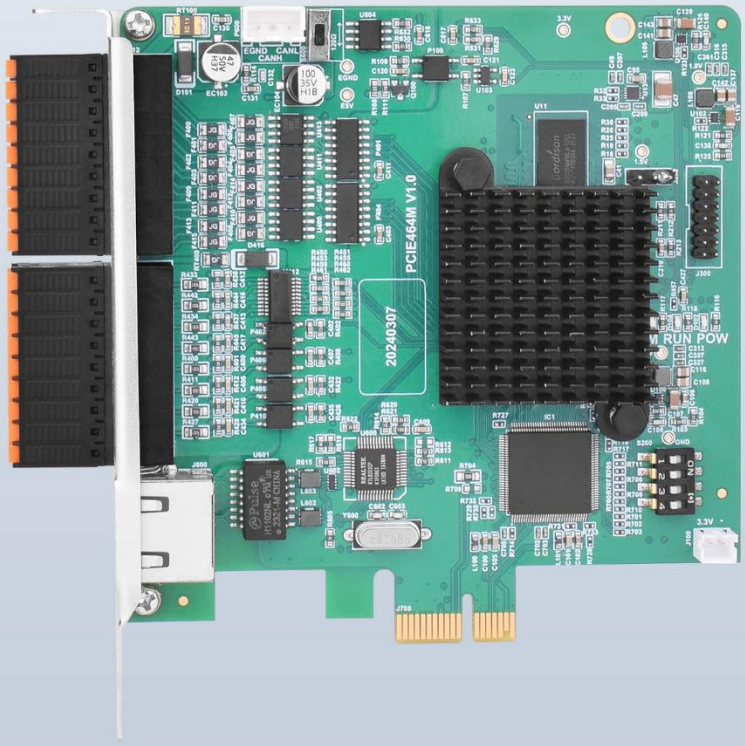
Zmotion®
正运动技术

做更好用的运动控制，智造美好生活
Better Motion Control, Smarter Life

# PCIE EtherCAT Motion Contro Card

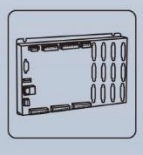
# PCIE464M

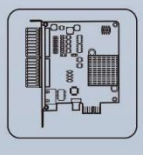
This manual is mainly for PCIE464M-AX16,PCIE464M-AX32, PCIE464M-AX64.

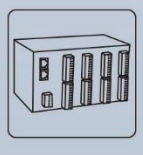




Vision Motion Controller


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.



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. | |

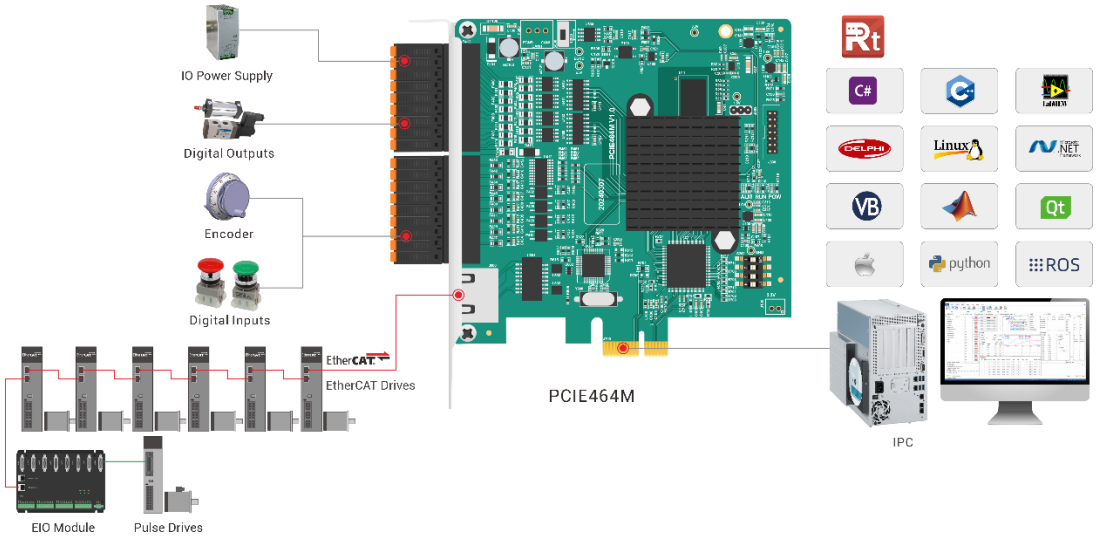
# Content

# Chapter I Production Information

## 1.1. Product Information

PCIE464M 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.

PCIE464M 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.

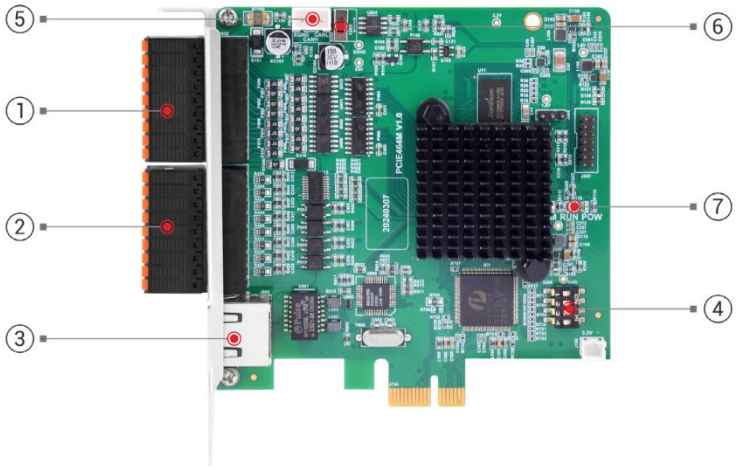



- Support encoder position measurement, which can be configured as handwheel input mode.
- Support HW hardware comparison output, high-speed latch, PWM, and other special functions.
- Max output pulse frequency of pulse axis is 500kHz.
- The max output current of OUT can reach 300mA, which can drive some solenoid valves.
- Support many motion control functions, like, point to point, electronic cam, linear interpolation, circular, continuous interpolation, manipulator command, etc.

- Support pulse closed loop, and pitch compensation.

PCIE464M 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 |
| | IO OUT | NPN Type output |
| ② | 5V Voltage Output | 5V voltage output, the current can reach 300mA. |
| | IO IN | NPN Type input |
| ③ | J600 | EtherCAT |
| ④ | S200 | DIP switch, used to set ID of PCIE464M |
| ⑤ | P600 | Connect to CAN expansion module for expanding resources |
| ⑥ | S600 | DIP switch, used to set CAN's 120ohm terminal resistor |
| ⑦ | Controller State Led | RUN: ON when the power is connected<br>RUN: ON when it runs normally |

| | | |
|---|---|---|
| | | ALM: ON when it runs wrongly |

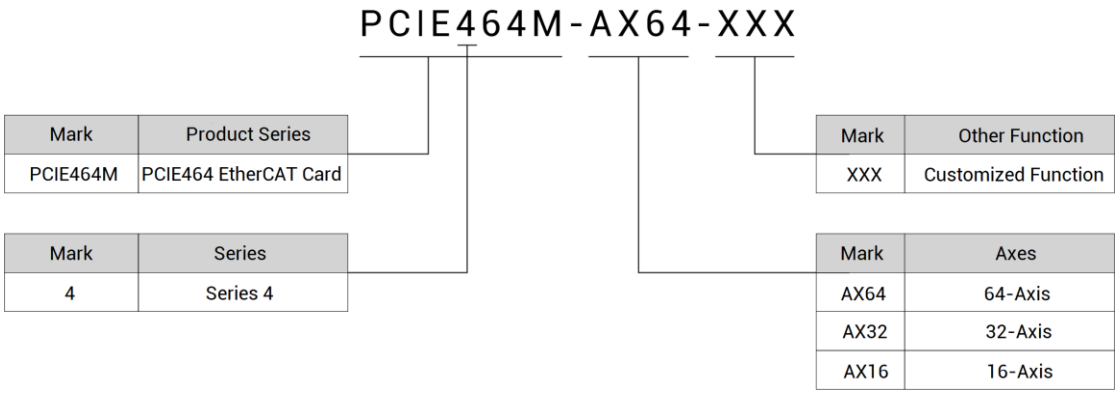
## 1.3. System Frame Specification Model Selection

| Model | PCIE464M-AX64 | PCIE464M-AX16 | PCIE464M-AX32 |
|---|---|---|---|
| Basic Axes | 64 Axes:<br>● 8 single-ended pulse axes<br>● 2 single-ended 24V high-speed encoders<br>● 2 single-ended 24V low-speed encoders | 16 Axes: others are same as PCIE464M-AX64 | 32 Axes: others are same as PCIE464M-AX64 |
| Total Axes | 64-Axis (basic axis + virtual axis) | | |
| | | | |
| EtherCAT Bus Axis | ✓ | | |
| IN Single-Ended Encoder Axis | 4 (2 single-ended 24V high-speed encoder, 2 single-ended 24V low-speed encoder) | | |
| OUT Single-Ended Pulse Axis | 8 (pulse + directional) | | |
| | | | |
| Digital IN | 16 (general), IN0-7 are high-speed inputs | | |
| Digital OUT | 16 (general), OUT0-15 are high-speed outputs | | |
| Expanded Digital IN | ≤4096 | | |
| Expanded Digital OUT | ≤4096 | | |
| | | | |
| EtherCAT | 1 | | |
| | | | |
| High-Speed Latch | 4, IN0-3 | | |

| | |
|---|---|
| Hardware Comparison Output HW | 12, OUT0-11 |
| General PWM | 4, OUT0-3 |
| | |
| Point to Point | ✓ |
| Electronic Cam | |
| Linear Interpolation | |
| Circular Interpolation | |
| Continuous Interpolation | |
| Manipulator Command | |
| | |
| Program Space | 1920kbyte |
| Power Down Storage | ✓ |
| Dimension (mm) | 105*120 |

# 1.4. Nameplate & Models

➢ **Nameplate Information**



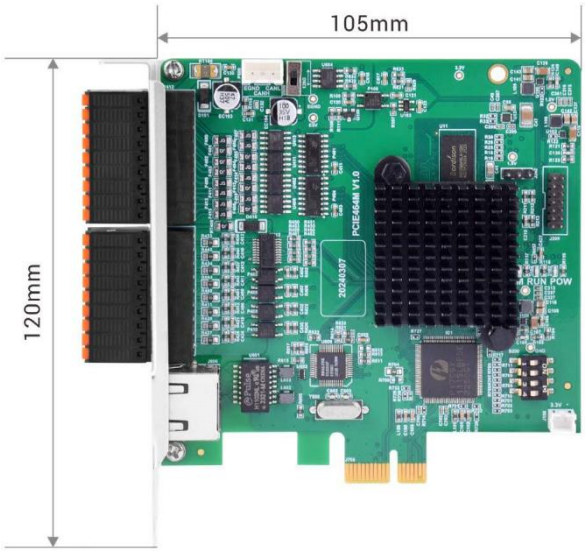
➢ **Order Information**

| No. | Model | Specification Description |
|---|---|---|
| 1 | PCIE464M-AX16 | 16 EtherCAT axes, it supports linear interpolation, any circular interpolation, helical interpolation, hardware comparison output. |
| 2 | PCIE464M-AX32 | 32 EtherCAT axes, it supports linear interpolation, any circular interpolation, helical interpolation, hardware comparison output. |
| 3 | PCIE464M-AX64 | 64 EtherCAT axes, it supports linear interpolation, any circular interpolation, helical interpolation, hardware comparison output. |

## 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.

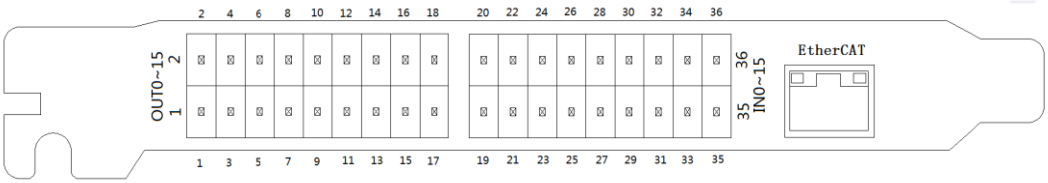
- PCIE doesn't support plug in or pull out when in hot, so please close the computer before inserting and pulling the card.
- Please handle it carefully. Before touching the control card circuit or inserting/pulling the control card, please wear anti-static gloves or touch an effectively grounded metal object to discharge the human body to prevent possible static electricity from damaging the motion control card.

# Chapter II Hardware Interface

## 2.1. IO Signal Interface

IO signal interface is the main interface for PCIE464M 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 | Notes |
|---|---|---|---|
| 1 | E24V | IO power 24V input | IO power supply port – supply the power |
| 2 | EGND | IO power ground / IO public end | |
| 3 | OUT0 | OUT0, PWM0, HW0, Single-Ended DIR 7 | 1. All outputs are high-speed outputs, but they are general outputs by default.<br>2. OUT0-3 can be configured as PWM output and hardware comparison output / precision output at the same time through RTSys.<br>3. OUT0-15 can be configured as 8 pulse outputs. |
| 4 | OUT1 | OUT1, PWM1, HW1, Single-Ended PUL 7 | |
| 5 | OUT2 | OUT2, PWM2, HW2, Single-Ended DIR 6 | |
| 6 | OUT3 | OUT3, PWM3, HW3, Single-Ended PUL 6 | |
| 7 | OUT4 | OUT4, HW4, Single-Ended DIR 5 | |
| 8 | OUT5 | OUT5, HW5, Single-Ended PUL 5 | |
| 9 | OUT6 | OUT6, HW6, Single-Ended DIR 4 | |
| 10 | OUT7 | OUT7, HW7, Single-Ended PUL 4 | |
| 11 | OUT8 | OUT8, HW8, Single-Ended DIR 3 | |
| 12 | OUT9 | OUT9, HW9, Single-Ended PUL 3 | |
| 13 | OUT10 | OUT10, HW10, Single-Ended DIR 2 | |
| 14 | OUT11 | OUT11, HW11, Single-Ended PUL 2 | |
| 15 | OUT12 | OUT12, Single-Ended DIR1 | |

| | | | |
|---|---|---|---|
| 16 | OUT13 | OUT13, Single-Ended PUL1 | |
| 17 | OUT14 | OUT14, Single-Ended DIR0 | |
| 18 | OUT15 | OUT15, single-Ended PUL0 | |
| 19 | E5V | E5V power output | Supply the power for external devices |
| 20 | EGND | E5V power ground / IO public end | |
| 21 | IN0 | IN0, Latch R0, Encoder EA0 | 1. IN0-7 are high-speed inputs, but they are general inputs by default.<br>2. IN0-3 can be configured as latch input by RTSys.<br>3. IN0-2 and IN4-6 can be configured as 2 encoder inputs |
| 22 | IN1 | IN1, Latch R1, Encoder EB0 | |
| 23 | IN2 | IN2, Latch R2, Encoder EZ0 | |
| 24 | IN3 | IN3, Latch R3 | |
| 25 | IN4 | IN4, Encoder EA1 | |
| 26 | IN5 | IN5, Encoder EB1 | |
| 27 | IN6 | IN6, Encoder EZ1 | |
| 28 | IN7 | IN7 | |
| 29 | IN8 | IN8, Encoder EA2 | 1. IN8-15 are general inputs, they can connect to button, switch.<br>2. IN8-10, IN12-14 can be set as 2 low-speed encoder inputs, that is, they only can connect to low-speed encoder or low-speed handwheel. |
| 30 | IN9 | IN9, Encoder EB2 | |
| 31 | IN10 | IN10, Encoder EZ2 | |
| 32 | IN11 | IN11 | |
| 33 | IN12 | IN12, Encoder EA3 | |
| 34 | IN13 | IN13, Encoder EB3 | |
| 35 | IN14 | IN14, Encoder EZ3 | |
| 36 | IN15 | IN15 | |

**Description:**

- It only can use 24V encoder, and the max pulse input frequency of encoder 1 and encoder 2 is 100kHz, high-speed encoders can be connected, others are normal inputs (the pulse max frequency is 10kHz, only low-speed encoders can be connected, like, encoder).
- The number after pulse output and encoder input is default axis No., and use "ATYPE" command to determine whether the IO is general IO or not (if the target axis' ATYPE is 0, it is general IO, if ATYPE=1, it is pulse output, if ATYPE=3, it is encoder input, if ATYPE=4, it is pulse output + encoder input).

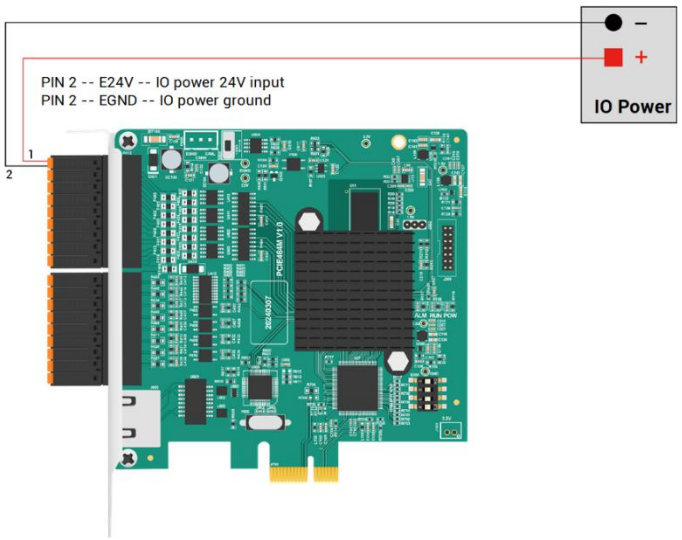
## 2.2. IO Power Input

Power of I/O signal terminal uses DC24V power supply, which connects to PIN1 (E24V), and PIN2 (EGND) of IO.

### → 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 |

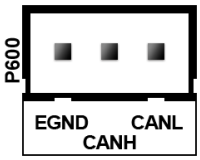
### → Wiring:




## 2.3. CAN Communication Interface

CAN communication interface is connected by CANH and CANL of P600. And please note EGND must be connected to CAN ground of CAN module, that is, achieve grounded to

prevent CAN chip from burning out.

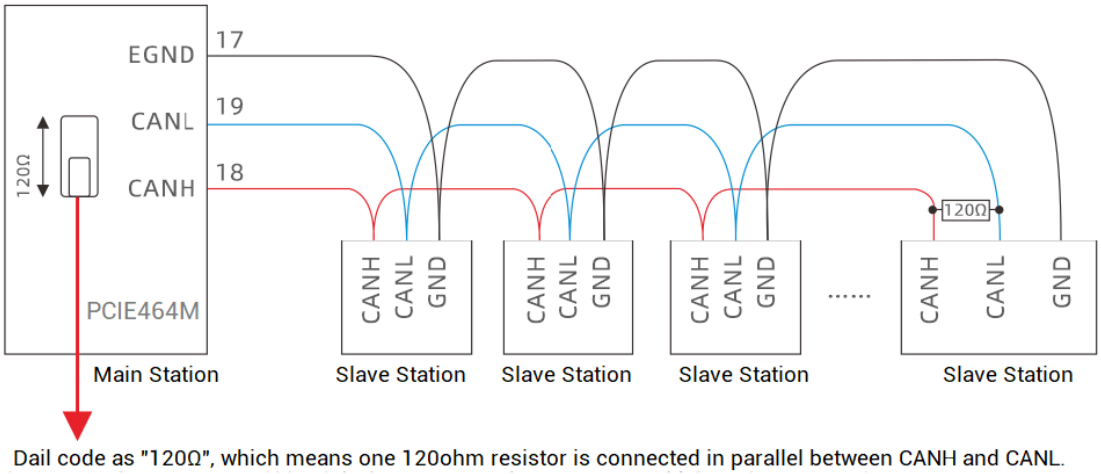



Control card's 120Ω terminal resistor on CAN bus is controlled by DIP switch (near to S600 signal), switch the "120Ω" as ON.

## → 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, and there is one 120Ω terminal resistor on the PCIE464M board (please turn to "120Ω").
- 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" interface.

(2) Configure controller CAN main station:

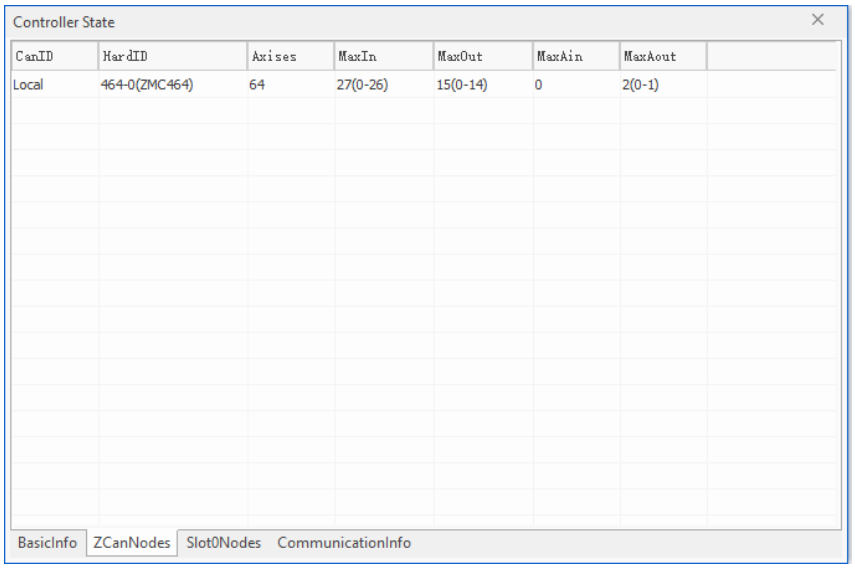
a) Use "CANIO_ADDRESS" command to set main station "address" and "velocity".

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".




(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 "ZBasic Programming Manual".

## 2.4. IN Digital Input Interface

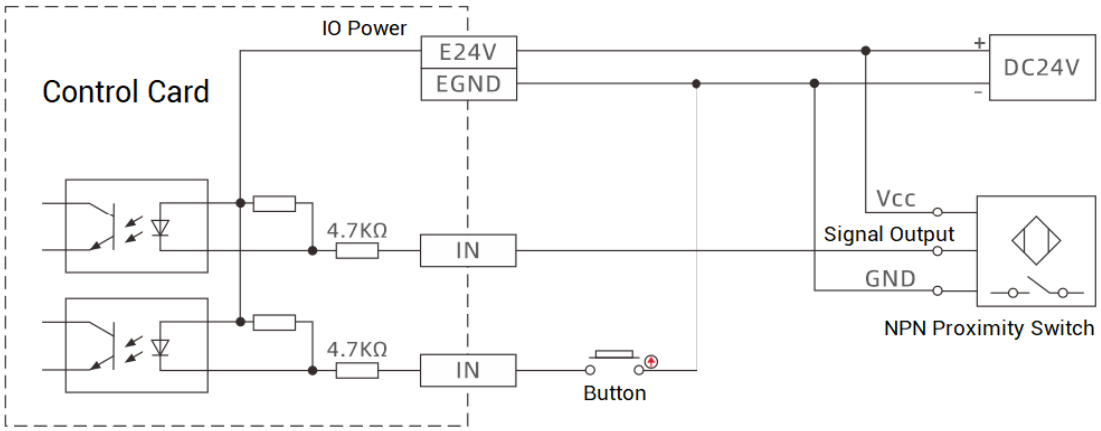
### → Specification:

| Item | High-speed input (IN0-IN7) | Low-speed input (IN8-IN15) |
|---|---|---|
| Input method | NPN type | |
| Input frequency | ≤100KHz | ≤5KHz |
| Input voltage level | DC24V (-15%~+20%) | DC24V (-15%~+20%) |

| | | |
|---|---|---|
| Input current (typical value) | 6.8mA | 4.8mA |
| Voltage to open | <15V | <14.5V |
| Min current | 2.3mA | 1.8mA |
| Impedance | 3.3KΩ | 4.7KΩ |
| Isolation | Optical isolation | Optical isolation |
| Respond time | <10ms | <10ms |
| Description:<br>➢ There are high-speed inputs and low-speed inputs.<br>➢ Above parameters are typical values when the IO power voltage (E24V) is 24V.<br>➢ For high-speed IN, <100kHz is recommended. For higher, please contact us to adjust parameters or custom the hardware. | | |

## → 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,

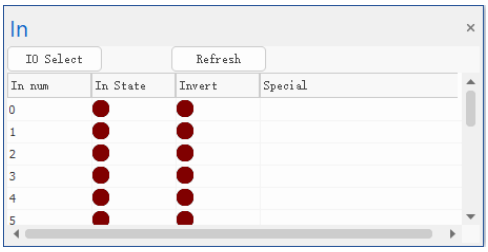
otherwise, it needs to connect to negative poles of two powers.

- 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" interface.

(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 "ZBasic Programming Manual".

# 2.5. OUT Digital Output Interface

## → Specification:

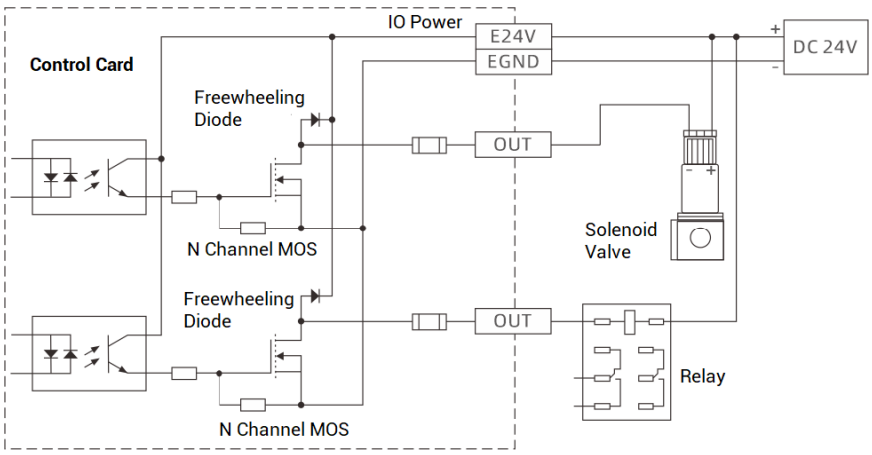
| Item | High-speed output (OUT0-15) |
|---|---|
| Output method | Transistor NPN type, OD output |
| Output frequency | ≤500KHz |
| Voltage level | Load power: ≤36V |
| Max output current | +300mA |
| Max leakage current when OFF | 25uA |
| Respond time for conduct | 1us (resistor load typical value) |
| Respond time for OFF | 3us |
| Isolation | Capacitive Isolation |
| Overcurrent protection | It supports, action current is 600mA |
| Respond time | <0.5ms |

Description:

- "time" in above form are typical values based on resist load. It may be different when the load circuit changes.
- Due to the leakage output, the output shutdown will be obviously affected by the external load circuit. The output frequency should not be set too high in the application. The high-speed output is recommended to be below 500kHz. For higher, please contact us to adjust the parameters or customize the hardware.

## → Wiring:

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



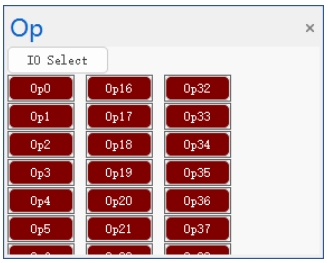
## NOTES

- 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" interface.

(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 "2.6 single-ended axis interface".

(6) For above command details and other commands, please refer to "ZBasic

Programming Manual".

## 2.6. Single-Ended Axis Interface

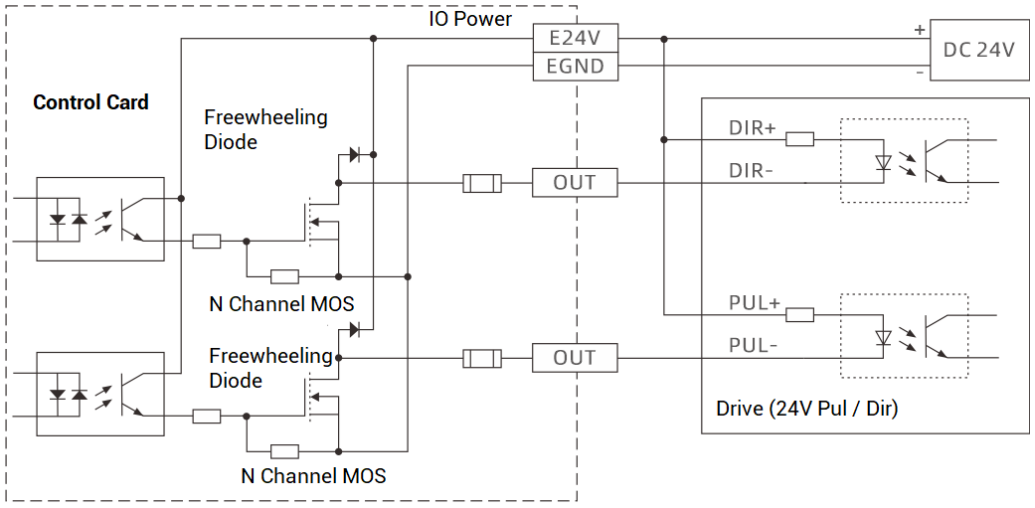
Single-ended pulse output interface and single-ended encoder input interface are distributed in IO signal interface, for specific information, please go to "IO Singal Interface".

### → Specification:

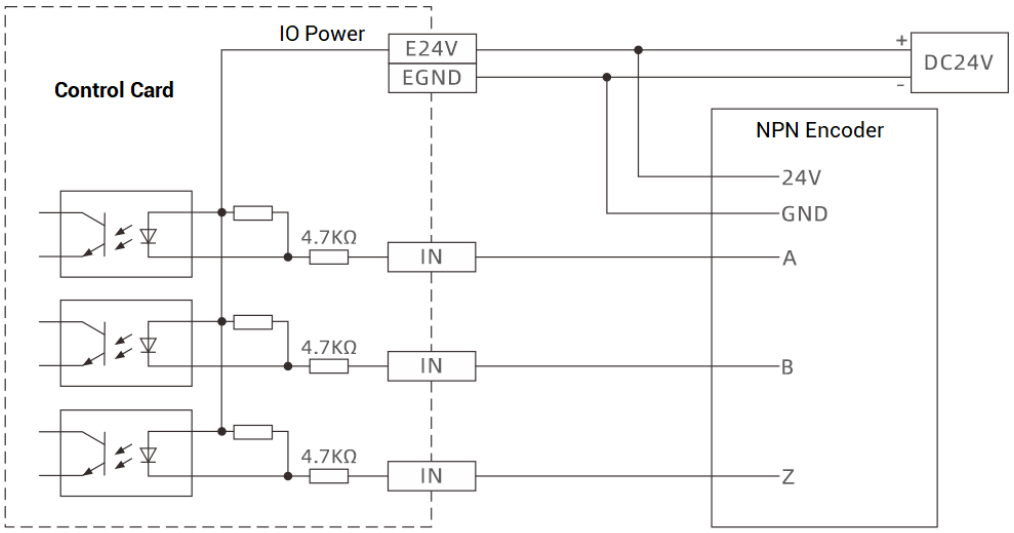
| Item | Description |
|---|---|
| Pulse / Directional (PUL/DIR) Signal Type | Single-Ended output signals |
| Pulse / Directional (PUL/DIR) Signal Voltage Range | 0-24V |
| Pulse / Directional (PUL/DIR) Signal Max Frequency | <500kHz |
| Encoder (A/B/Z) Signal Type | Single-Ended input signals |
| Encoder (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 OUT0 and OUT1 as the example):**



■ **Single-Ended Encoder Wiring Reference (take IN0, IN1, and IN2 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.

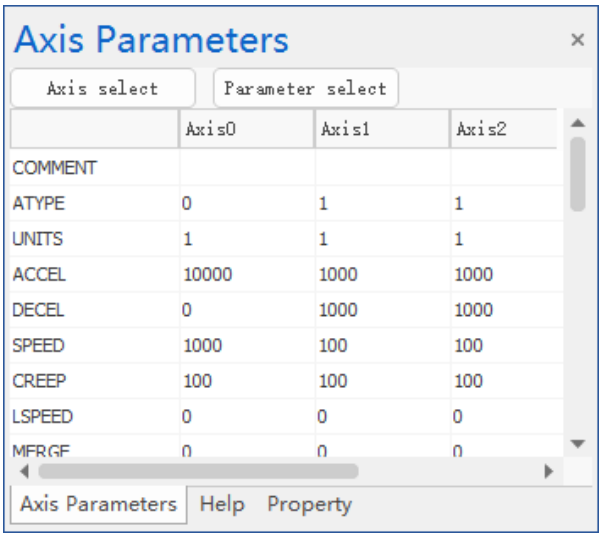
## → Usage:

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

(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".

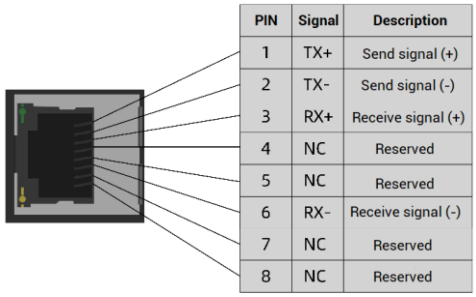
## 2.7. EtherCAT Interface / Ethernet

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.

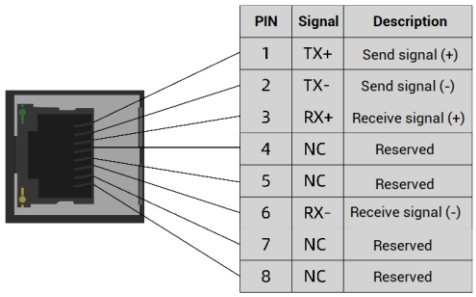
### → Specification:

**--As EtherCAT Bus Interface--**

| PIN | Item | Description |
|---|---|---|
| | Communication | EtherCAT |

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

**--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 |

## → 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 sending data |
| Yellow | Build the 10M communication | |

**--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 sending data |
| Yellow | Build the 10M communication | |

**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" interface.

(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.

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

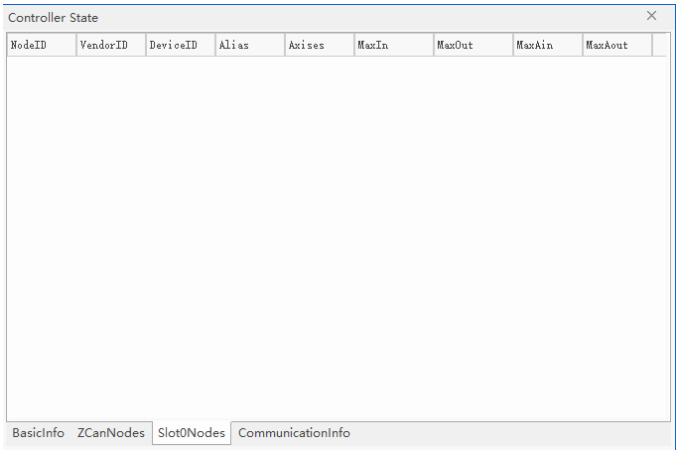
a) Use SLOT_SCAN command to scan the slot No. on the bus.

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 2.4 & 2.5 – 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 “ZBasic Programming Manual”.

**--As Ethernet Interface--**

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

(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 "ZBasic Programming Manual".

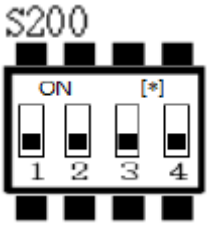
## 2.8. DIP Switch

This control card has 2 DIP switches (dial code). Please see below functions and usage.

### → S600

S600 DIP switch is the 120ohm terminal resistor on the control card CAN bus, dial the "120Ω" as ON.

### → S200




DIP switch S200 is used to set ID of PCI464M. 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 |

# Chapter III Resources Expansion

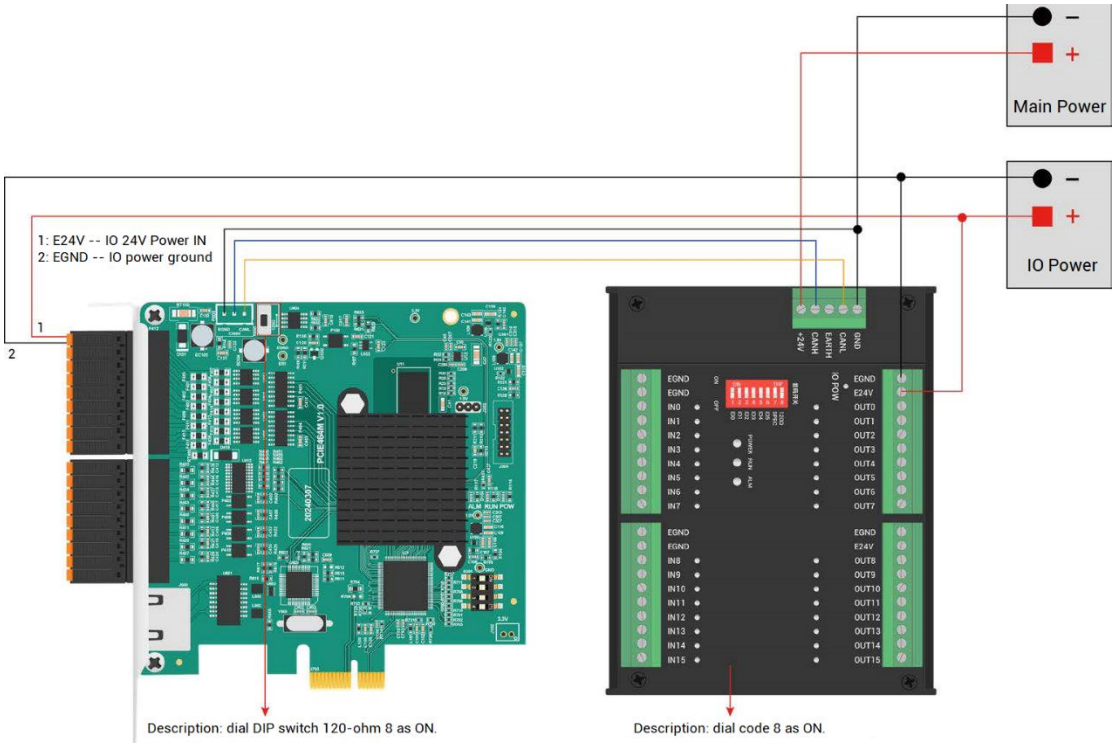
When there are no enough local resources in this card, it can expand more through CAN bus or EtherCAT bus.

## 3.1. CAN 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 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.

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

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

## Notes

- How to configure the controller as the master station, please refer to "2.1 power input / CAN communication configuration" – usage.
- Communication speed rates of each node on the bus must be consistent, and the mapping IO No. and axis No. can't conflict.

### ➢ 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

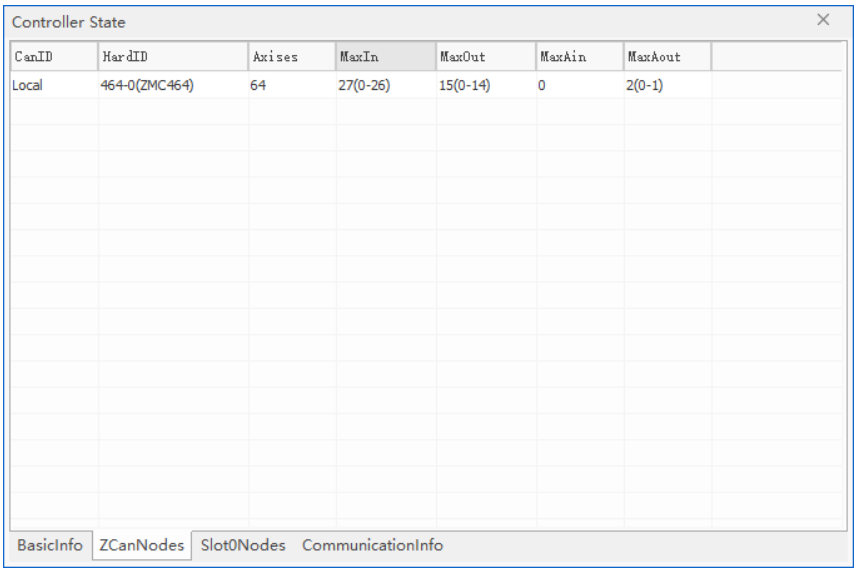
AXIS_ADDRESS(7)=(32*1)+2

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

For more command details and other commands, please refer to “ZBasic 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.




## 3.2. EtherCAT Bus Expansion

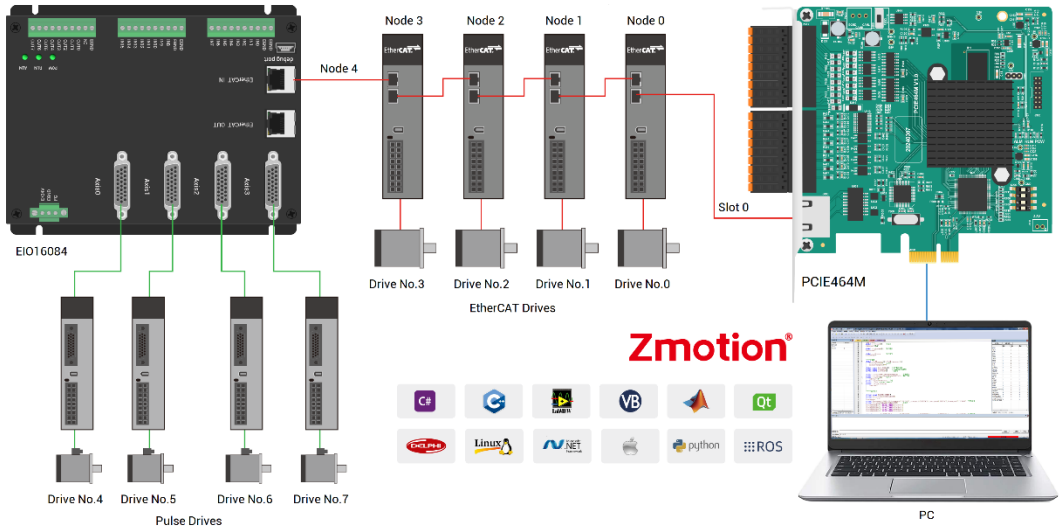
There are EIO and ZMIO310-ECAT EtherCAT bus expansion modules to expand digital IO / analog IO / axis.

### → 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**

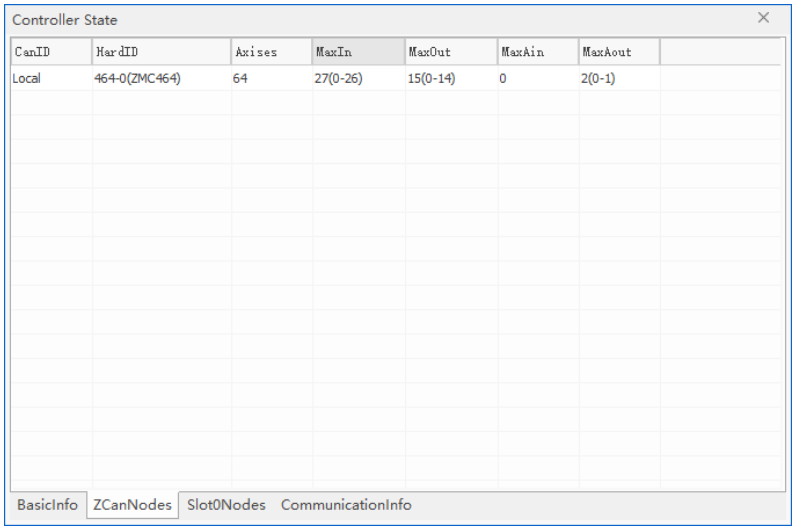
AXIS_ADDRESS(6)=(0<<16)+0+1 'the first ECAT driver, drive No. is 0, bind it with axis 6

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

For more command 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.




There are many EtherCAT bus commands, please refer to “Basic Programming Manual”.

# Chapter V Installation

## 4.1. PCIE464M 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.

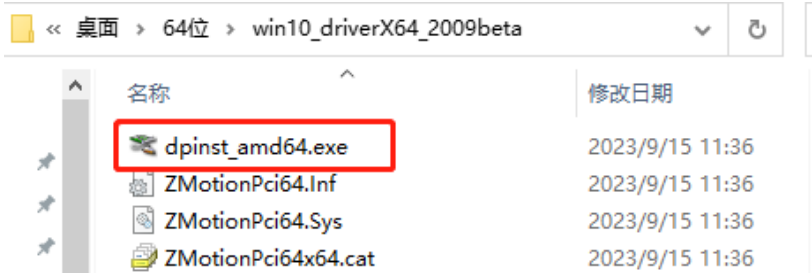
3. Insert the motion control card into the slot securely, and tighten the fixing screws on the baffle strip.

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.

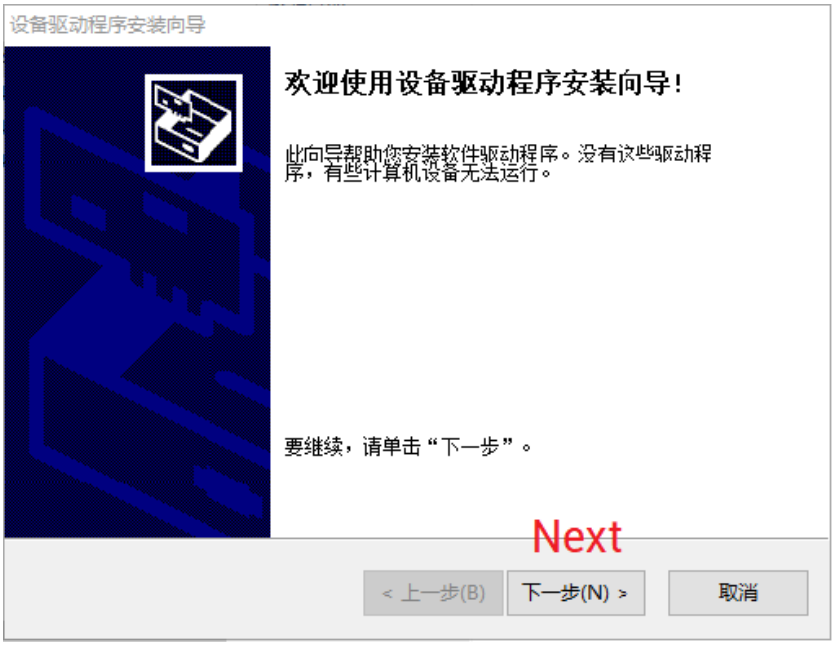
## 4.2. Drive Program Installation

**Method 1: install automatically**

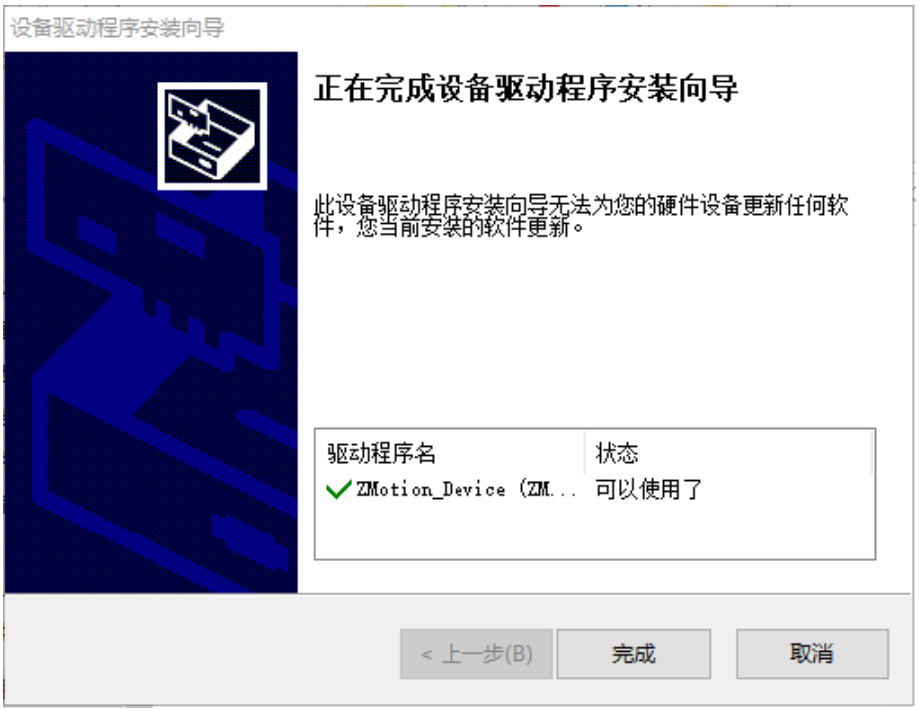
a. use the built-in installation wizard software "dpinst_amd64.exe" in the driver directory to automatically install, and the specific operation is according to the software guide. For PCIE signed drive installation package, please contact us.



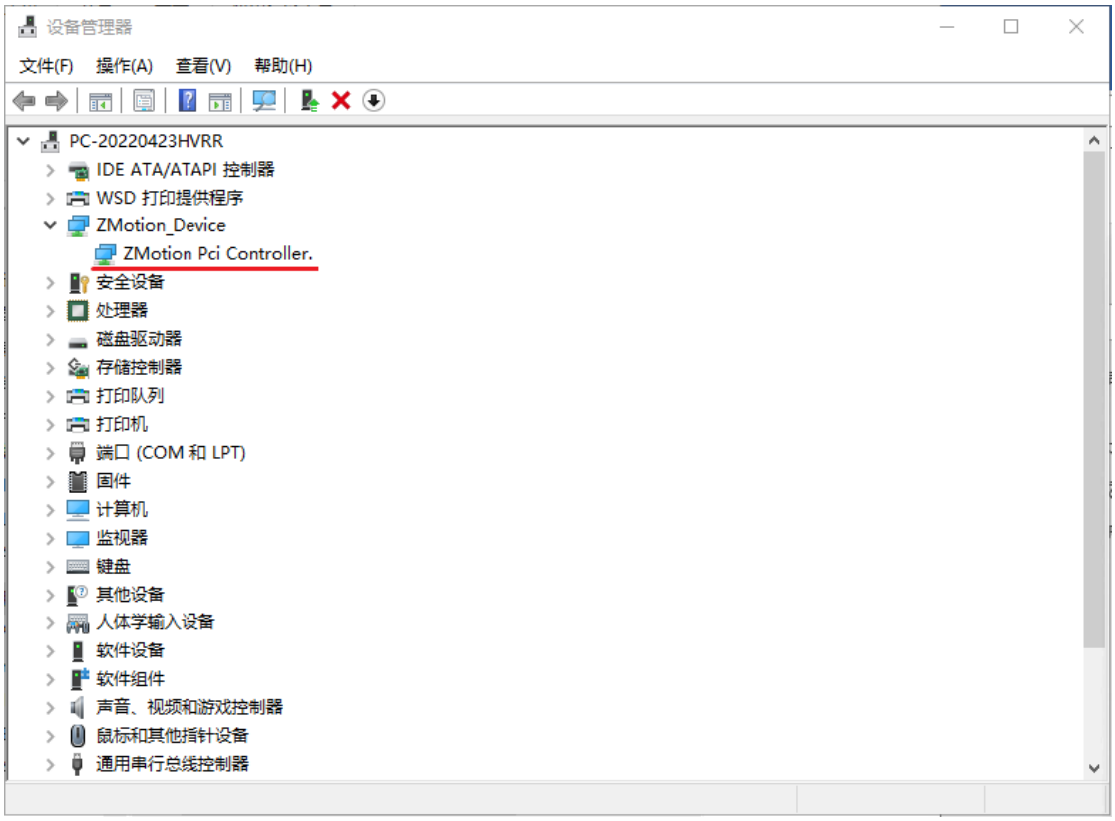

b. when hardware was installed, open the PC, at this time, Windows will detect the motion control card automatically, then please open "find new hardware wizard", and click "next":



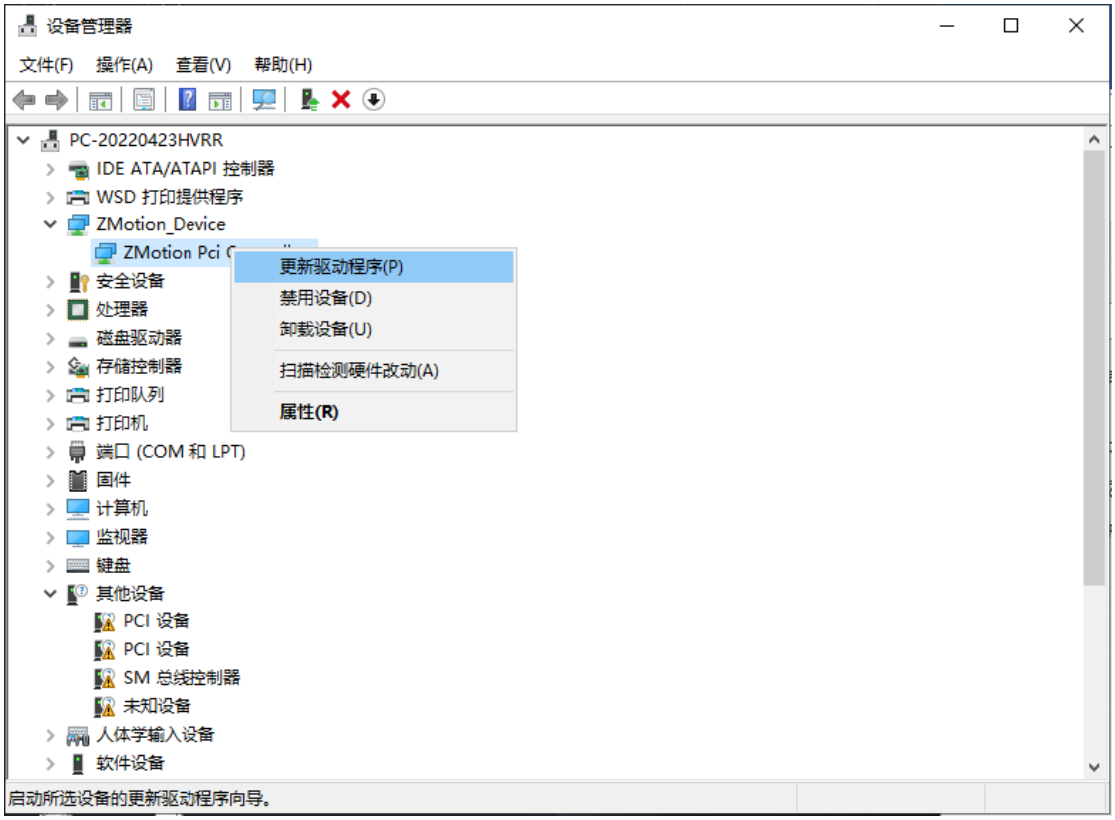

c. after clicking “next”, it is installing. If there is antivirus software or safety manager risk tip, please allow them, or you could exit corresponding software before install. When installed, below window will appear:




d. open device manager, it can be seen it is installed successfully.

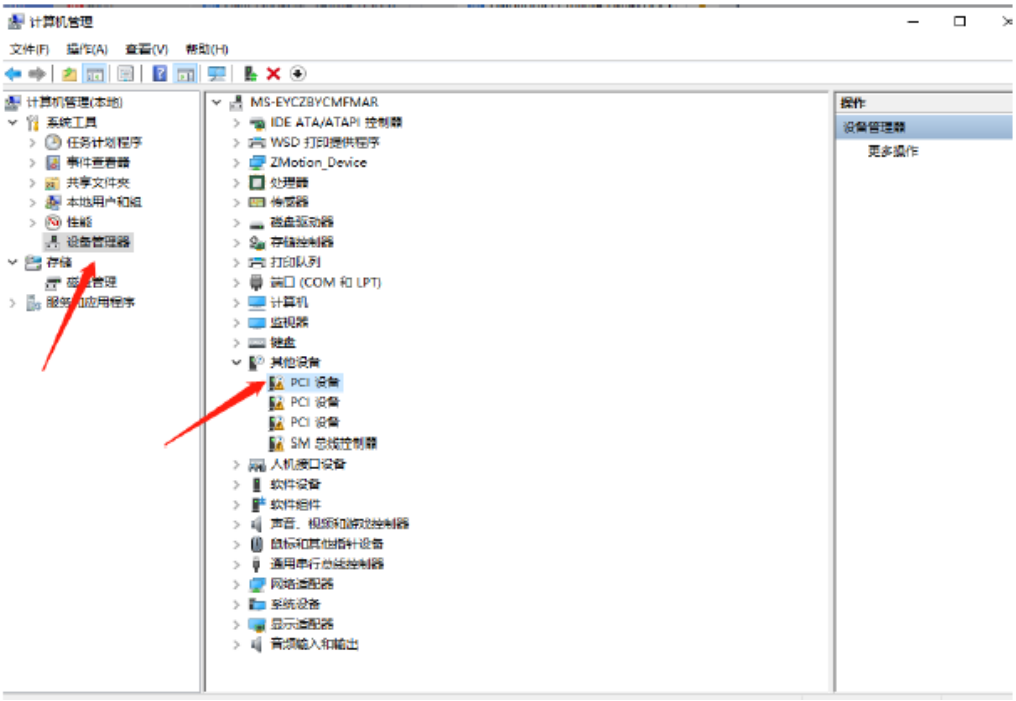



**Note:** if there is no drive program detected by Windows automatically after opening PC, or the drive program is removed, you could manually update drive program in device manager, then do above step by step.

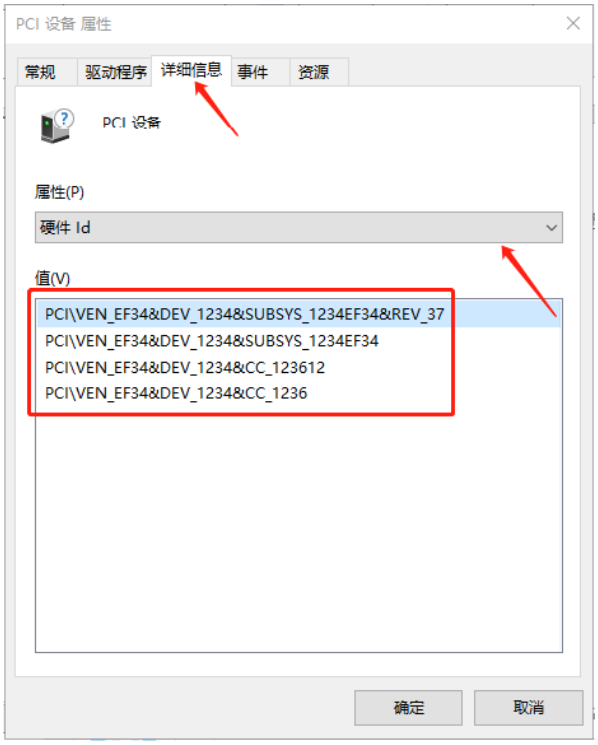


**Method 2: install manually**

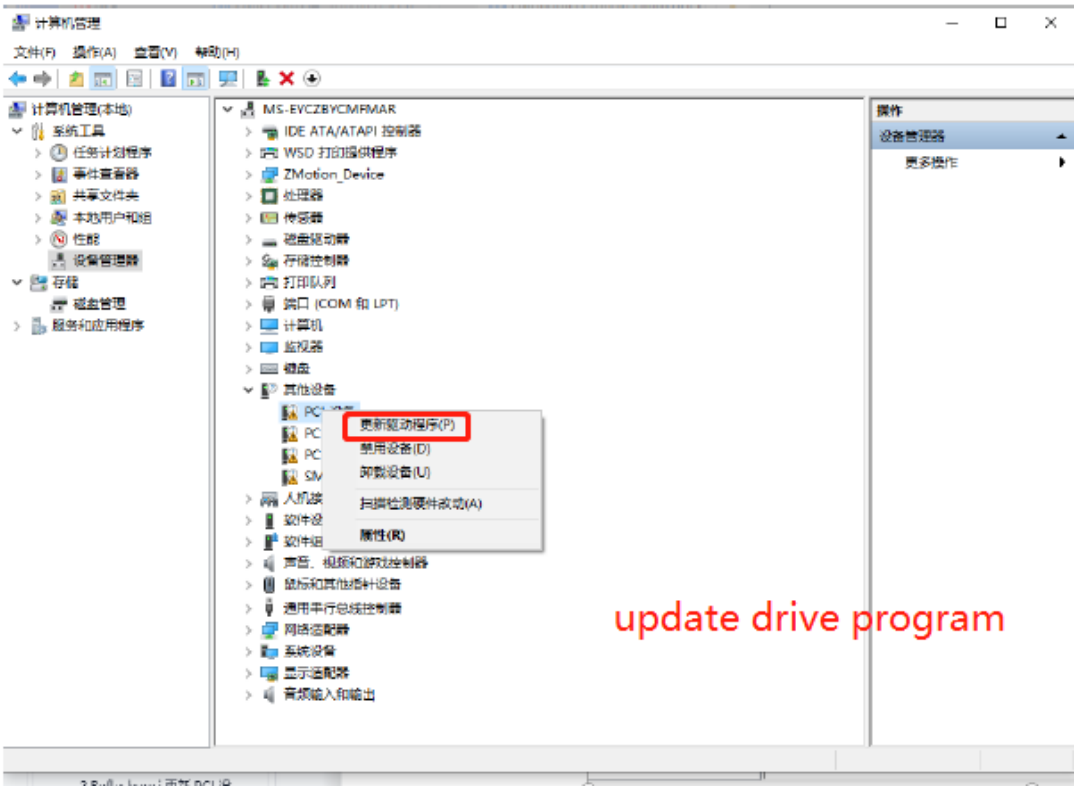
a. open the Device Manager menu and select the PCI device in Other Devices.



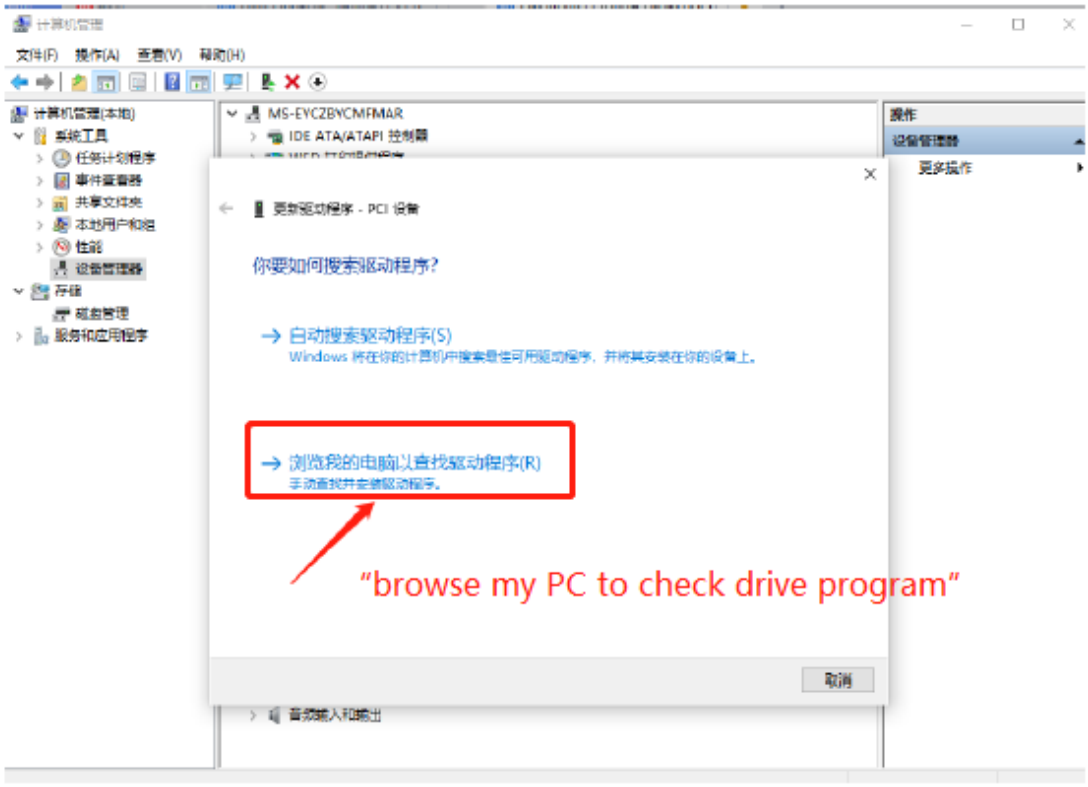

b. if there are multiple PCI devices, right-click "Properties" to view detailed information, select "Hardware ID" for properties, and confirm that it is a PCI device starting with PCI\VEN_EF34&DEV_1234&.



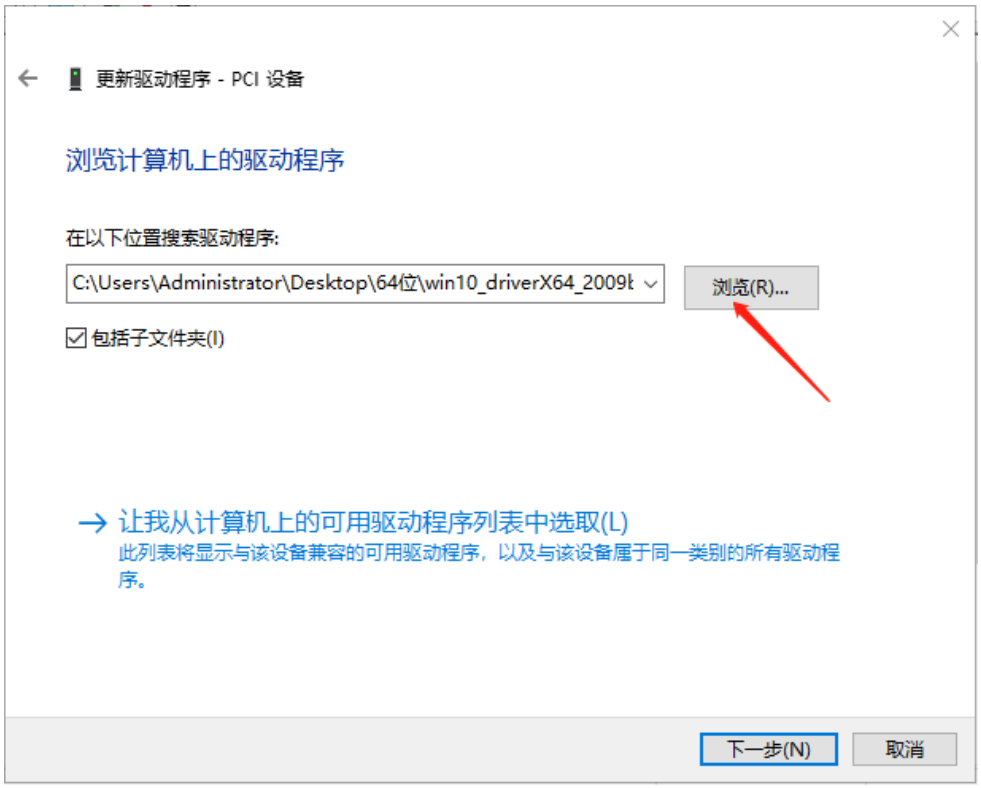
c. find PCI Device, right-click to select “update drive program”.



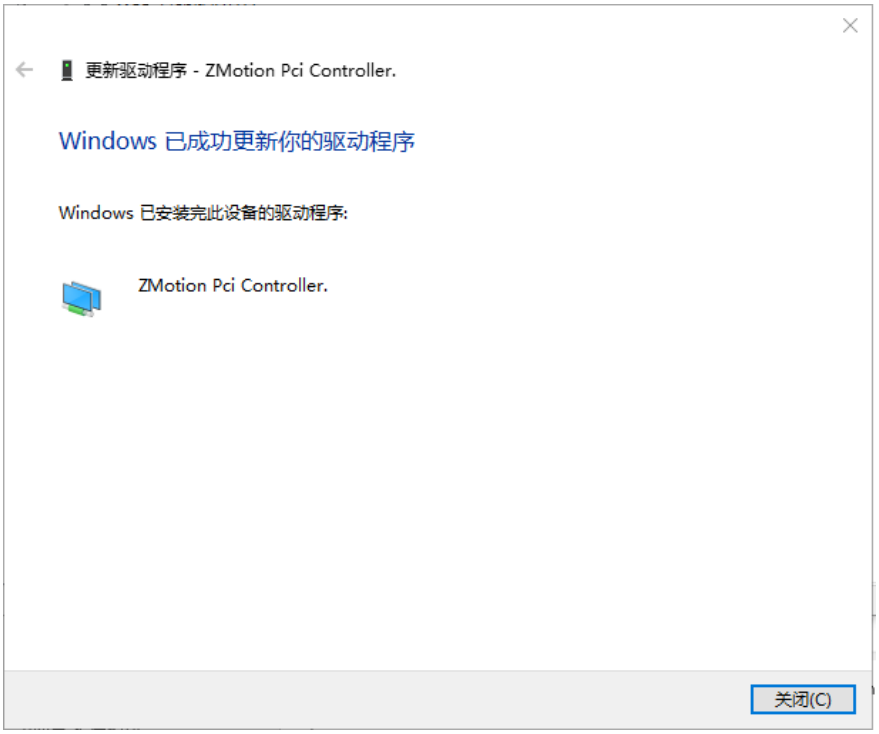

d. select “browse my PC to check drive program”.



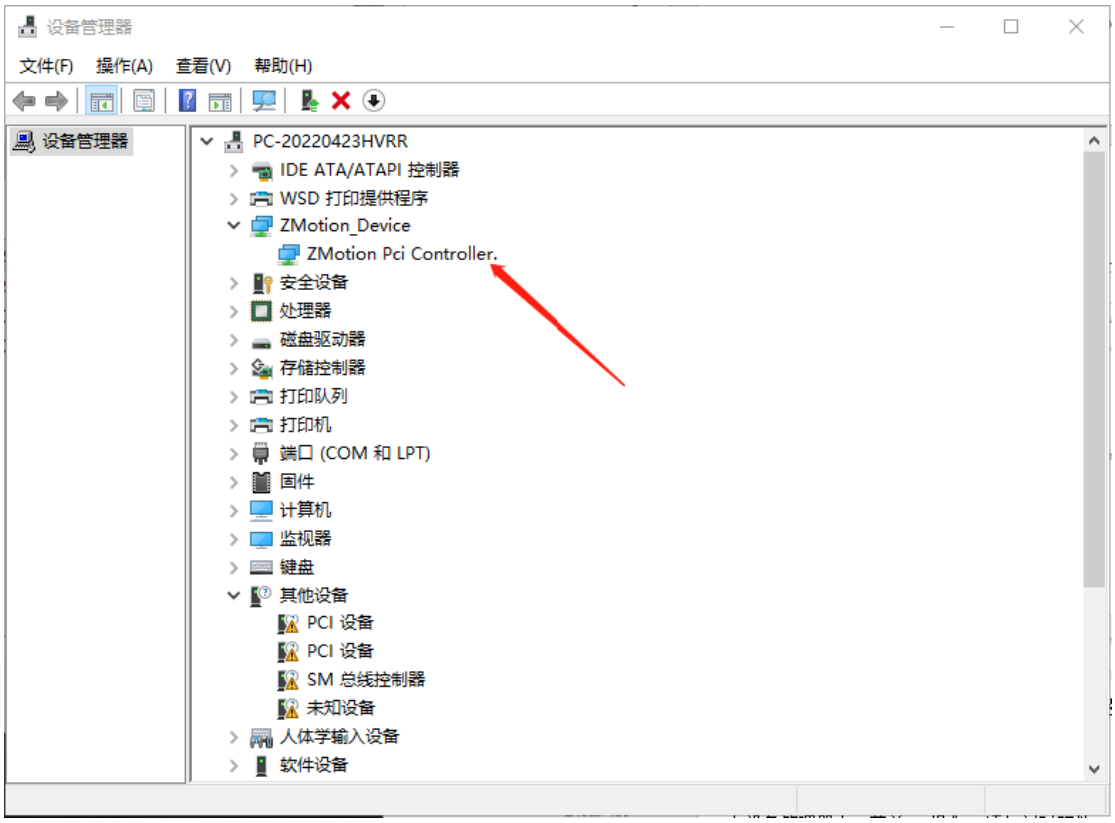
e. click “browse”, and select driver folder. Then, click “next”.




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 V Programming

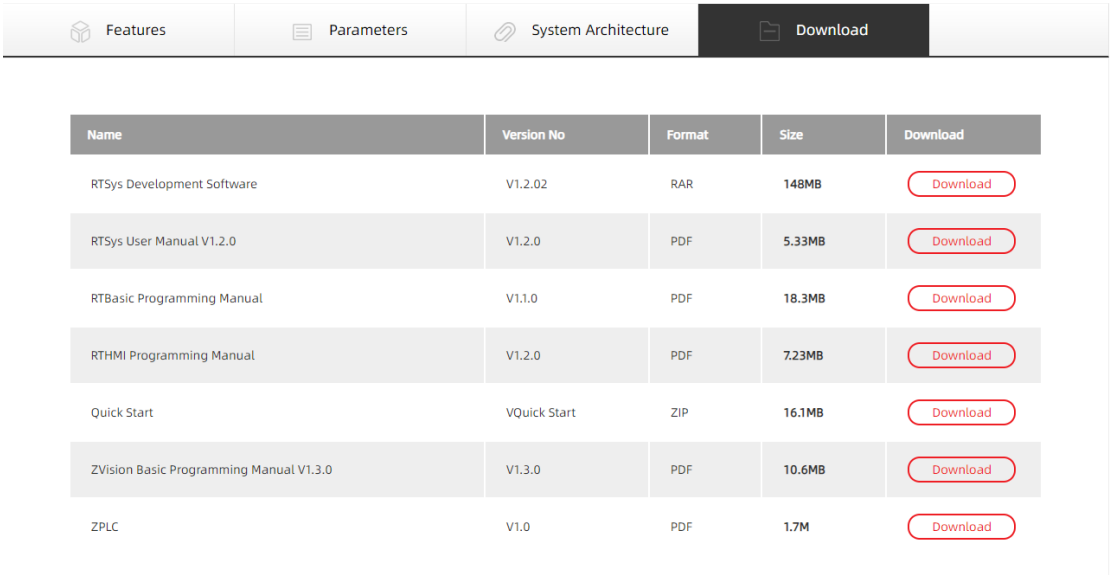
## 5.1. Program in RTSys Software

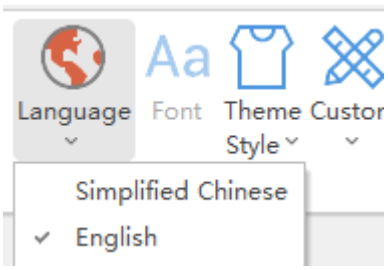
RTSys is a PC-side program development, debugging and diagnostic software for the Zmotion motion controllers. Through it, users can easily edit and configure the controller program, quickly develop applications, diagnose system operating parameters in real time, and debug the running program in real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

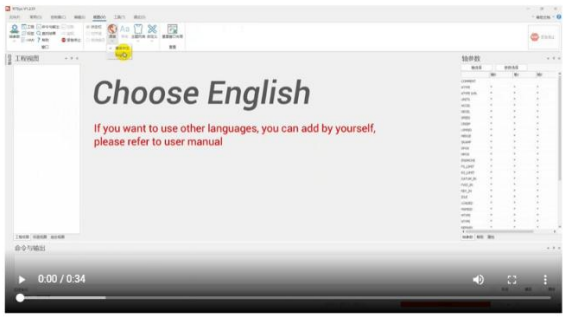
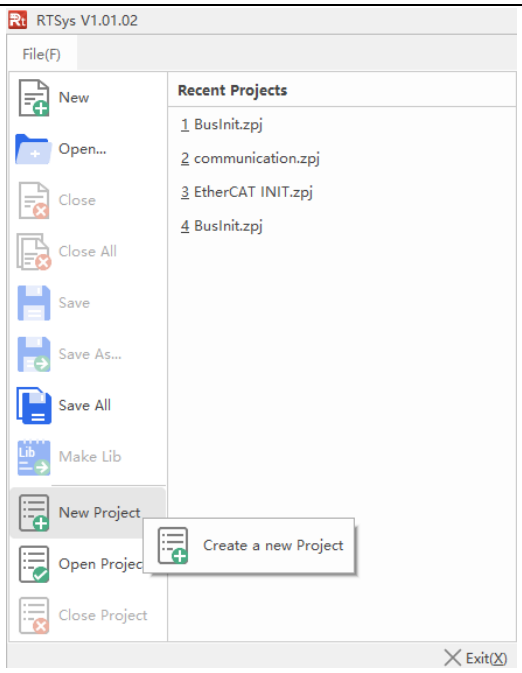
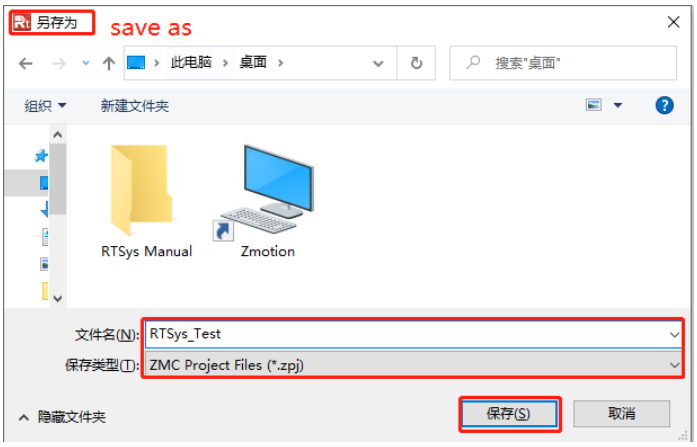
In RTSys, there are 4 programming languages for motion control development, Basic, PLC, HMI and C language, they can run multi-tasks among them, especially for Basic, multi-task running can be achieved separately, hybrid programming is also OK with PLC, HMI and C language.

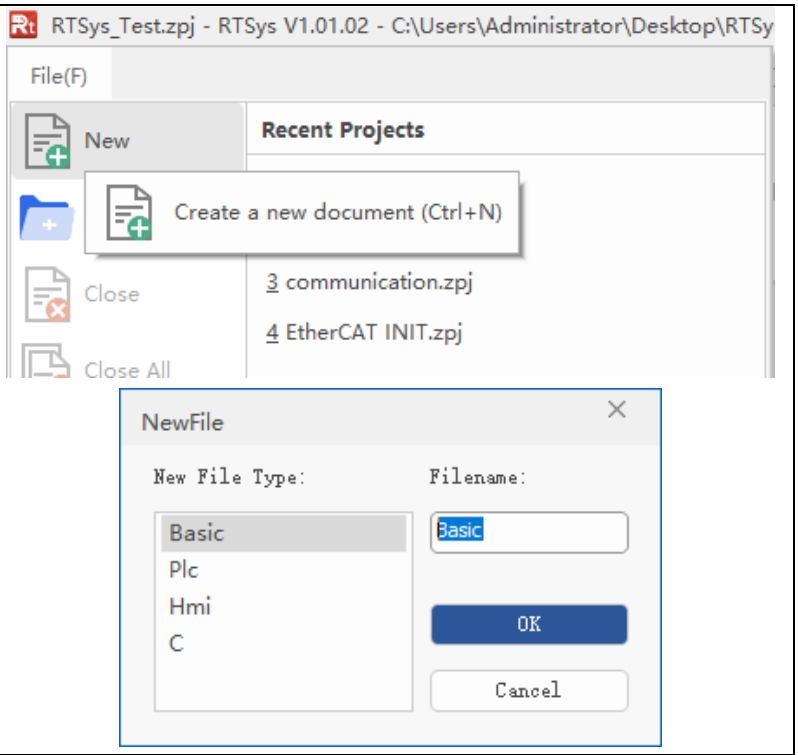
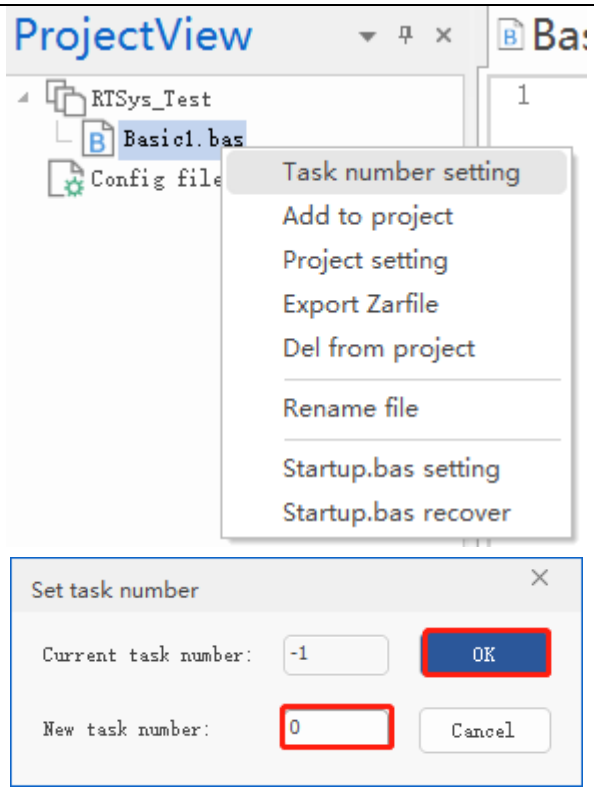
RTSys Downloading Address: https://www.zmotionglobal.com/pro_info_282.html

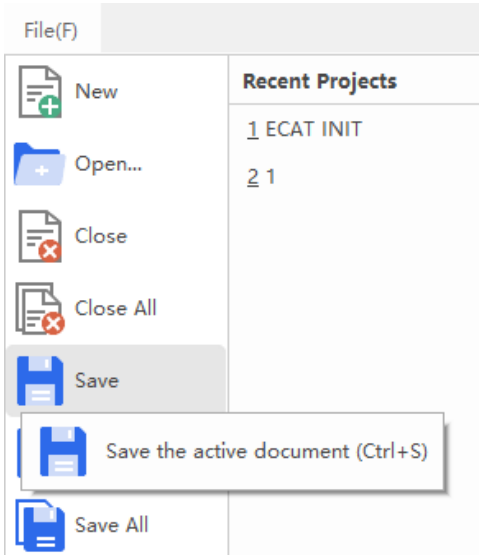
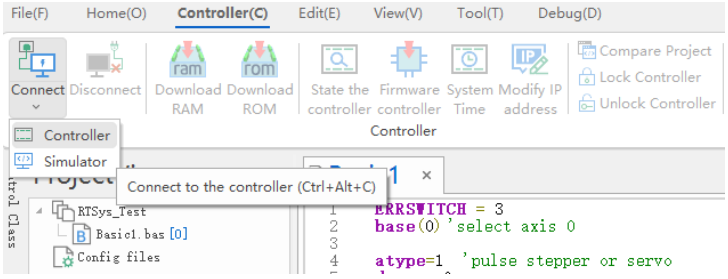
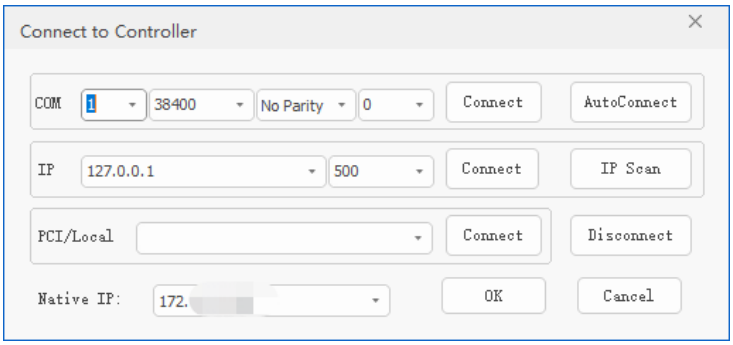
**And related manuals can be found in "Download":**

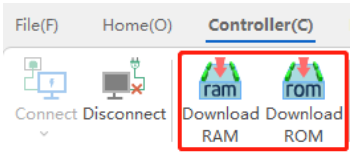
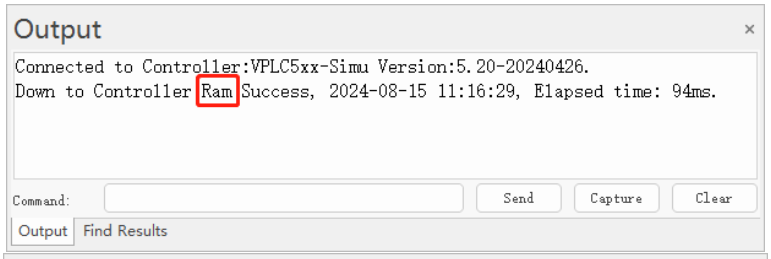
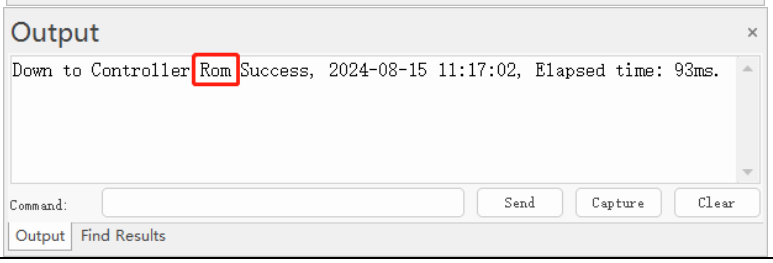
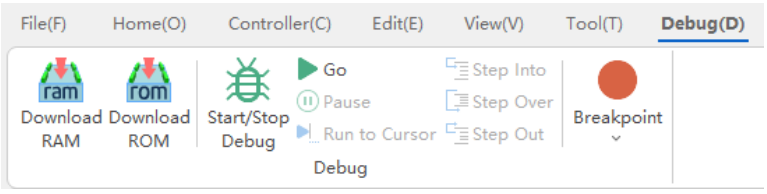
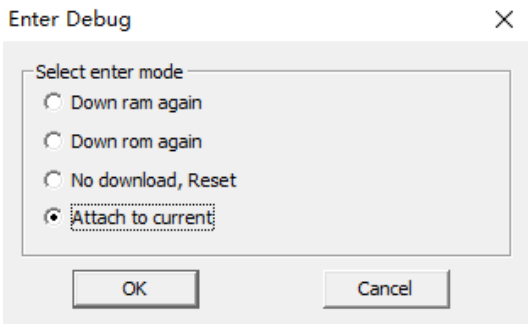
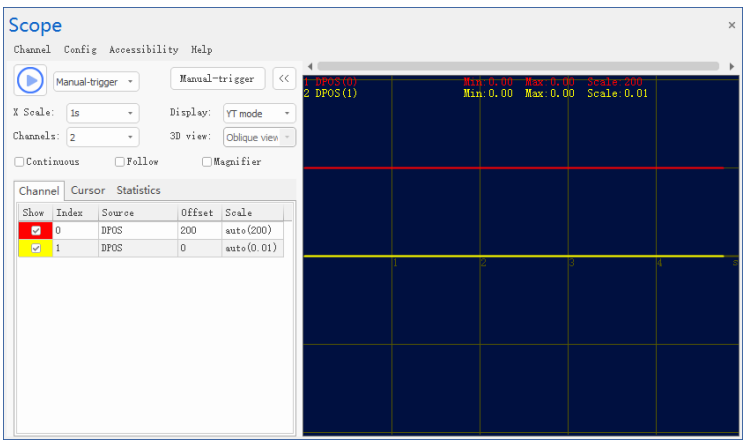



| Step | Operations | Display Interface |
|---|---|---|
| 1 | Switch the Language: "Language" – "English", then there will pop |  |

<table>
<tr>
<td></td>
<td>up one window, click OK, and restart it.</td>
<td>Language Switch Video Showing:<br><br>E. How to Switch the Language<br>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.<br> 
</td>
</tr>
<tr>
<td>2</td>
<td>New Project: “File” – “New Project”, Save as window will pop up, then enter file name, save the project file with suffix “zpj.”.</td>
<td> 
<br> 
</td>
</tr>
</table>

| | | |
|---|---|---|
| 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.<br>● **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.<br>  <br>  <br>  |
| 8 | Debug: "Debug" – "Start/Stop Debug" to call "Task" and "Watch" window, because it was downloaded before, here select "Attach the current". |  <br>  |
| 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

## 5.2. 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”.

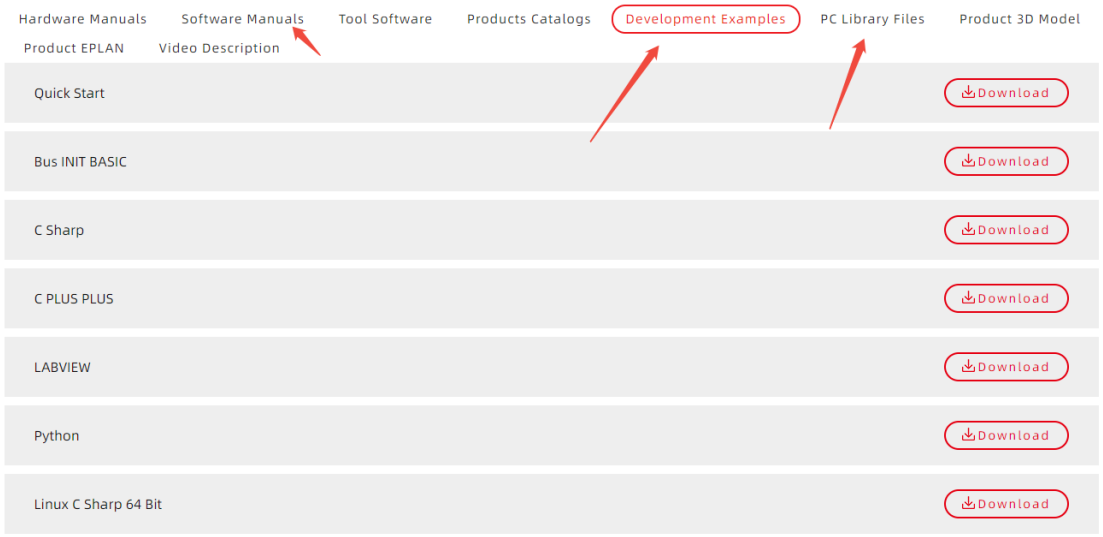
h. Do step a and step b again, check whether the firmware is updated or not.

## 5.3. Program in Host-Computer by PC Languages

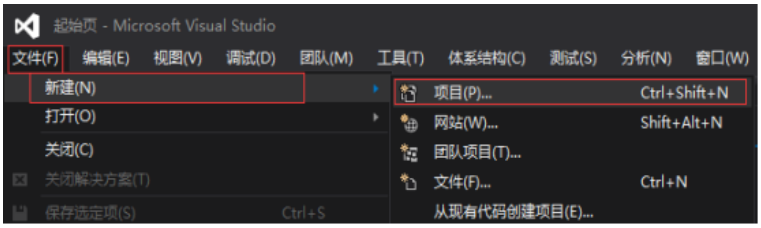
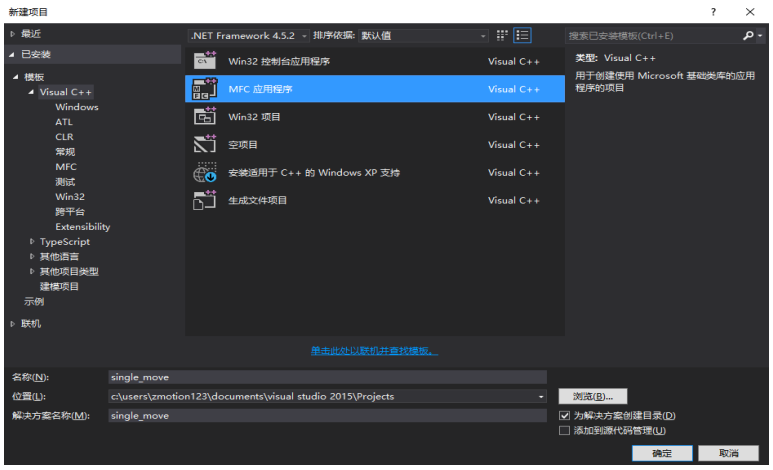
The controller supports development under various operating systems such as windows, linux, Mac, Android, and wince, and provides dll libraries in various environments such as vc, c#, vb.net, and labview, as shown in the figure below. PC software programming refers to "Zmotion PC Function Library Programming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

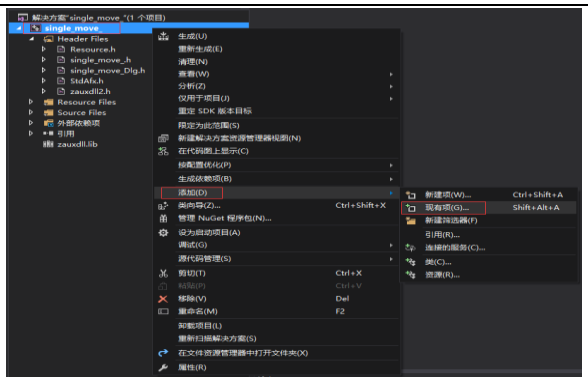
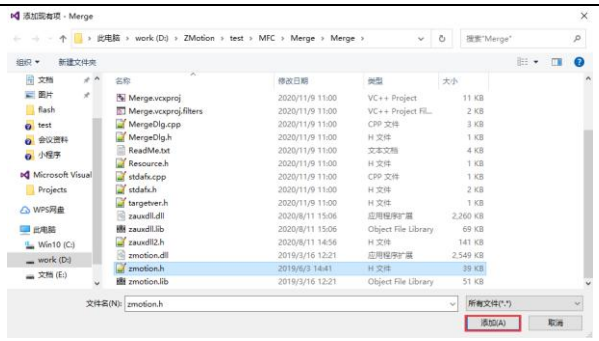
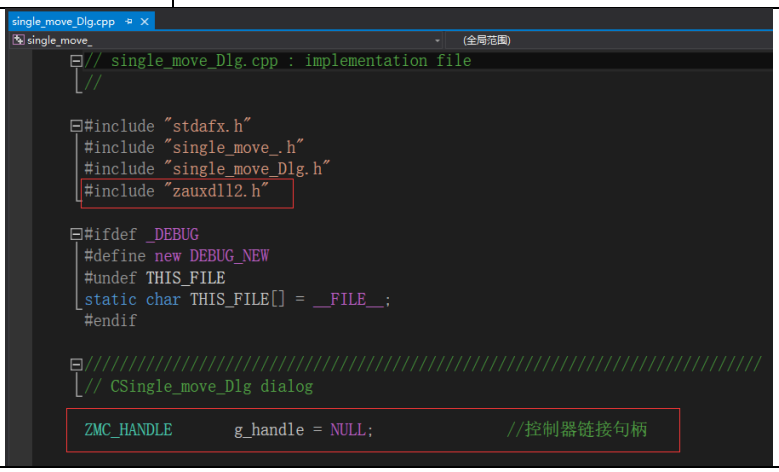

The program developed using the PC software cannot be downloaded to the controller, and it is connected to the controller through the dll dynamic library. The dll library needs to be added to the header file and declared during development.

- 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. | |

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

# Chapter VI 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.

## 6.1. 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 |

## 6.2. Common Problems & Solutions

| Problems | Suggestions |
|---|---|
| Motor does not rotate. | 1. Check whether the ATYPE of the controller is correct.<br>2. Check whether hardware position limit, software position limit, alarm signal work, and whether axis states are normal.<br>3. Check whether motor is enabled successfully.<br>4. Confirm whether pulse amount UNITS and speed values are suitable. If there is the encoder feedback, check whether MPOS changes.<br>5. Check whether pulse mode and pulse mode of drive are matched.<br>6. Check whether alarm is produced on motion controller station or drive station.<br>7. Check whether the wiring is correct.<br>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.<br>2. Check whether the mapping of the limit switch is correct.<br>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.<br>2. Check whether the mapping of the limit switch is correct.<br>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.<br>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.<br>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 and power supply circuit, whether the 120 ohm resistor is installed at both ends.<br>2. Check the master-slave configuration, communication speed configuration, etc.<br>3. Check the DIP switch to see if there are multiple expansion modules with the same ID.<br>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) |

# Appendix

Wiring reference