Light is the solution

ENCELIUM® Energy Management System DALI® Specification

Section 26 09 43 – Networked Lighting Controls

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SECTION 26 09 43
NETWORKED LIGHTING CONTROLS

1. **GENERAL**
	* + 1. **SUMMARY**
				1. Section Includes:

Digital-Network Lighting Controls - 26 09 43.13

* + - 1. **REFERENCES**
				1. National Fire Protection Association (NFPA)
				2. cULus Listing/Certification

Certified as Energy Management Equipment (UL 916)

Certified as Emergency Lighting Equipment (UL 924)

Meet Heat and Smoke Release for Air-Handling Spaces (UL 2043)

* + - * 1. CSA Listing/Certification

Emergency lighting equipment (CSA C22.2 NO. 141-15)

Signal equipment (CSA C22.2 No. 205)

* + - * 1. Federal Communications Commission (FCC) / Industry Canada (IC)
				2. California Energy Commission (CEC)
				3. Local Building Codes
			1. **SYSTEM DESCRIPTION**
				1. Lighting Control System includes computer-based software that provides control, configuration, monitoring and reports. System includes the following components:

Energy Control Unit

System Server

DALI Interface

DALI Ballasts or DALI LED Drivers

System Field Devices (Input Modules)

Occupancy Sensors – Low Voltage/Wireless

Photo Sensors – Low Voltage/Wireless

Wallstations - Low Voltage/Wireless

Graphical User Interface based Lighting Control System Software

LCD Touch Screen Panel

Communication Wire

Occupancy Sensors – Low Voltage/Wireless

Photo Sensors – Low Voltage/Wireless

AC Phase Cut Dimming Module (Forward & Reverse)

Wireless Integration (Wireless Interface Module or Wireless Manager)

Interface to Audio Visual equipment (for integration with 3rd party LCD Touch Screen Panel)

Interface to BACnet

Interface to Tridium Niagara

Interface to customizable Energy dashboard

* + - 1. **SUBMITTALS**
				1. General: Provide submittals per 1.4 (B – J) below:
				2. Bill of Materials: Complete list of all parts needed to fully install selected system components.
				3. Product Data: For each type of product indicated.
				4. Shop and Wiring Drawings: Submit shop drawings detailing control system, as supplied, including one-line diagrams, wire counts, coverage patterns, interconnection diagrams showing field-installed wiring and physical dimensions of each item.
				5. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.

Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.

For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

* + - * 1. Software Operational Documentation:

Software operating and upgrade manuals

Program Software Backup: On portable memory storage device, compact disc, or DVD, complete with data files.

Printout of software application and graphic screens, or upon request, a live demonstration of Control, Configure and Analyze functionality or a video demonstrating above stated system capabilities.

* + - * 1. Installation Instructions: Manufacturer’s installation instructions.
				2. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
				3. Warranty: Copy of applicable warranty.
				4. Additional information as required on a project specific basis.
			1. **QUALITY ASSURANCE**
				1. Installer Qualifications: Installer shall be one who is experienced in performing the work of this section, and who has specialized in installation of work similar to that required for this project.
				2. Manufacturer Requirements: The manufacturer shall have a minimum of 15 years’ experience manufacturing networked lighting control systems and shall provide 24/7 telephone support by qualified technicians.
				3. Contractor shall ensure that lighting system control devices and assemblies are fully compatible and can be integrated into a system that operates as described in the lighting control notes on drawings and as described within this specification. Any incompatibilities between devices, assemblies, and system controllers shall be resolved between the contractor and the system provider, as required to ensure proper system operation and maintainability.
				4. Performance Requirements: Shall provide all system components that have been manufactured, assembled, and installed to maintain performance criteria stated by manufacturer without defects, damage, or failure.
				5. Performance Testing Requirements

Manufacturer shall 100% test all equipment prior to shipment. Sample testing is not acceptable.

* + - * 1. Code Requirements

System Control Unit and System Field Devices shall be cULus listed and certified.

All system components shall be FCC /IC compliant.

All system components shall be installed in compliance with National Electrical Codes and Canadian Electrical Code.

Building Codes: All units shall be installed in compliance with applicable, local building codes.

* + - * 1. ISO Certification: System components shall be manufactured at ISO-9000 certified plants.
				2. Coordination

Shall coordinate lighting control components to form an integrated interconnection of compatible components.

Match components and interconnections for optimum performance of lighting control functions.

Display graphics showing building areas controlled; include the status of lighting controls in each area.

* + - 1. **PROJECT CONDITIONS**

Operating Temperature Range: -40 deg F (-40 deg C) to 131 deg F (+55 deg C) ‘applicable devices’

Humidity: 0% to 100% RH condensing rated for damp locations.

 0% to 95% RH non-condensing rated for indoor locations.

* + - 1. **DELIVERY, STORAGE & HANDLING**
				1. Ordering: Comply with manufacturer’s ordering instructions and lead-time requirements to avoid construction delays.
				2. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged packaging with intact identification labels.
				3. Storage and Protection: Store materials away from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
			2. **WARRANTY**
				1. On-going system expansion, service and support shall be available from multiple factory certified vendors. Recommended service agreements shall be submitted at the time of bid complete with manufacturers suggested inventory and pricing for system parts and technical support labor.
				2. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.
				3. Manufacturer’s Warranty: All equipment shall be warranted free of defects in materials and workmanship.

Warranty Period: All system hardware components, excluding third party components, shall have full warranty (non-prorated) for a period of sixty (60) months and all software, excluding Open Source Software and third party operating systems, perform substantially in accordance with published specifications for a period of twelve (12) months from the date of System Start-up.

1. **PRODUCTS**
	* + 1. **ACCEPTABLE MANUFACTURERS**
				1. Controls: ENCELIUM® Energy Management System by OSRAM SYLVANIA
				2. Sensors: ENCELIUM Sensors by OSRAM SYLVANIA, Leviton Mfg. Co., Hubbell Building Automation, Inc., SensorSwitch, Inc., PLC Multipoint Inc., The Watt Stopper, Inc. Cooper Controls or equivalent.
				3. DALI Ballasts and/or DALI LED Drivers: OSRAM Sylvania, Inc., Tridonic, Universal Lighting Technologies, Philips Lighting or equivalent.
			2. **SYSTEM PERFORMANCE REQUIREMENTS**

This specification is intended to fully describe all of the design, engineering, programming, hardware, software, ancillary devices and associated technical services required to provide a building-wide networked lighting control system. This system is specified to perform scheduled and automated lighting control sequences.

* + - * 1. The lighting control “system” shall include a fully distributed WAN/LAN network of global controller/routers, individually addressable System Field Devices that are not integral to luminaires, sensors, switches, relays and other ancillary devices required for a complete and operable system. The system WAN/LAN start-up shall be by the control system manufacturer or contractors certified by the manufacturer.
				2. The basis of system design shall utilize non-proprietary industry standard DALI Ballasts and/or DALI LED drivers, occupancy sensors, daylight sensors, etc.
				3. System software interface shall have the ability to notify communication failures to system users via system & email messages. Email messages shall be available in html and text formats.
				4. On-going system expansion, service and support shall be available from multiple factory certified vendors. Recommended service agreements may be submitted at the time of bid complete with manufacturers suggested inventory and pricing for system parts and technical support labor.
				5. Lighting Control Software: The system shall offer two separate levels of lighting control: (1) personal lighting control for the average building occupant to control and adjust basic lighting functions in their workspace, and (2) central lighting control for the facility lighting administrator to perform energy management, configuration maintenance, monitoring operations, and providing support to building occupants.

Native central control software shall be utilized for energy performance monitoring and complete programming without the need for any third party hardware or software. Systems that require any third party linked software or graphics shall be unacceptable.

Software shall provide information on general system settings via mouse click on a floor plan. Left clicking over a device on the graphical software interface shall show a description of the selected device/function attribute.

 Central Lighting Control:

Shall provide an Interactive, Web-based graphical user interface (GUI) showing floor plans and lighting layouts that are native to the lighting control software. The only means required to program and operate the lighting control system shall be programmed and operated from a user interface that is based on a plan view graphical screen on the user’s computer or the lighting control system’s main computer. Shall include the navigational features listed below to allow for user’s orientation within the controlled space, geographic heading and/or landmarks:

Interactive;

Vector based;

Zoom;

Rotate;

Pan;

Tilt.

Shall allow building operator to navigate through an entire facility both in two- dimensional and three-dimensional multi-floor view, allowing for fast and easy navigation.

Three-dimensional view shall exclude walls and other structural features to avoid shadowing and cluttering of the plan view.

Shall display multiple floors in single view resulting in easier system performance visualization for the entire site as well as individual zones or spaces.

Shall allow system performance visualization across a portfolio of buildings via a single interface.

All programming, assignments of lighting loads to control strategies, lighting status and lighting energy reporting shall be native to the software and executed from this GUI. Editing shall be available from this GUI in a drag and drop format or from drop down menus without the need for any third party software. Systems that utilize or require third party linked graphics are unacceptable. The GUI shall continuously indicate the status of each connected device on the system and a warning indicator on the software if a device goes offline. Systems requiring spreadsheet editing for programming and that don’t offer real time feedback are not acceptable.

Software settings and properties shall be selectable per individual device, room based, floor based or global building based.

Lighting Control Software interface shall provide current status and enable configuration of all system zones including selected individual luminaire availability, current light level, maximum light level, on/off status, occupancy status, and emergency mode (response to an emergency signal) status.

Shall have the ability to display various lighting system parameters such as Lighting status (ON/OFF); Lighting levels, Load shedding status, or Lighting energy consumption, Occupancy status in a colorized gradient (“weather” map) type of graphical representation.

Energy Analysis data shall be exportable in CSV or image file formats.

Shall allow import of native AutoCAD files.

Reports: Reporting feature shall be native to the lighting control software and capable of reporting the following parameters for each device and zone individually without requiring any third party hardware and software:

Energy consumption broken down by energy management strategy.

Energy demand broken down by energy management strategy.

Occupancy data by zone.

Building wide occupancy status

Time Schedule status

Lighting energy consumption in a color gradient (“weather map” type) view

Energy performance reports shall be printable in a printer friendly format and downloadable for use in spreadsheet applications, etc.

* + - * 1. Personal Lighting Control: The Personal Control Software interface shall provide current status and enable each user with the ability to dim and brighten lights, and turn them on and off by individual luminaire or zone. The Software shall offer user configurable light scenes, which may be programmed and then selected via the Software. Personal lighting control shall be available in open/private office environments. This software shall have the capability of acting as a “virtual occupancy sensor” for the system by detecting keyboard or mouse activity on each PC for incremental occupancy status data.

Fade Time: The software shall offer user configurable fade times (up to 86400 seconds) for individual or group of luminaire during transition between scenes.

* + - * 1. Daylight Harvesting (Light Regulation Averaging): In a photo sensor-equipped system, the Central Controller Unit shall rationalize changes to light levels when ambient (natural) light is available and shall maintain a steady light level when subjected to fluctuating ambient conditions where 0-10V dimmingballasts and/or drivers exist. Areas equipped with fixed output ballasts and/or drivers shall energize when natural light falls below foot-candle levels specified. System shall utilize light level inputs from common and/or remote sensor locations to minimize the number of photo sensors required. The System shall operate with multiple users in harmony and not react adversely to manual override inputs.
				2. Time Clock Scheduling: The system shall be programmable for scheduling lights on or off via the Lighting Control Software interface.

Programming: User friendly, Outlook style interface shall be available for programming schedules.

Override: Manual adjustments via wallstations or personal control software shall temporarily override off status imposed by time clock schedule.

Response to Power Failure: In the event of a power failure, the time clock shall execute schedules that would still be in progress had they begun during the power outage.

Flick Warning: Prior to a scheduled lights-off event or expiry of a temporary override, the system shall provide two short light level drops as a warning to the affected occupants. Flick warning time shall have the ability to be programmed via software between 1 and 5 minutes.

Option to automatically turn on or wait for an input: Using this option, a group of luminaires can be made to turn on automatically in response to a scheduled event or wait for a signal from a wallstation to turn the same group of luminaires on (and stay on) for the reminder of the scheduled event.

Shall support BMS Schedules/Calendars

* + - * 1. Load Shed Mode: An automatic load shedding mode shall be available where, when activated through the system, the control unit will reduce its output to a programmable maximum electrical demand load. The system shall not shed more load than required and load shedding priority shall be centrally configurable by control zone or by common uses (i.e., all hallways can be treated as one load shed group), with subsequent load shed priority groupings being utilized until the required defined load has been shed, for either a defined period, or until the demand response input has been removed. Systems that simply select a “load shed scene” whereby there is no guarantee that the defined required load will actually be shed are not acceptable.
				2. Emergency Mode: There shall be a mode, when activated through the system, that will immediately adjust lights to full light output and retain that level until the mode is deactivated in the event of an emergency. This setting shall override all other inputs. The system shall interface with the building emergency monitoring system at a convenient point and not require multiple connections.
				3. Addressing: All ballasts and/or drivers shall be centrally addressable, on a per luminaire or multiple luminaire/zone basis, through the Central Control Software. The basis of design shall utilize 0-10V Dimming, Fixed Output Ballasts and/or 0-10V LED Drivers connected to an Output Module. To simplify ongoing maintenance, the system shall not require manual recording of addresses for the purpose of start-up or reconfiguration.
				4. Programmable Task Tuning: The light output level of an individual or group of luminaires shall be programmed via system software.
				5. Continuous Dimming: Dimming individual or group of luminaires in response to user initiated or system generated signal shall be over a continuous range.
				6. Unoccupied State: The system shall provide two states when occupancy status is vacant as per an occupancy sensor - lights turn off or lights adjust to configurable (dimmed) light level.
				7. Occupied State: The system shall be capable of creating “comfort” or “support” zones to ensure that occupants are not isolated by turning off lights in adjacent areas, such as a hallway path to exit the premises for occupant comfort and safety.
				8. Overlapping Zones: System shall be capable of creating “overlapping” zones to ensure continuous lighting and safety of the occupants as they move from one lighting zone to another (for example, hallways) while minimizing the energy use.
				9. Participation in Intelligent Building Framework: The system shall have the ability to be a component of Intelligent Building framework. Central Control Units and System server communication shall be based on TCP/IP over Ethernet backbone.
				10. LAN Operations: System shall be capable of operating independent of building’s existing network infrastructure if desired and shall not rely on tenant supplied PCs for operation. Network infrastructure shall only be utilized for Personal Control Software.
				11. Network Security: Firewall Technologies & VLAN Configuration methods shall be utilized to separate tenants from the lighting control network and ensure the integrity of lighting control network.
				12. Lamp Burn In: The system software shall have the capability of not permitting dimming of new lamps prior to completion of lamp manufacturer recommended accumulated operation at full brightness.
				13. Lighting Maintenance:

Percentage left in Lamp & Ballast Life Time shall be programmed to display in different colors for easier visual representation and quicker maintenance turnaround time.

System software shall have the ability to notify lamp & DALI Control Gear (DALI Ballasts and/or DALI LED Drivers) failures on the bus to system users via system & email messages. Email messages shall be available in html & text formats.

* + - * 1. Group (zone) Configuration: The assignment of individual or group of system components to zones shall be performed via Central Control Software such that physical rewiring will not be necessary when workspace reconfiguration or re-zoning is performed. Removal of covers, faceplates, ceiling tiles, etc. shall not be required.
				2. Sensor Control Parameters: Occupancy sensor time delays shall be configurable through software. Light level sensor parameters shall be configurable through software.
				3. Automatic Time Adjustment: System shall automatically adjust for leap year and daylight savings time and shall provide weekly routine and annual holiday scheduling.
				4. The system software shall have the capability of providing an optional web based energy dashboard to show real time energy savings data and carbon footprint reductions.
				5. Contact closure input: System shall be capable of receiving a momentary and sustained contact closure input from third party sources to control lighting zones.
				6. The system shall have the ability to control (dim/switch) a group of luminaires with loads up to 20A.
				7. The system shall offer occupancy sensing or time schedule based plug load control capability.
				8. Astronomical Clock feature: Luminaires switch ON/OFF with the sunset and sunrise (with an option to select offset, depending on the geographic location (latitude & longitude) of the building. An offset option shall be available to turn the schedule ON/OFF up to 12 hours before or after dusk or dawn.
				9. System shall auto-configure lighting controls for spaces that have been combined or divided temporarily by moving wall or similar systems.
				10. White Light Tuning: System shall emulate the changing colors of the natural daylighting cycle via continuous and smooth tuning of white light sources. Daylight tracking shall be via longitude and latitude settings specific to the building’s astronomical location. Speed of transition and color representation shall be based on the luminaire, its source/s and the sunrise/sunset times.
				11. System shall automatically lock wallstations and/or disable sensors based on one of the following system inputs: contact closure, a time schedule or the status of a monitored space.
				12. BAS Interface: The light management system shall be capable of interfacing digitally with a building automation system via either BACnet/IP or Tridium Niagara AX interface. The lighting control system shall be capable of communicating the status of output devices (lighting loads) as well as input devices (dry contacts, switches, occupancy sensors, vacancy sensors, and photocells) to the BAS. Building Automation System, utilize data from lighting control system input devices such as occupancy sensors to determine the status (occupied/unoccupied) of the mechanical control zones and perform climate adjustments accordingly.
				13. AV Interface: The light management system shall be capable of interfacing with audio-visual system (e.g. LCD Touch Screen Panel) via TCP/IP interface.
				14. Minimized system down time: Communication bus for sensors and wallstations shall be able to self diagnose and display communication shorts or open loops resulting in minimum system down time.
				15. AC Phase Cut Dimming circuit Integration: System shall have the ability to control Incandescent, Fluorescent or LED lighting load that are otherwise controlled by manual AC Phase Cut Dimmers.
				16. Wireless Devices (Wallstation & Sensor) Integration: System design shall ensure seamless communication among devices when hybrid wired/wireless control systems are implemented. Hybrid control system refers to devices that communicate over a DALI field bus and/or wireless medium that uses non-proprietary open protocol (e.g., ZigBee) for communication. Devices in the hybrid control system shall communicate with all the devices in the system regardless of their native protocol they are designed to work with.
			1. **WALLSTATIONS**
				1. General: The system shall connect with the wallstations via field bus that carry low voltage control signals.

Software configurable wall station shall provide on/off switching and dimming control for up to six lighting zones/ five lighting scenes per wallstation or more with allowable multi-gang configurations.

Shall allow manual dimming of light levels and override of the time schedule.

Scenes/zones in the system control software shall be synchronized with the buttons on the wallstation.

Addressing: All wallstations shall be individually addressable & reconfigurable via System Control Software.

LED’s: All wall stations shall feature status LED’s

Lighting scenes shall automatically reconfigure based on scene changes from personal control software.

* + - * 1. Electrical:
1. Class 2 Low Voltage device
2. Power source: Communication bus
	* + - 1. Communication: Shall be via NEC/CEC Class 2 communication wire
				2. Performance:

Wallstation configuration shall be via GUI in a drag and drop format

1. Custom button cap configuration shall allow combination of scene & zone in one wallstation
2. Custom commands shall be applied to individual wallstation buttons
3. Status LED: Wall station shall display its current status (zone/scene under system control or OFF) when motion is detected in the close proximity of the wallstation

The following User Interface and custom labelling options shall be available:

1. Up to five (5) scene switching & dimming
2. Up to six (6) zone switching
3. One (1) zone switching

Shall have icons that will illuminate when Loss of communication with the system control unit, Fire Alarm & Wallstation Lock statuses are detected.

Shall allow vacancy sensor configuration

* + - * 1. Mechanical:

Dimensions: Shall meet NEMA WD-6 spec.

Color: Shall meet NEMA WD1 color specifications

The following mounting options shall be supported:

Mount in standard size wall box

On mounting brackets for low voltage devices

Shall be used with “Decorator” style wall plate

* + - * 1. Reliability:

Operating temperature range: 14 deg F (-10 deg C) to 140 deg F (60 deg C)

Humidity: 5% to 95% RH non-condensing rated for indoor locations.

* + - * 1. Regulatory:

Safety: UL916 listed

Environmental protection: Rated for dry location; RoHS compliant

Radio Interference: FCC Part 15/ICES-003

Shall comply or exceed the following electromagnetic requirements:

EN 61000-4-2

EN 61000-4-4

EN 61000-4-5

* + - 1. **TOUCH SCREEN PANEL**
				1. General: Shall enable the ability to display light level, status and recall multiple lighting scenes for large multi-purpose spaces such as an auditorium, conference room, etc.
				2. Electrical:

Input voltage: Via Power over Ethernet or +9VDC to +16VDC, 1A max.

* + - * 1. Communication:
				2. Communication ports: One (1) Ethernet port (same port for powering the device/communication)
				3. Performance:

Full color 7" TFT LCD, Full VGA (800 x 480 pixels) with 65K colors

CPU: 32 bit, 533 MHz

Memory: 128 Non-volatile Flash Memory

Flexible configurations for custom buttons, text and graphics

Integrated high-resolution capacitive touch screen

* + - * 1. Mechanical:

Installation Cut-Out (W X H): 7.7" X 5.6" (195mm X 143mm)

Outer Bezel Dimension (W X H): 8.5" X 5.9" (217mm X 151mm)

Total Depth in Wall: 1.4" (36mm)

Weight: 1.4lbs (634g)

* + - * 1. Reliability:

Operating Temperature Range: -32 deg F (0 deg C) to +122 deg F (+50 deg C)

Humidity: 0% to 95% RH non-condensing rated for indoor locations

* + - 1. **SYSTEM FIELD DEVICES (SIM)**
				1. General: Shall provide a common interface to low voltage occupancy sensors and photo sensors via Input Modules. These modules shall automatically detect the type of devices they are connected to (i.e., photo sensor). Addresses to the field devices shall be assigned during system start-up. Upon establishing two way communication with the Central Control Unit (CU), these individually addressable modules shall enable each lighting component to be independently controlled and configured to best meet the needs of the facility. These modules shall connect directly to the NEC/CEC Class 2 communication bus.

Addressing: System Field Devices shall be individually addressable via Central Control Software.

System shall automatically address individual nodes during system start-up thus eliminating the need to pre-address devices or record serial numbers during installation.

* + - * 1. Electrical:

Shall supply up to 24VDC.

* + - * 1. Communication:

Shall connect to NEC/CEC Class 2 communication wire

* + - * 1. Performance:

Memory: Shall retain all system settings in non-volatile memory.

* + - * 1. Mechanical:

Suitable junction box mounting in standard 1/2" knockout (7/8” dia.)

* + - * 1. Reliability:

Operating Temperature Range: -40 deg F (-40 deg C) to +131 deg F (+55 deg C)

Humidity: 0% to 100% RH condensing rated for damp locations.

 0% to 95% RH non-condensing rated for indoor locations.

* + - * 1. Regulatory:

Safety:

UL916, UL924 & UL2043 listed

Radio Interference: FCC Part 15/ICES-003

Shall comply or exceed the following electromagnetic requirements:

EN 61000-4-2

EN 61000-4-4

EN 61000-4-5

* + - 1. **DALI INTERFACE (DALI BRIDGE)**
1. General: Shall provide an interface between the ECU and DALI Control Gear (DALI Ballasts and/or DALI LED Drivers). The ECU, through the DALI Interface, automatically detects and addresses the DALI Ballasts and/or DALI LED Drivers it is connected to and establishes two-way communication. The DALI Interface shall connect directly to the Class 2 communication wire.

Addressing: System shall automatically address DALI Control Gear during system commissioning thus eliminating the need to pre-address the devices or record serial numbers during installation.

1. Electrical Specifications:
2. DALI Output: 22.5V, 200mA minimum. Rated for NEC/CEC Class 1 or Class 2 wiring
3. Powered by an external power supply that supplies 24DC
4. Communication:
5. Screw Terminals shall be available for connecting NEC/CEC Class 2 communication wire, DC Input & DALI Output).
6. Performance:
7. Memory: Shall retain all system settings in non-volatile memory.
8. Mechanical:
9. Mounting rail guide for mounting onto a 35x7.5 or 35x15 “Top-hat” style DIN rail
10. Reliability:
11. Operating Temperature Range: 32 deg F (0 deg C) to 122 deg F (50 deg C)
12. To be installed in dry, indoor locations ONLY
13. Regulatory:
14. Radio Interference: FCC Part 15/ICES-003
15. Shall comply or exceed the following electromagnetic requirements:
	1. EN 61000-4-2
	2. EN 61000-4-4
	3. EN 61000-4-5
		* 1. **AREA LIGHTING CONTROLLER (ALC)**
				1. General: Shall provide a common interface (DIM/SWITCH) to a group of 0-10V Dimming, Fixed Output Ballasts and/or 0-10V LED Drivers via field bus that carry low voltage control signals.

Addressing: Area Lighting Controllers shall be addressable via Control Software.

System shall automatically address individual area lighting controllers during system start-up thus eliminating the need to pre-address devices or record serial numbers during installation.

* + - * 1. Electrical:

Maximum Load Ratings:

20A 120-347 Vac Ballast

20A 120-347 Vac Resistive

20A 120-347 Vac Tungsten

20A 120-347 Vac General Purpose

1.5 HP 120-277 Vac Motor

* + - * 1. Communication: Shall be via NEC/CEC Class 2 communication wire
				2. Performance:

Control Options

ON/OFF Switching

Continuous dimming

Shall be able to communicate with 0-10V ballasts/drivers

Shall be used for general purpose plug load control

Group Control: Shall control up to 30 ballast/LED Drivers

Air Gap Off: Shall enforce physical disconnection of AC power to the ballast or driver when “OFF” is selected either automatically or manually.

Memory: Shall retain all system settings in non-volatile memory

* + - * 1. Mechanical:

Mounting: Standard 1/2" electrical box knockout

Material: Plenum rated black plastic (UL2043)

* + - * 1. Reliability:

Operating temperature range: 32 deg F (0 deg C) to 131 deg F (55 deg C)

Humidity: 5% to 95% RH non-condensing rated for indoor locations

* + - * 1. Regulatory:

Safety: UL916, UL924 & UL2043 listed

Environmental protection: Rated for damp location; RoHS compliant

Radio Interference: FCC Part 15/ICES-003

Shall comply or exceed the following electromagnetic requirements:

EN 61000-4-2

EN 61000-4-4

EN 61000-4-5

* + - 1. **RELAY BASED LIGHTING CONTROL PANELS (RP/RPM)**
				1. General: An addressable lighting control panel that allows each relay to be individually controlled and configured.

Addressing: All lighting control panel relays shall be individually addressable via Central Control Software.

Wiring: Lighting control panels shall be interconnected on the same field bus as all other system components.

Relay Panel Modules are suitable for 35 mm DIN rail mounting.

* + - * 1. Electrical:

Input Power Supply: 40 VA, 50/60 Hz

* + - * 1. Communication:

Shall be via NEC/CEC Class 2 communication wire

* + - * 1. Performance: ON/OFF Switching at Circuit level
				2. Reliability:

Maximum Operating Ambient Temperature: 140 deg F (60 deg C).

* + - * 1. Regulatory:

Safety: UL916, UL924 listed

Radio Interference: FCC Part 15/ICES-003

Shall comply or exceed the following electromagnetic requirements:

EN 61000-4-2

EN 61000-4-4

EN 61000-4-5

* + - 1. **AC PHASE CUT DIMMING MODULE (PCDM)**
				1. General: AC Phase Cut Dimming Modules shall provide a common interface to a group of Incandescent, Fluorescent or LED light systems that are otherwise connected to manual forward/reverse phase cut dimming devices. These modules shall connect directly to the NEC/CEC Class 2 communication bus.

Addressing: AC Phase Cut Dimming Modules shall be individually addressable via Control Software.

* + - * 1. Electrical:

Input Voltage: 120-277 VAC 50/60Hz

Maximum Output Load Ratings shall be:

120 VAC: 450W, 3.8 A MAX

277 VAC: 900W, 3.3 A MAX

Shall have built-in short circuit protection

Shall offer ANSI C62.41 Category A Transient protection

* + - * 1. Communication:

Via NEC/CEC Class 2 communication bus

* + - * 1. Performance:

Shall provide an interface between the phase cut dimmable (forward and reverse phase) ballasts/LED drivers

Shall have configuration stored in non-volatile flash memory.

* + - * 1. Mechanical:

Installation on top of a standard square junction box

* + - * 1. Reliability:

Operating temperature range: 32 deg F (0 deg C) to 104 deg F (40 deg C)

Case Temperature: up to 158 deg F (70 deg C)

Suitable for indoor dry locations only

* + - * 1. Regulatory:

Safety: UL916, UL924 listed

Radio Interference: FCC 47 CFR Part 18

Shall comply or exceed the following electromagnetic requirements:

EN 61000-4-2

* + - 1. **PHOTO SENSOR**
				1. General: Photo sensor connectivity shall be via field bus that carry low voltage control signals.
				2. Electrical:

Class 2 Low Voltage device

Power source: Communication bus

* + - * 1. Communication: Shall be via Class 2 communication bus
				2. Performance:

Accuracy: +/-1% at 21 deg C (70 deg F), derated to +/-5% at 49 deg C (120 deg F) or at -18 deg C (0 deg F).

The indoor sensor range shall be between 0 and 750 FC.

The Outdoor sensor range shall be between 0 and 750 FC.

Atrium sensor range shall be from 2 to 2,500 FC.

Skylight sensor range shall be between 10 and 7,500 FC.

* + - * 1. Mechanical:

Mounting options shall include the following:

Junction Box mounting

Knock-out mounting

* + - * 1. Reliability:

Operating temperature range: 13 deg F ((-11 deg C) to +140 deg F (60 deg C)

Humidity: 5% to 95% RH (non-condensing)

* + - 1. **OCCUPANCY SENSORS**
				1. General: Occupancy sensor connectivity shall be via field bus that carry low voltage signals.

Shall allow timeouts configurable via system software.

Sensors using passive infrared, ultrasonic, microphonic, and multi-technology shall be available.

Shall allow occupancy and vacancy sensor configurations via system software.

Depending on the software configuration shall switch or dim the luminaires.

Shall allow overlapping and comfort zone configurations via system software.

* + - * 1. Electrical:

Class 2 Low Voltage device

Power source: Communication bus

* + - * 1. Communication: Shall be via Class 2 communication bus
				2. Performance:

Shall allow flexible timer settings

Shall have the ability to self-calibrate and retain settings during power interruptions

Shall have the ability to automatically analyze and adjust sensitivity and time delay

Shall provide the following coverage:

Ceiling mount: 450 sq. ft. to 2000 sq. ft.

Wall mount: 1200 sq. ft. to 2500 sq. ft.

* + - * 1. Mechanical:

Wired: Sensors for mounting on ceilings and walls, including corners, shall be available.

* + - * 1. Reliability:

Operating temperature range: 32 deg F to +104 deg F. (0 deg C to 40 deg C)

Humidity: 0% to 95% RH (non-condensing)

* + - 1. **COMMUNICATION WIRE (GREENBUS)**
				1. General: The system shall have the capability to use both NEC/CEC Class 1 and Class 2 wiring to integrate peripheral devices such as ballasts/LED drivers, occupancy sensors, photo sensors, relay-based controls, area lighting controllers, and wallstations into a complete, networked programmable lighting control system.
				2. Electrical: NEC/CEC Class 2 Communication bus
				3. Mechanical:

Multi-conductor cable with stranded-copper conductors

* + - * 1. Performance:

Shall power photo sensors, PIR and dual-technology occupancy sensors.

Shall allow random devices connection without the need for special network channel termination.

Minimize system down time by self-diagnosing the field bus for any shorts and open loops.

* + - * 1. Regulatory:

Flame rated jacket for plenum use NFPA 262 (UL: FT6, CSA: CMP).

* + - 1. **ENERGY CONTROL UNIT (ECU)**
				1. General: The Energy Control Unit (ECU) shall collect, process and distribute lighting control information to the system field devices and wall stations over NEC/CEC Class 2 communication bus. Each CU shall feature multiple NEC/CEC Class 2 communication channels that can control a large quantity of nodes (sensors, wall stations, 0-10V Dimming, Fixed Output Ballasts, 0-10V LED Drivers, etc.) per channel, per the manufacturers recommended maximum.

The ECU shall be the central intelligence point for the area it controls collecting signal information from sensors, wallstations and personal control software and determining appropriate brightness levels or on/off status for each luminaire or zone. The CU shall connect with a facility’s or tenant’s Local Area Network (LAN) via Ethernet to enable desktop personal control.

* + - * 1. Electrical:

External Power Supply: 100–240VAC/50-60Hz/1.8A; do not connect to a UPS or normal/emergency power source

Input Power Supply: 24 VDC

* + - * 1. Communication:

Ethernet communication ports that employ TCP/IP protocol shall be provided to simultaneously enable the following connections:

Lighting Control Network

Tenant LAN Access Point

Shall have 8 ports that accept 18 AWG, pre-fabricated, polarity independent quick connecting NEC/CEC Class 2 communication bus that supplies 24 VDC

* + - * 1. Performance:

Each CU channel shall support up to 100 nodes or 800 nodes in total

Shall have status LEDs for the following:

Network activity on CU’s Ethernet port/s

CU channel status

CU status

Shall enable the following functionalities:

Backup to and Restore from USB flash drives

Cycle lights through 100%, 25% & 0% steps

Disable/enable all controller functionalities

IP Address Reset

Electronically deactivate individual channels

Shall have configuration stored in non-volatile flash memory.

* + - * 1. Mechanical:

Shall mount in a standard 19” rack (1U width), or alternatively where no rack is shown, via an individual wall mount.

* + - * 1. Reliability:

Operating temperature range: 32 deg F (0 deg C) to 104 deg F (40 deg C)

* + - * 1. Regulatory:

Safety: UL916 listed

Radio Interference: FCC Part 15/ICES-003

Shall comply or exceed the following electromagnetic requirements:

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EN 61000-4-4

EN 61000-4-5

* + - 1. **SYSTEM SERVER**
				1. General: System Server shall host the lighting control system database for all the lighting control devices. In addition, it shall provide remote accessing capability to change system settings and/or parameters.

Server shall have the ability to:

Analyze system performance or energy data or generate system report;

Record energy consumption with  average sampling every 5 minutes for unlimited duration;

Host the web interface required for the web enabled Personal Control Software or web based Central Control Software;

Reside on a client server (virtual server);

Interconnect with Control Units over standard Ethernet connection that employs TCP/IP protocol;

Hardware based servers shall at minimum meet the specifications listed below:

* + - * 1. Electrical:

Power Supply: 120V/60Hz/200W. Provide dedicated 120V receptacle fed from a dedicated normal power circuit.

* + - * 1. Communication:

Each System Server shall have two Ethernet 10/100Base - Tx Cat 5 RJ45 ports that employ TCP/IP protocol.

* + - * 1. Mechanical:

Shall mount in a standard 19” rack (1U width), or alternatively where no rack is shown, via an individual wall mount.

* + - * 1. Reliability:

Operating temperature range: 50 deg F (10 deg C) to 95 deg F (35 deg C)

Operating Relative Humidity: 10% to 90% (non-condensing)

* + - * 1. Regulatory:

FCC (US only) Class A.

DOC (Canada) Class A.

UL 60950.

CAN/CSA-C22.2 No. 60950.

* + - 1. **LIGHTING CONTROL SYSTEM SOFTWARE**
				1. Personal Control Software: Shall enable individuals in a building to control lighting levels in their workspace from their own desktop PC. Shall enable light level control for each luminaire in their workspace or control all of the luminaire together as a group. Preset lighting scenes shall be stored, recalled and modified. This software shall have the capability of acting as a “virtual occupancy sensor” for the system by detecting keyboard or mouse activity on each PC for incremental occupancy status data.

Technical Information:

TCP/IP network traffic < 2kb/s.

* + - * 1. Web based Personal Control Software: Shall enable majority of the Personal Control Software features via a web browser. Shall allow tasks such as individual luminaire dimming control, on/off switching, modify and save preset lighting scenes.
				2. Technical Information: Adobe Flash ® based user interface.

System shall require:

Internet web browser with Flash® Player 8 or later.

Internet/Intranet connection.

SSU enabled and configured to host dynamic website.

Network connection with access to a network-enabled CU.

* + - * 1. Web based Central Control Software: Central control software application shall be used to start-up, configure and manage the system. Every system parameter in a building (or campus of buildings) shall be configured for each individual user or space and baseline settings shall be established for each of the following (depending on the basis of design) system features:

Daylight harvesting.

Occupancy control.

Smart time scheduling.

Task tuning.

Personal control.

Load shedding.

Software shall utilize a web based interface that permits a user to easily navigate between zones, floors or different buildings and allows a user to zoom in or zoom out of specific areas of a building. Both 3-dimensional and two-dimensional multi-floor views shall be available. System features such as creation of zone hierarchies, overlapping and support zone definitions, user access rights, timeout settings for occupancy sensors, calibration of light levels for daylight harvesting and the configuration of multiple time schedule profiles shall be available. A web based Graphical User Interface (GUI) application integral to the system shall be used to develop a dynamic, real-time, point-and-click graphic of each floor plan with representation of all light luminaire, wallstations, sensors, switches, etc. A central system server shall be provided to support system data base and enterprise control management.

System shall require:

Software that can run on a Windows Operating systems (Windows XP or newer) and also on Apple Mac Intel PCs (Mac OS 10.4 or newer).

Ability to support common browsers

Network connection/access to all network-enabled CUs.

Color gradient (“weather map” type) data view (see below for an example) to display the following criteria:

* Lamp & ballast life time
* Current energy consumption
* Current energy savings
* Current luminaire brightness
* Current luminaire status
* Current occupancy data
* Current load shedding status
* Other custom modes that may be specified elsewhere
	+ - 1. **AUDIO-VISUAL INTERFACE**
				1. General: Shall allow users command (e.g. LCD Touch Screen Panel) various lighting scenarios depending on the audio & visual requirements of the room or building.

The lighting control system shall interface to the AV system via TCP/IP protocol using Telnet.

The lighting control system shall allow a common AV processor to individually control multiple rooms from a single TCP/IP port through unique room, zone, and scene addresses for lighting in each room.

* + - 1. **BAS INTERFACE**
				1. General: Two separate software interfaces (BACnet/IP or Tridium Niagara AX) shall be available for integration with Building Automation System. The lighting control system, via these interfaces, communicate the status of output devices (lighting loads) as well as input devices (dry contacts, switches, occupancy sensors, vacancy sensors, and photocells) over to the building automation system. Building Automation System, utilize data from lighting control system to switch/dim lighting, perform load shedding of lighting load, to turn lights on in response to emergency signal through fire alarm and perform HVAC adjustments.

The Lighting Control System shall support the following BACnet Objects:

Binary Value:

Light Zone State: State of the defined lighting zone – ON or OFF

Analog Value:

Light Zone Dimming: Light output level of the defined lighting zone, from 100% (maximum light output) to 0% (minimum light output)

Scheduling:

Support for BACnet Schedules/Calendars

Analog Input:

Shed Request: Requested total amount of load reduction, defined in watts or as a percentage of sheddable load

Shed Request (Group): (As above, for the selected group)

Analog Output:

Photo Sensor Daylight Readings (available via BACnet interface only): Reports daylight readings by photo sensors

Sheddable Load: Reports the total lighting load available for load reduction according to the Light Management System, defined in watts

Sheddable Load (Group): (As above, for the selected group)

Shed Status: Reports the total current load reduction achieved according to Light Management System defined prioritization, defined in watts

Shed Status (Group): (As above, for the selected group)

Load Shedding Total Demand: Reports the total lighting demand of all devices in a load shedding group (in Watts)

Binary Input:

Fire Alarm State: State of the fire alarm system – alarm activated or alarm not activated

Binary Output:

Occupancy State: State of the defined occupancy sensor – occupancy detected or not detected

The Lighting Control System shall allow Floor plans imports into Tridium Niagara AX:

Importing lighting control software floor plans into Tridium Niagara AX framework for viewing current status and changing the proxy values.

1. **EXECUTION**
	* + 1. **EXAMINATION**
				1. Site Verification: Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer’s instructions.
				2. Inspection: Inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.
			2. **INSTALLATION**
				1. The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control as described herein and shown on the plans (including but not limited to System Field Devices, 0-10V dimming ballasts, fixed output ballasts, 0-10V LED drivers and communication wire). The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.
				2. Power: The contractor shall test that all branch load circuits are operational before connecting loads to sensor system load terminals, and then de-energize all circuits before installation.
				3. Related Product Installation: Refer to other sections listed in Related Sections for related products’ installation.
			3. **SENSOR INSTALLATION**
				1. Adjust sensitivity to cover area installed
				2. Set time delay on occupancy sensors that are connect to the lighting control system to the minimum. Time delays shall be controlled via Central Control Software.
				3. Vacancy sensor configurations shall be via Central Control Software.
				4. Sensors shall be powered through Input Module, Wireless Control Module, Kinetic energy or batteries.
				5. Install occupancy sensors on vibration free stable surface.
				6. Install atrium and skylight light sensor facing toward window or skylight.
				7. Install interior light sensor in ceiling facing the floor.
			4. **WIRING INSTALLATION**
				1. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.
				2. Wiring within Enclosures: Comply with NEC & CEC. Separate power-limited and non power-limited conductors according to conductor manufacturer's written instructions.
				3. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
				4. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
			5. **SOFTWARE INSTALLATION**
				1. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current site licenses for software.
			6. **FIELD QUALITY CONTROL**
				1. Manufacturer’s Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
				2. Perform the following field tests and inspections with the assistance of a factory-authorized service representative:

Operational Test: After installing wallstations and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

* + - * 1. Lighting control devices will be considered defective if they do not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. **SYSTEM START-UP REQUIREMENTS & SUPPORT SERVICES**
				1. System Start-up: The manufacturer shall supply factory trained representatives to start-up the lighting control system.
				2. Training: As part of the system start-up service, the provider of the service shall train the facility staff, or end users, responsible for changing the lighting characteristics in a building in the operation of the system. The start-up service provider shall also provide owner’s representatives with system operating manuals.
				3. Extended Service Coverage: Maintenance agreements shall be available from the manufacturer to provide service for the system both during and after the warranty period.
				4. Requests for start-up or technical services shall be at least fifteen (15) business days prior to date desired for service.
				5. Electrical contractor shall perform functional testing under the guidance of technical service agent and in accordance with factory specified guidelines.
				6. Technical service provider shall provide technical services for the lighting control system.

Verify proper communication over control wires.

Map addresses of all 0-10V, DALI gear and wireless devices.

Verify communication to control units and system server.

Software configuration of occupancy sensors, light level sensors, wallstations and other contacts to suit design specifications.

Configure and program lighting control sequences as described on contract documents.

Demonstrate to Owner and Engineer proper operation of all areas the system is installed.

* + - 1. **TESTING**
				1. Upon completion of all line, load and interconnection wiring, and after all luminaire are installed and lamped, a qualified factory representative shall completely configure and test the system.
				2. At the time of checkout and testing, the owner’s representative shall be thoroughly instructed in the proper operation of the system.
			2. **DEMONSTRATION**
				1. The provider of the service shall train the facility staff, or end users, responsible for changing the lighting characteristics in a building to adjust, operate, utilize, troubleshoot, conduct software installation, and maintain lighting controls and software training for PC-based control systems.

**END OF SECTION**



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