PCS-9671

Transformer Relay

PCS-9671 is a compact numerical relay for two-winding transformers. It can be utilized for reactor or stub-bus current differential protection. It also can be used to protect reactors or implemented as a stub current differential protection in a one-and-a-half breaker arrangement. The restraint current differential protection, unrestraint differential protection and restricted earth fault protection are provided.

Comprehensive flexibility is provided via the modular hardware design, scalable function library, programmable logics, configurable I/Os and definable LEDs. This allows users to create customized schemes for specific projects. Two fixed LEDs and 18 configurable 3-color LEDs (Green/Yellow/Red) are provided. The relay is compatible with IEC 61850 station bus and process bus applications. It supports IEC 61850-8-1 MMS, GOOSE and IEC 61850-9-2 Sampling Value. The RJ-45 faceplate port is implemented in effort to make testing, setting, commissioning and maintenance easier.

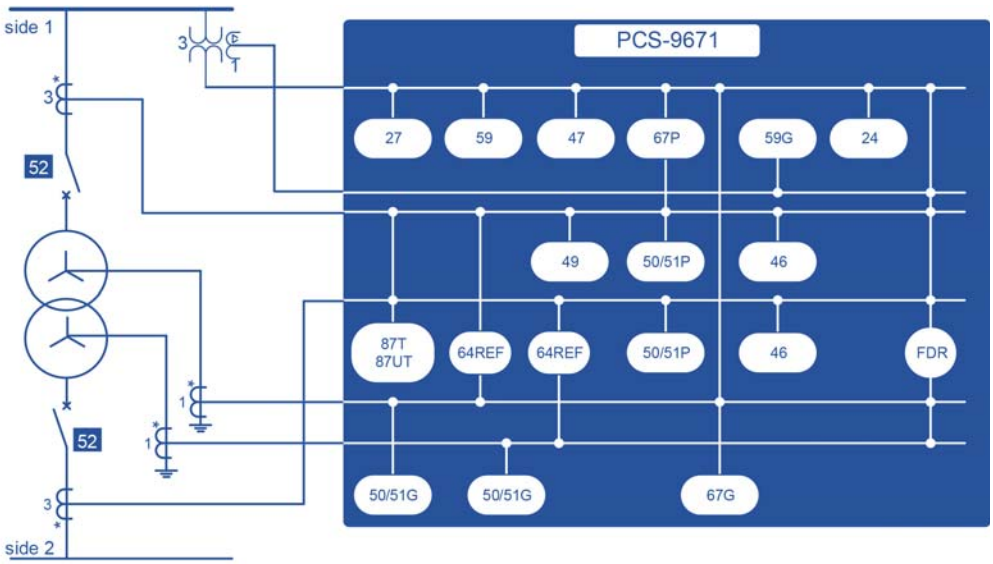

Figure 1 PCS-9671 Functional Block Diagram

Functions

Protection and Control

- Restraint current differential protection (87T)
  A high-setting stage and a low-setting stage are provided to ensure the operating speed and sensitivity. The high-setting stage is supervised by inrush blocking and CT failure blocking. In addition, the low-setting stage is supervised by inrush blocking, CT saturation blocking, over excitation blocking and CT failure blocking.
- Unrestraint current differential protection (87UT)
  The unrestraint current differential protection instantaneously clears serious internal faults without any restraining characteristics and blocking elements.
- Restricted earth fault protection (64REF)
  Zero sequence differential protection is used as REF to detect sensitive ground faults. A REF protection is provided for each side of a transformer respectively.
- Inrush current blocking by 2^{nd} and 3^{rd} harmonic
  Phase-segregated blocking, cross blocking and composited blocking are provided upon selection.
- Overexcitation blocking by 5^{th} harmonic
  Overexcitation is detected via the ratio of the 5^{th} harmonic current and fundamental current.
- CT saturation detection
  CT saturation is distinguished via combined 2^{nd} and 3^{rd} harmonics.
- Phase overcurrent protection (50/51P)
  Overcurrent protections are provided for each side of a transformer. Inverse-time curves take into account both IEC/IEEE curves and a self-definable curve.
- Zero sequence overcurrent protection (50/51G)
  Zero sequence overcurrent protections are provided for each side of a transformer. Inverse-time curves take into account both IEC/IEEE curves and a self-definable curve.
- Negative sequence overcurrent protection (46)
  Negative sequence overcurrent protections are provided for each side of a transformer.
- Thermal protection (49)
  A thermal model is adopted to continuously calculate the heat capacity of a transformer. Two stages are integrated for alarm and tripping.
- Undervoltage and overvoltage protection (27/59)
  The voltage input can select either phase voltage or phase-to-phase voltage. VT failure blocking is integrated in this protection.
- Zero sequence overvoltage protection (59G)
  Zero sequence voltage could be set as external voltage injection or internal calculated voltage.
- Negative sequence overvoltage protection (47)
  Negative sequence overvoltage protection could be used to detect the unbalance situation.
- Overexcitation protection (24)
  Overexcitation protection is based on the ratio of voltage to frequency (V/Hz).
- CT circuit supervision (CTS)
  CT circuit supervision consists of two elements: CT circuit abnormality without fault detector pickup and CT circuit failure with fault detector pickup.

Management

- 1024 supervision alarm records, 1024 control operation records and 1024 user operation records
- 64 fault and disturbance records
- 1024 SOE records
- Up to four 10Base-T/100Base-TX (RJ45) ports or two 100Base-FX ports with IEC 61850-8-1 MMS, IEC 60870-5-103 over TCP/IP
- Two RS-485 rear ports with IEC 60870-5-103
- Up to six 100Base-FX ports with IEC 61850-9-2 Sampling Value and GOOSE
- One RS-485 rear port for clock synchronization
- One RS-232 rear port for printer
- One faceplate RJ-45 port for testing and setting
- Clock synchronization via pulse, IRIG-B and SNTP

Auxiliary Testing Functions

- Virtual tripping report generation and communication testing
- Virtual self-supervision report generation and communication testing
- Virtual binary input state change report generation and communication testing
- Binary output testing
- Manually triggering fault recording

Features

- This device is based on a 32-bit high performance dual-core processor, internal high speed bus and intelligent I/O ports, and the hardware is in module design and can be configured flexibly, featuring interchangeability and easy extension and maintenance.
- Modularized hardware design makes this relay be easily upgraded or repaired by a qualified service person.
- The adoption of 16-bit A/D converter and the dual-channel

sampling technology can ensure the accuracy and reliability of protection sampling and the correctness of protection operation.

- This device can sample the analog values from the traditional instrument transformers, or receive the sampled values from the electronic transformers. It can support the protocol IEC61850-9-2 and GOOSE.
- Various methods of GPS time synchronization are supported in this relay, including IRIG-B, SNTP, pulse per second (PPS) and IRIG-B synchronization.
- This device can communicate with a SCADA or RTU via different communication intermediates: Ethernet network, RS-485 serial ports. The communication protocol of this device is optional: IEC61850 or IEC60870-5-103.
- The human machine interface (HMI) with a small control module (a 240×128-dot LCD, a 9-key keypad and 20 LED indicators) on the front panel is very friendly and convenient to the user.
- Complete event recording function is provided: 64 latest protection operation reports, 1024 latest supervision records, 1024 latest control operation records, 1024 latest user operation records and 1024 latest records of time tagged sequence of event (SOE) can be recorded.
- The powerful fault and disturbance recording function is supported: 64 latest fault or disturbance waves, the duration of a wave recording is configurable.
- The Y→ △ transfer method is used to compensate phase angle of secondary current on each side of the transformer, and correction coefficients are adopted to complete amplitude compensation.
- The vector group of each side transformer is settable, and 24 vector groups available for two-winding transformer, and 288 vector groups available for 3-winding transformer.
- The unrestrained instantaneous differential protection does not be blocked by any condition so as to ensure fast tripping in case of serious faults inside transformer.
- Three slopes biased differential protection is adopted to avoid mal-operation caused by unbalance current during external fault. At the same time, restraint capability for CT saturation due to external faults can be improved.
- The 2^{nd}, 3^{rd} and 5^{th} harmonic blocking function for biased differential protection is available. The 2^{nd} harmonic and the 3^{rd} harmonic are selectable to identify inrush current, and the 5th harmonic is used to detect overexcitation condition. Besides, phase segregated blocking mode or phase crossing blocking mode is selectable for harmonic blocking.
- The CT transient detection function based on the ratio of residual current to positive current is adopted to eliminate the influence of difference of transient characteristic and saturation of various CT to restricted earth fault protection.