

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Occupancy sensors.
- B. Outdoor photo controls.
- C. Digital load controllers.
- D. Emergency lighting control devices.
- E. Lighting contactors.

1.2 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 260529 - Hangers and Supports for Electrical Systems
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.

1.3 REFERENCE STANDARDS

- A. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2023.
- B. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment—Nonlocking (Button)—Type Photocontrols; 2026.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- G. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.
- J. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.
- K. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- L. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- M. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.
- N. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.
- O. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

##### A. Coordination:

1. Coordinate placement of lighting control devices with millwork, furniture, equipment and other potential conflicts.
2. Coordinate placement of wall switch occupancy sensors with installed door swings.
3. Coordinate placement of occupancy sensors with millwork, furniture, equipment and other potential obstructions to motion detection coverage.
4. Coordinate placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement.
5. Notify Architect of conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

#### 1.5 SUBMITTALS

##### A. Product Data: Include ratings, operating modes or sequence of functions, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.

##### B. Shop Drawings:

1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
2. Digital Load Controllers: Provide dimensioned plan views indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing factory and field connections. Include manufacturer product characteristics and application instructions for wired and wireless applications, including start-up and commissioning.

##### C. Field quality control reports.

#### 1.6 QUALITY ASSURANCE

##### A. Comply with NFPA 70.

#### 1.7 DELIVERY, STORAGE, AND PROTECTION

##### A. Store products in clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

#### 1.8 WARRANTY

##### A. Manufacturer Warranty: Provide manufacturer warranty for defects in material and workmanship for duration below. Complete forms in Owner's name and register with manufacturer.

1. Occupancy Sensors: 5 years.

## PART 2 - PRODUCTS

### 2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for purpose intended.
- B. Unless specifically indicated as excluded, provide components necessary for complete operating system including, but not limited to, conduit, wiring, connectors, hardware, and accessories.

### 2.2 OCCUPANCY SENSORS

- A. General Requirements:
  - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
  - 2. Sensor Technology:
    - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
    - b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
    - c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using combination of both passive infrared and ultrasonic technologies.
    - d. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using combination of both passive infrared and audible sound sensing technologies.
  - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
  - 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during adjustable turn-off delay time interval.
  - 5. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
  - 6. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
- B. Wall Switch Occupancy Sensors:
  - 1. General Requirements:
    - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
    - b. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during delayed-off time interval.

2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within area of 900 square feet (83.6 sq m).
  3. Ultrasonic Wall Switch Occupancy Sensors: Capable of detecting motion within area of 400 square feet (37.2 sq m).
  4. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within area of 900 square feet (83.6 sq m).
- C. Wall Dimmer Occupancy Sensors:
1. General Requirements:
    - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180 degrees, integrated dimming control capability, and no leakage current to load in off mode.
    - b. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
  2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within area of 900 square feet (83.6 sq m).
- D. Ceiling Mounted Occupancy Sensors:
1. General Requirements:
    - a. Description: Low profile occupancy sensors designed for ceiling installation.
  2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
    - a. Standard Range Sensors: Capable of detecting motion within area of 450 square feet (41.8 square meters) at mounting height of that compatible with ceiling height, with field of view of 360 degrees.
  3. Ultrasonic Ceiling Mounted Occupancy Sensors:
    - a. Standard Range Sensors: Capable of detecting motion within area of 500 square feet (46.5 sq m) at mounting height of that compatible with ceiling height, with field of view of 360 degrees.
  4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
    - a. Standard Range Sensors: Capable of detecting motion within area of 450 square feet (41.8 sq m) at mounting height of that compatible with ceiling height, with field of view of 360 degrees.
  5. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
    - a. Standard Range Sensors: Capable of detecting motion within area of 450 square feet (41.8 sq m) at mounting height of that compatible with ceiling height, with field of view of 360 degrees.
- E. Directional Occupancy Sensors:
1. General Requirements:
    - a. Description: Occupancy sensors designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
  2. Passive Infrared (PIR) Directional Occupancy Sensors:

- a. Standard Range Sensors: Capable of detecting motion within distance of 40 feet (12 m) at mounting height of that compatible with ceiling height.
- 3. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within distance of 40 feet (12 m) at mounting height of that compatible with ceiling height.
- F. Luminaire Mounted Occupancy Sensors: Designed for direct luminaire installation and control, suitable for use with specified luminaires.
- G. Power Packs for Low-Voltage Occupancy Sensors:
  - 1. Description: Plenum rated, self-contained low-voltage class 2 transformer and relay compatible with specified low-voltage occupancy sensors for switching of line-voltage loads.
  - 2. Provide quantity and configuration of power and slave packs with associated wiring and accessories as required to control load indicated on drawings.
  - 3. Input Supply Voltage: Dual rated for 120/277 V ac.

## 2.3 OUTDOOR PHOTO CONTROLS

- A. Stem-Mounted Outdoor Photo Controls:
  - 1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
  - 2. Housing: Weatherproof, impact resistant polycarbonate.
  - 3. Photo Sensor: Cadmium sulfide.
  - 4. Provide external sliding shield for field adjustment of light level activation.
  - 5. Light Level Activation: 1 to 5 footcandles (10.8 to 53.8 lux) turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
  - 6. Voltage: As required to control load indicated on drawings.
  - 7. Failure Mode: Fails to the on position.
  - 8. Load Rating: As required to control load indicated on drawings.
- B. Locking Receptacle-Mounted Outdoor Photo Controls
  - 1. Description: Plug-in locking type photo control unit complying with ANSI C136.10 for mounting on compatible receptacle, listed and labeled as complying with UL 773.
  - 2. Housing: Weatherproof, impact resistant UV stabilized polypropylene, color to be selected.
  - 3. Photo Sensor: Cadmium sulfide.
  - 4. Light Level Activation: 1 to 3 footcandles (10.8 to 32.3 lux) turn-on and 1.5 to 1 turn-off to turn-on ratio with instant turn-on and delayed turn-off.
  - 5. Voltage: As required to control load indicated on drawings.
  - 6. Failure Mode: Fails to the on position.
  - 7. Load Rating: As required to control load indicated on drawings.
  - 8. Surge Protection: 160 joule metal oxide varistor.

C. Button Type Outdoor Photo Controls

1. Description: Direct-wired photo control unit complying with ANSI C136.24 with weatherproof gasketed wall plate where required or indicated, listed and labeled as complying with UL 773A.
2. Housing: Weather resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Light Level Activation: 1 to 3 footcandles (10.8 to 32.3 lux) turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
5. Voltage: As required to control load indicated on drawings.
6. Failure Mode: Fails to the on position.
7. Load Rating: As required to control load indicated on drawings.

2.4 DIGITAL LOAD CONTROLLERS

A. System Description:

1. Stand-alone system, including interconnected modules and accessories, for lighting and plug load low-voltage control as indicated on drawings and schedules.
2. Product standard system configurations preconfigured out of box, plug-and-play, automatically self-addressing devices for communications, and without need to field configure or program features, or requiring device setting adjustments. LEDs on unit indicate operation and troubleshooting without software intervention.
3. Provide quantity and configuration of power and slave packs, communication modules, and load expansion modules, including associated wiring, wired and wireless components, and accessories to control loads indicated.

B. General Requirements:

1. Listed for powering and controlling line-voltage loads, power packs, contactors, relays, and other lighting control devices.
2. Input Supply Voltage: Dual rated for 120/277 VAC.
3. Cabling Terminations:
  - a. Provide field fabricated, and tested before installation, control wiring.
  - b. Include line and load wiring leads.
4. Compatibility:
  - a. Compatible with luminaires specified with integral sensors; include auxiliary contact closure accessory components for controls indicated.
5. Provide UL 2043 plenum rated control unit with self-contained relay(s) and low-voltage class 2 transformer, compatible with specified wired and wireless sensors, components, and ballasts/drivers.
  - a. Comply with NFPA 70 for use in plenum spaces.
  - b. Provide UL 2043 plenum rating for associated system control components for control indicated.
6. Surface Mounting: Standard junction box attachments.
7. Provide one auxiliary contact closure output where indicated.

8. Control Inputs:
  - a. Digital: Two.
  - b. Analog: One.
  - c. Include automatic-on and manual-on occupancy control wiring inputs.
  - d. Include wiring inputs for manual overrides as indicated.
9. Output Control Capability:
  - a. Single Zone Switching Modules: One programmable channel.
  - b. Multi-Zone Switching Modules: Up to three separately programmable channels.
  - c. Channel Dimming as Indicated:
    - 1) Range: From 1 percent to 100 percent, allowing for precise control of light levels.
    - 2) Method: 0-10 VDC protocol; coordinate maximum current draw as required.
- C. Additional Integrated Requirements for Digital Load Controllers:
  1. Central Monitoring and Management: Include programmable user interface for lighting system controllable features; control access locally by plugging into devices and LAN network via browser-based software with settings retained in nonvolatile memory.
  2. Provide additional auxiliary contact closure outputs where required for functions and operating modes indicated.
  3. Occupancy Controls:
    - a. Scene Control: Occupant selections by lighting control devices for controls as indicated.
    - b. Bi-level Switching: Multi-level lighting for controls as indicated.
    - c. Dimming: Occupancy controlled dimming, including blink warning; 50 percent light-level after programmed delay time.
    - d. Shade Control: Interfacing capability.
  4. Daylight Harvesting:
    - a. System Description:
      - 1) Control system with compatible control modules, power packs, contactors, or relays as required for automatic control of load indicated according to available natural light.
      - 2) System control responds to changes in measured light levels according to selected settings.
      - 3) Capable of integrating with daylighting sensors, occupancy sensors, and manual override controls.
    - b. Daylighting Control Photo Sensors: Low-voltage class 2 photo sensor units with output signal proportional to measured light level and provision for zero or offset based signal.
      - 1) Sensor Type: Filtered silicon photo diode.
      - 2) Sensor Range:
        - a) Indoor Photo Sensors: 5 to 100 footcandles (53.8 to 1,080 lx).
        - b) Outdoor Photo Sensors: 5 to 250 footcandles (53.8 to 2690 lx).

- c) Atrium Photo Sensors: 200 to 2,500 footcandles (2150 to 2,6910 lx).
  - d) Skylight Photo Sensors: 1,000 to 6,000 footcandles (10,760 to 64,580 lx).
  - e) Open Loop Photo Sensors: 3 to 6,000 footcandles (32.3 to 64,580 lx).
- 3) Finish: White unless otherwise indicated.
- 4) Where wired sensors are indicated, wireless sensors are not acceptable without prior approval of Architect.
- c. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts/drivers, for direct continuous dimming of up to 50 ballasts/drivers.
- d. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
- e. Daylight Control Switching Modules: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with no-switching dead band between set points to prevent unwanted cycling.
- f. Daylight Control Dimming Module Operation:
  - 1) Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
  - 2) Load to be turned off when available daylight is sufficient to fully dim load, after selected time delay.
  - 3) Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
  - 4) Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.
  - 5) Output Voltage: Compatible with specified dimming ballasts/drivers.
- 5. Accessories:
  - a. Where indicated, provide compatible accessory wall switches for manual override control.

## 2.5 EMERGENCY LIGHTING CONTROL DEVICES

- A. Automatic Load Control Relays:
  - 1. Listed and labeled as complying with UL 924.
  - 2. Bypass/shunt lighting controls upon loss of normal power source to turn controlled emergency lighting loads on at full light output.
- B. Devices Installed in Spaces Used for Environmental Air: Plenum rated, suitable for use in air-handling spaces; listed and labeled as complying with UL 2043.

## 2.6 LIGHTING CONTACTORS

- A. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on drawings.



- B. Enclosures:
  - 1. Comply with NEMA IA 10030.
  - 2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
  - 3. Finish: Manufacturer's standard unless otherwise indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- B. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- C. Verify that final surface finishes are complete, including painting.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- E. Verify that service voltage and ratings of lighting control devices are appropriate for service voltage and load requirements at location to be installed.
- F. Verify that conditions are satisfactory for installation prior to starting work.

#### 3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

#### 3.3 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes as required for installation of lighting control devices; see Section 260533.16.
- C. Maintain separation of remote-control, signaling, and power-limited circuits.
  - 1. See manufacturer instructions and Section 260519 for control wiring conductors, wiring methods, and identification requirements.
- D. Install lighting control devices in accordance with manufacturer's instructions.
- E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- F. Install lighting control devices plumb and level, and held securely in place.
- G. Where required and not furnished with lighting control device, provide wall plate; see Section 262726.

- H. Provide required supports; see Section 260529.
- I. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- J. Occupancy Sensor Locations:
  - 1. Location Adjustments: Within design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
  - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors minimum of 4 feet (1.2 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- K. Outdoor Photo Control Locations:
  - 1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
  - 2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by photo control itself.
- L. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into photo control.
- M. Daylighting Control Photo Sensor Locations:
  - 1. Location Adjustments: Within design intent, reasonably minor adjustments to locations may be made in order to optimize control and avoid conflicts or problems affecting proper detection of light levels.
  - 2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure light level controlled at designated task location, while minimizing measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
  - 3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into space, while minimizing measured amount of lighting from artificial sources.
- N. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

### 3.4 FIELD QUALITY CONTROL

- A. Inspect each lighting control device for damage and defects.
- B. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- C. Test outdoor photo controls to verify proper operation, including time delays where applicable.
- D. Correct wiring deficiencies and replace damaged or defective conductors, cables, and lighting control devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Adjust position of directional occupancy sensors to achieve optimal coverage as required.
- D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- E. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

END OF SECTION