

M-Series Motion Controller

M500

Hardware Manual



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※ Preface

Thank you for purchasing and using the M500-series controller products independently developed and manufactured by Hechuan Technology Co., Ltd.

The M500-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.

This manual primarily describes the products listed in the table:

Name	Model	I/O quantity	Brief description
	HCM511-32MT4-D		M500-series CPU Unit with built-in I/O input/output,
	HCM512-32MT4-D		supporting multi-channel high-speed input/output.
	HCM513-32MT4-D	16-channel input (2 channels of	It allows for the expansion of 16 I/O modules on the
M-series controller		200K high-speed counting)	right side of the main unit and is equipped with built-
M-Series controller		16-channel output (4 channels of	in communication interfaces (USB, RS-485, Ethernet,
	HCM514-32MT4-D	200K pulse output)	EtherCAT). Additionally, communication interfaces
			such as RS485, RS232, and CAN can be expanded via
			expansion cards.

Target reader

Users who purchase or use HCFA's M500-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 M500-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)
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

X 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.



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 1

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 A

• 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.

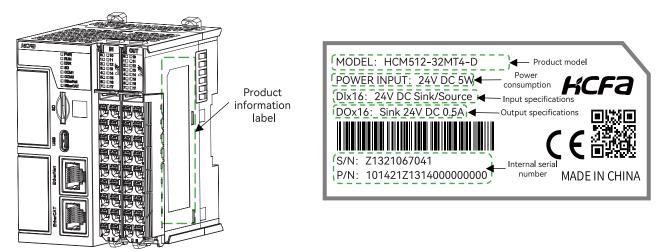
X Version information confirmation

Each unit and slave device in the M500 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 M500 Series CPU Unit HCM5 $\Box\Box$ - $\Box\Box\Box\Box$ - \Box is shown in the figure below.

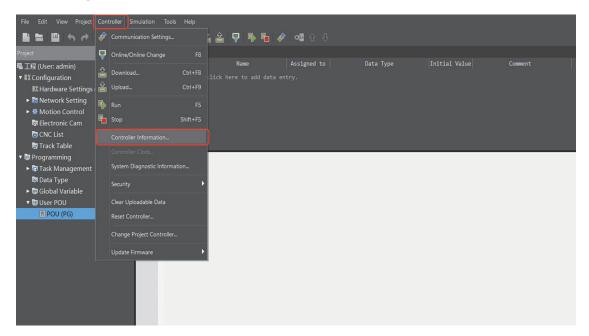


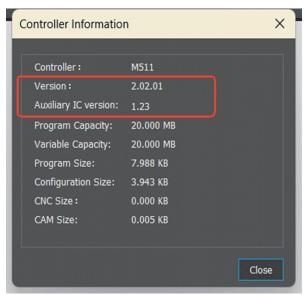
Note: "POWER INPUT" on this label indicates the power consumption of the unit itself.

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

Software version

When the PC (host computer) and M-series controller are in normal communication, 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

X Term description

Term	Description
CPU unit	The control center of the automation controller. It executes tasks, refreshes I/O of each unit and slave
CPO unit	device, etc. In the M500 Series, it is denoted as HCM5 XX - XXXX - X.
A	A functional unit in the motion control function module. It assigns drive mechanisms of external servo
Axis	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 definition commands required for executing motion control functions. Motion control com-
Motion control command	mands include those based on PLCopen's motion control function blocks and those independent of the
	motion control function module.

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- 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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1.1 Product feature and main function description of M500-series controller

1.1.1 Hardware feature

Model	IO quantitu	SD card	Expansion	Communication interface		
Model	IO quantity	SD Card	slot	Ethernet	Serial port	USB
HCM511-32MT4-D	16-channel input (2 high-speed					
HCM512-32MT4-D	counting channels, 200K)	1*00	2	1*ETherCAT	2*DC/05	1*1.100
HCM513-32MT4-D	16-channel output (4 high-speed	1*SD card	Z	1*EtherNet	2*RS485	1*USB
HCM514-32MT4-D	pulse output channels, 200K)					

1.1.2 Main function description

The M500 Series controller is an EtherCAT bus-type + pulse-type motion controller independently developed and manufactured by HCFA. It features rich interfaces, superior performance, and user-friendly operation. The M500 Series motion controller is equipped with one built-in EtherCAT bus interface, supporting at least 8 bus axes and up to 64 bus axes, as well as 4 pulse axes. It comes with built-in communication interfaces including USB, RS485, Ethernet, and EtherCAT, supports expansion of 16 IO modules on the right side, and allows expansion of two expansion cards.

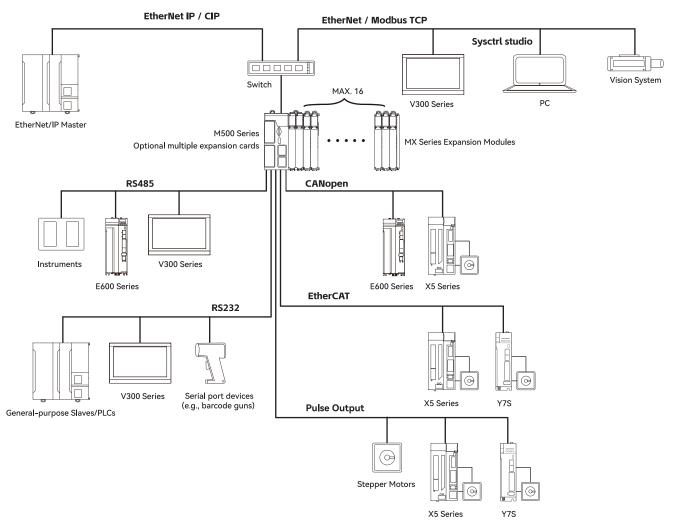
The M500 Series controller is equipped with multiple communication interfaces, including USB, RS485, RS232, Ethernet, and CAN. Among these, the RS485 and RS232 interfaces support Modbus protocol and custom serial protocol; the Ethernet interface supports multiple protocols such as ModbusTCP, EIP, and Socket; the CAN communication interface supports the CANopen DS301v4.02 protocol and can function as both a master and a slave.

The M500 Series controller offers a comprehensive and user-friendly range of motion control functions. It adheres to the standard motion commands outlined by the international organization PLCopen, supporting single-axis commands such as homing, positioning, and speed control. Additionally, it features electronic gears and multi-axis commands, including electronic cams, rotary cutting, and axis grouping. This controller can be widely utilized in various automatic control applications, such as packaging, woodworking, wire winding, and wire cutting.

1.2 Controller overview

1.2.1 System configuration

The M500 Series bus-type motion controller features rich communication interfaces, allowing connections to various types of host computers, servo drives/VFDs, and other devices. A reference system topology is shown below.



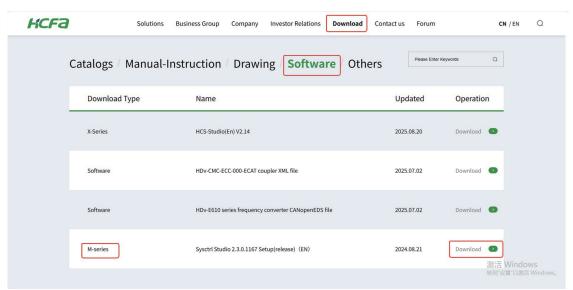
1.2.2 Software description

Supported connection method

Model		M511 M512 M513			M514	
LICD	Quantity	1x Type-C (USB 2.0)				
USB	Supported function	Reserved				
EtherNet	Quantity	1x EtherNet				
	Supported function	Software monitoring and debugging, program upload and download				

♦ Software download link

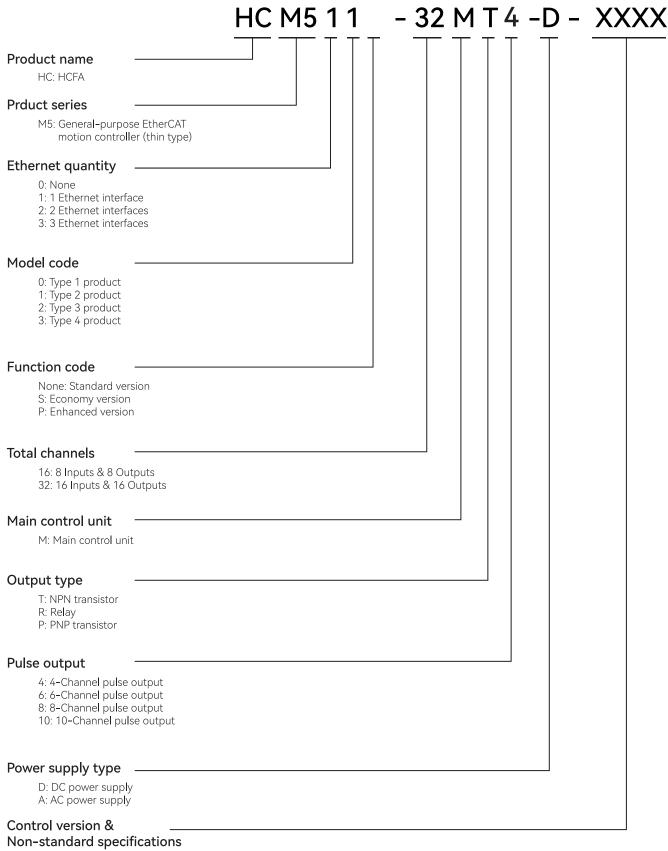
To download the software, please visit the official English website of Zhejiang Hechuan Technology Co., Ltd.: https://www.hcfaglobal.com/. Click [Download] at the top of the page, then on the redirected page, click [Software] \rightarrow [Sysctrl Studio 2.3.0.1167 Setup (Release) (EN)] \rightarrow [Download].



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2.1 Product model

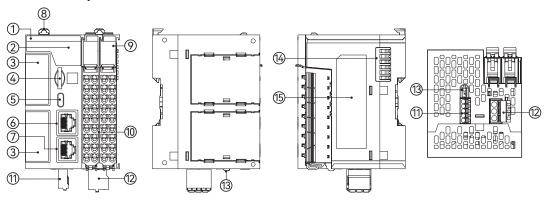


xxxx: None

2.2 Basic composition

2.2.1 Names and functions of controller components

♦ Interface description of M500-series controller



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	
(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)		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	D+: 485 communication signal positive; D-: 485 communication signal negative;	
(11)	terminal	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	

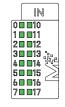
^{*} Note: The SD card needs to be purchased by the customer; no functions are supported in the current version.

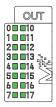
2.2.2 Indicator description

♦ M500-series controller indicator

Silkscreen	Indicator	Color	State	Function
DIA/D	December		Not lit	Power not connected
PWR	Power status	Green	Lit	Power normally connected
RUN	On a matical atatus	C	Not lit	Controller stopped
KUN	Operation status	Green	Lit	Normal operation
FRR	Controller error status	Red	Not lit	No error
	Controller error status	Red	Lit	Error occurred
			Not lit	SD card not inserted
SD	SD card status	Yellow	Blinking	SD card being read/written
			Lit	SD card inserted but not reading/writing
COM1	RS485	Yellow	Not lit	No communication
COM2	communication status	Yellow	Blinking	Sending data to other devices
		Green	Not lit	No physical connection
	Ethernet communication status		Blinking	Physical connection established with data
EtherNet				transmission
			Lit	Physical connection established but no data
				transmission
			Not lit	No physical connection
	EtherCAT		Blinking	Physical connection established with data
EtherCAT	communication status	Green	Dilliking	transmission
	Communication status		Lit	Physical connection established but no data
			LIL	transmission
IN N	Input status	Groon	Not lit	Input signal not detected on channel N
	input status	Green	Lit	Input signal detected on channel N
OUT N	Output status	Green	Not lit	No signal output on channel N
	Output status	Olecil	Lit	Signal output on channel N

M511/M512/M513/M514 | PWR | RUN | ERR | SD | COM1 | COM2 | EtherNet | EtherCAT





2.2.3 Expansion card

Model/Optional card	HCMXB-RTC-BD	HCMXB-AB-500-BD	HCMXB-2RS485-BD	HCMXB-2RS232-BD	HCMXB-CAN-BD
HCM511-32MT4-D					CAN communication
HCM512-32MT4-D	1-Channel RTC battery		RS485 communication	RS232 communication	card: 1 independent
HCM513-32MT4-D			card: 2 independent	card: 2 independent	CAN communication
		1-Channel AB-phase	RS485 communication	RS232 communication	interface (supports
		differential encoder	interfaces (each	interfaces (each	master/slave mode;
HCM514-32MT4-D			interface can function	interface can function	compatible with
11011314-321114-0			as master or slave)	as master or slave)	CANopen Protocol
					DS301v4.02)

- * 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., HCM511 controller cannot mix HCMXB-2RS485-BD and HCMXB-2RS232-BD cards).
- Only one expansion card of the same model is allowed per controller (e.g., HCM511 controller cannot use two HCMXB-2RS232-BD cards).
- HCMXB-CAN-BD, HCMXB-2RS485-BD, and HCMXB-2RS232-BD expansion cards all support master or slave mode.
- HCMXB-AB-500-BD expansion card must be installed in Slot 1 only; it cannot be used in Slot 2.

2.2.4 Button cell battery

The M500-series controller can add a RTC battery by installing an RTC expansion card.

2.2.5 USB/Type-C interface

Item		Specification
LICD	Number of interfaces	1x USB2.0 Type-C
USB Supported function		Reserved

2.2.6 SD card

The M500-series controller supports SD card expansion. The following specifications are applicable for SD cards:

Item	Specification		
Supported model	M500 Series		
SD card type	SD	SDHC	
SD card capacity	0~2GB	4GB~32GB	
SD card file format	FAT/FAT32	FAT32	
Function	Update firmware, backup and restore proje	ects, and retain data during power outages	

2.2.7 Expansion module

♦ Supported expansion module

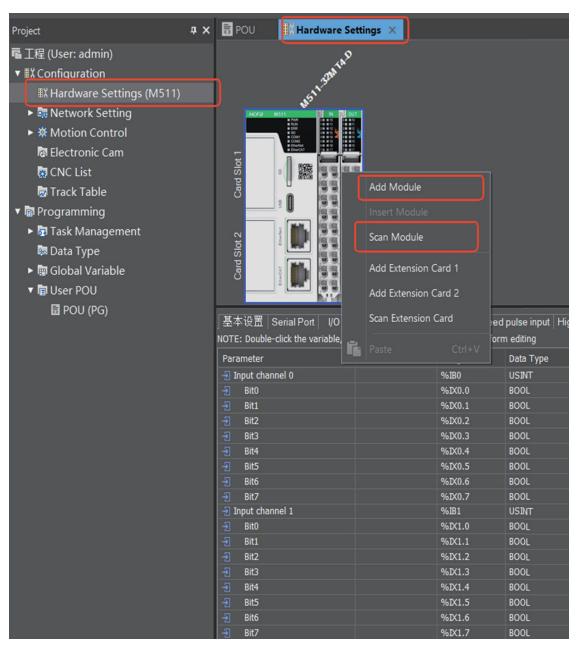
Module name	Number of input channels	Number of output channels
HCMX-ID08-D	8-channel DI	-
HCMX-ID16-D	16-channel DI	-
HCQX-ID32-D	32-channel DI	-
HCMX-OD08-D	-	8-channel DO
HCMX-OD08-D-PNP	-	8-channel DO
HCMX-OD16-D	-	16-channel DO
HCMX-OD16-D-PNP	-	16-channel DO
HCMX-OD32-D	-	32-channel DO
HCMX-OD32-D-PNP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

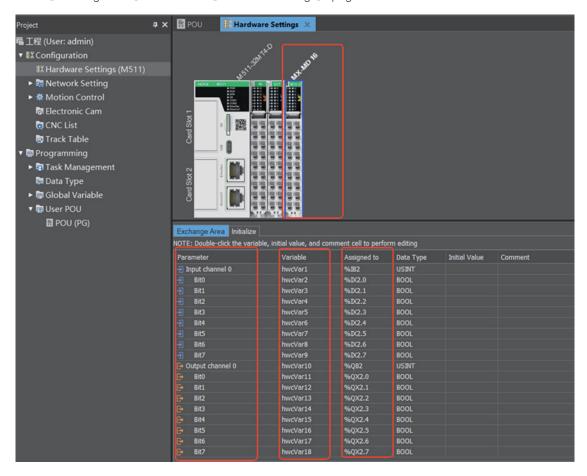
Mapping of expansion modules to controller variables and addresses

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.



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3.1 General specifications

ltem				Specification				
		M500 series						
	Weight			Net weight: 240g				
D	imensions		68 mm	n(W) *100 mm(H)*80.2	2 mm(D)			
	1			Without terminal bloo	ck			
	Operating temperature	0~55°C						
	Storage temperature	-25~70°C						
	Ambient humidity	10% ~ 95% (no-conde	nsing)					
	Ambient environment	Low levels of dust and	l corrosive gases					
	Altitude/Pressure	Below 2000 m (80 kPa	Below 2000 m (80 kPa)					
	Noise immunity	≥ 1500 Vp-p, pulse width 1µs, 50ms (based on noise simulator); compliant with IEC standards (IEC						
	Noise immunity	61000-4-2/3/4/6)						
Operating environment	Vibration resistance	Installation condition	Frequency (Hz)	Acceleration (m/s²)	Single amplitude (mm)	10 times in each of X, Y, Z directions		
		When installed on a	10~57	_	0.035	(total 80 times		
		DIN rail:	57~150	4.9	_	each)		
	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						
1 ollution degree		occasional condensation should be expected.						
Isolation method		Digital isolation						
Heat dissipation method		Passive heat dissipation, natural air cooling						
Installation position		Inside the control cabi	net					
Main body material		Standard PPE materia						
Ce	ertification	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

	ltom		Specification					
	Ite	m	M511	M512	M513	M514		
	Program capacity		20MBytes					
	Variable capacity		20 MBytes (including 128 KBytes of persistent data memory)					
Programming	I area (%	SI)	128Bytes					
	Q area (%Q)		128Bytes					
	M area (%M)	128kBytes					
Pro	grammin	g language	LD, ST, C/C++					
	Servo ax	kes (EtherCAT axes)	8 Axes	16 Axes	32 Axes	64 Axes		
	Number	of pulse axes	4 Axes, 200KHz					
	Number	of encoder axes	4 (2-channel built-in inp	outs + 2-channel expans	ion card inputs)			
	Number	of virtual axes (virtual						
Axis capacity	servo ax	es + virtual encoder	Total ≤ 64			Total ≤ 128		
Axis capacity	axes)							
	Total nu	mber of axes (servo						
	axes + pulse axes + encoder		Total ≤ 64			Total ≤ 128		
	axes + virtual axes)							
EtherCAT	Maximum number of con-		16 (including servo	32 (including servo	64 (including servo	128 (including servo		
nodes	nectable EtherCAT slaves		axes)	axes)	axes)	axes)		
Right	Maximum number of expan-		16					
expansion	sion mo	dules						
	RTC battery		Supported with optional HCMXB-RTC-BD card					
Optional card	Maximu cards	m number of optional	2					
		Number of channels	16-channel inputs (IX0.0~IX0.7, IX1.0~IX1.7)					
	Input		Supports 8-channel external interrupts (IX1.0~IX1.7)					
	Imput	Function	Supports 2-channel hig	orts 2-channel high-speed pulse inputs (200kHz) (AB phase, pulse+direction, single pulse),				
Host IO			corresponding to IX0.0~	·IX0.3				
channel		Number of channels	16-channel outputs (QX0.0~QX0.7, QX1.0~QX1.7)					
	Output		Supports 4-channel hig	h-speed pulse outputs (200KHz) (pulse+directio	n), corresponding to		
	Output	Function	QX0.0~QX0.7, where ev	0.0~QX0.7, where even-numbered channels are pulse and odd-numbered channels are				
			direction.					
	Number of cam profiles		64					
Electronic cam Number of key points per		2048						
curve								
Axis groups Maximum number of ax		m number of axis	8 Axis groups (each sup	porting up to 8-axis inte	erpolation)			
	groups		8 Axis groups (each supporting up to 8-axis interpolation)					
	SD c		1 slot					
USB		of interfaces	1 USB2.0 Type-C					
	Supported fur		Reserved					

		Number of interfaces	Max. 4 channels: 2 built-in channels, expandable by 2 more with optional HCMXB-2RS485-BD			
			card			
RS485		Supported protocol	Modbus Master/Slave (ASCII/RTU); Custom protocol			
	RS485	Max. number of				
		slaves per communi-	32			
Carial part		cation interface				
Serial port		Baud rate (bps)	9600, 19200, 38400, 57600, 115200			
		Number of interfaces	Max. 2 channels: expandable by 2 more with optional HCMXB-2R232-BD card			
		Supported protocol	Modbus Master/Slave (ASCII/RTU); Custom protocol			
	RS232	Max. number of	4			
		slaves				
		Baud rate (bps)	9600, 19200, 38400, 57600, 115200			
	Numbe	r of interfaces	Expandable by 1 channel with optional HCMXB-CAN-BD card			
CAN			CANopen protocol (DS301), can act as master or slave; supports 32 slaves when acting as			
	Suppor	ted protocol	master			
	Numbe	r of interfaces	1 interface, acting as master			
			1. It can connect EtherCAT drives and EtherCAT remote IO. When connecting to EtherCAT drives,			
			axes can be associated with drives, and axes can be controlled via motion commands. Users			
EtherCAT	Functio	n	can configure EtherCAT slave parameters through PDOs, and the master assigns correspondir			
			mapped variables to slave parameters.			
			2. It can read or write to Service Data Objects (SDOs) supported by the slave.			
	Data transfer speed		100Mbps			
	Numbe	r of interfaces	1 channel			
	Functio	n	Communication, program upload/download, etc.			
	Data tra	nsfer speed	100/10Mbps			
	Total nu	ımber of TCP connec-	4//44 700.0 1.1.5 11.4(0)			
	tions		16(ModbusTCP+Socket + EtherNet/IP)			
			The total number of connections for client and server is 16;			
	Modbus	TCP	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			
EtherNet	Numbe	r of simultaneous				
	commu	nications for Modbus	16			
	TCP and	d Socket				
	CIP serv	rice type: Cyclic com-	Max. number of connections: 8; Max. data volume per connection: 200 Bytes;			
	municat	tion (IO Connection)	Cycle interval time: 5~1000 ms			
	OID O		Number of Class 3 connections: 8;			
	CIP Serv	vice Type: Explicit	Number of clients that can be accessed simultaneously via UCMM (Unconnected message			
	1					
	messag	e	manager): 16			
		e r of simultaneous	manager): 16			
	Numbe		manager): 16 16(ModbusTCP+Socket + EtherNet/IP)			

3.4 IO specifications

3.4.1 General IO input/output

♦ General IO input

ltem		Specification	
		M500 series	
Number of input channels (number)		16	
		Sink mode or source mode	
Input si	ignal 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.	
Common terminal configuration		16 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	e when ON	≥ DC 15V	
Voltage	when OFF	≤ DC 5V	
Input curr	ent when ON	>4mA	
Input curre	ent when OFF	<2.5mA	
Standard i	nput channels	IX0.0~IX0.7, IX1.0~IX1.7	
Response	OFF -> ON	< 2.5µs	
time	ON -> OFF	< 2.5µs	
Input impedance		2.7K	
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

ltem		Specification	
		M500 series	
Number of	f input channels	16	
(n	umber)		
Output	channel type	Transistor sink output	
Common terminal configuration		16 channels per common terminal; 16 output channels share one common terminal (COM)	
Leakage current when OFF		<10µA	
		Resistive load: 0.5A per channel, 4A for all channels of the host	
Maxi	mum load	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	
Mini	mum load	1mA / 5V	
Maximum	OFF -> ON	< 2.5µs	
response time	ON -> OFF	< 2.5µs	
Output isolation voltage		3.75KV	
Standard Output channels QX0.0~ QX0.7, QX1.0~ QX1.7		QX0.0~ QX0.7, QX1.0~ QX1.7	
output Function		Controller cylinders, etc.	

3.4.2 High-speed input/output

♦ High-speed input

Item		Specification
Input channel		2 channels (AB phase, pulse+direction, single pulse)
Maximum pulse frequency		200kHz
	AB phase	Channel 1: IX0.0~IX0.1; Channel 2: IX0.2~IX0.3
Input form	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
Input type		Source or sink input
Interrupt		IX1.0~IX1.7; supports interrupt tasks (rising edge or falling edge)

♦ High-speed output

Item		Specification
Output channel		4 channels (pulse+direction)
Maximum pulse frequency		200kHz
Output form Pulse+direction	Dulsa+direction	QX0.0~QX0.7, QX1.0~QX1.3
	Pulse+alrection	Even-numbered channels are pulse, odd-numbered channels are direction
Output type		Sink output

3.5 Communication specifications

3.5.1 Ethernet specifications

Item	Specification	
Interface type	RJ45	
Data transfer speed	100/10Mbps	
Maximum transmission distance (length	100m	
between hub and node)		
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 EtherCAT specifications

ltem	Specification
Interface type	RJ45
Communication protocol	EtherCAT protocol
Supported service	COE(PDO, SDO)
Supported synchronization method	Distributed Clock (DC)
Data transfer speed	100Mbps
Maximum transmission distance	The distance between connected EtherCAT nodes is less than 100m.
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	32

Chapter 4 Software Configuration and Usage Steps

4.1	Software usage steps	.30

4.1 Software usage steps

♦ Software usage steps

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

♦ Step 2. Wiring

Step	Content	Reference
2-1	Wiring of built-in EtherNet/IP interface	Charter Clastellation and Misian
EtherNet cable wiring		
2-2	Minimum of Innaia 1/0 wait	
I/O wiring	Wiring of basic I/O unit	Chapter 5 Installation and Wiring
2-3	USB cable wiring	
Computer (Sysctrl Studio) 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 Controller Model and Component Description
3-2 Configure communication	Establish communication between modules	
3-3 Configure hardware configuration	Create slave/unit configurations	
3-4 Configure task cycles	Relationship between tasks and programsCycle of each tasksRefresh cycle of slaves/units	Software Instruction Manual
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

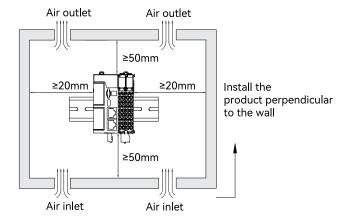
Chapter 5 Installation and Wiring

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5.1 Installation instructions

5.1.1 Installation within a control cabinet

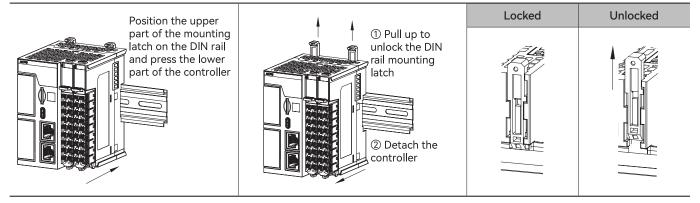
♦ M500-series controller



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.

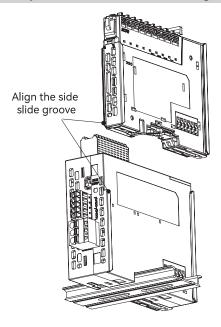
5.1.2 DIN rail mounting and dismounting

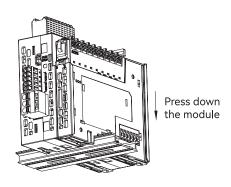
♦ M500-series controller



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.

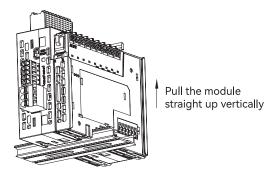
5.1.3 Expansion module mounting and dismounting





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.)

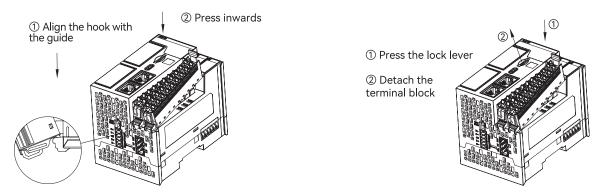
During dismounting, first release the latch, then pull the module straight up vertically (as indicated by the arrow in the figure) from the bottom.



5.1.4 Removable terminal block mounting and dismounting

♦ M500-series controller

• Removable terminal block mounting and dismounting I

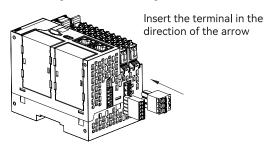


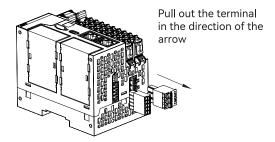
During mounting, align the mounting hook at the bottom of the terminal block to the guide of the module and press in-

wards 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

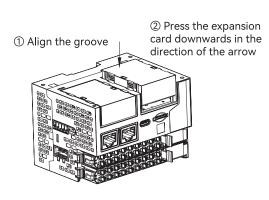
The mounting and dismounting of the removable terminal block are shown in the figures below.

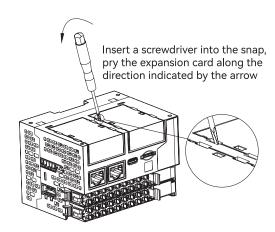




5.1.5 Expansion card mounting and dismounting

◆ M500-series controller





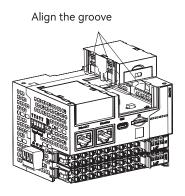
During mounting, place the controller horizontally, align the groove of the expansion card with that of the controller, and press the expansion card downwards. After hearing the "click" sound, check whether the junction surface is flush; if it is, then the installation is completed. During dismounting,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

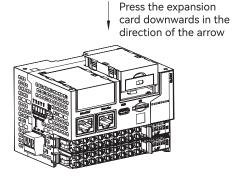
5.1.6 RTC (Real-Time Clock) battery mounting and dismounting

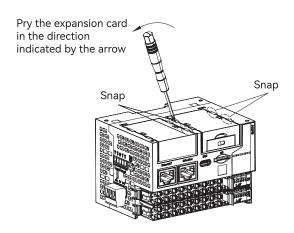
♦ M500-series controller

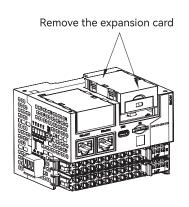
Overall unit mounting/dismounting

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.



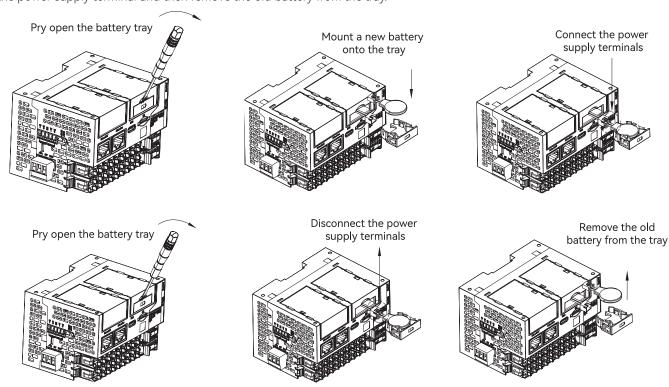






• RTC battery mounting and dismounting

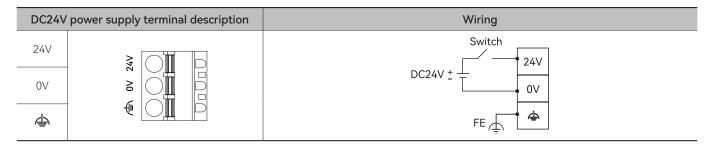
During mounting, use a flathead screwdriver to pry open the battery tray at the designated notch, mount a new battery onto the tray, and then connect the power supply terminal to complete the installation. During dismounting, disconnect the power supply terminal and then remove the old battery from the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



5.2 Wiring instructions

5.2.1 Power supply wiring

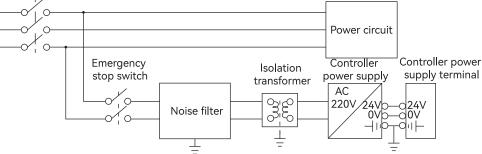
The M500-series motion controller requires a DC 24V power input, with an input voltage range of 20.4 VDC to 28.8 VDC. Connect the power supply to the 24V and 0V terminals, and ground the grounding terminal.



◆ 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.

Emergency stop switch



5.2.2 I/O wiring

♦ M500-series terminal wiring

Terminal definition:

Te	rminal descript	ion	II	N	0	UT	Туре	General IO wiring	High-speed IO wiring
0		10	10	110	Q0	Q10		Switch	Encoder Shield 10
1		11	11	111	Q1	Q11	Sink input	DC24V 7 S0	DC24V - + GND S0
2		12	12	112	Q2	Q12			Fncoder
3		13	13	113	Q3	Q13	Source input	Switch DC24V ± T	A Shield 0
4		14	14	114	Q4	Q14		SO	DC24V DC24V SO
5		15	15	115	Q5	Q15			PLS_out Q0
6		16	16	116	Q6	Q16	Cial autaut	Load Q0	PLS_dir Q1
7		17	17	117	Q7	Q17	Sink output	DC24V ± T COM	Resistor* Resistor* 24V DC24V
8		18	S0	S0	24V	СОМ			+- (CÓM)

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

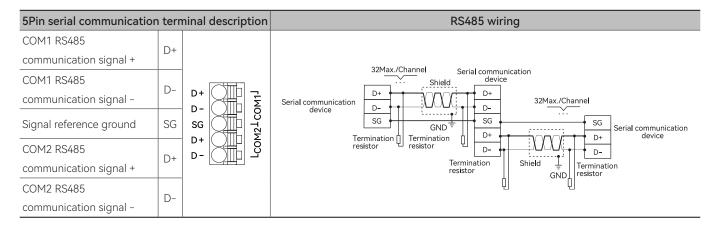
♦ M500-series high-speed I/O terminal configuration

							Terminal	confi	guration										
٨	lo.	0	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	17	18
Input terr	ninal name	10	I1	12	13	14	15	16	17	S0*	110	111	112	113	114	115	116	117	S1*
Supporte	d channels	Cha	annel 1	Cha	annel 2		-	-						-	=				
High- speed	Pulse + Direction	Pulse	Direction	Pulse	Direction		-	-		Common				-	-				Common
input	AB phase	А	В	А	В		-	-		terminal				-	=				terminal
definitions	Single pulse	Pulse	-	Pulse	-		-	-						-	_				
Output ter	minal name	Q0	Q1	Q2	Q3	Q4	Q5	Q6	Q7	24V	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	COM
	eed output nnels	Cha	annel 1	Cha	annel 2	Ch	annel 3	Ch	annel 4					-	-				
High- speed output definitions	Direction	Pulse	Direction	Pulse	Direction	Pulse	Direction	Pulse	Direction	DC24V				-	-				Common terminal

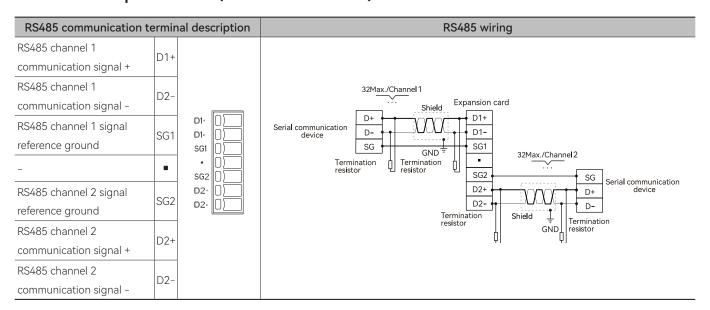
5.2.3 Communication wiring

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

◆ M500-series controller



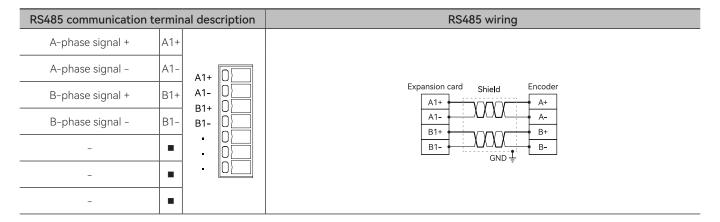
◆ RS485 expansion card (HCMXB-2RS485-BD)



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

RS232 communication	termir	al description	RS232 channel 1 wiring	RS232 channel 2 wiring
RS232 channel 1 data	Tx1			
transmission	IXI			
RS232 channel 1 data	Rx1			
reception	IXXI	T.1		
RS232 channel 1 signal	SG	Tx1 U	, Serial communication	Serial communication
reference ground	30	sg 🛛	Expansion card device	Expansion card device
-	-	sg O	Rx1 Tx	Rx2 Tx
RS232 channel 2 signal	SG	Tx2	SG Shield SG	SG Shield SG
reference ground	30	Rx2 U	-	-
RS232 channel 2 data	Tx2			
transmission	IXZ			
RS232 channel 2 data	Rx2			
reception	IKXZ			

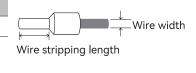
◆ AB phase differential encoder expansion card (HCMXB-AB-500-BD)



5.2.4 Installation and wire gauge specifications

♦ M500-series controller

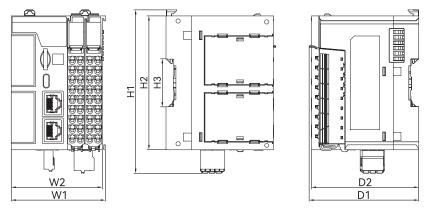
Controller terminal	Wire gauge range: AWG	Wire stripping length: mm	Crimping force:	Pull-out force: N
18-Pin IO terminal	24~18	8~10	25	40
5-Pin serial communication terminal	24~16	8~10	16	40
DC24V power supply terminal	26~12	9~10	25	60



5.3 Product dimensions

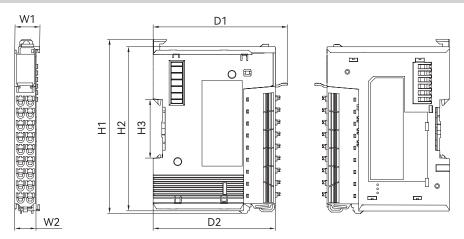
5.3.1 Controller dimensions

♦ M500-series controller

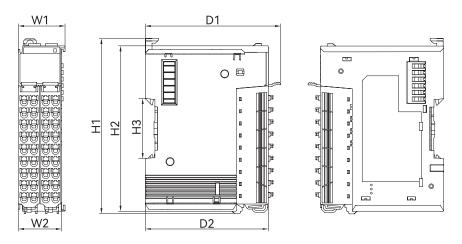


			Outline dimensions	3		
W1	W2	H1	H2	H3	D1	D2
70.30	67.99	122.05	100.00	35.40	81.92	80.20

5.3.2 Expansion module dimensions



Single-row terminal			0	utline dimensio	ns		
module	W1	W2	H1	H2	Н3	D1	D2
HCMX-OD08-D							
HCMX-OD08-D-PNP							
HCMX-OD16-D							
HCMX-OD16-D-PNP							
HCMX-ID08-D							
HCMX-ID16-D	15 20	12.00	122.15	107.50	25 (0	05.77	00.20
HCMX-MD16-D	15.20	13.00	122.15	104.50	35.40	95.64	80.20
HCMX-MD16-D-PNP							
HCMX-AD04-D							
HCMX-AD04S-D							
HCMX-DA04-D							
HCMX-DA04S-D							



Double-row terminal	Outline dimensions											
module	W1	W2	H1	H2	Н3	D1	D2					
HCMX-OD32-D												
HCMX-OD32-D-PNP												
HCMX-ID32-D	22.20	20.00	122.15	107.50	25 (0	95.64	00.20					
HCMX-MD32-D	32.30	30.00	122.15	104.50	35.40	95.64	80.20					
HCMX-MD32-D-PNP												
HCMX-OC08-D												

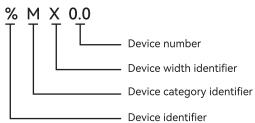
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6.1 Device and Modbus address

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		%: I	ndicates the use of a de	vice	
Davisa satawan	I	Q	М	-	_
Device category	Input device	Output device	Intermediate device	-	-
Davisa wielth	X	В	W	D	L
Device width	Bit device	Byte device	Word device	Double word device	Quad word device
Device index	-	-	-	-	-
Bit offset	-	-	-	-	-
	%IX0.0	%IB0	%IW0	%ID0	%IL0
Device example	%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.

										D	evice	corre	espor	nden	ce									
Device		Th	ne 1st	: WOF	RD			Th	e 2nc	l WO	RD			Th	e 3rc	WO!	RD			Th	e 4th	WOI	RD	
category	Bit		Bit	Bit		Bit	Bit		Bit	Bit		Bit	Bit		Bit	Bit		Bit	Bit		Bit	Bit		Bit
	0	•••	7	8	•••	15	0	•••	7	8	•••	15	0	•••	7	8	•••	15	0	•••	7	8	•••	15
%MX	%N	1X0.0	~0.7	%M	1X1.0^	1.7	%M	X2.0~	2.7	%M	X3.0 ⁻	-3.7	%M	1X4.0^	~4.7	%M	1X5.0^	-5.7	%M	1X6.0^	-6.7	%M	X7.0~	7.7
%MB		%MB()		%MB1		9	%MB2)		%МВ3	3		%MB4	4		%MB5	5		%МВ6	5		%MB7	,
%MW			%M	W0					%M	W1					%M	1W2					%M	W3		
%MD						%M	1D0											%N	1D1					
%ML												%N	1L0											

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.

										D	evice	corr	espor	nden	ce										
Device		Th	e 5th	WOI	RD			Th	e 6th	WOF	RD		The 7th WORD						The 8th WORD						
category	Bit		Bit	Bit		Bit	Bit		Bit	Bit		Bit	Bit		Bit	Bit		Bit	Bit		Bit	Bit		Bit	
	0	•••	7	8	•••	15	0	•••	7	8	•••	15	0	•••	7	8	•••	15	0	•••	7	8	•••	15	
%MX	%M	X8.0^	8.7	%M	1X9.0 [~]	9.7	%MX	(10.0~	10.7	%MX	(11.0	-11.7	%MX	(12.0^	12.7	%M>	〈13.0 [^]	13.7	%M>	(14.0^	14.7	%M>	(15.0~	15.7	
%MB	Ġ,	%MB8	3		%MB9)	%	6MB1	0	%	6МВ1	1	%	6MB1	2	9	6MB1	3	9	6MB1	4	9	6MB1	5	
%MW			%M	W4					%M	IW5					%M	1W6					%M	W7			
%MD						%M	1D2											%M	1D3						
%ML												%N	1L1												

♦ Device range:

The device range of the M500-series controller is shown in the table below:

Device category	Device representation method	Device range
0/1\/	%IX0.0~%IX0.7	0/1//0.0.0/1//1.07.7
%IX	%IX1.0~%IX1.7	%IX0.0~%IX127.7
%/OV	%QX0.0~%QX0.7	% OV0 0. % OV127 7
%QX	%QX1.0~%QX1.7	%QX0.0~%QX127.7
9/ h 4 \/	%MX0.0~%MX0.7	%MX0.0~%MX131071.7
%MX	%MX1.0~%MX1.7	%IMXU.U~%IMX131U/1./
%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 address 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
		%IX0.0~%IX0.7	0x6000~0x6007
	Dit daviag (hit)	%IX1.0~%IX1.7	0x6008~0x600F
I (Input device)	Bit device (bit)		
		%IX127.0~%IX127.7	0x63F8~0x63FF
	Word device (word)	%IW0~%IW63	0x8000~0x803F
		%QX0.0~%QX0.7	0xA000~0xA007
	Bit device (bit)	%QX1.0~%QX1.7	0xA008~0xA00F
Q (Output device)	bit device (bit)		
		%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:

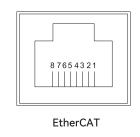
For example, QXA.B: Convert A×8+B to hexadecimal, then add 16#A000.

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

Signal	Description
Tx+	Transmit data positive (TX+)
Tx-	Transmit data negative (TX-)
Rx+	Receive data positive (RX+)
Reserved	Reserved
Reserved	Reserved
Rx-	Receive data negative (RX-)
Reserved	Reserved
Reserved	Reserved
	Tx+ Tx- Rx+ Reserved Reserved Rx- Reserved

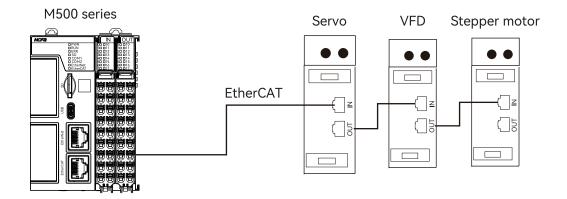


6.2.2 EtherCAT communication interface function description

- 1. It can connect to EtherCAT drives and EtherCAT remote I/O. When connecting to an EtherCAT drive, axes can be associated with the drive, and axes can be controlled via motion commands. Users can configure parameters of EtherCAT slaves through PDO (Process Data Object) configuration, and the master station assigns corresponding mapped variables to slave parameters.
 - 2. It supports reading from or writing to Service Data Objects (SDOs) supported by the slave.

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

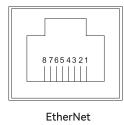
The distance between adjacent EtherCAT nodes shall not exceed 100 meters.

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



6.3.2 EtherNet communication interface function description

The M500-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 M500-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
Maxi	mum transmission distance (between hub and node)	100 meters
Number of simultane	ous 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
Madaya TCD Caakat	Sum of simultaneous communication connections for Modbus TCP and	16
Modbus TCP, Socket	Socket	10

	CIP service type: Cyclic	CIP connec	ction count	8
	communication (IO	Requested Pack	ket Interval (RPI)	5ms~1000ms
	connection)	Maximum data volu	ıme per connection	200bytes
EtherNet/IP (slave only)		Class 3 (Conn	ection count)	8
	CIP service type: Explicit	UCMM (Unconnected	Maximum number	
	message	message management)	of simultaneous	16
		message management)	communication clients	

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

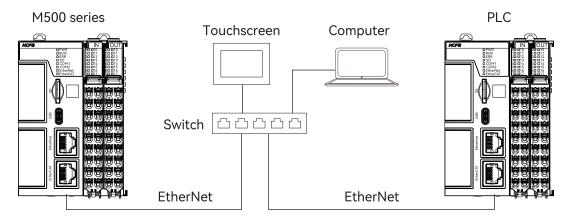
The following table lists the function codes supported by the EtherNet communication interface of the M500-series motion controller when using the Modbus TCP protocol:

Category	Function code	Description	Broadcastable (Y/N)	Read/Write maximum length	Operable device
		Definition: Read the value of bit devices.			
	0x01	M-series controller bit device values can all be read using	Υ	256	%IX,%QX
		function code 01.			
D:: 1 :		Definition: Read the value of input bit devices.			
Bit device	0x02	M-series controller bit device values can all be read using	N	256	%IX,%QX
		function code 02.			
	0x05	Write the value of a single bit device.	Υ	1	%QX
	0x0F	Write the values of multiple bit devices.	Υ	256	%QX
	0x03	Read the value of single or multiple word devices.	N	100	%MW,%QW,%IW
		Definition: Read the value of single or multiple input word			
	0x04	devices.	N	100	0/84/8/0/0/8/0/1/8/
NA / 1	UXU4	M-series controller word device values can all be read using	IN	100	%MW,%QW,%IW
Word		function code 04.			
device	0x06	Write the value of a single word device.	Υ	1	%MW,%QW
	0x10	Write the values of multiple word devices.	Υ	100	%MW,%QW
	0.17	Decil A A / Charles and the control of the charles and the charles are charles		100	%MW,%QW,
	0x17	Read/Write the value of single or multiple word devices.	Y	100	%IW (read only)

The following table lists the exception response codes supported by the EtherNet communication interface of the M500-series motion controller when using the Modbus TCP protocol:

Exception re- sponse 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

The HCM500 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	CAN
1	CAN_H	CAN communication signal (high)	
2	CAN_L	CAN communication signal (low)	8 765 43 2 1
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.

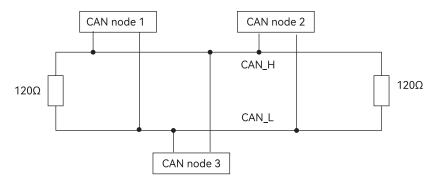
6.4.2 PDO mapping of CANopen communication interface

When the M500 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 M500 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.

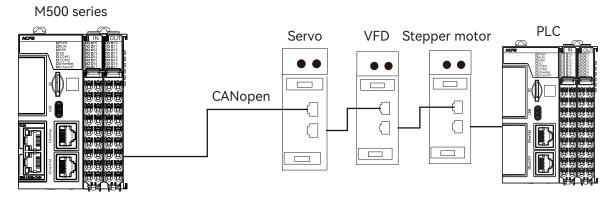
6.4.3 CANopen bus hardware connection

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 M500-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-	RS48-	RS485 negative signal
SG	Reference ground	RS485 signal reference ground

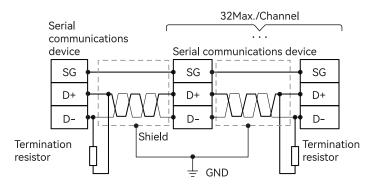
The M500-series motion controller can be expanded with one expansion card to add two independent RS485 communication interfaces. Only one RS485 expansion card can be installed. The model of the RS485 expansion card is HCMXB-2RS485-BD. The pin definitions of the RS485 expansion card communication interface 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 -	

6.5.2 RS485 communication interface function description

The RS485 communication interfaces of the M500-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 M500-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					ΓU
Communication format	7,E,1	7,E,2	7,N,1	7,N,2	8,E,1	8,E,2
	7,0,1	7,0,2	8,E,1	8,E,2	8,N,1	8,N,2
	8,N,1	8,N,2	8,O,1	8,0,2	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 M500-series motion controller are listed in the table below:

Category	Function code	Description	Broadcastable (Y/N)	Read/Write maximum length	Operable 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
Bit device	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.	Υ	1	%QX
	0x0F	Write the values of multiple bit devices.	Υ	256	%QX
	0x03	Read the value of single or multiple word devices.	N	100	%MW,%QW,%IW
Word device	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.	Υ	1	%MW,%QW
	0x10	Write the values of multiple word devices.	Υ	100	%MW,%QW
	0x17	Read/Write the value of single or multiple word devices.	Υ	100	%MW,%QW, %IW (read only)

♦ The following table lists the exception response codes supported by the RS485 communication interface of the M500-series motion controller:

Exception re- sponse 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 M500-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	Tx1 0 Rx1 0 SG 0	Expansion card Serial communication device Tx1 Rx	Expansion card Serial communication device	
-	•	sg O	Rx1 Tx Shield SG	Rx2 Rx2 Shield SG	
RS232 channel 2 signal reference ground	SG	Tx2 U Rx2	‡ GND	ê GND	
RS232 channel 2 data transmission	Tx2				
RS232 channel 2 data reception	Rx2				

6.6.2 RS232 communication interface function description

The RS232 communication interfaces of the M500-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 M500-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 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					ΓU
Communication format	7,E,1	7,E,2	7,N,1	7,N,2	8,E,1	8,E,2
	7,0,1	7,0,2	8,E,1	8,E,2	8,N,1	8,N,2
	8,N,1	8,N,2	8,0,1	8,0,2	8,0,1	8,O,2

6.6.4 Function codes and exception response codes supported by RS232

♦ The function codes supported by the RS232 communication interface of the M500-series motion controller are listed in the table below:

Category	Function code	Description	Broadcastable (Y/N)	Read/Write maximum length	Operable device
	0x01	Definition: Read the value of bit devices. M-series controller bit device values can all be read using	N	256	%IX,%QX
		function code 01.			
Bit device	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.	Υ	1	%QX
	0x0F	Write the values of multiple bit devices.	Υ	256	%QX
	0x03	Read the value of single or multiple word devices.	N	100	%MW,%QW,%IW
Word device	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.	Υ	1	%MW,%QW
	0x10	Write the values of multiple word devices.	Υ	100	%MW,%QW
	0×17	Read/Write the value of single or multiple word devices.	Υ	100	%MW,%QW, %IW (read only)

♦ The following table lists the exception response codes supported by the RS232 communication interface of the M500-series motion controller:

Exception re-	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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