

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Digital-network lighting control system and associated components:
 - .1 Lighting management hubs.
 - .2 Lighting Control Modules
 - .3 Lighting management system software.
 - .4 Control stations.
 - .5 Low-voltage control interfaces.
 - .6 Wireless sensors.

1.2 RELATED REQUIREMENTS

- .1 Section **12 24 00 - Window Shades**: Low-voltage motorized roller window shades, for interface with lighting control system on same RS485 network.
- .2 Section **26 05 00 - Common work results for electrical**
- .3 Section **26 27 26 - Wiring Devices**:
 - .1 Finish requirements for wall controls specified in this section.
 - .2 Accessory receptacles and wallplates, to match lighting controls specified in this section.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed by departmental representative.
 - .2 Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment installed under other sections.
 - .3 Where motorized window treatments are to be controlled by the lighting control system provided under this section, coordinate the work with other trades to provide compatible products.
 - .4 Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.
- .2 Preinstallation Meeting: Conduct on-site meeting with lighting control system manufacturer prior to commencing work as part of manufacturer's standard startup services. Manufacturer to review with installer:
 - .1 Low voltage wiring requirements.
 - .2 Separation of power and low voltage/data wiring.
 - .3 Wire labeling.
 - .4 Lighting management hub locations and installation.
 - .5 Control locations.
 - .6 Load circuit wiring.
 - .7 Network wiring requirements.
 - .8 Connections to other equipment.
 - .9 Installer responsibilities.
 - .10 Power panel locations.

- .3 Sequencing:
 - .1 Do not install sensors and wall controls until final surface finishes and painting are complete.

1.4 FIELD CONDITIONS

- .1 Maintain field conditions within manufacturer's required service conditions during and after installation.
 - .1 System Requirements -, Unless Otherwise Indicated:
 - .1 Ambient Temperature:
 - .1 Lighting Control System Components, Except Those Listed Below: Between 32 and 104 degrees F (0 and 40 degrees C).
 - .2 Lighting Management System Computer: Between 50 and 90 degrees F (10 and 35 degrees C).
 - .3 Fluorescent Electronic Dimming Ballasts: Between 50 and 140 degrees F (10 and 60 degrees C).
 - .2 Relative Humidity: Less than 90 percent, non-condensing.

1.5 WARRANTY

- .1 Manufacturer's Standard Warranty, With Manufacturer Start-Up; ***Standard 2-Year Warranty:***
 - .1 Manufacturer Lighting Control System Components, Except Lighting Management System Computer, Ballasts/Drivers and Ballast Modules:
 - .1 First Two Years:
 - .1 100 percent replacement parts coverage, 100 percent manufacturer labor coverage to troubleshoot and diagnose a lighting issue.
 - .2 First-available on-site or remote response time.
 - .3 Remote diagnostics for applicable systems.
 - .2 Telephone Technical Support: Available 24 hours per day, 7 days per week, excluding manufacturer holidays.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 Basis of Design: Digital-network lighting control using RS485; **CAT 5 CABLING IS NOT ALLOWED**

2.2 LIGHTING MANAGEMENT HUBS

- .1 Product : ***Light Management Hub.***
- .2 Provided in a pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.
- .3 Connects to controls and power panels via RS485.

- .4 Enables light management software to control and monitor compatible dimming ballasts and ballast modules, power panels, power modules, and window treatments.
 - .1 Utilizes Ethernet connectivity to light management computer utilizing one of the following methods:
 - .1 Dedicated network.
 - .2 Dedicated VLAN.
 - .3 Corporate network where managed switches are configured to allow multicasting and use of IGMP.
- .5 Integrates control station devices, power panels, shades, preset lighting controls, and external inputs into a single customizable lighting control system with:
 - .1 Multiple Failsafe Mechanisms:
 - .1 Power failure detection via emergency lighting interface.
 - .2 Protection: Lights go to full on if ballast wires are shorted.
 - .3 Distributed architecture provides fault containment. Single hub failure or loss of power does not compromise lights and shades connected to other lighting management hubs.
 - .2 Manual overrides.
 - .3 Automatic control.
 - .4 Central computer control and monitoring.
- .6 Furnished with astronomical time clock.
- .7 Furnished with solar clock to track the position of the sun to control the shades to limit penetration of direct sunlight.
- .8 Maintains a backup of the programming in a non-volatile memory capable of lasting more than ten years without power.

2.3 LIGHTING CONTROL MODULES

- .1 Provide lighting control modules as indicated or as required to control the loads as indicated.
- .2 General Requirements:
 - .1 Listed to UL 508 as industrial control equipment.
 - .2 Delivered and installed as a listed factory-assembled panel.
 - .3 Passively cooled via free-convection, unaided by fans or other means.
 - .4 Mounting: Surface.
 - .5 Connects to lighting management hub via RS485.
 - .6 LED status indicators confirm communication with occupancy sensors, daylight sensors.
 - .7 Contact Closure Input:
 - .1 Directly accept contact closure input from a dry contact closure or sold-state output without interface to:
 - .1 Activate scenes.
 - .1 Scene activation from momentary or maintained closure.
 - .2 Enable or disable after hours.
 - .1 Automatic sweep to user-specified level after user-specified time has elapsed.
 - .2 System will provide occupants a visual warning prior to sweeping lights to user-specified level.
 - .3 Occupant can reset timeout by interacting with the lighting system.
 - .3 Activate or deactivate demand response (load shed).
 - .1 Load shed event will reduce lighting load by user-specified amount.

- .3 0-10V Lighting Control Modules:
 - .1 Product(s):
 - .1 0-10V Energi Savr Node: 16 A continuous-use per channel.
 - .2 Coordination Between Low Voltage Dimming Module and Line Voltage Relay: Capable of being electronically linked to single zone.
 - .3 Single low voltage dimming module; capable of controlling following light sources:
 - .1 0-10V analog voltage signal.
 - .1 Provide Class 2 isolated 0-10V output signal conforming to IEC 60929.
 - .2 Sink current per IEC 60929.

2.4 LIGHTING MANAGEMENT SYSTEM SOFTWARE

- .1 Provide system software license and hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
- .2 Control and Monitor Software:
 - .1 General Requirements:
 - .1 Web-based; runs on most HTML5 compatible browsers (including Internet Explorer, Chrome, and Safari).
 - .2 Supports multiple platforms and devices; runs from a tablet, desktop, laptop, or smartphone; optimized for displays of 1024 by 768 pixels or higher.
 - .3 User interface supports multi-touch gestures such as pinch to zoom, drag to pan, etc.
 - .4 Utilizes HTTPS (industry-standard certificate-based encryption and authentication for security).
 - .5 All functionality listed below must be available via a single application.
 - .2 System Navigation and Status Reporting:
 - .1 Performed using graphical floor plan view or a generic system layout.
 - .2 Graphical Floor Plan View: Utilizes customized CAD based drawing of the building. Pan and zoom feature allows for easy navigation; dynamically adjusts the details presented based on zoom level.
 - .3 Area, scene, and zone names can be changed in real time.
 - .4 Adjustments can be made based on area type.
 - .3 Control of Shades:
 - .1 Area shades can be monitored for current preset or position.
 - .2 Area shades can be opened/closed, sent to a preset, or sent to a specific position.
 - .3 Activity Report: Show what activity has taken place over a period of time for one or more areas. Activity includes occupant activities (e.g. wall controls being pressed), building manager operation (e.g. controlling/changing areas using the control and monitor tool), and device failures (e.g. keypads or ballasts that are not responding).
 - .1 Includes shade related activities (e.g. automatic movements from automated shade algorithm, manual overrides from personal controls, automatic overrides from sensors).
 - .4 Lamp Failure Report: Shows which areas are currently reporting lamp failures.
 - .5 Shade Level Report: Shows the shade level for any shade group in the system over any historical 24 hour period.
 - .6 Shade Position Report: Shows the percentage of time shade groups in the system are at each position.
 - .7 Sensor Level Report: Shows the light level in footcandles of any photosensor in the system.
 - .8 Alert Activity Report: Capable of generating historical reports of all alert activity within the system.

- .9 Automated Shade Control Activity Report: A single chart that displays historical data regarding the position and performance of automated shades for a given shade group, which can be displayed and exported over any single hour or 24 hour period, and includes the following:
 - .1 Shade Level: Shows the shade level for any shade group in the system over the time period, and also indicates the reason for shade movement.
 - .2 Sensor Level: Shows the light level in footcandles over time for a given shade group.
 - .3 Sensor Threshold: Shows the sensor override thresholds in footcandles over time for a given shade group.
 - .4 Shows the system mode transitions over time (Dark Override, Bright Override, Manual Override, etc.).
 - .5 Sun Position: Shows the sun position with respect to the façade.
 - .6 Shade Positional Parameter: Expected position of the shade under normal, bright, or dark operations.
- .4 Diagnostics: Allows the building manager to check on the status of all equipment in the lighting control system. Devices to be listed with a reporting status of OK, missing, or unknown.
- .5 Alerts and Alarms: Monitors the system for designated events/triggers and automatically generates alerts according to configured response criteria.
 - .1 Capable of monitoring for the following events/triggers:
 - .1 A failed piece of equipment (e.g. ballast, control, sensor, etc.); alert cleared when equipment is replaced.
 - .2 Low battery conditions in battery-operated sensors and controls; alert cleared when battery is replaced.
 - .3 Potential sensor failures (Radio Window sensors that have not seen a change in light level).
 - .2 View alerts on a customized graphical floor plan.
 - .3 Capable of generating alerts through visible changes in software or through email messages.
 - .4 Capable of customizing the frequency of alerts and providing notifications immediately or through daily, weekly, or monthly summaries.
 - .5 Capable of sending different alerts to different system users.
 - .6 Capable of generating historical reports of all alert activity within the system.
- .6 Administration:
 - .1 Users: Allows new user accounts to be created and existing user accounts to be edited.
 - .1 Supports Active Directory (LDAP) tying user accounts to network accounts.
 - .2 Area and feature access can be restricted based on login credentials with assigned levels of access rights (Monitor, Control Only, Control and Edit, Admin) and customized access levels available.
- .7 Quick Controls: Create shortcuts to activate customized system-wide actions, such as updating lighting and/or shade levels.
- .8 Provides control/monitoring of partition status to automatically reconfigure how the space operates based on the partition's open/closed status.
- .9 Variables: Used for custom program of a system and/or to signal a third party system. Any change may cause a change in the behavior of the system.
 - .1 View the current state of system variables across subsystems.
 - .2 Update the current variable state across all subsystems.
- .10 Device Lock/Unlock: Allows the building manager to lock control station devices to prevent building occupants from activating their programming (button presses), until they are unlocked.
 - .1 Keypads can be locked to help ensure occupants cannot change light and shade levels in a public space during specific events or business hours.
 - .2 Keypads can be unlocked after events/during after hours to allow maintenance, cleaning to perform their tasks without needing to contact a building manager.

- .3 Automated Shade Control Software:
 - .1 Product: ***Automated Shading Mode***
 - .2 Objectives:
 - .1 Uses open loop solar adaptive algorithm to minimize the penetration depth of direct sunlight.
 - .2 Optimizes energy savings from daylight.
 - .3 Provides manual override capability for occupants via wall-mounted keypad or simple remote control.
 - .4 Provides automatic override capability utilizing a local sensor in dark conditions or when excessive brightness occurs.
 - .5 Maximizes occupants' connectivity with outdoors by optimizing view.
 - .6 Provides diffuse daylight and minimizes direct sunlight in the space to reduce solar heat gain and maximize occupant comfort in the space.
 - .7 Reduces glare.
 - .8 Shades along same facade to start, stop and track in unison to maintain a consistent exterior aesthetic.
 - .9 Provides optional presets to allow shades to align with architectural elements of the facade.
 - .10 Provides a preset, also referred to as visor position, to limit maximum amount of light entering a space.
 - .11 Provides configurable dark and bright override positions.
 - .3 Hardware: Independent operation of solar tracking program through non-Windows based operating system provided in one or more lighting management hubs.
 - .4 Control Software:
 - .1 Incorporates a solar tracking software that:
 - .1 Calculates the sun's position in the sky relative to the building and then calculates when shade movement is necessary by facade.
 - .2 Calculates the position of the shade to limit direct sunlight penetration to a predetermined limit.
 - .2 Controlled using the following inputs for startup:
 - .1 Building location.
 - .2 Facade orientation.
 - .3 Window dimensions.
 - .4 Solar depth of penetration.
 - .5 Number of shade movements per day.
 - .6 Visor position of shades.
 - .7 Optional presets that align shades with architectural features of the facade.
 - .8 Light level thresholds for dark and bright override.
 - .9 Shade position for dark and bright override.
 - .10 Window position on wall.
 - .3 Requires minimal long term maintenance and service. Does not require user to make daily changes to programming or overall system functionality, unless desired by owner.
 - .5 Automated Shade Operation Adjustment and Configuration:
 - .1 Access to all adjustable parameters (e.g. solar depth of penetration, number of shade movements per day, manual override timeout, run schedules, override levels).
 - .2 Manual adjustment of any parameter.
 - .3 Calculates and recommends adjustments.
 - .1 Software algorithm computes recommendations.
 - .2 Recommendation based on space end-user experience.
 - .1 Space too bright.
 - .2 Space too dark.
 - .3 Shades move too frequently.
 - .4 For specified shade.

- .5 For specified time.
- .3 Recommendation tweaks any or all adjustable parameters to improve shade performance.
- .6 Override:
 - .1 Manual:
 - .1 Temporary override of the control program capability through optional manual keypads, remote controls, or end-user control software.
 - .2 Keypads, remote controls, or end-user control software to be capable of providing manual control of shades in a particular area.
 - .3 Time of manual override to be programmable.
 - .2 Automatic overrides achievable via Radio Window sensors or rooftop cloudy day sensors:
 - .1 Radio Window Sensors:
 - .1 Product(s):
 - .1 ***Mullion mounted Window sensor;*** (mullion mount sensor pair).
 - .2 Monitors exterior light conditions and provides automatic override of system on dark cloudy days or in the presence of shadows from neighboring buildings and rooftop mechanical equipment.
 - .3 Capable of detecting a light range of 0 to 10,000 footcandles (0 to 107,000 lux).
 - .4 Sensors update the system with the light level conditions based on daylight event changes, not periodic transmissions.
 - .5 During dark conditions, shades to go to predetermined dark override position to maximize view and available daylight.
 - .6 Monitors exterior light conditions and provides automatic override of system during excessive brightness.
 - .7 During excessive bright conditions, shades to go to predetermined bright override position to maximize occupant comfort.
 - .8 Capable of having one or multiple sensors per facade for more localized detection of exterior light conditions.
 - .9 Capable of having one sensor control one shade group or multiple shade groups.
 - .10 Provides flexible grouping capabilities to achieve optimal hembar alignment and daylight autonomy by allowing for any of the following three grouping options in the software:
 - .1 Smart Adaptive Grouping: Shades in the same facade share sensor data and intelligently adapt grouping to balance daylight autonomy, hembar alignment, and maintain consistent shade positions for groups with similar perceived daylight conditions.
 - .2 Always Aligned: Shades in the same facade share sensor data and always maintain hembar alignment across the entire facade.
 - .3 Independent Grouping: Shades in the same facade operate independently based on individual sensor data.
 - .11 Software enables the ability to adjust thresholds, timeouts, and shade movement frequency globally or per area to meet the unique preferences of different individuals.
 - .12 Sensor to not require external power packs, power wiring, or communication wiring.
 - .13 Light level readings of the two mullion mount sensors to be combined together to act as one sensor.
 - .14 Sensor to be easily mountable to mullion (mullion mount sensor pair) or window (window mount) and can be easily removed and repositioned without marring or damaging window surface.
 - .15 Provides typical battery lifetime of 7 to 10 years when installed per manufacturer instructions.

- .16 Communicates directly to compatible *wireless* sensor module via **434MHz Clear Connect Technology** to ensure reliable RF communications.
- .17 RF Frequency: 434 MHz.
- .18 RF Range: 30 feet (9 m) between sensor and compatible RF receiving device(s).
- .19 Intuitive test mode to provide instant system verification of associated shades and programmed visor position.

2.5 POWER PANELS

- .1 Shade Power Supplies: Provide as indicated or as required to power system devices and accessories.
 - 1. Product(s):
 - .1 Ten output power supply panel for shades, keypads and accessories, and for providing additional low voltage power to communication link; **10 low-voltage outputs**; no replaceable fuses required for overload/miswire protection; contains DOE Level VI Compliant power supplies.

2.6 CONTROL STATIONS

- .1 Wireless (Radio Frequency) Controls:
 - .1 Product(s):
 - .1 3-Button with Raise/Lower Control;
 - .1 Button Marking: *Shade (text)*
 - .2 Wallbox Adapter; As indicated on drawings
 - .2 Quantity: *As indicated on the drawings;*
 - .3 Communicates via radio frequency (434MHz) to compatible RS485 wired repeater antenna (sensor module).
 - .4 Does not require external power packs, power or communication wiring.
 - .5 Allows for easy reprogramming without replacing unit.
 - .6 Button Programming:
 - .1 Single action.
 - .2 Toggle action.
 - .3 Defined action on press and defined action on release.
 - .7 Includes LED to indicate button press or programming mode status.
 - .8 Mounting:
 - .1 Capable of being mounted with a table stand or directly to a wall under a faceplate.
 - .2 Faceplates: Provide concealed mounting hardware.
 - .9 Power: Battery-operated with minimum ten-year battery life.

2.7 LOW-VOLTAGE CONTROL INTERFACES

- .1 Provide low-voltage control interfaces as indicated or as required to control the loads as indicated.
- .2 Connects to lighting management hub via RS485.
- .3 UL listed.
- .4 Sensor Modules:
 - .1 Products:
 - .1 Sensor module with wireless inputs.

- .2 Wireless Modules:
 - .1 Provide wireless communication inputs for:
 - .1 Occupancy sensors.
 - .2 Daylight sensors.
 - .3 Wireless controller.
 - .2 RF Range: 30 feet (9 m) between sensor and compatible RF receiving devices.
 - .3 RF Frequency: 434 MHz; operates in FCC governed frequency spectrum for periodic operation; continuous transmission spectrum is not permitted.
- .3 Communicate sensor information to wired low-voltage digital link for use by compatible devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify that field measurements are as shown on the drawings.
- .2 Verify that ratings and configurations of system components are consistent with the indicated requirements.
- .3 Verify that mounting surfaces are ready to receive system components.
- .4 Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- .1 Automated Shade Control Sensors:
 - .1 Ensure that window shadow sensor placement provides an unobstructed view of outdoors. Do not place at a skylight or above indirect luminaires.
 - .2 Many lamp manufacturers recommend seasoning fluorescent lamps prior to dimming in order to ensure full rated life.
 - .3 Coordinate scheduling of visit with Lighting Control Manufacturer. Manufacturer recommends that this visit be scheduled early in construction phase, after system purchase but prior to system installation.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Startup Services; ***Standard Startup Services:***
 - 1. Manufacturer's authorized Service Representative to conduct minimum of two site visits to ensure proper system installation and operation.
 - 2. Conduct Pre-Installation visit to review requirements with installer as specified in Part 1 under "Administrative Requirements".
 - 3. Conduct second site visit upon completion of lighting control system to perform system startup and verify proper operation:
 - .1 Verify connection of power wiring and load circuits.
 - .2 Verify connection and location of controls.
 - .3 Energize lighting management hubs and download system data program.
 - .4 Address devices.
 - .5 Verify proper connection of panel links (low voltage/data) and address panel.

- .6 Download system panel data to dimming/switching panels.
- .7 Check dimming panel load types and currents and supervise removal of by-pass jumpers.
- .8 Verify system operation control by control.
- .9 Verify proper operation of manufacturer's interfacing equipment.
- .10 Verify proper operation of manufacturer's supplied PC and installed programs.
- .11 Configure initial groupings of ballast for wall controls, daylight sensors and occupancy sensors.
- .12 Provide initial rough calibration of sensors; fine-tuning of sensors is responsibility of Contractor unless provided by Lighting Control Manufacturer as part of Sensor Layout and Tuning service where specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS".
- .13 Train Owner's representative on system capabilities, operation, and maintenance, as specified in Part 3 under "Closeout Activities".
- .14 Obtain sign-off on system functions.

END OF SECTION