

SECTION 260933
(previously 16575)
Central Lighting and Dimming Controls

PART 1 - GENERAL

1.1 SUMMARY:

- A. Work Included: The work of this Section shall cover all labor, materials, and equipment to furnish Central Dimming Controls herein specified, including:
 - 1. Lighting Controllers with Integrated Dimmers & Switches
 - 2. Lighting Control System Processors
 - 3. Lighting Control System User Interfaces
 - a. Keypads
 - b. Touch Panels
 - c. Web Based Interfaces
 - 4. Lighting Control System Software
 - 5. Lighting Control Communications Network
- B. Complete System: The Contractor shall provide all items necessary for a complete, safe, fully functional system as described herein including all tools, labor and supervision, even though they may not be specifically enumerated.
 - 1. Any errors, omissions or ambiguities do not relieve the Contractor of this responsibility, but shall be brought to the attention of the Engineer for clarification.
 - 2. The Contractor shall be responsible for acquiring, installing, wiring and coordination of all components and equipment.
 - 3. The Contractor shall furnish all conduit, wire, connectors, hardware and other materials necessary for a complete and properly functional lighting control and dimming system as specified.
- C. Related Sections:
 - 1. Section [122000 - Window Treatments:] Window treatments controlled by the Lighting Control System.
 - 2. Section [260923 – Lighting Control Devices:] Occupancy and Daylight sensors used in conjunction with the Lighting Control System.
 - 3. Section [260926 – Lighting Control PanelBoards:] Lighting panels (switching) controlled by the Lighting Control System.
 - 4. Section [262726 - Wiring Devices]
 - 5. Section [265113 – Interior Lighting Fixtures, Lamps, and Ballasts:] Fluorescent lighting ballasts controlled by Lighting Control System.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Contractor shall maintain accurate, as-built Panel Schedules detailing connection and type of lighting loads in the system.
 - a. Schedules shall detail, at a minimum:
 - 1) Circuit ID, Number, Or Designation.
 - 2) Actual Connected Load, Voltage, And Load Type Per Circuit.
 - 3) Clear Designation Of Emergency Loads, Where Applicable.
 - 4) Circuits And Their Respective Control Zones.
 - b. Panel Schedules shall be indexed on a per panel per dimmer/ relay basis
 - c. Panel Schedules shall be updated and provided to the Manufacturer of the Lighting Control System no later than (30) days prior to commissioning.
 - 2. Contractor shall ensure that connected loads are compatible with the dimming and switching equipment provided. These steps shall include:
 - a. Provision of manufacture of LED fixtures with associated drivers to the Manufacturer of the Central Dimming Controls.
 - b. Provision of manufacture of Fluorescent fixtures with associated ballasts and lamps to the manufacturer of the Central Dimming Controls.

- c. Provision of manufacture of Low-voltage fixtures including model number and type of transformer

1.3 SUBMITTAL REQUIREMENTS

- A. Submittals for Review: The manufacturer shall provide Submittals for approval prior to fabrication of the equipment, in quantities and schedule as defined by Section [013300]. A set of drawings shall be returned, appropriately marked, as the approval document. Submittals for Review shall include:
 - 1. Product Data:
 - a. Bill of Materials
 - 1) Bill of Materials shall include all components in the system and shall include quantity, description, and model #.
 - 2) Components shall be logically grouped by assembly (station, panel, or device)
 - b. Manufacturer's catalog cut sheets for standard equipment.
 - 1) Cut sheets must contain full information on dimensions, construction, applications, etc. to permit proper evaluation
 - 2) Cut sheets must be properly identified as to their intended use.
 - 3) Options or variations must be clearly noted.
 - c. A copy of the Manufacturer's warranty document for this project.
 - 2. Shop Drawings:
 - a. Full system schematics and riser diagram(s) illustrating interconnection of system components, including:
 - 1) Wiring Requirements.
 - 2) Power Feeds.
 - 3) Back Box Sizes.
 - 4) Any Special Installation Considerations.
 - b. Load Schedules Indexed By Panel, Clearly Indicating:
 - 1) Circuit ID, Number, Or Designation.
 - 2) Actual Connected Load, Voltage, And Load Type Per Circuit.
 - 3) Clear Designation Of Emergency Loads, Where Applicable .
 - 4) Circuits And Their Respective Control Zones.
 - 3. Specification Conformance: Clearly indicate one of the following conditions:
 - a. The equipment and systems submitted conform exactly with project specifications and drawings.
 - b. The equipment and systems submitted meet the intent of the specification via an alternate means.
 - 1) Provide a detailed statement indicating paragraph by paragraph and line by line wherein the equipment submitted deviates from the specifications.
 - 2) Note all variations from the specified system on the Shop Drawings in ¼" high bold notations.
 - 3) Provide a narrative confirming specified function and detailing alternate means for achieving specified function.
- B. Submittals for Project Record: The Manufacturer shall provide submittals for Project Record as defined by Section [017800]. Submittals for Project Record shall include:
- C. Warranties: All equipment shall be warranted free of defects in materials and workmanship.
 - 1. All materials provided will be covered for a period of 2 years following date of commissioning.
 - a. The warranty shall cover 100% of the parts and manufacturers labor costs required during the warranty period, which are directly attributable to the manufacturer.
 - b. Warranty coverage shall begin on the date that the equipment is energized.
 - 2. Operations and Maintenance Manuals, including:
 - a. Operations manuals for system components.
 - b. Operations manuals for user interfaces and system program.

- c. Contact information for 24 hour a day, 7 day a week, 365 day a year technical support hotline.
- 3. As-Built System Drawings, including:
 - a. Shop drawings annotated to reflect installed condition of the system
 - 1) Device Network ID's.
 - 2) Room numbers for installed equipment and devices.
 - 3) Feed circuit panel and breaker designations.
 - b. As-wired load schedules per panel reflecting zone, room, and group designations.

1.4 REFERENCES

A. Reference Standards

- 1. Listing and Labeling: Where applicable standard have been established, equipment shall be "Listed and Labeled" by a "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7. The terms "Listed and Labeled" shall be defined as they are in the National Electrical Code, Article 100.
- 2. NEC Compliance: National Electrical Code (NFPA 70)
- 3. NEMA Compliance: National Electrical Manufacturers Association
- 4. Materials: All materials used in this project shall be new, unused and of the latest design. Re-furbished and obsolete materials are not permitted.
- 5. The mechanical fabrication and workmanship shall incorporate best practices for good fit and finish. There shall be no burrs or sharp edges to cause a hazard nor shall there be any sharp corners accessible to personnel.
- 6. All moving parts shall have specified tolerances. All equipment shall be built and installed to facilitate future maintenance and replacement.
- 7. Paint shall be the manufacturer's standard finish and color except as noted.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer[s]: All base bids will include dimming, switching, and control equipment as specified and manufactured by the following approved manufacturer[s]:
 - 1. Crestron Electronics, Inc., Commercial Lighting Controls, 15 Volvo Drive, Rockleigh, NJ 07647 Phone: 800.237.2041 Fax: 201.767.1903.
- B. Single Manufacturer: Provide system hardware with one common manufacturer. In order to establish single manufacturer responsibility, no integration of more than one manufacturer's hardware shall be allowed unless otherwise clearly noted in this specification.
- C. Basis of Design Products: The following products establish the basis of design for the quality and function of the equipment and systems specified herein.
 - 1. DIN Series Commercial Dimming & Switching Panels
 - 2. CNX, Cameo™. C2N Series Keypads
 - 3. DIN-AP2 Series Lighting Processor
 - 4. CAEN Automation Enclosure
 - 5. Crestron iLux Integrated Multi-Zone Lighting System
- D. Substitutions:
 - 1. The base bid shall be as specified with equipment manufactured by Crestron Electronics. Alternate equipment proposals, including those by Manufacturers approved by addenda as outlined below, shall be provided as an add or deduct from the base bid.
 - 2. Other equipment manufacturers seeking acceptance must submit an Application for Approval at least (10) working days prior to the bid opening date.
 - a. Approval of alternate manufacturers shall be by addenda.
 - b. Submittals for systems by Manufacturers not pre-approved shall be rejected without review.
 - 3. Applications for approval of alternate manufacturers shall contain, at a minimum, the following information:

- a. Evidence of compliance with Manufacturer Qualifications as outlined below.
 - b. A listing of three (3) equivalent installations including:
 - 1) Name, address and telephone number of Owner
 - 2) Name, address and telephone number of Architect
 - 3) Scope of work
 - c. Full system riser diagram(s) illustrating interconnection of system components, wiring requirements, back box sizes and any special installation considerations. Drawings shall include load and feed wiring as well as control wiring.
 - d. A detailed statement indicating paragraph by paragraph and line by line wherein the equipment submitted deviates from the specifications.
 - e. A narrative confirming specified function and detailing alternate means for achieving specified function.
4. Approval to bid does not guarantee acceptance:
- a. It shall be the responsibility of the Contractor to ensure that equipment and systems provided meet the requirements of this specification
 - b. Modifications to other equipment, systems, and infrastructure mandated by the use of alternate manufacturers, equipment, and systems shall be the sole responsibility of the Contractor.
- E. Manufacturer Qualifications:
1. Experience: The manufacturer shall have a minimum of ten (25) years of experience in the manufacture, programming, and support of Lighting Control Systems of similar size and scope.
 2. Phone Support: The Manufacturer shall maintain a dedicated 24 hour a day, 7 day a week, 365 day a year toll free technical support hotline.
 3. Online Support: Installation and operations manuals for all standard products shall be available for download at no charge from the Manufacturer's website.
 4. Field Support: The manufacturer must maintain on staff field service technicians for the purpose of programming, commissioning, repairing, and supporting control systems.
 - a. Manufacturers relying on outside contractors or field service agents to commission, support, program the systems herein specified shall not be acceptable.
 - b. On site support shall be available within (72) hours of notification.
 5. Environmental: Manufacturer shall be RoHS compliant in manufacture of all products provided
- F. Quality Control:
1. Wiring: Manufacturer shall offer assembly of all dimming modules into dimming cabinets and complete all internal wiring at the factory prior to shipment. Wiring shall be 100% factory tested prior to shipment.
 2. Testing: System testing shall be done as a complete, powered system.
 - a. All dimmers shall be simultaneously connected to actual loads and all control stations shall be connected to the dimmer cabinet(s).
 - b. The on-site testing and check out shall verify the system to be completely functional.
- G. Delivery, Storage, and Handling:
1. Systems shall be ordered and released in compliance with manufacturer's instructions and stated lead-times to avoid construction delays.
 2. Storage: Prior to installation, Contractor shall provide secure, dry, broom clean storage for all system components in an area or facility suitable for the storage of electronic devices.
 3. Contractor shall install equipment only after the following conditions can be maintained in the area(s) where equipment is to be installed:
 - a. Ambient temperature: 0° to 40° C (32° to 104° F).
 - b. Relative humidity: Maximum 90 percent, non-condensing.
 - c. Equipment must be protected from dust during installation

4. Control Surfaces (preset controllers, touch panels and keypads) shall only be installed once the installation area is a “conditioned space”, as determined by the conditions outlined above and the following additional considerations:
 - a. Heating/ cooling and humidity control systems are on line.
 - b. All cutting, patching, painting, and sanding work is complete.

2.2 DIMMING & SWITCHING CABINETS

A. Mechanical

1. Panels shall be passively cooled via free-convection, unaided by fans. Systems that are fan dependent or fan assisted for cooling of components are not acceptable. Systems that require or recommend regularly scheduled maintenance for air filtration components are not acceptable.
2. All input feed, load and control terminals shall be front accessible without the need to remove dimmer assemblies or other components.
3. Panels shall be UL listed, CSA certified, NOM approved or CE marked (as appropriate).
4. DIN Series modules shall mount in panel using custom mounting kit or shall be mounted in universal generic DIN enclosures.

B. Electrical

1. Dimming control cabinet(s) shall contain all dimming modules, control wiring, relays, and power supplies.
2. Dimming control cabinets shall be capable of being operated from a normal feed, an emergency feed or a normal/ emergency feed.
3. Normal / Emergency dimming control cabinets shall be fed by a single Normal / Emergency feed through the use of a line side (upstream) normal / emergency power transfer switch supplied by others.

C. Dimming Modules

1. Each channel of the dimmer should be capable of auto-detecting the dimmable load type connected to it and selecting the appropriate operating mode to control that load. Reverse phase (trailing edge) mode should support incandescent and electronic low-voltage load types, while forward phase (leading edge) mode handles magnetic low-voltage, neon, and other inductive load types. A non-dim mode is also selectable for switching of non-dimmable lighting fixtures. Any channel may be set for any mode, allowing one dimmer module to handle any combination of lighting types on four separately controlled circuits.
2. Dimming module shall utilize zero-cross filter technology to provide immunity to noise on the power line, reducing lamp flicker and compensating for fluctuations in line voltage and frequency.
3. Dimming module shall utilize built-in OCP (over current protection) which prevents failure of the module caused by excessive loading or improper wiring of the outputs
4. Dimming module shall contain an internal master relay which automatically opens providing air-gap isolation to allow safe servicing and changing of light bulbs on all four controlled circuits.
5. Dimming module shall utilize an override input which provides an external contact closure to momentarily override the control system program and set each channel output to its override preset level. Levels can be adjusted and saved locally from the front panel, or remotely via software.
6. Dimming modules shall be compatible with the load types that are to be controlled. Each module shall be able to control a minimum of 4 separate circuits – each independently controllable and fed from their own circuit breaker.
7. Dimming modules for 0-10V fluorescent dimming ballasted fixtures shall have 4 independent circuits using a an analog 0-10 VDC signal plus an air-gap relay and an LED indicator confirming 24 VDC power supply from Cresnet network. Up to 30 ballast will be supported

D. Relay / Switching Modules

1. Relay modules shall have eight separate channels or circuits that can be independently controlled through the Cresnet system. Each circuit shall be a SPST mechanically held latched relays or magnetically held air gap relays rated for 50,000 switching cycles under full load.
2. Relay / switching modules shall also have LED indicators that confirm 24 VDC power from the Cresnet network as well as individual LEDs to indicate which relays are energized.

E. Normal / Emergency Panels

1. Panel shall be capable of operating from a normal feed or a normal/emergency feed. Panels requiring additional devices to make them capable of accepting normal/emergency or emergency feeds are not acceptable.
2. Upon the loss of normal input power, a panel operating from a normal/emergency feed shall immediately turn all circuits within that panel to full-on condition when emergency input power is present.
3. During the presence of normal power, circuits designated as emergency circuits shall be controlled via the same controls as circuits designated normal. If both normal and emergency circuits are on the same zone of control, all circuits shall react identically to a control intensity change.
4. Emergency power feed may be provided by an emergency generator, a UPS system, or an IPS system with true sine wave output and a maximum of 10% THD when driving dimmed loads. The generator or UPS system must be capable of operating under no load conditions.
5. Normal / Emergency panels shall be fed by a single Normal / Emergency feed through the use of a line side (upstream) normal/emergency power transfer switch supplied by others.
6. Under Emergency input power feed, unless otherwise indicated all dimmers shall operate at 100% of dimmer output voltage. Under these conditions, semiconductor device will be in the full-on state.
7. Under Emergency input power feed, if required, dimmer shall be capable of operating lighting load at an emergency level lower than 100% dimmer output voltage.
8. Under Emergency input power feed, all local control stations shall be inoperable. Once normal power is restored, all lighting zones shall revert back to their status prior to the emergency condition without requiring any action on the part of the user. Restoration to OFF, ON, or a "default" level is not acceptable.
9. Illumination levels shall be field-programmable to meet local code requirements for Emergency power conditions. Such options include, but are not limited to, providing a constant minimal light level for emergency circuits during normal operation or providing full function dimming under emergency power.
10. System shall be capable of directly interfacing with a voltage detection/sensing device for Emergency lighting. The 3-Phase detection/sensing device shall: be UL 924 listed as Emergency Lighting and Power Equipment, with two dry contact closure input (normally open). The normally open input requires a maintained dry contact closure to activate the Emergency mode status indicator will indicate when these inputs are activated, and have a function test switch with status indicator to simulate a phase failure.

2.3 LIGHTING CONTROL SYSTEM PROCESSOR

- A. The control processor for the lighting control system shall be a Crestron 2 Series control system with a Motorola ColdFire microprocessor with 8MB of Flash Memory, 32MB of SDRAM and 256KB of NVRAM with expandability options.
- B. Ethernet connectible with 10/100Base T, Static IP or DHCP/DNS, SSL Protection, auto negotiating, full/half duplex TCP/IP, UDP/IP, SMTP, built-in Web server and email client; supports Crestron e-control2 Xpanel and RoomView applications.
- C. Connections: minimum of 8 Digital input/output or analog input ports (referenced to GND)
 1. Digital input: rated for 0-24VDC; input impedance 20K ohms; logic threshold 1.24 VDC.

2. Digital output: 250 mA sink from maximum 24VDC; catch diodes for use with "real world" loads.
 3. Analog input: Rated for 0-10VDC, protected to 24 VDC maximum; input impedance 20K ohms.
 4. Programmable 5V, 2K ohms pull-up resistor per pin.
 - D. Computer ports: (1) USB computer console port shall be provided on the processor.
 - E. Relay outputs: (4) normally open isolated relays rated 1A, 30V AC/DC with MOV arc suppression across contacts & (2) 8 pin 3.5mm detachable terminal blocks.
 - F. Power supply: processor shall be power by an external power supply.
 - G. Control processor shall support both standard and astronomical timed events capable of up to 500 different events. User adjustments shall be via touch panel or web-based interface.
- 2.4 KEYPADS AND CONTROL PANELS
- A. Manufacturer shall provide pushbutton style keypads with engravable button caps with integral LED light pipe feedback indicators.
 - B. Optional keypads shall have the capability to emit audible sound using fully customizable WAV files for feedback, button clicks, voice prompts or other sounds.
 - C. Each keypad and control panel interface shall communicate to the control system over the Cresnet bus, providing a 4-wire bidirectional communication and 24V power for up to 252 devices connectable by Cresnet wire or CAT5 UTP.
- 2.5 TOUCHPANELS
- A. General
 1. Touchpanels shall be manufactured by the same manufacturer as the rest of the lighting controls system. Touchpanels supplied by others are not acceptable.
 2. The display shall be an active matrix color LCD screen in panels of 5 inches diagonal or larger with edge lit fluorescent illumination and a minimum viewing angle of +/- 60 degrees on the horizontal and a minimum of +40/-55 degrees on the vertical axis.
 3. Touchpanel manufacturer shall also provide optional touchpanels that have video capability to display video input.
 4. Touchpanel manufacturer shall also provide optional touchpanels that have capability for built in audio speakers.
 5. Pushbuttons (if needed) shall be replaceable, engraveable and programmable.
 6. Touchpanel design and programming shall be included in the base cost of the system as determined by the manufacturer, and based on the scope of the project. Additional changes and programming of the touchpanel shall be available for additional fees.
 - B. PROGRAMMING: (define system control design intent for operation and interface requirements)
 1. Touchpanel design and function with defined graphics
 2. Ability to adjust scheduling of lighting events secured with password protection)
 3. Ability to show graphic representation of room combine option where required
 4. Ability to integrate with other building systems to control AV sources, HVAC controls, display security video inputs, and other systems as required.
- 2.6 IP-BASED CONTROL
- A. Web browser based control using ActiveX rather than Java to attain true touchpanel behavior. Web pages are hosted on a control system allowing control from any connected PC by launching a browser and entering the IP address (or URL) of the control system.
 - B. Control through an executable application rather than Web pages. The runtime executable loads directly onto one or more specific computers and runs from the desktop or start menu. The executable file resides and runs on the controlling PC. Control shall function over the Internet.
 - C. Web browser based control using Adobe® Flash®, Microsoft® .NET, Microsoft® ActiveX® shall be available options.
- 2.7 INTEGRATED MULTI-ZONE LIGHTING CONTROLLERS

- A. General: The Integrated Multi-Zone Controller(s) shall have, at a minimum, the following features:
1. Integrated phase-forward dimming, switching, and control in a recessed, wall mounted unit (up to 16 amps of 120vAC/10A of 230vAC). Connectivity for additional loads, voltages, and load types via outboard lighting expansion modules.
 2. Simultaneous control of up to six (6) independent channels of dimming or switching and six (6) independent zones of control for motorized shades, lifts, and screens. Connectivity for series of multiple units shall be supported for systems with more than six (6) zones of lighting and/ or shades.
 3. Up to sixteen (16) user programmable scenes per controller or series of controllers.
 4. The controller shall have dedicated and clearly labeled "ON" and "OFF" buttons with associated presets.
 5. The unit shall support an optional built-in infrared motion detector, enabling automated control based on room occupancy.
 - a. Available configurations shall include manual on/ automatic off, automatic on/ manual off, manual on/ manual off, automatic on/ automatic off.
 - b. There shall be an assignable timeout interval from 0 (no timeout) to 17 hours, 59 minutes. The timeout is the interval that must elapse with no change in motion detection before the state of the room changes from occupied to unoccupied.
 - c. Occupied and unoccupied actions can be set to recall any of the (16) presets, last lighting levels, or last state.
 6. Smooth, continuous fade for all dimmed circuits without visible hunting for levels or stepping.
 7. Adjustable fade time per preset, assignable from 0 seconds to 99 minutes via front panel controls or configuration software.
 8. Assignable Dimmer Ramp Rate adjustable from 1 to 10 seconds via front panel controls or configuration software.
 9. LED Bar graphs for all outputs indicating level of lighting and shade zones. Two-digit percentage display for selected lighting or shade zone during adjustment.
 10. System configuration via front panel controls or direct connection to a PC and configuration software.
 11. Programmable "glow" level for LED indicators on controller and remote stations to facilitate location of control surfaces in a dark room.
 12. Permanent, configurable, wear-resistant labeling system for each zone and preset providing for user customization over the life of the controller without requiring external labels, appliques, or re-engraving.
- B. Local Connectivity: The Integrated Multi-Zone Controller(s) shall provide for the following connectivity without the addition of an external processor:
1. Support for up to (16) remote keypads via local control port providing for remote operation from any connected keypad.
 2. Support for up to (16) shade, drape, or screen controllers via local control port (up to thirty-two (32) individual motors).
 3. Integrated IR Receiver for use with optional IR Remote for scene selection and level mastering.
 4. Master/ slave configuration supporting a series of up to nine (9) controllers for a total of up to fifty-four (54) lighting zones and fifty-four (54) shade groups.
 - a. Commands for typical functions like scene recall, scene off, master dimming, and occupancy status shall be shared between controllers.
 - b. Each individual unit shall support a complete assortment of local devices including keypads, shade controllers, and motion detectors.
 5. Integrated programming port for connection to a laptop computer for system programming and configuration.
- C. Network Connectivity: The Integrated Multi-Zone Controller(s) shall provide for the following connectivity via any Crestron 2 Series Network Control System:

1. Connection to touch panels for custom interfaces, programming, preset recall, system state selection, and room combine/ partitioning functions.
 2. Connection to additional occupancy sensors, photo-cells, and partition sensors.
 3. Connection to system processor providing astronomical and real time clock with programmable events.
 4. Preset definition, event definition, and system control via HTML web interface.
 5. Integration with other systems such as A/V, security, HVAC and energy management, plus remote monitoring via SNMP and manufacturer specific system wide monitoring applications.
- D. Electrical: The Integrated Multi-Zone Controller(s) shall have the following electrical characteristics:
1. Controller shall be fed via a dedicated 2-wire + ground 120vAC 20amp, 60hz (230vAC 10amp 50 hz) circuit.
 2. Controller shall provide integrated dimming & switching for (6) channels 120vAC incandescent, magnetic low-voltage, neon/cold cathode, two-wire dimmable fluorescent, and non-dim loads.
 - a. Each channel will handle up to 800 watts individually with a total rating of 1920 watts (2300 watts at 230vAC) for the complete unit.
 - b. Larger loads, Electronic Low-voltage, 3-wire fluorescent, 4-wire fluorescent, and 277vAC loads shall be supported via outboard lighting expansion modules connected to the dimmed outputs of the controller.
 - c. Load type, low end limit, and high end limit shall be assignable on a channel by channel basis.
 3. Air gap relays shall be provided per zone for all dimmed/ switched outputs, disconnecting the load from the line supply when the "off" condition is selected.
- E. Physical: The Integrated Multi-Zone Controller(s) shall have the following physical characteristics:
1. Color: Controller shall be available in White, Black, or Almond colors.
 2. Style: Faceplate shall be seamless, showing no visible means of wall connection.
 3. Mounting: Unit shall be suitable for mounting in a 3.5" deep 4-gang electrical box.
 4. Dimensions: The Integrated Multi-Zone Controller(s) shall not exceed the following dimensions:
 - a. 4.48" H x 8.89"W x 2.47" deep (no motion detector)
 - b. 4.48" H x 8.89"W x 2.60" deep (with motion detector)
 - c. Weight: 1.43lbs
- F. Environmental: The Integrated Multi-Zone Controller(s) shall be suitable for installations within the following range of environmental characteristics:
1. Ambient Temperature: 32° to 104°F (0° to 40°C)
 2. Relative Humidity: 10% to 90% (non-condensing)

2.8

EXPANSION MODULES

- A. General: Expansion Modules shall provide for control of additional capacity and voltages via the output standard, 2-wire phase forward dimmers (including Integrated Multi-Scene Controllers, Wireless Network Wall Box Dimmers, and Wired Network Wall Box Dimmers).
1. Expansion Modules shall be surface mountable as provided in their own enclosure.
 2. Expansion Modules shall have a low end trim adjustment potentiometer.
 3. System shall support control of up to (4) Expansion Modules of the same type and voltage from a single dimmed output.
 4. Expansion Modules shall emulate the fade characteristics of the dimmer controlling the module.
 5. Expansion Modules shall be available in the following configurations:
 - a. Dimming Control 120vAC to 277vAC: 2-Wire 20amp 120 to 277vAC Expansion Module, supporting up to 1920VA of the following load types:
 - 1) incandescent
 - 2) magnetic low voltage
 - 3) halogen

- 4) neon/ cold cathode
- 5) Advance Mark X Ballasts
- b. Dimming Control 120vAC to 277vAC: 3-Wire 20amp 120 to 277vAC Expansion Module, supporting up to 1920VA of the following load types:
 - 1) Lutron Hi-Lume Ballasts
 - 2) Eco-10 Ballasts
- c. Analog Fluorescent Dimming Control 0-10vDC: 4-wire 120 to 277vAC Expansion Module, supporting up to 1920VA of the following load types:
 - 1) Advance Mark 7, 120 & 277 vAC
 - 2) Sylvania Quicktronic Helios 120 & 277vAC
 - a) 0-10vDC Controlled LED Drivers
 - 3) Switched 2-wire Loads
- d. Universal Dimming Control 120vAC or 277vAC: 2-Wire or 3-Wire 20amp 120/277vAC Expansion Module, supporting up to 1920VA of the following load types:
 - 1) incandescent
 - 2) magnetic low voltage
 - 3) halogen
 - 4) neon/ cold cathode
 - 5) Advance Mark X Ballasts
 - 6) Lutron Hi-Lume Ballasts
 - 7) Eco-10 Ballasts
 - 8) Reverse phase controlled electronic low voltage
- B. Electrical: Expansion Modules shall have the following electrical characteristics:
 - 1. Power Feed: Each Expansion Module shall be fed via a dedicated 2-wire + ground 20 amp circuit of appropriate voltage (120vAC to 277vAC depending on voltage of module being used and load being controlled).
 - 2. Control Input: Dimmer Control Input shall be 120vAC 50/60 Hz phase or 230vAC independent of line input and load output.
 - 3. Air gap relays shall be incorporated into each Expansion Module, disconnecting the load from the line supply when the "off" condition is selected.
 - 4. Expansion Modules shall be UL listed, NOM certified, CSA Certified.
 - 5. Replacing Expansion Modules shall not require re-programming of system or processor.
- C. Physical: Expansion Modules shall have the following physical characteristics:
 - 1. Mounting: Expansion Modules shall be surface mountable.
 - 2. Cooling: Expansion Modules shall be convection cooled.
- D. Environmental: Expansion Modules shall be suitable for installations within the following range of environmental characteristics:
 - 1. Ambient Temperature: 32° to 131°F (0° to 55°C)
 - 2. Relative Humidity: 10% to 90% (non-condensing)

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Qualifications: Installer shall be one who is experienced in performing the work of this section and who has specialized in the installation of work similar to that required for this project, and licensed or certified by local authorities having jurisdiction as an approved installer.

3.2 FIELD CONDITIONS:

- A. All bidders shall fully inform themselves of the conditions under which the work is to be performed.
- B. No additional compensation shall be allowed for any labor or item the bidder could have been fully informed of prior to the bid date.

3.3 COMMISSIONING

- A. The Manufacturer shall provide the services of a qualified factory-employed field service engineer for a minimum of one (1) pre-wire visit and inspection. During this visit, the engineer will review the following with the Contractor's designated foreman or representative:
 1. Layout and requirements of low-voltage control wiring network.
 2. Separation of line voltage and control wiring.
 3. Equipment locations and installation, including:
 - a. Dimming/ switching panels
 - b. Control processors
 - c. Control interfaces
 - d. Shade controllers
 4. Control wiring network labeling and termination.
 5. Load/ Feed wiring connections and termination.
 6. Required information for programming and commissioning, including "As-Built" load schedules.
 7. Connections to other equipment and systems.
- B. The Manufacturer shall provide the services of a qualified factory-employed field service engineer for a system check out and commissioning visit
 1. The Contractor shall forward a written request to the manufacturer for this visit no less than fourteen (14) days prior to the requested commissioning date.
 2. Contractor shall request final check-out and commissioning following installation and termination of all feed, load, and control wiring as well as installation of all lighting fixtures and lamps,
 3. Contractor shall provide "As-Built" schedules for all dimming & switching panels to the Manufacturer with the commissioning request.
 4. Field service engineer shall, in coordination with the Contractor, shall complete and document the following during final check-out and commissioning of the system:
 - a. Verification of the proper connection of Manufacturer's equipment to feed, load, and control wiring.
 - b. Energization & configuration of manufacturer's equipment, including: dimming & switching panels, control processors, and control devices.
 - c. Installation and testing of control software and program.
 - d. Verification of proper system operation and response on a circuit by circuit, control by control basis.
 - e. Verification of the proper operation of manufacturer's interfaces to other equipment and systems.
 - f. Obtain sign-off on system functions
- C. The manufacturer shall provide (1) visit for the purpose of educating the owner's representative(s) on the capabilities, operation and maintenance of Lighting Control Systems as installed.