Flex-EC Series Expansion Card

User Manual

SHENZHEN INVT ELECTRIC CO., LTD.

Preface

Overview

Thank you for choosing INVT Flex-EC series expansion card.

Target audience

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

About documentation obtaining

In addition to this user guide, you can also obtain product documentation and technical support from our website:

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

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	June, 2025

Contents

Safety precautions

Safety declaration

Read this manual carefully and follow all safety precautions before moving, installing, operating and servicing 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.

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 symbols	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.

Personnel requirements

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

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. Ensure that all the input power supplies are disconnected before wiring and inspection. ● The product design is applied to indoor electrical environments at overvoltage category II. Ensure that the power supply system of the product has lightning protection devices to prevent lightning overvoltage from being applied to the power input or signal I/O terminals of the product so as to avoid equipment damage. ● Do not modify the product unless authorized; otherwise fire, electric shock or other injury may result. ● Prevent cables and other conductive parts from falling into the product. ● Do not contact the product with damp objects or body parts. Otherwise, electric shock may result.

Moving	
	● Select appropriate tools for product delivery, and take mechanical protective measures like wearing safety shoes and working uniforms to avoid personal injury. ● Protect the product against physical shock or vibration.

Installation	
	● Do not install the product on inflammables. In addition, prevent the product from contacting or adhering to inflammables. ● Do not run a damaged or incomplete product.
	● 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. ● During installation, ensure that the modules are tightly connected and fastened. Insecure connection may cause problems such as communication failure and fall-off. ● After installation, ensure that there are no obstructions on the vents of the product; otherwise, the chips of the product may be burned due to overheating and poor heat dissipation, which causes system control failure and misoperation.

Wiring	
	● Before wiring, clearly understand the necessary information including interfaces, power supply types, and specifications, and comply with relevant standards and requirements to ensure that the system wiring is correct. ● To ensure personal safety and equipment use safety, reliably ground the product using cables with proper diameters and specifications. ● Route the control signal and communication signal cables separately from cables with strong interference such as power cables. ● Apply fastening means to long-distance or heavy cables.
	● Cut off all power supplies connected to the product before performing wiring. ● Before power-on for running, ensure that each module terminal cover is properly installed in place after the installation and wiring are completed. This prevents a live terminal from being touched. Otherwise, physical injury, equipment fault or misoperation 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 (see installation environment requirements for details), 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. ● When the output units such as relays and transistors of the product are damaged, the output cannot be controlled to be On or Off as configured. ● 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. ● In the external circuit of the product, configure an emergency braking circuit, a

Commissioning and running	
	protection circuit, a circuit for interlocking between forward and reverse operations, and an anti-equipment-damage switch for interlocking between the position upper limit and lower limit. ● To ensure the safe running of equipment, design external protection circuits and safety mechanisms for output signals related to major accidents. ● Design proper external control circuits to ensure the proper running of equipment, since outputs may be out of control when the control circuit has an exception.

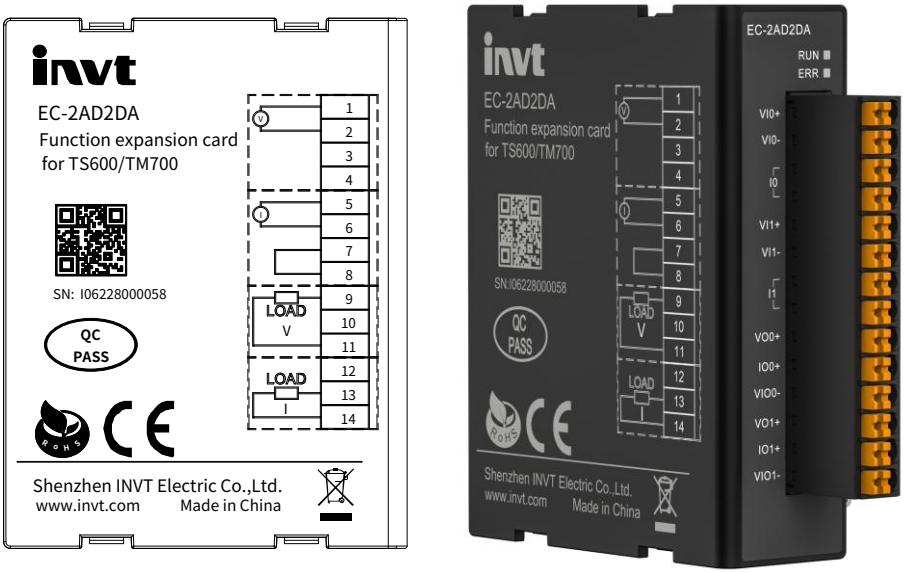
Maintenance and component replacement	
	● Keep the product and its parts and components away from combustible materials and ensure they have no combustible materials adhered. ● Before carrying out product maintenance or component operations, cut off all power supplies connected to the product. ● Prevent the screws, cables and other conductive parts from falling into the product during maintenance or component replacement. ● During maintenance and component replacement, take proper anti-static measures on the product and its internal parts.
Note	Use proper torque to tighten screws.

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.

1 EC-2AD2DA analog I/O expansion card

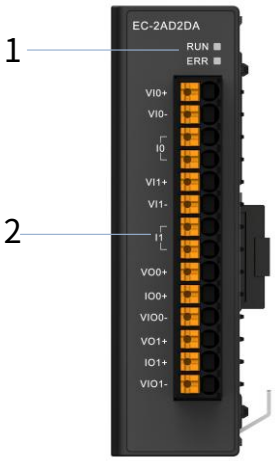
1.1 Product overview

1.1.1 Product model and nameplate



Model	Ordering code	Description	Applicable model
EC-2AD2DA	11060-00333	2-in 2-out analog I/O expansion card (2 channels of analog input and 2 channels of analog output)	Applicable to INVT TS/TM series

1.1.2 Component description



No.	Name	Description		
1	Status indicator	RUN: Yellow green	Power-on/Run status indicator	On: The expansion card is running.
				Slow flashing (2.5 Hz): Waiting for master station configuration
				Off: The module is not powered on or it is abnormal.
		ERR: Red	Module fault indicator	Steady on: System error
				Slow flashing (2.5 Hz): General error, including configuration error, sampling over-range error, and expansion card communication error
				Off: The module works normally
2	User terminal	External wiring terminal		

1.1.3 Basic specifications

Item	Specifications
IP rating	IP20
Size (W×H×D)	70.8mm×20mm×53.5mm
Net weight	36g

1.1.4 Power supply specifications

Item	Specifications
Rated input voltage of power interface	5VDC (4.75VDC–5.25VDC)
Rated input current of power interface	600mA (Typical value at 5V)
Hot swapping function	Not supported

1.1.5 Input specifications

Item	Specifications
Number of input channels	2 channels
Voltage input range	0–10V, 0–5V, 1–5V
Voltage input resistance	>400kΩ
Converting speed	<6ms/channel
Current input range	0–20mA, 4–20mA
Current sampling impedance	200Ω
Input accuracy (at room temperature of 25°C)	Voltage: ±1%, Current: ±1% (full scale)
Input accuracy (in full temperature range)	Voltage: ±3%, Current: ±3% (full scale)
Input signal frequency	<20Hz

Item	Specifications
Resolution	12 bits
Digital input	0–20000

1.1.6 Output specifications

Item	Specifications
Number of output channels	2 channels
Output voltage range	0–10V, 0–5V, 1–5V
Output current range	0–20mA, 4–20mA
Output voltage load	>2kΩ
Current-driven load	<250Ω
Conversion time	Follows CPU scan cycle, minimum 1 ms
Output accuracy (at room temperature of 25°C)	±1% (full scale)
Output accuracy (in full temperature range)	±5% (full scale)
Resolution	12 bits
Digital output	0–20000

1.1.7 Other specifications

Item	Specifications
Sampling period	1ms
Communication cycle with the host	200ms
Isolation method	Isolation
Output short-circuit detection	Not supported
Output open-circuit detection	Not supported

1.1.8 Environment requirements

Item	Specifications
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference	Zone B, compliant with IEC61131-2

Item	Specifications
level	
vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

1.2 Mechanical installation

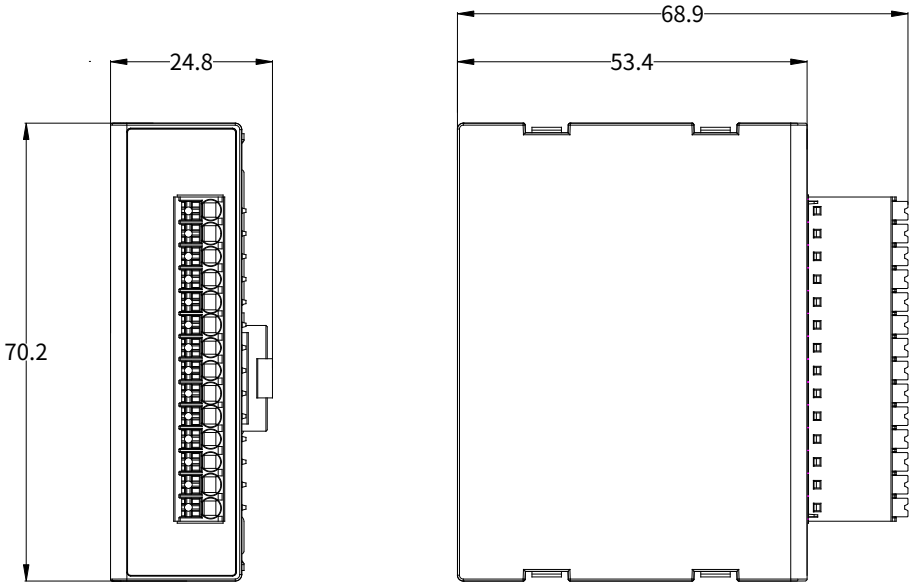
1.2.1 Installation environment requirements

When installing this product on a DIN rail, full consideration should be given to operability, maintainability, and environmental resistance before installation.

Item	Specifications
IP rating	IP20
Pollution degree	Level 2: Generally there is only non-conductive pollution, but you shall consider transient conductivity accidentally caused by condensation.
Altitude	2000m (80kPa)
Storage temperature and humidity range	Temperature: -20°C–60°C; RH: <90%, no condensation
Transportation temperature and humidity range	Temperature: -40°C–70°C; RH: <95%, no condensation
Working temperature and humidity range	Temperature: -20°C–55°C; RH: <95%, no condensation

1.2.2 Installation dimensions

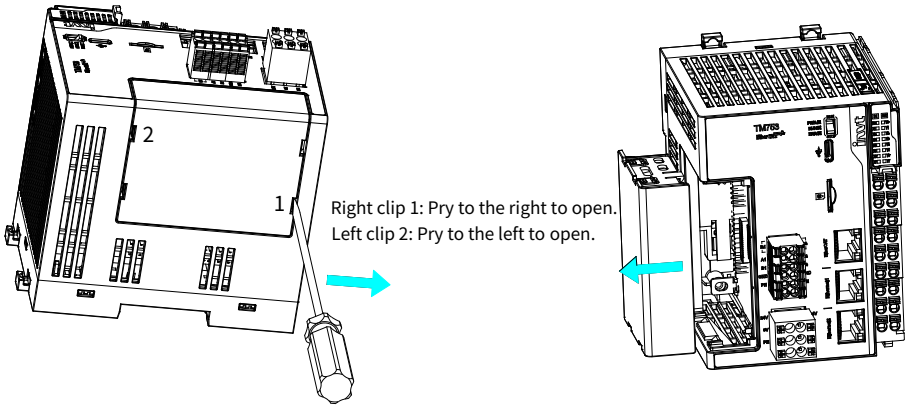
The installation dimensions are shown in the figure below, with units in millimeters (mm).



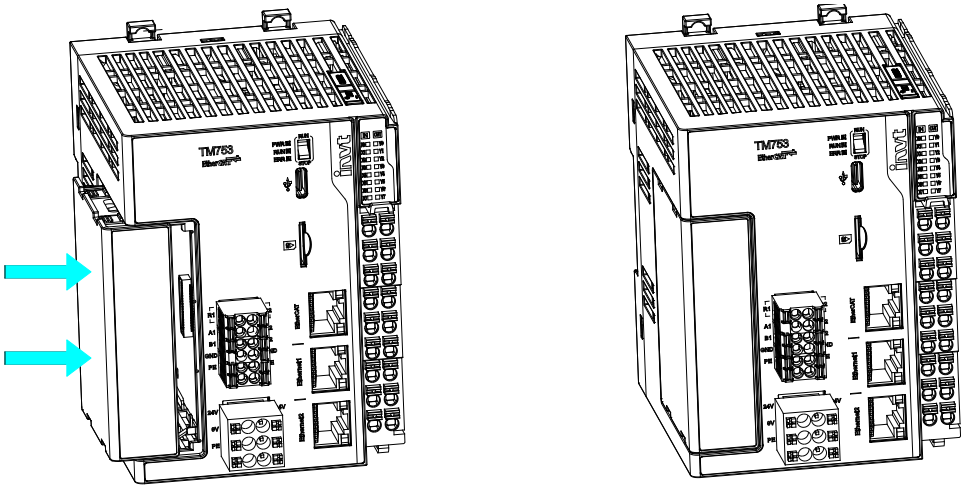
1.2.3 Installation

Take out the cover before installing the expansion card. The installation steps are as follows.

Step 1 Gently pry open the cover plate clips with a tool on the side of the product (in the order of positions 1 and 2); Slide the cover plate to the left horizontally and take it out.



Step 2 Slide the expansion card into the guide slot in parallel, then press the clip positions on the upper and lower sides of the expansion card until the expansion card is clamped (there is an obvious sound of clamping after they are installed in place).



1.2.4 Disassembly

Use a tool to gently pry the cover snap-fits on the side of the product (in sequence of position 1 and 2), and slide the expansion card to the left to remove it. See Step 1 in 1.2.3 Installation for reference.

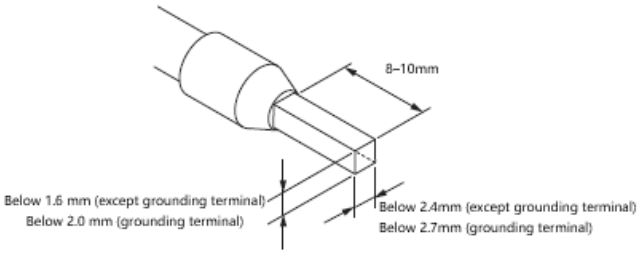
1.3 Electrical installation

1.3.1 Cable model selection

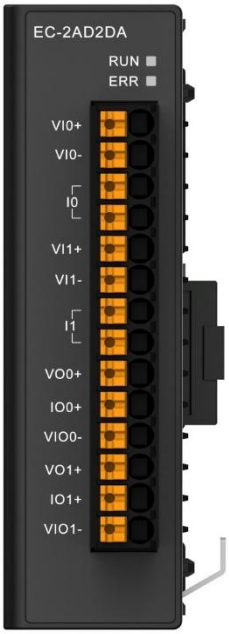
Cable material	Cable diameter		Crimping tool
	Chinese standard (mm^2)	American standard (AWG)	
Tubular cable lug	0.3	22	Use a proper crimping plier.
	0.5	20	
	0.75	18	
	1.0	18	
	1.5	16	

Note:

- The cable diameters of the tubular cable lugs in the preceding table is only for reference, which can be adjusted based on actual situations.
- When using other tubular cable lugs, crimp multiple strands of cable, and the processing size requirements are as follows:



1.3.2 Terminal definition

Schematic diagram	Terminal	Terminal signal	Description
	1	VI0+	Positive terminal of voltage/current input channel 0
	2	VI0-	Negative terminal of voltage/current input channel 0
	3	I0	Short-circuit point of current-mode channel 0
	4		
	5	VI1+	Positive terminal of voltage/current input channel 1
	6	VI1-	Negative terminal of voltage/current input channel 1
	7	I1	Short-circuit point of current-mode channel 1
	8		
	9	VO0+	Positive terminal of voltage output channel 0
	10	IO0+	Positive terminal of current output channel 0

Schematic diagram	Terminal	Terminal signal	Description
	11	VIO0-	Negative terminal of voltage/current output channel 0
	12	VO1+	Positive terminal of voltage output channel 1
	13	IO1+	Positive terminal of current output channel 1
	14	VIO1-	Negative terminal of voltage/current output channel 1

1.3.3 Terminal wiring

Figure 1-1 Voltage input wiring

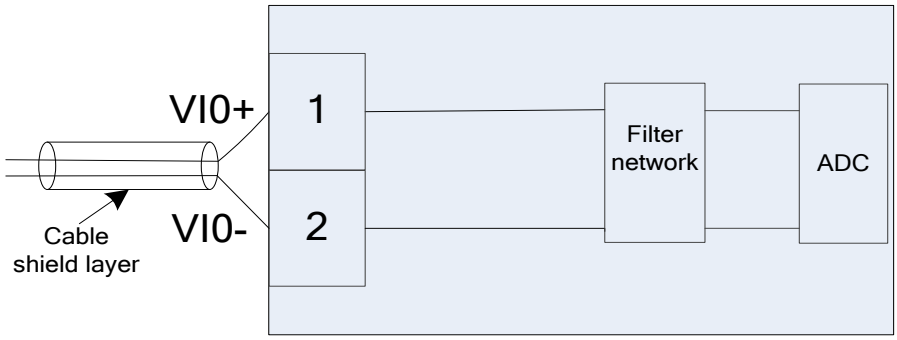


Figure 1-2 Current input wiring

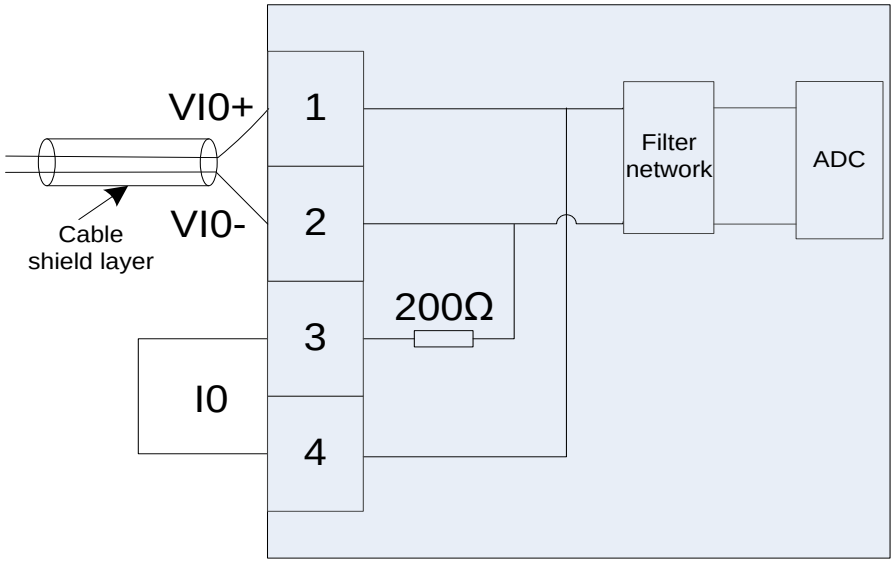


Figure 1-3 Voltage output wiring

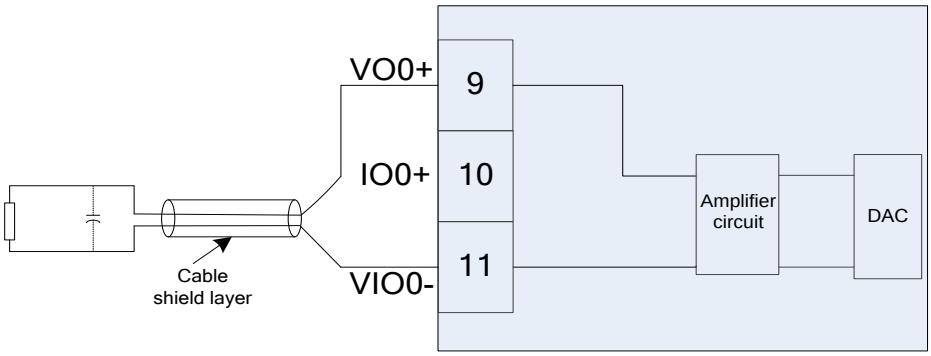
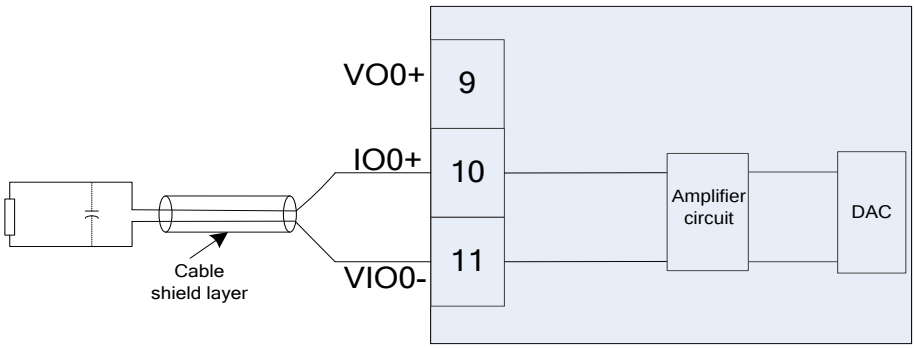


Figure 1-4 Current output wiring



1.4 Fault diagnosis

1.4.1 Diagnosis method

1.4.1.1 Fault diagnosis methods for TS series PLC

Fault diagnosis methods for the EC-2AD2DA expansion card in the TS series PLC include indicator lights, host controller PLC log files, and host controller PLC error codes.

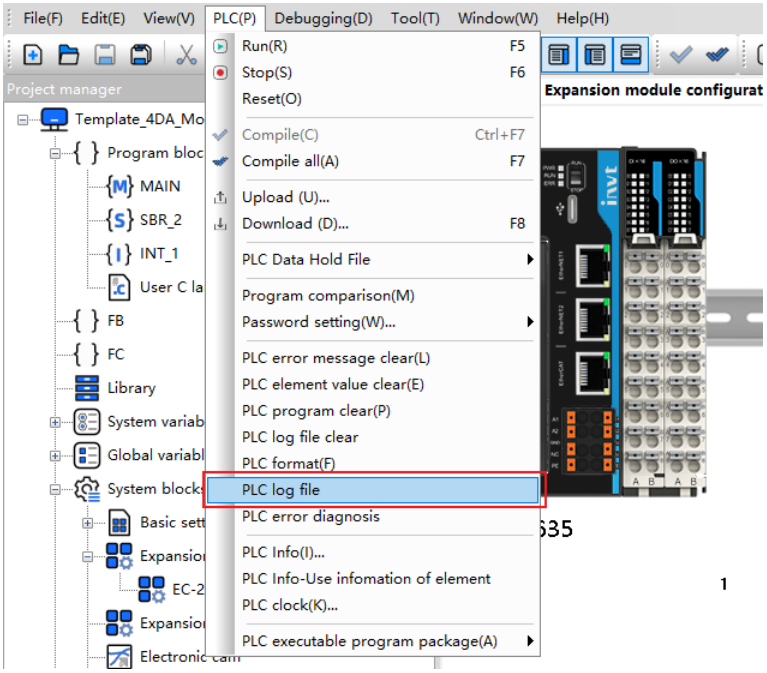
- **Indicator**

Error indicator state	Description	Solution
Steady on	Expansion card system error	Restart the expansion card. If the error persists, contact the manufacturer.
Slow flashing (2.5 Hz)	Expansion card general error	Determine the error type and solution through the host controller error codes.
Off	No error	-

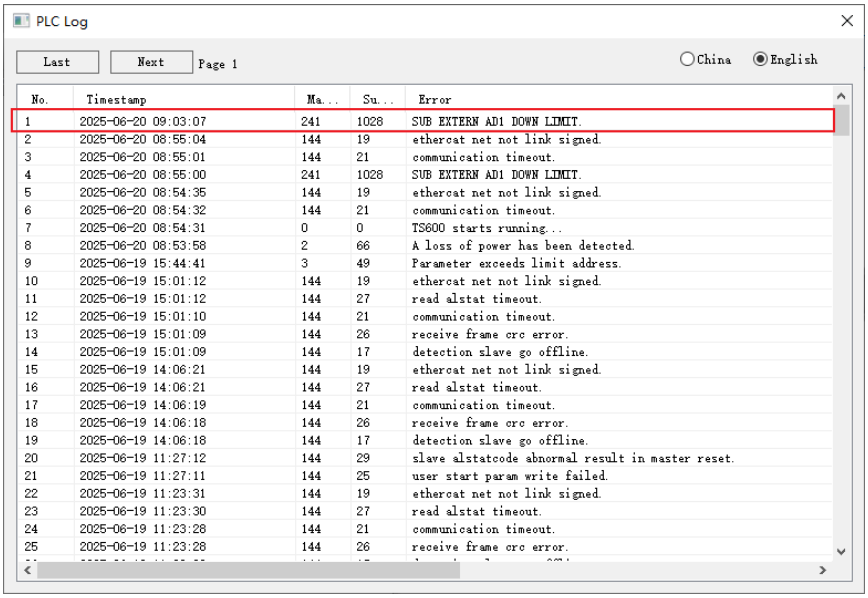
- **Host controller PLC log files**

Refer to the following steps:

Step 1 Open the Autostation Pro software in the host controller, then choose **PLC > PLC log file** from the menu bar.



Step 2 Check the latest error information in the **PLC Log** object box.



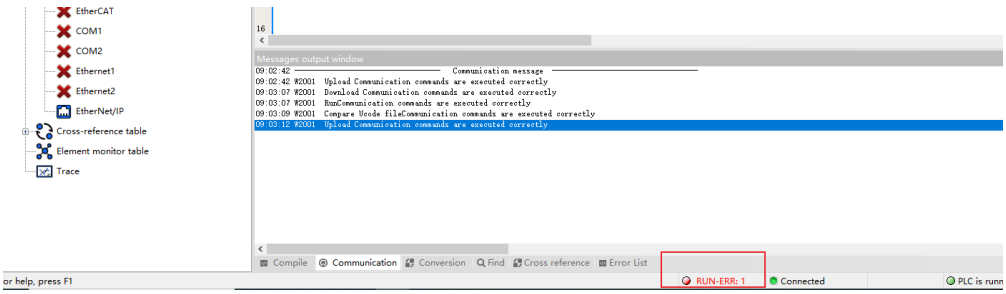
No.	Timestamp	Ma...	Su...	Error
1	2025-06-20 09:03:07	241	1028	SUB EXTERN AD1 DOWN LIMIT.
2	2025-06-20 08:55:04	144	19	ethercat net not link signed.
3	2025-06-20 08:55:01	144	21	communication timeout.
4	2025-06-20 08:55:00	241	1028	SUB EXTERN AD1 DOWN LIMIT.
5	2025-06-20 08:54:35	144	19	ethercat net not link signed.
6	2025-06-20 08:54:32	144	21	communication timeout.
7	2025-06-20 08:54:31	0	0	TS600 starts running...
8	2025-06-20 08:53:58	2	66	A loss of power has been detected.
9	2025-06-19 15:44:41	3	49	Parameter exceeds limit address.
10	2025-06-19 15:01:12	144	19	ethercat net not link signed.
11	2025-06-19 15:01:12	144	27	read alstat timeout.
12	2025-06-19 15:01:10	144	21	communication timeout.
13	2025-06-19 15:01:09	144	26	receive frame crc error.
14	2025-06-19 15:01:09	144	17	detection slave go offline.
15	2025-06-19 14:06:21	144	19	ethercat net not link signed.
16	2025-06-19 14:06:21	144	27	read alstat timeout.
17	2025-06-19 14:06:19	144	21	communication timeout.
18	2025-06-19 14:06:18	144	26	receive frame crc error.
19	2025-06-19 14:06:18	144	17	detection slave go offline.
20	2025-06-19 11:27:12	144	29	slave alstatcode abnormal result in master reset.
21	2025-06-19 11:27:11	144	25	user start param write failed.
22	2025-06-19 11:23:31	144	19	ethercat net not link signed.
23	2025-06-19 11:23:30	144	27	read alstat timeout.
24	2025-06-19 11:23:28	144	21	communication timeout.
25	2025-06-19 11:23:28	144	26	receive frame crc error.

As shown in the figure above, the current main code 241 (0xF1) and subcode 1028 (0x404) correspond to an input under-limit error on AD channel 1.

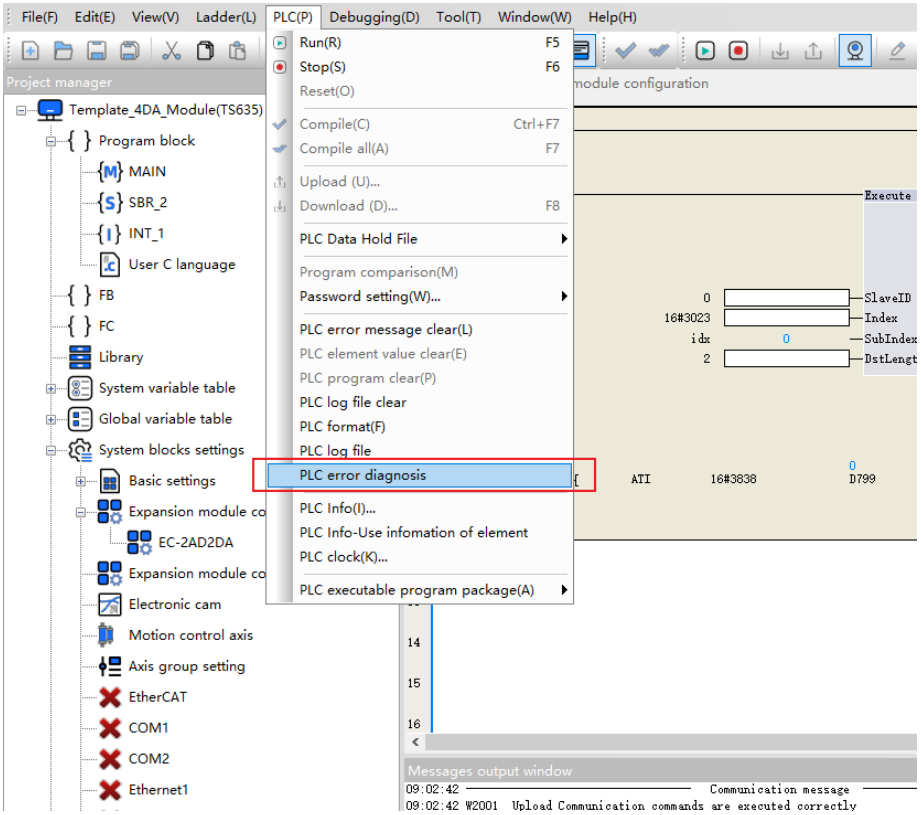
■ Host controller PLC error diagnosis

Step 1 Open the error diagnosis interface in the Autostation Pro on the host controller.

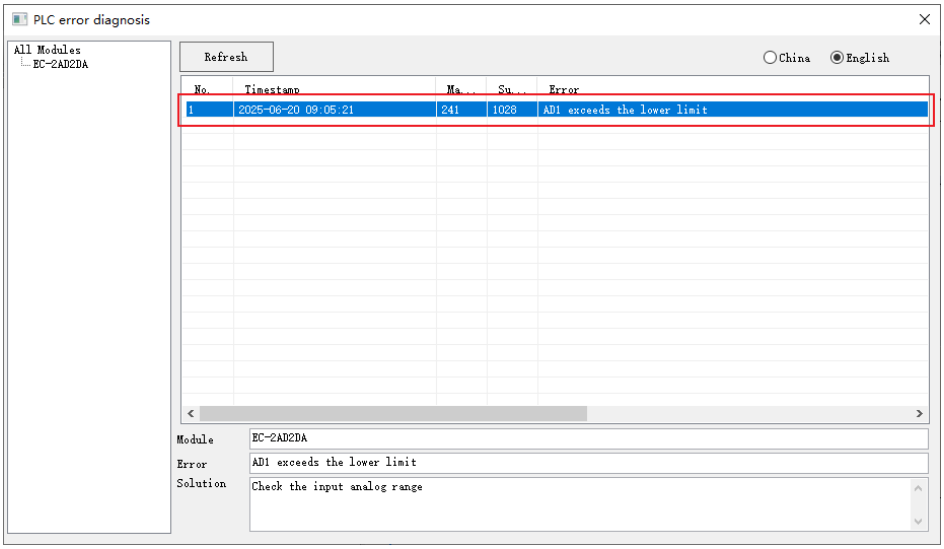
Method 1: Double-click the error indicator in the **Messages output window** below.



Method 2: Click on **PLC > PLC error diagnosis** in the menu bar.

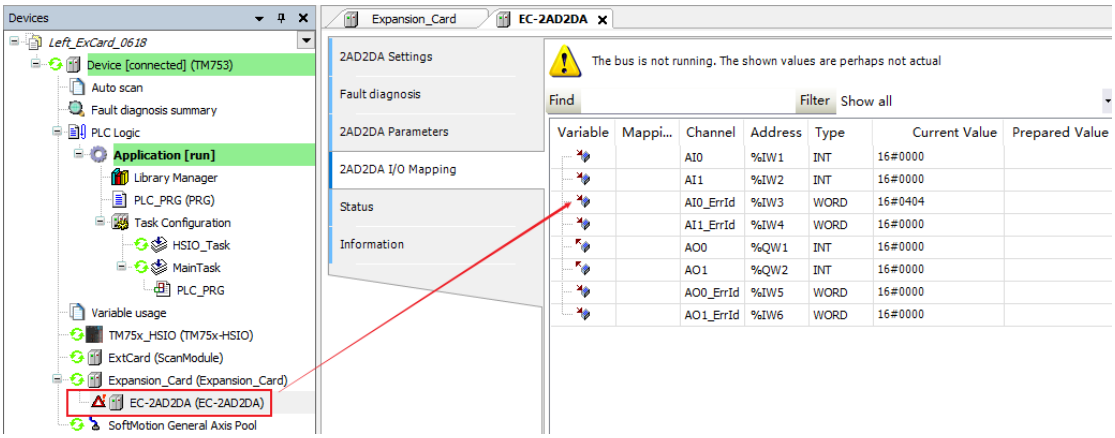


You can view the error occurrence time, main error code, sub error code, module information, error description, and solution in the **PLC error diagnosis** window.



1.4.1.2 Fault diagnosis methods for TM series PLC

Diagnosis method for TM series: When an error occurs, the device icon in the device panel of the host controller's Invtmatic Studio will change. At this time, you can obtain the specific error code value through the I/O mapping interface.



1.4.2 Fault code

Main error code	Sub error code	Error description	Solution
0xF1	0x0001	SPI initialization error	Check whether the factory system version of the TS series supports SPI initialization
	0x0002	Expansion card information verification error	Check whether the expansion card type matches
	0x0003	SPI device transmission timeout	Check whether the expansion card is in an error state.
	0x0005	Expansion card module configuration failed	Check whether the expansion card is in an error state.
	0x0401	MCU fault	Restart the expansion card or replace it.
	0x0402	AD1 configuration fault	Check AD1 configuration
	0x0403	AD1 over-range	Check the input analog range
	0x0404	AD1 under-range	Check the input analog range
	0x0405	AD2 configuration fault	Check AD2 configuration
	0x0406	AD2 over-range	Check the input analog range
	0x0407	AD2 under-range	Check the input analog range
	0x0408	DA1 configuration fault	Check DA1 configuration
	0x0409	DA2 configuration fault	Check DA2 configuration

1.5 Programming instance

1.5.1 TS600 series programming instance

Note:

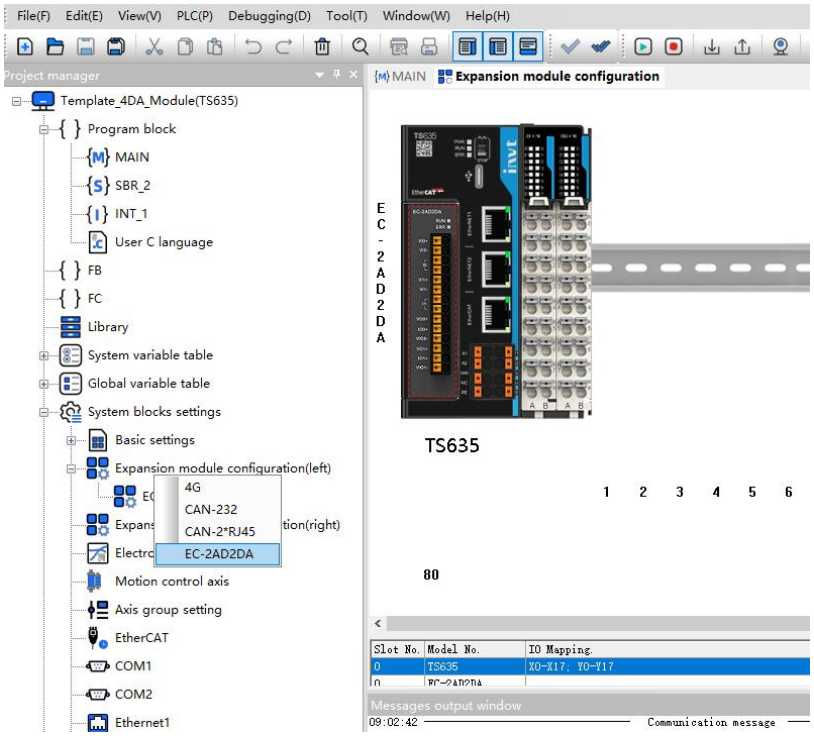
- The type ID of EC-2AD2DA expansion card is 4. During configuration, ensure that the configured expansion card type matches the actual installed card.
- You can check the configured expansion card type ID by viewing the value of the variable "_sExtCard.CfgType" in the system variable table "_SYS_INFO". The actual installed expansion

card type ID can be viewed via the variable "_sExtCard.ActType" in the same table.

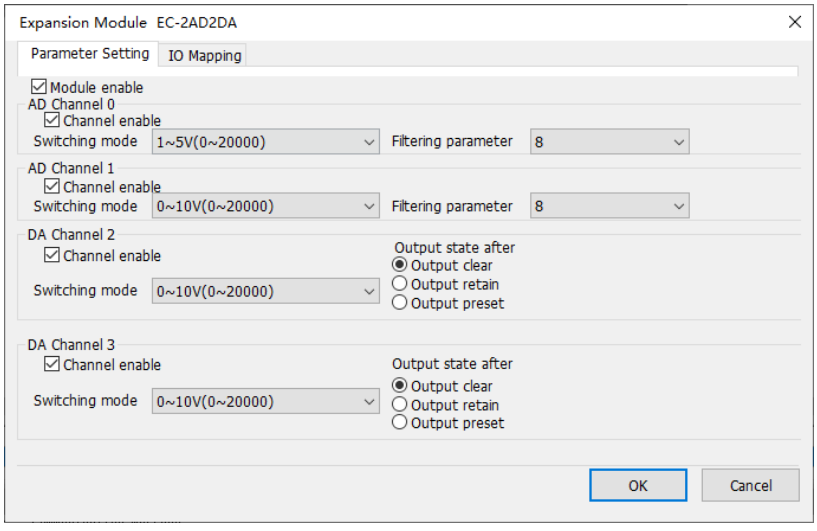
The operating steps are as follows:

Step 1 Create a new project.

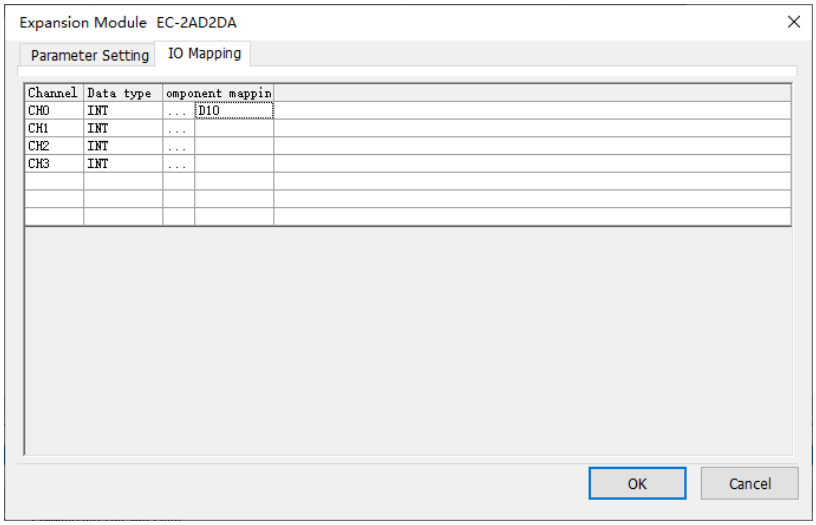
Step 2 In the **Project manager** window, right-click **System blocks settings > Expansion module configuration (left)**, and choose **EC-2AD2DA**.



Step 3 Double-click **EC-2AD2DA** to open the parameter setting interface. Enable each channel, and modify the **Switching mode**, **Filtering parameter**, and **Output state after stop** as needed, as shown in the figure below.



Step 4 Click **IO Mapping** to configure the channel IO mapping for the EC-2AD2DA expansion card. You can choose to map channel data to currently unused component variables, as shown in the figure below.

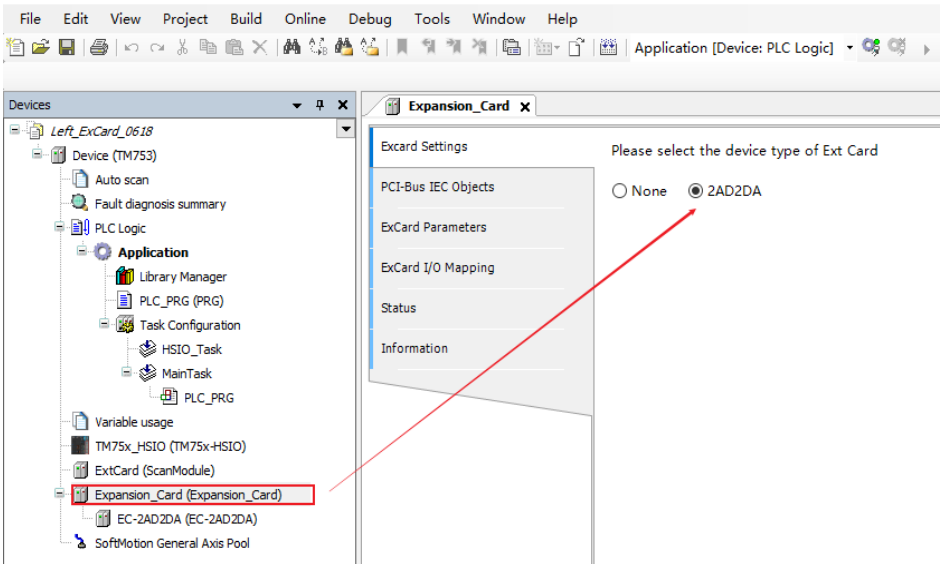


Step 5 Compile and download the program to run.

1.5.2 TM700 series programming instance

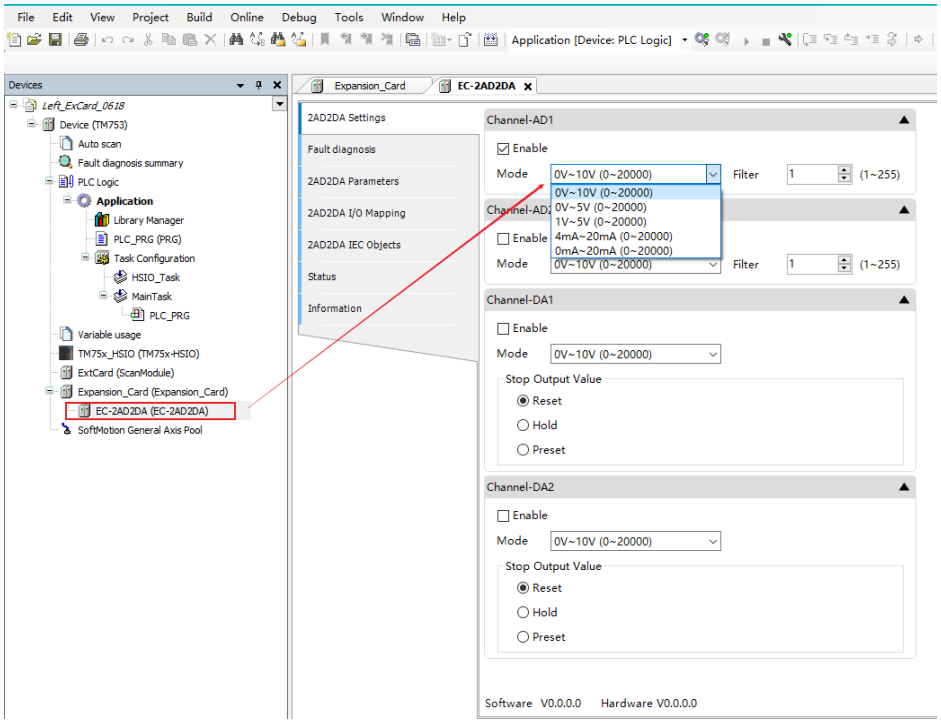
Step 1 Add devices.

Create a new project and choose the TM700 series controller. In the **Devices** section, double-click **Expansion_Card**, then choose **2AD2DA**.



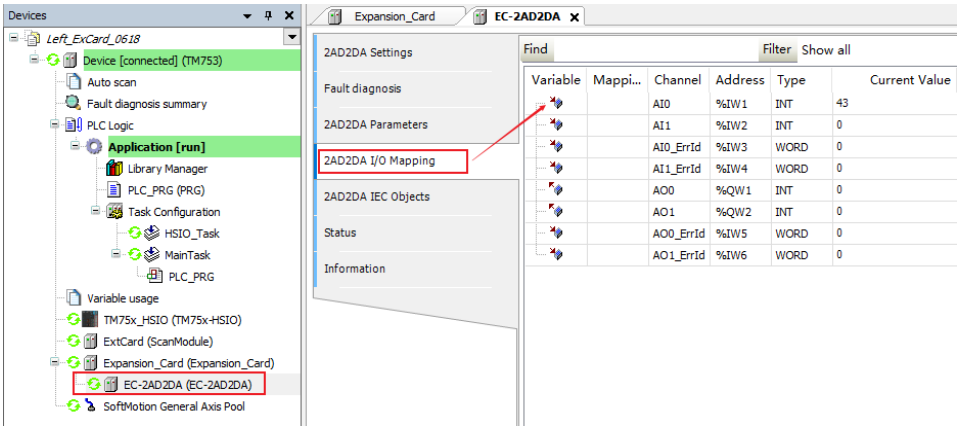
Step 2 Configure parameters.

Double-click the **EC-2AD2DA** device and configure it as needed by checking the required options.



Step 3 Read or write process data

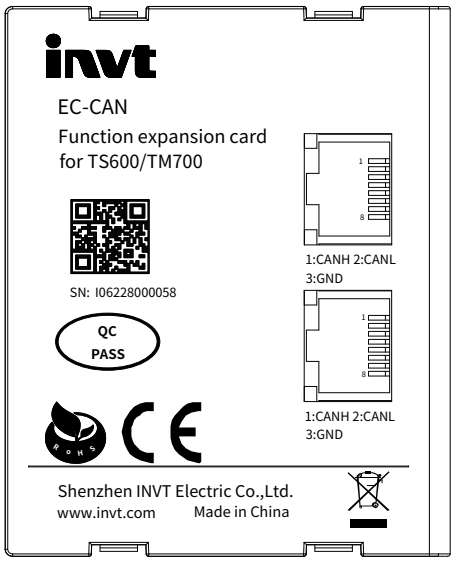
After the device is connected and the project is downloaded, you can obtain or write AD/DA data through the I/O Mapping interface. Channel AD1, after being enabled, converts and outputs a specific value based on the configuration. The same applies to the other channels.



2 EC-CAN expansion card

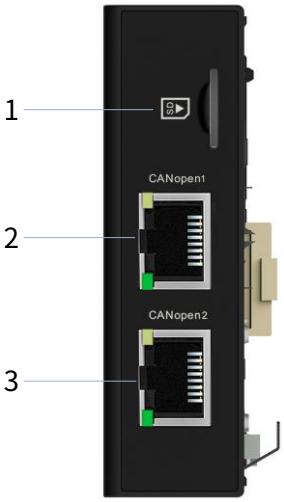
2.1 Product overview

2.1.1 Product model and nameplate



Model	Ordering code	Description	Applicable model
EC-CAN	11060-00332	CAN expansion card with 2 RJ45 ports, supporting MicroSD card (SD card interface is only supported for TS series).	Applicable to INVT TS/TM series

2.1.2 Component description



No.	Port type	Interface sign	Definition	Description
1	SD card socket	SD	Micro SD	Standard definition
2	CANopen interface	CANopen1	CANopen interface 1	See the specific definition in the later sections
3	CANopen interface	CANopen2	CANopen interface 2	See the specific definition in the later sections

When CANopen communicates, you can judge the working state according to the CANopen indicator. The definitions of the CANopen indicator states are as follows:

LED indicator	CAN running (Green light)	CAN error (Yellow light)
Off	None	No error
On	Working state	Bus off
Slow flash (cycle: 0.8s)	Pre-running status	Pre-running status
Single flash (cycle: 1.2s)	Stopped state	At least one error count of the CAN controller reaches or exceeds a warning value
Double flash (cycle: 1.6s)	None	Error control event (heartbeat timeout)

2.1.3 Basic specifications

Item	Specifications
IP rating	IP20
Size (W×H×D)	70.8mm×20mm×53.5mm
Net weight	39g

2.1.4 Power supply specifications

Item	Specifications
Rated input voltage of power interface	5VDC (4.75VDC–5.25VDC) 3.3VDC (3.2VDC–3.4VDC)
Rated input power of power supply interface	250mW
Hot swapping function	Not supported

2.1.5 Communication specifications

Item	Specifications	
	Slave	Master
Supported protocols	DS301 V4.02	DS301 V4.02
Number of slave nodes	-	30
Maximum supported number of RxPDOs	4	64
Maximum supported number of TxPDOs	4	64

Item	Specifications	
Baud rate and communication distance	1Mbps/20m 800kbps/40m 500kbps/70m 250kbps/140m 125kbps/280m 100kbps/350m 50kbps/700m	1Mbps/20m 800kbps/40m 500kbps/70m 250kbps/140m 125kbps/280m 100kbps/350m 50kbps/700m
Terminal resistor	Built-in 120Ω termination resistor, which can be connected or disconnected via the onboard DIP switch.	
Isolation method	Capacitive isolation	

2.1.6 SD card specifications

Item	Specifications
Communication interface	SDIO
SD card specifications	Micro SD
SD card capacity	Up to 32GB
SD card hot swapping	Supported

2.1.7 Environment requirements

Item	Specifications
Working environment temperature	-20°C–+55°C
Working environment relative humidity (RH)	RH < 95%, no condensation
Storage temperature	-40°C–+70°C (RH < 90%, no condensation)
Air	No corrosive gas
Altitude	Lower than 3000m
Pollution degree	Below degree 2
Immunity	2kV power cable, compliant with IEC61000-4-4
Overvoltage category	Category II
EMC anti-interference level	Zone B, compliant with IEC61131-2
vibration resistance	Compliant with IEC60068-2-6
Impact resistance	Compliant with IEC60068-2-27

2.2 Mechanical installation

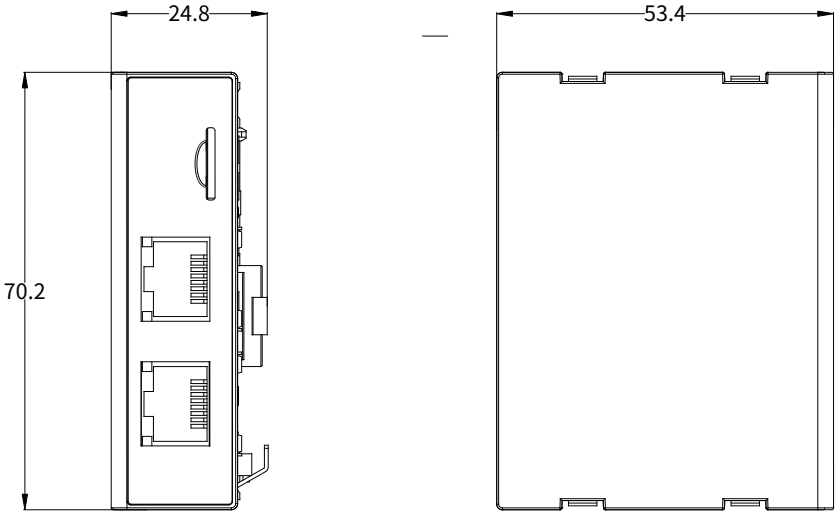
2.2.1 Installation environment requirements

When installing this product on a DIN rail, full consideration should be given to operability, maintainability, and environmental resistance before installation.

Item	Specifications
IP rating	IP20
Pollution degree	Level 2: Generally there is only non-conductive pollution, but you shall consider transient conductivity accidentally caused by condensation.
Altitude	2000m (80kPa)
Storage temperature and humidity range	Temperature: -20°C–60°C; RH <90%, no condensation
Transportation temperature and humidity range	Temperature: -40°C–70°C; RH <95%, no condensation
Working temperature and humidity range	Temperature: -20°C–55°C; RH <95%, no condensation

2.2.2 Installation dimensions

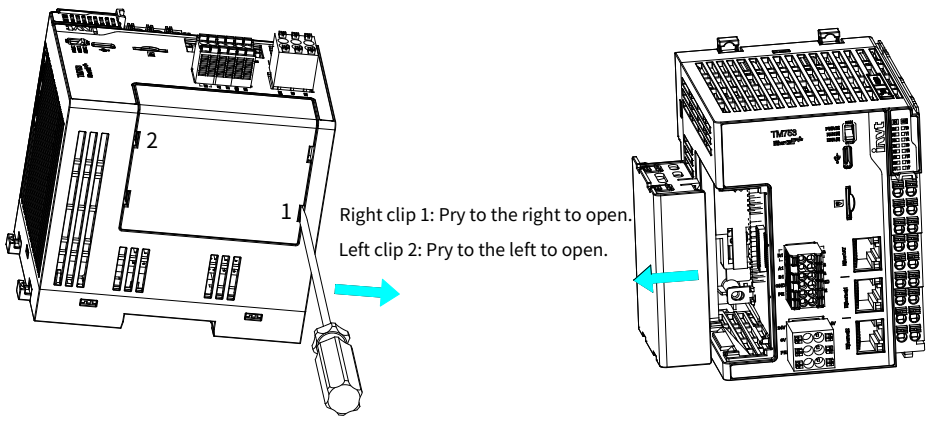
The installation dimensions are shown in the figure below, with units in millimeters (mm).



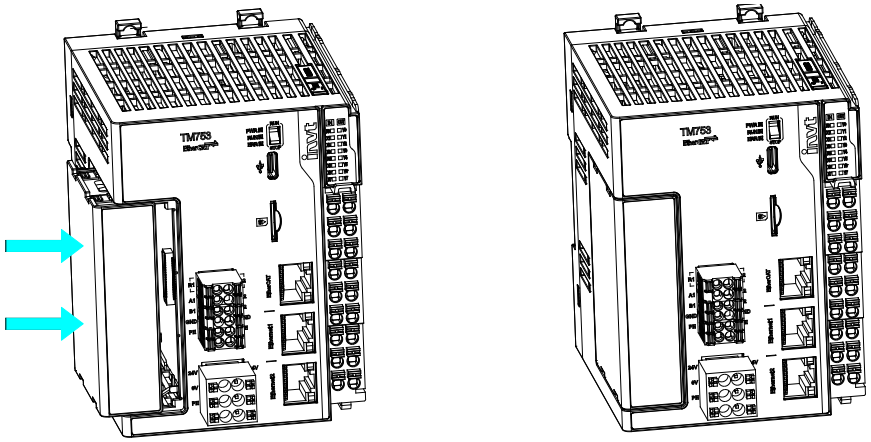
2.2.3 Installation

Take out the cover before installing the expansion card. The installation steps are as follows.

Step 1 Gently pry open the cover plate clips with a tool on the side of the product (in the order of positions 1 and 2); Slide the cover plate to the left horizontally and take it out.



Step 2 Slide the expansion card into the guide slot in parallel, then press the clip positions on the upper and lower sides of the expansion card until the expansion card is clamped (there is an obvious sound of clamping after they are installed in place).



2.2.4 Disassembly

Use a tool to gently pry the clips of the SD card on the side of the product (in sequence of position 1 and 2), and take out the SD card horizontally to the left. Refer to Step 1 in 2.2.3 Installation.

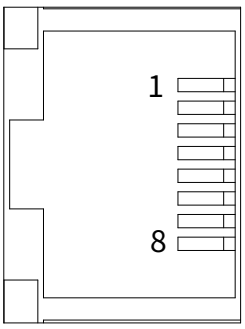
2.3 Electrical installation

2.3.1 Cable model selection

It is recommended to use Ethernet cables for CAN communication. Stripping wires for separate connections is not advised. If separate connection is necessary, refer to 2.3.2 Terminal definition for the RJ45 pin definitions.

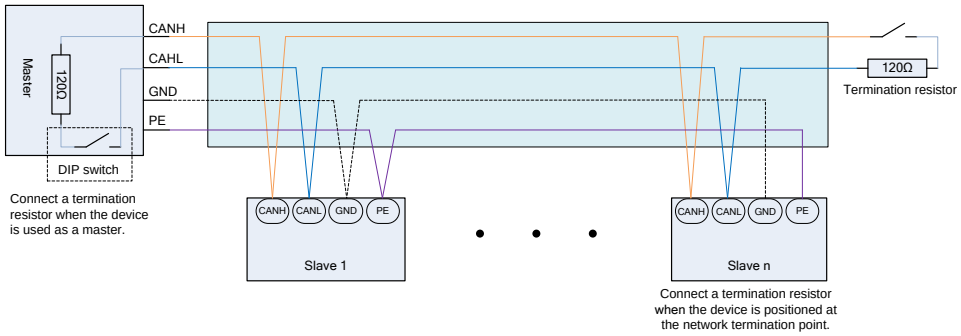
2.3.2 Terminal definition

The CANopen interface is defined as follows:



PIN	Definition Description
1	CANH: CAN communication signal positive (CAN High)
2	CANL: CAN communication signal negative (CAN Low)
3	GND: Communication ground
4	NC
5	NC
6	NC
7	NC
8	NC

2.3.3 Terminal wiring



Note: For the CANopen bus cable, use Category 5e shielded Ethernet cable.

2.4 Fault Diagnosis

2.4.1 Diagnosis method:

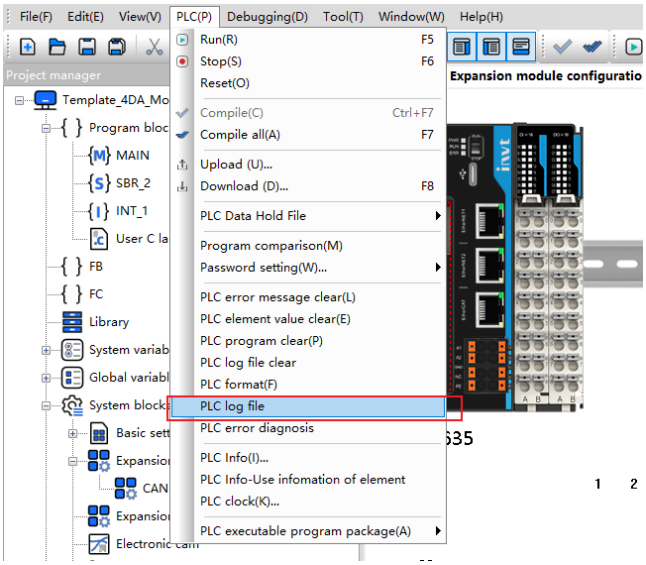
2.4.1.1 Fault diagnosis methods for TS series PLC

Fault diagnosis methods for the EC-CAN expansion card in the TS series PLC include the host controller PLC log files and PLC error diagnosis. SDO errors and emergency error codes during communication can be viewed through the commissioning interface.

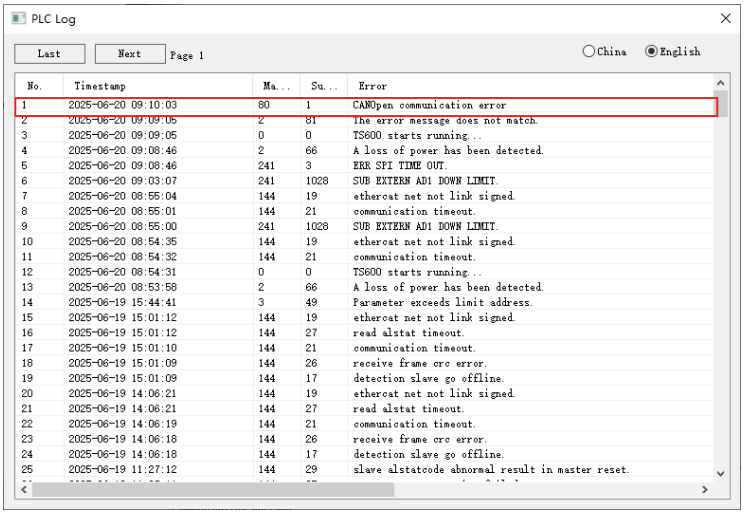
- **Host controller PLC log files**

Refer to the following steps:

Step 1 Open the Autostation Pro and choose **PLC > PLC log file** from the menu bar.



Step 2 Check the latest error information in the **PLC log** object box.

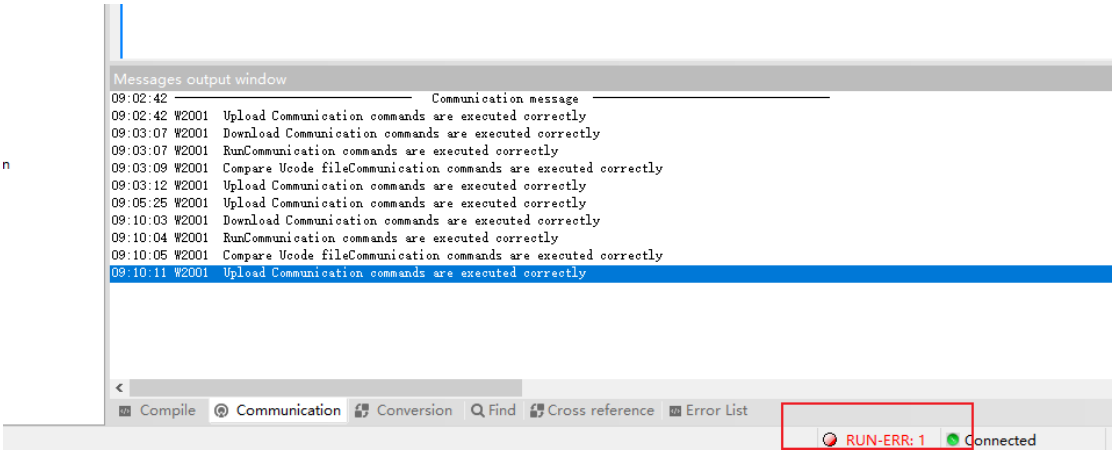


As shown in the figure above, the current main code is 80 (0x0050), and the subcode is 1 (0x0001), corresponding to a CANopen communication error.

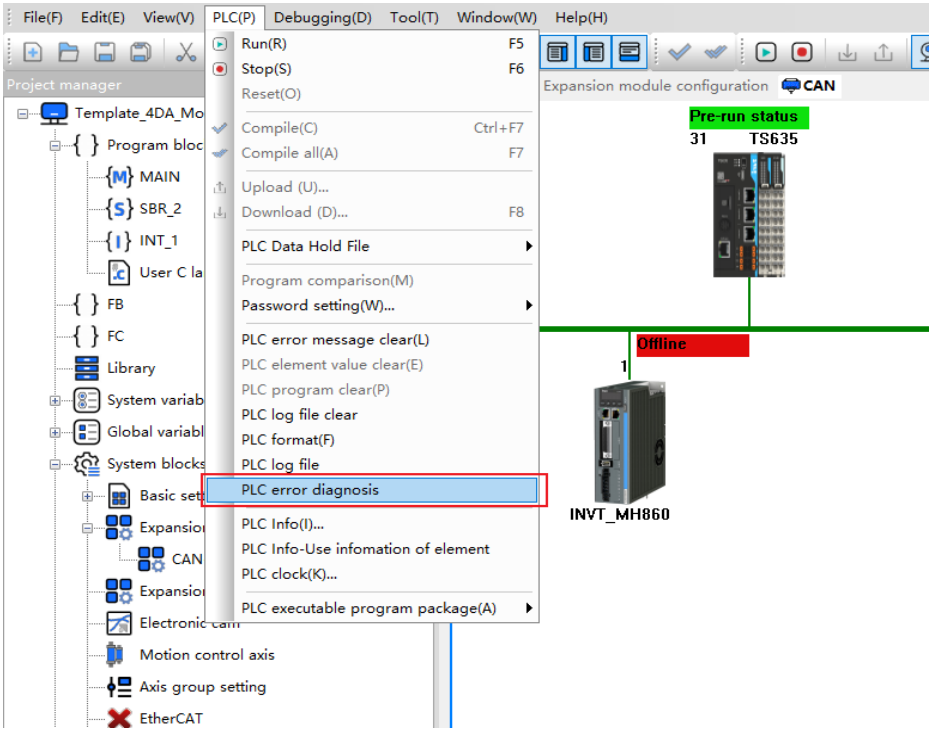
■ Host controller PLC error diagnosis

Open the error diagnosis interface in the Autostation Pro.

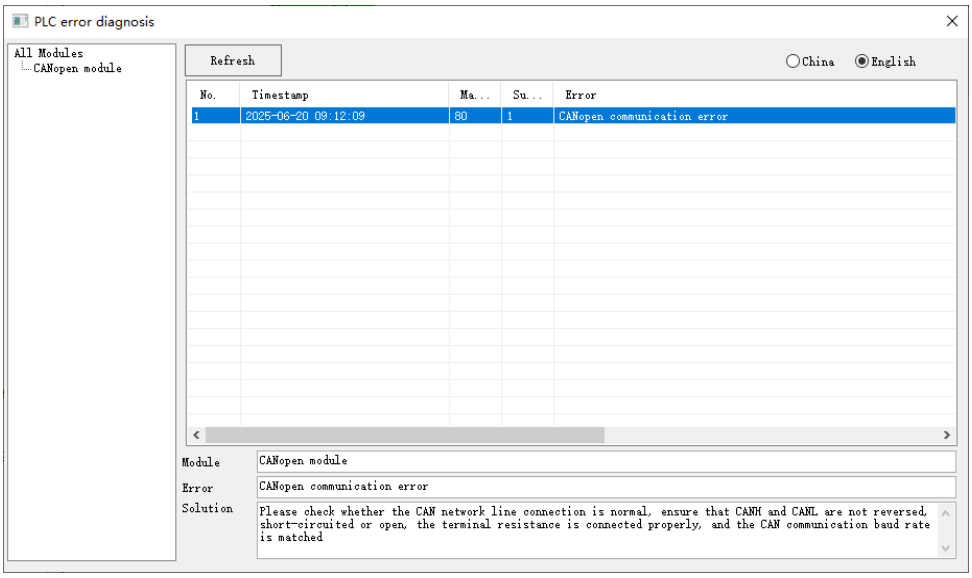
Method 1: Double-click the error indicator in the **Messages output window**.



Method 2: Click on **PLC > PLC error diagnosis** in the menu bar.



In the **PLC error diagnosis** window, you can view the error occurrence time, main error code, sub error code, module information, error message, and solution.



■ **SDO error and emergency message error code diagnosis**

Through the online debugging interface, you can view the current SDO error codes and emergency message error codes. Refer to 2.5.1.6 Online debugging function for details, and 2.4.2 Fault code for troubleshooting the error causes.

2.4.1.2 Fault diagnosis methods for TM series PLC

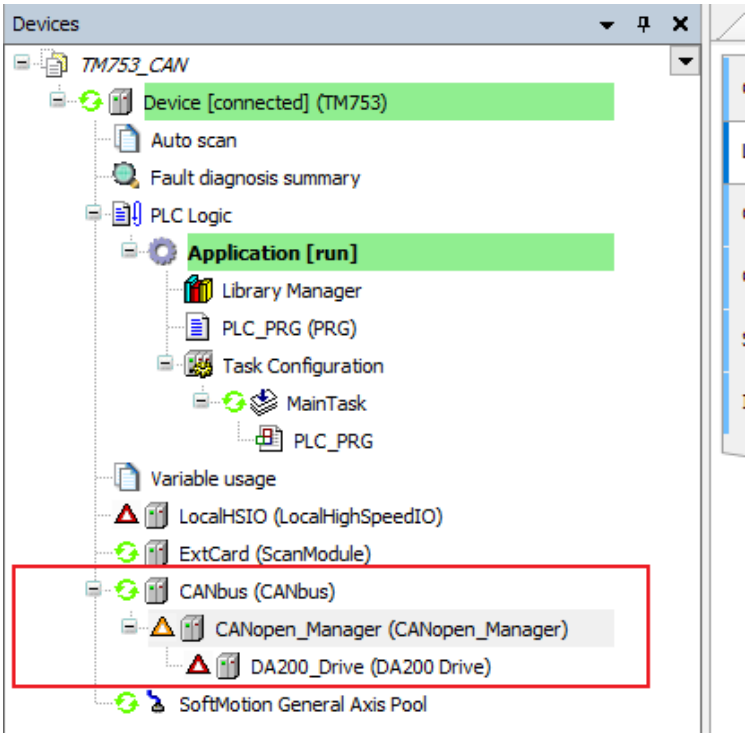
In the configuration interface, the diagnostic status of each communication module is indicated by different icons to represent various states. The status icons are described as follows:

: Running state. The device is running normally with no faults.

: Stopped state. The device is not running and is in a stopped state.

: Fault state. The device is in a fault state and cannot run normally.

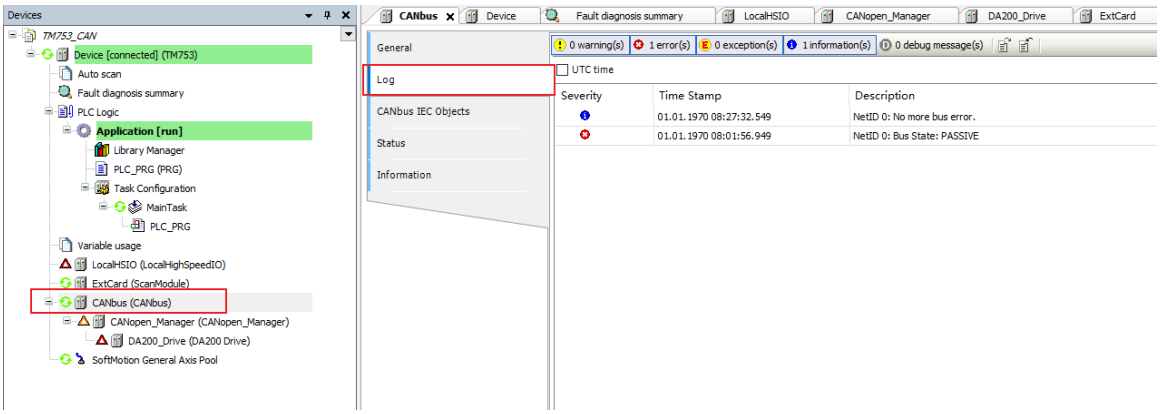
You can directly view the device's running state in the configuration interface.



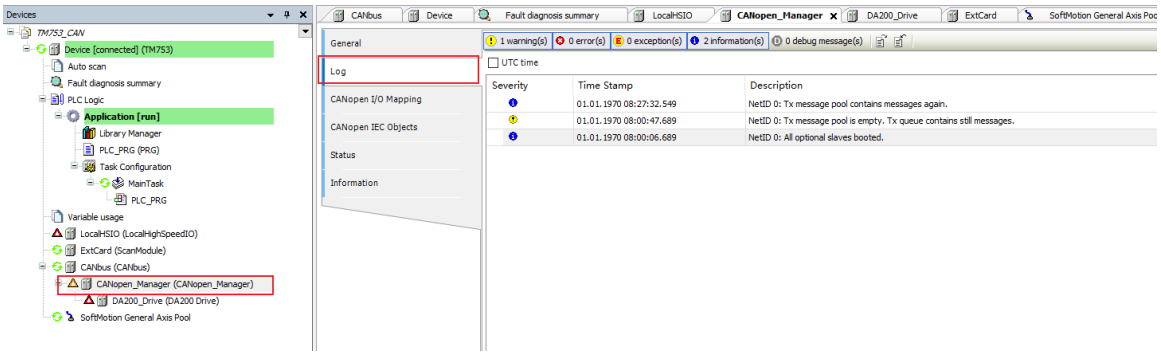
As shown in the figure above, the CAN bus has started, but the DA200 servo drive has not connected successfully.

The steps to view CANopen error logs are as follows:

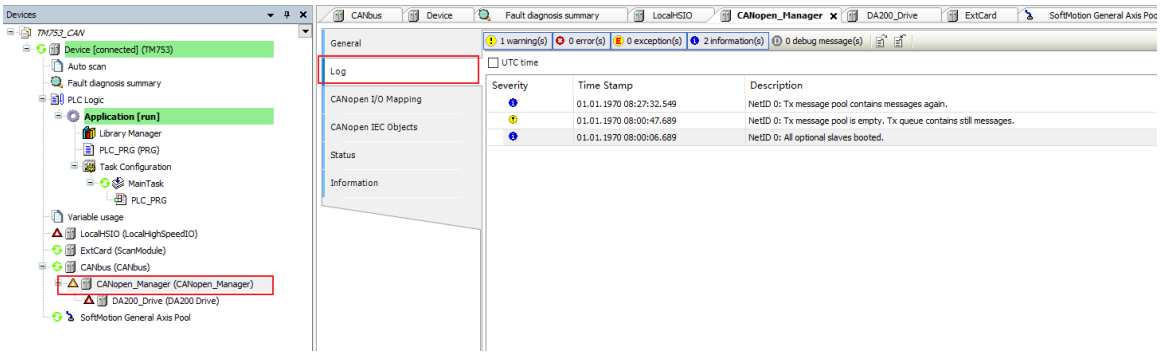
Step 1 Double-click **CANbus** in the device tree and choose **Log** to view the CAN bus error logs.



Step 2 Click **CANbus > CANopen_Manager** (master device) and go to the **Log** tab to view the CANopen master error logs.



Step 3 Click **CANopen_Manager > DA200_Drive** (slave device) > **Log** to view the CANopen slave device error logs.



2.4.2 Fault code

2.4.2.1 PLC error code

Main error code	Sub error code	Description	Solution
0x0050	0x0001	CANopen communication error	Check whether the CAN network wiring is properly connected.
	0x0002	CANopen configuration error	Check whether the configuration on the host controller matches the actual situation.
	0x0003	CANopen load rate is too high	Detect whether too many PDOs are configured, and whether there are devices on the bus that transmit CAN messages autonomously, such as CAN analyzers or multiple CANopen masters. These conditions may lead to poor communication status and data loss.

2.4.2.2 SDO error code

Interruption code (hexadecimal)	Code function description	Interruption code (hexadecimal)	Code function description
0503 0000	Triggering bit not alternated	0601 0002	Attempts to write information to a read-only object
05040000	SDO protocol times out	0602 0000	Object cannot be found in the object dictionary
0504 0001	Illegal or unknown Client/Server instruction word	0604 0041	Object cannot be mapped to PDO
0504 0002	Invalid block size (Block Transfer mode only)	0604 0042	Number and length of the object to be mapped exceeds the PDO length
0504 0003	Invalid serial number (Block Transfer mode)	0604 0043	Common parameter incompatibility
0503 0004	CRC Error (Block Transfer mode)	0604 0047	Common internal incompatibility of the device
0503 0005	Memory overflow	0606 0000	Object access failure caused by hardware error
0601 0000	No access to the object	0607 0010	Data type not matched; service parameter length not matched
0601 0001	Attempts to read a write-only object	0607 0012	Data type mismatch, service parameter length is too long
0601 0002	Attempts to write information to a read-only object	0607 0013	Data type mismatch, service parameter length is too short
0602 0000	Object cannot be found in the object dictionary	0609 0011	Subindex does not exist
06040041	Object cannot be mapped to PDO	0609 0030	Out of value range of parameter (on write access)
0800 0000	Common error	0609 0031	Written parameter value too large
08000020	Data failed to be transmitted or stored in the application	0609 0032	Written parameter value too small
0800 0022	Data failed to be transmitted or stored in the application due to the current state of the device	0609 0036	Max. value less than Min. value

2.4.2.3 Emergency error code

Emergency error (hexadecimal)	Description	Emergency error code (hexadecimal)	Description
0000	Error reset or no error	6300	Data setting
1000	General error	7000	Additional module error
2000	Current error	8000	Monitoring error
2100	Device input current	8100	General communication error

Emergency error (hexadecimal)	Description	Emergency error code (hexadecimal)	Description
2200	Internal device current	8110	CAN communication overload
2300	Device output current	8120	CAN passive mode error
3000	Voltage error	8130	Node protection or heartbeat error
3100	Power supply voltage	8140	Bus off restore
3200	Internal device voltage	8150	CAN-ID conflict
3300	Output voltage	8200	Protocol error
4000	Temperature error	8210	PDO length error
4100	Ambient temperature	8220	PDO length overrun
4200	Device temperature	8240	Unrecognized SYNC data length
5000	Device hardware error	8250	RPDO timeout
6000	Device software error	9000	External error
6100	Internal error	F000	Additional function error
6200	User software	FF00	Special device error

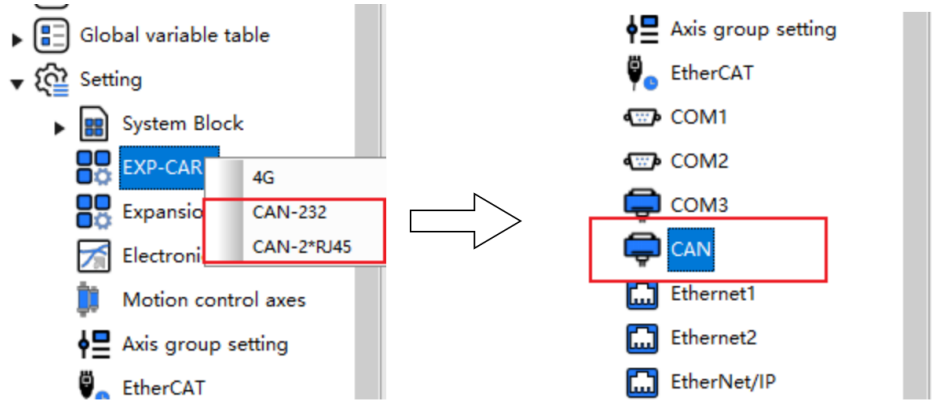
2.5 Programming instance

2.5.1 TS600 series programming instance

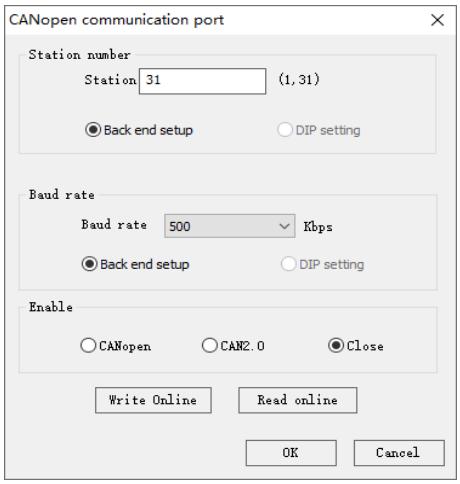
2.5.1.1 CANopen configuration

When **CAN-232** or **CAN-2*RJ45** is selected for the expansion card, the CAN communication configuration option will appear. When the CANopen communication protocol is enabled, the system will decide whether the local computer is the CANopen master or the CANopen slave according to whether there is CANopen configuration.

Step 1 After establishing the project, right-click **Setting>EXP** and choose the corresponding physical expansion module **CAN-232** or **CAN-2*RJ45**.

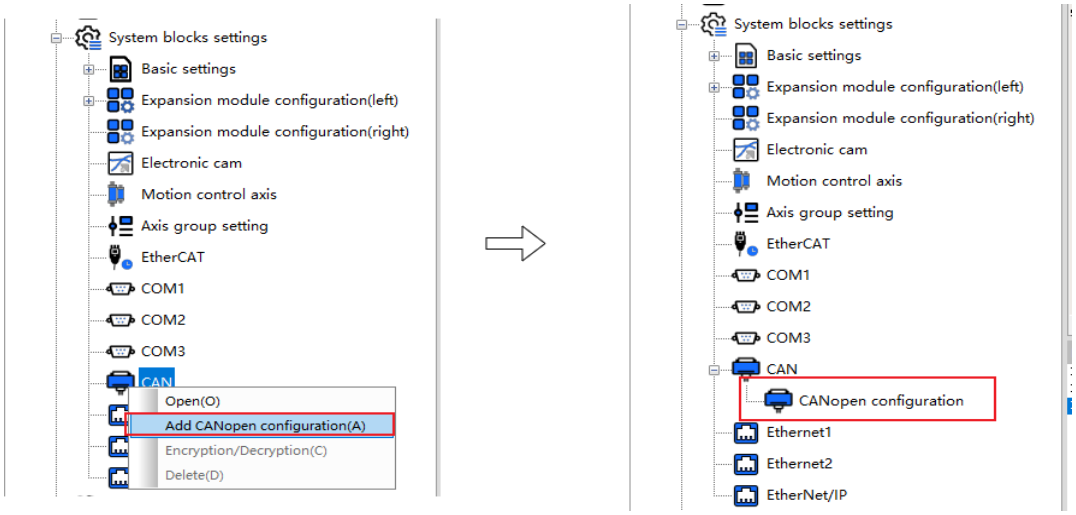


Step 2 Double-click **CAN** in **Setting** to pop up the following window.

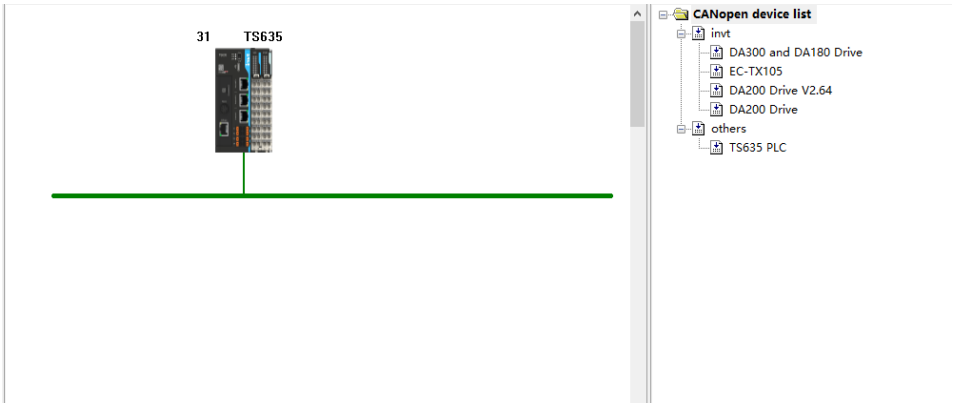


Step 3 Check to **Enable CANopen**, and set the **Station number** and **Baud rate** as required, and then click **OK**.

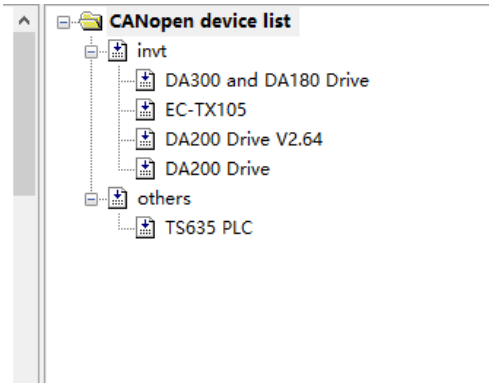
CAN, which is configured as the CANopen slave currently, can be configured as the CANopen master by clicking **Setting** > **CAN** and choosing **Add CANopen configuration** in the pop-up menu, as shown in the following figure.



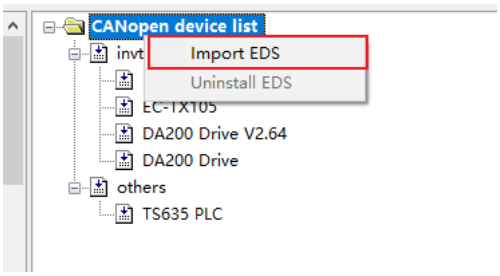
Step 4 Double-click **CANopen configuration** to open the CANopen configuration interface, as shown in the following figure.



Step 5 Double-click the CANopen slave you want to add in the **CANopen device list**.



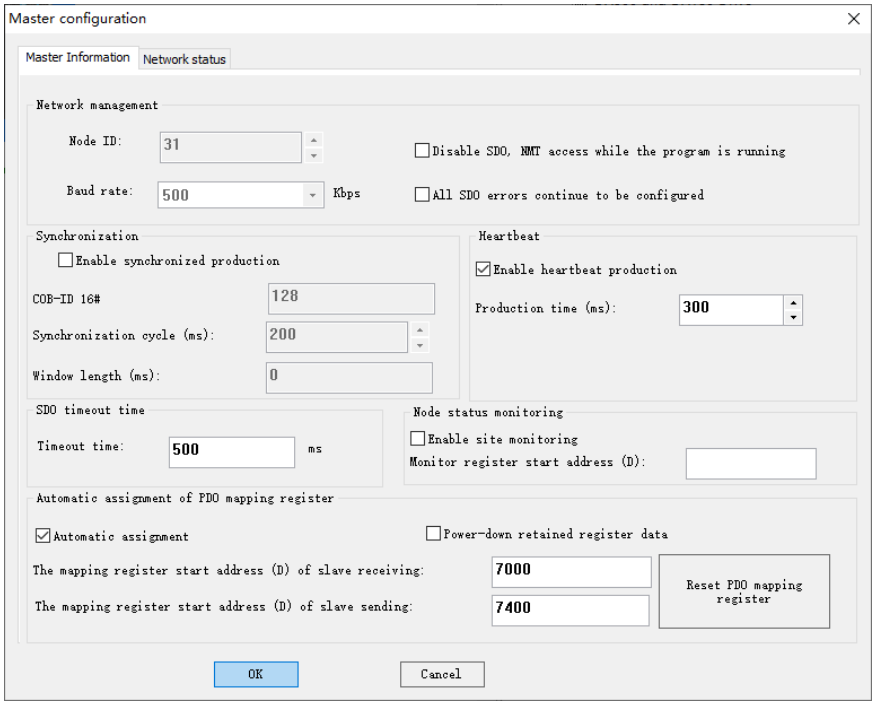
Note: If the slave device is not in the list, right-click on the **CANopen device list** and click **Import EDS** file (available from the device vendor).



2.5.1.2 Master configuration

■ **Master information**

Set the master parameters, double-click the TS635 master in the network, and the following window appears.



- **Network management**

  Node ID: Set the network master number.

  ✧ When the node number is the same as the node number of the PLC itself, the PLC is initialized as the CANopen master.

  ✧ When the node number is different from the node number of the PLC itself, the PLC is initialized as a CANopen slave.

  Baud rate: The valid communication baud rate of the master.

  Disable SDO, NMT access while the program is running: After checking this function, online commissioning function will not be used during program running.

  Note: This function only limits background software.

  All SDO errors continue to be configured:

  ✧ After checking this function, if SDO is configured incorrectly, it will continue to configure; This function is valid for all slaves.

  ✧ If this function is not checked, the master will broadcast reset the slave if SDO error occurs.

- **Synchronization**

  Enable synchronization production: When checking this option, the node will transmit synchronization frames according to the time cycle set in **synchronization cycle (ms)**.

  COB-ID: Synchronization frame transmit ID, which defaults to 0x80 and is not allowed to be changed.

  Synchronization cycle (ms): The cycle period of sending synchronization frame, default to 200 (unit: ms).

  Window length (ms): This parameter defaults to 0, and is not allowed to be changed.

  Note: Only one synchronous message can be sent at the same time in a CANopen network

- **Heartbeat**

  Enable heartbeat production: When checking this option, the node will transmit heartbeat frames according to the time cycle set in **Prodcution time (ms**).

  Production time (ms): The cycle period of sending heartbeat, default to 300 (unit: ms).

  Note: The default heartbeat monitoring consumption time of the master is 2.5 times the heartbeat production time.

- **SDO timeout**

  Timeout time: SDO wait time, default to 500 (unit: ms).

  SDO frames are mainly used for network configuration. If SDO does not receive the return frame on time within before timeout, the master determines the configuration timeout. This time is the waiting interval time of each frame.

- **Node status monitoring**

  The node's online status is updated to the system variable _sCANOpen.NodeState[64], where _sCANOpen.NodeState[0] is the local state and _sCANOpen.NodeState[node number] is the corresponding slave state.

Numerical value	State
0	Initialization state
4	Stopped state
5	Running state
127	Pre-running status

Numerical value	State
255	Offline state

Note: This function only makes sense when the slave enables the heartbeat, because this state is fed back by the slave heartbeat.

- **Automatic assignment of mapping register**

  Automatic assignment: This function is checked by default.

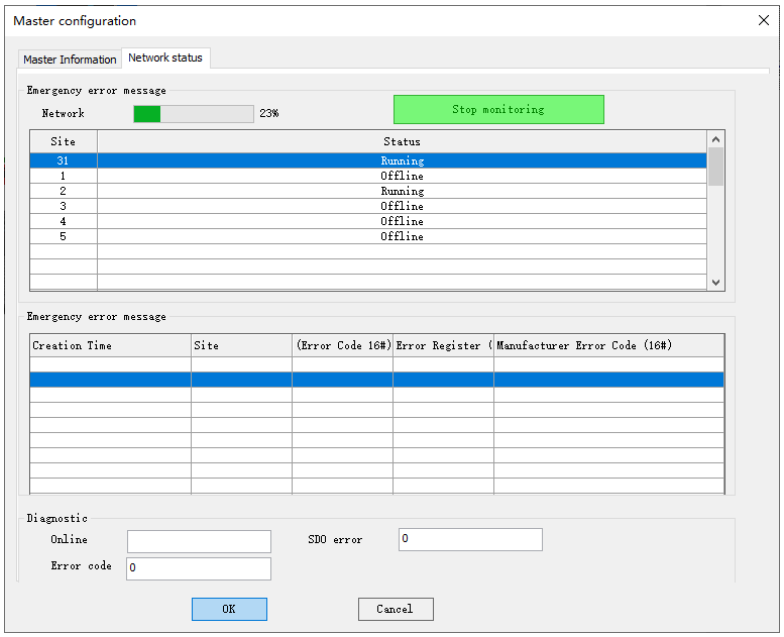
  ✧ If this function is selected, the register address for master-slave data interaction will be automatically assigned.

  ✧ If this function is not selected, you need to manually set the start address of data interaction (set the start address of each PDO separately).

  The mapping register start address (D) of slave receiving: The start address of the data sent by the master is automatically allocated (it makes sense only when automatic assignment is checked).

  The mapping register start address (D) of slave sending: The start address of the data received by the master is automatically allocated (it makes sense only when automatic assignment is checked).

- **Network status**



Start monitoring / Stop monitoring: Click this option to start status monitoring on this page. When monitoring is started, click **Stop monitoring** to exit network monitoring.

Network: Monitors the real-time load status of the CAN network.

Network status: Displays the current running status of network nodes. This status is retrieved from the node status system variable.

Emergency error message:

✧ Displays the current emergency error information in the network. The PLC master only stores the latest error message. If this page is not closed, up to 5 messages can be cached in the background.

✧ For details on emergency error message, refer to 2.4.2.3 Emergency error code.

SDO configuration:

✧ Node number: The incorrect node number for SDO configuration.

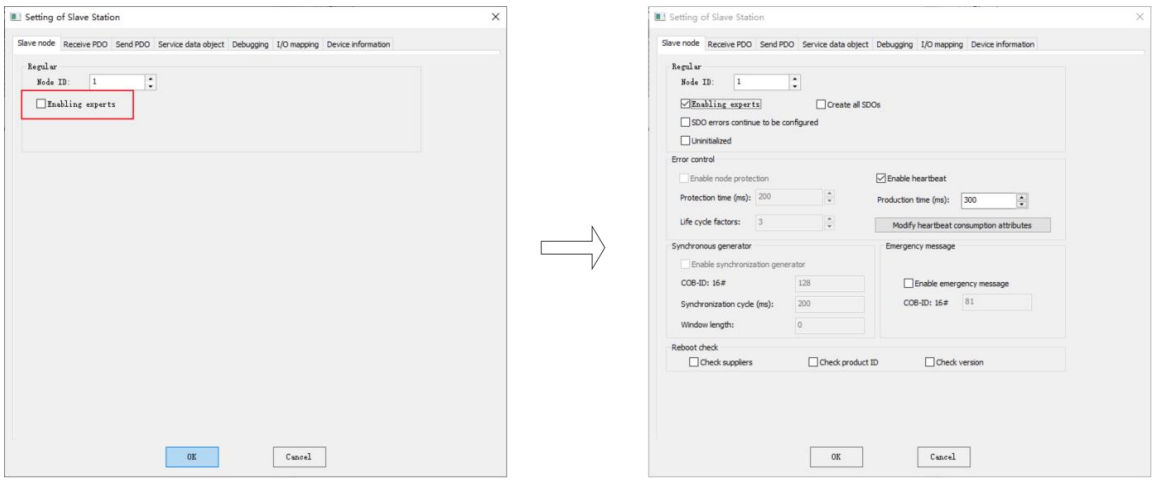
- ✧ Error step number: The number of the SDO error. Check the corresponding number information in the **Service Data Object** tab of the slave with the corresponding error parameter.
- ✧ Error code: The SDO error code (CANopen standard error code).

2.5.1.3 Slave configuration

This section takes EC-TX105 as an example to introduce the configuration process and related parameters of CANopen slaves.

■ **Slave Configuration**

After checking **Enabling experts**, the window as shown on the right below appears.



- **Regular**

  Node ID: The slave node number to be configured.

  Enabling experts: When this option is selected, detailed slave configuration will be displayed. This option is not selected by default.

  SDO errors continue to be configured: This option is not selected by default.

  - ✧ Valid: Skip to the next configuration item if configuration error occurs.
  - ✧ Invalid: The master will not proceed with the configuration if configuration error occurs, and the node will be re-configured.

  Create all SDOs: When this option is selected, all writable object dictionaries in the EDS will be added and initialized during configuration. This option is not selected by default.

- **Error control**

  Enable heartbeat: When this option is checked, the slave will generate heartbeats. After the slave heartbeat is checked, the master monitors the heartbeat status of the slave by default.

  Production time (ms): The cycle time when the heartbeat is sent.

  Modify heartbeat consumption attributes: This option is not selected by default.

  - ✧ This function is used to set the heartbeats of other nodes that will be monitored by this slave.
  - ✧ This function also requires the slave to support heartbeat monitoring function.

- **Synchronization generator (if supported by slave)**

  Enable synchronization generator: When checking this option, the node will transmit synchronization frames according to the time cycle set in **Synchronization cycle (ms)**.

  COB-ID: Synchronization frame transmit ID, which defaults to 0x80 and is not allowed to be changed.

Synchronization cycle (ms): The cycle period of sending synchronization frame, default to 200 (unit: ms).

Window length: This parameter defaults to 0, and is not allowed to be changed.

Note: Only one synchronization frame can be sent in a CANopen network.

- **Emergency message**

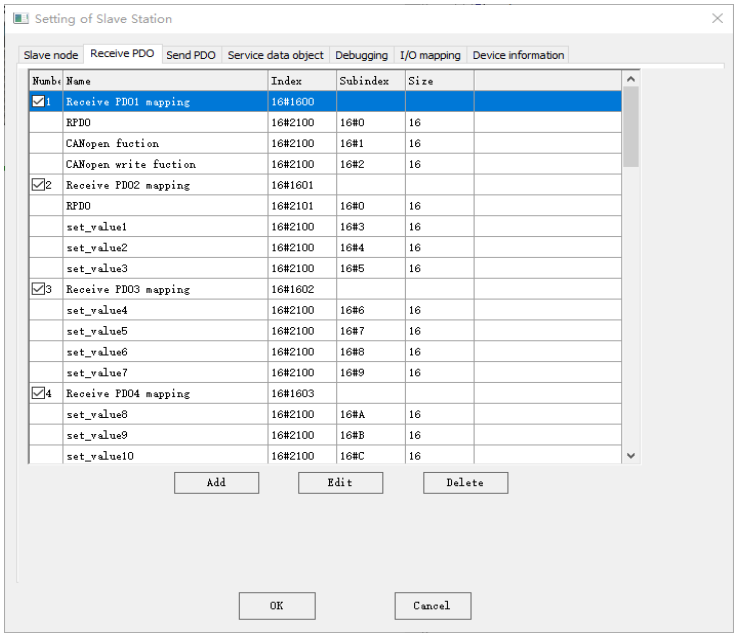
Enable emergency message: If this function is checked, the COB-ID of emergency packets will be set in the configuration process, but it is not checked by default.

Reboot check

Check suppliers, Check product ID, Check version: When checking the corresponding function, the relevant check will be carried out before starting slave configuration. If the check fails, the node cannot be started.

■ Receive PDO/Send PDO

Click to choose **Receive PDO/Send PDO**, and the interface will appear:



Receive PDO: master -> slave data

Send PDO: slave -> master data

■ PDO enabling

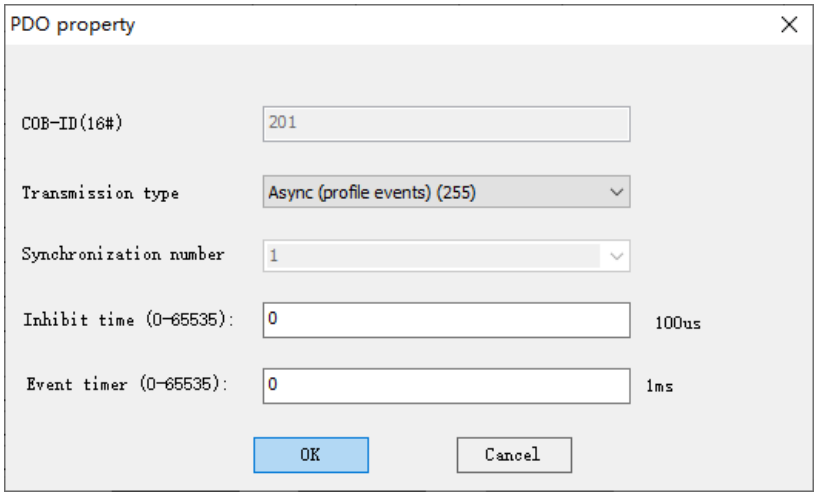
The checkbox before the index number is used to determine whether the PDO is active. If the PDO does not contain any mapped objects, it cannot be checked. PDOs that are enabled by default in the slave's EDS file are pre-checked.

■ PDO mapping editing

You can edit the PDO mapping through the **Add, Edit** and **Delete** buttons in the window.

2.5.1.4 PDO attribute settings

The PDO attribute interface appears as follows:



- **COB-ID(16#)**

ID number used for PDO transmission.

- **Transmission type**

Type	Data Transmission Conditions	Data Effective Conditions
Acyclic-synchronous (Type 0)	Data changes and a synchronization frame is received	It does not take effect immediately after receiving data, and it takes effect only after receiving one frame synchronization
Cyclic-synchronous (Type 1- 240)	The data is transmitted after receiving the synchronization frame of the corresponding "synchronization number"	It does not take effect immediately after receiving data, and it takes effect only after receiving one frame synchronization
Asynchronous-Manufacturer-specific (Type 254)	Customized by each manufacturer	Customized by each manufacturer
Asynchronous-Device Profile-specific (Type 255)	The time when data changes or meets the event, and the change frequency is less than the suppression time	Effective immediately

Note: When setting up a certain node for synchronous transmission, it is necessary to enable synchronous production of the master

- **Synchronization number**

Used to set the synchronization number, only valid after choosing **Cyclic-synchronous (Type 1-240)**.

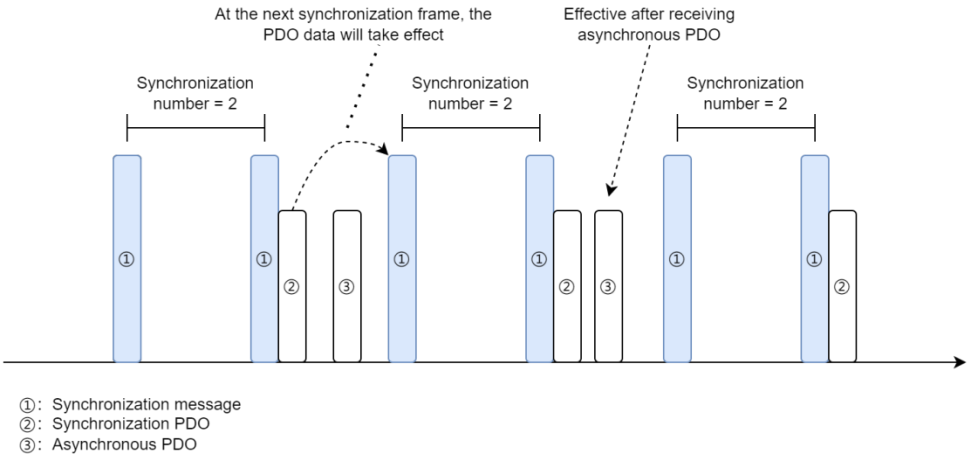
- **Inhibition time**

Available only after choosing **Asynchronous-Device Profile-specific (Type 255)**. This function is invalid when set to 0; If it is not 0, it indicates the minimum interval for frame transmission.

■ **Event time**

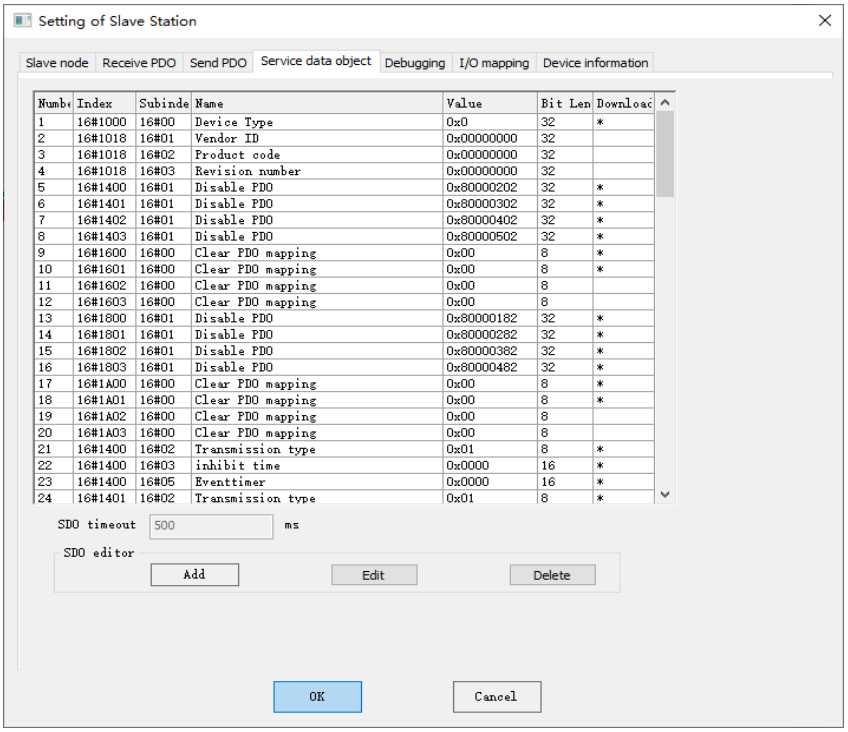
Available only after choosing **Asynchronous-Device Profile-specific (Type 255)**. This function is invalid when set to 0. If it is not 0, it indicates the period of regular transmission (This transmission condition is also limited by the inhibition time).

The following figure takes Synchronous cycle-synchronous type = 2 as an example.



2.5.1.5 Service data object

The **Service data object** tab interface is shown below (using DA200 as an example). This table automatically generates SDO configuration data based on the EDS file and user settings.

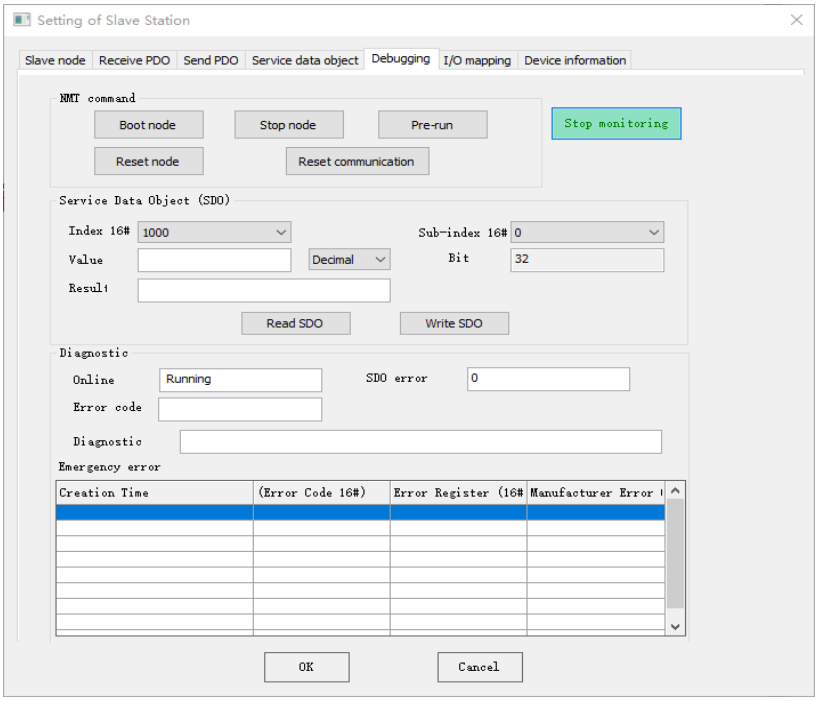


SDO Edit options description:

- Add: Adds a user-defined configuration. Mainly used to assign initial values to the object dictionary.
- Edit: Re-edits user configuration.
- Delete: Deletes user configuration.

2.5.1.6 Online debugging function

The interface of the online debugging tab is shown as below.



Note: If **Disable SDO, NMT access while the program is running** is selected in the master, this function cannot be used.

- **NMT commands**

  Boot node: Sends a start node command to this slave.

  Stop node: Sends a stop node command to this slave.

  Pre-run: Sends a pre-run command to this node.

  Reset node: Sends a reset node command to this node.

  Reset communication: Sends a reset communication command to this node.

- **Service data object**

  Index and sub-index: Only the object dictionary provided in the slave EDS can be selected.

  Value: The data to be sent or returned.

  Bit length: Obtained from the slave EDS object dictionary.

  Result: Read and write state information.

  Read SDO, Write SDO: Perform the read and write operations of corresponding object dictionary.

- **Diagnosis**

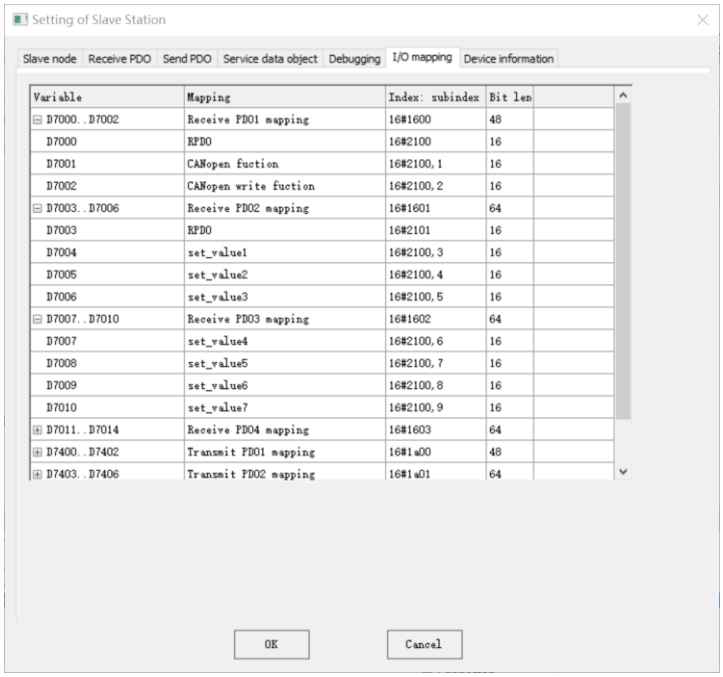
  Online: The current status of the slave (based on heartbeat monitoring).

  SDO error step number: The step number where an SDO error occurred during configuration. This number corresponds to the entry in the **Service Data Object** tab.

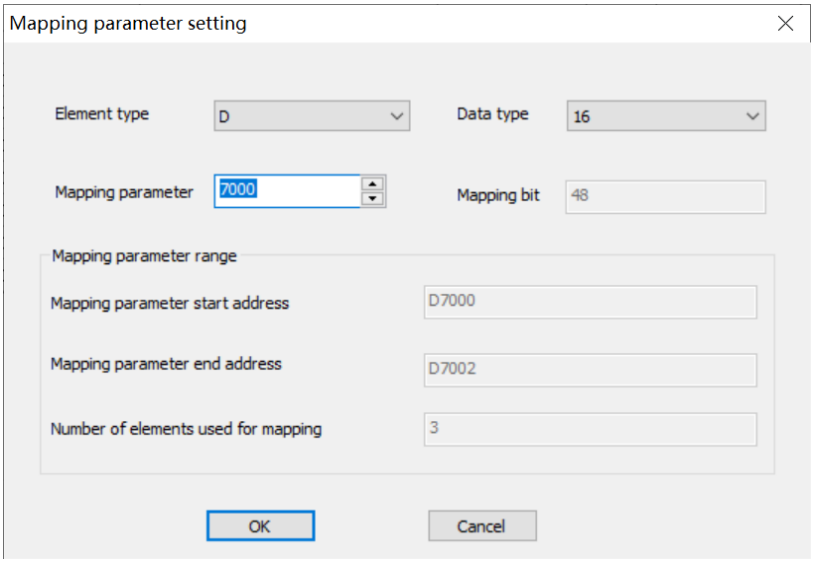
  Diagnostic string: The current error message (SDO error). For details, refer to 2.4.2.2 SDO error code.

2.5.1.7 I/O mapping

The I/O mapping option interface appears as follows.

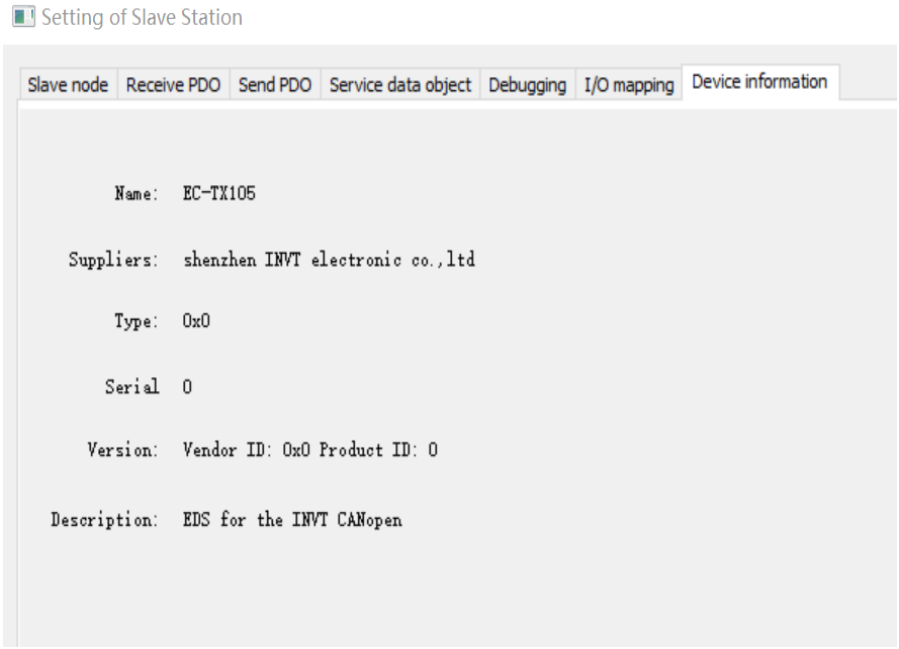


This tab is used to set the data communication mapping relationship between master and slave PDO. If **Automatic assignment** is not checked in the master settings, you can double-click one of the mappings to set it, as shown in the following figure. You can set the master register start address corresponding to each salve PDO.



2.5.1.8 Device information

The device information interface is displayed as shown in the figure below.

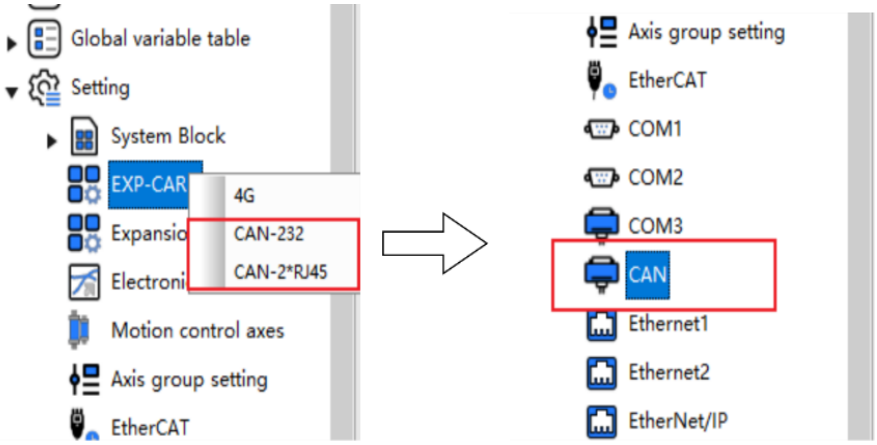


Note: The device information of the slave is obtained from the EDS file provided by the device manufacturer.

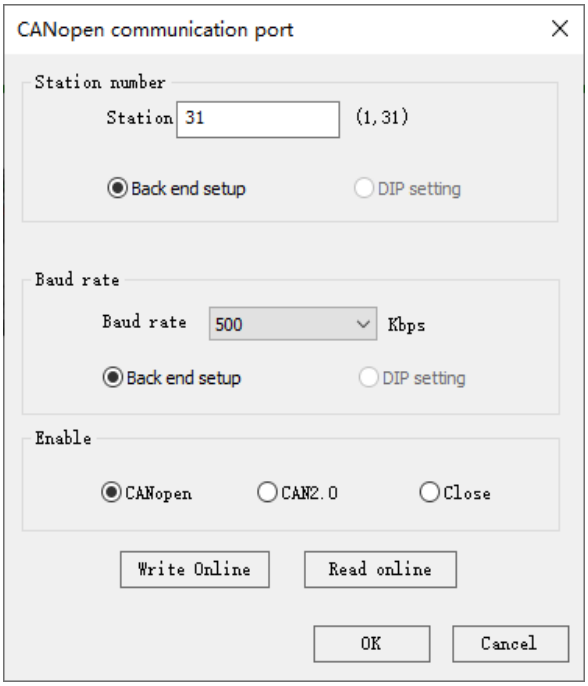
2.5.1.9 CANopen slave instruction

- **Slave Configuration**

  Step 1 After establishing the project, right-click **Setting>EXP** and choose the corresponding physical expansion module **CAN-232** or **CAN-2*RJ45**.



Step 2 Double-click **CAN** in **Setting** to pop up the following window.



Step 3 Check to **enable CANopen**, and set the **Station number** and **Baud rate** as required, and then click **OK**.

Note: Do not continue to add CAN configuration by right-clicking, otherwise this machine will act as the CANopen master.

■ **Slave CANopen data interaction**

The TS600 series programmable logic controller, when used as a slave, supports only 4 TPDOs and 4 RPDOs, with each PDO supporting up to 8 bytes of data. Therefore, 16 16-bit mapped addresses are set in the slave's object dictionary to buffer the transmitted data, and another 16 16-bit mapped addresses are set to buffer the received data. These are respectively bound to the corresponding slave's R500–R531 elements, as shown in the table below.

Table 2-1 Reference for received data

Index	Sub-index	Name	Access type	Data type	Slave bound element
2109	1	1st Rx Buffer	RW	16	R500
2109	2	2st Rx Buffer	RW	16	R501
2109	3	3st Rx Buffer	RW	16	R502
2109	4	4st Rx Buffer	RW	16	R503
2109	5	5st Rx Buffer	RW	16	R504
2109	6	6st Rx Buffer	RW	16	R505
2109	7	7st Rx Buffer	RW	16	R506
2109	8	8st Rx Buffer	RW	16	R507
2109	9	9st Rx Buffer	RW	16	R508
2109	10	10st Rx Buffer	RW	16	R509
2109	11	11st Rx Buffer	RW	16	R510
2109	12	12st Rx Buffer	RW	16	R511
2109	13	13st Rx Buffer	RW	16	R512
2109	14	14st Rx Buffer	RW	16	R513
2109	15	15st Rx Buffer	RW	16	R514

Index	Sub-index	Name	Access type	Data type	Slave bound element
2109	16	16st Rx Buffer	RW	16	R515

Table 2-2 Reference for sent data

Index	Sub-index	Name	Access type	Data type	Slave bound element
2108	1	1st Tx Buffer	RW	16	R516
2108	2	2st Tx Buffer	RW	16	R517
2108	3	3st Tx Buffer	RW	16	R518
2108	4	4st Tx Buffer	RW	16	R519
2108	5	5st Tx Buffer	RW	16	R520
2108	6	6st Tx Buffer	RW	16	R521
2108	7	7st Tx Buffer	RW	16	R522
2108	8	8st Tx Buffer	RW	16	R523
2108	9	9st Tx Buffer	RW	16	R524
2108	10	10st Tx Buffer	RW	16	R525
2108	11	11st Tx Buffer	RW	16	R526
2108	12	12st Tx Buffer	RW	16	R527
2108	13	13st Tx Buffer	RW	16	R528
2108	14	14st Tx Buffer	RW	16	R529
2108	15	15st Tx Buffer	RW	16	R530
2108	16	16st Tx Buffer	RW	16	R531

2.5.2 TM700 series programming instance

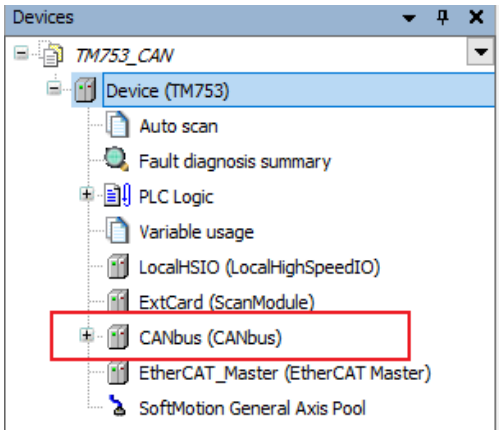
2.5.2.1 Master node usage process

Step 1 Install the CANopen slave devices.

The associated CANopen slave device profile must first be installed into the system. The device profile can be a *.devdesc.xml file or an EDS (Electronic Data Sheet) file for the manufacturer.

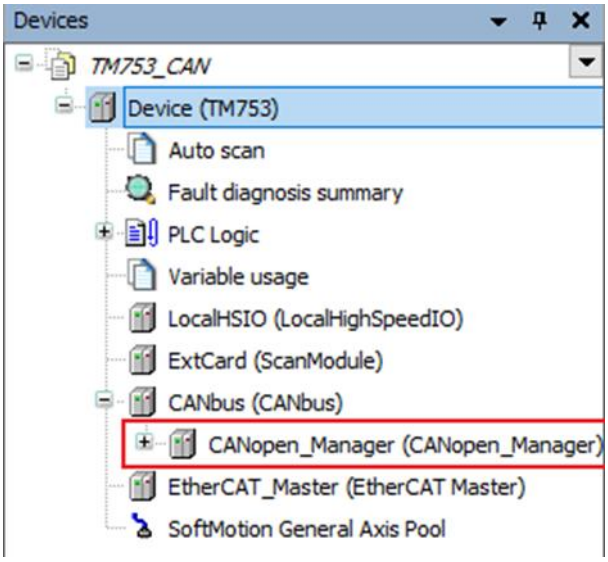
Step 2 Add **CANbus** to the device tree.

The base node of CANopen (the uppermost entry in the CANbus configuration tree) must be a CANbus object. A CAN bus can be inserted under the programmable controller device node. The diagram after adding the CAN bus is shown below.



2.5.2.2 Adding CANopen management device

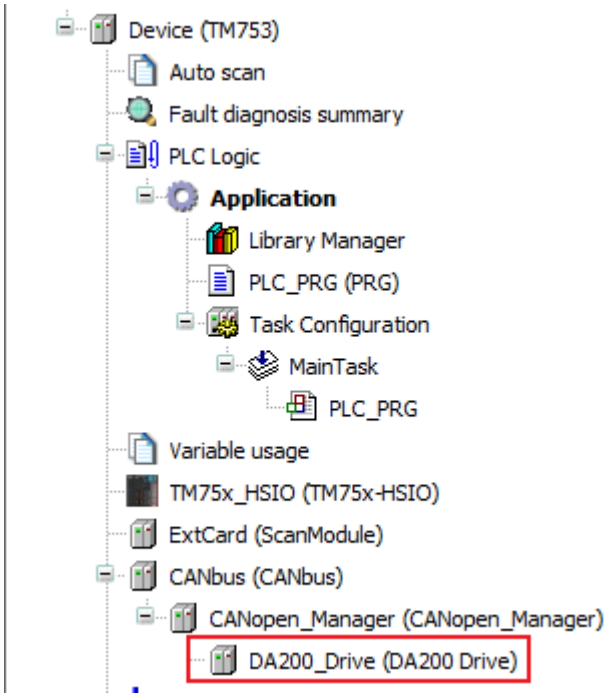
Under the CANbus, add a **CANopen_ Management** device, which can be used as a CANopen master. The diagram after adding is shown below.



2.5.2.3 Adding CANopen slave node

Take INVT DA200 CANopen slave as an example. Add the DA200 slave device under CANopen Manager after adding the EDS file of this slave, as shown in the following diagram.

Figure 2-1 Device tree structure with a CANopen slave



The software configuration of the CANopen master is complete.

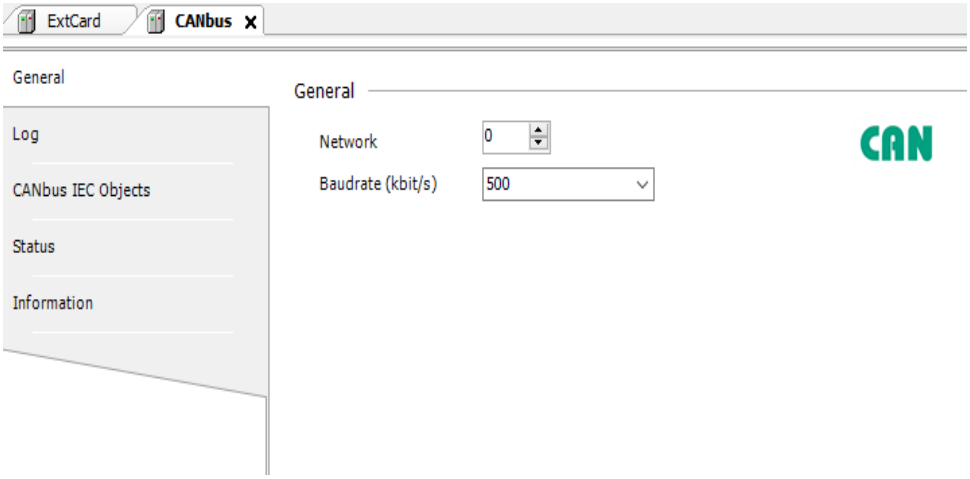
2.5.2.4 Parameter configuration of CANopen master

Step 1 Configure **Network** and **Baud Rate** of the CANbus.

Network: The number of CAN networks connected via the CANbus, range: 0–100.

Baud rate: The baud rate used for transmission on the bus (The following baud rates can be set: 10kbits/s, 20kbits/s, 50kbits/s, 100kbits/s, 125kbits/s, 250kbits/s, 500kbits/s, 800kbits/s, and 1000kbits/s).

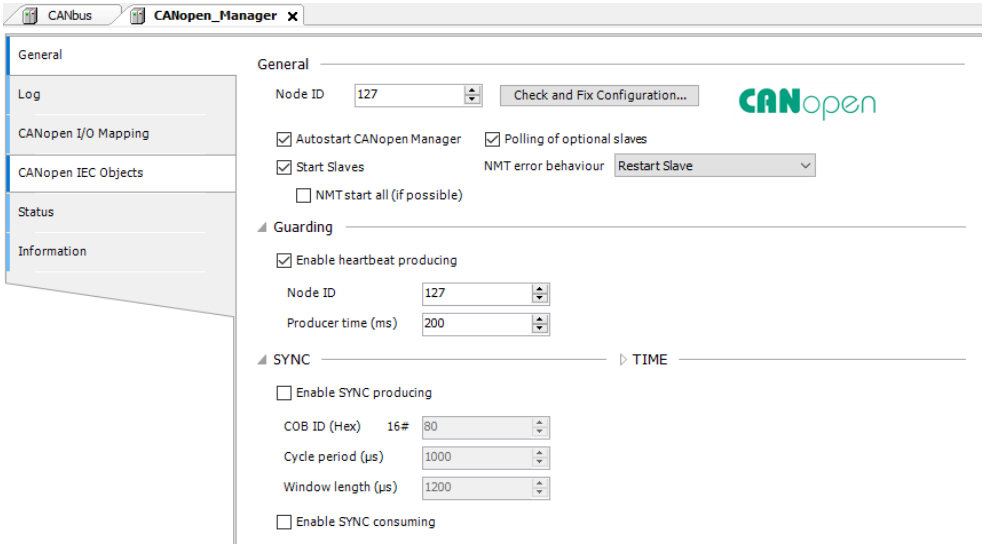
Figure 2-2 Parameter configuration of CANbus



Step 2 Configure **CAN_Manager.**

CANopen_Management: A node under the CANbus node that supports CANbus configuration through internal functions. It is generally used as the CANbus master. The configuration page is shown in the following figure.

Figure 2-3 Parameter configuration of CANopen master



Master parameter	Description
Node ID	The Node ID parameter allows the CANopen Manager to establish a one-to-one correspondence with up to 127 modules, with ID values

Master parameter	Description
	ranging from 1 to 127, and the ID must be entered as a decimal integer.
Guarding	Heartbeat mode is a traditional protection mechanism that can be handled by the master station and the slave station modules, different form node protection. Normally the master is configured to send a heartbeat to the slave.
Enable heartbeat producing	If this option is enabled, the master will send heartbeats continuously according to an internally defined heartbeat time. If a new slave heartbeat function is added, their heartbeat actions will be automatically activated and configured. That means the node ID is automatically set in the management configuration and the heartbeat interval is automatically multiplied by a factor of 1 and 2. If this option is disabled, the node protection (with a life time factor of 10 and a protection time of 100ms) is activated in the slave.
Node ID	Unique identifier of heartbeat generation (1-127) on the bus.
Producer time (ms)	Defines the internal heartbeat time in milliseconds.

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