Low-voltage power distribution and control systems > Busway

PowerWave 2 bus system—250–1000 A

Contents

Powering Business Worldwide

More about this product
Eaton.com/Powerwave2

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General Description

This Design Guide describes PowerWave 2 bus system components.

Monitoring for PowerWave 2 bus systems is described in PowerWave 2 bus system, branch circuit monitoring system, setup and operation.

System Summary

PowerWave 2 bus systems are compact, lightweight busways that can be deployed quickly using easy-to-assemble kits. PowerWave 2 bus systems are designed for demanding data center power environments.

PowerWave 2 bus systems allow any voltage less than or equal to 600 V and are available in 250 A, 400 A, 600 A, 800 A, and 1000 A systems. 100% neutral is standard on all bus systems. A 150% neutral option is available for 250–400 A systems.

PowerWave 2 bus systems provide compact power distribution systems to server racks:

- PowerWave 2 is installed completely overhead, requiring no server room floor space
- Power and communications for monitoring are integrated into a single bus run, reducing space required for multiple cable and conduit runs
- Busway space is very efficiently used; continuous rail design allows tap-off boxes to be inserted nearly anywhere along the rail
- On 250 A and 400 A systems, a tap-off box can overlap a coupler (splice), resulting in little or no “lost” bus rail space at the coupler; consequently, couplers can be placed directly above servers without displacing tap-off boxes

Through tap-off boxes, the exact circuit breaker capacity and receptacle type can be specified at any location along the rail simply by inserting the correct tap-off box into the busway:

- Tap-off boxes are highly configurable to meet load demands and specific requirements, including monitoring
- Tap-off boxes are available for horizontal and vertical orientations
- Up to six poles can be monitored for current and voltage, such as two three-phase circuits
- PowerWave 2 bus systems have an IP2X finger-safe rating (IEC 60529)
- Tap-off boxes have a two-stage insertion into the bus rail; ground connections are made automatically before contact is made with conductors

Infrared scanning is available without requiring exposure to high voltages:

- Power feeds have built-in or optional infrared windows for scanning customer power connections to the bus run

Product specifications are found in these documents:

- PowerWave 2 bus system brochure contains specifications in tabular format
- PowerWave 2 bus system guide specifications has specifications suitable for proposals

See the bibliography for information on downloading specifications and other documentation from the Eaton website.

PowerWave 2 bus systems are assembled at the customer site using kitted components according to the customer’s bus run design. All PowerWave 2 bus runs are variants of three basic bus run structures:

- Straight vertically oriented bus runs
- Straight horizontally oriented bus runs
- Angled or branched vertically oriented bus runs

Most of the components used to create these structures are common to all of them. Moreover, components and bus run structures are similar across all rated amperages (250 A, 400 A, 600 A, 800 A, and 1000 A).

This secton surveys PowerWave 2 bus system layouts, components, and component options.

Designing Your Bus Run

Revit Models

To help you design your bus runs, Eaton Revit® models are available for PowerWave 2 bus systems. Models can be downloaded from the PowerWave 2 bus system page on the Eaton website: Eaton.com/Powerwave2

Click the downloads tab on the page and click the following titles to download: PowerWave 2 Revit model library (.zip file)

Component Options Compatibility

When specifying components for your bus run, keep in mind that some options must be the same throughout the bus run:

- Bus run amperage (250 A, 400 A, 600 A, 800 A, or 1000 A)
- Neutral size (100 or 150%) (150% only available for 250–400 A)
- Source voltage as connected at the power feed (required for tap-off box specification), maximum 600 V
- Housing ground, dedicated ground or isolated ground
- Horizontal or vertical orientation must be uniform for the bus run, though it is only an option for hangers

Bus Run Layouts

Vertical Straight Bus Runs

A straight bus run is the simplest and by far the most common bus run.

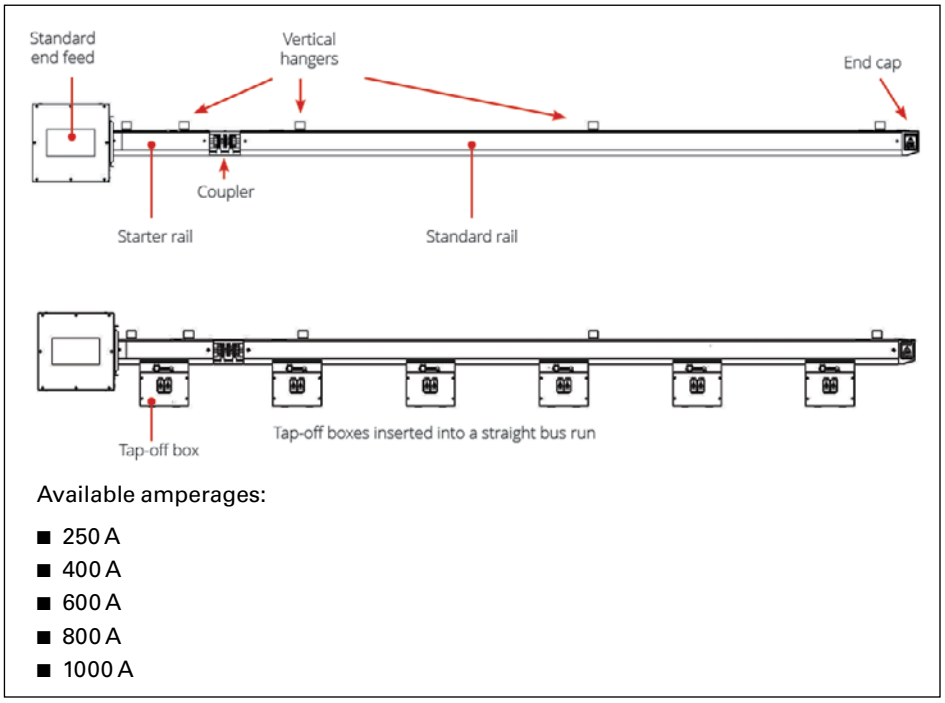
A straight bus run has at minimum:

- One power feed: A standard end feed or alternatively a center feed, where customer power, ground, dedicated ground (optional), and isolated ground (optional)
- One starter rail, which is always the first bus rail in the bus run. Customer three-phase and neutral power connections are made directly to the starter rail inside the standard end feed or to busbars in the center feed

A straight bus run can be extended by adding:

- Standard rails
- Couplers to join bus rails together

The neutral conductor must be aligned on the same side of the rail throughout the bus run. Tap-off boxes can be inserted into bus rails nearly anywhere along the bus run and must all face outward from the neutral side.



Available amperages:

- 250 A
- 400 A
- 600 A
- 800 A
- 1000 A

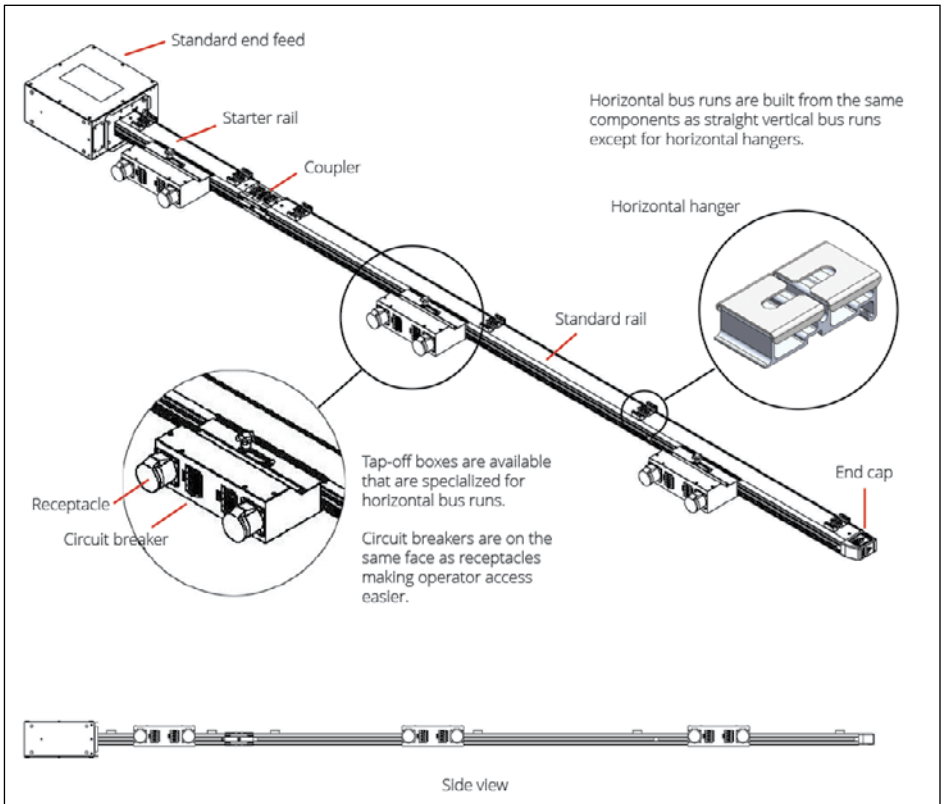
Figure 24.4-1. Vertical Straight Bus Run (250–1000 A)

Horizontal Straight Bus Runs

Straight bus runs can also be horizontally oriented, that is, rotated 90° so that tap-off boxes face upward. Orienting the bus run horizontally is uncommon and is typically used when there is not enough overhead space for a normal vertically oriented bus run.

Horizontal bus runs have these special adaptations and restrictions:

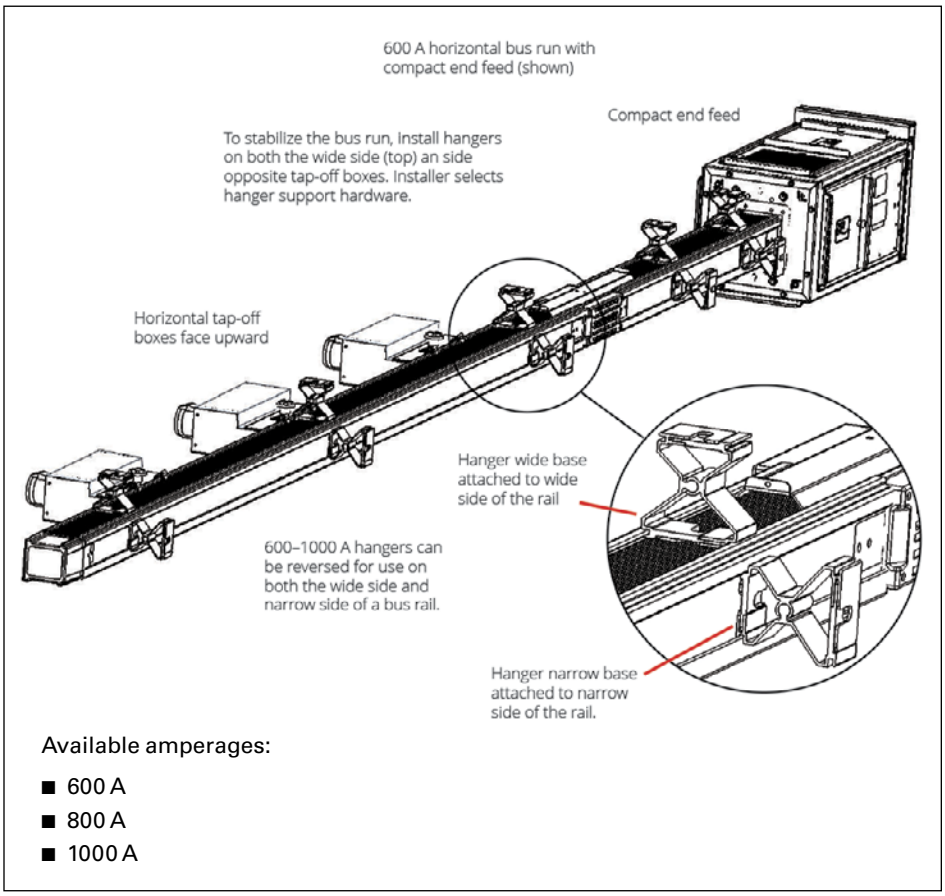
- Horizontal bus runs must be straight runs; there are no elbows or tees for this orientation
- Neutral and tap-off boxes should face upward
- Tap-off boxes are available that are specialized for horizontal bus runs; these tap-off boxes have circuit breakers positioned on the connector/receptacle side for easier operator access
- Horizontal hangers for 250–400 A bus runs are positioned on the wide side (top) of bus rails with two all-thread rod positions for extra support
- Horizontal 600–1000 A bus runs require hangers both on the wide side (top) of the rails and on the side opposite the tap-off boxes



Available amperages:

- 250 A
- 400 A

Figure 24.4-2. Horizontal Bus Run (250–400 A)



Available amperages:

- 600 A
- 800 A
- 1000 A

Figure 24.4-3. Horizontal Bus Run (600–1000 A)

Elbows and Tees

With an elbow, a vertical bus run is turned at a right angle. With a tee, a leg is branched off at a right angle from a straight bus run.

Elbows:

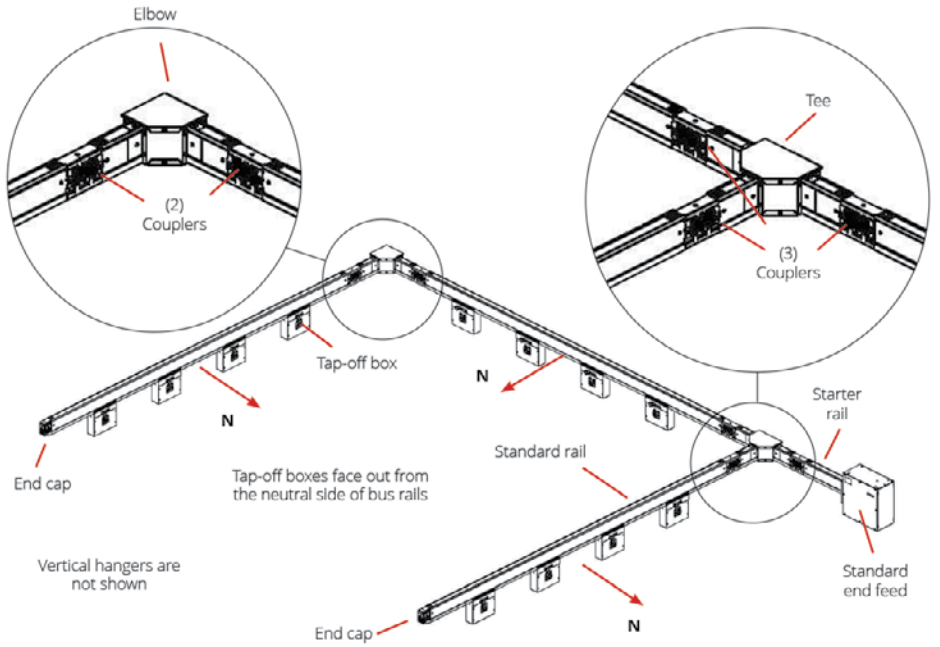
- The orientation of neutral after the turn is customer-selectable—the neutral can remain on the same side or can cross over. Because tap-off boxes must face outward from the neutral side of the bus run, this flexibility allows tap-off boxes to be appropriately oriented for server racks

Tees:

- Neutral on the branched-off leg can be on either side of the bus rail

For more information on neutral orientation, refer to the sections on elbows and tees later in this chapter.

There are no elbows or tees for horizontally oriented bus runs. Horizontal bus runs must be straight runs.



Available amperages:

- 250 A
- 400 A
- 600 A
- 800 A
- 1000 A

Figure 24.4-4. Angled and Branched Vertical Bus Runs (250–1000 A)

Standard End Feeds

A standard end feed is an enclosure where customer power, grounding, and communications are connected for a bus run. Each standard end feed must be ordered with a starter rail, which must be the first bus rail in the bus run.

Although a standard end-feed enclosure can be used in either right-hand (RH) or left-hand (LH) orientation, the combination of a standard end feed and its starter rail must be ordered in LH or RH orientation, which determines the position of neutral in the bus run.

Standard End Feed (250 A)

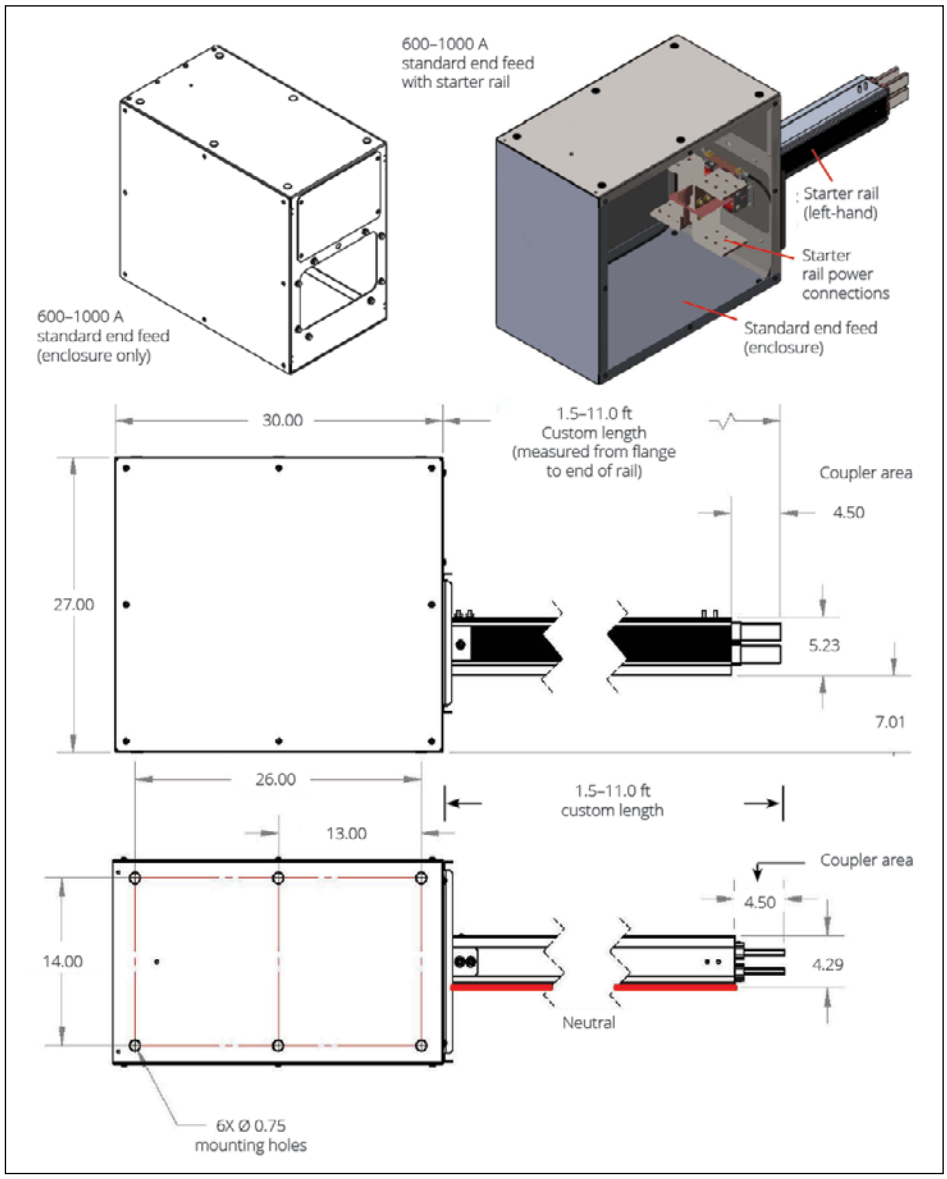


Figure 24.4-5. Standard End Feed (250 A)

Standard End Feed (400 A)

The standard end feed for 400 A bus systems is larger than the 250 A enclosure to accommodate larger conductors, conduit, and cable bend radius. Each standard end feed must be ordered with a starter rail, which must be the first bus rail in the bus run.

Like the 250 A standard end feed, the 400 A enclosure can be used in either right-hand (RH) or left-hand (LH) orientation, but the combination of the end feed and its starter rail must be ordered in LH or RH orientation, which determines the position of neutral in the bus run.

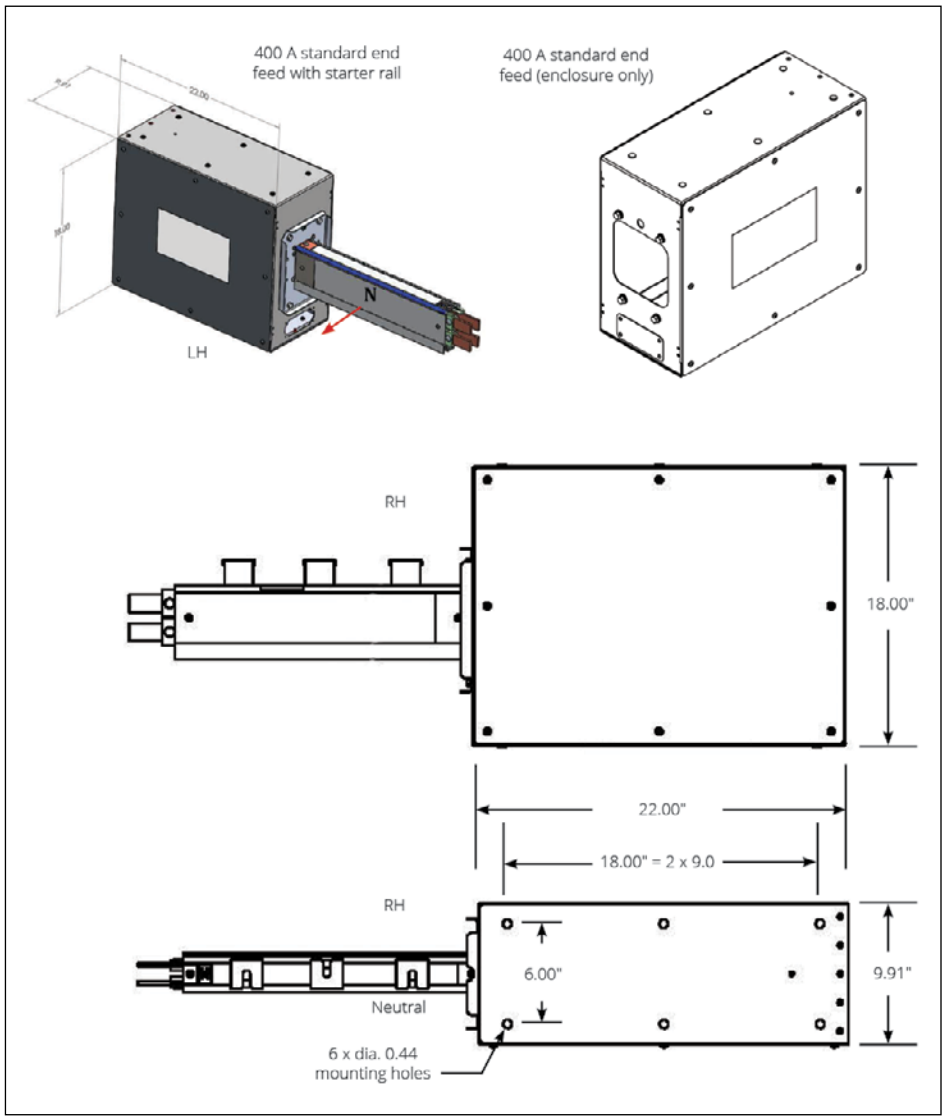


Figure 24.4-6. Standard End Feed (400 A)

Standard End Feed (600–1000 A)

The standard end feed for 600–1000 A bus systems is larger than the 400 A and 250 A enclosures to accommodate larger conductors, conduit, and cable bend radius. Each standard end feed must be ordered with a starter rail, which must be the first bus rail in the bus run.

Like the other standard end feeds, the 600–1000 A enclosure can be used in either right-hand (RH) or left-hand (LH) orientation, but the combination of the standard end feed and its starter rail should be ordered in LH or RH orientation, which determines the position of neutral in the bus run.

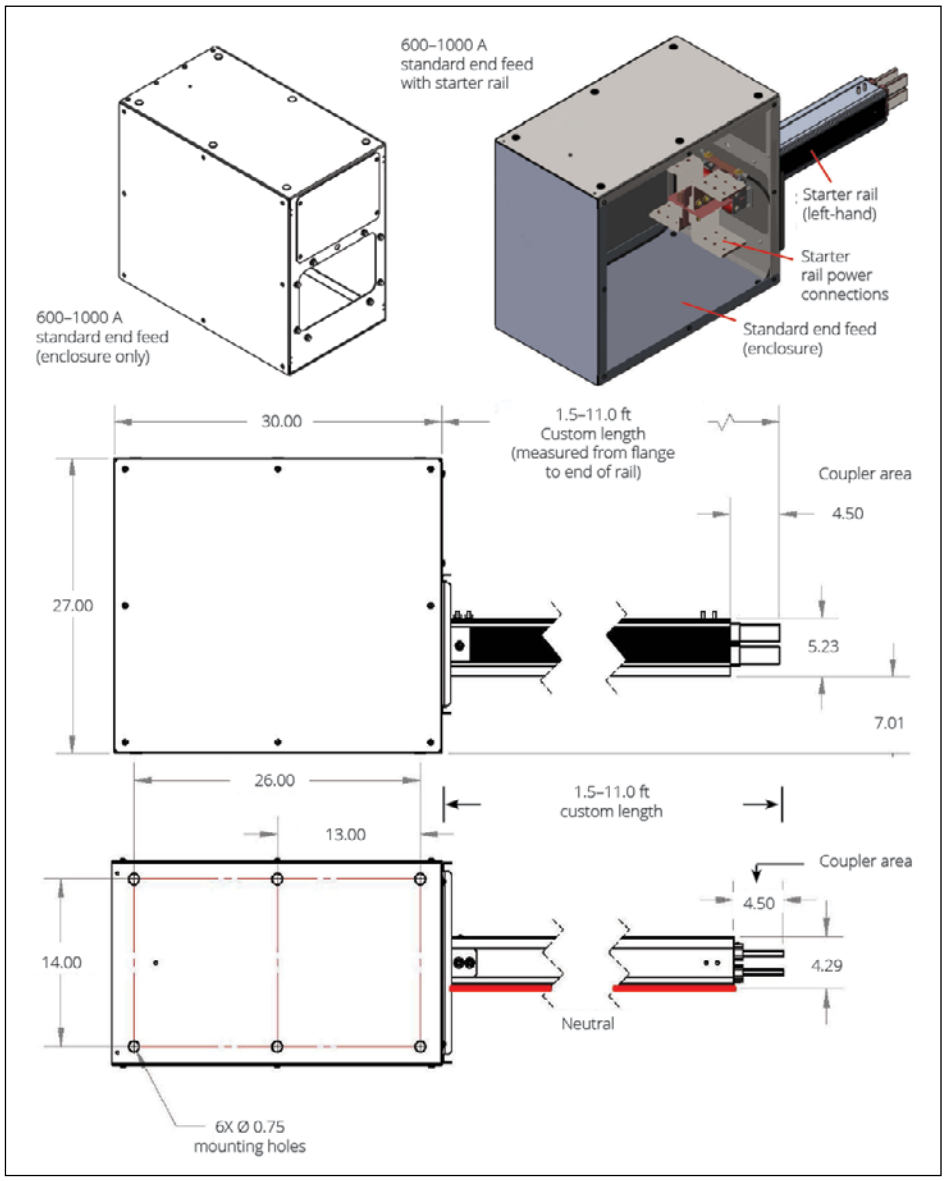


Figure 24.4-7. Standard End Feed (600–1000 A)

Standard End-Feed Options

Both LH and RH standard end feeds can have the following options:

- Housing ground
- Source power monitoring
- Dedicated ground
- Isolated ground
- Power disconnect (various options), providing local circuit breaker, usually on bottom of end feed, or fuse
- Infrared scan window

Dedicated ground

Similar to isolated ground shown on **Figure 24.4-9**, a cable is attached to the uninsulated dedicated ground busbar in the starter rail and propagated through the bus run.

Instead of the cable connecting to the isolated ground stand-off, the cable would be installed into a lug similarly to **Figure 24.4-8** showing the housing ground view.

Isolated ground

When the isolated ground option is selected, a stand-off is installed in the top panel of the standard end feed where customer isolated ground is connected.

The isolated ground cable is then connected to the isolated ground busbar in the starter rail and propagated through the bus run.

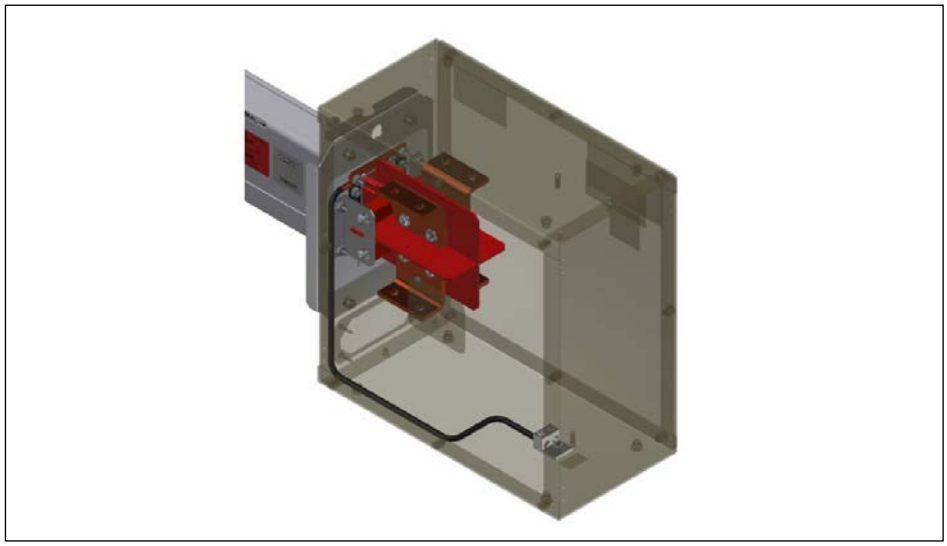


Figure 24.4-8. Housing Ground

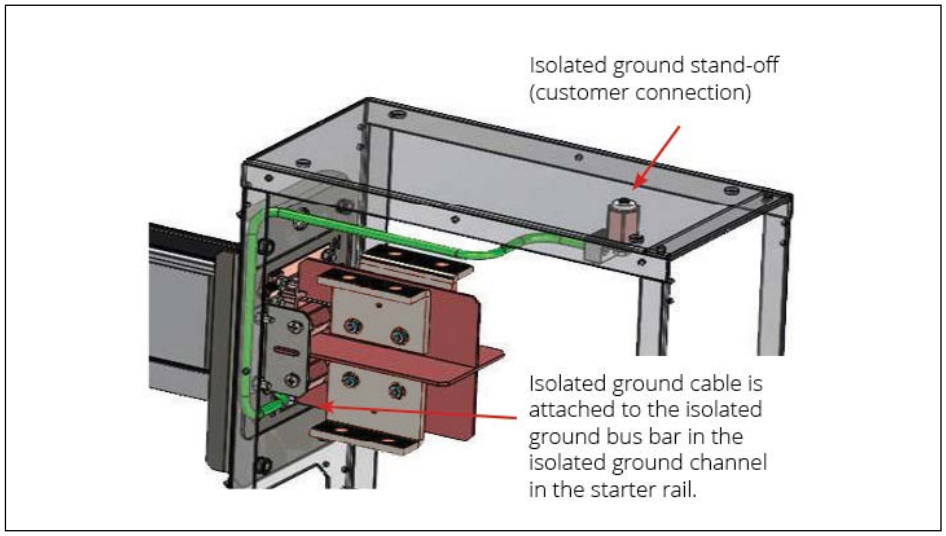


Figure 24.4-9. Isolated Ground

Power disconnects

Any standard end feed can have a disconnect mounted in the bottom of the enclosure, providing a local disconnect for the bus run that is accessible to operators.

The following disconnects are available:

- Three-pole main circuit breaker (80% rated)
- Three-pole main switch/isolator
- Four-pole main circuit breaker (80% rated)
- Four-pole main switch/isolator
- Three-pole fuse disconnect

Infrared Scan Window

An infrared scan window can be installed on the left or right panel or panel door of the standard end-feed enclosure. The scan window allows infrared scanning of the busbar connections on the starter rail.

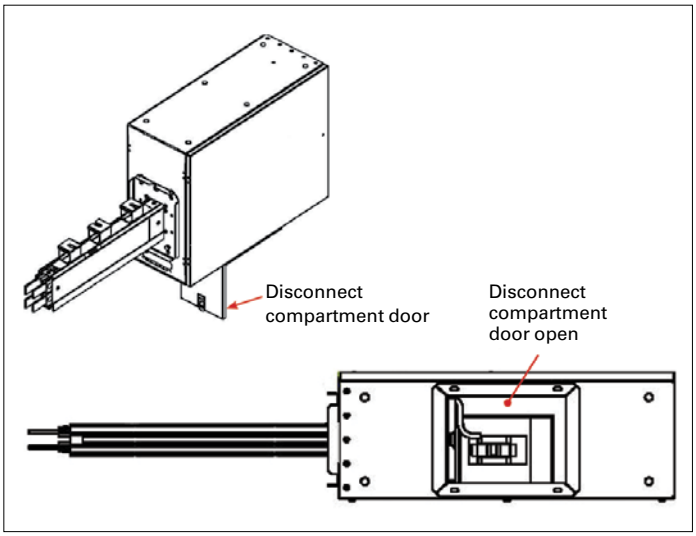


Figure 24.4-10. Standard End Feed 400 A, RH with Disconnect Panel

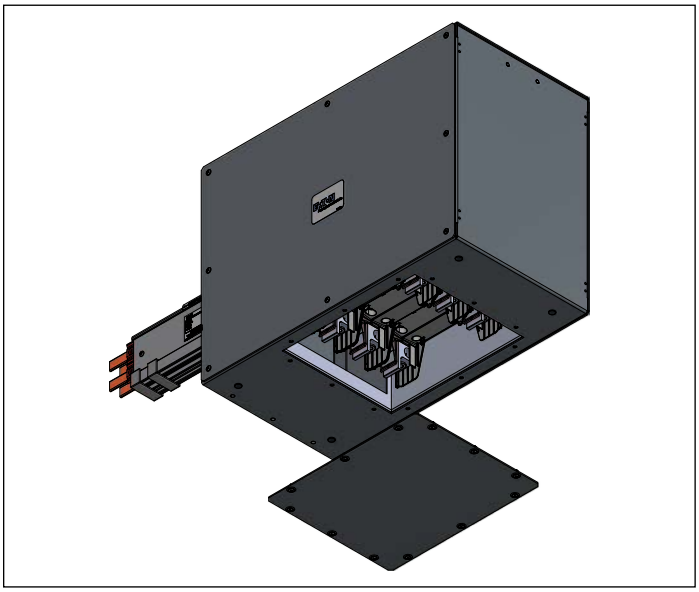


Figure 24.4-11. Fusible

Figure 24.4-12. Infrared Scan Window

Standard End-Feed Options Summary and Part Numbers

Standard end-feed options summary:

- Neutral: 100% or 150% for 250–400 A
- Neutral: 100% only for 600–1000 A
- Dedicated ground
- Isolated ground
- Monitoring: Source power
- Disconnects:
  - Three-pole main circuit breaker (80% rated)
  - Three-pole main switch/isolator
  - Four-pole main circuit breaker (80% rated)
  - Four-pole main switch/isolator
  - Three-pole fuse disconnect
- Infrared scan window

Table 24.4-1. Standard End-Feed Options Summary and Part Numbers

Ampere Rating	Enclosure Type	Base Part Number (Options to be Filled In)
250	Left-hand—standard door	HPW2-250-4PG-..-....-.-EN-LH-....
	Left-hand—reverse door	HPW2-250-4PG-..-....-.-EN-LH-RD-....
	Right-hand—standard door	HPW2-250-4PG-..-....-.-EN-RH-....
	Right-hand—reverse door	HPW2-250-4PG-..-....-.-EN-RH-RD-....
400	Left-hand—standard door	HPW2-400-4PG-..-....-.-EN-LH-....
	Left-hand—reverse door	HPW2-400-4PG-..-....-.-EN-LH-RD-....
	Right-hand—standard door	HPW2-400-4PG-..-....-.-EN-RH-....
	Right-hand—reverse door	HPW2-400-4PG-..-....-.-EN-RH-RD-....
600	Left-hand—standard door	SPW2-600-4PG-..-....-.-EN-LH-....
	Left-hand—reverse door	SPW2-600-4PG-..-....-.-EN-LH-RD-....
	Right-hand—standard door	SPW2-600-4PG-..-....-.-EN-RH-....
	Right-hand—reverse door	SPW2-600-4PG-..-....-.-EN-RH-RD-....
800	Left-hand—standard door	HPW2-800-4PG-..-....-.-EN-LH-....
	Left-hand—reverse door	HPW2-800-4PG-..-....-.-EN-LH-RD....
	Right-hand—standard door	HPW2-800-4PG-..-....-.-EN-RH-....
	Right-hand—reverse door	HPW2-800-4PG-..-....-.-EN-RH-RD....
1000	Left-hand—standard door	HPW2-1000-4PG-..-....-.-EN-LH-....
	Left-hand—reverse door	HPW2-1000-4PG-..-....-.-EN-LH-RD....
	Right-hand—standard door	HPW2-1000-4PG-..-....-.-EN-RH-....
	Right-hand—reverse door	HPW2-1000-4PG-..-....-.-EN-RH-RD....

Center Feeds

A center feed provides an alternative customer connection location for power, grounding, and monitoring in the center of a bus run, rather than at one end. Center feeds are available for 250–400 A bus systems.

Center Feeds (250–400 A)

The center feed has two starter rails and the following characteristics:

- The bus run has uniform electrical characteristics: both bus run legs must have the same amperage, neutral rating (100% or 150%), and neutral orientation. Tap-off boxes must face the same direction on both legs of the bus run
- Unlike standard end feeds, the center feed is shipped with both starter rails already installed as a single pre-assembled unit
- The length of each starter rail can be separately customized from 1 ft to 11.5 ft. However, shorter starter rails minimize the difficulty of shipping, storing, moving, and installing the pre-assembled unit
- The two starter rails are cross-connected with busbars in the center-feed enclosure; customer power is connected to these busbars
- Starter rails are also cross-connected for grounding. Customer safety ground optional dedicated or isolated ground connections are the same as for the standard end feed: ground is made to a single point (shown below) and isolated ground (optional) is made to a stand-off at the top of the enclosure (not shown)
- The enclosure is the same size for both 250 A and 400 A

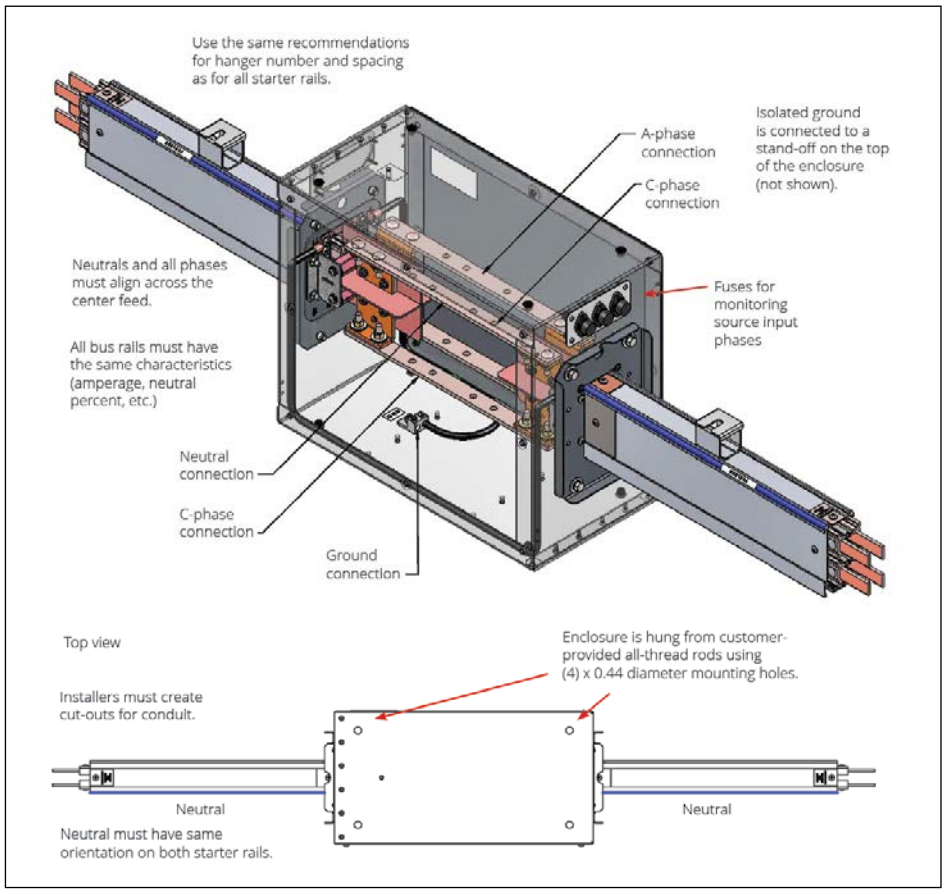


Figure 24.1-13. Center Feeds (250–400 A)

Center-Feed Options Summary and Part Numbers

Center-feed options summary:

- Neutral: 100% (standard) or 150% for 250–400 A
- Neutral: 100% only for 600–1000 A
- Dedicated ground
- Isolated ground
- Monitoring:
  - ❑ Source power
  - ❑ Tap-off boxes
- Disconnects (see standard end feed for mounting location):
  - ❑ Three-pole main circuit breaker (80% rated)
  - ❑ Three-pole main switch/isolator
  - ❑ Four-pole main circuit breaker (80% rated)
  - ❑ Four-pole main switch/isolator
  - ❑ Three-pole fuse disconnect
- Infrared scan window (see standard end feeds for mounting location)

Note: Center-feed options are very similar to standard end-feed options. See standard end-feed options in the previous section for illustrations and descriptions.

Table 24.4-2. Center-Feed Options Summary and Part Numbers

Ampere Rating	Enclosure Type	Base Part Number (Options to be Filled In)
250	Center feed—standard door	HPW2-250-4PG-..-....-.-EN-CH-....
	Center feed—reverse door	HPW2-250-4PG-..-....-.-EN-CH-RD-....
400	Center feed—standard door	HPW2-400-4PG-..-....-.-EN-CH-....
	Center-feed—reverse door	HPW2-400-4PG-..-....-.-EN-CH-RD-....

Compact End Feeds

The compact end feed is an alternative end feed for busway applications where there is limited overhead space. The bus run can be vertically or horizontally oriented. Conduit connections are made to the rear of the unit and cables are routed straight to the starter rail. The compact end feed is shipped as an assembled unit, but must be partially disassembled and reassembled over the starter rail during installation.

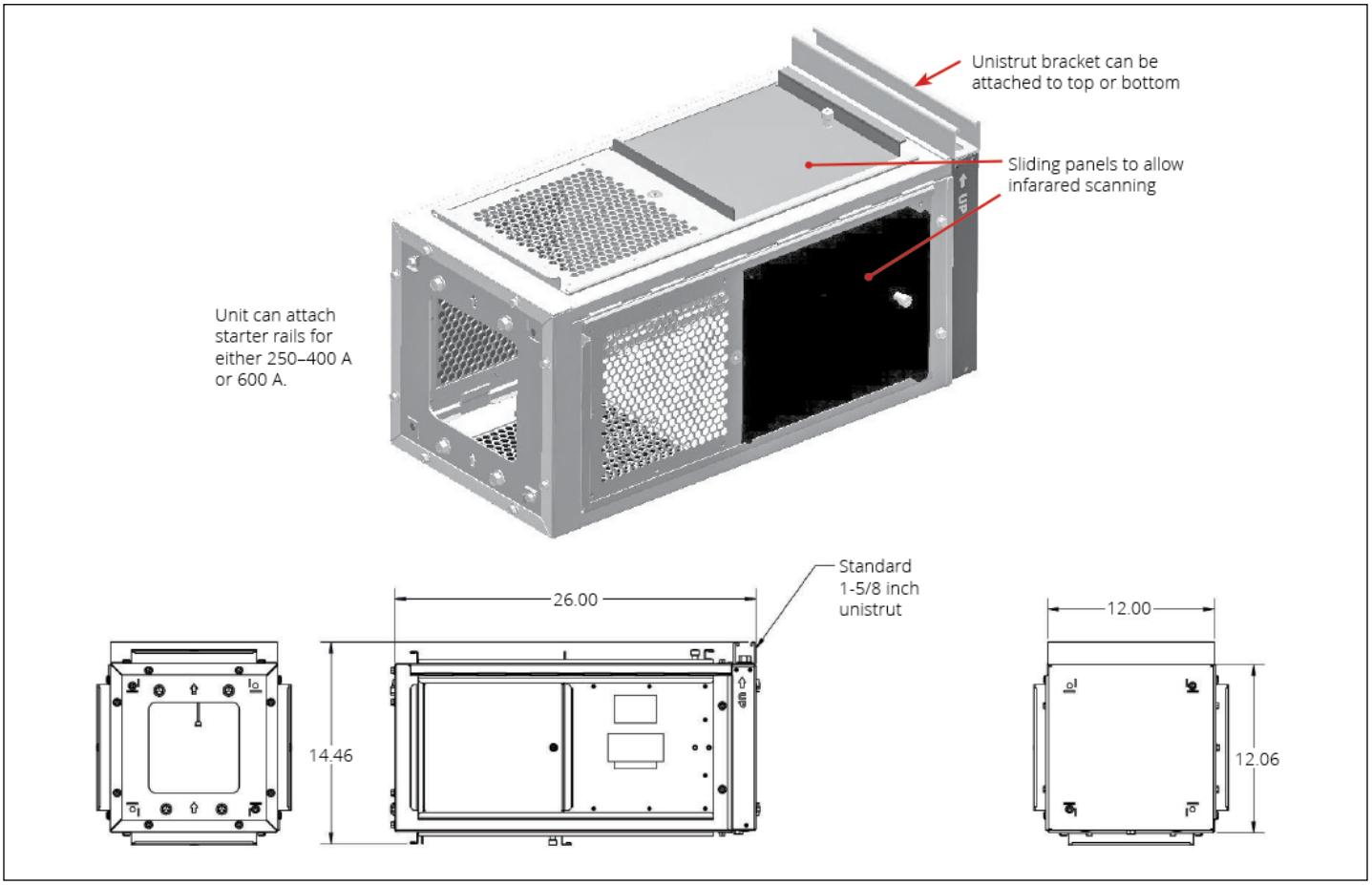


Figure 24.4-14. Compact End Feeds (250–400 A)

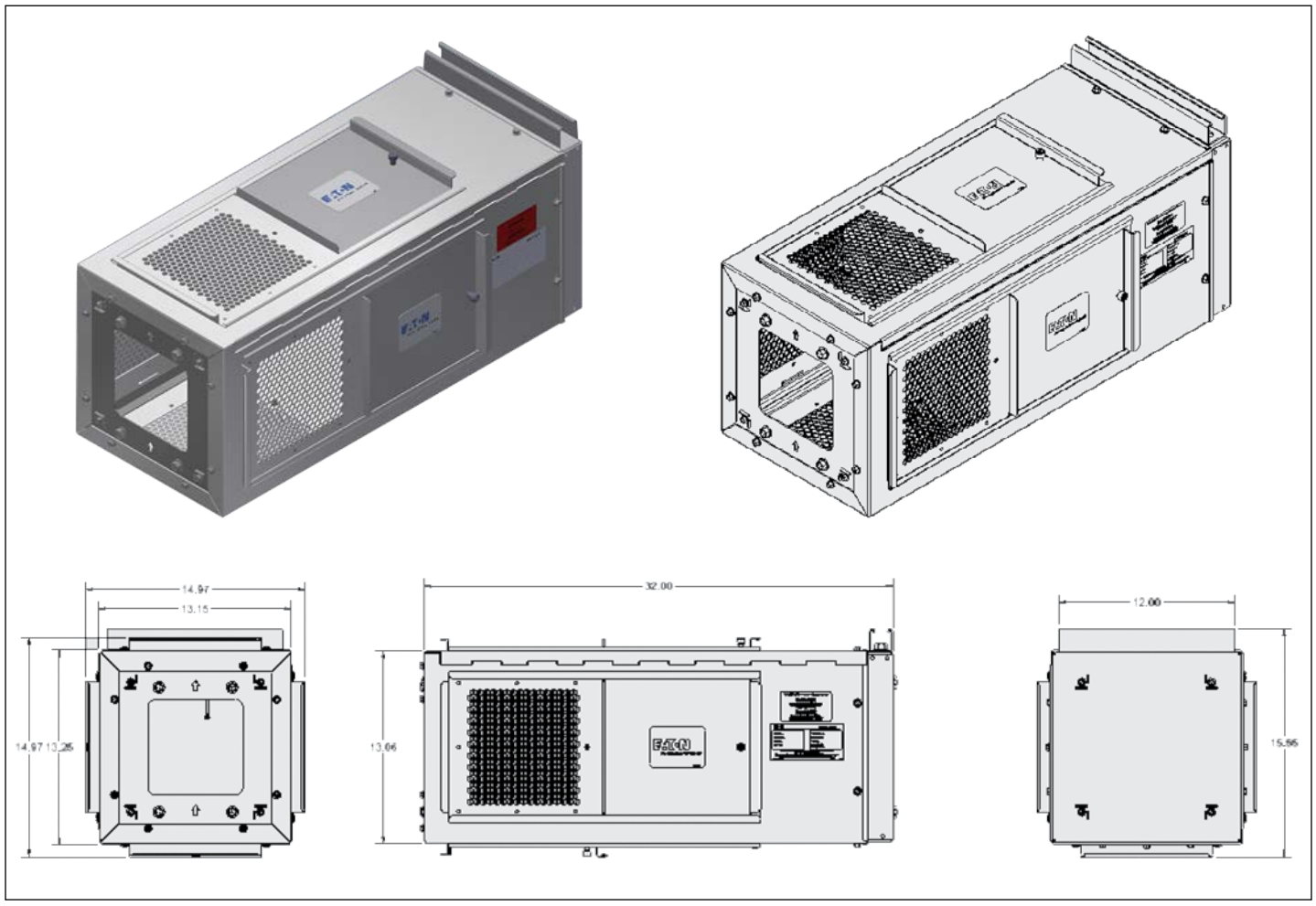


Figure 24.4-15. Compact End Feed (600 A)

Compact End-Feed Options and Part Numbers

The compact end feed should be specified with the same amperage and neutral size of the bus run:

- Amperage 250 A, 400 A, 600 A, 800 A, and 1000 A
- Neutral 100% or 150% for 250–400 A
- Neutral 100% only for 600–1000 A

Infrared scan window is standard. See **Figure 24.4-14**.

Available options:

- Dedicated ground
- Isolated ground (see **Figure 24.1-16**)

The following options are not available:

- Monitoring
- Power disconnects

Table 24.4-3. Compact End-Feed Options and Part Numbers

Ampere Rating	Base Part Number
250	HPW2-250-4PG-EN-...
400	HPW2-400-4PG-EN-...
600	HPW2-600-4PG-EN-...
800	HPW2-800-4PG-EN-...
1000	HPW2-1000-4PG-EN-...

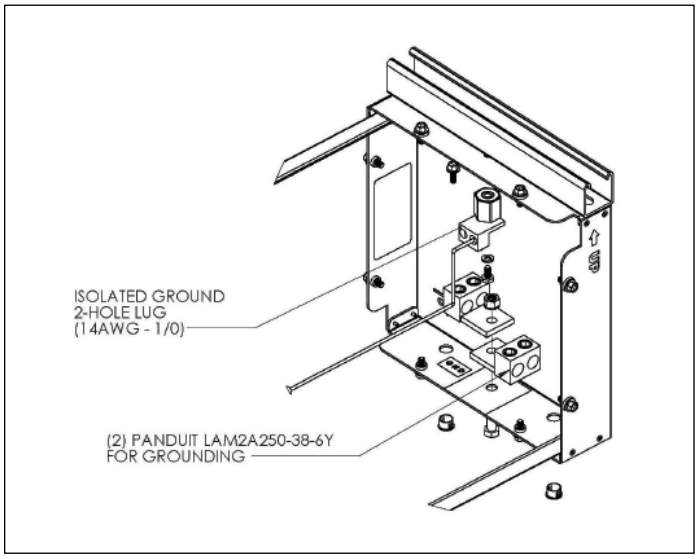


Figure 24.1-16. Compact End-Feed Options and Part Numbers

Starter Rails

Each bus run has only one starter rail. A starter rail must be the first bus rail connected to a power feed and has the following connections:

- Power cables (ABCN) from customer power are connected directly to the starter rail
- Ground is connected from the power feed to the starter rail and propagated through the rail housing
- (Optional) dedicated ground is connected from the power feed to the dedicated ground busbar in the starter rail's dedicated ground channel
- (Optional) isolated ground is connected from the power feed to the isolated ground busbar in the starter rail's isolated ground channel
- (Optional) Modbus RTU communications cable is connected from the power feed comm box to the communications channel Modbus connector if tap-off box BCMS monitoring is selected

Starter Rails (250–400 A)

A 250–400 A starter rail does not come with side plates or a ground jumper plate, as standard rails do. If a starter rail is coupled to a standard rail, elbow, or tee, the side plates and ground jumper plate are provided with the adjoining part. If the starter rail is the only bus rail in a short bus run, a coupler is not required.

Starter rails must be ordered as left-hand or right-hand, which determines the position of neutral and phase conductors and the orientation of tap-off boxes.

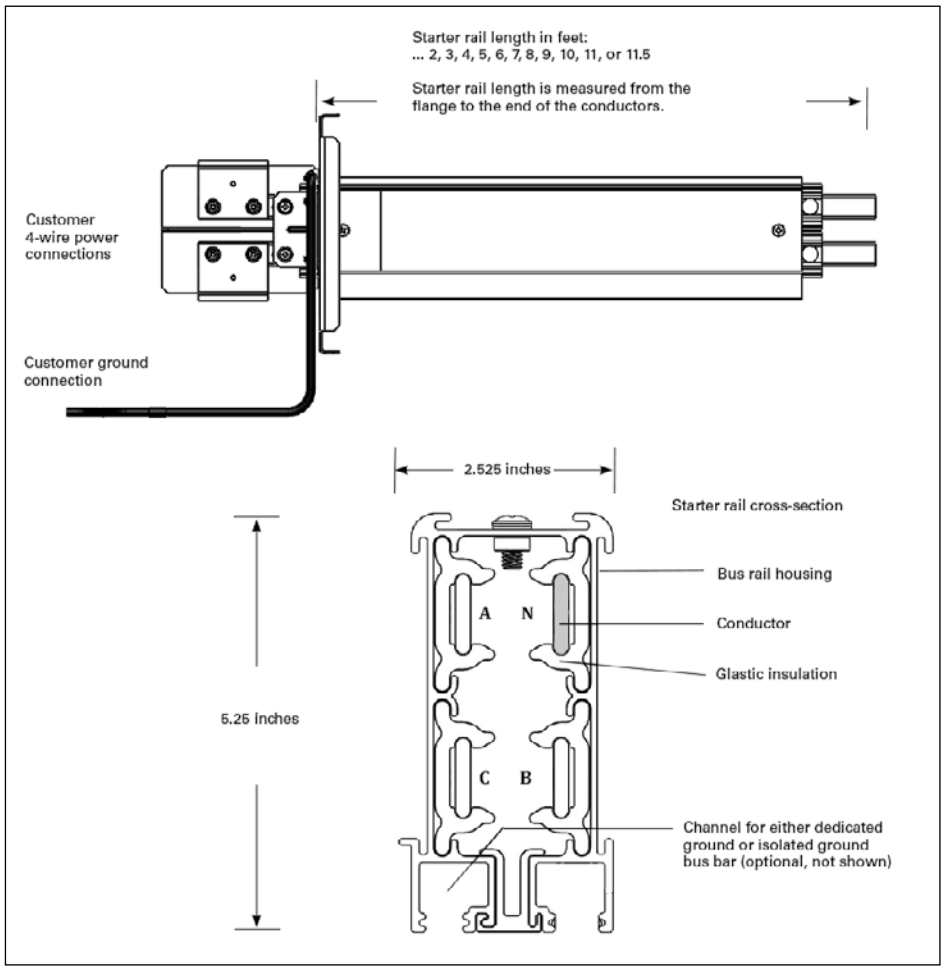


Figure 24.4-17. Starter Rails (250–400 A)

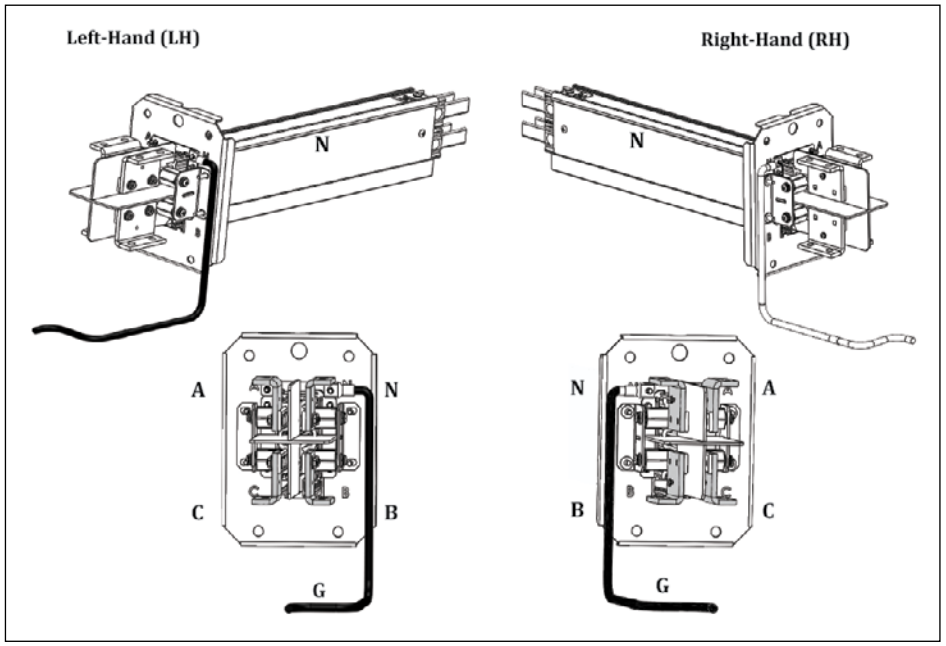


Figure 24.4-18. Starter Rails

Starter Rails (600–1000 A)

A 600–1000 A starter rail does not come with side plates or a ground strap as 600–1000 A standard rails do. If a starter rail is coupled to a standard rail, elbow, or tee, the side plates and ground strap are provided with the adjoining part. If the starter rail is the only bus rail in a short bus run, then a coupler is not required.

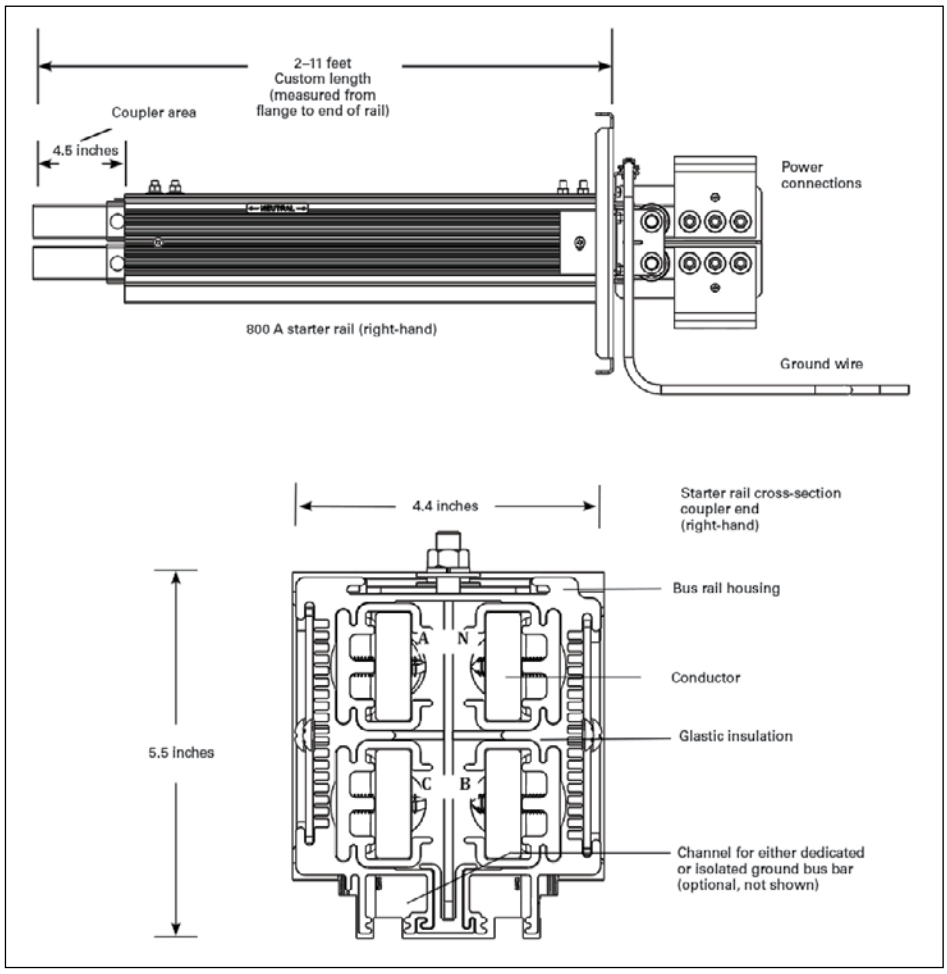


Figure 24.4-19. Starter Rails (600–1000 A)

Starter Rail Options Summary and Part Numbers

Starter rail options summary:

- Neutral: 100% or 150% for 250–400 A
- Neutral: 100% only for 600–1000 A
- Either dedicated or isolated ground busbar provided in a starter rail bottom channel

Table 24.4-4. Starter Rail Options Summary and Part Numbers

Ampere Rating	Starter Rail	Base Part Number (Some Options to be Filled In)
250	Left hand	HPW2-250-4PG-..-....-.-SR-LH-...
	Right hand	HPW2-250-4PG-..-....-.-SR-RH-...
400	Left hand	HPW2-400-4PG-..-....-.-SR-LH-...
	Right hand	HPW2-400-4PG-..-....-.-SR-RH-...
600	Left hand	SPW2-600-4PG-..-....-.-SR-LH-...
	Right hand	SPW2-600-4PG-..-....-.-SR-RH-...
800	Left hand	HPW2-800-4PG-..-....-.-SR-LH-...
	Right hand	HPW2-800-4PG-..-....-.-SR-RH-...
1000	Left hand	HPW2-1000-4PG-..-....-.-SR-LH-...
	Right hand	HPW2-1000-4PG-..-....-.-SR-RH-...

Note: Left-hand or right-hand determines neutral position. Neutral position determines the direction that tap-off boxes face.

Note: Starter rails must be ordered with a compatible standard end feed or center feed.

Note: Eaton recommends that bus run length be customized by specifying a custom length for the starter rail while using full-length 12 ft standard rails.

Customer must specify starter rail length: 2–11.5 ft in 6-inch increments for 250–400 A starter rails.

Customer must specify starter rail length: 2–11 ft in 6-inch increments for 600–1000 A starter rails.

Standard Rails

All bus rails in a bus run after the starter rail are standard rails. A standard rail must be joined to a starter rail, elbow, or tee using a coupler.

Standard Rails (250–400 A)

The 250–400 A standard rail kit includes the following:

- One standard rail
- One coupler
- Two side plates to slide over the coupler
- One ground jumper plate to connect ground from the bus rail housing across the coupler to the housing of another bus rail, elbow, or tee

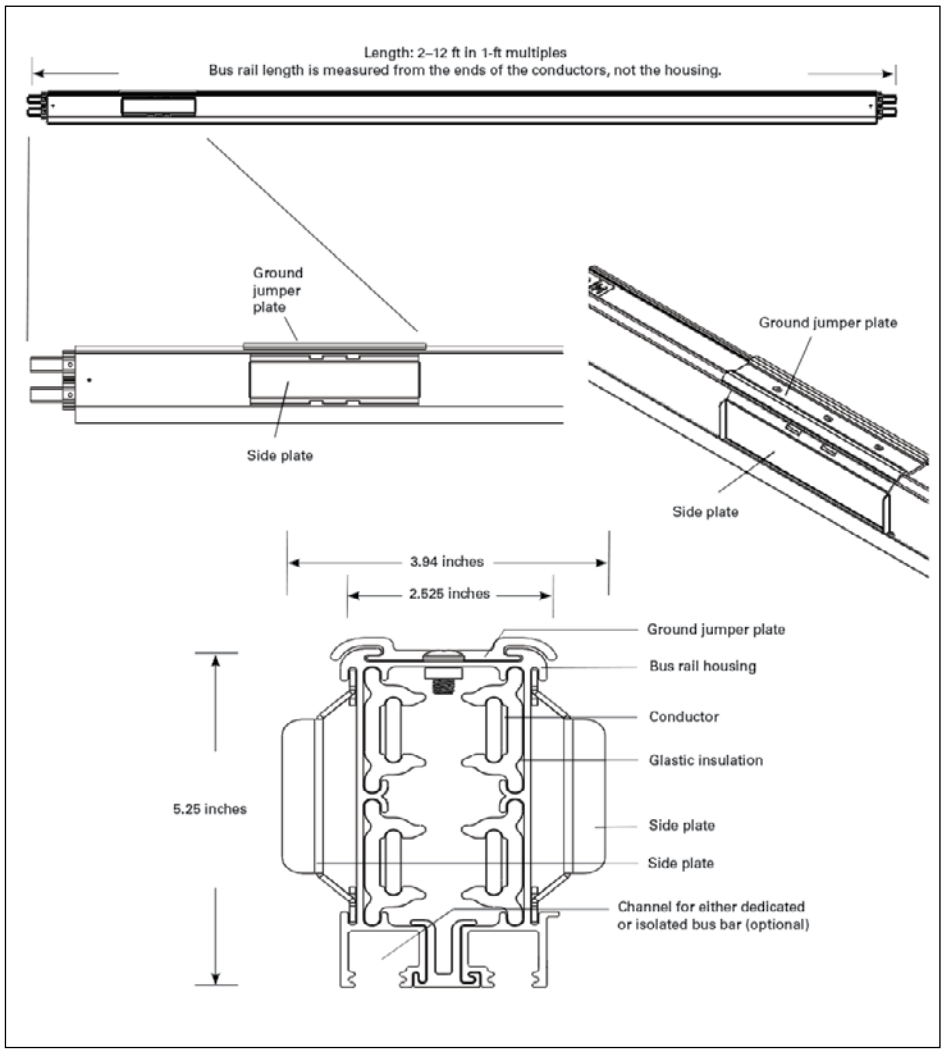


Figure 24.4-20. Standard Rails (250–400 A)

Standard Rails (600–1000 A)

A standard rail kit for 600–1000 A includes the following:

- One standard rail
- One coupler
- Two side plates to slide over the coupler
- One ground strap to connect ground across the coupler to the housing of another bus rail, elbow, or tee

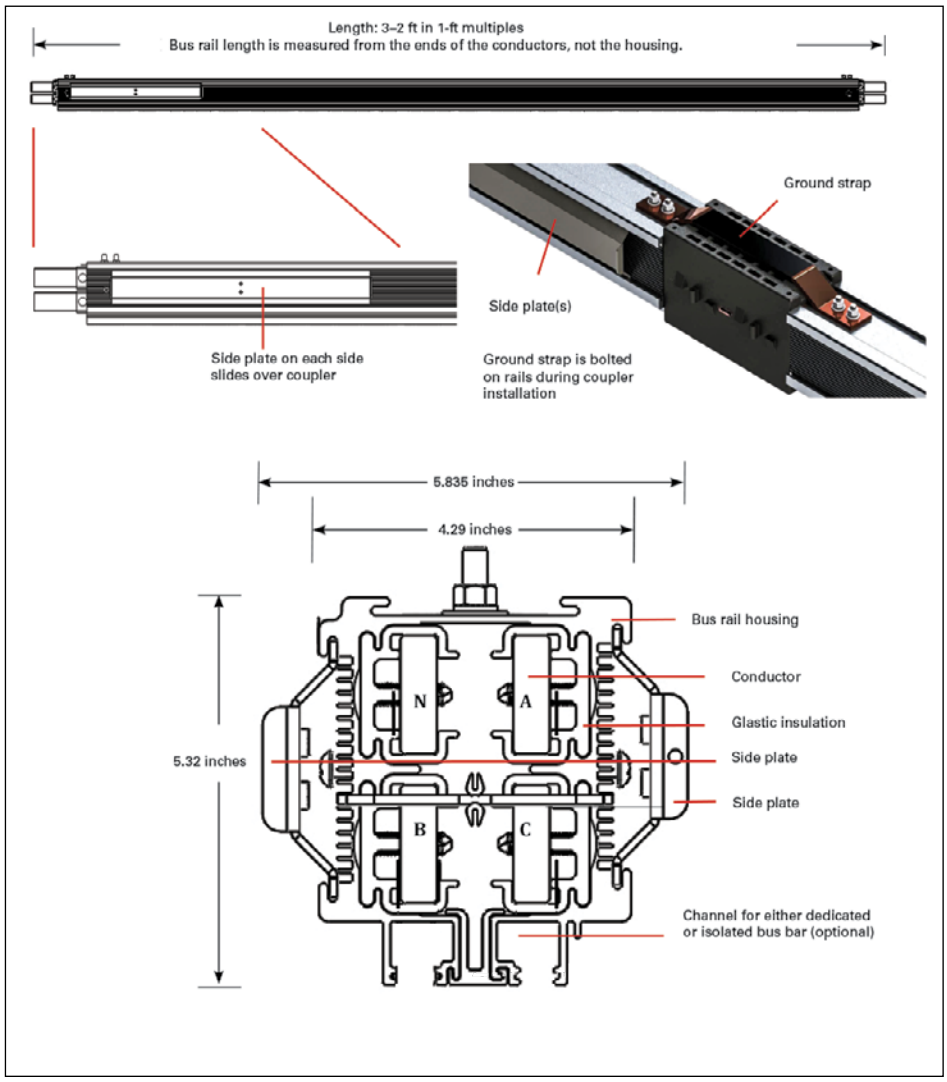


Figure 24.4-21. Standard Rail Cross-Section with Side Plates (600–1000 A)

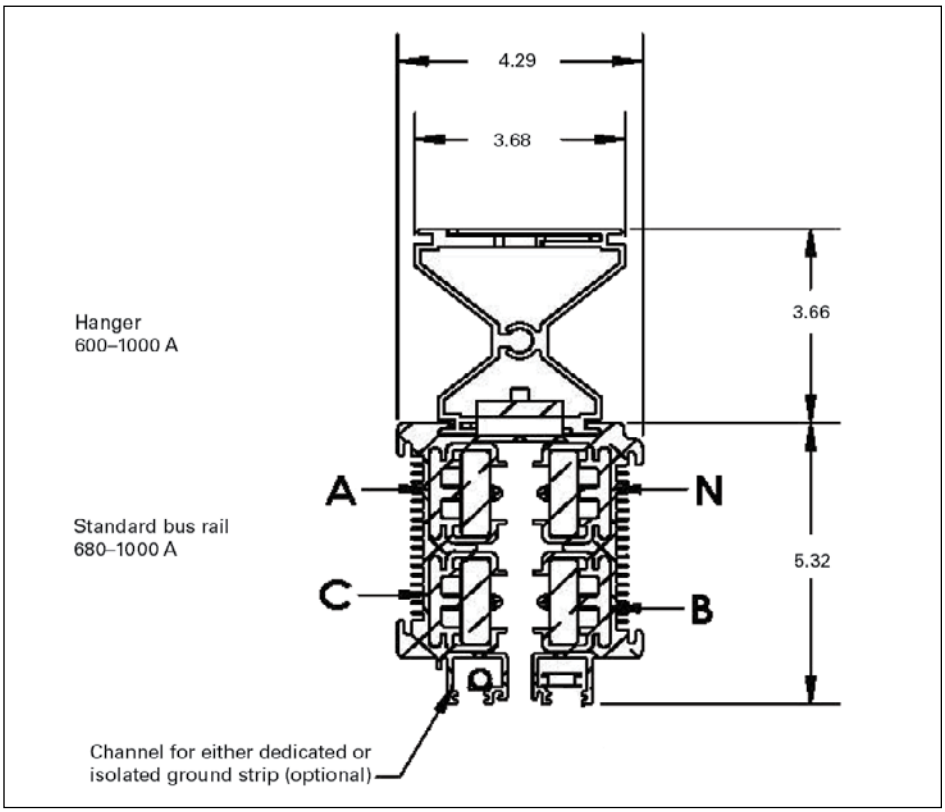


Figure 24.4-22. Standard Bus Rail with Hanger (600–1000 A)

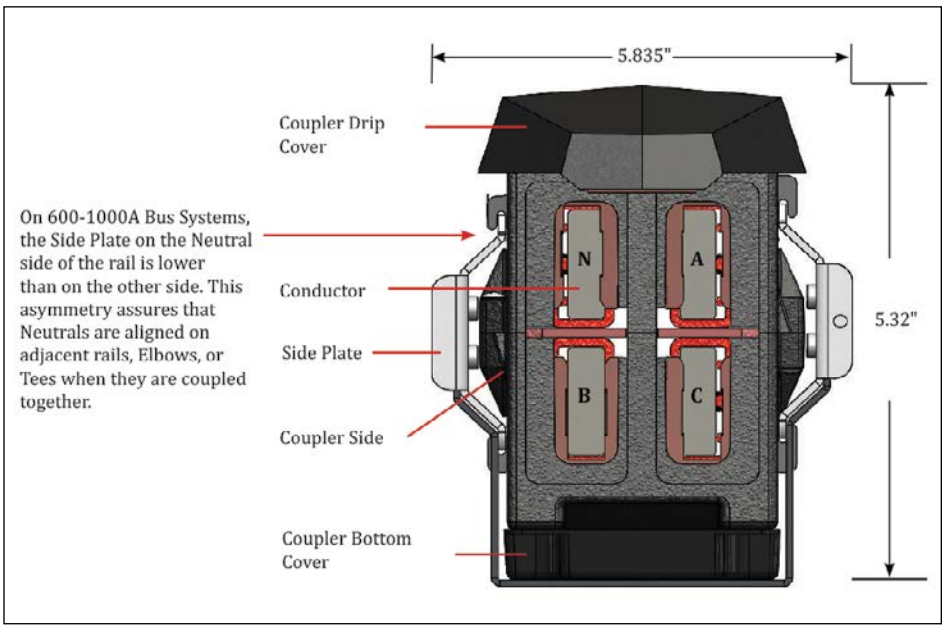


Figure 24.4-23. Standard Rail with Coupler Installed (600–1000 A)

Standard Rail Options Summary and Part Numbers

Standard rail options summary:

- Neutral 100% or 150% for 250–400 A
- Neutral 100% only for 600–1000 A
- Tap-off box monitoring: Modbus RTU cable provided in standard rail bottom channel
- Isolated ground: isolated ground strip provided in a standard rail bottom channel

Table 24.4-5. Standard Rail Options Summary and Part Numbers

Ampere Rating	Standard Rail Length in Feet	Part Number (Some Options to be Filled In)
250	2	HPW2-250-4PG-.....-BR-024-....
	4	HPW2-250-4PG-.....-BR-048-...
	6	HPW2-250-4PG-.....-BR-072-....
	10	HPW2-250-4PG-.....-BR-120-..
	12	HPW2-250-4PG-.....-BR-144-....
400	2	HPW2-400-4PG-.....-BR-024-....
	4	HPW2-400-4PG-.....-BR-048-....
	6	HPW2-400-4PG-.....-BR-072-....
	10	HPW2-400-4PG-.....-BR-120-....
	12	HPW2-400-4PG-.....-BR-144-....
600	2	SPW2-600-4PG-.....-BR-024-....
	4	SPW2-600-4PG-.....-BR-048-....
	6	SPW2-600-4PG-.....-BR-072-....
	10	SPW2-600-4PG-.....-BR-120-....
	12	SPW2-600-4PG-.....-BR-144-....
800	2	HPW2-800-4PG-.....-BR-024-....
	4	HPW2-800-4PG-.....-BR-048-....
	6	HPW2-800-4PG-.....-BR-072-....
	10	HPW2-800-4PG-.....-BR-120-....
	12	HPW2-800-4PG-.....-BR-144-....
1000	2	HPW2-1000-4PG-.....-BR-024-....
	4	HPW2-1000-4PG-.....-BR-048-....
	6	HPW2-1000-4PG-.....-BR-072-....
	10	HPW2-1000-4PG-.....BR-120-....
	12	HPW2-1000-4PG-.....-BR-144-....

Note: Left-hand or right-hand determines neutral position. Neutral position determines the direction that tap-off boxes face.

Note: Eaton recommends that bus run length be customized by specifying a custom length for the starter rail while using full-length 12 ft standard rails.

Note: Customer must specify standard rail length: 2–12 ft in 6-inch increments.

Elbows

An elbow turns the bus run at a right angle. An elbow has two legs and must be connected to bus rails on each leg with couplers. Elbows are standard parts with fixed leg lengths. Leg lengths cannot be customized.

Options for the neutral conductor:

- The neutral position can "cross-over" or change sides from one leg of the elbow to the other; see "Elbow Neutral Positions" on page 25
  - Because tap-off boxes must face out from the neutral side of the bus run, changing the neutral side from one elbow leg to the other repositions the bus run for a different server-rack orientation
  - As with other bus run components, the position of neutral on each leg determines the position of all conductors, and the optional dedicated or isolated ground busbar on that leg
- Neutral percent can be 100% or 150% of phase conductors; however, the amperage rating and neutral percent must be the same as the bus rails in the same bus run

Other elbow characteristics:

- Elbows are available for vertical bus runs only
- Elbows use the same hangers as vertical bus rails of the same amperage
- Optional dedicated or isolated ground must be specified identically for the adjacent bus rails

Elbows (250–400 A)

Part dimensions are the same for both 250 A and 400 A elbows, although the conductor busbars are larger for 400 A. See the following illustration for part dimensions.

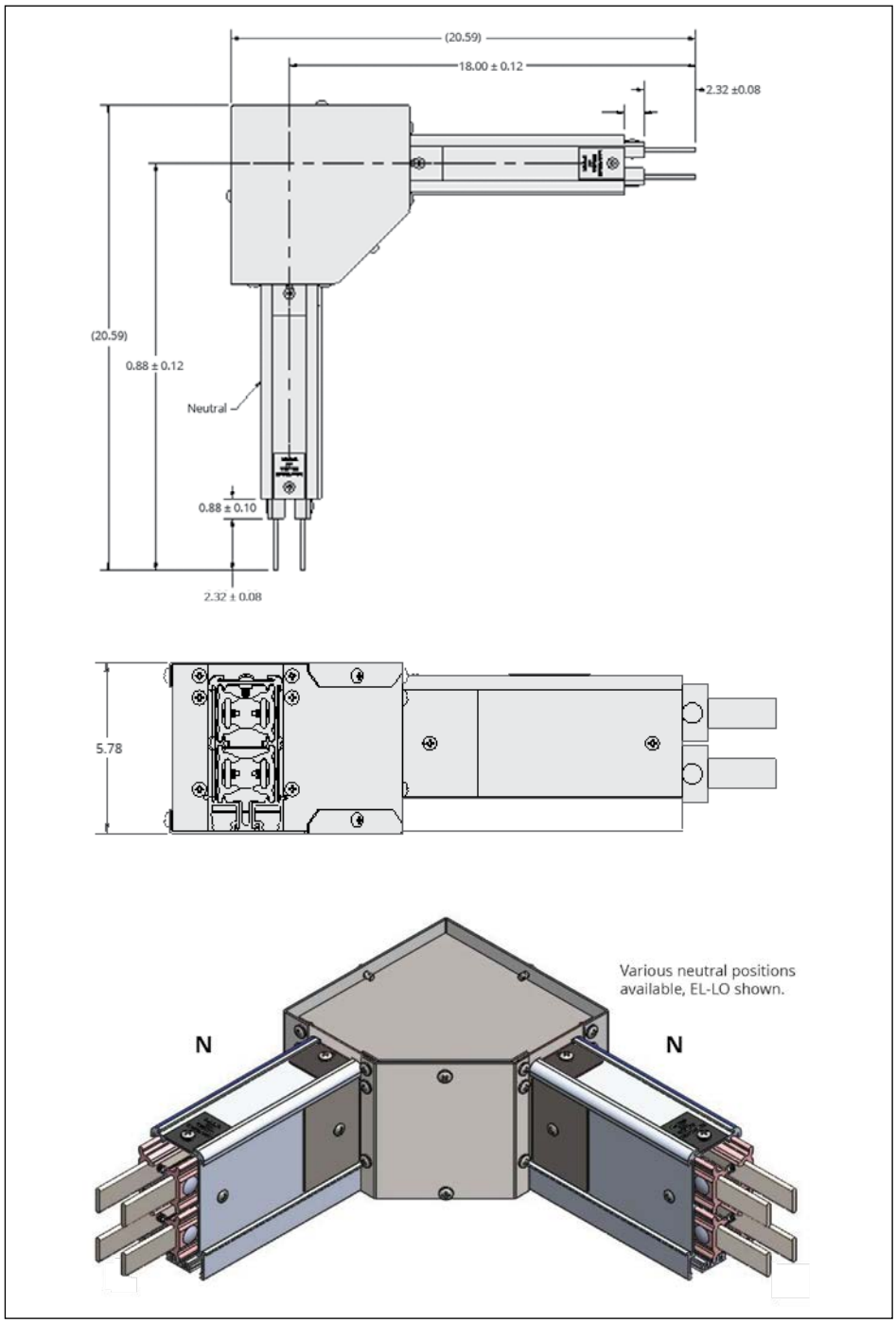


Figure 24.4-24. Elbows (250–400 A)

Elbows (600–1000 A)

Part dimensions are the same for 600 A, 800 A, and 1000 A elbows, although the conductor busbars are larger when increasing to 800 A or 1000 A. See the following illustration for part dimensions.

Elbow leg lengths are fixed at 22 inches.

Other options are the same as for 250 A and 400 A elbows.

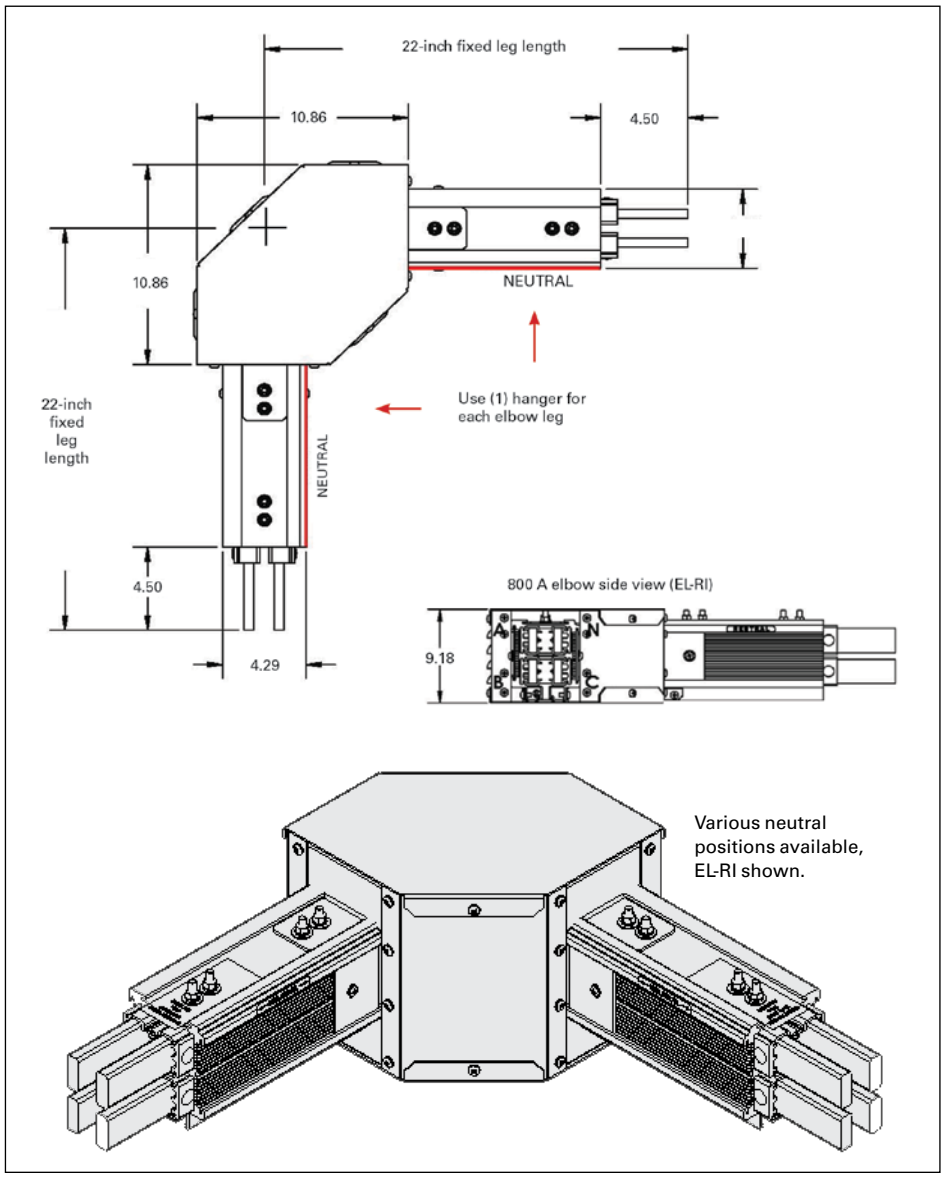


Figure 24.4-25. Elbows (600–1000 A)

Elbow Neutral Positions

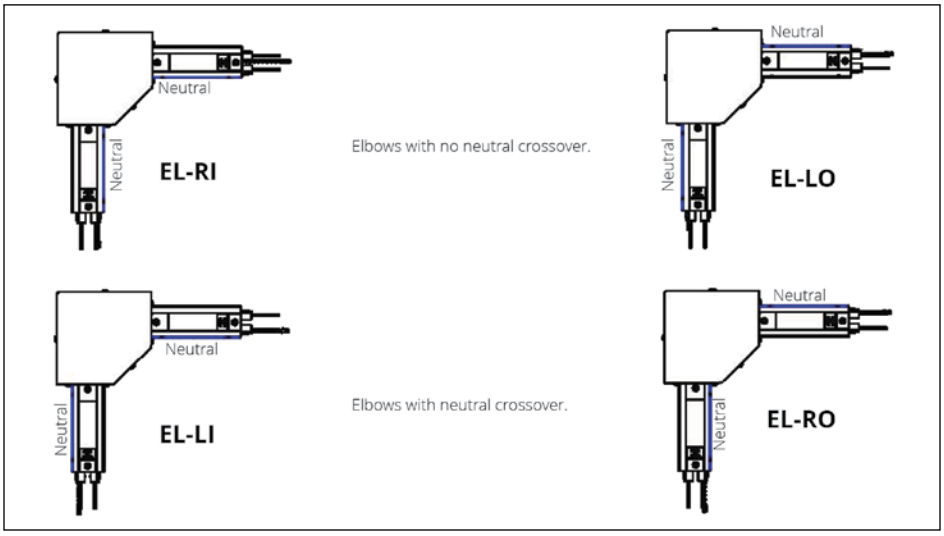


Figure 24.4-26. Elbow Neutral Positions

Elbow Options Summary and Part Numbers

Elbow options summary:

- Neutral 100% or 150% for 250–400 A
- Neutral 100% only for 600–1000 A
- Dedicated or isolated ground: Strip provided in a standard rail bottom channel

Table 24.4-6. Elbow Options Summary and Part Numbers

Ampere Rating	Elbow Orientation	Part Number
250	ELLO	HPW2-250-4PG-...-ELLO-A018-B018
	ELLI	HPW2-250-4PG-...-ELLI-A018-B018
	ELRO	HPW2-250-4PG-...-ELRO-A018-B018
	ELRI	HPW2-250-4PG-...-ELRI-A018-B018
400	ELLO	HPW2-400-4PG-...-ELLO-A018-B018
	ELLI	HPW2-400-4PG-...-ELLI-A018-B018
	ELRO	HPW2-400-4PG-...-ELRO-A018-B018
	ELRI	HPW2-400-4PG-...-ELRI-A018-B018
600	ELLO	SPW2-600-4PG-...-ELLO-A022-B022
	ELLI	SPW2-600-4PG-...-ELLI-A022-B022
	ELRO	SPW2-600-4PG-...-ELRO-A022-B022
	ELRI	SPW2-600-4PG-...-ELRI-A022-B022
800	ELLO	HPW2-800-4PG-...-ELLO-A022-B022
	ELLI	HPW2-800-4PG-...-ELLI-A022-B022
	ELRO	HPW2-800-4PG-...-ELRO-A022-B022
	ELRI	HPW2-800-4PG-...-ELRI-A022-B022
1000	ELLO	HPW2-1000-4PG-...-ELLO-A022-B022
	ELLI	HPW2-1000-4PG-...-ELLI-A022-B022
	ELRO	HPW2-1000-4PG-...-ELRO-A022-B022
	ELRI	HPW2-1000-4PG-...-ELRI-A022-B022

Note: Amperage and elbow orientation determine part number.

Tees

A tee creates a bus run leg perpendicular to a straight bus run. A tee has three legs and must be connected to bus rails on each leg with couplers. Tees are standard parts with fixed leg lengths. Leg lengths cannot be customized.

Options for the neutral conductor:

- A tee has two legs that are part of the straight bus run. The neutral can be on either side of these legs but must always be on the same side on both legs
- The tee has a third perpendicular leg that branches off 90° from the straight bus run legs. The neutral position on this leg can be on either side. See "Tee Neutral Positions" on page 28
  - Because tap-off boxes must face out from the neutral side of the bus run, you should specify the neutral side of the perpendicular leg according to server-rack orientation
  - As with other bus run components, the position of neutral on each leg also determines the position of all conductors, the optional tap-off box monitoring cable, and the optional isolated ground busbar on that leg
  - Neutral percent can be 100% or 150% of phase conductors for 250–400 A. Neutral is 100% for 600 A, 800 A, and 1000 A. The ampere rating and neutral percent must be the same as the attached bus rails

Other tee characteristics:

- Tees are available for vertical bus runs only
- Tees require one hanger per leg, which should be the same hanger used for vertical bus rails of the same amperage
- Optional dedicated or optional isolated ground must be specified identically to that for the adjacent bus rails

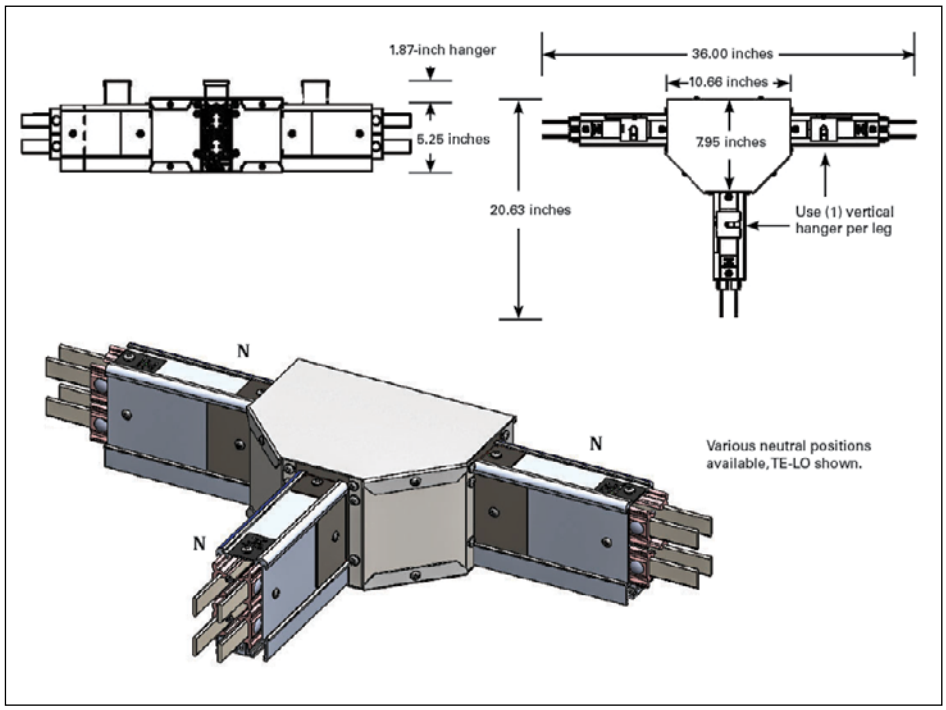


Figure 24.4-27. Tees (250–400 A)

Tees (250–400 A)

Part dimensions are the same for both 250 A and 400 A tees, although the conductor busbars are larger for 400 A. See the following illustration for part dimensions.

Tees (600–1000 A)

600–1000 A tees are larger than 250 A and 400 A tees. 250 A or 400 A tees can have 100% or 150% neutral.

600–1000 A tees have 100% neutral. Other options are the same as for 250–400 A tees.

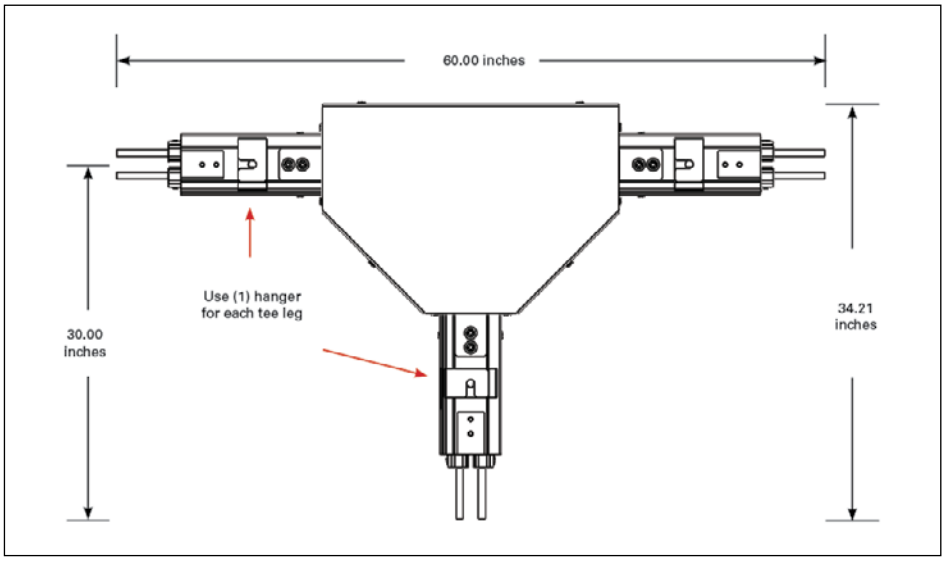


Figure 24.4-28. 600–1000 A Tee (TE-LI) Top View

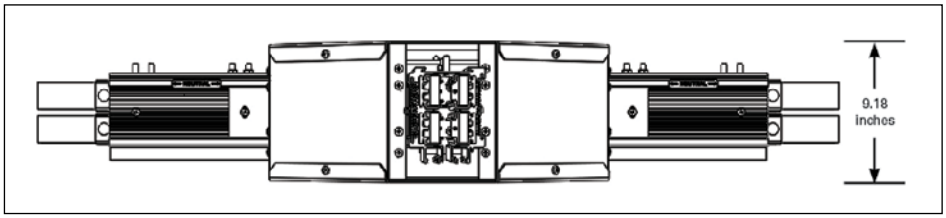


Figure 24.4-29. 600–1000 A Tee (TE-LI) Front View

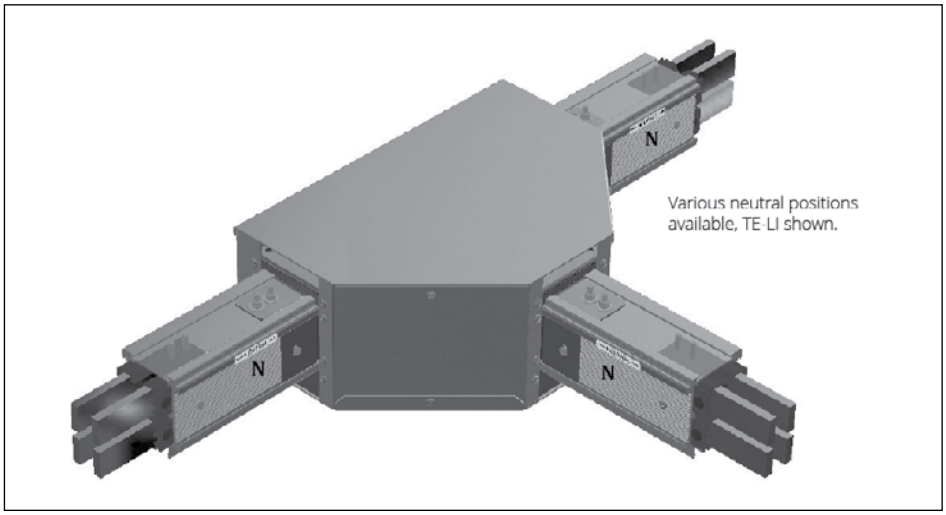


Figure 24.4-30. 600–1000 A Tee (TE-LI)

Tee Neutral Positions

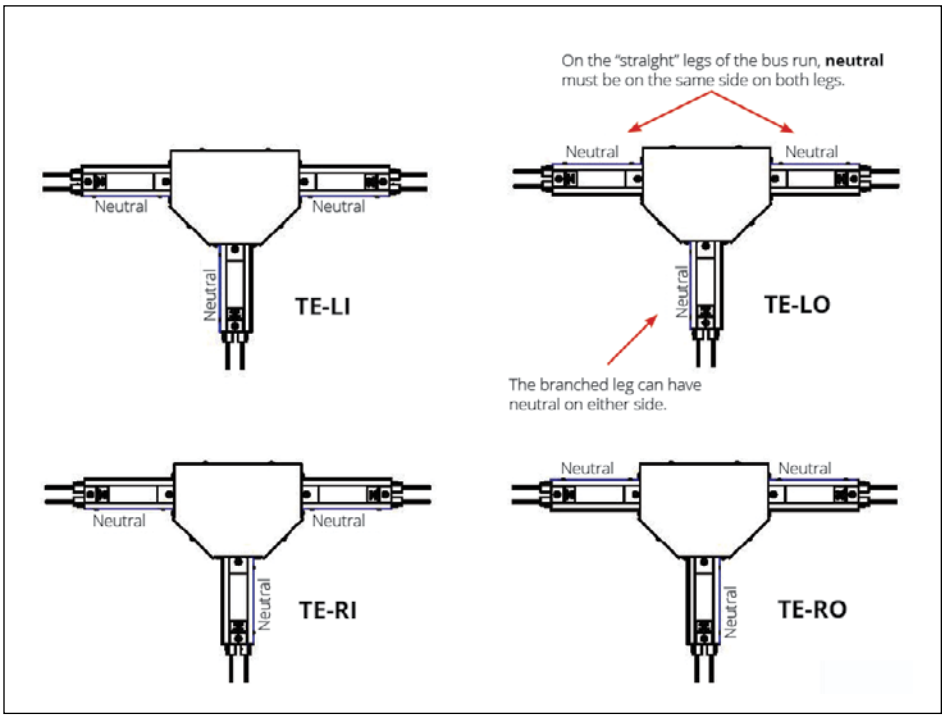


Figure 24.4-31. Tee Neutral Positions

Tee Options Summary and Part Numbers

Tee options summary:

- Neutral: 100% or 150% for 250–400 A
- Neutral: 100% only for 600–1000 A
- Dedicated or isolated ground strip provided in a standard rail bottom channel

Table 24.4-7. Tee Options Summary and Part Numbers

Ampere Rating	Tee Orientation	Part Number
250	TELO	HPW2-250-4PG-X-TELO-A012-B012-C012
	TELI	HPW2-250-4PG-X-TELI-A012-B012-C012
	TERO	HPW2-250-4PG-X-TERO-A012-B012-C012
	TERI	HPW2-250-4PG-X-TERI-A012-B012-C012
400	TELO	HPW2-400-4PG-X-TELO-A018-B018-C018
	TELI	HPW2-400-4PG-X-TELI-A018-B018-C018
	TERO	HPW2-400-4PG-X-TERO-A018-B018-C018
	TERI	HPW2-400-4PG-X-TERI-A018-B018-C018
600	TELO	SPW2-600-4PG-X-TELO-A018-B018-C018
	TELI	SPW2-600-4PG-X-TELI-A018-B018-C018
	TERO	SPW2-600-4PG-X-TERO-A018-B018-C018
	TERI	SPW2-600-4PG-X-TERI-A018-B018-C018
800	TELO	HPW2-800-4PG-X-TELO-A018-B018-C018
	TELI	HPW2-800-4PG-X-TELI-A018-B018-C018
	TERO	HPW2-800-4PG-X-TERO-A018-B018-C018
	TERI	HPW2-800-4PG-X-TERI-A018-B018-C018
1000	TELO	HPW2-1000-4PG-X-TELO-A018-B018-C018
	TELI	HPW2-1000-4PG-X-TELI-A018-B018-C018
	TERO	HPW2-1000-4PG-X-TERO-A018-B018-C018
	TERI	HPW2-1000-4PG-X-TERI-A018-B018-C018

Note: Amperage and tee orientation determine part number.

Accessories

Couplers (250–400 A)

A coupler is provided as a kit to join starter rails, standard rails, elbows, and tees into a bus run. One coupler and one ground jumper plate are included with each standard rail.

250–400 A couplers install quickly and require no special tools. 250 A and 400 A couplers have the same dimensions, but the 400 A coupler accommodates the larger 400 A conductor busbars.

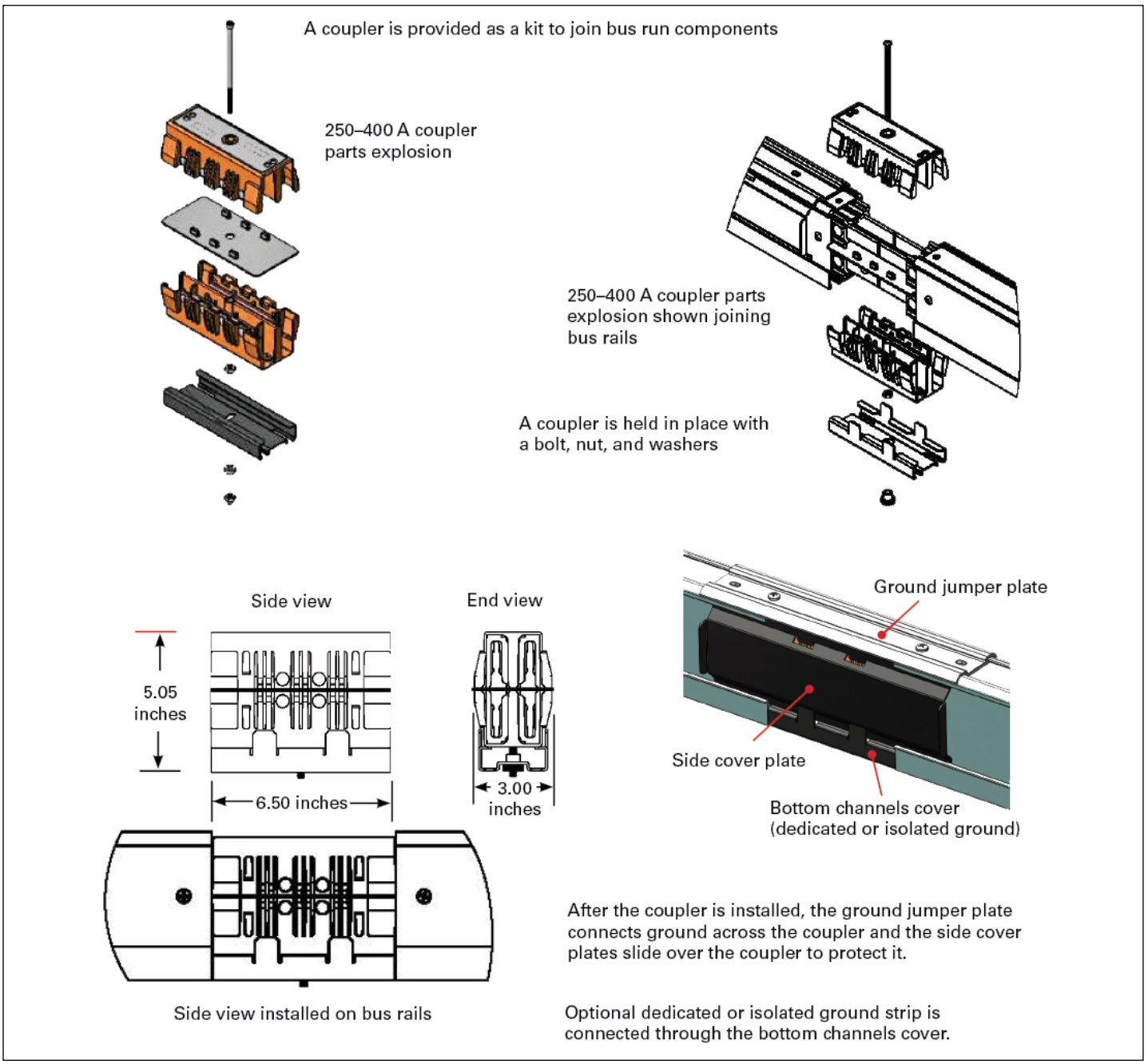


Figure 24.4-32. Couplers (250–400 A)

Couplers (600–1000 A)

A coupler is provided as a kit to join starter rails, standard rails, elbows, and tees into a bus run. Each standard rail is shipped with one coupler and one ground strap.

To accommodate larger conductor busbars, 600–1000 A couplers are larger than 250 A or 400 A couplers and have a different but similar structure.

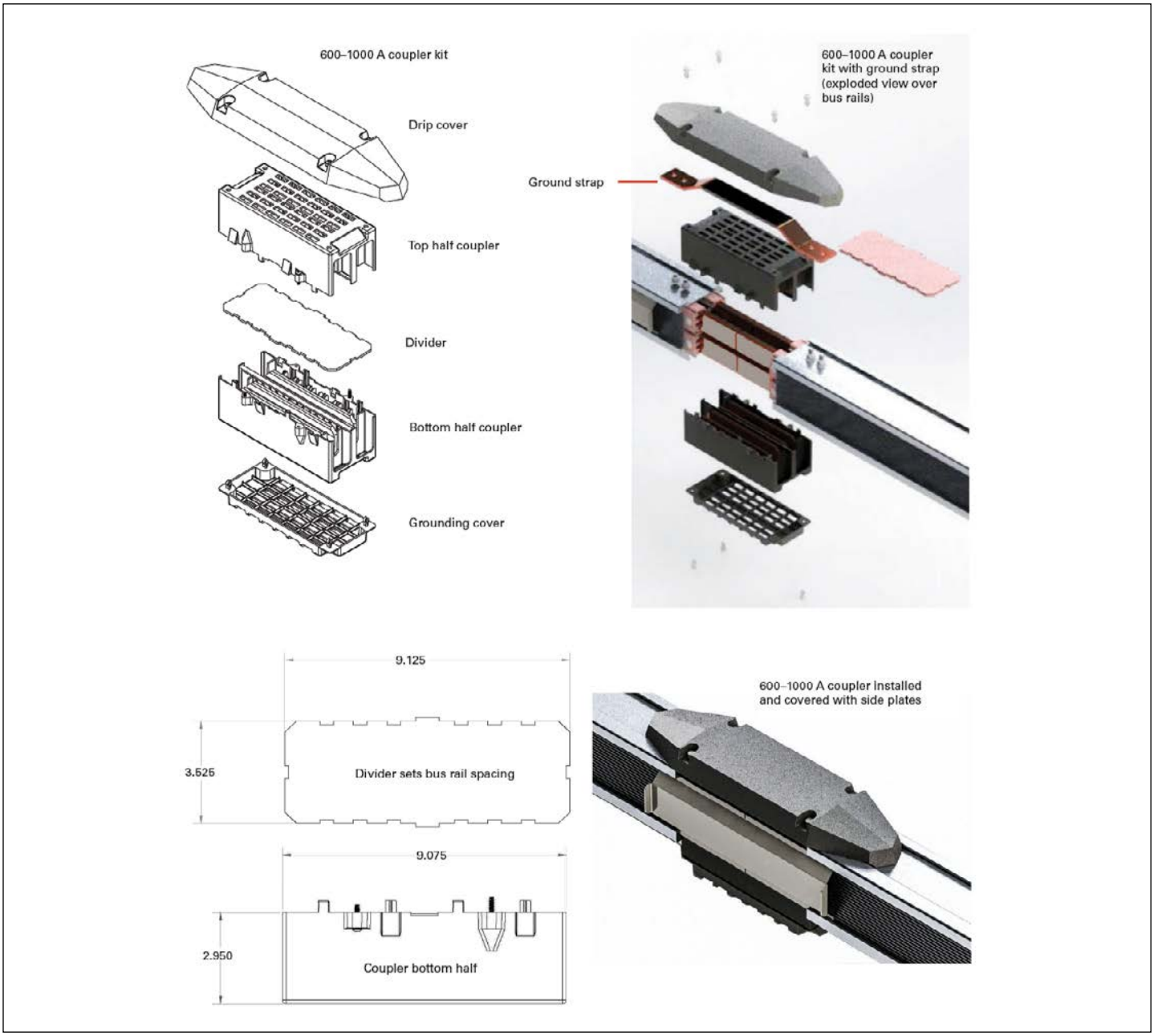


Figure 24.4-33. Couplers (600–1000 A)

Vertical Hangers (250–400 A)

Vertical hangers are used in vertical bus runs to suspend starter rails, standard rails, elbows, and tees from overhead structures (but not standard end feeds or center feeds).

Eaton recommends three vertical hangers per 12 ft (3.66 m) bus rail:

- Place a hanger within 1 ft of each bus rail end
- Place one hanger evenly spaced between the end hangers at about 5-ft spacing on full-sized rail
- Hangers should be spaced no more than 5 ft from each other

Elbows and tees: place a hanger on each leg of the elbow or tee.

Vertical hangers are suspended using all-thread and Unistrut nuts. Hangers are for 0.375-inch rods. All-thread rods and Unistrut nuts are provided by the customer.

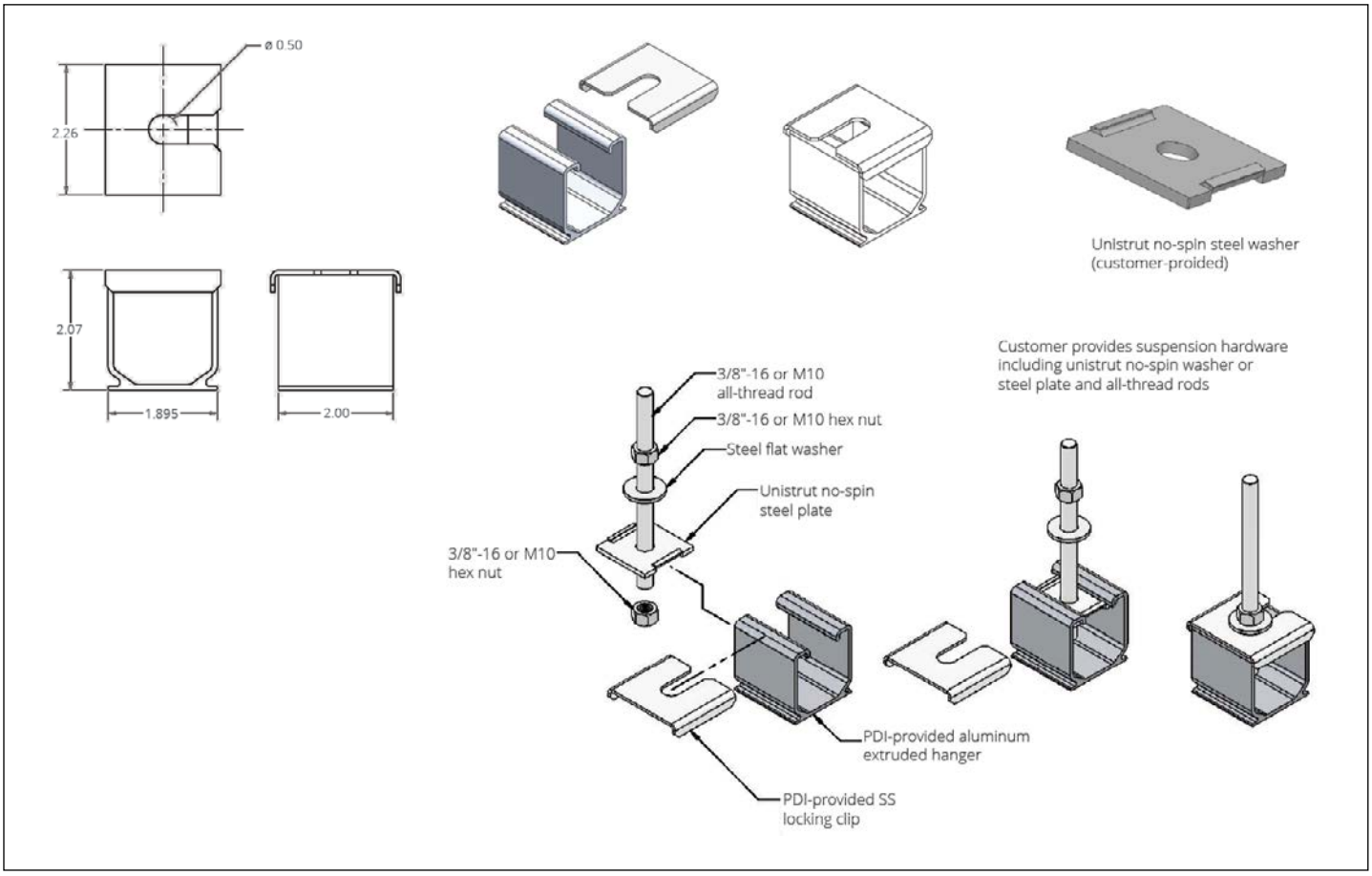


Figure 24.4-34. Vertical Hangers (250–400 A)

Horizontal Hangers (250–400 A)

Horizontal hangers are used to suspend starter rails and standard rails from ceilings or overhead support structures.

Horizontal hangers are suspended using all-thread and Unistrut nuts. Hangers are for 0.375-inch rods. All-thread rods and Unistrut nuts are provided by the customer.

Horizontal bus runs require a wider hanger because the broad side of the bus rail faces upward. Horizontal bus runs also require more hangers per length than vertical runs.

Eaton recommends four horizontal hangers per 12 ft (3.66 m) bus rail:

- Place a hanger within 1 ft of each bus rail end
- Place two hangers evenly spaced between the end hangers or about 3.33-ft spacing
- Hangers should be spaced no more than 4 ft from each other

Horizontal hangers are not used to suspend standard end feeds or center feeds.

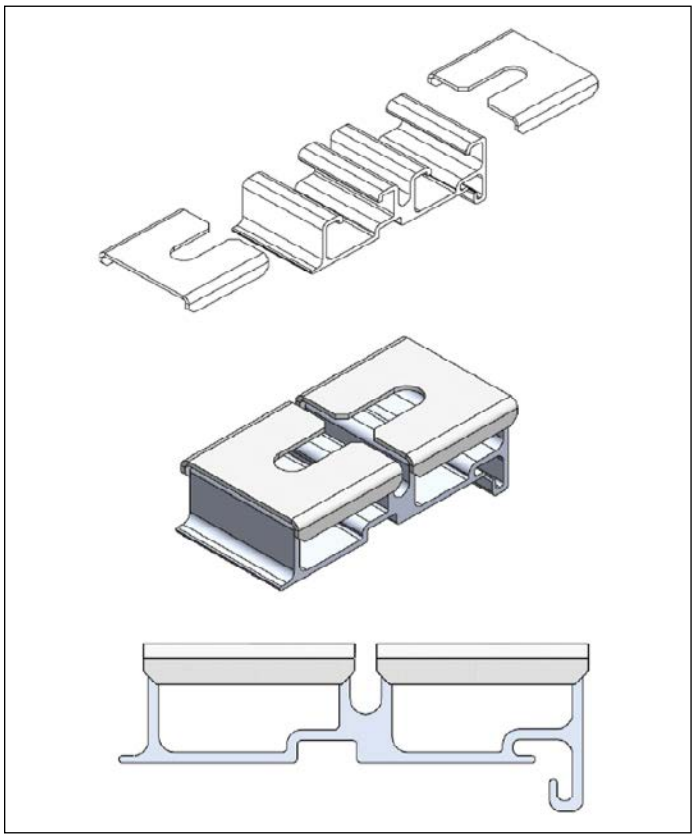


Figure 24.4-35. Horizontal Hangers (250–400 A)

Hangers (600–1000 A)

600–1000 A hangers are used to suspend starter rails, standard rails, elbows, and tees from overhead structures (but not standard or compact end feeds). They are used in both vertical and horizontal bus runs.

Eaton recommends three hangers per 12 ft (3.66 m) bus rail in vertical applications:

- Place a hanger within 1 ft of each bus rail end
- Place one hanger evenly spaced between the end hangers at about 5 ft spacing on full-sized rail
- Hangers should be spaced no more than 5 ft from each other

Elbows and tees: place a hanger on each leg of the elbow or tee.

Hangers are suspended from concrete or Unistruts. Hangers are for 0.50-inch rods. Suspension hardware other than hangers is provided by the customer.

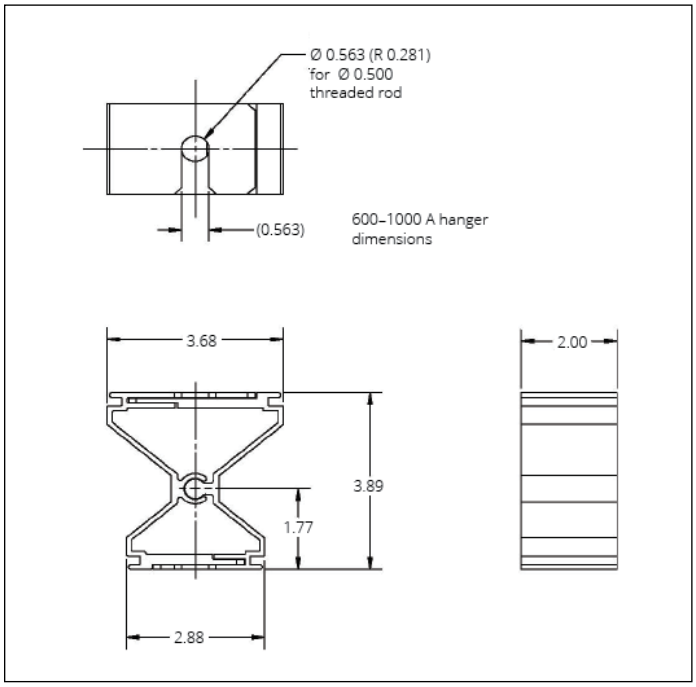
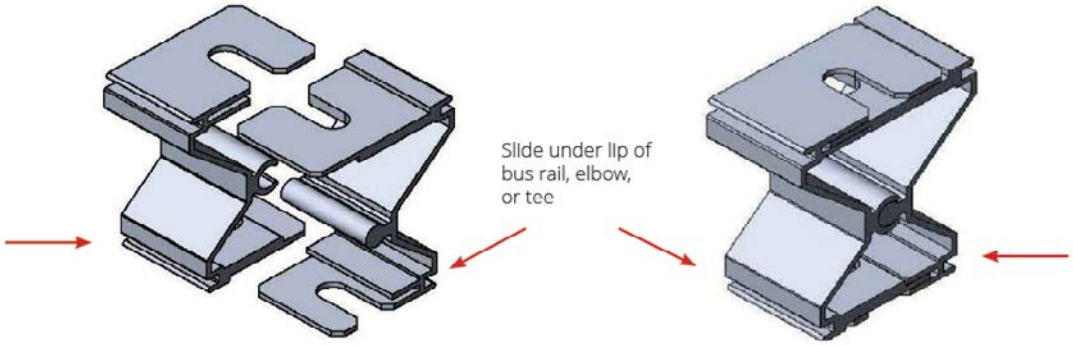
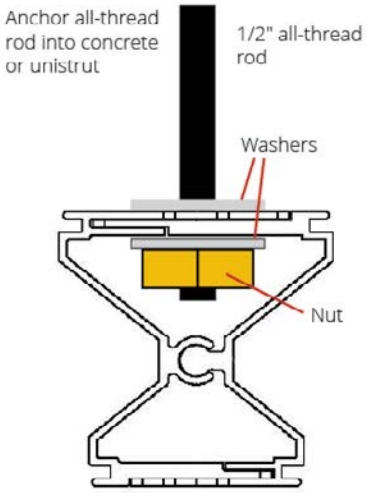


Figure 24.4-36. 600–1000 A Hanger Dimensions



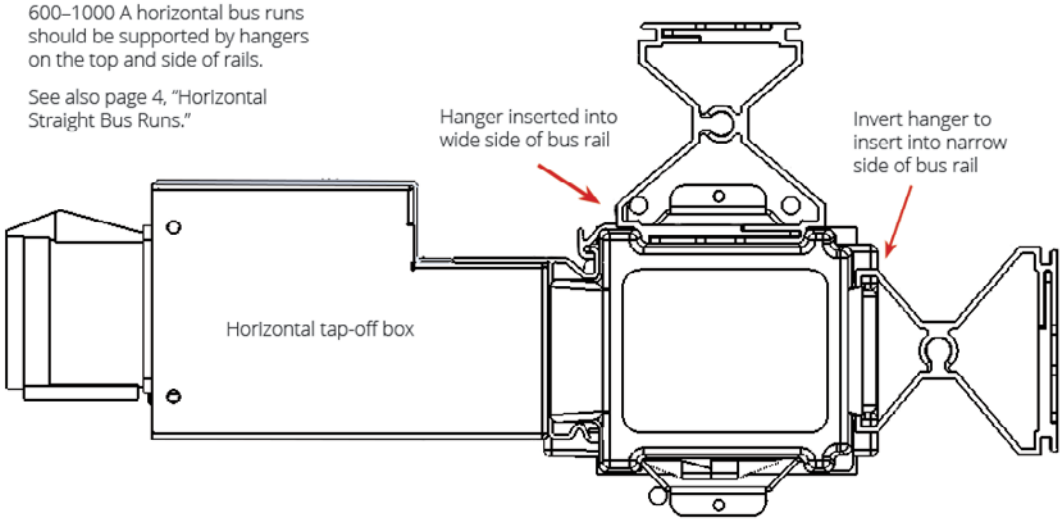
600–1000 A hangers can be inserted into bus rails at any point. Insert the halves into the rail, securing them to the lip of the top (ground) channel and slide them together.

When the halves are joined together; the hanger provides a robust support point for the bus run.



600–1000 A horizontal bus runs should be supported by hangers on the top and side of rails.

See also page 4, "Horizontal Straight Bus Runs."



Horizontal 600–1000 A bus run view from end cap

Figure 24.4-37. 600–1000 A Hanger Part Descriptions

End Caps (250–400 A)

The end of each bus run has exposed high voltage and amperage busbars and must be covered by an end cap. If the bus run is forked by a tee, the bus run will need an extra end cap to cover the exposed leg of the forked bus run.

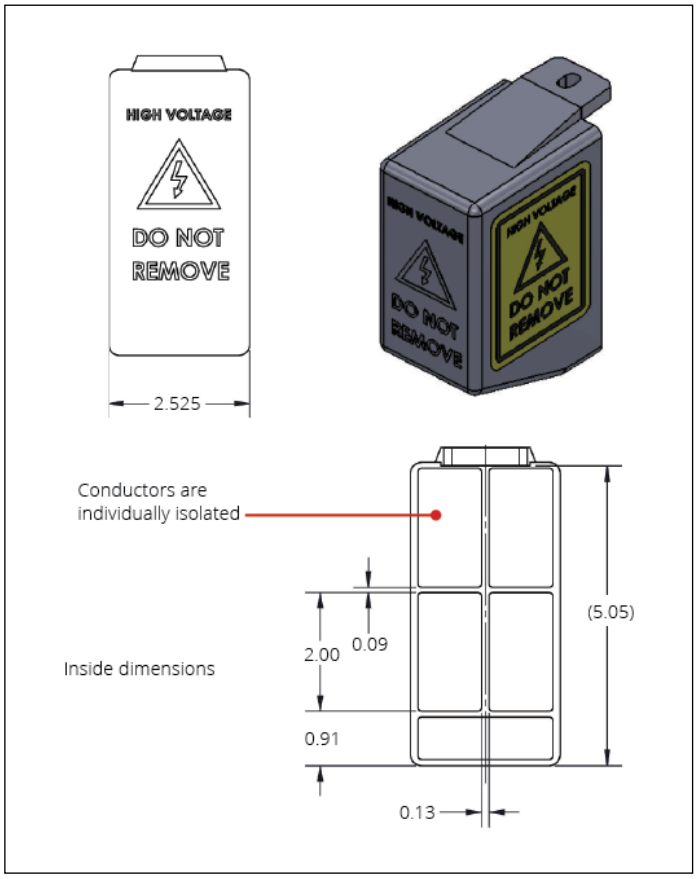


Figure 24.4-38. End Caps (250–400 A)

End Caps (600–1000 A)

The end of each bus run has exposed busbars and must be covered by an end cap. If the bus run is forked by a tee, the exposed end of the extra bus rail leg must also be covered by an end cap.

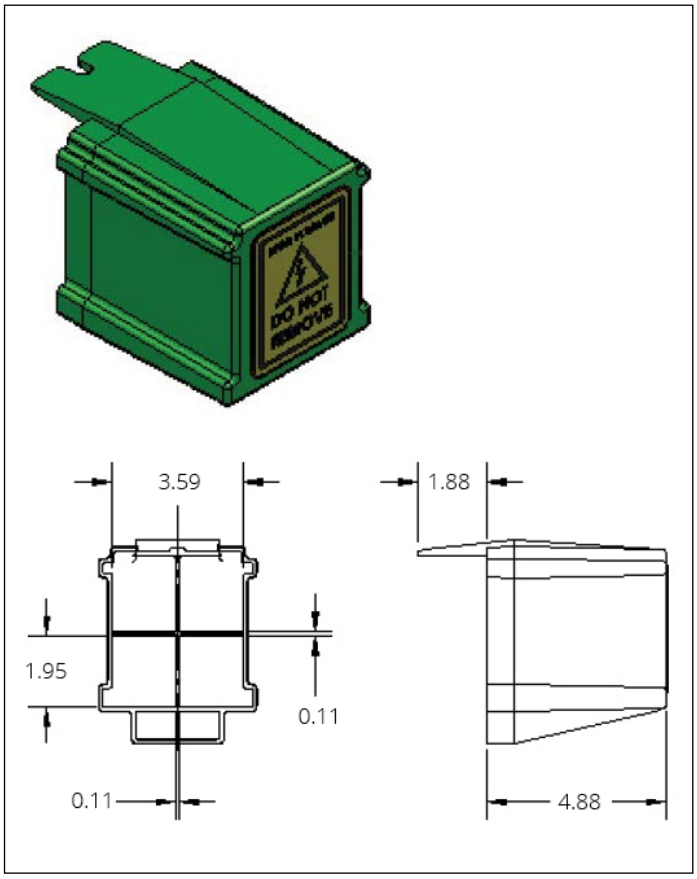


Figure 24.4-39. End Caps (600–1000 A)

Table 24.4-8. Accessory Part Numbers

Accessory	Ampere Rating	Part Number
Coupler	250	HPW2-250-4PG-SP
	400	HPW2-400-4PG-SP
	600	SPW2-600-4PG-SP
	800	HPW2-800-4PG-SP
	1000	HPW2-1000-4PG-SP
End cap	250	HPW2-250-EC
	400	HPW2-400-EC
	600	SPW2-600-EC
	800	HPW2-800-EC
	1000	HPW2-1000-EC
Vertical hanger	250	HPW2-250-VH38
Horizontal hanger	250	HPW2-250-HH38
Vertical hanger	400	HPW2-400-VH38
Horizontal hanger	400	HPW2-400-HH38
Hanger	600	SPW2-800-VH38
	800	HPW2-800-VH38
	1000	HPW2-1000-VH38

Tap-Off Boxes

Tap-off boxes are inserted into bus rails, providing power to server racks.

- PowerWave 2 bus systems are continuous rail applications; tap-off boxes can be inserted nearly anywhere along bus rails
- Each tap-off box along the bus run can have a unique configuration
- Currently offered and legacy tap-off boxes can all be used together in the same PowerWave 2 bus run

Tap-Off Box with Universal U-Channel

The universal u-channel provides a standard physical interface to all bus rails with ampere ratings less than or equal to 1000 A. Tap-off boxes with the universal u-channel are secured to bus rails with retainer clips.

Tap-off boxes are available in a variety of configurations and sizes:

- Up to five circuits:
  - ❑ Up to five circuit breakers and receptacles/connectors
  - ❑ 128 A mast allows up to two 63 A circuits
  - ❑ NEMA® and IEC drop cords
  - ❑ Up to 42 kAIC with fuses
  - ❑ Up to 22 kAIC with breakers
- Fuses up to 60 A
- Dedicaed ground option (requires dedicated ground option in all bus run components)
- Isolated ground option (requires isolated ground option in all bus run components)
- Enclosure widths: 10.25 inches, 12 inches, 14 inches, 17 inches
- Tap-off boxes specialized for horizontal orientation with circuit breakers on the same face with receptacles; this configuration makes it easier for operators to access circuit breakers

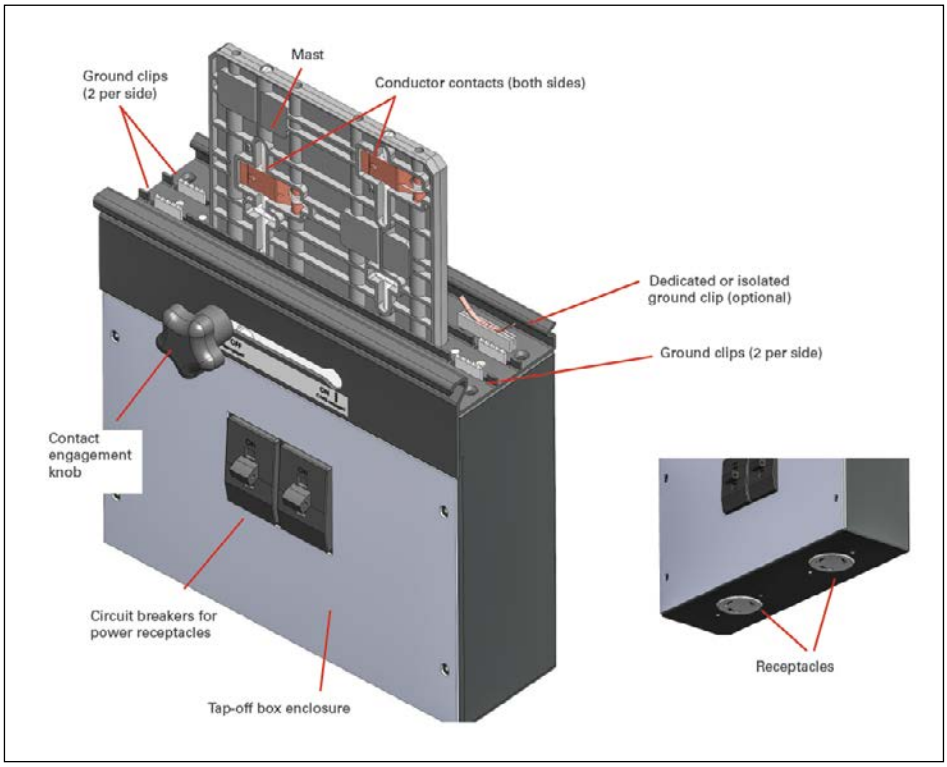


Figure 24.4-40. Universal U-Channel Tap-Off Box Components

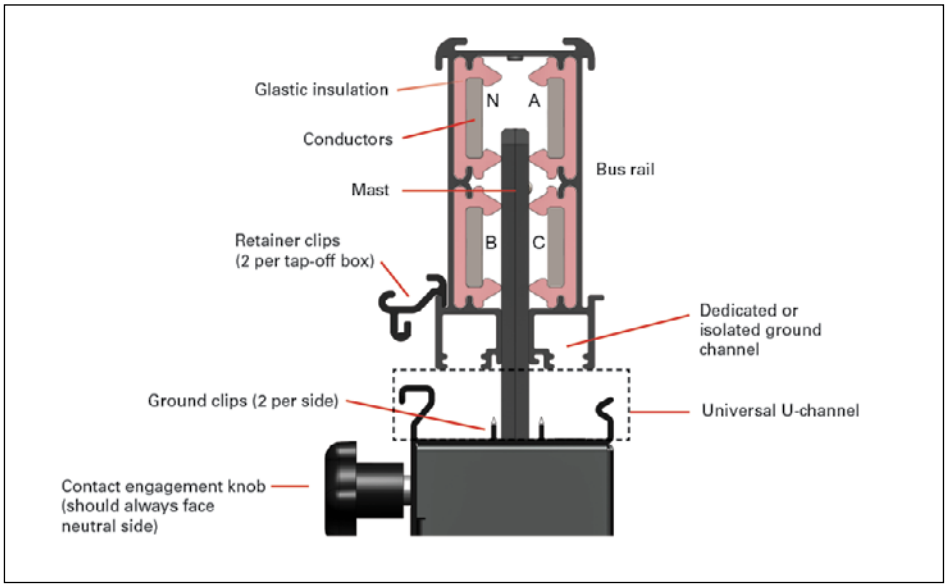


Figure 24.4-41. Universal U-Channel Tap-Off Box Enclosure (Side View)

Note: Bus runs of any amperage can be rotated 90° for horizontal applications.

Tap-off boxes specialized for horizontal orientation have circuit breakers and receptacles on the same face for easier operator access.

Limitations on Number of Tap-Off Boxes per Bus Run

The number of tap-off boxes that can be installed per bus run is limited by the following:

- The total amperage load of the tap-off boxes compared to the ampere rating of the bus run
- The monitoring capacity of the bus run, if tap-off box monitoring is selected
- Space available on the bus rails

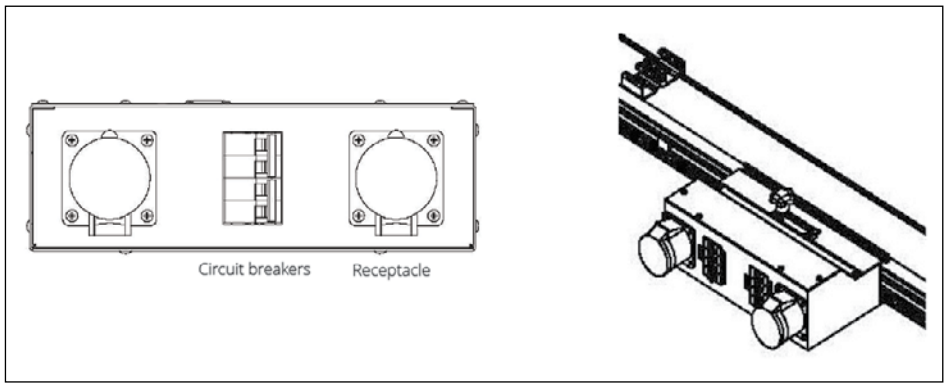


Figure 24.4-42. Tap-Off Boxes Specialized for Horizontal Orientation

Spares Kits

Spares kits are available for PowerWave 2 bus systems. Parts will be selected to match the amperage of your system.

Table 24.4-9. PowerWave 2 Bus System Spare Parts Kits

Spare parts kit components	Quantity
Side plates	6
Ground plates (250–400 A) or ground straps (600–1000 A)	6
Couplers	2
End caps	2
Hangers	6
Hot sticks	2

Glossary

1P	Single-phase
2P	Two-phase
3P	Three-phase
AWG	American wire gauge
Coupler	A component used to join bus rails, elbows, and tees into a bus run.
ETL	Intertek's ETL listed mark, North American certification
IEC	International Electrotechnical Commission
IP2X	Finger-safe International Protection Marking
kAIC	Kilo amperes interrupting capacity
NEC	National Electrical Code (U.S.)
NEMA	National Electrical Manufacturers Association
Power feed	Standard end feed or center feed. Site or customer three-phase, four-wire power, ground, and optional isolated ground connections are made at the power feed to provide power for the bus run.
RMS	Root mean squared
Starter rail	The first bus rail in a bus run. Customer power is connected directly to the starter rail.
Standard rail	All bus rails coming after the starter rail are standard rails.
TOB	Tap-off box
UL	Safety certification company

Bibliography

PowerWave 2 bus system documentation

Most of the following documentation can be downloaded from the PowerWave 2 bus system product page on the Eaton website:

Eaton.com/powerwave2

Specifications

PowerWave 2 bus system guide specifications (.docx and .pdf)

See also: Specifications summary in the PowerWave 2 brochure

See also: Specifications on PowerWave 2 bus system product web page. On the product web page, select *PowerWave 2 busway system guide specifications* to download the document:

https://www.eaton.com/us/en-us/catalog/low-voltage-power-distribution-controls-systems/eaton-pdi-busway.html#tab-1

Revit models

PowerWave 2 Revit family model library (.zip file)

https://www.eaton.com/us/en-us/support/business-resources/consultants-engineers/consultant---engineer-resources-for-medium-voltage-power---eaton/bim-models-and-drawings.html

Installation and operation documentation

PowerWave 2 bus system, 250–1000 A, installation and operation

Videos

The following videos on PowerWave 2 bus systems are available from your regional sales manager:

PowerWave 2 bus system introductory video

PowerWave 2 coupler (250–400 A) assembly video

PowerWave 2 load bank (250–400 A) installation video

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