

LC3 LIGHTING CONTROLLER
OPERATIONS & MAINTENANCE MANUAL
2013 Dec

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1. DESCRIPTION AND SPECIFICATIONS

1.1 GENERAL

Tennis court lights may be managed more effectively by limiting their usage to certain periods and by limiting the amount of time they are used at any one time. The LC3 Light Controller allows defining the period of use according to day of week, time of day and condition of darkness.

The LC-3 Controller is an all solid-state electronic device using a microprocessor and single quartz crystal-controlled clock to time all functions. It controls up to eight court lighting zones independently, and also security or night-lights.

Each court light-zone is turned on by a button at the court-side. The lights will remain on for the duration time pre-set in the controller. A few minutes before the lights go off, a warning bell at the court-side sounds. At this time, if the players wish to continue, they can operate the button again and extend the operation time without turning the lamps off.

The hours and week-days of allowable operation are pre-set in the controller so that curfews and special considerations may be accommodated. The night-lights are pre-set to operate certain hours each day. With the optional photocell installed, none of the lights will work unless it is dark.

1.2 MECHANICAL

The controller is housed in a weather-proof steel NEMA-12 wallmount enclosure 50cm wide by 50cm high by 15cm deep (20x20x6"). Wiring enters the box by conduit. The door has a padlock hasp.

1.3 OUTPUT

The outputs are in modular assemblies, and may be set up for either two, four, six, or eight independent lighting zones. Each zone has a 120Vac @ 3 Amp output which is used to drive the coil of a magnetic power contactor, and a 24Vac @ 3 Amp output for the warning bell. The actual switching of the heavy lighting loads is done by contactors in separate cabinets (not a part of this control) which may be some distance away. Optional switches on the outside of the controller enclosure allow local control for maintenance.

1.4 POWER REQUIREMENTS

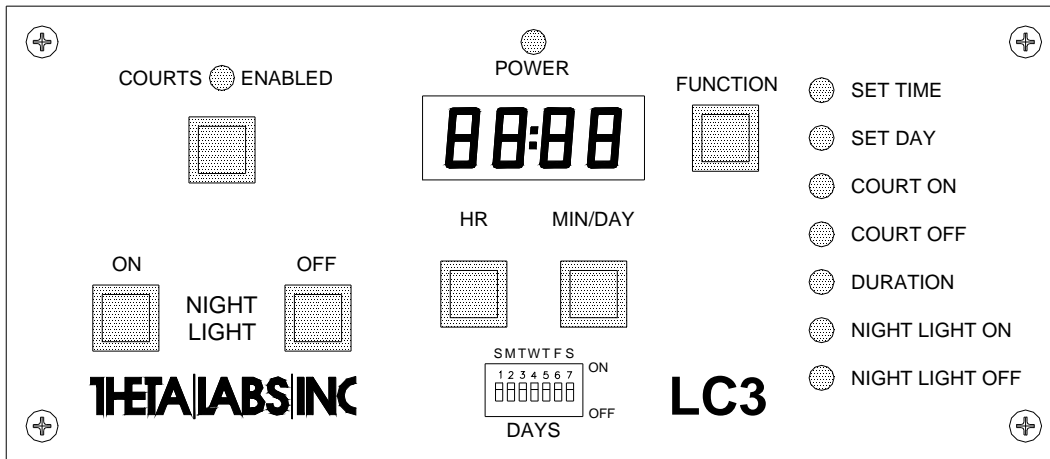
120Vac @ ¼ Amp, plus the power passed thru to drive the contactor coils and bells.

2. SET-UP & OPERATION

NOTE: After initial installation, or if the battery back-up has been disconnected, an additional initialization procedure is required before using the procedure below. See section 4.5 Start-Up Procedure.

2.1 INITIALIZATION

Prior to any usage, the functions listed below must be set. Normally, the four-digit LCD display at the top of the panel shows the current time from the clock. The display is also used to read the settings of all these functions. Which function is being displayed is shown by the vertical column of lamps at the right of the panel. Pressing the FUNCTION button for ½ second and releasing it will cause the function selection to advance down the column. If a lamp in the vertical column is lighted, the indicated set-up function is being displayed, and normal operation of the controller is stopped. If none are lighted, the display is showing the time from the clock and the controller is operating normally. If a set-up function is selected but no setting buttons are being pressed, the controller will time out and revert to normal operation.



SET TIME If the correct time of day is not shown, press the HR and MIN buttons as required until the correct time is shown. The 24-hour system is used, eg. 9am=0900, noon=1200, 2:30pm=1430, 8:30pm=2030, midnight=0000, etc.

SET DAY If the correct day of week is not shown, press the MIN/DAY button as required until the correct day is shown. The display is numeric, coded as follows:

- 1=Sunday 2=Monday 3=Tuesday 4=Wednesday
- 5=Thursday 6=Friday 7=Saturday

COURT ON Set the time when the court lights are enabled, ie. the earliest time they may be turned on. The court enable, disable and duration times apply to all courts.

COURT OFF Set the court light disable time, ie. the latest time they may be on or used. Court lights will turn off at this time, regardless of when they were turned on.

DURATION Set the length of time the court lights will stay on after the last push of the start button.

NIGHT LIGHT ON Set the time for the night light to turn on.

NIGHT LIGHT OFF Similarly, set the night-light off time.

DAY SELECT The miniature slide switch at the bottom center of the panel selects the days of the week that courts may be used. Using a tooth-pick or similar small tool, push up the slide under the days to be allowed, and push down the slide for those days when the courts may not be used.

2.2 NORMAL OPERATION

The following assumes that the photo-cell on the controller (if installed) is in darkness. For testing in daylight, see section 2.3.

If the court lights are enabled, pushing the start button near the court will turn on the lights for that court. The lights will be enabled if the appropriate DAY-SELECT switch is on, and the COURT ON time has passed. The COURTS ENABLED lamp on the panel will show this status.

The court lights will stay on for the DURATION time set. Three minutes before they go off, a warning is sounded for two seconds. If the start button is pushed again before the lights time out, operation will continue for the DURATION time again without going off.

The night (security) light will activate anytime after the N.L. on time that the photocell shows dark, and will de-activate at the N.L. OFF time. The DAY-SELECT switch has no effect.

2.3 TESTING & MANUAL OPERATION

To test in daylight a controller equipped with the optional photocell, it is necessary to simulate darkness by covering the photocell so no light reaches it. There may be a time delay of several minutes before the cell reacts. The small red indicator lamp by module 7 (yellow) of the relay strip on the left side of the controller panel will be on when the photocell is reporting the necessary dark condition.

If no photocell is installed, typically module 7 is deleted and replaced with a short jumper wire. This simulates a dark condition, although the indicator lamp will not light.

The court lights may be enabled or disabled manually at any time without disturbing the COURT ON or OFF settings by pressing the button under the COURT ENABLED indicator lamp. This allows the court lights to be operated outside the normal hours of operation. The push-button(s) will not start the lights unless the COURT ENABLE lamp is on and the photocell is reporting dark.

The NIGHT LIGHT may be operated manually by pressing the NIGHT LIGHT ON or OFF buttons. The photocell must be reporting dark, but the COURT ENABLE does not matter.

For a quick functional test, temporarily set the DURATION time to four minutes. Ensure that the photocell shows dark or is jumpered, and the COURT ENABLE lamp is on.

To test each set of court lights:

- a. Press the START push button and start timing. The court lights will start immediately.
- b. The warning bell will sound within one minute, when the clock advances.
- c. The court lights will turn off three minutes after the bell sounds.

If the controller does not respond like this, refer to section 5.

After all courts have been tested, return the DURATION time to the desired setting.

4. INSTALLATION

ref: Installation Dwg. 09-006

4.1 CABINET

Mount cabinet per drawing using 9.5mm (3/8") bolts. For indoor installations allow at least 72cm (29") door opening clearance, measured from the mounting wall. Locate cabinet for easy access to power and contactor leg conduits.

4.2 POWER REQUIREMENTS

120VAC power must be supplied from a 15 or 20 Amp circuit breaker not shared with loads other than this controller. The breaker should be located conveniently near and marked so as to provide a safety disconnect for maintenance of the controller.

4.3 OUTPUT LOAD REQUIREMENTS

The rated capacity of each 120Vac output is 3 Amp. continuous, although they are fused at 5 Amp for surges. If the load current exceeds 3 Amp, an intermediate buffer relay must be used. Also, the combined total of all outputs used must not exceed 80% of the supply breaker capacity; for a 15A breaker this allows 12 Amp.

4.4 OUTPUT WIRE SIZE & LENGTH

Power contactors or other loads are located separately from the controller and connected through two wires for each contactor, one for the hot wire and one for the return to neutral in the controller cabinet. The wire size, based on the maximum load current of three Amperes, must be a minimum of 18 ga. If the loads are separated from the controller, the wire size may need to be larger to prevent excessive Voltage drop (5V max) to the load. The following table gives maximum one-way lengths from the controller to load for several wire sizes, allowing for drop in both the hot wire and return.

| | |
|--------|----------------|
| 18 ga. | 39m (128 ft.) |
| 16 ga. | 62m (200 ft.) |
| 14 ga. | 99m (324 ft.) |
| 12 ga. | 157m (515 ft.) |
| 10 ga. | 250m (820 ft.) |

Loads located further from the controller may be connected with low-Voltage telephone-type wire and driven by a 20 mA current loop and buffer relay. Depending on the cost of the wire, this may be an attractive alternative at shorter distances as well. Contact Theta Labs for details.

4.5 START-UP PROCEDURE

If the panel has been totally powered-down with the back-up battery disconnected, as in shipping, the clock and calendar and the internal data registers that hold the court on & off times , duration etc. may contain garbage (illegal numbers) which will not show correctly in the displays. The following procedure will recover from this condition.

First, ensure that the back-up battery is connected. The battery is at the lower right corner of the circuit board; between it and the edge of the board are two small pins (W3). When a shorting clip is across these pins, the battery is connected. When the battery is disconnected, as in shipping, this clip is installed sideways on one pin only.

Another pair of pins (W2), a little higher and to the left of the corner, should always have a clip across them to enable the watch-dog timer.

Then, go to each of the setting functions described in section 2.1 and run each through a full cycle past zero. For each time function the hours and minutes must be run through separately. They may then be set to their correct settings.

Next, test the system operation as described in section 2.3.

5. TROUBLESHOOTING AND MAINTENANCE

5.1 POWER TEST

With a Voltmeter, check for 5 Volts dc at the two-screw terminal strip on the lower-left corner of the main electronic circuit board, neg. (black) on the bottom screw, pos. (red) on the top. The green indicator lamp at the top of the control panel shows if power is on, but not the accurate Voltage. Check for 24-30 Volts ac between the right-most two terminals of the terminal strip at the top of the panel. These Voltages derive from the power supply and transformer respectively, which are powered through the clip-in fuses.

5.2 COURTSIDE PUSHBUTTON TEST

Whenever a START pushbutton is pressed, the small red indicator lamp beside the corresponding PB input module should light. Refer to the module list in appendix A. This module is activated by 24Vac from the bell/button circuit. Ref. drawing 09-006, Installation Wiring. If the appropriate Voltage is across the two terminals by the module, but the lamp does not light, the fuse or module may be at fault. See the fuse note below.

5.3 OUTPUT RELAY MODULE TEST

Whenever the computer commands a black output relay module (courts, nite-lite, bells) to activate, it lights the little red indicator lamp beside the module. The relay module closes the circuit through a fuse to the terminal screws. Thus, if the red lamp is on but lights or bells not activated, the fault lies in the fuse or external wiring.

Fuse Note: Each module (input & output) is connected to the terminal screws through a tiny fuse plugged in just above the module. The recommended replacement is a 3 Amp slow-blow Pico Fuse by Littelfuse. It may be necessary to remove a module to get access to this fuse.

5.4 REMOVAL/REPLACEMENT OF MAIN CIRCUIT BOARD

Removal or replacement of the main circuit board must be done with the power turned off. The ribbon cable connector can be removed by flipping out the latch/ejector handles at the ends of the connector. Loosening the two screws on the terminal strip at the lower-left of the board allows the power wires to be removed. Note that the red wire goes to the top.

The back-up battery (see para. 4.5) will operate the clock and maintain settings for one or two months total time without power to the board, after which the battery must be replaced. For this reason the battery must be disabled if the board is not to be powered up soon. The battery should measure above 3.5Vdc at the bottom terminals.

After a board is installed and power restored, the start-up procedure of para. 4.5 must be performed.

5.5 CLOCK FREQUENCY ADJUST

The accuracy of the clock/calendar oscillator is checked as follows. For this test an oscilloscope and frequency counter with accuracy within 5 ppm (.0005%) are required.

5.5.1 Remove the clip from W2 to disable the watch-dog timer. See para. 4.5 for location.

5.5.2 Turn off the 120Vac power to the panel.

5.5.3 Halt the processor and put the clock in test mode by holding in the HR-set button while turning the power back on.

5.5.4 Check that a 5V square wave appears on U19 pin 13. If the frequency is not $32,768 \pm 1$ Hz, adjust C16 to bring it in. Use the counter's 10-second gate to get resolution to 0.1 Hz. This is a slow process, and may take many minutes.

5.5.5 While the processor is halted for the clock frequency check, the w.d. timer is free-running and may be checked. A 5V square wave with a 1.2 second period should be on the top pin of W2.

5.5.6 Re-install the shorting clip across the W2 pins to enable the watchdog timer and re-start normal operation of the processor.

5.5.7 Reset the clock time. Check all function settings and, if necessary, perform the startup procedure of para. 4.4.

APPENDIX A

Relay module list

note: Two-zone controllers have only modules 0-7 of left strip, four-zone controllers have modules 0-15, six-zone controllers add modules 0-7 of the right strip, and eight-zone controllers have all modules shown.

| Left relay strip | Right relay strip |
|---------------------|-------------------|
| 15 not used | 0 black court 5 |
| 14 not used | 1 black court 6 |
| 13 white p b 4 | 2 black bell 5 |
| 12 white p b 3 | 3 black bell 6 |
| 11 black bell 4 | 4 white p b 5 |
| 10 black bell 3 | 5 white p b 6 |
| 9 black court 4 | 6 not used |
| 8 black court 3 | 7 not used |
| ----- | |
| 7 yellow photocell | 8 black court 7 |
| 6 white p b 2 | 9 black court 8 |
| 5 white p b 1 | 10 black bell 7 |
| 4 black bell 2 | 11 black bell 8 |
| 3 black bell 1 | 12 white p b 7 |
| 2 black night light | 13 white p b 8 |
| 1 black court 2 | 14 not used |
| 0 black court 1 | 15 not used |

ADDENDUM for 120V BELLS & BUTTONS

The LC3 manual was written for systems using 24 Volts AC for the push-button and bell circuits. For systems using 120Vac buttons & bells, there are a few differences. Apart from the obvious that all references to 24V should be replaced with 120V, and that the version of the installation wiring drawing 09-006 for 120V bells should be used, the following changes to the manual apply:

Section 5, Troubleshooting & Maintenance

5.1 Power Test – There will be no 24V terminals at the top of the panel.

Appendix A, Relay Module List

Modules 5, 6, 12 & 13 on the left strip, and modules 4,5,12 & 13 on the right strip (if installed) will be yellow IAC5 120Vac modules instead of the white 24V ones listed.