LC8 & LC8-15

Single Level Lighting Controller

INSTALLATION AND MAINTENANCE MANUAL (IMM)

PLC Buildings
Lighting Control Systems

205 LC8 & LC8-15 Rev5

1 INTRODUCTON

1.1 General

Please read these instructions carefully to prevent any possible injury or equipment damage. For installation of the product, the installer must be a qualified and experienced technician. Prior to any installation, inspect the panel for damage and verify the product ratings to confirm that this product will satisfy your requirements and application.

The LC8 Lighting Controller is a generic term used throughout this document to describe both the

LC8 24VDC product as well as the LC8-15 15VDC product. Where there are differences these are clearly noted. The LC8 is used with either a CES or MAS sensor.

Note that PLC discontinued sales of the PC sensor several years ago and therefore it will no longer be supported by the LC8. Any replacement LC8 will also need a replacement sensor. PLC recommends the use of the MAS sensor due to the fact that it has a two conductor hookup similar to the PC sensor; therefore no new cabling is needed. Reference materials can be located on the PLC Multipoint website or by calling Customer Service at (425) 353-7552.

1.2 Overview

The LC8 Lighting Controller automatically switches a dry contact in response to change in natural daylight. The LC8 provides a maintained single pole, double throw relay output to drive electrically held contactors or relays, or has the ability to provide inputs to Energy Management Systems (EMS).

The LC8 can control incandescent, fluorescent or HID lighting. The low voltage controller requires a remotely mounted CES or MAS sensor. The LC8 controller provides Low and High setpoints, with a deadband to eliminate nuisance, intermittent changes.

2 INSTALLATION

The LC8 controller can be mounted anywhere that 24VDC or 15VDC can be provided, and with a wiring distance with-in 500' of the CES Sensor and/or 5000' of a MAS Sensor. The sensor should be mounted per its Installation and Maintenance Manual.

2.1 Power Connections

The LC8 +24VDC (+15VDC) power should be connected to Terminal 5 at the bottom of the controller board; DC Common should be connected to Terminal 4 (see Figure 1).

2.2 Load Connections

The LC8 Form C output has Common connected to Terminal 7 (LOAD RATING 3A MAX), the Normally Open contact is connected to Terminal 6, and the Normally Closed contact is connected to Terminal 8 (see Figure 1).

2.3 CES Sensor Connections

CES sensor has three (3) wires. The Yellow wire should be connected to Terminal 1 at the bottom of the controller board. The Black wire should be connected to Terminal 2 and the Red wire should be connected to Terminal 3 (see Figure 1).

2.4 MAS Sensor Connections

MAS sensor has two (2) wires. Using the MAS sensor with the LC8 requires the PC Replacement Kit (PCRK). Please consult the PCRK Installation and Maintenance Manual for further clarification. The Black wire should be connected to Terminal 2 and the Red wire should be connected to Terminal 3 (See Figure 2).

2.5 M-Series Simulator Connections

The M-Series simulator connections are the same as the CES sensor; remove the sensor if connected and attach the Yellow wire from the simulator to Terminal 1 at the bottom of the controller board.

The Black wire should be connected to Terminal 2 and the Red wire should be connected to Terminal 3 (see Figure 1).

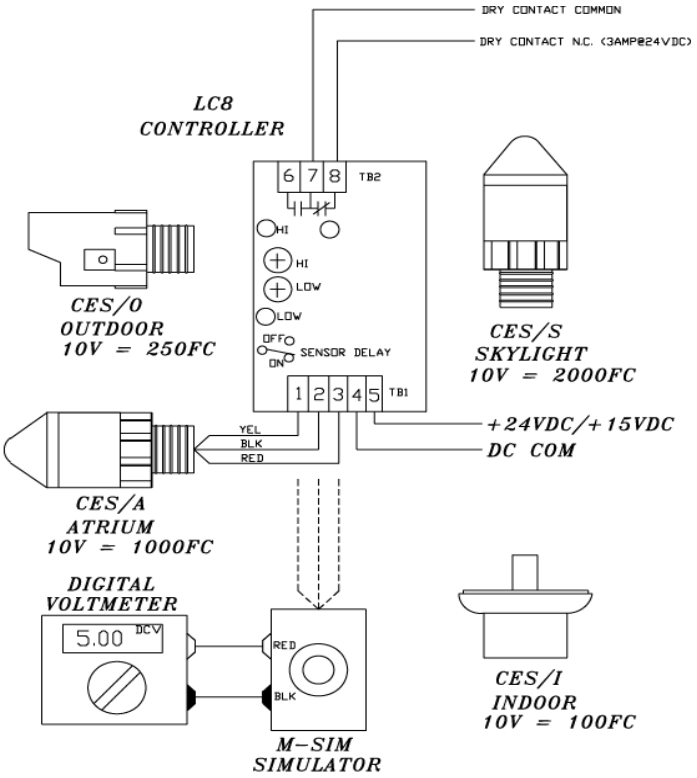

Figure 1: LC8 w/CES Sensor and M-Simulator

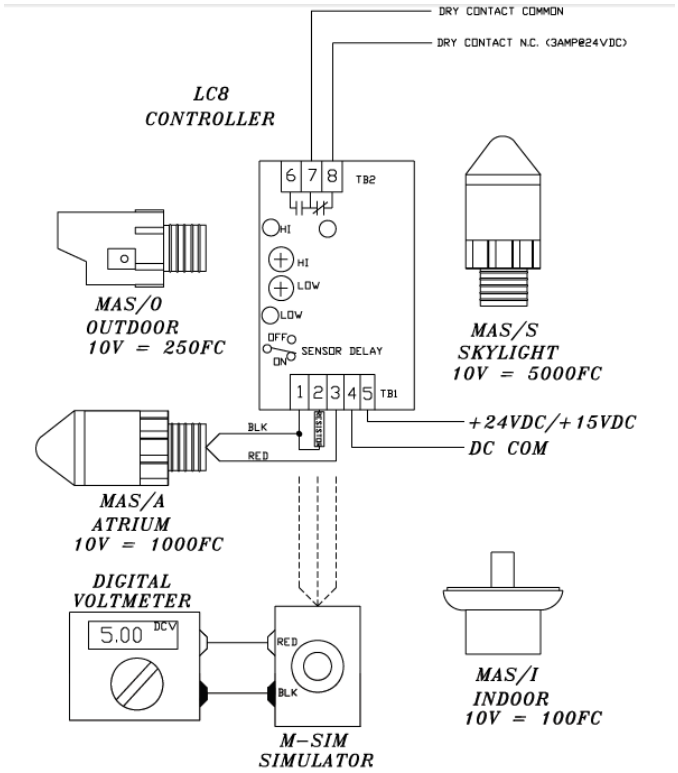

Figure 2: LC8 w/MAS Sensor and M-Simulator (Use of PCRK Required)

3 OPERATION

After installation, the LC8 will need to be properly calibrated if it was not ordered with pre-calibrated setpoints from the factory. In order to better understand the calibration procedures, a familiarity of the LC8 controller's parts and operating principles would be useful. Therefore, this section will describe in detail the various indicator LEDs, switch functions, control options, and sequence of operations.

3.1 High Level Setpoint and LED Indicator

The top trimpot labeled "OFF" (see Figure 3) sets the High Level Setpoint which is the level commonly set for dawn. As the sun rises, the LC8 will switch on both the relay and upper LED signifying that the lighting will be switched off. This setup is typical for most applications. Note that while the daylight is increasing the Low Level LED will illuminate, but this will be disregarded by the controller.

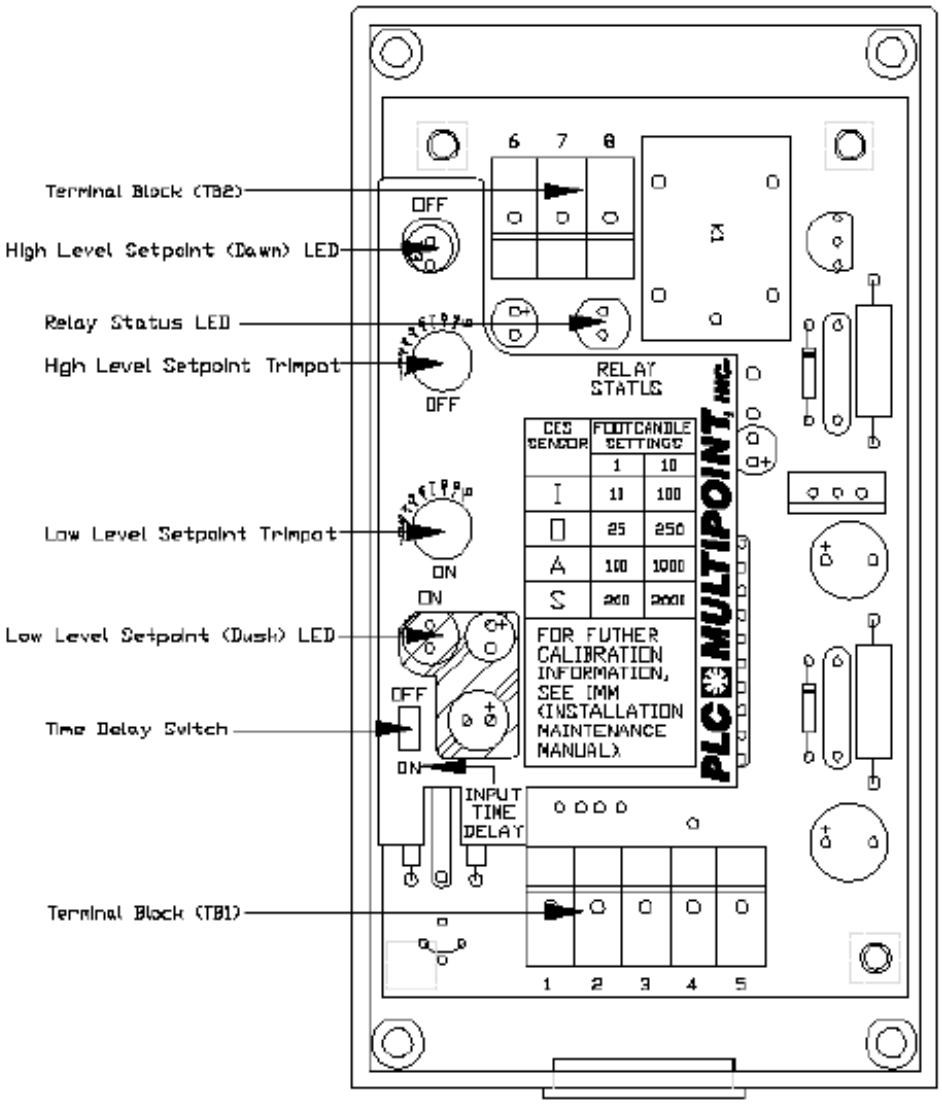

Figure 3: LC8 Controller with Placard

3.2 Low Level Setpoint and LED Indicator

The bottom trimpot labeled "ON" (see Figure 3) sets the Low Level Setpoint which is the level commonly set for dusk. As the sun sets, the LC8 will switch off both the relay and the lower LED signifying that the lighting will be switched on. This setup is typical for most applications. Note that while the daylight is decreasing the High Level LED will switch off, but this will be disregarded by the controller.

3.3 Relay

A single pole, Form C relay is provided with the LC8 controller. The Common is connected to Terminal 7, the Normally Open contact is connected to Terminal 6, and the Normally Closed contact is connected to Terminal 8.

3.4 Relay Status Indicator

The third LED located beneath Terminal 8 (See Figure 3) indicates the status of the LC8's relay. If the LED is lit, the relay is energized. Since this is a normally closed relay, energizing the relay will open its contacts. Therefore as described above if the LED is lit the lighting connected to the LC8 is off in typical dusk to dawn applications and if the LED is off the lighting connected to the LC8 is on in typical dusk to dawn applications.

3.5 Input Time Delay Switch

The Input Time Delay Switch (see Figure 3) when switched ON (Down Position), enables the time delay feature. With this feature enabled, a change of state must occur for a minimum of 30 seconds for the controller to react. This keeps transient lighting events such as lightning flashes or passing car headlights from switching the controlled lights OFF as well as temporary cloud cover from switching controlled lights ON.

3.6 Sequence of Operation

The LC8 operating sequence will be described below referencing Figure 4.

1. At dawn the sensed light level increases approaching the High Level Setpoint through the Low Level Setpoint, the Low Level Setpoint LED will switch ON, while the High Level Setpoint LED remains OFF. The output relay is de-energized with the Relay Status LED OFF and the lighting circuit ON. (See Figure 4A)
2. As the sensed light level increases and passes through the High Level Setpoint, the High Level Setpoint LED will switch ON energizing the Relay, and thus switching ON the Relay Status LED, and switching OFF the lighting circuit. The Low Level Setpoint LED will remain ON. (See Figure 4B)
3. The above status remains throughout the day as the sensor light level increases to the maximum light level and then starts to decrease towards dusk. As the light level passes through the High Level Setpoint the High Level Setpoint LED will switch OFF, leaving the Low Level Setpoint LED ON, and the Relay energized with the Relay Status LED ON. (See Figure 4C)
4. As the light level decreases through the Low Level Setpoint the Low Level Setpoint LED switches OFF. The relay de-energizes switching the Relay Status LED OFF, and thus switching ON the lighting circuit. (See Figure 4D).
5. As dawn approaches and the sensed light level again rises the lighting cycle is in position to repeat again.

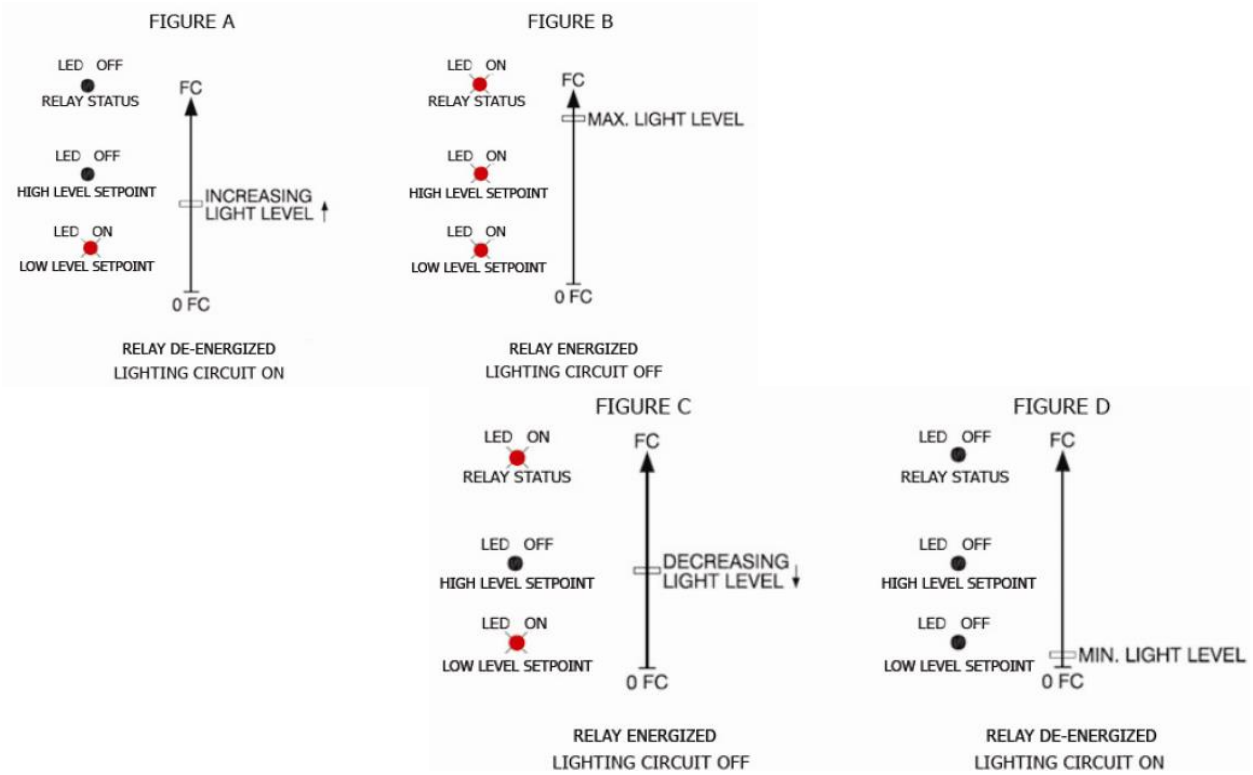

Figure 4: LC8 Sequence of Operation

It is important to note that the output relay does not change state while the input signal is in the deadband. The output relay will only change state when the ambient light level crosses the far setpoint in the light level's direction of travel.

4 CALIBRATION

The general theory behind ON and OFF setpoint calibration is to set the ON setpoint at a lower footcandle level than the OFF setpoint. This way, the controlled lights will not switch OFF during a period when they should be ON. The difference between the ON and OFF setpoints is called the Deadband. In general, the deadband should be large enough (about 10% of the expected calibration range) to provide system stability.

In a dusk-to-dawn lighting application, it is important to have a deadband sufficient to prevent confusing the control board as the desired setpoint is reached. To insure that lights are ON when needed, the deadband should be biased to leaving the lights ON longer rather than switching them OFF too soon.

4.1 Dusk-To-Dawn Calibration Procedure

The Dusk-To-Dawn technique of calibration has been developed that, when followed, will work well for most calibration needs. If specific footcandle settings are required, a M-Series simulator and following the Simulator Calibration Procedure in Section 4.2 is highly recommended. Additionally, if you have a different lighting application other than dusk-to-dawn, you should be able to discern the method of this technique and apply it to your situation.

The CES and MAS sensors have a very linear response which makes it simple to predict the setpoints of the LC8 Controller. Use of non-PLC sensors will likely make this task more difficult.

This procedure has been created in such a manner as to not require any sophisticated calibration equipment. Shown below are the tools needed for Dusk-To-Dawn calibration of the LC8.

- TOOLS NEEDED: SMALL FLATHEAD SCREWDRIVER 1/8”
- PROCEDURE: **begin this procedure just before dawn**

1. Switch the Input Delay Switch OFF (UP).
2. At the time during dawn when the daylight is at the level where you would want the lights to switch ON at dusk, turn both the High Level Setpoint and the Low Level Setpoint trimpots all the way counter clockwise so that both setpoint LEDs are ON. The Relay Status LED will be ON and the lighting circuit will be OFF.
3. Turn the Low Level Setpoint trimpot clockwise to the point that the Low Level Setpoint LED switches OFF. The Relay Status LED and lighting circuit will remain unchanged.
4. Wait for a period of time for the light level to increase (the Low Level Setpoint LED will switch back ON), and adjust the High Level Setpoint trimpot clockwise to the point that all LEDs switch OFF. The LC8 should now be calibrated for a dusk-to-dawn application.
5. Return the Input Delay Switch to the ON (DOWN) position. Note; the lights will switch Off at dawn, but if a greater deadband is required set the High Level Setpoint trimpot ahead of the Low Level Setpoint trimpot (adjust as required). Should the Dusk-to-Dawn lighting cycle fail to switch the lights ON and OFF as planned please refer to the Troubleshooting section of this manual.

4.2 Simulator Calibration Procedure

If you have the need to have more precise setpoints or would like to perform the calibration of the LC8 without waiting for ideal daylight conditions, PLC Multipoint provides this Simulator Calibration Procedure.

This procedure has been created to follow the example below.

EXAMPLE: A CES Outdoor sensor with an output signal of 0-10VDC (CES/O-0-10) will be used.

The CES Outdoor sensor is factory calibrated such that 250 footcandles will equal its full-scale output (In this case 10VDC).

The first step is to calculate the voltage value for the for the footcandle (Fc) level of the setpoint you are setting. In this example the desired High Level Setpoint will be 150Fc. Since the sensor has a linear response and the factory set full-scale range of this sensor at 250Fc, and, it should be readily apparent that 150 is 3/5 of 250, therefore 3/5 of 10VDC is 6VDC. Thus, the setpoint corresponding to 150Fc is 6VDC. Similarly, a Low Level Setpoint of 75Fc corresponds to a reading of 3VDC.

There are four styles of CES or MAS sensors that can be used with the LC8 and each has four output signal scales. For more information on the sensor please refer to its corresponding Installation and Maintenance Manual. Each type of CES or MAS sensor has a default setting for its full-scale sensitivity.

Each application will be different; therefore the values used in the procedure should be adjusted accordingly. Shown below are the tools needed for Simulator calibration of the LC8.

- TOOLS NEEDED: SMALL FLATHEAD SCREWDRIVER 1/8”
  M-SIM – PLC M-SERIES SIMULATOR
  DIGITAL VOLT METER (DVM)
- PROCEDURE: **this procedure may be performed at any time of day**

1. Switch the Input Delay Switch OFF (UP).
2. Plug the DVM into the Simulator and attach the Simulator to the LC8 in place of the Sensor (see Figure 1).
3. Set both the High Level Setpoint trimpot and the Low Level Setpoint trimpot fully counter clockwise.
4. With the DVM set to DC Volts and the Simulator OFF, switch ON the Simulator and rotate the knob clockwise until the DVM reads 6VDC.
5. Using a small flathead screwdriver, adjust the High Level Setpoint trimpot from clockwise until the corresponding LED switches OFF. This is the setpoint that will switch the lights OFF at dawn.
6. With the DVM set to DC Volts, rotate the knob counter clockwise on the Simulator until the DVM reads 3VDC.
7. Using a small flathead screwdriver, adjust the Low Level Setpoint trimpot clockwise until the corresponding LED switches OFF. This is the setpoint that will switch the lights ON at dusk. The LC8 should now be calibrated for the exact settings for this application.
8. Unplug the Simulator from the LC8 and rewire the Sensor in its place (see Figure 1).
9. Return the Input Delay Switch to the ON (DOWN) position.

Note: The condition of the LC8 should match the desired application. Should the LC8 fail to switch the lights ON and OFF as planned please refer to the Troubleshooting section of this manual.

4.3 Footcandle Settings Guide

The LC8 has a placard attached to the front of the controller which can be used as a reference guide for a CES 0-10 volt sensor, which is the most common application. Included below is an expanded guide for the CES sensors as well as a guide for the MAS sensors.

TICK MARK GUIDES

CES SENSOR	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Indoor "I"	10Fc	20Fc	30Fc	40Fc	50Fc	60Fc	70Fc	80Fc	90Fc	100Fc
Outdoor "O"	25Fc	50Fc	75Fc	100Fc	125Fc	150Fc	175Fc	200Fc	225Fc	250Fc
Atrium "A"	100Fc	200Fc	300Fc	400Fc	500Fc	600Fc	700Fc	800Fc	900Fc	1000Fc
Skylight "S"	200Fc	400Fc	600Fc	800Fc	1000Fc	1200Fc	1400Fc	1600Fc	1800Fc	2000Fc

Table 1: CES Sensor Footcandle Chart

MAS SENSOR	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Indoor "I"	NA	0Fc	12.5Fc	25Fc	37.5Fc	50Fc	62.5Fc	75Fc	87.5Fc	100Fc
Outdoor "O"	NA	0Fc	31.3Fc	62.5Fc	93.8Fc	125Fc	156.3Fc	187.5Fc	218.8Fc	250Fc
Atrium "A"	NA	0Fc	125Fc	250Fc	375Fc	500Fc	625Fc	750Fc	875Fc	1000Fc
Skylight "S"	NA	10Fc	625Fc	1250Fc	1875Fc	2500Fc	3125Fc	3750Fc	3475Fc	5000Fc

Table 2: MAS Sensor Footcandle Chart

5 SPECIFICATIONS

Input Voltage:	24VDC or 15VDC
Output:	Standard – Form C SPDT Relay
Capacity:	3 Amps resistive @ 24VDC
Input Sensor Type:	CES Photodiode – 3 wire or MAS Photodiode – 2 wire (with PCRK)
Input Time Delay:	30 seconds (may be overridden with the Input Time Delay Switch)
Dead Band:	Adjustable - 5-95%
Operating Temperature:	-12°F to +140°F (-11°C to 60°C)
Accuracy:	+/-1% at 70°F (21°C) +/-5% above 120°F or below 0° F. (49° C /-18° C)
Enclosure Dimensions:	4.75”H x 2.25”W x 1.5”D

6 LC8 TROUBLESHOOTING GUIDE

When an LC8 does not function as expected, the solution can usually be isolated to one of four possible problems. This guide will help to determine which problem(s) is preventing the proper operation of the LC8.

Observed Behavior	Possible Cause	Troubleshooting Instructions
LC8 does not switch state or the LEDs do not respond as expected	Lack of Power	Connect a DC voltmeter between Terminal 4 and Terminal 5. The reading should be 24VDC for the LC8 or 15VDC for the LC8-15
	Lack of Sensor Signal	Connect a DC voltmeter between the yellow and black wire (for CES) or red and black (for MAS). When the sensor is covered the reading should be 0VDC, 2VDC respectively. When the sensor is exposed to bright light the reading should be approximately 10VDC.
	Faulty Controller	Examine the gross functionality of the LC8 by doing the following: 1. Turn off the Input Time Delay Switch 2. Disconnect the Sensor – the lighting circuit should come on 3. Jumper Terminal 1 to Terminal 5 – the lighting circuit should go off
	Poor Calibration	Review the Calibration Procedures in Section 4.
Lighting Circuits Cycling	Poor Calibration / Sensor Mounting	The deadband will likely need to be increased. It is common for the mounting of a sensor to result in a reading of the sensor being influenced by the lighting circuit that it is controlling. The additional light contribution of the circuit should not allow the lights to be turned back off.

Table 3: Trouble Shooting Guide

NOTE: For additional technical support please call
PLC Customer Service at (425) 353-7552 or (866) 998-5483