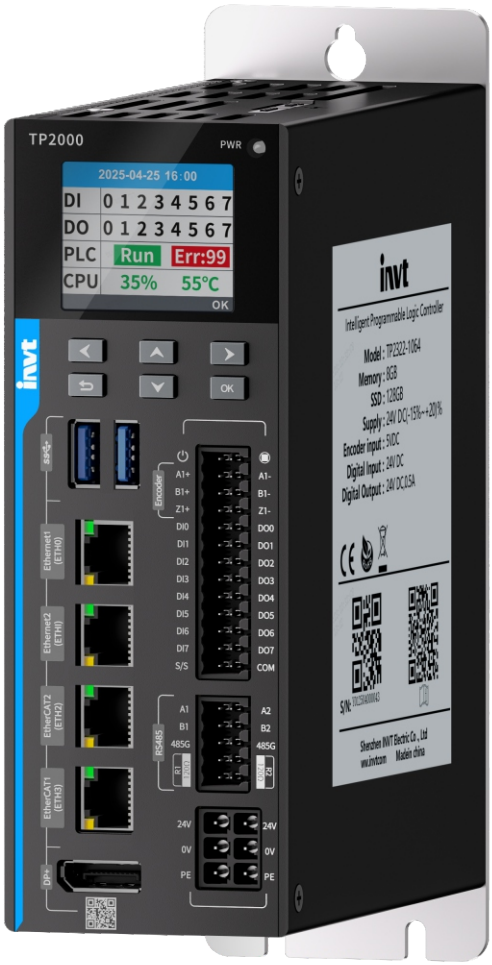
TP2000 Series PLC

User Manual



SHENZHEN INVT ELECTRIC CO., LTD.

Preface

Overview

Thank you for choosing TP2000 series programmable logic controller (PLC for short, if not otherwise specified, the PLC in this manual always indicates TP2000 series PLC).

The TP2000 series PLC is a new generation of large-scale PLC independently developed by INVT. Featuring a compact, book-style metal housing, it supports a comprehensive set of communication buses—including EtherCAT, Ethernet, and RS485—and integrated high-speed I/O interfaces to meet diverse project expansion requirements. With a high-performance processor and ample memory, the TP2000 series offers powerful motion control capabilities, supports scalable expansion for diverse automation projects, and excels in compute-intensive, large-scale application environments.

The manual mainly introduces the installation and wiring of the product, including product information, mechanical installation, and electrical installation.

Read through this manual carefully before installing the PLC.

The manual is subject to change without prior notice. Please visit www.invt.com to download the latest manual version.

Audience

Personnel with electrical professional knowledge (such as qualified electrical engineers or personnel with equivalent knowledge).

About documentation obtaining

This manual is not delivered along with the product. To obtain it electronic PDF file, you can:

- Visit www.invt.com, choose **Support** > **Download**, enter a keyword, and click **Search**.
- Scan the QR code on the product housing, enter a keyword, and download the manual.

More documentation

Manual name	Description
INVT Medium and Large-scale PLC Software Manual	Mainly provides detailed information on the use of Invtmatic Studio programming tools, the use of programming tools, PLC hardware, and communication.
INVT Medium and Large-Scale PLC Programming Manual	Mainly describes PLC instructions and programming methods.
TP2000 Series PLC User Manual	Mainly describes the installation and wiring of the product, including product information, mechanical installation, and electrical installation.

Change history

The manual is subject to change irregularly without prior notice due to product version upgrades or other reasons.

No.	Change description	Version	Release date
1	First release.	V1.0	August 2025

Contents

1 Safety precautions

1.1 Safety declaration

Read this manual carefully and follow all the safety precautions before moving, installing, wiring, commissioning and running the product. Otherwise, equipment damage or physical injury or death may be caused.

We shall not be liable or responsible for any equipment damage or physical injury or death caused due to failure to follow the safety precautions.

1.2 Safety level definition

To ensure personal safety and avoid property damage, you must pay attention to the safety symbols and warnings in the manual.

Warning symbol	Name	Description
	Danger	Severe personal injury or even death can result if related requirements are not followed.
	Warning	Personal injury or equipment damage can result if related requirements are not followed.

1.3 Personnel requirements

Trained and qualified professionals: People operating the equipment must have received professional electrical and safety training, and must be familiar with all steps and requirements of equipment installing, commissioning, running and maintaining and capable to prevent any emergencies according to experiences.

1.4 Safety guidelines

General principles	
	• Only trained and qualified professionals are allowed to carry out related operations. • Do not perform wiring, inspection or component replacement when power supply is applied.

Delivery and installation	
	• Do not install the product on inflammables. In addition, prevent the product from contacting or adhering to inflammables. • Install the product in a lockable control cabinet of at least IP20, which prevents the personnel without electrical equipment related knowledge from touching by mistake, since the mistake may result in equipment damage or electric shock. Only personnel who have received related electrical knowledge and equipment operation training can operate the control cabinet. • Do not run the product if it is damaged or incomplete. • Do not contact the product with damp objects or body parts. Otherwise, electric shock may result.

Wiring	
	• Fully understand the interface types, specifications, and related requirements before wiring. Otherwise, incorrect wiring cause abnormal running. • Cut off all power supplies connected to the product before performing wiring. • Before power-on for running, ensure that the product terminal covers are properly installed in place after the installation and wiring are completed. This prevents a live terminal from being touched or misoperation. Otherwise, physical injury or equipment fault may result. • Install proper protection components or devices when using external power supplies for the product. This prevents the product from being damaged due to external power supply faults, overvoltage, overcurrent, or other exceptions.

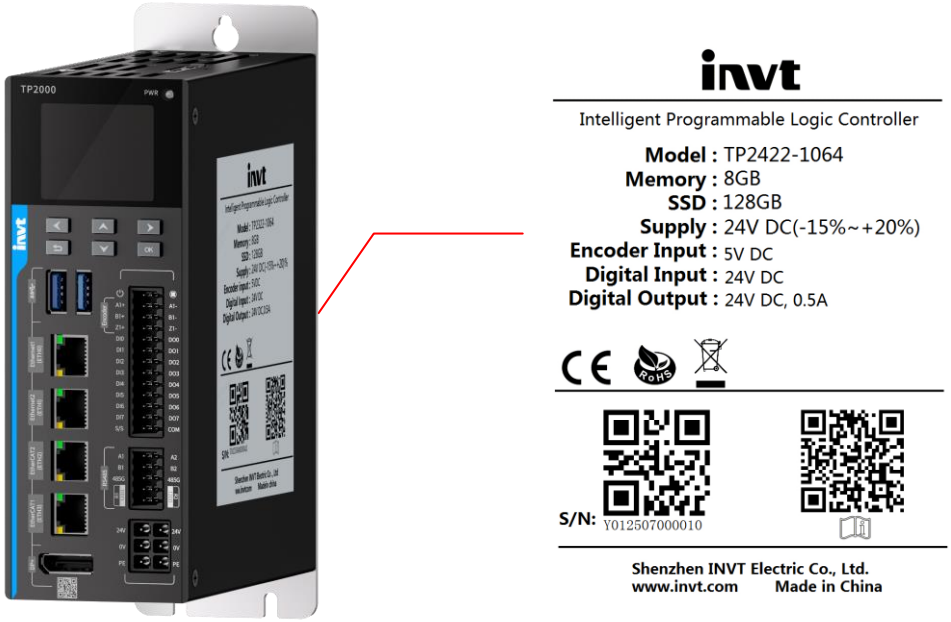
Commissioning and running	
	• Before power-on for running, ensure that the working environment of the product meets the requirements, the input power specifications meet the requirements, the wiring is correct, and a protection circuit has been designed to protect the product so that the product can run safely even if an external device fault occurs. • For modules or terminals requiring external power supply, configure external safety devices such as fuses or circuit breakers to prevent damage caused due to external power supply or device faults.

Maintenance and component replacement	
	• Cut off all power supplies connected to the product before performing terminal wiring. • During maintenance and component replacement, take measures to prevent screws, cables and other conductive matters from falling into the internal of the product.

Disposal	
	The product contains heavy metals. Dispose of a scrap product as industrial waste.
	Dispose of a scrap product separately at an appropriate collection point but not place it in the normal waste stream.

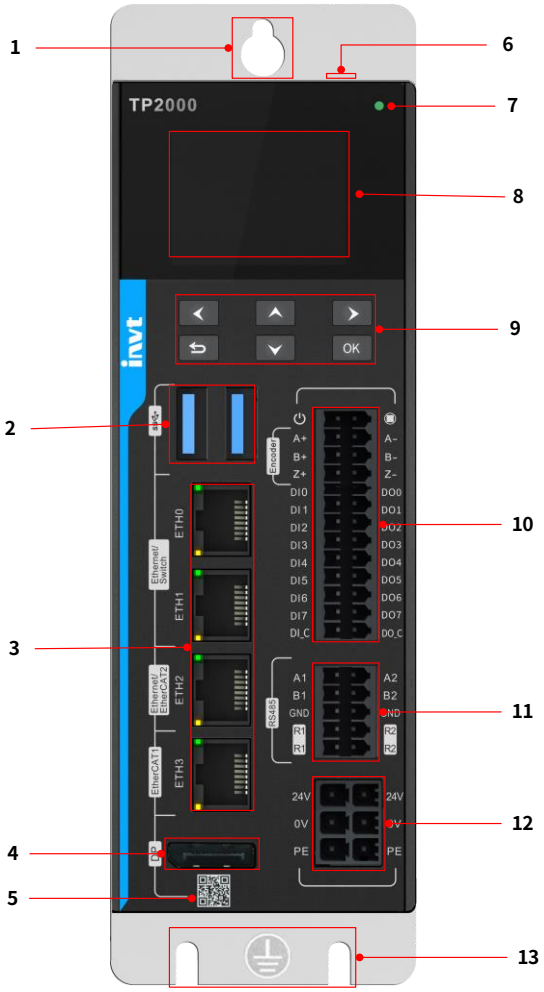
2 Product overview

2.1 Product nameplate and model

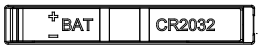
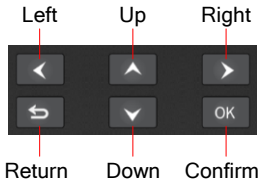


Ordering code	Model	Specifications
11015-00043	TP2321-1016	Finished PLC; IPC; 1xEtherCAT master station; 16 axes; 64GB flash storage; 8GB memory; Linux operating system; RoHS
11015-00042	TP2321-1032	Finished PLC; IPC; 1xEtherCAT master station; 32 axes; 64GB flash storage; 8GB memory; Linux operating system; RoHS
11015-00045	TP2422-1048	Finished PLC; IPC; 2xEtherCAT master station; 48 axes; 128GB flash storage; 8GB memory; Linux operating system; RoHS
11015-00032	TP2422-1064	Finished PLC; IPC; 2xEtherCAT master station; 64 axes; 128GB flash storage; 8GB memory; Linux operating system; RoHS
11015-00044	TP2422-1096	Finished PLC; IPC; 2xEtherCAT master station; 96 axes; 128GB flash storage; 8GB memory; Linux operating system; RoHS
11015-00046	TP2422-1128	Finished PLC; IPC; 2xEtherCAT master station; 128 axes; 128GB flash storage; 8GB memory; Linux operating system; RoHS

2.2 Interface description



No.	Interface		Description	
1	Rear mounting lug		For book-type PLC mounting and fixing	
2	USB interface x2		Specifications	USB3.0 Type-A
			Function	USB drive/Mouse/Keyboard
3	Ethernet port x4	Ethernet1 (ETH0)	Specifications	10/100/1000BASE-T
			IP address	192.168.1.10 (initial value)
			Default function	Program download, debug, and monitoring
			Yellow indicator	Steady off: Not connected. Blinking: Data is sent and received. Steady on: Connected.
			Green indicator	Steady off: Not connected. Steady on: Connected.
		Ethernet2 (ETH1)	Specifications	10/100/1000BASE-T
			IP address	192.168.2.10 (initial value)
			Default function	Modbus TCP, UDP master/slave station
			Yellow indicator	Steady off: Not connected. Blinking: Data is sent and

No.	Interface		Description	
				received. Steady on: Connected.
			Green indicator	Steady off: Not connected. Steady on: Connected.
		EtherCAT2 (ETH2)	Specifications	100/ 1000BASE-T
			IP address	-
			Default function	EtherCAT master station 2 (EtherCAT ring input)
			Yellow indicator	Steady off: Not connected. Blinking: Data is sent and received. Steady on: Connected.
			Green indicator	Steady off: Not connected. Steady on: Connected.
		EtherCAT1 (ETH3)	Specifications	100/ 1000BASE-T
			IP address	-
			Default function	EtherCAT master station 1 (EtherCAT ring output)
			Yellow indicator	Steady off: Not connected. Blinking: Data is sent and received. Steady on: Connected.
			Green indicator	Steady off: Not connected. Steady on: Connected.
4	Display interface	DP+	Display output interface	
5	QR code on machine		Scanned with your phone to obtain the user manual.	
6	Button battery cover		For button battery installing or removing 	
7	Power indicator		Steady green: The power supply is normal. Steady red: The power supply is undervoltage or the product is not on. Steady off: No power supply.	
8	Display screen		For product status display **Note:** A full-screen red display indicates product crash. Re-power-on is required.	
9	Key			
10	I/O terminal	⏻	Product power-on/off input signal	
		◉	Product start/stop input signal	
		A1+	Differential encoder A-phase signal +	
		A1-	Differential encoder A-phase signal -	
		B1+	Differential encoder B-phase signal +	
		B1-	Differential encoder B-phase signal -	

No.	Interface		Description
		Z1+	Differential encoder Z-phase signal +
		Z1-	Differential encoder Z-phase signal -
		DI0–DI7	Single-ended digital input signal n (n=0, 1, 2...7)
		S/S	Single-ended digital input signal common terminal
		DO0–DO7	Single-ended digital output signal n (n=0, 1, 2...7)
		COM	Single-ended digital output signal common terminal
11	Serial port terminal	A1	Channel-1 RS485 differential signal +
		B1	Channel-1 RS485 differential signal -
		485G	RS485 chip power ground
		PE	Shield ground wire
		R1	Channel-1 RS485 built-in 120Ω termination resistor port Short circuited: The termination resistor is connected. Disconnected: The termination resistor is disconnected.
		R1	
		A2	Channel-2 RS485 differential signal +
		B2	Channel-2 RS485 differential signal -
		485G	RS485 chip power ground
		PE	Protective earth
		R2	Channel-2 RS485 built-in 120Ω termination resistor port Short circuited: The termination resistor is connected. Disconnected: The termination resistor is disconnected.
		R2	
12	Power supply terminals	24V	Positive pole of 24V DC power supply
		0V	Negative pole of 24V DC power supply
		PE	Grounding
13	Rear fixing/grounding terminal		For book-type PLC mounting/fixing and housing grounding

2.3 Product specifications

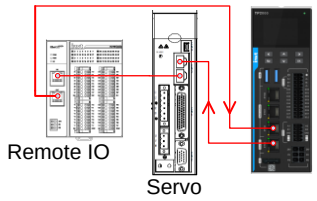
2.3.1 General specifications

Item	TP2321-1016	TP2321-1032	TP2422-1048	TP2422-1064	TP2422-1096	TP2422-1128
Memory size	8GB					
Hard disk capacity	64GB		128GB			
Number of EtherCAT master stations	x1		x2			
EtherCAT axis capacity	16 axes	32 axes	48 axes	64 axes	96 axes	128 axes

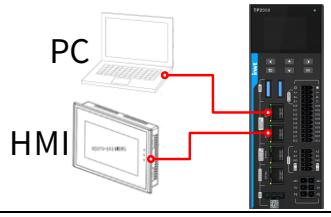
Item	TP2321-1016	TP2321-1032	TP2422-1048	TP2422-1064	TP2422-1096	TP2422-1128
Ethernet	● 2xRJ45, 10/100/1000Base-TX self-adaptive ● Supporting Modbus TCP, OPC UA, TCP/UDP, program upload and download, and firmware upgrade. ● Soft routing (switch) function configurable.					
RS485	2xRS485, push-in terminal, supporting Modbus RTU master/slave function and free protocol port.					
Local I/O count	● 1 channel of ABZ differential encoder input, supporting up to 2MHz ● 8 channels of HSDI single-ended input, supporting up to 200kHz ● 8 channels of HSDO single-ended output, supporting up to 200kHz ● 1 channel of product power-on/off control input ● 1 channel of APP start/stop control input					
Remote I/O count	Up to 32000 points (EtherCAT bus)					
USB	2x USB3.0, Type-A					
Display	● 1x display port ● 1x1.8 inch TFT color screen					
Key	6x tactile push keys					
Operating system	Linux					
Programming method	IEC 61131-3 programming languages (IL, ST, FBD, SFC, CFC, and LD)					
Program execution method	Compile and execute					
Programming platform	Invtmatic Studio 3.0.0.7 or later					
User program storage space	256M bytes					
User data storage space	256M bytes					
Power-failure retention space	5M bytes					
Real-time clock	Supported (CR2032 button battery is user provided)					
Input power	24V DC (-15%–+20%)/1.5A Reverse connection and surge protection are supported.					
Standalone power consumption	< 36W					
Cooling method	Natural cooling					
Ingress protection (IP) rating	IP20					
Working environment temperature	-10°C–+55°C					
Working environment	10%–95% (no condensation)					

Item	TP2321 -1016	TP2321 -1032	TP2422 -1048	TP2422 -1064	TP2422 -1096	TP2422 -1128
relative humidity (RH)						
Storage temperature	-25°C–+70°C					
Storage environment humidity	5%–100% (No condensation)					
Air	No corrosive gas					
Altitude	2000m					
Pollution degree	Degree 2 or lower, compliant with IEC 61131-2					
Impact test	5–8.5Hz, vibration amplitude of 3.5mm; 8.5–150Hz, acceleration of 10m/s²; X/Y/Z axis, 10cycles					
Product dimensions	See Appendix A Dimension drawing.					
Product weight	Net weight: approx. 1.41kg/Gross weight: approx. 1.59kg					

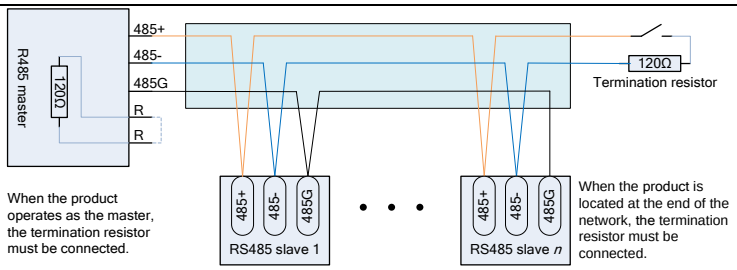
2.3.2 EtherCAT specifications

Item	Specifications
Communication protocol	Standard EtherCAT
Baud rate	100/1000Base-T self-adaptive
Transmission medium	Standard industrial Ethernet cable (Cat.5 or higher)
Duplex mode	Full duplex
Transmission distance	< 100m
Topology structure	Linear
Distinctive functions	● Supporting dual EtherCAT master stations (not supported by TP2321) ● Supporting EtherCAT ring topology, with the slave count consistent with the total axis count ● Supporting Ethernet over EtherCAT (EOE) topology, with the slave count consistent with the total axis count **Note:** The EOE function supports a single channel only.
Wiring diagram	

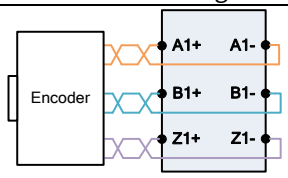
2.3.3 Ethernet specifications

Item	Specifications
Communication protocol	● Standard Ethernet ● Modbus TCP ● OPC UA Server ● EtherNet/IP TCP/IP and UDP free protocols
Baud rate	10/100/1000Base-T self-adaptive
Transmission medium	Standard industrial Ethernet cable (Cat.5 or higher)
Duplex mode	Full duplex
Transmission distance	<100m
Topology structure	Linear
Distinctive functions	● Supporting Ethernet switch function, which is configured using Invtmatic Studio Tool ● Supporting user program upload and download, firmware upgrade, and file transfer ● Supporting WebVisu visualization ● Supporting tag-based communications
Modbus TCP specifications	Up to 63 slave stations
Ethernet Switch specifications	● TP2321 supports the configuration of ETH0, ETH1, and ETH2. ● TP2422 supports the configuration of ETH0 and ETH1.
Wiring diagram	

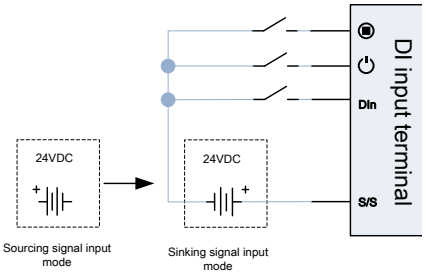
2.3.4 RS485 specifications

Item		Specifications
Connection terminal		Removable push-in terminal
Communication protocol		Standard Modbus RTU master/slave protocol
Transmission medium		Twisted-pair shielded cable
Duplex mode		Half duplex
Distinctive functions		Built-in configurable 120Ω termination resistor
Wiring specifications		Cable length less than 1500m (compliant with RS485 bus specifications)
Modbus RTU	Baud rate	2400/4800/9600/19200/38400/57600/115200bps
	Data length	8 bits
	Parity bit	None, odd, even
	Stop bit	1, 2
	Number of slave stations	Up to 31
Wiring diagram		 **Note:** ● RS485 port wiring should use twisted-pair shielded cables or multi-core twisted-pair shielded cables. ● When the PLC is positioned at the RS485 network master station or at the end of the RS485 slave station, a termination resistor must be properly configured. ● Due to signal attenuation over distance, it is recommended to use thicker cables when the connection length exceeds 3 meters. ● If the slave device interface does not define a chip-level GND pin, 485G signal can be left unconnected. ● Except for node connection points, do not connect the 485G or shielding wire at any intermediate point along the cable.

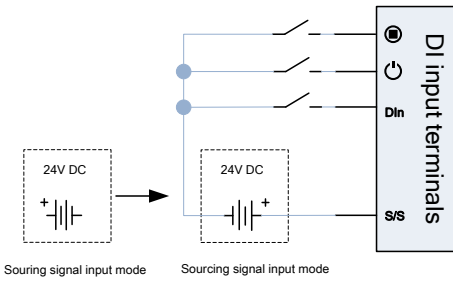
2.3.5 Encoder input specifications

Item	Specifications
Connection terminal	Removable push-in terminal
Supported functions	A/B/Z differential encoder input
Counting mode	● A/B phase (x1, x2, x4 quadrature decoding) ● CW/CCW
Quantity	1
Input type	Differential input
Input voltage class	5V DC±10%
Hardware response time ON/OFF	0.25μs/0.25μs
Interface protection	Supporting 24V overvoltage protection
Isolated	Yes (Magnetic isolation)
Wiring specifications	Recommended length: < 3m
Wiring diagram	

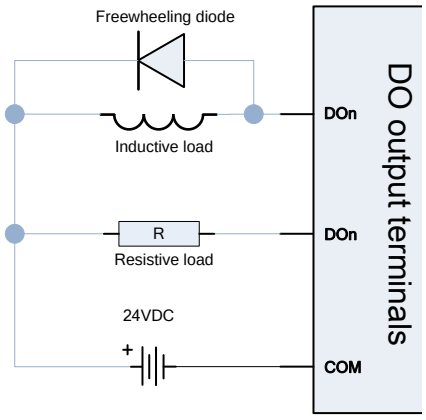
2.3.6 Digital input specifications

Item		Specifications	
Connection terminal		Removable push-in terminal	
Function	Digital input	Interface quantity	8
	High-speed counting	Interface quantity	4
		Counting mode	A/B phase (x1, x2, x4 quadrature decoding), CW/CCW, Pulse + Direction, Unidirectional (8 channels supported)
		Supported functions	Hardware reset, probe 0, probe 1, interrupt input, and comparison output
Input type		Digital input	
Input mode		Sourcing/sinking	
Input voltage class		24V DC±10% (21.6V DC–26.4V DC)	
Input current (Typical)		14mA	
ON voltage		> 15V	
OFF voltage		< 5V	
Hardware response time ON/OFF		2.5μs/2.5μs	
Software filter time		Supported	
Input resistance		Reference value: approx. 2.3kΩ	
Isolated		Yes (Optocoupler isolation)	
Wiring specifications		Recommended length: < 3m	
Wiring diagram			

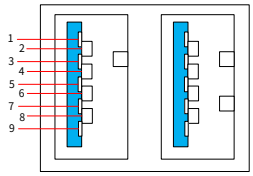
2.3.7 Product start/stop and power-on/off interface specifications

Item		Specifications
Connection terminal		Removable push-in terminal
Function	⏻ Product power-on/off input	• Input signal active: The product powers off. • Input signal inactive: The product powers on. **Note:** Interface disconnection equals signal inactive.
	⏹ Product start/stop input	• Input signal active: The product stops. • Input signal inactive: The product starts. **Note:** Interface disconnection equals signal inactive.
Input type		Digital input
Input mode		Sourcing/sinking
Input voltage class		24V DC±10% (21.6V DC–26.4V DC)
Input current (Typical)		14mA
ON voltage		> 15V
OFF voltage		< 5V
Hardware response time ON/OFF		0.5s/0.5s
Software filter time		Not supported
Input resistance		Reference value: approx. 2.3kΩ
Isolated		Yes (Optocoupler isolation)
Wiring specifications		Recommended length: < 3m
Wiring diagram		 **Note:** The signals share the same common terminal as DI.

2.3.8 Digital output specifications

Item		Specifications	
Connection terminal		Removable push-in terminal	
Function	Digital output	Interface quantity	8 (output presetting function supported)
	Comparator output	Interface quantity	4
	Pulse axis output	Interface quantity	4
		Output mode	● Supporting Pulse + Direction ● Supporting both positive and negative logic ● Supporting quadrature mode ● Supporting PWM output
		Supported functions	Z signal, homing signal, positive/negative limit, probe 0, probe 1, and preset value output
Output type		Digital output	
Output mode		Sinking	
Output load (Resistance load)		0.5A/point, 4A/module	
Output load (Inductance load)		7.2W/point, 24W/module	
Output load (Light load)		5W/point, 18W/module	
Hardware response time ON/OFF		Resistive load: 2.5μs/2.5μs Inductive load: 2.5ms/2.5ms Lamp load: 2.5ms/2.5ms	
Leakage current at OFF		10μA	
Isolated		Yes	
Output action display		When the output is in the driving state, the corresponding point on the LCD screen lights up.	
Protection functions		Overcurrent protection (short-circuit protection), reverse connection protection	
Wiring specifications		Recommended length: < 3m	
Wiring diagram			

2.3.9 USB interface specifications

<table>
<tr><th>Item</th><th>Specifications</th></tr>
<tr><td>Communication protocol</td><td>Standard USB3.0 protocol</td></tr>
<tr><td>Communication rate</td><td>Up to 5.0Gbps</td></tr>
<tr><td>Interface type</td><td>Type-A</td></tr>
<tr><td>Communication distance</td><td>< 3m</td></tr>
<tr><td>Isolation method</td><td>Non-isolated</td></tr>
<tr><td>Power supply short-circuit protection</td><td>Supported (built-in overcurrent protection chipset)</td></tr>
<tr><td>Max. supply current</td><td>1.5A per port</td></tr>
<tr><td>Function</td><td>● Supporting USB drive and mouse
● Supporting firmware upgrade via USB drive
● Supporting APP update via USB drive</td></tr>
<tr><td>Definition</td><td>
<table>
<tr><th>Interface schematic</th><th>Pin</th><th>Signal definition</th><th>Pin</th><th>Signal definition</th></tr>
<tr><td rowspan="5">  </td><td>1</td><td>SSTX-</td><td>6</td><td>D-</td></tr>
<tr><td>2</td><td>GND</td><td>7</td><td>SSRX-</td></tr>
<tr><td>3</td><td>SSTX+</td><td>8</td><td>VBUS</td></tr>
<tr><td>4</td><td>D+</td><td>9</td><td>SSRX+</td></tr>
<tr><td>5</td><td>GND_DRAIN</td><td>-</td><td>-</td></tr>
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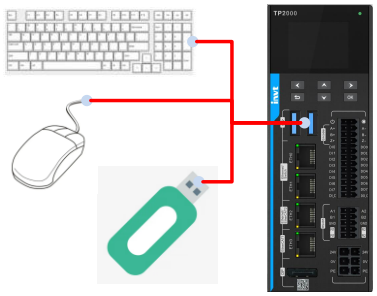
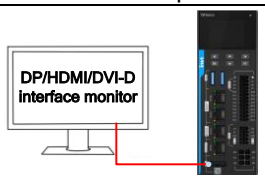
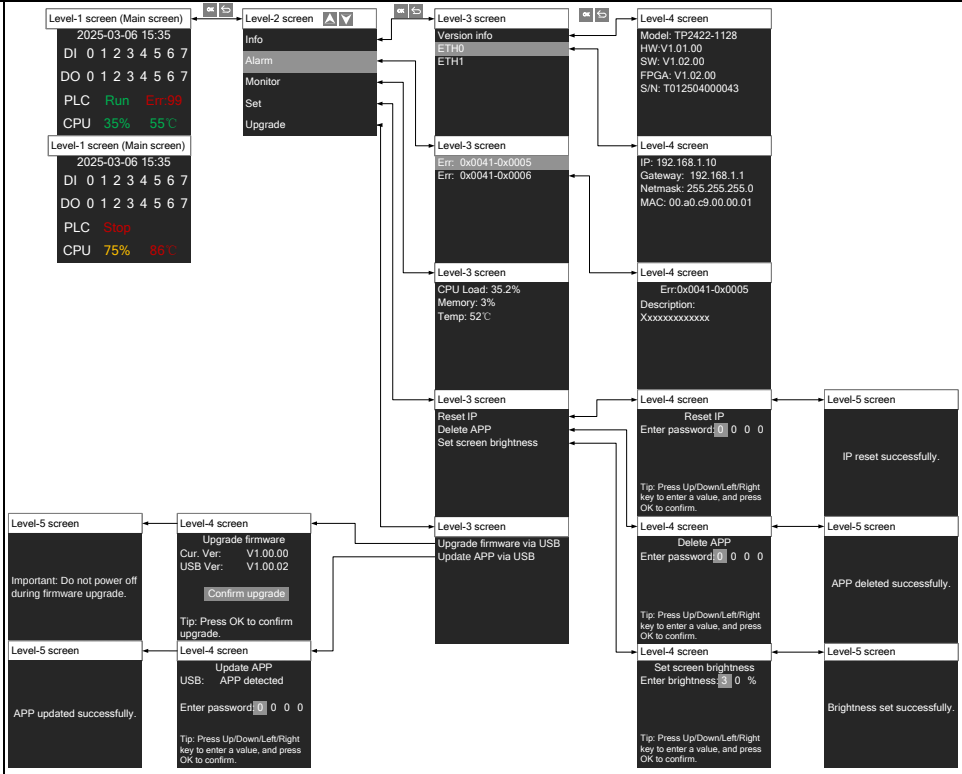
</td></tr>
<tr><td>Wiring diagram</td><td>  </td></tr>
</table>

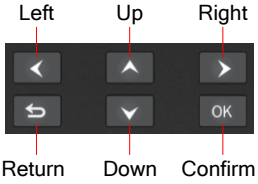
2.3.10 DP+ interface specifications

Item	Specifications
Signal type	Digital signal
Interface type	Standard DP interface
Number of channels	1
Highest resolution	1920x1200 @60Hz
Distinctive functions	Supporting DP+ (with signal conversion for HDMI and DVI-D)
Wiring specifications	Length: < 1.5m
Function	Visualization output
Wiring diagram	

2.3.11 TFT display specifications

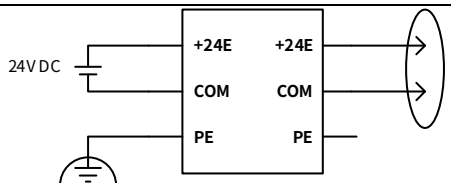
Item	Specifications
Size	1.8 inches
Resolution	128(RGB) x 160
Function	Function block information display
HMI information	 **Note:** The system returns to the main interface automatically if no key is operated within 1 minute.

2.3.12 Key specifications

<table>
<tr><th>Item</th><th colspan="2">Specifications</th></tr>
<tr><td>Key type</td><td colspan="2">Tactile push key</td></tr>
<tr><td>Key definition</td><td colspan="2"> 

Note:
● On the digital input interface, press the up key to increase the value or the down key to decrease.
● On the digital input interface, press the left key to shift leftward or the right key to shift rightward.</td></tr>
<tr><td rowspan="2">Distinctive functions</td><td>Press and hold Return about 3s.</td><td>The main interface is displayed.</td></tr>
<tr><td>Press and hold OK about 3s.</td><td>The Run/Stop state is switched.</td></tr>
</table>

2.3.13 Power supply interface specifications

<table>
<tr><th>Item</th><th>Specifications</th></tr>
<tr><td>Power supply</td><td>24V DC (-15%–+20%)/1.5A</td></tr>
<tr><td>Interface protection</td><td>● Supporting reverse connection protection
● Supporting surge protection</td></tr>
<tr><td>Wiring specifications</td><td>Recommended length: < 3m</td></tr>
<tr><td>Wiring diagram</td><td> 

Note:
● The AC power must have been turned off before wiring. Otherwise, electric shock, personal injury, or product damage can result.
● Do not bind the 110V/220V AC power cable together with the 24V power cable or communication cable, or route the 110V/220V AC power cable with the latter adjacently. The distance between such cables must be at least 100mm.
● The PE terminal of the power supply is electrically connected to the housing ground ⏚. It is recommended to connect both points to the protective ground separately.</td></tr>
</table>

3 Mechanical installation

3.1 Installation environment requirements

When installing this product on a DIN rail, operability, maintainability, and environmental resistance should be fully considered in advance.

Item	Specifications
Operating environment	No corrosive gas
Installation position	Indoor control cabinet
Random vibration	10–500Hz, 0.01g_n^2/Hz, 30min/axis, X/Y/Z axis
Sinusoidal vibration	5–8.4Hz, vibration amplitude of 3.5mm; 8.4–150Hz, acceleration of 10m/s^2; X/Y/Z axis, 10cycles
Mechanical shock	● Shock pulse type: Half-sine wave ● Acceleration: 150m/s^2 ● Duration: 11ms ● For axes X/Y/Z, 3 pulses in both positive and negative directions per axis, 18 pulses in total
Random vibration for package	10Hz–100Hz 0.05g_n^2/Hz,100Hz–200Hz -7dB/Oct, 30min/axis, X/Y/Z axis
Storage temperature and humidity range	Temperature: 25°C–70°C; relative humidity: less than 90%; no condensation
Working temperature and humidity range	Temperature: 10°C–55°C; relative humidity: less than 95%; no condensation

3.2 Installation space

For the ease of replacement and heat dissipation, keep sufficient clearances between the product upper/lower parts and cabinet and between components. See Figure 3-1.

Figure 3-1 Installation clearance diagram

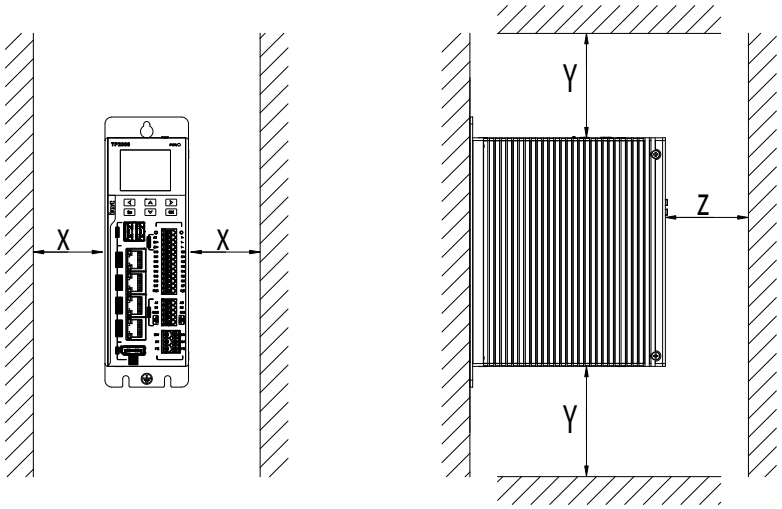


Table 3-1 Installation clearances

Direction	Min. clearance (mm)
X	50
Y	100
Z	50

3.2.1 Check before installation

- Ensure that the product has been powered off.
- Ensure that the installation space meets the requirements. The product must be mounted inside a control cabinet, with a minimum clearance of 50mm on all sides for adequate heat dissipation.
- Fully evaluate the installation environment; do not install the product in the following locations:
  - ✧ With temperature out of the range of -10–+55 C.
  - ✧ With relative humidity out of the range of 5%–95%.
  - ✧ Temperature changes sharply, and condensation may occur.
  - ✧ With explosive or flammable gases.
  - ✧ With dust, conductive materials such as iron powder, oil mist, salt, or organic solvents exceeding allowable concentrations.
  - ✧ With direct sunlight.
  - ✧ With strong electric or magnetic fields.
  - ✧ With factors that will cause the equipment to directly vibrate or suffer conductive shocks.

3.2.2 Installation precautions

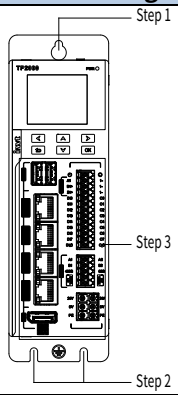
- Use only specified components such as screws and washers.
- Prevent metal wire heads, debris, screws, and other objects from falling into the internal of equipment. Otherwise, short circuit may occur, or heat dissipation may be degraded.
- Do not use fasteners with excessive torque. Otherwise, terminals may be damaged.

3.2.3 Check after installation

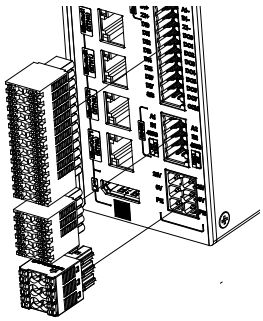
- Ensure that communication cables and terminals are firmly connected.
- Ensure that the equipment is securely mounted and fixed.
- Ensure that power and control cables are routed separately and neatly arranged inside the cabinet to prevent disorder that may hinder heat dissipation.
- Remove the sticker attached to the heat dissipation hole of the equipment to make the heat dissipation smooth.

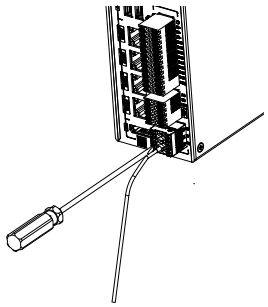
3.3 Installation and disassembly

3.3.1 Main unit installation

Installation diagram	Installation procedure
	Preparation: Check product accessories and make location planning. Step 1 Hang the product onto the pre-installed screws of the fixed cabinet. Step 2 Secure the lower part of the product with 2 screws and connect the grounding conductor of the housing. Step 3 Connect the power supply cable and other functional cables.

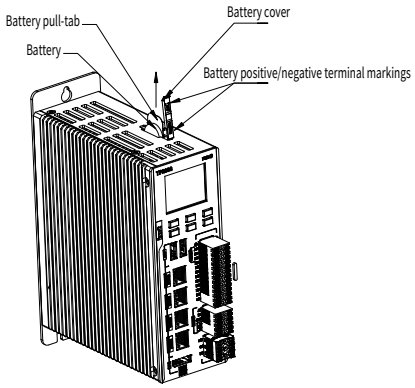
3.3.2 Mounting, removal, and wiring of power supply, serial port, and I/O terminals

Terminal installation/removal diagram	Operation description
	Terminal removal: Pull the terminal block outward firmly. Terminal installation: Push the terminal block fully into the slot until it is securely seated.

Wire connection/disconnection diagram	Operation description
	The power supply terminals adopt a spring-clamp wiring method. Connection: Insert the prepared cable connector directly into the terminal block. Disconnection: Step 1 Press the orange release button on the terminal block with a small flat-blade screwdriver. Step 2 Pull the wire out.

Note: Do not use excessive force when removing or installing terminals to avoid damaging the components.

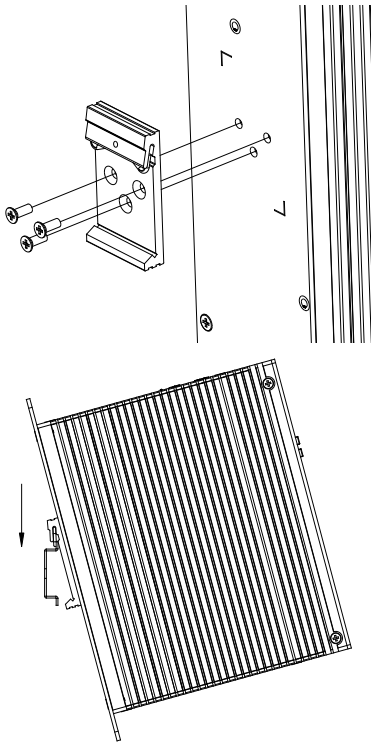
3.3.3 Battery installation/removal

Diagram	Operation description
	Removal procedure: Step 1 Open the battery cover on the top of the PLC. Step 2 Pull the battery pull-tab outward by hand (or with a suitable tool); the batteries will slide out accordingly. Step 3 Remove the batteries using your hand or insulated tweezers. Installation procedure: Step 1 Insert new batteries into the battery slot in the correct direction. Step 2 Tuck the battery pull-tab into the recess and close the battery cover.

Note:

- Do not use metal tweezers when removing or installing the battery to prevent short circuits.
- Dispose of used batteries properly to avoid environmental pollution or personal injury.
- Ensure the battery polarity is correct; do not insert batteries in reverse.
- After replacing batteries, recalibrate the system clock to ensure correct timekeeping.

3.3.4 DIN rail clip installation/removal

DIN rail clip installation/removal diagram	Operation description
	Installing the DIN rail clip: Step 1 Align the DIN rail clip with the reserved mounting holes on the back of the equipment. Step 2 Tighten it with the supplied screws. Mounting the PLC onto the DIN rail: Step 1 Hook the upper part of the DIN rail clip on the PLC back onto the DIN rail. Step 2 Using the engaged point on the DIN rail as a pivot, rotate the PLC and press the DIN rail clip lower part into place. Removing the PLC from the DIN rail: Step 1 Push the PLC downward to compress the spring of the DIN rail clip. Step 2 Rotate the PLC counterclockwise to release the bottom part of the clip from the rail. Step 3 Lift the PLC upward to detach the upper part of the clip from the rail and remove the PLC.

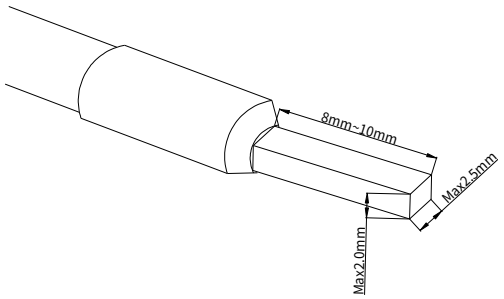
Note: The DIN rail clip is an optional accessory and must be purchased separately.

4 Wiring

4.1 Cable specifications

4.1.1 Single-conductor cable specifications

Table 4-1 Single-conductor cable dimensions

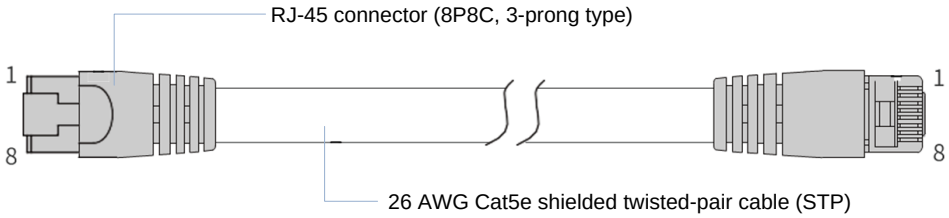
Applicable conductor cross-section		Tubular cable lug
GB size/mm²	AWG size/AWG	
0.3	22	
0.5	20	
0.75	18	
1.0	18	
1.5	16	

Note:

- Before installing or wiring, ensure that all external power supplies have been cut off. Failure to cut off the power supplies may result in electrical shock or equipment damage.
- After completing installation or wiring, always check for short circuits before switching on the power supply. Failure to do so may result in electric shock or equipment failure.
- During wiring, verify the rated voltage and terminal configuration specified in the product specifications to ensure correct and safe wiring. Using a power supply that does not match the ratings or incorrect wiring methods may cause serious accidents such as fire and equipment damage.
- Tighten screws using required torque. Loose screws may lead to short circuits, fire, or equipment failure; excessive tightening may damage screws or equipment, resulting in detachment, short circuits, or malfunctions.
- Ensure that no foreign objects such as metal chips or wire ends remain inside the equipment. Such foreign objects may cause short circuit, fire, or operational failures.

4.1.2 Ethernet cable specifications

Figure 4-1 Ethernet cable diagram



Pin	1000Mbps Ethernet port		100Mbps Ethernet port	
	Signal	Signal description	Signal	Signal description
1	DA+	Data A+	TD+	Data transmission +
2	DA-	Data A-	TD-	Data transmission -
3	DB+	Data B+	RD+	Data receiving +
4	DC+	Data C+	Not used	Do not use
5	DC-	Data C-	Not used	Do not use
6	DB-	Data B-	RD-	Data receiving -
7	DD+	Data D+	Not used	Do not use
8	DD-	Data D-	Not used	Do not use

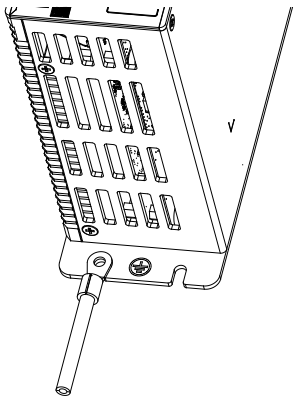
Note:

- All cables must undergo a 100% continuity test to ensure there are no short circuits, open circuits, wiring errors, or poor contacts.
- To ensure communication quality, the EtherCAT communication cable length cannot exceed 100 meters.
- For self-made Ethernet cables, it is recommended to use shielded twisted pair cables. Category 5e cables or higher are recommended, complying with EIA/TIA-568A, EN 50173, ISO/IEC 11801, EIA/TIA bulletin TSB, and EIA/TIA SB40-A & TSB36 standards.

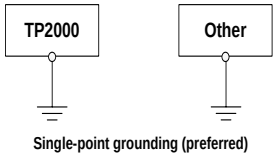
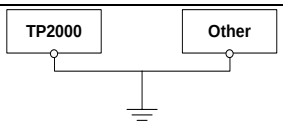
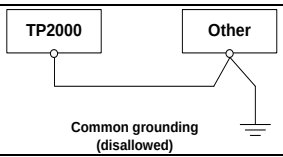
4.2 Grounding

The grounding conductor of the housing must meet the following requirements:

- A dedicated (independent) grounding method must be used.
- The grounding conductor shall have a cross-sectional area ≥ 2mm² and a length ≤ 30cm.
- The grounding point should be located close to the equipment to ensure a secure and reliable connection of the grounding cable.



Grounding principles:

 Single-point grounding (preferred)	The cross-sectional area of the grounding cable must not be smaller than that of the power supply cable. Perform single-point grounding when multiple types of equipment are used at the same time.
 Common grounding (allowed)	If single-point grounding cannot be performed, use the common ground method.
 Common grounding (disallowed)	During grounding, the grounding method shown in the figure cannot be used.

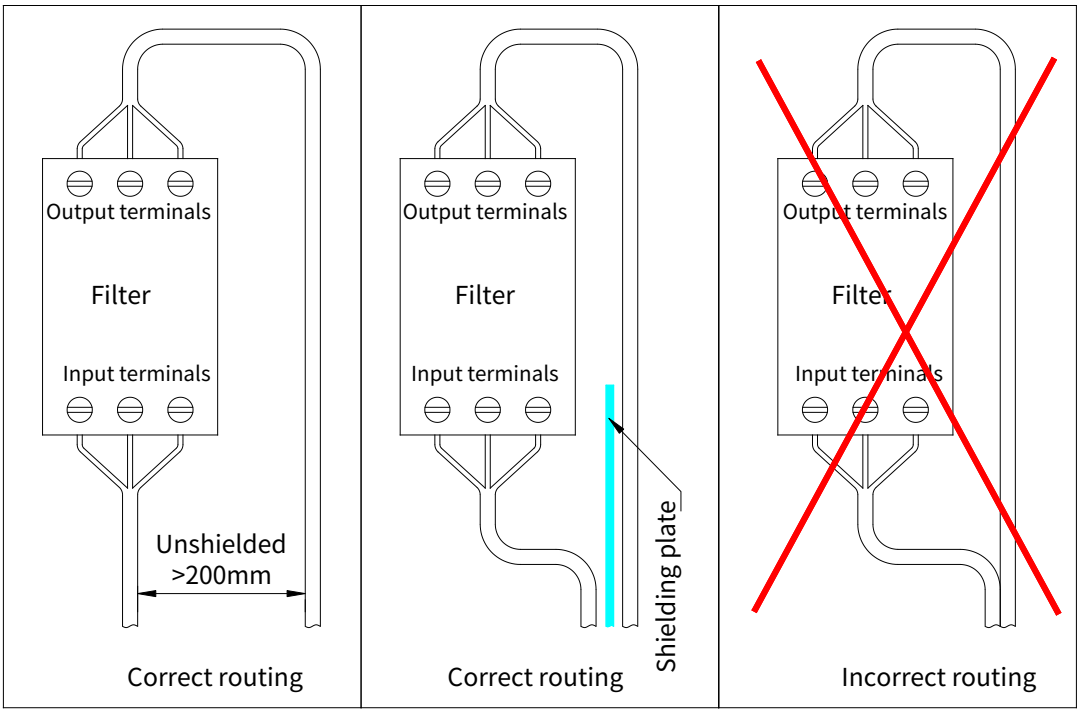
Shielded cable grounding

Shielded cables must be used for RS485, EtherCAT, Ethernet, USB, and other cables carrying sensitive transmission signals. Grounding should be implemented as close to the equipment end as possible. After stripping the cable jacket, the exposed shield layer must be brought into large-area contact with the conductive backplane to ensure proper grounding.

4.3 Installing an EMI filter

If the product is used in a site with strong interference sources (such as VFDs), it is recommended to add an additional EMI filter to suppress interference noise.

The EMI filter should be installed as close as possible to the product's power input interface and fastened to the conductive backplane with screws. To ensure reliable grounding, apply protective coating treatment to the screw installation area. During installation, route the input line and output line of the filter separately to avoid noise coupling.



Note: The EMI filter is not a standard accessory and must be purchased separately.

5 Programming

5.1 Introduction to Invtmatic Studio

Invtmatic Studio is a PLC programming software developed by Shenzhen INVT Electric Co., Ltd. It provides an open and fully integrated programming development environment with advanced technology and powerful functions for project development that is based on programming languages compliant with IEC 61131-3. It is widely applied in energy, transportation, municipal, metallurgy, chemical, pharmaceutical, food, textile, packaging, printing, rubber and plastics, and machine tool industries.

5.2 Invtmatic Studio obtaining and installation requirements

5.2.1 Software obtaining

Invtmatic Studio is free software, and you can obtain the installation files and related documentation as follows:

Visit www.invt.com, choose **Support** > **Download**, enter a keyword, and click **Search**.

Note: As INVT continuously improves its products and documentation, you are advised to check for software updates regularly and consult the latest released reference documentation.

5.2.2 Software installation requirements

Desktop or laptop computer meeting the following requirements:

- Operating system: Windows 7/10/11 (64-bit version)
- Memory: ≥ 4GB
- Hard disk space: Total free space ≥ 10GB (C drive free space ≥ 5GB)
- LAN port: 1 available LAN port in the local network.

5.3 Invtmatic Studio installation and uninstallation

For details, see *INVT Medium and Large-scale PLC Software Manual*.

5.4 Connecting your PC to the PLC

5.4.1 Hardware connection between your PC and PLC

An Ethernet cable provides the hardware connection between the PC and the PLC. The default debugging/download port of the PLC is the Ethernet1 (ETH0) port.

5.4.2 Local network IP address settings on your PC

The local network IP address on the PC must be set to be in the same subnet as the PLC's Ethernet port IP

address (but not identical) in order to establish a successful connection.

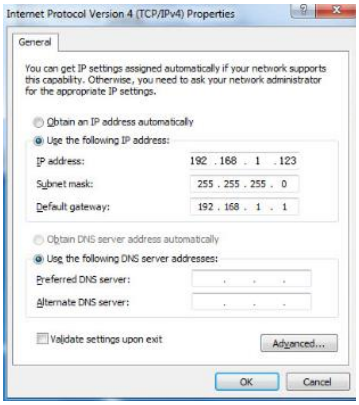
- Default IP address of the PLC ETH0 port

  IP address: 192.168.1.10

  Subnet mask: 255.255.255.0

  Default gateway: 192.168.1.1

- Recommended local network IP address settings on your PC



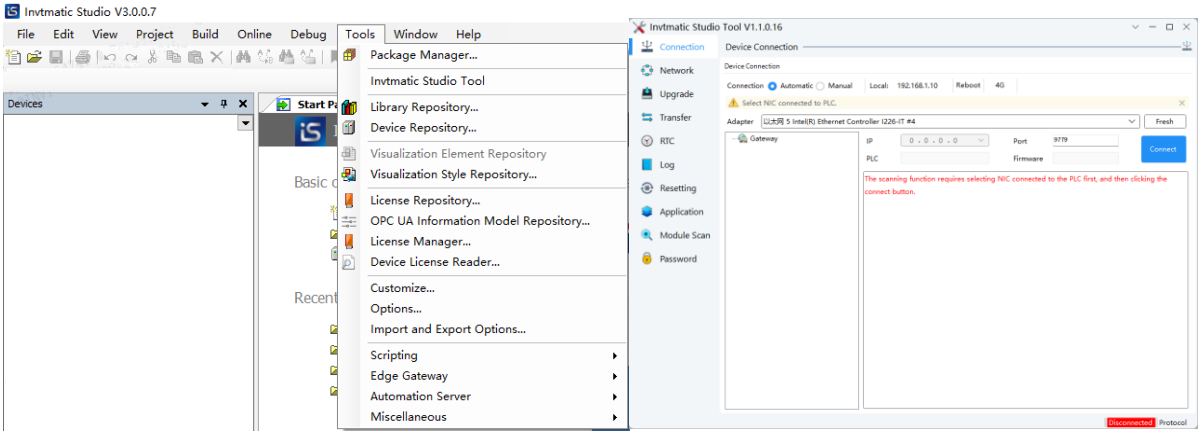
5.5 Invtmatic Studio use cases

For details, see *INVT Medium and Large-scale PLC Software Manual*.

5.6 Invtmatic Studio Tool

In Invtmatic Studio, choose **Tools** > **Invtmatic Studio**.

Then the Invtmatic Studio Tool is launched. See the following figure.



6 Other instructions

6.1 Restoring factory settings

Method 1: Restore factory settings through Invtmatic Studio Tool.

Open Invtmatic Studio Tool, choose **Factory settings**, and then follow the on-screen instruction messages.

Method 2: Restore factory settings through the local keys of the PLC.

Press **OK** > **Settings** > **Reset IP** or **Delete APP** > **Enter password (default 1234**) > **OK**.

6.2 User program download

Method 1: Download user programs through Invtmatic Studio.

For details, see *INVT Medium and Large-scale PLC Software Manual*.

Method 2: Download via USB drive.

Copy the user program APP file to the root directory of the USB drive, and then press **OK** > **Upgrade** > **Update APP via USB** > **Enter password (default 1234)** > **OK**.

Note: The user program APP file is generated by the Invtmatic Studio programming tool.

6.3 Software version query method

Method 1: View through the product's built-in display.

Press **OK** > **Information** > **Version information**.

Method 2: View through Invtmatic Studio Tool.

Open Invtmatic Studio Tool, choose **Connection** > **Adapter** > **Connect**.

6.4 PLC firmware upgrade

Method 1: Upgrade through Invtmatic Studio Tool.

Open Invtmatic Studio Tool, choose **Connection** > **Adapter** > **Connect**. On the firmware upgrade page, select the firmware package, and click the upgrade button.

Or: On the firmware upgrade page, choose **Online download** > **TP2000**, click the **Download** icon and then the **Open** icon, and click the upgrade button.

Method 2: Upgrade via USB drive.

Copy the user program APP file to the root directory of the USB drive, and then press **OK** > **Upgrade** > **Update APP via USB** > **Enter password (default 1234)** > **OK**.

6.5 Maintenance and inspection

6.5.1 Daily inspection

No.	Check item	Check criteria	Handling method
1	Exterior inspection	Visually check for dirt accumulation.	Clean off dust and contaminants.
2	Equipment installation	Check whether the equipment is securely installed.	Fasten the equipment.
3	Connection terminals	Check whether the connection terminals are loose.	Retighten and secure the terminals.
4	PE grounding	Check whether the PE grounding is reliable.	Retighten and secure the grounding terminals.
5	Loose terminals	Check for loose terminals.	Connect terminals securely.
6	Cable connection ports	Check whether cable connection ports are firm and reliable.	Connect terminals securely.
7	Indicators	Check whether indicators display status correctly.	Ensure that indicators display status correctly.

6.5.2 Periodic maintenance inspection

No.	Check item	Check criteria	Handling method
1	Ambient environment	Use a thermometer and hygrometer to check whether the environment temperature/humidity meets the product specifications.	Locate the exception cause and handle the exception in time.
2	Air	Measure corrosive gas.	Find out the source of the gas and handle it properly to meet the operating environment requirements.
3	Power supply voltage	Check whether the input AC power meets the input specifications of the power supply module.	Ensure that the power supply system meets the requirements.
4	Installation	Check whether the product is installed reliably and securely.	Ensure that correct methods are used.
5	Loose terminal screws	Check whether screws are loose with a screwdriver.	Fasten terminal screws.

Note: If the equipment has been relocated, modified, or has suffered collision, both daily inspection and periodic maintenance inspection must be carried out.

6.6 Battery maintenance

Purpose of battery installation

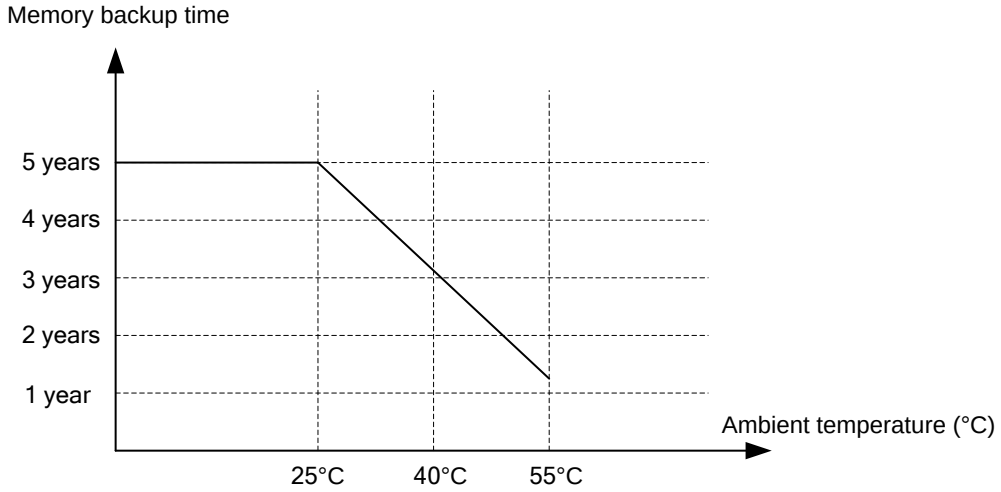
The real-time clock (RTC) function inside the PLC and the CMOS data retention in the BIOS during power off

rely on battery supply. If the battery is not installed or the battery level is low, the RTC will stop counting, and the CMOS data in the BIOS will be lost when the power is off.

Battery life and replacement interval

The actual service life of the battery varies depending on the PLC's operating environment. The curve shown below indicates the theoretical maximum service life (for reference only).

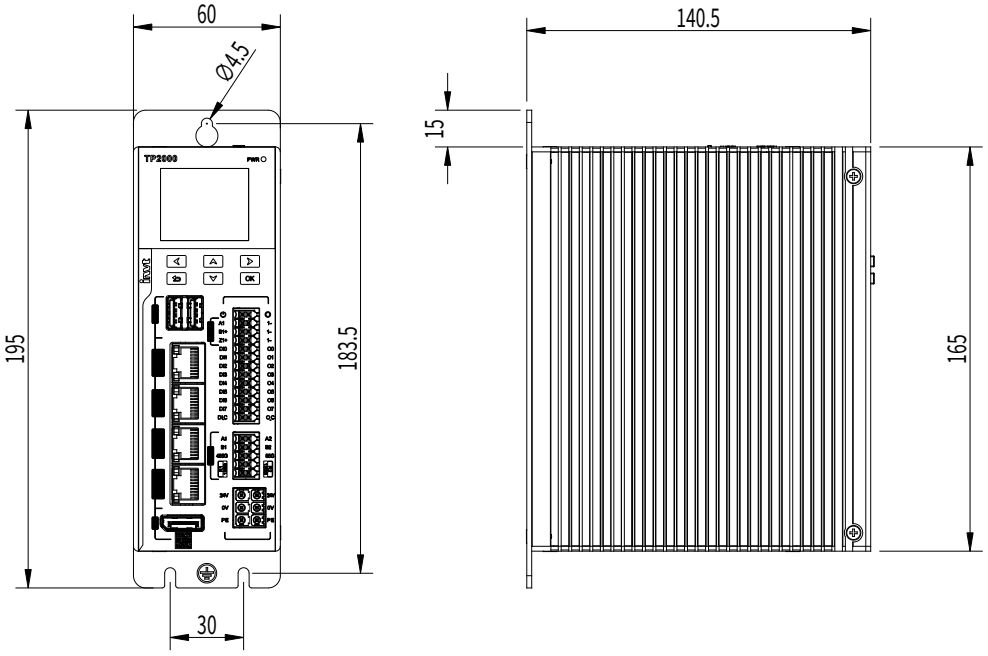
If the PLC clock becomes inaccurate, replace the battery immediately to ensure the proper operation of the RTC function.



Note: The values shown in the figure indicate reference values of memory backup time.

Appendix A Dimension drawing

Figure A-1 Dimension drawing (unit: mm)



Appendix B Optional accessories

No.	Ordering code	Specifications
1	19005-00463	Accessory kit; DIN rail mounting accessory for TP2000; RoHS

Your Trusted Industry Automation Solution Provider

Shenzhen INVT Electric Co., Ltd.
Address: INVT Guangming Technology Building, Songbai Road, Matian,
Guangming District, Shenzhen, China
INVT Power Electronics (Suzhou) Co., Ltd.
Address: No.1 Kunlunshan Road, Science & Technology Town,
Suzhou New District, Jiangsu, China
Website: www.invt.com

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