PRS-7395

Merging and Control Unit

Instruction Manual

CYG SUNRI CO., LTD.

Preface

User's Guideline

This instruction manual contains full information of the equipment, including function descriptions, logic diagrams, input signals, output signals, setting parameters and technical parameters. It also lists the operations on safe handling, commissioning and maintaining of this equipment. The instruction manual can be used as a technical reference during the whole product life cycle.

Documentation and manufactured equipments purchased from CYG SUNRI CO., LTD. are dispatched separately due to the necessary manufacturing period. Therefore, they sometimes may not reach the recipients at the same time. Therefore this manual is provided as a technical reference to commission the equipment.

The installation and commissioning personnel should read all relevant chapters carefully and get a thorough knowledge of the contents of this manual, before conducting any operation to the equipment. In this way, the personnel can get the required knowledge in handling electronic equipment.

This manual contains a security chapter which describes the safety precautions recommended when using the equipment. Before installing and using the equipment, this chapter is recommended to be thoroughly read and understood.

Personnel Security

The content in this chapter specifically describes to prevent and reduce the safety accidents in electric power production and construction processuses, to ensure the personal safety and health of employees in production activities and to ensure the power grids stable operation and reliable power supply.

Any kind of direcily touching with the metal parts of the electrical equipment should be avoided when electrical equipment is on operation, because of the potential electric shock risk. Neglecting warning notices should be prevent because the improperly operation may damage the device, even cause personnel injury.

The good operating condition of the equipment depends on proper shipping and handling, proper storage, installation, commissioning and maintenance. Therefore, only qualified personnel should be allowed to operate the equipment. Intended personnel are individuals who:

● Have a thorough knowledge of protection systems, protection equipment, protection functions and the configured functional logic in the IEDs;

● Have a basic knowledge in the installation, commissioning, and operation of the equipment;

● Are familiar with the working field where it is being installed;

● Are able to safely perform operations in accordance with accepted safety engineering steps;

● Are authorized to energize and de-energize equipment, and to isolate, ground, and label it;

- Are trained in the maintanence and use of safety apparatus in accordance with safety engineering regulations;

- Have been trained in first aid if any emergency situations happen.

Warning Indications

The following indicators and standard definitions are used:

⚠ **DANGER!** means that death, severe personal injury and considerable equipment damage will occur if safety precautions are disregarded.

⚠ **WARNING!** means that death, severe personal and considerable equipment damage could occur if safety precautions are disregarded.

⚠ **CAUTION!** means that light personal injury or equipment damage may occur if safety precautions are disregarded.

NOTICE! is particularly applies to damage to device and to resulting damage of the protected equipment.

⚠ **DANGER!**

NEVER allow the current transformer (CT) secondary circuit connected to this equipment to be opened while the primary system is live. Opening the CT circuit will produce a dangerously high voltage.

⚠ **WARNING!**

ONLY qualified personnel should work on or in the vicinity of this device. This personnel **MUST** be familiar with all safety regulations and service procedures described in this manual. During operating of electrical device, certain part of the device is under high voltage. Severe personal injury and significant device damage could result from improper behavior.

⚠ **WARNING!**

Do **NOT** touch the exposed terminals of this device while the power supply is on. The generated high voltage causes death, injury, and device damage.

⚠ **WARNING!**

Thirty seconds is **NECESSARY** for discharging the voltage. Hazardous voltage can be present in the DC circuit just after switching off the DC power supply.

⚠ **CAUTION!**

● **Earthing**

Securely earthed the earthing terminal of the device.

● **Operating environment**

ONLY use the device within the range of ambient environment and in an environment free of abnormal vibration.

● **Ratings**

Check the input ratings **BEFORE** applying AC voltage/current and power supply to the device.

● **Printed circuit board**

Do **NOT** attach or remove printed circuit board if the device is powered on.

● **External circuit**

Check the supply voltage used when connecting the device output contacts to external circuits, in order to prevent overheating.

● **Connection cable**

Carefully handle connection cables without applying excessive force.

NOTICE!

The firmware may be upgraded to add new features or enhance/modify existing features, please **MAKE SURE** that the version of this manual is compatible with the product in your hand.

the products and to make improvements to the documents without notice.

The users are responsible for understanding the information and should not rely on this information as absolute. If the users do act upon the suggestions contained in this document, the users should be responsible for themself and their actions.

Documentation Outline

The manual provides a functional and technical description of this relay and a comprehensive set of instructions for the relay's use and application.

All contents provided by this manual are summarized as below:

1 Briefly Introduction

Briefly introduce the application scope, the selectable functions and product features about this equipment.

2 Technical Specifications

Introduce the technical specifications about this relay, including electrical specifications, mechanical specifications, ambient temperature and humidity range, communication interface parameters, type tests, setting ranges and accuracy limits etc.

3 Operation Theory

Provide a comprehensive and detailed function description.

4 Supervision Functions

Introduce the automatic self-supervision function of this equipment.

5 Monitoring&Control

Introduce the measurement, controlling, signaling, recording and other functions of this device.

6 Hardware

Introduce the main module functions of this device and describe the definition of all terminals of each module.

7 Communication Protocol

Introduce the communication interfaces and protocol that this relay contains. IEC60970-5-103 and IEC61850 protocols are introduced in details.

8 Commissioning

Introduce how to commission this relay, check the calibration and test all the function of this relay.

9 Installation

Recommend on unpacking, handling, inspection and storage of this relay. A guide to the mechanical installation and electrical wiring of this relay is also provided, including earthing recommendations. Some typical wiring connection is demonstrated in this manual manual as well.

10 Maintenance

A general maintenance steps for this device is outlined.

11 Decommissioning and Disposal

A general decommissioning and disposal steps for this relay is outlined.

12 Manual Version History

List the instruction manual versions and their corresponding modification history records.

Table of contents

1 Introduction

1.1 Application Scope

PRS-7395 Merging and Control Unit (hereinafter referred to as "the device") is a device integrating smart substation's Smart Control Unit and Merging Unit with the function of local operating box to provide digital interfaces and act as smart accessories for traditional CBs, disconnect switches and instrument transformers.

The merging and control unit receives relevant status signals of traditional CBs and sends received signals to the secondary devices such as protective, monitoring & controlling and digital oscillography via a fiber optical interface. It also receives analog signals from traditional primary instrument transformers, voltage signals from the voltage merging units or digital signals of other merging units, and provides multiple secondary devices such as protective, monitoring & controlling equipment, digital watt-hour meter and digital oscillography with sampling information via a fiber Ethernet interface after synchronously processing all these signals. At the same time, it can receive the control commands from associated bay devices via a fiber Ethernet interface to achieve the operation and control of a CB. The data output formats conform to smart substation IEC61850 standard.

PRS-7395 can work together with CBs for three-phase linkage operation, main transformer or reactor body and busbar devices under the condition of double configuration. The device, with 4U enclosed design and strong anti-interference capacity, can be installed near a CB.

1.2 Product Function

- Sampling

- Digital Signal

- Binary Input

- DC Sampling

- Apparatus Control

- Time Synchronization

- Supervision Alarm

1.3 Product Features

- The device adopts a 4U 19" Case, reinforced chassis with multiple layers of shielding. It features strict separation of strong and weak electrical components, as well as anti-vibration and anti-interference design. It has high anti-interference performance and is suitable for installation in harsh environments.

- 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 modularized 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. Various function optional modules can satisfy various situations according to the different requirements of the users..

● The high-impedance, low-power relays reduce the power consumption and heat generation of the device, thereby improving its safety.

● The adoption of 16-bit A/D converter and the dual-channel sampling technology can ensure the high accuracy and reliability of sampling. It samples at 80-point high speed sampling rate per cycle and has a sampling frequency of 4 kHz.

● It is with flexible communication modes. The device can be configured with up to 12 independent MAC fiber optical ports and one RJ45 debug port. It supports substation communication standards like IEC61850.

● Various methods of GPS time synchronization are supported in this device, including IRIG-B synchronization and IEEE 1588, pulse per second (PPS).

● Complete event recording function is provided: 8000 latest operation reports.

● Under any network operating conditions with traffic shocks, the device will not crash or restart, nor emit error messages. After the network abnormality disappears, the device can resume normal operation.

● The device has a self-diagnosis and alarm function, supporting both hard contact and sent to communication client.

● The device features a lockout alarm function, which includes signals for power interruption, communication interruption, communication abnormality, GOOSE disconnection, and internal device anomalies.

● The device has undergone rigorous high and low temperature tests, allowing it to operate in harsh outdoor environments. It is specifically designed for outdoor cabinets, meeting various technical requirements such as moisture and heat resistance, waterproofing, dustproofing, and radiation protection to ensure its suitability for outdoor installation.

● The device offers a simulative LCD interface with a user-friendly human-machine interface, allowing for easy on-site device debugging, testing, and other operations.

2 Technical Specifications

2.1 Electrical Specifications

2.1.1 Current Transformer Ratings

Reference		IEC 60255-1, IEC 60255-27
Rated frequency (fn)		50Hz, 60Hz
Nominal range		fn ± 10Hz
Rated current (In)		1/5A
Thermal withstand capability	continuously	3×In
	for 10s	20×In
	for 1s	100×In
Burden		< 0.05VA/phase @1A, < 0.2VA/phase @5A

2.1.2 Voltage Transformer Ratings

Reference		IEC 60255-1, IEC 60255-27
Rated frequency (fn)		50Hz, 60Hz
Nominal range		fn ± 10Hz
Rated voltage (Un)		100V / 220V
Thermal withstand capability	continuously	240V
	10s	360V
	1s	400V
Burden at rated voltage		< 0.10VA @57.7V

2.1.3 Auxiliary Power Supply

Reference	IEC 60255-1, IEC 60255-26
Rated voltage	110V/125V/220VDC
Variation	80% ~ 120%
Maximum interruption time in the auxiliary DC voltage without resetting the IED	0%Un,100ms； 40%Un,200ms； 70%Un,500ms At the Un=DC220V
Gradual shut down / Start up	Class C (60s shut down ramp, 5 min power off, 60s start up ramp)
Ripple in the DC auxiliary voltage	Class A (15% of rated @200Hz, 220VDC)
Maximum load of auxiliary voltage supple	≤40W (normal state), ≤50W (maximum state)

2.1.4 Binary Input

Reference	IEC 60255-1, Clause:6.10.5
Binary input number	Up to 109
Rated voltage	110V/125V/220VDC
Pickup voltage	55% ~ 70% rated voltage

"ON" value voltage	70% ~ 120% rated voltage
"OFF" value voltage	< 55% rated voltage
Maximum permitted voltage	120% rated voltage
Resolution of binary input signal	≤ 1ms
Resolution of SOE	≤ 1ms

2.1.5 Binary Output

Reference	IEC 60255-1	
Item	Tripping output	Signal output
Binary output number	Up to 39	2
Output model	Potential-free contact	Potential-free contact
Max system voltage	250Vdc	250Vdc
Voltage across open contact	1000V RMS for 1min	1000V RMS for 1min
Continuous carry	1250VA, 150W	1250VA, 150W
Short duration current	12A, 0.5s 6A, 3s	12A, 0.5s 6A, 3s
Breaking capacity	0.40A @ 110Vdc, L/R=40ms 0.30A @ 220Vdc, L/R=40ms	0.40A @ 110Vdc, L/R=40ms 0.30A @ 220Vdc, L/R=40ms
Wear resistance	100 000 cycles	100 000 cycles
Pickup time	< 8ms	< 10ms
Dropout time	< 5ms	< 8ms

2.2 Mechanical Specifications

Mounting Way	Flush mounted
Weight per device	Approx. 8.0kg (fully equipped)
Merchanical size (width×high×deepth)	482.6mm*177 mm *283 mm
Hole size (width×high)	450 mm *178 mm
Display language	Optional: Chinese, English
Housing material	Metallic plates, parts and screws: Steel Plastic parts: Polycarbonate
Housing color	Silver grey
Location of terminal	Rear panel of the device
Protection class	IEC60225-1: 2009	Front side:IP40 (IP52 with seal strip) Rear side, connection terminals: IP20 Other Sides: IP40

2.3 Ambient Temperature and Humidity Range

Standard	IEC 60255-1:2009
Operating temperature range	-40°C ~ +70°C
Transport and storage temperature range	-40°C ~ +70°C

Damp heat steady	+40℃ 95%humidity
Damp-heat test, cyclic	6 cycles， +25℃ to +55℃， Humidity 5% to 95%

2.4 Communication Interfaces

2.4.1 Ethernet Port

Medium		Parameters	
Ethernet	Optical	Port number	Up to 12
		Connector type	LC
		Transmission rate	100Mbits/s
		Transmission standard	100Base-FX
		Optical fiber type	Multi-mode
		Wavelength	1310nm
		Transmission distance	≤ 2000m
		Protocol	IEC61850

2.4.2 Time Synchronization

Medium	Parameters	
Optical Ethernet	Port number	1
	Transmission distance	≤ 2000m
	Timing standard	IRIG-B

2.4.3 Ethernet Port for Debugging

Medium	Parameters	
Electrical Ethernet (in front panel)	Port number	1
	Connector type	RJ-45
	Transmission rate	100Mbits/s
	Transmission standard	100Base-TX
	Transmission distance	≤ 100m
	Safety level	Isolation to ELV level

2.5 Type Tests

2.5.1 Mechanical Tests

Vibration response test	IEC 60255-21-1, IEC 60255-27	Class 1： Vibration Response: Class 1 (10-59Hz: 0.035mm, 59-150Hz: 0.5gn)
Vibration Endurance:	IEC 60255-21-1, IEC 60255-27 IEC 60068-2-6	10 to 55 Hz / 0.15 mm or 2 gn, 2 hours per axe
Shock Response	IEC 60255-21-2, IEC 60255-27 IEC 60068-2-27	15 g 11 ms

Shock Withstands	IEC 60255-21-2, IEC 60255-27	Class 1 (15gn)
Bump	IEC 60255-21-2, IEC 60255-27	Class 1(10gn)
Seismic +Verifcation of function	IEC 60255-21-3 IEC 60255-1, Clause 6.13.3	Class I

2.5.2 Electrical Tests

Impulse Voltage Tests.	IEC 60255-27	Impulse test: 5kV (rated insulation voltage ≤ 63V);Impulse test: 1kV (rated insulation voltage ＞63V);
AC or DC Dielectric Test	IEC 60255-27	Dielectric 50,60Hz 5/60s DC 2.8KV AC 2KV
Insulation Resistance	IEC 60255-27	>100Mohm @500Vdc
Rated insulation voltage	IEC 60255-27	2 kV , 50 Hz , 1 mn
Protective Bonding Resistance	IEC 60255-27	Test current DC20A, >12 Vac /Vdc, >60s,< 0.1 ohm
High Voltage Impulse	IEC 60060-1	5 kV, 0.5 J
Electrical Disturbances (1 MHz Burst)	IEC 60255-22-1	Class 3:2.5 kV CM,1.0 kV DM

2.5.3 Electromagnetic Compatibility

Burst Disturbance Test / Damped Oscillatory Wave Immunity Test	IEC 60255-26, IEC 61000-4-18	For Power Supply, Binary Input / Output:Common Mode: 2.5kV, Differential Mode: 1kV;For Communication Port:Common Mode: 1kV
Oscillatory Transient Immunity	IEC 61000-4-12 ANSI/IEEE C37.90.1	Ring Wave, Damped Oscillatory,2.5 kV
Electrostatic Discharge test	IEC 60255-26, IEC 61000-4-2	Contact Discharge: 15kV, Air Discharge: 15kV
Fast Transient test	IEC 60255-26, IEC 61000-4-4	(Power / Earth Port: 4kV, Signal / Control Port: 4kV)
1 MHz damped oscillatory wave	IEC 60255-26	Supply:2.5kVCM,input/output:2.5kV,communication:2.5 kV
Semi-sinusoidal shock in operation	IEC 60068-2-27	15 g / 11 ms, 1 shock per sense and per axe

Surge Immunity Test	IEC 60255-26, IEC 61000-4-5	For Power Supply, Binary Input / Output: L-E: 4kV, L-L: 2kV, voltage waveform: 1.2/50μs, current waveform: 8/20μs；Communication Port: L-E: 1kV, L-L: -, voltage waveform: 1.2/50μs, current waveform: 8/20μs)
Conducted radio interference test	IEC 60255-26, IEC 61000-4-6	150kHz~80MHz(Uo: 140dB μV or Uo: 10V)
Electromagnetic fields immunity	IEC 60255-26, IEC 61000-4-3	Test Field Strength: 10V/m , Sweep frequency: 80MHz – 1000MHz, Spot frequency: 80MHz, 160MHz, 450MHz, 900MHz @ 80% Modulation & Pulse
Immunity to conduct, common mode disturbance in frequency range 0 Hz to 150KHz	61000-4-16	Level 4：continuous 30V,short duration 300V at 50/3,50,60Hz; 15Hz~150Hz:30-3 decreases at 20dB/decade; 150Hz~1.5kHz:3 constant; 1.5kHz~15kHz:3-30 increases at 20dB/decade; 15kHz~150kHz:30 constant
Power frequency magnetic fields	IEC 61000-4-8, IEC 60255-26	Continuous: 100A/m, Short Duration 1s to 3s: 1000A/m)
Pulse magnetic field immunity test	IEC 61000-4-9	Class 5: Current 6.4/16μs, 1000A/m
Damped oscillatory magnetic field immunity test	IEC 61000-4-10	Class 5: 0.1MHz&1MHz, 100A/m
Power frequency immunity tests	IEC 60255-26	Input: Class A,Common Mode: 300V, Differential Mode: 150V
Ring wave immunity test	IEC 61000-4-12	Ring Wave Class 4,4kV
Conducted RF interference on power supply terminals	IEC 60255-26, CISPR 22	Conducted Emission Limit for Auxiliary Power Supply Port：Frequency range: 0.15MHz – 0.5MHz (Quasi Peak: 79μV, Avg: 66μV), Frequency range: 0.5MHz – 30MHz (Quasi Peak: 73μV, Avg: 60μV)；
Radiated interference	IEC 60255-26, CISPR 22	Radiated Emission Limit on Enclosure Port：Frequency range: 30MHz - 230MHz (Quasi Peak: 40μV), Frequency range: 230MHz - 1000MHz (Quasi Peak: 47μV)

2.5.4 Environmental Tests

Dry heat operation test	IEC 60068-2-2, IEC 60255-27	96h, +70℃
Cold operation test	IEC 60068-2-1, IEC 60255-27	96h, -25℃
Dry heat storage test	IEC 60068-2-2, IEC 60255-27	96h , +70℃
Cold storage test	IEC 60068-2-1, IEC 60255-27	96h , +5℃
Damp heat steady state test +Verifcation of function & dielectric (10 days）	IEC60255-27,Clause10.5.1.5 IEC 60255-1,Clause 6.12.3.6 IEC 60068-2-78	96 h,+40℃ 93%humidity
Damp heat storage test	IEC 60068-2-78	96 h,+55℃ 95%humidity
Damp-heat test, cyclic	IEC 60068-2-30, IEC 60255-27	6 cycles, +25℃ to +40℃, Humidity 97% to 93%
Change of temperature test	IEC 60068-2-14	5 Cycles , 1℃/min, -40℃ to +70℃

2.6 Terminals

Connection Type	Wire Size
AC current	Screw terminals, 2.5mm^2~4.0mm^2 lead
AC voltage	Screw terminals, 2.5mm^2~4.0mm^2 lead
Power supply	Screw terminals, 1.5mm^2~2.5mm^2 lead
Contact I/O	Screw terminals, 1.5mm^2~2.5mm^2 lead

2.7 Measurement Range and Accuracy

Metering Item	Range	Accuracy
Phase range	0° ~ 360°	≤ 0.5% or ±1°
Frequency	35.00Hz ~ 70.00Hz	≤ 0.01Hz
Current	0.05In~1.4In	Measurement: ≤0.25% for 0.6 In to 1.2 In Protection:≤ 2.5% up to 40 x In
Voltage	0.05 Un~1.2Un	Measurement: ≤ 0.25% for 0.8 Vn to 1.2 Vn Protection:≤ 1.5 % for 0.1 Vn to 1.2 Vn

3 Operation Theory

3.1 Overview

PRS-7395 Merging and Control Unit is applied in digital substations to collect and process analog sampling and status signals from primary equipment. It transmits the data via SV and GOOSE protocols. It responds to control commands for primary equipment and provides output contact. It serves as a physical unit for the measurement, control, and other functionalities of primary equipment such as transformers, circuit breakers, and transformers.

3.2 System Parameters

3.2.1 Overview

To correct configuration of analog input channels, other protected system information, such as the parameters of voltage transformer and current transformer are also required.

3.2.2 Settings

Table 3-1 System parameters

No.	Name	Range	Unit	Step	Description
1	Prot_TA_Primary	1~9999	A	1	Primary rated current of Protection CT
2	0_Seq_TA_Primary	1~9999	A	1	Primary rated current of Zero sequence CT
3	Gap_TA_Primary	1~9999	A	1	Primary rated current of Gap CT
4	Meas_TA_Primary	1~9999	A	1	Primary rated current of Measurement CT
5	TV_Primary	1~1000	kV	0.1	Primary rated voltage of protection VT
6	TV_Secondary	1~200	V	1	Secondary rated voltage of VT
7	Z_S_Mod	0.No_D 1. Z_S grounding 2. Z_S ungrounded			0.no action taken 1. zero-sequence grounding：measured value *1.732 2. zero-sequence ungrounded：measured value /1.732

3.3 Configuration Parameters

3.3.1 Overview

PRS-7395 can flexibly configure corresponding parameters to meet the operational requirements of the field conditions.

3.3.2 Settings

Table 3-2 Configuration parameters

No.	Name	Range	Unit	Step	Description
1	FD_Ena	0/1			Enabling/disabling general fault detector element 0: disable 1: enable
2	3PH_Imba_Ena	0/1			Specific settings for phase separation device： Enabling/disabling three-phase imbalance element 0: disable 1: enable
3	3PH_ T_ImbaAlm	0-10	S	0.001	Specific settings for phase separation device：Time delay of three-phase imbalance alarm
4	GOOS_BloAR_Ena	0/1			Enabling/disabling block AR GOOSE signal forwarding 0: disable 1: enable
5	PRP_Ena	0/1			Enabling/disabling PRP function 0: disable 1: enable
6	Out-of-step_Resyn_T	5~20	S	1	Return delay of synchronization abnormality after the time signal is restored to normal

3.4 AC Analog Input

The device acquire the analog signals from traditional primary instrument transformer, voltage signals from received voltage merging unit or digital signals from other merging units. After the synchronous processing, transmit sampling information to such secondary devices as protection, measurement and control, digital electric meters and digital fault recorder through the fiber optic interface.

The device adopts high-conversion-precision components and algorithm, thus improving the collection and calculation precision, and the fine setting of amplitude and phase angle can be implemented through software.

The data format of sampling frame being sent meets the message frame format of IEC 61850-9-2 LE SV.

3.5 DC Analog Input

The device can acquire two-channel DC value, calculate the corresponding temperature, humidity and pressure etc. of DC value measured via setting the parameters of DC transmitter and send by GOOSE.

The input of DC quantity is usually 4～20mA or 0～5V, and can be provided with an external transmitter to collect the main transformer temperature, and DC current.

3.6 Binary Input

The PRS-7395 device be capable of realizing the control (opening, closing and five-anti interlock) of switches, knife switches and ground knives and signal acquisition.

The device compliance with IEC-61850 GOOSE standard, accept such GOOSE commands like remote open/close under monitoring and control, protected three-phase tripping and reclosing.

The circuit of the input signal and the external circuit are implemented with optocoupler isolation. Each binary input signal can be setting with debounce time.

3.7 Binary Output

The device provide control output function performs execution to primary equipment, such as CB/DS/ES switching for signaling purpose. The state of the device's output will remain unchanged until a command change occurs.

3.8 Trip Logic

3.8.1 Protection GOOSE Trip

When the device receives a GOOSE protection trip command, it activates the tripping output and illuminates the corresponding trip indicator light. The tripping output triggers the corresponding tripping coil.

Figure 3.8.1.1 PRS-7395: Protection GOOSE Trip(3PH)
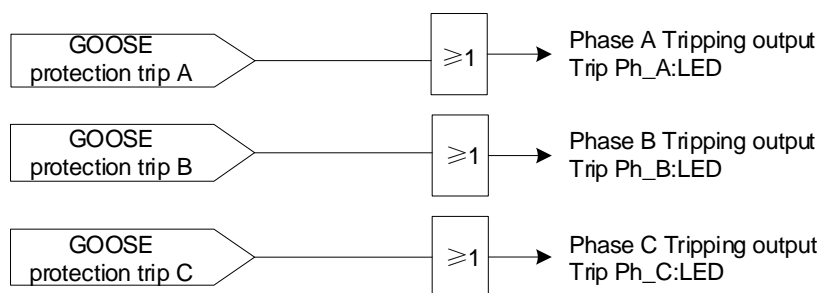
Figure 3.8.1.2 PRS-7395: Protection GOOSE Trip (phase separation)

3.8.2 TJR Trip

When the device receives a GOOSE TJR (Tripping without Reclosing) command from the protection device, it activates the tripping output and illuminates the corresponding tripping indicator light, and simultaneously sends a "Lock AR" GOOSE signal. It closes the " Lock AR " output to the " Lock AR " input of another redundant unit. The tripping output triggers the corresponding tripping coil.
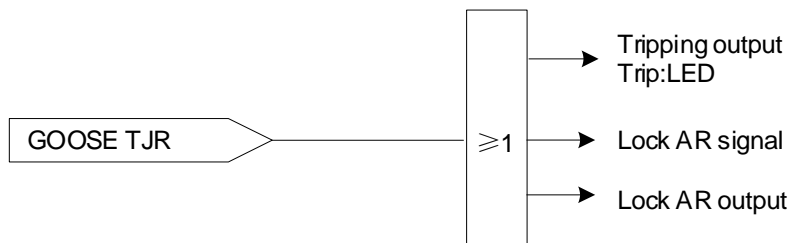
Figure 3.8.2.1 PRS-7395: Protection GOOSE Trip(3PH)
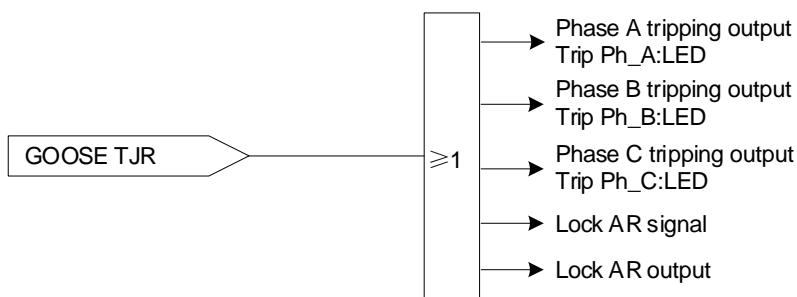
Figure 3.8.2.1 PRS-7395: Protection GOOSE Trip (phase separation)

3.8.3 Remote trip

When the device receives a GOOSE remote trip command from BCU, it activates the remote open output for the circuit breaker. It simultaneously sends a GOOSE signal for block AR and triggers the hard contact.
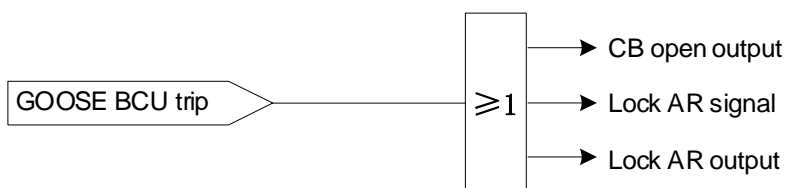
Figure 3.8.3.1 Remote trip

3.9 Close Logic

3.9.1 Remote Close

When the device receives a GOOSE remote close command from BCU, it activates the remote close output for the circuit breaker. It simultaneously sends a GOOSE signal for block AR and triggers the hard contact. After being powered by the operating power supply, the remote close output of the circuit breaker is connected to the hand-close input of the operating circuit.
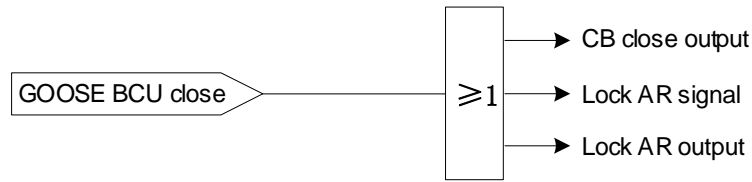
Figure 3.9.1 Remote close

3.9.2 Reclose

When the device receives a GOOSE close command from the protection device, it activates the closing output and illuminates the closing indicator light. The closing output triggers the corresponding closing coil.

Figure 3.9.2.1 PRS-7395: Reclose logic(3PH)
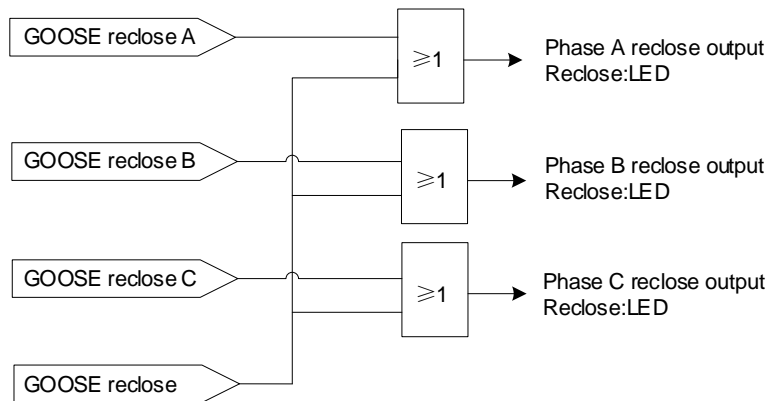
Figure 3.9.2.1 PRS-7395: Reclose logic (phase separation)

3.10 AR Block and lockout

When remote close/hand close, remote trip/hand trip, three-shot start failure without close, AR block input, and device power-up occur, a AR block signal should be send to the protection system. If GOOSE AR block input forwarding is enabled and the GOOSE AR block input status is 1, the device sends a AR block signal.
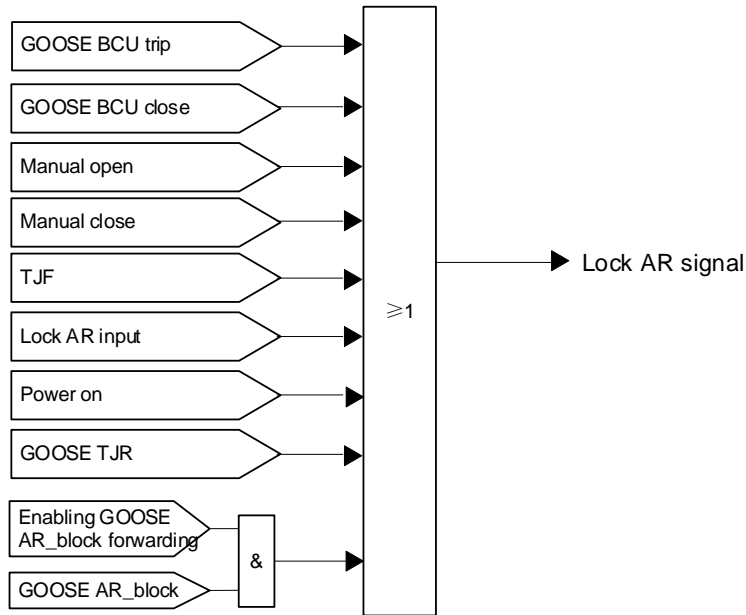
Figure 3.10.1 AR block

When configuring the device in a redundant configuration, it should have an output contacts for AR block to the other devices.
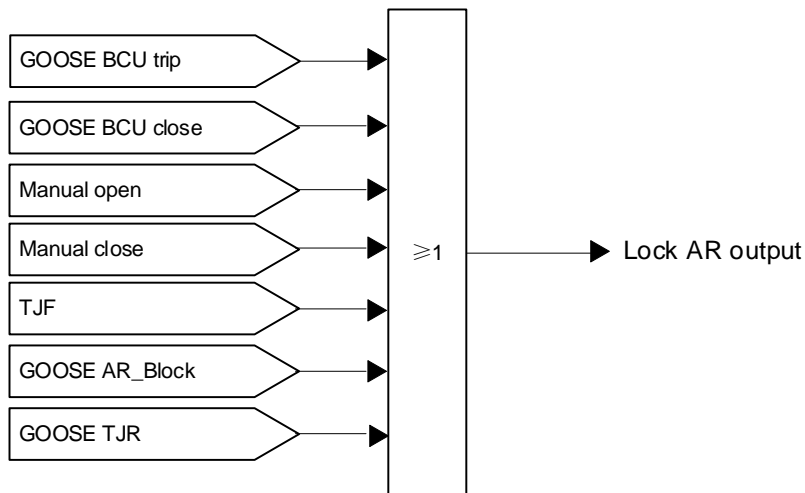
Figure 3.10.2 AR block signal to another devices

3.11 General Accident Signal

After enable the general accident signal, if both the circuit breaker position opening input and KKJ signal are simultaneously 1, a general accident signal will be issued after a delay of 200ms.
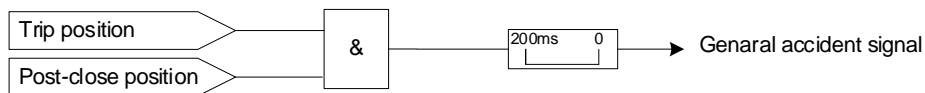
Figure 3.11.1 PRS-7395: General accident signal (3PH)
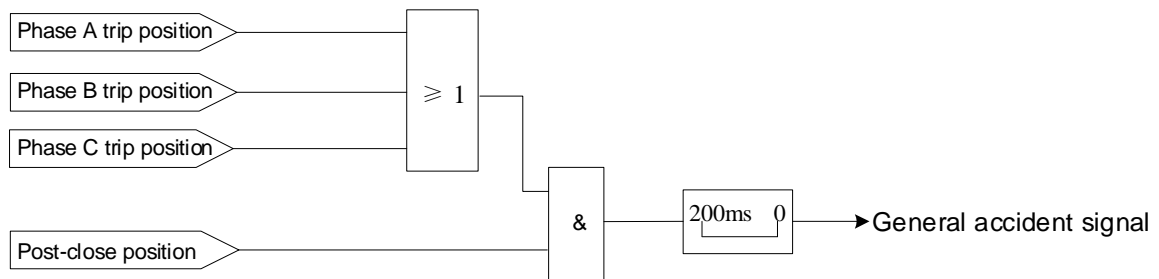
Figure 3.11.2 PRS-7395: General accident signal (phase separation)

3.12 Three-phase Imbalance Alarm

The phase separation device has three-phase imbalance alarm function: the device collects the positions of switch auxiliary contacts by using the position inputs of phase A open, phase A close, phase B open, phase B close, phase C open, and phase C close. When the following logic is satisfied, the device reports a "three-phase imbalance" alarm. The three-phase imbalance function can be enabled or disabled by setting.
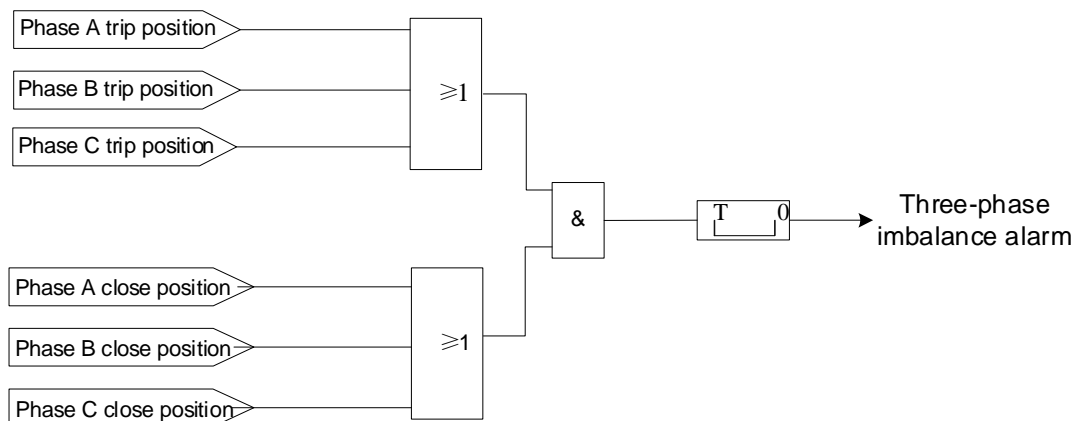
Figure 3.12.1 Three-phase imbalance alarm

3.13 Test Inconsistency

When the device's test status is inconsistent with the test status of the GOOSE sender, the "Test Inconsistency" indicator on the device panel lights up, and the device sends a "Test Inconsistency" signal.

If the device's test status is inconsistent with the test status of the GOOSE sender, the device does not operate. When they are consistent, the device operates.

3.14 Synchronization Function

● When the device is powered on, it enters the desynchronized state directly.

- When the device is in the desynchronized state, it enters the follow state and sets the synchronization flag when it continuously receives at least 10 valid clock time synchronization signals (with a time uniformity error of less than 10µs).

- When the device is in the timing state, if it receives more than 5 valid clock time synchronization signals with a time difference greater than 10µs, it re-enters the desynchronized state and clears the synchronization flag.

- If the device loses the synchronized clock signal and exceeds the timing range, it generates a data synchronization invalid flag.

- It supports full calendar support (including leap year).

4 Supervision

4.1 Overview

When the equipment is in energizing process, the equipment needs to be checked to ensure there are no errors. Therefore, the automatic supervision function, which checks the health of the protection system during startup and normal operation procedure, plays an important role.

4.2 Operation Power Monitoring

When the voltage of the operation power supply drops to an abnormal value, the status of the operation voltage monitoring signal becomes 0, and the device generates an operation power failure alarm.

Operating power monitoring —○ & → Operating power failure alarm
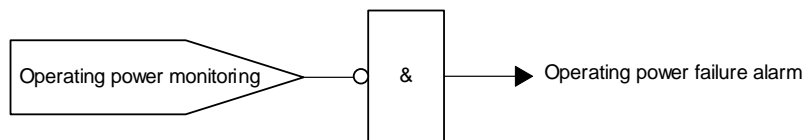
Figure 4.2.1 operation power monitoring

4.3 Optocoupler Power Failure

When the voltage of the BI power supply drops to an abnormal value, the status of the BI voltage monitoring signal becomes 0, and the device generates an optocoupler power failure alarm. Simultaneously, the alarm indicator is lit, and the device sends a running abnormal signal and closes the running abnormal signal.

Optocoupler power monitoring —○ &
→ Alarm:LED
→ Optocoupler power failure alarm
Running abnormal
→ Running abnormal output
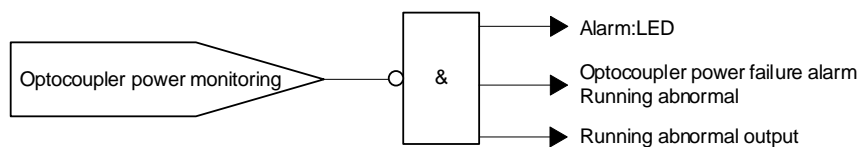
Figure 4.3.1 Optocoupler power failure

4.4 Control circuit failure alarm

When the signals of the operation box's position (open/close) are both 0, a control circuit failure signal is sent to the device. Upon receiving the control circuit failure signal, the device generates a control circuit failure alarm, illuminates the control circuit failure indicator, activates the alarm

indicator, and sends a running abnormal signal.
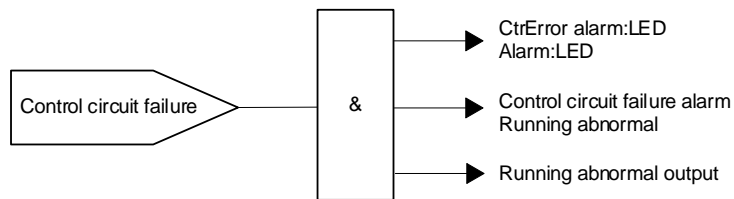
Figure 4.4.1 Control circuit failure

4.5 TJF

When the operation box detects the TJF signal, it simultaneously sends the TJF signal to the merging and control unit. Upon receiving the TJF signal, the device illuminates the non-electric quantity trip signal indicator and the protection trip indicator, generates the TJF signal, AR block signal, and closes the AR block output.
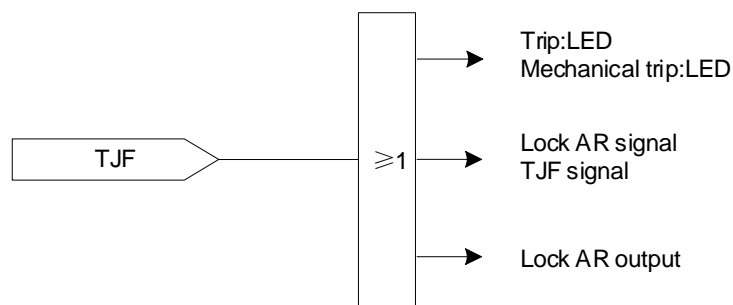
Figure 4.5.1 TJF

5 Monitoring&Control

5.1 Overview

By connecting to the device through a simulation interface, you can obtain information such as input status, GOOSE and SV states, optical port power, DC measurements, and report records from the device.

5.2 BI Status

On this page, can view the real-time status of the hardwired input signals and GOOSE input signals of the device.

5.3 GOOSE and SV Status

On this page, can view the link status of the subscribed GOOSE and SV on the device. The GOOSE status includes subscription packet information, test status, frames received every ten seconds, receiving port, link status, total correct frames, and error frames since power-up. The SV status includes subscription packet information, frames received per second, receiving port, rated delay, link status, total correct frames, and error frames since power-up, as well as test status and quality bits for each channel.

5.4 Optical Port Power

On this page, can view the transmit power and receive power of each optical port.

5.5 DC Measurement

On this page, can view the real-time values of the DC measurements for each channel. Once the correct parameters for the DC transmitters are set, the displayed values on the instrument will be reflected in real-time.

5.6 Event Recording

The device can store up to 8000 records of various reports, which are listed in chronological order from the most recent to the oldest.

5.6.1.1 Alarm Recording

The device provides self-check alarm information that reflects the communication status between devices. This includes indications of time synchronization anomalies, synchronization anomalies, SV communication anomalies, GOOSE communication anomalies, and more.

5.6.1.2 Device self-check record

➢ **Hardware self-check record**

The device provides hardware health condition self-check alarm, such as analog sampling circuit abnormal self-check, LVDS bus self-check is abnormal.

➢ **Software self-check record**

The device provides software operation status self-check alarm records, such as memory status self-check alarm, parameter verification error and the like.

➢ **Configuration file self-check record**

The device provides self-check records that reflect the status of the device configuration file, such as CCD configuration file error, CCD configuration file change, etc.

5.6.1.3 Sequence Of Event

The device has event sequence record (SOE) function:

·   When the state quantity input signal is from a hard contact, the time tag of the state quantity is marked by the device, and the time is defined before debouncing.

·   When the state quantity input is GOOSE signal, the time tag of the state quantity adopts the external input source signal time tag, and GOOSE signal acquisition has no debouncing time.

5.6.1.4 Device Running Record

The running record is the device power-on, power-off record, the time tag of the state quantity adopts the external input source signal time tag.

6 IED Hardware

6.1 Overview

The modular design structure of this relay enables a qualified commissioning technician to easily check and locate the damaged hardware modular, so as to eliminate the fault in the very first time. The hinged front panel allows easy access to the HMI modules and the back-plugging design makes it easy to upgrade, maintain or replace any module.

There are several types of hardware modules in this relay, which play different roles in the practical application. The specific modules can be configured flexibly according to the practical engineering demands.

The overall hardware designing frame of this relay is shown as below.
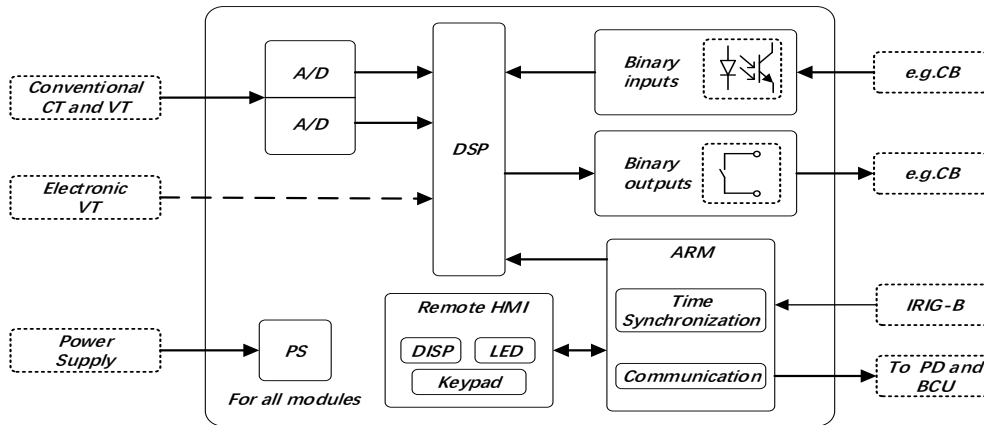
Figure 6.1.1 Hardware Frame of PRS-7395

The following figures show the front panel and the rear panel of PRS-7395.

Figure 6.1.2 Front Panel of PRS-7395
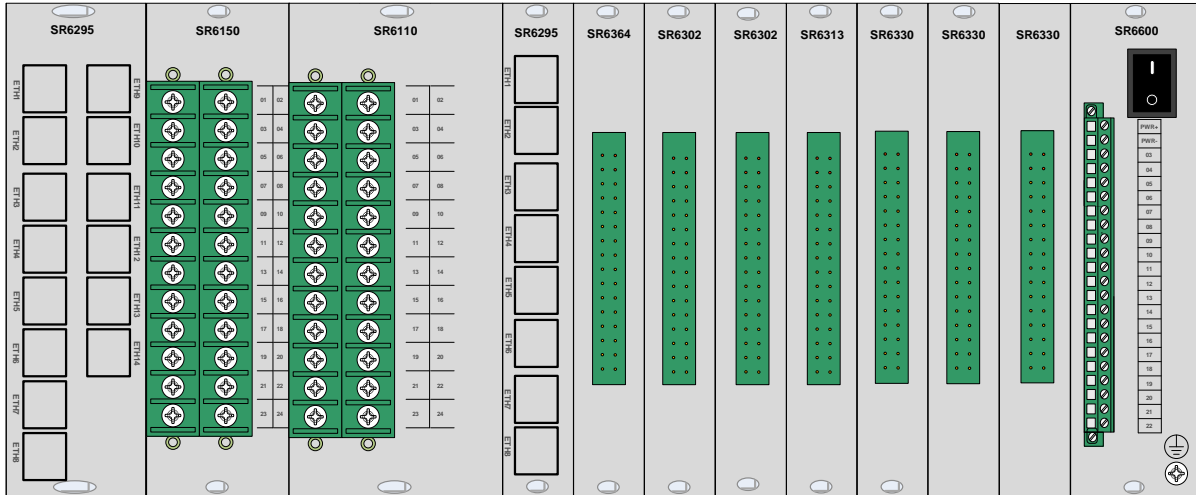
Figure 6.1.3 Real Panel of PRS-7395

The following figures show the front panel and the rear panel of PRS-7395(phase separation).
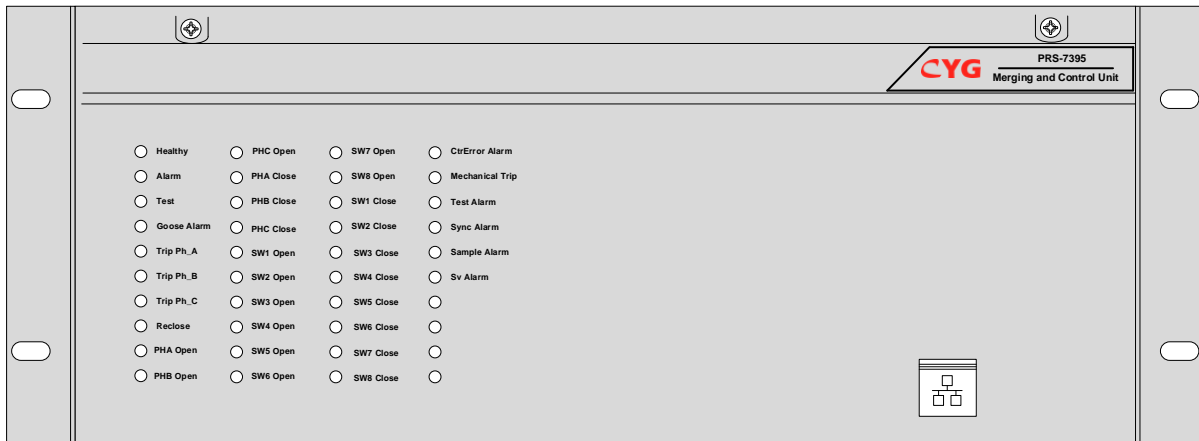
Figure 6.1.4 Front Panel of PRS-7395
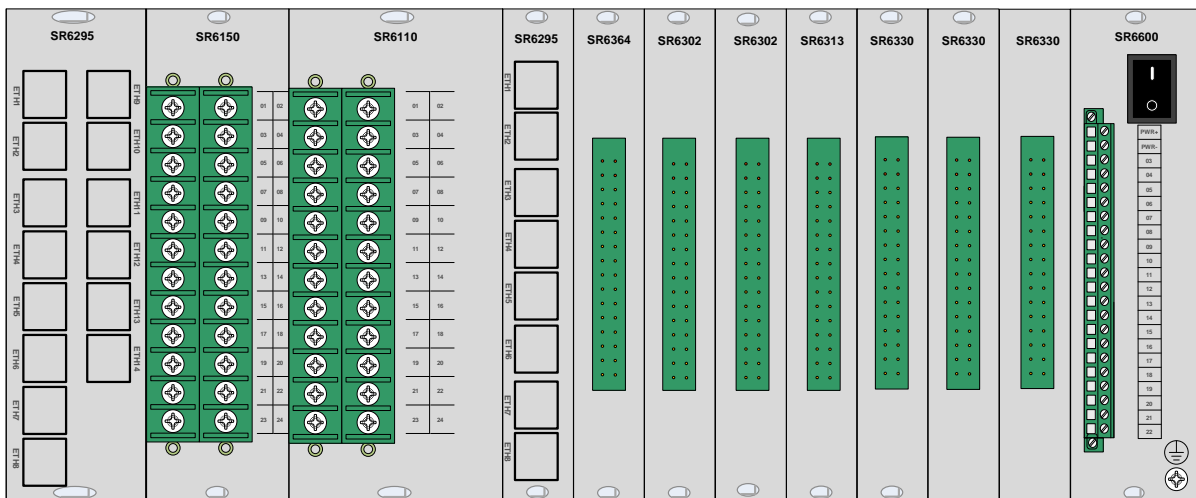
Figure 6.1.5 Real Panel of PRS-7395

6.2 Hardware Module

The PRS-7395 is comprised of randomly coordinated modules, except that a few particular modules, e.g., PWR module, CPU module and HMI module, cannot be replaced in the whole device. The other modules, including TF (current or voltage transformer) module and IO (input and output) module, can be flexibly configured and then placed in the remained slots. The TF module includes AC current transformer, AC voltage transformer, DC current transformer and etc. The IO (input and output) module includes binary input, tripping output, signal output and etc.

Table 6-1 Module Configuration

No.	ID	Module Description	Remark
1	SR6600	Power supply module (PWR module)	standard
2	SR6295	Device calculation module (CPU module)	standard
3	SR6100/SR6150	Current/voltage transformer module (TF module)	standard
4	SR6330	Binary input module (BI module)	standard
5	SR6302	Binary output module (BO module)	standard
6	SR6364	DC input module (DC module)	standard
7	SR6313	Binary input/output module (IO module)	standard

6.3 Power Supply Module

When placing an order, it is necessary to specify the power supply specifications of the device. Before conducting on-site commissioning, it is important to check whether the external input voltage meets the requirements.

The power supply module provides 2 binary outputs, some dry contacts, which conduct the signal functions showing the operating conditions (device error) or device alarm.

The frame of all the power supply module terminal are shown below.
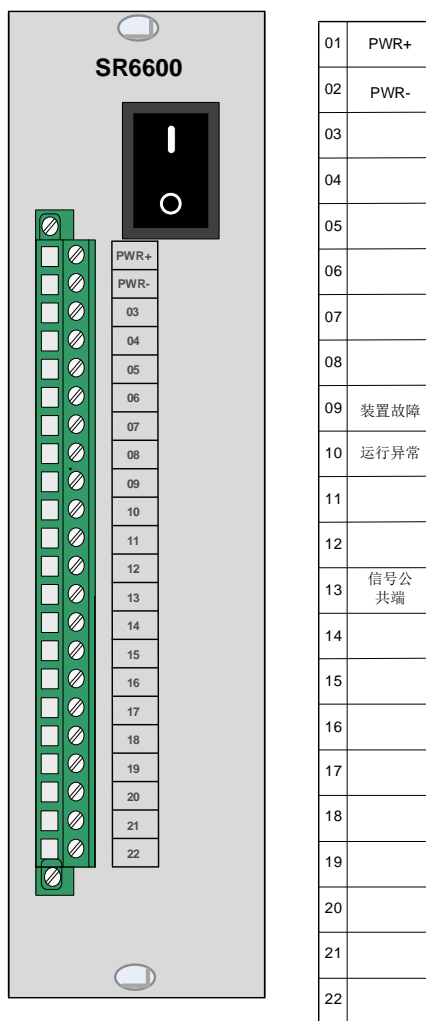
Figure 6.3.1 Frame of the Power Supply Module Terminals

The specific terminal definition of the connector is described as below.

Table 6-2 Terminal Definition and Description of PWR Module

Name	Description
PWR+	Positive input of power supply for the device.
PWR-	Negative input of power supply for the device.
Signal Common	Device output signals common terminal
Device error	Device abnormality alarm normal close terminal
Device alarm	Device alarm normal open terminal

6.4 Main CPU Module

The main CPU module, containing powerful microchip processors and some necessary electronic accessories, is the core part of this relay. This powerful processor executes all the functions of the relay and conduct the commands, including data acquisition, data processing, data communication, display management, time synchronization, and other functionalities.

The main functions of the main CPU module include as below:

- Data Acquisition

  The CPU module is equipped with an A/D conversion chip that converts analog signals from each channel into digital signals. All digital signals are transmitted to the SOC chip for further processing.

  The CPU module is also equipped with a CPLD chip that communicates with the sub-modules to obtain the status of all inputs.

- Data Processing

  The CPU module processes the digital signals from each channel into primary values based on amplification factors. It assigns quality bits based on maintenance status, invalid status, etc.

- Data Communication

  The CPU module can receive GOOSE command signals from protection and BCU, as well as SV sampling signals from the bus merging unit. It can also send input information, alarm information, and analog sampling data to protection and BCU.

- Display Management

  The CPU module features human-machine interaction. Through a remote interface, all device information can be viewed. The panel indicator lights promptly notify any device abnormalities or alarms.

- Time Synchronization

  The CPU module provides an interface for receiving time synchronization signals from an external clock synchronization source. It supports IRIG-B optical signal input. It has a local crystal oscillator that maintains internal time accuracy even in the event of a failure in the external time source. The time accuracy is within ±2ppm, with a drift of not more than 20ms per hour.

6.5 Binary Input Module

The BI module contains 26 binary inputs, the optical isolated input terminals, which can perform different monitoring functions, such as detecting the breaker and switch positions of the corresponding bay. All the BI terminals can be used as general purpose binary inputs or special purpose (protection function or control function) binary inputs. All the BI signals can be sent to the monitoring system through protection or BCU.

The frame of the BI module terminal is described as below.

01	BI01	BI14	02
03	BI02	BI15	04
05	BI03	BI16	06
07	BI04	BI17	08
09	BI05	BI18	10
11	BI06	BI19	12
13	BI07	BI20	14
15	BI08	BI21	16
17	BI09	BI22	18
19	BI10	BI23	20
21	BI11	BI24	22
23	BI12	BI25	24
25	BI13	BI26	26
27	/	/	28
29	/	/	30
31	COM1-	COM2-	32

Figure 6.4.1 Frame of BI Terminal

The specific terminal definition of the connector is described as below.

Table 6-3 Terminal Definition and Description of BI Module

Name	Description
BI01~BI26	Binary input 1~26
COM1-、COM2-	BI signals common terminal

6.6 Binary Output

The BO module consists of binary output, dry contacts, which conduct the signal functions showing the operating conditions or tripping and closing commands (protection, auto-recloser or remote control). The specific function is performed by setting the relevant settings and wiring the external copper cable. All the contacts can independently receive tripping or closing commands from the main CPU module and then conduct these commands.

The output module provides 16 output contacts. The frame of the BO module terminal is described as below.
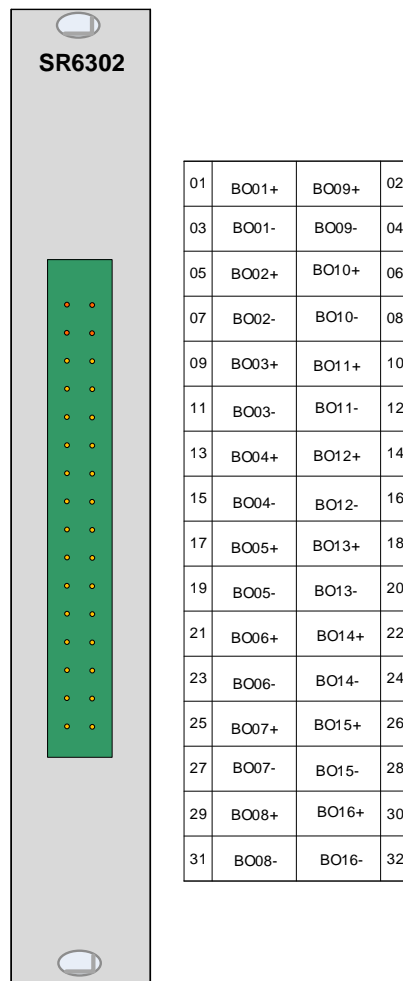
Figure 6.5.1 Frame of BO Terminal

The terminal definition of the BO module is described as below.

Table 6-4 Terminal Definition and Description of BO Module

Name	Description
BO01~BO16	Binary output1~16

6.7 Binary Input/Output Module

The IO module provides 7 binary outputs, also contains 15 binary inputs.

The frame of the IO module terminal is described as below.

SR6313

01	BI01	BO01+	02
03	BI02	BO01-	04
05	BI03	BO02+	06
07	BI04	BO02-	08
09	BI05	BO03+	10
11	BI06	BO03-	12
13	BI07	BO04+	14
15	BI08	BO04-	16
17	BI09	BO05+	18
19	BI10	BO05-	20
21	BI11	BO06+	22
23	BI12	BO06-	24
25	BI13	BO07+	26
27	BI14	BO07-	28
29	BI15	/	30
31	COM-	/	32

Figure 6.6.1 Frame of IO Terminal

The terminal definition of the IO module is described as below.

Table 6-5 Terminal Definition and Description of IO Module

Name	Description
BO01~BO15	Binary input 1~16
COM-	BI signals common terminal
BO01~BO07	Binary output 1~7

6.8 BI/DC Input Module

BI/DC module includes 16 optically isolated binary inputs and 2 DC inputs, DC such as temperature sensor, humidity sensor, etc. The supported interface modes include 0-5V signal or 4-20mA signal.

The terminal definition of the BI/DC module is described as below.

01	DC small signal 1+	DC small signal 1-	02
03	DC small signal 2+	DC small signal 2-	04
05			06
07			08
09	BI01	BI10	10
11	BI02	BI11	12
13	BI03	BI12	14
15	BI04	BI13	16
17	BI05	BI14	18
19	BI06	BI15	20
21	BI07	BI16	22
23	BI08		24
25	BI09		26
27			28
29			30
31	COM1-	COM2-	32
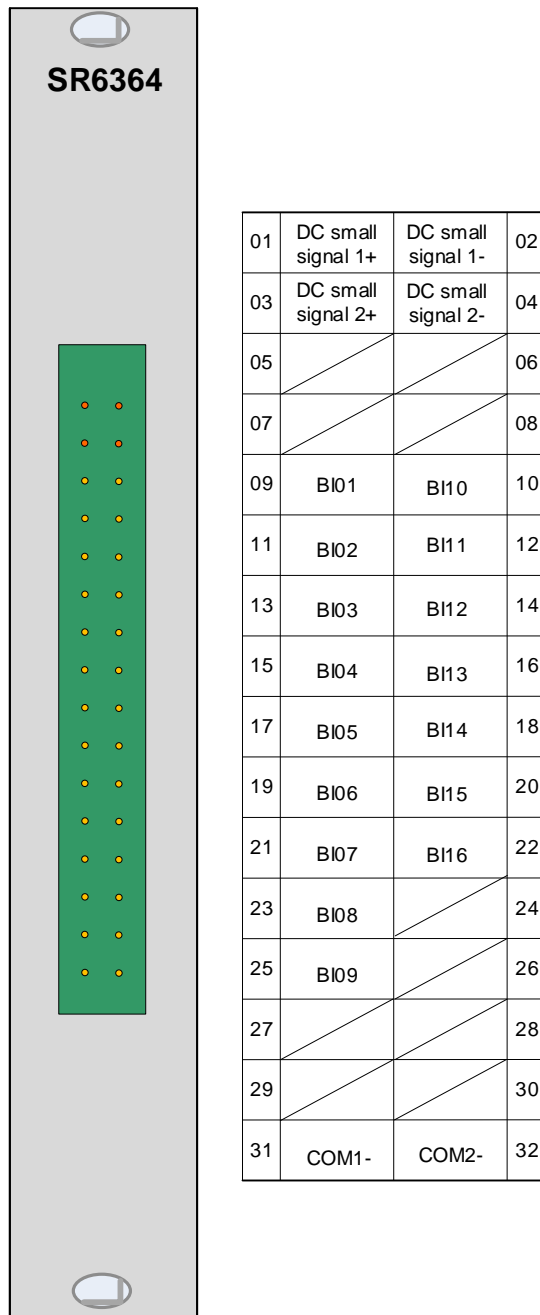
Figure 6.7.1 Frame of BI/DC Terminal

The terminal definition of the BI/DC module is described as below.

Table 6-6 Terminal Definition and Description of BI/DC Module

Name	Description
DC small signal 1+	DC1 channel, supported interface include 0-5V signal or 4-20mA
DC small signal 1-	
DC small signal 2+	DC2 channel, supported interface include 0-5V signal or 4-20mA
DC small signal 2-	
BI01~ BI16	Binary input 1~16
COM1-、COM2、	BI signals common terminals

6.9 Transformer Module

The transformer module can decrease the high input analog values to relevant low output analog values as to the small transformer ratio, acting as an effective isolation between the relay and the power system. The low output analog values, within the range of the AD module after the conversion, are sent to the AD module for further processing. A low pass filter circuit is used to reduce the noise of each analog channel.

The frame of two transformer modules of different specifications are shown below.

● **SR6110**

The SR6110 transformer module consists of 5 current channels and 1 synchronous voltage channels. The terminal definition is described as below.
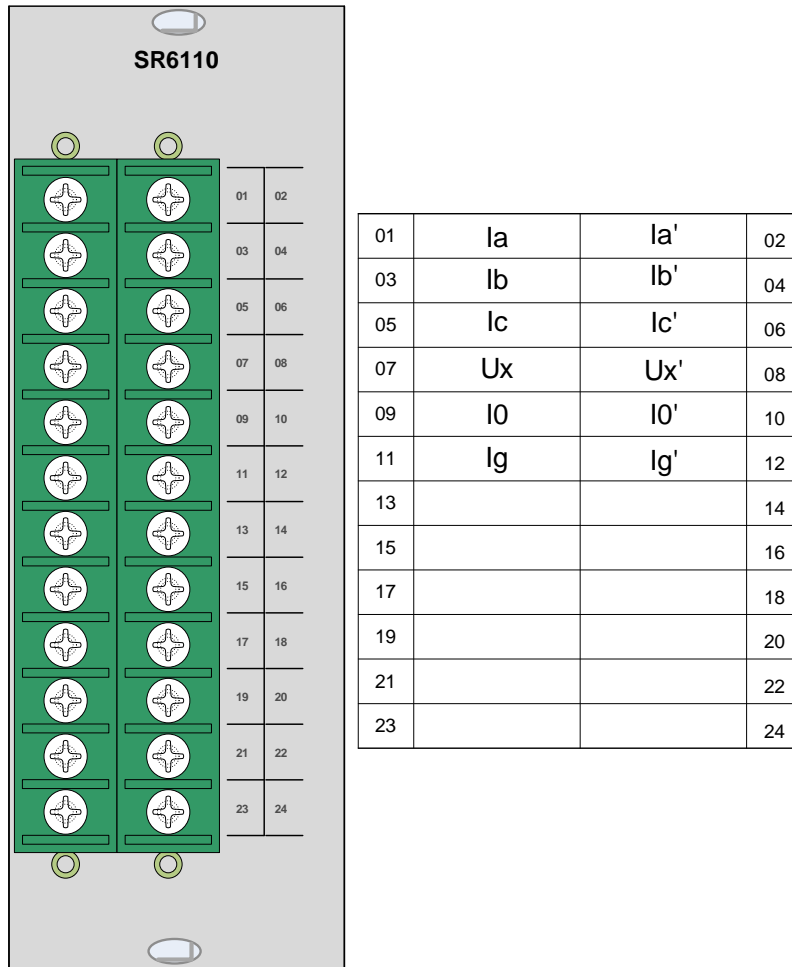
Figure 6.9.1 Frame of SR6110 Terminal

Table 6-7 Terminal Definition and Description of SR6110

Name	Description
Ia	Protection Current Phase A
Ib	Protection Current Phase B
Ic	Protection Current Phase C
Ux	Synchronous voltage
I0	Zero-sequence current
Ig	Gap current

● **SR6150**

The SR6150 transformer module consists of 3 protection voltage channels, 1 zero-sequence voltage, 3 measurement voltage and 3 measurement current channels. The terminal definition is described as below.
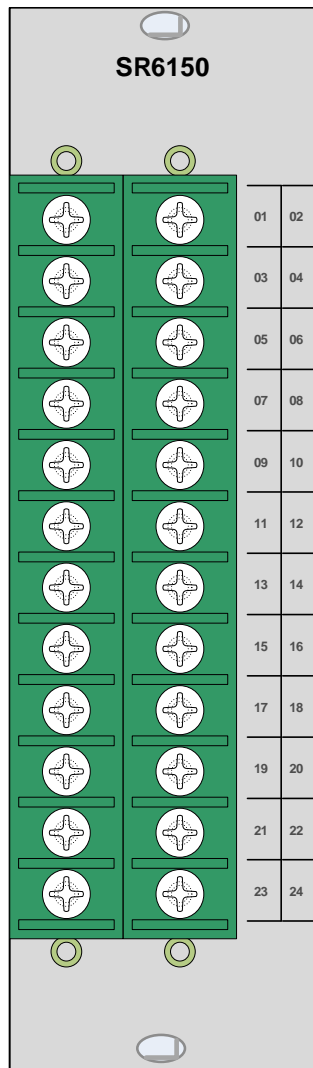
SR6150

01	Ua	Ua'	02
03	Ub	Ub'	04
05	Uc	Uc'	06
07	U0	U0'	08
09	Uam	Uam'	10
11	Ubm	Ubm'	12
13	Ucm	Ucm'	14
15	Iam	Iam'	16
17	Ibm	Ibm'	18
19	Icm	Icm'	20
21			22
23			24

Figure 6.9.2 Frame of SR6150 Terminal

Table 6-8 Terminal Definition and Description of SR6150

Name	Description
Ua	Protection Voltage Phase A
Ub	Protection Voltage Phase B
Uc	Protection Voltage Phase C
U0	Zero-sequence voltage
Uam	Measurement Voltage Phase A
Ubm	Measurement Voltage Phase B
Ucm	Measurement Voltage Phase C
Iam	Measurement current Phase A
Ibm	Measurement current Phase B
Icm	Measurement current Phase C

7 Communication Protocol

7.1 Overview

This chapter introduces the data communication and the corresponding hardware of the IEDs. The IED support a wide range of protocols via communication interface (Ethernet port). The protocols are of international standard for communication in substations and it can be selected by modifying the communication parameters.

Local communication with the IED via a computer is achievable throught both the front and back Ethernet ports. Furthermore, remote communication with SCADA or the station gateway is also achievable by choosing the IEC60870-5-103, IEC61850, DNP3.0 communication protocol via RS485 or Ethernet port.

It should be noted that the descriptions contained within this chapter do not aim to fully detail the protocol itself. This section serves to describe the specific implementation of the protocol in the relay.

7.2 Rear Communication Interface

7.2.1 Ethernet Interface

This protective device can provide rear Ethernet interfaces (optional) and they are unattached each other. Parameters of each Ethernet port can be configured in the menu.

7.2.1.1 Ethernet Standardized Communication Cable

A picture is shown bellow.

Figure 7.2.1 Ethernet communication cable

7.2.1.2 Ethernet Communication protocol

Ethernet communication protocols are supported by the device including: IEC61850 etc. For more details about these communication protocols, see the correlative standards.

7.3 Network Topology

7.3.1 PRP Topology

This network topology is supported by the device.

7.4 IEC61850 Protocol

7.4.1 Overview

The IEC 61850 standard is the result of years of work by electric utilities and vendors of electronic equipment to produce standardized communications systems. IEC 61850 is a series of standards describing client/server and peer-to-peer communications, substation design and configuration, testing, environmental and project standards. The complete set includes:

- IEC 61850-1: Introduction and overview

- IEC 61850-2: Glossary

- IEC 61850-3: General requirements

- IEC 61850-4: System and project management

- IEC 61850-5: Communications and requirements for functions and device models

- IEC 61850-6: Configuration description language for communication in electrical substations related to IEDs

- IEC 61850-7-1: Basic communication structure for substation and feeder equipment– Principles and models

- IEC 61850-7-2: Basic communication structure for substation and feeder equipment - Abstract communication service interface (ACSI)

- IEC 61850-7-3: Basic communication structure for substation and feeder equipment– Common data classes

- IEC 61850-7-4: Basic communication structure for substation and feeder equipment– Compatible logical node classes and data classes

- IEC 61850-8-1: Specific Communication Service Mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3

- IEC 61850-9-1: Specific Communication Service Mapping (SCSM) – Sampled values over serial unidirectional multidrop point to point link

- IEC 61850-9-2: Specific Communication Service Mapping (SCSM) – Sampled values over ISO/IEC 8802-3

- IEC 61850-10: Conformance testing

These documents can be obtained from the IEC (http://www.iec.ch). It is strongly recommended that all those involved with any IEC 61850 implementation obtain this document set.

7.4.2 Communication Profiles

The PRS-7000 series relay supports IEC 61850 server services over TCP/IP communication protocol stacks. The TCP/IP profile requires the PRS-7000 series to have an IP address to establish communications.

7.4.2.1 Peer-to-peer

This is a non-connection-oriented, high speed type of communication usually between substation equipment, such as protection relays, intelligent terminal. GOOSE is the method of peer-to-peer communication.

7.4.2.2 Substation configuration language (SCL)

IEC 61850 has defined a series of configuration documents (ICD, IID, SCD, SED, CID), which are prepared with SCL (substation configuration language). The SCL includes the following:

Head: it is used to identify a SCL configuration document and its version, and also to designate relevant names into the mapping option of information (FuntionName)

Substation: it is used to describe the function structure of the substation, and mark the primary devices and their electrical connection relationship.

IED: intelligent electronic device description, to describe the IED pre-configuration, access points, logic devices, logic nodes, data objects, etc.

DataTypeTemplate: the instantiated logic node type, and logic node type is a specific sample of logic node data.

The purpose to define and use SCL is: the description of intelligent electronic device capability and description of substation automation system can be exchanged in a compatible manner between the intelligent electronic device management tools and system configuration tools provided by different manufacturers.

7.4.2.3 GOOSE

GOOSE service is used to transmit fast messages, such as trip and switch position.

The GOOSE service adopts the pear-to-pear transmission, and is classified as GOOSE sending and GOOSE receiving.

7.4.2.4 GOOSE sending mechanism

GOCB is automatically enabled when the unit is powered on, when all status of the unit are determined, it performs sending according to the data set shifting mode, to quickly send the initial status of the own GOOSE information;

The time interval for immediate re-sending after shift of GOOSE message is the MinTime parameter (i.e. T1); the "timeAllowedtoLive" parameter in GOOSE message is 2 times the "MaxTime" configuration parameter (i.e. 2T0);

7.4.2.5 GOOSE receiving mechanism

The GOOSE receiving buffer zone of the unit receives the new GOOSE messages, after a strict check of the relevant parameters of GOOSE messages, the receiving side first compares if the StNum (status number) of the newly received frame and that in the GOOSE message of the

previous frame are equal. If the StNum of the two frames of GOOSE messages are equal, the SqNum (sequence number) of the two frames of GOOSE messages are compared, if the SqNum of the newly received GOOSE frame is bigger than the SqNum of the previous frame, this GOOSE message is discarded, otherwise the data of the receiving side is updated. If the two GOOSE messages have different StNum, the data of the receiving side are updated;

When receiving GOOSE messages, the PRS-7000 series unit strictly checks if parameters such as AppID, GOID, GOCBRef, DataSet and ConfRev are matching;

In receiving GOOSE messages, it will take into account cases of communication interruption of fault with issuing unit, when the GOOSE communication is interrupted or the configured versions are not identical, the received GOOSE message should maintain the status before interruption.

7.4.3 Data set and control block

PRS-7000 series devices support real-time sending of data. The data objects requiring real-time monitoring are configured into data set, and the data set are associated to report control and GoCB, so that the change information of monitored objects can be sent in real-time to the background via the report service and GOOSE.

7.4.3.1 Data set

PRS-7000 series devices usually configure data sets in advance in the ICD document, such as protection event, protection digital input and protection measurement. The SCT (system configuration tool) can also add, delete and modify data set configuration according to the needs of existing actual projects.

A data set is an ObjectReference set of orderly DATA or DataAttrubutes. It usually include the following attributes:

- ldInst: the logic device containing the DATA or DataAttrubutes;
- lnClass: the logic node class containing the DATA or DataAttrubutes;
- lnInst: the logic node instant number containing the DATA or DataAttrubutes;
- Fc: all attributes of functional constraint required by DATA or DataAttrubutes;
- doName: name of DATA, or name belonging to the DataAttrubutes;
- daName: attribute name.

7.4.3.2 Report control block

IEC 61850 has defined the report control block, to describe how the changed information is actively submitted via report service when the data set members have changed. Report control blocks are classified into buffered report control block and non-buffered report control block. In case of communication interruption, the newly occurring event will still be stored as buffered report control block, otherwise, it is a non-buffered report control block.

The report control block performs the control of report submission via a series of attribute configurations. Specifically, it has the following important attributes:

RptID

The identity of report control block, globally unique within the scope of LD, if the RptID of the RCB is set by the client side as NULL, in the report submitted by device, RptID is full path.

OptFlds

The option fields OptFlds contained in the report. The PRS-7000 series device supports the following option fields:

- Bit 1: Sequence-number
- Bit 2: Report-time-stamp
- Bit 3: Reason-for-inclusion
- Bit 4: Data-set-name
- Bit 5: Data-reference
- Bit 7: EntryID (for buffered reports only)
- Bit 8: Conf-revision

- Bit 9: Segmentation

When an item is set as 1, the corresponding information will be embodied in the report.

DatSet

The name of the data set associated with the report control block and under the same LD. The members of this data set are monitored by this report control block.

BufTm

Buffer time, it is the buffer time internally prompted by the dchg (data change), qchg (quality change), and dupd (data updating) of the rcb, in ms, with missing value as 0, indicating not using the buffer time attribute, and the maximum value is 1h.

The timer is started when the first internal prompt arrives, after it is reached in timer, all event messages within the buffer time are packed into one report, and submitted to the client side.

When the second change of the same signal arrives in the buffer time, the buffered report is submitted immediately, and the timer is booted again, to start again the subsequent internal prompt buffer.

TrgOps

Trigger option, used to filter the conditions for sending reports. PRS-7000 supports the following trigger options:

- *Bit 1:* Data change

- Bit 2: Quality change

- Bit 3: Data updating (the service follow-up of Ed2)

- Bit 4: Completeness period

- Bit 5: Total call

IntgPd

Completeness period time, to be set by the client side. After successful device enabling (RptEna = TRUE), the timer is started immediately, and after the expiration of completeness period time, the current values of all members in the data set associated by the report are packed and submitted.

The completeness period time set as 0 means the completeness submission function is not enabled.

GI

Total call is launched by the client side with initiative. After the report is enabled, the client side takes initiative to issue GI = TRUE, then the device immediately submit all data values in the current data set.

PurgeBuf

Purge buffer. When the client side sets PurgeBuf = TRUE, all report entries in the IED buffer report are purged.

When the client side modifies RptID, DataSet, BufTime, TrgOps, IntgPd, the device will automatically set purging buffer reports, equivalent to setting PurgeBuf = TRUE.

7.4.3.3 GOOSE control block

The fast messages of the PRS-7000 series device is transmitted via GOOSE, and the transmission characteristics of GOOSE is controlled by the GOOSE control block (GoCB). GoCB has the following important characteristics:

App ID

The application ID, representing the logic device where the GoCB is located. The missing value of App ID is the Object Reference of GoCB.

DatSet

The values of members of the data set associated by GoCB are transmitted by GOOSE.

7.4.4 Logic nodes and data modeling

7.4.4.1 Logic nodes

IEC 61850 7-4 has defined a series of logic nodes, which constitute the minimum communication unit of intelligent electronic devices as classified by functions. There are three types of logic nodes used by the PRS-7000 series unit: management logic nodes (LLN0), physical device logic nodes (LPHD) and application function logic nodes.

LLN0

Management logic nodes provide the management and control functions for all logic nodes and data objects within the logic devices. Some common services are modeled in LLN0, such as setting group control block (SGCB), GOOSE control block (GoCB), SV control block (MsvCB), reported control block (BRCB and URCB) and log control block (LCB); some common data objects are modeled in this node, such as Loc, to represent the local and remote operation enabling of the unit, and the based function VEBI and common settings; some data objects represent the meaning of

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the whole logic device, such as Beh, it is jointly formed by the Beh value of all logic nodes in the logic device, to represent the behavior and status of the whole logic device.

LPHD

It represents the information of physical devices, including the device manufacturer, unit model, software version, unit serial No., if it has an agency and the device health status. In this logic node, it is also extended to include device information such as name of protected device and unit time calibration method.

Application function logic nodes

Application function logic nodes include when classified by functions:

A: automatic control logic nodes

C: monitoring related logic nodes, such as CSWI

G: general purpose function logic nodes, such as GGIO, GAPC

I: filing related logic nodes,

M: measurement and metering related logic nodes, such as MMXU

P: protection function logic nodes, such as PDIF, PDIS, PTOC, PTRC

R: protection related functional logic nodes, such as RREC, RBRF

S: sensors, monitoring

T: instrument transducer logic nodes, such as TVTR, TCTR

X: switching device logic nodes, such as XCBR, XSWI

Y: power transformer and related function logic nodes

PRS-7000 series unit uses the corresponding logic nodes according to the functions selected by user. For the corresponding logic nodes, please refer to the instruction manual for unit of the specific model.

7.4.4.2 Data object

IEC 61850 7-3 defined common data types, including:

➢ Status information: such as SPS, INS, ACT, ACD

➢ Measured value information: such as MV, CMV, WYE

➢ Controllable status information: such as SPC, INC, DPC

➢ Status set values: such as SPG, ING

➢ Analog set values: such as ASG

➢ Description information: such as LPL, DPL

The PRS-7000 series unit uses the above common data types, and instantiate the specific data objects according to the need of application functions, to meet the need of application functions. There are the following common data objects in all logic nodes (except for LPHD):

Mod

The model of logic node. It represents the behavior mode of the logic node, such as normal, testing and blocked.

Beh

The performance of the logic node, representing the current performance status of the logic node, the value of the same Mod is read-only and cannot be modified.

Health

Health status, it reflects the status of the relevant software and hardware of the logic node.

NamPlt

The name plate of the logic node

8 Commissioning

8.1 General

This part contains a brief description about how to verify the function, including functional verification items, functional verification methods and more.

With high degree of self-checking, any fault with the internal hardware and software can be diagnosed by the device itself. So for the commissioning, only hardware interface and the application-specific software function are necessary to verify.

Before carrying out commissioning, users should pay close attention to the safety, technical data and the ratings on the front panel label.

8.2 Safety Instructions

This section contains some safety information, some of which are given warning signs to avoid personal injury or equipment damage, to prompt the user to be careful.

8.2.1 Safety Identification

Electrical warning icon indicating a danger of electric shock.

Notice icon, indicating important information or warnings involved in the article. This icon may indicate a danger of software, equipment or property damage.

Information icons alert readers to important facts or conditions.

Prompt staff not to forget the dangers of static electricity and make prevention.

Forbid to energize the device while not grounded, to avoid endangering the personal safety due to electrical insulation damage!

Although these markings warn of the danger, it is important to note that operating damaged equipment under certain operating conditions can result in reduced process performance and may result in death or personal injury. Therefore, be sure to fully comply with all warnings and cautions.

8.2.2 Safety Identification Examples

For the various safety instructions given in the previous section, the following are examples

8.2.2.1 Warning Signs

Do not touch the circuit during operation. There may be fatal voltage and current.

Strict compliance with safety regulations. Work in high voltage environment need to be serious to avoid personal injury or equipment damage.

When measuring signals in an open circuit, remember to use a properly isolated test clamp that can have fatal voltages and currents.

During normal operation, never disconnect or connect the wires or connectors connected with the terminals. It may cause deadly dangerous voltage and current, may also interrupt the operation of the equipment, damage the terminals and the measuring circuit.

Never disconnect the secondary winding of the current transformer. Current transformers that operate when the secondary windings are open will create strong potentials that may damage the transformers and may cause personal injury.

When the device is energized, never plug the module. Hot plug may damage the device and measuring circuit, may also result in injury.

8.2.2.2 Caution Signs

Do not connect the protective shell to the live wire, charging the shell may damage the internal circuit.

During installation and commissioning, be careful not to get an electric shock if you touch the leads and connecting terminals

8.2.2.3 Notice Signs

Do not modify the settings in the running device. After modify the setting, verify it according to the rules.

8.2.2.4 Anti-static Signs

Remember to avoid touching circuits, including electronic circuits, and the device may be damaged if subjected to static electricity. Electronic circuits may also contain deadly high voltages.

Remember to use a certified conductive bag when transporting the module. Remember to connect the anti-static wristband to the ground when handling the module and remember to operate it on a suitable anti-static surface. Static electricity discharge may cause damage to the module.

Remember to wear the anti-static wristband connected to the ground when replace the module, Static electricity discharge may damage the module and device.

8.2.2.5 Earthing Signs

Regardless of operating conditions, remember to connect the device to the earth, also needed for special occasions such as testing, demonstrating and off-line configuration on the desk. Operation of the device without proper earthing may damage the device and the measuring circuit and may also cause an injuring accident.

8.3 Commission Tools

8.3.1 Instrumentation and Meters Notice:

- Instruments, meters must pass the inspection, and within the validity of the inspection

- instruments, meters should be accurate level higher than the seized equipment related indicators 2 to 4 levels.

8.3.2 Tools Requirement:

- Relay protection testing devices: Multifunctional dynamic current and voltage injection test set with interval timer.

- Regulative DC power: DC output can be adjustable within 0 ~ 240V.

- Accuracy meter: support three-phase voltage, three-phase current output.

- Tong-type ammeter

- Multifunction phase meter

- Multimeter

- Megger

- Laptop: with appropriate software

- Network cable

- Optical power meter

8.4 Commission Preparation

8.4.1 Basic Knowledge

When commissioning this device for the first time, sufficient time should be allowed to become familiar with the manual to understand the basic operation, protection principles, and related basic performance of the devices as much as possible. If find any doubt in the process, consult the manufacturer's field service personnel or technical support staff of our company.

If the application-specific settings have been applied to the relay prior to commissioning, it is advisable to make a copy of the settings so as to allow them restoration later. This could be done by extracting the settings from the relay itself via printer or manually creating a setting record.

8.4.2 Operation Preparation

⚠ Attention! The device should be checked before power on. The appearance should be no damage. The module is plugged and fastened, and the insulation of the DC voltage circuit meets the specified requirements. The indicators can refer to the commissioning record of the device.

⚠ Attention! Disconnect the external AC circuit of the cubicle   before the test to avoid causing a safety accident, which will cause serious damage to the construction workers on site.

⚠ Attention! When you need to plug and unplug the device module, you should ensure the device is powered off and make the anti-static measures to prevent the module damage or performance degradation.

⚠ Attention! Temporarily open or shorted terminals should be well documented for reliable recovery after the end of the test.

If it has been necessary to disconnect any of the external wiring from the device in order to perform any of the following tests, it should be ensured that all connections are replaced in accordance with the relevant external connection or scheme diagram. Confirm current and voltage transformer wiring.

8.5 Product Checks

These product checks cover all aspects of the relay which should be checked to ensure that it has not been physically damaged prior to commissioning, is functioning correctly and all input quantity measurements are within the stated tolerances.

8.5.1 Document Check

Document acceptance check include: device inspection and factory test reports, certificates, drawings, technical manual of related equipment.

8.5.2 Appearance Inspection

Check the the front and back of the cubicle of various electrical components, terminal blocks, hard-switch. All should be marked with the number, name, application and operating position. The marked handwriting should be clear, neat, and not easy to bleach.

The device mark inspection shall include the product type, name, manufacturer's name and trademark, date of manufacture and serial number, safety mark, etc., the mark and installation location shall be consistent with the design drawings.

Inspect the surface of the device. There shall not be scratches, bumps, groove marks, rust, deformation and other defects that affect the quality and appearance;

Check the device panel keyboard is complete, flexible operation, the LCD is clear, the indicator shows normal;

Uncharged metal part of the device should be connected as one, and reliable grounding;

Check the cubicle shell of the device must be grounded reliably;

8.5.3 Insulation Check

Disconnect the weak electric link with other devices and short circuit the AC voltage circuit terminal, AC current circuit terminal, DC circuit terminal and signal circuit terminal inside the cubicle terminal block, and measure the insulation resistance value using the tester whose open circuit voltage is 500V. Insulation should meet the following requirements:

Device independent circuit and exposed conductive parts, 500V megger insulation resistance measured value should be no less than 100MΩ;

Between electrically disconnected independent circuits, 500V megger insulation resistance measured value should be no less than 100MΩ;

After the insulation test is completed, make sure that all external wiring is properly connected.

8.5.4 External Wiring Check

External protection wiring should be consistent with the design drawings; Internal and external wiring on the terminal block and cable marking on it is correct, complete, and consistent with the drawings; Secondary circuit wiring should be neat and beautiful, solid and reliable;

All secondary cables and terminal blocks wiring connection should be solid. Cable mark should be complete, correct and clear;

The correct mark should be attached to the optical fiber (including optical cable, pigtail, jumper) and both ends of the device port. Such fiber-optic annotation should include the optical fiber number, destination. The starting point of the fiber should indicate the cubicle   number. The content of the port mark should include the port number and destination. The starting point of the port should include the cubicle   number, switch number and port number.

8.5.5 Test Category

The following tests are necessary to ensure the normal operation of the equipment before it is first put into service.

These tests are performed for the following hardware to ensure that there is no hardware defect. Defects of hardware circuits other than the following can be detected by self-monitoring when the power supply is energized.

- User interfaces test

- Binary input circuits and output circuits test

- AC input circuits test

- Function tests

These tests are performed for the following functions that are fully software-based.

- Measuring elements test

- Timers test

- Metering and recording test

- Conjunctive tests

The tests are performed after the relay is connected with the primary equipment and other external equipment.

- On load test.

- Phase sequence check and polarity check.

8.6 With the Relay Energized

Check that the input range of the external power supply should meet the power requirements of the "technical data" section within the permissible power supply input voltage range.

⚠️ Attention! All external circuits connected to the unit must be checked to ensure correct installation before the unit is powered on or the test procedure started.

8.6.1 Date and Time

If the time and date is not being maintained by substation automation system, the date and time should be set manually.

Set the date and time to the correct local time and date using menu item "Clock".

For devices using IRIG-B (DC) time code and SNTP, IEEE 1588 time synchronization, you can verify the timing accuracy by modifying the clock setting of the device. For PPM, PPS time synchronization system, through the time synchronization binary input check.

8.6.2 Light Emitting Diodes (LEDs)

The device has two lights that can not be defined. the two lights are as follows:

"Healthy": indicates that the device is in normal operation, no software, hardware failure. When the "healthy" light goes out, it indicates a serious problem with the device, resulting in the device not functioning properly.

"Alarm": indicates that there are some alarm events on the device. On this condition, you can analyze the cause of the alarm and how to handle it by checking the "supervision" section of the manual.

The rest of the indicators are configurable indicators.

If the indicator of the device is set to the self-retaining state, if the signal is not reset before the latest power-off, the signal will continue to be triggered when the device is powered on again, and the indicator can be reset by resetting operation. It is likely that alarms related to voltage transformer supervision will not reset at this stage.

8.6.2.1 Test the HEALTHY and ALARM LEDs

Apply the rated power supply and check that the "HEALTHY" LED is lighting in green. We need to emphasize that the "HEALTHY" LED is always lighting in operation course except that this device finds serious errors in it.

Produce one of the abnormal conditions listed in Chapter 4, the "ALARM" LED will light in yellow. When abnormal condition reset, the "ALARM" LED extinguishes.

8.6.2.2 Test the Other LEDs

Test the other LEDs according to the configuration of the LEDs (through the PRS IED Studio software). If the conditions which can turn on the selected LED are satisfied, the selected LED will

be on.

8.6.3 Test the AC Current Circuit

⚠ Attention! The wiring must be checked in strict accordance with the AC current connection drawings provided.

The purpose of this test is to check whether the wiring of the AC circuit in the cubicle   is correct and whether the sampling precision meets the requirements. The sampling accuracy and polarity of the device can be checked through sourcing rated AC current at the AC current input terminal on the back of the cubicle .

Protection current measurement accuracy requirement shall be no higher than 2.5%. Measuring current measurement accuracy requirement shall be no higher than 1%.However an additional allowance must be made for the accuracy of the test equipment being used.

Apply current equal to the current transformer secondary winding rating to each currenttransformer input in turn, see the following table, checking the magnitude using a multimeter/test set readout. The corresponding reading can then be checked in the relays menu.

Table 8.6-1 Current channel checkout

Group No.	Item	Input Value	Input Angle	Display Value	Display Angle
Three-phase current 1	Ia				
	Ib				
	Ic				
Three-phase current 2	Ia				
	Ib				
	Ic				
Three-phase current …	Ia				
	Ib				
	Ic				
Residual current 1	3I0				
Residual current 2	3I0				
Residual current …	3I0				

8.6.4 Test the AC Voltage Inputs

⚠ Attention! The wiring must be checked in strict accordance with the AC voltage connection drawings provided.

The purpose of this test is to check whether the wiring of the AC voltage in the cubicle   is correct and whether the sampling precision meets the requirements. The sampling accuracy and polarity of the device can be checked through sourcing rated AC voltage at the AC voltage input terminal on the back of the cubicle .

Protection voltage measurement accuracy requirement shall be no higher than 1.5%. Measuring voltage measurement accuracy requirement shall be no higher than 0.25%However an additional allowance must be made for the accuracy of the test equipment being used.

Apply voltage equal to the voltage transformer secondary winding rating to each voltagetransformer input in turn, see the following table, checking the magnitude using a multimeter/test set readout. The corresponding reading can then be checked in the relays menu.

Table 8.6-2 Voltage channel checkout

Group No.	Item	Input Value	Input Angle	Display Value	Display Angle
Three-phase voltage 1	Ua				
	Ub				
	Uc				
Three-phase voltage 2	Ua				
	Ub				
	Uc				
Three-phase voltage …	Ua				
	Ub				
	Uc				
Residual voltage 1	3U0				
Residual voltage 2	3U0				
Residual voltage …	3U0				

8.6.5 Test the Binary Inputs

The purpose of this test is to check whether the connection of binary input circuit is correct. During the test, the voltage applied to the binary input terminal must be within the allowable operating range.

Each binary input status can be checked by the device LCD panel, and the status "1" indicates that the binary input has been applied with an input voltage, and the opening status becomes "0" when the input voltage disappears.

Table 8.6-3 Binary inputs checkout

Teminal N0.	Signal Name	States on LCD	Correct?

8.6.6 Test the Binary Onputs

The purpose of this test is to check whether the binary output circuit connection is correct. According to the logic of the device and various kinds of signal output logic, stimulate a fault condition. The corresponding relay contact of the device shall be operated with the corresponding action or alarm signal.

8.6.7 Function Checks

The purpose of this experiment is to verify the correctness of the logic.

For details on how to implement the logic function, refer to "Operation Theory"

8.6.8 On-load Checks

The objectives of the on-load checks are:

- Confirm the external wiring to the current and voltage inputs is correct.

- Measure the magnitude of on-load current and voltage (if applicable).

- Check the polarity of each current transformer.

8.6.9 Final Checks

After the above tests are completed, remove all test or temporary shorting leads, etc. Restore the original correct wiring. Tighten the secondary circuit terminals, especially for the current terminals, circuit breaker closing and opening, operating power supply circuit.

Ensure that all records have been cleared and LED's has been reset before leaving the device.

Ensure that the device has been restored to service.

9 Installation

9.1 General

Design and installation chapter is suit for design, installation, commissioning and maintenance staff. Designers must have a wealth of experience in electrical design. The installer must have the basic knowledge of electronic equipment and cubicle drawing reading. Commissioning and maintenance personnel must have extensive experience in operating equipment and test equipment.The equipment must be shipped, stored and installed with the greatest care.

Choose the place of installation such that the communication interface and the controls on the front of the device are easily accessible.

Air must circulate freely around the equipment. Observe all the requirements regarding place of installation and ambient conditions given in this instruction manual.

Take care that the external wiring is properly brought into the equipment and terminated correctly and pay special attention to grounding. Strictly observe the corresponding guidelines contained in this section.

9.2 Safety Instructions

⚠️ Warning! Only insert or withdraw a module while the device power supply is switched off. To this end, disconnect the power supply cable that connects with the power supply module.

⚠️ Attention! A module can only be inserted in the reserved slot. Components can be damaged or destroyed by inserting module in a wrong slot.

The basic precautions to guard against electrostatic discharge are as follows:

● Should boards have to be removed from this relay installed in a grounded cubicle in an HV switchgear installation, please discharge yourself by touching station ground (the cubicle) beforehand.

● Only hold electronic boards at the edges, taking care not to touch the components.

● Only works on boards that have been removed from the cubicle on a workbench designed for electronic equipment and wear a grounded wristband.

● Always store and ship the electronic boards in their original packing. Place electronic parts in electrostatic screened packing materials.

9.3 Checking the Shipment

Vehicles, trains, ships and all other means of transport are available, but to prevent snow and rain, shock, impact and collision, to ensure product packaging integrity.

Check that the consignment is complete immediately upon receipt. Notify the nearest CYG SUNRI CO., LTD. Company or agent, should departures from the delivery note, the shipping papers or the order be found.

Visually inspect all the material when unpacking it. When there is evidence of transport damage, lodge a claim immediately in writing with the last carrier and notify the nearest CYG SUNRI CO., LTD.Company or agent.

➢ **Unpacking and checking procedures**

1. Remove the shipping package.

2. Before unpacking, you should first check the equipment packaging intact, whether there are signs of serious collision and phenomenons that equipment in the box may be damaged. If found abnormal, it is recommended to take pictures as a record, confirm and contact with the manufacturer at first time.

3. When unpacking, you should use a claw, and pull out the nails, and then pry off the box lid; If the crowbar is used, never take the device as a fulcrum, and it is forbidden to stick into the wooden box carelessly with the crowbar. Open the box with the greatest care and avoid excessive vibration.

4. Check the appearance of the device is intact.

5. Check the delivery list. Check the device certificate of competency, supporting documents, attachments, spare parts, etc. are consistent with the order requirements, whether the packing list and the type, name, quantity, etc. are consistent and complete. If correct, sign the confirmation.

6. Manufacturer documents and spare parts should be assigned to personal keeping and registration.

7. If any abnormalities occur during unpacking, feedback CYG SUNRI CO., LTD. Company or agent at the first time, so as to avoid the follow-up of unclear responsibilities.

If the equipment is not going to be installed and commissioned immediately, store all the parts in their original packing in a clean dry place and keep air circulation. And to prevent the intrusion of various harmful gases, non-corrosive items stored in the same place.

9.4 Material and Tools Required

The necessary mounting kits will be provided, including screws, pincers and assembly instructions.

A suitable drill and spanners are required to secure the cubicles to the floor using the plugs provided (if this relay is mounted in cubicles).

9.5 Device Location and Ambient Conditions

The mechanical and electrical environmental conditions at the installation site must comply with the requirements of "Chapter 2 Technical Data". Avoid adverse conditions caused by the environment:

- Avoid installing in wet, dark and other places likely to cause damp and rust. If in unavoidable rainy area, install the device in a higher position;

- If the area is an earthquake prone area, fix the protection device tightly;

- If there is a lot of dust in the installation place, clean it before installing.

The place of installation should permit easy access especially to front of the device, i.e. to the human machine interface of the equipment. There should also be free access at the rear of the equipment for additions and replacement of electronic boards.
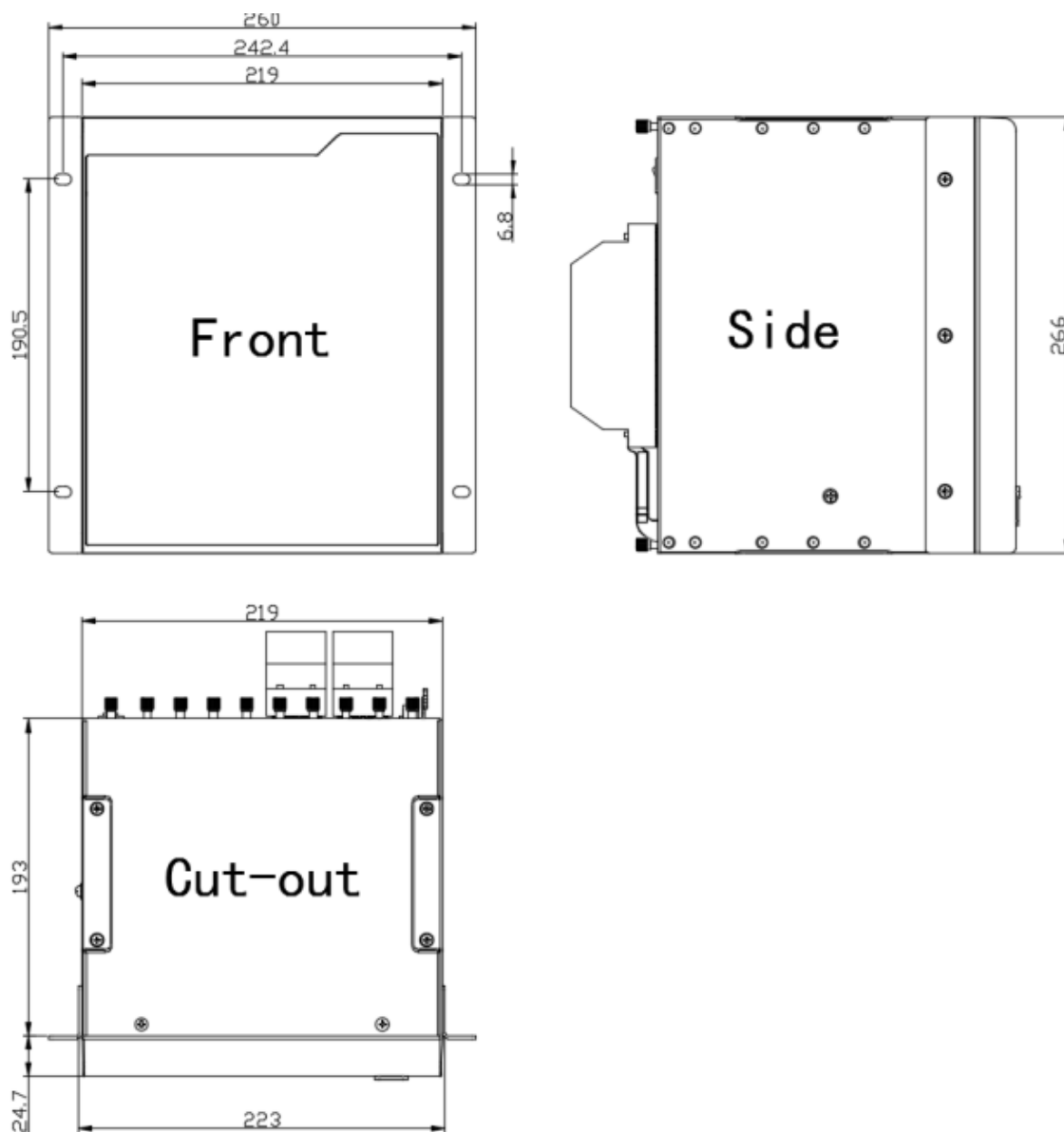
9.6 Mechanical Installation

In the case of equipment supplied in cubicles, place the cubicles on the foundations that have been prepared. Take care while doing so not to jam or otherwise damage any of the cables that have already been installed. Secure the cubicles to the foundations.

The device should be firmly fixed in the cubicle(cabinet), and the connecting screws should be tightened. The grounding wire of each device should be connected with the copper grounding busbar inside the cubicle, and reliably connected with the secondary grounding network. Device wiring should be consistent with the wiring diagram requirements.

The device features a 6U height, 1/1 19 "or 1/2 19" width chassis, integral panel and pluggable functional modules with lock. The device is designed conforming to IEC 60297-3. Embedded Installation as a whole, rear wiring. The current/ voltage connector structure are in the same size, and can be expanded, combined flexibly. Installation hole size as below.

⚠ Attention! It is necessary to leave enough space top and bottom of the cut-out in the cubicle for heat emission of this relay.
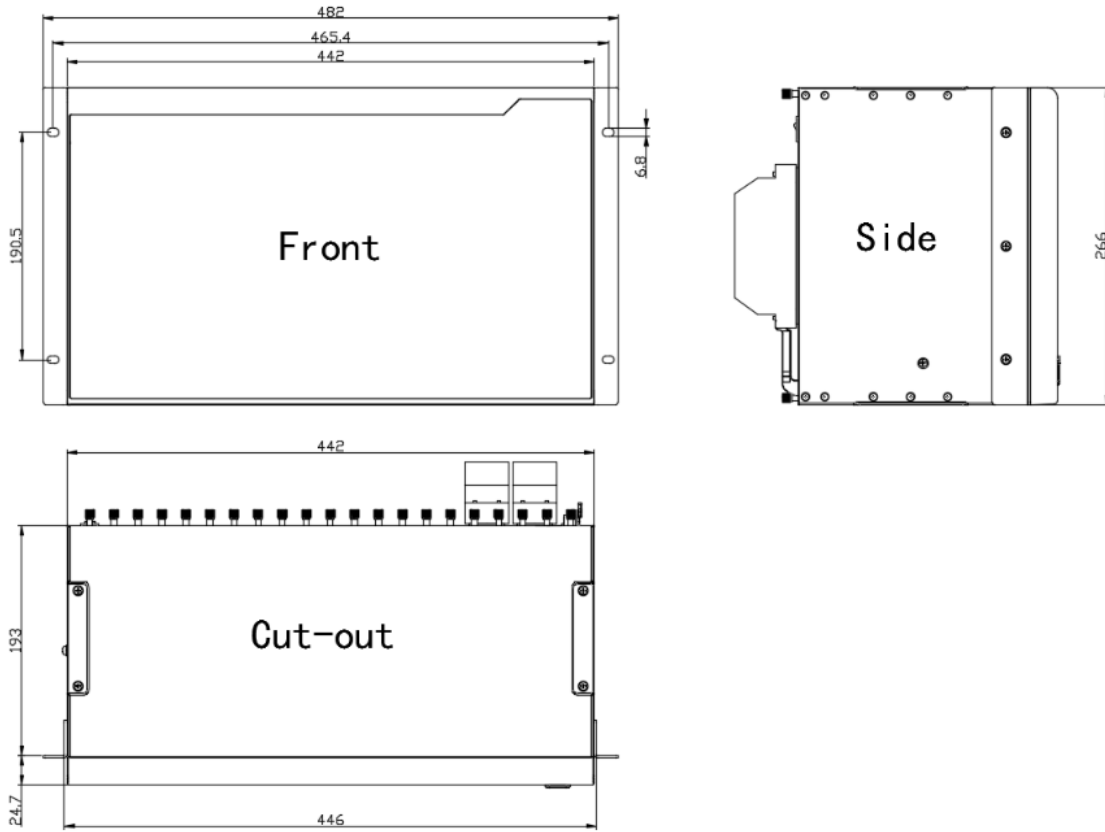
Figure 9.6.1 Dimensions of this relay and the cut-out in the cubicle (unit: mm)

9.7 Electrical Installation and Wiring

9.7.1 TA Circuit Connection

According to the wiring diagram of the device, connect the terminal block of rear AC module with the CT loop using multiple wires, of which the cross-sectional area should be 2.5 ~ 4.0mm^2.

9.7.2 Power Supply, TV, BI and BO, Signal Wiring

According to the wiring diagram of the device, connect the AC, Phoenix terminal of module and the terminal block in the cubicle side with multiple wires.

DC voltage power supply wiring power +, power - should be distinguish in different colors, for example power + (brown), power - (blue).

Power supply, binary inputs & outputs: stranded conductor, 1.0mm^2 ~ 2.5mm^2.

AC voltage inputs: stranded conductor, 1.5mm^2.

Grounding: braided copper cable, 2.5mm^2 ~ 6.0mm^2.

⚠️ For wires connected to two points, there should be no joint in the middle, and the wire core should not be damaged. If the wire length is not enough during the process of wiring or rewiring, the worker must replace it. There should be no excess wire in the slot. If it is required to remove the wire, the whole wire must be completely removed.

⚠️ When wiring the AC terminal of module, current and voltage wires must adopt 12mm size cable lug, to avoid loose contact. Strictly prohibit electric screwdriver, so as to avoid terminals damage.

⚠️ Attention! Never allow the current transformer (CT) secondary circuit connected to this equipment to be opened while the primary system is live. Opening the CT circuit will produce a dangerously high voltage.

9.7.3 Grounding

Use a yellow-green multi-core cable with a cross-section of at least 2.5 mm^2 to connect the grounded copper bars. The cubicle should reliably connected to the secondary ground network.

9.7.4 Shielded cable connection

When using a shielded cable, connect the shielded cable to ground and follow the engineering application method. This includes checking of the appropriate grounding point near the device, such as the grounding point inside the cubicle and the grounding point near the measurement source. Ensure a single shield connection a suitable short cross-sectional wire (maximum 10CM) for ground connection.
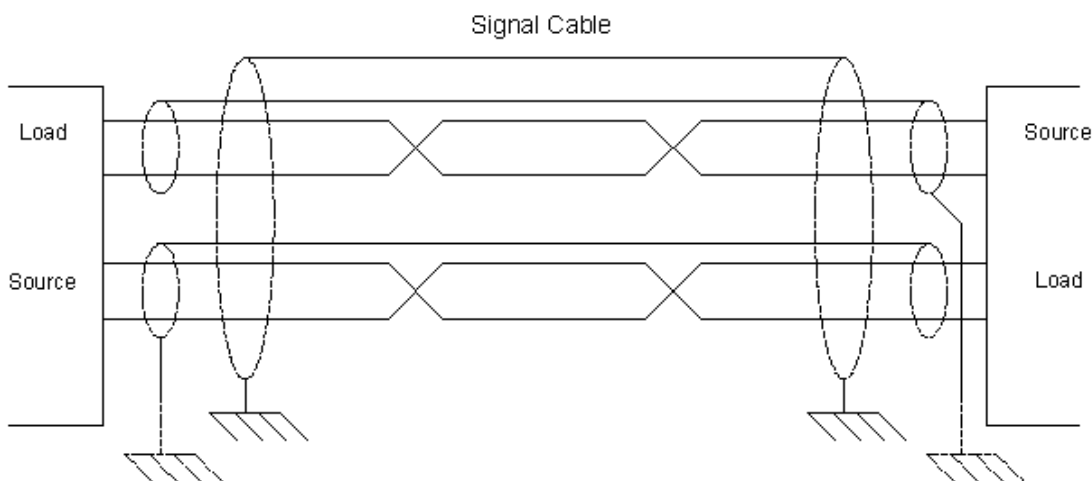
9.7.5 Install the optical cable

Care should be taken to handle the cable without substantial bending. The minimum curvature radius of the plastic optical fiber is 15 cm and the glass optical fiber is 25 cm. To use the cable clamp, a loose buffer sleeve should be used.

⚠️ When connecting or removing the optical fiber, please take hold of the connection ends. Do not take the cable. Do not twist, stretch, bend the cable. Invisible damage can increase the attenuation of the fiber and can destroy the communication.

9.7.6 Install the communication cable

When using electrical connections between the protection device and the communication device, or point-to-point electrical connections between the two protection devices, it is important to install the cables carefully. Due to the low electrical level of communication signals, the factors susceptible

to noise interference must be considered.

The best way is to use shielded twisted pair(STP), one for each twisted pair and the other for the all twisted pairs for surround shielding. Each signal uses the twisted pair shown in the following figure to shield each individual twisted-pair cable by connecting its internal shielded cable to the device's ground connection or, alternatively, to a device near the signal transmitter Connected, at the receiving end, shielded line let it hang in the air, not connected with the ground. The outer shield surrounding all twisted pairs is physically connected near each end of the equipment.
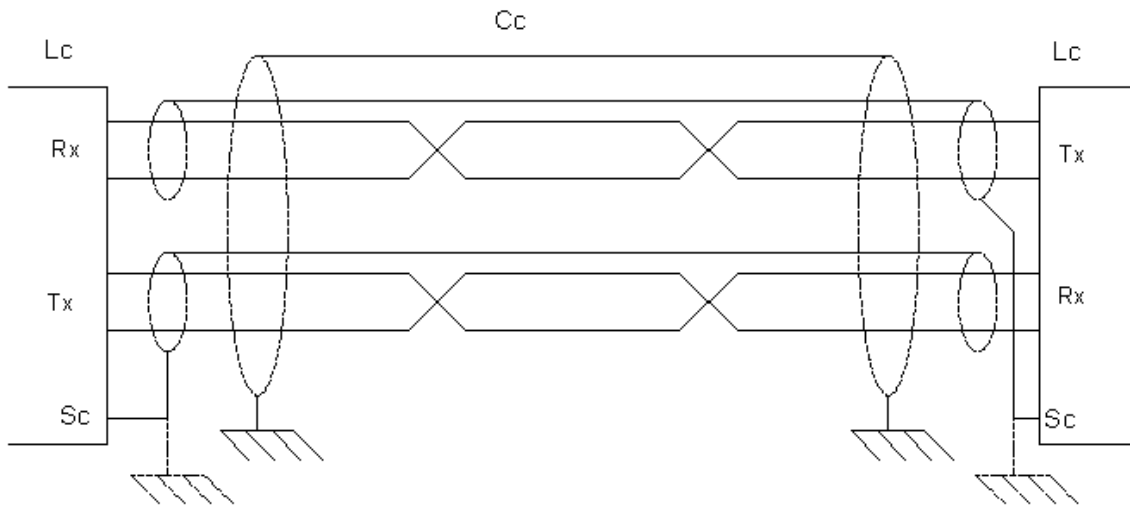
Cc: communication cable

Lc: line connector

Rx: receive signal input

Tx: transmit signal output

Sc: shielded (grounding) connection

9.8 Installation check

9.8.1 Check the installation

Check that all terminal screws with external wiring are tightened, the wiring is neat, and all wiring labels are clearly defined.

9.8.2 Confirm the hardware and software version

Hardware and software version information is available on the device label. After the device is powered on, the software version can also be checked through the LCD interface.

9.8.3 Device start

if confirm that the wiring is correct during the installation check, you can supply device with power and start it.

Configuration file needs to read during device startup process. It needs a certain period of time for the startup process. The startup time is related to the size of configuration file. In general, the startup time is less than 1 minute.

The "HEALTHY" indicator lights up when the unit starts up normally. If a fault is detected during the startup procedure, the "ALARM" indicator is lit and the internal fault code, alarm information can be checked via LEDs.

10 Maintenance

10.1 Maintenance General

A strict and detailed laboratory test is carried out in the development and design of the relay device. All the relay devices are strictly tested according to national or international standards.

The relay device has powerful real-time self-check capability. However, during the long time running of the relay device, there is no real time supervision for the input terminals and output circuits. Therefore, some periodic tests should be done to ensure that the relay is functioning correctly and the external wiring is intact.

The maintenance of the relay device mainly includes the following two conditions:

- Regular testing;
- Failure maintenance

10.2 Regular Testing

Regular testing is to test the normal relay devices in a certain period of time, so as to find potential defects or failures and eliminate hidden dangers to ensure the healthy operation of the devices.

The regular testing cycle depends on a number of factors, such as the environment conditions, the complexity, etc. Advices of CYG are as the following:

- The relay device must be tested for the first time in the first year of operation, mainly including protection logic, AC circuit, tripping circuit and power supply circuit.

- A partial test should be carried out every 3 years, mainly including the inspection of the AC circuit and the tripping circuit.

- An overall test should be carried out every 6 year, mainly including the protection function logic, the AC circuit, the tripping and closing circuit, the power supply circuit.

10.3 Failure Maintenance

Failure maintenance refers to the maintenance of a faulty relay device.

10.3.1 Hardware Failure

1) Check whether the hardware is in trouble or not according to the device alarm signal.
2) visual check of the device
   - Check whether the device has obvious physical fault
   - If you can find a clear physical fault point of the device, please contact CYG for repair or replacement
3) Confirm the scope of the fault
   - Check whether this fault is caused by an external circuit.
   - Carry out the input and output test for the relay device by test instrument.

- If it is determined that the fault belongs to the relay device, please contact CYG for repair or replacement

10.3.2 Software Failure

1) Check whether the hardware is in trouble or not according to the device alarm signal.
2) Try to restart the device and check if the fault is recoverable if possible.
3) If the fault is not recoverable, please contact CYG for repair or replacement

10.4 Replace Failed Modules

If the failure is identified to be in the relay module and the user has spare modules, the user can replace the failed modules to recover the protection device.

Repair at the site should be limited to module replacement. Maintenance at the component level is not recommended.

Before replacement, the user should check that the replacement module has an identical module name and hardware type-form as the removed module. Furthermore, the replaced module should have the same software version. For the replaced analog input module and power supply module, it should be confirmed of the same ratings.

NOTICE!

After replacing modules, it must be checked that the same configuration is set before and after the replacement. If it is not the case, there is a danger of the unintended operation of switchgear taking place or of relay device not running correctly. Persons may also be in danger.

Units and modules must only be replaced while the power supply is switched off and only by appropriately trained and qualified personnel. Strictly observe the basic precautions to guard against electrostatic discharge.

Take anti-static measures such as wearing an earthed wrist band and placing modules on an earthed conductive mat when handling a module. Otherwise, the electronic components may suffer damage. After replacing the main CPU module, check the settings and configurations.

11 Decommissioning and Disposal

11.1 Decommissioning

11.1.1 Switching off

To switch off this relay, break down the cable connected to the power supply module or switch off the external miniature circuit breaker.

11.1.2 Disconnecting cables

Disconnect the cables in accordance with the rules and recommendations made by relational department.

⚠ **DANGER!**

Before disconnecting the power supply cables that connected with the power supply module of this relay, make sure that the external miniature circuit breaker of the power supply is switched off.

⚠ **DANGER!**

To decline the possibility of electrical shock, all current terminal should be shorted before attempting to remove or replace any modules.

11.1.3 Dismantling

The rack of this relay may be removed from the system cubicle, after which the cubicles may also be removed.

⚠ **DANGER!**

When the station is in operation, make sure that there is an adequate safety distance to other operating parts or equipments, especially as dismantling is often performed by unskilled personnel.

11.2 Disposal

In every country there are companies specialized in the proper disposal of electronic waste.

NOTICE!

Each module used in the device is fixed to several specific module type, as oftenly indicated with a label on the backside of the chassis. There are some chances that the modules will be damaged if they are installed in the wrong chassis slot. When removing and replacing modules, it is best to use the label in the chassis as a indicator, so as to make sure each module is installed in the proper slot.

NOTICE!

Strictly observe all local and national regulations when disposing of the device.

12 Manual Version History

In the current version of the instruction manual, several descriptions on existing features have been modified.

Table 12-1 Manual version and modification history records

Manual Version		Software Version	Date	Description of change
Source	New			
Beta	1.00	1.00	2023-03-25	Form the original manual.