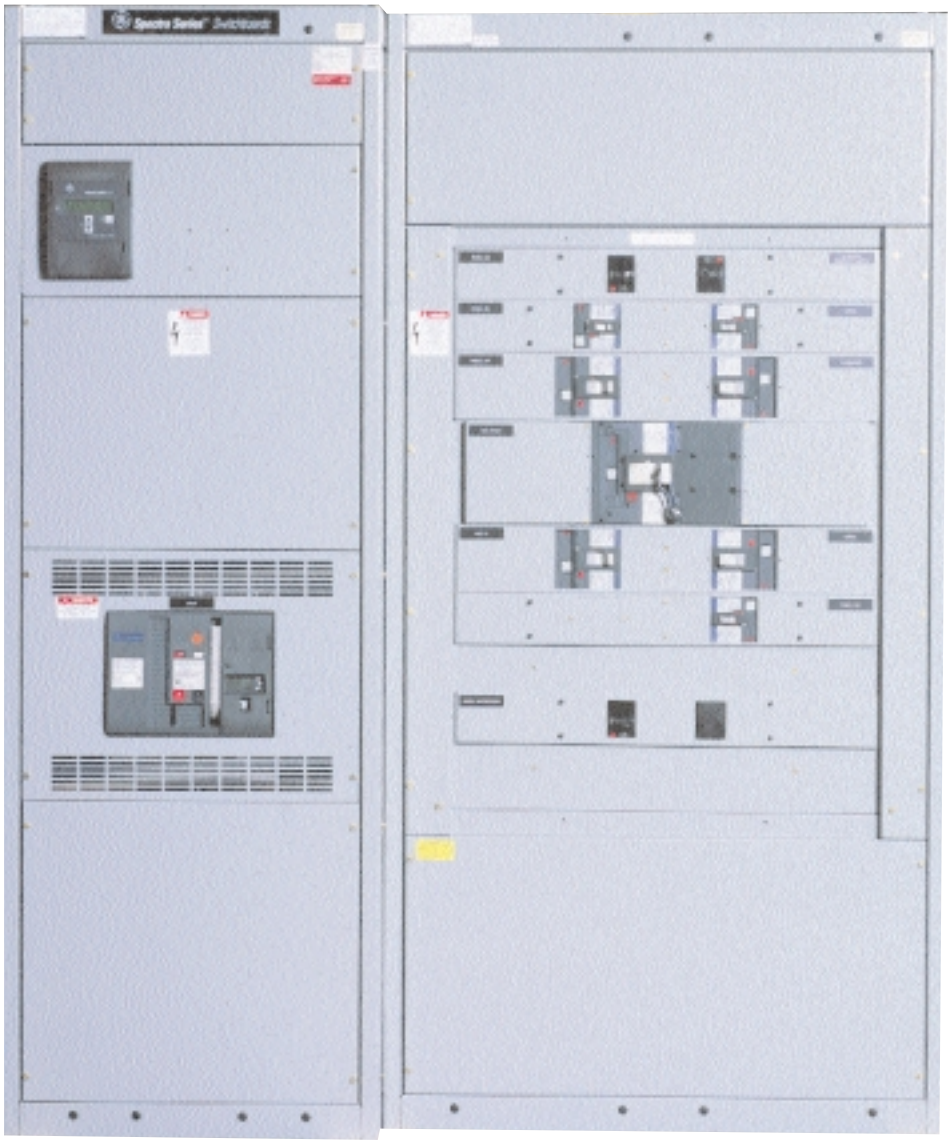
GE Industrial Systems



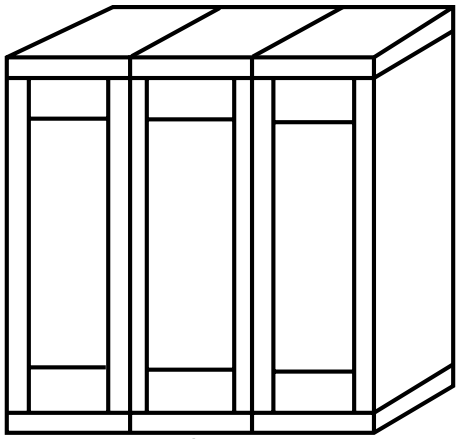
SPECTRA SERIES SWITCHBOARDS

Introduction

Spectra Series™ Switchboards offer a state-of the-art design that provides the high quality, safety and reliability long associated with GE group-mounted switchboards. Spectra Series Switchboards are designed and manufactured to meet the stringent GE internal standards along with NEMA, NEC, UL and CSA requirements. In addition, Spectra RMS™ Circuit Breakers meet all NEMA, NEC, UL and CSA requirements, plus those for JIS and IEC.

Contents

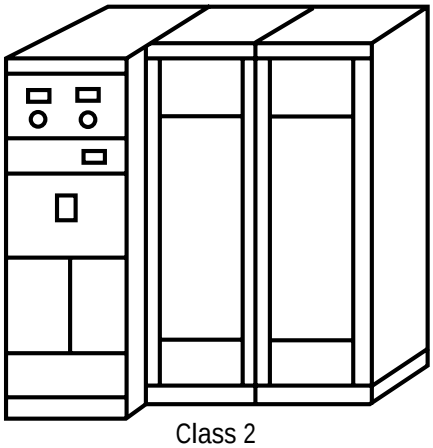
Spectra Series™ Switchboards



Class 1

- **Group-Mounted Main and Feeders Front-Accessible**
  1200A Mains maximum
  1200A Feeders maximum
  Rear alignment standard
  Minimum depth 25"
  Main lugs to 2000A
  May be mounted against wall

- **Main and Feeder Devices Group-Mounted**
  Molded case circuit breakers
  Fusible switches type ADS (Spectra plug-in only)
  Spectra RMS™① Molded case circuit breakers
  Spectra RMS① Molded case circuit breakers with MicroVersaTrip Plus™ or MicroVersaTrip PM™ trip units
  Current-limiting circuit breakers
  Integral ground fault with MicroVersaTrip Plus and PM, and Power+™
  Integral protective relay functions with MicroVersaTrip PM
  Integral POWER LEADER™ network communications with MicroVersaTrip PM



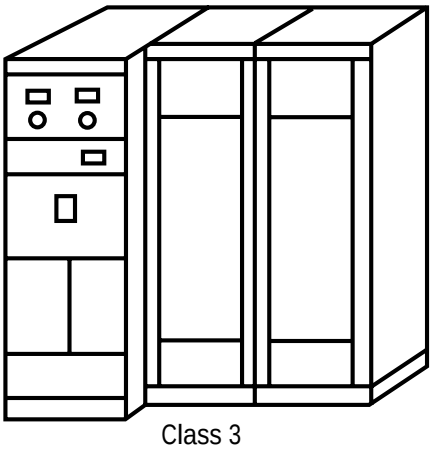
Class 2

- **Individually-Mounted Main, Group-Mounted Feeders Front Accessible or Front/Rear**
  4000A Mains maximum
  1200A feeders maximum
  Rear alignment standard
  Utility CT Compartments
  Main lugs to 6000A
  Depths: Mains 25" - 60" Feeders 25" minimum
  Plug-In™ or Bolt-On™ Construction for feeders

- **Mains Individually-Mounted**
  Power Break I® & Power Break II® Insulated case circuit breakers 800-4000A with Power+, MicroVersaTrip Plus or MicroVersaTrip PM trip units
  High pressure contact switches 800-4000A
  Integral ground fault with High Pressure Contact Switch, Spectra Series and Power Break Series
  Integral protective relay functions with MicroVersaTrip PM
  Integral POWER LEADER network communications with MicroVersaTrip PM
  Bolted Pressure Switches 800 - 4000A

- **Feeder Devices, Group-Mounted**
  Molded case circuit breakers
  Fusible switches type ADS (Plug-In only)
  Spectra RMS™① Molded case circuit breakers
  Spectra RMS① Molded case circuit breakers with MicroVersaTrip Plus or MicroVersaTrip PM trip units
  Current-limiting circuit breakers
  Integral ground fault with MicroVersaTrip Plus or MicroVersaTrip PM
  Integral protective relay functions with MicroVersaTrip PM
  Integral POWER LEADER network communications with MicroVersaTrip PM

AV3 Access Switchboards



Class 3

Class 3 Access Switchboards

• Features and Options

Rear accessible
Front and rear alignment
Depths 50-60 inches
Molded case / insulated case / low voltage power circuit breaker mains
Molded case distribution sections
Copper bus
Feeder operating handles “thru the door”

• Main and Tie Devices - Individually Mounted

Spectra molded case breaker up to 1200A
PowerBreak II insulated case breaker up to 4000A
WavePro / AKR low voltage power circuit breaker up to 5000A

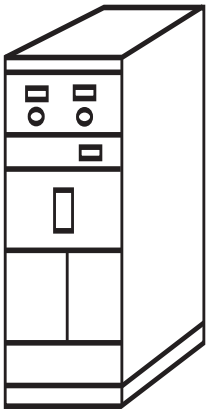
• Feeder Devices, Individually Mounted

Spectra molded case circuit breaker - E (150A), F (250A), G (600A), K (1200A) frame breakers, 80 & 100% rated
Current limiting breakers
Fuseless THLC 225 & 400A
Fused Tri-Break 400 / 600 / 800A

• General Construction Features

Tin plated copper main bus - standard, silver plating optional
2000A silver plated copper vertical (riser) bus - standard in MCCB sections
Shutters available on ICCB and LVPCB main and tie breakers
6000A main bus rating - maximum
Plug-in MCCB mounting with racking bolts - standard
Standard 30 cycle bus short circuit withstand rating up to 85ka allows LVPCB main w / o instantaneous trips
200ka bus bracing available with fused main device
Bare bus standard
Optional insulated horizontal main bus with phase isolated vertical bus available in all sections
Bus sizing based on 1000A IN^2 current density
15 / 30 / 45 inch wide MCCB sections

Spectra Series™ Switchboards



Class 5

- **Individually-Mounted Mains and Feeders**

800A - 4000A
HPC Switch
PowerBreak
400A - 1200A
QMR Switch
Spectra Breaker
5000A Boltco Pressure Switch
AKR Breaker (Mains & Tie Devices only)
800A - 5000A AKR Breaker

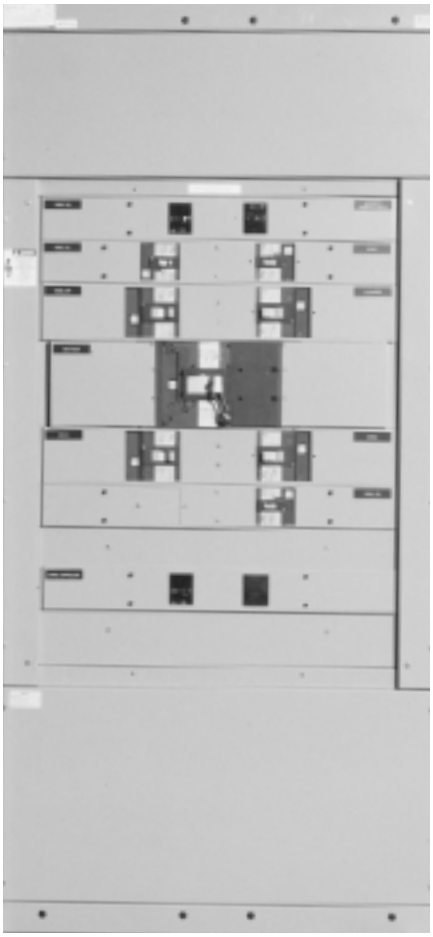
Note: For applications requiring insulated/isolated bus, generator control and extensive relaying refer to AV-3 or PowerBreak (EPC section 4).

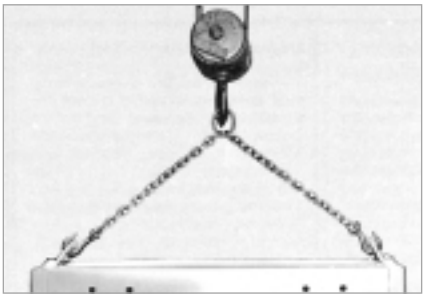
Flexibility, Reliability, Simplicity & Safety

GE has designed a bus bar interior for use in Spectra Series™ (group-mounted) Switchboards and Spectra Series Power Panelboards.

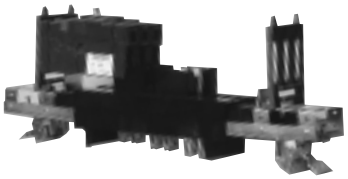
The distribution section interior is the basic building block, designed for use with either fusible switches (plug-in only) or molded case circuit breakers, or both.

The modularity of Spectra Plug-in is possible because the interior is designed to accept device modules with spring-reinforced jaws and pressure-locked connections. The jaws and connections are an integral part of the branch modules.





Standard lifting plates, shown, are normally furnished. Alternate lifting beams may be furnished depending on switchboard size and device loading.



Spectra Series Plug-In™ circuit breaker modules accept standard off-the-shelf GE breakers and are available far single- or double-branch mounting (through 600A) without any modifications, assuring proper phase arrangement.

Spectra Series Plug-In branch fusible modules can be single- or double- (through 200A) mounted, two- or three-pole.

Snap-on filler plates provide a durable attachment with no loose hardware.

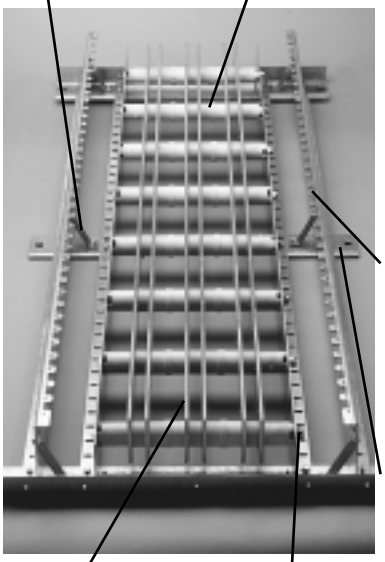
Spectra Switchboard - Group - Mounted Interior Design

The vertical design of the bus maximizes convective heat transfer. The bus bar insulator system provides short circuit bracing to 200 kA, Plug-In and 100kA Bolt-on 600-volt spacing (without having to add baffles) and eliminates the need for any additional insulation.

Spectra Plug-In™

Mounting support brackets between bus support rails and mounting rails.

Double-insulated system consisting of bus support assemblies of molded, glass-filled polyester insulation and insulating tubes over high-strength steel bolts spaced on 7" centers that prevent bus bars from distorting during short-circuit conditions.



Mounting rails (2) with means for positioning, engaging and grounding pressure-locked connections. (plug-in only)

Interior cross-member supports for mounting rails and bus support rails.

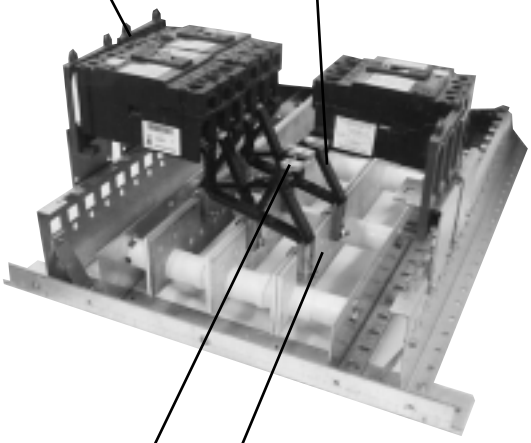
Isolated bus support rails (2).

Standard bus is aluminum, heat rated per UL. Optional ratings include 750A psi or 600A psi aluminum and heat rated per UL, 1000A psi or 800A psi copper. All vertical bus bars are silver plated.

Spectra Bolt-On™

Bolted connection between switchboard vertical bus and breaker primary connection.

Vertical bus oriented edgewise for ease of bolted breaker strap connections.



Vertical bus is pre-drilled for location of breakers in any standard position.

Anti-turn device utilized at the bolted connection between the breaker strap and vertical bus.

Field Changes Are Quick and Easy

Spectra Plug-In™ Switchboard Construction

The universal interior has made possible a family of modular components that provide the flexibility unique to the Spectra Series™ product line. By utilizing modular assembly and pressure-locked connections to the interior, maintenance and tests are easier and faster.

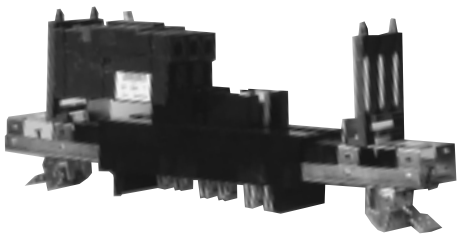
This innovative design approach also facilitates field reconfiguration. Branch fusible units can be removed and circuit breaker units substituted.

Fusible switch and circuit breaker modules each consist of two assemblies: the protective device (fusible switch unit or molded case circuit breaker) and a connecting mechanism. The connecting mechanisms are the intermediate electrical/mechanical connections between the protective device and the bus structure in the interior. The fusible connecting mechanism is in the same housing as the fusible switch unit. The molded case circuit breaker connecting mechanism is separate from the breakers and is designed to accept standard GE circuit breakers.

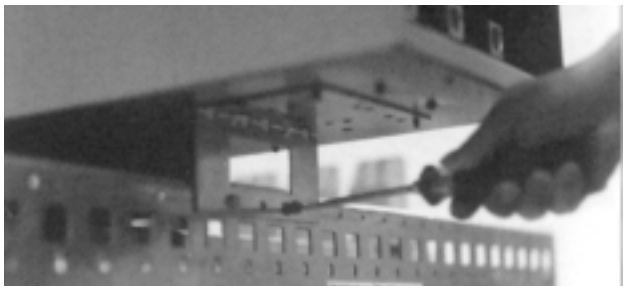
The electrical connection is made utilizing spring-reinforced jaws that engage the bus bars. This type of proven design, long utilized in switchgear and busway, provides a reliable and superior electrical connection.

Mechanical connection is made with a positive, self-aligning, spring-loaded locking device bolted to each side of the mounting module. When the device module is inserted in the interior, this mechanism springs into place and positive engaging latches secure the module to the interior mounting rails.

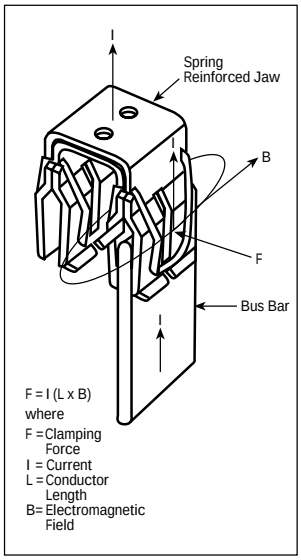
To prevent personnel from accidentally releasing the locked pressure connections, circuit breaker modules handles are bolted to each side of the module. Fusible modules are bolted directly to the interior mounting rails.



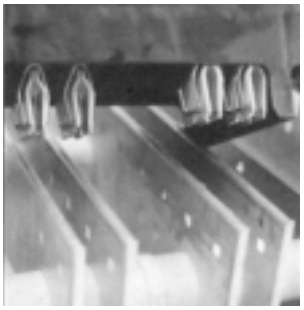
The circuit breaker mounting module has provisions for bolting various breaker ratings in place and barriers to divert ionized gases away from line terminals of opposite devices on the same module. Both types of connector-mounting modules are UL listed and CSA certified.



The fusible switch module has a self-aligning bracket screwed to the interior mounting rails.



The spring-reinforced jaw clamps onto the interior bus and maintains the electrical connection. At short circuit, a strong electro-magnetic field develops around the jaw. The resulting force increases the jaw pressure on the bus and maintains a secure connection. The design creates current paths and generates clamping forces as shown in the illustration.

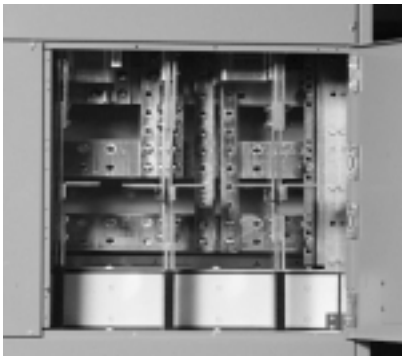


Features

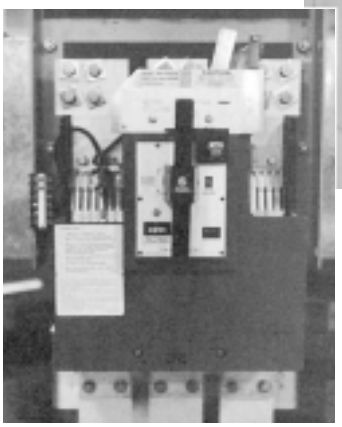
The main and utility CT compartments are designed to offer maximum flexibility. Individually-mounted main is available with Power Break II® insulated case circuit breakers, 800A-4000A; high pressure contact switches, 800A-4000A; fusible switches, 400A-1200A; AKR low voltage power circuit breakers, 800A-5000A; molded case circuit breakers, including MicroVersaTrip®, 400A-1200A; and bolted pressure switches. (800 - 5000A)

PCU units are available, allowing for motor starter applications up to 15hp. (plug-in only)

Standard utility current transformer compartments have barriers rear, top and bottom. Door has concealed hinges, three-point catch, with lockable and sealable handle. Optional side barriers are available. Current transformer compartments to meet other utility requirements are available.



A hinged door is standard on instrument and metering compartments.



Type HPC high pressure contact switches are available with integral ground fault protection.

Power Breaker II circuit breakers with MicroVersaTrip Plus™, MicroVersaTrip PM™ and Power+™ trip units are available as mains, submains, and ties in switchboards.

Spectra Bolt-On™ Specifications

Front & Front/Rear Accessible Group-Mounted Switchboards

- The contractor shall furnish and install complete all switchboards as shown on the drawings and as described in these specifications.
- The switchboards shall be designed, built and tested in accordance with NEMA PB-2 and Underwriters Laboratories No. UL 891 and the latest requirements of the National Electrical Code. All sections and devices shall be UL listed and labeled.
- Class 1 Switchboard shall be GE Spectra with all devices -- mains and branches -- group-mounted in panelboard construction. Switchboard shall be front and capable of being installed against a wall. Maximum main device rating is 1200A.
- Class 2 Switchboard shall be GE Spectra with an individually-mounted main device section feeding a group-mounted distribution section(s). Switchboard shall be front or front/rear accessible. Maximum device rating is 4000A.
- Switchboard shall be a completely self supporting structure with 90" high vertical sections bolted together to form the required arrangement. All sections shall be rear aligned and may be rolled, moved or lifted into the installation position and bolted directly to the floor without the addition of floor sills. The structure frame shall be die formed 12 gauge steel with reinforcing corner gussets. Bolt-on enclosure covers shall be code gauge steel. All steel surfaces shall be chemically cleaned prior to painting; exterior paint color shall be ANSI 61 Light Gray.
- Bus bars shall be tin plated aluminum (standard) having a cross-section that meets UL heat rise requirements.① They shall be mounted on supports of high impact non-tracking insulating material, and shall be braced to withstand the mechanical forces exerted during short circuit conditions; 65,000 amperes RMS Symmetrical short circuit bracing is standard, and optional bracing up to 100,000 amperes RMS Symmetrical is available. A full length horizontal ground bus is secured to each vertical section.
- Panel vertical bus bars shall be tin plated aluminum or silver plated copper.
- A-B-C type bus arrangement (left-to-right, top-to-bottom, front-to-rear) shall be used throughout to assure convenient safe testing and maintenance. Where special circuitry precludes this arrangement, bus bars shall be labeled.
- All lugs shall be UL listed for use with copper or aluminum cable whose ampacity is based on 75°C conductor temperature ratings.
- Switchboard current ratings including devices shall be based on operation in a 25°C room ambient, per UL 891. For higher ambient, refer to section 6-1, for derating.
- Group-mounted branch devices must be capable of being installed or removed without loosening or removing bus bars. The switchboard symmetrical interior shall be designed and assembled so that the main and branch circuit breakers are connected to the interior bus bars with copper mounting straps. Anti-turn clips shall be used to prevent the straps from twisting during installation. If anti-turn clips are not used, at least two bolts shall be used to prevent twisting or turning of the straps during installation. The interior shall have insulation barriers installed over unused spaces for extra safety when field service is required.
- When switchboards are series rated to meet short circuit requirements, appropriate labels shall be included in the equipment. The tested UL listed combination ratings shall also be included in the UL recognized Component Directory DKSY2 (UL Yellow Book).
- Bellville washers on aluminum bus.
- Alstan plating process on aluminum bus.
- Copper & aluminum electrical joints shall be plated as required for compatibility.
- Ground bus is sized per UL 891 optional ground bus available, rated at 25% of incoming ampacity.
- 200% rated neutral bus available.
- Standard horizontal bus is tapered per UL 891. Full size horizontal bus with provisions for future connections is available.
- Internal control wiring is per UL 891.
- Switchboard shall be constructed for 120/208 3Ø, 4W WYE, 120/240 3Ø, 4W delta 277/480 3Ø, 4W WYE, and 480V 3Ø, 4W delta.
- NEMA 3R construction available.

① Optional bus bars shall be tin-plated aluminum, having a cross-section with a current density not exceeding 750 amperes per square inch or 600 amperes per square inch or silver plated copper heat rated, 1000 amperes per square inch, or 800 amperes per square inch.

Spectra Plug-In™ Specifications

Front & Front/Rear Accessible Group-Mounted Switchboards

- The contractor shall furnish and install complete all switchboards as shown on the drawings and as described in these specifications.
- The switchboards shall be designed, built and tested in accordance with NEMA PB-2 and Underwriters Laboratories No. UL 891 and the latest requirements of the National Electrical Code. All sections and devices shall be UL listed and labeled.
- Class 1 Switchboard shall be GE Spectra with all devices -- mains and branches -- group-mounted in panelboard construction. Switchboard shall be front accessible and capable of being installed against a wall. Maximum main device rating is 1200A.
- Class 2 Switchboard shall be GE Spectra with an individually-mounted main device section feeding a group-mounted distribution section(s). Switchboard shall be front or front/rear accessible. Maximum device rating is 4000A.
- Switchboard shall be a completely self supporting structure with 90" high vertical sections bolted together to form the required arrangement. All sections shall be rear aligned and may be rolled, moved or lifted into the installation position and bolted directly to the floor without the addition of floor sills. The structure frame shall be die formed 12 gauge steel with reinforcing corner gussets. Bolt-on enclosure covers shall be code gauge steel. All steel surfaces shall be chemically cleaned prior to painting; exterior paint color shall be ANSI 61 Light Gray.
- Bus bars shall be tin plated aluminum (standard) having a cross-section that meets UL heat rise requirements.① They shall be mounted on supports of high impact non-tracking insulating material, and shall be braced to withstand the mechanical forces exerted during short circuit conditions; 65,000 amperes RMS Symmetrical short circuit bracing is standard, and optional bracing up to 200,000 amperes RMS Symmetrical is available. A full length horizontal ground bus is secured to each vertical section.
- Panel vertical bus bars shall be silver plated. (aluminum or copper).
- A-B-C type bus arrangement (left-to-right, top-to-bottom, front-to-rear) shall be used throughout to assure convenient safe testing and maintenance. Where special circuitry precludes this arrangement, bus bars shall be labeled.
- All lugs shall be UL listed for use with copper or aluminum cable whose ampacity is based on 75°C conductor temperature ratings.
- Switchboard current ratings including devices shall be based on operation in a 25°C room ambient, per UL 891. For higher ambient, refer to section 6-1, for derating.
- Group-mounted branch devices must be capable of being installed or removed without loosening or removing bus bars. The devices shall utilize spring reinforced jaws for engaging the bus bars, except 800 and 1,200 amp fusible modules. The mechanical connection to the bus structure shall be separate from the electrical connection. Circuit breaker modules shall utilize positive, self-aligning, spring loaded locking devices with handles that can be bolted to each side of the device to prevent accidentally releasing the locked pressure connections. Fusible modules shall utilize positive, self-aligning mounting brackets that are bolted to each side of the device. The group-mounted switchboard interior must be UL listed to accept both circuit breaker and fusible switches which may be intermixed.
- When switchboards are series rated to meet short circuit requirements, appropriate labels shall be included in the equipment. The tested UL listed combination ratings shall also be included in the UL recognized Component Directory DKSY2 (UL Yellow Book).
- Bellville washers on aluminum bus.
- Alstan plating process on aluminum bus.
- Copper & aluminum electrical joints shall be plated as required for compatibility.
- Ground bus is sized per UL 891 optional ground bus available, rated at 25% of incoming ampacity.
- 200% rated neutral bus available.
- Standard horizontal bus is tapered per UL 891. Full size horizontal bus with provisions for future connections is available.
- Internal control wiring is per UL 891.
- Switchboard shall be constructed for 120/208 3ø, 4W WYE, 120/240 3ø, 4W delta 277/480 3ø, 4W WYE, and 480V 3ø, 4W delta.
- NEMA 3R construction available.

① Optional bus bars shall be tin-plated aluminum, having a cross-section with a current density not exceeding 750 amperes per square inch or 600 amperes per square inch or silver plated copper heat rated, 1000 amperes per square inch, or 800 amperes per square inch.

Spectra Series™ Terminology

Accessible means not permanently closed in by the switchboard section structure, and capable of being inspected and maintained through access plates or doors without disturbing the switchboard section structure.

Ambient Temperature is the temperature of the surrounding medium that comes in contact with a fuse, breaker or conducting bus within a switchboard defined by UL 891 as 25°C for switchboard.

Ampacity is the amount of current in amps a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

AMP rating is the amount of current a fuse will carry continuously without deterioration, or a circuit breaker without tripping and without exceeding temperature rise limits specified for a particular fuse or circuit breaker by NEC requirements and UL standards.

Amp Setting, Adjustable varies the continuous current-carrying ability of a breaker through a predetermined range.

Arcing Fault is a high-impedance connection, such as an arc through air or across insulation, between two conductors.

Arcing Time, in a fuse, is the amount of time that elapses between the melting of the current-responsive element, such as a link, to the final circuit interruption. Arcing time is dependent upon such factors as circuit voltage and impedance.

Available Short-Circuit Current is the maximum rms (root-mean-square) symmetrical current at a given point in a power system, operating with maximum generating capacity and connected load, can deliver to any zero impedance short circuit applied at that given point.

Blank Space Only is specified when corresponding vertical bus device mounting and connecting straps are not furnished.

Branch Circuit is the circuit conductor between the final overcurrent device protection and the outlets or point of use.

Bus Bar is a solid aluminum or copper alloy bar that carries current to the branch or feeder devices in a power panelboard or switchboard. There is at least one bus bar for each phase of the incoming electrical service.

Bus Stub is a prefabrication provision manufactured in the switchboard for connection of incoming service or load bus.

Class I--Group mounted main and feeders.

Class II-Individually mounted main and group mounted feeders.

Class III-Individually mounted main and feeders with compartmentalization (not available in Spectra Switchboard.)

Class V-Individually mounted mains and feeders without compartmentalization.

Compartment is an area within a section that is so constructed as to isolate devices in that compartment from the surrounding area except for openings used for interconnections, control or ventilation.

Compression Lug, also called a crimp lug, is a lug that is crimped to hold cable.

Continuous Load is when the maximum current is expected to continue for three hours or more.

Current Density is rated current divided by the cross-section area of the conducting member (cable, bus bar, etc.) expressed in amps per square inch.

Current Sensors monitor and measure load current. A ground fault current is an imbalance that causes a relay to signal the breaker to trip at a preset time and current level if ground fault function is present.

Dead Front construction is where energized parts are not exposed to a person on the operating side of the equipment.

Distribution Switchboard is any switchboard which is not UL listed for service entrance or classified as a main switchboard.

Double-Branch is mounting that has two fusible switch units or circuit breakers installed side by side.

Draw-Out Mounted device can be removed from the stationary portion of a switchboard without unbolting connections or mounting supports. Draw-out mounting is available in Power Break II and AKR devices only.

Spectra Series™ Terminology

Electrically Operated refers to an electrically operated mechanism to remotely open and close a circuit breaker. Typically used in automatic throwover schemes and automatic control schemes.

Electrical Service or System is the conductors and equipment which delivers energy from the electrical supply system to the wiring system of the premises served. The service or system consists of the number of phases, number of wires, voltages and amps. Type of service determines the number of poles on the main device, the number of poles valid for feeder or branch devices and the minimum voltages for 1-, 2-, or 3-pole breakers and fusible switches.

Enclosure is a constructed case to protect personnel against contact with the enclosed equipment and to protect the enclosed equipment against environmental conditions.

Equipment Grounding is the interconnection and grounding of electrical conduction material that either encloses or is adjacent to power conducting components.

Expansion Kit is an assembled kit that can be installed in an empty side of a double-branch fusible switch unit to create a new fusible switch unit It includes the handle, base plate, cover plate, load base and switch.

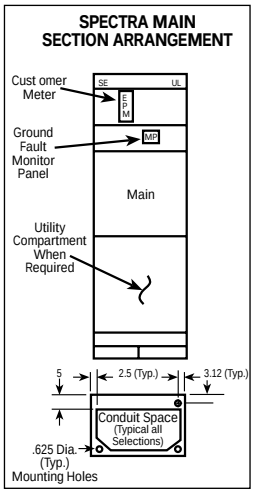
Feeder Circuit is all circuit conductors between the service equipment or the source of a separately derived system and the final branch-circuit overcurrent device.

Filler Mounts on side of fusible switch module, circuit breaker module, or between side trims to cover the front of the enclosure. The fillers plus trim comprise the enclosure front around the installed devices.

Fire Pump Disconnect serves only the code required fire pump. It must be connected ahead of any main device and sized to carry the locked rotor current of the fire pump per NFPA-20.

Frame Size is the physical size of the breaker with a specific range of amp ratings. For example, an Frame breaker is available in ratings of 70 amps to 225 amps in a 225 amp frame.

Front Accessible Single section arrangements with main device and utility cabinet furnished through 2000A ratings when the utility does not require potential transformers. If customer metering and/or ground fault relay is required, service cables must enter from above. Otherwise, two sections are provided. All other arrangements may require side or rear access, or additional section(s).



Front Only Accessible is a UL classification requiring that all line & load connections can be made from the front of the switchboard.

Front/Rear Access is configured where rear access is required for some or all of the line and load connections.

Front and Rear Line-Up occurs when all sections in a switchboard lineup are the same depth and front and rear surfaces are aligned.

Full Height Bus refers to the maximum vertical bus length available for the application.

Fully Rated Bus refers to having the same ampacity for the horizontal bus across the whole line-up.

Fuse Pullers are installed in fusible switch units to facilitate removal of the fuse.

Fuseholder or Fuse Block is an assembly of fuse clips and insulation for mounting and connecting a fuse into the circuit.

Fusible Switch is a device that can switch off current flow and to which a fuse(s) is added to protect conductors.

Spectra Series™ Terminology

Ground Bus is horizontal bus which is electrically continuous with the switchboard housing for termination of circuit ground conductor.

Ground Fault A fault condition created when an energized conductor comes in contact with earth ground or metallic structure, or causes an arc current to flow to ground.

Group (Panel)-Mounted device is one of a closely grouped assembly of devices which is mounted on a common base or mounting surface utilizing panelboard type construction. The total assembly is then mounted in a switchboard combination or distribution section.

Handle Lock Device is a mechanism to insert a lock to prevent operation of a circuit protective device. Most commonly used to lock device in the open or off position for safety while performing maintenance.

Heat Rise is the maximum temperature a component in a switchboard can increase in temperature over a defined amount 65°C per UL 891.

I^2t is the measure of heat energy developed within a circuit, in which I2 stands for effective let-through current squared and t is time in seconds.

Individually Mounted means device which is not panel-mounted and which may or may not be enclosed in its own compartment. Separated from other devices to minimize undesired influence from them. (i.e. GE Class 3 and PowerBreak Switchboard). Power Break, HPC, AKR and BPS devices are individually mounted.

Interior refers to the side rails, bus bars and insulation system that mounts in the enclosure. It is energized through the main device (lugs, fusible switch or circuit breaker) and, in turn, energizes the installed circuit-protective devices (fusible switch or circuit breaker).

Interrupting Rating is the highest rms-rated current a fuse or breaker is intended to interrupt under specified conditions.

Jaw refers to the metal parts that grip the interior bus bar and conduct electricity to the module bus bars. The jaws are spring-reinforced to provide a highly reliable electrical connection.

Key Interlock, commonly called Kirk-keys, provides a mechanical method to interlock two or more devices utilizing a removable key which can only be inserted in one location at one time.

Line refers to the incoming (live) side of equipment or device.

Load is the outgoing (switched) side of equipment or device.

Lug is a device to terminate cables.

Magnetic Trip is synonymous with instantaneous trip and describes a tripping action with no intentional time delay. Current exceeding the magnetic trip level will actuate the trip mechanism and open the breaker contacts immediately.

Main Device is a single device that disconnects all ungrounded switchboard conductors, other than control power conductors when used, from the supply bus.

Main Lug is the connecting means between the incoming service cable and the bus bar.

Mechanical Lug is a terminal with one or more wire binding screws that are tightened to hold the conductor or cable.

Mimic Bus functionally displays internal buswork by applying tape or plastic strip on equipment exterior.

NEMA Type 1 Enclosure - General Purpose Indoor is intended primarily to prevent accidental contact of personnel with the enclosed equipment. In addition, it provides protection against falling dirt and is gasketed with insect screens. The enclosure is intended for use indoors where it isn't exposed to unusual service conditions, dripping or splashing water, steam or conductive dusts (NEMA PB2-5.02).

NEMA 3R Outdoor Enclosures are intended for use in wet locations or outdoors to protect the enclosed equipment against rain. They are sleet (ice) resistant but are not dust, snow or sleet (ice) proof. If conduit connections are provided, these enclosures shall have a conduit hub or equivalent provision for watertight connections at the conduit entrance when the conduit enters at a level higher than the lowest live part. They have provisions for drainage.

Spectra Series™ Terminology

Overcurrent is any current in excess of the rated current of equipment or the ampacity of a conductor that can result from an overload, a short circuit or a ground fault.

Phase Failure Relay senses a loss of voltage in any of the three phases of a power system. It is used to alarm or trip an overcurrent device.

Plug-In Mounted device for line and load is one that can be plugged in to make electrical connections to a line and load bus bar. The device need not be self-supporting when withdrawn. It may be removed when switchboard is energized.

Pole The number of output terminals on a fusible switch or breaker that must be insulated and separated from each other.

Power Panelboard is any panelboard that is not a lighting or appliance panelboard as specified by UL and NEC and is not limited as to the number and rating of branch circuits, except for available spacing and physical size. The dead-front panelboard is accessible from the front only.

Quick-make, Quick-break refers to the action of mechanism, where the speed of the contacts in opening and closing a breaker or fusible switch is not controlled by the operator.

Rear-Only Accessible switchboards have all incoming and outgoing cable or bus connections accessible from the rear. Other connections may be front accessible.

Rear Line-Up Sections in a switchboard line-up are different depths and rear surfaces are aligned.

Rejection Fuse and Clip is a combination of Class R fuses and clips that will not accept fuses with a lower short-circuit rating. This type of fuse and clip has a mechanism that rejects standard NEMA Class H fuses.

Reverse Feed The following devices have been tested and are listed for reverse feeding: Fixed trip molded case circuit breakers, MVT+, MVT PM and Spectra Circuit Breakers. Reverse feed devices may have incoming (line) bottom and load top. They simplify bottom feed connections and minimize switchboard depth. High pressure contact switches (HPC) can be specified as bottom-fed devices. Power Break circuit breakers with MVT+, MVT PM and Power+ programmers can be reverse-fed without special ordering.

Rotor is a mechanism in a fusible switch unit that mechanically ensures all switch blades open/close simultaneously.

Selective Tripping is the application of circuit breakers or fuses in series, so that, of the breakers or fuses carrying fault current, only the one nearest the fault opens and isolates the faulted circuit from the system.

Series-Connected Rated Panel means the UL Listed short-circuit rating of the panel is equal to the IC rating of the main protective device when properly applied with branch circuit protective device. See section 6.2 for further details.

Service Disconnect is a device or group of devices that disconnects all ungrounded load conductors from the service (supply) conductors. The number of service disconnects is limited to 6 per the NEC.

Service Entrance Equipment usually consists of circuit breakers or switches and fuses and their accessories. It is located near the point of entrance of supply conductors to a building and is intended to constitute the main control and means of cutoff for the supply to the building. Service entrance equipment have a removable link between the neutral bus and ground bus. The main device must also be barriered from feeder devices.

Shunt Trip opens a circuit protection device by remote control.

Single-Branch A mounting module is a single device mounted in a designated vertical space. Refers to breakers or fused units.

Space and Busing for future when space and busing is only required for future inclusion of any specified devices, appropriate device supports, proper bus connections and corresponding vertical bus are furnished.

Standard (80%) and 100% Ratings Circuit breakers or fusible switches are to be applied at 80% of their ratings unless the overcurrent devices and the assemblies in which they are mounted are listed for operation at 100% of their ratings (NEC Articles 210-22(c), 220-3(a), 220-10(b), 384-16(c). Refer to listings for available 100% rated devices.

Spectra Series™ Terminology

Stationary-Mounted device can be removed only by unbolting electrical connections and mounting supports. Should only be removed when switchboard is deenergized.

Tapered Bus on UL 89 is the downsizing of the Busway ampacity based diversity standards.

Thermal Trip protects against sustained overloads. A bimetallic element reacts time-wise in inverse proportion to the current. If a circuit is overloaded, heat from excessive current flow causes the bimetal to bend, actuating the trip mechanism to open the breaker.

Time Delay is a term used by NEMA, ANSI and UL to denote a minimum opening time of 10 seconds on an overload current five times the amp rating of a circuit breaker or Class H, K, J and R fuses. Time delay is useful to let through momentary current inrushes, such as in motor startups, without interrupting the circuit.

Trip Function is that portion of the breaker that senses fault conditions, controls the associated logic functions and initiates and powers the breaker trip device.

Trip Mechanisms are independent of manual control handles. The breaker will trip when a fault occurs, even if the handle is held in the "ON" position.

Under voltage release instantaneously trips the breaker when voltage (control or line) drops to 30%-70% of nominal rating.

Voltage is electrical pressure that moves electrons through a conductor and is measured in volts.

Voltage Rating is the rms alternating current voltage at which a fuse or circuit breaker is designed to operate.

X Value is an arbitrary vertical measurement of the usable mounting space on a panelboard for a fusible switch or breaker. X is equal to 1 3/8 inches (1.375"). Height of the interior is the sum of the horizontally mounted, panel-mounted components.

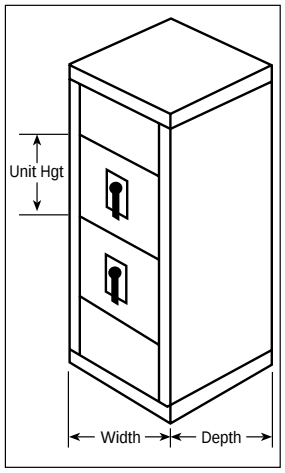
5.1 General

Switchboard Sizing Considerations
Listed below are rules and arrangements that must be considered when sizing and dimensioning Spectra Series switchboards.

Switchboard depth is the most variable of section dimensions as depth varies depending upon type and size of feed required; type, size, feed and combination of devices required; and the circuitry involved.

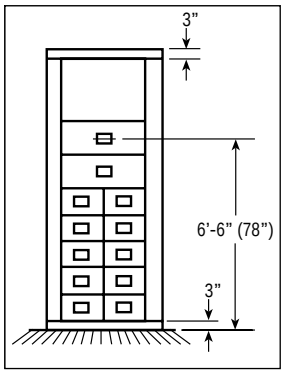
The dimensions shown in this publication are based on the following considerations.

- Typical circuit and device arrangements.
- Lug or busway feed not exceeding the ampacity of the largest rated devices. For oversize lugs, a lug section may be required. See Section 6.17.



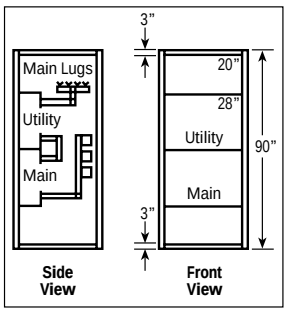
- When two or more devices are involved in the same section, the section width and depth is to be determined by the largest of the devices.
- Where bottom feed is involved, use reverse mounted or reverse fed main devices, if possible.(does not affect feeders) If not, a pull section may be required to prevent looping of bus bars and to facilitate barrier placement.
- Where main lugs are involved, spaces must be allowed for bending cable. Allow space at top (or bottom) of section per Section 6.17.
- In combining lug space and devices, there will be cases where it will not be possible to fit more than one device per section. When such space becomes critical, refer to factory for alternate arrangements.
- For connection to substation transformers, see Section 5-9 for further sizing requirements.
- Use of busway may dictate section dimensions. For busway locations and dimensions, see Section 5.9.
- Dimensions for front accessible sections may be reduced if rear accessibility is available.

6'-7" Handle Rule



The National Electrical Code (Article 380-8) requires that switches or circuit breakers shall be installed so that the center of the grip of the operating handle of the switch or circuit breaker when in its highest position is not more than 6'-7" above the floor or working platform. Housekeeping pads that elevate the switchboard above the standing surface may violate this rule. If' housekeeping pads are specified, they may have to be extended for the full working space.

Wiring Bending Space



The National Electrical Code latest issue (Tables 373-6 (a and b)) specify minimum wire bending space. A 20" unit height allowance as shown in Section 6.17 will meet NEC requirements and provide wire bending space for front and rear accessibility. The 20" allowance for wire bending space may be utilized for metering, but not for devices. If there is rear accessibility, then it may be possible to reduce or eliminate the 20" allowance. Refer to factory.

Wiring Terminals (Lugs)
Pressure type mechanical lugs suitable for 250-600 KCMIL aluminum or copper wire are provided for short circuit ratings to l00,000A. Above 100,000A, compression type lugs may be required.

When oversize lugs are required, a lug section with minimum width shown in Section 6.17 may be furnished.

Bused Pull Sections
Section has cross bus that connects to adjacent main section bus.

5.1 General

Pull Sections ③

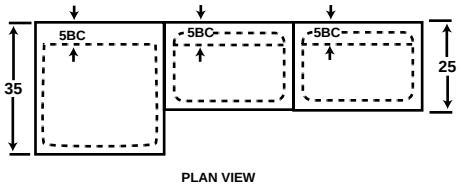
Pull sections are available in widths and depths from 15" to 60" in 5" increments. 20" width is standard. Depth is the same as the main section. The pull section provides space for pulling and installing cables. It is also used in bottom feed applications when reverse feed devices cannot be used. A barrier is provided for service entrance to meet NEC requirements. Busing and lugs are not provided.

Bused Pull Section Dimensions

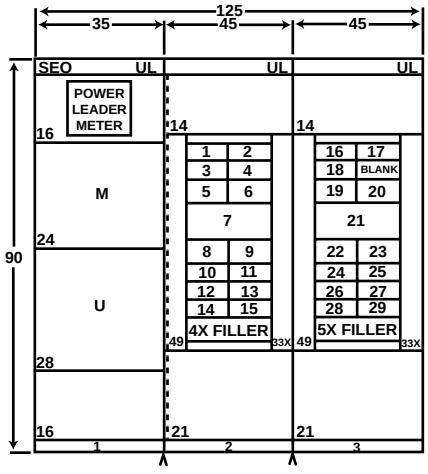
Amperes	Number of Lugs per Ø and N①	Section Width Minimum (inches)	Section Depth Minimum (inches)
800	3	30	25
1000	4	30	25
1200	4	30	25
1600	5	--	--
2000	6	30	25
2500	8	35②	--
3000	9	35②	30
4000	12	40	35
5000	15	45	40

① 50% neutral will have one-half the lugs shown, 250-600 MCM, Al or Cu wire.
② Section width minimum is 40" for 200KA.
③ Refer to Section 6.17 for cable bending space table.

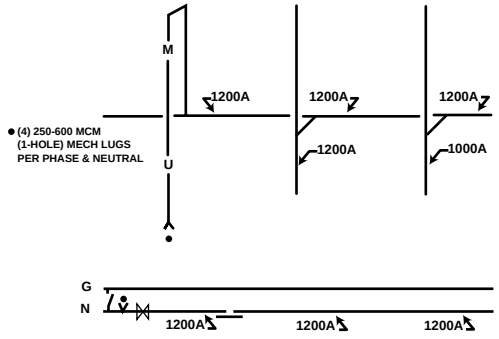
5.2 Typical Drawing



PLAN VIEW



FRONT VIEW



BUSSING DIAGRAM

Spectra Series™ Switchboard

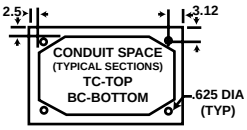
ORDER
MEB9410832X
CONT. ON SH.FL. SH.NO. 1

ACCESS TO: Front	PHASE: 3P4W
CLASS: 2	AMPERE: 1200A
LABEL: U/L SEO	BUS MATL: Copper
VOLTAGE: 480/277V	PLATE: Silver Plate
BUS BRACING (RMS SYM) 65000A	
SWITCHBOARD SC RATING (RMS SYM) 22000A	

POWER CO. STANDARD UTILITY CODE ZZ
C/T SPACE & MTG ONLY
C/T TYPE WINDOW
P/T TYPE
PER CE DWG 75C143813 PV101, 101A, 101B
PER PWR CO SPEC 75C323045A SH 1

CKT. NO.	DEVI CE DESCRIPTION	TRIP OR FUSE CLIP AMPS	POLES	CIRCUIT IDENTIFICATION ◘ LABELS ◘ NAMEPLATES
M	TK4V	1200	3	MAIN
1	SEHA	150	3	
2	SEHA	150	3	(SPACE AND BUS)
3	SFHA	200	3	
4	SFHA	200	3	
5	SGHA4	400	3	
6	SGHA4	400	3	
7	SKHA8	800	3	
8	SGHA6	600	3	
9	SGHA6	600	3	
10	SFHA	250	3	
11	SFHA	250	3	
12	SEHA	150	3	
13	SEHA	150	3	
14	SEHA	50	3	
15	SEHA	50	3	
16	SEHA	150	3	(SPACE AND BUS)
17	SEHA	50	3	
18	SFHA	200	3	
19	SFHA	250	3	
20	SFHA	250	3	
21	SKHA8	800	3	
22	SGHA4	400	3	
23	SGHA4	400	3	
24	SFHA	250	3	(SPACE AND BUS)
25	SFHA	250	3	(SPACE AND BUS)
26	SEHA	150	3	
27	SEHA	150	3	
28	SEHA	50	3	
29	SEHA	50	3	

NOTES:
1. Shipping splits between each section, ship each section separately.
2. Main furnished with integral ground fault protection.



NO.	DATE	REVISIONS	INITIALS
1	03/29/93	RELEASE FOR PRODUCTION	JY

MAT'L	MARK: MDS		PLANT: MEBANE
COST	JOB NAME: GET DRAFT		CUSTOMER: SPECTRA SWITCHBOARD
PANEL	ARCHITECTS:		CUST. ORDER NO. 3678-3456
SWBD	ENGINEER:		REQN NO: 37357 4935-1
	CONTRACTOR:		ED&C ORDER NO: MEB9410932XITEM 1
INSP.	MADE BY: ROGERW	ISSUED 3/29/93	MEB9410832X
CUST.	REL BY:	ROGERW	CONT. ON SH.FL. SH.NO. 1

5.3 Class 1 Switchboard - Group Mounted

Main Lug Section

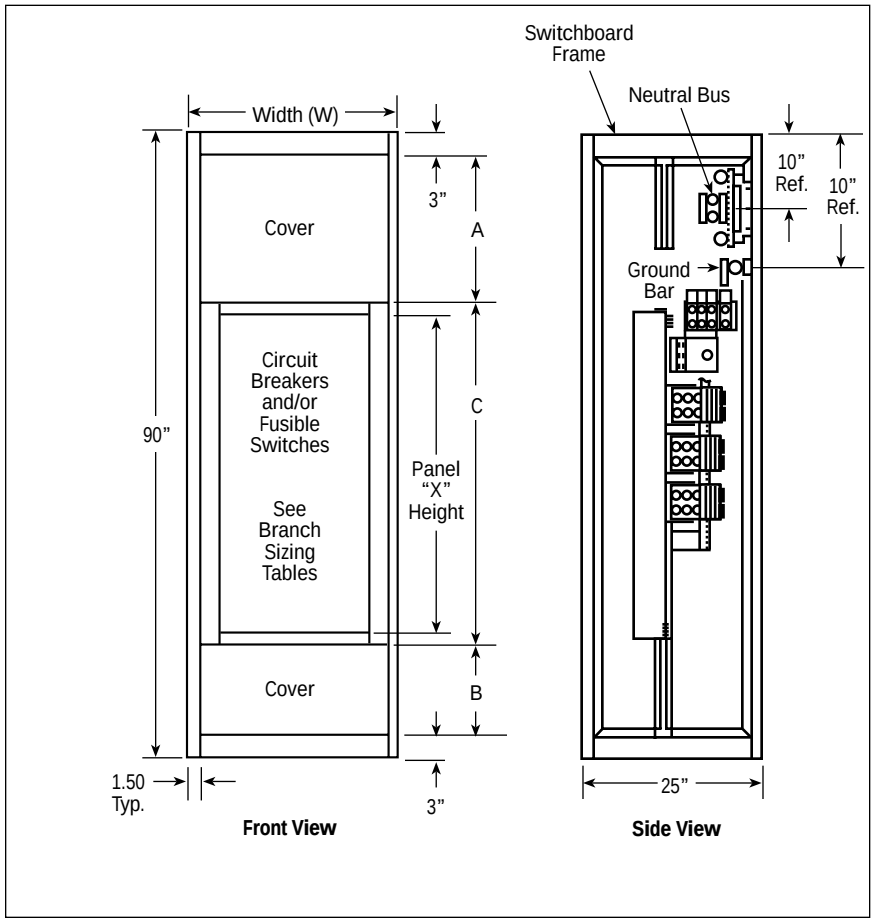
Standard Main Lug Terminations

Ampere Rating	Quantity and Size per Ø and N	Minimum Width (W)
400 & 600	(2) 1/0-600MCM	35
800 & 1000	(3) 1/0-600MCM	35
1200	(4) 1/0-600MCM	35
1600	(5) 1/0-600MCM	35
2000	(6) 1/0-600MCM	35
Over 2000	①	

① Rear access required.

Panel Rating	Panel X Height (X=1.375")	A	B	C
400-2000A	23X	21	28	35
	33X	21	14	49
	38X	21	7	56
	43X	21	0	63

Note: For bottom feed, reverse A & B dimensions.

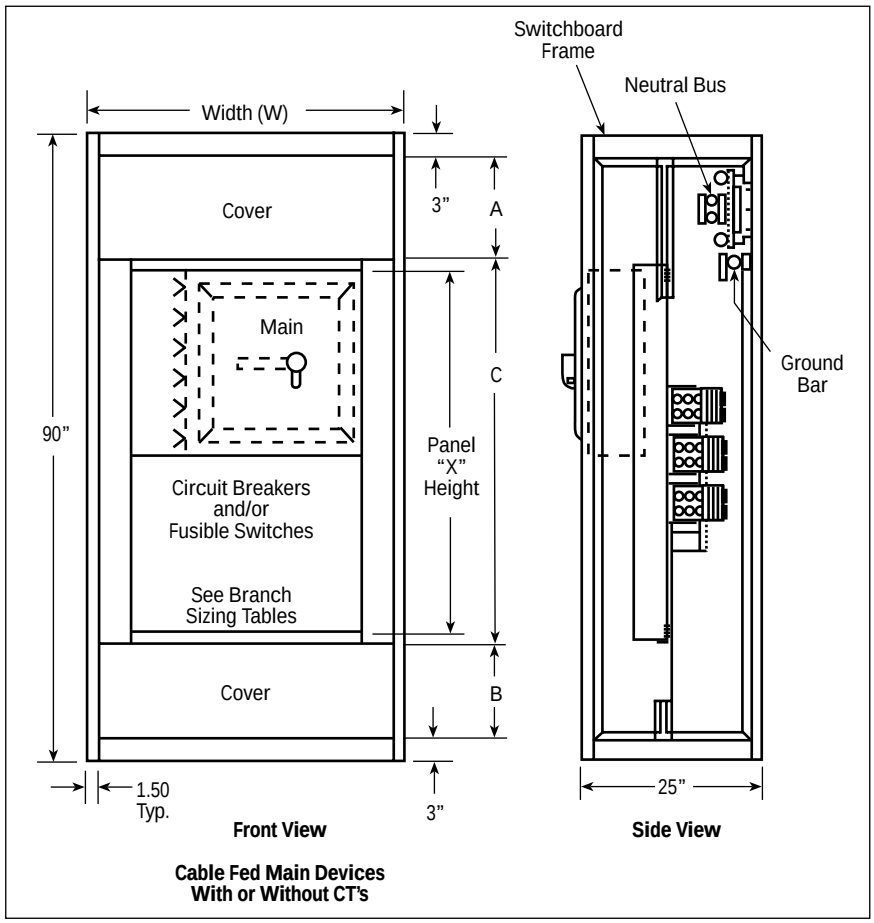


5.3 Class 1 Switchboard - Group Mounted

Main Device – Section

Type	Device	Amp Range	Main "X" Height	Min. Width (W)	Panel "X" Height	Top Main A	Top Main B	Bottom Main C	Bottom Main A	Bottom Main B	Bottom Main C
Circuit Breakers	SGDA, SGHA SGLA, SGPA SKHA, SKLA SKPA	400-600	4	35	33X	14	21	49	14	21	49
		800-1200	6	45	38X	14	14	56	23	21	56
Fusible Switch	ADS	4/600-H,K,R	10	45	43X	14	7	63	0①	21	63
		4/600-J,T	10	40	43X	14	7	63	0①	21	63
		800-1200	19	45	43X	14	7	63	0①	21	63

① Rear access is required.



Cable Fed Main Devices With or Without CT's

5.3 Class 1 Switchboard - Group Mounted

Distribution Section

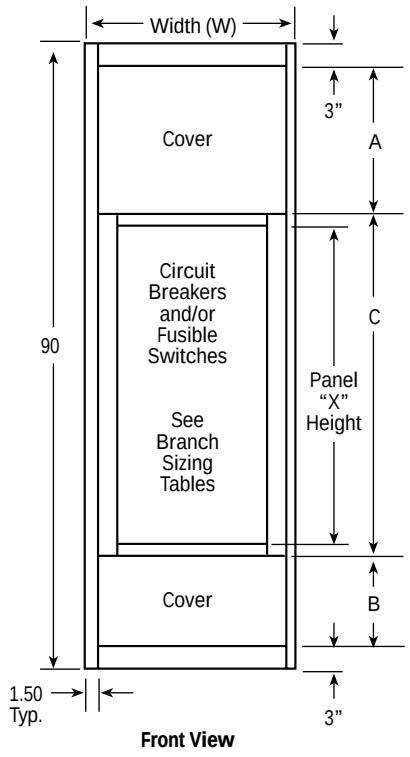


Figure 20.1

Panel "X" Height	A	B	C
23X	21	28	35
33X	14	21	49
38X	14	14	56
43X	7	14	63
53X	7	0①	77

① Rear access is required.

Distribution section side view same as main lug section side view except omit lugs.

5.3 Class 1 Switchboard - Group Mounted

Section Layout Notes

- These switchboard arrangements assume line cables enter top. When line cables enter from below, neutral and ground bus are mounted at bottom, and A and B cover dimensions are reversed.
- All dimensions are in inches and X values (1X = 1 3/8 inches).
- Front access to load cables requires a 7" high cover minimum.
- Front access to neutral and/or ground bus requires a 14" high cover minimum.
- Any circuit breakers with externally wired accessories (such as shunt trip, undervoltage release, auxiliary switches) will require a 1X filler between adjacent devices.
- For double branch units, only same circuit breaker type devices can be mounted across from each other.

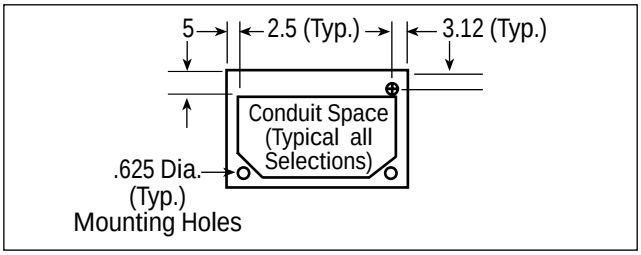


Figure 21.1

- All single branch circuit breakers, in service entrance equipment, are mounted with load lugs staggered to allow for equal cabling in both wire gutters. Main device line lugs are located on the left side.
- After determining all applicable conditions, lay out switchboard and calculate branch circuit "x" heights, including future space. Add spaces sufficient to fill panel to standard X increment.

ADS Fusible Switch Branch Device Sizing (Spectra Plug-In Only)

Switch Rating	Branch	Volts	Poles	Fuse Class	Blank Option	Minimum Width	X Height	Minimum Depth
30A	Double Branch	240V 600V	2, 3P	H, K, R	Yes	40W	4X	
60A	Double Branch	240V 600V	2, 3P	H, K, R	Yes	40W	4X 5X	
100A	Double Branch	240V 600V	2, 3P	H, J, K, R T	Yes	40W	5X 7X	
200A	Single Branch	240V 600V	2, 3P	H, K, R	No	40W	7X	25
	Double Branch			J, T	Yes			
	Double Branch			H, K, R	Yes	45W		
400A	Single Branch	240V 600V	2, 3P	J, T H, K, R	No	40W 45W		
600A	Single Branch	240V 600V	2, 3P	J, T H, K, R	No	40W 45W	10X	
800A 1200A	Single Branch	240V 600V	2, 3P	L	No	45W	19X	

5.3 Class 1 Switchboard - Group Mounted

Molded Case Circuit Breaker Branch Device Sizing - Plug-In

Mounting	Max. Breaker Amps	Breaker Frames	3-Pole Module② X-height	2-Pole Module② X-height	Minimum Width (Inches)	Minimum Depth (Inches)
Double	100	THQB, THHQB, TEY	3	--	35	25
		SE, SF	3	3	35	25
		SG	4	4	40	25
	150	TEB, TED, TQD, THQD	3	2	35	25
		THED, SF	3	3	35	25
		SG	4	4	40	25
	225	TQD, THQD	3	2	35	25
		SF	3	3	35	25
		SG	4	4	40	25
		TJD	6	6	45	25
	250	SF	3	3	35	25
		SG	4	4	40	25
		TJD	6	6	45	25
	400	SG	4	4	40	25
		SG	4	4	40	25
	600①	MicroVersaTrip Plus SGHB, SGLB, SGPB	4	–	40	25
Double Adjacent to Fusible Switch	150	SEDA, SEHA, SELA, SEPA	4	4	40	25
	250	SFHA, SFLA, SFPA	4	4	40	25
Single	250	SF	3	3	35	25
		SG	4	4	35	25
	400	TJD	6	6	35	25
		SG	4	4	35	25
		SG	4	4	35	25
	600	MicroVersaTrip Plus SGHB, SGLB, SGPB	4	–	35	25
		SK	6	6	40	25
	1200	MicroVersaTrip Plus SKHB, SKLB	6	–	40	25
Single Adjacent to Fusible Switch	250	SF	4	4	40	25
		SKP	6	6	45	25

① Double mounting not available in 2500A or higher main bus rating.
② Add 1x to height for accessories on breakers.

5.3 Class 1 Switchboard - Group Mounted

Molded Case Circuit Breaker Branch Device Sizing - Bolt-On

Mounting	Max. Breaker Amps	Breaker Frames	3-Pole Module② X-height	2-Pole Module② X-height	Minimum Width (Inches)	Minimum Depth (Inches)
Double	100	TED	3	2	35	25
		TEY	3	–	35	25
		SE, SF, THED	3	3	35	25
		SG	4	4	40	25
		THLC1	3	–	40	25
	150	TED	3	2	35	25
		SE, SF	3	3	35	25
		SG	4	4	40	25
		THLC1	3	–	40	25
		THLC2	5	–	40	25
	225	SF	3	3	35	25
		SG	4	4	40	25
		THLC2	5	–	40	25
	250	SF	3	3	35	25
		SG	4	4	40	25
		THLC4	5	–	45	25
	400	SG	4	4	40	25
		THLC4	5	–	45	25
	600①	SG	4	4	40	25
		MicroVersaTrip Plus SGHB, SGLB, SGPB	4	–	40	25
Single	250	SF	3	3	35	25
		SG	4	4	35	25
		THLC4	5	–	40	25
	400	SG	4	4	35	25
		SK	6	6	40	25
		THLC4	5	–	40	25
	600	SG	4	4	35	25
		MicroVersaTrip Plus SGHB, SGLB, SGPB	4	–	35	25
		SKH, SKL	6	6	40	25
	1200	SKH, SKL	6	6	40	25
		MicroVersaTrip Plus SKHB, SKLB	6	–	40	25
		SKP	6	6	45	25

① Double mounting not available in 2500A or higher main bus rating.
② Add 2x to height for accessories on breakers.

5.3 Class 1 Switchboard - Group Mounted

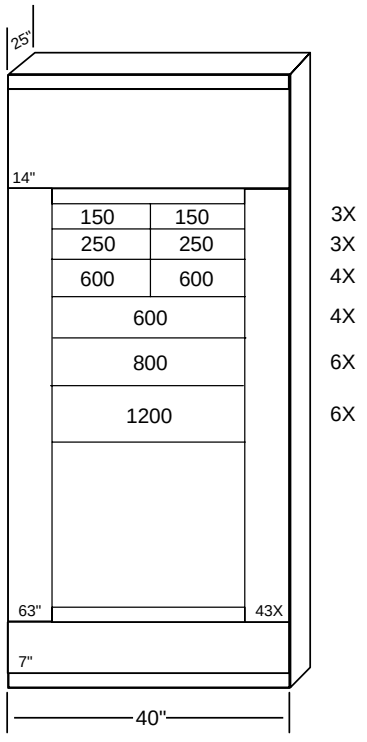
Branch Devices, Group Mounted, Breakers 100% Equipment Rated

Mounting	Max. Breaker Amps	Breaker Frames	3-Pole Module X-height①	2-Pole Module X-height①	Minimum Width (inches)	Minimum Depth (inches)
Twin	400	Spectra RMS Breaker SGHHA, SGLLA, SGPPA	4	4	40	25
Single	1000	Spectra RMS Breaker SKHHA, SKLLA, SKPPA	8	6	40	25
Twin	400	Spectra RMS Breaker with MicroVersaTrip Plus Trip Unit SGHHB, SGLLB, SGPPB	4	-	40	25
Single	1000	Spectra RMS Breaker MicroVersaTrip Plus Trip Unit SKHHB, SKLLB, SKPPB	8	-	40	25
Twin	400	Spectra RMS Breaker with MicroVersaTrip PM Trip Unit② SGHHB, SGLLB, SGPPB	6 or 5③	-	40	25
Single	1000	Spectra RMS Breaker MicroVersaTrip PM Trip Unit② SKHHB, SKLLB, SKPPB	8	-	40	25

① Add 1X per double or single branch for internal accessories side control wiring space (Shunt trip, auxiliary switch, bell alarm, undervoltage release).
② Breakers with MicroVersaTrip PM trip units must use a Voltage Module.
③ Breakers with MicroVersaTrip PM trip units must have installed auxiliary switch; 1X breaker side control wiring space is included.

Sample Feeder Mounting

Spectra Breakers



Notes:

600A frame breakers can only twin mount on main bus under 2500A.

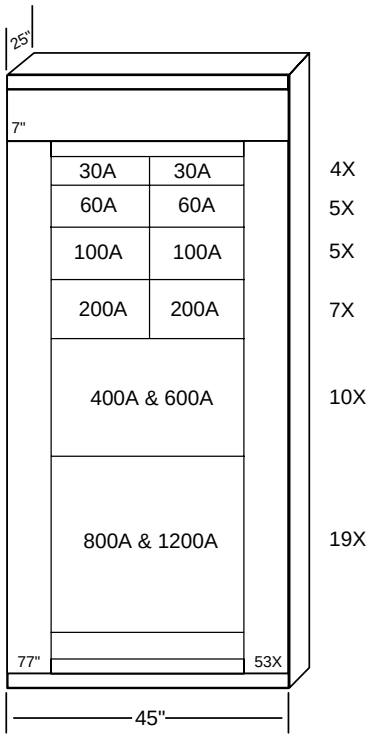
800A & 1200A breakers can mount in 40" wide section for 65kA and under. For 100kA ratings, 45" section is required.

X=1.375"

Front/Rear Access 53X interior available.

Font Only Access 43X interior available.

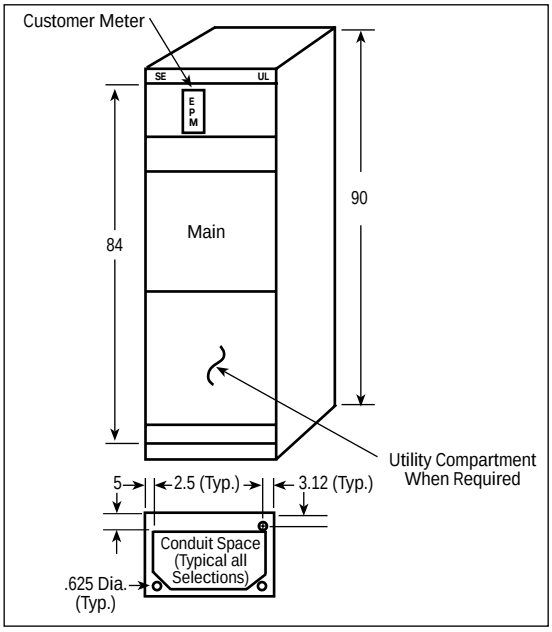
Ads Fused Switches



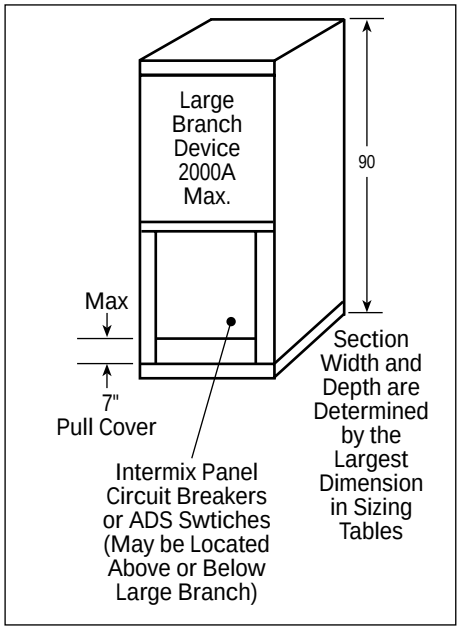
5.4 Class 2 Individually Mounted Main Group Mounted Feeders/ Class 5 Individually Mounted Switchboard

Single section arrangements with main device and utility cabinet are furnished through 2000A ratings when the utility does not require potential transformers. If customer metering and/or ground fault relay is required, service cables must enter from above. Otherwise, two sections are provided.

Spectra Main Section Arrangement



Intermix Design - side or rear access is required. Cable exit must be same as end panel.



Power Break Dimensions (Inches)
Includes Meter CTs

		Stationary③						Draw Out②					
Amp		Manual			Electrical			Manual			Electrical		
Rating		Unit	Section		Unit	Section		Unit	Section		Unit	Section	
Frame	Sensor	Height	Width	Depth	Height	Width	Depth	Height	Width	Depth	Height	Width	Depth
800②	200-800	20"	25"③	25"	20"	25"	30"	20"③	30"	35"	20"③	30"	40"
1600	800-1600	32	30	25	32	30	30	28	30	35	28	30	40
2000②	1000-2000	32	30	25	32	30	30	28	30	35	28	30	40
2500	400-2000	40	40	30	40	40	35	32	30	35	32	30	40
2500	2500	40	40	30	40	40	35	32	30	35	32	30	40
3000	3000	40	40	35	40	40	40	32	40	35	32	40	40
4000	4000	40	40	35	40	40	40	48	40	45	48	40	45

① MagneTrip is not available in 800A or small frame 2000A sizes.
② Max. of 24 secondary contacts for 800A frame drawout devices. All other frame sizes 48 secondary contact can be provided.
③ Two devices per section. Three or four devices require 30" section width.

5.4 Class 2 Individually Mounted Main Group Mounted Feeders/ Class 5 Individually Mounted Switchboard

The dimensions shown are minimum widths and depths of switchboard sections containing CT compartments only. If there are other devices located in the section, actual width will be based on the largest device required. Also, the entire switchboard lineup depth will be based on the largest device depth required.

The following utilities have approved the type of metering compartment shown. Compartments are available with the following features:

- CT bus bars mounted on high impact glass fiber polyester insulation and arranged in an edgewise plane.
- Door with concealed hinges, 3-point catch and lock, handle seal over CT compartment barriers rear and bottom (top). Note: The bottom barrier is furnished at top if main device is over CT compartment.
- 9" or 11" centerline is standard. For other centerlines, refer to factory.
- CT bus bars drilled for transformers with NEMA terminations.
- #10-32 and 1/4-20 screws for potential taps.
- Removable links provided if part of utility requirements.
- Cold sequence metering has CT compartment on load side of main device. Hot sequence CT compartment is on line side.

CT Compartment Dimensions

CT Centerline	Ampere Ratings	Minimum Section Width (inches) ①	Minimum Section Depth (inches) ①
9" or 11"	600	35	35
	800		
	1000		
	1200		
	1600		
	2000		
	2500		
	3000		
	4000	40	40

① Add 5" to depth when busway entrance is required.

Power Break II Dimensions (Inches)
Includes Incoming Lugs and Customer Meter CTs

		Stationary①						Draw Out① ② ③					
Amp Rating		Manual			Electrical			Manual			Electrical		
		Unit	Section		Unit	Section		Unit	Section		Unit	Section	
Frame	Sensor	Height	Width	Depth	Height	Width	Depth	Height	Width	Depth	Height	Width	Depth
800②	200, 400, 800	20"	25"①	30"	20"	25"	30"	20"①	30"	45"	20"①	30"	45"
1600	800, 1000, 1600	20	30	35	20	30	35	20	30	45	20	30	45
2000②	2000	20	30	35	20	30	35	20	30	45	20	30	45
2500	1000, 2000, 2500	40	40	40	40	40	40	32	30	45	32	30	45
3000	3000	40	40	40	40	40	40	32	40	45	32	40	45
4000	4000	40	40	40	40	40	40	44	40	45	44	40	45

① Width and depth will vary depending on lug arrangement and number of devices included in the section.
② Max. of 72 secondary contacts.
③ Rear access may be required for 2500A through 4000A drawout.

5.4 Class 2 Individually Mounted Main Group Mounted Feeders/ Class 5 Individually Mounted Switchboard

Main Devices (Inches)

Type	Device Designation	Ampere Rating	Stationary Min. Unit Height	Stationary Min. Section Width	Stationary Min. Section Depth②⑥	Draw out Min. Unit Height	Draw out Min. Section Width	Draw out Min. Section Depth②⑥
High Pressure Contact Switches	THPR⑦	800	28"①	30"	25"	--	--	--
		1200	32①	30	25	--	--	--
	THPC	1600	32	30	25	--	--	--
		2000	40	30	25	--	--	--
		2500	44	35	30	--	--	--
		3000	44	40	35	--	--	--
		4000③	52	40	40	--	--	--
Bolted Pressure Switches	QA or CBC	800	28	25	30	--	--	--
		1200	32	30	30	--	--	--
		1600	32	30	30	--	--	--
		2000	32	30	30	--	--	--
		2500	36	35	35	--	--	--
		3000	48	45	35	--	--	--
		4000	48	45	35	--	--	--
MCCB Standard & Hi-Break	SG	600	20	25⑤	25	--	--	--
	SK	1200	24	25⑤	25	--	--	--
Fuseless	THLC4	400	20	25⑤	25	--	--	--
Fusible Switch	QMR	400	28	25	25	--	--	--
		600	28	25	25	--	--	--
		800	28	35	25	--	--	--
		1200	28	35	25	--	--	--
AKR⑧	30	800	24	30	35	28	30	40④
	50	1600	24	30	35	28	30	40④
	T50H	2000	24	30	35	28	30	40④
	75	3200	32	35	40(	32	35	50
	100	4000	32	40	40	32	40	50④
	125	5000	(refer to factory GE-Houston)					
Metering		--	--	25	25	--	--	--
Ground Fault-Ground Break		--	8	25	25	--	--	--
Automatic Throwover	800	--	28H x 35W x 35D			--	--	--
	4000	--	28H x 35W x 35D			--	--	--

① CT compartment on line side requires 4" filler.
② If metering CTs are required, add 5" to depth. For devices at extreme top or bottom, depth shown may not provide sufficient conduit entrance space. See Section 5.10 for conduit space available.
③ When integral ground fault is present, a 4" filler is required on the load side.
④ Additional depth for metering CTs not required for any stationary units or for electrical drawout units.
⑤ 30" width is recommended for 1200A devices or when more than three devices are stacked in one section.
⑥ If vertical neutral bar is required, add 5" to depth.
⑦ Not available in electrical unit.
⑧ Refer to factory for integrally fused AKR breakers dimensions.

5.5 Utility Metering Compartments

Utility Company Information Request Matrix

		Known Sequence		Check marks indicate utility details required on each order		
Electric Utility Company	ED&C Utility Code	Hot	Cold	Sequence① (Hot or Cold)	CT Info②	PT Info 480V & Above②
Anderson Municipal, IN	AM	-	-	✔	✔	-
Anoka Electric Company, MN	AN	-	-	✔	✔	-
Appalachian Power Company, VA	AP	X	-	-	✔	✔
Atlantic Electric, NJ	AE	X	-	-	-	✔
Austin Electric Dept., TX	AU	-	-	✔	✔	-
Baltimore Gas & Electric, MD	BG	X	-	-	-	-
Bangor Hydro-Electric Co., ME	BH	-	X	-	✔	-
Belmont Municipal, MA	BM	-	X	-	✔	-
Blackstone Valley Electric Co., RI	BV	X	-	-	-	-
Boston Edison Co., MA	BE	-	X	-	-	-
Braintree Electric Light Co., MA	BL	-	X	-	✔	-
Burlington Electric Lighting Dept., VT	BD	-	-	✔	✔	-
Cambridge Electric Co., MA	CA	-	X	-	-	✔
Central Colorado Power/Centel Corp., CO	CX	X	-	-	✔	-
Central Hudson Gas & Electric, NY	CH	-	-	✔	✔	-
Central Illinois Light Co., IL	CT	-	-	✔	✔	-
Central Illinois Public Service, IL	CV	X	-	-	✔	-
Central Maine Power Co., ME	CM	-	-	✔	-	✔
Central Vermont Public Service Corp., VT	CR	X	-	-	✔	-
Chicopee Light & Power, MA	CL	-	X	-	✔	-
Cincinnati Gas & Electric, OH	CG	X	-	-	✔	✔
City of Dover, DE	CD	-	-	✔	✔	-
City of Vineland, NJ	CI	-	X	-	✔	-
Cleveland Electric Illuminating Co., OH	CC	-	X	-	✔	-
Colorado Springs Dept. of Utilities, CO	ZS	X	-	-	✔	-
Columbus Division of Electric, OH	CY	-	X	-	✔	-
Columbus Southern Power, OH	CU	-	-	✔	✔	-
Commonwealth Edison Co., IL	CE	X	-	-	-	-
Commonwealth Electric, MA	CW	-	X	-	-	✔
Concord Electric Co., NH	CO	-	X	-	✔	-
Connecticut Light & Power Co., CT	CN	-	X	-	✔	✔
Consolidated Edison Co., NY	CS	X	-	-	-	-
Consumers Power of Michigan, MI	CF	-	X	-	-	✔
Cornbelt Electric Co-Op., Il	CB	-	-	✔	✔	-
Danvers Electric Div., MA	DC	-	X	-	✔	-
Dayton Power & Light Co., OH	DP	X	-	-	✔	-
Delaware Power & Light Co., DE	DL	-	-	✔	✔	-
Delmarva Power & Light, DE	DM	-	-	✔	✔	✔
Detroit Edison Co., MI	DE	X	-	-	✔	-
Duquesne Light Co., PA	DU	X	-	-	✔	✔
East Central Electric, MN	EC	-	-	✔	✔	-
Eastern Edison Co., MA	EE	X	-	-	-	✔
Exeter & Hampton Electric Co., NH	EH	-	X	-	✔	✔
Freeport Electric Dept., NY	FE	X	-	-	-	-
Georgia Power Co., GA	GP	-	-	✔	✔	✔
Granite State, NH	GS	-	X	-	✔	-
Green Mountain Power Co.,VT	GM	X	-	-	✔	-
Greenport Electric Dept., NY	GL	X	-	-	-	-

5.5 Utility Metering Compartments

Utility Company Information Request Matrix (cont.)

		Known Sequence		Check marks indicate utility details required on each order		
Electric Utility Company	ED&C Utility Code	Hot	Cold	Sequence① (Hot or Cold)	CT Info②	PT Info 480V & Above②
Entergy Co., TX	GE	X	-	-	✔	-
Hancock Co. Rural Electric Corp., IA	HC	-	-	✔	✔	-
Illinois Power Co., IL	IC	X	-	-	✔	-
Indiana & Michigan Electric Co., IN	IM	X	-	-	✔	-
Indianapolis Power & Light, IN	IP	-	-	✔	✔	✔
Interstate Power Co., IA	IN	-	-	✔	✔	-
Iowa Electric Light & Power Co., IA	IE	-	-	✔	✔	-
Iowa Illinois Gas & Electric, IA	II	-	X	-	✔	-
Iowa Power & Light Co., IA	IO	-	-	✔	✔	-
Iowa Public Service, IA	IS	-	X	-	✔	-
Iowa Southern Utilities Co., IA	IU	-	-	✔	✔	-
Jacksonville Electric Authority, FL	JE	-	-	✔	✔	-
Jersey Central Power & Light, NJ	JC	-	-	✔	-	✔
Kansas City Power & Light Co., MO	KC	X	-	-	-	-
Kansas Gas & Electric Co., KS	KG	-	-	✔	✔	-
Kansas Power & Light, KS	KL	-	-	✔	✔	-
Kentucky Power, KY	KP	X	-	-	✔	-
Kentucky Utilities, KY	KU	X	-	-	✔	-
Lake Superior District Power Co., MN	LS	X	-	-	✔	-
Laverne Municipal Electric Plant, OK	LM	X	-	-	✔	-
Lincoln Electric System, NE	LO	-	-	✔	✔	-
Long Island Lighting Co., NY	LI	X	-	-	-	-
Louisville Gas & Electric Co., KY	LG	X	-	-	✔	-
Lubec Water & Electric District, ME	LL	-	X	-	✔	-
Madison Gas & Electric Co., WI	MG	-	X	-	-	-
Maine Public Service Corp., ME	MP	-	X	-	✔	-
Massachusetts Electric Co., MA	MC	X	-	-	-	✔
Metropolitan Edison Co., PA	ME	X	-	-	✔	✔
Minnesota Power & Light Co., MN	ML	-	-	✔	✔	-
Mississippi Power & Light Co., MS	MS	X	-	-	✔	-
Monongahela Power Co., WV	MO	-	-	✔	✔	✔
Montana Dakota Utilities, MT/ND/SD	MD	X	-	-	-	-
Muscatine Power & Water, IA	MW	-	-	✔	✔	-
Narragansett Electric Co., RI	NE	X	-	-	-	✔
New Orleans Public Service, LA	NO	X	-	-	✔	-
New York State Electric & Gas Corp., NY	NY	-	X	-	✔	✔
Newport Electric Corp., RI	NC	-	X	-	✔	-
Niagara Mohawk Corp., NY	NM	-	X	-	-	-
Northern Indiana Public Service, IN	NI	X	-	-	✔	-
Northern States Power Co., MN/WI/ND/SD	NS	X	-	-	✔	-
Northwestern Public Service, SD	NP	-	-	✔	-	-
Norwich Dept. of Public Utilities, CT	ND	-	X	-	✔	-
Norwood Municipal Light Co., MA	NL	-	X	-	✔	-
Ohio Edison Co., OH	OE	X	-	-	✔	-
Ohio Power Co., OH	OP	X	-	-	✔	✔
Omaha Public Power District, NE	OP	X	-	-	-	✔
Orange & Rockland Utilities	OR	X	-	-	-	-
Otter Tail Power Co., MN	OT	X	-	-	-	-

5.5 Utility Metering Compartments

Utility Company Information Request Matrix (cont.)

		Known Sequence		Check marks indicate utility details required on each order		
Electric Utility Company	ED&C Utility Code	Hot	Cold	Sequence① (Hot or Cold)	CT Info②	PT Info 480V & Above②
Parker Municipal Light Dept., SD	PM	-	-	✔	✔	-
Pennsylvania Electric Co., PA	PF	X	-	-	-	✔
Pennsylvania Power & Light Co., PA	PL	X	-	-	-	✔
Pennsylvania Power Co., PA	PY	-	-	✔	✔	-
Philadelphia Electric Co.,	PH	X	-	-	-	✔
Potomac Edison Co., MD	PT	X	-	-	✔	-
Potomac Electric Power Co., DC	PP	X	-	-	-	-
Public Service Electric & Gas Co., NJ	PS	-	-	✔	-	-
Public Service of Colorado, CO	PC	X	-	-	-	-
Public Service of Indiana, IN	PI	X	-	-	✔	-
Public Service of New Hampshire, NH	PU	-	-	✔	✔	-
Rochester Gas & Electric Co., NY	RG	X	-	-	✔	-
Rockville Centre Electric Dept., NY	RE	X	-	-	-	-
South Central Electric Association, MN	SC	-	-	✔	✔	-
South Hadley Electric Light Dept., MA	SH	-	-	✔	✔	-
South Norwalk Electric, CT	SN	-	X	-	✔	-
Southern Indiana Gas & Electric, IN	SI	-	X	-	✔	-
Southern Maryland Co-Op, MD	SM	X	-	-	✔	-
St. Louis Municipal Electric, MI	SL	-	-	✔	✔	-
Superior Water, Light & Power, MN	SW	X	-	-	✔	-
Toledo Edison, OH	TE	-	X	-	✔	-
Unified Illuminating Co., CT	UI	-	X	-	-	-
Union Electric of St. Louis, MO	UE	X	-	-	-	-
Union Light Heat & Power Co., KY	UL	X	-	-	✔	✔
Vermont Public Service, VT	VP	-	-	✔	✔	-
Village of Hamiliton, NY	VH	-	-	✔	✔	-
Virginia Electric Power Co., VA	VE	X	-	-	-	-
Wakefield Municipal, MA	WM	-	X	-	✔	-
Watertown Municipal Utilities, SD	WU	X	-	-	-	-
Watertown Municipal, NY	WA	-	X	-	✔	-
Wellesley Dept. of Public Works, MA	WY	-	X	-	✔	-
West Penn Power Co., PA	WP	X	-	-	✔	✔
Western Massachusetts Electric Co., MA	WT	-	X	-	✔	-
Westerville Electric Co., OH	WR	-	-	✔	-	-
Wheatland Electric Co-Op, KS	WC	-	-	✔	✔	-
Wisconsin Electric Power Co., WI	WE	X	-	-	-	-
Wisconsin Power & Light Co., WI	WL	X	-	-	-	✔
Wisconsin Public Service, WI	WS	X	-	-	-	-

① When CT and PT information is required, provide manufacturer's name, catalog number and rating.
② When sequence information is required, advise whether hot or cold sequence is to be provided.

Consult factory for other utilities.

West Coast Utilities - EUSERC

Spectra Switchboards constructed to EUSERC utility requirements are available. EUSERC covers utility termination and metering provisions. When ordering switchboards for EUSERC areas, please specify the utility. For more details, contact the factory.

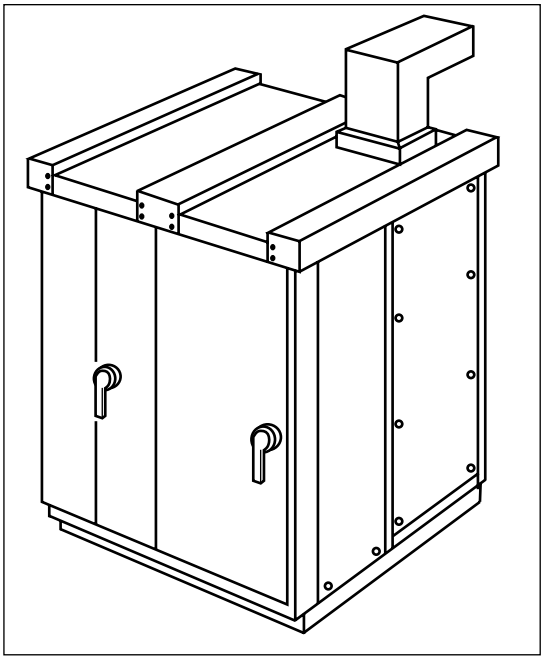
5.6 Outdoor Enclosures

NEMA 3R outdoor enclosures consist of standard indoor cubicles and components enclosed with a front frame and roof assembly to provide a weather resistant structure. Any number of sections may be bolted together. However, all sections must be of the same depth. Standard outdoor construction consists of:

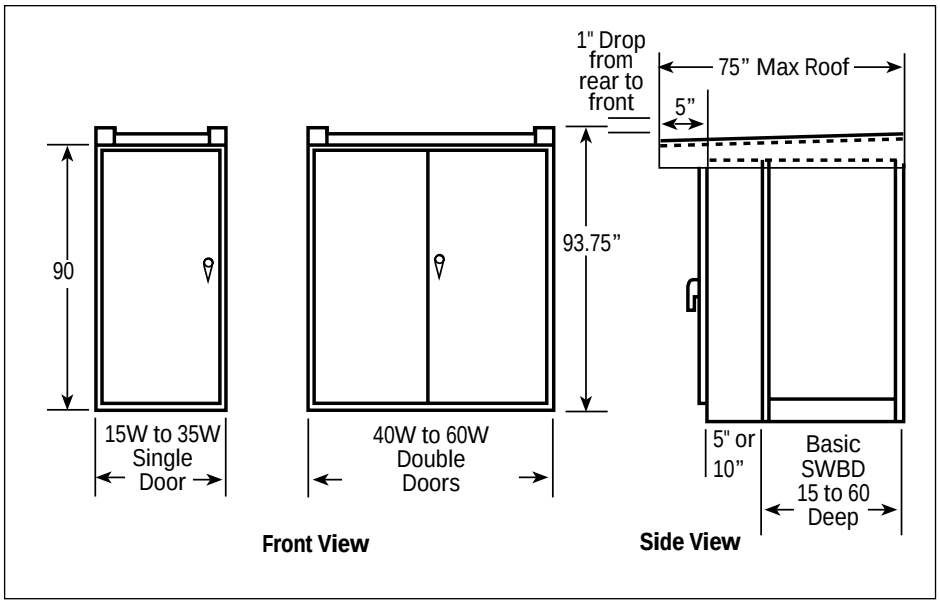
- 90" high sections.
- 1" sloped roof.
- Filtered front roof vents.
- Flat, front area floor.
- Single doors 15"-35" width; double doors 40"-60" width.
- Wind stop on each door.
- 3-point catch with provision for padlock.
- Front to rear full depth lifting beams.

Options available are:

- Gasketing.
- Fluorescent light, 120-volt, 15-amp and grounded convenience outlet.
- 1(" high floor sills with rodent guards.
- Rear doors same as front with wind stops.
- Inside, movable, 4-way hoist and trolley (walk-in only).
- Busway entrance.



Walk-in and Non-walk-in

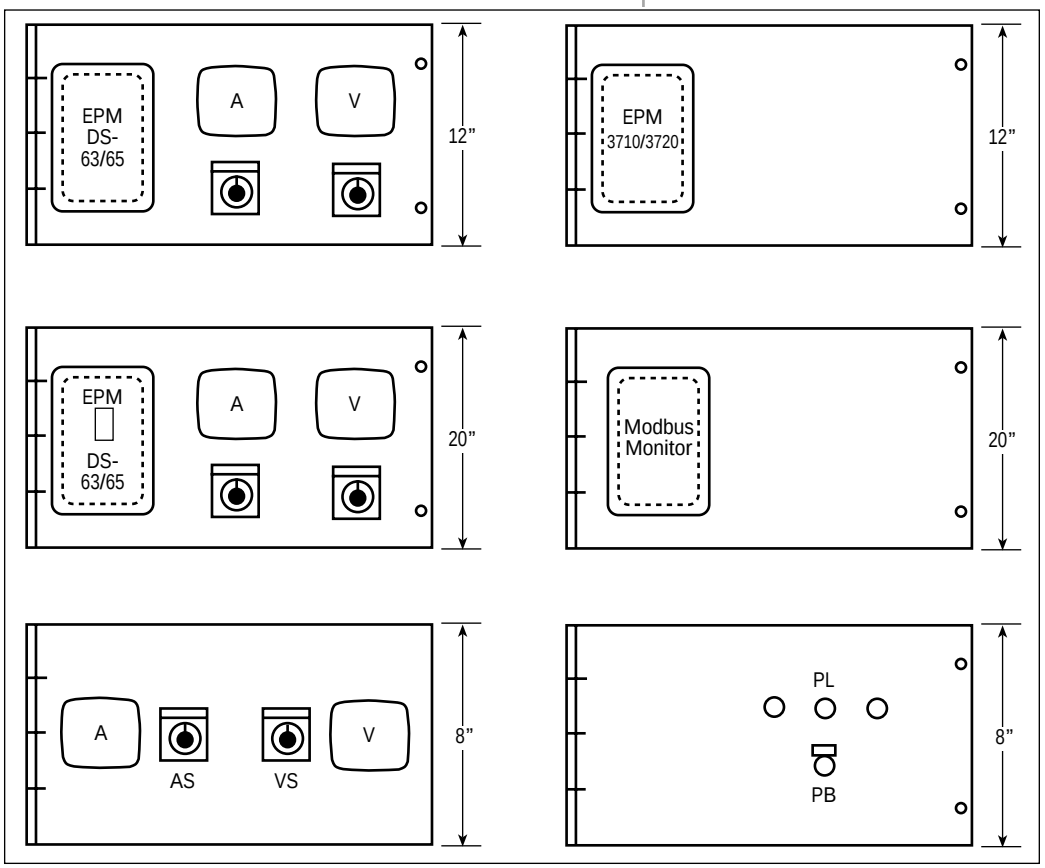


Note: For busway top exit application flat roof is used.

5.7 Instrument and Metering Arrangements

Instruments and metering for mains and feeders can be provided in top compartment of switchboard. Minimum height and width for different types of switchboards are shown. The minimum height should be increased in indicated increments as necessary to accommodate required instruments and/or meters. Some preferred arrangements are shown. Hinges door is standard on all meter doors.

Abbreviation	Description
A	Ammeter type AB40-250
V	Voltmeter type AB40, 250
EPM	EPM 3710/3720, 7300/7700
PQM	PQM, EPM
AS	Ammeter Switch
VS	Voltmeter Switch
PL	Pilot Light
PB	Push Button
GBR	Ground Break Relay



5.8 Busway Entrance

Busway Entrance

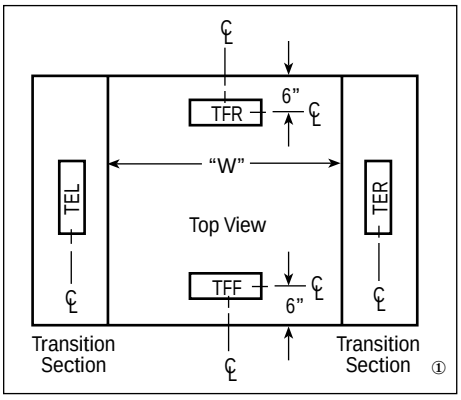
The Spectra Series Busway switchboard stub may connect to the switchboard top main bus or the line or load terminals of a device in the switchboard section into which it enters. All dimensions shown are to centerline of busway. The above is based on individually-mounted devices in switchboards. For main lug connection to group mounted switchboards, refer to factory. When two busway runs enter a switchboard section, refer to factory. For busway entrance locations other than Spectra Series™, refer to factory.

Switchboard Stubs

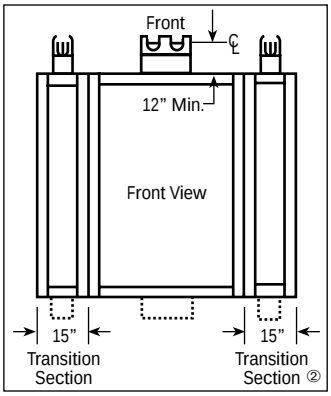
Both top and bottom entrance is available, however, TFR is the recommended standard entrance position. Dimensions for bottom entrance are the same as top entrance. Note that TEL and TER entrance positions require a separate 15-inch wide switchboard transition section adjacent to the switchboard main device for entrance.

TFR/TFF	W-Minimum Width Requirement	Minimum Depth Adder For TFR Only
800 - 1600A	25 W	10"
2000 - 2500A	30 W	10"
3000 - 4000A	40 W	10"

TEL - TER	Minimum Depth	Width Adder
800 - 2000A	30 D	15 W
2500 - 4000A	40 D	15 W



① TFR requires rear access or must be preassembled into switchboard before it is set into place.



② 15" dimensions become 20" on outdoor switchboards.

5.9 Low Voltage Transition Sections and Dual Voltage Switchboards

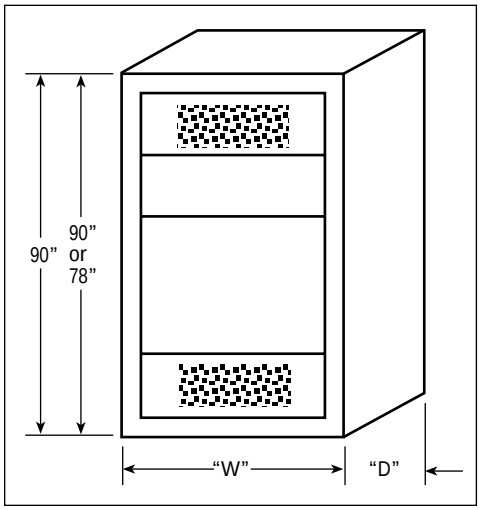
Spectra Series Low Voltage Transition Sections
Transition sections are required for connection of low voltage Spectra Series switchboards to all liquid-filled transformers 750 to 2500 kVA. They are also required for connection of switchboards to motor control centers. Transformer and transition sections are always aligned on center of depth of both sections.

Transition section depth is determined by device and circuitry of service entrance section. Transformer depth can be deeper, the same or shallower than the transition section depth.

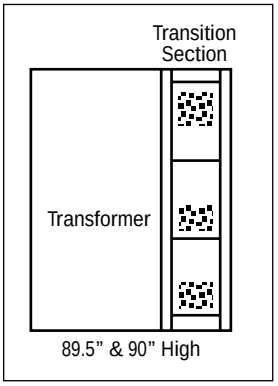
Note that the minimum allowable switchboard depth is 35" for connection to a transformer.

For the 1500 and 2000 kVA, 95 BiL transformers, a 100" high transition section is required. The switchboard remains 90" high.

Transition sections are 15" wide. Consult factory for non-standard applications.



Spectra Series Dual Voltage Switchboards
750 and 1000 kVA transformers are provided in NEMA 1 transformer enclosures. Primary and secondary flanges to switchboard sections do not require transition sections.

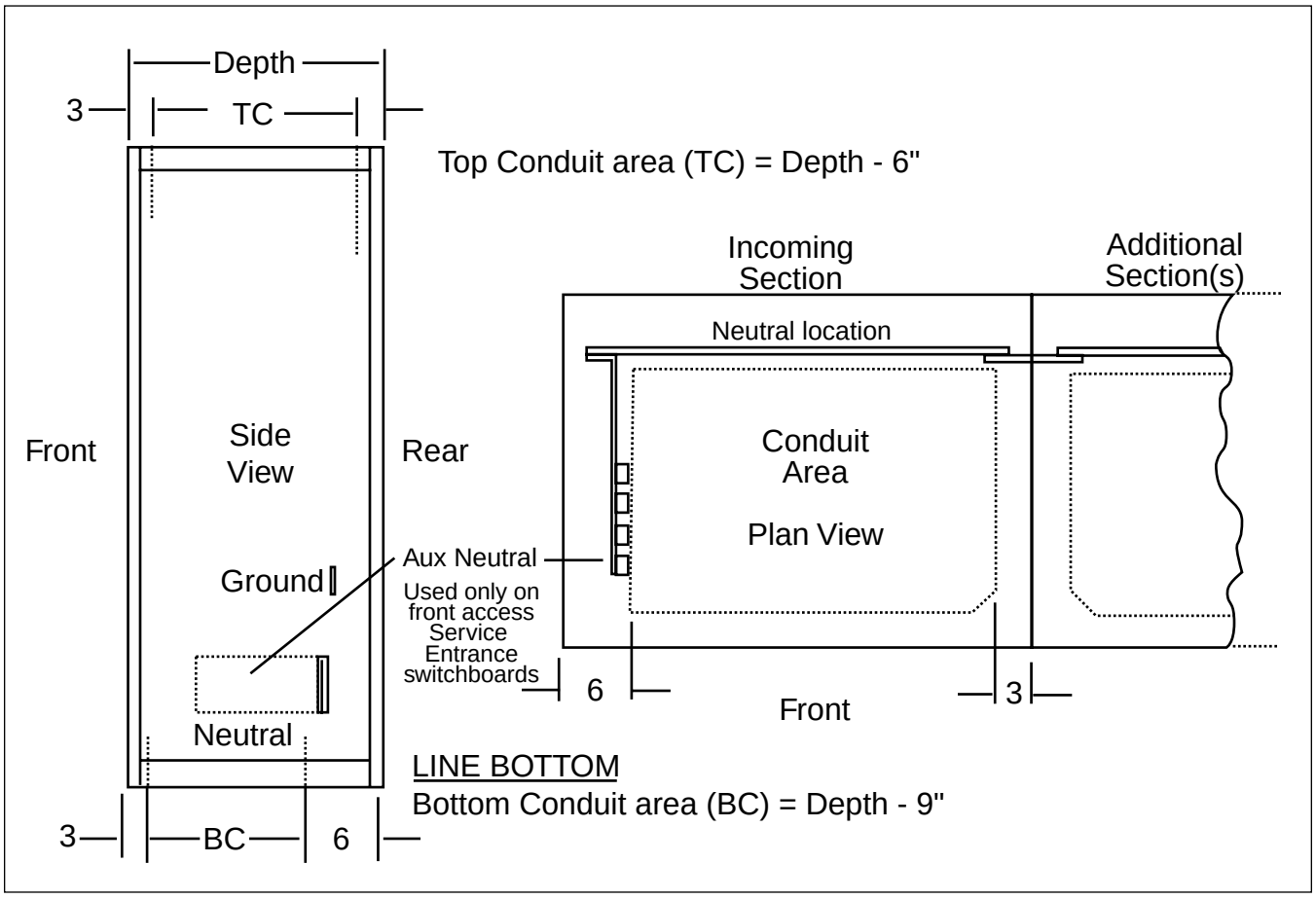


Core & coil type QLC transformers provided in switchboard enclosures cable connected to primary and secondary by equipment plant.

KVA	Self-Cooled	
	Width	Depth
30	30"	35"
45	30"	35"
75	35"	35"
112.5	40"	35"
150	45"	40"
225	45"	40"
300	55"	45"
500	55"	45"
750	50"	60"
1000	50"	60"

5.10 Conduit Entrance Space

Incoming Line Sections



Drawing is for basic guideline purposes, refer to factory for exact dimensions.

5.11 Switchboard Weights

Due to the great variety of sections, devices and circuitry, it is not feasible to give total weights for specific combinations. However, an estimate may be made by selecting device weights to average section weights (by bus material and ampacity). The resulting total weights are in a ±20% range and should be used for estimating purposes only.

Device Modification Weight (lbs.)

Type	Weight (lbs.)
Motor operator	15
MDP SR 735/737	
Ammeter-voltmeter	15
Metering C/T	10
Potential C/T	10
EPM	5
EPM 3710/3720	5
PQM	5
Meter switch	5
Test block	5

① Based on average section size and bus circuitry.

Utility Compartment Weight (lbs.)

Ampere Rating	Weight (lbs) Cu	Al
1000	80	70
2000	100	80
3000	120	90
4000	150	100

Section Weight (lbs.)

Type of Section	Approx. Weight Steel Only	Combined Weight Steel & Busing ① 1000A Cu	1000A Al	2000A Cu	2000A Al	3000A Cu	3000A Al	4000A Cu	4000A Al
Individually-Mounted Devices	600	750	650	900	750	1050	850	1200	950
Group-Mounted Devices	400	600	500	660	530	700	580	800	620

5.11 Switchboard Weights

Device Weights (lbs.)

Device	Type	Approx. Weight (lbs.)
Molded Case Circuit Breakers	THQB, TEY, TEB, TED, SE	5
	TQD - SF, SG	10
		20
	SK	50
Circuit Breakers Stationary	AKR15	200
	AKR50	210
	AKR75	420
	AKR100	540
Power Circuit Breakers Drawout	AKR30	250
	AKR50	260
	AKR75	470
	AKR100	590
Transformers Core and Coil	35 kVA	275
	45 kVA	375
	75 kVA	600
	1125 kVA	700
	150 kVA	900
	225 kVA	1150
	300 kVA	1550
	500 kVA	2100
Transformers Lighting Type QM	1-1.5 kVA	30
	2-3 kVA	50
	5 kVA	80
	7.5 kVA	115
	10 kVA	150
HPC Switches	800A	100①
	1600A	160①
	2000A	190①
	2500A	240①
	3000A	400①
	4000A	450①
Bolted Pressure Switches	800A	140①
	1200A	230①
	2000A	250①
	2500A	330①
	3000A	500①
	4000A	550①
Fusible Switches	30-30A	15①
	60-60A	15①
	100-100A	25①
	100A	25①
	200A	50①
	400A	50①
	600A	50①
	800A	75①
	1200A	75①

Device	Type	Approx. Weight (lbs.)
Power Break II Circuit Breakers, Stationary (Lbs.)	800A Manual	71
	800A Electrical	80
	1600A Manual	79
	1600A Electrical	88
	2000A Manual	79
	2000A Electrical	88
	2500A Manual	178 ②
	2500A Electrical	187 ②
	3000A Manual	179 ②
	3000A Electrical	188 ②
	4000A Manual	320
	4000A Electrical	329
Power Break II Circuit Breakers, Drawout (Lbs.) (Include substructure weight)	800A Manual	140
	800A Electrical	155
	1600A Manual	205
	1600A Electrical	220
	2000A Manual	233
	2000A Electrical	247
	2500A Manual	336
	2500A Electrical	376
	3000A Manual	342
	3000A Electrical	382
	4000A Manual	464
	4000A Electrical	504

① Weight does not include fuses.

② Weights based on front connection. For back connection weights, refer to GET-8052B, Power Break II.

6.1 Standards/Codes/Ratings/Conditions

System Selectivity and Protection
The design of a protective system involves two separate but interrelated steps:

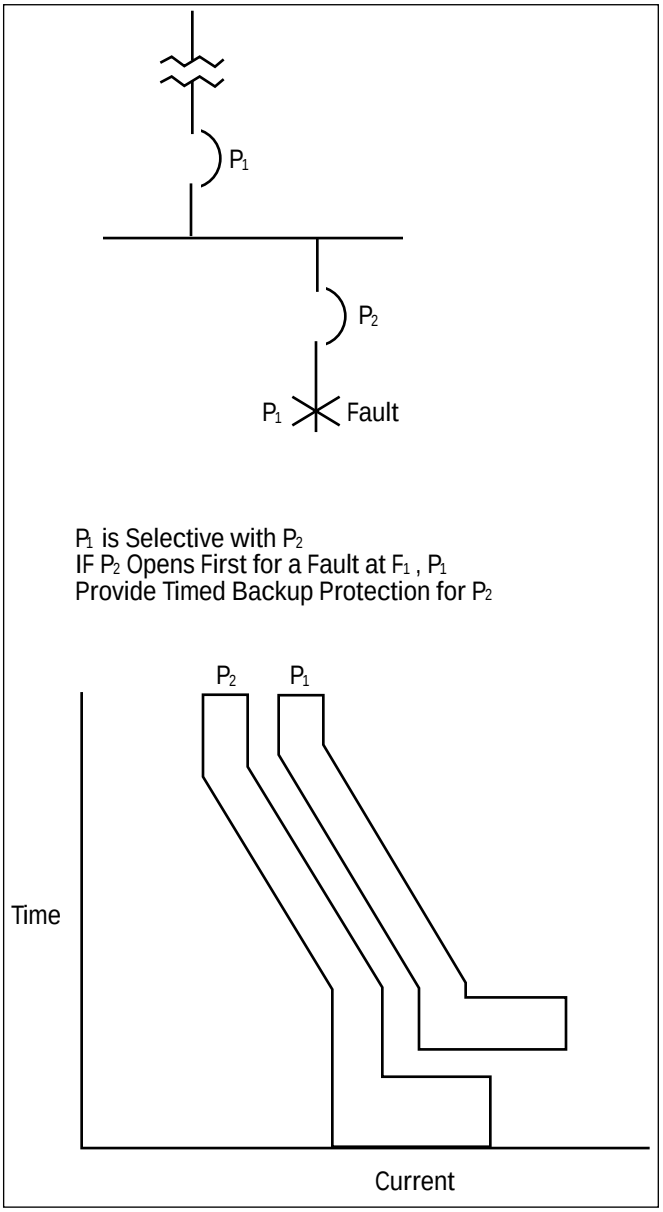
1. Selection of the proper device.
2. Selection of the setting for the devices to achieve the degree of protection and selectivity desired.

A protective device is selective with another protective device if the downstream device operates first when both see the same fault current.

By the proper selection and setting of protective devices, the system designer can achieve a time current coordination (selectivity) among these devices that provides the maximum circuit and equipment protection consistent with the service continuity requirements. Protective device coordination is generally a compromise between maximum protection and maximum service continuity. To maintain maximum service continuity, only the devices supplying the defective element should open. This may require time delay of upstream devices. However, this prevents maximum protection that requires the upstream protective device to open instantaneously for a fault anywhere in the system. A coordination study should be performed to determine the degree of selectivity that may be achieved.

Device Selection
All protective devices should be applied within their ratings - voltage, frequency, current and short circuit - under usual switchboard service conditions.

Size and Number of Services
The use of services rated 2000 amperes or less is strongly recommended for better protection, service continuity and lower cost. Smaller transformers permit lower rated protective devices, which provide better protection and service continuity. The National Electrical Code recognized this in Section 230-2, which permits two or more services when the capacity requirements are in excess of 2000 amperes at 600 volts or less.



6.1 Standards/Codes/Ratings/Conditions

Service Entrance Equipment
The National Electric Code has specific rules for the equipment that controls and protects the service or supply of electricity to a building.

The general rule is that a building is to be supplied by only one service. Exceptions includes fire pumps, multiple occupancy buildings, high capacity and large areas (NEC 230-2). The single service shall consist of not more than six switches or circuit breakers (NEC 230-71).

The service disconnecting means shall be located either inside or or outside of a building at a readily accessible location nearest the point of entrance of the service conductors (NEC 230-70).

Switchboards used as service equipment shall be marked "suitable for use as service equipment" and shall provide:

1. A bonding jumper to bond the enclosure and ground bus to the neutral (NEC250-23(a).
2. A neutral disconnect link to disconnect neutral from premises wiring (NEC 230-75).
3. A barrier to isolate service bus bars and terminals from rest of switchboard (NEC 384-3).

Ground fault protection shall be provided for solidly grounded wye services with more than 150 volts to ground but not exceeding 600 volts phase-to-phase for each service disconnecting means rated 1000 amperes or more (NEC 230-95).

Switchboard Enclosure
The standard switchboard enclosure is a NEMA Type 1 general purpose indoor enclosure. It is intended primarily to prevent accidental contact of personnel with live parts and to provide protection against dirt and foreign objects. NEMA 1 enclosures should be used indoors in dry locations.

Devices may require ventilation for operation at rated current. The standard switchboard enclosure should not be used in environments where ventilation is not acceptable.

Outdoor enclosures are available and should be used outdoors to protect the equipment against rain, and indoors where water may intrude, such as beneath fire sprinklers.

Switchboard Ratings
Switchboards are designed, tested and rated to Underwriters Standard 891 for dead-front switchboards and NEMA Standard PB2 for dead-front distribution switchboards.

Current
The continuous current ratings of switchboards are 400, 600, 800, 1000, 1200, 1600, 2000, 2500, 3000 and 4000 amperes.

Switchboard bus bars are rated on a current density basis -750A per square inch for aluminum and 1000A per square inch for copper.

Frequency
AC switchboards are rated 60 Hertz and may be applied on 50 Hertz services without derating. For other ratings, refer to factory.

Insulation Level
Switchboards have an insulation level rating at twice the rated voltage plus 1000 volts. The dielectric test for this rating consists of applying a 60 hertz voltage for 1 minute phase-to-phase and phase-to ground with switching devices closed.

Working Space
The National Electrical Code (Article 110-16) requires that sufficient access and working space shall be provided and maintained about electrical equipment to permit ready and safe operation and maintenance of such equipment.

The minimum working space required by the National Electric Code for switchboards 150 volts-to-ground is three (3) feet. For voltages over 150 volts-to-ground, three feet is required from the enclosure to insulated surfaces, three and one-half (3-1/2) feet to grounded surfaces, including concrete, and four (4) feet to exposed live parts. Working space is required from all accessible surfaces (front, rear, sides).

Working space is not required in back of switchboards (Class 1, Class 2) when all connections are accessible from locations other than the back.

System		Voltage Rating	
No. of phases	No. of wires	AC	DC
3	4	480Y/277, 208Y/120	
3	4①	240/120	
3	3	600, 480, 240, 120	
1	3	240/120	125/250
1	2	120, 240, 277	125/250

① Delta with neutral at center of one leg

6.1 Standards/Codes/Ratings/Conditions

Access and Entrance to Working Space
At least one entrance of sufficient area shall be provided to give access to the working space about switchboards. For switchboards rating 1200A or more and over six feet wide, there shall be one entrance not less than twenty-four (24) inches wide and six and one-half (6-1/2) feet high at each end (NEC 110-16(c)).

Exceptions to this are:
1. Where the equipment location permits a continuous and unobstructed way of exit travel.

2. Where work space is double the amount required.

Phase Arrangement
The phase arrangement on three-phases buses is A, B, C, from top to bottom, front to back, or left to right as viewed from the front of the switchboard. On three-phase, four-wire delta-connected systems, the B-phase shall have the higher voltage to ground and is marked "Hi-Leg."

Protective Device Continuous Current Ratings
The continuous load supplied by a protective devices shall not exceed 80% of the device rating unless the switchboard, including the protective device, is UL listed for continuous operation at 100% of its rating. The non-continuous load may be 100% of the device rating. A continuous load is one that continues for three hours or more.

Standard group mounted MCCBs are 80% rated. 100% ratings are available with the Spectra G up to 400A & K up to 1000A.

All individually-mounted molded case circuit breakers are standard (80%) rated only.

Fusible switches 30-1200A group-mounted or individually-mounted are standard (80%) rated only.

Insulated case circuit breakers (Power Break) can be 80% and 100% rated.

High pressure contact and bolted pressure switches are 100% rated in switchboards.

Switchboard Short-Circuit Ratings
Switchboards shall be applied on a system having an available short-circuit current not greater than the short circuit rating of the switchboard. All switchboards are marked with a short circuit rating. The switchboard will be fully rated or series connected rated. When fully rated, the short circuit rating of the switchboard is that of the lowest rated device in the switchboard. Series connected ratings are based on short circuit ratings given to two or more devices connected in series.

In either case, the bus bar bracing must be equal to or exceed the short circuit rating of the switchboard. Bus bar bracings available are 65,000, 100,000, 150,000 and 200,000 rms symmetrical amperes; 65,000 is the standard bracing.

Short-Circuit Rating Tests
Switchboard buses are tested and assigned short-circuit ratings in according with UL Standard No. 891 and NEMA Standard No. PB-2. The test current duration is three cycles and the test circuit power factor is 20%.

Devices are tested and rated in accordance with the applicable standards.

If the switchboard, including devices, is applied in a circuit with a power factor less than it is tested at, deration may be required. Refer to applicable standards or the factory.
Unless otherwise noted, all GE switchboards meet the latest revision of the following standards:

- UL 50 Cabinets and Boxes, Electrical
- UL 67 Panelboards
- UL 98 Enclosed and Dead Front Switches

Device	UL Standard	ANSI Standard	NEMA Standard	Test Circuit Power Factor (%)
Molded Case Circuit Breakers	489		AB-1	20
Power Break II Circuit Breakers	489		AB-1	20
Low Voltage Power Circuit Breakers	1066	C37.50	SG-3	20
High Pressure Contact Switches	977		KS-2	20
Bolted Pressure Switches	977		KS-2	20
Fusible Switches	98			20
Fuses	198 E.B		FU-1	20

6.1 Standards/Codes/Ratings/Conditions

- UL 489 Circuit Breakers, Molded Case and Circuit Breaker Enclosures
- UL 512 Fuseholders
- UL 891 Dead Front Switchboards
- UL 969 Marking and Labeling
- Article 384 National Electrical Code
- NEMA PB1 Panelboards; NEMA KS1, Switches
- NEMA PB2 Switchboards
- CSA Certified as Distribution Switchboards
- Federal Specifications Panelboards W-P-115a Molded Case Circuit Breakers, WC-357B/GEN Fusible Switches, W-S-865C

Note: Only switchboards containing all UL listed/recognized devices can be UL labeled.

In addition to meeting or exceeding all applicable standards shown above, Spectra Series switchboards meet GE's more stringent internal requirements, offering a greater margin or performance and safety.

The following classifications and limitations of panelboards have been established by Underwriters Laboratories and the National Electrical Code.

Note: An overcurrent protective device is a circuit breaker pole or single fuse.

Service Entrance Equipment

- Must be located near the point of entrance of building supply conductors.
- Lighting and appliance panels must have one, but not more than two, main disconnections with a current rating equal to or less than panelboard rating.
- Power panelboards may have up to six operating handles to entirely disconnect panelboard from the source.
- Must include connector for bonding and grounding neutral conductor.
- A service entrance-type UL label must be factory installed and will be provided on the equipment (when specified).

Service Conditions

1. Switchboards are rated for use in a 25°C room ambient per UL891. For higher ambients, the current rating of the equipment should be derated by multiplying factors in Table on following page.
2. Switchboards can be applied for use in altitudes up to 6600 feet (2000 meters). Above 6600 feet, the derating factors in Table on following page apply.
3. Ambient temperature rating of installed protective devices should not be exceeded without derating. The ambient temperature ratings of the most frequently used devices are listed in Table on following page. This temperature is around the device inside the switchboard enclosure. Refer to the applicable device standard for derating factors.
4. The National Electrical Code specifies ampacity of conductors for various temperatures. Standard ratings are based on 30°C ambient. Higher ambient temperatures will require derating as shown in NEC Table 310-16. Maximum operating temperature of conductor insulation must not exceed that shown in NEC Table 310-16.
5. All device lugs and equipment lug assemblies are UL listed and rated for use with conductors whose ampacity is based on the ampere rating of 75°C conductors, which is in compliance with NEC 11-14. Higher ampacity may be used & in some cases should be used, but it must be applied at it's 75° C ampacity.
6. Switchboards will resist seismic forces of 0.6G in any direction when installed with structurally certified fasteners in accordance with the installation instructions.
7. For unusual service conditions, such as corrosive atmosphere, vibration or unique equipment arrangements, refer to factory.

6.1 Standards/Codes/Ratings/Conditions

Room Ambient °C	Switchboard Current Derating Factor
25	1.00
30	.96
40	.87
50	.78

Altitude		Temperature	Voltage
Feet	Meters	Derating	Derating
6600	2000	1.00	1.00
8500	2600	.99	.95
13000	3900	.96	.80

Short circuit ratings are not affected by altitude.

Device Ambient Temperature Rating

Molded Case and Insulated Case Circuit Breakers	40°C
ADS Fusible Switches	40°C
Low Voltage Power Circuit Breakers	55°C
High Pressure Contact and Bolted Pressure Switches	40°C

6.2 Protective Device Ratings

Series Connected Ratings

UL permits assigning a short circuit rating to a combination of molded case circuit breakers or fuses and molded case circuit breakers connected in series that is higher than the lowest rating protective device of the combination. This is defined as series connected ratings. The combination rating cannot exceed the rating of the protective device farthest upstream, although it will exceed the rating of the downstream protector.

The upstream protector can be a molded case breaker or fuse. Device combinations are not limited to those in the same equipment. They can be in different equipment, such as a switchboard feeder or a panelboard main versus panelboard branches. Any distance between devices in different equipment is permitted. Total fault current magnitude must flow through both protectors. Thus, fault current contribution from motors, as well as power source fault current, must flow through upstream and downstream protectors.

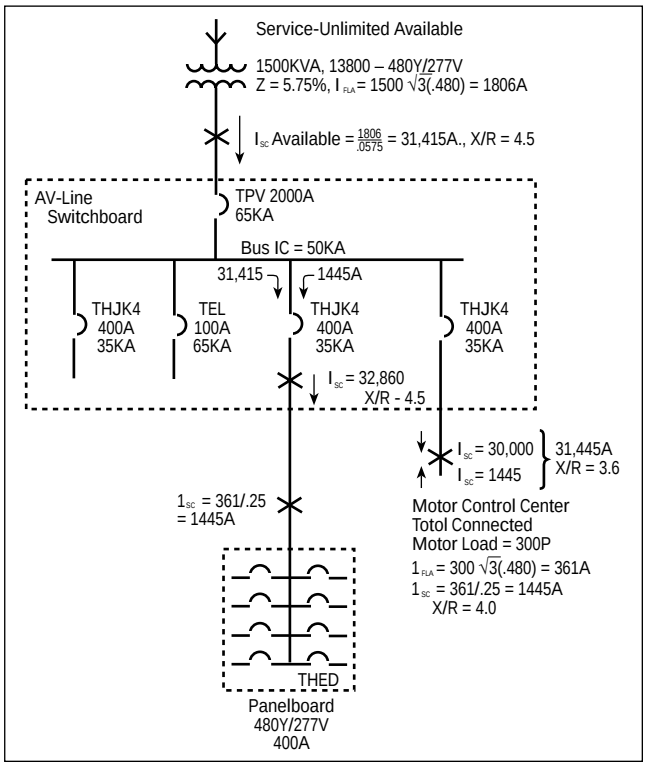
Molded case circuit breakers may be applied as fully rated or series connected.

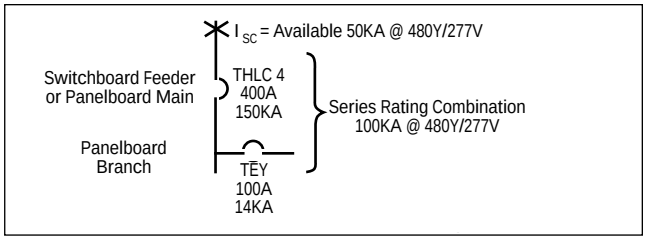
In a fully rated system, Figure adjacent, the short circuit rating of all protective devices is equal to, or exceeds, the circuit short circuit requirement and, if mounted in equipment, the bus short circuit withstand rating and equipment short circuit rating exceeds the circuit available.

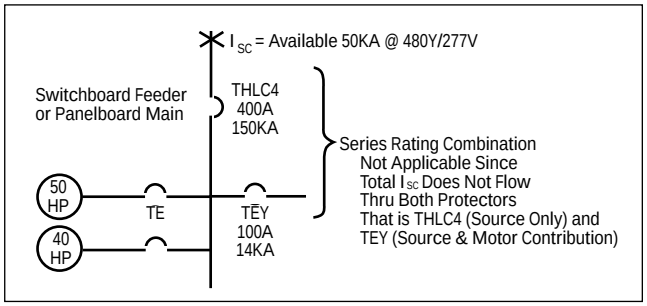
In a series connected system, Figure adjacent, the short circuit rating of the upstream protector is fully rated but the downstream protector is not fully rated.

Systems employing molded case circuit breakers or fuses as mains should not be used where full selectivity between devices is required. For series rated or fully rated systems, both protectors will open on short circuits. The fault current magnitude where selectivity is lost is determined by instantaneous pickup of the main. For panelboards, fully rated systems exhibit the same lack of selectivity as series rated systems.

Examples where selectivity is desirable include:
- Buildings where the equipment supplies important loads such as elevators, emergency lighting, etc.
- Manufacturing facilities where loss of power can result in economic loss due to production downtime or damage to equipment or work.
- Hospitals where life support is critical.



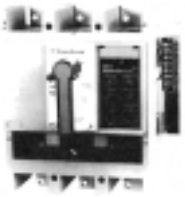




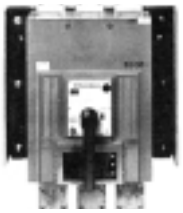
6.3 Power Break® I Circuit Breaker


4000A Envelope


3000A Envelope


2000A Envelope


1600A Envelope


800A Envelope

Power Break® Insulated Case Circuit Breakers

Power Break is a versatile breaker designed for a wide variety of applications with features such as:

- Solid-state or dual magnetic trip units.
- Push-to-open and close buttons.
- Maximum five-cycle close time on electrically operated breakers. Three-cycle opening.
- UL-listed, field installable accessories.
- Easy to operate, rotary, stored energy mechanism. A full line of selective tripping characteristics can be used to provide over-current protection from overloads, short circuits and ground faults. Local fault target indicators to signal overloads or actual fault conditions which have caused the breaker to trip are available.

Power Break insulated case circuit breakers offer the rugged, reliable type of system protection critical for heavy-duty applications. Power Break circuit breakers are rated up to 200,000 RMS symmetrical Amperes interrupting capacity without fuses or current limiters. The PowerBreak design consists of five physical envelope sizes, providing protection from 200 to 4000 amperes.

Power Break is standard (80%) and 100% rated (requires 90C wire sized at 75C to comply with UL) with MicroVersaTrip and Magne Trip™. Magne Trip is a dual magnetic trip unit with adjustable current setting (70% - 100%) and either adjustable instantaneous or adjustable short time with fixed instantaneous. For further information on Power Break Circuit Breaker see GET-6211A or contact your local GE Industrial Systems Sales Engineer.

MicroVersaTrip® Programmer Characteristics

(See Time Current Curves GES6235 & GES6228)

Characteristic		Frame/Sensor Maximum Amp Rating		
		800, 1600, 2000, 2500, 3000, 4000		
	Current Setting	.5, .6, .7, .8, .9, .95, 1.0 multiples of Rating Plug Amp (X)		
Long-time	Pick-up	Fixed at 1.1 of Current Setting (C)		X = Rating plug amps
	Delay①	2.4, 4.9, 9.8, 20 seconds	C= Current setting	
	Pick-up	1.5, 2, 2.5, 3, 4, 5, 7, 9 Multiple of Current Setting (C)		S = Sensor amp rating
Short-time	Delay (I^2t in)①	40 seconds	H= Frame short-time rating	
	Delay (I^2t out)②	10, 21, 35 Seconds		
		800, 1600, 2000	2500, 3000	4000
Adjustable Instantaneous Pick-up	Without Short-time (Multiple of rating plug amps (XL))	1.5, 2, 3, 5, 7, 9, 10	1.5, 2, 3, 5, 7, 9, 10	1.5, 2, 3, 5, 7, 9
	With Short-time (Multiple of rating plug amps (X))	1.5, 2, 3, 5, 7, 9, 10, 13, 15	1.5, 2, 3, 5, 7, 9, 10, 13	1.5, 2, 3, 5, 7, 9
High Instantaneous Pick-up	With Short-time (Multiple of frame ST rating (H))	.4, .6, .8, 1.0	.4, .6, .8, 1.0	.4, .6, .8, 1.0
Ground Fault	Pick-up (Multiple of sensor amp rating (S))	.2, .25, .3, .4, .45, .5, .6	.2, .22, .24, .26, .28, .3, .34, .37	.2, .22, .24, .26, .28, .3)
	Delay (I^2t in)③	.40 Seconds	.40 Seconds	.40 Seconds
	Delay (I^2t out)②	.10, .21, .35 Seconds	.10, .21, .35 Seconds	.10, .21, .35 Seconds

① Time delay shown at 600% of current setting.
② Time delay shown at lower limit of each band.
③ Delay shown at 200% of Pick-up.

6.3 Power Break® I Circuit Breaker

MicroVersaTrip® Plus Trip Unit

The MicroVersaTrip Plus trip units utilize a digital, LCD display with a four-button keypad to provide local set-up and read-out of trip settings. A 3-phase ammeter and trip indicators are standard, as is a clear plastic cover with provisions for sealing to allow tamper-resistant installation. The trip unit digitally measures the current waveform in each phase to determine the true RMS value of the current, regardless of the waveshape. MicroVersaTrip Plus trip units provide accurate, predictable overload and short circuit protection for standard circuits as well as distribution systems that include variable speed drives, rectifiers, induction heating and other loads that cause high harmonic distortion. They provide optimum breaker-to-breaker selectivity and custom load protection. Shor-time and ground fault functions include the flexibility of coordination with or without an I^2t ramp and are also available with high range instantaneous.

MicroVersaTrip PM Trip Unit

The MicroVersaTrip PM trip unit adds power management system capability, including advanced metering, and protective relays to the basic functions of the MicroVersaTrip Plus. MicroVersaTrip PM trip units communicate directly on the GE POWER LEADER™ communications bus (commnet).

MicroVersaTrip® Power Break Programmers

Programmer Suffix	Long -time (L)	Short -time (S)	Instantaneous (I)	High Inst. (H)	Ground Fault (G)	OL/SC Targets (T1)	OL/SC/GF Targets (T2)	GF Zone Interlock	GF/ST Zone Interlock (Z2)
Adjustable Instantaneous									
L1	•		•						
L1TI	•		•			•			
LIG	•		•		•				
LIGT2	•		•		•		•		
LIG2Z1	•		•		•		•		
LSI	•	•	•					•	
LSIT1	•	•	•			•			
LSIG	•	•	•		•				
LSIGT2	•	•	•		•		•		
LSIGT2Z1	•	•	•		•		•	•	
LSIGT2Z2	•	•	•		•		•		•
Adjustable High Range Instantaneous									
LSHT1	•	•		•		•			
LSHGT2	•	•		•	•		•		
LSHGT2Z1	•	•		•	•		•	•	
LSHGT2Z2	•	•		•	•		•		•

6.3 Power Break® I Circuit Breaker

MicroVersaTrip® Plus and PM Trip Unit Characteristics

Envelope Size	Frame Max. Amp Rating	Sensor Rating (Amps) (S)	Long-Time Current Setting (C) (Pick-Up) Multiple of Rating Plug Amps (X)	Long-Time Delay① (Seconds)	Short-Time Pick-Up (Multiple of Current Setting) (C)	Short-Time Delay (Seconds)
800	800	200, 400, 800	0.5 thru 1.0 in increments of 0.05	2.4, 4.9 9.8, 20	1.5 thru 9.0 in increments of 0.5	I^2t out ① 0.40 I^2t in ② .10, .21, .35
1600	1600	1000, 1600				
2000	2000	2000				
3000	2500 3000	1000, 2000, 2500, 3000				
4000	4000	4000				

Trip Unit Characteristics (cont'd)

Envelope Size	Adjustable Instantaneous Pick-Up without ST (Multiple of Rating Plug Amps) (X)	Adjustable Instantaneous Pick-Up with ST (Multiple of Rating Plug Amps) (X)	High Range Instantaneous (Multiple of Frame Short-time Rating) (H)	Ground Fault Pick-Up (Multiple of Sensor Amp Rating) (S))	Ground Fault Delay with I^2t (Seconds)	Ground Fault Delay ③ with I^2t (Seconds)
800	1.5 thru 10.0 in 0.5 increments	1.5 thru 15.0 in 0.5 increments	1.0	0.20 thru 0.60 in increments of 0.01	.44 at 200% of pickup at lower limit of band	.10, .21, .35
1600						.10, .21, .35
2000						.10, .21, .35
3000		1.5 thru 13.0 in 0.5 increments		0.20 thru 0.37 in increments of 0.01		.10, .21, .35
4000	1.5 thru 9.0 in 0.5 increments	1.5 thru 9.0 in 0.5 increments		0.20 thru 0.30 in increments of 0.01		.10, .21, .35

MicroVersa Trip PM Unit Features (All Frames)④

Function	Description	Trip Unit Suffix M (Metering)	P (Relaying)	PM (Metering & Relay)
Amperes (A) ⑤	Selectable Phase Current ± 20%	X	X	X
Voltage (V)	L-L or L-N Volts ± 1.5%	X		X
Energy (kwh/MWh)	Total Energy Usage on Brkr ± 3.5%	X		X
Real Power (kW)	L-L or L-N Power ± 3.5%	X		X
Total Power (kVA)	L-L or L-N Power ± 3.5%	X		X
Frequency (HZ)	Circuit Frequency ± 1HZ	X		X
Under Voltage Trip	-Adjustable pickup, 10-50% -Adjustable delay, 1-15 seconds, OFF		X	X
Over Voltage Trip	-Adjustable pickup, 110-150% -Adjustable delay, 1-15 seconds, OFF		X	X
Voltage Unbalance	-Adjustable pickup, 10-50% -Adjustable delay, 1-15 seconds, OFF		X	X
Current Unbalance	-Adjustable pickup, 10-50% -Adjustable delay, 1-15 seconds, OFF		X	X
Power Reversal	-Adjustable pickup, .01-3.00 per unit -Adjustable delay, 1-15 seconds, OFF		X	X

① Time delay shown at 600% of current setting at lower limit of band.
② Time delay shown at lower limit of each band. All pick-up tolerances are ±10%.
③ Time delay shown at lower limit of each band. Ground fault pick-up not to exceed 1200 amps.
④ MicroVersaTrip PM functions require 24 Vdc control power.
⑤ Ampere reading also standard on MircoVersaTrip Plus.

X = Rating plug amps
S = Sensor amp rating
C = Long-time current setting (pick up)
H = Short-time rating

6.3 Power Break® I Circuit Breaker

Power Break Rating Plugs

Frame Size (Amps)	Sensor Rating (Amps)	Current Rating (Amps)	Rating Plug Cat. No.
800	200	100	TR2S100
		150	TR2S150
		200	TR2S200
800	400	150	TR4S150
		200	TR4S200
		225	TR4S225
		250	TR4S250
		300	TR4S300
		400	TR4S400
800	800	300	TR8S300
		400	TR8S400
		500	TR8S500
		600	TR8S600
		700	TR8S700
		800	TR8S800
1600	1000	400	TR10S400
		600	TR10S600
		800	TR10S800
		1000	TR10S1000
1600	1600	600	TR16S600
		800	TR16S800
		1000	TR16S1000
		1200	TR16S1200
		1600	TR16S1600
2000	2000	800	TR20S800
		1000	TR20S1000
		1200	TR20S1200
		1600	TR20S1600
		2000	TR20S2000

Frame Size (Amps)	Sensor Rating (Amps)	Current Rating (Amps)	Rating Plug Cat. No.
2500	1000	400	TR10S400
		600	TR10S600
		800	TR10S800
		1000	TR10S1000
2500	2000	800	TR20S800
		1000	TR20S1000
		1200	TR20S1200
		1600	TR20S1600
		2000	TR20S2000
2500	2500	1600	TR25S1600
		2000	TR25S2000
		2500	TR25S2500
3000	3000	2000	TR30S2000
		2500	TR30S2500
		3000	TR30S3000
4000①	4000	1600	TR40S1600
		2000	TR40S2000
		2500	TR40S2500
		3000	TR40S3000
		4000	TR40S4000

① Draw-out breaker only.

6.3 Power Break® I Circuit Breaker

Interrupting Capacity

Envelope Size		800 Amps	1600 Amps	2000 Amps	3000 Amps	4000 Amps
Max. Short-Time Rating, kA		25	30	30	42	42
		Interrupting Capacity, kA				
Standard Break	240V ac	65	85	85	100	100
	480V ac	65	65	65	100	100
	600V ac	42	50	50	85	85
	250V dc①	--	22	--	42	42
High Break®	240V ac	100	125	125	200	200
	480V ac	100	100	100	150	150
	600V ac	65	65	65	100	100
	250V ac	--	35	--	85	85
	500Vdc①	--	--	--	65	65
	600V dc①	--	--	--	65	65

Power Break® Molded Case Switch Withstand Ratings

Switch Frame Size (Amps)	Continuous Current Rating (Amps)	Short-time Rating, RMS Sym Amps at 600V ac Max., 500 ms Max.	Suitable on 200,000 rms Sym Amp Fault Circuit When Protected by Class L Fuses as Follows:		Short Circuit Withstand Rating When Protected by Power Break with MicroVersaTrip Programmer		
			Line Side Max. Fuse Amp Rating	Load Side Max. Fuse Amp Rating	Breaker Frame Size (Amps)	480V ac	600V ac
800	800	25,000	2000	800	800	100,000	65,000
1600	1600	30,000	2500	1600	2000	100,000	65,000
2000	2000	30,000	2500	2000	2000	100,000	65,000
2500	2000 2500	42,000	2500	2500	4000	100,000	65,000
3000	3000	42,000	4000②	3000②	4000	100,000	65,000
4000	4000	42,000	4000②	4000②	4000	100,000	65,000

① Dc rating apply with MagneTrip unit only.
② Use only Hi-Break® breaker with 4000 amp fuses.

6.4 Power Break® II Circuit Breaker

Basic Configuration
The insulated case circuit breaker - GE Electrical Distribution & Control pioneered the design and created the name. Power Break® II insulated case circuit breakers offer reliable, flexible and easy-to-use circuit protection.

Power Break II circuit breakers are UL Listed, CSA Certified and IEC Certified for up to 200,000 amps at 240 volts rms symmetrical interrupting capacity without fuses or current limiters. These insulated case circuit breakers can be applied on ac power systems through 600 volts. Featuring a 2000A compact design up to 40% smaller than its predecessors, Power Beak II circuit breakers consist of three envelope sizes from 800 to 4000 amps.

Greater Convenience and Operational Safety.
The controls and status indicators you need most are readily accessible. The flush-mounted handle, ON/OFF buttons, rating plug test receptacles, bell alarm reset buttons (with or without lockout) are easy reached, and all are double-insulated from live components. For added security, a standard padlock devices let you prevent accidental or unauthorized closing of the breaker.

Quick, Error-Free Installation of Universal Accessories
Drop-in bell alarm, bell alarm with manual lockout, shunt trip (with or without lockout) and undervoltage release install in seconds. No special tools. No breaker disassembly. Just slide them into place. The modules are universal across all frame sizes, and each is mechanically keyed to its compartment so you make the right connection, every time. These accessories are field installable and upgradeable.

Three Choices of Advanced, Solid-State Trip Units
Enhanced MicroVersaTrip Plus™ and MicroVersaTrip PM™ trip units give you two new ways to monitor and control the Power Break II breaker with unprecedented ease. A simple keypad lets you program and display a variety of functions, including tripping characteristics, remote communications, status information and protective relaying, and it allows integration with GE POWER LEADER™ Power Management Systems. The trip unit display also allows viewing of many standard metering parameters as well as pickup alarms, trip target indications and fault status information. For less demanding functionality, the Power+™ trip unit gives you a third choice in Power Break II breaker control. Tripping characteristics are easily adjusted by a set of simple-to-use switches. The trip unit is upgradable to ground fault by simply inserting a ground fault rating plug. An optional target module allows for target monitoring and also functions as a trip unit health indicator.

Rating Plugs
The same interchangeable rating plugs are used in all of the MicroVersaTrip Plus™ and MicroVersatrip PM™ trip units across the entire Power Break® II breaker product line. Rating plugs are the key devices that establish the current rating of the breaker. They provide an essential scaling function for the unit's microprocessor and ensure maximum accuracy. They also provide an external jack for connection to an external battery pack, for cold set-up and target viewing.

Rating plugs have rejection features that allow them to be inserted only with breakers containing the correct current sensors. Rating plugs for the enhanced MicroVersaTrip Plus and MicroVersaTrip PM trip units cannot be used with Spectra RMS™ molded case circuit breakers, but are compatible with Power Break and AKR breakers with MicroVersaTrip Plus and MicroVersaTrip PM trip units. See Table below.

Rating Plug and Current Sensor Ratings

Envelope Size	Frame Max. Rating (Amps)	Sensor Rating (Amps) (S)	Rating Plug Amps (X)
2000	800	200	100, 150, 200
		400	150, 200, 225, 250, 300, 400
	800, 1600	800	300, 400, 450, 500, 600, 700, 800
	1600	1000	400, 600, 800, 1000
		1600	600, 800, 1000, 1100, 1200, 1600
	2000	2000	800, 1000, 1200, 1500, 1600, 2000
3000	2500	1000	400, 600, 800, 1000
		2000	800, 1000, 1200, 1500, 1600, 2000
		2500	1600, 2000, 2500
	3000	3000	2000, 2500, 3000
4000	4000	4000	1600, 2000, 2500, 3000, 3600, 4000

S = Sensor amp rating
X = Rating plug amps

6.4 Power Break® II Circuit Breaker

Current Sensors

Toroidally wound current sensors are furnished for all major protective functions, and for use with all Power Break II trip units. Toroidal sensors, including a second air-core winding, are provided with the high-range instantaneous function. Current sensors are factory installed and are not changeable in the field. There are 11 current ratings for the Power Break II breaker line through 4000 amps. See Table below for current ratings. Rating plugs must be coordinated with the current sensor rating (S) listed on the face of the rating plug.

Accessory Configuration

Activation of the bell alarm - alarm only and bell alarm with lockout are controlled by switch settings on the rear of the trip unit. To change the conditions that activate these accessories, configure the trip unit switch settings as described below.

Accessory Switch Settings

Switch	Factory Setting	Function
1	Disable	Shunt trip activates bell alarm - alarm only
2	Disable	UVR trip activates bell alarm - alarm only
3	Enable	Protection trip activates bell alarm - alarm only
4	Disable	Shunt trip activates bell alarm/lockout
5	Disable	UVR trip activates bell alarm/lockout
6	Enable	Protection trip activates bell alarm/lockout

Power+™ Trip Unit Characteristics

			Long-Time		Short-Time	
Envelope Size	Frame Max. Amp Rating	Sensor Rating (Amps) (S)	Current Setting (C) (Pick-Up) Multiple of Rating Plug Amps (X)	Delay① (Seconds 4 Bands)	Pick-Up (Multiple of Current Setting) (C)	Delay (Seconds 3 Bands)
2000	800	200, 400, 800	0.5, 0.6, 0.7, 0.8, 0.9, 0.95, 1.0	2.4, 4.9, 9.8, 20	1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.0, 9.0	I^2t in① .10, .21, .35
	1600	800, 1000, 1600				
	2000	2000				
3000	2500	1000, 2000, 2500				I^2t out② .10, .21, .35
	3000	3000				
4000	4000	4000				

Trip Unit Characteristics (continued)

Envelope Size	Adjustable Instantaneous Pick-Up without ST (Multiple of Rating Plug Amps) (X)	Adjustable Instantaneous Pick-Up with ST (Multiple of Rating Plug Amps) (X)	Ground Fault	
			Pick-Up (Multiple of Sensor Amp Rating)	Delay ③ (Seconds 3 Bands)
2000	1.5 thru 10.0	1.5 thru 15.0	0.20 thru 0.60	1^2T in④ .10, .21, .35
	1.5 thru 10.0	1.5 thru 15.0	0.20 thru 0.60	
	1.5 thru 10.0	1.5 thru 15.0	0.20 thru 0.60	
3000	1.5 thru 10.0	1.5 thru 13.0	0.20 thru 0.37	1^2T out② .10, .21, .35
4000	1.5 thru 9.0	1.5 thru 9.0	0.20 thru 0.30	

① Time delay shown at 600% of current setting at lower limit of band.
② Time delay shown at lower limit of each band. All pick-up tolerances are ±10%.
③ Time delay shown at lower limit of each band. Ground fault pick-up not to exceed 1200 amps.
④ Time delay shown at 200% of pick-up at lower limit of band.

X = Rating plug amps
S = Sensor amp rating
C = Long-time current setting (pick up)

6.4 Power Break® II Circuit Breaker

Power Break II Insulated Case Circuit Breaker Interrupting Capacity

Envelope Size		800 Amps	1600 Amps	2000 Amps	3000 Amps	4000 Amps
Max. Short-Time Rating, kA		25	30	30	42	42
		Interrupting Capacity, kA				
Standard Break	240Vac	65	85	85	100	100
	480Vac	65	65	65	100	100
	600Vac	42	50	50	85	85
High-Break	240Vac	100	125	125	200	200
	480Vac	10	100	100	150	150
	600Vac	65	65	65	100	100

Note: For 100% Rated requires 90C wire sized at 75C to comply with UL.

For complete information on Power Break II Circuit Breakers, refer to GET-8052B.

6.5 AKR Low-Voltage Power Circuit Breakers

AKR low-voltage power circuit breakers are intended for use in commercial, industrial and utility applications. Designed for severe duty, AKR breakers are serviceable and suitable for mains, feeders and applications such as motor starting, capacitor switching/generator protection and resistance welding. They are fully rated; that is, the short time rating in most cases is equal to the short circuit rating providing the greatest opportunity for selectivity with downstream devices. The breakers are maintainable and meet ANSI Standard C37.13 and C37.16, as well as applicable UL Standards.

There are five frame sizes from 800 - 4000 amperes with interrupting ratings to 130,000 amperes rms symmetrical without fuses. For further information on AKR Circuit Breakers see GET-6218 or contact your local GE Industrial Systems Sales Engineer.

Trip Unit Characteristics

Frame Size	Max. Amp Rating	Sensor Rating (Amps) (S)	Long-Time Current Setting (Multiple of Rating Plug Amps) (X)	Long-Time Pick-Up (Multiple of Current Setting (C)	Short-Time Delay① (Seconds)	Short-Time Pick-Up (Multiple of Current Setting) (C)	Short-Time Delay (Seconds)
AKR-30S AKR-30H	800	150, 400, 800	.5, .6, .7, .8, .9, .95, 1.0, 1.1	Fixed at 1.0 of Current Setting	2.4, 4.6, 9, 20,		
AKR-50	1600	800, 1600	5, .6, .7, .8, .9, .95, 1.0, 1.1	Fixed at 1.0 of Current Setting	2.4, 4.6, 9, 20		I^2t in: ① .40
AKRT-50	2000	2000	5, .6, .7, .8, .9, .95, 1.0, 1.1	Fixed at 1.0 of Current Setting	2.4, 4.6, 9, 20	1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.0, 9.0	
AKR-75	3200	3200	5, .6, .7, .8, .9, .95, 1.0, 1.1	Fixed at 1.0 of Current Setting	2.4, 4.6, 9, 20		I^2t out: ② .10, .21, .35
AKR-100	4000	4000	5, .6, .7,.8, .9, .95, 1.0, 1.1	Fixed at 1.0 of Current Setting	2.4, 4.6, 9, 20		
AKR-125	5000	5000	(Refer to factory GE-Houston)				

Trip Unit Characteristics (cont'd)

Frame Size	Adjustable Instantaneous Pick-Up without ST Rating (Multiple of Plug Amps) (X)	Adjustable Instantaneous Pick-Up with ST (Multiple of Rating Plug Amps) (X)	High Range Instantaneous (Multiple of Frame Short-time③ Rating) (H)	Triple Selective Trip, Fixed High Range Instantaneous④⑤	Ground Fault Pick-Up (Multiple of Sensor Amp Rating) (S))	Ground Fault Delay with I^2T (Seconds)	Ground Fault Delay⑥ without I^2T (Seconds)
AKR-30S AKR-30H	1.5, 2, 3 5, 7, 9, 10	1.5, 2, 3, 5, 7, 9, 10, 13, 15	.4, .6, .8, 1.0	+0 22ka -20%	.2, .25, .3, .35, .4,.45, .5, .6		.10, .21, .35
AKR-50	1.5, 2, 3, 5, 7, 9, 10	1.5, 2, 3, 5, 7, 9, 10, 13, 15	.4, .6, .8, 1.0	N/A	.1, .25, .3, .35, .4,.45, .5, .6	.40 at 200% of pickup at lower limit of band	.10, .21, .35
AKRT-50	1.5, 2, 3, 5, 7, 9, 10	1.5, 2, 3, 5, 7, 9, 10, 13, 15	.4, .6, .8, 1.0	N/A	.2, .25, .3, .35, .4,.45, .5, .6		.10, .21, .35
AKR-75	1.5, 2, 3, 5, 7, 9, 10	1.5, 2, 3, 5, 7, 9, 10, 13	.4, .6, .8, 1.0	N/A	.2, .22, .24, .26, .28, .30, .34, .37		.10, .21, .35
AKR-100	1.5, 2, 3, 5, 7, 9	1.5, 2, 3, 5, 7, 9	.4, .6, .8, 1.0	N/A	.2, .22, .24, .26, .28, .3		.10, .21, .35
AKR-125	(Refer to factory GE-Houston)						

① Time delay shown at 600% of current setting at lower limit of band.
② Time delay shown at lower limit of each band.
③ Refer to GET-6218 for frame short-time ratings.
④ For AKR-30S only.
⑤ Triple selective trip is standard when long-time/short-time only is required.
⑥ Time delay shown at lower limit of each band.

X = Rating plug amps
S = Sensor amp rating
C = Current setting
H = Short-time rating

6.5 AKR Low-Voltage Power Circuit Breakers

MicroVersaTrip® Plus Trip Unit
The MicroVersaTrip Plus trip units utilize a digital, LCD display with a four-button keypad to provide local set-up and readout of trip settings. A 3-phase ammeter and trip indicators are standard, as is a clear plastic cover with provisions for sealing to allow tamper-resistant installation. The trip unit digitally measures the current waveform in each phase to determine the true RMS value of the current, regardless of the waveshape. MicroVersaTrip Plus trip units provide accurate, predictable overload and short circuit protection for distribution systems that include variable speed drives, rectifiers, induction heating and other loads that cause high harmonic distortion as well as standard circuits. They provide maximum breaker-to-breaker selectivity and custom load protection. Short-time and ground fault functions include the flexibility of coordination with or without an I^2t ramp and are also available with high range instantaneous.

MicroVersaTrip PM Trip Unit
The MicroVersaTrip PM Trip Unit adds power management system capability, including advanced metering, and protective relays to the basic functions of the MicroVersaTrip Plus. MicroVersaTrip PM trip units communicate directly on the GE POWER LEADER™ communications bus (commnet).

MicroVersaTrip® MVT PM and MVT+ AKR Programmers

Programmer Suffix	Long -time (L)	Short -time (S)	Adj. Inst.(I)	Adj. High Inst. (H)	Fixed High Inst. (K)	Ground Fault (G) ②	OL/SC Targets (T1)	OL/SC/GF Targets (T2)	GF Zone Interlock (Z1) ①	GF/ST Zone Interlock (Z2) ①	Siwtch Inst/GF (X)
Adjustable Instantaneous											
L1	•		•								
L1TI	•		•				•				
LIGT2	•		•					•			
LIG2Z1	•		•			•		•	•		
LSIT1	•		•			•					
LSIG	•	•	•				•				
LSIGT2	•	•	•			•		•			
LSIGT2Z1	•	•	•				•		•		
LSIGT2Z2	•	•	•			•		•		•	
Adjustable High Instantaneous											
LSHT1	•	•		•			•				
LSHGT2	•	•		•		•		•			
LSHGT2Z1	•	•		•		•		•	•		
LSHGT2Z2	•	•		•		•		•		•	
Fixed High Instantaneous ③											
LSKT1	•	•			•		•				
LSKGT2	•	•			•	•		•			
LSKGT2Z1	•	•			•	•		•	•		
LSKGT2Z2	•	•			•	•		•		•	

① Requires separate zone selective interlock module(s) Type TIM1 (120 Vac control voltage).
② For single-phase, 3-wire or 3-phase, 4-wire applications, order appropriate neutral current sensor.
③ Only available for AKR-7D-30S or AKRU-7D-30S.

6.5 AKR Low-Voltage Power Circuit Breakers

MicroVersaTrip® PM Trip Unit Features (All Frames)①

Function	Description	Trip Unit Suffix		
		M (Metering)	P (Relaying)	PM (Metering & Relay)
Amperes (A) ②	Selectable Phase Current ± 2.0%	X	X	X
Voltage (V)	L-L or L-N Volts ± 1.5%	X		X
Energy (kwh/MWh)	Total Energy Usage on Brkr ± 3.5%	X		X
Real Power (kW)	L-L or L-N Power ± 3.5%	X		X
Total Power (kVA)	L-L or L-N Power ± 3.5%	X		X
Frequency (HZ)	Circuit Frequency ± 1HZ	X		X
Under Voltage Trip	--Adjustable pickup 10-50%		X	X
	--Adjustable delay, 1-15 seconds, OFF			
Over Voltage Trip	--Adjustable pickup, 110-150%		X	X
	--Adjustable delay, 1-15 seconds, OFF			
Voltage Unbalance	--Adjustable pickup, 10-50%		X	X
	--Adjustable delay, 1-15 seconds, OFF			
Current Unbalance	--Adjustable pickup, 10-50%		X	X
	--Adjustable delay, 1-15 seconds, OFF			
Power Reversal	--Adjustable pickup, .01-3.00 per unit		X	X
	--Adjustable delay, 1-15 seconds, OFF			

① MicroVersaTrip PM functions require voltage module.
② Ampere reading also standard on MicroVersaTrip Plus.

AKR Rating Plugs

Frame Size (Amps)	Sensor Rating (Amps)	Current Rating (Amps)	Rating Plug Cat. No.
800	150	60	TR1S60
		80	TR1S80
		100	TR1S100
		125	TR1S125
		150	TR1S150
800	400	150	TR4S150
		200	TR4S200
		225	TR4S225
		250	TR4S250
		300	TR4S300
		400	TR4S400
800 or 1600	800	300	TR8S300
		400	TR8S400
		500	TR8S500
		600	TR8S600
		700	TR8S700
		800	TR8S800

Frame Size (Amps)	Sensor Rating (Amps)	Current Rating (Amps)	Rating Plug Cat. No.
1600	1600	600	TR16S600
		800	TR16S800
		1000	TR16S1000
		1200	TR16S1200
		1600	TR16S1600
2000	2000	800	TR20S800
		1000	TR20S1000
		1200	TR20S1200
		1600	TR20S1600
		2000	TR20S2000
3200	3200	1200	TR32S1200
		1600	TR32S1600
		2400	TR32S2400
		3200	TR32S3200
4000	4000	1600	TR40S1600
		2000	TR40S2000
		2500	TR40S2500
		3000	TR40S3000
		4000	TR40S4000
5000	5000	(Refer to factory GE-Houston)	

6.5 AKR Low-Voltage Power Circuit Breakers

Low-Voltage Power Circuit Breakers, Type AKR-Interrupting Ratings

Power Circuit Breaker Type	Maximum Breaker Frame Rating (Amps)	Trip Rating (Amps) 60 Hz	Ac Voltage Rating	Short Circuit Ratings Rms Symmetrical Amps (In Thousands) With Instantaneous Trips
AKR-30	800	100-800	600	30
			480	30
			240	42
AKR-30H	800	100-800	600	42
			480	42
			240	50
AKR-50	1600	300-1600	600	42
			480	50
			240	65
AKR-50H	1600	300-1600	600	65
			480	65
			240	65
AKRT-50H	2000	800-2000	600	65
			480	65
			240	65
AKR-75	3200	1200-3200	600	65
			480	65
			240	85
AKR-100	4000	1600-4000	600	85
			480	85
			240	130
AKR-125	5000	5000	(Refer to factory GE-Houston)	

250V dc Current Ratings with EC Trip Device Only

Breaker Type	Frame Size Amps	Short Circuit KA
AKR-30	800	25
AKR-50	2000	50
AKR-75	4000	50

Fused Breaker Ratings, Maximum 600V ac 50/60 Hz

Breaker Type	Frame Size (Amps)	Fuse Rating Amps ①		Interrupting Rating rms Symmetrical KA
		Minimum	Maximum	
AKRU-30S	800	300	1600	200
AKRU-50	1600	450	2500	200
AKR-75①	3200	2000	4000	200
AKR-100①	4000	2000	5000	200

① Fuses mounted on separate fuse roll-out element.

6.6 WavePro™ Low Voltage Power Circuit Breakers

Product Overview

WavePro Low Voltage Power Circuit Breaker

The new GE line of WavePro Low Voltage Power Circuit Breakers is intended for use in commercial, industrial and utility applications. Built to withstand intense service conditions, these circuit breakers provide the ultimate in system selectivity because of their high withstand capabilities. These circuit breakers are UL listed and meet the ANSI standards for low-voltage power circuit breakers. The WavePro line consists of six frame sizes with current ratings of 800 to 5000 amperes and short-circuit ratings through 200,000 amperes.

Power+ Trip Unit

The Power+ trip unit is a new addition to the list of trip units available on GE low voltage power circuit breakers. It provides the same true RMS sensing as the MicroVersaTrip trip units. The liquid crystal display and keypad are replaced by plug-in modules and rotary switches. The plug-in module provides optional LED targets for overload, short circuit and ground fault trips. View and reset push buttons are also provided to monitor status, including a battery check LED. The rating plug module serves the dual purpose of providing the trip rating for the circuit breaker as well as ground fault protection when required. All pickup and delay settings are selected with detented rotary switches.

Enhanced MicroVersaTrip Plus Trip Unit

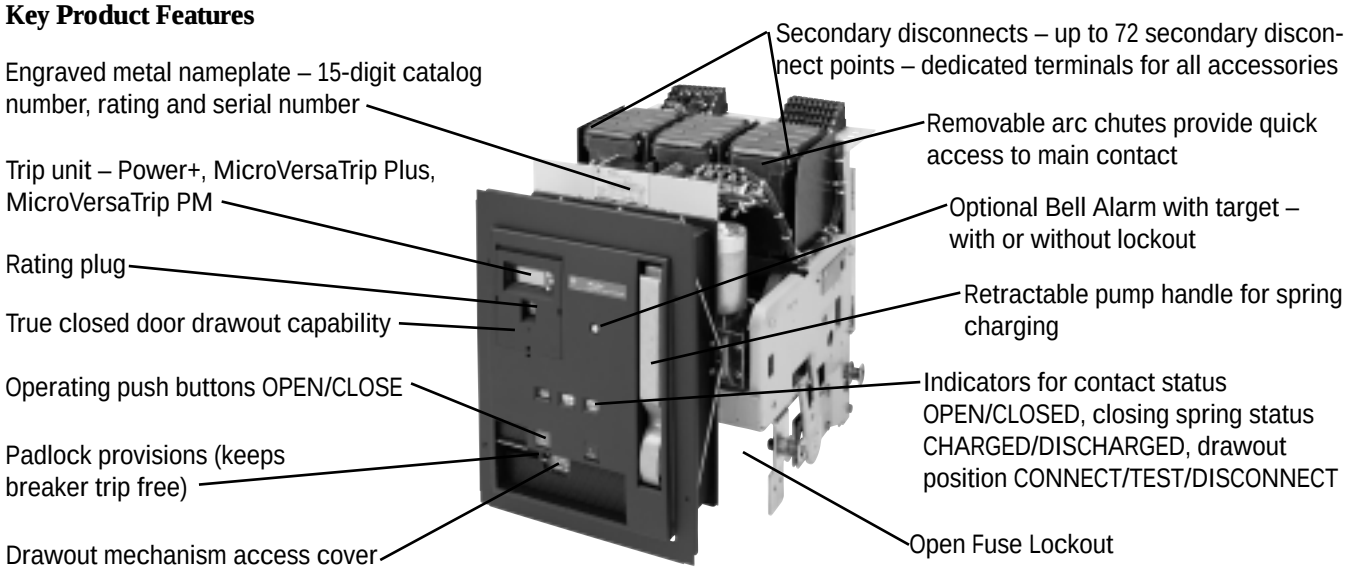
The Enhanced MicroVersaTrip Trip unit contains a digital liquid crystal display with a five-button keypad for local setup and readout of trip settings. These enhanced trip units contain a lithium battery for cold setup capability and viewing of targets without external power. A three-phase ammeter and trip indicators are standard. A sealable cover in the breaker escutcheon provides a tamper-resistant installation.

The trip unit digitally measures the current waveform in each phase to determine the true RMS value of the current, regardless of the wave shape. MicroVersaTrip Plus trip units provide accurate, predictable overload and short-circuit protection for distribution systems that include variable-speed drives, rectifiers, induction heating, and other loads that cause high harmonic distortion, as well as standard circuits. The wide range of trip characteristics allows maximum breaker-to-breaker selectivity and custom load protection. Short-time and ground-fault functions include the flexibility of coordination with or without I2t ramp.

Enhanced MicroVersaTrip PM Trip Unit

The Enhanced MicroVersaTrip (MVT) PM trip unit adds power management system capability, including advanced metering and protective relaying to the basic functions of the MVT Plus. The MVT/PM can be interfaced with either Modbus RTU or Ethernet TCP/IP compatible systems.

Key Product Features



WPF-16 Electrically Operated Circuit Breaker

6.6 WavePro™ Low Voltage Power Circuit Breakers

Breaker Features③

- Designed to meet ANSI C37.13, C37.16, C37.17 and tested to ANSI C37.50
- Listed and labeled to UL-1066 and CSA C22.2
- 100% rated (requires 90C wire sized at 75C to comply with UL), 40°C room ambient temperature
- Six frame sizes: 800, 1600, 2000, 3200, 4000, 5000
- Integral spring charging handle standard on manual and electrically operated breakers
- Improved breaker rating rejection feature
- Trip unit is mounted in the breaker escutcheon, “thru the door” access
- True closed-door drawout for maximum operator safety
- Breaker drawout position indicator in the escutcheon
- Up to 72 secondary disconnect points — accessories have dedicated wiring points
- Choice of three trip units
- Short circuit ratings through 200,000 amperes rms symmetrical
- Metal frame construction provides rigidity and endurance
- Easy access to main components to facilitate inspection and maintenance
- Optional "power management ready" for easy field upgrade

Power+™, MicroVersaTrip PlusTM and MicroVersaTrip PMTM Trip Unit Characteristics

			Long-time		Short-time	
Frame Size	Max. Amp Rating	Sensor Rating (Amps) (CT)	Long Time (LT) (Pickup) Multiple of Rating Plug Amps (In)	Delay ① [Band] (Seconds)	Pickup (Multiple of Long Time) (LT)	Delay [Band] (Seconds)
WPS-08 / WPH-08			Power+		Power+	
WPX-08 / WPF-08	800	150, 400, 800	0.5 thru 1.1 in		1.5, 2.0, 2.5, 3.0, 4.0,	I2T in ①
WPS-16 / WPH-16	1600	800, 1600	in steps of 0.1	[1] [2] [3] [4]	5.0, 7.0, 9.0	0.40
WPF-16				2.4, 4.9, 9.8, 20		
WPS-20	2000	2000				I2T out ②
WPS-32 / WPH-32	3200	3200	MVT Plus/PM		MVT Plus/PM	[1] [2] [3]
WPS-40	4000	4000	0.5 thru 1.1 in		1.5 thru 9.0	.10, .21, .35
WPS-50	5000	5000	in steps of 0. 05		in steps of 0.5	

① Time delay shown at 600% of current setting at lower limit of band.
② Time delay shown at lower limit of each band. All pickup tolerances are ± 10%.

In or X = Rating plug amps
CT or S = Sensor amp rating
LT or C = Long-time current setting
ST = Short time characteristic

③ **WavePro breakers are available only in Class 3 and Power Break II switchboards. Contact factory for future offerings in Class 2 and Class 5 switchboards.**

6.6 WavePro™ Low Voltage Power Circuit Breakers

Power+™, MicroVersaTrip PlusTM and MicroVersaTrip PMTM Trip Unit Characteristics

Frame Size	Adjustable Instantaneous Pickup without ST (Multiple of Rating Plug Amps) (In)	Adjustable Instantaneous Pickup with ST (Multiple of Rating Plug Amps) (In)	Ground Fault Pickup (Multiple of Sensor Amp rating) (CT)	Delay with I2T (Seconds)	Delay without I2T① [Band] (Seconds)
WPS-08 / WPH-08 WPX-08 / WPF-08 WPS-16 / WPH-16	Power+ 1.5, 2.0, 3.0, 5.0, 7.0, 9.0, 10.0	Power+ 1.5, 2.0, 3.0, 5.0, 7.0, 9.0, 10.0, 13.0, 15.0	Power+ .20, .25, .30, .35, .40, .45, .50, .60		
WPF-16 WPS-20		MVT Plus/PM 1.5 thru 15.0 in steps of 0.5	MVT Plus/PM 0.20 thru 0.60 in steps of 0.01	.44 at 200%	
WPS-32 / WPH-32	MVT Plus/PM 1.5 thru 10.0 in steps of 0.5	Power+ 1.5, 2.0, 3.0, 5.0, 7.0, 9.0, 10.0, 13.0 MVT Plus/PM 1.5 thru 13.0 in steps of 0.5	Power+ .20, .22, .24, .26, .28, .30, .34, .37 MVT Plus/PM 0.20 thru 0.37 in steps of 0.01	of pickup at lower limit of band	[1] [2] [3] .10, .21, .35
WPS-40	Power+ 1.5, 2.0, 3.0, 5.0, 7.0, 9.0 MVT Plus/PM 1.5 thru 9.0 in steps of 0.5	Power+ 1.5, 2.0, 3.0, 5.0, 7.0, 9.0 MVT Plus/PM 1.5 thru 9.0 in steps of 0.5	Power+ .20, .22, .24, .26, .28, .30 MVT Plus/PM 0.20 thru 0.30 in steps of 0.01		
WPS-50 ②	MVT Plus/PM 1.5 thru 7.0 in steps of 0.5	MVT Plus/PM 1.5 thru 7.0 in steps of 0.5	MVT Plus/PM 0.20 thru 0.24 in steps of 0.01		

Enhanced MicroVersaTrip PM™ Trip Unit Features (All Frames)③

Function	Description	Trip Unit Suffix M (Metering)	Trip Unit Suffix PM (Metering & Relaying)
Amperes (A)	Selectable phase current, ±2.0%	X	X
Voltage (V)	L-L or L-N Volts, ±1.5%	X	X
Energy (kWh, MWh)	Total energy usage on breaker, ±3.5%	X	X
Real Power (kW)	L-L or L-N Power, ±3.5%	X	X
Frequency (Hz)	Circuit Frequency, ±1 Hz	X	X
Undervoltage Trip	Adjustable pickup: 50-90%; adjustable delay: 1-15 s, OFF		X
Overvoltage Trip	Adjustable pickup: 110-150%; adjustable delay: 1-15 s, OFF		X
Voltage Unbalance	Adjustable pickup: 10-50%; adjustable delay: 1-15 s, OFF		X
Current Unbalance	Adjustable pickup: 10-50%; adjustable delay: 1-15 s, OFF		X
Power Reversal	Adjustable pickup: 10-990 kW; adjustable delay: 1-15 s, OFF		X
Power Direction	Setup as line-to-load or load-to-line		X
Communication		X	X

① Time delay shown at lower limit of band. Ground fault pick up not to exceed 1200 amps.
② Power+ not available on 5000 amp (WPS-50) circuit breaker.
③ **WavePro breakers are available only in Class 3 and Power Break II switchboards. Contact factory for future offerings in Class 2 and Class 5 switchboards.**

In or X = Rating plug amps
CT or S = Sensor amp rating
LT or C = Long-time current setting
ST = Short time characteristic

6.6 WavePro™ Low Voltage Power Circuit Breakers

Product Specifications③

WavePro Breaker Interrupting Ratings

Rated AC Voltage, Nominal (max)	Breaker Type	Frame Size (amps)	Short-Circuit RMS Symmetrical kA Short-Time Withstand	With Instantaneous Trip	Without Instantaneous Trip
600 (635)	WPS-08	800	30	30	30
	WPH-08	800	42	42	42
	WPX-08	800	50	50	50
	WPS-16	1600	42	42	42
	WPH-16	1600	65	65	65
	WPS-20	2000	65	65	65
	WPS-32	3200	65	65	65
	WPH-32	3200	85	85	85
	WPS-40	4000	85	85	85
	WPS-50	5000	85	85	85
480 (508)	WPS-08	800	30	30	30
	WPH-08	800	42	42	42
	WPX-08	800	65	65	65
	WPS-16	1600	50	50	50
	WPH-16	1600	65	65	65
	WPS-20	2000	65	65	65
	WPS-32	3200	65	65	65
	WPH-32	3200	85	85	85
	WPS-40	4000	85	85	85
	WPS-50	5000	85	85	85
240 (254)	WPS-08	800	30	42	30
	WPH-08	800	42	50	42
	WPX-08	800	65	65	65
	WPS-16	1600	50	65	50
	WPH-16	1600	65	65	65
	WPS-20	2000	65	65	65
	WPS-32	3200	65	85	65
	WPH-32	3200	85	130	85
	WPS-40	4000	85	130	85
	WPS-50	5000	85	130	85

① The maximum fuse rating is the largest fuse that tests show will result in proper performance of the breaker and fuse in combination under short-circuit conditions. Only Gould- Shawmut fuses should be used for proper coordination.

② Fuses are mounted on separate fuse roll-out element.

Fused Breaker Ratings (Max. 600 Vac. 50/60 Hz)

Breaker Type	Frame Size (amps)	Fuse Rating, A ① Min.	Max.	Interrupting Rating RMS Symmetrical kA
WPF-08	800	300	1600	200
WPF-16	1600	450	2500	200
WPS-20 ②	2000	2000	2500	200
WPS-32 ②	3200	2000	4000	200
WPS-40 ②	4000	2000	5000	200
WPS-50 ②	5000	2000	5000	200

Shipping Weight

Draw-Out Breaker Element	Net (lbs) Manual	Electrical
WPS/WPH/WPX-08	200	205
WPF-08	245	250
WPS/WPH-16	210	215
WPF-16	255	260
WPS-20	220	225
WPS/WPH-32	475	485
WPS-40	535	545
WPS-50	575	585

Operating Time (Cycles on 60 Hz Base; All Frame Sizes)

Closing electrically
Time from energizing closing circuit until contacts touch _____ 5
Open (maximum clearing time)
With instantaneous overcurrent trip _____ 3
With shunt trip _____ 3.5

③ **WavePro breakers are available only in Class 3 and Power Break II switchboards. Contact factory for future offerings in Class 2 and Class 5 switchboards.**

For further information on WavePro Low Voltage Power Circuit Breakers, refer to DET-167

6.7 High Pressure Contact Switches

High Pressure Contact Switches
GE type HPC switches are UL Listed in accordance with Standard 977, Fused Power Circuit Devices.

The overcenter toggle mechanism provides stored energy, quick-make / quick-break operation. Multiple spring-loaded, high-pressure current-carrying contacts and an arcingcontact arm provide excellent current carrying capability without sacrificing high interrupting fault performance. These switches can interrupt, on a make and break basis, a minimum of 12 times their nameplates rating without fuse assistance at 600 volts ac. Complete HPC switch and Class L fuse coordination is therefore achieved for all levels of fault current up to 200,000 rms amperes symmetrical at 600 volts ac maximum. Type HPC switches used as service disconnects comply with the National Electrical Code Section 230-65 for adequate short-circuit current and ground-fault protection.

- High durability, safety of operation - High dielectric strength. Glass-reinforced insulating case.
- High interrupting capability - Arc chute of unique construction suppresses arcs and cools gases rapidly, providing quick arc interrupting and extended switch life.
- High transient voltage withstanding - Interphase partitions mesh with switch cover to completely isolate each pole.
- Extended switch life - Preloaded constant pressure pivot eliminates braid whip and fraying on high short-circuit currents and repeated operations.
- Positive "On-Off" indication - Green (Off), red (On), eliminates any question about the position of the switch contacts.
- Easy operation - Quick Make - Extra heavy duty, low torque rotary-operated closing mechanism. L-handle 800-1600 amperes; T-handle 2000 amperes and above.
- Emergency Open - Quick Break - Fingertip "Off" button instantly opens the switch contacts.
- Positive door and switch interlock - Separate fuse access door is not required.

Product Forms
- Top Feed - Line terminals at top of switch.
- Bottom Feed - Line terminals at bottom of switch; fuses are de-energized when switch is in Off position. Same size switchboard as top feed. When switchboard is bottom fed it permits shallow design. Space for running feed to top terminals is not required.

Options Available
Manual Operation - For manual, high-interrupting capacity, disconnects not requiring remote tripping and / or ground-fault protection.

Integral Ground Fault - Incorporates a solid-state, inverse-time and fixed-time response. Ground fault function is self-powered and has field adjustable ground fault current and delay time settings for maximum coordination and selectivity. Through 3000 amperes, switches with integral ground fault are the same size as manual switches.

Electric Trip - For remote tripping or for use with GroundBreak® components. All electric trip switches are the same size as manual devices.

Blown-fuse Protector - Provides single phase protection by tripping switch when a fuze blows or when switch is closed with a blown fuse or no fuse installed. Suitable for system voltage of 208-480 volts ac. Mounted internally. Does not provide protection of voltage loss of the power source.

Auxiliary Switch - Provides remote indication of main contact position. Switch elements are Type AB, single pole, double-throw. Switch element ratings are: 0.25A at 250Vdc; 0.5A at 125Vdc; 6.0 Amps at 240Vac.

1. Mechanical Indicator-protrudes when ground fault occurs.
2. Field Adjustable Ground Fault Trip Point - from 200 to 100 amperes in six steps.
3. Field Adjustable Ground Fault Delay Time - min. (0.03 sec), intermediate (0.20 sec) and max (0.50 sec) delay time settings.
4. No Trip Test Button - permits ground fault system check without tripping switch.
5. Test Button - simulates an actual ground fault and will trip switch unless "No Trip" button is depressed prior to pushing test button. Ground fault indicator will protrude when system is tested or when actual ground fault occurs.

Note: Although the integral ground fault function is self-powered, the test function does require an external 120Vac (200VA nominal) control power source.

6.7 High Pressure Contact Switches

GE HPC Switch Interrupting Ratings

Type	Available Ratings		Contact Interrupting Rating Based on Ability to Operate on Overload Unassisted by the Fuse	Switch-fuse Combination at Switch-rated ac Volts with Class L Fuse
	Continuous Amperes	Maximum ac Volts		
HPC/R	800, 1200, 1600, 2000, 2500, 3000, 4000	600	"Open" - 12X amp rating; "Close-Open" - 12X amp rating	200,000

For further information on HPC switches, see GET-6205 or contact your local GE Industrial Systems Sales Engineer.

6.8 Molded Case Circuit Breakers

SE 15 Through 150 Amperes

SF 70 Through 250 Amperes

SG 125 Through 600 Amperes

SK 200 Through 1200 Amperes

Molded case circuit breakers are circuit protective devices that primarily perform two functions: (1) manual switching operation to open and close a circuit by means of a toggle handle and (2) automatic opening of the circuit under sustained overload and/or short circuit conditions. Circuit breakers inherently provide the automatic protective function of opening the circuit under abnormal sustained overload or short circuit conditions without the use of fuses. When a circuit breaker opens to clear a fault, the toggle handle goes to the TRIPPED position, midway between the ON and OFF position, thus clearly indicating that a circuit breaker has opened. When the cause of the fault has been removed, the circuit breaker can again be closed simply by moving the toggle handle to the RESET OFF position and then moving the handle to the ON position.

The quick-make, quick-break, trip-free mechanism minimizes arcing during breaker operation. Contacts cannot be "teased" into position. The trip-free mechanism is independent of manual handle control. The breaker trips under short circuit or overload, even though the operating handle is held in the ON position.

Circuit breakers have several advantages over fuses:

- A fault or overload on one pole of a multi-pole breaker actuates a common trip bar that opens all poles simultaneously, thus avoiding single phasing a motor circuit, as could occur in a fusible device when one fuse opens.
- Circuits may be "repowered" after a circuit breaker trips without obtaining and replacing a "blown" fuse.
- Adjustable characteristics of circuit breakers provide the opportunity for better protection of conductors and loads.
- Molded case circuit breakers are available with thermal magnetic or solid state trip units.

Molded Case Switches (Non-Automatic Circuit Breakers or Magnetic Only Devices)

NEC Section 210-20 specifies that branch circuit conductors shall be protected by overcurrent protective devices. This provision is included in Switchboard Standard UL891. For these reasons, molded case switches and magnetic only devices cannot be included in switchboard equipment as branch circuits.

6.8 Molded Case Circuit Breakers

Molded case switch requirements for main devices must be reviewed by application engineering.

Current Limiting Circuit Breaker (Fuseless)
Current limiting circuit breakers (fuseless) use a thermal trip that protects against overloads and a magnetic trip to guard against moderate short circuits. The circuit breakers, when operating within their current limiting range, limit the let-through (I2t) and peak current (Ip) to a value less than that of a 1/2 cycle-wave of the available short circuit current. They are available in the following frame styles and ratings:

- THLC1: 15-150 amps
- THLC2: 125-225 amps
- THLC4: 250-400 amps
- SELA, SEPA: 15-150 amps
- SFLA, SFPA: 70-250 amps
- SGLA, SGPA: 125-600 amps

Digital, Solid State Spectra RMS™ Breakers
Spectra RMS circuit breakers are available in four frame sizes and meet UL Standard 489, International Electrotechnical Commission (IEC) Standard 947.2, and Japanese Industrial Standard (JIS) No. C83370. The trip units employ digital sampling techniques to accurately determine the true RMS heating value of the load current. These devices include the following features:

- UL Listed current limiting capability in a 150A through 600A frame.
- UL Listed for reverse feed applications.
- Field interchangeable rating plugs.
- Field installable control accessories - shunt trip, UV release, auxiliary switch and bell alarm switch.
- Field adjustment of the instantaneous characteristics, which include a tracking short-time function and current setting values.
- Interrupting Ratings to 200,000A RMS at 240V and 100,000A RMS at 480V.
- 100% Rated Devices in the G & K frames with trip ratings of 125 - 1000A.

For further information on Spectra RMS circuit breakers, see GET-7002 or contact your local GE Industrial Systems Sales Engineer.

6.8 Molded Case Circuit Breakers

Spectra RMS™ Circuit Breaker Current Ratings: SE & SF Frame Circuit Breakers

Frame	Max. Frame Amps	Rating Plug Amps	Instantaneous Trip Settings, Nominal RMS SYM Amps Trip Setting Adjustment Position Lo	2	3	4	5	6	Hi
SE	30	15	43	55	69	86	111	143	182
		20	58	74	93	116	151	196	254
		25	73	93	117	147	193	253	332
		30	87	112	142	179	237	314	415
	60	40	118	150	188	237	308	394	501
		50	148	187	236	296	386	498	637
		60	178	224	284	355	464	604	777
		70	206	261	329	411	534	684	863
	100	80	236	299	377	472	614	787	999
		90	267	338	426	532	694	892	1138
		100	297	376	475	593	775	998	1280
		110	328	415	524	654	857	1105	1426
	150	125	374	474	598	745	979	1265	1640
		150	450	570	720	897	1181	1528	1991
SF	250	70	205	260	330	410	535	--	700
		90	265	335	425	530	690	--	900
		100	295	375	470	590	765	--	1000
		110	325	410	520	650	845	--	1100
		125	370	465	570	740	960	--	1250
		150	440	560	705	885	1150	--	1500
		175	515	655	825	1035	1345	--	1750
		200	590	750	940	1180	1535	--	2000
		225	665	840	1050	1330	1730	--	2250
		250	740	935	1180	1480	1920	--	2250

Spectra RMS Circuit Breaker Current Ratings: SG & SK Frame Circuit Breakers

Frame	Max. Frame Amps	Rating Plug Amps	Instantaneous Trip Settings, Nominal RMS SYM Amps Trip Setting Adjustment Position Lo	2	3	4	5	Hi
SG	400	125	380	480	620	765	990	1275
		150	455	575	740	920	1185	1530
		175	530	670	865	1070	1385	1785
		200	605	765	990	1225	1580	2040
		225	680	860	1115	1375	1780	2295
		250	755	955	1235	1530	1975	2550
		300	905	1145	1480	1835	2370	3060
		350	1060	1340	1730	2140	2765	3570
		400	1210	1530	1980	2445	3160	4080
	600	250	765	965	1215	1500	1960	2530
		300	915	1155	1455	1800	2355	3035
		350	1070	1350	1700	2100	2745	3545
		400	1220	1540	1940	2400	3135	4050
		450	1375	1735	2185	2695	3530	4555
		500	1525	1925	2425	2995	3920	5060
		600	1830	2310	2910	3595	4705	6075
SK	800	300	940	1150	1445	1795	2375	3015
		400	1255	1535	1930	2395	3165	4015
		500	1570	1915	2410	2990	3955	5020
		600	1875	2290	2895	3610	4740	6195
		700	2155	2665	3375	4240	5525	7420
		800	2440	3035	3860	4875	6305	8705
	1200	600	1825	2310	2905	3685	4730	6110
		700	2125	2695	3390	4300	5515	7125
		800	2430	3080	3870	4910	6305	8145
		1000	3040	3850	4840	6140	8880	10180
		1200	3650	4620	5805	7370	9455	12215

6.8 Molded Case Circuit Breakers

Digital, Solid State Spectra RMS™ Breakers
Quick Reference Guide
Ratings do not apply to molded case switches

Spectra RMS Circuit Breakers UL/CSA Rating

Circuit Breaker Type	Ampere Rating	No. of Poles	Max ac Voltage Rating	UL Listed Interrupting Rating - rms Symmetrical Amps (in Thousands) 40Vac	480Vac	600Vac	Federal Spec. C/B Class W-C375B
2SE150 Current Limiting (UL File No. E11592; CSA LR 84929-8)①							
SED②	15-150	2	480	18	18	--	13b
		3	600			14	18b
SEH②		2	480	65	25	--	13b, 15b
		3	600			18	22a
SEL		2	480	100	65	--	13b, 15b
		3	600				
SEP		2	480	200	100	--	16a
		3	600			25	16a, 23a
SF250 Current Limiting (UL File No. E11592, CSA LR 84929-1)①							
SFH②	70-250	2	480	65	35	--	13b
		3	600			18	20a, 22a
SFL		2	480	100	65	--	13b
		3	600			25	21a, 23a
SFP		2	480	200	100	--	16a
		3	600			25	16a, 23a
SG600 Current Limiting (UL File No. E11592; CSA LR 84929-8)							
SGD¡	125-400	2	240	65	--	--	14b
		3	240				
SGH¡		2	600	65	35	25	21a, 23a
		3	600				
SGH6¡	250-600	2	600	65	35	25	23a
		3	600				
SGL4	125-400	2	600	100	65	65	23a
		3	600				
SGP4		2	600	200	100	65	23a
		3	600				
SGL6	250-600	2	600	100	65	65	24a
		3	600				
SGP6		2	600	200	100	65	25a
		3	600				
SK1200 (UL File No. E11592; CSA LR 84929-7)							
SKH8	300-800	2	600	65	50	25	21a, 23a
		3					
SKL8		2	600	100	65	42	24a
		3					
SKP8		2	600	200	100	65	25a
		3					
SKH12	600-1200	2	600	65	50	25	21a, 23a
		3					
SKL12		2	600	100	65	42	24a
		3					
SKP12		2	600	200	100	65	25a
		3					

① UL Listed as HACR type.
② Not current limiting circuit breaker.

6.8 Molded Case Circuit Breakers

Features and Options

- Overcurrent protection
  - Adjustable long-time (pickup and time delay)
  - Adjustable instantaneous (pickup)
- Status
  - Trip targets (overcurrent and short circuit)
  - Long-time pickup indication
- Metering display
  - Phase current (selectable among phases)

+24 Vdc control power is available as an option only on the MicroVersaTrip Plus breaker. It provides power to the display if the breaker is not energized.

The optional functions available on both the MicroVersaTrip Plus and MicroVersaTrip PM breakers are:

- Overcurrent protection
  - Adjustable short-time protection (pickup and time delay bands having I^2T ramp in or I^2T ramp out)
  - Adjustable ground-fault protection (pickup and time delay bands having I^2T ramp in or I^2T ramp out
- Status trip targets (ground fault when that optional function is in the Trip Unit)

Additional functions available only with MicroVersaTrip PM breakers, and which require +24 Vdc control power from the Power Supply Assembly, Power Supply Plate, or Voltage Module and a MicroVersaTrip PM voltage-sensing signal from the Voltage Conditioner Assembly, Voltage Conditioner Plate, or Voltage Module are:

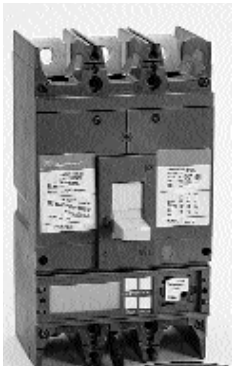
- Metering functions
  - Voltage (selectable among phases or phase to neutral)
  - Energy (kWh/MWh)
  - Real Power (kW/MW)
  - Apparent power (kVA/MVA)
  - Frequency (Hz)
- Communications
  - Communicate with GE POWER LEADER Power Management System

Optional functions available only on MicroVersaTrip PM Trip Units in breakers are:

- Protective relays
  - Undervoltage
  - Overvoltage
  - Voltage unbalance
  - Current unbalance
  - Power reversal

6.8 Molded Case Circuit Breakers

Spectra RMS Circuit Breakers
MicroVersaTrip Plus™ and MicroVersaTrip PM™ Trip Units



SG Frame with MicroVersaTrip Plus Trip Unit

SG Frame with MicroVersaTrip PM Trip Unit

MicroVersaTrip Plus and PM Trip Unit Characteristics

Current Setting (C) Pickup Multiple of Rating Plus Amps (x)	Long Time① Delay (Seconds)	Short-time Pickup (Multiple of Current Settings) (C)	Short-time Delay (Seconds)	Adjustable instantaneous Pickup (Multiple of Rating Plug Amps) (X)	Ground Fault Pickup Multiple of Sensor Amp Rating (S)	Ground Fault Delay (Seconds)
0.50 to 1.0 in increments of 0.05 (11 Settings)	2.4.4.9.9.8.20 ②③ (3-4 Bands)	1.5 to 9.0 in increments of 0.5 (16 Settings)	I^2T IN ③ 0.44 I^2T OUT ⑤ 0.1.0.2.0.3.0.4 (8 Bands)	1.5 to 10.0 in increments of 0.5 (18 Settings)	0.2 to 1.0 in increments of 0.05 (17 Settings)	I^2T IN ④ 0.41 I^2T OUT ⑤ 0.1.0.2.0.3.0.4 (8 Bands)

① Pickup fixed at 1.1C.
② 20 Second delay (band) not available on SG frames.
③ Time delay at 600% of current setting at lower limit of each band
④ Time delay at 200% of pickup setting at the lower limit of each band.
⑤ Time delay shown at lower limit of each band. Pickup tolerances ± 10%. Ground Fault Pickup not to exceed 1200 amps.

X = Rating plug amps
S = Sensor amp rating
C= Long-time current settings (Pickup)
C= X times Rating Plug Amps

MicroVersaTrip PM Metering Functions

Functions	Accuracy and Description	PM Trip Unit	
Amperes (A)	Current ± 4% Selectable Phase	Metering (M)	Metering and Relaying (PM)
Voltage (V)	Volts ± 2% Selectable Phase in L-L or L-N á	x	x
Energy (kWh/MWh)	Watt Hours ± 7% Total energy flow through breaker	x	x
Real Power (kW/MW)	Watts ± 6% L-L or L-N Power á	x	x
Apparent Power (kVA/MVA)	Volt amps ± 6% L-L or L-N Power á	x	x
Frequency (45-66 Hz)	Hertz ± 6%	x	x
Voltage Unbalance Relay	Adjustable pickup, 10 to 50% Adjustable delay, 1 to 15 seconds or OFF	x	x
Current Unbalance Relay	Adjustable pickup, 10 to 50% Adjustable delay, 1 to 15 seconds or OFF		x
Undervoltage Relay	Adjustable pickup, 50 to 90% Adjustable delay, 1 to 15 seconds or OFF		x
Overvoltage Relay	Adjustable pickup, 110 to 150% Adjustable delay, 1 to 15 seconds or OFF		x
Power Reversal Relay	Adjustable pickup, 0.01 MW to 90 MW Adjustable delay, 1 to 15 seconds or OFF		x
Communications	POWER LEADER Communications System Link (common)	x	x

6.8 Molded Case Circuit Breakers


Q-Line


TEY


E450

Thermal Magnetic Trip Units
Thermal magnetic circuit breakers are available in six frame styles: Q, TEY, E140, F225, J600, K1200. These devices are UL listed and are rated to carry 80% of their trip size rating continuously (more than 3 hours).

The thermal action of the bimetal provides a time-delay which prevents service interruption on normal in-rush currents or temporary overloads. Continuous overloads cause the bimetal to deflect which releases the trip latch and opens the main contacts. An electromagnet which partially surrounds the bimetal provides an instantaneous trip for high current short circuits. This current creates a strong magnetic field which attracts the armature and releases the trip latch to open the main contacts.

600 Volt rated breakers are provided with an ambient compensated trip unit. These devices may be applied within an operating ambient temperature of 10-50(C without derating. whereas enclosure compensated trip units may be applied in a 40(C environment. Trip time response as a function of temperature is included on the device time current curve. Ambient temperature is the temperature around the device in an enclosure.

Circuit Breaker	Spectra Bolt-On	Spectra Plug-In
Q-Line		x
TEY	x	x
TED	x	x

① Available in DC applications only

For further information on thermal magnetic circuit breakers see GET-2779 or contact your local GE Industrial Systems Sales Engineer.

6.8 Molded Case Circuit Breakers

Molded Case Circuit Breakers Interrupting Ratings

Molded Case Circuit Breakers						UL Listed Interrupting in Thousands Amps								
		Trip			Federal Specs									
Construction	Frame	Range	No.	Rated Volts	C/B Class	rms Symmetrical ac Volts						dc Volts		
		(Amps)	Poles	ac dc	W-C 375B	120	120/240	240	277	480Y/277	480	600	125	250
HQ Frames	THQB⑤	15-70	1	120/240 -	12a	10	10	-	-	-	-	-	-	-
		15-100	2	120/240 -	12a	-	10	-	-	-	-	-	-	-
		15-100	2,3	240 -	12b	-	-	10	-	-	-	-	-	-
HHQ Frames	THHQB⑤	15-70	1	120/240 -	14a	22	22	-	-	-	-	-	-	-
		15-100	2	120/240 -	14a	-	22	-	-	-	-	-	-	-
		15-100	2,3	240 -	14b	-	-	22	-	-	-	-	-	-
Standard Frames	TEY	15-100	1	277 125	13a	-	-	65	14	-	-	-	10	
		15-100	2,3	480Y/277 250	13b	-	-	65	-	14	-	-		10
	TEB	15-100	1	120 125	12a	10	10	-	-	-	-	-	5	
	TEB	15-100	2	240 250	12b	-	-	10	-	-	-	-	-	5
		15-100	3	240	12b	-	-	10	-	-	-	-	-	-
	TED	15-100	1	277 125	13a	-	-	-	14	-	-	-	10	-
	TED4	15-50①	1	480 250	13b	-	-	-	14	-	18	-	-	-
	TED4	15-100	2	480 250	13b	-	-	18	-	-	18	-	-	10
	TED4	15-150	3	480	13b	-	-	18	-	-	18	-	-	10
	TED6	15-100	3	600	18a	-	-	18	-	-	14	14	-	-
	TED6	110-150	3	600	N/A	-	-	18	-	-	14	14	-	-
	TQD	125-225	2,3	240	12b	-	-	10	-	-	-	-	-	-
Hi-Break® Frames	THED	15-30	1	277 125③	13a	-	-	-	65	-	-	-	20②	-
	THED4	15-100	2	480 250③	22a	-	-	65	-	-	25	-	-	20②
	THED4	110-150	3	480 -	-	-	-	42	-	-	25	-	-	-
	THED6	15-100	3	600 -	22a	-	-	65	-	-	25	18	-	-
	THED6	110-150	3	600 -	N/A	-	-	42	-	-	25	18	-	-
	THQD	125-225	2,3	240 -	N/A	-	-	22	-	-	-	-	-	-
Current Limiting Circuit Breakers	THLC1	15-150	3	600 -	-	-	-	200⑤	-	-	200⑤	50	-	-
	THLC2	125-225	3	480 -	-	-	-	200⑤	-	-	200⑤	50	-	-
	THLC4	225-400	3	600 -	-	-	-	200⑤	-	-	200⑤	50	-	-

① Not UL Listed.
② DC ratings above 10,000 AIC are not UL Listed.
③ 3-pole devices are not dc rated.
④ 2P device rated 480V max.
⑤ Not available in bolt-on style strap kits.

6.8 Molded Case Circuit Breakers

Molded Case Circuit Breakers Interrupting Ratings (continued)

Molded Case Circuit Breakers							UL Listed Interrupting in Thousands Amps								
		Trip				Federal Specs									
Construction	Frame	Range	No.	Rated Volts		C/B Class	rms Symmetrical ac Volts						dc Volts		
		(Amps)	Poles	ac	dc	W-C 375B	120	120/240	240	277	480Y/277	480	600	125	250
	SED			600	-	18b	-	-	18	-	-	18	14	-	-
	SEH	30-150	2,3	600	-	22a	-	-	25	-	-	25	18	-	-
	SEL			600	-	13b,21a,22a	-	-	100	-	-	65	25	-	-
	SEP			600	-	16a	-	-	200⑤	-	-	100	35	-	-
Spectra	SFH④			600	-	13b,20a,22a	-	-	65	-	-	25	14	-	-
RMS	SFL④	70-250	2,3	600	-	13a,21a,23a	-	-	100	-	-	65	18	-	-
Circuit	SFP④			600	-	16a	-	-	200⑤			100	25		
Breaker	SGD	125-400		240	-	14b	-	-	65	-	-	-	-	-	-
	SGH④	SG4		600	-	21a, 23a	-	-	65	-	-	35	25	-	-
	SGL④	250-600	2,3	600	-	23a	-	-	100	-	-	65	50	-	-
	SGP④	SG6		600	-	23a	-	-	200⑤	-	-	100	65	-	-
	SKH	300-800		600	-	21a, 23a	-	-	65	-	-	50	25	-	-
	SKL	SK8		600	-	24a	-	-	100	-	-	65	42	-	-
	SKP	600-1200	2, 3	600	-	25a	-	-	200⑤	-	-	100	65	-	-
		SK12													

① Not UL Listed.
② DC ratings above 10,000 AIC are not UL Listed.
③ 3-pole devices are not dc rated.
④ 2P device rated 480V max.
⑤ Not available in bolt-on style strap kits.

6.9 Fusible Switches

Spectra Plug-In™

Module Features

Fusible ADS Switches

All Spectra Series fusible switch units are quick-make, quick-break. The powerful mechanisms are over-center types. When operated, stored energy opens the blades quickly, interrupting the circuit. Contacts and blades are self-aligning and spring-reinforced. The design of the switch takes advantage of the magnetic forces during short-circuit to prevent popping of the contacts while the fuse clears the circuit.

The 30 amp through 200 amp switches are double-break designs that allow internal and external visible proof of contact separation. The blades of the switch are mounted in a single rotor to ensure simultaneous multiple operation. The 100 amp through 200 amp designs have two blades per pole, a feature of the GE heavy-duty safety switch. The bright red handgrip is highly visible. Fuse pullers are a standard feature.

The 400 amp through 1200 amp designs are modular with heavy copper blades. The contact separation is visible. The long, rotary handle makes these high-amp switches easy to throw. All fuse types available in these switches are bolted in place and easily removable.

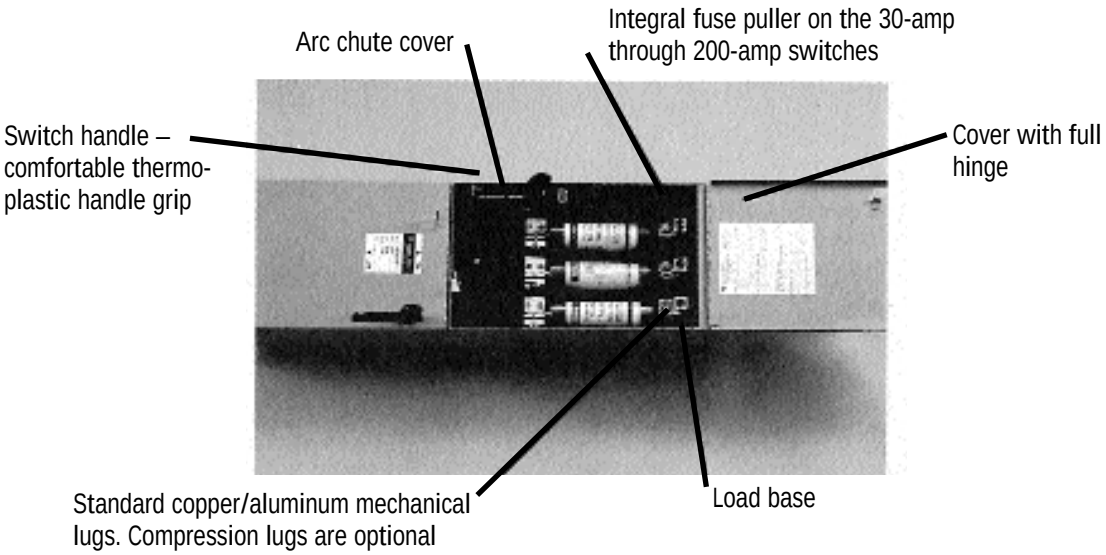
All current-carrying parts are tin or sliver-plated. Wiping action ensures clean, cool-running contact surfaces. The 30 amp through 200 amp switches have double-branch capability for all fuse types.

Single-branch 30 amp through 100 amp (and 200 amp T and J fuse only as an option) modules have a fusible switch unit on one side and a blank space on the other. Larger units are single-branched switches.

A narrow T-fused 200 amp double-branch module is available in the same width as the 30 amp module, saving panel space.

Class R fuse clips are standard on 30 through 600 amp and class L are standard on 800 and 1200 amp design. Optional fuse clips include H, J, K and T through 600 amp design. U/L prohibits converting class R clips to another type in the field.

Available in Spectra Plug-In Construction Only



6.9 Fusible Switches

Short-Circuit Ratings
Fusible Switch Units

The short-circuit or interrupting rating of the fusible switch is the lower of the fuse or the switch rating. Spectra Series① switches have a 200,000 amp short-circuit rating.

Fuse Classification

UL Class	Available Amp Rating	Maximum Short-Circuit Rating in Sym. RMS Amps	Max Voltage	Application
H	30-600	10,000	250/600	One-time general purpose
J	30-600	200,000	600	
K	30-600	50,000 100,000 200,000	250/600	Fast-acting rejection sizing mains & feeders, current limiting
L	800-1200	200,000	600	Rejection means available in two forms: Fast-acting mains & feeders Time-delay motor starting current limiting
R	30-600	100,000 200,000	250/600	Duel element rejection means, motor starting current limiting
T	100-800	200,000	250/600	Fast-acting small physical mains & feeders, current limiting

Maximum Horsepower① Fusible Switch

Rating in Amps①	Volts, ac							Volts, dc	
	2-Pole				3-Pole			2-Pole	3-Pole
	120	240	480	600	240	480	600	125	250
With Standard Fuses									
30	1/2	11/2	3	3	3	5	71/2	2	5
60	11/2	3	5	10	71/2	15	15	5	10
100	-	71/2	10	15	15	25	30	-	20
200	-	15	25	30	25	50	60	-	40
400	-	-	-	-	50	100	125	-	50
600	-	-	-	-	75	150	200	-	50
With "Time-delay" Fuses									
30	2	3	71/2	10	71/2	15	20	3	-
60	3	10	20	25	15	30	50	-	-
100	-	15	30	40	30	60	75	-	-
200	-	15	50	50	60	125	150	-	-
400	-	-	-	-	125	250	350	-	-
600	-	-	-	-	200	400	500	-	-

① Ratings are based on latest revision of the National Electric Code Article 430. Horsepower ratings for switches with Standard Class H fuses are based on one-time fuses having minimum time delay. When time delay fuses are used, the horsepower ratings are maximum for the switches.

6.10 TVSS

TVSS in Spectra Switchboard

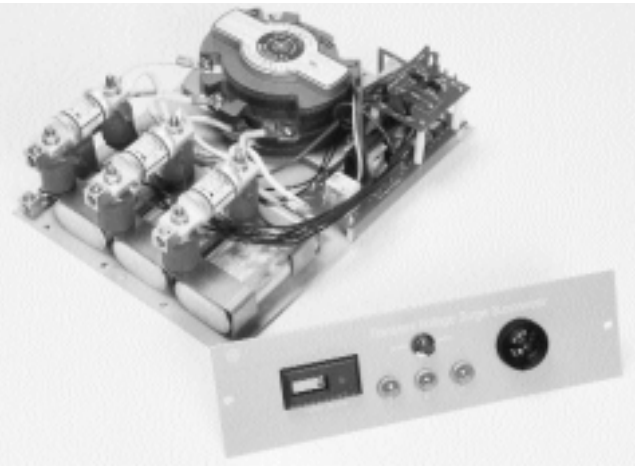
GE Tranquell Series TVSS units are the standard TVSS offering in GE Spectra Series Switchboards. It is important to remember that if a group mounted Switchboard is ordered with Main Lug Only (MLO), a service disconnect breaker must be included in prior to the Tranquell TVSS unit to provide for future maintenance. The TVSS disconnect is counted as one of the six service disconnects.

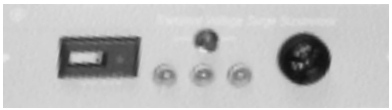
Recommendations: Include a 60 amp SELA on MLO boards to serve as the disconnect for the TVSS unit.

GE Tranquell is available in our Spectra Series Switchboards.

System monitoring - indicating light surge counter and audible alarm

Tranquell TVSS uses arrester wafer technology (utility grade MOV's)





Type ATVS Transient Voltage Surge Supression Module

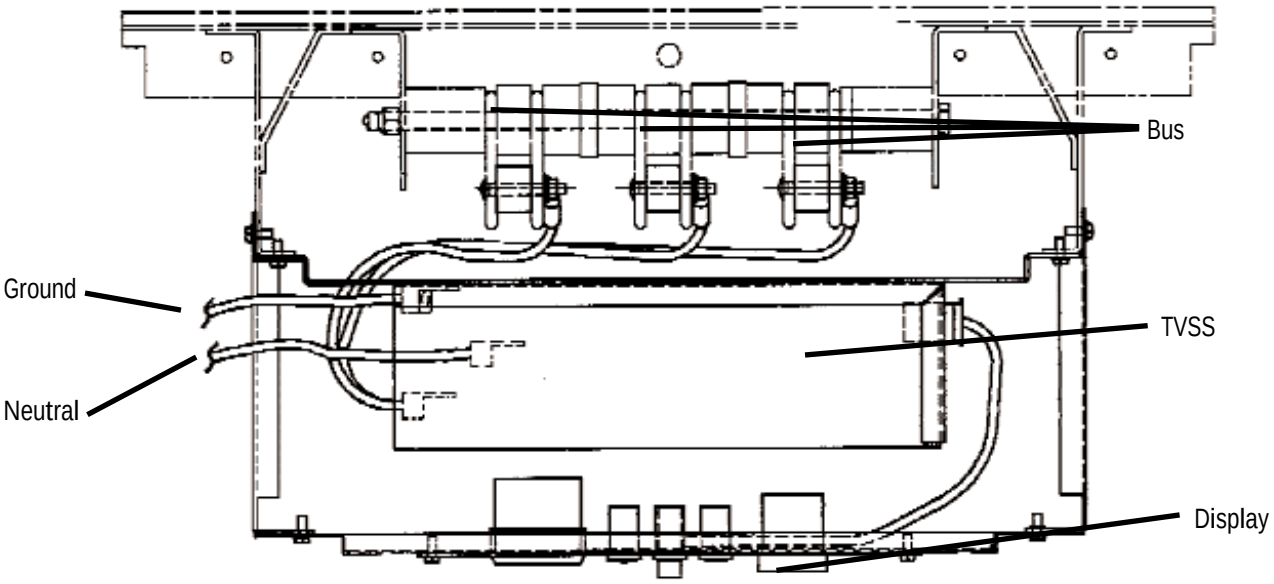
Catalog Number	System Voltage	Configuration	Surge Current Capability (per mode)	X-Height	Panel Type	Panel Width
ATVS3002S	120/240VaC	1PH/3W+Grn	100kA	7x	Plug/Bolt	35-45W
ATVS3002D	240 Delta	3PH/3W&4WHI-Leg	100kA	7x	Plug/Bolt	35-45W
ATVS3002W	208Y/240Vac	3PH/4W	100kA	7x	Plug/Bolt	35-45W
ATVS3004D	480 Delta	3PH/3W+Grn	100kA	7x	Plug/Bolt	35-45W
ATVS3004W	480Y/277VaC	3PH/4W	100kA	7x	Plug/Bolt	35-45W

7x required for panel or switchboard distribution section mounting
12" mounting height required when mounted in switchboard main section

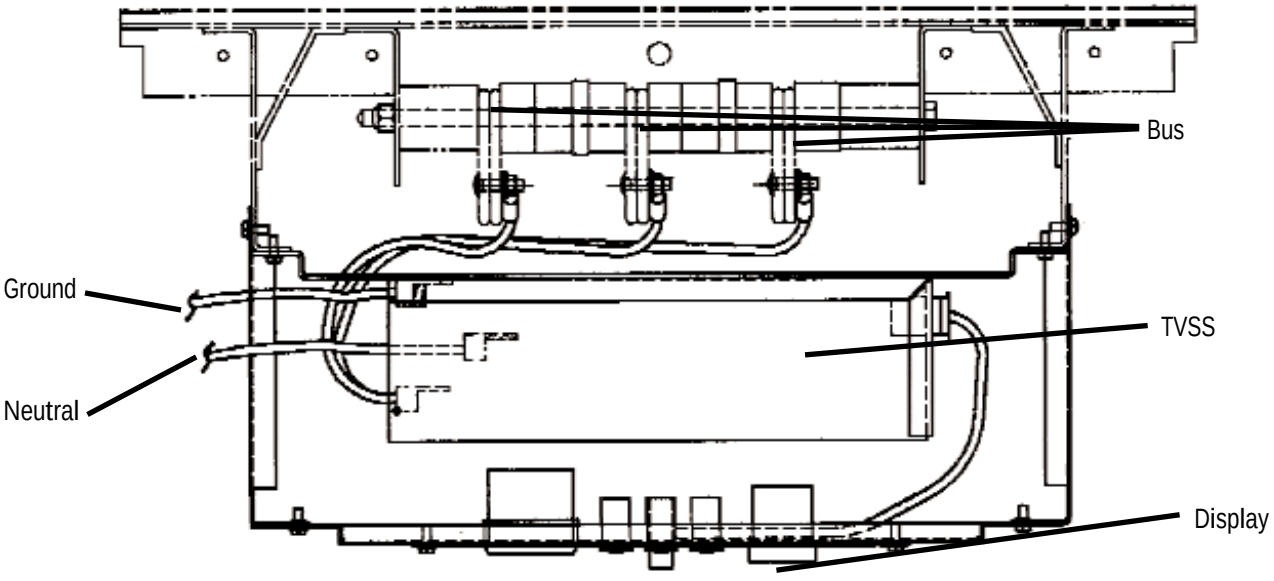
Mounting	On the load side of the main device
Listing	UL 1449 Second Edition
Standards	IEEE/ANSI C62.41; IEEE/ANSI 62.45; NEMA LS-1
System Monitoring	Per phase indicating lights; Surge counter & audible alarm
Temperature	-40°C to +60°C
Humidity	95% RH, non-condensing atmosphere
Operating Altitude	0-12,000 ft (above sea level)
Seismic	UBC seismic zone 4
Frequency	50 or 60Hz

6.10 TVSS

Assembly End View – Plug-in



Assembly End View – Bolt-on

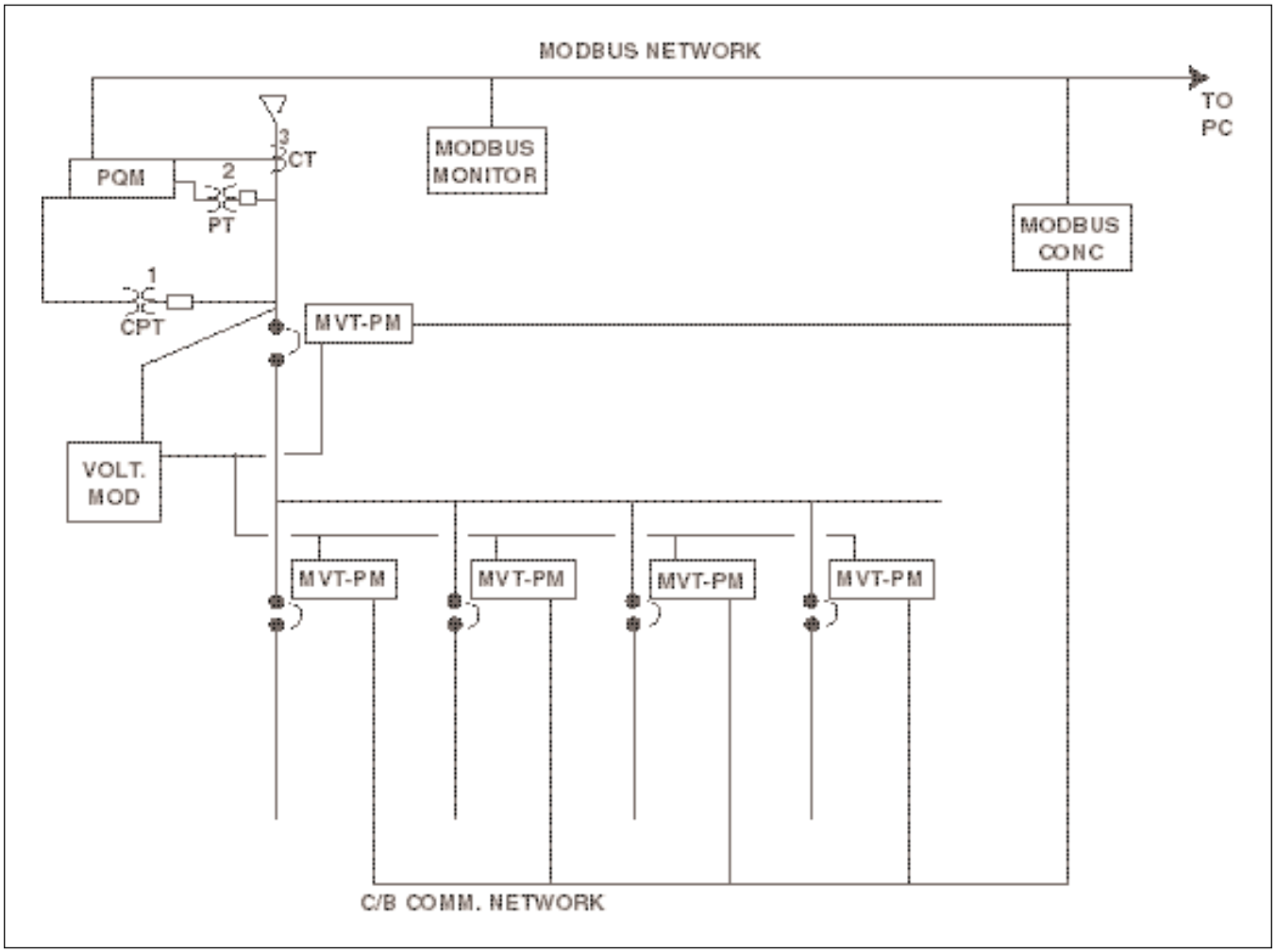


6.11 GE POWER LEADER™ Power Management System

The GE POWER LEADER Power Management System offers a complete selection of components and software. Components include electronic meters, protective relays, digital circuit breakers and Modbus Monitors. The software is proprietary and is based on WonderWare InTouch. The communication protocol is Modbus® RTU or Ethernet TCP/IP which is open and non-proprietary.

Electronic meters offered are the PQM, EPM 3710, EPM 3720 and EPM. The circuit breaker trip units are the MicroVersaTrip PM™. The Modbus Concentrator transfers data to the Modbus network and meter. The Modbus Monitor is a display device that allows the user to view data at one location on the switchboard. Voltage modules provide voltage inputs and components control power to the circuit breaker trip units. Standard drivers are available for GE/FANUC PLC's, and other GE and 3rd party devices.

Typical Spectra Switchboard with Power Management



For more information and a free demonstration contact your local GE Industrial Systems sales office.

6.12 POWER LEADER™ Metering Products

A full function revenue-class electronic meter.

EPM
Electronic Power Meter

Application
- Energy and demand billing meter
- Three or four-wire 3 phase systems

Metering and Monitoring
- Up to 51 display options
- Accurate metering includes: actual A V W var VA PF Wh varh frequency demand A W var VA peak A W var VA
- 15 to 60 minute demand interval
- V & I sampled 480 times per second
- Display updated every 3 seconds
- Wye-wye, open-delta, or delta
- Self-test at power up

User Interface
- 2 line LCD display
- 3 button keypad
- Programming security code
- ModBus® RTU protocol (optional)

Features
- Pulse initiation (for KWH, KVAH, KVARH & KQL standard now)
- Easy retrofit
- Drawout S1 case or panel mount versions
- Revenue class metering

Description
The EPM is a full function electronic power meter with optional pulse initiation and Modbus® RTU communications. It continuously monitors specified line characteristics and displays the functions and values on a two-line LCD display. A complete list of all metering functions is found under the flip down door on the front of the unit. Up to 51 different items can be displayed.

The meter samples each of the current and voltage inputs 480 times per second. The display is updated every three seconds. The demand data intervals can be set to 15, 20, 30 or 60 minutes.

The EPM has a self-test feature which will disable the device if a critical error is detected. It also has a programming mode which allows the user to perform such functions as resetting data. For added security, programming functions may be restricted by a password.

The EPM can be used on three or four-wire three phase systems having a nominal frequency of 50/60 Hz. Units are available which can accept direct line voltage from 69 to 600 volts.

The EPM is self powered requiring no separate control power to operate.

All set-up and historical data is stored in a non-volatile memory in case of power loss.

With the optional ModBus RTU card the EPM can become part of a power management system. When used with the Power Management Control System (PMCS) this can provide additional features such as remote viewing of metered values, graphical trend display, remote alarms, and reporting.

The EPM is available in an S1 compatible case which provides drawout capability. This allows easy retrofit for existing switchboard meters, without wiring changes or power interruption.

Metering and Monitoring

Metering
The electrical parameters and status information displayed by the EPM are available on a normal scroll and an alternate scroll. Displayed parameters differ depending on whether the EPM is configured as wye or delta.

Metering includes:
- actual A V W var VA PF Wh varh Vah
- demand A W var VA PF
- peak A W var VA Hz
- frequency
- total Q-hours

Additional information includes:
- number of demand resets
- time left in demand subinterval
- number of power outages
- potential transformer ratio
- current transformer ratio

Self-test
Each time the unit is powered up it performs a self-test. If a critical failure is detected "Self-Test Failed" appears on the display and the EPM will not continue normal operations.

The self-test also checks the integrity of the stored

6.12 POWER LEADER™ Metering Products

The EPM can be connected to a Power Management Control System (PMCS) for remote communication and data management.

accumulated energy and metering values. If some or all of the accumulated data is invalid it displays an error message on the first line of the display and continues normal metering displays on the second line of the display.

During normal operation if phase B or phase C voltage inputs are less than 25% of the rated value the EPM displays "Phase Loss V B" (or V C, or V BC as appropriate).

If the optional ModBus® RTU card is installed the EPM indicates a loss of communications with an error message.

User Interface

Keypad and display

A 16 character two line LCD display is provided on the front of the unit. The select/enter key allows the user to toggle the display between the normal scroll and the alternate scroll. The two scroll keys can be used at any time to scroll up or down the list of metered parameters. A complete list of all metering functions and a contrast-adjustment knob are found under a flip-down door. The GE logo is the "hidden" key that allows the user to enter the Program Mode of the EPM. Programming functions may be restricted by a password.

Pulse Outputs

With this standard function the user can have a pulse sent at defined incremental energy usage levels.

Communication

The EPM is available with the factory installed or field upgradeable ModBus RTU card. This is compatible with Power Management Control System software. With this option the EPM can provide:

- remote viewing of all metered functions and configuration data
- graphical trends of most metered functions
- user-defined remote alarms
- extensive reporting capabilities, including dynamic data exchange for exporting data for analysis by external software programs

6.12 POWER LEADER™ Metering Products

EPM 3710

Description
The EPM 3710 offers 38 high-accuracy real-time measured parameters, minima and maxima for 21 parameters, and 25 status parameters (see sidebars). Measured parameters are quickly accessible via the font panel display. All measured parameters and status parameters are accessible via the meter's communications port.

All voltage, current, power and energy readings are true RMS, including harmonics. Energy readings provide bidirectional (import/export) indication.

Status information includes real-time conditions for the 3 on-board relays, 4 (digital) status inputs, and 17 user-programmable setpoints.

Summary
Metering 0.2% accuracy, relaying analog/discrete I/O, 3 phase waveform capture

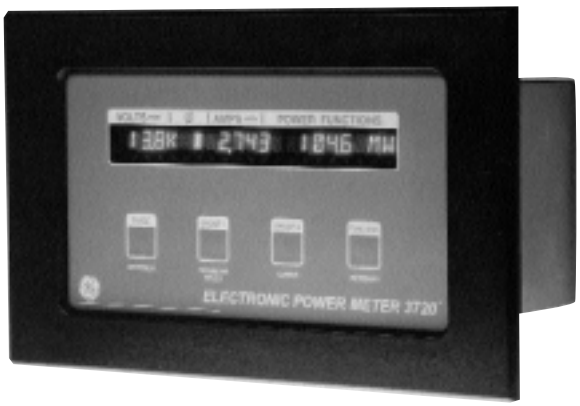
Parameters
38 parameters: 25 status values -- over 80 total via network. Real-time values: Volts I-I, I-n, ABC, average; Current ABC, N, average; Demand values: Energy: Real Power kW; Reactive Power KVAR, Apparent Power KVA; Real Energy kWh import, export; Reactive Energy KVARH import, export; Apparent Energy KVAH; Auxiliary voltage; Sliding window demand I average, KW, KVA; Minimum/Maximums: VI-I, I-n ABC, V average; Amps ABC; Amps average; Amps N; Real Power; Reactive Power, Apparent Power, Power Quality: PF, Frequency, Auxiliary voltage, Amps Demand; KW demand; KVA total. Via network only: ABC: kW; KVAR, KVA, kWh total; KVARH total.

Accuracy
% of full scale V, I 0.2%; KW, KVAR, KVA 0.4%; PF 1% KWH, KVARH, KVAH 0.4% frequency 0.2 Hz.

Waveform Capture
Yes, 3 phase I, V, 8 cycles, 128 samples.

- 80 measured parameters and 25 status parameters
- 1 cycle high-speed waveform capture
- Setpoint control system
- On-board data logging
- 3 control relays
- 4 digital inputs (including 1 counter input)
- Auxiliary analog voltage input
- Auxiliary analog current output
- Remote communications
- Extremely rugged and reliable design

6.12 POWER LEADER™ Metering Products



EPM 3720

Description
The EPM 3720 offers hundreds of high-accuracy real-time measured parameters, as well as minima, maxima, and status parameters. All parameters are quickly accessible via the front panel display or through the communications port.

All voltage, current, power and energy readings are true RMS, and sensitive to beyond the 50th harmonic. Four-quadrant readings measure bidirectional (import/export) energy flow, useful in any cogeneration application.

On-board power quality analysis capability offers total and individual harmonic distortion values for all voltage and current inputs. Waveform recordings of short duration disturbances can be stored automatically for analysis of voltage sags and swells, ground faults, inrush and surge currents, and so on.

Status information includes real-time conditions for the 3 on-board relays, 4 status inputs, and 17 user-programmable setpoints.

Summary
Advanced Metering 0.2% accuracy, Pwr Quality, harmonics, relaying advanced analog/discrete I/O, 3 phase waveform capture

Parameters
700 parameters: Real-time values: Volts I-I, I-n, ABC, average; Current ABC, N, average; Demand values: Energy: Real Power kW ABC, total; Reactive Power KVAR, ABC, total, Apparent Power KVA ABC, total; Real Energy kWh import, export, total; Reactive Energy KVARH import, export, total, net; Apparent Energy KVAH; PF ABC, total; Phase reversal; Power Quality: harmonics 1-15, total even, total odd; THD; K-factor: Frequency hertz; Auxiliary voltage; Sliding window demand and predicted demand for 10 selected parameters, KW, KVA; current/voltage unbalance %; Minimum/Maximum: provided for all parameters. Six sets of time of use registers to record energy and demand values for up to ten different tarifs.

Accuracy
% of full scale V, I 0.2%; KW, KVAR, KVA 0.4%; PF 1% KWH, KVARH, KVAH 0.4% frequency 0.05 Hz.

Waveform Capture
Yes, 3 phase and neutral I, V = 8 parameters Options: 128 samples/1 cycle or 12, 18, or 36 cycles/16 samples per cycle. Storage space for multiple events.

- Hundreds of measured parameters and status parameters available
- On-board harmonic analysis
- Time-Of-Use registers
- 1-cycle high-speed waveform capture
- 36-cycle digital waveform recorder
- High-speed (67 msec) setpoint control system
- Extensive on-board data logging
- 3 control relays
- 4 digital inputs (with scalable counters)
- Auxiliary analog voltage input
- Auxiliary analog current output
- Remote communications
- Extremely rugged and reliable design

6.12 POWER LEADER™ Metering Products

PQM T20CA
Power Quality Meter

Applications
- Metering of distribution feeders, transformers, generators, capacitor banks and motors
- Medium and low voltage systems
- Commercial, industrial utility
- Flexible control for demand load shedding, power factor, etc.
- Power quality analysis

Metering/Control
- A V W var VA varh WH PF Hz unbalance
- A W var VA demand
- Load shedding
- Power factor control
- Output
- Pulse output based on Kwh, kvarh or kVAh

Monitoring
- Harmonic analysis through 63rd with THD and TIF
- Event recorder
- Waveform capture
- Data logger
- Triggered trace memory

Communication
- Ports: RS232 front, dual RS485 rear
- ModBus® RTU protocol
- Digital 4 in / 4 out
- Analog 1 in / 4 out
- Local/remote display of all value
- Min SCADA software

Description
The PQM is an ideal choice when continuous monitoring of a three phase system is required. It provides metering for current, voltage, real and reactive power, energy use, cost of power, power factor and frequency. Programmable setpoints and 4 assignable output relays allow control functions to be added for specific applications. This includes basic alarm on over/under current or voltage, unbalance, demand based load shedding, and capacitor power factor correction control. More complex control is possible using the 4 switch inputs which also can be used for status such as breaker open/closed, flow information etc.

The PQM may be used as a data gathering device for a plant automation system that integrates process, instrument and electrical requirements. All monitored values are available via two digital RS485 communication ports running the ModBus® protocol. If analog values are required for direct interface to a PLC, any of the monitored values can be output to one of 4 isolated analog outputs. A process variable can be measured using an analog input. A front panel RS232 communication port can be connected to a PC for simultaneous access of information by other plant personnel.

The quality of the power system is important with increasing use of electronic loads such as computer, ballasts or variable frequency drives. With the PQM's power analysis option, any phase current or voltage can be displayed and the harmonic content calculated. By knowing the harmonic distribution, action can be taken to prevent overheated transformers, motors, capacitors, neutral wires and nuisance breaker trips. Redistribution of system loading can also be determined. Waveform and chart recorder printouts available from the PQM assist in problem diagnosis.

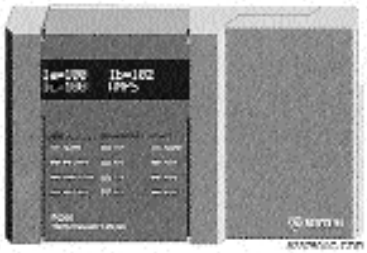
Economical system monitoring or control is possible by selecting the non-display chassis model as a system component and adding required options to obtain the desired level of functionality.

An easy to use windows based software package is available. This software can be used for meter set-up programming, can be used with a portable PC connected to the front-mounted RS-232 port for data gathering or waveform capture. It also can be utilized through the rear-mounted RS-485 port for remote monitoring of a single meter.

6.12 POWER LEADER™ Metering Products

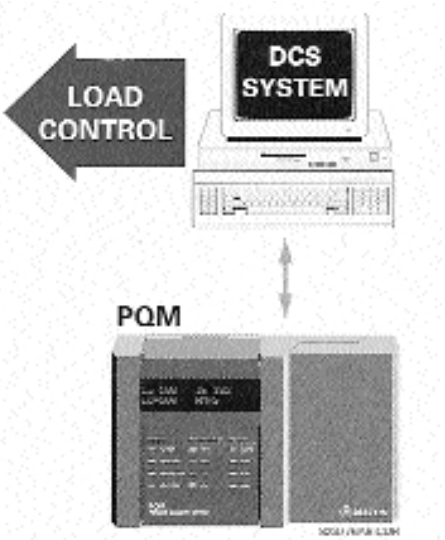
PQM T20CA
Standard Features

Select the panel mount with display version for easy local interface or for maximum economy select the chassis mount configuration. Both models offer RS485 ModBus® communications for programming and monitoring. Replace expensive additional devices by having the CONTROL, TRANSDUCER and POWER ANALYSIS standard in the PQM T20CA.



Panel mount with display for local/remote programming and monitoring.

Keep 600 volt wiring off a panel with reduced depth by using the detachable face plate (MOD 505); cable is 6 ft (2 meters) in length. Chassis mount without a display as a system component for lowest cost is also available.



Expensive peak demand penalties can be avoided using demand monitoring for load scheduling.

Metering
Each voltage and current is sampled 64 times per cycle for 0.2% accuracy true RMS measured values.

- I_a I_b I_c I_n
- V_a V_b V_c V_{ab} V_{bc} V_{ca}
- V I unbalance
- True PF crest & K factor
- Hz W var VA
- Wh varh Vah W cost
- Demand: A W var VA

A keypad and illuminated 40 character display are used for programming setpoints and monitoring values and status.

Select up to 10 different messages for automatic scanning of important information.

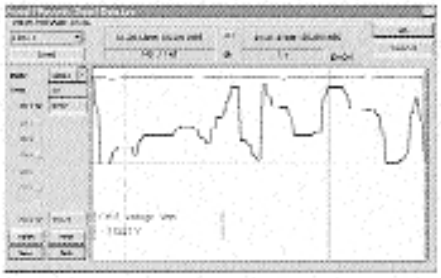
6.12 POWER LEADER™ Metering Products

PQM T20CA
Standard Features

Alarms
Any of the assignable output relays may be used to trigger an alarm for specific applications. Alarm messages are in clear English for easy interpretation.

Condition	Application
overcurrent	motors/transformers
undercurrent	pumps/compressors
neutral current	leakage/unbalance
current unbalance	motors
overvoltage	equipment protection
undervoltage	motors/load transfer
phase sequence	pumps/equipment
overfrequency	generators
underfrequency	load shedding
power factor	capacitor banks
switch input	process control

Data Logger (Trending)
Trending is useful as a troubleshooting aid when a problem is detected. Measured values can be selected and plotted with a programmable sampling rate to suit the time interval of interest. The generated chart recorder screen can be printed or exported to other programs for report writing.



Record trends of measured parameters over time.

Communication
Integrate process, instrumentation and electrical requirements in a plant automation system by connecting PQM meters together to a DCS or SCADA system. A PC running PQMPC can change system setpoints, monitor values, status and alarms.
Continuous monitoring minimizes process downtime by immediately identifying potential problems due to faults or changes from growth.

- RS485 ModBus® 1,200 - 19,200 bps
- Mini RTU SCADA system component
- Measure actual values
- Read status
- Issue control commands
- Load all setpoints from a file
- Change individual setpoints

The display version PQM comes complete with a front RS232 port. The RS232 port can be used for data collection, printing reports or problem analysis without disturbing the main communication interface to rear RS485 port.

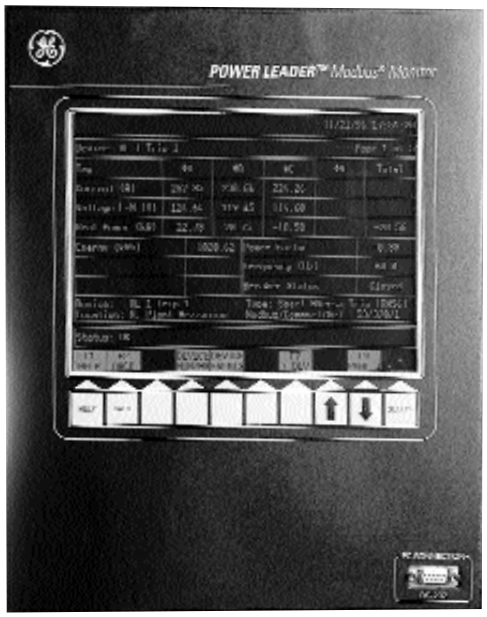
Future Expansion
Flash Memory is used for firmware storage within the PQM. This allows future product upgrades to be loaded via the serial port.

Initially PQM meters can be used as stand-alone units. Open architecture allows connection to other Multilin or ModBus® compatible devices on the same communication link. These can be integrated in a complete plant wide system for overall process monitoring and control.

Download the latest product enhancements via the serial port

6.12 POWER LEADER™ Metering Products

GE POWER LEADER Modbus® Monitor



The ModBus® Monitor reads monitoring and status information collected by GE Power Leader power management devices as well as standard ModBus® RTU devices. It connects to one or two ModBus® RTU networks implemented on RS485 wiring, and operates at baud rates up to 19,200 bps. It can monitor up to 246 devices on a single network, or up to 492 devices on two networks. It provides convenient, centralized viewing of data from remote devices. A local event log is maintained and a global event log may be viewed with a GE Power Management Control System is present.

The ModBus Monitor is capable of acting as a master on one or two ModBus RTU networks of Power Leader Power Management devices, collecting data from the devices for local display. It is also capable of acting as a secondary master to GE's Power Management Control System (PMCS). In this role the ModBus Monitor resides on the RS485 network with other Power Leader devices, acting as a slave to the PMCS master. If the master is disabled for any reason the ModBus® Monitor will immediately and transparently assume the role of master. The monitor works as a ModBus RTU master. It will also work seamlessly with the GE PMCS software present. However, it will not work with any other type of "dual" master, such as PLC present on the same network segment.

The monitor is supplied with a Windows-based software program which has been designed to be easy to use and includes on-line help. This program is used as a configuration tool to create a 'profile' of the monitor which consists o all configurable attributes, such as communications settings information on devices connected to the RS485 network, the register map for these devices, etc. The 'profile' can be downloaded to the monitor via the RS232 port supplied on the front panel.

The data collected may be viewed locally on the large 10.4 inch diagonal VGA electroluminescent (EL) display. A 10 key membrane keypad has been provided to navigate through a complete easy to use menu of tabular screens. Function keys are located at the bottom of the screen. The function of each key at the current time is displayed on the screen above the key.

6.13 Equipment Ground Fault Protection

Equipment Ground Fault Protection
The National Electrical Code Section 230-95 requires ground fault protection of equipment for solidly grounded wye electrical service of more than 150 volts to ground, but not exceeding 600 volts, phase-to-phase, for each service disconnecting means rated 1000 amperes or more. The maximum setting of the ground fault protection shall be 1200A and the maximum time delay shall be one second for ground fault currents equal to or greater than 3000A. The following discussion applies only to solidly grounded wye systems. Ungrounded and resistance grounded systems require special considerations and should be referred to your local GE representative.

The NEC requirement is for ground fault protection only on the main protective device. This is satisfactory only if loss of power to the entire system is acceptable under ground fault conditions. If not acceptable, then ground fault protection should be applied on successive downstream protectors until an acceptable level of system outage is obtained. The NEC recognizes this lack of selectivity and requires health care facilities which have ground fault protection to have two levels with selectivity between the main and feeder devices.

Detection of Ground Fault Current
Ground fault current may be monitored as it flows out from the source or as it returns to the source. In either case, care must be exercised to ensure that there is not ground connection on the neutral downstream from the ground fault sensors, and that systems with neutral interties and multiple grounds have ground fault sensors properly placed and connected so that all returning ground fault current is detected. Spot networks, secondary selective arrangements (main-tie-main) and systems with emergency generators are the most frequently encountered examples of multiple ground and neutral interties which require special consideration. Fortunately, the most commonly encountered system, the radial, lends itself to straightforward designs.

Ground Fault Equipment
Ground fault protection may be supplied as an integral part of the trip unit used with molded case, insulated case, AKR low voltage power circuit breakers and HPC switches.

NEC230-95(c) reads as follows: the ground fault protection system shall be performance tested when first installed. The test shall be conducted in accordance with approved instructions which shall be provided with the equipment. A written record of this test shall be made and shall be available to the authority having jurisdiction.

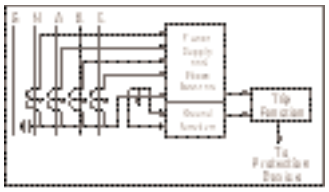
Testing by qualified personnel

Performance testing of the ground fault protection system should be undertaken only by qualified personnel. Particularly in the tests requiring the use of a high-current test set, it is usually necessary to obtain the services of a qualified testing organization. General Electric's Installation and Service Engineering organization, the Apparatus Service Shops, and GE's extensive FAS (Factory Authorized Service) Teams are qualified and equipped to provide this testing service.

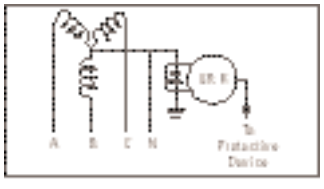
MicroVersaTrip® Trip Units
MicroVersaTrip and Power Plus units used on Power Break insulated case circuit breakers, AKR low voltage power circuit breakers and molded case circuit breakers are self-powered. The consist of three components, a programmer, current sensors and flux shifter, which are integral parts of the circuit breaker.

The MicroVersaTrip and Power Plus trip units can be used to detect ground fault current as it flows out from the source, or as it returns to the source, A neutral sensor (current transformer) is available for systems with neutral loading.

When monitoring the outgoing ground fault current, the currents in each phase and neutral, if used, are summed up vectorially. In the absence of ground fault currents, the vector sum of the phase and neutral currents, IG is zero. When a ground fault occurs, the vector sum, IG corresponds to the ground fault current. When ordering the MicroVersaTrip unit, suffix G provides integral ground fault protection.



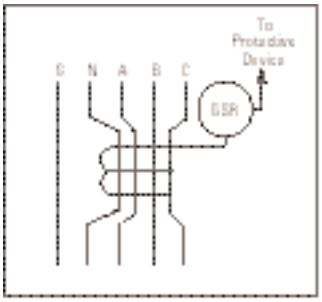
When monitoring the returning ground fault current, the MicroVersaTrip unit with suffix GR is ordered. The neutral CT is placed in the ground return circuit, not the neutral circuit. The trip unit responds to the current which the CT sees. Extreme care must be taken to insure that the CT is placed to detect all of the returning ground fault currents.

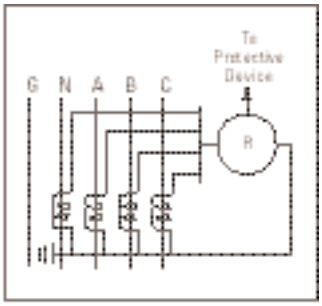


6.13 Equipment Ground Fault Protection

Ground Break® Type TGS
Ground Break, which consists of a relay, current transformers and monitor panel, can be used in a number of arrangements to provide ground fault protection.

Ground Sensor (Zero Sequence) Ground Fault Protection
In this frequently used application, the CT surrounds all phase conductors and neutral, if existing. The magnetic fluxes produced by current flowing in the power conductors cancel if there is no ground fault current and the output to the relay is zero. This is often referred to as the "zero sequence" method of detecting ground faults.





Residual Ground Fault Protection
Ground Break can also be used in a residual arrangement. A rely, residually connected, monitors the outgoing ground fault currently using three current transformers in a 3-phase, 3-wire system, or four current transformers in a 3-phase, 4-wire system.

The phase and neutral currents, if existing, add vectorially to zero if there is no ground fault current and there is no output to the relay.

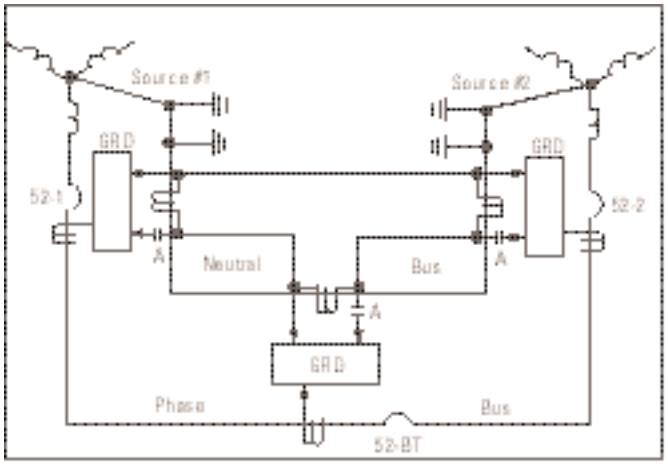
High Pressure Contact Switch
The HPC switch is available with integral ground fault protection that uses a current sensor which encompasses all phase conductors to monitor outgoing currents. A neutral current sensor is provided when required. A test function which permits testing with and without tripping the main device and a mechanical pop-out target to indicate tripping due to ground fault are provided.

Multi-Source Systems
Multi-Source systems with ground neutral interties, such as secondary selective and spot networks, require special ground fault circuitry. There are many circuits and types of electrical equipment that can be used to provide proper ground fault protection.

Circuits which use MicroVersaTrip® integral ground fault protection follow:

Extension of Integral

In the circuit shown in the Figure below, the neutral sensor secondary windings, in addition to being connected to their respective breaker, are interconnected with each other in a loop circuit. With this arrangement, the circuit is responsive to ground fault current only, regardless of its return path to the source supplying ground fault current. Each breaker must have an auxiliary contact connected as shown. The auxiliary contact "a" is open when the breaker is open. When the breaker is closed "a" is closed. One breaker must always be open so its neutral sensor will be disconnected from its associated breaker to provide the driving force to assure that the current flows around the sensor loop circuit.



6.14 Ground Break® Systems

Ground Break Systems Type TGSR
The Ground Break system consists of solid-state ground-fault signaling relays, sensors and monitor panels designed to operate together. These components will operate at lower magnitudes of ground-fault current and shorter time delays than conventional over-current protective devices. The built-in memory function integrates intermittent faults with time providing protection against low-level arcing faults. The components which comprise a complete system are:

Solid State Relay
Used in conjunction with devices having an electric trip, or shunt trip, this relay responds to ground currents and causes the interrupter to open when these currents reach a preselected value for a pre-selected length of time. Optional zone selective interlocking is available for a fully coordinated system. This type of relay initiates an instantaneous trip when a fault occurs in its own zone. In addition, it will block upstream zone selective relays for a preset delay time which allows the downstream breaker to clear the fault.

Monitor Panel
Provides a ground fault indicator, control power indicator and TEST and RESET buttons. The control circuitry offers the ability to test the complete Ground Break system with or without tripping the interrupter.

Current Sensor
Solid or split-core construction for easy installation, includes an integral test winding to check the complete system. A large variety of window sizes is available.

Current Sensor

System Selection Guide
Sensors may be used one per phase or any other combination. For this type of use, all outputs except "T" should be connected in parallel. When multiple sensors are applied, their thermal rating (current) must not be less than their maximum primary current.

- Maximum ground and phase fault current withstand ratings: 200,000 amperes for 0.1 sec
  60,000 amperes for 1.0 sec
- Thermal ratings (maximum continuous current which can exist without overheating the sensor):
  TGM Sensors - 600 amperes
  TGS0002 - 1600 amperes
  TGS005 - 2500 amperes
  TGS0408
  TGS0808- 4000 amperes
  All Other Sensors - 3000 amperes
- Dielectric withstand: Windings to mounting bushings - 1.5 kV Windings to CT window surface - 2.2 kV Mounting bushings to CT window surface - 2.2 kV
- Current Transformer Ratio - 800:1 except type TGM 160:1
- Integral Test Winding Ratio - 1:700 except type TGM 1:80
- Current Transformer Insulation - case Epoxy all sizes
- Dependable operation - solid state relay, cast insulated sensor
- Two N/O contacts, one of which is electrically isolated from the electronic device.
- Output contact rating 5 amperes continuous, 30 amperes inrush, up to 240 volts ac or 125 volts dc.

Solid-State Relay

6.14 Ground Break® Systems

- Adjustable pickup and delay time.
- Split-core sensors easily adapt to new or existing equipment.
- Memory function for system protection against intermittent arcing faults.

Components Features

- Instantaneous zone-selective trip for optimum system coordination and protection.
- Heavy-duty design permits direct operation of electric trip and alarm devices without external relays.

Monitor Panel

Monitor Panels①

Control Voltage	Catalog Number With GP Indicator Light	Catalog Number With Mechanical Target GF Indicator
120 VAC	TGSMP	TGSMA
125 VDC	TGSMPA	
48 VDC	TGSMPB	
36 VDC	TGSMPC	
24 VDC	TGSMPD	

① Monitor panel requires 120 volts ac for system test function.

Relays

Control Voltage	Adjustable Trip Range Amperes Low	Adjustable Trip Range Amperes High	Standard Catalog Number	Zone Selective Catalog Number
120 VAC	5	60	TGSR06	TGSR06Z
125 VDC	5	60	TGSR06	TGSR06Z
48 VDC	5	60	TGSR06B	TGSR06BZ
36 VDC	5	60	TGSR06C	TGSR06CZ
24 VDC	5	60	TGSR06D	TGSR06DZ
120 VAC	100	1200	TGSR12	TGSR12Z
125 VDC	100	1200	TGSR12	TGSR12Z
48 VDC	100	1200	TGSR12B	TGSR12BZ
36 VDC	100	1200	TGSR12C	TGSR12CZ
24 VDC	100	1200	TGSR12D	TGSR12DZ

Current Sensors

Window Diameter (Inches)	Catalog Number	Construction	Test Winding
21/2	TGS0002	Round-Solid Core	Yes
5	TGS0005		
8	TGS0008		
4 x 8	TGS0408	Rectangular - Split Core	
4 x 18	TGS0418		
4 x 24	TGS0424		
4 x 32	TGS0432		
4 x 8	TGS0808		
8 x 10	TGS0810		
8 x 18	TGS0818		
8 x 24	TGS0824		
8 x 32	TGS0832		
8 x 38	TGS0838		
11 x 13	TGS1113		

6.15 Short Circuit Currents - Transformers

KVA impedance and short-circuit available currents for transformers are shown in the following tables: Secondary Unit Substation Transformers; Distribution and Pad-Mounted Transformers; Network Transformers. Use these tables to obtain available short-circuit currents by selecting the appropriate transformer values. Then refer to section 6.3-6.9 for the rating of protective devices. When selecting the interrupting rating of overcurrent protective devices, allowance must be made for any future addition to system capacity. Any motor load contribution must be added to short-circuit from transformer alone. Use the Typical Short-Circuit Contribution from Motors table to calculate short-circuit contribution from rotating equipment. The values shown are equivalent to 50% or 100% motor load contributions. The values in these tables are the short-circuit currents available at the transformer terminals with a bolted fault. Short-circuit downstream currents will be reduced by the impedance of system components such as cable and busway. Refer to publication GET-3550 for more information. Arcing ground faults will also have lower currents.

Maximum Short Circuit Currents Secondary Unit Substation Transformers

Transformer Rating 3-Phase KVA and Impedance	Maximum Short Circuit KVA Available from Primary Source	Normal Load Continuous Current Amperes	Short Circuit Current Total rms Amperes Symmetrical (Average 3-Phase Amperes) 208 Volts Transformer Alone	208 Volts Combined Includes 50% Motor Load Contribution	Normal Load Continuous Current Amperes	480 Volts Transformer Alone	480 Volts Combined Includes 50% Motor Load Contribution
	50,000		16,300	18,000		7,100	8,500
	100,000		17,300	19,000		7,500	8,900
	150,000		17,700	19,400		7,700	9,100
300	250,000	834	18,000	19,700	360	7,800	9,200
4.5%	500,000		18,300	20,000		7,900	9,300
	750,000		18,400	20,100		7,900	9,300
	Unlimited		18,500	20,200		8,000	9,400
	50,000		25,300	28,000		10,900	13,300
	100,000		27,800	29,600		12,000	14,400
	150,000		28,700	31,500		12,400	14,800
500	250,000	1,388	29,500	32,300	601	12,800	15,200
4.5%	500,000		30,200	33,000		13,100	15,500
	750,000		30,400	33,200		13,200	15,600
	Unlimited		30,800	33,600		13,400	15,800
	50,000		28,700	32,900		12,500	16,100
	100,000		32,000	36,200		13,900	17,500
	150,000		33,300	37,500		14,400	18,000
750	250,000	2,080	34,400	38,600	902	14,900	18,500
5.75%	500,000		35,200	39,400		15,300	18,900
	750,000		35,600	39,800		15,400	19,000
	Unlimited		36,200	40,400		15,700	19,300
	50,000		35,800	41,400		15,500	20,300
	100,000		41,100	46,700		17,800	22,600
	150,000		43,200	48,800		18,800	23,600
1000	250,000	2,780	45,100	50,700	1,203	19,600	24,400
5.75%	500,000		46,600	52,200		20,200	25,000
	750,000		47,300	52,900		20,500	25.300
	Unlimited		48,200	53,800		20,900	25,700

6.15 Short Circuit Currents - Transformers

Maximum Short Circuit Currents Secondary Unit Substation Transformers (continued)

Transformer Rating 3-Phase KVA and Impedance	Maximum Short Circuit KVA Available from Primary Source	Short Circuit Current Total rms Amperes Symmetrical (Average 3-Phase Amperes)					
		208 Volts			480 Volts		
		Normal Load Continuous Current Amperes	Transformer Alone	Combined Includes 50% Motor Load Contribution	Normal Load Continuous Current Amperes	Transformer Alone	Combined Includes 50% Motor Load Contribution
	50,000		47,600	55,900		20,600	27,800
	100,000		57,500	65,800		24,900	32,100
	150,000		61,700	70,000		26,700	33,900
1500	250,000	4,160	65,600	73,900	1,804	28,400	35,600
5.75%	500,000		68,800	77,100		29,800	37,000
	750,000		69,900	78,200		30,300	37,500
	Unlimited		72,400	80,700		31,400	38,600
	50,000					24,700	34,300
	100,000					31,100	40,700
	150,000					34,000	43,600
2000	250,000	5,560	-	-	2,406	36,700	46,300
5.75%	500,000					39,100	48,700
	750,000					40,000	49,600
	Unlimited					41,900	51,500
	50,000					28,000	40,000
	100,000					36,400	48,400
	150,000					40,500	52,500
2500	250,000	-	-	-	3,008	44,500	56,500
5.75%	500,000					48,100	60,100
	750,000					49,500	61,500
	Unlimited					52,300	64,300
	50,000					30,700	45,100
	100,000					41,200	55,600
	150,000					46,500	60,900
3000	250,000	-	-	-	3,607	51,900	66,300
5.75%	500,000					56,800	71,200
	750,000					58,700	73,100
	Unlimited					62,700	77,100

6.15 Short Circuit Currents - Transformers

Maximum Short Circuit Currents Secondary Unit Substation Transformers

Transformer Rating 3-Phase KVA and Impedance	Maximum Short Circuit KVA Available from Primary Source	Short Circuit Current Total rms Amperes Symmetrical (Average 3-Phase Amperes) 208 Volts Normal Load Continuous Current Amperes	208 Volts Transformer Alone	480 Volts Normal Load Continuous Current Amperes	480 Volts Transformer Alone
	50,000		14,000		6,080
	100,000		14,800		6,400
112.5	250,000	312	15,000	135	6,600
2.0%	500,000		15,500		6,690
	750,000		15,500		6,720
	Unlimited		15,600		6,770
	50,000		18,100		7,840
	100,000		19,370		8,390
150	250,000	416	20,200	180	8,760
2.0%	500,000		20,510		8,890
	750,000		20,610		8,930
	Unlimited		20,820		9,020
	50,000		25,490		11,050
	100,000		28.070		12,160
225	250,000	625	29,880	270	12,950
2.0%	500,000		30,540		13,230
	750,000		30,770		13,330
	Unlimited		31,230		13,530
	50,000		32,030		13,880
	100,000		36,200		15,690
300	250,000	834	39,280	360	17,020
2.0%	500,000		40,420		17,520
	750,000		40,820		17,690
	Unlimited		41,640		18,040
	50,000		46,260		20,050
	100,000		55,510		24,060
500	250,000	1338	63,080	601	27,340
2.0%	500,000		66,080		28,640
	750,000		67,150		29,100
	Unlimited		69,390		30,070
	100,000		48,980		21,230
	250,000		54,780		23,740
750	500,000	2080	57,040	902	24,720
3.5%	750,000		57,830		25,060
	Unlimited		59,480		25,780
	100,000		61,680		26,730
	250,000		71,170		30,840
1000	500,000	2780	75,020	1203	32,510
3.5%	750,000		76,400		33,100
	Unlimited		79,300		34,370
	100,000		83,270		36,080
	250,000		101,550		44,000
1500	500,000	4160	109,570	1804	47,480
3.5%	750,000		112,530		48,760
	Unlimited		118,960		51,500

6.15 Short Circuit Currents - Transformers

Typical Short Circuit Contribution from Motors

Voltage	Short Circuit Contribution	Equivalent Motor Contribution
208	2X Transformer Normal Load Continuous Current Amperes (or service ampere rating)	50%
	Commercial Buildings:	
480	2X Transformer Normal Load Continuous Current Amperes (or service ampere rating)	50%
	Industrial Buildings:	
	4X Transformer Normal Load Continuous Current Amperes (or service ampere rating)	100%

Network Transformers Available Short Circuit Currents

Transformer Rating 3-Phase KVA and Impedance	Maximum Short Circuit KVA Available from Primary Source	Short Circuit Current Total rms Amperes Symmetrical (Average 3-Phase Amperes) 208 Volts Normal Load Continuous Current Amperes	208 Volts Transformer Alone	480 Volts Normal Load Continuous Current Amperes	480 Volts Transformer Alone
	100,000		15,710		6,810
	250,000		16,260		7,050
300	500,000	834	16,460	360	7,130
5%	750,000		16,520		7,160
	Unlimited		16,650		7,220
	100,000		25,230		10,930
	250,000		26,690		11,570
500	500,000	1388	27,210	601	11,790
5%	750,000		27,390		11,870
	Unlimited		27,760		12,030
	100,000		36,200		15,690
	250,000		39,280		17,020
750	500,000	2080	40,420	902	17,520
5%	750,000		40,820		17,690
	Unlimited		41,640		18,040
	100,000		46,260		20,050
	250,000		51,400		22,270
1000	500,000	2780	53,780	1203	23,130
5%	750,000		54,070		23,430
	Unlimited		55,510		24.060
	100,000		48,990		21,230
	250,000		54,780		23,740
1500	500,000	4160	57,030	1804	24,720
7%	750,000		57,830		25,060
	Unlimited		59,480		25,770
	100,000		61,680		26,730
	250,000		54,780		30,840
2000	500,000	5551	75,020	2406	32,510
7%	750,000		76,400		33,100
	Unlimited		79,310		34,370
	100,000		73,050		31,650
	250,000		86,740		37,500
2500	500,000	6939	92,520	3008	40,090
7%	750,000		94,630		41,000
	Unlimited		99,130		42,960

6.15 Short Circuit Currents - Transformers

Distribution and Pad Mounted Transformers Available Short Circuit Current - By Service Ratings

Service Rating In Amperes	Maximum Short Circuit KVA Available from Primary Source	Short Circuit Current Total rms Amperes Symmetrical (Average 3-Phase Amperes) 208 Volts Ultimate Transformer Size kVA and Impedance	208 Volts Transformer Alone	480 Volts Ultimate Transformer Size kVA and Impedance	480 Volts Transformer Alone
	100,000		28,070		24,060
	250,000		29,880		27,340
600	500,000	225	30,540	500	28,640
	750,000	2%	30,770	2%	29,100
	Unlimited		31,230		30,070
	100,000		36,200		21,230
	250,000		39,280		23,740
800	500,000	300	40,420	750	24,720
	750,000	2%	40,820	3.5%	25,060
	Unlimited		41,640		25,780
	100,000		36,200		21,230
	250,000		39,280		23,740
1000	500,000	300	40,420	750	24,720
	750,000	2%	40,820	3.5%	25,060
	Unlimited		41,640		25,780
	100,000		55,550		26,730
	250,000		63,000		30,840
1200	500,000	500	66,000	1000	32,510
	750,000	2%	67,200	3.5%	33,100
	Unlimited		69,300		34,370
	100,000		48,980		36,080
	250,000		54,780		44,000
1600 - 2000	500,000	750	57,040	1500	47,480
	750,000	3.5%	57,830	3.5%	48,760
	Unlimited		59,480		51,550
	100,000		61,680		32,500
	250,000		71,700		37,100
2500	500,000	1000	75,020	2000	38,900
	750,000	3.5%	76,400	5.75%	39,700
	Unlimited		79,300		41,200
	100,000		61,680		36,400
	250,000		71,700		44,500
3000	500,000	1000	75,020	2500	48,100
	750,000	3.5%	76,400	5.75%	49,500
	Unlimited		79,300		52,300
	100,000		83,270		72,160
	250,000		101,550		88,000
4000	500,000	1500	109,570	(2) 1500	94,960
	750,000	3.5%	112,530	3.5%	97,520
	Unlimited		118,960		103,100

6.16 Automatic Throwover Equipment

AV-LINE® Automatic Throwover Equipment

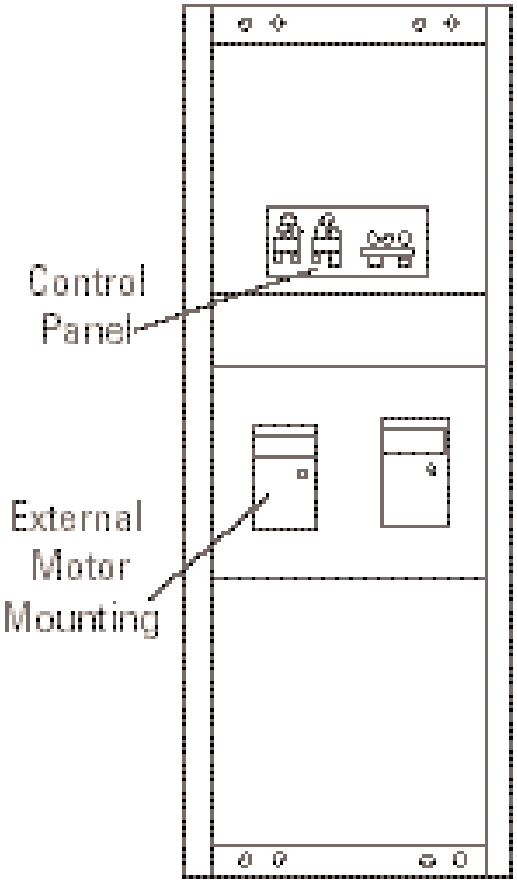
GE Automatic Throwover Equipment is for use with electrically-operated circuit breakers, either Power Break stationary or draw-out; type AKR stationary or draw-out; or molded case with motor operator stationary and 2-breaker throwover only.

For each breaker there is a control switch for manual closing and tripping. Above the switch are three lights indicating open, closed and tripped-on-overcurrent positions in green, red and amber, respectively.

Also included are a test switch and a manual-automatic mode selector switch. Above these switches are located two source available lights (clear) and a manual mode in indicator light (blue).

Specify automatic throwover by description. Include type of system required (2- or 3- breaker); type of breaker (AKR, Power Break, Molded Case); system voltage (208Y/120, 480Y/277, other); and types of functions required from table on next page.

UL Listed per 1008



Optional features include redundant PLC, hard-wire electrical lockout, closed transition, synchronizing for any of the above and any other special features. For more than 3 breaker throwover, refer to factory.

ASCO 940, Open Type Transfer Switch

Ampere Rating	Section Dimensions Height	Width	Depth
400	90”	30”	30”
600	90”	30”	30”
800	90”	30”	30”
1000	90”	40”	40”
1200	90”	40”	40”
1600	90”	40”	45”
2000	90”	40”	45”
3000	90”	40”	50”
4000	90”	50”	50”

6.16 Automatic Throwover Equipment

Standard Features

Function	2-Breaker	3-Breaker
1. Three-phase Voltage Sensing on Normal Sources	X	X
2. Single-phase Voltage and Frequency Sensing on Generator Source	X	
3. Delayed Throwover	X	X
4. Delayed Engine - Starting	X	
5. Delayed Engine - Shutdown (Cool-Off)	X	
6. Delayed Return, Automatic	X	X
7. Manual Return from Alternate Source	X	X
8. Manual-Automatic Mode Selector Switch	X	X
9. Test Switch - Simulates Loss of Normal	X	X
10. Breaker Control Switches for Manual Operations	X	X
11. Indicating Lights		
- Breakers Open (Green) or Closed (Red)	X	X
- Breakers Tripped by Overcurrent (Amber)	X	X
- Source Power Available (Clear)	X	X
- Operating in Manual Mode (Blue)	X	X
12. Overcurrent Trip Lockout-Electric & Mechanical	X	X
13. Breakers Interlocked to Prevent Paralleling the Sources:		
- By closing circuits electrically interlocked	X	X
Plus additional lockouts on:		
-Power Break Breakers - Hidden On Button	X	X
AKR Breakers - Electrically-Operated Mechanical Lockout Device	X	X
Molded-case Breakers - walking beam interlock	X	–
14. Position Switches in Draw-Out Breaker Housing Provide Bypass & Disconnect Functions	X	X
15. Control Power Transformers	X	X
16. Control Power Transfer Relay	X	X
17. Plant Exerciser Time-Switch - Once a week operation of automatic throwover or engine only - optional	X	X

6.17 Wire/Lug/Cable

Wiring Terminals (Lugs) Main Lug Connection

Pressure type mechanical lugs suitable for 250-600MCM aluminum or copper wire, are provided for short circuit ratings to 100,000A. Above 100,000A, compression type lugs are provided for all amperages.

When oversized lugs are required, a lug section with minimum width may be furnished.

Lug sizes and quantity also apply to main devices

Standard Main Lug Terminations	
Ampere Rating	Quantity and Size Per Ø and Ñ
800	(3) 250-600 MCM
1000	(4) 250-600 MCM
1200	(4) 250-600 MCM
1600	(6) 250-600 MCM
2000	(7) 250-600 MCM
2500	(9) 250-600 MCM
3000	(10) 250-600 MCM
4000	(13) 250-600 MCM
5000	(17) 250-600 MCM

Note: Lug sizes do not apply to Class I group mounted MCCB mains. Quantity will vary. Chart based on 500 MCM AL cable rated at 310 amps per cable.

Minimum Cable Bending Space Reference Tabulation (75°C Cable Ampacity Rating Applies)

Amps	Lug Qty	Conductor Al	Conductor Cu	MCM Size 500	MCM Size 750	Cable Bending Space
800①	3		x	x		15
	2		x		x	19
	3	x		x		15
	3	x			x	22
1000①	3		x	x		15
	3		x		x	22
	4	x		x		16
	3	x			x	22
1200①	4		x	x		16
	3		x		x	22
	4	x		x		16
	4	x			x	24
1600	5		x	x		16
	4		x		x	24
	6	x		x		16
	5	x			x	24
2000	6		x	x		16
	5		x		x	24
	7	x		x		16
	6	x			x	24
2500	7		x	x		16
	6		x		x	24
	7	x			x	24
	9	x		x		16
3000	7		x		x	24
	8		x	x		16
	8		x	x		16
	8	x			x	24
	10	x		x		16
4000	9		x		x	24
	11		x	x		16
	11	x			x	24
	13	x		x		16
5000	14		x	x		16
	11		x		x	24
	17	x		x		16
	13	x			x	24

① Compression lugs are provided at 100 KA

6.17 Wire/Lug/Cable

Standard Fusible Switch Module Terminations (Cu/Al Mechanical)

Amp Rating	Voltage	Wire Size (Cu/Al)	# Wires Per Pole
30	240/600	#14-#2	1
60	240	#14-#2	1
60	600	#14-1/0	1
100	240/600	#14-1/0	1
200	240/600	#6-250 MCM	1
400	240/600	1/0-250 MCM or #2-600 MCM	2 or 1
600	240/600	1/0-250 MCM or #2-600 MCM	4 or 2
800	600	1/0-250 MCM or #2-600 MCM	6 or 3
1200	600	1/0-250 MCM or #2-600 MCM	8 or 4

Optional Fusible Switch Module Terminations

	Max # Wires Per Pole								
	30A	60A 240V	60A 600V	100A	200A	400A	600A	800A	1200A
Cu/Al Mechanical									
#6 - 350 MCM					1	2	2	4	4
3/0 - 800 MCM Cu									
250 - 800 MCM Al									
Cu Mechanical									
#4 - #14	1	1							
#6 - #14			1						
#6 - 1/0			1	1					
#6 - 250 MCM					1				
1/0 - 600 MCM						2	2	4	
1/0 - 4/0						4	4	8	4
Cu/Al Compression									
#8 - 1/0	1	1	1	1					
#4 - 300 MCM					1				
2/0 - 500 MCM						2	2	4	4
400 - 500 MCM Cu						2	2	4	4
400 - 600 MCM Al						2	2	4	4
750 - MCM Cu						2	2	4	4
500 - 750 MCM Al						2	2	4	4
Cu Compression									
#6 - 1/0	1	1	1	1					
2/0 - 300 MCM					1				
250 - 500 MCM						2	2	4	4
400 - 750 MCM						2	2	4	4

6.17 Wire/Lug/Cable

Molded Case Circuit Breaker Lugs, Line Shields, Covers and Bus Connectors

Accessory	Wire Size	For Use With	Catalog Number
Copper-Aluminum Lugs	#14-6 Cu, #12-2 Al	TQC (15-60A)	TQAL 3
	#4-1/0 Cu-Al	TQC (70-100A)	TQAL 4
	#1-300 MCM	TQD	TCAL 25
	#14-8	E150, THLC1, TB1 (15-30A)	TCAL 14
	#14-3 Cu, #12-1 Al	E150, THLC1, TB1 (15-60A)	TCAL 12
	#6-2/0 Cu, #4-2/0 Al	E150, THLC1, TB1 (70-90A)	TCAL 12A
	#3-3/0 Cu, #1-3/0 Al	E150, THLC1, TB1 (100-150A)	TCAL 15
	#4-300 MCM	F225 Load end	TCAL 24
		Line end	TCAL 26
	#4-300 MCM Cu-Al	THLC2	TCAL 27
		J400, TB4, J600 (thru 400A)	
	(1) 6-600 MCM or (2) 2/0-250 MCM	TJD	TCAL 43
	(2) 4/0-350 MCM Cu or (2) 300-500 MCM Al	J600 (45-600A)	TCAL 63
	(1) 750 MCM Cu-Al	J400, TJD	TCAL 47
	(1) 3/0-500 MCM or	TLB4, THLC4	TCLK 43
	(2) 3/0-250 MCM Cu-Al		
	(2) 1/0-250 MCM or (1) #4-600 MCM	K1200, TB6 (300-400A)	TCAL 41
	(2) 2/0-500 MCM	K1200, TB6 (450-600A)	TCAL 61
	(3) 3/0-500 MCM	K1200, TB6 (700-1000A), TB8	TCAL 81①②
	(3) 3/0-500 MCM	TK4V - Load end	TCAL 91①②
	(4) 250-350 MCM or (4) 250-500 MCM Al	K1200 (1000-1200A)	TCAL 121④
	(4) 250-350 MCM or (4) 250-500 MCM Al	TK4V - Load end	TCAL 131④
Copper Only Lugs with Follower and Extra Plating	#14-2/0	E150, TB1 (thru 150A)	TCO 12
	#1-300 MCM	TQD (100 -225A)	TCT 25
		F225 Load end	TCO 24
	#14-300 MCM	Line end	TCO 26
	(1) 6-600 MCM or (2) 2/0-250 MCM	J400, TB4	TCO 43
	(2) 250-350 MCM	J600	TCO 63
	(1) 1/0-600 MCM or (2) 1/0-250 MCM	K1200, TB6 (300-400A)	TCO 41②
	(2) 2/0-500 MCM	K1200, TB6 (500-600A)	TCO 61
	(3) 250-500 MCM	K1200 (700-1000A), TB8	TCO 81A
	(3) 250-500 MCM	TK4V - Load end	TCO 91
	(4) 250-400 MCM	K1200 (1200A)	TCO 121
	(4) 250-400 MCM	TK4V - Load end	TCO 131
Line Shield		TEB, TEC, TED, THED	TEDLS
		TFH and TFK	TFKLS
		TJJ and TJK	TJKLS
Lug Cover, TKM Breaker (two per breaker)		TCO41, TCAL41 Lugs	789A448G3③
		TCO61, TCAL61, TCAL81 Lugs, TCO81A	789A448G1
		TCO121; TCAL 121 Lugs	789A448G2
		TH4V, THK9V	286A8066G1
Connector (back strap)		TKM	TKMC1

① Not suitable for 1000-amp aluminum conductor.
② Not UL listed.
③ End cover supplied with 800A frame is used as lug cover.
④ Suitable for 500 MCM copper for voltage drop considerations.

6.17 Wire/Lug/Cable

Spectra RMS Molded Case Circuit Breaker Lugs, Lug Covers and Bus Covers

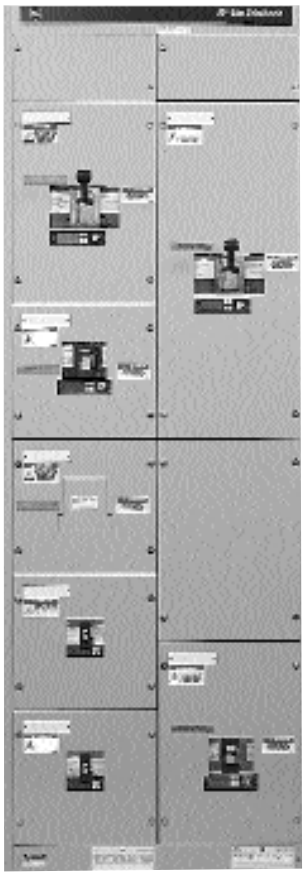
Accessory	For Use With	Wire Range (Qty) Copper	Wire Range (Qty) Aluminum	Catalog Number		Description	Ampacity Range ①
Plated Extruded Aluminum Lugs for Terminating Copper or Aluminum Cables	SE150	#12-3/0	#12-3/0	TCAL 18		single lug	15-150
	SF250	#8-350 kcmil	#8-350 kcmil	TCAL 29		single lug	70-250
				TCLK265		2-pole lug kit	125-600
	SG600	(2) 2/0-400 kcmil or (1) #6-600 kcmil	(2) 2/0-500 kcmil or (1) #6-600 kcmil	TCLK365		3-pole lug kit (with lug cover for line or load end)	-
				(Upper)	(Lower)⑥		
	SK1200	(3) 300-750 kcmil	(3) 300-750 kcmil	TCAL 124⑤	TCAL 134 ⑤⑥	single lug	Cu 275-1200 Al 225-1100
		(3) 3/0-500 kcmil	(3) 3/0-500 kcmil	TCAL 81	TCAL 91⑥	300-800	
		(4) 250-350 (kcmil	(4) 250-500 kcmil	TCAL 121	TCAL 131⑥	600-1200	
Replacement Lug Covers and End Covers	SE150	-	-	SE3LCK (252B1661G1)③		Three lug covers for upper (line) end	-
	SF250	-	-	SF3LCK (252B1659G1)③		Three lug covers for upper (line) end	-
	SG600	-	-	SG1LCK (331A1770G1)③		3-pole lug cover for upper (line) or lower (load) end	-
		-	-	SG1BCK (331A1770G2)②		3-pole end cover for use with bus bars. Fits both ends.	-
	SK1200	-	-	SK1LCK (252B1660G1)③		Lug cover for upper (line) or lower (load) end②	-
Plated Copper Lugs	SE150	#12-3/0	-	TC018		Refer to company for availability	15-150
	SF250	#8-350 kcmil	-	TC029			70-250
	SG600	(2) 2/0-400 kcmil or (1) #6-600 kcmil	-	TCOK265		2-pole lug kit	125-600
				TCOK365		3-pole lug kit	
				(Upper)	(Lower)⑥		
	SK1200	(3) 25-500 kcmil	-	TC081A	TC091⑥	Single lug	300-800
		(4) 25-400 kcmil	-	TC0121	TC0131⑥	Single lug	600-1200

① Both copper and aluminum cables may not cover full ampacity range.
② 100kA, 480 Vac (SKPA) uses longer lug cover/arc shield on upper end. Use Cat. No. SKPSHLD for replacement.
③ Order by new catalog number. Corresponding Part Number in parentheses for reference only.
④ 500 kcmil acceptable for voltage drop considerations.
⑤ UL Listing pending.
⑥ Breakers supplied less lugs with end covers. When ordering K-frame breaker and lugs, order appropriate lug covers.

Class 3 Switchboard

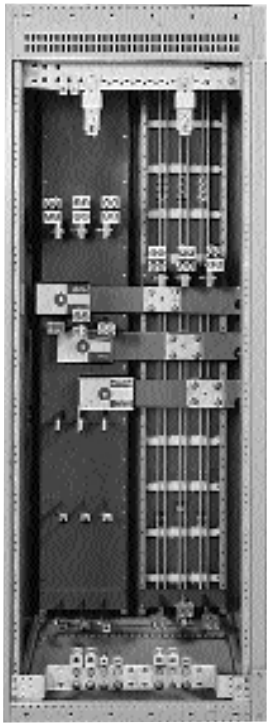
AV3 Access™ Switchboard

The reliability and flexibility of AV3 Access Switchboards are now available with all the advantages of Power Break II Insulated Case Circuit Breakers.



- Meets UL 891 and NEMA PB2 standards for switchboard construction.
- Standard rugged plug-on molded case circuit breaker design for interchangeability with same compartment heights.
- Indoor and outdoor (walk-in and non-walk-in) enclosure available (5000A offering indoor only).
- Optional POWER LEADER™ Power Management System capability (AKR, Power Break II, SG, SK).
- 100% rated Spectra Molded Case Circuit Breaker combines ease of use and state-of-the-art performance in 150A, 250A, 600A and 1200A frame sizes.
- Convenient “thru-the-door” access to breaker controls, trip units and rating plugs.
- Fully equipped solid state MicroVersaTrip Plus™ or PM™ trip units on SG/SK/Power Break II/AKR breakers provide additional savings.
- Individual breakers isolated (top, bottom and rear) from adjacent breaker compartments and main bus/rear cable compartment.
- Padlocking capability for additional safety (optional).

Standard full height 2000A silver-plated copper riser bus allows for easy breaker add-ins to future spaces.



- Riser bus bracing (RMS symmetrical).

  65kA

  100kA

- Main bus bracing (RMS symmetrical).

  65kA

  100kA

  150kA

  200kA

  5000A maximum main bus rating

- Industry-exclusive 30 cycle short circuit withstand bus rating up to 85kA eliminates need for instantaneous tripping function.
- Optional double- or triple-wide rear compartment permits easy accessibility for cable terminations and maintenance.

Class 3 Switchboard

AV3 Access™ Switchboard

Standards and Interrupting Ratings

Standards

Equipment
AV3 Access Switchboard
- UL 891
- NEMA PB-2

Insulated Case Circuit Breaker
Power Break II
- UL 489
- CSA C22.2 No. 5.1
- NEMA AB-1
- IEC (pending)

Molded Case Circuit Breaker
Spectra
- UL 489
- NEMA AB-1

Low Voltage Circuit Breaker
AKR
- ANSI C37.13; C37.16; C37.17; C37.50; C37.51
- NEMA SG-3

Interrupting Rating, RMS symmetrical (kA)

Molded Case Circuit Breakers

	Spectra													
Frame size	150A				250A			600A				1200A		
	SEDA	SEHA	SELA	SEPA	SFHA	SFLA	SFPA	SGDA	SGHA	SGLA	SGPA	SKHA	SKLA	SKPA
240Vac	18	65	100	200	65	100	200	65	65	100	200	65	100	200
480Vac	14	25	65	100	25	65	100	—	35	65	100	50	65	100
600Vac	10	18	25	25	18	25	25	—	25	65	65	25	42	65

Insulated Case Circuit Breakers – Main Devices

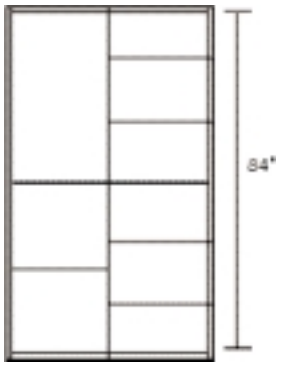
	Power Break II					
Frame size	800A	1600A	2000A	2500A	3000A	4000A
Standard						
240Vac	65	85	85	100	100	100
480Vac	65	65	65	100	100	100
600Vac	50	50	50	85	85	85
High-Break						
240Vac	100	125	125	200	200	200
480Vac	100	100	100	150	150	150
600Vac	65	65	65	100	100	100
Short-time (0.5 sec)	25	30	30	42	42	42

Low Voltage Circuit Breakers – Main Devices

	AKR								
Frame Size	800A		1600A		2000A	3200A		4000A	5000A
Breaker Type	AKR-30	AKR-30H	AKR-50	AKR-50H	AKRT-50H	AKR-75	AKR-75H	AKR-100	AKR-125
Instantaneous									
240Vac	42	50	65	65	65	85	130	130	130
480Vac	30	42	50	65	65	65	85	85	85
600Vac	30	42	42	65	65	65	85	85	85
Short-time									
240Vac	30	42	50	65	65	85	85	85	85
480Vac	30	42	50	65	65	85	85	85	85
600Vac	30	42	42	65	65	85	85	85	85

Class 3 Switchboard

AV3 Access™ Switchboard Sizing



Available compartment height is 84".

Main and Feeder Devices

Device			Main & Tie Devices Manual & Electrical Operations			Feeder Devices① Manual & Electrical Operations		
			Unit	Section		Unit	Section	
Type	Rating	Structure	Height	Width	Depth	Height	Width	Depth
Molded Case Circuit Breakers								
Spectra	150	80%						
		100%	14"②			14"②		
	250	80%						
		100%		15"	45", 50", 60"		15"	45", 50", 60"
	600	80%						
		100%	21"			21"		
	1200	80%③				21", 28"		
		100%④	35"			35"		

Main Devices ⑤

Insulated Case Circuit Breakers			Height	Width	Depth
Power Break II	800	Stationary			
		Drawout	14"		
	1600	Stationary		22" Std	
		Drawout		30" Opt	
	2000	Stationary			50", 60"
		Drawout	21"		
	2500	Stationary			
		Drawout	35"	22" Std	
	3000	Stationary		30" Opt	
		Drawout			
	4000⑥	Drawout	42"	22" Std	60"
				30" Opt	
Low Voltage Power Circuit Breakers					
AKR⑥	800	Drawout			
		Fused Drawout		22" Std	
	1600	Drawout	21"	30" Opt	
		Fused Drawout			
	2000	Drawout			
		Fused Drawout⑦			
	3200	Drawout			60"
		Fused Drawout⑦		30" Std	
	4000	Drawout		38" Opt	
		Fused Drawout⑦			
	2000/4000 D/O Fuse Carriage	Fused Drawout	35"		
	5000	Drawout⑧⑨		38"	67"⑩

① Feeder devices can be located in the same section with mains rated 3000A and lower.
② Requires 7" blank at top to meet 6'6" rule.
③ Maximum 3 per stack with 21" blank.
④ Maximum 2 per stack with 14" blank.
⑤ A 2" transition is needed when using a Power Break II or AKR main device.
⑥ Selections adjacent to a 4000A device or AKR breaker must be a minimum of 30" wide. Add 2" for non walk-in outdoor construction.
⑦ 2000A-4000A fused breakers require separate drawout fuse carriage.
⑧ An 8" transition is needed when using an AKR 5000A main or tie device.
⑨ Horizontal main bus available up to 6000A
⑩74" required if section contains incoming or outgoing busway or is cable fed

See Engineered Products Catalog for additional information.

GE Industrial Systems

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