



Type GM38 38 kV metal-clad switchgear selection and application guide

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Answers for energy.

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Type GM38 Medium-voltage metal-clad switchgear

Siemens' experience gained in over 80 years of supplying metal-clad switchgear in the U.S. has been captured in the type GM38 design. The objective has been to incorporate features designed to provide safety, while simplifying operation and maintenance, as well as minimizing installation cost.

Type GM38 switchgear is designed for use in industrial plants, commercial buildings, electric utility systems, cogeneration installations and other electrical systems.

Overview



Front



Side (barrier removed)



Rear

Figure 1: Type 38-3AH3 circuit breaker

Siemens type GM38 38 kV metal-clad power switchgear assemblies with horizontal drawout type 38-3AH3 vacuum circuit breakers take advantage of the latest developments in vacuum interrupter technology.

Voltage transformers (VTs) with their associated drawout primary fuses can be located in the cell above a 1,200 A or 2,000 A circuit breaker, allowing significant space savings. Siemens introduced this feature to the 38 kV switchgear market with the launch of the type GM38 design in 1993.

The equipment meets or exceeds the latest standards of ANSI, IEEE and NEMA.

Type GM38 switchgear is designed for use in industrial plants, commercial buildings, electric utility systems, cogeneration installations and other electrical systems. It is commonly used for protection and switching of transformers, capacitors, buses, distribution feeder lines and, in general, for protection of any medium-voltage power circuit.

Siemens experience gained in over 80 years of supplying metal-clad switchgear in the U.S. has been captured in the type GM38 design. The objective has been to incorporate features designed to provide safety, while simplifying operation, maintenance and minimizing installation cost.

The switchgear structure and the drawout vacuum circuit breaker are an integrated design, with dielectric, thermal and interruption integrity built directly into the basic design, not added as an afterthought.

Siemens type 3AH3 operating mechanism

The type 38-3AH3 circuit breaker uses the proven Siemens type 3AH3 stored-energy operating mechanism. This operator is an evolution of the type 3A family of operators first introduced in 1976. Over 60,000 type 3AH3 operating mechanisms have been produced since 1998.

Faster interruption

Standard interrupting time is 5-cycles, with an option available for 3-cycles.

Siemens vacuum interrupters

The vacuum interrupters used in the type 3AH3 circuit breaker are manufactured by Siemens and have been proven in thousands of installations since 1976. The chrome-copper contact design used in these vacuum interrupters assures low chopping levels, eliminating the need for surge protection on most circuits.

Front mounted operating mechanism

The simple type 3AH3 operating mechanism makes maintenance and inspection easy. The mechanism is located on the front of the circuit breaker, rather than underneath.

Maintenance intervals

If applied under ANSI "usual service" conditions, maintenance of the circuit breaker mechanism is only needed at five year intervals.

Maintenance of the switchgear cubicle is recommended at five year intervals and primarily consists of cleaning insulation.

Floor rollout

No lift truck or dolly is needed to insert or remove circuit breakers or drawout fuse trucks in the lower cell of switchgear located at floor level. For indoor switchgear located on a raised "housekeeping" pad or for outdoor non-walk-in switchgear, a lift truck is required to handle circuit breakers or drawout fuse trucks.

Overview

“Universal” spare circuit breaker

The physical configuration and interlock logic allow the use of a single circuit breaker to serve as a “universal” spare circuit breaker at an installation site. The interlock logic checks the principal rating characteristics (continuous current, maximum voltage and interrupting current) and allows a circuit breaker to be inserted in any circuit breaker cell, provided that the ratings of circuit breaker equal or exceed the ratings required by the cell.

Single source responsibility

Single source responsibility is assured since the complete equipment is designed by Siemens and is manufactured and tested in a single facility. The vacuum circuit breakers are checked in the switchgear cells as part of production testing. After tests and interchangeability checks, the circuit breakers are separately packed for shipment.

Full ANSI design background

Full design integrity is assured. ANSI/IEEE C37.09 and C37.20.2 require design tests on circuit breakers and structures together. The type 3AH3 operator is produced in our global center of competence for circuit breakers in Berlin, and final assembly of both the drawout type 38-3AH3 circuit breaker and the switchgear structures occurs in a single facility. Siemens controls the entire process, from design concept to production. Records are maintained and production is certified to ISO 9001 requirements to document compliance with ANSI/IEEE standards.

UL or C-UL Listing available (40 kA only)

Where the arrangement of components allows, UL or C-UL Listing is available.

Quality systems

Facilities involved with application, engineering, design and production are certified to ISO 9001 requirements.



Overview

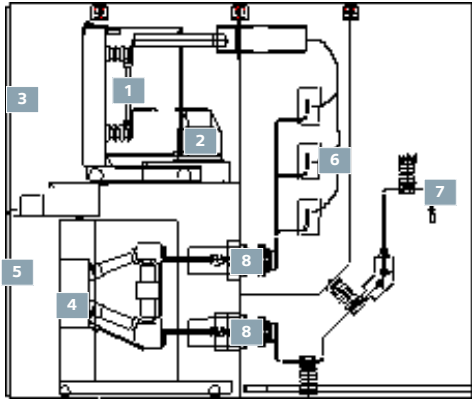


Figure 2: Circuit breaker cell (1,200 A or 2,000 A) with VT auxiliary (3,000 A similar except upper cell reserved for fan-cooling equipment)

1. Drawout primary CL fuses for VTs
2. VTs (stationary)
3. Upper door for protective relays, instruments, etc.
4. Type 38-3AH3 vacuum circuit breaker
5. Lower door (blank)
6. Copper main bus 1,200 A, 2,000 A or 3,000 A self-cooled
7. Power cable termination area
8. CTs

Structural flexibility

Siemens type GM38 metal-clad switchgear provides enhanced flexibility in locating circuit breaker, auxiliary and metering cells within the structure layout. Circuit breakers are located in the lower cell positions. The upper cell position can be used for voltage transformers with the associated drawout primary fuses.

Each vertical section contains the main bus bar compartment, plus a rear compartment for incoming and outgoing connections. The front portion of the vertical section contains an upper cell for auxiliary devices, VTs or drawout primary fuses for a control power transformer (CPT) located in the lower cell.

The front portion of the vertical section contains a lower cell for circuit breaker, auxiliary devices, VTs, CPT (if primary fuses are located in upper cell) or drawout primary fuses for a CPT located in the rear of the section.

Circuit breaker cells include primary and secondary disconnects, current transformers (CTs) and secondary wiring, as necessary. Instruments, protective relays and power meters along with their secondary wiring and other components are located in the upper cell. The switchgear is normally designed so that additional vertical sections may be added in the future.

Enclosure design

The type GM38 design includes full ANSI/IEEE C37.20.2 metal-clad construction. This means complete enclosure of all live parts and separation of major portions of the circuit to retard the spread of faults to other compartments. Removable plates permit access to all compartments. The rear panels are removable to allow access to outgoing cable connections.

The structure is constructed of bolted steel for better dimensional control than with welded designs. Sheet steel inter-unit barriers extend the full height and depth of each vertical section for isolating adjacent sections. The ground bus extends the entire length of the complete switchgear lineup and to each circuit breaker cell.

Circuit breaker interchangeability

The type GM38 switchgear cubicle and the drawout type 38-3AH3 circuit breaker element are both built to master fixtures, so circuit breakers of the same ratings are interchangeable with each other even if the circuit breaker is required for use with a cell with "provisions only" supplied years earlier. The type 38-3AH3 circuit breaker is interchangeable with the type 38-3AF circuit breaker, provided the ratings are equal. The type 38-3AF circuit breaker is not interchangeable with the 40 kA type 38-3AH3.

A circuit breaker of higher rating can be used in a cell of equal or lower rating, i.e., a 2,000 A 40 kA type 38-3AH3 circuit breaker can be used in a 1,200 A 31.5 kA type 38-3AH3 or type 38-3AF circuit breaker cell.

Tested to ANSI/IEEE standards

Siemens type GM38 switchgear is tested to meet the requirements of ANSI/IEEE standards. A complete design test program, including short-circuit interruption, load-current switching, continuous current, mechanical endurance, close and latch current, short-time and momentary withstand, impulse withstand and the other tests required by the standards, has been successfully completed.

These tests encompass the complete equipment design, including both the switchgear structure and the circuit breaker removable element. Production tests in accordance with ANSI/IEEE standards are performed on every group of switchgear and on each circuit breaker. Certified copies of test data can be furnished to customers upon request.

The switchgear is not classified as arc-resistant switchgear and has not been tested for resistance to internal arcing per ANSI/IEEE C37.20.7. Qualification to seismic requirements of various codes (for instance, IBC-2006, UBC, IEEE 693, etc.) is available. Consult your local Siemens representative with detailed requirements.

UL or C-UL Listing available

When specified, if the component configuration allows, the switchgear rated 40 kA can be provided with the UL or C-UL (for use in Canada) Listed label, indicating conformance to the requirements of ANSI/IEEE C37.54 and ANSI/IEEE C37.55.

Construction

Switchgear compartments

Vacuum circuit breaker cell

The circuit breaker cell is a bolted, reinforced sheet steel enclosure, with provisions for a type 38-3AH3 vacuum circuit breaker. It includes a hinged front door, inter-compartment and inter-unit barriers, primary and secondary disconnects, racking mechanism, interlocks and CTs, as required by the application.

Vacuum circuit breaker element

The type 38-3AH3 vacuum circuit breaker includes a stored-energy operating mechanism, primary and secondary disconnects, auxiliary switch, ground contact, control wiring and interlocks.

Auxiliary cell

An auxiliary cell is similar to a circuit breaker cell, except without provisions for a circuit breaker. Space may be used for VTs, a CPT, drawout primary fuses or other auxiliary devices. Opening of the front door does not automatically disconnect a drawout primary fuse truck located inside the cell. Instruments and protective relays can be located on the front door of an auxiliary cell.

Bus compartment

The bus compartment is a separately enclosed space for three-phase insulated main power bus bars, supports and connections to circuit breaker cells.

Primary termination compartment

The rear area of the unit includes space for connecting incoming or outgoing power cables, bus duct connections, transformer connections or surge protection devices.



Figure 3: Two views of same circuit breaker cell interior

1. Shutter operating linkage
2. Shutters
3. Racking mechanism padlock provisions
4. Primary disconnects (behind shutters)
5. Mechanism operated cell (MOC) switch (optional)
6. CTs (behind barrier)
7. Secondary disconnect
8. Trip-free padlock provisions
9. CT barrier
10. Racking mechanism
11. Ground bar
12. Rating interlocks

Construction



Figure 4: Circuit breaker being racked out with door closed



Figure 5: Electrical racking accessory mounted on the switchgear

Circuit breaker cell features

Vacuum circuit breaker cell

A circuit breaker cell consists of a bolted, reinforced sheet steel enclosure, with provisions for a type 38-3AH3 vacuum circuit breaker. The cell includes a blank hinged front door, inter-compartment and inter-unit barriers, stationary primary and secondary disconnects, automatic shutters, drawout guide rails, circuit breaker racking mechanism and necessary interlocks. Control wiring, terminal blocks and CTs are provided as needed for the application. Instruments and protective relays are mounted as needed on the front panel of the upper cell. Secondary control circuit cutouts are located inside the upper cell.

Floor rollout

Circuit breakers in the lower cell can be rolled out directly on the floor in front of the unit without a handling device, lift truck or hoist for indoor (if not on raised "housekeeping" pad) and Shelter-Clad installations. A lift truck accessory is optionally available for handling drawout primary fuse trucks in upper cells, or circuit breakers in non-walk-in outdoor enclosures.

Closed door circuit breaker racking

The circuit breaker can be racked in or out with the cell door open or closed. The mechanism includes an indicator to show the racking mechanism position with the door closed. For racking, a manual drive crank or an optional electric motor drive may be used.

Electrical racking accessory (optional)

An electrical racking motor accessory is available. This consists of a motor drive assembly, which installs (without tools) on mounting brackets on the switchgear front panel of a circuit breaker compartment. The unit includes a power cord, which can be plugged into a duplex receptacle in the vicinity of the switchgear, plus a control cable, which allows the operator to control the racking operation from a distance.

An alternative arrangement is available, which includes a control box that can be mounted at a distance from the switchgear and permanently connected to control power. In turn, the racking motor can be connected to the control box with a long cord.

Interlocks

Interlocks prevent moving a closed circuit breaker in the cell by preventing engagement of the racking crank (or electric racking accessory) if the circuit breaker is closed. A second interlock lever holds the circuit breaker mechanically and electrically trip-free between positions. The racking mechanism can be padlocked to restrict unauthorized racking of the circuit breaker. Separate padlock provisions may be used to hold the circuit breaker in the trip-free condition.

Automatic shutters

Automatically operated grounded steel shutters allow or block access to the stationary primary disconnects in circuit breaker cells. The shutters are opened by the circuit breaker as it moves toward the connected position. The shutters close as the circuit breaker is racked away from the connected position to the test position. The shutters remain closed until they are forced open by insertion of the circuit breaker. This design enhances protection for personnel, as compared to shutters, which link to the racking mechanism.

Current transformers (CTs)

Front-access CTs may be mounted around both the upper and lower stationary primary disconnect bushings. Up to a total of four CTs per phase may be located in each circuit breaker cell, two on the bus side and two on the load side, around the primary disconnect bushings. The CTs may be standard accuracy (type MD38) or optional special accuracy (type MDD38).

Wiring

Secondary wiring is neatly bundled and secured on the sides of the cell. Wiring is not routed on the floor of the switchgear.

Construction

Primary disconnects

The cubicle stationary primary disconnect contacts are recessed inside the insulator assemblies, and are located behind grounded steel shutters to prevent accidental contact when the circuit breaker is withdrawn. The primary disconnect finger clusters are mounted on the circuit breaker for ease of inspection.

Secondary disconnects

The cubicle mounted stationary disconnect contacts mate with spring loaded secondary contacts on top of the circuit breaker. The secondary disconnects automatically engage in both the test and connected positions, and they remain engaged between these positions.

Mechanism operated cell (MOC) switch

When required, up to 24 stages of the MOC auxiliary switch can be mounted in the circuit breaker cell. All spare MOC contacts are wired to accessible terminal blocks for user connections. As a standard, these MOC switches are operated only when the circuit breaker is in the connected position. Optionally, they may be arranged to operate in both the connected and test positions.

Truck operated cell (TOC) switch

When required, up to 12 stages of the TOC switch can be mounted in the circuit breaker cell. All spare TOC contacts are wired to accessible terminal blocks for user connections.

Unobstructed terminal block space

Terminal block areas are located on each side of circuit breaker or auxiliary cells. Since racking system components are not mounted on the cubicle sides, the side-mounted terminal blocks are not obstructed as in other designs. Installation of field wiring is simplified, as wiring can be easily laid directly against the side sheets. It is not necessary to "fish" the wiring under, around and through obstructions.

Auxiliary cells

Auxiliary cells are constructed in a similar manner as the circuit breaker cells, except without provisions for a circuit breaker element. Auxiliary cells may be located in the upper cell or lower cell of a vertical section.

The front door panels may be used to mount meters, protective relays or other instrumentation. The interior portion of the cell may be used for mounting devices, such as VTs, CPTs (lower cell only), automatic transfer switches or other auxiliary devices.

For ease in operation, primary current limiting fuses for CPTs and VTs are arranged in a drawout configuration, while the heavy transformers are stationary. This greatly reduces the effort required to isolate transformers for inspection or maintenance. The racking mechanism for the drawout fuse truck is manually operated with the compartment door open, but it is otherwise similar to the circuit breaker racking mechanism.

Auxiliary cell relay and instrument space

The front panel of auxiliary cells is suitable for mounting devices. Even if the auxiliary cell contains rollout tray devices (rollout fuses for VTs or CPTs), the space available allows for mounting any of the devices commonly specified for use on metal-clad switchgear.

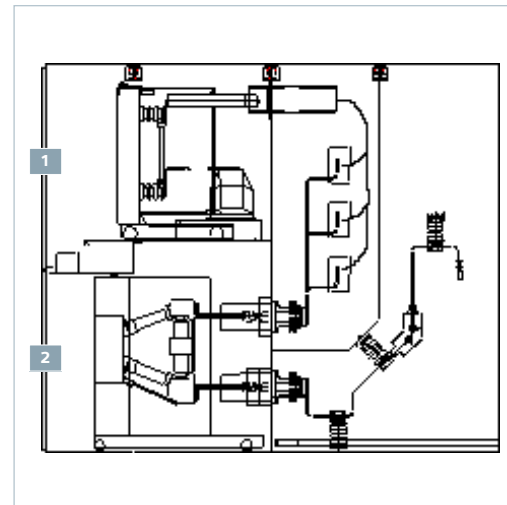


Figure 6: Auxiliary cells

Footnotes:

1. For VTs or rollout fuses for a CPT located in lower cell, or for fan if 3,000 A circuit breaker in lower cell
2. For circuit breaker, VTs, rollout fuses for CPT located in rear or remote, or CPT when rollout fuses located in upper cell.

Construction



Figure 7: Primary CL fuses accessible when fuse truck in disconnect position and access door open



Figure 8: VT cell with fuse truck withdrawn (shutter closed, VT primaries grounded)

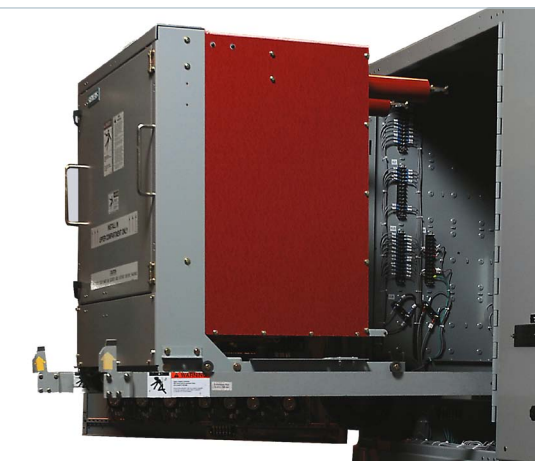


Figure 9: Fuse truck on extension rails

Voltage transformers (VTs)

Up to three VTs with their drawout mounted current limiting fuses may be mounted in an auxiliary cell. VTs can be accommodated in the upper cell above a circuit breaker, or in either the upper or lower cells of a section that does not have a circuit breaker cell.

When the drawout fuses are moved to the disconnect position, they are automatically disconnected, and the transformer windings are grounded to remove any static charge. An insulating shutter is provided, arranged to operate before primary fuses become accessible for inspection or removal.

Control power transformers (CPTs)

CPTs can be accommodated in either of two manners. For single-phase and small three-phase transformers, the primary drawout fuses can be located in the upper auxiliary cell of a vertical section, and the fixed-mounted CPT can be located in the lower front cell of the same vertical section.

Alternatively, the primary drawout fuses can be located in the lower auxiliary cell of a vertical section, and the fixed-mounted CPT can be located in the rear of the section.

The secondary molded case breaker is interlocked with the drawout primary fuses so that the secondary circuit breaker must be open before the CPT primary can be disconnected or connected.

This prevents accidental load-current interruption on the main primary contacts. With the secondary molded case breaker open and the latch released, the primary fuse truck can be moved easily to the disconnect position. The operation of the drawout fuse truck and insulating shutter is similar to that for the VTs.

Current transformers (CTs)

Siemens toroidal CTs comply with ANSI/IEEE standards and are mounted at the rear of the circuit breaker cell. Up to four standard accuracy type MD38 or special accuracy type MDD38 CTs may be mounted on each phase: two on the bus side and two on the load side around the primary disconnect bushings. CTs may be added or changed with the cell de-energized without removing bus bar or cable connections. Multi-ratio CTs are available.

Primary termination compartment

The primary termination compartment at the rear of the switchgear section is separated from all other compartments by barriers. This space can be used for connecting power cables, bus duct or for connection to an adjacent power transformer (PT). Surge arresters may also be provided in this compartment. Bolted rear plates are provided as standard to provide access to the cable area for each unit. Hinged rear doors are available as an option.

Infrared (IR) viewing windows are optionally available for use in checking temperature of conductors in the primary termination compartment.

Bus bar system

Full-round-edge copper bus bar with silver-plated joints is standard. Tin-plated copper bus is available as an option. High strength grade 5 steel hardware with split lock washers assures constant pressure, low-resistance connections. A 0.25 in. (6 mm) x 2.0 in. (51 mm) copper ground bus bar is standard in all vertical sections and is accessible at each end of the lineup and in the primary termination of each section. The main bus is available in 1,200 A, 2,000 A or 3,000 A self-cooled ratings. The main bus bar system is enclosed by grounded metal barriers.

Construction

Bus bar insulation

Bus bars are insulated using heat-shrink insulation. Bolted bus joints are insulated by pre-formed molded boots, which are held in place by nylon hardware. For bus configurations where no boot design is available, taped joints are used. The main bus is supported with cycloaliphatic epoxy inserts where the bus passes from one section to another. Other bus is supported using porcelain standoff insulators. Circuit breaker support insulators and cubicle primary disconnect supports are molded epoxy. Interphase and other barriers are track-resistant, flame retardant glass polyester.

Bus joint insulation

For normal joint configurations, bolted bus joints are insulated by pre-formed molded polyvinyl boots (double), which are held in place by nylon hardware. Preformed insulating materials eliminate the need for molding and taping joints when connecting shipping groups in the field, reducing installation time and costs. The same preformed, high-dielectric strength joint boots used in factory assembly are also used in field assembly of shipping-split bus connections. For uncommon joint configurations, taped joint insulation is used. Boots for insulating user's power connections are available as an option.

Bus support insulation

Bus bars are supported on porcelain standoff insulators using a glass-polyester saddle-clamp system. Inter-unit bus is supported on cycloaliphatic epoxy inserts mounted in a glass-polyester sheet.

Wiring

The secondary and control wiring is connected to terminal blocks, which have numbered points for identification. One side of the terminal blocks for connections leaving the switchgear is reserved for external connections. Secondary and control wire is minimum No. 14 AWG, extra-flexible, stranded type SIS wire, insulated for 600 volts, except when devices (for instance, transducers, communicating devices, etc.) require different wire. Insulated barrel, crimp-type locking fork terminals are used for most applications, except where the devices require a different type of terminal. Where they pass through primary compartments, secondary control wires are armored or enclosed in grounded metal wire covers or sheaths.

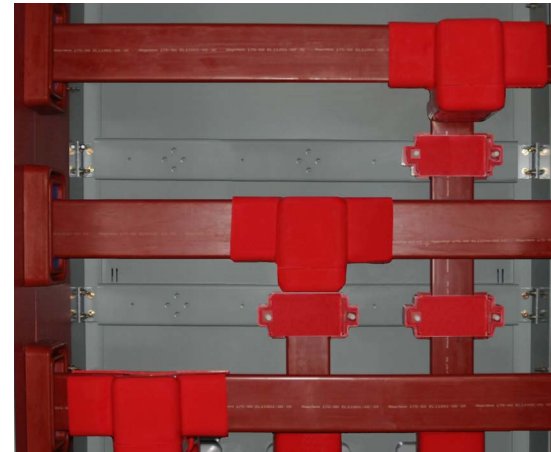


Figure 10: Main bus construction

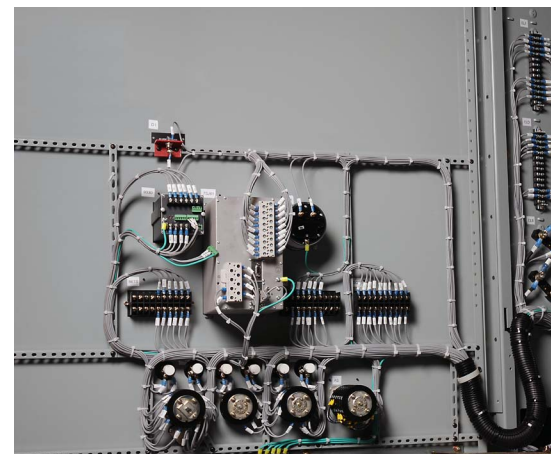


Figure 11: Cell wiring

Construction



Figure 12: Shelter-Clad type GM38 lineup (aisle portion not shown - refer to Figure 13)



Figure 13: Shelter-Clad single-aisle braced for shipment

Instrumentation and protective relays

Instruments, meters and protective relays can be traditional switchboard type or modern electronic type, depending on the requirements of the specification. If traditional electromechanical devices are used, they have semi-flush cases with dull black covers. Indicating and recording instruments, meters and protective relays are of the rectangular type, semi-flush mounted. All scales have a suitable range and are designed with black letters on a white background.

Control and instrument switches

Switches furnished are rotary, switchboard type and have black handles. Circuit breaker control switches have pistol-grip handles, while instrument transfer switches have round notched handles, and auxiliary or transfer switches have oval handles.

Circuit breaker control switches have a mechanical flag indicator showing a red or green marker to indicate the last manual operation of the switch.

Outdoor housings

Two types of outdoor housing – non-walk-in and Shelter-Clad – are available to meet almost any application. For both types, the underside of the base is coated with a coal tar emulsion. The switchgear is shipped in convenient groups for erection in the field.

Non-walk-in design

The non-walk-in switchgear consists of indoor type circuit breaker and auxiliary cubicles located in a steel housing of weatherproof construction. Each vertical section has a full height exterior front door with provision for padlocking. Each cell is also equipped with an inner hinged front door for mounting protective relays, instrumentation and control switches. Two removable rear panels are included for cable access to the primary termination area. Each cubicle includes necessary space heaters, a switched lamp receptacle for proper illumination of the cubicle during maintenance and inspection and a duplex receptacle for use with electric tools. A molded-case circuit breaker for space heaters is located in one cubicle.

Shelter-Clad design – single aisle

The Shelter-Clad switchgear consists of indoor type circuit breaker and auxiliary cubicles located in a weatherproof steel housing having an operating aisle space of sufficient size to permit withdrawal of the circuit breakers for inspection, test or maintenance. An access door is located at each end of the aisle, arranged so that the door can be opened from the inside regardless of whether or not it has been padlocked on the outside. The aisle space is provided with incandescent lighting, which is controlled by means of a three-way switch at each access door. Each cubicle includes necessary space heaters. Each lineup includes two utility duplex receptacles, one at each aisle access door, for use with electric tools, extension cords, etc. The weatherproof enclosure for the aisle-way is shipped disassembled for erection in the field. Optionally, for single-aisle configurations, the aisle portion of the enclosure can be shipped assembled.

Shelter-Clad design – common aisle

The Shelter-Clad common-aisle switchgear consists of two lineups of indoor type circuit breaker and auxiliary units located in a weatherproof steel housing having a common operating aisle space of sufficient size to permit withdrawal of the circuit breakers for inspection, test or maintenance. Otherwise, the construction is as described for single-aisle design, except that the aisle portion is always shipped disassembled for erection in the field.

Accessories

Standard accessories include:

- Manual racking crank
- Manual spring charging crank
- Drawout extension rails (facilitate handling of circuit breakers in outdoor non-walk-in switchgear or drawout fuse trucks when located above floor level)
- Lifting sling (for circuit breakers or drawout fuse trucks located above floor level)
- Split plug jumper (standard unless test cabinet is furnished)
- Contact lubricant
- Touch up paint.

Optional accessories include:

- Lift device (facilitate handling of circuit breakers in outdoor non-walk-in switchgear or drawout fuse trucks when located above floor level)
- Test cabinet (in place of split plug jumper)
- Test plugs (if required by devices)
- Electric racking motor assembly (to enable racking while operator is at a distance from the switchgear)
- Manually or electrically operated ground and test device.

Test provisions, either a split plug jumper or a test cabinet, are available for testing the circuit breaker outside its cubicle.

The split plug jumper is used to bridge the secondary disconnects with a flexible cable, so the circuit breaker may be electrically closed and tripped with the control switch on the instrument panel while the circuit breaker is outside of its compartment. The test cabinet, including a control switch, is used for closing and tripping the circuit breaker at a location remote from the switchgear.

Manually operated ground and test device

This is a drawout element that can be inserted into a circuit breaker cell. It opens the shutters, connects to the cell primary disconnecting contacts, and so provides a means to make the primary disconnect stabs available for testing. It is suitable for high-potential testing of outgoing circuits of the switchgear main bus or for phase-sequence checking. It also provides a means to connect temporary grounds to de-energized circuits for maintenance purposes. Either three-stud or six-stud devices are available.

Electrically operated ground and test device

An electrically operated ground and test device includes a power operated switch (derived from a type 38-3AH3 circuit breaker) arranged to allow grounding one set of disconnect stabs. Two devices, one each for the upper and lower stabs, are required if grounding is desired to either side of the unit. The device includes test ports to allow for testing for presence of voltage on both the line side and the load side of the cell. The device also provides a means of access to the primary circuits for high-potential tests or for phase-sequence checking. These devices are able to close and latch against short-circuit currents corresponding to the ratings of the equipment. Due to the unique requirements frequently involved in such devices, all applications of electrically operated ground and test devices should be referred to Siemens for review.

Note: Each user must develop definitive operating procedures for incorporating safe operating practices. Only qualified personnel should be allowed to use ground and test devices.



Figure 14: Manually operated ground and test device with doors open and closed



Figure 15: Electrically operated ground and test device

Protective relays



Figure 16: Type SIPROTEC numerical multifunction protective relays



Figure 17: Type GM38 low-voltage protective relay and instrument compartment

SIPROTEC™

SIPROTEC has established itself across the market as the standard for numerical protective relaying. Besides the common system platform and the unique type DIGSI 4 service interface that may be used for all protective devices, it also supports the new IEC 61850 communication standard.

IEC 61850 – what it is and what it can achieve?

Users and manufacturers jointly developed the new international standard IEC 61850, which was approved in early 2004. The agreed aim of this standard is to arrive at a complete communication solution for substations, thus providing users with interoperability among different makes on the basis of Ethernet technology. This opens up a whole new dimension in efficient substation management. Not only short-term savings in operation and maintenance, but also simplified engineering, less complexity and long-term expandability can make you one of the winners in tomorrow's power market.

With type SIPROTEC protective relays and bay control units from Siemens, we offer all the advantages of an expert and innovative partner in the field of protective relaying and substation automation. We bring you attractively priced intelligent solutions by paying particular attention to lowering your life cycle and system management costs. These solutions are the first ones available on the market with the international IEC 61850 standard.

To enable you to profit from these advantages as quickly as possible, Siemens collaborated in the preparation of this international standard and made every effort to ensure no time was lost in bringing it out. The result is certainly worth a look, because type SIPROTEC and other power automation products and Siemens systems are available on the basis of the IEC 61850 standard and can even be retrofitted in systems supplied since 1998.

System advantages one bay, one unit

The type SIPROTEC 4 protective relay family offers fully integrated protection, control, monitoring and automation functions incorporated in a single device. For many applications, this product contains all the functions you need to meet all your protection and control requirements with just one unit per section, saving on investment and installation costs and enhancing availability.

Type DIGSI 4 – one tool for all tasks and products

Type DIGSI 4 is a computer program designed for all type SIPROTEC protective relays. Type DIGSI 4 offers users a universal tool for all support tasks from setting and commissioning of devices to simple analysis and documentation of system faults. Our powerful analysis tool speeds up troubleshooting and supplies important service information.

Type SIPROTEC protective relays and bay controllers - the first devices available with IEC 61850.

Vacuum circuit breakers

Type 38-3AH3 vacuum circuit breakers

Siemens type 38-3AH3 circuit breakers are available in 31.5 kA through 40 kA interrupting classes, or 1,500 MVA on the older “constant MVA” rating basis. Continuous current ratings include 1,200 A and 2,000 A self-cooled and 3,000 A forced-air cooled.

Maintenance features

The type 38-3AH3 circuit breakers incorporate many features designed to reduce and simplify maintenance, including:

- Virtually maintenance-free vacuum interrupter
- Five-year maintenance interval
- Floor rollout
- Front-mounted operator
- Common operator family
- Simple interphase and outerphase barriers
- “Universal” spare circuit breaker concept
- Non-sliding current transfer
- Rugged secondary disconnects.

Five-year maintenance interval on type 38-3AH3 circuit breaker

When applied under mild conditions (ANSI “usual service” conditions), maintenance is only needed at five-year intervals on the circuit breaker. The maintenance interval for the switchgear cubicles is also five years.

Low maintenance requirements

The vacuum interrupter is a sealed unit, so the only maintenance necessary is to clean off any contaminants and to check the vacuum integrity. The vacuum interrupters can be disconnected from the stored-energy mechanism quickly, without tools, and vacuum integrity inspected by hand; alternatively, a simple high-potential test can be used.

Floor rollout

The circuit breakers are arranged to rollout directly on the floor in front of the switchgear, if the indoor switchgear is not located on a “housekeeping” pad. No adapter, hoist or lift truck is necessary for circuit breakers located at floor level.

Mechanism operation

The mechanism is arranged to pre-store closing energy in the closing springs. The closing springs are selected so that they provide sufficient energy not only to close the circuit breaker safely into maximum “close and latch” currents, but also to pre-store the tripping energy necessary to open the circuit breaker. The closing springs can be manually charged during maintenance or in emergency conditions, but are normally charged electrically automatically after each closing operation.

Interlocks

The racking system prevents racking of a closed circuit breaker and keeps the circuit breaker trip-free during racking. The racking mechanism can be padlocked to prevent unauthorized operation. Padlocks can also be applied to the racking mechanism to maintain the circuit breaker in the trip-free condition.

Stored-energy operator

The type 38-3AH3 circuit breaker utilizes the Siemens type 3AH3 stored-energy operator for long life, high reliability and ease of maintenance. Parts used in the manufacture of the circuit breaker are precision tooled or produced on numerically controlled equipment. The circuit breaker design includes frequent use of inherent alignment techniques.



Front



Side (barrier removed)



Rear

Figure 18: Type 38-3AH3 circuit breaker

Vacuum circuit breakers

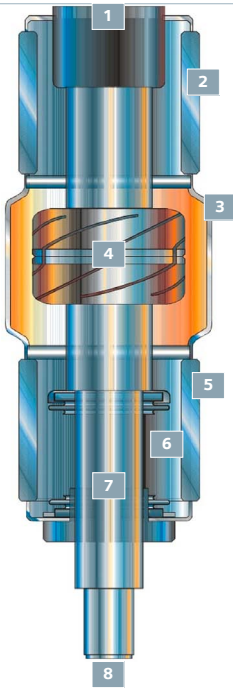


Figure 19: Vacuum interrupter

1. Stationary current connection terminal
2. Ceramic insulator
3. Arc chamber
4. Chrome-copper contacts
5. Ceramic insulator
6. Stainless steel bellows
7. Moving contact stem
8. Mechanical coupling for operating mechanism

Manual controls and indicators

All circuit breaker manual controls and indicators are conveniently located on the front of the circuit breaker. Standard features include manual close button, manual trip button, open-close indicator, stored-energy closing spring charge/discharge indicator, manual spring-charging access port and close operation counter.

Common operator family

Since the entire type 38-3AH3 range of ratings uses a common stored-energy operating mechanism design, less training of maintenance personnel is required, and stocking of spare parts is reduced. The operating mechanism is essentially the same operator as used on the Siemens type GMSG circuit breaker for 5 kV-15 kV switchgear.

Front accessible operating mechanism

The type 38-3AH3 stored-energy operator is located at the front of the circuit breaker. The front cover can be easily removed to expose the operator for inspection and maintenance. This feature eliminates the need to tilt or turn over the circuit breaker for normal service.

Trip-free design

The operating mechanism conforms to the trip-free requirements of ANSI/IEEE standards. The mechanism design assures that the tripping function prevails over the closing operation.

Simple barriers

Outerphase and interphase barriers are of very simple design and located on the circuit breaker, allowing the cell to be free of barriers, except the CT barrier located in front of the shutters. The barriers on the circuit breaker remove quickly and easily for maintenance. Most maintenance can be performed with the barriers in place.

Vacuum interrupters

The type 38-3AH3 circuit breakers use the Siemens family of vacuum interrupters, proven in over 600,000 circuit breakers produced since 1976. Axial magnetic-field contacts are used to maintain the arc in diffuse mode and minimize contact erosion. The chrome-copper contact material assures lower chopping currents than with designs employing copper-bismuth contacts.

Vacuum circuit breakers



- | | |
|--|--------------------------------------|
| 1. Gearbox | 10. Closed circuit breaker interlock |
| 2. Closing spring | 11. Trip-free interlock |
| 3. Opening spring | 12. Ground disconnect |
| 4. Jack shaft | 13. Charged/discharged indicator |
| 5. Auxiliary switch | 14. Open/closed indicator |
| 6. MOC switch operator | 15. Operations counter |
| 7. Spring charging motor (behind limit switches) | 16. Secondary disconnect |
| 8. Push-to-close | 17. Close coil |
| 9. Push-to-trip | 18. Trip coil |
| | 19. Capacitor trip (optional) |

Figure 20: Type 38-3AH3 circuit breaker key components

Vacuum circuit breakers

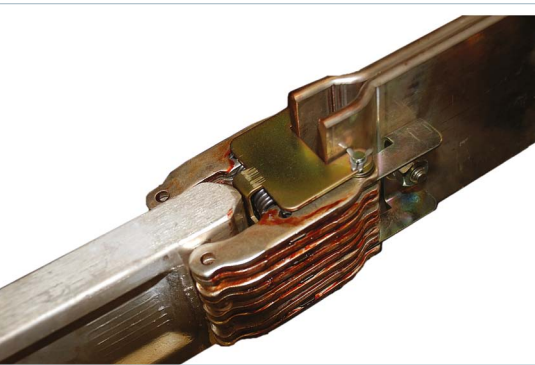


Figure 21: Primary disconnects



Figure 22: Secondary disconnect (cell portion)

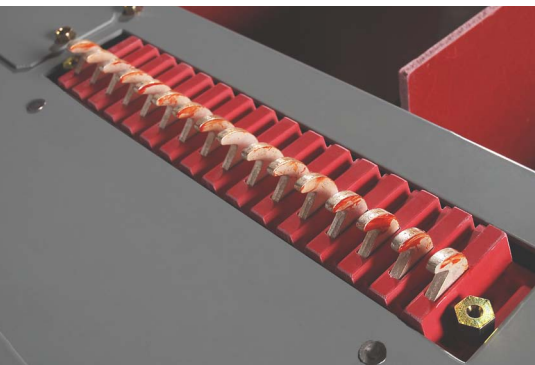


Figure 23: Secondary disconnect (circuit breaker portion)

Non-sliding current transfer

The vacuum interrupter movable stem is connected to the lower disconnect stab of the circuit breaker by a reliable flexible connector, a method pioneered by Siemens in the 1970s. This provides a low-resistance current transfer path, not subject to the wear and contamination problems associated with sliding or rolling joints used in some designs.

Primary disconnects

The primary connection between the circuit breaker and the cubicle is made of multiple sets of silver-plated copper finger contacts that engage with silver-plated copper stationary contacts. The cubicle primary disconnect studs have a tapered leading edge, that contributes to smooth racking of the circuit breaker.

The contacts, mounted on the ends of the circuit breaker disconnect stabs, have multiple fingers and are compression spring loaded (one spring per double pair of fingers). This arrangement offers a large number of contact points to ensure proper alignment. The circuit breaker finger assemblies are withdrawn with the circuit breaker, and are available for inspection without de-energizing the switchgear main bus.

“Universal” spare circuit breaker

The physical configuration and interlock logic allow the use of a single circuit breaker to serve as a “universal” spare circuit breaker at an installation site. The rating interlock logic checks the principal rating characteristics (continuous current, maximum voltage and interrupting current), and allows a circuit breaker to be inserted in a circuit breaker cell provided that the ratings of the circuit breaker equal or exceed the ratings required by the circuit breaker cell.

Secondary disconnects

Circuit breaker-to-cubicle secondary disconnects are of the silver-plated sliding finger design. The secondary disconnects are automatically engaged as the circuit breaker is racked into the test position. They remain engaged as the circuit breaker is racked to the connected position. Since the secondary disconnects automatically engage in both the test and connected positions, there is no need to operate a separate linkage for testing.

The secondary disconnects are located on the top of the circuit breaker element, where they are shielded from accidental damage. They are of an extremely rugged design, in contrast to other designs, which employ light-duty electronics-style disconnects located in hidden or inaccessible locations. Alignment of the disconnects can be visibly observed, if desired, allowing positive verification of secondary integrity, a feature not possible with designs employing a disconnect underneath or behind the circuit breaker.

Vacuum circuit breakers

Auxiliary switch (circuit breaker mounted)

The auxiliary switch assembly is mounted on the vacuum circuit breaker with contacts for use in the circuit breaker control circuit and as spare contacts for other use. Normally, four auxiliary switch contacts, two NO (52a) and two NC (52b) can be wired out for purchaser use.

Mechanism operated cell (MOC) switch

When required, 6, 12, 18 or 24 stages of MOC auxiliary switch can be mounted in the circuit breaker cell. This switch is operated by the circuit breaker mechanism, so that the switch contacts change state whenever the circuit breaker is closed or tripped. Normally, the MOC switch is operated only when the circuit breaker is in the connected position, but provisions for operation in both the connected and the test positions can be furnished. All spare MOC contacts are wired to accessible terminal blocks, as shown in Figure 24: MOCS (12 stages shown) and TOCs (8 stages shown), for user connections.

Truck operated cell (TOC) switch

When required, 4, 8, or 12 stages of TOC switch can be mounted in the circuit breaker cell. The TOC switch contacts change state when the circuit breaker moves into or out of the connected position. All spare TOC contacts are wired to accessible terminal blocks, as shown in Figure 24: MOCS (12 stages shown) and TOCs (8 stages shown), for user connections.

Siemens vacuum heritage

The type 38-3AH3 vacuum circuit breakers take full advantage of Siemens' long history with vacuum interrupters for power applications. While early work was carried out in the 1920s, a successful vacuum interrupter could not be perfected until the high vacuum pump became available in the 1960s. Focused development effort began in 1969, culminating in the introduction of the type 3AF circuit breaker in 1976. The knowledge gained over years of application of this technology in the type 3AF and type 3AH circuit breakers is now available in the type 38-3AH3 design. The advantages inherent in vacuum interruption are summarized as follows:

■ Ideal dielectric

In a vacuum, the dielectric strength across a contact gap recovers very rapidly, allowing a small contact separation and an efficient interrupter design. The vacuum does not interact with the arc or its components as do other dielectrics.

■ Quiet operation

Interruption of current by a vacuum circuit breaker is very quiet as compared to the loud report that accompanies interruptions in some other types of circuit breakers.



Figure 24: MOCs (12 stages shown) and TOCs (8 stages shown)

Vacuum circuit breakers



Figure 25: Side view of type 38-3AH3 circuit breaker (outer phase barrier removed)

■ Low current chopping characteristics

The chrome-copper contact material used in Siemens vacuum interrupters limits chopping currents to a maximum of 5 A. This low value prevents the build-up of unduly high voltages and results in lower stress on the insulation of load equipment.

■ No arc products vented to the atmosphere

The sealed vacuum interrupter prevents venting of arc products to the atmosphere, and prevents any possible contamination of the contacts by the atmosphere. The metal vapor of the arc quickly recondenses on the surface of the contacts, although a small amount may recondense on the arc chamber wall or arc shield. The recondensing metal vapor acts as a “gutter” and recaptures more molecules of certain gases that might be liberated during vaporization. This action tends to improve the vacuum in the interrupter during its operating life.

■ Non-toxic interruption by-products

The interruption process occurs entirely within the sealed vacuum interrupter. Even if a vacuum interrupter is physically broken, the arc products inside the vacuum interrupter are not toxic. In contrast, gas-filled interrupters produce toxic arc by-products, requiring special precautions in the event of a ruptured interrupter housing.

■ Fewer components

The vacuum interrupter pole construction is extremely simple and consists of only seven moving parts within the high-voltage area and only two moving parts within the vacuum interrupter chamber. This means greater reliability and less maintenance with vacuum interrupters as compared to the greater number of parts in other type interrupters, such as gas or oil.

■ Long vacuum interrupter life

The vacuum interrupter has a long expected service life due to the careful selection of components. The chrome-copper contacts allow efficient interruption with very little contact erosion.

■ Immunity to environment

The capability of the vacuum interrupter to interrupt current or to withstand voltage is not directly affected by conditions external to the vacuum interrupter. High or low altitudes, hot or cold temperatures, moist or dry conditions or heavy dust conditions do not affect the conditions internal to the vacuum interrupter. Conditions external to the vacuum interrupter, however, could affect the overall system operation and should be considered in the specifications.

■ Virtually maintenance free

Vacuum interrupter maintenance requires merely wiping dust or other atmospheric elements from the exterior, visually checking the contact wear indicator and periodic dielectric testing to confirm vacuum integrity.

■ Lower force requirements

The vacuum interrupter has a very low moving mass compared to that found in other interrupters. This allows a smaller, more compact stored-energy operator leading to long life and low maintenance of the circuit breaker.

Vacuum circuit breakers

Vacuum interrupter principles

With Siemens type 38-3AH3 vacuum circuit breakers, the chopping currents are held to 5 A or less. This is low enough to prevent the build-up of unduly high voltages, which may occur on switching of inductive circuits. The chrome-copper contact material keeps overvoltages to a minimum, so special surge protection is not required in most applications.

When the contacts open, the current to be interrupted initiates a metal vapor arc discharge, and current continues flowing through this plasma until the next current zero.

The arc is extinguished near the current zero, and the conductive metal vapor recondenses on the contact surfaces and the arc chamber wall or arc shield within a matter of microseconds. As a result, the dielectric strength of the break recovers very rapidly and contact erosion is almost negligible.

The arc drawn in the vacuum interrupter is not cooled. The metal vapor plasma is highly conductive and the resulting arc voltage is only 20 to 200 volts. This low arc voltage, combined with very short arcing times, produces only a very small arc energy in the vacuum interrupter, accounting for the long electrical life expectancy of the Siemens vacuum interrupter.

Axial magnetic-field design is employed. In this configuration, the current flow creates a magnetic field along the longitudinal axis of the vacuum interrupter. This magnetic field prevents constriction of the arc, and this forces the arc to remain in diffuse mode. Since the arc remains in diffuse mode, localized overheating is avoided and contact erosion is held to low levels.



Figure 26: Siemens vacuum interrupter family

Technical data

These ratings are in accordance with the following standards:

- ANSI/IEEE C37.04-1999 Standard Rating Structure for AC High-Voltage Circuit Breakers
- ANSI C37.06-2009 AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Required Capabilities
- ANSI/IEEE C37.09-1999 Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
- ANSI/IEEE C37.010-1999 Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.

| Rated values | | Units | Circuit breaker type ¹ | |
|--|-------------------------|--------------|-----------------------------------|---------------------------|
| | | | 38-3AH3-31 | 38-3AH3-40 |
| Maximum design voltage (V) ² | | kV rms | 38.0 | 38.0 |
| Voltage range factor (K) ³ | | ---- | 1.0 | 1.0 |
| Withstand voltage levels | Power frequency | kV rms | 80 | 80 |
| | Lightning impulse (BIL) | kV crest | 150 | 150 |
| Continuous current ⁴ | | A rms | 1,200 2,000 3,000FC | 1,200 2,000 3,000FC |
| Short-circuit (I) ^{5,6} | | kA rms sym | 31.5 | 40 |
| Interrupting time ⁷ | | ms cycles | 83 5 | 83 5 |
| Permissible tripping delay (Y) | | Sec | 2 | 2 |
| Maximum symmetrical interrupting (I) | | kA rms sym | 31.5 | 40 |
| % dc component | | % | 47 | 47 |
| Short-time current (I) (3 seconds) | | kA rms | 31.5 | 40 |
| Closing and latching (momentary) asymmetrical (1.55 x I) | | kA rms | 50 | 62 |
| Closing and latching (momentary) peak (2.6 x I) | | kA peak | 85 | 104 |

Table 1: Type 38-3AH3 circuit breaker ratings (new "constant kA" ratings basis)

Footnotes:

- ¹ "xxxx" in type designation refers to the continuous current rating 1,200, 2,000 or 3,000 A as appropriate. The 3,000 A fan-cooled rating is achieved using fan cooling as indicated in Footnote 4.
- ² Maximum design voltage for which the circuit breaker is designed, and the upper limit for operation.
- ³ K is listed for informational purposes only. For circuit breakers rated on a "constant kA basis", the voltage range factor is 1.0.
- ⁴ 3,000FC indicates that fan cooling is included in the switchgear structure for this rating. 3,000 A rating is not available in outdoor equipment.
- ⁵ All values apply to polyphase and line-to-line faults.
- ⁶ Standard duty cycle is O - 0.3 s - CO - 3 min. - CO.
- ⁷ Three-cycle (50 ms) interrupting is optionally available.

Technical data

These ratings are in accordance with the following standards:

- ANSI/IEEE C37.04-1979 Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
- ANSI C37.06-1987 AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Required Capabilities
- ANSI/IEEE C37.09-1979 Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
- ANSI/IEEE C37.010-1979 Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.

| | Measure parameter | | Units | Circuit breaker type ¹ | |
|--------------------------------------|--|---|-------------------------|-----------------------------------|---------------------------|
| | | | | 38-3AH3-1500 | |
| General | Nominal voltage class | | kV | 38.0 | |
| | Nominal 3-phase MVA class ⁹ | | MVA | 1,500 | |
| Rated values | Rated voltage | Maximum design voltage (V) ² | kV rms | 38.0 | |
| | | Voltage range factor (K) ³ | ---- | 1.65 | |
| | Insulation levels | Withstand voltage levels | Power frequency | kV rms | 80 |
| | | | Lightning impulse (BIL) | kV peak | 150 |
| | Rated current | Continuous current ⁴ | | A rms | 1,200 2,000 3,000FC |
| | | Short-circuit (at rated maximum design voltage) (I) ^{5, 6, 10} | | kA rms sym | 21 |
| | | Interrupting time ¹¹ | | ms cycles | 83 5 |
| | | Permissible tripping delay (Y) | | Sec | 2 |
| Related required capabilities | Current | Rated maximum design voltage (V) divided by K (=V/K) | kA rms | 23 | |
| | | Maximum symmetrical interrupting (K x I) ⁷ | kA rms sym | 35 | |
| | | Short-time current (K x I) (three- Seconds) | kA rms sym | 35 | |
| | Closing and latching (momentary) | Asymmetrical (1.6 x K x I) ⁸ | kA rms | 56 | |
| | | Peak (2.7 x K x I) ⁸ | kA peak | 95 | |

Table 2: Type 38-3AH3 circuit breaker ratings (historic “constant MVA” ratings basis)

Footnotes:

1. “xxxx” in type designation refers to the continuous current rating 1,200, 2,000 or 3,000 A, as appropriate. The 3,000 A fan-cooled rating is achieved using fan cooling as indicated in Footnote 4.
2. Maximum design voltage for which the circuit breaker is designed, and the upper limit for operation.
3. K is the ratio of the rated maximum design voltage to the lower limit of the range of operating voltage in which the required symmetrical and asymmetrical interrupting capabilities vary in inverse proportion to the operating voltage.
4. 3,000FC indicates that fan cooling is included in the switchgear structure for this rating. 3,000 A rating is not available in outdoor equipment.
5. To obtain the required symmetrical interrupting capability of a circuit breaker at an operating voltage between 1/K times rated maximum design voltage and rated maximum design voltage, the following formula shall be used: Required symmetrical interrupting capability = rated short-circuit current (I) x [(rated maximum design voltage)/(operating voltage)]. For operating voltages below 1/K times maximum design voltage, the required symmetrical interrupting capability of the circuit breaker shall be equal to K times rated short-circuit current.
6. Within the limitations stated in ANSI/IEEE C37.04-1979, all values apply to polyphase and line-to-line faults. For single phase-to-ground faults, the specific conditions are stated in clause 5.10.2.3 of ANSI/IEEE C37.04-1979.
7. Current values in this row are not to be exceeded even for operating voltage below 1/K times rated maximum design voltage. For operating voltages between rated maximum design voltage and 1/K times rated maximum design voltage, follow Footnote 5.
8. Current values in this row are independent of operating voltage up to and including rated maximum voltage.
9. “Nominal 3-phase MVA class” is included for reference only. This information is not listed in ANSI C37.06-1987.
10. Standard duty cycle is CO - 15s - CO.
11. Three-cycle (50 ms) interrupting is optionally available.

Technical data

| Control voltages, ANSI C37.06 | | Close coil | Trip coil | Spring charging motor | | | |
|-------------------------------|-----------|------------|-----------|-----------------------|------------------|----------|----|
| Nominal | Range | | | Run (avg.) | Inrush (peak) | Charging | |
| | | Close | Trip | A ¹ | A ^{1,3} | A | A |
| 48 Vdc | 38 - 56 | 28 - 56 | 11.4 | 11.4/30 | 8 | 25 | 10 |
| 125 Vdc | 100 - 140 | 70 - 140 | 2.1 | 4.8/7.4 | 4 | 18 | 10 |
| 250 Vdc | 200 - 280 | 140 - 280 | 2.1 | 4.2/9.6 | 2 | 10 | 10 |
| 120 Vac | 104 - 127 | ---- | 2.0 | ---- ² | 6 | ---- | 10 |
| 240 Vac | 208 - 254 | ---- | 2.0 | ---- ² | 3 | ---- | 10 |

Footnotes:

- ¹ Current at nominal voltage.
- ² Capacitor trip.
- ³ Value preceding slash (/) is the current for the standard trip coil with standard rated interrupting time. Value following slash (/) is the current for optional trip coil with three-cycle interrupting time.
- ⁴ ---- means this selection not available in this voltage.

Table 3: Circuit breaker control data⁴



Figure 27: Type SGM38 assembled aisle (optional fluorescent lamp fixtures and insulated aisle shown)

| Type switch | Continuous current A | Control circuit voltage | | | | |
|-----------------|-------------------------|-------------------------|---------|--------------------|---------|---------|
| | | 120 Vac | 240 Vac | 48 Vdc | 125 Vdc | 250 Vdc |
| Non-inductive | | | | | | |
| Circuit breaker | 10 | 10 | 5 | 10/30 ¹ | 9.6 | 4.8 |
| TOC | 15 | 15 | 10 | 0.5 | 0.5 | 0.2 |
| MOC | 20 | 15 | 10 | 10 | 10 | 5 |
| Inductive | | | | | | |
| Circuit breaker | 10 | 6 | 3 | 10 | 6 | 3 |
| TOC | 15 | 15 | 10 | 0.5 | 0.5 | 0.2 |
| MOC | 20 | 15 | 10 | 10 | 10 | 5 |

Table 4: Interrupting capacity auxiliary switch contacts²

Footnotes:

- ¹ Two contacts in series.
- ² All switch contacts are non-convertible.

| Voltage class | Ratio | Accuracy class at 120 V sec. | | VA thermal rating (55 °C amb) |
|-----------------------|--|------------------------------|-----|----------------------------------|
| | | W, X, Y, Z | ZZ | |
| 38 kV one bushing | 20,125/115 | 0.3 | 1.2 | 1,000 |
| 38 kV two bushings | 24,000/120 27,600/115 34,500/115 | 0.3 | 1.2 | 1,000 |

Table 5: VTs

Technical data

| Ratio | 60 Hz metering accuracy at burden | | | | Relay class |
|--|-----------------------------------|------|------|------|-------------|
| | B0.1 | B0.5 | B1.0 | B2.0 | |
| Type MD38A toroidal standard accuracy | | | | | |
| 100:5 | 2.4 ² | ---- | ---- | ---- | C10 |
| 150:5 | 1.2 | 4.8 | ---- | ---- | C20 |
| 200:5 | 0.6 | 2.4 | ---- | ---- | C25 |
| 250:5 | 0.6 | 1.2 | 2.4 | ---- | C35 |
| 300:5 | 0.6 | 1.2 | 2.4 | 2.4 | C40 |
| 400:5 | 0.3 | 0.6 | 1.2 | 2.4 | C60 |
| 500:5 | 0.3 | 0.3 | 0.6 | 1.2 | C75 |
| 600:5 ³ | 0.3 | 0.3 | 0.6 | 1.2 | C100 |
| 800:5 | 0.3 | 0.3 | 0.6 | 0.6 | C130 |
| 1,000:5 | 0.3 | 0.3 | 0.3 | 0.3 | C170 |
| 1,200:5 ³ | 0.3 | 0.3 | 0.3 | 0.3 | C200 |
| 1,500:5 | 0.3 | 0.3 | 0.3 | 0.3 | C200 |
| 2,000:5 ³ | 0.3 | 0.3 | 0.3 | 0.3 | C210 |
| 2,500:5 | 0.3 | 0.3 | 0.3 | 0.3 | C300 |
| 3,000:5 ³ | 0.3 | 0.3 | 0.3 | 0.3 | C300 |
| Type MDD38A toroidal special accuracy | | | | | |
| 50:5 | 4.8 ² | ---- | ---- | ---- | C10 |
| 75:5 | 2.4 ² | ---- | ---- | ---- | C15 |
| 100:5 | 2.4 | 4.8 | ---- | ---- | C20 |
| 150:5 | 1.2 | 2.4 | 4.8 | 4.8 | C30 |
| 200:5 | 0.6 | 1.2 | 2.4 | 4.8 | C40 |
| 250:5 | 0.6 | 1.2 | 1.2 | 2.4 | C50 |
| 300:5 | 0.3 | 0.6 | 1.2 | 2.4 | C60 |
| 400:5 | 0.3 | 0.6 | 0.6 | 1.2 | C90 |
| 500:5 | 0.3 | 0.3 | 0.6 | 0.6 | C110 |
| 600:5 ³ | 0.3 | 0.3 | 0.6 | 0.6 | C130 |
| 800:5 | 0.3 | 0.3 | 0.3 | 0.3 | C190 |
| 1,000:5 | 0.3 | 0.3 | 0.3 | 0.3 | C200 |
| 1,200:5 ³ | 0.3 | 0.3 | 0.3 | 0.3 | C280 |
| 1,500:5 | 0.3 | 0.3 | 0.3 | 0.3 | C340 |
| 2,000:5 ³ | 0.3 | 0.3 | 0.3 | 0.3 | C330 |
| 2,500:5 | 0.3 | 0.3 | 0.3 | 0.3 | C420 |
| 3,000:5 ³ | 0.3 | 0.3 | 0.3 | 0.3 | C500 |

Table 6: Current transformers¹

Footnotes:

- ¹ 1-second through-current and momentary current are equal to the ratings of the associated circuit breakers.
- ² Exceeds ANSI/IEEE C37.20.2 accuracy limit.
- ³ Multi-ratio current transformers available. The accuracy ratings shown apply only to the full secondary winding.

Dimensions

| Type | Dimensions in inches (mm) | | | | Weight in lbs (kg) |
|---------------------------------|---------------------------|---------------------------|----------------|-------------------------------|--------------------|
| | Height | Width | Depth | Drawout aisle ^{4, 5} | |
| Indoor GM38 | 110.0 (2,794) | 48.0 (1,219) | 130.0 (3,302) | 96.0 (2,438) recommended | 5,000 (2,273) |
| Shelter-Clad single-aisle SGM38 | 132.5 (3,366) | 48.0 (1,219) ¹ | 234.5 (5,956) | 96.0 (2,438) included | 6,400 (2,909) |
| Shelter-Clad common-aisle SGM38 | 132.5 (3,366) | 48.0 (1,219) ¹ | 363.75 (9,239) | 96.0 (2,438) included | 11,700 (5,318) |
| Aisle-less non-walk-in OGM38 | 130.5 (3,315) | 48.0 (1,219) | 139.35 (3,539) | 96.0 (2,438) recommended | 5,800 (2,636) |

Table 7: Cubicle dimensions per vertical section^{1,3,6,7}

| Continuous current (A) | Circuit breaker type | | |
|------------------------|----------------------|-------------|--------------|
| | 38-3AH3-31 | 38-3AH3-40 | 38-3AH3-1500 |
| 1,200 | 800 (364) | 850 (387) | 800 (364) |
| 2,000 | 900 (409) | 950 (432) | 900 (409) |
| 3,000 | 1,000 (455) | 1,050 (478) | 1,000 (455) |

Table 8: Type 38-3AH3 vacuum circuit breaker weight in lbs. (kg)^{2,3,8}

Footnotes:

- ¹ Weight does not include circuit breakers, add separately from Table 8: Type 38-3AH3 vacuum circuit breaker weight in lbs (kg)^{2,3,8}.
- ² Weight estimates are for circuit breaker only. Add 125 lbs (57 kg) for packaging.
- ³ Weight and dimensions are approximate.
- ⁴ Add 6" (152 mm) to each end of lineup for aisle extension 12" (304 mm) total.
- ⁵ 96" (2,438 mm) aisle space is recommended and allows room for interchange of circuit breakers. Minimum aisle space required for handling circuit breaker is 80" (2,030 mm).
- ⁶ Add for roof overhang:

| | | |
|----------------------|-----------------|----------------|
| Rear (cable side) | Non-walk-in | Shelter-Clad |
| Front (drawout side) | 3.875" (98 mm) | 3.875" (98 mm) |
| | 6.875" (175 mm) | 1.5" (38 mm) |
- ⁷ If indoor switchgear is installed on a raised "housekeeping" pad, the pad must not extend further than 3" (75 mm) from the front of the switchgear to avoid interference with the use of the portable lift truck.
- ⁸ Approximate circuit breaker dimensions in inches (mm) (W x D x H):

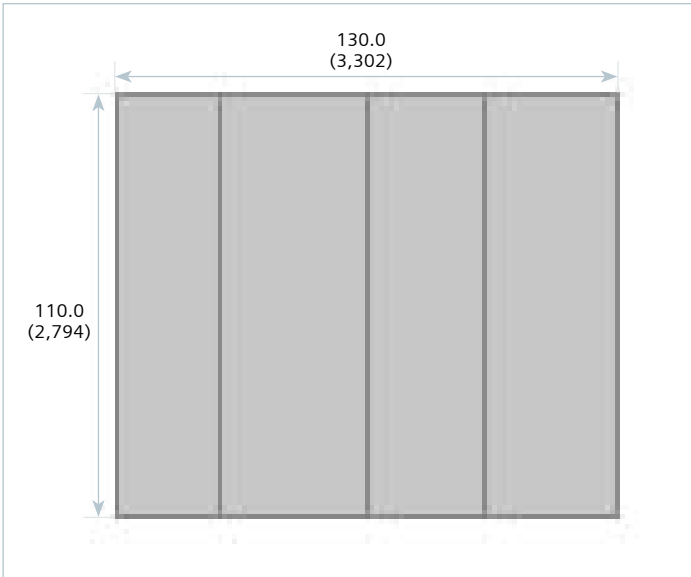
| | |
|-----|--|
| Net | 44" (1,117 mm) x 46" (1,168 mm) x 51" (1,294 mm) |
|-----|--|

 Packed for shipment separate from switch gear:

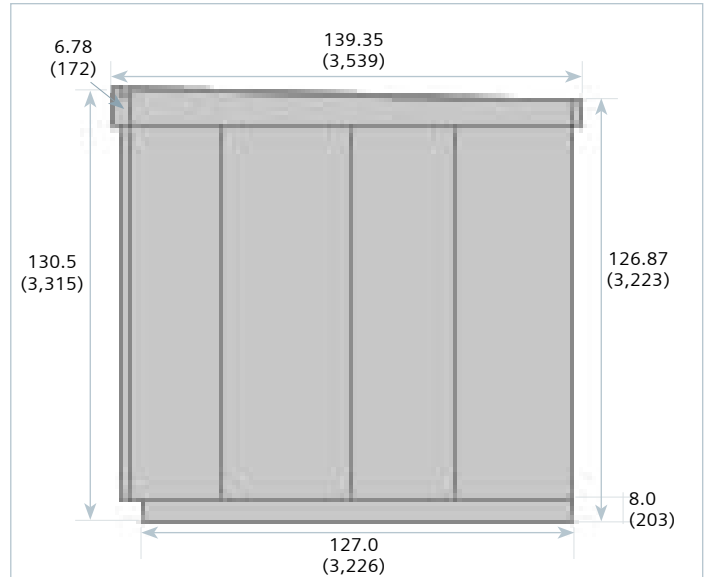
| | |
|--|---|
| | 48" (1,218 mm) x 48" (1,218 mm) x 60" (1,522 mm). |
|--|---|

Dimensions

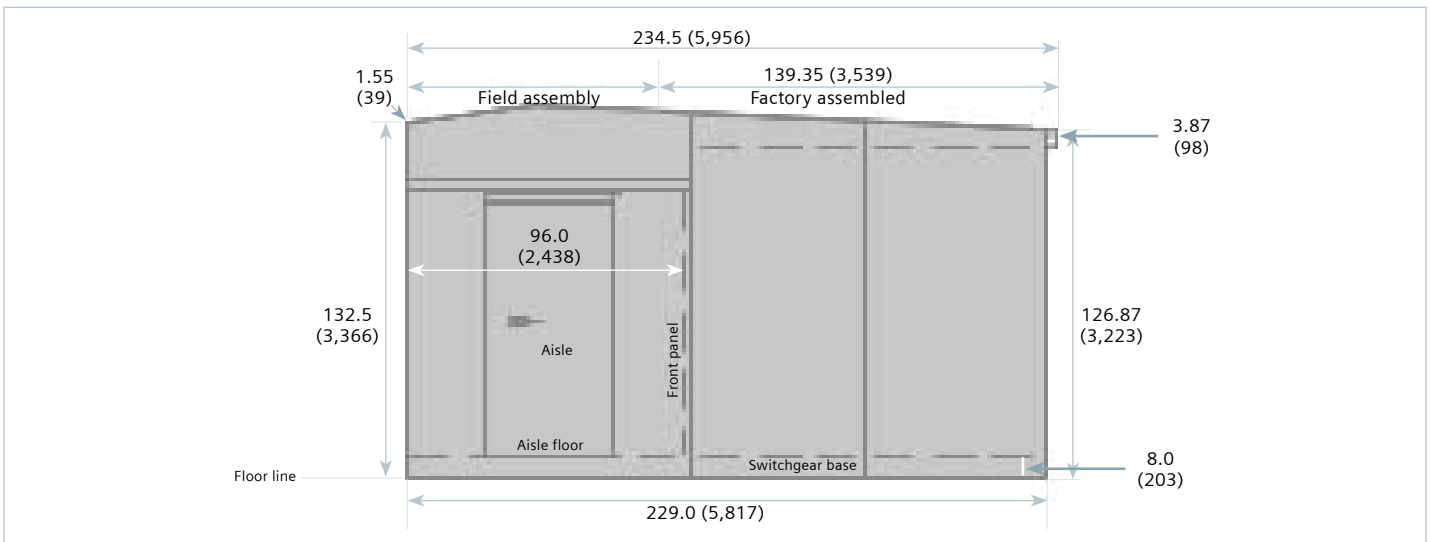
Figure 28: Switchgear end views



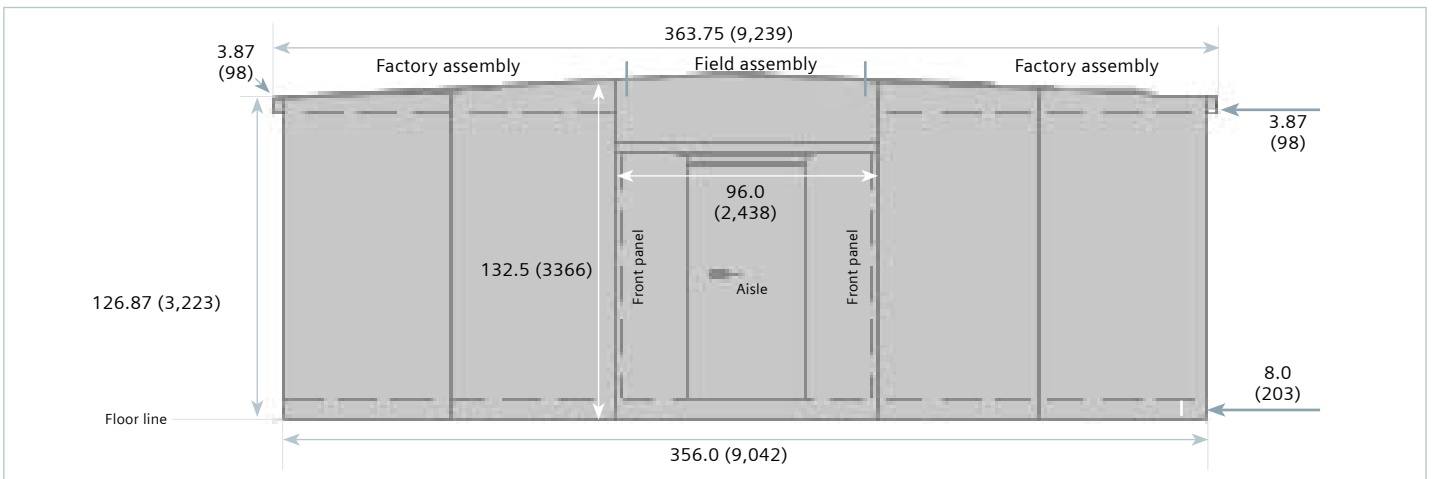
Type GM38 indoor switchgear



Type OGM38 non-walk-in outdoor switchgear



Type SGM38 Shelter-Clad single-aisle outdoor switchgear



Type SGM38 Shelter-Clad common-aisle outdoor switchgear

Dimensions

| A | B | C | D | E | F | G | H | J | K | L | M |
|------------------|-----------------|-----------------|---------------|------------------|------------------|-------------------|--------------|-----------------|------------------|------------------|---------------|
| 130.0 (3,302) | 48.0 (1,219) | 40.0 (1,016) | 4.25 (109) | 22.0 (559) | 4.0 (102) | 7.5 (191) | 3.5 (89) | 4.25 (109) | 43.75 (1,111) | 45.68 (1,160) | 0.12 (3) |
| N | P | Q | R | S | T | U | V | W | X | Y | Z |
| 42.12 (1,070) | 2.82 (72) | 2.13 (54) | 1.16 (29) | 45.84 (1,164) | 87.06 (2,211) | 126.91 (3,224) | 6.0 (152) | 47.5 (1,207) | 96.0 (2,438) | 99.0 (2,515) | 7.38 (187) |

Table 9: Type GM38 switchgear floor plan detail dimensions in inches (mm) ³

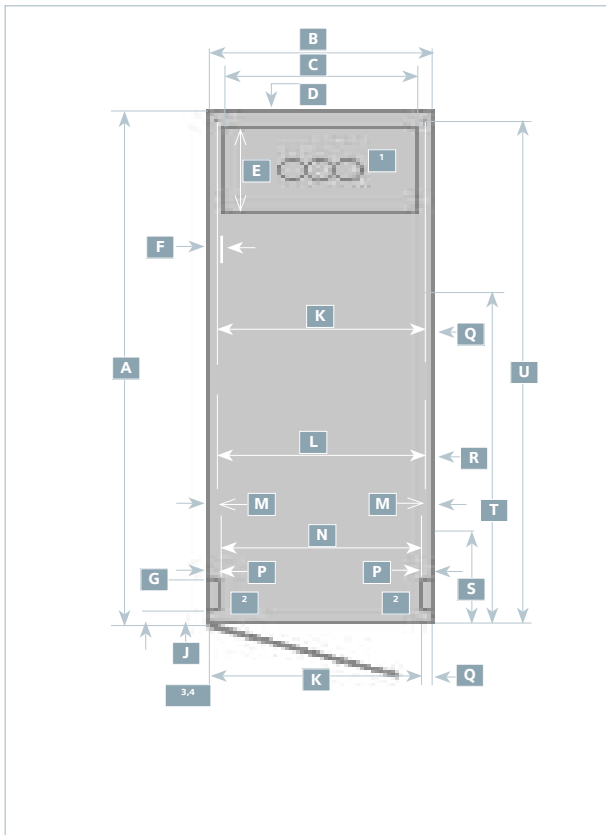


Figure 29: Indoor type GM38 switchgear floor plan

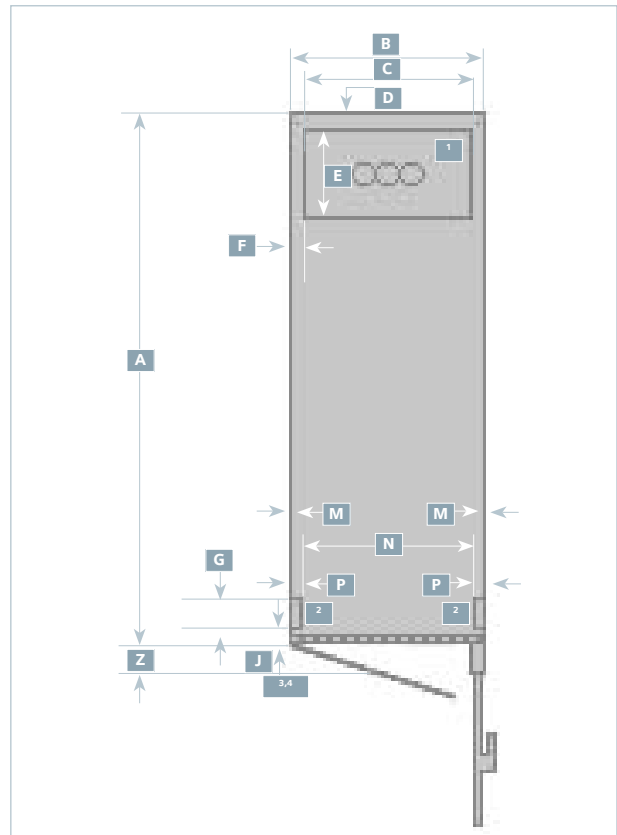


Figure 30: Outdoor type OGM38 non-walk-in switchgear floor plan

Footnotes:

- ¹ Recommended location of conduits for power cables, top or bottom.
- ² Recommended location of secondary leads, top or bottom.
- ³ Allow 6" (152 mm) clearance for lift truck on each end.
- ⁴ Floor must be level 80" (2,032 mm) in front of switchgear to allow proper operation of lift truck.

Dimensions

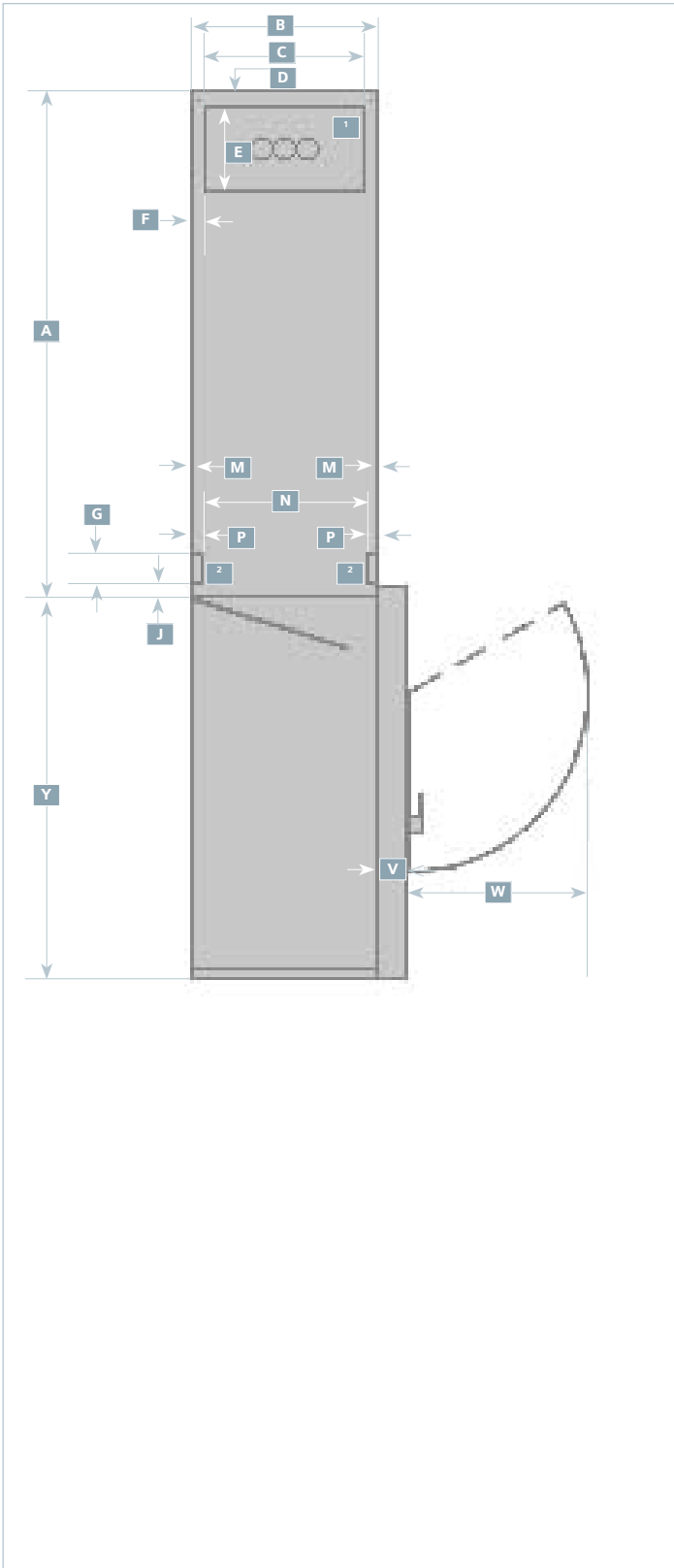


Figure 31: Outdoor type SGM38 Shelter-Clad walk-in single-aisle switchgear floor plan

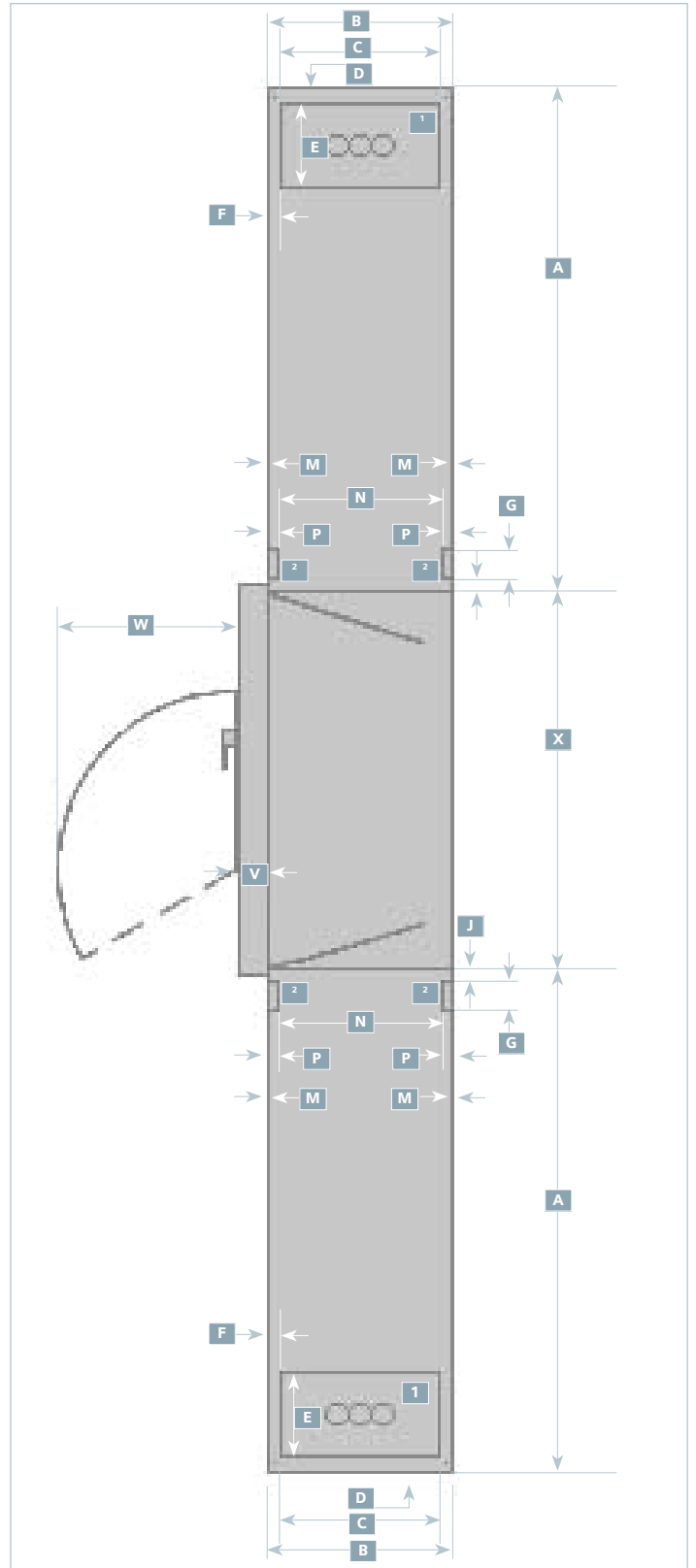


Figure 32: Outdoor type SGM38 Shelter-Clad walk-in common-aisle switchgear floor plan

Side views

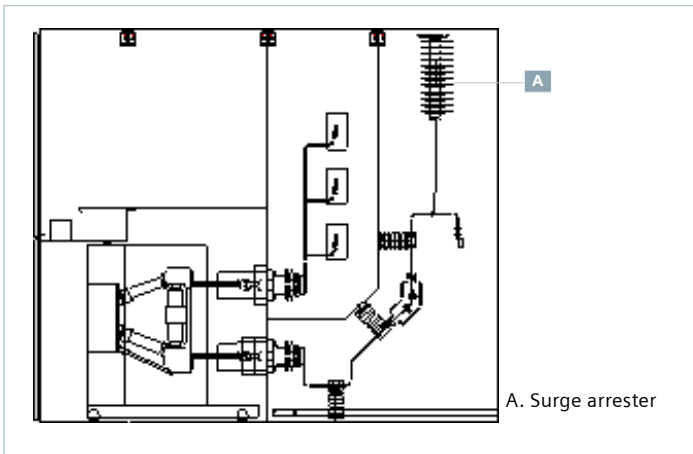


Figure 33: Auxiliary/1,200A, 2,000 A or 3,000 A circuit breaker (no drawout auxiliaries in upper cell for 3,000 A fan-cooled circuit breaker)

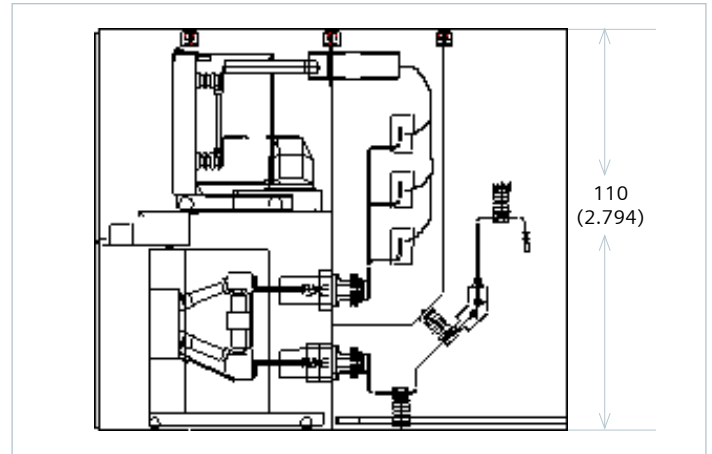


Figure 34: Circuit breaker 1,200 A or 2,000 A with VT auxiliary (downfeed cables)

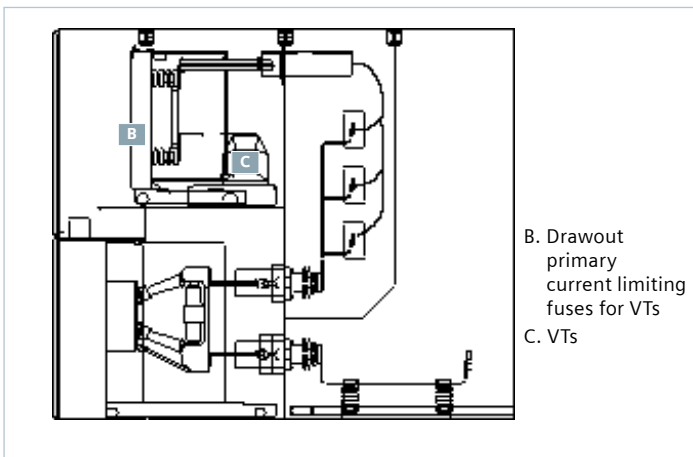


Figure 35: VT auxiliary/1,200 A or 2,000 A circuit breaker (upfeed cables)

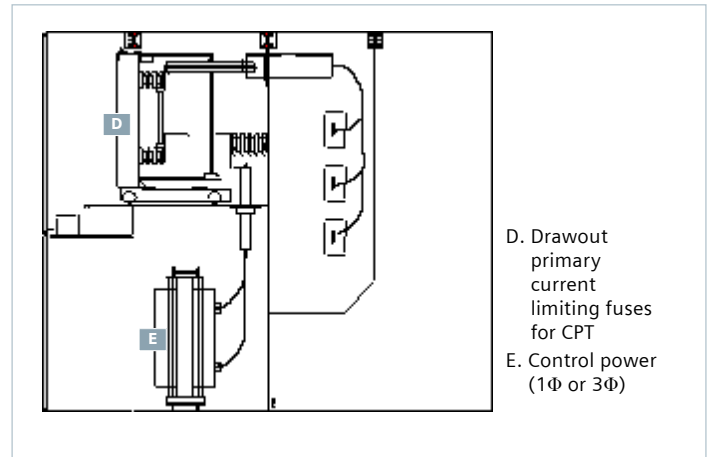


Figure 36: CPT fuse truck/stationary CPT 1Φ or 3Φ

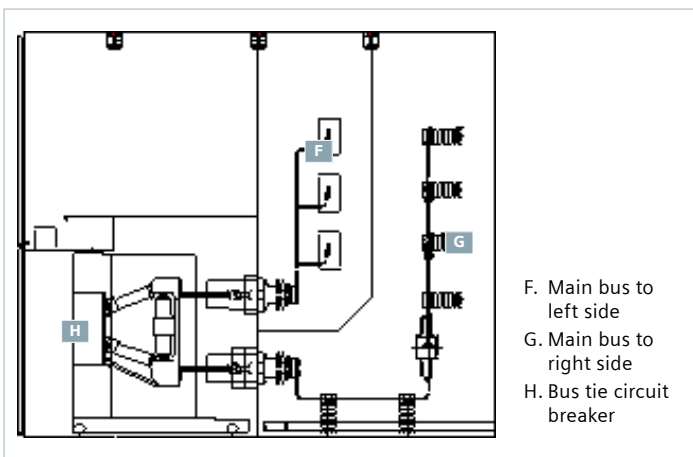


Figure 37: Auxiliary/Bus Tie Circuit Breaker

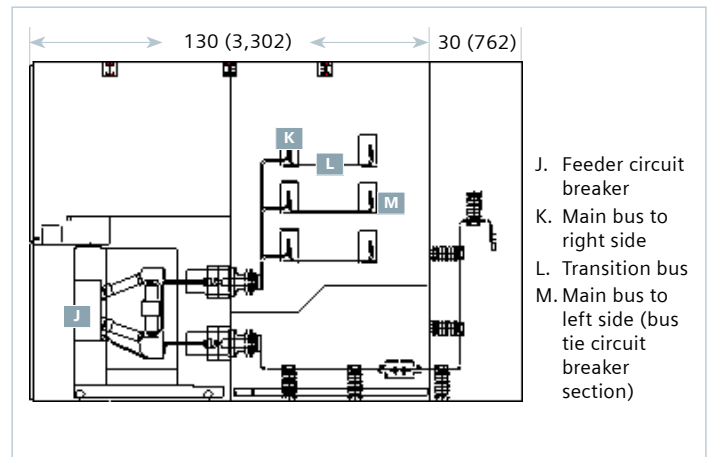


Figure 38: Auxiliary/feeder circuit breaker (adjacent to right side of bus tie circuit breaker section)

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