PRS-7391

Time Synchronization Device

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 list the operations on safe handling, commissioning and maintaining of this equipment. The instruction manual can be 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. Therefor, 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 processures, 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.

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P/N: ZL_PRS-7391_X_Instruction Manual_EN_Overseas General_X

Version: 2.01

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 of all modules.

4 Supervision Functions

Introduce the automatic self-supervision function of this equipment.

5 IED Hardware

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

6 Settings

List of all the settings and their ranges and step sizes, together with a brief explanation of each setting and some notices about the setting application.

7 Human Machine Interface

Human machine interface (HMI) is an important tool of the equipment used to access the relay from the front local control panel of this relay to view desired information or modify some system parameters or protection settings.

8 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.

9 Commissioning

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

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 Briefly Introduction

1.1 Application Scope

PRS-7391 time synchronization device is applicable to substations and power plants with the voltage grade ranking at or above 10KV, which provides time and synchronization information for various secondary equipments in the plants and stations, such as dispatch automation system, microcomputer relay protection device, fault recorder, event sequence recording device, tele-control device (RTU), computer data exchanging network, intelligent electronic device (IED),etc.

1.2 Product Feature

- **Remote supervision**

This device supports local SCADA and remote control centre communication in using of protocols such as IEC 61850 to realize the device running status supervision.

- **Time service**

This device supports GPS (Global Positioning System) and BDS (BeiDou Navigation Satellite System). In addition, it supports antenna transmission time delay compensation.

- **Signal reception**

This device provides 2 reception channels for IRIG-B signal via its optical port or RS-485/422 port. In addition, it supports link-based reception time delay compensation.

- **IEEE 1588 protocol**

This device supports the IEEE 1588V2 protocol (BC mode and OC mode) for clock synchronization.

- **SNTP/NTP protocol**

This device supports the SNTP/NTP protocol and can work as a network time server.

- **Recording**

This device has a self-diagnostic record processing mechanism, so the latest 1024 record reports can be saved.

- **Output clock synchronization signal**

The kinds of output clock synchronization signal is rich, including PPS (Pulse Per Second), PPM (Pulse Per Minute), PPH (Pulse Per Hour), IRIG-B signal, timing message (serial), SNTP/NTP timing message (network), IEEE 1588 signal, etc.

- **Output interface**

Various types of output interfaces are provided, including RS-485, RS-232, TTL, dry contact, AC modulation, optic fiber, RJ45, etc.

- **Dual power supplies redundancy**

Dual power supply module is an option，The extra power supply module will be placed next to each other and works independently.

- **Double devices redundancy strategy**

Two PRS-7391 can form a "dual source, dual network" clock synchronization system with a interconnection in using of IRIG-B signal.

- **Output interface extension**

The output interface extension is very flexible. Full support for up to 9 output modules, All signal outputs of the devices are isolated with strong anti-interference capability;

- **Human machine interface**

The friendly HMI provides 5.7” LCD and navigation keypad for the display of real time, satellite tracking status, IRIG-B inputting status, current clock source, etc.

2 Techanical Specifications

2.1 Power Supply

Standard	IEC 60255-11:2008
Rated voltage	48V/110V/125V/220V（DC），220V （AC）
Variation	80% ~ 115%
Permissible AC ripple voltage	Max 5% of the rated voltage
Burden	<50W

2.2 Binary Output for Alarm

Output model		Potential-free contact
Max system voltage		380Vac, 250Vdc
Voltage across open contact		1000V RMS for 1min
Continuous carry		2000VA, 150W
Short duration current		6A for 3000ms; 15A for 500ms
Breaking capacity		0.60A @ 48Vdc, L/R=40ms 0.10A @ 110Vdc, L/R=40ms 0.05A @ 220Vdc, L/R=40ms
Pickup time		< 10ms
Dropout time		< 8ms
Bounce time		1ms
Durability	loaded contact	10,000 operations minimum
	unloaded contact	20,000 operations minimum

2.3 Mechanical Specifications

Mounting Way	Flush mounted
Chassis material	Aluminum alloy
Chassis color	Silver grey
Location of terminal	Rear panel of the device
Device structure	Plug-in modular type @ rear side, integrated frontplate
Protection class	6A for 3000ms; 15A for 500ms
Standard	IEC60225-1: 2009
Front side	IP52
Rear side, connection terminals	IP20
Other Sides	IP40

2.4 Ambient Temperature and Humidity Range

Standard	IEC 60255-1:2009
Operating temperature range	-40°C ~ +70°C (for the LCD -20°C ~ +70°C)
Transport and storagetemperature range	-40°C ~ +70°C
Permissible humidity	5% ~ 95%, condensation not permissible
Altitude	<3000m

2.5 Communication Port

2.5.1 Ethernet Port for RTU/SCADA

Port number	2
Connector type	RJ-45
Transmission rate	100Mbits/s
Transmission standard	100Base-TX
Transmission distance	≤ 100m
Protocol	IEC60870-5-103:1997, IEC61850 etc.
Safety level	Isolation to ELV level

2.5.2 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

2.6 Clock Synchronization Port

2.6.1 Input

Port number	2
Connector type	ST
Fiber type	Multi-mode (62.5/125 μ m)
Wave length	850nm
Transmission distance	≤ 2km
Transmission power	Min. -19.0dBm
Receiving power	Min. -24.0dBm
Margin	Min.+3.0dBm

2.6.2 Output

2.6.2.1 RS-485/ 422 Port

Type	Differential
Transmission distance	≤ 500m
Timing standard	IRIG-B(DC)
Safety level	Isolation to ELV level

2.6.2.2 Optical-coupled Contact

Operating voltage	Max.220Vdc
Operating current	Max.50mA
Transmission distance	Max.300m
Safety level	Isolation to ELV level

2.6.2.3 TTL

Output voltage	0~5V
Impedance	50Ω
Transmission distance	Max.100m
Safety level	Isolation to ELV level

2.6.2.4 Optical Port

Characteristic	Glass optical fiber
Connector type	ST
Fiber type	Multi-mode (62.5/125 μ m)
Wave length	850nm
Transmission power	Min. -19.0dBm
Margin	Min.+3.0dBm

2.7 Type Test

2.7.1 Environmental Test

Dry cold test	IEC60068-2-1:2007, 16h at -40°C
Dry heat test	IEC60068-2-2: 2007, 16h at +70°C
Damp heat test	IEC60068-2-78: 2001, 10 days, 93%RH, +55°C
Cyclic temperature with humidity test	IEC60068-2-30: 2005, six (12+12hours) cycles, 95%RH, low temperature +25°C, high temperature +55°C

2.7.2 Mechanical Tests

Vibration test	IEC60255-21-1:1988, Class I
Shock test	IEC60255-21-2:1988, Class I
Bump test	IEC60255-21-2:1988, Class I
Seismic test	IEC60255-21-3:1988, Class I

2.7.3 Electrical Tests

Dielectric test	IEC60255-27:2013, test voltage: 2kV, 50Hz, 1min
Impulse voltage test	IEC60255-27:2013, test voltage: 5kV, unipolar impulses, waveform 1.2/50μs, source energy 0.5J
Insulation measurement	IEC60255-27:2013, insulation resistance >100MΩ @ 500Vdc
Overvoltage category	IEC60255-27:2013, Class III
Pollution degree	IEC60255-27:2013, Class II

2.7.4 Electromagnetic Compatibility

Slow damped oscillatory wave	IEC 61000-4-18
	Common mode: class Ⅲ 2.5kV
	Differential mode: class Ⅲ 1.0kV
Electrostatic discharge	IEC 61000-4-2 class Ⅳ
	For contact discharge: 8kV
	For air discharge: 15kV
Radiated radio-frequency electro- magnetic field	IEC 61000-4-3 class Ⅲ
	Frequency sweep Radiated amplitude-modulated 10V/m (rms), f=80~1000MHz, 1400~2700MHz
	Spot frequency Radiated amplitude-modulated 10V/m(rms), f=80MHz/160MHz/380MHz/450MHz/900MHz/1850MHz/2150MHz
Electrical fast transients	IEC 61000-4-4 class Ⅳ
	Power supply, I/O, Earth: class Ⅳ, 4kV, 5kHz, 5/50ns
	Communication port: class Ⅳ, 2kV, 5kHz, 5/50ns
Surge immunity	IEC 61000-4-5 class Ⅳ
	Power supply, AC input, I/O port: class Ⅳ,1.2/50us Common mode: 4kV Differential mode: 2kV Communication port: classⅣ,1.2/50us
	Common mode: 4kV
Conducted disturbance induced by radio-frequency field	IEC 61000-4-6 class Ⅲ
	Power supply, AC, I/O, Communication, Functional earth port: Class Ⅲ, 10Vrms, 150 kHz~80MHz
Power Frequency Magnetic Field Immunity	IEC 61000-4-8class Ⅴ
	100A/m for 1min, 1000A/m for 3s
Pulse Magnetic Field Immunity	IEC 61000-4-9class Ⅴ
	Class Ⅴ, 6.4/16μs, 1000A/m for 3s
Damped oscillatory magnetic field immunity	IEC 61000-4-10class Ⅴ
	Class Ⅴ, 100kHz & 1MHz–100A/m
Power frequency	IEC 61000-4-16 class A
	Binary input port Common mode:300V Differential mode: 150V
Radiated emission	CISPR 11
	Enclosure port: the highest frequency of the internal sources of the EUT is less than 108MHz. 30MHz to 230MHz 40 dB(uV/m) quasi peak at 10m, 50 dB(uV/m) quasi peak at 3m 230MHz to 1000MHz 47 dB(uV/m) quasi peak at 10m, 57 dB(uV/m) quasi peak at 3m

Conducted emission	CISPR 22
	0.15 MHz to 0.50Mhz 79dB(uV) quasi peak, 66dB(uV) average 0.5MHz to 30Mhz 73dB(uV) quasi peak, 60dB(uV) average
Auxiliary power supply performance - Voltage dips -Voltage short interruptions	IEC 61000-4-11, IEC 61000-4-29 Up to 200ms for dips to 40% of rated voltage without reset 100ms for interruption without rebooting

2.8 Time synchronization Specifications

2.8.1 PPS/PPM/PPH

	RS-485/422	TTL	Contact	Optical
Rising edge(Max.)	50ns	50ns	50ns	50ns
Accuracy(Max.)	100ns	100ns	100ns	100ns
Pulse width	100ms	100ms	100ms	100ms

2.8.2 IRIG-B DC Code

	RS-485/422	TTL	Contact	Optical
Rising edge（Max.）	50ns	50ns	\	50ns
Accuracy（Max.）	100ns	100ns	\	100ns
Format	1. For IRIG-B code, 1 frame per second, 100 code elements per frame and 10ms per code element; 2. Code element information of IRIG-B code includes: time zone information, time quality information, leap second identification information, SBS information.			

2.8.3 Serial Port Timing Message

Baudrate	1200bps, 2400bps, 4800bps, 9600bps, 19200bps, 38400bps, 57600bps, 115200bps	
Data format	Data bits	8
	Stop bit	1
	Parity	Odd or Even
Message format	Motorola binary format	
Transmission period	1s	
Accuracy	Max.3ms	

2.8.4 Network

SNTP/NTP	Max. 100μs
IEEE1588	Max.1μs

2.8.5 GPS Receiver

Frequency	1575.42MHz	
Sensitivity（max.）	Tracking -133dBm Acquisition -130dBm	
Satellites quantity	Max.12	
Acquisition time(max.)	TTFF-hot	30S（with current almanac,position,time and ephmeris）
	TTFF-cold	10min(no stored information)
	Reacquisition	1s
Accuracy	Max.50ns	

2.8.6 BDS Receiver

Frequency	1561.098MHz	
Sensitivity（max.）	Tracking -133dBm Acquisition -130dBm	
Satellites quantity	Max.12	
Acquisition time(max.)	TTFF-hot	30S（with current almanac,position,time and ephmeris）
	TTFF-cold	10min(no stored information)
	Reacquisition	1s
Accuracy	Max.50ns	

2.8.7 Internal Clock

Inaccuracy	Max.3×10^{-10}（1μs/h）

2.9 Certifications

- ISO9001:2015
- ISO14001:2015
- OHSAS18001:2015
- ISO/IEC 20000:2016

3 Operation Theory

3.1 Overview

This device is based on a 32-bit high performance dual-core processor, internal high speed bus and intelligent I/O ports, and the hardware is in modularized design and can be configured flexibly, featuring interchangeability and easy extension and maintenance.

The PRS-7961-G receives standardized time signals, such as BDS, GPS, IRIG-B, via its built-in receiver. After a decode, it converts the source time into IRIG-B, PPS, PPM, PPH signals or timing message, and sends them via various output interfaces.

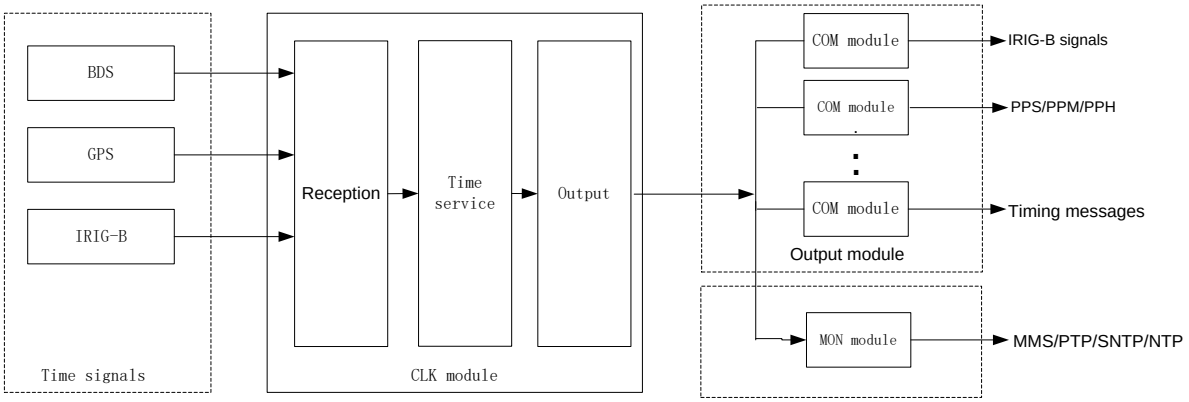


Figure 3.1.1 Operating sketch

3.1.1 Reception Function

The reception function takes the received timing signal as its external time reference. Its main components include antenna, feeder line, low-noise amplifier, surge protector and BDS/GPS receiver.

3.1.2 Time Service Function

The time service function will decode and convert the time reference. Depends on the "Multiple sources judgment" and "Optimization selection", it selects the optimizing external time reference, makes it to be the clock synchronization source, set the source in tracking and fixing status and compensates the transmission delay.

If all external time references are lost, the internal clock will enter the "Punctuality mode" to maintain its accuracy. After the recovery of any external time reference, the internal clock will quit the "Punctuality mode" and takes the "Tracking and fixing mode" again. In this period, there is no influence to the output function.

3.1.3 Output Function

The output function converts the internal clock information into various time codes, such as PPS/PPM/PPH, IRIG-B, serial code, SNTP/NTP, IEEE1588, etc. Then, it outputs these time codes via different interfaces, such as TTL, optical-coupled contact, RS-485/422, RS-232, optical fiber, AC modulation, RJ45,etc. for other IEDs.

3.1.4 Double Devices Redundancy Strategy

This device can work in the dual devices (redundant) mode to ensure stable output time, The two devices are interconnected by two optical fibers in using of IRIG-B signal.

Typically, each device receives a time signal from its own satellite receiver and decodes / converts the signal for time output.If the satellite tracking of one of these two devices is lost, the lost will take the interconnection IRIG-B signal as its external time reference. Else if both the two have lost their satellite tracking, the internal clock of the device, which lost its tracking signal later, will be used as the time source.

4 Supervision Functions

4.1 Overview

This device is in quiescent state under running conditions, and it is required to respond promptly for faults. When the device is in energizing process before the LED “Run” is on, the device need to be checked to ensure no abnormality. Therefore, the automatic supervision function, which checks the health of the protection system when startup and during normal operation, plays an important role.

This device based on the microprocessor operations is suitable for implementing this automatic supervision function of the system.

4.2 Supervision Alarm

In case a defect is detected during initialization when power supply is provided to the device,the LED” Run” is off and LED ”Fault” or LED”Alarm” is on. The LED "Fault" trigger conditions see Table 4.2.1,the LED ”Alarm” trigger conditions see table 4.2.2.

Table 4.2.1 Fault Triggering Condition of Time Synchronization Device

Triggering criteria	Master clock unit	Slave clock unit	Judging criteria
Status of BDS satellite receiving module is abnormal	■	-	Output is abnormal for more than 60s
Status of GPS satellite receiving module is abnormal	■	-	Output is abnormal for more than 60s
Fault of BDS antenna	■	-	Short circuit or open circuit of antenna

Triggering criteria	Master clock unit	Slave clock unit	Judging criteria
Fault of GPS antenna	■	-	Short circuit or open circuit of antenna
CPU or other core module is abnormal	■	■	Module is abnormal or fault existing, and fails to initialize
Status of tame crystal oscillator is abnormal	■	■	Crystal oscillator cannot be tamed or crystal oscillator is beyond control for more than 60s
All the independent time sources are unavailable (The device synchronize for the first time)	■	■	All the independent time sources are unavailable for more than 30min
All the independent time sources are unavailable (The device once completed synchronization)	■	■	All the independent time sources are unavailable for more than 24h
Other faults which are unrecoverable or seriously affect normal operation of device	■	■	

Table 4.2.2 Alarm Triggering Condition of Time Synchronization Device

Triggering criteria	Master clock unit	Slave clock unit	Judging criteria
Loss of power from any power supply source	■	■	Loss of power from any power supply source
Loss of locking of BDS satellite	■	-	The number of BDS satellites searched by the device is less than 4
Loss of locking of GPS satellite	■	-	The number of GPS satellites searched by the device is less than 4
Input quality of IRIG-B code is lower than local	■	■	Input quality of any way of IRIG-B code is lower than the device
Time continuity is abnormal	■	■	Time continuity of any time source is abnormal
Any time source is unavailable	■	■	Any time source is unavailable
All the independent time sources are unavailable (The device synchronize for the first time)	■	■	All the independent time sources are unavailable for not more than 30min

Triggering criteria	Master clock unit	Slave clock unit	Judging criteria
All the independent time sources are unavailable (The device once completed synchronization)	■	■	All the independent time sources are unavailable for not more than 24h
Other faults which are recoverable or do not affect normal operation of device	■	■	

When a failure is detected by the automatic supervision, it is followed by a LCD message, LED indication and alarm contact outputs. The failure alarm is also recorded in event recording report and can be printed if required.

5 IED Hardware

5.1 Overview

This device consists several different modules. The application and terminal description of each module will be introduced in this chapter.

- MON module provides management functions like communication with SAS, event record, setting management etc.
- COM module provides different output interfaces with other IEDs.
- PWR module converts the power supply into various voltage levels for different modules and components in this device.
- HMI module is comprised of LCD, keypad, LED indicators and a multiplex RJ45 debugging port.

This device based on the microprocessor operations is suitable for implementing this automatic supervision function of the system.

5.2 Module configuration（for EXAMPLE only）

NOTICE!

This section shows several examples of device terminal view and module arrangement.

The following figures should NOT be used as reference for device configuration or wiring design. For such purpose, please use the latest corresponding Manufacture Ordering Table and consult our design department.

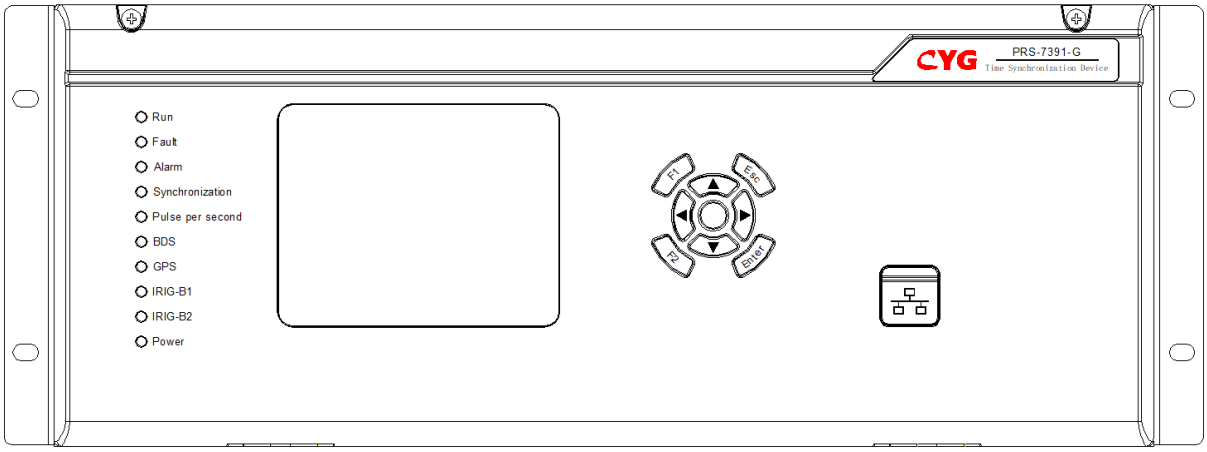


Figure 5.2.1 Front view of PRS-7391

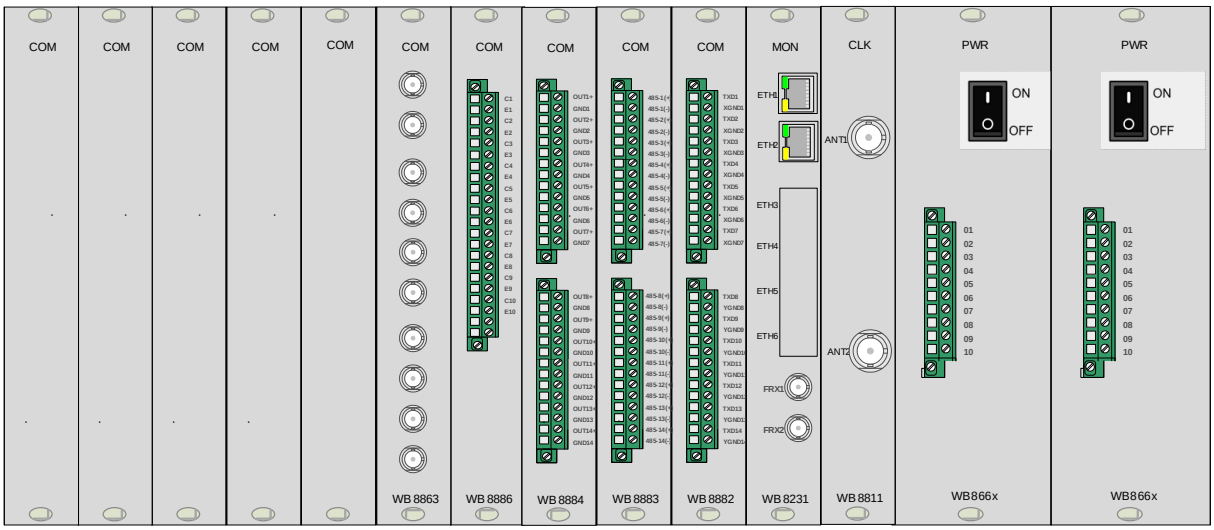


Figure 5.2.2 Terminal view example

Table 5.2.1 Module Arrangement

Symbol	Slot No.	Type	Remark	Remark
PWR	P1,P2	WB8663	48V/110/125/220Vdc,110/220Vac	At least 1
PWR	P1,P2	WB8660	110/125/220Vdc,110/220Vac	At least 1
CLK	P3	WB8811	1*BDS+1*GPS signal	Obligatory
MON	P4	WB8231	2*RJ45+2*IRIG-B signal	Obligatory
COM	P5~P14	WB8882	14*RS-232	Optional
		WB8883	14*RS485/422	
		WB8884	14*TTL	
		WB8886	10* optical-coupled contacts	
COM	P5~P14	WB8863	10*ST connectors（TX）	Optional

5.3 PWR Module(Power Supply)

The PWR module is a DC/DC or AC/DC converter with electrical insulation between the input and output. It has an input voltage range as described in the chapter 2. The tolerance of the output

voltage for the electronic components is continuously monitored.

The use of an external miniature circuit breaker is recommended. The miniature circuit breaker must be in the on position when the device is in operation and in the off position when the device is in cold reserve.

A 10-pin connector is fixed on the PWR module. The pin definition of the connector is described as below.

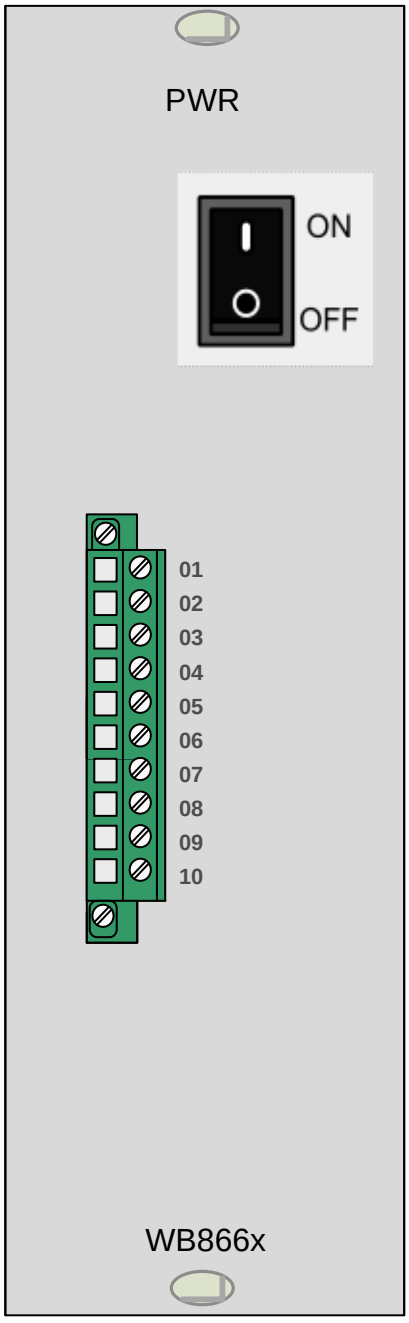


Figure 5.3.1 PWR module(WB866x)

Table 5.3.1 Pin definition of WB866x

Pin No.	Symbol	Description
01	BO_COM1	Common terminal 1
02	B0_ LOST	Indication of device(module) power supply lost
03		Not used
04		Not used
05		Not used
06	PWR+	Positive pole of power supply for device
07		Not used
08	PWR-	Negative pole of power supply for device
09		Not used
10	GND	Grounded connection of device

NOTICE!

The standard rated voltage of PWR module is self-adaptive to 38~300Vdc. For other non-standard rated voltage, please specify when placing order and check if the rated voltage of power supply module is the same as the voltage of power source before the device being put into service.

NOTICE!

The PWR module provides the terminal 10 and a grounding screw for device grounding. The terminal 10 shall be connected to grounding screw and then connected to the earth copper bar of panel via dedicated grounding wire.

Effective grounding is the most important measure for a device to prevent EMI, so it must be ensured before the device is put into service.

NOTICE!

This device, like all electronic equipments, contains electrolytic capacitors. These capacitors are well known to be subject to deterioration over time if voltage is not applied periodically. Deterioration can be avoided by powering the device up once a year.

5.4 MON Module(Monitoring and Communication)

The MON module consists of high-performance built-in processor, FLASH, SRAM, SDRAM, Ethernet controller and other peripherals. Its functions include management of the complete device, human machine interface, communication, etc.

The MON module uses the internal bus to receive data from other modules. It communicates with the LCD module by inner RS-485 bus.

The MON module WB8231 provides two RJ45 ports. The RJ45 ports are used for MMS communication and SNTP/NTP time message. All the two RJ45 ports support the IEEE 1588 protocol.

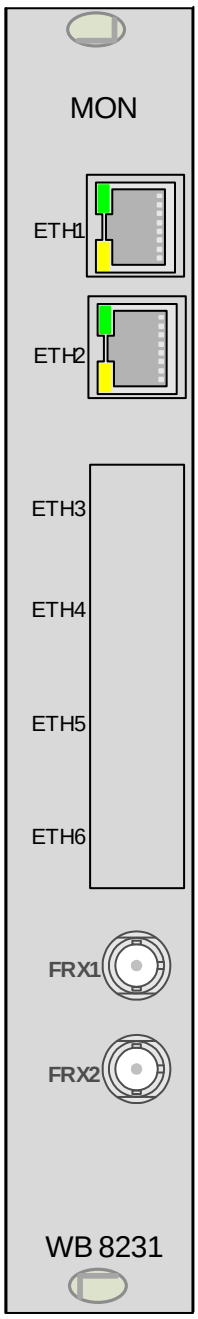


Figure 5.4.1 MON module(WB8231)

5.5 CLK Module（Satellite Signal Rceiver）

The CLK module receives and processes satellite signal. It converts them into PPS/PPM/PPH, IRIG-B code and timing message and transmits them to the MON module and COM modules via the internal bus.

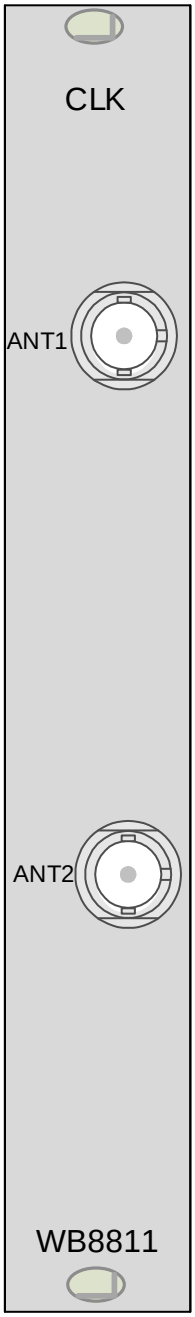


Figure 5.5.1 CLK module(WB8811)

5.6 COM Module

5.6.1 RS-232 Modlue(WB8882)

The COM module WB8882 provides 14 RS-232 serial ports. The No.1~7 ports form the group 1 and the No.8~14 ports form the group 2 .PPS, PPH, PPM, serial port message and IRIG-B (DC) output can be selected through dial-up switch.

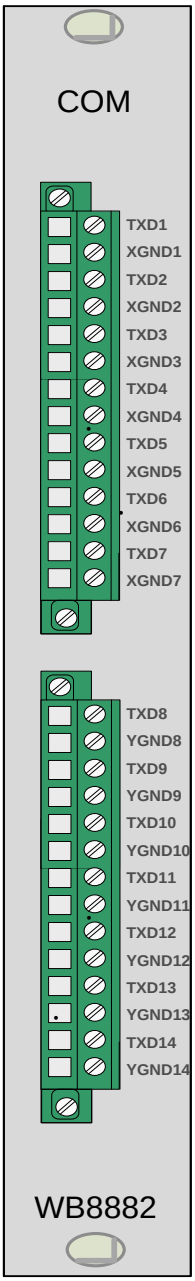


Figure 5.6.1 COM module (WB8882)

Table 5.6.1 Pin definition of WB8882

Pin No.	Symbol	Description	Port No.
01	TXD1	RS-232:TXD	Serial port 1
02	XGND1	Signal reference	
03	TXD2	RS-232:TXD	Serial port 2
04	XGND2	Signal reference	
05	TXD3	RS-232:TXD	Serial port 3
06	XGND3	Signal reference	
07	TXD4	RS-232:TXD	Serial port 4

Pin No.	Symbol	Description	Port No.
08	XGND4	Signal reference	
09	TXD5	RS-232:TXD	Serial port 5
10	XGND5	Signal reference	
11	TXD6	RS-232:TXD	Serial port 6
12	XGND6	Signal reference	
13	TXD7	RS-232:TXD	Serial port 7
14	XGND7	Signal reference	
15	TXD8	RS-232:TXD	Serial port 8
16	YGND8	Signal reference	
17	TXD9	RS-232:TXD	Serial port 9
18	YGND9	Signal reference	
19	TXD10	RS-232:TXD	Serial port 10
20	YGND10	Signal reference	
21	TXD11	RS-232:TXD	Serial port 11
22	YGND11	Signal reference	
23	TXD12	RS-232:TXD	Serial port 12
24	YGND12	Signal reference	
25	TXD13	RS-232:TXD	Serial port 13
26	YGND13	Signal reference	
27	TXD14	RS-232:TXD	Serial port 14
28	YGND14	Signal reference	

the output signal mode can be selected by setting the corresponding jumpers on the module.

Table 5.6.2 Output signal mode of WB8882

Signal mode	Group 1 (Jumper “ON”)	Group 2 (Jumper “ON”)
IRIG-B	SW1-1	SW2-1
Serial port message	SW1-3	SW2-3
PPH	SW1-6	SW2-6
PPM	SW1-7	SW2-7
PPS	SW1-8	SW2-8

5.6.2 RS-485/422 Module(WB8883)

The COM module WB8883 provides 14 RS-485/422 serial ports. The No.1~7 ports form the group 1 and the No.8~14 ports form the group 2 .PPS, PPH, PPM, serial port message and IRIG-B (DC) output can be selected through dial-up switch.

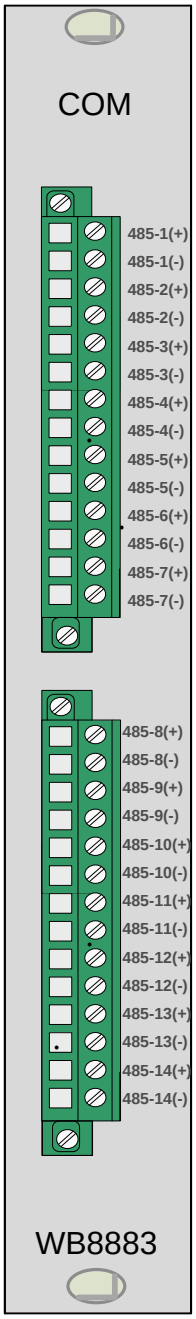


Figure 5.6.2 COM module(WB8883)

Table 5.6.3 Pin definition of WB8883

Pin No.	Symbol	Description	Port No.
01	485-1(+)	RS-485:A	Serial port 1
02	485-1(-)	RS-485:B	
03	485-2(+)	RS-485:A	Serial port 2
04	485-2(-)	RS-485:B	
05	485-3(+)	RS-485:A	Serial port 3
06	485-3(-)	RS-485:B	

Pin No.	Symbol	Description	Port No.
07	485-4(+)	RS-485:A	Serial port 4
08	485-4(-)	RS-485:B	
09	485-5(+)	RS-485:A	Serial port 5
10	485-5(-)	RS-485:B	
11	485-6(+)	RS-485:A	Serial port 6
12	485-6(-)	RS-485:B	
13	485-7(+)	RS-485:A	Serial port 7
14	485-7(-)	RS-485:B	
15	485-8(+)	RS-485:A	Serial port 8
16	485-8(-)	RS-485:B	
17	485-9(+)	RS-485:A	Serial port 9
18	485-9(-)	RS-485:B	
19	485-10(+)	RS-485:A	Serial port 10
20	485-10(-)	RS-485:B	
21	485-11(+)	RS-485:A	Serial port 11
22	485-11(-)	RS-485:B	
23	485-12(+)	RS-485:A	Serial port 12
24	485-12(-)	RS-485:B	
25	485-13(+)	RS-485:A	Serial port 13
26	485-13(-)	RS-485:B	
27	485-14(+)	RS-485:A	Serial port 14
28	485-14(-)	RS-485:B	

Table 5.6.4 Output signal mode of WB8883

Signal mode	Group 1 (Jumper “ON”)	Group 2 (Jumper “ON”)
IRIG-B	SW1-1	SW2-1
Serial port message	SW1-3	SW2-3
PPH	SW1-6	SW2-6
PPM	SW1-7	SW2-7
PPS	SW1-8	SW2-8

5.6.3 TTL Module(WB8884)

The COM module WB8884 provides 14 TTL output ports. The No.1~7 ports form the group 1 and the No.8~14 ports form the group 2 .PPS, PPH, PPM, serial port message and IRIG-B (DC) output can be selected through dial-up switch.

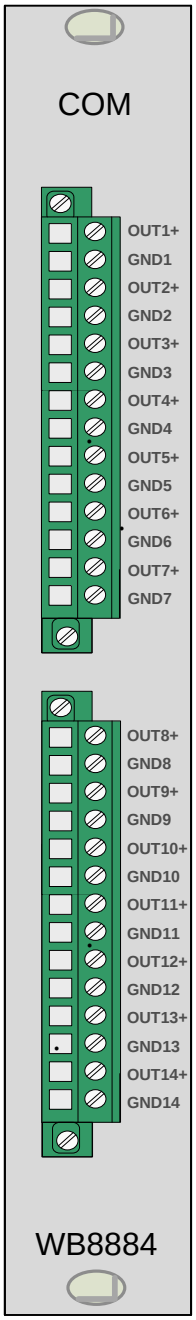


Figure 5.6.3 COM module(WB884)

Table 5.6.5 Output signal mode of WB8884

Signal mode	Group 1 (Jumper “ON”)	Group 2 (Jumper “ON”)
IRIG-B	SW1-1	SW2-1
Serial port message	SW1-3	SW2-3
PPH	SW1-6	SW2-6
PPM	SW1-7	SW2-7
PPS	SW1-8	SW2-8

5.6.4 Optical-Coupled Contact Module(WB8886)

The COM module WB8886 provides 10 optical-coupled contacts. The No.1~10 contacts form the group 1. PPS, PPH, PPM, serial port message and IRIG-B (DC) output can be selected through dial-up switch.

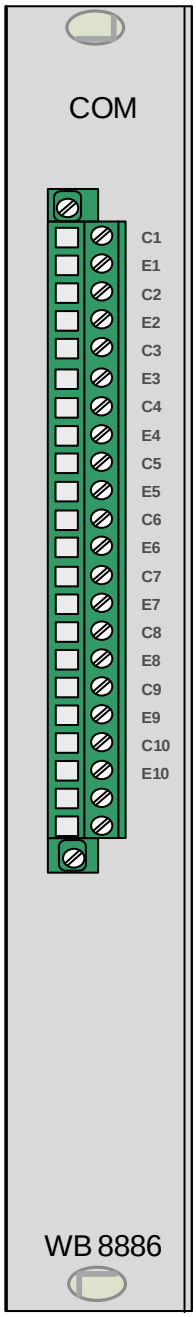


Figure 5.6.4 COM module(WB8886)

Table 5.6.6 Pin definition of WB8886

Pin No.	Symbol	Description
01	C1	The positive pole of the No.1 output contact
02	E1	The negative pole of the No.1 output contact
03	C2	The positive pole of the No.2 output contact

Pin No.	Symbol	Description
04	E2	The negative pole of the No.2 output contact
05	C3	The positive pole of the No.3 output contact
06	E3	The negative pole of the No.3 output contact
07	C4	The positive pole of the No.4 output contact
08	E4	The negative pole of the No.4 output contact
09	C5	The positive pole of the No.5 output contact
10	E5	The negative pole of the No.5output contact
11	C6	The positive pole of the No.6 output contact
12	E6	The negative pole of the No.6 output contact
13	C7	The positive pole of the No.7 output contact
14	E7	The negative pole of the No.7 output contact
15	C8	The positive pole of the No.8 output contact
16	E8	The negative pole of the No.8 output contact
17	C9	The positive pole of the No.9 output contact
18	E9	The negative pole of the No.9 output contact
19	C10	The positive pole of the No.10 output contact
20	E10	The negative pole of the No.10 output contact

Table 5.6.7 Output signal mode of WB8886

Signal mode	Group 1 (Jumper “ON”)	Group 2 (Jumper “ON”)
IRIG-B	SW1-1	SW2-1
Serial port message	SW1-3	SW2-3
PPH	SW1-6	SW2-6
PPM	SW1-7	SW2-7
PPS	SW1-8	SW2-8

5.6.5 ST Connector Module(WB8863)

The COM module WB8863 provides 10 optical ports(ST connector). The working mode for idle and the output signal mode can be selected by setting the corresponding jumpers on the module.

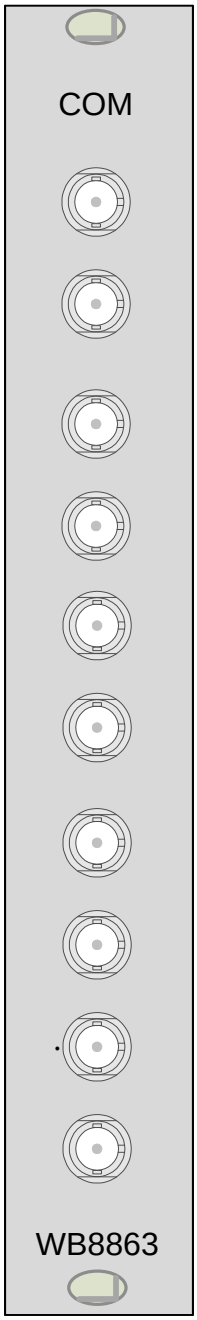


Figure 5.6.5 COM module(WB8863)

Table 5.6.8 Output signal mode of WB8863

Signal mode	Group 1 (Jumper “ON”)	Group 2 (Jumper “ON”)
IRIG-B	SW1-1	SW2-1
PPH	SW1-6	SW2-6
PPM	SW1-7	SW2-7
PPS	SW1-8	SW2-8

6 Settings

6.1 Overview

Setting configuration is an important function of device. The device normal operation depends in the correct setting configuration. Thus, only a qualified technician should be responsible for the configuration. Furthermore, if the device is operating abnormally, please check the setting configuration firstly.

NOTICE!

According to different applications for different engineering requirements, settings may be different. This chapter describes as many settings as possible to make a reference for user.

6.2 Settings

“Parameter setting” menu includes: master-slave setting, serial port information, IP configuration, delay compensation, input time source, output setting, ex-factory date, operation date.

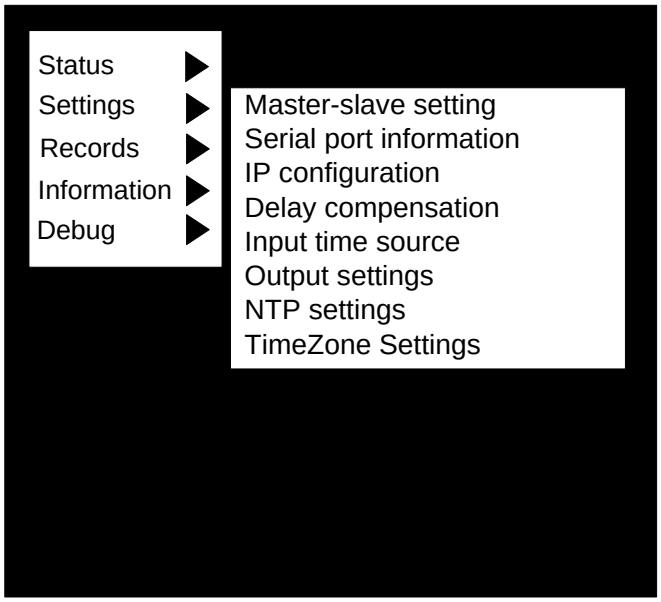


Figure 6.2.1 Diagram of Parameter Setting Menu of Device

6.2.1 Master-slave Setting

This is the device clock service mode option for the dual device redundancy strategy. It should be "Master" if the CLK module WB8810A/WB8810B/WB8810C is selected. Otherwise, it should be "Slave".

6.2.2 Serial-port Information

No.	Item	Range(Uint)	Default Value	Description
1	Type of serial port message	M12,DLT	DLT	Sending message format for serail port
2	Baud rate of serial port message	None,Odd,Even	Even	Parity check mode for serial port
3	Verification method of serial port message	1200,2400,4800,9600, 19200,38400,57600, 115200	9600	Baud rate for serial port

6.2.3 IP Configuration

No.	Item	Range	Default Value
NET1	IP	000.000.000.000~255.255.255.255	222.111.112.100
	Mask	000.000.000.000~255.255.255.255	255.255.255.0
	Gateway	000.000.000.000~255.255.255.255	000.000.000.000
NET1	IP	000.000.000.000~255.255.255.255	222.111.112.100
	Mask	000.000.000.000~255.255.255.255	255.255.255.0
	Gateway	000.000.000.000~255.255.255.255	000.000.000.000

6.2.4 Delay Compensation

Item	Range	Default Value
the satellite channel 1 input compensation value	-30000ns~30000ns	0
the satellite channel 2 input compensation value	-30000ns~30000ns	0
the IRIG-B channel 1 input compensation value	-30000ns~30000ns	0
the IRIG-B channel 2 input compensation value	-30000ns~30000ns	0

6.2.5 Input Settings

Item	Range(Uint)	Default Value	Description
Satellite 1	Disable,Enable	Disable	Enable/Disable the satellite channel 1
Satellite 2	Disable,Enable	Disable	Enable/Disable the satellite channel 2
IRIG-B 1	Disable,Enable	Disable	Enable/Disable the IRIG-B channel 1
IRIG-B 2	Disable,Enable	Disable	Enable/Disable the IRIG-B channel 2

6.2.6 Output Settings

Item	Range(Uint)	Default Value	Description
IRIG-B_Parity	None,Odd,Even	Odd	The parity check mode option for IRIG-B output signal.

7 Human Machine Interface

7.1 Overview

Human machine interface (HMI) is an important component of the equipment. It is a

convenientfacility to access the relay from the front local control panel of this relay to view desired information,such as measurement quantity or binary inputs state or program version etc. Or modify somesystem parameters or protection settings. This function is very helpful during commissioning before putting the equipment into service.

Furthermore, all above functions can be realized in a remote terminal with special softwarethrough a communication bus via an Ethernet port.

This chapter will describe human machine interface (HMI), menu tree and LCD display of theequipment. In addition, how to input settings using keypad is described in detail.

7.2 Design

The following operation instructions are specific for the PRS-7391 device, and the operation instructions for other seriesof PRS devices are similar.

The human machine interface (HMI) provides several modules for operating the relay. The HMI including:

- A 320×240 dot matrix color LCD with backlight for monitoring the relay status, fault report and setting etc.
- 10 LED indicators on the front panel of the device for denoting the status of fault, alarm etc.
- An 9-key keypad on the front panel of the device for full access to the device.
- An Ethernet R45 interface (generally used by the manufacture debugging personnel).

7.2.1 LED Indicator

The device is equipped with 10 indicator lights with the functions and implications shown in Table 7.2.1.

Table 7.2.1 Function and Implication of Indicator Light

Name of indicator light	Logic	Implication
Run	Normally on	Device is under normal working condition
	Off	Device is under abnormal working condition
Fault	Normally on	Fault exists, and it is unrecoverable or seriously affects working condition of the device.
	Off	No fault
Alarm	Normally on	Fault exists, and it is recoverable or does not affect normal operation of device.
	Off	No alarm
Synchronization	Normally on	The device synchronizes with at least one external reference source input.
	Off	No synchronization of device

Name of indicator light	Logic	Implication
Pulse per second	Flashing	Rhythm of pulse per second
	Off	No pulse output
BDS	Normally on	BDS is normal
	Off	BDS is abnormal or not been applied
GPS	Normally on	GPS is normal
	Off	GPS is abnormal or not been applied
IRIG-B1	Normally on	IRIG-B1 is normal
	Off	IRIG-B1 is abnormal or not been applied
IRIG-B2	Normally on	IRIG-B2 is normal
	Off	IRIG-B2 is abnormal or not been applied

7.2.2 Keypad

The keypad contains push-buttons which are used to navigate in different views or menus. The push-buttons are also used to acknowledge alarms, reset indications.

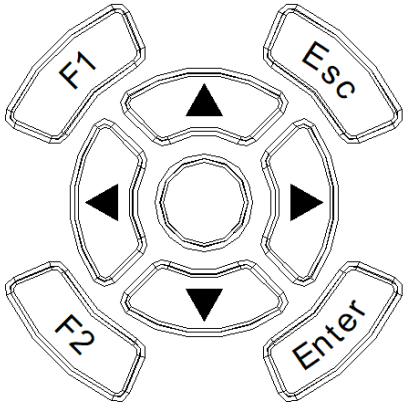


Figure 7.2.1 Structural Diagram of Keypad

Layout of device keypad is shown above, including 8 keys: “▲” “▼” “◄” “►” “Ok” “Cancel” “+” “-” and “reserve (empty)”.

“▲”, “▼”, “◄” and “►”	Key“▲”, “▼”, “◄”and“►”are used to change contents displayed in interface of current layer, to increase or decrease numbers, to move cursor up and down and to move display information. “◄”and“►” can be used for page turning under multi-page display.
“Enter” and “Eec”	“Enter” is used to modify or perform current options. “Eec” is used to exit a menu or to Cancel modification. Switching between each layer of interface is obtained through key “Enter” and “Eec”.

	When the device is powered, the main interface appears. After pressing “Eec”, enter the first-level menu interface, and if press “Enter” at the moment, enter into the second-level menu interface. At this moment, press “Eec” to return to the first-level menu interface, and then press “Enter” to return to the main interface.
“F1” and “F2”	“+/F1” and “-/F2” can be used for adding and subtracting of figure or both the keys can be used as function keys. When used as figure keys, adding and subtracting of figure can be applied when it is required to set figure parameter. When used as function keys, the functions can be defined under different menus. See the following descriptions.
“Reserve”	Standby, and not configured at present

7.2.3 LCD

PRS-7391 provides a 320×240 dot matrix color LCDscreen on the front panel. The user can fully view the information and control the relay with the LCD.

The LCD lights up in the following states:

- The device is power on and is ready to serve.
- There is any action or alarm issued during the relay service.
- When the user press any key on the keypad.

To extend the service life of the LCD, the backlight of the LCD will turn off automatically when there is no operation in 2 minutes in normal conditions.

7.3 Menu Tree

7.3.1 Main Display Interface

After initializing the device, the following interface is displayed:

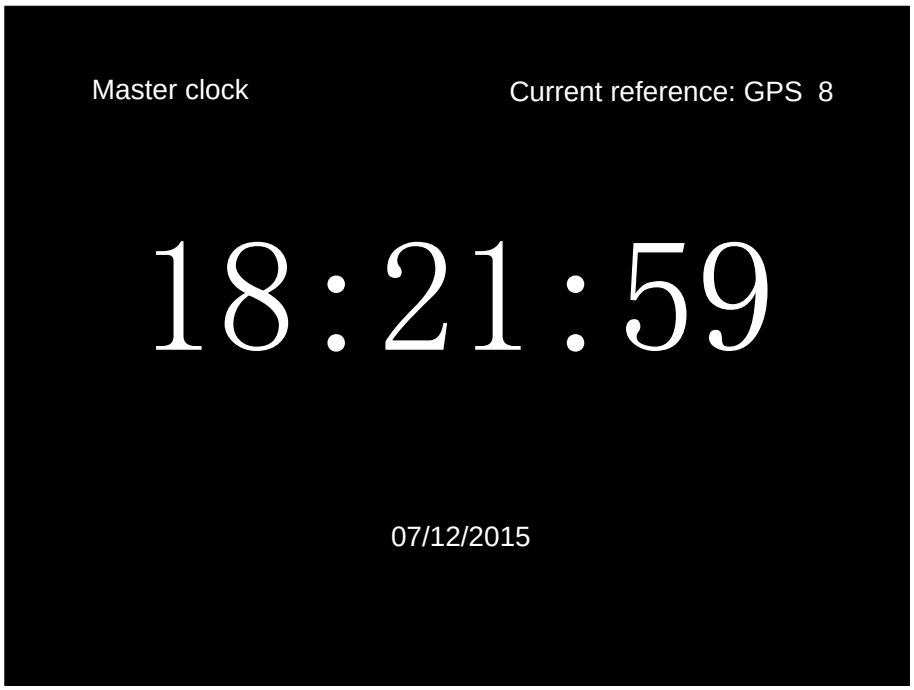


Figure 7.3.1 Display of Main Interface of Device

The following shows information of the main interface:

- Master or slave configuration of the device is displayed in the top left corner in the interface. Two states can be displayed: “master clock” and “slave clock”.
- Both the current reference time source and related number of satellites captured by the devices are displayed in the top right corner of the interface. Five states can be displayed: “BDS”, “GPS”, “IRIG-B1”, “IRIG-B2” and “local clock”.
- Current time is displayed in the center of the interface with the format of “h: m: s”.
- Current date is displayed at the bottom middle of the interface.

7.3.2 Main Menu

Main menu of the device is arranged according to the following sequences: device status, parameter setting, log query, ex-factory information. The main menu is shown as follows:

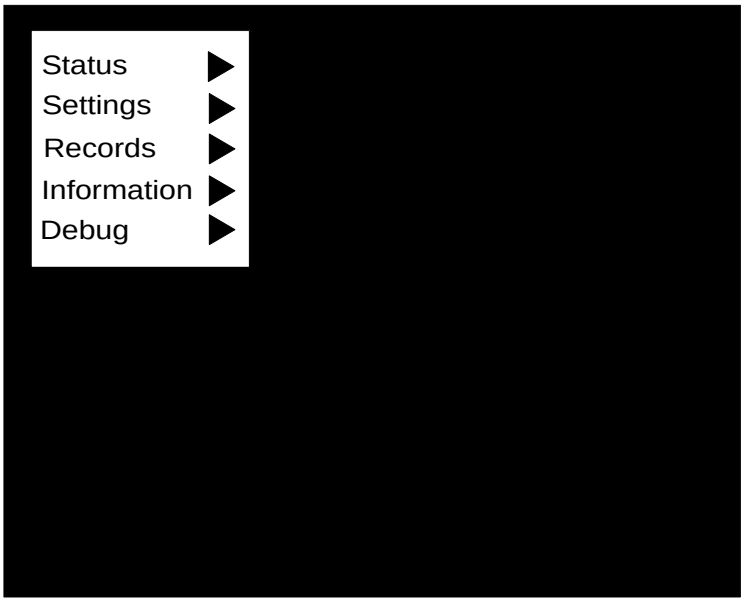


Figure 7.3.2 Main Menu of Device

7.3.3 Device Status Menu

This menu is mainly used to display some real-time states, including self-supervision and clock sources states.

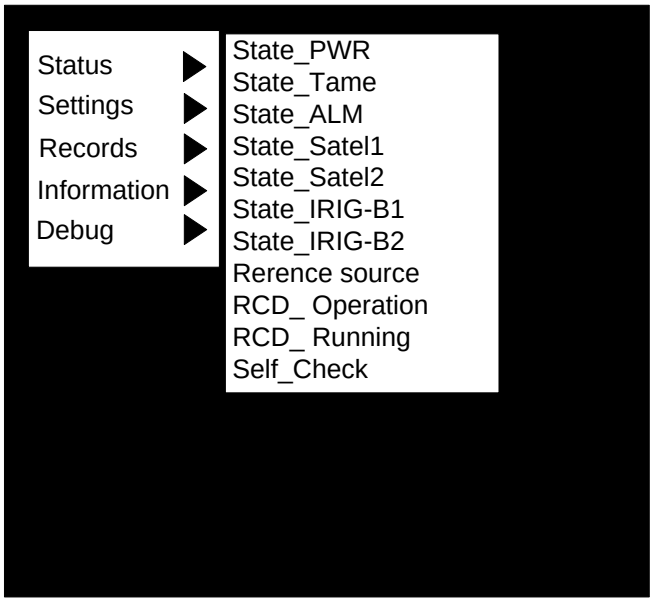


Figure 7.3.3 Diagram of Device Status Menu

Table 7.3.1 Contents and Implications of Device Status Menu

No.	Item	Description
1	State_PWR	Operating state of current power supply(Normal,Abnormal)
2	State_Tame	Tame status of current frequency source of device(Tame,No tame)
3	State_ALM	Current alarm status of device

No.	Item	Description
4	State_Satel1	State of the satellite channel 1,include: ● Synchronization state of the satellite channel 1 (synchronize, Not synchronized) ● Antenna state of the satellite channel 1(Invalid,Valid) ● Receiver state of the satellite channel 1 (Invalid,Valid) ● Connected satellite number of the satellite channel 1 ● Time difference, between the time source and the internal clock, of the satellite channel 1 ● Quality state of the receiver 1 output (Invalid,Valid) Leapsecond state of the satellite channel 1(Normal,Positive leapsecond,Negative leapsecond)
5	State_Satel2	State of the satellite channel 2,include: ● Synchronization state of the satellite channel 2 (synchronize, Not synchronized) ● Antenna state of the satellite channel 2(Invalid,Valid) ● Receiver state of the satellite channel 2 (Invalid,Valid) ● Connected satellite number of the satellite channel 2 ● Time difference, between the time source and the internal clock, of the satellite channel 2 ● Quality state of the receiver 2 output (Invalid,Valid) Leapsecond state of the satellite channel 1(Normal,Positive leapsecond,Negative leapsecond)
6	State_IRIG-B1	State of the IRIG-B1,include: ● Synchronization state of the IRIG-B1 (synchronize, Not synchronized) ● Accuracy class(0~F) ● Time difference, between the time source and the internal clock, of the satellite IRIG-B1 Leapsecond state of the satellite IRIG-B 1(Normal,Positive leapsecond,Negative leapsecond)
7	State_IRIG-B1	State of the IRIG-B2,include: ● Synchronization state of the IRIG-B2 (synchronize, Not synchronized) ● Accuracy class(0~F)

No.	Item	Description
		● Time difference, between the time source and the internal clock, of the satellite IRIG-B2 Leapsecond state of the satellite IRIG-B 2(Normal,Positive leapsecond,Negative leapsecond)
8	reference source	Current reference source(BDS,GPS,IRIG-B1,IRIG-B2)
9	RCD_Operation	Device operation record
10	RCD_Running	Power on / off record
11	Self_Check	Device self-check record

7.3.4 Parameter setting menu

“Parameter setting” menu includes: master-slave setting, serial port information, IP configuration, delay compensation, input time source, output setting, ex-factory date, operation date. Please refer to the chapter " Settings" for the detail of all settings.

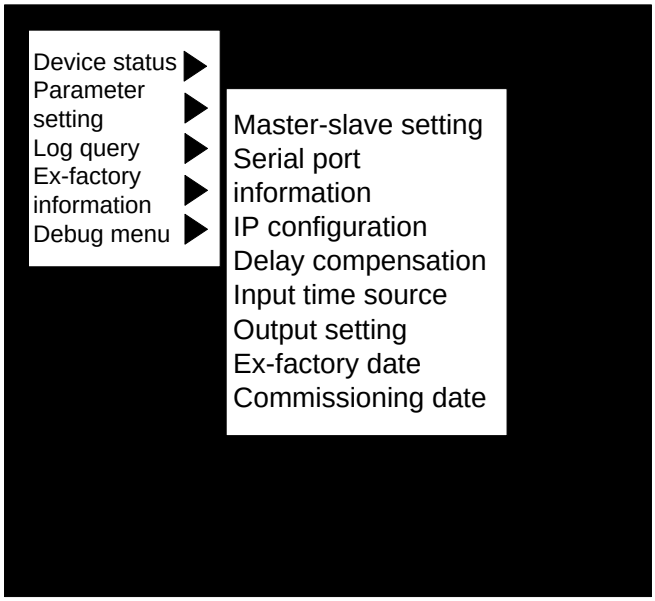


Figure 7.3.4 Diagram of Parameter Setting Menu of Device

7.3.5 Log query menu

1) Display contents of latest 1200 logs correctly;
2) Each log include generation time of log and triggering event;
3) Please see Table 8 for log record triggering condition of time synchronization device

Table 7.3.2 Log Record Triggering Condition of Time Synchronization Device

Triggering condition	Master clock unit	Slave clock unit
BDS signal is abnormal	■	-
BDS signal recovers	■	-

Triggering condition	Master clock unit	Slave clock unit
GPS signal is abnormal	■	-
GPS signal recovers	■	-
The n.th IRIG-B code input signals abnormal	■	■
The n.th IRIG-B code input signals recovers	■	■
Status of BDS antenna abnormal	■	-
Status of BDS antenna recovers	■	-
Status of GPS antenna abnormal	■	-
Status of GPS antenna recovers	■	-
Status of receiving module of BDS satellite abnormal	■	-
Status of receiving module of BDS satellite recovers	■	-
Status of receiving module of GPS satellite abnormal	■	-
Status of receiving module of GPS satellite recovers	■	-
Status of time jump detection abnormal	■	■
Status of time jump detection recovers	■	■
Status of tame crystal oscillator abnormal	■	■
Status of tame crystal oscillator recovers	■	■
Initial status abnormal	■	■
Initial status recovers	■	■
Status of power supply module abnormal	■	■
Status of power supply status recovers	■	■
Result of time source selection	■	■

7.3.6 Ex-factory information

“Ex-factory information” menu includes: software information, bottom layer information, ex-factory date and commissioning date.

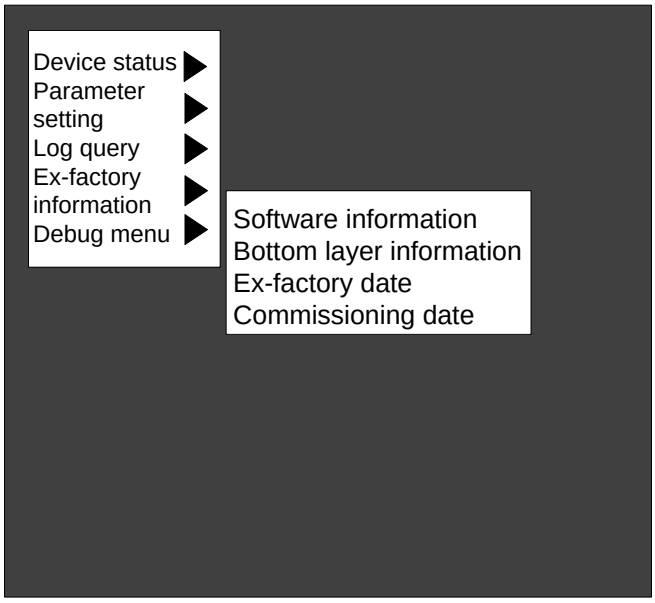


Figure 7.3.5 Diagram of Ex-factory Information Menu of Device

Table 7.3.3 Contents and Implications of Ex-factory Information Menu

First-level menu	Contents included	Implication
Ex-factory information	Software information	Type of device, version of program, check code of program, generation time of program ,unique code of device
	Operating system information	Version information of Operating system of CPU plug-in module
	Ex-factory information	Ex-factory date can be set only once, so current time of device may be utilized during first setting.
	commissioning date	Commissioning date can be set only once, so current time of device may be utilized during first setting.
Remarks: please confirm the password (0001) after modifying contents of menu.		

8 Installation

8.1 Overview

The device 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.

8.2 Safety Information

Modules and units may only be replaced by correspondingly trained personnel. Always observe the basic precautions to avoid damage due to electrostatic discharge when handling the equipment.

In certain cases, the settings have to be configured according to the demands of the engineering configuration after replacement. It is therefore assumed that the personnel who replace modules and units are familiar with the use of the operator program on the service PC.

WRANING!

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 PWR module.

NOTICE!

Industry packs and ribbon cables may **ONLY** be replaced on a workbench for electronic equipment. Electronic components are sensitive to electrostatic discharge when not in the unit's housing.

NOTICE!

Jumper links may **ONLY** be changed on a workbench for electronic equipment. Electronic components are sensitive to electrostatic discharge when not in the unit's housing.

NOTICE!

A module can **ONLY** be inserted in the slot designated in the chapter 5. 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 device installed in a grounded cubicle in an HVswitchgear 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 the board that has been removed from the cubicle on a workbench designed for electronic equipment and wear a grounded wristband. Do not wear a grounded wristband, however, while inserting or withdrawing units.
- Always store and ship the electronic boards in their original packing. Place electronic parts in electrostatic screened packing materials.

8.3 Shipment Checking

Check that the consignment is complete immediately upon receipt. Notify the nearest CYG 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 Company or agent.

If the equipment is not going to be installed immediately, store all the parts in their original packing in a clean dry place at a moderate temperature. The humidity at a maximum temperature and the permissible storage temperature range in dry air are listed in Chapter “Technical Data”.

8.4 Required Material and Tools

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 device is mounted in cubicles).

8.5 Device Location and Ambient Conditions Overview

NOTICE!

Excessively high temperature can appreciably reduce the operating life of this device.

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.

Since every piece of technical equipment can be damaged or destroyed by inadmissible ambient conditions, such as:

- The location should not be exposed to excessive air pollution (dust, aggressive substances).
- Surge voltages of high amplitude and short rise time, extreme changes of temperature, high levels of humidity, severe vibration and strong induced magnetic fields should be avoided as far as possible.
- Air must not be allowed to circulate freely around the equipment.

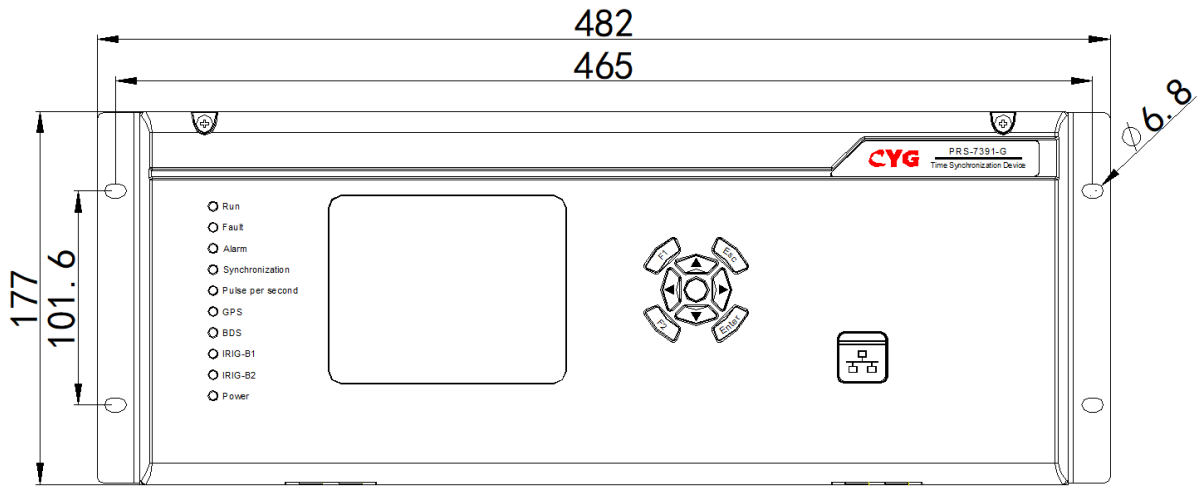
The equipment can in principle be mounted in any attitude, but it is normally mounted vertically (visibility of markings).

8.6 Mechanical Installation

NOTICE!

It is necessary to leave enough space top and bottom of the cutout in the cubicle for heat emission of this device.

This device is made of a single layer 4U chassis. Following figure shows the dimensions and cutout size in the cubicle of this device for reference in mounting.



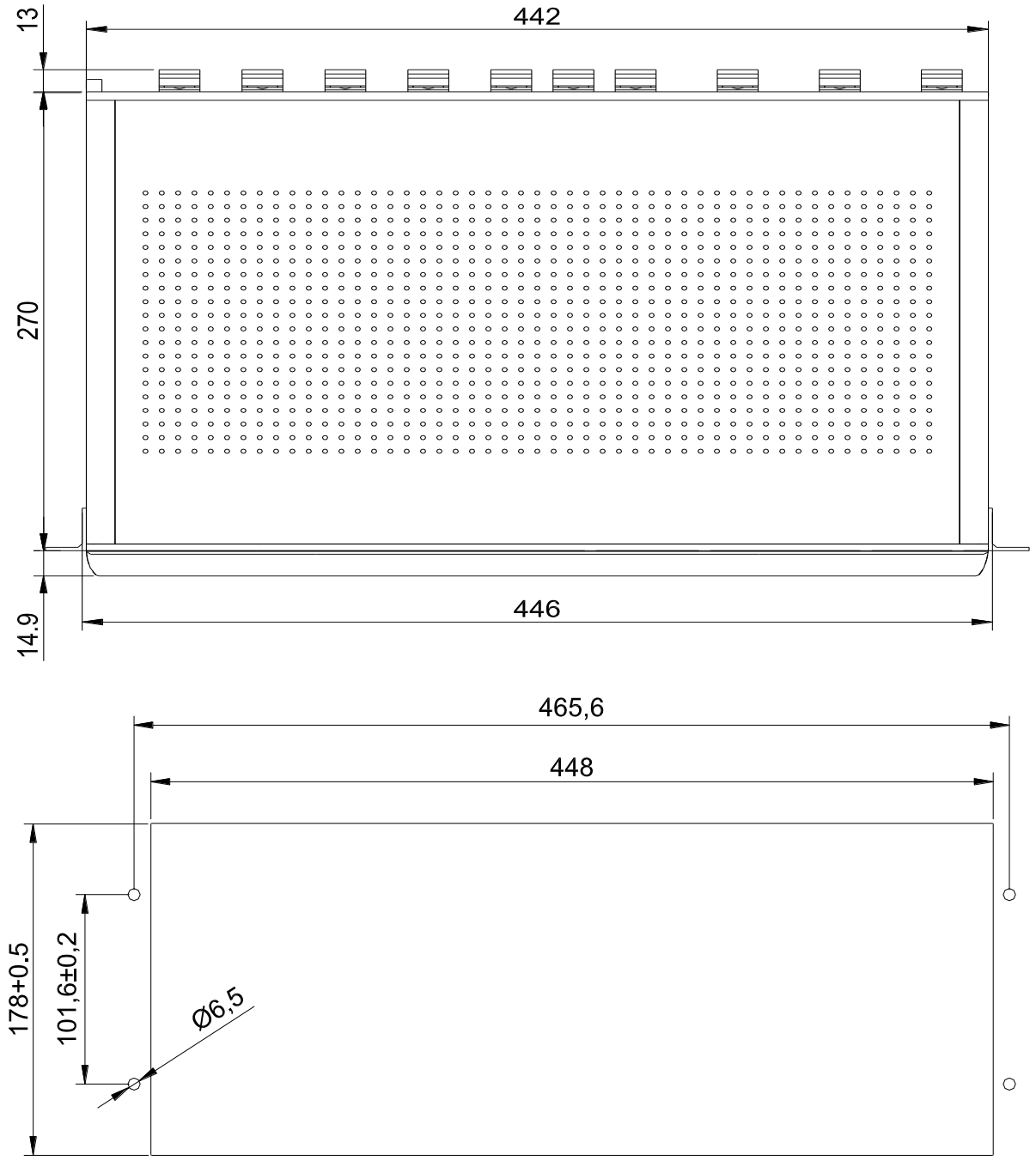


Figure 8.6.1 Dimensions (unit: mm, 4U 19" rack)

8.7 Electrical Installation and Wiring

8.7.1 Grounding Guidelines

NOTICE!

All these precautions can only be effective if the station ground is of good quality.

Switching operations in HV installations generate transient over voltages on control signal cables. There is also a background of electromagnetic RF fields in electrical installations that can induce spurious currents in the devices themselves or the leads connected to them.

All these influences can influence the operation of electronic apparatus.

On the other hand, electronic apparatus can transmit interference that can disrupt the operation of other apparatus.

In order to minimize these influences as far as possible, certain standards have to be observed with respect to grounding, wiring and screening.

8.7.2 Cubicle Grounding

The cubicle must be designed and fitted out such that the impedance for RF interference of the ground path from the electronic device to the cubicle ground terminal is as low as possible.

Metal accessories such as side plates, blanking plates etc., must be effectively connected surface-to-surface to the grounded frame to ensure a low-impedance path to ground for RF interference. The contact surfaces must not only conduct well, they must also be non-corroding.

NOTICE!

If the above conditions are not fulfilled, there is a possibility of the cubicle or parts of it forming a resonant circuit at certain frequencies that would amplify the transmission of interference by the devices installed and reduce their immunity to induced interference.

Movable parts of the cubicle such as doors (front and back) or hinged equipment frames must be effectively grounded to the frame by three braided copper strips.

The metal parts of the cubicle housing and the ground rail are interconnected electrically conducting and corrosion proof. The contact surfaces shall be as large as possible.

NOTICE!

For metallic connection, please observe the voltage difference of both materials according to the electrochemical code.

The cubicle ground rail must be effectively connected to the station ground rail by a grounding strip (braided copper).

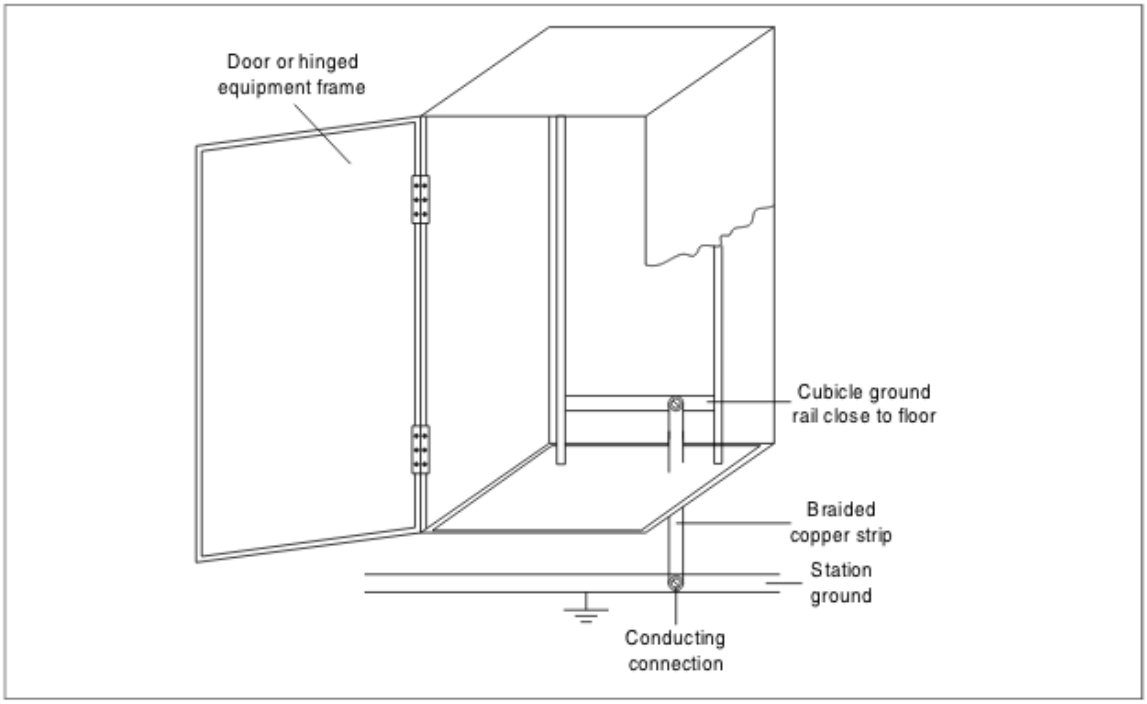


Figure 8.7.1 Cubicle grounding system

8.7.3 Device Ground Connection

There is a ground terminal on the rear panel, and the ground braided copper strip can be connected with it. Take care that the grounding strip is always as short as possible. The main thing is that the device is only grounded at one point. Grounding loops from unit to unit are not allowed.

There are some ground terminals on some connectors of this device , and the sign is “GND”. All the ground terminals are connected in the cabinet of this device. Therefore, the ground terminal on the rear panel (see Figure 8.7.2) is the only ground terminal of this device.

Figure 8.7.2 Device ground terminal

8.7.4 Grounding Strips

High frequency currents are produced by interference in the ground connections and because of skin effect at these frequencies, only the surface region of the grounding strips is of consequence.

The grounding strips must therefore be of (preferably tinned) braided copper and not round copper conductors, as the cross-section of round copper would have to be too large.

Proper terminations must be fitted to both ends (press/pinch fit and tinned) with a hole for bolting them firmly to the items to be connected.

The surfaces to which the grounding strips are bolted must be electrically conducting and non-corroding.

The following figure shows the ground strip and termination.

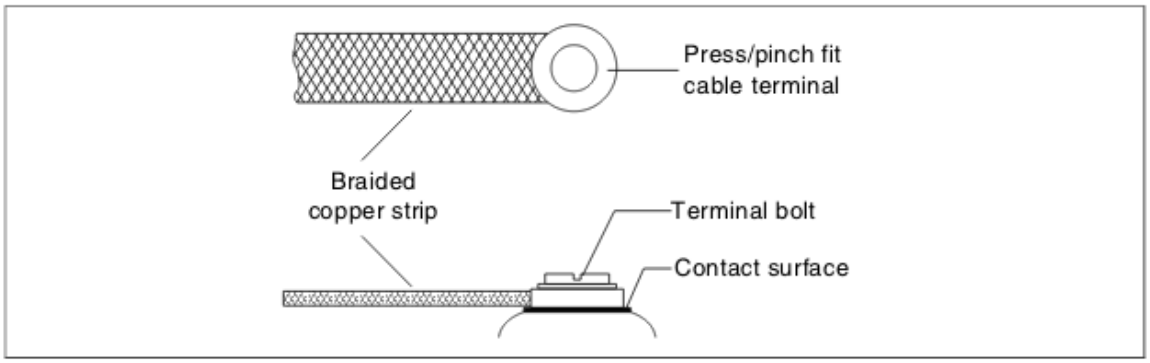


Figure 8.7.3 Ground strip and termination

8.7.5 Wiring Guideline

There are several types of cables that are used for connection of this device. Recommendation of cable is:

- Grounding: braided copper cable, 2.5mm 2 ~ 6.0mm 2
- Power supply, binary inputs & outputs: stranded conductor, 1.0mm 2 ~ 2.5mm 2
- Serial communication: 4-core shielded cable
- Ethernet communication: 4-pair twisted shielded cable (category 5E)

8.7.6 Antenna Installation

The active receiving antenna includes three parts: the head, the feeder and the support. The diameter of the mushroom-shaped head is 96mm and the hight is 126mm. The length of the feeder is 30m (should be declared if there is other requirement). The longer the feeder is, the more serious the signal attenuation will be. Thus, a feeder longer than 60m should be sectionned by amplifier.

To realize a good reception of satellite signal, the antenna head should be installed outdoor with as large reception range as possible.

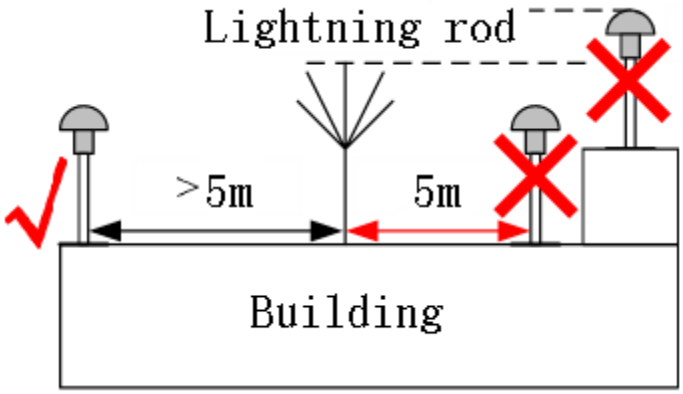


Figure 8.7.4 Antenna head installation

NOTICE!

The antenna may be installed in an open space if it is impossible to be installed on the top of a building. Make sure that there is no roof on the top and the installation height is no lower than the surronding obstacle.

NOTICE!

It is possibe to cover a glass or plastic sheild over the antenna head. Make sure that there is no metallic composant in the sheild.

NOTICE!

This antenna has a great anti-interference capability, while if the inteference signal is too strong, there will still be influence. So it is suggested to install the antenna as far as possible to avoid any other transimission or reception antenna.

NOTICE!

The low-loss coaxial cable feeder is one of the keys in signal transmission. It is suggested to use the cable pipe while wiring in case of animal bit or corrosion.

NOTICE!

Because of outdoors installation, a surge arrestor is obligatory. The arrestor should be installed between the antenna and the device. It also should be directly and independently grounded.

9 Commissioning

9.1 Overview

This device is numerical in their design, implementing all functions in software. The device employs a high degree self-checking so in the unlikely event of a failure, it will give an alarm.

Blank commissioning test and setting records are provided at the end of this manual for completion as required.

Before carrying out any work on the equipment, the user should be familiar with the contents of the safety and technical data sections and the ratings on the equipment's rating label.

9.2 Safety Instructions

WARNING!

ONLY qualified personnel should work on or near 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.

Particular attention must be drawn to the following:

- The earthing screw of the device must be connected solidly to the protective earth conductor before any other electrical connection is made.
- Hazardous voltages can be present on all circuits and components connected to the supply voltage or to the measuring and test quantities.
- Hazardous voltages can be present in the device even after disconnection of the supply voltage (storage capacitors).
- The limit values stated in the Chapter "Technical Data" must not be exceeded at all, not even during testing and commissioning.
- When testing the device with secondary test equipment, make sure that no other measurement quantities are connected. Take also into consideration that the trip circuits and may be close commands to the circuit breakers and other primary switches are disconnected from the device unless expressly stated.

9.3 Product Checks

These product checks cover all aspects of the device that 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.

9.3.1 With the Device De-energized

This device is numerical and the hardware is continuously monitored. Commissioning tests can be kept to a minimum and need only include hardware tests and conjunctive tests. The function tests are carried out according to user's correlative regulations.

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

- Hardware tests

  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 DC power is supplied.

- Function tests

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

- Conjunctive tests

  These tests are performed after the device is connected with the primary equipment and other external equipment.

9.3.1.1 Visual Inspection

After unpacking the product, check for any damage to the device case. If there is any damage, the internal module might also have been affected, contact the vendor. The following items listed are necessary.

- Device panel

  Carefully examine the device panel, device inside and other parts inside to see that no physical damage has occurred since installation.

- Panel wiring

  Check the conducting wire that is used in the panel to assure that their cross section meeting the requirement. Carefully examine the wiring to see that they are no connection failure exists.

- Device plug-in modules

  Check each plug-in module of the equipment on the panel to make sure that they are well installed into the equipment without any screw loosened.

- Earthing cable

  Check whether the earthing cable from the panel terminal block is safely screwed to the panel steel sheet.

- Switch, keypad, isolator binary inputs and push button

  Check whether all the switches, equipment keypad, isolator binary inputs and push buttons work normally and smoothly.

9.3.1.2 Insulation Tests(if required)

Insulation resistance tests are only necessary during commissioning if it is required for them to be done and they have not been performed during installation.

Isolate all wiring from the earth and test the isolation with an electronic or brushless insulation tester

at a DC voltage not exceeding 500V, The circuits need to be tested should include:

- Voltage transformer circuits
- Current transformer circuits
- DC power supply
- Optic-isolated control inputs
- Output contacts
- Communication ports

The insulation resistance should be greater than 100MΩ at 500V.

Test method:

To unplug all the terminals sockets of this device, and do the Insulation resistance test for each circuit above with an electronic or brushless insulation tester.

On completion of the insulation resistance tests, ensure all external wiring is correctly reconnected to the device.

9.3.1.3 External Wiring

Check that the external wiring is correct to the relevant device diagram and scheme diagram. Ensure as far as practical that phasing/phase rotation appears to be as expected.

Check the wiring against the schematic diagram for the installation to ensure compliance with the customer’s normal practice.

9.3.1.4 Power Supply

WARNING!

Energize this device ONLY if the power supply is within the specified operating range in the chapter "Technical Data" .

The device only can be operated under the auxiliary pow er supply depending on the device’s nominal power supply rating.

The incoming voltage must be within the operating range specified in the chapter "Technical Data".before energizing the device, measure the auxiliary supply to ensure it within the operating range.

Other requirements to the auxiliary power supply are specified in the chapter "Technical Data". See this section for further details about the parameters of the power supply.

9.3.2 With the Device Energized

The following groups of checks verify that the device hardware and software is functioning correctly and should be carried out with the auxiliary supply applied to the device.

The current and voltage transformer connections must remain isolated from the device for these checks. The trip circuit should also remain isolated to prevent accidental operation of the associated circuit breaker.

9.3.2.1 Front Panel LCD Display

Connect the device to DC power supply correctly and turn the device on. Check program version and forming time displayed in command menu to ensure that are corresponding to what ordered.

9.3.2.2 LED Test

Apply the rated DC power supply and check that t he " Run " LED is lighting in green. We need to emphasize that the " Run" LED is always lighting in operation course ex cept that the equipment find seriou s errors in It.

Produce one of the abnormal conditions listed in Chapter "Supervision" , the " Fault" LED will light in red . When abnormal condition reset, the " Fault " LED extinguishes.

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

9.4 Final Check

- Check cables behind the panel which shall be in line with the installation drawing. Make sure all temporary wiring and anti-misoperation measures have recovered.
- Switch on the power supply.
- Check external antenna, and GPS, BDS, B1 and B2 signal shall be normal and without alarm.
- Configure the device adhere to requirements for configuration.
- The device will be normally put into operation if there is no fault of other parts.

10 Maintenance

This device is designed to require no special maintenance. All measurement and signal processing circuit are fully solid state. All input modules are also fully solid state. The output relays are hermetically sealed.

Since the device is almost completely self-monitored, from the measuring inputs to the output relays, hardware and software defects are automatically detected and reported. The self-monitoring ensures the high availability of the device and generally allows for a corrective rather than preventive maintenance strategy. Therefore, maintenance checks in short intervals are not required.

Operation of the device is automatically blocked when a hardware failure is detected. If a problem is detected in the external measuring circuits, the device normally only provides alarm messages.

10.1 Appearance Check

The device case should be clean without any dust stratification. Case cover should be sealed well. No component has any mechanical damage and distortion, and they should be firmly fixed in the case. Device terminals should be in good condition. The keys on the front panel with very good feeling can be operated flexibly.

Check weld spots on PCB whether they are well soldered without any rosin joint. All dual inline components must be well plugged.

10.2 Failure Tracing and Repair

Failures will be detected by automatic supervision or regular testing.

When a failure is detected by supervision, a remote alarm is issued and the failure is indicated on the front panel with LED indicators and LCD display. It is also recorded in the event record. Failures detected by supervision are traced by checking the " Superv State " screen on the LCD.

When a failure is detected during regular testing, confirm the following:

- Modules are securely inserted in position
- Correct DC power voltage is applied
- Test procedures comply with those stated in the manual

10.3 Failed Module Replacement

WARNING!

Module can ONLY be replaced while the device power supply is switched off.

ONLY appropriately, trained and qualified personnel can perform the replacement by strictly observing the precautions against electrostatic discharge.

WARNING!

Five 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!

Take anti-static measures such as wearing an earthed wristband and placing modules

on an earthed conductive mat when handling a module. Otherwise, electronic components could be damaged.

CAUTION!

Check the device configuration after a replacement of module. Unintended operation of device may occur.

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

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

Check that the replacement module has an identical module name (AI, PWR, MON, BI, BO, etc.) and hardware type-form as the removed module. Furthermore, the MON module replaced should have the same software version. In addition, the AI and PWR module replaced should have the same ratings.

The module name is indicated on the bottom front of the module.

- To replace a module

1. Switch off the DC power supply.
2. Disconnect the trip outputs.
3. Unscrew the module connector.
4. Unplug the connector from the target module.
5. Unscrew the module.
6. Pull out the module.
7. Inset the replacement module in the reverser procedure.
8. After replacing the MON module, input the application-specific setting values again.

- To replace the Human Machine Interface Module (HMI panel)

1. Open the device front panel.
2. Unplug the ribbon cable on the front panel by pushing the catch outside.
3. Detach the HMI module from the device.
4. Attach the replacement module in the reverse procedure.

10.4 Storage

The spare device or module should be stored in a dry and clean room. Based on IEC standard 60255-1 the storage temperature should be from -40°C to +70°C, but the temperature of from 0°C to +40°C is recommended for long-term storage.

11 Decommissioning and Disposal

11.1 Storage

WARNING!

Switch **OFF** the external miniature circuit breaker of device power supply **BEFORE** disconnecting the power supply cable connected to the PWR module.

WARNING!

KEEP an adequate safety distance to live parts of the power substation.

1. Switching off

To switch off this device, switch off the external miniature circuit breaker of the power supply.

2. Disconnecting Cables

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

3. Dismantling

The device rack may now be removed from the system cubicle, after which the cubicles may also be removed.

11.2 Disposal

NOTICE!

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

12 Manual Version History

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

Table 11.2.1 Manual version and modification history records

Manual Version		Software Version	Date	Description of change
Source	New			
Beta	1.00	1.00	2014-04-15	Form the original manual.
1.00	1.01	1.01	2015-05-21	Update the number of the binary inputs and binary outputs.. Add the binary input hardware demo diagrams in the binary input tables. Update the description of IEC61850 dual-MMS Ethernet.
1.01	1.02	1.02	2016-01-24	Add parameters of fault location function. Output TEMP_RL is added Internal improvements. Update the configurable signals.
1.02	1.03	1.03	2016-08-16	Update the communication description. Update the mechanical specifications. Update the main CPU module picture. Update the setting list.
1.03	2.01	2.01	2017-12-16	Update the document format.
2.01	2.04	2.04	2019-12-30	Add the description of DC48V power supply