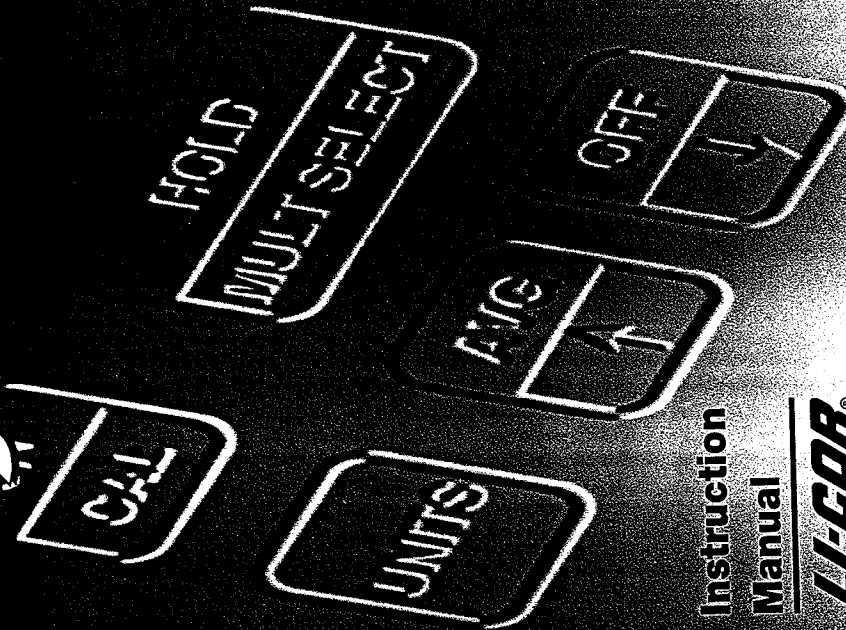


LI-250 Light Meter



Instruction
Manual

LI-COR®

Declaration of Conformity

Manufacturer's Name: LI-COR Inc.

Manufacturer's Address: 4421 Superior Street
Lincoln, Nebraska USA 68504

declares that the product

Product Name: Light Meter

Model Number(s): LI-250

Product Options: Light Sensors

conforms to the following Product Specifications:

EMC: CISPR 11: 1990 / EN 55011:1991 - Group 1, Class B

EN 50082-1 : 1992

IEC 801-2 : 1991 - 15 kV Air Discharge, 8 kV

Contact Discharge

IEC 801-3 : 1984 - 10V/m

Supplementary Information:

The product herewith complies with the requirements of the
EMC Directive 89/336/EEC.

Gregory L. Biggs

Gregory L. Biggs
Director of Engineering
Environmental Division

Document #53-04111

January 25, 1996

LI-250 Light Meter Instruction Manual

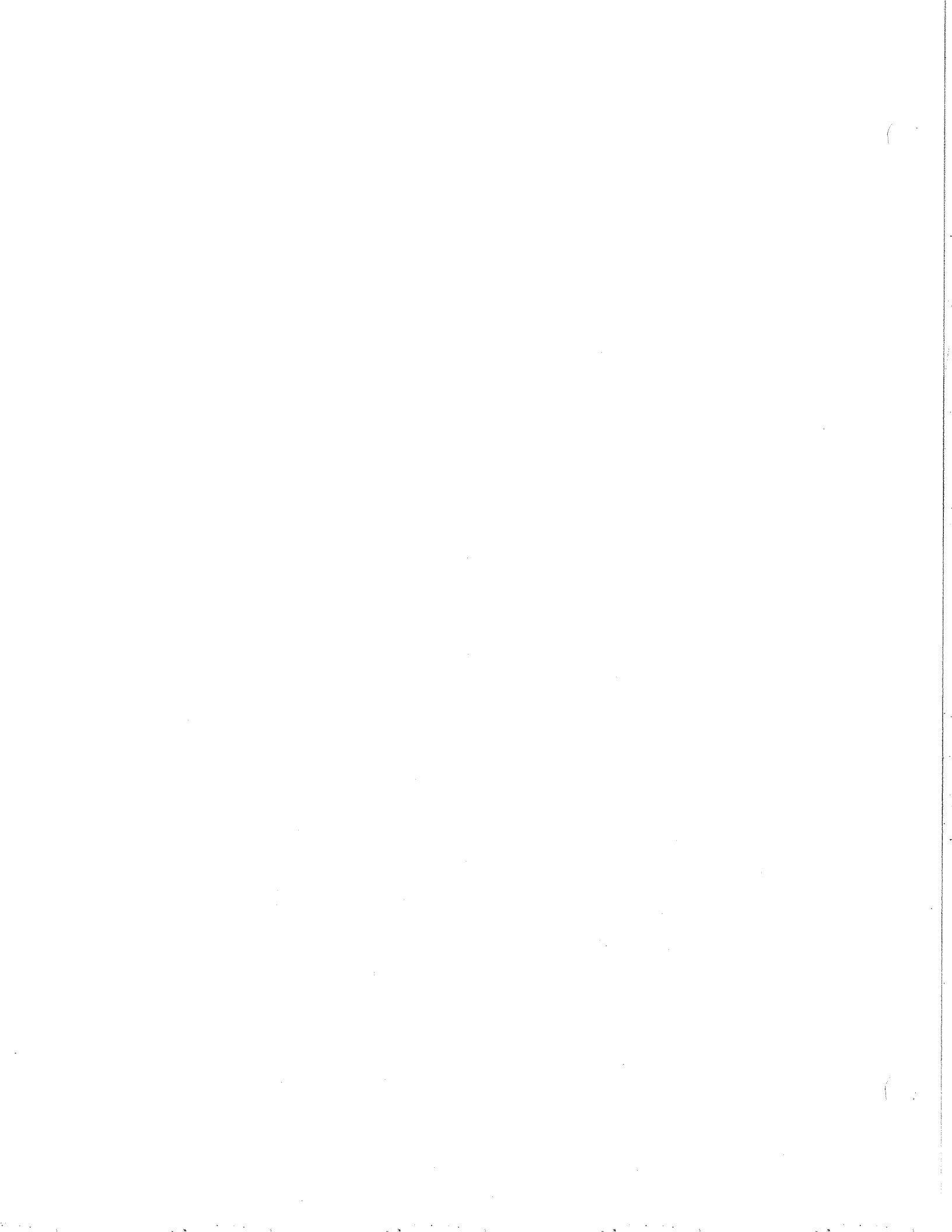
Publication Number 9604-114
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How to Use this Manual

This manual contains operation and maintenance information for the LI-250 Light Meter. Read the operating instructions before using the LI-250.

NOTICE

The information contained in this document is subject to change without notice.

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1st Printing - April, 1996

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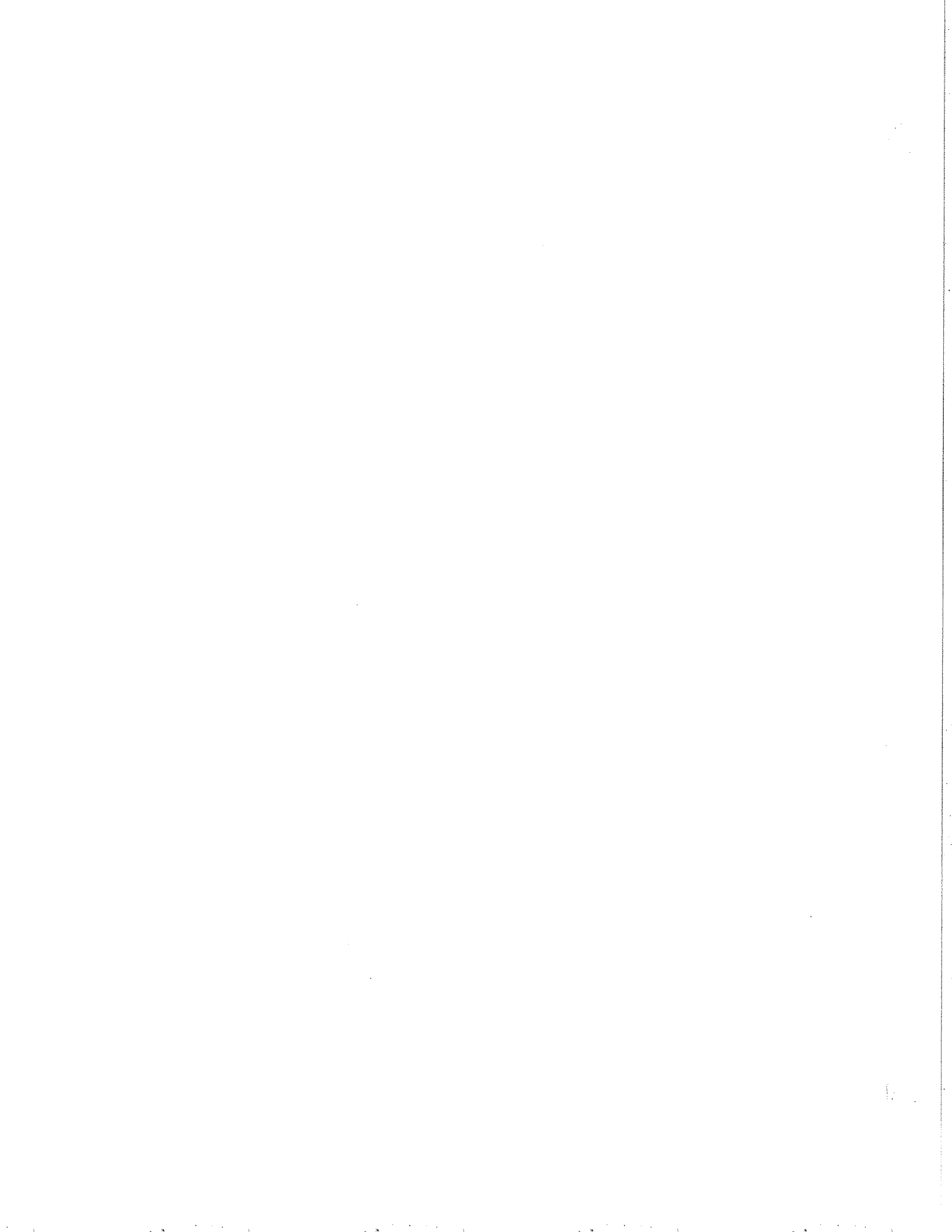
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1 Operation Summary

Read this section to configure and operate the LI-250. Note that programming instructions can also be found on the LI-250 back panel.

1.1 Configuration vs. Measurement Mode

The LI-250 has two modes of operation; *Configuration* and *Measurement* mode. In configuration mode, you can enter calibration multipliers for two different light sensors, or enter two multipliers for the same sensor. For example, you might enter a multiplier that applies to measurements under water and one that applies to measurements in air for an LI-192SA Underwater Quantum Sensor. In measurement mode the LI-250 makes continuous measurements until either the HOLD key or the CAL key is pressed.

1.2 Making Measurements

The LI-250 utilizes a 5-key keypad; note that many of the keys have two functions. The active function depends on whether the LI-250 is in Measurement or Configuration mode. In measurement mode, the keys perform the function shown in green; in configuration mode, the keys perform the function shown in white.



7. Press **MULT SELECT** if you wish to display the second multiplier. **NOTE:** Pressing **MULT SELECT** before pressing **CAL** (step 6) discards any changes you have made to the multiplier currently shown on the display.
8. Edit the second multiplier following steps 5-7 above.
9. Press **CAL** again to store the displayed multiplier value and units label and use them to take measurements.

Note that pressing **CAL** when in measurement mode will display the multiplier in current use. The multiplier displayed when **CAL** is pressed again will be stored as the active multiplier, whether you have changed it or not.

While in measurement mode, you can press **HOLD** to retain the current reading on the display, until the **HOLD** key is pressed again.

Press **AVG** to perform a 15 second average, which will be displayed in Hold mode. Press the **HOLD** key to resume measurements.

Press the **OFF** key to turn the power off. The LI-250 will automatically shut off after 25 minutes of inactivity in measurement mode.

1. Attach the desired sensor.
2. Press *and hold* the **ON** key for about 2 seconds, and then release to turn the instrument on. You will be in measurement mode.
3. Press **CAL** to enter configuration mode, where you can display or change *the calibration multiplier currently in use*. The display will show **CAL**.

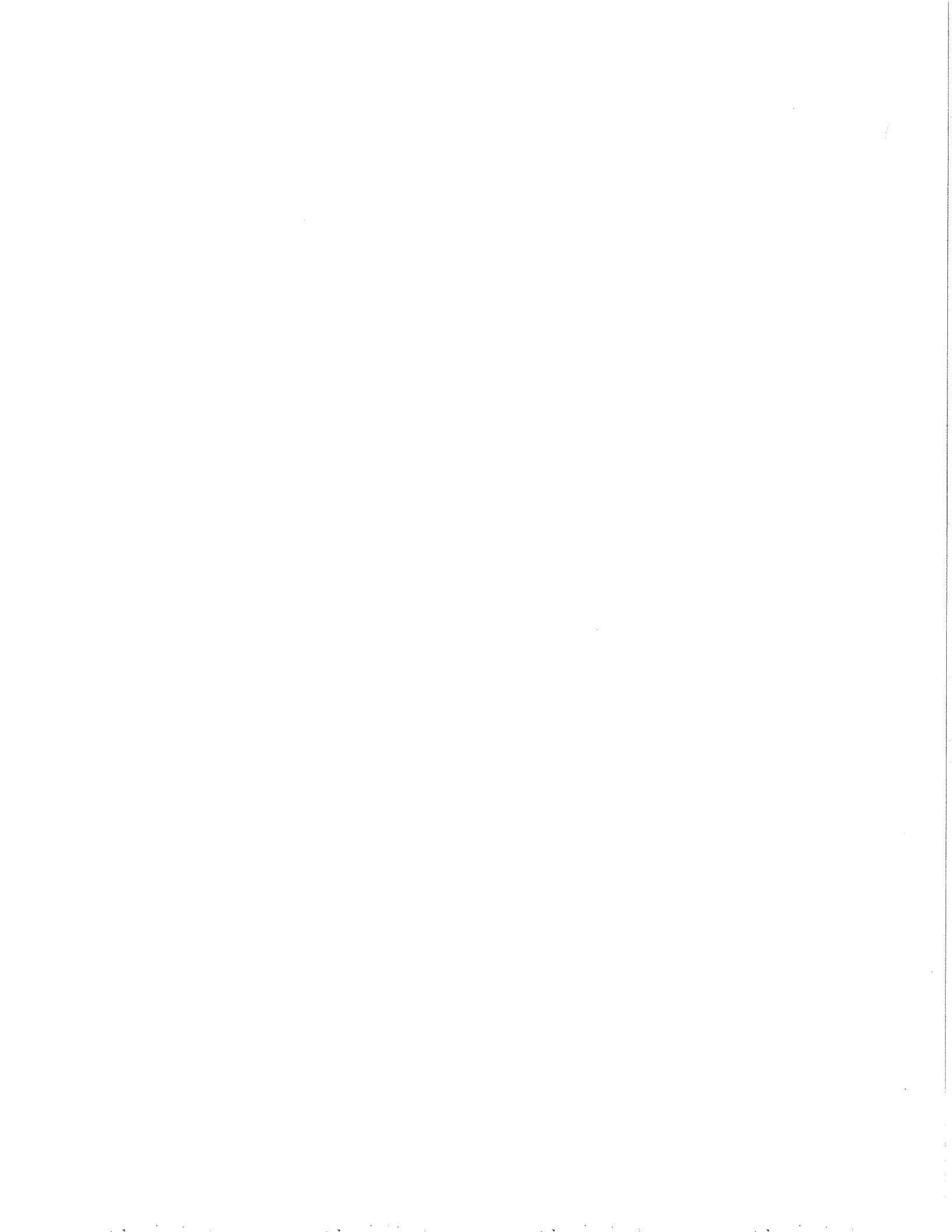
4. Press **UNITS** until the units label on the display matches the sensor type. Readings will be incorrect if the Units Label does not match the sensor type.

Sensor Type	Units Label	Readout Units
Quantum Pyranometer Photometric	$\mu\text{mol W m}^{-2}$ lux or Klux	$\mu\text{mol s}^{-1} \text{m}^{-2}$ Watts m^{-2} lux or Kilolux

5. Press the \uparrow or \downarrow keys to change the displayed multiplier value. Press *and hold* the arrow keys down to scroll the values rapidly.

Important Note: Measurement units *must* match the sensor type; no unit conversions are performed.

6. Press **CAL** again to store the displayed multiplier value and units label and use them to take measurements; or



2 Sensors & Accessories

2.1 Compatible Sensors

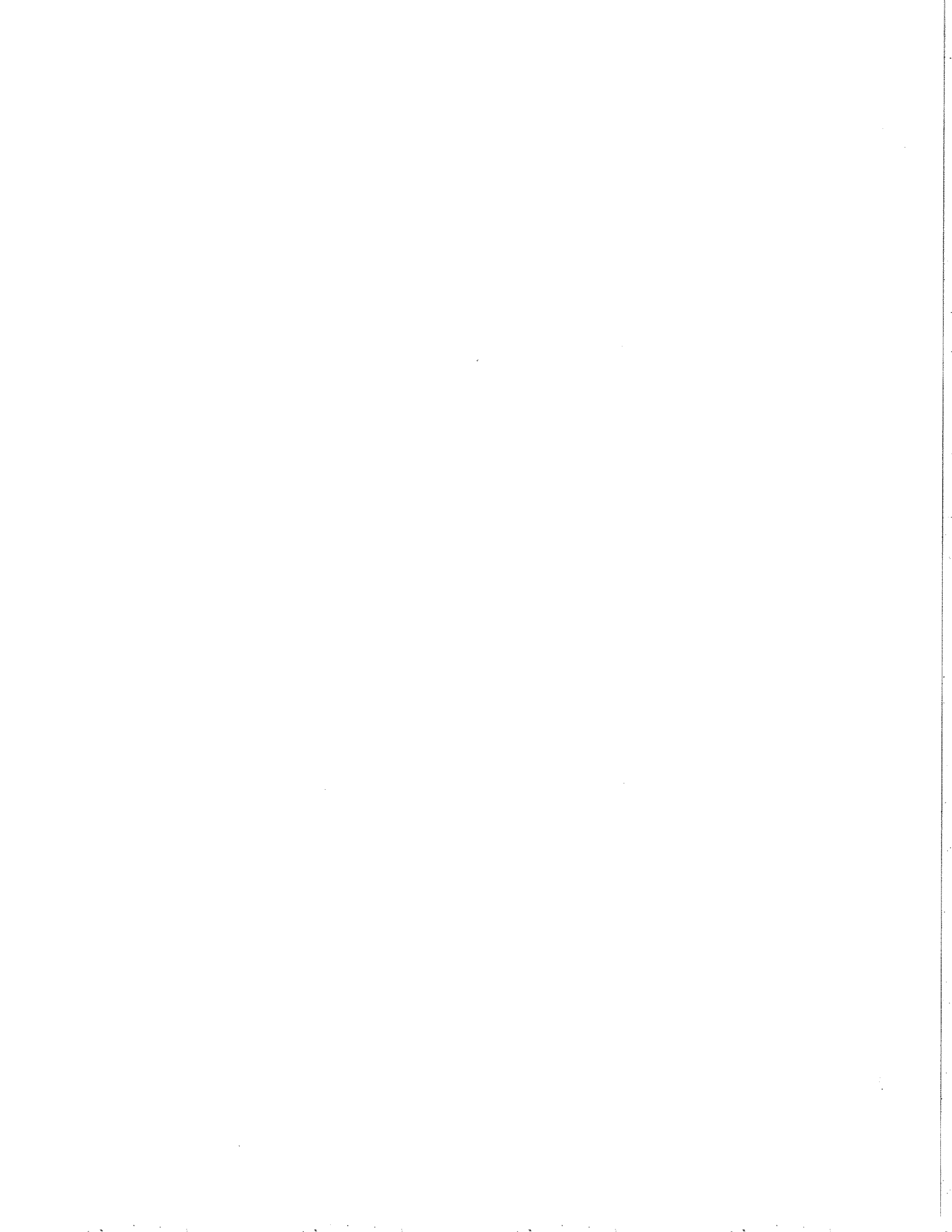
The LI-250 is compatible with all LI-COR type 'SA' radiation sensors. It is important that the LI-250 be properly configured for the specific sensor used. A quantum sensor must be used to make measurements of photosynthetically active radiation ($\mu\text{mol s}^{-1} \text{m}^{-2}$ of PAR), a pyranometer for measurements of solar radiation (W m^{-2}), and a photometric sensor for measurements of illuminance (lux). For example, it is not possible for a pyranometer to read out in units of lux. If you want to configure the LI-250 to read out in lux, you must use the photometric sensor.

LI-COR type 'SB' radiation sensors are also compatible if the Calconnector (Calibration connector) is detached from the BNC connector.

LI-COR type 'SZ' radiation sensors are not compatible with the LI-250; they may, however, be fitted with a BNC connector. Contact LI-COR for further information.

Recalibration of all LI-COR radiation sensors is recommended every two years.

Complete information concerning the sensors that can be used with the LI-250 is found in the type 'SA' LI-COR Radiation Sensors instruction manuals. In addition, several technical reports on LI-COR sensors are available. These



include a report entitled "Radiation Measurements", which summarizes the types of measurements that can be made with each LI-COR sensor and contains conversion factors for commonly used measurement units. A report concerning the immersion effect and cosine collecting properties of underwater sensors is also available (Roemer, Hoagland report. Request Application Note #110).

2.2 Sensor Calibration

All LI-COR radiation sensors produce a current proportional to the radiation intensity. During factory calibration, sensor output (in microamps) is measured while the sensor is exposed to a standard lamp of known intensity. The sensor output at this intensity has general units of microamps per radiation unit and is called the **Calibration Constant** (Calconstant). Each sensor has a slightly different output at a given radiation intensity and will therefore have a unique Calconstant.

The LI-250 measures the current output of the sensor in units of microamps, and converts the measured current to units of radiation. To make this conversion, the LI-250 uses the sensor **Calibration Multiplier**. The Calibration Multiplier is the negative reciprocal of the Calconstant.

$$\text{Multiplier} = \frac{-1}{\text{Calconstant}}$$

The Calibration Multiplier is always a negative number (because the shield of the coaxial cable is positive instead of negative), and is expressed in radiation units per microamp.

The LI-250 multiplies the current reading in microamps by the multiplier.

Since the Calibration Multiplier is unique for each sensor, it must be entered into the LI-250 each time the sensor is changed or recalibrated.

NOTE: Always enter the Calibration Multiplier, not the Calconstant. If the Calconstant is entered any data collected will be erroneous.

For type 'SA' sensors purchased after September, 1985, the calibration multiplier is given on the certificate of calibration, and is also attached to the sensor. An example of a calibration label attached to a quantum sensor appears below, which would contain the value of the multiplier, as well as the serial number of the sensor, and the date of its most recent calibration.

NOTE: Tcoeff is a time coefficient that is used to convert integrated data to the proper units when using the LI-1000 Datalogger to log data with certain sensors. This value can be ignored when using the LI-250.

MULT: XXX.XX

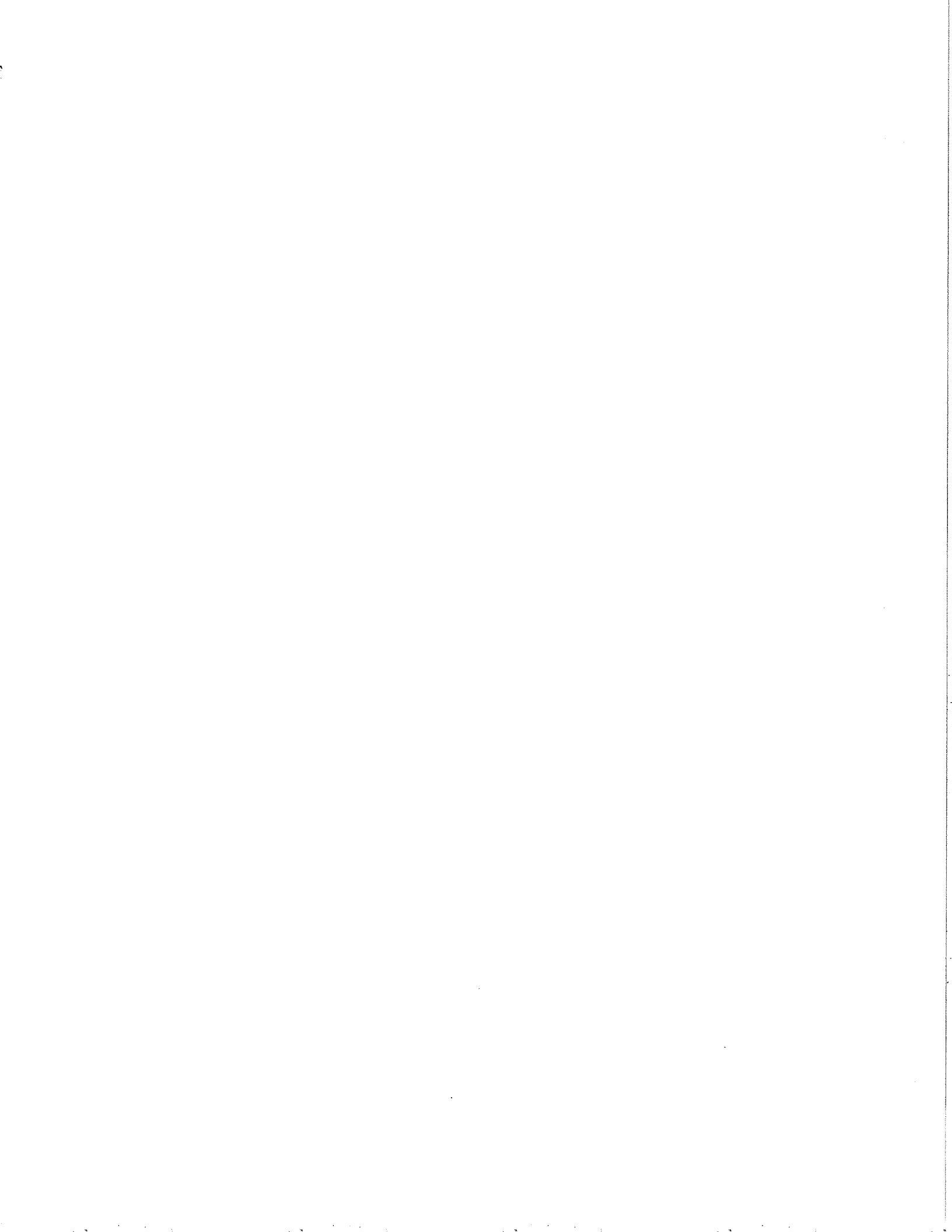
tcoeff: 0.0036

Units: $\mu\text{mol s}^{-1} \text{ m}^{-2}$ per μA

SERIAL NO.

CAL DATE: DD/MM/YR

LI-COR.



For the LI-192SA and LI-193SA Underwater Quantum Sensors there are two calibration multipliers; one for "in air" operation and one for "in water" operation. Use the multiplier that is appropriate for your application.

If the calibration constant for your sensor has been lost or misplaced, it can be obtained from LI-COR by providing the serial number of the sensor.

Converting Calconstants to Multipliers

For LI-COR sensors that are not type 'SA' (i.e., type 'SB'; etc.), the calibration multiplier must be calculated from the calibration constant given on the certificate of calibration.

EXAMPLE: Calculate the multiplier for an LI-190SB Quantum sensor with a calibration constant of 8.0 $\mu\text{Amps}/1000 \mu\text{mol s}^{-1} \text{m}^{-2}$.

$$\begin{aligned} \text{Multiplier} &= \frac{(-1)(1000 \mu\text{mol s}^{-1} \text{m}^{-2})}{8 \mu\text{Amps}} \\ &= \frac{-125.0 \mu\text{mol s}^{-1} \text{m}^{-2}}{1 \mu\text{Amp}} \end{aligned}$$

2.3 Accessories

The following accessories and sensors are available for the LI-250. Contact LI-COR for current information.

250-01 Carrying Case - A soft-sided case for the LI-250 and terrestrial type radiation sensors. Size: 20.3 cm L x 10.2 cm W x 9 cm D (8" x 4" x 3.5"). Weight: 98 g (0.216 lbs).

LI-COR Radiation Sensors: Type 'SA' (e.g. LI-190SA) with BNC connectors.

LI-190SA Quantum Sensor - measures Photosynthetically Active Radiation (PAR) in natural sunlight, under plant canopies, and in growth chambers and greenhouses.

LI-191SA Line Quantum Sensor - averages PPF over its one meter length for plant canopy PPF profile studies.

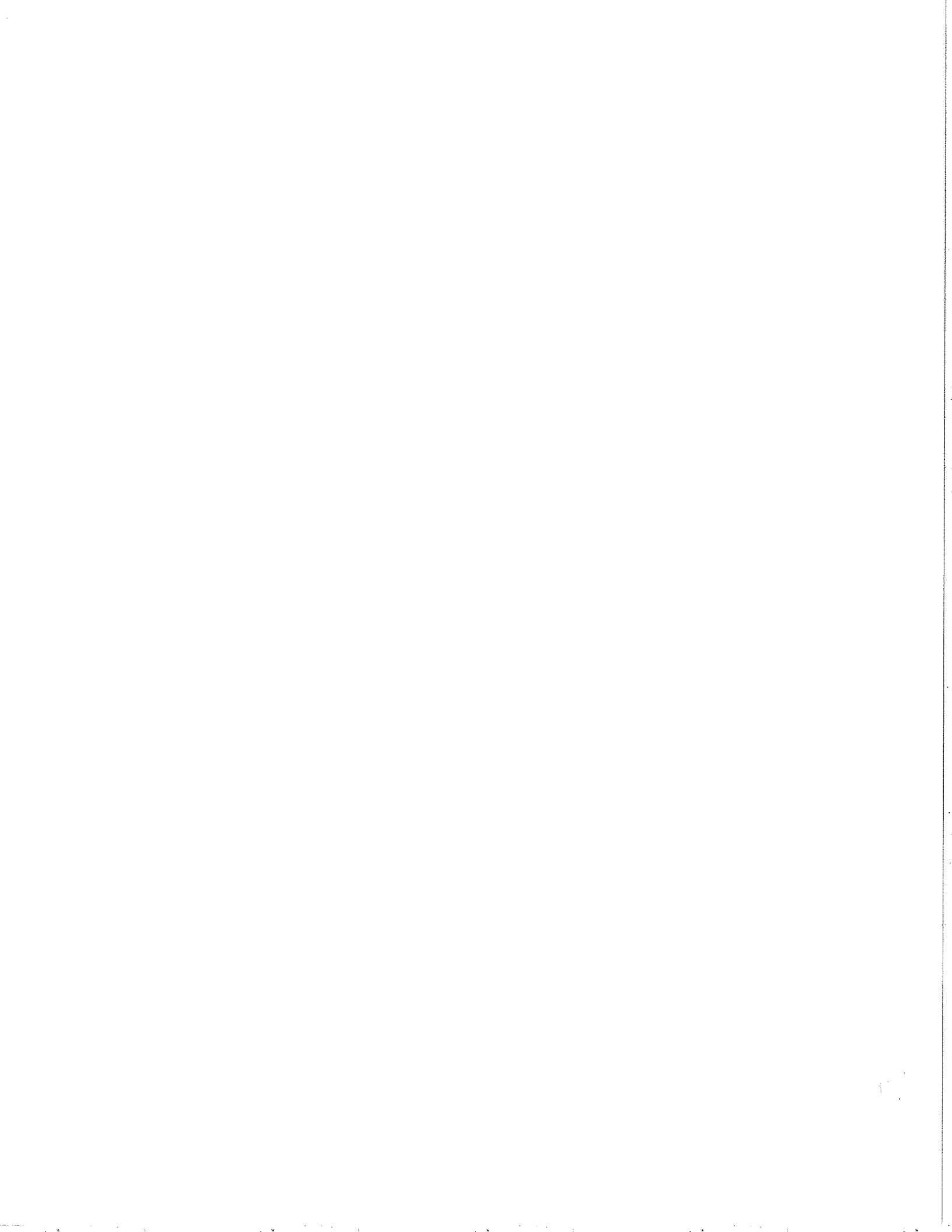
LI-192SA Underwater Quantum Sensor* - measures Photosynthetic Photon Flux Density (PPFD) in air or under water incident on a flat plane.

LI-193SA Spherical Quantum Sensor* - measures photon flux from all directions under water. This measurement is called Photosynthetic Photon Flux Fluence Rate (PPFFR).

LI-200SA Pyranometer Sensor - measures global solar radiation (sun plus sky) and provides a typical accuracy of $\pm 5\%$ under unobstructed daylight conditions.

LI-210SA Photometric Sensor - measures visible radiation and has a spectral response equal to that for the average human eye. Readout of illuminance (in lux) is used for lighting studies or architectural modeling.

* Requires 222UWB cable.



Sensors & Accessories

2003S Mounting and Leveling Fixture - The 2003S is for use with all LI-COR terrestrial type sensors.

222SB Extension Cable - For use with all LI-COR terrestrial type sensors. Available in 15.2 m (50 ft), 30.4 m (100 ft), or custom lengths to 304 m (1000 ft).

216 Replacement Battery - 9 Volt transistor type. The LI-250 requires one for replacement.

2.4 Power Requirements

Power is supplied by one 9 volt transistor battery. Eveready alkaline #522 (LI-COR part #216) or equivalent may be used. Battery life is in excess of 150 hours. A LO BAT message is displayed when there is less than 20 hours of battery life remaining. The battery should be replaced immediately after the LO BAT message is displayed to ensure reliable operation.

The battery compartment is accessed through a slide-out panel on the back of the instrument case.

Although typical battery life is more than 150 hours of continuous operation, it is dependent upon the storage temperature. Do not store the LI-250 at high temperatures.

Appendix A. Specifications

Accuracy: 25 °C: Typically $\pm 0.4\%$ of reading [± 3 counts on the least significant digit displayed (all ranges)].
0-55 °C: Typically $\pm 0.6\%$ of reading [± 3 counts on the least significant digit displayed (all ranges)].

Range Selection: Autoranging (3 ranges).

Sensor Calibration: Calibration multipliers for two sensors are stored in memory. Calibration multipliers are entered from the keypad.

Sensor Averaging: Sensor output is averaged for 15 seconds when AVG key is pressed in Measurement mode. Averages are displayed in HOLD mode to retain the average on the display.

Linearity: $\pm 0.05\%$.

Operating Conditions: 0 to 55 °C, 0 to 95% RH (non-condensing).

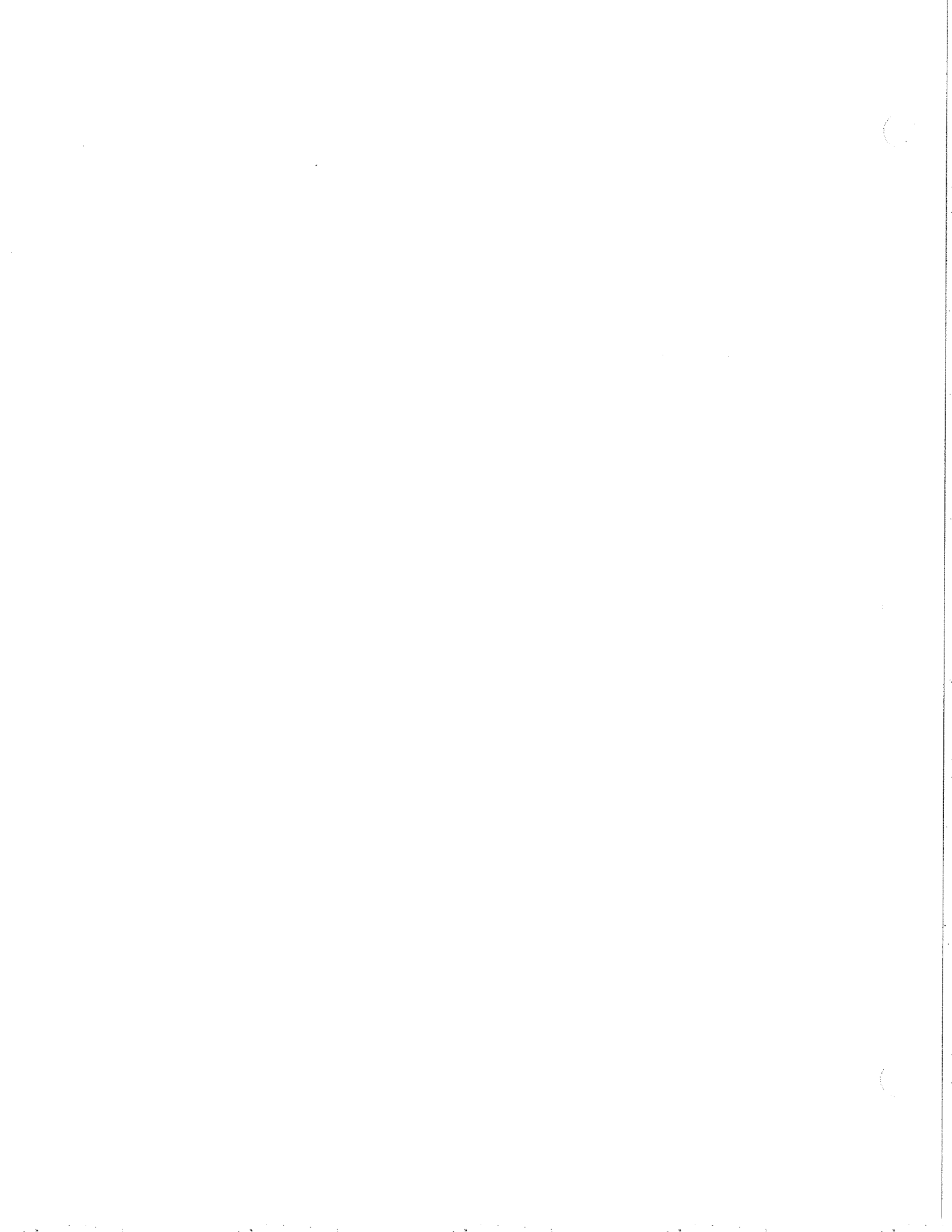
Storage Conditions: -55 to 60 °C, 0 to 95% RH (non-condensing).

Display: 4 1/2 digit custom LCD display. Updated every 0.5 seconds.

Keypad: Sealed, 5-key tactile response keypad.

Battery Life: 150 hours typical with continuous operation. Automatic shutoff after 25 minutes of inactivity in measurement mode.

Power Requirement: One 9V Eveready Alkaline #522 or equivalent.



Specifications

Low Battery Detection: Low battery indicator displayed with approximately 20 hours battery life remaining.

Size: 14 L x 7.7 W x 3.8 cm D (5.5" x 3" x 1.5").

Weight: 0.26 kg (0.57 lbs).

Sensors: Any LI-COR sensor with BNC connector; Quantum, Pyranometer, or Photometric.

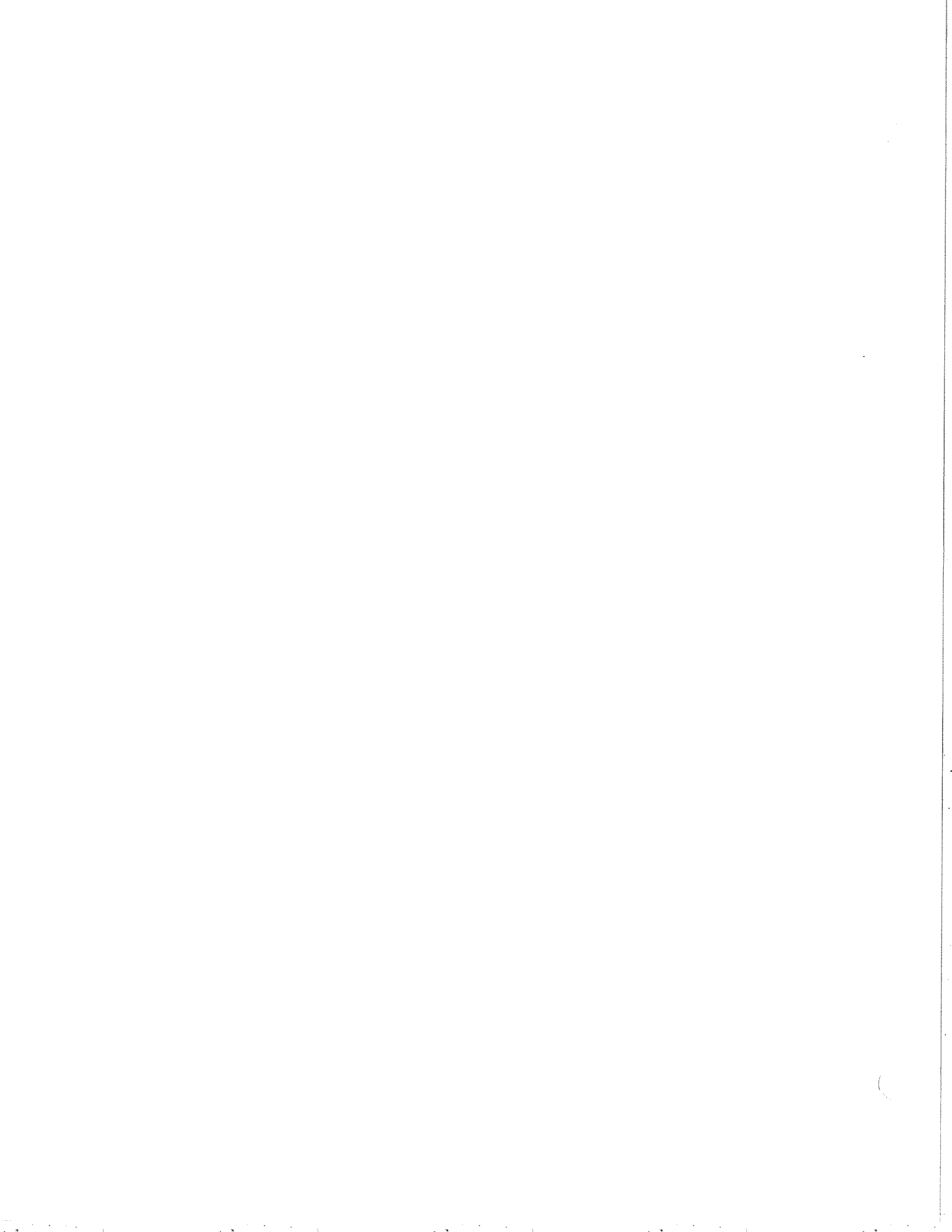
Warranty: 1 year parts and labor.

LI-250 Range and Resolution:

Sensor Type	Range	Resolution
Quantum	0-199 $\mu\text{mol s}^{-1} \text{m}^{-2}$ -1999 -19999	0.01 $\mu\text{mol s}^{-1} \text{m}^{-2}$ 0.1 1
Radiometric	0-19 W m^{-2} -199 -1999	0.001 W m^{-2} 0.01 0.1
Photometric	0-1999 lux -19999 lux 0-199 klux 0-199 fc -1999 -19999	0.1 lux 1 lux 0.01 klux 0.01 fc 0.1 1

Appendix B. Conversion Table

Type of Measurement	Instantaneous Measurements
Quantum	$1.0 \mu\text{m s}^{-1} \text{m}^{-2} = 1 \mu\text{E s}^{-1} \text{m}^{-2}$ $= 6.022 \cdot 10^{17} \text{ photons s}^{-1} \text{m}^{-2}$ $= 6.022 \cdot 10^{17} \text{ quanta s}^{-1} \text{m}^{-2}$ $= 6.022 \cdot 10^{13} \text{ quanta s}^{-1} \text{cm}^{-2}$
Radiometric	$1 \text{ W m}^{-2} = 1,433 \cdot 10^{-3} \text{ cal cm}^{-2} \text{ min}^{-1}$ $= 1.433 \cdot 10^{-3} \text{ langley min}^{-1}$ $= 0.100 \text{ mW cm}^{-2}$ $= 100 \mu\text{W cm}^{-2}$ $= 1.0 \text{ J s}^{-1} \text{m}^{-2}$ $= 1000 \text{ erg s}^{-1} \text{cm}^{-2}$ $= 0.317 \text{ BTU ft}^{-2} \text{ h}^{-1}$ $= 5.283 \cdot 10^{-3} \text{ BTU ft}^{-2} \text{ min}^{-1}$
Photometric	$1 \text{ lux} = 1 \text{ lm m}^{-2}$ $= 0.0929 \text{ lm ft}^{-2}$ $= 0.0929 \text{ fc}$ $= 0.001 \text{ klux}$



Warranty

Each LI-COR, inc. instrument is warranted by LI-COR, inc. to be free from defects in material and workmanship; however, LI-COR, inc.'s sole obligation under this warranty shall be to repair or replace any part of the instrument which LI-COR, inc.'s examination discloses to have been defective in material or workmanship without charge and only under the following conditions, which are:

1. The defects are called to the attention of LI-COR, inc. in Lincoln, Nebraska, in writing within one year after the shipping date of the instrument.
2. The instrument has not been maintained, repaired, or altered by anyone who was not approved by LI-COR, inc.
3. The instrument was used in the normal, proper, and ordinary manner and has not been abused, altered, misused, neglected, involved in and accident or damaged by act of God or other casualty.
4. The purchaser, whether it is a DISTRIBUTOR or direct customer of LI-COR or a DISTRIBUTOR'S customer, packs and ships or delivers the instrument to LI-COR, inc. at LI-COR inc.'s factory in Lincoln, Nebraska, U.S.A. within 30 days after LI-COR, inc. has received written notice of the defect. Unless other arrangements have been made in writing, transportation to LI-COR, inc. (by air unless otherwise authorized by LI-COR, inc.) is at customer expense.
5. No-charge repair parts may be sent at LI-COR, inc.'s sole discretion to the purchaser for installation by purchaser.
6. LI-COR, inc.'s liability is limited to repair or replace any part of the instrument without charge if LI-COR, inc.'s examination



disclosed that part to have been defective in material or workmanship.

There are no warranties, express or implied, including but not limited to any implied warranty of merchantability of fitness for a particular purpose on underwater cables or on expendables such as batteries, lamps, thermocouples and calibrations.

Other than the obligation of LI-COR, inc. expressly set forth herein, LI-COR, inc. disclaims all warranties of merchantability or fitness for a particular purpose. The foregoing constitutes LI-COR, inc.'s sole obligation and liability with respect to damages resulting from the use or performance of the instrument and in no event shall LI-COR, inc. or its representatives be liable for damages beyond the price paid for the instrument, or for direct, incidental or consequential damages.

The laws of some locations may not allow the exclusion or limitation on implied warranties or on incidental or consequential damages, so the limitations herein may not apply directly. This warranty gives you specific legal rights, and you may already have other rights which vary from state to state. All warranties that apply, whether included by this contract or by law, are limited to the time period of this warranty which is a twelve-month period commencing from the date the instrument is shipped to a user who is a customer or eighteen months from the date of shipment to LI-COR, inc.'s authorized distributor, whichever is earlier.

This warranty supersedes all warranties for products purchased prior to June 1, 1984, unless this warranty is later superseded.

DISTRIBUTOR or the DISTRIBUTOR'S customers may ship the instruments directly to LI-COR if they are unable to repair the instrument themselves even though the DISTRIBUTOR has been approved for making such repairs and has agreed with the customer to make such repairs as covered by this limited warranty.

Further information concerning this warranty may be obtained by writing or telephoning Warranty manager at LI-COR, inc.

IMPORTANT: Please return the User Registration Card enclosed with your shipment so that we have an accurate record of your address. Thank you.

