

LEX PRODUCTS PCS TRIO™ POWER CONTROL FOR PERMANENT INSALLATION - SYSTEM SPECIFICATION

1. GENERAL

- 1.1. The power control system shall be fully digital, designed for both entertainment and architectural lighting loads.
- 1.2. Each power control panel shall be capable of simultaneously supporting 120 VAC relays, 240 VAC relays and 120 VAC dimmers.
 - 1.2.1. Due to space constraints, systems that do not support all three types within a single panel shall not be acceptable.
- 1.3. The power control system shall be capable of supporting up to sixteen (16) modules within a single panel.
- 1.4. Power control system shall be cULus Listed.
- 1.5. Power control system shall be UL924 compliant.
 - 1.5.1. System shall require a UL1449 Listed surge protective device (SPD), designed and rated for repeated limiting of transient voltage surges, at the main panel feed to maintain UL924 compliance.

2. MECHANICAL

- 2.1. The power control installation system shall be a wall-mounted, dead front switchboard, manufactured and enclosed using 14-gauge formed steel and zinc-plated steel panels. All non-plated rack components shall be treated, primed and finished using a fine texture, scratch resistant, powder coating.
- 2.2. The power control system shall be capable of supporting up to sixteen (16) modules within a single panel.
- 2.3. The power control panel dimensions shall not exceed 14.50" (36.83cm) W. Remaining panel dimensions shall not exceed:
 - 2.3.1. Four (4) module panel: 21.50" (54.61 cm) H x 19.85" (50.35 cm) D
 - 2.3.2. Eight (8) module panel: 34.00" (86.36 cm) H x 21.85" (55.50 cm) D
 - 2.3.3. Sixteen (16) module panel: 58.50" (148.59 cm) H x 21.85" (55.50 cm) D
 - 2.3.4. Racks shall be designed for wall mounting.
 - 2.3.4.1. Due to space constraints, floor mounted panels shall not be acceptable.
- 2.4. The module chamber shall be capable of being mounted as a separate component to facilitate landing of conduit and pulling of cabling.
 - 2.4.1. Removable panels to facilitate locating conduit and conduit punches shall be provided at the top and bottom of the module chamber.
- 2.5. A lockable front door on the module chamber shall provide secure access while allowing easy insertion and removal of all modules. The front door shall prevent, while closed, incidental removal of modules or unauthorized configuration modification. Panels shall have slots to accept module guides for accurate alignment of power and communication connections.

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- 2.5.1. Modules shall have dual side clips for module retention. Clips shall be molded into the module guides and access shall be prevented by closing the lockable front door.
- 2.6. Fans shall be utilized to maintain a safe operating temperature for the modules. Fans shall be paired in order to provide redundancy in the event of fan failure. The fans shall maintain the required operating temperature of the modules providing the ambient temperature of the room does not exceed 104 degrees Fahrenheit (40 degrees Celsius). Air flow shall be achieved using a combination of convection and fan assistance.
- 2.7. In the event a module approaches an over-temperature condition, a warning shall be displayed on the module chamber.
 - 2.7.1. Individual modules shall have temperature sensing. If any module temperature rises 15 degrees Fahrenheit (10 degrees Celsius) over the warning threshold, the individual module shall shut down automatically and a notification shall be displayed on the module chamber.
 - 2.7.2. In order to ensure maximum full system reliability, a system that shuts down an entire rack for the over-temperature of a single module rather than shutting down individual overheating modules shall not be acceptable.
- 2.8. The module chamber shall have an air filter incorporated at the bottom of the compartment. Filter shall be removable for cleaning and/or replacement only when the module chamber door is open. All air for cooling of the rack shall be drawn through this air filter.
- 2.9. Plenum modules shall be installed in all module chamber slots not otherwise occupied to ensure proper airflow and control signal integrity as well as restrict access to high-voltage components.
- 2.10. General panel status shall be indicated by four (4) LEDs mounted on the face panel of the module chamber visible through the closed module chamber door.
 - 2.10.1. Three (3) blue power LEDs shall indicate line power presence on each of the three phases of the supply.
 - 2.10.2. One (1) LED shall indicate panel status.
 - 2.10.2.1. Steady Green: Panel is operating normally
 - 2.10.2.2. Blinking Red: Module(s) are indicating an over-temperature
 - 2.10.2.3. Steady Red: Loss of control signal
- 2.11. Module grips shall incorporate LED indicators displaying individual circuit status.

3. ELECTRICAL

- 3.1. The power control system shall operate at a nominal voltage of **[SPECIFY EITHER]** 208Y/120 VAC 3-phase, 4-wire plus ground **[OR]** 240/120 VAC single phase, 2 wire plus ground at 60Hz.
 - 3.1.1. Switching between voltage types shall be possible in the field.

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- 3.2.** Units shall be capable of operating within a range of 90 to 250 VAC at 50 to 65Hz.
- 3.3.** Line wiring lugs shall be located in the module chamber for hot, neutral, and ground.
 - 3.3.1.** The four (04) module chamber line lugs shall accept a maximum of dual 2/0 AWG (70 sq-mm) wire.
 - 3.3.2.** The eight (08) and sixteen (16) module unit line lugs shall accept a maximum of dual 350MCM (177.35 sq-mm) wire.
 - 3.3.3.** Line lugs shall accept either copper or aluminum wiring.
- 3.4.** The minimum fault current protection of the rack shall be 100,000 AIC.
- 3.5.** System shall require a UL1449 Listed surge protective device (SPD), designed and rated for repeated limiting of transient voltage surges, at the main panel feed to maintain UL924 compliance.
- 3.6.** Load wiring terminals located in the panel for load connections shall accept a maximum #4 AWG (21.14 sq-mm) wire.
 - 3.6.1.** Load lugs shall accept either copper or aluminum wiring.
 - 3.6.2.** Load hots shall be clearly marked with the slot designation.
 - 3.6.3.** All load circuits shall require dedicated neutrals.
- 3.7.** Control signal terminations shall be via plug-in screw terminals or insulation displacement to facilitate contracting and servicing and shall be clearly labeled.
- 3.8.** With modules removed the module chamber shall provide access to line, load and control terminals.
 - 3.8.1.** Power control panels that require removal of plates for access to line, load and control terminals shall be unacceptable.
- 3.9.** Each module chamber slot shall be capable of supporting 120 VAC and/or 240 VAC modules.
 - 3.9.1.** Modules shall be available in the following configurations:
 - 3.9.1.1.** Three (3) 20A 120 VAC single pole relays.
 - 3.9.1.2.** One (1) 20A 120 VAC single pole relay and one (1) 20A 240 VAC double pole relay.
 - 3.9.1.3.** Three (3) 20A 120 VAC forward-phase SCR dimmers.
 - 3.9.1.4.** One (1) 20A 120 VAC forward-phase SCR dimmer and two (2) 20A 120 VAC double pole relay.
 - 3.9.1.5.** One (1) 20A 120 VAC forward-phase SCR dimmer and one (1) 20A 240 VAC double pole relay.
 - 3.9.1.6.** Plenum.
- 3.10.** Modules can be interchanged by the qualified personnel as desired at any time.

4. CHAMBER CONTROLLER

- 4.1.** The power control system shall utilize centralized control electronics housed within the module chamber.

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- 4.2. All setup and preset data shall be stored in a non-volatile RAM within the chamber controller.
- 4.3. Minimal initial rack setup shall be required. Configuration shall be performed utilizing the five (5) button keypad on the control electronics face.
- 4.4. Where applicable, circuits may be addressed either sequentially or on a per-circuit basis.
- 4.5. The module shall store up to eight (8) presets.
- 4.6. A previously recorded preset may be selected to serve as an 'emergency' look (UL924) and activated from a remote source.
- 4.7. Local control may be activated via the keypad to initiate previously recorded presets.
- 4.8. Local control may be utilized via the keypad to set individual circuits to specific levels for 'rig check'.
- 4.9. The module shall possess a user interface lockout to prevent unauthorized changes to the system configuration.
- 4.10. Each chamber controller module shall have on 'ALL ON' function where modules are made active without the need for initial rack setup or outside controller.
 - 4.10.1. Relays shall switch to ON and dimmers shall go to 50% in a staggered order to limit peak electrical demand.
 - 4.10.2. Owing to electrical utility peak demand costs systems without this feature shall not be acceptable.
- 4.11. The control electronics shall allow setup of UL 924 panic configuration with a recorded preset in a non-volatile control electronics memory.
 - 4.11.1. Triggering of panic shall be performed via a dry contact terminal supporting either a normally open or a normally closed configuration.
- 4.12. The panel shall be controlled using **[SPECIFY EITHER]** DMX-512A or RDM control protocol **[OR]** streaming ACN (E1.31 sACN) or Art-Net Ethernet control protocols.
- 4.13. All communication ports and remote contact input connections shall be optically isolated from all processor electronics by a minimum of 2,500V RMS isolation.
- 4.14. Control wiring connections shall be either removable screw terminals (DMX-512A, RDM) or insulation displacement connection (sACN, Art-NET).
 - 4.14.1. DMX-512A/RDM connections shall include 'IN' and 'THRU' terminations.

5. EMERGENCY OPERATION

- 5.1. Power control system shall be UL 924 Compliant
 - 5.1.1. The power control system shall be UL 924 Compliant when installed with a UL 1449 Listed surge protective device (SPD), designed for repeated limiting of transient voltage surges, upstream of the system.
- 5.2. Unit shall accept a closed-contact signal (either normally open or normally closed, user selectable) to indicate state (either normal or emergency).

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- 5.3. Where an emergency state is indicated the power control system shall execute a pre-programmed look configuration within five (5) seconds of restoration of power.

6. SINGLE POLE RELAY CIRCUITS

- 6.1. Single Pole Relays shall be located in module chassis requiring no tools for insertion or removal.
- 6.2. Single Pole Relay modules shall be provided in three (3) different configurations:
 - 6.2.1. Three (3) 20A 120VAC latching relays responsible for switching three (3) individual 20A 120 VAC circuits.
 - 6.2.2. One (1) 20A 120 VAC latching relay responsible for switching one (1) individual 20A 120 VAC circuit and dual 20A 120 VAC single latching relays electronically coupled responsible for switching one (1) individual 240 VAC circuit.
 - 6.2.3. One (1) 20A 120 VAC forward-phasing SSR dimmer responsible for the voltage modulation of one (1) 20A 120 VAC AC power circuit and two (2) 20A 120VAC latching relays responsible for switching two (2) individual 20A 120 VAC circuits.
- 6.3. Each Single Pole Relay circuit shall have one (1) solid-state relay.
- 6.4. Relays shall be high quality, mechanically latching, open-air types that are rated for a minimum of 500,000 cycles.
 - 6.4.1. Relay modules that use electronic/solid state switching shall not be acceptable, since these devices are not compatible with most LED fixture loads and violates UL 924 compliance
- 6.5. Relays shall only require power during change of state (open to close, close to open) to reduce idle power consumption.
 - 6.5.1. Upon loss of control signal relays shall maintain last state (open or closed) until signal is restored or are manually manipulated.
 - 6.5.2. Relays shall possess an exposed switch to allow for the manual change of state (open or closed) at the relay itself.
- 6.6. Modules shall possess zero-cross detection for relay trigger timing to extend relay life.
 - 6.6.1. Due to the reduction of relay life and reliability, relay modules that do not detect zero-cross shall not be acceptable.
- 6.7. Each circuit shall be protected by an appropriate branch-rated, hydraulic-magnetic 20 Amp circuit breaker with a 10,000 AIC surge and 100% trip rating.
 - 6.7.1. The circuit breaker shall be rated for tungsten loads having an inrush rating of no less than twelve (12) times normal current.
- 6.8. Single pole relay circuits shall be rated to 20 Amps at 1.5 HP.
- 6.9. Relays shall be mounted to a vertical PCB to increase heat dissipation.

7. DOUBLE POLE RELAY CIRCUITS

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- 7.1.** Double pole relays shall be located in module chassis requiring no tools for insertion or removal.
- 7.2.** Double pole relay modules shall be provided in two (2) different configurations:
 - 7.2.1.** One (1) 20A 120 VAC latching relay responsible for switching one (1) individual 20A 120 VAC circuit and dual 20A 120 VAC single latching relays electronically coupled responsible for switching one (1) individual 240 VAC circuit.
 - 7.2.2.** One (1) 20A 120 VAC forward-phasing SSR dimmer responsible for voltage modulation of one (1) 20A 120 VAC AC power circuit and dual 20A 120 VAC single latching relays electronically coupled responsible for switching one (1) individual 240 VAC circuit.
- 7.3.** Each double pole relay circuit shall have two (2) solid-state relays acting in tandem.
- 7.4.** Relays shall be high quality, mechanically latching, open-air types that are rated for a minimum of 500,000 cycles.
 - 7.4.1.** Relay modules that use electronic/solid state switching shall not be acceptable, since these devices are not compatible with most LED fixture loads and would violate UL924 compliance
- 7.5.** Relays shall only require power during change of state (open to close, close to open) as a power saving technique.
 - 7.5.1.** Upon loss of control signal relays shall maintain last state (open or closed) until signal is restored or are manually manipulated.
 - 7.5.2.** Relays shall possess an exposed switch to allow for the manual change of state (open or closed) at the relay itself.
- 7.6.** Modules shall possess zero-cross detection for relay trigger timing to enhance relay life.
 - 7.6.1.** Due to the reduction of relay life and reliability relay modules that do not detect zero-cross shall not be acceptable.
- 7.7.** Each circuit shall be protected by an appropriate branch-rated, hydraulic-magnetic 20 Amp circuit breaker with a 10,000 AIC surge and 100% trip rating.
 - 7.7.1.** The circuit breaker shall be rated for tungsten loads having an inrush rating of no less than twelve (12) times normal current.
- 7.8.** Double pole relay circuits shall be rated to 20 Amps at 1.5 HP.
- 7.9.** Relays shall be mounted to a vertical PCB to increase heat dissipation.

8. DIMMER CIRCUITS

- 8.1.** Dimmers shall be located in module chassis requiring no tools for insertion or removal.
- 8.2.** Dimmer modules shall be provided in three (3) different configurations:
 - 8.2.1.** Three (3) 20A 120VAC forward-phasing SSR dimmers responsible for the voltage modulation of three (3) individual 20A 120 VAC circuits.

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- 8.2.2.** One (1) 20A 120 VAC forward-phasing SSR dimmer responsible for the voltage modulation of one (1) 20A 120 VAC AC power circuit and two (2) 20A 120 VAC single latching relays responsible for switching two (2) 20A 240 VAC circuits.
- 8.2.3.** One (1) 20A 120 VAC forward-phasing SSR dimmer responsible for the voltage modulation of one (1) 20A 120 VAC AC power circuit and dual 20A 120 VAC single latching relays electronically coupled to switch one (1) 20A 240 VAC circuit.
- 8.3.** Each dimmer circuit shall have one (1) solid-state dimmer.
- 8.4.** Solid-state dimmers shall be of the solid state relay (SSR) type for forward phasing sine-wave operation.
- 8.5.** The dimmers shall utilize a minimum 10 bit fade processing, providing a fade resolution on 1024 steps.
- 8.6.** The dimmer update rate shall be a minimum of 40 updates per second.
- 8.7.** Dimmers set to the same level shall output within +/- .5V of each other, regardless of phase or input voltage, as long as the desired level is less than the phase input voltage less the dimmer insertion voltage.
- 8.8.** The dimmer output levels shall be regulated to accommodate incoming line voltage variations. The regulation shall make adjustments for both RMS voltage and frequency of the incoming AC wave form. Regulation shall maintain the desired output voltage +/- .5V volt for the entire operation range (90 – 135 VAC). The regulation shall compensate for variations of the AC waveform on a dimmer-by-dimmer basis.
- 8.9.** There shall be no adverse interaction between control devices in the system or any other devices.
 - 8.9.1.** Control systems that do not accommodate line voltage and frequency variations shall not be acceptable.
- 8.10.** The modules shall be capable of hot patching incandescent loads up to its full rated capacity without fault, with the control at full.
- 8.11.** Dimmers shall be filtered to a 350µsec rise time.
- 8.12.** Each circuit shall be protected by an appropriate branch-rated, hydraulic-magnetic 20 Amp circuit breaker with a 10,000 AIC surge and 100% trip rating.
 - 8.12.1.** The circuit breaker shall be rated for tungsten loads having an inrush rating of at least twelve (12) times normal current.
- 8.13.** SSRs shall be mounted to a vertical PCB and an extruded sink to increase heat dissipation.
- 8.14.** All loads shall require a dedicated neutral to minimize switching harmonics.

9. QUANTITIES

- 9.1.** Provide lighting control panels with module types as scheduled.

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10.APPROVED MANUFACTURER AND PRODUCTS

- 10.1.** Power control panels and modules shall be the PCS TRIO™ Install system, as manufactured by Lex Products Corp. of Shelton, CT.