

Bex HuanTemperature Control-Precise Temperature Regulation

TEC Thermostat (TTD6101) User Manual

V1. 01

Handwriting practice lines with a large, stylized, light gray watermark reading "Khan" across the center.

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.

Bex HuanTemperature Control-Precise Temperature Regulation

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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	5
1 Device Features	6
1.1 Device Overview.....	6
1.2 demonstration of the type.....	7
1.3 Device Features.....	8
1.3.1 Industrial design.....	8
1.3.2 reliability and stability.....	8
1.3.3 Product usability.....	8
1.3.4 Product Features.....	8
1.4 thermostat parameter.....	9
2 Device installation and connection	11
2.1 Device appearance dimensions.....	11
2.1.1 Thermostat dimensions.....	11
2.2 equipment installation.....	12
2.2.1 Installation requirements.....	12
2.3 Device interface function.....	13
2.3.1 Interface function of thermostat.....	13
2.3.2 power supply wiring.....	15
2.3.3 Communication RS485 wiring.....	16
2.3.4 code switch definition.....	17
2.3.5 Input-output channel wiring.....	18
3 Device Application and Debugging	19
3.1 Network configuration and debugging.....	19
3.1.1 Network topology diagram.....	19
3.1.2 Device setup and connection.....	20
3.2 The host computer software (TSC) is used.....	21
3.2.1 software interface.....	21
3.2.2 Software Features.....	21
3.3 Alarm code.....	23
4 Common faults	24
5 Maintenance	25
6 safety requirements	25

Preface

Company Profile

Guangzhou Bex Huanis 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:

TEC温控器



(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: $\leq \pm 0.1^\circ\text{C}$, Resolution: 0.01°C

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 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℃/0.01℃, 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

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	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 environ- ment	Working temperature	-20~85℃
	Storage temperature	-20~105℃
	Working humidity	10~95% (no condensation)
Functional descri- ption	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	$\leq \pm 0.1^{\circ}\text{C}$
	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	

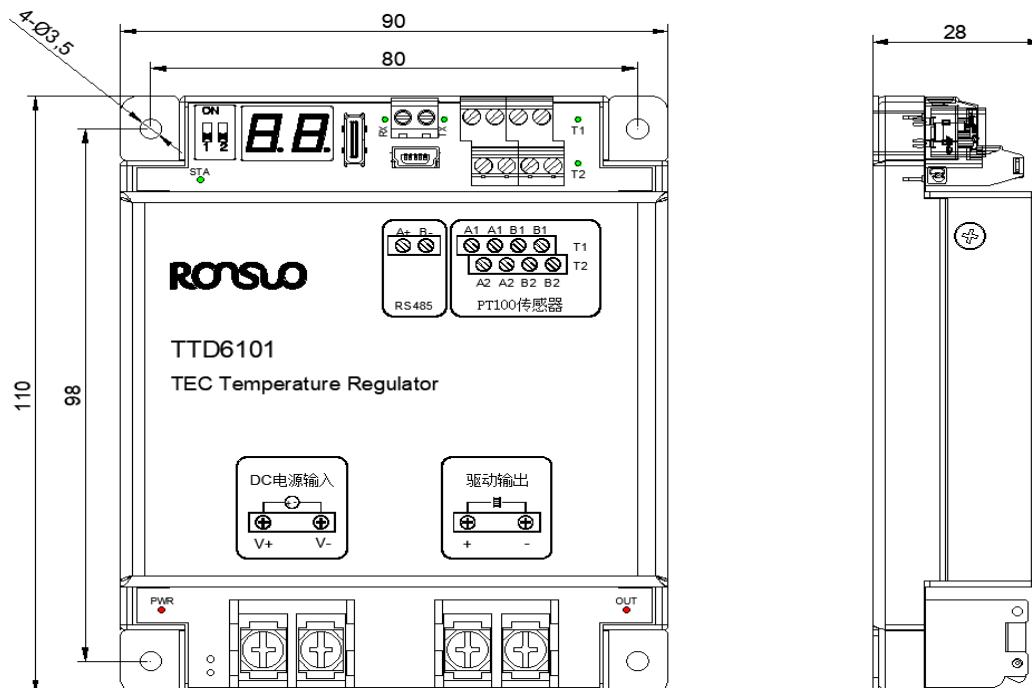
pay attention to :

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

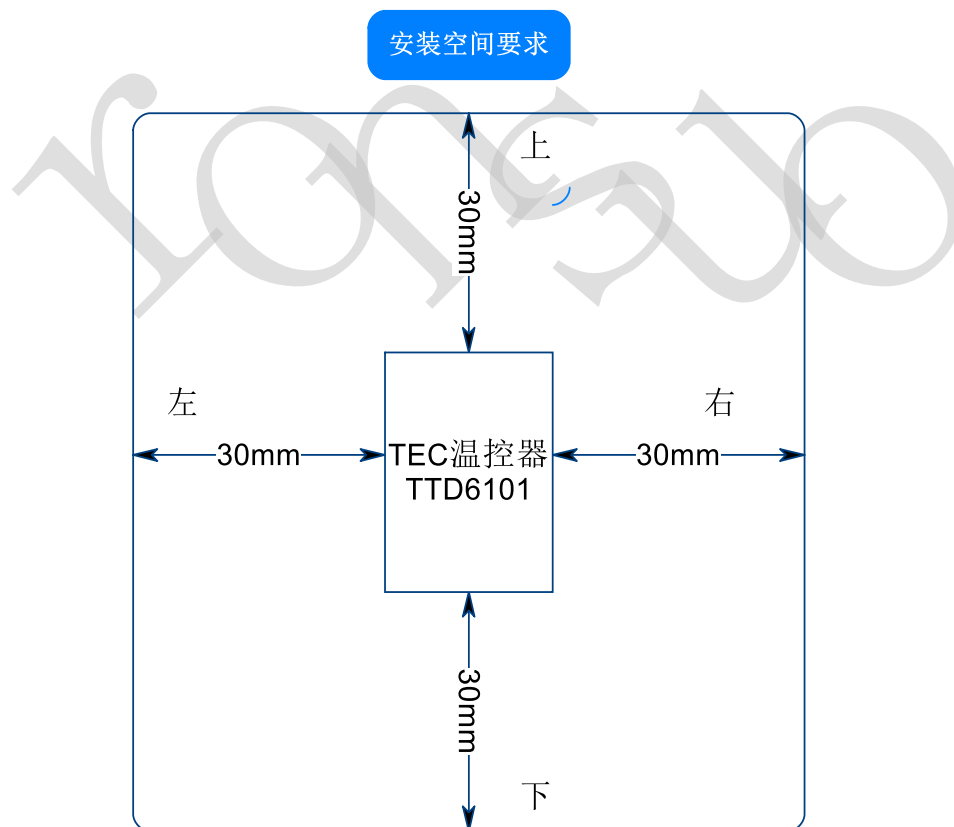
1、 Installation Notes

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

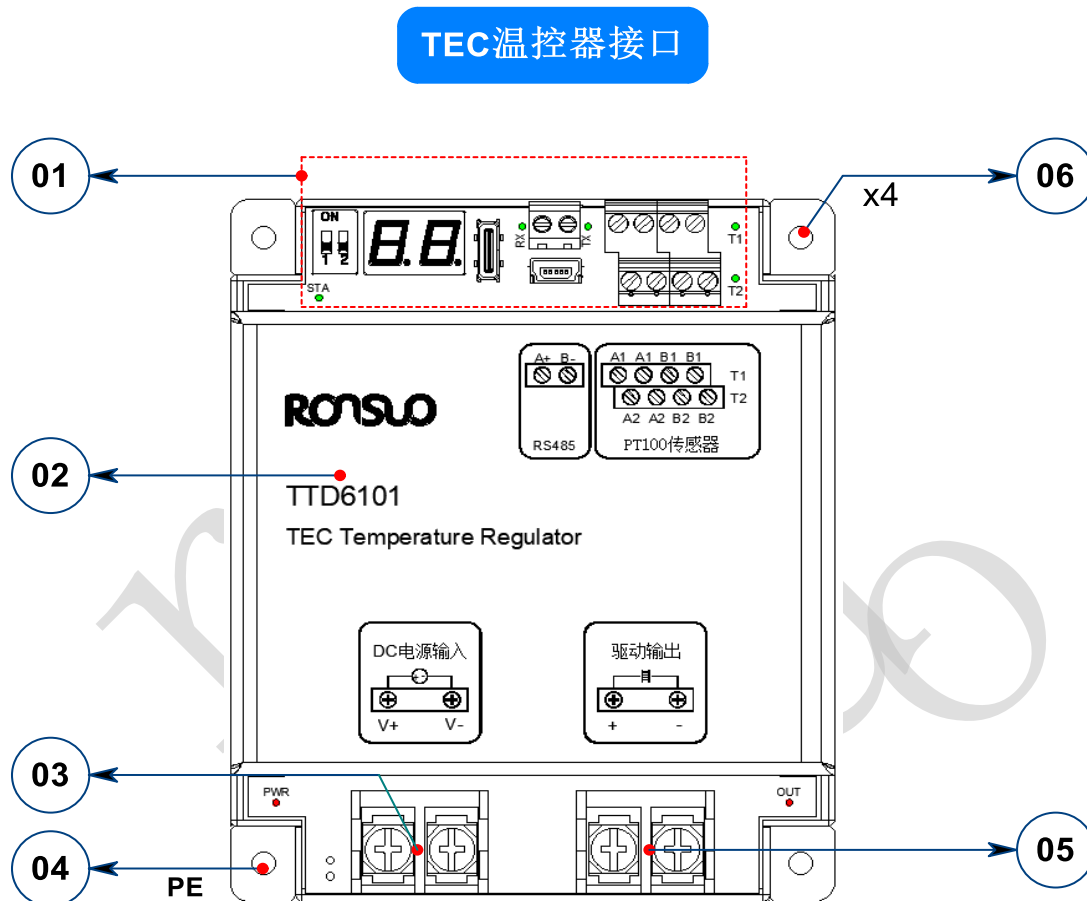
When installing or removing thermostat devices, maintain a minimum operational clearance of 30mm on both sides and 30mm vertically.



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:

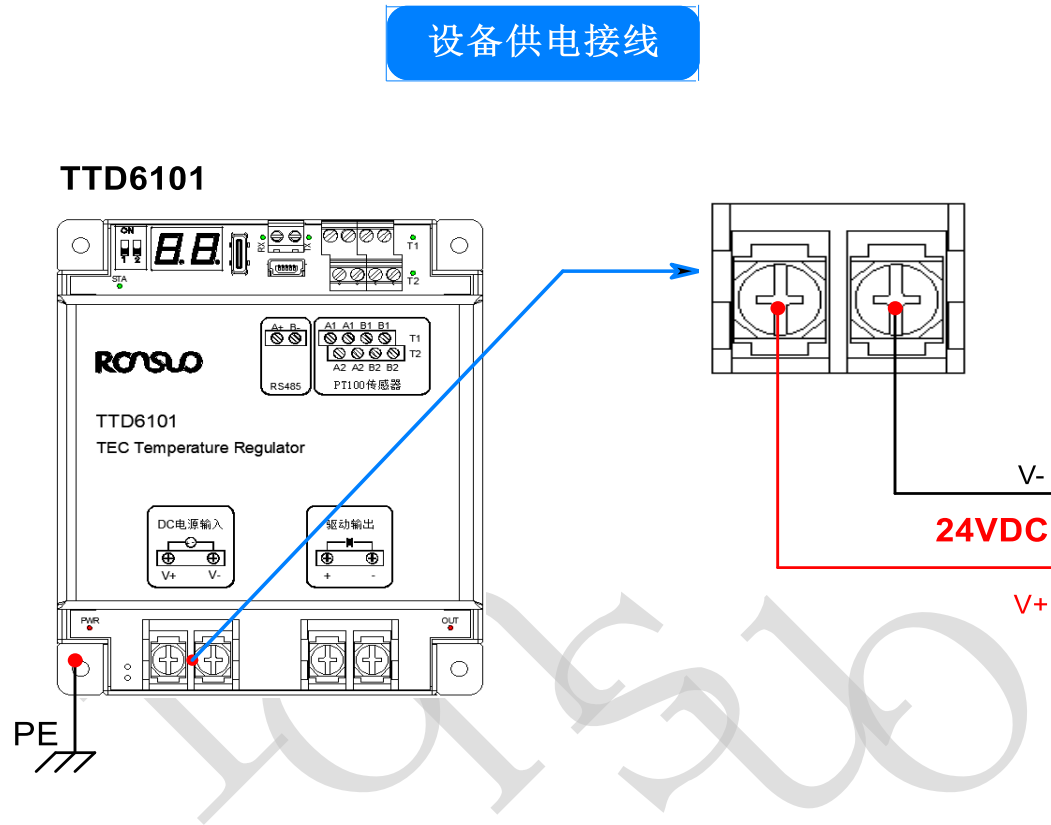


2、TEC Thermostat Interface Specifications:

Number	Definition	Explain
01	Code decoding switch	2 bit position switch (see 2.3.4) 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) T1: Channel 1 PT100 (4-wire) sensor interface (temperature control and acquisition) 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) Power supply input (12~36VDC)
04	Landing	Grounding of installed equipment (PE)
05	Drive output	Load access (see 2.3.5) 1 TEC cooling plate load connection (up to 30A)
06	Installing screw hole	4 Φ 3.5 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.

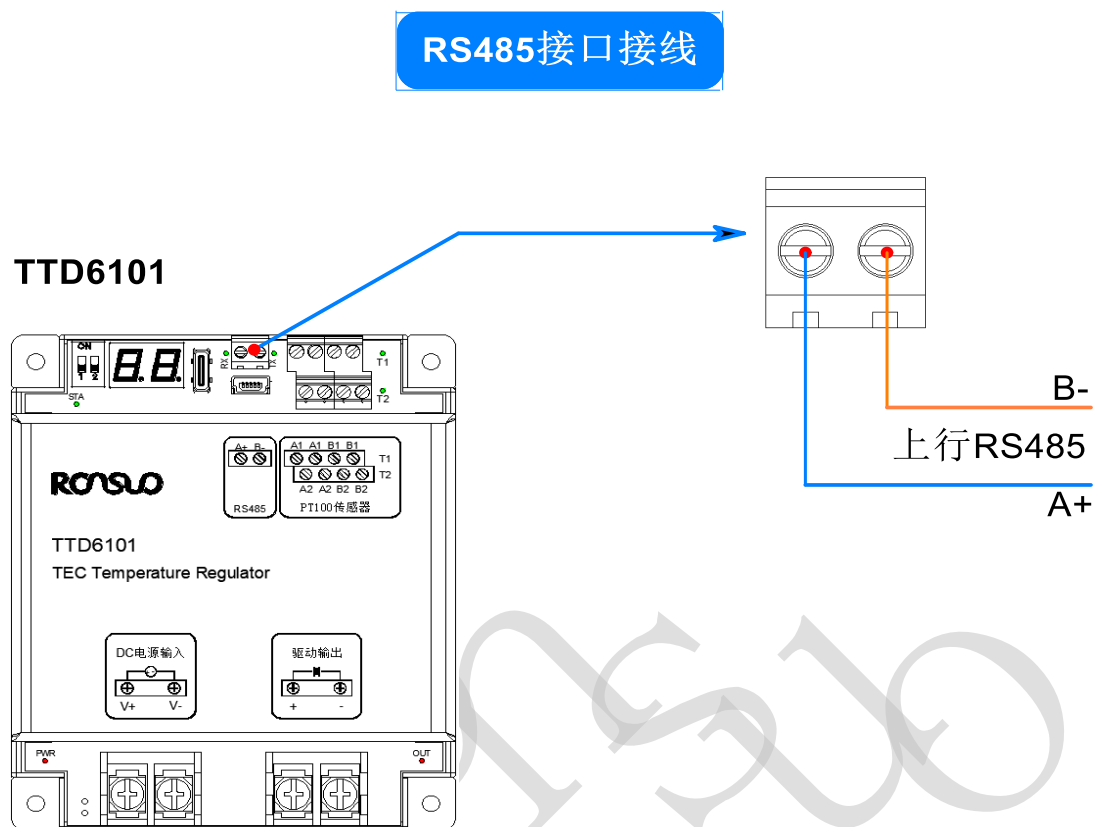


Power interface terminal definition description:

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:

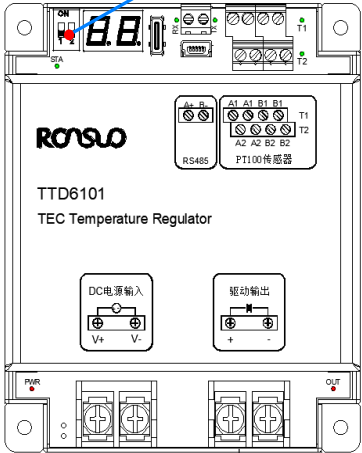


2.3.4 Code Switch Definition

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

拨码开关定义

TTD6101



ON

1

2

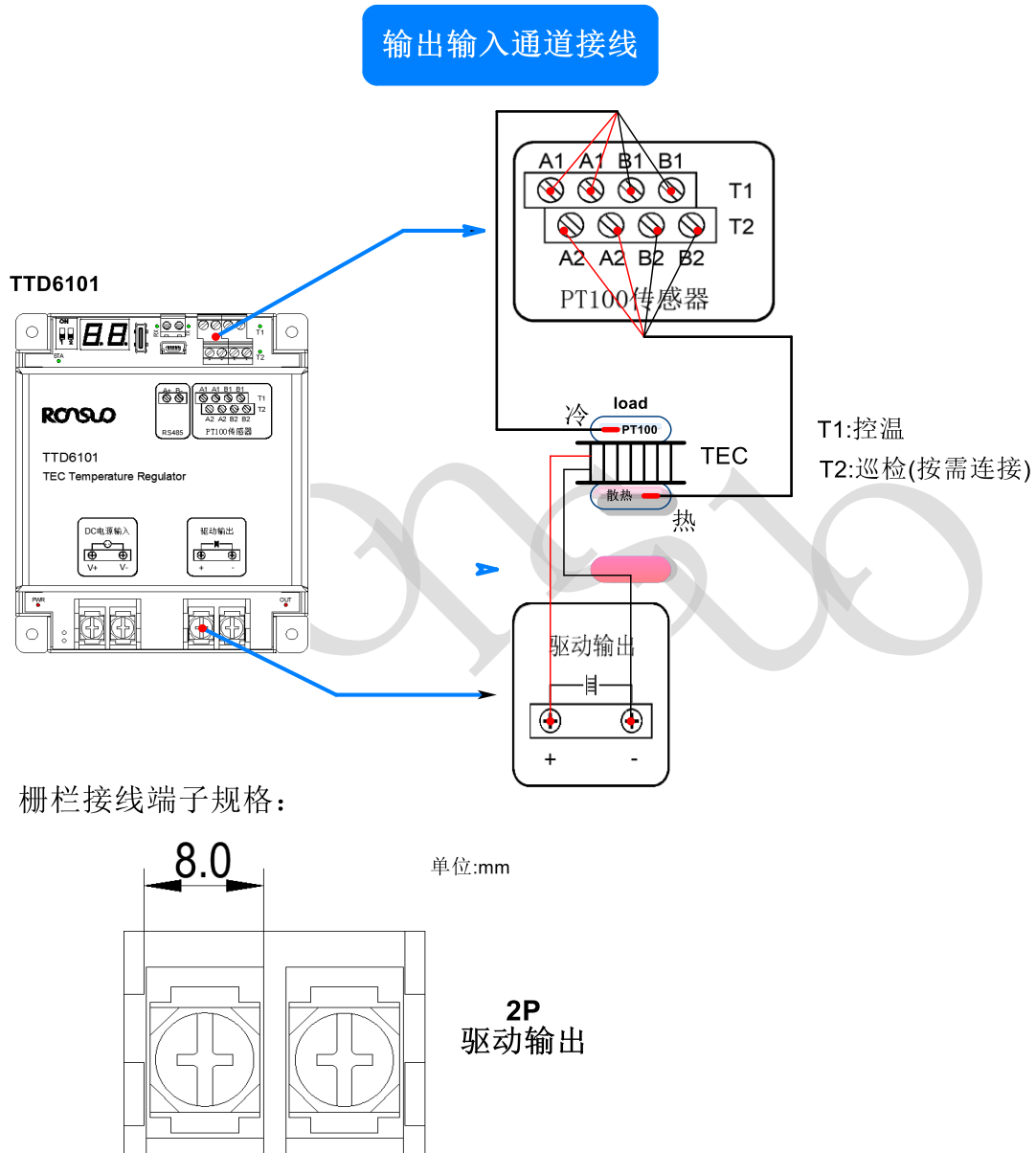
ON(1)
OFF(0)

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.



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

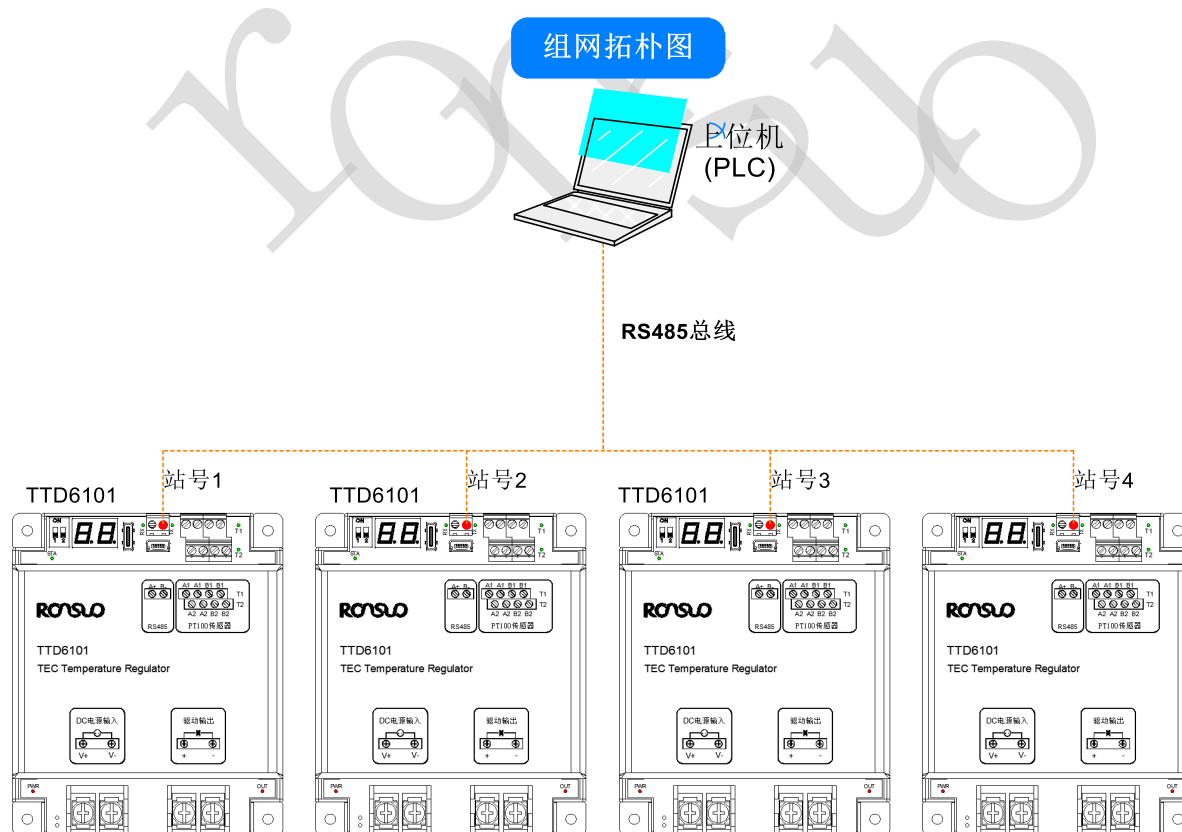
About this chapter

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

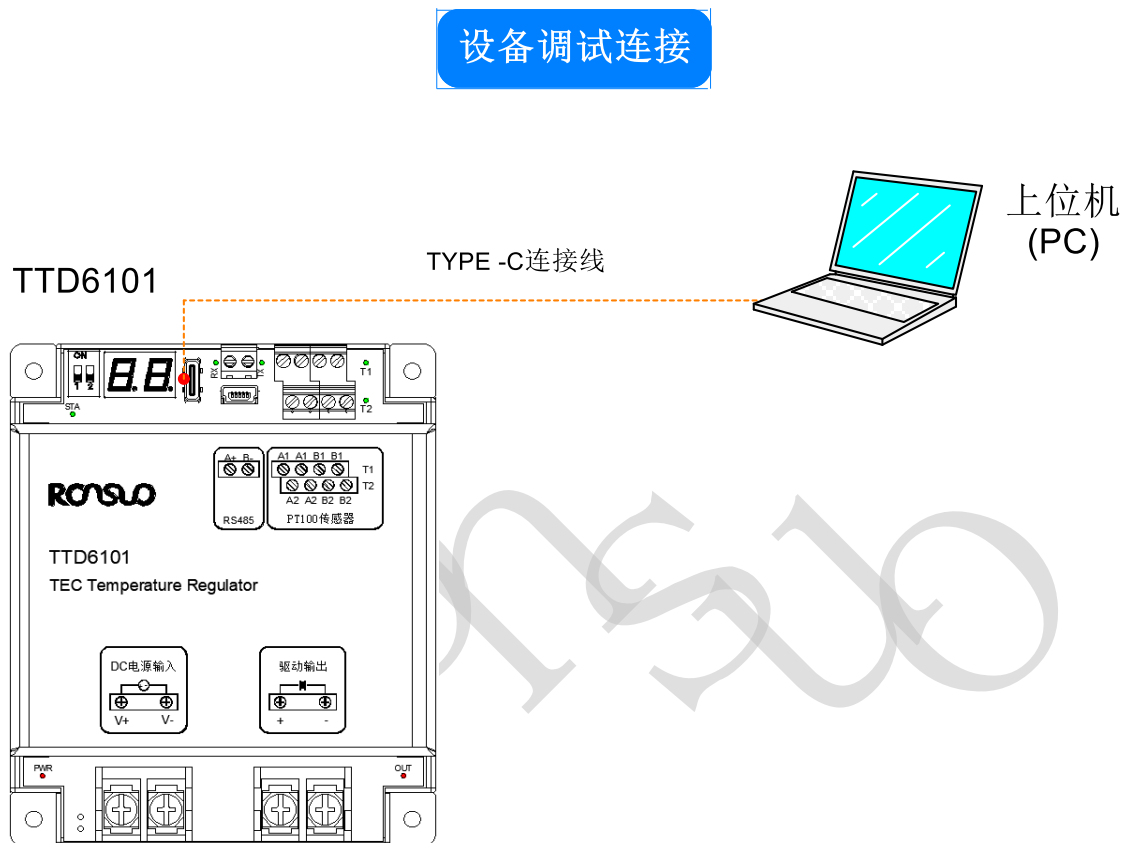
The typical networking configuration for TEC thermostat (TTD6101) in practical project applications is illustrated in the following diagram:



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

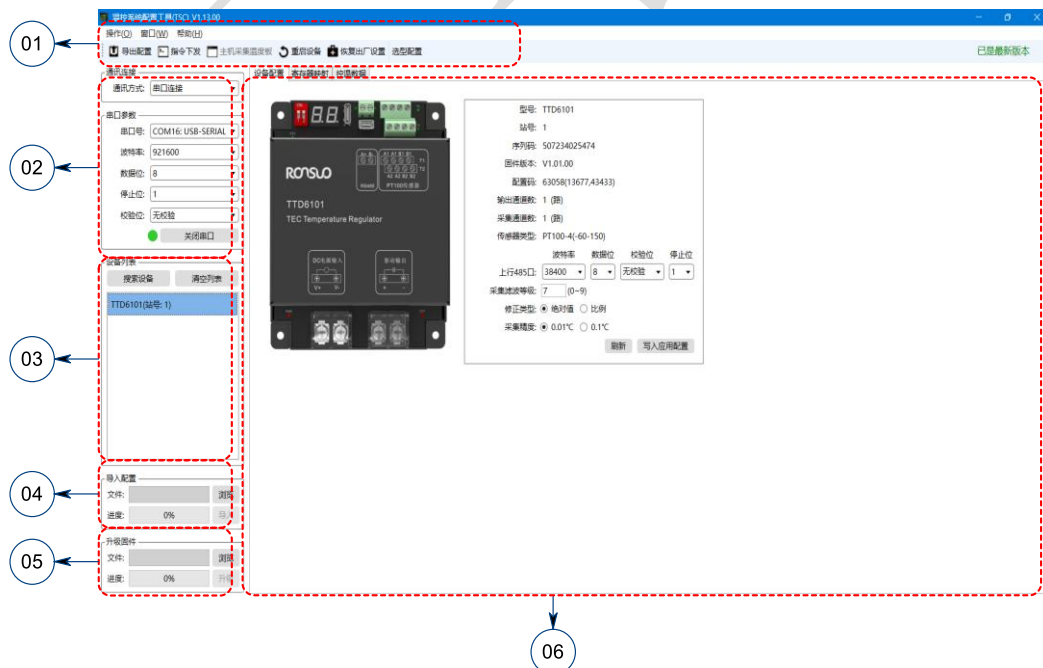
3.2.1 Software Interface

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.  Issue command: Debugging application window. Use when debugging is needed.  Host temperature acquisition board: The current device model is not supported  Restart device: Restart the current connected device  Restore factory settings: Reset all parameters of the connected device to their default factory settings
02	Communication junction	Configure communication parameters for connected devices: 【 communication junction 】 : Network connection: Ethernet communication devices are used Serial port connection: RS485 serial communication device usage Serial port parameter: RS485 serial communication device Serial port: Select the correct COM port for the current connected device Baud rate: 921600 (fixed at 921600 when the thermostat is connected via TYPE-C); 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: [Device List]: Search devices: Search connected devices Clear list: Clear devices displayed in the list List window: Displays the device model and IP address or station number address 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). File: Click the [Browse Files] button to select the path to the .cfg file Progress: Shows the import progress percentage Import: Click the button to start importing the configuration
05	Upgrade firmware	For device firmware updates: File: Click the [Browse Files] button to select the path to the .bin file Progress: Shows the percentage of the upgrade update progress Upgrade: Click the button to start firmware update
06	Configuration	Basic device attribute configuration area: 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

Temperature control data: Device temperature control debugging window

3.3 Alarm Code

Order number	Alarm code (digital tube)	Explain
		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.

