LC8 CONTROLLER BOARD INSTALLATION AND MAINTENANCE MANUAL (IMM) p/n 52280T rev 9/11/07

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GENERAL

1. Please read these instructions carefully to prevent any possible injury or equipment damage.
2. Installer must be a qualified and experienced service technician.
3. Verify the product ratings to confirm that this product will satisfy your requirements and application.

INTRODUCTION

The LC8 controller is a single channel lighting controller that features an adjustable ON setpoint as well as an adjustable OFF setpoint. This feature allows a signal dead-band to be calibrated that is of sufficient size to lend stability to the lighting circuit (s) being controlled. Another feature that adds stability to the circuits is the Input Time Delay. This feature allows the controller to prevent transient lighting events (i.e. lightning flashes or car headlights) from switching circuits. A Hold-On Timer is usually added to ensure minimum warm-up times for HID fixtures. The LC8 can be used with either a CES or PC sensor.

INSTALLATION

The LC8 controller can be mounted anywhere that 24VAC or DC can be provided. If a CES sensor is to be used, a 24VDC power source is required. Sensor should be mounted per the Installation Instructions in its Installation and Maintenance Manual.

Power Connections

If the LC8 is being used with a CES sensor, =24VDC should be connected to Terminal 5 at the bottom of the controller board, -24VDC should be connected to Terminal 4. **(See Fig. 1)**

Load Connections

A single pole, Form C relay is located near the top right corner of the LC8 controller. Its contact ratings are 10A @ 125VAC and 6A @ 277VAC. The Common is tied to Terminal 7, the Normally Open contact is tied to Terminal 6, and the Normally Closed contact is tied to Terminal 8. **(See Fig 1)**

Sensor Connections

If a CES sensor is used, the **Yellow** wire should be connected to Terminal 1 at the bottom of the controller board. The **Black** wire should be connected to Terminal 4 along with the -24VDC supply and the **Red** wire should be connected to Terminal 5 along with the +24VDC supply. **(See Fig 1)**

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 lights, switch functions, control options, and sequence of operations.

Low Level Setpoint And LED Indicator

The bottom trimpot **(See Fig. 1)** sets the Low level setpoint which is the level at which the LC8's relay will energize. When the bottom LED will be lit the signal from the sensor is below this setpoint.

High Level Setpoint And LED Indicator

The top trimpot **(See Fig. 1)** sets the high level setpoint which is the level at which the LC8's relay with de-energize. When the signal from the sensor is above this set-point, the top LED will be lit.

Relay Status Indicator

The third LED located beneath Terminal 8 **(See Fig. 1)** indicates the status of the LC8's relay. If the LED is lit, the relay is energized.

Relay

A single pole, Form C relay is located near the top right corner of the LC8 control-ler. Its contact ratings are 10A@125VAC and 6A@277VAC. The Common is tied to Terminal 7, the Normally Open contact is tied to Terminal 6, and the Normally Closed contact is tied to Terminal 8.

Input Time Delay Switch

The Input Time Delay Switch **(See Fig. 1)** when switched **ON** (Down Position), prevents the real-time signal from the sensor from switching the state of the relay, if it should cross a setpoint, for 30 seconds. This keeps transient lighting events such as lightning flashes or passing car headlights from switching the controlled lights OFF.

Hold-On Timer

The Hold-On Timer is an option that is used to ensure that HID lights are kept ON for at least 30 minutes before allowing them to switch off. This greatly increases the lamp life of HID fixtures. The 30 minute period begins from the moment the controlled lights are switched ON in the AUTO mode. If the controller attempts to switch the lights OFF before the 30 minute period has elapsed, the lights will stay ON for the remainder of the 30 minute period. The timer connects to a four-pin connector just above the bottom row of terminals.

Sequence of Operation

The LC8 controller use CES sensors and the operating sequence will be described on **Fig. 3,** which shows the difference between the two sequences. (LC8 with PC sensor will no longer be supported. Reference for LC8 with PC sensor is available on our website.) The High Level and Low Level indicator LEDs will operate the same, the relay and its indicator LED will operate exactly opposite of each other.

1. When the sensed light level is in the zone above the High setpoint, the output relay is energized. The High and Low LEDs are OFF. **(See Fig. 3A)**
2. As the sensed light level decreases and passes into the deadband (below the High setpoint), the High LED switches ON and the Low LED remains OFF. The output relay is still energized. **(See Fig. 3B)**
3. When the sensed light level drops below the Low setpoint, the output relay is de-energized. Now, both the High and the Low LEDs are switched ON. **(See Fig. 3C)**
4. As the sensed light level rises again into the deadband (above the Low setpoint), the Low LED switches off and the output relay remains de-energized. **(See Fig. 3D)**
5. When the sensed light level rises above the High setpoint, the High LED will also switch OFF and the output relay will energize. **(See Fig. 3E)**

NOTE: THE CYCLE IS NOW SET TO REPEAT ITSELF.

The main observation to make is that the output relay does not change state while the input signal is in the deadband. It is only by crossing the far setpoint in the light level's direction of travel that causes a change of state.

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 turn 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%) to provide system stability. That is to say, the controller can become "confused" if the ON and OFF setpoints are set too close together. The deadband can and should be made larger in circumstances where an increase in ambient lighting conditions after the ON setpoint was reached warrant a higher OFF setpoint to keep the controlled lights on. One example might be an illuminated sign that turns ON after the ON setpoint was reached and that is within view of the sensor. This additional contribution to the sensor's signal should not be allowed to switch the controlled lights back OFF. Therefore, the deadband is increased by raising the OFF setpoint above that of the amount of light the sign contributes.

PC vs. CES Sensors (PC Sensor is now obsolete.)

There are two main differences between PC sensors and CES sensors.

1. The PC sensor returns a high signal in dark conditions while the CES sensor returns a low signal in dark conditions.
2. The CES sensor has a very linear response that can be easily predicted while the PC sensor in nonlinear and has enough variability from one sensor to the next so as to make predicting setpoint values cumbersome at best.

Because of these differences, a "Seat of the Pants" technique of calibration has been developed that, when followed, will work equally well for both type of sensors. If specific footcandle settings are required, a CES sensor and the use of a PC simulator are highly recommended. Since the vast majority of LC8 controllers are used in dusk/dawn applications, the "Seat of the Pants" technique is based upon this lighting application. If you have a different lighting concern, you should be able to discern the method of this technique and apply it to your situation.

SEAT-OF-THE-PANTS LC8 CALIBRATION GUIDE

Calibrating an LC8 Lighting Control System without technical equipment for dawn and dusk operation.

TOOLS NEEDED: SMALL FLATHEAD SCREWDRIVER
SENSE OF ELAPSED TIME (OR WRISTWATCH)

THEORY

In a dusk/dawn lighting application, it is important to have a deadband built into the calibration to prevent confusing the control board as the desired setpoint is reached. To insure that lights are ON when need, the deadband errors on the side of leaving the lights ON a little to long rather than turning them OFF too soon.

PROCEDURE

1. Turn the Hold-ON-Timer OFF (Out position or remove jumper P2).
2. Switch the Input Delay Switch OFF (UP).
3. In the morning, as the sky is becoming brighter, imagine that you are looking at the evening sky.
4. Though the sky is getting brighter, when the ambient light level is such that, if it were evening, you would desire the controlled lights to switch ON. Use a small flathead screwdriver to adjust the bottom trimpot until the bottom LED switches OFF. Then adjust it back counterclockwise until the LED just switches to full ON.
5. Wait for approximately 15 to 20 minutes while the sky continues to brighten. Then adjust the top trimpot until the top LED switches OFF. Then adjust it back counterclockwise until the LED just switches to full ON.
6. Switch the Input Delay Switch back ON (DOWN).
7. Switch the Hold-ON-Timer back ON (IN position or replace jumper P2).

The LC8 controller should now be usefully calibrated for a dusk/dawn application. There is a possibility that the controlled lights will remain switched ON at this point due to the Hold-ON-Timer needing to finish its cycle. If the controlled lights do not switch OFF within 30 minutes refer to the troubleshooting section of this manual.

LC8 SETPOINT CALIBRATION USING A PC SIMULATOR

If you have an LC8 controller that utilizes a CES sensor and have access to a PC Simulator, it is quite easy to set specific ON and OFF setpoints based on desired footcandle levels and to replicate those setting in other LC8 units. There are four styles of CES sensors and each has four output signal scales. Fore more information on CES sensors, you are referred to the CES Installation and Maintenance Manual. Each type of CES sensor has a default setting for its full-scale sensitivity.

EXAMPLE 1:

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 PC Simulator is a hand held unit that has an adjustable knob on the front, a length of wire with a phone plug on the end, and two jacks that accept test leads from a DVM.

EXAMPLE 2:

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 setpoint will be 150Fc. Since the factory set full-scale range of this sensor at 250Fc, and the sensor has a linear response, it should be readily apparent that since 150 is 3/5 of 250, a quick calculation will show that 3/5 of 10VDC is 6VDC. Therefore, the setpoint should be set to 6VDC (for a less obvious fraction, a calculator could be handy). Then use the following procedure:

1. Switch the Hold-ON-Timer OFF (OUT position or remove jumper P2).
2. Switch the Input Delay Switch OFF (UP).
3. Plug a DVM into the PC Simulator and plug the PC Simulator's phone plug into the LC8 controller's phone jack (**See Fig. 1**).
4. With the DVM set to DC Volts, rotate the knob on the PC Simulator until the DVM reads 6VDC.
5. Using a small flathead screwdriver, adjust the desired trimpot clockwise until the corresponding LED switches OFF. Then adjust it back counterclockwise until the LED just switches to full ON.
6. Repeat steps 5 and 6 for the other trimpot using the desired value for that setting.
7. Switch the Input Delay Switch back ON (Down).
8. Switch the Hold-ON-Timer ON (IN position or replace jumper P2).

SPECIFICATIONS

Accuracy: +/-1% at 70 F (21 C) Derated to +/-5% above 120 F or below 0 F. (49 C /-18 C)

Operating Temp: -13 F. to +140 F. (-11 C to 60 C)

Sensor Type: Blue-enhanced Photo Diode

Sensor	Lens	Filter	Mounting	Orient	Height	Dia
CES/I	Fresnel	Clear	Ceiling	Down	2.00”	1.23”
CES/O	Flat	Clear	1/2” IPT	Horizontal	1.85”	1.28”
CES/A	Dome	Opaque	1/2” IPT	Horizontal	2.25”	1.28”
CES/S	Dome	Dark	1/2” IPT	Up	2.25”	1.28”
CES/IL	Fresnel	Clear	Ceiling	Down	2.00”	1.23”

Input Voltage: 120VAC or 277VAC standard

Dead Band: Adjustable 5 - 95%

Input Delay: Standard - 30 second sensor (with override switch)

Output LC81: 2 120/277VAC 20A N.O. Contact

LC82: 4 120/277VAC 20A N.O. Contact

Load: Incandescent, Fluorescent & HID

Enclosure LC81: NEMA 3R 8”H x 8”W x 6”D

LC82: NEMA 3R 12”H x 12”W x 6”D

Control Modes: HAND: Force lights ON

OFF: Force lights OFF

AUTO: Photo sensor control (ON at LOW, OFF at HIGH setpoint)

Control Input: CES sensors & PC Simulator

Indicators: Red High & Low LED’s Door & Board Red Relay on LED

LC8 TROUBLESHOOTING GUIDE

When an LC8-Photo-controller doesn't 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.

The first step in troubleshooting the Photo-Control System is to confirm that the LC8 is receiving 24 volts AC or DC at terminals 4 & 5 at the bottom of the board. If the LC8 is being supplied with 24VDC, terminal 4 should be -24VDC and terminal 5 should be +24VDC.

With proper power to the Photo-controller, attention should turn to the sensor. First disconnect the sensor from the LC8 and connect the two green wires to the leads of an ohmmeter. Then, by alternately covering the sensor and exposing the sensor to light, the meter should show a change of resistance that will usually swing between ranges of less than 100K ohms and several Meg ohms. If there is no change in resistance during this test, the sensor is probably faulty and should be replaced.

A CES sensor will produce a 0-10v signal on its yellow wire. Connect a DC voltmeter between the Yellow and Black wires. When covered, the sensor should produce 0 VDC and when in bright light, the sensor should produce approximately 10 VDC. If this does not happen, the sensor is probably faulty and should be replaced.

If the sensor is functioning, the LC8 should then be examined for it's gross functionality. That is to say, despite the setpoint adjustments, will the LC8 turn it's relay on and off at the extremes of possible input signals. To perform this test, the Input Delay switch must be turned off (up position). This switch is located just below the bottom LED on the LC8 board. Also, if a Hold On Timer is being used, it must be turned off (switched to OUT position). At this time, with no sensor connected to the LC8, all three LEDs should be lit. Then, with the sensor still disconnected, short terminals 1&2 together. The LEDs should turn off. When the short is removed, the LEDs should come back on. If this does not happen, the LC8 is probably faulty and should be replaced.

If the LC8 passes the above test, then the problem most likely is in poor setpoint adjustment. There are several methods of correctly setting the ON and OFF setpoints. A few of the more technical methods are mentioned in previous sections of this manual.

The last possible problem could occur if the optional Hold-On-Timer is being used. If the Timer is functioning properly, the relay on the LC8 will remain ON (as indicated by the LED located just below terminal 8 near the top of the board) for a minimum of 1/2 hour once the ON setpoint is reached. After the 1/2 hour is passed, if the relay is being held on despite all indications that the OFF setpoint has been reached, turn the Hold-IN-Timer switch to OUT. If the relay goes OFF, the Hold-ON-Timer is probably faulty and should be replaced.

If all tests were passed and the setpoints are properly adjusted, the Input Delay switch should be returned to the ON position (down) and the Hold-ON-Timer (if used) should be set back to the IN position.

CALIBRATION PLACARD

If the LC8 controller has a plastic placard attached to its front and a CES 0-10 volt sensor is providing the input signal, the ON and OFF setpoints can be relatively easily selected by using the following table.

TICK MARK

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

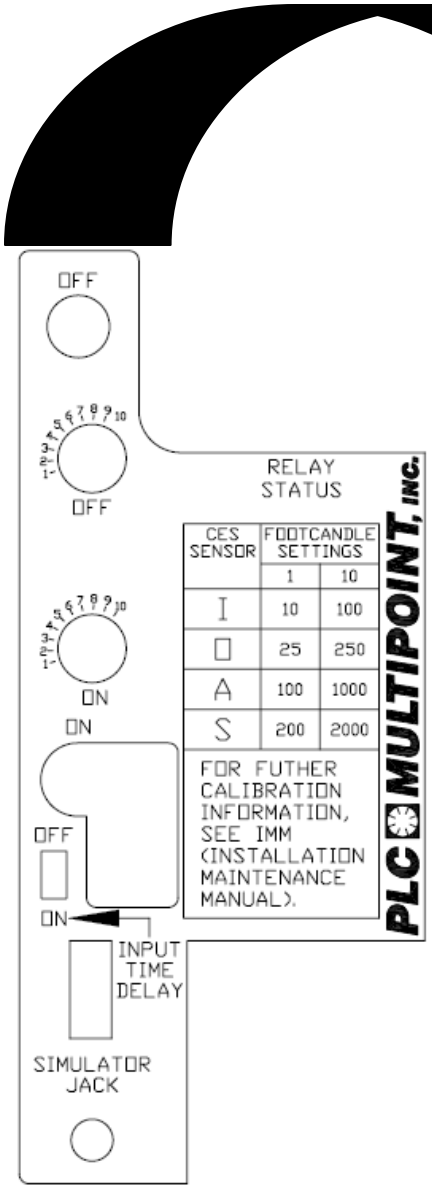
EXAMPLE 1:

If a CES/O-0-10 (Outdoor) sensor is providing the input signal and it is desired to switch lights ON at 30Fc and back OFF at 50Fc, the bottom trimpot should be set just slightly more than 1 and the top trimpot should be set to 2.

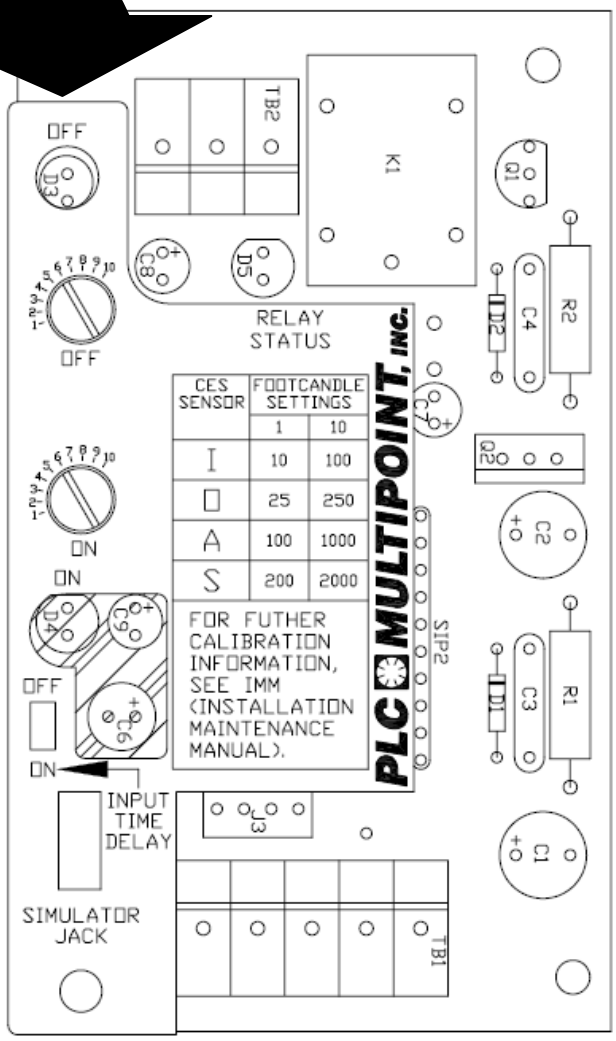
EXAMPLE 2:

If a CES/S-0-10 (Skylight) sensor is providing the input signal and it is desired to switch lights ON at 1200Fc and back OFF at 1400Fc, the bottom trimpot should be set to 6 and the top trimpot should be set to 7.

See LC8 Tick Marks Template in page 11, these should provide guidance when setting OFF and ON footcandle settings (1 tick = 10Fc).



LC8 Tick Marks Template



LC8 Controller Board with Tick Marks Template

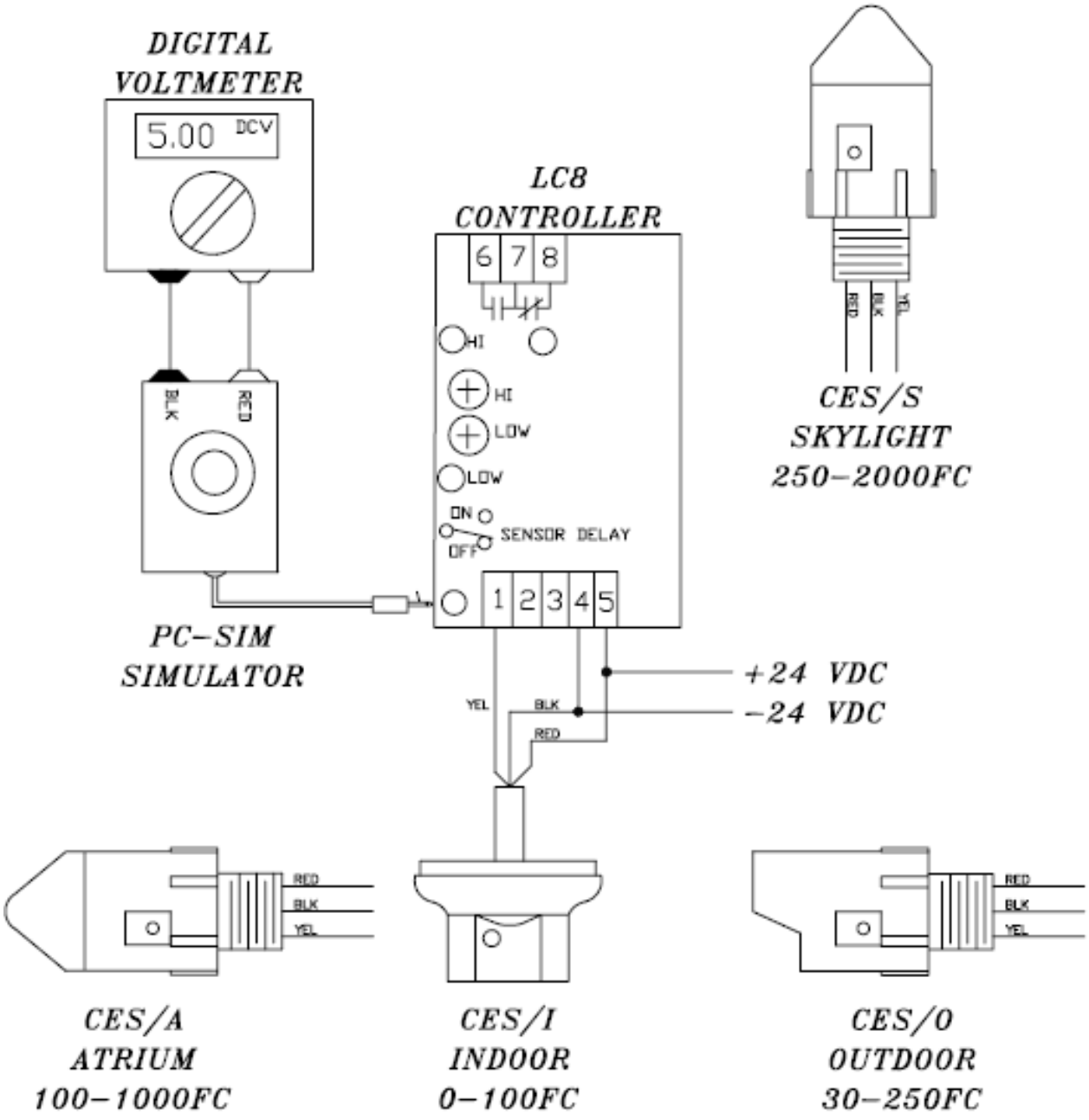


FIGURE 2: LC8 WITH CES SENSOR & PC SIMULATOR

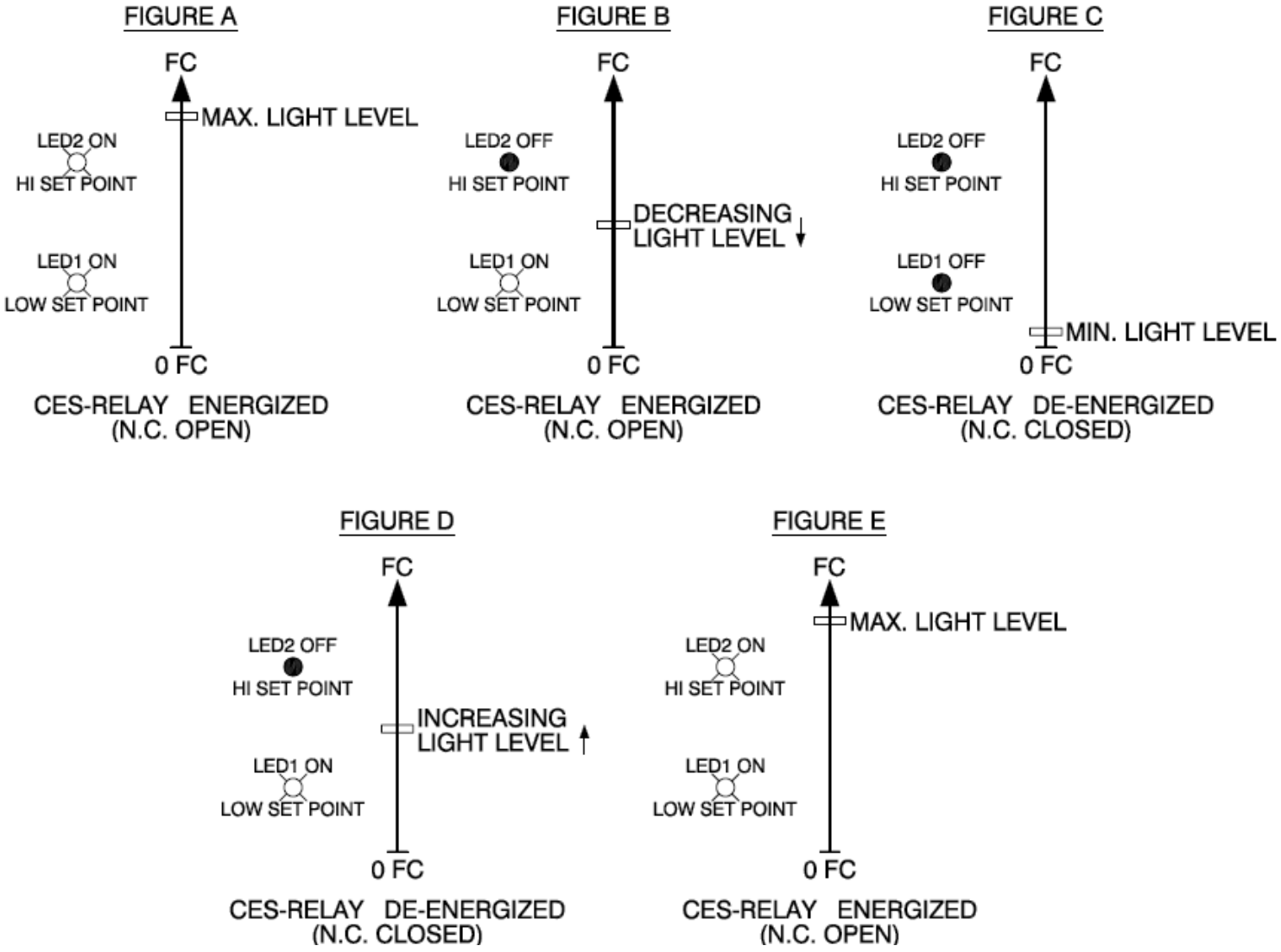


FIGURE 3: LC8 OPERATION SEQUENCE USING CES SENSOR