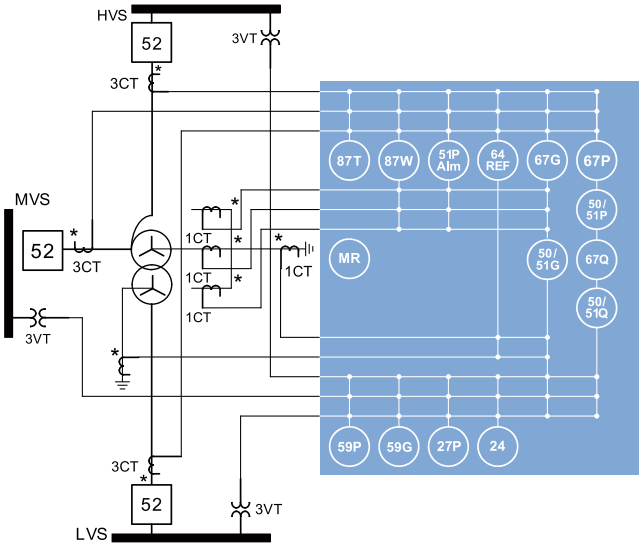
PCS-978S Transformer Relay

PCS-978S has been designed specifically for the protection of various type power transformers, including two-winding transformers, three-winding transformers (up to 6 branches), as well as auto-transformers in any voltage level. PCS-978S is the main protection for the transformer and contains many other protection, control and monitoring functions. With its modular structure, flexibility and the powerful PCS-Studio engineering tool, PCS-978S offers future-oriented system solutions with high investment security and low operating costs.



Features

- High degree of functional integration and flexible configuration modes, transformer main protection and back-up protection can be integrated in one device, or be separated in two devices.
- Up to 36 analog inputs can be provided and configured flexibly.
- The tripping output contacts can be configured by tripping matrix, which is flexible, convenient and suitable to any mode of tripping.
- The relay supports at most 6 branches differential protection. The transformer angle can be adjusted flexibly, and any transformer angle compensation mode is supported and any side can be chosen as the reference side of differential protection.

  Reliable differential CT circuit failure supervision. The relay can detect multi-phase CT wire-break, multi-side CT wire-break, short-circuit, and other complex situation. The corresponding logic setting can be used to select blocking differential protection or not, in case of CT circuit failure.
- Multiple inrush current blocking options are provided. Self-adaptive inrush current blocking criterion can ensure the relay fast operation for transformer energized on to a slight fault, meanwhile it will avoid the unwanted operation in the case of the energization inrush current caused by energizing transformer with no load, the recovery inrush current caused by cutting off the transformer external fault, and the sympathetic inrush current.
- Biased DPFC differential protection is regardless of load current and is sensitive to small internal fault current within the transformer. Its anti CT saturation performance is also strong.
- The unique power swing blocking releasing logic without setting and can properly supervise distance protection during power swing, which ensures distance protection to operate correctly for internal faults during power swing, and prevents distance protection from mal-operation during power swing.

Functions

Protection and Control

- Transformer differential protection (87T)

  Conventional and sensitive biased differential elements are available for fast and sensitive fault clearance. The conventional biased differential element can be with inrush current blocking, while the sensitive biased differential element can be further blocked by CT saturation, over excitation and CT failure. Instantaneous differential element instantaneously responds and clears serious internal faults without any restraining characteristics and blocking elements. DPFC differential element is immune to load fluctuations and provides high sensitivity for turn-to-turn faults and high impedance faults.
- Inrush blocking

  Two methods are provided for inrush blocking: waveform distortion method and harmonic method. In the waveform distortion method, the symmetry principle is utilized to detect interrupted and unsymmetrical inrush currents. The harmonics method relies on the 2nd and 3rd harmonics in order to determine the inrush current. The self-adaptive blocking mode and phase-to-phase cross-blocking mode are both provided for inrush blocking.
- CT saturation blocking

  The 2nd and 3rd harmonics are both employed to detect both steady-state CT saturation and transient CT saturation. In addition, the time intervals between difference current and restraint current are utilized to distinguish internal faults and

external faults.

- Overexcitation blocking

  The 3rd and 5th harmonics are utilized in the V/Hz calculation to detect the overexcitation conditions and prevent mal-operation due to overexcitation.

- CT circuit failure blocking

  The percentage current differential protection can be blocked to prevent mal-operation due to CT circuit failure. Combined current and voltage detection are employed to accurately discriminate CT circuit failure conditions.

- Amplitude compensation

  The current amplitudes can be internally corrected to compensate the amplitude difference due to mismatched CT ratios and transformer ratios.

- Phase angle compensation

  The current phase angles can be internally corrected to compensate phase shifts due to Δ-Y connections. Y→Δ and Δ →Y compensation methods are provided to meet different protection requirements.

- Restricted earth-fault protection (64REF)

  Zero-sequence differential protection is used as REF for each Y-connection winding to detect sensitive ground faults. Up to 3 REF protections are provided for different sides of the transformer. Furthermore, up to four 3-phase CTs and one neutral CT are integrated in each REF protection.

- Winding differential protection (87W)

  Winding differential protection can be applied where winding CTs exist. In comparison to REF, it provides high sensitivity for both earth faults and phase-to-phase faults. Up to three winding differential protections are provided for the different sides of a transformer, and up to five 3-phase CTs can be integrated in each differential protection. It can also be used as T-zone current differential protection when the transformer is connected to a one-and-a-half breaker arrangement or ring breaker arrangement.

- Overexcitation protection (24)

  Overexcitation protection is based on the ratio of voltage to frequency (V/Hz).

- Mechanical protection (MR)

  Eight high-power-pickup binary inputs are provided for mechanical relays in order to realize mechanical tripping or alarm. Four of these inputs are provided with time delay. The high-power-pickup design reduces the risk of Electro-Magnetic Interference (EMI) to improve reliability. Generally, mechanical relays include winding temperature relays, oil temperature relays and buchholz relays.

- Phase overcurrent protection (67P, 50/51P)

  Selectable time characteristics (definite-time or inverse-time) and directional elements (forward, reverse or non-directional) are provided. A harmonic blocking function is integrated to restrain each stage independently.

- Earth-fault protection (67G, 50/51G)

  Selectable time characteristics (definite-time or inverse-time) and directional elements (forward, reverse or non-directional) are provided. A harmonic blocking function is integrated to restrain each stage independently.

- Negative-sequence overcurrent protection (67Q, 50/51Q)

  Selectable time characteristics (definite-time or inverse-time) and directional elements (forward, reverse or non-directional) are provided. Stage 3 can be selected as alarm purpose.

- Undervoltage protection (27P)

  Time characteristics is selectable between definite-time and inverse-time. Phase voltage or phase-to-phase voltage can be selected for protection calculation. “1-out-of-3” or “3-out-of-3” logic can be selected for protection criterion.

- Overvoltage protection (59P)

  Time characteristics is selectable between definite-time and inverse-time. Phase voltage or phase-to-phase voltage can be selected for protection calculation. “1-out-of-3” or “3-out-of-3” logic can be selected for protection criterion.

- Zero-sequence overvoltage protection (59G)

- Switch-onto-fault (SOTF) logic

  Switch-onto-fault logic is used to acceleratedly clear the faults during manual closing and auto-reclosing based on overcurrent element.

- Remote/local control

  The control of circuit breaker, disconnector and earth switch can be implemented via communication, LCD menu and binary inputs. User programmable interlocking logics are available by PCS-Studio.

- Voltage and current drift auto adjustment

  The relay continually and automatically traces the voltage and current drifts and adjusts the zero point to acquire accurate measurements.

- Frequency tracking

  Frequency tracking is provided to accommodate the frequency shifts in power system.

PCS S Series

Monitoring and Measurement

- Energy measurement (active and reactive energies for import and export)
- CT circuit failure supervision
- VT circuit failure supervision
- Self diagnostic
- Event recorder including 1024 change-of-binary-input events, 1024 supervision events, 256 control logs and 1024 device logs
- Disturbance recorder including 32 disturbance records with waveforms (The format is compatible with COMTRADE.)
- System frequency supervision
- Clock synchronization using IRIG-B, SNTP, PPS (Pulse-Per-Second) and PPM (Pulse-Per-Minute) , IEEE1588

Communication

- Up to four 10Base-T/100Base-TX copper Ethernet ports using IEC 61850, DNP3.0 or IEC 60870-5-103 over TCP/IP
- Up to four 100Base-FX optical Ethernet ports using IEC 61850, DNP3.0 or IEC 60870-5-103 over TCP/IP
- Two RS-485 serial ports using IEC 60870-5-103
- One RS-485 serial port for clock synchronization
- Support GOOSE communication module using IEC 61850-8-1 GOOSE
- Full compatibility between IEC 61850 Editions 1 and 2
- Redundancy protocols PRP and HSR
- One front RJ-45 port for debugging

Front Panel

1. Front-panel status indication and control of switches
2. Easy-to-use keypad aids simple navigation and set-point adjustment
3. Push buttons for open/close, switch for selection between local and remote control, and user's login and logout authority management
4. Programmable operator pushbuttons with user-configurable labels
5. RJ45 Interface
6. Up to 18 programmable target LEDs with user-configurable labels
7. Target reset