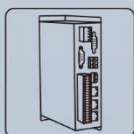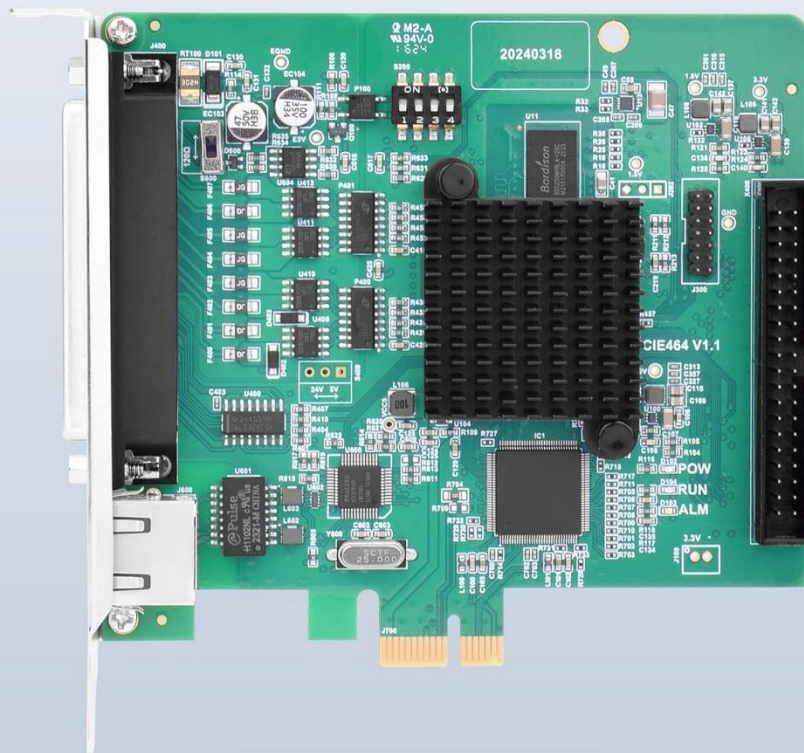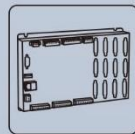# PCIE EtherCAT Motion Control Card

PCIE464
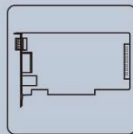
This manual is mainly for PCIE464-AX16, PCIE464-AX32, PCIE464-AX64.
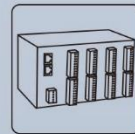

| Vision Motion Controller | Motion Controller | Motion Control Card | IO Expansion Module | HMI |

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

Chapter I Production Information

1.1. Product Information

PCIE464 is a kind of EtherCAT + Pulse motion control card that is with PCIE interface, then it can control several stepper motors or digital servo motors.

PCIE464 motion control card can be applied in multi-axis point to point, interpolation motion, trajectory planning, handwheel control, encoder position measurement, IO control, position latch, etc.
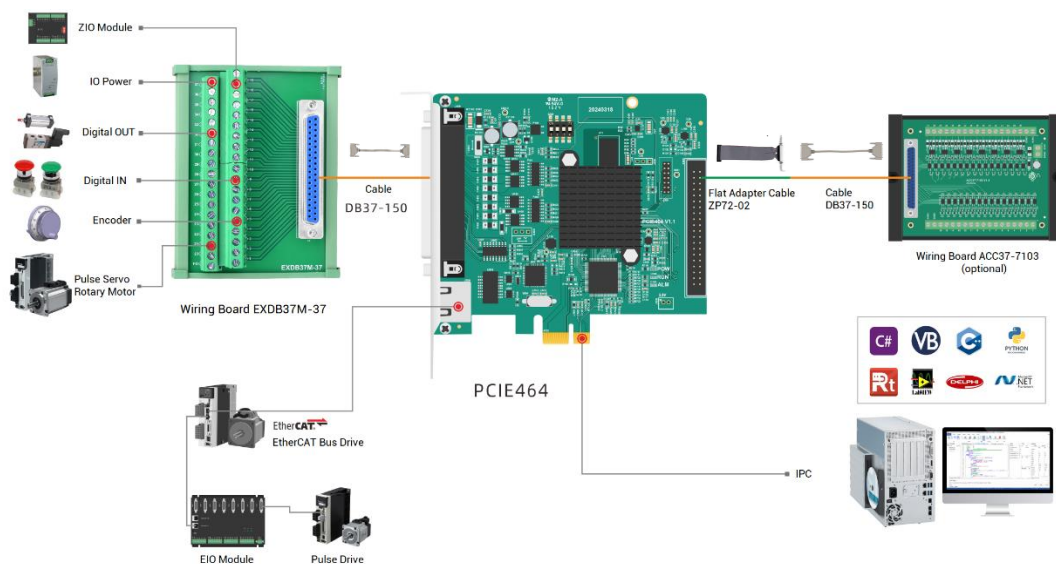
➕ Support encoder position measurement, which can be configured as handwheel input mode.

➕ Support HW hardware comparison output, high-speed latch, PWM, and other special functions.

➕ The X400 signal interface supports 32-channel for IN & OUT (ACC37 wiring board can be connected to together to select IO channels)

➕ The max output current of OUT can reach 300mA, which can drive some solenoid valves.

➕ Support many motion control functions, such as, point to point, electronic cam, linear interpolation, circular interpolation, continuous interpolation, manipulator command, etc.

➕ Support pulse closed loop, and pitch compensation.

PCIE464 motion control card is applied in high-speed and high-precision situation, like, 3C electronics processing, detection equipment, semiconductor equipment, SMT processing, laser processing, optical communication equipment, lithium battery and photovoltaic equipment, and non-standard automated equipment.

1.2. Interface Introduction
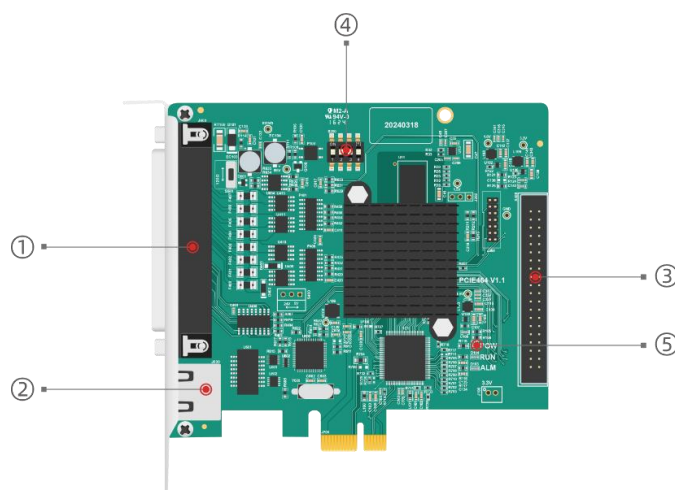
No.	Interface	Description
①	IO Power	Connect to 24V DC power supply
	CAN	Connect to CAN expansion module to expand resources.
	J400	It is one multi-functional signal interface, which connects to wiring board, including pulse signal output, encoder input, and IO interface.
②	J600	EtherCAT interface

③	X400	I/O control signal, for more IOs, please use together with ACC37 wiring board.
④	S200	DIP switch, used to set ID of PCIE464
⑤	Controller State Led	POW: ON when the power is connected RUN: ON when it runs normally ALM: ON when it runs wrongly

1.3. Product Specification

Model	PCIE464-AX64	PCIE464-AX16	PCIE464-AX32
Basic Axes	64 Axes: ● 4 pulse-axis (1 differential axis + 3 IO single-ended axes) ● 3 encoders (1 differential encoder + 2 24V single-ended encoders)	16 Axes: others are same as PCIE464-AX64	32 Axes: others are same as PCIE464-AX64
Total Axes	64-Axis (basic axis + virtual axis)		
EtherCAT Bus Axis	✓		
IN Single-Ended Encoder Axis	2		
OUT Single-Ended Pulse Axis	3 (pulse + directional)		
Digital IN	24 (general), IN0-7 are high-speed inputs		
Digital OUT	24 (general), OUT0-7 are high-speed outputs		
Expanded Digital IN	≤4096		

Expanded Digital OUT	≤4096
EtherCAT	1
High-Speed Latch	4
Hardware Comparison Output HW	8
General PWM	8
Point to Point	
Electronic Cam	
Linear Interpolation	
Circular Interpolation	✓
Continuous Interpolation	
Manipulator Command	
Program Space	1920kbyte
Power Down Storage	✓
Dimension (mm)	144*120

1.4. Order Information

➢ **Nameplate Information**

P C I E 4 6 4 - A X 6 4 - X X X

Mark	Product Series
PCIE464	PCIE EtherCAT Card

Mark	Series
4	Series 4

Mark	Other Functions
XXX	Customized Function

Mark	Axes
AX16	16-Axis
AX32	32-Axis
AX64	64-Axis
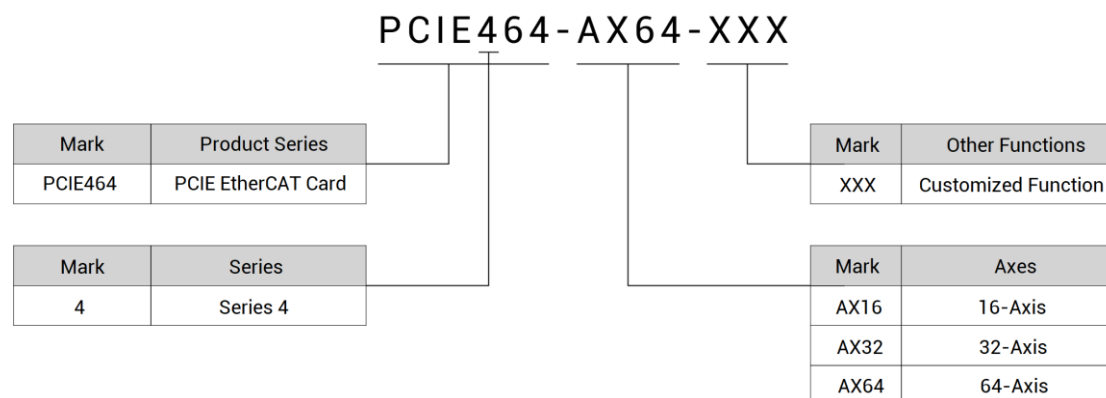
➢ **Order Information**

No.	Model	Specification Description
1	PCIE464-AX16	16 EtherCAT axes, it supports linear interpolation, any circular interpolation, helical interpolation, hardware comparison output.
2	PCIE464-AX32	32 EtherCAT axes, it supports linear interpolation, any circular interpolation, helical interpolation, hardware comparison output.
3	PCIE464-AX64	64 EtherCAT axes, it supports linear interpolation, any circular interpolation, helical interpolation, hardware comparison output.

➢ **Models of PCIE464 accessories:**

Name	Model	Specification Description	Description
Shielded Cable	DB37-150	DB37 cable (chip of male to male)	Optional
Wiring Board	EXDB37M-37	DB37 wiring board (convert terminals)	Optional
Adapter Cable	ZP72-02	Flat cable (convert 40P plug to DB37 female head)	Optional
Wiring Board	ACC37-7103	16 IN & 16 OUT digital wiring board after changing IDC40 as DB37.	Optional

1.5. Application Environment

Item		Parameters
Work Temperature		-10℃-55℃
Work relative Humidity		10%-95% non-condensing
Storage Temperature		-40℃～80℃（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

1.6. Hardware Installment
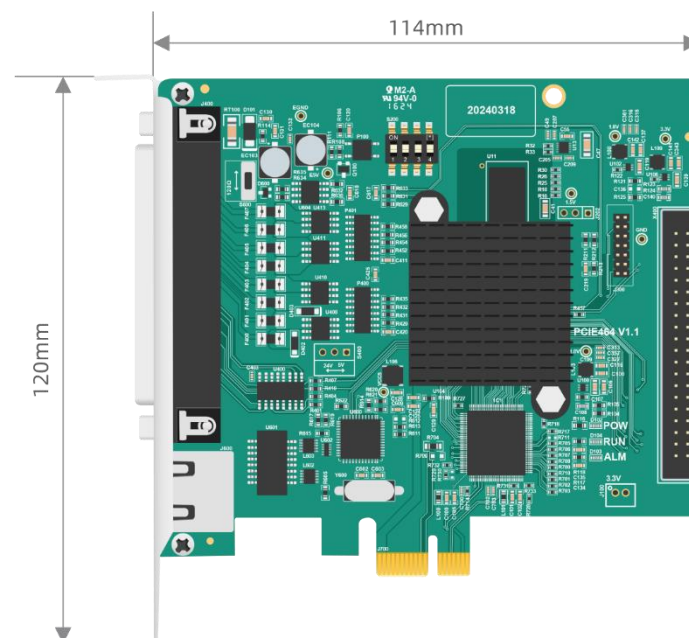
The card slot interface is designed according to PCIE*1 standard card, which means it can be compatible with PCIE*1 ~ PCIE*16.

♦ PCIE doesn't support plug in or pull out when in hot, so please close the computer before inserting and pulling the card.

♦ Please handle it carefully. Before touching the control card circuit or inserting/pulling the control card, please wear anti-static gloves or touch an effectively grounded metal object to discharge the human body to prevent possible static electricity from damaging the motion control card.

Chapter II Hardware Interface

2.1. J400 Signal Interface

J400 is the main interface of PCIE464 motor control and I/O signal control. Signal terminal is shown as below.

For terminals, please refer to "single-ended axis interface", "IN digital input", and "OUT digital output".
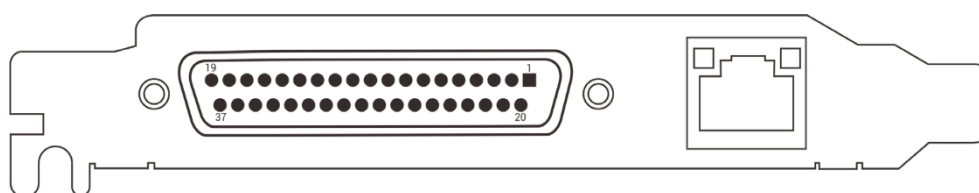
PIN	Name	Description	Functions		
			1	2	3
1	VCC5	Internal 5V OUT, 300mA	/	/	/
2	EA0+	A + of Encoder 0	/	/	/
3	EA0-	A - of Encoder 0	/	/	/
4	EB0+	B + of Encoder 0	/	/	/
5	EB0-	B - of Encoder 0	/	/	/
6	EZ0+	Z + of Encoder 0	/	/	/
7	EZ0-	Z - of Encoder 0	/	/	/
8	GND	Internal power ground	/	/	/
9	IN0	High-speed IN0 (isolated)	Latch	/	/
10	IN1	High-speed IN1 (isolated)	Latch	/	/
11	IN2	High-speed IN2 (isolated)	Latch	/	Z of encoder 3
12	IN3	High-speed IN3 (isolated)	Latch	/	Z of encoder 2
13	IN4	High-speed IN4 (isolated)	/	/	A of encoder 3
14	IN5	High-speed IN5 (isolated)	/	/	B of encoder 3

15	IN6	High-speed IN6 (isolated)	/	/	A of encoder 2
16	IN7	High-speed IN7 (isolated)	/	/	B of encoder 2
17	EGND	IO power ground / CAN communication public end	/	/	/
18	CANH	CAN signal – High (isolated)	/	/	/
19	CANL	CAN signal – Low (isolated)	/	/	/
20	GND	Internal power ground	/	/	/
21	PUL0+/EA1+	Pulse + of axis 0	/	/	A + of encoder 1
22	PUL0-/EA1-	Pulse - of axis 0	/	/	A - of encoder 1
23	DIR0+/EB1+	Directional + of axis 0	/	/	B + of encoder 1
24	DIR0-/EB1-	Directional - of axis 0	/	/	B - of encoder 1
25	EZ1+	/	/	/	Z + of encoder 1
26	EZ1-	/	/	/	Z - of encoder 1
27	OUT0	High-speed OUT0 (isolated)	HW	PWM	/
28	OUT1	High-speed OUT1 (isolated)	HW	PWM	/
29	OUT2	High-speed OUT2 (isolated)	HW	PWM	DIR of axis 3
30	OUT3	High-speed OUT3 (isolated)	HW	PWM	PUL of axis 3
31	OUT4	High-speed OUT4 (isolated)	HW	PWM	DIR of axis 2
32	OUT5	High-speed OUT5 (isolated)	HW	PWM	PUL of axis 2
33	OUT6	High-speed OUT6 (isolated)	HW	PWM	DIR of axis 1
34	OUT7	High-speed OUT7 (isolated)	HW	PWM	PUL of axis 1
35	E5V	External 5V power output	/	/	/
36	E24V	IO 24V power input	/	/	/
37	EGND	IO power ground	/	/	/

Description:

1. Max output load of PCIE464 E5V is 300mA, please don't connect to large power load.

2. Max current of PCIE464 OUT is 300mA, it can connect to most of loads directly, please calculate the current.

3. IN2-7 support single-ended encoder axis, but they only support 24V encoder input. When ATYPE=0, they are general inputs, please attention wiring method.

4. OUT2-7 support single-ended pulse axis, For the pulse directional interface of 5V drive, please connect drive PUL+ and DIR+ to E5V. When ATYPE=0, they are general outputs, please attention wiring method.

5. VCC5 and GND are used for local pulse axis and encoder axis wiring.

6. Local pulse-axis / encoder function of J400 PIN21-PIN26 depends on firmware, that is, it can't be used as IN and OUT at the same time.

7. IOs of PCIE464 are isolated IOs, please input from EGND and E24V for IO power supply. Note the positive pole and negative pole.

2.2. X400 Signal Interface

X400 is I/O signal control interface. Use ACC37-7103 adapter board (16 inputs & 16 outputs, PIN No.1 – No.16 corresponds to IN8-IN23, PIN No.21 – No.36 corresponds to OUT8-OUT23) to connect to external device (this adapter board is optional when more IO are needed). For more details, please refer to Chapter IV.

X400 interface itself is the inner IO, is not-isolated signal, which means it can't connect to external devices directly, it needs ACC37 wiring board, or the wiring board that supports isolation function.

Note: when there is no wiring board installed, this interface's IO signals only can be shown in software interface, but the real functions are invalid, that is, it can do normal data transferring / signal interaction.
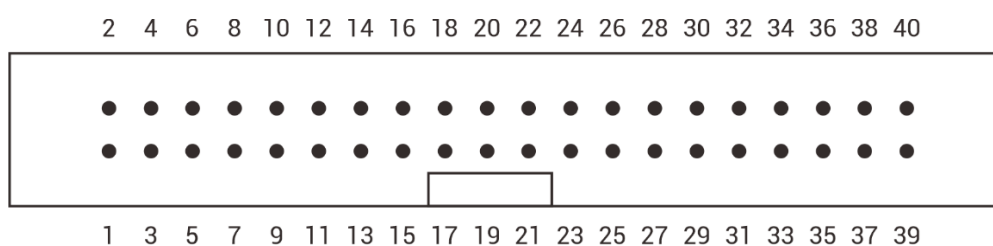
PIN	Name	Description	PIN	Name	Description
1	IN8/OUT39	General IO Signal	21	OUT8/IN39	General IO Signal
2	IN9/OUT38	General IO Signal	22	OUT9/IN38	General IO Signal
3	IN10/OUT37	General IO Signal	23	OUT10/IN37	General IO Signal

4	IN11/OUT36	General IO Signal	24	OUT11/IN36	General IO Signal
5	IN12/OUT35	General IO Signal	25	OUT12/IN35	General IO Signal
6	IN13/OUT34	General IO Signal	26	OUT13/IN34	General IO Signal
7	IN14/OUT33	General IO Signal	27	OUT14/IN33	General IO Signal
8	IN15/OUT32	General IO Signal	28	OUT15/IN32	General IO Signal
9	IN16/OUT31	General IO Signal	29	OUT16/IN31	General IO Signal
10	IN17/OUT30	General IO Signal	30	OUT17/IN30	General IO Signal
11	IN18/OUT29	General IO Signal	31	OUT18/IN29	General IO Signal
12	IN19/OUT28	General IO Signal	32	OUT19/IN28	General IO Signal
13	IN20/OUT27	General IO Signal	33	OUT20/IN27	General IO Signal
14	IN21/OUT26	General IO Signal	34	OUT21/IN26	General IO Signal
15	IN22/OUT25	General IO Signal	35	OUT22/IN25	General IO Signal
16	IN23/OUT24	General IO Signal	36	OUT23/IN24	General IO Signal
17	/	/	37	/	/
18	/	/	38	/	/
19	/	/	39	/	/
20	/	/	40	/	/
Note: terminal definition of X400 and AC337 adapter board are the same.					

2.3. IO Power Input

Power of I/O signal terminal uses DC24V power supply, which connects to PIN36 (E24V), and PIN37 (EGND) of J400.

If ACC37-7103 wiring board is configured, it also needs power from DC24V power supply. For this, it is connected by EGND and E24V of 5.08mm screw type terminals.

→ **Specification:**

Power Supply	Description
IN voltage	DC24V±5%

Max Power	10W
Anti-inverse	√
Overcurrent Protection	√
Isolated Power	√
Cable Type	Recommend 1 mm^2 copper core cable

→ Wiring:
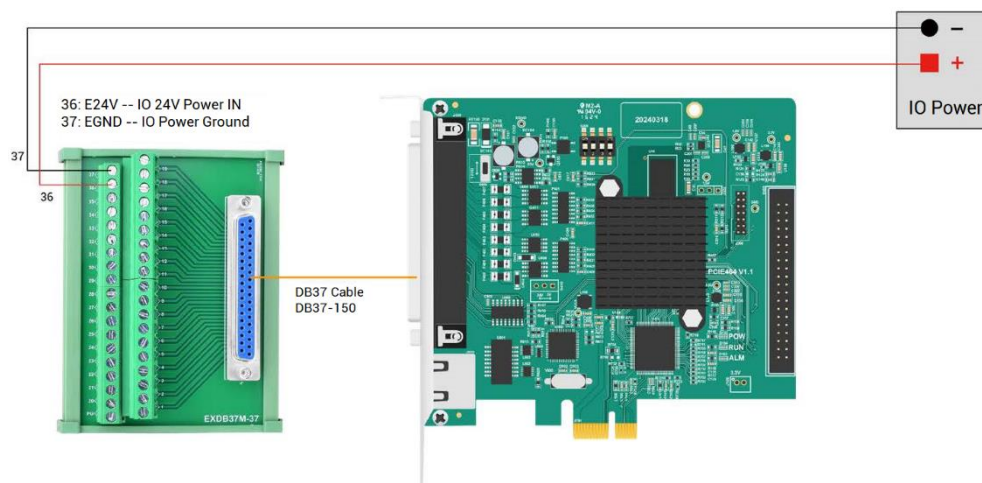
2.4. CAN Communication Interface

CAN communication interface is connected by PIN18 (CANH) and PIN19 (CANL) of J400. And please note PIN17 (EGND) must be connected to CAN ground of CAN module, that is, achieve grounded to prevent CAN chip from burning out.
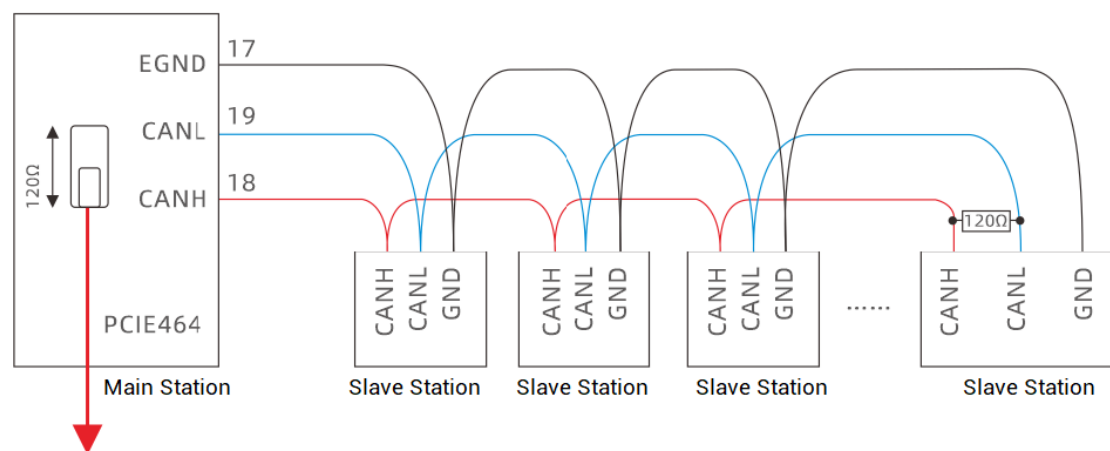
Control card's 120Ω terminal resistor on CAN bus is controlled by DIP switch (near to J400 signal), switch the "120Ω" as ON.

→ Specification:

CAN	Description
Communication Speed Ratio	≤1Mbps
Terminal Resistor	120Ω

Wiring Structure	Daisy Chain Structure
The number of nodes that can be expanded	≤16
Wiring Length	Recommend <30m (500kbps)
Communication Distance	√

→ Wiring:

Dail code as "120Ω", which means one 120ohm resistor is connected in parallel between CANH and CANL.

NOTES

- As above, the daisy chain topology is used for wiring (the star topology structure cannot be used). And the distance between nodes is shorter, it is 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 (turn to "120Ω" as above graphic).

- Please be sure to connect the public ends of each node on the CAN bus to prevent the CAN chip from burning out.

- Please use STP (Shielded Twisted Pair), especially in bad environments, and make sure the shielding layer is fully grounded.

- When on-site wiring, pay attention to make the distance between strong current and weak current, it is recommended for the distance to be more than 30cm.

- It should be noted that the equipment grounding (chassis) on the entire line must be good, and the grounding of the chassis should be connected to the standard factory ground pile.

→ Usage:

(1) Please wiring correctly and power on, then connect controller to RTSys through "PCI".

(2) Configure controller CAN main station:

    a) Use "CANIO_ADDRESS" command to set main station "address" and "velocity".

    b) Use "CANIO_ENABLE" command to enable or disable CAN main station function.

    c) View parameters by "RTSys – Controller – State the Controller – CommunicatioInfo".

    d) View bus node parameters by "RTSys – Controller – State the Controller – ZCanNodes".

CanID	HardID	Axises	MaxIn	MaxOut	MaxAin	MaxAout	
Local	464-0(ZMC464)	64	27(0-26)	15(0-14)	0	2(0-1)	

BasicInfo ZCanNodes Slot0Nodes CommunicationInfo

(3) Match "Velocity" and "Address" of CAN slave station module correctly, then complete resource mapping. It can refer to "3.1 CAN Bus Expansion".

(4) After setting, restart all stations, then it can communicate normally. If "ALM" led of slave station is ON, which means the communication fails.

(5) Please note "speed" of each node on CAN bus must be consistent, and "address" setting and resource mapping can't conflict, otherwise, communication will fail or be wrong.

(6) For above command details and other commands, please refer to "RTBasic Programming Manual".

2.5. IN Digital Input Interface

Digital inputs are distributed in J400 (IN0-IN7) and X400 (IN8-IN39).

→ Specification:

Item	High-speed input (IN0-IN7)	Low-speed input (IN8-IN39)
Input method	NPN type (triggered by low electric level)	
Input frequency	<400KHz	<5KHz
Impedance	4.7KΩ	4.7KΩ
Voltage to open	≤24V	≤24V
Communication Distance	√	√ (X400 is one non-isolated signal)

→ Wiring:

General Input Wiring (for single-ended encoder-axis wiring, please refer to "Single-Ended Interface".
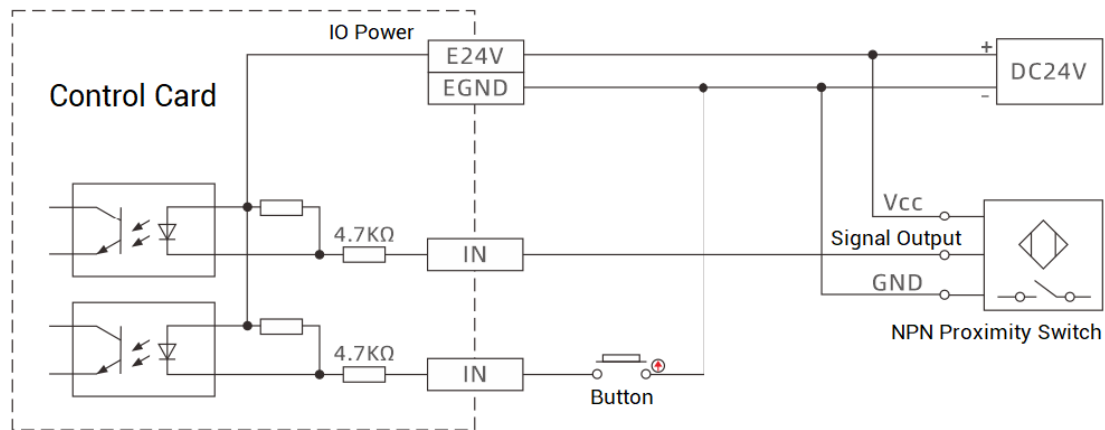
NOTES

- Digital input wiring is shown above, external load can be button switch, or sensor, or others, they need to match signals correctly.

- It is recommended to use the same one power supply of load and controller, otherwise, it needs to connect to negative poles of two powers.

- When on-site wiring, pay attention to make the distance between strong current and weak current, it is recommended for the distance to be more than 30cm.

- It should be noted that the equipment grounding (chassis) on the entire line must be good, and the grounding of the chassis should be connected to the standard factory ground pile.

→ Usage:

(1) Please wiring correctly and power on, then connect controller to RTSys through "PCI".

(2) Read state value of related IN through "IN" command, or through "RTSys – Tool – IN to check.
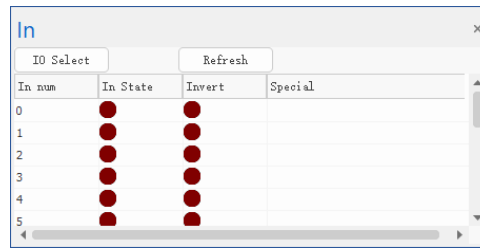
(3) Configure latch function through "REGIST", "REG_POS", "REG_INPUTS" commands.

(4) Set axis positive/negative position limit signa / origin signal through "FWD_IN", "REV_IN", "DATUM_IN" commands.

(5) For above command details and other commands, please refer to "RTBasic Programming Manual".

2.6. OUT Digital Output Interface

Digital outputs are distributed in signal interfaces of J400 (OUT0-7) and X400 (OUT8-OUT39).

→ Specification:

Item	High-speed output (OUT0-7)	Low-speed output (OUT8-39)
Output method	NPN Type	
Output frequency	<400KHz	<8KHz
Load Voltage	≤24V	≤24V
Current	≤300mA	≤300mA
Overcurrent Protection	√	√
Communication Distance	√	√ (X400 is one non-isolated signal)

→ Wiring:

General output Wiring (for single-ended encoder-axis wiring, please refer to "Single-

Ended Interface".
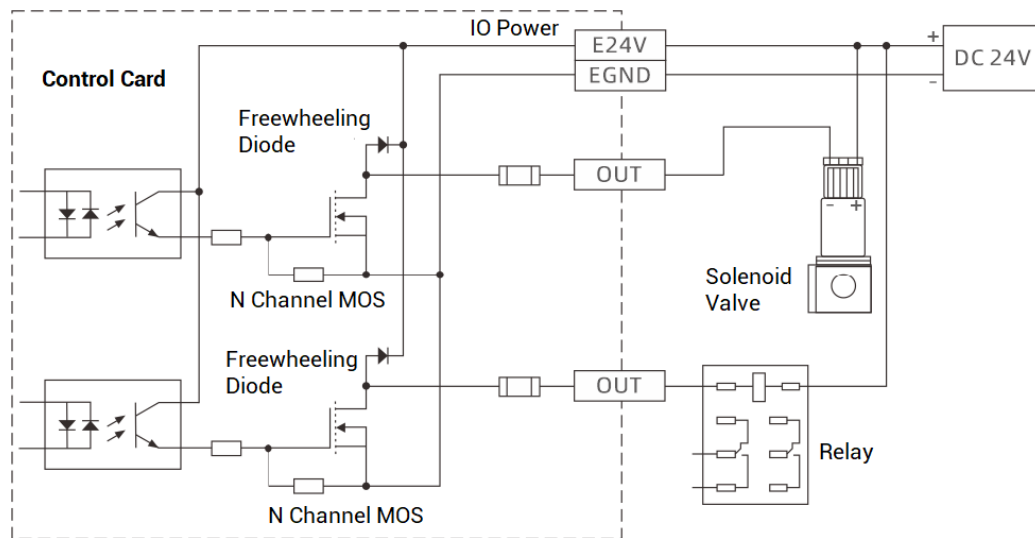
NOTES

● Digital output wiring is shown above, external load can be the relay, or solenoid valve, or others. Please note their signals should be matched.

● It is recommended to use the same one power supply for load and controller, otherwise, it needs to connect to negative poles of two powers.

● When on-site wiring, pay attention to make the distance between strong current and weak current, it is recommended for the distance to be more than 30cm.

● It should be noted that the equipment grounding (chassis) on the entire line must be good, and the grounding of the chassis should be connected to the standard factory ground pile.

→ Usage:

(1) Please wiring correctly and power on, then connect controller to RTSys through "PCI".

(2) ON / OFF output ports through OP command directly, or through "RTSys – Tool – OP.
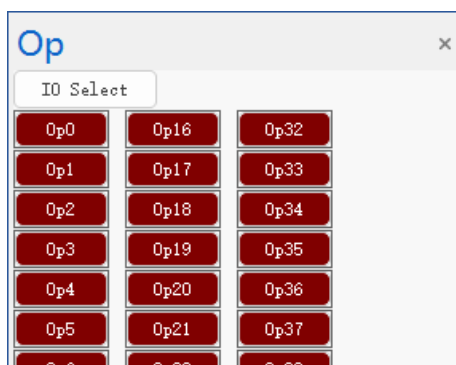
(3) It supports PWM function. PWM frequency is set through "PWM_FREQ" command, and PWM duty cycle is set through "PWM_DUTY".

(4) It also supports hardware comparison output function, which is opened and configured by "HW_PSWITCH2" command.

(5) When it is used as pulse-axis, the usage is same as AXIS. For more details, please check "usage" in "2.8 single-ended axis interface".

(6) For above command details and other commands, please refer to "RTBasic Programming Manual".

2.7. Local-Axis Interface

Differential pulse output interfaces and differential input interfaces are distributed into J400, and the connection is built through wiring board. For specific information, please go to "J400 Singal Interface".

→ Specification:

J400 signal interface includes one differential pulse output interface, and one differential encoder feedback.

Signal	Item	Description
PUL+/PUL- DIR+/DIR-	Signal Type	Differential Output Signal
	Signal Volage Range	0-5V
	Signal Max Frequency	10MHz

	Isolation	Non-isolation
EA+/EA-	Signal Type	Differential Input Signal
EB+/EB-	Signal Volage Range	0-5V
EZ+/EZ-	Signal Max Velocity	10Mbps
VCC5, GND	Max Output Current for 5V Power	50mA

→ Wiring:

Wiring of differential pulse-axis and differential encoder-axis (take Panasonic A5 and A6 as the example):

NOTES

● Local-axis interface wiring is shown above, but it may differ from drive models, please wire them carefully.

● While using differential signals, both grounding sides must be connected, then it can make sure communication stability and device safety.

● Please use STP (shielded twist pair), especially when the environment is not good, please make the shield layer be grounded fully.

→ Usage:

(1) Please wiring correctly and power on, then connect controller to RTSys through "PCI".

(2) Set basic parameters through corresponding commands, like, BASE, ATYPE, UNITS, SPEED, ACCEL, DECEL, etc. In addition, remap axis No. through AXIS_ADDRESS command, enable through AXIS_ENABLE, and run linear motion through MOVE.

(3) If you need to check or configure above parameters directly, go to "RTSys – View – Axis Parameters" window. What's more, in "RTSys – Tool – Manual" window, it can operation and control axis motion directly.

Axis Parameters				✕
Axis select	Parameter select			
	Axis0	Axis1	Axis2	
COMMENT				
ATYPE	0	1	1	
UNITS	1	1	1	
ACCEL	10000	1000	1000	
DECEL	0	1000	1000	
SPEED	1000	100	100	
CREEP	100	100	100	
LSPEED	0	0	0	
MERGE	0	0	0	

Axis Parameters | Help | Property

(4) For above command details and other commands, please refer to "RTBasic Programming Manual".
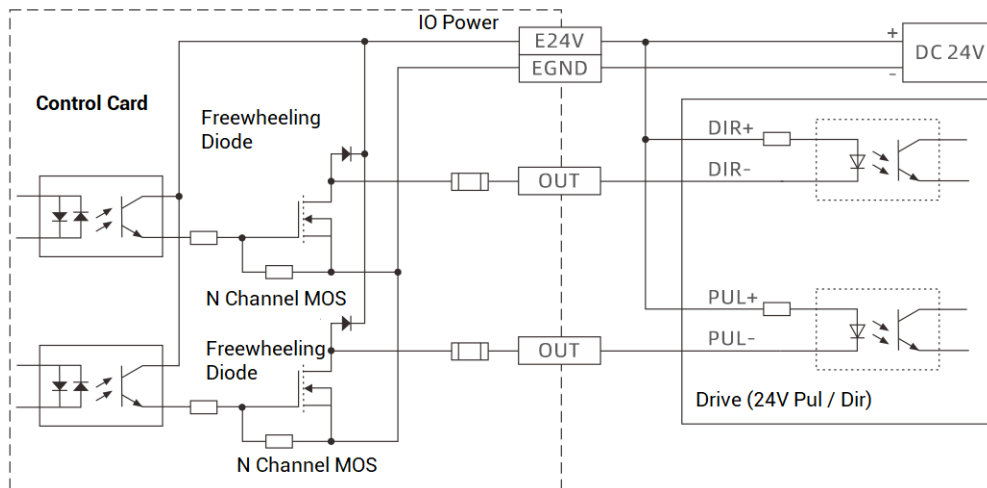
2.8. Single-Ended Axis Interface

Single-ended pulse output interface and single-ended encoder input interface are distributed in IO signal of J400, they are connected through wiring boar. For specific information, please go to "J400 Singal Interface".

→ Specification:

Item	Description
Pulse / Directional (PUL/DIR) Signal Type	Single-ended output signals
Pulse / Directional (PUL/DIR) Signal Voltage Range	0-24V
Pulse / Directional (PUL/DIR) Signal Max Frequency	<500kHz
Encoder (A/B/Z) Signal Type	Single-ended input signals
Encoder (A/B/Z) Signal Voltage Range	0-24V
Encoder (A/B/Z) Signal Max Frequency	<100kHz
Isolation	Isolated

→ Wiring:

■ **Single-Ended Pulse Wiring Reference (take OUT2 and OUT3 as the example):**

■ **Single-Ended Encoder Wiring Reference (take IN6, IN7, and IN3 as the example):**
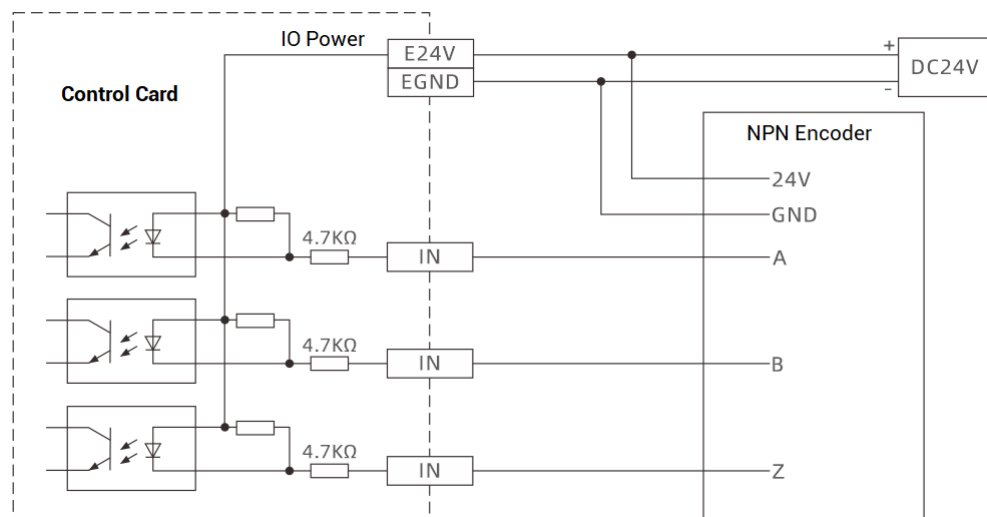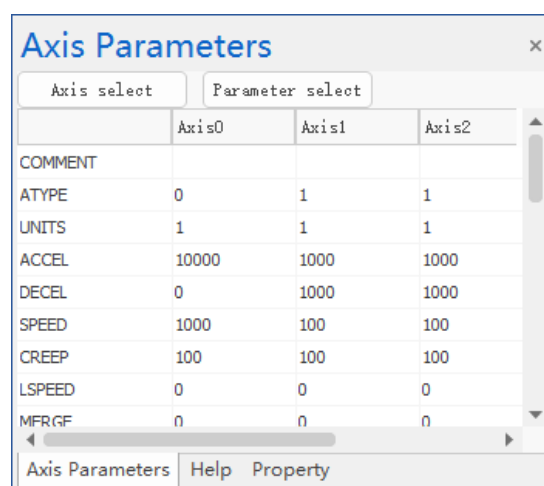

NOTES

● Local-axis interface wiring is shown above, but it may differ from drive models, please wire them carefully.

● For pulse directional interface of 5V drive, please connect drive PUL+ and DIR+ to E5V interface.

● Please use STP (shielded twist pair), especially when the environment is not good, please make the shield layer be grounded fully.

→ **Usage:**

(1) Please wiring correctly and power on, then connect controller to RTSys through "PCI".

(2) Set basic parameters through corresponding commands, like, BASE, ATYPE, UNITS, SPEED, ACCEL, DECEL, etc. In addition, remap axis No. through AXIS_ADDRESS command, enable through AXIS_ENABLE, and run linear motion through MOVE.

(3) If you need to check or configure above parameters directly, go to "RTSys – View – Axis Parameters" window. What's more, in "RTSys – Tool – Manual" window, it can operation and control axis motion directly.
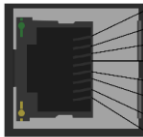

(4) For above command details and other commands, please refer to "RTBasic Programming Manual".
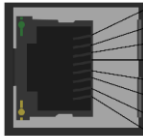
2.9.EtherCAT Bus Interface / Ethernet

This interface can be used as EtherCAT interface to connect to bus device, also can be used as Ethernet. But please note EtherCAT and EtherNET can't be used synchronously.

→ Specification:

--As EtherCAT Bus Interface--

PIN		Item	Description
		Communication protocol	EtherCAT
		Communication speed	100Mbps
		Refresh Period	Max 500us
		Communication cable	Category 5e STP (shielded twist pair)
		Communication length	Recommended <50m

PIN	Signal	Description
1	TX+	Send signal (+)
2	TX-	Send signal (-)
3	RX+	Receive signal (+)
4	NC	Reserved
5	NC	Reserved
6	RX-	Receive signal (-)
7	NC	Reserved
8	NC	Reserved

--As EtherNET Interface--

PIN		Item	Description
		Communication protocol	MODBUS_TCP
		Communication speed	100Mbps
		Default IP	192.168.0.11
		Communication cable	Category 5e STP (shielded twist pair)
		Communication length	Recommended <50m

PIN	Signal	Description
1	TX+	Send signal (+)
2	TX-	Send signal (-)
3	RX+	Receive signal (+)
4	NC	Reserved
5	NC	Reserved
6	RX-	Receive signal (-)
7	NC	Reserved
8	NC	Reserved

→ Wiring:

--As EtherCAT Bus Interface--

➢ When connecting to EtherCAT bus drive or other slave station devices, it can connect

to EtherCAT IN port of behind device through one category 5e shielded cable, and multi-level expansion can be achieved by connecting to EtherCAT OUT port of this slave station device to EtherCAT IN port of next slave device.

➢ EtherNET LED:

LED STATUS	Commonly-ON	Shrink
Green	Build the 100M communication	While receiving and
Yellow	Build the 10M communication	sending data

--As EtherNET Interface--

➢ Controller Ethernet can be connected to PC, HMI by point-to-point connection through one category 5e shielded cable.

➢ Controller also can be connected to the interchanger, that is, through the interchanger, expand the Ethernet channel and connect to other devices, then achieve multi-to-point connection.

➢ EtherNET LED:

| LED STATUS	Commonly-ON	Shrink
Green	Build the 100M communication	While receiving and
Yellow	Build the 10M communication	sending data

NOTES

● Please use category 5e shielded cable, especially in bad environment, to promote signal interference.

● When on-site wiring, pay attention to make the distance between strong current and weak current, it is recommended for the distance to be more than 30cm.

● It should be noted that the equipment grounding (chassis) on the entire line must be good, and the grounding of the chassis should be connected to the standard factory ground pile.

→ Usage:

--As EtherCAT Bus Interface--

(1) Please wiring correctly and power on, then connect controller to RTSys through "PCI".

(2) How to connect to the driver device through EtherCAT bus:

    a) Use SLOT_SCAN command to scan the slot No. on the bus.

    b) Use AXIS_ADDRESS command to map axis No., it can refer to 3.2 EtherCAT expansion – resources mapping.

    c) Use SLOT_START command to open the bus or use SLOT_STOP to close the bus.

    d) When connection is done, if you need to configure and operate local pulse axes, please refer to 2.7 local axis interface – usage.

(3) How to connect to expansion module through EtherCAT bus:

    a) Use SLOT_SCAN command to scan the slot No. on the bus.

    b) Use AXIS_ADDRESS command to map axis No., and use NODE_IO/NODE_AIO to map IO No., they can be referred from 3.2 EtherCAT expansion – resources mapping.

    c) Use SLOT_START command to open the bus or use SLOT_STOP to close the bus.

    d) When all are done, if you need to configure and operate local IO and axes, please refer to 2.5 & 2.6 & 2.7 – usage.

(4) Check slot No. node information directly and clearly through RTSys – controller – state the controller – Slot0Node.
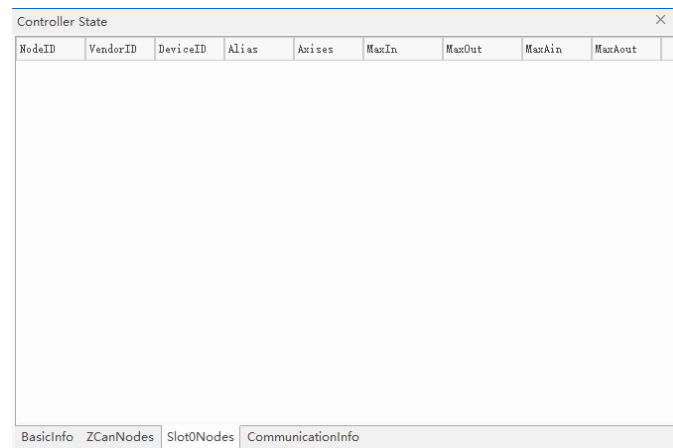
(5) For above command details and other commands, please refer to "RTBasic Programming Manual".

--As Ethernet Interface--

(1) Please wiring correctly and power on, then connect controller to RTSys by "Ethernet".

(2) It can modify controller IP through "IP_ADDRESS" command, please attention controller IP address and PC IP address should be in the same network segment.

(3) Support custom ethernet communication, it can use "OPEN #" command to do custom ethernet communication, and use "CLOSE #" to close it. In addition, data in the custom ethernet channel can be read and saved by "GET #" command.

(4) For above command details and other commands, please refer to "RTBasic Programming Manual".

2.10. DIP Switch

This control card has one DIP switch (dial code). Please see below functions and usage.
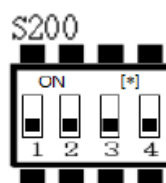
→ **Usage:**

DIP switch S200 is used to set ID of PCI464. Control card ID can be checked by sending "ID_PCICARD" command in RTSys.

Form of relationship between code state and ID (ON = 1):

| Code 1	Code 2	Code 3	Code 4	Card ID
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

→ **Usage:**

Chapter III Resources Expansion

When there are no enough local resources in this card, it can expand more through CAN bus or EtherCAT bus.

3.1.IO CAN Bus Expansion

There are three kinds of CAN bus expansion modules to extend more IOs, analog IOs, and axes (up to 2 for axis), they are ZIO, ZAIO, and ZMIO310-CAN. Therefore, it only needs to use the expansion module according to your specific requirements, and then to do IO mapping or axis mapping, but please attention mapping No., they should be assigned appropriately.

→ **Wiring:**
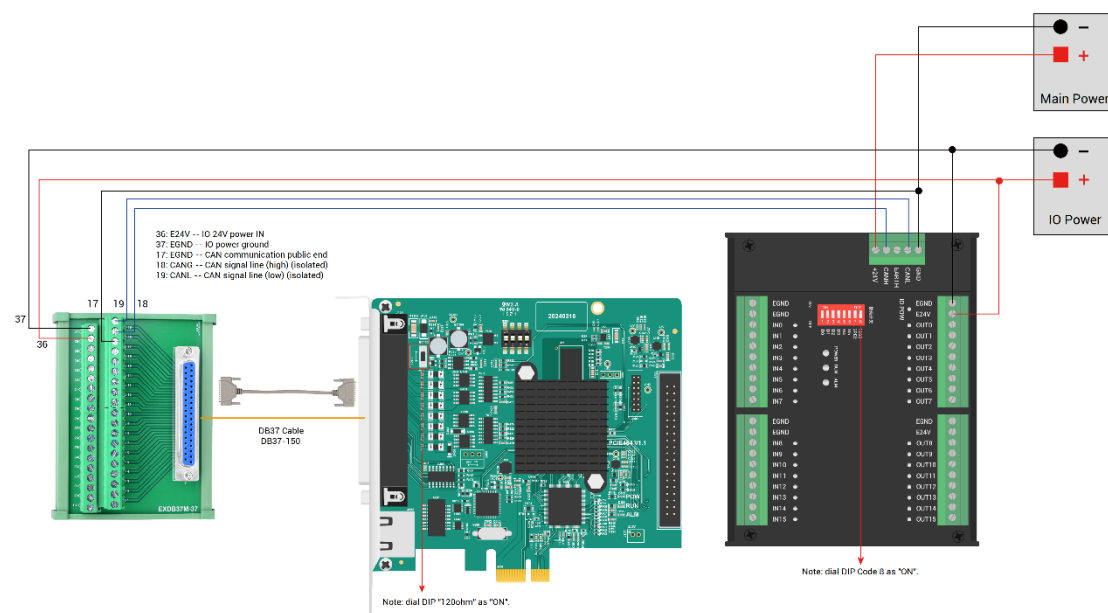
NOTES

- Control card and expansion module share the main power supply, but IO power supplies of ZIO and ZMIO310-CAN need to be supplied independently for isolation.

- 120-ohm resistor on CAN bus is controlled by DIP switch (dial code, which is near to J400), dial it as ON.

● When there are multiple expansion modules connected on the CAN bus, please connect to each one 120ohm resistor on the two ends of CAN bus (CANH and CAHL) in parallel, in this way, impendence can be matched. If the expansion module has 8-code, it only needs to dial code 8 as ON.

→ Resources Mapping:

➢ DIP Switch

The CAN expansion module generally has an 8-code DIP switch used for communication configuration and resources mapping, dial ON to take effect, and the meaning of the DIP is as follows:

● 1-4: CAN module address ID, the combination value is 0-15 (from 4-digit binary to decimal system)
  Dial code 1-4 to select CAN module address ID. The controller automatically maps expansion module's IO No. range according to this address ID, but for axis No., please map it manually.

● 5-6: CAN communication speed, the combination value is 0-3 (from 2-digit binary to decimal system), there are four options.

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

● 7: reserved

- 8: 120-ohm resistor, dial it as ON = one 120-ohm resistor is connected between CANL and CANH.

➢ **IO Mapping**

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

- IO Mapping

Code 4	Code 3	Code 2	Code 1	Card ID	Starting IO No.	End IO No.
0	0	0	0	0	16	31
0	0	0	1	1	32	47
0	0	1	0	2	48	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

- AIO Mapping (code 1 – code 4 state and corresponding address ID, please refer to above form)

Address ID	Starting AD No.	End AD No.	Starting DA No.	End DA 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

➢ Axis Mapping:

When the CAN bus expansion mode is used to expand the pulse axis, 2 axes can be expanded at most. And these two pulse axes can be accessed after mapping and binding with axis No. through AXIS_ADDRESS.

AXIS_ADDRESS(axis No. to be mapped)=(32*axis No. on expansion module)+ID

AXIS_ADDRESS(6)=(32*0)+2

'map axis 0 of CAN expansion module whose ID is 2 as axis 6

AXIS_ADDRESS(7)=(32*1)+2

'map axis 1 of CAN expansion module whose ID is 2 as axis 7

For more command details and other commands, please refer to "RTBasic Programming Manual".

> ➢ **Expanded Resources Checking**

Connect controller to RTSys, then open "controller – state the controller – ZcanNodes" window. In this window, all expansion modules' ID and corresponding mapping No. can be viewed clearly.

Controller State							×
CanID	HardID	Axises	MaxIn	MaxOut	MaxAin	MaxAout	
Local	464-0(ZMC464)	64	27(0-26)	15(0-14)	0	2(0-1)	

BasicInfo   ZCanNodes   Slot0Nodes   CommunicationInfo

3.2. EtherCAT Bus Expansion

There are EIO and ZMIO310-ECAT EtherCAT bus expansion modules to expand digital IO / analog IO / axis.

→ Wiring:

While wiring, use one category 5e shielded twist pair to connect controller EtherCAT to EtherCAT IN port of next expansion device, and then EtherCAT OUT port of this expansion device can be connected to next slave device's EtherCAT IN port for multi-level expansion.

When each EIO expansion module completes wiring, no need to second develop, it only needs to map module IO No. and axis No. on the controller EtherCAT.

--EIO Expansion Module Wiring Reference--
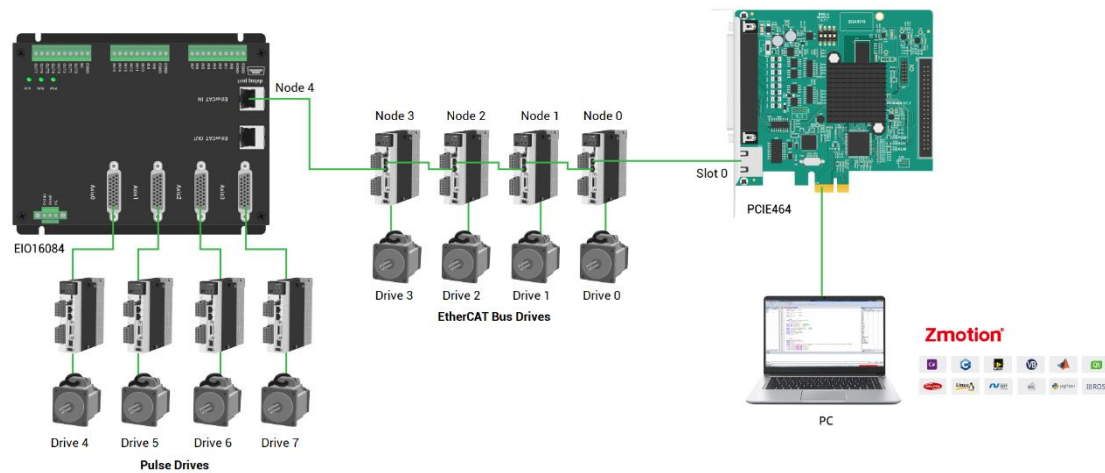
No. and corresponding meaning:

● Slot No. (slot)

"slot" means bus interface No. on the controller, EtherCAT bus slot No. is 0.

● Device No. (node)

"node" means all device No. connected one slot, starting from 0, and it will automatically number according to the device connection sequence on the bus. How many devices in total connected on the bus can be checked through NODE_COUNT(slot) command.

● Drive No.

Controller will automatically identify the drive on the slot, starting from 0, and also they are numbered automatically according to the drive connection sequence on the bus.

Please note drive No. and device No. are different. Drive No. is only for driver on the slot, IO and other interfaces are not included. When mapping axis No., it will use drive No.

→ Resources Mapping:

➢ IO Mapping

EtherCAT expansion module IO mapping is set by code NODE_IO and NODE_AIO commands.

Before mapping IO, please check controller local max IO No. (there are general IO interface and specialized IO interface). Then assign expansion IO No. in order.

Note: IO No. on the bus can't be the same, otherwise, both are valid.

- Digital IO Mapping

Example: NODE_IO (0,0) = 32   'set device 0's IO starting No. as 32

- Analog IO Mapping

Example: NODE_AIO (0,0,3) = 3   'set device 0's AIN starting No. as 3

For more command details and other commands, please refer to "ZBasic Programming Manual".

➢ Axis Mapping:

When the CAN bus expansion mode is used to expand the pulse axis, 2 axes can be expanded at most. And these two pulse axes can be accessed after mapping and binding with axis No. through AXIS_ADDRESS.

For EtherCAT bus expansion module axis mapping, also, the axis No. in the whole system can't repeat. The operation command is:

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

AXIS_ADDRESS(6)=(0<<16)+0+1 'the first ECAT driver, drive No. is 0, bind it with axis 6

AXIS_ADDRESS(7)=(0<<16)+1+1 'the second ECAT driver, drive No. is 1, bind it with axis 7

For more command details and other commands, please refer to "RTBasic Manual".

➢ **Expanded Resources Checking**

Connect controller to RTSys, then open "controller – state the controller – ZcanNodes" window. In this window, all expansion modules' ID and corresponding mapping No. can be viewed clearly.

There are many EtherCAT bus commands, please refer to "RTBasic Programming Manual".

Chapter IV Accessories

For PCIE464 motion control card, it can use with IO accessories together, order below accessories as needed.

4.1. EXDB37M-37 Wiring Board

EXDB37M-37 wiring board is for J400 signal interface, using DB37 cable to connect the J400. For this specification, please refer to J400 signal interface specification.
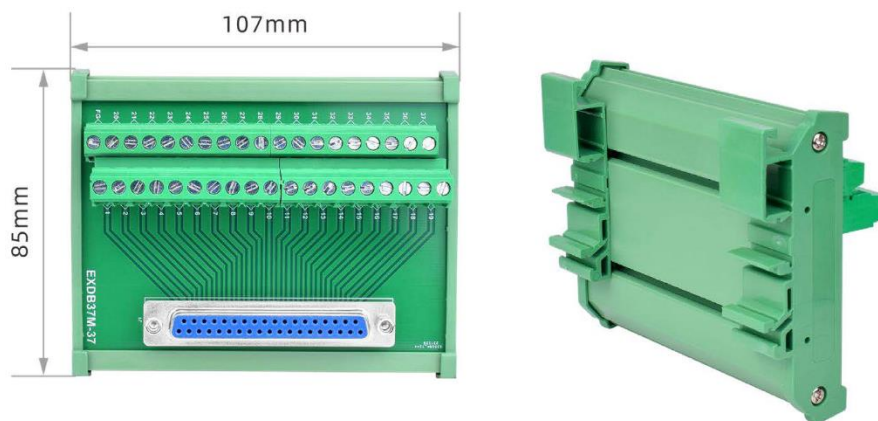
4.2. DB37-150 Shielded Cable

● Use DB37-150 shielded cable to connect J400 signal interface to EXDB37-37 wiring board, which is convenient for users to install and wire

● Use DB37-150 shielded cable to connect ZP72-02 wiring cable CN1 interface to ACC37 wiring board, which is convenient for users to install and wire

DB37-150 cable is one 37-pin male-to-male full contact, that is, they are corresponding and with shield. The cable length is 1.5 meters.

4.3. ACC37 Wiring Board

ACC37 is the wiring board for X400 signal, using flat wiring cable and DB37 to connect to X400. For this wiring board specification, please refer to X400 signal interface specification.
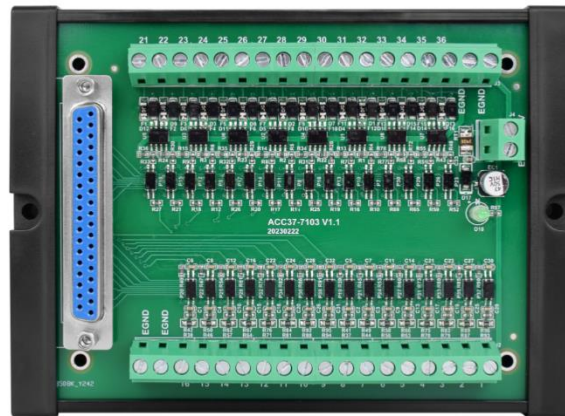
Size: 144mm*104mm

When users need more IO, ACC37-7103 can be purchased together. It can be up to 16 inputs and 16 outputs. While using adapter board, it also needs DC24V power to supply for adapter board.

If there are more other inputs and outputs:

Model	Specification
ACC37-2408M	24 inputs (IN8-31) & 8 outputs (OUT8-15)
ACC37-3200M	32 inputs (IN8-39)
ACC37-0824M	8 inputs (IN8-15) & 24 outputs (OUT8-31)
ACC37-0032M	32 outputs (OUT8-39)

4.4.ZP72-02 Adapter Cable

The 40P X400 socket of the control card can be converted to DB37 through the ZP72-02 conversion cable, and can be installed on the card slot of the IPC for easy wiring. Connect CN1 to DB37-150 cable, connect CN2 to X400.
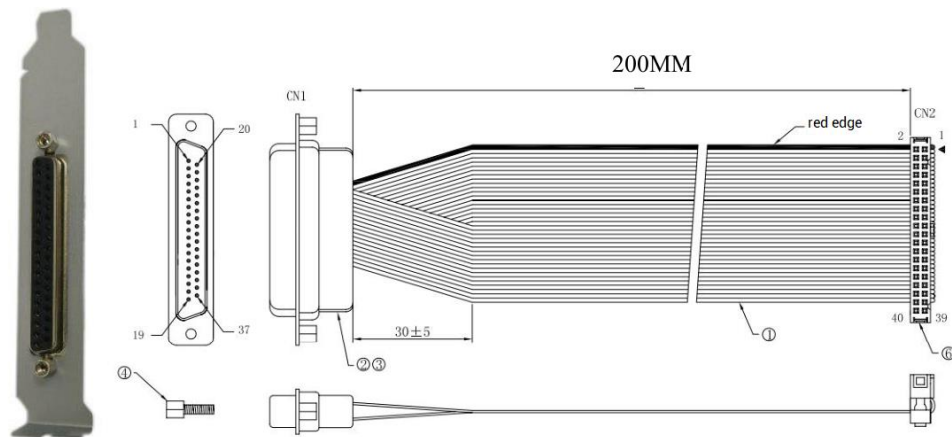
Chapter V Installation

5.1. PCIE464 Installation

Install steps:

1. Turn off the PC power.

2. Open the computer case, select a free PCIE card slot, and use a screwdriver to remove the corresponding baffle strip.

3. Insert the motion control card into the slot securely, and tighten the fixing screws on the baffle strip.

Note: While connecting to control card, the PC / IPC must be in non-sleep state (In windows setting, "power & sleep", set the "time" as "never"). If it is in the state of "sleep", you can prohibit the PCIE drive in "device manager", then open it.

5.2. Drive Program Installation

Method 1: install automatically

a. use the built-in installation wizard software "dpinst_amd64.exe" in the driver directory to automatically install, and the specific operation is according to the software guide. For PCIE signed drive installation package, please contact us.
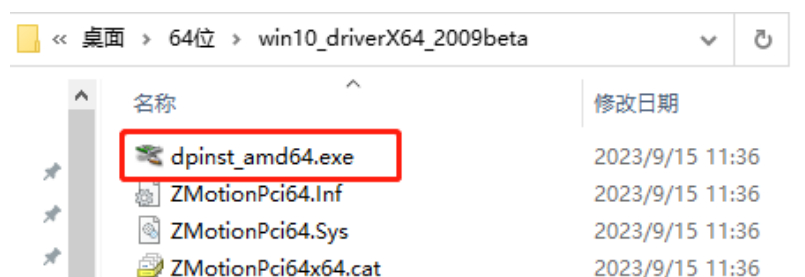
b. when hardware was installed, open the PC, at this time, Windows will detect the motion control card automatically, then please open "find new hardware wizard", and click "next":

c. after clicking "next", it is installing. If there is antivirus software or safety manager risk tip, please allow them, or you could exit corresponding software before install. When installed, below window will appear:
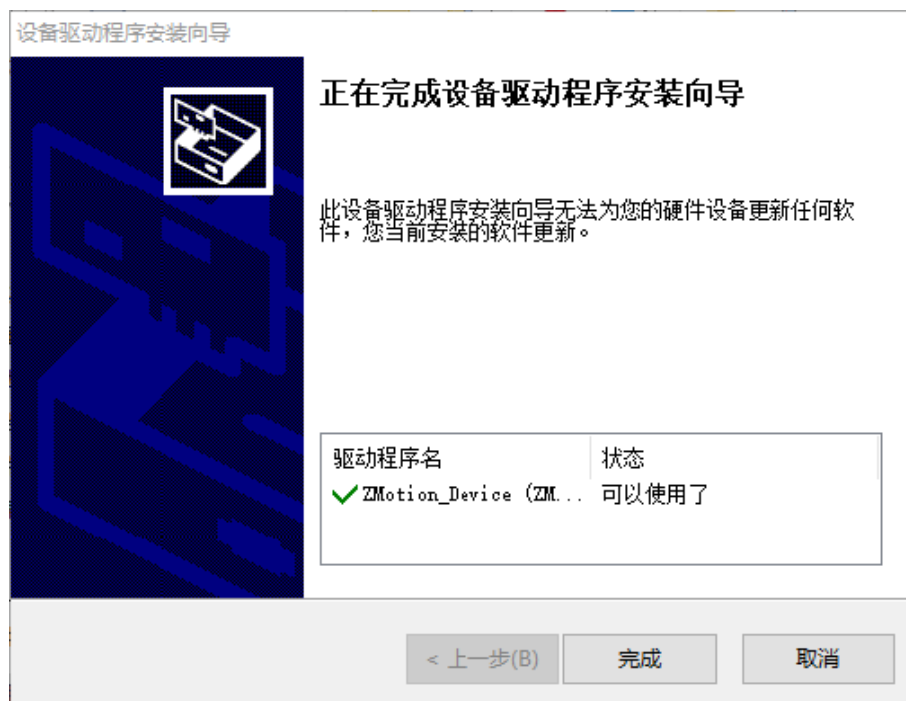
d. open device manager, it can be seen it is installed successfully.
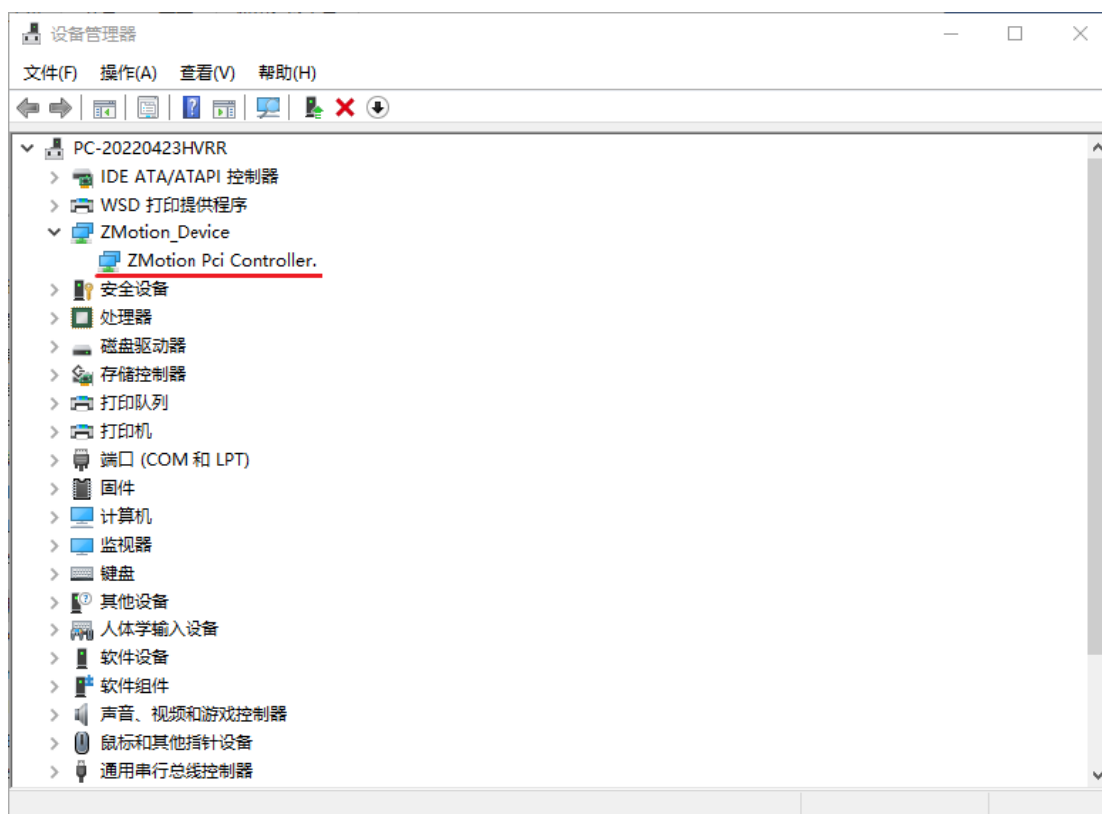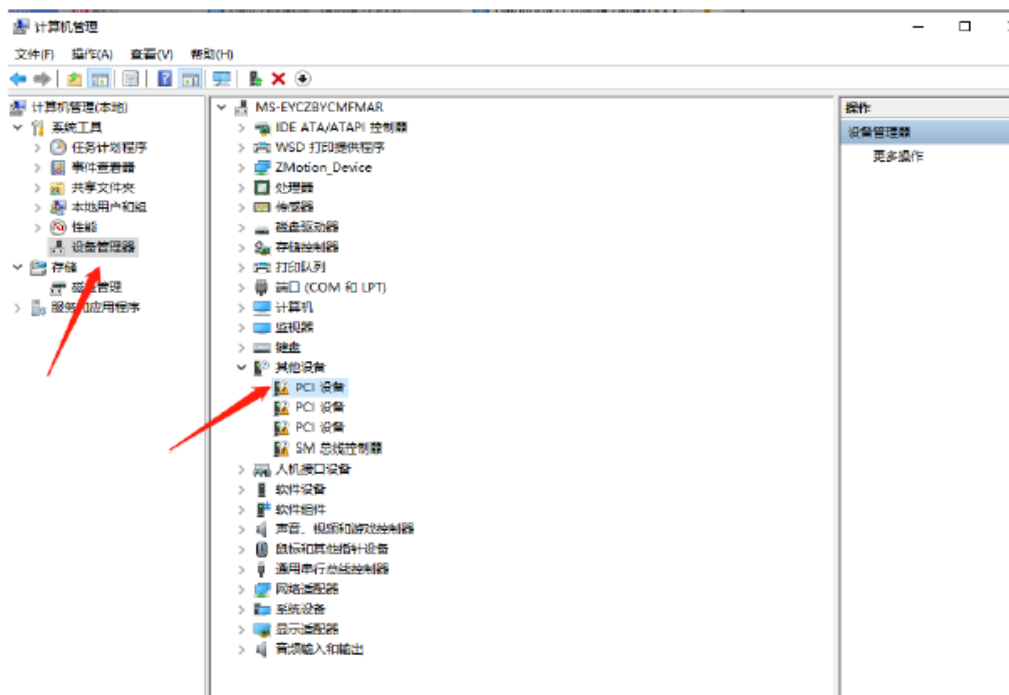
Note: if there is no drive program detected by Windows automatically after opening PC, or the drive program is removed, you could manually update drive program in device manager, then do above step by step.
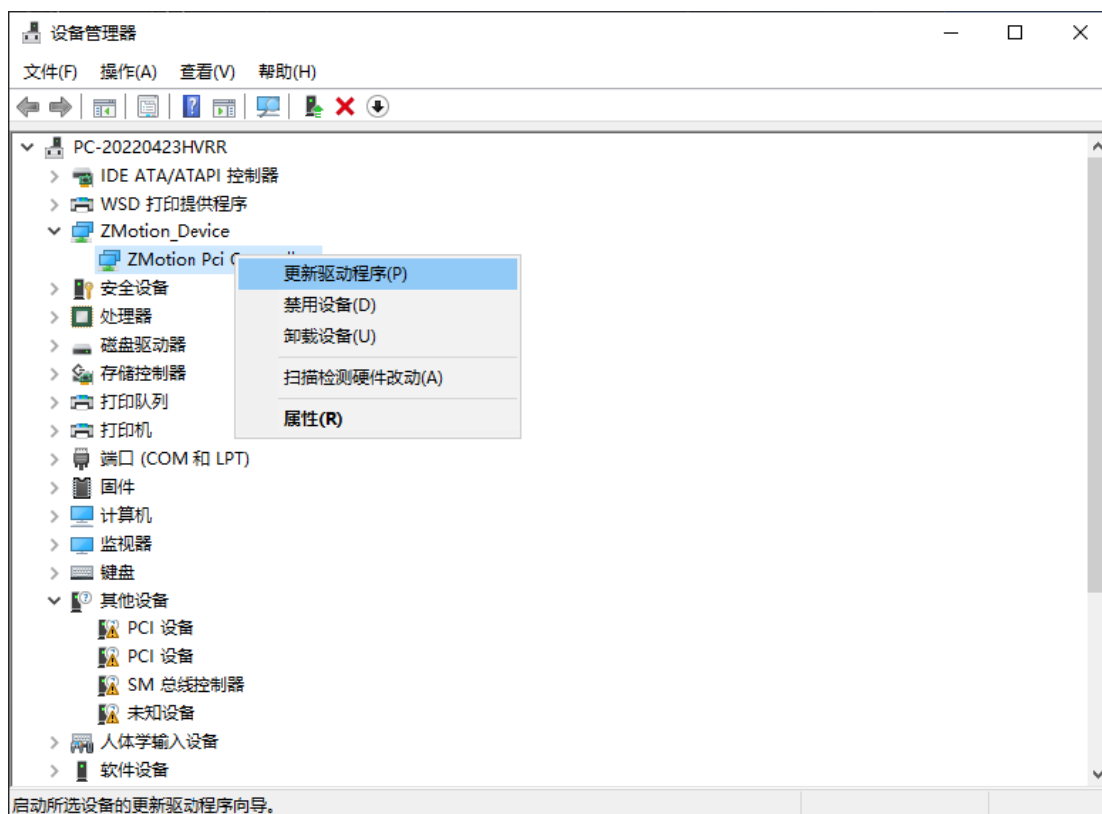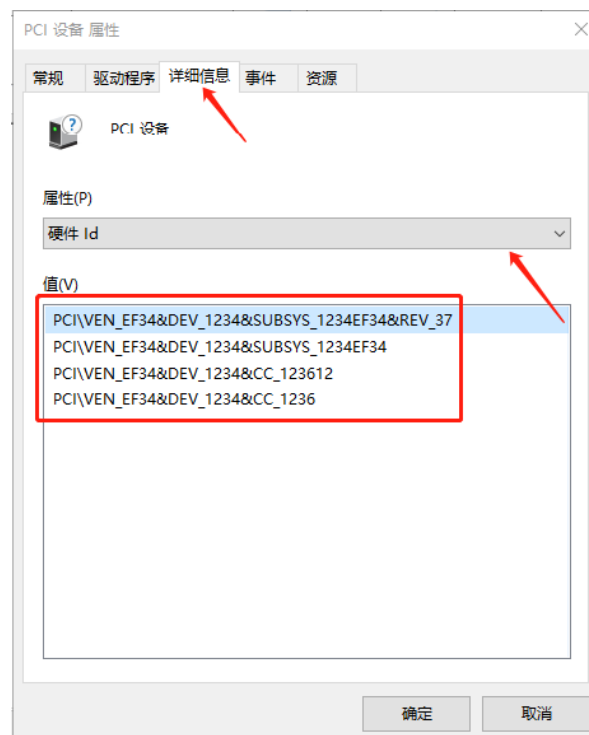
Method 2: install manually

a.   open the Device Manager menu and select the PCI device in Other Devices.

b.   if there are multiple PCI devices, right-click "Properties" to view detailed information, select "Hardware ID" for properties, and confirm that it is a PCI device starting with PCI\VEN_EF34&DEV_1234&.
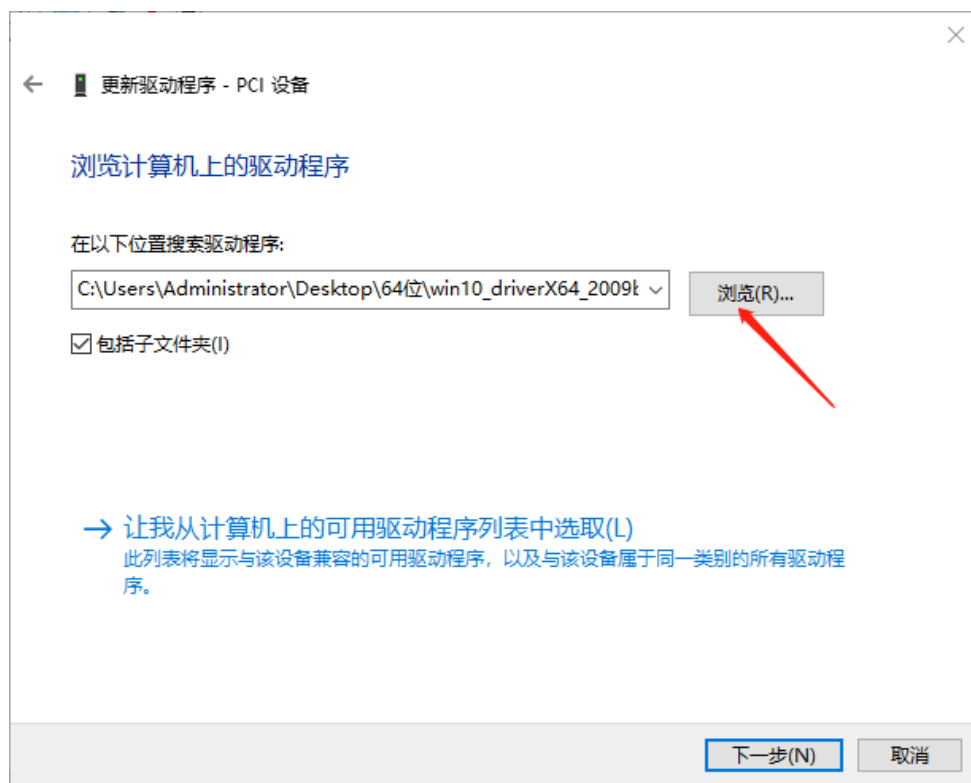
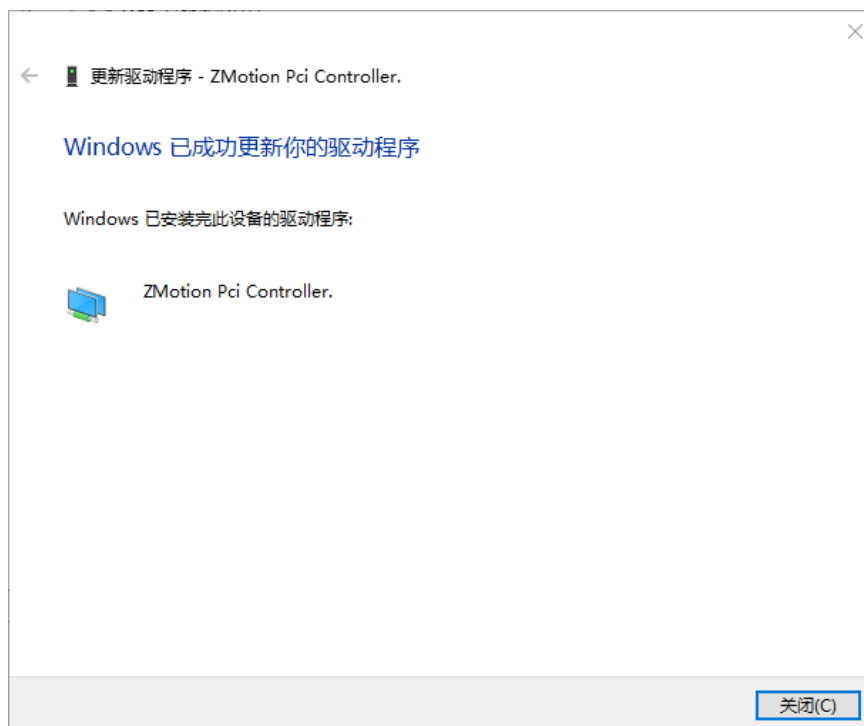c.   find PCI Device, right-click to select "update drive program".
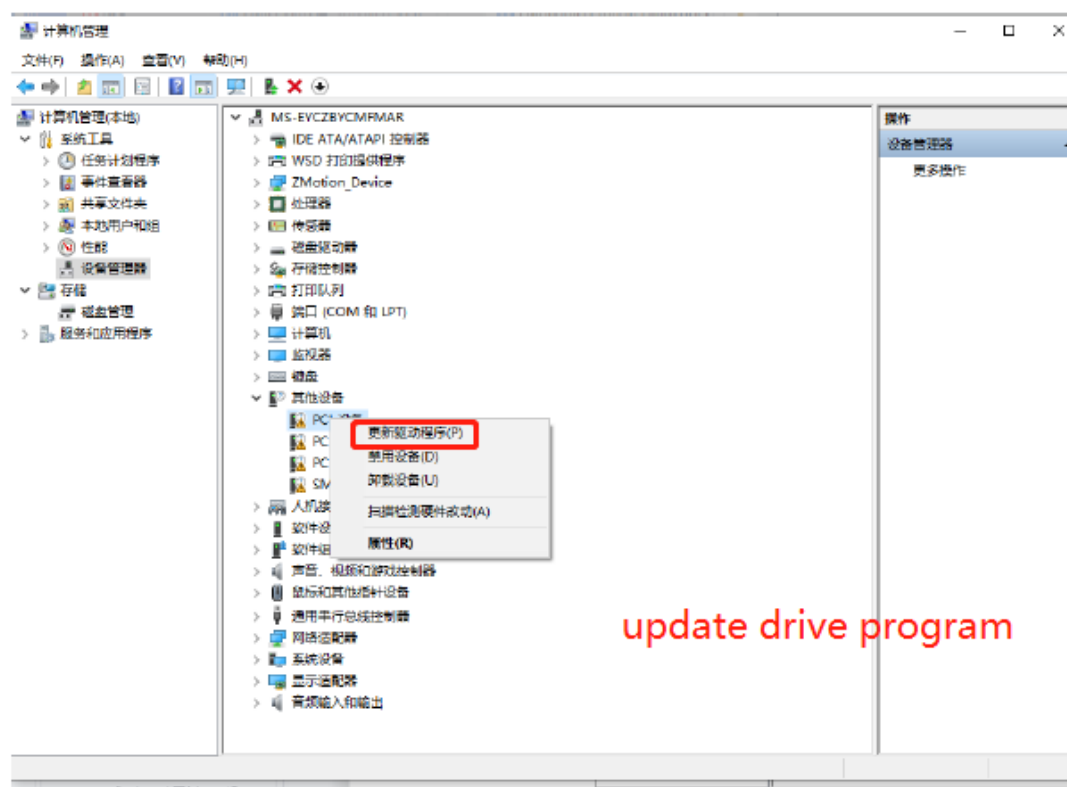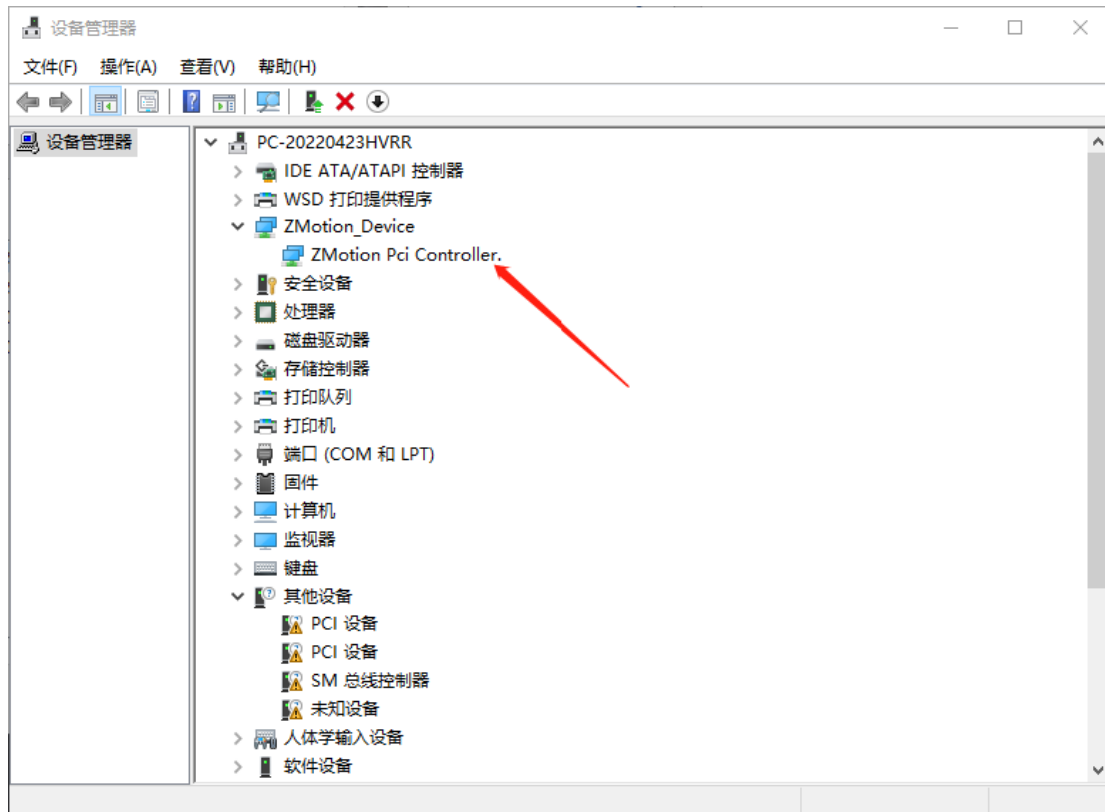

d.   select "browse my PC to check drive program".
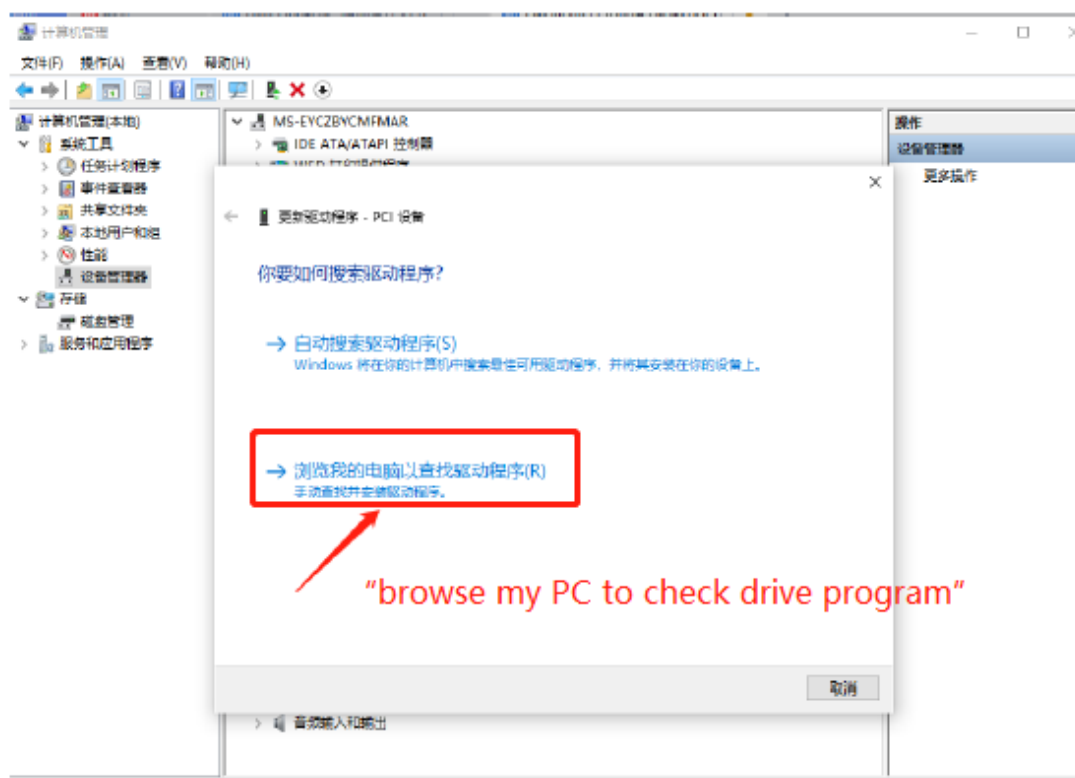
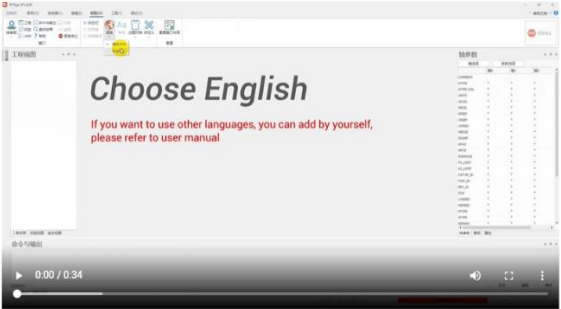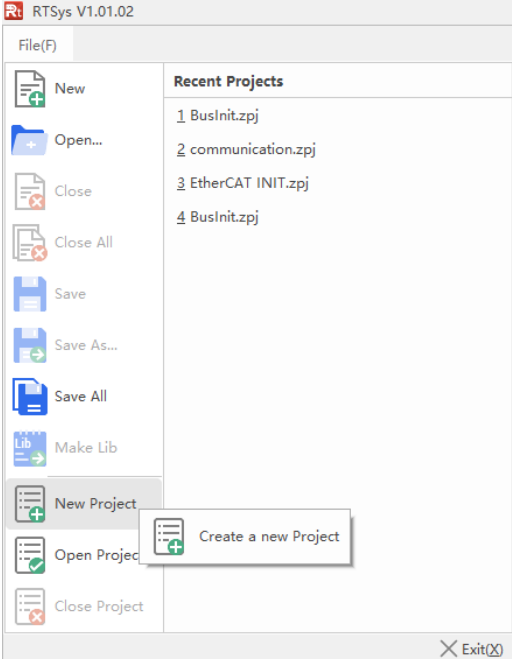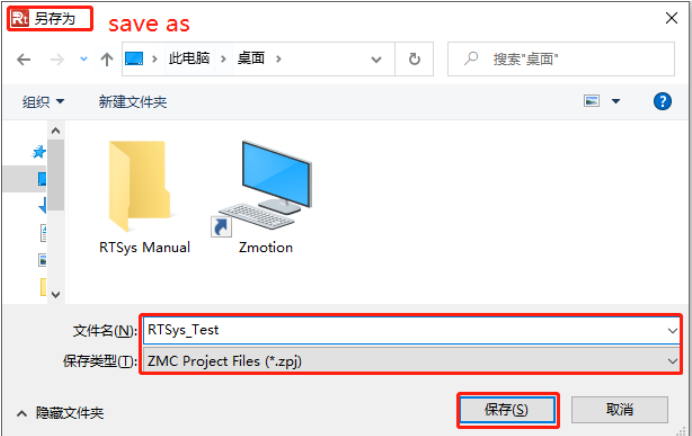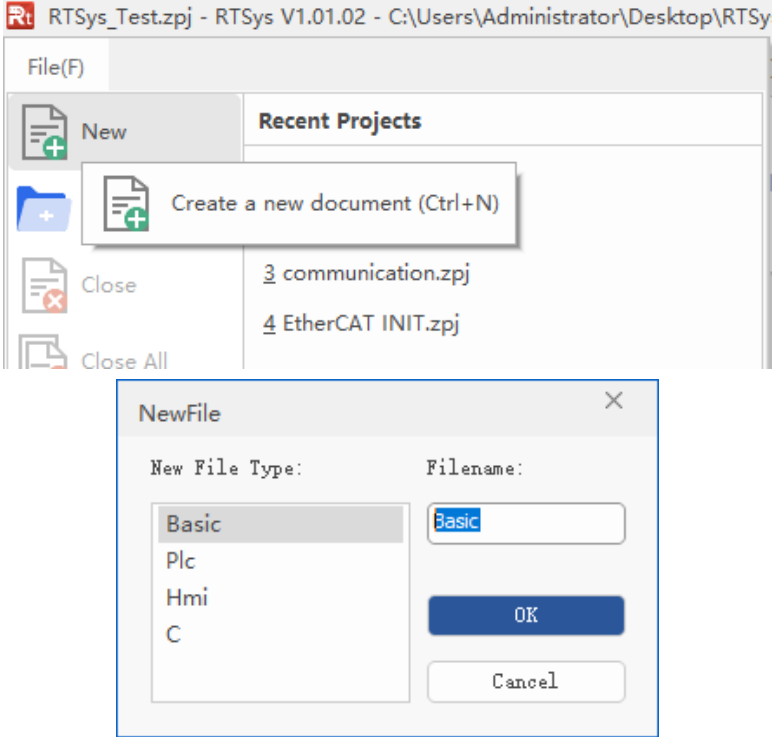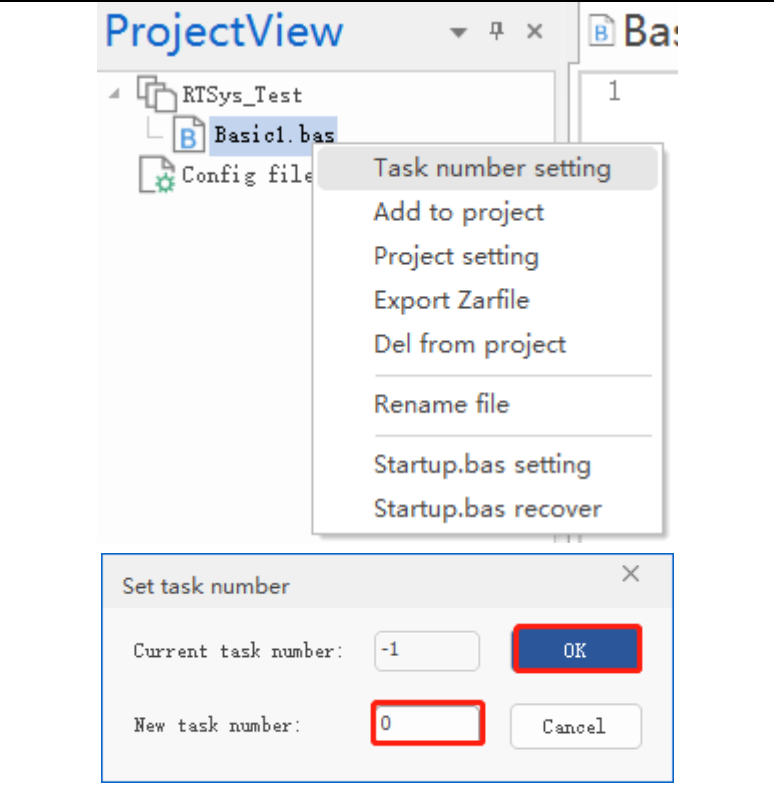e. click "browse", and select driver folder. Then, click "next".

f. If there is antivirus software or safety manager risk tip during installing, please allow them, or you could exit corresponding software before install. When installed, below window will appear:
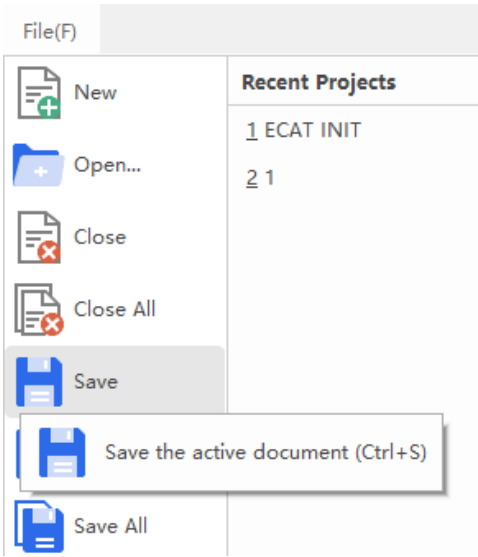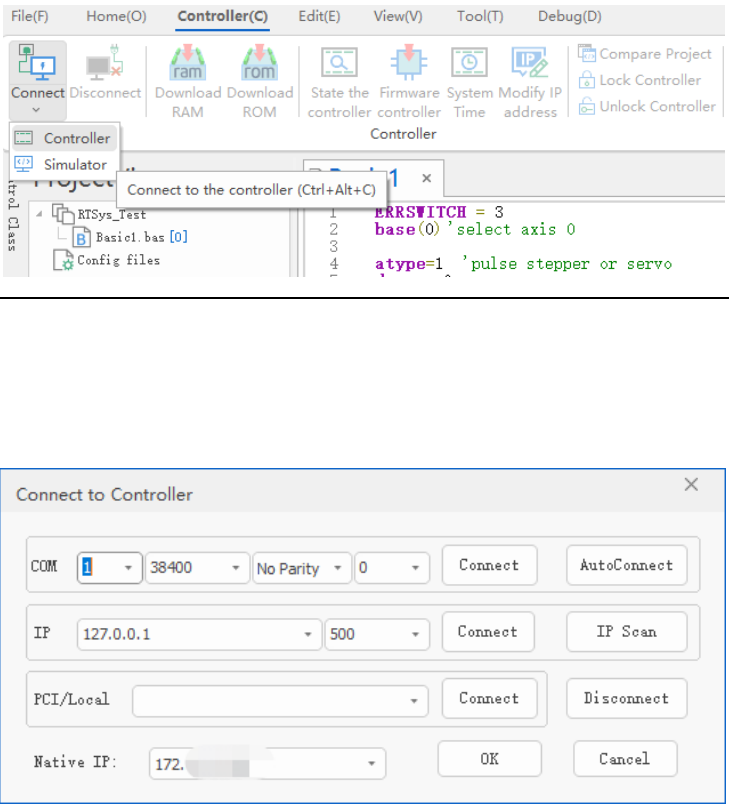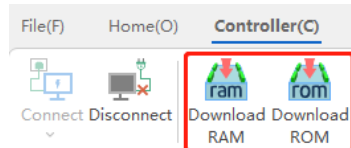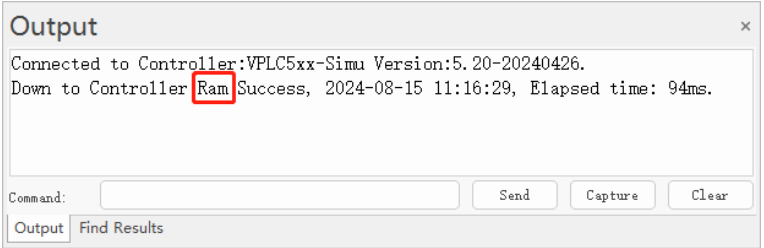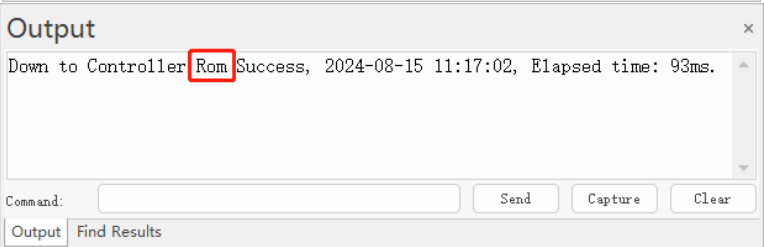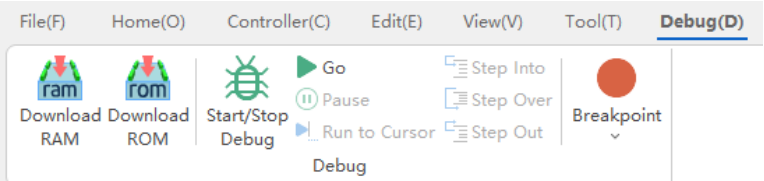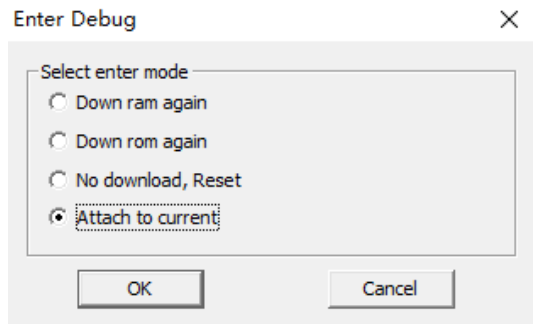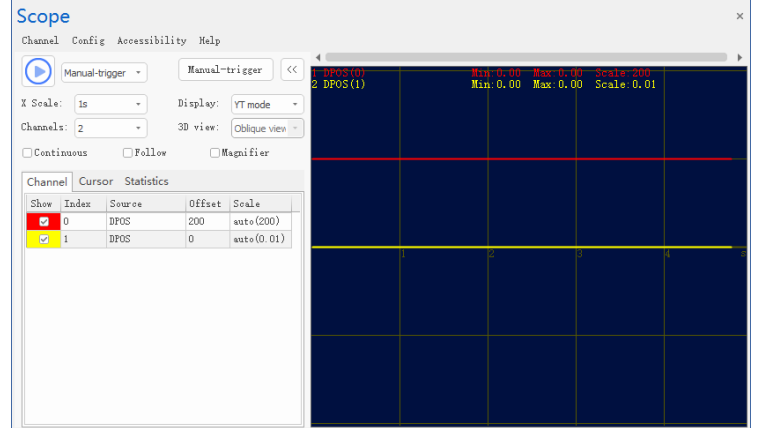
g. If there is "Zmotion Pci Controller" in the device manager, the installation is successful.

Chapter VI Programming

6.1. 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":

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.	 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. Enligsh RTSys will take effect when opened again. **Choose English** If you want to use other languages, you can add by yourself, please refer to user manual ▶ 0:00 / 0:34
2	New Project: "File" – "New Project", Save as window will pop up, then enter file name, save the project file with suffix "zpj.".	RTSys V1.01.02 File(F) New Open... Close Close All Save Save As... Save All Make Lib New Project — Create a new Project Open Project Close Project ✕ Exit(X) **Recent Projects** 1 BusInit.zpj 2 communication.zpj 3 EtherCAT INIT.zpj 4 BusInit.zpj save as 另存为 ← → ↑ 此电脑 › 桌面 › 组织 ▼ 新建文件夹 RTSys Manual Zmotion 文件名(N): RTSys_Test 保存类型(T): ZMC Project Files (*.zpj) 保存(S) 取消 ∧ 隐藏文件夹

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.	

> **Notes:**
> - 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

6.2. 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.

6.3. 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".
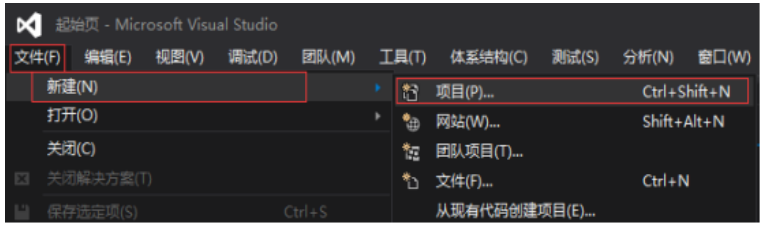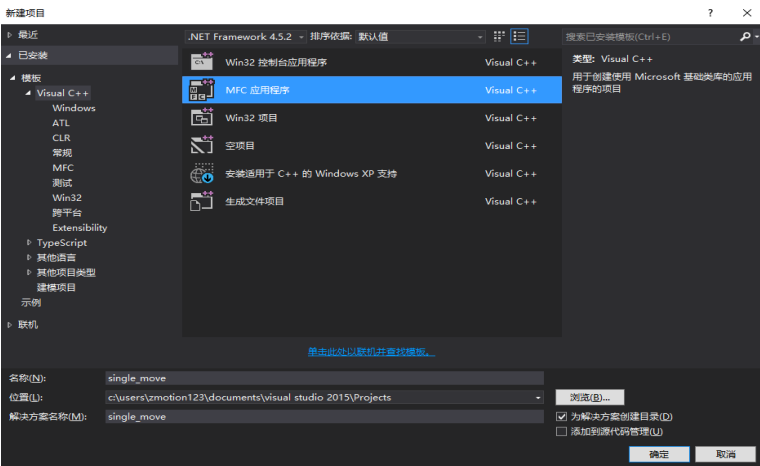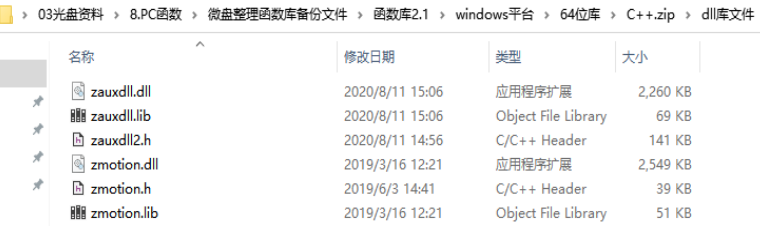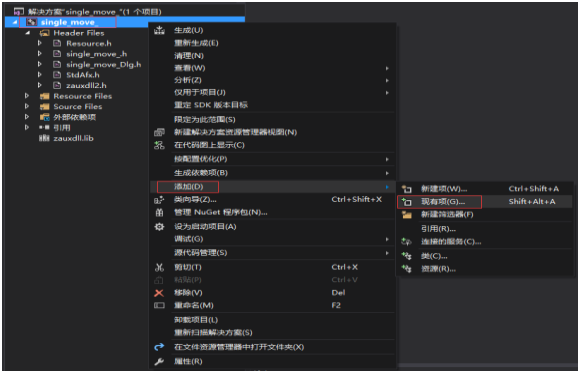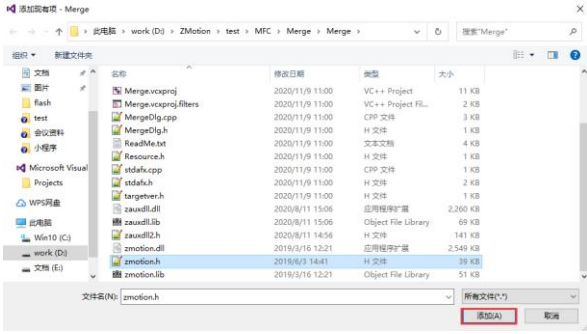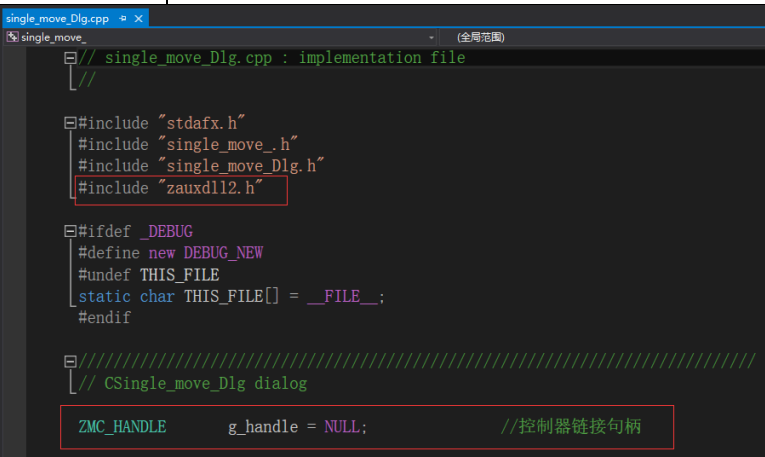

The program developed using the PC software cannot be downloaded to the controller, and it is connected to the controller through the dll dynamic library. The dll library needs to be added to the header file and declared during development.

● Get PC library file, example: https://www.zmotionglobal.com/download_list_17.html
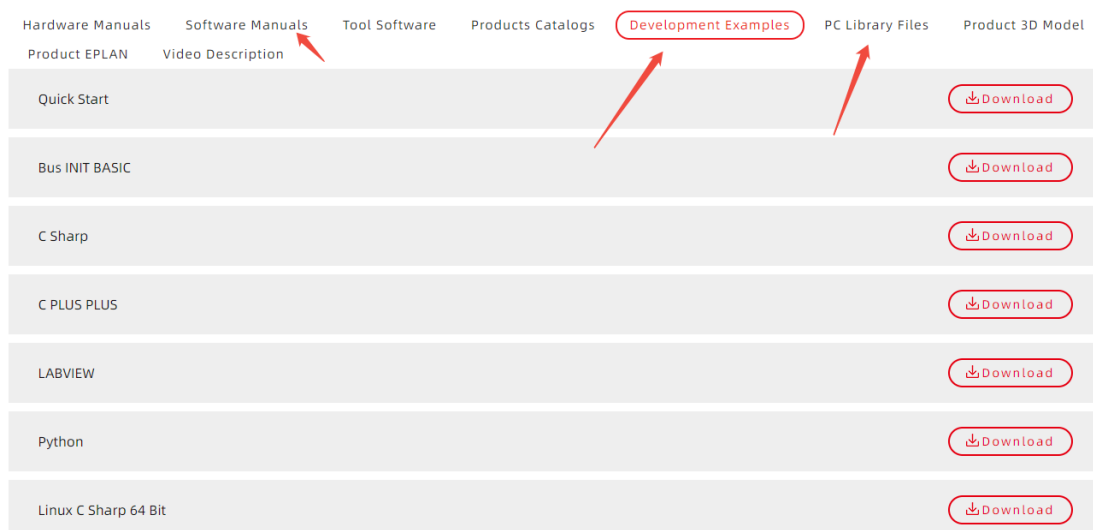
The c++ project development process in VS is as follows:

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: zauxdll.lib, zmotion.lib	1) Right-click the header file first, and then select: "Add" → "Existing Item".	
	Related header files: zauxdll2.h, zmotion.h	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 VII 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.

7.1. 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℃ - 55℃
	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

7.2. 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	1. Check whether the limit sensor is working normally,

is invalid.	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 RTSys error code, and check application program.
CAN expansion module cannot be connected.	1. Check the CAN wiring & 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)