Outdoor vacuum circuit-breakers and reclosers for medium voltage

Switching technology for distribution networks

Answers for energy.

SIEMENS

Reliable quality for all your medium-voltage network needs

Quality from Siemens

Circuit-breakers form a most vital part of your medium-voltage network. They must make and break all currents within the scope of their ratings, from small inductive and capacitive load currents up to the short-circuit current, regardless of earth faults, phase opposition, etc. Outdoor vacuum circuit-breakers (OVCB) and reclosers have to face even higher demands, with the additional influence of weather conditions. For its proven reliability, network operators around the world have chosen Siemens medium-voltage vacuum circuit-breakers for over 35 years, with over 350,000 vacuum circuit-breakers in service to date.

A partner to rely on

Siemens puts large effort into developing and manufacturing its medium-voltage circuit-breakers to the highest possible standards, enabling them to withstand the toughest climates and function reliably in practically every kind of environment. The circuit-breaker research and development center in Berlin, Germany, and the Siemens Centers of Competence worldwide are part of a global R&D network, underscoring the emphasis Siemens places on the reliability of its products. Here, circuit-breaker operators and interrupters are designed, developed, and tested, while design (type) short-circuit tests are performed at independent power test laboratories. In addition, the worldwide design and production of the circuit-breakers' operating mechanism is also controlled from Berlin – to reach the same quality and reliability for all Siemens customers worldwide.

Siemens OVCBs and reclosers

Your benefits:

- Excellent products thanks to over thirty-five years of Siemens' experience in vacuum technology
- Ideally matched, high-quality system components for highest possible reliability
- The right product for practically any network or industry need
- Environmentally sound solutions thanks to vacuum technology

The right solutions for tomorrow's intelligent networks

Siemens offers a broad portfolio of outdoor vacuum circuit-breakers and reclosers. Due to their high reliability and performance, they are used in many different types of power systems.

They have been especially designed to reach a long electrical and mechanical service life, employing a minimum of moving parts and a simple structure. To fully meet your needs, the Siemens outdoor portfolio comprises

- Vacuum reclosers
- Live-tank circuit-breakers
- Traction breakers
- Dead-tank circuit-breakers
- Accessories

Always at your service

While Siemens is able to provide all the equipment for your network needs anywhere in the world, its service organization is also set out to provide the support, wherever and whenever you need it. With its 24/7 service hotline, Siemens service is at your fingertips, with a special emergency service as well as a training center for both operation and parameterization. In addition, Siemens offers remote expert advice and power system analysis to help you run your network more reliably and efficiently.

Reliable vacuum interrupters from Siemens

At the heart of matters

Our outdoor vacuum circuit-breakers rely on a well-established technology Siemens has developed and introduced into series production some 30 years ago: the Siemens vacuum interrupter. It offers high performance and reliability and is being continuously improved. For example, some of Siemens' most modern vacuum interrupters are only 45 percent the diameter of similar types developed 20 years ago. These compact designs allow for the construction of outdoor vacuum circuit-breakers for numerous applications.

Built-in performance advantages

When utmost reliability is required, there is no room for compromise in the choice of materials. That is why the Siemens vacuum interrupters use chrome-copper contact materials that keep the chopping current to 5 amperes or less, which minimizes over-voltages. To reduce contact erosion, Siemens uses radial magnetic field contacts for 15.5 kV and 27.6 kV circuit-breakers up to 25 kA, to force high current arcs (>10 kA) to rotate rapidly around the contact surfaces. For the same reason, Siemens employs axial magnetic field contacts for 15.5 kV 31.5 kA and 40 kA and all 38 kV circuit-breakers: they force the arc to remain diffused, thus preventing excess contact erosion. As a result, the Siemens vacuum interrupters can handle up to 100 full rated faults (depending on the rating) before they have to be replaced. Contact wear is easily monitored through the external wear indicator to trigger timely replacement.

Performance overview:

Siemens vacuum interrupters are among the best in class in short-circuit breaking capacity. They offer:

- 30,000 circuit-breaker operation cycles
- 5 million operation cycles for contactors
- Practically maintenance-free service life
- Extremely high short-circuit breaking capacity
- Excellent dielectric performance
- Very low chopping currents
- Minimal contact resistance

The Siemens vacuum interrupters offer predictable and stable interruption over the entire product lifetime, even for extreme applications such as:

- Vibrating environments
- High and low frequencies
- Horizontal or vertical installation

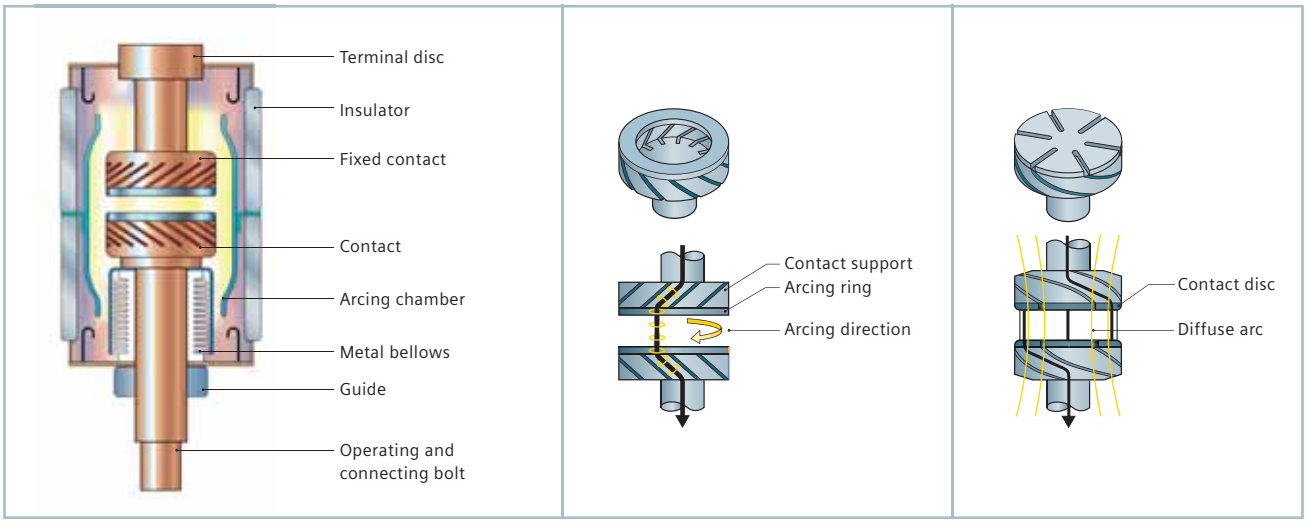
Secure arc quenching

When the contacts are galvanically separated during the switching process, the current to break produces a metal-vapor arc discharge until the arc extinguishes near the next current zero. Since the metal vapor loses its conductivity after few microseconds, the insulating capability of the contact gap recovers quickly. However, the metal vapor arc will extinguish and the current will chop unless a specific minimum current is achieved. To maximize contact service life and to prevent impermissible overvoltages while switching inductive circuits, the chopping current in the Siemens vacuum interrupters is limited to just 2 to 3 A by using special contact materials.

Optimized contact geometries

To further minimize contact erosion, and depending on breaking current and the interrupter dimensions, different contact geometries are used:

- In radial magnetic-field contacts, the arc burns diffusely up to a momentary value of approximately 10 kA, while higher currents burn across a contracted arc. To avoid local contact overheating, an additional magnetic field lets the arc rotate on the contacts' arcing rings, thus distributing contact erosion at the base point of the arc across the entire ring surface.
- In axial magnetic-field contacts, the arc remains diffuse even with high currents. The disc-type contact surfaces are uniformly stressed, and local melting is avoided.



Vacuum reclosers 3AD

Economic success through intelligent technology

Siemens vacuum reclosers 3AD were developed to provide safe and efficient fault interruption and to avoid temporary faults, especially in overhead lines where lightning strikes, wind-borne debris, crossed lines, fallen branches, or small animals and birds on the insulation can cause problems. The pole-mounted high-quality Siemens vacuum switch unit and a well adapted controller at ground level provide recent innovations and most user-friendly operation in recloser technology. They offer flexible solutions for both your automatic protection and remote operation requirements for the needs of intelligent networks, and meet or exceed the requirements of the recent revision of ANSI/IEEE C37.60 and IEC 62271-111.

Digital, for better results

More than ninety years of experience in digital protection technology have led to the development of the Siemens vacuum reclosers 3AD. In the control cubicle, the controller provides comprehensive protection functions. Besides directional over-current time protection (definite and inverse), it is equipped for earth-fault and sensitive earth-fault detection. Inrush restraint and load shedding are additional functions for better protection of your network. Special features like USB ports and tricolor LEDs also make the withdrawable controller very easy to work with.

Built to cut costs

Since switching is done using practically maintenance-free vacuum interrupters, the Siemens reclosers help prolong contact life and operate in an environment-friendly way, while also cutting lifecycle costs. In addition, the vacuum interrupters are set in bushings made of weatherproof epoxy resin. To make the systems even more durable, the vacuum reclosers' control cubicle is composed of corrosion-resistant mild or stainless steel. Additionally, they successfully passed the very demanding KIPTS environmental test in South Africa.

Vacuum reclosers 3AD

Your benefits:

- High-performance portfolio for up to 16 kA short-circuit breaking current and a rated operating voltage of up to 38 kV
- Uniform design for all applications single, single triple, and three-phase
- Large number of protection, metering, and monitoring functions including loop automation
- Controller based on a protection relay family
- Completely programmable via menu (not only PC)
- Integrated ring-core CT for high accuracy SEF protection in compensated networks

Expertly designed for your needs

In order to meet the highest possible safety requirements, integrated current transformers and optional voltage sensors provide highly accurate measurements for protection, power monitoring, and metering. Siemens vacuum reclosers 3AD are rated 12 kV up to 38 kV, up to 800 A three phase/single phase/single triple application.

International recognition

The skillful design of the Siemens reclosers won us a red dot design award in the "industry and crafts" category in 2008. This international award evaluates the overall design quality and ecological compatibility of a product. The primary reason that the reclosers were honored is their unobtrusive and highly aesthetic outward appearance, which allows them to blend harmoniously into public spaces while at the same time communicating a sense of high energy and performance.

reddot design award
product design 2008

Technical data and ratings	
Rated operating current	400 A to 800 A
Rated voltage acc. to ANSI C37-60	12 kV; 15.5 kV; 27 kV; 38 kV
Short-circuit breaking current	12.5 kA; 16 kA
Lightning impulse withstand voltage	95 kV to 190 kV
Recloser sequence	O – 0.2s *1 – CO – 2s – CO – 2s – CO (– 30s – CO)
Opening time	30 ms
Closing time	60 ms
Number of operating cycles	10,000 *2
Number of short circuit operations	up to 200
Number of phases	three-phase, single-phase, single-triple
Standards	ANSI C37.60; IEC 62271-111; IEC 60255; IEC-62271-100

Rated voltage	Short-circuit breaking current	Lightning impulse withstand voltage	Operational current 400 A	630 A	800 A
12 kV	12.5 kA	95 kV		□	□
15.5 kV	12.5 kA	110 kV	□	□	□
	16 kA	110 kV		□	□
27 kV	12.5 kA	125 kV	□	□	□
	12.5 kA	150 kV	□	□	□
	16 kA	150 kV		□	□
38 kV	12.5 kA	170 kV/optional 190 kV		□	□
	16 kA	170 kV/optional 190 kV		□	□

*1 can be set to up to 14,400 s
*2 higher number of operation cycles on request

Live-tank circuit-breakers 3AF0 and 3AG0

Your benefits:

- Capacitor and reactor switching
- Up to 40.5 kV and 31.5 kA
- High operational safety, restrike-free
- Suitable for practically all environments
- SF_6 free

Live-tank circuit-breakers 3AF0 and 3AG0

Minimum maintenance and high operational safety

The Siemens live-tank circuit-breakers 3AF0 and 3AG0 excel in their ability to reliably switch off overhead lines. Special technical features of the live-tank design are the placement of the interrupter chamber in the weatherproof porcelain (or composite material) insulator and is at high potential or live. With live-tank designs, the voltage level determines the length of the insulators for the interrupter chamber and the insulator column. The Siemens live-tank circuit-breakers 3AF0 and 3AG0 are restrike-free and offer reliable operation through their stored-energy spring operating mechanism.

Easy to install, operate, and maintain

Due to their modular structure and lightweight components, the Siemens live-tank circuit-breakers 3AF0 and 3AG0 can easily be transported to their installation site. Their switching function is based on the same well-proven components indoor circuit-breakers. In addition, they can be optimally adapted to each application using current and voltage transformers. And since they contain very few moving parts, the Siemens live-tank circuit-breakers 3AF0 and 3AG0 are practically maintenance-free.

Increased reliability and operational safety

The sealed pole design makes these circuit-breakers suitable for practically all environments. In addition, all live-tank circuit-breakers up to 40.5 kV conform to the new IEC 62271-100, and all models have been type-tested at the KEMA laboratory in the Netherlands.

Technical data and ratings	
Rated operating current	1,250 A to 2,500 A
Rated voltage	12 kV to 40.5 kV
Short-circuit breaking current	20 kA to 31.5 kA
Lightning impulse withstand voltage	75 kV to 200 kV
Operating sequences	O – 0.3s – CO – 3m – CO; O – 0.3s – CO – 15s – CO
Opening time	< 75 ms
Closing time	< 50 ms *1
Number of operating cycles	10,000 *2
Number of short circuit operations	up to 100
Standards	IEC 62271-100, IEC 62271-1

Rated voltage	Short-circuit breaking current	Lightning impulse withstand voltage	Operational current [A] 1,250	1,600	2,000	2,500
17.5 kV	25 kA	95 kV		□	□	
36 kV	25 kA	170 kV		□	□	
	31.5 kA	170 kV		□	□	
40.5 kV	25 kA	200 kV				□

*1 with second shunt release
*2 higher switching cycle rates on request

AC traction power OVCBs 3AF04 and 3AF05

Your benefits:

- One- and two-pole designs available
- Well-established vacuum technology for reliable switching duties
- Practically maintenance-free up to 10,000 make/break operations
- Weather-proof, compact design
- Fulfills IEC 62271-1, IEC 62271-100 as well as EN 50152-1, EN 50163 for railway applications

Outdoor vacuum circuit-breakers 3AF04/3AF05 for AC traction power supply

Built to meet demanding requirements

The 3AF04/3AF05 OVCBs for AC traction power supplies consist of three major parts: the pole assembly, the operating mechanism box, and the supporting steel structure. For easy access, the operating mechanism box is situated inside the supporting steel frame. It features the circuit-breaker operating mechanism including motor, release and auxiliary switches and the control cabinet. The actual switching is carried out by a vacuum interrupter mounted inside the weatherproof pole assembly at electrical potential (live). The two pole assemblies rest on a base frame with a common operating shaft.

The pole assemblies consist of two porcelain insulators that separate the terminal connectors from the steel structure. The upper insulator contains the vacuum interrupter: its upper end is fixed to the upper terminal connector, while its lower end allows free axial movement inside flexible connectors to connect it the lower terminal connector. Underneath the lower insulators covers the switching rod is located, which transmits the switching movement from the operating mechanism box to the vacuum interrupter.

Proven live-tank design

The design of our AC traction power supply OVCBs 3AF04 and 3AF05 respectively offers all the advantages of the proven 3-pole live-tank OVCB 3AF01. It comprises a minimum number of moving parts and a simple construction, which guarantee outstanding operational reliability and mechanical endurance. All control elements have been placed in the operating mechanism box, which also contains the fully wired control cabinet for local operation of the circuit-breakers.

Technical data and ratings	
Rated operating current	2,000 A
Rated frequency	50/60 Hz
Rated voltage	27.5 kV
Short-circuit breaking current	31.5 kA
Lightning impulse withstand voltage	200 kV
Number of poles	One or two
Operating sequences	O-3min-CO-3min-CO O-0.3s-CO-3min-CO O-15s-CO
Opening time	< 75 ms
Closing time	< 50 ms *1
Number of operating cycles	10,000 *2
Number of short circuit operations	up to 100
Standards	IEC 62271-100; IEC 62271-1; EN 50152-1; EN 50163

Rated voltage	Short-circuit breaking current	Lightning impulse withstand voltage	Operational current 2,000 A
27.5 kV	31.5 kA	200 kV	□

*1 with second shunt release
*2 higher switching cycle rates on request

Dead-tank circuit-breaker SDV6

Extended ratings and reliability

In 2006, Siemens introduced the new global-class dead-tank SDV6 outdoor vacuum circuit-breaker with the trustworthy Siemens 3AH3 vacuum circuit-breaker (with over 60,000 units manufactured since 1999). Designed specifically for the U.S. ANSI market, the stationary-distribution vacuum circuit-breaker has passed the entire ANSI type-testing program and provides a significant increase in performance over its predecessor, the SDV4A, over a full range of voltages in three classes (15 kV, 27.6 kV, 38 kV) and up to 40 kA. Each group is specifically designed to optimize space and material for the voltage class while retaining common features across the entire product line.

Superior dead-tank design

The distinguishing feature of SDV6 dead-tank technology is that the interrupter chambers are accommodated in an earthed metal housing.
On the 3AH3 vacuum interrupter, the poles are mounted directly onto the operator. A gearbox allows for quieter operation with reduced vibration. All key components are accessible from the front for easy servicing. However, in outdoor applications maintenance is normally only needed at at 5-year 10,000 operations on any circuit' intervals, if the ANSI 'usual service' conditions are applied.

Able to meet the most demanding requirements, the SDV6 outdoor vacuum circuit-breaker can be enhanced so that it is capable of maintaining structural integrity during and after seismic disturbances, as appropriate for the specified UBC zones 1–4. In addition, the SDV6 meets the following standards:

- IEEE C37.04-1999 rating structure for A-C HV circuit-breakers
- IEEE C37.09-1999 test procedure for A-C HV circuit-breakers
- IEEE C37-06-200X draft 7.8 (September 2006) preferred ratings A-C HV circuit-breakers
- NEMA SG-4-2000 A-C HV circuit-breakers

Technical data and ratings	
Rated operating current	1,200 A to 3,000 A
Rated voltage acc. to ANSI C37-60	15.5 kV; 27.6 kV; 38 kV
Short-circuit breaking current	25 kA to 40 kA
Lightning impulse withstand voltage	110 kV to 200 kV
Operating sequence	O – 3min – CO – 3min – CO
Opening time	< 80 ms
Closing time	< 50 ms *1
Number of operating cycles	10,000 *2
Number of short circuit operations	up to 100
Standards	ANSI C37.20; IEEE C037.06

Rated voltage	Short-circuit breaking current	Lightning impulse withstand voltage	Operational current [A] 1,250	2,000	3,000
15.5 kV	20 kA	110 kV	□	□	
	25 kA	110 kV	□	□	
	31.5 kA	110 kV	□	□	□
	40 kA	110 kV	□	□	□
27.6 kV	20 kA	150 kV	□	□	
	25 kA	150 kV	□	□	
38 kV	20 kA	200 kV	□	□	
	25 kA	200 kV	□	□	
	31.5 kA	200 kV	□	□	
	40 kA	200 kV	□	□	

*1 with 48 Vdc, 125 Vdc, or 250 Vdc trip voltage or capacitor trip
*2 60,000 operations, with overhaul and vacuum interrupter replacement at 10,000 operations

Additional components for increased performance

Instrument transformers

Instrument transformers are a prerequisite for measuring high voltages or currents. Their task is to transform them into small current or voltage values for measurement or protection purposes. In the latter case, the instrument transformer feeds analyzable signals to the protection devices, enabling them to switch off a device depending on the situation. In addition, instrumentation transformers may be used to record the transmitted power, e.g., for monitoring purposes.

In contrast to normal voltage transformers, instrumentation transformers can be equipped with several secondary windings with magnetically separated cores of the same or different characteristics, e.g., for measuring and protection purposes. Single-pole insulated voltage transformers can be provided with an additional winding for earth-fault detection, if necessary.

Surge arresters and limiters

Surge arresters and limiters protect operational equipment from overvoltages caused by lightning strikes in overhead lines, switching operations, or earth faults. The arresters are usually mounted between phase and earth. When a certain overvoltage limit value is reached, the voltage-dependent metal-oxide resistors (varistors) become conductive and the surge can be discharged to earth. After returning to their original high resistance value, a leak-current of a few µA flows through the varistors.

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