

Strand Lighting Preliminary Dimmer Specification

I. STRAND SLD SERIES DIMMERS 48 MODULE DIMMER RACK(S)

A. GENERAL

1. The dimmer racks shall be fully digital, designed specifically for entertainment lighting, and shall consist of up to 48 dimmer module spaces. Dimmer rack systems shall be CE, UL and cUL listed.
2. Rack setup and preset data shall, as standard, be fully user programmable on a per rack or system wide basis. The dimmer rack shall report rack and dimmer status to a remote personal computer or control console and report load status information.
3. All dimmer racks shall have isolated passages for rack cooling and electrical wiring to insure maximum cooling efficiency and component life.
4. Matching Auxiliary service cabinets shall be available to provide mounting for a wide range of equipment including main breakers, auxiliary breakers, power bussing and miscellaneous equipment.

B. MECHANICAL

1. The dimmer rack shall be a free standing, dead-front switchboard, substantially framed and enclosed with formed steel panels. All rack components shall be properly treated, primed and finished in fine texture, scratch resistant, powder coat paint.
2. The dimmer rack shall not exceed 80" (2050mm) H x 24" (600mm) W x 18" (460mm) D. Racks shall be designed to allow for adjacent mounting and for bolting to the floor or optional vibration pads. Rack doors shall not increase the total rack depth by more than 1.5", and will not increase the rack footprint. Doors are reversible and may be mounted for left or right opening.
3. The rack shall be designed to allow for easy insertion and removal of all dimmer modules without the use of tools. Dimmer support frames shall be provided for precise alignment of dimmer modules into power and signal connector blocks.
4. Module spaces shall be mechanically keyed such that modules of greater current capacity cannot be accepted for that space. Racks that allow modules of higher wattage to plug into the same space shall not be acceptable.
5. Low-noise fans shall be provided for rack cooling. The fans shall maintain the temperature of all components at proper operating levels with dimmers at any load, providing the ambient temperature of the dimmer room does not exceed 40 C and humidity of 10-90% non-condensing. Air shall flow over the surfaces of the heat generating components using fan-assisted airflow to maintain optimum rack temperature. Each rack shall be outfitted with a lockable door that does not impede airflow.
6. The fans shall be gradually controlled between off and full speed in order to minimize fan noise under all operating conditions. In the event of a rack over temperature condition, a warning shall be displayed on the rack or on a remote personal computer or control system. If the temperature rises 5 C over the warning threshold, power to SSR control circuits will be automatically shut off.
7. Load terminations shall be clearly marked with the rack circuit number. Signal terminations shall be by plug-in screw terminals to facilitate contracting and servicing and shall be clearly labeled.

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8. Power and load wiring may enter the rack from the top or bottom to simplify installation.

C. ELECTRICAL

1. Dimmer racks shall operate at 90 to 264 VAC 3 phase, 4 wire + ground, 47 - 63 Hz at a maximum of 800A per phase. Bussing across adjacent multiple racks shall be possible. Delta power feeds shall be supported in racks designed for this purpose.
2. Load phase, neutral, and ground terminals shall, as standard accept up to a #6 (16 mm²) gauge wire. An optional terminal adapter accepting up to #2 (25mm²) gauge wire shall be provided to minimize load voltage losses.
3. The fault current rating of the rack shall be 100,000 AIC.

D. ENVIRONMENTAL

1. The ambient temperature for proper rack operation shall be 0-40 C.
2. Racks shall be installed in adequately ventilated environments with a minimum of dust.
3. The operating environment shall have a relative humidity of 10-90%, non-condensing.

E. RACK ELECTRONICS, PHYSICAL

1. The main dimmer control electronics shall be housed in one Rack Processor Module plug in module. The dimmer control electronics shall be completely digital without employing any digital to analog demultiplexing schemes or analog ramping circuits.
2. All rack setup and preset data shall be stored in a non-volatile manner and may be transferred to a replacement Rack Processor Module without losing data.
3. Each Rack Processor Module shall have a back-lit LCD with a multi- function keypad for rack setup, preset control, testing, rack status, error and diagnostics. Each processor shall have the following indicators:
 - a. Processor OK
 - b. PANIC active.
 - c. 3 Phase Indicators
 - d. Over-temp
 - e. Dimmer Error
 - f. DMX A
 - g. DMX B
4. An optional second Rack Processor Module shall provide full Redundant Tracking Backup. The Backup Processor module shall plug into the main Rack Processor Housing and may be added at any time. The Backup Processor module shall exactly track all setup, preset and other commands at all times without any operator action. The Backup Processor Module shall take over all communications and dimming control upon activation. It shall be possible to return control to the main Rack Processor Module.
5. All rack setup and preset data shall be electronically transferable between the main Rack Processor Module and the Backup Processor module in case of replacing either of the modules.
6. All rack setup and preset data shall be transferable to and from library storage on a personal computer on a per rack basis. The system shall be capable of monitoring multiple racks on a single cable connection.

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7. A permanently mounted Central Termination Card shall provide signal connections and security features in conjunction with rack mounted power supply units. This card shall provide the only point for contractor connection of signal cables and PANIC activation. The connections shall be made with two part plug-in screw terminals for ease of contracting. Inter-rack control connections shall be via Strand S Buss cable (Category 5 cable) and RJ45 connectors for simple plug in connectivity.
8. All digital multiplex, RS-485 communication ports shall be optically isolated from all processor electronics by 2,500V RMS isolation. An optional Ethernet connection port shall also be available.
9. The Central Termination Card shall have the provision to activate the system PANIC function. The PANIC function shall be activated or de-activated by one or more local or remote contact closures.

F. RACK ELECTRONICS, CONTROL AND COMMUNICATIONS

1. The control electronics shall provide the following control and communication inputs as standard:
 - a. Two optically isolated DMX512 control inputs. Each mux input shall have a patch to allow overlapping or separation of any mux control level.
 - b. 12 analog 0 to +10V signal inputs. The analog inputs shall be fully patchable to any rack dimmer circuit.
 - c. RS-485 optically isolated signal inputs for System Wide Control (SWC) and Outlook preset use. SWC is separate from the mux control signal, allowing sophisticated and independent remote control of circuits and presets through a hand held programmer and/or preset stations.
 - d. One RS-232 signal input for local connection to a personal computer, providing setup, playback, library storage and reporter feature supervision shall be provided.
 - e. An optically isolated RS 485 signal link shall be provided for remote dimmer rack configuration and dimmer status reporting from a console or suitably equipped Windows based Personal computer.
 - f. Optional Ethernet control signal input for all Dimmer level, status reporting and system configuration shall be an available option. This input shall be fully configurable with a range of patching and priority programming capabilities.
2. The control electronics shall provide the following outputs as standard:
 - a. Strand S Buss to drive all dimmer module interface cards.

G. RACK ELECTRONICS, FEATURES

1. The dimmer control electronics shall have a dimmer update rate better than 16 ms (60 Hz) or 20 ms (50 Hz). Dimmer outputs shall exhibit no oscillating or hunting for levels. Dimmers with the same choke type, set to the same level shall output within +/-1V of each other, regardless of phase or input voltage, providing the desired level is less than the phase input voltage less the dimmer insertion voltage and the load on the dimmers is the same.
2. The dimmer output levels shall be regulated for incoming line voltage and waveform variations. The regulation shall adjust for both RMS voltage and frequency changes of the

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incoming AC wave form. Regulation shall maintain the desired output voltage +/- 1 volt for the entire operation range (90 - 240VAC) with the exception that the maximum output will be no greater than the phase input voltage less the dimmer insertion voltage. There shall be no interaction between dimmers in the system. The output shall be regulated to the user programmable maximum voltage level on a dimmer-by-dimmer basis between 24V and 240V.

3. The control electronics shall allow the maximum output levels of individual dimmers to be adjusted, e.g. to compensate for load circuit voltage loss. The selected dimmer curve shall regulate so that the curve is proportional to the programmed maximum voltage.
4. The RPM shall also have the capability to support dimmers of different types and sizes that may be mixed throughout the rack. Individual dimmers may be dimmed or switched (non-dim). The individual phase control or switching of positive and negative line voltage half cycles shall not be acceptable, as the net resultant DC line current may damage or degrade line supply transformers.
5. The control electronics shall contain diagnostic routines to perform a self-test (Built In Self Test). Standard status reporting shall consist of:
 - a. Dimmer type in slot
 - b. Input line voltage per phase.
 - c. Mux A/B input fail.
 - d. Dimmer output level (%).
 - e. Rack overheat warning.
 - f. Rack overheat shut-down.
6. Load status reporting shall consist of the following on a per dimmer basis:
 - a. Load (Wattage).
 - b. Deviation from recorded load.
 - c. No load/breaker open.
 - d. Overload.
 - e. SSR failure.
 - f. Dimmer fault.
7. The control electronics shall provide the following setup functions that shall be user programmable on a per rack or system wide basis (using a computer):
 - a. Mux A/B patch.
 - b. Analog inputs
 - c. Set rack circuit ID.
 - d. Dimmer status reporting enable/disable.
 - e. Record Outlook and SWC preset and preset crossfade time.
 - f. Call SWC preset.
 - g. Set SWC backup preset on DMX loss
 - h. Set dimmer level (%).
 - i. Set dimmer max. voltage (24V - 240V in 1V steps).
 - j. Set dimmer min. level (0 to 99%).
 - k. Set dimmer curve.
 - l. Set dimmer response time.
 - m. Set control logic.

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8. The mux A and B patching shall support a rack start address and individual dimmer patch. The architectural patch shall define the rack circuit / room / room channel relationship for Outlook control systems.
9. Each individual rack circuit shall have a 5 digit ID (Circuit ID) that is addressable by a personal computer connection or by SWC, enabling continuous numbering over several mux spans, Ethernet or enabling other user programmable groupings or labeling.
10. The control electronics shall provide a facility to disable the output of any individual dimmer by setting the level to 0. It shall also be possible to enable and disable dimmer status reporting on a per dimmer basis.
11. The control electronics shall contain 99 System Wide Control (SWC) user programmable presets and a permanent blackout preset (preset 0). It shall be possible to record individual preset crossfade times, including preset 0. The presets shall be simply user programmable as a snapshot of the current dimmer outputs resulting from all dimmer control sources according to selected control logic, on a per rack or system wide basis. Each preset may have an individual crossfade time between 0 seconds and 10 minutes.
12. The control electronics shall support a user assignable backup preset. Each rack shall, in the event of loss of mux control according to selected control logic, maintain the last levels for a user programmable period after which it shall automatically fade in the assigned backup preset. Alternatively it shall be possible to program the rack to indefinitely hold the last dimmer levels. Systems that do not offer this feature shall not be acceptable. It shall be possible to continue control without an active mux signal using any of the SWC presets, Outlook presets as well as the analog inputs.
13. The control electronics shall provide the ability to set one or all dimmers to any level.
14. The control electronics shall provide the ability to set a library or user programmable curve to any individual dimmer. Library curves shall be:
 - a. Square curve.
 - b. S-curve.
 - c. Linear power output curve.
15. User selectable curves shall be:
 - a. Non-dim (switched) with a programmable trigger level 0 - 99%.
 - b. Electronic ballast fluorescent curve with a kick-start voltage and user programmable top set and bottom cut-off point.
 - c. Magnetic ballast fluorescent curve with user programmable top set and bottom cut-off point.
 - d. Five user defined programmable curves.
16. The ShowNet interface to the rack control electronics shall provide a number of user programmable control logic schemes for systems using ShowNet Ethernet SN series nodes (optional), regulating the logical relationship between dimmer control sources. Each dimmer may have up to three network control inputs with either a highest takes precedence or priority patching similar to that available on all ShowNet series nodes.

H. DIMMER PERIPHERAL EQUIPMENT

1. The dimmer system shall support the following range of specialist peripherals:
 - a. Remote SWC backup preset panels.
 - b. Remote SWC Stage Manager's auxiliary preset panels.
 - c. Remote SWC hand held programmers.

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- d. Remote personal computer for user programming, library storage of dimmer setup data and remote monitoring of dimmer and load status.
 - e. Dimming status reporting to all 300 and 500 series consoles shall also be supported. In addition to receiving dimmer status consoles shall be capable of remotely recording SWC presets and fade times.
 - f. Outlook Architectural stations shall be available for use with all SLD series dimmers.
2. The dimmer system shall support a remote hand held SWC Programmer unit with 40 tactile keys and a 4 line by 16 character backlit LCD offering channel control using standard control system syntax and direct action level keys, preset and preset time recording and control and riggers functions Check+, Check- and Rem Dim. The SWC programmer shall be functional with distributed dimming systems in conjunction with other SWC panels and shall not require the presence of a control system to function. Dimming systems that do not offer this facility shall not be acceptable.
 3. The dimmer system shall support 8- and 16-preset SWC wall mounted panels with tactile keys and integral LED indicators per key. The panel shall control 8 or 16 consecutive presets stored in the dimmer racks following a user programmable start address. The panel shall enable the recording of presets, the playback of presets and the turning off of the active playback. It shall be possible to disable the panel recording function.
 4. The dimmer system shall support a range of wall mounted Outlook architectural style panels consisting of preset keys with integral LED's, channel and master faders for setting, recording and playback of architectural style presets in individual assigned zones (rooms). Additional peripherals shall consist of panels allowing the zone (room) channels and presets to be joined and un-joined, infra-red remote control for up to 8 zone (room) presets and Audio-Visual (A/V) interface units enabling 8 dimmer presets, on and off to be controlled by external contact closures.

II. DIMMER MODULES

A. GENERAL

1. The dimmer modules shall be designed using advanced, state-of-the-art components specifically for entertainment lighting. All dimmers shall include dimmer status reporting as a standard feature. Systems without this capability shall not be acceptable. Dimmer modules shall be available in dual 15 amp, dual 20 amp, single 50 amp and single 100 amp module configurations.

B. PHYSICAL

1. The dimmer modules shall be fully plug in and factory wired. Dimmer modules shall be of rugged and heavy-duty construction enclosed by a cast aluminum chassis. Power and signal pins shall be recessed in a self-aligning housing to avoid handling, storage, and insertion damage. A contoured handle shall be provided for ease of insertion and withdrawal. All chassis parts, except heat sinks, shall be properly treated, primed and finished in fine texture, scratch resistant, powder coat paint. Each module shall be labeled with the manufacturer's name, catalog number and rating. Modules constructed of molded plastic for structural support shall not be acceptable. Dimmer modules shall be CE, UL and cUL recognized devices.
2. Dimmer modules shall be keyed so that dimmer modules of greater capacity shall not be interchangeable.

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3. Standard factory modules shall be available to provide neutral disconnect (using two pole circuit breakers) or RCD devices as required by local electrical codes.

C. ELECTRICAL

1. Each dimmer module shall contain circuit breakers, associated solid state switching modules, filters, LED status indicators power and control components.
2. Dimmer electronics shall be completely solid state. They shall utilize two silicon controlled rectifiers in a back-to-back electrical configuration. The full load of the circuit is to be carried and controlled by the silicon controlled rectifiers.
3. Each dimmer shall be protected by a fully magnetic plug in circuit breaker of the appropriate current rating and up to a 10,000 AIC surge rating mounted on the face plate of the dimmer module so that the trip current is not affected by ambient or rack temperature. The circuit breaker shall be rated for tungsten loads having an inrush rating of no less than 20 times normal current and shall disconnect the power to the dimmer module before damage can be done to the dimmer power components. The circuit breakers shall be rated for 100 percent switching duty applications and shall be a UL and cUL recognized device and bear the CE mark. Breaker exchange and replacement shall be a simple plug in operation for ease of maintenance.

D. SOLID STATE RELAY (SSR)

1. 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.
2. The SSR block shall include an integral heatsink 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.

E. FILTERING

1. 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.
2. Type (i) dimmers 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 millivolts per microsecond in any point of the wave under full load conditions.
3. Type (ii) dimmers 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 millivolts per microsecond in any point of the wave under full load conditions.
4. The use of type (i) or (ii) dimmers shall not reduce rack density. 20 amp and 50 amp modules are available as types (i) or (ii).

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F. PERFORMANCE

1. 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.
2. The dimmer power efficiency shall be at least 97% at full load with a no load loss of 3V RMS for type i dimmers.

G. DUAL CONTACTOR MODULES

1. Contactor modules with a rating of 20 amps shall be available as a standard accessory. These modules shall provide two switched outputs. Electro-mechanical relays shall be provided to accomplish this function. Modules employing solid state relays shall not be acceptable.
2. Contactor modules shall be available with all circuit breaker options that may be applied to dimmer modules.
3. Module construction shall be similar in all respects to standard dimmer modules and shall be interchangeable with modules of the same rating.
4. All contactor modules shall be fully status reporting