NOTICE

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

LI-COR MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT
LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.
LI-COR shall not be liable for errors contained herein or for incidental or consequential damages in connection with the
furnishing, performance, or use of this material.

This document contains proprietary information which is protected by copyright. All rights are reserved. No part of this
document may be photocopied, reproduced, or translated to another language without prior written consent of LI-COR, Inc.

© Copyright 1993, LI-COR, Inc.
# Table of Contents

## Section I. Calibration Adjustment and Troubleshooting
For SSP274 and below.

1.1 Instrument Identification ................................................................. 1-1
1.2 Required Test Equipment ................................................................. 1-1
1.3 Battery Charging Voltage Adjustment .................................................. 1-1
1.4 Power Supply Voltage Adjustment ....................................................... 1-1
1.5 Cuvette Temperature Calibration Adjustment .......................................... 1-2
1.6 Quantum Sensor Amplifier Adjustment ................................................ 1-2
1.7 Relative Humidity Calibration Adjustment ............................................. 1-2
1.8 Leaf Temperature Calibration Adjustment ............................................ 1-3
1.9 Digital to Analog Converter Adjustment ............................................... 1-3
1.10 Flow Controller Bias Adjustment ...................................................... 1-3
1.11 Null Meter and Flow Control Gain Calibration ..................................... 1-3
1.12 Cassette Tape Output Voltage Adjustment ........................................... 1-4
1.13 Mass Flowmeter Calibration Adjustment .............................................. 1-4
1.14 Leaf Temperature Thermocouple Offset Adjustment ............................ 1-5
1.15 Microprocessor Circuit Description ................................................... 1-5

## Section II. Calibration Adjustment and Troubleshooting
For SSP275 and above.

2.1 Required Test Equipment ................................................................. 2-1
2.2 Battery Charging Voltage Adjustment .................................................. 2-1
2.3 Power Supply Voltage Adjustment ....................................................... 2-2
2.4 Cuvette Temperature Calibration Adjustment .......................................... 2-2
2.5 Quantum Sensor Amplifier Adjustment ................................................ 2-2
2.6 Relative Humidity Calibration Adjustment ............................................. 2-2
2.7 Leaf Temperature Calibration Adjustment ............................................ 2-2
2.8 Digital to Analog Converter Adjustment ............................................... 2-3
2.9 Flow Controller Bias Adjustment ...................................................... 2-3
2.10 Null Meter and Flow Control Gain Calibration ..................................... 2-3
2.11 Cassette Tape Output Voltage Adjustment ........................................... 2-3
2.12 Mass Flowmeter Calibration Adjustment .............................................. 2-3
2.13 Leaf Temperature Thermocouple Offset Adjustment ............................ 2-3
2.14 Microprocessor Circuit Description ................................................... 2-3

## Schematic Diagrams

Main Board - Digital (SSP275-XXXX and above) ........................................ S-1
Main Board - Analog (SSP275-XXXX and above) .......................................... S-2
Important Notice

These technical documents and drawings are given in good faith solely for the purpose of servicing the LI-1600 Steady State Porometer.

This information is a proprietary product of LI-COR, inc., Lincoln, Nebraska, USA, and shall not be released nor be disclosed, duplicated, or used for the purpose of design or manufacturing, without the express written permission of LI-COR.

LI-COR
4421 Superior Street
P.O. Box 4425
Lincoln, Nebraska  68504 USA
Phone: 402-467-3576
FAX: 402-467-2819
Toll-free 1-800-447-3576 (U.S. & Canada)
Section I
Calibration Adjustment and Troubleshooting
(SSP274-XXXX and below)

1.1 Instrument Identification

Serial numbers for the LI-1600 Steady State Porometer are designated as SSPNNN-YYMM, where NNN is the instrument's individual serial number and YYMM designates the year and month of that unit's manufacture.

This manual is intended only as an aid to servicing the LI-1600. For operation instructions please consult the LI-1600 Instruction Manual.

IMPORTANT: The information in this section applies only to instruments with serial numbers SSP274-XXXX and below.

1.2 Required Test Equipment

To make adjustments to the LI-1600, or to troubleshoot circuitry failures, the following test equipment may be required:

1. Power supply, adjustable 0 to 15 VDC, 1.5 amp.
2. Oscilloscope.
3. Digital voltmeter/ammeter.
4. LI-610 Dew Point Generator or Dew point hygrometer.
5. Mass flow controllers or sources (air) for 5, 10, 50, 500, and 1000 standard cubic centimeters per minute (sccm).

1.3 Battery Charging Voltage Adjustment

1. Disconnect the AC line cord and unplug the battery connector.
2. Connect a 1K ohm, 1/4 watt resistor in place of the battery.
3. Connect 12 VDC to C1 (4700 µF). Observe polarity. (Component Layout page C-2).
4. Adjust R85 for 7.50 volts across the 1K ohm resistor.
5. Connect a 5 ohm 5 watt resistor in place of the battery. The voltage drop across the resistor would be 4.5 to 5.0 volts (900 to 1000 mA).
6. Reconnect the battery and AC power.
7. The voltage on C1 should be greater than 10.5 volts with full charge current.

1.4 Power Supply Voltage Adjustment

There are three power supply voltages in the LI-1600: +5.100 VDC, +7.000 VDC, and -5.0 VDC. The +7.000 VDC and -5.0 VDC supplies are powered by a DC to DC converter with a push-pull saturating transformer oscillator. Transistors Q5 and Q6 oscillate at an approximate frequency of 40 kHz.
1. Disconnect the AC line cord and unplug the battery.
2. Apply 6.0 VDC in place of the battery.
3. Adjust R86 for 5.100 volts on the 5.100 volt supply. (Component Layout page C-2).
4. Adjust R87 for 7.000 volt supply.
5. The negative 5 volt supply is developed from a fixed regulator. The voltage should be between -5.25 VDC and -4.75 VDC.
6. Lower the battery voltage to 5.3 volts. All three supply voltages should not drop out of regulation.

1.5 Cuvette Temperature Calibration Adjustment

1. Disconnect the ribbon cable from J1. (Component Layout page C-2).
2. Connect a 12,175 ohm ± 5 ohm 1/4 W resistor from pin 7 to pin 11 on J1.
3. Adjust R92 for 0.000 volts on pin 8 of U2.
4. Replace the 12,175 ohm resistor with a 5693 ohm ± 5 ohm 1/4 W resistor.
5. Adjust R93 for 5.080 volts on pin 8 of U2.
6. Repeat steps 2 through 5.

1.6 Quantum Sensor Amplifier Adjustment

1. Disconnect the LI-190S-1 Quantum Sensor.
2. Adjust R88 for 0.000 volts on pin 6 of U5 (Component Layout page C-2).
3. Adjust R90 for 0.000 volts on pin 7 of U1.
4. Inject a low negative current into the quantum sensor input jack until pin 6 on U5 is 0.500 volts.
5. Adjust R91 for 5.000 volts on pin 7 of U1.
6. To calibrate to a specific quantum sensor, inject twice (2X) the calibration constant current into the quantum sensor input jack. This current is given in µA on the Certificate of Calibration.
7. Adjust R89 so that the display (function switch set to “QUANTUM”) reads 2000.
8. Lower the current to that of the calibration constant. The display should read 999.9.
9. Repeat steps 1 through 8.

1.7 Relative Humidity Calibration Adjustment (Room Temp. or above)

If using the 1600SC Salt Cup Humidity Test Kit, refer to the LI-1600 instruction manual. If you are using the LI-610 Portable Dew Point Generator, refer to the LI-610 instruction manual. If you are using a dew point hygrometer, use the following procedure to calibrate relative humidity:

1. Connect the exit port of the cuvette to the dew point hygrometer using as short a piece of tubing (preferably teflon) as possible.
2. Swing out the digital printed circuit board to expose the analog board. Leave the ribbon cables attached.
3. Install the 1600MP micropipette. The 1600MP bore can be overfilled with water so that it will supply moisture throughout the entire calibration procedure.
4. Null the instrument to 25% RH as described in the instruction manual.
5. Wait long enough for the dew point reading to stabilize (5 to 20 minutes).
6. Calculate the relative humidity from the saturation vapor pressure (SVP). A table of SVP is provided in the instruction manual.

\[
\text{RH} = 100 \times \frac{(\text{SVP at dew point temp})}{(\text{SVP at cuvette temp})}
\]

7. Adjust R95 so that the instrument displays the calculated RH (Component Layout page C-2).
8. Null the instrument to 75% RH, and wait for a stable dew point.
9. Calculate the RH and adjust R96 to obtain the proper RH reading on the display. Note that R95 and R96 will affect each other.
10. Repeat steps 4 through 9 until good accuracy is attained.

1.8 Leaf Temperature Calibration Adjustment

1. Disconnect the sensor head.
2. Adjust R94 for 2.540 volts on pin 7 of U2 (Component Layout page C-2).

1.9 Digital to Analog Converter Adjustment

1. Set the RH somewhere between 90% and 100%. Hold "HUM SET" closed. See the instruction manual.
2. Adjust R22 for 0 volts on pin 8 of U3 (Component Layouts, pages C-2 and C-3).
3. Slowly change the RH with "HUM SET" closed. Voltage on pin 8 of U3 should be 0 ± 0.020 over the entire RH range. R22 has the greatest effect at high relative humidities because it is a gain adjustment. There is no zero adjustment.

1.10 Flow Controller Bias Adjustment

1. Short pin 8 of U3 to ground (short duration only). (Component Layout page C-2).
2. Adjust R84 for 2.0 volts on pin 2 of P4.
3. Remove short from pin 8.

1.11 Null Meter and Flow Control Gain Calibration

The null meter and flow controller are normally adjusted to track each other’s response.

1. Mechanically zero the null meter by adjusting the zero lever on the back top end of the meter. Use a non-magnetic tool to do this adjustment while the instrument is laying horizontally.
2. Set RH and HUM SET so that pin 8 of U3 is -0.20 volts, or apply -0.20 volts to pin 8 of U3 (Component Layout page C-2).
3. Adjust R97 so that the meter needle is at the right full scale indication.
4. Adjust R98 so that pin 2 of P4 is approximately 3.8 volts.
1.12 Cassette Tape Output Voltage Adjustment

The cassette output voltage can be adjusted for 0 to 5 mV peak-to-peak voltage. Most audio cassette recorders operate best with 2 to 3 mV microphone input voltage. The cassette output voltage is adjusted using R29 (Component Layout page C-2). Setting R29 to 400 ohms from wiper to ground is good.

1.13 Mass Flowmeter Calibration Adjustment

Flowmeter calibration is most easily accomplished using precision flow rate standards. The required flow rates are 5, 10, 50, 100, 500, and 1000 sccm. The power supply voltages must be properly adjusted before calibrating the flowmeter.

1. Remove the battery from the instrument.
2. Remove the 2 screws that secure the flowmeter to the compartment.
3. Remove input and output hoses. The output hose can be pulled off with pliers.
4. Remove the flowmeter from the compartment, leaving the ribbon cable attached. Connect a jumper wire between the flowmeter metal chassis and the instrument chassis.
5. Be sure to make all adjustments with the flowmeter laying horizontally and allow a 5-minute warm-up time.
6. Heater voltage adjustment: Adjust R32 for -2.73 volts on pin 14 of U1. This voltage will vary by -0.45 percent per °C (Component Layout page C-4).
7. Zero adjustment: (No flow, no strong drafts). Adjust R39 for 0.0 volts on TP1. Adjust R35 for 0.0 volts on TP2. Adjust R43 for 0.0 volts on TP3. TP4 is signal common.
8. Span, linearity, and crossover adjustments:
   a. FLOW LOW. Connect a 10 sccm flow to the input fitting. Adjust R37 for 5.08 volts on TP1. Apply 5 sccm. TP1 should be 2.540 volts. If this is less than 2.540 volts, turn the linearity pot R38 counterclockwise to double the offset difference. For example, if TP1 is 2.50 volts, adjust R38 so that TP1 is 2.46 volts. Recalibrate span at 10 sccm and zero with no flow. Repeat procedure.
   b. FLOW MED. Connect 100 sccm flow to the input fitting. Adjust R33 for 5.08 volts on TP2. Connect 50 sccm flow. Adjust linearity pot R34 using the same procedure as in FLOW LOW. Connect 10 sccm and adjust R35 for 0.508 volts. Repeat procedure.
   c. FLOW HIGH. Connect 1000 sccm flow to the input fitting, and adjust R41 for 5.08 volts on TP3. Connect 500 sccm and adjust the linearity pot R42 using the same procedure as in FLOW LOW. Connect 100 sccm and adjust R43 for 0.508 volts on TP3. Repeat procedure.
9. For best results, repeat steps 7 and 8.
10. Reinstall the flowmeter as shown below, taking care to connect the air lines correctly.
1.14 Leaf Temperature Thermocouple Offset Adjustment

See the instruction manual.

1.15 Microprocessor Circuit Description

The microprocessor-based CMOS digital circuitry in the LI-1600 is used to read and calculate all displayed instrument functions. The processor is an 8-bit CMOS device. Three kilobytes of program memory are stored in Erasable Programmable Read-Only Memory (EPROM). A multiplexed 16-channel 8-bit analog-to-digital converter (ADC) is used to convert the various analog signals into digital form. An 8-bit digital-to-analog converter (DAC) is used to provide a null reference relative humidity for the "HUM SET" function. The liquid crystal digital display is driven by a microprocessor-interfaceable display driver.
Section II
Calibration Adjustment and Troubleshooting
(SSP275-XXXX and above)

IMPORTANT: The information in this section applies only to instruments with serial numbers SSP275-XXXX and above.

2.1 Required Test Equipment

To make adjustments to the LI-1600, or to troubleshoot circuitry failures, the following test equipment may be required:

1. Power supply, adjustable 0 to 15 VDC, 1.5 amp.
2. Oscilloscope.
3. Digital voltmeter/ammeter.
4. LI-610 Dew Point Generator or Dew point hygrometer.
5. Mass flow controllers or sources (air) for 5, 10, 50, 500, and 1000 standard cubic centimeters per minute (sccm).

2.2 Battery Charging Voltage Adjustment

1. Connect 12 VDC across C2. Disconnect the battery (Component Layout page C-1).
2. Connect an 18 ohm 10%, 10 watt resistor between terminal 4 and terminal 1 on P1.
3. Adjust R10 for 7.80 volts across the 18 ohm resistor at room temperature (20 to 25 °C).

Note that the charge voltage is temperature dependent and will decrease as the temperature rises. The charger uses a two voltage step hysteresis technique for charging the battery. It operates as follows: A current limit of 600 mA "instrument off", 1200 mA "instrument on" is always in effect. The voltage limits at 7.8 volts until the charge current drops below approximately 300 mA, at which time the voltage limits at 7.1 volts. If the charge current goes above 10 mA, the voltage limit will increase back to 7.8 volts. After the battery has acquired a full charge, the charge voltage will remain at the lower voltage.

A normal battery recharge is accomplished as follows: As the battery voltage rises to 7.8, the current is limited to 600 mA. This is followed by a short period during which voltage is limited to 7.8 volts and a lowering of charge current occurs. There may then be several hours of cycling between high and low voltage, and finally a constant low voltage charging rate.

Charging with the instrument turned on is done with a constant 7.1 volts and 1200 mA current limit.
2.3 Power Supply Voltage Adjustment

1. Adjust R62 for 5.100 volts on the 5.1 volt test point (Component Layout page C-1).
2. Check the -5.100 V ± 0.020 V on the -5.1 volt test point.
3. Check the 7.5 V ± 0.35 V on the 7.5 volt test point.

AC ripple on all three voltages is 25 mV peak-to-peak maximum. When battery voltage drops below approximately 5.2 volts, the power supply shuts down automatically.

2.4 Cuvette Temperature Calibration Adjustment

1. Connect a 12,175 ohm ± 5 ohm 1/4 W resistor between pins 2 and 11 of J1.
2. Adjust R17 for 0.000 volts on pin 8 of U6 (Component Layout page C-1).
3. Connect a 5,693 ohm ± 5 ohm 1/4 W resistor between pins 2 and 11 of J1.
4. Adjust R18 for 5.08 volts on pin 8 of U6.

2.5 Quantum Sensor Amplifier Calibration Adjustment

1. Adjust R15 for 0.000 volts on pin 6 of U5 (Component Layout page C-1).
2. Adjust R86 for 0.000 volts on pin 1 of U6.
3. Inject enough negative current into pin 10 of J1 to give 0.5000 volts on output pin 6 of U5. Adjust R37 for 5.000 volts on pin 1 of U6.
4. To calibrate to a sensor constant, inject a current equal to twice (2X) the sensor calibration constant. This current is given in µA on the Certificate of Calibration. Adjust R20 for a reading of "2000" on the instrument display with the function switch set to "QUANTUM".
5. Lower the current to that of the calibration constant. The display should read 999.9.

2.6 Relative Humidity Calibration Adjustment

Proceed according to Section 1.7 with the following exceptions:

a. In place of R95, adjust R16 (step 7). (Component Layout page C-1).
b. In place of R96, adjust R45 (step 9).

2.7 Leaf Temperature Calibration Adjustment

With the sensor disconnected, the leaf temperature amplifier output should be 2.550 ± 0.050 volts at pin 7 of U6. There is no adjustment for this voltage (Component Layout page C-1).
2.8 Digital to Analog Converter Adjustment

1. Adjust the RH to be less than 5% and steady.
2. Hold the "HUM SET" switch closed and adjust R127 for 0.0 volts on pin 1 of U22 (Component Layout page C-1).
3. Adjust RH to be between 95% and 100% and steady.
4. Hold the "HUM SET" switch closed and adjust R87 for 0.0 volts on pin 1 of U22.
5. Repeat procedure.
6. Slowly vary RH over the whole range while holding "HUM SET" closed. The null adjust meter should stay within scale limits.

2.9 Flow Control Bias Adjustment

1. Short pin 1 of U22 to ground (short duration only). (Component Layout page C-1).
2. Adjust R95 for 2.0 volts on pin 2 of P4.

2.10 Null Meter and Flow Controller Calibration

1. Disconnect the sensor head.
2. Inject enough current into pin 2 of U22 to make the null meter indicate full scale to the right side (approximately 10 µA). (Component Layout page C-1).
3. Adjust R96 for 4.0 volts on pin 2 of P4.
4. The overall gain of the flow control system is controlled by the Null Gain trimpot on the front panel of the console, and is normally set at midscale. If the instrument has a tendency to oscillate when nulling to low diffusive resistances, the gain should be reduced by turning the potentiometer counterclockwise. If increased nulling sensitivity to high diffusive resistances is desired, the gain control potentiometer can be turned clockwise to increase the null control gain.

2.11 Cassette Tape Output Voltage Adjustment

See Section 1.12. To change the output voltage, adjust R117 (Component Layout page C-1).

2.12 Mass Flowmeter Calibration

See Section 1.13.

2.13 Leaf Temperature Thermocouple Offset Adjustment

See the instruction manual.

2.14 Microprocessor Circuit Description

See Section 1.15.
## Specifications

### Diffusive Resistance (s cm\(^{-1}\))

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 to 1</td>
<td>0.05</td>
<td>± 10%</td>
</tr>
<tr>
<td>1 to 50</td>
<td>0.1</td>
<td>(20 to 80% RH)</td>
</tr>
</tbody>
</table>

### Stomatal Conductance (cm s\(^{-1}\))

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to 1</td>
<td>0.05</td>
<td>± 10%</td>
</tr>
<tr>
<td>1 to 0.02</td>
<td>0.01</td>
<td>(20 to 80% RH)</td>
</tr>
</tbody>
</table>

### Stomatal Conductance (mmol m\(^{-2}\) s\(^{-1}\))

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 to 400</td>
<td>20</td>
<td>± 10%</td>
</tr>
<tr>
<td>400 to 8</td>
<td>4</td>
<td>(20 to 80% RH)</td>
</tr>
</tbody>
</table>

### Transpiration

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 to 1</td>
<td>0.01</td>
<td>± 6%</td>
</tr>
<tr>
<td>1 to 50</td>
<td>0.1</td>
<td></td>
</tr>
</tbody>
</table>

### Quantum (µmol s\(^{-1}\) m\(^{-2}\))

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 250</td>
<td>1</td>
<td>± 5%</td>
</tr>
<tr>
<td>250 to 2500</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

### Relative Humidity (%)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 95</td>
<td>0.4</td>
<td>± 3% RH</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(10% to 80% RH)</td>
</tr>
</tbody>
</table>

### Leaf Temperature (°C)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 64</td>
<td>0.1</td>
<td>± 0.7 °C</td>
</tr>
</tbody>
</table>

### Cuvette Temperature (°C)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 51</td>
<td>0.2</td>
<td>± 0.5 °C</td>
</tr>
</tbody>
</table>

### Flow (cm\(^{2}\) s\(^{-1}\))

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 0.167</td>
<td>0.001</td>
<td>± 5% full</td>
</tr>
<tr>
<td>0.167 to 1.67</td>
<td>0.01</td>
<td>scale each</td>
</tr>
<tr>
<td>1.67 to 16.7</td>
<td>0.1</td>
<td>range</td>
</tr>
</tbody>
</table>
Aperture Set (cm²)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 to 12</td>
<td>0.05</td>
<td>---</td>
</tr>
</tbody>
</table>

Pressure Set (kPa)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 to 105</td>
<td>0.2</td>
<td>---</td>
</tr>
</tbody>
</table>

Time On (seconds)

<table>
<thead>
<tr>
<th>Range</th>
<th>Resolution</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>45,800</td>
<td>0.7</td>
<td>± 0.05%</td>
</tr>
</tbody>
</table>

(=12 hours)

Relative Humidity Sensor: Vaisala Humicap® (thin-film capacitance type).

Temperature Coefficient: ± 0.05% per °C.

Response Time: <1 second at 20 °C.

Leaf Temperature: Chromel-constantan thermocouple, 0.051 mm Dia. (0.002").

Cuvette Temperature: Linearized thermistor.

Flow Measurement: Thermal-sensing mass flowmeter, temperature compensated. Three stages (autoranging) for a range of 0.001 to 16.7 standard cm³ per second (sccs).

Output

Cassette Tape: ≈1000 complete sets of data can be recorded on a 60 minute tape; requires 2229S leads (61 cm L); interfaced to computer system (RS-232C) using 1600-05A Cassette Tape Reader.

Computer: Direct RS-232C connection to computer system or printer, requires 2230S leads (61 cm L); 300 Baud standard, 2400 optional.

Sensor Head Attachments

Broadleaf Aperture, 1600-01 Narrow Aperture, 1600-02 Square Chamber, 1600-06 Small Aperture: Nickel-plated aluminum aperture caps with clear acrylic matching clamps. 1600-07 Cylindrical Chamber: Nickel-plated aluminum construction for low moisture absorption.

Display: Full 4-digit liquid crystal display (LCD).

Desiccant: Two stage desiccant (indicating silica gel).

Power Requirement: Rechargeable 6V sealed lead acid battery; or 92-138/184-276VAC, 50 to 400 Hz, 25 watt maximum.

Battery Capacity: 6 to 8 hours continuous operation at 25 °C. Low battery indication on the display and cassette tape.

Recharging Time: 12 to 16 hours, instrument non-operating. Charging circuitry built in. Battery can be charged during AC operation.

Battery Voltage Sensor: Automatically shuts instrument off before battery is completely discharged.

Operating Conditions: 0 to 50 °C, 0 to 95% RH (non-condensing).

Storage Conditions: -20 to 55 °C, 10 to 80% RH (non-condensing).

Readout Control Console

Size: 14.5 H × 25.4 W × 15.0 cm D (5.7" × 10.0" × 5.9").

Weight: 4.6 kg (10.2 lb.)

Sensor Head

Cuvette: Approx. 50 cm³ (3.1 in.³). Nickel-plated aluminum for low moisture adsorption.

Outer Cylinder: 6.3 cm Dia. × 11.5 cm L (2.5" × 4.5").

Weight: 1.0 kg (2.2 lb.).
LI-190S-1 Quantum Sensor

**Absolute Calibration:** ± 5% traceable to the U.S. National Institute of Standards and Technology (NIST).

**Sensitivity:** Typically 8 µA per 1000 µmol s⁻¹ m⁻².

**Linearity:** Maximum deviation of 1% up to 10,000 µmol s⁻¹ m⁻².

**Stability:** < ± 2% change over a 1 year period.

**Response Time:** 10 µs.

**Temperature Dependence:** ± 0.15% per °C maximum.

**Cosine Correction:** Cosine corrected up to 80° angle of incidence.

**Azimuth:** <± 1% error over 360° at 45° elevation.

**Tilt:** No error induced from orientation.

**Detector:** High stability silicon photovoltaic detector (blue enhanced).

**Sensor Housing:** Weatherproof anodized aluminum case with acrylic diffuser and stainless steel hardware.

**Size:** 2.38 Dia. × 2.54 cm H (0.94” × 1.0”).

**Weight:** 28 g (1 oz.).
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 or 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.

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