SECTION 16581R
THEATRICAL DIMMING SYSTEM

PART 1 – GENERAL

1.01 SCOPE

A. Work included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connetion with furnishing, delivery and installation of the work of this section, complete, as shown on the drawings and/or specified herein.

B. Examine all other specifications sections and drawings for related work required to be included as work under this section.

C. Coordinate and comply with the General Commissioning Requirements in Section 16050.

1.02 SYSTEM DESCRIPTION

A. The system shall be designed for the control of architectural and theatrical lighting and shall consist of factory pre-wired dimming and processing rack enclosures containing dimmers, relays, power supplies, breakers, terminals and/or control electronics.

B. System shall work in conjunction with specified low-voltage control stations.

1.03 SUBMITTALS

A. Manufacturer shall provide 6 sets of full system submittals. Submittals shall include:

1. Full system riser diagram(s) illustrating interconnection of system components, wiring requirements, back box sizes and any special installation considerations.

2. Full set of printed technical data sheets.

3. Detailed set of dimmer schedules

4. Detailed set of circuit and control schedules, including a complete list of all deviations from specifications.

B. Manufacturer shall provide any additional information, including equipment demonstrations, as required by the engineer or specifier to verify compliance with specifications.

1.04 QUALITY ASSURANCE

A. Manufacturer shall be one who has been continuously engaged in the manufacturer of lighting control equipment for a minimum of ten years. All dimmer and cabinet fabrication must take place in a U.S. manufacturing plant.

B. The manufacturer shall have a factory authorized stocking service center with at least one full time service technician on staff located within 150 miles of the job site. In addition, the manufacturer shall have a toll free 24-hour hotline with a maximum response time of 20 minutes, 24 hours a day and 365 days a year.

C. All equipment, where applicable standards have been established, shall be built to the standards of Underwriters Laboratories, Inc., the National Electric Code and the United States Institute for Theater Technology. Permanently installed power distribution equipment such as dimmer racks and distribution shall be UL and C-UL Listed, and/or CE marked (where applicable) and bear the appropriate labels. Portable equipment such as consoles and fixtures shall be UL and C-UL Listed, ETL Listed and/or CE marked (where applicable) and bear the appropriate labels.

1.05 ACCEPTABLE MANUFACTURERS

A. The equipment herein specified shall be manufactured by

Electronic Theatre Controls
PO Box 620979
Middleton, WI 53562
Phone: 608/831-4116
Fax 608/836-1736

B. Alternative manufacturers must submit a full pre-approval package ten days prior to bid date. Package shall consist of items listed in Part 1, Section 1.03A.

C. Permission to bid does not imply acceptance of the manufacturer. It is the sole responsibility of the electrical contractor to ensure that any price quotations received and submittals made are for controls systems that meet or exceed the specifications.

PART 2 - PRODUCT

2.01 RACK ENCLOSURES

A. The control enclosure shall be the Unison DRd Series Rack Enclosure as manufactured by Electronic Theatre Controls, Inc., or equal.

B. The Rack Enclosure shall be a surface mounted, deadfront switchboard, constructed of 18-guage formed steel panels with a hinged, lockable full-height door containing an integral electrostatic air filter. Control Enclosures shall be sized to accept one Control Processor, options and accessories.

C. All rack components shall be properly treated and finished.

1. Exterior surfaces shall be finished in fine textured, scratch-resistant, epoxy paint.

D. The fully digital rack enclosure shall be available with six or twelve dimmer module spaces, one processor and a single station power supply.

E. A single low-noise fan shall be located at the top of each rack. The fan shall draw all intake air through the integral electrostatic air filter, over the surfaces of the module housing and out the top of the rack.

F. Control Enclosures shall be available in 100, 120, 230, 240, and 277 volt configurations.

G. Rack enclosures shall be completely pre-wired by the manufacturer. The contractor shall provide input feed, load, and control wiring.

H. All control wire connections shall be terminated via factory provided connectors.

I. External Processing enclosures shall be designed to support the wire terminations for AC (single phase), Echelon link power, 24Vdc, configurable DMX512A (In or Out), DMX512A Output, RS232 Serial In/Out ,Unshielded Twisted Pair (UTP) Category 5/5e, 4x Contact Closure In, and 4x Contact Closure Out.

2.02 CONTROL PROCESSOR MODULES

A. The Architectural Control Processor shall be the Unison SmartLink S-ACP Series Control Processor as manufactured by Electronic Theatre Controls, Inc., or equal.

B. The Architectural Control Processor (ACP) assembly shall be designed for use in DRd Series Dimming Enclosures.

C. The processor shall utilize microprocessor based, solid state technology to provide multi-scene lighting control.

1. ACP shall support functions such as system programming. ACP shall allow configuration of the control system via the menus.

2. When used in a dimming enclosure, the ACP shall allow access to dimming control menus including the status screen, dimming configuration screen, backup menu, test menu and configuration menu.

D. One ACP shall be rated to drive up to 48 channels of control, 64 presets, and 16 button stations.

E. ACP module electronics shall be convection cooled.

F. The ACP shall provide front-panel Secure Digital (SD) card slot for configuration and data exchange.

G. Architectural Lighting System configuration and program information shall be stored in flash memory, which does not require battery backup.

H. The ACP shall be contained in a plug-in assembly and require no discrete wiring connections; all wiring shall be terminated into the Rack Enclosure.

1. The ACP shall support the following communications:

a. Echelon LinkPower

b. ESTA DMX512A

2.03 DIMMER MODULES

A. Mechanical

1. ETC dimmer modules shall be designed for use with Unison or Sensor dimming racks.

2. Dimmer modules shall consist of a heavy-duty, die-cast aluminum chassis with an integral faceplate. All parts shall be properly treated, primed and finished in fine-texture, scratch-resistant gray epoxy powder coat.

3. With the exception of the circuit breaker, the module shall contain no moving parts.

4. Each module shall be labeled with the manufacturer’s name, catalog number and rating.

5. All electronic components (current/voltage sensors and indicators) shall be contained in a single field-replaceable housing.

B. Electrical

1. Each dimmer shall consist of the following components:

a. One or two single-pole circuit breakers
   1) Circuit breakers shall be fully magnetic so the trip current is not affected by ambient temperature.
   2) Circuit breakers shall be rated for tungsten loads having an inrush rating of no less than 20 times normal current.
   3) Circuit breakers shall be rated for 100 percent switching duty applications.

b. A solid-state switching module
   1) Each dimmer module shall use a solid-state relay (SSR) consisting of two silicon-controlled rectifiers (SCRs) in an inverse parallel configuration, and all required gating circuitry on the high-voltage side of an integral, opto-coupled control voltage isolator. Rectifiers, copper leads and a ceramic substrate shall be reflow soldered to an integral heat sink for maximum heat dissipation. Dimmers employing triac power devices, pulse transformers, or other isolating devices not providing at least 2,500V RMS isolation shall not be acceptable.
   2) The SSR shall also contain a control LED, a thermistor for temperature sensing, and silver-plated control and load contacts.
   3) The entire SSR shall be sealed in a plastic housing requiring only a screwdriver to replace.
   4) Dimmer modules requiring disassembly, heat sink grease, or additional tools for repair shall not be acceptable.

c. Toroidal filters
   1) Dimmer modules shall include toroidal filters to reduce the rate of current rise time resulting from switching the SCRs. The filter shall limit objectionable harmonics, reduce lamp filament sing and limit radio frequency interference on line and load conductors.
   2) Modules shall be available in models offering 200-500 microsecond filter rise times depending upon model. Rise time shall be measured at the worst case slew rate (about 50 percent) from 10 to 90 percent of the output waveform with the dimmer operating at full load.

d. Power and control connectors.
   1) Modules shall not have any protruding pins subject to physical damage when the module is not installed.
   2) Power efficiency for standard dimmers shall be at least 97 percent at full load with a no-load loss of 3V RMS.
   3) The dimmer shall accept hot patching of a cold incandescent load up to the full rated capacity of the dimmer.
   4) Standard AIC fault current protection shall be 10,000 at 120V and 14,000 at 230V/277V.

2.04 LIGHTING CONSOLE AND ACCESSORIES

A. General

1. The lighting control console shall be a microprocessor-based system specifically designed to provide complete control of stage, studio, and entertainment lighting systems. The console shall be the SmartFade 2496 as manufactured by Electronic Theatre Controls, Inc., or equal.

2. The system shall provide control of 512 DMX512 controlled dimmers or devices on a maximum of 96 control channels. Any or all of the DMX512 outputs may be controlled by a channel.

3. A maximum of 576 memories (cues), may be contained in non-volatile electronic memory.

4. A playback fader pair shall be provided, with highest level operation between pair and last action operation within pair. Dynamic rate control shall be provided for playback within the memory stack.

5. 48 overlapping additive channel sliders shall provide access to individual channels. The console shall provide three modes of operation: two-preset mode, Normal mode and DMX Backup mode. In two-preset mode, the console shall provide two scenes of 24 control channels each. In Normal mode, the console shall combine the two-scene channel fader controls into one scene of 48 control channels with access to the second half of the available channel sliders via a page button. In DMX Backup mode, 48 memory locations are available for recording and playing back the state of the entire DMX universe (512 levels). Selection of the operating mode shall be a menu option in the LCD display.

6. Console software upgrades shall be made by the user via USB connection to a PC. Changing internal components shall not be required.

7. The console shall provide an SD memory card socket allowing show data to be saved for archival or transfer to other consoles or a personal computer.

8. Systems that do not provide the above capabilities shall not be acceptable.

B. Controls and Playback

1. Programming Section

   a. The console shall provide an LCD with button and dial controls for navigation. The LCD shall provide system configuration, show data and channel level information.
   b. The console shall provide dedicated buttons for recording and editing memories, recording sequences and snapshots, copying memories and sequences, and creating random chases.

2. Playback Section

   a. Two-Preset Operation
      1) Fading between scenes shall be accomplished with the crossfader pair. Each crossfader may be operated manually in real time or may be assigned a time. Timed crossfades are assigned using the LCD and dial for proportional modification of cue timing. The actual modified time value for the cue shall be dynamically displayed as the rate is altered.
   b. Normal Operation
      1) Normal mode shall provide manual single scene operation via channel faders, two scene operation using a combination of the channel faders, the [Next] key and the [Go] key, and memory operation via pages of recordable memories and cue stack playback. Switching among these playback options shall be provided through direct keys.

c. DMX Backup operation
   1) DMX Backup mode shall provide one memory location per channel fader. Each memory location shall store the static state of the full DMX universe (512 channels) at the time of recording.

3. Channel Faders

   a. 48 proportional, fully overlapping faders shall be provided with 45mm potentiometers and bump buttons.
   b. The 48 faders shall provide direct manual control of the first 24 or 48 channels, depending on console model and mode of operation. Channel levels may be affected at any time by the individual channel sliders.

4. Master faders and Blackout key

   a. A 60mm Master potentiometer shall be provided that shall master output levels of all channel faders and the crossfader. An alternate action Blackout key shall be located near the Master fader.
   b. A 60mm Bumps potentiometer shall be provided that shall master the maximum output level of the channel bump buttons.

C. Operating Modes

1. Two Preset Mode
   a. Two Preset mode shall provide two banks of 24 channel faders and a manual/timed crossfader.
   b. The mode shall provide both 1-to-1 and custom DMX patches. All 512 DMX addresses may be patched to the 24 available channels.
   c. Channel faders shall have bump buttons that illuminate to mimic the output level. Bumps shall operate in pile-on and solo modes.
   d. A bump level master shall be provided.
   e. A grand master fader and black out button shall be provided.
   f. Two independent channels shall be provided with on/off functionality. Independents may be patched like any other channel.
   g. Output levels shall be displayed in the LCD menu.
   h. DMX merge functionality shall be provided.

2. Normal Mode
   a. Normal mode shall provide 96 channels in two blocks of 48 faders. Channel faders shall have bump buttons that illuminate to mimic the output level. Bumps shall operate in pile-on and solo modes.
   b. The mode shall provide both 1-to-1 and custom DMX patches. All 512 DMX addresses may be patched to the 96 available channels.
   c. The Next function shall allow manual, preset -style playback of all 96 channels using the two blocks of channel faders and the crossfader GO button.
   d. Faders shall also control up to 576 (12 pages of 48) recordable memories. Memories shall record user-selected channel levels or console-generated random levels.
   e. Four faders shall provide control of up to 48 sequences (12 pages of 4 faders). Sequences shall include up to 24 steps containing channel levels and/or recorded memories, or console-generated random chases. Steps shall be editable and steps shall be able to be individually deleted and inserted.
   f. A cue stack of up to 199 steps shall be provided. Steps shall be editable and steps shall be able to be individually deleted and inserted.
   g. The cue stack and sequences shall be able to be played back using manual fades, timed fades, or overridden timed fades using the Rate function.
   h. Preview of recorded memories and sequences shall be provided in the LCD display.

i. Snapshot memories shall provide temporary storage of up to 10 looks.
j. An Undo command shall undo the last record command executed.
k. A bump level master shall be provided.
l. A grand master fader and black out button shall be provided.
m. Two independent channels shall be provided with on/off functionality. Independents may be patched like any other channel.
n. Output levels shall be displayed in the LCD menu.
o. DMX Input functionality shall be provided. DMX Input may either be merged with DMX output from the console, or mapped to a fader for control.

3. DMX Backup Mode
   a. DMX Backup mode shall provide 48 memories of 512 channels each.
   b. Memories shall be available for manual playback on the memory faders and for crossfader playback in a pre-formatted 48 step sequence. Crossfader playback shall be adjusted using the Rate button and the dial.
   c. Memories shall record the DMX output of the console. DMX output shall be generated by DMX input to the console.
   d. The console shall be able to pile-on its levels with the DMX input levels or to automatically take control if the DMX input fails.

4. MIDI Operation

   a. In DMX Backup mode, multiple consoles shall be able to connect via MIDI to provide DMX Backup for multiple universes. Critical playback operations performed on the master console shall be followed by the slave consoles.
   b. The console shall be able to receive MIDI data from a time-based sequencer or show control system.
   c. Two consoles shall be able to be connected via MIDI to double the available channel count. One unit is set to master and the other to slave. DMX Input on the master console shall provide merge functionality.

D. Interface Options

1. The console shall provide connectors for the following:
   a. AC or 12V DC input for external power supply
   b. DMX512/1990 outputs (one connector)
   c. DMX512/1990 input (one connector)
   d. MIDI In
   e. MIDI Out
   f. USB input (Series B device connector)
   g. SD Memory Card socket

E. Displays

1. The console shall support connection via USB to the SmartSoft software application. SmartSoft shall run on either a PC with Windows XP or Windows 7 OS, or on a Macintosh computer with OS X. SmartSoft shall provide live display of show data and on screen data editing. The show file may be stored directly to and opened from the hard disk of the computer as well as to/from the SD card on the SmartFade console.

F. Physical

1. All operator controls and console electronics for a standard system shall be housed in a single desktop console.

2. SmartFade 2496 console shall be 27" nom. wide x 10" x nom. deep x 2.5" nom. high (including controls). Weight APPROX 3.6kg ~ 8lbs.

3. Console power shall be 12V AC or DC via an external power unit. The power unit shall operate with 90-265VAC line voltage, 50 or 60Hz.

2.05 DATA PLUG-IN STATIONS

A. General

1. The Plug-in Stations shall consist of the appropriate connectors required for the functional intent of the system. These stations shall be available with DMX input or output, Remote Focus Unit, Network, or architectural control connectors. Custom control connectors shall be available.

B. Connector Options

1. The following standard components shall be available for Plug-in Stations:

   a. 5-Pin male XLR connectors for DMX input
   b. 5-Pin female XLR connectors for DMX output
   c. 6-Pin female XLR connectors for RFU and ETCLink connections
   d. RJ45 connectors for Network connections - Twisted Pair
   e. 6-Pin female DIN connectors for Unison connections
   f. DB9 female serial connector for architectural control from a computer

2. Custom combinations and custom control connections shall be available.

C. Physical

1. Station faceplates shall be .80” aluminum, finished in fine texture, scratch-resistant black powder coat. Silk-screened graphics shall be white.
2. The station panel shall mount into an industry standard back box, depending on size and quantity of connectors. A terminal block shall be supplied for contractor terminations.

2.06 eDIN INSTALLATION REPEATER 480X SPECIFICATIONS

A. General

1. The Pathway Installation Repeater shall permit star-wiring of DMX512 signals and shall isolate DMX transmitters and DMX receivers from common mode voltages, ground loop currents and other electrical faults.

2. Each Installation Repeater shall have one input port and four, eight, twelve or sixteen output ports. No in-line processing of the input signal is permitted to ensure the highest reliability.

3. DMX signal splitting shall be provided using 4-output DIN-rail mounted modules for easy expansion and/or servicing.

4. The system shall be capable of repeating simplex protocols other than DMX512, provided they meet the electrical requirements of EIA-RS422 or RS485.

B. Physical

1. Enclosures shall be surface-mount NEMA 1 enclosure types, and shall be constructed from 18 gauge steel, finished in satin black powder epoxy, with a non-louvered, surface cover.

2. Dimensions shall be 10.25”w x 13.25”h x 4.5”d (260mm x 335mm x 120mm) for four or eight output models, and shall be 10.25”w x 23.25”h x 4.5”d (260mm x 510mm x 120mm) for twelve or sixteen output models.

3. Enclosures shall be provided with ½” and ¾”conduit knockouts, appropriate internal voltage barriers, and shall be clearly labeled as “Pathway eDIN System”.

C. Electrical

1. The power supply shall be a field-replaceable, wide-range input (115/240VAC, 50/60 Hz), UL-listed switching power supply. There shall be no power switch to reduce the chance of accidental shut-off.

2. There shall be 2500-volt electrical isolation between all input and output sections.

3. The input and each output shall be capable of withstanding the continuous application of up to 250V without damage to internal components. Input and output protection shall be of the self-resetting type, rated for 250V. Replaceable fuses are not acceptable.

D. Field Connections

1. All internal field wiring connections shall be clearly labeled according to their function.

2. Connections for all data input, output and pass-thru ports, and DC power shall be two-part, Phoenix-type screw terminal strips, capable of accepting #26 to #14 gauge solid or stranded wire.

3. A direct, passive data pass-thru connection shall be provided to allow daisy-chaining of additional modules or Installation Repeaters.

4. The power supply connections shall be capable of accepting up to #12 gauge solid or stranded wire. A suitable terminal shall be provided for ground wire connection.

E. Features

1. Each repeater module shall incorporate LED indicators for DC power input, isolated DC power, and DMX input.

2. An LED per output port shall indicate active DMX output for that port.

3. A labeled DMX termination switch shall be provided. DIP switches or the like shall not be acceptable.

F. Compliance

1. The Installation Repeater shall be compliant with ANSI E1.11 DMX512-A (2004), USITT DMX512 (1990) or any EIA 422/485-based protocol.

2. The Installation Repeater shall be ETL-listed.

3. The Installation Repeater shall be compliant with the RoHS 2002/95/EC directive.

G. Acceptable Product

1. Supply Pathway Installation Repeaters only.

2. This specification applies to Pathway model #4807, 4808, 4809, and 4810 only.

2.06 POWER DISTRIBUTION EQUIPMENT

A. General

1. Connectors available are 20A, 50A and 100A grounded stage pin, 20A twist lock and 20A "U" ground (dual rated "T-slot"); other connectors available as specified. Pigtails shall be three-wire type "SOW" rubber jacketed cable sized for the circuit ampacity. Internal wiring shall be sized to circuit ampacity and shall be rated at 125°C.

   a. 20 amp cable mount stage pin connectors shall be 12 gauge 4 way indent crimp (with inspection window) type where the wire is inserted and crimped directly in the socket.

2. Terminations shall be at one end using feed through terminals individually labeled with corresponding circuit numbers. 20 amp circuits shall use screwless tension clamp terminals listed for 20 – 8 gauge wire. 50 amp circuits shall use compression terminals listed for 10 – 1 gauge wire and 100 amp circuits shall use compression terminals listed for 8 – 2/0 gauge wire. (Terminals that place a screw directly on the wire are not acceptable.)

3. Equipment, except for wall-mounted boxes, shall be supplied with appropriate brackets and hardware for mounting as shown on the drawings. Connector strips shall have brackets on 5' centers. Brackets shall be 1½" x .188" ASTM A 36 steel and hardware shall be ASTM A307 grade 5.

4. A low voltage distribution system for DMX (other protocols as specified) shall be available, incorporated in the connector strip, locations and methods to be per print. Connector strips shall have a voltage barrier installed to accommodate these systems. Distributed DMX systems shall use DMX pass through assemblies consisting of a 6" panel with the following: one DMX Output Connector, one DMX Input (Pass Through) connector, one DMX Pass Through (Bypass) Switch, and a label detailing the use of the pass through assembly. The bypass switch shall be used when no DMX devices are present at that location. When activated, the DMX pass through switch shall pass DMX directly through to the next DMX panel on the strip. The pass through switch shall have a mechanical indicator to show the operator that it has or has not been engaged. Low Voltage signals shall enter the connector strip via a strain relief or connector mounted in a separate DMX terminal box at the specified end of the connector strip.

5. Power distribution equipment shall be Underwriter Laboratories (UL) Listed.

B. Outlet and Pigtail Boxes

1. Outlet and Pigtail Boxes shall be fabricated from 18-gauge cold rolled steel with 16 gauge covers. They shall be finished with fine-textured, scratch-resistant, black powder coat. Circuit numbers shall be 2" or ¾" labels with white letters on black background (sized to match product). Pigtails and outlets shall be spaced on 3" centers, or as otherwise specified.

   a. Optional Outlet and Pigtail Box circuit number labeling:
   b. Circuits labeling shall be 2" or ¾" (sized to match product) lettering engraved in the cover. (Note: this changes cover material to .080 AL).

2.07 BILL OF MATERIALS

A. Provide and install the following:

(1) DRd12-24 – Unison dimmer rack for 12 modules

(1) S-ACP – Smartlink Architectural Control Processor

(12) D20 – Standard Dual 20A Dimmer Modules

(1) SF2496 – SmartFade 2496 console with Dust Cover and Memory Card

(40) CD10-DMX – 10' DMX Cable

(1) 19-LCD – LCD Monitor for Control Console

(1) ECPB DMXin – DMX Plug-in Receptacle

(10) ECPB DMXOut – DMX Plug-out Receptacles

(20) 9102B-U – 2-gang plug boxes with 2 Stagepin Outlets, with u-bolt kit

(4) 9102B – 2-gang plug boxes with 2 Stagepin Outlets

(1) Pathway 4808– Opto Splitter, 1 in, 12 out

2.08 LIGHTING FIXTURES

A. Provide and install the following light fixtures:

(12) Strong NEEVA Tunable White LED Ellipsoidal

(24) ETC Selador D40 HD LED Wash Fixture

B. All lighting fixtures to be supplied complete with filter frames, C-clamps, safety cables, 20A stage pin connectors attached and any required control boxes needed for a complete operating system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. It shall be the responsibility of the Electrical Contractor to receive and store the necessary materials and equipment for installation of the dimmer system. It is the intent of these specifications and plans to include everything required for proper and complete installation and operation of the dimming system, even though every item may not be specifically mentioned. The contractor shall deliver on a timely basis to other trades any equipment that must be installed during construction.

B. The electrical contractor shall be responsible for field measurements and coordinating physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.

C. The electrical contractor shall install all lighting control and dimming equipment in accordance with manufacturer's approved shop drawings.

D. All branch load circuits shall be live tested before connecting the loads to the dimmer system load terminals.

3.02 MANUFACTURER'S SERVICES

A. Upon completion of the installation, including testing of load circuits, the contractor shall notify the dimming system manufacturer that the system is available for formal checkout.

B. Notification shall be provided in writing, two weeks prior to the time that factory-trained personnel are needed on the job site.

C. No power is to be applied to the dimming system unless specifically authorized by written instructions from the manufacturer.

D. The purchaser shall be liable for any return visits by the factory engineer as a result of incomplete or incorrect wiring.

E. Upon completion of the formal check-out, the factory engineer shall demonstrate operation and maintenance of the system to the owner's representatives. Training shall not exceed four working hours. Additional training shall be available upon request.

3.03 WARRANTY

A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of two years from date of delivery.

B. Warranty shall cover repair or replacement of such parts determined defective upon inspection.

C. Warranty does not cover any product or part of a product subject to accident, negligence, alteration, abuse or misuse. Warranty does not cover any accessories or parts not supplied by the manufacturer.

D. Warranty shall not cover any labor expended or materials used to repair any equipment without manufacturer's prior written authorization.

END OF SECTION
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