Blue Guardian Temperature Control-Precise Temperature Regulation

# TEC Thermostat (TTD6101) User Manual

V1.01

| Update record of specification | | | |
|---|---|---|---|
| Date | Edition | Update content | Remarks |
| 2025-08-27 | V1.00 | TTD6101 User Manual | |
| 2025-09-19 | V1.01 | Correct the description of some part parameters | |
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If you encounter any difficulties or technical issues while using the TEC thermostat, please feel free to contact us. We will provide you with the most satisfactory and prompt technical support. We also welcome your valuable feedback.

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Blue Guardian Temperature Control-Precise Temperature Regulation

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## Copyright Statement



## claim of trademark

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## pay attention to

Due to device version upgrades or other reasons, this document may be updated periodically. This manual is for internal reference only and will not be updated separately.

## scope of application

This instruction manual is applicable to the use of **TEC Thermostat (TTD6101)**.

# Catalogue

# Preface

## Company Profile

Guangzhou Blue Guardian is a high-tech enterprise specializing in industrial temperature control, automation control, and information system integration. It provides precision temperature control, environmental monitoring, and industrial data interconnection solutions for industries including optoelectronics manufacturing, semiconductors, thermal equipment, new energy, rubber and plastics, as well as research institutions and universities.

With the mission of 'Smart Temperature Control for More Efficient and Safe Industries', the company provides customers with a series of temperature control products featuring high-precision data acquisition and intelligent control algorithms. These include modular thermostats, TEC thermostats, integrated thermostats, power regulators, I/O acquisition modules, protocol gateways, and host computer software platforms.

## unit type

| Device name | Model | Remarks |
|---|---|---|
| TEC thermostat | TTD6101 | |

## Suitable Object

Applicable to:

R&D engineer, technical support engineer, end user

## Brief Introduction of the Content

This document describes the usage of TEC thermostats as follows.

| Chapters and sections | Content | Remarks |
|---|---|---|
| 1 Device Features | Introduce the overall functional performance index parameters of the equipment | |
| 2 Device installation and connection | Introduction to Equipment Installation and Wiring Marking | |
| 3 Device Application and Debugging | Introduction to Network and Debugging Equipment of Device Application | |
| 4 Common faults | Introduction to Common Equipment Faults and Troubleshooting | |
| 5 Maintenance | Introducing equipment maintenance | |
| 6 safety requirements | Safety Tips for Using the Device | |

# 1 Device Features

About this chapter

| Chapters and sections | Content | Remarks |
|---|---|---|
| 1.1 Device Overview | Display device basic information | |
| 1.2 demonstration of the type | Introduce the device model and combination usage instructions | |
| 1.3 Device Features | Introduction to the basic features of the device | |
| 1.4 thermostat parameter | Display device specifications | |

## 1.1 Device Overview

The TEC thermostat is a highly integrated temperature control device that combines temperature acquisition with bidirectional DC temperature control output, enabling direct drive.

The DC load (such as TEC cooling elements) eliminates the cumbersome steps of external collectors and solid-state relays. This thermostat operates based on real-time data acquisition.

The temperature value (PV) and the user-set target value (SV) are used to intelligently calculate the PID control ratio and adjust the cooling/heating power via PWM.

The device's output enables precise temperature control. Additionally, it features an RS485 interface for uplink communication with host systems (e.g., PLCs).

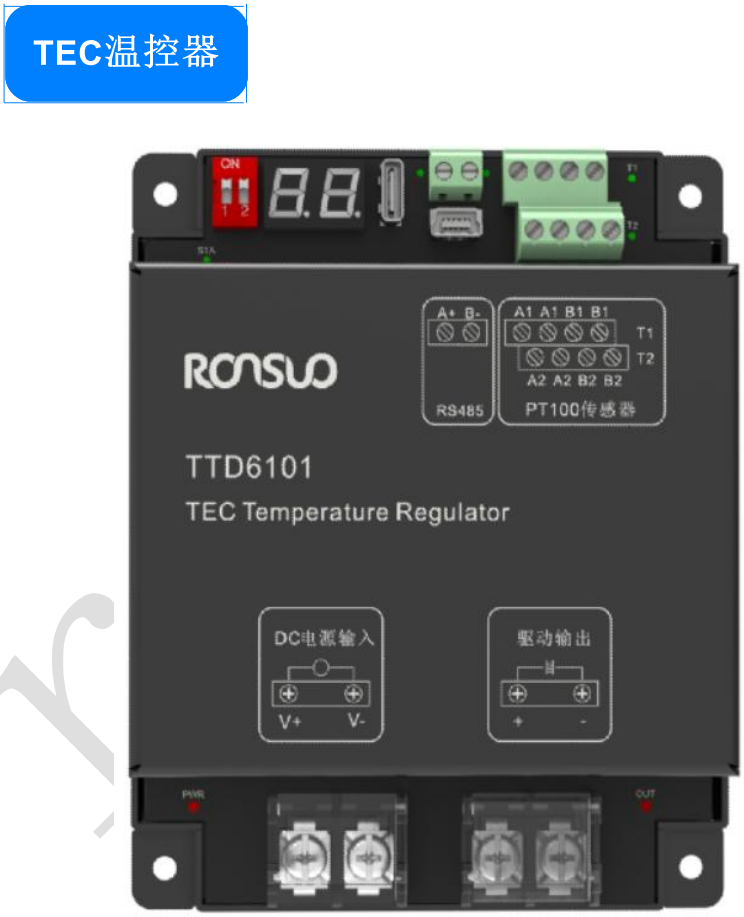
Establishes connections and supports the standard Modbus RTU communication protocol to ensure efficient and compatible data transmission.

The device features precise temperature control, good stability, strong anti-interference capability, and multi-stage over-temperature protection. It stops PWM operation when temperature control or over-temperature alarms occur.

The output function, which shuts down when the temperature exceeds the upper limit, effectively safeguards the controlled items.

## 1.2 Demonstration of the Type

Front view of the TEC thermostat (TTD6101), with detailed product appearance as shown below:




（**TTD6101**正面视图）

Device model list:

| Order number | Name | Model | Explain |
|---|---|---|---|
| 1 | TEC thermostat | TTD6101 | 2 One PT100 temperature acquisition channel (4-wire) for temperature control/patrol, one 30A DC load bidirectional output channel (TEC cooling element), one upstream RS485 interface for standard Modbus RTU protocol communication, and screw-fixed installation. |

## 1.3 Device Features

### 1.3.1 Industrial Design

- Equipped with a high-performance industrial-grade 32-bit processor
- Supports long-term stable operation at-20 to 85°C
- Aluminum alloy shell, anti electromagnetic interference

### 1.3.2 Reliability and Stability

- With a watchdog design, ensure long-term stable operation of the equipment
- Implement comprehensive protective mechanisms to ensure equipment stability
- Power input interface with built-in surge and static protection
- Power input interface anti-reverse protection and load output channel short-circuit protection function

### 1.3.3 Product Usability

- Supports plug-and-play without complex configuration
- Communication standard: Modbus RTU protocol
- The host features a TYPE-C port on the front for easy debugging
- Supports upper computer software (TSC) configuration management

### 1.3.4 Product Features

- Supports 2-channel PT100 (4-wire) temperature acquisition (range-60 to 150°C)
- Supports 1-channel bidirectional DC control output (directly drives TEC heating or cooling)
- Supports the Modbus RTU standard protocol and function codes 01,03,05,06,15, and 16.
- The thermostat supports RS485 communication.
- The thermostat has a compact appearance and occupies minimal space.
- PID Parameter Setting and Self-tuning Function of Temperature Controller
- The device features multiple over-temperature protection mechanisms
- The device is equipped with output circuit breaker alarm and short-circuit protection functions.
- Temperature control accuracy: ≤±0.1℃, Resolution: 0.01℃

## 1.4 Thermostat Parameter

The TEC thermostat (TTD6101) device has the following detailed specifications.

| Technical Parameters of TTD6101 Thermostat | | |
|---|---|---|
| **Project** | | **Parameter** |
| Power supply for equipment | Mode of connection | 2P-8.0 Fence terminal block |
| | Working voltage | 24VDC（12~36V） |
| | Device power consumption | ≤1W (static) |
| | Power supply protection | Surge protection, static protection, reverse connection protection |
| Uplink serial communication | Interface type | RS485 |
| | Serial port count | 1 individual |
| | Communicating protocol | Standard Modbus RTU protocol, supporting function codes 01,03,05,06,15, and 16 |
| | Station address | Set station number addresses 1 to 4 by dialing |
| | 485 communicational parameter | Baud rate: 9600~115200<br>Default: 38400, N, 8, 1 (Baud rate, parity bit, data bit, stop bit) |
| | Transmission distance | ≤1000m |
| Acquisition channel | Mode of connection | Double-layer 8P-3.81 terminal block (4P per channel) |
| | Sensor type | PT100 (4-wire) thermistor |
| | Channel number | 2 Channel (1 for temperature control acquisition, 1 for inspection acquisition) |
| | Sampling period | ≤10ms |
| | Temperature measurement range | -60~150℃ |
| | Temperature measurement accuracy | ≤±0.2℃ |
| | Resolution ratio | 0.1°C/0.01°C, default: 0.01 |
| Outgoing channel | Interface type | 2P-8.0 Bar-type terminal block |
| | Output channels | 1 Channel (Voltage and device supply voltage-1 to) |
| | Output type | PWM switching mode |
| | Load current | ≤30A (directly drives the TEC cooling element to heat or cool) |

| | | |
|---|---|---|
| | Output protection | Short-circuit/overload protection, circuit breaker alarm detection |
| Design feature | Shell material | Aluminum alloy shell |

| | | |
|---|---|---|
| | Way to install | M3.5*4 threaded hole for fixed installation (see Section 2.1.1) |
| | Product size | 110mm*90mm*28mm (length x width x height) |
| Service environment | Working temperature | -20~85℃ |
| | Storage temperature | -20~105℃ |
| | Working humidity | 10~95% (no condensation) |
| Functional description | Pilot lamp | Power indicator, operation indicator, output indicator, alarm display digital tube |
| | Alarm indication | When an alarm is detected, it can be displayed on a digital tube or read from a register. |
| | Self-tuning | Channel auto-tuning support |
| | PID control | Open PID parameters |
| | Temperature control accuracy | ≤±0.1℃ |
| | Data communication | Modbus RTU (RS485) communication |

# 2 Device Installation and Connection

**About this chapter**

| Chapters and sections | Content | Remarks |
|---|---|---|
| 2.1 Device appearance dimensions | Describe the device's dimensions | |
| 2.2 equipment installation | Introduce the installation steps and precautions | |
| 2.3 Device interface function | Introduce the functions of each interface of the device | |

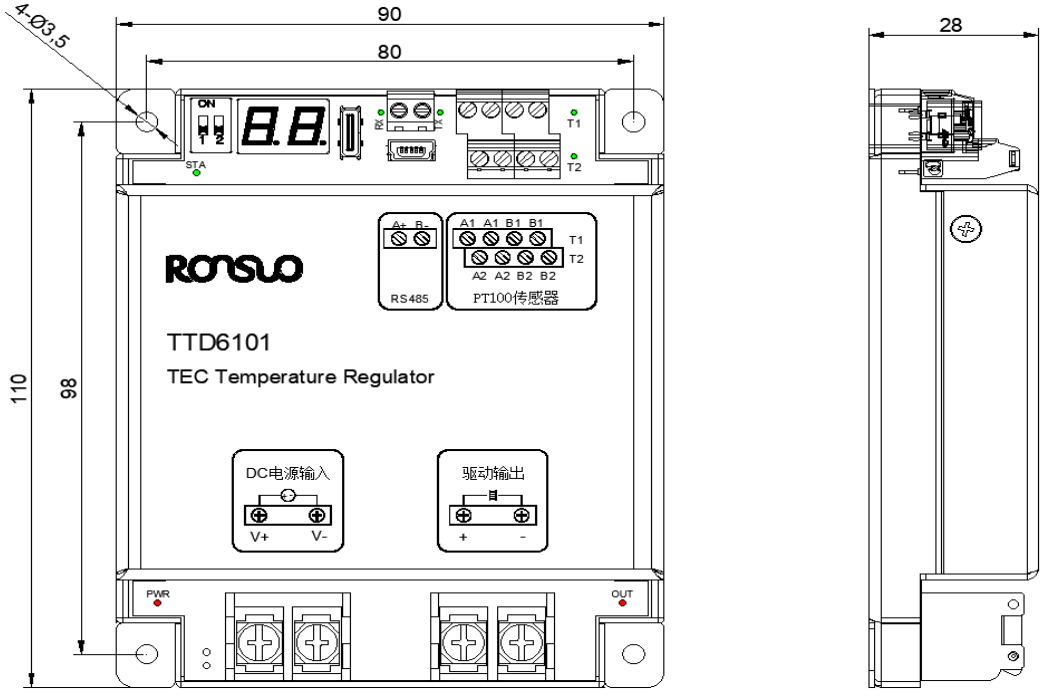
**pay attention to：**

The TEC thermostat must be properly installed to achieve its intended functionality. Always read the user manual carefully before installation. For any questions, please contact our company.

## 2.1 Device Appearance Dimensions

### 2.1.1 Thermostat Dimensions

The TEC thermostat (TTD6101) features the following dimensions, as shown in the figure below:



## 2.2 Equipment Installation

### 2.2.1 Installation Requirements

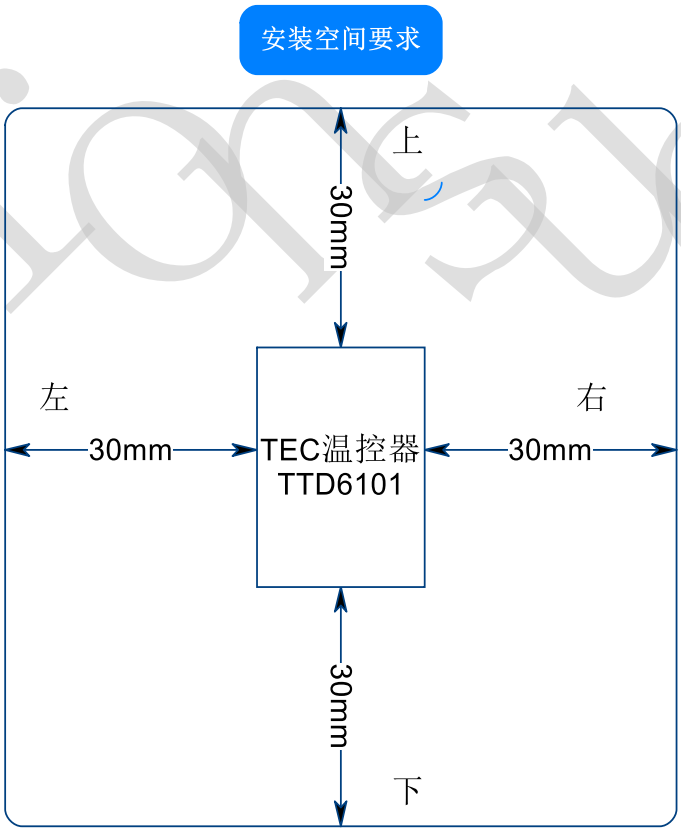
1、 Installation Notes

The TEC thermostat (TTD6101) is installed using screws and must be mounted within an electrical cabinet. The installation environment should be kept ventilated and dry. When installed in an electrical cabinet, the device must also be properly grounded (see Section 2.3.2).

The TEC thermostat is a precision electronic device. Do not install it in environments with strong electromagnetic interference, humidity, or flammable/explosive conditions to prevent unnecessary malfunctions or accidents.

2、 Storage space requirements

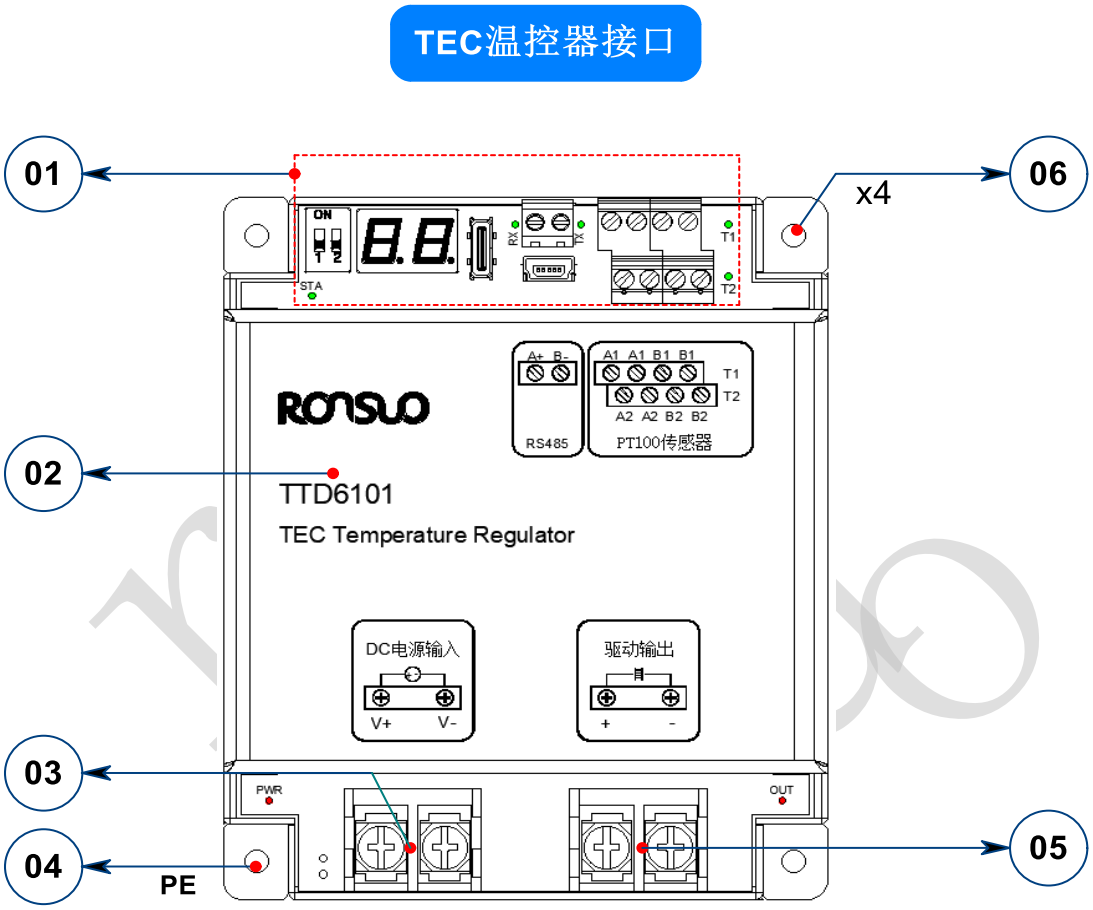
When installing or removing thermostat devices, maintain a minimum operational clearance of 30mm on both sides and 30mm vertically.



## 2.3 Device Interface Function

### 2.3.1 Interface Function of Thermostat

1、 The TEC thermostat (TTD6101) features the following device interface functions, as shown in the figure below:



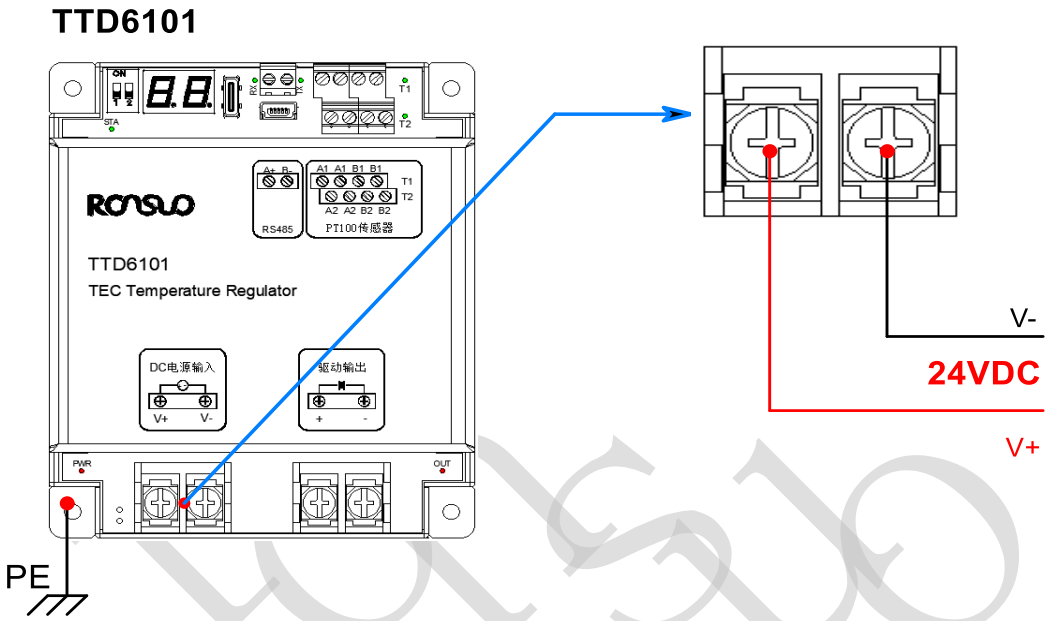
2、 TEC Thermostat Interface Specifications:

| Number | Definition | Explain |
|---|---|---|
| 01 | Code decoding switch | 2 bit position switch (see 2.3.4)<br>Set the 485 communication station number address: 1~4 |
| | Digital display | Display device alarm codes (see 3.3) |
| | TYPE-C port | Debugging interface |
| | RS485 interface | Upstream RS485 communication interface (see 2.3.3) |
| | Mini USB port | Device firmware flashing |
| | PT100 (4-wire) sensor connection | PT100 (4-wire) connection (see 2.3.5)<br>T1: Channel 1 PT100 (4-wire) sensor interface (temperature control and acquisition)<br>T2: 2nd PT100 (4-wire) sensor interface (temperature monitoring) |
| 02 | Panel screen printing | Print the device's external interface labels |
| 03 | Power supply input | Power supply input (see 2.3.2)<br>Power supply input (12~36VDC) |
| 04 | Landing | Grounding of installed equipment (PE) |
| 05 | Drive output | Load access (see 2.3.5)<br>1 TEC cooling plate load connection (up to 30A) |
| 06 | Installing screw hole | 4 Φ3.5 mounting and fixing hole |

### 2.3.2 Power Supply Wiring

The 2P bar terminal on the TEC thermostat (TTD6101) serves as the power input for the device, with the wiring configuration shown in the diagram below.

设备供电接线

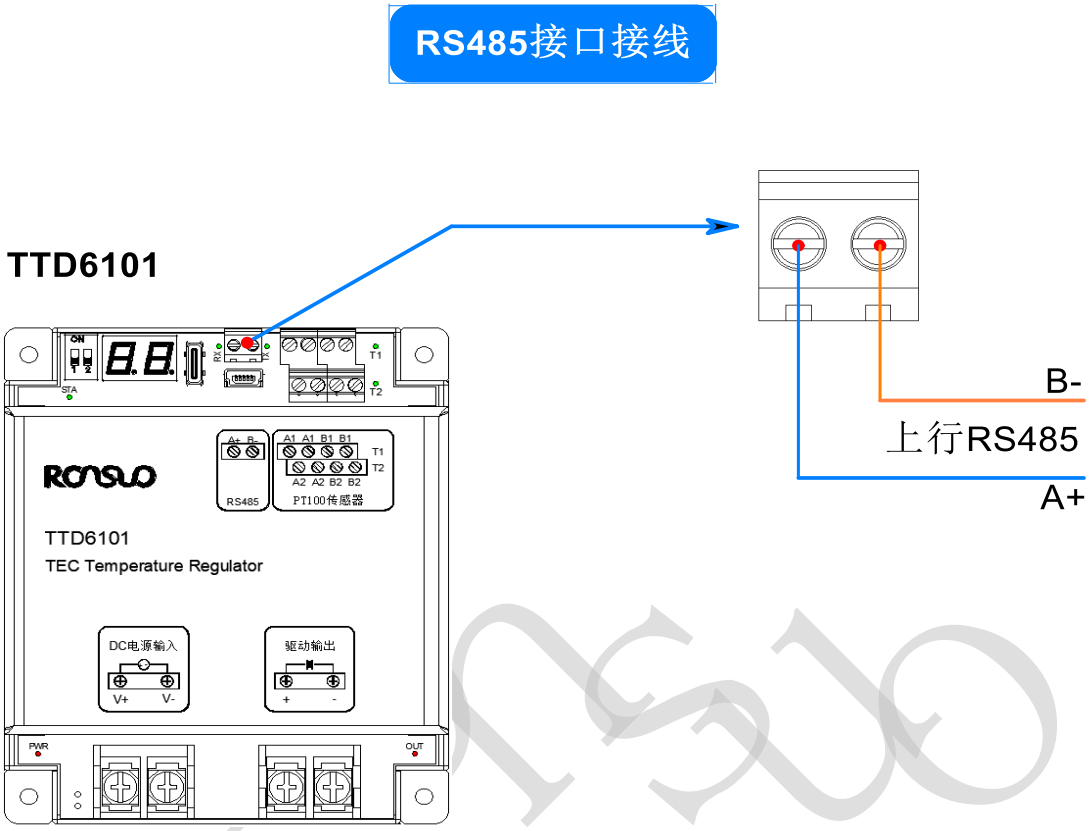



Power interface terminal definition description:

| Number | Definition | Explain |
|---|---|---|
| 1 | V+ | 24VDC power input positive terminal |
| | V− | Negative terminal of the 24VDC power input |
| | PE | Connecting the Earth |

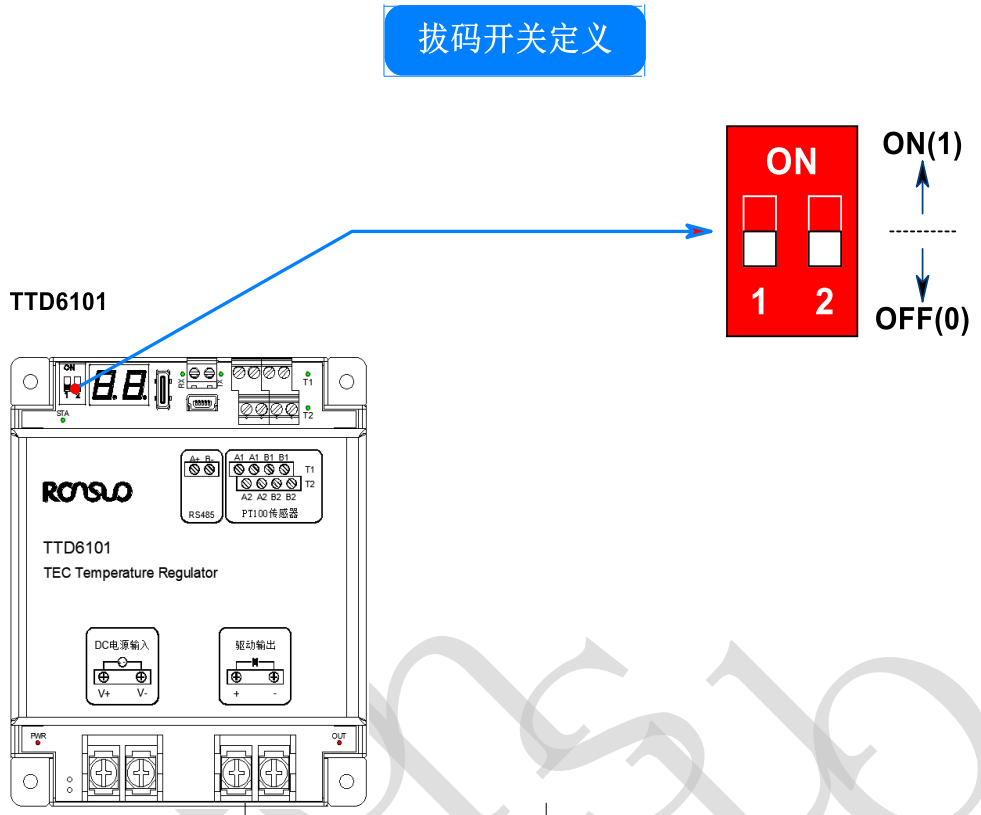
### 2.3.3 Communication RS485 Wiring

The 2P-3.81 RS485 communication interface on the TEC thermostat (TTD6101) is wired as shown in the diagram below:



### 2.3.4 Code Switch Definition

The 2-bit pull-up code on the TEC thermostat (TTD6101) can set the 485 communication station address, as shown in the figure below:

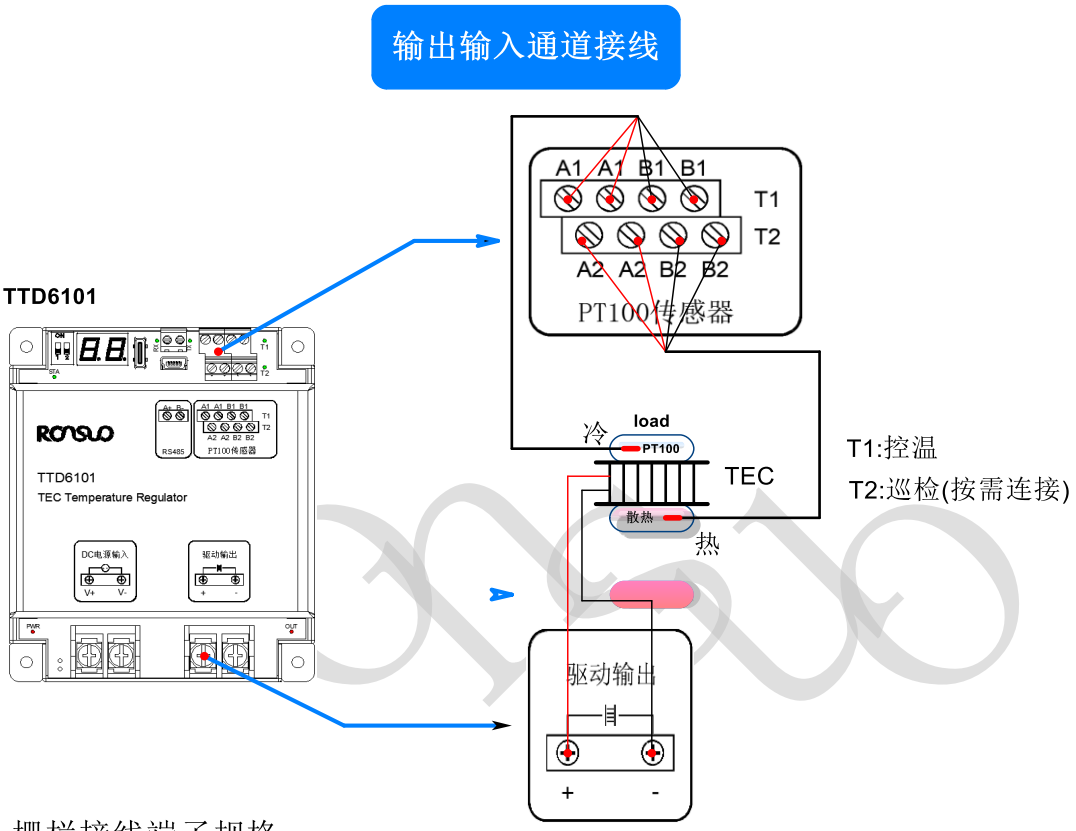



**Pull-up switch definition(requires device restart to take effect after setup):**

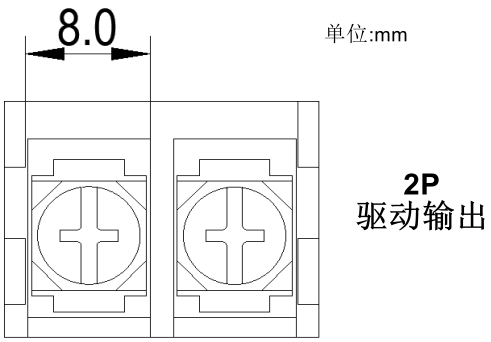
| ON=1 OFF=0 | 2 bit position code switch | | Scan the barcode to get the address |
|---|---|---|---|
| | 1 | 2 | |
| 0x01 ON 1 2 | 0 | 0 | Stop:**1** |
| 0x02 ON 1 2 | 1 | 0 | Stop number:**2** |
| 0x03 ON 1 2 | 0 | 1 | Stop number:**3** |
| 0x04 ON 1 2 | 1 | 1 | Stop number:**4** |

### 2.3.5 Input-Output Channel Wiring

The TEC thermostat (TTD6101) features a 2P-8.0 terminal block for output channels, directly connecting to the TEC's DC load. Its input channels employ dual-layer 8P-3.81 terminals, supporting two 4-wire PT100 sensors. The detailed wiring configuration is illustrated in the diagram below.




栅栏接线端子规格：




Note: 1. Connect the TTD6101 driver output to the TEC cooling element, and properly connect it to the TEC's positive and negative terminals as shown in the diagram above.

2、 The output voltage value is the input voltage value for the device.

3、 In the diagram, the T1 temperature sensor collects temperature data for temperature control, while the T2 sensor collects inspection temperature (connected as needed, and can be disconnected when heat dissipation temperature is not required).

4、 When using Y-type terminal blocks for fence wiring, attention should be paid to the specifications and dimensions of the terminal blocks.

# 3 Device Application and Debugging

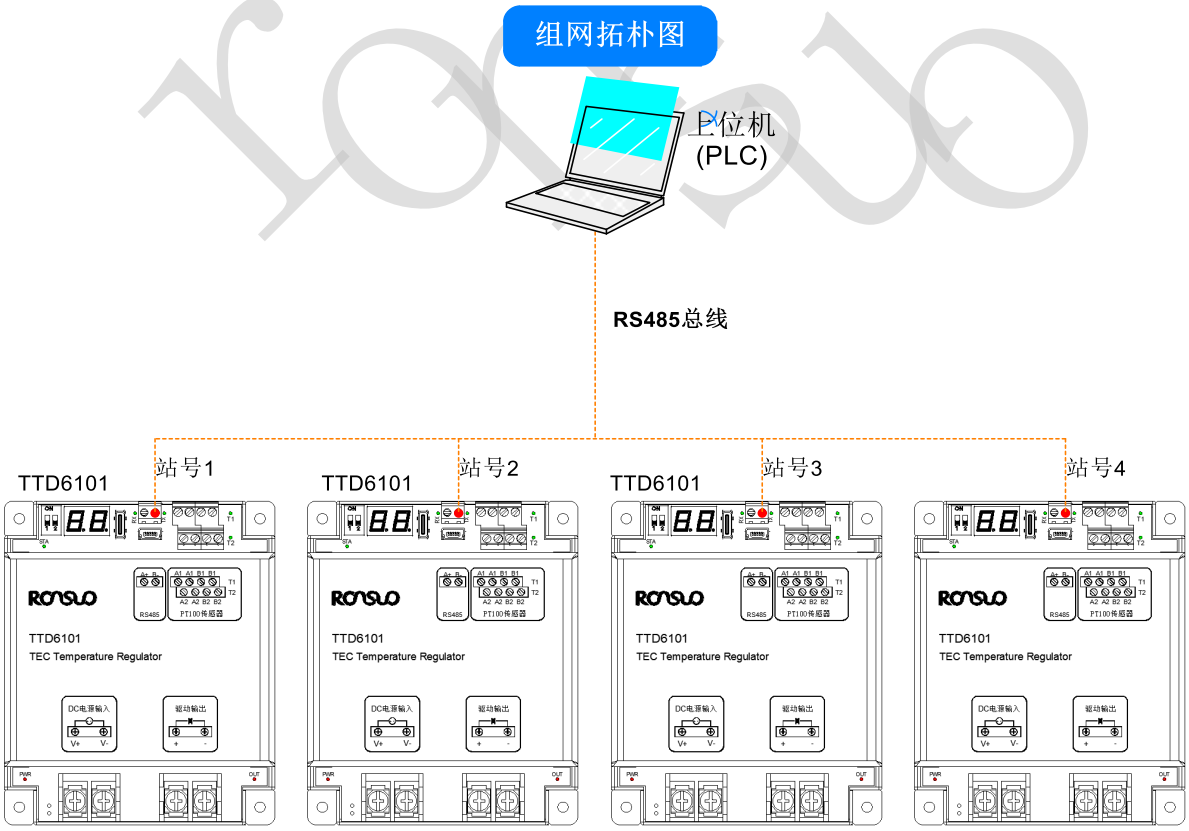
**About this chapter**

| Chapters and sections | Content | Remarks |
|---|---|---|
| 3.1 Network configuration and debugging | Introduction to device networking and connection debugging | |
| 3.2 The host computer software (TSC) is used | Introduce the detailed method of upper computer software configuration | |
| 3.3 Alarm code | Display code explanation for device alarms | |

## 3.1 Network Configuration and Debugging

### 3.1.1 Network Topology Diagram

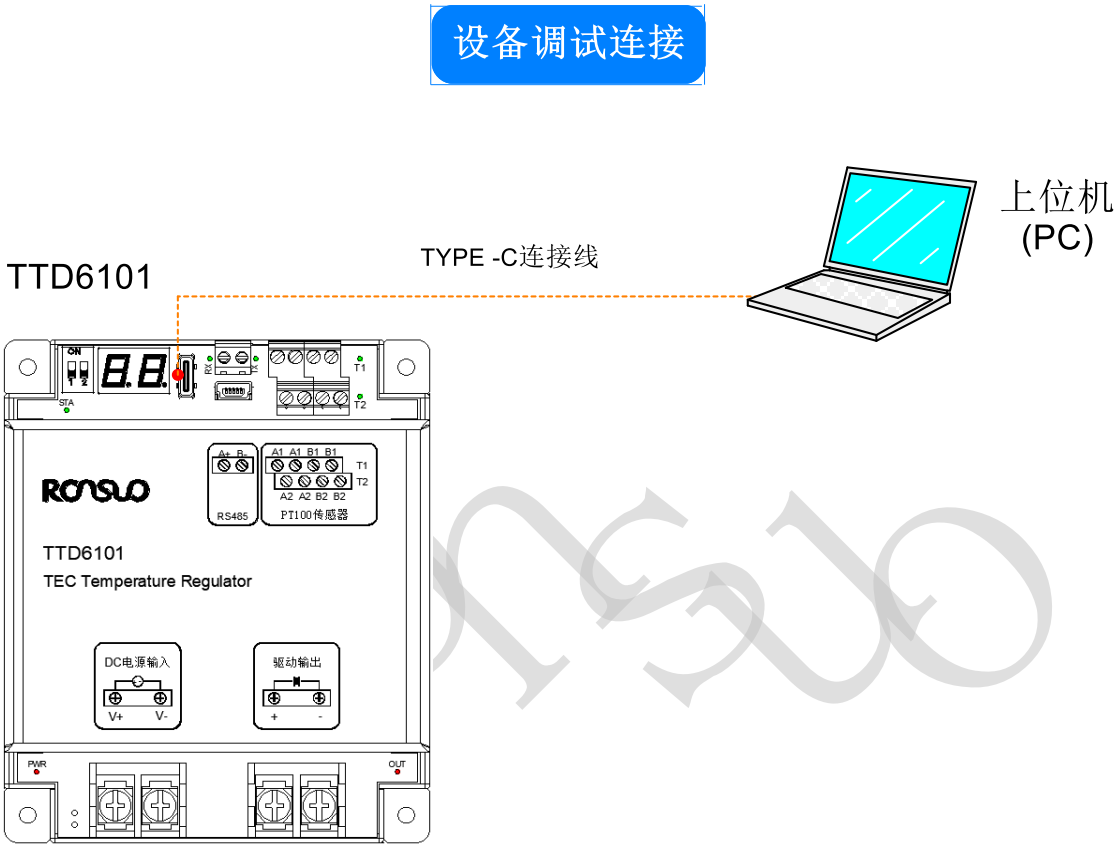
The typical networking configuration for TEC thermostat (TTD6101) in practical project applications is illustrated in the following diagram:




Note: The above describes a typical network topology. When using 485 bus communication, the device's station address must be configured via the pull code.

### 3.1.2 Device Setup and Connection

The device comes with default parameter settings upon factory delivery. For field deployment, simply use the Temperature Control System Configuration Tool (TSC) to configure it according to the project's specific requirements for proper operation. Connect it to the host computer using the following method (default TYPE-C interface parameters: 921600, N, 8, 1), as illustrated in the diagram below:




Note: 1. For debugging the computer-connected thermostat, connect it correctly using the TYPE-C USB method shown in the diagram.

2、 When performing data communication, please refer to our company's temperature control device communication protocol for debugging.

3、 The TSC tool can be used to directly operate temperature control and data acquisition.

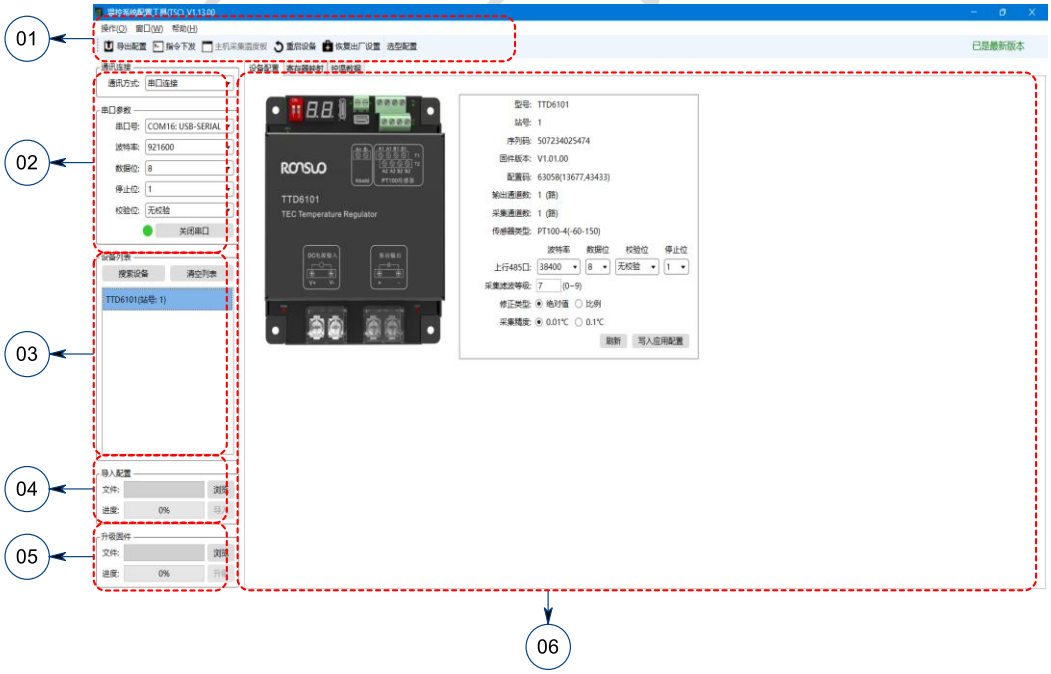
## 3.2 The Host Computer Software (TSC) Is Used

### 3.2.1 Software Interface

The TEC thermostat (TTD6101) supports configuration management via the desktop-based " Thermostat System Configuration Tool (TSC)". Double-click [TSC.exe] to launch the configuration software. After connecting the TYPE-C device, the home screen displays as shown below:

### 3.2.2 Software Features

1、 The TSC tool features the following sections:



2、 TSC Tool Function Area Description:

| Number | Definition | Explain |
|---|---|---|
| 01 | Quick Access | Export configuration: Export the device's configuration file (.cfg) for import into other devices of the same model.<br>Issue command: Debugging application window. Use when debugging is needed.<br>Host temperature acquisition board: The current device model is not supported<br>Restart device: Restart the current connected device<br>Restore factory settings: Reset all parameters of the connected device to their default factory settings |
| 02 | Communication junction | Configure communication parameters for connected devices:<br>【 communication junction 】：<br>Network connection: Ethernet communication devices are used<br>Serial port connection: RS485 serial communication device usage<br>Serial port parameter: RS485 serial communication device<br>Serial port: Select the correct COM port for the current connected device<br>Baud rate: 921600 (fixed at 921600 when the thermostat is connected via TYPE-C);<br>Data bits: 8 bits, stop bit: 1 bit, parity bit: none. Open/Close serial port: operation button |
| 03 | Device list | After searching for devices, the connected device list is displayed:<br>[Device List]:<br>Search devices: Search connected devices<br>Clear list: Clear devices displayed in the list<br>List window: Displays the device model and IP address or station number address<br>Selected device: Click any device found to display its information on the right side of the tool software. |
| 04 | Import configuration | Used for importing device profiles (in practice, you only need to configure one device to export the profile, which can then be imported to other devices of the same model).<br>File: Click the [Browse Files] button to select the path to the.cfg file<br>Progress: Shows the import progress percentage<br>Import: Click the button to start importing the configuration |
| 05 | Upgrade firmware | For device firmware updates:<br>File: Click the [Browse Files] button to select the path to the.bin file<br>Progress: Shows the percentage of the upgrade update progress<br>Upgrade: Click the button to start firmware update |
| 06 | Configuration | Basic device attribute configuration area:<br>Write application configuration: Click the button to save configuration after modifying device parameters |
| | | Device Configuration: Basic Device Settings |
| | Classification window | Register Mapping: Device Register Mapping Configuration Window<br>Temperature control data: Device temperature control debugging window |

## 3.3 Alarm Code

| Order number | Alarm code (digital tube) | Explain<br>The digital display flashes when an alarm is triggered. |
|---|---|---|
| 1 | E1 | The device is not authorized |
| 2 | E2 | Device self-check error alert |
| 3 | E3 | The output channel short-circuit alarm will not be automatically cleared after restoration. |
| 4 | C4 | Output circuit breaker alarm (load circuit breaker), the alarm will be automatically cleared after restoration |
| 5 | C5 | The overload alarm (load exceeds the limit) will not be automatically cleared after the system returns to normal. |
| 6 | Always on | The system is working properly. The display shows the number of output channels. |

# 4 Common Faults

During use, the device may experience certain malfunctions. Users can address the issues by following the troubleshooting methods listed below to restore normal operation. If the problem persists, please contact our company.

**power failure**

Fault: All panel indicators fail to illuminate after power-on.

Exclusion method:

1、 Check if the power connection is properly connected to the terminals.

2、 Check if the positive and negative terminals of the power cord are connected in reverse.

3、 Use a multimeter to check if the input voltage is within the specified range (12~36VDC).

**Communication error**

Fault: RS485 communication failed

Exclusion method:

1、 Check if the device parameters are configured correctly.

2、 Check if the device panel indicator lights are displaying correctly.

3、 Check if the communication wiring is correct. After confirming the wiring is correct, verify that the communication parameters are properly configured.

4、 Check if the 485 DIP switch address matches the host computer's communication address.

**Abnormal temperature during collection**

Fault: Abnormal temperature acquisition

Exclusion method:

1、 Check whether the temperature sensor wiring is correct.

2、 Check if the terminal is securely fastened without any looseness.

3、 Check whether the temperature sensor is in good contact with the object.

4、 Check whether the model of the access temperature sensor matches the device configuration model.

5、 Check whether the register address and the number of reads are correct.

# 5 Maintenance

When maintenance is required, disconnect the power supply first. Under normal operating conditions, the equipment requires no regular maintenance. Simply check the equipment status and verify that the wiring terminals and interfaces are not loose every 12 months, then clean the surface dust using a dry soft-bristled brush. When the equipment is not in use for an extended period, disconnect the power supply. Avoid storing it in areas with excessively cold or hot temperatures or high humidity.

# 6 Safety Requirements

Please read the following safety precautions to avoid personal injury and prevent damage to this product or any other connected products.

Inadvisable. To avoid potential hazards, this product must be used strictly within the specified parameters.

**Only authorized technicians from our company are permitted to perform repairs.**

**Use the appropriate power supply.**

Check the input power type, voltage value, and polarity of the device.

**Connect and disconnect correctly.**

Do not disconnect the data communication cable while the device is powered on.

**equipment ground 。**

To prevent electric shock, the casing grounding wire must be connected to the earth. Before connecting to the input or output terminals of this product, ensure that this device

The grounding is correct. The grounding wire resistance should be less than 1 Ω.

**Correct connection.**

When connecting, use the original accessories provided with the device. If you need to make special connections, check the port labels.

**Avoid contact with exposed circuits.**

Do not touch exposed contacts or components while the equipment is energized.

**Do not operate when a suspected fault is present.**

If you suspect this product is damaged, please have it repaired by our authorized service personnel.

**Provide a well-ventilated environment.**

**Handle this device carefully to avoid strong impacts or vibrations. Do not install it in areas with severe shaking. Never touch the power switch or this**

device with wet hands.


Do not operate in humid environments.

Do not operate in explosive environments.

Keep the surface of the device clean and dry.