

3.4 Cable connection and specifications

3.4.1 EtherCAT bus connection

EtherCAT bus specifications

Item	Description
Communication protocol	EtherCAT
Supported service	COE (PDO/SDO)
Min. synchronization interval	1ms/4 axes (Typical value)
Synchronization method	DC for sync/DC unused
Physical layer	100BASE-TX
Duplex mode	Full duplex
Topology structure	Serial connection
Transmission medium	Network cable (see the section "Cable selection")
Transmission distance	Less than 100m between two nodes
Number of slave nodes	Up to 125
EtherCAT frame length	44 bytes~1498 bytes
Process data	Up to 1486 bytes contained in a single frame

Cable selection
The CPU module can implement EtherCAT bus communication through the CN3 port. INVT standard cables are recommended. If you make the communication cables by yourself, ensure the cables meet the following requirements:

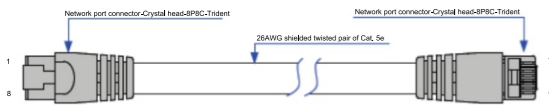


Figure 3-7 User-made network cable requirements

- Note:**
- The communication cables you use must pass the conductivity test 100%, without short circuit, opened circuit, dislocation or poor contact.
 - To ensure communication quality, the EtherCAT communication cable length cannot exceed 100 meters.
 - You are recommend to make the communication cables by using the shielded twisted pair cables of category 5e, compliant with EIA/TIA568A, EN50173, ISO/IEC11801, EIA/TIA bulletin TSB, and EIA/TIA SB40-A&TSB36.

3.4.2 CANopen cable connection

Networking
The CAN bus connection topology structure is shown in the following figure. It is recommended that the shielded twisted pair be used for CAN bus connection. Each end of the CAN bus connects to a 120Ω terminal resistor to prevent signal reflection. In most cases, the shield layer uses single-point grounding.

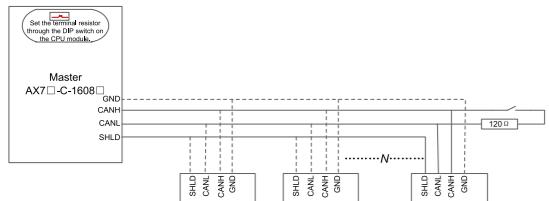


Figure 3-8 CAN bus connection

- Cable selection**
- For AX7□-C-1608P CPU module, the same terminal is used for both CANopen communication and RS485 communication, using a DB9 connector for data transmission. The pins in the DB9 connector have been described earlier.
 - For AX7□-C-1608N CPU module, the RJ45 terminal is used for CANopen communication for data transmission. The pins in the RJ45 connector have been described earlier.

INVT standard cables are recommended. If you make the communication cables by yourself, make the cables according to the pin description and ensure the manufacturing process and technical parameters meet communication requirements.

- Note:**
- To enhance cable anti-interference capability, you are recommended to use aluminum foil shielding and aluminum-magnesium braid shielding techniques when making the cables.
 - Use the twisted-pair winding technique for differential cables.

3.4.3 RS485 serial communication connection

- The CPU module supports 2 channels of RS485 communication.
- For AX7□-C-1608P CPU module, the ports COM1 and COM2 uses the DB9 connector for data transmission. The pins in the DB9 connector have been described earlier.

- For AX7□-C-1608N CPU module, the port uses the 12-pin push-in terminal connector for data transmission. The pins in the terminal connector have been described earlier.
- INVT standard cables are recommended. If you make the communication cables by yourself, make the cables according to the pin description and ensure the manufacturing process and technical parameters meet communication requirements.

- Note:**
- To enhance cable anti-interference capability, you are recommended to use aluminum foil shielding and aluminum-magnesium braid shielding techniques when making the cables.
 - Use the twisted-pair winding technique for differential cables.

3.4.4 Ethernet connection

Networking
The Ethernet port of the CPU module is CN4, which can connect to another device such as a computer or HMI device by using a network cable in the point-to-point mode.

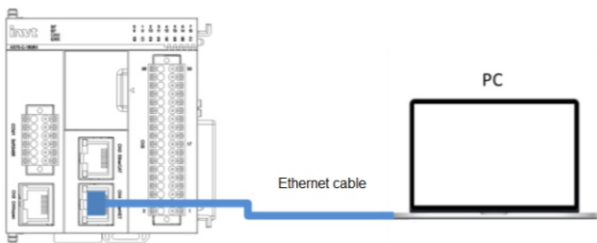


Figure 3-9 Ethernet connection

You can also connect the Ethernet port to a hub or switch by using a network cable, implementing multi-point connection.

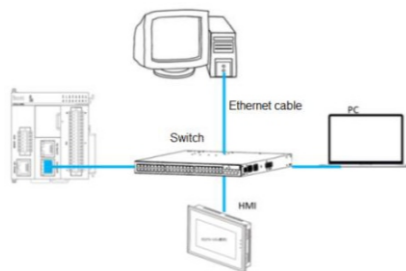


Figure 3-10 Ethernet networking

Cable selection
To improve communication reliability, use shielded twisted-pair cables of category 5 or higher Ethernet cables. INVT standard cables are recommended.

4 Use instructions

4.1 Technical parameters

4.1.1 CPU module general specifications

Item	Description					
Input voltage	24VDC					
Power consumption	< 15W					
Power-failure protection time	300ms (no protection within 20 seconds after power-on)					
Backup battery of the real-time clock	Supported					
Backplane bus power supply	5V/2.5A					
Programming method	IEC 61131-3 programming languages (LD, FBD, IL, ST, SFC, and CFC)					
Program execution method	Local online					
User program storage space	10MB					
Flash memory space for power failure protection	512KB					
SD card specifications	32G MicroSD					
Soft elements and characteristics	Element	Name	Count	Storage characteristics		
				Default	Writable	
	I	Input relay	64KWord	Not save	No	X: 1 bit B: 8 bits W: 16 bits D: 32 bits
	Q	Output relay	64KWord	Not save	No	
M	Auxiliary output	256KWord	Save	Yes	L: 64 bits	
Program retention method upon power failure	Retention by the internal flash					
Interruption mode	The high-speed DI signal of the CPU module can be set as interruption input, allowing up to eight points of input, and the rising edge and falling edge interruption modes can be set.					

4.1.3 High-speed I/O specifications

High-speed input specifications

Item	Specifications	
Signal name	High-speed differential input	High-speed single-end input
Rated input voltage	2.5V< V _{IN+} - V _{IN-} <6V	24VDC (-15% ~ +20%, pulsating within 5%)
Rated input current	6.8mA	5.7mA (Typical value) (at 24V DC)
ON current	/	Less than 2mA
OFF current	/	Less than 1mA
Input resistance	540Ω	2.2kΩ
Max. counting speed	800K Pulses/s (2PH fourfold frequency), 200KHz (single channel of input)	
2PH input duty ratio	40%: 60%	
Common terminal	/	One common terminal is used.

High-speed output specifications

Item	Specifications	
Signal name	Output (Y0~Y7)	
Output polarity	AX7□-C-1608P: Source type output (active high) AX7□-C-1608N: Sink type output (active low)	
Control circuit voltage	DC 5V~24V	
Rated load current	100mA/point, 1A/COM	
Max. voltage drop at ON	0.2V (Typical value)	
Leakage current at OFF	Less than 0.1mA	
Output frequency	200KHz (The output of 200KHz requires the externally connected equivalent load must be greater than 12mA.)	
Common terminal	Every eight points use one common terminal.	

- Note:**
- The high-speed I/O ports have restrictions on the allowed frequency. If the input or output frequency exceeds the allowed value, control and identification may be abnormal. Arrange the I/O ports properly.
 - The high-speed differential input interface does not accept the differential pressure input level of greater than 7V. Otherwise, the input circuit may be damaged.

4.2 Programming software introduction and download

Programming software introduction
INVTMATIC Studio is programmable controller programming software that INVT develops. 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 used in energy, transportation, municipal, metallurgy, chemical, pharmaceutical, food, textile, packaging, printing, rubber and plastics, machine tools and similar industries.

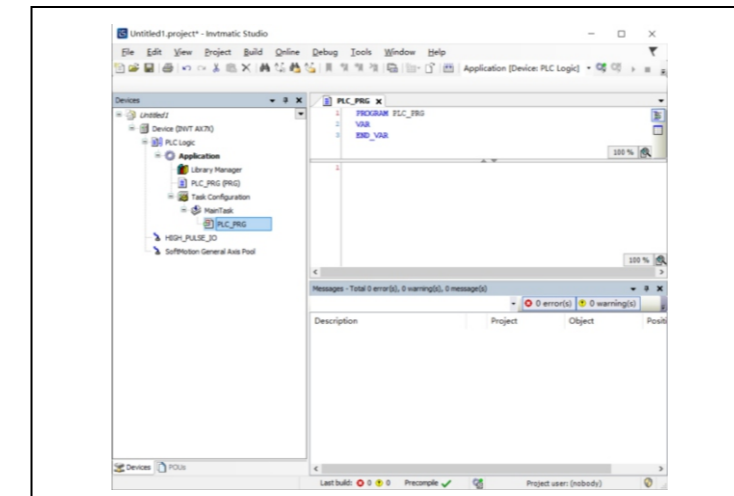
Running environment and download
You can install Invtmatic Studio on a desktop or portable computer, of which the operating system is at least Windows 7, memory space is at least 2GB, free hardware space is at least 10GB, and the CPU main frequency is higher than 2GHz. Then you can connect your computer to the CPU module of the programmable controller through a network cable and edit the user programs through the Invtmatic Studio software so that you can download and debug user programs.

5 Programming instance

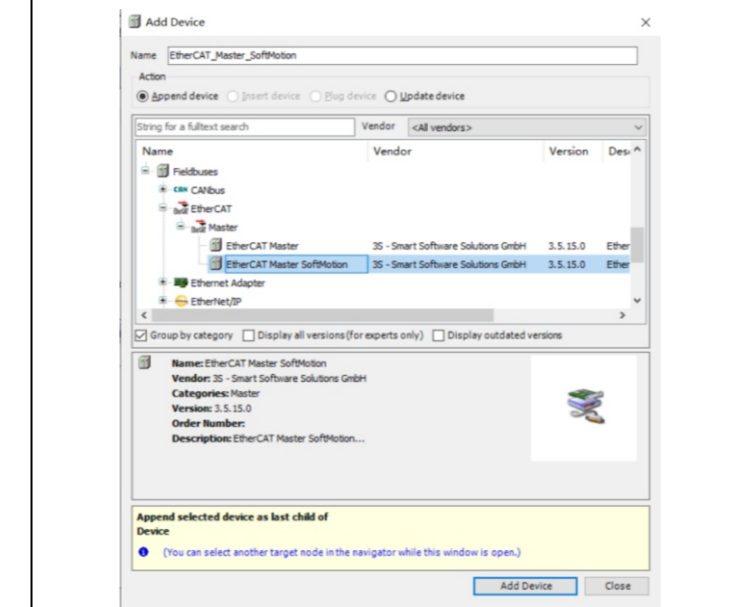
The following describe how to perform programming by using an example (AX72-C-1608N). First of all, connect all the hardware modules of the programmable controller, including connecting the power supply to the CPU module, connecting the CPU module to the computer where Invtmatic Studio has been installed and to the required expansion module, and connecting the EtherCAT bus to the motor drive. Start Invtmatic Studio to create a project and perform programming configuration.

The procedure is as follows:

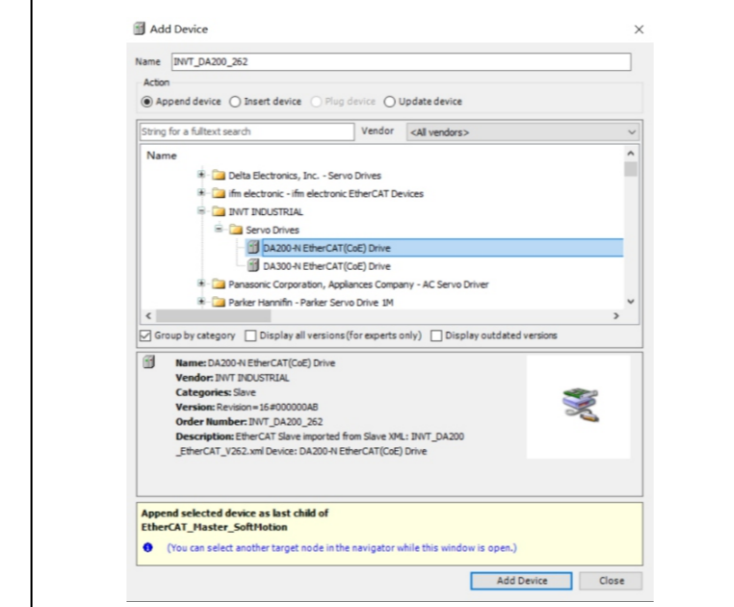
Step 1 Choose File > New Project. select the standard project type, and set the project saving location and name. Click **OK**. Then select the **INVT AX7X** device and **Structured Text (ST)** programming language in the standard project configuration window that appears. The CODESYS configuration and programming interface appears.



Step 2 Right-click on the Device navigation tree. Then choose **Add Device**. Choose **EtherCAT Master SoftMotion**.

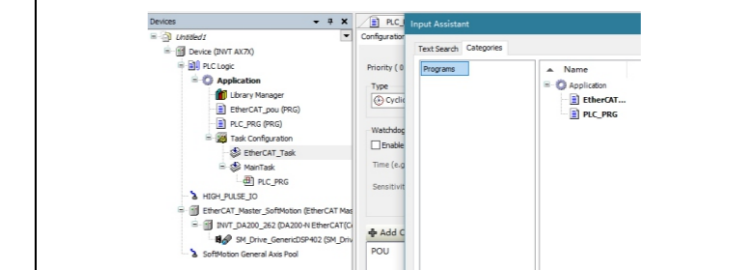
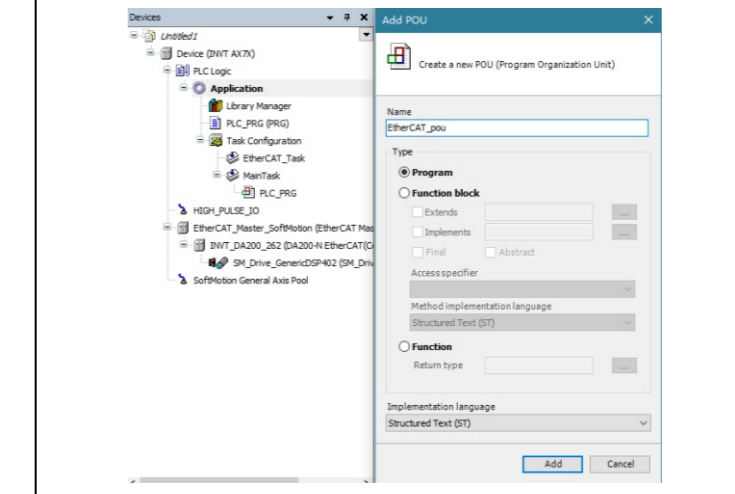


Step 3 Right-click EtherCAT_Master_SoftMotion on the left navigation tree. Choose **Add Device**. Choose **DA200-N EtherCAT(CoE) Drive** in the window that appears.

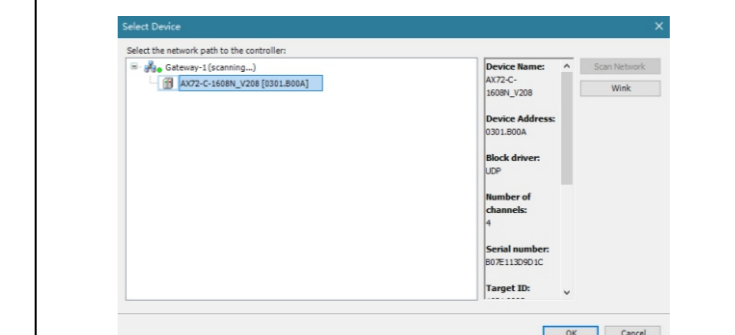


Step 4 Choose Add SoftMotion C1A402 Axis in the shortcut menu that appears.

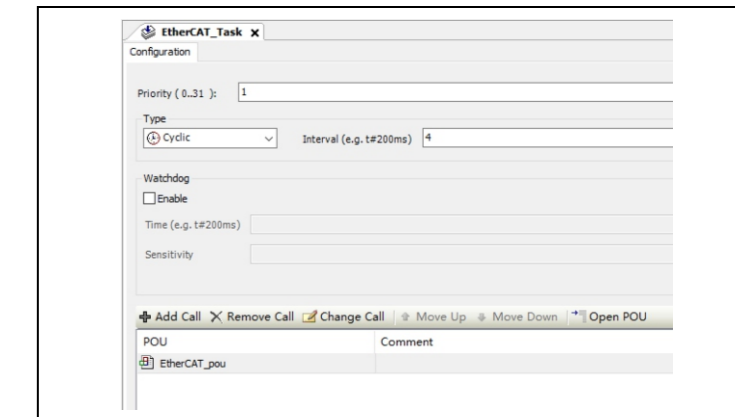
Step 5 Right-click Application on the left navigation tree and choose to add an EtherCAT POU. Double-click the automatically generated **EtherCAT_Task** to invoke. Choose the created **EtherCAT_pou**. Write the application program based on the application control process.



Step 6 Double-click the Device navigation tree, click **Scan Network**, choose **AX72-C-1608N** shown in the following figure, and click **Wink**. Then click **OK** when the CPU system indicator blinks.



Step 7 Double-click EtherCAT_Task under **Task Configuration** in the left pane. Set task priorities and execution intervals based on task real-time requirements.



In Invtmatic Studio, you can click to compile programs, and you can check for errors according to logs. After confirming the compilation is fully correct, you can click to log in and download user programs to the programmable controller and you can perform simulation debugging.

6 Pre-startup check and preventive maintenance

6.1 Pre-startup check

If you have completed the wiring, ensure the following before starting the module to work:

- The module output cables meet requirements.
- The expansion interfaces at any levels are reliably connected.
- The application programs use the correct operation methods and parameter settings.

6.2 Preventive maintenance

- Perform preventive maintenance as follows:
- Clean the programmable controller regularly, prevent foreign matters falling into the controller, and ensure good ventilation and heat dissipation conditions for the controller.
 - Formulate maintenance instructions and regularly test the controller.
 - Regularly check the wiring and terminals to ensure that they are securely fastened.

7 Further information

Please feel free to contact us for further information. Please provide the product model and serial number when making an inquiry.

To obtain related product or service information, you can:

- Contact INVT local office.
- Visit www.invt.com.
- Scan the following QR code.



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