Basics of Busway

A quickSTEP Online Course

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Course Topics

Welcome to Busway. This course covers the following topics:

Chapter 1 - Introduction
- Overview
- Circuit Protection

Chapter 2 – Sentron Busway
- Overview
- Components
- Bus Plugs

Chapter 3 – System Design
- Planning a System

Chapter 4 – XJ-L HD, XL-U, and BD Busway
- XJ-L HD Busway
- XL-U Busway
- BD Busway

Final Exam

If you do not have an understanding of basic electrical concepts, you should complete Basics of Electricity before attempting this course.

Course Objectives

- Upon completion of this course you will be able to…
- Describe the role of busway in an electrical distribution system.
- Define common terms used to describe busway systems.
- Describe the cost-saving benefits of using busway rather than cable and conduit.
- Describe key features and advantages of Siemens Sentron busway.
- Describe the functions of various busway components.
- Describe the steps involved in planning a busway layout.
- Describe the key features of Siemens XJ-L HD, XL-U, and BD busway.

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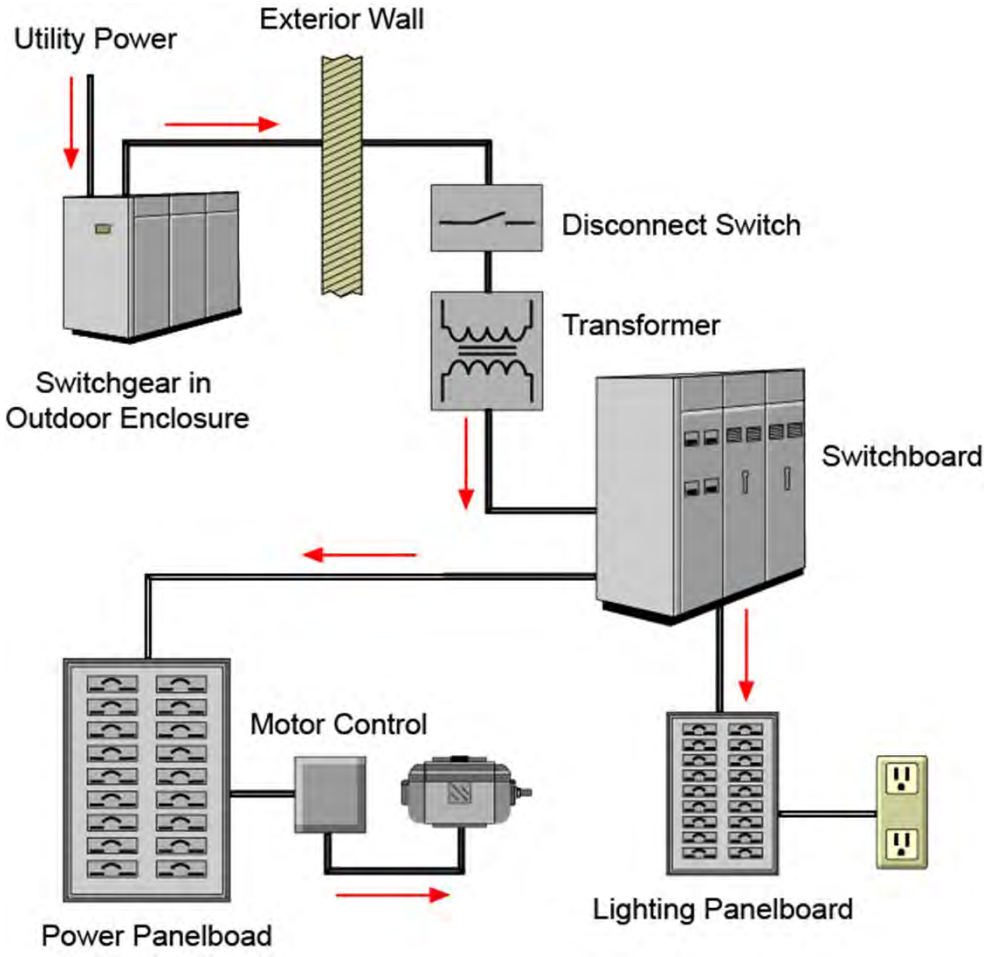
Power Distribution Systems

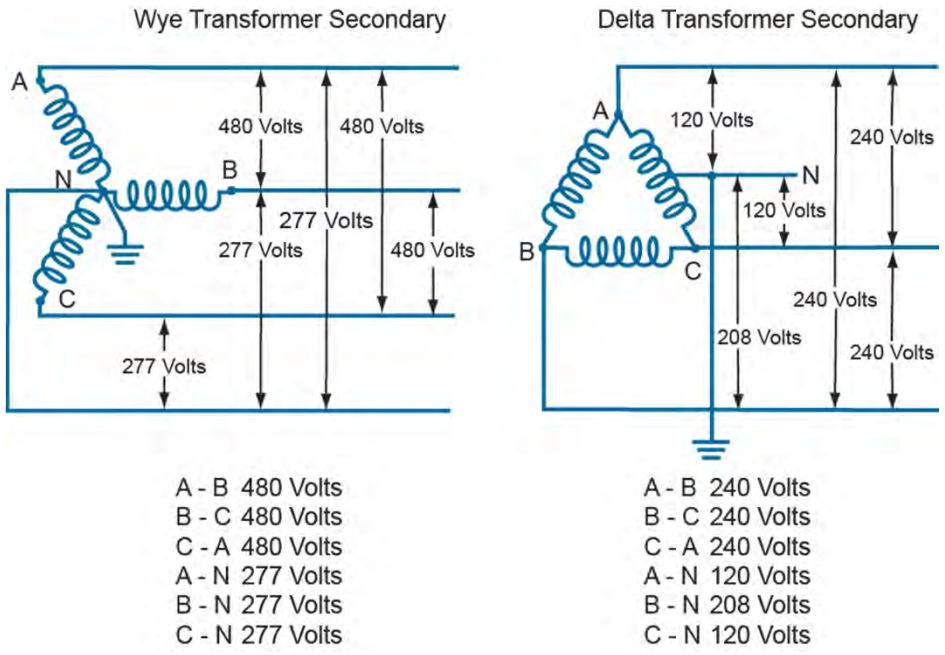


Every residential, commercial, and industrial building has at least one power distribution system that distributes power. Distribution systems used in commercial and industrial locations are complex. As shown in the accompanying graphic, a commercial or industrial power distribution system can include switchgear, switchboards, transformers, and panelboards.

In many cases, especially in smaller facilities, power is distributed to these various components using only cables contained in conduit and/or cable trays. Busway is an alternative approach for distributing power and is the focus of this course.

Good distribution systems don't just happen. Careful engineering is required to ensure the distribution system safely and efficiently supplies adequate electric service to both present and possible future loads.

Commercial and Industrial Power Systems



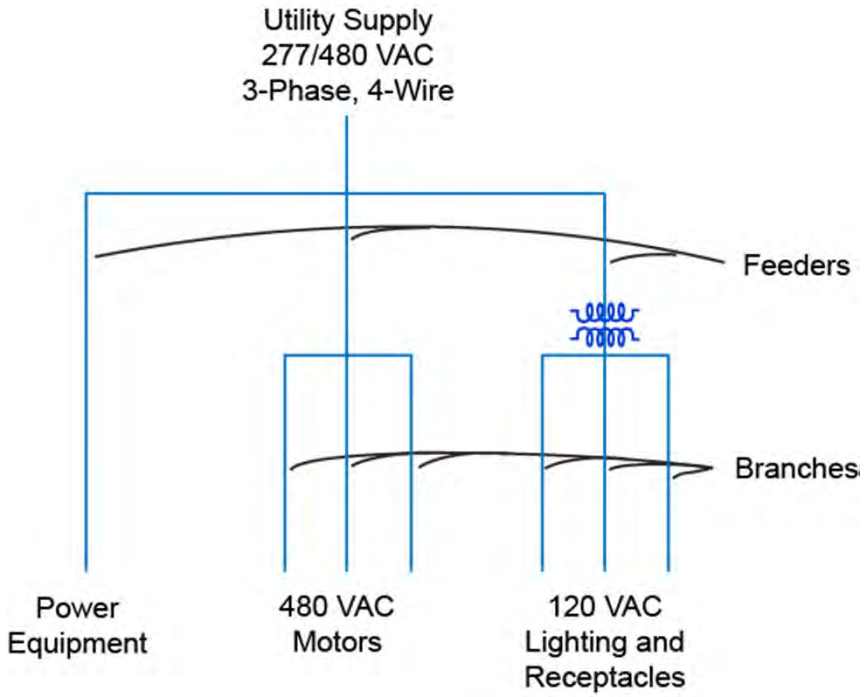
Unlike single-family residential applications, which in most cases use only single phase power, commercial and industrial applications primarily use three-phase power.

Transformers used with three-phase power require three interconnected coils in both the primary and the secondary. These transformers can be connected in either a wye or a delta configuration. The type of transformer and the voltage depend on the requirements of the power company and the needs of the customer.

The accompanying illustration shows the secondary windings of a wye-connected transformer and the secondary windings of a delta-connected transformer. For simplicity, the primary windings are not shown.

These are only examples of possible distribution configurations, the specific voltages and configurations vary widely depending upon the application requirements.

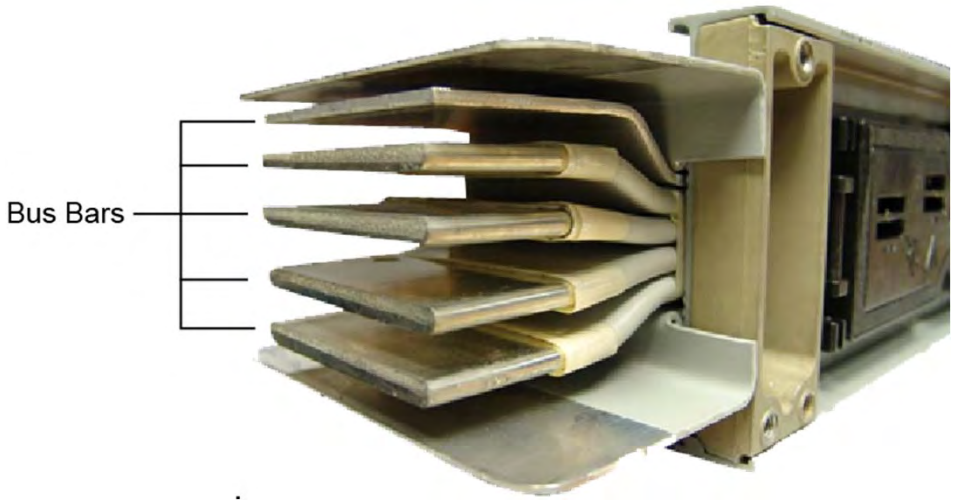
Feeders



A feeder is a set of conductors that originate at a main distribution center and supply one or more secondary or one or more branch circuit distribution centers.

Three feeders are shown in the accompanying graphic. The first feeder is used for various types of power equipment. The second feeder supplies a group of 480 VAC motors. The third feeder is used for 120VAC lighting and receptacles.

Busway Bus Bars

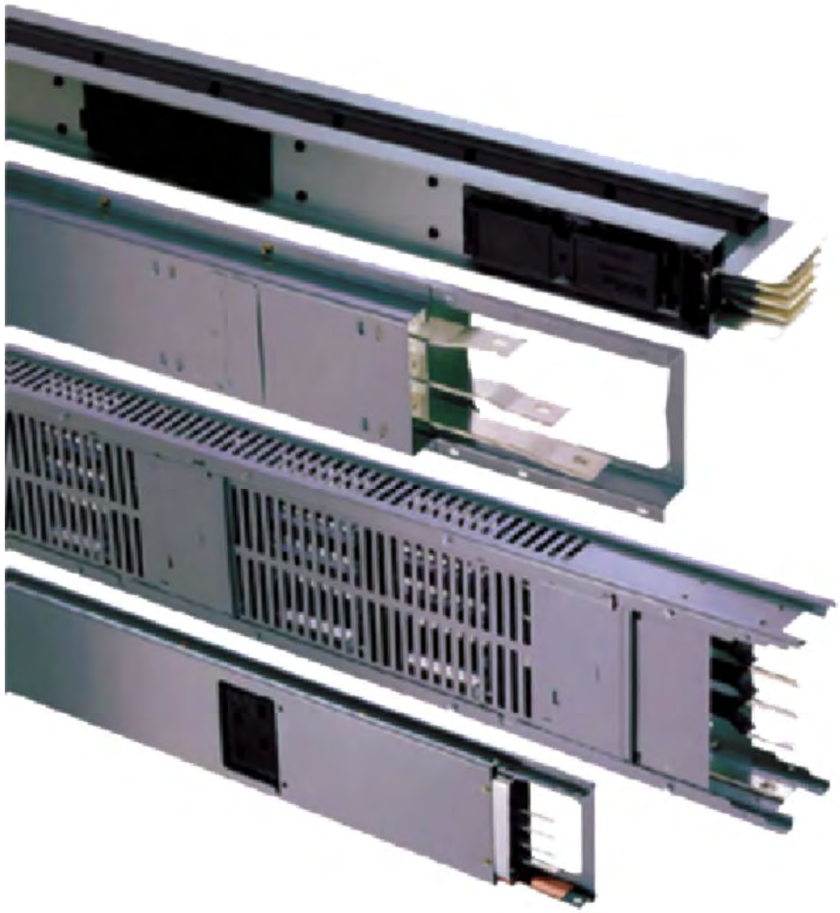


Commercial and industrial distribution systems use several methods to transport electrical energy. These methods may include heavy conductors run in trays or conduit.

Cable and conduit assemblies are costly and time consuming to install. Once installed, they are difficult to change. To eliminate these shortcomings, power is often distributed using bus bars in an enclosure. This is referred to as busway.

A bus bar is a conductor that serves as a common connection for two or more circuits. Bus bars are used in a variety of power distribution components, including busway. Bus bars in Siemens busway are made of aluminum or copper.

NEMA Definition



Siemens Busway

Busway is defined by the National Electrical Manufacturers Association (NEMA) as:

…a prefabricated electrical distribution system consisting of bus bars in a protective enclosure, including straight lengths, fittings, devices, and accessories.

Siemens offers busway systems with the capabilities and options needed for a wide range of applications.

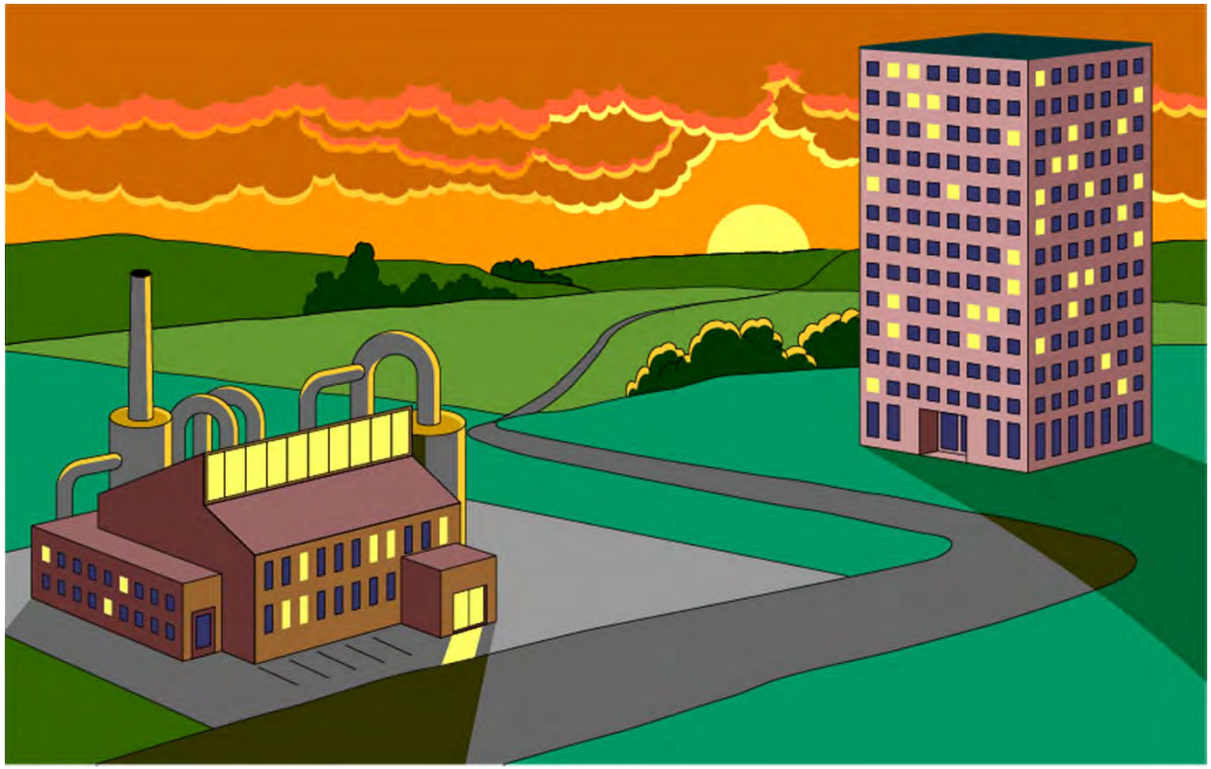
Busway Advantage

Sentron Busway Assembly

A major advantage of busway is the ease with which busway sections are connected. Electrical power can be supplied to any area of a building by connecting quickly connecting busway sections.

Because busway takes many fewer labor hours to install than comparable cable and conduit assemblies, busway costs between 15% to 40% less to install, depending upon amperage.

Busway Applications



Busway is used in a wide variety of applications, including complex industrial plants, data centers, offices, continuous process/ manufacturing facilities, high-rise buildings and many more. There are two major types of busway installations: horizontal and vertical.

Horizontal busway is often used in industrial and data center applications to supply power to heavy equipment, lighting, and HVAC systems.

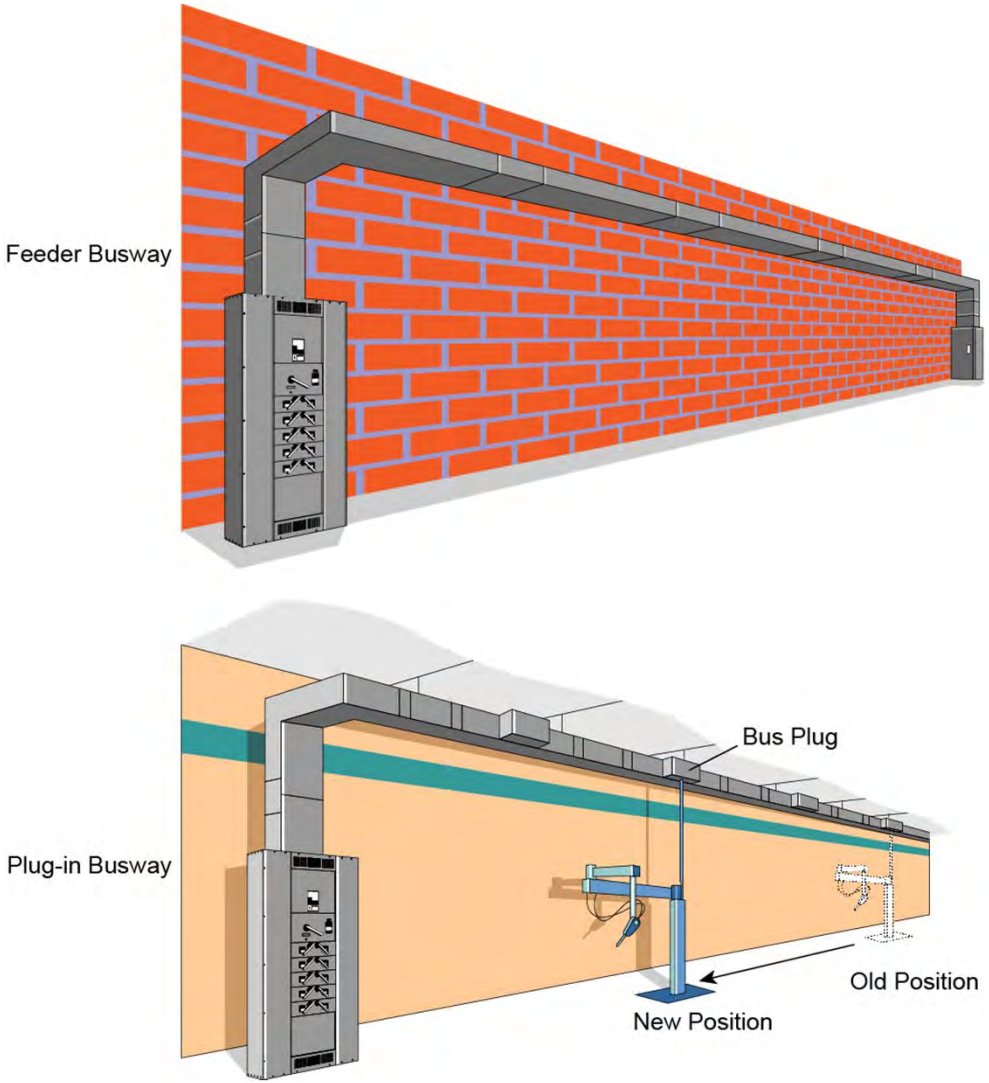
Vertical busway, busway risers, can be installed economically in high-rise buildings where it is used to distribute power to lighting, building systems, office equipment, and HVAC loads.

Siemens Busway Product Portfolio

Busway System	Sentron	XJ-L	XL-U	BD
Image				
Amperage Range	225-5000A	100-400A	224-6500A	224-1600A
Applications	Commercial Industrial Institutional	Commercial Light Industrial	Industrial Welding	Industrial
Environment	Indoor/Outdoor	Indoor	Indoor/Outdoor	Indoor
Configurations	3Ø,3W 3Ø,4W,100% Neutral 3Ø,4W,200% Neutral	3Ø,3W 3Ø,4W,100% Neutral 3Ø,4W,200% Neutral	3Ø,3W 3Ø,4W,100% Neutral	3Ø,3W 3Ø,4W,100% Neutral
Plug-ins per 10 ft.	10	12	10	10

Siemens manufactures Sentron busway and the other types of busway shown above. Throughout this course, Siemens Sentron busway examples are used to explain and illustrate busway principles and features. An overview of XJ-L HD, XL-U, and BD busway is provided later in this course.

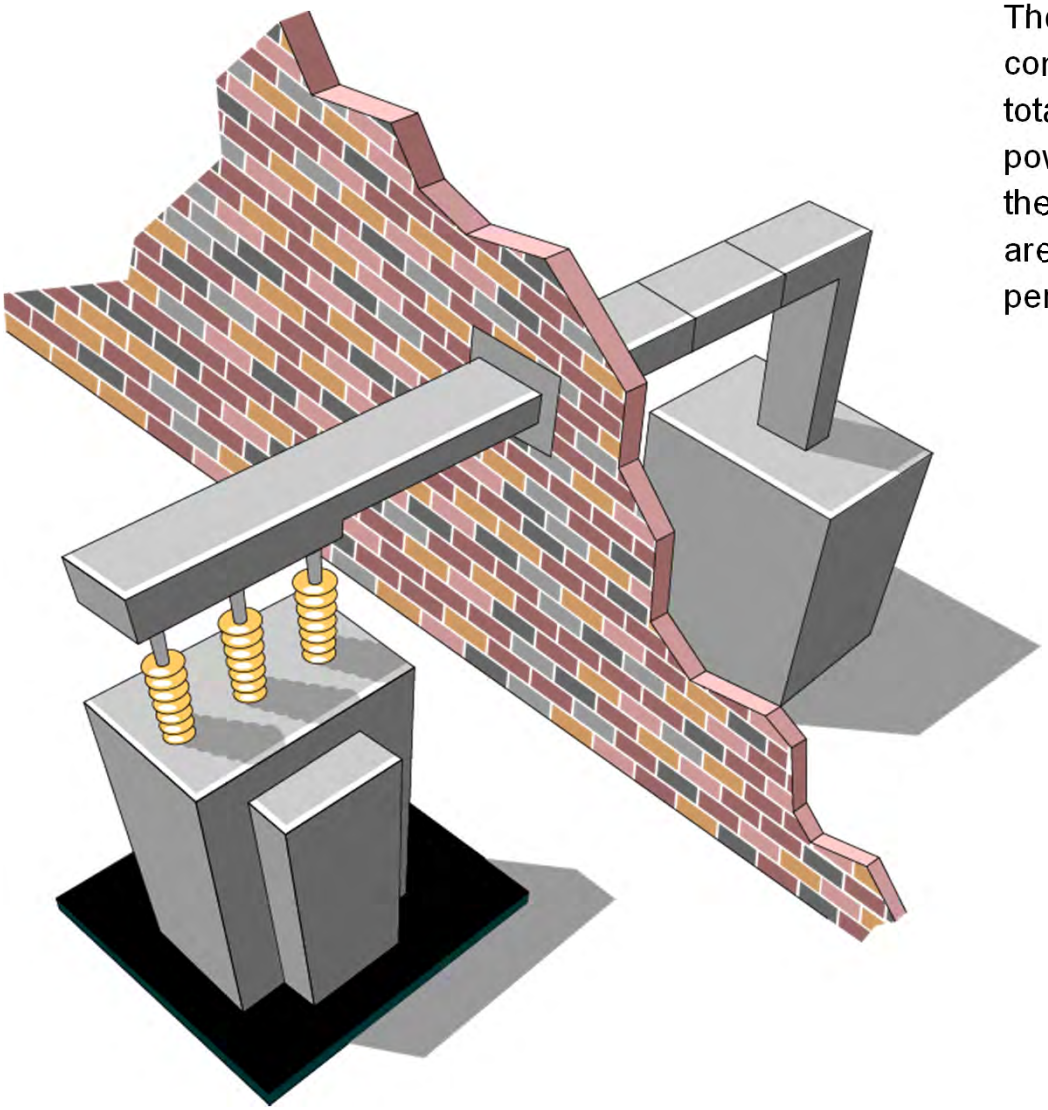
Feeder and Plug-in Busway



There are two general types of busway: feeder and plug-in. Feeder busway is used to distribute power to loads that are concentrated in one physical area. Industrial applications frequently involve long runs from the power source to a single load. This load may be a large machine, motor control center, panelboard, or switchboard.

Plug-in busway is used when power requirements are distributed over a large area. The use of bus plugs allows load connections to be easily added or relocated.

Service Entrance



The service entrance is the point of entry for power conductors to a building. Feeder busway, which can be totally enclosed for outdoor use, can be used to distribute power from a utility transformer to a main disconnect inside the building. Be careful to ensure that minimum clearances are observed between busway joints and the wall penetration.

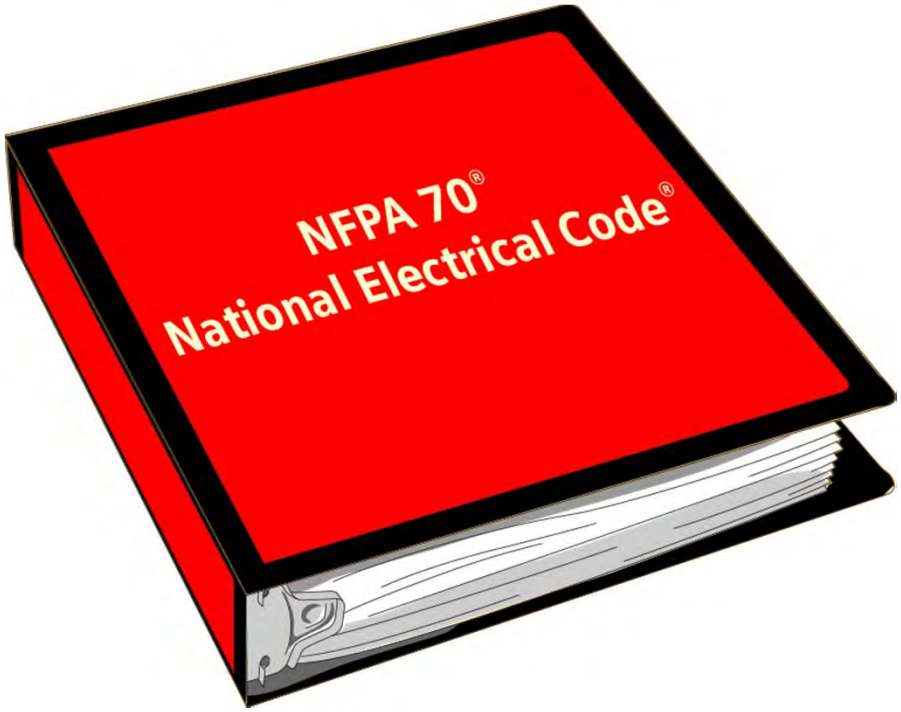
Standards

- UL 857
- NEMA BU1
- CSA C22.2
- IEC 60429 (2004)
- BS EN 60529
- BS EN 60439-1, 60439-2
- UL 1479
- DIN 4102 Parts 9 & 12
- BS 6387 Parts 11.1 and 11.2

Multiple standards define busway design, construction, installation, and performance. For example, Sentron busway meets the standards shown in the accompanying list.

- BS standards are issued by British Standards Institution (BSI).
- CSA standards are issued by the CSA Group (formerly the Canadian Standards Association; CSA).
- DIN standards are issued by Deutsches Institut für Normung e.V. (German Institute for Standardization).
- IEC standards are issued by the International Electrotechnical Commission.
- NEMA standards are issued by the National Electrical Manufacturers Association.
- UL standards are issued by UL, LLC. (formerly Underwriters Laboratories).

National Electrical Code®



The National Electrical Code® (NEC®), also known as NFPA 70®, is issued by the National Fire Protection Association (NFPA). An updated version of the NEC is issued every three years. Article 368 of the *NEC*® specifically applies to busway. Other articles also have applicable information.

State and local electrical codes are often based on a version of the NEC, but can also provide additional requirements.

In addition, busway used at a service entrance may be connected to a distribution transformer owned by an electric power company, which may also have its own requirements.

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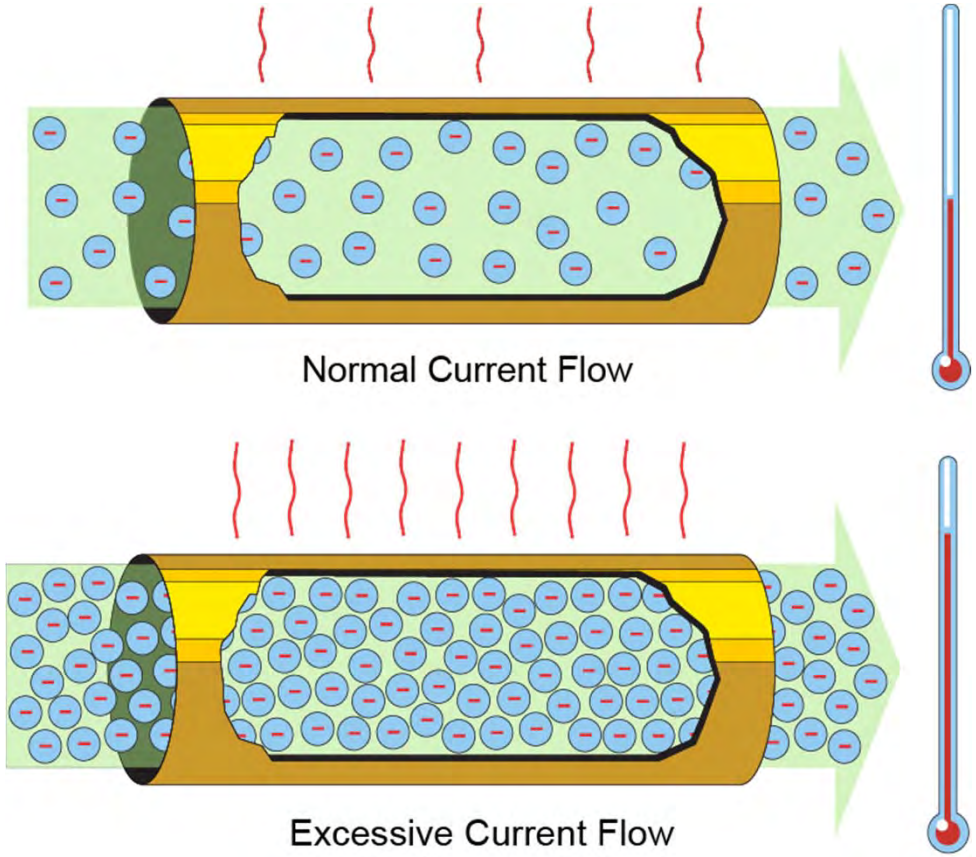
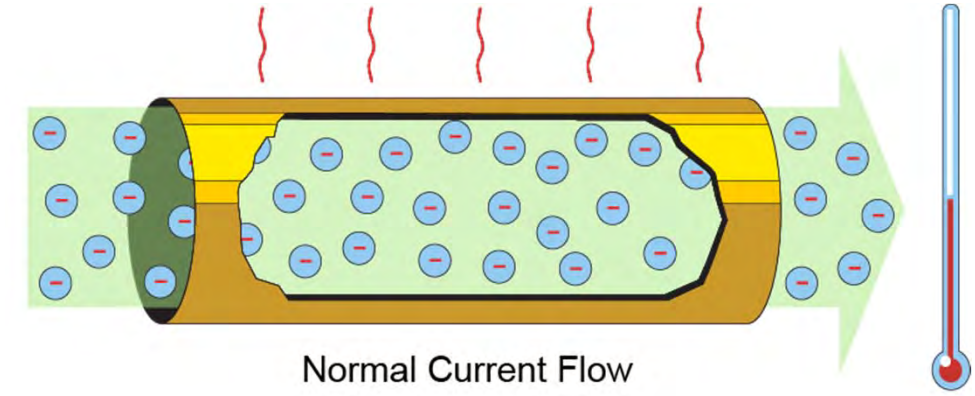
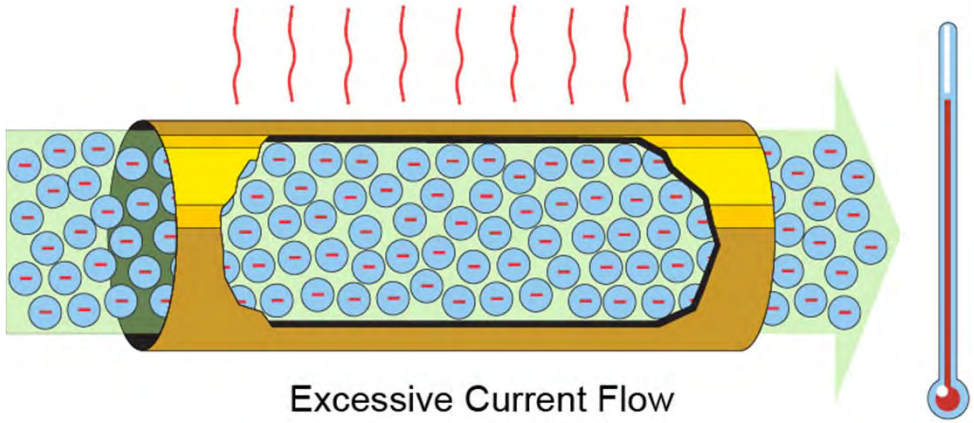


This chapter covers the following topics:

- **Overview**
- Circuit Protection

Overcurrent



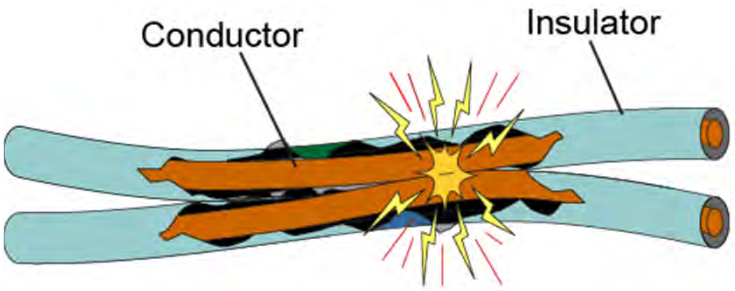


Current flow in a conductor always generates heat. The greater the current flow, the hotter the conductor. Excess heat is damaging to electrical conductors. For that reason, conductors have a rated continuous current carrying capacity or ampacity. Current beyond the rated ampacity of a conductor is referred to as overcurrent. Overcurrent can result from a short circuit, an overload, or a ground fault. The first two types of overcurrent conditions are described in the following paragraphs.

A short circuit occurs when two bare conductors touch causing the resistance between the conductors to drop significantly. This reduction in resistance causes an immediate and destructive increase in current.

An overload is a typically a much lower current than a short circuit. An overload occurs when too many devices or the wrong type of devices are connected to a circuit or when electrical equipment is made to work beyond its rated capabilities.

Short Circuits



$$I = \frac{E}{R}$$

I represents current (in amps)
E represents voltage (in volts)
R represents resistance (in ohms)

$$I = \frac{240\ \text{Volts}}{24\ \text{Ohms}} = 10\ \text{Amps}$$

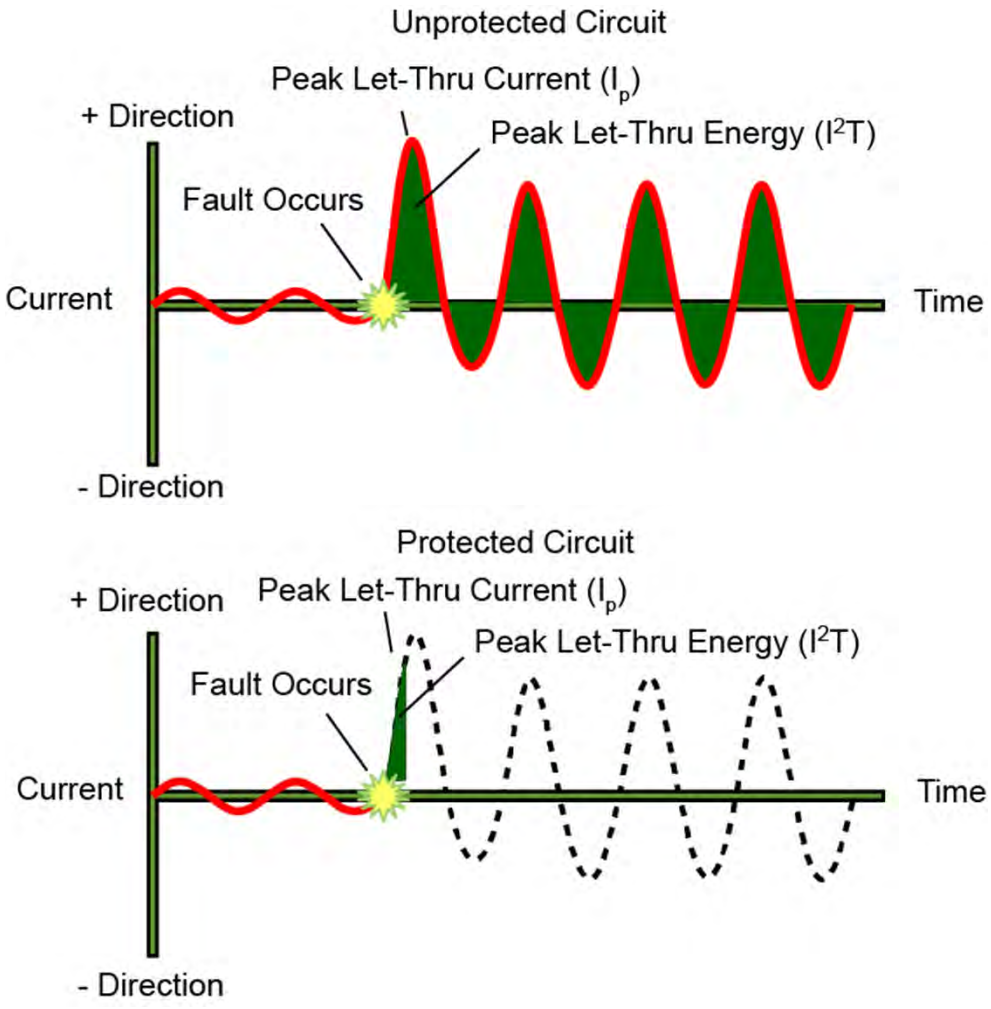
$$I = \frac{240\ \text{Volts}}{0.024\ \text{Ohms}} = 10{,}000\ \text{Amps}$$

When exposed conductors touch, a short circuit occurs, and the circuit resistance drops to nearly zero. Because of this very low resistance, short circuit current can be thousands of times higher than normal operating current.

Ohm's Law shows the relationship of current, voltage, and resistance. For example, a 240 volt motor with 24 ohms of resistance would normally draw 10 amperes of current.

When a short circuit occurs, resistance drops dramatically. For example, if the above resistance dropped to 24 milliohms (0.024 ohms) due to a short circuit, the current would increase to 10,000 amps.

Instantaneous Overcurrent Protection



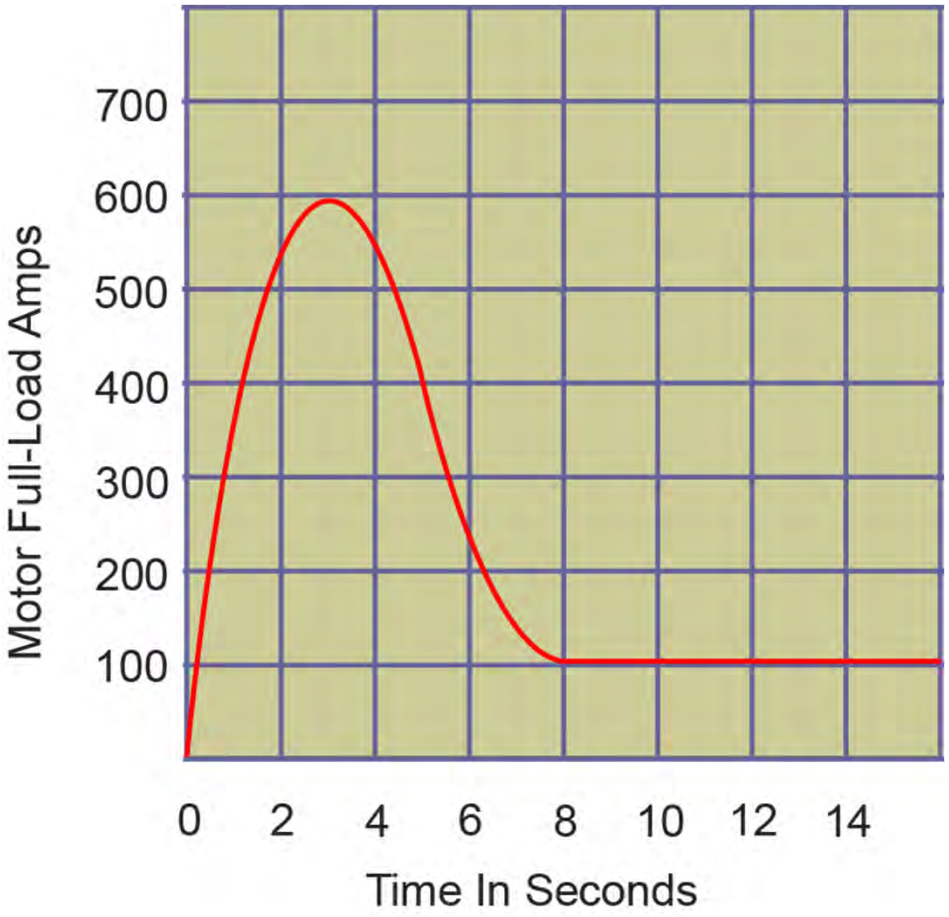
When a short circuit occurs in an unprotected circuit, current continues to flow until the circuit is damaged or the power is removed manually.

The peak short-circuit current of the first cycle is the greatest and is referred to as peak let-through current (I_P). The electromagnetic force associated with this current can cause mechanical damage to electrical components.

The peak let-through energy (I^2T) associated with this current can produce enough heat to melt conductors.

A properly applied overcurrent protection device instantaneously opens the circuit, limiting peak let-thru current and peak let-thru energy.

Overloads

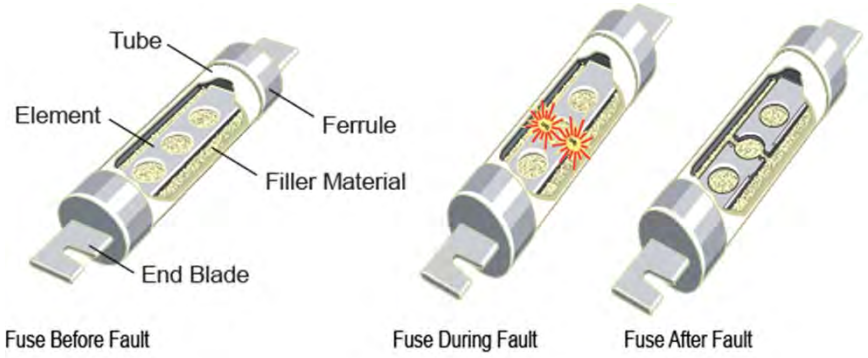


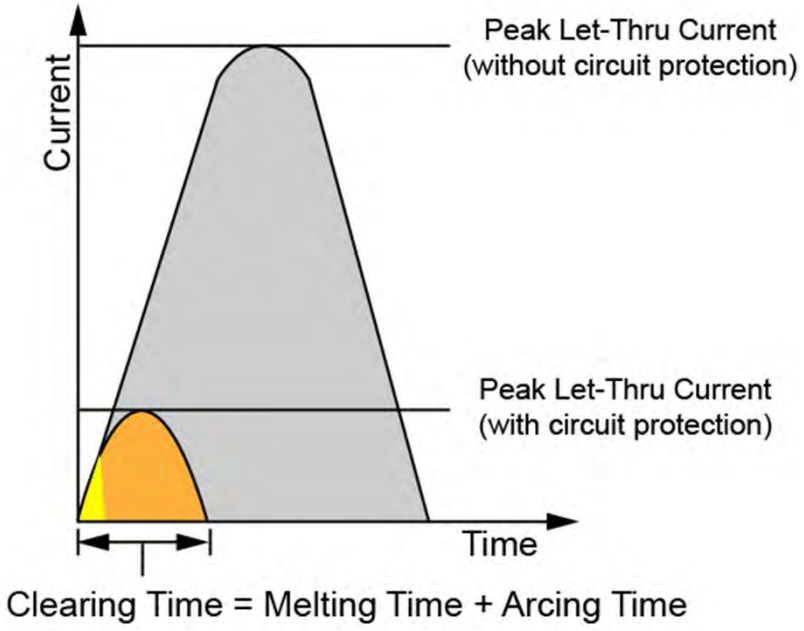
In general, the greater the amount of overcurrent, the more quickly a circuit must be disconnected from its power source. Therefore, instantaneous overcurrent protection is essential when a short circuit occurs. Overloads, however, require a delayed response. To understand this better, consider the operation of a typical AC induction motor.

When most motors start, they draw current in excess of their full-load current rating. For example, a NEMA design B motor typically has a starting current of about six times its full-load current. For some high-efficiency motors, the starting current is even higher. Motors are designed to tolerate a high starting current for a short time. As a motor accelerates to operating speed, its current drops off quickly.

In the accompanying example, the motor's starting current rises to 600% of full load current, but after eight seconds, current has dropped to the rated value. Depending on the size of the motor, the time required for the current to drop to the full load level or below may be shorter or longer. Whatever this time is, the motor's power circuit must be designed to handle this short-duration overload.

Fuses





Most fuses are one-shot devices. When a fault occurs, the fuse element melts and opens the path for current, interrupting the fault. The time it takes for a fuse to interrupt the fault is called the clearing time, which includes the time it takes for the fuse element to melt plus the time it takes to extinguish the arc of current across the melting element.

The clearing time for a fuse is inversely related to the level of fault current over a fuse's designed range. This means that the fuse clearing time is less for a higher level of fault current than for a lower level of fault current.

Many fuses used in power distribution systems are current limiting. There are various factors required to classify a circuit protection device as current limiting, but essentially it means that, as shown in the accompanying graphic, a current limiting fuse significantly reduces the peak let-thru current when a fault occurs. The intent is prevent damage to conductors and protected equipment by reducing the electrical energy applied to the conductors and load.

Fuse Types

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- Fast-Acting Fuse
- Time-Delay Fuse
- Dual Element Fuse

There are various types of fuses used in power distribution systems. Three common types are shown in the accompanying list.

Fast-acting fuses open quickly when an overcurrent occurs. For this reason, they are used to provide short circuit protection for non-inductive loads. As such, they are not suitable for use with motors and other inductive loads.

Time-delay fuses provide a delayed response to allow temporary overloads to clear. Because the amount of delay required varies with the load characteristics, fuses are available to fit the full range of load requirements. Time-delay fuses provide both short circuit and overload protection and are used in a wide range of applications.

Dual-element fuses may have time-delay designation because these fuses have two fuse elements. One element provides overload protection with a time delay. (UL states that time delay means having a 10-second operating delay at 500% of the fuse label rating.) The second element provides short circuit protection similar to a single-element fuse. Dual-element fuses are most frequently used on motor loads.

Circuit Protection Device Ratings

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- Voltage Rating
- Ampere Rating
- Interrupting Rating

Because application requirement vary, circuit protection devices (fuses and circuit breakers) are available with a wide range of characteristics. In addition to size, mechanical design, and element type, the ratings shown in the accompanying list must be considered when choosing a circuit protection device for an application.

The voltage rating of a device must be at least equal to the circuit voltage. The voltage rating of a device can be higher than the circuit voltage, but never lower. A 600 volt device, for example, could be used in a 480 volt circuit, but a 240 volt fuse should not be used in a 480 volt circuit.

The ampere rating, also called the continuous current rating, of a circuit protection device is its continuous current-carrying capacity. The ampere rating of device must match the requirements of the load and associated conductors.

The interrupting rating of a circuit protection device is the maximum current that the device can safely interrupt. The interrupting rating required must be at least equal to the level of fault current available for the circuit.

Low Voltage Fuse Classes

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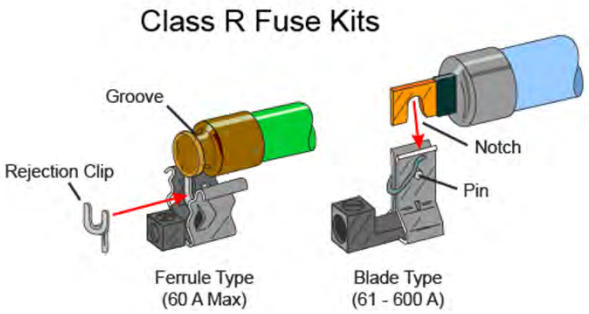
UL Fuse Class	Voltage Ratings	Ampere Ratings	Interrupting Ratings
H	250 & 600 VAC	up to 600 A	10 kA
J	600 VAC	up to 600 A	200 kA
K	250 & 600 VAC	up to 600 A	50 kA, 100 kA, 200 kA
L	600 VAC	601 to 6000 A	200 kA
	600 VDC	601 to 6000 A	50 kA, 100 kA, 200 kA
R	250 & 600 VAC	up to 600 A	200 kA
	125 & 250 VDC	up to 600 A	200 kA
T	300 & 600 VAC	up to 1200 A	200 kA
	125 & 300 VDC	up to 1200 A	200 kA



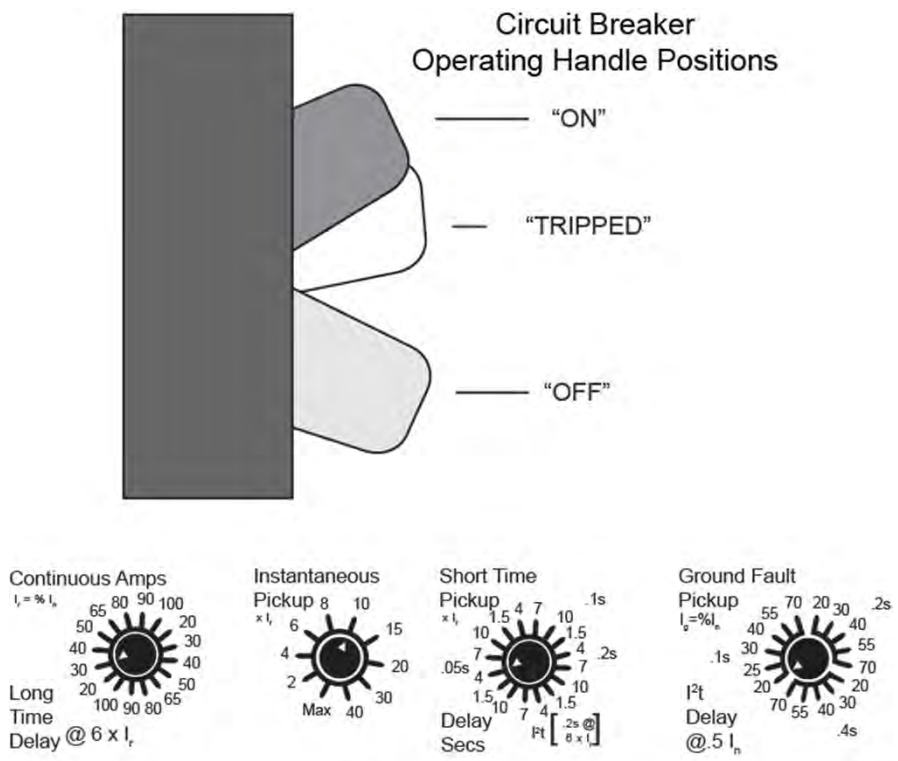
UL, LLC. (formerly Underwriters Laboratories) establishes and standardizes basic performance and physical specifications for products that undergo its safety test procedures. Among the standards developed by UL are standards for classes of low voltage fuses (fuses with voltage ratings of 600 volts or less).

Fuses are grouped into classes based on their operating and construction characteristics and ratings. When selecting fuses, it is a good idea to refer to the fuse manufacturer's application data to make sure that a specific fuse is appropriate for the fault characteristics and types of loads involved.

The accompanying graphic shows the most commonly used low voltage fuse classes with Siemens busway.

The accompanying graphic also shows fuse kits required for class R fuses. A class R fuse kit prevents the use of lower rated H and K fuses.

Circuit Breakers



Adjustments Found on Some Circuit Breakers

Another device used for overcurrent protection is a circuit breaker. Although some circuit breakers do incorporate fuses, most do not, but, like a fusible switch, a circuit breaker provides overcurrent protection and a manual means of controlling power distribution.

When an overcurrent occurs, the circuit breaker trips to remove power from the circuit. The greater the overcurrent, the more rapidly the circuit breaker trips. Once the overcurrent condition has been corrected, a simple flip of the breaker's operating handle restores the circuit.

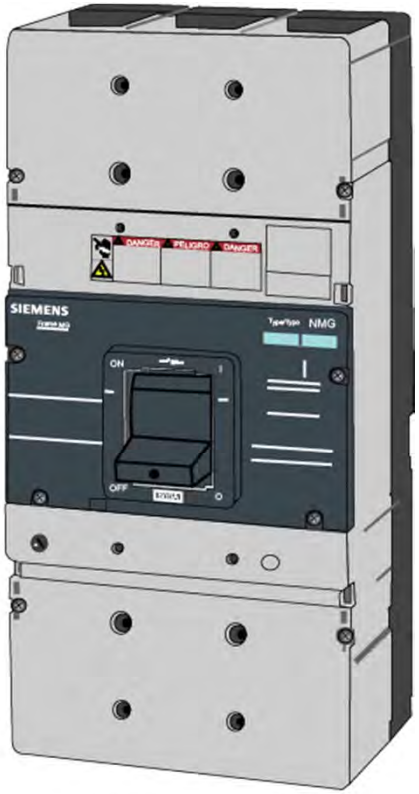
The ability to restore a circuit without replacing a fuse is one of the key advantages of a circuit breaker. However, circuit breakers have other advantages as well.

For example, some circuit breakers have adjustments or a replaceable trip unit to allow the level of fault current required to trip the breaker to be set to match the application.

Some circuit breakers also have communication capability to allow information to be sent to power monitoring equipment or display devices.

Circuit Breaker Frame Size

150 Amp Frame
Circuit Breaker



800 Amp Frame
Circuit Breaker

The circuit breaker frame includes all the various components that make up a circuit breaker except for the trip unit.

For any given frame, circuit breakers with a range of current ratings can be manufactured by installing a different trip unit for each rating.

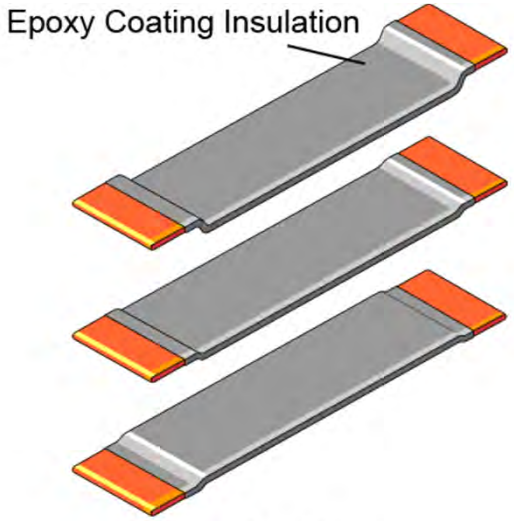
The breaker frame size is the highest continuous current rating for a breaker with a given frame.

Chapter 2 – Sentron Busway

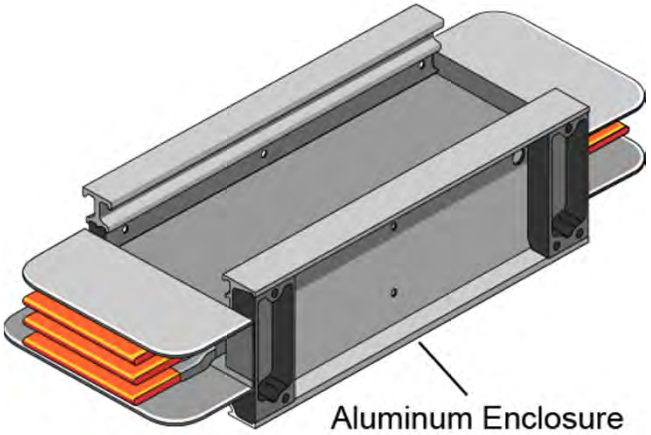
This chapter covers the following topics:

- **Overview**
- Components
- Bus Plugs

Conductors and Housing



Copper Bus Bars



The following Sentron busway bus bar (conductor) types are available:

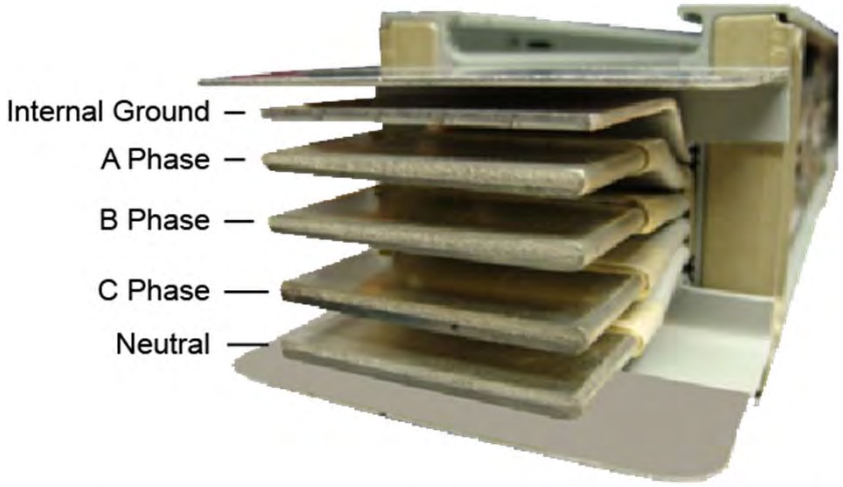
- 98% conductivity copper
- M-rated, 1000 A/in^2 copper
- 58% conductivity aluminum
- L-rated, 750 A/in^2 aluminum

Standard conductors are electroplated with tin. Silver finished conductors are optional. The conductors are insulated with a state-of-the-art epoxy insulation system applied using an electrostatic spray process for optimal insulation integrity. Sentron Busway insulation is Class B 130°C Rated. Every conductor and completed assembly is dielectric tested to ensure the insulation is free of defects.

Sentron busway conductors are installed in a light-weight, all aluminum housing. The totally enclosed, non-ventilated housing resists rust and other elements, distributes heat away from the conductors, and provides an excellent ground path. The totally enclosed design also eliminates the need for derating of the system regardless of installation orientation.

The housing is covered with an electrostatically-applied light gray ANSI 61 polyester urethane powder paint that is scratch resistant and has a 1,000-hour salt spray resistance rating.

Conductor Configurations



3-phase, 4 conductor, 100% Neutral Configuration

Sentron busway is available for the following power configurations:

- 3-phase, 3-wire
- 3-phase, 4-wire, 100% neutral
- 3-phase, 4-wire with 200% neutral

Sentron busway with aluminum conductors is available with ampere ratings up to 4000 amps. Sentron busway with copper conductors is available with ampere ratings up to 5000 amps.

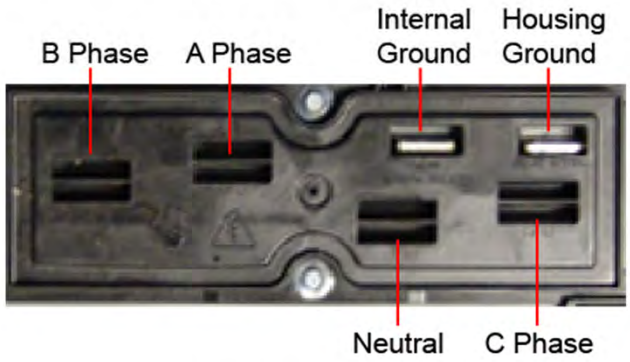
The accompanying graphic shows the standard NEMA phase arrangement for a 3-phase, 5-wire, 200% neutral configuration with an internal ground.

The optional 200% neutral is designed to handle additional harmonics currents generated by some types of lighting and electronic equipment.

The NEC® requires the metal enclosure of a busway run to be grounded at the service entrance equipment. Sentron busway includes a standard integral aluminum housing ground (at least 50% of phase current carrying capacity) and can include optional internal grounding bars (at least 100% of phase current carrying capacity). An optional isolated ground is also available.

Busway Sections

Sentron Plug-in Busway Section



Plug-in Base Connections

Sentron feeder busway sections are available in custom lengths from 2 to 10 feet.

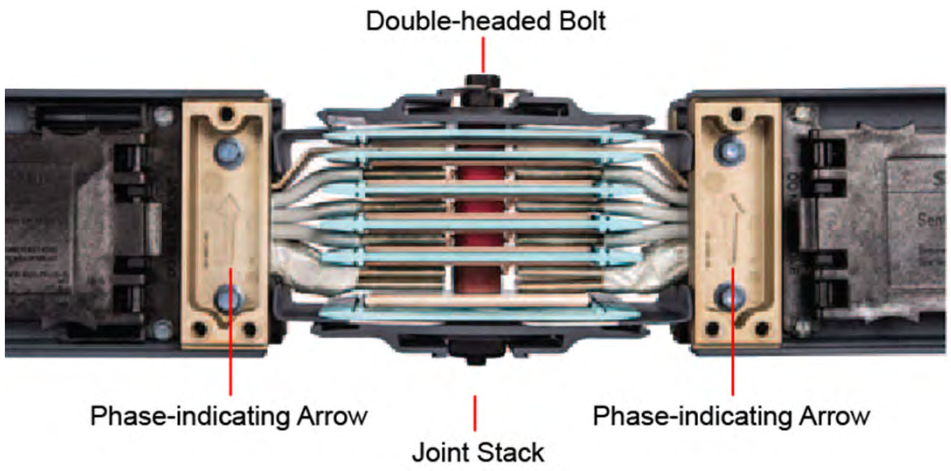
Sentron plug-in busway with plugs on both sides and riser busway with plugs on one side (sometimes referred to as one sided plug-in) are available in the following lengths: 4, 6, 8, and 10 feet. Note that riser bus may be used in horizontal applications if plug-ins are only required on one side of the busway.

Plug-in outlets are located on 2 feet centers on both sides of the busway for plug-in busway and on one side for riser busway. The plug-in outlet features a molded guard which prevents incidental finger contact with live conductors. This meets IEC, IP 2X requirements for preventing a 0.472” probe from entering. This is referred to as “finger safe”.

Outdoor feeder busway is available with a NEMA 3R enclosure for NEMA markets or an IP66 ingress protection rating for IEC markets.

Indoor feeder and plug-in busway are available with an IP40 or IP55 (splash proof) rating.

Joint Stack



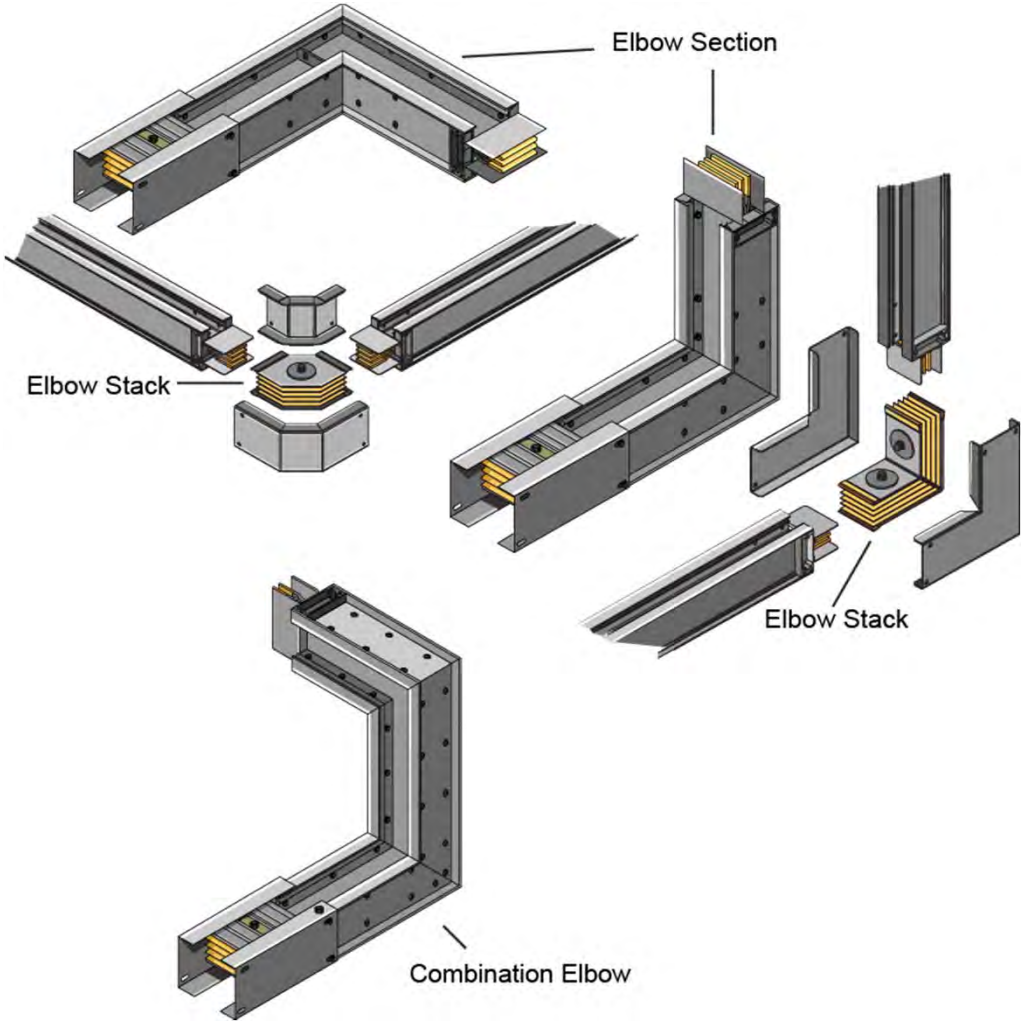
Each Sentron busway piece is shipped with a joint stack and joint covers installed at one end of the busway and a shipping end protector at the other end. Joint stacks feature a single bolt design and a special, torque indicating, double-headed, break-off bolt. This eliminates the need for torque wrenches and assures proper torque at installation of 50 ft.-lbs.(68 N-m).

When the proper torque value is achieved, the top bolt head shears off. Each joint stack allows for +/- 0.625 inches adjustability at each joint. Over adjustment is prevented by the joint covers, which will only allow a 0.625 inch adjustment when the knockouts on the joint cover are removed.

A joint connection assembly can be removed to allow electrical isolation or removal of a busway length without disturbing adjacent busway lengths. Isolation joint stacks are available and used to electrically isolate a busway section within a busway run. For easy visual identification, isolation joint stack assemblies are painted white.

Link to Sentron Joint Assembly Instructional Video:
https://www.youtube.com/watch?v=PI8In1a0nmc

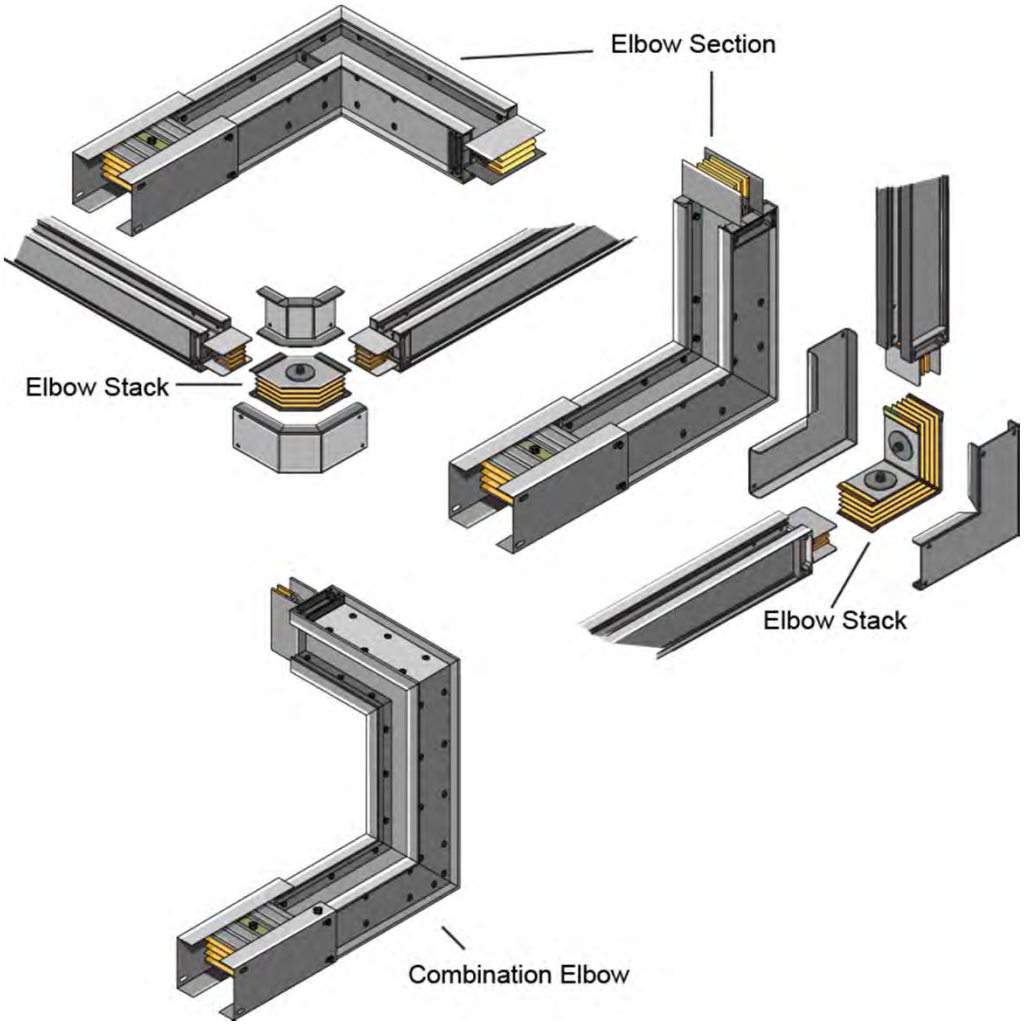
Chapter 2 – Sentron Busway



This chapter covers the following topics:

- Overview
- **Components**
- Bus Plugs

Elbows

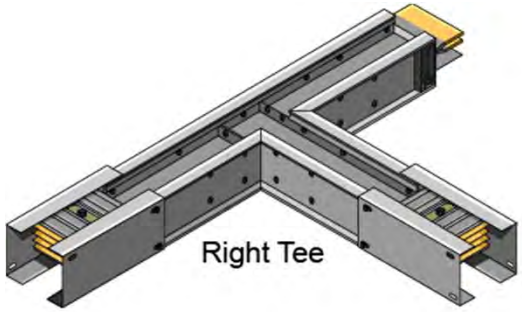


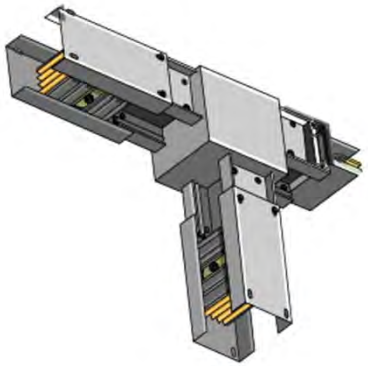
Elbows enable turns and height changes in the busway system. An elbow can turn the busway system right, left, up, or down.

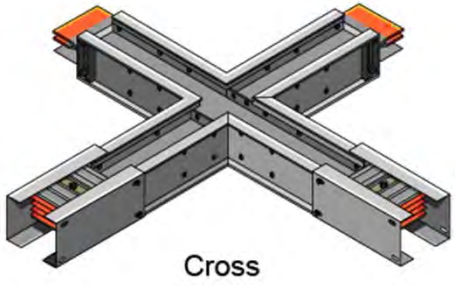
Elbows are supplied with a joint stack and covers. Elbows may be ordered as stacks or sections. Elbow stacks are joint stacks that are angled edgewise (for up/down changes) or flatwise (for left/right changes).

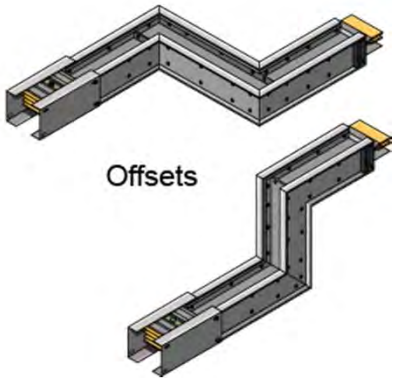
Combination elbows can route the busway system up or down, and right or left. They are available in a variety of configurations.

Tees, Crosses, and Offsets







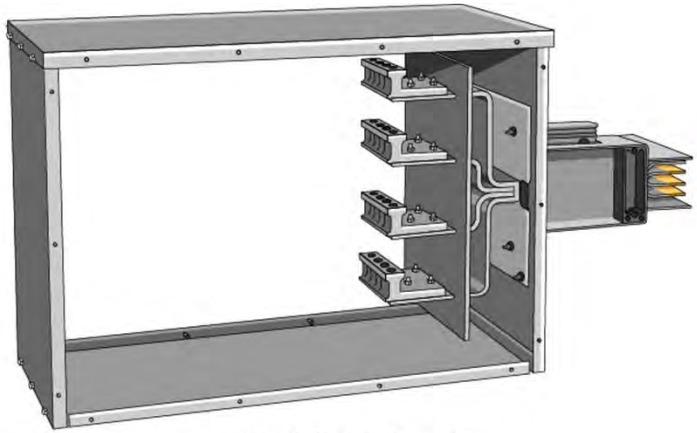


Tees are used to start a new section of busway in a different direction. Tees can start a new section to the right, to the left, up, or down. Tees are supplied with two joint stacks.

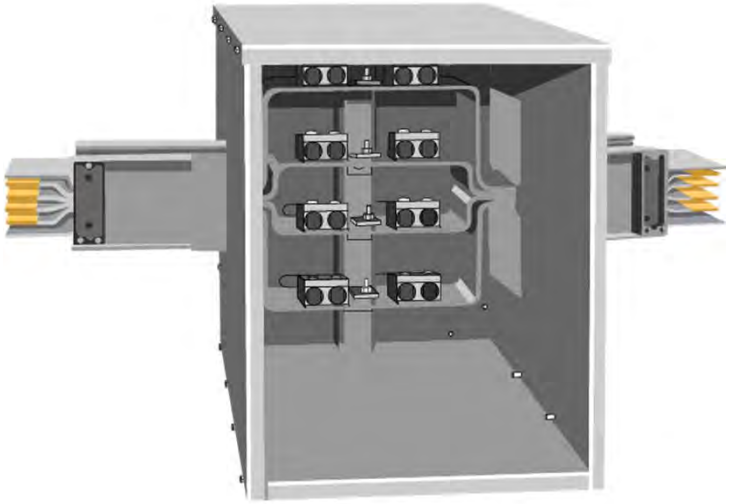
A cross allows a busway run to extend in four directions.

Offsets allow the busway system to shift left, right, up, or down while continuing in the same direction. Offsets are supplied with a joint stack. When space is tight, a single offset can be used instead of two connected elbows.

Tap Boxes



End Cable Tap Box

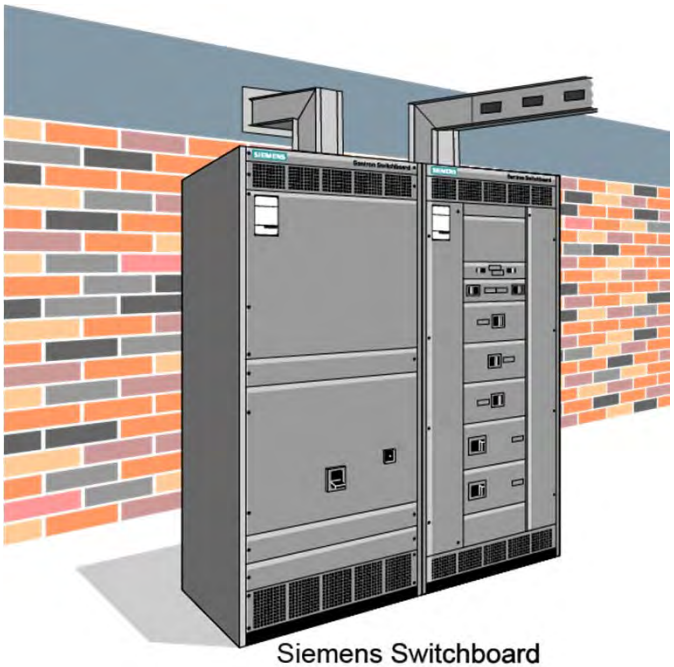


Center Cable Tap Box

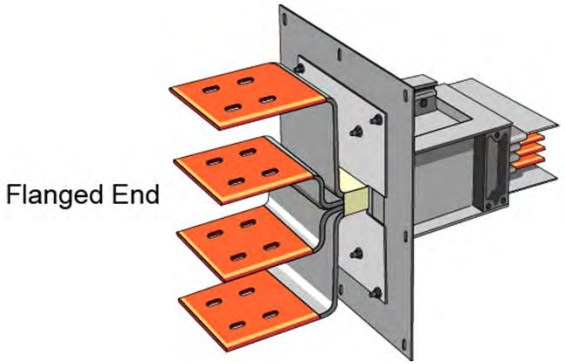
Tap boxes are used to connect electrical cable to busway. End cable tap boxes can be installed at either end of the busway system. They can be used on feeder or plug-in busway.

Center cable tap boxes are used to feed power to or take power from the busway run at a point other than the start or end.

Flanged Ends



Siemens Switchboard

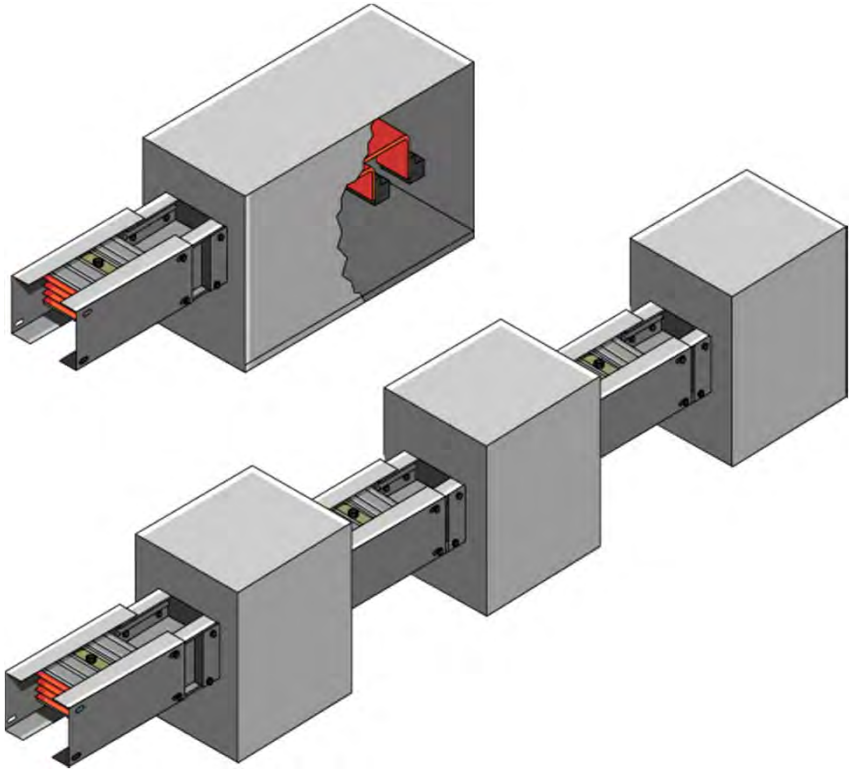


Flanged End

Sentron busway standard flanged ends are used to connect busway to other Siemens equipment, such as switchgear and switchboards.

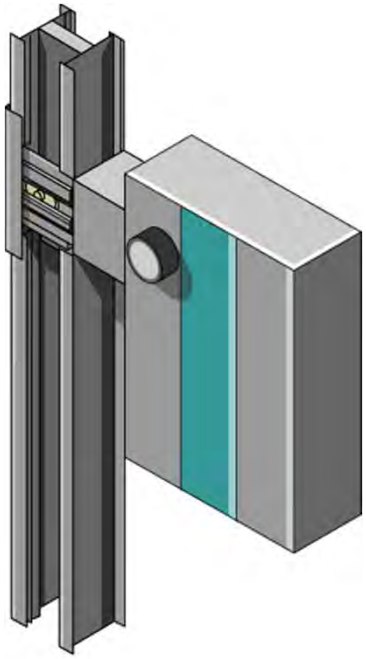
Flanged ends can also be used with existing equipment. Siemens will furnish the outline drawings of this flanged end to the coordinating switchboard or equipment installer.

Service Heads



Service heads are used to connect the busway to the electrical service. There are two types in the Sentron series. A single service head that has all three phases, or three separate heads, one for each phase.

Riser Adaptors (or Tap Stacks)



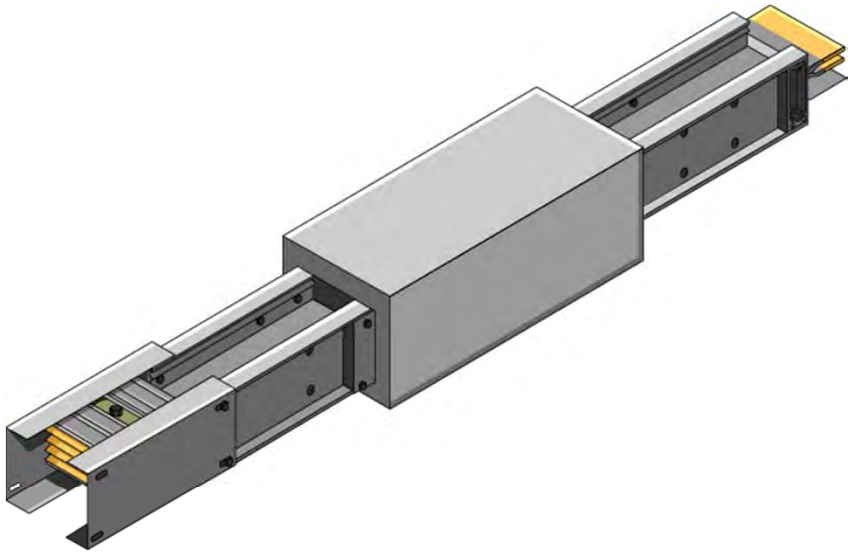
Side Mounted Adaptor

For vertical applications, Sentron plug-in busway can be ordered with the plug-in receptacles located only on one side. This is called “riser” busway.

The phasing on vertical busway is A, B, C, N from left to right on the predominant side of the busway. This ensures proper bus plug orientation.

Some panelboards and meter centers, such as Siemens Power Mod, can be mounted directly to risers with a joint mounted adapter, sometimes referred to as a tap stack. A meter center cubicle, with main breaker in the cubicle, may also be used to feed a meter center lineup. The circuit protection in the cubicle means a main switch or breaker is not required in the meter lineup.

Bus Bar Phase Rotation

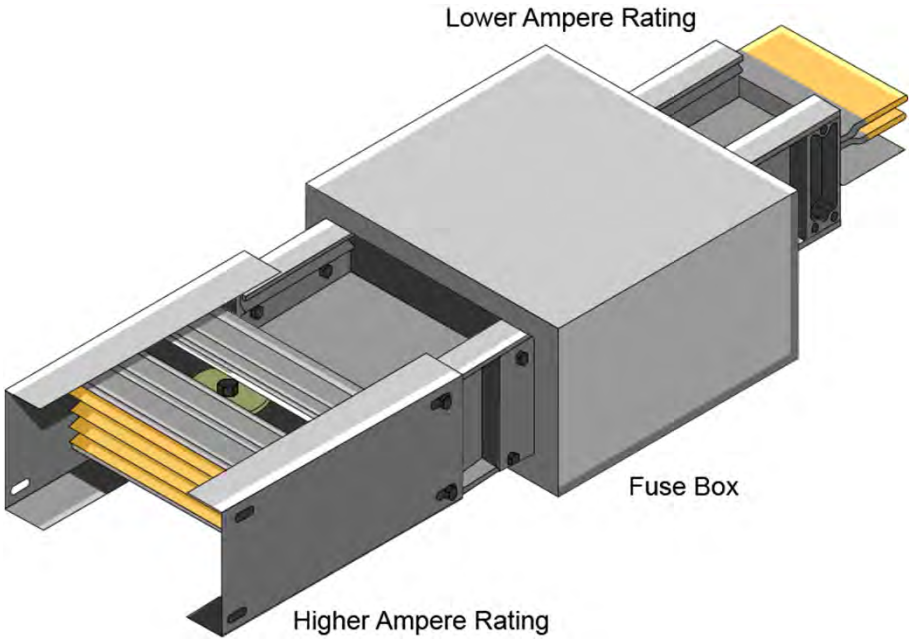


Phase Rotation Examples

Some applications may require a phase rotation of the power supply. The direction of rotation of a 3 phase AC motor, for example, is determined by the phase sequence of the power supply. These fittings are most common in transitions from horizontal to vertical runs, where specific phase sequences are required to properly position bus plugs.

Phase rotation fittings are available as phase and ground, phase only, and ground only rotations. Note: phase rotation fittings are difficult to manufacture and should be limited in use.

Reducers

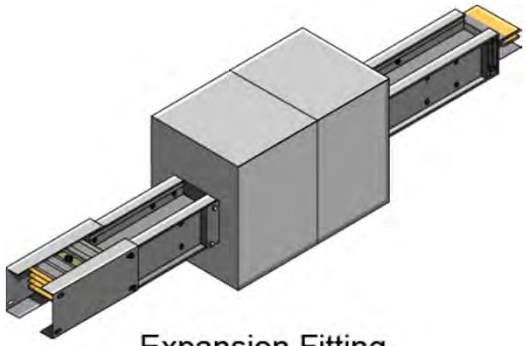


A busway reducer is used to reduce the ampere rating from one busway section to another, This allows a lower rated busway section to be connected further down a run. A branch circuit, for example, does not need as high an ampere rating as the main feeder circuit.

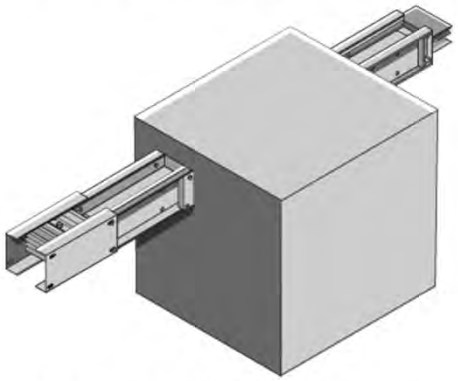
The NEC® requires overcurrent protection where busways are reduced in ampacity. There is an exception to this requirement for industrial applications. Refer to the NEC for additional information.

Sentron busway offers reducers with fuse provisions. With the proper fuses installed, these reducers meet NEC overcurrent protection requirements. Non-fused reducers are available for applications in which the exception is allowed. The accompanying graphic shows a fused reducer.

Expansion Fittings, Cubicles, and End Closers



Expansion Fitting



In-line Disconnect Cubicle

End Closer

Expansion fittings accommodate expansion and contraction of a busway run and building movement. The Sentron expansion fitting is configured with a sliding enclosure and flexible conductors that allow up to 2 inches of movement.

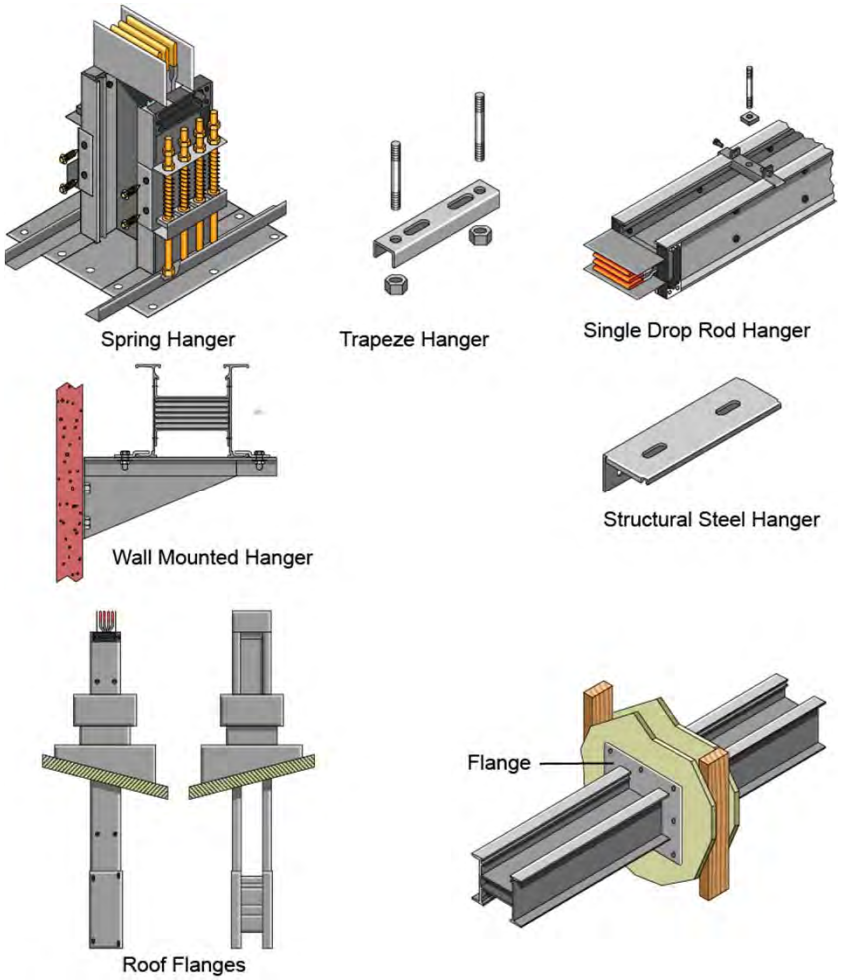
Expansion fittings are typically installed in the middle of long busway runs, and at the beginning of certain riser runs.

One expansion section should be used for every 200 feet of continuous busway run length, at the beginnings of most vertical runs, and at each building expansion joint. The busway run must be positioned accordingly to accommodate the expansion section(s).

Cubicles provide a means of mounting switches or circuit breakers where power enters or leaves a busway system. In-line disconnect cubicles are used where bolted connections are preferred or at ampere ratings exceeding the standard plug-in unit ratings. Modifications are available to accommodate key interlocks, ground fault detectors, and power monitors.

End closers are used to safely terminate a run of busway and protect the bus bar ends. They are easily removed to extend a busway run.

Hangers and Flanges



Link to Sentron Supports Instructional Video:
https://www.youtube.com/watch?v=IWpJClEizUE&t=19s

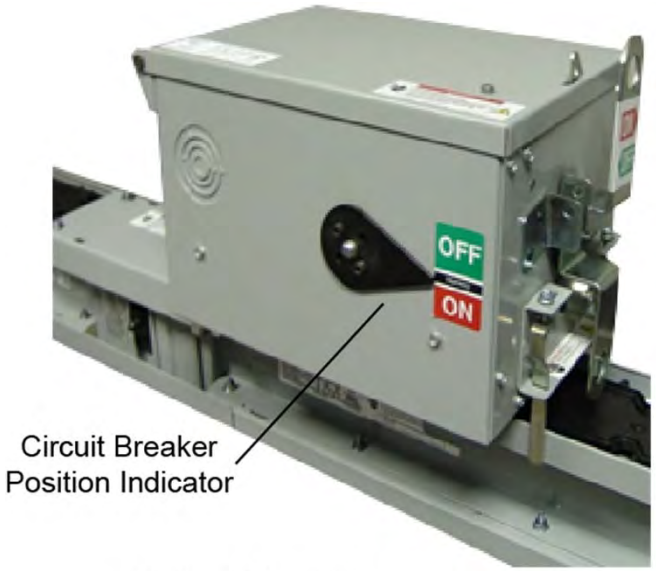
Various hangers are used to support busway. When a vertical run of busway passes through a floor, a floor support is required. Spring hangers provide secure mounting of Sentron busway in riser applications. These hangers counter the weight of the busway on each floor and compensate for minimal building movement and thermal expansion and contraction of the product.

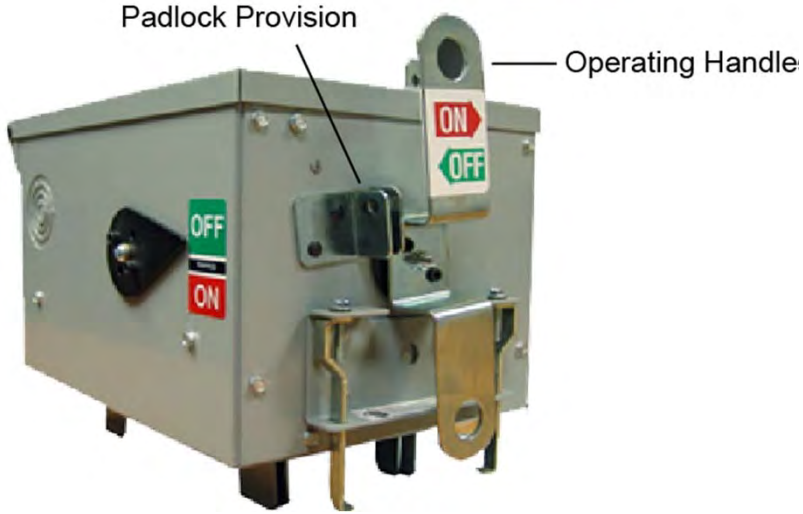
Several types of hangers are available to suspend the busway from the ceiling or a structural steel support, or to mount busway on a wall.

Flanges are used when the busway run passes through a roof, wall or ceiling. It is important to note that flanges do not support the busway; rather they provide a means of covering the hole through which the busway passes. Sealant, may be required to meet fire codes or other local requirements. Sealant, caulking, or gaskets are not provided with Sentron flanges.

Roof flanges provide a watertight seal when outdoor rated busway enters through a roof. The pitch or angle of the roof must be specified when ordering roof flanges.

Wall, ceiling, and floor flanges are designed to close off the area around busway as it passes through a wall, ceiling, or floor. The flange does not provide an air tight seal.

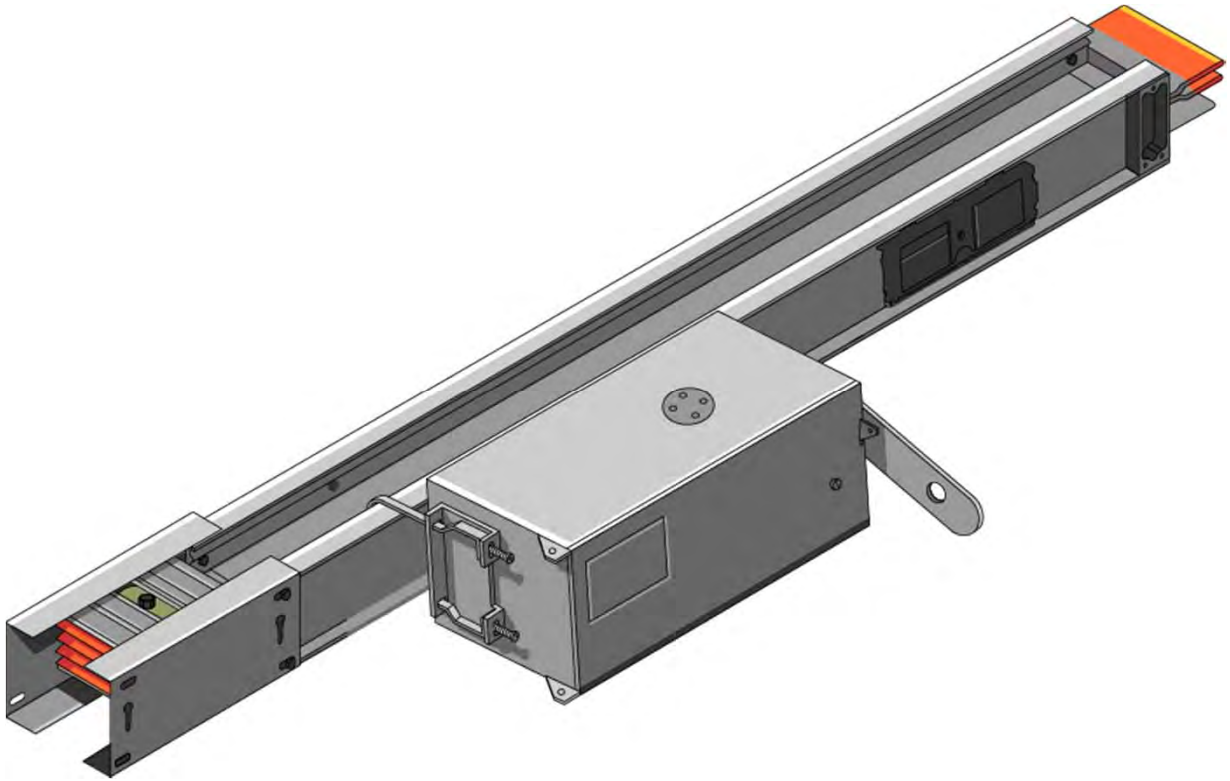




This chapter covers the following topics:

- Overview
- Components
- **Bus Plugs**

Sentron Bus Plugs

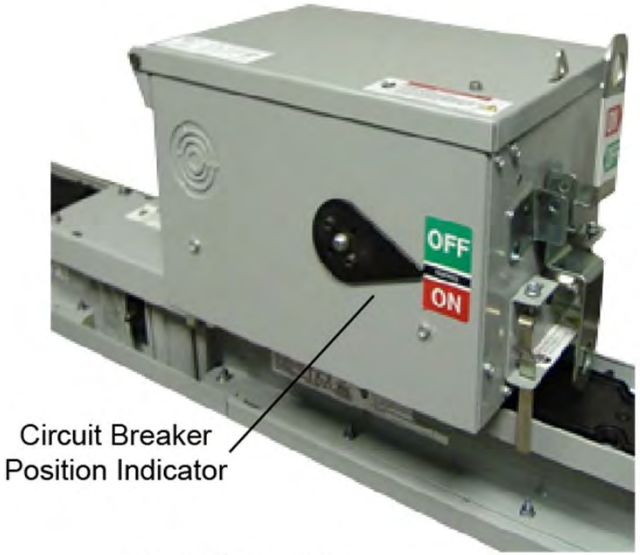


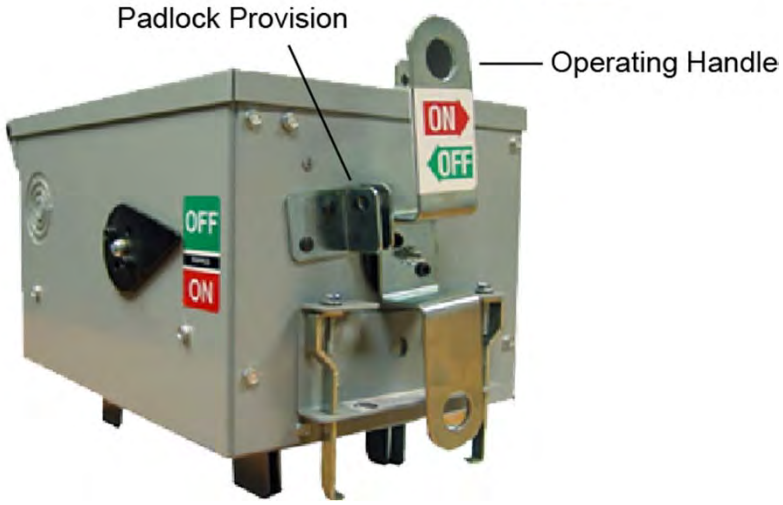
Sentron busway bus plugs with vertical or horizontal plug configurations are available. Most are equipped with either a Siemens molded case circuit breaker or Siemens fusible switch.

Circuit breaker bus plugs rated below 600 amps and fusible switch bus plugs use one plug-in location, allowing up to 10 bus plugs (five per side) for a 10 ft. section. Circuit breaker bus plugs rated 600 or 800 amps use two plug-in locations.

Sentron bus plugs are engineered to be easy to install and use. Installation is simplified by features such as factory installed circuit breakers, compact footprint, generous wire bending space, and dual interlocks.

Sentron Circuit Breaker Bus Plugs





Sentron bus plugs are available with circuit breakers in ampere ranges from 15 to 800 amps. Both thermal-magnetic and solid-state circuit breakers are available with the full range of interrupting ratings (standard, high, and current limiting). Solid state breakers featuring a 200% neutral with trip types LIG and LSIG are not standard due to neutral CT coordination.

Both horizontal and vertical configurations are available in a non-ventilated steel housing with either an IP40 (indoor) or IP55 (splash proof) rating. Circuit breaker bus plugs rated 600 amps and above require two plug spaces. All other bus plugs use one plug-in opening.

Circuit breaker bus plugs feature an easy to read position indicator visible from the shop floor that clearly marks whether the internal circuit breaker is in the off, on, or tripped position.

The operating handle is hook stick operable, has a label that clearly marks the on and off position, and can be padlocked in the off position.

Sentron Fusible Switch Bus Plugs

Sentron fusible switch bus plugs are available with a voltage rating of 240 or 600 VAC and ampere ratings from 30 to 600 amps. Fuses are not provided, but, these bus plugs are compatible with H, J, K, R, and T fuses. All fusible switch plugs use one plug-in opening.

Both horizontal and vertical configurations are available in a non-ventilated steel housing with either an IP40 (indoor) or IP55 (splash proof) rating.

The rugged, easy-to-grip operating handle is hook stick operable, has a label that clearly marks the on position, and has padlock provisions.

Link to Sentron Fusible Switch Installation Video is below:
https://www.youtube.com/watch?v=mwFpv3he6lY

Sentron Fusible Switch SPD Bus Plugs

Sentron fusible switch bus plugs with a surge protection device (SPD) are available for the following power configurations:

- 120/240V 1Ø, 3W
- 240/120V 3Ø, 4W
- 240V 3Ø, 3W
- 480Y/277V 3Ø, 4W
- 480V 3Ø, 3W
- 600V 3Ø, 3W
- 600Y/347V 3Ø, 4W

Depending on the configuration, ampere ratings from 30 to 600 amps are available. Both fused and non-fusible versions are available, Fuses are not provided, but, fusible bus plugs are compatible with H, J, K, R, and T fuses. All fusible switch plugs use one plug-in opening.

The inclusion of an SPD limits internal and externally-generated surges from propagating through a facility. SPDs with surge current ratings from 100 kA to 500 kA per phase are available. The SPD is a UL 1449 third edition device that utilizes thermally- protected metal oxide varistors (MOVs) specifically designed for safe operation in high fault current or sustained overvoltage conditions.

Both horizontal and vertical configurations are available in a non-ventilated steel housing with an IP55 (splash proof) rating.

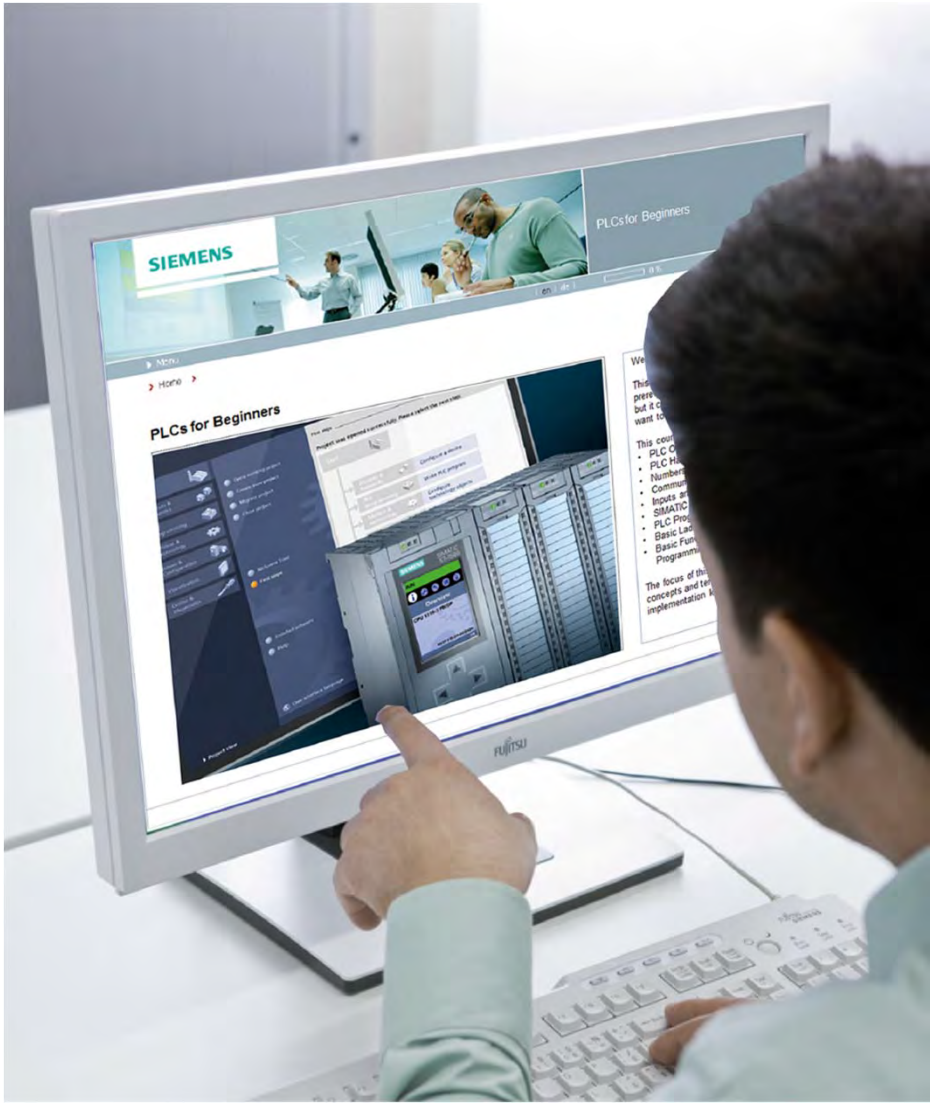
Sentron 3/6 Bus Plugs

Sentron 3/6 bus plugs are available with one to six poles and rated up to 100 amps per pole (up to 200 amps per phase). A range of circuit breakers are available. These plugs are based on the XJ-L 3/6 offering, and are intended for use in the same applications, i.e., data centers. These plugs bring all the features, and more, of the XJ-L 3/6 plug to the Sentron line, eliminating the 400 amp constraint of the XJ-L Busway line.

Optional integrated metering packages with Siemens Embedded Micro Metering (SEM3) are available for energy monitoring, data analysis, and sub billing (co-location) applications. Meter racks with three or six high or low accuracy meters can be included.

Possible configurations include: corded receptacle with cord lengths from 3 to 10 ft., surface mount receptacle, and a field-wired variant.

Online Self-paced Learning



With Siemens online self-paced learning, you select the topics and set your own pace for completing chosen courses. All course material can be accessed online. Instruction starts upon completing the purchase of a subscription.

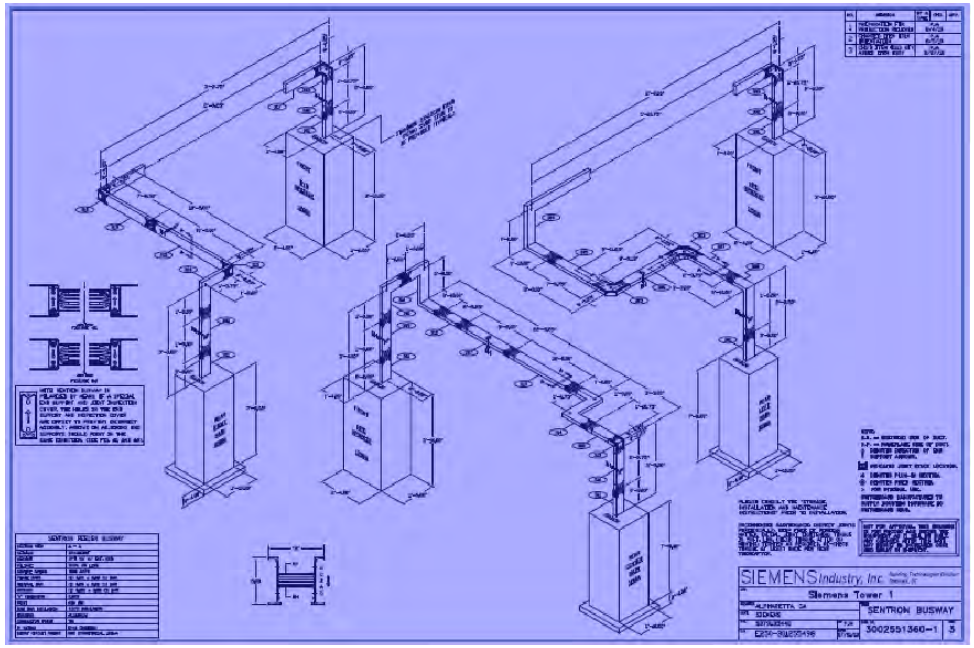
You can choose from over 500 courses consisting of high-quality graphics, on-screen text, supporting voiceover narration, and interactive exercises. Features include printable course content for reference and underlined key vocabulary terms with definitions displayed with a simple mouse-over action.

Depending on the subscription purchased, you can choose any 10 or 25 courses or select the entire online self-paced course catalog.

These courses are offered 24/7/365, so you can begin your subscription at any time. From the date of registration, you have one year to complete your course selections.

For additional information: www.usa.siemens.com/sitrain

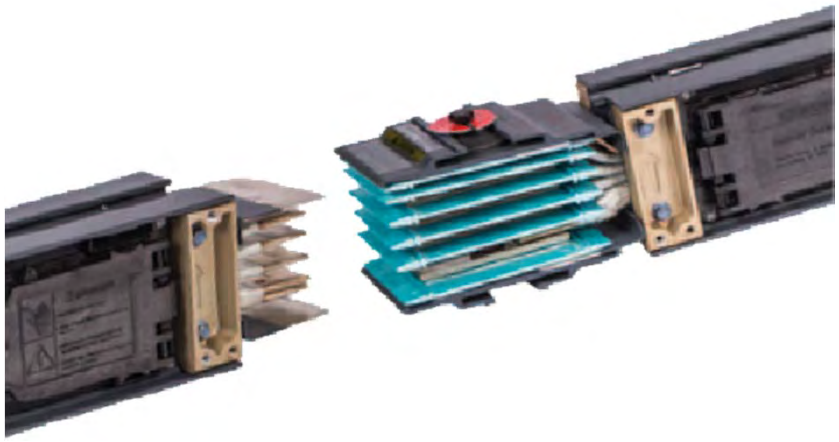
Chapter 3 – System Design



This chapter covers the following topics:

- **Planning a System**

Power II Fit Program



Siemens Power II Fit (P II F) program is for use with Sentron busway applications and compensates for dimensional busway layout deviations. With the P II F program, specific dimensions on straight sections and/or elbows may be left out of factory released drawings. After the busway run has been installed (minus P II F pieces), final measurements are taken and sent to the factory. The P II F Program guarantees shipment of five or fewer straight sections per project and/or 90° angle elbows within five business days for indoor (IP40) busway and eight business days for outdoor (NEMA 3R) busway after receipt of the P II F order form.

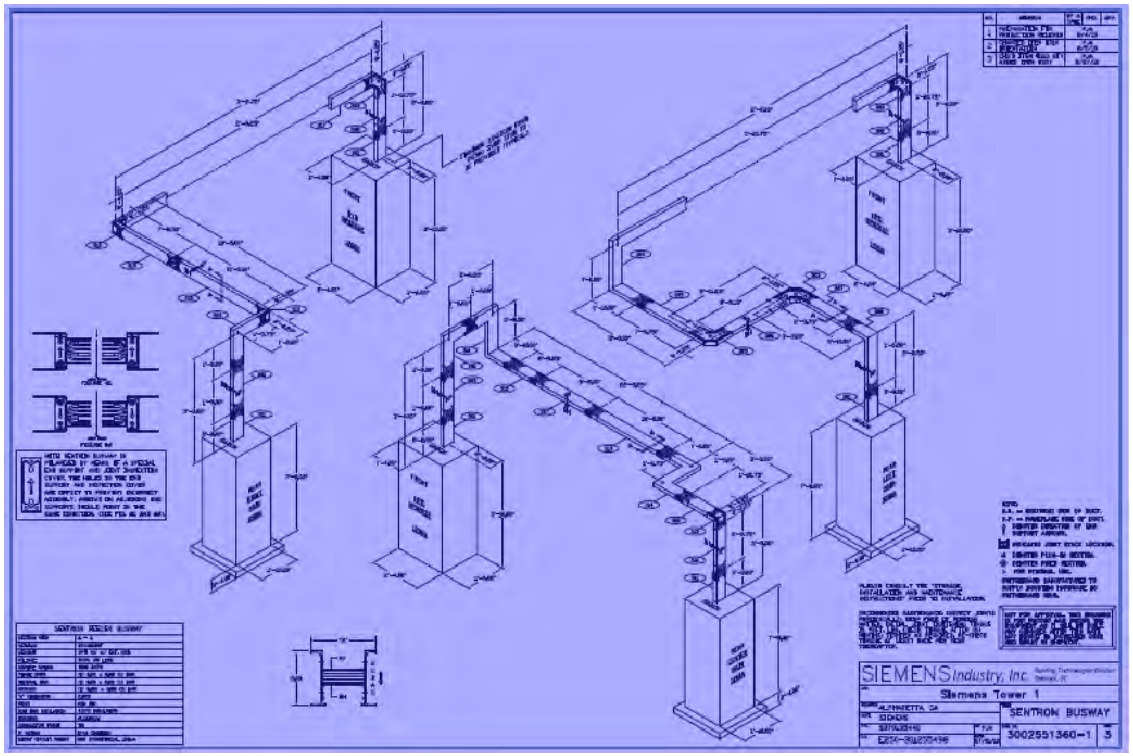
Why use the Power II Fit Program?

The P II F program saves you time and money by eliminating uncertainty in busway measurements. With the P II F Program, your busway runs fit exactly the first time, eliminating incorrect pieces and costly reordering time.

When should the Power II Fit Program be used?

The P II F Program benefit you if you are uncertain of exact dimensions on long busway runs and when difficult contour situations require special attention.

Power II Measure Service



Siemens Power II Measure (P II M) service provides professional busway routing and measurement by a factory representative. Our P II M representative meets with the designated site contact, reviews project details, and discusses routing options. All pertinent site dimensions are laser measured, recorded, and transferred to a CAD approval drawing. The P II M service guarantees correct busway alignment and routing.

Why use the Power II Measure service?

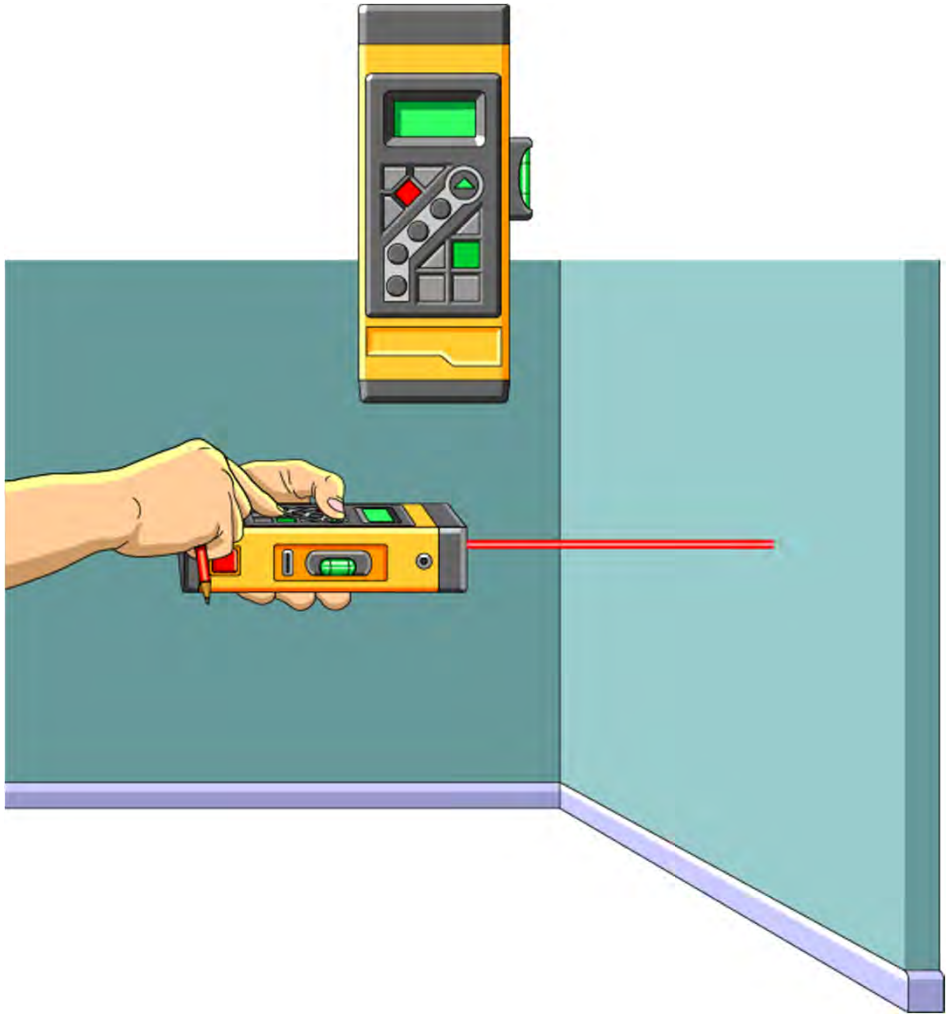
The P II M service saves you time and money by:

- Ensuring the most cost effective busway routing
- Ensuring accurate measurements
- Reducing order engineering lead-time

When should the Power II Measure service be used?

The P II M service is beneficial for all projects (new or existing, large or small), but is especially beneficial for large or complex projects.

Busway Measurements

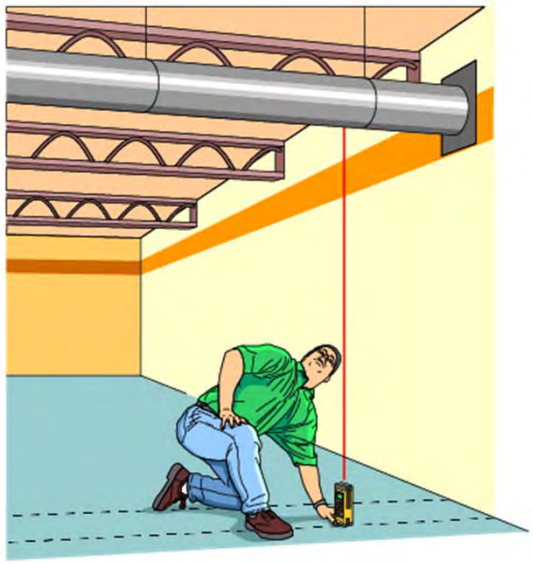


The most efficient and least expensive busway route requires the fewest fittings and utilizes the maximum number of 10 ft. straight sections. When planning this route, it is critical to make accurate measurements.

There are a number of techniques to ensure an accurate measurement before purchasing and installing busway. The following procedures are provided as an example and are useful in obtaining a correct measurement.

Laser measuring devices, such as the one illustrated, provide an easy and highly accurate means of measuring a busway run. These devices project a laser beam which is reflected on an object such as a wall, ceiling, floor, or piece of machinery. The device accurately displays the distance traveled by the beam.

Laying Out a Busway System

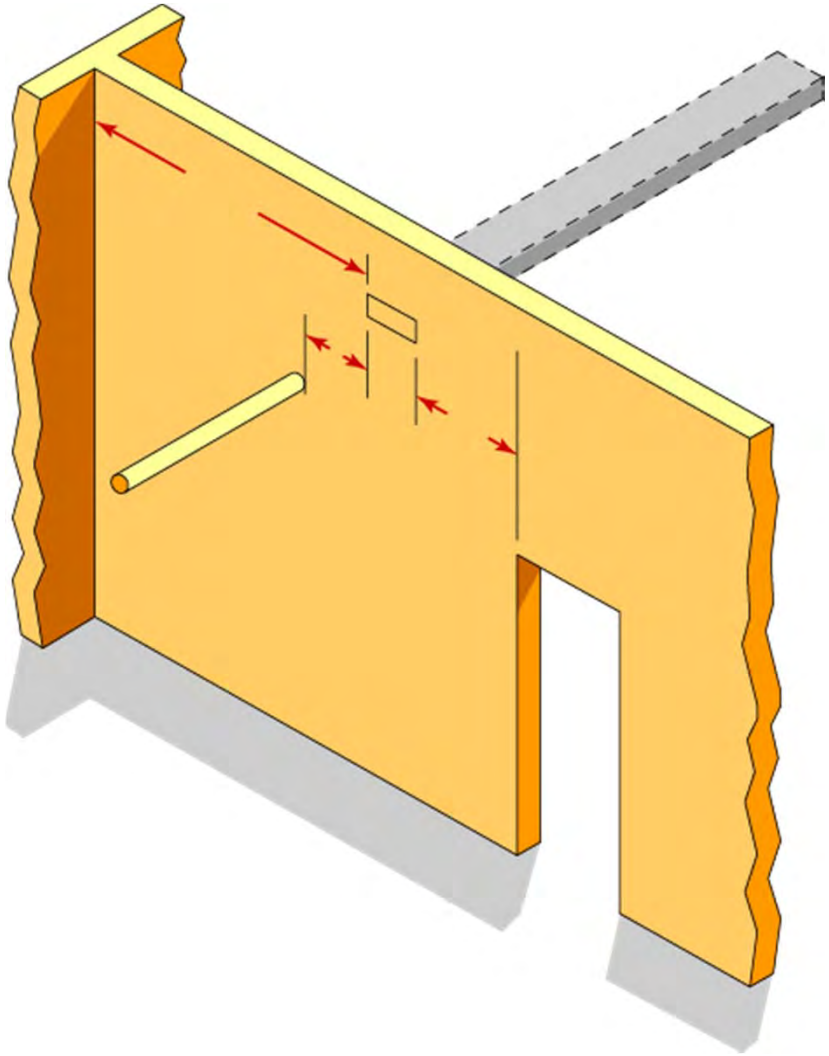


Using the laser measuring device, determine the height and location of obstructions. Select a route requiring the fewest offsets.

The planned route can be laid out on the floor with a pencil or chalk. Transfer the position of pipes, ducts, beams, and other obstructions to the floor. It will be easier to transfer the planned busway route to paper if significant portions are laid out full scale first.

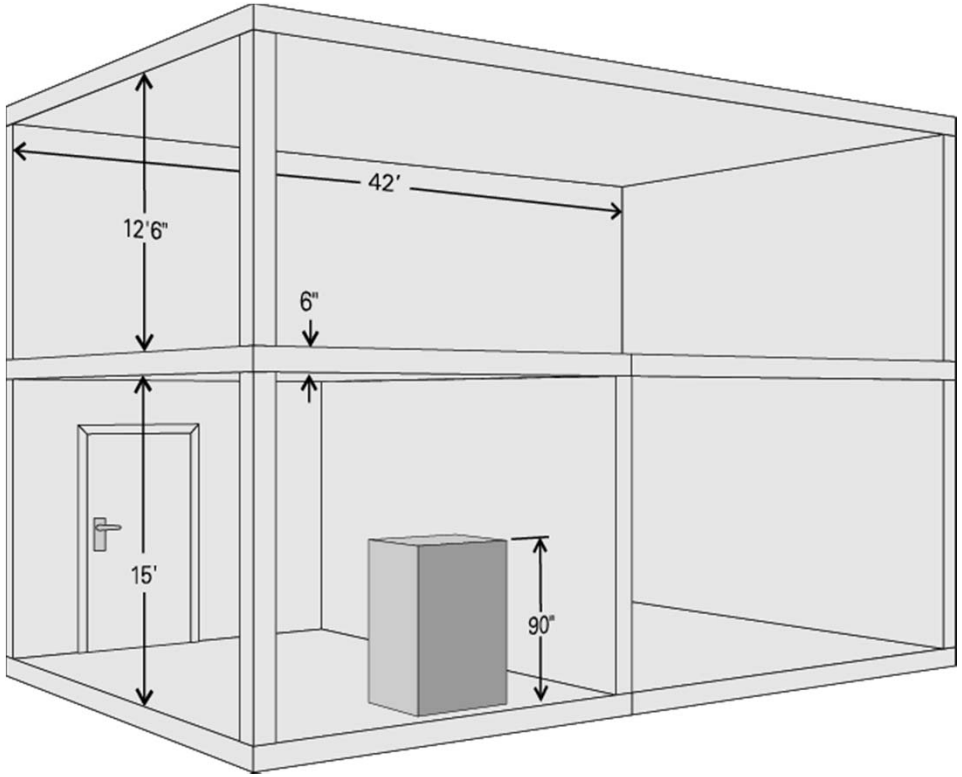
Once the route is laid out, the laser measuring device can be used along the run to measure distance.

Piercing Partitions



When piercing a wall, ceiling, or floor find a reference point which is common to both sides and measure from it. This may be a pipe, a wall, or a door.

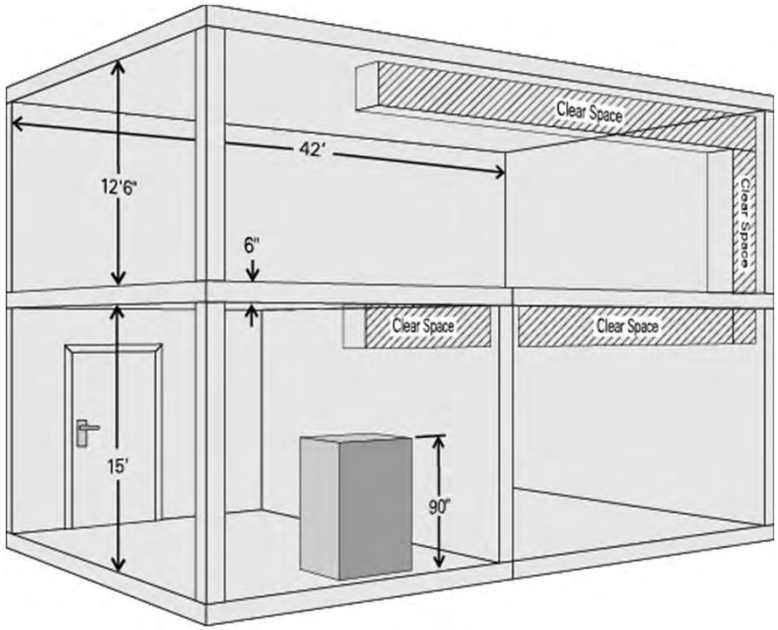
First and Second Floor Dimensions

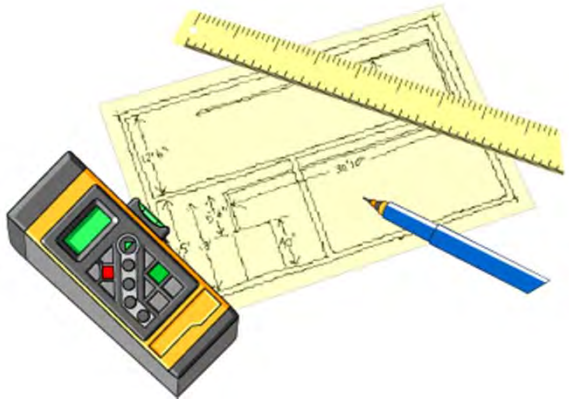


In the following example, a busway system, connected to a switchboard, will pass through three rooms. The floor to ceiling height is 15 ft. on the first floor and 12 ft. 6 in. on the second floor.

The overall length is 42 ft. Walls and floors are 6 in. thick. The switchboard height is 90 in. Various types of equipment on the second floor will be connected to the busway via plug-in outlets along the length of the room.

Busway Layout Sketch

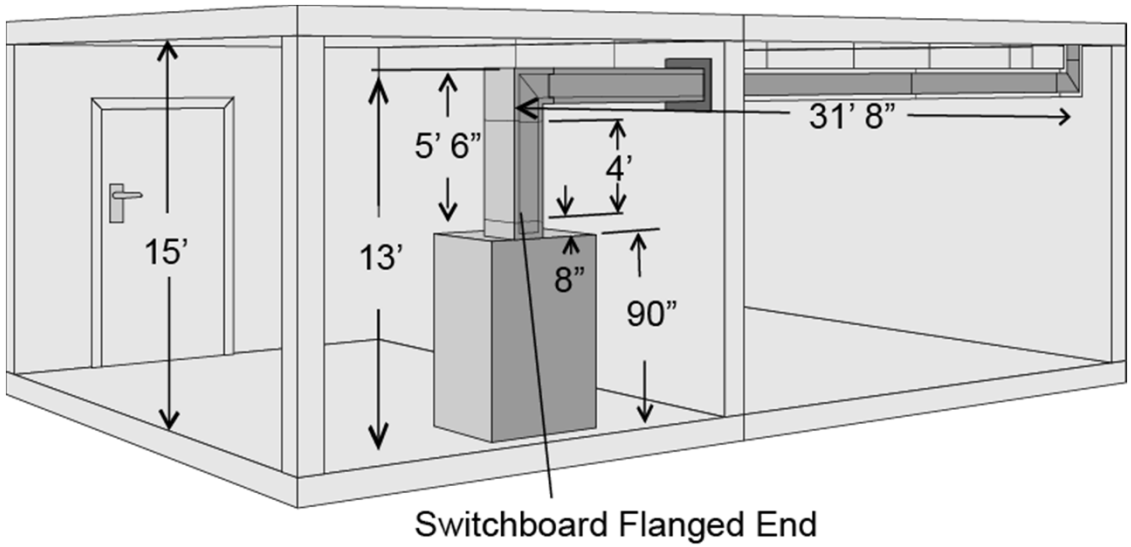




In this example, there is a clear space available 13 ft. above the floor in the switchboard room (5 ft. 6 in. from the top of the switchboard). The clear space extends on the other side of the wall in the second room to the far right wall. It is also clear on the second floor along the far right wall and 10 ft. above the floor for the length of the second floor.

The accompanying graphic shows a rough sketch of the proposed busway system route

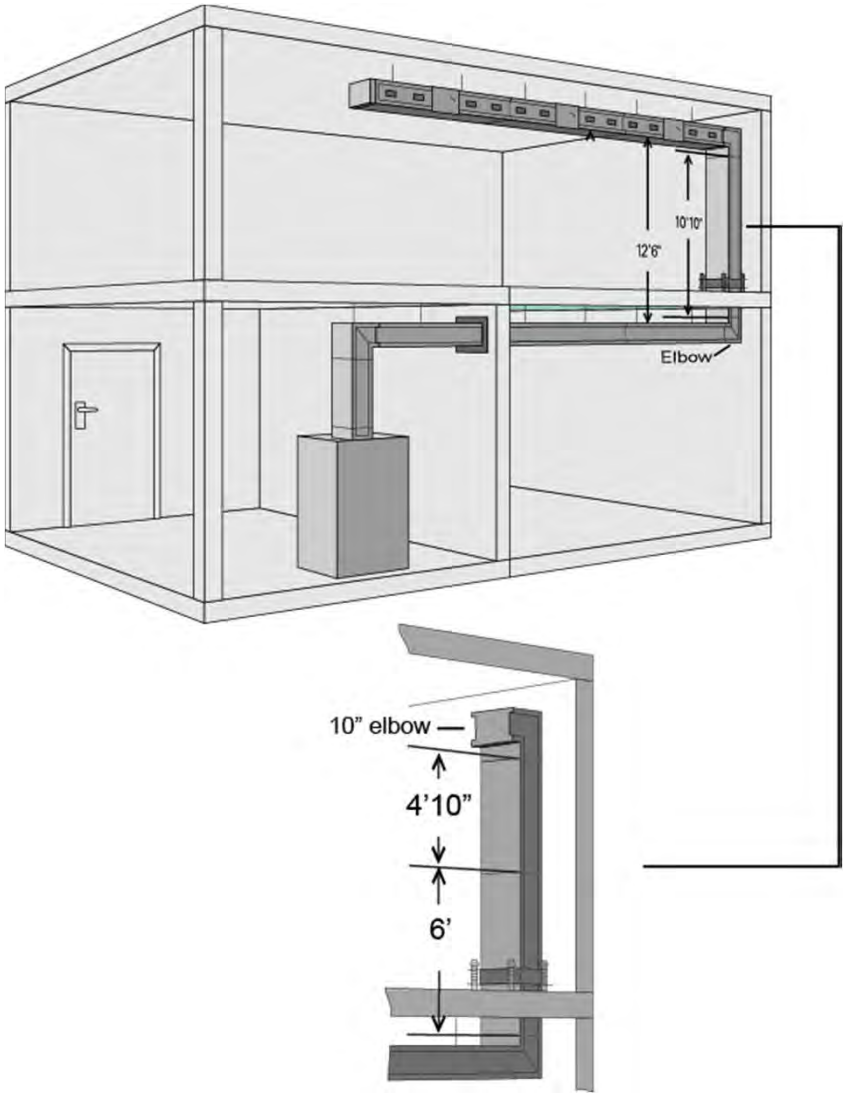
First Floor



The components can now be selected for the installation. On the first floor, The height from the top of the switchboard is 5 ft. 6 in. An 8 in. switchboard flanged end, a 4 ft. section of feeder busway, and one 10 in. elbow are selected.

The busway runs horizontally on the first floor 31 ft. 8 in. before making its second turn. A second 10 in. elbow is needed. After subtracting 20 inches for the elbows, this leaves room for three 10 ft. feeder sections. Feeder busway is selected because no equipment will be connected to it on the first floor.

Second Floor

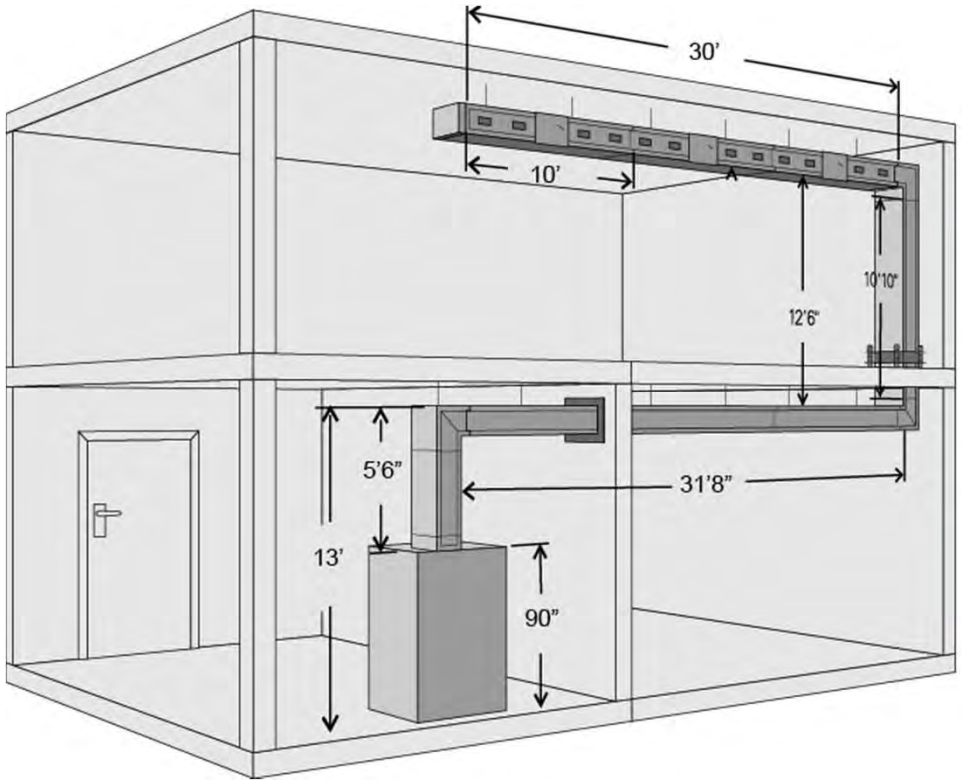


It is 2 ft. 6 in. from the top of the horizontal feeder run to the second floor level. The horizontal busway run on the second floor will be installed 10 ft. from the floor for a total rise of 12 ft. 6 in.

One elbow is already installed on the first floor horizontal feeder busway run. A second elbow is needed at the top of the vertical riser. Each elbow is 10 in., which is subtracted from the total rise of 12 ft. 6 in. 10 ft. 10 in. of vertical riser completes the vertical rise.

Sentron feeder busway comes in custom lengths from 2 ft. to 10 ft. One solution for the vertical riser is to select one 6 ft. and one 4 ft. 10 in. section.

Bill of Materials



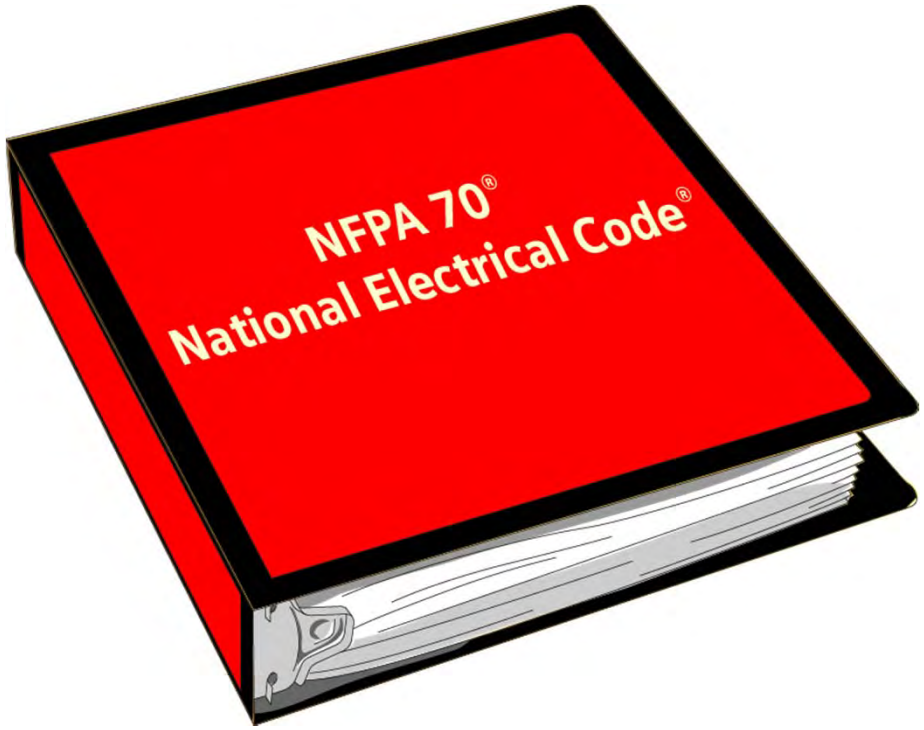
Qty	Item
3	Bus Plugs
1	0'8" Stub
1	4'0" Feeder
3	10'0" Feeder
1	4'10" Feeder
1	6'0" Feeder
3	Edge Elbow
3	10'0" Plug-In
1	End Closer
1	Floor Flange
2	Floor/Wall Flange
12	Hangers

The busway run is completed with three 10 ft. plug-in sections on the second floor.

An end closer, wall and floor flanges, floor support, hangers, and the desired number of bus plugs finish the system. In this example three bus plugs were used.

The bill of material for this example is shown in the accompanying graphic.

NEC Requirements



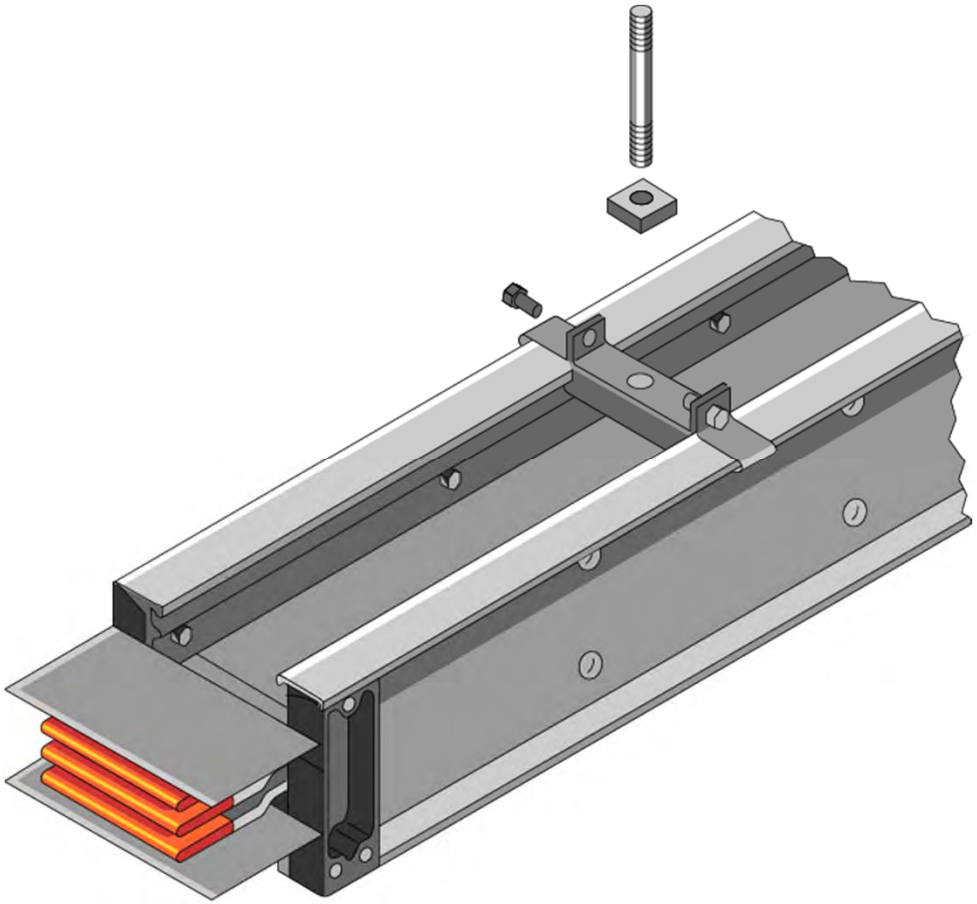
An important part of applying a busway system is ensuring that the system meets electrical code requirements. For example, the National Electrical Code® Article 368 restricts where busway can be used and provides important requirements for busway installations.

Concealed busway must be non-ventilated and totally enclosed and joints between sections must be accessible for maintenance purposes. In addition, the space behind the access panels cannot used for air handling, there can be no plug-in connections and the conductors must be insulated.

The NEC Article 368 restricts the use of busway in conditions where it may be damaged or cause damage. For example:

- Where corrosive vapors are present
- In hoistways
- Outdoors or in hazardous or wet locations unless approved for such use

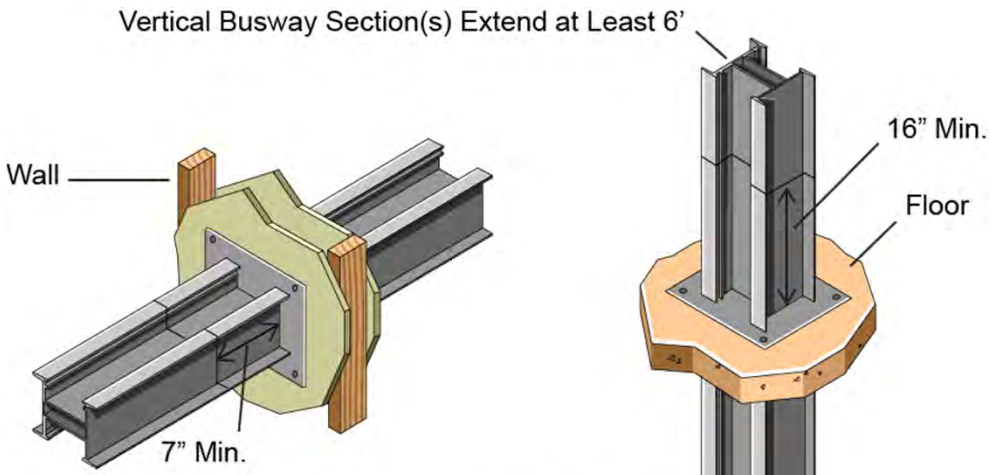
Busway Support



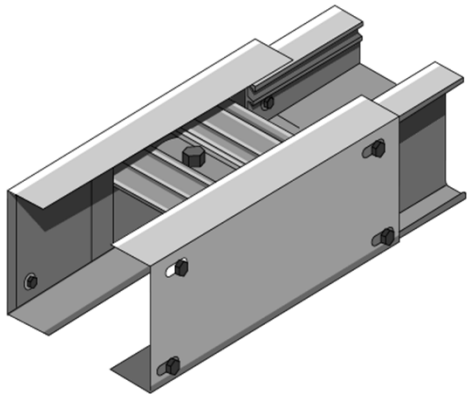
The accompanying graphic shows one type of support available for Sentron busway. NEC® Article 368 requires busway supports at intervals of 1.5 m (5 ft.) or less unless it is specifically designed and marked for fewer supports. For example, picture frame and trapeze hangers used with Sentron busway are designed on a maximum of 10 ft. centers.

Link to Sentron Supports Instructional Video:
https://www.youtube.com/watch?v=IWpJClEizUE&t=19s

Walls, Floors, and Terminations



Unbroken Busway Section Can Pass Through a Wall or Floor



End Closer

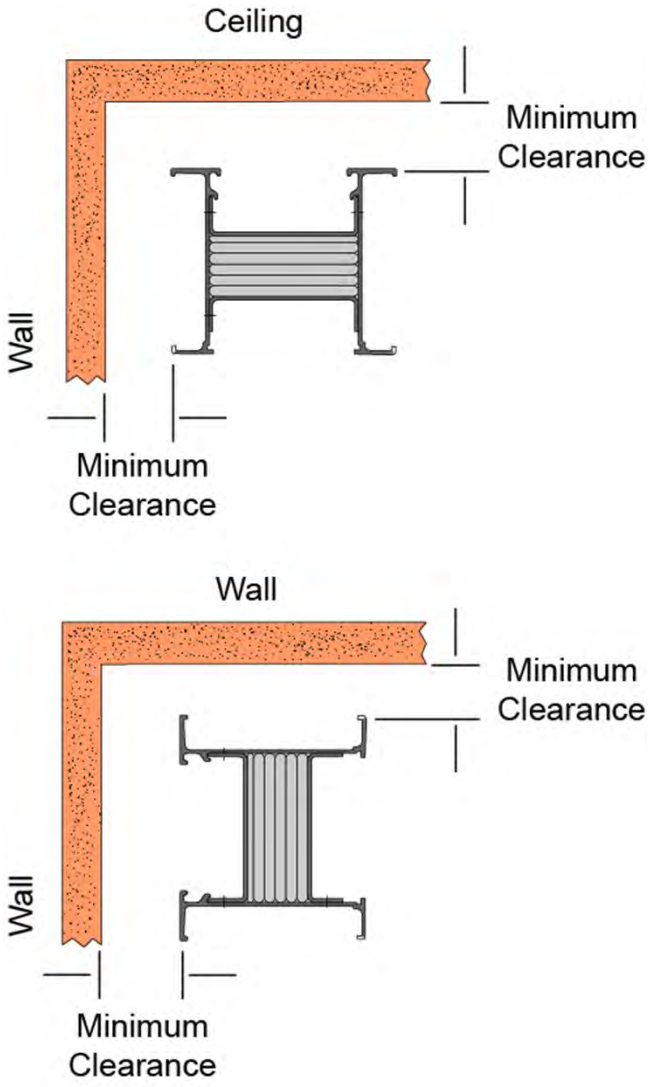
NEC® Article 368 allows busway to pass through walls and floors provided there are no section joints in the wall or floor and vertical busway extends at least 6 ft. through the floor. In addition, certain applications may require the use of a curb around busway passing through two or more dry floors. This helps to eliminate the possibility of spilled liquid running down the busway causing damage to the electrical system.

In addition to NEC requirements, Sentron busway requires a minimum of 7 in. from a wall to a joint where a new section of busway begins.

Sentron busway passing through a floor requires a minimum of 16 in. between the floor and a joint. This space is required for the spring hanger supports.

NEC Article 368 requires the dead end of a busway section to be closed. The accompanying drawing shows the Sentron busway end closer.

Minimum Clearance

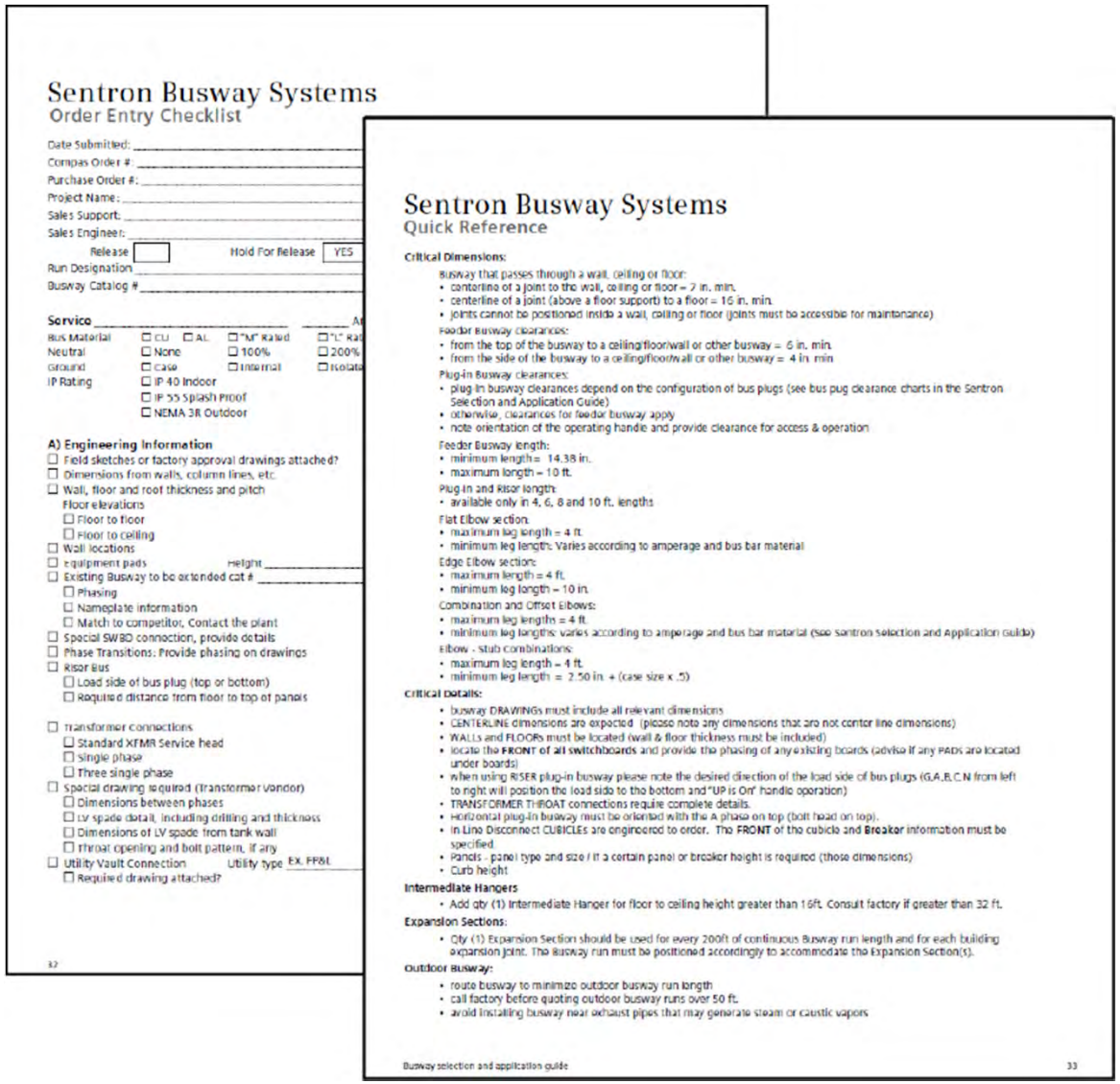


There are certain minimum clearances required when installing busway near a wall, ceiling, or another busway run. It is beyond the scope of this course to cover in detail the minimum clearances of every component.

The minimum clearances of Sentron busway components are listed in the *Sentron Busway Systems Selection and Application Guide* which is available on the Siemens Power Distribution Download Center . Specifications for other systems are listed in their respective selection and application guides.

Component dimensions must also be considered when planning a busway system. The dimensions given in the following examples are for illustrative purposes. For a complete listing of Sentron busway components refer to the *Sentron Busway Systems Selection and Application Guide*. Specifications for other systems are listed in their respective selection and application guides.

Additional Information



Sentron Busway Systems
Order Entry Checklist

Date Submitted: _____
Compas Order #: _____
Purchase Order #: _____
Project Name: _____
Sales Support: _____
Sales Engineer: _____
Release ☐ Hold For Release YES
Run Designation _____
Busway Catalog # _____

Service _____ _____ A
Bus Material ☐ CU ☐ AL ☐ "M" Rated ☐ "L" Rat
Neutral ☐ None ☐ 100% ☐ 200%
Ground ☐ case ☐ internal ☐ Isolate
IP Rating ☐ IP 40 Indoor
☐ IP 55 Splash Proof
☐ NEMA 3R Outdoor

A) Engineering Information
☐ Field sketches or factory approval drawings attached?
☐ Dimensions from walls, column lines, etc.
☐ Wall, floor and roof thickness and pitch
Floor elevations
☐ Floor to floor
☐ Floor to ceiling
☐ Wall locations
☐ equipment pads Height _____
☐ Existing Busway to be extended cat # _____
☐ Phasing
☐ Nameplate information
☐ Match to competitor, Contact the plant
☐ Special SWBD connection, provide details
☐ Phase Transitions: Provide phasing on drawings
☐ Riser Bus
☐ Load side of bus plug (top or bottom)
☐ Required distance from floor to top of panels

☐ Transformer connections
☐ Standard XFMR Service head
☐ Single phase
☐ Three single phase
☐ Special drawing required (Transformer Vendor)
☐ Dimensions between phases
☐ LV spade detail, including drilling and thickness
☐ Dimensions of LV spade from tank wall
☐ Throat opening and bolt pattern, if any
☐ Utility Vault Connection Utility type EX. PP&L
☐ Required drawing attached?

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Sentron Busway Systems
Quick Reference

Critical Dimensions:

Busway that passes through a wall, ceiling or floor:
- centerline of a joint to the wall, ceiling or floor = 7 in. min.
- centerline of a joint (above a floor support) to a floor = 16 in. min.
- joints cannot be positioned inside a wall, ceiling or floor (joints must be accessible for maintenance)

Feeder Busway clearances:
- from the top of the busway to a ceiling/floor/wall or other busway = 6 in. min.
- from the side of the busway to a ceiling/floor/wall or other busway = 4 in. min

Plug-in Busway clearances:
- plug-in busway clearances depend on the configuration of bus plugs (see bus pug clearance charts in the Sentron Selection and Application Guide)
- otherwise, clearances for feeder busway apply
- note orientation of the operating handle and provide clearance for access & operation

Feeder Busway length:
- minimum length = 14.38 in.
- maximum length = 10 ft.

Plug-in and Riser length:
- available only in 4, 6, 8 and 10 ft. lengths

Flat Elbow section:
- maximum leg length = 4 ft.
- minimum leg length: Varies according to amperage and bus bar material

Edge Elbow section:
- maximum length = 4 ft.
- minimum leg length = 10 in.

Combination and Offset Elbows:
- maximum leg lengths = 4 ft.
- minimum leg lengths: varies according to amperage and bus bar material (see Sentron Selection and Application Guide)

Elbow - Stub combinations:
- maximum leg length = 4 ft.
- minimum leg length = 2.50 in. + (case size x .5)

Critical Details:
- busway DRAWINGs must include all relevant dimensions
- CENTERLINE dimensions are expected (please note any dimensions that are not center line dimensions)
- WALLs and FLOORs must be located (wall & floor thickness must be included)
- locate the **FRONT of all switchboards** and provide the phasing of any existing boards (advise if any PADS are located under boards)
- when using RISER plug-in busway please note the desired direction of the load side of bus plugs (G.A.B.C.N from left to right will position the load side to the bottom and "UP is On" handle operation)
- TRANSFORMER THROAT connections require complete details.
- Horizontal plug-in busway must be oriented with the A phase on top (bolt head on top).
- In Line Disconnect CUBICLES are engineered to order. The **FRONT** of the cubicle and **Breaker** information must be specified.
- Panels - panel type and size / if a certain panel or breaker height is required (those dimensions)
- Curb height

Intermediate Hangers
- Add qty (1) Intermediate Hanger for floor to ceiling height greater than 16ft. Consult factory if greater than 32 ft.

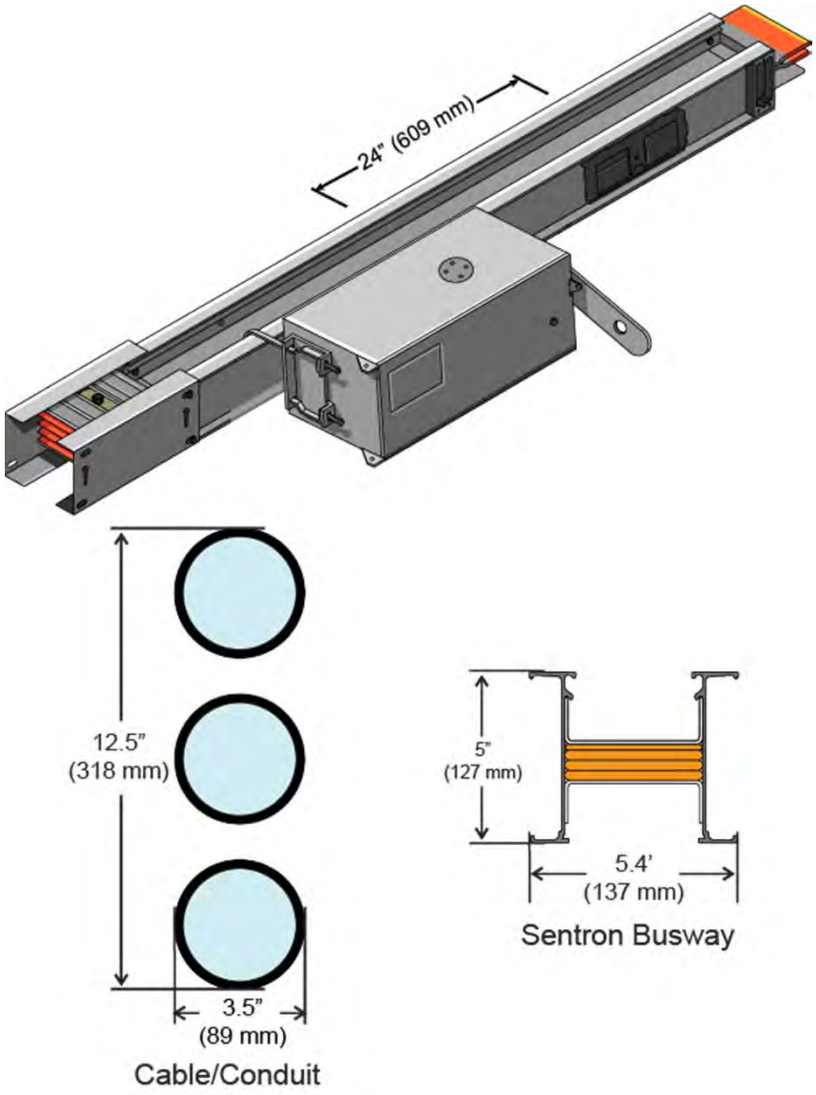
Expansion Sections:
- Qty (1) Expansion Section should be used for every 200ft of continuous Busway run length and for each building expansion joint. The busway run must be positioned accordingly to accommodate the expansion Section(s).

Outdoor Busway:
- route busway to minimize outdoor busway run length
- call factory before quoting outdoor busway runs over 50 ft.
- avoid installing busway near exhaust pipes that may generate steam or caustic vapors

Busway selection and application guide 33

The *Sentron Busway Systems Selection and Application Guide* also includes the Sentron Busway Systems Order Entry Checklist and the Sentron Busway Systems Quick Reference. These are useful documents for planning a Sentron busway application.

Benefits of Busway



Busway can be used in many applications where cable and conduit are more commonly used. The question arises, “Why use busway instead of conventional cable and conduit?”

There are several reasons why busway may be a better choice over cable and conduit. Busway provides greater flexibility by allowing equipment to be connected anywhere along the run on 24-inch centers. Equipment can be easily disconnected and moved to a new location without major rewiring.

Busway has a smaller cross section. This means less installation space is required. Sentron busway with aluminum bus bars rated at 1000 amps, for example, occupies a much smaller space than a comparable cable and conduit installation. The smaller cross section also means that busway is lighter in weight, by as much as half, which means less loading on the building.

Sentron busway is lightweight, compact and takes half the time to install as cable and conduit. Using Sentron Busway instead of cable and conduit can create savings of up to 20 to 30% on total installed costs.

Virtual Instructor-led Learning

Siemens virtual instructor-led courses offer you a live, classroom experience with the convenience and cost savings of online learning. These courses provide hands-on instruction and live interaction, delivered anywhere an internet connection is available.

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Chapter 4 – XJ-L HD, XL-U, and BD Busway

This chapter covers the following topics:

- **XJ-L HD Busway**
- XL-U Busway
- BD Busway

XJ-L HD Busway

XJ-L HD busway is available up to 400 amps and is the leading power distribution solution for demanding applications that require reliable, high quality power.

XJ-L HD busway is the optimal choice for both contractors and users concerned with designing superior electrical systems that require a high plug density and optimal space utilization.

Typical applications for XJ-L HD busway include: data centers, laboratories, large retail stores, and higher education.

XJ-L HD Busway Features

- Up to twelve 100 amp bus plugs can be installed per 10 ft. section of plug-in busway. Plug-in busway can be configured with six plug-in openings per side (standard) or twelve on one side (high density).
- Bus plugs can be installed on energized busway and are fully interchangeable for 100, 225 and 400 amp configurations.
- Bus plugs are available with fusible or circuit breaker disconnects and configured with a wide variety of optional receptacles, branch circuit breakers, drop cords, etc.
- Bus bars are solid copper (98% conductivity) and tin-plated for superior electrical performance and corrosion resistance. Optional silver plating is also available. The solid bus bar design provides superior short circuit strength (up to 35 kA) compared to track busway products and cable.
- The totally enclosed steel housing is robust, guarding against incidental contact and contamination of live parts. The enclosed box design will not twist or distort during bus plug installation.
- Installation is fast and easy. Joint connections simply snap together without special tools, housing couplers, or bus connectors.
- XJ-L HD busway is suitable for horizontal and vertical mounting and under-the floor applications.

XJ-L HD Busway Competitive Advantages

- Compact size – small cross section for applications where busway routing is constrained.
- Joint Connection – dual spring clamp assemblies ensure
- reliable, maintenance-free joints.
- Safety – plug-in outlets are IP2X finger safe.
- Reliability – fundamental design has a 60-year history of reliability.
- Service – simple snap together installation, maintenance-free joints ensure quick and easy serviceability.
- Fittings – elbow, tee, crosses, flanged end, and tap boxes are offered in standard and custom configurations.
- Compatibility – the full range of XJ-L HD bus plugs are interchangeable for 100, 225, and 400 amp busway.

XJ-L HD Bus Plugs and XPM Power Modules

SIEMENS

Selection Guide

Enclosure Type	Plug-in Spacing	Breaker Type	Application
B = 3 Circuit - XQR Series	20.00 & 9.75[13]	BQ, BQH, HBQ	XQR style — with duplex receptacle provision. May be used for custom receptacles or when additional wiring space is required
C = 3 Circuit HD XPM	20.00 & 9.75		Use for applications that require factory installed breakers and receptacles
D = 3-6 Circuit HD XPM	20.00 & 9.75	BL, BLH, HBL, BQD	
G = XLEC	20.00 & 9.75[13]	ED2,ED4,ED6, HED4	Cover operable handle. Uses heavy duty E-Frame Breakers
H = XEC	20.00 & 9.75[13]		Uses heavy duty E-Frame breakers
J = Plug-in Tap Box	20.00[15]	na	Plug-in tap off device - lugs only
K = XLVB Fusible	20.00 & 9.75[13]	na	Cover operable Vacu-Break Switch

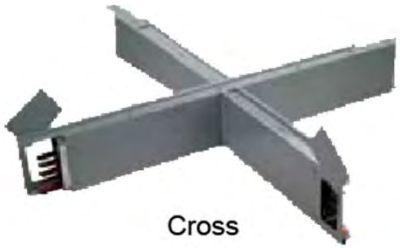
Bus plugs for XJ-L HD busway are available from 15 to 100 amps with molded case circuit breakers or 30, 60, or 100 amps with a Vacu-Break fusible switch. All XJ-L bus plugs are fully interchangeable with all XJ-L busway configurations.

Lightweight and portable, plugs can be installed or relocated as required without de-energizing the busway. Pre-engineered plug-in opening locations ensure no interference for greater density and maximum flexibility. This is especially important in high tech areas requiring frequent movement of equipment.

XJ-L HD power modules (XPMs) are available with 3 or 6 branch circuit protection in both 1-phase and 3-phase configurations ranging from 15 to 60 amps per circuit for maximum power density and flexibility.

A wide variety of NEMA and IEC receptacles or cord connections are available for XPMs.

Additional XJ-L HD Busway Components

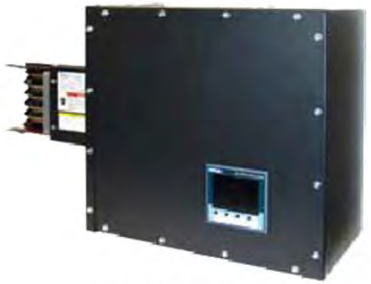

Cross


Tee


Flat Right Elbow


Edge Right Elbow


Center Tap Box


End Tap Box


Flanged End


Hanger


End Closer

In addition to straight plug-in sections with lengths of two, five, or ten ft. and straight feeder sections in lengths from 16 in. to ten ft., a full range of additional XJ-L HD busway components are available. Some of these components are shown in the accompanying graphic.

Classroom Learning

Studies indicate that when students practice what they have learned in a classroom setting they retain 75% of the lesson, as compared with lecture-only settings where they retain just 20% of the lesson.

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Chapter 4 – XJ-L HD, XL-U, and BD Busway

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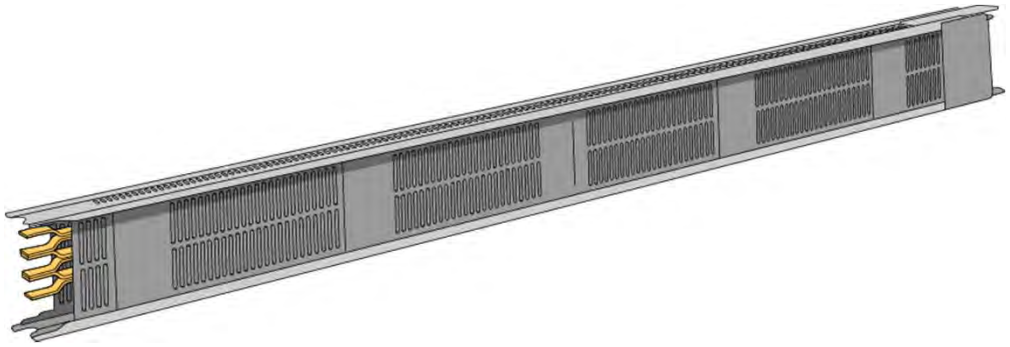
- XJ-L HD Busway
- **XL-U Busway**
- BD Busway

XL-U Busway



XL-U busway is designed for applications with grueling duty cycles, such those including heavy-duty welding. XL-U busway is available for 3-phase, 3-wire and 3-phase, 4-wire applications with a maximum voltage of 600 volts.

Both feeder and plug-in XL-U busway are available with ratings of 225 to 5000 amps for aluminum bus bars or 225 to 6500 amps for copper bus bars.

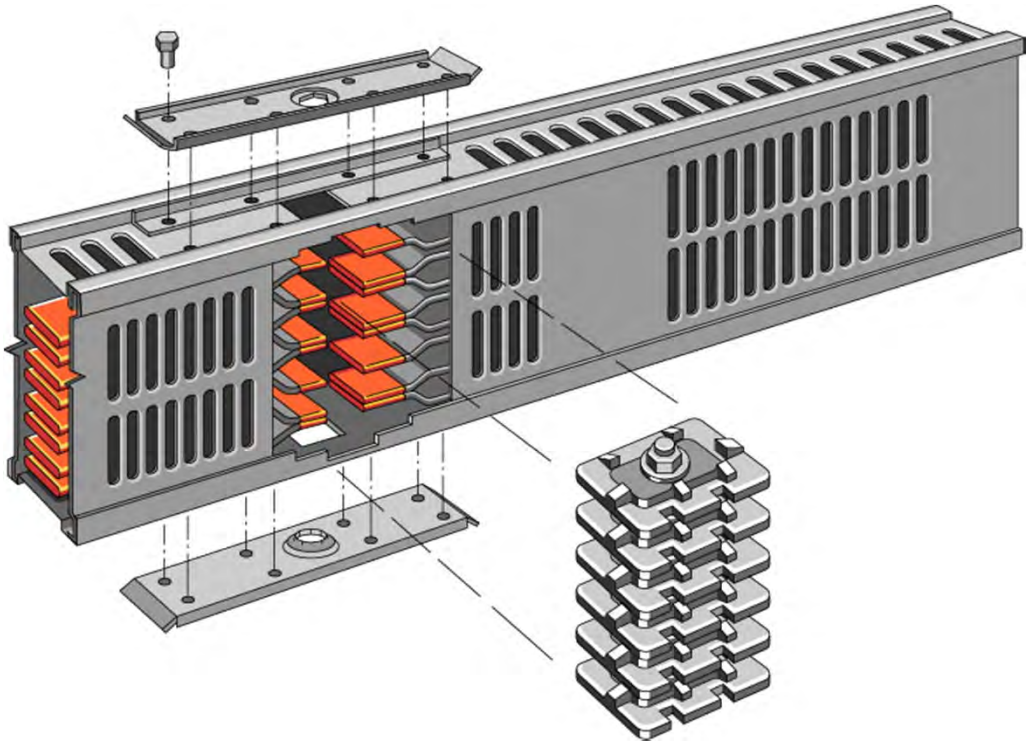
XL-U feeder busway is available with either an indoor or outdoor enclosure. XL-U plug-in busway has a ventilated, indoor enclosure. Outdoor enclosures are totally enclosed.

Sections and Components

XL-U feeder busway sections can be supplied in any length from 14 in. to 10 ft. XL-U plug-in busway is available in 4, 6, 8, and 10 ft. sections.

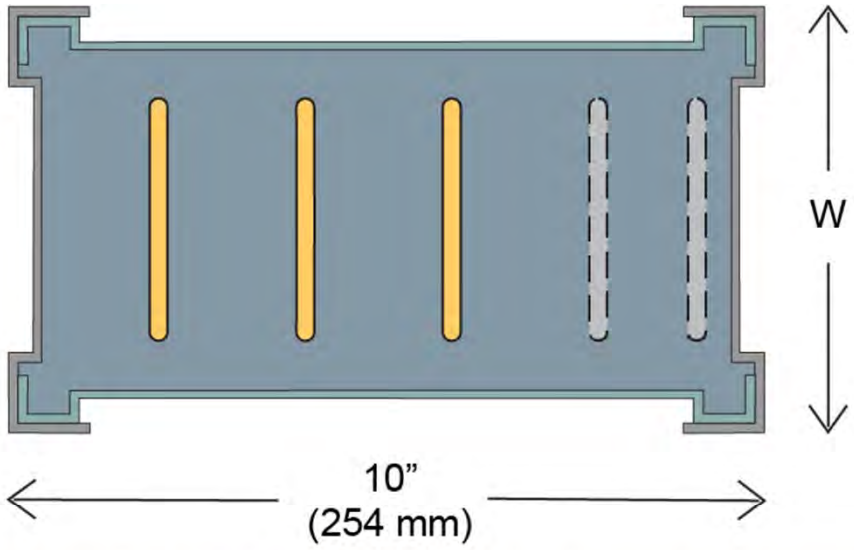
Elbows, tees, crosses, end closers, wall flanges, tap boxes, flanged end connections, switchboard connections, bus plugs, reducers, and hangers are available.

Joint Stack



XL-U busway uses a joint stack to connect sections together. The joint stack bolt is secured with a recommended 35 ft. lbs. of torque.

One Bus Bar Per Phase



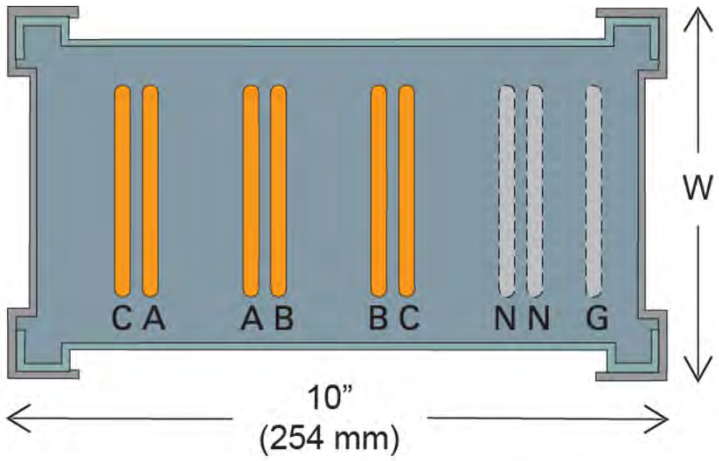
W	Bus Bars			Copper Ampere Ratings					
	Number of Conductors			Ventilated Bars on Edge		Ventilated Bars Flat		Totally Enclosed	
	Per Ø	N	G	UL	Std.	UL	Std.	UL	Std.
4.5" (114 mm)	1	1	1	225	225	225	225	225	225
4.5" (114 mm)	1	1	1	400	400	400	400	400	400
4.5" (114 mm)	1	1	1	600	600	600	600	600	600
			Aluminum Ampere Ratings						
4.5" (114 mm)	1	1	1	225	225	225	225	225	225
4.5" (114 mm)	1	1	1	400	400	400	400	400	400
5.5" (140 mm)	1	1	1	600	600	600	600	600	600

Ground bus capacity = 100%

XL-U busway is available from 225 to 6500 amperes. The number of bus bars and the dimensions depend on the maximum current rating. XL-U busway can be mounted vertically or horizontally and bus bars can either be on edge or flat.

The cross sections illustrated in the accompanying graphic are shown edgewise mounted. The W dimension varies with the current rating. XL-U busway is available in a one-bar-per-phase configuration for the maximum current ratings shown in the accompanying table.

Two Bus Bars Per Phase



W	Bus Bars			Copper Ampere Rating					
	Number of Conductors			Ventilated Bars on Edge		Ventilated Bars Flat		Totally Enclosed	
	Per Ø	N	G	UL	Std.	UL	Std.	UL	Std.
4.5" (114 mm)	2	2	1	800	800	800	800		
4.5" (114 mm)	2	2	1	1200	1200	1000	1000	800	800
4.5" (114 mm)	2	2	1	1450	1350	12000	1200	1000	1000
5.5" (140 mm)	2	2	1	1700	1600	1350	1350	1100	
5.5" (140 mm)	2	2	1	2000	2000	1600	1600	1250	1200
				Aluminum Ampere Rating					
4.5" (114 mm)	2	2	1	800	800	800	800		
4.5" (114 mm)	2	2	1	1000	1000	900		800	800
5.5" (140 mm)	2	2	1	1250	1200	1000	1000	900	
5.5" (140 mm)	2	2	1	1400	1350	1200	1200	1000	1000

Ground bus capacity = 50%

XL-U busway is available in a two-bar-per-phase, paired-phase configuration for the maximum current ratings shown in the accompanying table.

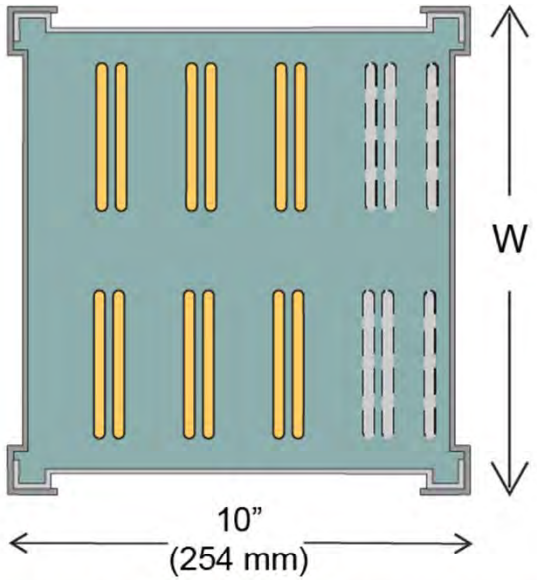
XL-U bus bars are grouped in pairs so that current in each pair is nearly equal in magnitude and opposite in direction. Two bus bars per phase are used. Phase C is paired with phase A, phase A is paired with phase B, and phase B is paired with phase C.

The result is a minimized magnetic field. Current is balanced, temperature rise is kept to a minimum, and voltage drop is reduced.

XL-U busway can be used on any application within its current rating but it is usually used for long runs where end-of-run voltage is critical.

Due to its paired-phase design, XL-U busway is known throughout the industry as the best product available for welder loads.

Four Bus Bars Per Phase



W	Bus Bars Number of Conductors			Copper Ampere Rating Ventilated Bars on Edge		Ventilated Bars Flat		Totally Enclosed	
	Per Ø	N	G	UL	Std.	UL	Std.	UL	Std.
7.5" (191 mm)	4	4	2	2300		2000		1400	1350
7.5" (191 mm)	4	4	2	2700	2500	2300	2000	1600	1600
9.5" (241 mm)	4	4	2	3000	3000	2500	2500	1900	
9.5" (241 mm)	4	4	2	3500	3500	2800	2800	2100	2000
				Aluminum Ampere Rating					
7.5" (191 mm)	4	4	2	1700	1600	1500	1350		
7.5" (191 mm)	4	4	2	2000	2000	1700	1600	1200	1200
9.5" (241 mm)	4	4	2	2300		1900		1400	1350
9.5" (241 mm)	4	4	2	2500	2500	2100	2000	1600	1600

Ground bus capacity = 50%

At higher current ratings bus bars are doubled up. Four bars per phase are used in the current ratings shown in the accompanying table. Paired-phasing is used.

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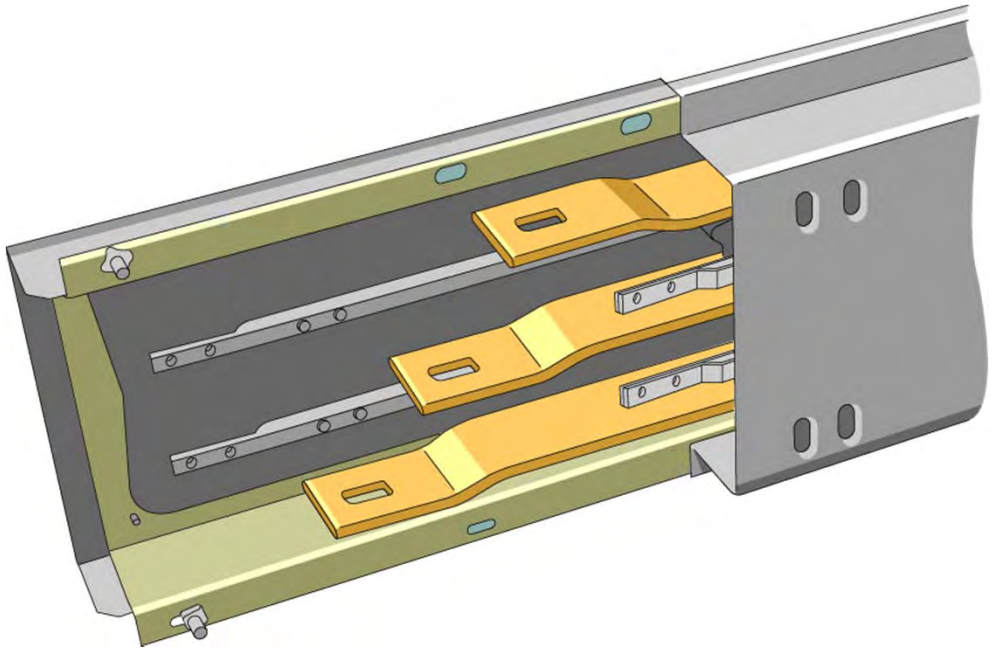
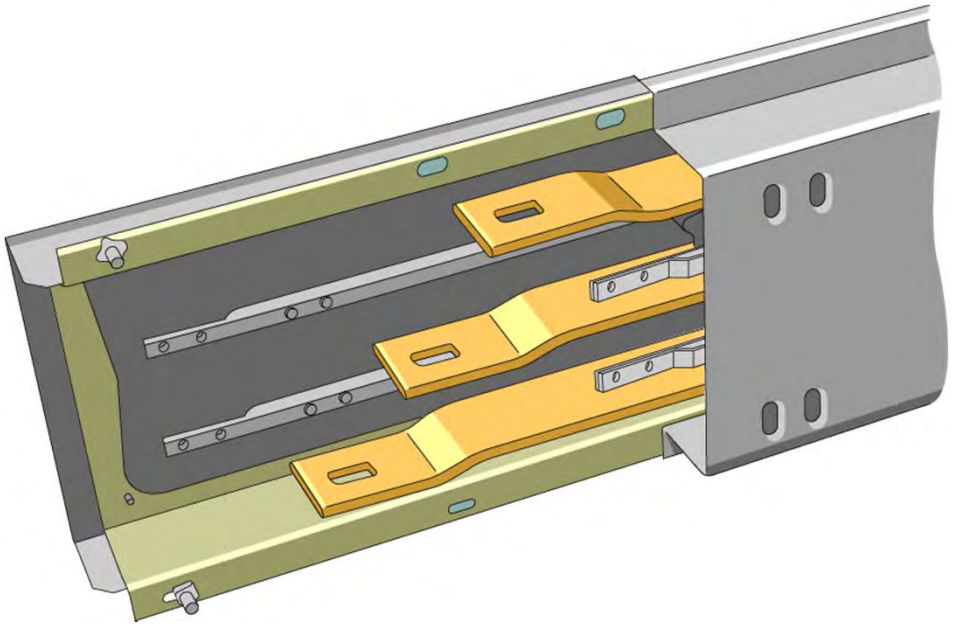


This chapter covers the following topics:

- XJ-L HD Busway
- XL-U Busway
- **BD Busway**

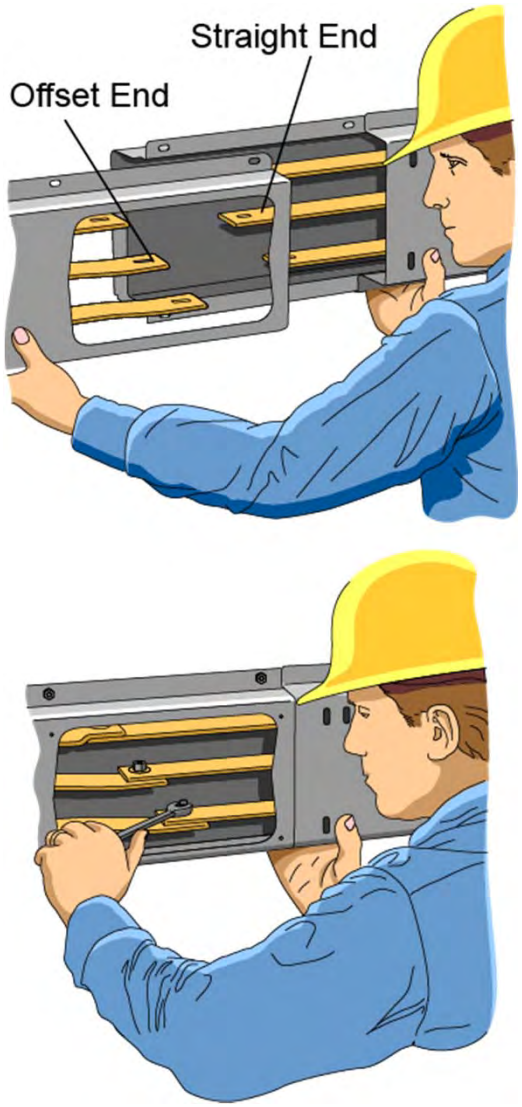
BD Busway



Siemens BD busway is a general purpose power distribution busway of the plug-in design. BD busway is well established in the industry and has proven to be a dependable system.

BD busway was first introduced in 1932, and, with the exception of minor upgrades in materials, the basic design has remained unchanged. This means older systems can be expanded with new BD busway components.

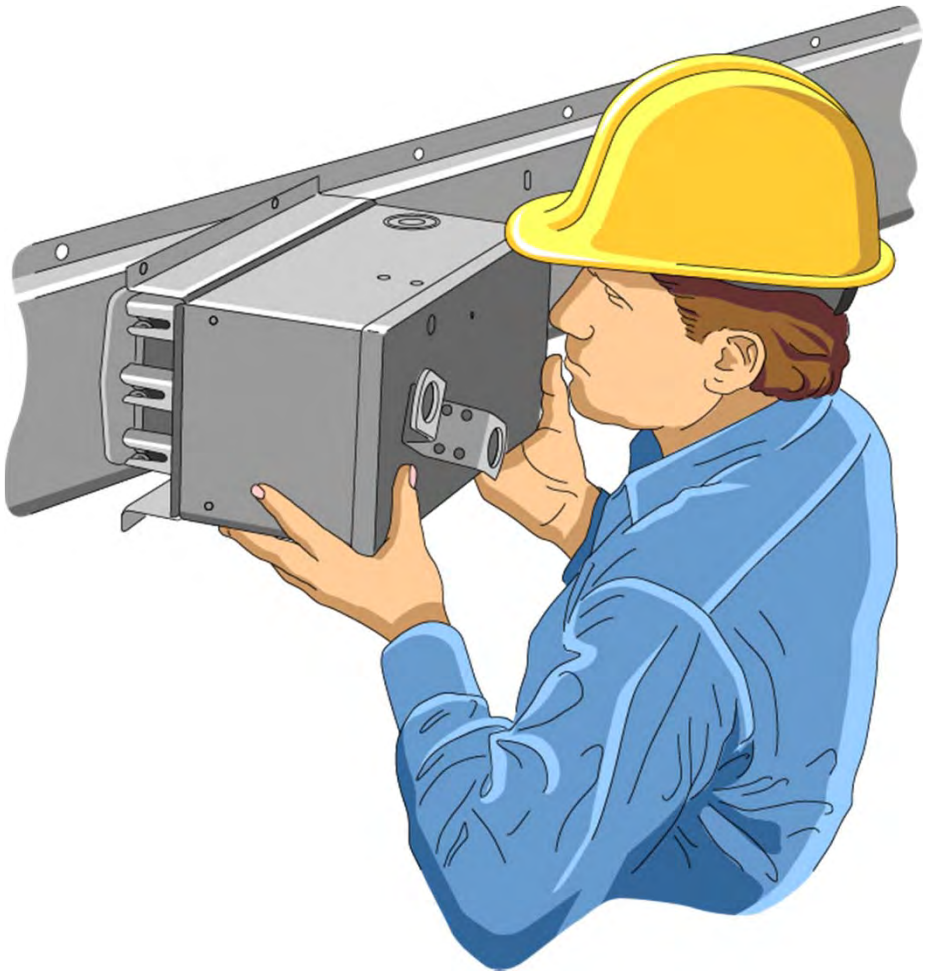
BD Busway Installation



The bus bars of one end of a section are offset and the other end is straight. To connect two sections together, match an offset end with a straight end. When ordering new BD busway to expand an existing system it is important to note if the new connection will be to an existing offset or straight end.

Bus bars are bolted together with a recommended 25 ft. lbs. of torque.

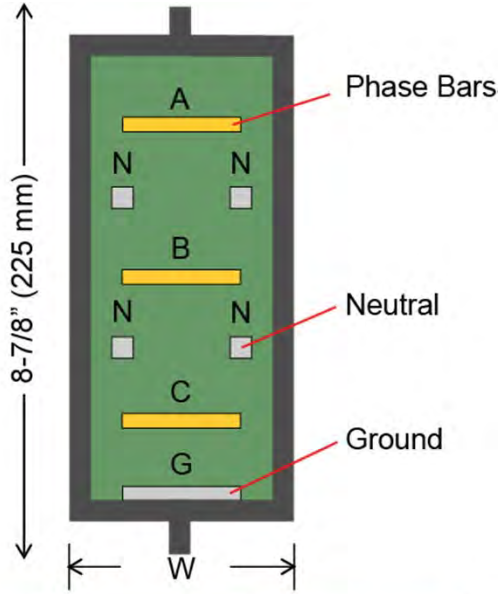
Bus Plugs



Each 10 ft. section has ten bus plug receptacles, spaced alternately on each side (five on each side) of the busway section.

Circuit breaker plugs are available in sizes from 100 to 250 amps for voltages of 600 VAC or less. Fusible Vacu-Break switch plugs are available in sizes of 30 to 200 amps, 3-pole, 600 VAC or less, or 4-pole solid neutral, 240 or 480 VAC.

BD Busway Components



3Ø3W		3Ø4W - 100% Neutral	
Ampere Rating	Width (W)	Ampere Rating	Width (W)
Aluminum			
225	4 1/16" (103 mm)	225	4 1/16" (103 mm)
400	4 1/16" (103 mm)	400	4 1/16" (103 mm)
600	6 1/16" (154 mm)	600	6 1/16" (154 mm)
800	6 1/16" (154 mm)	800	8 1/8" (206 mm)
1000	12 1/8" (308 mm)	1000	12 1/8" (308 mm)
1200	12 1/8" (308 mm)	1200	12 1/8" (308 mm)
Copper			
225	4 1/16" (103 mm)	225	4 1/16" (103 mm)
400	4 1/16" (103 mm)	400	4 1/16" (103 mm)
600	4 1/16" (103 mm)	600	4 1/16" (103 mm)
800	6 1/16" (154 mm)	800	8 1/8" (206 mm)
1000	6 1/16" (154 mm)	1000	8 1/8" (206 mm)
1350	12 1/8" (308 mm)		
1600	12 1/8" (308 mm)		

BD busway comes in 10 ft. lengths in current ratings from 225 to 1600 amps. The number of bus bars per phase is determined by the current rating. A section of 225 amp aluminum busway, for example, has one bar per phase. A section of 1000 amp aluminum busway has two bus bars per phase. The accompanying busway cross section diagram and table show the ampere ratings and dimensions of BD busway.

In addition to straight sections and bus plugs, the following components are available for BD busway: crosses, end closers, elbows, hangers, tap boxes, and tees.

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Course Completion

This course covered the following topics:

Chapter 1 - Introduction

- Overview
- Circuit Protection

Chapter 2 – Sentron Busway

- Overview
- Components
- Bus Plugs

Chapter 3 – System Design

- Planning a System

Chapter 4 – XJ-L HD, XL-U, and BD Busway

- XJ-L HD Busway
- XL-U Busway
- BD Busway

This course has covered the topics shown on the left. Thank you for your efforts. You can complete this course by taking the final exam and scoring at least 70%.