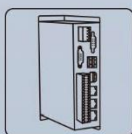
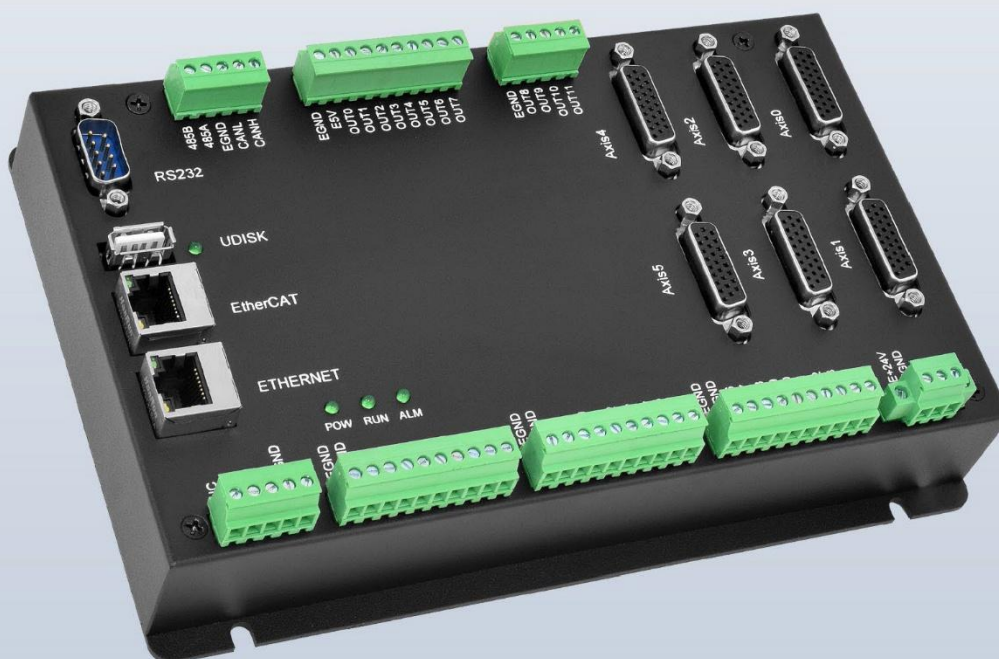
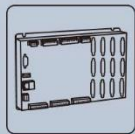


Pulse & EtherCAT Motion Controller

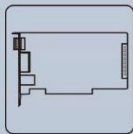
ZMC404-V2



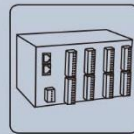
Vision Motion
Controller



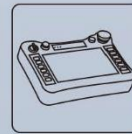
Motion
Controller



Motion
Control Card



IO Expansion
Module



HMI

Statement

Thank you for choosing our Zmotion products. Please be sure to read this manual carefully before use so that you can use this product correctly and safely. Zmotion is not responsible for any direct or indirect losses caused by the use of this product.

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The information in this manual is for reference only. Due to design improvements and other reasons, Zmotion reserves the right of final interpretation of this information! Contents are subject to change without prior notice!

➤ Notes

In order to prevent possible harm and damage caused by incorrect use of this product, the following instructions are given on matters that must be observed.

■ Danger

Do not use it in places with water, corrosive or flammable gases, or near flammable substances.	May cause electric shock, fire, damage, etc.
When installing or disassembling, make sure the product is powered off.	
Cables should be connected securely, and exposed parts that are energized must be insulated by insulators.	
Wiring work must be performed by professionals.	

■ Notes

It should be installed within the specified environmental range.	May cause damage, mis-operation, etc.
Make sure there are no foreign objects on the product hardware circuit board.	
After installation, the product and the mounting bracket should be tight and firm.	
After installation, at least 2-3cm should be left between the product and surrounding components for ventilation and replacement.	
Never disassemble, modify, or repair it by yourself.	

Content

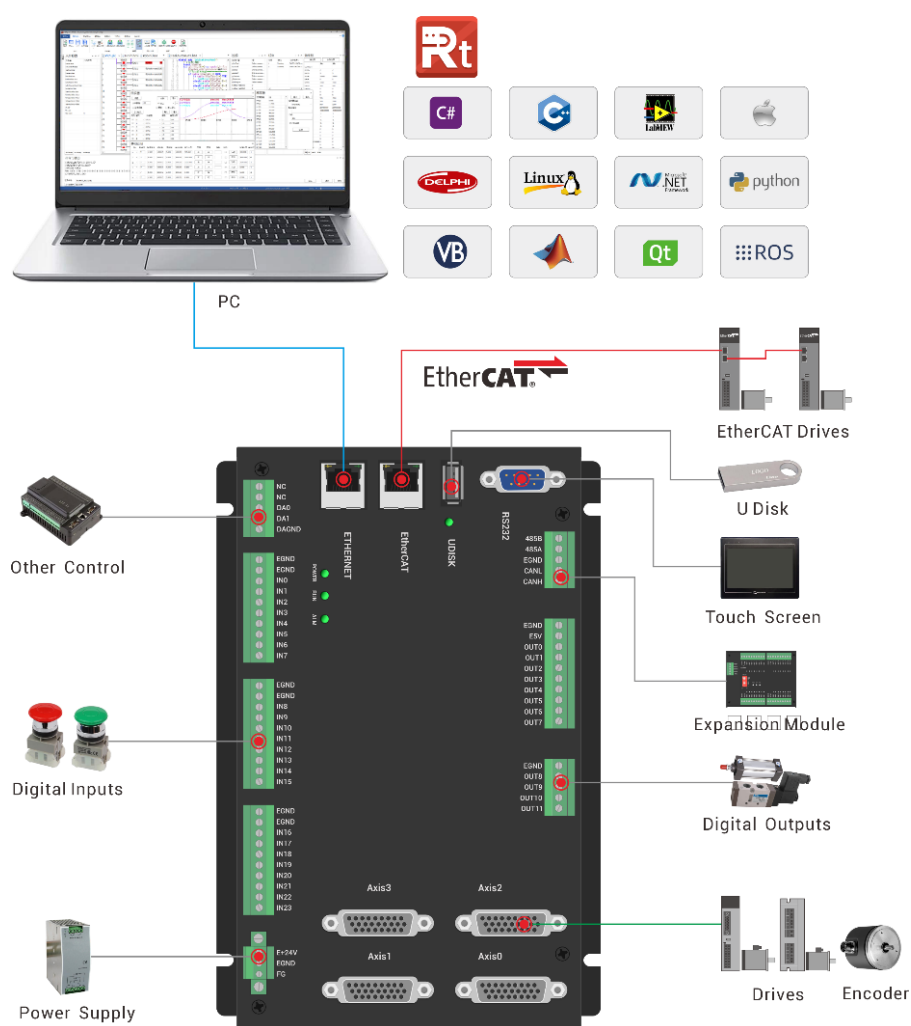
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Chapter I Production Information

1.1. Product Information

ZMC404-V2 high-performance multi-axis motion controller is a stand-alone motion controller that is compatible with EtherCAT and pulse type, which supports max 6 axes for complex continuous trajectory control.

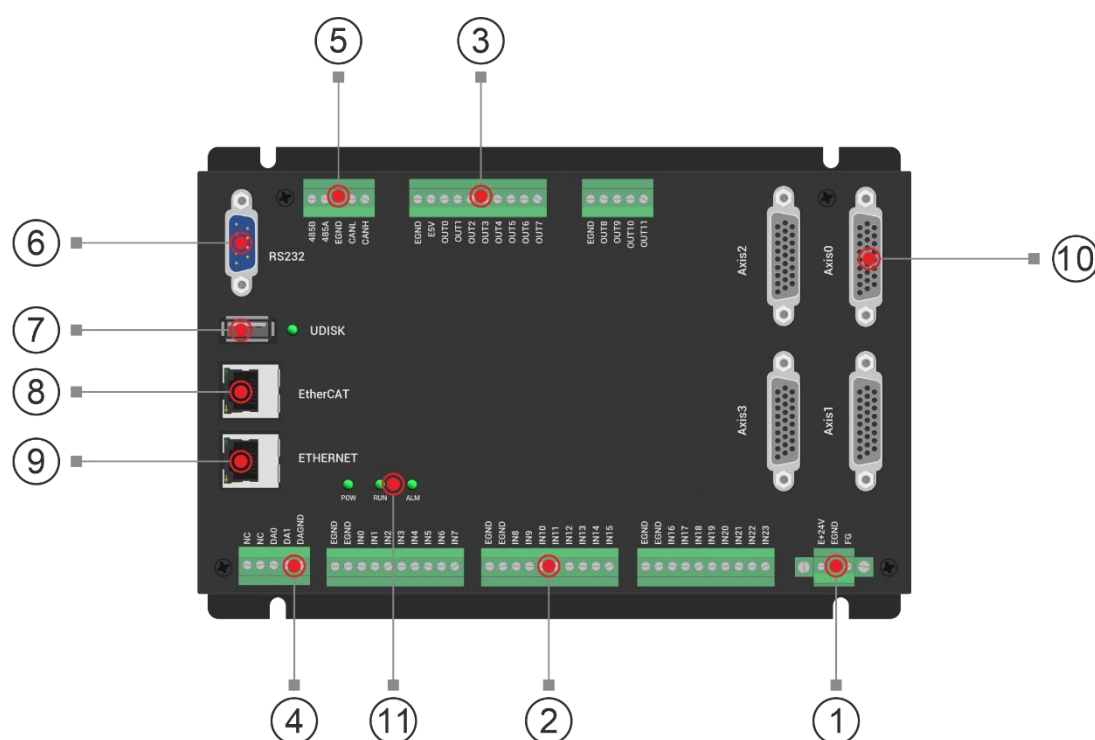


- There are interfaces of EtherCAT, differential pulse axes, differential encoders.
- Basic Motion Control Functions:** point motion, electronic cam, linear interpolation, circular interpolation, continuous interpolation, robot algorithms, etc.
- Special Motion Control Functions:** HW hardware comparison output, high-speed latch, PWM, etc.,

- One UDISK interface is equipped, for writing and reading files, updating the program, easy to do remote support and maintain.
- It can be programmed in multi-file and multi-task by BASIC, also, PC program and controller inner RTBasic program can work at the same time.

ZMC4XX high-performance multi-axis motion controllers can be applied in robots (SCARA, Delta, 6 joints), electronic semiconductor equipment (testing equipment, assembly equipment, locking equipment, soldering machine), dispensing equipment, non-standard equipment, printing and packaging equipment, textile and garment equipment, stage entertainment equipment, medical equipment, assembly line, etc.

1.2. Interface Introduction



No.	Interfaces	Descriptions
①	Power	connect to 24V DC power supply
②	DI	- NPN type; - IN0-23; - some inputs (IN0~IN1) can be set as single-ended encoder, or used to do position latch.
③	DO	NPN type;

		● OUT0-11; ● some outputs (OUT0~OUT3) can be used as single-ended pulse axes, or can be used to do PWM, HW.
④	DA	● single-ended type; ● 12-bit, 0-10V.
⑤	CAN	● connect to CAN expansion modules to expand more resources;
	RS485	● connect to upper computer; ● MODBUS_RTU.
⑥	RS232	● connect to upper computer; ● MODBUS_RTU.
⑦	UDISK	● connect to USB external devices (mouse, keyboard, U disk, etc.) for program upgrading, data importing & exporting.
⑧	EtherCAT	● connect to EtherCAT drive; ● or connect to EtherCAT expansion modules.
⑨	EtherNET	● connect to upper device (PC, etc.); ● MODBUS_TCP protocol; ● it can be extended by one industrial switch.
⑩	AXIS (differential)	● connect to servo drives, including directional / pulse, encoder, specialized I/O.
⑪	Controller Status Led	● POWER Led: ON when power is connected.
		● RUN Led: ON when it runs normally.
		● ALM Led: ON when it runs abnormally.

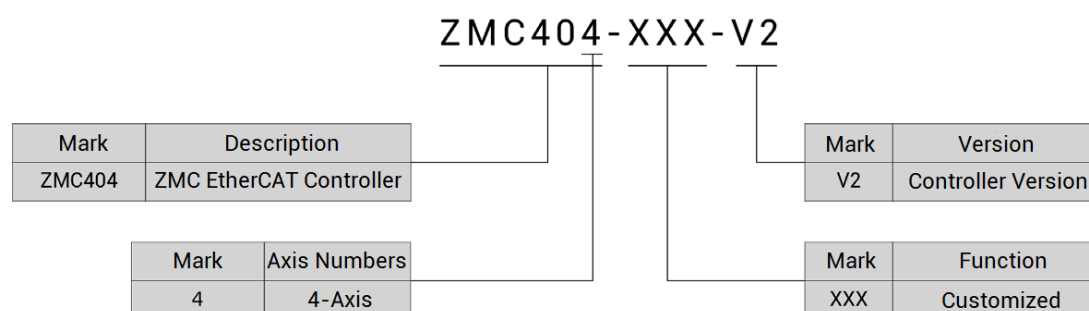
1.3. Product Specifications

ZMC404-V2	
Base Descriptions	
Motor Axes	4
Max Extended Axes	32 (motor axes + virtual axes)
Program Space	32MBYTE
Dimensions (mm)	205*135.25*45.8
Axis Type	

EtherCAT Axis	√; 1 EtherCAT bus axis
AXIS Differential Pulse Axes	4 (directional / pulse + encoder + Digital I/O)
DI & DO	
DI	24 (general) + 6 (specialized DI for AXIS)
DO	12 (general) + 6 (specialized DI for AXIS)
Max Extended DI	≤4096
Max Extended DO	≤4096
AD & DA	
AD	0
DA	2 (0-10V, 12-bit)
Max Extended AD	≤1000
Max Extended DA	≤1000
Communication Interfaces	
EtherNET	1
EtherCAT	1
CAN	1
RS232	1
RS485	1
U Disk	1
Basic Motion Control Functions	
Point & Jog	√
Electronic Cam	
Linear Interpolation	
Circular Interpolation	
Continuous Interpolation	
Normal Robot Algorithm	
Power-Down Storage	
Advanced Motion Control Functions	
High-Speed Latch	2
Hard Comparison Output HW	4 (OUT0~1: high-speed; OUT2~3: low-speed)
General PWM	4 (OUT0~1: high-speed; OUT2~3: low-speed)

1.4. Nameplate & Order Information

■ Nameplate Information:



■ Product Model Selection

Model	Description
ZMC404-V2	4 axes, point to point, linear, circular, electronic cam, continuous trajectory motion, robotic car instructions.
ZMC404R-V2	Functions of ZMC404-V2 + Delta + 6-joint robotic arm instructions.

1.5. Environment Requirements

Item		Parameters
Work Temperature ^[1]		-10°C-55°C
Work relative Humidity		10%-95% non-condensing
Storage Temperature		-40°C ~ 80°C (not frozen)
Storage Humidity		Below 90%RH (no frost)
vibration	Frequency	5-150Hz
	Displacement	3.5mm(directly install)(<9Hz)
	Acceleration	1g(directly install)(>9Hz)
	Direction	3 axial direction
Shock (collide)		15g, 11ms, half sinusoid, 3 axial direction
Degree of Protection		IP20

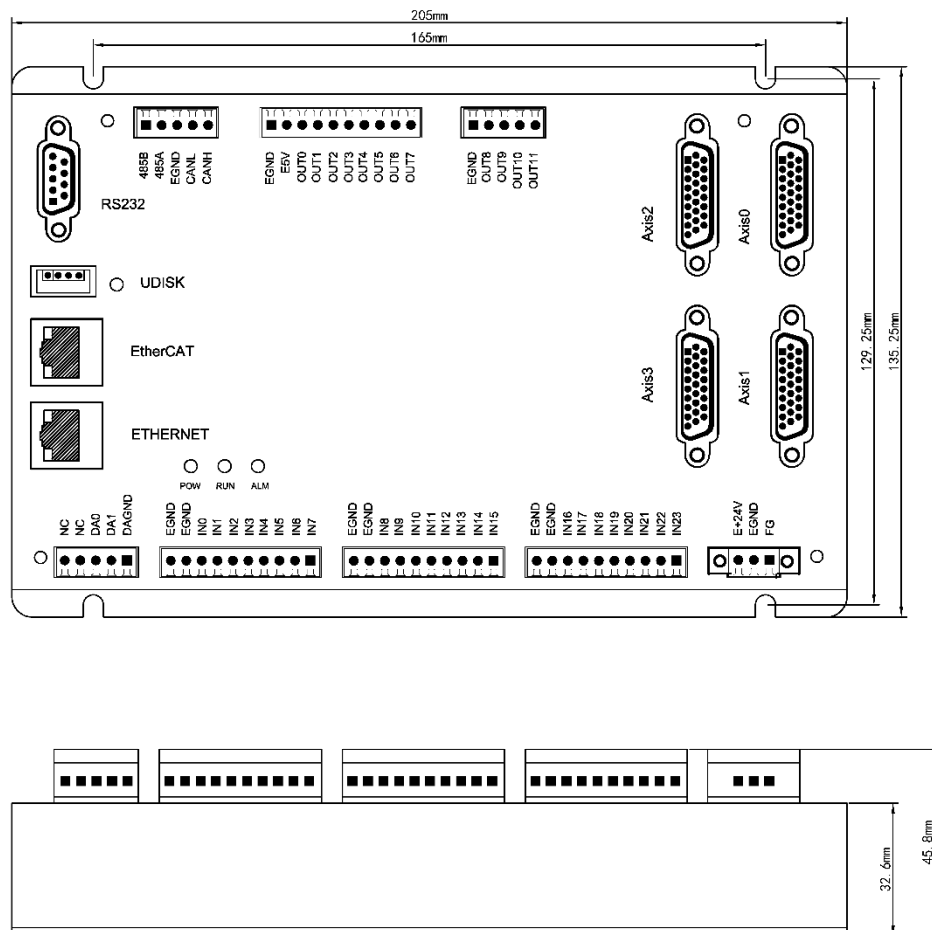
Note [1]: if the environment temperature is too high or too low, please operate fan cooling (fan) or heat Preservation, to ensure controller can work normally and stably.

1.6. Hardware Installment

The ZMC404-V2 motion controller adopts the horizontal installation method of screw fixing, and each controller should be installed with 4 screws for fastening.

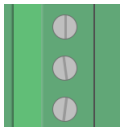
→ Unit: mm

→ Installment Hole Diameter: 4.5mm



Chapter II Hardware Interfaces

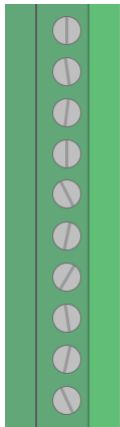
2.1. Power IN

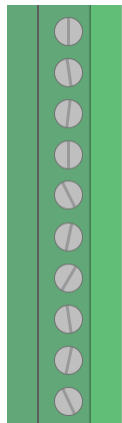
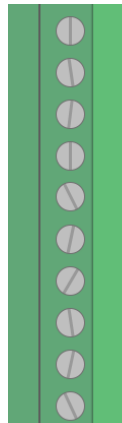
Terminal	Name	Function
 E+24V EGND FG	E+24V	DC Input +
	EGND	DC Input -
	FG	Protection

Specification

Item	Descriptions
Voltage	DC24V±5%
Max Power	10W
Anti-reverse connection	√
Overcurrent Protection	√
Isolation Power	√
Cable Type	Recommend "1.0 mm ² copper conductor cable"

2.2. DI: Digital Inputs

Terminal	Name	Type	Function 1	Function 2
 EGND EGND IN0 IN1 IN2 IN3 IN4 IN5 IN6 IN7	EGND	/	IO Public End	/
	EGND	/		/
	IN0	NPN type, high-speed input	Input 0	High Speed Latch
	IN1		Input 1	High Speed Latch
	IN2	NPN type, low-speed input	Input 2	/
	IN3		Input 3	/
	IN4		Input 4	/
	IN5		Input 5	/
	IN6		Input 6	/
	IN7		Input 7	/
	EGND	/	IO Public End	/
	EGND	/		/

	EGND	IN8	NPN type, low-speed input	Input 8	/
	EGND	IN9		Input 9	/
	IN8	IN10		Input 10	/
	IN9	IN11		Input 11	/
	IN10	IN12		Input 12	/
	IN11	IN13		Input 13	/
	IN12	IN14		Input 14	/
	IN13	IN15		Input 15	/
	IN14				
	EGND	/	IO Public End	/	
	EGND	/		/	
	IN16	NPN type, low-speed input	Input 16	/	
	IN17		Input 17	/	
	IN18		Input 18	/	
	IN19		Input 19	/	
	IN20		Input 20	/	
	IN21		Input 21	/	
	IN22		Input 22	/	
	IN23		Input 23	/	

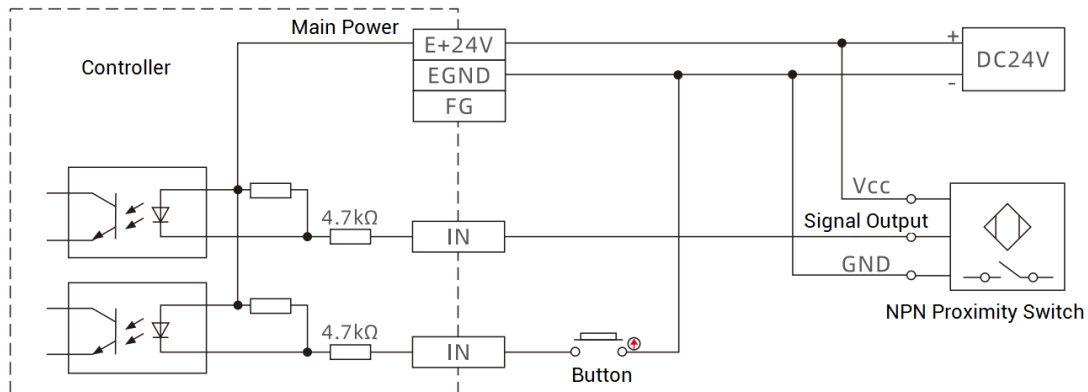
Note: functions can't be reused (please choose one function).

Specification

Item	High-Speed Input (IN0-1)	Low-Speed Input (IN2-23)
Input mode	NPN type, the input is triggered when there is low level	
Frequency	<100kHz	<5kHz
Impedance	3.3KΩ	4.7KΩ
Voltage level	DC24V	DC24V
The voltage to open	<15V	<14.5V
The voltage to close	>15.1V	>14.7V
Minimal current	-2.3mA (negative)	-1.8mA (negative)
Max current	-7.5mA (negative)	-6mA (negative)
Isolation mode	optoelectronic isolation	optoelectronic isolation

Wiring

General Wiring:



Notes:

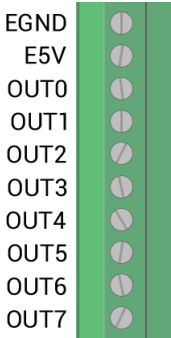
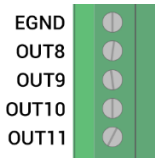
- The wiring for the digital input is as shown in the diagram above. The external load can be a button switch, sensor, etc., but it is important to ensure that the signal specifications match.
- It is recommended to use the same power supply for both the load and the controller, otherwise, the negative terminals of two power supplies should be connected.
- During on-site wiring, maintain a distance from high-voltage power lines, preferably 30cm or more.
- Ensure that the controller is properly grounded, and the chassis ground should be connected to a standard factory ground rod.

Usage Method

- (1) Please follow the above wiring instructions to wiring correctly, then connect the controller to [RTSys](#) through ethernet / serial port.
- (2) IN states can be read directly through "IN" command, also, it can be read through *"RTSys / Tool / IN"*.
- (3) Latch function can be set and triggered by "REGIST", "REV_IN", "DATUM_IN".

- (4) Axis position limit signals / origin signals can be set by "FWD_IN", "REV_IN", "DATUM_IN" commands.
- (5) For above and other commands, please refer to "[RTBASIC Programming Manual](#)", or check in *RTSys / Help / RTBasic*.

2.3. DO: Digital Outputs

Terminal	Name	Type	Function 1	Function 2	Function 3
	EGND	/	IO public end	/	/
	E5V	/	5V power output, max is 300mA	/	/
	OUT0	NPN, high-speed	Output 0	PWM 0	HW: Hardware Comparison Output
	OUT1		Output 1	PWM 1	
	OUT2	NPN type, low-speed output	Output 2	PWM 2	
	OUT3		Output 3	PWM 3	
	OUT4		Output 4	/	/
	OUT5		Output 5	/	/
	OUT6		Output 6	/	/
	OUT7		Output 7	/	/
	EGND	/	IO public end	/	/
	OUT8	NPN type, low-speed output	Output 8	/	/
	OUT9		Output 9	/	/
	OUT10		Output 10	/	/
	OUT11		Output 11	/	/

Notes:

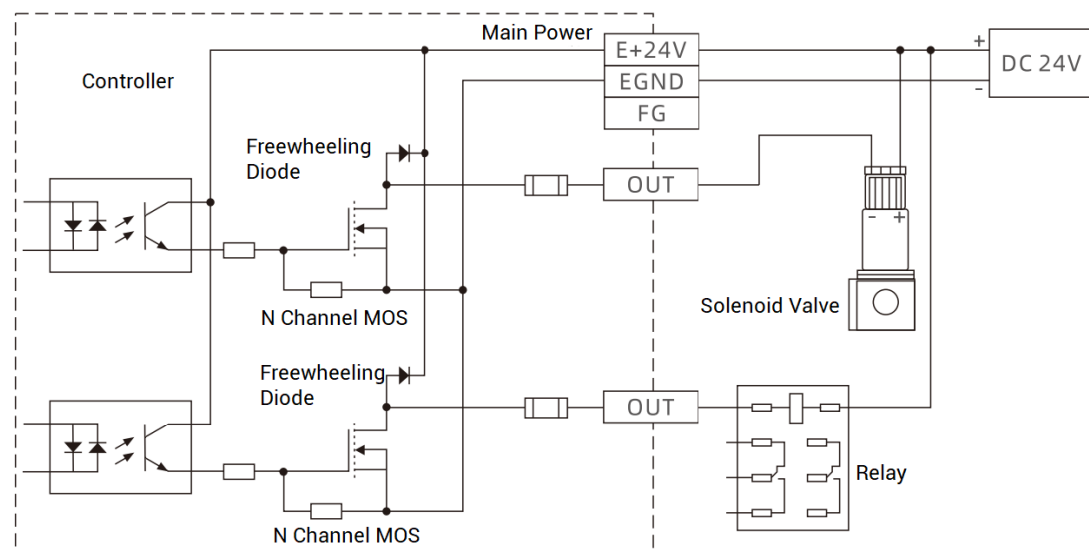
- ✧ The E5V power output port is used for PWM or common anode wiring of single-ended axis. It is not recommended for other purposes due to lower power.
- ✧ OUT0-3 have the functions of PWM and hardware comparison output, among which OUT2 and 3 are low-speed outputs.
- ✧ Functions can't be reused (please choose one function).

Specification

Item	High Speed OUT (OUT0-1)	Low Speed OUT (OUT2-11)
Output mode	NPN type, it is 0V when outputs	
Frequency	<400kHz	<8kHz
Load Voltage	≤24V	≤24V
Output Current	≤300mA	≤300mA
Overcurrent Protection	√	√
Isolation method	Optoelectronic Isolation	

Wiring

General Wiring:



Notes:

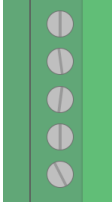
- The wiring for the digital output is as shown in the diagram above. The external load can be a relay, valve solenoid etc., but it is important to ensure that the signal specifications match.
- For 5V pulse direction interface, please connect PUL+ and DIR+ to E5V interface.
- It is recommended to use the same power supply for both the load and the controller, otherwise, the negative terminals of two power supplies should be connected.

- During on-site wiring, maintain a distance from high-voltage power lines, preferably 30cm or more.
- Ensure that the controller is properly grounded, and the chassis ground should be connected to a standard factory ground rod.

Usage Method

- (1) After correct wiring & powered-on, please connect controller to [RTSys](#) by EtherNET or COM ports.
- (2) OUT can be set directly through "OP" command, also, it can be operated by *"RTSys / Tool / OP"*.
- (3) PWM function can be set by "PWM_FREQ" (frequency), "PWM_DUTY"(duty cycle).
- (4) Hardware comparison output can be set by "HW_PSWITCH2" command.
- (5) For above and other commands, please refer to ["RTBASIC Programming Manual"](#), or check in *RTSys / Help / RTBasic*.

2.4. DA: Analog Outputs

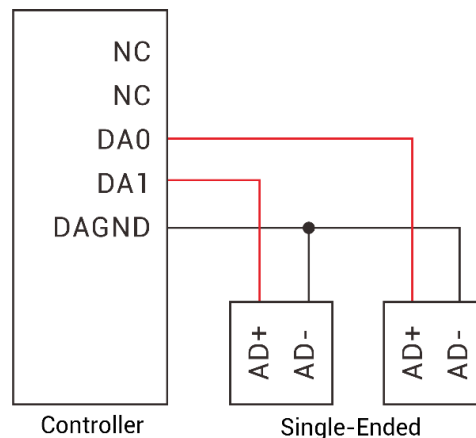
Terminal	Name	Function
 NC NC DA0 DA1 DAGND	NC	Reserved
	NC	Reserved
	DA0	Analog output terminal: AOUT(0)
	DA1	Analog output terminal: AOUT(1)
	DAGND	Analog public end

Specification

Item	DA (0-1)
Resolution	12-bit

Data Range	0-4095
Signal Range	0-10V output
Data Refresh Ratio	1ksps
Input Impedence / Output Load	>1K Ω (load requirement)
Wiring Length	<5 meter (recommended)

Wiring



Notes:

- The wiring for the analog output is as shown in the diagram above. The load signal should be matched with impedance, otherwise, it will affect precision.
- Please use STP, especially in bad environments, and make sure the shielding layer is fully grounded.
- During on-site wiring, maintain a distance from high-voltage power lines, preferably 30 cm or more.
- Ensure that the controller is properly grounded, and the chassis ground should be connected to a standard factory ground rod.

Usage Method

- (1) After correct wiring & powered-on, please connect controller to [RTSys](#) by EtherNET or COM ports.

- (2) AD states can be read directly through "AIN" command, and DA can be set directly through "AOUT", also, they can be checked and operated in *"RTSys / Tool / AD/DA"*.
- (3) Please refer to ["RTBASIC Programming Manual"](#), or check in *RTSys / Help / RTBasic*.

2.5. RS485 & CAN

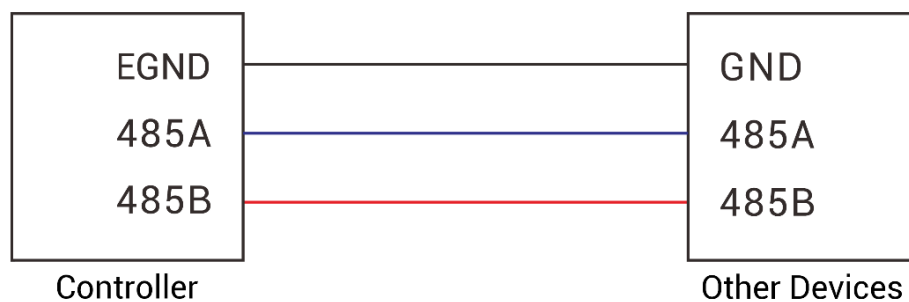
Terminal	Name	Function
485B	485B	RS485 Signal B / -
485A	485A	RS485 Signal A / +
EGND	EGND	Communication Public End
CANL	CANL	CAN Differential Side L
CANH	CANH	CAN Differential Side H

Specification

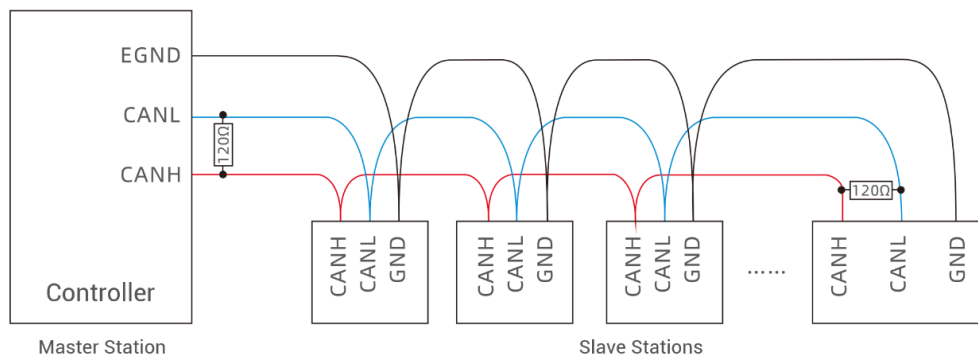
Item	RS485 (port 1)	CAN
Communication Rate	$\leq 115200\text{bps}$	$\leq 1\text{Mbps}$
Terminal Resistor	No	120 Ω
Topology	Daisy Chain Connection Structure	
Nodes can be extended	Up to 127	Up to 16
Wiring Distance	<30m	<30m (500kbps)
Communication Isolation	√	

Wiring

RS485 Wiring:



CAN Wiring:



Notes:

- As above, the daisy chain topology is used for CAN / RS485 wiring (the star topology structure cannot be used). The shorter distance between nodes, the better.
- Please connect a 120Ω terminal resistor in parallel to each end of the CAN bus for matching the circuit impedance and ensuring communication stability.
- Please be sure to connect the public ends of each communication node to prevent CAN / RS485 chips from burning out.
- Please use STP (Shielded Twisted Pair), especially in bad environments, and make sure the shielding layer is fully grounded.
- During on-site wiring, maintain a distance from high-voltage power lines, preferably 30 cm or more.
- Ensure that the controller is properly grounded, and the chassis ground should be connected to a standard factory ground rod.

Usage Method

- (1) Please follow the above wiring instructions to wiring correctly, then connect the controller to [RTSys](#) through ethernet / serial port.

- (2) How to use CAN:

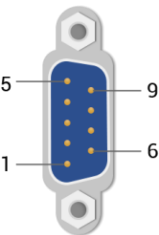
- 1) Set controller as CAN master station:
 - a) Use "**CANIO_ADDRESS**" to set master station "address" and "velocity".
 - b) Use "**CANIO_ENABLE**" to enable / disable CAN master station function.
 - c) In "*RTSys>Controller>Controller Status>Communication Config*" interface, you can check communication parameters.
 - d) In "*RTSys>Controller>Controller Status>ZCanNodes*" interface, you can check bus nodes parameters.
- 2) Correctly set the "address" and " velocity" of the slave station CAN expansion module for completing resources mapping, you can refer to ["3.1 CAN Expansion"](#).
- 3) After configured, repower on all slave stations to build normal communication, if the slave module "ALM" led is ON, which means the communication fails.
- 4) Note that the "velocity" settings of each node on the CAN bus must be consistent, and the "address" settings cannot cause conflicts, otherwise the communication establishment will fail or the communication will be disordered.

(3) How to use RS485:

- 1) Please use "ADDRESS" and "SETCOM" commands to check protocol station No. and set parameters, also, you can check and set in "*RTSys>Controller>Controller Status>Communication Config*" interface.
 - 2) According to description, set the third-party device parameters correctly to match each node.
 - 3) After all configured, it is time to communicate.
- (4) Please refer to ["RTBASIC Programming Manual"](#), or check in *RTSys / Help / RTBasic*.

2.6. RS232

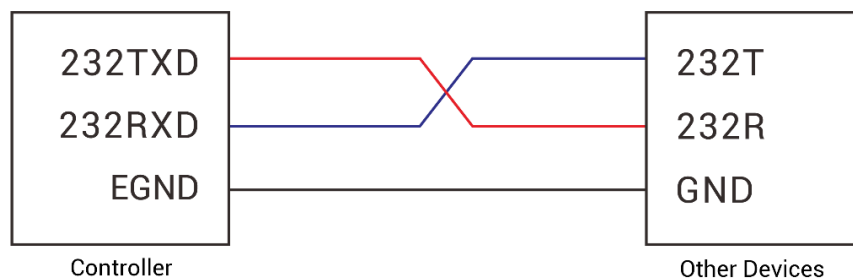
Terminal	PIN No.	Name	Function
	1, 4, 6, 7, 8	NC	Reserved

	2	RXD	RS232 signal, receive data
	3	TXD	RS232 signal, send data
	5	EGND	5V power -, and output for the public end
	9	E5V	5V power +, maximum is 300mA

Specification

Item	RS232 (port 0)
Communication Rate	$\leq 115200\text{bps}$
Terminal Resistor	No
Topology	Connect Correspondingly (1 to 1)
Nodes can be Extended	1
Wiring Distance	<5m (recommended)
Communication Isolation	√

Wiring



Notes:

- The wiring of RS232 is as above, it needs to cross-wiring for sending and receiving signals, and it is recommended to use a double-female head cross line when connecting to a computer.
- Please be sure to connect the public ends of each communication node to prevent the communication chip from burning out.
- Please use STP (Shielded Twisted Pair), especially in bad environments, and make

sure the shielding layer is fully grounded.

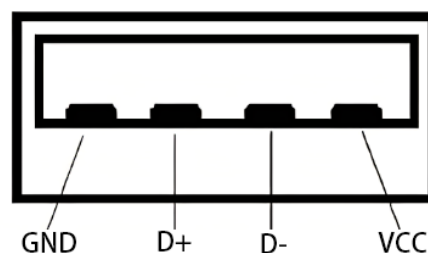
- During on-site wiring, maintain a distance from high-voltage power lines, preferably 30 cm or more.
- Ensure that the controller is properly grounded, and the chassis ground should be connected to a standard factory ground rod.

Usage Method

- (1) Please follow the above wiring instructions to wiring correctly, then connect the controller to [RTSys](#) through ethernet / serial port.
- (2) Please use "ADDRESS" and "SETCOM" commands to check protocol station No. and set parameters, also, you can check and set in *"RTSys>Controller>Controller Status>Communication Config"* interface.
- (3) According to description, set the third-party device parameters correctly to match each node.
- (4) After all configured, it is time to communicate.
- (5) Please refer to ["RTBASIC Programming Manual"](#), or check in *RTSys / Help / RTBasic*.

2.7. U Disk

The ZMC404-V2 motion controller provides a USB communication interface, which can insert the U disk device. It is used for ZAR program upgrading, controller data importing and exporting, Z3P file executing, etc.



Specification

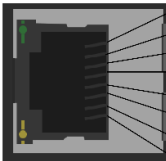
Item	Descriptions
Communication Protocol	USB2.0
Communication Ratio	≤12Mbps
Whether Isolates	No

Usage Method

- (1) Please follow the above wiring instructions to wiring correctly, then connect the controller to [RTSys](#) through ethernet / serial port.
- (2) Insert UDISK into controller UDISK terminal, when it is connected successfully, the UDISK led will be ON, then you can use U_STATE command to check UDISK state. When you make sure the communication is OK, corresponding operations (firmware upgrade, data copy, etc.) can be done (using FILE series instructions).
- (3) Please refer to "[RTBASIC Programming Manual](#)", or check in *RTSys / Help / RTBasic*.

2.8. ETHERNET

Specification

PIN Definition				Item	Description
	PIN	Signal	Description	Communication Protocol	MODBUS_TCP
	1	TX+	Send signal (+)	Communication Velocity	100Mbps
	2	TX-	Send signal (-)		
	3	RX+	Receive signal (+)	Default IP	192.168.0.11
	4	NC	Reserved		
	5	NC	Reserved	Communication Cable	Shielded Cat 5e Cable
	6	RX-	Receive signal (-)		
	7	NC	Reserved		
8	NC	Reserved	Cable Length	<50m	

Wiring

- (1) Controller Ethernet can be connected to PC / HMI by one shielded cat 5e cable.
- (2) Controller also can be connected to the switch for expanding ethernet channels, then connect to other devices.
- (3) Ethernet LED state:

Led	Normal-ON	Shrink
Green	Build 100M communication	Now it is sending & receiving data
Yellow	Build 10M communication	Now it is sending & receiving data

Notes:

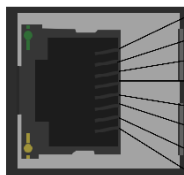
- Please use STP, especially in bad environments, and make sure the shielding layer is fully grounded.
- During on-site wiring, maintain a distance from high-voltage power lines, preferably 30 cm or more.
- Ensure that the controller is properly grounded, and the chassis ground should be connected to a standard factory ground rod.

Usage Method

- (1) Please follow the above wiring instructions to wiring correctly, then connect the controller to [RTSys](#) through ethernet / serial port.
- (2) "IP_ADDRESS" can be used to modify controller IP, please note controller IP and PC IP should be in same net segment.
- (3) It supports custom ethernet communication, "OPEN#" can open custom ethernet communication, "CLOSE#" can close it, "GET#" can read data from the channel and save data into it.
- (4) Please refer to "[RTBASIC Programming Manual](#)", or check in *RTSys / Help / RTBasic*.

2.9. EtherCAT

Specification

PIN Definition				Item	Description
	PIN	Signal	Description	Communication Protocol	EtherCAT
	1	TX+	Send signal (+)	Communication Velocity	100Mbps
	2	TX-	Send signal (-)		
	3	RX+	Receive signal (+)	Refresh Cycle	Max: 500us
	4	NC	Reserved		
	5	NC	Reserved	Communication Cable	Shielded Cat 5e Cable
	6	RX-	Receive signal (-)		
	7	NC	Reserved	Cable Length	<50m
	8	NC	Reserved		

Wiring

(1) Controller EtherCAT can be connected to EtherCAT drives / other EtherCAT devices via one shielded cat 5e cable: connect to controller EtherCAT to slave EtherCAT IN, then connect slave EtherCAT OUT to next one EtherCAT IN.

(2) Ethernet LED state:

Led	Common-ON	Shrink
Green	Build 100M communication	Now it is sending & receiving data
Yellow	Build 10M communication	Now it is sending & receiving data

Notes:

- Please use STP, especially in bad environments, and make sure the shielding layer is fully grounded.
- During on-site wiring, maintain a distance from high-voltage power lines, preferably 30 cm or more.
- Ensure that the controller is properly grounded, and the chassis ground should be connected to a standard factory ground rod.

Usage Method

(1) Please follow the above wiring instructions to wiring correctly, then connect the controller to [RTSys](#) through ethernet / serial port.

(2) How to connect to drive devices through EtherCAT:

- 1) Use SLOT_SCAN command to scan the slot No. on the bus.
- 2) Use AXIS_ADDRESS command to map axis No., you can refer to "[3.2 EtherCAT Expansion](#)" – "Resource Mapping".
- 3) Use SLOT_START to open bus, SLOT_STOP to stop.
- 4) After completed, configure and operate local pulse axis.

(3) How to connect to expansion module by EtherCAT:

- 1) Use SLOT_SCAN command to scan the slot No. on the bus.
- 2) Use AXIS_ADDRESS to map axis No., use NODE_IO / NODE_AIO command to map IO No., you can refer to "[3.2 EtherCAT Expansion](#)" – "Resource Mapping".
- 3) Use SLOT_START to open bus, SLOT_STOP to stop.
- 4) After completed, configure and operate local IO, same as axis, for details, please refer to "2.2, 2.3, 2.10" – "Usage Methods".

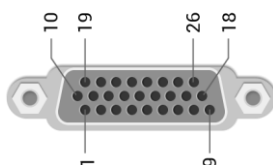
(4) For slot No. and device node information, you can check in *"RTSys>controller>controller status>slot0node"*.

(5) Please refer to "[RTBASIC Programming Manual](#)", or check in *RTSys / Help / RTBasic*.

(6) How to configure EtherCAT axis in RTSys: [RTSys – EtherCAT Quick Configurations](#).

2.10. AXIS (Differential Pulse Axis)

ZMC404-V2 provides 6 local differential pulse axis interfaces, each interface is a standard DB26 female socket, which can be used to control servo drives.



Pin	Signal	Description
1	EGND	Negative pole of IO 24V power
2	IN24-27/ALM	General input (recommended as driver alarm)
3	OUT12-15/ENABLE	General output (recommended as driver enable)
4	EA-	Encoder differential input signal A-
5	EB-	Encoder differential input signal B-
6	EZ-	Encoder differential input signal Z-
7	+5V	Positive pole of 5V power of pulse/encoder signal
8	Reserved	Reserved
9	DIR+	Servo or step directional output differential signal +
10	GND	Negative pole of 5V power of pulse/encoder signal
11	PUL-	Servo or step pulse output differential signal -
12	Reserved	Reserved
13	GND	Negative pole of 5V power of pulse/encoder signal
14	OVCC	Positive pole of IO 24V power
15	Reserved	Reserved
16	Reserved	Reserved
17	EA+	Encoder differential input signal A+
18	EB+	Encoder differential input signal B+
19	EZ+	Encoder differential input signal Z+
20	GND	Negative pole of 5V power of pulse/encoder signal
21	GND	
22	DIR-	Servo or step direction output differential signal -
23	PUL+	Servo or step pulse output differential signal + /
24	GND	Negative pole of 5V power of pulse/encoder signal
25	Reserved	Reserved

26	Reserved	Reserved
Notes: ✧ ALM and ENABLE are recommended to be used as axis IO, because the drive capacity is small. ✧ OVCC, +5V are only used for communication between the controller and the servo driver, please do not use it as power supply for other places.		

Pulse-Axis DB26 PIN & I/O:

Pulse-Axis No.	Corresponding IN / ALM	Corresponding OUT / ENABLE
AXIS 0	IN24	OUT12
AXIS 1	IN25	OUT13
AXIS 2	IN26	OUT14
AXIS 3	IN27	OUT15

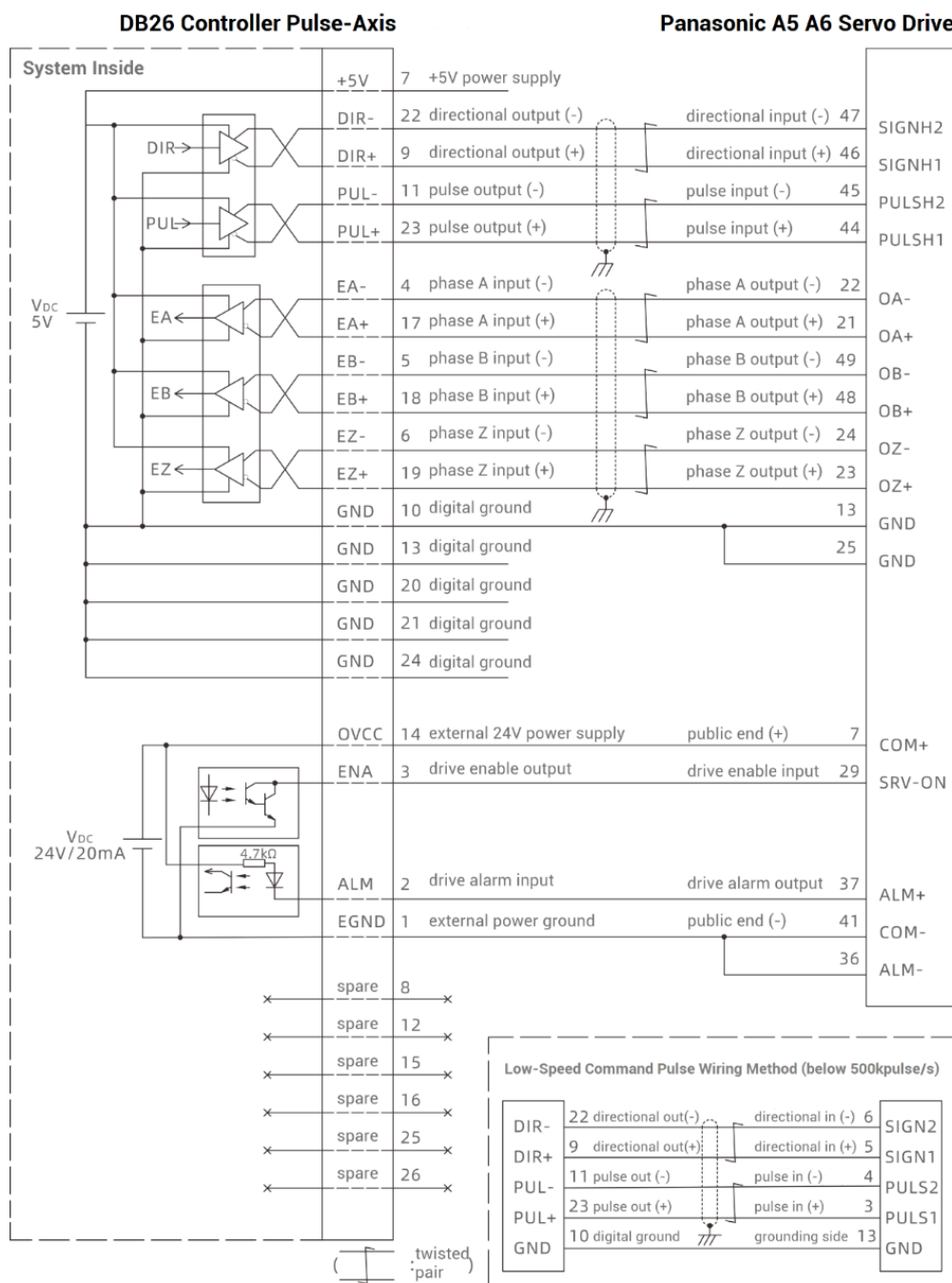
Specification

Signal	Item	Description
PUL/DIR	Signal Type	Differential output signal
	Voltage Range	0-5V
	Maximum Frequency	10MHz
EA/EB/EZ	Signal Type	Differential input signal
	Voltage Range	0-5V
	Maximum Frequency	5MHz
IN24-29	Input Method	NPN type, trigger by low level
	Input Frequency	<5kHz
	Input Impedance	6.8KΩ
	Voltage Level	DC24V
	ON Voltage	<10.5V
	OFF Voltage	>10.7V
	Minimal Current	-1.8mA (negative)
	Maximum Current	-4mA (negative)
	Isolation	Optoelectronic Isolation
OUT12-17	Output Method	NPN type, trigger by low level
	Frequency	<8kHz
	Load Voltage	≤24V
	Output Current	≤50mA

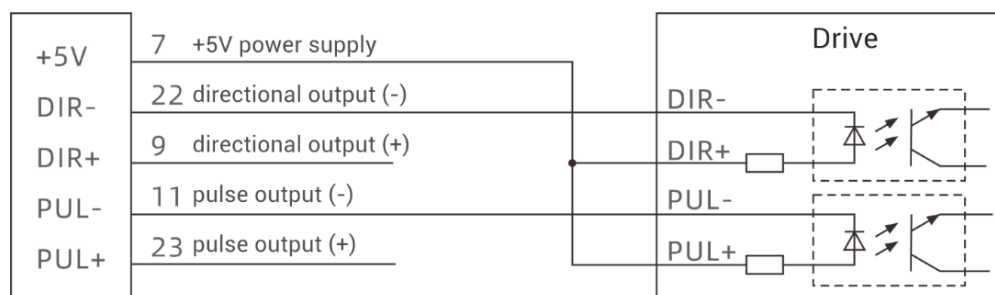
	Overcurrent Protection	No
	Isolation	Optoelectronic Isolation
+5V	Output Current	≤50mA
OVCC	Output Current	≤50mA

Wiring

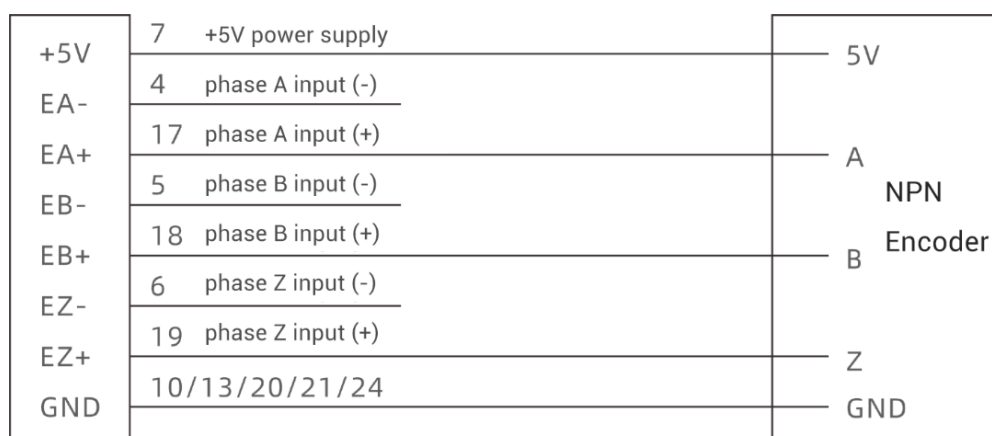
Wiring Reference with Panasonic A5/A6 Servo Drive.



Wiring Reference of PUL/DIR Common Anode:



Wiring Reference of Single-Ended EA/EB/EZ:



Notes:

- The wiring principle of the differential pulse axis interface is shown in the figure above, and the wiring methods of different types of drivers are different, please connect carefully.
- When using differential signals, be sure to connect the common zero terminals of both sides to ensure communication stability and equipment security;
- Please use STP, especially in bad environments, and make sure the shielding layer is fully grounded.
- During on-site wiring, maintain a distance from high-voltage power lines, preferably 30 cm or more.
- Ensure that the controller is properly grounded, and the chassis ground should be connected to a standard factory ground rod.

Usage Method

- (1) Please follow the above wiring instructions to wiring correctly, then connect the controller to [RTSys](#) through ethernet / serial port.
- (2) Set axis basic parameters via commands of BASE, ATYPE, UNITS, SPEED, ACCEL, DECEL, etc.; and do axis remapping through AXIS_ADDRESS; enable through AXIS_ENABLE; do linear motion through MOVE.
- (3) Some parameters can be set and checked in "*RTSys / View / Axis Parameter*" window; at the same time, motions also can be operated in "*RTSys / Tool / Manual*" window
- (4) Please refer to "[RTBASIC Programming Manual](#)", or check in *RTSys / Help / RTBasic*.

Chapter III Resources Expansion

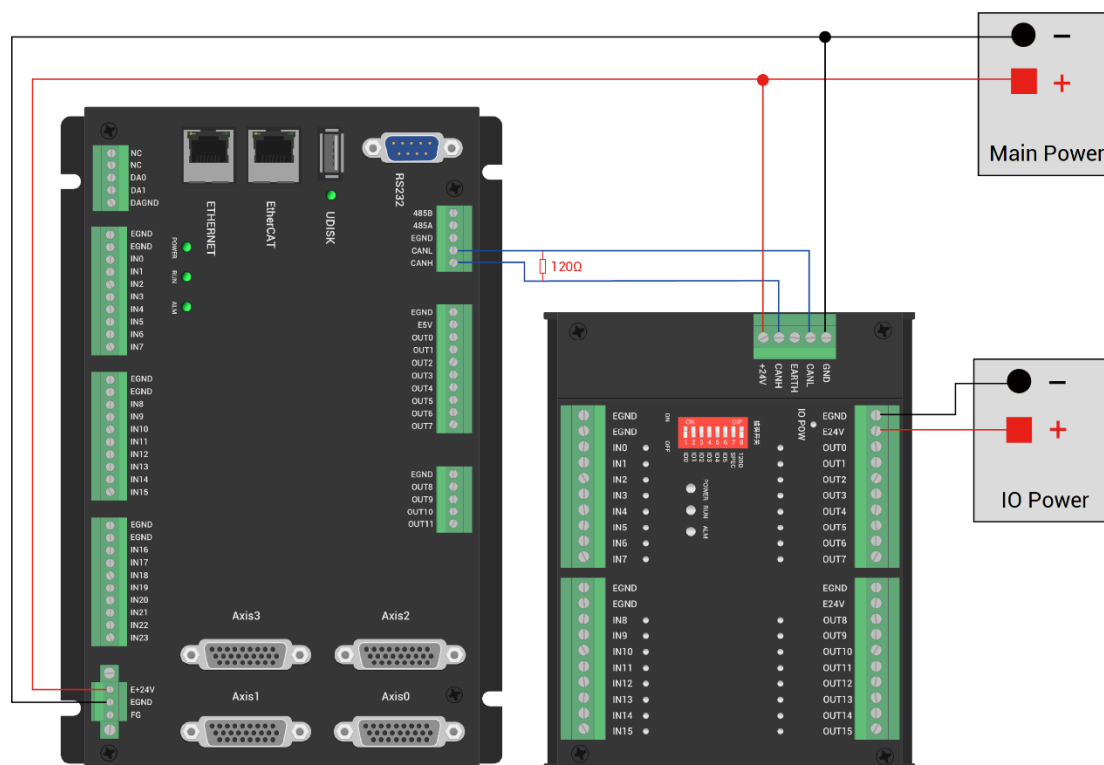
When you need more resources, expansion modules can be used by CAN / EtherCAT.

3.1. CAN Expansion

For Zmotion, there are 3 types [CAN bus expansion modules](#): ZIO, ZAI0, ZMIO-CAN, through them, more digital IO, analog IO, axes (up to 2) can be expanded.

Please select the expansion module according to the requirements, and select IO mapping or axis mapping according to the resources of the expansion module. Attention the No. must be different while mapping.

Wiring



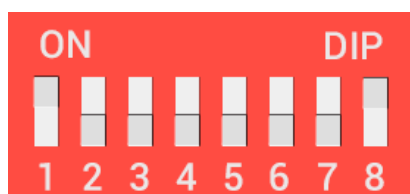
Notes:

- The controller and modules need to share a main power supply, while the I/O power of ZIO & ZMIO310-CAN need to be independently powered to achieve isolation.

- When connecting multiple expansion modules on CAN, a 120-ohm resistor is needed to be connected in parallel between the CANL & CANH, for the ZIO expansion module that is with 8-digit dialing codes, the terminal resistor can be realized by dialing the code (DIP).

Resources Mapping

A. DIP Switch



DIP Switch

Generally, the ZCAN expansion module has an 8-code DIP switch to do communication configuration and resource mapping, dial ON to take effect, and the meaning of the DIP is as follows:

- ✚ 1-4: they are used for ZCAN expansion module IO address mapping, the corresponding value is 0-15 (4-bit binary to decimal system).
- ✚ 5-6: CAN communication speed, corresponding value is 0-3 (2-bit binary to decimal system), four different speeds are optional.
- ✚ 7: reserved.
- ✚ 8: 120-ohm resistor, dial ON means a 120-ohm resistor is connected between CANL and CANH.

Dial 1-4 to select the CAN address, then the controller automatically maps expansion module IO range according to this address ID, but for axis No., please map manually.

Dial code 5-6 to select CAN bus communication speed, the corresponding speeds are as follows:

Code 6	Code 5	DIP 5-6 combination value	CAN communication speed
0	0	0	500KBPS (default value)
0	1	1	250KBPS
1	0	2	125KBPS
1	1	3	1MBPS

Notes:

- "How to configure controller as master station", please check ["2.5 RS485 & CAN" – "Usage Methods"](#).
- Communication velocities of each node on the CAN bus must be consistent, please note mapped IO No. and axis No. can't conflict.

B. IO Mapping

IO mapping of CAN expansion module is determined by dial code 1-4, below shows digital IO mapping and analog IO mapping No. allocation:

--Digital IO Mapping No.--

(0: OFF, 1: ON)

Code 4	Code 3	Code 2	Code 1	Address ID	Start IO No.	End IO No.
0	0	0	0	0	16	31
0	0	0	1	1	32	47
0	0	1	0	0	0	63
0	0	1	1	3	64	79
0	1	0	0	4	80	95
0	1	0	1	5	96	111
0	1	1	0	6	112	127
0	1	1	1	7	128	143
1	0	0	0	8	144	159
1	0	0	1	9	160	175
1	0	1	0	10	176	191
1	0	1	1	11	192	207
1	1	0	0	12	208	223
1	1	0	1	13	224	239
1	1	1	0	14	240	255
1	1	1	1	15	256	271

--Analog IO Mapping, for bit 1-4 code state & ID, please refer to above form--

Address ID	Start AD No.	End AD No.	Start DA No.	End AD No.
0	8	15	4	7

1	16	23	8	11
2	24	31	12	15
3	32	39	16	19
4	40	47	20	23
5	48	55	24	27
6	56	63	28	31
7	64	71	32	35
8	72	79	36	39
9	80	87	40	43
10	88	95	44	47
11	96	103	48	51
12	104	111	52	55
13	112	119	56	59
14	120	127	60	63
15	128	135	64	67

C. Axis Mapping

When expanding pulse axis through CAN, max 2 pulse axes can be expanded, and these two should be bound with axis No. by **AXIS_ADDRESS** at first.

"AXIS_ADDRESS(axis No.)=(32*expanded axis)+ID "

AXIS_ADDRESS(6)=(32*0)+2 'map axis 0 expanded by CAN module (ID is 2) as axis 6

AXIS_ADDRESS(7)=(32*1)+2 'map axis 1 expanded by CAN module (ID is 2) as axis 6

Please refer to "[RTBASIC Programming Manual](#)", or check in *RTSys / Help / RTBasic*.

D. Extended Resources Checking

Connect the controller to RTSys at first, then in RTSys, enter "*controller > controller status > ZCanNode*" interface, you can know expansion module ID and corresponding mapping No. (below take ZMC432-V2 controller as the example).

[illegible]

3.2. EtherCAT Expansion

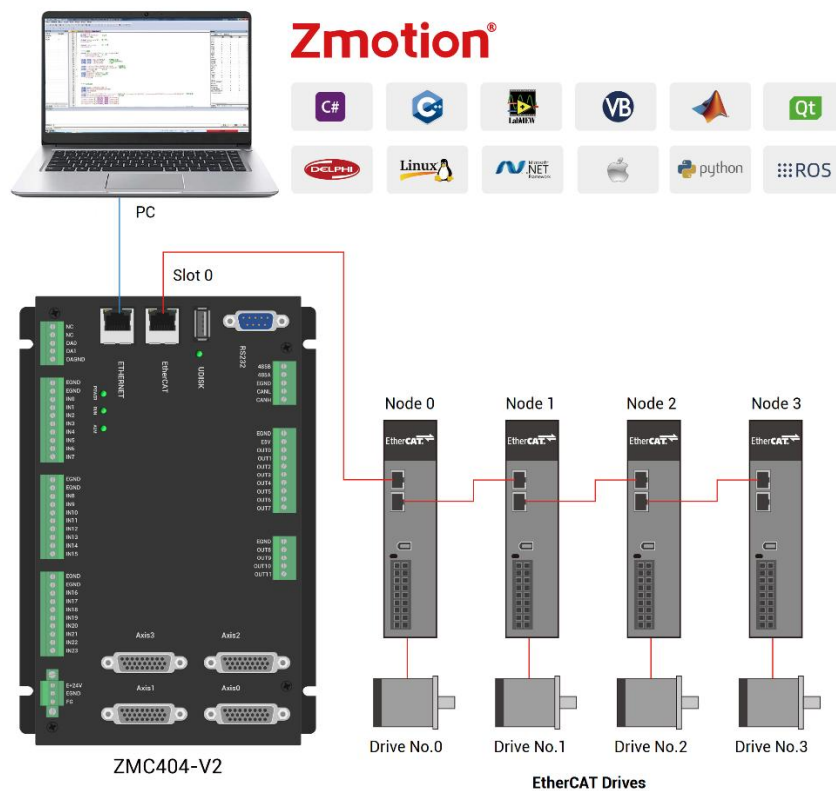
The [EIO expansion modules](#) and [ZMIO310-ECAT](#) are expansion modules used to expand digital IO / analog IO / pulse axis by EtherCAT.

Wiring

During wiring, use a “shielded category 5e (Cat 5e) twisted pair cable” to connect the controller's EtherCAT port to the EtherCAT IN port of the slave expansion device. Additionally, more slave devices can be connected, also, connect the EtherCAT OUT port of this expansion = to the EtherCAT IN port of the slave device to achieve multi-level expansion.

After completing the wiring for each EIO expansion module, no secondary development is required. Simply map the IO numbers and axis numbers of the expansion modules in the EtherCAT master controller to access them.

EIO expansion module wiring reference example:



Involved number concepts in above figure are as follows: the bus-related command parameters will use the following numbers:

■ **Slot No. (slot):**

The slot number refers to the number of the bus interface on the controller, and the slot number of the EtherCAT bus is 0.

■ **Device No. (node):**

The device number refers to the number of all devices connected to a slot. It starts from 0 and is automatically numbered according to the connection sequence of the devices on the bus. You can view the total number of devices connected to the bus through the `NODE_COUNT(slot)` command.

■ **Drive No.:**

The controller will automatically identify the drive on the slot, and the number starts from 0, and the number is automatically numbered according to the connection sequence of the drive on the bus.

The drive No. is different from the device No. Only the drive device number on the slot is assigned, and other devices are ignored. While mapping axis No., drive No. will be used.

Resources Mapping

A. IO Mapping:

For EtherCAT expansion module IO No., they are set by **NODE_IO** and **NODE_AIO**.

When IO mapping, first check the maximum IO No. of the controller itself (including the external IO interface and the interface in the pulse axis), and then use the command to set. If the extended IO coincides with the IO No. of the controller itself, both two will work at the same time, so the IO mapped No. must not be repeated in the entire control system.

Examples (IO & AIO):

NODE_IO(0,0)=32	'set the IO start No. of slot 0 interface device 0 to 32
NODE_AIO(0,0,3)=3	'set the AIO start No. of slot 0 interface device 0 to 3

B. AXIS Mapping:

Before using the axis of the expansion module, you need to use the **AXIS_ADDRESS** command to map the axis number, and the axis mapping also needs to pay attention to the axis number of the entire system cannot be repeated. The mapping syntax of the EIO series extended axis is the same as that of the bus driver.

Axis mapping syntax:

AXIS_ADDRESS(axis No.)=(slot No.<<16)+driver No.+1

Example:

AXIS_ADDRESS(6)=(0<<16)+0+1 '1st drive on EtherCAT, drive No. 0, bound as axis 6

AXIS_ADDRESS(7)=(0<<16)+1+1 '2nd drive on EtherCAT, drive No. 1, bound as axis 7

C. Extended Resources Checking

Connect the controller to RTSys at first, then in RTSys, enter **"controller > controller status > Slot"** interface, you can know expansion module ID and corresponding mapping No.

Chapter IV Programming

4.1. Program in RTSys Software

RTSys is a PC-side program development, debugging and diagnostic software for the Zmotion motion controllers. Through it, users can easily edit and configure the controller program, quickly develop applications, diagnose system operating parameters in real time, and debug the running program in real time. What's more, it supports Chinese and English bilingual environments.

In RTSys, there are 4 programming languages for motion control development, Basic, PLC, HMI and C language, they can run multi-tasks among them, especially for Basic, multi-task running can be achieved separately, hybrid programming is also OK with PLC, HMI and C language.

RTSys Downloading Address: https://www.zmotionglobal.com/pro_info_282.html

And related manuals can be found in "Download":

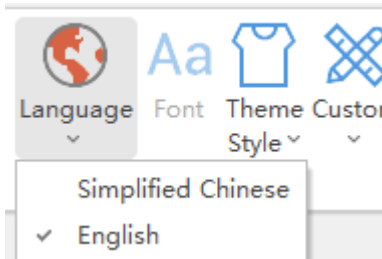
Features

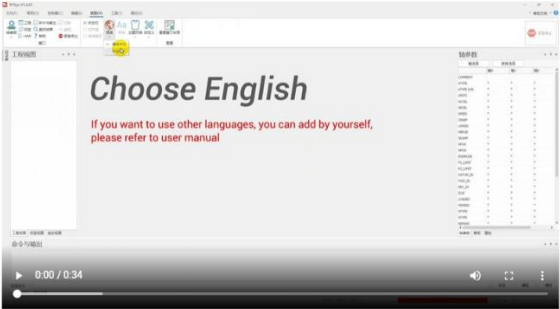
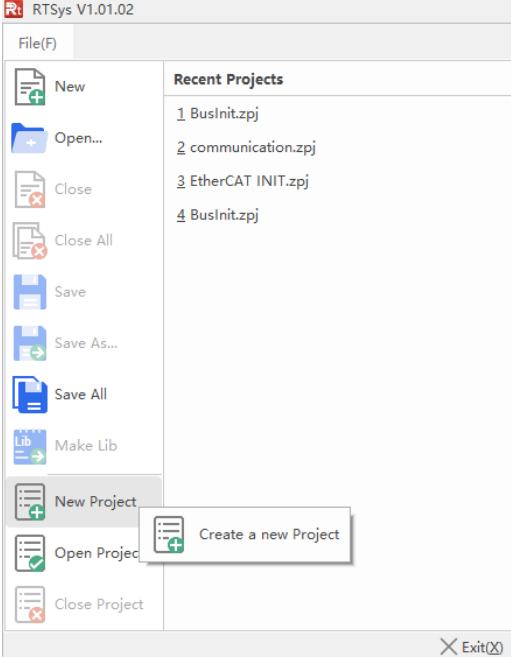
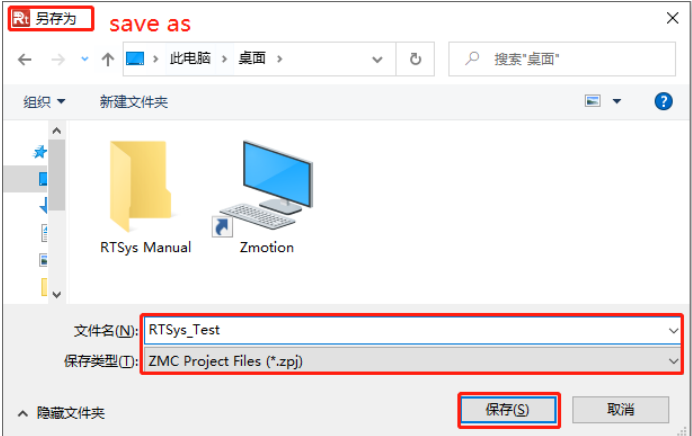
Parameters

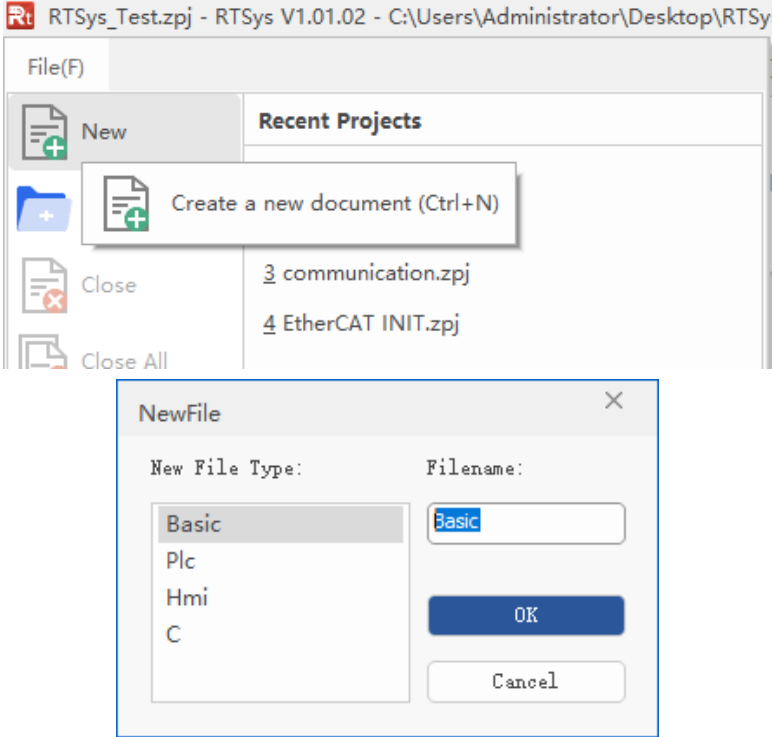
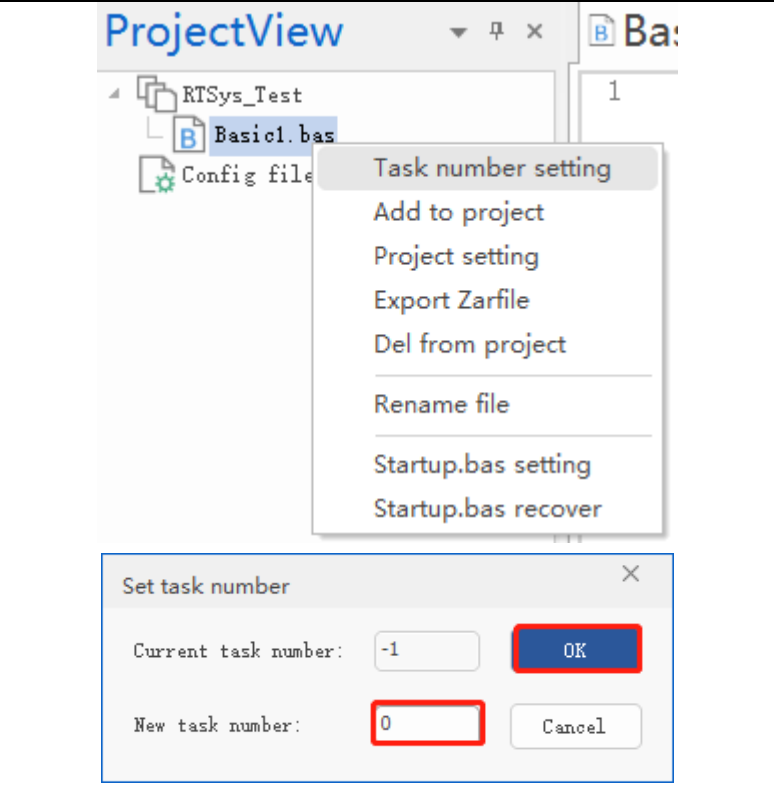
System Architecture

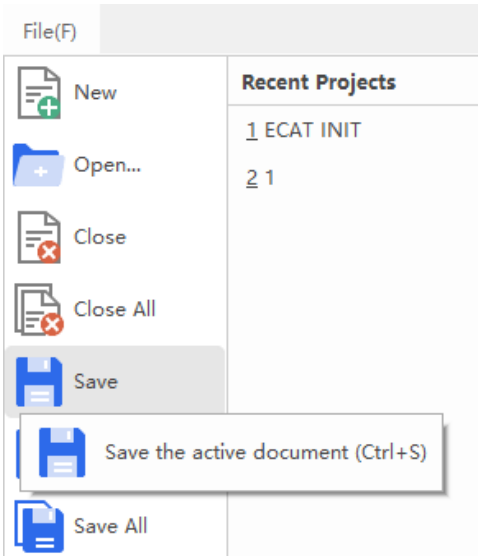
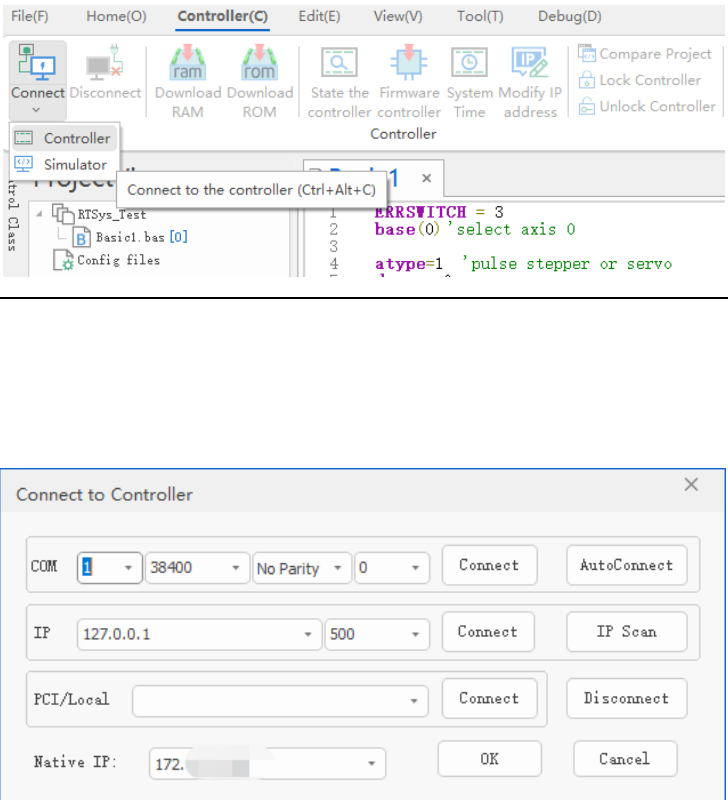
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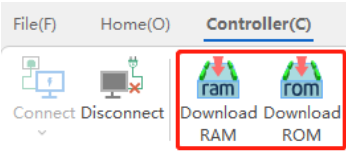
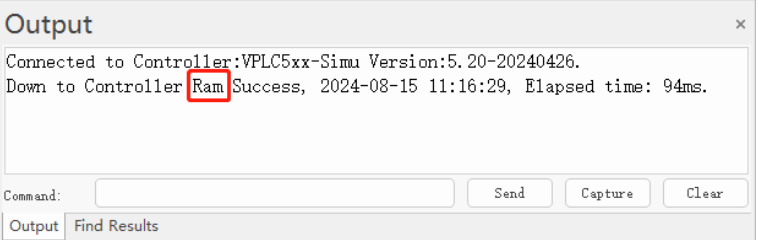
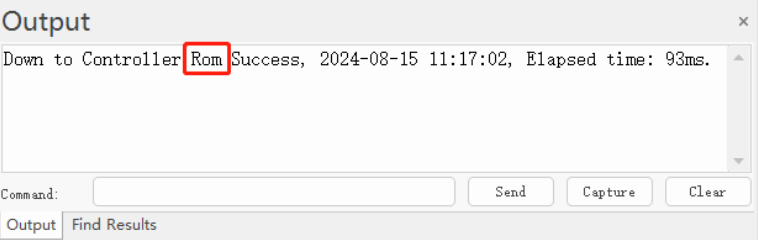
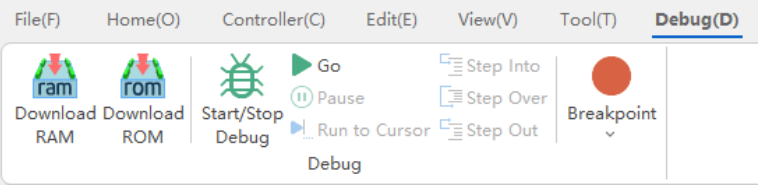
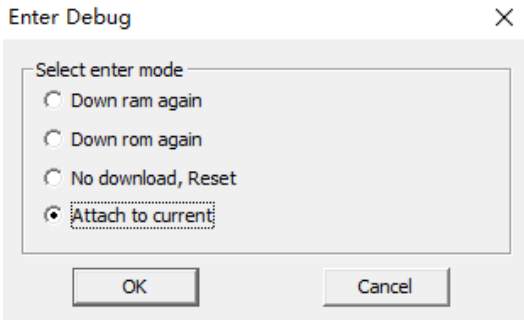
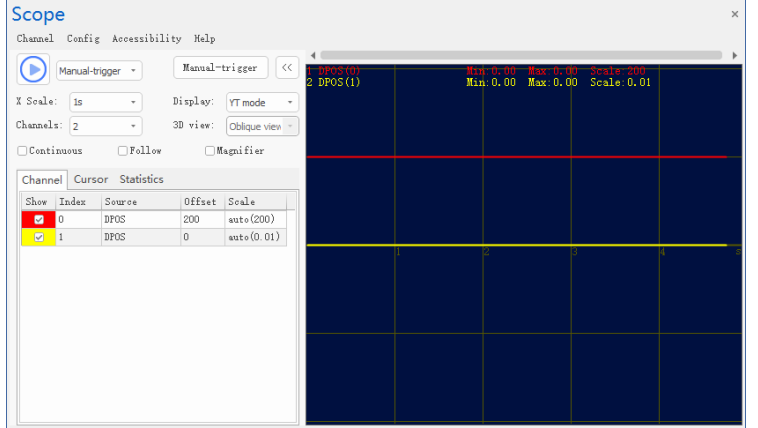
Name	Version No	Format	Size	Download
RTSys Development Software	V1.2.02	RAR	148MB	Download
RTSys User Manual V1.2.0	V1.2.0	PDF	5.33MB	Download
RTBasic Programming Manual	V1.1.0	PDF	18.3MB	Download
RTHMI Programming Manual	V1.2.0	PDF	7.23MB	Download
Quick Start	VQuick Start	ZIP	16.1MB	Download
ZVision Basic Programming Manual V1.3.0	V1.3.0	PDF	10.6MB	Download
ZPLC	V1.0	PDF	1.7M	Download

Step	Operations	Display Interface
1	Switch the Language: "Language" – "English", then there will pop	

	up one window, click OK, and restart it.	<u>Language Switch Video Showing:</u> E. How to Switch the Language Find “视图” (the fourth one in the above menu), then find the “语言”, choose English, restart RTSys. English RTSys will take effect when opened again. 
2	New Project: “File” – “New Project”, Save as window will pop up, then enter file name, save the project file with suffix “zpj.”.	 

3	New File: "File" – "New File", select file type to build, here select Basic, click "OK".	
4	Set Auto Run No.: right click the file, open task number setting window, enter task No., which can be any + value, no priority, but not the same.	

5	Save File: edit the program in program editing window, click "save", new built file will be saved under "zpj." project automatically. "Save all" means all files under this project will be saved.	
6	Connection: Click "controller – connect", if no controller, select connect to simulator. Then, "connect to controller" window will pop up, you can select serial port or net port to connect, select matched serial port parameters or net port IP address, then click "connect".	
7	Download Program into	● RAM: it will not save when power off. ● ROM: it will save data when power off, and when the program

	Controller: “Ram/Rom” – “download RAM / download ROM”, if it is successful, there is print indication, at the same time, program is downloaded into controller and runs automatically.	is connected to controller again, running according to task No.   
8	Debug: “Debug” – “Start/Stop Debug” to call “Task” and “Watch” window, because it was downloaded before, here select “Attach the current”.	 
9	Scope function: Click “View” – “Scope” to open oscilloscope. It can capture needed data, for debugging.	

sdNotes:

- When opening an project, choose to open the zpj file of the project. **If only the Bas file is opened, the program cannot be downloaded to the controller.**
- When the project is not created, only the Bas file **cannot be** downloaded to the controller.
- The number 0 in automatic operation represents the task number, and the program runs with task 0, and the task number has no priority.
- If no task number is set for the files in the entire project, when downloading to the controller, the system prompts the following message **WARN: no program set autorun**

4.2. Upgrade Controller Firmware

Firmware upgrade can be achieved by downloading zfm firmware package in RTSys. zfm file is the firmware upgrade package of controller, please select corresponding firmware because different models are with different packages, please contact manufacturer).

How to update:

- a. Open [ZDevelop](#) / [RTSys](#) software, then click "controller – connect", find PCI/LOCAL method, click "connect". If connected, there will be "Connected to Controller: PCIE464 Version: 4.93 – 20231220." In "output" window.
- b. Click "controller – state the controller", find basic info, then current software version can be checked.
- c. Click "controller – update firmware", current controller model and software version can be viewed.
- d. Click "browse", and select saved firmware file, click "update", then one window will pop up, please click "ok".
- e. After that, "connect to controller" window appears again, and please select "PCI/Local" again, and click "connect".
- f. When connection is successful, "firmware update" interface is shown. Now

system enters ZBIOS state, please click "update" again.

- g. When it is loaded, "firmware update" window disappears, now in output window, it shows "Update firmware to Controller Success".
- h. Do step a and step b again, check whether the firmware is updated or not.

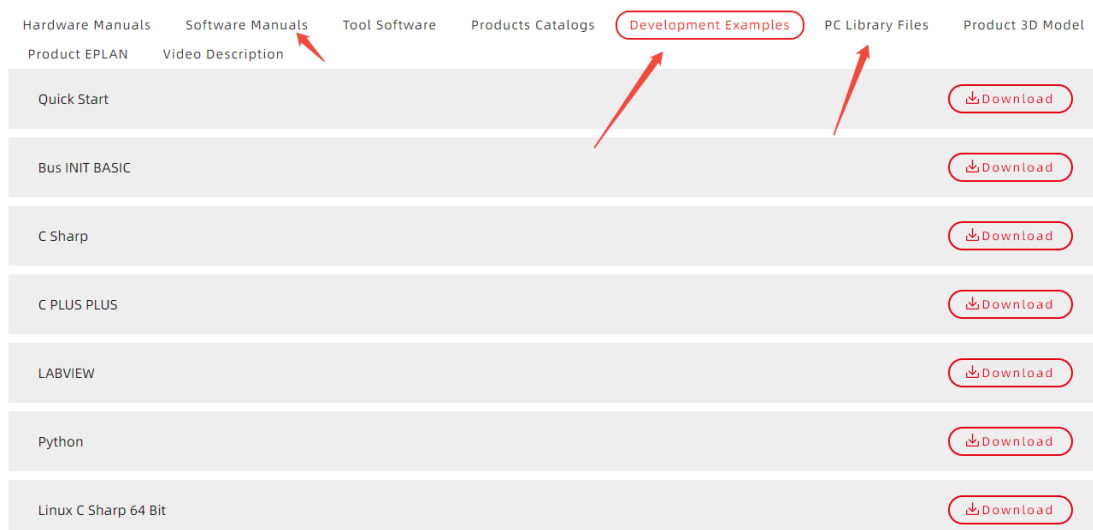
4.3. Program in Host-Computer by PC Languages

The controller supports development under various operating systems such as windows, linux, Mac, Android, and wince, and provides dll libraries in various environments such as vc, c#, vb.net, and labview, as shown in the figure below. PC software programming refers to "[Zmotion PC Function Library Programming Manual](#)".

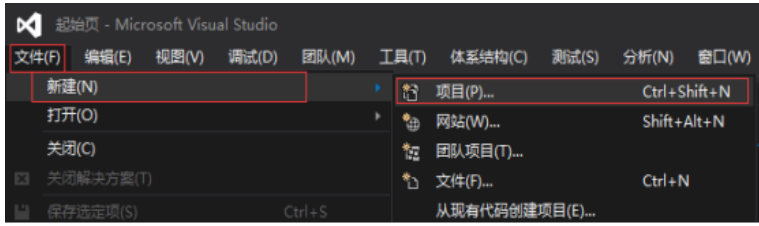
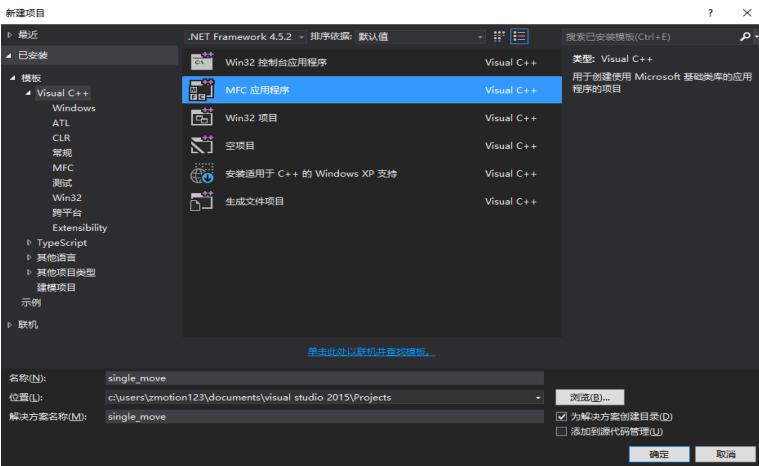
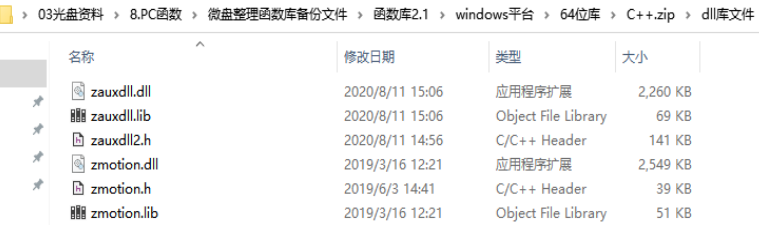


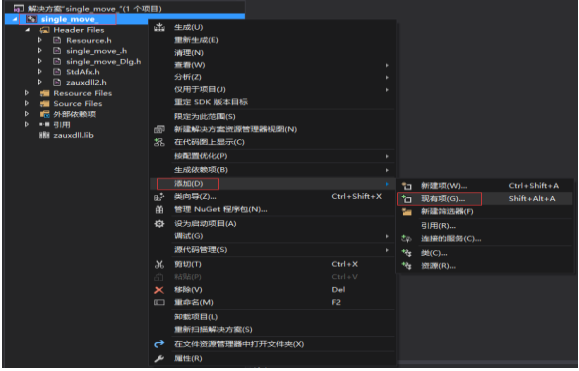
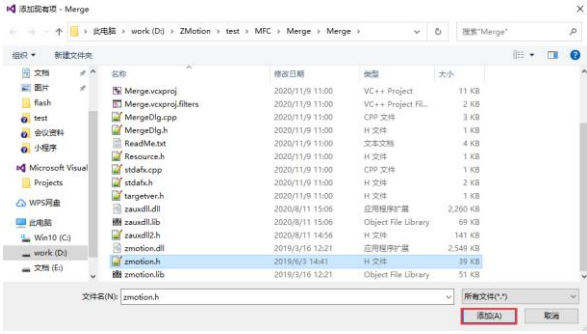
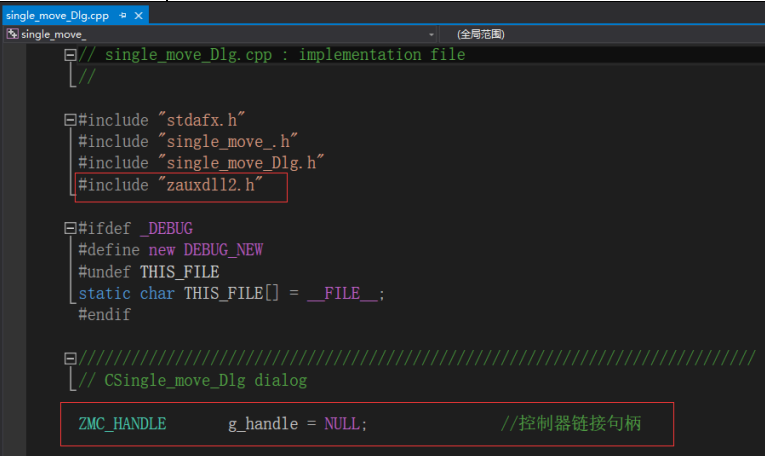
The program developed using the PC software cannot be downloaded to the controller, and it is connected to the controller through the dll dynamic library. The dll library needs to be added to the header file and declared during development.

- Get PC library file, example: https://www.zmotionglobal.com/download_list_17.html



The c++ project development process in VS is as follows:

Step	Operations	Display Interface
1	Open VS, click "File" – "New" – "Project".	
2	Select development language as "Visual C++" and the select program type as "MFC application type".	
3	Select "Based on basic box", click "next" or "finish".	
4	Find C++ function library provided by manufacturer. Routine is below (64-bit library)	
5	Copy all DLL related library files under the above path to the newly created project.	

6	Add a static library and related header files to the project. Static library: <code>zauxdll.lib</code>, <code>zmotion.lib</code> Related header files: <code>zauxdll2.h</code>, <code>zmotion.h</code>	1) Right-click the header file first, and then select: "Add" → "Existing Item". 2) Add static libraries and related header files in sequence in the pop-up window.	 
7	Declare the relevant header files and define the controller connection handle, so far the project is newly created.		

Chapter V Operation and Maintain

The correct operation and maintenance of the device can not only guarantee and extend the life cycle of the equipment itself, but also take technical management measures according to the pre-specified plan or the corresponding technical conditions to prevent equipment performance degradation or reduce the probability of equipment failure.

5.1. Regular Inspection and Maintenance

The working environment has an impact on the device. Therefore, it is usually inspected regularly based on the inspection cycle of 6 months to 1 year. The inspection cycle of the device can be appropriately adjusted according to the surrounding environment to make it work within the specified standard environment.

Check item	Check content	Inspection standards
power supply	Check whether the voltage is rated	DC 24V (-5%~5%)
surroundings	Whether the ambient temperature is within the specified range (when installed in the cabinet, the temperature inside the cabinet is the ambient temperature)	-10°C - 55°C
	Whether the ambient humidity is within the specified range (when installed in the cabinet, the humidity in the cabinet is the ambient humidity)	10%-95% non-condensing
	Is there direct sunlight	No
	With or without droplets of water, oil, chemicals, etc.	No
	Whether there is dust, salt, iron filings, dirt	No
	Whether there is corrosive gas	No
	Whether there are flammable and	No

	explosive gases or articles	
	Whether the device is subjected to vibration or shock	Should be within the range of vibration resistance and impact resistance
	Is the heat dissipation good	Keep good ventilation and heat dissipation
Installation and Wiring Status	Whether the basic unit and the expansion unit are installed firmly	The mounting screws should be tightened without loosening
	Whether the connecting cables of the basic unit and the expansion unit are fully inserted	The connection cable cannot be loosened
	Are the screws of the external wiring loose	Screws should be tightened without loosening
	Whether the cable is damaged, aged, cracked	The cable must not have any abnormal appearance

5.2. Common Problems & Solutions

Problems	Suggestions
Motor does not rotate.	1. Check whether the ATYPE of the controller is correct. 2. Check whether hardware position limit, software position limit, alarm signal work, and whether axis states are normal. 3. Check whether motor is enabled successfully. 4. Confirm whether pulse amount UNITS and speed values are suitable. If there is the encoder feedback, check whether MPOS changes. 5. Check whether pulse mode and pulse mode of drive are matched. 6. Check whether alarm is produced on motion controller station or drive station. 7. Check whether the wiring is correct. 8. Confirm whether controller sends pulses normally.

The position limit signal is invalid.	1. Check whether the limit sensor is working normally, and whether the "input" view can watch the signal change of the limit sensor. 2. Check whether the mapping of the limit switch is correct. 3. Check whether the limit sensor is connected to the common terminal of the controller.
No signal comes to the input.	1. Check whether the limit sensor is working normally, and whether the "input" view can watch the signal change of the limit sensor. 2. Check whether the mapping of the limit switch is correct. 3. Check whether the limit sensor is connected to the common terminal of the controller.
The output does not work.	1. Check whether IO power is needed. 2. Check whether the output number matches the ID of the IO board.
POWER led is ON, RUN led is OFF.	1. Check whether the power of the power supply is sufficient. At this time, it is best to supply power to the controller alone, and restart the controller after adjustment. 2. Check whether the ALM light flickers regularly (hardware problem).
RUN led is ON, ALM led is ON.	1. Program running error, please check ZDevelop error code, and check application program.
Fail to connect controller to PC through serial port.	1. Check whether the serial port parameters are modified by the running program, you can check all the current serial port configurations through ?*SETCOM. 2. Check whether the serial port parameters of the PC match the controller. 3. Open the device manager and check whether the serial driver of the PC is normal.
CAN expansion module cannot be connected.	1. Check the CAN wiring and power supply circuit, whether the 120 ohm resistor is installed at both

	ends. 2. Check the master-slave configuration, communication speed configuration, etc. 3. Check the DIP switch to see if there are multiple expansion modules with the same ID. 4. Use twisted-pair cables, ground the shielding layer, and use dual power supplies for severe interference (the main power supply of the expansion module and the IO power supply are separately powered)
Fail to connect controller to PC through net port.	1. Check IP address of PC, it needs to be at the same segment with controller IP address. 2. Check controller IP address, it can be checked and captured after connection through serial port. 3. When net port led is off, please check wiring. 4. Check whether controller power led POWER and running indicator led RUN are ON normally. 5. Check whether the cable is good quality, change one better cable to try again. 6. Check whether controller IP conflicts with other devices. 7. Check whether controller net port channel ETH are all occupied by other devices, disconnect to other devices, then try again. 8. When there are multiple net cards, don't use other net cards, or change one computer to connect again. 9. Check PC firewall setting. 10. Use "Packet Internet Groper" tool (Ping), check whether controller can be Ping, if it can't, please check physical interface or net cable. 11. Check IP address and MAC address through arp-a.