ELECTRONIC THEATRE CONTROLS, INC.

Distribution Applications Guide

Everything you always wanted to know about ETC's Distribution Products

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The ETC Distribution Applications Guide is to assist you with system design, understanding, use and specification of ETC distribution equipment.

Introduction

Here is a story that is interesting, educational, historical, completely true, and hysterical all at the same time:

The US standard railroad gauge (width between the two rails) is 4 feet, 8.5 inches. That's an exceedingly odd number.

Why was that gauge used?

Because that's the way they built them in England, and US railroads were built by English expatriates.

Why did the English build them like that?

Because the first rail lines were built by the same people who built the pre-railroad tramways, and that's the gauge they used.

Why did "they" use that gauge then?

Because the people who built the tramways used the same jigs and tools that they used for building wagons that used that wheel spacing.

Okay! Why did the wagons have that particular odd wheel spacing?

Well, if they tried to use any other spacing, the wagon wheels would break on some of the old, long distance roads in England, because that's the spacing of the wheel ruts.

So who built those old rutted roads?

The first long distance roads in Europe (and England) were built by Imperial Rome for their legions. The roads have been used ever since. And the ruts in the roads? Roman war chariots first formed the initial ruts, which everyone else had to match for fear of destroying their wagon wheels. Since the chariots were made for (or by) Imperial Rome, they were all alike in the matter of wheel spacing. The United States standard railroad gauge of 4 feet, 8.5 inches derives from the original specification for an Imperial Roman war chariot. Specifications and bureaucracies live forever. So the next time you are handed a specification and wonder what horse's ass came up with it, you may be exactly right, because the Imperial Roman war chariots were made just wide enough to accommodate the back ends of two war horses. Thus, we have the answer to the original question.

How does this apply to ETC's new Distribution?

Why were connector strips 4" x4"?

Because they've been that way for 60+ years and there was no reason to change it.

That's not an answer!

Okay, they were 4" x 4" because they originally were adaptations of standard electrical raceways.

Why were the standard raceways 4" by 4"?

Because back then labor was cheap and steel was expensive. Squares use the least sheet metal when manufactured, making it the cheapest shape to make. (Actually, circles are the most efficient shape but don't adapt well to manufacturing distribution.)

Why doesn't ETC acquiesce to the paradigm? (subtitled "Get over it!!")

We examined each stage of all processes involved with distribution products used in our industry, especially our own. It was apparent there was a lot (we mean just a bunch!) of room for improvement. We set our goals high. The short list was: lower cost, lower price, faster turn, easily configurable product, include DMX and other low voltage distribution, better specs, easier installation and shipping, better documentation, improve quality and the introduction of standard product.

So: What'd you get!

All that and more; read on, and on, and on, and on...

The ETC Distribution Applications Guide *(a.k.a. Infomercial)*

...is to assist you with system design, understanding, use and specification of ETC distribution equipment. Specification "spec" points are marked with a "♦"; items that will add significant cost are noted with "$"; cost saving items noted with a "¢"; and those that add time to manufacture, assembly and/or delivery are marked with a "🕓." Occasionally you'll see an FYI: (For Your Information). With many significant features in our Distribution products these FYI's explain their features and/or benefits.

General Information...
(Common for Connector Strips, Outlet & Gridiron Junction Boxes)

Mechanical

Products are all steel construction, using 18, 16 and/or 14 ga. steel and/or galvanized steel (see specific product sections for exact construction; mounting brackets are 7, 12 and 14 ga. construction).

Cover dimensions are reduced from overall dimensions for a smoother feel and appearance, which also reduces exposure to corners.

Screws are all #2 Phillips pan heads. (This reduces exposure to the sharp facets of slotted hex heads during manufacture and installation; reduces damage during packing, shipping and unpacking; reduces the number of tools needed for installation; and we are told is aesthetically better.)

Load Connectors... (Stage Pin, NEMA[1] and Multi-pin)

20 Amp Stage Pin inline – ETC developed and uses an inline connector where the termination end of the pin in the male connector or socket in the female connector is a 4-way indent with inspection window machined crimp♦ similar to Mil spec terminations. This means the wire is inserted directly in the pin or socket and that portion of the socket is crimped directly on the wire, resulting in almost no chance of failure. In response to specifications by others, clear covers are available for 20 amp stage pin inline connectors.

20 Amp Stage Pin panel mount - connectors are UL listed and self-grounding.

The 60 and 100 amp stage pin connectors mount behind panels with 1/4-20 screws. The connector's mounting flange extends beyond the exposed face on all sides behind the panel to support the weight of heavy cables plugged into them. The electrical terminations are also ¼-20 hardware, attached to the back of the connector. This allows bussing connectors where applicable and application of far greater torque than other connector designs and provides superior electrical connections.

Colored (red, blue, white, green and yellow[2]) stage pin connectors and covers for inline connectors are available♦ (not stock🕓). When specifying these, add 3-4 weeks lead-time and expect a modest charge. $

Because of their reputation for quality and extensive product line, Hubbell NEMA devices and Kellems® grips are ETC's choices. Please specify by Hubbell part number, ETC part number or NEMA configuration.

FYI: All black 20A Twist-lock connectors are available to match specifications when needed. There may be a small additional charge and minimum quantities, please contact your ETC quotations person for details.

Other stage pin and NEMA connectors are available. Specify manufacturer and manufacturer's part number, and call ETC for price and delivery. These *must* be UL listed to maintain UL listing of the complete unit.

Multi-pin connectors

When using multi pin connectors other than Socapex compatible (Pro) you must specify manufacturer, part number and "pin out". **Part numbers are critical!** Manufacturers may have several versions of a connector with options for covers, pin arrangement, mounting, grounding etc.... **Pin out is critical!** The most common multi pin connectors are Socapex® compatible (the "industry standard"), wired six circuits with one ground per circuit. Customers have ordered these wired with eight and nine circuits and fewer grounds (three or one). You see the dilemma? We cannot proceed without all of the correct information!🕓

♦ This is a "spec" item: It is noteworthy that there have been no reported failures on the over 500,000 connections with this exceptionally dependable unit.

[1] National Electrical Manufacturers Association

[2] yellow 100 amp stage pins denote 250V connectors

Keep in mind that many multi-pin connectors are not stocked (anywhere) but built to order and may have long lead times (12 – 16 weeks). This translates into 14 to 20 weeks from receipt of order to delivery, depending on the size of your project. ETC rarely uses anything but 19 pin multipins in the North America so call the factory for price and availability. 🕓🕓🕓 $

In some cases, using multi pin connectors requires custom metal work, which may add several weeks to your project (for drawings, fabrication, paint and assembly). 🕓

When designing with multi pin connectors, leave enough space between them so mating connectors will fit, can be mated and can be used adjacent to each other. (Check the manufacturer's specification for spacing, or call your project manager).

Note: We have yet to discover a UL® **Listed** multi-pin connector! Most multi-pins we are asked to install are UL recognized components, the use of which will not likely maintain the UL listing of a complete assembly. A recognized component must be evaluated for each product. If UL listing is needed our recommendation is to design using either the 19 pin Pro, 19 pin VSC or 37 Pin Pyle National Star Line connectors because these are already approved for our use. Other UL recognized components can be written into our UL report but require UL evaluation which involves any or all of the following: engineering, product testing, shipping of parts to be tested, cost of parts for testing, travel if needed and possibly site inspections. Also keep in mind that all this takes time, so this process could take several months. 🕓🕓🕓🕓

Terminals (for contractor wiring)

20 and 30 amp circuits – Weidmuller tension clamp terminals♦ are used in all connector strips, gridiron junction boxes and pigtail boxes. They are listed for a maximum wire size of 8 gauge, and the correct screwdriver required to operate the clamp is provided. These terminals save about 1/3 of the wiring time compared to screw terminals and don't loosen during shipping. A detailed report on these terminals is available. In custom applications we may opt to use other terminals as needed, depending on space available.

50 and 100 amp circuits – Screw clamp terminals♦ are used for 50, 60 and 100 amp circuits. A screw draws a yoke around the wire and against the tang with these terminals. Terminals that place the screw directly on the wire tend to tear conductors and/or displace them around the screw. The wire range for terminals used on 50/60 amp circuit's is 10 ga. to 1 ga. and for 100 amp circuits is 8 ga. to 2/0. (It's a good practice to give screw terminals one last tightening on the factory terminated side during installation).

Ground bars (minimum 9 position or large enough for 20% grounds) are provided in each device[3] and are capable of accepting up to 6 ga. wire. 100-amp circuits are installed with one 2/0 ground lug provided per circuit.

Wire

All internal wiring is 600V[4], 125º C wire and follows standard electrical color codes.

Pigtails are assembled with Type SOW, SEO or SEOW multi conductor cable.

For details, see wire tables in appendix.

UL

ETC distribution is UL listed and labeled.

Custom projects are UL listed only when electrical components are UL listed; recognized components or alternate agency compliance (ETL, EL, etc.) does not necessarily maintain UL listing.

[3] except 1 and 2 circuit pigtail and outlet boxes, which get a single ground lug.

[4] In rare cases 300V wire may be substituted for wire fire calculations, see "wire fill"

Paint and Cu$tom Color$ - Q & A

What color and finish is used on distribution?

ETC uses textured black powder coat (durable and environmentally friendly ☺ to paint distribution products. Powder paint is electrostaticly applied to parts that have been cleaned in a multi-stage cleaning system and then baked to complete the finish.

Are there any colors ETC provides besides black?

White is the most common alternate color we're asked for, with other colors available.

What about white connectors and pigtails?

White stage pin connectors are available – see *connectors*.
White pigtail's are available for 20 amp circuits $

Why do custom-colors cost more?

To change colors requires the automated paint line be stopped, the spray guns cleaned, and the paint booth vacuumed of all of the current color to avoid spotting the next finish. It may take up to an hour and the downtime is billed as a "setup" charge. The same thing happens again after the custom finish is applied. In addition to the setup and paint costs, keep in mind that all parts must be fabricated in short runs per project as opposed to our standard parts that are run in larger quantities, painted black, and stocked. Lastly, some custom finishes require special handling to avoid damaging the finish during assembly and/or shipping. To minimize cost with custom colors, all parts are painted at one time avoiding multiple setup charges. This requires the coordination and personal attention of an expeditor to manage the manufacture and fabrication of parts. Changes in the configuration of a released job will likely incur the cost of the additional setup charge(s) for both fabrication and paint.

What happens if I want an exact color match?

This can be a lengthy process.

- Our Quotations department must quote custom colors. (FYI, the quote includes the entire batch of paint because it is unlikely others will use this color). $$
- A color sample is sent to the paint manufacturer. 🕓
- The paint manufacturer determines if they have an available color or must make a custom color.
- They send a sample ETC along with their quote to us, which includes the quantity we must purchase, along with cost and lead-time.
- The sample is sent to purchaser for written approval. 🕓
- After we receive written approval and a PO we order the paint. (For planning purposes add a minimum of five weeks for paint manufacture, which can be concurrent with part manufacture). 🕓🕓

Other issues for custom colors and/or finishes

- As stated earlier special handling may be required in assembly to avoid damage or marring product finish. $🕓🕓
- Stage pin connectors will be black unless otherwise specified.
- Pigtail wire, (if applicable) will be black unless specified as white; no other options are available.
- Don't forget to specify how you want these products labeled! (Should there be special colored labels? see labeling, next in this guide, otherwise labels are black with white text).
- Hardware will be black or zinc plated.

Labeling

Circuit and Outlet Labeling

White-on-black adhesive labels[5] mounted on the cover side are standard and included at no additional cost. Typically, 2" characters are used for connector strips, and 1¼" characters are used for pigtail and outlet boxes, although lengthy circuit designations or close proximity to other circuits may require smaller labels.

Optional Circuit and Outlet labeling **$** 🕓

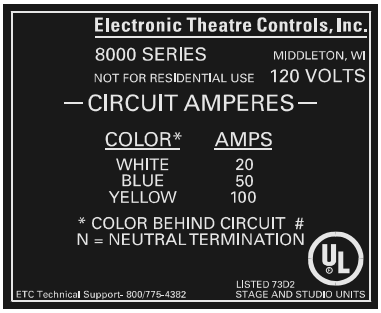
(Call your quotations person pricing.)

- Standard labels applied to two sides *(connector strips, pipe boxes and drop boxes)*
- 5" tall white adhesive "Studio" labels – one side *(connector strips only)*
- 5" tall white adhesive "Studio" labels – two sides *(connector strips only)*
- Engraved covers♦. Legends are engraved directly in an aluminum cover. The engraved characters can be optionally filled with paint in a color of your choice. This option is available only for the cover. **$** 🕓
- Engraved lamicoid labels – one side. We mount these with an adhesive backing. ¢ We can also, using CAD/CAM and NC[6] machines, punch and engrave exact mounting holes to precisely locate and screw these labels to the cover side of the connector strip. $ The standard color for lamicoid labels is black with white text, but other colors are available at little or no charge. (Depending on material cost and whether it is a stock item, call your project manager for details)
- Engraved lamicoid labels – two sides. If you're screw mounting these, the second side must be hand drilled with a drill fixture to ensure accuracy. This requires more labor and will add time and cost to your project. $ 🕓🕓
- Custom-colored reverse screened polycarbonate adhesive labels – one side. There is a setup charge, a screen charge and a minimum order for the screening of custom label colors. They will also have to be scheduled in production. $ 🕓🕓
- Custom-colored reverse screened polycarbonate adhesive labels – two sides.

UL

Each device is identified as UL compliant with this label.

The 120 volt listing refers to 120/208 Wye power. Products with other voltages require custom labels.



Terminal Labels

Terminals are clearly marked with marker tabs or printed labels.

20 amp circuits are black text on a white background.

50 amp circuits are black text on a white background using blue terminals (note: may be black text on a blue background).

100 amp circuits are black text on a yellow background.

Product Identification

[5] FYI – we have changed to an improved adhesive for these labels. For anyone who has had a bad experience in the past with adhesive labels, be assured these are much better! The problems are related to powder coat finishes. Some label adhesives were not intended for powder coat and would randomly not adhere. 3M developed a specific adhesive for powder paint, which is the adhesive we use.

[6] Computer Aided Design, Computer Aided Manufacturing, Numerically Controlled

Each unit has a laser-printed label affixed to it for identification. Custom product will list job name, model number, location, job number and page number from the prints. Standard product will have model and part numbers. For quality assurance this label has the name of the assemblers and test personnel.

Job:

Name: _____

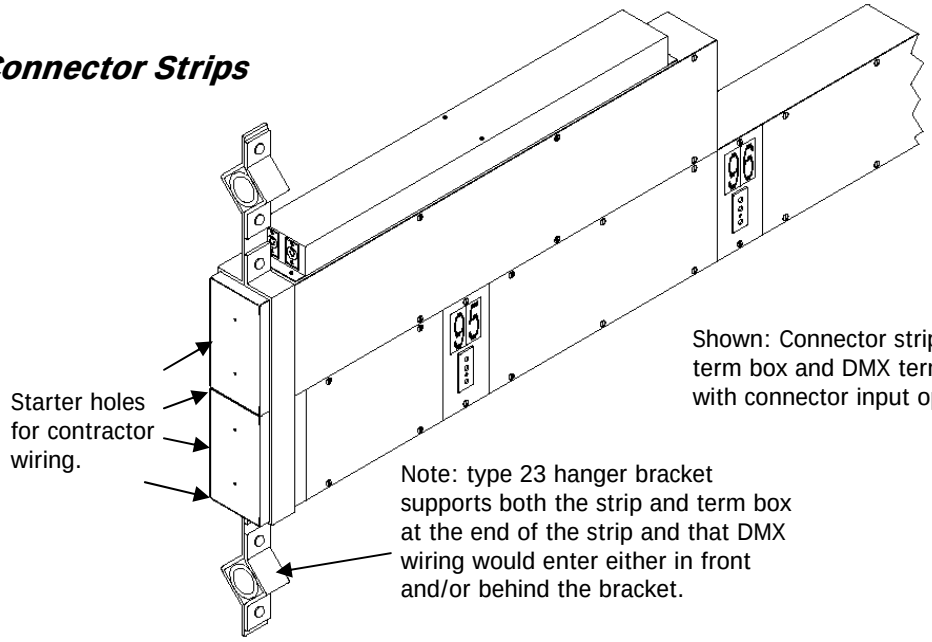
Page Number: _____

Catalog Number: _____

Quantity: _____

Initials: _____ Date: _____

Connector Strips



Dimensions and Mechanical

The cross section of a connector strip is 6.25"H x 3.3"D outside dimensions.

FYI: These dimensions allow us to build a strip with up to twenty-eight 20 amp circuits without a terminal box, which is a real benefit in many locations. This size accommodates up to two 2" conduits (set screw or compression connectors) or wire mesh strain relief's for two runs of 12/36 SO, even Deluxe Kellums grips, (admittedly a fairly tight fit). Its 29% larger cross sectional area (19.4 in^2 vs. 15 in^2, 4 inch square device minus material) allows for more circuits, and the extra height can be used to segregate DMX or Ethernet data distribution.

The connector strip is constructed of sections that are a maximum of six feet long. Multiples of the six-foot sections along with appropriate other length lengths are used to make longer strips. (Connector strips must me specified in increments of 6 inches). The six-foot length has several advantages over our previous eight and ten-foot lengths, which contribute to price reductions, improved quality, improved finish, better packaging, and easier handling and faster installation. (For other benefits see Shipping and Site Assembly and Wiring)

Connector strips are 18 ga. galvanized steel[7] with 14 ga. end caps and junction straps. End caps have starter holes for installer's conduit fittings or multi-cable strain relief's (see Site Assembly and Wiring for details).
FYI: 18 ga. steel makes this larger connector strip 11% lighter than our previous units. The question comes up occasionally, "Doesn't a strip need to be 16 ga. to be strong enough?". No! Our 18 ga. strips are UL approved!

Junction brackets hold sections together and are fastened further into the connector strip than our previous design for added strength and rigidity. These are 14 ga. for additional strength. They are painted to prevent wire abrasion on the punched edges.

Terminal boxes are added for more than 28 circuits or as specified. These are 6.25"H x 3.3"D x 30" long and are typically mounted on a specified end of a connector strip but can be located at any point along the connector strip if needed; for instance, in the center of the strip is fairly common. A "Jumbo" terminal box is available. It is 48" x 12.5" and is capable of up to roughly 100 x 20 amp circuits, although routing that many circuits to one end of a connector strip will be at the very least – difficult!!

[7] FYI - With galvanized steel we do not paint the inside of connector strips, which improves grounding and reduces cost. ¢

Top wiring a connector strip may require additional room for the contractor's wire. The terminal box (term box) is designed for use as a "breakout" box for multi-cable and can be field installed. This maintains the standard packaging and allows for easy site changes to the configuration of the connector strip. (Maintaining standard packaging is a benefit to the installer and shipper – see Site Assembly and Wiring).

Pigtail connector strips are manufactured with double D knockouts (for Heyco strain relief's and 12/3 wire) on 3" centers. ¢ (Connectors strips with no knock outs will have additional charge for engineering and manufacture.) $

Shipping

Connector strips ship standard wired through, folded in a single row[8] of six foot lengths protected by ethyfoam collars that reduce damage during shipment. Strips are boxed and shipped on a skid so standard material-handling equipment can be used.

These units are easier to box and unbox because the individual sections are folded back to back "accordion" style. ¢ (Our previous design, similar to that of others, did not always fold in an organized way and could be tedious to unfold for site assembly and often resulted in cosmetic damage.)

We can ship connector strips in 12' or 18' lengths if required by assembling sections at the factory.

In addition to the standard shipping labels on each box, large colored "dots" (2" round labels) appear on your shipment. A color is assigned and used on all boxes for each job. The job name is also written on the "dots" to quickly identify that job's boxes. Our shippers use these as an organizing aid, and you may find it useful when working on multiple projects.

Site Assembly and Wiring

Tools needed for assembly:

- #2 Philips screwdriver (all screws are #2 Phillips, including stage pin and NEMA devices)
- 9/16" wrench (used to assemble hanger brackets. A good cordless drill with a 9/16" socket can also be used)
- 7/16" wrench for grid iron junction box and outlet box mounting brackets
- Terminal insertion screwdriver (supplied by ETC)
- Drill and bits
- Greenlee® (or equivalent) punch for conduit or multi-cable strain relief

Connector strips arrive packaged with protective ethyfoam collars that keep the sections from rubbing together during shipment. They are intended to be left on to prevent damage during installation. They are labeled: ***Attention Installer:*** *This protective collar is intended to be left on during shipping and site assembly of connector strips to reduce damage during installation.* These collars keep the strip off the floor and allow you to get your hands underneath the connector strip during installation.

The screws used for the assembly of the connector strip are black #2 Philips pan head #8 x 5/16" type B sheet metal (blunt tip, doesn't harm internal wiring).

In the ends of each connector strip (or plug box) there are two .128" holes. These starter holes are optimally located for the largest wiring devices; Kellems Grips (Hubbell # 074-01-034, ETC # HW6183 for 12/36 SO) or 2" conduit. The end of the terminal box has the same holes. Because of wiring congestion we don't typically build connector strips that would require four of the largest conduit or Kellems and recommend wiring at more locations.

Hanger Brackets

All pipe brackets are designed for **1½" schedule 40 black iron pipe** (1.9" nominal O. D.). Other pipe requires custom hanger brackets to be engineered and fabricated.[9]

The minimum distance from the top of a pipe to the connector strip is 2.5" (types 21 - 26 are 3.25")

The formula for the quantity of hanger brackets needed per connector strip is one for every five feet, plus one.

The correct spacing for hanger brackets is one every 5 feet.

Hanger brackets (load bearing) are manufactured with 7 gauge ASTM A 36 structural grade steel, with 12 gauge cold rolled connector strip trough clamps.

We rate the hanger brackets at 300 lbs with an 8 to 1 safety factor to failure based on independent testing and FEA (finite element analysis).

Hanger Bracket Hardware

- Bracket Hardware is black ASTM A307 SAE Grade 5♦. Nuts are Grade B (equivalent to grade 5)
- U-Bolts are black grade 5♦

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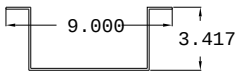
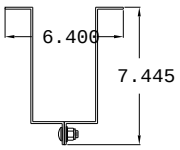
[8] For lengths up to 54', longer lengths may need special packaging.

[9] For 1¼" and 2" pipe we have special pipe clamps that mate to our standard center hung brackets. They are off center by .18" for the 1¼" and pipe and .34" for the 2" pipe. See table of pipe sizes and weights in appendix.

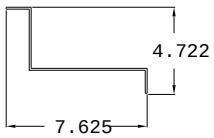
- All nuts are nylon locking to provide secure vibration resistant assemblies
- Carriage bolts are used for pipe and trough clamps so only one wrench or nutdriver (9/16”) is needed for installation
- All hanger bracket hardware is 3/8-16 (9/16” wrench size) to avoid having to sort out different sized hardware or requiring extra tools during installation



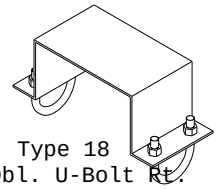
Type 11
Shallow
Wall/Ceiling
Mounting Bracket



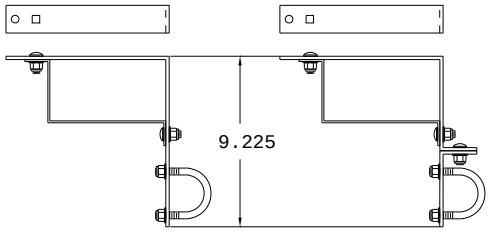
Type 12
Deep Wall/Ceiling
Mounting Bracket



Type 13
Corner Mounting
Bracket

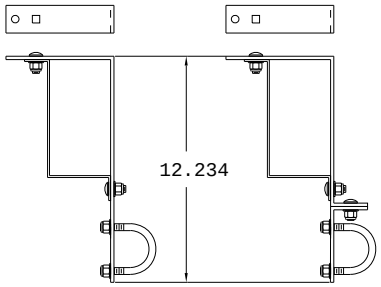


Type 18
Dbl. U-Bolt Rt.
Angle Mounting
Bracket



Type 14
Right Angle Studio
Mounting Bracket

Type 15
Variable Right
Angle Studio
Mounting Bracket



Type 16
Verticle Studio
Mounting Bracket

Type 17
Variable Vert
Studio Mounti
Bracket

Types 11 through 18 are strictly Mounting Brackets and ***support the connector strip only!***

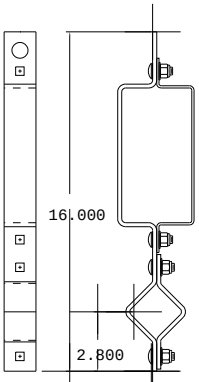
Type	Description	ETC Part #	Weight	Usage and notes
Type 11	Shallow Surface bracket	7099A1011	0.65 lb.	Mounts strips with the 6.25” dimension parallel to and directly on a wall or ceiling. *No mounting hardware is supplied.*
Type 12	Deep surface bracket	7099A1012	0.95 lb.	Mounts strips with the 3.3” dimension parallel to and directly on a wall or ceiling. *No mounting hardware is supplied.*
Type 13	Corner bracket	7099A1013	.5 lb.	Mounts strips in a corner. *No mounting hardware is supplied.*
Type 14	right angle studio bracket (see drawing on page 10)	7099A1014	2.3 lb.	Mounts strips to a pipe with the 6.25” dimension parallel to the floor. Especially good for studio grids with low ceilings. The bracket is attached to the pipe with a U-bolt. The connector strip is mounted to the inside corner of the bracket. The pipe bolted to the outside surface of the vertical member. This arrangement allows full access to the strip for wiring, repair and use. It also has the least height above the pipe, has the largest C-clamp opening, and circuit labeling is easier to read. The .560 hole on the top of the bracket is used to bolt stiffeners (see illustration on page 10) between parallel sections, which prevents the connector strip from rotating from vertical.
Type 15	variable right angle studio bracket	7099A1015	2.55 lb.	Same as type 14, but the vertical segment of the hanger is bolted together to allow the connector strip to be mounted at any angle over the pipe
Type 16	vertical studio bracket	7099A1016	2.3 lb.	Similar to type 14 but mounts strips to pipes with the 6.25” dimension perpendicular to the floor. The u-bolt can be mounted from either side making this hanger useful for any application where a connector strip is mounted to a pipe
Type 17	variable vertical studio bracket	7099A1017	2.55 lb.	Same as type 16, but the vertical segment of the hanger is bolted together to allow the connector strip to be mounted at any angle to the pipe
Type 18	90 Degree dbl. U bolt TS	7099A1018	2.2 lb.	Use where a connector strip is mounted directly on a pipe at 90 degrees

Types 21 through 26 are Hanger Brackets and support both the connector strip and 1½” schedule 40 pipe

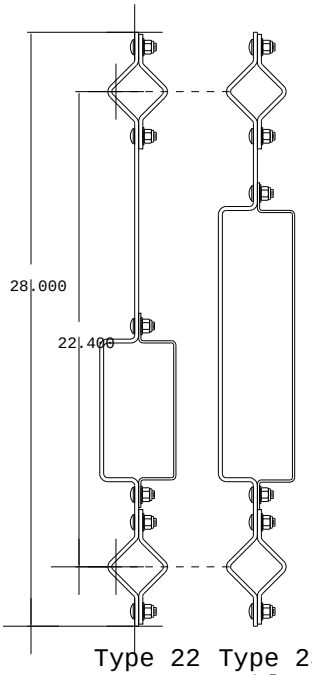
2" Pipe Clamp 1 1/4" Pipe Clamp

The 2” or 1¼”pipe clamps are for use with center load hangers.

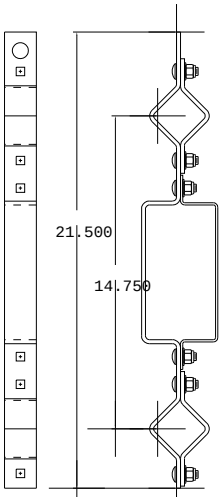
Note: Types 22 and 23 are designed for pipe to pipe mounting only.



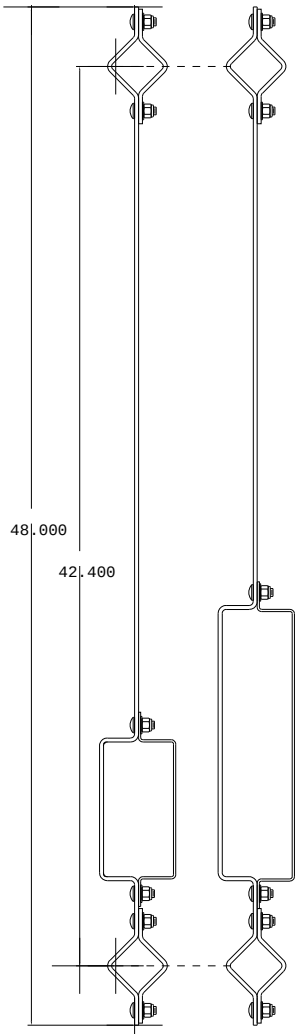
Type 21
Center Single Pipe



Type 22 Type 23
Center Double Pipe
Standard Term Box



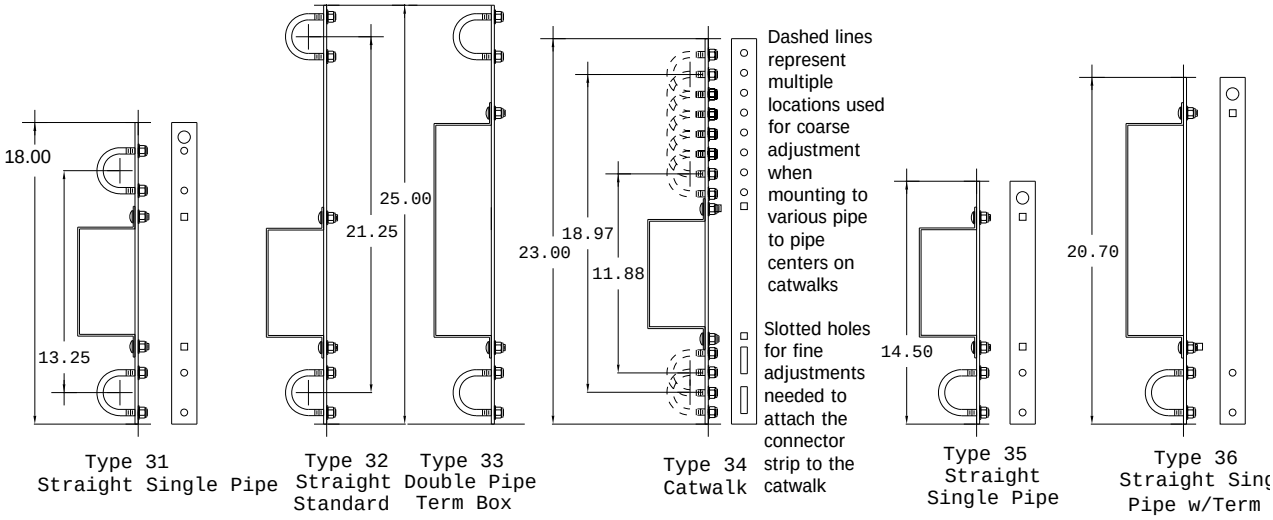
Type 26
Short Center
Double Pipe



Type 24 Type 25
Center Double H
Standard Term Bo

Type 21	Center single pipe hanger	7099A1021	2.75 lb.	The default hanger, this unit hangs the connector strip and a pipe to a fly system. The .75” hole in the top of the bracket is for shackles or thimbles.
Type 22	Center double pipe hanger	7099A1022	4.35 lb.	Designed to hang the connector strip and a pipe from a system pipe already installed.
Type 23	Center double pipe w/term	7099A1023	4.65 lb.	Similar to type 22, but designed to support the connector strip and the term box at the end of the pipe (This unit is automatically substituted for one type 22 when a strip has a term box; do not order)
Type 24	Center double hung hanger	7099A1024	5.85 lb.	Hangs the connector strip and a pipe from a system pipe (already installed in a fly system) to under hang fixtures from both pipes. The .75” hole in the top of the bracket for shackles or thimbles can be used to hang both pipes.
Type 25	Center double hung w/term	7099A1025	6.15 lb.	Like type 23 this is the term box version of the center double hung hanger. Specify type 24, and we will substitute as needed.
Type 26	Short Center double pipe	7099A1026	3.85 lb.	Similar to type 23 but 7” shorter. Use where space is a concern. Cannot be used on connector strips with term boxes. The .75” hole in the top of the bracket is for thimbles and wire rope.
Type 27	Center single term hanger	7099A1027		(not shown) Similar to type 21, but tall enough to support a strip with a term box.

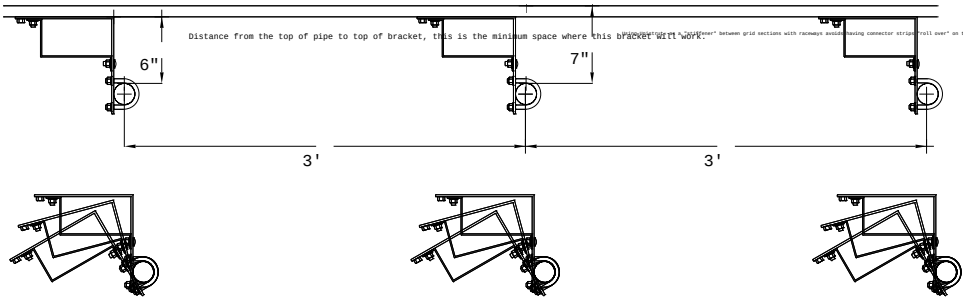
Types 31 through 35 are “flat” Hanger Brackets that support both the connector strip and 1½” schedule 40 pipe (Note: These ***do not*** center hang loads).



Type 31	Straight single pipe hanger	7099A1031	2.5 lb.	Straight version of the type 21 hanger. Pipe is attached with U-bolts.
Type 32	Straight dbl. pipe hanger	7099A1032	3.1 lb.	Straight version of the type 22 hanger. Pipe is attached with U-bolts.
Type 33	Straight dbl. pipe w/term	7099A1033	3.4 lb.	Straight version of the type 23 hanger. Pipe is attached with U-bolts.
Type 34	Catwalk	7099A1034	2.75 lb.	Unit is designed to mount a connector strip on catwalk railings. Place u-bolts from 11.88” to 18.95” center to center, using six positions on the top and slots on the bottom of bracket to cover a range of spacing.
Type 35	Straight single pipe hanger	7099A1035	2.4 lb.	Shorter version of the type 31, no u-bolt hole on top.
Type 36	Straight single pipe W/term	7099A1036	3.2 lb	Straight version of the type 27. Pipe is attached with U-Bolts.

For detailed dimensions on mounting and hanger brackets please refer to prints.

The following drawing is of 3 type 14 mounting brackets shown with Unistrut® bolted across the top acting as a “stiffener” preventing the connector strip from rotating around the pipe.



Custom Connector Strips

Length

Connector strips are available from 2½' long in 6" increments. Strips of two feet or less are built as an outlet/pigtail box (same cross section as connector strips for uniformity) but constructed so connectors can be placed closer to the ends. Using bolt on C-clamp or U-bolt hangers also frees up space for circuits (Connector Strip hanger brackets are 1 ½" wide and wrap around the unit).

A note to system designers: Although it is possible to make and ship a 100' strip, consider the effect on the installers! At some point during the installation they will have to lift this 100'-long 500-pound (or more) unit and carefully mount it without damaging the strip, the building or themselves. We'd like to suggest that if it is necessary to have a long continuous connector strip, you design it in two (or more) sections to be site assembled. At the junctions we provide terminals for the electrical splice and hardware for the mechanical splice so the installer can assemble the sections into the complete unit.

Load Connector Spacing and Location

Load connector locations should start at not less than 7½" from the terminal end of the connector strip and not less than 4½" from the other end. The connector location pattern starts at 1½" from the terminal end of all units and is on 3" centers from this point. This prevents connectors from being located on junctions, and maintains uniform connector spacing. The 7½" and 4½" spaces at each end are to allow room for hanger brackets at the ends and easier access for wiring to the ground bar.

Panel connectors are mounted on individual connector strip covers♦ – 20 and 30 amp are 3" wide; 50, 60 and 100 amp connector covers are 6" wide. Spaces are filled with blanks, and the assembly is similar to an EIA rack mount. This modularity allows for easy service and repositioning if necessary during installation.

All pigtails (including 50 and 100 amp) are on 3" centers that start with the same 1½" offset and should also not be located less than 7½" from the terminal end and 4½" from the other end of the strip.

Term Boxes

Standard term boxes are used according to the table in the next section. The standard term box is designed primarily for 20 amp circuits but will accommodate a few 50 and 100 amp circuits, for details see tables.

Jumbo term boxes should be used for strips with more than four 100 amp or eight 50-amp circuits. This unit attaches to the end of the strip (not the top) and is 48"L X 12.5"H. The height is the same as the standard term box/connector strip section combination, which allows standard hanger brackets (type 23, 25 and 33) to be used. Because of the size and weight of this box we supply two hanger brackets to support it, one at each end. The advantage of the box is it's open throughout and is much easier to route wire for 50 amp and larger circuits. It can also be used to reduce wiring congestion when over 40 20-amp circuits are used.☺ The jumbo term box has limitations for circuit placement. Don't put a pigtail under the hanger brackets needed to support the box (1½" and 46½") and don't put panel mount connectors at 1 ½", 4 ½", 43 1/5" and 46 ½". To do so will require a reasonably expensive custom item. ☹

Circuits, Connectors, Terminals and Wire Fill

Circuits vs. Connectors

A circuit is any number of connectors/outlets wired in parallel to a single source, such as a dimmer. An outlet or pigtail connector is where the lighting fixture is plugged in. One or more connectors may be wired to a circuit.

Two or more connectors/outlets wired to the same circuit are typically wired directly to individual terminals and paralleled with jumpers. This allows easier field reconfiguration if needed. This is important for wire fill calculations because each outlet is calculated for wire fill. If the number of outlets causes us to exceed wire fill limits, we can parallel them at the connector. This reduces the wire fill calculation from the number of outlets to the number of circuits. Situations may also arise where so many connectors paralleled on half the number of circuits in the design of a connector strip that there may not be enough space for the terminals. In this case we will also parallel the circuits at the outlet or pigtail.

Although possible, we recommend no more than forty-five circuits wired from any end of a connector strip. We advise that when more than forty-five circuits are required you consider alternate wiring solutions (e.g. from both ends or by adding an additional terminal location in the center of the strip). Call your project manager for details and exceptions.

Terminals

20 & 30 amp circuits use Weidmuller tension clamp terminals♦, listed for a maximum wire size of 8 gauge, good for most installations (This is an improvement over our old design that used 10 ga. terminals). In cases where even larger wire is required be sure to specify the required terminal size (wire size) for these circuits and keep in mind larger terminals will reduce the number of circuits that can be installed in a connector strip and may require a larger terminal box. Call your project manager for details. There is an additional charge for larger terminals. **$**

50 amp circuits use yoke and tang screw terminals listed for 10 ga. to 1 ga. wire, and take the terminal space of two 20 amp circuits. Multiple 50 amp circuits will require the addition of a term box to allow for proper wiring.

100 amp circuits use yoke and tang screw terminals listed for 8 ga. to 2/0 wire, and take the terminal space of three 20 amp circuits.

Terminals used for 50 and 100 amp circuits are sized for larger wire so specifying even larger terminals required for deratings is rarely needed. However, due to other limitations please consult with your project manager for specific design details and suggestions when using multiple 50 and 100 amp circuits.

Notes On Wire Derating And Terminal Size

- As the number of circuits in a conduit or raceway increases, the NEC prescribes a derating for the individual conductors used. For example, from the 1999 NEC table 310-16, a 12 ga. THHN 90°C wire has a maximum ampacity of 30 amps. When 4 to 6 current-carrying conductors are installed in a conduit or raceway the wire is derated to 80% of its value – in this case, 24 amps (from 1999 NEC, table 310-15(b)(2)(a)). When there are 30 current-carrying conductors the derating is 45% of the original value, or 13.5 amps. To compensate for the loss of capacity, a larger wire is substituted. In this case 8 ga. wire is required to maintain a 20 amp minimum value (derated to 24.75 amps). For specific details consult the National Electric Code.
- Neutrals are current carrying in dimming systems, grounds are not.
- In installations with long wire runs consultants and engineers will often specify larger wire to minimize voltage drop. The formula for voltage drop is V=IR where V is voltage, I is current and R is resistance. Resistance is published in Chapter 9, Table 9 of the 1999 NEC and listed in ohm's per 1000 feet.

- With Sensor Dimming's Scale feature each dimmer can be tuned to a specific voltage, (assuming your incoming voltage is adequate). For the sake of argument and round numbers: Transformers for a facility can be specified for a nominal incoming voltage of, for example, 135 volts. If you have 12 ga. wire runs from your dimmers of 500 feet the voltage drop is 20 volts, perfect for a 115V HPL lamp (now you know why I picked the numbers, you wouldn't likely use 12 ga. wire at this distance). However, your lamps at 100 feet are getting 131 volts and are very bright for a very short time with a very blue color temperature. Accessed through the CEM (control module), you can "Scale" the 131 volts back to 115 and all the other circuits so all your fixtures have the same output and color temperature. For details contact ETC or your project manager.

Wire Fill

Wire fill calculations include the insulation when calculating the cross section area. All calculations in the following tables are based on the use of 600V 125° (or 150°) wire.

When designing connector strips with more than 45 x 20 amp circuits, 8 x 50 amp circuits or 4 x 100 amp circuits please consult your project manager for suggestions.

Also, keep in mind that distribution with a large number of circuits wired to one position may create issues for the installer. (see deratings in the previous section)

The following tables are for the four basic electro-mechanical configurations of connector strips. In cases where the maximum wire fill exceeds the number of circuits that can be brought into the strip the lower number is used to avoid confusion.

Wire Fill Table: Pigtail Connector Strips							
Circuit Rating in Amps	**Wire Gauge**	**Maximum Wire Fill**	**Exchange Qty for # of 20A Circuits**	**Maximum # of Circuits Without Term Box**	**Maximum # of Circuits With Term Box**	**Maximum # of Circuits With Jumbo Term Box**	**Terminals Accept Up To This Wire Size**
20	12 ga.	98	1	28	56	66[10]	8 ga.
30	10 ga.	62	1.6	28	56	62	8 ga.
50	6 ga.	20	4.9	4	8	20	1 ga.
100	2 ga.	9	10.5	2	4	9	00 ga.

Wire Fill Table: Panel Mount Connector Strips							
Circuit Rating in Amps	**Wire Gauge**	**Maximum Wire Fill**	**Exchange Qty for # of 20A Circuits**	**Maximum # of Circuits Without Term Box**	**Maximum # of Circuits With Term Box**	**Maximum # of Circuits With Jumbo Term Box**	**Terminals Accept Up To This Wire Size**
20	12 ga.	88	1	28	56	66[10]	8 ga.
30	10 ga.	56	1.6	28	56	56	8 ga.
50	6 ga.	18	4.9	4	8	18	1 ga.
100	2 ga.	8	10.5	2	4	8	00 ga.

Wire Fill Table: Pigtail Connector Strips w/ Low Voltage Barrier (DMX)							
Circuit Rating in Amps	**Wire Gauge**	**Maximum Wire Fill**	**Exchange Qty for # of 20A Circuits**	**Maximum # of Circuits Without Term Box**	**Maximum # of Circuits With Term Box**	**Maximum # of Circuits With Jumbo Term Box**	**Terminals Accept Up To This Wire Size**
20	12 ga.	66	1	28	56	66	8 ga.
30	10 ga.	42	1.6	28	42	42	8 ga.
50	6 ga.	14	4.9	4	8	14	1 ga.
100	2 ga.	6	10.5	2	3	6	00 ga.

Wire Fill Table: Panel Mount Connector Strips w/ Low Voltage Barrier (DMX)							
Circuit Rating in Amps	**Wire Gauge**	**Maximum Wire Fill**	**Exchange Qty for # of 20A Circuits**	**Maximum # of Circuits Without Term Box**	**Maximum # of Circuits With Term Box**	**Maximum # of Circuits With Jumbo Term Box**	**Terminals Accept Up To This Wire Size**
20	12 ga.	56	1	28	56	56	8 ga.
30	10 ga.	37	1.6	28	37	37	8 ga.
50	6 ga.	12	4.9	4	6	12	1 ga.
100	2 ga.	5	10.5	2	3	5	00 ga.

[10] This limit is based on using (4) 12/37 multiconductors and maintaining sufficient grounds. Other calculations with conduit and other wire gauges may change this number, i.e. (4) 2" conduits with 8 ga. may add a few circuits, but distance derating for voltage drop may require 6 gauge and the number of circuits will drop significantly. Please refer to the current NEC for requirements.

Data Distribution in Connector Strips♦

DMX

We recommend that each connector strip be fed with its own discrete opto-isolated DMX line.

When “home runs” are not practical, DMX junction boxes are available and can be mounted individually, or conveniently bolted to a grid iron junction box.

DMX Input to the Connector Strip

DMX is typically brought into the strip with a DMX input box that mounts on top of connector strips or terminal boxes. Hard-wired inputs to terminals (screw clamp type) are standard. Hard wired inputs may be through conduit or wired with an included strain relief. XLR inputs are also available (1 or 2, one for each universe).

Note: With the DMX input box you cannot top wire the connector strip! To top wire a strip with DMX use a DMX input panel. This allows you to top wire the strip by using only the sixth hole (the top hole furthest into the strip) for DMX.

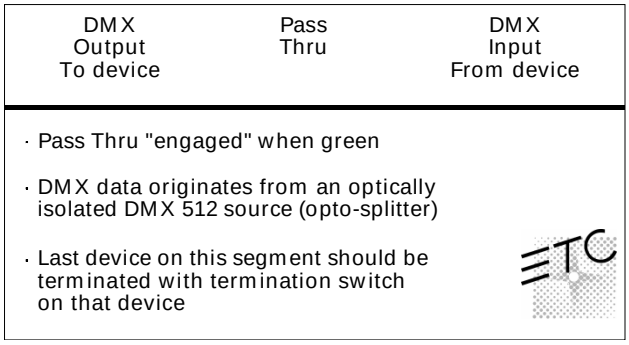
One or two universes are standard. *For more than two universes of DMX in a connector strip, please have your head examined and call your project manager!*

DMX Panels: Their Usage and Placement

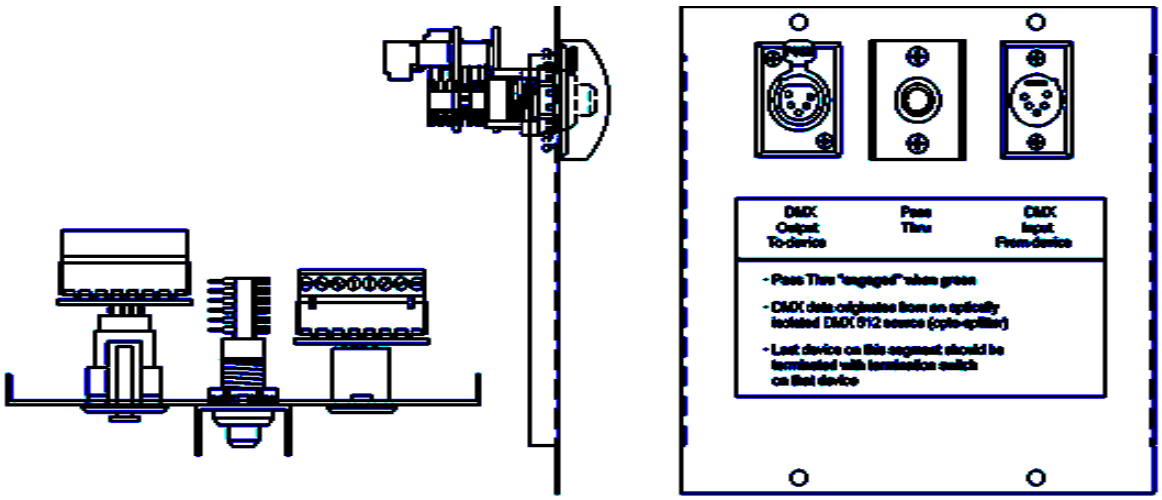
DMX is distributed on the connector strip with an In & Through panel. The panel has a male and female 5-pin XLR, wired to go to and from your DMX device, maintaining a continuous segment. The bypass switch is engaged when a location is not used. The switch has a green mechanical indicator to indicate the location is bypassed and switches pins 2-5 on the XLR’s. Grounds are passed through. This panel is 6" wide and can be located anywhere except within the first two feet (terminal section) or over joints in the connector strip. If we receive a specification that places DMX in an unacceptable location, we will move the DMX panels to make the best use of space and even distribution of connections. Check your prints when you receive them to make sure all outlets are located where you want them. (Note: if you choose not to use the In & Through panels, it’s not our fault if your DMX doesn’t work. No matter what, case closed, the end...)

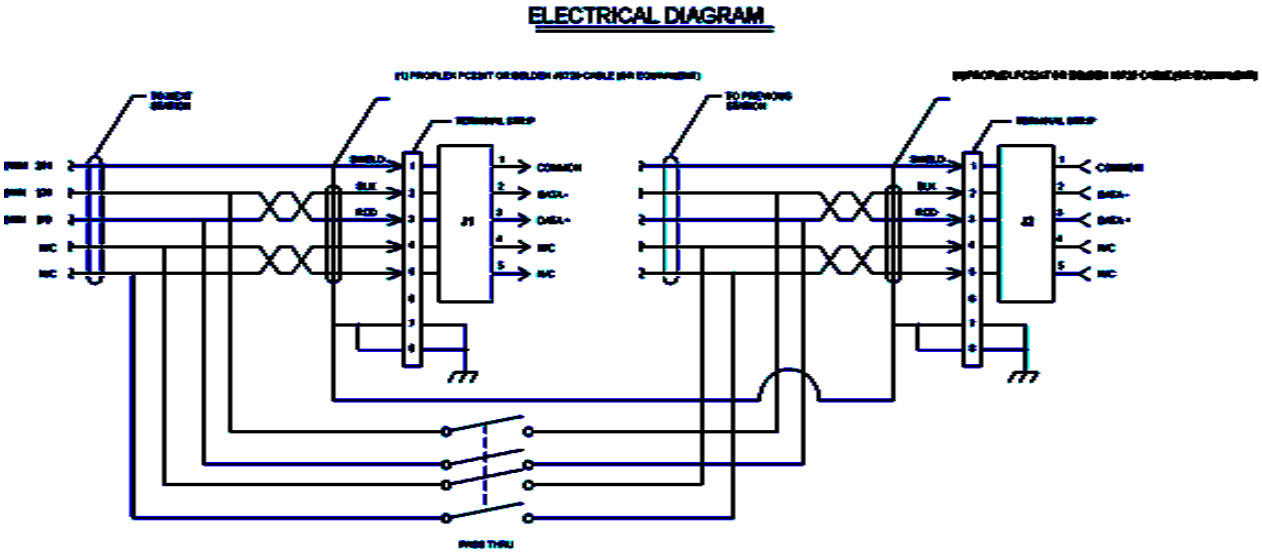
If you absolutely have to have DMX in the first 24” of the strip, we will make a custom input box with the DMX connectors mounted in its side that are hand wired. This will add two or three weeks to your lead-time (design, fabrication, paint, assembly) and incur additional engineering and assembly costs. **$** 🕒

Each DMX pass-thru panel is labeled for operator use. Please note that the last device on each connector strip should be terminated.



The illustration below is of the DMX pass through panel including mechanical and electrical drawings.



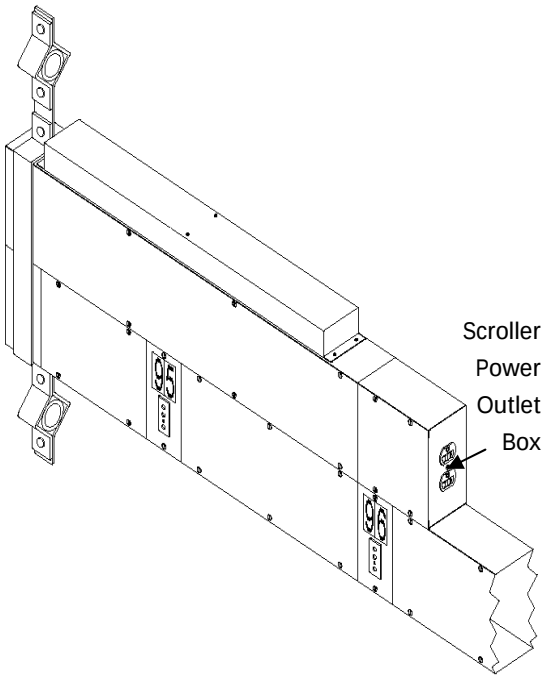


Data Wiring

Internal is Proplex PC224T (O. D. .280, 42 lbs/1000') or Belden 9729
External in conduit should be Proplex PC224T (O. D. .280, 42 lbs/1000') or Belden 9729
External not in conduit must be Proplex. PC224P (O. D. .280, 48 lbs/1000')

Scroller Power Outlet Box

The scroller power outlet box is added to a terminal box and faces the away from the terminal end of the connector strip. Use the scroller power outlet box to hang a power supply nested between the pipe and the connector strip with an outlet clearly marked for scroller power and physically out of the way.



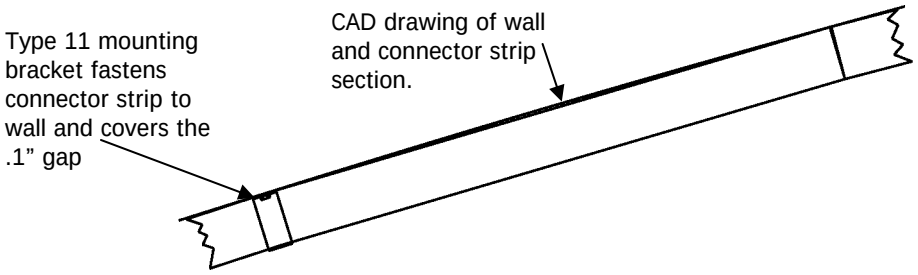
6 Circuit Multipin Chassis Mount Inputs

Connector strip end panels with one or two 6 circuit multipin connectors are stock. The mounting is biased towards the outside edges of the end panel in order to allow room to fasten the mating connectors. You may add a term box for a single additional connector, but there is not room to actually use four multipins on the end of a connector strip (although there is room enough to mount them, you can't actually plug into them – you've been warned!)

Balcony Rail Connector Strips

Using a model of a 100' radius balcony rail (a reasonably tight radius) we've come up with a flexible *(double entendre)* solution.

- The connector strip is constructed with 3' (instead of 6') sections. The shorter length keeps the gap between the center of the connector strip section and a 100' radius wall at about .135". These are buildings and we all know they aren't built to a thousandth of an inch, so obviously this number is for reference. With larger radii the gap decreases, and smaller radii will increase the gap.
- The angle between sections is approximately 1.72°.
- The sections stay butted together at the front, flexing only at the back of each junction. The back of the strip opens a little under a 1/10". This is covered internally by the junction bracket, and covered externally by the mounting bracket.
- The junction bracket is a special design with floating fasteners that allow this special connector strip to "flex" around the curve of a balcony rail.
- Please contact your project manager for details.



Standard Distribution: *a.k.a. "Distro Basics"*

We have recently introduced "Distro Basics". It's a sales program where distribution is sold through customer service. It has limited connector strip options to keep it simple, no prints and quick delivery (typically 2 weeks or less, check with your customer service person for exact scheduling). Available are Connector Strips, Outlet/Pigtail Boxes and Gridiron Junction Boxes.

Connectors Strips:

- Connector Strips are available with 20 amp Stage Pin, Twist-lock® and Edison connectors only.
- Pigtail or panel-mount connectors.
- May be wired Left or Right
- Are listed without hanger brackets. When ordering please specify which hanger bracket you want by type: If none is specified we will default to the type 21 single center hung bracket.
- Remaining specifications are the same as Custom Connector strips.

Outlet and Pigtail Boxes:

- Outlet Boxes are available in 20 amp Stage Pin, Twist-Lock® and Edison connectors.
- 1, 2, 3, 4, 5, 6, 8 connectors.
- Pigtail or panel-mount connectors.
- Surface or recessed mounting.
- Pipe mounting available.

Gridiron Junction Boxes:

- Gridiron Junction Boxes are 20 amp only and are available from 5 to 60 circuits in multiples of 5.

Connector Strips - Model Number 7099 CS

Description		List Price
Price per foot:		22.00
20A Stage Pin	18" pigtail BP	26.00
20A Stage Pin	24" pigtail BP24	27.00
20A Stage Pin	36" pigtail BP36	29.00
20A Stage Pin	Panel Mount BO	22.00
20A Twistlock	18" pigtail, L5-20R CP	30.00
20A Twistlock	24" pigtail, L5-20R CP24	31.00
20A Twistlock	36" pigtail, L5-20R CP36	33.00
20A Twistlock	Panel Mount, L5-20R CO	26.00
20A Edison	18" pigtail, 5-20R AP	34.00
20A Edison	24" pigtail, 5-20R AP24	35.00
20A Edison	36" pigtail, 5-20R AP36	37.00
20A Edison	Panel Mount, 5-20R AO	31.00
20A Edison	Duplex, 5-20RD AOD	28.00

Distro Basics Notes:

For connector strips to be priced as part of the distro basics program, the strips must adhere to the following rules:

- Evenly spaced circuits
- Individual circuits can have multiple outlets.
- Numbered from terminal end.
- Standard Pigtail lengths: 18", 24" or 36"
- Common Brackets are included in pricing (See Worksheet for Common Brackets).

Other brackets available at additional cost. Contact the ETC Quotations department.

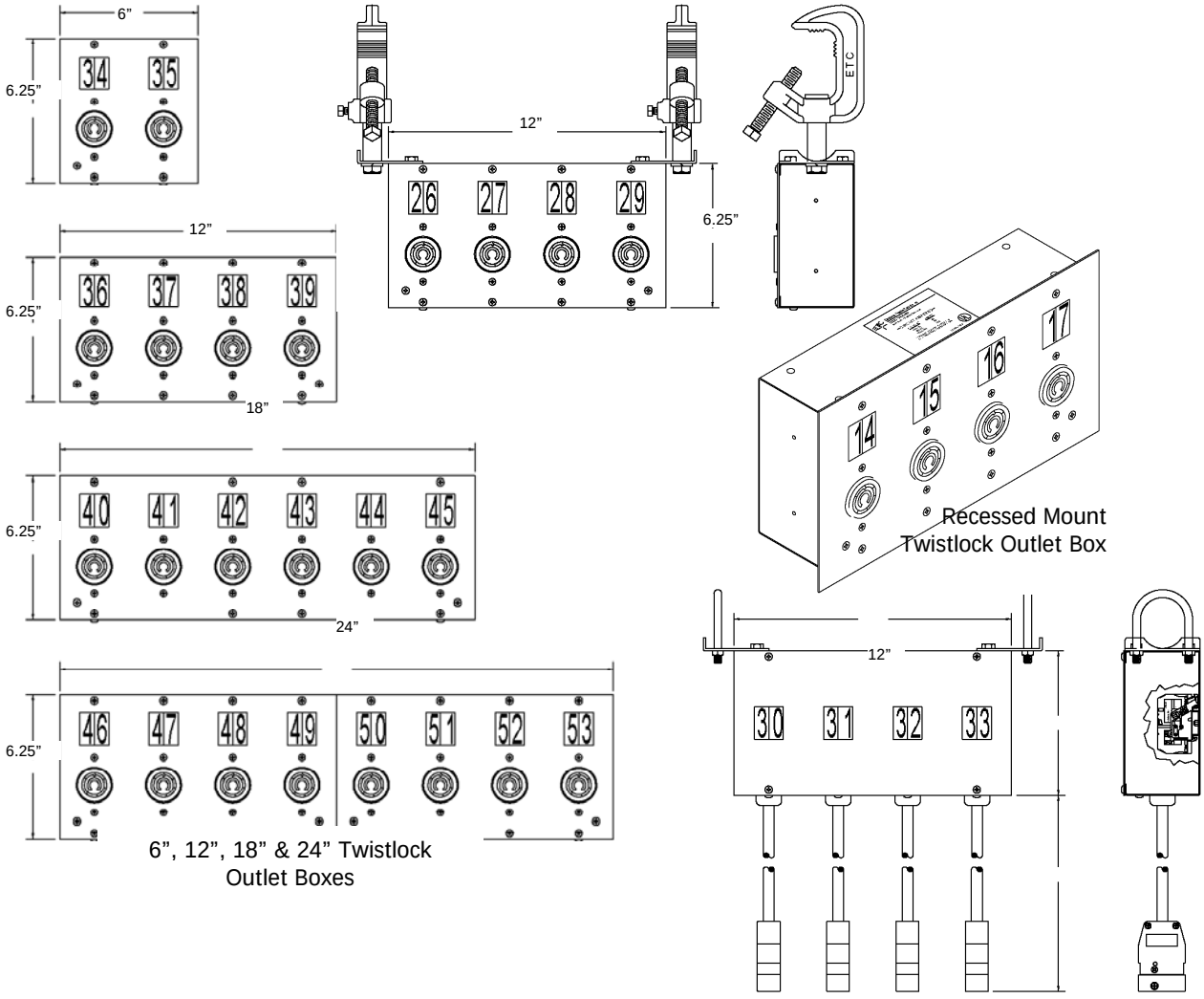
- Standard labels: 2" high white-on-black circuit labels on one side.
- Shipped standard 6' lengths, completely wired through and folded; splicing hardware included
- No Drawings for approval or records. Drawings may be purchased for an additional price.

Outlet And Pigtail Boxes - General

- Have the same cross section as connector strips.
- Are available with U-Bolt mounting brackets that are formed on one side, similar to a muffler clamp to strengthen the mounting and help avoid flexing the mounting bracket around the pipe.
- Are also available with C-clamp mounting brackets, which are used to space the box away from the pipe, allowing fixtures to be hung directly next to the box.

Standard Outlet Boxes – for surface or pipe mounting

- Available with 20 amp Stage Pin, Twist-Lock® and U-ground (Edison Connectors).
- For pipe mounting, order either U-bolt or C-clamp mounting kits.
- Are labeled with 1¼" reverse-screened white-on-black polycarbonate adhesive labels. Please copy the print supplied you, fill in the circuit numbering information and send or fax it to us with your PO.
- May be ordered through Customer Service
- Any variation from these standards must be quoted and processed by our Project Management department.



6", 12", 18" & 24" Twistlock
Outlet Boxes

Add offset pipe
brackets (1052's)

U-Bolt Pipe Mounted
Stage Pin Pigtail Box

Standard Outlet Boxes

Description	Circuits	W" x H" x D"	Weight	ETC Part #	Model #
Stage Pin					
Outlet box Surf, 1 PIN, 9101B	1	6" x 6.25" x 3.3"		7099A1101B	9101B
Outlet box Surf, 2 PIN, 9102B	2	6" x 6.25" x 3.3"		7099A1102B	9102B
Outlet box Surf, 3 PIN, 9103B	3	12" x 6.25" x 3.3"	4.8	7099A1103B	9103B
Outlet box Surf, 4 PIN, 9104B	4	12" x 6.25" x 3.3"	5	7099A1104B	9104B
Outlet box Surf, 5 PIN, 9105B	5	18" x 6.25" x 3.3"		7099A1105B	9105B
Outlet box Surf, 6 PIN, 9106B	6	18" x 6.25" x 3.3"		7099A1106B	9106B
Outlet box Surf, 8 PIN, 9108B	8	24" x 6.25" x 3.3"		7099A1108B	9108B
Twist-Lock®					
Outlet BOX Surf, 1 TW, 9101C	1	6" x 6.25" x 3.3"		7099A1101C	9101C
Outlet BOX Surf, 2 TW, 9102C	2	6" x 6.25" x 3.3"		7099A1102C	9102C
Outlet BOX Surf, 3 TW, 9103C	3	12" x 6.25" x 3.3"		7099A1103C	9103C
Outlet BOX Surf, 4 TW, 9104C	4	12" x 6.25" x 3.3"		7099A1104C	9104C
Outlet BOX Surf, 5 TW, 9105C	5	18" x 6.25" x 3.3"		7099A1105C	9105C
Outlet BOX Surf, 6 TW, 9106C	6	18" x 6.25" x 3.3"		7099A1106C	9106C
Outlet BOX Surf, 8 TW, 9108C	8	24" x 6.25" x 3.3"		7099A1108C	9108C
U-Ground					
Outlet BOX Surf, 1 ED, 9101A	1	6" x 6.25" x 3.3"		7099A1101A	9101A
Outlet BOX Surf, 2 ED, 9102A	2	6" x 6.25" x 3.3"		7099A1102A	9102A
Outlet BOX Surf, 3 ED, 9103A	3	12" x 6.25" x 3.3"		7099A1103A	9103A
Outlet BOX Surf, 4 ED, 9104A	4	12" x 6.25" x 3.3"		7099A1104A	9104A
Outlet BOX Surf, 5 ED, 9105A	5	18" x 6.25" x 3.3"		7099A1105A	9105A
Outlet BOX Surf, 6 ED, 9106A	6	18" x 6.25" x 3.3"		7099A1106A	9106A
Outlet BOX Surf, 8 ED, 9108A	8	24" x 6.25" x 3.3"		7099A1108A	9108A
6 Circuit Mulitpin					
OUTLET BOX MULTI PIN 9101V	1	6" x 6.25" x 5"		7099A1101V	9101V
OUTLET BOX MULTI PIN 9102V	1	12" x 6.25" x 5"		7099A1102V	9102V
OUTLET BOX MULTI PIN 9103V	1	18" x 6.25" x 5"		7099A1103V	9103V

Pigtail Boxes – for wall surface or pipe mounting with pipe kits

	Circuits	W" x H" x D"	Weight	ETC Part #	Model
Stage Pin					
Pigtail box Surf, 1 PIN, 9301B	1	6" x 6.25" x 3.3"		7099A1121B	9301B
Pigtail box Surf, 2 PIN, 9302B	2	6" x 6.25" x 3.3"		7099A1122B	9302B
Pigtail box Surf, 3 PIN, 9303B	3	12" x 6.25" x 3.3"		7099A1123B	9303B
Pigtail box Surf, 4 PIN, 9304B	4	12" x 6.25" x 3.3"		7099A1124B	9304B
Pigtail box Surf, 5 PIN, 9305B	5	18" x 6.25" x 3.3"		7099A1125B	9305B
Pigtail box Surf, 6 PIN, 9306B	6	18" x 6.25" x 3.3"		7099A1126B	9306B
Pigtail box Surf, 8 PIN, 9308B	8	24" x 6.25" x 3.3"		7099A1128B	9308B
Twist-Lock®					
Pigtail BOX Surf, 1 TW, 9301C	1	6" x 6.25" x 3.3"		7099A1121C	9301C
Pigtail BOX Surf, 2 TW, 9302C	2	6" x 6.25" x 3.3"		7099A1122C	9302C
Pigtail BOX Surf, 3 TW, 9303C	3	12" x 6.25" x 3.3"		7099A1123C	9303C
Pigtail BOX Surf, 4 TW, 9304C	4	12" x 6.25" x 3.3"		7099A1124C	9304C
Pigtail BOX Surf, 5 TW, 9305C	5	18" x 6.25" x 3.3"		7099A1125C	9305C
Pigtail BOX Surf, 6 TW, 9306C	6	18" x 6.25" x 3.3"		7099A1126C	9306C
Pigtail BOX Surf, 8 TW, 9308C	8	24" x 6.25" x 3.3"		7099A1128C	9308C
U-ground					
Pigtail BOX Surf, 1 ED, 9301A	1	6" x 6.25" x 3.3"		7099A1121A	9301A
Pigtail BOX Surf, 2 ED, 9302A	2	6" x 6.25" x 3.3"		7099A1122A	9302A
Pigtail BOX Surf, 3 ED, 9303A	3	12" x 6.25" x 3.3"		7099A1123A	9303A
Pigtail BOX Surf, 4 ED, 9304A	4	12" x 6.25" x 3.3"		7099A1124A	9304A
Pigtail BOX Surf, 5 ED, 9305A	5	18" x 6.25" x 3.3"		7099A1125A	9305A

Pigtail BOX Surf, 6 ED, 9306A	6	18” x 6.25” x 3.3”		7099A1126A	9306A
Pigtail BOX Surf, 8 ED, 9308A	8	24” x 6.25” x 3.3”		7099A1128A	9308A

Recessed Outlet Boxes – (mounted in the wall)

Back box dimensions are one inch less than height and width.

	Circuits	W” x H” x D”	Weight	ETC Part #	Model
Stage Pin					
Outlet box, Recs, 1 PIN, 9201B	1	7” x 7.25” x 3.3”		7099A1111B	9201B
Outlet box, Recs, 2 PIN, 9202B	2	7” x 7.25” x 3.3”		7099A1112B	9202B
Outlet box, Recs, 3 PIN, 9203B	3	13” x 7.25” x 3.3”	5.28	7099A1113B	9203B
Outlet box, Recs, 4 PIN, 9204B	4	13” x 7.25” x 3.3”	5.38	7099A1114B	9204B
Outlet box, Recs, 5 PIN, 9205B	5	19” x 7.25” x 3.3”		7099A1115B	9205B
Outlet box, Recs, 6 PIN, 9206B	6	19” x 7.25” x 3.3”		7099A1116B	9206B
Outlet box, Recs, 8 PIN, 9208B	8	25” x 7.25” x 3.3”		7099A1118B	9208B
Twist-Lock®					
Outlet BOX, Recs, 1 TW, 9201C	1	7” x 7.25” x 3.3”		7099A1111C	9201C
Outlet BOX, Recs, 2 TW, 9202C	2	7” x 7.25” x 3.3”		7099A1112C	9202C
Outlet BOX, Recs, 3 TW, 9203C	3	13” x 7.25” x 3.3”		7099A1113C	9203C
Outlet BOX, Recs, 4 TW, 9204C	4	13” x 7.25” x 3.3”		7099A1114C	9204C
Outlet BOX, Recs, 5 TW, 9205C	5	19” x 7.25” x 3.3”		7099A1115C	9205C
Outlet BOX, Recs, 6 TW, 9206C	6	19” x 7.25” x 3.3”		7099A1116C	9206C
Outlet BOX, Recs, 8 TW, 9208C	8	25” x 7.25” x 3.3”		7099A1118C	9208C
U-ground					
Outlet BOX, Recs, 1 ED, 9201A	1	7” x 7.25” x 3.3”		7099A1111A	9201A
Outlet BOX, Recs, 2 ED, 9202A	2	7” x 7.25” x 3.3”		7099A1112A	9202A
Outlet BOX, Recs, 3 ED, 9203A	3	13” x 7.25” x 3.3”		7099A1113A	9203A
Outlet BOX, Recs, 4 ED, 9204A	4	13” x 7.25” x 3.3”		7099A1114A	9204A
Outlet BOX, Recs, 5 ED, 9205A	5	19” x 7.25” x 3.3”		7099A1115A	9205A
Outlet BOX, Recs, 6 ED, 9206A	6	19” x 7.25” x 3.3”		7099A1116A	9206A
Outlet BOX, Recs, 8 ED, 9208A	8	25” x 7.25” x 3.3”		7099A1118A	9208A

Recessed Pigtail Boxes – (mounted in the wall)

Back box dimensions are one inch less than height and width.

	Circuits	W” x H” x D”	Weight	ETC Part #	Model
Stage Pin					
Pigtail box Recs, PIN, 9401B	1	7” x 7.25” x 3.3”		7099A1131B	9401B
Pigtail box Recs, PIN, 9402B	2	7” x 7.25” x 3.3”		7099A1132B	9402B
Pigtail box Recs, PIN, 9403B	3	13” x 7.25” x 3.3”		7099A1133B	9403B
Pigtail box Recs, PIN, 9404B	4	13” x 7.25” x 3.3”		7099A1134B	9404B
Pigtail box Recs, PIN, 9405B	5	19” x 7.25” x 3.3”		7099A1135B	9405B
Pigtail box Recs, PIN, 9406B	6	19” x 7.25” x 3.3”		7099A1136B	9406B
Pigtail box Recs, PIN, 9408B	8	25” x 7.25” x 3.3”		7099A1138B	9408B
Twist-Lock®					
Pigtail BOX Recs, 1 TW, 9401C	1	7” x 7.25” x 3.3”		7099A1131C	9401C
Pigtail BOX Recs, 2 TW, 9402C	2	7” x 7.25” x 3.3”		7099A1132C	9402C
Pigtail BOX Recs, 3 TW, 9403C	3	13” x 7.25” x 3.3”		7099A1133C	9403C
Pigtail BOX Recs, 4 TW, 9404C	4	13” x 7.25” x 3.3”		7099A1134C	9404C
Pigtail BOX Recs, 5 TW, 9405C	5	19” x 7.25” x 3.3”		7099A1135C	9405C
Pigtail BOX Recs, 6 TW, 9406C	6	19” x 7.25” x 3.3”		7099A1136C	9406C
Pigtail BOX Recs, 8 TW, 9408C	8	25” x 7.25” x 3.3”		7099A1138C	9408C
U-ground					
Pigtail BOX Recs, 1 ED, 9401A	1	7” x 7.25” x 3.3”		7099A1131A	9401A
Pigtail BOX Recs, 2 ED, 9402A	2	7” x 7.25” x 3.3”		7099A1132A	9402A
Pigtail BOX Recs, 3 ED, 9403A	3	13” x 7.25” x 3.3”		7099A1133A	9403A
Pigtail BOX Recs, 4 ED, 9404A	4	13” x 7.25” x 3.3”		7099A1134A	9404A

Pigtail BOX Recs, 5 ED, 9405A	5	19" x 7.25" x 3.3"		7099A1135A	9405A
Pigtail BOX Recs, 6 ED, 9406A	6	19" x 7.25" x 3.3"		7099A1136A	9406A
Pigtail BOX Recs, 8 ED, 9408A	8	25" x 7.25" x 3.3"		7099A1138A	9408A

NEMA Style Wall Plates

NEMA style wall plates are available for Stage pin, Edison and Twistlock connectors The are designed to be used with industry standard back boxes. Note the Twist-Lock versions are 1,3 and 5 gang for 1, 2 and 3 connectors. This is because most male Twist-Lock's have a larger diameter than the standard 1.812" NEMA spacing, so adjacent plugs could not be plugged in.

Nema Panel ordering information			
Connector	**Qty**	**# of gangs**	**Model #**
Stage Pin	1	1	9801B
Stage Pin	2	2	9802B
Stage Pin	3	3	9803B
Stage Pin	4	4	9804B
Twist-Lock	1	1	9801C
Twist-Lock	2	3	9802C
Twist-Lock	3	5	9803C
Edison	1	1	9801A
Edison	2	2	9802A
Edison	3	3	9803A
Edison	4	4	9804A
Edison	1	1	9801AD
Edison	2	2	9802AD
Edison	3	3	9803AD
Edison	4	4	9804AD

Custom Outlet and Pigtail Boxes

Design Constraints and Suggestions for Custom Outlet Boxes

- UL-Listed devices are required to maintain UL listed finished units
- Terminals are not standard for 20 and 30 amp outlet boxes because the terminations on the receptacles are normally adequate.

But (there's always a but): The National Electric Code (NEC) prescribes that as the number of current carrying conductors in conduit increases the wire used be derated (to account for the additional heat and resistance). This means the contractor has to pull larger wire which may be larger than the wiring devices can accept. In this case you should to include terminals in outlet boxes to convert, for example, a 6 ga. wire feeding a 20 amp device that is designed for a maximum of 10 gauge. Please specify the wire or terminal size needed, and keep in mind this may necessitate a larger outlet box to accommodate the larger terminals. Also, please specify terminal location. (Another case for terminals is the use of larger wire gauges specified to reduce voltage loss due to long wire runs; see section on wire fill).

- 50 amp stage pin outlets come with 6 ga. ¼" ring crimps and 100 amp stage pins come with 2 ga. ¼" ring crimps. Your electrician may or may not have crimps for other wire sizes but we'd like to supply the correct ones, so if you have the wire ga. information, include it on your prints. An alternative is to add terminals to the outlet box, but this adds cost and makes the box larger.
- Ground bars are standard
- For multipin inputs specify manufacturer and connector part number
- For hardwired drop boxes we recommend the use of Kellems® (or equivalent) wire grips on the box and at the grid to support the cable and the box
- Indicate on prints how the unit is labeled (typically 1¼" reverse screened polycarbonate adhesive labels, see labeling for options)

We can and do manufacture boxes to specified dimensions, however designs using our existing boxes are more cost effective and have a shorter lead time. (They need only custom flat panels for outlets that require only one machinery setup and process in the metal shop; custom boxes require at least 3). These are the standard boxes we manufacture, their dimensions and notes on use and construction.

- Cover dimensions assume the box is mounted horizontally. (Okay, this is way to obvious, but for vertical mounting reverse the width and height dimensions)
- Cover dimensions are the overall dimensions including mounting holes. This space can be used for labeling if needed
- Connector area is the usable space to mount connectors. Note: 1) leave adequate space for contractor wiring, 2) 60 and 100 amp connectors will mount vertically exactly in the 5.25" space available.
- Panels/Covers are 16 ga. CRS (cold rolled steel) unless otherwise specified
- 6.25" boxes are 18 ga. with 14 ga. end caps
- Standard U-Bolt and C-Clamp mounting brackets are available for 6.25" boxes
- 14" boxes are 16 ga. with 14 ga. end caps

Box Dimensions	**Cover dimensions for surface and pipe boxes**	**Connector Area for both surface and recessed boxes**	**Cover dimensions for recessed boxes**
W x H x D	W x H	W x H	W x H
6" x 6.25" x 3.25"	6" x 6.25"	5" x 5.15"	7" x 7.25"
12" x 6.25" x 3.25"	12" x 6.25"	11" x 5.15"	13" x 7.25"
18" x 6.25" x 3.25"	18" x 6.25"	17" x 5.15"	19" x 7.25"
24" x 6.25" x 3.25"	24" x 6.25"	23" x 5.15"	25" x 7.25"
14" x 14" x 4"	14" x 14"	12.5" x 12.5"	16" x 16"
14" x 28" x 4"	14" x 28"	12.5" x 28.5"	16" x 30"

For details on outlets see appendix.

Design Constraints and Suggestions for Custom Pigtail Boxes

- UL-Listed devices are required to maintain UL listed finished units
- 12 ga. pigtails use Heyco® strain relief's, 10 ga. and larger pigtails use T&B® non metallic strain relief's, for other strain relief's specify manufacturer and part number
- Terminals are standard in pigtail boxes. For terminal sizes see table in *terminals and wire fill*.
- Ground bars are standard
- For multipin inputs specify manufacturer and connector part number
- For hardwired drop boxes we recommend the use of Kellems® (or equivalent) wire grips on the box and at the grid to support the cable and the box
- Indicate on prints how the unit is labeled (typically 1¼" reverse screened polycarbonate adhesive labels, see labeling for options)

We can and do manufacture boxes to specified dimensions, however designs using our existing boxes are more cost effective. These are the standard boxes we manufacture.

- Standard boxes have K/O's on 3" centers starting at 1½" in from either end, all of which are usable for 15 through 100 amp circuits. Keep in mind 50, 60 and 100 amp connectors typically use 6" laterally.
- Panels/Covers are 16 ga. CRS (cold rolled steel) unless otherwise specified
- Boxes are 18 ga. with 14 ga. end caps
- U-Bolt and C-Clamp mounting brackets are available

Box Dimensions	Cover dimensions for recessed boxes	Number of pigtails in box or recessed cover
W x H x D	W x H	
6" x 6.25" x 3.25"	7" x 7.25"	1 or 2
12" x 6.25" x 3.25"	13" x 7.25"	3 or 4
18" x 6.25" x 3.25"	19" x 7.25"	5 or 6
24" x 6.25" x 3.25"	25" x 7.25"	7 or 8

- The Gridiron Junction Box is also used regularly for custom projects. Their dimensions are 14" x 14" x 4" and 14" x 28" x 4". These are typically assembled with flat covers without the hinge used for the actual Gridiron Junction Box.

Gridiron Junction Boxes

Two Sizes

- 14” x 14” x 4” for 5 - 30 20A circuits, approximately 16.5 lbs. unwired.
- 14” x 28” x 4” for 31- 60 20A circuits, approximately 27.25 lbs. unwired.

Terminals

For 20 and 30 amp circuits Weidmuller tension clamp terminals♦ are used. They are listed for a maximum wire size of 8 gauge.

Terminals for 50 amp circuits are screw w/yoke type; take the terminal space of two 20-amp circuits and are listed for 10 ga. to 1 ga. wire.

Terminals for 100 amp circuits are also screw w/yoke type; take the terminal space of three 20-amp circuits and are listed for 8 ga. to 2/0 wire.

For example, a small gridiron junction box would be completely full with 16 x 20 amp, 4 x 50 amp and 2 x 100 amp circuits

The terminal track (35mm DIN rail) for gridiron junction boxes is mounted with two screws located at the ends of the rail. The bottom of the grid box has several additional mounting locations. This allows the installer to reorient and/or relocate the DIN rail and tailor the gridiron junction box to the requirements of a particular installation with minimal effort.

Hinged covers and Mounting brackets

Hinged covers are standard with all gridiron junction boxes♦. Attached with 10-32 Tinnerman-style nuts and truss head screws, the covers can be reoriented to open in any direction on the 14” x 14” box. The 14” x 28” box ships with two hinged covers (“doors”) set to open left and right. They can also be reoriented to open both up or down.

Two mounting brackets are shipped with small, and four with large gridiron junction boxes. They are not required for mounting, but are there should they be needed, and you won’t have to call the factory for them or fabricate your own. They are designed for ¼” mounting hardware. We include the appropriate nuts and bolts to attach the brackets to the grid box. It is the installer’s responsibility to select and provide the correct hardware to attach the gird box to a selected surface. The grid box and its mounting hardware are not intended to support multi conductor cable. Please follow accepted rigging practices when attaching multi-cable.

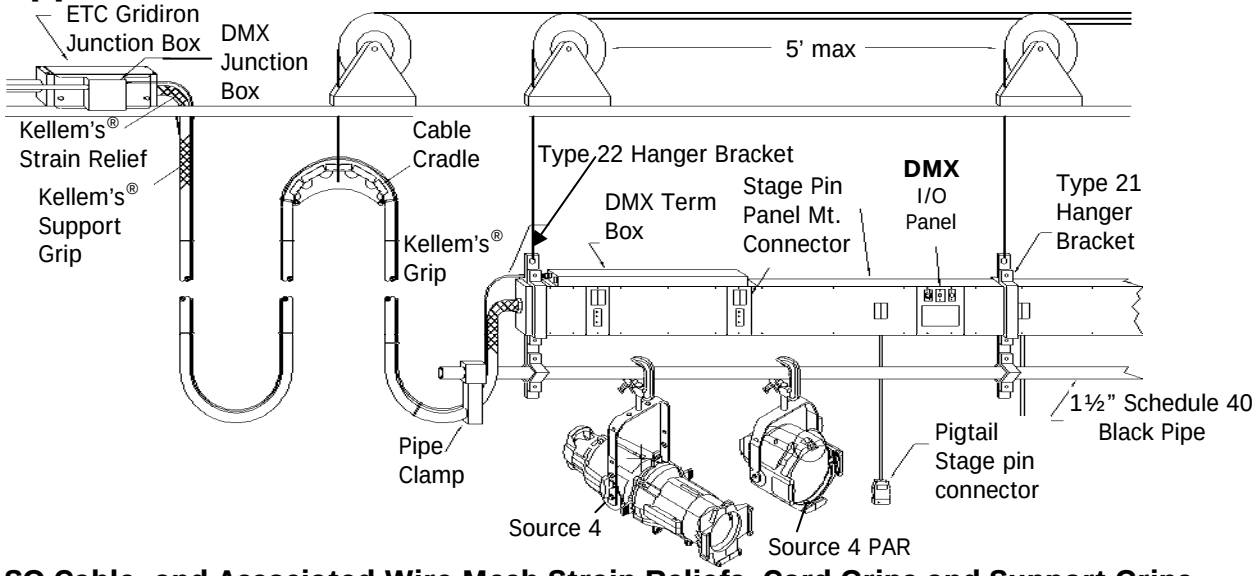
DMX Grid Iron Junction Boxes

The DMX Grid Iron Junction Box is a small unit designed to pass DMX through to your opto-splitters. It comes in three varieties: Strain relief in and out for one or two universes (standard), 5 pin XLR in and out for one universe and 5 pin XLR in and out for two universes. The DMX box bolts to the side of a Grid Iron Junction box using the same bolts as and nesting inside the mounting brackets. The mounting holes are “key holed” so this unit can be added later without totally disassembling the mounting brackets.

Grid Iron Junction boxes and custom projects

Our project people have discovered these boxes are a very convenient size for mounting all sorts of things for custom projects. Using the grid box as a back box saves you engineering charges, so feel “*free*” to design using them. Typically a 14” x 14” or 14” x 28” non-hinged cover is used in these designs, with all connectors mounted not less than .75” from any side.

Appendices



SO Cable, and Associated Wire Mesh Strain Reliefs, Cord Grips and Support Grips

				Kellums Strain Relief Grips			Kellems Deluxe Cord Grips			Kellems Standard Support (a.k.a. pickup) dbl. eye			Cable Cradle
Cable	**Part #**	**OD**	**Lb/ft**	**ETC #**	**Hubbell #**	Thread **Size NPT**	**ETC #**	**Hubbell #**	Thread **Size NPT**	**ETC #**	**Hubbell #**	**Approx. Breaking Strength Lbs.#**	
12/3	W707	0.61	0.24	HW633	073-03-1209	¾	HW6186	074-01-017	¾	HW6206	022-01-001	530	
12/4	W723	0.66	0.282	HW633	073-03-1209	¾	HW6187	074-01-021	1	HW6207	022-01-002	790	
12/5	W724	0.735	0.355	HW634	073-03-1210	1	HW6187	074-01-021	1	HW6207	022-01-002	790	
12/9	W721	0.915	0.60	HW634	073-03-1210	1	HW6188	074-01-025	1	HW6208	022-01-003	1020	PSE8804
12/14	W718	1.105	0.85	HW635	073-03-1211	1¼	HW6189	074-01-027	1¼	HW6209	022-01-005	1610	PSE8804
12/20	W713	1.315	1.10	HW636	073-03-1212	1½	HW6191	074-01-032	1½	HW6210	022-01-006	1610	PSE8804
12/26	W715	1.453	1.45	HW636	073-03-1212	1½	HW6192	074-01-033	2	HW6210	022-01-006	1610	PSE8804
12/30	W716	1.535	1.54	HW636	073-03-1212	1½	HW6192	074-01-033	2	HW6211	022-01-007	1610	PSE8804
12/36	W722	1.653	1.65	HW637	073-03-1213	2	HW6193	074-01-034	2	HW6211	022-01-007	1610	PSE8804
10/3	W512	0.671	0.31	HW633	073-03-1209	¾	HW6187	074-01-021	1	HW6207	022-01-002	790	PSE8804
10/4	W516	0.73	0.371	HW633	073-03-1209	¾	HW6187	074-01-021	1	HW6207	022-01-002	790	PSE8804
10/5	W517	0.83	0.496	HW634	073-03-1210	1	HW6187	074-01-021	1	HW6208	022-01-003	1020	PSE8804
10/10	W513	1.12	0.98	HW635	073-03-1211	1¼	HW6189	074-01-027	1¼	HW6209	022-01-005	1610	PSE8804
10/16[11]	W514	1.305	1.19	HW636	073-03-1212	1½	HW6191	074-01-032	1½	HW6210	022-01-006	1610	PSE8804
10/20[11]	W515	1.44	1.45	HW636	073-03-1212	1½	HW6192	074-01-033	2	HW6210	022-01-006	1610	PSE8804
6/3	W814	0.885	0.76	HW634	073-03-1210	1	HW6188	074-01-025	1	HW6208	022-01-003	1020	PSE8804
6/5	W815	1.09	1.14	HW635	073-03-1211	1¼	HW6189	074-01-027	1¼	HW6209	022-01-005	1610	PSE8804
2/3	W829	1.15	1.19	HW635	073-03-1211	1¼	HW6190	074-01-031	1½	HW6209	022-01-005	1610	PSE8804

#Hubbell catalog 2000 technical section L-84 load ratings:

The maximum recommended working load then is the tension to be exerted on the grip in application with a margin of safety to take care of unforeseen and unusual circumstances.

It is the end-user's decision to determine how much of a safety factor is acceptable to him.

Under normal conditions, Kellems' recommended factor of safety is 10 for catalog listed support grips. The factory should be consulted for specific application recommendations where strength and holding power are important factors.

Example: A support grip with listed breaking strength of 1610 lbs. with a safety factor of 10 has maximum recommended load of 161 lbs. (part number 02101018)

Strain reliefs and Cord grips don't have load ratings because they are not intended for load support!

Because specifications change, always contact Hubbell for current engineering data and recommendations.

[11] May require minimum order and longer lead time.

Knockout Hole Diameters & Lock Nut Dimensions

N.P.T. Hub Size	Knockout hole min. to max. - inches	Lock Nut Sizes Thread	Min. Thick	Max. Dia.
1/4"	.540 to .570			
3/8"	.671 to .701			
1/2"	.859 to .906	½" - 14	.09"	1.14"
3/4"	1.094 to 1.141	¾" - 14	.11"	1.43"
1"	1.359 to 1.406	1" - 11½	.13"	1.77"
1¼"	1.719 to 1.766	1¼" - 11½	.13"	2.28"
1½"	1.969 to 2.016	1½" - 11½"	.13"	2.60"
2"	2.453 to 2.500	2" - 11½"	.13"	3.18"
2½"	2.953 to 3.000	2½" - 8	.18"	3.56"
3"	3.578 to 3.625	3" - 8	.36"	4.13"

Internal Wiring For Connector Strips And Boxes

All internal wire is rated 600V, 125° C.

Circuit Rating	Internal Wire	Nominal O. D.	LB/FT	Stranding
20 Amp	12 ga.	.153"	.028#	65 x 30 ga.
30 Amp	10 ga.	.192"	.042#	105 x 30 ga.
50 Amp[12]	6 ga.	.338"	.110#	133 x 27 ga.
100 Amp	2 ga.	.496"	.283#	266 x 26 ga.

Pipe - (Steel Round Black Pipe)

Nominal Size in Inches	Schedule	Wall	O. D.	Lbs. Per Ft.
1¼"	40	.140	1.660	2.27
1¼"	80	.191	1.660	3
1½"	40	.145	1.900	2.72
1½"	80	.200	1.900	3.63
2"	40	.154	2.375	3.65
2"	80	.218	2.375	5.02

[12] The stage pin connector is rated for 60 amps. When used in combination with our dimming it will serve for 50A circuits and the wire is sized accordingly. If you have need for fully rated 60A distribution, please specify 4 ga. wire.

Connectors

Female Connectors – 120V, 2 wire and ground

Type	Amps	Weight (lbs.)	ETC Part #	Mfg. #	Notes	Wire size	Recommended spacing
Stage pin, panel receptacle	20A	.12	J210		Self grounding		> 1.1”
Stage pin, cable	20A	.28	J212		Crimp pin		
Stage pin, cable	20A	.28	J212S		Screw with wire shoe		
Twist-Lock®, panel receptacle	20A	.24	J215	2310	NEMA L5-20R		> 2.5”
Twist-Lock® connector body (cable)	20A	.32	J242	2313	NEMA L5-20R		
Edison, single, panel receptacle	20A	.20	J243	5361	NEMA 5-20R		1.812 (NEMA)
Edison, duplex, panel receptacle	20A	.24	J258	5362	NEMA 5-20R		1.812 (NEMA)
Edison, connector body, cable	20A	.17	J244	5369C	NEMA 5-20R		
Stage pin, panel receptacle	60A	.44	J288		6 ga. crimp connector		>2”
Stage pin, cable connector	60A	.87	J249		10 – 6 ga. SO		
Stage pin, panel receptacle	100A	.56	J284		2 ga. crimp connector		>2”
Stage pin, cable connector	100A	1.19	J263		2 – 8 ga. SO		

Female Twist lock Connectors – 2, 3 or 4 wire and ground, 125V-250V

	Amps		Voltage	weight	Hubbell Part #	NEMA #	ETC#
Twist-Lock® panel receptacle	20A	2 W & G	250V		HBL2320	L6-20R	J2002
Twist-Lock® connector body (cable)	20A	2 W & G	250V		HBL2323	L6-20R	
Twist-Lock® panel receptacle	20A	3 W & G	125/250V		HBL2410	L14-20R	J2072
Twist-Lock® connector body (cable)	20A	3 W & G	125/250V		HBL2413	L14-20R	
Twist-Lock® panel receptacle	20A	4 W & G	120/208V		HBL2510	L21-20R	J2073
Twist-Lock® connector body (cable)	20A	4 W & G	120/208V		HBL2513	L21-20R	
Twist-Lock® panel receptacle	30A	2 W & G	125V		HBL2610	L5-30R	J2075
Twist-Lock® connector body (cable)	30A	2 W & G	125V		HBL2613	L5-30R	
Twist-Lock® panel receptacle	30A	2 W & G	250V		HBL2620	L6-30R	J298
Twist-Lock® connector body (cable)	30A	2 W & G	250V		HBL2623	L6-30R	
Twist-Lock® panel receptacle	30A	3 W & G	125/250V		HBL2710	L14-30R	J2071
Twist-Lock® connector body (cable)	30A	3 W & G	125/250V		HBL2713	L14-30R	
Twist-Lock® panel receptacle	30A	4 W & G	120/208V		HBL2810	L21-30R	J2067
Twist-Lock® panel receptacle	30A	4 W & G	120/208V		HBL2816	L21-30R	J250
Twist-Lock® connector body (cable)	30A	4 W & G	120/208V		HBL2813	L21-30R	

Maximum wire size for 20 amp Twist-Lock® connector is 10 ga. - 30 amp is 8 ga.

Model Numbering For Connector Strips.

This is a list of the abbreviations needed for ordering.

A.... Edison (parallel blade and ground, U-ground, T-slot) connector type
B.... Stage pin connector
C.... Twist lock connector
D ... DMX connectors
L .... left
M ... middle
O ... Outlet (receptacle, flush outlet)
P .... Pigtail mounted outlet
R .... Right
X .... XLR input
H.... Hardwired with either strain or conduit

The following is an example of a very complicated connector strip, used here to illustrate the features of our model numbering scheme. (No, no one's ever asked for anything this bizarre... yet).

9938.5-(36BP/16)(4AO/1)(2*HBL2510/2)(6BO@50/3)(1BP@100/1)(8D/2)-LX-22,23

99 ..... Distribution model # prefix

38.5..... Length (in this case thirty eight and one half feet long – ½ foot increments minimum)

-..... Separates model prefix and length from outlets

Note: When using multiple outlet types, other voltages or adding control circuitry each outlet type is bracketed in parentheses containing all information for each type. If there is only one outlet type the parentheses are omitted. The first outlet listed should be the device with the lowest current and highest quantity, adding devices ordered to the highest current lowest quantity with DMX or other low voltage control being the last type.

(36BP/18) ..... quantity 36, B *stage pin* P *pigtail* / wired on 18 circuits. *All circuits are 20 amp 120 volt, otherwise unless indicated. Please note the order here: connector type, then mounting. (It is important not to reverse these because the O of outlet could be easily confused with 0 [zero] and would have an entirely different meaning.) We chose not to use the word "receptacle" because R already indicates right.*

(4AO/1) ..... 4 A *Edison* O *outlets* / wired on 1 circuit (work lights)

(2*HBL2410/2) ..... 2 Hubbell HBL2410's wired each individually. *For outlets other than 20, 50, and 100 amp stage pin, 20 amp twist lock and 20 amp Edison use the manufacturer's part number. Separate it from the quantity with an asterisk to avoid confusion when a manufacturers part number begins with a numeral. It is not necessary to indicate mounting here because a cable mount connector will never be panel mounted.*

(6BO@50/3) ..... 6 stage pin outlets at 50 amps on 3 circuits. *When ordering connectors other than 20 amp use the @ symbol and indicate the required current rating. For other than 120V indicate the correct voltage. If both voltage and current are different, indicate current first and voltage second, i.e. 30A250V. (Note: ETC is only UL listed for 120/208 Wye)*

(1BP@100/1) ..... 1 stage pin outlet at 100 amps on 1 circuit

(8D/2)..... 8 DMX IO (pass through) panels wired on two universes. To avoid potential problems, all DMX in distribution should be wired with our pass-thru assemblies. To indicate strips with voltage barriers and top hats WITHOUT installed DMX wiring or connectors use 0D/0

- LX ..... wired to terminals located on the left side of the open raceway. Other choices here would be R *right*, M *middle* or a combination such as LR *left and right* or RM *right and middle.* X is XLR input to the DMX portion of the strip

-22,23..... type 22 hanger brackets. Because there is a terminal box on this strip there is also a single type 23 hanger on the end to support the strip/box combination. (Custom hangers are type 00).

9940-18BP/18-L-21

This is a simple 40-foot strip with 18 pigtails, wired left and with type 21 hangers. Parentheses are not required unless multiple outlet types are mixed on a connector strip.

Specifications

POWER DISTRIBUTION EQUIPMENT

GENERAL

Connector Strips shall be fabricated from 18-gauge galvanized steel 6.25”H x 3.3”D with length specified in increments of 6” and shipped fully wired in minimum 6'0" sections with all splicing hardware included. They shall be finished with fine-textured, scratch-resistant, black powder coat. Pigtails and outlets shall be spaced on 18" centers, or as otherwise specified.

Connector Strip 20 Amp Outlets (a.k.a. panel mount outlets, flush outlets or receptacles) shall be mounted on individual 3” panels. 50, 60 and 100 amp outlets shall be mounted on 6” panels. These panels shall be removable for easy servicing and replacement of connectors and interior components.

Connector strip circuit numbers shall be marked with one of the following methods:

1.a 2” polycarbonate reverse-screened white lettering on black background labels affixed to the “front” covers of the connector strip (this is the default unless otherwise specified).

1.b Two sided 2” polycarbonate reverse-screened white lettering on black background labels affixed to the front and the back of the connector strip.

2.a 2” engraved lamicoid, white lettering on black background labels affixed with screws to the front covers of the connector strip.

2.b Two-sided 2” engraved lamicoid, white lettering on black background labels affixed with screws to the front and back of the connector strip.

3.a 5” “Studio” reflective die cut labels affixed to the front covers of the connector strip.

3.b Two-sided 5” “Studio” reflective die cut labels affixed to the front and back of the connector strip.

4. 2” lettering, engraved in the cover (this changes cover material to .080 Al. and is only available on the cover side).

Connector strips shall be fed with load circuits from either or both ends of the strip as required and specified. For units with 28 or fewer circuits, external terminal boxes shall not be required unless otherwise specified. Load circuits shall be landed on internal 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 shall not be acceptable).

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: 1 – DMX Output Connector, 1—DMX Input (Pass Through) connector, 1—DMX Pass Through (Bypass) Switch, 1—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.

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.
Standard circuit numbers shall be 2”, 1 ¼” or ¾” polycarbonate labels reverse screened with white letters on black background, sized to match the product. Available options are engraved lamicoid labels and engraved covers. Pigtails and outlets shall be spaced on 3" centers, or as otherwise specified. For pipe mounting specify either U-Bolt or C-clamp brackets.

Load connectors available are 20A, 50A and 100A grounded stage pin, 20A twistlock and 20A "U" ground (dual rated “T-slot” Edison); 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.

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. Clear connector covers shall be available.

Gridiron Junction Boxes shall be fabricated from 16-gauge cold-rolled steel with 14-gauge end panels. Gridiron Junction Boxes shall be finished with fine-textured, scratch-resistant, black powder coat. For 30 circuits and less they shall be 14”H x 14”W x 4”D. For 31 to 60 circuits they shall be 14”H x 28”W x 4”D. Cover(s) shall be attached with machine screws and Tinnerman-style retainer nuts. Cover(s) shall be hinged and mounting should allow installer to orient the hinged door(s) to open in any direction.

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. All bracket and mounting hardware shall be black ASTM A307 SAE Grade 5 or equivalent.

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

Drop Boxes

6 Circuit Outlet Box With Attached Multi-Cable For Hard Wired Installation

The box shall be welded steel 18"W x 3.3"D x 6.25"H, constructed with an 18-gauge shell and 14-gauge end caps. It shall mount with two standard theatrical C-clamps (provided). One end of the multi-cable (12 ga. SO or SJO) shall be attached to the box with a wire mesh strain relief. Each of the six circuits shall be terminated in an industry standard 2 pole and ground 20 amp female panel mounted stage pin connector mounted on 3" centers and numbered with reverse-screened white-on-black polycarbonate labels (per print, provided by others). The opposite end of the multi-cable shall be blunt cut and supplied with appropriate wire mesh strain relief and double eye single weave closed mesh "pick-up" grip or optional cable cradle.

6 Circuit Outlet Box W/Attached Multi-Cable And Multipin Connector

The box shall be welded steel 18"W x 3.3"D x 6.25"H, constructed with an 18-gauge shell and 14-gauge end caps. It shall mount with two standard theatrical C-clamps (provided). One end of the multi-cable (12 ga. SO or SJO) shall be attached to the box with a wire mesh strain relief. Each of the six circuits shall be terminated in an industry standard 2 pole and ground 20 amp female panel mounted stage pin connector mounted on 3" centers and numbered with reverse-screened white-on-black polycarbonate labels (per print, provided by others). The opposite end of the multi-cable shall be terminated in an industry standard male 19 pin, 20 amp, 6 circuit VSC connector, with wire mesh strain relief (and double eye single weave closed mesh "pick-up" grip). Circuit assignment shall be industry standard with sockets 1, 3, 5, 7, 9, and 11 being the hot outputs for circuits 1-6; sockets 2, 4, 6, 8, 10, and 12 the neutral sockets for circuits 1-6 and sockets 13-18 the grounds.

6 Circuit Outlet Box With Multipin Input Connector

The box shall be welded steel 18"W x 3.3"D x 6.25"H, constructed with an 18-gauge shell and 14-gauge end caps. It shall mount with two standard theatrical C-clamps (provided). One end of the box shall have an industry standard male 19 pin, 20 amp, 6 circuit VSC connector. Each of the six circuits shall be terminated in an industry standard 2 pole and ground 20 amp female panel mounted stage pin connector mounted on 3" centers and numbered with reverse-screened white-on-black polycarbonate labels (per print, provided by others). Circuit assignment shall be industry standard with sockets 1, 3, 5, 7, 9, and 11 being the hot outputs for circuits 1-6; sockets 2, 4, 6, 8, 10, and 12 the neutral sockets for circuits 1-6 and sockets 13-18 the grounds.

Multi-Cable Breakouts

6 Circuit Breakout, Batten Lay, Stage Pin

One end of the multi-cable (12 ga. SO or SJO) shall be terminated in an industry standard male 19 pin 20 amp (6 circuit) VSC connector with wire mesh strain relief. The opposite end of each of six 3 wire circuits shall be terminated in an industry standard 2 pole and ground 20 amp female stage pin connector. The first stage pin connector shall be wire with an 18" pigtail from the multipin connector with each subsequent stage pin and circuit wired an additional 18". Circuit assignment shall be industry standard with sockets 1, 3, 5, 7, 9, and 11 being the hot outputs for circuits 1-6; sockets 2, 4, 6, 8, 10, and 12 the neutral sockets for circuits 1-6 and sockets 13-18 the grounds.

6 Circuit Breakout, Fan Out, Stage Pin

One end of the multi-cable (12 ga. SO or SJO) shall be terminated in an industry standard male 19 pin 20 amp (6 circuit) VSC connector with wire mesh strain relief. The opposite end of each of six 3 wire circuits shall be terminated in an industry standard 2 pole and ground 20 amp female stage pin connector. All stage pin connectors shall be mounted on 36" tails wired from the multipin connector. Circuit assignment shall be industry standard with sockets 1, 3, 5, 7, 9, and 11 being the hot outputs for circuits 1-6; sockets 2, 4, 6, 8, 10, and 12 the neutral sockets for circuits 1-6 and sockets 13-18 the grounds.

6 Circuit Breakout, Fan In, Stage Pin

One end of the multi-cable (12 ga. SO or SJO) shall be terminated in an industry standard female 19 pin 20 amp (6 circuit) VSC connector with wire mesh strain relief. The opposite end of each of six 3 wire circuits shall be terminated in an industry standard 2 pole and ground 20 amp male stage pin connector. All stage pin connectors shall be mounted on 36" tails wired from the multipin connector. Circuit assignment shall be industry standard with sockets 1, 3, 5, 7, 9, and 11 being the hot outputs for circuits 1-6; sockets 2, 4, 6, 8, 10, and 12 the neutral sockets for circuits 1-6 and sockets 13-18 the grounds.

Dimension Comparison Connector Strips
(from published data and subject to change)

Manufacturer	Height	Depth
SSRC - SL	3.375	2.500
Colortran	4.000	3.000
Altman (AL version)	4.000	3.000
EDI	3.750	3.125
L&E	4.625	3.188
SSRC - BAL	4.750	3.375
Channel Mount	6.125	3.375
Union	4.000	4.000
Strand	4.000	4.000
Performance Electric PCS	5.000	4.000
Performance Electric PLP	3.250	2.750
Altman	4.000	4.000
Average	4.240	3.359
ETC 8000 series, 9900 models	6.250	3.300

The fine print:

To the best of our knowledge the information contained herein is correct, but nobodies perfect, especially me. It is the responsibility of the users of this document to confirm all data. Designs are subject to change.

The End