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ILC LIGHTMASTER
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, neon, cold cathode, fluorescent and HID lighting sources.
- B)** Where shown on the drawings, the contractor shall furnish and install a complete low-voltage lighting control system consisting of, but not limited to, relays, contactors, controllers, enclosures, switch station and miscellaneous components as required for a complete, operable 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 (UL), the National Electrical Code (NEC), Federal Communications Commission (FCC) and any local or state codes that may be applicable.
- D)** The products specified herein are those of Intelligent Lighting Controls, Inc. Low-voltage lighting control systems manufactured by the following manufacturers shall be considered provided they meet the requirements of these specifications and provide the quality and performance specified herein.
 - 1. ILC — Intelligent Lighting Controls, Inc.
 - 2.
 - 3.
- E)** Listing of a manufacturer as acceptable does not in any way 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 specifications requirement and the system being proposed.
- G)** Any ambiguities in the drawings or specifications 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 station 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) **Component Testing:** All system components and assemblies shall be individually tested prior to assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications prior to shipment.
- C) **NEC Compliance:** All system components shall comply with all applicable sections of the National Electrical Code (NEC) as required.
- D) **NEMA Compliance:** All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
- E) **UL Approval:** All applicable equipment shall be UL listed under section 916 / 508 and shall bear labels indicating compliance.
- F) **FCC Emissions:** All applicable equipment shall comply with FCC emissions standards specified in Part 15, for commercial applications and shall bear labels indicating compliance testing. Equipment that does not meet these standards shall not be acceptable.

1.3 SUBMITTALS

- A) Manufacturer shall provide 10 copies of submittal drawings and data for approval prior to beginning manufacture of equipment.
- B) 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 specifications requirement and the equipment / systems being proposed. Comparison shall include a complete listing of how the proposed equipment / systems differ from that specified with regard to 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 relative placement of major system components and the required connections between each.
6. **Shop Drawings:** Submittal shall include shop drawings that accurately represent the system or systems specified herein. Shop drawings shall include the name of the project, quantity and physical dimensions of all major system components, wire sizes and counts for all required connections between system components.

1.4 WARRANTY

- A) **Manufacturer's Warranty:** Manufacturer shall provide a written warranty that shall cover all lighting control equipment. Manufacturer shall agree to repair or replace any equipment that fails due to material or workmanship for a period of 1 year.
- B) **Relay Warranty:** Manufacturer shall provide a separate written warranty that shall cover all lighting control relays within the lighting control system. Manufacturer shall agree to repair or replace any relay that fails due to material or workmanship for a period of 3 years.
- C) **Warranty Period:** The warranty period shall begin after the completion of the installation and the systems start-up and training, the point at which the system owner receives beneficial use of the control system or 1 year after shipment from the manufacturer, whichever occurs first.

PART 2 - PRODUCTS

2.1 PROGRAMMABLE LIGHTING CONTROLLER(S)

- A) Where shown on the drawings, the contractor shall furnish and install a programmable lighting control system consisting of programmable lighting controllers, switches and other devices in the quantities, sizes and types shown on the drawings and specified herein.

B) Programmable lighting controllers shall contain relays, contactors and other devices of the sizes and quantities indicated on the drawings and specified herein.

C) 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. Back-box must be capable of being shipped ahead of 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. 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 requiring only the connection of lighting circuits and control devices.
3. **Line Voltage / Control Voltage Separation:** Each programmable lighting 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 within the line voltage section that shall provide 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.
5. **Controller Capacity/Configurations:** Controllers shall be available in sizes to accommodate 4, 8, 16, 24, 32, 40, and 48 switch inputs and relay outputs. Controllers shall be available in either the standard configuration in which the electronics are to the left of the voltage barrier with the line voltage compartment on the right or with the electronics in the center and two line/low voltage dividers with the lighting relays on the right and left sides.

D) Electrical:

1. **Controller Power Supply:** Each programmable lighting controller shall be provided with two dual-rated, UL listed Class 2 transformers capable of either 120 or 277 VAC primary (50 to 60 Hz). It shall contain an internal self-resetting fuse.
2. **Connections:** All connections shall be made to clearly and permanently labeled termination points.

E) Controller Electronics:

- 1. Controller CPU:** Each programmable controller shall be provided with a CPU (Central Processing Unit) that shall provide all the programming and control functions for the entire controller. CPU shall be protected against loss of memory during a power outage through nonvolatile RAM for a period of up to 10 years without power of any type. The power input shall be protected against surges and transients.
- 2. Real-Time Clock:** Real-Time Clock shall be used to perform all time-controlled functions. Clock accuracy shall be displayed to the second. Real-Time Clock functions shall include time of day, day of week, date and automatic daylight savings and leap year adjustments. 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.
- 3. I/O Controller:** I/O (input/output) cards shall be provided to expand the controller capability from 8 to 48 switch inputs and relay outputs in increments of 8. Electronics shall feature surge protection and opto-isolation.
- 4. Switch Input Characteristics:** Each switch input shall be designed to be actuated by dry contact from 2 or 3 wire momentary or maintained switches or their logical equivalents (Photo-cell contacts, Building Automation System Outputs, Time clocks etc.)
- 5. Input LEDs:** For each input there shall be three LEDs: **ON input contact status** (hardwired), **OFF input contact status** (hardwired) and **Programmable Pilot Output**. The LEDs reflect the true status of the relay controlled by the switch input. Normally these Pilot LEDs track with the status LED(s) of the affected relays. (If the switch turns on relay output 5 for example, relay 5 output LED will light.) However the user has the option of programming the LED to indicate the status of any relay, group or preset.
- 6. Relay Output Characteristics:** Each Relay Output shall control either a latching lighting relay rated for 120 or 277 VAC @ 20 full load amps, or a dry contact output that shall provide pulsed or maintained switching of the Class 2 circuits of other devices such as two pole relays, contactors etc. Each output is equipped with manual ON and OFF buttons that shall be used to control the output regardless of programming and with the CPU off if desired. In addition, each output has a status LED that indicates the current status of the output.
- 7. Communications:** The controller shall be equipped with a serial (RS232) port and also may be provided a modem or TCP/IP for monitoring and programming purposes.

F) Optional LightSync Switching Devices:

- 1. Device Node Capacity:** The lighting controller network shall support switch input control of up to 256 data line LightSync device nodes. The first 8 device nodes shall be powered by the lighting controller. The addition of a power supply or power supply/repeater is required for each additional 20 device nodes up to the maximum of 256. 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. Momentary push buttons are required to implement the momentary switch types and maintained switches are required to execute the maintained switch types.
- 2. Data Line Media:** The data line shall consist of RS485 communications protocol transmitted over CAT-5 or CAT-6 Cable. The controller and the data line devices shall each be equipped with two RJ45 female connectors to facilitate cable connection. 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. It shall be able to be wired in a home run configuration for LightSync devices by the addition of a LightSync Hub.
- 3. LightSync Switch Stations:** LightSync data line switch stations shall be available in momentary push button (1-6 switches and pilots) and each switch shall have a pilot light. The LightSync switch pilot lights shall be programmable to track the status of relays (default pilot1 to relay1), relay groups and presets. The pilot lights may also be programmed to be always OFF or always ON. The 1-6 push button stations shall be designed for single gang mounting.
- 4. LightSync Photocell Controllers:** The photo controller shall be provided with 256 light to dark levels (0- 1800fc). It shall allow selection of 8 individual set points for OFF and ON and includes a selectable range of dead-band. It shall have a settable filter. It shall be programmable to any relay(s) on the network.
- 5. LightSync Dry Contact Switch Module:** The LSIB-4 module shall provide 4 inputs that accepts momentary, momentary PB and maintained switch closures. Each input shall control any or all of the relays in the lighting controllers on the network. It shall provide four pilot outputs that provide true status of relays, groups and presets.
- 6. LightSync BAS Interface Switch Module:** The LSD6 module shall provide 6 optically isolated inputs/outputs that accept maintained switch closures from the BAS via a 12-24 VDC signal. Each input shall control any or all of the relays in the lighting controllers on the network. It shall provide six 100mA open collector outputs that provide true status of relays, groups and presets.

7. LightSync Disable Key Switch: The disable switch shall provide a 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.

8. SwitchVue Graphical Touch Control LCD Switch Station: The Touch switch station shall display the status and control the lighting control panel relay outputs via preprogrammed control objects on standard or custom bitmap screens. It shall be a flush mounted stainless steel LCD touch station. The touch activated screen resolution shall be 240 x 128 pixels. The screen shall be backlit for better visibility. Data connection shall be two RJ45 connectors. It shall be powered by a 24 VA transformer with a 120/277 VAC primary. The control station shall support control of any or all of the relays in any of the lighting control panels making up the lighting control system. It shall also support display of the ON/OFF status of the relays, groups or presets. The station shall support up to 126 custom screens. Screens shall be a Windows bitmap format. Each screen shall, at the user's option, be password protected. Each screen shall support up to 32 control objects. There shall be 16 control object icons. The touch station shall be programmed using software and downloaded from a lap top or PC via RS232 communications linked to the lighting controller master node.

G) Optional Special Purpose Modules: The following special purpose controller nodes shall be available.

1. DTMF Telephone Control: An optional telephone module shall support Input Status, Relay Status and Control, Preset Control and Group Control in the lighting panel via voice prompted commands and DTMF signals from a touch-tone telephone.

2. DMX Control: An optional DMX module shall support the control of relays using standard USITT DMX512 protocol used by theatrical lighting systems. Each relay in the lighting panel may be configured to be controlled by any DMX channel. A DMX filter may be set from 1 – 16 frames.

3. MODBUS Control: An optional module shall communicate directly to the lighting controller through serial communications from the BAS systems using Modicon MODBUS RTU or ASCII protocol. It shall be able to read status of inputs and relays and control single or multiple relays in the lighting controller. It shall also be able to disable/enable hardwired inputs and shall be able to force timer options.

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

- 5. BACnet Control:** An optional module shall communicate directly to the lighting controller through serial communications from the BAS systems using BACnet MSTP or BACnet IP protocol. It shall be able to read status of inputs and relays and control single or multiple relays in the lighting controller. It shall also be able to disable/enable hardwired inputs and shall be able to force timer options.
- 6. LonWorks Control:** An optional module shall communicate directly to the lighting controller through serial communications from the LonWorks network. It shall be able to read status of inputs and relays and control single or multiple relays in the lighting controller. It shall also be able to disable/enable hardwired inputs and shall be able to force timer options.

H) Programming: Programmable controllers shall be capable of being programmed, monitored 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 Key Pad and Display:** The system user shall be able to program, monitor and control any of the controller features and functions through the use of simple menu-driven self-prompting user interface consisting of a 4-line 20-character backlit LCD display and 6 selection keys that change function based on the current operating mode.
- 2. Handheld Key Pad:** For clarity and ease of use, programmer shall function identically to the Local Key Pad and Display, but shall be designed to be handheld.
- 3. Serial Direct Connect:** The system user shall be able to program, monitor or control any of the controller features and functions utilizing LightMaster Pro Windows-based graphical user interface software or the ILC NET open protocol (ASCII) using RS232 serial communications.
- 4. Modem:** The system user shall be able to remotely program, monitor or control any of the controller features and functions utilizing LightMaster Pro Windows-based graphical user interface software or the ILC NET open protocol (ASCII) using a dial-up modem.
- 5. TCP/IP:** The system user shall be able to remotely program, monitor or control any of the controller features and functions utilizing LightMaster Pro Windows-based graphical user interface software or the ILC NET open protocol (ASCII) using TCP/IP on a LAN or WAN.

- I) Diagnostic Aids:** Each programmable lighting controller shall be provided with an LED that shall indicate that the main power supply is present and operational. Each relay output shall have an LED pilot to indicate the current status of all controlled relay outputs. In addition, the system user shall be able to monitor and control any programmable lighting controller directly and in real time through any of the programming methods listed above. System users shall be able to view the current status of any or all relay outputs, force any relay output ON or OFF, and view the current status of any or all switch inputs.
- J) Data Protection and Storage:** All programmed data shall be stored in nonvolatile RAM that shall protect all stored programming data from loss during a power outage for a minimum period of 10 years without power of any type.
- K) Power Failure and Power-Up Options:** Each programmable lighting controller shall be provided with circuitry that shall automatically shut down the controller whenever the incoming power fails to be delivered to the controller within required limits. When power is returned to the controller, one of the following power-up modes will be implemented (user selectable) 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 operations and all circuits will be maintained in the condition they were last in.
 - 2. Forced ON:** Controller will force the selected relay output to the ON state after power-up. Time-scheduled events that were to take place during the power outage will be ignored; however, all future scheduled events will be activated.
 - 3. Forced ON with Input 1 Closed:** Controller will force the selected relay output to the ON state after power-up if input 1 is closed. Time-scheduled events that were to take place during the power outage will be ignored; however, all future scheduled events will be activated.
 - 4. Forced OFF:** Controller will force the selected relay output to the OFF state after power-up. Time-scheduled events that were to take place during the power outage will be ignored; however, all future scheduled events will be activated.
 - 5. Forced OFF with Input 1 Closed:** Controller will force the selected relay output to the OFF state after power-up if input 1 is closed. Time-scheduled events that were to take place during the power outage will be ignored; however, all future scheduled events will be activated.
- L) Manual Push Buttons:** Each relay output shall be supplied with an ON and OFF manual push-button with LED pilot that shall allow the system user to view the current status and/or manually turn any relay output to the ON or OFF state.

- M) True Relay Status Feedback:** Each controller shall be provided with circuitry that shall monitor the actual current status of each relay via a set of pilot contacts mechanically linked to the relay main contacts.
- N) Staggered or Instant Relay ON/OFF Activation:** Programmable lighting controller shall be support user selectable instantaneous or staggered relay activation. (17 or 50 ms duration)
- O) Input Flexibility:** Each switch input shall accept the logical equivalent of a dry contact 2 or 3 wire maintained or momentary switch.
- P) Input to Output Programmability:** Any switch input may be programmed to control any or all of the controllers relay outputs without limitations in the network.
- Q) Relay Groups:** The controller also shall support the grouping of individual relay outputs into 48 relay groups and be controlled network wide. These groups may be controlled by switch or time based signals.
- R) Switch Input Types:** Each of the programmable lighting controller switch inputs shall be programmable for one of the below listed switch types.
- 1. Momentary ON/OFF:** When momentary contact is made between the ON and COM, relay outputs controlled by this input are turned ON. When momentary contact is made between OFF and COM, relay outputs controlled by this input are turned OFF.
 - 2. Momentary Push-Button:** When momentary contact is made between the ON and COM, relay outputs controlled by this input are turned ON and OFF alternately, based on current state, each time contact is made.
 - 3. 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.
 - 4. 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.
 - 5. Set Preset:** When momentary contact is made between the ON and COM, the selected preset scene will be activated. Controller shall provide 48 user definable presets that can be activated by switch input or timer.

- 6. 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 switch input OFF and COM. Then the ON/OFF outputs and HI/LOW outputs are turned OFF.
- 7. 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.
- 8. 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.
- 9. 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 timed 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.
- 10. Input Disable:** When maintained contact is made between the ON and COM, inputs programmed for disable from this switch input will be ignored.
- 11. Timer Disable:** When maintained contact is made between the ON and COM, timers programmed for disable from this switch input will be ignored.
- 12. Network Disable:** When maintained contact is made between the ON and COM, network commands sent to the controller via the control network are ignored.
- 13. Output Override:** When maintained contact is made between the ON and COM, relay outputs controlled by this input are either turned ON, OFF or HELD in their current state until the input is released. All inputs, timers and network commands are ignored for controlled relay outputs.

14. Force Timer: When momentary contact is made between ON and COM, the selected timer shall be activated.

S) Photo / Motion Sensor Inputs: Programmable lighting controllers shall be designed to accept dry contact control inputs from photo or motion sensors and program them to perform any of the available switch input functions.

T) Fire Alarm System Inputs: Programmable lighting controllers shall be designed to accept dry contact control inputs from fire alarm control systems and program them to perform any of the available switch input functions.

U) Switch Input Active Times: The system shall support the ability to enable/disable switch inputs according to a user-defined set of times.

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

1. Blink Alert: Each relay output within the programmable lighting controller can be individually programmable to blink prior to being turned OFF. 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, relay output will be overridden and left ON for the override time. Override times shall be adjustable from 5 to 999 minutes in 1-minute increments.

2. Astronomical Clock: Each controller shall contain an astronomical time clock that shall calculate sunrise and sunset times based on the geographical positioning information provided during the programming of the system. 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 for the system timer for before and after these times based on an offset of 1-999 minutes either before or after the calculated sunrise or sunset event.

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.

4. **Time-of-Day Scheduling:** Each programmable lighting controller shall be provided with a minimum of 48 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, OFF at any standard time in 1-minute increments or at times calculated by the astronomical clock for sunrise and sunset with offset. Timers shall be day-of-week selectable timers and may be programmed to activate on any combination of days of the week (Sunday through Saturday), on all days, or to activate on a specific date only (“Holiday Schedule”). Each non-holiday timer shall be capable of being programmed to either halt operation on holidays or to ignore holidays and continue normal operations on holidays.
 5. **OFF Hour Sweeps:** The system shall also support after hours OFF sweeps of selected relay outputs at user defined one, two, or three hour intervals.
 6. **Alarm ON:** Relays shall be capable of performing a momentary ON function. The ON function shall be programmable from 1 to 99 seconds.
 7. **Alarm OFF:** Relays shall be capable of performing a momentary OFF function. The ON function shall be programmable from 1 to 99 seconds.
 8. **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.
 9. **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.
- W) **Pre-Sets:** The lighting controller shall support up to 48 user-defined presets (ON/OFF relay patterns). The presets may be invoked by switch or timer actuation.
- X) **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.
- Y) **Password Protection:** Each Programmable controller shall have a user definable 6-number password, which will lock out the keypad programming functions.
- Z) **Networking:**
1. **Network Capacities:** In addition to the data line devices mentioned in Section F, LightMaster Controllers shall be linked together on the data line to form a Local Area Network (LAN) of up to 128 controller nodes.

2. **Network Features:** The LightMaster controller addressed as Node 1 shall be the LAN Master and process all communications, command and data with the other controllers. The LAN supports global switching, time based control, and data sharing. Should the Master controller become inactive, the other controllers shall continue to execute their locally programmed parameters.
3. **Network Configurations:** The Standard Network shall consist of up to 32 lighting controller nodes (a single Master controller and up to 31 Slave controllers). Programming of the LAN shall be done from the master controller screen/keypad or with software. The Extended Network shall support up to the maximum of 128 controller nodes. It shall consist of a Network Manager (which does not count as one of the controller nodes) and Slave controllers. Programming of the Extended Network shall be through the Network Manager and software using a personal computer.
4. **Network Options:** The following special purpose controller nodes shall be available. Each special purpose node shall be counted as one of the 128 permissible controller nodes and provides network wide control for its specialized function:
 - a) **DTMF Telephone Control:** An optional telephone Gateway shall support the control of relays, Presets and Groups on the network via voice prompted commands and DTMF signals from a touch-tone telephone. This Gateway is capable of supporting up to 4 lines.
 - b) **DMX Control:** An optional DMX Gateway shall support the control of relays on the network from a single point connection using standard USITT DMX512 protocol used by theatrical lighting systems.
 - c) **MODBUS:** An optional Modbus Gateway shall support communications from the BAS systems using Modicon Modbus protocol from a single point connection. All network input status and relay status and control are supported.
 - d) **N2:** An optional N2 Gateway supports communications from the BAS systems using Metasys-N2 protocol from a single point connection. Node 01 input status and network wide group status and control are supported.
5. **BAS System/ LightMaster Operation:** Programmable lighting controllers integrated/interfaced to other building control and alarm systems must remain completely functional and continue to process all programmed commands, including time schedules and local switching.

6. Optional Programming Mechanisms: Both the Standard and Extended network configurations support programming from a properly equipped personal computer loaded with LightMaster Pro software. In addition to the software a RS232/RS485 interface and conversion cards are required if the distance between the P.C. and Master node 01 is more than 50 feet.

2.2 LIGHTING CONTROL RELAYS

- A) Electrical contractor shall provide quantities of Class 2 lighting control relays as indicated on the drawings and schedules as specified herein.
- B) Class 2 lighting control relays shall be individually UL and CUL listed and shall bear labels indicating compliance.
- C) Class 2 lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 1,000,000 ON/OFF cycles at no load.
- D) Class 2 lighting control relays shall be designed for control of 120, 277 or 347 VAC lighting control circuits at a full 20 AMPS and motor loads of 1 Hp @ 120 VAC.
- E) Class 2 lighting control relays shall be designed with a magnetic 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.
- F) Each Class 2 lighting control relay shall contain an auxiliary set of contacts (rated at 1 AMP 30 VAC) electrically isolated but mechanically linked to the main contacts for the purpose of true status monitoring and pilot light activation.
- G) Relays shall be capable of panel or remote mounting up to 2,500 feet from the controlling device.

2.3 20 AMP 2 POLE CONTACTORS

- A) Electrical contractor shall provide quantities of 20 AMP 2 pole contactors as indicated on the drawings and schedules as specified herein.
- B) 20 AMP 2 pole contactors shall be individually UL and CUL listed and shall bear labels indicating compliance.

- C) 20 AMP 2 pole contactors shall be designed for the control of 208, 240 and 480 VAC loads at a full 20 Amps.
- D) Poles within the contactor 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.

2.4 SWITCH PLATES & CONTROL STATIONS

A) **Standard Switch Plates (NFP):** Electrical contractor shall provide and install switch plates and switches of the quantities and types shown on the drawings and specified herein.

1. Switch plates shall consist of a control panel faceplate, switches, LED pilot lights and all mounting hardware.
2. Switch plates shall be manufactured from a single piece of stainless steel or aluminum, finished and labeled as per the plans and specifications or as indicated on approved drawings.
3. Switch plates shall be designed to mount to standard electrical gang boxes supplied by the electrical contractor for either flush or surface mounting.
4. Switch plate labeling and switch identification shall be accomplished through the use of engraved phenolic labels, permanently attached to the switch plate or engraved into the control panel faceplate material. Silk-screened or painted labeling shall not be acceptable.
5. Switch plates shall be supplied with the appropriate number of center OFF momentary rocker switches as indicated on the drawings.
6. Switch shall consist of a single-pole double-throw center OFF momentary switch rated at 6 Amps @ 125 VAC with or without pilot as required.

B) **Decorative Switch Plates (Decora):** Electrical contractor shall provide and install switch plates and switches of the quantities and types shown on the drawings and specified herein.

1. Switch plates shall consist of a control panel faceplate, switches and all mounting hardware.
2. Switch plates shall consist of an injection-molded faceplate with matching switch.

3. Switch plates shall be designed to mount to standard electrical gang boxes supplied by the electrical contractor for either flush or surface mounting.
4. Switch plate labeling and switch identification shall be accomplished through the use of engraved phenolic labels, permanently attached to the switch faceplate.
5. Switch plates shall be available in standard configurations of 1 to 8 gangs with 1 switch per gang.
6. Switch shall consist of single-pole double-throw center OFF momentary switches rated at 15 Amps @ 125 VAC with or without pilot as required.

C) Key-Switch Switch Stations: Electrical contractor shall provide and install key-switch switch stations of the quantities and types shown on the drawings and specified herein.

1. Key-switch switch plates shall consist of a control panel faceplate, key switches, LED pilot lights and all mounting hardware.
2. Key-switch switch stations shall be manufactured from a single piece of stainless steel or aluminum, finished and labeled as per the plans and specifications or as indicated on approved drawings.
3. Key-switch switch stations shall be designed to mount to standard electrical gang boxes supplied by the electrical contractor for either flush or surface mounting.
4. Key-switch switch station labeling and switch identification shall be accomplished through the use of engraved phenolic labels, permanently attached to the switch plate or engraved into the control panel faceplate material. Silk-screened or painted labeling shall not be acceptable.
5. Key-switch switch stations shall be available in standard configurations of 1 to 8 gangs with 1 key switch per gang.
6. Key switches shall consist of a single-pole double-throw center OFF momentary key switch rated at 6 Amps @ 125 VAC with or without pilot as required.

D) Custom Switch Plates and Graphic Switching Stations: Electrical contractor shall provide and install custom switch plates and graphical switching stations of the quantities and types shown on the drawings and specified herein.

1. Switch plates shall consist of a control panel faceplate, switches and other control devices as required, LED pilot lights and all mounting hardware.

2. Switch plates shall be manufactured from a single piece of stainless steel, aluminum, brass or bronze, finished and labeled as per the plans and specifications or as indicated on approved drawings.
3. Switch plates shall be designed to mount either to a standard electrical gang box supplied by the electrical contractor for either flush or surface mounting or to a custom back-box supplied by the manufacturer.
4. Switch plate graphics and labeling shall be accomplished through the use of one or a combination of multi-color anodized, engraving or phenolic labels, permanently attached to the faceplate material. Painted graphics and labeling shall not be acceptable.
5. Switch plates shall be supplied with the appropriate number of switches, LED pilots and other control devices as indicated on the drawings.
6. Graphic switching station shall contain a graphic representation of the controlled space with switches and other control devices graphically located on the station so as to indicate their associated areas of control.

PART 3 - EXECUTION

3.1 INSTALLATION

- A) Where shown on 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) All equipment shall be installed in accordance with manufacturer requirements and in compliance with all applicable local and national codes and requirements.
- C) Load circuit wiring shall be sized so that voltage drop shall not exceed 5% at socket of fixture farthest from the power source on any branch circuit.

3.2 MANUFACTURER'S SERVICES

- A) **Factory Programming:** All controllers shall be factory programmed in accordance with the project specifications prior to shipment. All required firmware and software shall be installed prior to final testing and 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 (Optional):** The system manufacturer shall provide a factory authorized field technician to the project site after installation has been completed and prior to system energization 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 2 weeks prior to scheduling a field technician for 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 in order 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 Toll-Free Telephone Support:** The system manufacturer shall provide a toll-free telephone number to the system user and shall allow access to free telephone support for the life of the system.