



softMC 804

控制器软件用户手册

Controller Software User Manual

Revision History

Document Revision	Date	Remarks
1.0	March 2023	Initial release.
1.1	March 2023	Adapter specifications were added to the power interface in Table 3-1.
1.2	April 2023	The description of power interface in Table 3-1 was modified.
1.3	May 2023	The pin definition of RS485 port was modified in Table 3-8.
1.4	May 2023	Software download path was added in 2.2.3 Chapter 3.1.1 was added, and some hardware interface information were adjusted in 3.1.2.

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Unpacking

Upon arrival, please open the package and remove all packaging materials.

Check the product to ensure that there is no visible damage. If damage is found, please inform the carrier immediately.

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1. Safety Precautions

1.1 Safety statement

1) This chapter explains the safety matters that need to be paid attention to when using this product. Before using this product, please read the instruction manual and correctly understand the relevant information of safety precautions. Failure to comply with the agreed items in safety matters may lead to death, serious injury or equipment damage.

2) The words “Danger”, “Warning” and “Caution” in the manual do not represent all safety matters that should be observed, but only serve as supplements to all safety precautions.

3) This manual should be used in an environment that meets the requirements of design specifications, otherwise it may cause failure, and abnormal function or partial damage caused by non-compliance with relevant regulations is not within the product quality assurance scope.

4) Our company will not bear any legal responsibility for personal safety accidents and property losses caused by non-compliance with the contents of this manual and illegal operation of products.

1.2 Definition of security level



means that if you don't follow the fixed principles, it will lead to death or serious physical injury.



means that if you don't follow the fixed principles, it may lead to death or serious physical injury.



means that if you don't follow the fixed principles, it may lead to minor physical injury or equipment damage.

1.3 Safety precautions

1) In the illustrations in this manual, sometimes the product is in the state of removing the cover or safety cover in order to show the details of the product. When using, please be sure to install the cover or protective cover according to the requirements, and operate according to the fixed principles.

2) The pictures shown in this manual are only sample pictures, which may be slightly different from the products you ordered. The products actually ordered shall prevail.

Table 1-1

Unpacking acceptance	
 Warning	● When unpacking, if the product and accessories are found to be damaged, rusted or have traces of use, please do not install it! ● When unpacking, if water is found inside the product, parts are missing or damaged, please do not install it! ● Please check the packing list carefully. If the packing list does not match the product name, please do not install it!
 Caution	● Before unpacking, please check whether the outer packaging of the equipment is intact, and whether there is damage, soaking, deformation. ● Please open the package according to the hierarchical order, and it is forbidden to knock violently! ● Before unpacking, please check whether the surface of the equipment and accessories are damaged. ● After unpacking, please check the packing list and check whether the quantity and information of equipment and accessories are complete.
Storage and transportation	
 Warning	● Please use professional lifting equipment, and carry large or heavy products by qualified professionals. Otherwise, there is a risk of injury or product damage! ● Before lifting the product vertically, please ensure that the product components such as the front cover and terminal block have been firmly fixed with screws, otherwise the parts will fall off, which may lead to personal injury or product damage! ● When the product is lifted by lifting equipment, no one is allowed to stand or stay under the product! ● When lifting the product with wire rope, please lift it smoothly and evenly, so as to avoid the product from vibration and shock. Don't flip the product, and don't let it hang for a long time, otherwise there will be a risk of personal injury or product damage!
 Caution	● Please handle the product with care, and always pay attention to the objects under your feet to prevent tripping or falling, otherwise there is a risk of injury or product damage! ● When carrying the product by hand, please hold the product shell firmly to avoid the product parts falling off, otherwise there is a risk of injury! ● Please store and transport in strict accordance with the storage and transportation conditions required by the product, otherwise there is a risk of product damage!

- Avoid storing and transporting products in places such as splashing rain, direct sunlight, strong electric field, strong magnetic field and strong vibration.
- Avoid storing the product for more than 3 months. If the storage time is too long, please carry out strict protection and necessary inspection.
- Please pack the products strictly before vehicle transportation, and a closed box must be used for long-distance transportation!
- It is strictly forbidden to transport this product together with equipment or articles that may affect or damage this product!

Installation



- Only professionals who have been trained in electrical equipment and have electrical knowledge can operate this equipment. Operation by non-professionals is strictly prohibited!



- Please read the instruction manual and safety precautions carefully before installation!
- Please do not install this product in places with strong electric field or strong electromagnetic interference!
- Before installation, please ensure that the mechanical strength of the installation location is enough to support the weight of the equipment, otherwise it will lead to mechanical danger!
- Please don't wear loose clothes or accessories during installation, otherwise there may be the risk of electric shock!
- When installing the product in a closed environment (such as a cabinet), please use a cooling device (such as a cooling fan or a cooling air conditioner) to fully cool it to meet the requirements of the installation environment, otherwise it may lead to overheating or fire!
- No modification of this product is allowed!

Installation

- Do not twist the fixing bolts of product parts and components and the bolts marked in red!
- When this product is installed in a cabinet or terminal equipment, the cabinet or terminal equipment should be equipped with corresponding protective devices such as fire-proof enclosure, electrical protective enclosure and mechanical protective enclosure, and the protection class should meet the requirements of relevant IEC standards and local laws and regulations.
- When it is necessary to install transformers and other equipment with strong electromagnetic interference, please install shielding devices to avoid misoperation

of this product!

- Please install the product on metal and other flame-retardant objects, and do not let flammable materials touch or attach to the product, otherwise there will be a risk of fire!

 Caution

- When installing, please cover the top of the product with cloth or paper to prevent foreign objects such as metal chips, oil and water from entering the product during drilling, thus causing product failure. After the operation, please remove the cover to prevent the cover from blocking the ventilation hole, affecting the heat dissipation and causing the product to generate abnormal heat.
- When a machine running at a constant speed runs at a variable speed, resonance may occur. At this time, installing anti-vibration rubber under the motor base or using vibration suppression function can effectively weaken resonance.

Wiring

 Danger

- Non-professionals are forbidden to install, wire, maintain, check the equipment, or replace parts of equipment!
- Please cut off the power supply of all equipment before wiring. After the power supply is cut off, there is residual voltage in the internal capacitor of the equipment. Please wait at least the time specified in the product warning label before wiring and other operations. Measure the DC voltage of the main circuit, and ensure it is below the safe voltage, otherwise there will be danger of electric shock!
- Please connect the wires, remove the product cover or touch the circuit board when the power supply is cut off, otherwise there will be danger of electric shock!
- Please ensure that the equipment and products are well grounded, otherwise there will be danger of electric shock!

 Warning

- It is forbidden to connect the input power supply to the output end of equipment or products, otherwise it will cause equipment damage and even fire.
- When the driving equipment is connected to the motor, please ensure that the sequence of the product and the motor terminal is accurate and consistent, so as to avoid the reverse rotation of the motor.
- The cable used in wiring must meet the requirements of corresponding wire diameter and shielding, and the shielding layer of the cable needs to be reliably grounded at one end.
- Please tighten the terminal screws according to the tightening torque specified in the manual. Inadequate or excessive tightening torque may cause overheating,

damage and fire. ● After wiring, please ensure that all cables are wired correctly, and there are no dropped screws, washers or exposed cables inside the product, otherwise there may be electric shock danger or damage to the product.
 Caution ● Please follow the steps specified in ESD measures, and wear an electrostatic bracelet for wiring and other operations to avoid damaging the internal circuits of equipment or products. ● When wiring the control loop, please connect the shielding layer to the grounding terminal of the product by using the shielded twisted pair cable, otherwise the product will act abnormally.
Powering on
 Danger ● Before powering on, please ensure that the product is installed, the wiring is firm, and the motor is allowed to restart! ● Before powering on, please ensure that the power supply meets the product requirements to avoid product damage or fire! ● It is forbidden to open the product cabinet door or product protective cover, touch any terminal of the product, or remove any device or parts of the product when it is energized, otherwise there is a danger of electric shock!
 Warning ● After the wiring operation and parameter setting are completed, please carry out a trial run of the machine to confirm that the machine can run safely, otherwise personal injury or equipment damage may be caused. ● Please ensure that the rated voltage of the product is consistent with the power supply voltage before powering on. If the power supply voltage is not used properly,, there will be a fire hazard. ● Please ensure that there are no people around the products, motors and machinery before powering on, otherwise personal injury or death may be caused.
Running
 Danger ● Non-professionals are strictly forbidden from running the product, otherwise it will lead to personal injury or death! ● It is forbidden to touch any terminal of the equipment and remove any device or parts of the equipment and products during operation, otherwise there is a danger of electric shock!
 Warning ● Do not touch the device housing, fan or resistor to test the temperature, otherwise it

may cause burns! ● During operation, avoid other articles or metal objects falling into the equipment, otherwise it may lead to fire or product damage!
Maintenance
 Danger ● Non-professionals are forbidden to install, wire, maintain, check the equipment, or replace parts of equipment! ● It is forbidden to carry out equipment maintenance under the power-on state, otherwise there is a danger of electric shock! ● After cutting off the power supply of all equipment, please wait at least the time specified in the warning label on the product before checking, maintaining and other operations on the equipment.
 Warning ● Please maintain the equipment according to the product warranty agreement. ● In case of fuse blowing, circuit breaker tripping or earth leakage circuit breaker (ELCB) tripping, please wait at least the time specified in the warning label on the product before turning on the power supply or operating the machine, otherwise it may cause casualties and equipment damage. ● When the equipment breaks down or is damaged, professionals are required to troubleshoot and repair the equipment and products according to the maintenance instructions, and keep maintenance records. ● Please follow the instructions for replacing the easily damaged parts of the product. ● Please do not continue to use the damaged machine, otherwise it may cause casualties or damage to the product to a greater extent. ● After replacing the device, be sure to check the device wiring and set parameters again.
Scrapping
 Warning ● Please scrap the equipment and products according to the relevant national regulations and standards, so as to avoid property losses or casualties! ● Please recycle the equipment and products according to the industrial waste treatment standards to avoid environmental pollution.

2. Introduction

2.1 Overview of softMC 804

2.1.1 Product overview

The softMC 804 motion controller from Midea SERVOTRONIX provides users with intelligent automation solutions. The softMC 804 adopts IEC61131-3 programming language system and supports PLCopen programming language. This product can realize high-performance motion control function through EtherCAT bus and provides single-axis acceleration and deceleration control function, electronic gear function and electronic cam function. It also supports RS232, RS485, Ethernet, USB and other communication functions. The softMC 804 can support up to 16 axes of motion through bus expansion. It is a flexible product, which can meet the diverse application needs of users.



Figure 2-1 softMC 804 Motion Controller

2.1.2 Controller features

- 1) A variety of motion control: point-to-point motion, linear interpolation, electronic cam;
- 2) Adequate program capacity and data storage area;
- 3) Fast instruction execution;
- 4) Support online editing mode.

2.2 CODESYS overview

2.2.1 Introduction of CODESYS

CODESYS stands for controller development system. It is a development environment for programming controller applications developed by 3S Company. The version currently used by our company is CODESYS V3.5 SP17 Patch4 platform, which provides a complete set of configuration, programming, debugging and monitoring environment for programming controllers. It also can deal with the powerful IEC language.

It supports functions such as program writing, downloading, and debugging, providing the following conveniences for programmers.

- Standardized programming (in line with IEC 61131-3 standard)

Supporting a variety of programming languages: Structured Text (ST), Ladder Diagram (LD), Sequential Function Chart (SFC), and the IEC 61131-3 programming language, Continuous Function Chart (CFC).

- Flexible function block library

Comprehensive function block library, supporting user-defined libraries.

- Offline simulation function

No need to connect PLC hardware to complete program debugging and simulation.

- Intelligent debugging and error checking

Pre-compile and compile to check for errors; quickly locate programming errors; diagnose and record.

- Sampling tracking

Establishment of timing diagram of process variables.

2.2.2 Connecting CODESYS to hardware

Programming devices can use CODESYS software to write user programs via Ethernet (which can go through hubs, switches, etc.). Download the program to PLC, then monitor the program and control PLC.



Figure 2-2 Controller and PC Connected via Network Cable

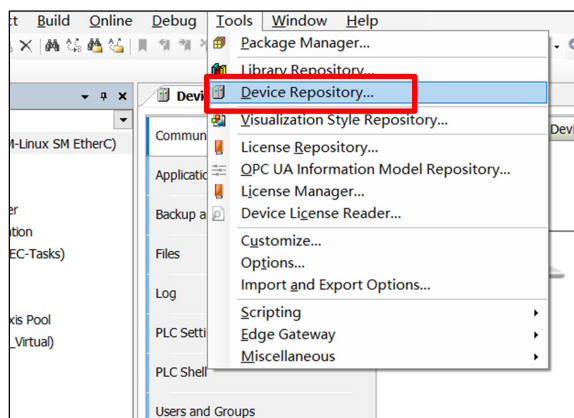
When downloading CODESYS application using the network port, please modify the IP of the computer network port, which must be located in the same network segment as the controller IP. The default Ethernet IP address is 90.0.0.1, subnet mask is 255.255.255.0, and the computer IP needs to be changed to 90.0.0.XX (XX can not be 1, i.e. it can not be the IP address of the controller).



Figure 2-3 Network Setting for PC Connected to Controller

Alternatively, you can also connect through other network ports, as long as it is the same network segment as the IP address of the connected network port. The IP address of EtherCAT is 192.168.39.220.

Open CODESYS IDE and install the device description XML file of the controller (get it from SERVOTRONIX sales staff), then you can scan the controller and download the application program.



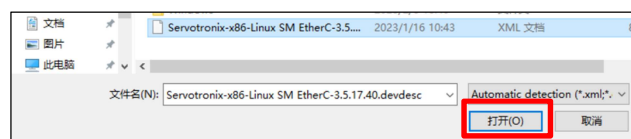
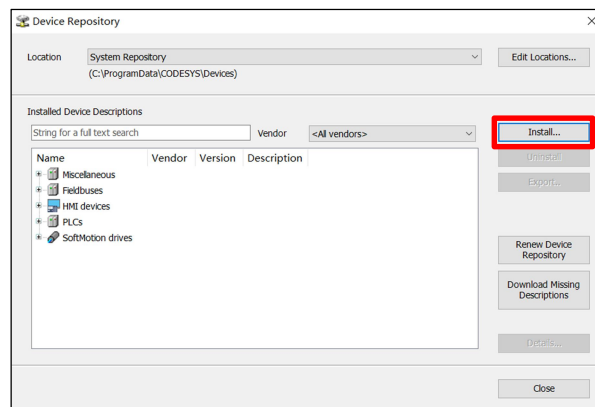
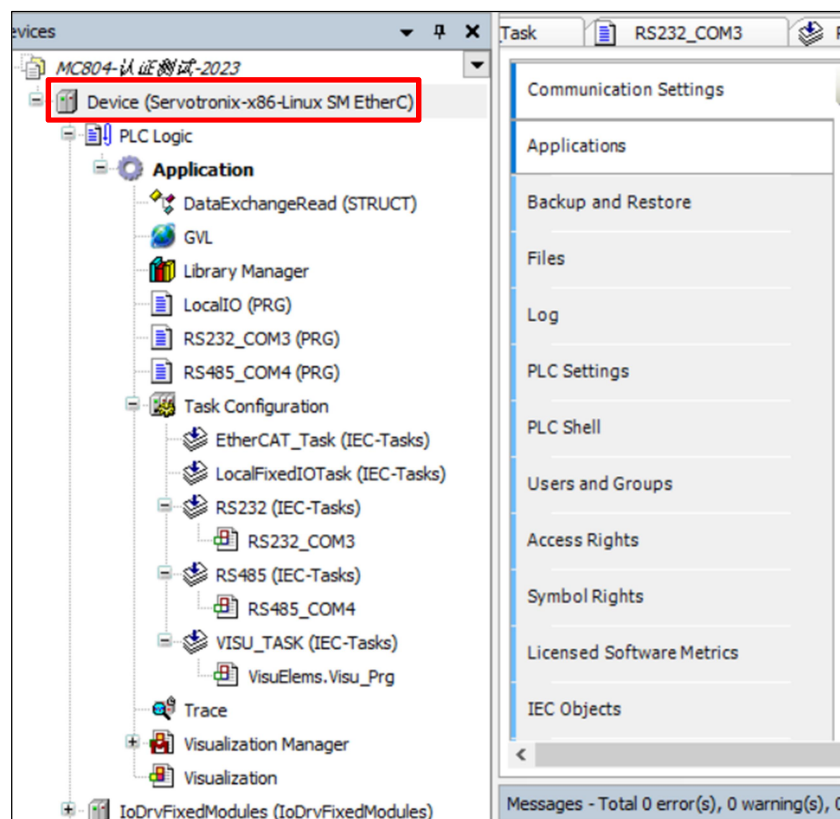


Figure 2-4 Installing the Controller Description File



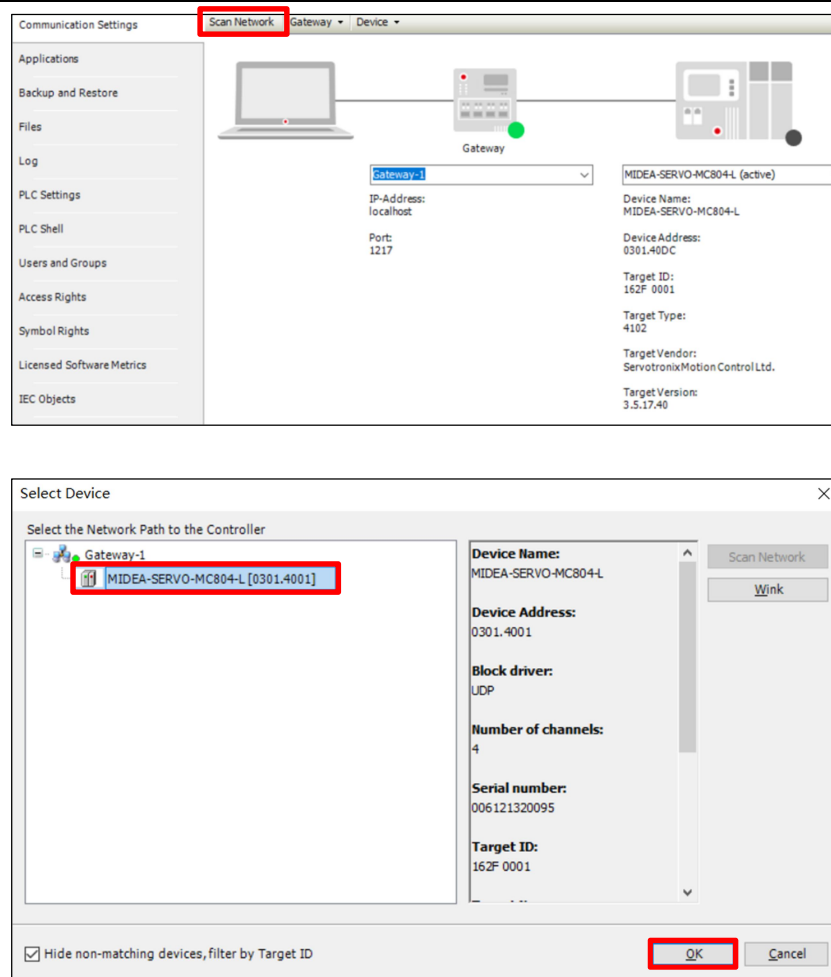


Figure 2-5 CODESYS Online Scanning Controller

2.2.3 Software acquisition and installation

CODESYS software is a free software, which can be installed by downloading CODESYS V3.5SP17 Patch 4 from CODESYS official website, or you can contact the sales staff of Midea SERVOTRONIX to obtain it.

Download address of CODESYS website:

<https://store.codesys.com/codesys.html#product.attributes.wrapper>

Download address of SERVOTRONIX website: <https://www.servotronic.cn/ydkzq/414.html>

The desktop PC or laptop PC on which the software is installed requires the following:

- ✧ Window10 operating system, 64bit operating system is recommended;
- ✧ Memory: at least 8GB;
- ✧ Space: at least 20G of free hard disk space;
- ✧ It is suggested that the CPU frequency of computer should be above 2 GHz, otherwise it will affect the running speed;
- ✧ It is suggested that the firewall function of Windows be turned off.

2.2.4 Installation steps

When installing CODESYS for the first time, please check the free space on the computer hard disk, and ensure that the target disk to be installed has more than 20 GB of free space, and then you can install directly. If you are upgrading and installing CODESYS, please back up your existing working files, and then uninstall the old version of CODESYS, and restart your computer before starting to install the new version of the software.

During installation, it is recommended to connect the computer to the Internet. Click the installation package with administrator privileges, select the installation directory, and then click Next until the end.

3. Introduction to Controller

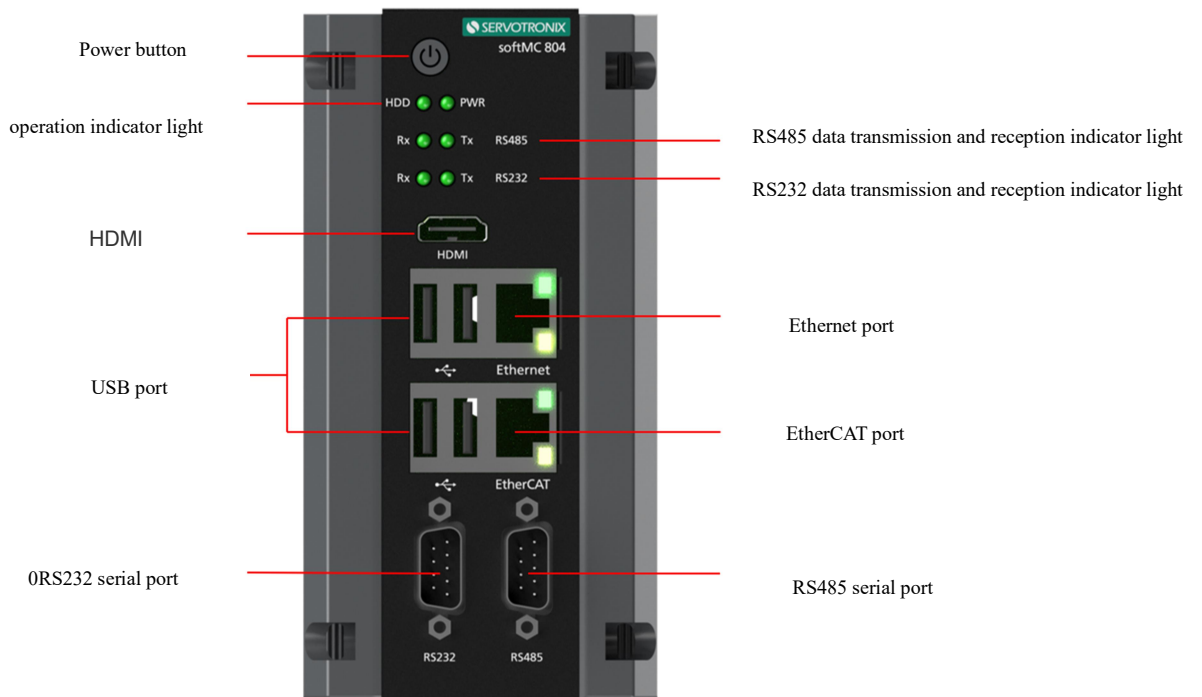
3.1 Specification

3.1.1 Hardware configuration

Table 3-1 Hardware Configuration

Processor	2.0GHz Intel® J3355 Dual-Core Processor
RAM	4 GB
HD	SSD 64GB

3.1.2 Hardware interface



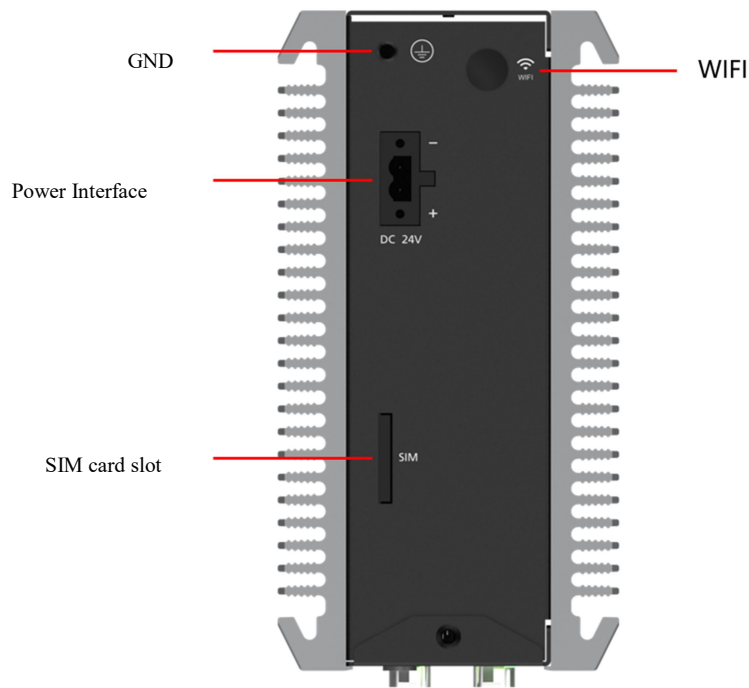


Figure 3-1 Controller Hardware Interface

Table 3-2 Hardware Interface Descriptions

Name	Function					
Power button	Startup and shutdown of the controller					
Power interface	DC 12-24V power supply, minimum current 3A					
	Note: There is no surge protection device inside the controller, a stable and reliable power supply or adapter must be used.					
	Recommended adapter/power supply specification:					
	Output power	Output voltage range	Load current range	Fluctuation and interference	Overvoltage protection	Overcurrent protection
	60W	DC 11.4V~24.0V	0~5A	Maximum 150mV	DC 30V	8.8A
System	Hard disk operation indicator light HDD					
indicator light	System operation indicator light PWR					
	RS485 data receiving and transmitting indicator lights Rx and Tx					
	RS232 data receiving and transmitting indicator lights Rx and Tx					
USB port	4 USB 3.0 ports					
HDMI interface	Maximum resolution 4096*2160@30Hz					
Ethernet port	Support ModbusTCP, TCP/IP					
EtherCAT port	Support all kinds of EtherCAT slaves					
RS232 port	9 Pin RS232 pinout (male)					
RS485 port	9 Pin RS485 pinout (male)					

3.1.3 Application environment specifications

Table 3-3 Application Environment Specifications

Environmental parameters	
Operating temperature	-20 ~ 60 °C
Storage temperature	-40 ~ 80 °C
Relative humidity	5 ~ 95%, no condensation
Protection class	IP20
Vibration during operation	5 ~ 500 Hz, 15 Grms, according to IEC60068-2-64
Impact during operation	20G (11ms duration, half-sine wave), according to IEC60068-2-27
Electromagnetic compatibility (EMC)	CE/FCC Class A certification
Safety certification	CCC certification

3.1.4 Software performance index specifications

Table 3-4 Software Performance

Item	Rule description					
Programming method	IEC 61131-3 programming language (LD, FBD, IL, ST, SFC, CFC)					
Program execution mode	Compilation					
User program storage space	20M Bytes					
Components and features	Item	Description	Number	Storage characteristics		
				Default	Attributes can be changed	Remarks
	I	Input relay	64KWords	Not save	No	X: 1-bit B: 8-bit W: 16-bit D: 32-bit L: 64-bit
	Q	Output relay	64KWords	Not save	No	
	M	Auxiliary relay	240KWords	Save	Yes	
	SM	Special marking	10000bits	Save	Special use	Special marking
	SD	Special register	10000Words	Save	Special use	Special register

3.1.5 External dimensions

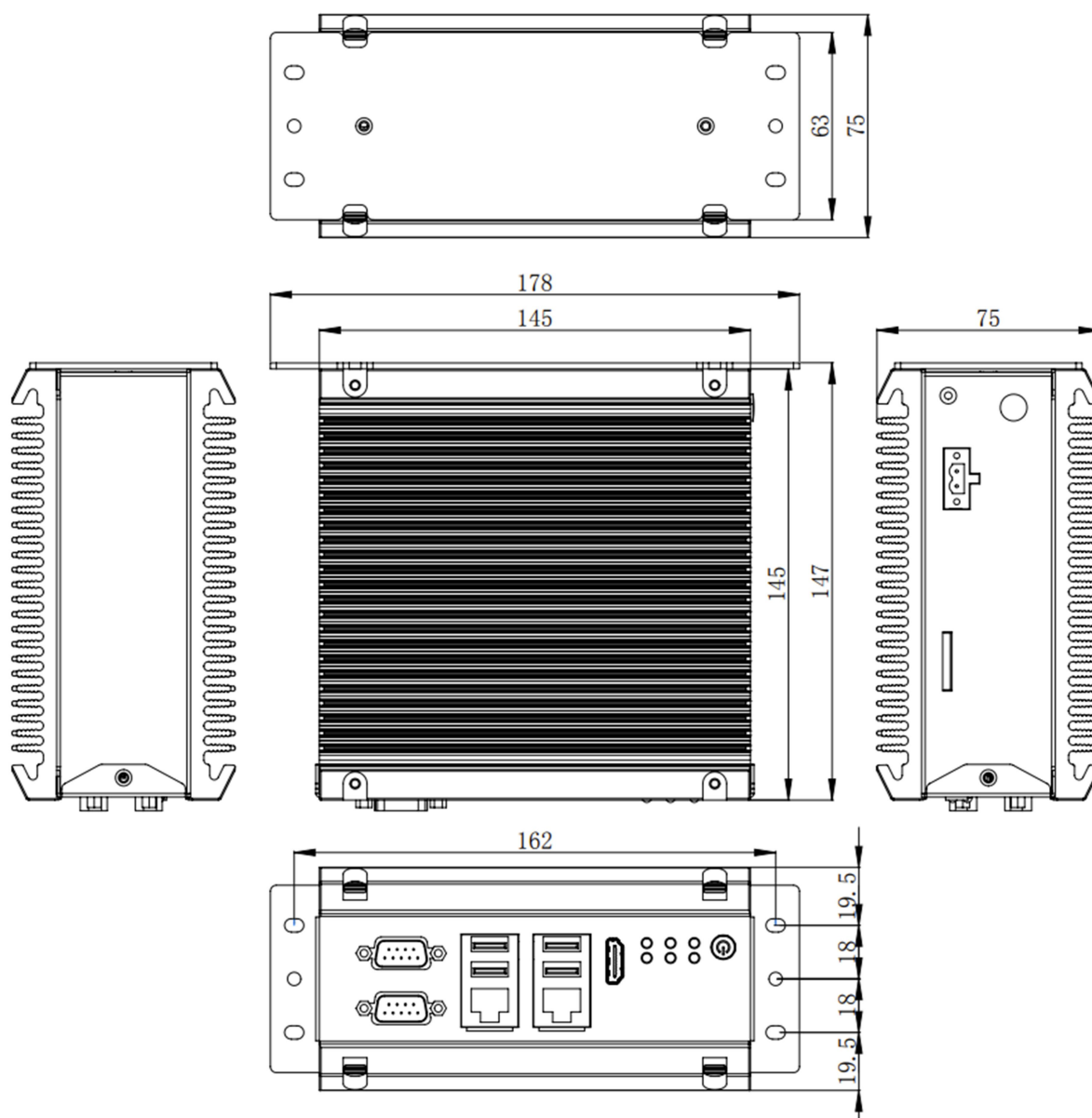
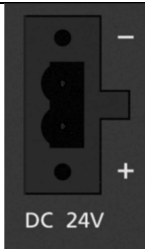


Figure 3-2 Controller Dimensions

3.2 Hardware interface details

3.2.1 Power supply interface

Table 3-5 Power Supply Specifications

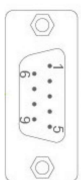
	DC	12~24V, minimum working current 3A
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3.2.2 RS232 interface

Table 3-6 RS232 Settings

	Controller port	COM2
	Baud rate	9600-115200
	Data bit	8
	Check bit	None
	Stop bit	1

Table 3-7 RS232 Pin Definitions

	Pin	Signal name	Function
	2	RXD	RS232 data receiving
	3	TXD	RS232 data transmitting
	5	GND	Power ground

3.2.3 RS485 interface

Table 3-8 RS485 Settings

	Controller port	COM1
	Baud rate	9600-115200
	Data bit	8
	Check bit	None
	Stop bit	1
	Supported protocols	No Protocol, Modbus RTU Slave, Modbus RTU Master

Table 3-9 RS485 Pin Definitions

	Pin	Signal name	Function
	1	RS485-	RS485 differential to negative signal
	2	RS485+	RS485 differential to positive signal
	5	GND	Power ground

For RS485 bus, it is recommended to use shielded twisted pair cable, and two 120Ω terminal matching resistors are connected at both ends of the bus to prevent signal reflection. The shielding layer generally uses single-point grounding.

- Multi-node connection

When there are many nodes, the 485 bus must be daisy-chained connection. When branch line connection is needed, the branch length from bus to node should be as short as possible, and it is recommended not to exceed 3m. Put an end to star connection. The common bus structure is shown below:

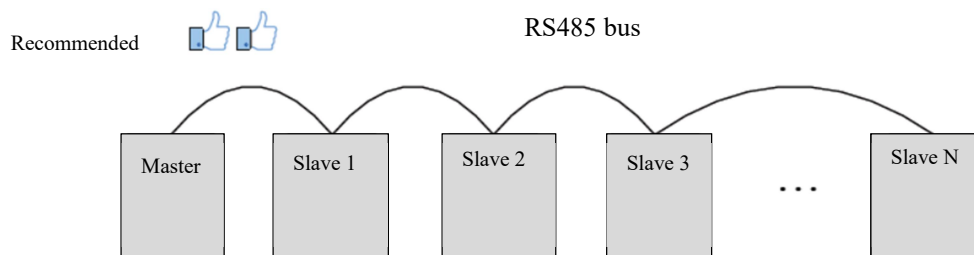


Figure 3-3 Daisy Chain Connection Structure

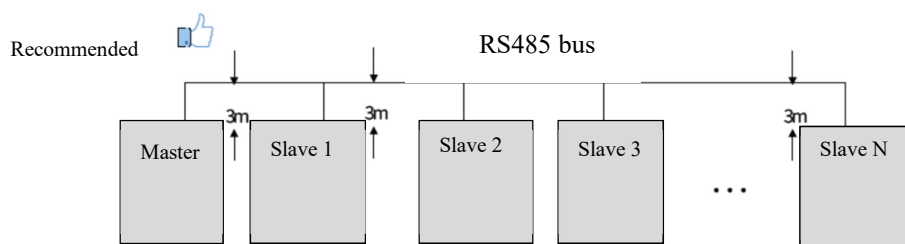


Figure 3-4 When branch line connection is used, the branch line is recommended not to exceed 3m

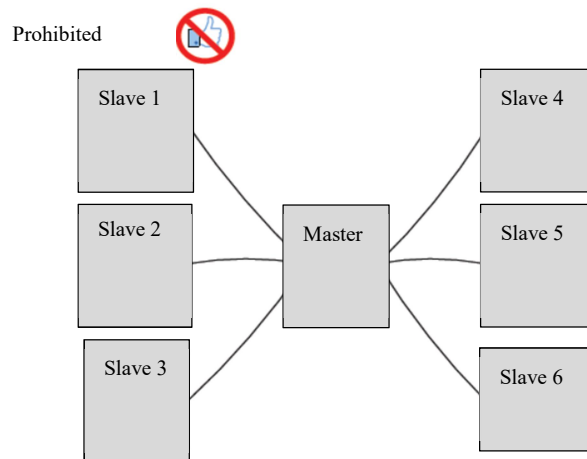


Figure 3-5 Incorrect Star Connection

- Terminal wiring

Check whether the field 485 bus contains three cables connected with 485+, 485- and CGND terminals, and ensure that the terminals are not connected backwards or wrongly. When a shielded cable is used, it is especially important to note that the shielding layer must also be connected to the CGND terminal. In any node or midway position, the shielding layer is forbidden to be connected to any other place (including the field casing and equipment grounding terminal, etc.) except the CGND of the node. Due to the attenuation of cables, it is recommended to use AGW26 or thicker cables for cables with connection length greater than 3m, and it is recommended to use twisted pair cables for 485+ and 485- connection cables at any time.

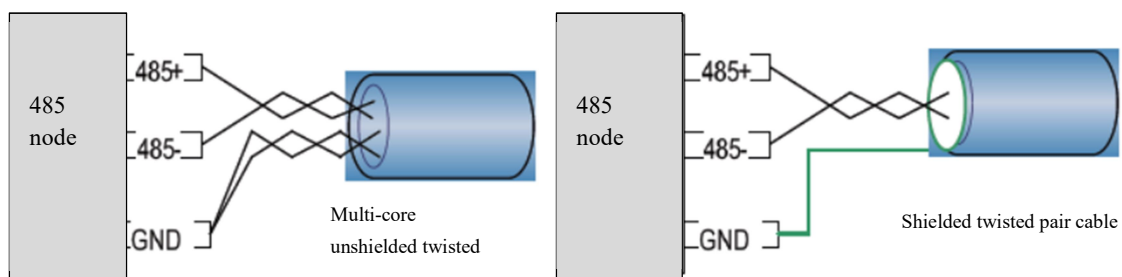


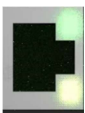
Figure 3-6 RS485 Communication Cable Terminal Wiring Diagram

Recommended wiring cable 1: Multi-core cable with twisted pair cables, in which one pair of twisted pair cables is used as the connecting wire of 485+ and 485-, and the other redundant cables are twisted together as the connecting wire of CGND.

Recommended wiring cable 2: Twisted pair cables with shielding layer. The twisted pair cables are used as the connecting wire of 485+ and 485-, and the shielding layer is used as the connecting wire of CGND. In the case of using shielded cables as connecting cables, it is especially important to note that the shielding layer can only be connected to CGND, but not to the site earth.

3.2.4 Ethernet port

Table 3-10 Ethernet Port

Network card name	Default IP	Supported protocols	LED
eth1 	90.0.0.1 Subnet mask: 255.255.255.0	TCP, UDP, Modbus TCP Slave	Connection: The green light is on Data communication: The yellow light flashes.

3.2.5 EtherCAT network port

Network card name	Default IP	Supported protocols	LED
eth2 	192.168.39.220	TCP, UDP, Modbus TCP Slave, EtherCAT	Connection: The green light is on Data communication: The yellow light flashes.

Table 3-11 EtherCAT Network Port

Note: This network port can also be used as a download and debugging port for CODESYS applications.

Table 3-12 EtherCAT Performance Index

Item	Description
Communication protocol	EtherCAT protocol
Supporting service	CoE (PDO/SDO)
Minimum synchronization period of 16-axis cam	1000us
Synchronization mode	Servo adopts distributed clock (DC); input and output synchronization for IO
Physical layer	1000BASE-TX
Baud rate	1000Mbit/s
Duplex mode	Full duplex
Topological mode	Ring topology
Transmission medium	Network cable
Transmission distance	Less than 100M between bright nodes
Number of slave stations	65535
EtherCAT frame length	44 bytes – 1498 bytes

Process data	A single Ethernet frame has a maximum of 1486 bytes.
Synchronization jitter of two slave stations	<1us
Refresh time	For 1000 switches input and output, it is about 30us(16 servos about 100us).

How to make network cable

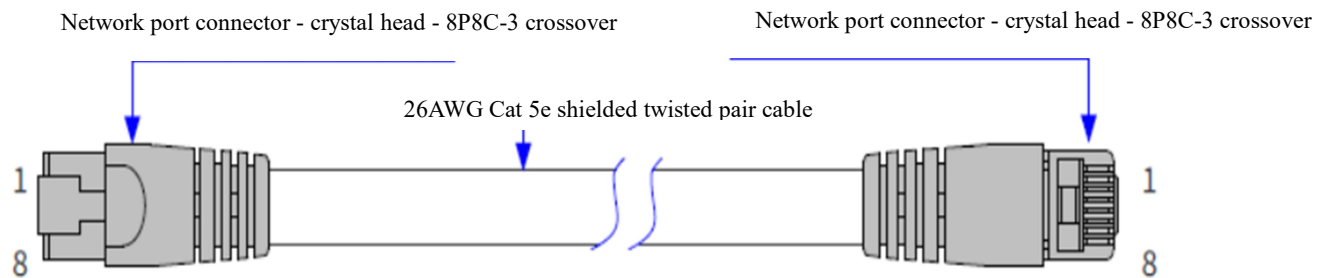


Figure 3-7 Requirements for Making EtherCat Network Cable

Pin	Signal	Signal direction	Signal description
1	TD+	Output	Data transmitting+
2	TD-	Output	Data transmitting-
3	RD+	Input	Data receiving+
4	--	--	No use
5	--	--	No use
6	RD-	Input	Data receiving-
7	--	--	No use
8	--	--	No use

Table 3-13 Signal Lead Distribution

Length requirements:

According to FastEthernet technology, when using EtherCAT bus, the length of cables between devices should not exceed 100 meters, which will attenuate signals and affect normal communication.

Technical requirements:

100% conductivity test; there is no short circuit, open circuit, dislocation and poor contact. The cable length is within the allowable tolerance range.

EtherCAT bus uses cables with shielding layer for network data transmission, and the specific specifications are shown in the following table:

Table 3-14 Specifications

Cable type	Elastic crossover cable, S-FTP, Cat 5e
Standards	EIA/TIA568A, EN50173, ISO/IEC11801 EIA/TI Abulletin TSB, EIA/TIA SB40-A&TSB36
Cable section	AWG26
Cable type	Twisted pair cables
Pairs	4

3.2.6 LED status indicator light

Table 3-15 Meaning of LED indicator light

Indicator light name	Colour	Status	Function
RUN	Green	Flashing	Data writing
SYS	Green	Normally on	The controller is running
RS232 RX and TX	Green	Flashing	RS232 data receiving and transmitting
RS485 RX and TX	Green	Flashing	RS485 data receiving and transmitting

4. Configuring EtherCAT Servo

4.1 Installation

Install the xml description file of the servo.

Please refer to 1.2.2 Installing the Controller Description File for the method of installing the xml description file of the servo.

4.2 Adding EtherCAT Master

Right click and select Device (Servotronics-x86-Linux SM EtherCAT) in the device tree; select Add Device, select EtherCAT Master, and select Add Device.

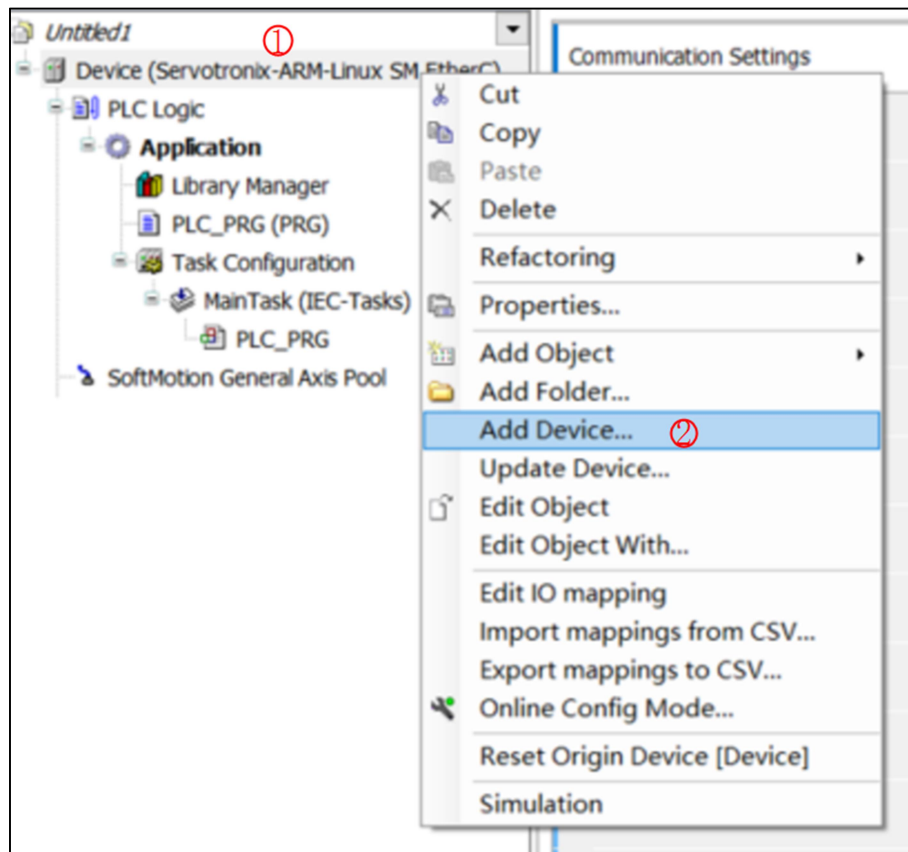


Figure 4-1 Adding EtherCAT Master (1)

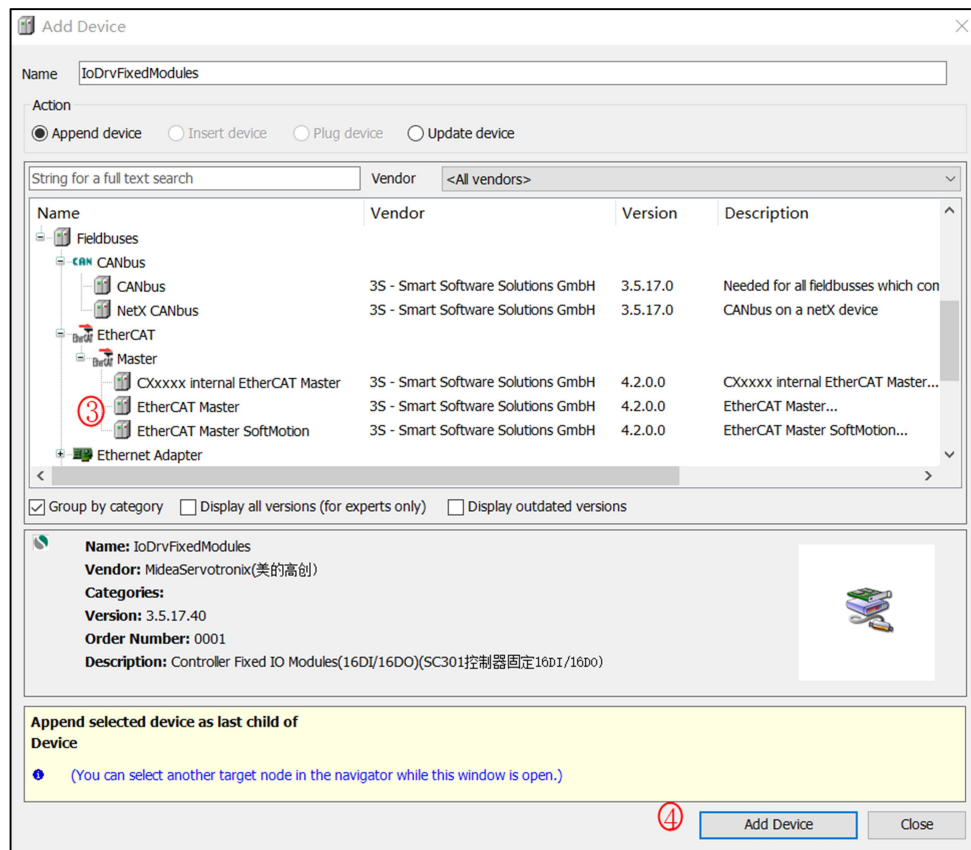


Figure 4-2 Adding EtherCAT Master (2)

4.3. Configuring EtherCAT Master

Double click the EtherCAT Master in the device tree. In the General options, select Select network by name, and Network name, and fill in eth2. eth2 is the EtherCAT network port for connecting EtherCAT devices. Set the EtherCAT bus cycle. Bus cycle: MC804 controller supports various scanning cycles. Users can choose the appropriate bus cycle according to the number of connected slaves.

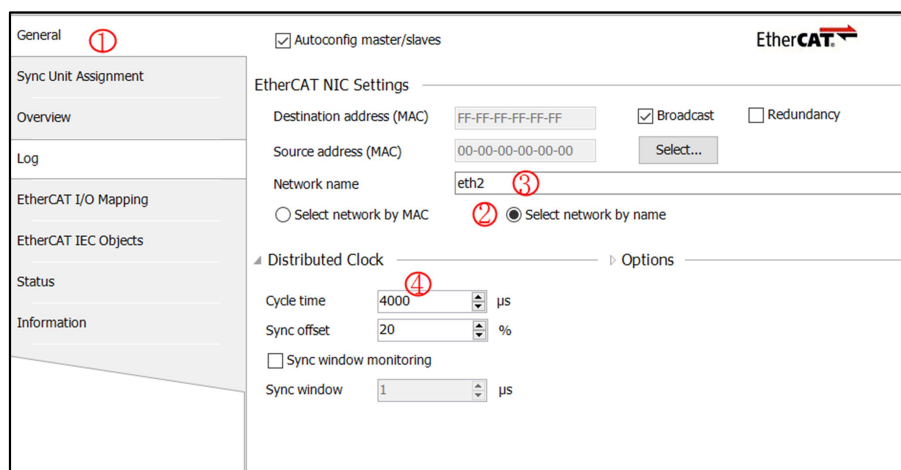


Figure 4-3 Configuring EtherCAT Network Port

4.4 Scanning devices

Before scanning devices, you need to log in the software first, then right click EtherCAT Master in the device tree, and select Scan for Devices.

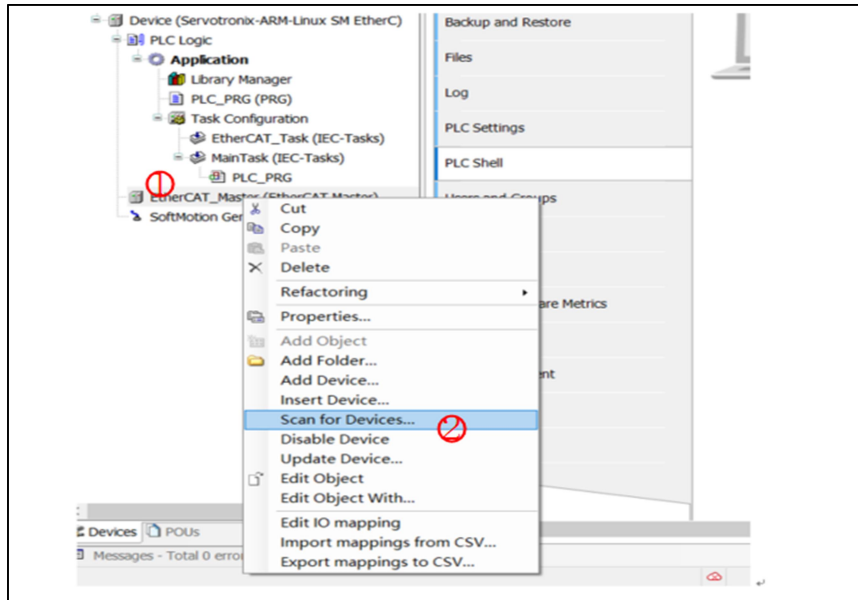


Figure 4-4 Automatic Scanning

In the pop-up interface, select all modules. Click Copy All Devices to Project, and the corresponding modules will appear under EtherCAT Master after adding successfully.

4.5 Adding 402 Axis

Right click the servo, then Add SoftMotion CiA402 Axis

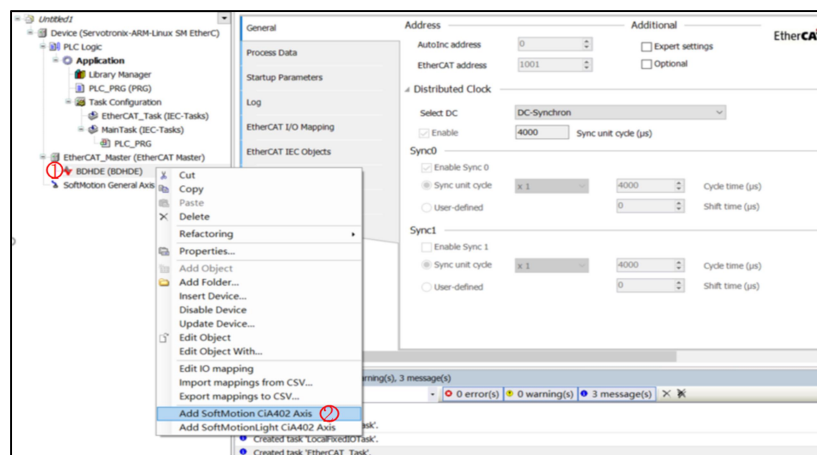


Figure 4-5 Adding 402 Axis

4.6 Configuring axis parameters

Configure the motor resolution according to the actual motor parameters, and configure the reduction ratio according to the actual needs.

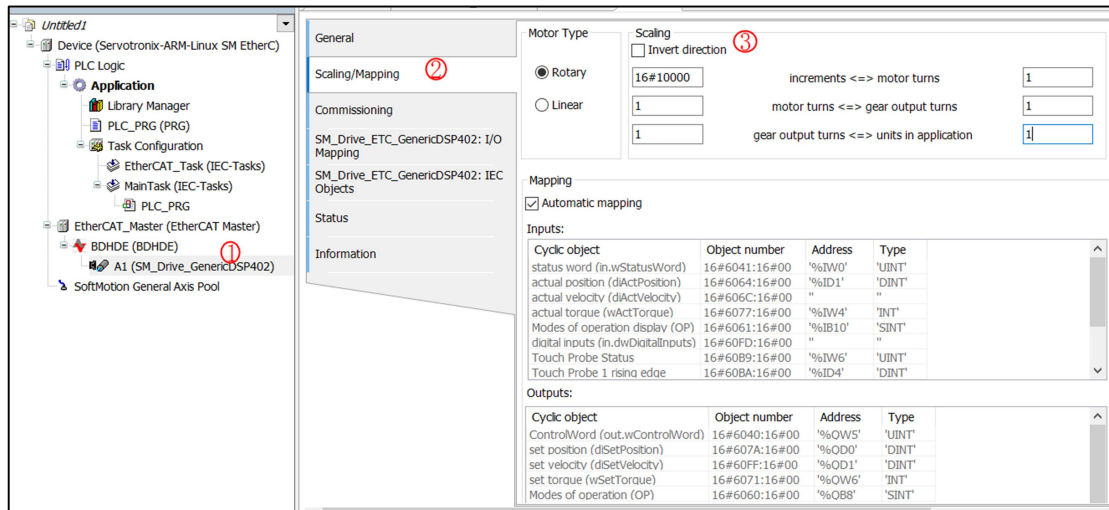


Figure 4-6 Configuring 402 Axis



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