

Tandem

NETWORKED

Lighting Control System

PROJECT	
LOCATION	

Part 1 General

1.01 INTRODUCTION

The work covered in this section is subject to all the requirements in the General Conditions of the specifications. The contractor shall coordinate all the work in this section with all trades covered in other sections of the specification to provide a complete and operative system.

1.02 DESCRIPTION OF WORK

The extent of lighting control system work is indicated by drawings, and by the requirements of this section. It is defined to include low voltage lighting control panels, switch inputs, and wiring. The type of lighting control equipment and wiring specified in this section include the following:

- Low Voltage Lighting Control Panels

Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways and electrical boxes and fittings required for installation of lighting control equipment and wiring.

- Not work of this section

1.03 QUALITY ASSURANCE

- A. UL Approvals
The lighting control panels shall be tested and listed by a nationally recognized testing laboratory under UL 508A.
- B. NEC Compliance
The lighting control system shall comply with all applicable National Electrical Codes regarding electrical wiring standards.
- C. NEMA Compliance
The lighting control panels shall comply with all applicable portions of the NEMA standards regarding the types of electrical equipment enclosures.
- D. Component Pre-testing
All lighting control equipment shall undergo strict inspection standards. The equipment shall be tested at the factory prior to installation.
- E. System Checkout
A factory-trained technician/other factory authorized personnel or contractor shall functionally test the lighting control system and verify performance after installation.
- F. Manufacturer
The manufacturer shall have a minimum of 20 years of experience in lighting control systems. The manufacturer shall provide off-the-shelf control products from its inventory. Lighting control systems that require custom assembly and sizing shall not be acceptable.

1.04 SUBMITTALS

- A. Product Data
Manufacturer's data on lighting control system and components shall be submitted.
- B. Shop Drawings
Drawings of lighting control panel and accessories including, but not necessarily limited to the low voltage relay panels, power wiring, switch inputs, and sensor wiring shall be submitted.

Part 2 Products

2.01 MATERIALS AND COMPONENTS

A. Product Data

Product shall be Tandem Networked Lighting Control System manufactured by PLC Multipoint or approved equal.

B. System Description

- i. The lighting controller shall offer four (4) analog inputs, eight (8) control relays, and four (4) 0-10V dimming outputs. The switch inputs shall consist of eight (8) programmable switch inputs and one (1) digital input capable of supporting up to sixteen (16) switches.
- ii. Each low voltage lighting control panel shall be microprocessor controlled with an integral LCD display. The LCD screen shall provide relay status information. All normal programming features shall be permissible through the self-prompting LCD display.
- iii. Programmable intelligence shall include Time-Of-Day control, default and programmable holiday dates, a warning to occupants of an impending OFF, timed inputs, preset control (patterns), automatic daylight savings, an astronomical clock with offsets, local control, analog control (photosensors), switch input control, group control and an interface to digital wall control stations.
- iv. The lighting control panel shall be capable of setting the relay and/or dimming output function for each location. The relays may be designated in software as Normal, Inverting, Sentry, AS100, HID and Beacon to allow various programming options. The lighting controller shall be capable of reporting whether the relays are overridden via software, override switches, or via on-board hardware overrides.
- v. Each lighting control panel shall provide a Warn OFF (flash the lights) to inform the occupants of an impending OFF command. The occupants may exit the premises with adequate lighting or cancel the Warn OFF by overriding the lighting zone.
- vi. The lighting controller shall permit lighting to be overridden ON for after-hours use. The lighting controller shall provide optional switch timer assignments or timed overrides. The override choices for various relays shall provide for special event occurrences and the lighting controller shall return to the programmed state after the override event has expired. Also, the lighting controller shall provide profile choices to customize the functions of switch inputs. The following are types of physical analog wired control inputs that shall be provided.
 - Momentary Push-Button (2-wire alternate action) - When ON terminal is pressed, the switch state will toggle once from ON to OFF or OFF to ON, depending on last state.
 - Momentary ON/OFF (3-wire) - When ON terminal is pressed, the switch goes ON. When OFF terminal is pressed, switch goes OFF.
 - Maintained ON/OFF (2-wire) - When ON terminal is pressed the switch goes ON. When ON terminal is released, switch goes OFF.
 - Motion Sensor ON/OFF (2-wire) - When ON terminal is pressed, the switch goes ON. When ON terminal is released, switch goes OFF. Multiple motion sensors connected to the same group wait until all sensors are OFF before turning the group OFF. Any sensor in the group will turn ON the group.
 - Cleaning Momentary Push-Button (2-wire alternate action) - When ON terminal is pressed, the switch state will toggle once from ON to OFF or OFF to ON depending on last state. Cleaning switches have a higher priority than regular switches. When ON, they override the ability of regular switches to turn OFF the load.
 - Cleaning Momentary ON/OFF (3-wire) - When ON terminal is pressed, the switch goes ON. When OFF terminal is pressed, switch goes OFF. Cleaning switches have a higher priority than regular switches. When ON, they override the ability of regular switches to turn OFF the load.
- vii. Programming the lighting controller shall be through the local integral LCD display and keypad. Descriptive information shall assist the user in setting up the system for most basic functions without a programming manual.
- viii. Remote Access
 1. Provide remote access as follows:
 - a. Configuration of the equipment to allow the user to remotely access the lighting control system shall include at a minimum: customer network connection or cellular modem or router, antenna for the modem or router, cellular

service contract or wireless service plan and any connections required to enable communication to the specified Network Lighting Control System. Owner's authorized site contact can request the manufacturer to check the system for proper operation and make any programmable changes desired. Manufacturer shall provide a phone number dedicated to customer calls concerning remote access to systems, and a support organization capable of enabling cellular communication to the system for troubleshooting and making requested changes to the system.

b. Remote access capability shall provide at a minimum the following features:

- (i) Access to the PLC Designer software tool.
- (ii) Ability to override any relay or dimming output on any lighting controller in the network via PLC Designer.
- (iii) Access to all devices via PLC Designer allowing for programmability of device features. This will include all scheduling of Time-of-Day Events and programming of individual device parameters to meet Sequence of Operation requirements.
- (iv) Access to the IP Setup Tool to setup the network interface with a static IP address per project documentation, and to confirm that all functional operations are working properly.
- (v) On demand access to manufacturer technical support that will provide remote troubleshooting, diagnostics, and configuration/programming assistance. After the scheduled on-site startup, all manufacture-provided support work for a site will be performed remotely, or via later return trips.
- (vi) Additional client training on the lighting control system after building occupancy can be performed while remotely connected to the site.

ix. BACnet

1. Provide BACnet capability as follows:

- a. Configuration of the equipment to allow the user to access the lighting control system shall include at a minimum: BACnet IP or BACnet MS/TP-compliant connections required to enable communication to the specified Network Lighting Control System. System Integrator shall check the system for proper operation and make any programmable changes desired. Manufacturer shall provide a phone number dedicated to customer calls concerning BACnet access to systems, and a support organization capable of troubleshooting the system. BACnet capability shall provide at a minimum the following features:
- b. BACnet IP or BACnet MS/TP-based lighting controller with web browser-based user interface for system control, scheduling, device parameter administration and reporting.
- c. Programming and Configuration Software: PLC Designer shall be capable of accessing control parameters of the lighting control system simultaneously with the BACnet IP or BACnet MS/TP communication.
- d. BACnet IP or BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS).

x. Additional Features shall include:

- 1. Time-Of-Day Scheduling – The lighting controller shall have 48 (6 per group) Time-Of-Day/holiday schedules for 365-day programming.
- 2. Holidays – The lighting controller shall have three holiday types: Perpetual (13) (self-adjusting), Single day floating holidays (16) and range holidays (16).
- 3. Warn Off – The lighting controller shall have the ability to flash the lights and provide a warn time of 10 minutes prior to lights going OFF. The lighting controller shall provide special warn off types: No Warn, Warn Off, Sentry Warn, AS100 Warn, and HID Warn.
- 4. Presets (Patterns) – The lighting controller shall have the ability to store pre-programmed relay patterns with user defined algorithms.

5. Hold ON Timer – The lighting controller shall have Hold ON timers configurable for 1 - 999 minutes for the switch inputs. The Hold ON timer shall function such that the relay will return to the state it was in prior to receiving the input after the timer expires.
6. Astronomical Clock – The lighting controller shall accept City and State input with sunset/sunrise offsets for astronomical control.
7. Auto Daylight Savings Adjust – The lighting controller shall automatically adjust the clock at the appropriate dates for daylight savings. This feature shall be selectable by the user. The dates for daylight savings shall be programmable by the user.
8. Groups – The lighting controller shall provide groups for linking control commands with multiple relays and/or dimming outputs for ease of use and rapid programming.
9. Analog Inputs – The lighting controller shall have four (4) analog inputs, each having eight (8) control thresholds programmable by the user. PLC photosensors and their associated ranges shall be included in the default setup of the lighting controller.
10. Building Occupancy – The lighting controller shall simplify programming by defining an Open and Close Time.
11. Data Logs – The lighting controller shall provide the ability to record operating data and present that data in a useable format.
12. Alarms – The lighting controller shall provide alarm indication when operations are outside of programmed parameters. This shall include relay status, switch status, and photosensor analog values.

C. Hardware Features

i. Diagnostic Aids

Each lighting control panel shall incorporate diagnostic aids for confirmation of proper operation, or in case of failure, these aids shall guide the individual in rapid troubleshooting of the system. The lighting control panels shall employ an LCD screen and LEDs to indicate:

- Status (LED)
- System Power (LED)
- ON/OFF Status of each relay (LED & display)
- System Clock – Time and Date (display)
- Programming Confirmation (display)
- Alarm Status (display)
- CAN bus TX/RX (LED)
- NET TX/RX (LED)

Lighting control systems that do not provide visual selfhelp diagnostics shall not be acceptable.

ii. MicroSD

The lighting controller shall provide the capability of performing firmware upgrades, programming backups, and programming downloads via a MicroSD slot.

iii. USB Port

Each lighting controller shall come equipped with a USB port that allows for direct connection to a PC for firmware upgrades, programming backups, programming downloads, and realtime programming.

iv. Remote Access

If requested, the lighting controller shall allow for remote programming and override of outputs via PLC Designer.

v. BACnet

If requested, the lighting controller shall allow for interface to other systems via BACnet.

vi. Modular Design

All connections for the analog and physical switch inputs shall incorporate modular connectors. The relay board shall be modular and

designed for rapid field replacement or upgrading. Systems that do not employ modular connectors shall not be acceptable.

vii. Memory Backup

The system shall utilize a Flash Memory backup device that is system-integrated and shall be non-serviceable. The data in Flash Memory shall be protected against power interruptions for the life of the product. The power interrupt protection circuit shall be entirely maintenance-free.

D. Control Relays

The system shall provide status indication of all relays via the relay control LEDs and through the LCD of each lighting control panel. The visual indication shall disclose ON/OFF Status and relay number. The relay design shall also provide indication to the user if the relay is in a hand-actuation condition.

- i. The relay shall be a UL Recognized component. Each relay shall be an SPST, dual-coil latching relay with a manual override lever that allows for load power even when control power is not maintained at the panel. The relay shall be rated for the following:
 - 20A Tungsten @ 120VAC
 - 20A ballast @ 120VAC
 - 20A Tungsten @ 277VAC
 - 20A ballast @ 277VAC
 - 1.5 Horsepower @ 120VAC
- ii. Each relay terminal shall be a box clamp style field connection with the capacity to accept one 8 -20AWG wire, solid or stranded, copper only.
- iii. Each relay terminal screw shall have a slotted drive.
- iv. Each relay shall be individually replaceable and shall directly connect to the relay interface board without the use of wires or soldering. Relay blanks shall be provided for unpopulated slots.
- v. Each relay shall be rated for a minimum of 300,000 ON and OFF cycles at full load.

E. Multi-Tapped Transformer

The lighting control panel shall incorporate the use of a multi-tapped transformer. The panel shall not require specification of voltage for each control location. The voltages of 120VAC & 277VAC shall be available with each lighting control panel. The transformer shall be breaker protected with automatic shutdown in the event that an inappropriate electrical connection has occurred. The power supply shall have the capability of providing enough capacity to power up to eight (8) low voltage occupancy sensors.

F. Enclosure

The lighting controller enclosure shall provide both Class 1 and Class 2 connection areas. The enclosure shall be NEMA 1 rated and have a physical size of: 12" H x 12" W x 4.25" D. The enclosure shall be manufactured out of 1/16" steel. The enclosure shall include a lockable hinged cover.

G. Operator Interface

The lighting control panel programming interface shall reside in firmware in the lighting control panel. The programming interface shall consist of a circuit board mounted LCD screen capable of linking switch inputs to relay outputs and schedule assignments. The integral LCD screen shall provide access to the main programming features. The LCD screen shall permit the user to manually command any or all relays individually. Features of Remote Access and BACnet shall be accessed via PC application, PLC Designer.

H. PLC Designer

Software shall allow programming of lighting control system in its entirety, with the additional benefit of custom profiles for most control functions (dimmer behavior when controlled via switch, dimming curves, group profiles, schedule profiles, photocontrol, switch specific behavior, etc.)

2.02 OVERRIDES/CONTROLS

The lighting controller shall provide timers for each override. Each override timer shall be capable of 1 - 999 minutes. Software shall enable or disable overrides based on time or other pre-assigned actions and/or profile designation.

A. Digital Wall Control Stations

The lighting controller shall support digitally addressable LED annunciated switches. The maximum total number of digital switches that shall be connected to one lighting controller is sixteen (16) with up to eighty (80) individual control buttons. The digital switches shall require a 4-conductor cable between control stations. The digital control stations shall control any relay group combination in the lighting controller. Data communications status feedback for system checkout and troubleshooting (transmit and receive → LED'S) shall be visible on both the lighting controller and interface. The digital control stations configuration system shall permit custom labeling for multiple button locations. The digital switch configuration shall be of Decora™ form and function.

B. Dry Contact Inputs

The lighting control system shall permit eight (8) dry contact inputs for override purposes. Momentary 3 wire or 2 wire (toggle) inputs shall be supported. Maintained contacts shall be supported as 2 wire (SPST) inputs. Inputs shall be dry contacts (24VDC internally supplied to the inputs). Any switch input shall be software linked to any number of relays for override control. Each switch input shall provide an LED to visually provide switch status on the lighting controller for program verification and troubleshooting.

C. Lighted Switch Outputs (LSO)

The lighting controller shall provide an output for pilot light wall switch annunciation of dry contact inputs. A fourth connection point on the lighting controller shall provide power to illuminate pilot light switches. This option shall confirm relay and switch operation. When a relay is in the "ON" position, the pilot light switch shall be illuminated.

D. Photo Sensor

- i. Photo sensors shall be specifically designed to operate with the environment in which they are placed and shall provide 1-10VDC or 4-20mA signal ranges to the input of the lighting controller. This signal shall be directly proportional to the amount of daylight entering the monitored area.
- ii. Sensor range shall be from a minimum of 0fc to an adjustable range of 7,500fc maximum. Actual range shall be as follows; 0-55fc indoor low light, 0-100fc for indoor normal light, 0-250fc for outdoor, 1-1,000fc for atrium operation, and 10-2,000fc for skylight operation unless specified on the facility drawings. The sensor range shall be set at the factory and sealed against tampering in the field.
- iii. Footcandle "ON" setpoint and "OFF" setpoint shall be preset at the factory and field tuning adjustments shall be made at the lighting controller.
- iv. The location of sensor placement shall be specified on the drawings and placed in such a way to prevent interference from obstacles.
- v. Sensors shall have an accuracy of +/- 1% at 70°F or +/- 5% over a 100°F temperature range.
- vi. The sensor shall have a focusing lens to provide the proper view for the area being monitored. Wiring of the sensor shall be with a shielded three-wire stranded cable rated at NEC Class 2 or 2P. It shall be #18 AWG or larger. Conductor shall be Belden type 27082AS or equal. (Colors must match sensor conductors and are Yellow = 1-10VDC signal; red = 24VDC supply; Black = -24VDC Return)
- vii. The Photo Sensor shall be PLC Multipoint or approved equal.

E. Auto/Manual Override

The lighting controller shall provide a single master override two-position switch with the option of a Manual (Hold) position and an Auto position. The master switch shall not be accessible from the exterior. This master switch shall override all relays in their present state when invoked by the user. The master switch shall supersede all commands from the lighting controller when the switch is in the Manual (Hold) position. The master switch shall function to override all relays should the lighting controller programming differ from the space function.

The system shall remember the last command to the individual relays. Upon returning the master switch to the Auto position, the relays shall remain in their present state until the next command occurs.

Part 3 Execution

3.01 EQUIPMENT INSTALLATION AND DOCUMENTATION

A. Installation

The lighting control system shall be installed and fully wired as shown on the plans by the installing contractor. The contractor shall complete all electrical connections to all control circuits and override wiring.

B. Documentation

The contractor shall provide accurate "as-built" drawings to the owner for correct programming and proper maintenance of the lighting control system. The "as-builts" shall indicate the load controlled by each relay and the relay panel number.

C. Operation and Service Manuals

The factory shall supply all operation and service manuals.

3.02 PRODUCT SUPPORT AND SERVICE

A. Factory Support

Factory technical support shall be available at no cost to the owner. Factory assistance shall consist of resolving programming or application questions concerning the lighting control system.

B. Pre-Programming

Pre-programming shall require the Owner to provide a detailed description of control intent prior to order shipment. A program shall be generated by PLC Multipoint that captures the provided control intent and the lighting controller(s) shall be loaded with this program prior to shipment.

C. Programming Support

Programming Support shall require the Owner to provide a detailed description of control intent, via phone or email, after order shipment. PLC Multipoint shall generate a program that captures the control intent described by the Owner. Program shall be loaded into lighting controller(s) on-site by a factory-trained technician or other factory-authorized personnel or contractor.

D. Onsite Support

A factory-trained technician or other factory-authorized personnel shall be on-site to provide system checkout, startup and commissioning services and Owner training.

3.03 SYSTEM DELIVERY AND ACCEPTANCE

A. Delivery

The contractor is responsible for complete installation of the entire system according to strict factory standards and requirements. The following items shall constitute factory standards and requirements:

- i. All system equipment shall operate in accordance with specification and industrial standard procedures.
- ii. An operational user program shall exist in the lighting control system. The program shall execute and perform all functions required to effectively operate the site according to the requirements.
- iii. Demonstration of program integrity during normal operation and pursuant to a power outage.
- iv. Contractor shall provide a minimum of two training hours on the operation and use of the lighting control system. Additional support services shall be negotiated between the contractor and the building owner or manager.

3.04 WARRANTY

Manufacturer shall supply a five (5) year warranty on all hardware and software.