

**SECTION 26 0923**  
**DIGITAL LIGHTING CONTROL SYSTEM**

**PART 1 – GENERAL**

- 1.1 Furnish and install automatic lighting controls as shown on the drawings and as specified herein Submit manufacturers' data on all items.
- 1.2 Equipment shall be UL listed, comply with those portions of CEC as applicable to electrical wiring work and comply with those portions of NEMA or UL pertaining to types of electrical equipment and enclosures. The equipment shall also be certified by the California Energy Commission.
- 1.3 The manufacturer of the lighting control equipment shall have been actively engaged in the manufacture of the types and capacities required for the application for at least three years. It is the sole responsibility of the Division 26 contractor to ensure that submittals of material meets the performance specifications contained herein.
- 1.4 All components and assemblies shall be factory pre-tested and burned-in as a system for 48 hours prior to shipping.
- 1.5 Control Intent – Control Intent includes, but is not limited to:
  - 1.5.1 Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
  - 1.5.2 Initial sensor and switching zones
  - 1.5.3 Initial time switch settings
  - 1.5.4 Task lighting and receptacle controls
  - 1.5.5 Emergency Lighting control
  - 1.5.6 Manufacturer shall submit a point-to-point line diagram of the system configuration including all devices and accessories required to complete the system.
  - 1.5.7 Manufacturer shall submit data sheets on the components and system submitted, with descriptions of hardware and software components.

**SYSTEM DESCRIPTION & OPERATION**

- 1.6 The Lighting Control and Automation system as defined under this section covers the following equipment:
  - 1.6.1 Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications
  - 1.6.2 Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications
  - 1.6.3 Handheld remotes for personal control – One-button dimming, two-button on/off, or five-button scene remotes provide control using infrared communications.

Remote may be configured in the field to control selected loads or scenes without special tools

- 1.6.4 Digital Daylighting Sensors – Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications can provide switching, bi-level, tri-level or dimming control for daylight harvesting
- 1.6.5 Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities
- 1.6.6 Configuration Tools – Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow bi-directional communication of room variables and occupancy sensor settings. Computer software also customizes room settings
- 1.6.7 Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices
- 1.6.8 Digital Lighting Management (DLM) segment network – Linear topology, BACnet MS/TP network (1.5 twisted pair, shielded,) to connect multiple DLM local networks for centralized control
- 1.6.9 Programming and Configuration software – Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication
- 1.6.10 Emergency Lighting Control Unit (ELCU) – allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

## LIGHTING CONTROL APPLICATIONS

- 1.7 Unless relevant provisions of the applicable local Energy Codes are more stringent, provide a minimum application of lighting controls as follows:
  - 1.7.1 Space Control Requirements – Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.
  - 1.7.2 Bi-Level Lighting – Provide multi-level controls in all spaces except toilet rooms, storerooms, library stacks, or applications where variable dimming is used
  - 1.7.3 Task Lighting / Plug Loads – Provide automatic shut off of non-essential plug loads and task lighting in all spaces except toilet rooms and storerooms. Provide

Automatic-ON of plug loads whenever spaces are occupied. For spaces with multiple occupants a single shut off consistent with the overhead lighting may be used for the area

1.7.4 Daylit Areas – Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:

1.7.4.1 All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones

1.7.4.2 Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes

1.7.4.3 Multiple-leveled switched daylight harvesting controls may be utilized for areas marked on drawings

1.7.4.4 Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.

1.7.5 Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four (4) pre-set lighting scenes unless otherwise specified. Occupancy / vacancy sensors shall be provided to extinguish all lighting in the space. Spaces with up to four moveable walls shall include controls that can be reconfigured when the room is partitioned.

1.8 Submit shop drawings and manufacturers' data for all components including:

1.8.1 Manufacturer shall submit in bill-of-material form an itemized list of all materials supplied to meet the specification.

1.8.2 Manufacturer shall submit dimensional drawings of lighting control panel(s).

1.8.3 Manufacturer shall submit a point-to-point line diagram of the system configuration including all devices and accessories required to complete the system.

1.8.4 Manufacturer shall submit data sheets on the components and system submitted, with descriptions of hardware and software components

1.8.5 Composite wiring and/or schematic diagram of each control circuit as proposed to be installed

1.8.6 Show exact location of all digital devices, including at minimum sensors, room controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format reflected ceiling plans)

1.8.7 Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies

- 1.8.8 Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades

#### QUALITY ASSURANCE

- 1.9 Manufacturer: Minimum 10 years' experience in manufacture of lighting controls

#### PROJECT CONDITIONS

- 1.10 Do not install equipment until following conditions can be maintained in spaces to receive equipment:
  - 1.10.1 Ambient temperature: 0° to 40° C (32° to 104° F)
  - 1.10.2 Relative humidity: Maximum 90 percent, non-condensing.

#### WARRANTY

- 1.11 Provide a five-year limited manufacturer's warranty on all room control devices and panels

#### MAINTENANCE

- 1.12 Spare Parts:
  - 1.12.1 The contactor shall provide as a part of this contract additional Control modules of each type used, Switches of each type used, Daylight sensors, Ceiling mounted occupancy sensors, Wall mounted occupancy sensors, Room controller, etc, three (3) for each type. Any devices not required to be included during construction shall be delivered to the District at the completion of the project. **The quantities of these devices shall be listed as a part of the Phase 1 submittals.**

### PART 2 – PRODUCTS

- 2.1 Acceptable Manufacturers: **WattStopper, Digital Lighting Management (DLM), Acuity nLight, Current Nx.**  
Substitutions:
- 2.2 Bidder's wishing to obtain approval on manufacturers other than those specified in these specifications or on the drawings shall comply with the following procedures:
  - 2.2.1 All substitution requests shall be submitted to the Architect / Engineer no less than 10 business days prior to the project bid opening date. Approvals when accepted will be issued in the form of an addendum to the contract. No consideration for substitutions will be provided after the award of the contract.
  - 2.2.2 The substitution request must include a statement indicating how the substituted product may impact the completion of the project.

- 2.2.3 The substitution request must include a statement indicating the difference in price (both list price and Contractor price) between the specified product and the substitution.
- 2.2.4 The substitution request must include a detailed analysis indicating any differences between the specified product and the substitution.
- 2.2.5 Catalog literature for both the specified and the substitution shall be provided along with contact information of the manufacturer for the substituted product.
- 2.3 The contractor shall pay the Engineer (at their current standard hourly rates) for the time spent reviewing substitutions. These costs will be included as an addendum to be issued to all bidders to include in their proposals and must be paid to the Engineer within 60 days of award of the project.

#### DIGITAL LIGHTING CONTROLS

- 2.4 Furnish the Company's system which accommodates the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories which suit the lighting and electrical system parameters.

#### DIGITAL WALL SWITCH OCCUPANCY SENSORS

- 2.5 Wallbox mounted passive infrared PIR or dual technology (passive infrared and ultrasonic) digital occupancy sensor with 1 or 2 switch buttons
- 2.6 Digital Occupancy Sensors shall provide scrolling LCD display for digital calibration and electronic documentation. Features include the following:
  - 2.6.1 Digital calibration and pushbutton configuration for the following variables:
    - 2.6.1.1 Sensitivity – 0-100% in 10% increments
    - 2.6.1.2 Time delay – 1-30 minutes in 1 minute increments xx
    - 2.6.1.3 Test mode – Five second time delay
    - 2.6.1.4 Detection technology – PIR, Dual Technology activation and/or re-activation.
    - 2.6.1.5 Walk-through mode
    - 2.6.1.6 Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network
  - 2.6.2 Programmable control functionality including:
    - 2.6.2.1 Each sensor may be programmed to control specific loads within a local network
    - 2.6.2.2 Sensor shall be capable of activating one of 16 user-definable lighting scenes.

- 2.6.2.3 Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically during the configurable period of time (default 10 seconds) after turning off.
- 2.6.2.4 On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
  - 2.6.2.4.1 Ultrasonic and Passive Infrared
  - 2.6.2.4.2 Ultrasonic only
  - 2.6.2.4.3 Passive Infrared only
- 2.6.3 Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods
- 2.6.4 Two RJ-45 ports for connection to DLM local network
- 2.6.5 Two-way infrared (IR) transceiver to allow remote programming through handheld configuration tool and control by remote person controls.
- 2.6.6 Device Status LEDs including:
  - 2.6.6.1 PIR detection
  - 2.6.6.2 Ultrasonic detection
  - 2.6.6.3 Configuration mode
  - 2.6.6.4 Loading binding
- 2.6.7 Assignment of occupancy sensor to a specific load within the room without wiring or special tools
- 2.6.8 Assignment of local buttons to specific loads within the room without wiring or special tools
- 2.6.9 Manual override of controlled loads
- 2.6.10 All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH memory within the wall switch sensor itself. Memory shall have an expected life of no less than 10 years.
- 2.7 BACnet object information shall be available for the following objects:
  - 2.7.1 Detection state
  - 2.7.2 Occupancy sensor time delay
  - 2.7.3 Occupancy sensor sensitivity, PIR and Ultrasonic
  - 2.7.4 Button state

- 2.7.5 Switch lock control
- 2.7.6 Switch lock status
- 2.8 Units shall not have any dip switches or potentiometers for field settings
- 2.9 Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required
- 2.10 Two-button wall switch occupancy sensors, when connected to a single relay dimming room controller, shall operate in the following sequence as a factory default:
  - 2.10.1 Left button
    - 2.10.1.1 Press and release – Turn load on
    - 2.10.1.2 Press and hold – Raise dimming load
  - 2.10.2 Right button
    - 2.10.2.1 Press and release – Turn off
    - 2.10.2.2 Press and hold – Lower dimming load
- 2.11 Low voltage momentary pushbuttons shall include the following features:
  - 2.11.1 Load/Scene Status LED on each switch button with the following characteristics:
    - 2.11.1.1 Bi-level LED
    - 2.11.1.2 Dim locator level indicates power to switch
    - 2.11.1.3 Bright status level indicates that load or scene is active
  - 2.11.2 The following button attributes may be changed or selected using a wireless configuration tool:
    - 2.11.2.1 Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
    - 2.11.2.2 Individual button function may be configured to Toggle, On only or Off only.
    - 2.11.2.3 Individual scenes may be locked to prevent unauthorized change.
    - 2.11.2.4 Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
    - 2.11.2.5 Ramp rate may be adjusted for each dimmer switch.

2.11.2.6 Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple load

2.12 WattStopper part numbers: LMPW, LMDW. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening

#### DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

2.13 Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor

2.14 Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:

2.14.1 Digital calibration and pushbutton configuration for the following variables:

2.14.1.1 Sensitivity – 0-100% in 10% increments

2.14.1.2 Time delay – 1-30 minutes in 1 minute increments

2.14.1.3 Test mode – Five second time delay

2.14.1.4 Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.

2.14.1.5 Walk-through mode

2.14.1.6 Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.

2.14.2 Programmable control functionality including:

2.14.2.1 Each sensor may be programmed to control specific loads within a local network.

2.14.2.2 Sensor shall be capable of activating one of 16 user-definable lighting scenes.

2.14.2.3 Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off

2.14.2.4 On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:

2.14.2.4.1 Ultrasonic and Passive Infrared

2.14.2.4.2 Ultrasonic or Passive Infrared

2.14.2.4.3 Ultrasonic only

#### 2.14.2.4.4 Passive Infrared only

- 2.14.3 Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
- 2.14.4 One or two RJ-45 port(s) for connection to DLM local network
- 2.14.5 Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls
- 2.14.6 Device Status LEDs, which may be disabled for selected applications, including:
  - 2.14.6.1 PIR detection
  - 2.14.6.2 Ultrasonic detection
  - 2.14.6.3 Configuration mode
  - 2.14.6.4 Load binding
- 2.14.7 Assignment of occupancy sensor to a specific load within the room without wiring or special tools
- 2.14.8 Manual override of controlled loads
- 2.14.9 All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years
- 2.15 BACnet object information shall be available for the following objects:
  - 2.15.1 Detection state
  - 2.15.2 Occupancy sensor time delay
  - 2.15.3 Occupancy sensor sensitivity, PIR and Ultrasonic
- 2.16 Units shall not have any dip switches or potentiometers for field settings
- 2.17 Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- 2.18 WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

#### DIGITAL WALL SWITCHES

- 2.19 Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configurations. Wall switches shall include the following features:
  - 2.19.1 Two-way infrared (IR) transceiver for use with personal and configuration remote controls.

- 2.19.2 Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
- 2.19.3 Configuration LED on each switch that blinks to indicate data transmission.
- 2.19.4 Load/Scene Status LED on each switch button with the following characteristics:
  - 2.19.4.1 Bi-level LED
  - 2.19.4.2 Dim locator level indicates power to switch
  - 2.19.4.3 Bright status level indicates that load or scene is active
- 2.19.5 Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps
- 2.19.6 Programmable control functionality including
  - 2.19.6.1 Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority.
  - 2.19.6.2 Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels
- 2.19.7 All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years
- 2.20 BACnet object information shall be available for the following objects:
  - 2.20.1 Button state
  - 2.20.2 Switch lock control
  - 2.20.3 Switch lock status
- 2.21 Two RJ-45 ports for connection to DLM local network
- 2.22 Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching
- 2.23 The following switch attributes may be changed or selected using a wireless configuration tool:
  - 2.23.1 Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa)
  - 2.23.2 Individual button function may be configured to Toggle, On only or Off only.
  - 2.23.3 Individual scenes may be locked to prevent unauthorized change.

- 2.23.4 Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours
- 2.23.5 Ramp rate may be adjusted for each dimmer switch.
- 2.23.6 Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads
- 2.24 WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening

#### HANDHELD REMOTE CONTROLS

- 2.25 Battery-operated handheld devices in 1, 2 and 5 button configurations for remote switching or dimming control. Remote controls shall include the following features:
  - 2.25.1 Two-way infrared (IR) transceiver for line of sight communication with DLM local network within up to 30 feet
  - 2.25.2 LED on each button confirms button press
  - 2.25.3 Load buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads
  - 2.25.4 Inactivity timeout to save battery life
- 2.26 A wall mount holster and mounting hardware shall be included with each remote control
- 2.27 WattStopper part numbers: LMRH-101, LMRH-102, LMRH-105

#### DIGITAL PARTITION CONTROLS

- 2.28 Partition controls shall enable manual or automatic coordination of lighting controls in flexible spaces with up to four moveable walls by reconfiguring the connected digital switches and occupancy sensors
- 2.29 Four-button low voltage pushbutton switch for manual control.
  - 2.29.1 Two-way infrared (IR) transceiver for use with configuration remote control.
  - 2.29.2 Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall
  - 2.29.3 Configuration LED on each switch that blinks to indicate data transmission.
  - 2.29.4 Each button represents one wall; Green button LED indicates status.
  - 2.29.5 Two RJ-45 ports for connection to DLM local network.
- 2.30 WattStopper part number: LMPS-104. Available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening

- 2.31 Contact closure interface for automatic control via input from limit switches on movable walls (by others).
  - 2.31.1 Operates on Class 2 power supplied by DLM local network.
  - 2.31.2 Includes 24VDC output and four input terminals for maintained third party contract closure inputs.
    - 2.31.2.1 Input max. sink/source current: 1-5Ma
    - 2.31.2.2 Logic input signal voltage High: >18VDC
    - 2.31.2.3 Logic input signal voltage Low: <2VDC
  - 2.31.3 Four status LEDs under hinged cover indicate if walls are open or closed; supports LMPS-104 as remote status indicator.
  - 2.31.4 Two RJ-45 ports for connection to DLM local network.
- 2.32 WattStopper part number: LMIO-102

#### DIGITAL DAYLIGHTING SENSORS

- 2.33 Digital daylighting sensors shall work with room controllers to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to a room controller. Daylighting sensors shall be interchangeable without the need for rewiring
  - 2.33.1 Closed loop sensors measure the ambient light in the space and control a single lighting zone
  - 2.33.2 Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones
  - 2.33.3 Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone
- 2.34 Digital daylighting sensors shall include the following features:
  - 2.34.1 The sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers
  - 2.34.2 Sensor light level range shall be from 1-6,553 footcandles (fc).
  - 2.34.3 The capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).

- 2.34.4 For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the “ON Setpoint” and the “OFF Setpoint” that will prevent the lights from cycling excessively after they turn off.
- 2.34.5 For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level
- 2.34.6 Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
- 2.34.7 Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off
- 2.34.8 Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy
- 2.34.9 Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls
- 2.34.10 Configuration LED status light on device that blinks to indicate data transmission
- 2.34.11 Status LED indicates test mode, override mode and load binding.
- 2.34.12 Recessed switch on device to turn controlled load(s) ON and OFF.
- 2.34.13 BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell’s settings:
  - 2.34.13.1 Day and night setpoints
  - 2.34.13.2 Off time delay
  - 2.34.13.3 On and off setpoints
  - 2.34.13.4 Up top three setpoints
  - 2.34.13.5 Operating mode – on/off, bi-level, tri-level or dimming
- 2.34.14 One RJ-45 port for connection to DLM local network
- 2.35 A choice of accessories to accommodate multiple mounting methods and building materials. The photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62” thickness (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62”-1.25” thickness (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well
- 2.36 Any load or group of load in the room can be assigned to a daylighting zone

- 2.37 Each load within a daylighting zone can be individually enabled or disabled for discrete control ) load independence)
- 2.38 All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years

Closed loop digital photosensors shall include the following additional features:

- 2.39 An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
- 2.40 Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software
- 2.41 Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads
- 2.42 WattStopper Product Number: LMLS-400, LMLS-400-L

Open loop digital photosensors shall include the following additional features:

- 2.43 An internal photodiode that measures light in a 60-degree angle cutting off the unwanted light from the interior of the room
- 2.44 Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone
- 2.45 Each of the three discrete daylight zones can include any non-overlapping group of loads in the room
- 2.46 WattStopper Product Number: LMLS-500, LMLS-500-L

Dual loop photosensors shall include the following additional features:

- 2.47 Close loop portion of dual loop device must have an internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from sources outside.
- 2.48 Open loop portion of dual loop device must have an internal photodiode that can measure light in a 60 degree angle, cutting off the unwanted light from the interior of the room
- 2.49 Automatically establishes application-specific set-points following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of load
- 2.50 Device must reference closed loop photosensor information as a base line reference. The device must be able to analyze the open loop photosensor information to determine if an adjustment in light levels is require

- 2.51 Device must be able to automatically commission setpoints each night to provide adjustments to electrical lighting based on changes in overall lighting in the space due to changes in reflectance within the space or changes to daylight contribution based on seasonal changes
- 2.52 Device must include extendable mounting arm to properly position sensor within a skylight well
- 2.53 WattStopper product number LMLS-600

#### DIGITAL ROOM CONTROLLERS AND PLUG – LOAD CONTROLLERS

- 2.54 Digital controllers for lighting and plug loads automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room and plug load controllers shall be provided to match the room lighting and plug load control requirements. The controllers will be simple to install, and will not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units will include the following features:
  - 2.54.1 Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room
  - 2.54.2 Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf
  - 2.54.3 Multiple room controllers connected together in a local network must automatically prioritize each room controller, without requiring any configuration or setup, so that loads are sequentially assigned using room controller device ID's from highest to lowest
  - 2.54.4 Device Status LEDs to indicate:
    - 2.54.4.1 Data transmission
    - 2.54.4.2 Device has power
    - 2.54.4.3 Status for each load
    - 2.54.4.4 Configuration status
  - 2.54.5 Quick installation features including:
    - 2.54.5.1 Standard junction box mounting
    - 2.54.5.2 Quick low voltage connections using standard RJ-45 patch cable
  - 2.54.6 Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power
    - 2.54.6.1 Turn on to 100%
    - 2.54.6.2 Remain off
    - 2.54.6.3 Turn on to last level

- 2.54.7 Each load shall be configurable to operate in the following sequences based on occupancy:
  - 2.54.7.1 Auto-on/Auto-off (Follow on and off)
  - 2.54.7.2 Manual-on/Auto-off (Follow off only)
- 2.54.8 The priority of each load output shall be reversible, via digital configuration, so that on is off and off is on
- 2.54.9 BACnet object information shall be available for the following objects:
  - 2.54.9.1 Load status
  - 2.54.9.2 Electrical current
  - 2.54.9.3 Total watts per controller
  - 2.54.9.4 Schedule state – normal or after-hours
  - 2.54.9.5 Demand response control and cap level
  - 2.54.9.6 Room occupancy status
  - 2.54.9.7 Total room lighting and plug loads watts
  - 2.54.9.8 Total room watts/sq ft
  - 2.54.9.9 Force on/off all loads
- 2.54.10 UL 2043 plenum rated
- 2.54.11 Manual override and LED indication for each load
- 2.54.12 Dual voltage (120/277 VAC, 60 Hz), or 347 VAC, 60 Hz (selected models only). 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming); 347 volt models rated for 15A total load; plug load controllers carry application-specific UL 20 rating for receptacle control.
- 2.54.13 Zero cross circuitry each load
- 2.54.14 All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
- 2.55 On/Off Controllers shall include:
  - 2.55.1 One or two relay configuration
  - 2.55.2 Efficient 150 mA switching power supply
  - 2.55.3 Three RJ-45 DLM local network ports with integral strain relief and dust cover
  - 2.55.4 WattStopper product numbers: LMRC-101, LMRC-102

- 2.56 On/Off/Dimming enhanced Room Controllers shall include:
  - 2.56.1 Real time current monitoring
  - 2.56.2 Multiple relay configurations
    - 2.56.2.1 One, two or three relays (LMRC-21 x series)
    - 2.56.2.2 One or two relays (LMRC-22x series)
  - 2.56.3 Efficient 250 mA switching power supply
  - 2.56.4 Four RJ-45 DLM local network ports with integral strain relief and dust cover
  - 2.56.5 Once dimming output per relay
    - 2.56.5.1 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. (LMRC-21x series)
    - 2.56.5.2 Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. (LMRC-22x series)
    - 2.56.5.3 Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver
    - 2.56.5.4 The LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim
    - 2.56.5.5 Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim
    - 2.56.5.6 Calibration and trim levels must be set per output channel
    - 2.56.5.7 Devices that set calibration or trim levels per controller are not acceptable
    - 2.56.5.8 All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable
  - 2.56.6 Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events

- 2.56.7 Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value
  - 2.56.8 The following dimming attributes may be changed or selected using a wireless configuration tool:
    - 2.56.8.1 Establish preset level for each load from 0-100%
    - 2.56.8.2 Set high and low trim for each load
    - 2.56.8.3 Set lamp burn in time for each load up to 100 hours
  - 2.56.9 Override button for each load provides the following functions:
    - 2.56.9.1 Press and release for on/off control
    - 2.56.9.2 Press and hold for dimming control
  - 2.57 WattStopper product numbers: LMRC-211, LRMC-212, LMRC-221, LMRC-222
  - 2.58 Plug Load Room Controllers shall include the following:
    - 2.58.1 One relay configuration with additional connection for unswitched load
    - 2.58.2 Configurable additive time delay to extend plug load time delay beyond occupancy sensor time delay (e.g. a 10 minute additive delay in a space with a 20 minute occupancy sensor delay ensures that plug loads turn off 30 minutes after the space is vacated)
    - 2.58.3 Factory default operation is Auto-on/Auto-off, based on occupancy
    - 2.58.4 Real time current monitoring of both switched and un-switched load (LMPL-201 only)
    - 2.58.5 Efficient switching power supply
      - 2.58.5.1 150mA (LMPL-101)
      - 2.58.5.2 250mA (LMPL-201)
    - 2.58.6 RJ-45 DLM local network ports
      - 2.58.6.1 Three RJ-45 ports (LMPL-101)
      - 2.58.6.2 Four RJ-45 ports (LMPL-201)
  - 2.59 Wattstopper product numbers: LMPL-101, LMPL-201
- DLM LOCAL NETWORK (Room Network)
- 2.60 The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building

- 2.61 Features of the DLM local network include:
- 2.61.1 Plug n' Go® automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached
  - 2.61.2 Simple replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup
  - 2.61.3 Push n' Learn® configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network
  - 2.61.4 Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver
- 2.62 Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable
- 2.63 If manufacturer's pre-terminated Cat 5e cables are not used for the installation, the contractor is responsible for testing each cable following installation and supplying manufacturer with test results
- 2.64 WattStopper Product Number: LMRJ-Series

#### DLM SEGMENT NETWORK (Room to Room Network)

- 2.65 The segment network shall be a linear topology, BACnet-based MS/TP subnet to connect DLM local networks (rooms) and LMCP relay panels for centralized control
- 2.65.1 Each connected DLM local network shall include a single network bridge (LMBC-300), and the network bridge is the only room-based device that is connected to the segment network
  - 2.65.2 Network bridges, relay panels and segment managers shall include terminal blocks, with provisions for separate "in" and "out" terminations, for segment network connections
  - 2.65.3 The segment network shall utilize 1.5 twisted pair, shielded, cable supplied by the lighting control manufacturer. The maximum cable run for each segment is 4,000 feet. Conductor-to-conductor capacitance of the twisted pair shall be less than 30 pf/ft and have a characteristic impedance of 120 Ohms
  - 2.65.4 Network signal integrity requires that each conductor and ground wire be correctly terminated at every connected device
  - 2.65.5 Substitution of manufacturer-supplied cable must be pre-approved: Manufacturer will not certify network reliability, and reserves the right to void warranty, if non-approved cable is installed, and if terminations are not completed according to manufacturer's specific requirements

2.65.6 Segment networks shall be capable of connecting to BACnet-compliant BAS (provided by others) either directly, via MS/TP, or through NB-ROUTERS, via BACnet/IP or BACnet/Ethernet. Systems whose room-connected network infrastructure require gateway devices to provide BACnet data to a BAS are unacceptable

2.66 WattStopper Product Number: LM-MSTP, LM-MSTP-DB

## CONFIGURATION TOOLS

2.67 A wireless configuration tool facilitates optional customization of DLM local networks using two-way infrared communications, while PC software connects to each local network via a USB interface

2.68 Features and functionality of the wireless configuration tool shall include but not be limited to:

2.68.1 Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet

2.68.2 High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation

2.68.3 Must be able to read and modify parameters for room controllers, occupancy sensors, wall switches, daylighting sensors, network bridges and relay panels, and identify room devices by type and serial number

2.68.4 Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors

2.68.5 Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings

2.68.6 Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls

2.68.7 Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings

2.68.8 Verify status of building level network devices

2.69 WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

## NETWORK BRIDGE

2.70 The network bridge module connects a DLM local network to a BACnet-compliant segment network for communication between rooms, relay panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. The network bridge shall use

industry standard BACnet MS/TP network communication and an optically isolated EIA/TIA RS-485 transceiver

2.70.1 The network bridge shall be provided as a separate module connected on the local network through an available RJ-45 port

2.70.2 Provide Plug n' Go operation to automatically discover room devices connected to the local network and make all device parameters visible to the segment manager via the segment network. No commissioning shall be required for set up of the network bridge on the local network

2.70.3 The network bridge shall automatically create standard BACnet objects for selected room device parameters to allow any BACnet-compliant BAS to include lighting control and power monitoring features as provided by the DLM room devices on each local network. BACnet objects will be created for the addition or replacement of any given in-room DLM device for the installed life of the system. Products requiring that an application-specific point database be loaded to create or map BACnet objects are not acceptable. Systems not capable of providing BACnet data for control devices via a dedicated BACnet Device ID and physical MS/TP termination per room are not acceptable. Standard BACnet objects shall be provided as follows:

2.70.3.1 Read/write the normal or after hours schedule state for the room

2.70.3.2 Read the detection state of each occupancy sensor

2.70.3.3 Read the aggregate occupancy state of the room

2.70.3.4 Read/write the On/Off state of loads

2.70.3.5 Read/write the dimmed light level of loads

2.70.3.6 Read the button states of switches

2.70.3.7 Read total current in amps, and total power in watts through the room control

2.70.3.8 Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings

2.70.3.9 Activate a preset scene for the room

2.70.3.10 Read/write daylight sensor fade time and day and night setpoints

2.70.3.11 Read the current light level, in footcandles, from interior and exterior photosensors and photocells

2.70.3.12 Set daylight sensor operating mode

2.70.3.13 Read/write wall switch lock status

2.70.3.14 Read watts per square foot for the entire controlled room

2.70.3.15 Write maximum light level per load for demand response mode

2.70.3.16 Read/write activation of demand response mode for the room

2.70.3.17 Activate/restore demand response mode for the room

2.71 Wattstopper product number: LMBC-300

## SEGMENT MANAGER

2.72 For networked applications, the Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP traffic via a configurable port (default is 80) or 256 bit AES encrypted SSL TCP/IP traffic via a configurable port (default is 443)

2.73 Each segment manager shall have integral support for at least three segment networks. Segment networks may alternately be connected to the segment manger via external routers and switches, using standard Ethernet structured wiring. Each router shall accommodate one segment network. Provide the quantity of routers and switches as shown on the plans

2.74 Operational features of the Segment Manager shall include the following:

2.74.1 Connection to PC or LAN via standard Ethernet TCP/IP via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic

2.74.2 Easy to learn and use graphical user interface, compatible with Internet Explorer 8, or equal browser. Shall not require installation of any lighting control software to an end-user PC

2.74.3 Log in security capable of restricting some users to view-only or other limited operations

2.74.4 Automatic discovery of DLM devices and relay panels on the segment network(s). Commissioning beyond activation of the discovery function shall not be required to provide communication, monitoring or control of all local networks and lighting control panels

2.74.5 After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the use

2.74.6 Ability to view and modify room device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation including sensor time delays and sensitivities, and load response to sensor including Manual-On or Auto-On

2.74.7 Ability to set up schedules for rooms and panels, view and override current status of panel channels and relays and assign relays to groups. Schedules shall automatically set controlled zones or areas to either a normal hour or after hours mode of operation. Support for a minimum of 100 unique schedules, each with up to four-time events per day. Support for annual schedules, holiday schedules and unique date-bound schedules

2.74.8 Ability to group rooms and loads for common control by schedules, switches or network commands

- 2.74.9 Ability to monitor connected load current and display power consumption for areas equipped with room controllers incorporating the integral current monitoring feature
- 2.74.10 Provide capabilities for integration with a BAS via BACnet protocol. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the segment manager: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug-load power; load ON/OFF state; load dimming level; panel channel schedule state; panel relay state; and Segment Manager Group schedule state control
- 2.74.11 The Segment Manager shall allow access and control of the overall system database via Native Niagara AX FOX connectivity. Systems that must utilize a Tridium Niagara controller in addition to the programming, scheduling and configuration server are not acceptable
- 2.75 Segment Manager shall support multiple DLM rooms as follows:
  - 2.75.1 Support up to 120 network bridges and 900 digital in-room devices (LMSM-3E)
  - 2.75.2 Support up to 300 network bridges and 2,200 digital in room devices, connected via network routers and switches (LMSM-6E)
- 2.76 WattStopper Product Numbers: LMSM-3E, LMSM-6E, NB-ROUTER, NB-SWITCH, NB-SWITCH-8, NB-SWITCH-16

#### PROGRAMMING, CONFIGURARION AND DOCUMENTATION SOFTWARE

- 2.77 PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when connected via the optional LMCI-100 USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication. Additional parameters exposed through this method include but are not limited to:
  - 2.77.1 Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
  - 2.77.2 Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
  - 2.77.3 Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
  - 2.77.4 Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
  - 2.77.5 Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.

- 2.77.6 Load control polarity reversal so that on events turn loads off and vice versa.
- 2.77.7 Per-load DR (demand response) shed level in units of percent.
- 2.77.8 Load output pulse mode in increments of 1second.
- 2.77.9 Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer
- 2.78 Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:
  - 2.78.1 Device list report: All devices in a project listed by type.
  - 2.78.2 Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
  - 2.78.3 BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
  - 2.78.4 Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
  - 2.78.5 Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
  - 2.78.6 Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100%, 2 = all loads 75%, 3 = all loads 50%, 4 = all loads 25%, 5-16 = same as scene 1).
  - 2.78.7 Occupancy sensor report: Basic settings including time delay and sensitivity(ies) for all occupancy sensors
- 2.79 Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations
  - 2.79.1 Set, copy/paste an entire project site of sensor time delays.
  - 2.79.2 Set, copy/paste an entire project site of sensor sensitivity settings.
  - 2.79.3 Search based on room name and text labels.
  - 2.79.4 Filter by product type (i.e. LMRC-212) to allow parameter set by product.
  - 2.79.5 Filter by parameter value to search for product with specific configurations
- 2.80 Network-wide firmware upgrading remotely via the BACnet/IP network
  - 2.80.1 Mass firmware update of entire rooms
  - 2.80.2 Mass firmware update of specifically selected rooms or areas
  - 2.80.3 Mass firmware upgrade of specific products

2.81 WattStopper Product Number: LMCS-100, LMCI-100

#### LMCP LIGHTING CONTROL PANELS

2.82 Provide lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:

2.82.1 Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 - 8 relays, 1 - 24 relays and 6 four-pole contactors, or 1 - 48 relays and 6 four-pole contactors

2.82.2 Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. The panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel

2.82.3 Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features

2.82.3.1 Removable, plug-in terminal blocks with connections for all low voltage terminations

2.82.3.2 Individual terminal block, override pushbutton, and LED status light for each relay

2.82.3.3 Direct wired switch inputs associated with each relay shall support 2-wire momentary switches only

2.82.3.4 Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches; digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs; digital IO modules capable of receiving momentary or maintained contact closure inputs or analog sensor inputs; digital daylighting sensors; and digital occupancy sensors. Inputs are divided into two separate digital networks, each capable of supplying 250mA to connected devices

2.82.3.5 True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet

2.82.3.6 Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously

2.82.3.7 Group and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any set of relays can be associated with a group for direct on/off

control or pattern (scene) control via a simple programming sequence using the relay override pushbuttons and LED displays for groups 1-8 or a handheld IR programmer for groups 1-99

2.82.3.8 Relay group status for shall be provided through LED indicators for groups 1-8 and via BACnet for groups 1-99. A solid LED indicates that the last group action called for an ON state and relays in the group are on or in a mixed state

2.82.3.9 Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:

Electrical

2.82.3.9.1 30 amp ballast at 277V

2.82.3.9.2 20 amp ballast at 347V

2.82.3.9.3 20 amp tungsten at 120V

2.82.3.9.4 30 amp resistive at 347V

2.82.3.9.5 1.5 HP motor at 120V

2.82.3.9.6 14,000 amp short circuit current rating (SCCR) at 347V

2.82.3.9.7 Relays shall be specifically UL 20 listed for control of plug-loads

Mechanical

2.82.3.9.8 Replaceable, ½" KO mounting with removable Class 2 wire harness

2.82.3.9.9 Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel

2.82.3.9.10 Dual line and load terminals each support two #14 - #12 solid or stranded conductors

2.82.3.9.11 Tested to 300,000 mechanical on/off cycles

2.83 Isolated low voltage contacts provide for true relay status feedback and pilot light indication

2.84 Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection

2.85 Where indicated, lighting control panels designated for control of emergency lighting shall be provided with factory installed provision for automatic by pass of relays controlling emergency circuits upon loss of normal power. Panels shall be properly listed and

labeled for use on emergency lighting circuits and shall meet the requirements of UL924 and NFPA 70 - Article 700

- 2.86 Integral system clock shall provide scheduling capabilities for panel-only projects without DLM segment networks or BAS control
  - 2.86.1 Each panel shall include digital clock capability able to issue system wide automation commands to up to (11) eleven other panels for a total of (12) twelve networked lighting control panels. The clock shall provide capability for up to 254 independent schedule events per panel for each of the ninety-nine system wide channel groups
  - 2.86.2 The clock capability of each panel shall support the time-based energy saving requirements of applicable local energy codes
  - 2.86.3 The clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery back up for the clock function and program retention in non-volatile FLASH memory. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed
  - 2.86.4 The clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:
    - 2.86.4.1 Scheduled ON / OFF
    - 2.86.4.2 Manual ON / Scheduled OFF
    - 2.86.4.3 Astro ON / OFF (or Photo ON / OFF)
    - 2.86.4.4 Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)
  - 2.86.5 The user interface shall be a portable IR handheld remote control capable of programming any panel in the system (LMCT-100)
  - 2.86.6 The clock capability of each panel shall employ non-volatile memory and shall retain user programming and time for a minimum of 10 years
  - 2.86.7 Schedules programmed into the clock of any one panel shall be capable of executing panel local schedule or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost. Lighting control panels that are not capable of executing events independently of the global network shall not be acceptable
- 2.87 The lighting control panel can operate as a stand-alone system, or can support schedule, group, and photocell control functions, as configured in a Segment Manager controller, via a segment network connection
- 2.88 The lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices. Digital communications shall be RS485 MS/TP-based using the BACnet® protocol

- 2.88.1 The panel shall have provision for an individual BACnet device ID and shall support the full  $2^{22}$  range (0 – 4,193,304). The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network
- 2.88.2 The panel shall support MS/TP MAC addresses in the range of 0 – 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second
- 2.88.3 Lighting control relays shall be controllable as binary output objects in the instance range of 1 – 64. The state of each relay shall be readable and writable by the BAS via the object present value property
- 2.88.4 Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 – 64
- 2.88.5 The 99 group Normal Hours/After Hours control objects associated with the panel shall be represented by binary value objects in the instance range of 201 – 299. The occupancy state of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will put all relays associated with the channel into the normal hours mode. Commanding 0 or NULL shall put the relays into the after hours mode
- 2.88.6 Setup and commissioning of the panel shall not require manufacturer-specific software or a computer. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the handheld IR programming remote. Provide BACnet objects for panel setup and control as follows:
  - 2.88.6.1 Binary output objects in the instance range of 1 – 64 (one per relay) for on/off control of relays
  - 2.88.6.2 Binary value objects in the instance range of 1 – 99 (one per channel) for normal hours/after hours schedule control
  - 2.88.6.3 Binary input objects in the instance range of 1 – 64 (one per relay) for reading true on/off state of the relays
  - 2.88.6.4 Analog value objects in the instance range of 101 – 199 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and set a 5-minute grace-time period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches
- 2.88.7 The description property for all objects shall be writable via the network and shall be saved in non-volatile memory within the panel
- 2.88.8 The BO and BV 1 – 99 objects shall support BACnet priority array with a relinquish default of off and after hours respectively. Prioritized writes to the channel BV objects shall propagate prioritized control to each member relay in a way analogous to the BACnet Channel object described in addendum aa. (<http://www.bacnet.org/Addenda/Add-135-2010aa.pdf>)
- 2.88.9 Panel-aggregate control of relay Force Off at priority 2 shall be available via a single BV5 object. Force On at priority 1 shall be available via a single BV4 object

2.88.10 Lockout of all digital switch buttons connected to a given panel shall be command-able via a single BV2 object. The lock status of any connected switch station shall be represented as BV101-196

2.89 WattStopper Product Number: LMCP8, LMCP24 or LMCP48

#### USER INTERFACE

2.90 Each lighting control panel system shall be supplied with at least (1) handheld configuration tool (LMCT-100). As a remote programming interface the configuration tool shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. The user interface shall have the following panel-specific functions as a minimum:

2.90.1 Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.

2.90.2 Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.

2.90.3 Program up to 254 separate scheduled events. Events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.

2.90.4 Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays.

2.90.5 Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.

2.90.6 Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.

2.90.7 An additional handheld IR remote may optionally be specified to be permanently mounted to the panel interior via a retractable anti-theft lanyard to allow for convenient programming of the panel while assuring that the handheld programmer is always present at that panel. An unlimited number of handheld IR remotes may also be purchased for facilities staff as determined by the end user's representative.

2.91 WattStopper Product Number: LMCT-100

## EMERGENCY LIGHTING CONTROL DEVICES

- 2.92 Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
- 2.92.1 120/277 volts, 50/60 Hz, 20 amp ballast rating
  - 2.92.2 Push to test button
  - 2.92.3 Auxiliary contact for remote test or fire alarm system interface
- 2.93 WattStopper Product Numbers: ELCU-100, ELCU-200

## PART 3 - EXECUTION

### PRE-INSTALLATION MEETING

- 3.1 A factory authorized manufacturer's representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:
- 3.1.1 Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.
  - 3.1.2 Review the specifications for low voltage control wiring and termination.
  - 3.1.3 Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
  - 3.1.4 Discuss requirements for integration with other trades

### CONTRACTOR INSTALLATION AND SERVICES

- 3.2 Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs
- 3.3 Contractor to install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable. The contractor shall supply the Project Engineer with test results.
- 3.31 Performance of installed cables shall satisfy all current addendums to the EIA/TIA 568A standard for Category-5e wiring and the manufacturers installation requirements. The contractor must provide clear room by room, individual cable by cable testing of all UTP wiring provided for the lighting control system.
  - 3.32 Upon completion of testing all cable links used as a part of the lighting control system, the Contractor shall supply a copy of the original database files downloaded from the tester in original format on a USB Flash Drive. Contractor shall provide with the testing database files, an original copy of the tester's

manufacturer software program (included in original cost) for record management and archiving, in a Window format (i.e., Fluke Linkware software program).

- 3.3.3 The manufacturer's software program will be used by the Project Engineer to review all test results, and then turned over to the District to keep as their record copy with the final approved test results. Provide (3) copies of tests on USB Flash Drives. Do not submit test results for review in Excel or PDF file formats, as the submittal will be rejected and not reviewed.
- 3.3.4 Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification.
- 3.3.5 Low voltage wiring topology must comply with manufacturer's specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings
- 3.4 Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication
- 3.5 Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings
  - 3.5.1 Adjust time delay so that controlled area remains lighted while occupied
- 3.6 Provide written or computer-generated documentation on the configuration of the system including room by room description including:
  - 3.6.1 Sensor parameters, time delays, sensitivities, and daylighting setpoints.
  - 3.6.2 Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
  - 3.6.3 Load Parameters (e.g. blink warning, etc
- 3.7 Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner's requirements. Provide a detailed report to the Architect / Owner of post start-up activity

#### FACTORY SERVICES

- 3.8 Upon completion of the installation, the manufacturer's factory authorized representative shall start up and verify a complete fully functional system
- 3.9 The electrical contractor shall provide both the manufacturer and the electrical engineer with three weeks written notice of the system start up and adjustment date
- 3.10 Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system

## COMMISSIONING SUPPORT SERVICES

- 3.11 On this project, a commissioning agent will be hired to verify the installation and programming of all building systems, which includes the lighting control system. Manufacturer should include an extra day of technician's time to review the functionality and settings of the lighting control hardware with the commissioning agent, including reviewing submittal drawings and ensuring that instructions on how to configure each device are readily available. Manufacturer is NOT responsible for helping the commissioning agent inspect the individual devices. It will be the commissioning agent's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the agent with this task.
- 3.12 The commissioning agent shall work with the electrical contractor during installation of the lighting control hardware to become familiar with the specific products. The agent may also accompany the manufacturer's technicians during their start-up work to better understand the process of testing, calibration and configuration of the products. However, the contractor and manufacturer shall ensure that interfacing with the agent does not prevent them from completing the requirements outlined in the contract documents

## ACCEPTANCE TESTING SUPPORT SERVICES

- 3.13 On all California projects, a certified lighting controls acceptance test technician (CLCATT) must verify the installation of the lighting control system. Manufacturer should include an extra day of factory technician's time to assist the CLCATT review the functionality and settings of the lighting control hardware per the requirements in the California State forms. It will be the CLCATT's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the CLCATT with this task

**END OF SECTION**