



S&C's Trans-Rupter II[®]

Transformer Protector

Affordable sophisticated transformer protection

S&C Trans-Rupter II Transformer Protector: The Low-Cost Solution for Sophisticated Transformer Protection

- Are you spending more than you want for transformer protection? Are you buying circuit breakers with expensive features you don't need?
- Do you want a device that's economical and easy to install, like power fuses, but with three-phase tripping and the ability to coordinate with downstream protective devices, like a circuit-switcher or circuit breaker?
- Is increasing system capacity challenging the fault interrupting capability of your existing protective devices?
- Are you building a compact or mobile substation and need a device with flexible mounting arrangements?
- Are you planning a new substation or an upgrade of an existing substation and want to keep costs down?

Utilities everywhere are being challenged to reduce substation costs, while simultaneously improving the reliability of power to their customers. S&C's Trans-Rupter II Transformer Protector is the answer to your transformer protection needs. S&C worked closely

with utilities, substation designers, and transformer manufacturers to develop a device that does what none other can: provide sophisticated transformer protection at an affordable cost.

Want proof? Look at this comparison of today's alternatives for transformer protection.

Feature	Power Fuses	Circuit-Switchers	Circuit Breakers	Trans-Rupter II Model EX	Trans-Rupter II Model SE
Three-Phase Tripping		✓	✓	✓	✓
Activated by Relays		✓	✓	✓	✓
Resettable		✓	✓	✓	✓
High Interrupting Ratings		✓	✓	✓	✓
SCADA Compatibility		✓	✓	✓	✓
No Substation Batteries	✓				✓
Mounting Flexibility	✓			✓	✓
Low Installed Cost	✓			✓	✓

Trans-Rupter II is designed exclusively for primary-side application on distribution substation transformers, where operation is infrequent and continuous-current requirements are modest. It provides all the features needed for reliable transformer protection—and eliminates the cost of those that aren't.

Trans-Rupter II doesn't just provide a low purchased cost. With its simple installation procedure and no periodic maintenance needs, Trans-Rupter II provides low installed and operating costs, too. Its lightweight, compact design allows Trans-Rupter II to be mounted on many substation structures, or even directly on the transformer or disconnect switch.

The Model EX is perfect for substations where control power and relays are already in place. It's especially suited for retrofitting overdutied circuit breakers or circuit-switchers . . . or for updating transfer-trip, flash-bus, or high-speed grounding switch transformer protection schemes.

The Model SE features a self-powered overcurrent protection system activated by the current transformers on the primary bushings of the transformer. The Model SE is ideal for retrofitting power fuse installations and for new substation construction . . . saving the cost of substation batteries, relays, and even the control house!

Trans-Rupter II is an economical and technological breakthrough in transformer protection.

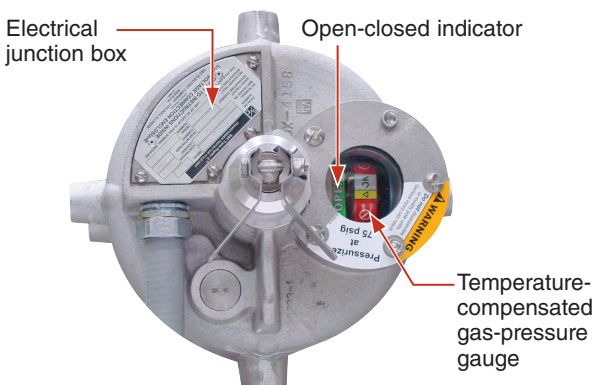
A Design Specifically Tailored to Transformer Protection

Trans-Rupter II features individual hermetically sealed, SF₆-gas-filled pole-units, each with its own electrically tripped operating mechanism. There's no mechanical interphase linkage to install, adjust, or maintain. The reliable single-gap puffer-type interrupters interrupt the circuit in three cycles, and maintain dielectric ratings when open. Trans-Rupter II has a 31.5-kA fault-interrupting rating . . . more than enough for most applications.

The pole-units are extremely lightweight: 69-kV pole-units weigh just 175 lbs., 115-kV pole-units weigh 210 lbs., and 138-kV pole-units weigh 217 lbs. The pole-units feature durable composite-polymer silicone insulation that is lightweight and shatterproof. The insulation system exhibits no sensitivity to ultraviolet radiation and it's hydrophobic . . . water beads on the surface, rather than forming a film. This property prevents the formation of leakage paths that can cause tracking and flashover. And the insulation maintains its hydrophobic properties regardless of the amount or type of contaminants on its surface, so there's no need to power-wash pole-units . . . even in coastal regions or areas with heavy industrial pollution.

The pole-units meet the criteria of IEC Standard 815 for medium insulation. The unique skirt arrangement provides a leakage distance of 58 inches line-to-ground and 59 inches across the interrupter at 69 kV. At 115 kV, the leakage distance is 101 inches line-to-ground and 115 inches across the interrupter. And at 138 kV, the leakage distance is 118 inches line-to-ground and 115 inches across the interrupter.

The unique sealing process draws on S&C's 40+ years of expertise in designing Circuit-Switchers and ensures a zero leakage rate at temperatures from -35°C to +40°C. The pole-units are factory-filled to full pressure under controlled conditions and then permanently sealed. Field-filling is never needed, eliminating the risk of contaminating the interrupting medium. All pole-units undergo thorough leak tests prior to shipping, using an ultra-sensitive "sniffer" capable of detecting minute traces of SF₆ . . . thus ensuring superior reliability in the field.

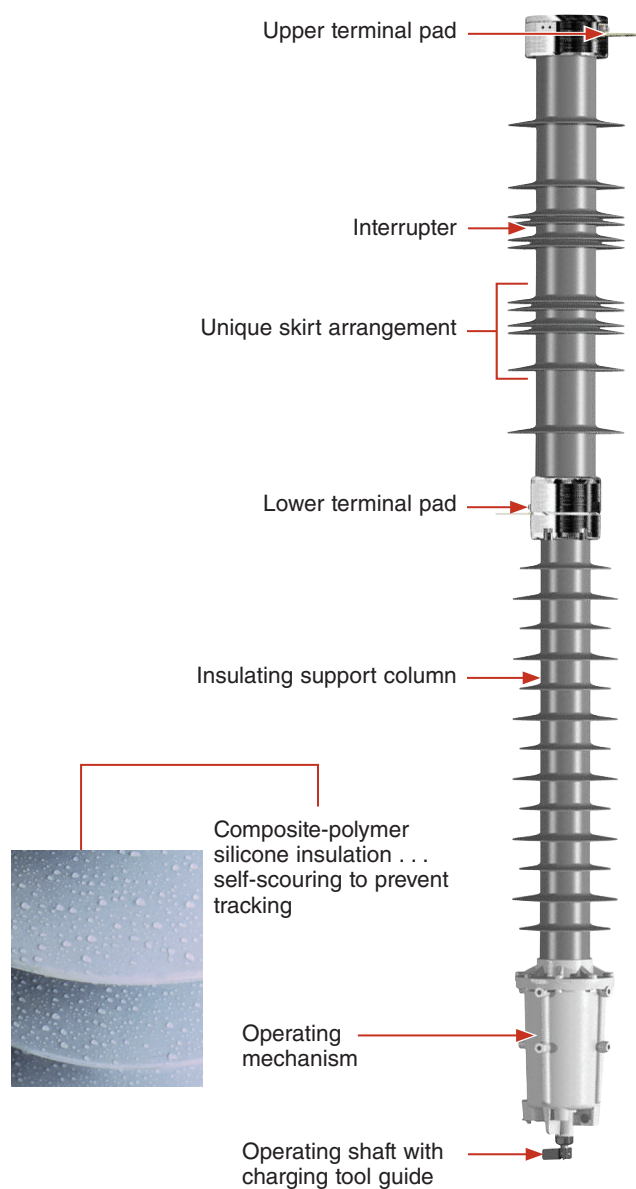


Pole-unit base detail.

Maintenance-Free Operating Mechanism

The operating mechanism is a spring-charged, stored-energy device. It uses a minimum of parts for heightened reliability. The operating mechanism is sealed in SF₆ for excellent protection from the environment. No heaters are necessary. Unlike many other transformer-protective devices, Trans-Rupter II's operating mechanism doesn't require periodic maintenance.

An indicator on the underside of each pole-unit base shows whether the pole-unit is: "closed and charged" or "open and discharged." Each pole-unit includes contacts for remote indication of pole-unit state, which can be monitored via SCADA. A temperature-compensated gas-pressure gauge on the underside of each pole-unit base provides local visibility of gas density and two-level leak indication. A remote gas-density indicator is optionally available.



138-kV Trans-Rupter II Transformer Protector pole-unit.

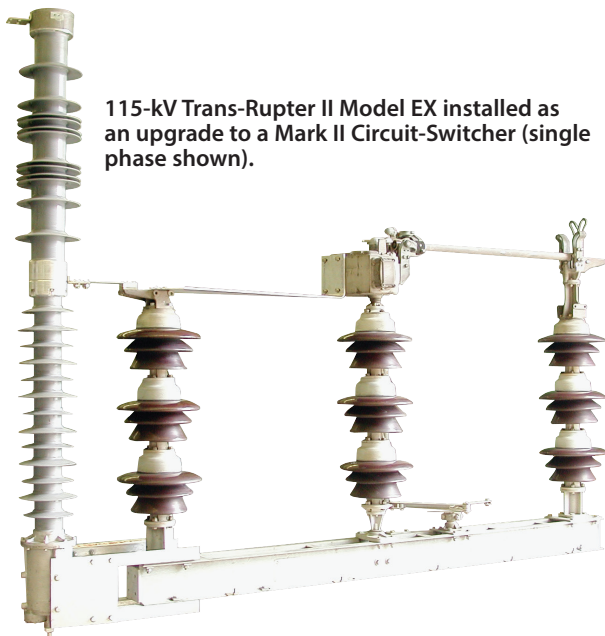
Model EX for Use with User-Furnished Control System

Model EX is tripped by an external signal from a user-furnished differential, sudden-pressure, overcurrent, or other relay. Model EX requires a user-furnished 48-Vdc or 125-Vdc control power source. A low-voltage connection enclosure is provided for connecting the user-furnished relays and control-power source. No heaters are required.

Each pole-unit has three contacts that can be used to monitor pole-unit state remotely. If specified, two extra contacts for the remote gas-density indicator can be included.



Model EX protecting a wind-generation substation transformer.



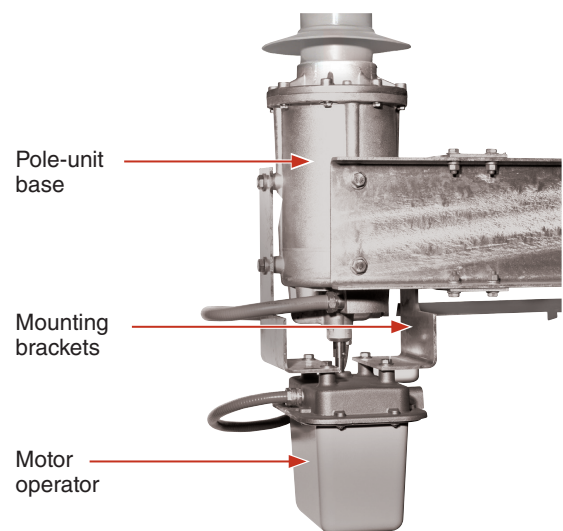
115-kV Trans-Rupter II Model EX installed as an upgrade to a Mark II Circuit-Switcher (single phase shown).

The Model EX is an economical way to upgrade S&C Mark II through Mark V Circuit-Switchers in transformer-protection applications. Trans-Rupter II pole-units mount directly to the Circuit-Switcher bases, and provide enhanced 31.5-kA fault-interrupting protection and 3-cycle operating time. The blade assemblies of the Circuit-Switcher are retained as a source-side series disconnect; their fault-closing capability is maintained. Trans-Rupter II Transformer Protector uses the existing relays, structure, and foundation . . . minimizing installation time and cost.

Model EX is perfect for new substations, as well as for retrofitting outdated circuit breakers, transfer-trip schemes, or high-speed grounding switches.

Motor operators are optionally available for Model EX and provide remote resetting capability. The operators mount under the Trans-Rupter II pole-units. They're easy to install and are removable for manual closing and charging in the event control power is lost. No heaters are required.

The motor operators eliminate the need to manually close the interrupters. Their operation may be coordinated with that of a motor operated disconnect used to pick up the transformer.



Motor operator mounted to pole-unit.

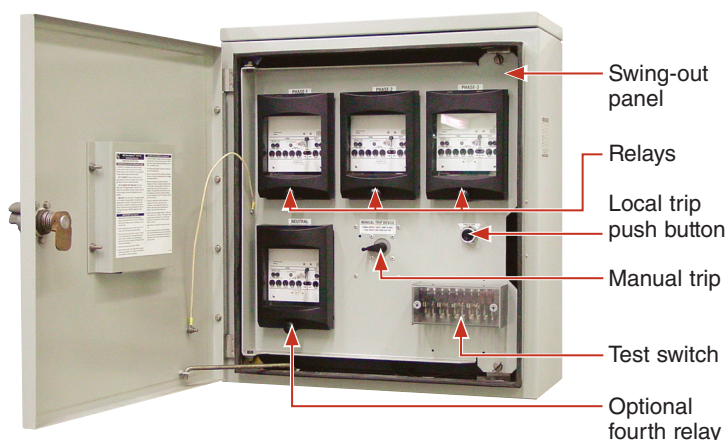
Model SE with Self-Powered Overcurrent Protection System

Model SE is ideal for new installations, as well as for retrofitting overdutied power fuse installations where there's no control house or control power source. The Model SE is great for mobile substations too, as well as remote substations where constructing a control house is impracticable. Since no batteries are required, there's no battery maintenance to contend with and no control house necessary. And no batteries can significantly lower initial purchase cost as well as lifetime costs.

The three microprocessor-based, self-powered overcurrent relays and the trip-energy supply are housed in a weatherproof control cabinet that mounts easily on most substation structures. The relays provide both time-overcurrent and instantaneous-overcurrent protection, and are field-settable with adjustable time delays.



138-kV Trans-Rupter II Transformer Protector Model SE mounted to transformer at a temporary installation on railroad ties.



Model SE control cabinet.

The Model SE relays are mounted on a swing-out panel which provides easy access to the terminals for making the wiring connections to the pole-units and the transformer's primary-side current transformers. The draw-out style relays may be tested in place or removed for setting and testing at a testing bench. Both the relays and the Model SE's trip-energy supply can be tested without taking the Trans-Rupter II Transformer Protector out of service.

The overcurrent relays feature a variety of industry standard time-current characteristics. A fourth overcurrent relay is optionally available to monitor neutral current and provide enhanced ground-fault sensing. Relay power-up time is two cycles. Combined with Trans-Rupter II's three-cycle interrupting time, Model SE can provide a total fault-clearing time of five cycles.

Sensing for the overcurrent relays, as well as power for the relays and the trip-energy supply, is provided by primary-side current transformers. A push button is furnished in the control cabinet to initiate local trip operation; a manual trip device provides the energy to trip the pole-units during installation before the transformer is energized and in the event control power is lost. An optional test switch is available to test the trip circuit without opening the pole-units.



69-kV Trans-Rupter II Transformer Protector Model SE on S&C Mounting Pedestal.



How It Works

Tripping

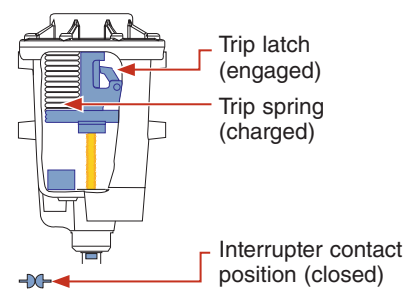
Trans-Rupter II features three-phase tripping of the electrically linked pole-units.

Step 1. Each pole-unit operating mechanism receives a trip signal from the user-furnished protective relay (on Model EX) or the self-powered overcurrent relay system (on Model SE).

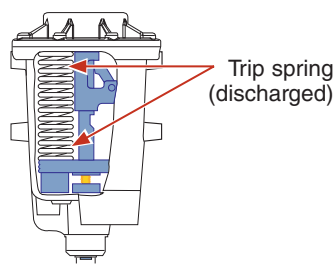
Step 2. The trip solenoid is energized. The solenoid armature drops down on the trip latch, releasing the latch.

Step 3. Stored energy from the trip springs pulls the operating rod downward, opening the interrupter.

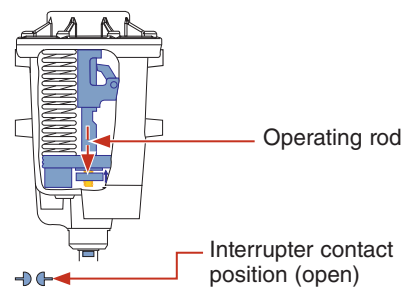
Step 4. Open the source-side disconnect to isolate transformer (Not shown).



Step 1. Interrupter closed.



Step 2. Trip solenoid energized.
Trip latch released.



Step 3. Interrupter open.

Closing and Charging

Trans-Rupter II pole-units are manually closed and charged on a single-phase basis—a simple procedure that typically takes less than five minutes to complete for all three phases. Trans-Rupter II is furnished with an easy-to-use ergonomic manual charging tool. This tool is held captive during the charging process, and cannot be removed until the pole-unit is fully closed.

springs, and resetting the trip solenoid, trip latch, and closing latch. A torque limiter in the handle of the charging tool prevents overcharging.

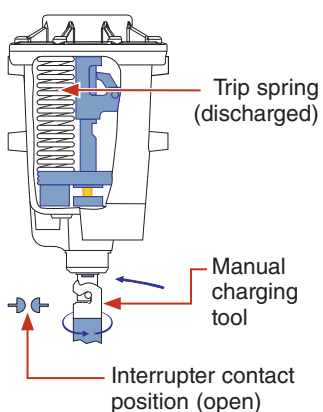
Step 3. To complete the process, crank the tool clockwise. The spring resetting plate returns to the mechanism base, ready for another trip operation.

Step 4. When the tool reaches its definite stop, the tool can be removed.

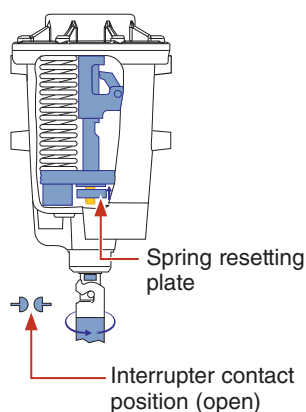
Step 5. Close source-side disconnect to pick-up transformer magnetizing current and energize transformer (Not shown).

Step 1. Hook the charging tool to the operating shaft under the pole-unit base.

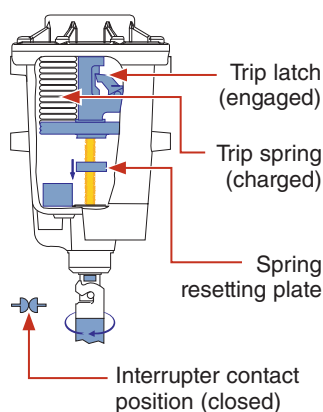
Step 2. Turn the tool counterclockwise. The spring resetting plate is driven upward, charging the trip



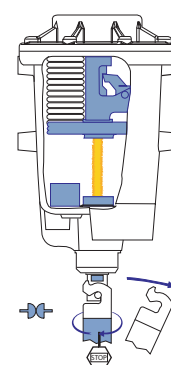
Step 1. Attach manual charging tool.



Step 2. Turn tool counterclockwise to charge trip spring and engage trip latch.



Step 3. Turn tool clockwise to reset spring resetting plate.



Step 4. Remove manual charging tool.

S&C Mounting Pedestals

Trans-Rupter II Transformer Protector can be furnished with optional easy-to-install S&C Mounting Pedestals. Pedestals are available at 48- through 102-inch phase spacings at standard heights of eight, ten, and twelve feet. All pedestals are of an 8-inch-square galvanized steel-tube construction and come with pre-wired conduit and all of the hardware necessary for installation.

Trans-Rupter II Transformer Protector is also available with an integral manually operated source-side disconnect . . . when a complete transformer protection package is required. The disconnect can be power operated by an S&C Type LS-1 Switch Operator, which can be coordinated with the optional motor operators on Model EX for complete remote operation capability.

Accessories

The following accessories are available for the Trans-Rupter II. Other accessories are available, consult your nearest S&C Sales Office for details.

- A Motor operators, 48-Vdc (applicable to Model EX switches)
- B Motor operators, 125-Vdc (applicable to Model EX switches)
- C2 Pole-unit quick-connect control cable (applicable to Trans-Rupter II furnished with S&C Mounting Pedestals)
- C3 Complete quick-connect control cable for connecting pole-unit charging motors and the low-voltage connection enclosure (applicable to Model EX furnished with S&C Mounting Pedestals)
- F Bypass accessory (applicable on 69-kV through 115-kV Models only)
- L Tool key interlock
- P Remote gas-density indicator

Trans-Rupter II Ratings ^①											
kV			Amperes, RMS								
Nom.	Max	BIL	Cont.	4-Hour	Peak Withstand	1-Sec.	Duty-Cycle Fault-Interrupting, Sym.®				Secondary Faults®
							3-time®	5-time	10-time	30-time	
69	72.5	350	420	630	81 900	31 500	31 500	18 900	9450	3150	4200
115	123	550	420	630	81 900	31 500	31 500	18 900	9450	3150	2600
138	145	650	420	630	81 900	31 500	31 500	18 900	9450	3150	2600

① Ratings for applications between -35° to +45°C. A cold-temperature version of the transformer protector is available for application at -50°C with reduced interrupting ratings. Call your nearest S&C Sales Office for details.

② Rating is based on transient-recovery-voltage parameters defined in the following tables of IEC Standard 60056, Edition 4.0: 1987:

For Trans-Rupter II models rated 69 kV: Tables IIa, XVa, and XVIa.
For Trans-Rupter II models rated 115 kV and 138 kV: Tables IIc, XVc, XVIc, and XVII.

③ Trans-Rupter II cannot be applied on systems with short-circuit currents in excess of this value.

④ Trans-Rupter II is suitable for transformer-primary applications where the *inherent* secondary-fault current—the secondary-side fault current as reflected on the primary side of the transformer, assuming an infinite (zero-impedance) source—does not exceed this value for a fault external to the transformer. The *inherent* secondary-fault current may be calculated as follows:

$$I = \frac{57.8P}{(\%Z)E}$$

where I = Inherent secondary-fault current, amperes

P = Transformer self-cooled three-phase rating, kVA

E = Primary-side system phase-to-phase voltage, kV

$\%Z$ = Percent transformer primary-to-secondary impedance, referred to transformer self-cooled three-phase kVA rating (example: enter 7% as 7.0)

$$57.8P = \text{where } \frac{1}{1.73} \quad 100 \text{ where } \sqrt{3} = 1.73$$

