

Quick Start Guide

Universal Current Loop Converter Amplifier for LI-COR™ Sensors

The UCLC is a special purpose amplifier. It converts the micro-amp level current output of LI-COR™ light sensors into an industry standard current-loop level. Using the internal switch settings, the UCLC can be configured at the factory (or by the end user) for any one of three standard LI-COR sensors. The UCLC provides a simple interface between LI-COR sensors and current loop signal processing equipment (such as data loggers, PLC's, industrial control equipment, HVAC, and green house control systems). Please visit www.emesystems.com/uclc_dat.htm for more information and documentation.



Connections Instructions:

The only tool required is a 3.8 mm or 0.15" slot screwdriver. To open the enclosure, loosen the captive screws at the two corners and lift the top. Please refer to the connection diagram below.

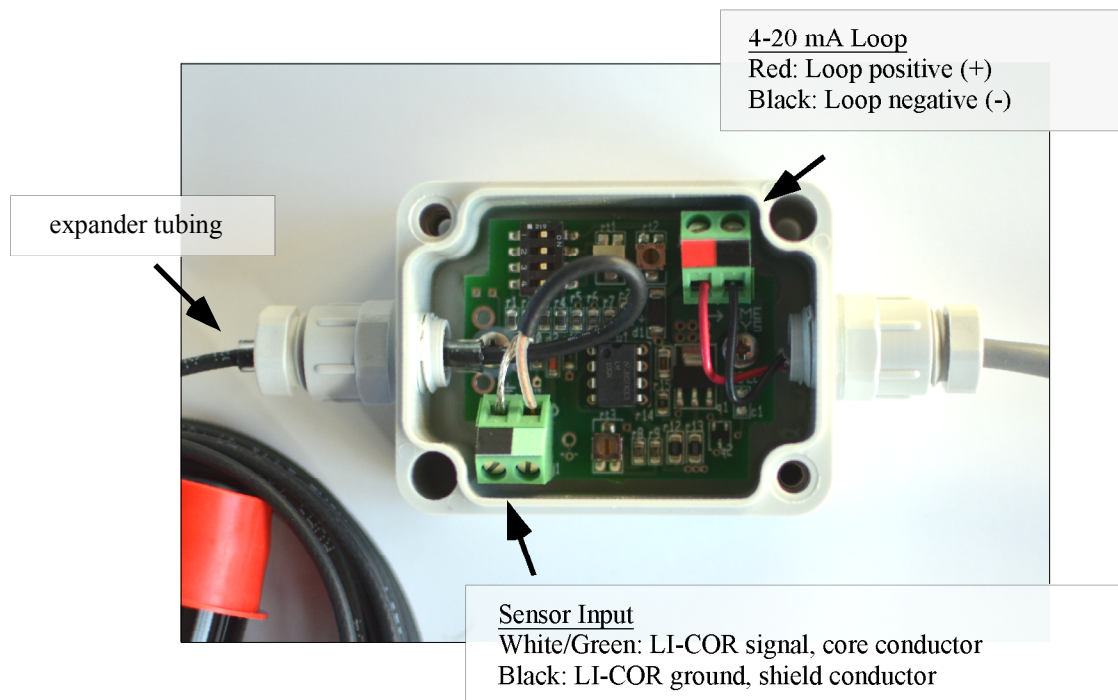
1) CONNECT LI-COR SENSOR to UCLC INPUT: Pass the LI-COR sensor cable through the expander tubing (included). Then pass the combination through the UCLC gland closest to the 2-terminal (BLACK/WHITE) connection block. Loosen the gland nut if necessary. Connect as follows:

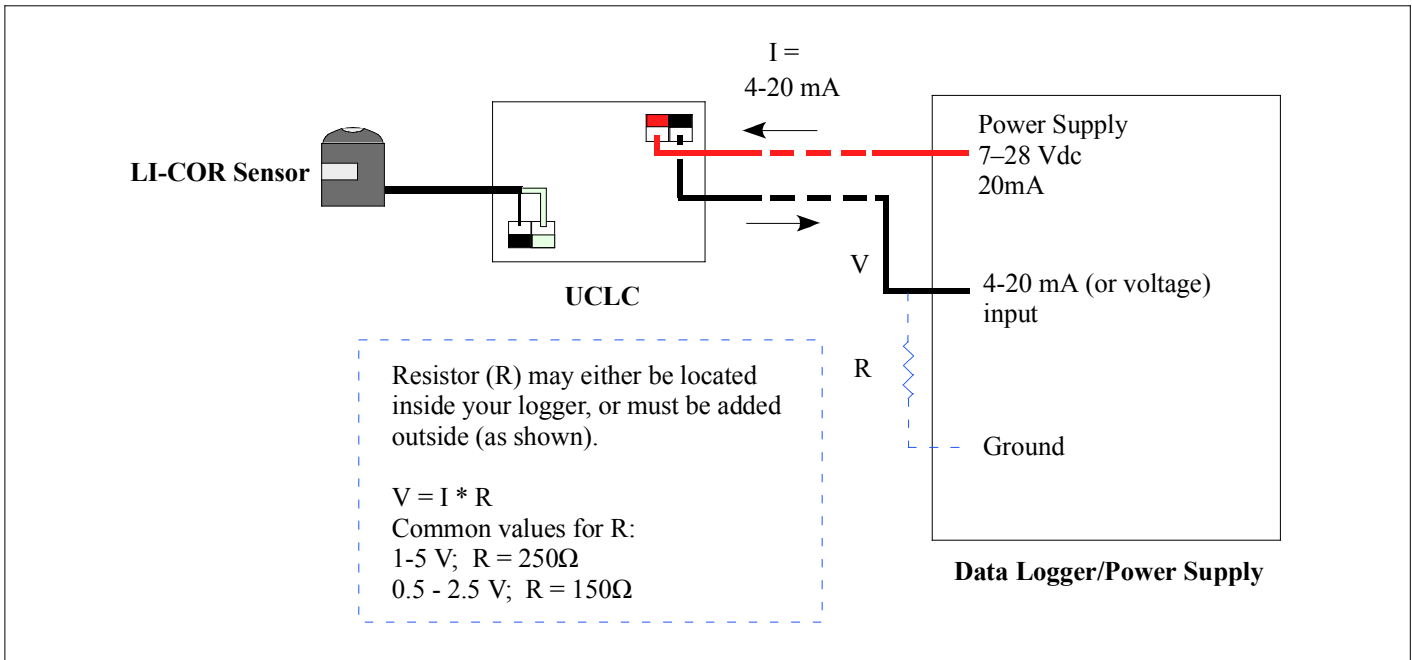
- LI-xxx, shield (ground) to black terminal.
- LI-xxx core conductor (signal) to white/green terminal.

2) CONNECT THE LOOP TO UCLC: Pass a 2-core cable (not included) through the UCLC gland closest to the BLACK/RED 2-terminal connection block. Use up to a 28 volts loop supply. Connect as follows:

- loop negative (-) to black terminal.
- loop positive (+) to red terminal.

To make sure that all wires are clamped solidly in place, tighten the gland nuts on both ends. Replace the top cover of the enclosure and tighten the corner screws. Take care not to over-tighten the cover screws. Over-tightening may cause the cover to deform or "saddle" which can compromise the seal.





Calculate Light Level:

The UCLC produces a loop current proportional to the light level. In order to convert the units, you will have to program your equipment with the following formula (or enter this formula for post processing in a program such as Microsoft EXCEL™).

$$\text{Light Level} = \frac{(\text{loop current} - 4\text{mA}) * (\text{LI-COR multiplier})}{(\text{UCLC current gain})}$$

Each individual LI-COR sensor has a distinct **calibration multiplier**. You can find the multiplier for your particular sensor on the calibration certificate that accompanies the sensor (in the *For use with LI-COR handheld meters* section). Please refer to the table below for **UCLC current loop gain** and light level units of measurement.

| Sensor | Light level units | UCLC current gain |
|----------------------|--|----------------------------------|
| LI-200 Pyranometer | Watts meter ⁻² per μA Typical full sun: 1,000 W/m ² | 0.128 mA/μA |
| LI-210 Photometer | klux per μA Typical full sun: 100 klux | 0.32 mA/μA |
| LI-190 Quantum PAR | μmoles meter ⁻² sec ⁻¹ per μA Typical full sun: 2,000 μM/m ² s | 1.0 mA/μA (16 μA FS) |
| | | or 1.28 mA/μA (12.5μA FS) |
| high gain, low light | special for low light levels | 4.57143 mA/μA |

Example: A pyranometer with a **multiplier** of **-9.8 W/m²/μA** is connected to an UCLC. According to the table above, the **UCLC current gain** for an LI-200 is **0.128 mA/μA**. Suppose you have a measured current of **14.5 mA**. Using the equation above, your light level is $(14.5 - 4) * 9.8 / 0.128 = 804 \text{ Watt/m}^2/\mu\text{A}$.

Installation Notes

1) A minimum of 4 volts must be maintained across the UCLC at all times. The necessary loop supply voltage will depend on voltage drops across other elements in the loop at full scale output. For example, a data logger that loads the loop with a 250Ω resistance, its voltage drop at 20mA full scale would be $250 * 0.02 = 5$ volts. This would require a power supply of $4 + 5 = 9$ volts or greater. The voltage across the UCLC should not exceed 28 volts. There is a Schottky diode in series with the loop at the amplifier input. The diode protects the circuit against polarity reversal.

2) If the UCLC is used with a voltage input logger or meter, the current loop must be terminated with a resistor. This will convert the loop current into corresponding voltage. The red wire should be connected to the positive supply voltage and the black wire should be connected to the logger's signal input with a precision resistor ($\pm 1\%$ or better) between the signal input and ground. Choose a termination resistor according to Ohm's law: $R = V / I$ where R is the resistor value, V is the maximum input voltage of your logger, and I is 0.02 amp.

3) The UCLC should be placed near the LI-COR sensor. The LI-COR sensors come with cable lengths of either 10 or 50 feet. The 4-20 mA loop will minimize the effect of noise and electro-magnetic interference. In cases where halide lamps, motors, or other strong noise sources are present use shielded, twisted-pair cable between the data logger and the UCLC for best results .

4) There is a 0.2 volt reverse bias across the input of the UCLC. Therefore, any resistance across the input will result in a current flow that cannot be distinguished from a signal. Because of this, a short circuit or resistor placed across the input is not equivalent to zero input signal. Only an open input is equivalent to zero signal. Do not allow leakage paths in parallel with the LI-COR sensor. The photodiode in the LI-COR sensor is a current source and will operate well with the small reverse bias.

Troubleshooting:

A) UCLC appears to be dead—the loop current is stuck at zero regardless of light conditions:

- 1) Make sure the protective red cap on the LI-COR sensor has been removed.
- 2) Check loop supply voltage and polarity at the red and black terminals of the UCLC circuit board.
- 3) Check sensor polarity, making sure the inner sensor wire is connected to the green/white, and that the outer shield wire is connected to the black terminal.
- 4) Check the screw terminal connections, make sure all of the wires are clamped solidly in place.
- 5) Check if the switch settings for selecting sensor type and loop gain are correct.
- 6) Check for evidence of water inside the enclosure. In regions of extreme humidity or precipitation it may be wise to place a desiccant such as silica gel inside the enclosure.
- 7) Has there been a lightning strike in close proximity to the sensor? Although the UCLC is protected against excess or reversed power supply voltages, it can not survive catastrophic extremes.

B) UCLC seems to be responding to light on the sensor, but the output is wrong:

- 1) Check the position of the switches on the PCB board.
- 2) Be sure the protective red cap on the LI-COR sensor has been removed, or that there is no dirt or debris blocking the sensor element.
- 3) Check that the loop supply is high enough.
- 4) If accessible, check the resistor that converts current into voltage at the input of your equipment.
- 5) Indoor lighting does not compare in intensity to full sunlight. The standard currents we use to set the full scale loop currents are designed to accommodate full tropical sunlight conditions. If you will be using your sensor in generally low-light conditions (for example indoors or underwater), you may wish to select a higher gain setting.
- 6) Check for leakage across the sensor, due to moisture, a damaged cable, or other causes.

C) The UCLC is working but the loop current is unstable under constant lighting conditions:

- 1) Check all of the connections to the screw down terminals. Make sure all connections are tight and secure.
- 2) Check for an AC component in the loop power supply. The power should be filtered DC.
- 3) Is the sensor too close to a strong electromagnetic field, such as a halide lamp or a motor? Route the cable away from AC power lines or outlets. Do not run the sensor cable in a conduit with AC wiring. Use shielded, twisted pair cable in extreme cases.

D) Often the UCLC is part of a system with a sensor, an analog to digital converter, and several layers of software routines to display or log readings. You want to know if the final reading is correct. Lacking an independent means of measuring light intensity, you must rely on the LI-COR sensor. Most quality digital multimeters can measure DC current down to 0.1 microamp or better:

Disconnect the LI-COR sensor from the UCLC and connect it directly to the multimeter and observe the microamp reading. Multiply the reading in microamps by the calibration multiplier provided by LI-COR. Without changing the light level, reconnect the sensor to the UCLC and to the rest of your system. If the readings agree, voila. If they disagree, you will have to check the various stages to find the problem. You can measure the output current of the UCLC directly with an ammeter to see if the transconductance gain is correct. If it is correct, the problem is not with the UCLC, rather it lies in the conversion math in the data logger or software.