M-Series Motion Controller

M500S

Hardware Manual

August 2025 V1.00
Version: ATC/MM5S12510

※ Preface

Thank you for purchasing and using the M500S-series controller products independently developed and manufactured by Hechuan Technology Co., Ltd.

The M500S-series controller is an EtherCAT bus-type + pulse-type motion controller independently developed and manufactured by HCFA, featuring rich interfaces, superior performance, and user-friendly operation. It integrates the functions of a Programmable Logic Controller (PLC) and motion control. The controller is equipped with one built-in EtherCAT bus interface supporting at least 4 bus axes, along with built-in input/output channels and multiple communication interfaces. Its built-in input/output channels support high-speed I/O, with a maximum of 4 high-speed output channels and 2 high-speed input channels. Additionally, it supports expansion of up to 16 IO modules on the right side. All models are standardly equipped with EtherCAT, USB, and RS485 communication interfaces. Some models come with a built-in RS232 interface, while others can expand their capabilities to include RS485, RS232, CAN, and other communication interfaces via expansion cards.

This manual primarily describes the products listed in the table:

Name	Model	I/O quantity	Brief description
M-series CPU unit	HCM500S-16MT4-D	8-channel input 8-channel output	The M500S-series CPU unit is equipped with built-in input/output channels and multiple communication interfaces. It supports high-speed input/output, with a maximum of 4 high-speed output channels and 2 high-speed input channels. The right side of the main unit supports expansion of up to 16 I/O modules. All models are standard-equipped with EtherCAT, USB, and RS485 communication interfaces; some models come with a built-in RS232 interface, while others can expand RS485, RS232, CAN, and other communication interfaces via expansion cards.
	HCM501S-16MT4-D		
	HCM511S-32MT4-D	16-channel input 16-channel output	

Target reader

Users who purchase or use HCFA's M500S-series motion controllers can refer to this manual for wiring, installation, diagnosis, post-maintenance procedures, and other related tasks. Users are required to have a basic understanding of electrical and automation knowledge.

This manual contains essential information for using HCFA's M500S-series motion controllers. Please read this manual carefully before use and operate correctly while paying full attention to safety.

Related manual

Partial specifications or restrictions for products in this manual may be described in other manuals, as detailed in the table below:

Name	Main content
M300/M500/M500S series (32 points) installation instruction	Instruction sheet (installation & operation)
M300/M500/M500S series (16 points) installation instruction	Instruction sheet (installation & operation)
M-Series Controller Basic Logic Instruction Manual	Instruction manual
M-Series Controller Motion Control Instruction Manual	Instruction manual
M-Series Controller Communication Instruction Manual	Instruction manual

※ Safety precautions

Safety icons

To ensure safe use of this product, this manual uses the following icons and icon descriptions to indicate precautions. The precautions listed here are all of critical importance to safety. These must be strictly observed. The icons and their meanings are as follows.

DANGER ⚠	Improper operation may cause minor to moderate injuries, or major injuries/death in severe cases, and potential property damage.
WARNING ⚠	Improper operation may cause minor to moderate injuries or equipment damage
CAUTION ⚠	Improper operation may cause minor injuries or equipment damage.
NOTE	Improper operation may damage the environment/equipment or cause data loss.

Safety rules

Precautions for startup and maintenance

DANGER ⚠

- Do not touch terminals in a powered state. There is a risk of electric shock and potential malfunctions.
- Ensure the power supply is completely disconnected from the external source before cleaning or wiring the module or terminals.
- Operating with power applied poses a risk of electric shock.
- For operations such as program changes, forced outputs, RUN, and STOP on running equipment, ensure familiarity with this manual and confirm safety beforehand. Incorrect operations may lead to mechanical damage or accidents.

Precautions during startup and maintenance

CAUTION ⚠

- Do not disassemble or modify the module, as this may cause malfunctions, errors, or fires.
- For equipment repairs, consult Hechuan Technology Co., Ltd.
- Always disconnect the power supply before installing or removing equipment cables; otherwise, module malfunctions or errors may occur.
- Ensure the power supply is disconnected before installing or removing the following equipment; otherwise, module malfunctions or errors may occur:
  --- Peripheral devices, display modules, functional expansions
  --- Expansion modules, special adapters
  --- Batteries, power supply terminals, memory cards

Precautions for disposal

CAUTION ⚠

- When disposing of the product, treat it as industrial waste. For battery disposal, follow the specific regulations designated by each region for separate processing.

Precautions for transportation and storage

CAUTION ⚠

• As the equipment is precision equipment, avoid subjecting it to impacts exceeding the general specification values stated in Section 3.1 during transportation. Otherwise, it may cause equipment malfunctions. After transportation, perform an operational check on the equipment.

Safety key points

Transportation and disassembly

• When transporting the unit, use a dedicated packaging box. Additionally, avoid applying excessive vibration or impact to the unit during transportation.

• Do not disassemble, repair, or modify this product; otherwise, malfunctions or fires may occur.

• Do not drop the product or subject it to abnormal vibration or impact; otherwise, product malfunctions or burnout may occur.

During installation

• Always cut off the power supply when assembling the unit. Failure to disconnect the power supply may cause the unit to malfunction or become damaged.

• When connecting the power supply unit, controller, or I/O unit, ensure that the connectors between the units are properly engaged.

During wiring

• Follow the specified wiring procedures outlined in this manual. Before powering on, carefully check the settings of all wiring and switches.

• Perform terminal wiring using the methods described in this manual.

• Use appropriate wiring components and tools during wiring; otherwise, cable disconnection, short circuits, or broken wires may occur.

• Select suitable cables for wiring. For details, refer to Section 5.2. Do not forcefully twist or pull the cables.

During power supply design

• When selecting an external power supply, consider the power capacity and surge current during turn-on specified in this manual, and choose a power supply with sufficient margin. Otherwise, the external power supply may fail to start or the power voltage may be unstable, leading to malfunctions.

• Use the capacity of the IO power supply within the unit's specifications.

• Do not apply a voltage exceeding the rated value to the input unit.

• Do not apply a voltage or load exceeding the rated value to the output unit or slave devices.

• A surge current may be generated when the power is turned on. When selecting fuses or circuit breakers for the external circuit, consider the melting characteristics and the above points, and ensure sufficient margin in the design.

• For surge current specifications, refer to this manual.

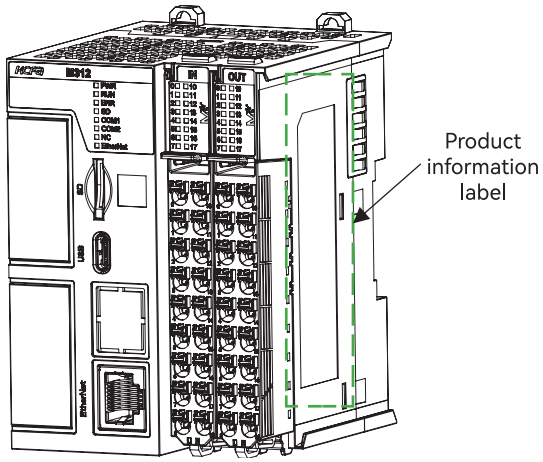
※ Version information confirmation

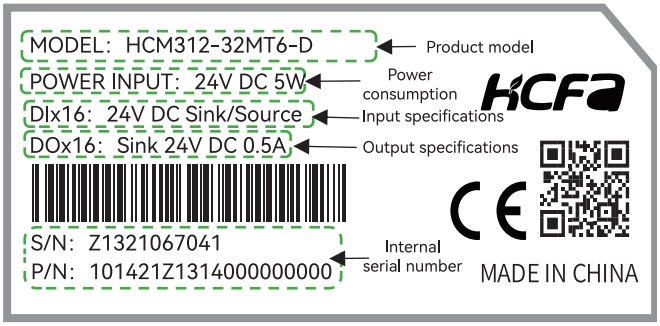
Each unit and slave device in the M500S series is identified by a unique number that represents its hardware revision or version. When there are changes to the hardware or software specifications, the respective hardware revision or version is updated. As a result, even units or slave devices of the same model can have different functions or performance if their hardware revisions or versions differ.

Hardware version

The version can be confirmed via the identification information on the product's side label.

The identification information label for the M500S-series CPU unit HCM5 □□ - □□□□ - □ is shown in the figure below.



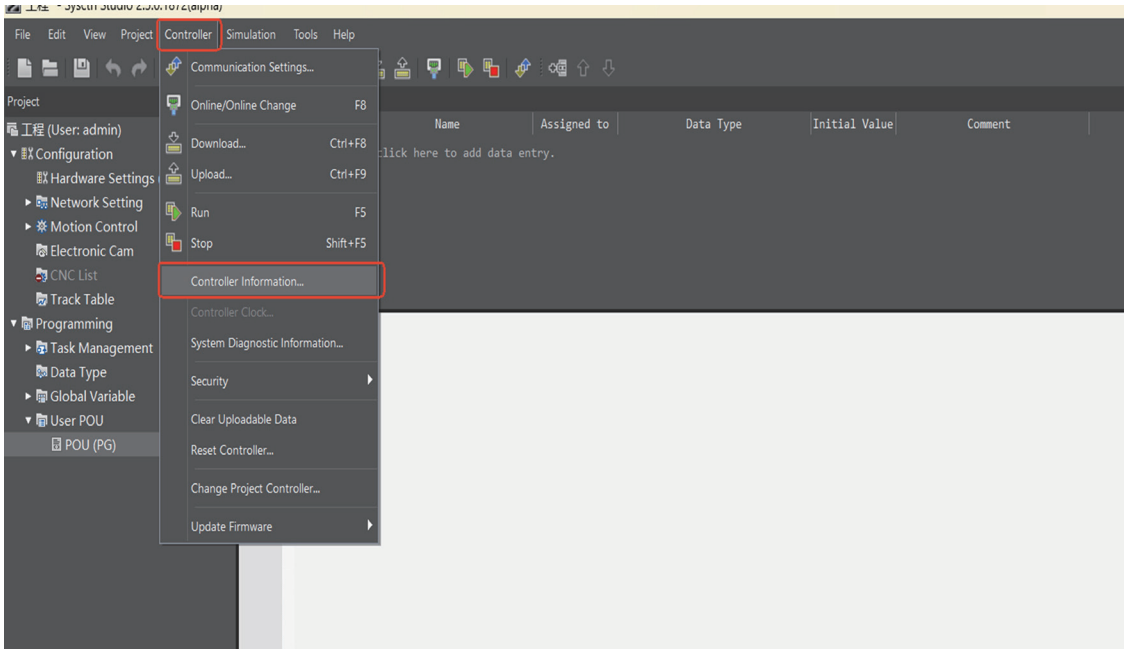


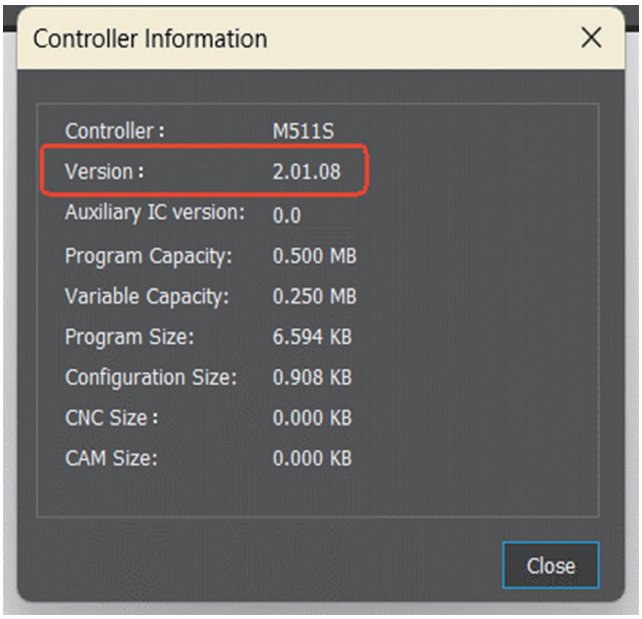
Note: "POWER INPUT" on this label indicates the power consumption of the unit itself.

Item	Description
Product information label	Describes basic product information such as the current product model and power consumption.
Product model	Displays the product model. MODEL: Product model
Power consumption	Displays the rated voltage and power consumption required for normal operation of the product. POWER INPUT: Rated voltage and power consumption.
Input specifications	Displays the number of input channels and the type of input circuitry of the product. DI x16: Supports 16-channel digital input. 24V DC Sink/Source: Supports 24V DC sinking and sourcing inputs.
Output specifications	Displays the number of output channels and the type of output circuitry of the product. DO x16: Supports 16-channel digital output. Sink 24V: Supports 24V DC sinking output DC 0.5A: Maximum load (resistive type) of 0.5A per channel.
Internal serial number	Displays the internal serial number of the product. P/N, S/N: Internal serial number.

Software version

Select 【Controller】 - 【Controller Information】from the top menu bar of Sysctrl Studio. The current controller's software version can be viewed in the pop-up 【Controller Information】window.





Manual version record

Version number	Update description
V1.0	Initial version

※ Term description

Term	Description
CPU unit	The control center of the automation controller. It executes tasks, refreshes I/O of each unit and slave device, etc. In the M500S series, it is denoted as HCM5 □□□ - □□□□ - □
Axis	A functional unit in the motion control function module. It assigns drive mechanisms of external servo drives, detection mechanisms of encoder inputs, etc.
Upload	Transfer data from the controller to Sysctrl Studio.
Download	Transfer data from Sysctrl Studio to the controller.
Motion control command	Motion control definition commands required for executing motion control functions. Motion control commands include those based on PLCopen's motion control function blocks and those independent of the motion control function module.

※ Copyright notice

※ Table of contents

Chapter 1 M-series Controllers Overview

1.1 Product feature and main function description of M500S-series controller

1.1.1 Hardware feature

Model	IO quantity	EtherCAT bus axis quantity	Pulse axis quantity	Communication interface		
				Ethernet	Serial port	USB
HCM500S-16MT4-D	8-channel input	4 axes	4 axes	-	1*RS485 1*RS232	1
HCM501S-16MT4-D	8-channel output	8 axes				
HCM511S-32MT4-D	16-channel input 16-channel output			1	2*RS485	

• M-series expansion modules support

The controller supports various M-series expansion modules. The M511S model supports CAN communication for connecting CAN bus-type remote I/O modules.

• Standard USB/Type-C interface

The Sysctrl Studio (PC software) can communicate with the CPU unit and transfer data via the USB/Type-C interface.

• EtherNet protocol support

Some models support Ethernet protocol for communication and data exchange with the Sysctrl Studio (PC software), including program upload/download. Additionally, Modbus TCP is supported for communication with HMI touchscreens.

• RS485/RS232 communication interface (RS232 requires optional expansion card for some models)

Some models support RS485/RS232 (master/slave) connections for devices such as HMIs, VFDs, and barcode scanners.

• Ethernet communication interface

Some models' Ethernet interface supports Modbus TCP slave mode for data exchange with Modbus TCP master devices.

1.2 M-series controller definition

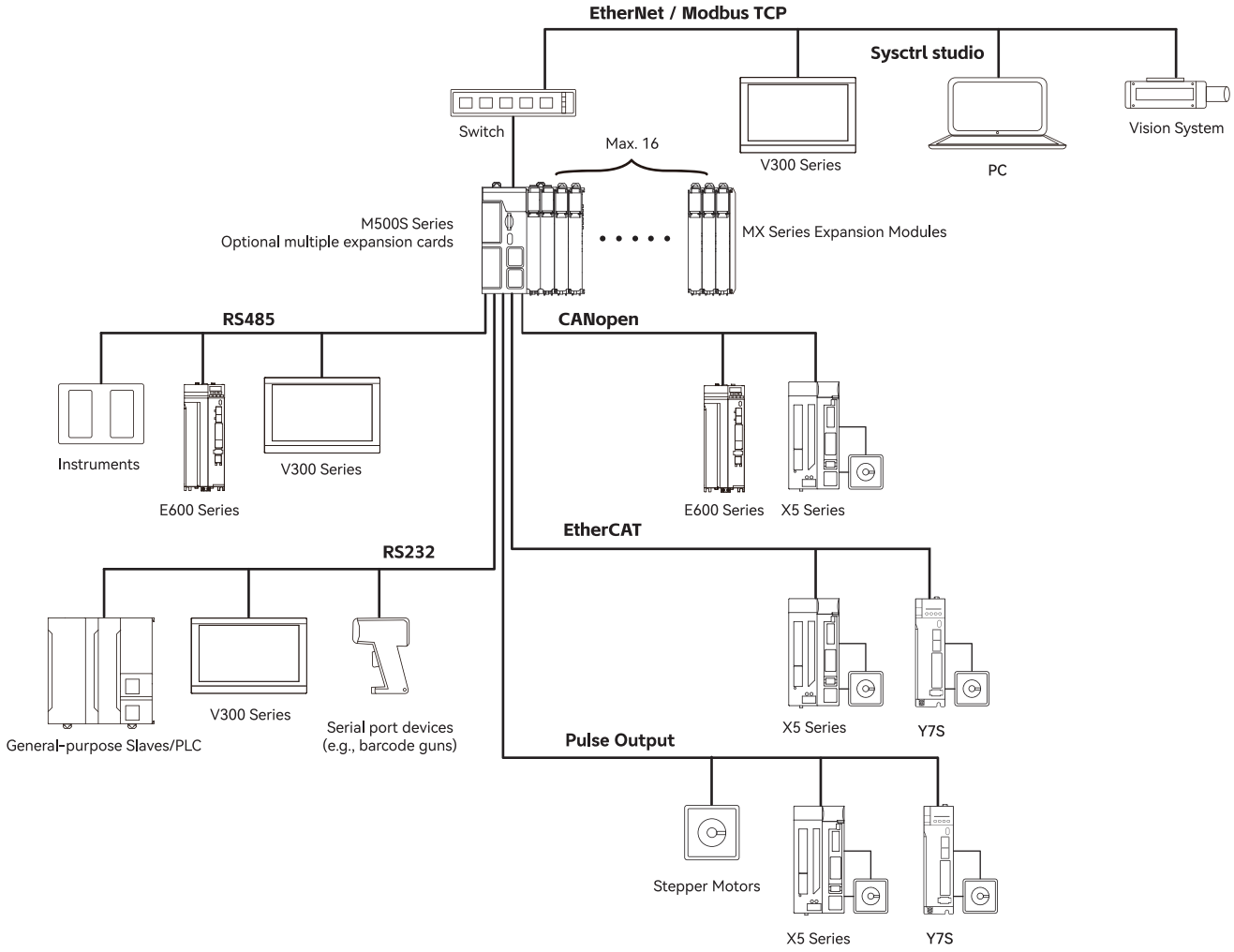
The M500S-series controller is an EtherCAT bus-type + pulse-type motion controller independently developed and manufactured by HCFA, featuring rich interfaces, superior performance, and user-friendly operation. It integrates the functions of a Programmable Logic Controller (PLC) and motion control. The controller is equipped with one built-in EtherCAT bus interface supporting at least 4 bus axes, along with built-in input/output channels and multiple communication interfaces. Its built-in input/output channels support high-speed I/O, with a maximum of 4 high-speed output channels and 2 high-speed input channels. Additionally, it supports expansion of up to 16 IO modules on the right side. All models are standardly equipped with EtherCAT, USB, and RS485 communication interfaces. Some models come with a built-in RS232 interface, while others can expand their capabilities to include RS485, RS232, CAN, and other communication interfaces via expansion cards.

The M500S-series controller is equipped with multiple communication interfaces, including EtherCAT USB, RS485, RS232, Ethernet, and CAN. Among these, the RS485 and RS232 interfaces support Modbus protocol and custom serial protocol; the Ethernet interface supports multiple protocols such as ModbusTCP and Socket; the CAN communication interface supports the CANopen DS301v4.02 protocol and can function as both a master and a slave.

1.3 Controller overview

1.3.1 System configuration

The system topology of the M500S series is shown below.



Note: Supported on some models. For details, refer to Chapter 3.

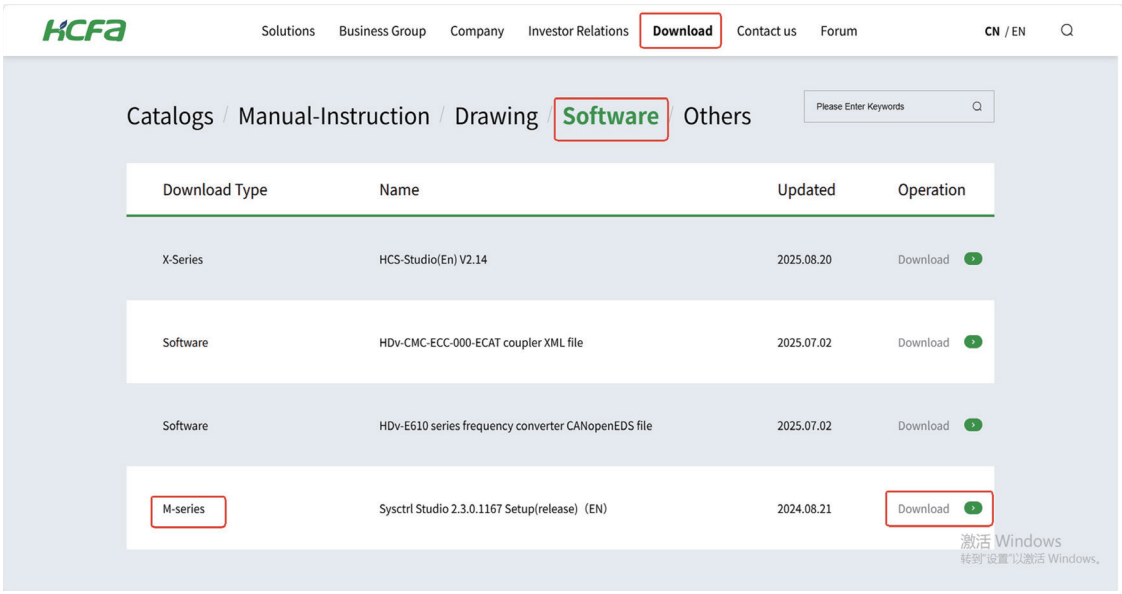
1.3.2 Software description

◆ Supported connection method

Model		M500S	M501S	M511S
USB	Quantity	1x Type-C (USB 2.0)		
	Supported function	Program upload/download, software monitoring and debugging, firmware upgrade, etc.		
EtherNet	Quantity	-		1x EtherNet
	Supported function	-		Software monitoring and debugging, program upload and download

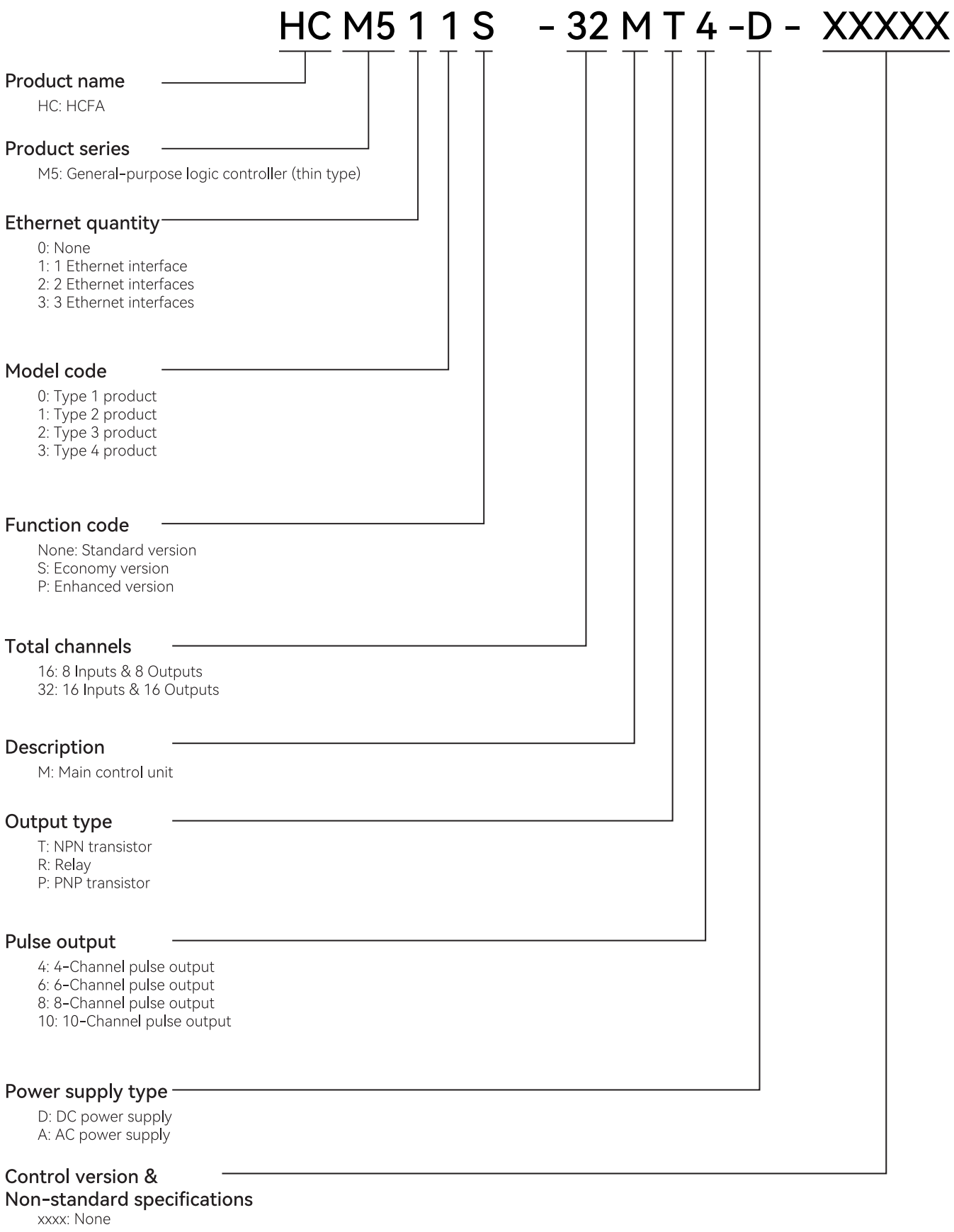
◆ Software download link

To download the software, please visit the official English website of Zhejiang Hechuan Technology Co., Ltd.: https://www.hcfaglobal.com/. Click 【Download】 at the top of the page, then on the redirected page, click 【Software】 → 【Sysctrl Studio 2.3.0.1167 Setup (Release) (EN)】 → 【Download】.



Chapter 2 CPU Unit Model and Component Description

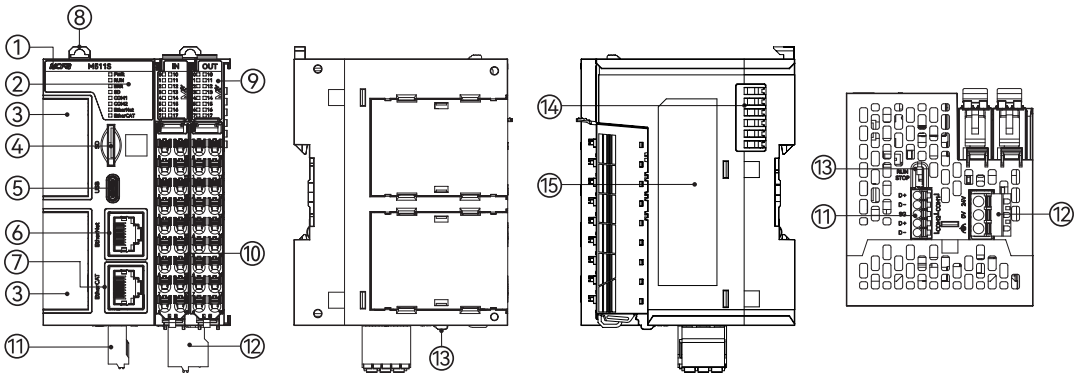
2.1 Product model



2.2 Basic composition

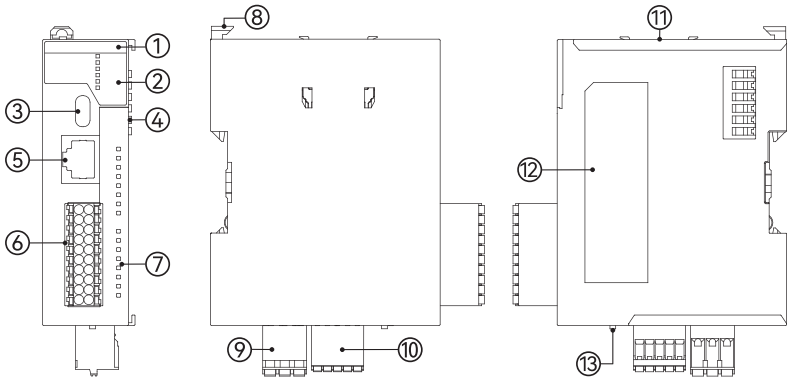
2.2.1 Names and functions of CPU unit components

◆ **M511S-series CPU unit**



No.	Name	Function
(1)	Product name	Product model
(2)	System status indicator	Displays the operating status of the controller system
(3)	Expansion slot	Expansion card slot, supporting optional expansion cards
(4)	SD card slot	SD card slot (SD card needs to be purchased by the customer; no functions are supported in the current version)
(5)	Type-C interface	USB 2.0 interface, supporting user program upload/download, firmware upgrade, etc. after connecting to a host computer.
(6)	RJ45 interface	Ethernet interface supporting Modbus TCP and custom socket protocol. Default IPv4: 192.168.1.8; Subnet mask: 255.255.255.0
(7)		EtherCAT interface
(8)	DIN rail mounting latch	Latch structure for mounting the controller on a DIN rail
(9)	Channel status indicator	Indicates the current channel status. For details on the indicators, refer to 2.2.2 Indicator description.
(10)	18-Pin IO terminal	Digital IO input/output terminals and their common terminals
(11)	5-Pin serial communication terminal	D+: 485 communication signal positive;
		D-: 485 communication signal negative;
		SG: 485 communication signal ground
(12)	DC24V power supply terminal	DC24V power supply interface
(13)	RUN/STOP switch	Starts or stops the operation of the controller's programs. Toggle to RUN to start, and to STOP to stop.
(14)	Expansion module communication interface	Communication and power supply interface between the host and IO modules (hot-swapping not supported)
(15)	Label	Describes basic information such as the device model and power consumption

◆ M500S/ M501S CPU unit



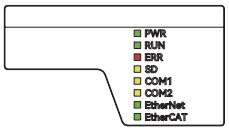
No.	Name	Function
(1)	Product name	Product model
(2)	System status indicator	Displays the operating status of the CPU
(3)	Type-C interface	USB 2.0 interface. Program upload/download, firmware upgrade, etc., can be performed after connecting to a host computer.
(4)	Expansion module communication interface	Connects to expansion modules
(5)	RJ45 interface	Ethernet interface
(6)	20-Pin I/O terminal	Electrical interfaces for receiving external input signals and controlling external actuators and other devices
(7)	Channel status indicator	Indicates the current channel status. For details on the indicators, refer to 2.2.2 Indicator description.
(8)	DIN rail mounting latch	Latch structure for mounting the controller on a DIN rail
(9)	DC24V power supply terminal	DC24V power supply interface
(10)	5-Pin serial communication terminal	Serial communication terminal details refer to Section 5.2.3 Communication Wiring.
(11)	RTC battery compartment	-
(12)	Label	Describes basic information such as the device model and power consumption
(13)	RUN/STOP switch	Starts or stops the operation of the controller's programs. Toggle to RUN to start, and to STOP to stop.

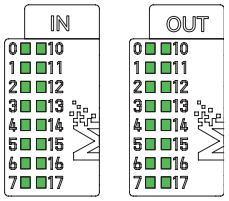
2.2.2 Indicator description

◆ M511S CPU unit

Silkscreen	Indicator	Color	State	Function
PWR	Power status	Green	Not lit	Power not connected
			Lit	Power normally connected
RUN	Operation status	Green	Not lit	Initialization state
			Lit	Normal operation
ERR	System fault status	Red	Not lit	No fault
			Lit	Fault occurred
SD	SD card status	Yellow	Not lit	SD card not inserted
			Blinking	SD card being read/written
			Lit	SD card inserted but not reading/writing
COM1	RS485 communication status	Yellow	Not lit	No communication
COM2			Blinking	Sending data to other devices
EtherNet	Ethernet communication status	Green	Not lit	No physical connection
			Blinking	Physical connection established with data transmission
			Lit	Physical connection established but no data transmission
EtherCAT	EtherCAT communication status	Green	Not lit	No physical connection
			Blinking	Physical connection established with data transmission
			Lit	Physical connection established but no data transmission
IN N (0~7,10~17)	Input status	Green	Not lit	Input signal not detected on channel N
			Lit	Input signal detected on channel N
OUT N (0~7,10~17)	Output status	Green	Not lit	No signal output on channel N
			Lit	Signal output on channel N

M511S

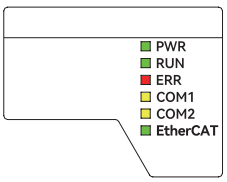


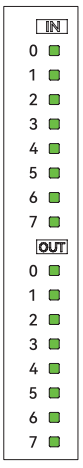


◆ M500S/ M501S CPU unit

Silkscreen	Indicator	Color	State	Function
PWR	Power status	Green	Not lit	Power not connected
			Lit	Power normally connected
RUN	Operation status	Green	Not lit	Controller stopped
			Lit	Normal operation
ERR	System fault status	Red	Not lit	No fault
			Lit	Fault occurred
COM1	RS232 communication status	Yellow	Not lit	No communication
			Blinking	Sending data to other devices
COM2	RS485 communication status	Yellow	Not lit	No communication
			Blinking	Sending data to other devices
EtherCAT	EtherCAT communication status	Green	Not lit	No physical connection
			Blinking	Physical connection established with data transmission
			Lit	Physical connection established but no data transmission
IN N(0~7)	Input status	Green	Not lit	Input signal not detected on channel N
			Lit	Input signal detected on channel N
OUT N(0~7)	Output status	Green	Not lit	No signal output on channel N
			Lit	Signal output on channel N

M500S/M501S





2.2.3 Expansion card

Item		Specification	
		M511S	M500S/M501S
Supported quantity		2	Not supported
Model	RTC (Real-Time Clock) battery	HCMXB-RTC-BD	
	CAN communication	HCMXB-CAN-BD	
	RS485 communication	HCMXB-2RS485-BD	
	RS232 communication	HCMXB-2RS232-BD	

* For details on the CAN communication expansion card, refer to 6.4 CAN communication.

* For details on the RS485 communication expansion card, refer to 6.5 RS485 communication.

* For details on the RS232 communication expansion card, refer to 6.6 RS232 communication.

◆ Expansion card usage rules

• A single controller can only be equipped with one serial communication expansion card (e.g., M511S controller cannot mix HCMXB-2RS485-BD and HCMXB-2RS232-BD cards).

• A single controller can only be equipped with one expansion card of the same model (e.g., M511S controller cannot use two HCMXB-2RS232-BD cards).

• All the HCMXB-CAN-BD, HCMXB-2RS485-BD, and HCMXB-2RS232-BD expansion cards can act as a master or slave.

2.2.4 Button cell battery

The M500S-series (except M511S) CPU has a built-in battery with a lifespan of 5 years. The M511S CPU unit can add an RTC (Real-Time Clock) battery by installing an RTC expansion card.

2.2.5 USB/Type-C interface

Item		Specification		
		M500S	M501S	M511S
USB	Number of interfaces	1x USB2.0 Type-C		
	Supported function	Program upload/download, software monitoring and debugging, firmware upgrade		

2.2.6 SD card

The M511S-series controller supports SD card expansion. The following specifications are applicable for SD cards:

Item	Specification	
Supported model	M511S	
SD card type	SD	SDHC
SD card capacity	0~2GB	4GB~32GB
SD card file format	FAT/FAT32	FAT32
Function	Reserved	

2.2.7 Expansion module

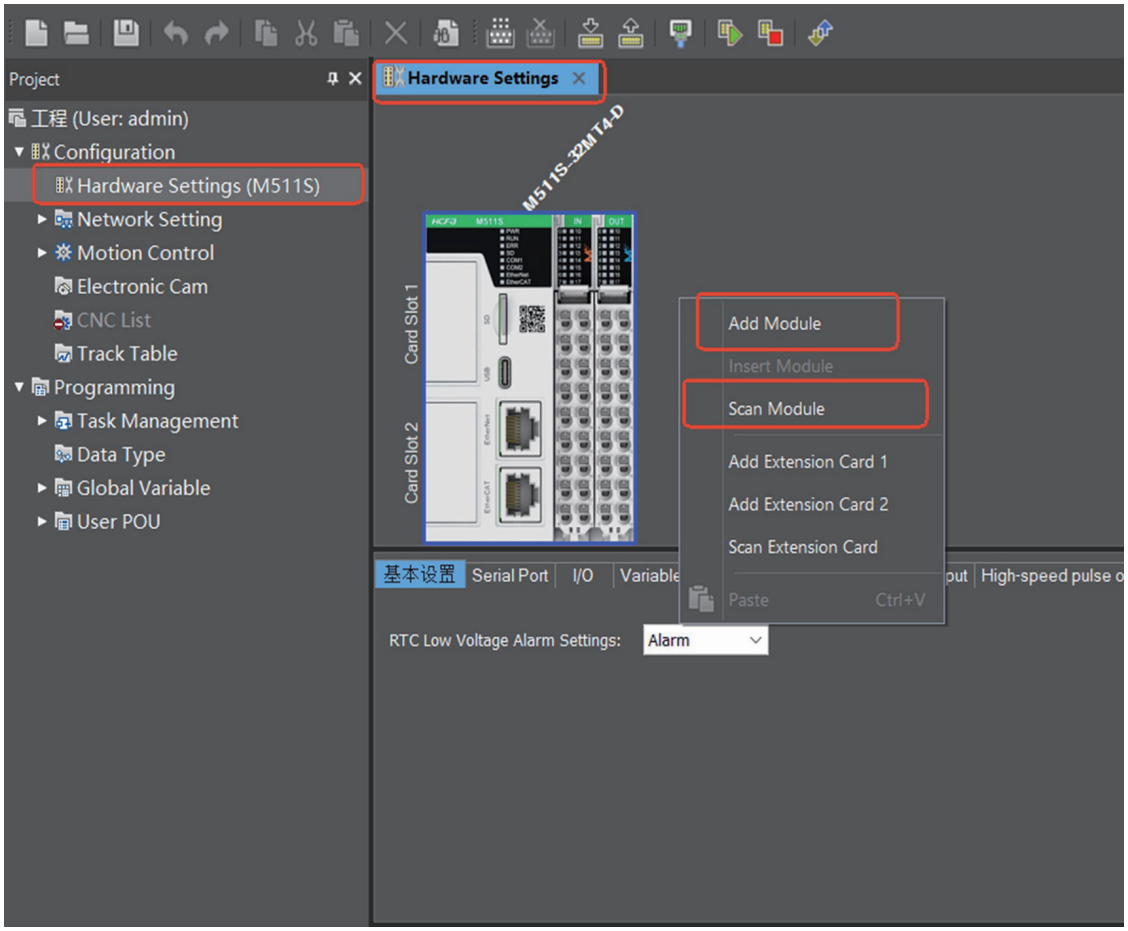
◆ Supported expansion module

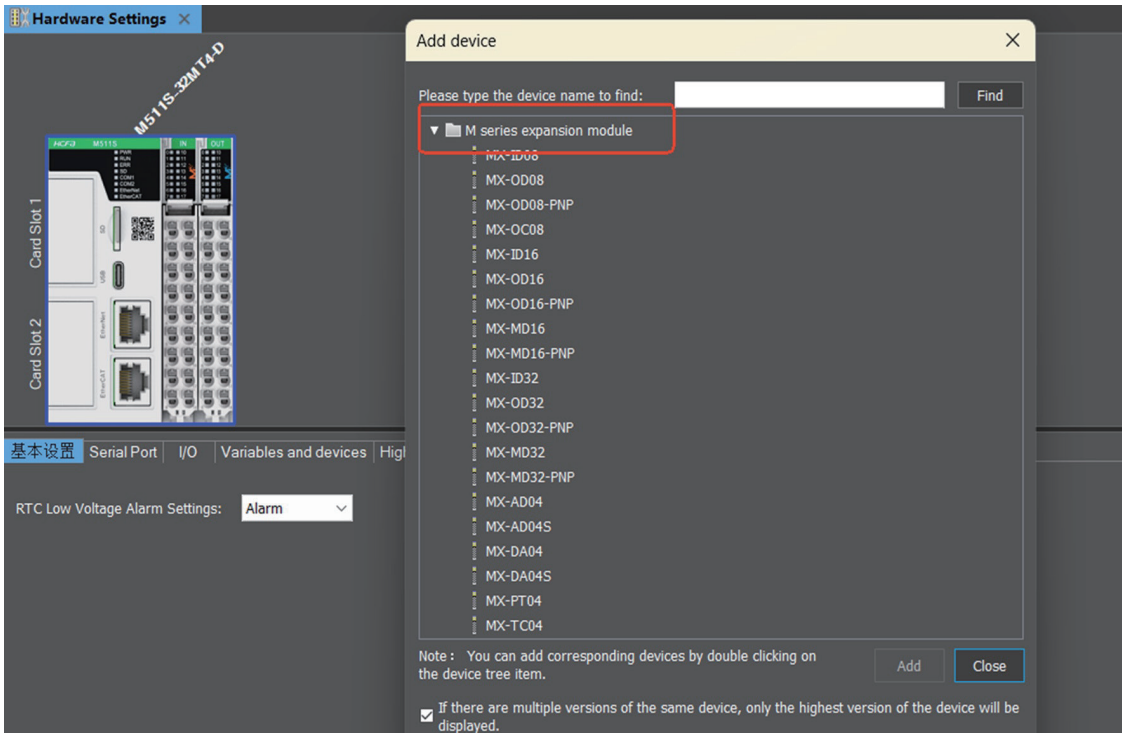
Module name	Number of input channels	Number of output channels
HCMX-ID08-D	8-channel DI	-
HCMX-ID16-D	16-channel DI	-
HCQX-ID32-D	32-channel DI	-
HCMX-OD08-D	-	8-channel DO
HCMX-OD08-D-PNP	-	8-channel DO
HCMX-OD16-D	-	16-channel DO
HCMX-OD16-D-PNP	-	16-channel DO
HCMX-OD32-D	-	32-channel DO
HCMX-OD32-D-PNP	-	32-channel DO
HCMX-MD16-D	8-channel DI	8-channel DO
HCMX-MD16-D-PNP	8-channel DI	8-channel DO
HCMX-MD32-D	16-channel DI	16-channel DO
HCMX-MD32-D-PNP	16-channel DI	16-channel DO
HCMX-OC08-D	-	8-channel relay output
HCMX-AD04-D	4-channel 16-bit AI	-
HCMX-AD04S-D	4-channel 14-bit AI	-
HCMX-DA04-D	-	4-channel 16-bit AO
HCMX-DA04S-D	-	4-channel 14-bit AO

◆ Mapping of expansion modules to controller variables and addresses

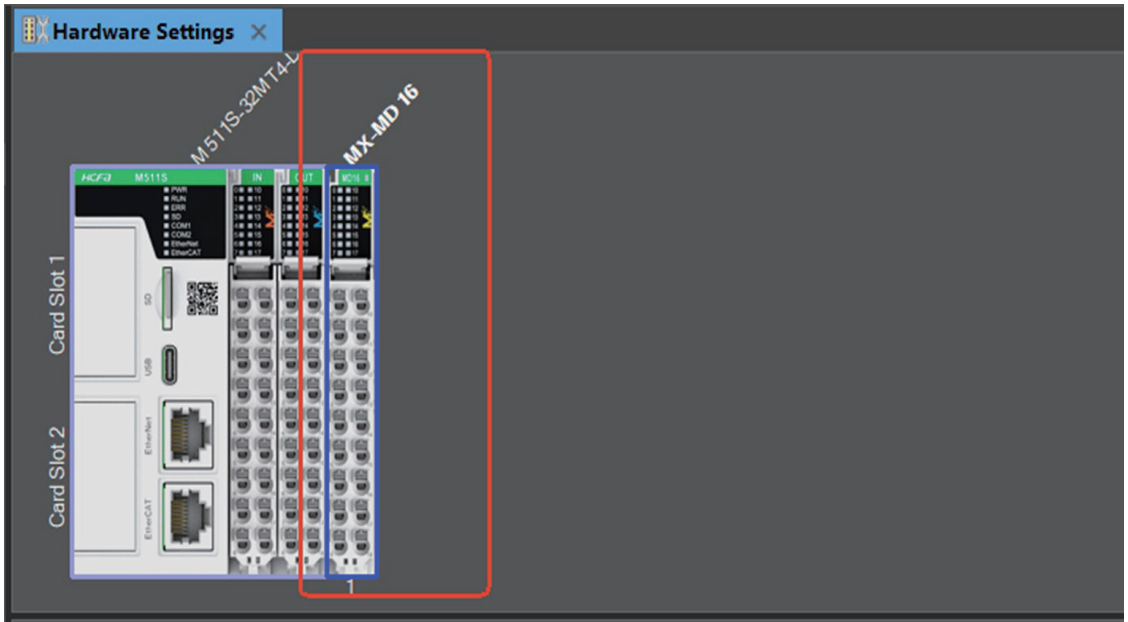
Expansion modules on the right side of the CPU can be added in the sysctrl Studio software interface by right-clicking in the left tree menu 【Configuration】-> 【Hardware Settings】, then selecting either 【Add Module】or 【Scan Module】in the pop-up dialog. After clicking 【Add Module】, options for M-series expansion modules will appear. Select the device to add below these options, then click 【Add】 to complete the configuration.

Note: Manually added modules in the software must match the externally connected modules; otherwise, the controller will report an error.





After adding or scanning is completed, the address and variable mapping information of the current expanded IO will be displayed in the 【Exchange Area】 below the 【Hardware Settings】 page.



Exchange Area | Initialize

NOTE: Double-click the variable, initial value, and comment cell to perform editing

Parameter	Variable	Assigned to	Data Type	Initial Value	Comment
Input channel 0	hwcVar1	%IB2	USINT		
Bit0	hwcVar2	%IX2.0	BOOL		
Bit1	hwcVar3	%IX2.1	BOOL		
Bit2	hwcVar4	%IX2.2	BOOL		
Bit3	hwcVar5	%IX2.3	BOOL		
Bit4	hwcVar6	%IX2.4	BOOL		
Bit5	hwcVar7	%IX2.5	BOOL		
Bit6	hwcVar8	%IX2.6	BOOL		
Bit7	hwcVar9	%IX2.7	BOOL		
Output channel 0	hwcVar10	%QB2	USINT		
Bit0	hwcVar11	%QX2.0	BOOL		
Bit1	hwcVar12	%QX2.1	BOOL		
Bit2	hwcVar13	%QX2.2	BOOL		
Bit3	hwcVar14	%QX2.3	BOOL		
Bit4	hwcVar15	%QX2.4	BOOL		
Bit5	hwcVar16	%QX2.5	BOOL		
Bit6	hwcVar17	%QX2.6	BOOL		
Bit7	hwcVar18	%QX2.7	BOOL		

Chapter 3 Product Specifications

3.1 General specifications

Item		Specification				
Weight		M511S: 235g (net weight) M500S series (except M511S): 145g (net weight)				
Dimensions		M511S: 70.3 mm (W) × 104.5 mm (H) × 80.2 mm (D) M500S series (except M511S): 32.3 mm (W) × 104.5 mm (H) × 80.2 mm (D) (Without terminal blocks)				
Operating environment	Operating temperature	0~55℃				
	Storage temperature	-25~70℃				
	Ambient humidity	10% ~ 95% (no-condensing)				
	Ambient environment	Low levels of dust and corrosive gases				
	Altitude/Pressure	Below 2000 m (80 kPa)				
	Noise immunity	≥ 1500 Vp-p, pulse width 1μs, 50ms (based on noise simulator); compliant with IEC standards (IEC 61000-4-2/3/4/6)				
	Vibration resistance	Installation condition	Frequency (Hz)	Acceleration (m/s^2)	Single amplitude (mm)	10 times in each of X, Y, Z directions (total 80 times each)
		When installed on a DIN rail:	10~57	—	0.035	
			57~150	4.9	—	
	Shock (Impact) resistance	Acceleration: 150 m/s^2; Duration: 11 ms; 2 times in each of X, Y, Z directions.				
	IP rating	IP20				
	Pollution degree	Pollution degree II: Generally only non-conductive contamination, but temporary conductivity due to occasional condensation should be expected.				
Isolation method		Digital isolation				
Heat dissipation method		Passive heat dissipation, natural air cooling				
Installation position		Inside the control cabinet				
Main body material		Standard PPE material				
Certification		CE				

3.2 Electrical specifications

Item	Specification
Power supply voltage	DC20.4V~28.8V (-15%~+20%)
Power consumption	5W
Withstand voltage	500V, 1min, ≤ 10mA
Power supply protection	Overcurrent protection, reverse polarity protection, surge absorption

3.3 Performance specifications

Item			Specification		
			HCM500S	HCM501S	HCM511S
Programming	Program capacity		512KBytes		
	Variable capacity		256KBytes (including 32 KBytes of persistent data memory)		
	I area (%I)		128Bytes		
	Q area (%Q)		128Bytes		
	M area (%M)		128KBytes		
Programming language			LD, ST, C/C++		
Axis capacity	Servo axes (EtherCAT axes)		4 Axes	8 Axes	8 Axes
	Number of pulse axes		4 Axes, 200KHz		
	Number of encoder axes		2		
	Number of virtual axes		≤ 16		
	Total number of axes (servo axes + pulse axes + encoder axes + virtual axes)		≤ 16		
Right expansion	Maximum number of expansion modules		16		
RTC battery			Built-in		Supported with optional HCMXB-RTC-BD card
Optional card	Maximum number of optional cards		-		2
Host IO channel	Input	Number of channels	8-channel inputs		16-channel inputs
		Function	Supports 8 channels of external interrupts; 2 channels of 200K high-speed pulse input (AB phase, pulse + direction, single pulse).		
	Output	Number of channels	8-channel outputs		16-channel outputs
		Function	Supports 4 channels of 200K high-speed pulse output (pulse + direction).		
Electronic cam	Number of cam profiles		16		
	Number of key points per curve		32		
Axis group	Maximum number of axis groups		One axis group (each supporting up to 8-axis interpolation)		
SD card			-		1 channel (function not supported temporarily)
USB	Number of interfaces		1x USB2.0 Type-C		
	Supported function		Program upload/download, software monitoring and debugging, firmware upgrade		

Serial port	RS485	Number of interfaces	One channel	Max. 4 channels: 2 built-in channels, expandable by 2 more with optional HCMXB-2RS485-BD card
		Supported protocol	Modbus Master/Slave (ASCII/RTU); Custom protocol	
		Max. number of slaves	32	
		Baud rate (bps)	9600, 19200, 38400, 57600, 115200	
	RS232	Number of interfaces	One channel	Expandable by 2 more with optional HCMXB-2R232-BD card
		Supported protocol	Modbus Master/Slave (ASCII/RTU); Custom protocol	
		Max. number of slaves	1	
		Baud rate (bps)	9600, 19200, 38400, 57600, 115200	
CAN	Number of interfaces		-	Expandable by 1 channel with optional HCMXB-CAN-BD card
	Supported protocol		-	CANopen protocol (DS301), can act as master or slave; supports 16 slaves when acting as master
EtherNet	Number of interfaces		1 channel (act as a master)	
	Function		1. It can connect to EtherCAT drives supported by the controller firmware, associate axes with drives, and control axes via motion commands. Users cannot configure EtherCAT drive parameters through PDOs. 2. It supports reading from or writing to Service Data Objects (SDOs) supported by slaves. 3. Remote IO modules cannot be connected via the EtherCAT communication interface.	
	Data transfer speed		100Mbps	
	Number of interfaces		-	1 channel
	Function		-	Communication, program upload/download, etc.
	Data transfer speed		-	100/10Mbps
	Modbus TCP & Socket Number of simultaneous communication			12
	Modbus TCP		-	The total number of connections for client and server is 8; When acting as a client, the maximum number of client connections can reach 4; When acting as a server, the maximum number of server connections can reach 4.
	Socket		-	Max. 4, supports TCP/UDP

3.4 IO specifications

3.4.1 General IO input/output

◆ General IO input

Item		Specification	
		M511S	M500S/M501S
Number of input channels (number)		16	8
Input signal mode		Sink mode or source mode Sink mode: The common terminal is connected to the 24V of the DC 24V power supply. Source mode: The common terminal is connected to the 0V of the DC 24V power supply.	
Input channel terminal type		Spring-type detachable terminal	
Common terminal configuration		16 channels per common terminal; Common terminal S0 can be connected to 24V or 0V of the DC 24V power supply.	8 channels per common terminal; Common terminal S0 can be connected to 24V or 0V of the DC 24V power supply.
Input voltage/current		DC 24V/5mA	
Voltage when ON		≥ DC 15V	
Voltage when OFF		≤ DC 5V	
Input current when ON		>4mA	
Input current when OFF		<2.5mA	
Standard input channels		IX0.0~IX0.7, IX1.0~IX1.7	IX0.0~IX0.7
Response time	OFF -> ON	< 2.5μs	
	ON -> OFF	< 2.5μs	
Input impedance		2.7kΩ	
Isolation method		Integrated chip capacitive isolation	
Input operation indication		When the isolated digital input receiver is driven, the input channel indicator lights up.	

◆ General IO output

Item		Specification	
		M511S	M500S/M501S
Number of input channels (number)		16	8
Output channel type		Transistor sink output	
Common terminal configuration		16 channels per common terminal; 16 output channels share one common terminal (COM)	8 channels per common terminal; 8 output channels share one common terminal (COM)
Input channel terminal type		Spring-type detachable terminal	
Leakage current when OFF		<10μA	
Maximum load		Resistive load: 0.5A per channel, 4A for all channels of the host	
		Inductive load: 7.2W per channel, 24W for all channels of the host	
		Bulb load: 5W per channel, 18W for all channels of the host	
Minimum load		1mA / 5V	
Maximum response time	OFF -> ON	< 2.5μs	
	ON -> OFF	< 2.5μs	
Output isolation voltage		3.75kV	

Standard output	Output channels	QX0.0~ QX0.7, QX1.0~ QX1.7	QX0.0~ QX0.7
	Function	Controller cylinders, etc.	

3.4.2 High-speed input/output

◆ High-speed input

Item		Specification	
		M511S	M500S/M501S
Input channel		2 channels	
Maximum pulse frequency		200KHZ	
Input form	AB phase	Channel 1: IX0.0~IX0.1; Channel 2: IX0.2~IX0.3	
	Pulse+direction	In channel 1: IX0.0 is pulse, IX0.1 is direction; In channel 2: IX0.2 is pulse, IX0.3 is direction	
	Single pulse	Channel 1: IX0.0; Channel 2: IX0.2	
Interrupt		IX1.0~IX1.7; supports interrupt tasks (rising edge or falling edge), and can also precisely capture the position of the high-speed input channel via the input channel.	

◆ High-speed output

Item		Specification	
		M511S	M500S/M501S
Output channel		4 Axes	4 Axes
Maximum pulse frequency		200KHZ	
Output form	Pulse+direction	QX0.0~ QX0.7 Even-numbered channels are pulse, odd-numbered channels are direction	QX0.0~ QX0.7 Even-numbered channels are pulse, odd-numbered channels are direction

3.5 Communication specifications

3.5.1 EtherCAT specifications

Item	Specification
Interface type	RJ45 connector
Communication protocal	EtherCAT
Supported service	COE(PDO, SDO)
Supported synchronization method	Distributed Clock (DC)
Data transfer speed	100Mbps
Maximum transmission distance	The distance between two EtherCAT nodes is less than 100m.
Cable	Category 5e shielded twisted pair cable

3.5.2 Ethernet specifications

Item	Specification
Interface type	RJ45

Data transfer speed	100/10Mbps
Maximum transmission distance (length between hub and node)	100m
Supported protocol	Modbus TCP, Socket, custom communication protocols
IP address	Initial value: 192.168.1.8
Cable	Category 5e shielded twisted pair cable

3.5.3 RS485 specifications

Item	Specification
Interface type	5-Pin serial communication terminal
Data transfer rate	9600, 19200, 38400, 57600, 115200bps
Maximum transmission distance	500m (at 9600bps)
Supported protocol	Modbus master/slave (ASCII/RTU); custom communication protocol
Isolation method	Digital isolator insulation
Termination resistor	External 120Ω
Number of supported slaves	32

3.5.4 CANOpen specifications

Item	Specification
Interface type	RJ45
Data transfer rate	Maximum 1Mbps
Maximum transmission distance	2500m (at 20kbit/s)
Supported protocol	CANOpen
Isolation method	Digital isolator insulation
Termination resistor	External 120Ω
Number of supported slaves	16

Chapter 4 Software Configuration and Usage Steps

4.1 Software usage steps

◆ Step 1. Installation

Step	Content	Reference
1-1 Establish configuration	• Install on DIN rail • Connect units to each other	Chapter 5 Installation and Wiring
1-2 Configure slave	• Slave node address setting	

◆ Step 2. Wiring

Step	Content	Reference
2-1 EtherNet cable wiring	• Wiring of built-in ModbusTCP interface	Chapter 5 Installation and Wiring
2-2 I/O wiring	• Wiring of basic I/O unit	
2-3 Computer (Sysctrl Studio) wiring	• USB cable wiring • Wiring of built-in ModbusTCP interface	

◆ Step 3. Software configuration and setup

Step	Content	Reference
3-1 Configure IO and addresses	• Create a new project • Assign device variables to I/O ports • Create axes and assign to real or virtual axes	Chapter 2 CPU Unit Model and Component Description
3-2 Configure communication	• Establish communication between modules	Software Instruction Manual
3-3 Configure hardware configuration	• Create slave/unit configurations	
3-4 Configure task cycles	• Relationship between tasks and programs • Cycle of each tasks • Refresh cycle of slaves/units	
3-5 Design programs	• Design POU (Program Organization Unit) • Design variables	

◆ Step 4. Download and debugging

Step	Content	Reference
4-1 Online connection with Sysctrl Studio and project download	• Turn on the power of the controller and connect online with Sysctrl Studio.	Chapter 5 Installation and Wiring Software instruction manuals

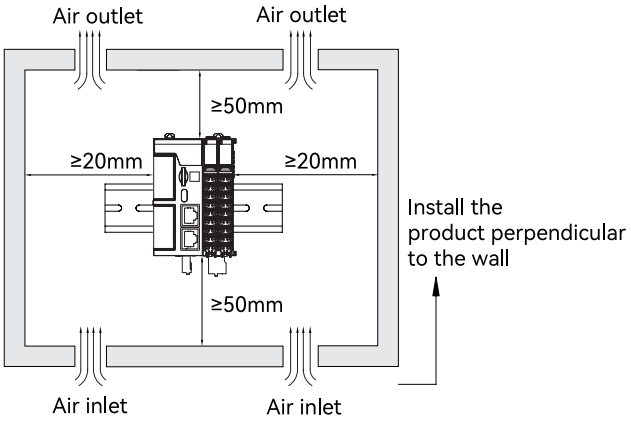
Chapter 5 Installation and Wiring

5.1 Installation instructions

5.1.1 Installation within a control cabinet

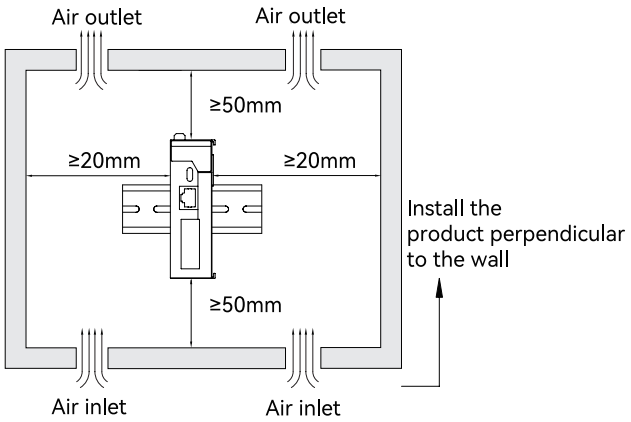
◆ M511S CPU unit

Please install the product perpendicular to the wall and ensure a sufficient cooling effect via natural air or a cooling fan. Please leave enough clearance around the product as shown in the right figure. During a side-by-side installation, please leave a horizontal clearance of more than 20 mm on both sides.



◆ M500S-series CPU unit (except M511S)

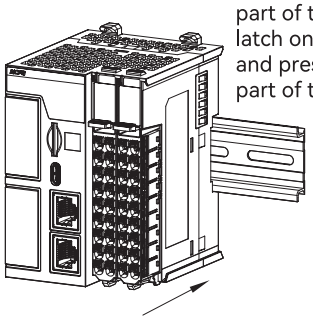
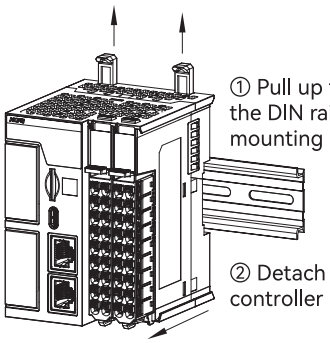
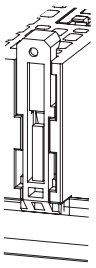
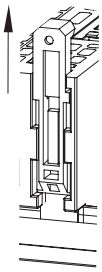
Please install the product perpendicular to the wall and ensure a sufficient cooling effect via natural air or a cooling fan. Please leave enough clearance around the product as shown in the right figure. During a side-by-side installation, please leave a horizontal clearance of more than 20 mm on both sides.



5.1.2 DIN rail mounting and dismounting

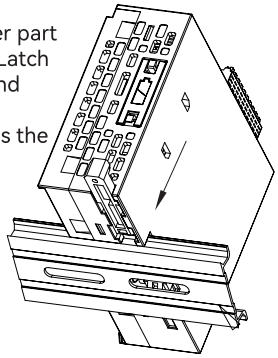
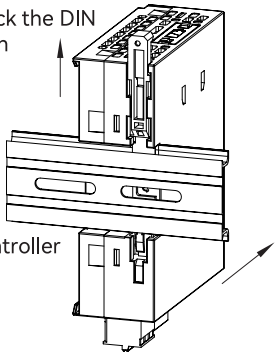
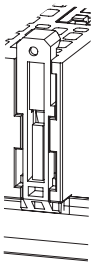
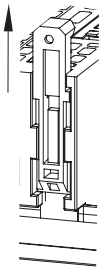
◆ M511S CPU unit

Before installation, check that the DIN rail mounting latch is in a locked state. During mounting, position the upper part of the mounting latch of the module on the DIN rail, and then press the controller against the DIN rail until a clear click is heard (which indicates the latch is momentarily opened and locked onto the rail). During dismounting, pull the latch upwards until a clear click is heard (which indicates the latch is unlocked), and then directly remove the controller.

<table>
<tr><td>Position the upper part of the mounting latch on the DIN rail and press the lower part of the controller
  </td><td> 
① Pull up to unlock the DIN rail mounting latch
② Detach the controller</td><td>(Locked)
  </td><td>(Unlocked)
  </td></tr>
</table>

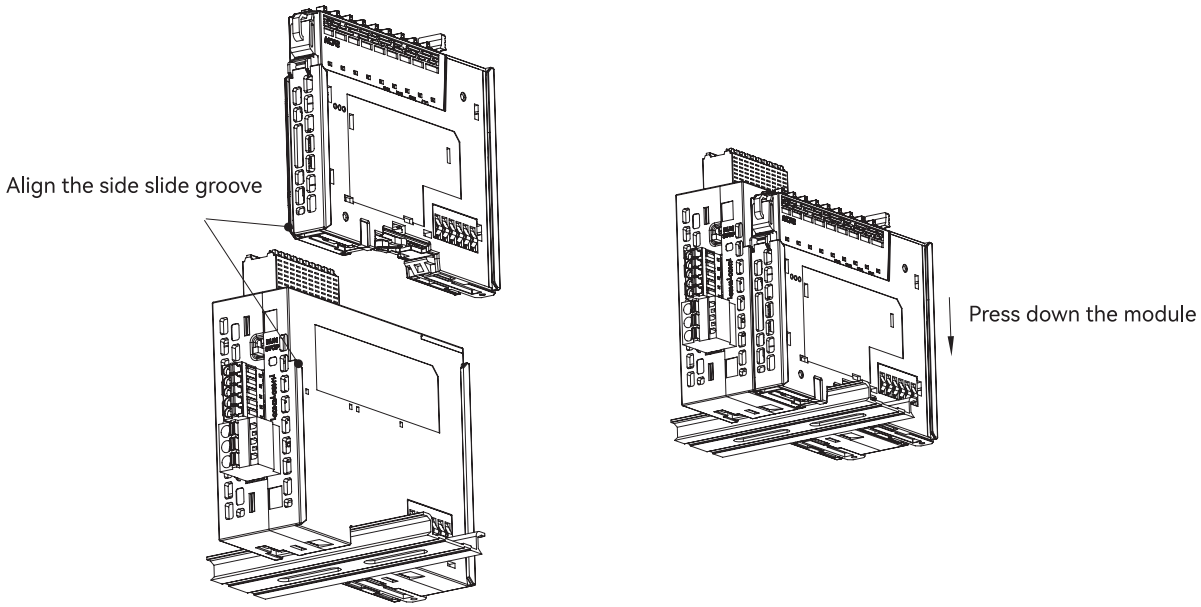
◆ M500S-series CPU unit (except M511S)

Before installation, check that the DIN rail mounting latch is in a locked state. During mounting, position the upper part of the mounting latch of the module on the DIN rail, and then press the controller against the DIN rail until a clear click is heard (which indicates the latch is momentarily opened and locked onto the rail). During dismounting, pull the latch upwards until a clear click is heard (which indicates the latch is unlocked), and then directly remove the controller.

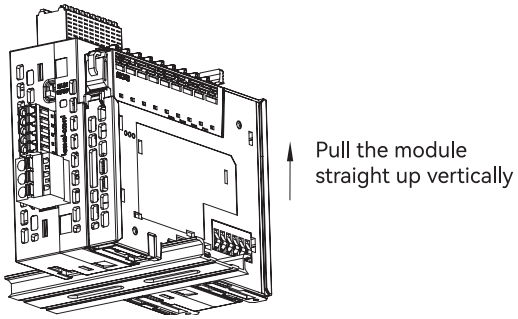
<table>
<tr><td>Position the upper part of the mounting Latch on the DIN rail ,and then press the controller towards the DIN rail
  </td><td>① Pull up to unlock the DIN rail mounting latch
 
② Detach the controller</td><td>(Locked)
  </td><td>(Unlocked)
  </td></tr>
</table>

5.1.3 Expansion module mounting and dismounting

During mounting, align the side slide groove (area marked with a dot) of the entire module with the slide groove (area marked with a dot) of the M-series controller, then press down the module. At this point, the mounting of the entire module is complete. (Before installation, ensure the installation direction is correct; otherwise, the device will not operate properly.)



During dismounting, first release the latch, then pull the module straight up vertically (as indicated by the arrow in the figure) from the bottom.

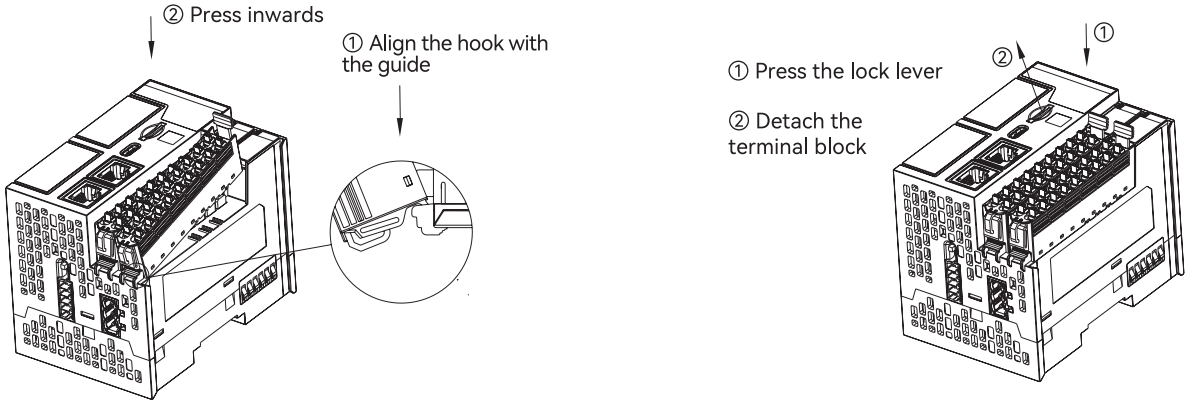


5.1.4 Removable terminal block mounting and dismounting

◆ M511S CPU unit

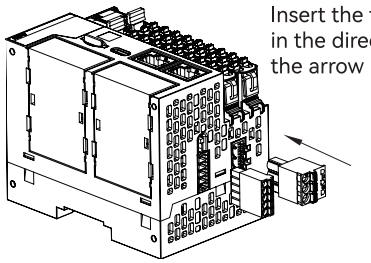
• Removable terminal block mounting and dismounting I

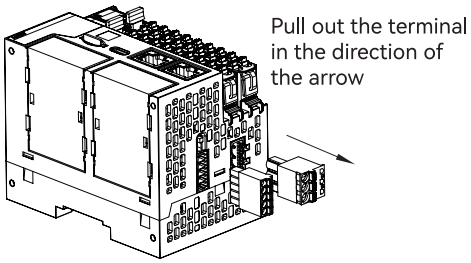
During mounting, align the mounting hook at the bottom of the terminal block to the guide of the module and press inwards on the terminal block until a clear click is heard (which indicates the terminal block has been locked to the module). During dismounting, press the lock lever on the terminal block and then detach it from the module.



• Removable terminal block mounting and dismounting II

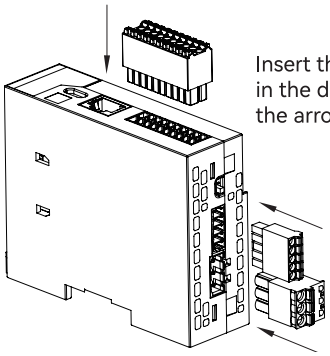
The mounting and dismounting of the removable terminal block are shown in the figures below.

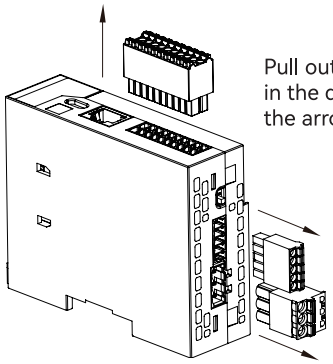




◆ M500S-series CPU unit (except M511S)

The mounting and dismounting of the removable terminal block are shown in the figures below.

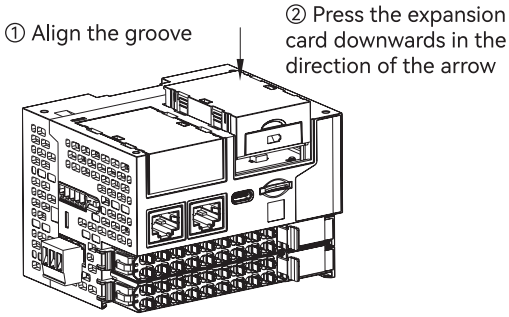


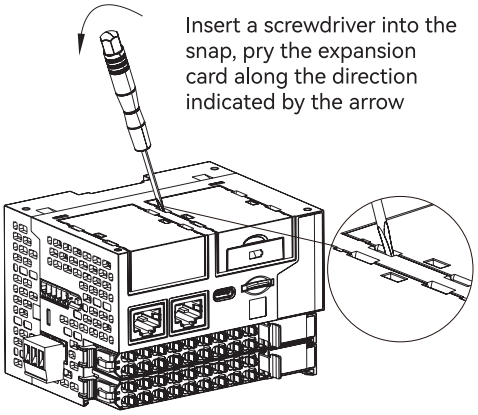


5.1.5 Expansion card mounting and dismounting

◆ M511S CPU unit

During mounting, place the controller horizontally, align the groove of the expansion card with that of the controller, and press the expansion card downwards. After hearing the "click" sound, check whether the junction surface is flush; if it is, then the installation is completed. During dismounting, insert a screwdriver into the snap, pry the expansion card along the direction indicated by the arrow. When a "click" sound is heard, the expansion card disengages from the controller, remove the expansion card vertically to complete the dismounting process.



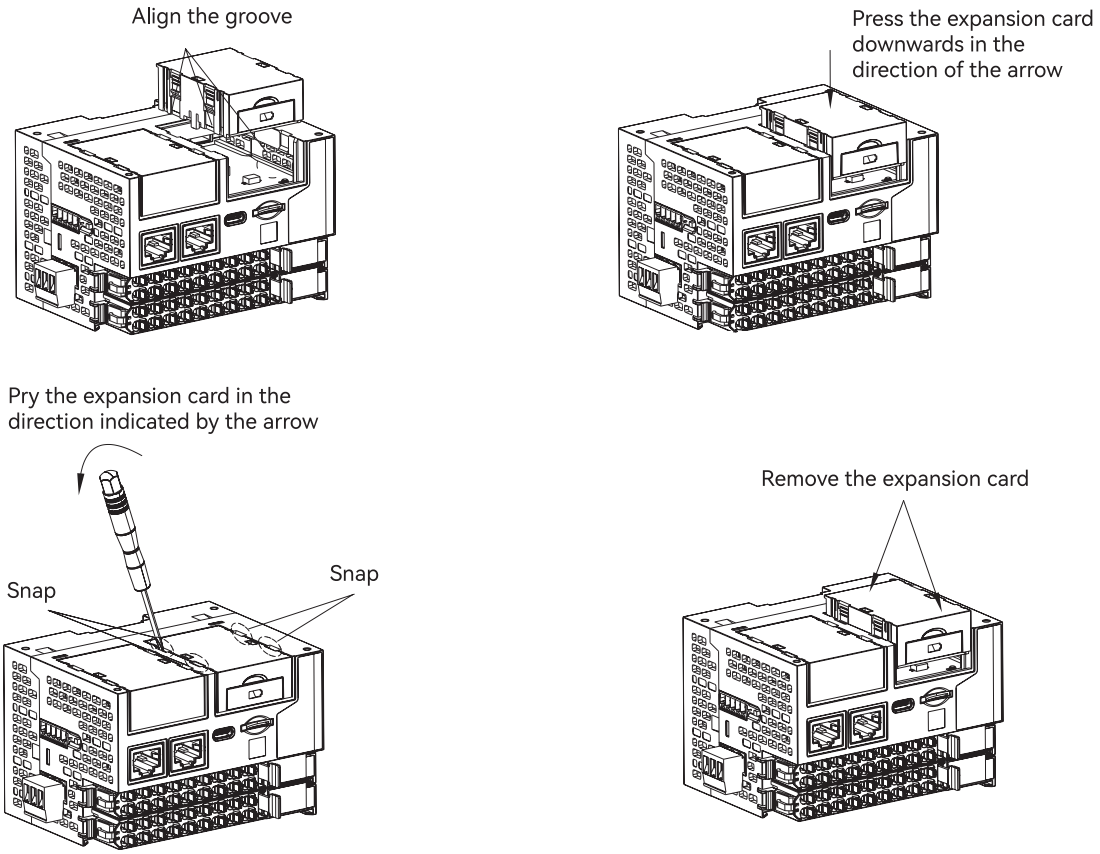


5.1.6 RTC (Real-Time Clock) battery mounting and dismounting

◆ M511S CPU unit

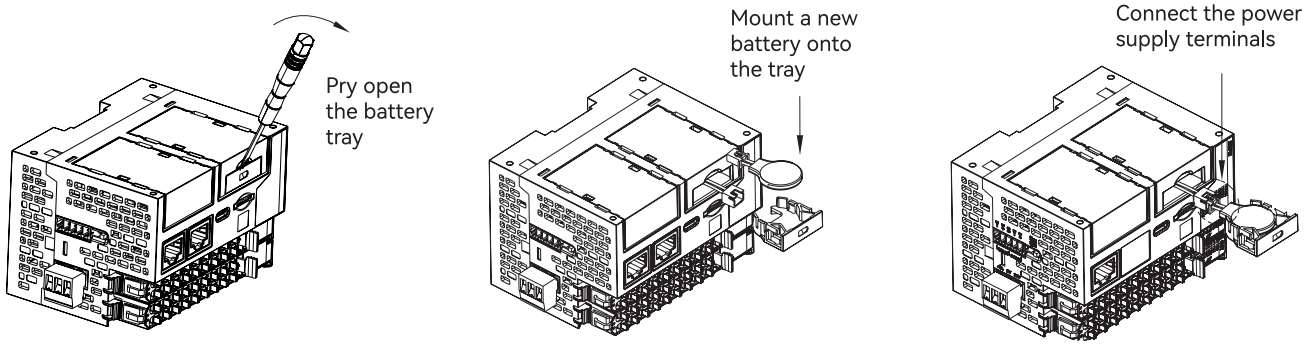
• Overall unit mounting/dismounting

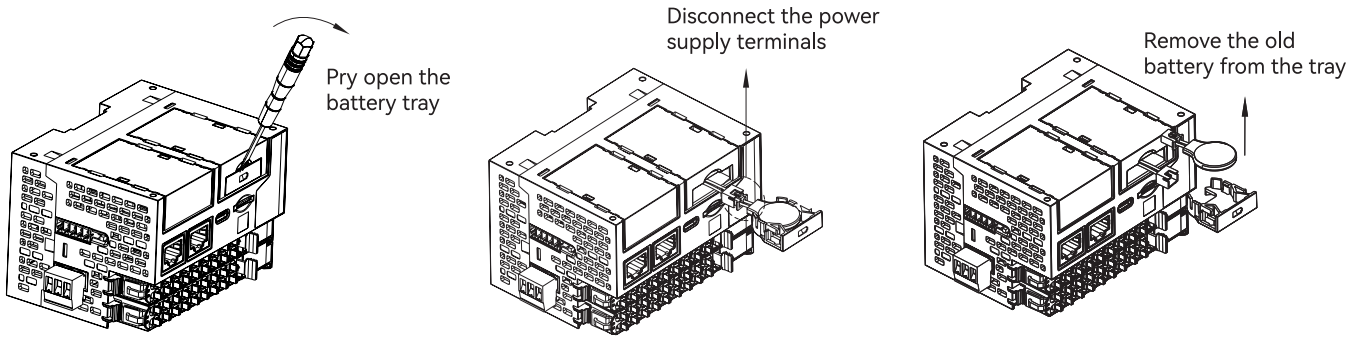
During mounting, place the controller horizontally, align the groove of the expansion card with that of the controller, and press the expansion card downwards. After hearing the "click" sound, check whether the junction surface is flush; if it is, then the installation is completed. During dismounting, insert a screwdriver into the snap, and pry the expansion card in the direction indicated by the arrow. When a "click" sound is heard, the expansion card disengages from the controller, remove the expansion card vertically to complete the dismounting process. At this point, place two fingers at the arrow position shown in the figure below and remove the expansion card vertically.



• RTC battery mounting and dismounting

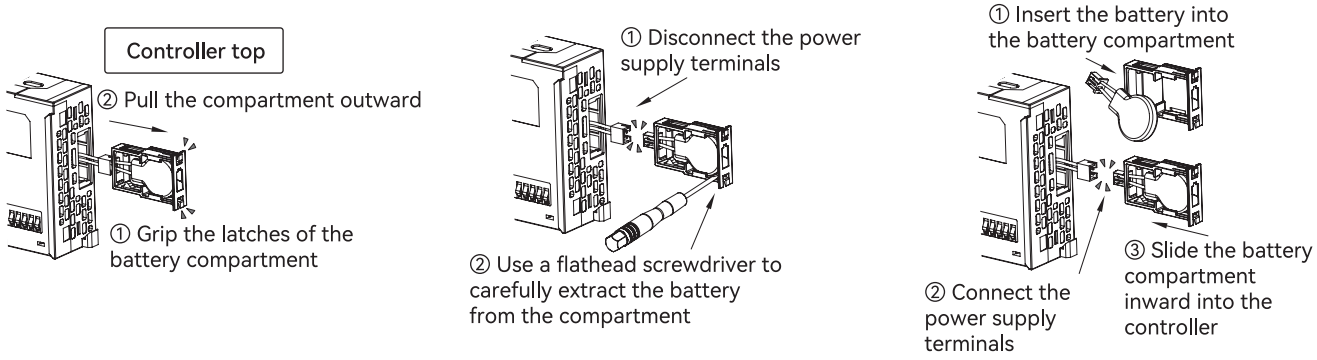
During mounting, use a flathead screwdriver to pry open the battery tray at the designated notch, mount a new battery onto the tray, and then connect the power supply terminal to complete the installation. During dismounting, disconnect the power supply terminal and then remove the old battery from the tray.





◆ M500S-series CPU unit (except M511S)

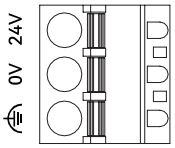
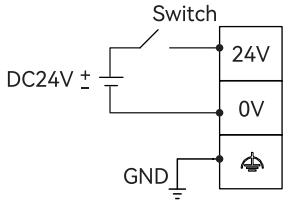
During dismounting, grip the upper and lower latches of the battery compartment and pull the compartment outward to remove it from the controller. Disconnect the power supply, and use a flathead screwdriver to carefully extract the battery from the compartment. During mounting, insert the battery into the battery compartment. Then, connect the male and female power supply terminals. Finally, slide the battery compartment inward into the controller until it is fully secured.



5.2 Wiring

5.2.1 Power supply wiring

The M500S-series motion controller requires a DC 24V power input, with an input voltage range of DC20.4 V to DC28.8 V. Connect the power supply to the 24V and 0V terminals, and ground the grounding terminal.

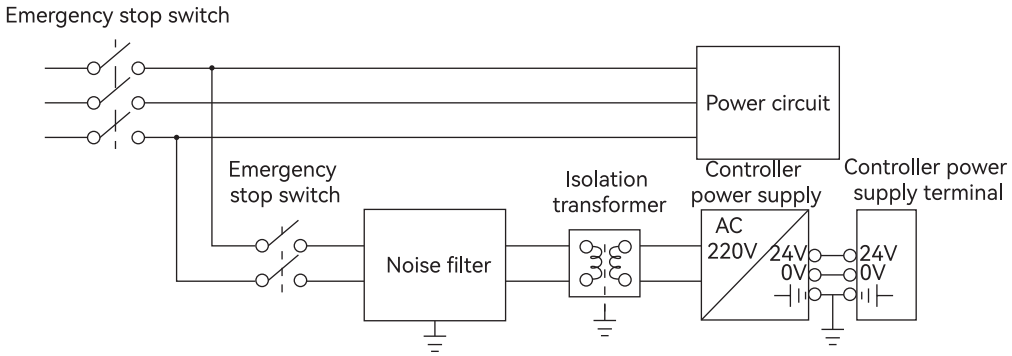
DC24V power supply terminal description		Wiring
24V 0V ⏚		

◆ The recommended wiring method for the controller's power supply is as shown in the figu-re below:

• It is recommended to install a noise filter and an isolation transformer in front of the controller's power supply. The isolation transformer should be placed between the noise filter and the controller's power supply.

• It is recommended to separate the controller's power supply from the power supplies of other input/output devices, ensuring the controller is powered separately.

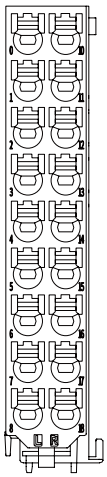
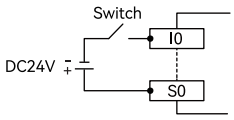
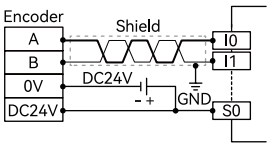
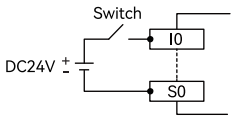
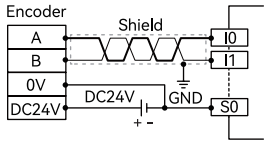
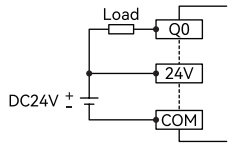
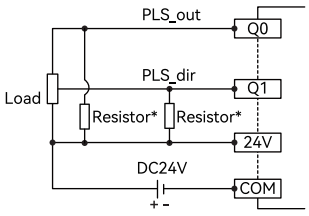
• It is recommended to add an emergency stop switch to the power input terminal of the controller to enable immediate power-off in case of emergency.



5.2.2 I/O wiring

◆ M511S CPU unit

Terminal definition:

Terminal description			IN		OUT		Type	General IO wiring	High-speed IO wiring
0		10	I0	I10	Q0	Q10	Sink input		
1		11	I1	I11	Q1	Q11			
2		12	I2	I12	Q2	Q12			
3		13	I3	I13	Q3	Q13	Source input		
4		14	I4	I14	Q4	Q14			
5		15	I5	I15	Q5	Q15	Sink output		
6		16	I6	I16	Q6	Q16			
7		17	I7	I17	Q7	Q17			
8		18	S0	S0	24V	COM			

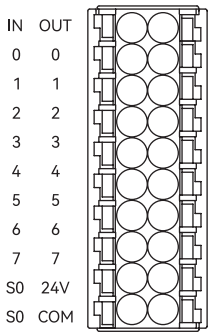
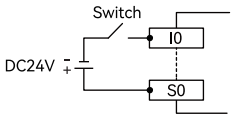
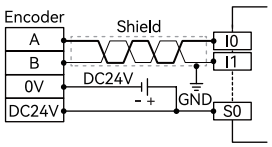
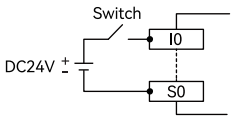
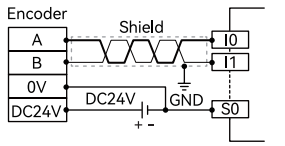
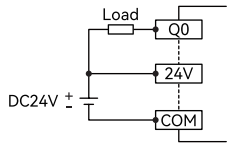
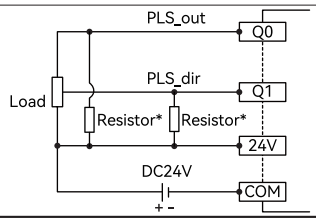
*Note : Connect a resistor of about 500 Ω between the output terminal and the 24V terminal when the external load current is small.

Terminal configuration																			
No.		0	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18
Input terminal name		I0	I1	I2	I3	I4	I5	I6	I7	S0*	I10	I11	I12	I13	I14	I15	I16	I17	S0*
High-speed input channel supported by M511S		Channel 1		Channel 2		-				Common terminal	-								Common terminal
High-speed input definitions	Pulse + Direction	Pulse	Direction	Pulse	Direction	-					-								
	AB phase	A	B	A	B	-					-								
	Single pulse	Pulse	-	Pulse	-	-					-								
Output terminal name		Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7	24V	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	COM

High-speed output channel supported by M511S		Channel 1		Channel 2		Channel 3		Channel 4		DC24V	-	Common terminal
High-speed output definitions	Pulse + Direction	Pulse	Direction	Pulse	Direction	Pulse	Direction	Pulse	Direction		-	

◆ M500S-series CPU unit (except M511S)

Terminal definition:

Terminal description	IN	OUT	Type	General IO wiring	High-speed IO wiring
	I0	Q0	Sink input		
	I1	Q1			
	I2	Q2			
	I3	Q3	Source input		
	I4	Q4			
	I5	Q5			
	I6	Q6	Sink output		
	I7	Q7			
	S0	24V			
	S0	COM			

*Note : Connect a resistor of about 500 Ω between the output terminal and the 24V terminal when the external load current is small.

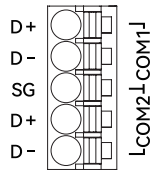
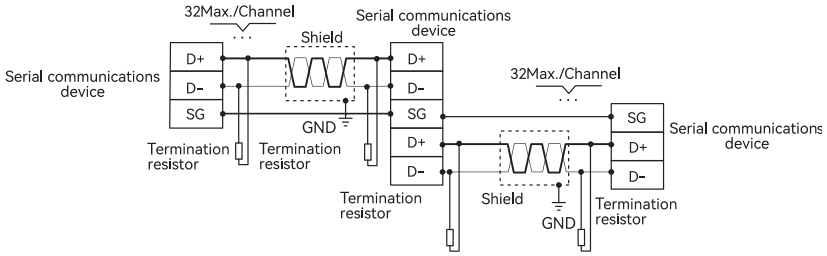
Terminal configuration											
Input terminal name		I0	I1	I2	I3	I4	I5	I6	I7	S0*	S0*
High-speed input channel supported by M500S		Channel 1		Channel 2		-				Common terminal	Common terminal
High-speed input definitions	Pulse + Direction	Pulse	Direction	Pulse	Direction	-					
	AB phase	A	B	A	B	-					
	Single pulse	Pulse	-	Pulse	-	-					
Output terminal name		Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7	24V	COM
High-speed output channel supported by M500S		Channel 1		Channel 2		Channel 3		Channel 4		DC24V	Common terminal
High-speed output definitions	Pulse + Direction	Pulse	Direction	Pulse	Direction	Pulse	Direction	Pulse	Direction		

*Note: The input common terminal S0 is internally conductive.

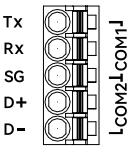
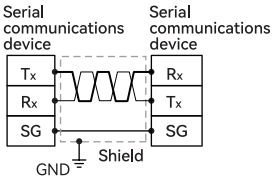
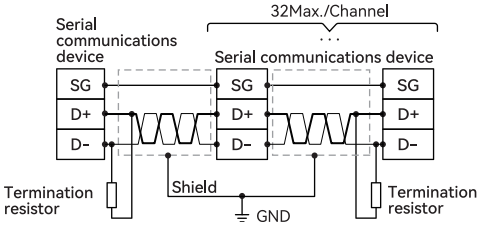
5.2.3 Communication wiring

Please refer to Chapter 6 for communication wiring in this chapter.

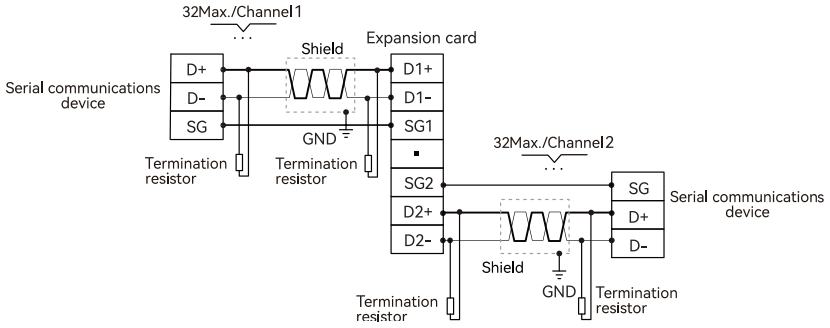
◆ M511S CPU unit

5-Pin serial communication terminal description			RS485 wiring
COM1 RS485 communication signal +	D+		
COM1 RS485 communication signal −	D−		
Signal reference ground	SG		
COM2 RS485 communication signal +	D+		
COM2 RS485 communication signal −	D−		

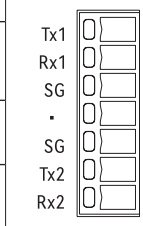
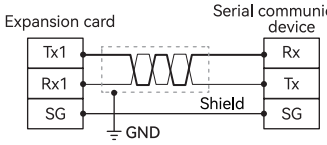
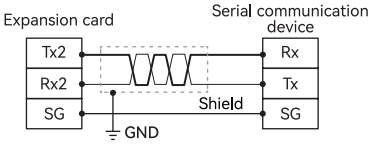
◆ M500S-series CPU unit (except M511S)

5-Pin serial communication terminal description			RS232 wiring	RS485 wiring
COM1 RS232 data transmission	Tx			
COM1 RS232 data reception	Rx			
Signal reference ground	SG			
COM2 RS485 communication signal +	D+			
COM2 RS485 communication signal −	D−			

◆ RS485 expansion card (HCMXB-2RS485-BD)

RS485 communication terminal description			RS485 wiring
RS485 channel 1 communication signal +	D1+		
RS485 channel 1 communication signal −	D2−		
RS485 channel 1 signal reference ground	SG1		
−	■		
RS485 channel 2 signal reference ground	SG2		
RS485 channel 2 communication signal +	D2+		
RS485 channel 2 communication signal −	D2−		

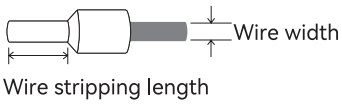
◆ RS232 expansion card (HCMXB-2RS232-BD)

RS232 communication terminal description			RS232 channel 1 wiring	RS232 channel 2 wiring
RS232 channel 1 data transmission	Tx1			
RS232 channel 1 data reception	Rx1			
RS232 channel 1 signal reference ground	SG			
-	■			
RS232 channel 2 signal reference ground	SG			
RS232 channel 2 data transmission	Tx2			
RS232 channel 2 data reception	Rx2			

5.2.4 Installation and wire gauge specifications

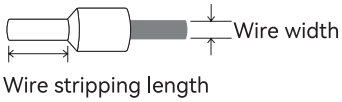
◆ M511S CPU unit

Controller terminal	Wire gauge range: AWG	Wire stripping length: mm	Crimping force: N	Pull-out force: N
18-Pin IO terminal	24~18	8~10	10	50
5-Pin serial communication terminal	24~16	8~10	16	40
DC24V power supply terminal	26~12	9~10	25	60



◆ M500S-series CPU unit (except M511S)

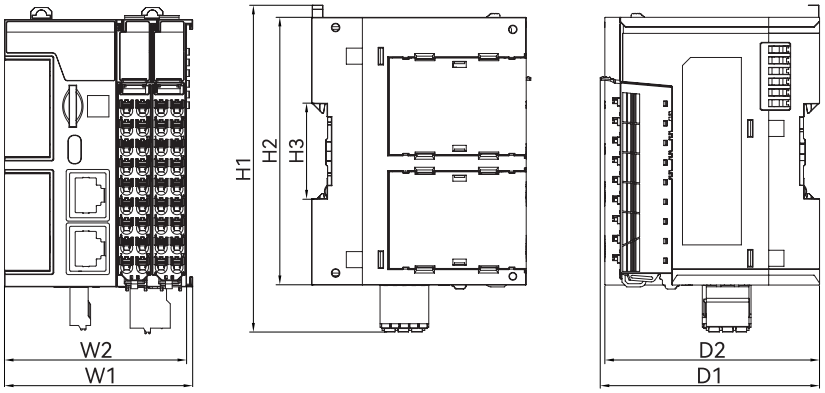
Controller terminal	Wire gauge range: AWG	Wire stripping length: mm	Crimping force: N	Pull-out force: N
20-Pin IO terminal	24~16	9~10	25	40
5-Pin serial communication terminal	24~16	8~10	16	40
DC24V power supply terminal	26~12	9~10	25	60



5.3 Product dimensions

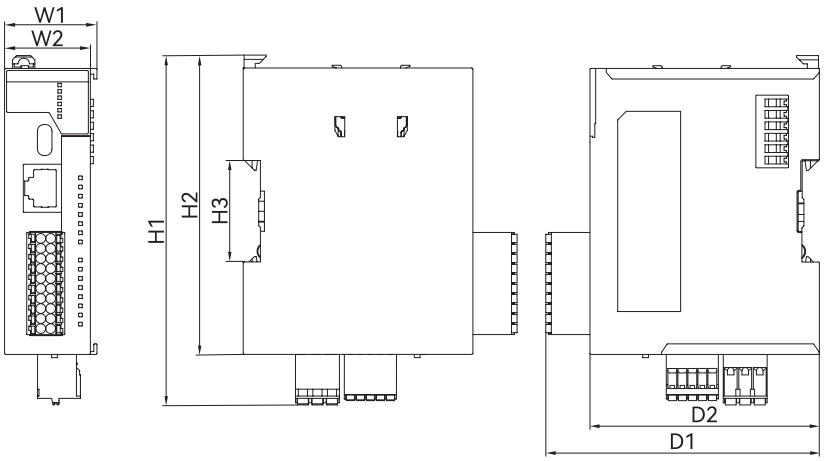
5.3.1 CPU unit dimensions

◆ **M511S CPU unit**



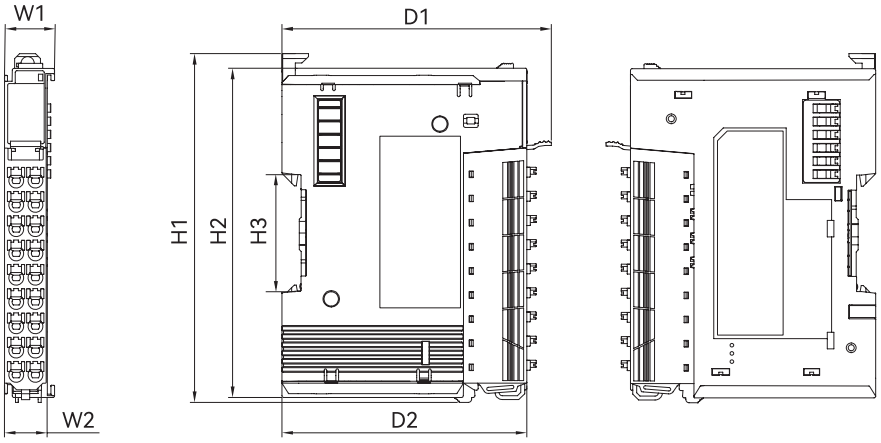
Outline dimensions						
W1	W2	H1	H2	H3	D1	D2
70.30	67.99	122.05	100.00	35.40	81.92	80.20

◆ **M500S-series CPU unit (except M511S)**

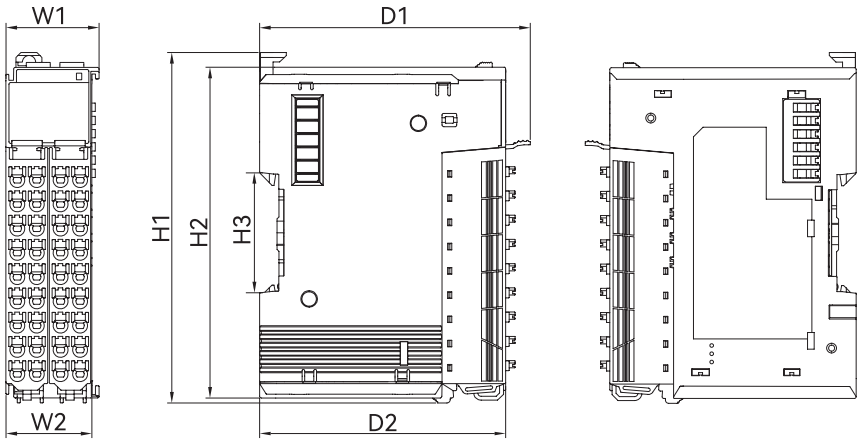


Outline dimensions						
W1	W2	H1	H2	H3	D1	D2
32.30	30.00	122.15	104.50	35.40	95.64	80.20

5.3.2 Expansion module dimensions



Single-row terminal module	Outline dimensions						
	W1	W2	H1	H2	H3	D1	D2
HCMX-OD08-D HCMX-OD08-D-PNP HCMX-OD16-D HCMX-OD16-D-PNP HCMX-ID08-D HCMX-ID16-D HCMX-MD16-D HCMX-MD16-D-PNP HCMX-AD04-D HCMX-AD04S-D HCMX-DA04-D HCMX-DA04S-D	15.20	13.00	122.15	104.50	35.40	95.64	80.20



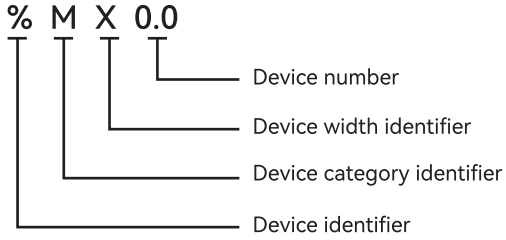
Double-row terminal module	Outline dimensions						
	W1	W2	H1	H2	H3	D1	D2
HCMX-OD32-D HCMX-OD32-D-PNP HCMX-ID32-D HCMX-MD32-D HCMX-MD32-D-PNP HCMX-OC08-D	32.30	30.00	122.15	104.50	35.40	95.64	80.20

Chapter 6 Communication

6.1 Device and Modbus address

6.1.1 Device name and range

◆ **Device representation method**



M-series controller devices use the "%" symbol for identification. Users can select the required device based on the device category and width. Devices can be accessed by bit, byte, word, double word, or quad word. The representation method is shown in the table below:

Item	Content				
Device identifier	%: Indicates the use of a device				
Device category	I	Q	M	-	-
	Input device	Output device	Intermediate device	-	-
Device width	X	B	W	D	L
	Bit device	Byte device	Word device	Double word device	Quad word device
Device index	-	-	-	-	-
Bit offset	-	-	-	-	-
Device example	%IX0.0	%IB0	%IW0	%ID0	%IL0
	%QX0.0	%QB0	%QW0	%QD0	%QL0
	%MX0.0	%MB0	%MW0	%MD0	%ML0

◆ **The device correspondence is shown in the table below:**

As shown in the table, %ML0 consists of %MB0~%MB7, %MW0~%MW3, and %MD0~%MD1; %MD0 consists of %MB0~%MB3 and %MW0~%MW1; %MW0 consists of %MB0~%MB1. The numbering of bit devices is consistent with the labeling of byte devices. For example, Bit 0 of %MB2 corresponds to %MX2.0; %MB2 consists of %MX2.0~2.7; %MW1 consists of %MX2.0~2.7 and %MX3.0~3.7.

Device category	Device correspondence																							
	The 1st WORD						The 2nd WORD						The 3rd WORD						The 4th WORD					
	Bit 0	…	Bit 7	Bit 8	…	Bit 15	Bit 0	…	Bit 7	Bit 8	…	Bit 15	Bit 0	…	Bit 7	Bit 8	…	Bit 15	Bit 0	…	Bit 7	Bit 8	…	Bit 15
%MX	%MX0.0~0.7			%MX1.0~1.7			%MX2.0~2.7			%MX3.0~3.7			%MX4.0~4.7			%MX5.0~5.7			%MX6.0~6.7			%MX7.0~7.7		
%MB	%MB0			%MB1			%MB2			%MB3			%MB4			%MB5			%MB6			%MB7		
%MW	%MW0						%MW1						%MW2						%MW3					
%MD	%MD0												%MD1											
%ML	%ML0																							

As shown in the table, %ML1 consists of %MB8~%MB15, %MW4~%MW7, and %MD2~%MD3; %MD2 consists of %MB8~%MB11 and %MW4~%MW5; %MW4 consists of %MB8~%MB9. The numbering of bit devices is consistent with the labeling of byte devices. For example, Bit 0 of %MB8 corresponds to %MX8.0; %MB8 consists of %MX8.0~8.7. %MW4 consists of %MX8.0~8.7 and %MX9.0~9.7.

Device category	Device correspondence																							
	The 5th WORD						The 6th WORD						The 7th WORD						The 8th WORD					
	Bit 0	…	Bit 7	Bit 8	…	Bit 15	Bit 0	…	Bit 7	Bit 8	…	Bit 15	Bit 0	…	Bit 7	Bit 8	…	Bit 15	Bit 0	…	Bit 7	Bit 8	…	Bit 15
%MX	%MX8.0~8.7			%MX9.0~9.7			%MX10.0~10.7			%MX11.0~11.7			%MX12.0~12.7			%MX13.0~13.7			%MX14.0~14.7			%MX15.0~15.7		
%MB	%MB8			%MB9			%MB10			%MB11			%MB12			%MB13			%MB14			%MB15		
%MW	%MW4						%MW5						%MW6						%MW7					
%MD	%MD2												%MD3											
%ML	%ML1																							

◆ Device range:

The device range of the M511S controller is shown in the table below:

Device category	Device representation method	Device range
%IX	%IX0.0~%IX0.7 %IX1.0~%IX1.7	%IX0.0~%IX127.7
%QX	%QX0.0~%QX0.7 %QX1.0~%QX1.7	%QX0.0~%QX127.7
%MX	%MX0.0~%MX0.7 %MX1.0~%MX1.7	%MX0.0~%MX131071.7
%IB	%IB0	%IB0~%IB127
%QB	%QB0	%QB0~%QB127
%MB	%MB0	%MB0~%MB131071
%IW	%IW0	%IW0~%IW63
%QW	%QW0	%QW0~%QW63
%MW	%MW0	%MW0~%MW65535
%ID	%ID0	%ID0~%ID31
%QD	%QD0	%QD0~%QD31
%MD	%MD0	%MD0~%MD32767
%IL	%IL0	%IL0~%IL15
%QL	%QL0	%QL0~%QL15
%ML	%ML0	%ML0~%ML16383

Note: %MW0~%MW999 are default as power-outage retention addresses.

6.1.2 Modbus addresses corresponding to devices

The devices listed in the table below support standard MODBUS function codes (e.g., 03/06/10/01/02/05/0F, etc.) and can be accessed via Ethernet, RS232, or RS485 communication. When users need to read/write the bit devices of the controller through an HMI (Human-Machine Interface), they can use the bit devices of output devices as intermediate bit devices. For example, %QX50.0~%QX127.7 can be used as intermediate bit devices; any output device without control output channels can serve as an intermediate bit device.

Device area	Device category	Device range	Modbus address
I (Input device)	Bit device (bit)	%IX0.0~%IX0.7	0x6000~0x6007
		%IX1.0~%IX1.7	0x6008~0x600F
		……	……
		%IX127.0~%IX127.7	0x63F8~0x63FF
	Word device (word)	%IW0~%IW63	0x8000~0x803F
Q (Output device)	Bit device (bit)	%QX0.0~%QX0.7	0xA000~0xA007
		%QX1.0~%QX1.7	0xA008~0xA00F
		……	……
		%QX127.0~%QX127.7	0xA3F8~0xA3FF
	Word device (word)	%QW0~%QW63	0xA000~0xA03F
M (Intermediate device)	Word device (word)	%MW0~%MW32767	0x0000~0x7FFF

Conversion method for QX-related bit devices to Modbus addresses:

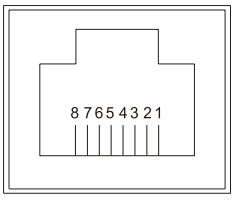
For example, QXA.B: Convert A×8+B to hexadecimal, then add 16#A000.

Example: %QX50.1 corresponds to Modbus address 0xA191. Calculation: 50×8+1=401=16#191; 16#191+16#A000=0xA191.

6.2 EtherCAT communication

6.2.1 EtherCAT communication interface pin definition

Pin	Signal	Description
1	Tx+	Transmit data positive (TX+)
2	Tx-	Transmit data negative (TX-)
3	Rx+	Receive data positive (RX+)
4	Reserved	Reserved
5	Reserved	Reserved
6	Rx-	Receive data negative (RX-)
7	Reserved	Reserved
8	Reserved	Reserved



Ethernet

6.2.2 EtherCAT communication interface function description

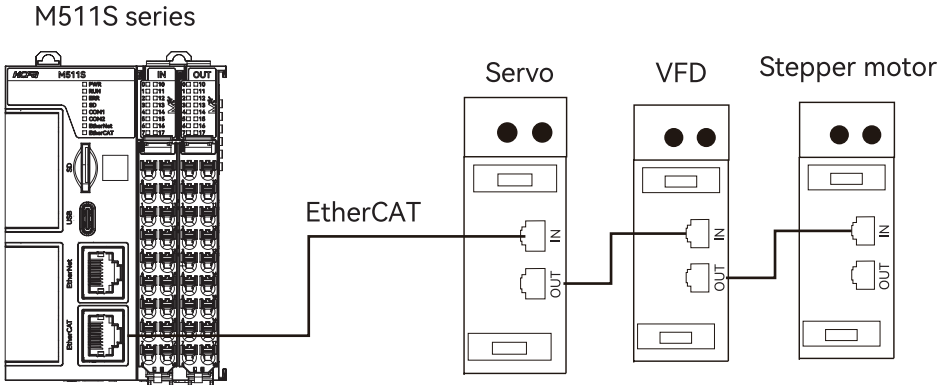
1. It can connect to EtherCAT drives supported by the controller firmware, associate axes with the drives, and control the axes via motion commands. Users cannot configure the parameters of EtherCAT drives via PDOs.

2. It supports reading from or writing to Service Data Objects (SDOs) supported by the slave.

3. Remote IO modules cannot be connected via the EtherCAT communication interface.

6.2.3 EtherCAT network connection

As shown in the figure below, the EtherCAT network has strict requirements for network topology. It must follow the connection rule: the controller's EtherCAT communication interface connects to the IN (input) of the first slave's EtherCAT communication interface; the OUT (output) of the first slave's EtherCAT communication interface connects to the IN of the next slave's EtherCAT communication interface, and so on.



6.2.4 EtherCAT communication distance

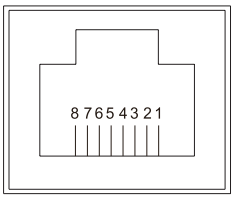
The distance between adjacent EtherCAT nodes shall not exceed 100 meters.

6.3 EtherNet communication

6.3.1 EtherNet communication interface pin definition

The default IP address of EtherNet is 192.168.1.8.

Pin	Signal	Description
1	Tx+	Transmit data positive (TX+)
2	Tx-	Transmit data negative (TX-)
3	Rx+	Receive data positive (RX+)
4	Reserved	Reserved
5	Reserved	Reserved
6	Rx-	Receive data negative (RX-)
7	Reserved	Reserved
8	Reserved	Reserved



Ethernet

6.3.2 EtherNet communication interface function description

The M500S-series motion controller with an Ethernet communication interface supports Modbus TCP and Socket. It can act as a Modbus TCP master or slave. The Ethernet communication interface automatically detects 10/100 Mbps transmission rates.

The Ethernet communication interface can be used to download hardware configurations, programs, electronic cams, etc. Touchscreens, PLCs, or other Modbus TCP devices can perform read/write operations on the internal devices of the M500S-series motion controller via the Ethernet communication interface.

The detailed specifications of the Ethernet communication interface is shown in the table below:

Item	Description
Communication protocol	Modbus TCP, Socket

Maximum transmission distance (between hub and node)		100 meters
Number of simultaneous communication connections for Modbus TCP, Socket		12
Modbus TCP	Maximum number of connections as a client	4
	Maximum number of connections as a server	4
Socket	Sum of TCP and UDP connection counts	4

6.3.3 Function codes and exception response codes supported by the EtherNet communication interface using Modbus TCP protocol

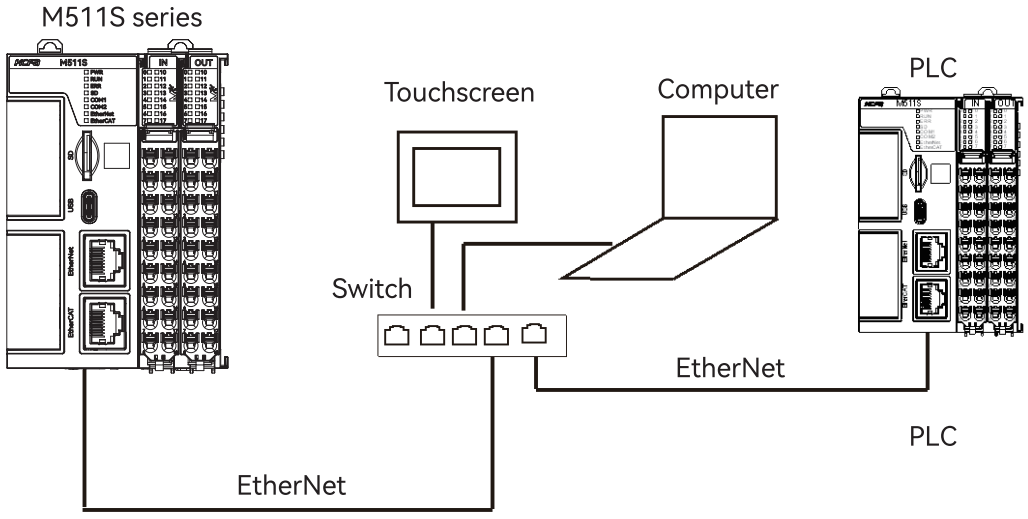
The following table lists the function codes supported by the EtherNet communication interface of the M500S-series motion controller when using the Modbus TCP protocol:

Category	Function code	Description	Broadcastable (Y/N)	Read/Write maximum length	Operable device
Bit device	0x01	Definition: Read the value of bit devices. M-series controller bit device values can all be read using function code 01.	N	256	%IX,%QX
	0x02	Definition: Read the value of input bit devices. M-series controller bit device values can all be read using function code 02.	N	256	%IX,%QX
	0x05	Write the value of a single bit device.	Y	1	%QX
	0x0F	Write the values of multiple bit devices.	Y	256	%QX
Word device	0x03	Read the value of single or multiple word devices.	N	100	%MW,%QW,%IW
	0x04	Definition: Read the value of single or multiple input word devices. M-series controller word device values can all be read using function code 04.	N	100	%MW,%QW,%IW
	0x06	Write the value of a single word device.	Y	1	%MW,%QW
	0x10	Write the values of multiple word devices.	Y	100	%MW,%QW
	0x17	Read/Write the value of single or multiple word devices.	Y	100	%MW,%QW, %IW (read only)

The following table lists the exception response codes supported by the EtherNet communication interface of the M500S-series motion controller when using the Modbus TCP protocol:

Exception response code	Description	Troubleshooting
1	The slave does not support the function code specified by the master.	Specify a function code supported by the slave.
2	The slave does not support the Modbus address specified by the master.	Specify a Modbus address supported by the slave.
3	The read/write data length specified exceeds the limit.	When the controller acts as a slave: For word devices, the maximum read/write length per operation is 100 WORDs. For bit devices, the maximum read/write length per operation is 256 bits. The controller returns this exception code if the limits are exceeded.
7	The checksum calculated by the master and slave differs.	Confirm that the baud rate and communication format of the master and slave are consistent. Check for interference near the bus. Check that the bus is a shielded cable. Ensure both the master and slave are grounded.

6.3.4 EtherNet network connection



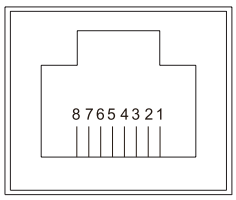
6.4 CAN communication

6.4.1 CAN communication interface pin definition

Other M500S-series motion controllers do not support the CAN interface. The M511S-series motion controller does not have a built-in CAN communication interface, but it can be expanded with an expansion card to add an independent CAN communication interface. Only one CAN expansion card can be installed. The model of the CAN expansion card is HCMXB-CAN-BD. The pin definitions of the CAN expansion card communication interface are shown in the figure below:

Pin	Signal	Description
1	CAN_H	CAN communication signal (high)
2	CAN_L	CAN communication signal (low)
3	CAN_GND	CAN communication signal reference ground

CAN



The CAN communication interface can be used as a master in a CANopen network or as a slave to another master. The master/slave role can be selected in the software.

◆ **When used as a master, it supports the following functions:**

- Supports the CANopen protocol DS301v4.02.
- Supports master services for network management (Network Management Object: NMO).
- Supports monitoring of slave disconnection.

  * The master's slave disconnection monitoring mechanism includes two types: Heartbeat and NodeGuarding. The controller only supports Heartbeat.

  * Other stations can send Heartbeat messages to the controller, which monitors their disconnection status.

- Supports up to 32 slaves.
- Supports Process Data Object (PDO) services:

  * Up to 200 RxPDOs are supported, with a total data size of up to 1000 bytes for all RxPDOs.

  * Up to 200 TxPDOs are supported, with a total data size of up to 1000 bytes for all TxPDOs.

  * PDO transmission types: Data change trigger (asynchronous 255), synchronous periodic trigger (synchronous 1~240),

synchronous aperiodic trigger (synchronous 0).

* PDO mapping: Each PDO can map up to 8 bytes of parameters.

- Supports Service Data Object (SDO) services.
- Data types that PDO and SDO can operate on:

Number of data bits	Data type
8-bit	SINT, USINT, BYTE
16-bit	INT, UINT, WORD,
32-bit	DINT, UDINT, REAL, DWORD

- Synchronous message range: 1-65535ms. Synchronous messages enable synchronized actions among multiple devices.

◆ When used as a slave, it supports the following functions:

- Supports the CANopen protocol DS301v4.02.
- Supports Network Management Object (NMO) services.
- Supports monitoring of other stations' disconnection status.

  * Supports Heartbeat error control but not NodeGuarding error control.

  * Other stations can send Heartbeat messages to the controller, which monitors their disconnection status.

- Supports PDO services:

  * Up to 8 RxPDOs are supported, with each PDO mapping up to 8 bytes of parameters. The total data size of all RxPDOs is up to 64 bytes.

  * Up to 8 TxPDOs are supported, with each PDO mapping up to 8 bytes of parameters. The total data size of all TxPDOs is up to 64 bytes.

- PDO transmission types: Event trigger, data change trigger, synchronous periodic trigger, synchronous aperiodic trigger.
- Supports Service Data Object (SDO) services.

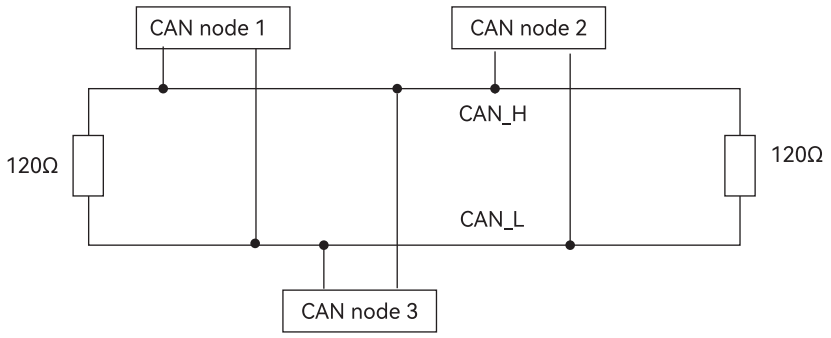
6.4.2 PDO mapping of CANopen communication interface

When the M511S motion controller is configured as a CANopen master, the PDO data area for controlling slaves has a length of 500 WORDs, ranging from %MW63500 to %MW63999; the data area for receiving slave data also has a length of 500 WORDs, ranging from %MW63000 to %MW63499.

When the M511S motion controller is configured as a CANopen slave, the PDO data area for receiving master data has a length of 32 WORDs, ranging from %MW63000 to %MW63031; the data area for sending data to the master also has a length of 32 WORDs, ranging from %MW63500 to %MW63531.

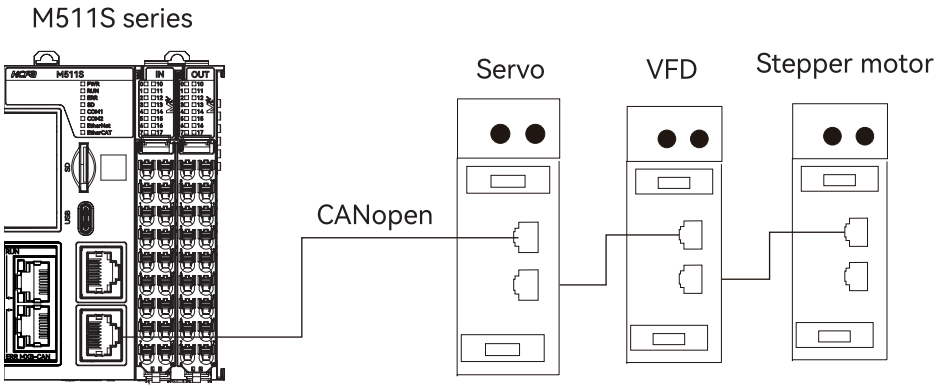
6.4.3 CANopen bus hardware connection

To enhance the stability of CANopen communication, both ends of the CANopen bus network need to be connected to a 120Ω termination resistor. The diagram below shows a schematic of the basic CANopen network topology.



- When building a CANopen network, it is recommended to use dedicated CANopen cables.
- Connect a 120Ω resistor in series between CAN_H and CAN_L at both ends of the CANopen network.

6.4.4 CANopen bus network topological architecture



6.4.5 Communication rate and distance of CANopen communication interface

The transmission distance of the CANopen bus is related to its baud rate. The table below shows the maximum communication distance corresponding to different baud rates.

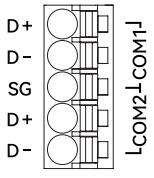
Transmission speed (bits per second)	20K	50K	125K	250K	500K	1M
Maximum communication distance (meters)	2500	1000	500	250	100	40

6.5 RS485 communication

6.5.1 RS485 communication interface pin definition

The M511S-series controller has two built-in independent RS485 communication interfaces. The pin definitions of the RS485 communication interface are shown in the figure below:

Pin definition	Abbreviation	Description
D+	RS485+	RS485 positive signal
D-	RS485-	RS485 negative signal
SG	Reference ground	RS485 signal reference ground



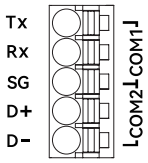
The M511S-series motion controller can be expanded with one expansion card to add two independent RS485 communication interfaces. Only one RS485 expansion card can be installed. The model of the RS485 expansion card is HCMXB-2RS485-

BD. The pin definitions of the RS485 expansion card communication interface are shown in the figure below:

Pin definition	Function
D1+	RS485 channel 1 communication signal +
D1-	RS485 channel 1 communication signal -
SG1	RS485 channel 1 signal reference ground
■	-
SG2	RS485 channel 2 signal reference ground
D2+	RS485 channel 2 communication signal +
D2+-	RS485 channel 2 communication signal -

Other M500S-series CPU units (except M511S) integrally include one RS232 communication interface and one RS485 communication interface.

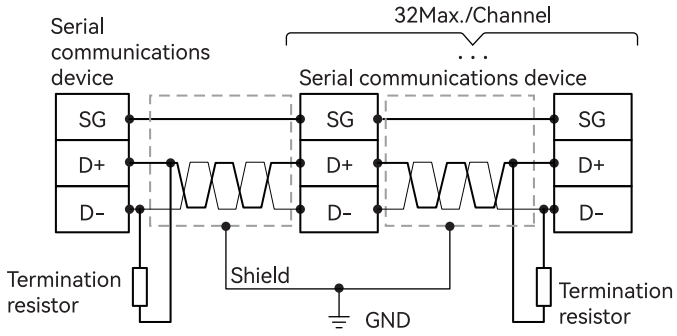
Pin definition	Function
Tx	RS232 channel 1 data transmission
Rx	RS232 channel 1 data reception
SG	Signal reference ground
D+	RS485 channel 2 communication signal +
D-	RS485 channel 2 communication signal -



6.5.2 RS485 communication interface function description

The RS485 communication interfaces of the M500S-series motion controller support the same functions: they support Modbus communication protocols, can act as a Modbus master or slave, and support custom communication protocols. Touch-screens, PLCs, or other Modbus master devices can read/write data from/to the internal devices of the M500S-series motion controller via the RS485 communication interface. When the RS485 communication interface acts as a master, it can connect to 32 slaves; when acting as a slave, the station number range is 1~255, and broadcast functionality is not supported.

6.5.3 RS485 bus network topological architecture



◆ **Recommended RS-485 wiring method:**

- Install a 120Ω termination resistor (with power ≥ 1/4 W) at both the start and end of the RS485 bus.
- Use shielded twisted-pair cables with grounded shielding wires to ensure stable communication.
- Connect the RS485 reference grounds of different devices together to prevent communication instability caused by differing system reference grounds.

6.5.4 RS485 supported communication format

The RS485 communication interface supports ASCII or RTU communication formats, with a maximum baud rate of up to 115200 bps.

Baud rate	9600; 19200; 38400; 57600; 115200					
Mode	ASCII				RTU	
Communication format	7,E,1	7,E,2	7,N,1	7,N,2	8,E,1	8,E,2
	7,O,1	7,O,2	8,E,1	8,E,2	8,N,1	8,N,2
	8,N,1	8,N,2	8,O,1	8,O,2	8,O,1	8,O,2

6.5.5 Function codes and exception response codes supported by RS485

◆ The function codes supported by the RS485 communication interface of the M500S-series motion controller are listed in the table below:

Category	Function code	Description	Broadcastable (Y/N)	Read/Write maximum length	Operable device
Bit device	0x01	Definition: Read the value of bit devices. M-series controller bit device values can all be read using function code 01.	N	256	%IX,%QX
	0x02	Definition: Read the value of input bit devices. M-series controller bit device values can all be read using function code 02.	N	256	%IX,%QX
	0x05	Write the value of a single bit device.	Y	1	%QX
	0x0F	Write the values of multiple bit devices.	Y	256	%QX
Word device	0x03	Read the value of single or multiple word devices.	N	100	%MW,%QW,%IW
	0x04	Definition: Read the value of single or multiple input word devices. M-series controller word device values can all be read using function code 04.	N	100	%MW,%QW,%IW
	0x06	Write the value of a single word device.	Y	1	%MW,%QW
	0x10	Write the values of multiple word devices.	Y	100	%MW,%QW
	0x17	Read/Write the value of single or multiple word devices.	Y	100	%MW,%QW, %IW (read only)

◆ The following table lists the exception response codes supported by the RS485 communication interface of the M500S-series motion controller:

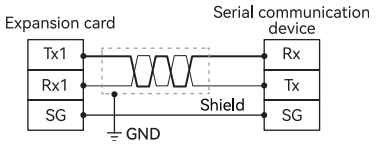
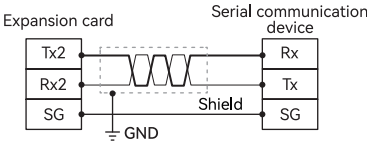
Exception response code	Description	Troubleshooting
1	The slave does not support the function code specified by the master.	Specify a function code supported by the slave.
2	The slave does not support the Modbus address specified by the master.	Specify a Modbus address supported by the slave.
3	The read/write data length specified exceeds the limit.	When the controller acts as a slave: For word devices, the maximum read/write length per operation is 100 WORDs. For bit devices, the maximum read/write length per operation is 256 bits. The controller returns this exception code if the limits are exceeded.

7	The checksum calculated by the master and slave differs.	Confirm that the baud rate and communication format of the master and slave are consistent. Check for interference near the bus. Check that the bus is a shielded cable. Ensure both the master and slave are grounded.

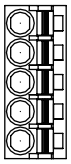
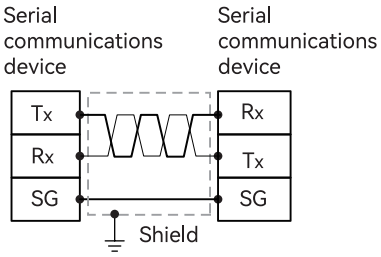
6.6 RS232 communication

6.6.1 RS232 communication interface pin definition and wiring method

The M511S-series motion controller does not have a built-in RS232 communication interface, but it can be expanded with one expansion card to add two independent RS232 communication interfaces. Only one RS232 expansion card can be installed. The model of the RS232 expansion card is HCMXB-2RS232-BD. The pin definitions and wiring method of the RS232 expansion card communication interface are shown in the figure below:

RS232 communication terminal description			RS232 channel 1 wiring	RS232 channel 2 wiring
RS232 channel 1 data transmission	Tx1			
RS232 channel 1 data reception	Rx1			
RS232 channel 1 signal reference ground	SG			
-	■			
RS232 channel 2 signal reference ground	SG			
RS232 channel 2 data transmission	Tx2			
RS232 channel 2 data reception	Rx2			

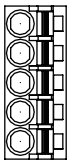
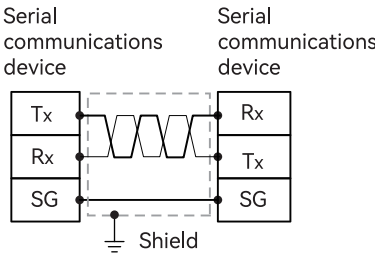
Other M500S-series motion controllers integrally include one RS232 communication interface and one RS485 communication interface. The pin definitions and wiring diagram of the RS232 communication interface are shown in the figure below.

Communication interface		
Interface description		RS232
Tx		
Rx		
SG		
D+		
D-		

6.6.2 RS232 communication interface function description

The RS232 communication interfaces of the M500S-series motion controller support the same functions: they support the Modbus communication protocol, can act as a Modbus master or slave, and support custom communication protocols. Touchscreens, PLCs, or other Modbus master devices can read/write data from/to the internal devices of the M500S-series motion controller via the RS232 communication interface. Each RS232 communication interface can connect to one slave when acting as a master. When the controller acts as a slave, the station number range is 1~255, and broadcast functionality is not supported.

6.6.3 RS232 bus network topological architecture

Communication interface		
Interface description		RS232
Tx		
Rx		
SG		
D+		
D_		

Recommended wiring method for RS232: Use shielded twisted-pair cables with grounded shielding wires to ensure stable communication.

6.6.4 RS232 supported communication format

The RS232 communication interface supports ASCII or RTU communication formats, with a maximum baud rate of up to 115200 bps.

Baud rate	9600; 19200; 38400; 57600; 115200					
Mode	ASCII				RTU	
Communication format	7,E,1	7,E,2	7,N,1	7,N,2	8,E,1	8,E,2
	7,O,1	7,O,2	8,E,1	8,E,2	8,N,1	8,N,2
	8,N,1	8,N,2	8,O,1	8,O,2	8,O,1	8,O,2

6.6.5 Function codes and exception response codes supported by RS232

◆ The function codes supported by the RS232 communication interface of the M500S-series motion controller are listed in the table below:

Category	Function code	Description	Broadcastable (Y/N)	Read/Write maximum length	Operable device
Bit device	0x01	Definition: Read the value of bit devices. M-series controller bit device values can all be read using function code 01.	N	256	%IX,%QX
	0x02	Definition: Read the value of input bit devices. M-series controller bit device values can all be read using function code 02.	N	256	%IX,%QX
	0x05	Write the value of a single bit device.	Y	1	%QX
	0x0F	Write the values of multiple bit devices.	Y	256	%QX

Word device	0x03	Read the value of single or multiple word devices.	N	100	%MW,%QW,%IW
	0x04	Definition: Read the value of single or multiple input word devices. M-series controller word device values can all be read using function code 04.	N	100	%MW,%QW,%IW
	0x06	Write the value of a single word device.	Y	1	%MW,%QW
	0x10	Write the values of multiple word devices.	Y	100	%MW,%QW
	0x17	Read/Write the value of single or multiple word devices.	Y	100	%MW,%QW, %IW (read only)

◆ The following table lists the exception response codes supported by the RS232 communication interface of the M500S-series motion controller:

Exception response code	Description	Troubleshooting
1	The slave does not support the function code specified by the master.	Specify a function code supported by the slave.
2	The slave does not support the Modbus address specified by the master.	Specify a Modbus address supported by the slave.
3	The read/write data length specified exceeds the limit.	When the controller acts as a slave: For word devices, the maximum read/write length per operation is 100 WORDs. For bit devices, the maximum read/write length per operation is 256 bits. The controller returns this exception code if the limits are exceeded.
7	The checksum calculated by the master and slave differs.	Confirm that the baud rate and communication format of the master and slave are consistent. Check for interference near the bus. Check that the bus is a shielded cable. Ensure both the master and slave are grounded.

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