

Medium Voltage Equipment

5-15 kV GM-SG and 38 kV GM38 Metal-Clad Switchgear

General

Overview

Siemens 5, 7, 15 and 38kV class medium voltage, one- or two-high vacuum circuit breaker switchgear is of the metal-clad type as covered by ANSI standard C37.20.2. All parts are completely enclosed within grounded metal barriers. Circuit breakers are the horizontal drawout type. Secondary control devices and primary circuits are isolated from each other by shutters or barriers. Primary circuits of different potential are also separated by barriers. All primary bus work and joints are completely encased with insulation material to suit the voltage class of the equipment.

Each vertical section may contain a main bus bar section and two compartments for auxiliary devices and / or circuit breakers, with primary and secondary disconnects, instrument transformers, instruments and relays, secondary wiring and other necessary components. The switchgear is designed so that additional vertical sections with circuit breakers and / or auxiliary compartments may be added in the future.

The space saving potential of the 5-15kV type GM-SG cubicle and GMSG circuit breaker designs allows up to two drawout elements to be furnished in a single vertical section. The units can be furnished with two 2000 ampere circuit breakers in one unit. For 3000 ampere self-cooled or 4000 ampere fan-cooled circuit breakers, one rollout auxiliary can be located in the lower cell, with the circuit breaker in the upper cell; or the cell can be left blank, with the circuit breaker located in the lower cell.

Features

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 and Shelter-Clad (walk-in) outdoor installations. A lift truck accessory is optionally available for handling circuit breakers in the upper cell of the 5-15kV GM-SG switchgear, or in non-walk-in outdoor enclosures, or for installations of switchgear on a raised "housekeeping" pad.

Closed Door Racking

The cell mounted racking mechanism may be operated with the cell door open or closed, through a small opening in the lower section of each door. For racking, a manual drive crank or an optional electric motor drive may be used.

Automatic Shutters

Automatically operated grounded steel shutters are included to allow or block access to the stationary primary disconnects. The shutters are designed to remain closed until they are forced open by insertion of the circuit breaker. This design maximizes protection for maintenance personnel, as compared to racking mechanism operated shutters, which could be opened with the circuit breaker out of the cell thereby exposing personnel to energized components.

White Interior Device Panels in Front Compartments Standard

5 through 15kV Available in Two-High Design

38kV Available in One-High Design Only

Tested to ANSI Standards

Siemens switchgear is tested to meet the requirements of ANSI 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. Certified test data can be furnished to customers upon request. These tests encompass the complete equipment design, including both the switchgear structure and the circuit breaker removable element.

4000A Rating (5-15kV)

Designs are available to 3000A self-cooled, and 4000A fan cooled.

3000A Rating (38kV)

Designs are available to 2000A self-cooled and 3000A fan cooled.

UL listing

UL listings to ANSI C37.54/C37.55 standards is optionally available.

cUL Available

50kA Interrupting Rating Available at up to 15kV

Siemens Relays, see Relaying section on page 13-25



For more information, please visit <http://automation.usa.siemens.com/consultant/> or contact your local sales office.

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GM-SG Overview

General

Siemens GM-SG 5kV, 7.2kV and 15kV metal-clad power switchgear assemblies with horizontal drawout type GMSG vacuum circuit breakers take advantage of the latest developments in vacuum interrupter technology. Up to two circuit breakers can be stacked in a single vertical section, allowing significant space savings.

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

GM-SG 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, motors, generators, 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 GM-SG 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 3AH3 Operating Mechanism

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

Faster Interruption

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

Siemens Vacuum Interrupters

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

Front Mounted Operating Mechanism

The simple GMSG 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 ten 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 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.

"Universal" Spare Breaker (up to 50kA)

The physical configuration and interlock logic allow the use of a single circuit breaker to serve as a "universal" spare breaker at an installation site for up to 50kA. 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 circuit breaker equals or exceeds 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, and shipped in the switchgear to assure interchangeability and reduce the possibility of damage to circuit breakers in shipment.

Full ANSI Design Background

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

UL or C-UL Listing Available

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

Quality Systems

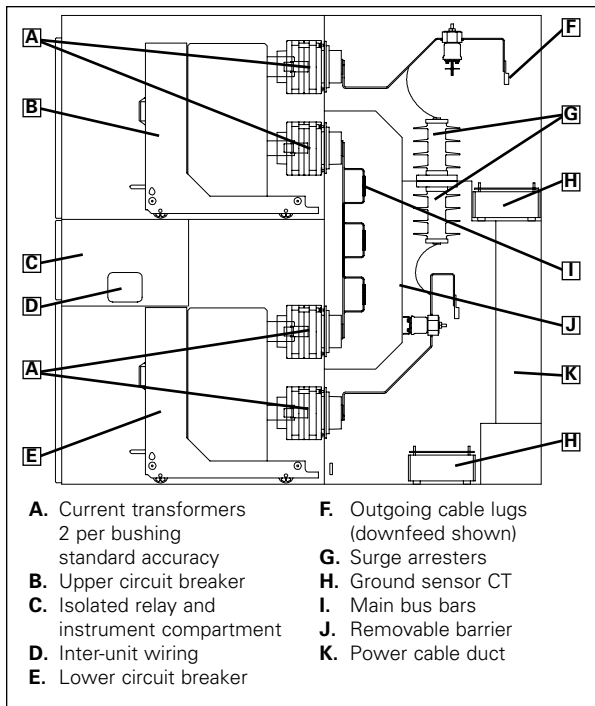
Facilities involved with application, engineering, design and production are certified to ISO 9001 requirements.

Medium Voltage Equipment

GM-SG Overview

General

Figure 1: GM-SG Switchgear 1200A or 2000A
Circuit Breaker Section



Structural Flexibility

Siemens GM-SG metal-clad switchgear provides enhanced flexibility in locating circuit breaker, auxiliary, and metering cells within the structure layout. Circuit breakers rated 1200A and 2000A may be located in upper or lower cell positions.

Bus sectionalizing (tie) circuit breaker cells may be located on the upper or lower levels and are ordinarily located next to an auxiliary cell on the same level to accommodate transition bus work.

3000A circuit breakers can be located either in the bottom cell or the top cell of a vertical section. If the 3000A circuit breaker is located in the lower cell, the upper cell can be used for metering devices only. If the 3000A circuit breaker is in the upper cell, the lower cell may be used to house a set of drawout voltage transformers, or a drawout control power transformer, or rollout fuses for a remote control power transformer.

The 3000A circuit breaker can be used for 4000A continuous current applications, with the addition of fan cooling equipment in the auxiliary cell above or below the circuit breaker. This application of fan cooling is well suited if loads above 3000A are infrequent, as for example, in the case of a fan-cooled rating on a power transformer.

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

a central secondary device compartment, located between two cells for auxiliary devices and / or circuit breakers, including primary and secondary disconnects, instrument transformers, instruments and relays, secondary wiring, and other components as necessary. The switchgear is normally designed so that additional vertical sections may be added in the future.

Enclosure Design

The GM-SG 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 individually removable to allow separate access either to downfeed or upfeed cable connections.

The structure is constructed of bolted steel for better dimensional control than with welded designs. Sheet steel interunit 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 all circuit breaker cells.

Circuit Breaker Interchangeability

The GM-SG switchgear cubicle and the removable GMSG 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 GMSG circuit breaker is not interchangeable with the older designs.

A circuit breaker of higher rating (up to 50kA) can be used in a cell of equal or lower rating, i.e., a 3000A 50kA 15kV circuit breaker can be used in a 1200A 25kA 15kV circuit breaker cell.

Tested to ANSI/IEEE Standards

Siemens GM-SG 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 all 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 IEEE C37.20.7. Qualification to seismic requirements of various codes (e.g., IBC-2006, UBC, IEEE 693, etc.) is available. Consult Siemens with detailed requirements.

UL or C-UL Listing Available

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

Medium Voltage Equipment

GM-SG Vacuum Circuit Breakers

General

Type GMSG Vacuum Circuit Breakers 5kV, 7.2kV and 15kV

Siemens Type GMSG circuit breakers are available in 25kA through 63kA* interrupting classes, or 250MVA through 1000MVA on the older "constant MVA" rating basis. Continuous current ratings include 1200A, 2000A, and 3000A self-cooled. 4000A is available using a 3000A circuit breaker together with forced-air (fan) cooling in the switchgear cubicle.

*Consult factory for availability of 63kA

Maintenance Features

The GMSG circuit breakers incorporate many features designed to reduce and simplify maintenance, including:

- Virtually maintenance-free vacuum interrupter
- Ten year maintenance interval
- Floor rollout
- Front mounted operator
- Common operator family
- Simple outer-phase barriers
- "Universal" spare circuit breaker concept
- Non-sliding current transfer
- Rugged secondary disconnects

Ten Year Maintenance Interval on GMSG Circuit Breaker

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

Low Maintenance Requirements

The 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 hi-pot test can be used.

Floor Rollout

When located in the lower cell, the circuit breakers are arranged to rollout directly on the floor in front of the switchgear if the switchgear is not located on a "housekeeping" pad. No adapter, hoist, or lift truck is necessary.

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 GMSG circuit breaker utilizes the Siemens 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.

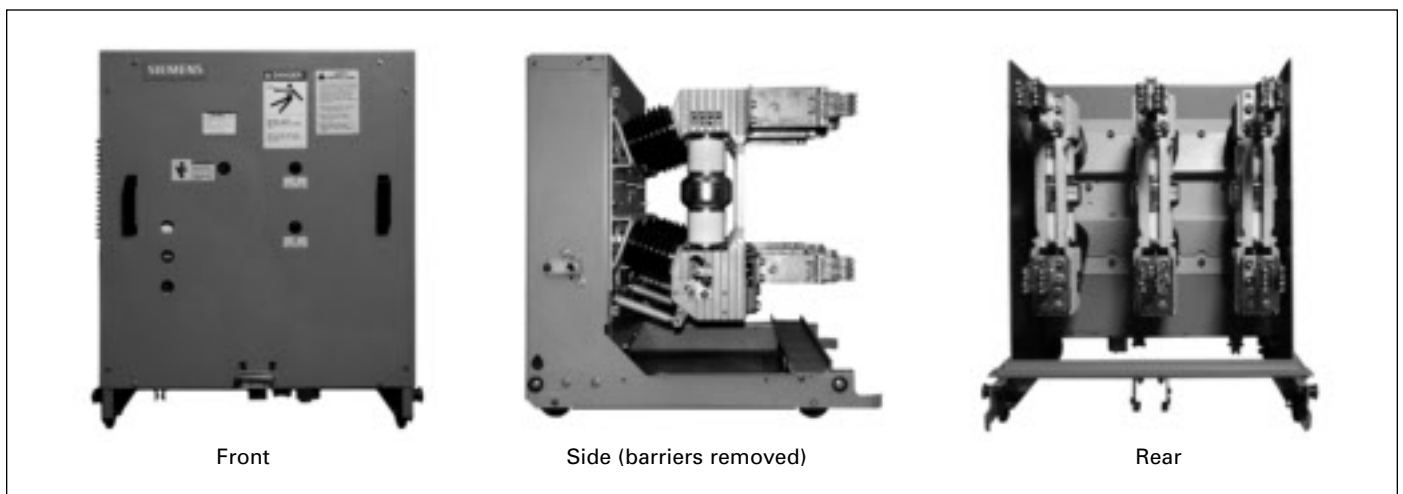


Figure 2: GMSG Circuit Breaker

Medium Voltage Equipment

GM-SG Ratings

Selection

Table 1: Type GMSG Circuit Breaker Ratings (New “Constant kA” Ratings Basis)

These ratings are in accordance with the following standards:

- ANSI/IEEE C37.04-1999 Standard Rating Structure for AC High-Voltage Circuit Breakers
- ANSI C37.06-2000 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							
			5-GMSG-40 xxxx-104	5-GMSG-50 xxxx-130	5-GMSG-63 ^② xxxx-164	7-GMSG-40 xxxx-104	15-GMSG-25 xxxx-65	15-GMSG-40 xxxx-104	15-GMSG-50 xxxx-130	15-GMSG-63 ^② xxxx-164
Maximum Design Voltage (V) ^②		kV rms	4.76	4.76	4.76	8.25	15.0	15.0	15.0	15.0
Voltage Range Factor (K) ^③		—	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Withstand Voltage Levels	Power Frequency	kV rms	19	19	19	36	36	36	36	36
	Lightning Impulse (BIL)	kV crest	60	60	60	95	95	95	95	95
Continuous ^④		A rms	1200 2000 3000 4000FC	1200 2000 3000 4000FC	1200 2000 3000 4000FC	1200 2000 3000 4000FC	1200 2000 3000 4000FC	1200 2000 3000 4000FC	1200 2000 3000 4000FC	1200 2000 3000 4000FC
Short-Circuit (I) ^{⑤⑥}		kA rms sym	40	50	63	40	25	40	50	63
Interrupting Time ^⑦		ms cycles	83 5	83 5	83 5	83 5	83 5	83 5	83 5	83 5
Permissible Tripping Delay (Y)		Sec	2	2	2	2	2	2	2	2
Max. Sym. Interrupting (I)		kA rms sym	40	50	63	40	25	40	50	63
% dc Component		%	47	47	47	47	47	47	47	47
Short-Time Current (I) (3 seconds)		kA rms	40	50	63	40	25	40	50	63
Closing & Latching (Momentary) Asymmetrical (1.55 x I)		kA rms	62	78	98	62	39	62	78	98
Closing & Latching (Momentary) Peak (2.6 x I)		kA peak	104	130	164	104	65	104	130	164

① “xxxx” in type designation refers to the continuous current rating 1200, 2000, or 3000A, as appropriate. The 4000A fan-cooled rating is achieved using a 3000A circuit breaker, in combination with 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 4000FC indicates that fan cooling is included in the switchgear structure for this rating. 4000A rating is not available in outdoor equipment.

⑤ All values apply to polyphase and line-to-line faults.

⑥ Standard duty cycle is O - 0.3s - CO - 3 min. - CO.

⑦ Standard rated interrupting time is 5 cycles (83ms). Optional rated interrupting time of 3 cycles (50ms) is available.

⑧ Consult factory for availability.

Medium Voltage Equipment

GM-SG Ratings

Selection

Table 2: Type GMSG Circuit Breaker Control Data^④

Control Voltages, ANSI C37.06			Close Coil	Trip Coil	Spring Charging Motor	
Nominal	Range				Amperes	Charging
	Close	Trip			Amperes ^①	Run (Avg.) ^①
24 VDC	19 - 28	14 - 28	5.8	17 / —	—	—
48 VDC	36 - 56	28 - 56	2.9	11.4 / 30	8	10
125 VDC	100 - 140	70 - 140	1.0	4.8 / 7.4	4	10
250 VDC	200 - 280	140 - 280	0.5	2.1 / 4.2	2	10
120 VAC	104 - 127	104 - 127	0.9	— ②	6	10
240 VAC	208 - 254	208 - 254	0.4	— ②	3	10

^① Current at nominal voltage.

^② Capacitor trip.

^③ Value preceding slash (/) is the current for the standard trip coil with standard rating interrupting time. Value following (/) is current for optional trip coil with 3-cycle interrupting time.

^④ — means this selection not available in this voltage.

Table 3: Interrupting Capacity Auxiliary Switch Contacts^②

Type Switch	Continuous Current Amperes	Control Circuit Voltage				
		120 AC	240 AC	48 DC	125 DC	250 DC
Circuit Breaker	10	10	5	10 / 30 ^①	5	3
TOC	15	15	10	0.5	0.5	0.2
MOC	20	15	10	10	10	5

^① 2 contacts in series.

^② All switch contacts are non-convertible.

Table 4: Voltage Transformers

Voltage Class	Ratio	Accuracy Class at 120V Sec.			VA Thermal Rating
		X, Y, Z	Z	ZZ	
5kV	2400 / 120	0.3	1.2	—	500
5kV	4200 / 120	0.3	1.2	—	500
5kV	4800 / 120	0.3	1.2	—	500
15kV	7200 / 120	0.3	0.3	1.2	1000
15kV	8400 / 120	0.3	0.3	1.2	1000
15kV	12000 / 120	0.3	0.3	1.2	1000
15kV	14400 / 120	0.3	0.3	1.2	1000

Table 5: Current Transformers^①

Ratio	60Hz Metering Accuracy at Burden				Relay Class
	B0.1	B0.5	B1.0	B2.0	
Type MD Torroidal Standard Accuracy					
100:5	2.4 ^②	—	—	—	C 15
150:5	0.6	2.4	—	—	C 20
200:5	0.6	1.2	—	—	C 25
250:5	0.6	1.2	2.4	—	C 35
300:5	0.6	0.6	1.2	2.4	C 40
400:5	0.3	0.6	1.2	2.4	C 60
500:5	0.3	0.3	0.6	1.2	C 75
600:5 ^③	0.3	0.3	0.6	1.2	C100
800:5	0.3	0.3	0.6	0.6	C130
1000:5	0.3	0.3	0.3	0.3	C170
1200:5 ^③	0.3	0.3	0.3	0.3	C200
1500:5	0.3	0.3	0.3	0.3	C200
2000:5 ^③	0.3	0.3	0.3	0.3	C210
2500:5	0.3	0.3	0.3	0.3	C300
3000:5 ^③	0.3	0.3	0.3	0.3	C240
4000:5 ^③	0.3	0.3	0.3	0.3	C230
Type MDD Torroidal Special Accuracy					
75:5	2.4 ^②	4.8	—	—	C 20
100:5	1.2	2.4	—	—	C 30
150:5	0.6	1.2	2.4	4.8	C 40
200:5	0.6	1.2	1.2	2.4	C 60
250:5	0.3	0.6	1.2	2.4	C 80
300:5	0.3	0.6	0.6	1.2	C100
400:5	0.3	0.3	0.6	0.6	C130
500:5	0.3	0.3	0.3	0.6	C160
600:5 ^③	0.3	0.3	0.3	0.3	C210
800:5	0.3	0.3	0.3	0.3	C270
1000:5	0.3	0.3	0.3	0.3	C340
1200:5 ^③	0.3	0.3	0.3	0.3	C425
1500:5	0.3	0.3	0.3	0.3	C510
2000:5 ^③	0.3	0.3	0.3	0.3	C460
2500:5	0.3	0.3	0.3	0.3	C580
3000:5 ^③	0.3	0.3	0.3	0.3	C660
4000:5 ^③	0.3	0.3	0.3	0.3	C460

^① 1-second through-current and momentary current are equal to the ratings of the associated circuit breakers.

^② Exceeds ANSI C37.20.2 Accuracy Limit.

^③ Multi-ratio current transformers available. The accuracy ratings shown apply only to the full secondary winding.

Medium Voltage Equipment

GM-SG

Dimensions

Table 6: Cubicle Dimensions Per Vertical Section^{①③}

Type	Dimensions in Inches (mm)				Weight in lbs. (kg)
	Height	Width	Depth	Drawout Aisle	
Indoor GM-SG	95.25 (2419)	36.0 (914)	98.5 (2502) ^⑦	72.0 (1829) recommended ^⑤	3300 (1497)
Shelter-Clad Single-Aisle SGM-SG	114.75 (2915)	36.0 (914) ^④	173.5 (4407) ^④	72.0 (1829) included	5000 (2268)
Shelter-Clad Common Aisle SGM-SG	114.75 (2915)	36.0 (914) ^④	269.0 (6833) ^⑤	72.0 (1829) included	8900 (4037)
Aisle-Less Non-Walk-In OGM-SG	113.62 (2886)	36.0 (914) ^④	101.9 (2588) ^⑤	72.0 (1829) recommended ^⑤	3950 (1792)

Table 7: GMSG Vacuum Circuit Breaker Weight in lbs. (kg)^{②③}

Continuous Current (A)	Circuit Breaker Type							
	5-GMSG-40 5-GMSG-250	5-GMSG-50 5-GMSG-350	5-GMSG-63	7-GMSG-40 7-GMSG-500	15-GMSG-25 15-GMSG-500	15-GMSG-40 15-GMSG-750	15-GMSG-50 15-GMSG-1000	15-GMSG-63
1200	440 (200)	455 (206)	809 (368)	455 (206)	430 (195)	445 (202)	460 (209)	819 (372)
2000	650 (295)	665 (302)	819 (372)	665 (302)	640 (290)	670 (304)	675 (306)	829 (377)
3000	665 (302)	670 (304)	824 (375)	675 (306)	—	675 (306)	680 (308)	834 (379)

① Weight does not include circuit breakers, add separately from table 7.

② Weight estimates are for circuit breaker only. Add 75 lbs (34 kg) if shipped separately packaged.

③ Weight and dimensions are approximate.

④ Add 6" (152 mm) to each end of lineup for aisle extension 12" (304 mm) total.

⑤ 72" (1829 mm) aisle space recommended allows room for interchange of circuit breakers. Minimum aisle space required for handling circuit breaker with lift truck is 65" (1651 mm). Minimum aisle space required if all circuit breakers are at floor level is 54" (1372 mm).

⑥ Add for roof overhang.

	Non-Walk-In	Shelter-Clad
Rear (cable side)	3.62" (92 mm)	3.62" (92 mm)
Front (drawout side)	5.37" (136 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	32" (813 mm) X 39" (991 mm) X 36" (914 mm)
If packed for shipment separate from switchgear:	42" (1067 mm) X 47" (1194 mm) X 43" (1092 mm)



Medium Voltage Equipment

GM-SG Stacking Versatility

Dimensions

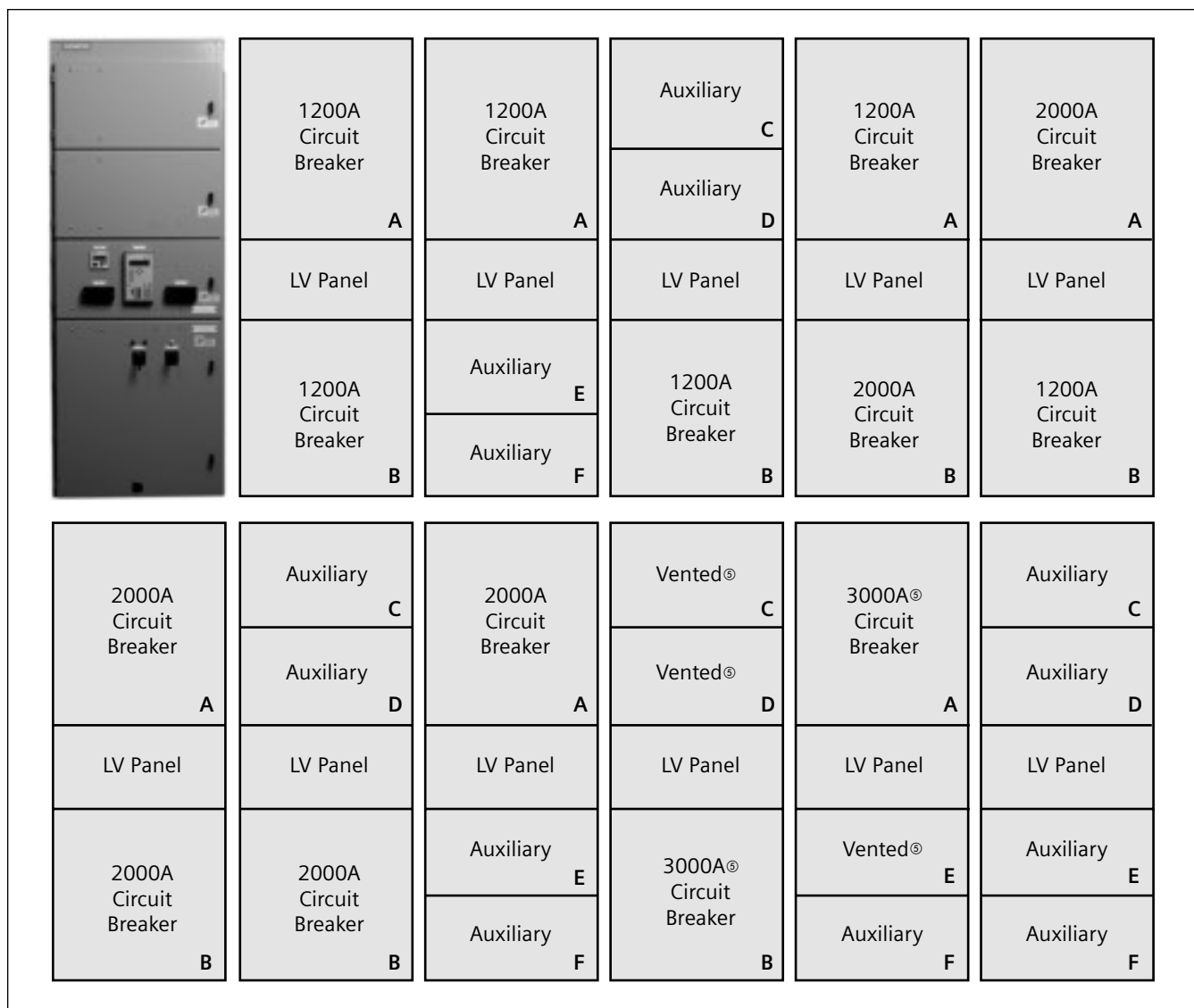


Figure 3: GM-SG Stacking Versatility

- ① Main bus sizes 1200A, 2000A, 3000A or 4000A (self-cooled).
- ② No rollout auxiliaries allowed in upper cell (C or D) if lower cell (B) has 3000A circuit breaker. If 3000A circuit breaker is located in upper cell (A), one rollout auxiliary may be located in lower cell F.
- ③ Auxiliary cells (C, D, E, or F) may each contain 1 rollout (except as indicated in notes 2 and 5).
- ④ Fuse rollout for stationary control power transformer must be located in lower rollout cell F, if CPT is located in rear or is remote. If CPT is located in lower auxiliary cell (E and F), fuse rollout is located in upper auxiliary cell.

- ⑤ For fan cooled 4000A rating, circuit breaker (3000A self-cooled, 4000A fan-cooled) may be located in upper cell (A) with fan cooling in cell E, or may be located in lower cell (B) with fan cooling in cells C and D.
- ⑥ Stacking arrangements are available as shown. Total circuit breaker loading in a vertical unit may not exceed main bus rating. Consult Siemens for specific application assistance regarding total load limits in each unit, or refer to ANSI/IEEE C37.20.2.

Medium Voltage Equipment

GM-SG Accessories

General

Standard Accessories Include:

- Manual racking crank
- Spring charging crank
- Drawout extension rails (facilitate handling of circuit breakers in upper cell)
- Lifting sling (for circuit breakers above floor level)
- Split plug jumper (standard unless test cabinet is furnished)
- Contact lubricant
- Touch up paint

Optional Accessories Include:

- Circuit breaker lift device
- 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)
- Manual or electrical 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.

Manual 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.

The manual ground and test incorporates three-position single-pole switches (upper stabs to ground, neutral, and lower stabs to ground), eliminating the need for user-furnished ground cables. The switches are hook-stick operable and are rated for the full momentary and short-time ratings of the associated switchgear. User-furnished grounding cables and commercially available ground clamps seldom have ratings equal to those of the switchgear.

Electrical Ground and Test Device

An electrical ground and test device includes a power operated switch (derived from a GMSG 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 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: Due to the special nature of ground and test devices, each user must develop definitive operating procedures for incorporating safe operating practices. Only qualified personnel should be allowed to use ground and test devices.



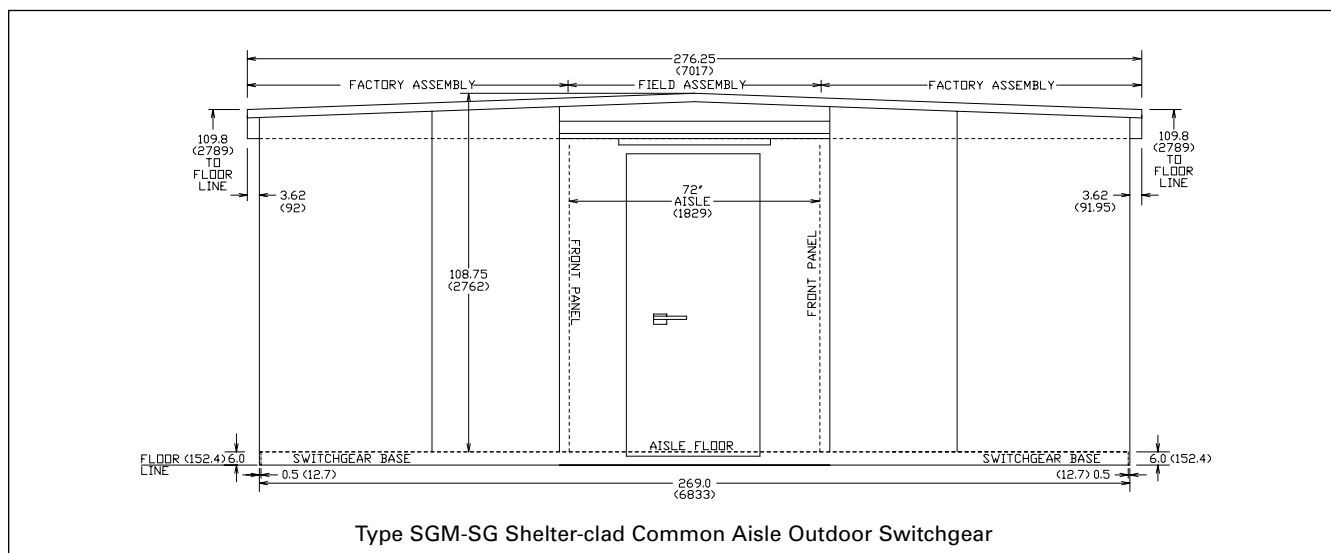
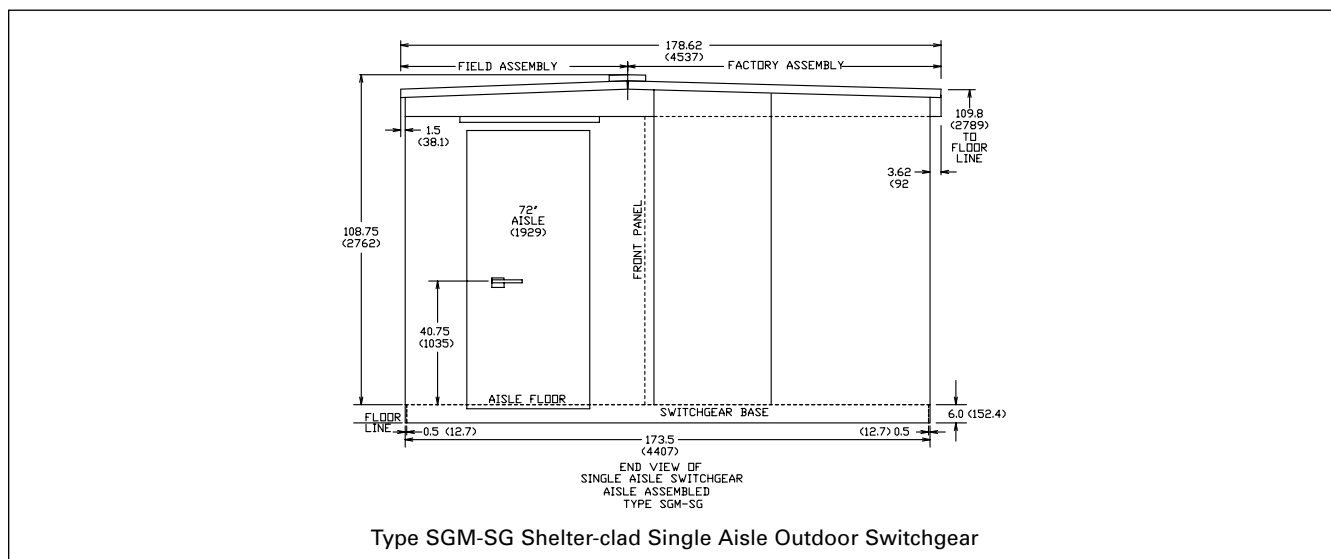
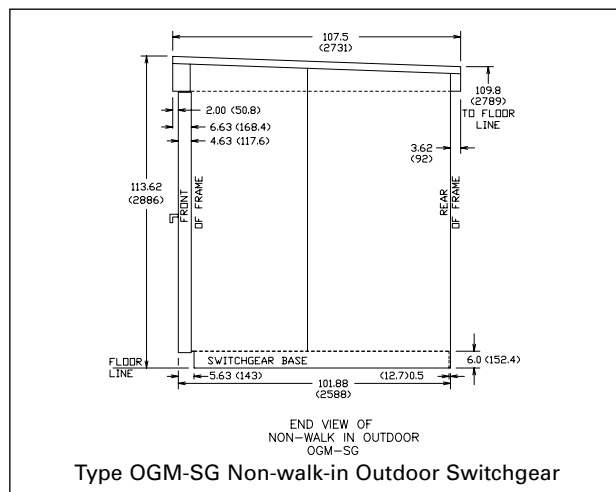
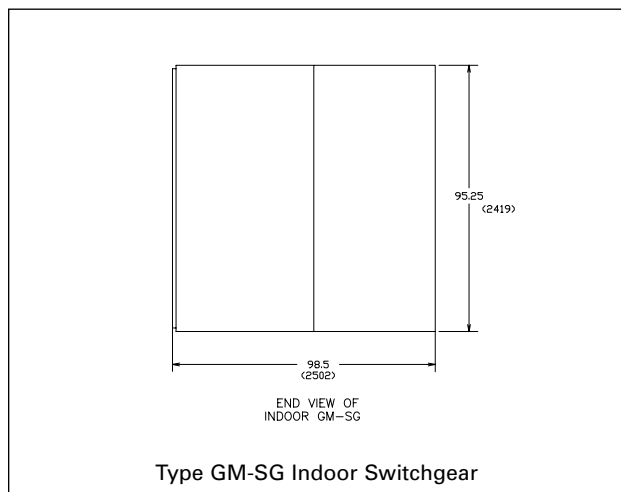
Figure 4: Accessory Cabinet

Medium Voltage Equipment

GM-SG

Dimensions

Figure 5: Switchgear End Views



Medium Voltage Equipment

38 kV GM38 Metal-Clad Switchgear



- Highly reliable vacuum interrupters – MTTF over 42,500 years
- Up to 50 full-fault interruptions
- Meets or exceeds the latest ANSI, IEEE and NEMA standards
- Universal spare circuit breaker
- Interlock permits insertion of higher rating vacuum circuit breaker into lower rated cell but not vice-versa
- Front accessible circuit breaker operating mechanism for ease of maintenance
- Closed door racking
- Floor rollout circuit breaker in lower cell without a dolly

Drawout Indoor Switchgear

- Horizontal drawout type 38-3AH vacuum circuit breaker
- Uses the latest developments in vacuum interrupter technology

Ratings

Table 8 Type 38-3AH Circuit Breaker Ratings

Table 8 Type 38-3AH Circuit Breaker Ratings				Circuit Breaker Type			
				38-3AH-1500 ①	38-3AH-31 ①	38-3AH-40 ①	
Measured Parameter							
General	Nominal Voltage Class			kV	38.0	38.0	38.0
	Nominal 3-Phase MVA Class ②			MVA	1500	—	—
Rated Values	Rated Voltage	Max		E kV RMS	38.0	38.0	38.0
		Voltage Range Factor			K	1.65	1.0
	Insulation Levels	Rated Withstand Test Voltage	Low Frequency	kV RMS	80	80	80
			Impulse	kV Crest	150	150	150
	Rated Current	Continuous ④		Amperes	1200 2000 3000FC	1200 2000 3000FC	1200 2000 3000FC
		Short circuit (at rated max. kV) ⑤④		I kA RMS	21	31.5	40
		Interrupting Time		Cycles	5	5	5
		Permissible Tripping Delay Y		Sec.	2	2	2
Related Required Capabilities	Current	Rated Max. Voltage Divided by K		E/K kV RMS	23	38	38
		Max. Sym. Interrupting ⑦	K Times Rated Short Circuit Current KI	kA RMS	35	31.5	40
		3-Sec. Short Time Current Carrying		kA RMS	35	31.5	40
	Closing and Latching (Momentary)⑧			kA RMS	56	50	62
				kA Crest	95	85	104

① Type 38-3AH-1500 ratings are in accord with ANSI C37.06-1987. Type 38-3AH-31 and 38-3AH-40 ratings conform to C37.06-2000 ratings.

② Maximum voltage for which the circuit breaker is designed and the upper limit for operation.

③ K is the ratio of rated maximum 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 3000 ampere ratings are achieved using forced air cooling in the switchgear cubicle.

⑤ To obtain the required symmetrical interrupting capability of a circuit breaker at an operating voltage between 1/K times rated maximum voltage and rated maximum voltage, the following formula shall be used.

$$\text{Required Symmetrical Interrupting Capacity} = \text{Rated Short Circuit Current} \times \frac{\text{Rated Maximum Voltage}}{\text{Operating Voltage}}$$

For operating voltages below 1/K times rated maximum voltage, the required symmetrical interrupting capability of the circuit breaker shall be equal to K times rated short circuit current.

⑥ With the limitations stated in 5.10 of ANSI Standard C37.04-1979, all values apply for polyphase and line-to-line faults.

For single phase-to-ground faults, the specific conditions stated in 5.10.2.3 of ANSI Standard C37.04-1979 apply.

⑦ Current values in this row are not to be exceeded even for voltages below 1/K times rated maximum voltage.

For voltages between rated maximum voltage and 1/K times rated maximum voltage, follow 5 above.

⑧ Current values in this row are independent of operating voltage up to and including rated maximum voltage.

⑨ Included for reference only—not listed in ANSI C37.06.

Table 9 Type 38-3AH Circuit Breaker Control Data

Control Voltages, ANSI C37.06 Table 10			Coil Amperes ①		Spring Charging Motor		
Nominal	Range		Close	Trip	Amperes		Charging Seconds
	Close	Trip			Run (Avg.)	Inrush (Peak)	
48 VDC	38–56	28–56	2.1	20	8	25	10
125 VDC	100–140	70–140	1.0	5.4	4	18	10
250 VDC	200–280	140–280	0.5	2.1	2	10	10
120 VAC	104–127	—	0.9	—	6	—	10
240 VAC	208–254	—	0.4	—	3	—	10

① Current at nominal voltage.

General/Specifications

- Visible secondary disconnect
- One high construction
- Pair with Siemens relays to match any application

Table 10 Interrupting Capacity Auxiliary Switch Contacts

Type Switch	Cont. Current Amperes	Circuit Interrupting Capacity in Amperes				
		Control Circuit Voltage				
		120 AC	240 AC	48 DC	125 DC	250 DC
Non-inductive						
Breaker	10	10	5	10	9.6	4.8
TOC	15	15	10	0.5	0.5	0.2
MOC	20	15	10	10	10	5
Inductive						
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 11 Current Transformers ①

Ratio	60 Hz Metering Accuracy at Burden				Relay Class
	B0.1	B0.5	B1.0	B2.0	
Type MD38 Toroidal Standard Accuracy					
100:5	2.4 ②	—	—	—	C 10
150:5	0.6	2.4	—	—	C 20
200:5	0.6	1.2	—	—	C 25
250:5	0.6	1.2	2.4	—	C 35
300:5	0.6	1.2	1.2	2.4	C 40
400:5	0.3	0.6	1.2	1.2	C 60
500:5	0.3	0.3	0.6	1.2	C 75
600:5 ③	0.3	0.3	0.6	1.2	C100
800:5	0.3	0.3	0.6	0.6	C130
1000:5	0.3	0.3	0.3	0.3	C170
1200:5 ③	0.3	0.3	0.3	0.3	C200
1500:5	0.3	0.3	0.3	0.3	C180
2000:5 ③	0.3	0.3	0.3	0.3	C210
2500:5	0.3	0.3	0.3	0.3	C300
3000:5 ③	0.3	0.3	0.3	0.3	C300
Type MDD38 High Accuracy					
75:5	2.4 ②	4.8	—	—	C 15
100:5	2.4 ②	4.8	—	—	C 20
150:5	1.2	2.4	4.8	4.8	C 35
200:5	0.6	1.2	2.4	4.8	C 50
250:5	0.6	1.2	1.2	2.4	C 70
300:5	0.3	0.6	1.2	2.4	C 90
400:5	0.3	0.6	0.6	1.2	C120
500:5	0.3	0.3	0.6	0.6	C150
600:5 ③	0.3	0.3	0.6	0.6	C200
800:5	0.3	0.3	0.3	0.3	C250
1000:5	0.3	0.3	0.3	0.3	C300
1200:5 ③	0.3	0.3	0.3	0.3	C400
1500:5	0.3	0.3	0.3	0.3	C440
2000:5 ③	0.3	0.3	0.3	0.3	C450
2500:5	0.3	0.3	0.3	0.3	C550
3000:5 ③	0.3	0.3	0.3	0.3	C700

① 1-second through-current and momentary current are equal to the ratings of the associated circuit breakers.

② Exceeds ANSI C37.20.2 Accuracy Limit.

③ Multi-ratio current transformers available. The accuracy ratings shown apply only to the full secondary winding.

Table 12 Voltage Transformers

Volt. Class	Ratio	Accuracy Class at 120V		VA Thermal Rating (55°C Amb)
		W,X,Y,Z	ZZ	
38kV 1 Bushing	20125:115	0.3	1.2	1000
38kV 2 Bushing	24000:120 27600:115 34500:115	0.3	1.2	1000

Medium Voltage Equipment

38 kV GM38 Metal-Clad Switchgear

Dimensions

Enclosure Dimensions

Table 13 Cubicle Dimensions-Per Vertical Section

Type		Weight in lbs. (kg)	Dimensions in inches (mm)		
			Width	Depth	Drawout Aisle
Indoor	GM38	5000 (2273)	48 (1219)	110 (2794)	96 (2438) Recommended
Shelter-Clad Single-Aisle	SGM38	6400 (2909)	48 (1219)Ⓢ	132.5 (3366)	96 (2438) Included
Shelter-Clad Common-Aisle	SGM38	11700 (5318)	48 (1219)Ⓢ	132.5 (3366)	96 (2438) Included
Aisle-Less Non-Walk-In	OGM38	5800 (2636)	48 (1219)	130.5 (3315)	96 (2438) Recommended

Ⓢ Add 6 in. (152 mm) to each end of lineup for aisle extension, 12 in. (305 mm) total.

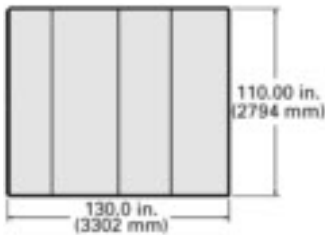
Add for roof overhang
Rear (Cable Side)
Front

Non-Walk-in
3.875 in. (98 mm)
6.875 in. (175 mm)

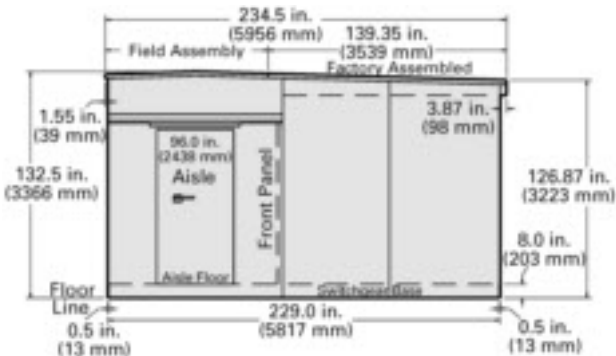
Shelter-Clad
3.875 in. (98 mm)
1.5 in. (38 mm)

Table 14 38-3AH Circuit Breaker Weights in lbs. (kg)

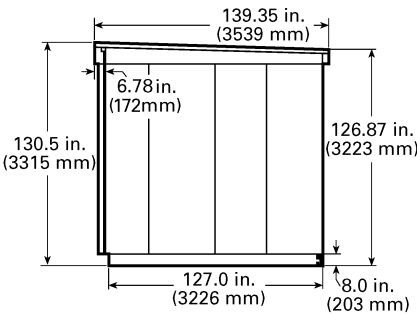
Cont. Current Amps	Circuit Breaker Type		
	38-3AH-1500	38-3AH-31	38-3AH-40
1200	800 (364)	800 (364)	850 (387)
2000	900 (409)	900 (409)	950 (432)
3000	1000 (455)	1000 (455)	1050 (478)



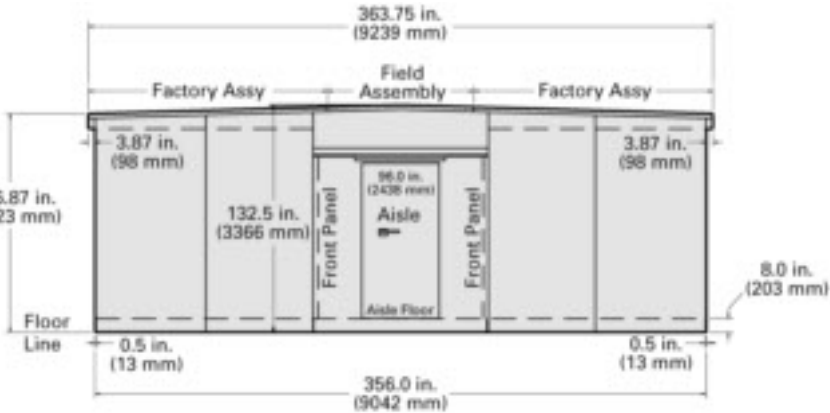
End View of Indoor Switchgear
Type GM38



End View of Single Aisle Switchgear
Type SGM38



End View of Aisle-Less Outdoor Switchgear
(Non Walk-In) Type OGM38



End View of Common Aisle Switchgear
Type SGM38

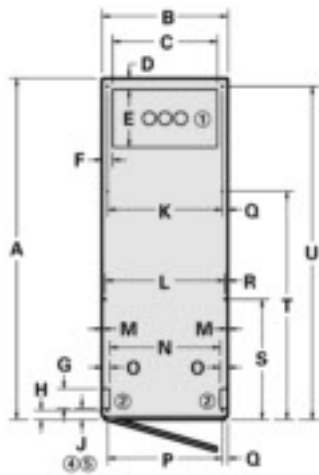
For more information, please visit <http://automation.usa.siemens.com/consultant/> or contact your local sales office.

Medium Voltage Equipment

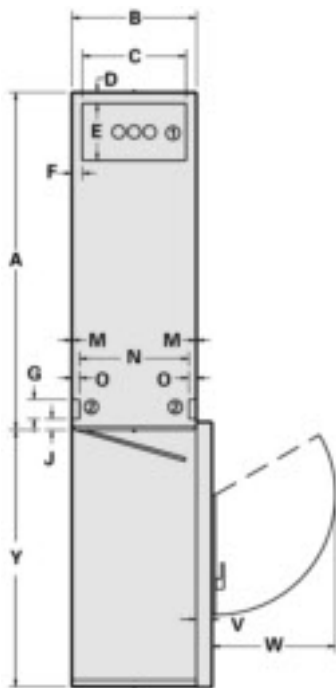
38 kV GM38 Metal-Clad Switchgear

Dimensions

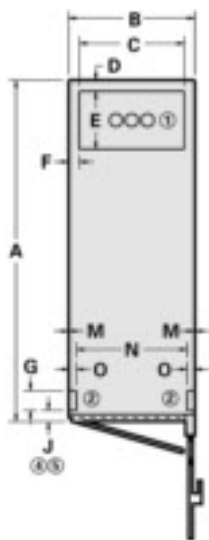
Floor Plans



Indoor GM38 Switchgear

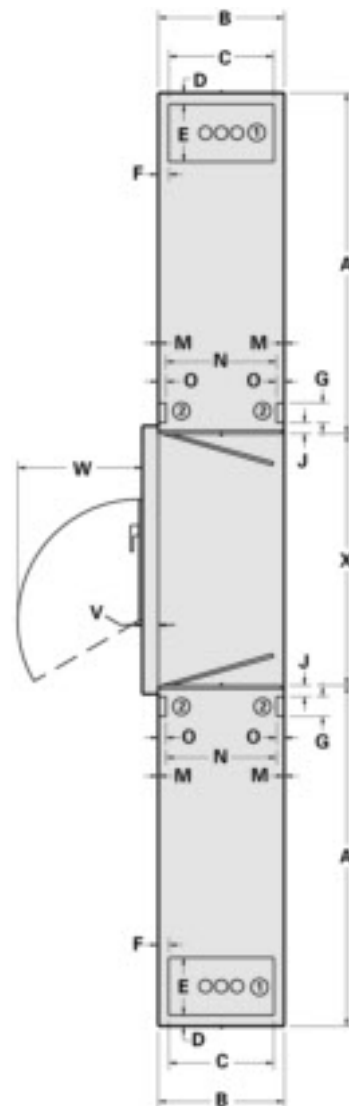


Outdoor SGM38 Shelter-Clad Walk-In Single Aisle Switchgear



Outdoor OGM38 Non Walk-in Switchgear

- ① Recommended location of conduits for power cables, top or bottom.
- ② Recommended location of secondary leads, top or bottom.
- ③ Customer conduit not to extend more than 1 in. (25 mm) above floor line.
- ④ Allow 6 in. (152 mm) clearance for lift truck on each end.
- ⑤ Floor must be level 80 in. (2032 mm) in front of switchgear to allow proper operation of lift truck.



Outdoor SGM38 Shelter-Clad Walk-In Common-Aisle Switchgear

Table 15 38kV Switchgear Floor Plan Detail
Dimensions in inches (mm)

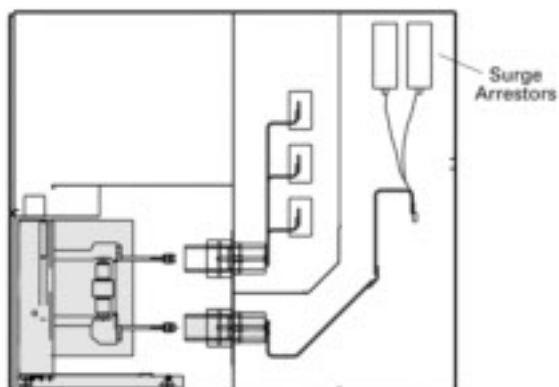
A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
130.0 (3302)	48.0 (1219)	40.0 (1016)	42.5 (1080)	22.0 (559)	4.0 (102)	7.5 (191)	3.5 (89)	4.25 (108)	43.75 (1111)	45.88 (1165)	0.12 (3)	43.12 (1095)	2.82 (72)	43.75 (1111)	2.13 (54)	1.16 (29)	45.84 (1164)	87.06 (2211)	126.91 (3224)	6.0 (152)	47.5 (1207)	96.0 (2438)

Medium Voltage Equipment

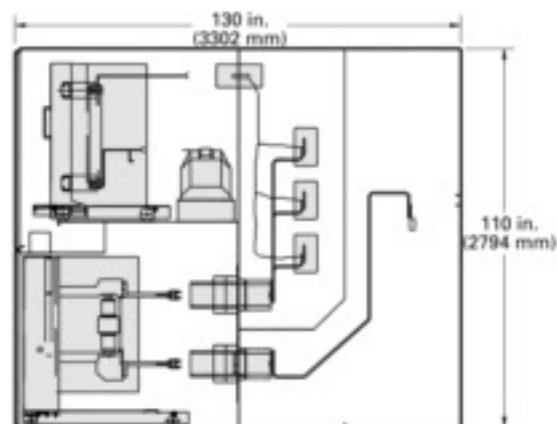
38 kV GM38 Metal-Clad Switchgear

Dimensions

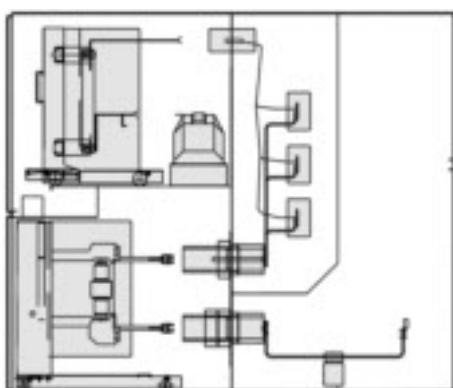
Side Views — 1200, 2000, 3000A Breakers / Auxiliary



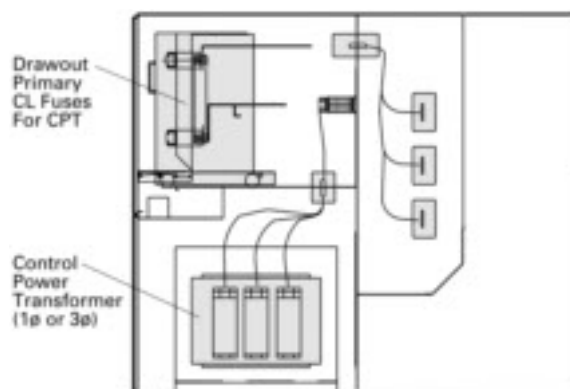
Auxiliary / 1200A-3000A Breaker
(No drawout auxiliaries in upper cell for 3000A breaker)



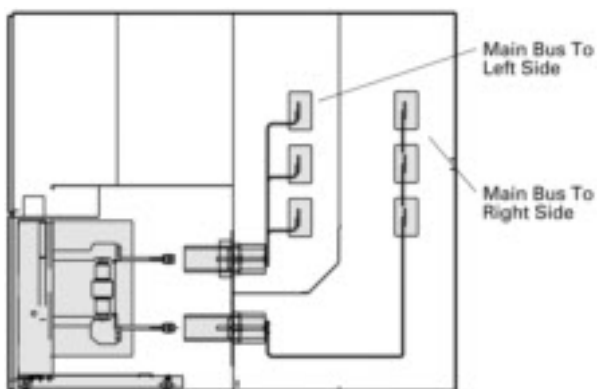
VT Auxiliary / 1200A or 2000A Breaker
(Downfeed Cables)



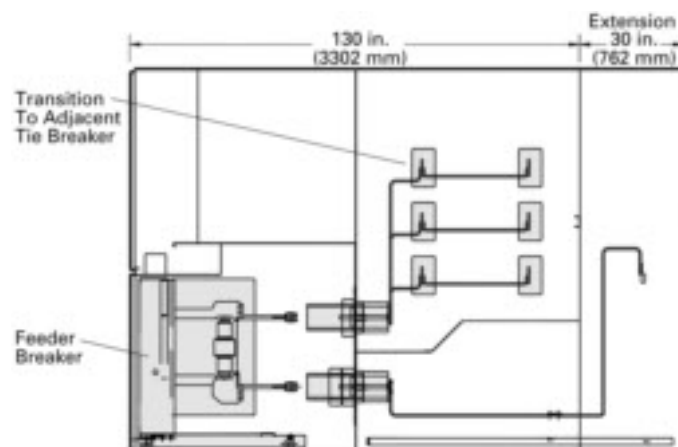
Auxiliary / 1200A or 2000A Breaker
(Upfeed Cables)



CPT Fuse Truck / Stationary 3Ø CPT



Auxiliary / Bus Tie Breaker



Auxiliary / Feeder Breaker
(Adjacent to right side of tie breaker section)

Medium Voltage Equipment

38 kV GIS Metal-Clad Switchgear

GIS

Types 8DA10 and 8DB10 Medium Voltage Gas-Insulated Switchgear are gas insulated, vacuum circuit breaker designs with a voltage range of 4.16kV to 38kV. Lightning impulse withstand voltage ratings up to 200kV BIL and interrupting ratings up to 40kA are available.

The 8DA10 and 8DB10 Medium Voltage Gas-Insulated Switchgear designs feature fixed-mounted vacuum circuit breakers, connectable to the main bus through three-position (closed-open-ready to ground) switches. The position of the switches is externally observable from the front of the unit using a convenient camera system. Medium Voltage Gas-Insulated Switchgear is suitable for systems where small size, arc resistance, environmental immunity, or reduced maintenance needs are important. Depending upon the voltage rating, Medium Voltage Gas-Insulated Switchgear is approximately 1/5 the

size of conventional air insulated switchgear.

MV Vacuum Interrupter GIS

The 8DA and 8DB – up to 38kV, 2500A, 40kA, 200kV BIL.

- Inherently arc-resistant
- Significantly reduced P.P.E. needs
- Compact – 80% smaller than air insulated switchgear
- 20 year internal maintenance cycle
- Meets IEEE and IEC standards
- UL or C-UL Listing available
- Single phase design eliminates phase-to-phase faults
- Meets NEC visible disconnect requirement
- Well suited for contaminated environments
- Pair with Siemens Protective Relays to match any application

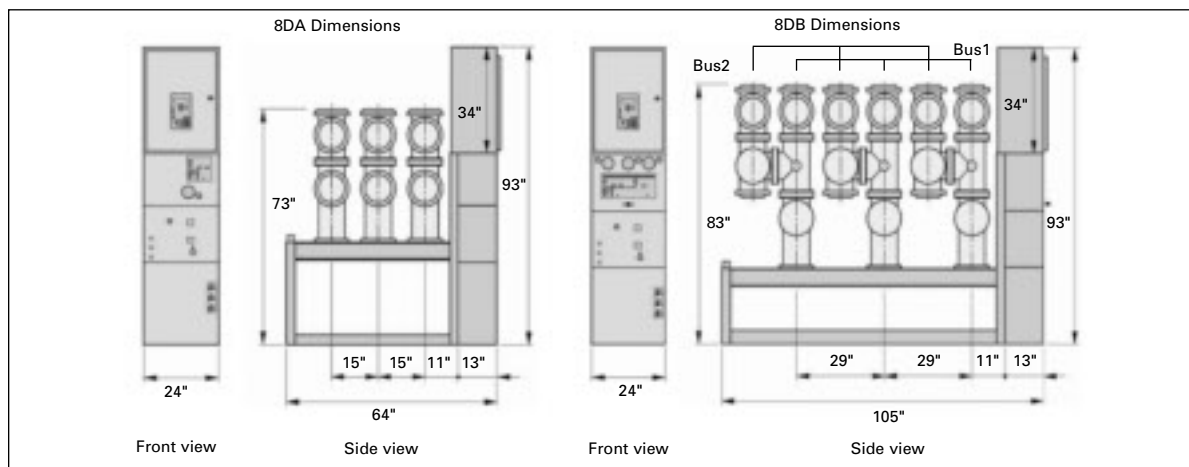
General/Specifications



GIS Specification Sheet

Rated Values		8DA10 3-pole / 8DB10 3-pole		
Voltage	Max. kV	15	27	38
Frequency	kV	60 Hz	60 Hz	60 Hz
Short-dur. power-frequency withstand voltage	kV	36	60	80
Lightning impulse withstand voltage	kV	95	125	170; 200*
Short-circuit breaking current		up to 40kA	up to 40kA	up to 40kA
Short-time withstand current, 3s		up to 40kA	up to 40kA	up to 40kA
Short-circuit making current (peak)		up to 104kA	up to 104kA	up to 104kA
Peak withstand current		up to 104kA	up to 104kA	up to 104kA
Normal current of busbar		up to 4000A	up to 4000A	up to 4000A
Normal current of feeders		up to 2500A	up to 2500A	up to 2500A

* On request. Consult factory



Medium Voltage Equipment

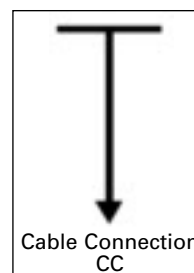
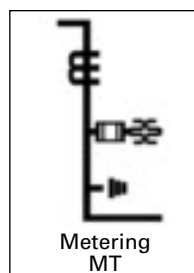
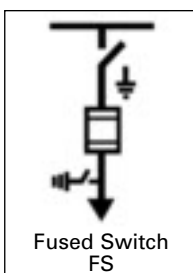
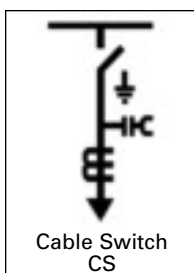
5–15–27 kV SIMOSEC Metal-Enclosed Load Interrupter Switchgear

General/Specifications

SIMOSEC

Medium voltage metal-enclosed load interrupter indoor switchgear up to 27.6kV.

- Extremely compact footprint
- Meets ANSI / IEEE C37.20.3
- UL or C-uL listing available
- Seismic up to Zone 4 (optional)
- High switching capacity – 100 operations @ 600A
- Gas insulated three-position switch-disconnector, hermetically sealed for life inside the stainless steel vessel
- Switch-disconnector combines the function of a load interrupter switch (with CLOSED-OPEN indication) and a grounding switch (with OPEN-GROUND indication)
- HV HRC fuses and cable terminations accessible only if the feeder grounding switch is in the grounded position
- Fuses and outgoing cables front accessible
- Standard viewing window for visible verification of isolating distance
- Standard capacitive voltage presence indicator
- Integrated mechanical interlocking
- Animated mimic diagram
- Main bus at top or bottom to suit application
- Configurations: individual feeder switches, transformer primary switches & switch lineups
- Ideal for utility, construction & industrial applications
- Over 20 years field experience and more than 350,000 switch-disconnector units installed




SIMOSEC Specification Sheet

Dimensions

	Cable Switch CS	Fused Switch FS	Metering MT	Cable Connection CC
Width ¹ Single cable or fuse	14.8" ¹ (375mm)	14.8" ¹ (375mm)	19.7" ² (500mm)	14.8" ¹ (375mm)
Width ² Two cables or double-barrel fuse	19.7" ² (500mm)	19.7" ² (500mm)	29.5" ³ (750mm)	19.7" ² (500mm)
Width ³ Width depends on equipment arrangement				
Depth	48.4" (1230mm)			
Height	88.6 - 100.4" (2250 - 2850mm) depending on arrangement			

Ratings

Rated voltage		Up to 5kV	8.25kV & 15kV	27.6kV
Rated frequency		50 / 60	50 / 60	50 / 60
Rated short-duration power-frequency withstand voltage		19kV	36kV	60kV
Rated lightning impulse withstand voltage (BIL)		60kV	95kV	125kV
Rated short-time withstand current t_k = rated duration of short	2 Sec	Up to 25kA	Up to 25kA	Up to 20kA
Maximum fused continuous current (not fuse E rating)	Single fuse FS-1	325A	165A	65A
	Double fuse FS-2	575A	305A	117A
	Triple fuse FS-3	600A	430A	156A
Main bus continuous		600A, 1200A	600A, 1200A	600A, 1200A
Switch-disconnector	Continuous	600A	600A	600A
	Interrupting	600A	600A	600A

 Capacitive voltage indicator

 Cable discharge switch (1.6kA 1-sec) (optional)

Medium Voltage Equipment

MV Controllers (MVC) up to 7.2 kV

General

General

The design and manufacture of the Series 81000™ medium voltage controller unit is based on our experience as a leading manufacturer of motors worldwide. The benefits of this experience result in control scheme flexibility and increased safety, while simplifying operations, maintenance, and minimizing installation costs. Typical applications include:

- Squirrel-Cage Induction Motors (non-reversing, reversing, and multi-speed)
- Reduced Voltage Starters (autotransformer reactor or solid-state type)
- Synchronous motors (brush or brushless type)
- Wound Rotor Motors — with or without secondary control
- Transformer Feeders
- Capacitor Bank Feeders
- Power Bus Feeders (Tie)

The utilization voltage range for the controllers is 2300 through 7200 volts AC.

The Siemens Series 81000 medium voltage controller allows the user to combine vacuum contactors, latched contactors and load break switches in one lineup. The user can also connect directly to Siemens GM-SG Medium Voltage switchgear without additional transition sections. This provides extreme flexibility in systems design.

Stationary Controllers:

- Full Voltage (FVNR)
- Reduced Voltage Primary Reactor (RVPR)
- Reduced Voltage Autotransformer (RVAT)

Load Break Switches (LBS)

Drawout Controllers:

- Full Voltage (FVNR)
- Reduced Voltage Primary Reactor (RVPR)
- Reduced Voltage Autotransformer (RVAT)
- Reduced Voltage Solid State (SSRV)
- Brushless Synchronous (BL-SYNCH)
- Brush-type Synchronous (BT-SYNCH)
- Two Speed Two Winding (2S2W)
- Two Speed One Winding (2S1W)
- Wound Rotor (WR)
- Reversing

E2 (Fused) Contactors — To meet interrupting capability required for NEMA Class E2 controllers, the 97H3 and 96H6 contactors are provided with primary current limiting fuses in all three phases. The resulting interrupting ratings are shown in the Table 17.

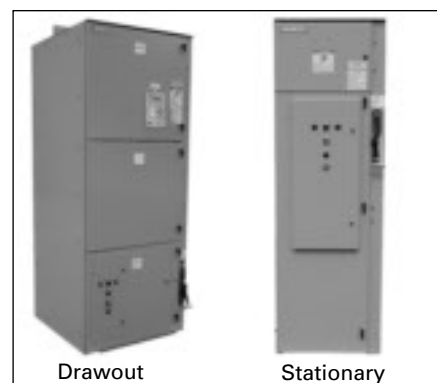


Table 16 Controllers and Load Break Switches Selection Table

	Controller Type	2.3kV	4.16kV	6.9kV	13.8kV
Maximum Motor Size	Stationary	to 1500HP	to 2500HP	to 4000HP	—
	Drawout	to 3000HP	to 5500HP	to 4000HP	—
	SSRV	to 3000HP	to 5500HP	to 4000HP	to 5500HP
Load Break Switch (LBS)	600A	Fused Unfused	Fused Unfused	— Unfused	—
	1200A	Fused Unfused	Fused Unfused	— Unfused	—

Table 17 Series 81000 Ratings

System Voltage	Enclosed Continuous Ampere Rating	Interrupting Capacity		Motor Horsepower Rating (3 Phase)				Transformer Loads	
		Unfused Class E1	Fused Class E2	Synchronous Motors		Induction Motors	Maximum Motor Fuse Rating	Maximum 3-Phase kVA	Maximum Fuse Rating
				0.8 PF	1.0 PF				
2300	360	5kA	200 MVA	1500	1750	1500	24R	1500	450E
2300	720	10kA	200 MVA	3000	3500	3000	57X	2000	600E
4000	360	5kA	350 MVA	2500	3000	2500	24R	2500	450E
4000	720	10kA	350 MVA	5500	6000	5500	57X	3500	600E
4600	360	5kA	400 MVA	2500	3000	2500	24R	2500	450E
4600	720	10kA	400 MVA	5500	6000	5500	57X	4000	600E
6900 ^①	360	7.2kA	570 MVA	4000	5000	4000	24R	1500	200E

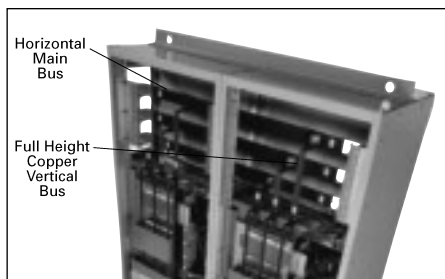
^① Nominal motor voltage 6600V.

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Medium Voltage Equipment

MV Controllers (MVC) up to 7.2 kV

General



Main and Vertical Bus Construction (shown with optional insulation)

Power Bus

All power bus is isolated behind grounded steel barriers. Automatic shutters are provided to cover the line-side bus stabs whenever a starter door is opened. Horizontal bus ratings range from 600 through 3000 amperes and are further detailed in Table 18. Vertical tap buses in each section are rated 360, 540, or 720 amperes, depending on the application. Insulated bus with boots are available as options.

Drawout

The Siemens Series 81000 Drawout Medium Voltage Motor Controller is a modular design consisting of up to three vacuum contactors per vertical section each with three current limiting fuses, all housed in a free-standing sheet steel enclosure.

The completely drawout contactor carriage (360A) includes all major power components (vacuum contactor, power fuses, CPT, CPT fuses) on a wheeled, drawout carriage. The drawout contactor carriage includes a quick disconnect plug for secondary connections. Drawout fuse carriages are used when loads require 720A vacuum contactors.

Contactors are available in up to three high mounting for 5kV and 360A.

The drawout controllers are available in a wide range of starter types, including Solid State Reduced Voltage.

Stationary

The Siemens Series 81000 MVC is also offered in a stationary contactor design. The one high stationary starters can be configured in a reduced height (75") and reduced width (24") stand-alone enclosure facilitating a smaller footprint and reduced shipping cost.

Solid State Reduced Voltage Controller (SSRVC)

Soft Start Advantages

- Minimize system maintenance and repair
- Reduce system downtime
- Increase productivity
- Minimize mechanical wear and tear
- Reduce inrush currents
- Reduce motor torque for prolonged motor life

Standard Features

- Drawout main fused contactor (360A)
- Drawout main fuses with fixed-mounted main contactor (720A)
- Bypass contactor
- Heavy duty soft start module
- 125% continuous duty rating (on soft start module only)
- Digital microprocessor control with non-volatile memory
- Fiber optic isolation
- Advanced electronic motor protection
- Metering
- Alphanumeric LCD display
- Keypad programming
- Modbus RTU communications



Solid State Reduced Voltage

Standard Adjustment Capabilities

- Soft start and stop
- Voltage and current ramp

Starting Methods (settable)

- Current limit and dual ramp
- Learned acceleration curve or user defined (custom) acceleration curve
- Kick start and jog

Optional Features

- Zero sequence ground fault protection
- Profibus communications

Flexibility

- Available in lineups with up to 3000A main bus directly connected with Metal-Clad Switchgear, Load Interrupter Switches, or other Class E2 Controllers

Safety

- Full drawout construction means power fuse changes are done outside of the enclosure

Reliability

- Made under ISO 9001 Quality System standards

Dependability

- Series 81000 Controllers have been in production for over 20 years

UL Listed

Table 18 Series 81000 Bus Ratings

Type Bus	Continuous Amperes	Conductor Size in Inches (mm)	Conductor Material	Current Density (Amps/in ²)
Main Horizontal	600	0.25 (6) x 3.0 (76)	Aluminum	800
	1000	0.375 (10) x 3.0 (76)		889
	1200	0.50 (13) x 3.0 (76)		800
	1000	0.25 (6) x 3.0 (76)		1333
	1200	0.375 (10) x 3.0 (76)	Copper	1067
	2000	2 x 0.375 (10) x 3.0 (76)		889
	3000 ^①	3 x 0.50 (13) x 3.0 (76)		667
	360	0.25 x (6) x 1.0 (25)		1440
Vertical	540	0.25 (6) x 1.5 (38)		1440
	720	0.50 (13) x 2.0 (51)		720
Ground	600	0.25 (6) x 2.0 (51)		1200

① 3000A bus must be located on top of unit.

For more information, please visit <http://automation.usa.siemens.com/consultant/> or contact your local sales office.

Medium Voltage Equipment

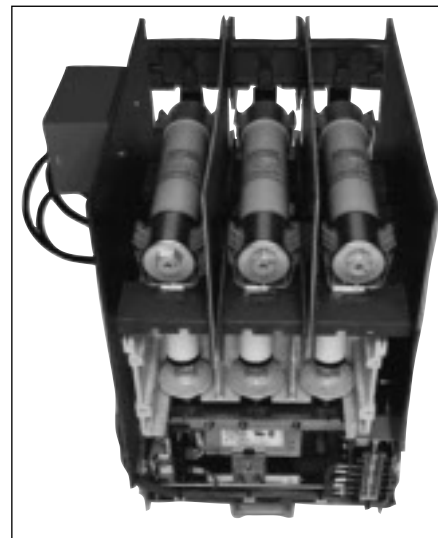
MV Controllers (MVC) up to 7.2 kV

General

Fuse Application

Table 19 Type FM Fuse Data

Maximum Designed Voltage	Current Designation	Continuous Current at 40°C	Minimum Interrupting Capability	Interrupting Rating 50/60 Hz
5080	2R (1 barrel)	70	190	Single Phase 80kA RMS Asymmetrical (210MVA at 2.4kV) (415MVA at 4.8kV)
	3R	100	225	
	4R	130	330	
	6R	170	500	
	9R	200	740	
	12R	230	955	
	18R (2 barrel)	390	1440	
	24R	450	1910	
	38R	600	3000	
7200	57X (3 barrel)	900	4500	Single Phase 80kA RMS Asymmetrical (620MVA at 7.2kV)
	2R (1 barrel)	70	190	
	3R	100	225	
	4R	130	330	
	6R	170	500	
	9R	200	740	
	12R	230	955	
	18R (2 barrel)	390	1440	
	24R	450	1910	



Type FM Fuses Installed on 97H3 Contactor

For Non-Motor Loads

The principal application for ANSI "E" rated fuses in Series 81000 controllers is for non-rotating loads, such as transformer feeders. The following tabulation may be used for estimating which "E" rated fuse is appropriate for a particular 3-phase transformer application.

Table 20 Typical Fuse Sizes for Transformer Protection

Transformer kVA	Fuse Size at:			
	2.4kV	4.16kV	4.8kV	6.9kV
45	25E	10E	10E	—
75	30E	15E	15E	10E
112.5	40E	20E	20E	15E
150	50E	30E	25E	20E
225	80E	40E	40E	25E
300	100E	65E	50E	40E
500	200E	100E	80E	65E
750	250E	150E	125E	100E
1000	400E	200E	200E	125E
1500	450E	300E	250E	200E
2000	—	400E	350E	—
2500	—	450E	400E	—
3000	—	—	450E	—

Note: Fuse sizes are based on 133% overload capacity, except 1500kVA at 2.4kV, 2500kVA at 4.16kV, and 3000kVA at 4.8kV.

Fuse ratings higher or lower than those listed in Table 20 may be necessary if the transformer has unusual magnetizing (inrush) current characteristics, or for proper coordination with the secondary protective device (secondary fuse, low voltage circuit breaker trip device, overcurrent relay, etc.). Transformer overload capability may also have a bearing on fuse selection. However, this

table is accurate for most typical transformer feeder applications.

The "E" rated fuses have the same interrupting current ratings as the type FM or A720R "R" rated fuses. Both are rated at 50kA symmetrical and 80kA asymmetrical interrupting.

All medium voltage controllers employ current limiting fuses for short circuit protection. The term "current limiting" derives from the operating characteristics of the fuse. Figure 6 shows graphically how, for maximum fault levels, the fuse operates within the first 1/4 cycle of short circuit current. This limits the energy "let-thru" well below peak values, thus providing "current limitation."

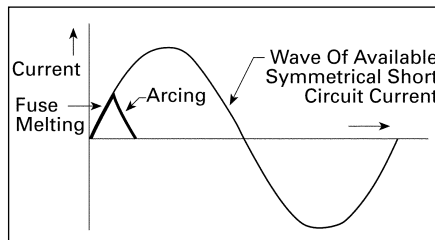


Figure 6 Current Limiting Effect

A mechanical indicator "pops-out" of the end of the fuse if the fuse has operated. This provides a visual means for checking the condition of the fuse, and also acts to engage the optional blown fuse trip bar on the 97H3 contactor.

Current designations 2R through 24R (38R and 57X ("X" rated) for fuses on 720A) are used to distinguish one fuse size from another within the same voltage rating. Ampere ratings are not

used to identify medium voltage fuses, since fuse selection involves many different variables. Among these are motor locked rotor and running current, acceleration time, and the time current characteristics of the overload relay used. The fuses are installed on the top of the 97H3 vacuum contactor or on the draw-out fuse carriage used with the 96H6 contactor. No fuse pullers or special tools are required to install or replace the fuses.

Medium Voltage Equipment

MV Controllers (MVC) up to 7.2 kV

Dimensions/Specification

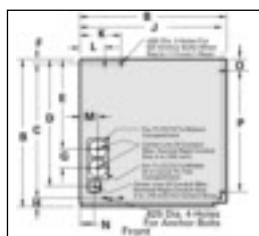
Table 21 MV Controllers Dimensions and Specification Sheet

Type	Stationary	Drawout or Rating	Number of Contactors	Enclosure Dimensions in Inches				
				NEMA 1, 1A or 12			N3R-WI 107" Width	N3RNWI 103" Width
				Height	Width	Depth		
Induction Full Voltage Non-Reversing (FVNR)	Drawout	5kV 360A 5kV 720A 7kV 360A	1	30 90 90 ^①	36	36	42	42
	Stationary	5kV 360A 7kV 360A	1	75/90	24	36	42	42
Reduced Voltage Primary Reactor Non-Reversing (RVPR)	Drawout	5kV 360A 5kV 720A 7kV 360A	2	90	60/72 96/108 72/96	36	78 114 78/114	78 120 120
	Stationary	5kV 360A 7kV 360A	2	75/90	60	36	78	78
Reduced Voltage-Autotransformer Non-Reversing (RVAT)	Drawout	5kV 360A 5kV 720A 7kV 360A	3	90	60/72 96/108 72/96	36	78 114 78/114	78 120 120
	Stationary	5kV 360A 7kV 360A	3	75/90	60	78	78	
Induction Full Voltage Reversing (FVR)	Drawout	5kV 360A 5kV 720A 7kV 360A	3	90	36 72 36	36	42 78 42	42 78 42
Synchronous Full Voltage Non-Reversing (FVNRS)	Drawout	5kV 360A 5kV 720A 7kV 360A	1	90	60/72 72/84 72/84	36	78 78/114 78/114	78 78/120 78/120
Synchronous Reduced Voltage-Autotransformer Non-Reversing (RVATS)	Drawout	5kV 360A 5kV 720A 7kV 360A	3	90	84/108 132/144 132	36	114 150 150	120 156 156
Induction Full Voltage 2-Speed 2-Winding (2S2W)	Drawout	5kV 360A 5kV 720A 7kV 360A	2	90	36 72 72	36	42 78 78	42 78 78
Induction Full Voltage 2-Speed 1-Winding (2S1W)	Drawout	5kV 360A 5kV 720A 7kV 360A	3	90	36 ② 72	36	42 ② 78	42 ② 78
Latched Contactor	Drawout	5kV 360A 5kV 720A 7kV 360A	1	30 90 90	36	36	42	42
Solid State Reduced Voltage Non-Reversing (SSRV)	Drawout	5kV 360A 5kV 720A 7kV 360A 15kV 300A	2	90	36 72 72 126	36 36 36 48	42 78 78 —	42 78 78 —
LBS Unfused 600A or 1200A	—	5kV / 7kV	—	90	36	36	42	42
LBS 600A Fused or 1200A/900E Fused	—	5kV	—	90	72	36	78	78
Incoming Line Main Lugs Only	—	5kV / 7kV	—	90	18 24 36	36	42	42

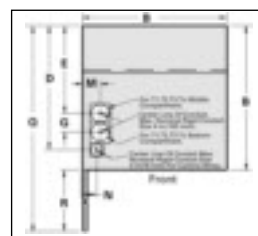
① Also available in 45" construction for 2-high arrangement, requires top mounted bus.

② Consult factory.

Typical Floor Plan Details for Class E2 Medium Voltage Controllers



Detail A — Floor Plan View — Bottom Conduit Entry



Detail B — Floor Plan View — Conduit Entry Top

Table 22 MVC Floor Plan Dimensions in Inches (mm)

A	B	C	D	E	F	G	H	J
90.00 (2286)	36.00 (914)	32.75 (832)	31.00 (787)	21.88 (556)	1.12 (28)	4.68 (119)	2.13 (54)	34.94 (887)
K	L	M	N	O	P	Q	R	
10.06 (256)	6.06 (154)	4.42 (112)	3.50 (89)	2.87 (73)	29.50 (749)	68.50 (1740)	32.50 (826)	

Medium Voltage Equipment

MV Controllers (MVC) up to 7.2 kV

Motor Protection Options

Drive motors often play a decisive role in the functioning of a production process. Motor damage and breakdowns not infrequently lead also to consequential damage and production shutdowns, the cost of which significantly exceeds the cost of repairing the motor. Optimum design of the motor protection ensures that damage following thermal overload is prevented, meaning that there is no reduction to the normal service life. Secondary faults are minimized in the event of short circuits, ground faults and

winding faults. The spectrum extends from small low-voltage motors with an output of a few kW to high voltage motors with outputs measured in MW. Protection system design must be based on the rating of the motor, the importance of the drive for the technological process, the operating conditions and the requirements of the motor manufacturer.

Common motor protection functions and SIPROTEC motor protective relay selection tables are provided below.

Protective Relaying



Protection functions for various types of motor faults

Fault	Protection	ANSI Number
Stator thermal overload	Stator thermal overload protection	49
Rotor thermal overload during start too long or blocked too frequent	2 Protection principles for the rotor overload protection Motor starting time supervision Restart inhibit	48 66, 49R
Ground-fault	Ground-fault protection ($I_0 > U_0 > < (U_0, I_0)$)	50G, 64G, 67G
Short-Circuit	Overcurrent time protection Current differential protection	50, 51 87
Loss of phase	Negative sequence protection (I_2/I_N)	46
Bearing overload	Temperature sensors (RTD's)	38
Overheating of plant on unloaded drives (pumps, compressors)	Undercurrent protection, Active power protection (P<)	37 32U
Undervoltage (starting torque not reached $M \sim U^2$ or start too long)	Undervoltage protection	27
Asynchronous operation (of a synchronous motor)	Underexcitation protection	40

Motor Protection Selection Table

Asynchronous Motor		Synchronous Motor
100 kW – 500 kW 7SJ60 Basic device	7SJ61 + more I/O's + control functions + flexible serial interfaces + better local HMI (4 line display; digital keyboard)	< 2 MW 7UM61 (Option: Generator Basic)
500 kW – 2 MW 7SJ62 Basic device + control functions or with control functions via bay mimic diagram in graphic display 7SJ63 Basic device	7UM61 + more I/O's (7UM612) + control functions + high accuracy + high sensitivity + operating range in a wide frequency band (11Hz - 68Hz) 7SJ64 + Synchro check function + high sensitivity + extensive control function + 1 serial interface more	< 10 MW 7UM62 (Option: Generator Basic)
> 2 MW	7UM62 + differential protection + control functions + high accuracy + high sensitivity + operating range in a wide frequency band (11Hz - 68Hz)	> 10 MW 7UM61 + (Option: Generator Basic) 7UM62 (Option: Generator Basic) or with control functions via bay mimic diagram in graphic display 7SJ64 + (Option: Generator Basic)

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Medium Voltage Equipment

Arc Flash Solutions

General



SARRACS™ Remote Breaker Racking

Protection for your most important investments: your personnel and your equipment!

Incidents of serious and sometimes fatal injury have become an all too common occurrence when faults occur while circuit breakers are being racked in or out on a live bus. NFPA 70E-2004 (referenced in OSHA 29CFR-1910-S Appendix "A") requires that personnel wear full-body flash suits during racking procedures on an energized system. However, as operators must stand within the flash

boundary, they are still at considerable risk due to intense heat, concussion forces and airborne debris should a fault explosion occur. Now, by allowing operators to remotely perform racking procedures from a distance of up to 40 feet, SARRACS safety breaker system from Siemens provides increased protection for your most important investments: your personnel and your equipment.

SARRACS (with Custom Torque) provides the following:

Operator Safety

- Remote operation
 - Personnel safely operate breaker racking system from a distance of up to 40 feet
- Eliminates need for special personal protective equipment (PPE) during racking
 - Since operator is outside the flash boundary, a full-body flash suit is not required
- Completely portable
 - Ball bearing wheels, casters, and transport handle for easy maneuvering

Breaker Safety

- Utilizes state-of-the-art SIMATIC® S7-200 PLC from Siemens
 - Digital position control for consistent and accurate breaker engagement
 - Customized position-torque control provides protection to minimize equipment damage
 - Auto reverse (optional)
 - Speed control
 - Ramp up/ramp down
 - Interface options

Flexibility

- Programmable to allow for varying torque profiles and mechanical requirements of individual circuit breakers in a lineup
- Mechanically adjustable to allow for different circuit breakers in the same lineup
- Portable and self-contained
 - Easy to store and transport
 - Strong but light (approx. 200 lb.)
- Designs available for most circuit breakers

Siemens Industrial Services can provide training and on-site modifications if required.

Medium Voltage Equipment

Arc Flash Solutions

General

Remote Circuit Breaker Controller System

Alternate to Arc-Resistant switchgear

Siemens can offer a cost effective solution that satisfies the NFPA 70E requirements which provides improved personnel safety when coupled with conventional switchgear.

With the Siemens CB Controller (C7) there is no longer a need to stand in front of the circuit breaker cell to view circuit breaker status, operate the circuit breaker or view metering information. All of this can be done from a safe distance from the switchgear.

This places the operator or maintenance personnel at a safe distance while they perform these necessary functions.

Each lineup would be supplied with its own controller as follows.

The system consists of two hardware levels. They are the Siemens SIPROTEC protective relays installed for each circuit breaker in the switchgear and the touch screen CB Controller C7 mounted remote. The two levels are connected via a

Profibus communication link. All necessary security measures are available to prevent unauthorized usage.

Siemens will configure the system completely and test all communication functionality and relay data.

The above solution in conjunction with remote circuit breaker racking (see

SARRACS above) allows for circuit breaker operation and racking without being in front of any circuit breaker during the trip/close function or the racking in/out procedure.

When operated correctly, a circuit breaker can be tripped and racked out without being in the flash hazard zone.

