

SECTION 26 09 61
THEATRICAL LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes furnishing the following equipment for installation as described under Section 260963:

1. Dimmer Racks
2. Dimmer Modules
3. Panic Control System
4. Emergency Lighting Transfer System
5. Relay Panels
6. Equipment Racks
7. House & Work Lighting Controls
8. Ethernet Network System
9. Control Device Faceplates
10. Outlet Device Faceplates
11. Spare Parts

- B. Related sections include the following:

1. Theatrical Lighting Controls Installation
2. Common Work Results for Electrical
3. Interior Lighting Fixtures
4. Theatrical Lighting Fixtures
5. Rigging Systems and Controls
6. Catwalks & Wire Rope Assemblies

1.3 FULLY WORKING SYSTEMS

- A. The Manufacturer is responsible for reviewing all Drawings and Specifications which affect the work in this Section. Notify the Architect whenever analysis of the Drawings and Specifications, or progress of other trades, indicates that the work in this Section cannot be completed as specified or as scheduled.
- B. The Manufacturer shall provide any additional electrical and electronic parts and other necessary or auxiliary devices not specifically listed in these specifications or shown on the Drawings but needed to effect the functional requirements of the control systems, at no extra cost to the Owner.

1.4 DEFINITIONS

- A. Dimmer Rack: A cabinet accommodating dimmer modules, load and line connections, and circuit protection.
- B. Plug-In Module: A modular unit that is installed in a standardized mounting location throughout the dimmer rack.
- C. Dimmer Module: A plug-in module containing one or more dimmers.

- D. Control Module: A plug-in module containing centralized control electronics for the dimmer modules.
- E. Data Communication Protocol: A signal that provides control and feedback communications between devices in the system.
- F. DMX 512: A data communications protocol compliant to the USITT DMX-512/1990 specification.
- G. RDM: A data communications protocol compliant to the ANSI/PLASA Remote Device Management specification.
- H. ACN: A data communications protocol compliant to the ANSI/PLASA Architecture for Control Networks specification.
- I. POE: Power Over Ethernet: An 802.3AF compliant scheme of powering devices on an Ethernet system.
- J. BACnet: A data communication protocol for building automation and control networks.

1.5 **QUALITY ASSURANCE AND STANDARDS**

- A. References to code, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies will refer to the latest edition of such publications adopted and published prior to submittal of the bid. All such codes and standards will be considered a part of this specification as if they were fully included herein.
- B. Work and materials shall comply with the rules and recommendations of:
 - 1. Prevailing national, state and local building codes.
 - 2. UL, ETL, cUL, CSA and CE Labels – where materials and equipment are available under the continuing inspection and labeling service of applicable independent product testing and certification services, provide such labels, materials, and equipment.
 - 3. National Fire Protection Associate (NFPA) Publication: National Electrical Code, NFPA70 as applicable to installation and construction of stage lighting and control equipment.
 - 4. NEMA Compliance pertaining to components of stage lighting equipment.
 - 5. United States Institute for Theatre Technology, Inc. (USITT) DMX512/1990 (ANSI E1.11-2004).
 - 6. ANSI/PLASA Remote Device Management (ANSI/PLASA E1.20 RDM) and Architecture for Control Networks (ANSI E1.17-2006 ACN & E1.31 Streaming ACN) standards.
 - 7. Institute of Electrical and Electronics Engineers, Inc. (IEEE) 802.3 and 802.11n.
 - 8. BSR/ASHRAE Standard 135 (ISO 16484-5) BACnet protocol.

1.6 **SUBMITTALS**

- A. Submit the following with the bid:
 - 1. Bill of materials, with parts identified by common industry standard numbers and/or descriptions.
 - 2. Specified manufacturer's catalog cut sheets of all products called out in the bill of materials.
 - 3. Statement that the Manufacturer agrees to the warranty provisions.
 - 4. Projected timetable listing the time in weeks for each of the following activities:
 - a. Shop drawing preparation

- b. Fabrication
- c. Shipping to site
- d. System commissioning
- e. As built drawing preparation

B. Shop Drawings

1. Submit shop drawings for review. Drawing sheet size shall be uniform. Submittals of more than 5 drawings shall be bound. Shop drawings shall include:
 - a. Pictorial drawings of all major components including sub-assemblies, parts list, dimensions, material and finish notes, quality assurance listings, and any other applicable information.
 - b. Wiring diagrams of each component, including interconnections to other components.
 - c. Accessories and spare parts list as specified, fully itemized.
2. Fabrication shall not commence until the Theatre Consultant and the Architect determine that the shop drawings are in compliance with the design intent of the Contract Documents.
3. Shop drawings shall be revised and resubmitted as required.

C. Manuals

1. Provide an operations and maintenance manual. The manual shall include:
 - a. System description
 - b. Operation instructions, including safety measures
 - c. Maintenance instructions, including recommended procedures and schedules for inspecting system components
 - d. Catalog cuts for all purchased equipment
 - e. Recommended spare parts list
2. Provide the above manuals on letter size and/or tabloid size paper, bound in standard 3-ring binders. Also provide documents in printable electronic format, such as PDF or other universal format files, on an archival quality storage media.

D. As-built Drawings

1. Within one month of system acceptance, provide complete as-built drawings. The as-built drawings shall include:
 - a. All control schematics, risers, drawings of all system components.
 - b. Final bill of materials.
2. Provide the above as-built drawings on tabloid size paper, bound in standard 3-ring binders. Also provide as-built drawings in printable electronic format, such as PDF or other universal format files, on an archival quality storage media.

1.7 **PROJECT CONDITIONS**

- A. Within 3 weeks of the award of contract, submit written confirmation that related electrical work (as appears on the Contract Documents) provides the necessary physical accommodations for the installation and operation of the equipment in this Section.

1.8 **WARRANTY**

- A. The Manufacturer shall warrant the equipment as follows:
1. Part One - According to the guarantee provisions in the General Conditions.

2. Part Two - Additionally, for three (3) years from acceptance of the systems, provide the services detailed below:
 - a. Provide for the Owner's operating staff a technical and operational assistance hotline advice service at no additional cost for the duration of the warranty period. Such advice to be available during normal working hours and on evenings and weekends.
 - b. In-stock spares shall be available for major assemblies within 24 hours of the telephone call to the hotline establishing the need for such an exchange. For all exchanges not caused by misuse, there shall be no charge whatsoever to the Owner, including no charge for parts and no charge for freight in either direction. This service shall be free for the duration of the warranty period, but is to be offered for a fee thereafter.
 - c. The Warranty shall include two (2) service visits which will take place at the end of the first and last year under Warranty. The Manufacturer's field service representative shall consult with the Owner, inspect the system, and perform any necessary maintenance and repair. The Manufacturer shall submit a report to the Owner and the Theatre Consultant after the service visit. The report shall include recommended inspection and maintenance schedules based on the actual use of the equipment.
 - d. The Warranty period shall commence upon final acceptance by the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Except where otherwise stated, the systems described herein shall be provided by a single manufacturer responsible for furnishing all products and services described on the Drawings and/or herein. Manufacturer shall be only the following:
 1. Electronic Theatre Controls
3031 Pleasant View Road
Middleton, WI 53562
Tel: +1 608 831 4116
Web: www.etcconnect.com
- B. Manufacturer shall have been continuously engaged in the production of theatrical lighting and control equipment for at least twenty (20) years.
- C. Manufacturer shall have a twenty four hour emergency service phone line. A field service engineer shall respond to an emergency call on this line within thirty (30) minutes.
- D. Substitution of manufacturer or parts will not be allowed without prior approval of Architect, Electrical Engineer, Theatre Consultant, or Owner. Substitutions will only be accepted if, in the opinion of Architect, Electrical Engineer, Theatre Consultant, or Owner, the new product is an equal or exceeds the specified product.
- E. When a manufacturer's product has been replaced by a newer model prior to shipment, the later model shall be furnished provided the new model retains or exceeds all of the specified characteristics of the product specified herein. Products including control consoles, dimmer racks and network devices shall require a demonstration for the Architect, Electrical Engineer, Theatre Consultant or Owner.
- F. All equipment must be tested and labeled at factory prior to shipment.

2.2 PARTS

- A. All materials and equipment provided in the work of this Section shall be new and of high quality.
- B. Manufacturers' part numbers are given occasionally to indicate levels of quality and type of product expected. Parts and items by other manufacturers that equal or exceed the quality and type of those referred to herein may be acceptable. The Architect or his representative shall be the sole judge of equivalence and acceptability.

2.3 GROUNDING

- A. These systems shall be grounded, as shown on Drawings and in accordance with applicable codes and regulations and/or at the advice of the Manufacturer.

2.4 CIRCUIT BREAKERS

- A. Circuit breakers shall conform to all applicable codes and standards. The interrupting capacity of all primary and secondary circuit breakers for dimmers and relays shall be not less than 10,000 amperes SCCR.
- B. Branch circuit breakers in equipment rack component mounting panels, control device faceplates, and outlet device faceplates shall be flat-front breakers or shall be protected by a circuit breaker toggle guard.

2.5 IDENTIFICATION LABELS

- A. Provide labeling and signage for equipment as described herein and/or noted on the Drawings.
 - 1. Use 1/4" (18 pt.) letters for equipment designations and headings.
 - 2. Use 3/16" (12 pt.) letters for subsidiary information.

2.6 DIMMER RACKS

- A. Provide theatrical dimming equipment as indicated on the Drawings and specified herein. The dimmer rack and plug-in modules shall be from the following systems:
 - 1. Electronic Theatre Controls Sensor3 dimming system
 - 2. Electronic Theatre Controls Unison Paradigm dimming system
- B. General
 - 1. Dimmer racks shall be designed specifically for entertainment lighting. The dimmer racks shall be floor mounted, dead front switch boards complete with all dimmers, control electronics, timers, circuit breakers, and wiring terminations. No external components shall be required.
 - 2. Auxiliary racks shall be available to provide mounting for a wide range of subcomponents including main circuit breakers, branch circuit breakers and control components.
 - 3. Racks shall be designed for front access to allow back-to-back or side-by-side installation.
 - 4. Dimmer rack dimensions shall not exceed 85" (216cm) high x 24" (61cm) wide x 27" (70cm) deep unless otherwise shown on Drawings.
 - 5. Dimmer racks shall operate on 90 to 264 VAC 3 phase, 4 wire + ground, 47 - 63 Hz service.
 - 6. Racks shall accept a feed size of up to 800A per phase or as shown on Drawings. Bussing across multiple adjacent racks shall be possible. Delta power feeds shall be supported in racks designated for this purpose.

7. Power distribution shall be by copper buss bars. Aluminum buss bars shall not be acceptable.
8. Provide racks configured to receive the electrical services shown on the Drawings. If the quantity of dimmer modules specified, scheduled or required to compose a complete system requires additional rack spaces, provide internal inter-rack bussing to supply the additional required racks from the service shown.
9. Branch circuit load phase, neutral, and ground terminals shall accept as standard up to a #6 (16mm²) gauge wire. An optional terminal adapter accepting up to #4 (20mm²) gauge wire shall be provided as required.
10. The fault current protection rating of the rack shall be 100,000 SCCR minimum.
11. Plug-in modules shall be available in a variety of types, including 15A SCR dimmer, 20A SCR dimmer, 50A SCR dimmer, 100A SCR dimmer, 20A sinewave dimmer, 20A SCR dimmer with bypass, 20A relay and 20A constant breaker modules.
12. Racks shall be designed to allow easy insertion and removal of all modules without the use of tools. Supports shall be provided for precise alignment of dimmer modules into power and signal connector blocks. With modules removed, racks shall provide clear front access to all load, neutral and control terminations.
13. Module spaces shall be mechanically keyed to accept only the module type (20A, 50A or 100A) specified for that space. Racks that allow modules of varying wattages to plug into the same space shall not be acceptable. The rack shall be configurable to accept mixed dimmer types and sizes throughout the rack.
14. Provide ventilation of modules and control electronics by forced filtered air using multiple low-noise fans providing redundancy in case of fan failure.
 - a. Configure fans to turn on when control is energized.
 - b. Design dimmer rack to maintain the temperature of all components at proper operating levels with dimmers under full load, provided the ambient temperature of the dimmer room does not exceed 40°C/104°F.
 - c. The fans shall remain on during thermal shutdown.
15. Module spaces and circuit breakers shall be labeled with name plates or tags permanently attached to the equipment with circuit identification text, character size not less than 1/4" (18 pt.) high. Circuit identification text shall be verified to match as-built conditions.
16. Dimmers and dimmer rack shall be UL/cUL listed and UL/cUL labeled.
17. Provide signage on the dimmer bank permanently attached to the equipment indicating the following information:
 - a. Project name
 - b. Manufacturer name and contact information including location and service telephone number
 - c. Statement "System Designed by Fisher Dachs Associates"
18. Provide additional signage on each dimmer rack section permanently attached to the equipment indicating the following information:
 - a. Performance space name
 - b. Equipment designation
 - c. Feed size and source identification
 - d. Schedule of dimmer numbers listing use, circuit identification, dimmer type, and load; verified to match final as-built conditions
19. Provide vibration isolation pads for each dimmer rack. Isolators shall be Mason Industries ND double deflection neoprene-in-shear type with steel reinforced base.

Neoprene shall be no harder than 50 durometer, maximum rated deflection 13mm, capacity adequate for manufacturer's dimmer rack weight.

C. Electronics

1. Control electronics shall use digital electronic circuitry, be microprocessor based, and designed specifically for the control of dimming systems.
2. Dimmer rack setup and rack status, dimmer load, and dimmer temperature monitoring shall be fully user programmable locally at each dimmer rack and remotely via personal computer connected to the stage lighting network. Setup and monitoring functions shall be available with multi-language support.
3. Dimmer racks shall have the capacity to adjust output voltage per dimmer module to any predetermined waveform. Curves shall be available for installation through rack and/or control console software. Field adjustment of dimming curve shall not be required for standard operation.
4. System configuration, operating parameters, presets, levels and fade times shall be field modifiable and shall not require components to be returned to the Manufacturer for such modifications.
5. Control modules shall accept two (2) DMX-512/1990 control signal inputs and Category 5 or greater IEEE 802.3 Ethernet interface including sACN/ACN network protocols, in addition to any proprietary protocol control signals supported by the Manufacturer. An opto-isolated contact input shall be provided for panic system control.
6. Control signal input of each individual dimmer rack shall be fully opto-isolated from control signal input of any other rack, and fully opto-isolated from any control signal output.

2.7 **DIMMER MODULES**

A. SCR Dimmer Modules

1. The dimmer modules shall be designed using advanced, state-of-the-art components specifically for entertainment lighting.
2. Each dimmer module shall contain circuit breakers, a solid-state switching module, associated toroidal filters, and power and control connectors.
3. Modules shall be keyed so that dimmer modules of different capacity shall not be interchangeable.
4. Circuit breakers shall be fully magnetic so the trip current is not affected by ambient temperature. Circuit breakers shall be rated for tungsten loads having an inrush rating of no less than 20 times normal current. Circuit breakers shall be rated for 100 percent switching duty applications. Dimmers that do not operate continuously at 100 percent load shall not be acceptable.
5. SSR devices shall be encapsulated in high impact plastic cases packaged with associated optically isolated firing circuits and control circuitry. There shall be a minimum of 2,500 volts RMS of isolation between the AC line and the control lines of the SSR.
6. The SSR block shall include an integral heat sink and all necessary connections for line load and control as a single plug in assembly. Service and exchange of this component shall be a simple plug in operation.
7. Each dimmer module shall have an integral inductive filter to reduce the rate of current rise time resulting from the SCR switching on. The filter shall limit objectionable harmonics, reduce lamp filament sing and limit the radio frequency interference on line and load conductors.
8. Each "standard" dimmer shall have a rise time of not less than 500 μ s measured at 90 degrees conduction angle from 10% to 90% of output wave form with dimmer

operating at maximum load. Voltage rate of rise (slew rate) must not exceed 300 mill volts per microsecond in any point of the wave under full load conditions.

9. Each "high-rise" dimmer shall have a rise time of not less than 800 μ s measured at 90 degrees conduction angle from 10% to 90% of output wave form with dimmer operating at maximum load. Voltage rate of rise (slew rate) must not exceed 210 mill volts per microsecond in any point of the wave under full load conditions.
 10. The dimmer module shall be capable of "hot patching" cold, incandescent loads up to its full rated capacity without malfunction with the control signal at full ON.
 11. The dimmer power efficiency shall be at least 97% at full load with a no load loss of 3V RMS for type "standard" dimmers.
 12. Dimmers shall not interact with each other during any executable cue sequence of individual and/or collective control level changes. There shall be no interaction due to the size and/or changing of currents in the neutral or other feeders.
- B. Non-Dim & Constant Modules
1. Non-dim modules shall utilize a latching type relay and have a full magnetic primary circuit breaker. Modules employing solid state relays shall not be acceptable.
 2. Constant circuit modules shall distribute overcurrent protected power from the dimmer rack to non-dimmed loads. There shall be no moving parts other than the circuit breakers.
 3. Module construction shall be similar in all respects to standard dimmer modules and shall be interchangeable with modules of the same rating.
- C. Fluorescent Dimmer Modules
1. Fluorescent dimmer modules shall provide operating power and dimming control to three-wire electronic dimmer ballasts for fluorescent fixtures.
 2. Dimmer modules shall be available with current ratings of 20 amps (120 volts).
 3. Module construction shall be similar in all respects to standard dimmer modules.
 4. Circuit breakers shall be fully magnetic so the trip current is not affected by ambient temperature. Circuit breakers shall be rated for 100 percent switching duty applications.

2.8 PANIC CONTROL SYSTEM

- A. Provide panic control system at each location shown in the Drawings consisting of the following:
1. Each panic control location shall consist of two EAO Series 61 momentary pushbutton switches with requisite switching electronics.
 2. Pushbutton momentary switches shall be illuminated, with colored lens engraved with button label.
 3. One button shall be labeled "Normal" with green lens.
 4. One button shall be labeled "Panic" with red lens and clear flap guard.
- B. The panic control system shall instantly bring a programmable selection of dimmers and non-dim relays to full with the push of "Panic" button. Panic state shall be released with the push of "Normal" button.
- C. The system shall always be enabled at every control location, regardless of the state of other control systems and independent of emergency power transfer relays.

2.9 EMERGENCY LIGHTING TRANSFER SYSTEM

- A. Provide emergency lighting transfer system with pole count for branch circuits and power configuration as shown on the Drawings. The emergency lighting transfer system shall have the following characteristics:
 - 1. The emergency transfer system shall monitor three phases of the normal feed. Upon loss of power to one or more phases, normal system failure, or activation of the panic condition the ELTS shall transfer designated branch circuits from the dimming system to a second power source.
 - 2. Transfer poles shall be provided for the phase and neutral legs of each branch circuit load.
 - 3. The transfer switch unit shall be electrically-operated and mechanically-held. The electrical operator shall be a single-solenoid mechanism, momentarily energized.
 - 4. The switch shall be positively locked and unaffected by voltage variations or momentary outages such that constant contact pressure is maintained and temperature rise at the contacts is minimized.
 - 5. The transfer switch shall be rated to withstand the RMS symmetrical short circuit current without welding contacts.
 - 6. The control module sensing and logic shall be controlled by a built-in microprocessor. Control power for all logic and transfer functions shall always seek the acceptable power source to prevent the system from locking up in one position of either of the power sources is available, regardless of the sequence of failure events.
 - 7. The transfer switch and the control module shall be each completely enclosed with a protective cover and be mounted separately from dimmer racks.
 - 8. An isolated signal input shall be provided for connection to the facility fire alarm. It shall automatically transfer loads to the available secondary power source when the facility fire alarm is activated.
 - 9. A key-operated momentary test switch shall be provided to manually control the transfer switch.
- B. Remote control stations shall be provided as located on the Drawings.
- C. The Emergency Lighting Transfer System shall comply with ANSI/UL1008, ANSI/NFPA 70, and ANSI/NFPA 110 safety standards.
- D. The Emergency Lighting Transfer System shall be UL/cUL listed and UL/cUL labeled.
- E. Provide additional signage on each enclosure permanently attached to the equipment indicating the following information:
 - 1. Performance venue name
 - 2. Equipment designation
 - 3. Feed size and source identification

2.10 RELAY PANELS

- A. Provide relay panels with pole count for branch circuits and power configuration as shown on the Drawings. Relay panels shall have the following characteristics:
 - 1. Voltage separation shall be provided between high voltage and low voltage compartments of the panel, and shall separate branch circuits of varying voltages.
 - 2. Branch load circuit breakers shall be provided as required for branch load terminations.
 - 3. Relays shall be capable of simultaneous on/off within a given relay cabinet enclosure. Sequenced switching shall not be acceptable.

4. Relays shall be mechanically latching. Electronically held or solid state relays shall not be acceptable.
 5. Relay panels shall be controlled via a microprocessor based programmable lighting controller with a DMX512 interface and Category 5 or greater IEEE 802.3 Ethernet interface for sACN/ACN network protocols.
 6. DMX control channel assignment shall be easily field modified, allowing non-sequential numbering and functional grouping of relays to a single DMX channel as required.
- B. Relay panels shall be UL/cUL listed and UL/cUL labeled.
- C. Provide signage on the relay panel permanently attached to the equipment indicating the following information:
1. Project name
 2. Manufacturer name and contact information including location and service telephone number
 3. Statement "System Designed by Fisher Dachs Associates"
- D. Provide additional signage on each panel section permanently attached to the equipment indicating the following information:
1. Performance venue name
 2. Equipment designation
 3. Feed size and source identification
 4. Schedule of relay numbers listing use, circuit identification, relay type, and load; verified to match final as-built conditions

2.11 **EQUIPMENT RACKS**

- A. Provide fully enclosed self-standing cabinets as shown on the Drawings.
- B. Cabinets shall be Middle Atlantic Products #WR-44-32 featuring roll-out rotating equipment frame detachable from host rack enclosure, unless otherwise noted on the Drawings.
- C. Frames, closure panels, and doors shall be painted semi-gloss black.
- D. Equipment and components mounted in Equipment Racks shall be as shown on the Drawings and described herein.
- E. If the equipment specified, scheduled or required to compose a complete system requires additional rack spaces, utilize area of blank filler panels and provide additional cabinets as necessary.
- F. Component mounting panels and blank filler panels shall be as specified and as shown on the Drawings. Legends and lines where shown shall be engraved in the panels and filled with engraver's enamel.
- G. Provide blank filler panels in the racks for the Owner's use. The internal space behind these blank panels shall not be used or obstructed.
- H. Provide non-combustible brackets, shelves, and other supports for heavy components and internal wiring assemblies and harnesses. Provide interior mounting angles to support work-writing tops and drawers.
- I. Wire the components on each panel to a numbered barrier terminal block with a 3'-0" (1m) long flexible cable harness. Attach terminal blocks to frames in line with their associated panels so that they do not interfere with adjacent component or blank panels.

- J. Provide signage on each equipment rack permanently attached to the equipment indicating the following information:
1. Project name
 2. Performance venue name
 3. Equipment designation
 4. Manufacturer name and contact information including location and service telephone number
 5. Statement "System Designed by Fisher Dachs Associates"

2.12 HOUSE & WORK LIGHTING CONTROLS

- A. Provide an integrated microprocessor based control system that functions independently and in conjunction with the lighting control console. The system shall have the capacity to control dimmer racks, relay panels, LED arrays, moving lights, and other DMX/RDM or sACN/ACN devices through remote control stations and programmed control events.
- B. The control system shall consist of components as shown on the Drawings and described in this specification, and shall have the following characteristics and functions:
1. The lighting control processor shall allow programming and selection for playback of a minimum of (512) different preset lighting states and control of the fade time between presets.
 2. It shall be possible to modify the rate of a fade time from a control within the system.
 3. The total output may be the combination of many different presets running concurrently.
 - a. Multiple presets controlling the same attribute shall first interact based on priority and second based on latest takes precedence (LTP) or highest takes precedence (HTP) as configured.
 - b. A preset may be designated as an HTP override and shall cause HTP values to be discarded. It shall be possible to specify that a preset or attribute will persist when overridden.
 - c. When in use, the lighting control console shall override preset levels on a HTP basis. Where there are multiple external sources then priority and HTP shall be used to perform arbitration.
 4. The system shall have the ability to "snapshot" DMX levels from the lighting control console and other DMX control devices on the network and record into preset states all DMX values including dimmed circuits, relay circuits, LED arrays, moving lights and other DMX devices in the system up to a capacity of 1024 DMX channels.
 5. The system shall support 10/100BaseTX, UDP message transmission and receipt, 802.3af compliant Ethernet networking using TCP/IP, ESTA BSR E1.17 Advanced Control Networks (ACN) and ESTA BSR E1.31 (sACN) Protocols for internal communication and integration with third-party equipment.
 6. The system shall support EIA-RS232 serial protocol for bi-directional command and communication interconnection with other similarly enabled external systems. Serial input and output messages shall be fully customizable.
 7. The system shall accept dry contact closure inputs for integration with third-party products.
 8. There shall be support for occupancy functions using proximity sensors and for daylight harvesting functions using photo sensors.

9. The system shall support the use of Network Time Protocol for real time clock synchronization.
 10. It shall be possible to trigger control events using local and remote control stations, via recurring calendar-based time clock schedule, astronomical timed events, using occupancy sensing systems, or via interfaced external systems.
 11. Control stations shall provide real-time status indication representing the active state of all presets, zones and/or devices assigned to the remote station by use of illuminated pushbuttons and graphic controls.
 12. It shall be possible to disable remote indicators and to lockout or fully disable remote control devices through end user configuration.
 13. Data storage facilities shall retain memory for an indefinite period of time. In case of power failure, the system shall retain preset memory for a minimum of 72 hours.
- C. Houselight Master Stations
1. The houselight master station shall be a color LCD capacitive touchpanel in quantities and locations as shown on Drawings. Viewable display size shall be 7" diagonal or larger, except where otherwise noted.
 2. Provide sheet metal backbox and mounting frames as required.
 3. Houselight master station shall provide control of lighting processor presets, sequences, fade times, macros, timeclock events, and interfaced external systems.
 4. Houselight control processing may be achieved using electronics internal to the display or via an external interface.
 5. Stations shall operate using graphic buttons, faders, and other images on programmable control pages. There shall be up to thirty (30) custom control pages available.
 6. Graphic controls shall represent the active state of all presets, zones and devices. Status indication shall be tracked across all stations in real-time including tracking of fades on graphical fader controls.
 7. Stations shall allow programming of multiple-level passcodes, page lockout and visibility.
 8. Page layout and interface functionality shall be determined by the Theatre Consultant following approval of shop drawings. Programming services shall be provided by the Manufacturer.
 9. Control pages shall include:
 - a. Houselight presets (House Full, House Half, House Preset, House Out, Tour, Cleaning); worklight presets (Pre-Show, Show, Post-Show, Rehearsal, Work, Off); systemwide presets (Blackout, Night)
 - b. Stage lighting presets with snapshot record function
 - c. Houselight zone faders and houselight master fader
 - d. Color picker for dynamic selection of color with LED and multi-parameter fixtures
 - e. Worklight, runlight and non-dim zone control buttons
 - f. Lockout function to disable other stations and remote switches
 - g. Setup display for administrative functions including timed-event creation, edit and override
 10. Houselight master station shall be connected to the control system using Category 5E or better wire.
- D. Preset Stations

1. Preset Stations shall consist of programmable momentary pushbutton switches in a face panel designed for flush or surface mounting and housed in a standard NEMA backbox.
2. Face panel material and finish shall be per Architect. Face panel shall include engraving, indicators and button quantities as shown on the Drawings.
3. Pushbuttons shall provide control of a single channel, lighting processor presets, sequences, fade times, macros, timeclock events, and interfaced external systems as required.
4. Preset Stations shall connect to the control system using Manufacturer's recommended wire type, network topology, and communication protocols.

E. Remote Worklight Switches

1. Remote Worklight Switches shall consist of EAO Series 61 momentary pushbutton switches mounted in a 1/8" (3mm) T-5 aluminum component mounting panel and housed in a standard NEMA backbox.
2. Face panel finish shall be per Architect. Face panel shall include engraving, indicators and button quantities as shown on the Drawings.
3. Pushbutton momentary switches shall be illuminated, with colored lens as noted on the Drawings.
4. Remote worklight switches shall provide control of a single channel or presets as required.
5. Electronics shall consist of an interface board connected to the control system using Manufacturer's recommended wire type, network topology, and communication protocols.

F. Tour/Cleaning Light Stations

1. Tour/Cleaning Light Stations shall consist of a Hubbell 1557-L three-position momentary contact key-operated switch and an EAO Series 61 #61-137.00 three-position momentary contact key-operated switch mounted in a 1/8" (3mm) T-5 aluminum component mounting panel and housed in a standard NEMA 2-gang backbox.
2. Face panel finish shall be per Architect.
3. The tour and cleaning switches shall energize user programmable presets of houselight dimmers.
4. Electronics shall consist of an interface board connected to the control system using Manufacturer's recommended wire type, network topology, and communication protocols.

2.13 **ETHERNET NETWORK**

- A. Provide a fully functioning Ethernet system. Systems using proprietary formats or protocols other than TCP/IP shall not be accepted.
- B. Network Components
 1. Provide IEEE 802.3af Dual speed 10/100Base switches in quantities and locations shown in the Drawings and described herein.
 - a. Switches shall contain dual speed auto-sensing ports supporting both 100Base-T and 10Base-T. Switches shall support IEEE 802.3i Type 100Base-T standard.
 - b. Switches shall be rack mounted in standard 19" racks.

- c. Switches shall have UTP ports on the front face for connection to other network devices via standard 19" patch panels.
 - d. Switches shall have high mean time between failure (MTBF) value as comparatively analyzed with industry standard 802.3af products.
 - e. Provide media converter modules as required for UTP to Fiber-Optic conversion.
 - f. Provide switches in quantities and configurations having sufficient UTP ports for simultaneous connection of all patch bay ports assigned to lighting network devices.
 - g. Acceptable manufacturer shall be Cisco Systems or approved equal.
2. Provide Category 6 or better patch bays as required for termination of network cabling.
 - a. Patch bays shall be rack mounted in standard 19" racks.
 - b. Provide Category 5E or better patch cords as required for connection between the patch bays, switches and other network devices.
 - c. Provide rack mounted standard 19" cable management systems for each patch panel.
 - d. Acceptable manufacturer shall be Hubbell or approval equal.
 3. Provide lighting Network Services Gateway(s) as shown on Drawings.
 - a. The lighting network service gateway shall be a microprocessor-based unit specifically designed to provide network services and storage for entertainment and architectural lighting control systems specified herein. The gateway shall provide all necessary network services for automatic network configuration of lighting control system components over an Ethernet network.
 - b. The gateway shall support multiple protocols including:
 - 1) Dynamic Host Control Protocol (DHCP) for automatic assignment of IP addresses to the entire lighting control system
 - 2) Dynamic Name Service (DNS)
 - 3) Simple Network Time Protocol (sNTP) for automatic time assignment and synchronization of the lighting control system
 - 4) File Transfer Protocol (FTP) for configuration storage and backup
 - 5) Windows File Sharing (SMB) for configuration and file storage and backup
 - c. The gateway shall support real-time logging and notification of system errors.
 - d. The gateway shall support storage of system device configurations and complete stem configurations.
 - e. User definable reports that detail historical errors and power usage shall be supported. Reports shall be generated using the gateway database and queried from manufacturer's configuration software or third party applications.
 4. Provide lighting system Configuration Computer(s) as shown on Drawings.
 - a. Computer shall be an industrial PC having 2Ghz processor, 1 GB RAM and 40GB hard drive or better.
 - b. Provide most current Windows based operating system compatible with the proprietary application software and system configuration.
 - c. Provide network configuration software as required to allow online and offline configuration and operation of all system parameters, DMX Gateways, dimmer rack configuration settings and system monitoring.

- d. Provide house and work lighting controls configuration software.
 - e. Provide console client software and any associated hardware dongles to remotely view and interact with the Lighting Control Console.
 - f. Software shall be preinstalled on Configuration Computer(s) and furnished complete with installation disks and manuals.
5. Provide DMX Gateways in quantities and types as shown on Drawings.
- a. DMX Gateways shall be an intelligent Ethernet device providing DMX & RDM data distribution over the Ethernet data network. Gateways shall be connected using Category 5e or better wire, and powered via its Ethernet connection using Power Over Ethernet (IEEE 802.3af). Ethernet connection receptacle shall be Neutrik Ethercon D-Series CAT5e receptacle.
 - b. DMX Gateways shall support ANSI E1.17 ACN and sACN network protocols. Products that do not support ANSI E1.17 shall not be acceptable.
 - c. There shall be as standard DMX512 5-pin XLR connectors. It shall be possible to factory configure the connectors to be male or female to meet project requirements.
 - d. The DMX Gateways shall be remotely configurable via the network system wiring using manufacturer's software, control console interface and a standard Web Browser. The specific DMX channels input or output by the Gateway shall be freely configurable by the user. Configuration of the gateway shall be stored in non-volatile memory.
 - e. Portable nodes shall be provided with appropriate mounting hardware for 1.9" (48mm) O.D. pipe as shown on Drawings.
 - f. Portable nodes shall be supplied with a 5'-0" (1.5m) Category 5e or better

2.14 CONTROL DEVICE FACEPLATES

- A. Control Device Faceplates shall consist of a floor box or backbox with 1/8" (3mm) T-5 aluminum component mounting panels.
- B. Floor boxes shall be FSR-FL500P series or as otherwise noted in the Drawings. Hinged cover material, finishes and style to be determined by the Architect.
- C. The mounting panels and backbox shall be painted with black satin epoxy baking enamel unless otherwise shown on Drawings.
- D. Legends shall be engraved in the component mounting panels and filled with engraver's enamel of a contrasting color. Legends in black mounting panels shall be white.
- E. Provide in mounting panels receptacles and other components as shown on Drawings.
- F. Panel mounted Ethernet receptacles shall be Neutrik Ethercon D-Series CAT5e receptacles unless otherwise noted on Drawings.
- G. Panel mounted XLR receptacles shall be Neutrik XLR DX-Series unless otherwise noted on Drawings.
- H. Panel mounted fiber-optic receptacles shall be LC-Duplex compatible unless otherwise noted on Drawings.
- I. Install low voltage barriers between control and power receptacles.
- J. Provide all requisite mounting hardware for installation of Control Device Faceplates. Coordinate all device mounting requirements as noted on Drawings and per field conditions.

2.15 OUTLET DEVICE FACEPLATES

- A. Outlet Devices shall consist of a backbox with 1/8" (3mm) T-5 aluminum component mounting panels.
- B. The mounting panels and backbox shall be painted with black satin epoxy baking enamel unless otherwise shown on Drawings.
- C. Legends shall be engraved in the component mounting panels and filled with engraver's enamel of a contrasting color. Legends in black mounting panels shall be white.
- D. Provide in mounting panels receptacles and other components as shown on Drawings.
- E. Flush receptacles shall be individually mounted, readily replaceable, and installed off-center in the mounting panels to allow extra space for circuit identification labels.
- F. Receptacles on pigtails shall have suitable strain relief grips for SOOW cables as appropriate. Receptacles shall be fitted onto cables so that strain relief grips engage the cable's outer jacket. Pigtail length shall be 1'-6" (0.5m) or as otherwise noted on Drawings.
- G. Multi-pin connectors shall be LEX Products LSC-19 series or approved equal.
- H. Within each Outlet Device provide numbered screw terminals on barrier terminal blocks for field connections. Devices shall be internally wired by the Manufacturer.
- I. Provide all requisite mounting hardware for installation of Outlet Devices. Coordinate all device mounting requirements as noted on Drawings and per field conditions.
- J. Label each outlet with a circuit designation number. Character heights shall be as noted on the Drawings.

PART 3 - EXECUTION

3.1 SUPERVISION OF INSTALLATION

- A. Manufacturer shall provide instruction and supervision to the Division 26 Contractor as it pertains to the installation of these systems. Provide the necessary personnel for coordination meetings and site visits as requested by the Division 26 Contractor.

3.2 COMMISSIONING

- A. Manufacturer shall provide the services of a qualified on-site engineering representative who shall perform the following:
 - 1. Supervise and instruct equipment installer in all Manufacturer's requirements and specifications.
 - 2. Prior to system energization, inspect the finished installation and confirm that the installation conforms to manufacturer's requirements and specifications. Supervise correction of any deficiencies and retest deficient items.
 - 3. Manufacturer's engineering representative shall be present during energization of the system.
 - 4. In conjunction with the equipment installer, measure and adjust the full dimmer output voltage at each stage lighting receptacle. Typical voltage shall be uniform at each receptacle regardless of branch wiring length. Specific voltage requirements shall be determined by the Theatre Consultant or Electrical Engineer.
 - 5. Verify operation of all control devices and network wiring.

6. Configure all hardware and software to a “show ready” state, including:
 - a. Network device addressing
 - b. Ethernet switches configured for industry standard control protocols
 - c. Dimmer and relay patch, dimmer curves, dimmer output voltage, control priority and similar variables
 - d. Panic preset and fade time
 - e. Houselight control zones, presets, sequences, fade times, macros, timeclock events, and interfaced external systems
 - f. Lighting control console patched 1 to 1 for all control channels in system
 - g. Console accessories such as remote video, tracking backup, and hand-held remote configured to operate with main lighting control console
 - h. DMX node/gateway patch, priority, and soft labeling
 - i. Lighting system computer software
 - B. Provide to the Architect and Theatre Consultant a written report confirming that the system has been properly installed and successfully energized within fourteen (14) days of energization.
- 3.3 DEMONSTRATION AND ACCEPTANCE**
- A. The Architect and Theatre Consultant (or their representatives) shall witness a full demonstration by the Manufacturer of each feature of each piece of equipment in the system. Comply with the following conditions:
 1. The Manufacturer shall provide all necessary personnel and equipment to demonstrate fully the system’s compliance to the specifications.
 2. Contractor’s project representative shall be present during testing as required.
 3. Full and uninterrupted access to all areas shall be provided as necessary for complete testing and demonstration.
 4. All loose equipment provided under this Section shall be on site and available for testing.
 5. All architectural lighting fixtures circuited to the dimming system shall be installed and lamped.
 - B. Subject to satisfactory on-site demonstration, the Owner’s representative shall accept the equipment on behalf of the Owner.
 - C. Should the demonstration prove unsatisfactory, the Theatre Consultant and the Architect shall inform the Manufacturer in writing, and the Manufacturer shall rectify the problems. Problems shall be rectified in the shortest time possible. During this period of remedial work, the Owner shall have beneficial use of the equipment. The Warranty period shall commence upon final acceptance by the Owner.
- 3.4 TRAINING**
- A. Provide a factory field service representative to offer instruction to the owner’s staff in the proper operation and maintenance of the control systems for at least two (2) full days at a date and time convenient to the Owner.

END OF SECTION