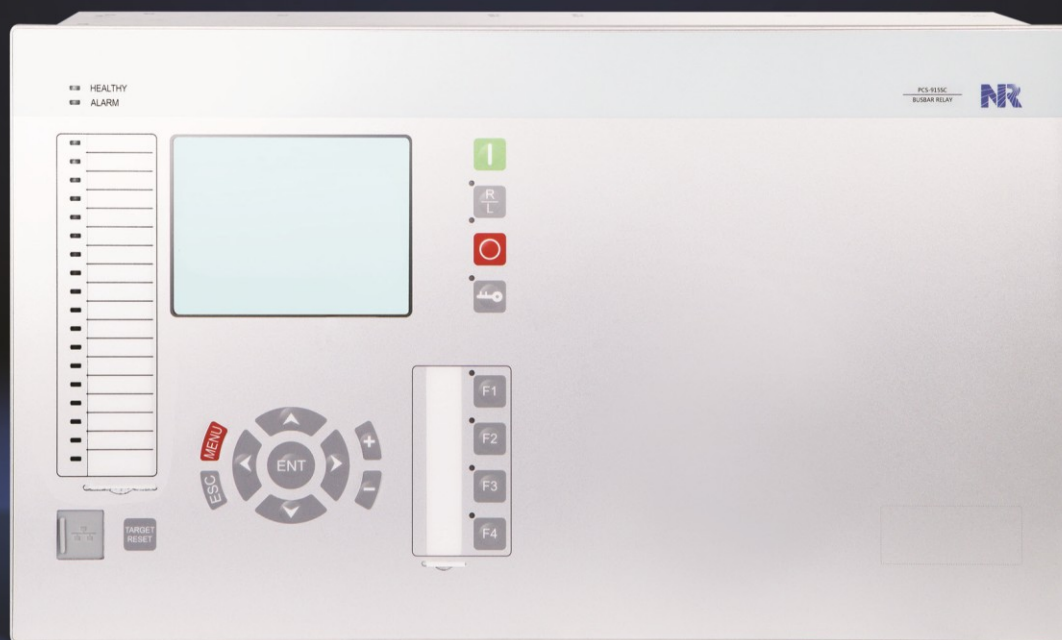




PCS-915SC Centralized Busbar Relay

DataSheet

About This Document

The manual describes the protection, measurement and monitoring functions with the information of relevant hardware for PCS-915SC Centralized Busbar Relay.

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To the extent required the products described herein meet applicable IEC and IEEE standards, but no such assurance is given with respect to local codes and ordinances because they vary greatly.

Although every reasonable effort is made to present current and accurate information, this document does not purport to cover all details or variations in equipment nor provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for your purposes, please do not hesitate to contact us.

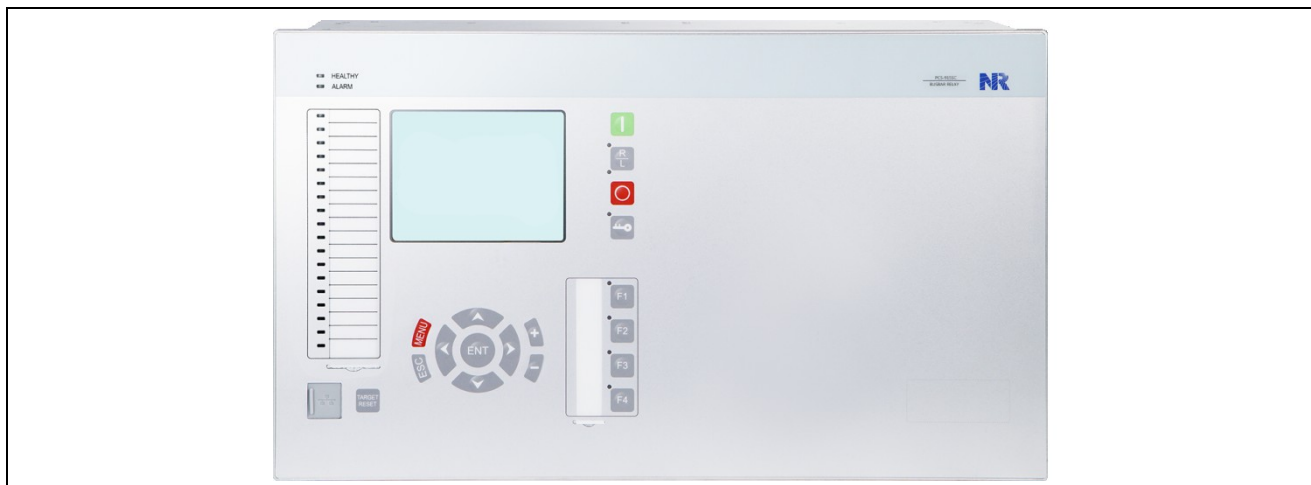
Document Revision History

PN: ZL_PCS-915SC_X_DataSheet_EN_Overseas General_X

Current version: R1.11

Corresponding Version		Release Date	Description of change
Document	Software		
R1.00	R1.00	2019-01-31	Form the original manual.
R1.01	R1.11	2019-07-25	Digital related contents are added
R1.10	R1.21	2019-11-25	- BC/BS dead zone differential protection is added; - Phase overvoltage protection and phase undervoltage protection are added; - Overfrequency protection, underfrequency protection and frequency rate-of-change protection are added; - VT circuit supervision function is modified.
R1.11	R1.21	2020-01-08	The technical data is modified

Overview



PCS-915SC centralized busbar relay integrates busbar differential protection, bus coupler/section protection (includes overcurrent protection, switch-onto-fault protection, dead zone fault protection, dual CTs BC/BS dead zone differential protection and breaker failure protection), feeder protection (includes overcurrent protection, dead zone fault protection and breaker failure protection), voltage protection (phase overvoltage protection and undervoltage protection) and frequency protection (overfrequency protection, underfrequency protection and frequency rate-of-change protection). With its flexibility and the powerful PCS-Studio configuration tool, PCS-915SC offers future-oriented busbar solutions with high investment security and low operating costs.

The PCS-915SC is widely adopted not only for conventional substations, but also for digital substations. It supports IEC 61850 Editions 1 and 2 and provides GOOSE and SV network interfaces with high real-time performance. The process level network supports peer-to-peer (P2P) mode and networking mode, including single network mode and dual network mode. The station level network can also receive and send MMS messages (such as interlocking signals) or process level GOOSE messages (such as circuit breakers or disconnectors positions and trip signals).

Highlights

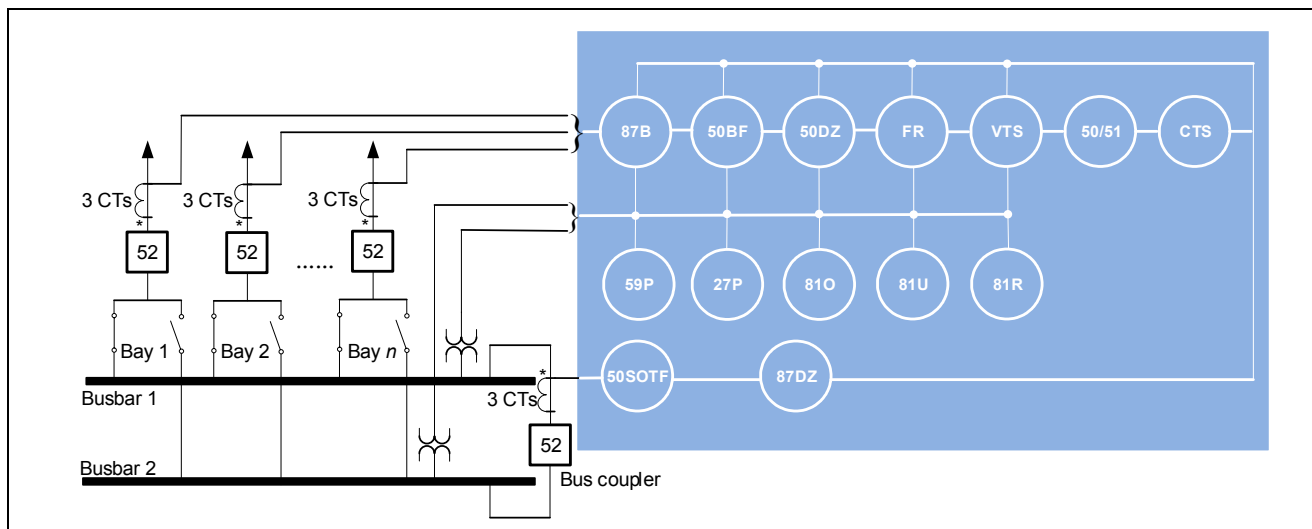
- Unified software and hardware platform, comprehensive power grid solutions of protection, measurement and monitoring, easy to use and maintain.
- High reliability and redundancy design for drive systems of the sampling and the output circuit ensure that the overall reliability of the device is high. Real-time sampling based on dual AD can mutually check and detect the potential abnormality in the sampling circuit in time. The control power supply of the output relay is independent with the control circuit of trigger signals, which can prevent from undesired operation caused by the abnormality of drive circuit of output relays.
- Various function modules can satisfy various situations according to the different requirements of users. Flexible and universal logic programming, user-defined configuration of BI/BOs, buttons and LEDs and powerful analogue programming are supported.
- Modularized hardware design makes the device be easily upgraded or repaired by a qualified service person. It can be combined with different I/O modules, with online self-check and monitoring function, and the device can be restored from abnormal operation only need to replace a single abnormal module.
- Support memory check and error correction function, ensure high reliability and safety.
- Support the internet communication protocol of native PRP/HSR and RSTP.
- Fully compatible with IEC 61850 edition 1 & edition 2, support MMS service, IEC 62351 communication service, GOOSE communication in station level & process level, SV communication with multi-sampling rate.
- Full complys with cyber security standards, including IEC62443, IEC62351, IEEE1686, NERC-CIP, support role based access control (RBAC), security audit, security encryption communication and security tool, improve the cyber security capability of devices.
- Powerful COMTRADE fault and disturbance recording function is supported. The whole recording time is automatically configurable by the fault duration, which is convenient to fault analysis and replay. The recording sample rate is up to 9.6kHz.
- Settable secondary rated current (1A/5A) and settable voltage threshold of binary input
- Support large size LCD, control and multifunction button
- Support flush mounting, semi-flush mounting and rack mounting methods.
- Cross screw IO, CT/VT terminals can support AWG12 specification connector and 4mm² lead
- Protection class of front side is up to IP54
- PCS-Studio engineering tool is the application software on the user's PC to interface with PCS S series devices providing all the related functionality. It ranges from device configuration to entire substation design of bay integration.

- Support IEEE1588, IRIG-B clock synchronization
- Support actual system phase sequence, either ABC or ACB, incorrect connection of actual phase sequence can automatically be verified and relevant protection functions can be blocked.
- Equipped with high-speed large capacity output relay, its operation speed is less than 1ms and its break capacity is up to 10A. The real-time supervision for output drive circuit can detect the abnormality in advance.
- Support setup up to 40 users and allow each user to own different password and access authority.

Features

- Applicable for single busbar, single bus with bus section, double busbar, double busbar with bus section, etc. busbar arrangement, and the busbar differential protection can connect up to 6 busbars and 36 bays.
- Comprehensive functionality including phase segregated current differential protection, breaker failure protection, overcurrent protection, dead zone protection, voltage protection and frequency protection, etc.
- The phase segregated differential protection adopts both of deviation of power frequency component (DPFC) and steady-state component, that can guarantees fast and reliable performance during CT saturation. It can ensure no mal-operation of external fault and fast operation of internal fault in the case of the correct transfer time of CT is no less than 3ms.
- With patented adaptive-weight anti-saturation algorithm and harmonic restrain algorithm, the DPFC differential protection operates fast and not affected by load current, the typical operation time is within 15ms.
- Voltage blocking is an option for the current differential protection and breaker failure protection, which will improve the reliability of current differential protection and breaker failure protection.
- With CT circuit supervision function, once CT circuit failure is detected, the user can choose discrimination zone or check zone differential protection blocking.
- Both of phase segregated and three phase breaker failure binary inputs can be connected for breaker failure protection, users can choose whether or not blocked by the current criterion. The overcurrent element of breaker failure protection have been especially treated, the drop-out time of it is no more than 12ms.
- Selectable IEC, ANSI inverse-time characteristic curves that can be defined by users, and the inverse-time drop-out curve selection is supported.
- With the disconnecter position status monitor and memory function, the device can check the rationality of the memorized disconnecter position status and automatically correct the error.
- Users can disable the discrimination zone differential element by the external binary input during the busbar maintenance. Also the bay can be disabled by the external binary input when it is in maintenance.
- LCD can display real-time main wiring diagram, the number of each bay, the state of each breaker and disconnecter, current and power flow, etc.

Functions Overview



Protection Function

- Busbar current differential protection (87B)

It consists of phase current differential protection and DPFC differential protection. Voltage control element and CT saturation blocking element are available to supervise the current differential protection.

- ✧ DPFC differential protection

DPFC differential protection is sensitive to high resistance fault and is immune to load fluctuations.

- ✧ Voltage control element

The used voltage can be phase voltage, zero sequence voltage or negative sequence voltage.

- ✧ Detection of CT saturation

Two principles for CT saturation detection are provided: patented adaptive weighted anti-saturation algorithm and harmonic algorithm. It keeps the current differential protection stable to external faults and quickly clears internal faults and external-to-internal evolving faults during CT saturation.

- ✧ Check zone and discrimination zone

The check zone differential element is used to distinguish between internal and external fault of the overall busbar system, the discriminating zone differential elements are used to select faulty zone.

- Bus coupler/section protection

- ✧ Breaker failure protection (50BF)

It can be supervised by voltage control element. Re- tripping and busbar tripping are executed in sequence.

- ✧ Dead zone protection (50DZ)

It is provided to clear the dead zone faults between CT and breaker.

- ✧ BC/BS dead zone differential protection (87DZ)

It can be used for the occasion that dual-CTs are configured for BC/BS, and the CTs are not cross-connected to the discriminating zone differential circuit.

- ✧ Switch-onto-fault protection (50SOTF)

Switch-onto-fault logic of bus coupler/section is used for bus energizing.

- ✧ Overcurrent protection (50/51)

Phase overcurrent protection and earth fault overcurrent protection are both provided.

- Feeder protection

- ✧ Breaker failure protection (50BF)

It can be supervised by voltage control element. Re-tripping and busbar tripping are executed in sequence.

- ✧ Dead zone protection (50DZ)

It is provided to clear the dead zone fault between CT and breaker.

- ✧ Overcurrent protection (50/51)

Overcurrent protection consists of phase overcurrent element and earth fault overcurrent element, each can be set as inverse-time or definite-time.

- Phase overvoltage protection (59P)

The device can provide two stages of phase overvoltage protection with independent logic. In addition, the overvoltage protection also provides the alarm function, prompting the overvoltage of the system.

- Phase undervoltage protection (27P)

The device can provide two stages of phase undervoltage protection with independent logic. In addition, the undervoltage protection also provides the alarm function, prompting the undervoltage of the system.

- Overfrequency protection (81O)

Six stages of overfrequency protection with independent definite time delay characteristic and instantaneous dropout characteristic are provided.

- Underfrequency protection (81U)

Six stages of underfrequency protection with independent definite time delay characteristic and instantaneous dropout characteristic are provided.

- Frequency rate-of-change protection (81R)

Six stages of frequency rate-of-change protection with independent definite time delay characteristic and instantaneous dropout characteristic are provided.

- 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.

Measurement Functions

- 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.)

Monitoring Functions

- Dynamic busbar replica
- VT circuit failure supervision
- DC power supply supervision
- CT circuit failure supervision
- Self-diagnostic

Digital Interface

- Support IEC 61850 MMS Server via extendable electrical or optical Ethernet port
- Support IEC 61850-8-1 GOOSE via extendable electrical or optical Ethernet port
- Support IEC 61850-9-2LE SV via extendable electrical or optical Ethernet port

Communication Functions

- 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 or Modbus

- 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 RJ45 port for debugging

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 push-buttons with user-configurable labels
- Up to 18 programmable target LEDs with user-configurable labels
- 1 RS-485 rear ports for printer
- Language switchover—English+ selected language
- Auxiliary software—PCS-Studio

Additional Functions

- User programmable logic
- Fault location
- Fault phase selection
- Parallel line compensation for fault location
- Switching system phase sequences function (ABC or ACB) with user-defined phase label
- Clock synchronization
 - ✧ IRIG-B: IRIG-B via RS-485 differential level or TTL level
 - ✧ PPS: Pulse per second (PPS) via RS-485 differential level or binary input
 - ✧ PPM: Pulse per minute (PPM) via RS-485 differential level or binary input
 - ✧ IEEE1588: Clock message based on IEEE1588 via optical fibre interface
 - ✧ SNTP (PTP): Unicast (point-to-point) SNTP mode via Ethernet network
 - ✧ SNTP (BC): Broadcast SNTP mode via Ethernet network
 - ✧ Message (IEC103/Modbus/DNP3.0): Clock messages through IEC103 protocol, Modbus

protocol and DNP3.0 protocol

- Cyber security
 - ✧ NERC CIP
 - ✧ IEC 62351
 - ✧ IEC 62443
 - ✧ IEEE 1686

Typical Application

PCS-915SC can be configured to be used for protecting and monitoring various busbar arrangement of various voltage levels. It is capable to protect up to 6 busbars and 36 bays including bus coupler/section (if busbar voltage is not connected).

Single BB Arrangement

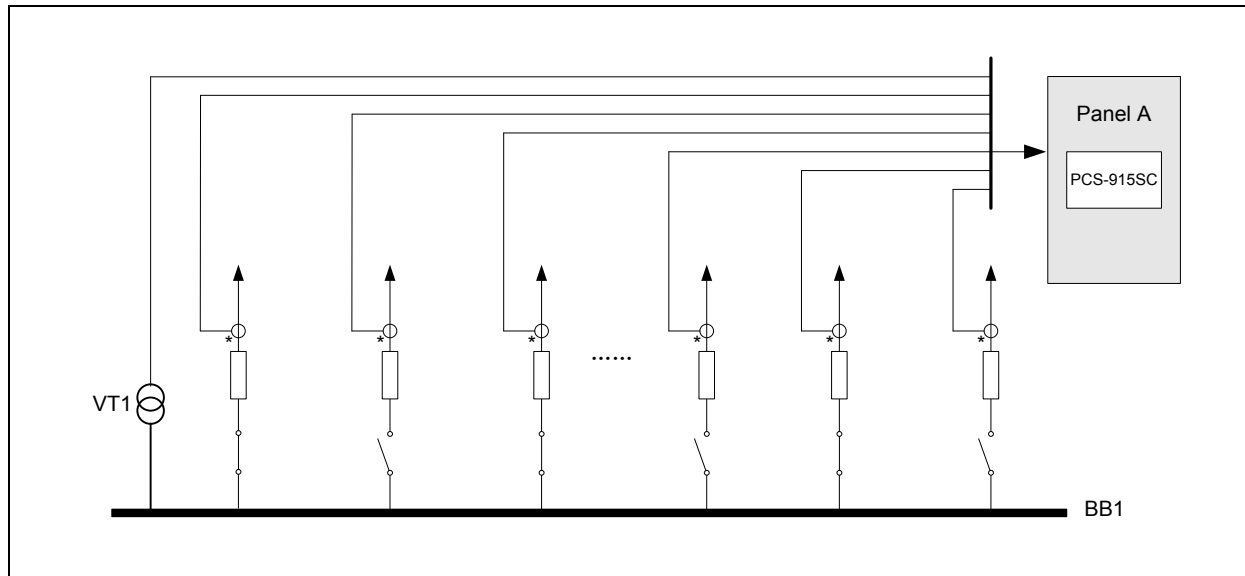


Figure 1 Typical application for Single BB arrangement

Single BB with one BS (single CT) Arrangement

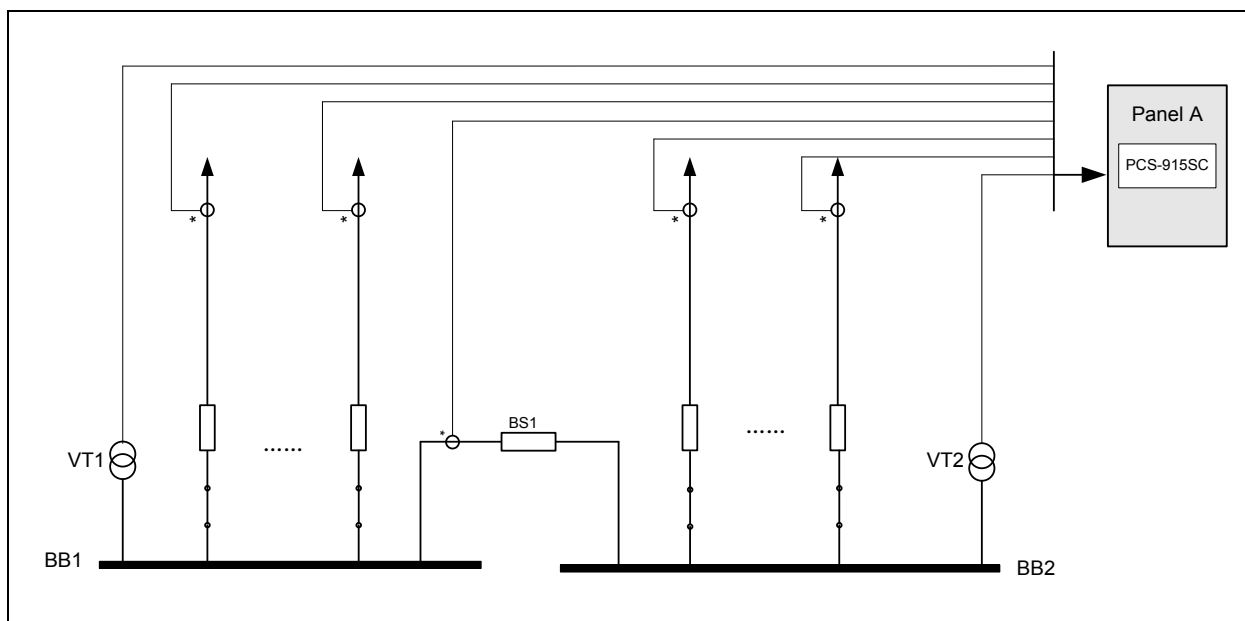


Figure 2 Typical application for Single BB with one BS (single CT) arrangement

Single BB with one BS (dual CTs) Arrangement

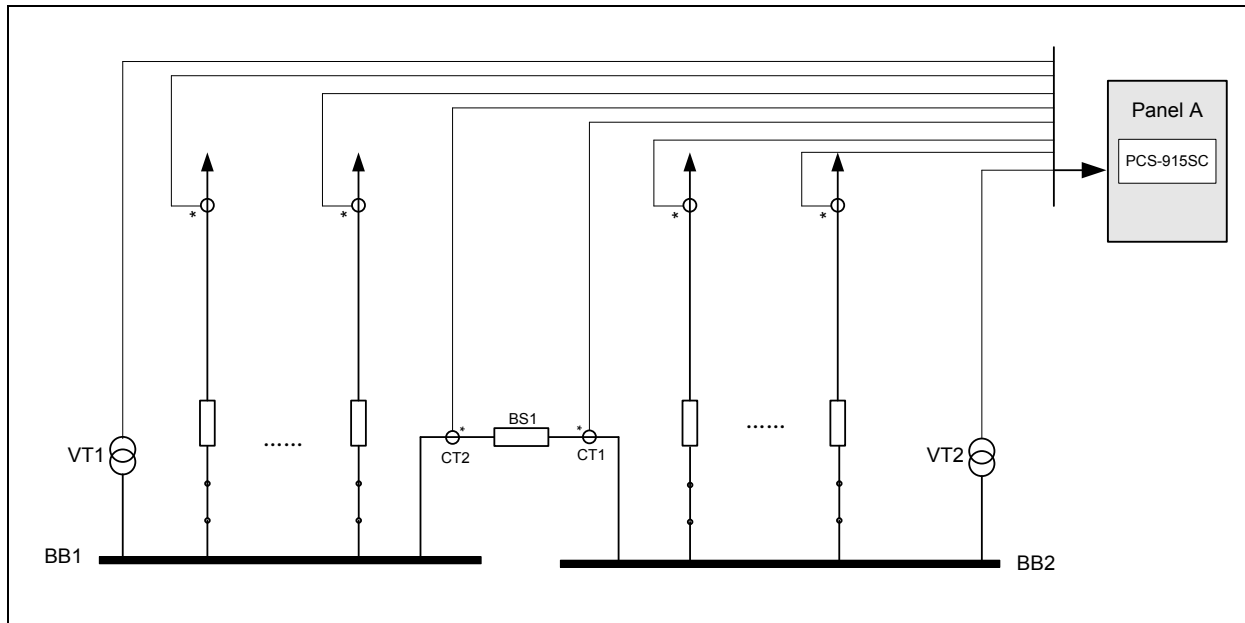


Figure 3 Typical application for Single BB with one BS (dual CTs) arrangement

Single BB with two BS (single CT) Arrangement

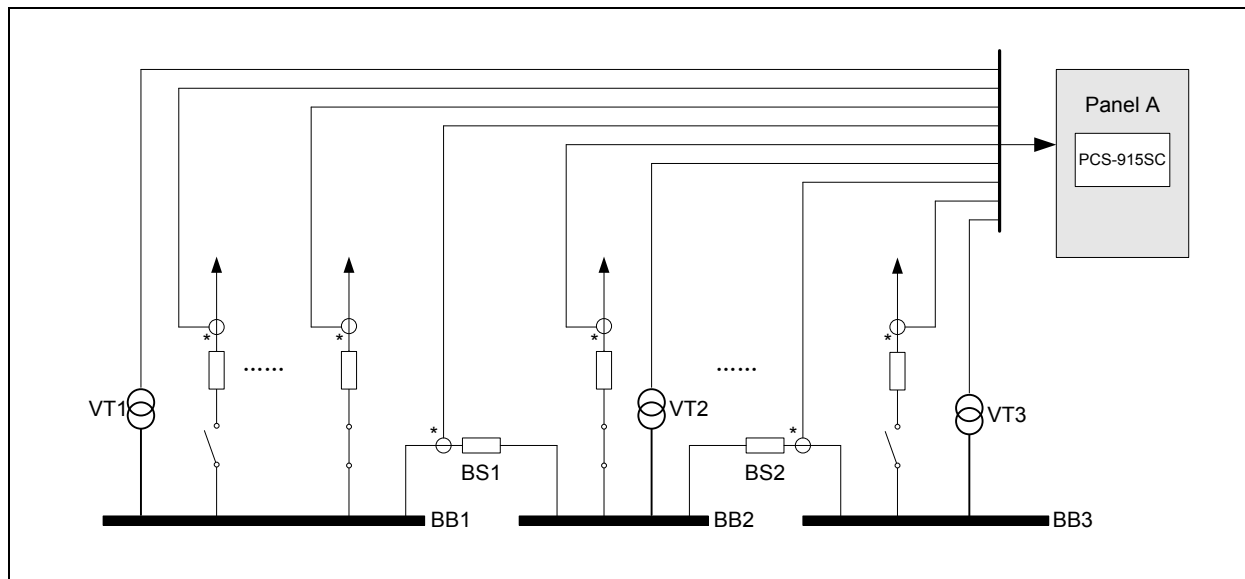


Figure 4 Typical application for Single BB with two BS (single CT) arrangement

Single BB with two BS (dual CTs) Arrangement

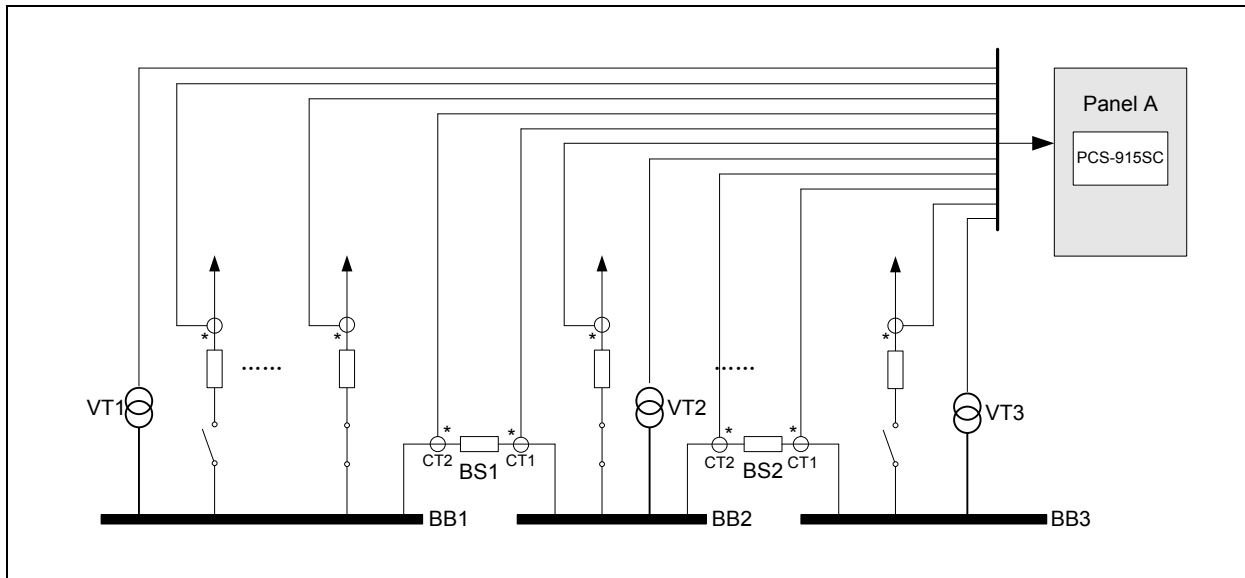


Figure 5 Typical application for Single BB with two BS (dual CTs) arrangement

Double BB with one BC (single CT) Arrangement

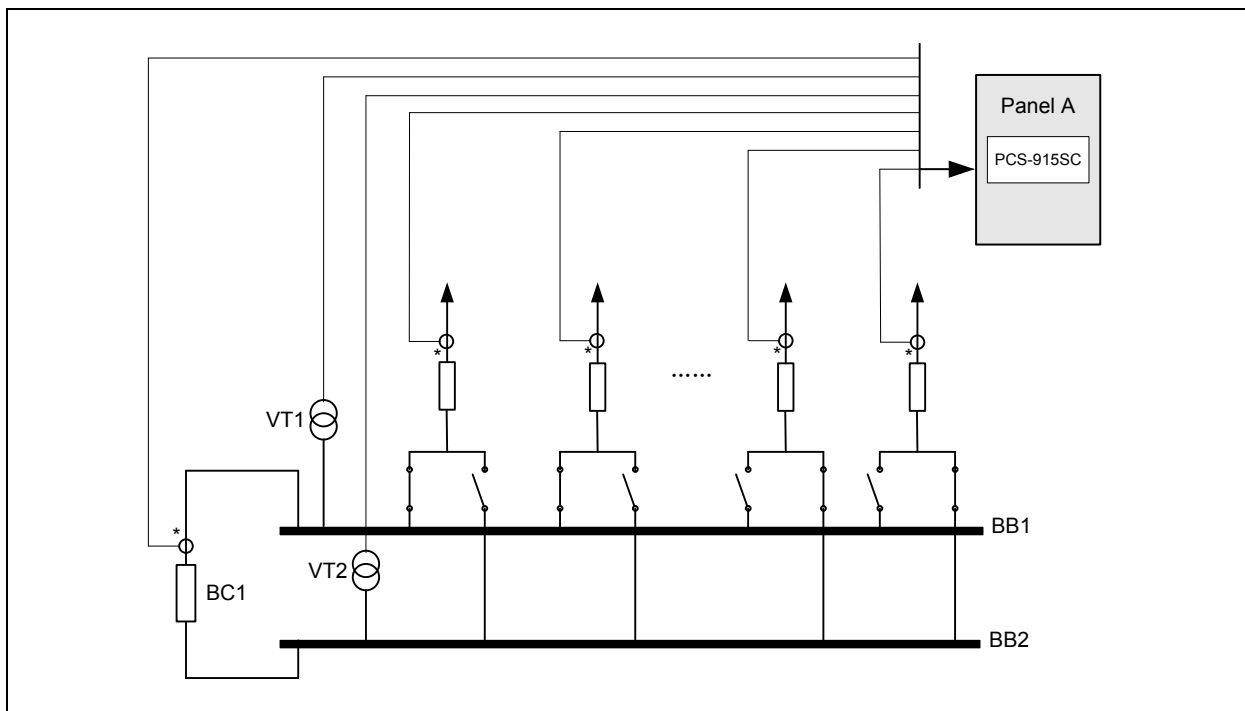


Figure 6 Typical application for Double BB with one BC (single CT) arrangement

Double BB with one BC (dual CTs) Arrangement

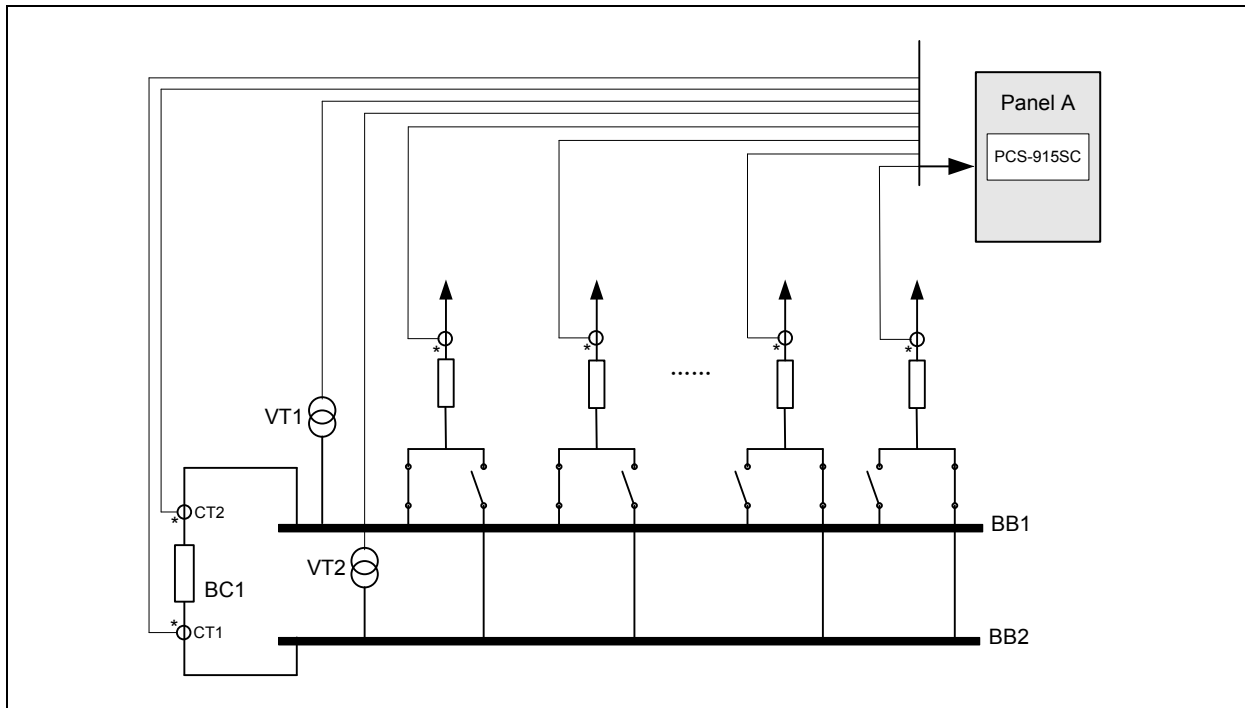


Figure 7 Typical application for Double BB with one BC (dual CTs) arrangement

Double BB with one BC (single CT) and two BS (single CT) Arrangement

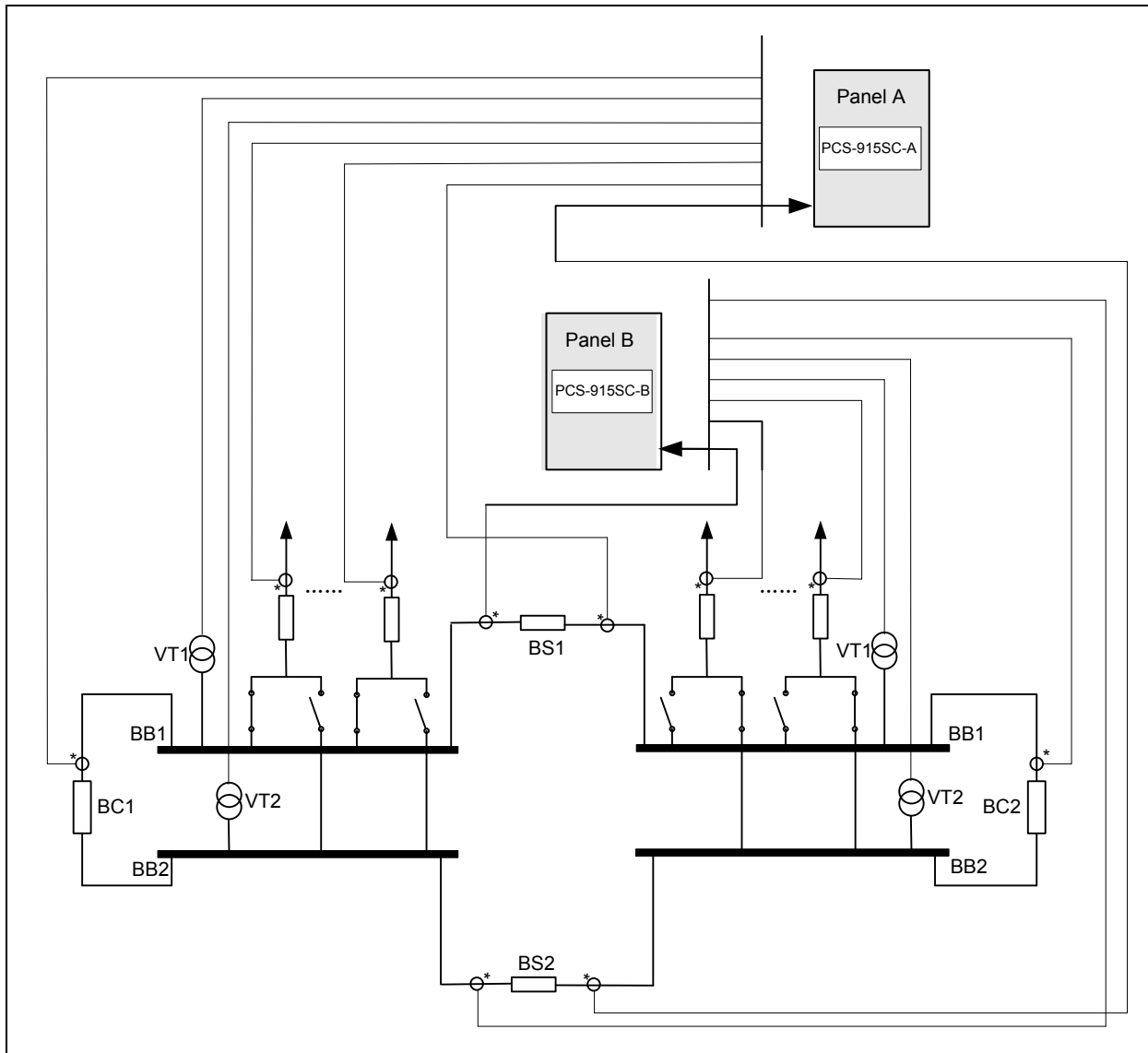


Figure 8 Typical application for Double BB with one BC (single CT) and two BS (single CT) arrangement

The diagram illustrates a power system configuration for two substations, Substation A and Substation B, connected by a transmission line. The system includes busbars (BB1, BB2), circuit breakers (BC1, BC2), voltage transformers (VT1, VT2), current transformers (CT1, CT2), and potential transformers (PT1, PT2). Two protection panels, Panel A (PCS-915SC-A) and Panel B (PCS-915SC-B), are connected to the substations via communication lines. The diagram shows the physical connections between the substations and the protection system components, including the use of CTs and PTs for protection and measurement.

Figure 9 Typical application for Double BB with one BC (dual CTs) and two BS (single CT) arrangement

Protection Functions

Busbar Differential Protection (87B)

The busbar differential protection is phase-segregated percentage restraint differential protection, it includes steady-state percentage restraint differential element and DPFC percentage restraint differential element.

The differential circuits of busbar differential protection include check zone differential circuit and discriminating zone differential circuits of each busbar zone. The check zone differential element is used to distinguish between internal and external fault of the overall busbar system, it measures the current from all the bays connected to the busbar system except BC and BS. The discriminating zone differential elements are used to select the faulty busbar zone by measuring the current of all the bays connected to individual busbar zone of the busbar system separated by BC or BS.

DPFC percentage restraint differential element and steady-state percentage restraint differential element adopt the different CT anti-saturation principles, that can guarantee fast and reliable performance during CT saturation. It can ensure no mal-operation of external fault and fast operation of internal fault in the case of the correct transfer time of CT is no less than 3ms.

If only the check zone percentage restraint differential element operates, but the discriminating zone percentage restraint differential element does not operate, in order to prevent the busbar differential protection from refusing to operate, two stages of backup protection with fixed time delay are applied to trip the corresponding circuit breakers.

Users can select whether the busbar differential protection is controlled by the voltage element via the logic setting to further improve the operation reliability of the busbar differential protection. The CT circuit failure alarm and the differential current high value alarm also may effect the operation of busbar differential protection.

The device provides a binary input to block busbar differential protection of all zones through external binary signal, it also provides a binary input to block busbar differential protection of respective busbar zone through external binary signal.

Under the inter-connection operation mode, the discriminating zone differential elements measure the current signals are the same as that of check zone differential element. The coupled busbars will be tripped simultaneously when there is a fault.

BC/BS Dead Zone Fault Protection (50DZ)

BC/BS dead zone fault protection is used to quickly isolate the fault which occurs between the BC/BS breaker and the BC/BS CT. It needs to take into account the operation behaviour when the BC/BS breaker is open or BC/BS breaker is closed. In addition, it is also necessary to consider the operation behaviour when one CT or two CTs are configured for BC/BS.

BC/BS Dead Zone Differential Protection (87DZ)

BC/BS dead zone differential protection can be used for the occasion that dual-CTs are configured for BC/BS, and the CTs are not cross-connected to the discriminating zone differential circuit.

The fault detector element, percentage restraint differential element, the voltage controlled element and the CT saturation detection element is the same as that of busbar differential protection.

Feeder Dead Zone Fault Protection (50DZ)

Feeder dead zone fault protection is used to quickly isolate the fault which occurs between the feeder breaker and the feeder CT. It needs to take into account the operation behaviour when the feeder breaker is open or feeder breaker is closed. In addition, the operation behaviour of feeder dead zone fault protection is also related to the installation location of the feeder CT.

BC/BS Switch-onto-fault (SOTF) Protection (50SOTF)

When a busbar is first energized via a BC/BS after maintenance or newly installed, the BC/BS SOTF protection can make the device trip the BC/BS immediately when it is closed on to a fault. BC/BS SOTF protection is not controlled by voltage controlled element.

Breaker Failure Protection (50BF)

When the bay protection or the busbar protection operates to trip the breaker of a bay, but the breaker fails, the breaker failure protection of the bay needs to be initiated. When the breaker failure protection operates, it will re-trip the circuit breaker of the bay with the first time delay, then it will trip all the breakers on the busbar that connected to the bay with the second time delay, and transfer trip the breaker of the remote end of a line or inter-trip the breakers on other sides of a main-transformer.

Users can choose whether breaker failure protection is blocked by the current criterion or the voltage control element. Breaker failure protection of each bay can be enabled or disabled independently, the breaker failure current setting and the corresponding time delay of breaker failure protection of each bay can be set independently.

The breaker failure protection also can be initiated externally, once it is initiated externally, the breaker failure protection will operate to trip all the breakers on the busbar that connected to the bay with another time delay, and transfer trip the breaker of the remote end of a line or inter-trip the breakers on other sides of a main-transformer.

When breaker failure protection is initiated, but the CB has some abnormality at the same time, breaker failure protection will operate to trip all the breakers on the busbar that connected to the bay with the dedicated time delay, and transfer trip the breaker of the remote end of a line or inter-trip the breakers on other sides of a main-transformer.

Phase Overcurrent Protection (50/51P)

The device can provide two 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. 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 two 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. Earth fault overcurrent protection 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).

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.

Monitoring Functions

VT Circuit Supervision (VTS)

VT circuit supervision can detect failure of single-phase, two-phase and three-phase on busbar VT. Under normal condition, the device continuously supervises input voltage from VT, VT circuit failure signal will be activated if residual voltage exceeds the threshold value, or negative voltage exceeds the threshold value or positive-sequence voltage is lower than the threshold value. If the DPFC current element operates to pick up or the busbar is not in service, the VT circuit supervision function will be blocked.

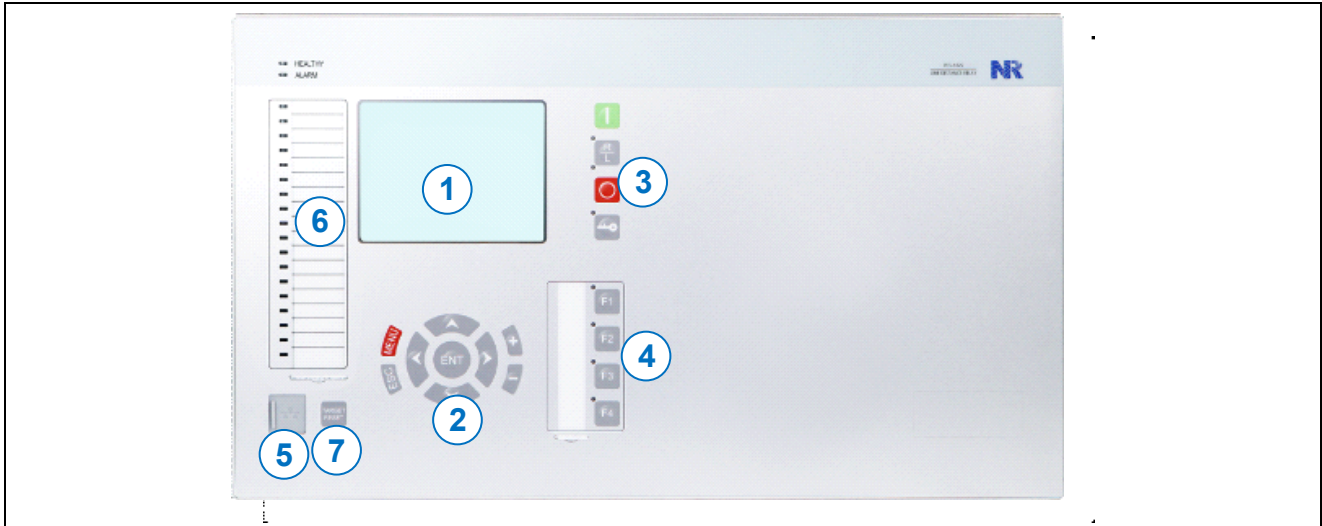
CT Circuit Supervision (CTS)

CT circuit supervision can detect CT circuit failure or CT circuit abnormality. The check zone differential current and discriminating zone differential current of each busbar zone are used for CT circuit supervision.

CT circuit failure will affect the calculation result of the busbar differential current, and then affect the operation behaviour of busbar differential protection.

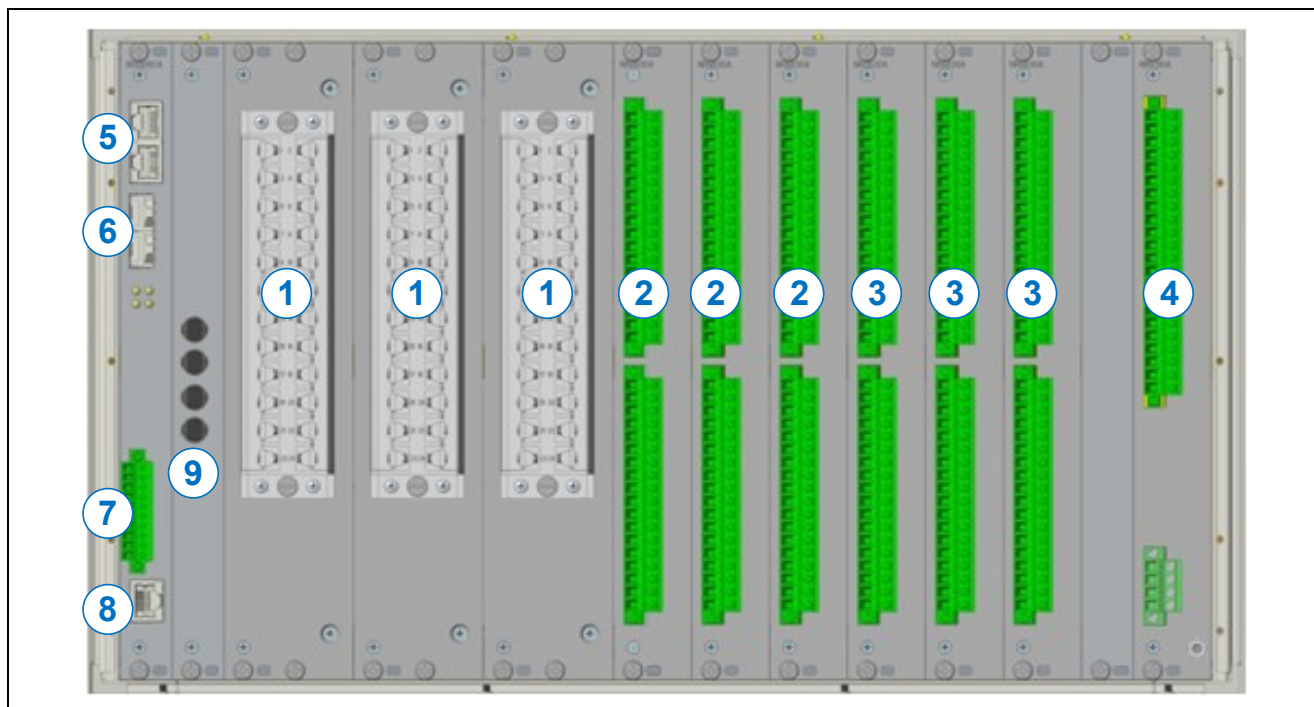
Hardware

Front Panel

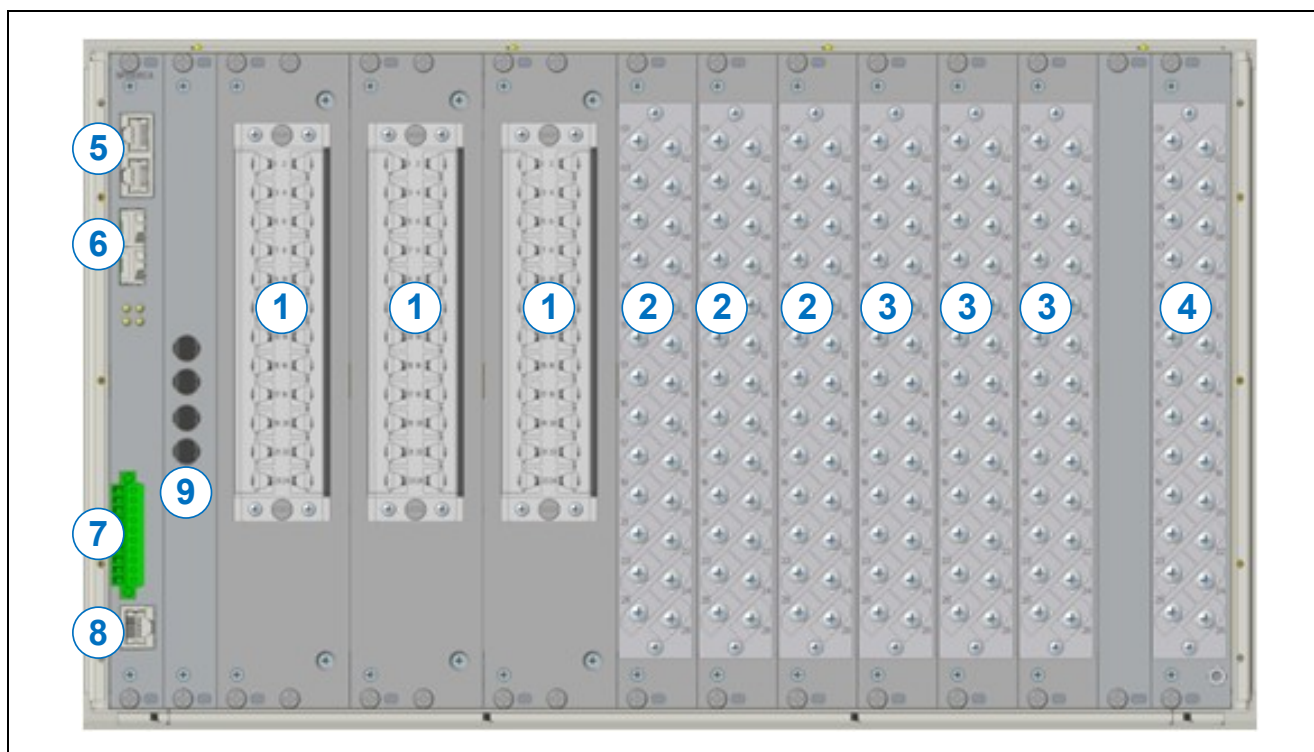


1. Front-panel status indication
2. Easy-to-use keypad aids simple navigation and set-point adjustment
3. Push buttons for open/close, switch for selection between local and remote control, and user's login and logout authority management
4. Programmable operator push-buttons with user-configurable labels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

Rear Panel



Typical rear view of this device (pin-ferrule-terminal modules)



Typical rear view of this device (ring-ferrule-terminal modules)

1. Current and voltage analog inputs
2. Binary inputs
3. Binary outputs

4. Power supply and binary I/O
5. Copper Ethernet port
6. Fiber-optic Ethernet port
7. RS-232 or RS-485 serial port
8. Rear debugging port
9. Fiber-optic communication port for cascading of multiple devices

Typical Wiring

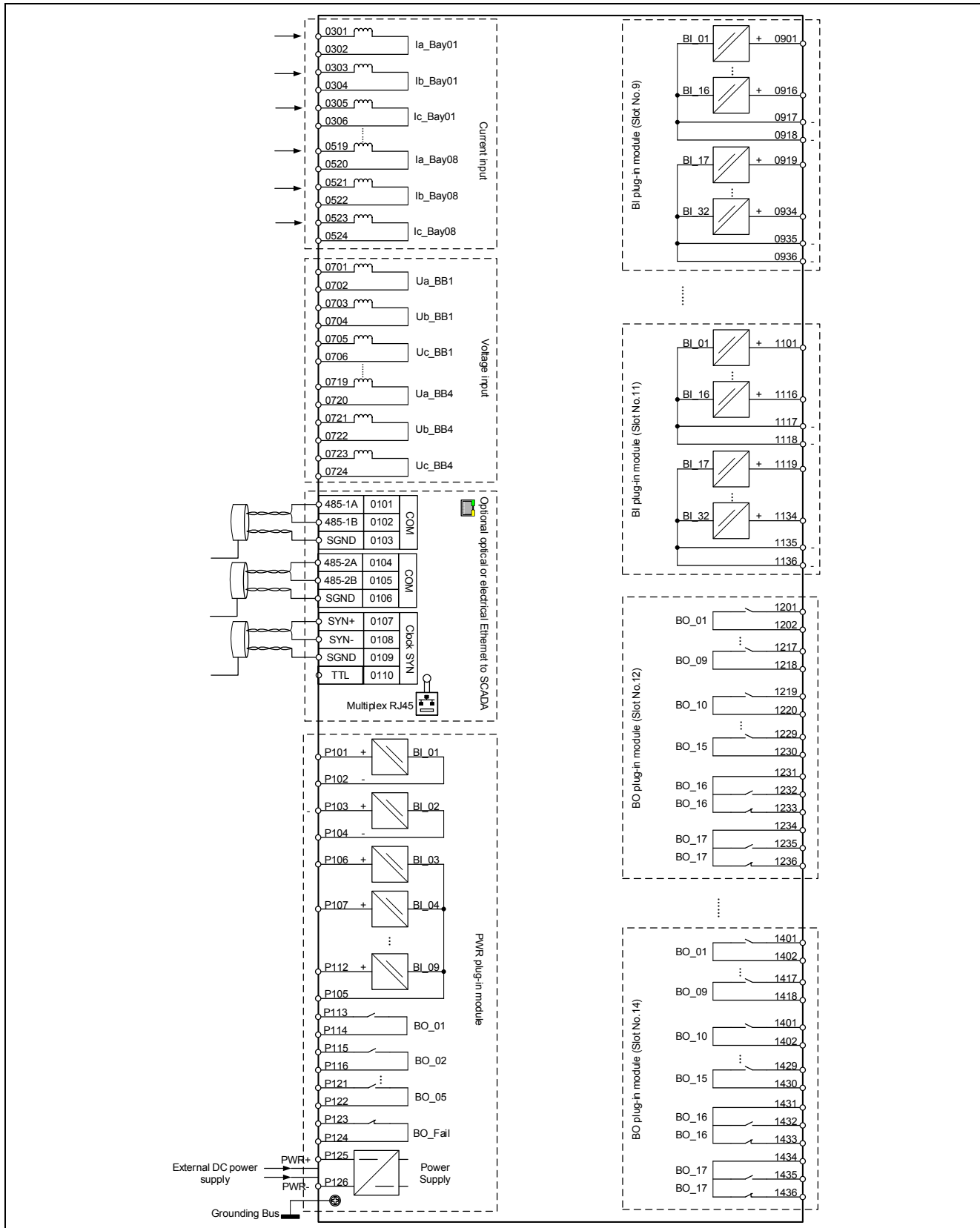


Figure 12 Typical wiring 1 of PCS-915SC (pin-ferrule-terminal modules)

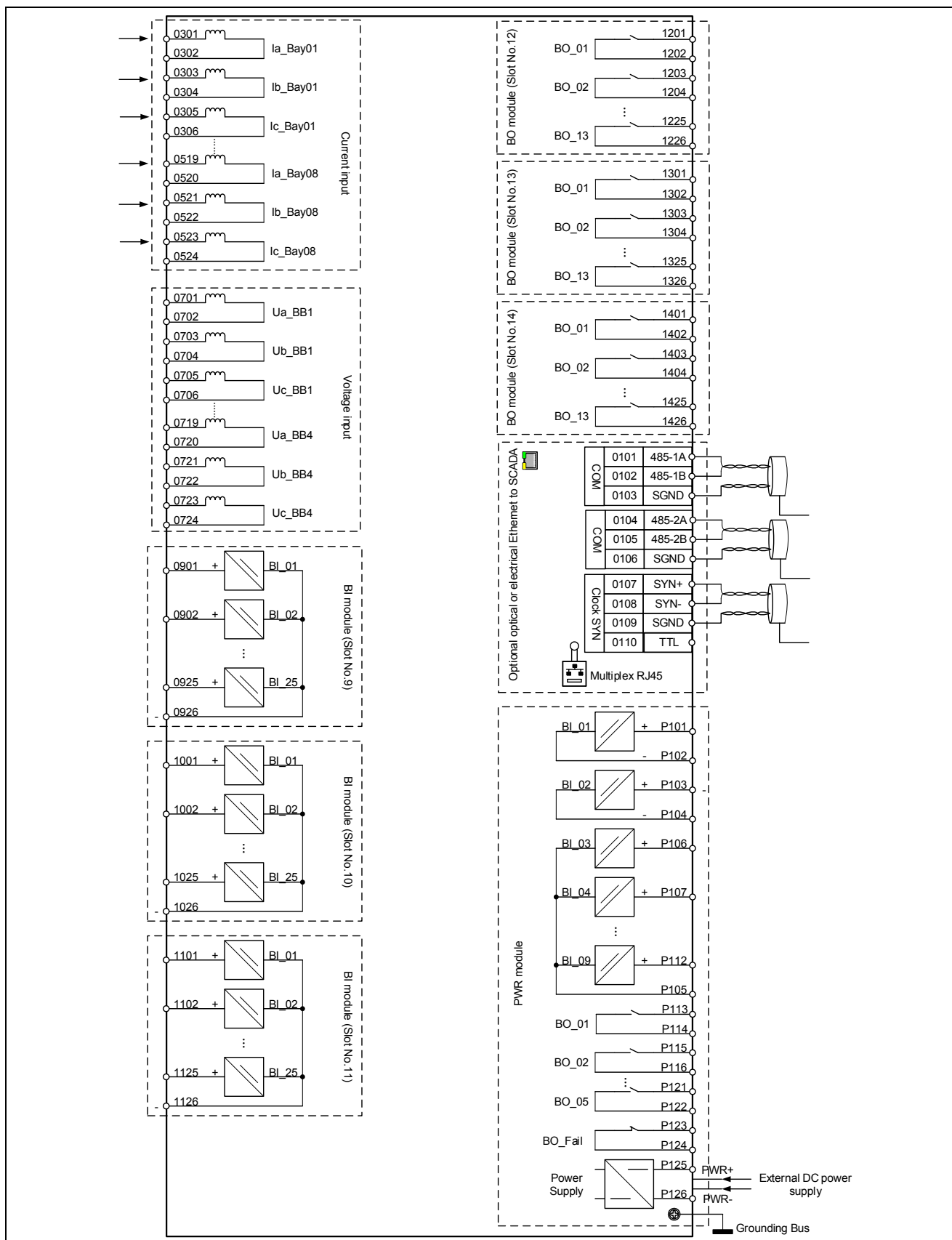
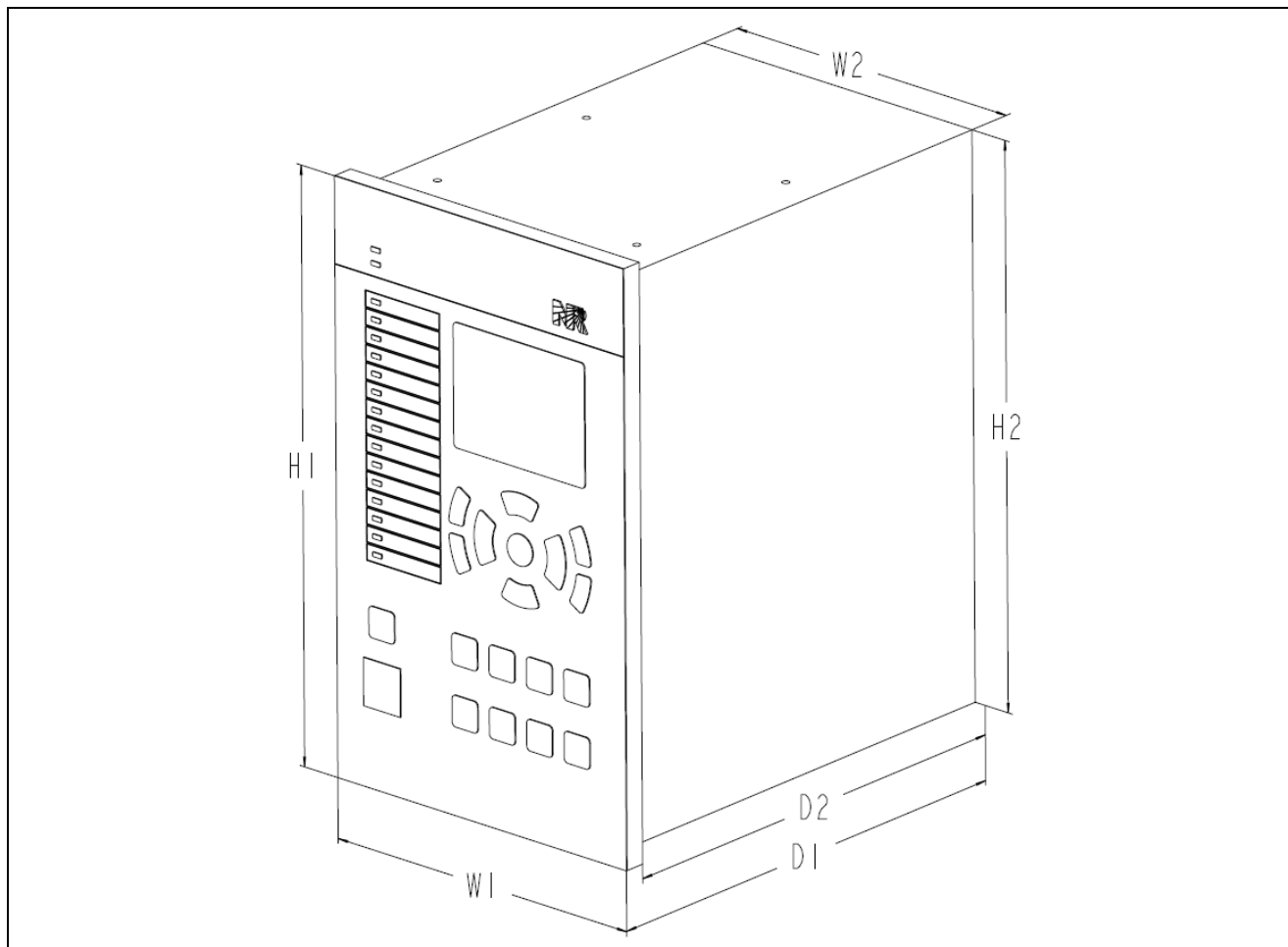


Figure 13 Typical wiring 2 of PCS-915SC (ring-ferrule-terminal modules)

Installation

Dimensions



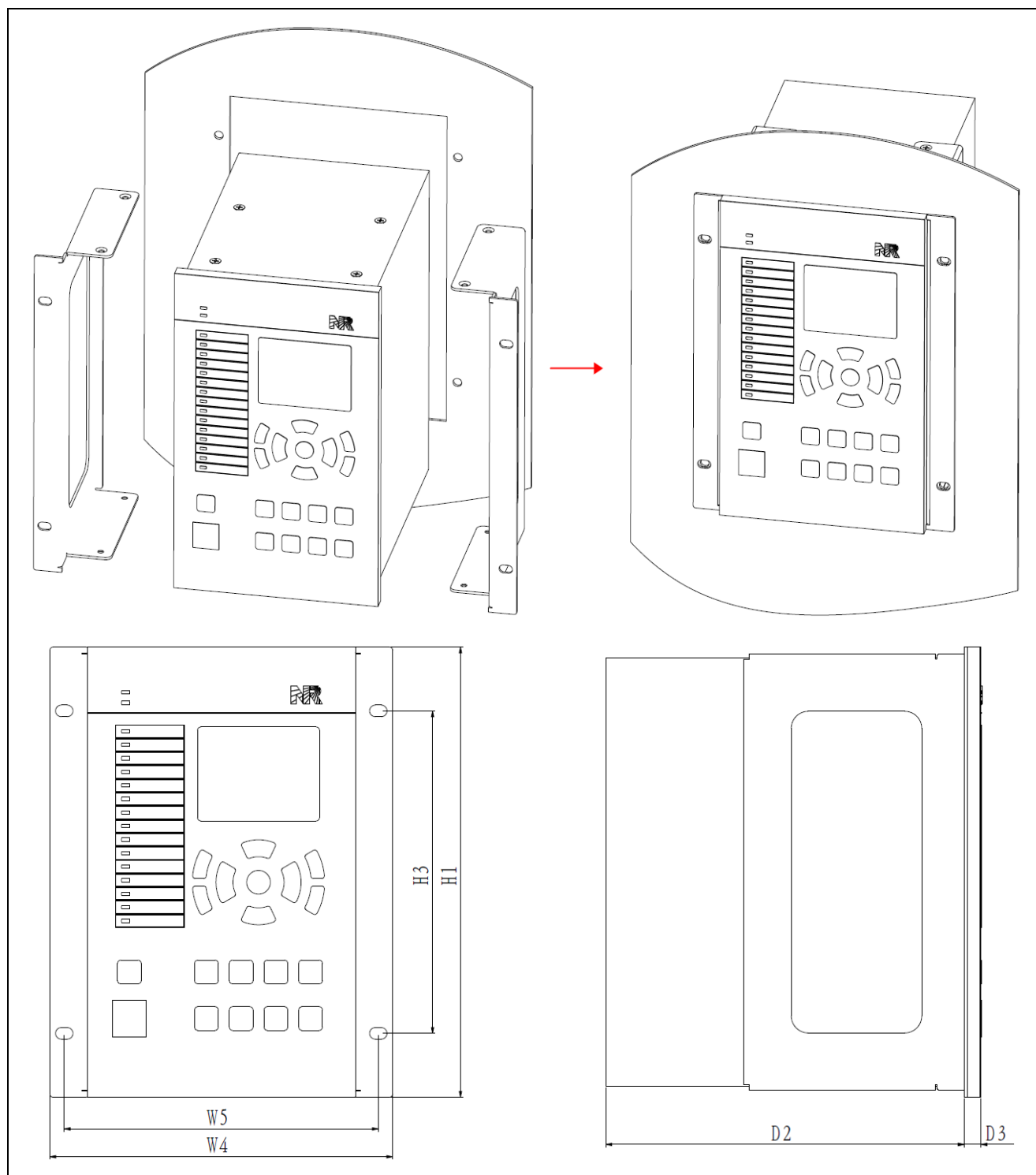
The device includes one kind of case sizes

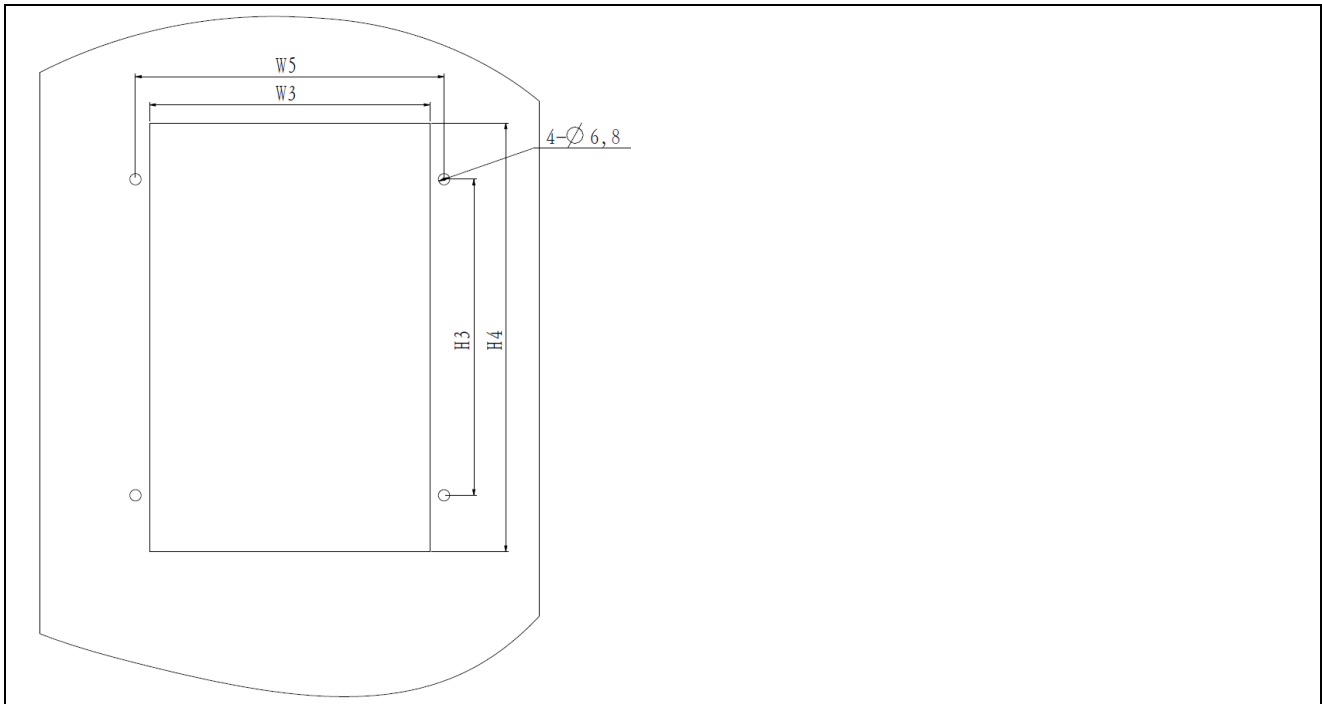
Case size (mm)	H1	H2	D1	D2	W1	W2
6U, 1/1 × 19"	265.9	253	243	233.5	453	442

Note: The dimensions of device depth include the dimension of terminal connector without wire harness 22mm.

Certain mounting method needs special mounting accessory for support.

Flush Mounting

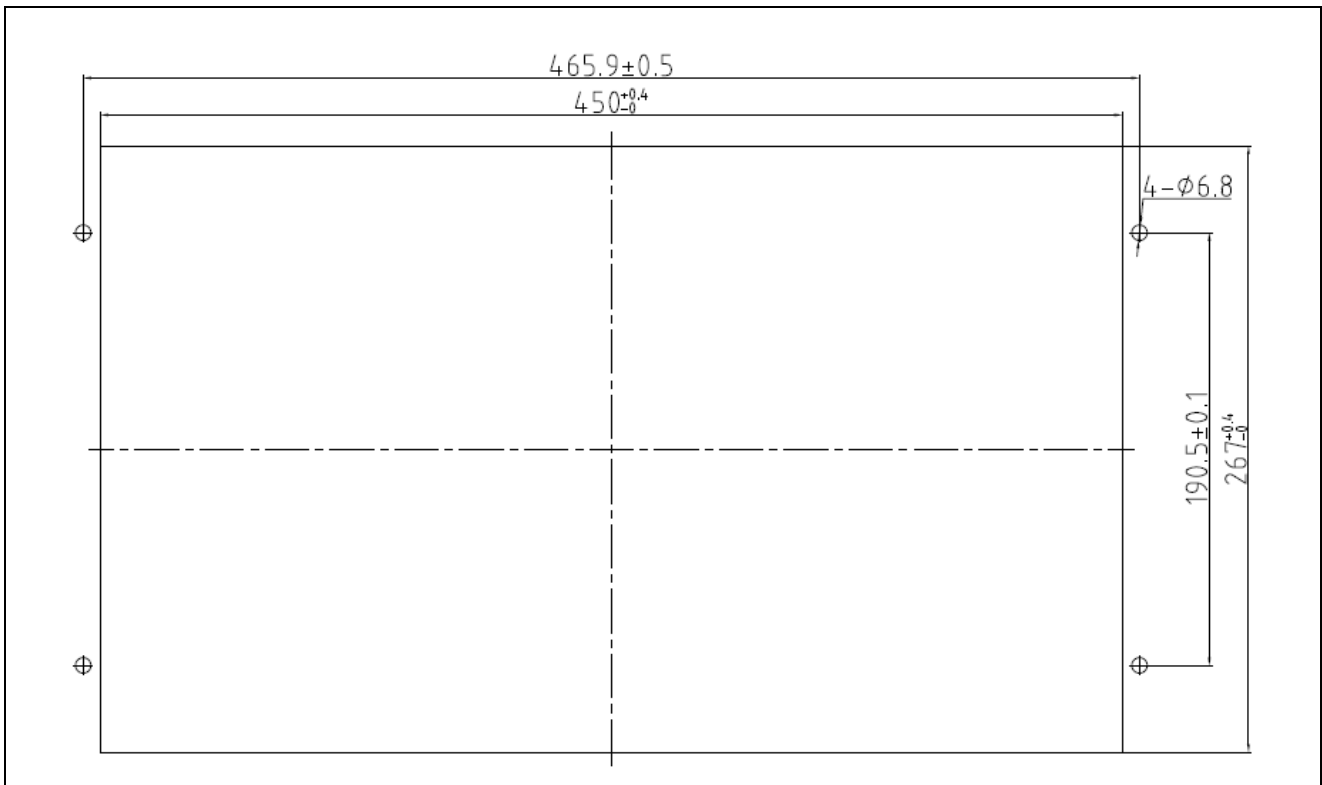




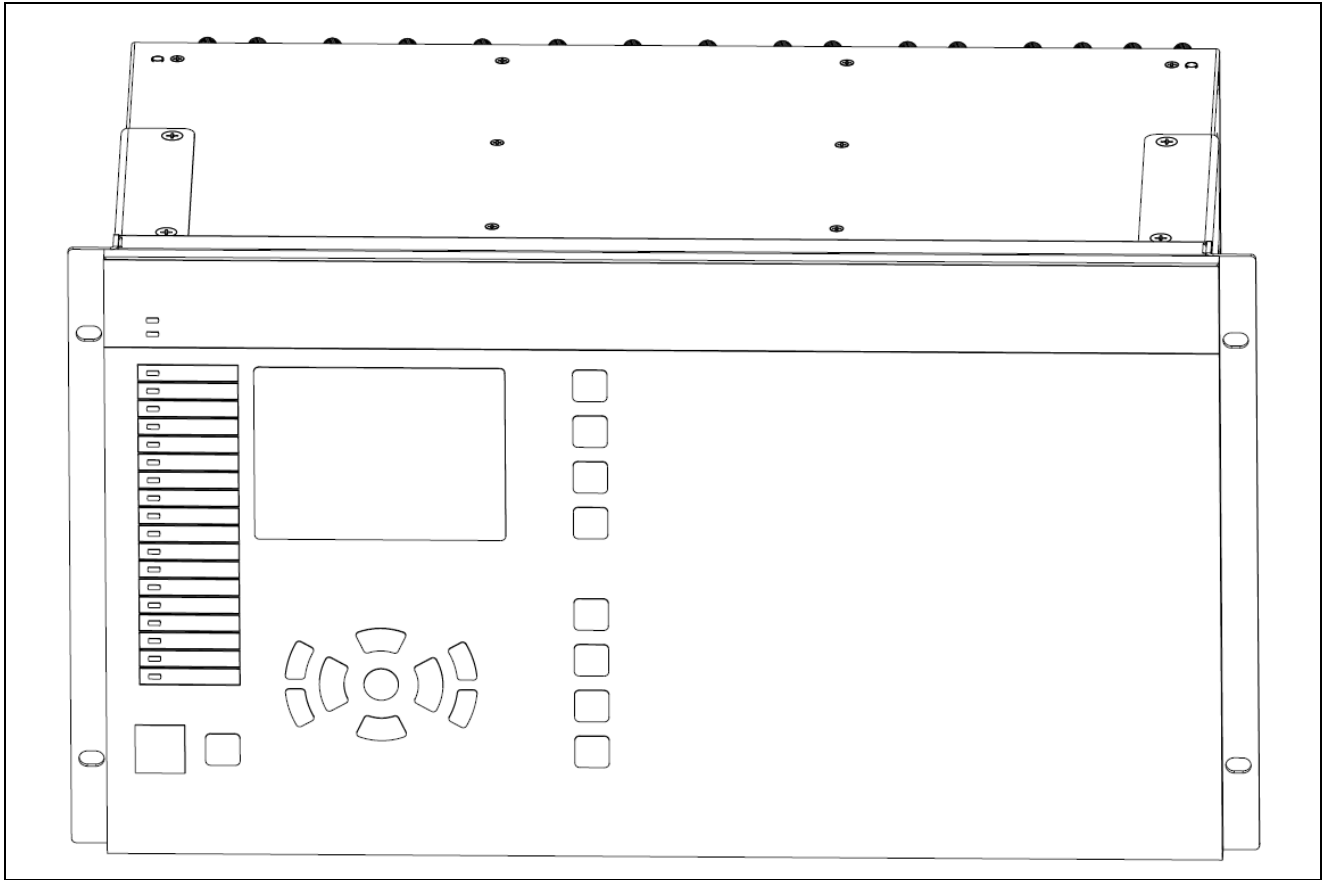
Case size (mm)	H3	H4	D3	W3	W4	W5
6U, 1/1 × 19"	190.5	259	9.5	463	497	480

Rack Mounting

Cut-out



Single 6U, 1/1 × 19"



Technical Data

Electrical Specifications

AC Current Input	
Phase rotation	ABC or ACB
Nominal frequency (fn)	50Hz, 60Hz
Rated current (In)	1A/5A (settable)
Linear to	0.05In~40In
Thermal withstand	
-continuously	4In
-for 10s	30In
-for 1s	100In
-for half a cycle	250In
Burden	<0.05VA/phase @1A or <0.25VA/phase @5A

AC Voltage Input		
Phase rotation	ABC or ACB	
Nominal frequency (fn)	50Hz, 60Hz	
Rated voltage (Un)	100V~130V	
Linear to	1V~300V	
Thermal withstand	Phase-to-ground	Phase-to-phase
-continuously	300V	519V
-10s	600V	1038V
-1s	660V	1141V
Burden at rated	<0.10VA/phase @100V	

Power Supply		
Standard		IEC 61000-4-29:2000
Rated voltage		110Vdc/125Vdc/220Vdc/250Vdc 100Vac/110Vac/115Vac/120Vac/127Vac/ 220Vac/230Vac/240Vac/250Vac
Permissible voltage range		88~300Vdc 80~275Vac
Permissible AC ripple voltage		≤15% of the nominal auxiliary voltage
Burden	Quiescent condition	<30W (Default hardware configuration)
	Additional for each energized SFP	0.25W ~ 0.35W
	Additional for each BI module	Quiescent condition : <1W Additional for each energized binary input: 0.004W @ 24VDC 0.008W @ 48VDC 0.015W @ 110VDC 0.32W @ 220VDC 0.41W @ 250VDC
	Additional for each BO module	Quiescent condition: <0.1W Additional for each energized binary output: <0.44W
	Additional module for SV sampling	<7W

Binary Input: Settable pickup voltage and drop-out voltage				
Rated voltage	110Vdc	125Vdc	220Vdc	250Vdc
Rated current drain	0.73mA	0.83mA	1.47mA	1.67mA
On value (default set)	69.3~132Vdc	78.75~160Vdc	138.6~264Vdc	157.5~300Vdc
Off value (default set)	<55V	<62.5V	<110Vdc	<125Vdc
Maximum permissible voltage	300Vdc			
Withstand voltage	2000Vac, 2800Vdc (1 min)			

Binary Input: Settable pickup voltage and drop-out voltage		
Rated voltage	110Vac	220Vac
Rated current drain	0.73mA	1.47mA
On value (default set)	69.3~132Vac	138.6~264Vdc
Off value (default set)	<55Vac	<110Vac
Maximum permissible voltage	300Vdc	
Withstand voltage	2000Vac, 2800Vdc (1 min)	

Binary Input: Settable pickup voltage and drop-out voltage		
Rated voltage	24Vdc	48Vdc
Rated current drain	0.16mA	0.32mA
On value (default set)	15.12~28.8Vdc	30.24~57.6Vdc
Off value (default set)	<12V	<24V
Maximum permissible voltage	300Vdc	
Withstand voltage	2000Vac, 2800Vdc (1 min)	

Binary Output: Tripping/signalling contact	
Output mode	Potential free contact
Maximum system voltage	250Vac, 300Vdc
Continuous carry	10A
Pickup time (Typical value)	<5ms
Drop-off time (Resistive load)	<6ms
Breaking capacity (L/R=40ms)	0.5A@48Vdc L/R=40ms 0.35A@110Vdc L/R=40ms 0.30A@125Vdc L/R=40ms 0.20A@220Vdc L/R=40ms 0.15A@250Vdc L/R=40ms

Cyclic capacity (2.5 cycle/second, L/R=40ms)	0.5A@48Vdc L/R=40ms 0.35A@110Vdc L/R=40ms 0.30A@125Vdc L/R=40ms 0.20A@220Vdc L/R=40ms 0.15A@250Vdc L/R=40ms
Short duration current	30A@3s 50A@1s
Durability (Loaded contact)	10000 operations

Binary Output: Heavy-capacity tripping contact	
Output mode	Potential free contact
MOV Protection (Maximum voltage)	350Vdc, 275Vac
Continuous carry	10A
Pickup time (Typical value)	<1ms
Drop-off time (Resistive load)	<10ms
Breaking capacity (L/R=40ms)	10A@48V L/R=40ms 10A@110V L/R=40ms 10A@125V L/R=40ms 10A@250V L/R=20ms
Cyclic capacity (4cycles in 1 second, followed by 2 minutes idle for thermal dissipation)	10A@48V L/R=40ms 10A@110V L/R=40ms 10A@125V L/R=40ms 10A@250V L/R=20ms
Short duration current	30A@3s 50A@1s
Durability (Loaded contact)	10000 operations

Mechanical Specifications

Chassis color	Silver grey
Weight per device	Approx. 23kg (6U, 1/1 × 19")

Chassis material	Aluminum alloy
Location of terminal	Rear panel of the device
Device structure	Plug-in modular type @ rear side, integrated front plate
Protection Class	
Standard	IEC 60529-2013
Front side	IP52
Other sides	IP50
Rear side, connection terminals	IP20

Ambient Temperature and Humidity Range

Standard	IEC 60255-1:2009
Operating temperature	-40°C to +80°C (Readability of display may be impaired below -20°C or above 70°C)
Transport and storage temperature range	-40°C to +80°C
Permissible humidity	5%-95%, without condensation
Pollution degree	II
Altitude	<3000m

Communication Port

EIA-485 Port	
Baud rate	4.8kbit/s, 9.6kbit/s, 19.2kbit/s, 38.4kbit/s, 57.6kbit/s, 115.2kbit/s
Protocol	IEC 60870-5-103:1997 or Modbus
Maximum capacity	32
Maximum transmission distance	500m
Safety level	Isolation to ELV level
Twisted pair	Screened twisted pair cable

Ethernet Port			
Connector type	RJ-45	LC	
Transmission rate	100Mbit/s		1.25Gbit/s
Transmission standard	100Base-TX	100Base-FX	1000Base-SX
Maximum transmission distance	100m	2km (1310nm)	500m (50/125μm) 300m (62.5/125μm)
Protocol	IEC 60870-5-103:1997, DNP 3.0 or IEC 61850		
Safety level	Isolation to ELV level		

Optical Fibre Port: For Station Level	
Characteristic	Glass optical fiber
Connector type	LC
Fibre type	Multi mode
Maximum transmission distance	2km
Wave length	1310nm
Minimum transmission power	50μm: -24dBm 62.5μm: -20dBm
Minimum receiving power	-31.0dBm
Margin	50μm: -7dBm 62.5μm: -9dBm

Print Port	
Type	RS-232
Baud rate	4.8kbit/s, 9.6kbit/s, 19.2kbit/s, 38.4kbit/s, 57.6kbit/s, 115.2kbit/s
Printer type	EPSON® 300K printer
Safety level	Isolation to ELV level

Clock Synchronization Port	
Type	Serial port
Input	Demodulated IRIG-B or PPS
Nominal voltage	5Vdc+10%
Maximum voltage	5.5Vdc
Input impedance	2.5k Ω
Isolation	500Vdc

Type Tests

Environmental Tests	
Dry cold test	IEC60068-2-1:2007
Dry heat test	IEC60068-2-2:2007
Damp heat test, cyclic	IEC60068-2-30:2005

Mechanical Tests	
Vibration	IEC 60255-21-1:1988 Class I
Shock and bump	IEC 60255-21-2:1988 Class I

Electrical Tests	
Standard	IEC 60255-27:2013
Dielectric tests	Test voltage 2kV, 50Hz, 1min
Impulse voltage tests	Test voltage 5kV
Overvoltage category	III
Insulation resistance measurements	Isolation resistance >100M Ω @500VDC

Electromagnetic Compatibility	
1MHz burst disturbance test	IEC 60255-26:2013
	Common mode: class III 2.5kV

	Differential mode: class III 1.0kV
Electrostatic discharge test	IEC 61000-4-2:2008
	For contact discharge: 8kV
	For air discharge: 15kV
Radio frequency interference tests	IEC 60255-26:2013 class III
	Frequency sweep
	Radiated amplitude-modulated
	10V/m (rms), f=80~1000MHz, 1400~2700MHz
Fast transient disturbance tests	Spot frequency
	Radiated amplitude-modulated
	10V/m (rms), f=80MHz/160MHz/450MHz/900MHz
Fast transient disturbance tests	IEC 60255-26:2013
	Power supply, I/O, Earth: class IV, 4kV, 5kHz, 5/50ns
	Communication terminals: class IV, 2kV, 5kHz, 5/50ns
Surge immunity test	IEC 60255-26:2013
	Power supply, AC input, I/O port: class IV, 1.2/50μs
	Common mode: 4kV
	Differential mode: 2kV
Conducted RF electromagnetic disturbance	IEC 60255-26:2013
	Power supply, AC, I/O, Comm. Terminal: Class III, 10V (rms), 150 kHz~80MHz
	Spot frequency
	10V (rms), f=27MHz/68MHz
Power frequency magnetic field immunity	IEC 61000-4-8:2009
	Class V, 100A/m for 1min, 1000A/m for 3s
Pulse magnetic field immunity	IEC 61000-4-9:2016
	Class V, 6.4/16μs, 1000A/m for 3s
Damped oscillatory magnetic field immunity	IEC 61000-4-10:2016
	Class V, 100kHz & 1MHz~100A/m

Conducted emission	IEC 60255-26:2013	
	0.15MHz ~ 0.50MHz: 79dB(μ V) quasi peak, 66dB(μ V) average	
	0.50MHz ~ 30MHz: 73dB(μ V) quasi peak, 60dB(μ V) average	
Radiated emission	IEC 60255-26:2013	
	Below 1GHz	30MHz ~ 230MHz: 40dB(μ V/m) quasi peak @10m, 50dB(μ V/m) quasi peak @3m 230MHz ~ 1000MHz: 47dB(μ V/m) quasi peak @10m, 57dB(μ V/m) quasi peak @3m
	Above 1GHz	1GHz ~ 3GHz: 56dB(μ V/m) average, 76dB(μ V/m) peak @3m 3GHz ~ 6GHz: 60dB(μ V/m) average, 80dB(μ V/m) peak @3m
Auxiliary power supply performance - Voltage dips - Voltage short interruptions	IEC 60255-26:2013 Up to 200ms for dips to 40% of rated voltage without reset 50ms for interruption without rebooting without energy storage board (Typical application) 500ms for interruption without rebooting with energy storage board (Typical application)	

Liquid Crystal Display (LCD)

Type	Resolution
Large size	320x240 pixels

Terminals

Ring Ferrule			
Connection Type	Wire Size	Screw Type	Torque
AC current	Screw terminals, 1.5~4mm ² lead	M4	1.6~1.8 N•m
AC voltage	Screw terminals, 0.8~4mm ² lead	M4	1.6~1.8 N•m
Power supply	Screw terminals, 0.8~4mm ² lead	M4	0.8~1.4 N•m
Contact I/O	Screw terminals, 0.8~4mm ² lead	M4	0.8~1.4 N•m
Grounding (Earthing) Connection	BVR type, 0.8~4mm ² lead	M3	0.6~0.8 N•m

Pin Ferrule			
Connection Type	Wire Size	Screw Type	Torque
Power supply	Screw terminals, 0.3~3.3mm ² lead	M2.5	0.4~0.6 N•m
Contact I/O	Screw terminals, 0.3~3.3mm ² lead	M2.5	0.4~0.6 N•m

Measurement Scope and Accuracy

Item	Range	Accuracy
Phase range	0° ~ 360°	≤±1°
Frequency	f _n ±3 Hz	≤ 0.01Hz
Currents from protection measurement current transformers		
Current	0.05~4.00I _n	≤ 1.0% of rating (0.05~1.00I _n) ≤ 0.5% of applied quantities (1.00~4.00I _n)
Voltage	0.05~1.50U _n	≤ 1.0% of rating (0.05~1.00U _n) ≤ 0.5% of applied quantities (1.00~1.50U _n)

Management Function

Clock Performance	
Real time clock accuracy	≤1s/day
Accuracy of GPS synchronization	≤1ms
External time synchronization	IRIG-B (200-98), PPS, IEEE1588 or SNTP protocol

Fault and Disturbance Recording	
Duration & Recording position	Settable pre-disturbance, post-disturbance and maximum recorded duration
Sampling rate	Up to 9.6kHz

Binary Input Signal	
Resolution of binary input signal	≤1ms
Binary input mode	Potential-free contact

Communication Functions

GOOSE Function	
Receiving Control Block (RCB)	Max. 64 (Typical configuration: 50×FCD+200×BOOL+16×FLOAT)
Sending Control Block (SCB)	Max. 16 (Typical configuration: 100×BOOL)
Receiving route delay	Max. 2ms
Sending route delay	Max. 3ms

SV Function	
Receiving Control Block (RCB)	Max. 12
Receiving route delay	Max. 2ms



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