INSTRUCTION MANUAL

LI200S Pyranometer

Revision: 2/96

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

CAMPBELL SCIENTIFIC, INC. does not accept collect calls.

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 $kWm^{-2}mV^{-1}$
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.

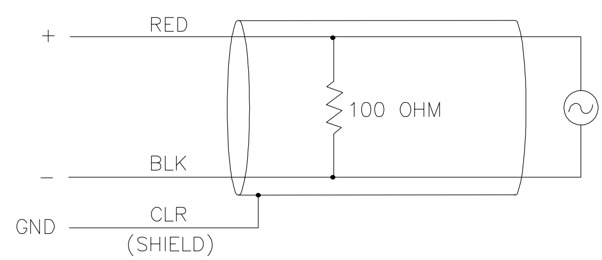


Figure 1. LI200S Schematic

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 1. Multipliers Required for Flux Density and Total Fluxes

UNITS	MULTIPLIERS	
kJ m-2	(1/C)*t	(Total)
kW m-2	(1/C)	(Average)
cal cm-2	(1/C)*t*(0.0239)	(Total)
cal cm-2 min-1	(1/C)*(1.434)	(Average)

C = (LI-COR calibration)*0.100
t = 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.

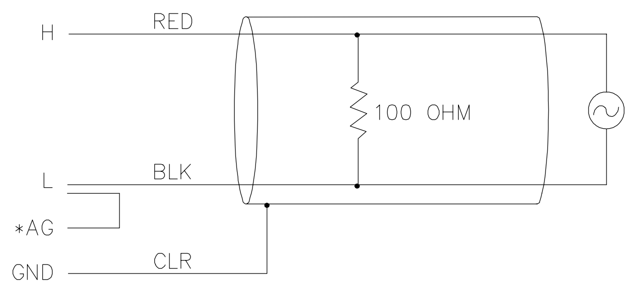


Figure 2. Differential Measurement Connection

*AG in Figure 2 refers to Analog Ground in the CR10 which is the same as ground for the 21X and CR7.

On a differential measurement, jumper the low side of the signal to AG to keep the signal in common mode range, as shown in Figure 2.

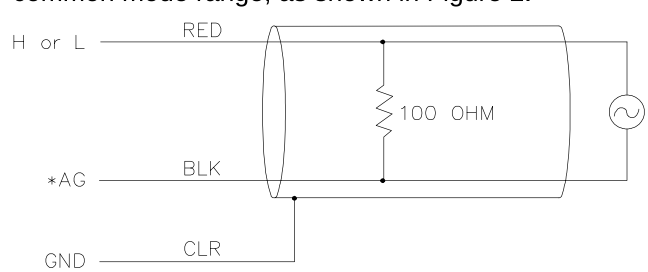
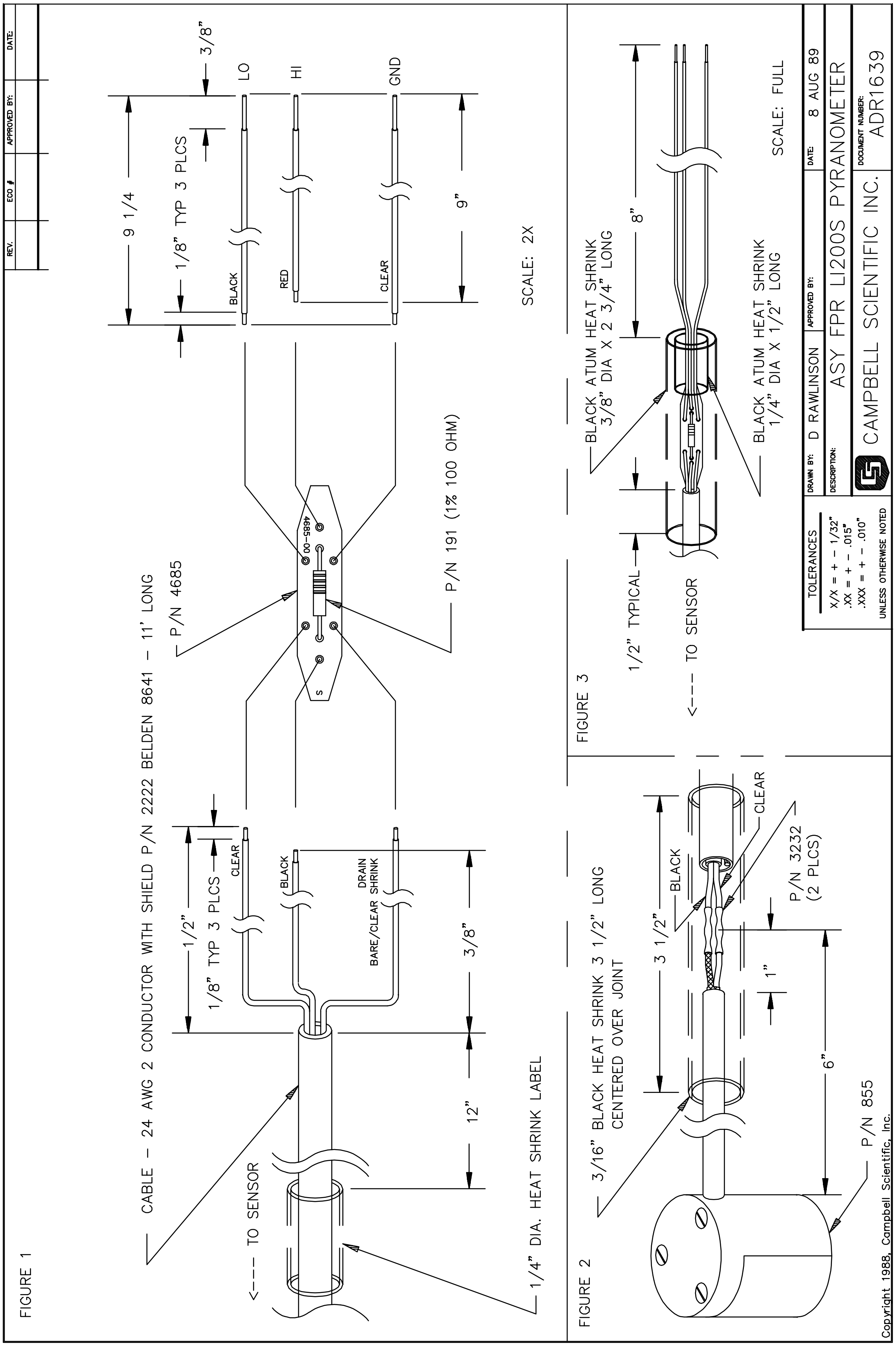


Figure 3. Single-ended Measurement Connection

*AG in Figure 3 refers to Analog Ground in the CR10, which is the same as ground for the 21X and CR7.



REV.
ECO #
APPROVED BY:
DATE:
FIGURE 1
CABLE - 24 AWG 2 CONDUCTOR WITH SHIELD P/N 2222 BELDEN 8641 - 11' LONG
<--- TO SENSOR
1/4" DIA. HEAT SHRINK LABEL
12"
3/8"
1/2"
1/8" TYP 3 PLCS
CLEAR
BLACK
DRAIN
BARE/CLEAR SHRINK
P/N 4685
4685-00
S
P/N 191 (1% 100 OHM)
9 1/4
1/8" TYP 3 PLCS
3/8"
LO
HI
GND
BLACK
RED
CLEAR
9"
SCALE: 2X
FIGURE 2
3/16" BLACK HEAT SHRINK 3 1/2" LONG
CENTERED OVER JOINT
3 1/2"
BLACK
CLEAR
P/N 3232
(2 PLCS)
1"
6"
P/N 855
Copyright 1988, Campbell Scientific, Inc.
FIGURE 3
<--- TO SENSOR
1/2" TYPICAL
BLACK ATUM HEAT SHRINK
3/8" DIA X 2 3/4" LONG
BLACK ATUM HEAT SHRINK
1/4" DIA X 1/2" LONG
8"
SCALE: FULL
TOLERANCES
X/X = + - 1/32"
.XX = + - .015"
.XXX = + - .010"
UNLESS OTHERWISE NOTED
DRAWN BY: D RAWLINSON
APPROVED BY:
DATE: 8 AUG 89
DESCRIPTION:
ASY FPR LI200S PYRANOMETER
CAMPBELL SCIENTIFIC INC.
DOCUMENT NUMBER:
ADR1639

Campbell Scientific Companies

Campbell Scientific, Inc. (CSI)
815 West 1800 North
Logan, Utah 84321
UNITED STATES
www.campbellsci.com
info@campbellsci.com

Campbell Scientific Africa Pty. Ltd. (CSAf)
PO Box 2450
Somerset West 7129
SOUTH AFRICA
www.csafrica.co.za
sales@csafrica.co.za

Campbell Scientific Australia Pty. Ltd. (CSA)
PO Box 444
Thuringowa Central
QLD 4812 AUSTRALIA
www.campbellsci.com.au
info@campbellsci.com.au

Campbell Scientific do Brazil Ltda. (CSB)
Rua Luisa Crapsi Orsi, 15 Butantã
CEP: 005543-000 São Paulo SP BRAZIL
www.campbellsci.com.br
suporte@campbellsci.com.br

Campbell Scientific Canada Corp. (CSC)
11564 - 149th Street NW
Edmonton, Alberta T5M 1W7
CANADA
www.campbellsci.ca
dataloggers@campbellsci.ca

Campbell Scientific Ltd. (CSL)
Campbell Park
80 Hathern Road
Shepshed, Loughborough LE12 9GX
UNITED KINGDOM
www.campbellsci.co.uk
sales@campbellsci.co.uk

Campbell Scientific Ltd. (France)
Miniparc du Verger - Bat. H
1, rue de Terre Neuve - Les Ulis
91967 COURTABOEUF CEDEX
FRANCE
www.campbellsci.fr
campbell.scientific@wanadoo.fr

Campbell Scientific Spain, S. L.
Psg. Font 14, local 8
08013 Barcelona
SPAIN
www.campbellsci.es
info@campbellsci.es

Please visit www.campbellsci.com to obtain contact information for your local US or International representative.