MASTERCLAD™ Medium Voltage
Metal-Clad Switchgear with
Type VR Vacuum Circuit Breakers

The Reliability of a Quality Design

SQUARE D
GROUPE SCHNEIDER

MASTERCLAD™ VACUUM METAL-CLAD SWITCHGEAR

As a leading manufacturer of electrical distribution equipment for over ninety years, Square D has long had a reputation for quality, service and technical innovation. Today, as a major switchgear manufacturer in the international marketplace, Square D continues to lead the industry with ISO 9001 certification. Along with high-quality equipment, we offer an engineering and support staff that is considered the best in the industry.

MASTERCLAD switchgear components include available state-of-the-art electronics like POWERLOGIC power monitoring and control systems, digital microprocessor-based protective relays and SY-MAX PLC-based automatic throwover systems.

The Reliability of a Quality Design

The quality of Square D MASTERCLAD™ medium voltage metal-clad switchgear stems from a design and manufacturing process that focuses on long-term switchgear performance with the highest degree of reliability.

Reliable performance and safety is enhanced by the rugged construction of MASTERCLAD switchgear. Each switchgear assembly consists of individually grounded, compartmentalized steel structures (with -gauge barriers between vertical sections and major parts of each primary circuit) to protect operating personnel.

Based on specific customer application needs, Square D engineers and technicians select the appropriate standard sections and bus configurations, with the ability to customize where needed. After the specified circuit breakers, instrument and control power transformers, relays, meters and other components are selected and approved, all are factory-assembled, wired and tested as a complete assembly. This testing is performed to insure reliability by energizing the control circuits and verifying the specified sequence of operation for each metal-clad switchgear project along with the ANSI C37.20.2 Production Tests.

MASTERCLAD Vacuum Switchgear

Ratings:

- 4.76-15 kV (to 13.8 kV nominal)
- 1200-3000 Amperes
- 250-1000 MVA Interrupting Capacity
- 60 and 95 kV BIL
- Indoor and Outdoor Enclosures

Standard Features:

Metal-Clad Switchgear as defined by ANSI C37.20.2 includes:

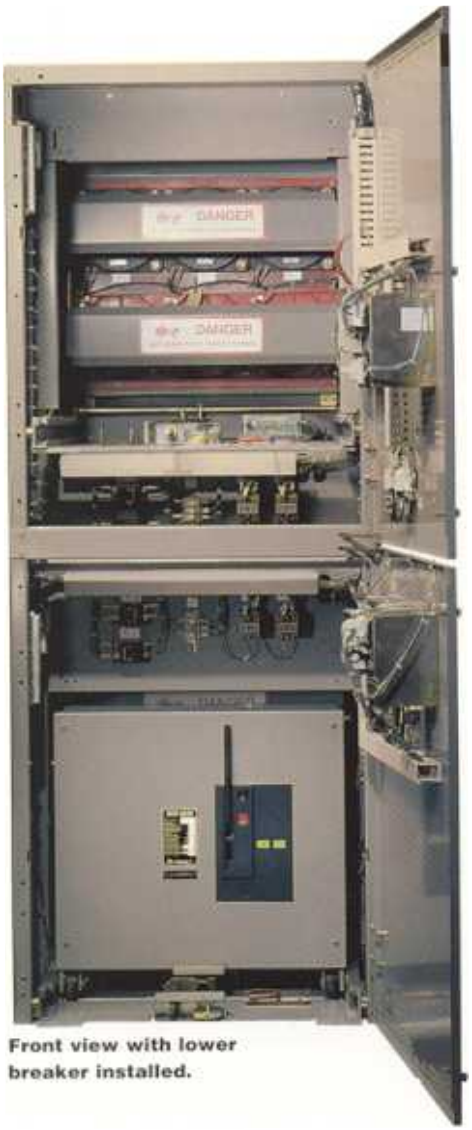
- Removable (Drawout) Circuit Breaker
- Fully Compartmented Construction
- Grounded Metal Barriers Enclose all Live Parts
- Automatic Shutters
- Insulated Bus
- Mechanical Interlocks
- Disconnect Type Voltage Transformers—CPT and VTs
- Grounded Breaker Truck in and between Test/Disconnected and Connected Positions
- Low Voltage Instrument/ Control Compartment Isolated from Primary Voltage areas

Applications

MASTERCLAD medium voltage switchgear is used in a wide variety of switching, control and protective applications including electric utility generation and distribution systems, industrial plants, commercial buildings, hospitals, municipal pumping stations, wastewater treatment plants, transportation systems, and pipeline stations. Transformers, motors, generators, capacitors, distribution lines, and feeder circuits are protected by this class of switchgear. Significantly, most of the MASTERCLAD switchgear specified for these applications is relied upon to provide the critical main service entrance protection and controls.

Standardization

Standardization of the design incorporates a series of basic modular units, control packages, and instrumentation. For most switchgear ratings, circuit configurations and functions, one basic size unit is used. These features provide application flexibility, versatility, efficiency and economy in minimizing engineering time to plan and lay out the switchgear.



Front view with lower breaker installed.

SQUARE D COMPANY
REGISTERED TO ISO 9001
CERTIFICATE NO. A2211

Square D Metal-Clad Switchgear is designed and manufactured in a facility that is Quality Systems Registered by Underwriters Laboratories, Inc. to ISO 9001.

Features and Benefits

Long Life/Minimum Maintenance

Reliability is the main priority. The VR vacuum circuit breakers are designed for long life. The interrupter's copper-chromium contacts, hermetically sealed for life in a vacuum, are protected from external atmospheric influences. Dust, moisture, and all other possible contaminants are sealed out. This state-of-the-art vacuum interrupter design is capable of 20-100 full fault interruptions (varies by rating).

The high dielectric strength of the vacuum environment allows a very short clearing time during fault interruption to limit the energy dissipated into the arc. Total fault clearing time is less than 3 cycles and contact travel is only 3/8 to 1/2 inch, depending on the ratings of the circuit breaker. The short stroke produces less mechanical shock to the operating mechanism.

For evaluation of wear on the main contacts over the life of the circuit breaker, contact erosion indication is provided on each interrupter pole assembly.

Together with a total commitment to quality, these features provide long life with high reliability.

Safety Barriers and Interlocks

Full compartmentalization is supplied with primary functions separated by grounded metal barriers. All bussing is insulated and live parts are not exposed. Safety interlocks work with the breaker racking system. These protective features furnish integrity to the equipment and provide safety for operating personnel.

Floor Space Economy and Application Flexibility

The two tier configuration permits feeder breakers to be stacked two high to save valuable floor space, or stacked one high combined with auxiliary units for the ultimate in application flexibility.

Convenient Handling

The VR breaker is a horizontal drawout type designed to provide long life, reduced maintenance and ease of handling. The breaker truck has wheels for easy movement into a lower cell (indoor switchgear) without use of any lifting device. A lifting truck is provided for installation of a breaker into an upper cell. Typical breaker weight is 350-480 lbs.

Comprehensive Test Program

A comprehensive design testing program has been performed by Square D development engineers. The switchgear and breakers are designed and tested in accordance with all applicable ANSI Standards C37.04, C37.06, C37.09 and C37.20.2. The switchgear and breakers meet the requirements of ANSI, IEEE, NEMA, and generally exceed IEC standards.

Rear view/termination compartment with incoming line and load bus runbacks.

Hinged Front Door

Relays and metering instruments are mounted on the doors in standardized arrangements to satisfy customer requirements. Each breaker compartment door provides a racking access port to allow moving the circuit breaker to or from the connected position with the door closed. (Option for single full-height door with "one-high" construction.)

Horizontal Drawout Circuit Breaker

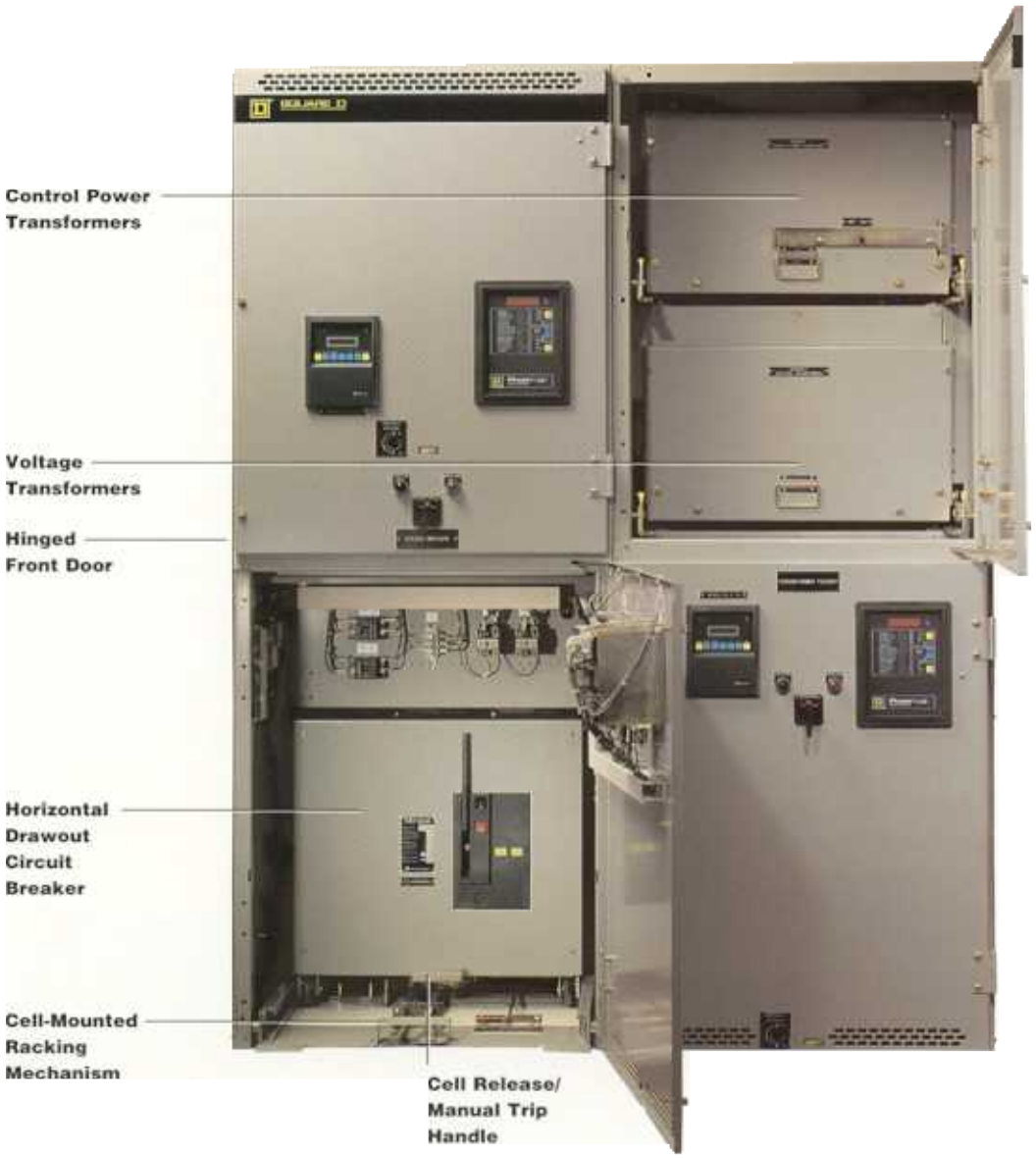
VR vacuum circuit breakers utilize the horizontal drawout design. Test/disconnected and connected positions are provided.

Control Power Transformers

Control power transformers rated up to 15 kVA are drawer mounted and can be completely withdrawn from the front of the switchgear for ease of maintenance. A secondary circuit breaker mechanical interlock is provided and must be opened before the transformer can be withdrawn for access to primary fuses.

Voltage Transformers

Front accessible, drawer mounted voltage transformers can be completely withdrawn on extension rails. For operator safety, the voltage transformers are disconnected and grounded during movement to the withdrawn position.



Racking System

The high quality gear-driven racking mechanism is center-mounted on the cell floor, providing balanced movement of the breaker between cell positions. The racking system is coordinated with safety interlocks to prevent movement of the breaker unless main contacts are in the open position.

Racking access port with front door closed.

SQUARE D COMPANY REGISTERED TO ISO 9001

Square D Metal-Clad Switchgear is designed and manufactured in a facility that is Quality Systems Registered by Underwriters Laboratories, Inc. to ISO 9001.

Cable Space

Top or bottom power cable entry space is provided. The quantity of cable termination devices and space for surge arresters vary with the ratings of breakers selected for each vertical section.

Compartment Barriers

Grounded metal barriers separate the main compartments—breaker, main bus, cable, instrument/relay (low voltage area), and auxiliary (VT and/or CPT).

Main Bus and Insulation

Main bus and runbacks are insulated with a track-resistant, flame retardant epoxy coating by the fluidized bed process. Bus support standoff insulators are glass polyester at 5 kV and porcelain at 15 kV. Bus joints are insulated by vinyl boots. Access covers are provided for main bus inspection from front and rear.

Main Bus Barriers

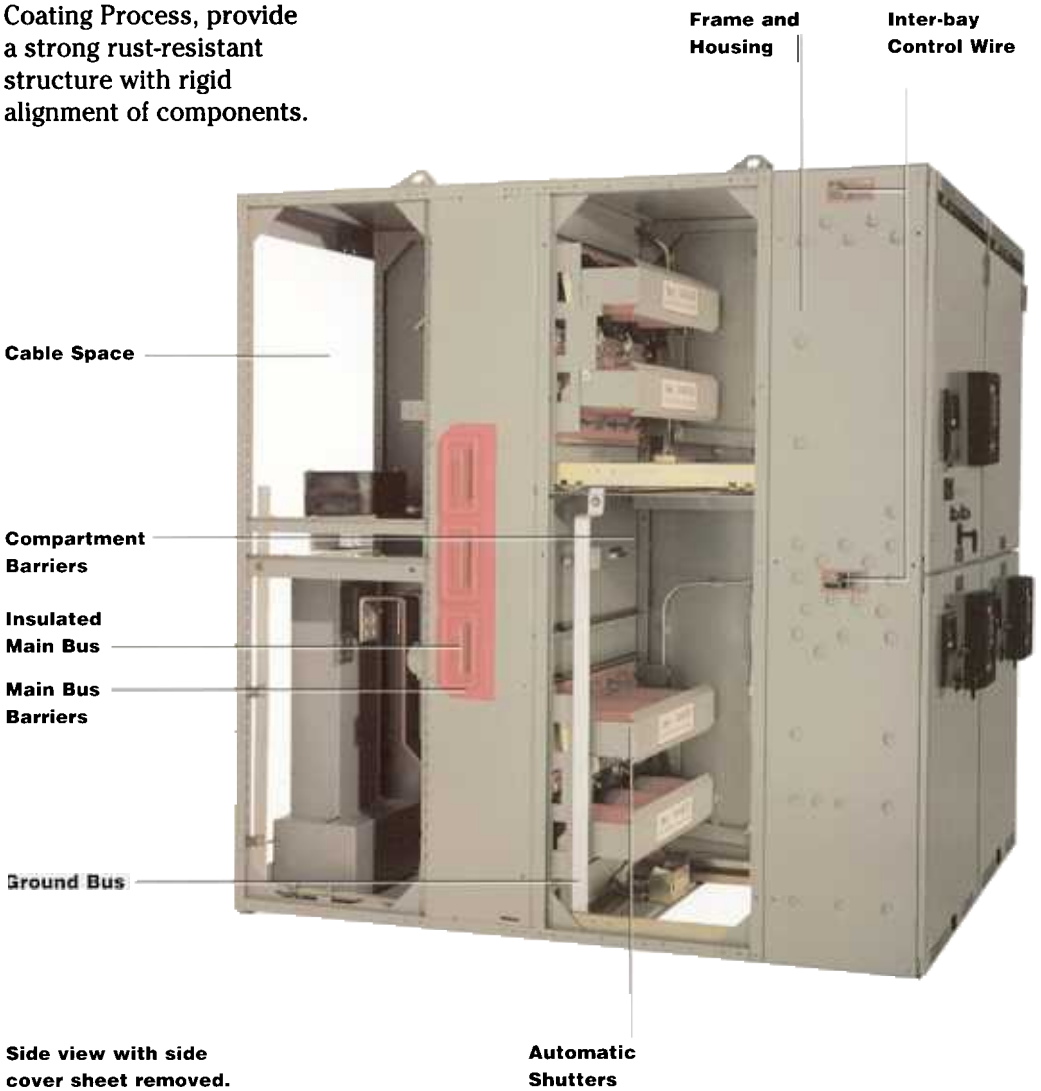
Main bus barriers between bays are track-resistant, flame retardant glass polyester. Optional porcelain inserts are available with the glass polyester barriers.

Automatic Shutters

When the breaker is withdrawn from the connected position, the racking mechanism linkage positively rotates the grounded metal shutters into a position which covers the energized components.

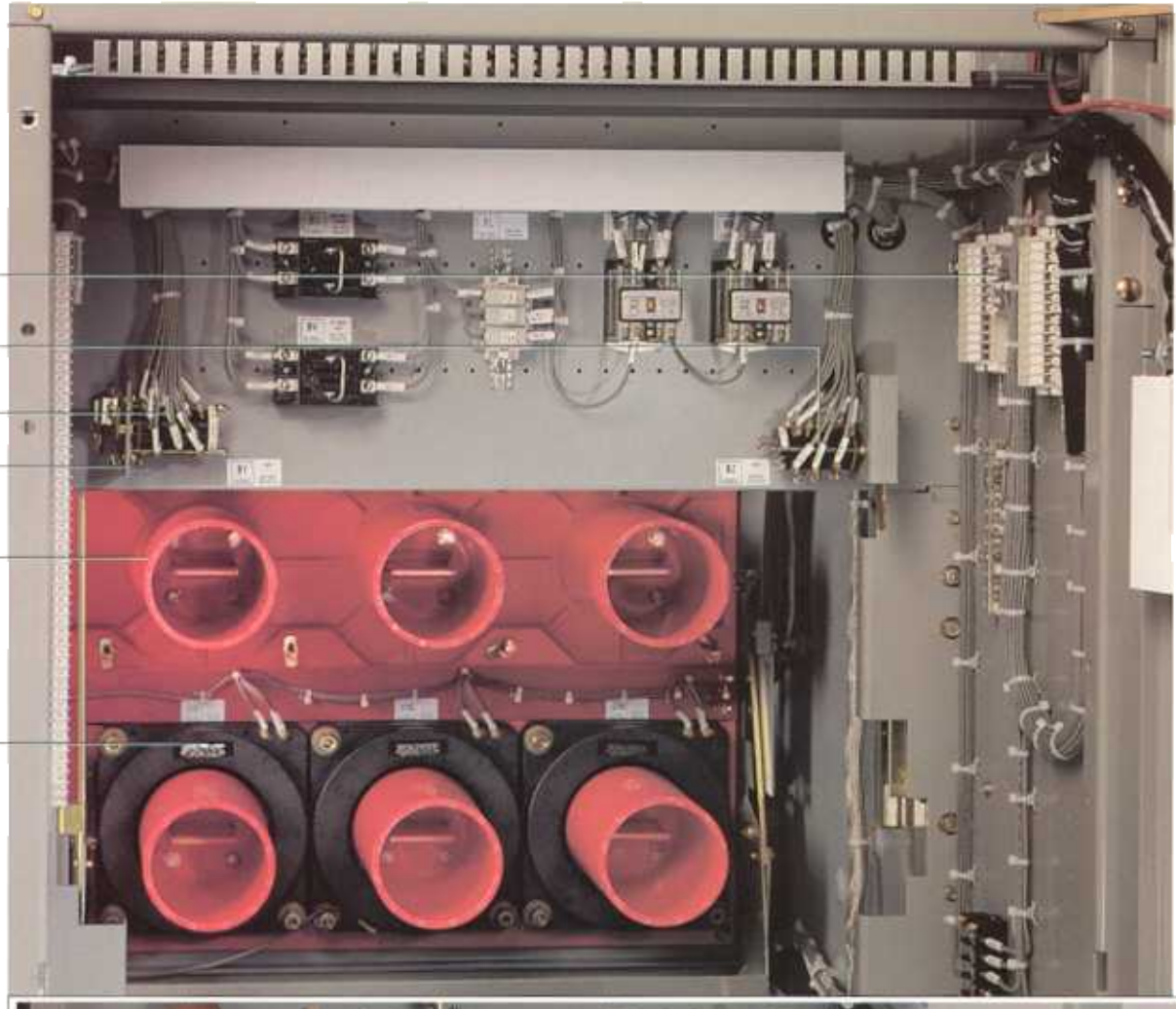
Frame and Housing

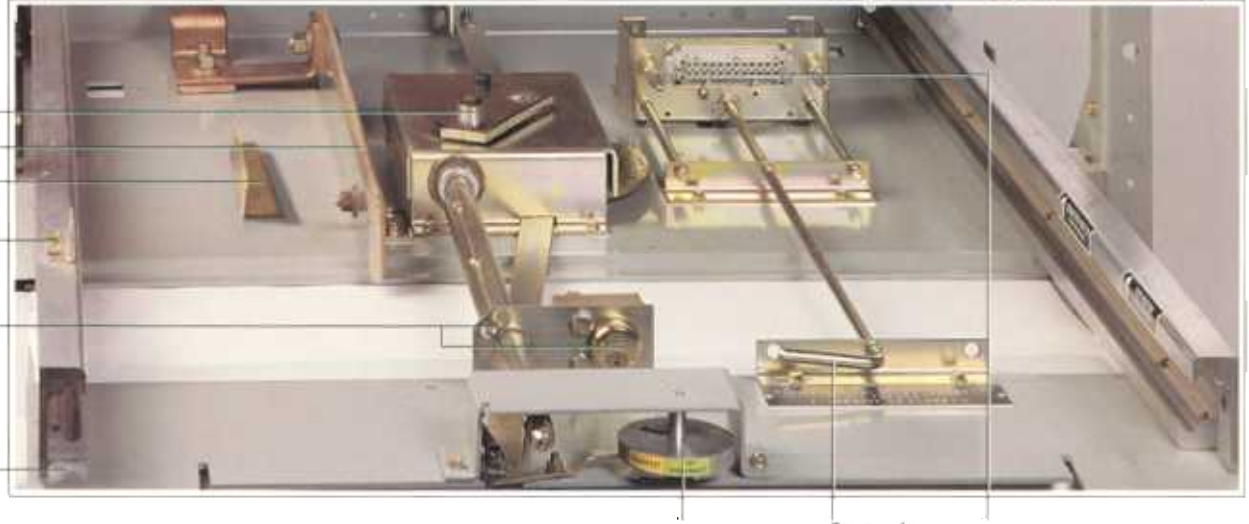
Precision-formed steel frames and inner panels, painted by the superior TGIC Polyester Powder Coating Process, provide a strong rust-resistant structure with rigid alignment of components.



Side view with side cover sheet removed.

MASTERCLAD™ BREAKER COMPARTMENT FEATURES





Breaker Compartment Floor Details (Highlighted View)

SQUARE D COMPANY
REGISTERED TO ISO 9001
CERTIFICATE NO. A2211

Square D Metal-Clad Switchgear is designed and manufactured in a facility that is Quality Systems Registered by Underwriters Laboratories, Inc. to ISO 9001.

Control Wiring

All secondary/control wiring, including terminal blocks, CT shorting blocks, and other devices are located in the instrument compartment at the front of each breaker section, isolated from the primary voltage areas. Each section has provisions for control wiring entry from top or bottom.

Cell Switch—T-O-C

(Optional) Stationary-mounted switch, 6 or 10 contacts, provides electrical indication of the position of the circuit breaker in the cell—connected position or test/disconnected position.

Auxiliary Switch—M-O-C

(Optional) Stationary-mounted switch, 6 or 10 contacts, maintains the same position as the breaker-mounted auxiliary switch—indicating breaker open or breaker closed.

Current Transformers

(Mounted behind shutters)

Bushing type current transformers are front accessible—located behind the shutters (shown in open position*, in photo at left) and mounted on the primary insulating bushings. Space will permit one or two current transformers on both sides of each circuit breaker—up to four total with ANSI standard relay accuracy class rating; two maximum with higher relay accuracies.

Secondary Control Receptacle

Self-aligning receptacle automatically engages the control plug when circuit breaker is racked to the connected position.

Auxiliary Switch Actuator

Operates M-O-C Auxiliary Switch when the circuit breaker is in the connected position and in the test position (unless otherwise specified).

Breaker Alignment Rails

The breaker cell has slotted alignment rails which capture the breaker rail rollers on each side of the breaker to provide assurance of breaker alignment with the cell. Note that the rail rollers are side-mounted and different from the wheels on the breaker truck.

Breaker Removal Latch Cam

Prevents removal of circuit breaker until handle at bottom front of circuit breaker is pulled by the operator.

Primary Insulating Bushings/Stationary Main Contacts

(Shown with current transformers)

Standard glass polyester (or optional porcelain) insulating bushings are used to support the primary stationary disconnect main contacts. The same bushings provide insulated mounting provisions for the current transformers.

Spring Discharge Interlocks

Both opening and closing springs are automatically discharged when circuit breaker is removed from the compartment. Racking arm operates linkage on bottom of breaker.

Breaker Rating Block

Prevents insertion of a breaker with lower rating, either MVA or continuous ampacity, than the compartment is designed to accept.

Breaker Position Indicator

The breaker position, either "connected" or "test/disconnected," is shown by the rotation of a colored indicator wheel driven by the racking mechanism and clearly visible with the cell front door either open or closed.

Locking Provisions

The safety shutters may be locked closed by padlocking (1 or 2) or by key interlock to prevent installation of a circuit breaker when required by customer maintenance procedures.

Racking Trip

Maintains breaker trip position during racking between test and connected positions. Racking arm operates linkage on bottom of breaker.

**Note: Shown with shutter barrier removed and shutters in the open position for illustrative purposes only. If access to current transformers is required, the switchgear must be de-energized before the shutters are moved to the open position.*

The VR circuit breaker with the Type RI advanced design motor-charged stored energy mechanism is a model of reliability with simplicity—virtually maintenance free. With an operating life exceeding the ANSI test requirements, the RI mechanism with synchronizing crossbar is electrically and mechanically trip-free. An integral handle (non-removable) is provided for manual charging and slow-closing during testing.

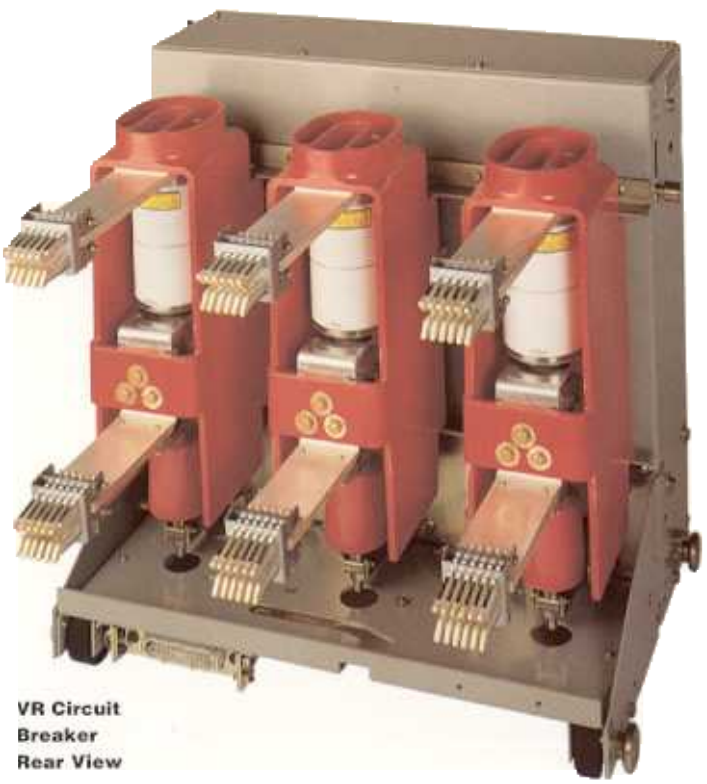
The VR is completely tested and certified to all applicable ANSI circuit breaker standards.

SQUARE D COMPANY
REGISTERED TO ISO 9001
CERTIFICATE NO. A2211

Square D Metal-Clad Switchgear is designed and manufactured in a facility that is Quality Systems Registered by Underwriters Laboratories, Inc. to ISO 9001.

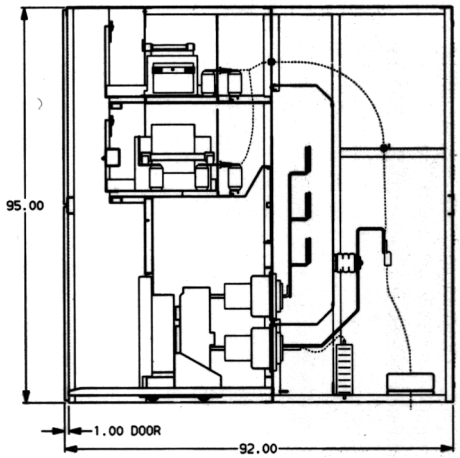
The vacuum interrupters of the VR circuit breaker are mounted in high-strength, molded glass-reinforced polyester insulation/support housings. The molded housings position the bus runbacks for precise alignment. The completed pole units are bolted directly to the breaker truck. The inherent rigidity and mechanical strength of this circuit breaker design complement the operating mechanism, resulting in high endurance and reliability.

VR Circuit Breaker with Front Cover Removed



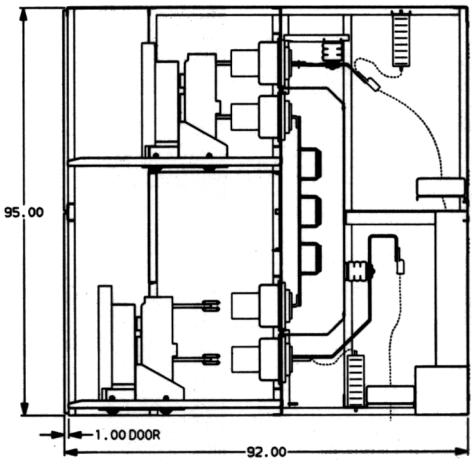
VR Circuit Breaker Rear View

36"w Sections with Standard Dimensions

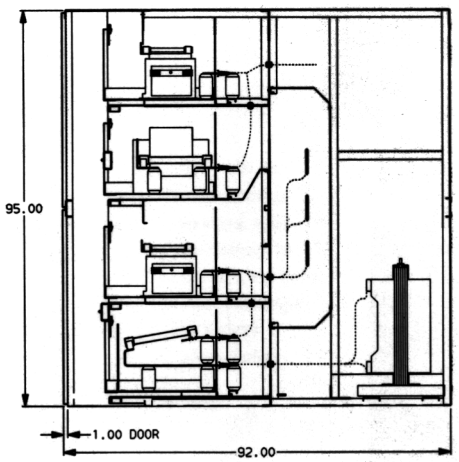


One high (main or feeder) arrangement with auxiliary drawout units behind the relay/meter door.

Note: For 3000A applications, the compartment above the 3000A breaker is blank except for relays, control switches, and other instruments.

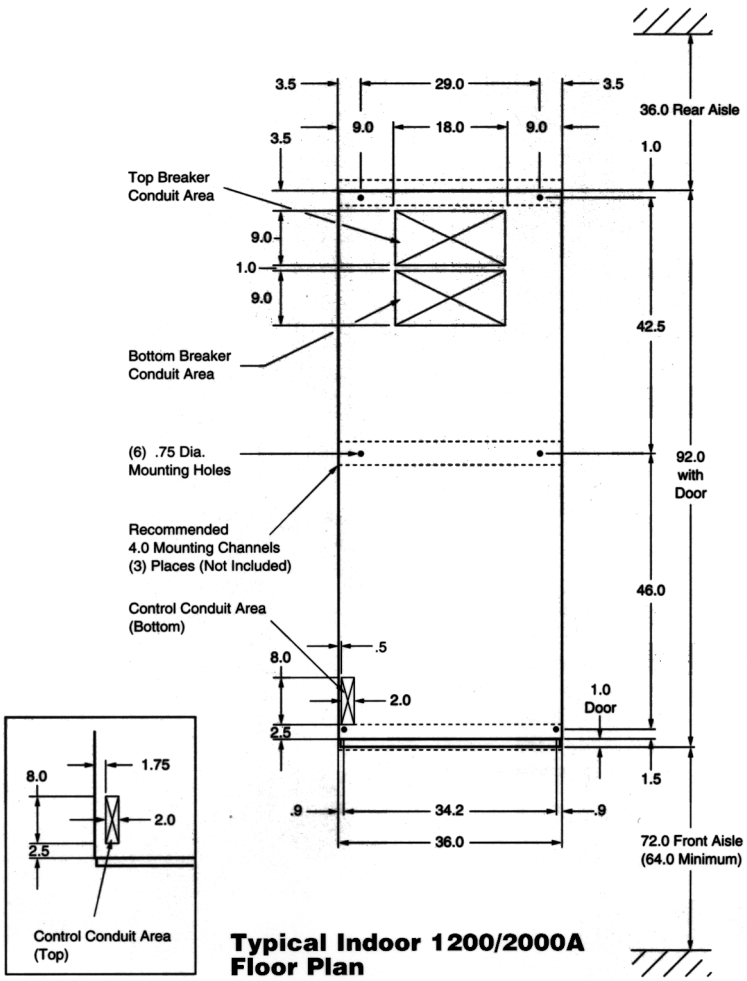


Two high feeder section arrangement—1200/1200A or 1200/2000A. Top or bottom cable entry.



Auxiliary section with up to four drawout units—VTs, CPT (to 15 kVA), primary fuse truck for (rear) fixed-mtd. CPT to 50 kVA-1Ø; 45 kVA-3Ø.

	Weights
Section, (less bkr):	2000 lbs
1200A Breaker:	360 lbs
2000A Breaker:	410 lbs
3000A Breaker:	480 lbs



Typical Indoor 1200/2000A Floor Plan

SQUARE D COMPANY REGISTERED TO ISO 9001

Square D Metal-Clad Switchgear is designed and manufactured in a facility that is Quality Systems Registered by Underwriters Laboratories, Inc. to ISO 9001.

Do Not Use for Construction. Dimensions are in Inches.

Circuit Breaker Ratings Data Chart

Type of Breaker	Nominal Rating: Three Phase MVA	Nominal Rating: Voltage kV–rms	Rated Cont. Current 60 Hertz Amps.–rms	Rated Voltages: Max. Voltage kV–rms	Rated Voltages: Range Factor K	Rated Voltages: Min. Voltage kV–rms	Insulation Level Rated Withstand: Low Freq. kV–rms	Insulation Level Rated Withstand: Impulse 1.2x50μS kV–Crest②	Interrupting Ratings① Amps. – Symmetrical: Max. kV Amps.–rms③	Interrupting Ratings① Amps. – Symmetrical: Nom. kV Amps.–rms	Interrupting Ratings① Amps. – Symmetrical: Min. kV Amps.–rms	Asymmetrical Rating Factor④	Short Time Rating 3 Sec. Amps.–rms	Close & Latch Rating Amps.–rms⑤	Interrupting Time Cycles
VR-05025-12	250	4.16	1200	4.76	1.24	3.85	19	60	29,000	33,200	36,000	1.2	36,000	58,000	3
VR-05025-20	250	4.16	2000	4.76	1.24	3.85	19	60	29,000	33,200	36,000	1.2	36,000	58,000	3
VR-05025-30*	250	4.16	3000	4.76	1.24	3.85	19	60	29,000	33,200	36,000	1.2	36,000	58,000	3
VR-05035-12	350	4.16	1200	4.76	1.19	4.0	19	60	41,000	46,900	49,000	1.2	49,000	78,000	3
VR-05035-20	350	4.16	2000	4.76	1.19	4.0	19	60	41,000	46,900	49,000	1.2	49,000	78,000	3
VR-05035-30*	350	4.16	3000	4.76	1.19	4.0	19	60	41,000	46,900	49,000	1.2	49,000	78,000	3
VR-08050-12	500	7.20	1200	8.25	1.25	6.6	36	95	33,000	37,800	41,000	1.2	41,000	66,000	3
VR-08050-20	500	7.20	2000	8.25	1.25	6.6	36	95	33,000	37,800	41,000	1.2	41,000	66,000	3
VR-08050-30*	500	7.20	3000	8.25	1.25	6.6	36	95	33,000	37,800	41,000	1.2	41,000	66,000	3
VR-15050-12	500	13.8	1200	15.0	1.30	11.5	36	95	18,000	19,500	23,000	1.2	23,000	37,000	3
VR-15050-20	500	13.8	2000	15.0	1.30	11.5	36	95	18,000	19,500	23,000	1.2	23,000	37,000	3
VR-15050-30*	500	13.8	3000	15.0	1.30	11.5	36	95	18,000	19,500	23,000	1.2	23,000	37,000	3
VR-15075-12	750	13.8	1200	15.0	1.30	11.5	36	95	28,000	30,400	36,000	1.2	36,000	58,000	3
VR-15075-20	750	13.8	2000	15.0	1.30	11.5	36	95	28,000	30,400	36,000	1.2	36,000	58,000	3
VR-15075-30*	750	13.8	3000	15.0	1.30	11.5	36	95	28,000	30,400	36,000	1.2	36,000	58,000	3
VR-15100-12	1000	13.8	1200	15.0	1.30	11.5	36	95	37,000	40,200	48,000	1.2	48,000	77,000	3
VR-15100-20	1000	13.8	2000	15.0	1.30	11.5	36	95	37,000	40,200	48,000	1.2	48,000	77,000	3
VR-15100-30*	1000	13.8	3000	15.0	1.30	11.5	36	95	37,000	40,200	48,000	1.2	48,000	77,000	3

* Availability to be announc

① For interrupting current ratings at operating voltages other than those listed, use the following formula:

$$I_{op} = \frac{V_{max}}{V_{op}} \times I_{V_{max}}$$

The calculated current should not exceed the maximum interrupting current rating, Imax:

$$I_{max} = K \times I_{V_{max}}$$

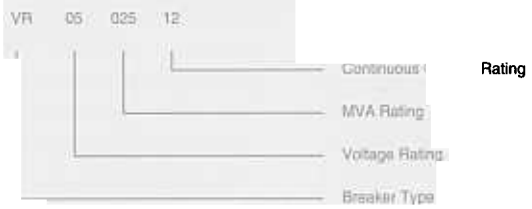
② These values apply with circuit breaker in or out of enclosure.

③ Rated Short Circuit Current (at rated Max kV).

④ Rating factor is based on breaker speed from initiation of trip signal to contact parting, allowing for 1/2 cycle relay time. To obtain the asymmetrical current interrupting capacity of the breaker, multiply the symmetrical current by 1.2.

⑤ Close and Latch Rating (Momentary) Amps rms = (1.6K) (Rated Short Circuit Current). Additional Close and Latch Rating in kA Crest = (2.7K) (Rated Short Circuit Current).

Breaker Identification



Rating

General

The (indoor) (outdoor non-walk-in) (outdoor walk-in) Metal-Clad Switchgear described in this specification is intended for use on a (2400) (4160) (4800) (6900) (13800) volt 3-phase (3) (4) wire (grounded) (ungrounded) 60 Hertz system. The switchgear shall be rated (4160) (7200) (13800) nominal volts and have VR horizontal drawout circuit breakers.

The switchgear and circuit breakers, individually and as a unit, shall have a BIL (impulse) rating of (60) (95) kV. The momentary rating of the switchgear bus shall be equal to the close and latch rating of the circuit breakers. The entire switchgear assembly including circuit breakers, meters, relays, etc., shall be completely factory tested and the circuit breakers of like ratings shall be interchangeable.

Applicable Standards

The switchgear covered by this specification shall be designed, tested, and assembled in accordance with the applicable standards of ANSI/IEEE and NEMA.

Stationary Structure

The switchgear shall consist of __ sections including __ breaker compartments and __ auxiliary compartments assembled to form a rigid, self-supporting, completely enclosed structure providing steel barriers between sections. The sections are divided by metal barriers into the following separate compartments: circuit breaker, instrument, main bus, auxiliary device, and cable. Each section may have up to two breaker compartments.

Circuit Breaker Compartment

Each circuit breaker cell compartment shall be designed to house a VR horizontal drawout (4160) (7200) (13800) volt vacuum circuit breaker. The stationary primary disconnecting contacts are to be silver-plated copper and mounted within glass polyester support bushings. The movable contacts and springs shall be mounted on the circuit breaker element for ease of inspection/maintenance.

Entrance to the stationary primary disconnecting contacts shall be automatically covered by metal shutters when the circuit breaker is withdrawn to the test or disconnected positions or removed from the circuit breaker compartment.

The metal shutters shall be operated by direct mechanical linkage to the floor-mounted racking mechanism. Extend a ground bus into the circuit breaker compartment to automatically ground the breaker frame when in the test and connected positions with high-current spring type grounding contacts located on the breaker chassis. Slotted guide rails for positioning the circuit breaker and all other necessary hardware are to be an integral part of the circuit breaker compartment. The circuit breaker rail rollers shall be held captive on both top and bottom by the slotted guide rails to provide assurance of breaker alignment with the cell, while preventing vertical movement of the breaker truck during normal operation and under short circuit conditions. A breaker position indicator ("connected" or "test/disconnected") shall be driven by the racking mechanism and be visible with the front door either open or closed. Blocking devices shall interlock breaker frame sizes to prevent installation of a lower ampere rating or interrupting capacity element into a compartment designed for one of a higher rating. It shall be possible with indoor or outdoor walk-in switchgear to install a circuit breaker into a bottom compartment without use of a transport truck or lift device.

Cable Compartment

(Clamp type cable lugs) (Potheads) (Cable terminators) shall be furnished as shown on plans. The copper ground bus shall extend through this compartment for the full length of the switchgear.

Main Bus Compartment

The main bus is to be rated (1200) (2000) (3000) amperes and be fully insulated for its entire length with an epoxy coating by the fluidized bed process. The conductors are to be (aluminum with tin-plated joints) (copper with silver-plated joints) and be of a bolted (not welded) design. Access to this compartment is gained from the front or rear of the structure by removing a steel barrier. Bus support standoff insulators shall be glass polyester at 5kV and porcelain at 15kV. Bus joints shall be insulated with vinyl boots.

SQUARE D COMPANY

Square D Metal-Clad Switchgear is designed and manufactured in a facility that is Quality Systems Registered by Underwriters Laboratories, Inc. to ISO 9001.

Doors and Panels — Indoor and Outdoor

Relays, meters, control switches, etc., shall be mounted on a formed front-hinged panel for each circuit breaker compartment. In addition, outdoor sections, NEMA 3R non-walk-in, have full-height weatherproof front door with 3-point latch. Indoor sections to be furnished with two screw-removable rear panels. Outdoor sections to be furnished with full-height rear-hinged panels.

Circuit Breakers

The VR circuit breakers shall be rated (4160) (7200) (13800) nominal volts, 60 Hertz, (1200) (2000) (3000) amperes and an interrupting class rating of (250) (350) (500) (750) (1000) MVA with one vacuum interrupter per phase. Breakers of equal rating shall be completely interchangeable. The circuit breaker shall be operated by means of a stored energy mechanism which is normally charged by a universal motor, but can also be charged by the integral handle for manual emergency closing or testing. The closing speed of the moving contacts is to be independent of both the control voltage and the operator. Provide a full front shield on the breaker. Positive contact secondary disconnect shall be through automatic self-aligning, self-engaging type plug and contact arrangement. Provision shall be made for control power plug to be manually connected in test position. A minimum of 4 auxiliary contacts (2a, 2b) shall be provided for external use. Provisions shall be made for (6) (10) additional cell-mounted auxiliary contacts (M-O-C type) (and) (T-O-C type) for external use.

An interlocking system shall be provided to make it impossible to rack a closed circuit breaker to or from any position. An additional interlock shall automatically discharge the stored-energy operating mechanism springs upon removal of the breaker from the compartment.

The circuit breaker control voltage shall be:

(48) (125) (250) volts DC

(120) (230) volts AC

Instrument Transformers

Current transformers: each breaker compartment shall have provision for front-accessible mounting of up to four current transformers per phase, two on bus side and two on cable side of circuit breaker. The current transformer assembly shall be insulated for the full voltage rating of the switchgear. Relaying and metering accuracy shall conform to ANSI standards.

Voltage transformers are drawout mounted with primary current-limiting fuses and shall have ratio as indicated. The transformers shall have mechanical rating equal to the momentary rating of the circuit breakers and shall have metering accuracy per ANSI standards.

Control Wiring

The switchgear shall be wired with Type SIS #14 AWG, except #12 AWG for current transformers wiring. The switchgear shall be provided with terminal blocks for outgoing control connections.

Finish

After pretreatment to form a primer coating of zinc phosphate on the metal, finish coating shall be an electrostatically applied TGIC polyester powder paint. The process shall be designed to withstand at least 2500 hours of salt spray as tested per ASTM B-117 and ASTM D-1654. Switchgear finish to be light gray ANSI #61.

Accessories

Standard accessories shall be furnished with the switchgear, including:

Manual charging/slow close handle (on front of each breaker.)

Manual racking crank handle (one per lineup.)

Optional Accessories: Test cabinet, test cable with jack and plug, 5th wheel, breaker lift truck*, manual ground and test unit (MGTU), automatic/electrically-operated ground and test unit (AGTU), and remote racking motor.

For further information about Square D MASTERCLAD Switchgear with Vacuum or SF_6 Circuit Breakers, contact your nearby Square D sales office. They are conveniently located in over 200 cities throughout the world to serve you.

**The lift truck is provided for indoor and outdoor walk-in switchgear with upper compartment breaker cells. The lift truck is also provided for all outdoor non-walk-in switchgear to install breakers over the base channels.*

Visit the Square D web site at www.squared.com

SQUARE D and D are registered trademarks of Square D Company.

POWERSUB is a trademark of Square D Company.

Order No. 6055BR9402R7/98 Printed in U.S.A. 07/98

SQUARE D
GROUPE SCHNEIDER

©1998 Square D Company All Rights Reserved