LI190SB
QUANTUM SENSOR

REVISION: 6/97

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

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LI190SB QUANTUM SENSOR

1. GENERAL

This manual provides information for interfacing a CR10(X), CR500, 21X, and CR7 datalogger to a LI190SB Quantum Sensor. 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 LI190SB 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)
Calibration:	±5% traceable to the U.S. National Institute of Standards Technology (NIST)
Sensitivity:	Typically 5 µA per 1000 µmoles $s^{-1}m^{-2}$
Linearity:	Maximum deviation of 1% up to 10,000 µmoles $s^{-1}m^{-2}$
Shunt Resistor:	604 ohms
Light Spectrum Waveband:	400 to 700 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.

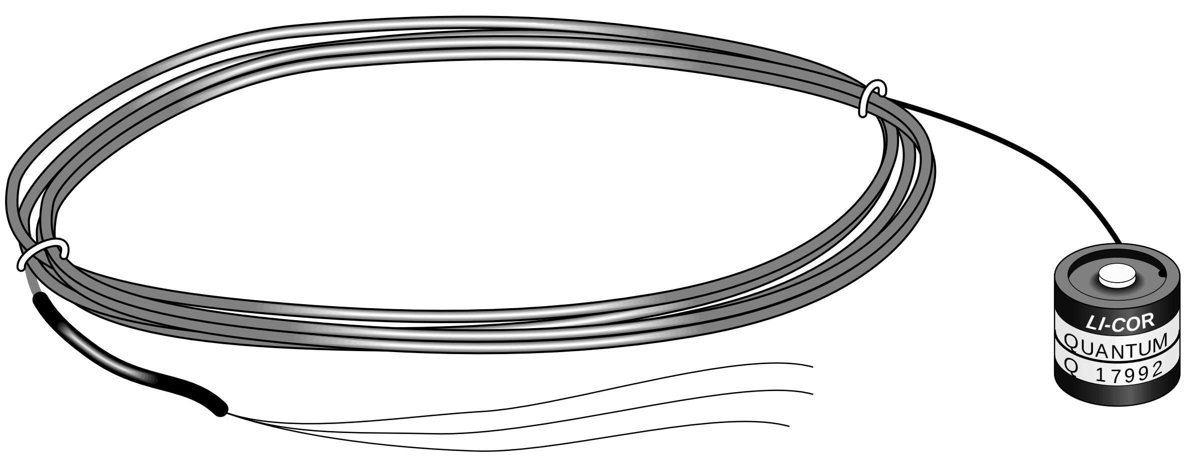


FIGURE 1. LI190SB Quantum Sensor

3. MEASUREMENT INSTRUCTION

The LI190SB is supported by Campbell Scientific's Short Cut program builder for the CR500, CR10(X), and 21X. This section describes the programming for those who use Edlog to create the datalogger program.

The LI190SB (refer to Figure 2) outputs a low level voltage ranging from 0 to a maximum of about 24 mV 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 LI190SB as shown in Figure 3 and make single-ended and differential measurements. Compare the 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 30 mA or greater, the LI190SB must be measured differentially.

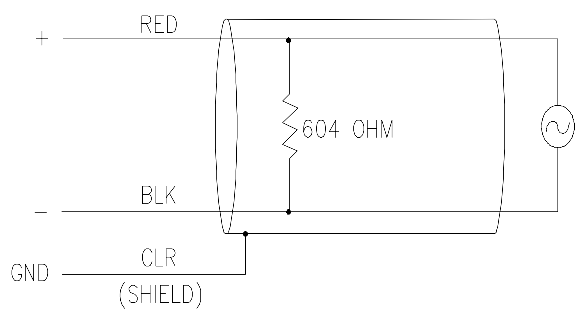


Figure 2. LI190SB Schematic

INPUT RANGE

An example showing how to determine the optimum input range for a given sensor calibration and maximum photosynthetically active radiation (PAR) is given below. **This is an example only. Your values will be different.**

EXAMPLE

-Sensor Calibration: Assume the sensor calibration is 8 microamps/1000 micromoles $s^{-1}m^{-2}$ (1000 micromoles = 1 mmole). The LI190SB outputs amperage which is converted to voltage by a 604 ohm shunt resistor in the cable, as shown in Figure 2. To convert the calibration from microamps to millivolts, multiply the calibration by 0.604. The example calibration changes to 4.83 mV/mmole $s^{-1}m^{-2}$.

-Maximum PAR: A reasonable estimate of maximum PAR is 2 mmoles $s^{-1}m^{-2}$.

-Input Range Selection: An estimate of the maximum input voltage is obtained by multiplying the calibration by the maximum expected PAR. That product is 9.66 mV for this example. Select the smallest input range which is greater than the maximum expected input voltage. In this case, the 15 mV range for the 21X and CR7, and the 25 mV range for the CR10(X) and CR500 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	MULTIPLIER
micromole s^{-1} m^{-2}	1000/C (flux density)
mmoles m^{-2}	(1/C)*t (total fluxes)

C = (LI-COR calibration)*0.604
t = datalogger program execution interval in seconds

Unit Conversions
microEinstien/micromole
(6.02×10^{17} photons s^{-1} m^{-2})/(µmoles s^{-1} m^{-2})

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 mmoles m^{-2} and an average PAR of 1 mmole s^{-1} m^{-2}, the maximum low resolution output limit will be exceeded in less than 2 hours (6999 seconds).

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 3 and 4, respectively.

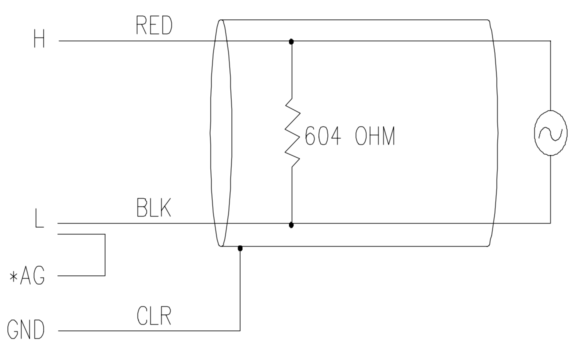


Figure 3. Differential Measurement Connection

*AG in Figure 3 refers to Analog Ground in the CR10(X) and CR500, 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 3.

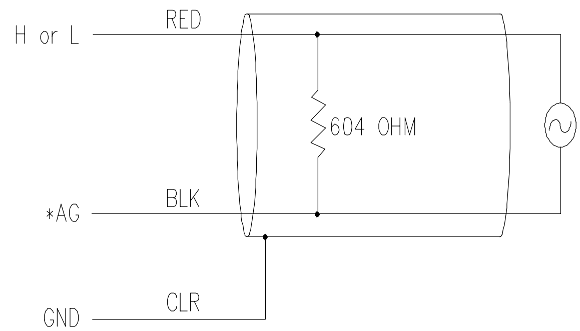
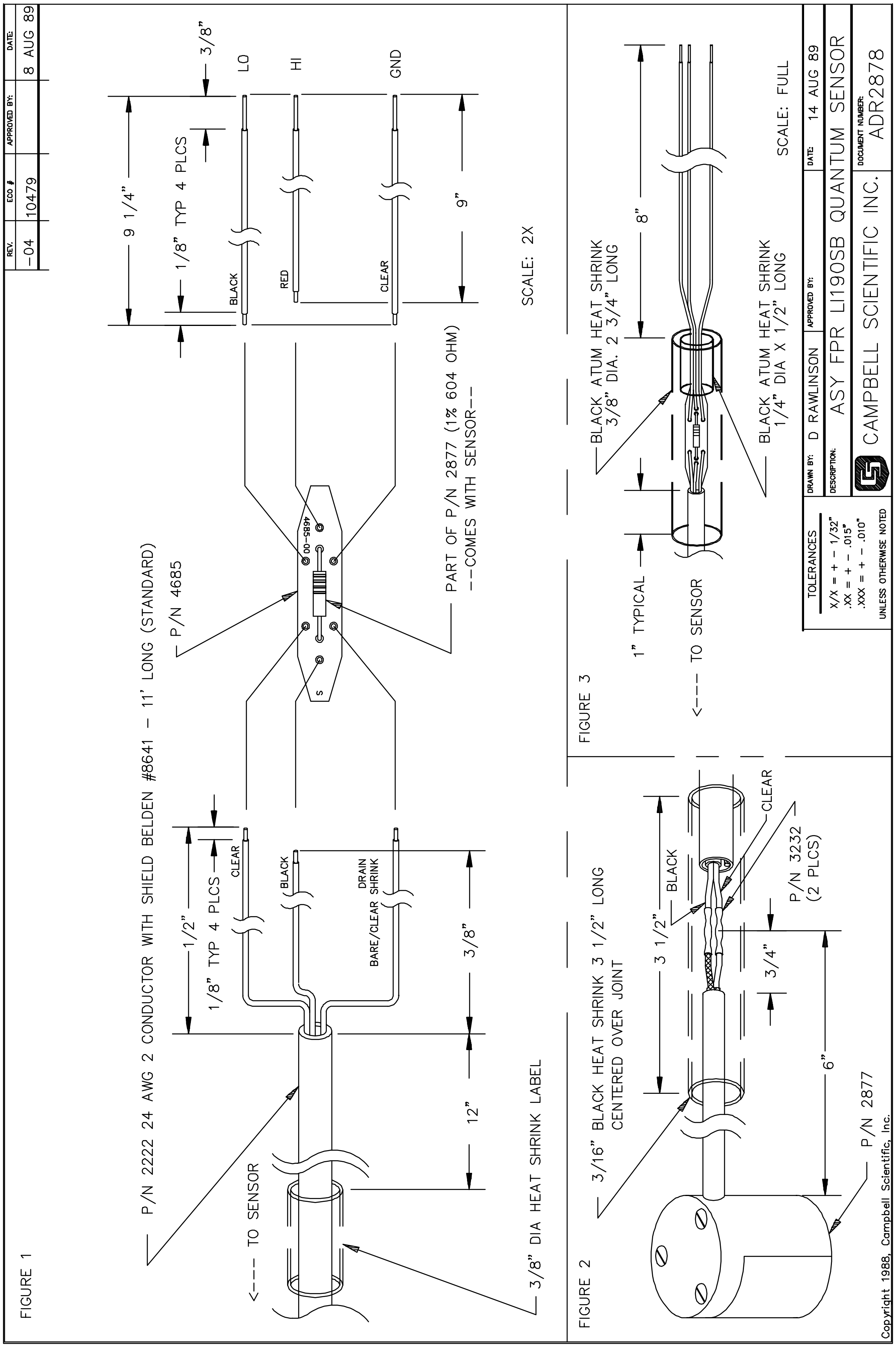


Figure 4. Single-ended Measurement Connection

*AG in Figure 4 refers to Analog Ground in the CR10(X) and CR500, which is the same as ground for the 21X and CR7.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APPROVED BY:
DATE:
8 AUG 89
FIGURE 1
P/N 2222 24 AWG 2 CONDUCTOR WITH SHIELD BELDEN #8641 – 11' LONG (STANDARD)
<--- TO SENSOR
3/8" DIA HEAT SHRINK LABEL
12"
3/8"
1/2"
1/8" TYP 4 PLCS
CLEAR
BLACK
DRAIN SHRINK
BARE/CLEAR
P/N 4685
4685-00
S
PART OF P/N 2877 (1% 604 OHM)
--COMES WITH SENSOR--
9 1/4"
1/8" TYP 4 PLCS
3/8"
9"
BLACK
RED
CLEAR
LO
HI
GND
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)
3/4"
6"
P/N 2877
FIGURE 3
<--- TO SENSOR
1" TYPICAL
BLACK ATUM HEAT SHRINK
3/8" DIA. 2 3/4" LONG
8"
BLACK ATUM HEAT SHRINK
1/4" DIA X 1/2" LONG
SCALE: FULL
TOLERANCES
X/X = + - 1/32"
.XX = + - .015"
.XXX = + - .010"
UNLESS OTHERWISE NOTED
DRAWN BY: D RAWLINSON
APPROVED BY:
DATE: 14 AUG 89
DESCRIPTION:
ASY FPR LI190SB QUANTUM SENSOR
CAMPBELL SCIENTIFIC INC.
DOCUMENT NUMBER:
ADR2878
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