±0.5 °C.

1400-101 Air Temperature Sensor. 20 foot cable. Accuracy: ±0.5 °C.

1400-104 Relative Humidity/Temperature Sensor, 1400-101 Air Temperature Sensor, and 1400-103 Soil Temperature Sensor (left to right).

1400-102 Air Temperature Sensor. Same as 1400-101 except cable length is 2 ft. for mounting in 1400-201 Vented Instrument Enclosure.

1400-104 Relative Humidity and Air Temperature Sensor (Vaisala). 9 ft. cable. Can be mounted in 1400-201 Vented Instrument Enclosure.

1400-106 Tipping Bucket Rain Gauge. Calibrated in millimeters. Tipping bucket mechanism activates a sealed reed switch that produces a contact closure for each 1 mm of rainfall. 50 foot cable.

DATA OUTPUT ACCESSORIES

1400-550 RS-232C Cable. For connection to PC-compatible computers with a 9-pin RS-232C communication port (DTE-to-DTE).

SPECIFICATIONS

Current Inputs: Five channels; three through external sealed BNC connectors, and two through the 1400-301 Standard Terminal Block.

Voltage Inputs: Four high impedance (>500M ohm) single-ended channels accessed through the 1400-301 Terminal Block.

Pulse Counting Input: One pulse counting channel. Switch closure for tipping bucket rain gauge (1 Hz maximum).

Math Channels: 9 math channels. Math channels combine results of two channels with addition, subtraction, multiplication and division operators. Other math channel functions include fifth order polynomial, Steinhart-Hart function for thermistors, natural log, saturation vapor pressure, and dew point. Five math libraries are available to store commonly used functions.

Analog-to-Digital Converter
Resolution: 16 bit (1 part in 65,536).
Scanning Speed: 10 channels per second.
Voltage Accuracy: < 0.1% of full scale reading (25 °C). ±0.15% (0 to 55 °C).
Current Accuracy: ±0.2% of full scale reading (25 °C). ±0.4% (0 to 55 °C).
Temperature Coefficient: ±0.01% of reading per °C.
Linearity: 0.07%.
Frequency Rejection: >90 dB at 50 or 60 Hz (software selectable).
Input Noise (25 °C)

	Typical	Maximum
Voltage	±76 μV	±152 μV
Current	±7.6 picoamps	±30.4 picoamps

Voltage Range (Channels V1-V4):

Voltage Range	Resolution:
±2.5 volts	76 microvolts

Current Range Selection:	Autoranging.

Current Ranges		Resolution
1	±250 nanoamps	7.6 picoamps
2	±2.5 microamps	76 picoamps
3	±25 microamps	760 picoamps
4	±250 microamps	7.6 nanoamps

Current Channel Input Impedance: Typically < 0.03 ohm for ranges 1, 2, or 3; < 0.3 ohm for range 4.

Voltage Channel Input Impedance: >500M ohm on voltage channels V1 through V4. 100K ohm for current channels I4 and I5, when configured for voltage input.

D.C. Voltage Excitation: Two regulated: + 5.0 V ±0.2% at 3 mA; Two unregulated: 9.5V ±10% or higher at 6mA. With external 14V input, unregulated output is ≈13.4V.
Logging Periods: Seconds: 1, 5, 15, 30. Minutes: 1, 5, 15, 30. Hours: 1, 3, 6, 12, 24.
Sampling Interval: Seconds: 1, 5, 15, 30. Minutes: 1, 5, 15, 30, 60.
Short Term Averaging: Selectable at 1, 5, 15, or 30 seconds. While averaging, the oldest point is dropped when the newest point is added. Averaged readings reduce instrument noise by approximately the square root of the number of samples.
Keyboard: Sealed, 24 key tactile response keypad.
Display: Two line, 16 character alphanumeric LCD. Updated once per second. Temperature compensated readability from -15 to 55 °C.
Real Time Clock: Year, month, day, hour, minute, seconds. Accuracy: ±3 minutes per month (25 °C).
Internal Memory: 96K bytes available for data storage.
Program Memory: Stored in Flash memory for easy upgrades via the RS-232C port.
Communications: RS-232C, hardwired Data Terminal Equipment (DTE) through 9-pin port. Baud rates are software selectable at 300,1200, 2400, 4800 and 9600. Communication is bi-directional.
Battery Requirements: Four Alkaline "AA" batteries in sealed battery compartment.
Back-up Battery: Internal lithium battery maintains memory up to seven years.
Battery Voltage: Automatic low battery instrument shut-off. Remaining power after shut-off maintains data stored in memory. Low battery warning displayed before automatic shut-off. Power management software also shuts off the instrument after 15 minutes of inactivity.
Battery Capacity with "AA" Batteries: 60 hours continuous operation.
External DC Power: 7 - 16 VDC.
Enclosure: ABS plastic case for splash resistant operation and protection from wind blown dust. Equivalent to an IP54 level.
Operating Conditions: -25 to 55 °C; 0 to 95% RH, non-condensing.
Storage Conditions: -30 to 60 °C; 0 to 95% RH, non-condensing.
Size: 22L x 13W x 4.3 cm D (8.6 x 5.1 x 1.7"). 9.3 cm (3.7") width of the lower case allows easy hand-held operation.
Weight: 0.7 kg (1.5 lb).

Specifications are subject to change without notice.

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