HVL/cc™ Medium Voltage, Metal-Enclosed Switchgear

2.4 to 38.0 kV, 60 to 150 kV BIL

User Guide

Class 6045

6045IB2401
Replaces 6045CT9801

www.schneider-electric.com

Legal Information

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Introduction

HVL/cc™ medium voltage, metal-enclosed switchgear from Schneider Electric provides switching, metering, and interrupting capabilities for medium-voltage electrical power distribution systems.

It is designed to provide increased electrical and mechanical life and it improves reliability by reducing the number of bus connections and using new switch technology. HVL/cc is designed for simplified system expansion and reduces equipment expense for systems ranging from 2.4 to 38.0 kV, 60 to 150 kV BIL. This switchgear is noted for its versatility, durability, and convenience. It can function as service entrance equipment and for controlling substation transformers, and is designed and manufactured in accordance with NEMA®, CSA®, UL®, and ANSI®/IEEE® standards C37.20.3, C37.20.4, C37.57, C37.58, CSA 22.2 no. 31, and CSA 22.2 no. 193, where applicable.

Made up of modular units, the HVL/cc is configured for expansion purposes. Two main bus positions allow future extensions and connections to existing equipment.

HVL/cc switchgear is available in either single or multiple section units. To simplify handling and installation, each section is assembled before shipping. The design is compact, with front access only options available at system voltages below 17.5 kV.

The HVL/cc switch can be equipped with either an over-toggle mechanism (OTM), which is standard, or an optional stored energy mechanism (SEM). An option with both mechanisms is the Fuselogic™ system. The Fuselogic system offers fuse tripping (with SEM) to provide protection against single phasing loads when a fuse has blown. It also has a mechanical interlock to minimize chances of inadvertent switching until fuses are installed or blown fuses are replaced (see additional details in Standard Features, page 6). An optional blown fuse flag is available with either an OTM or an SEM. The Fuselogic system on the OTM offers a Form “C” 1 N.O.-1 N.C. auxiliary contact in addition to the blown fuse flag.

Mechanical interlocks are standard to inhibit the removal of the load-side panel while the load interrupter switch is closed and/or the optional ground switch is open.

HVL/cc switchgear is available in both indoor and outdoor enclosures. Each type has features for convenience, reliability, and durability.

Indoor switchgear includes lifting angles at the top corners of each shipping section for ease in handling, provisions for expansion, an 11-gauge steel enclosure, full-length ground bus in multiple section enclosures, and padlocking provisions for the load-side panel. Optional features include key interlocking and clear windows for inspection of the optional Load-side Discharge Assembly (LDA).

The outdoor switchgear is constructed with a rear-sloping roof, a steel base and 11-gauge steel enclosure, gasketed front doors, and strip heaters in each switch section. Operating handles are enclosed by outer bulkhead type doors.

Where available, HVL/cc front access only enclosures can be positioned against walls, in small rooms, or in prefabricated buildings. The small footprint can result in considerable cost savings from the reduction of building or room sizes.

Meter sections are available in both hot and cold sequence designs for utilities and/or customer requirements (contact the factory for dimensions and availability).

Special utility metering sections are available as with our conventional HVL Metal-Enclosed switchgear.

General and Application Information

General

Square D™ brand medium voltage, metal-enclosed switchgear functions as a prime component of medium voltage, electrical power distribution systems providing necessary switching and overcurrent protection for the medium-voltage feeders. It is often used in conjunction with Square D brand unit substations. The switchgear is most frequently applied as service entrance equipment, although it performs equally well in controlling substation transformers and in the sectioning of medium-voltage feeder systems.

Standard Features

Square D™ brand DIN-E Medium Voltage Fuse Style with HVL/cc Switchgear have the following standard features:

- Tested per ANSI standards C37.20.3, C37.20.4, C37.57, C37.58, CSA 22.2 no. 31, and CSA 22.2 no. 193, where applicable
- Over-toggle mechanism (OTM)
- Fuse/cable access panel mechanically interlocked with the load interrupter switch and the optional grounding switch
- Removable switch operating handles
- With the optional grounding switch, the cable/fuse compartment is not accessible unless the grounding switch is closed into the grounded position
- Visible isolation viewing ports to view open, closed, and grounded switch positions
- Standard live line indicators (LLIs) powered by capacitor dividers internal to the insulators

  On incoming circuits:

  - On incoming circuits:
    - Provide incoming live line indication
    - Provide incoming line de-energized indication
  - On feeder circuits:
    - Provide live load indication
    - Provide load de-energized indication
    - Provide blown fuse indication (only on wye connected systems)
    - Provide back-fed circuit indication
    - Animated mimic bus:
      - On ungrounded switches, indicates closed and open positions
      - On units with grounding switches, indicates closed, open, and grounded positions
    - Cable lugs (one set per phase)
      - Up to two 500 kcmil cables per phase in switch bays
      - Up to four 500 kcmil cables per phase in incoming line terminal chambers (20-inch [508 mm] wide bay)

Figure 1 - Square D Brand (or Bussmann equivalent) DIN-E Medium Voltage Fuse Style with HVL/cc Switchgear

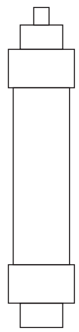
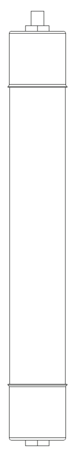


Figure 2 - Mersen CS-3 Medium Voltage Fuse Style with HVL/cc Switchgear



- Fuse ratings of:
  - 5.5 kV to 1080 A
  - 15.5 kV to 480 A
  - 17.5 kV to 270 A
  - 25.8 kV to 175 A
  - 38.0 kV to 115 A

Mersen® CS-3 Medium Voltage Fuse Style with HVL/cc Switchgear have the following standard features:

- 600/1200 A tin-plated copper main bus
- Belleville washers for all power connections
- Bi-phenol epoxy switch enclosure and insulators
- UL/cULus labels
- Tested to IEC 420 for switch-fuse integration
- 11-gauge steel enclosure
- 0.25 x 2-inch (6 x 51 mm) copper ground bus meeting ANSI requirements for short-circuit grounding
- Duplex switches. Single, load-side access panel mechanically interlocked to block access unless both switches are opened (key interlocks are not required)
- Provision for padlocks and/or key locks (optional).
- Fuse ratings of:
  - 5.5 kV to 450 A
  - 15.5 kV to 200 A

Options and Accessories

- The Fuselogic system:
  - Mechanical lockout feature to block reclosing the switch until three new fuses are installed
  - Single phasing protection due to blown fuses with the Fuselogic system
  - Blown fuse indicating contact for remote indication (one common contact)
  - Blown/missing fuse flag on mechanism cover
- Grounding switch with full fault-making capability:
  - On incoming switches, grounds the incoming line conductors
  - On feeder switches, grounds the outgoing load conductors
- LDA option is only available for fused units with Square D brand (or Bussmann equivalent) DIN-E style Medium Voltage fuses only. Used to discharge capacitive voltage on the load side of the fuses. (Application A < 17.5 kV, 600 A only)
- Switch position auxiliary switch

- 1200 A tin-plated copper main bus
- Live Line Indicators (LLIs) on main bus
- Infrared viewing windows for main bus and fuse/cable compartments
- Dual-spring stored energy mechanism (SEM type)
- Motor operator for OTMs and SEMs
- Opening and closing coils (SEM only)
- Fast / Auto transfer configuration (Main-Main and Main-Tie-Main):
  - Electrically interlocked
  - Mechanically interlocked
  - Operated from LLIs
- Protective relaying; contact your local field sales representative for application assistance
- Duplex configuration:
  - Optional mechanical interlock to lock out simultaneous closure of both duplex switches
- Surge arresters

System Voltage ≤ 17.5 kV in. (mm)	System Voltage 25.8 – 38.0 kV in. (mm)
Distribution, Intermediate, and Station class ≤ 12 kV Standard 14.75 (375) switch section Optional 20 (508) and 29.50 (749) section	Load-side surge arresters (all classes) with fuses require a 39.37 (1000) wide section. If unfused, a 29.5 (750) wide section may be used
Distribution, Intermediate, and Station class > 12 kV Standard 20 (508) switch section Optional 29.50 (749)	

- Modified cubicle widths for customers wanting additional working space for cable termination and fuse removal:

System Voltage ≤ 17.5 kV in. (mm)	System Voltage 25.8 – 38.0 kV in. (mm)
20 (508)	39.37 (1000)
29.50 (750)	

- Low voltage compartment with hinged door:
  - Space for metering or relaying system
  - Space for control components
- Heaters with thermostat
- Capacitor trip unit
- Transitions to other Square D brand medium voltage equipment and power transformers.

Class 1, Division 2 Hazardous Area Rated Switchgear

HVL/cc switchgear (up to 15 kV, 95 kV BIL, 600 A maximum) is certified for use in Class 1, Division 2 hazardous locations. This classification usually includes locations where volatile flammable liquids, flammable gases, or vapors are used, but would become hazardous only in case of an accident or unusual operating condition.

Modifications are made to the standard switchgear including:

- Manual operation with no electrical controls, over-toggle mechanism (OTM) only

- Optional, explosion proof, T3B rated heaters with sealed connections
- Fuses without indicating pins
- Modified LLI system that includes sealed connections at the insulator and plugged test ports to block use

These modifications are essential for the equipment to meet Class 1, Division 2 requirements. These modifications cannot be altered. Do not substitute components.

The Class 1, Division 2 switchgear without heaters are T5 rated and can be used in areas where the flash point of volatile liquids, gases, or vapors is 212°F (100°C) or above. Class 1, Division 2 switchgear with optional heaters are T3B rated and can be used in areas where the flash point of volatile liquids, gases, or vapors is 329°F (165°C) or above.

The Fuselogic System

Square D brand medium voltage current-limiting fuses set the standard for features and protection. The extended travel blown fuse indicator provides extended travel and increased energy to positively operate this optional feature.

The Fuselogic system also blocks closing the HVL/cc switch if a fuse is blown or is not installed. This reduces the potential of equipment damage due to single phasing because of a blown or missing fuse. The Fuselogic system can be used to operate auxiliary contacts for optional local and/or remote indication or for fuse tripping.

The Fuselogic fuse trip system requires the stored energy mechanism (SEM), with separate close and open springs. The motor operator is optional on both OTMs and SEMs.

Table 1 - Fuselogic System Options

Available Option	Mechanism Type	
	Over Toggle Mechanism (OTM)	Stored Energy Mechanism (SEM)
Blown fuse flag	Y	Y
Blown fuse flag w/ remote indication	Y	Y
Direct acting fuse trip	N	Y
Time delay fuse trip via blown fuse–fuse size dependent (control power required)	N	Y

NOTE: The Fuselogic system can only be operated by Square D brand (or Bussmann equivalent) DIN-E fuses.

Shunt-trip Applications

The HVL/cc load interrupter switch is, by definition and standard, only required to interrupt its continuous current nameplate rating (for example, a 15 kV, 600 A rated HVL/cc can interrupt no more than 600 A). Listed below are several applications in which it is appropriate to use a shunt trip coil, as well as applications in which it cannot be used.

- **Ground Fault Protection on Solidly Grounded Systems**: Occasionally, Masterclad™ switchgear, specifications are written to incorporate ground fault protection. Metal-enclosed switchgear is frequently used with solidly grounded systems where available short-circuit current is 12.5 kA or more. The HVL/cc load interrupter switch cannot be considered or used to interrupt ground fault currents on solidly grounded systems because the available fault current is far greater than its 600/1200 A load interrupting rating.
- **Ground Fault Current on Resistively Grounded Systems**: Frequently, three-phase electrical systems have a grounding resistor. The grounding resistor limits the level of the ground fault current and consequently reduces the potential damage to the equipment. If the system is resistively grounded with a nominally rated 400 A or less grounding resistor, then it may be possible to use HVL/cc metal-enclosed switchgear to interrupt ground fault currents. Contact your local field sales representative to determine if this is an appropriate application.
- **Transformer Protection Applications**: Medium voltage fuses are designed as short-circuit protection devices and generally are able to provide adequate transformer overcurrent protection per National Electrical Code® (NEC®) 450.3. For applications where the fuse E rating is less than half of the rated interrupting current of the switch, it may be possible to improve the overall protection scheme. Adding overcurrent (IEEE 51) relays can provide precise overload protection for the transformer. In this application, the selection of the CT ratio and the programming of the IEEE 51 (overcurrent) relay must be coordinated by the factory to minimize the chance that the interrupting rating of the switch is not exceeded. Contact your local field sales representative for application assistance.
- **Under/Over-Voltage Protection with Fuselogic System**: The Fuselogic system is well suited where under/over-voltage protection is required. The shunt trip coil, actuated by the voltage sensing relays, can be used to open the switch with the loss of incoming line voltage. This application requires optional voltage transformers (VTs) and voltage sensing relays.
- **Operating Times**:
  - OTM: The conventional single spring over-toggle mechanism equipped with the motor operator operates in approximately five seconds.
  - SEM: The stored energy mechanism operates in approximately 100 milliseconds. The motor operator recharges the springs in approximately five seconds and prepares the switch for any required reclose operations.

Type of Equipment Available-Indoor and Outdoor

Single Section Switchgear: Contains a single fused or unfused switch in a free-standing enclosure. It is ideally suited for locating close to a load to control a single medium-voltage circuit.

Special emphasis is placed on conduit area, cable entrance, and terminations. Normally, no main bus is furnished in a single section. A ground pad bonded to the steel frame is furnished with a cable lug termination.

Multiple Section Switchgear: Consists of a lineup of individual feeder switch sections connected to a common main bus. A main switch, fused or not fused, can be included in the lineup with a utility or user-metering cubicle, depending upon job requirements. A continuous ground bus is bonded to the frame of each section for the complete length of the lineup. The end cubicles have provisions for the addition of future feeder switch sections.

Figure 3 - Outdoor Single Section HVL/cc Medium Voltage, Metal-Enclosed Switchgear

Outdoor Single Switch or Multiple Section Switchgear: Consists of medium-voltage components in a NEMA Type 3R enclosure. Access is through a gasketed, front bulkhead-type door. The enclosure is designed so that the sheared edges of the steel are not exposed. The equipment is furnished with:

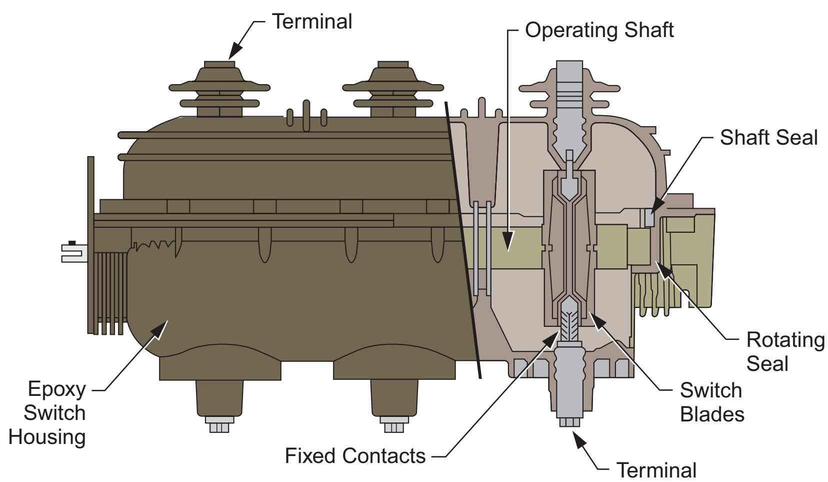
- Roof sloped to rear for precipitation runoff
- Polyester-powder paint finish
- Removable operating handles are enclosed
- Formed steel channel
- Full height, gasketed outer front doors
- 11-gauge steel enclosure per ANSI C37.20.3
- Removable split rear panels
- Strip heaters in each switch section
- Door-stay rods to hold outer-hinged doors in open position

HVL/cc Load Interrupter Switch Construction

HVL/cc Load Interrupter Switches are constructed with:

- Seal for Life® epoxy switch enclosure
- Rotary double break interrupting principle
- Interruption inside sealed enclosure
- Maintenance-free contacts
- Two viewing ports to view the main switch contacts and optional ground switch contacts from the front panel

Figure 4 - HVL/cc Load Interrupter Switch Construction



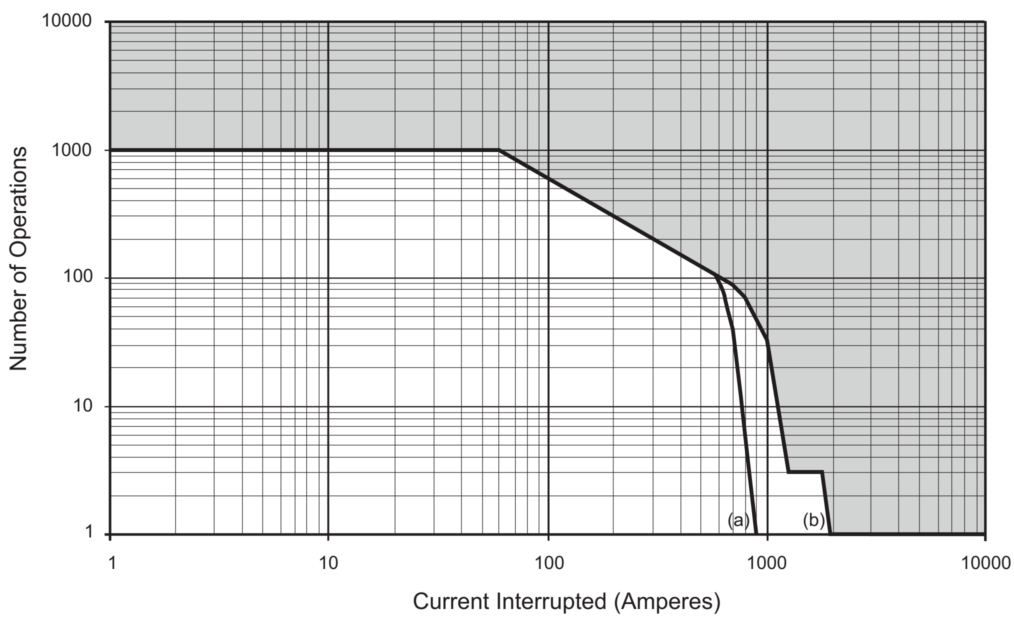
Gas Tightness

The HVL/cc switch has been designed and tested for a leakage rate that is less than 3 x 10^{-6} bar.cm^3 per second. The leakage rate will not exceed 0.1% of the total volume of the gas per year over the expected life of the switch.

Mean Time To Failure (MTTF)

The HVL/cc switch was introduced globally in 1990. According to the total number of installed switches since 1992 (over 250,000), the corresponding MTTF is approximately 4,300 years.

Figure 5 - Typical Life of HVL/cc–600 A, (a) 25.8 & 38 kV, (b) 5.5 & 15 kV



Operating Positions

Figure 6 - Closed

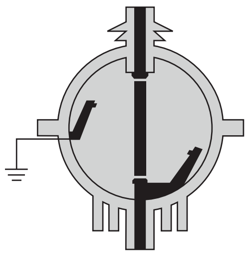


Figure 7 - Open

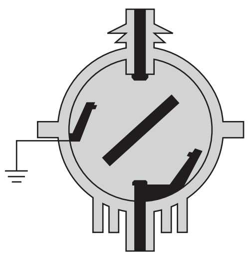
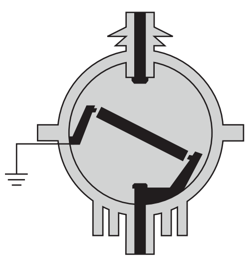


Figure 8 - Grounded



Contacts in closed position:

- Closing is high-speed and independent of the user
- Switch meets all ANSI requirements

Contacts in open position:

- Moving contacts isolated from fixed contacts by SF_6 gas
- Gap designed to withstand the recovery voltage

Contacts in grounded position:

- Closing is high-speed and independent of the user
- Grounding switch has full fault-making capability

The HVL/cc switch with the optional internal ground switch uses sulphur hexaflouride gas (SF6) for insulation and interrupting. The live parts are contained in a sealed-for-life insulated enclosure. This switch offers remarkable characteristics including:

- Increased operating reliability
- Low gas pressure–5.8 PSI ≤ 17.5 kV; 14.5 PSI at 25.8–38 kV
- Maintenance-free contacts
- High electrical endurance

Sequence of Operation-Opening the Switch (for switches equipped with an OTM)

In the closed position, the main switch blades are engaged on the stationary contacts. The circuit current flows through the main blades. Live line indicators (LLIs) on the front mechanism cover indicates that voltage is present on the circuit.

An operator handle inserted in the switch operator slot is used to manually rotate the switch operating mechanism counterclockwise. After the springs become fully charged, they toggle over the center position and discharge their stored energy to the switch operating mechanism. The speed of the operating mechanism is independent of the speed of the user.

The action of the switch operating mechanism forces the main blades off the stationary main contacts in a double-break configuration, thus causing circuit interruption. The mimic bus on the end of the switch shaft (visible on the mechanism cover) indicates that the contacts are in the open (ungrounded) position. The LLI no longer illuminates.

The qualities of SF6 gas are used to extinguish the electrical arc. The arc appears when the fixed and moving contacts separate. The combination of the current and the magnetic field created by the current cause arc rotation around the stationary contact. This rotation produces arc extension and cooling until the arc is extinguished at current zero. After this, the distance between the fixed and moving contacts is sufficient to withstand the recovery voltage. This system provides extended electrical endurance due to very low wear on the contacts.

Sequence of Operation-Grounding the Switch Main Contacts with Optional Ground Switch

The switch must be in the open position before it can be moved to the grounded position. An operator handle inserted in the mechanism ground slot is used to manually rotate the grounding mechanism clockwise. After the springs become fully charged, they toggle over the center position and discharge their stored energy to the ground mechanism.

The mechanism forces the main blades into the grounded position. The speed of the operating mechanism is also independent of the speed of the user, identical to the spring opening sequence. The mimic bus on the end of the switch shaft (visible on mechanism cover) indicates that the contacts are in the grounded position. The front load access panel can only be removed when the switch is in the grounded position.

Sequence of Operation-Closing the Switch with Optional Ground Switch

The front load access panel must be installed before the switch can be moved from its grounded to open position. With the front load access panel installed, an operator handle inserted in the mechanism ground slot is used to manually rotate the grounding mechanism counterclockwise. After the springs become fully charged, they toggle over the center position and discharge their stored energy to the ground mechanism. The mechanism forces the main blades into the open (ungrounded) position.

The speed of the operating mechanism is independent of the speed of the user. The mimic bus on the end of the switch shaft (visible on the mechanism cover) indicates that the contacts are in the open (ungrounded) position. Since the ground switch is immersed in SF_6 gas, it has a short-circuit-making capability should a trip condition exist on the circuit when the switch is operated.

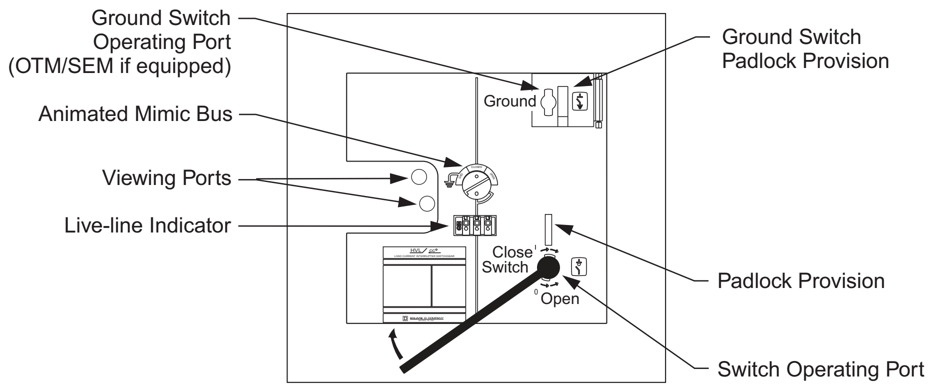
With the switch in its open/ungrounded position, an operating handle in the operating slot is rotated clockwise until the springs become fully charged and they toggle over the center position. The mechanism forces the main blades into the closed position. The speed of the operating mechanism is also independent of the speed of the user. The mimic bus on the end of the switch shaft indicates that the contacts are in the closed position. The LLIs indicate that voltage is present on the circuit.

When the movable main blades approach the stationary main blades, an arc is established across the diminishing gap. The arc occurs between the tip of the stationary main contacts and the edge of the movable main blades. The arc is short and brief, since the fast-closing blades minimize the arcing time. Spring pressure and the momentum of the fast-moving main blades completely close the contacts. The force is great enough to cause the contacts to close, even against the repelling short-circuit magnetic forces if a trip condition exists on the circuit.

The switch nameplate prominently lists performance ratings, fuse supplied, and equipment identification.

Motor-operated HVL/cc switches are available for applications requiring remote operation. Used with programmable controllers (such as Modicon™ controllers) or electromechanical relays, motor-operated switches may be used in automatic load transfer applications. Low voltage controls are in the top-mounted low voltage compartment.

Figure 9 - Mechanism Cover Application A, OTM Shown



Technical Overview

Construction Features of Indoor Equipment

- Eleven-gauge steel enclosure is completely grounded
- ANSI 61 paint finish is a TGIC polyester powder applied electrostatically to yield a rugged surface coating
- Epoxy insulators
- Shatter-resistant glass viewing ports for visual confirmation of switch blade position
- Interlocked, removable front panels for fuse or cable access
- Sectionalized shipment, when required
- Sealed switch enclosure separate from the bus bar compartment and the fuse/ cable compartment by the switch enclosure
- Electrically and/or mechanically interlocked fuse/cable access panel permitting entry to fuses or cables only when switch is open and grounded (optional). Mechanical interlock also functions for unfused applications
- Provisions for future expansion
- Full-length ground bus in multiple section enclosures
- Access panel interlock (electrical and/or mechanical) to block removal of the load-side panel while the switch is closed and/or the ground switch is open
- Switch interlock (electrical and/or mechanical) to block operation of the switch’s main contacts while the load-side panel is removed
- Provisions for padlocking the load-side panel
- Key interlocking is available when required

  The three, tin-plated copper bus bars are parallel mounted A, B, C, front to rear. 600 and 1200 A main bus is available. Connection is made to the fuses using field shapers.
- Bare copper ground bus is bonded to equipment frame

Figure 10 - HVL/cc Components (Square D brand DIN style fuses shown in illustration as reference)

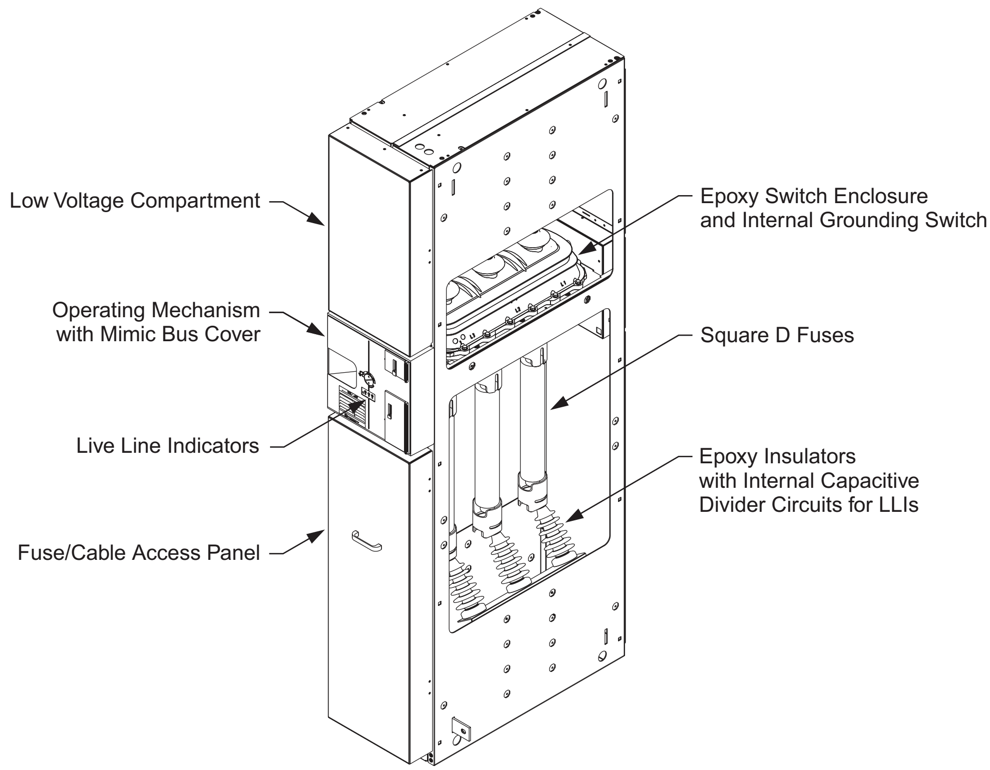
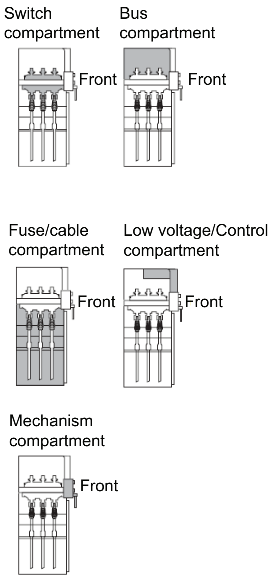


Figure 11 - Compartment Types



HVL/cc Compartments

NOTE: The HVL/cc compartments are shown as shaded areas in the figures to the left.

Switch Compartment:

- Sealed for life in SF_6 gas
- Interruption in sealed enclosure
  - No external arcing
- Unaffected by the environment

Bus Compartment:

- Separate compartment isolated by switch insulation or sheet metal
- Houses three, parallel-mounted bus bars
- Rating for main bus:
  - 600 A (standard)
  - 1200 A (optional)

Fuse/Cable Compartment:

- Located below switch (Application A)
- Frame-to-frame steel barriers
- Accessed only after grounding switch is closed. (With ground switch option)
- Optional grounding of both sides of fuse available. (With internal ground switch and LDA–Application A ≤ 17.5 kV, 600 A only).

Low Voltage/Control Compartment:

- Separate low voltage and control compartment
- Space for metering and control components

Mechanism Compartment:

- Contains operators for switch and optional grounding switch
  - Optional motor with padlock provisions on control power disconnect switch
  - Optional close and open coils
- Standard LLIs:
  - Externally mounted neon indicating lights (one per phase)
- Externally accessible

Additional Components

Metering sections for user or utility equipment are available. They can be supplied fully equipped with necessary current transformers, potential transformers, meters, and associated devices, or with provisions only for installing utility components at the job site.

Standardized utility metering sections match the adjacent switchgear and incorporate all the special requirements of the utility.

Standard HVL/cc customer meter sections are 29.50-inch (750 mm) wide ≤ 17.5 kV and 39.37-inch. (1000 mm) wide for 25.8 – 38.0 kV.

Cable Terminations

On unfused switches, the load cables are connected directly to the terminals of the switch. Transformer cables are connected to the lower fuse holder/field shaper.

Cables may have either:

- Simplified terminations for dry-type, one- or three-core cables
- Heat-shrink ends for dry-type or paper-insulated cables

With basic equipment, the maximum cable sizes are:

- 4–500 kcmil/phase for 1200 A incoming or outgoing terminal chambers
- 2–500 kcmil/phase for 600 A incoming or outgoing switch cubicles
- 2–1/0 AWG/phase for switches incorporating fuses and direct coupled to transformers.

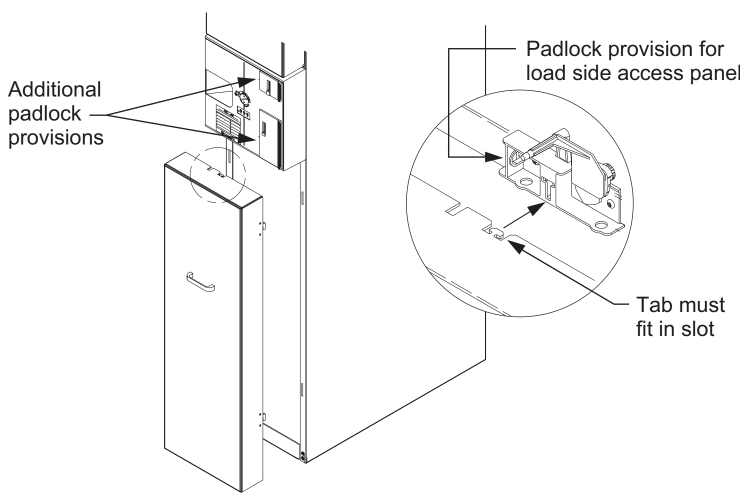
The optional grounding switch must be in the grounded position before the fuse/cable compartment can be accessed. The reduced depth of the cubicle allows for easy connection of all phases. An anti-rotation stud is incorporated in the field shaper. Schneider Electric-supplied lugs must be used with this switchgear.

Padlock provisions are standard for:

- Load interrupter switch
- Optional grounding switch
- Motor cut-off switch (if a motor operator is ordered)

Key interlocks are optional equipment. They are often suppled in conjunction with metal-enclosed switchgear to direct proper operation and coordination of the equipment. The key interlock schemes are usually described on the switchgear assembly drawings supplied with the equipment.

Figure 12 - Panel Interlock Provisions



Selection Guide

Integrated Equipment Ratings

HVL/cc switchgear is an integrated assembly of many components, properly selected and coordinated to provide consistent operation of the overall equipment. Each component has its own ratings defined by its own industry standards (usually ANSI). In the past, these individual component ratings have been emphasized since they often appear to be quite impressive. However, they may be irrelevant to the component's application.

Integrated ratings of the complete equipment are the natural solution, and Square D brand switchgear is rated in this manner. Integral equipment ratings are readily comparable with the anticipated voltage, short-circuit, and continuous current values obtained when designing a distribution system.

Equipment Ratings without Fusing, page 21 covers the HVL/cc load interrupter switches when applied without fuses.

Integrated short-circuit current ratings with Square D brand and Mersen CS-3 brand current-limiting fuses are shown in Integrated Ratings for 600 A HVL/cc Switches with Square D brand Current-limiting Fuses, page 22 and Fuse Rating Table with Fuses in Parallel. Integrated equipment, short-circuit current rating at a given voltage defines the maximum short-circuit current to which the entire equipment may be subjected without damage to the equipment.

Current ANSI standards for metal-enclosed switchgear and the components are rated individually in rms symmetrical amperes. The integrated rating may also be expressed this way (the asymmetrical rating is obtained by multiplying the symmetrical value by 1.6). For convenience, when comparing to older equipment, the integrated rating is also expressed in “MVA.” The MVA ratings are calculated at the nominal system voltage and with the rms symmetrical amperes, for example, MVA = Nominal System Voltage, kV x A rms sym kA x √3.

The integrated equipment rating combines the following ratings:

- Switchgear-momentary and short-time (bus bracing)
- Load Interrupter Switch-momentary, fault-closing and short-time
- Fuses-interrupting and energy let-through characteristics (current-limiting fuses limit the energy during a short circuit, thereby allowing higher integrated ratings than the switches and switchgear would have if unfused)
- Other components that may have limited capabilities

Table 2 - Equipment Ratings without Fusing

Switch (kV)-Maximum Design[1]	5.5	17.5	17.5	25.8	38.0
BIL (kV)	60	95	110	125	150
Frequency (Hertz)	50/60	50/60	50/60	50/60	50/60
Withstand (kV)	19	36	36	50	80
Continuous Current (A)	600/1200	600/1200	600/1200	600	600
Interrupting Current (A)	600/1200	600/1200	600/1200	600	600
Fault Close (kA ASYM)	40	40	40	32	32
Momentary Current (kA ASYM)	40	40	40	32	32
Short Time Current (kA SYM)	25	25	25	25	25
Electrical Endurance (Number of operations at 80% P.F.)	100/600 A 26/1200 A	100/600 A 26/1200 A	100/600 A 26/1200 A	100	100
Mechanical Endurance (Number of operations)	1000	1000	1000	1000	1000

Explanation of Ratings

Voltage Ratings: The voltage for a given system is normally expressed in nominal Volts and is operated in a range that fluctuates, based on a number of operating factors. ANSI standards generally recognize a tolerance of ± 5%. For switchgear, do not exceed the maximum design voltage. When operated below this maximum, the equipment withstands the 50 or 60 Hz voltage continuously, the low frequency withstand for one minute, and impulse voltages applied in accordance with ANSI design test procedures.

Continuous Current Rating: The overall continuous current is determined by the component with the smallest capacity–bussing, load interrupter switch, fuses, fuse mountings, and connections. Unfused equipment is normally rated by the main bus, which is available in ratings of 600 or 1200 A continuous. The continuous-current rating of fused equipment is generally determined by the fuses, since the other components have greater current-carrying capacities than the fuses.

HVL/cc Switch Interrupting Current Rating: The HVL/cc switch is designed and tested in accordance with ANSI standards as a "load interrupter" switch, capable of interrupting load currents up to its continuous current rating. However, per ANSI, this switch is not intended to be the main switching device. Load interrupter switches are not designed or tested for interrupting currents above their continuous currents.

Full Load Current Switching Endurance: In accordance with ANSI C37.20.4, the number of full-load current interruptions the switch can make at maximum design voltage is established through tests on "a circuit having a 0.8 power factor lagging," and "requiring no maintenance for the number of operations stated."

Short-Circuit Current Ratings: An integrated short-circuit current rating is normally established based on the Momentary, two-second short time, and fault-close capabilities of the equipment as explained in Integrated Equipment Ratings, page 20. The most important number is the Integrated Short-Circuit Current Rating, which establishes overall rating for the equipment. This number is normally based on unfused switches. Current-limiting fuses can be used to increase the integrated rating. Use Equipment Ratings with Fuses, page 23 and Fuse Rating Table with Fuses in Parallel to select the proper fuse and associated integrated short-circuit current rating.

1. All switches have a four-time fault-close duty cycle.

Mechanical Endurance: These numbers represent actual test values to which the given switch rating has been subjected. ANSI C37.20.3 and C37.20.4 do not require a rating, only testing to a specified minimum number of operations without repair, component replacement, or maintenance. In all cases, the switch rating shown has been tested to many more than the minimum number of operations shown here.

Medium Voltage Fuse Selection

Fuses are usually used with the medium-voltage switch to provide overcurrent protection. They are normally mounted vertically below the switch (Application A). When an Application B (inverted) arrangement is used, the fuses are mounted above the switch.

Unless user job requirements demand otherwise, fuses are always connected to the load-side of the switch and are de-energized when the switch is open. When mounted in the switchgear, the fuses are readily accessible through an interlocked panel for easy removal.

Square D brand current-limiting fuses or Mersen fuses must be used in Square D brand HVL/cc Metal-Enclosed Switchgear. These provide short-circuit current interrupting protection equal to or greater than the short-circuit current rating of the equipment in accordance with their nominal current ratings and characteristic curves.

Current-limiting type fuses offer the maximum short-circuit current rating and are most economical in the majority of “E” ratings in which they are available.

Fuses supplied with the equipment provide the following conditions when properly selected:

- Fuse-interrupting capacity is in accordance with the integrated equipment short-circuit current rating.
- Fuse continuous-current E rating is as required up to the maximum continuous-current rating of the fuse.
- Most applications seem to favor fast-acting, current-limiting fuses. These fuses limit the let-through current and minimize the short-circuit damage to a system. They are completely factory-assembled and sealed to keep out dust or foreign material, and they operate without any noise, pressure, or expulsion of gas, flame, and extinguishing material, even at maximum capacity. Boric acid fuses are not available with HVL/cc switchgear.

Integrated Ratings for 600 A HVL/cc Switches with Square D brand Current-limiting Fuses

Current-limiting fuses increase the integrated short-circuit current rating because of their energy-limiting capabilities. To increase the short-circuit current rating of the entire lineup of switchgear, current-limiting fuses must be used in the entrance sections.

Current ratings are shown in rms symmetrical amperes:

- Symmetrical amperes = asymmetrical amperes ÷ 1.6.
- Nominal 3Ø symmetrical MVA rating = system nominal voltage, kV x sym. amperes, kA x √3.
- Ratings are based on an X/R ratio of 16.

Table 3 - Equipment Ratings with Fuses with Square D brand (or Bussmann equivalent) DIN-E style Current-limiting Fuses

Nominal System Voltage (kV)	Maximum Design Voltage (kV)	Maximum Continuous Fuse Current (A)	Integrated Ratings	
			Short-Circuit Current Rating in rms Symmetrical A (kA)	Maximum MVA Rating (MVA)
2.40	5.50	10–540	65	270
		630	50	207
		720–1080	25	103
4.16		10–540	65	468
		630	50	360
		720–1080	25	180
4.80		10–540	65	540
		630	50	415
		720–1080	25	207
7.20	17.50	480	65	810
12.00		480	65	1350
12.47		480	65	1403
13.20		480	65	1486
13.80		480	65	1553
16.50		270	65	1857
20.78	25.80	180	25	899
22.86		180	25	989
23.0		180	25	995
24.94		180	25	1079
26.4	38.0	117	25	1143
34.5		117	25	1493

Table 4 - Equipment Ratings with Fuses with Mersen CS-3–style Current-limiting Fuses

Nominal System Voltage (kV)	Maximum Design Voltage (kV)	Maximum Continuous Fuse Current (A)	Integrated Ratings	
			Short-Circuit Current Rating in rms Symmetrical A (kA)	Maximum MVA Rating (MVA)
2.40	5.50	250	63	262
4.16				454
4.80				524
2.40		450	50	208
4.16				360
4.80				416
7.20	15.50	200	50	624
12.00				1039
12.47				1080
13.20				1143
13.80				1195

Fuse Ratings

E-rated, Square D brand DIN style and Mersen CS-3 style current-limiting fuses function as follows:

- 100E or less – Must melt in 300 seconds (five minutes) on 200–240% of E (A) rating.
- Over 100E – Must melt in 600 seconds (ten minutes) on 220–264% of E (A) rating.
- Refer to Fuse Ranges and Sizes (DIN Style), page 25 for available E-ratings.

Current-limiting Fuses (Square D brand DIN style and Mersen CS-3 style)

- Positive extended travel blown fuse indicator pin on Square D brand fuses only (used for the Fuselogic system applications)
- UL listed
- Fast acting to limit available trip-level current stresses on the system and minimize damage to system components
- Fuselogic system automatic fuse tripping requires stored energy mechanism
- Silent, non-venting interruption
- Completely factory-assembled and sealed for consistent characteristics
- High-interrupting capacity
- No refills to replace or parts to clean
- Requires minimal electrical clearance; no exhaust clearance required
- Controlled-arc voltages
- Single- and double-barrel fuse designs; double-barrel fuses increase ratings
- Standard ANSI characteristic curves
- Used for blown fuse indication and blown fuse tripping (Fuselogic system)

Ratings and Selection

Table 5 - Fuse Ranges and Sizes (Square D brand [or Bussmann equivalent] DIN-E style)

Description[2]	Length		Diameter	
	in.	mm	in.	mm
5.5 kV, 10–125E	17.40	442	2.00	51
5.5 kV, 150–450E	17.40	442	3.00	76
17.5 kV, 10–30E	17.40	442	2.00	51
17.5 kV, 40–100E	17.40	442	3.00	76
17.5 kV, 125–150E	17.40	442	3.50	88
15.5 kV, 175–200E	21.10	537	2.00	51
25.8 kV, 10-30E	21.10	537	2.00	51
25.8 kV, 40-65E	21.10	537	3.50	88
25.8 kV, 80-100E	28.00	712	3.50	88
38 kV, 10-30E	28.00	712	3.00	76
38 kV, 40-65E	28.00	712	3.50	88

Table 6 - Fuse Ranges and Sizes (Mersen CS-3 Style)

Description	Length		Diameter	
	in.	mm	in.	mm
5.5 kV, 10–200E	15.88	403	3.00	76
15.5 kV, 10–100E	18.77	477	3.00	76

2. Square D brand and Mersen CS-3 style, general purpose, E-rated, current-limiting fuses only. Includes blown fuse indicator.

Table 7 - Rating Table with Square D brand (or Bussmann equivalent) DIN-E style Fuses in Parallel

Maximum Voltage	Fuse Rating	Number of Fuses	Fuse Size	Derating Factor	Integrated Rating	Cubicle Width in. (mm)
5.5 kV	10-450E	1	Actual	1.0	65 kA	14.75 (374.65)
	540 A	2	300	0.9	65 kA	20.00 (508.00)
	630 A	2	350	0.9	50 kA	20.00 (508.00)
	720 A	2	400	0.9	25 kA	20.00 (508.00)
	810 A	2	450	0.9	25 kA	20.00 (508.00)
	840 A	3	350	0.8	25 kA	29.50 (749.30)
	960 A	3	400	0.8	25 kA	29.50 (749.30)
	1080 A	3	450	0.8	25 kA	29.50 (749.30)
15.5 kV	10-200E	1	Actual	1.0	65 kA	14.75 (374.65)
	225 A	2	125	0.9	65 kA	20.00 (508.00)
	270 A	2	150	0.9	65 kA	20.00 (508.00)
	315 A	2	175	0.9	65 kA	20.00 (508.00)
	360 A	2	200	0.9	65 kA	20.00 (508.00)
	420 A	3	175	0.8	65 kA	29.50 (749.30)
	480 A	3	200	0.8	65 kA	29.50 (749.30)
17.5 kV	10-150E	1	Actual	1.0	65 kA	14.75 (374.65)
	180 A	2	100	0.9	65 kA	20.00 (508.00)
	225 A	2	125	0.9	65 kA	20.00 (508.00)
	270 A	2	150	0.9	65 kA	20.00 (508.00)
25.8 kV	10E	1	Actual	1.0	25kA	29.50 (508.00)
	15-50E	1	Actual	1.0	25 kA	29.50 (749.30)
	65-100E	1	Actual	1.0	25 kA	29.50 (749.30)
	115 A	2	65	0.9	25 kA	39.37 (1000.00)
	140 A	2	80	0.9	25 kA	39.37 (1000.00)
	175 A	2	100	0.9	25 kA	39.37 (1000.00)
38.0 kV	10-40E	1	Actual	1.0	25 kA	29.50 (749.30)
	50-65E	1	Actual	1.0	25 kA	29.50 (749.30)
	75 A	2	40	0.9	25 kA	39.37 (1000.00)
	90 A	2	50	0.9	25 kA	39.37 (1000.00)
	115 A	2	65	0.9	25 kA	39.37 (1000.00)

Table 8 - Fuse Rating Table with Double-barreled Mersen CS-3 Style Fuses

Maximum Voltage	Fuse Rating	Number of Barrels	Integrated Rating	Cubicle Width in. (mm)
5.5 kV	10–200E	1	63 kA	14.75 (375)
	250E	2	63 kA	20.00 (508)
	300–450E	2	50 kA	20.00 (508)
15.5 kV	125-200E	1	50 kA	14.75 (375)
		2	50 kA	20.00 (508)

The following table contains correction factors for applying metal-enclosed switchgear above 3300 ft. (1000 m). The switch itself is sealed and not affected by altitude.

Table 9 - Altitude Correction Factors (ANSI C37.40-2.3)

Altitude Above Sea Level		Multiply BIL and 1-minute Withstand Voltages by:	Multiply Continuous Current by:*
Feet	Meters		
3300	1000	1	1
4000	1200	0.98	1
5000	1500	0.95	1
6000	1800	0.92	1
7000	2100	0.89	1
8000	2400	0.86	1
9000	2700	0.83	1
10000	3000	0.8	1
12000	3600	0.75	1
14000	4300	0.7	1
16000	4900	0.65	1
18000	5500	0.61	1
20000	6100	0.56	1

Typical Multiple Section Switchgear Arrangement

Table 10 - Section Dimensions–600 A switch shown

Voltage	Dimensions: in. (mm)				
	A	B	C	D	Depth
2.4–17.5 kV	14.75 (375)	29.50 (750)	90.00 (2286)	11.00 (279)	37.25 (946)
25.8–38 kV	29.50 (750)	39.37 (1000)	108 (2743)	24.00 (610)	59.12 (1502)

Typical Indoor Front Views

Figure 13 - Duplex Mains with Metering and One Feeder Switch

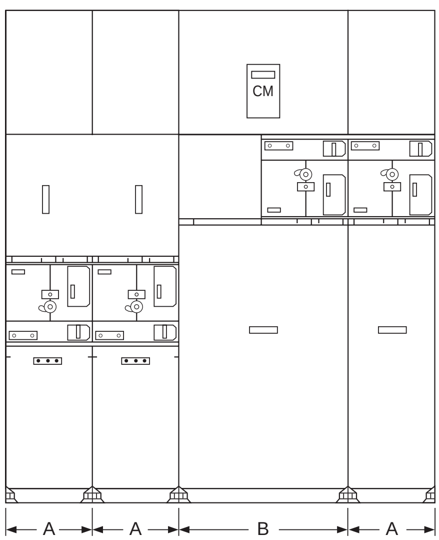


Figure 14 - Duplex Mains for Transformer

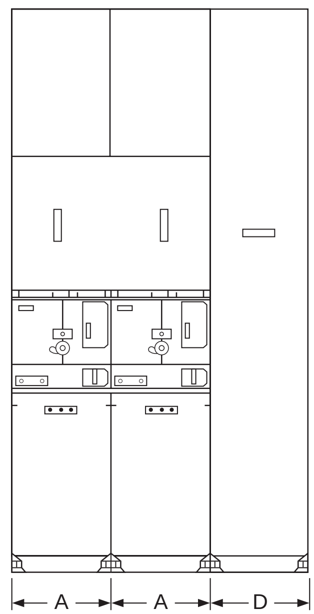
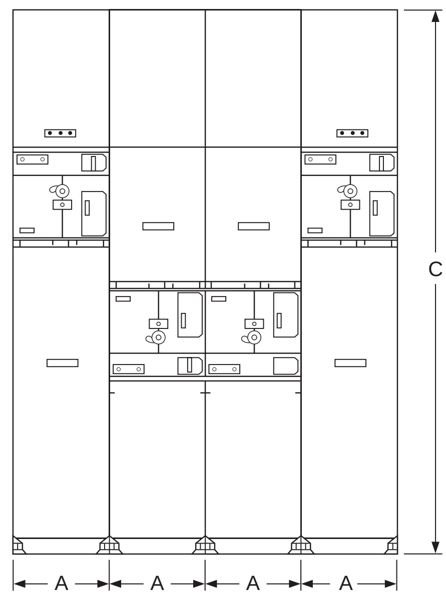


Figure 15 - Main Switches on Ends with Feeder Switches in Center



Typical Single Line Diagrams

Figure 16 - Bottom Cable Entry and Exit

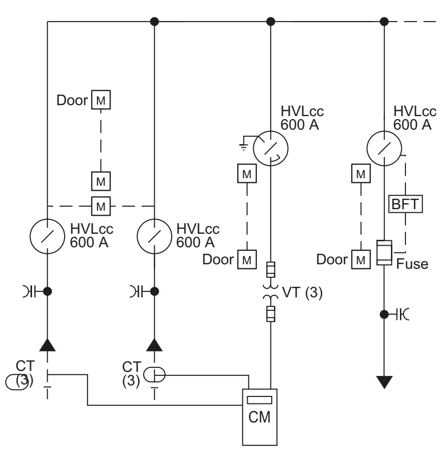


Figure 17 - Bottom Cable Entry with Connection to Transformer

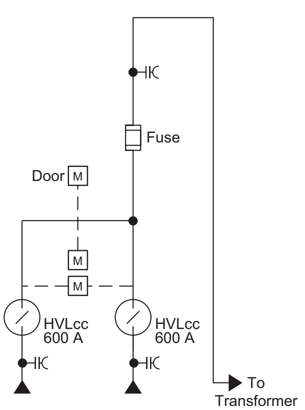
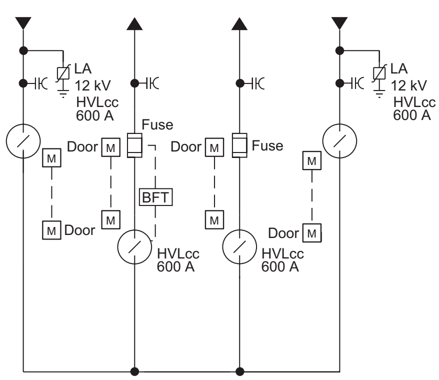


Figure 18 - Top Cable Entry and Exit



NOTE: When preparing HVL/cc lineups, group all top-entry switches together and all bottom-entry switches together to avoid transition sections. 2.4–17.5 kV: Standard shipping splits are two sections with a maximum of five 14.75-inch (375 mm) sections. 25.8–38 kV: Standard shipping splits are two 29.50-inch (750 mm) sections or one 39.37-inch (1000 mm) section.

Back-to-Back HVL/cc Section Configuration–Indoor Only (NEMA 1) 17.5 kV Max.

Figure 19 - Side View (Square D brand DIN style fuses shown in illustration as reference)

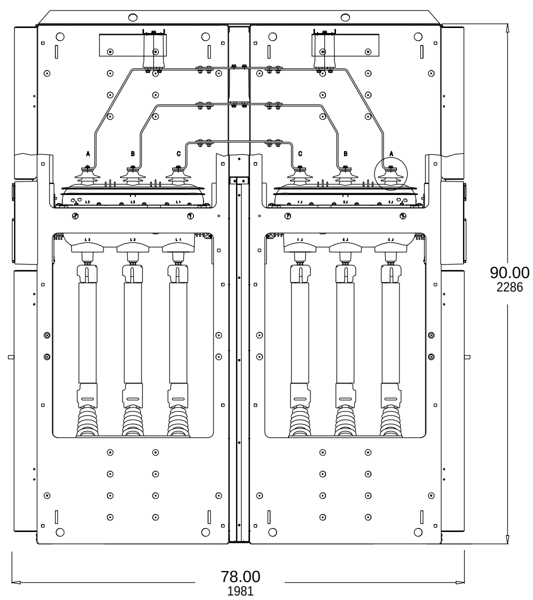
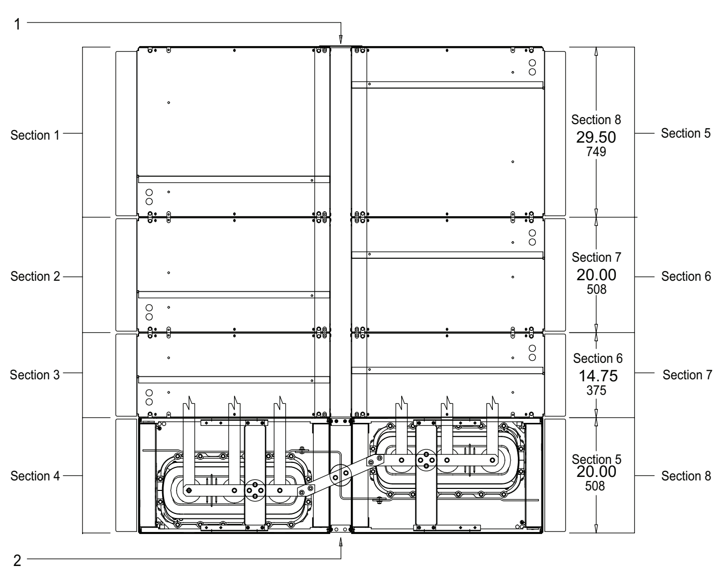


Figure 20 - Top View



NOTE:

1. Filler panels at top and end seal the lineup.
2. 3.5-inch (89 mm) collar between Sections 4 and 8.
3. Sections 4 and 8 are always assembled and shipped as a single section.
4. 1200 A bus is optional.
5. Available for both Application A and Application B switches.
6. Except for live bus indicators, no other devices or components can be placed in the back-to-back bus compartments.
7. Lineups are not required to be of equal lengths. End filler panels allow lineup to extend in uneven lengths.

Typical Multiple Section Switchgear Arrangements with Front Access Only

Table 11 - Section Dimensions

Voltage	Dimensions: in. (mm)			
	A	B	C	D
5–17.5 kV, 600 A	14.75 (375)	38 (965)	20 (508)	29.50 (750)
5–17.5 kV, 1200 A	29.50 (750)	38 (965)	29.50 (750)	29.50 (750)

NOTE: When laying out HVL/cc lineups, group all top entry switches together and all bottom entry switches together to avoid transition sections. The switch occupies the entire enclosure from front to back, so cables cannot enter and exit from the same section.

Figure 21 - Incoming Line Hot Sequence Meter Section with Bottom Cable Entry and Exit (Feeder Line-up Application A)

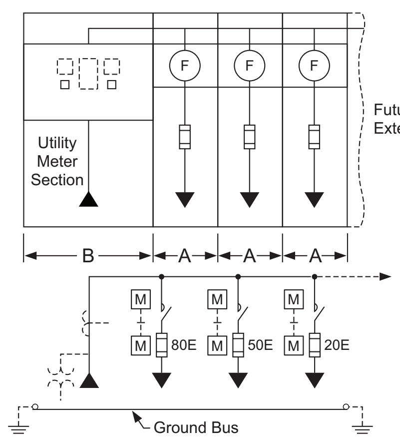


Figure 22 - Main-Main Center Application B Located with Feeders (Application A) on Each Side (with Bottom Cable Entry and Exit)

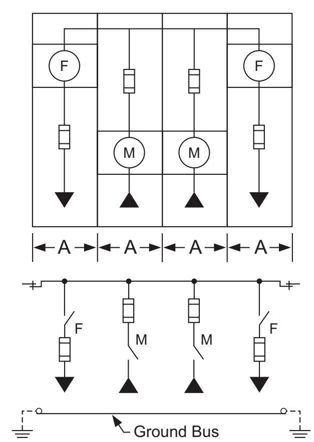


Figure 23 - Application B Main Switch with Cold Sequence Meter Section and Two Feeder Switches Application A (with Bottom Cable Entry and Exit)

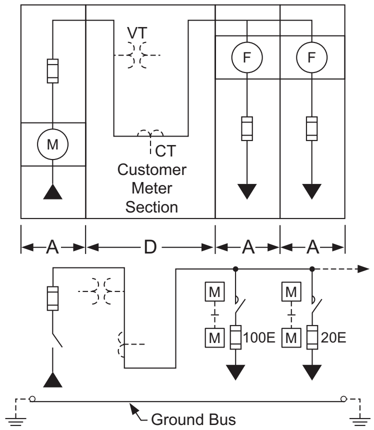


Figure 24 - Application B Main Switch with Surge Arresters and Feeders (Bottom Cable Entry and Exit)

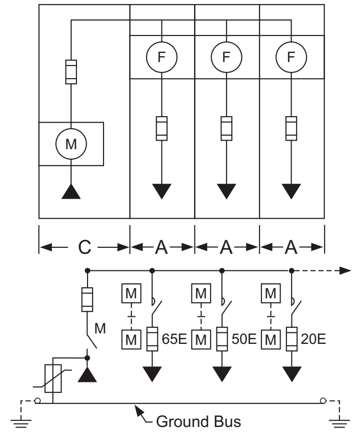


Figure 25 - Main-Tie-Main Lineup with Feeders on Outside Ends (Top Cable Entry and Exit) Mains and Tie are Application A and Feeders are Application B

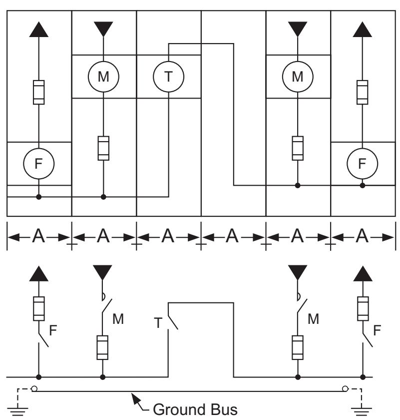
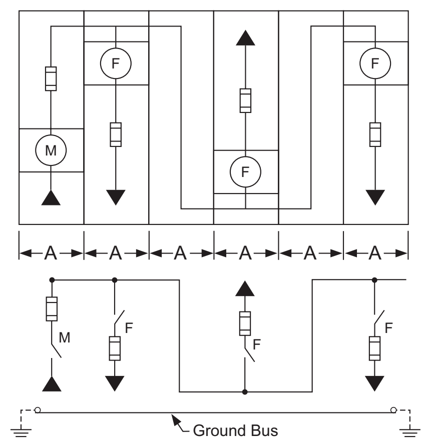
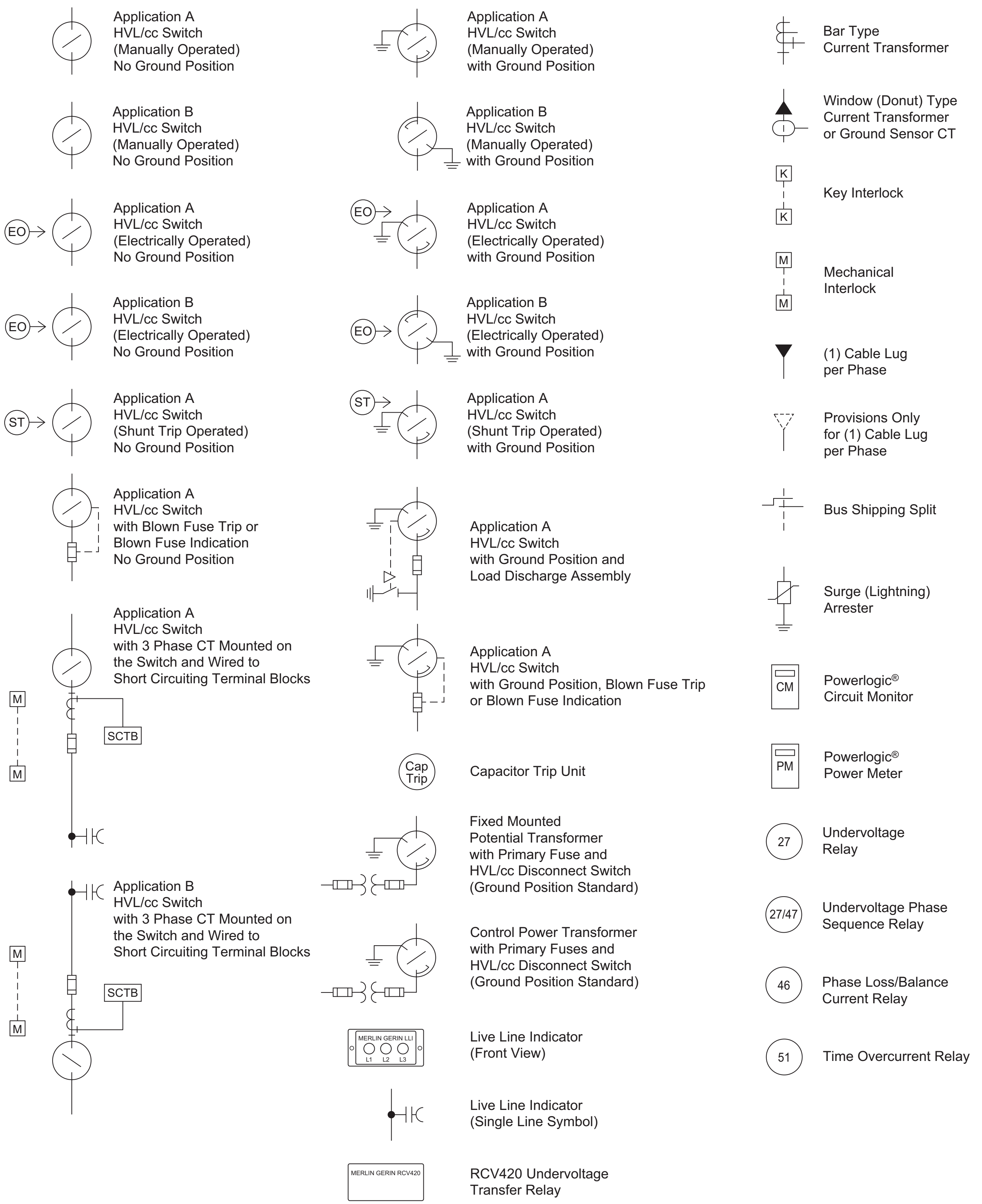


Figure 26 - Application B Main Switch with Top and Bottom Exit Feeders (Requires Extra Transition Sections/ Not Recommended)



Standard Symbols

Figure 27 - Standard Symbols



Dimensions

Table 12 - Section Data and Weight, Indoor (NEMA 1), 2.4–17.5 kV (not to be used for construction)

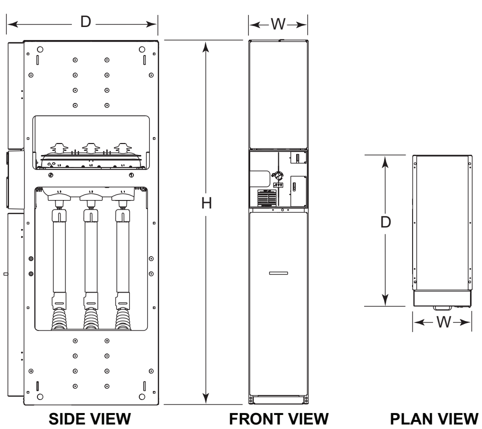
Description		H		W		D[3]		Weight	
		in.	mm	in.	mm	in.	mm	lb.	kg
Interrupter Section, 600 A	Unfused	90	2286	14.75	375	37.25	946	445	202
	Fused							480	216
Interrupter Section, 1200 A	Unfused	90	2286	29.50	750	37.25	946	465	211
	Fused							705	320
Interrupter Section (with surge arresters ≤12 kV) [4]		90	2286	14.75	375	37.25	946	503	228
VT Section		90	2286	20.00	508	37.25	946	600	272
CPT Section		90	2286	29.50	750	37.25	946	834	378
Customer Meter Section (hot or cold sequence)		90	2286	38.00	965	54.50	1384	1200	545
Power-Dry™, Power-Cast®, and Uni-Cast™ Transformer Connection Primary		[5]							
Power-Dry Transformer Connection Secondary		90	2286	[6]					
Liquid-filled Transformer Primary Connection[7]		90	2286	11.00	279	37.25	946	210	95
Liquid-filled Transformer Secondary Connection		90	2286	[6]					
Transition Section to HVL		90	2286	[5]					
Transition Section to Metal-Clad		90	2286	14.00	356	60.00	1524	210	95
Transition Section to Motorpact® Medium Voltage Motor Controller		90	2286	17.75	375	37.25	946	105	47
Bus Transition Section		90	2286	14.75	375	37.25	946	210	95

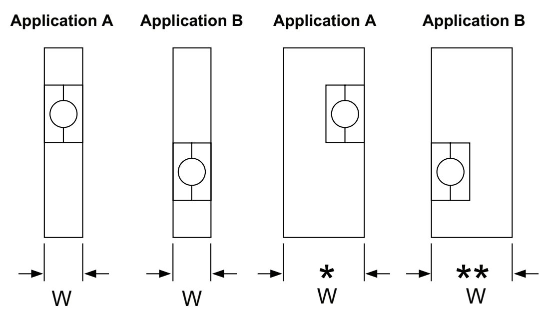
3. With front panels (footprint 33.25-inch [845 mm] with panels removed).
4. Above 12 kV surge arresters (all classes) can be installed in 20-inch (508 mm) wide section.
5. Not required.
6. Contact your Schneider Electric representative.
7. Plus 3-inch (76 mm) collar on transformer.

Table 13 - Section Data and Weight, Indoor (NEMA 1), 25.8–38 kV

Description		H		W		D[8]		Weight	
		in.	mm	in.	mm	in.	mm	lb.	kg
Interrupter Section	Unfused	108	2743	29.50	750	59.12	1502	760	345
	Fused							795	360
Interrupter Section (with surge arresters)[9]		108	2743	39.37	1000	59.12	1502	877	400
VT/CPT Section		108	2743	39.37	1000	59.12	1502	1200	545
Customer Meter Section (hot or cold sequence)		[10]							
Power-Dry, Power-Cast, and Uni-Cast Transformer Connection Primary		[11]							
Power-Dry, Power-Cast, and Uni-Cast Transformer Connection Secondary		[10]							
Liquid-filled Transformer Primary Connection[12]		108	2743	24	610	56.12	1425	510	230
Liquid-filled Transformer Secondary Connection		[10]							
Transition Section to HVL		[10]							
Transition Section to Metal-Clad		[10]							
Transition Section to MotorSeT™TM Medium Voltage Motor Controller		[10]							
Bus Transition Section		108	2743	29.5	750	59.12	1502	510	230

Figure 28 - Indoor (NEMA1 Construction) Enclosure (Square D brand DIN style fuses shown in illustration as reference)





NOTES:
* or 29.50 in. (750 mm) wider on left
** or 29.50 in. (750 mm) wider on right

8. With front panels (footprint 55.12-inch [1400 mm] with panels removed).
9. Load-side surge arresters (all classes) with fuses require a 39.37-inch (1000 mm) wide section. If unfused, a 29.5-inch (750 mm) wide section may be used.
10. Contact your Schneider Electric representative.
11. Not required.
12. Plus 3-inch (76 mm) collar on transformer.

Table 14 - Section Data and Weight, Outdoor (NEMA 3R), 2.4–17.5 kV (not to be used for construction)

Description		H		W		D[13]		Weight	
		in.	mm	in.	mm	in.	mm	lb.	kg
Interrupter Section, 600 A	Unfused	99.75	2534	14.75	375	47.25	1200	585	263
	Fused							629	278
Interrupter Section, 1200 A	Unfused	99.75	2534	29.50	750	47.25	1200	605	274
	Fused							870	395
Interrupter Section (with surge arresters ≤ 12 kV)[14]		99.75	2534	14.75	375	47.25	1200	652	288
VT Section		99.75	2534	20.00	508	47.25	1200	800	363
CPT Section		99.75	2534	29.50	750	47.25	1200	1115	502
Customer Meter Section (hot or cold sequence)		99.75	2534	38.00	965	60.00	1524	1400	636
Power-Dry, Power-Cast, and Uni-Cast Transformer Connection Primary[15]		[16]							
Power-Dry, Power-Cast, and Uni-Cast Transformer Connection Secondary		99.75	2534	—	—	—	—	—	—
Liquid-filled Transformer Primary Connection[15]		99.75	2534	11	279	47.25	1200	440	200
Liquid-filled Transformer Secondary Connection		99.75	2534	[17]					
Transition Section to HVL		99.75	2534	[17]					
Transition Section to Metal-Clad		99.75	2534	[17]					
Transition Section to MotorSeT™ Medium Voltage Motor Controller		[17]							
Bus Transition Section		99.75	2534	14.75	375	47.25	1200	440	200

NOTE: Dimensions do not apply to all situations and can vary depending on customer order requirements and switch/bus orientation. Refer to the product selector for drawings and dimension.

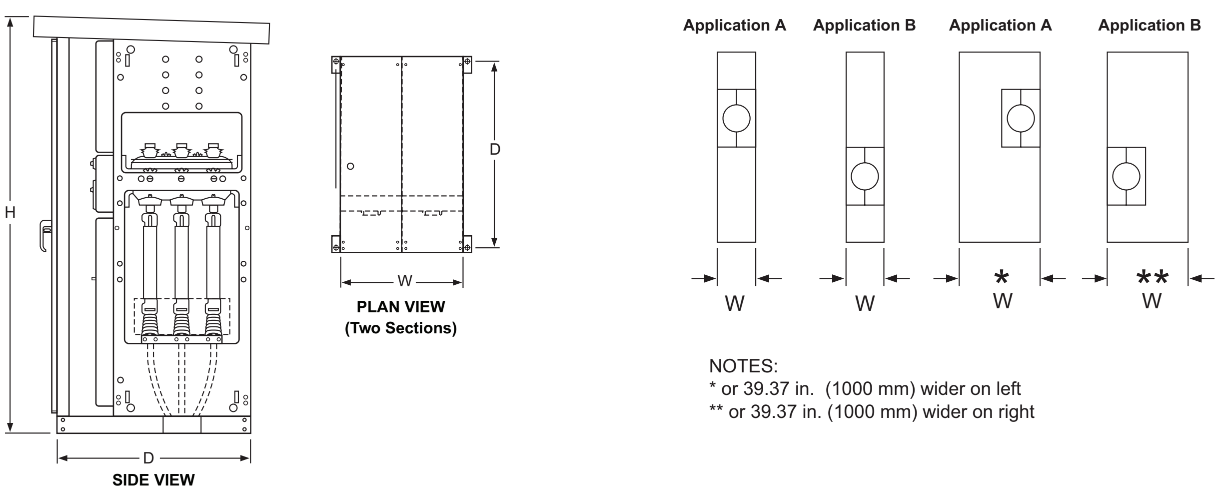
13. Dimensions listed are floor plan dimensions. Roof overhangs front and rear by 5.0-inch (127 mm), 10.0-inch (254 mm) total .
14. Above 12 kV arresters can be installed in 20-inch (508 mm) wide section.
15. Plus 3-inch (76 mm) collar on transformer.
16. Not required.
17. Contact your Schneider Electric representative.

Table 15 - Section Data and Weight, Outdoor (NEMA 3R), 25.8–38 kV

Description		H in.	H mm	W in.	W mm	D[18] in.	D[18] mm	Weight lb.	Weight kg
Interrupter Section	Unfused	118.45	3008	29.50	750	69.25	1760	1010	460
	Fused							1060	480
Interrupter Section (with surge arresters[19]		118.45	3008	29.50	750	69.25	1760	1142	517
VT/CPT Section118.45300839.371000		118.45	3008	39.37	1000	69.25	1760	1600	725
Customer Meter Section (hot or cold sequence)		[20]							
Power-Dry, Power-Cast, and UniCast Transformer Connection Primary[21]		[22]							
Power-Dry, Power-Cast, and UniCast Transformer Connection Secondary		[20]							
Liquid-filled Transformer Primary Connection[21]		118.45	3008	24	610	56.12	1425	510	230
Liquid-filled Transformer Secondary Connection		[20]							
Transition Section to HVL		[20]							
Transition Section to Metal-Clad		[20]							
Transition Section to MotorSeT™ Medium Voltage Motor Controller		[20]							
Bus Transition Section		118.45	3008	29.5	750	69.25	1760	680	310

NOTE: Dimensions are not to be used for construction. Dimensions do not apply to all situations and can vary depending on customer order requirements and switch/bus orientation. Refer to the product selector for drawings and dimension.

Figure 29 - Outdoor (NEMA 3R Construction) Enclosure (Square D brand DIN style fuses shown in illustration as reference)



18. Dimensions listed are floor plan dimensions. Roof overhangs front and rear by 5.0-inch (127 mm) 10.0-inch (254 mm) total.
19. Load-side surge arresters (all classes) with fuses require a 39.37-inch (1000 mm) wide section. If unfused, a 29.5-inch (750 mm) wide section may be used.
20. Contact your Schneider Electric representative.
21. Plus 3-inch (76 mm) collar on transformer.
22. Not required.

HVL/cc™ Grounding Switch Application

Grounding Switch

The HVL/cc switch may be equipped with an internally interlocked grounding switch that is formed as an integral part of the main power switch. The grounding switch feature is optional and must be specified at the time of order. The grounding switch is only effective on one side of the switch. The options are: (1) no grounding switch (see HVL/cc without Grounding Switch, page 38), (2) grounding switch located on the load side of the switch (see HVL/cc with Grounding Switch Ground on Load Side, page 38), or (3) grounding switch located on the line side of the switch (see HVL/cc with Grounding Switch Ground on Line Side, page 38).

NOTE: Fuses are not available when the grounding switch is located on the line side. Upstream protection must be provided.

The grounding switch is capable of trip-closing duty at the short-circuit current rating of the switch; however, this duty is not recommended.

Load-side Discharge Assembly (LDA) 600 A switch only/ Application A ≤ 17.5 kV

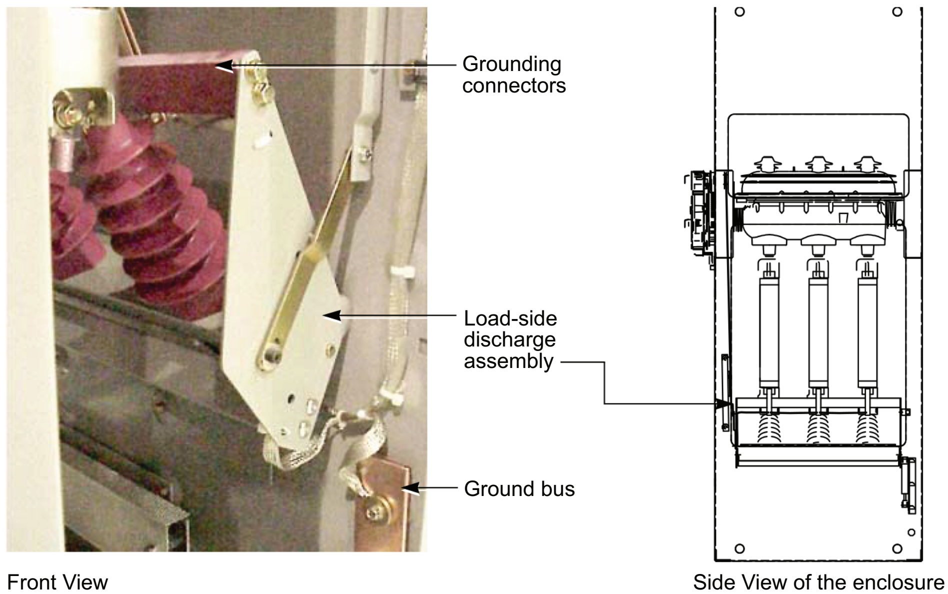
Load Side Discharge Assembly (LDA) located on the load side of the power fuses is available as an additional accessory (see HVL/cc with Grounding Switch Ground on Load Side, page 38). The purpose of this device is to drain capacitive charges from disconnected circuits. The LDA is available as an option when the HVL/cc grounding switch is specified, and only with DIN-E style fuses. The LDA is not rated for fault current duty and is not to be considered a grounding switch.

Do not use a Load-side Discharge Assembly in the following situations:

- If there is any possible source of power on the load or downstream side of the LDA. For example, do not use LDAs on the load side of switches involved in double-ended or multiple feed applications.
- Power transformer applications where there is a possibility of backfeeding from a low voltage generator. An exception to this general rule is when the source of downstream power is a generator that utilizes a key interlock scheme to block the closing of the LDA when the generator is connected.

The following illustrations depict the grounding switch and LDA options available with the basic HVL/cc switching unit.

Figure 30 - Load-side Discharge Assembly



HVL/cc Grounding Switch Positions

Figure 31 - HVL/cc without Grounding Switch

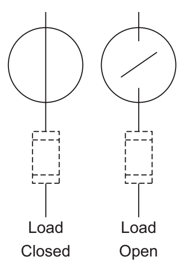


Figure 32 - HVL/cc with Grounding Switch Ground on Load Side

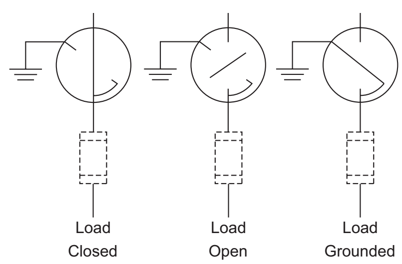


Figure 33 - HVL/cc with Grounding Switch Ground on Line Side

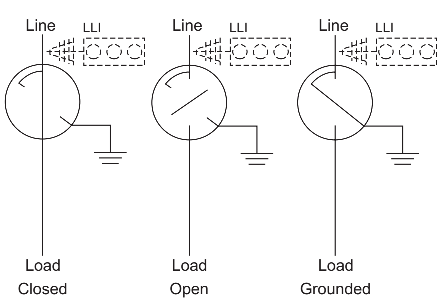
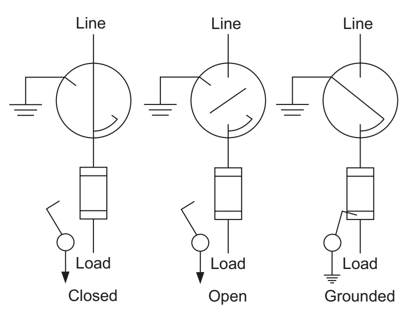


Figure 34 - HVL/cc with Grounding Switch on Load Side and Load Discharge Assembly



The LDA should only be used where there is no possibility of power back-feed from alternative power sources such as commercial power, a downstream generator, and/

or a charged capacitor bank. See the HVL/cc Metal Enclosed Switchgear instruction bulletin for more information about LDAs.

Live Line Indicators (LLI unit)

When an HVL/cc switch is provided with a grounding switch, an LLI unit is always provided on the grounding side of the HVL/cc switch to indicate the presence (see HVL/cc with Grounding Switch on Load Side and Live Line Indicators, page 39). In addition to indication lights, the LLI unit also has a provision for the use of a voltmeter or phase-testing devices.

Typical Installations

Figure 35 - HVL/cc with Grounding Switch on Load Side and Live Line Indicators

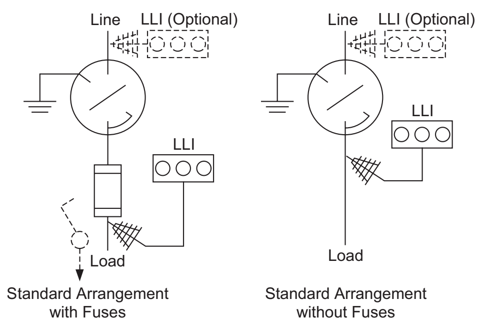
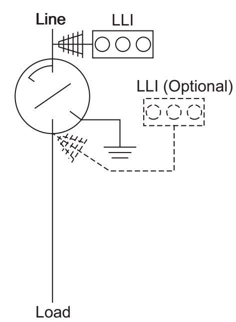


Figure 36 - HVL/cc with Grounding Switch on Line Side and Live Line Indicators



General Application Rules for Live Line Indicator Unit

- **Grounding Switch on Load Side, With Power Fuses**: When an HVL/cc switch is specified to have the grounding switch on the load side with power fuses, a LLI is provided as standard equipment with the voltage dividers located at the load end of the power fuses. A line-side LLI unit and voltage divider may also be used as an additional cost option (see HVL/cc with Grounding Switch on Load Side and Live Line Indicators, page 39).
- **Grounding Switch on Load Side, Unfused Switch**: An LLI unit and voltage divider are placed on the load side of the HVL/cc switch as standard. A line-side LLI unit and voltage divider may also be used as an additional cost option (see HVL/cc with Grounding Switch on Load Side and Live Line Indicators, page 39).
- **Grounding Switch on Line Side, Unfused Switch**: An LLI unit and voltage divider are placed on the line side of the HVL/cc switch as standard. A load-side LLI unit and voltage divider may also be used as an additional cost option (see HVL/cc with Grounding Switch on Line Side and Live Line Indicators, page 39).
- Test ports on the LLIs are suitable for testing voltage with a properly rated voltage sensing device. LLIs are not an indicator of the absence of voltage. Properly rated test equipment must be used to help ensure no voltage is present before performing any maintenance procedures.

General Application Rules for Grounding Switch Application

Never use a grounding switch in a circuit for which the operator does not have full control of the circuit and is capable of locking out and tagging out the circuit on both ends. For example, do not use a grounding switch on the line side of an HVL/cc that is considered a service disconnect (in accordance with NEC) connecting to a commercial utility source (see HVL/cc with Both Load Side Grounding Switch and Load Discharge Assembly Acceptable, page 40). A utility customer does not have control over the source of power, thus a grounding switch for this service is prohibited. Within a utility power system or within a premise where the owner has control of both ends of the circuit, do not use a grounding switch unless the operator has exclusive control of all sources of power to the grounding switch.

Acceptable and Unacceptable Uses of Load-side Grounding Switch and Load-side Discharge Assembly

HVL/cc with Both Load Side Grounding Switch and Load Discharge

Figure 37 - Assembly Acceptable

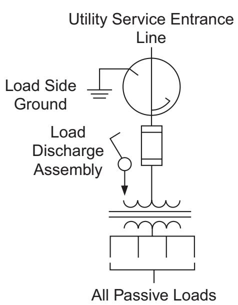


Figure 38 - Assembly Unacceptable and Physically Not Possible

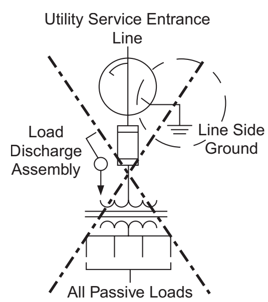


Figure 39 - Assembly with an Active Load Unacceptable

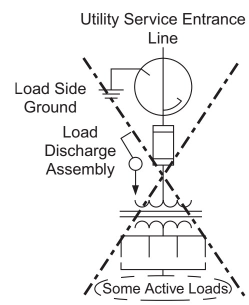
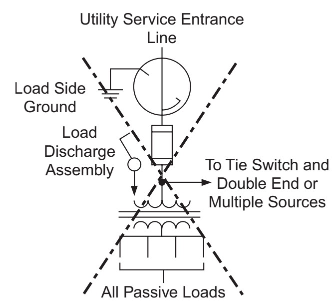


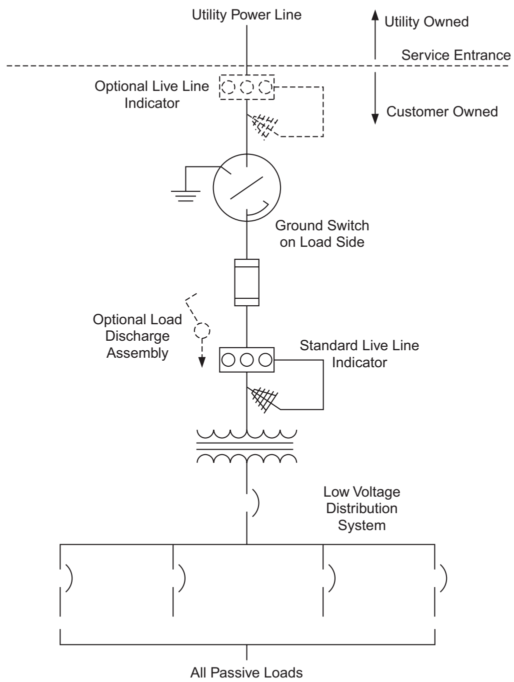
Figure 40 - Assembly in a Double Ended Substation Unacceptable



A grounding switch can be used with a great deal of prudence when used on the load side of fused feeder switches to transformers that have sources of low voltage power beyond the secondary of the transformer, such as generators or low-voltage, double-ended substations. Although grounding switches are rated to be able to withstand a fault closing, such an operation places a power system under stress. Improper use of the grounding switch may cause inadvertent operation of the power fuses. The use of a grounding switch on the load side of non-fused main switches involved in a double-ended or multiple feed system is unacceptable. Transformer standards require agreement between the user and transformer manufacturer for such an operation. Fuses are expensive and would need to be replaced. Key interlocking may be applied to assist in the proper direction of switching activity to help avoid inadvertent operation of the grounding switch under unfavorable conditions.

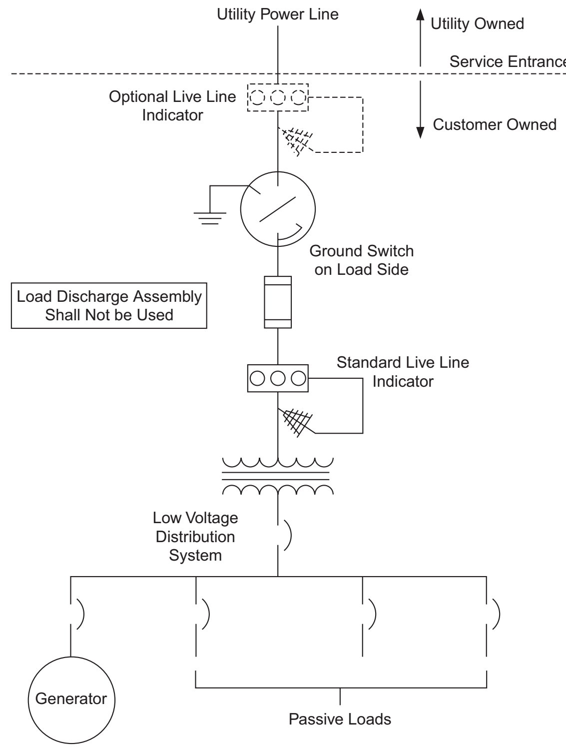
Application Diagrams

Figure 41 - Application 1



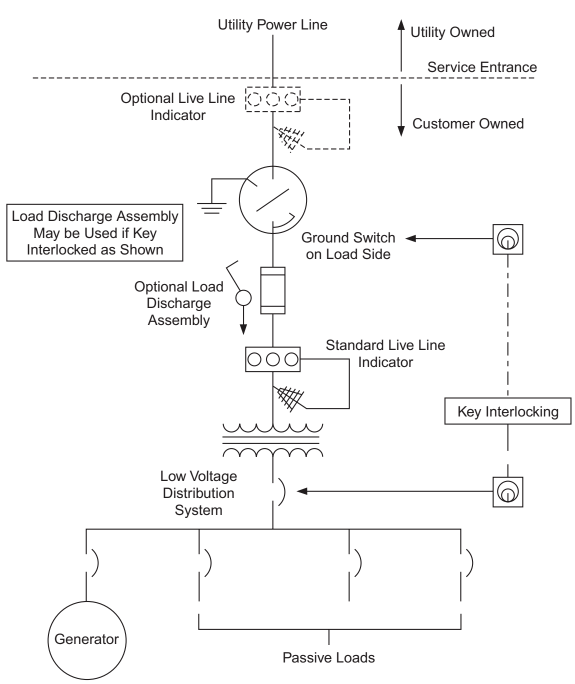
NEC Service Entrance to Single Transformer – All Passive Loads

Figure 42 - Application 2



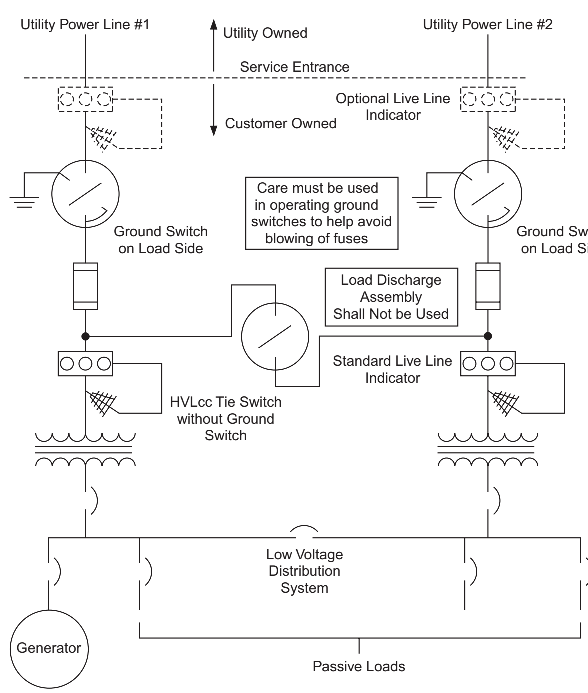
NEC Service Entrance to Single Transformer with Down Stream Generators

Figure 43 - Application 3



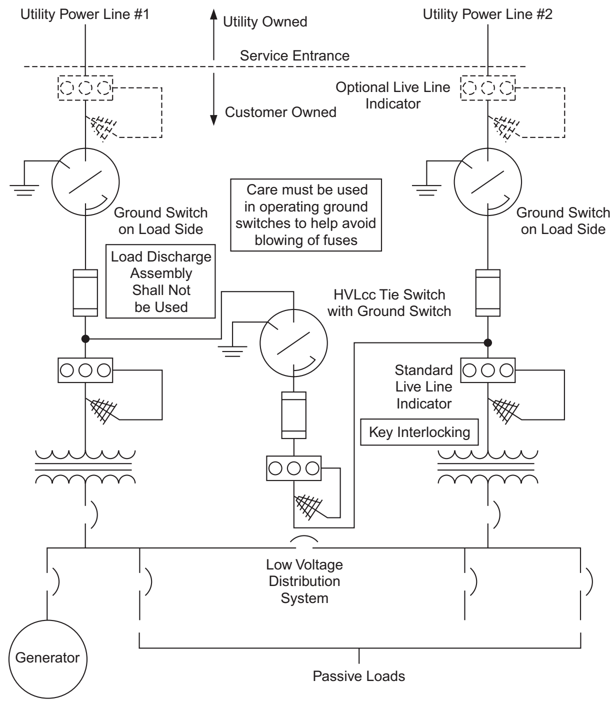
NEC Service Entrance to Single Transformer with Down Stream Generators

Figure 44 - Application 4



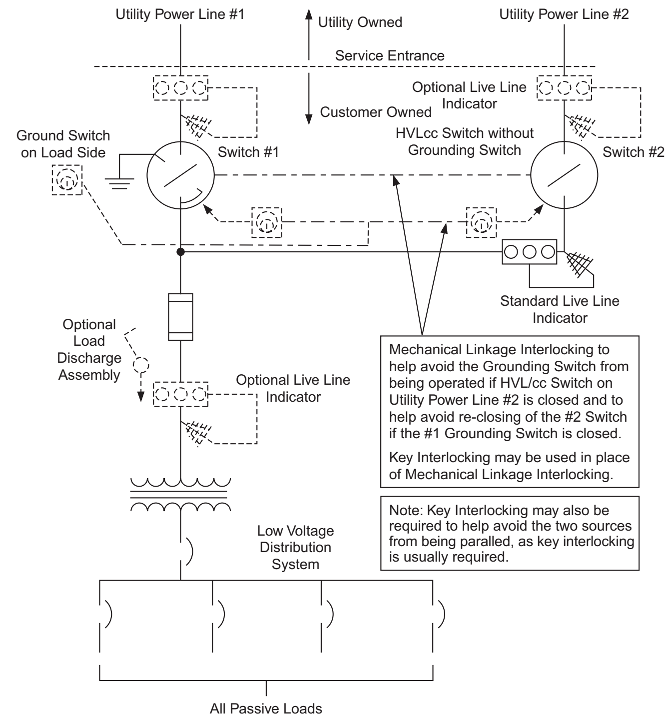
NEC Service Entrance to Double Ended Substation with or without Down Stream Generators

Figure 45 - Application 5



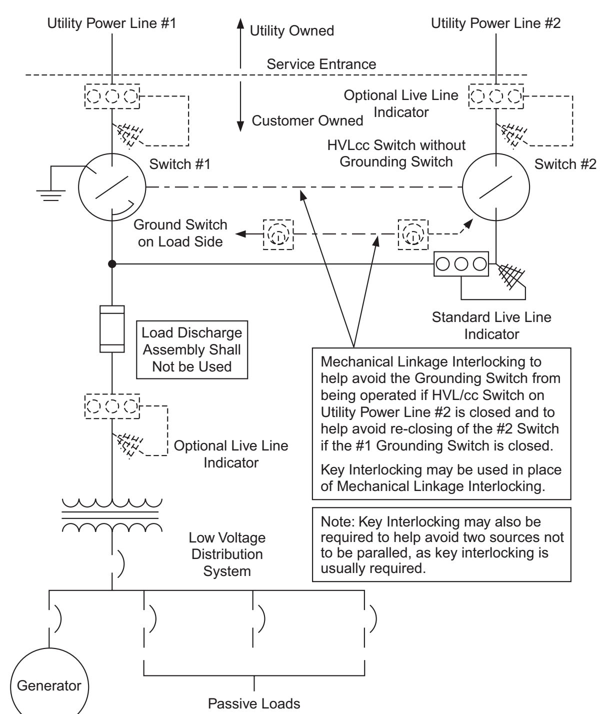
NEC Service Entrance to Double Ended Substation with or without Down Stream Generators with Fused Tie Switch

Figure 46 - Application 6



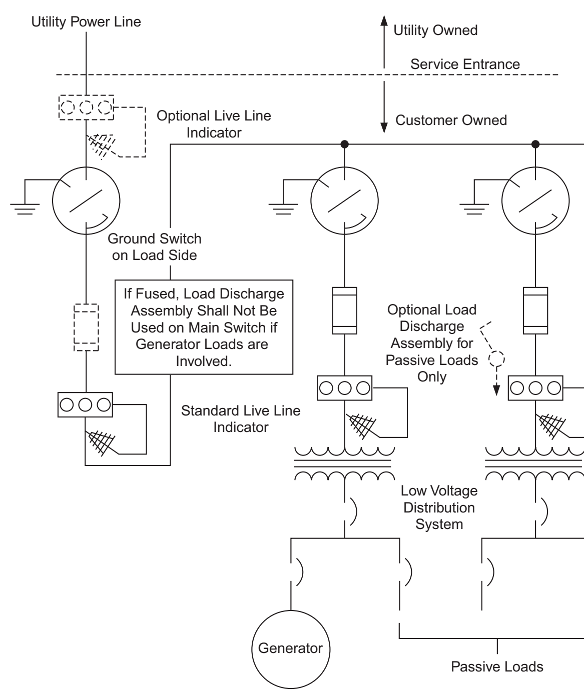
NEC Service Entrance to Duplex Switch with All Passive Loads

Figure 47 - Application 7



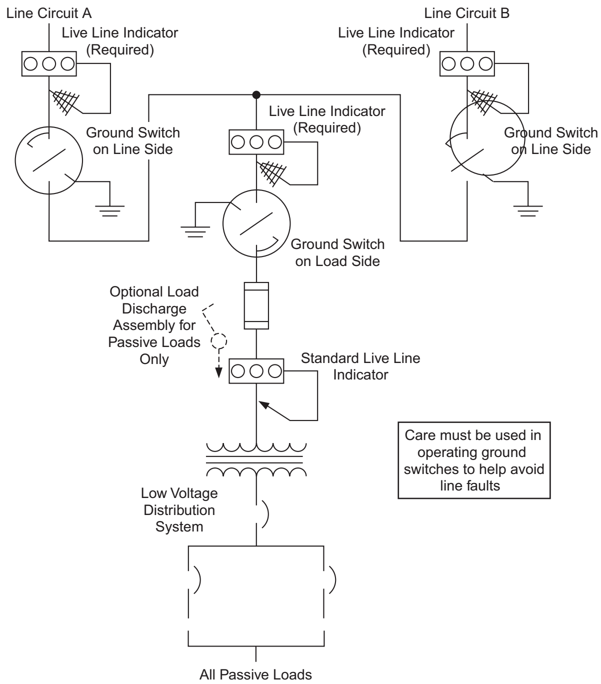
NEC Service Entrance to Duplex with Generator Loads

Figure 48 - Application 8



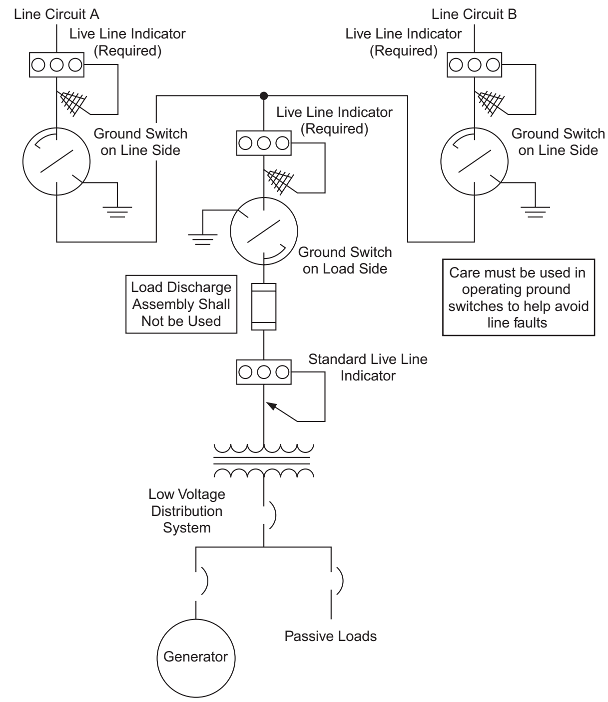
NEC Service Entrance to a Line – Up Feeders with Passive and Generator Loads

Figure 49 - Application 9



Utility or Heavy Industry Ring Bus Arrangement with Passive Loads

Figure 50 - Application 10



Utility or Heavy Industry Ring Bus Arrangement with Generator Loads

Duplex Switch Interlocking

See Application Diagrams, page 41.

Due to the popularity of the duplex switch (two services for a common fused load), mechanical interlocking is available between the two switches. The mechanical interlock is designed to prohibit paralleling of the two sources and requires the use of the stored energy mechanism. Key locks can be used for same functionality and are required for the over-toggle mechanism.

When duplex switches are equipped with load-side grounding, a single ground switch is incorporated on the duplex switch containing the fuse. This ground switch serves as the load-side grounding mechanism for both switches and is key interlocked with the two duplex mains. The duplex switch arrangement is designed so that both switches must be open to remove the load side panel. In addition, when equipped with the ground switch, the load-side panel cannot be removed until both switches are key-locked open, and the ground switch is key-locked closed.

Key Interlocking

Key interlocking is only shown as an alternative to mechanical interlocking for the duplex switch and to enable the use of the LDA for systems having a generator supply source downstream. Key Interlocking can be used as an additional application design feature and to assist in performing the proper operating sequence before switching operations. It is not the scope of this application section to cover all possible combinations of suitable key interlocking schemes. Each power system must be evaluated, and appropriate key interlocking specified to meet particular risks a system may have. This process is typically performed by the professional engineer of record for the facility. Key Interlocking may be applied considering the following general philosophy.

General Philosophy

HVL/cc grounding switches are rated to withstand a full-rated fault closure. It is not prudent to operate a power system in a manner that stresses the grounding switch to its rated capacity and subjects the balance of the system, including power transformers, to needless trip-inducing currents. Whenever it is possible for a grounding switch operation in this mode, request some mechanical means such as a mechanical interlock or key interlock from Schneider Electric to promote the proper operating sequence for the grounding switch.

Optional Mechanism Features and Ratings

Table 16 - Motor Option and Open/Close Coil Ratings (OTM/SEM Mechanisms)

Nominal Voltage		DC			AC	
		24	48	125	120	240
Motor Option (OTM/SEM)						
	Watts (DC)/VA (AC)	206/227	163/202	225/225	264/216	288/240
	Amperes	8.6/9.45	3.4/4.2	1.8/1.8	2.2/1.8	1.2/1.0
	Seconds	<6	<7	<5	<5	<5
Opening Coil (SEM only)						
Shunt Trip	Watts (DC)/VA (AC)	224	238	331	402	840
	Amperes	9.35	4.95	2.65	3.35	3.5
Closing Coil (SEM only)						
	Watts (DC)/VA (AC)	222	230	325	456	864
	Amperes	9.25	4.80	2.60	3.80	3.60

Table 17 - Mechanism Features

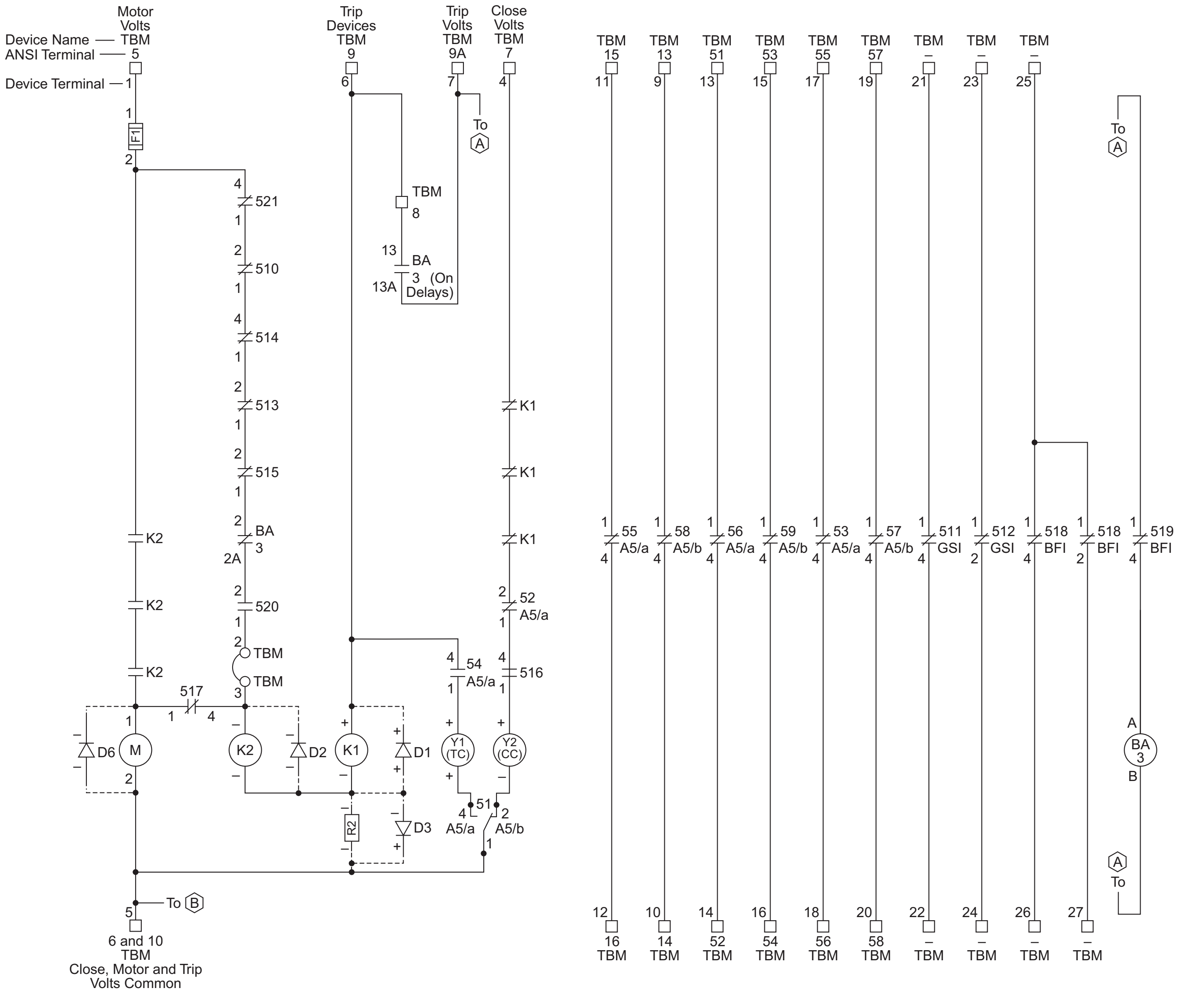
Component or Function	Over-Toggle Mechanism	Stored Energy Mechanism
Switch Function	Manually operated closing and opening independent of the speed of the user	• Springs pre-charged without closing the switch in two steps providing stored energy within the mechanism • Switch opened and closed by the stored energy independent of the user speed of the pushbuttons • Automatic fuse tripping with Fuselogic system
Grounding Switch	• Manually operated closing independent of the speed of the • Operating energy is provided by a compressed spring • Individual operator dependent opening	• Manually operated closing independent of the speed of the user • Operating energy is provided by a compressed spring • Individual operator dependent opening
Auxiliary Contacts	• Switch Position 3 N.O. and 3 N.C. and Grounding Switch 1 N.O. and 1 N.C.	• Switch Position 3 N.O. and 3 N.C. and Grounding Switch 1 N.O. and 1 N.C.
Mechanical Indication	Blown fuse indicator if switch equipped with fuses	Blown fuse indicator if switch equipped with fuses
Motor Operator	All circuits must be the same control voltage for motor operator mechanism.	All circuits must be the same control voltage for motor operator mechanism.
Close Coil	—	Yes
Trip Coil	—	Yes Operating Time: 100 milliseconds
Shunt Trip Options	—	• Manually operated locally at the switch/no coils/no motor • Manually charged springs with open coil (remote or local trip) • Motor operated with open and close coils; permits local and remote control of spring charging, close, and trip
Operation Counter	Yes	Yes

N.O. = Normally Open

N.C. = Normally Closed

Typical Control Circuit

Figure 51 - Typical Control Circuit-Electrically Operated SEM Control Circuit



Operation of Switch

1. The switch closes if the closing springs have been charged electrically or manually.
2. The closing circuit has continuity when the closing springs are charged, the switch is open and no continuous trip signal is applied. Applying a close signal energizes the close coil, Y2. It discharges the closing springs, closing the switch. When the switch closes. A5/a and A5/b change state.
3. A5/a closing allows continuity in the trip circuit. A5/b opens, opening the close circuit.
4. Applying a trip signal energizes the trip coil, Y1. It discharges the opening springs, opening the switch. When the switch opens, A5/a and A5b change state.
5. Spare A5/a and A5/b contacts indicate the breaker state. A5/a closes when the switch closes. A5/b closes when the switch opens.

Table 18 - Legend

F1	Cartridge Fuse, KLM3
K1	Anti-Pump Relay
K2	Control Relay
M	Charging Motor
51, 53-56	Switch Position Auxiliary Switch Contacts (A5/a)
52, 57-59	Switch Position Auxiliary Switch Contacts (A5/b)
510, 11, 12	Grounding Switch Position Auxiliary Switch Contacts
513	Load Break Switch Operating Lever Actuated Contact
514	Grounding Switch Operating Lever Actuated Contact
515, 16	Charging Limit Switch Contacts
517	End of Charge Motor Contact
518, 19	Blown/Missing Fuse Indiction/Interlock
520	Control Depress Contact
521	Lock Auxiliary Switch
TBM	Terminal Block
Y1	Trip Coil
Y2	Close Coil
3	Auxiliary Blown/Missing Fuse Relay (Instantaneous and TDE)

NOTE:

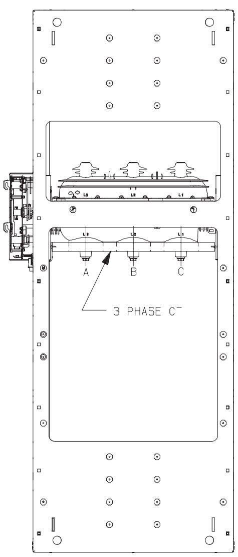
- Switch shown in the open state with closing springs discharged.
- Grounding switch shown in the open state.
- Some terminal points not shown for simplicity.
- Switch wiring diagram is 44044-177.
- Destination wire markers without wire numbers are used in mechanism.
- Diodes are on DC control power module only.

Optional Equipment

Current Transformers (CTs)

Three-phase CTs are only available on the load side of the switch. Donut-style or split-core type CTs may be used for line-side applications.

Figure 52 - Three-phase Current Transformer



HVL/cc uses a 3-in-1 molded current transformer (see Three-phase Current Transformer, page 48) as standard for metering applications in the switchgear. The molded CT is ideal for main or feeder switch applications and is mounted on the load side of the switch. The 3-in-1 molded CT is not available for units fused with the Mersen CS-3 fuses.

For applications requiring CTs on the line side of a switch, donut-type CTs are used in lieu of the 3-in-1 molded CT. Field installable, split-core style CTs are also applicable for line-side CT applications.

NOTE: A top hat (cable pull box) for incoming top cables or cable pit for bottom cable entry may be required when using donut-type CTs.

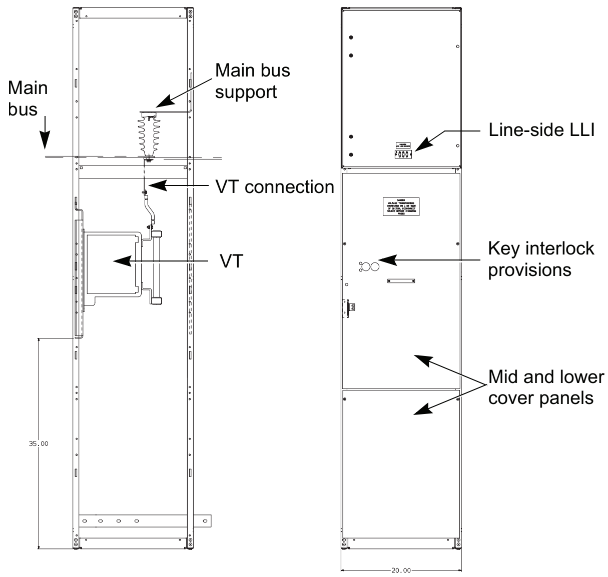
Table 19 - Current Transformer Ratings

Ratio	ANSI Metering Class Rating		
100:5	4.8	—	—
200:5	1.2	2.4	4.8
400:5	0.6	1.2	2.4
600:5	0.3	0.6	1.2
800:5	0.3	0.6	0.6
1000:5	0.3	0.3	0.6
1200:5	0.3	0.3	0.6

Voltage Transformers (VTs)

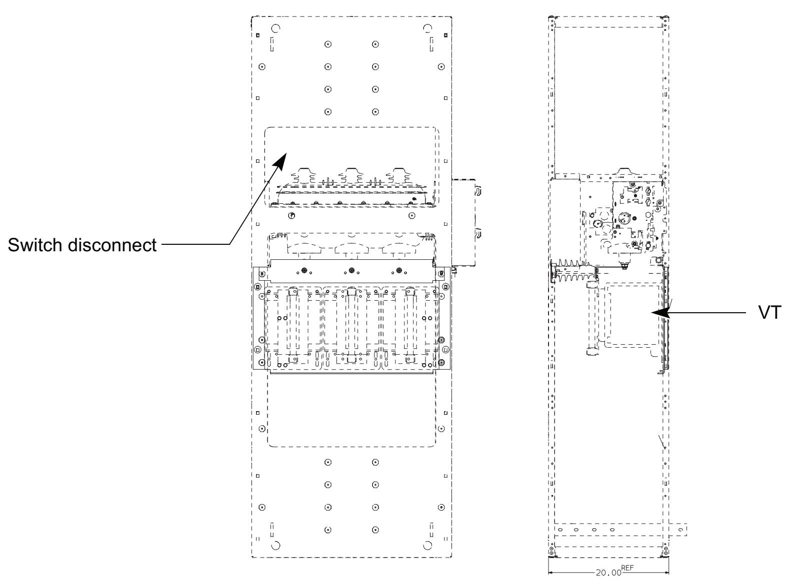
The standard HVL/cc VTs are enclosed in their own section to accommodate the size of the instrument transformers.

Figure 53 - VT Section without Switch Disconnect



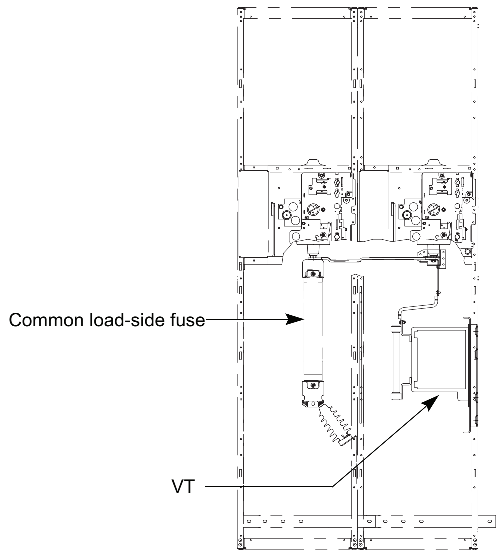
The standard enclosure has both padlocking and key-locking provisions to interlock with main devices or upstream disconnect devices.

Figure 54 - VT Section with Switch Disconnect



An optional switch is available to be used as a primary disconnect for isolating VTs from the primary bus or cable of the distribution system.

Figure 55 - Load-side VT for duplex switch applications



For duplex applications requiring metering, VTs are connected on the load side in the standard duplex switch footprint. To connect VTs on the line side, an additional section and set of VTs are required for each main.

Automatic Two-source Transfer Scheme

This HVL/cc Main-Main automatic transfer scheme is unique in that it does not require voltage or current transformers to initiate the transfer operations. It operates with the RCV 420 transfer relay specially designed for use with the Live Line Indicator bushings in the HVL/cc switchgear. These LLI bushings have internal capacitive circuits that supply the voltage information to the relay. All that is required is control power to operate the HVL/cc switches and the transfer relay.

- **Control Power**: 24 or 48 Vdc control power is preferred, but AC is also acceptable. When using AC control power, a DC power supply device is supplied for the transfer relay. Also, on all motor operated HVL/cc switches, the motor, close, and trip circuits must all be the same control voltage.
- **Automatic Transfer with External Control Power**: Automatic transfer can be accomplished with two switch sections if control power is supplied externally to the switchgear.
- **Description of Operation**: When two HVL/cc main switches are supplied from two different sources, there is a preferred source and an alternate (standby) source. The RCV 420 transfer relay is designed to transfer the load from the preferred source to the alternate source if a lost/low voltage condition occur on the preferred source. The system automatically transfers back to the preferred source when normal voltage conditions are restored. The manual controls use operator-actuated control switches for transferring loads locally in the manual mode.

- **Modes of Operation**:
  - Automatic operation is defined as opening or closing the main switches by means of an RCV 420 relay. The RCV 420 relay monitors the voltage condition and prompts the OPEN/CLOSE circuits of the switches. This is called unsupervised operation.
  - Manual operation is defined as:
    - Opening or closing the main switches by means of the manual control switches located on the control panel.
    - Opening or closing the main switches by means of the manual push buttons located on the mechanism front panel.
- **Protective Interlocking**:
  - This system is electrically interlocked to help avoid parallel connection of the two main switches when in the automatic or manual mode:
    - In the automatic mode, electrical interlocks help avoid parallel connection of the two main switches when an automatic transfer takes place.
    - In the manual mode, electrical interlocks help avoid parallel connection of the two main switches when closing either main switch with the manual control switch.
  - Key interlocks are not provided on the main switches.

    NOTE: Electrical interlocks can be bypassed to allow for manual operation of a parallel connection (closed transition).
- **Transfer Sequences**:
  - **Automatic Transfer**
    1. The preferred source main (PSM) switch is closed, and the alternate source main (ASM) switch is open during normal automatic operation. If a low voltage condition occurs on the preferred source, it is detected by the relay from the voltage sensors connected on the line side of the switch.
    2. The PSM switch opens on loss of voltage after a time delay (adjustable from 0.1-2 seconds). If the alternate source is available (RCV 420 relay settings are satisfied), the ASM switch closes automatically as soon as the PSM switch is open (open transition).
    3. When the preferred source again becomes available, an adjustable timer (five seconds-two minutes) begins timing to allow the restored source to stabilize. When timed out, the ASM switch opens. The PSM switch closes as soon as the ASM switch is open (open transition).

       NOTE: A test pushbutton is available on the RCV 420 relay to test the automatic transfer per descriptions 1, 2, and 3 above.
    4. Operating the manual control switch when in the automatic transfer mode results in main switch operation in the **OPEN (O)** position only.

       Exception: When the manual control switch is used to open a main switch while in automatic transfer mode, automatic operation is not disabled (initial startup settings must be reestablished) and an unsupervised main switch operation may occur, depending on source availability.
  - **Manual Transfer** If control power is available, the main switches can be operated manually using the control switches located on the control panel. These switches operate the main switches when the auto/manual selector switch is in the manual position.

Figure 56 - Typical Elevation and Single Line Diagram For Two Source Auto Transfer

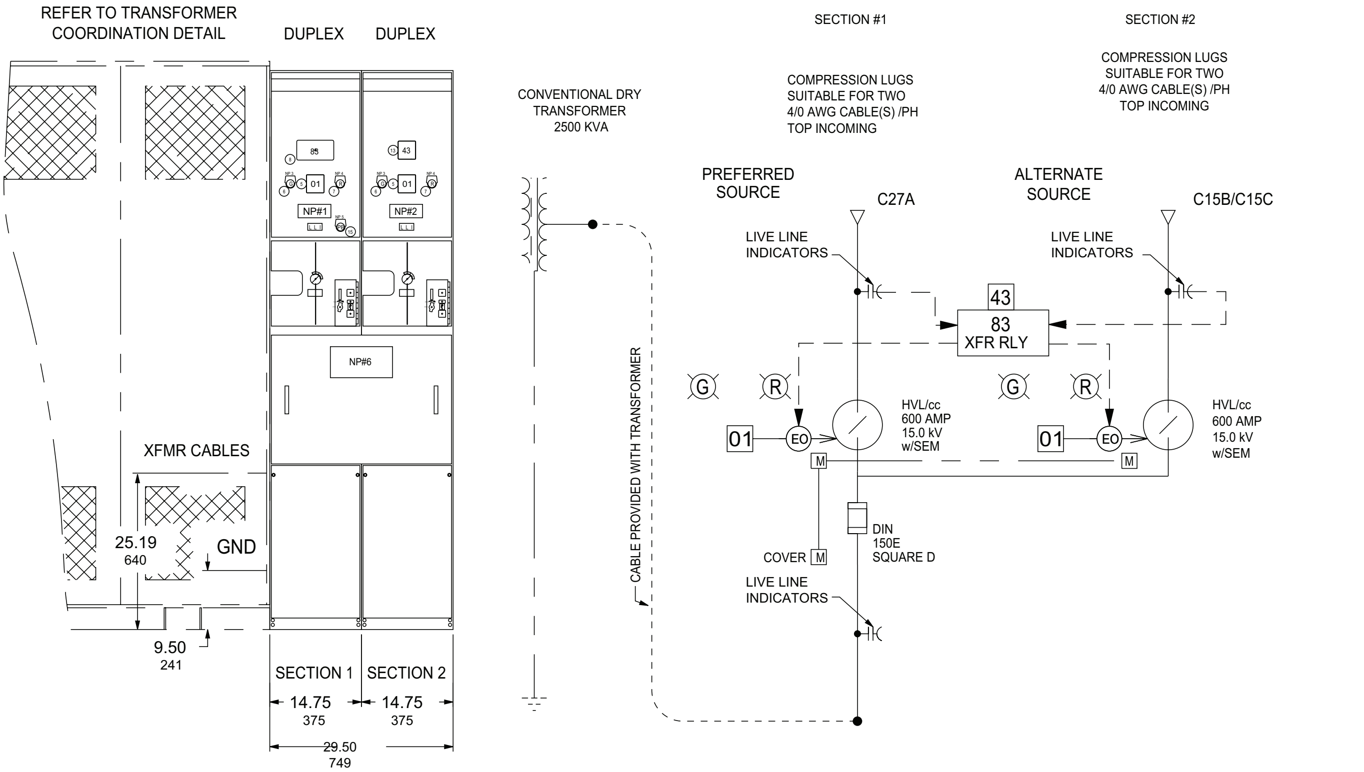


Figure 57 - Control Schematic for Preferred Source Switch

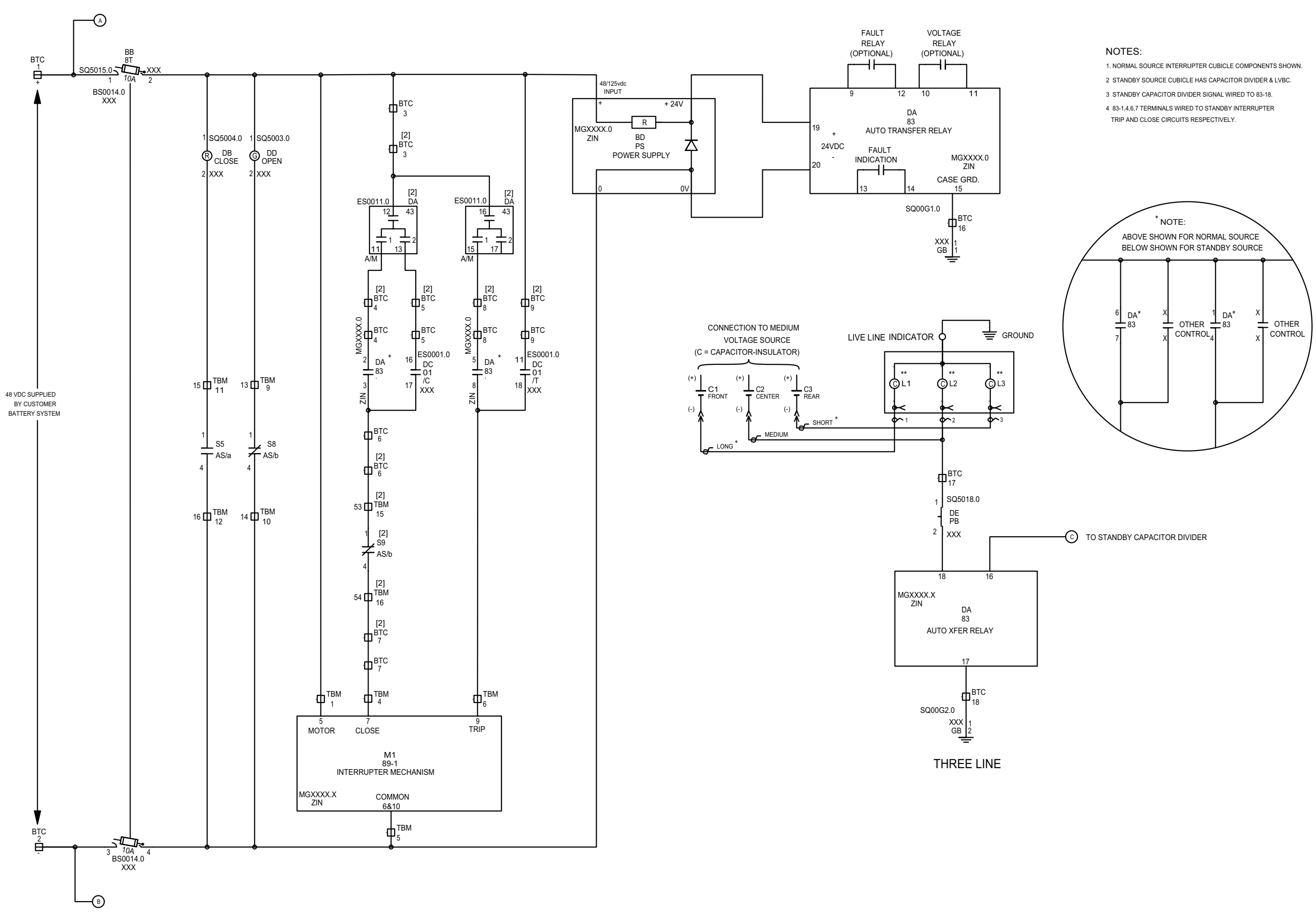
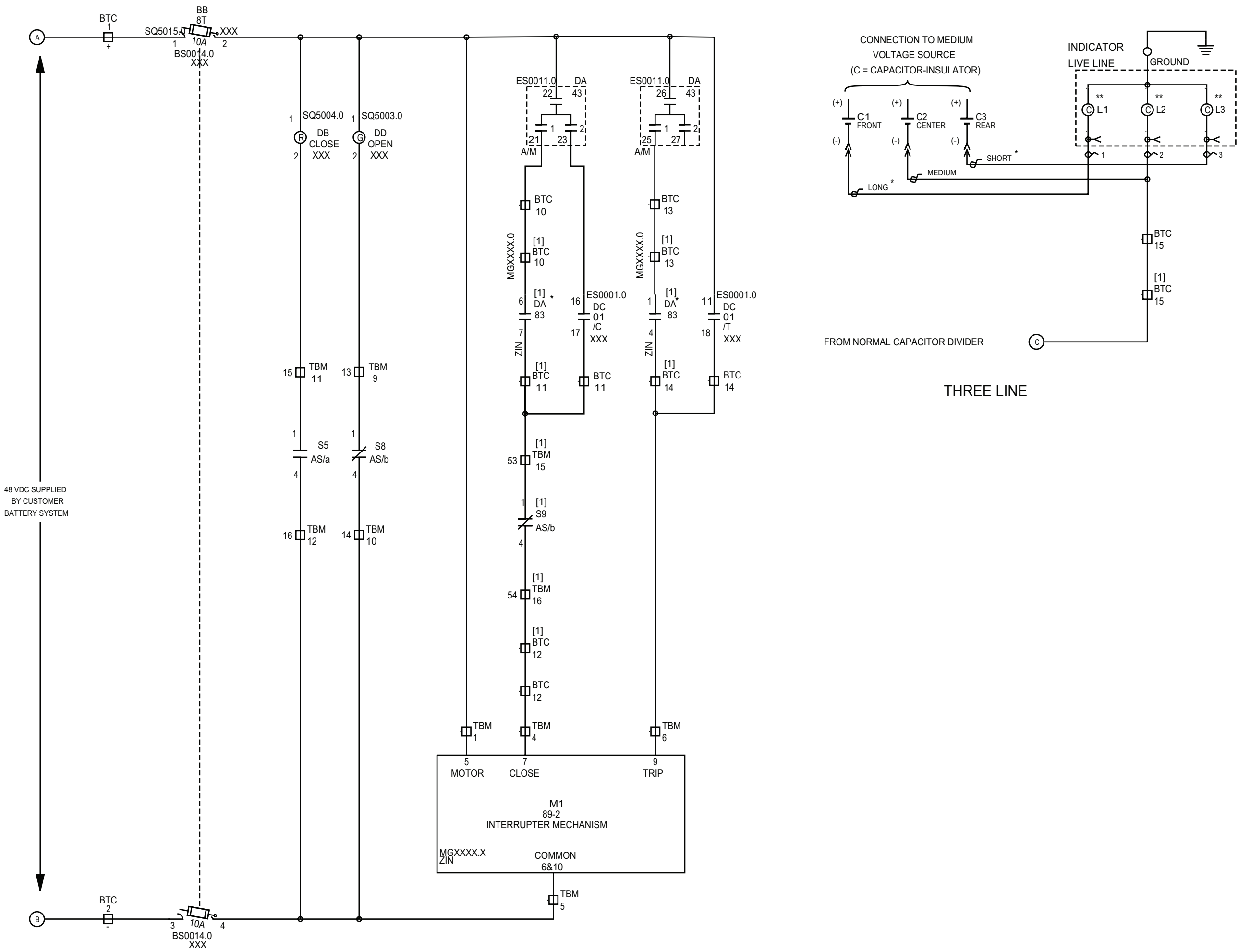


Figure 58 - Control Schematic for Alternate Source Switch



RCV 420 Auto Transfer Relay

Table 20 - RCV 420 Auto Transfer Relay Technical Data

Input		
Divider input	Input impedance	> 9 M Ω
	Maximum voltage	350 V rms
Contact and fault relay input	Power drain	20 mA at 24 Vdc
Power Supply		
DC voltage		24 V +20/-10%
		48-127 Vdc with plate
Power drain	When idle	25 mA at 24 Vdc
	In case of fault	45 mA at 24 Vdc
Threshold		
Setting	Fixed (preset at factory)	
Min-setting voltage		40 V rms + 2V
		hysteresis < 15%
Temperature drift	From -5°C to +40°C	10%
Time Delay		
t_1	By switch, for selection	0.1-0, 2-0, 4-0, 6-0, 8-1-1, 5-2 S
Return time	< 10 ms	
Accuracy	10%	
t_2	By switch, for selection	-10-20-40-60-80-100-120 S
	Return time	< 50 ms
	Accuracy	10%
Outputs		
RX2-RX3 relays	Number of contacts	2 make
	Closing current	8 A
	Breaking capacity	2A at 220 Vac cos ϕ + 0.3 or 0.3 A at 110 Vdc L/R = 20 ms
Remote fault signaling	Number of contacts	1 make
	Closing current	4 A
	Breaking capacity	1000 Va maximum
		100 W-50 Vdc
Other Characteristics		
Dielectric withstand	Between contacts of RX2-RX3 and rest of the device (all terminals)	2 kV rms 50 Hz 1mn
Impulse withstand	According to standard CEI 255-4 Class III	5 kV common and differential mode

NOTE: Relay operates on 24 or 48 Vdc. If AC control power is used, a UPS and AC to DC converter are provided.

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As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.

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