**SECTION 26 09 28**

**LIGHTING CONTROL PANELS**

**BASED ON DFD MASTER ELECTRICAL SPEC DATED 03/01/21**

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.

**PART 1 - GENERAL**

**SCOPE**

The work under this section includes power supplies, relays, control equipment, enclosures, and low-voltage switches associated with low voltage lighting control. Included are the following topics:

PART 1 - GENERAL

 Scope

 Related Work

 Submittals

 Record Documents

 Operation and Maintenance Data

 Warranty

PART 2 - PRODUCTS

 System Description

 Operator Interface

 Inputs and Outputs

 Diagnostic Aids

 Communication Accessories

 Programming Software

 System Management Software

 Miscellaneous

PART 3 - EXECUTION

 Examination

 Installation

 Sequence of Operation

 Factory Commissioning and Programming

 Factory Support

 Construction Verification

 Functional Performance Testing

 Agency Training

RELATED WORK

Section 01 91 01 or 01 91 02 – Commissioning Process

Section 26 08 00 – Commissioning of Electrical

**SUBMITTALS**

Submit product data indicating system and component construction, ratings, and operating parameters.

Submit manufacturer's installation instructions.

**RECORD DOCUMENTS**

Provide drawings showing where the lighting control panels are located within the building. Provide schedules indicating switch locations (room numbers) in the building and the associated relay number(s) in the panels. If multiple lighting control panels are networked together, provide a riser diagram showing how the lighting control panels are connected to each other.

**OPERATION AND MAINTENANCE DATA**

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

**WARRANTY**

Manufacturer shall supply a 3-year warranty on all hardware and software. A limited 10-year warranty shall be provided on all relay cards.

**PART 2 - PRODUCTS**

**SYSTEM DESCRIPTION**

The lighting control system shall consist of low voltage relay control panel(s) with up to 64 programmable switch inputs and up to 48 control relay outputs per panel.

Each low voltage lighting control panel shall be microprocessor controlled with a touch-screen display or Handheld Display Unit (HDU) interface. The touch-screen shall provide relay status information viewable through a protected windowed enclosure. All local programming shall be permissible through the self-prompting touch-screen.

Programmable intelligence shall include Time-Of-Day control, 32 holiday dates, warn occupants of an impending off, timed inputs, preset control, auto daylight savings, astronomical clock w/offsets, local control, digital switches, and network overrides:

Time-Of-Day Scheduling

64 Time-Of-Day/holiday schedules for 365-day programming

Holidays

32 holiday dates

Warn Off

Flash lights and provide an extra 1 second to 99 minutes of illumination

Preset

Pre-programmed switch patterns

Timed Inputs

Switch input timers 1-999 minutes

Timed Overrides

Timed override from the touch-screen 1-999 Overrides minutes, resumes to normal schedule

Local Control

From integral touch-screen or HDU, and local switch

Astronomical Clock

Longitude and latitude input with sunset-sunrise offsets to customize outdoor lighting

Auto Daylight Savings Adjust

Automatically adjusts the clock at the appropriate dates, selectable

Priorities

Establishes a hierarchy for inputs and network control commands

Masking

Masking provides permissions related to switch inputs and network commands, thereby ensuring software security.

Soft-Linking

Group linking for rapid programming

Global Linking

Each panel shall provide 64 addressable groups for network linking of control commands

Analog Inputs

Four analog inputs

The control panel shall be capable of reporting whether the relays are overridden via software, override switches, or via on board hardware override. Relay status shall not only disclose commanded relay status but next scheduled state to occur.

Each control panel shall provide a Warn Off (flashing of the lights) to inform the occupants of an impending OFF command. The Warn Off command shall provide adjustable time duration of 1 second to 99 extra minutes. The occupants may exit the premises with adequate lighting or cancel the Warn Off by overriding the lighting zone. This option occurs with all OFF commands except local overrides.

The controller shall permit lighting to be overridden ON for after-hours use or cleaning. The controller shall provide optional switch timer assignments or timed overrides. The override choices for various relays shall provide special event occurrences and the controller shall return to the programmed state after the override event. Also, the controller shall provide priority and masking choices to customize the functions of switch inputs, thereby enabling switches to function differently at different times of the day to meet special facility operational requirements. These overrides shall be digital, network, or hard-wired inputs.

Programming of the controller may be accomplished through the local integral touch-screen or HDU. Descriptive information shall assist the user to employ the system without a programming manual.

The lighting control system may also be fully programmed through PC programming software. Programming shall be permitted through a direct RS-232 connection, modem, or TCP/IP.

Priorities and/or Masking shall be assigned to inputs, telephone override, and global commands to ensure building integrity. Priorities enable or disable the inputs based on user actuation of overrides. Masks shall permit: ON only, OFF only and ON & OFF control for intelligent after-hours utilization of the controlled facility based on Time-Of-Day scheduling in the controller.

The control system shall provide networking between lighting control panels. One network may support a maximum of 254 control panels. Panels shall permit data sharing for global control. All inputs (no limitation) are transferable over the network to create any switching pattern required. The maximum length of the lighting control network shall be 4000 feet. Repeaters are available to extend the network as needed. Networks that rely on a single time clock for system operation shall not be acceptable.

The lighting control system shall log all control events. The controller shall monitor all relay actuations, switch inputs and user intervention. Log reports shall be available for any duration of time the operator chooses through the integral touch-screen or through the network software. Runtimes for each relay shall be available from the integral touch-screen or through the network software.

**Operator Interface**

The control panel programming interface resides in firmware in the control panel. The programming interface shall consist of a circuit board mounted touch-screen or Handheld Display Unit (HDU) capable of linking switch inputs to relay outputs and schedule assignments. Systems that utilize blocking diode technology for relay assignments shall not be acceptable.

The integral touch-screen or HDU shall provide access to the main programming features. The touch-screen shall permit the user to manually command any or all relays individually. Each panel shall control its own loads from internal memory. A control system that solely relies on a central control computer/processor or external time clocks shall not be permitted.

**Inputs and Outputs**

The controller shall provide timers for each input/output. Each input/output timer shall be capable of 0-999 minutes. Software shall enable or disable input/outputs based on Priorities, Masks or Time-Of-Day scheduling.

Switches

The lighting controller shall support digitally addressable LED annunciated switches. The digital switch network requires CAT 6 cabling between switches. The digital switches shall control any relay group combination on the lighting control network. Data communications status feedback for system checkout and troubleshooting (transmit and receive LED’s) shall be visible on both the controller and interface.

Switches shall be organized as one (1) to six (6) momentary contact buttons on a single mounting plate intended to fit into a single gang wallbox. Each button shall have an integral status LED indicator.

The switch configuration shall permit custom labeling for multiple button switch locations. The switch configuration shall be Decora™ form and function.

Dry Contact Inputs

The control system shall permit 32 dry contacts 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 (24 VDC @ 12 ma. internally supplied to the inputs). The 24 VDC power supply is provided with an auto-resettable fuse. Should an inappropriate electrical connection be made the design will protect the board and switches until the fault is removed. Any switch input shall be software linked to any number of relays for override control. The control panel shall have dry contact inputs on the logic board.

Lighted Switch Outputs (LSO)

The controller shall provide an output for pilot light wall switch annunciation of dry contact inputs. A fourth connection point on the controller board shall provide power to illuminate pilot light switches. This option shall confirm relay operation. When a relay is in the “ON” position the pilot light switch shall be illuminated. The pilot light outputs shall be software selectable to offer either incandescent, LED illumination or locator.

Photocell Control

The controller shall accept either dry contact or analog ambient light sensors. The controller shall provide power for the sensor thereby eliminating any external power supply. Sensors shall provide for outdoor, indoor or skylight applications and issue a command to the controller once the threshold is reached. The sensor shall provide either software or user adjustable dead band control.

Network Overrides

The controller shall accept network commands issued from other inputs or controllers on the network. The controller shall provide this feature without the need to add extra equipment to the controller. Network overrides can be issued from the Telephone Interface Module (TIM), Modbus® Gateway, DMX Gateway, Photocells, Motion Sensors, Digital or Dry Contact Switches, or other controllers.

Service Override & Priority Override

The control panel shall provide a three-position master-service override for the control unit.

The master service override provides a single three-position switch with the option of All Off, Auto, and All On, respectively. This master switch shall operate all of the relays in the controller. This switch shall override and supersede all commands from the logic board when the switch is in the All On or All Off position. The master switch shall function to override all the relays should the logic board programming differ from the space function.

The system shall report all master service overrides to the controller and shall be accessible via network query.

The system shall remember the last command to the individual relays. Upon returning the master override switch to the Auto position, the relays shall return to the most recent command state. This will occur even if the last command happened during the master override condition.

Additionally, the system shall provide external priority override for the entire panel. Through an externally maintained contact the override card shall place the panel in a priority state. This external contact will supersede any other programmed state and will command all the relays ON or OFF depending on operational choice. This priority state will continue until the external contact is removed. Once the external override is removed the control panel will return the relays to the appropriate programmed state.

Building Automation System Interface

The Lighting Control Panel network shall permit data protocol translation through an Automation Interface Module. The Automation Interface Module permits systems that utilize the Modbus®, N2, BACnet or LonWorks communication protocols to operate individual relays or relay groups and to read the status of the coils (status read).

Relays

Relay Card: The system shall utilize normally open control relays, which are rated to 20 amps at 120/277 VAC. The relays shall be magnetically held and are provided in groups of four relays per card. Each relay card shall permit individual override and LED confirmation of relay state. The relays shall be rated for 10 million mechanical operations. The wire terminations shall be able to accept 10 AWG. A limited 10-year warranty shall be provided on the individual relay cards.

Provide 2-pole relays as required for loads.

**Diagnostic Aids**

Each 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 control panels shall employ both a backlit touch-screen and LED’s to indicate:

• POWER (LED)

• SYSTEM OK (LED)

• NETWORK COMMUNICATIONS (LED)

• ON/OFF STATUS of EACH RELAY (LED & touch-screen)

• SYSTEM CLOCK and DATE (touch-screen)

• PROGRAMMING CONFIRMATION (touch-screen)

• CONTROL PANEL SUBNET NETWORK COMMUNICATIONS (TX & RX LED’s)

Status Indication of Relays

The system shall provide visible status indication of all relays through the window of each control panel. The visual indication shall disclose On/Off status and relay number.

Relay status shall also be visible via actual indication on the relay card. The serial standard relay cards shall provide visual status of the relay state and also the override state. The relay status LED shall also provide indication to the user if the relay is in a hand actuation condition. Each serial standard relay card shall permit manual overrides for each individual relay. The serial latched relay card shall provide relay status and permit hand actuation.

**COMMUNICATION ACCESSORIES**

Ethernet Interface Module (EIM)

The EIM control system accessory provides easy access to control panels over a TCP/IP connection by converting sent information into RS-232 communication capable information. The EC shall provide 120VAC to operate this accessory. Manufacturer shall provide proper cabling from lighting control panel controller to Ethernet Interface Modules. The EC shall provide the CAT 6 cabling from the EIM to the owner’s data rack. The owner shall provide the IP address.

VPN hardware device accessory

Provide a VPN hardware device to the lighting control network and building LAN to ensure security of the building LAN and lighting control network.RS-232 port. The controller shall provide an RJ-12 connection for RS-232 communications. Programming shall be permitted through either a local connection or remotely through a modem.

RS-485 Network

The controller shall be able to communicate to other controllers on a daisy chain twisted pair of wires. The RS-485 network shall support 254 controllers with a maximum distance of 4000 feet. Each controller shall be optically isolated. The networked controllers shall provide optical isolation between controller power supplies for true electrical isolation (communication grounds are 100% isolated). CAT 6 or Belden #9841 shall be acceptable for RS-485 network wiring.

Telephone Interface Module (TIM)

The control system shall provide intelligent software for the Telephone Interface Module (TIM) option. The optional TIM unit shall allow modem communications and touch-tone overrides from any touch-tone phone. The control system shall be multi-tasking and permit up to one TIM for each control panel.

Touch-tone interface shall permit the control panel to command pre-assigned control points On/Off. All user interfaces shall be through the twelve touch-tone keys on the telephone. All entries into the override system shall be prompted by a digitized voice.

The TIM shall provide individual control passwords. Each password shall allow a preset group designation (number of relays) and the duration of the telephone override. TIM shall also provide a password to prevent entry into the override control system.

Modem

The control system shall be capable of modem communications. Each control panel shall provide a serial communications port for external telecommunications. The modem shall utilize the Hayes compatibility standard and enable modem access as defined by the Bell 212A and CCITT V.22 protocol standards. The system shall be a multi-tasking system and permit more than one modem in operation at a time communicating on the network. Communication speed shall be a minimum of 14,400 baud.

Automation Interface Module

The Lighting Control Panel network shall permit data protocol translation through an Automation Interface Module. The Automation Interface Module permits systems that utilize the Modbus®, N2, BACnet or LonWorks communication protocols to operate individual relays or relay groups and to read the status of the coils (status read).

**PROGRAMMING SOFTWARE**

The PC based interface software accessory provides access to lighting control system files within a Microsoft Windows®‚ environment. The software shall support Windows 7 and above. The optional software package shall allow individual and network panel programming to be executed locally via direct connection, or remotely through a TCP/IP connection or modem. The central programming software shall permit the user to modify the control panel programming or configuration in an “OFF-LINE” mode. This software package shall store all programmed data and archive for future use. Systems using third party software are not acceptable. Systems that are not capable of creating program backups are not acceptable.

The following features shall be standard in the PC based software:

Standard Software Features:

• Real Time Relay Status Monitoring

• Alpha-Numeric Descriptors

• Communications: Direct, Network, TCP/IP, and Modem

• Network Status Indication

• Global Software Modifications

• Manual Relay Commands

• Remote Pattern Commands

• Preset Options

• User Management – Password protection and privilege modification for multi-user security

• Logging of Controller Actions (switch inputs, TIM commands, and relay actuations)

• Remote Commander – (entire network global commands from one screen)

File Maintenance:

Archive Programs

Data Base Restoration

Uploading and Downloading of Programs

Snap Shots indication of changes and flawless panel restoration.

Software package shall permit the PC to be utilized for other functions (i.e., word processing, database, etc.) besides lighting control. Systems that require an “on-line” dedicated computer for control system operation shall not be acceptable.

**SYSTEM MANAGEMENT SOFTWARE**

System Management Software requires the Ethernet Interface Module (EIM) accessory, connection to the building LAN, and Windows® 7 operating system or above.

The lighting zones may be controlled through a graphical representation software package. The software permits up to 255 floors or site plans to be illustrated for intuitive control. The software provides real-time feedback to the operator of network control overrides. The software shall be accessible through an Ethernet network permitting more than one location control access to the site. The software shall accept AutoCAD® drawing files to reduce programming set up of the control software.

**MISCELLANEOUS**

Modular Design

The control system shall employ all modular connectors to avoid repeat wiring in case of component failure. The system CPU board shall be mounted on quick release hinge pins that shall permit an entire change out of the controller in less than 1 minute.

All connections for the dry contact inputs shall incorporate modular connectors. The relay board shall be modular and designed for rapid field replacement or upgrading.

Memory Back-up

The system shall utilize a memory back-up 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.

Power Supply

A power supply shall be provided integral to the lighting control panel(s). The power supply shall incorporate the use of a multi-tapped transformer. The panel shall not require specification of voltage for each control location.

Enclosure

Each control panel shall be enclosed in a lockable NEMA class 1 enclosure. The enclosure shall be manufactured out of 1/16” steel and shall provide pre-punched knockouts for efficient installation. Include space for 10-percent minimum additional relays in each cabinet and enclosure.

Barriers

The control panel enclosure shall be provided with barriers for separating line and low voltage circuits. Barriers shall also be provided for voltage separation or for separation of emergency circuits from normal power circuits. Emergency circuit barriers shall be painted red to denote the emergency circuits.

Switch Plates

Switch Plates shall be thermoplastic. The switch plate color shall match the switches furnished by the Lighting Control Panel manufacturer.

**PART 3 - EXECUTION**

**EXAMINATION**

Verify panel relay quantities and low-voltage switch quantities.

Verify that surfaces are ready to receive work.

Verify that required utilities are available, in proper location, and ready for use.

Beginning of installation means installer accepts existing conditions.

**INSTALLATION**

Install in accordance with manufacturer's instructions.

Network the low-voltage switches together.

Network the lighting control panels together.

Connect the lighting control panel(s) to the facility’s data network. Coordinate required IP addresses with facility staff.

Provide Sequence of Operation descriptions either here or on the plans. Provide separate Sequences of Operation for areas/room that are intended to operate differently than other areas/rooms. The Sequence(s) of Operation shown below are examples only and shall be edited for the intended operation for your specific project.

# SEQUENCE of OPERATION

[See plans for Sequence of Operation descriptions.]

[See below for Sequence of Operation descriptions:

1. NON-DAYLIT AREAS
	1. Automatic Control
		1. Time based: ON at 6:00am, OFF at 11:00pm, seven days/week. Confirm hours with User Agency.
		2. Lights OFF during Holidays.
		3. Blink-warn before lights turn OFF.
	2. Manual control via Low Voltage Control Station.
		1. ON/OFF Button shall toggle between lights ON and OFF.
		2. Users may raise or lower levels by pressing arrow buttons from 10% to 100%. Dim settings to be retained until changed by users.
2. DAYLIT AREAS
	1. Automatic Control
		1. Time based: ON at 6:00am, OFF at 11:00pm, seven day/week. Confirm hours with User Agency.
		2. Lights OFF during Holidays.
		3. Blink-warn before lights turn OFF.
		4. Automatically dim lights down based on input from daylight sensor.
	2. Manual control via Low Voltage Control Station.
		1. ON/OFF Button shall toggle between lights ON and OFF.
		2. Users may raise or lower levels by pressing arrow buttons from 10% to 100%. Dim settings to be retained until changed by users.

# FACTORY COMMISSIONING and PROGRAMMING

Provide factory commissioning for a complete and operational system. Program the system for scheduled time or local switch ON operation of local lighting, with sweep OFF operation at times as directed by the facility staff.

Provide one additional factory commissioning follow-up site visit for making any agency-desired programming changes after one month of operation.

Turn over programming software to user agency staff.

**FACTORY SUPPORT**

Factory telephone support shall be available at no cost to the owner. Factory assistance shall consist of solving programming or application questions concerning the control equipment.

**CONSTRUCTION VERIFICATION**

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

**FUNCTIONAL PERFORMANCE TESTING**

Contractor is responsible for utilizing the functional performance test forms supplied under specification Section 26 08 00 in accordance with the procedures defined for functional performance testing in Section 01 91 01 or 01 91 02.

# AGENCY TRAINING

Provide two four-hour training sessions to agency staff on two separate days.

END OF SECTION