



softMC Compact 301

控制器软件用户手册

Controller Software User Manual
Revision V1.0

Revision History

Document Revision	Date	Remarks
1.0	March 2023	Initial release.

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Customer Service

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For all other inquiries regarding SC301 motion controller or other Servotronics products, contact: m.servotronics.com.cn

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

-  **Danger** means that if you don't follow the fixed principles, it will lead to death or serious physical injury.
-  **Warning** means that if you don't follow the fixed principles, it may lead to death or serious physical injury.
-  **Caution** 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	
 Danger	 Only professionals who have been trained in electrical equipment and have electrical knowledge can operate this equipment. Operation by non-professionals is strictly prohibited!
 Warning	 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 SC301 Overview

2.1.1 Product Overview

The SC301 motion controller from Midea SERVOTRONIX provides users with intelligent automation solutions. The SC301 adopts IEC61131-3 programming language system and supports PLCopen programming language. SC301 is built in 16 DI and 16 DO digital interfaces. Its expandable structure supports 16 local ET series IO modules through the internal bus protocol; besides, other devices can be connected through various industrial field buses such as EtherCAT and CANopen. 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 CAN, RS485, Ethernet, USB and other communication functions. SC301 supports 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 Side View of SC301 Motion Controller + ET Series IO Module



Figure 2-2 Front View of SC301 Motion Controller + ET Series IO Module

2.1.2 Controller Features

- 1) A variety of motion control, such as point-to-point motion, gear, linear interpolation, electronic cam;
- 2) Support up to 10000+ I/Os;

- 3) Adequate program capacity and data storage area;
- 4) Fast instruction execution;
- 5) Support more high-end field buses (EtherCAT, CANopen, EtherNet, OPC-UA);
- 6) Reliable and easy-to-use software, meeting the needs of different users;
- 7) Support online debugging mode;
- 8) Support online editing mode.

2.1.3 Software Functional Characteristics

Table 2-1 SC301 Software Functional Characteristics

Product model	Local extension IO module	Program storage space	Data storage space	Storage size of power down data	Number of motion control axes	Local fixed IO type	CODESYS authorization statement
SC-E8-301-0 101	16	10M	20M	256KB	16	Sink	PLC
SC-E8-301-0 102	16	10M	20M	256KB	16	Sink	PLC+WebVisu
SC-E8-301-0 103	16	10M	20M	256KB	16	Sink	Softmotion
SC-E8-301-0 104	16	10M	20M	256KB	16	Sink	Softmotion+WebVisu
SC-E8-301-0 105	16	10M	20M	256KB	16	Sink	CNC+Robotics

2.1.4 Document Attachments

ET Series _EtherCAT Coupler User Manual V1.1

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.

CODESYS provides the following configuration functions:

- 1) I/O module configuration;
- 2) EtherCAT bus configuration;
- 3) CANopen bus configuration;
- 4) OPC-UA configuration.

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.

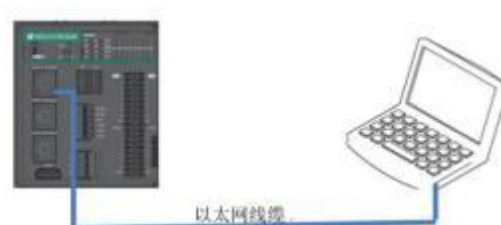


Figure 2-3 Controller and PC Connected via Network Cable

When downloading CODESYS application using PORT1 EtherNet port, please modify the IP of the computer network port, which must be located in the same network segment as the controller IP. For example, the default IP address of controller PORT1 is 90.0.0.1; the subnet mask is 255.255.255.0, and the IP of PC needs to be changed to 90.0.0.XX (XX cannot be 1, i.e. it cannot be the IP address of the controller).



Figure 2-4 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. 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.

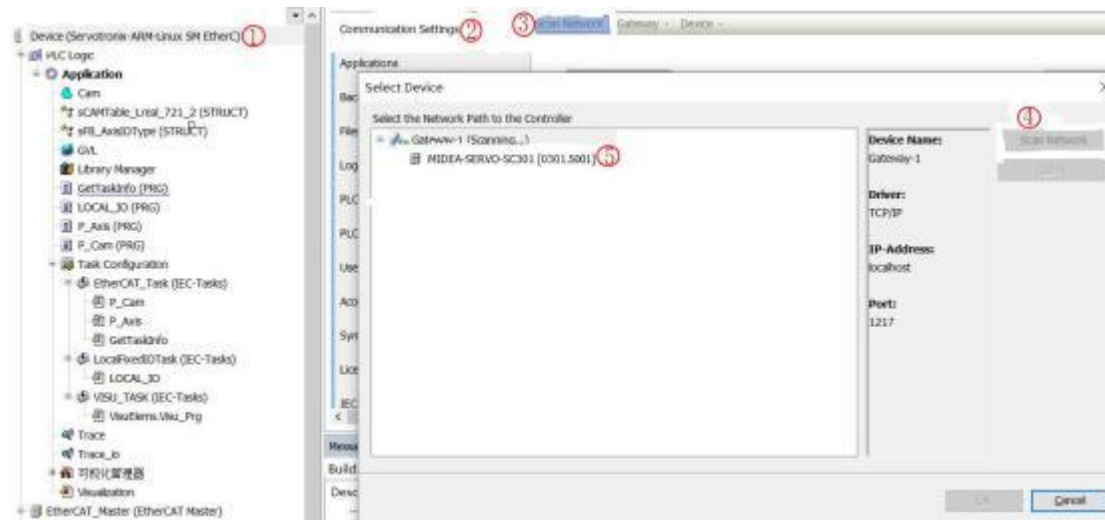


Figure 2--5 CODESYS Online Scanning Controller

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. CODESYS official website: <https://store.codesys.com/codesys.html#product.attributes.wrapper>; or you can contact the sales staff of Midea SERVOTRONIX to obtain it.

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

Preparation before installation:

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.

Installation:

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 Hardware Parameters

3.1 Hardware Parameter Specification

3.1.1 Hardware Interface Overview

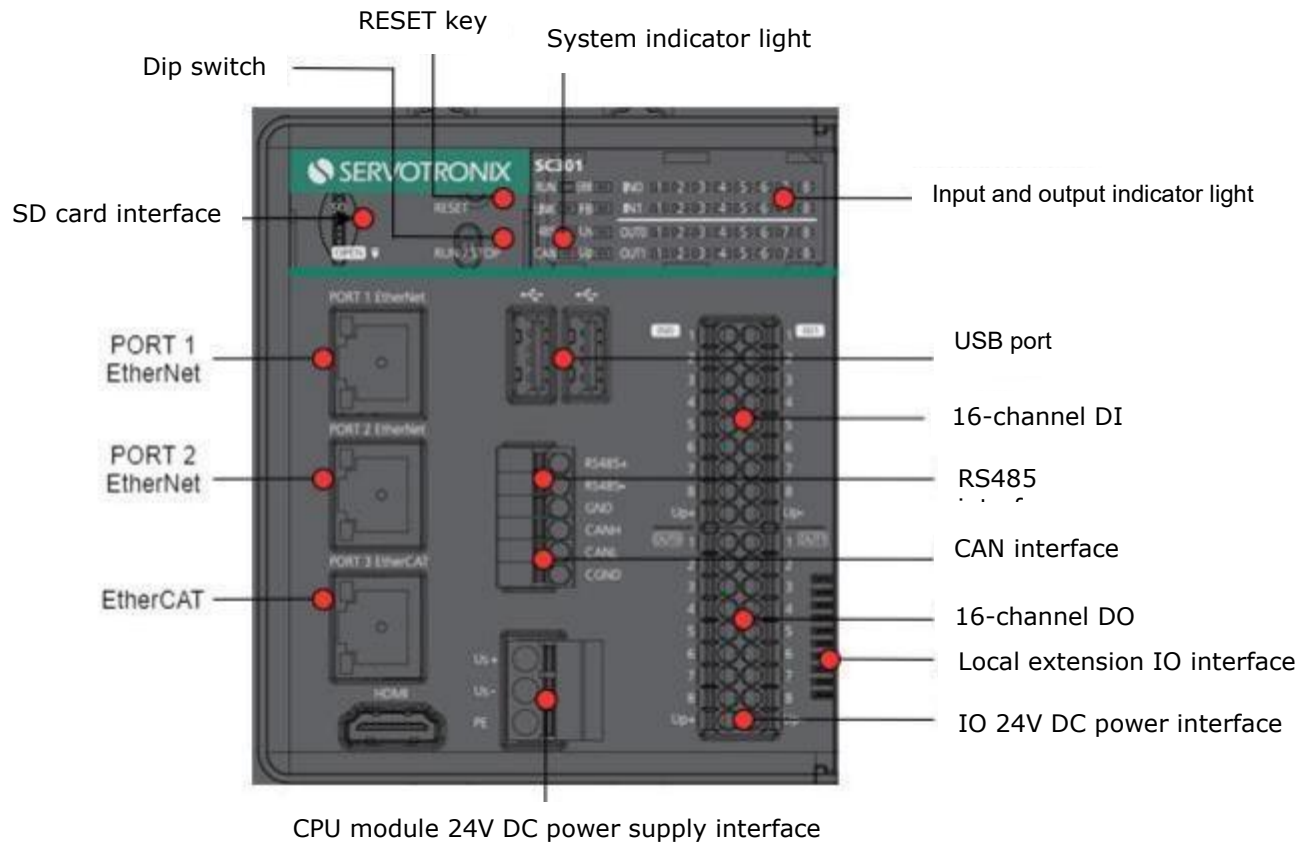


Figure 3-1 SC301 Controller Hardware Interface

Table 3-1 SC301 Hardware Interface Descriptions

Name	Function
SD card interface	Used to burn/store user CODESYS application program in factory system
Dip switch	Control the start and stop of CODESYS application
RESET button	Reset the default IP/delete CODESYS application
System indicator light	Running indicator light RUN
	Error indicator light ERR
	Extension IO module indicator light LINK
	EtherCAT bus indicator light FB
	Modbus RTU indicator light 485
	Power indicator Us
	IO Power indicator Up
	CANopen indicator light CAN
I/O indicator light	Local 16-channel DI DO indicator light; if the input and output are valid, the light will be on, otherwise it will be off.
USB port	For USB drive
16-channel DI	Local 16-channel DI terminal
RS485 interface	RS485 interface, supporting Modbus protocol
CAN interface	CANopen protocol
16-channel DO	Local 16-channel DO terminal
Local extension IO interface	Up to 16 IO modules can be expanded. The actual number and configuration are limited by the power consumption of each module. Hot swapping is not supported.
IO 24V DC power interface	24V DC voltage input
24V DC power supply interface of CPU module	24V DC voltage input
PORT1 EtherNET	PC communication/program download and debugging (IPv4 only).
PORT2 EtherNET	Standard Ethernet function/Modbus-TCP protocol /OPC-UA/User program download and debugging (IPv4 only).
EtherCAT	EtherCAT protocol

3.1.2 Application Environment Specifications

Table 3-2 Application Environment Specifications

	Parameter type	Operating environment	Transportation environment	Storage environment	
Environmental parameters (IEC60721-3)	Environmental Class	IE33	IE33	IE33	
	Temperature	-20-55℃	-40-85℃	-40-85℃	
	Humidity		10-95%, no condensation		
	Vibration	Frequency	5- 150Hz	2M2	1M2
		Displacement	3.5mm (direct installation) (< 9Hz)		
		Acceleration	1g (direct installation) (>9Hz)		
		Direction	3 axial directions		
	Impact (collision)		15 g, 11 ms, half sine wave, 3 axial directions		
Altitude/Pressure		0-2000m	0-3000m (>70kPa)		

3.1.3 Software Performance Index Specifications

Table 3-3 SC301 Basic Specifications

Item	Rule description					
Programming mode	IEC 61131-3 programming language (LD, FBD, IL, ST, SFC, CFC)					
Program execution mode	Compilation					
User program storage space	20M Bytes					
Power down holding data capacity	256K Bytes					
SD card storage capacity	8G					
Components and features	Components	Description	Number	Storage characteristics		
				Default	Attributes can be changed	Reference
	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	10000 Words	Save	Special use	Special register
Program power down mode	EMMC holding (if power down occurs when the power-on time is less than 30s, the power down holding will not be performed.)					

3.1.4 External Dimensions

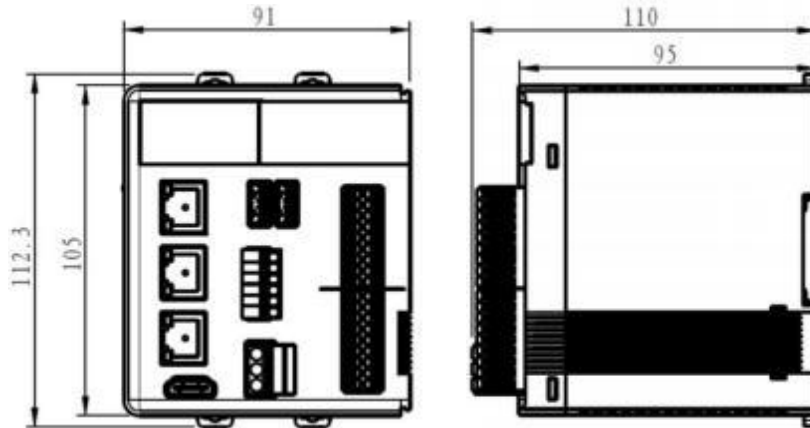


Figure 3-2 SC301 External Dimensions

3.2 Hardware Interface Details

3.2.1 Local Fixed 16 DI

Table 3-4 Basic Specifications

Item	Production specifications
Input channel	16
Input connection method	18-point terminal
Input type	Digital input
Input mode	Sink
Input voltage level	24V DC (up to 28.8V)
Internal 5V power consumption	55 mA (typical)
Input current (typical)	5.3mA
ON voltage	>15V DC
OFF voltage	< 5V DC
Port filter time	10ms
Input impedance	4.3k ohms
Input signal form	Voltage DC input form, supporting source input
Isolation mode	Optocoupler isolation
Input display	When the input is in the driving state, the input indicator light is on

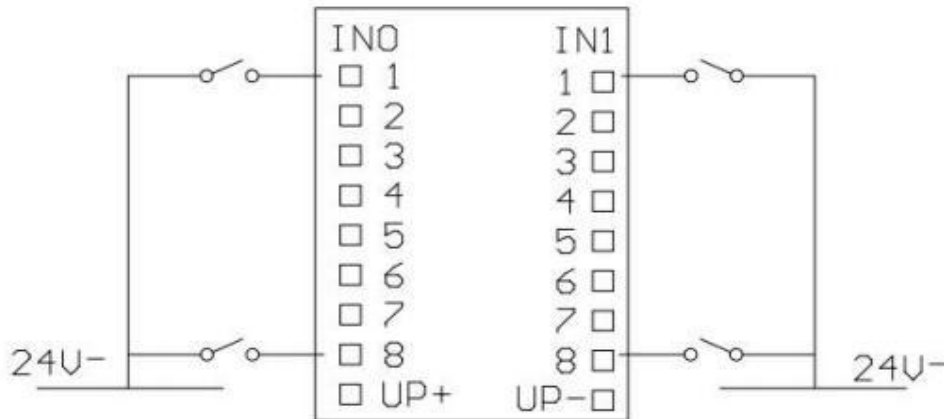


Figure 3-3 Wiring

3.2.2 Local Fixed 16 DO

Table 3-5 Basic Specifications

Item		Production specifications
Output channel		16
Output connection method		18-point terminal
Output type		Transistor, low-end output
Output mode		Sink
Voltage		24V DC(- 15%~+20%)
Output voltage level		12V~24V DC(- 15%~+20%)
Internal 5V power consumption		85mA (typical)
Maximum leakage current at OFF		Below 0.5 mA
ON response time		Below 0.5 ms (hardware response time)
Response time at OFF		Below 0.5 ms (hardware response time)
Maximum load	Resistance load	0.5A/point; 2A/common terminal
	Inductive load	12W/24V DC (in total)
	Lamp load	2W/24V DC (in total)
Isolation mode		Optocoupler isolation
Output display		When the optocoupler is in the driving state, the input indicator light is on
Preventing short-circuit output		Restore short circuit protection

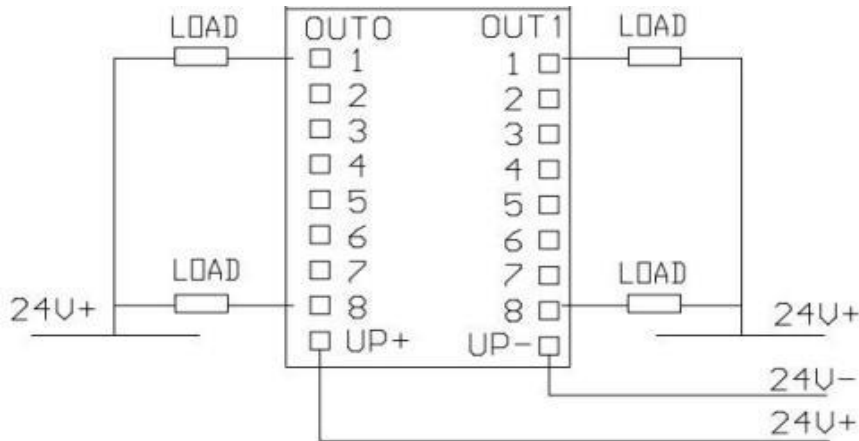


Figure 3-4 Wiring

3.2.3 CAN

Table 3-6 CAN Support Protocol

	NetWork	1
	Baud rate	100/125/250/500/800/1000Kbps
	Supported protocols	CANopen Master

USB 2.0 interface pin definition

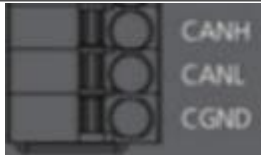
	Pin	Signal name	Function
	CANH	CANH	CAN_H
	CANL	CANL	CAN_L
	CGND	CGND	Grounded
Internal circuit: 120Ω terminal resistance			

Table 3-7 CAN Interface Definition

CAN bus connection topology is as follows. For CAN 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. When fixing cables, don't tie them together with AC power lines and high-voltage cables, so as to avoid interference of communication signals.

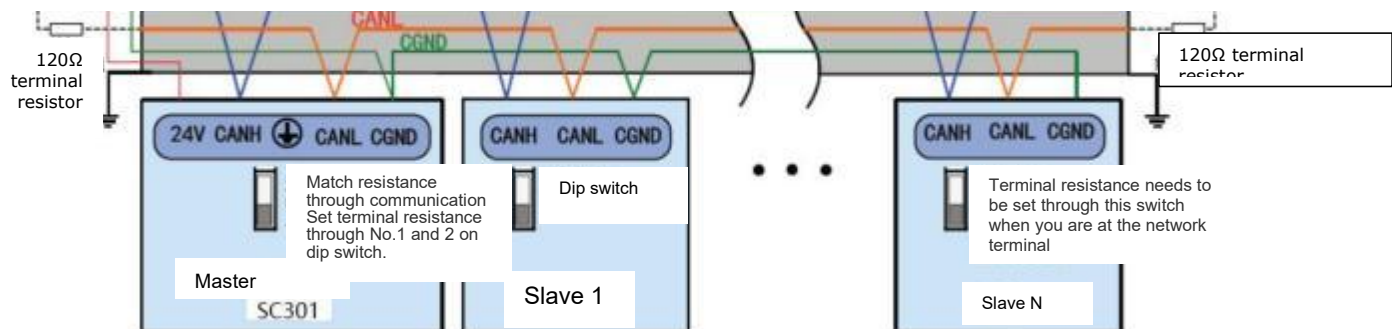


Figure 3-5 CAN Wiring

The relationship between CANopen transmission rate and transmission distance is shown in the following table:

Table 3-8 Relationship between CAN Baud Rate and Distance

Baud rate (bit/s)	Maximum length of bus (m)
1M	30
500k	80
250k	150
125k	300
50k	1000

3.2.4 RS485

Table 3-9 485 Support Protocol

	Port	COM4
	Baud rate	9600- 115200
	Data bit	8
	Check bit	None
	Stop bit	1
	Supported protocols	Free protocol, Modbus RTU Slave, Modbus RTU Master

Table 3-10 RS485 Interface Definition

USB 2.0 interface pin definition

	Pin	Signal name	Function
	RS485+	A	RS485 differential to positive signal
	RS485-	B	RS485 differential to negative signal
	GND	GND	Power ground
Internal circuit: 120Ω terminal resistance			

RS485 bus connection topology is as follows. 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.

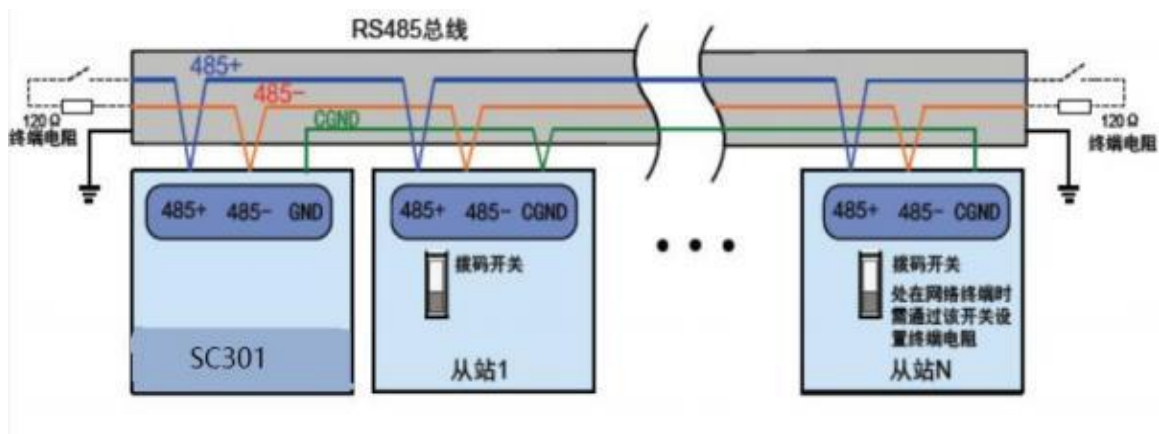


Figure 3-6 RS485 Communication Connection Diagram

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:

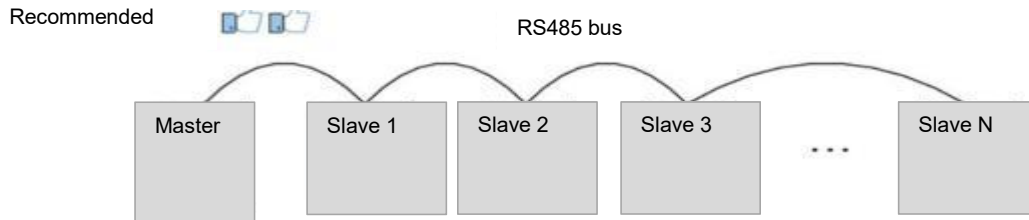


Figure 3-7 Daisy Chain Connection Structure

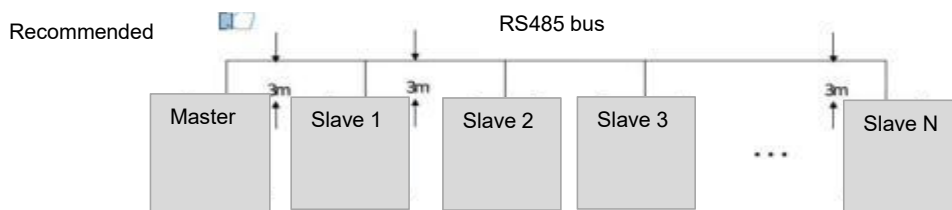


Figure 3-8 When branch line connection is used, the branch line is recommended not to exceed 3m

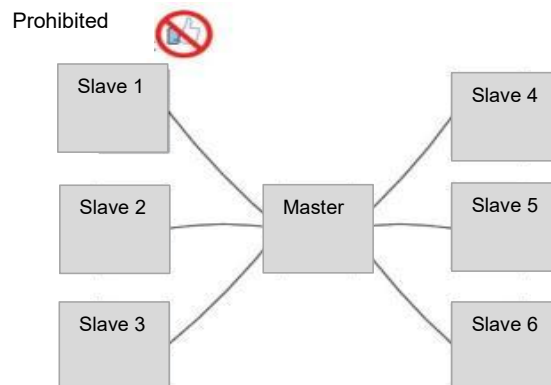


Figure 3-9 Incorrect Star Connection

Terminal wiring

(1) Nodes with CGND wiring point at the port

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.

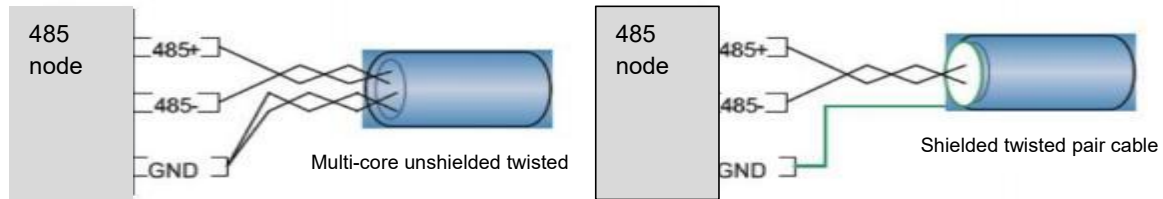


Figure 3-10 RS485 Communication Cable Terminal Wiring Diagram

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.

3.2.5 24V DC Power Supply

Table 3-11 DC24V Interface Definition

DC24V interface pin definition			
	Pin	Signal name	Function
	Us+	24 DC positive	Power supply positive
	Us-	24 DC negative	Power supply negative
	PE	GND	Grounded

3.2.6 USB

Table 3-12 USB interface definition

USB 2.0 interface pin definition			
	Pin	Signal name	Function
	1	VCC	Power supply
	2	DATA-	USB 2.0 differential data signal
	3	DATA+	
	4	GND	Power ground

SC301 provides 2 USB ports, both of which support plug-and-play and hot swapping functions; both of them conform to USB 2.0 standard and USB EHCI, Rev.2.0 standard.

3.2.7 EtherCAT

Table 3-13 EtherCAT Network Port Definition

Network card name	Default IP	Supported protocols	LED
eth2	192.168.39.220	TCP, UDP, OPC UA Server, WebVisu Server, Modbus TCP Slave, EtherCAT	Connecting: yellow light is on. Data communication: The yellow light flashes. MByte: Green light is on Gigabit: Red light is on

Table 3-14 Specific EtherCAT Performance Index

Item	Description
Communication protocol	EtherCAT protocol
Supporting service	CoE (PDO/SDO)
Minimum synchronization period of 6-axis cam	2000us
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	Input and output of 1000 switches: about 30 us (100us for about 32 servos)



Wiring

How to make network cable

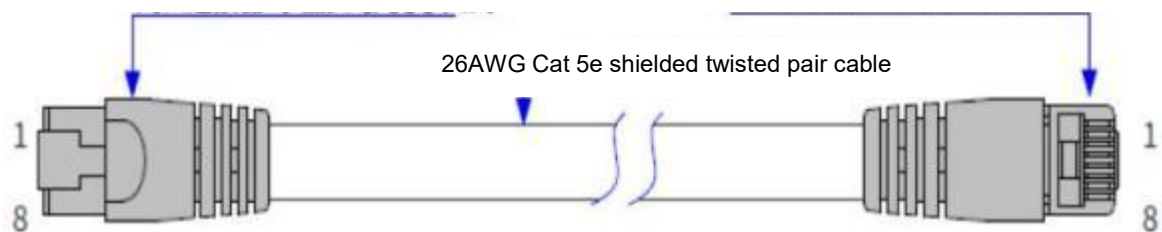


Figure 3-11 Requirements for Making EtherCat Network Cable

Table 3-15 Signal Lead Distribution

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

Length requirements

According to Fast Ethernet 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 3-16 Specifications

Item	Specification
Cable type	Elastic crossover cable
Standards	EIA/TIA568A, EN50173, ISO//EC11801, EIA/TIAbulletin TSB, EIA/TIA SB40-A&TSB36
Conductor section	AWG26
Conductor type	Twisted pair
wire pair	4

3.2.8 SD

Table 3-17 SD Interface

Use	Use description	Operation description	Remarks
1	SD storage	When the system is started from EMMC, SD can be used as general storage, and CODESYS applications are also stored in SD card. If the CODESYS program crashes abnormally, and the device can't be scanned online, you can pull out the SD, and plug it in the PC to manually delete the application files inside; and then plug in the SD.	

3.2.9 RESET

Table 3-18 RESET Interface

Use	Use description	Operation description	Remarks
1	Restore default IP	When the linux system starts normally (the system will start completely for about 20s), short press the RESET key for 5s to restore the IP address. Procedures: Under normal operation, short press the RESET key for 5s, and the red light 1Hz of RUN flashes 5 times; then release the RESET key and the default IP address of the controller will be restored. It will take effect after power-on again. Note: Pay attention to avoid the RESET key jitter or unexpected power-off operation during operation.	Check the factory default IP
2	Normal deletion program	When the CODESYS starts normally, long press RESET key for about 10s to delete the CODESYS application. Procedures: Under normal operation, long press the RESET key for about 10s and the red light 0.5Hz of RUN flashes 5 times; then release the RESET key and the CODESYS application in the controller will be deleted. Note: Pay attention to avoid the RESET key jitter or unexpected power-off operation during operation.	If the application causes the runtime to crash, this function may fail.
3	Force deletion Program	Before CODESYS starts normally, long press the RESET key until the green light of RUN flashes, and the CODESYS application will be deleted. Procedures: After the controller is powered on for about 5s, long press the RESET key until the red light 0.5Hz of RUN flashes 5 times; then release the RESET key and the CODESYS application in the controller will be deleted. Note: Pay attention to avoid the RESET key jitter or unexpected power-off operation during operation.	If you encounter a serious CODESYS program error and the runtime crashes, try this method.

Note:

Press and hold the RESET key for a long time until the timing begins. If you release, repeat the operation.

3.2.9 RUN/STOP

Table 3-19 RUN/STOP Interface

Direction	Use	Remarks
STOP (down)	CODESYS stopping	Equivalent to the STOP function in CODESYS IDE; if the hardware has been in Stop, you can also click Start to start running under IDE online mode.
RUN (up)	CODESYS running	Equivalent to the Run function in CODESYS IDE; if the hardware has been in RUN, you can also click Stop to stop running under IDE online mode, or debug in separate step

Note: If you turn the RUN/STOP switch for one or more times and then log in to the CODESYS to change the application download, the CODESYS IDE Start/Stop key shall prevail.

Note: If you log in to the CODESYS online and click Start in the IDE, it is still in the STOP state, please check

whether the hardware dip switch is in the STOP state.

3.2.10 LED Status Indicator Light

Table 3-20 LED Status Indicator Light

Indicator light name	Colour	Status	Function	Remarks
RUN (2-color light)	Red	Normally on	(1) When the PLC stops, the red light of RUN is normally on	
			(2) Normally on when the data is saved during power down	
			(3) During system startup (hardware default control)	
		Flash 5 times at 1Hz	(1) When the system is started normally, short press Reset for about 5s and the light will flash for 5 times at 1Hz; then release the key and the default IP will be restored	
	Green	Flash 5 times at 0.5Hz	(1) When the system is started normally, long press Reset for about 10s and the light will flash for 5 times at 0.5Hz; then release the key and the CODESYS project will be deleted	
		OFF	PLC is running normally	
	Green	Normally on	Normal operation of PLC (normal operation of CODESYS application) Green light is normally on During system startup (hardware default control)	
		1Hz Flashing	There is no CODESYS application; PLC is not running, and the RUN green light flashes at 1Hz.	
		OFF	Linux system is not running or CODESYS starts abnormally; light off	
LINK	Green	Normally on	Local extension IO module works normally, and the green light is normally on.	
		OFF	Local extension IO module is abnormal; light off	
485	Green	Normally on	When the modbus rt u slave/master is in normal data communication, the green light is normally on; when there is no data communication, the light is off	
		OFF	No data communication in Modbus rt u slave/master; light off	
CAN	Green	Normally on	CAN is running normally, and the green light is normally on.	
		OFF	CAN runs abnormally; light off	
ERR	Red	Normally on	PLC CODESYS fault; PLC stops running; normally on	
		OFF	PLC is running normally, no fault, light off	
FB	Green	Normally on	EtherCAT bus indicator light: Normal - normally on	
		1Hz Flashing	Ethercat bus indicator light: abnormal - 1Hz flashing (such as unplug the network cable)	
Us	Green		CPU module power indicator light	
Up	Green		Local IO power indicator light	

3.2.11 PORT1 EtherNET

Table 3-21 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	Connecting: yellow light is on. Data communication: Green light flashes

Note:

When downloading an application project as CODESYS, the downloading speed may +be slow due to the large CODESYS application project.

3.2.12 PORT2 EtherNET

Table 3-22 Ethernet Port

Network card name	Default IP	Supported protocols	LED
eth0	192.168.0.1	TCP, UDP, OPC UA Server, WebVisu Server, Modbus TCP Slave	Connecting: yellow light is on. Data communication: The yellow light flashes. MByte: Green light is on Gigabit: Red light is on

Note:

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

3.2.13 RTC Clock

Hardware supports RTC power down saving, and the service life of button cell is 3 years. If it needs to be replaced, please change the battery by yourself. Pull out the left shell of the controller and pull out the battery for replacement, as shown below.



Figure 3-11 Installation Position of Button Cell

3.2.14 Support Power Down Data Holding

Hardware supports accidental power down data holding, with a maximum data volume of 256KB, without external UPS power supply.

4. Local Fixed I/O Configuration

4.1 Installation Equipment Description

CODESYS software installation device description file IoDrvSub ModulesFix.devdesc.xml:

- 1) Open the CODESYS software;
- 2) Select Tools->Device Repository;
- 3) Select install and select the file IoDrvSub ModulesFix.devdesc.xml for installation. If it is installed successfully, it will display Device "IoDrvFixed Modules" installed to device repository.

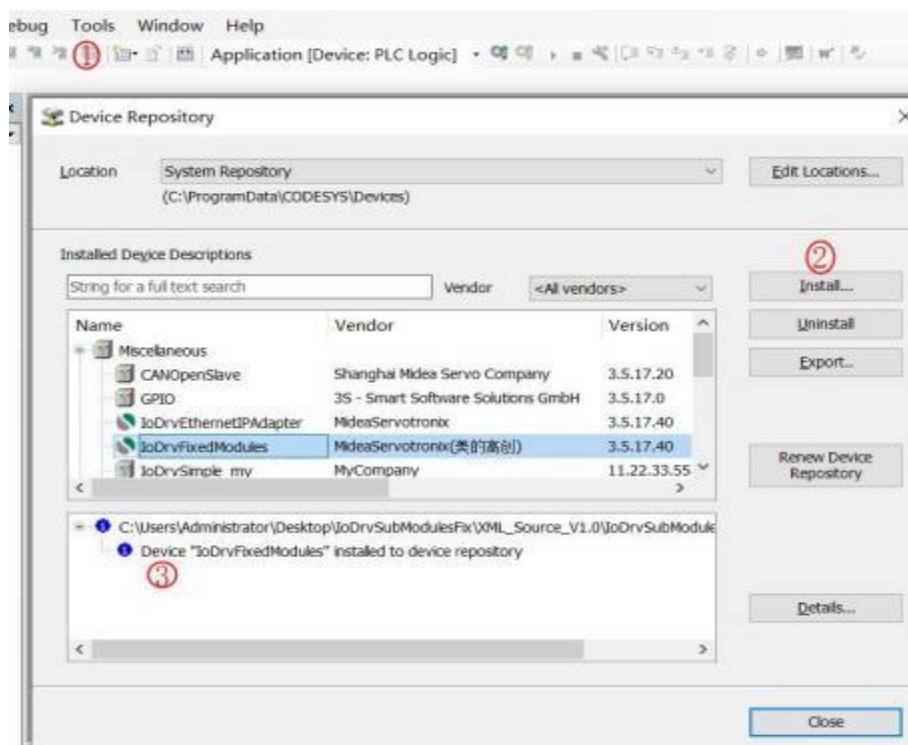


Figure 4-1 Installation of Local Fixed IO Device Description File

4.2 New Project and Configuration

4.2.1 Connecting CODESYS to the Controller

In CODESYS software, create a new application project using SC301 controller. Then double-click Device (Servotronics-ARM-Linux SM EtherCAT) in the device tree and the device window will popped up. Select "Scan Network" in the Communication Settings, and select the scanned controller; then click OK to establish the communication between the SC301 controller and the Codesys software;

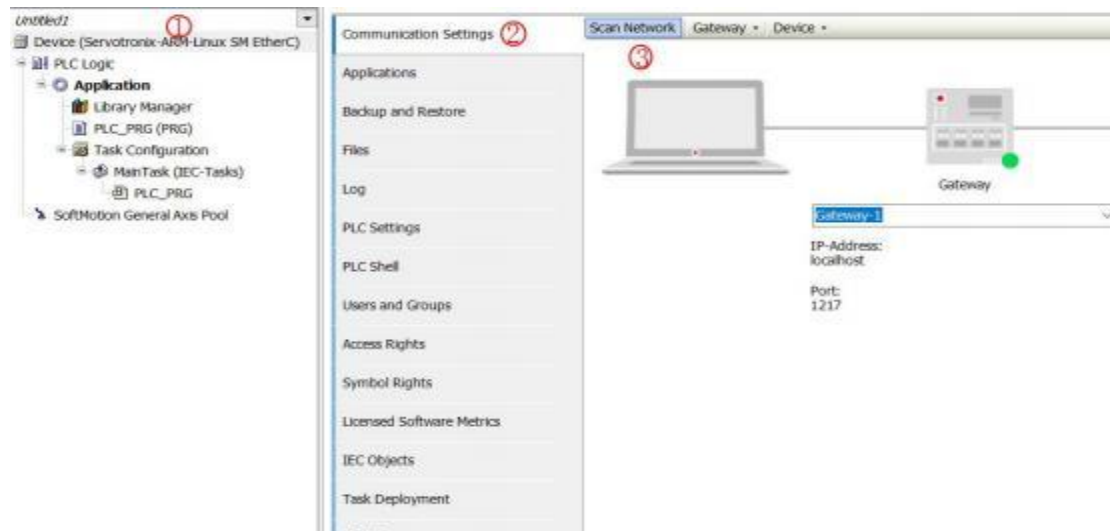


Figure 4-2 Online Scanning Controller

4.2.2 Adding IO Configuration

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

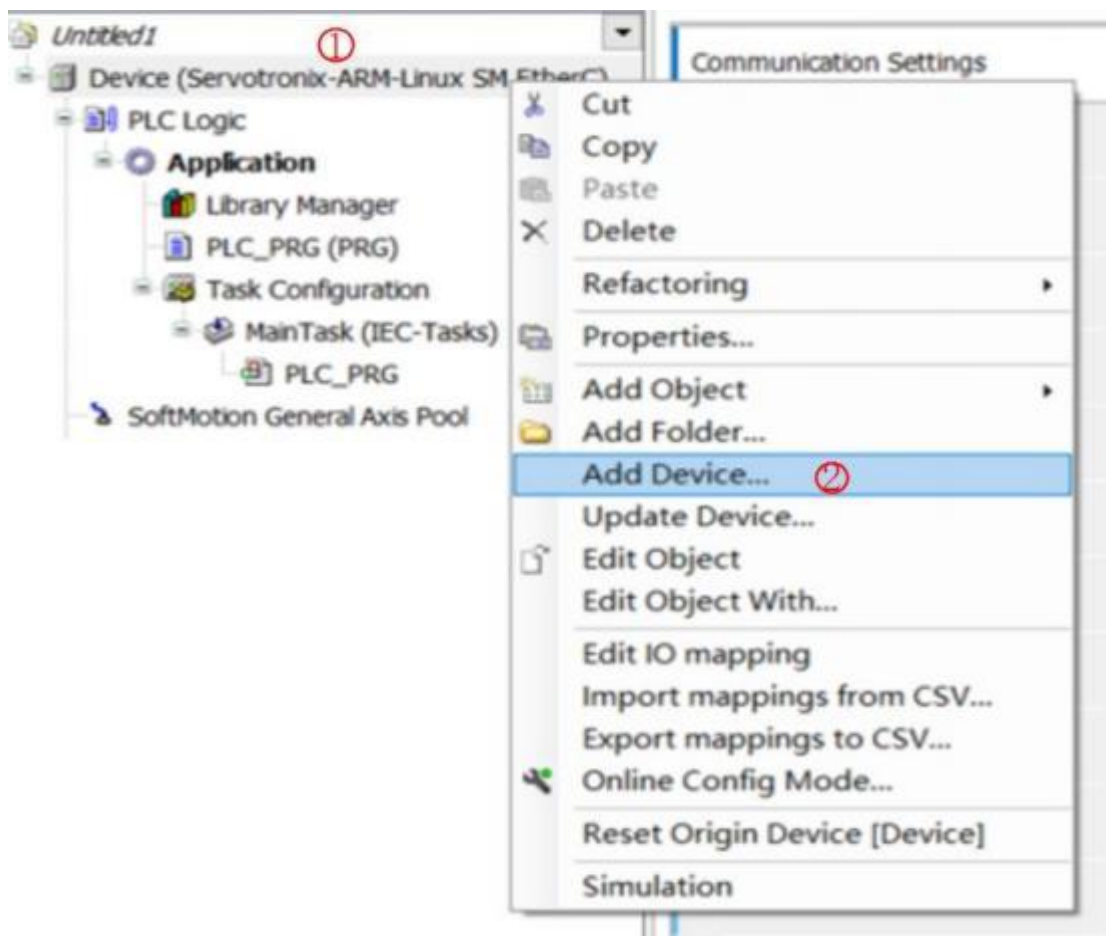


Figure 4-3 Adding IO Configuration Online (1)

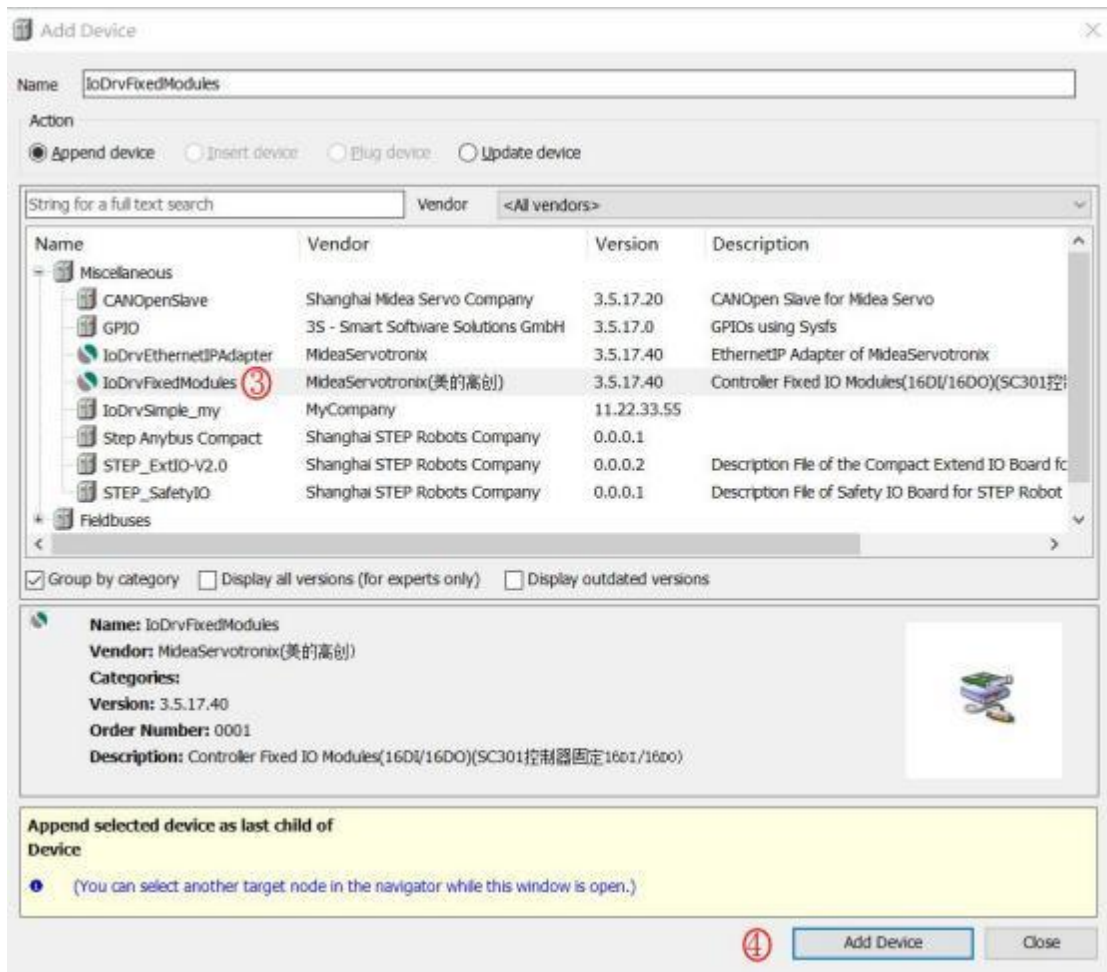


Figure 4-4 Adding IO Configuration Online (2)

4.3 Variable Binding

The added IO configuration is shown in Figure 4-5, where the 16DI _ module is DI and the 16DO _ Module is DO, and the IO channels can be bound with variables respectively, and then processed logically.

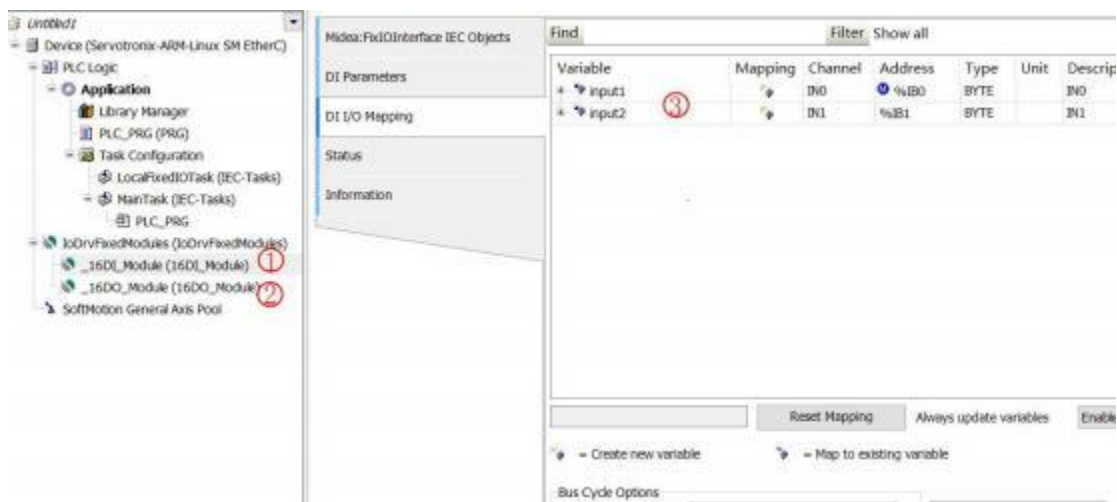


Figure 4-5 IO Configuration Variable Binding

5. Configuring EtherCAT Servo

5.1 Installation Equipment Description

Install the xml description file of the servo.

The steps of installing the xml description file of the servo are exactly the same as those of installing the xml description file of IO. Please refer to the installation of IO xml device description file

5.2 Adding EtherCAT Master

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

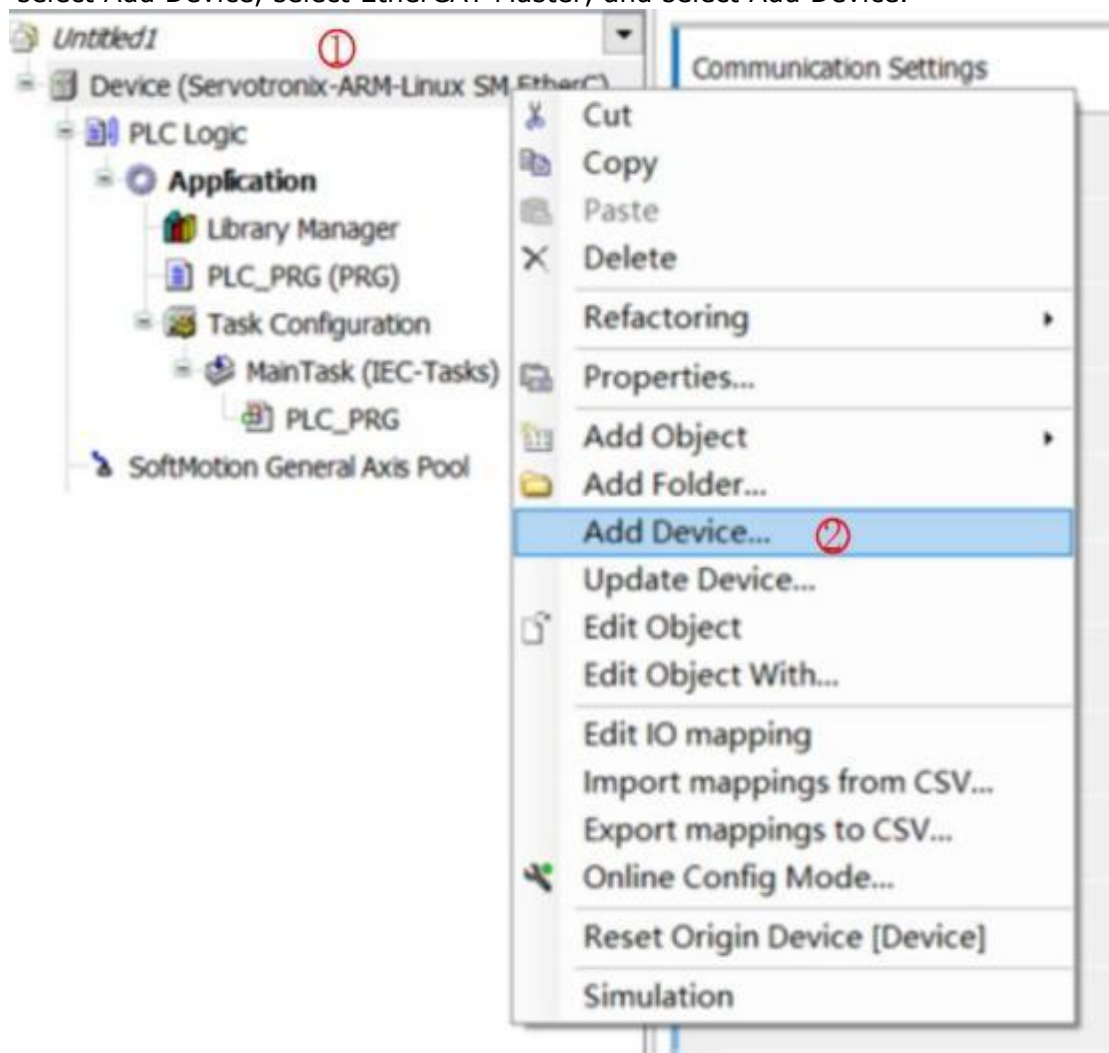


Figure 5-1 Adding EtherCAT Master (1)

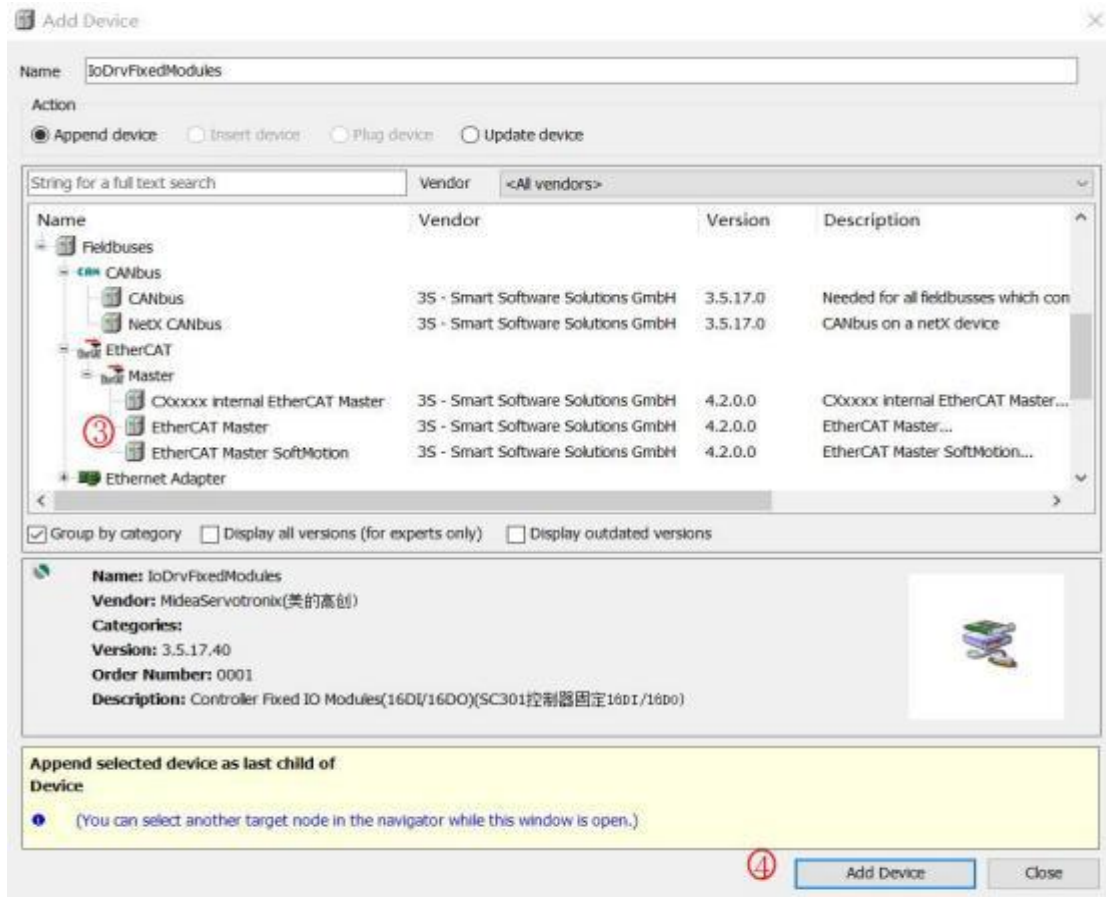


Figure 5-2 Adding EtherCAT Master (2)

5.3. 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: SC301 controller supports various scanning cycles. Users can choose the appropriate bus cycle according to the number of connected slaves.

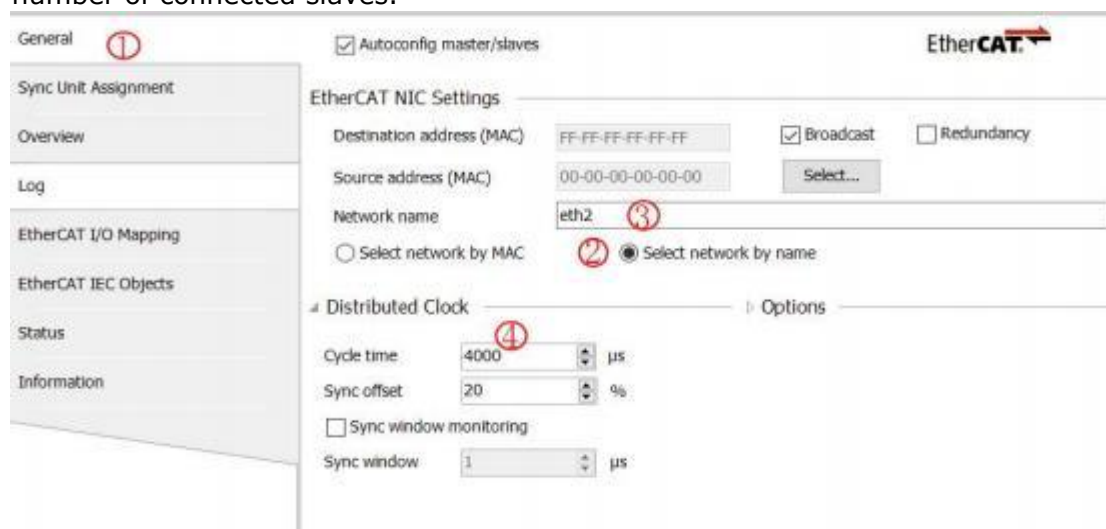


Figure 5-3 Configuring EtherCAT Network Port

5.4 Scanning Devices

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

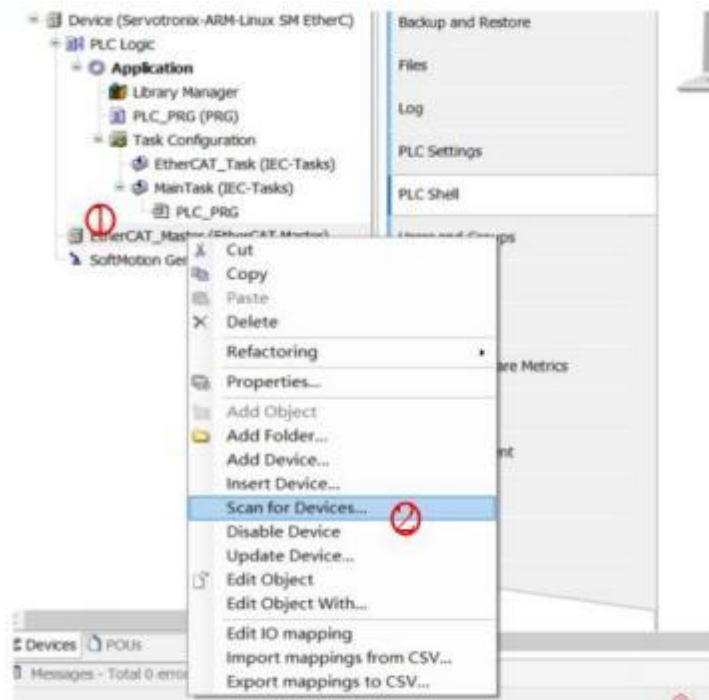


Figure 5-4 Automatic Scanning

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.

5.5 Adding 402 Axis

Right click the servo, then select Add SoftMotion CiA402 Axis

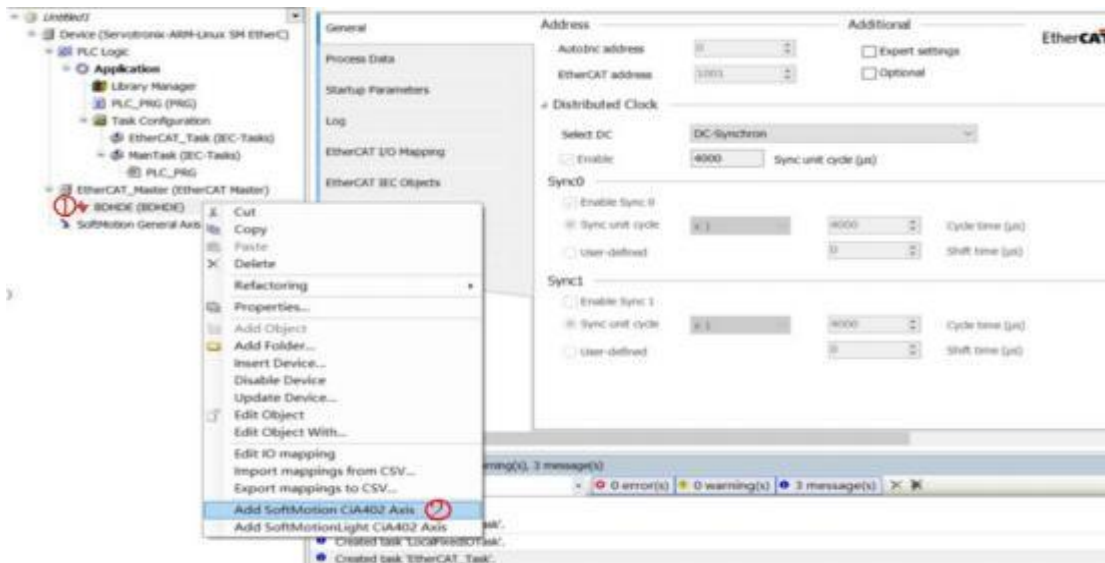


Figure 5-5 Adding 402 Axis

5.6 Configuring Axis Parameters

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

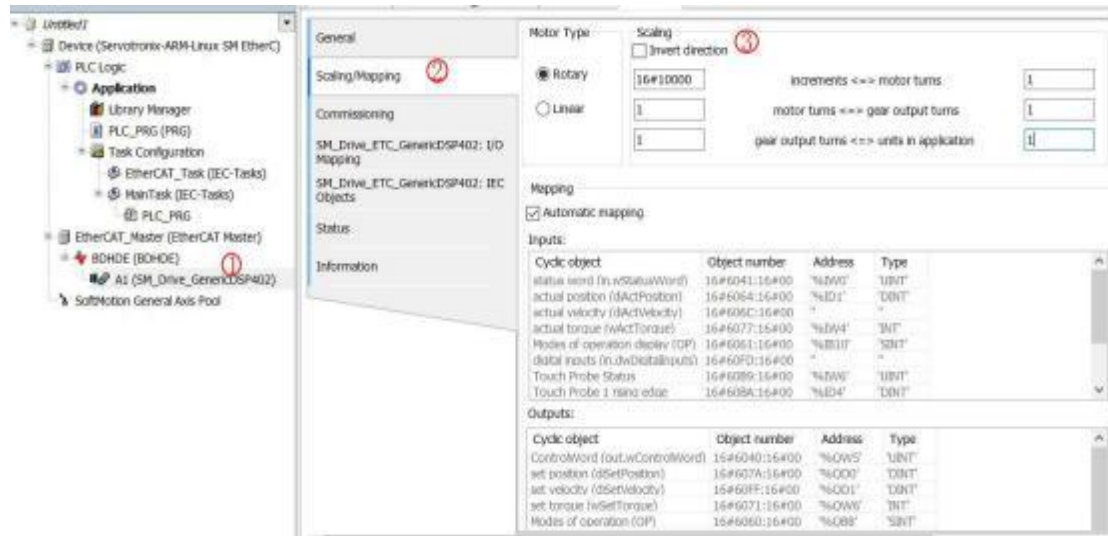


Figure 5-6 Configuring 402 Axis

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