Warranty and Assistance

The **LI200S SENSOR** is warranted by CAMPBELL SCIENTIFIC, INC. to be free from defects in materials and workmanship under normal use and service for twelve (12) months from date of shipment unless specified otherwise. Batteries have no warranty. CAMPBELL SCIENTIFIC, INC.’s obligation under this warranty is limited to repairing or replacing (at CAMPBELL SCIENTIFIC, INC.’s option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to CAMPBELL SCIENTIFIC, INC. CAMPBELL SCIENTIFIC, INC. will return such products by surface carrier prepaid. This warranty shall not apply to any CAMPBELL SCIENTIFIC, INC. products which have been subjected to modification, misuse, neglect, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose. CAMPBELL SCIENTIFIC, INC. is not liable for special, indirect, incidental, or consequential damages.

Products may not be returned without prior authorization. The following contact information is for US and International customers residing in countries served by Campbell Scientific, Inc. directly. Affiliate companies handle repairs for customers within their territories. Please visit www.campbellsci.com to determine which Campbell Scientific company serves your country. To obtain a Returned Materials Authorization (RMA), contact CAMPBELL SCIENTIFIC, INC., phone (435) 753-2342. After an applications engineer determines the nature of the problem, an RMA number will be issued. Please write this number clearly on the outside of the shipping container. CAMPBELL SCIENTIFIC’s shipping address is:

**CAMPBELL SCIENTIFIC, INC.**
RMA#____
815 West 1800 North
Logan, Utah 84321-1784

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LI200S PYRANOMETER

1. GENERAL

This manual provides information for interfacing a CR10, 21X, and CR7 datalogger to a LI200S Pyranometer. An instruction manual provided by LI-COR contains the sensor calibration constant and serial number. Cross check this serial number against the serial number on your LI200S to ensure that the given calibration constant corresponds to your sensor.

2. SPECIFICATIONS

- 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
- Operating Temperature: -40 to 65°C
- Relative Humidity: 0 to 100%
- Detector: High stability silicon photovoltaic detector (blue enhanced)
- Sensor Housing: Weatherproof anodized aluminum case with acrylic diffuser and stainless steel hardware
- Size: 0.94” dia x 1.00” H (2.38 x 2.54 cm);
- Weight: 1 oz. (28 g)
- Accuracy: Absolute error in natural daylight is ±5% maximum; ±3% typical
- Typical Sensitivity: 0.2 kWm⁻²mV⁻¹
- Linearity: Maximum deviation of 1% up to 3000 Wm⁻²
- Shunt Resistor: Adjustable, 40.2 to 100 Ω, factory set to give the above sensitivity
- Light Spectrum Waveband: 400 to 1100 nm

NOTE: The black outer jacket of the cable is Santoprene® rubber. This compound was chosen for its resistance to temperature extremes, moisture, and UV degradation. However, this jacket will support combustion in air. It is rated as slow burning when tested according to U.L. 94 H.B. and will pass FMVSS302. Local fire codes may preclude its use inside buildings.

3. MEASUREMENT INSTRUCTION

The LI200S (refer to Figure 1) outputs a low level voltage ranging from 0 to a maximum of about 12mV depending on sensor calibration and radiation level. A differential voltage measurement (Instruction 2) is recommended because it has better noise rejection than a single-ended measurement.

If a differential channel is not available, a single-ended measurement (Instruction 1) is a possibility. As a test, wire the LI200S as shown in Figure 2 and make single-ended and differential measurements. Compare results to determine the acceptability of a single ended measurement.

NOTE FOR 21X USERS: Slight ground potential differences are created along the 21X analog terminal strip when the datalogger power supply is powering external peripherals. If the peripherals draw about 30mA or greater, the LI200S must be measured differentially.

INPUT RANGE

An example showing how to determine the optimum input range for a given sensor calibration and maximum irradiance follows. This is an example only. Your values will be different.
EXAMPLE

-Sensor Calibration: Assume the sensor calibration is 87 microamps kW\(^{-1}\) m\(^{-2}\). The LI200S outputs amperage which is converted to voltage by 100 ohm shunt resistor in the cable, as shown in Figure 1. To convert the calibration from microamps to millivolts, multiply the calibration by 0.100. The example calibration changes to 8.7 mV kW\(^{-1}\) m\(^{-2}\).

-Maximum Irradiance: A reasonable estimate of maximum irradiance at the earth’s surface is 1 kW m\(^{-2}\).

-Input Range Selection: An estimate of the maximum input voltage is obtained by multiplying the calibration by the maximum expected irradiance. That product is 8.61mV for this example. Select the smallest input range which is greater than the maximum expected input voltage. In this case the 15mV range for the 21X and CR7, and the 25mV range for the CR10 are selected.

Measurement integration time is specified in the input range parameter code. A more noise free reading is obtained with the slow or 60 Hz rejection integration. A fast integration takes less power and allows for faster throughput.

MULTIPLIER

The multiplier converts the millivolt reading to engineering units. Commonly used units and how to calculate the multiplier are shown in Table 1.

<table>
<thead>
<tr>
<th>UNITS</th>
<th>MULTIPLIERS</th>
</tr>
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<tbody>
<tr>
<td>kJ m(^{-2})</td>
<td>(1/C)*t (Total)</td>
</tr>
<tr>
<td>kW m(^{-2})</td>
<td>(1/C) (Average)</td>
</tr>
<tr>
<td>cal cm(^{-2})</td>
<td>(1/C)<em>t</em>(0.0239) (Total)</td>
</tr>
<tr>
<td>cal cm(^{-2})</td>
<td>min-1 (1/C)*1.434 (Average)</td>
</tr>
</tbody>
</table>

\[ C = (LI-COR \text{ calibration}) \times 0.100 \]
\[ t = \text{datalogger program execution interval in seconds} \]

4. OUTPUT FORMAT CONSIDERATIONS

The largest number that the datalogger can output is 6999 in low resolution and 99999 in high resolution (Instruction 78, set resolution). If the measurement value is totalized, there is some danger of overranging the output limits, as shown in the following example.

EXAMPLE

Assume that daily total flux is desired, and the datalogger scan rate is 1 second. With a multiplier that converts the readings to units of kJ m\(^{-2}\) and an average irradiance of .5 kW m\(^{-2}\), the maximum low resolution output limit will be exceeded in less than four hours.

Solution #1 - Record average flux density and later multiply the result by the number of seconds in the output interval to arrive at total flux.

Solution #2 - Record total flux using the high resolution format. The drawback to high resolution is that it requires 4 bytes of memory per data point, consuming twice as much memory as low resolution.

5. CONNECTIONS

Differential and single-ended connections to the datalogger are shown in Figures 2 and 3, respectively.
Please visit www.campbellsci.com to obtain contact information for your local US or International representative.