

Selection Guide for S&C Substation Transformer Protective Devices

(34.5 kV through 230 kV)

Substation Transformer Protective Device Selector Table

| | Trans-Rupter II Transformer Protector, Model EX | Trans-Rupter II Transformer Protector, Model SE | Series 2000 Circuit-Switcher |
|---|---|---|---|
| Voltage Rating, kV | 69 through 138 | 69 through 138 kV | 69 through 230 kV |
| Base Transformer Rating^① (MVA) | 69 kV: 30; 115 kV: 36; 138 kV: 43 | 69 kV: 30; 115 kV: 36; 138 kV: 43 | 69 kV: 33; 115 kV: 55; 138 kV: 66; 161 kV: 77; 230 kV: 111 |
| Continuous Current Rating, Amperes | 420 | 420 | 1200, 2000■ |
| Primary-Fault Interrupting Rating | 31.5 kA RMS | 31.5 kA RMS | 69 to 138 kV: 25 kA or 40 kA* RMS; 161 and 230 kV: 20 kA RMS |
| Secondary-Fault Interrupting Rating | 69 kV: 4.2 kA; 115 and 138 kV: 2.6 kA | 69 kV: 4.2 kA; 115 and 138 kV: 2.6 kA | 4 kA |
| Three-Phase Fault Interruption? | Yes | Yes | Yes |
| Available Mounting Configurations | Vertical interrupter | Vertical interrupter | Vertical or horizontal interrupter |
| Available Phase Spacings and S&C Mounting Pedestal Heights^② | Phase spacings: 48, 84, and 102 inches; Pedestal heights: 96, 120, and 144 inches | Phase spacings: 48, 84, and 102 inches; Pedestal heights: 96, 120, and 144 inches | Phase spacings: 48, 84, 102, and 120 inches; Pedestal heights: 96, 120, 144, 168, 192, 216, and 240 inches■ |
| Integral Disconnect? | Optional vertical-break disconnect | Optional vertical-break disconnect | Model 2010 includes vertical-break disconnect; Model 2020 includes side-break disconnect |
| Installable on User-Furnished Structure? | Yes | Yes | S&C Mounting Pedestals included as standard. Modifiable for use on user structure |
| Control Power Source? | User-furnished substation batteries | Self-powered from transformer primary bushing CTs | User-furnished substation batteries |
| Interrupting Time | 3 cycles | 5 cycles (including relay power-up time for high-current faults) | 5 to 6 cycles |
| Duty Cycle (O=open, C=closed) | O | O | O or CO |
| Resetting Method | Manually using tool furnished. Motor operators optionally available for remote "hands-free" resetting | Manually using tool furnished | Motor-operated switch operator furnished |
| Transformer Magnetizing Current Picked-Up By | User-furnished disconnect or optional S&C-furnished disconnect | User-furnished disconnect or optional S&C-furnished disconnect | Interrupter contacts |
| Relay Compatible? | Yes | Self-contained overcurrent relays. Compatible with some sudden-pressure relays◆ | Yes |
| Operate/Monitor via SCADA? | Remote open. Remote close with optional motor operators.▼ Contacts available for monitoring pole-unit state | Remote open. Contacts available for monitoring pole-unit state▼ | Fully SCADA compatible▲ |
| Scheduled Maintenance | Visual inspection during regular transformer maintenance cycle◀ | Visual inspection during regular transformer maintenance cycle◀ | Mechanically linked interrupters and disconnect require inspection on approximate 5-year cycle |

① Based on 7%-impedance transformer. Base transformer rating can vary at temperatures lower than -35°C. See product specification bulletin for details.

② Special modifications to the standard phase spacings and pedestal heights are available. Contact your nearest S&C Sales Office for details.

▼ Remote gas-density indicator optionally available.

◀ Silicone-polymer insulation and electrically linked pole-units require no regular maintenance. Periodic testing of the protective relay circuit is recommended.

◆ Compatible with user-furnished relays and monitoring equipment that do not draw power from the control circuit. Contact your nearest S&C Sales Office for details.

■ 69 kV-138 kV Series 2000 Circuit-Switchers available in 2000 A continuous are not available with 40 kA primary-fault interrupting ratings.

* 69 kV-138 kV Series 2000 Circuit-Switchers available in 40 kA primary-fault interrupting capability are not available in 2000 A continuous.

■ Series 2000 Circuit-Switchers are furnished with 96-inch height mounting pedestals as standard. Taller pedestal heights are available.

▲ Remote gas-density monitor optionally available.

| | Mark V Circuit-Switcher | Mark VI Circuit-Switcher | Type SMD Power Fuses |
|--|--|--|---|
| | 34.5 through 230 kV | 69 through 138 kV | 34.5 through 138 kV |
| | 69 kV: 33; 115 kV: 55■; 138 kV: 66; 161 kV: 77; 230 kV: 111 | 69 kV: 30; 115 kV: 36; 138 kV: 43 | 34.5 kV: 12; 46 kV: 15; 69 kV: 18; 115 kV: 25; 138 kV: 30 |
| | 1200 | 420 | 250E and 300E |
| | 7 or 8 kA RMS | 31.5 kA RMS | 34.5 kV: 33.5 kA; 46 kV: 31.5 kA; 69 kV: 17.5 or 25.0 kA; 115 kV: 10.5 kA; 138 kV: 8.75 kA RMS |
| | 4 kA | 69 kV: 4.2 kA ; 115 and 138 kV: 2.6 kA | Depends on unit ampere rating and speed selected |
| | Yes | Yes | No, single phase |
| | Horizontal interrupter | Vertical interrupter | Vertical, vertical-offset, upright, inverted, and right-angle |
| | Phase spacings: 41, 51, 96, 108, and 123 inches★; Pedestal heights: 8, 9, 10, 11, and 12 feet | Phase spacings: 51, 84, and 102 inches; Pedestal heights: 96, 120, and 144 inches | Phase spacings vary according to mounting arrangement and voltage rating |
| | Vertical-break or center-break disconnect | Vertical-break disconnect | Not applicable |
| | Yes●★ | Yes● | Yes |
| | User-furnished substation batteries | User-furnished substation batteries | Not required |
| | 8 cycles with shunt-trip option; 30 cycles without shunt-trip option | 3 cycles | 1 cycle. Depends on fuse unit ampere rating and speed selected, and level of fault current |
| | O or CO | O or CO | O (Fuse will operate if fault current is present when circuit is energized) |
| | CS-1A Switch Operator available separately. Manual operating handle available at some voltages | Disconnect operated by CS-1A Switch Operator furnished. Interrupters reset by motor operators furnishedⓄ | Manually following fuse unit replacement |
| | Integral high-speed disconnect▲ | Integral high-speed disconnect | User-furnished disconnect |
| | Yes | Yes | Not applicable |
| | Fully SCADA compatible | Fully SCADA compatible△ | Not applicable |
| | Mechanically linked interrupters and disconnect require inspection on approximate 5-year cycle | Mechanically linked disconnect requires inspection on approximate 5-year cycle | Visual inspection during regular transformer maintenance cycle. Refinishing of fuse units if necessary◆ |

■ 40 MVA for 115-kV single-gap Mark V Circuit-Switchers.

★ Phase spacing of Integer Style Circuit-Switchers is fixed by the dimensions of the mounting frame. For Circuit-Switchers rated 34.5 kV and 46 kV: 41 inches; for Circuit-Switchers rated 69 kV: 51 inches.

● An as-built drawing of the user-furnished structure is required at the time of order.

▲ CS-1A Switch Operator is required to obtain high-speed disconnect operation.

Ⓞ Two-minute interrupter resetting time is required between opening operations.

◆ User must stock spare fuse units. Fuse unit end fittings are reusable.



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Transformer Protective Device Overview

S&C Series 2000, Mark V, and Mark VI Circuit-Switchers use stored-energy operating mechanisms to drive the interrupters open, and have trip-free operating capability. In the event the Circuit-Switcher is closed into a fault, it will open immediately to interrupt the fault. Mark V and Mark VI Circuit-Switchers, as well as some styles of Series 2000 Circuit-Switchers, are equipped with an integral disconnect which provides visual indication of the device's state in addition to working clearance for transformer maintenance or repair.

Circuit-Switchers are available in ratings from 34.5 through 230 kV, with primary-fault interrupting ratings up to 31.5 kA, secondary-fault interrupting ratings up to 4200 amperes, and interrupting times as low as 3 cycles.

Additional information on Series 2000 Circuit-Switchers is available in S&C Publications 716-30 and 716-31. Information on Mark V Circuit-Switcher is available in S&C Specification Bulletin 711-31. Information on the Mark VI Circuit-Switcher is available in S&C Specification Bulletin 712-31.

S&C Trans-Rupter II Transformer Protector, Models EX and Model SE feature puffer-type interrupters similar to those used in Series 2000 Circuit-Switchers. These interrupters provide a 31.5-kA fault interrupting rating and 3-cycle interrupting time. Trans-Rupter II has

been tested to confirm its ability to interrupt fast TRVs and has been assigned a secondary-fault interrupting rating similar to Circuit-Switchers. Each pole-unit has its own operating mechanism; the pole-units are filled with SF₆ and sealed.

Model EX is tripped by user-furnished relaying; it requires an external power source. Model SE features a self-contained overcurrent protection relay system and needs no external power source. Additional information on Trans-Rupter II Transformer Protector is available in S&C Publications 731-30 and 731-31.

S&C Type SMD Power Fuses provide reliable, economical protection of small-to-medium-sized transformers. The savings can be considerable because power fuses are less costly than other types of protective equipment. They also require no costly auxiliary equipment such as station batteries, motor-driven switch operators, or protective relays.

S&C Power Fuses are included in the selector table to help contrast their capabilities with those of S&C Circuit-Switchers and Trans-Rupter II Transformer Protector. Detailed information on the application of S&C Power Fuses for transformer protection can be found in S&C Data Bulletin 210-110.

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