Section_____
ILC LIGHTLEEDER
LIGHTING CONTROL SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. The intent of this set of specifications is to provide a complete, functional, intelligent, low-voltage lighting control system for the control of incandescent, low-voltage, LED, neon, cold cathode, fluorescent and HID lighting sources.

B. Where shown in the drawings, the contractor shall furnish and install a complete low-voltage lighting control system consisting of, but not limited to, relays, controllers, switch stations, and miscellaneous components as required for a complete, operational lighting control system.

C. Where applicable standards have been established, all items of equipment, individual components, and installation methods shall meet the requirements of these standards, including, but not limited to, Underwriter Laboratories, National Electrical Code, Federal Communications Commission, and any local or state codes that may be applicable.

D. The products specified herein are those of Intelligent Lighting Controls, a Cooper Lighting Solutions business. Low voltage lighting control systems manufactured by the following manufacturers shall be considered providing they meet the requirements of these specifications and provide the quality and performance specified herein.

1. Intelligent Lighting Controls
2.
3.

E. Listing a manufacturer as acceptable does not in relieve the contractor from the responsibility for providing a lighting control system that meets all the requirements of these specifications.

F. All manufacturers shall submit to the specifying engineer a line-by-line compliance comparison between each specification requirement and the system being proposed.

G. Any ambiguities in the drawing or specification shall be brought to the attention of the specifying engineer for clarification.

1.2 QUALITY ASSURANCE

A. Factory Assembly: All relays, contactors, controllers, enclosures, switch stations and miscellaneous components shall be factory assembled and tested. All system components shall

arrive at the job site completely pre-wired and ready for installation, requiring only the connection of lighting circuits and low-voltage control stations and/or network terminations. All connections shall be made to clearly and permanently labeled termination points. Systems that require field assembly shall not be acceptable.

B. Manufacturer: A minimum of 30 years of experience in the design and manufacture of lighting control equipment.

C. Component Testing: All system components and assemblies shall be individually tested before assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications before shipment.

D. NEC Compliance: All system components shall comply with all applicable sections of the National Electrical Code (NEC) as required.

E. NEMA Compliance: All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

F. UL/CUL Approval: All applicable equipment shall be UL/CUL listed under section 916 and shall bear labels indicating compliance.

G. FCC Emissions: All applicable equipment shall comply with FCC emissions standards specified in Part 15 and Part 68 where applicable for commercial applications and shall bear labels indicating compliance testing. Equipment not meeting these standards shall not be acceptable.

H. Made in USA: All products shall be made in the USA. Products manufactured other than in the USA are unacceptable.

1.3 SUBMITTALS

A. The manufacturer shall provide an electronic copy of submittal drawings and data for approval before beginning the manufacture of equipment.

B. Hard copy submittal package shall be provided upon request.

C. Submittal package shall include, but not be limited to, the following. Submittals that do not contain all the information listed below will not be considered for approval.

1. **Specifications Compliance:** Submit a line-by-line comparison that describes the differences between each specification requirement and the equipment/systems being proposed. The comparison shall include a complete listing of how the proposed equipment/systems differ from those specified in size, quantity, quality, method of control, features and functions, control software functions, and installation requirements.

2. **System Description:** Supply as part of the submittal package a brief description of the lighting control system's major features and functions.

3. **Bill of Materials:** Provide as part of the submittal package a detailed itemized listing of all proposed equipment, including quantities and capacities for all major system components.

4. **Product Data Sheets:** Provide as part of the submittal package detailed product data sheets for all major system components.

5. **Riser Drawing:** Provide as part of the submittal package a system riser drawing of sufficient detail to indicate the relative placement of major system components and the required connections between each. Drawings shall be project specific. Generic or typical riser diagrams shall not be acceptable.

6. **Control Schedules:** Provide as part of the submittal package a complete control schedule spreadsheet for relay panels, Timers, Inputs, Groups, and Presets.

7. **Switch Details:** Provide as part of the submittal package complete switch details including color, gangs, buttons, plate style, plate colors, and engraving.

8. **Warranty:** Provide as part of the submittal package a complete written warranty.

1.4 WARRANTY

A. **Manufacturer's Warranty:** The manufacturer shall provide a written warranty that shall cover all lighting control equipment. The manufacturer shall agree to repair or replace any equipment that fails due to material or workmanship for a period of 5 years.

B. **Relay Warranty:** The manufacturer shall provide a separate written warranty that shall cover all lighting control relays within the lighting control system. The manufacturer shall agree to replace any relay that fails due to material or workmanship for a period of 5 years.

C. **Warranty Period:** The warranty period shall begin after the completion of the installation and the systems field start-up and training. Systems not provided with a field start-up begin upon receiving the product.

PART 2 – PRODUCTS

2.1 LIGHTLEEDER PROGRAMMABLE LIGHTING CONTROL PANELS

A. **Hardware Features:**

1. **Controller Back-Box:** Each programmable lighting controller shall be provided with a factory furnished; UL listed NEMA 1 enclosure designed for wall mounting. The backbox must be capable of being shipped ahead of the controller chassis insert to allow for rough-in of all electrical connections prior to receipt of the controller chassis insert.

2. **Controller Chassis Insert:** Each programmable lighting controller shall be provided with a factory or field-installable controller chassis insert. The Controller chassis insert shall contain all controller electronics, power supplies, relays, contactors, and other required components. Controller chassis inserts shall arrive at the project site completely pre-wired and require only the connection of lighting circuits and control devices.

3. **Line Voltage / Control Voltage Separation:** Each LightLEEDer controller shall be provided with a mechanical barrier that separates all line voltage components and wiring from all control voltage components and wiring. An additional barrier may be installed that provides isolation between normal and emergency circuits where required.

4. **Controller Covers:** Each programmable lighting controller shall be provided with a dead front screw-held or hinged locking cover that is designed for either surface or flush mounting. Flush mount doors shall be provided with a trim ring. If a hinge-locking door is provided, it shall be provided with a slam-latch with 2 keys and door hooks to assist in mounting.

5. **Controller Capacity/Configurations:** Controllers shall be available in sizes to accommodate 4, 8, 16, 24, 32, 40, 48, 56, and 64 relay outputs. Controllers shall be available with the electronics in the center and voltage dividers with the lighting relays on the right/left sides.

B. Electrical:

1. **Controller Power Supply:** Each programmable lighting controller shall be provided with a dual-rated, UL-listed Class 2 transformer capable of either 120/277 VAC or 120/347 VAC primary (50 to 60 Hz). It shall contain an internal self-resetting fuse.

2. **Connections:** All connections shall have clearly and permanently labeled termination points.

C. Controller Electronics:

1. **Controller CPU:** Each programmable controller shall have a CPU (Central Processing Unit) that shall provide all the programming and control functions for the entire controller.

2. **Real-Time Clock:** Each controller shall be provided with a Real-Time Clock used to perform all time-controlled functions. It shall use a high-voltage line-sync circuit for timing and a crystal for backup. Clock accuracy shall be held +/- 2 minutes per year and displayed to the second with the line-sync setting. Real-Time Clock functions shall include the time of day, day of the week, date, and automatic daylight-saving time and leap year adjustments. The time clock shall be protected against loss of time during a power outage for a period of up to 45 days without power of any type. Daylight Saving Time shall be adjustable with an enable/disable feature. Systems relying on a single clock device shall not be acceptable.

3. **Relay Driver Module:** Relay output cards shall be provided to expand the controller capability from 8 to 64 relay outputs in increments of 8. Electronics shall feature surge protection and optic isolation. It shall also provide an interface for mounting input boards.

4. **Relay Control Switches:** Controller shall contain push-button switches to turn all relays ON or OFF without the presence of any programming.

5. **Backup and Restore:** The controller shall be equipped with an internal memory backup and restore capability. It shall have the ability to back up all internal programming into additional onboard memory, verify present programming with backup, and restore programming.

6. **Runtime Logging:** The controller shall be equipped with memory to log the runtime of each relay. It shall be capable of storing up to 30 days or 1092 hours of data and be able to be exported in a delimitative format.

7. **Non-Volatile Memory:** Controller shall have a minimum of 4MB of nonvolatile EEPROM memory with data retention of >200 years and electrostatic discharge protection of >4000V.

8. **Power Input Surge Suppression:** The controller's 24VAC power input shall be equipped with double surge suppression to protect the electronics from transient over-voltages. Protection shall clamp over-voltages up to 123 volts.

9. **Data Line Surge Suppression:** The controller data line communications shall be equipped with transient voltage suppression protection that will protect the electronics from electrostatic discharge and other transient over-voltages. Protection shall clamp transients up to 8kV direct discharges and 15kV air discharges.

10. **LightLEEDer Data Line Communications:** The controller shall be equipped with serial communications through RJ45 connectors for communicating on CAT-5 cable with other panels. It shall also be equipped with a separate local port for communicating with LightSync devices. The communications shall consist of 2-RS485 data lines.

11. **USB Serial Communications:** A USB port shall be provided for programming and interfacing the system with the use of a personal computer.

12. **TCP/IP Communications:** A TCP/IP port shall be provided for programming and interfacing the system with a computer over a network (LAN) or the internet (WAN).

13. **Optional Module Interface:** The controller shall contain 4 ports for interfacing optional modules which include communications and power. Optional modules shall be able to be mixed on each controller.

D. Switching and Control Devices:

1. **LightSync Device Capacity:** Each LightLEEDer controller shall have an RJ45 LightSync data line port with power for up to 8 LightSync data line devices and shall be able to support up to 64 LightSync data line devices when using Power Supply Repeaters. A network of 254 LightLEEDer panels would be able to support up to 16,510 LightSync devices. Each LightSync device shall have a unique address and shall be capable of being programmed to the applicable functions described in the Switched Input Types heading in this specification.

2. **Data Line Media:** The data line shall consist of RS485 communications protocol transmitted over CAT-5, CAT-5E, or CAT-6 Cable. The cable shall have male RJ45 connectors installed on each end for interfacing controllers and LightSync devices. Both daisy-chain and "T" (3-direction branching) of cable runs shall be permitted. "T" branching shall be accomplished by the addition of power supply repeaters.

3. **LightSync Switch Stations:** LightSync data line switch stations shall be available in momentary push button (1-7 switches and pilots) and each switch shall have an associated pilot light. It shall be provided with optional dimming Raise and Lower buttons. Switches can be provided as Scene Multi-zone, Scene Stations, Multi-zone Stations, or Non-Dim Stations. Each button shall control any or all the relays in the lighting controllers or the dimmer outputs on the network. There shall be an option to program each pilot LED to indicate the state of any Relay, Group, Preset, Scene, and static ON or OFF. It shall also have the capability to reverse the status: LED is ON if the relay is OFF etc.

4. **LightSync Digital Ceiling Occupancy Sensor:** The LightSync Digital Ceiling Sensor (LSCS) shall be a low-profile ceiling mount sensor and provide dual-tech detection with passive infrared and overlapping passive acoustic sensing.

    a. The LSCS shall have two RJ45 LightSync ports for connection to a LightSync data line and shall be powered via the LightSync data line with no external power pack required.
    b. The LSCS shall have an auxiliary relay for connection to BAS system or power pack.
    c. The LSCS shall have a built-in daylight harvesting photosensor that can be enabled for full-range continuous daylight dimming control with 0-255 step resolution in the 0 to 1,800 fc range. The photosensor can be configured for open loop or closed loop daylight dimming and supports all standard ILC photocell sensor options.
    d. The LSCS shall support occupancy and vacancy modes, have an adjustable time-delay, and be configurable over the LightSync digital bus for easy set-up and adjustment.
    e. Sensitivity adjustments for passive infrared and acoustic can be independently adjusted to three different levels, including PIR-only mode, and the LSCS shall have separate LED indicators for PIR and acoustic detection which can be independently disabled.
    f. Automatic Gain Control filters background noise to fine tune acoustic sensitivity, filtering out non-occupant noises.
    g. An initial PIR event shall be required to enable acoustic functionality, which will overlap and enhance overall detection once enabled, and will extend sensor time delay upon occupant sound detection. To prevent sounds alone from keeping lights on indefinitely, periodic PIR detection shall be needed to keep lights on for an extended period, otherwise lighting shall automatically shut-off after 5 minutes of acoustic only detection.
    h. Acoustic detection shall remain enabled for a brief period after the sensor times out, to allow for voice reactivation of the lights.

5. **LightSync Digital Wall Sensor Switch:** The LightSync Digital Wall Sensor Switch station (LSWS) shall provide dual-tech occupancy sensing via passive infrared (PIR) and overlapping passive acoustic sensor, along with the programmable functionality of a digital LightSync G3 switch station.

    a. The LSWS shall match the LSG3 family of digital switches and be available in the same 6 colors and 12 button configurations supporting: 1-3 non-dim zones, 1-3 dimming zones, 1-3 scene capture and control, and 3 combinations of Scene/Multi-Zone functionality.
    b. The LSWS shall have field replaceable faceplates with color change kits and the option for individually replaceable buttons that can be custom engraved. The LSWS shall also be field reconfigurable to change between different switch types.
    c. The LSWS shall have two RJ45 LightSync ports for connection to a LightSync data line and shall be powered via the LightSync data line with no external power pack required.
    d. The LSWS shall support occupancy and vacancy modes, have an adjustable time-delay, and be configurable over the LightSync digital bus for easy set-up and adjustment.
    e. Sensitivity adjustments for passive infrared and acoustic can be independently adjusted to three different levels, including PIR-only mode, and the LSWS shall have separate LED indicators for PIR and acoustic detection which can be independently disabled.
    f. Automatic Threshold Control filters background noise to fine tune acoustic sensitivity, filtering out non-occupant noises.
    g. An initial PIR event shall be required to enable acoustic functionality, which will overlap and enhance overall detection once enabled, and will extend sensor time delay upon occupant sound detection. To prevent sounds alone from keeping lights on indefinitely, periodic PIR detection shall be needed to keep lights on for an extended period, otherwise lighting shall automatically shut-off after 5 minutes of acoustic only detection.
    h. Acoustic detection shall remain enabled for a brief period after the sensor times out, to allow for voice reactivation of the lights.

6. **LightSync Photocell Controllers:** The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs on the network.

7. **LightSync Input Modules:** The input module shall provide 4 inputs that accept momentary, momentary PB, and maintained switch closures. Each input shall be optically isolated and can accept dry contact closures or 12-24VDC signals. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs on the network. It shall provide four pilot outputs that provide the true status of relays, groups, and presets. It shall be installed in the control panel or remotely mounted.

8. **LightSync Disable Key Switch:** The disable switch shall provide an RJ45 connector that shall disable all LightSync devices down line with the closure of a key switch. It shall also

provide two RJ45 connectors to pass data through. It shall indicate with an LED when the disable switch is active.

9. **LightSync Occupancy Sensor Module:** The LightSync Occupancy Sensor Module (LSOSM) shall provide 800mA of power for 24VDC hardwired motion sensors. It shall have 8 independent inputs that shall be able to interface multiple sensors. Each input shall control any or all of the relays in the lighting controllers or the dimmer outputs on the network. It shall have the ability to set AND/OR conditional logic. It shall be installed in the control panel or remotely mounted.

10. **LightSync 0-10V Dimmer Output Module:** The 0-10VDC dimmer output module shall be designed to control dimmable ballasts or other 0-10VDC devices. Each module shall have 4 independent output channels that can control up to 200 devices per output at .5mA per device. It shall have the capability to vary its level 256 steps between 0 and 10VDC. It shall be able to respond to photo controllers, switch inputs, DMX512 signals, and timers. Each output shall be galvanically isolated up to 1500V to protect electronics. It shall be installed in the control panel or remotely mounted.

11. **Graphical Touch Screen Control Station:** The Touch screen control station shall display the status and control the lighting control panel relay outputs via pre-programmed control objects on standard or custom bitmap screens.

E. Special Purpose Modules: The following special-purpose controller nodes shall be available. Four modules shall be permitted per controller.

1. **BACnet Control:** This module shall communicate directly to the lighting controller through serial communications from the BAS system using BACnet MSTP or BACnet IP protocol. It shall be able to read the status of inputs and relays and control single or multiple relays in the lighting controller. It shall also be able to disable/enable inputs and shall be able to force timer options.

2. **DMX Control:** This module shall support the control of relays using the standard USITT DMX512 protocol used by theatrical lighting systems. Each relay in the lighting panel shall be configured to be controlled by any DMX channel. It shall contain a frame filter that can be set from 1 – 16 frames. It shall have a priority setting for switch inputs or DMX signals. It shall have the capability to control any 0 – 10V dimming output throughout the network. It shall display current DMX levels from the keypad.

3. **DMX Driver:** This module shall send DMX signals from the lighting control panels using the standard USITT DMX512 protocol used by theatrical lighting systems. Each module added to the panel shall control up to 64 channels. Each dimming output channel shall be able to be mapped to 1-512 DMX channels. It shall be 1 to 1 mapped or programmed with free software. It shall be installed in the control panel or remotely mounted.

4. **Modbus Control:** This module shall communicate directly to the lighting controller through RS485, RS232, or TCP serial communications from the BAS system using Modicon Modbus RTU or ASCII protocol. It shall be able to read the status of inputs and relays and control single or multiple relays in the lighting controller. It shall also be able to disable/enable inputs and shall be able to force timer options.

5. **N2 Control:** This module shall communicate directly to the lighting controller through serial communications from the BAS system using the Metasys-N2 protocol. It shall be able to read the status of inputs and relays and control single or multiple relays in the lighting controller. It shall also be able to disable/enable inputs and shall be able to force timer options.

6. **Protocol Input Control:** This module shall allow serial communications from a Modbus, N2, or BACnet network. It shall be capable of emulating LightSync switches or photocells for direct control and status of relays, dimmers, or motor controls.

F. Programming: Programmable controllers shall be capable of being programmed, monitored, backed up, or controlled through any of the below methods. All programming changes shall take effect immediately as they are programmed and shall not suspend or disable switches or other system functions. The same functions shall be available for any of the connection types.

1. **Local Keypad and Display:** The system user shall be able to program, monitor, and control any of the controller features and functions through the use of a simple menu-driven self-prompting user interface consisting of a 4-line 20-character backlit LCD display and 8 selection keys that change function based on the current operating mode.

2. **USB Serial Direct Connect:** The system user shall be able to program, monitor, or control any of the controller features and functions utilizing LightLEEDer Pro Windows-based graphical user interface software using a USB port from a PC.

3. **TCP/IP Connect:** The system user shall be able to remotely program, monitor, or control any of the controller features and functions utilizing LightLEEDer Pro Windows-based graphical user interface software using a PC with TCP/IP on a LAN or WAN.

G. Diagnostics: Programmable controllers shall have the ability to do the following diagnostics.

1. **Power Status:** Each programmable lighting controller shall be provided with an LED on the controller and each output board shall indicate that power is present.

2. **Keypad:** System users shall be able to view thru the keypad the status of any relay, input, group, or preset and force any ON or OFF.

3. **Software:** System users shall be able to view thru the LightLEEDer Pro software the status of any relay, input, group, or preset and force any ON or OFF. It shall also be able to scan the network for devices and controllers and then poll them to verify network quality.

4. **Relay Cycle Test:** The controller shall have a cycle test for relays to turn them off/on/off and then return them to the original state to verify proper operation. It shall display the results for each relay for turning the relay ON and OFF.

5. **Device Finder:** It shall have the capability through the keypad to find LightSync devices, dimmer devices, and motor devices on the network.

6. **Switch Test Mode:** Shall be able to enter switch test mode, where normal control is disabled, and switch input activation will only control input status LEDs.

7. **Demo Clock:** It shall have the ability to speed the clock's time by 10, 30, or 60 times for testing timer functions.

H. Power Failure and Power-Up: Each LightLEEDer controller shall be provided with circuitry that shall automatically shut down the controller when the incoming power fails to be delivered to the within the required limits. When power is returned to the controller, one of the following power-up modes will be implemented for each controlled relay output in the system.

1. **No Action:** Upon restoration of incoming control power, the controller electronics shall be restarted and resume normal operation and all circuits will be maintained in the condition they were last in.

2. **Turn ON:** Controller shall turn the selected relay output to the ON state after power-up.

3. **Turn ON if Input Closed:** Controller shall turn the selected relay output to the ON state after power-up if the local input selected is closed. It shall be able to monitor any input.

4. **Turn OFF:** Controller shall turn the selected relay output to the OFF state after power-up.

5. **Turn OFF if Input Closed:** Controller shall turn the selected relay output to the OFF state after power-up if the local input selected is closed. It shall be able to monitor any input.

6. **On if Open Time, OFF if Closed Time:** Controller shall turn the selected relay output to the ON state during Open hours and shall turn selected relay outputs to the OFF state during Closed hours. This shall be used in conjunction with OPEN/CLOSED timers.

7. **OFF if Open Time, ON if Closed Time:** Controller shall turn the selected relay output to the OFF state during Open hours and shall turn selected relay outputs to the ON state during Closed hours. This shall be used in conjunction with OPEN/CLOSED timers.

8. **Time of Day:** Controller shall turn the selected relay output to the ON or OFF state based on the time of day in 30-minute increments for every day of the week.

I. **True Relay Status Feedback:** Each controller shall be provided with circuitry that shall monitor the actual status of each relay via pilot contacts mechanically linked to the relay main contacts.

J. **Switch Input Details:** All switch inputs shall have the following options:

1. **Input Flexibility:** Each switch input shall accept a 2 or 3-wire maintained or momentary switch. It shall be capable of accepting a dry contact, open collector closure, or a 12-24VDC signal. Each switch shall be able to have 2 switch types associated with it in an A/B form.

2. **Input to Output Programmability:** Any switch input shall be programmed to control any or all the controller's relay outputs without limitations in the network.

3. **Input Logic Conditionals:** All switch inputs shall have 2 conditionals that add a logic "AND" or "OR" dependent on a relay on, a relay off, an "on" input opened or closed, and an "off" input opened or closed. It shall also have a priority level setting.

4. **Input Active Times:** All switch inputs shall have a time-of-day or open/close time of action that can change the switch type on the time of day every 30 minutes or per open/closed times.

5. **Input Types:**

   a) **Momentary ON/OFF:** When momentary contact is made between the ON and COM, relay outputs controlled by this input shall be turned ON. When momentary contact is made between OFF and COM, relay outputs controlled by this input shall be turned OFF.
   b) **Momentary ON/OFF w/Blink:** When momentary contact is made between the ON and COM, relay outputs controlled by this input shall be turned ON. When momentary contact is made between OFF and COM, relay outputs controlled by this input shall blink and postpone being turned OFF. The alert time shall be programmable from 2 to 99 minutes. The blink alert function shall blink each relay twice prior to turning it OFF. If an ON command is received during the blink alert time, relay output shall be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.
   c) **Momentary Push-Button ON/OFF:** When momentary contact is made between the ON and COM, relay outputs controlled by this input are turned ON and OFF alternately, based on the current state, each time contact is made.
   d) **Momentary Push-Button ON:** When momentary contact is made between the ON and COM, relay outputs controlled by this input shall be turned ON.
   e) **Momentary Push-Button OFF:** When momentary contact is made between ON and COM, relay outputs controlled by this input shall be turned OFF.
   f) **Momentary Push-Button Toggle:** When momentary contact is made between ON and COM, relay outputs controlled by this input shall toggle from the present state.
   g) **Maintained ON/OFF:** When contact is made between the ON and COM, relay outputs controlled by this input are turned ON. When contact is broken between ON and COM, relay outputs controlled by this input are turned OFF.

h) **Maintained Multi-way:** When contact is either made or broken between the ON and COM, relay outputs controlled by this input will be toggled between ON and OFF conditions. This function shall be similar to that of standard 3 and 4-way switches.

i) **Maintained ON/OFF w/Blink:** When contact is made between the ON and COM, relay outputs controlled by this input are turned ON. When contact is broken between ON and COM, relay outputs controlled by this input shall blink and postpone being turned OFF. The alert time shall be programmable from 2 to 99 minutes. The blink alert function shall blink each relay twice prior to turning OFF. If an ON command is received during the blink alert time, relay output shall be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.

j) **Timed ON:** The timed-ON input shall operate either from the input closure or open. If programmed to operate from the closure, the relays turn ON when the input closes and turn OFF after the time duration. The relays do nothing when the input opens. If programmed to operate from the open, the relays turn ON when the input closes and remain ON. When the input opens, the relays turn OFF after the timed-ON duration.

k) **HID Bi-Level:** This feature requires the configuration of ON/OFF relay outputs and HI/LOW relay outputs. The first momentary contact between ON and COM sets the ON relay outputs to ON and the HI/LOW outputs to HI (for at least 15 Minutes). The second contact switches the HI/LOW outputs to LOW. Additional contact closures will toggle the HI/LOW relay outputs. The cycle then repeats until momentary contact is made between the switch input OFF and COM. then the ON/OFF outputs and HI/LOW outputs are turned OFF.

l) **Two-Step Alternating Sequence:** The first time the switch is activated, relay outputs programmed as “Group A” are turned ON, and relay outputs programmed as “Group B” are turned OFF. The second time the switch is activated, “Group A” relay outputs are turned OFF, and “Group B” relay outputs are turned ON. The third time the switch is activated, the pattern begins again at step one.

m) **Four-Step Alternating Sequence:** The first time the switch is activated, relay outputs programmed as “Group A” are turned ON, and relay outputs programmed as “Group B” are turned OFF. The second time the switch is activated, “Group A” relay outputs are turned OFF, and “Group B” relay outputs are turned ON. The third time the switch is activated; both “Group A” and “Group B” relay outputs are turned ON. The fourth time the switch is activated; both “Group A” and “Group B” relays are turned OFF. The fifth time the switch is activated, the process begins again at step one.

n) **Set Preset:** When momentary contact is made between the ON and COM, the selected preset scene will be activated.

o) **Set Scene:** When momentary contact is made between the ON and COM, the selected scene will be activated.

p) **Force Timer:** When momentary contact is made between the ON and COM, the selected timer will be activated.

K. **Timer Functions:** Each of the programmable lighting controllers shall have the described timer options listed below for the relay outputs.

1. **Time-of-Day Timers:** Each programmable lighting controller shall be provided with a minimum of 128 available timers (scheduled events) for use in developing time-of-day automated schedules. Each timer shall have the ability to turn any or all relay outputs ON or OFF at any time in 1-minute increments. Timers shall be day-of-week selectable and may be programmed to activate on any combination of days of the week. Each shall be capable of being programmed to be enabled or disabled for any day of the calendar year.

2. **Astronomical Scheduling:** Each controller shall contain an astronomical time clock that shall calculate sunrise and sunset times based on the geographical latitude and longitude positioning. Sunrise and sunset times may be used as activation times for any system timer. In addition to sunrise and sunset time activation, the control shall be capable of programming activation time before and after these times based on an offset of 1-999 minutes.

3. **Open/Closed Time Control:** The user shall also have the option of controlling relay outputs in relation to the Open/Closed times of the facility. The Open/Closed times may vary for different days of the week and may be programmed for each day of the year. In addition to Open/Closed time activation, the control shall be capable of programming activation time before and after these Open/Closed times based on an offset of 1-999.

4. **Off-Hour Sweeps:** The system shall also support after-hours OFF sweeps of selected relays or groups of relays at user-defined one, two, or three-hour intervals.

5. **Automated Circadian Rhythm Control:** The system shall be capable of providing Automated Circadian Rhythm color shifting via a 0-10VDC dimming output.

    a. Each dimming channel shall support up to a 100mA dimming load and be galvanically isolated up to 1500V to protect electronics.
    b. The Automated Circadian Rhythm dimming curve shall be able to vary its level 256 steps between 0 and 10VDC and smoothly change colors between setpoints with no abrupt color changes. The system shall be able to automatically turn fixtures on to color temperature specified by the Automated Circadian Rhythm color shifting program.
    c. The system shall have a default Automated Circadian Rhythm dimming curve that automatically adjusts start/stop times via astronomical time clock. Additionally, the system shall have the option for a user-defined dimming curve with static start/stop times.
    d. The system shall provide the option for local controls to be capable of temporarily overriding the current circadian rhythm color. The manual override duration shall not be reliant upon nor limited by the time-of-day setpoints in the Automated Circadian Rhythm color shifting program. The system shall be capable of instantly flipping back and forth between manual override mode and Automated Circadian Rhythm mode without being reliant upon nor limited by the time-of-day setpoints in the Automated Circadian Rhythm color shifting program.
    e. The system shall be capable of flipping between manual override mode and Automated Circadian Rhythm mode via inputs from 3rd party systems such as BAS, Fire, Security, AV etc.

f. The system shall be capable of providing multiple programming options for how/when to revert back to the Automatic Circadian Rhythm mode including the ability to revert back to the Automated Circadian Rhythm mode once a load is turned off and then back on.

L. Relay Output OFF Options: Each relay shall have the option to control the relay OFF in a certain way other than the default OFF.

1. **Single Blink Alert:** Each relay output within the programmable lighting controller shall be individually programmable to blink and postponed prior to being turned OFF. The alert time shall be programmable from 2 to 99 minutes. The blink alert function shall blink each relay twice prior to turning OFF with a timer OFF sweep to warn occupants of the upcoming OFF event. If an ON command is received during the blink alert time, the relay output shall be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.

2. **Double Blink Alert:** Each relay output within the programmable lighting controller shall be individually programmable to blink and postponed prior to being turned OFF and then blinked 1 minute before turning OFF. The alert time shall be programmable from 2 to 99 minutes. The blink alert function shall blink each relay twice for each alert to warn occupants of the upcoming OFF event. If an ON command is received during the blink alert time, the relay output shall be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.

3. **HID Delay:** Each relay output within the programmable lighting controller shall have the ability to be controlled like a Single Blink Alert as described above but without the blink, alert to prevent damage to HID lamps.
4. **Alarm ON:** Relays shall be capable of performing a momentary ON function. The ON function shall be programmable from 1 to 99 seconds.

5. **Alarm OFF:** Relays shall be capable of performing a momentary OFF function. The OFF function shall be programmable from 1 to 99 seconds.

6. **Alarm Pulsed ON:** Relays shall be capable of being cycled ON and OFF at 1-second intervals and returning to the OFF state. It shall be programmable from 1 to 90 seconds.

7. **Alarm Pulsed OFF:** Relays shall be capable of being cycled OFF and ON at 1-second intervals and returning to the ON state. It shall be programmable from 1 to 90 seconds.

8. **Automatic Control Switch-OFF:** Relays shall be capable of being cycled OFF for 5 seconds and then returned to the ON state for controlling Sentry or AS110 switches.

9. **Automatic Control Switch-Blink:** Relays shall be capable of being cycled OFF for 1.5 seconds and then returned to the ON state for controlling Delay-OFF mode on AS110 switches.

M. Presets: The lighting controller shall support up to 256 user-defined presets of ON/OFF relay patterns. The presets shall be invoked by a switch or timer actuation.

N. Descriptive Names: The system shall support the optional assignment of descriptive names (up to 10 characters) to the lighting controller, relay outputs, relay groups, inputs, timers, and presets. These names shall be able to switch from custom names to default names.

O. Password Protection: Each Programmable controller shall have user-definable 6-digit alphanumeric passwords with 2 levels of access. Level 1 is control & edit. Level 2 is control only.

P. Networking:

1. **Network Capacities:** In addition to the data line devices mentioned in Section D, LightLEEDer Controllers shall be linked together on the data line to form a Local Area Network (LAN) of up to 254 controller nodes.

2. **Network Features:** The network manager shall allow the connection of up to 254 controllers and 254 data line devices (on top of the 64 devices per panel) and provide USB communications. It shall have a high-speed LightSync scanner, 4 gateway device ports, power for LightSync devices, and TCP/IP.

3. **Network Universe:** The network of panels shall be capable to connect to other networks over a network (LAN) or over the internet (WAN) to interconnect multiple systems.

4. **Network Gateway:** The following special-purpose gateways shall be available and provides network-wide control from a single point for its specialized function:

    a) **Modbus Control:** The Modbus gateway shall support communications from the BAS system using Modicon Modbus protocol from a single-point connection. All network input status, relay status, and control shall be supported.
    b) **N2 Control:** The N2 gateway shall support communications from the BAS system using a Metasys-N2 protocol from a single-point connection. Network-wide group status and control shall be supported.
    c) **BACnet Control:** The BACnet gateway shall support communications from the BAS system using BACnet MSTP or BACnet IP protocol from a single point connection. It shall allow up to 500 single relays, 100 multiple relays, 48 groups, and 48 presets.
    d) **Advanced BACnet Control:** The Advanced BACnet gateway shall support communications from the BAS system using BACnet IP protocol from a single-point connection. It shall allow up to per panel; 20 Relays, 20 Dimmers, 16 LightSync devices (128 maintained inputs), 64 Groups/Presets, and 48 Scenes.

5. **BAS System / Lighting Control System:** Programmable lighting controllers interfaced with other building systems must remain functional and continue to process all programmed commands, including time schedules and local switching.

Q. **Runtime Logging and Trending:** Each lighting control panel shall be capable of logging Runtime and Trending data for each relay. This data shall be able to be harvested and exported from the entire system.

1. **Runtime Logging:** The controller shall be able to internally log the runtime of each relay for up to 30 days. This data shall be able to be harvested with a personal computer at 1-minute intervals.

2. **Logging and Trending Software:** Runtime Logging and Trending software shall be available for harvesting data from the lighting control panels. It shall have a dedicated personal computer connected to the system through a LAN or USB cable to the panel or network controller.

   a) **Load Configuration:** Each relay in the system shall be able to have a wattage load assigned to it to represent the actual load on the relay. Loads shall be able to be named, or names shall be exported directly from the system programming software.

   b) **Combined Loads:** Up to 254 combined relay loads from any panel in the network shall be allowed, for total wattage recording of areas in the facility. Combined loads shall be able to be named for identification in reports and graphs.

   c) **Daily or Monthly Usage Report:** The software shall be able to generate spreadsheet reports in a daily or monthly format for each relay or combined relays in the system.

   d) **Export Data:** The compiled reports shall be able to be exported to a .csv file. These files when exported shall be coded for the year, month, and date.

   e) **Daily or Monthly Usage Graphs:** The software shall be capable of generating usage graphs in a daily or monthly format for each relay or combined relays in the system.

   f) **Printing:** Daily or monthly usage graphs shall have the capability to be directly printed from the software.

   g) **Live Usage Graphs:** The software shall have 1 to 9 live usage meter dials to display the present wattage of combined loads.

   h) **Calendar View:** It shall provide a full-year calendar that shall display the number of calendar events.

R. **Graphical Control Interface (InSite Software):** The software shall be a Windows-based graphical interface that allows monitoring and control of LightLEEDer panels using icons on custom or standard graphical screens.

1. **Graphical Background Screens:** Graphical background screen shall consist of any bitmap image with any resolution or number of colors. There shall be virtually limitless numbers of screens with a limit to the capacity of the computer.

2. **Multiple Interfaces:** It shall support an unlimited number of satellite computers controlling the same system. (1 Main computer, multiple remote computers).

3. **Virtual PC:** It shall support web access via a virtual computer.

4. **Fault Log:** It shall log and notify of any relay or network faults.

    a) The software shall monitor itself and restart if there is a system communication issue.
    b) It shall automatically send an e-mail to the user(s) notifying them of the problem.
    c) An alarm shall report if a relay doesn't turn on/off correctly with real-time status updates.
    d) It shall log the loss of communications of each network and every node per network. It shall log when it goes offline and when it goes back online.

5. **Control Icons:** Control icons shall be unlimited per screen and shall be chosen from an extensive library. It shall be able to use custom control icons that can be created and saved as BMP, JPEG, or GIF images. Control icons shall be able to be placed anywhere on the screen and edited at any time. Control icons shall control relays, LL Groups, LL Presets, LL Scenes, LL Timers, or dimmer scenes.

6. **Control Options:** It shall have the following capabilities for control and setup.

    a) **Flood:** It shall have the capability to flood areas or change the color of a defined section of the screen (floor plan) for depicting On/Off states.
    b) **Sounds:** It shall be able to trigger custom sound WAV files for on/off triggers.
    c) **Verify:** There should be settings to verify control action and relay sweep commands.
    d) **Toggle:** This shall be a selectable action for relays which shall include always, never, or selective relays.
    e) **Sweep Enable:** There shall be an option for a sweep command.
    f) **Grid:** A grid shall be available for the design and placement of icons on the screens. This shall be adjustable for size and color, plus it shall be able to allow a snap-to-grid feature.
    g) **Tool Tips:** It shall have a Tool Tips option that displays text when hovered over an icon.
    h) **Extra Loads:** It shall have the capability to add extra loads to a single relay control icon.
    i) **Import:** It shall have the capability to import LightLEEDer settings and objects.
    j) **Synchronize InSite Screens:** Remote computers shall have the capability to synchronize screens with a single button push.
    k) **Text Icons:** Text icons can be added to any screen and shall be able to be placed anywhere on the screen and edited at any time. They should be adjustable for size, color, font, and transparency.
    l) **UDP Command:** It shall support UDP command strings for special functions in the system.

7. **Navigation Icons:** These shall have navigation buttons for going from one screen to another. These icons shall have the capability to be Global and be visible on all screens. Icons shall have standard sizes that shall be editable for color, size, and font. It shall be able to use custom control icons that can be created and saved as BMP, JPEG, or GIF images. Navigation icons shall be able to be placed anywhere on the screen and edited at any time.

8. **Sequence Control:** It shall be able to sequences with up to 16 transitions over a 12-hour period for events. It shall be able to turn on/off single relays, LL Groups, set a Preset, or LL Scenes in a sequence.

9. **Dimmer Control:**
   a) **Single Slider:** Slide dimmers shall be available for single control and/or status of a 0-10V output or an sACN slot.
   b) **Pop-up Multi-Sliders:** It shall have up to 16 pop-up control sliders. Each shall be able to be linked to any dimmer(s) in the system. It shall have the capability to have a slider to control all dimmers, direct or proportional.

10. **Security and User Access:**

    a) It shall have an Administrator lock-out for specific screens and for specific users during an event in the facility.
    b) It shall support up to 5 levels of user security.
    c) There shall be advanced managed user access for up to 32 users.
    d) A settable administrator timeout shall be settable from 15 minutes to 4 hours.
    e) The Administrator shall be able to assign users' access and passwords.

11. **Multi Network:** It shall be able to link together up to 32 LightLEEDer networks with up to 254 nodes per network to operate as one system.

12. **Schedules:** It shall have programmable schedules that send commands to each network and each node in the system.

    a) It shall have up to 4000 programmable schedules.
    b) It shall automatically control relays, groups, scenes, presets, or trigger a sequence.
    c) Schedules shall be based on a fixed time, shared time, or before-at-after sunrise-sunset.
    d) Latitude/Longitude and time-zone settings shall be settable with adjustable DST settings.
    e) It shall have a search option for all schedules that include relays, LL Groups, LL Presets, InSite Presets, and Sequences.

13. **Runtime Monitoring:** It shall incorporate the "Runtime Logging and Trending" software as specified in section "Q".

14. **Diagnostics Dashboard:** It shall have a tool to monitor all the relays/devices in the system.

15. **Serial Interfaces:**

    a) **sACN Interface:** It shall have the capability to view sACN via (no interface needed for viewing) and control sACN through an Interactive Technologies CueServer Interface optional add-on.
    b) **DMX Control:** It shall have an optional DMX output for lighting fixtures and ILC LightLEEDer dimmer outputs
    c) **BACnet IP:** It shall have an optional serial input for status and control from InSite. It shall have up to 750 control points and status for InSite Groups, InSite Presets, or InSite Sequence. It shall have an export to .csv file for documentation.

S. **Emergency UL924 Lighting Controller Option:** Each lighting controller shall have the option to provide an emergency lighting bypass without the use of external devices. It shall be UL924 listed and clearly marked.

1. **Bypass Control:** If normal power is lost, if selected, the panel shall force the EM relays to the ON position. It shall also force any 0-10V dimming to 100%.

2. **Control Type:** It shall have the option to select the EM relay control for Force On, Force Off, and No change.

3. **Phase Monitoring:** It shall be able to monitor up to three phases of normal power. Upon loss of any phase, the panel will go into an emergency state. It shall be selectable for each phase monitored. It shall be able to monitor 120/277 VAC circuits.

4. **Isolation:** It shall have barriers to separate Normal and Emergency circuits.

5. **Remote Testing:** It shall be provided with input for remote testing. It shall also be provided an output for driving a remote status LED.

2.2 LIGHTLEEDER EVO LIGHTING CONTROLLERS:

A. **LightLEEDer EVO Controller:** Each controller shall be designed to be remotely installed and provide control of 4 remote load control relays. This controller shall have the same programmable features as the Programmable Lighting Control Panels.

1. **Enclosure:** Each controller shall be provided with a NEMA 1 galvanized steel enclosure with removable screw cover, 1/2" nipple, and pre-drilled mounting holes.
2. **Plenum Rated:** Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.

3. **Listing:** Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.

4. **Controller Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC or optional 120/347 VAC primary (50 to 60 Hz). It shall contain an internal self-resetting fuse.

5. **High Voltage Connections:** Each controller shall be provided with 6" wire leads for terminating the high voltage connections. All connections shall be made to clearly and permanently labeled termination points.

6. **Low Voltage Connections:** Controllers shall also be provided with RJ45 connectors for the data line and relay connections, and push-to-connect connectors for occupancy and photo sensor inputs. All connections shall have clearly and permanently labeled termination points.

7. **Occupancy Sensor Inputs:** It shall have 4 independent inputs, and each input shall be able to interface multiple occupancy sensors or hardwired switches. Each input shall control any or all the relays in the lighting controller or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
    - 200mA w/4 LightSync devices connected to the controller
    - 160mA w/5 LightSync devices connected to the controller
    - 120mA w/6 LightSync devices connected to the controller
    - 90mA w/7 LightSync devices connected to the controller
    - 60mA w/8 LightSync devices connected to the controller

8. **Photocell Inputs:** It shall have 2 inputs for ILC photocell heads and shall be programmable for a 2 or 30-second delay. The controller shall be provided with 256 light-to-dark levels (0-1800fc). It shall include a selectable dead-band range and allow the selection of 8 individual setpoints for OFF and ON that can control any or all relays/dimmers in the lighting controller.

9. **Local LightSync Data Line Port:** It shall provide an RJ45 LightSync data line port with power for up to 8 LightSync data line devices. It shall be able to support up to 61 LightSync data line devices when using Power Supply Repeaters.

10. **Real-Time Clock:** Each controller shall be provided with its own Real-Time Clock used to perform all time-related functions. It shall use a high-voltage line-sync circuit for timing and a crystal for backup. Clock accuracy shall be held +/- 2 minutes per year and displayed to the second. Time clock functions shall include the time of day, day of the week, date, and automatic DST and leap year adjustments. DST shall be adjustable with an enable/disable feature. It shall be protected against loss of time for a period of up to 45 days without power. Systems relying on a single clock device shall not be acceptable.

11. **Pre-Configured Programs:** Each controller shall have up to 16 selectable pre-configured lighting application programs and 1 default contractor program.

B. **LightSync -EVO Room Controller:** Each controller shall be designed to be remotely installed and provide control of 4 load control relays. This controller shall have the same features as the

Programmable Lighting Control Panels excluding add-ons and naming.

1. **Enclosure:** Each controller shall be provided with a NEMA 1 galvanized steel enclosure with removable screw cover, 1/2" nipple, and pre-drilled mounting holes.

2. **Plenum Rated:** Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.

3. **Listing:** Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.

4. **Controller Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC or optional 120/347 VAC primary (50 to 60 Hz). It shall contain an internal self-resetting fuse.

5. **High Voltage Connections:** Each controller shall be provided with 6” wire leads for terminating the high voltage connections. All connections shall be made to clearly and permanently labeled termination points.

6. **Low Voltage Connections:** Controllers shall also be provided with RJ45 connectors for the data lines, and the relay connections. It shall also be provided push-to-connect connectors for occupancy sensors, and photo sensor inputs. All connections shall be made to clearly and permanently labeled termination points.

7. **Occupancy Sensor Inputs:** It shall have 4 independent inputs, and each input shall be able to interface multiple occupancy sensors or hardwired switches. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
    - 200mA w/4 LightSync devices connected to the controller

8. **Photocell Inputs:** It shall have 2 inputs for ILC photocell heads and shall be programmable for a 2 or 30-second delay. The controller shall be provided with 256 light-to-dark levels (0-1800fc). It shall include a selectable dead-band range and allow the selection of 8 individual setpoints for OFF and ON that can control any or all relays/dimmers in the lighting controller.

9. **Local LightSync Data Line Port:** It shall provide an RJ45 LightSync data line port with power for up to 4 LightSync data line devices.

C. **LightLEEDer EVO Integrated -4 -8 Relay Controller:** Each controller shall be designed to be remotely installed and provide control of 4 or 8 integrated load control relays. This controller shall have the same features as the Programmable Lighting Control Panels.

1. **Enclosure:** Each controller shall be provided with a NEMA 1 galvanized steel enclosure with removable screw cover, 1/2" knockouts, and pre-drilled mounting holes.

2. **Plenum Rated:** Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.

3. **Listing:** Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.

4. **Controller Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC primary (50 to 60 Hz). It shall contain an internal fuse for protection.

5. **Relay Ratings:** It shall be provided with 4- or 8- 50A load relays that shall be de-rated for 16 amps for durability. It shall control 16A for each set of 4 outputs:
    - 16A, 120/277VAC Electronic Ballast (LED)
    - 16A 120/277VAC Tungsten
    - 1/4 HP @ 120 VAC Motor Load

6. **High Voltage Connections:** Each controller shall be provided with terminal blocks for terminating the high voltage connections. All connections shall be made to clearly and permanently labeled termination points.

7. **Low Voltage Connections:** Controllers shall also be provided with RJ45 connectors for the data lines, and photo sensor connections. It shall also be provided push-to-connect and screw connectors for occupancy sensors, dimming, and low-voltage inputs. All connections shall be made to clearly and permanently labeled termination points.

8. **Occupancy Sensor Inputs:** It shall have 4 independent inputs able to interface multiple occupancy sensors or hardwired switches. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
    - 60mA w/4 LightSync devices connected to the controller
    - 50mA w/5 LightSync devices connected to the controller
    - 40mA w/6 LightSync devices connected to the controller
    - 20mA w/7 LightSync devices connected to the controller
    - 0mA w/8 LightSync devices connected to the controller

9. **Photocell Inputs:** It shall have 1 input for ILC photocell heads and shall be programmable for a 2 or 30-second delay. The controller shall be provided with 256 light-to-dark levels (0-1800fc). It shall include a selectable dead-band range and allow the selection of 8 individual setpoints for OFF and ON that can control any or all relays/dimmers in the lighting controller.

10. **Local LightSync Data Line Port:** It shall provide an RJ45 LightSync data line port with power for up to 8 LightSync data line devices. It shall be able to support up to 61 LightSync data line devices when using Power Supply Repeaters.

11. **Dimming:** It shall be provided with 4 or 8 independent 0-10V dimming control outputs that shall sink a maximum of 100mA per output. Each output shall be galvanically isolated up to 1500V to protect the electronics. Each output will revert to 100% upon a power loss.

12. **Real-Time Clock:** Each controller shall be provided with a Real-Time Clock used to perform all time-controlled functions. It shall use a high-voltage line-sync circuit for timing and a crystal for backup. Clock accuracy shall be held +/- 2 minutes per year and displayed to the second with the line-sync setting. Real-Time Clock functions shall include the time of day, day of the week, date, and automatic daylight-saving time and leap year adjustments. The time clock shall be protected against loss of time during a power outage for a period of up to 45 days without power of any type. Daylight Saving Time shall be adjustable with an enable/disable feature. Systems relying on a single clock device shall not be acceptable.

13. **Pre-Configured Programs:** Each controller shall have up to 1 pre-configured default contractor program or 1 job-specific custom program.

D. **LightLEEDer EVO Integrated 2 Relay Controller:** Each controller shall be designed to be remotely installed and shall provide 2 integrated load control relays with dimming.

1. **Enclosure:** Each controller shall be provided with a polycarbonate plastic enclosure provided with a ½" nipple and mounting tab.

2. **Plenum Rated:** Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.

3. **Listing:** Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.

4. **Controller Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC primary (50 to 60 Hz). It shall contain an internal fuse for protection.

5. **Relay Ratings:** It shall be provided with 2- 50A load relays that shall be de-rated for 20 amps for durability:
    - 16A, 120/277VAC Electronic Ballast (LED)
    - 20A 120/277VAC General
    - 1/4 HP @ 120 VAC Motor Load

6. **High Voltage Connections:** Each controller shall be provided with color-coded wire leads. All connections shall be made to clearly and permanently labeled terminations.

7. **Low Voltage Connections:** Controllers shall also be provided with RJ45 connectors for the data lines, occupancy sensor, and photo sensor connections. Dimming shall be provided with color-coded wire leads. All connections shall be permanently labeled terminations.

8. **Occupancy Sensor Inputs:** It shall have 1 input with power provided for the occupancy sensors. The input shall control any or all the relays in the lighting controller or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
    - 70mA w/1 LightSync device connected to the controller
    - 60mA w/2 LightSync devices connected to the controller
    - 50mA w/3 LightSync devices connected to the controller
    - 40mA w/4 LightSync devices connected to the controller

9. **Photocell Inputs:** It shall have 1 input for ILC photocell heads and shall be programmable for a 2 or 30-second delay. The controller shall be provided with 256 light-to-dark levels (0-1800fc). It shall include a selectable dead-band range and allow the selection of 8 individual setpoints for OFF and ON that can control any or all relays/dimmers in the lighting controller.

10. **Local LightSync Data Line Port:** It shall have an RJ45 LighSync data line port with power for up to 8 LightSync data line devices. It shall be able to support up to 61 LightSync data line devices when using Power Supply Repeaters.

11. **Dimming:** It shall be provided with 2 independent 0-10V dimming control outputs that shall sink a maximum of 100mA per output. Each output shall be galvanically isolated up to 1500V to protect the electronics. Each output will revert to 100% upon a power loss.

12. **Pre-Configured Program:** It shall have a pre-configured default plug-n-play program, with the option for a customizable job-specific program.

E. LightSync EVO Integrated 2 Room Controller: Each controller shall be designed to be remotely installed and shall provide 2 integrated load control relays with dimming.

1. **Enclosure:** Each controller shall be provided with a polycarbonate plastic enclosure provided with a ½" nipple and mounting tab.

2. **Plenum Rated:** Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.

3. **Listing:** Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.

4. **Controller Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC primary (50 to 60 Hz). It shall contain an internal fuse for protection.

5. **Relay Ratings:** It shall be provided with 2- 50A load relays that shall be de-rated for 20 amps for durability:
    - 16A, 120/277VAC Electronic Ballast (LED)
    - 20A 120/277VAC General

- 1/4 HP @ 120 VAC Motor Load

6. **High Voltage Connections:** Each controller shall be provided with color-coded wire leads. All connections shall be made to clearly and permanently labeled terminations.

7. **Low Voltage Connections:** Controllers shall also be provided with RJ45 connectors for the data lines, occupancy sensor, and photo sensor connections. Dimming shall be provided with color-coded wire leads. All connections shall be permanently labeled terminations.

8. **Occupancy Sensor Inputs:** It shall have 1 input with power provided. The input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
   - 70mA w/1 LightSync device connected to the controller
   - 60mA w/2 LightSync devices connected to the controller
   - 50mA w/3 LightSync devices connected to the controller

9. **Photocell Inputs:** It shall have 1 input for ILC photocell heads and shall be programmable for a 2 or 30-second delay. The controller shall be provided with 256 light-to-dark levels (0-1800fc). It shall include a selectable dead-band range and allow the selection of 8 individual setpoints for OFF and ON that can control any or all relays/dimmers in the lighting controller.

10. **Local LightSync Data Line Port:** It shall provide an RJ45 LightSync data line port with power for up to 3 LightSync data line devices.

11. **Dimming:** It shall be provided with 2 independent 0-10V dimming control outputs that shall sink a maximum of 100mA per output. Each output shall be galvanically isolated up to 1500V to protect the electronics. Each output will revert to 100% upon a power loss.

12. **Pre-Configured Programs:** Each controller shall have up to 1 pre-configured default contractor program or 1 job-specific custom program.

2.3 LIGHTING CONTROL RELAYS:

A. **LightLEEDer Reliant40-1 Single Pole Relay:** It shall be designed for controlling high-inrush single pole lighting circuits. It shall employ 4 latching nickel-silver contacts.

1. **Listing:** Lighting control relays shall be individually UL/CUL listed and shall bear labels indicating compliance.

2. **Labeling:** Lighting control relays shall bear labels for relay current and SCCR ratings.

3. **Endurance:** Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.

4. **SCCR:** Lighting relays shall have an SCCR rating of 18,000 amps up to 347 VAC.

5. **Relay Ratings:** It shall be rated for the following:
    - 16A, 120/277/347 VAC Electronic Ballast (LED)
    - 40A 120/277/347 VAC Ballast
    - 40A 120/277/347 VAC Tungsten
    - 1/5 HP @ 120 VAC Motor Load
    - It shall be suitable for plug-loads

6. **Latching:** Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.

7. **Auxiliary Contacts:** Each Lighting control relay shall contain an auxiliary set of contacts rated at 1 AMP 30 VAC/VDC electrically isolated but mechanically linked to the main contacts for the purpose of true status monitoring and pilot light activation.

8. **Mounting:** Relays shall be capable of panel mounting.

9. **Lock-Out:** Relays shall be equipped with an Enable/Disable switch to lock out On/Off control from the controller.

10. **Actuator:** Relays shall be equipped with a manual actuator switch for turning the relay ON or OFF along with status indication.

B. **LightLEEDer Reliant40-2 and 3 Pole Relay:** It shall be designed for controlling high-inrush 2-, 3-pole lighting circuits. Each pole shall employ 4 latching nickel-silver contacts.

1. **Listing:** Lighting control relays shall be individually UL/CUL listed and shall bear labels indicating compliance.

2. **Labeling:** Lighting control relays shall bear labels for relay current and SCCR ratings.

3. **Endurance:** Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.

4. **SCCR:** Lighting relays shall have an SCCR rating of 18,000 amps up to 347 VAC.

5. **Relay Ratings:** Each relay shall be designed for the control of 208, 240, and 480 VAC lighting loads at the following per pole.
    - 16A, 120/277/347 VAC Electronic Ballast (LED)
    - 40A 120/277/347 VAC Ballast
    - 40A 120/277/347 VAC Tungsten

- 1/5 HP @ 120 VAC Motor Load
- It shall be suitable for plug-loads

6. **Latching:** Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.

7. **Auxiliary Contacts:** Each Lighting control relay shall contain an auxiliary set of contacts rated at 1 AMP 30 VAC/VDC electrically isolated but mechanically linked to the main contacts for the purpose of true status monitoring and pilot light activation.

8. **Mounting:** Relays shall be capable of panel mounting.

9. **Lock-Out:** Relays shall be equipped with an Enable/Disable switch to lock out On/Off control from the controller.

10. **Actuator:** Relays shall be equipped with a manual actuator switch for turning the relay ON or OFF along with status indication

11. **Mechanical Link:** Poles within the relay shall be electrically isolated but mechanically linked so as to open and close together without the possibility of one pole being closed while the other remains open. Systems that utilize two single-pole relays to accomplish this function are not acceptable.

C. **LightLEEDer Remote R20D Single Pole Relay w/Dimming:** The remote relay shall be designed to be mounted to a junction box or fixture and shall control 1 load up to 16 Amp circuit and 0-10V dimming.

1. **Listing:** Lighting control relays shall be individually UL and CUL listed and shall bear labels indicating compliance.

2. **Plenum:** Each relay shall be suitable for plenum mounting and rated to the UL 2043 standards. Controllers without this rating shall be unacceptable.

3. **Labeling:** Lighting control relays shall bear labels for relay current ratings.

4. **Endurance:** Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.

5. **SCCR:** Lighting relays shall have an SCCR rating of 5,000 amps up to 277 VAC.

6. **Relay Ratings:** It shall be rated for the following:
   - 16A, 120/277/347 VAC Electronic Ballast (LED)
   - 16A 120/277/347 VAC Ballast
   - 16A 120/277/347 VAC Tungsten

- 16A 120/277/347 VAC Resistive
- 1/5 HP @ 120 VAC Motor Load
- It shall be suitable for plug-load

7. **Dimming:** Shall be able to control 0-10V dimming ballast and be able to sink up to 100 mA.

8. **Latching:** Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.

9. **Mounting:** It shall have a ½" nipple for mounting to an enclosure or fixture

D. **LightLEEDer Remote R20D-EM Dimming Relay with Emergency Bypass:** The R20D-EM relay shall be able to control 1 normal and 1 emergency 0-10V dimmable load together, providing UL924 bypass operation of the emergency load during a loss of normal power It shall be designed to be mounted to a junction box or fixture.

1. **Listing:** Lighting control relays shall be individually UL/CUL/UL924 listed and shall bear labels indicating compliance.

2. **Plenum:** Each relay shall be suitable for plenum mounting and rated to the UL 2043 standards. Controllers without this rating shall be unacceptable.
3. **Labeling:** Lighting control relays shall bear labels for relay current ratings.

4. **Endurance:** Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.

5. **SCCR:** Lighting relays shall have an SCCR rating of 5,000 amps up to 347 VAC.

6. **EM Function:** It shall have one normal power relay and one EM relay. Both shall be controlled by a LightLEEDer controller. Upon loss of power, the EM relay shall be forced to the ON state. During the EM state, 0-10 V dimming shall be forced to 100%.

7. **Relay Ratings:** It shall be provided with 2- 50A load relays that shall be de-rated for 20 amps for durability:
   - 16A, 120/277VAC Electronic Ballast (LED)
   - 20A 120/277VAC General
   - 1/4 HP @ 120 VAC Motor Load
   - It shall be suitable for plug-load

8. **Latching:** Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.

9. **Mounting:** It shall have a ½" nipple for mounting to an enclosure or fixture.

10. **Test Button:** It shall have a test button for testing the EM function.

11. **Test Input:** It shall have an input for testing the EM function from a remote location.

2.4 EVO LITE STANDALONE CONTROL DEVICES:

A. **ELPP – EVO Lite Power Pack:** Each ELPP Power Pack shall provide standalone on/off and 0-10V dimming control of a single 20A (16A LED) load and provide 350mA of power for connected low voltage EVO Lite devices.

1. **Enclosure:** Each ELPP Power Pack shall have a molded plastic enclosure with a ½" molded electrical nipple and mounting bracket.

2. **Plenum Rated:** Each ELPP Power Pack shall have a molded plastic enclosure with a 5VA flammability rating suitable for plenum mounting. Controllers without this rating shall be unacceptable.

3. **Listing:** Lighting controls shall be UL/CUL listed and be compliant with the following:
   a. FCC Part 15
   b. BAA and BABA
   c. Title 24, ASHRAE, IECC

4. **Controller Power Supply:** Each ELPP Power Pack shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC (50 to 60 Hz).

5. **High Voltage Connections:** Each ELPP Power Pack shall be provided with 6" wire leads for terminating the high voltage connections.

6. **Low Voltage Connections:** Each ELPP Power Pack shall be provided with x2 RJ45 connectors for connecting EVO Lite devices with CAT5/5e/6 cable and have x3 20 AWG wire leads as an alternate connection method for occupancy sensors.

7. **Configuration Options:** Each ELPP Power Pack shall have selectable configuration options to adjust the operation of the power pack.

B. **ELG3 – EVO Lite G3 Switch:** The ELG3 Switches shall be available in 1 or 2 zone, dimming or non-dimming configurations with 6 color options; White, Ivory, Light Almond, Gray, Black, and Red. Each switch shall have an associated pilot light.

1. **Listing:** Lighting controls shall be UL/CUL listed and be compliant with the following:
   a. FCC Part 15
   b. BAA and BABA
   c. Title 24, ASHRAE, IECC

2. **Low Voltage Connections:** Each ELG3 switch shall be provided with x2 RJ45 connectors for connecting to other EVO Lite devices with CAT5/5e/6 cable

3. **Power:** Powered from EVO Lite Power Pack via CAT5/5e/6 cable.

4. **Button Labelling:** Each ELG3 Switch shall have field replaceable faceplates with color change kits and the option for individually replaceable buttons that can be custom engraved. The LSWS shall also be field reconfigurable to change between different switch types.

C. **ELWS – EVO Lite Wall Sensor Switch:** The ELWS Sensor Switches shall provide dual-tech occupancy sensing via passive infrared (PIR) and overlapping passive acoustic sensing, and be available in 1 or 2 zone, dimming or non-dimming configurations with 6 color options; White, Ivory, Light Almond, Gray, Black, and Red. Each switch shall have an associated pilot light.

1. **Listing:** Lighting controls shall be UL/CUL listed and be compliant with the following:
   a. FCC Part 15
   b. BAA and BABA
   c. Title 24, ASHRAE, IECC

2. **Low Voltage Connections:** Each ELWS Sensor Switch shall be provided with x2 RJ45 connectors for connecting to other EVO Lite devices with CAT5/5e/6 cable.

3. **Power:** Powered from EVO Lite Power Pack via CAT5/5e/6 cable.

4. **Button Labelling:** Each ELWS Sensor Switch shall have field replaceable faceplates with color change kits and the option for individually replaceable buttons that can be custom engraved. The ELWS shall also be field reconfigurable to change between switch types.

5. **Sensor Functionality and Adjustments:** The ELWS Sensor Switch shall support occupancy and vacancy modes and require an initial PIR event to enable acoustic functionality, which will overlap and enhance overall detection once enabled, and will extend sensor time delay upon occupant sound detection. To prevent sounds alone from keeping lights on indefinitely, periodic PIR detection shall be needed to keep lights on for an extended period, otherwise lighting shall automatically shut off after 5 minutes of acoustic detection only. Acoustic detection shall remain enabled for a brief period after the sensor times out, to allow for voice reactivation of the lights. Automatic Threshold Control filters background noise to fine tune acoustic sensitivity, filtering out non-occupant noises. Additionally, the ELWS shall allow for the following manual adjustments:
   a. Sensitivity adjustments for passive infrared and acoustic which can be independently adjusted to three different levels, including PIR-only mode
   b. Vacancy time-delay adjustments
   c. Enable/Disable LED indicators.

D. ELCS – EVO Lite Ceiling Sensor: The ELCS Ceiling Sensor shall provide dual-tech occupancy sensing via passive infrared (PIR) and overlapping passive acoustic sensing and include a full range photosensor to support open loop daylight harvesting.

1. **Listing:** Lighting controls shall be UL/CUL listed and be compliant with the following:
   - **a.** FCC Part 15
   - **b.** BAA and BABA
   - **c.** Title 24, ASHRAE, IECC

2. **Low Voltage Connections:** Each ELCS Ceiling Sensor shall be provided with x2 RJ45 connectors for connecting to other EVO Lite devices with CAT5/5e/6 cable. Additionally, each ELCS Ceiling Sensor shall have the following:
   - **a.** x3 22 AWG wire leads as an alternate connection method to EVO Lite Power Packs or other 24VDC power supplies.
   - **b.** x3 22 AWG wire leads to provide N.O./N.C. auxiliary contacts for connection to HVAC or BAS systems.
   - **c.** x2 22 AWG wire leads for direct 0-10VDC control of fixtures by the ELCS's full range photosensor.

3. **Power:** Powered from EVO Lite Power Pack via CAT5/5e/6 cable or via x3 22 AWG wire leads as an alternate connection method.

4. **Sensor Functionality and Adjustments:** The ELCS Ceiling Sensor shall support occupancy and vacancy modes and require an initial PIR event to enable acoustic functionality, which will overlap and enhance overall detection once enabled, and will extend sensor time delay upon occupant sound detection. To prevent sounds alone from keeping lights on indefinitely, periodic PIR detection shall be needed to keep lights on for an extended period, otherwise lighting shall automatically shut off after 5 minutes of acoustic detection only. Acoustic detection shall remain enabled for a brief period after the sensor times out, to allow for voice reactivation of the lights. Automatic Threshold Control filters background noise to fine tune acoustic sensitivity, filtering out non-occupant noises. Additionally, the ELWS shall allow for the following manual adjustments:
   - **a.** Sensitivity adjustments for passive infrared and acoustic which can be independently adjusted to three different levels, including PIR-only mode
   - **b.** Vacancy time-delay adjustments
   - **c.** Enable/Disable LED indicators.
   - **d.** Photocell 0-10V Scale and Relay cutout adjustments.

2.5 SWITCH STATIONS AND COVER PLATES

A. Hardwired Switches and Cover Plates: Electrical contractor shall provide and install switch plates and switches of the quantities and types shown on the drawings and specified herein.

1. **Key Switch**

a) **Key Switch:** Key switch shall consist of a single-pole double-throw momentary or maintained switch. They shall be available to allow the key to being removed in the ON position or the OFF position.
b) **Cover plates:** Plates shall be available in stainless steel.

2. **Wet Location Touch Switch:**

a) **Switch**: Touch activated switches shall be momentary push-buttons with an IP65 rating.
b) **Cover plates:** Single-gang plates available in stainless steel with 1-3 buttons per gang.
c) **Gasket:** Cover plate neoprene gaskets shall be available for weatherproof applications.
d) **Status**: LED status indicators rings shall be optional for each switch provided.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation: Where shown in the drawings, the contractor shall furnish and install programmable lighting controllers of the quantities, sizes, and types shown on the drawings or specified herein.

B. Requirements: All equipment shall be installed in accordance with manufacturer requirements and in compliance with all applicable local and national codes and requirements.

3.2 MANUFACTURES SERVICES

A. Factory Programming: All controllers shall be factory programmed upon request in accordance with the project specifications prior to shipment.

B. Installation Assistance: During the installation process, the manufacturer shall provide, at no cost, technical support via a toll-free telephone line to the installing contractor or owner's representative to answer questions and supply additional information when required.

C. System Start-Up: The system manufacturer shall provide a factory authorized field technician to the project site after installation has been completed and prior to the system being energized for the purpose of testing and adjustment of the system. Factory field technician shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 4 weeks prior to scheduling a field technician for the start-up of the system. Should the field technician arrive on the job site and find the installation incomplete, the installing contractor shall pay the cost of any future visits by the field technician required to complete the system start-up.

D. On-Site Programming: During the start-up procedure, the factory field technician shall provide programming assistance and guidance to the building operating personnel to program the systems for initial operation.

E. Instruction: During the start-up procedure, the factory field technician shall provide training to the building operating personnel in the operation, programming, and maintenance of the lighting control system.

F. As-Built Drawings: After completion of the system installation and testing, the manufacturer shall provide 3 sets of "as-built" drawings.

G. Operation and Maintenance Manuals: After completion of the system installation and testing, the manufacturer shall provide 3 sets of Operations and Maintenance Manuals.

H. Lifetime Telephone Support: The system manufacturer shall provide a direct telephone number to the system user and shall allow access to free telephone support for the life of the system.