



M-Series *Motion Controller*

M300

Hardware Manual



✳ Preface

Thank you for purchasing and using the M300-series controller products independently developed and manufactured by Hechuan Technology Co., Ltd.

The M300-series controller is a pulse-type motion controller independently developed and manufactured by HCFA, featuring rich functionality, superior performance, and user-friendly operation. It integrates the functions of a Programmable Logic Controller (PLC) and motion control. The controller comes with built-in input/output channels and various communication interfaces. Its built-in I/O channels support high-speed input and output, with up to 6 high-speed output channels and 2 high-speed input channels. Additionally, it supports expansion of up to 16 I/O modules on the right side.

This manual primarily describes the products listed in the table:

Name	Model	I/O quantity	Brief description
M-series controller	HCM301-16MT4-D	8-channel input 8-channel output	The CPU unit comes with built-in input/output channels and various communication interfaces. The built-in I/O channels support high-speed input and output, with a maximum of 6 high-speed output channels and 2 high-speed input channels.
	HCM302-16MT4-D		
	HCM310-16MT4-D		
	HCM311-16MT4-D		
	HCM312-32MT6-D	16-channel input 16-channel output	All models are equipped with USB and RS485 communication interfaces as standard. Some models feature built-in RS232 and Ethernet interfaces, while others can expand communication interfaces such as RS485, RS232, and CAN via expansion cards. The right side supports expansion with up to 16 I/O modules.

Target reader

Users who purchase or use HCFA's M300-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 M300-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.

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 M300 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 M300-series CPU unit HCM3 □□ - □□□□ - □ is shown in the figure below.

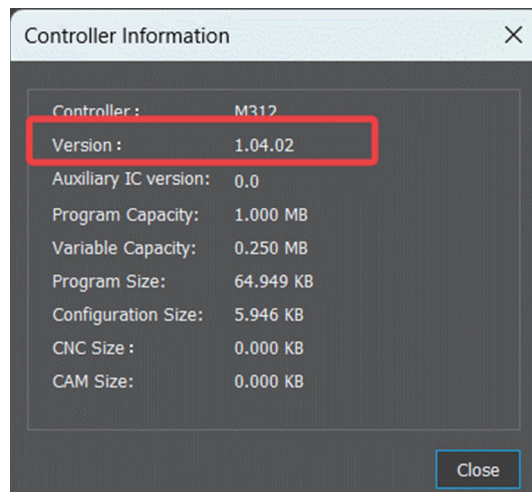
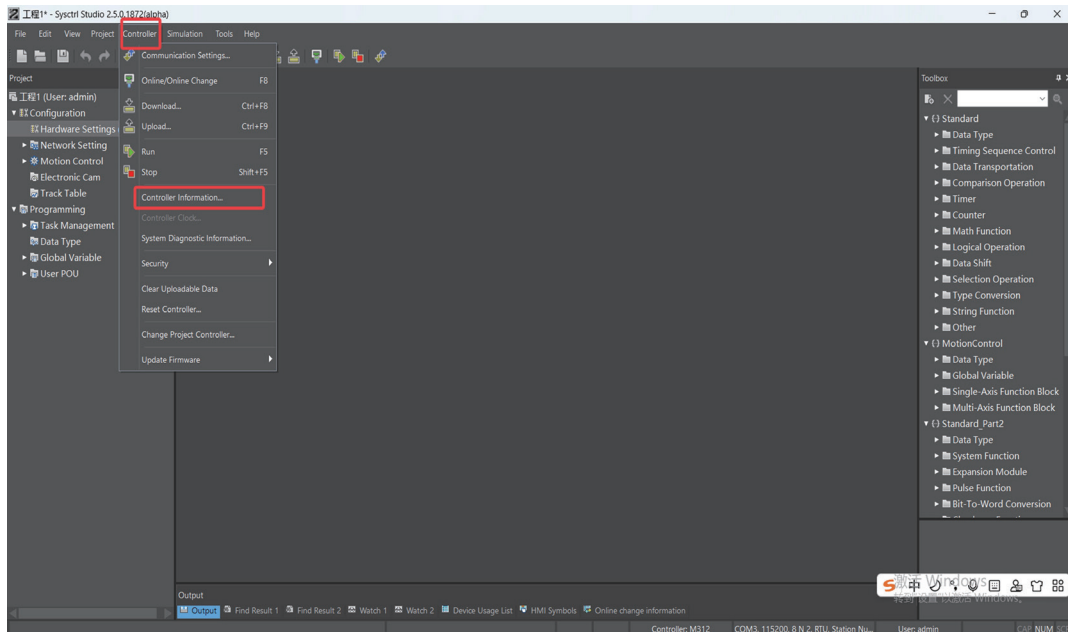


Note: "POWER INPUT" on this label indicates the power consumption of the unit itself.

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 DC 0.5A: Supports 24V DC sinking output, with a maximum load (resistive type) of 0.5A per point. DC 0.5A: Maximum load (resistive type) of 0.5A per point.
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
V1.1	Update of part of the technical parameters

※ 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 M300 series , it is denoted as HCM3 □□ - □□□□ - □ .
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

- Unauthorized printing, reproduction, or republication of any part or all of this manual is strictly prohibited.
- Product specifications and other information in this manual may change due to product improvements, and no prior notice will be given.
- While efforts have been made to ensure the accuracy of this manual, please contact 400@hcfa.cn if there are any unclear or incorrect points. Please include the manual number indicated on the cover when doing so.

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Chapter 1 M-Series Controllers Overview

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1.1 Product feature and main function description of M300-series controller

1.1.1 Hardware feature

Model	IO quantity	Pulse-type quantity	Communication interface		
			Ethernet	Serial port	USB
M301	8-channel input 8-channel output	4-axis	-	1*RS485 1*RS232	1-channel
M302					
M310					
M311					
M312	16-channel input 16-channel output	6-axis	1-channel	2*RS485	

• M-series expansion modules support

The controller supports various M-series expansion modules. The M312 model supports CAN communication for connecting CAN bus-type remote I/O modules.

• Standard USB/Type-C interfaces

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 M300-series controller is a pulse-type motion controller independently developed and manufactured by HCFA, featuring rich functionalities, superior performance, and user-friendly operation. It integrates the functions of a Programmable Logic Controller (PLC) and motion control. The controller is equipped 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 6 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 USB and RS485 communication interfaces. Some models come with a built-in RS232 and Ethernet interface, while others can expand their capabilities to include RS485, RS232, CAN, and other communication interfaces via expansion cards.

The M300-series controller is equipped with multiple communication interfaces, including 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, EIP and Socket; the CAN communication interface supports the CANopen DS301v4.02 protocol and can function as both a master and a slave.

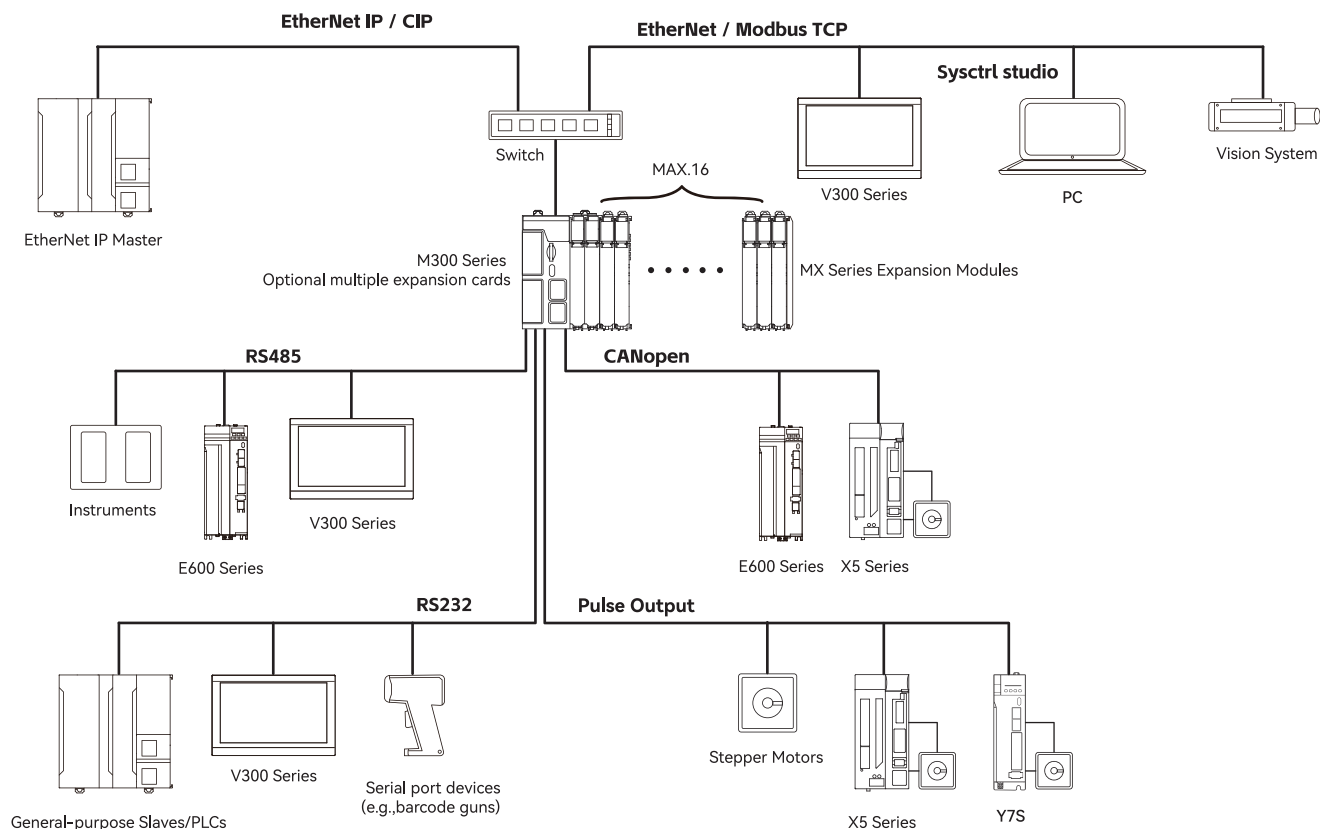
The M300-series controller provides a comprehensive and user-friendly set of motion control functions that comply with the internationally recognized motion command standards established by PLCopen. It supports a full range of single-axis operations, including homing, positioning, and speed regulation, while also incorporating advanced features such as electronic

gearing. For high-end applications, premium models enhance capabilities to include multi-axis commands, allowing for sophisticated operations like electronic cam control, rotary cutting, and axis grouping. These versatile functions make the M300 series a robust solution for various automated control scenarios, including packaging, woodworking, wire winding, and wire cutting systems.

1.3 Controller overview

1.3.1 System configuration

The system topology of M300-series controller is shown below.



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

1.3.2 Software description

◆ Supported connection method

Model		M301	M302	M310	M311	M312
USB	Quantity	1-channel Type-C (USB 2.0)				
	Supported function	Program upload/download, software monitoring and debugging, firmware upgrade, etc.				
Ethernet	Quantity	-		1-channel		
	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/](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】** .

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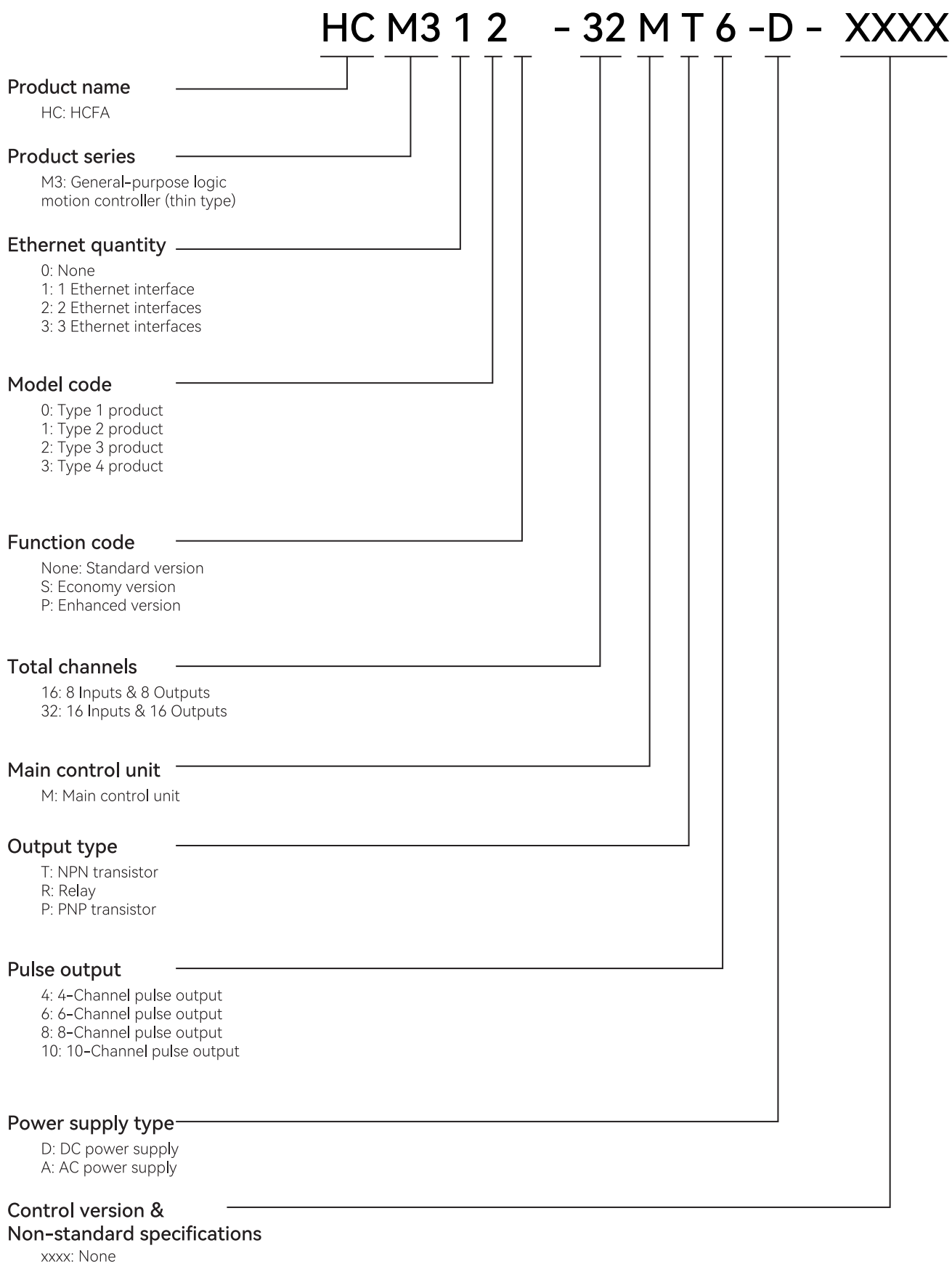
Download Type	Name	Updated	Operation
X-Series	HCS-Studio(En) V2.14	2025.08.20	Download
Software	HDv-CMC-ECC-000-ECAT coupler XML file	2025.07.02	Download
Software	HDv-E610 series frequency converter CANopenEDS file	2025.07.02	Download
M-series	Sysctrl Studio 2.3.0.1167 Setup(release) (EN)	2024.08.21	Download

激活 Windows
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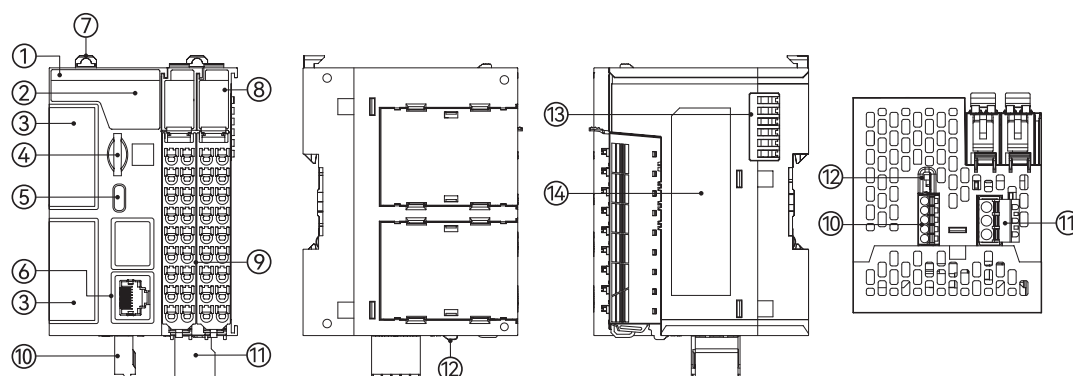
2.1 Product model



2.2 Basic composition

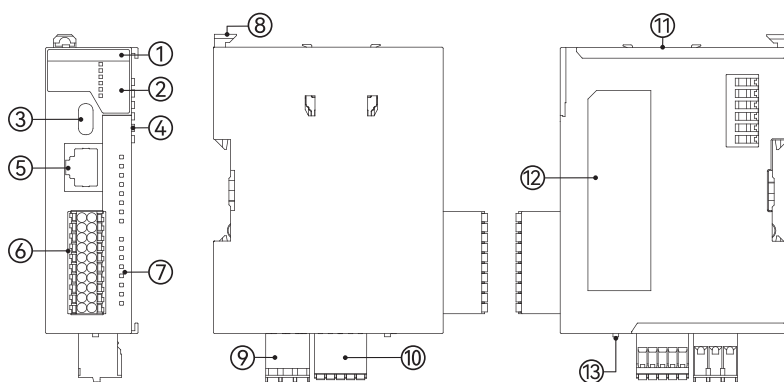
2.2.1 Names and functions of CPU unit components

◆ M312 CPU unit



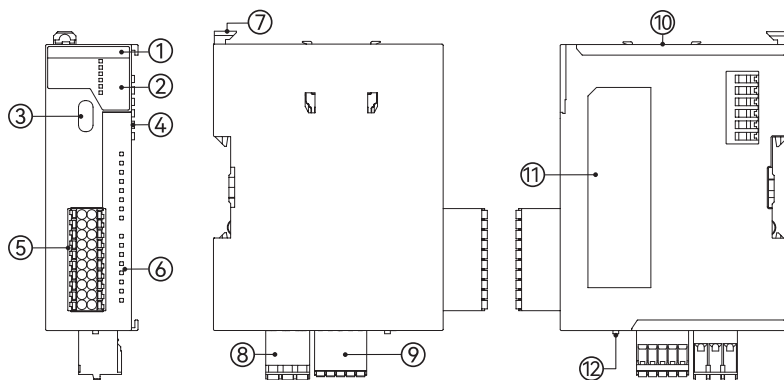
No.	Name	Function
(1)	Product name	Product model
(2)	System status indicator	Displays the operating status of the controller system
(3)	Expansion slot	Expansion card slot, supporting optional expansion cards
(4)	SD card slot*	SD card slot* (SD card needs to be purchased by the customer; no functions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

◆ M310/M311 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	Connect PLC scanner and download user program
(4)	Expansion module communication interface	Connect expansion module
(5)	RJ45 interface	EtherNet
(6)	20-Pin IO terminal	Electrical interfaces for receiving external input signals and controlling external actuators/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. Refer to Section 5.2.3 Communication Wiring for details.
(11)	RTC battery slot	-
(12)	Label	Describes basic information such as the device model and power consumption
(13)	RUN/STOP switch	Starts or stops the operation of the CPU unit's programs. Toggle to RUN to start, and to STOP to stop.

◆ M301/ M302 CPU unit



No.	Name	Function
(1)	Product name	Product model
(2)	System status indicator	Displays the operating status of the CPU

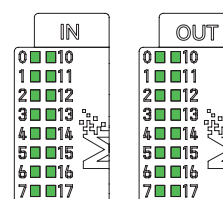
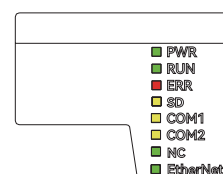
(3)	Type-C interface	Connect PLC scanner and download user program
(4)	Expansion module communication interface	Connect expansion module
(5)	20-Pin IO terminal	Electrical interfaces for receiving external input signals and controlling external actuators/other devices.
(6)	Channel Status Indicator	Indicates the current channel status. For details on the indicators, refer to 2.2.2 Indicator description.
(7)	DIN rail mounting latch	Latch structure for mounting the controller on a DIN rail
(8)	DC24V power supply terminal	DC24V power supply interface
(9)	5-Pin serial communication terminal	Serial communication terminal. Refer to Section 5.2.3 Communication Wiring for details.
(10)	RTC battery slot	-
(11)	Label	Describes basic information such as the device model and power consumption
(12)	RUN/STOP switch	Starts or stops the operation of the CPU unit's programs. Toggle to RUN to start, and to STOP to stop.

2.2.2 Indicator description

◆ M312 CPU unit

Silkscreen	Indicator	Color	State	Function
PWR	Power status	Green	Not lit	Power not connected
			Lit	Power connected
RUN	Operation status	Green	Not lit	Initialization status
			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 data sent
COM2			Blinking	Sending data to other devices
NC	-	-	-	-
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
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

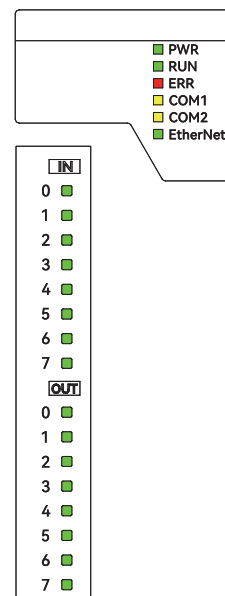
M312



◆ M310/M311 CPU unit

Silkscreen	Indicator	Color	State	Function
PWR	Power status	Green	Not lit	Power not connected
			Lit	Power 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 data sent
			Blinking	Sending data to other devices
COM2	RS485 communication status	Yellow	Not lit	No data sent
			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
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

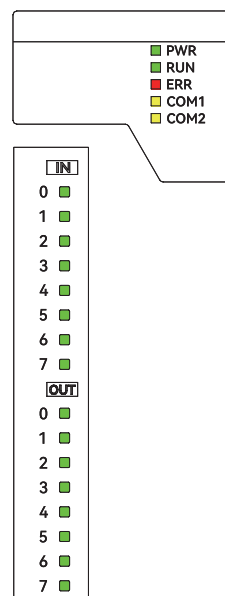
M310/M311



◆ M301/M302 CPU unit

Silkscreen	Indicator	Color	State	Function
PWR	Power status	Green	Not lit	Power not connected
			Lit	Power 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 data sent
			Blinking	Sending data to other devices
COM2	RS485 communication status	Yellow	Not lit	No data sent
			Blinking	Sending data to other devices
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

M301/M302



2.2.3 Expansion card

Item		Specification		
		M312	M311/M310	M301/M302
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., M312 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., M312 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 M300-series (except M312) CPU has a built-in battery with a lifespan of 5 years. The M312 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		
		M312	M311/M310	M301/M302
USB	Number of interfaces	1x USB2.0 Type-C		
	Supported function	Program upload and download, software monitoring and debugging, firmware upgrading.		

2.2.6 SD card

The M312-series controller supports SD card expansion. The following specifications are applicable for SD cards:

Item	Specification	
Supported model	M312	
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

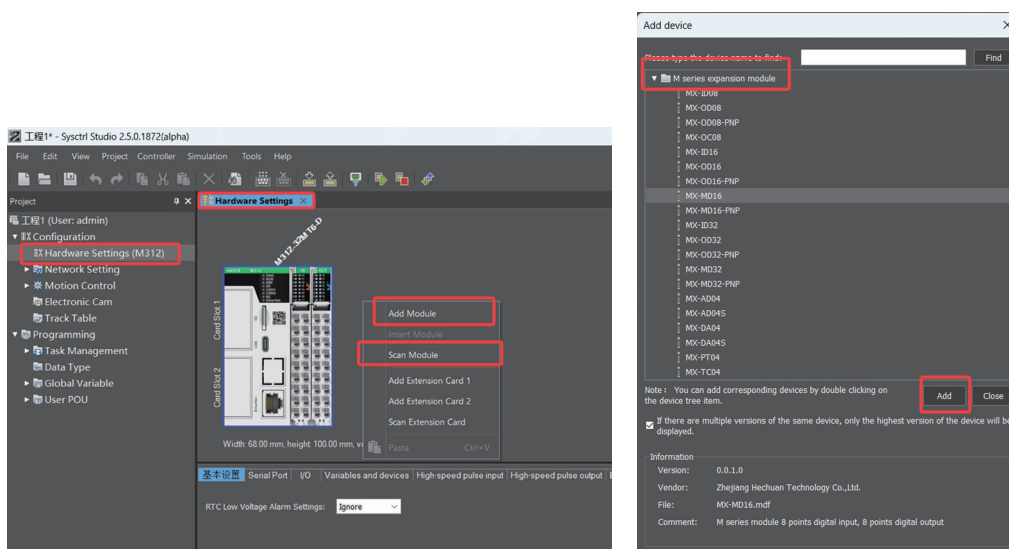
◆ Supported expansion module

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.

Width: 81.00 mm, height: 100.00 mm, voltage: DC24V, power: 6.00 W

Parameter	Variable	Assigned to	Data Type	Initial Value	Comment
Input channel 0	hwcVar7	%IB2	USINT		
Bit0	hwcVar8	%IX2.0	BOOL		
Bit1	hwcVar9	%IX2.1	BOOL		
Bit2	hwcVar10	%IX2.2	BOOL		
Bit3	hwcVar11	%IX2.3	BOOL		
Bit4	hwcVar12	%IX2.4	BOOL		
Bit5	hwcVar13	%IX2.5	BOOL		
Bit6	hwcVar14	%IX2.6	BOOL		
Bit7	hwcVar15	%IX2.7	BOOL		
Output channel 0	hwcVar16	%QB2	USINT		
Bit0	hwcVar17	%QX2.0	BOOL		
Bit1	hwcVar18	%QX2.1	BOOL		
Bit2	hwcVar19	%QX2.2	BOOL		
Bit3	hwcVar20	%QX2.3	BOOL		
Bit4	hwcVar21	%QX2.4	BOOL		
Bit5	hwcVar22	%QX2.5	BOOL		

Chapter 3 Product Specifications

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3.1 General specifications

Item		Specification				
Weight		M312: 235g (net weight) M300 series (except M312): 145g (net weight)				
Dimensions		M312: 70.3 mm (W) *104.5 mm (H) *80.2 mm (D) M300 series (except M312): 32.3 mm (W) *104.5 mm (H) *80.2 mm (D) Without terminal block				
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 2000m (80 kPa)				
	Noise immunity	≥ 1500 Vp-p, pulse width 1μs, 50ms (based on noise simulator); compliant with IEC standards (IEC61000-4-2/3/4/6)				
	Vibration resistance	Installation condition	Frequency (Hz)	Acceleration (m/s²)	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/s² ; 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				
		M301	M302	M310	M311	M312
Programming	Program capacity	256KBytes		512KBytes		
	Variable capacity	256KBytes (including 16 KBytes of persistent data memory)		256KBytes (including 32 KBytes of persistent data memory)		
	I area (%)	128Bytes				
	Q area (%Q)	128Bytes				
	M area (%M)	128KBytes				
Programming language		LD, ST, C/C++				
Axis capacity	Number of pulse axes	4 Axes, 100KHz		4 Axes, 200KHz		6 Axes, 200KHz
	Number of encoder axes	2				
	Number of virtual axes	≤ 16				
	Number of virtual encoder axes	≤ 16				
	Total number of axes (pulse axes + encoder axes + virtual axes)	≤ 16				
Right expansion	Maximum number of expansion modules	16				
RTC battery		Comes with the host			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-channel external interrupts; Supports 2-channel high-speed pulse inputs (100kHz) (AB phase, pulse+direction, single pulse)	Supports 8-channel external interrupts Supports 2-channel high-speed pulse inputs (200kHz) (AB phase, pulse+direction, single pulse)		
	Output	Number of channels	8-channel outputs			16-channel outputs
		Function	Supports 4-channel high-speed pulse outputs (100KHz) (pulse+direction)	Supports 4-channel high-speed pulse outputs (200KHz) (pulse+direction)		Supports 6-channel high-speed pulse outputs (200KHz) (pulse+direction)
Electronic cam	Number of cam profiles	-	16	-	16	16
	Number of key points per curve	-	32	-	32	32
Axis groups	Maximum number of axis groups	-	1 Axis groups (each supporting up to 8-axis interpolation)	-	1 Axis groups (each supporting up to 8-axis interpolation)	1 Axis groups (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	1-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	1-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 32 slaves when acting as master	
EtherNet	Number of interfaces	-	1-channel	
	Function	-	Communication, program upload/download, etc.	
	Data transfer speed 100/10Mbps	-	100/10Mbps	
	Total number of TCP connections	-	16(ModbusTCP+Socket + EtherNet/IP)	
	Modbus TCP	-	The total number of connections for client and server is 16; When acting as a client, the maximum number of client connections can reach 16; When acting as a server, the maximum number of server connections can reach 16	
	Socket	-	Max. quantity: 8, supporting TCP/UDP	
	Cable	-	Standard industrial Ethernet communication cable	
	Number of simultaneous communications for Modbus TCP and Socket	-	16	
	CIP service type: Cyclic communication (IO Connection)	-	Max. number of connections: 8; Max. data volume per connection: 200 Bytes; Cycle interval time: 5~1000 ms	
	CIP Service Type: Explicit message	-	Number of Class 3 connections: 8; Number of clients that can be accessed simultaneously via UCMM (Unconnected message manager): 16	
	Number of simultaneous communications for Modbus TCP, EtherNet/IP, and Socket	-	16 (ModbusTCP+Socket + EtherNet/IP)	

3.4 IO specifications

3.4.1 General IO input/output

◆ General IO input

Item		Specification		
		M312	M311/M310	M301/M302
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 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		
		M312	M311/M310	M301/M302
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 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		
		M312	M311/M310	M301/M302
Input channel		2 channels		
Maximum pulse frequency		200KHZ		100KHZ
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 high-speed input channels via input channels.		

◆ High-speed output

Item		Specification		
		M312	M311/M310	M301/M302
Number of output axes		6 Axes	4 Axes	
Maximum pulse frequency		200KHZ		100KHZ
Output form	Pulse+direction	QX0.0~QX0.7, QX1.0~QX1.3	QX0.0~QX0.7	
		Even-numbered channels are pulse, odd-numbered channels are direction	Even-numbered channels are pulse, odd-numbered channels are direction	

3.5 Communication specifications

3.5.1 Ethernet specifications

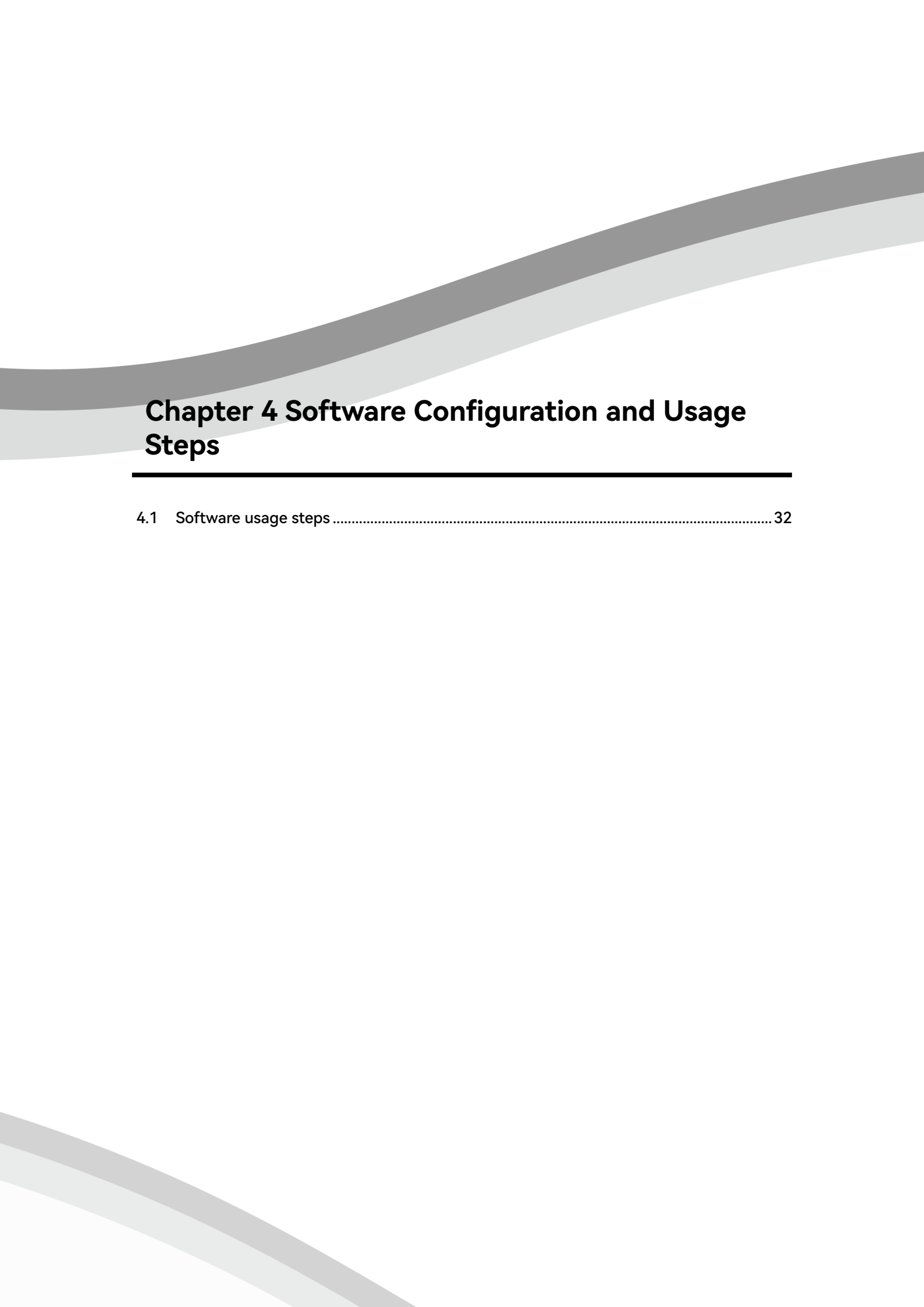
Item	Specification
Interface type	RJ45
Data transfer speed	100/10Mbps
Maximum transmission distance (length between hub and node)	100m
Supported protocol	Modbus TCP, EtherNet/IP, Socket, custom communication protocols
IP address	Initial value: 192.168.1.8
Cable	Category 5e shielded twisted pair cable

3.5.2 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

3.5.3 CAN 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	32



Chapter 4 Software Configuration and Usage Steps

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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 EtherNet/IP 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 EtherNet/IP 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 interfaces • 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	

◆ 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

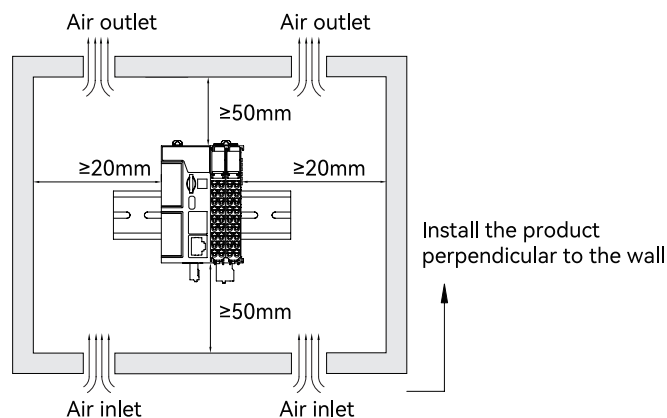
5.1	Installation instructions	34
5.1.1	Installation within a control cabinet	34
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5.1.3	Expansion module mounting and dismounting.....	36
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5.3	Product dimensions	44
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5.1 Installation instructions

5.1.1 Installation within a control cabinet

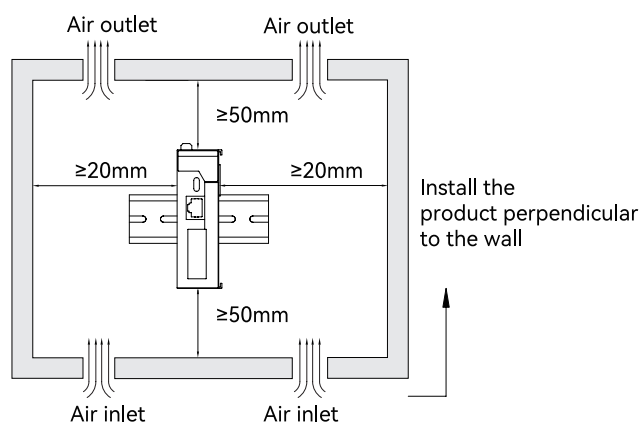
◆ M312 CPU unit

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.



◆ M300-series CPU unit (except M312)

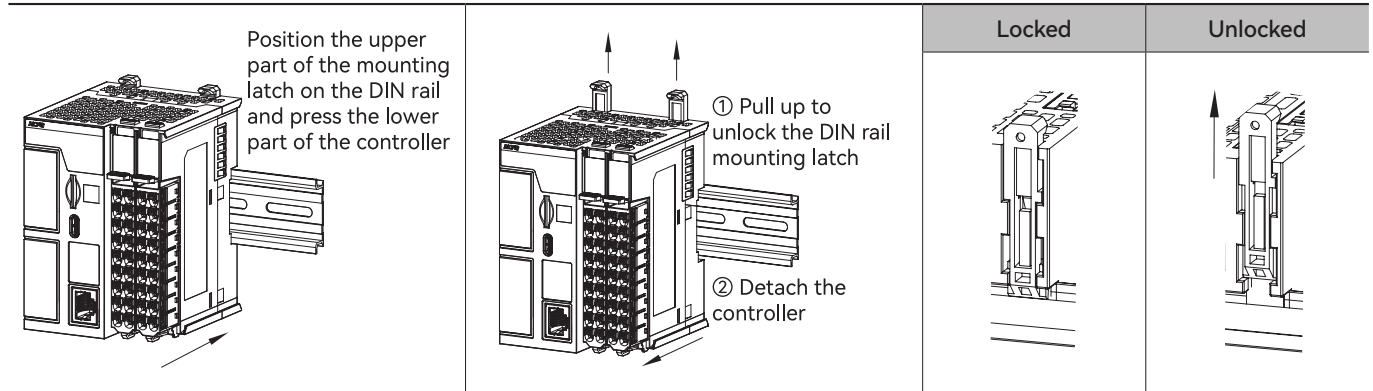
Please install the product perpendicular to the wall and ensure a sufficient cooling effect via natural air or a cooling fan. Please leave enough clearance around the product as shown in the right figure. During a side-by-side installation, please leave a horizontal clearance of more than 20 mm on both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



5.1.2 DIN rail mounting and dismounting

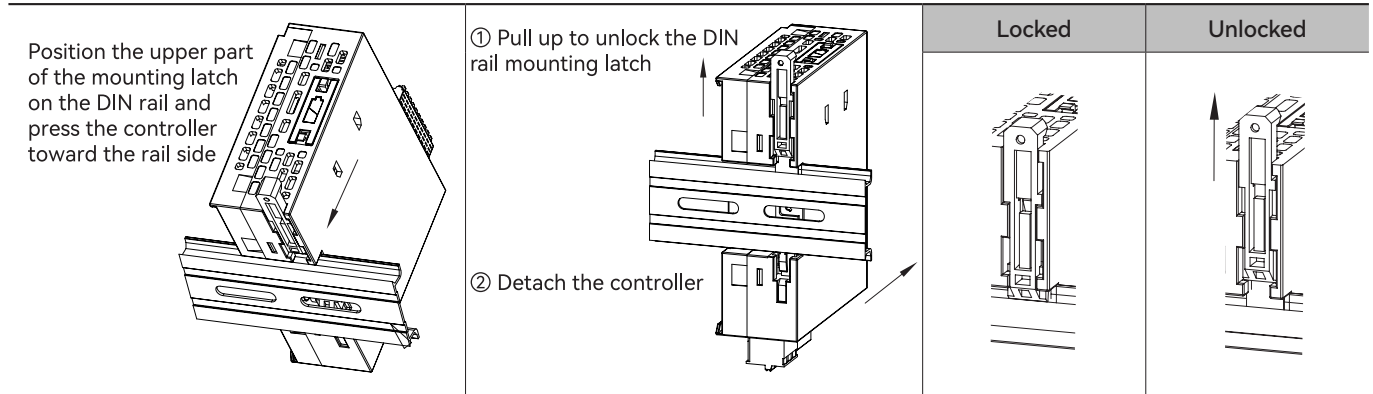
◆ M312 CPU unit

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.



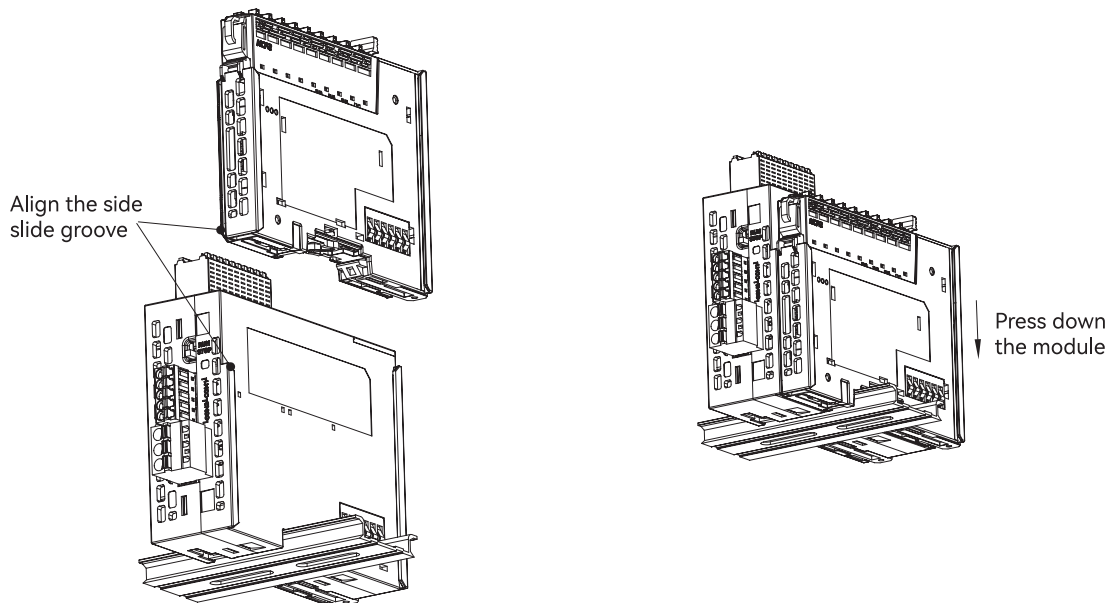
◆ M300-series CPU unit (except M312)

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.

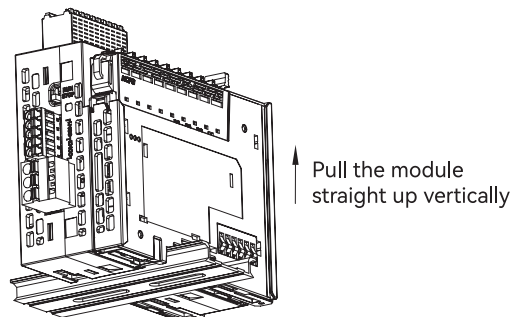


5.1.3 Expansion module mounting and dismounting

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.

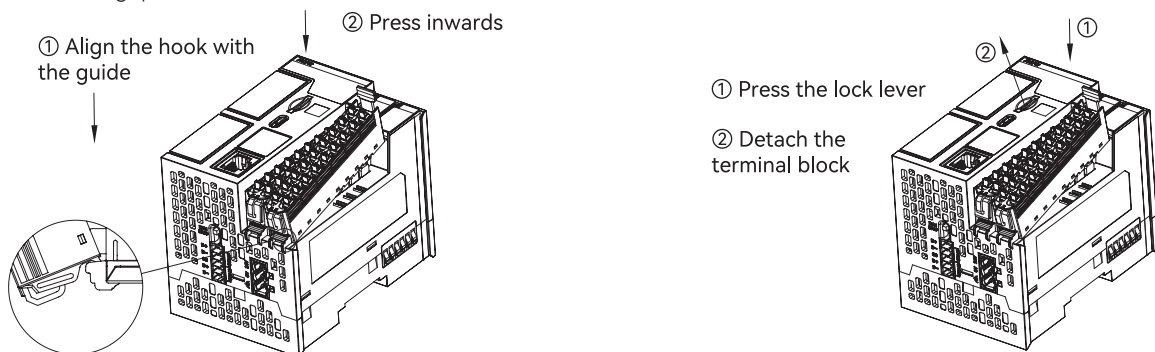


5.1.4 Removable terminal block mounting and dismounting

◆ M312 CPU unit

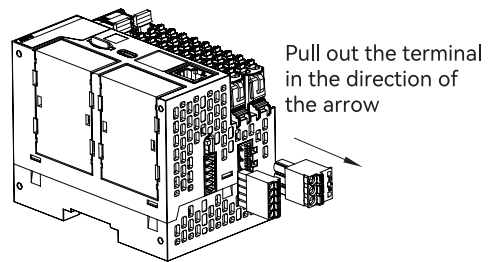
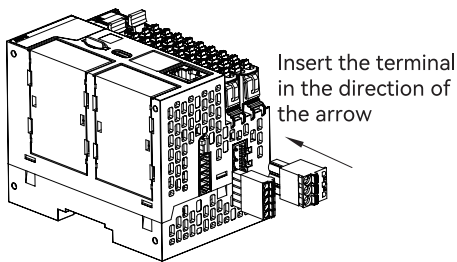
• Removable terminal block mounting and dismounting I

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.



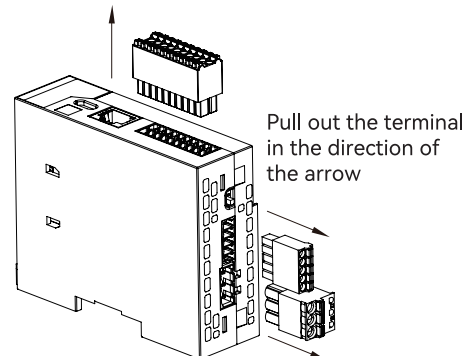
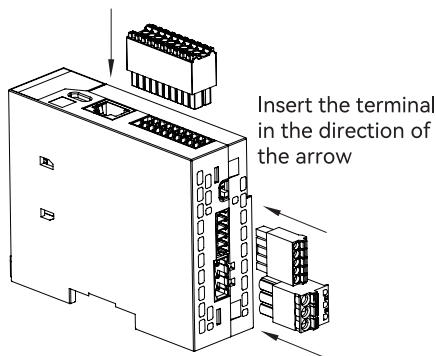
• Removable terminal block mounting and dismounting II

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



◆ M300-series CPU unit (except M312)

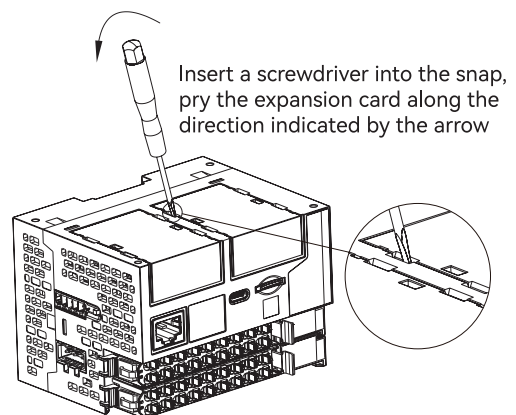
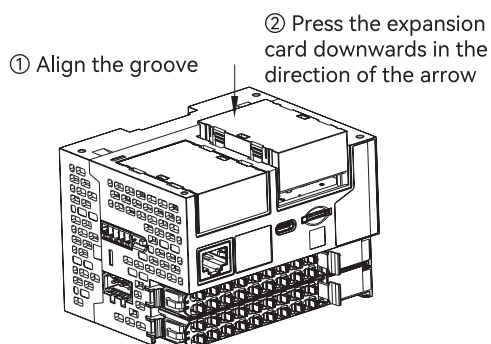
The mounting and dismounting of the removable terminal block are shown in the figures below.



5.1.5 Expansion card mounting and dismounting

◆ M312 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.

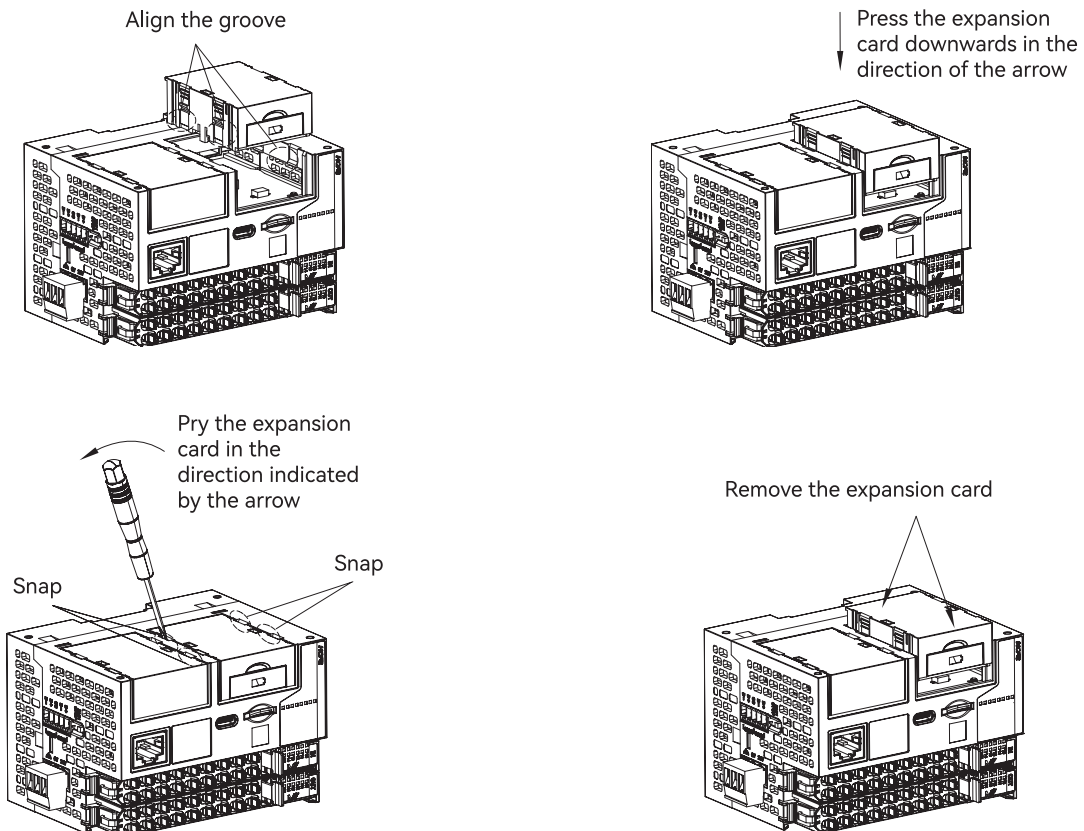


5.1.6 RTC (Real-Time Clock) battery mounting and dismounting

◆ M312 CPU unit

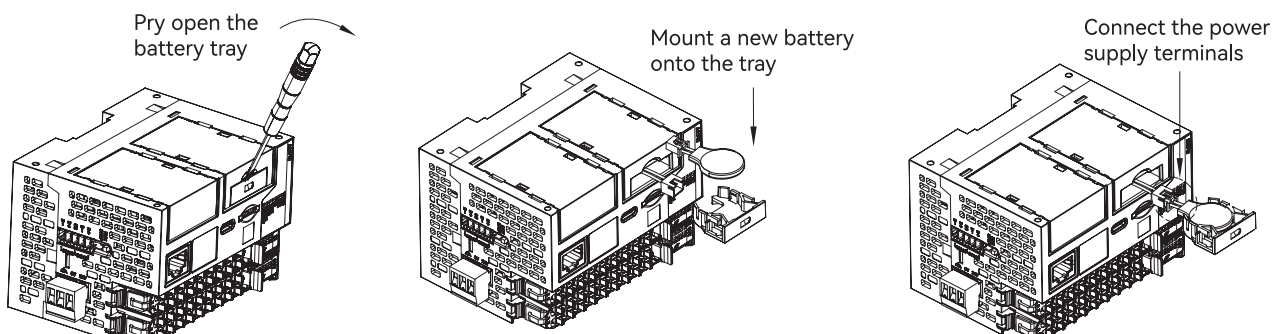
• Overall unit mounting/dismounting

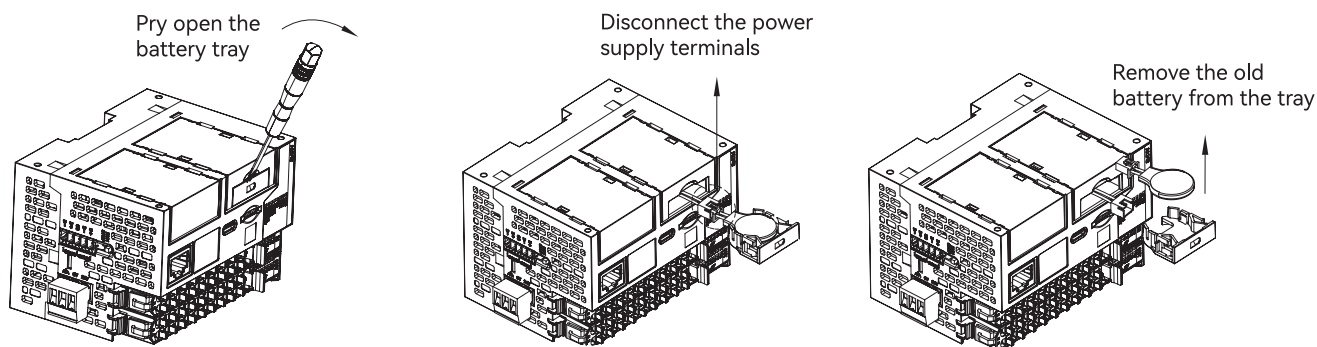
During mounting, place the controller horizontally, align the groove of the expansion card with that of the controller, and press the expansion card downwards. After hearing the "click" sound, check whether the junction surface is flush; if it is, then the installation is completed. During dismounting, 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

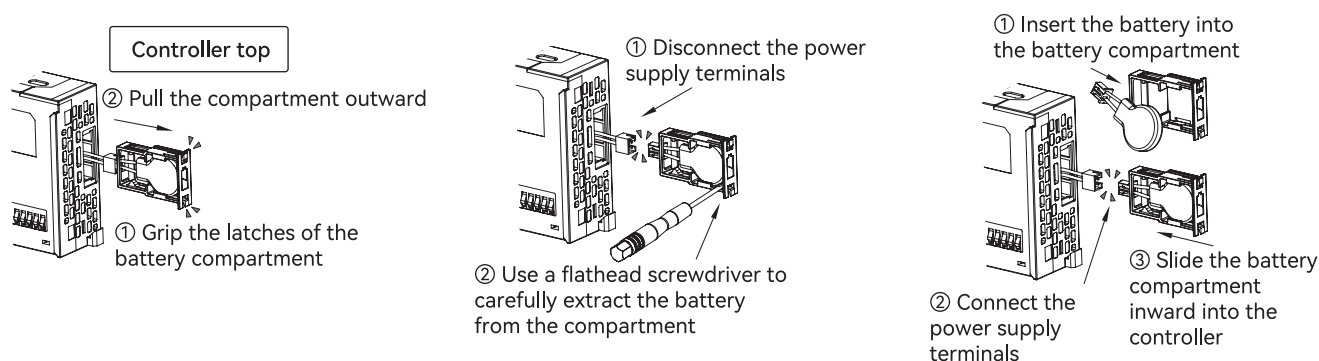
During mounting, use a flathead screwdriver to pry open the battery tray at the designated notch, mount a new battery onto the tray, and then connect the power terminal to complete the installation. During dismounting, disconnect the power terminal and then remove the old battery from the tray.





◆ M300-series CPU unit (except M312)

During dismantling, 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 instructions

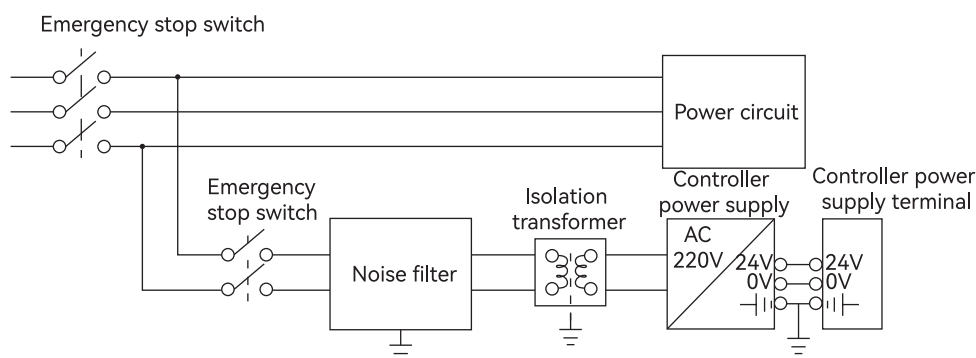
5.2.1 Power supply wiring

The M300-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 figure 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

◆ M312 CPU unit

Terminal definition:

Terminal description		IN		OUT		Type	General IO wiring	High-speed IO wiring
0		10	I0	I10	Q0	Sink input		
1		11	I1	I11	Q1			
2		12	I2	I12	Q2	Source input		
3		13	I3	I13	Q3			
4		14	I4	I14	Q4	Sink output		
5		15	I5	I15	Q5			
6		16	I6	I16	Q6			
7		17	I7	I17	Q7			
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 M312		Channel 1		Channel 2		-				Com- mon terminal	-							Com- mon 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 M312		Channel 1		Channel 2		Channel 3		Channel 4		DC24V	Channel 5		Channel 6		-				Common terminal
High-speed output definitions	Pulse +Direction	Pulse	Direction	Pulse	Direction	Pulse	Direction	Pulse	Direction		Pulse	Direction	Pulse	Direction	-				

◆ M300-series CPU unit (except M312)

Terminal definition:

Terminal description	IN	OUT	Type	General IO wiring	High-speed IO wiring
IN OUT 0 0 1 1 2 2 3 3 4 4 5 5 6 6 7 7 S0 24V S0 COM	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.

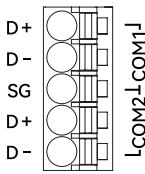
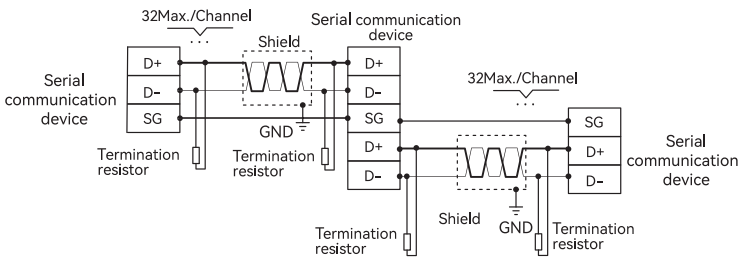
Terminal configuration											
Input terminal name		I0	I1	I2	I3	I4	I5	I6	I7	S0*	S0*
High-speed input channel supported by M301/M302/M310/M311		Channel 1		Channel 2		-				Common terminal	Common terminal
High-speed input definitions	Pulse +Direction	Pulse	Direction	Pulse	Direction	-					
	AB phase	A	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 M301/M302/M310/M311		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 common input terminal S0 is internally connected.

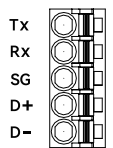
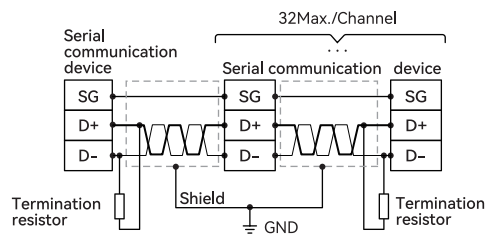
5.2.3 Communication wiring

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

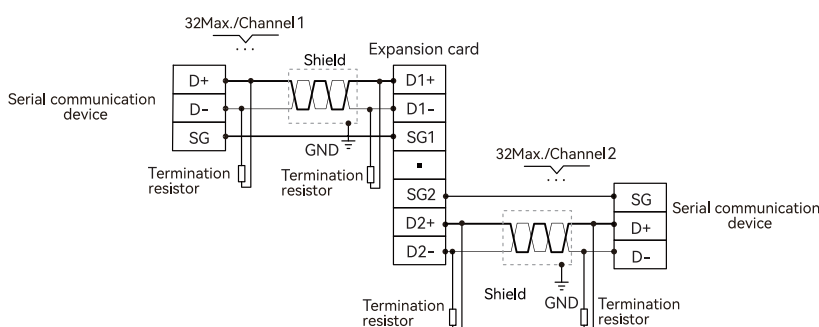
◆ M312 CPU unit

5-Pin serial communication terminal description		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-		

◆ M300-series CPU unit (except M312)

5-Pin serial communication terminal description		RS232 wiring	RS485 wiring
COM1 RS232 channel 1 data transmission	Tx		
COM1 RS232 channel 1 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	
	D1+		
RS485 channel 1 communication signal -	D2-		
RS485 channel 1 signal reference ground	SG1		
RS485 channel 1 communication signal +	D1+		
RS485 channel 2 signal reference ground	SG2		
RS485 channel 2 communication signal +	D2+		
RS485 channel 2 communication signal -	D2-		

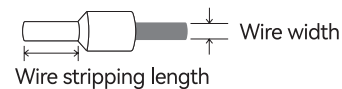
◆ RS232 expansion card (HCMXB-2RS232-BD)

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

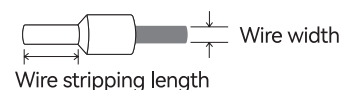
◆ M312 CPU unit

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	24~16	8~10	16	40
DC24V power supply terminal	26~12	9~10	25	60



◆ M300-series CPU unit (except M312)

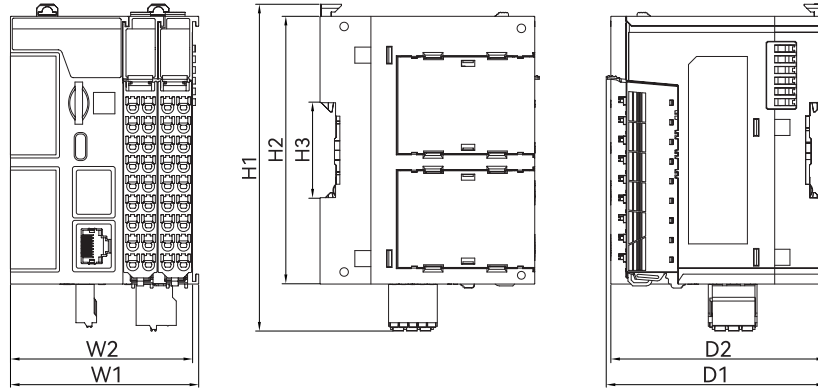
Controller terminal	Wire gauge range: AWG	Wire stripping length: mm	Crimping force:N	Pull-out force:N
20-Pin IO terminal	24~16	9~10	25	40
5-Pin serial communication	24~16	8~10	16	40
DC24V power supply terminal	26~12	9~10	25	60



5.3 Product dimensions

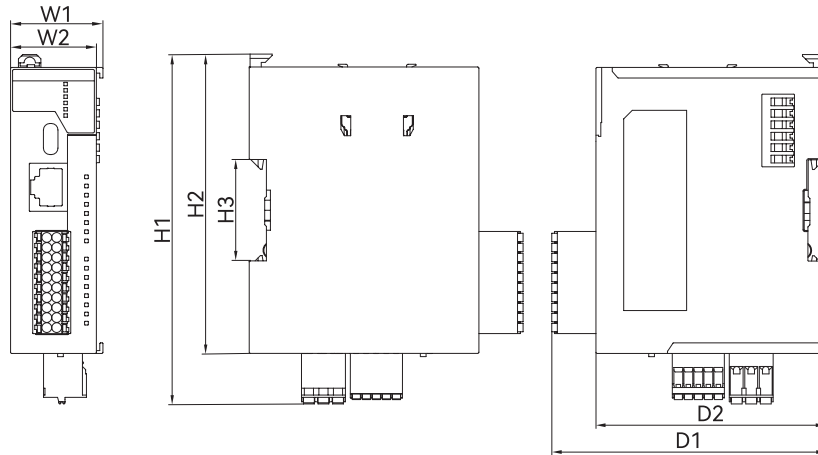
5.3.1 CPU unit dimensions

◆ M312 CPU unit



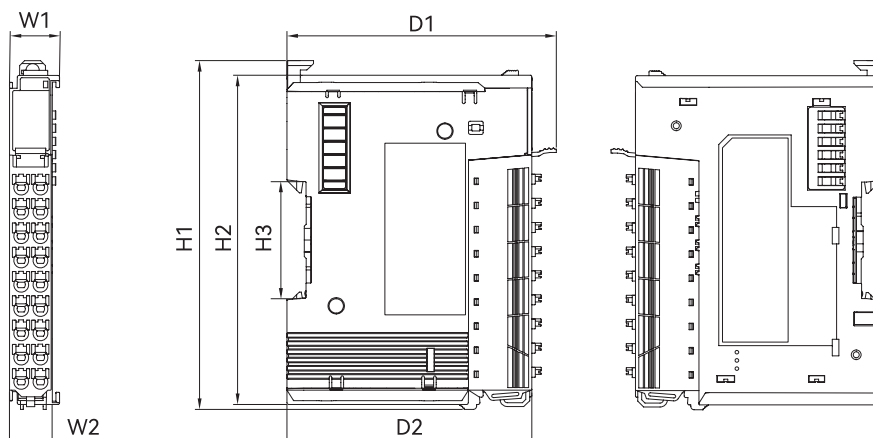
Outline dimensions						
W1	W2	H1	H2	H3	D1	D2
70.30	67.99	122.05	100.00	35.40	81.92	80.20

◆ M300-series CPU unit (except M312)

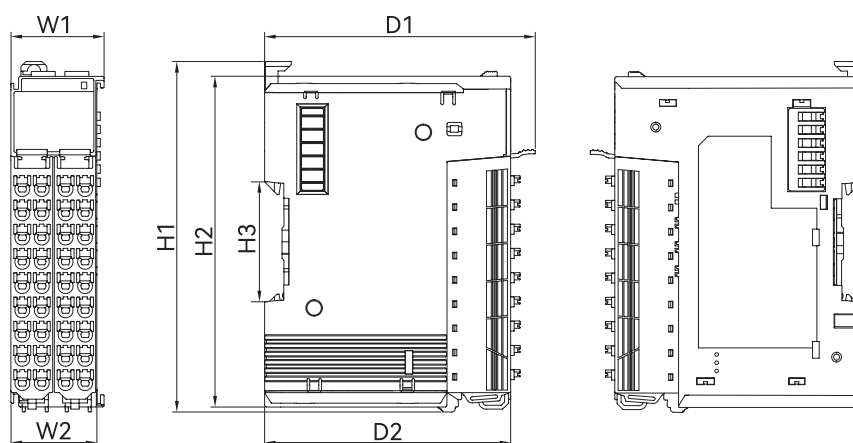


Outline dimensions						
W1	W2	H1	H2	H3	D1	D2
32.30	30.00	122.15	104.50	35.40	95.64	80.20

5.3.2 Expansion module dimensions



Single-row terminal module	Outline dimensions						
	W1	W2	H1	H2	H3	D1	D2
HCMX-OD08-D	15.20	13.00	122.15	104.50	35.40	95.64	80.20
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							



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

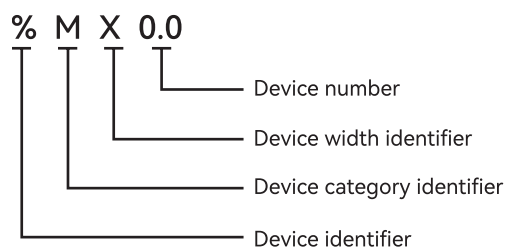
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6.1 Device and Modbus address

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	%ILO
	%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 M312 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 $A \times 8 + B$ to hexadecimal, then add 16#A000.

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

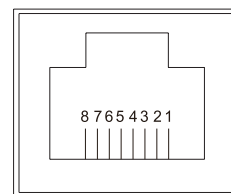
$16\#191 + 16\#A000 = 0xA191$.

6.2 EtherNet communication

6.2.1 EtherNet communication interface pin definition

The default IP address for 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

6.2.2 EtherNet communication interface function description

The M300-series motion controller with an Ethernet communication interface supports Modbus TCP, EtherNet/IP, and Socket. It can act as a Modbus TCP master or slave, while EtherNet/IP only supports slave mode. 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 M300-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, EtherNet/IP, Socket
Maximum transmission distance (between hub and node)		100 meters
Number of simultaneous communication connections for Modbus TCP, EtherNet/IP, Socket		16
Modbus TCP	Sum of client and server connection counts	16
Socket	Sum of TCP and UDP connection counts	8
Modbus TCP, Socket	Sum of simultaneous communication connections for Modbus TCP and Socket	16

EtherNet/IP (slave only)	CIP service type: Cyclic communication (IO connection)	CIP connection count		8
		Requested Packet Interval (RPI)		5ms~1000ms
		Maximum data volume per connection		200bytes
	CIP service type: Explicit message	Class 3 (Connection count)		8
		UCMM (Unconnected message management)	Maximum number of simultaneous communication clients	16

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

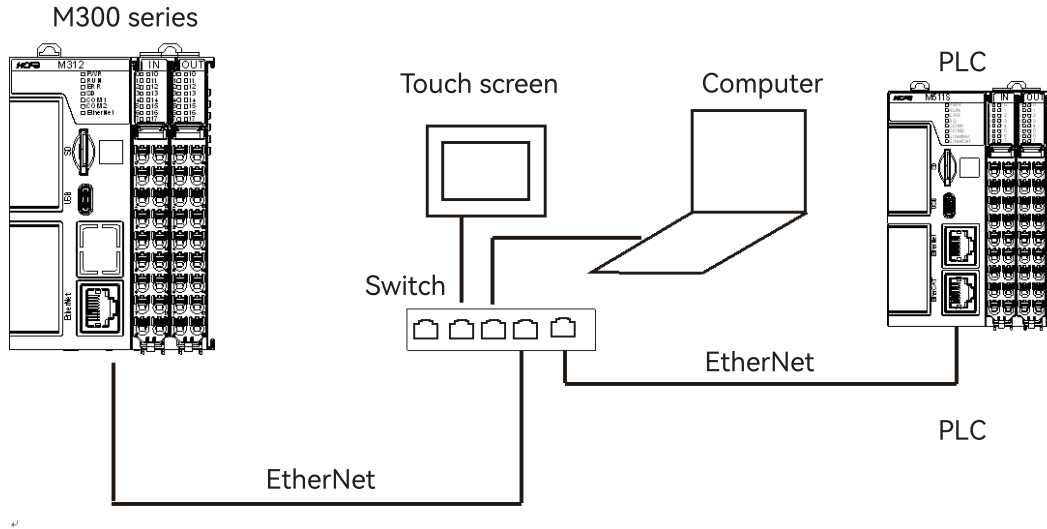
The following table lists the function codes supported by the EtherNet communication interface of the M300-series motion controller when using the Modbus TCP protocol:

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 M300-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.

6.2.4 EtherNet communication interface network connection



6.3 CAN communication

6.3.1 CAN communication interface pin definition

Other M300-series motion controllers do not support the CAN interface. The M312 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	CAN
1	CAN_H	CAN communication signal (high)	
2	CAN_L	CAN communication signal (low)	
3	CAN_GND	CAN communication signal reference ground	

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.

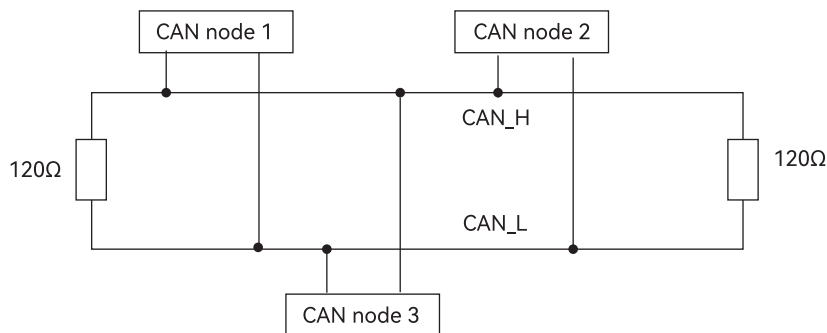
6.3.2 PDO mapping of CANopen communication interface

When the M312 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 M312 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.

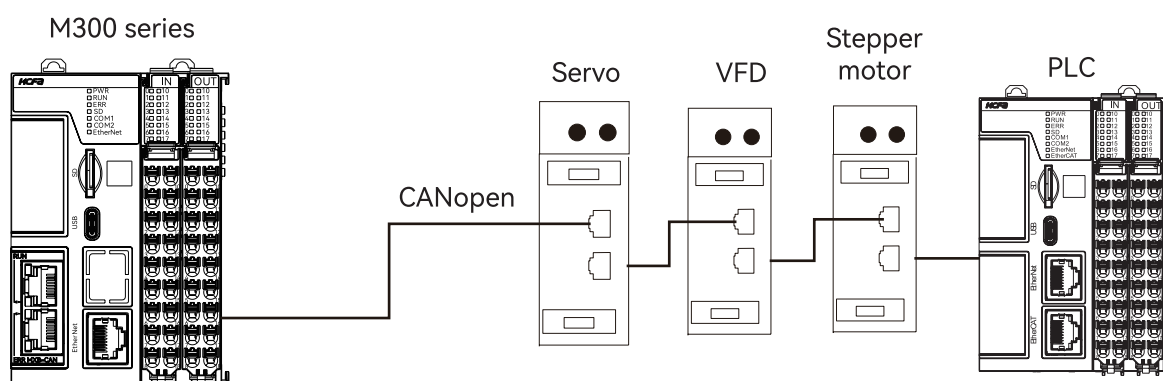
6.3.3 CANopen bus hardware connection

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.

6.3.4 CANopen bus network connection



6.3.5 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

6.4 RS485 communication

6.4.1 RS485 communication interface pin definition

The M312 motion controller has two built-in independent RS485 communication interfaces. The pin definitions of the RS485 communication interface are shown in the figure below:

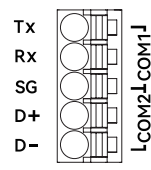
Pin definition	Abbreviation	Description	
D+	RS485+	RS485 positive signal	
D-	RS485-	RS485 negative signal	
SG	Reference ground	RS485 signal reference ground	

The M312 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 -	

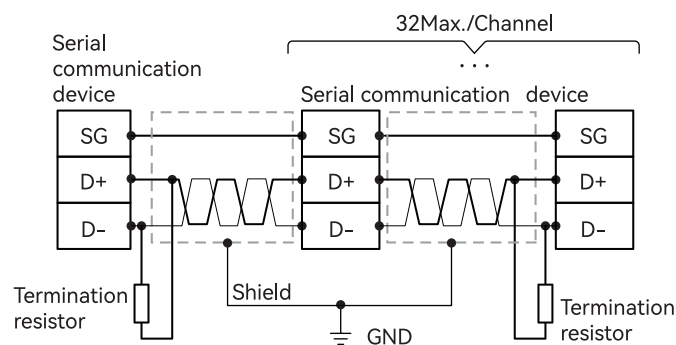
Other M300-series CPU units (except M312) integrate one RS232 and one RS485 communication interface.

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 -	

6.4.2 RS485 communication interface function description

The RS485 communication interfaces of the M300-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. Touchscreens, PLCs, or other Modbus master devices can read/write data from/to the internal devices of the M300-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.

6.4.3 RS485 bus network topological architecture



◆ Recommended RS-485 wiring method:

- Install a 120Ω terminating resistor (with power $\geq 1/4$ 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.

6.4.4 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

6.4.5 Function codes and exception response codes supported by RS485

◆ The function codes supported by the RS485 communication interface of the M300-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 M300-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.

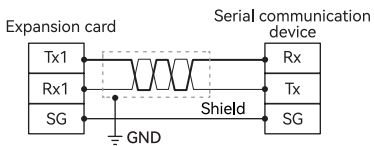
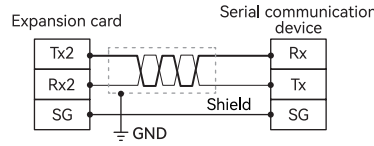
7	The checksum calculated by the master and slave differs.	Confirm that the baud rate and communication format of the master and slave are consistent. Check for interference near the bus. Check that the bus is a shielded cable. Ensure both the master and slave are grounded.
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6.5 RS232 communication

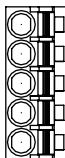
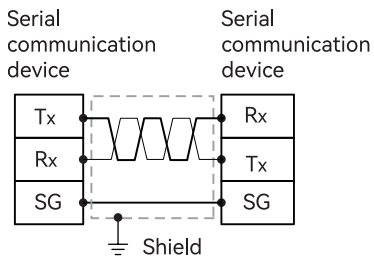
6.5.1 RS232 communication interface pin definition and wiring method

The M312 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			

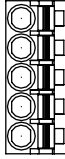
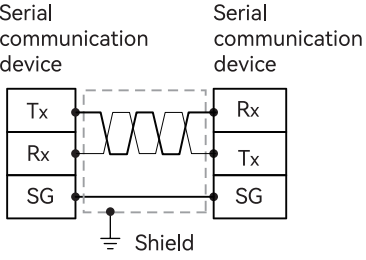
Other M300-series motion controllers integrate one RS232 and one RS485 communication interface. The pin definition and wiring for the RS232 interface are shown in the following diagram:

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

6.5.2 RS232 communication interface function description

The RS232 communication interfaces of the M300-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. Touch-screens, PLCs, or other Modbus master devices can read/write data from/to the internal devices of the M300-series motion controller via the RS232 communication interface. Each RS232 communication interface can connect to 1 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.

6.5.3 RS232 bus network topological architecture

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

Recommended RS232 wiring method: To ensure communication stability, it is advised to use a shielded twisted-pair cable with the shield grounded.

6.5.4 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

6.5.5 Function codes and exception response codes supported by RS232

◆ The function codes supported by the RS232 communication interface of the M300-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 M300-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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