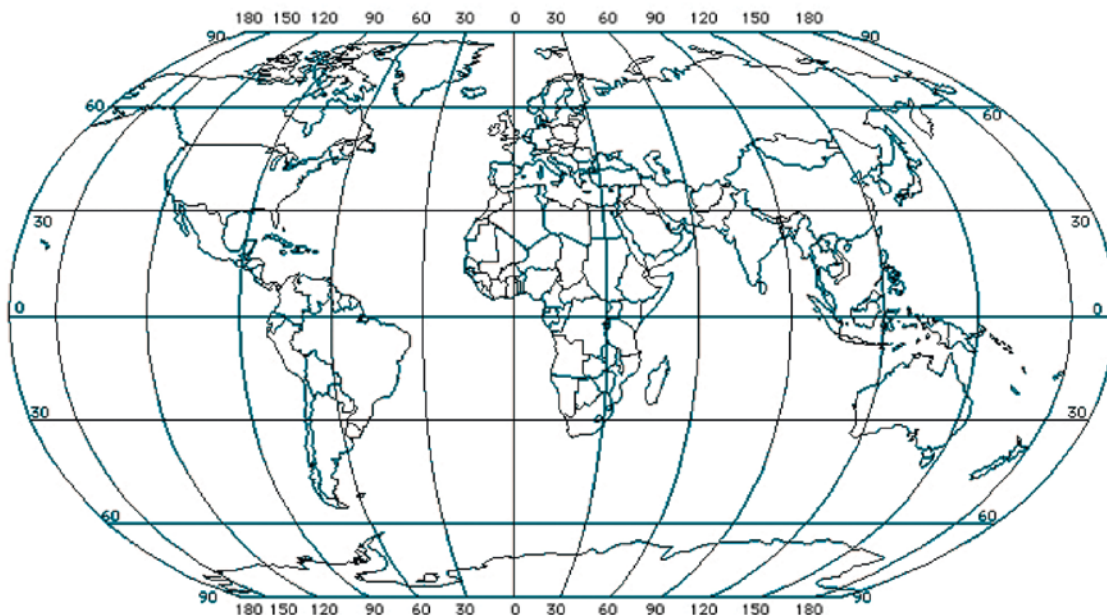




LCM-ASTRO

LIGHTING CONTROL PANEL WITH ASTRONOMICAL TIME CLOCK

INSTALLATION AND MAINTENANCE MANUAL (IMM)



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1 INTRODUCTION

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.

1.2 SYSTEM OVERVIEW

The LCM-Astro Lighting Control Panel is primarily for use in controlling exterior lighting loads based on an astronomical time clock. The LCM-Astro Lighting Control Panel is capable of supporting 2 or 3 contactors with the option of adding an additional contactor expansion panel, thus increasing the number of circuits. The program supports time clock control, remote switching, and conventional photo control.

The LCM-Astro provides a user interface via a LCD screen. The user will be prompted to enter the installed location coordinates in longitude, latitude, and the GMT Offset allowing for light control based on sunrise and sunset.

Adjustments to the settings and schedules can be made with pushbuttons on the controller face. Time based operations use the internal real-time clock which is battery backed and accurate to one second / month and can be adjusted for daylight savings time and leap year.

Advantages of the LCM-Astro Lighting Control Panel are found in the system's stability, versatility, quality, and accuracy. Once mounted, power, and lighting loads need only to be wired and the LCM-Astro is ready to operate.

For product safety; the LCM-Astro Lighting Control Panel is ETL approved and marked with the ETL symbol for product safety. This certification is shown by the data plate on each panel. In addition to ETL certification the LCM-Astro Lighting Control Panel complies with California Title 24.

1.3 PURPOSE

This document is created as an aide in installing, operating, and troubleshooting the LCM-Astro Lighting Control Panel.

1.4 SCOPE

This user's guide is intended to give the operators of the LCM-Astro Lighting Control Panel instruction for installation, set-up, and operation of the LCM-Astro Lighting Control Panel. Added to the user's guide is a troubleshooting section to help if a possible repair need should arise.

1.5 DOCUMENTATION

Additional documentation that may be helpful includes the following:

- CES- Sensors Installation and Maintenance Manual
- Contactors Installation Guide (to include OP4, OP8, and CP4)
- Remote Switch Installation Guide (to include ROT2, IROT2, and SWPB)
- Warning Beacon Installation Guide (FLB)

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1.6 ABBREVIATIONS

ETL	Electrical Testing Laboratory
UL	Underwriters Laboratories
ANSI	American National Standards Institute
NEC	National Electric Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturers Association

1.7 EQUIPMENT

The following equipment may be required or helpful when working with the LCM-Astro Lighting Control Panel:

Instructions

- LCM-Astro Operation Sequence Manual
- Photo Sensor Installation Guide

Voltage Measuring Device (AC and DC)

- DMM or analog voltage meter

Hand tools

- Small ¼" and large flat screw driver
- #1 and #2 philips screw driver
- Sockets and wrench
- Drill
- Drill bits

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2 CONFIGURATION

The LCM-Astro Lighting Control Panel has been designed with safety in mind. The controller is located in the low voltage compartment of the enclosure. The LCM-Astro controller is housed in a surface mount NEMA TYPE 1, hinged door, and gray painted steel enclosure. High and low voltage compartments are separated by NEC/NFPA mandated voltage barriers. The entire assembly is constructed to ANS/UL508A and CSAC22.2-14M91 standards and each unit carries an Electrical Testing Laboratories inspection label.

2.1 FEATURES

- 2 or 3 individual zones, each with astronomical time clock function, time clock scheduling, photo control, and remote switching.
- Factory programmable or user programmable Longitude, Latitude, and GMT Offset settings.
- User programmable astronomical time clock triggered morning and evening event (on-pulse) settings.
- Factory preprogrammed and field-configurable controller with eight zone configuration modes.
- Accumulated run time hours are logged.
- 20A zone relays include integrated hands-off-auto (HOA) override switching.
- Menu-driven LCD screens and front control buttons allow for easy user adjustment.
- Load switching options are available with factory-wired 4 or 8-pole 20A contactors.
- Base panel accommodates up to one photo sensor per zone, available in CES indoor, outdoor, atrium, and skylight models.
- Photo mode can be configured for set-up (no timers) or auto (full program).
- Input Photo Sensor time delay prevents intermittent or nuisance switching.
- 1/2 –hour Hold-On Timer prevents high intensity discharge lighting from short-cycling.
- Time Clock configurable as 7-day with two ON/OFF events per day; or 7-day with optional timed override and sweep sequence.
- System has a manual ON, and an automatic OFF operation.
- System does not require Holiday Programming.
- 2-year warranty.

2.2 TECHNICAL DATA – LCM-ASTRO

Input Voltage: 120VAC or 277VAC.

Output Zones: Two or Three 20A relays controlling optional 20A (4 or 8-pole) contactors.

Control Modes: The LCM-Astro includes the following operating modes:

- Astronomical Clock Mode
- Time Schedule Mode
- Astronomical + Time Schedule Mode
- Time Schedule + Remote Switch Mode
- Astronomical + Time Schedule + Remote Switch Mode
- Astronomical Morning/Evening Offset Mode (event pulse lighting)
- Photo Control Mode
- Photo Control + Time Schedule Mode

Override Switches: Internal hand-off-auto (HOA), integrated in each interposing zone relay.

Enclosure Dimensions: 16"H x 12"W x 6"D (NEMA- 1 Surface Mount Enclosure).



2.2.1 FACTORY RECOMMENDED WIRE SIZES.

The Table below lists the factory recommended wire sizes used in the insulation of the LCM-Astro Lighting Control Panel.

Device	Min AWG	Max AWG	Recommended AWG
Control Power	16	12	14
Output Power	14	10	12
Photo Sensor Inputs	22	18	18
Remote Override Switches	22	18	18

Table 1: Suggested Wire Size

2.2.2 LCM-ASTRO LIGHTING CONTROL PANEL, 2 OR 3 ZONE, 120VAC

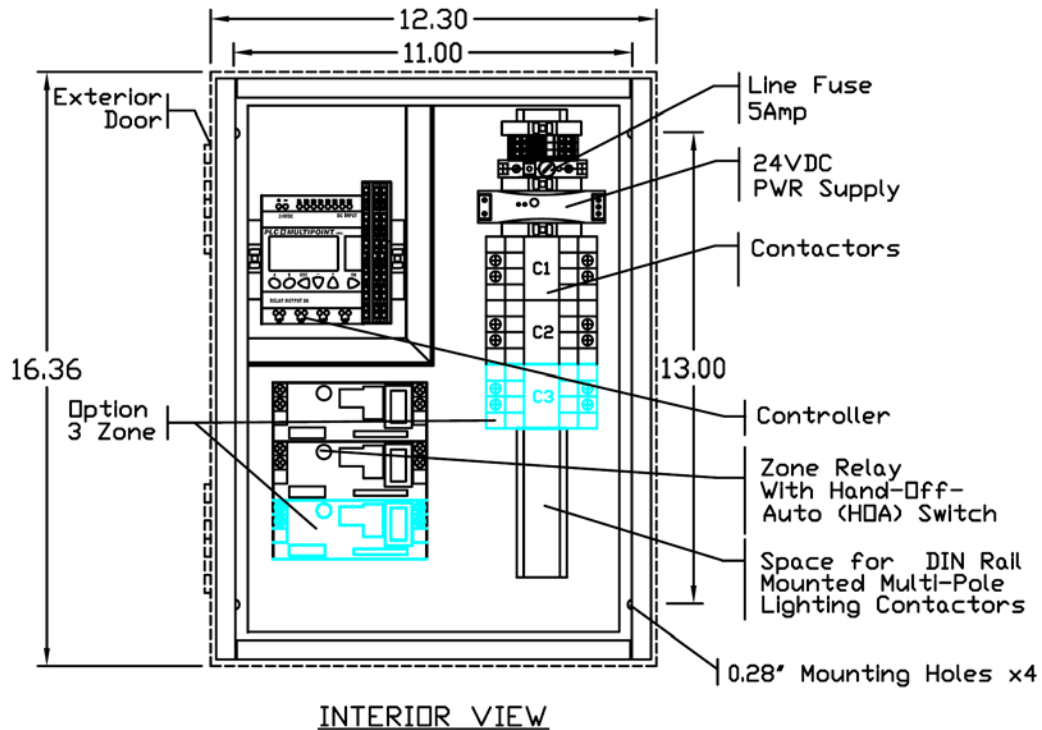


Figure 1: LCM-Astro 2-Zone or 3-Zone Layout

2.2.3 SMALL CONTACTOR EXPANSION PANEL

XPS; Small Contactor Expansion Panel (NEMA-1 type enclosure including a terminal block and DIN rail capable of mounting a maximum of six 4- or 8-pole contactors).

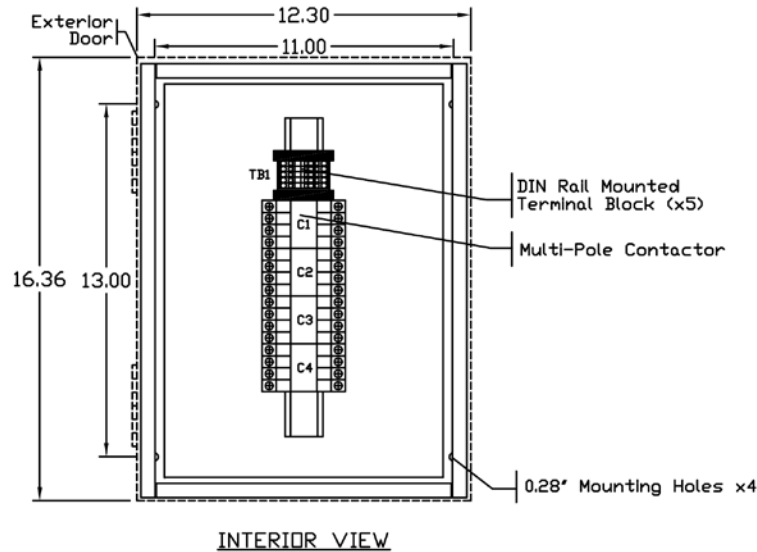


Figure 2: LCM-Astro Small Expansion Panel Layout

2.2.4 LARGE CONTACTOR EXPANSION PANEL

XPL; Large Contactor Expansion Panel (NEMA-1 type enclosure including two terminal blocks and DIN rails capable of mounting a maximum of fourteen 4- or 8-pole contactors).

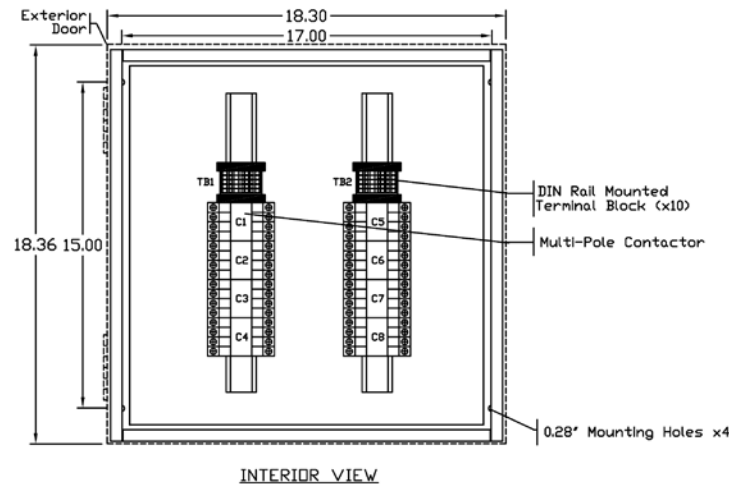


Figure 3: LCM-Astro Large Expansion Panel Layout

3 INSTALLATION

3.1 PANEL MOUNTING

The LCM-Astro Lighting Control Panel (NEMA- 1 Surface Mount Enclosure) is mounted to a structure by four 0.28" mounting holes located in the back of each panel. Each hole will accept a #1/4-20 fastener (secure the panel to the structure using hardware listed by your local code). Figure 4: NEMA – 1 Surface Mount Enclosure below shows the dimensions and footprint of the mounting holes, with the maximum weights of each panel.

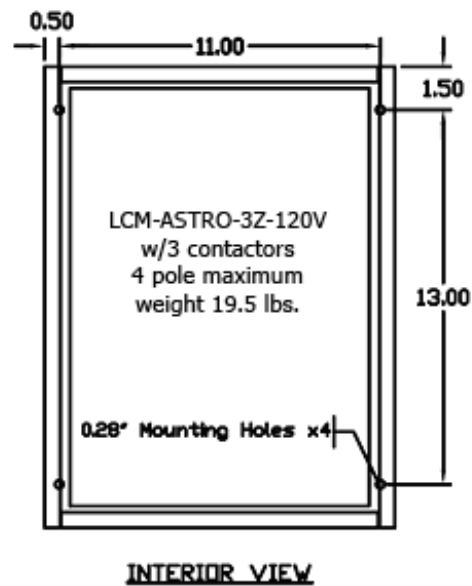


Figure 4: NEMA-1 Surface Mount Enclosure LCM Astro 2 or 3 Zones

3.2 PANEL WIRING

There are up to four types of field wiring requiring connections when installing an LCM-Astro. Control Power, Output Load, Photo Sensor Input (when used), and Remote Input (which may or may not include a Pilot Light connection). Wire size; refer to [Table 1: Suggested Wire Sizes](#).

WARNING: Working with high-voltage can be dangerous; whenever possible turn the LCM-Astro Lighting Control Panel OFF at the incoming power breaker when working with the system.

3.2.1 LCM-ASTRO 120V LINE CONTROL POWER CONNECTIONS

For 120VAC powered LCM-Astro; Line terminal blocks, Neutral terminal block, and a green/yellow Ground terminal block are mounted to TB1. The panel fuse (FU1/L 5A) is mounted as part of the Line terminal block, shown below in [Figure 5: LCM-Astro 120VAC Line Connections](#).

The 120V Line conductor from the appropriate circuit breaker connects to the Line terminal block, marked (L). The 120V Neutral conductor from the neutral bus bar connects to the Neutral terminal block, marked (N). The Ground conductor from the ground bus bar connects to the green/yellow Ground terminal block, marked (G).

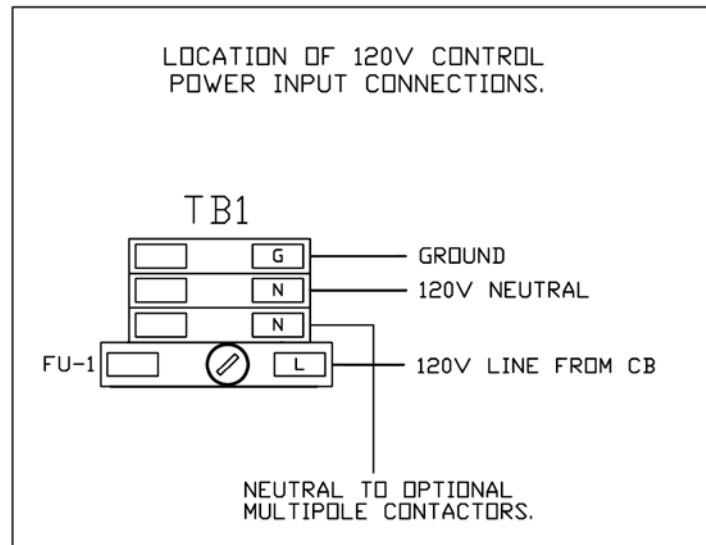


Figure 5: LCM-Astro 120VAC Line Connections

3.2.2 LCM-ASTRO 277V LINE CONTROL POWER CONNECTIONS

For 277V powered LCM-Astro; Line terminal blocks, Neutral terminal block, and a green/yellow Ground terminal block are mounted to TB1. The panel fuse (FNQ 1/2A) is mounted on the low-voltage barrier, shown below in Figure 6: LCM-Astro 277VAC Line Connections.

The 277V Line conductor from the appropriate circuit breaker connects to the Line terminal block, marked (L). The 277V Neutral conductor from the neutral bus bar connects to the Neutral terminal block, marked (N). The Ground conductor from the ground bus bar connects to the green/yellow Ground terminal block, marked (G).

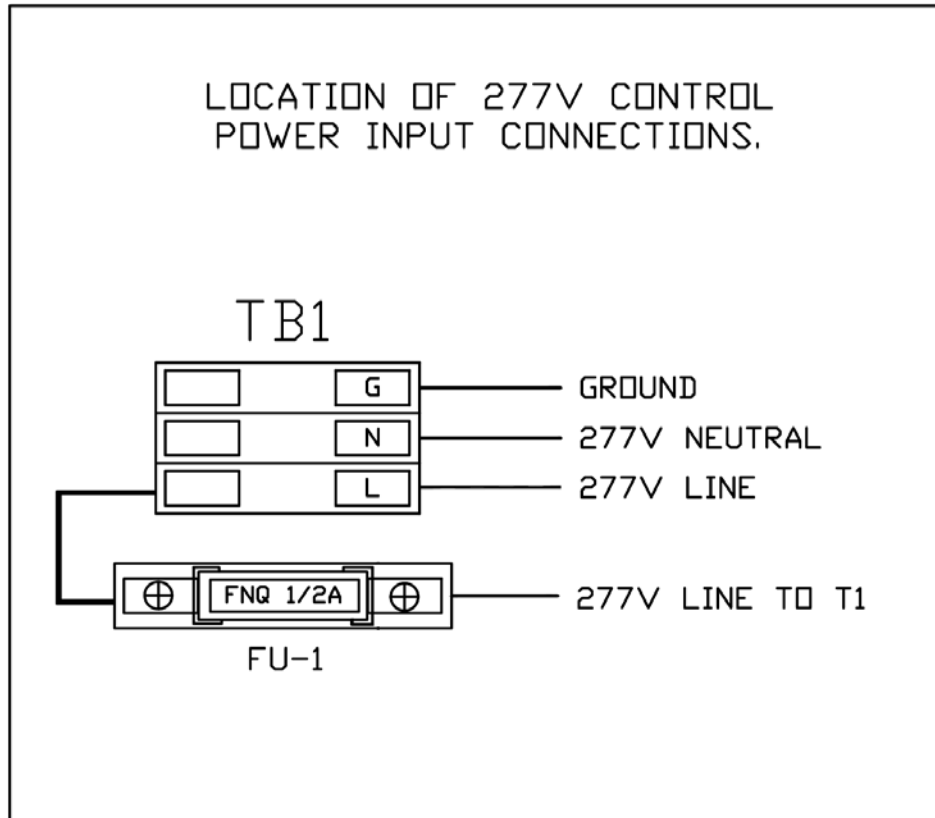


Figure 6: LCM-Astro 277VAC Line Connections

3.2.3 LCM-ASTRO 2 OR 3 ZONE LOW VOLTAGE FIELD CONNECTIONS

The Low Voltage Field connections are the CES Photo Sensor inputs and the Remote Switch inputs. Suggested wire size for Low Voltage Field Inputs can be found in [Table 1: Suggested Wire Sizes](#). A typical wiring method for both 2 and 3 Zone panels are shown below in [Figure 7: LMC-Astro 2 or 3 Zone Low Voltage Field Inputs](#). The Low Voltage section of the LCM –Astro Lighting Control Panel is located in the top left area of the enclosure.

Sensors

The RED wire of any sensor is connected to any P24 connection of terminal TB2. The BLACK wire is the 24 volt return and is connected to any N24 connection of TB2 terminal. The YELLOW wire is the analog signal and depending on control type, will connect to IB (Zone 1), IC (Zone 2), or ID (Zone 3) of the controller.

Remote Override Switches

The high side of the Remote Switch is connected to any P24 connection of terminal TB2. The low side of the switch is the control input and depending on control type, will connect to either I1 (Zone 1), I2 (Zone 2), or I3 (Zone 3) of the controller. Remote Switches with status pilot lights are connected to PL1 (Zone 1), PL2 (Zone 2), or PL3 (Zone 3) of the PL terminal block. The 24V Return of the pilot light will connect to any N24 connection of TB2.

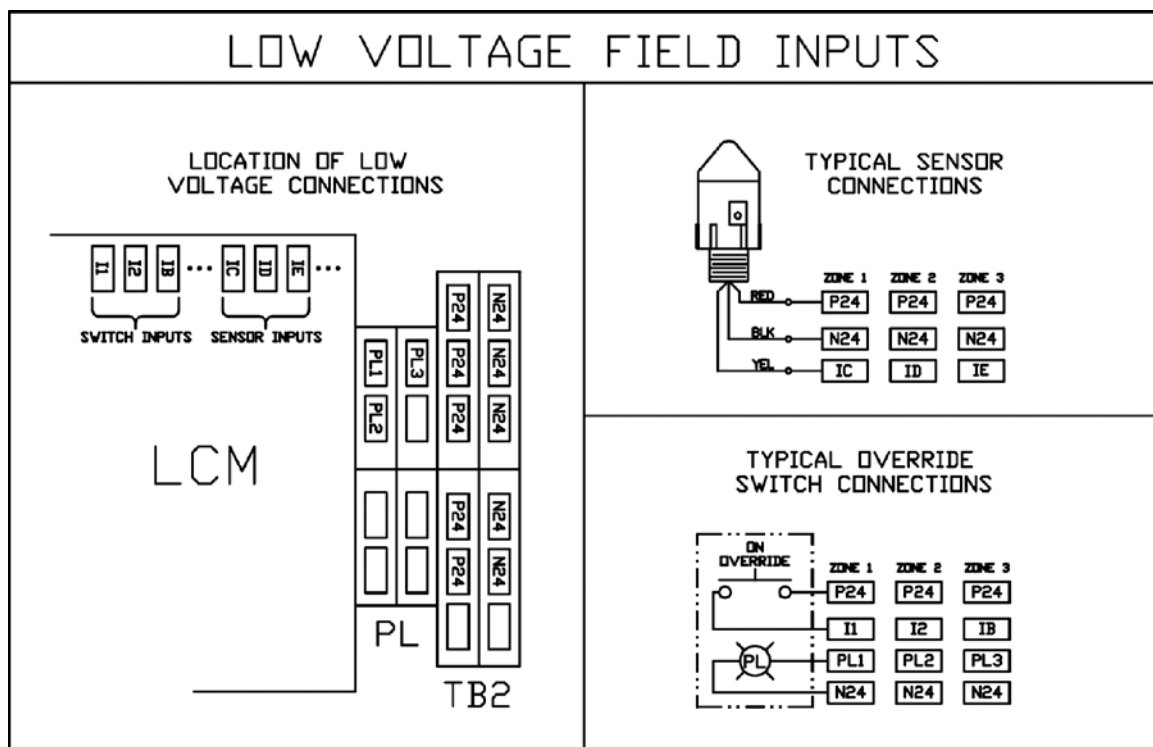


Figure 7: LCM-Astro 2 or 3 Zone Low Voltage Field Inputs

3.2.4 LCM ASTRO 2 OR 3 ZONE, HOA CONTROL SWITCH (OVERRIDE SWITCH)

A single-pole, 20A internal Hand-Off-Auto (HOA) relay is supplied for each zone of lighting control, which is used as an override switch for the system. Each relay is controlled by the output of the controller. On the relay is a HOA 3-position switch (Closed = Dry contacts are CLOSED, Open = Dry Contacts are OPEN, and Auto = Dry contacts are operated by the Controller). The dry-contact is convertible to NO or NC by changing the position of a Jumper wire.

The top terminal is normally connected to the Line from the circuit breaker that feeds the zone's lighting load and the bottom terminal connects to the lighting Load, see [Figure 8: LMC-Astro 2 or 3 Zone HOA Relays](#).

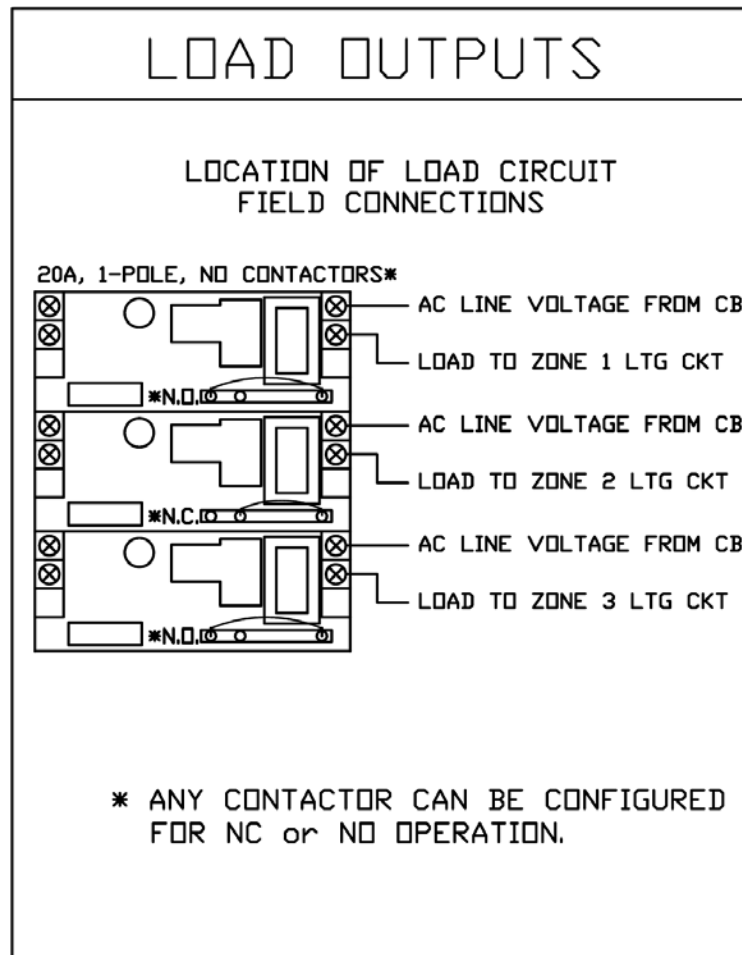


Figure 8: LCM-Astro 2 or 3 Zone HOA Relays

3.2.5 MULTI-POLE LIGHTING CONTACTOR

As an addition to the standard LCM-Astro Lighting Control Panel, the multi-pole contactor provides control of a greater number of circuits per zone. The methods of wiring a typical multi-pole contactor are shown in Figure 9: Multi - Pole Load Outputs.

A number of multi-pole lighting contactors, rated for lighting, can be installed as accessories to the LCM-Astro Lighting Control Panel, they are:

- CP4** – 4 pole 20A Normally Closed Contactor
- OP4** – 4 pole 20A Normally Open Contactor
- OP8** – 8 pole 20A Normally Open Contactor

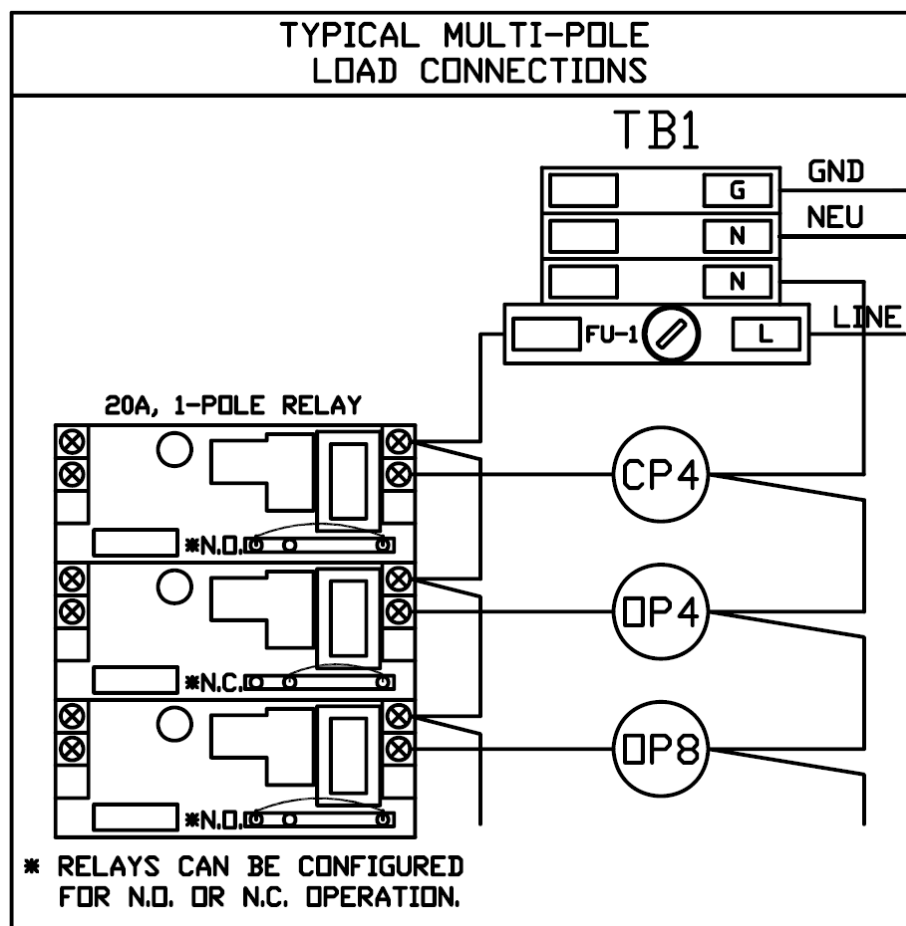


Figure 9: Multi-Pole Load Output

3.2.6 LCM-ASTRO EXPANSION PANEL LOAD CONNECTIONS

If a greater number of Load Contactors are needed, an Expansion Panel may be added to the LCM-Astro Lighting Control Panel. The typical Expansion Panel wiring method is shown in Figure 10: Typical Expansion Panel Load Connections.

There are two sizes of Expansion Panels, they are:

XPS; Small Contactor Expansion Panel can hold up to six 4- or 8-pole contactors.

XPL; Large Contactor Expansion Panel can hold up to fourteen 4- or 8-pole contactors.

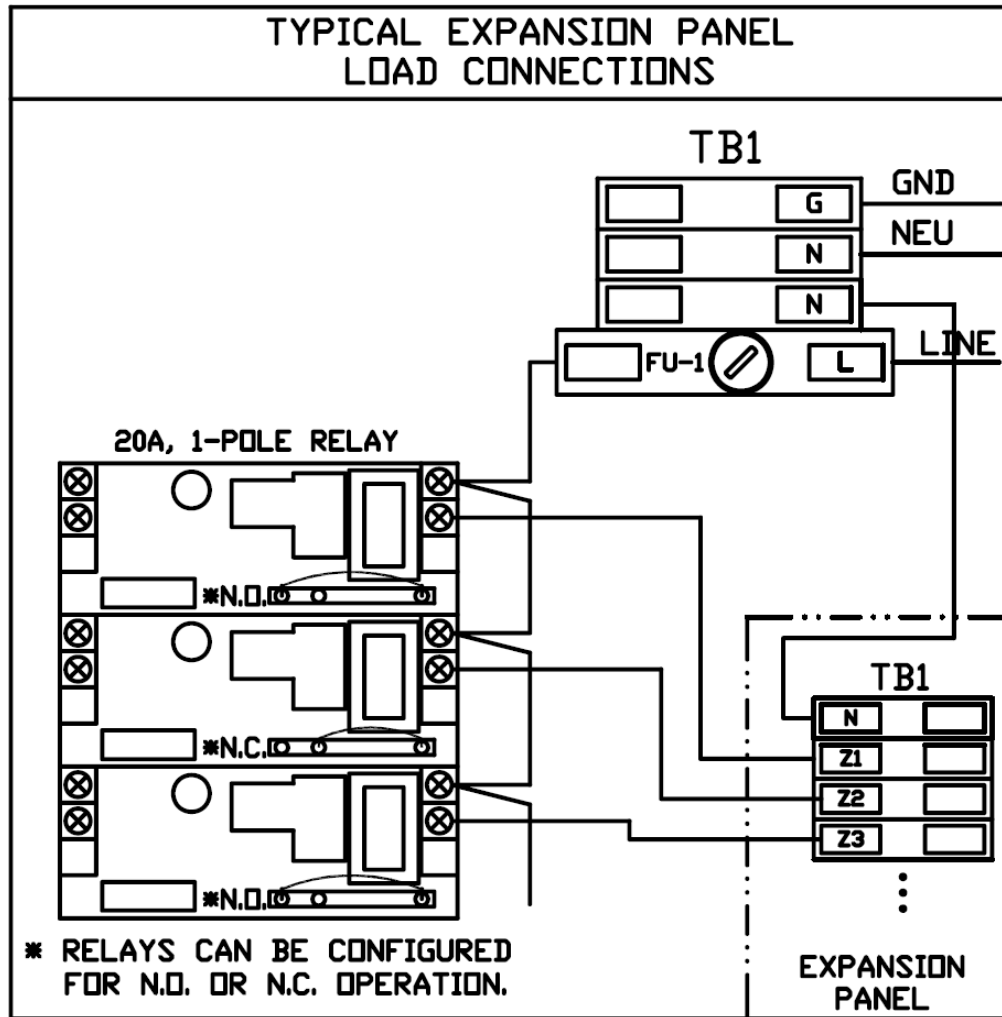


Figure 10: Typical Expansion Panel Load Connections

3.2.7 PHOTO SENSOR CONNECTIONS

There are four styles of CES Photo Sensor that can be connected to the LCM-Astro. All four connect in the same manner and return a 1-10VDC signal to the controller. Each sensor has three wires. The RED wire is the power wire and connects to the P24 Distribution terminal block labeled TB2. The BLACK wire is the common return and is connected to the N24 terminal block labeled TB2. The YELLOW wire carries the analog signal and is connected to one of the INPUT terminals located along the top of the Controller. One sensor can be used to control a single zone or one can be wired to control multiple zones [Figure 11: Photo Sensor Wiring Guide](#).

Refer to CES Sensors Installation and Maintenance Manual for further instruction.

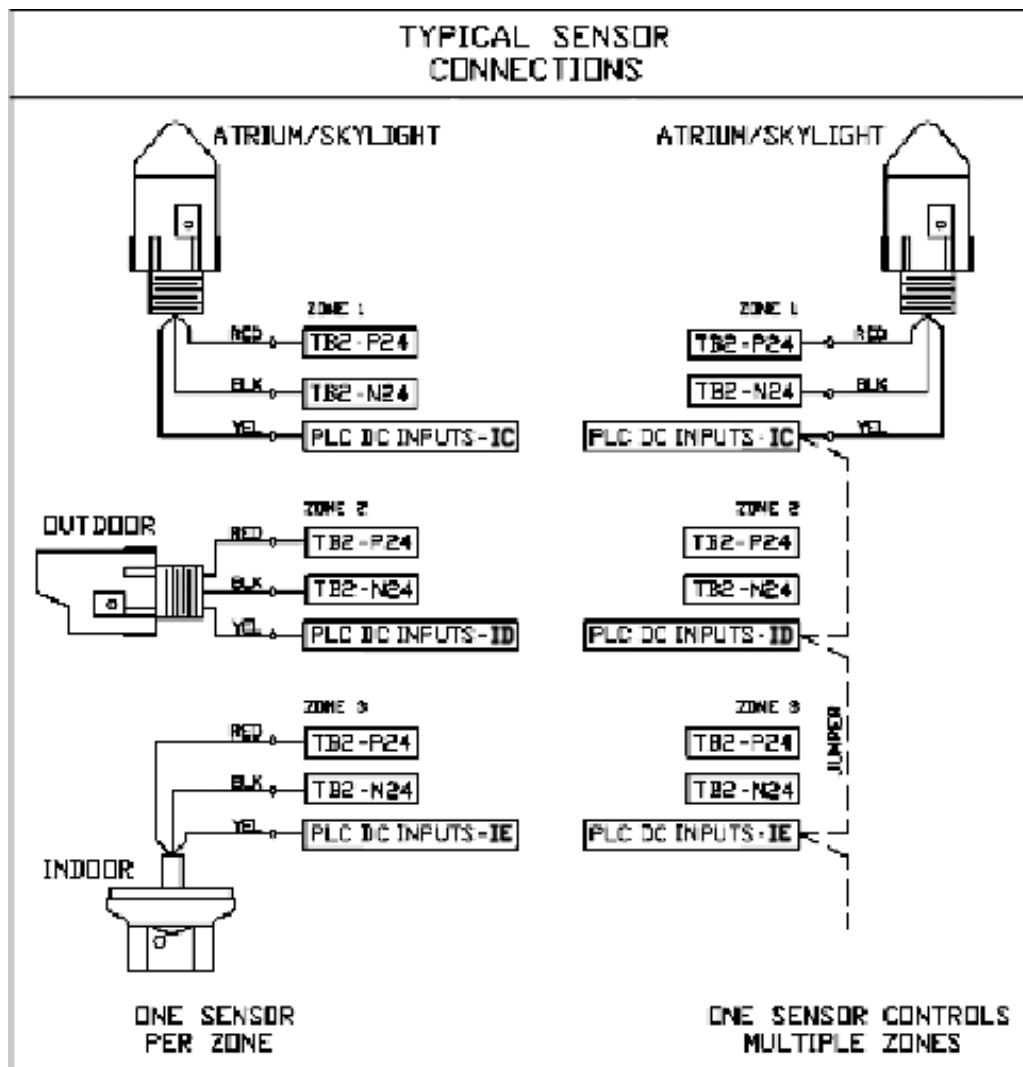


Figure 11: Photo Sensor Wiring Guide

3.2.8 REMOTE SWITCH CONNECTIONS

Remote Switches are wired into TB2 in the top left corner of the enclosure. Each switch requires two wires; 24VDC power and a signal wire. 18AWG wire is the recommended wire size for this connection; see [Table 1: Suggested Wire Sizes](#). The 24VDC wire is connected to the P24 on terminal block TB2. The signal wire is connected to the switch input terminal on the controller. If it is desirable to have one Remote Switch affects more than one zone, small jumper wires can be used to share the remote switch signal, see [Figure 12: Typical Remote Switch Connections](#).

The Remote Switches have an LED pilot light. The LCM-Astro illuminates the LED for the zone currently switched ON. The LED will have two wires connected to it; one will be connected to the N24 on terminal block TB2, and the signal wire will be connected to the appropriate PL terminal located next to the TB2 terminal blocks, [Figure 12: Typical Remote Switch Connections](#).

Note that if one Remote Switch is controlling several zones, the pilot light's signal wire should be connected to only one of the affected zones.

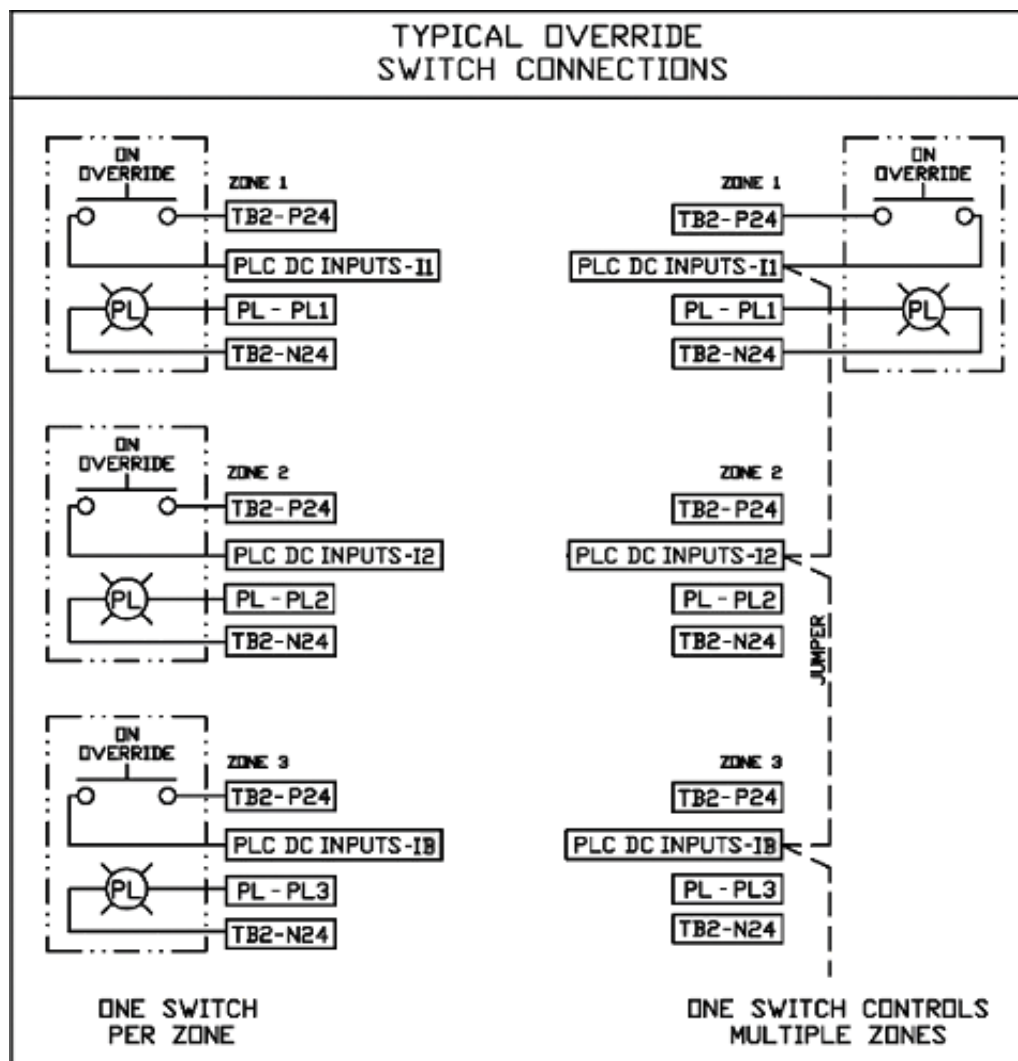


Figure 12: Typical Remote Switch Connections

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3.2.9 LCM-ASTRO ACCESSORIES

Remote Switching Devices

ROT2, Industrial Remote Single Pushbutton 22mm Mounting Collar with one N.O.24VAC/DC Contact Legend Plate, 22mm, One-Hole, Zinc. Enclosure, 22mm, One-Hole Zinc Recommended wire size #18AWG	
IROT2, Illuminated Industrial Remote Single Pushbutton 22mm Green LED with one N.O. 24VAC/DC Contact Legend Plate, 22mm ON Enclosure, 22mm, One-Hole, Zinc Recommended wire size #18AWG	
SWPB1, Commercial Remote LED Single Pushbutton Single Low Voltage wall switch with LED, N.O. Contact 24VAC/DC Recommended wire size #18AWG	

Load Contactors

OP4 (4-Pole Normally-Open Contactor / 20A / 120V Coil). Contact Rating: 600V 50/60Hz 4-Pole isolated normally-open (NO) contacts. 20A (Lighting) 30A (General Purpose / Ballast) Wiring: #16 to 10 AWG 75 Degree copper only	
OP8 (8-Pole Normally-Open Contactor / 20A / 120V Coil). Contact Rating: 600V 50/60Hz 8-Pole isolates normally –open (NO) contacts. 20A (Lighting) Wiring: #16 to 10 AWG 75 Degree copper only.	
CP4 (4-Pole Normally-Closed Contactor / 20A / 120V Coil). Contact Rating: 600V 50/60Hz 8-Pole isolates normally –closed (NC) contacts. 20A (Lighting) Wiring: #16 to 10 AWG 75 Degree copper only.	

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Expansion Panels

XPS, Small Contactor Expansion Panel (NEMA-1 type enclosure including a terminal block and DIN rail capable of mounting a maximum of six 4- or 8-pole contactors) SMALL: 16"H x 12"W x 6"D	
XPL, Large Contactor Expansion Panel (NEMA-1 type enclosure including a terminal block and DIN rail capable of mounting a maximum of fourteen 4- or 8-pole contactors) LARGE: 18"H x 18"W x 6"D	

Panel Heater

PHR Panel Heater 120 VAC / 240 VAC only, Factory installed.	
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Warning Beacon

FLB, Beacon for HID Sweeps, Factory Installed Needs Technical information Visual Signal (Amber) NEMA type 4X enclosure 3.88" x 3.25"	
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NEMA Enclosures

NEMA 3R, Rain Tight Outdoor rain resistant, ANSI 61 Grey polyester powder paint finish. SMALL: 16 x 16 x 6 – 16 gauge	
NEMA 4X, Water Tight / Corrosion Resistant; 304 stainless steel wash down and corrosion resistant. SMALL: 16 x 20 x 6	
NEMA 12, Oil tight; used in industrial areas where cutting oils or other non-corrosive mists are found in the environment. SMALL: 16 x 20 x 6	

4 CONTROLLER OPERATION

Section 4 outlines and explains the operation sequence for the LCM-Astro Lighting Control Panel.

4.1 LCM CONTROLLER

The LCM controller has a Front Panel user interface consisting of an 18X4-Line LCD and six keys. The LCD is used to display the system's user screens. The Keys are used for navigating the menus, and user variable entries.

The controller has six field inputs; I1 -IB are used for remote switching, and IC – IE are used for photo sensors. In addition to the field inputs the controller has four output relays; each relay controls one lighting zone.

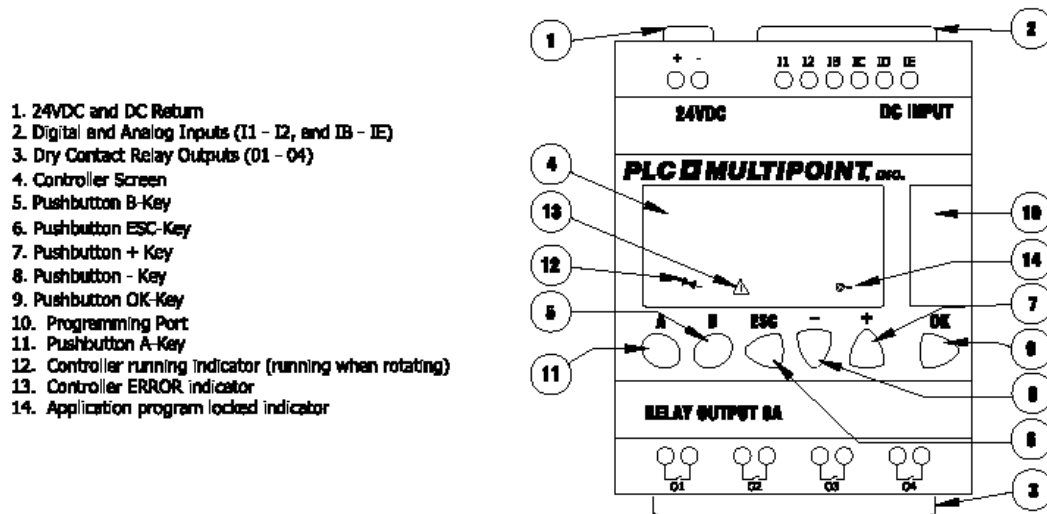


Figure 13: PLC Multipoint Astronomical Controller

4.2 LCM CONFIGURATION

The LCM has an operator interface that allows several modes of operation through the use of the Front Panel buttons, while information is shown on the display. The screens allow for selection of current system status, operating parameter review and editing.

4.3 CONTROLLER FRONT PANEL USER KEYS

The table below outlines the controller front panel user keys, these keys allows the operator to navigate and program the controller with the values tailored to the end user needs.

Front Panel	Key Definitions
	A Key is used in specific screens to toggle settings.
	B Key is used to navigate through the various screens.
	OK Key is used to select a variable for modification in SELECT mode and used to confirm value changes in ADJUST mode.
	ESC Key is used to cancel value changes in ADJUSTMENT mode, and to jump back to the Main Screen
	(+) & (-) Keys are used to move the cursor to the next variable on the current screen for modification in SELECT mode and used to increment or decrement values in ADJUSTMENT mode.

Table 2: Front Panel User Keys

4.4 ADJUSTMENT AND SELECT MODES

SELECT Mode; refers to the contrast flashing cursor area over a user entry, shown by the diagram to the right. The cursor may be moved between entries using either the + or - Keys. Pressing the OK Key changes from the SELECT Mode to ADJUSTMENT Mode.	
ADJUSTMENT Mode; refers to the clear flashing cursor area over a user entry or variable, as shown by the diagram to the right. In this mode pressing either the + or - Keys are used to increase and decrease the variables. Pressing the OK Key locks in the the new variable change, putting the display back into the SELECT Mode	

Table 3: Controller Select and Adjustment Modes

5 OPERATION SEQUENCE

5.1 MODES OF OPERATION

The LCM-Astro consists of up to three lighting zones that can be programmed with eight modes of operation. The eight modes of operation are outlined in the Table 4: Mode of Operation below.

No	MODE	DESCRIPTION
1	AC (only)	The Astronomical Clock (Astro CLK) Mode is based on the astronomical time of sunrise and sunset set by longitude, latitude, and offset; offset representing the time difference in minutes compared with Greenwich Mean Time (GMT) depending on the location of the controller. The Astro CLK switches the output zone OFF at sunrise and switches the zone ON at sunset.
2	TC (only)	The Time Schedule (TC) Mode is based on a user programmable schedule, which is programmable through the BIOS of the controller. The TC gives the user the option of independently switching ON/OFF each zone per the programmed time schedule. The TC shall switch the lights ON at a predetermined time, and OFF at a predetermined time and has fourteen (14) programmable events. The TC is varietal enough to accommodate daily, weekly, monthly events.
3	AC + TC	The AC + TC mode is a combination of the Astronomical Clock (Astro CLK) Mode and Time Schedule (TC) Mode. When both the AC and TC are active the lighting zone output is programmed to be ON, when either of the modes are not active the lighting system output is programmed to be OFF.
4	TC + RSW	A Remote Switch (RSW) has been added to the Time Schedule (TC), for each lighting zone. The RSW is an alternate toggle momentary switch. The RSW is programmed to operate only when the TC is activated ON. The RSW toggles ON then OFF each time the RSW is used. At the end of the TC event the lighting zone is programmed to switch OFF the lights and deactivate the RSW until the TC is ON again.
5	AC + TC +RSW	A Remote Switch (RSW) has been added to the Astronomical Clock (AC) and Time Schedule (TC), for each lighting zone. When both the AC and TC are active the lighting zone output is programmed to be ON, without the use of the RSW. The RSW is an alternate toggle momentary switch. The RSW operates as an override only when the TC is active. The RSW toggles the output ON then OFF each time the RSW is pressed and the TC function is active. At the end of the AC or TC events, the lighting zone output switches low leaving the switch and the output in the OFF position.

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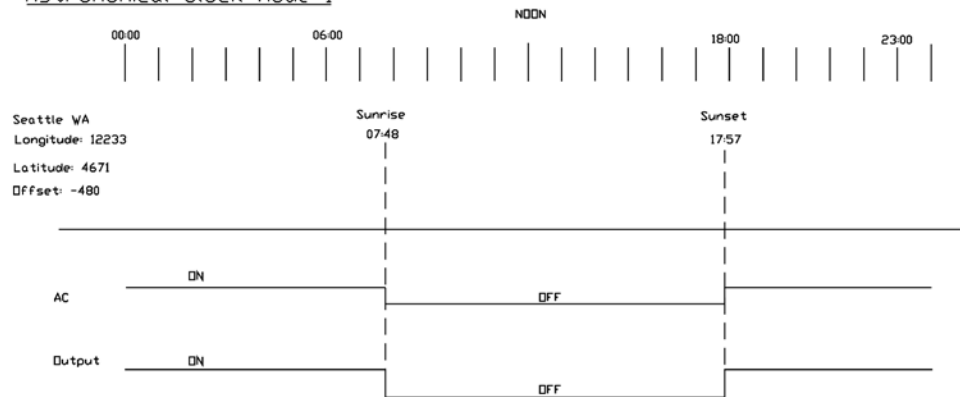
6	Astro M/E	The Astronomical Morning/Evening Offset Mode is programmed to switch ON and OFF a morning and evening event base around the astronomical clock. The AC M/E offset from the astronomical sunrise and sunset times are programmed by the user with a (Pre) or (Post) number in minutes.
7	PC	The Photo Control (PC) Mode is programmed to the user the option of independently switching ON/OFF each zone per a programmed photo control. The PC operates with all CES photo devices (CES/I, CES/O, CES/A, and CES/S), and allow for setting the photo parameters; HiLim/LoLim, and Gain, through the front screen. The PC mode output switches on only when the Lo/Lim is reached by the photo sensor, and switches off only when the HiLim is reached by the photo sensor. The PC mode incorporates a user programmable input/output delay and hold-on-timer, through the controller BIOS.
8	PC + TC	The Time Schedule (TC) mode is combined with the Photo Control (PC) Mode. Each lighting zone includes both the PC + TC mode. Both the PC and TC operate as one, with TC having priority. The lighting zone switches ON only when the TC is active and the photo sensor is in the active condition.

Table 4: Mode of Operation

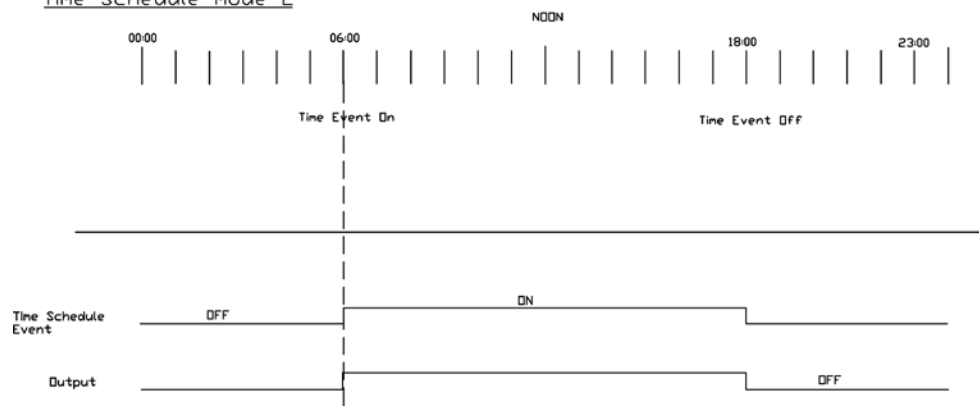
5.2 TIMING CHARTS

5.2.1 LCM ASTRO TIMING CHART MODES 1-3

Astronomical Clock Mode 1



Time Schedule Mode 2



Astronomical Clock + Time Schedule Mode 3

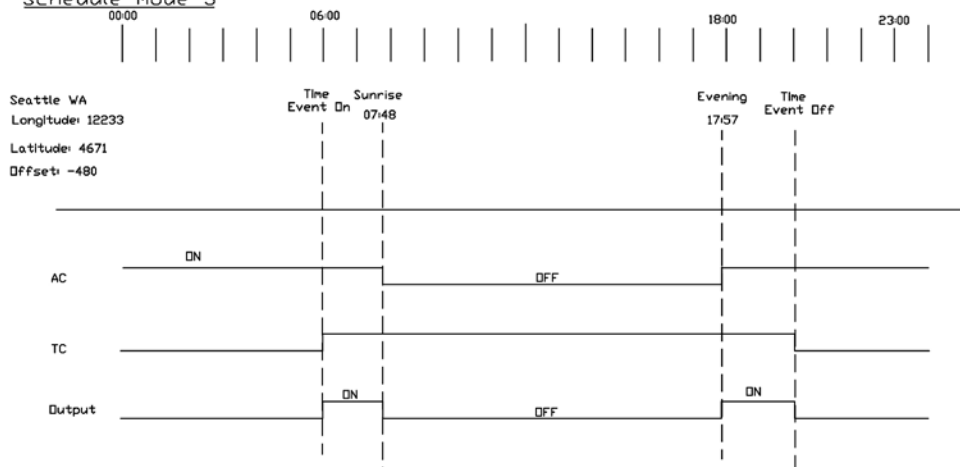


Figure 14: Timing Chart Modes 1-3

5.2.2 LCM ASTRO TIMING CHART MODES 4-6

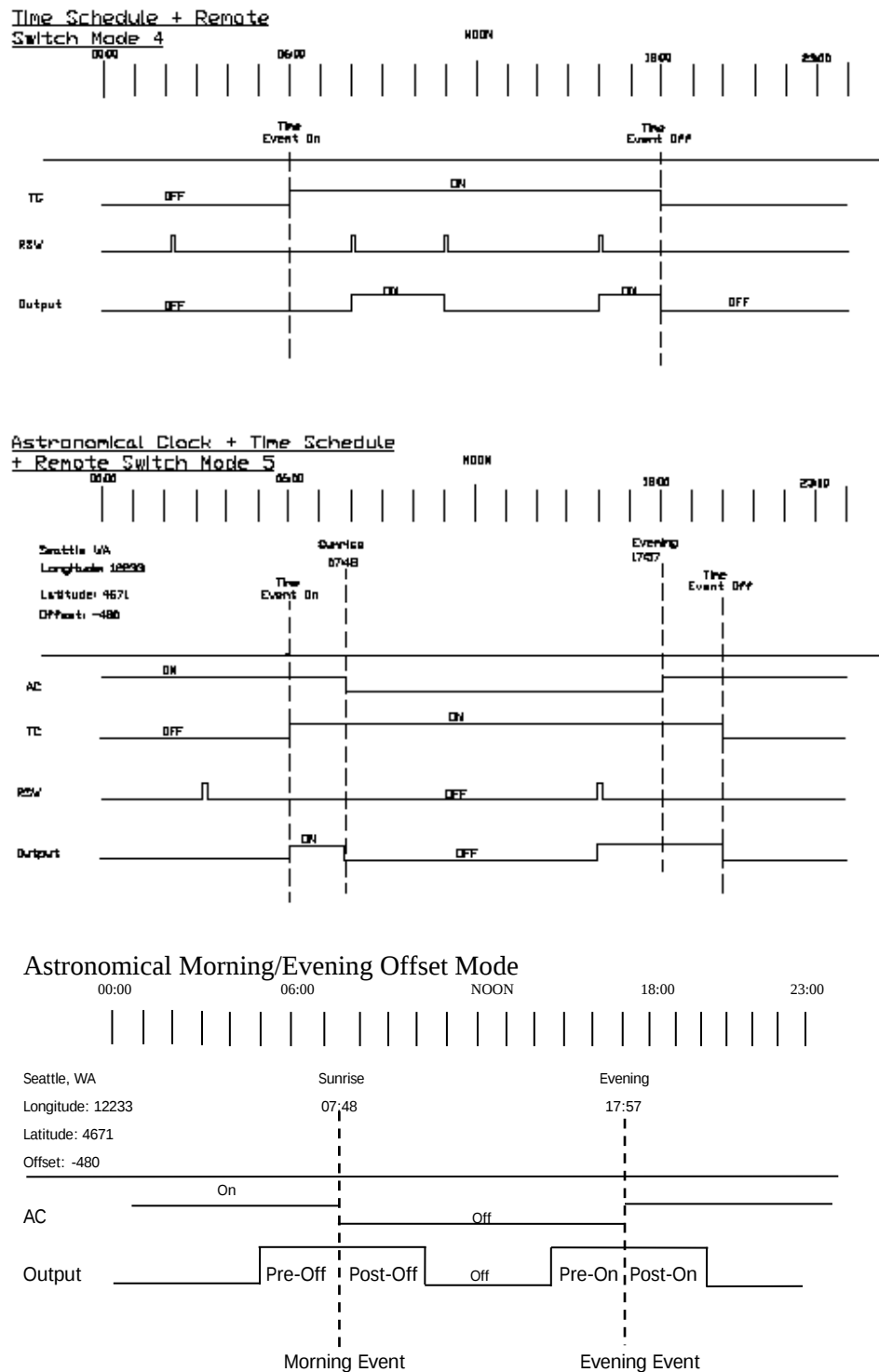


Figure 15: Timing Chart Modes 4-6

5.2.3 LCM ASTRO TIMING CHART MODES 7-8

Photo Control Mode 7

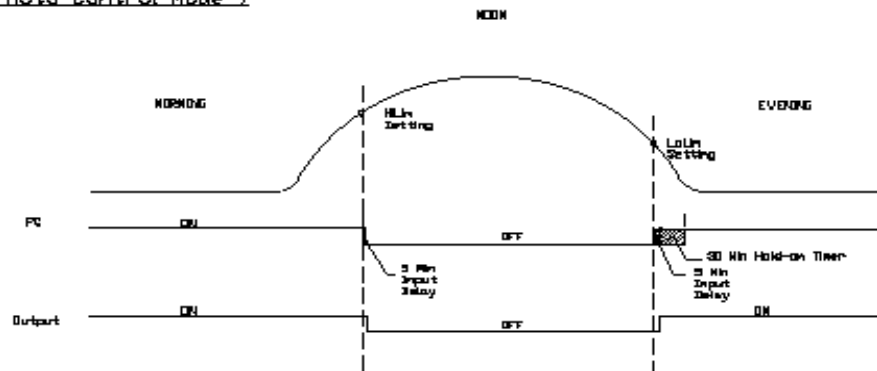


Photo Control + Timing
Schedule Mode 8

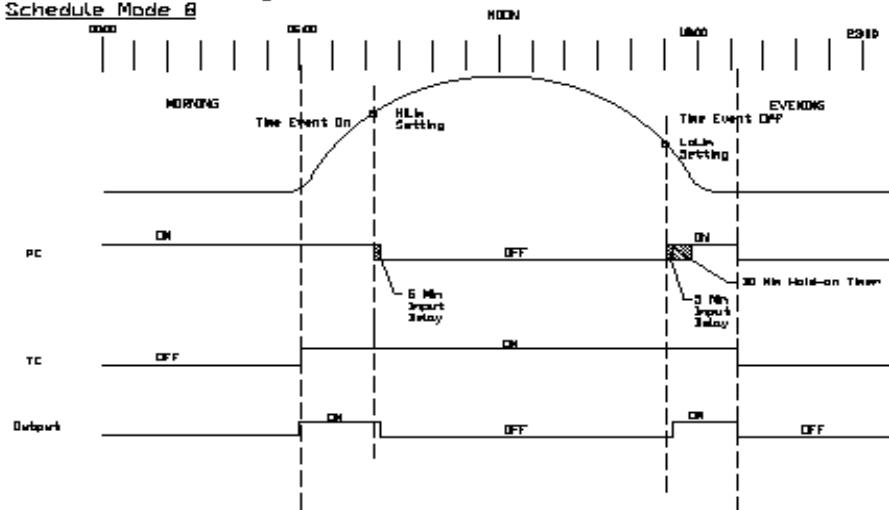
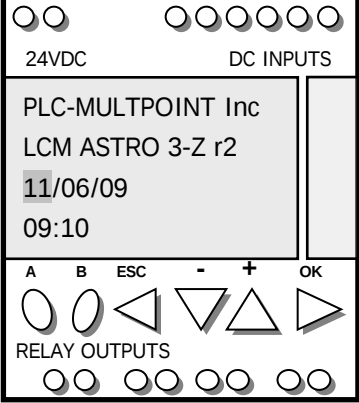
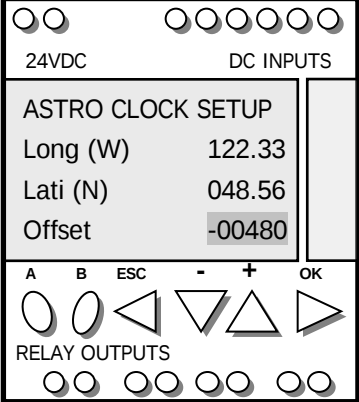
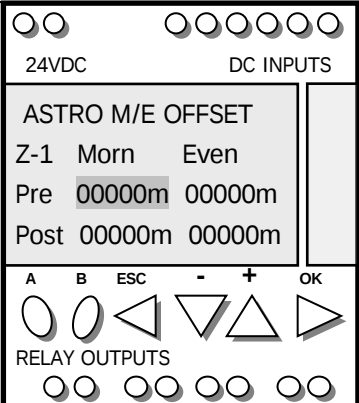
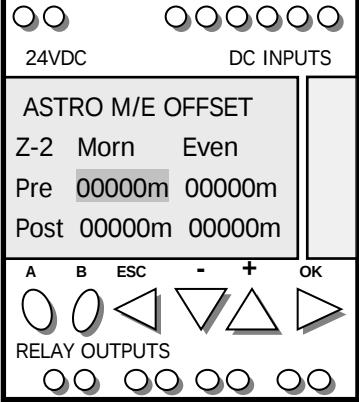
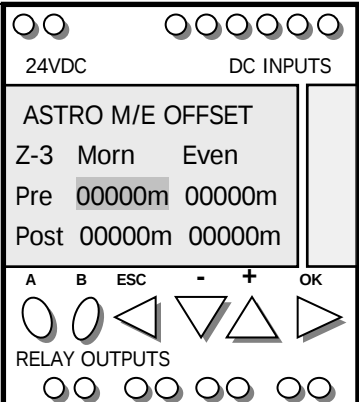
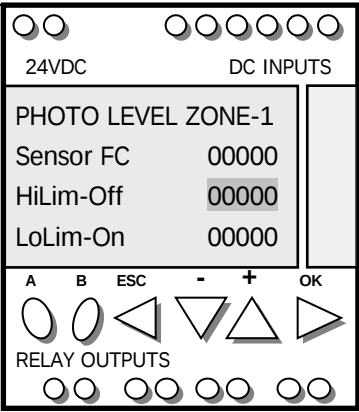


Figure 16: Timing Chart Modes 7-8

5.3 CONTROLLER USER PROGRAMMING SCREENS

	Main Screen Press the ESC Key at any time to access the Main Screen. The date and time are adjustable due to the various time zones the system may be distributed to. In the Select Mode press either the + or - Key to mover the cursor to the desired area, then press the OK Key to enter the Adjustment Mode. Change the value with either the + or - Key and press the OK Key to accept the entry and move to the next change. Repeat the process until all changes are made. The unit will automatically adjust for daylight savings time, although it may be set back to standard time.
	Astro Clock Set-up Screen Press the B Key until the screen is reached. With the screen in select mode use either the + or - Keys to move the cursor to one of the three variable user inputs (Long, Lati, or GMT Offset). Press the OK Key to enter the adjustment mode, and use either the + or - Keys to enter the number, pressing the OK Key to accept the entry. Repeat the step above for the remaining two entries.
	Astro M/E Event Screen Zone 1 Press the B Key until the screen is reached. With the screen in select mode use either the + or - Keys to move the cursor to one of user entries (M/E Pre or Post). Press the OK Key to enter the adjustment mode, and use either the + or - Keys to enter the number, pressing the OK Key to lock in the entry. Pre and Post values are in minutes. Repeat the step above for the remaining entries. Refer to timing chart in Section 5.2 for additional details.

	Astro M/E Event Screen Zone 2 Press the B Key until the screen is reached. With the screen in select mode use either the + or - Keys to move the cursor to one of user entries (M/E Pre or Post). Press the OK Key to enter the adjustment mode, and use either the + or - Keys to enter the number, pressing the OK Key to lock in the entry. Pre and Post values are in minutes. Repeat the step above for the remaining entries. Refer to timing chart in Section 5.2 and Section 5.1 Table 4 Mode of Operation- Mode 6 for more information on M/E Pre and Post events.
	Astro M/E Event Screen Zone 3 Press the B Key until the screen is reached. With the screen in select mode use either the + or - Keys to move the cursor to one of user entries (M/E Pre or Post). Press the OK Key to enter the adjustment mode, and use either the + or - Keys to enter the number, pressing the OK Key to lock in the entry. Pre and Post values are in minutes. Repeat the step above for the remaining entries.
	Photo Level Set-up Screen Zone-1 Press the B Key until the screen is reached. Sens FC is the current light level seen by the sensor. HiLim is the OFF set-point from low to high light levels. LoLim is the ON set-point from high to low light levels. To set the HiLim or LoLim, enter the adjustment mode and press either the + or - Key to the register to be changed and press the OK Key to enter the select mode, then use either the + or - Key to enter the value. Press the OK Key to lock in the number. Note: A negative Sensor FC indicates a signal problem.

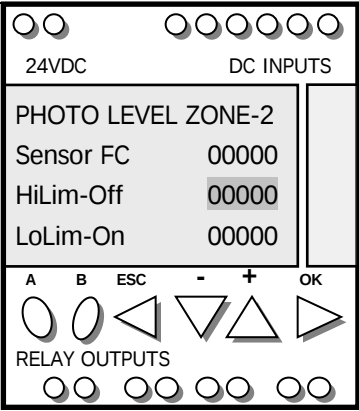
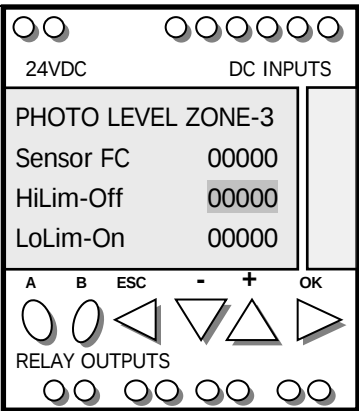
	Photo Level Set-up Screen Zone-2 Press the B Key until the screen is reached. Sens FC is the current light level seen by the sensor. HiLim is the OFF set-point from low to high light levels. LoLim is the ON set-point from high to low light levels. To set the HiLim or LoLim, enter the adjustment mode and press either the + or - Key to the register to be changed and press the OK Key to enter the select mode, then use either the + or - Key to enter the value. Press the OK Key to lock in the number. Note: A negative Sensor FC indicates a signal problem.
	Photo Level Set-up Screen Zone-3 Press the B Key until the screen is reached. Sens FC is the current light level seen by the sensor. HiLim is the OFF set-point from low to high light levels. LoLim is the ON set-point from high to low light levels. To set the HiLim or LoLim, enter the adjustment mode and press either the + or - Key to the register to be changed and press the OK Key to enter the select mode, then use either the + or - Key to enter the value. Press the OK Key to lock in the number. Note: A negative Sensor FC indicates a signal problem.

Table 5: Astronomical Controller User Programming Screens

5.4 CONTROLLER ZONE CONFIGURATION

	Zone Configuration Mode Screen Zones 1-3 Press the B Key until the screen is reached. The LCM configuration numbers are the result of specific system input and outputs requirements. Refer to Section 5.1, Table 4: Modes of Operation of this document to determine the number. From the select mode press either the + or - Key to move the cursor over the selected zone. Press the OK Key to enter the adjustment mode. Press either the + or - Key to adjust the number. Press the OK Key to lock in the entry.
	Photo Mode Auto / Setup Screen Press the B Key until the screen is reached. Pressing the A Key will toggle the mode to either SETUP or AUTO. Pressing the B Key will scroll to the next screen. SETUP mode will bypass all the photo control delay and hold timers to allow a fast photo sensor response from input to output. This mode should be used for troubleshooting only or calibration. NOTE: If the PHOTO MODE is left in SETUP, it will automatically switch back to AUTO mode after 60 minutes.
	Sensor Gain Set-up Screen Zones 1-3 Press the B Key until the screen is reached. From the select mode press either the + or - Key to move the cursor over the selected zone. Press the OK Key to enter the adjustment mode. Press either the + or - Key to adjust to corresponding sensor number. Press the OK Key to lock in the entry. I = CES/I Indoor Sensor O = CES/O Outdoor Sensor A = CES/A Atrium Sensor S = CES/S Skylight Sensor

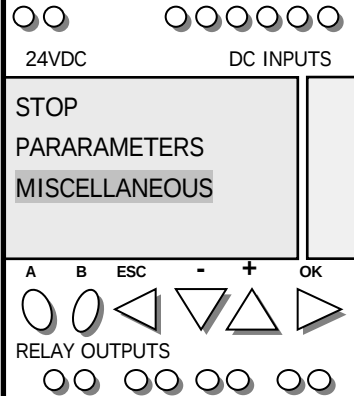
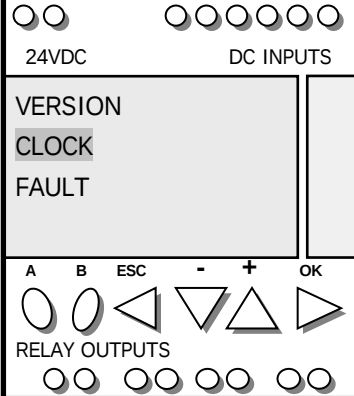
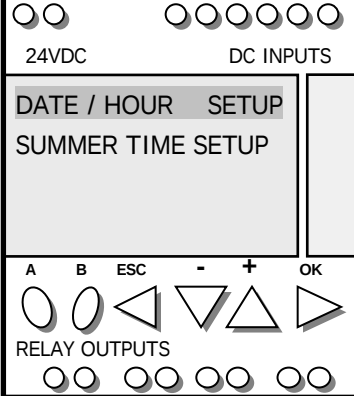
Table 6: Astronomical Controller Zone Configuration Screens

5.5 CONTROLLER INPUT / OUTPUT STATUS SCREENS

	Input / Output I/O Screen Press the B Key until the screen is reached. The first text line shows the RSW inputs 1, 2 & B and the photo sensor inputs C, D, and E (three zones). The next line shows the output relay states. If the output number is highlighted, the relay is ON. This example show relays 1 & 2 off and 3 & 4 ON. The bottom right line show the current time.
	Zone Run Time Screen Press the B Key until the screen is reached. This screen displays the run hours accumulated on all zones. The run hour range is from 0 to 32767. To reset the run hours, from the select mode press either the + or - Key to move the cursor over the selected zone. Press the OK Key to change to the adjustment mode. Press either the + or - Key to adjust value. Press the OK Key to accept the change.
	Astronomical Clock Output Screen Press the B Key until the screen is reached. This screen is where the astronomical clock information and status is displayed. There are no user interfaces with this screen, the screen information is read only. The screen displays both the astronomical morning sunrise and evening sunset times (Hr / Min), and whether the astronomical clock is OFF or ON.

Table 7: Astronomical Controller Input / Output Screens

5.6 REAL TIME CLOCK SETTING

	Controller Menu Parameters Screen To Set the clock: From the I/O Screen (Section 5.5) press the OK Key and enter the controller Parameters screen, as shown by the figure to the left. In the select mode move the cursor to MISCELLANEOUS by pressing + Key, then press the OK Key.
	Selection Screen In the select mode move the cursor to CLOCK by pressing either the + or - Key, then press the OK Key.
	Date / Hour Setup Screen In the select mode move the cursor to DATE / HOUR SETUP by pressing either the + or - Key, then press the OK Key.

	Weekly Setup Screen In the select mode move to the cursor to the desired field by pressing either the + or - Key. Press the OK Key to enter the adjustment mode. Press either the + or - Key to adjust value. Press the OK Key to accept change. Repeat the process for other entries. Press the ESC Key to go back to the Control Screen. Press ESC Key again to go back to the Main Screens.
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Table 8: Astronomical Controller Real Time Clock Setting

5.7 TIME SCHEDULE SETTINGS

	Controller Menu Screen To set the Time Schedule: From the I/O Screen (Section 5.5) press the OK Key and enter the controller Parameters screen, as shown by the figure to the left. In the select mode move the cursor to PARAMETERS by pressing + Key, then press the OK Key.
	FBD Time Schedule On Event Screen Time Schedule (TC) In the select mode move the cursor to the FBD field by pressing either the + or - Key. Press the OK Key to enter the adjustment mode, and then enter the TC FBD number into the field using the + or - Key. Press the OK Key to enter the chosen Time Schedule, using the + or - Key move the cursor to the TC event field and enter in the desired event number. Press the OK Key to lock in the entry. Event hour and minutes: 6am = 06:00, 5pm = 18:00 D: Day of the week the schedule applies to, (Mon...Sun). W: 12345: The week of the month the schedule applies to. ON: Indicator for ON or OFF clock event. ===== FBD: Zone 1= FBD 000, Zone-2 = FBD 001, Zone-3 = FBD 002. Scheduled ON event (n.00) even numbers = TC ON.

	FBD Time Schedule Off Event Screen Use either the + or - Key to move to the TC event fields, and then press the OK Key to enter the adjustment mode. Using the + or - Key enter 01, and press the OK Key to accept the entry and reenter the select mode. Use the either + or - Key to move the cursor to the other changes and repeat the process. Press the ESC Key to go back to the Control Screen. Press ESC Key again to go back to the Main Screens. ===== Scheduled OFF event (n=01) odd numbers = TC OFF.
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Table 9: Astronomical Controller Time Schedule Settings

5.8 DELAY AND HOLD TIMER SETTINGS

	Controller Menu Parameters Screen To set the Timers: From the I/O Screen (Section 5.5) press the OK Key and enter the controller Parameters screen, as shown by the figure to the left. In the select mode move the cursor to PARAMETERS using the + or - Key, then press the OK Key to enter the FBD Screen.
	FBD B/H Screen Hold-On Timer In the select mode pressing either + or - Key move the cursor to the FBD field. Press the OK Key to change to adjustment mode using either the + or - Key to enter the chosen HOLD (B/H) TIMER FBD number. Press the OK Key to accept the FBD number. The time is entered in seconds (30min = 1800s). FBD Number for Zone-1; Macro 002, FBD 022. Return to the FBD entry and repeat process for other zones.

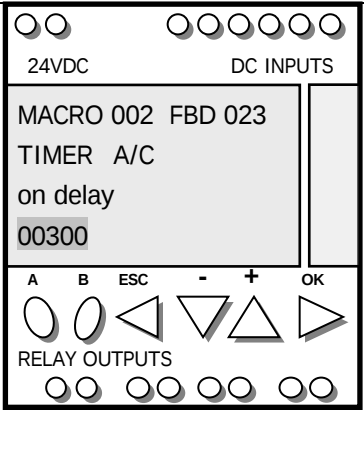
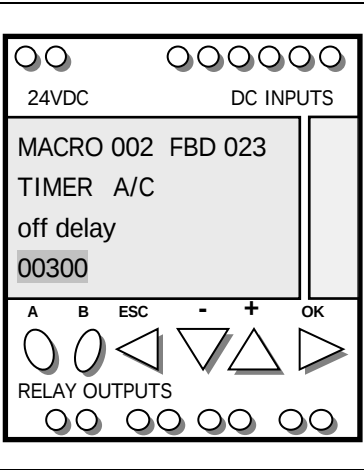
	FBD A/C Screen Delay Timers (On-Delay) In the select mode pressing either + or - Key move to the FBD field. Press the OK Key to change to adjustment mode, using either the + or - Key to enter the chosen DELAY (A/C) TIMER FBD number, and pressing the OK Key to accept the FBD number move the cursor to the bottom text field and make changes to the delay time. The time is entered in seconds (5min = 300s). Macro 002, FBD 023: Zone 1 Delay Timer.
	FBD A/C Screen Delay Timers (Off-Delay) There are two timers; ON DELAY and OFF DELAY. Moving the cursor to the third text line and pressing the OK Key, and then either the + or - Key will toggle between the two timers. The process is the same for both timers. The time is entered in seconds (5min = 300s). Return to the FBD entry and repeat process for other zones. Press the ESC Key to go back to the Control Screen. Press ESC Key again to go back to the Main Screens.

Table 10: Photo Delay and Hold Timer Settings

5.9 DAYLIGHT SAVINGS TIME SETTING

	Controller Menu Parameters Screen To Set the Daylight Savings Time: From the I/O Screen (Section 5.5) press the OK Key and enter the controller Parameters screen, as shown by the figure to the left. In the select mode move the cursor to MISCELLANEOUS by pressing + Key, then press the OK Key.
	SELECTION MENU SCREEN Select SUMMER TIME SETUP, and then press the OK Key.
	DAYLIGHT SAVINGS TIME SETUP SCREEN To Enter the Settings: From the screen to the left in the selection mode use either the + or - Key to move the cursor move to the desired field. Press the OK Key to enter the adjustment mode, then use either the + or - Key to enter the new value. Press the OK Key to accept the entry. Repeat the process for the other settings are completed. Press the ESC Key to go back to the Control Screen. Press ESC Key again to go back to the Main Screens.

Table 11: Controller Daylight Savings Time Setting

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6 FACTORY SETTINGS

6.1 FACTORY CONTROLLER SETTINGS

CONTROLLER SETTINGS	ENTERED VALUE	SCREEN
Astro Clock Time Seattle WA	Longitude: 122.33 Latitude: 47.61 GMT Offset: -480	Astro Clock Set-up Screen, Section 5.3
Real Time Clock	Pacific Time	Controller entry screen, Section 5.6
Daylight Savings Time	Summer: 2 nd Sunday in March Winter: 1 st Sunday in November	Controller entry screen, Section 5.9

Table 12: Factory Controller Settings

6.2 FACTORY ZONE-1 SETTINGS

FUNCTIONAL MODE	ENTERED VALUE	SCREEN and MACRO / FBD
Astro M/E Event	Morning Per: 00min Morning Post: 00min Evening Pre: 00min Evening Post: 060min	Astro M/E Event Screen Zone-1, Section 5.3
Time Schedule TC1	n00: ON = 06:00 n01: OFF = 18:00	FBD Time Schedule Event Screen, Section 5.7 MACRO 000 FBD 000
Configuration Index	Mode = 01 (Astro)	Zone Configuration Mode Screen Zones-1, Section 5.4
PHOTO GAIN	CES Select = 01	Sensor Gain Set-up Screen Zones-1, Section 5.4
OFF LIMIT (HiLim)	50FC	Photo Level Set-up Screen Zone-1, Section 5.3
ON LIMIT (LoLim)	30FC	Photo Level Set-up Screen Zone-1, Section 5.3
Hold-On Timer	HID Hold = 30min	FBD B/H Screen, Section 5.8 MACRO 002 FBD 022
Delay Timer	On-Delay = 5min Off Delay = 5min	FBD A/C Screen, Section 5.8 MACRO 002 FBD 023
Zone Run Time (Hr)	Zones-1 = 00000	Zone Run Time Screen, Section 5.5

Table 13: Factory Zone-1 Settings

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6.3 FACTORY ZONE-2 SETTINGS

FUNCTIONAL MODE	ENTERED VALUE	SCREEN and MACRO / FBD
Astro M/E Event	Morning Per: 00min Morning Post: 00min Evening Pre: 00min Evening Post: 00min	Astro M/E Event Screen Zone 2, Section 5.3
Time Schedule TC2	n00: ON = 06:00 n01: OFF = 18:00	FBD Time Schedule Event Screen, Section 5.7 MACRO 000 FBD 001
Configuration Index	Mode = 01 (Astro)	Zone Configuration Mode Screen Zones-1, Section 5.4
PHOTO GAIN	CES Select = 01	Sensor Gain Set-up Screen Zones-1, Section 5.4
OFF LIMIT (HiLim)	50FC	Photo Level Set-up Screen Zone-1, Section 5.3
ON LIMIT (LoLim)	30FC	Photo Level Set-up Screen Zone-1, Section 5.3
Hold-On Timer	HID Hold = 30min	FBD B/H Screen, Section 5.8 MACRO 002 FBD 022
Delay Timer	On-Delay = 5min Off Delay = 5min	FBD A/C Screen, Section 5.8 MACRO 002 FBD 023
Zone Run Time (Hr)	Zones-2 = 00000	Zone Run Time Screen, Section 5.5

Table 14: Factory Zone-2 Settings

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6.4 FACTORY ZONE-3 SETTINGS

FUNCTIONAL MODE	ENTERED VALUE	SCREEN and MACRO / FBD
Astro M/E Event	Morning Per: 00min Morning Post: 00min Evening Pre: 00min Evening Post: 00min	Astro M/E Event Screen Zone-3, Section 5.3
Time Schedule TC3	n00: ON = 06:00 n01: OFF = 18:00	FBD Time Schedule Event Screen, Section 5.7 MACRO 000 FBD 002
Configuration Index	Mode = 01 (Astro)	Zone Configuration Mode Screen Zone-3, Section 5.4
PHOTO GAIN	CES/I Select = 01	Sensor Gain Set-up Screen Zone-3, Section 5.4
OFF LIMIT (HiLim)	50FC	Photo Level Set-up Screen Zone-3, Section 5.3
ON LIMIT (LoLim)	30FC	Photo Level Set-up Screen Zone-3, Section 5.3
Hold-On Timer	HID Hold = 30min	FBD B/H Screen, Section 5.8 MACRO 002 FBD 022
Delay Timer	On-Delay = 5min Off Delay = 5min	FBD A/C Screen, Section 5.8 MACRO 002 FBD 023
Zone Run Time (Hr)	Zones-3 = 00000	Zone Run Time Screen, Section 5.5

Table 15: Factory Zone-3 Settings

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7 SYSTEM TROUBLESHOOTING

7.1 LCM-ASTRO LIGHTING CONTROL PANEL HARDWARE TROUBLESHOOTING GUIDE

7.1.1 TROUBLESHOOTING ELECTRICAL HARDWARE

TROUBLESHOOTING GUIDE	
High Voltage Electrical	
SYMPTOMS	DESCRIPTION
Panel does not switch ON	Check Main Breaker: With the Main AC Breaker ON, measure the AC voltage at Panel between TB1 Inputs AC Line to Neutral, if voltage is incorrect replace Main Breaker and/or repair wiring.
	Check Fuse (F1): Switch control power to the panel OFF at the main AC Breaker and check FI located on DIN Rail High Voltage section of panel. If fuse is open, replace the fuse.
	Check for Loose Wiring: Switch control power to the panel OFF at the main AC Breaker and measure continuity between wire connections, or with Panel On measure for voltage drops between connections. With control power to the panel switched OFF tighten loose connections.
Contactor/s not functioning	Check for Loose Wiring: Set the Zone Relay to CLOSED, the contactor is activated. Measure the contactor coil from the coil input to GND, the applied voltage should be present. Switch OFF the control power to the Panel at the Main Breaker and tighten connections, if problem is not corrected replace contactor.
AC to DC Converter, 24VDC output not correct or missing	Check AC to DC Power Supply: Visually check to see if the GREEN light of the AC to 24VDC converter is operating, if light is not operating measure the AC Input between the AC Line and Neutral Inputs. If the applied AC voltage is not present trace back to terminal connection, repair.
Low Voltage Electrical	
SYMPTOMS	DISCRIPTION
Converter, 24VDC power on the output side of the controller	Check 24VDC Output of Supply: Measure the DC Voltage at the Controller, between the V+ and V-, if the output voltage is not with-in specification adjust the voltage to 24VDC (24VDC between 19.2 – 30VDC). If not, the Power Supply is not working or can not be adjusted, replace.
Controller not switching ON	Check the 24VDC to the Controller: Follow the 24VDC wiring to the Controller section of the panel making sure the wires are secure, measure the voltage at the controller, between + (P24)and – (N24). If the applied voltage is present and the controller still does not function, contact PLC Multipoint for further instructions.
Zone Relay not operating in Auto Mode.	Check the Zone Relay Auto Function: From the Controller, set the Zone Configuration MODE for that Zone to mode 1, and return to the Front Display and change the Real-Time clock to 00:00. Check for RED light located on the Zone Relay. If LED does not illuminate contact PLC Multipoint for further instructions.

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7.1.2 TROUBLESHOOTING CONTROLLER OPERATION

TROUBLESHOOTING GUIDE	
Controller	
SYMPTOMS	DESCRIPTION
Controller does not switch ON	Check for 24VDC: Return to Section 7.1.1 and check for 24VDC. If no voltage contact PLC Multipoint for further instructions.
Controller ON, but appears to be frozen and non responsive.	Check for Controller Function: With the Controller ON, check for movement of the hourglass symbol, <u>Section 4.1, Figure 13 No. 12</u> , if not rotating try rebooting the controller by switching OFF the panel's control power and wait ten seconds and switch the panel back ON. If the problem does not correct it's self contact PLC Multipoint for further instructions.
The controller appears to operate in an abnormal manner.	Check for ERROR Codes: The Default menu of the controller's screen is used to display and acknowledge the ERRORS or WARNINGS detected by the controller software. When an ERROR or WARNING has been detected by the controller software, the screen will display a symbol, <u>Section 4.1, Figure 13, No 13</u> . The ERROR Codes are stored in memory. To enter the ERROR Code, select FAULT and not CLOCK <u>Section 5.6</u> . Entering the Menu Screens. Once in the FAULT mode an ERROR code will be displayed. Record the ERROR and press OK to acknowledge the ERROR. Press ESC until the Front Screen is displayed. If the controller continues to with the problem, call PLC Multipoint for further instructions.
ERROR	TYPE of WARNING
00	No faults
01	Fault in writing to EEPROM
02	Clock write error
04	Overload on solid state (controller) relay outputs
50	Controller software is damaged
51	Cycle overflow
52	The controller has executed an unknown operation
53	Link between controller and bus extension faulty
54	Link between controller and Input/Output extension faulty
58	A fault is present in the controller software or on a part of the controller hardware
59	At the start of the application in ON mode on the controller: The application cannot switch to ON mode because it is incompatible with the physically powered controller
60	At the start of the application in ON mode the controller: program incompatible with the bus extension physically connected to the supply
61	At the start of the application in ON mode on the controller: program incompatible with the Input/Output extension physically connected to the supply
62	Version incompatibility when loading a program from the backup memory
63	Hardware configuration incompatibility when loading a program from the backup memory

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7.1.3 TROUBLESHOOTING ASTRONOMICAL FUNCTION

TROUBLESHOOTING GUIDE	
Astronomical	
SYMPTOMS	DESCRIPTION
Lights ON after Sunrise, or still OFF at Sunset	Astronomical Clock Mode 1: Check Mode setting, for the astronomical clock to function the zone must be in Mode 1. Astronomical Clock in Mode 1 and zone NOT Functioning: ensure the setting for the Longitude, Latitude, and Offset are correct, see Section 5.3 for instructions. Settings for Longitude and Latitude can be found at http://itouchmap.com/latlog.html or other websites. Type in your address and press GO. Round-off the number given by the Website to two digits after the decimal point and enter the absolute value into the controller. Offset (GMT), check the website given and subtract your time from GMT time (in Zulu or military time) and multiply by sixty. Enter the value as a negative number. GMT can be found on this website http://www.timeanddate.com/worldclock/. If this does not solve the problem contact PLC Multipoint for further instructions.

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7.1.4 TROUBLESHOOTING FIELD INPUTS & OUTPUTS

TROUBLESHOOTING GUIDE			
Field Inputs & Outputs			
SYMPTOMS	DESCRIPTION		
Outdoor Lights ON too long, or stay ON all the time	Check for Photo Sensor Malfunction: To test the Photo Sensor verify the voltage between the red and black wires is ~24vdc. Disconnect the yellow signal wire at the sensor, place an opaque cover over the lens and measure the voltage across the yellow and black wires. With the sensor lens covered the voltage should read ~1VDC. Next, shine a light directly into the lens and read the voltage. The voltage should read ~10VDC with direct light. If the voltage remains high, and does not switch low when the sensor is covered, replace the sensor. Check for proper sensor Installation: Refer to CES Sensors Installation and Maintenance Manual P/N 5150XT rev 1/22/09, or relocate sensor. Check for Controller Mode Settings: To verify that the controller's settings are correct, switch the control power to the panel ON and follow the operation instruction in Section 4, and Table 2:, LCM-Astro Lighting System Mode Chart Check for Negative Sensor FC Values: To verify that the sensor FC value is not negative, refer to Section 5.3. If the sensor FC value is negative, check for proper wiring or replace the Photo Sensor. Check for an incorrect HiLim (OFF) Setpoint: If the Hi Setpoint value is set too high for the sensor used, the value will never be reached or reached too late in the day, the controller will not signal the lights to switch OFF. Verify the settings are correct, by referring to Section 6 or correct user entries, LCM-Astro Factory Preset. Correct values, by referring to Sections 5.3 and 5.4. Check for Faulty Remote Switch: Measure the voltage across the two connections, if the switch is OPEN the value will be the applied voltage, if the switch is CLOSED value will approach zero the switch will be functioning properly, if not replace switch, or rewire if miss-wired. Check for Incorrect Zone Time Clock settings: to check the Time Clock settings for each Zone refer to Section 5.7 of this document.		
Outdoor Lights are not switching ON	Check for Photo Sensor Malfunction: To test the Photo Sensor verify the voltage between the red and black wires is ~24vdc. Disconnect the yellow signal wire at the sensor, place an opaque cover over the lens and measure the voltage across the yellow and black wires. With the sensor lens covered the voltage should read ~1VDC. Next, shine a light directly into the lens and read the voltage. The voltage should read ~10VDC with direct light. If the voltage remains high, and does not switch low when the sensor is covered, replace the sensor.		
<table> <tr> <td> 3101 111th St SW #F, Everett WA 98204 TEL: 425 353-7552 FAX: 425 353-3353 WEB: WWW.PLCMULTIPOINT.COM </td><td> 45 / 48 </td></tr> </table>		3101 111th St SW #F, Everett WA 98204 TEL: 425 353-7552 FAX: 425 353-3353 WEB: WWW.PLCMULTIPOINT.COM	45 / 48
3101 111th St SW #F, Everett WA 98204 TEL: 425 353-7552 FAX: 425 353-3353 WEB: WWW.PLCMULTIPOINT.COM	45 / 48		

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	Check for proper sensor Installation: Refer to CES Sensors Installation and Maintenance Manual P/N 5150XT rev 1/22/09, or relocate sensor Check for Controller Mode Settings: To verify that the controller's settings are correct, switch control power to the panel ON and follow the operation instruction in Section 5. Check for an incorrect LoLim (ON) Setpoint: If the Low Setpoint value is set too Low for the sensor used, the value will never be reached to signal the controller to switch ON the lights. Verify the settings are correct, by referring to Section 5 and 6, LCM-Astro Factory Preset. Correct values, by referring to Sections 5.3 and 5.4. Check for Faulty Remote Switch: Measure the voltage across the two connections, if the switch is OPEN, the value will be the applied voltage. If the switch is CLOSED, the value will approach zero the switch will be functioning properly, if not replace switch, or rewire if miss-wired. Check for Incorrect Zone Time Schedules settings: To check the Time Schedules settings for each Zone refer to Section 5.7 Setting the Time Schedules of this document.
Maintenance Override lights will not switch ON/OFF as required	Check for maintenance override: The maintenance Override switch is located on the Interposing HOA Relay for each zone. Place the switch in the AUTO position. If problem persists contact PLC Multipoint for further instructions.

7.2 LONGITUDE AND LATITUDE REFERENCE CHARTS

	Lat. n.		Long. w.	
City	°	'	°	'
Albany, N.Y.	42	40	73	45
Albuquerque, N.M.	35	05	106	39
Amarillo, Tex.	35	11	101	50
Anchorage, Alaska	61	13	149	54
Atlanta, Ga.	33	45	84	23
Austin, Tex.	30	16	97	44
Baker, Ore.	44	47	117	50
Baltimore, Md.	39	18	76	38
Bangor, Maine	44	48	68	47
Birmingham, Ala.	33	30	86	50
Bismarck, N.D.	46	48	100	47
Boise, Idaho	43	36	116	13
Boston, Mass.	42	21	71	5
Buffalo, N.Y.	42	55	78	50
Calgary, Alba., Can.	51	1	114	1
Carlsbad, N.M.	32	26	104	15
Charleston, S.C.	32	47	79	56
Charleston, W. Va.	38	21	81	38
Charlotte, N.C.	35	14	80	50
Cheyenne, Wyo.	41	9	104	52
Chicago, Ill.	41	50	87	37
Cincinnati, Ohio	39	8	84	30
Cleveland, Ohio	41	28	81	37
Columbia, S.C.	34	0	81	2
Columbus, Ohio	40	0	83	1
Dallas, Tex.	32	46	96	46
Denver, Colo.	39	45	105	0
Des Moines, Iowa	41	35	93	37
Detroit, Mich.	42	20	83	3
Dubuque, Iowa	42	31	90	40
Duluth, Minn.	46	49	92	5
Eastport, Maine	44	54	67	0

	Lat. n.		Long. w.	
City	°	'	°	'
Fort Worth, Tex.	32	43	97	19
Fresno, Calif.	36	44	119	48
Grand Junction, Colo.	39	5	108	33
Grand Rapids, Mich.	42	58	85	40
Havre, Mont.	48	33	109	43
Helena, Mont.	46	35	112	2
Honolulu, Hawaii	21	18	157	50
Hot Springs, Ark.	34	31	93	3
Houston, Tex.	29	45	95	21
Idaho Falls, Idaho	43	30	112	1
Indianapolis, Ind.	39	46	86	10
Jackson, Miss.	32	20	90	12
Jacksonville, Fla.	30	22	81	40
Juneau, Alaska	58	18	134	24
Kansas City, Mo.	39	6	94	35
Key West, Fla.	24	33	81	48
Kingston, Ont., Can.	44	15	76	30
Klamath Falls, Ore.	42	10	121	44
Knoxville, Tenn.	35	57	83	56
Las Vegas, Nev.	36	10	115	12
Lewiston, Idaho	46	24	117	2
Lincoln, Neb.	40	50	96	40
London, Ont., Can.	43	2	81	34
Long Beach, Calif.	33	46	118	11
Los Angeles, Calif.	34	3	118	15
Louisville, Ky.	38	15	85	46
Manchester, N.H.	43	0	71	30
Memphis, Tenn.	35	9	90	3
Miami, Fla.	25	46	80	12
Milwaukee, Wis.	43	2	87	55
Minneapolis, Minn.	44	59	93	14
Mobile, Ala.	30	42	88	3

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