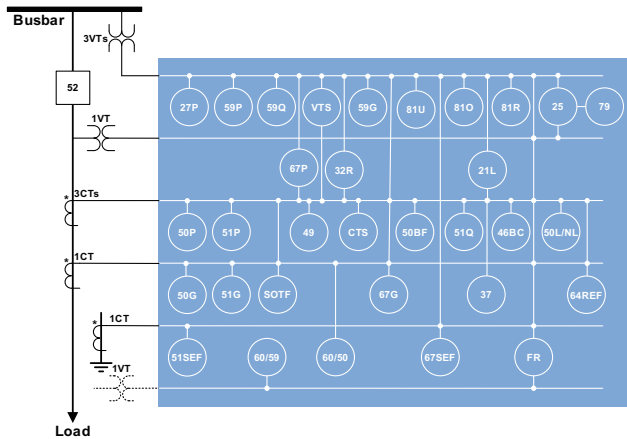


## PCS-9611S Feeder Relay



PCS-9611S is a protection, control and monitoring unit for various primary equipments (such as overhead line, underground cable, capacitor and transformer etc.) on solidly grounded, impedance grounded, Peterson coil grounded and ungrounded system. With its flexibility and the powerful PCS-Studio configuration tool, the PCS-9611S offers future-oriented system solutions with high investment security and low operating costs.



## Features

- Fully integrates multi functions into one device and can realize the protection and monitoring function of feeder and capacitor etc.
- Comprehensive functionality includes phase overcurrent protection, earth fault overcurrent protection, negative-sequence overcurrent protection, sensitive earth fault protection, overvoltage protection, undervoltage protection, frequency protection, reverse power protection, undercurrent protection, breaker failure protection, undercurrent protection etc. The breaker failure, reclosing, measuring, monitoring and control function are supported. The high sampling rate of recording is up to 9.6kHz.
- The overcurrent protection is combined with harmonic blocking and cold load pickup logic, which can prevent mal-operation affected by inrush current while the transformer is no-load energized.

- Selectable IEC, ANSI inverse-time characteristic curves that can be defined by users, and the inverse-time drop-out curve selection is supported.
- Overvoltage and undervoltage protection support single phase and three phase operation criteria setting, phase voltage and phase-to-phase voltage measurement mode are selectable, which can be for various applications.
- 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.

## Functions

### Protection functions

- Phase Overcurrent Protection (50/51P)**  
The device can provide six stages of phase overcurrent protection with independent logic. Each stage can be independently set as definite-time characteristics or inverse-time characteristics. The dropout characteristics can be set as immediate dropout, definite-time dropout or inverse-time dropout. Users can choose whether it is blocked by the voltage control element, direction control element, or harmonic control element, users can also choose whether it is controlled by cold load pickup. The direction control element can be set as no direction, forward direction and reverse direction. The phase overcurrent protection picks up when the current exceeds the current threshold value, and operates after a certain time delay, once the fault disappears, the phase overcurrent protection will dropout.
- Earth Fault Overcurrent Protection (50/51G)**  
The device can provide six stages of earth fault overcurrent protection with independent logic. Each stage can be independently set as definite-time characteristics or inverse-time characteristics. The dropout characteristics can be set as immediate dropout, definite-time dropout or inverse-time dropout. Users can choose whether it is blocked by the direction control element or the harmonic control element, users can also choose whether it is controlled by cold load pickup. The direction control element can be set as no direction, forward direction and reverse direction. The zero-sequence current used by earth fault overcurrent protection can be calculated zero-sequence current or the measured zero-sequence current, it can operate to trip or alarm, and it can be enabled or blocked by the external binary input.
- Another Group of Earth Fault Overcurrent Protection (A.50/51G)**  
The device can provide six stages of another group of earth fault overcurrent protection with independent logic. Each stage can be independently set as definite-time characteristics or inverse-time characteristics. The dropout characteristics can be set as immediate dropout, definite-time dropout or inverse-time dropout. The protection fixedly adopts the measured residual current, the calculated residual current is not supported. It can operate to trip or alarm, it can be enabled or blocked by the external binary input.
- Negative-sequence Overcurrent Protection (50/51Q)**  
The device can provide two stages of negative-sequence

overcurrent protection with independent logic. Each stage can be independently set as definite-time characteristics or inverse-time characteristics. The dropout characteristics can be set as immediate dropout, definite-time dropout or inverse-time dropout. For a double-circuit or a ring network line, the negative-sequence fault current may have different flow direction. Considering the protection selectivity, the negative-sequence overcurrent protection can be blocked by the direction control element. Negative-sequence overcurrent current can operate to trip or alarm, it can be enabled or blocked by the external binary input.

- **Broken Conductor Protection (46BC)**  
Broken-conductor fault mainly is single-phase broken or two-phases broken. According to the ratio of negative-sequence current to positive-sequence current ( $I_2/I_1$ ), it is used to judge whether there is a broken-conductor fault. Negative-sequence current under normal operating condition (i.e. unbalance current) is due to CT error and unbalance load, so the ratio of negative-sequence current to positive-sequence current (amplitude) is relative steady. The value with margin can then be used as the setting of broken conductor protection. It is mainly used to detect broken-conductor fault and CT circuit failure as well.

- **Sensitive Earth Fault Protection (50/51SEF)**  
The device can provide six stages of sensitive earth fault protection with independent logic. Each stage can be independently set as definite-time characteristics or inverse-time characteristics. The dropout characteristics can be set as immediate dropout, definite-time dropout or inverse-time dropout. Users can choose whether it is blocked by the direction control element. The direction control element can be set as no direction, forward direction and reverse direction. The zero-sequence current used by sensitive earth fault protection is the measured zero-sequence current from the high-precision CT. Sensitive earth fault protection can operate to trip or alarm, it can be enabled or blocked by the external binary input.

The sensitive earth fault protection can be used to accomplish the function of high impedance restricted earth fault protection. Once it is used as high impedance restricted earth fault protection, the direction control element should be disabled, and it will not be controlled by voltage element.

- **RMS Overcurrent Protection (50/51R)**  
The device can provide two stages of RMS overcurrent protection with independent logic. When the fault current with more harmonic components is generated in the system, the amplitude is larger than the current threshold of RMS overcurrent protection, the RMS overcurrent protection will operate.

The operating characteristics of RMS overcurrent protection is definite-time characteristics. The dropout characteristics can be set as immediate dropout or definite-time dropout. RMS overcurrent current can operate to trip or alarm, it can be enabled or blocked by the external binary input.

- **Phase Overvoltage Protection (59P)**  
The device can provide two stages of phase overvoltage protection with independent logic. When a high voltage occurs in the system, it is greater than the voltage threshold, phase

overvoltage protection will operate to remove the device from the system after a time delay. In addition, the overvoltage protection also provides the alarm function, prompting the overvoltage of the system, it allows users to find the cause timely, and preventing further deterioration of the fault. Each stage of phase overvoltage protection can be independently set as definite-time characteristics or inverse-time characteristics. The dropout characteristics can be set as immediate dropout and definite-time dropout.

Users can select phase voltage or phase-to-phase voltage for the protection calculation.

“1-out-of-3” or “3-out-of-3” logic can be selected for the protection criterion. (1-out-of-3 means any of three phase voltages, 3-out-of-3 means all three phase voltages).

- **Residual Overvoltage Protection (59G)**  
The device can provide two stages of residual overvoltage protection with independent logic. When the residual voltage is greater than the voltage threshold, the residual overvoltage protection will operate to remove the device from the system after a time delay. In addition, the residual overvoltage protection also provides the alarm function, it prompt that there is an earth fault leading to residual voltage generation, it allows users to find the cause timely, and preventing further deterioration of the fault. The dropout characteristics of residual overvoltage protection can be set as immediate dropout and definite-time dropout.
- **Negative-sequence Overvoltage Protection (59Q)**  
This device provides two stages of negative-sequence overvoltage protection. If the negative-sequence voltage is larger than the predefined setting, this protection will operate. The negative-sequence overvoltage protection can operate with a definite-time limit, and the supported dropout characteristics include instantaneous dropout and definite-time dropout.
- **Positive-sequence Overvoltage Protection (59Pos)**  
This device provides one stage of positive-sequence overvoltage protection. If the positive-sequence voltage is larger than the pre-defined setting, this protection will operate. The positive-sequence overvoltage protection can operate with a definite-time limit, and the supported dropout characteristics include instantaneous dropout and definite-time dropout.
- **Phase Undervoltage Protection (27P)**  
The device can provide two stages of phase undervoltage protection with independent logic. When the voltage drops in the system and it is lower than the voltage threshold, phase undervoltage protection will operate.

Taking into account that the role of undervoltage protection is to remove the running device from the system, but in order to prevent that undervoltage protection is always operating when it is not charged, the breaker closed position check criterion is added, users can choose to detect the breaker position, current or no-check as the releasing condition for the protection.

In addition, the undervoltage protection also provides the alarm function, prompting the voltage drop of the system, it allows users to find the cause timely, and preventing further deterioration of

the fault. Each stage of phase undervoltage protection can be independently set as definite-time characteristics or inverse-time characteristics. The dropout characteristics can be set as instantaneous dropout and definite-time dropout.

Users can select phase voltage or phase-to-phase voltage for the protection calculation.

“1-out-of-3” or “3-out-of-3” logic can be selected for the protection criterion. (1-out-of-3 means any of three phase voltages, 3-out-of-3 means all three phase voltages).

- Overfrequency Protection (81O)  
This device can provide six stages of overfrequency protection. If the system frequency is greater than the predefined setting, this protection will operate for removing some part of active power supplies from the system. The overfrequency protection is with independent definite time delay characteristic and with instantaneous dropout characteristic.
- Underfrequency Protection (81U)  
This device provides six stages of underfrequency protection. If the system frequency is less than the predefined setting, this protection will operate for shedding some part of loads from the system. The underfrequency protection is with independent definite time delay characteristic and with instantaneous dropout characteristic.
- Frequency Rate-of-change Protection (81R)  
This device can provide six stages of frequency rate-of-change protection. If the system frequency rate-of-change is greater than the predefined setting, this protection will operate. The frequency rate-of-change protection is with independent definite time delay characteristic and with instantaneous dropout characteristic.
- Reverse Power Protection (32R)  
This device can provide two stages of reverse power protection. If the reverse power is detected and it is greater than the predefined setting, the reverse power protection will operate. The reverse power protection is with independent definite time delay characteristic and with definite time delay or instantaneous dropout characteristic.
- Cold Load Pickup Logic (CLP)  
The cold load pickup (CLP) logic which is included within this relay serves to either inhibit the selected protective elements for an appointed duration, or to raise the settings of the selected protective elements. Therefore, it allows the protection settings to be set closer to the load profile by automatically increasing them following circuit energization. The CLP logic thus provides stability, whilst maintaining protection during starting.  
  
If the CLP logic operates, the CLP settings are enabled for the overcurrent protection and the earth fault overcurrent protection respectively. After the drop-out time delay of the CLP logic has elapsed, the normal protection settings are applied. And if a fast resetting signal is received, the normal protection settings are applied after the pre-defined short resetting time delay.
- Undercurrent Protection (37)  
The device can provide one stage of undercurrent protection for tripping purpose or alarm purpose. For different protected

equipment, the single-phase criterion or three-phase criterion can be selected. The position of circuit breaker, the load current also can be taken as the enabling conditions for the undercurrent protection. The undercurrent protection is with definite-time operation characteristic and instantaneous dropout characteristic. Undercurrent protection can operate to trip or alarm, it can be enabled or blocked by the external binary input.

- Breaker Failure Protection (50BF)  
According to the tripping information from the device and the auxiliary information (the current and the position) of target circuit breaker, breaker failure protection constitutes the criterion to discriminate whether the target circuit fails to open. If the criterion is confirmed, breaker failure protection will operate to trip the target circuit breaker with the re-trip time delay, trip it again with the first time delay and trip the adjacent circuit breakers with the second time delay. As a special backup protection, breaker failure protection can quickly isolate the fault, reduce the affected range by the fault, keep system stability and prevent generators, transformers and other primary equipment from seriously damaged.
- Switch-on-to-Fault Protection (SOTF)  
The device can provide one stage of phase overcurrent SOTF protection and one stage of earth fault overcurrent SOTF protection. The SOTF protection is with definite time delay characteristic and instantaneous dropout characteristic, users can choose whether it is blocked by the harmonic control element.  
  
The SOTF protection must be initiated by auto-reclosing signal or the condition that the circuit breaker is open, the initiating time can be set by the setting. After the acceleration condition is satisfied, the SOTF protection will operate with a time delay.  
  
In order to improve the reliability, phase overcurrent SOTF protection can select phase voltage element, phase-to-phase voltage element, zero-sequence voltage element and negative-sequence voltage element as auxiliary criterion.
- Thermal Overload Protection (49)  
The device provides two stages of thermal overload protection, one stage for alarm purpose and the other stage for trip purpose.  
  
The device provides two thermal overload calculation methods: 1) only calculated by current; 2) for the scenario with oil temperature measurement function, calculate the temperature difference between the equipment (such as transformer windings) and the oil, and then plus the oil temperature measured by the sensor, to obtain the final temperature.
- Restricted Earth Fault Protection (64REF)  
The difference between current differential protection and REF protection is that the first one is based on adjusted phase current balance and the latter is based on balance of calculated residual current and residual current from neutral point CT.  
  
Each side of transformer can be equipped with one group of REF protection, i.e., for a three-winding transformer, up to three groups of REF protection can be equipped, and this device can support only one group of REF protection. REF protection is not affected by inrush current and the tap of transformer.

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 to REF protection.

In order to ensure the selectivity of restricted earth fault protection, direction criterion is also available.

CT circuit supervision for REF protection is divided into two kinds: differential CT circuit abnormality without the pickup of the fault detector and differential CT circuit failure with the pickup of the fault detector.

- **Arc Flash Protection (50L/NL)**  
The device can support up to 4 channels of arc flash signals, each channel is composed of arc sensor and optical fiber, it is combined with the auxiliary fault current criterion. The arc sensor type is point sensor, and the connector between the optical fiber and the device is ST type connector. Because the arc energy for a busbar fault is mainly concentrated within the ultraviolet light range of 300~400nm (nanometer), the arc sensor of the device adopts ultraviolet light sensor, the sensor can ensure the reliable detection of arc signal and effectively prevent the adverse effects of interference light.
- **Current Unbalance Protection (60/50)**  
This device can provide two stages of current unbalance protection. If the unbalance current is greater than the predefined setting, this protection will operate. The current unbalance protection is with independent definite time delay characteristic and with definite time delay or instantaneous dropout characteristic.
- **Voltage Unbalance Protection (60/59)**  
This device can provide two stages of voltage unbalance protection. If the unbalance voltage is greater than the predefined setting, this protection will operate. The voltage unbalance protection is with independent definite time delay characteristic and with definite time delay or instantaneous dropout characteristic.
- **Automatic Reclosure (79)**  
AR can be used with either integrated device or external device. When AR is used with integrated device, the internal protection logic can initiate AR, moreover, a tripping contact from external device can be connected to the device via input signal to initiate integrated AR.  
  
When AR is used as an independent device, it can be initiated by operating signal of protections. The device can output some configurable output signals (such as, contact signals or digital signal, for example, GOOSE signal) to initiate external AR or block external AR. The contact signals includes tripping signal, blocking AR signal and protection operating signal, etc.,. According to requirement, these contacts can be selectively connected to external AR and the device can be set as one-shot or multi-shot AR.
- **Another Group of Phase Overcurrent Protection (S2.50/51P)**  
The device can provide six stages of another group of phase overcurrent protection with independent logic. Each stage can be independently set as definite-time characteristics or inverse-

time characteristics. The drop-out characteristics can be set as instantaneous drop-out, definite-time drop-out or inverse-time drop-out. Another group of phase overcurrent protection picks up when the current exceeds the current threshold value, and operates after a certain time delay, once the fault disappears, another group of phase overcurrent protection will drop-out.

- **Distance Protection (21L)**  
Up to 6 zones distance protection with settable direction are supplied. Each zone includes three independent phase-to-phase measuring loops as well as three independent phase-to-ground measuring loops. Both mho and quadrilateral characteristics are available for different application. Phase-to-ground distance element should be compensated by zero-sequence current of local line. Each zone can select forward direction, reverse direction and non direction.  
  
Load encroachment can distinguish effectively between heavily loaded line and faulty line, and the risk of encroachment of the load impedance into the tripping characteristics of the distance protection can be excluded.  
  
Power swing blocking and releasing can prevent distance protection from undesired operation during power swing, even if measured impedance reaches into the operation area of distance protection. Moreover, distance protection can operate reliably when a fault occurs during power swing.  
  
Based on distance protection characteristics, faulty phase can be identified correctly.
- **Fault Location (FL)**  
Single-end fault location function is available for the device. Fault location element picks up after the device operates to trip when there is a fault in the line. Fault location element can be activated only after the distance protection, phase overcurrent protection or earth fault overcurrent protection operates to trip. Once any of phase overcurrent protection or earth fault overcurrent protection operates, fault distance calculation starts after 25ms. The premise of fault location is to select the faulty phase. After selecting the fault phase, calculate the fault distance according to the fault type.

## Control functions

- Switchgear control
- Double point status synthesis
- Remote/Local control mode switch
- Interlocking logic for control
- Direct control
- Closing synchronism check with voltage selection
- Switchgear trip counter

## Measurement and metering

- U, I, P, Q, Cos
- Positive, negative and zero sequences

- Max.15th harmonics
- Energy metering (active and reactive energies for import and export)
- Power Quality Supervision (PQS) with Total Harmonic Distortion (THD), deviation and unbalance
- DC analogue outputs (4~20mA, 0~10V, 0~5V or 0~20mA)

## Synchrophasor measurement

- The integrated Phasor Measurement Unit (PMU) function of synchrophasor measurement is compatible with IEEE C37.118-2005, IEEE C37.118.1-2011, IEEE C37.118.2-2011 and IEEE C37.118.1a-2014.
- Supporting time synchronization by IRIG-B signal
- Supporting P Class or M Class measurement (user selectable)
- Measurement of three-phase and single-phase voltage and current
- Measurement of positive/negative/zero-sequence voltage and current
- Calculation of active power, reactive power, system frequency, and rate-of-change of frequency (ROCOF)
- Measurement of up to 32 binary status (user configurable)
- Output of synchrophasor with timestamp, support of multiple protocols (TCP, TCP-UDP, UDP) and multiple data rates for maximum 4 clients (PDC)

## Supervision functions

- VT circuit supervision
- CT circuit supervision
- Self-diagnostic
- DC power supply supervision
- System frequency supervision
- Event recorder including 1024 disturbance items, 1024 change-of-state events, 1024 supervision events, 256 control logs and 1024 device logs.
- Disturbance recorder including 64 disturbance records with waveforms (The file format of disturbance recorder is compatible with international COMTRADE file).
- Single line diagram representation in display

## Communication functions

- Support of various protocols
  - Modbus
  - DNP3
  - IEC 60870-5-103
  - IEC 61850 Ed1 & Ed2

- IEC 62439 Parallel Redundancy Protocol (PRP)
- IEC 62439 High-availability Seamless Ring (HSR) Redundancy Protocol
- IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)
- Support for digital substation
  - Extendable quantity of communication interfaces
  - Support of IEC 61850 MMS Server
  - Support of IEC 61850-8-1 GOOSE
  - Support of IEC 61850-9-2LE SV
- Up to four 10Base-T/100Base-TX copper Ethernet ports
- Up to four 100Base-FX optical Ethernet ports
- Two RS-485 serial ports for communication or printer
- One RS-485/TTL serial port for clock synchronization
- One BNC port for clock synchronization

## User Interfaces

- Friendly HMI interface with LCD, easy-to-use keypad aids simple navigation and set-point adjustment
- 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
- Up to 15/18 (6U, 1/3 × 19" or 6U, 1/2 × 19" chassis) programmable target LEDs with user-configurable labels
- 1 RS-232 rear port for printer (by jumper)
- Language switchover—English+ selected language
- Configuration tool—PCS-Studio

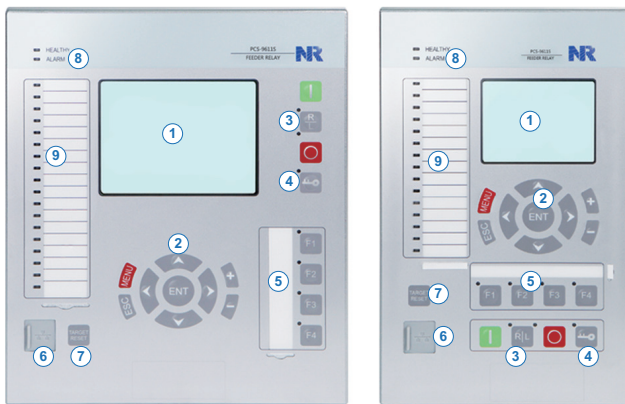
## Additional functions

- User programmable logic
- Fault location
- Fault phase selection
- System phase sequences rotation function (ABC or ACB)
- Clock synchronization
  - IRIG-B: IRIG-B via RS-485 differential level, TTL level, BNC or optical fiber interface
  - PPS: Pulse per second (PPS) via RS-485 differential level or binary input
  - IEEE1588: Clock message based on IEEE1588 via Ethernet network
  - SNTP (PTP): Unicast (point-to-point) SNTP mode via Ethernet network

- o SNTP (BC): Broadcast SNTP mode via Ethernet network
- o Message (IEC103/Modbus/DNP3): Clock messages through IEC103 protocol, Modbus protocol and DNP3 protocol
- Cyber security
  - o NERC CIP
  - o IEC 62351
  - o IEC 62443
  - o IEEE 1686

5. Push buttons with configurable labels for user-programmable functions
6. Front RJ45 multiplex port for debugging
7. Push button for target reset of all signals
8. Two LED indicators for device running status
9. Up to 18 (6U, 1/2 × 19")/15 (6U, 1/3 × 19") programmable target LEDs with user-configurable labels

## Front Panel



1. Local LCD screen for device status and information display
2. Easy-to-use keypad aiding simple navigation and set-point adjustment
3. Push buttons for opening/closing operation and switching of local/remote control mode
4. Push button for user login/logout of authority management

## Rear Panel



1. Current and voltage analog inputs
2. Power supply and binary I/O
3. Copper Ethernet port
4. Fiber-optic Ethernet port
5. RS-232 or RS-485 serial port
6. Debug port