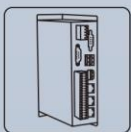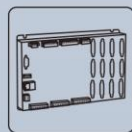# Verticale Bus Expansion Module
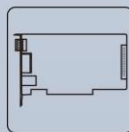
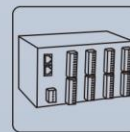## ZMIO310

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

⊞ Foreword

Zmotion®

The motion controller provides rich interface, and it has excellent motion control performance, which can meet the expansion requirements of various projects.

This manual is copyrighted by Shenzhen Technology Co., Ltd., without the written permission of the Zmotion Technology, no person shall reproduce, translate and copy any content in this manual. The above-mentioned actions will constitute an infringement of the copyright of the company's manual, and Zmotion will investigate legal responsibility according to law.

For details about the ZMC controller software and the introduction and routine of each command, please refer to the ZBASIC software manual.

Information contained in this manual is only for reference. Due to improvements in design and functions and other aspects, Zmotion Technology reserves the final interpretation! Subject to change without notice!

Pay attention to safety when debugging the machine!

Please be sure to design an effective safety protection device in the machine, and add an error handling program in the software, otherwise Zmotion has no obligation or responsibility for the loss caused.

In order to ensure the safe, normal and effective use of the product, please be sure to read this product manual carefully before installing and using the product.

⊞ Safety Statement

- This chapter describes the safety precautions required for the correct use of this product. Before using this product, please read the instructions for use and correctly understand the relevant information on safety precautions.
- This product should be used in an environment that meets the design specifications, otherwise it may cause equipment damage or personal injury, and malfunctions or component damage caused by failure to comply with relevant regulations are not within the scope of product quality assurance.
- Zmotion will not take any legal responsibility for personal safety accidents and property losses caused by failure to comply with the contents of this manual or illegal operation of products.

⊞ Safety Level Definition

According to the level, it can be divided into " Danger " and " Caution ". Failure to operate as required may result in moderate injury, minor injury or equipment damage.

Please keep this guide in a safe place for reading when needed, and be sure to hand this manual to the end user.

Install	
⚠️ Danger	◆ When the controller is disassembled, all external power supplies used by the system should be disconnected before operation, otherwise it may cause misoperation or damage to the equipment. ◆ It is forbidden to use in the following places: places with dust, oil fume, conductive dust, corrosive gas and flammable gas; places exposed to high temperature, condensation, wind and rain; places with vibration and shock. Electric shock, fire and misuse can cause product damage and deterioration.
⚠️ Notice	◆ Avoid metal shavings and wire ends falling into the hardware circuit board during installation. ◆ After installation, ensure that there are no foreign objects on the hardware circuit board. ◆ When installing, make it tightly and firmly with the mounting frame.

	◆ Improper installation of the controller may result in misoperation, failure and fire.
Wiring	
Danger	◆ The specifications and installation methods of the external wiring of the equipment shall comply with the requirements of local power distribution regulations. ◆ When wiring, all external power supplies used by the system should be disconnected before operation. ◆ When powering on and running after the wiring work is completed, the terminals attached to the product must be installed. ◆ Cable terminals should be well insulated to ensure that the insulation distance between cables will not be reduced after the cables are installed on the terminal block.
Notice	◆ Avoid metal shavings and wire ends falling into the hardware circuit board during installation. ◆ The cable connection should be carried out correctly on the basis of confirming the type of the connected interface. ◆ It should be confirmed that the cables pressed into the terminals are in good contact. ◆ Do not bundle the control wires and communication cables with the main circuit or power supply wires, etc., and the distance between the wires should be more than 100 mm, otherwise noise may cause malfunction. ◆ If the controller is not installed properly, it may cause electric shock or equipment failure or malfunction.

CONTENT

Chapter I Introduction

1.1. Product Introduction

ZMIO310 Series expansion module is a kind of vertical fieldbus expansion module, which supports EtherCAT and ZCAN fieldbus to expand IO, AD and DA. When IO, AD and DA are not enough, it needs a coupler module (ECAT or CAN communication module) matched with other submodules (input/output/AD/DA module) to expand. One coupler supports 16 sub expansion modules at most.

This manual mainly describes ZMIO310 specification, property, usage, etc. Please read this manual carefully to know more about the product, and then you could use more safely.

1.2. Function Features

◆ Digital inputs and outputs are with signal indication lights, which are used to check IO states.

◆ The resolution of analog is 16-bit, there are voltage type or current type, and there are multiple ranges.

◆ One single coupler can extend 256 inputs or 256 outputs at most. If you need more, please select several couplers.

◆ One single coupler can extend 32 ADs or 32 DAs at most. If you need more, please select several couplers.

◆ It is convenient to do expansion wiring.

1.3. System Architecture

→ **EtherCAT Bus Expansion Module:**

→ **CAN Bus Expansion Module:**
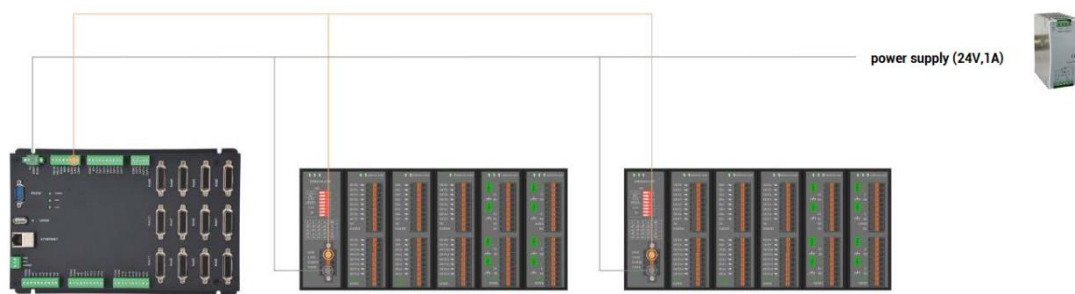
Chapter II Product Information

2.1.Nameplate Information

Here shows ZMIO310-ECAT, others are the same rule.

EtherCAT总线从站通讯模块

产品名称：扩展模块
产品型号：ZMIO310-ECAT
外形尺寸：95*32mm
输入规格：24V , 2.5A
制造商：深圳市正运动技术有限公司

EtherCAT Bus Slave Station Communication Module

product name: expansion module

product model: ZMIO310-ECAT

Size: 95*32mm

input specification: 24V, 2.5A

manufacturer: Shenzhen Zmotion Technology Co.,

→ Model description:

ZMIO	310	ECAT
Company Product Info	Series No.	Module Type
vertical bus expansion	310 series	ECAT Communication
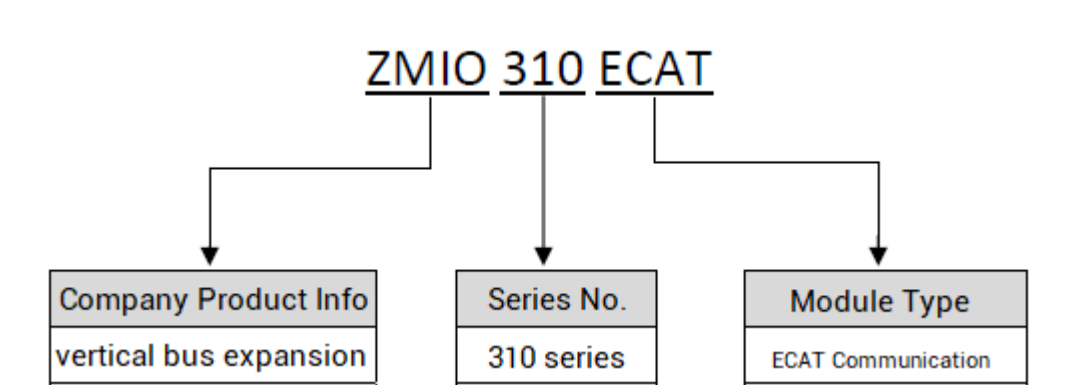
2.2. Order Information

Product name	In	Out	AD	DA	Communication interface	Function
ZMIO310-ECAT	-				EtherCAT	ECAT communication module
ZMIO310-CAN	-				CAN	CAN communication module
ZMIO310-16DI	16	-				Input module (NPN/PNP)
ZMIO310-16DO	-	16	-			Output module (NPN)
ZMIO310-16DOP	-	16	-			Output module (PNP)
ZMIO310-4AD	-		4	-		AD module (16 Bit)
ZMIO310-4DA	-			4		DA module (16 Bit)

2.3. Power Requirement

This expansion module uses dual-power supply, that is, one coupler module ZMIO310-ECAT or ZMIO310-CAN uses one power supply, then one submodule uses another power supply (when there is enough power for power supply, submodules can use one power supply, but submodule and coupler module can't use the same one power).

Model/Item	Power Voltage	Current to open	Current to work
ZMIO310-ECAT	Coupler main power, DC24V is recommended. 18V-36V is max.	1A	0.5A
ZMIO310-CAN		0.2A	0.1A
ZMIO310-16DI	Submodule power supply, DC24V is recommended. 18V-36V is max.	0.2A	0.1A
ZMIO310-16DO		0.2A	0.1A
ZMIO310-16DOP		1A	0.5A
ZMIO310-4AD		0.2A	0.1A

ZMIO310-4DA		0.2A	0.1A

2.4. Work 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

Chapter III Coupler Module

Coupler modules include ZMIO310-ECAT communication module and ZMIO310-CAN communication module.

3.1.ZMIO310-ECAT Communication Module

3.1.1.Interface Definition

Mark	Interface	Number	Description
POW	The led that indicates the current state.	1	Power state: green, it lights when power is conducted.
RUN		1	Run state: green, it lights when runs normally
ALM		1	Error state: red, it lights when runs incorrectly
EtherCAT Communication Interface	EtherCAT IN	1	EtherCAT input, used to connect EtherCAT master station or former level EtherCAT slave station.
	EtherCAT OUT	1	EtherCAT output, used to connect EtherCAT slave station.
Local expansion behind level interface		1	Connect to expansion submodules, plug in and pull out when in hot are unsupported.

User terminal	1	Power terminal

3.1.2. Performance & Specification

Item	Specification
Power Voltage	24V DC
Communication Protocol	EtherCAT Industrial Real-time Bus Protocol
Service	CoE (PDO, SDO), firmware upgrade
Communication Cycle	250μs, 500μs, 1ms, 2ms, 4ms, etc.
Max Communication Speed	Ethernet 100Mbqs
Network Port	Standard Ethernet RJ45 interface
Transfer Medium	5E Category STP
Transfer Distance	Distance between two nodes is less than 100m
Continuation Sub Module Expansion	Up to16 input/output modules are expanded, or 8 AD/DA modules, the total number can be up to 16, the actual number depends on each module's power.
Max IOs of Continuation Sub Module	256 inputs or 256 outputs
Max AIOs of Continuation Sub Module	32 ADs or 32 DAs
Power	1.6W
Internal power for behind level	8.4W

3.1.3. Installation Size
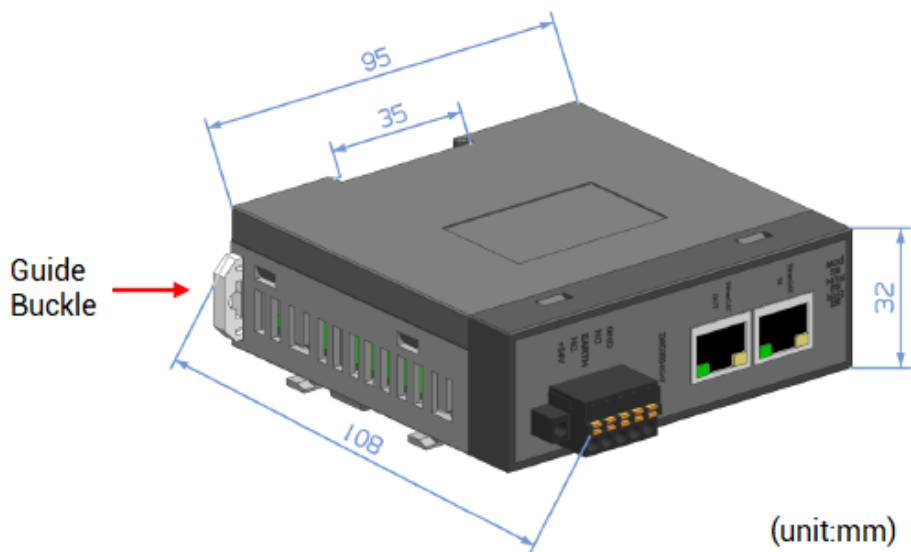
(unit:mm)

→ Installation Step:

➢ Please use 35mm standard DIN guide rail.

➢ Open guide rail buckle of ECAT communication module, then embed ECAT communication module in the DIN guide rail.

➢ Press and fit guide rail buckle of ECAT communication module, then fix ECAT communication module in the DIN guide rail.

3.1.4. EtherCAT Bus Interface Description

ZMIO310-ECAT communication module has 2 100M EtherCAT communication interfaces, and it supports EtherCAT protocol. The pin definition is as follows:

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
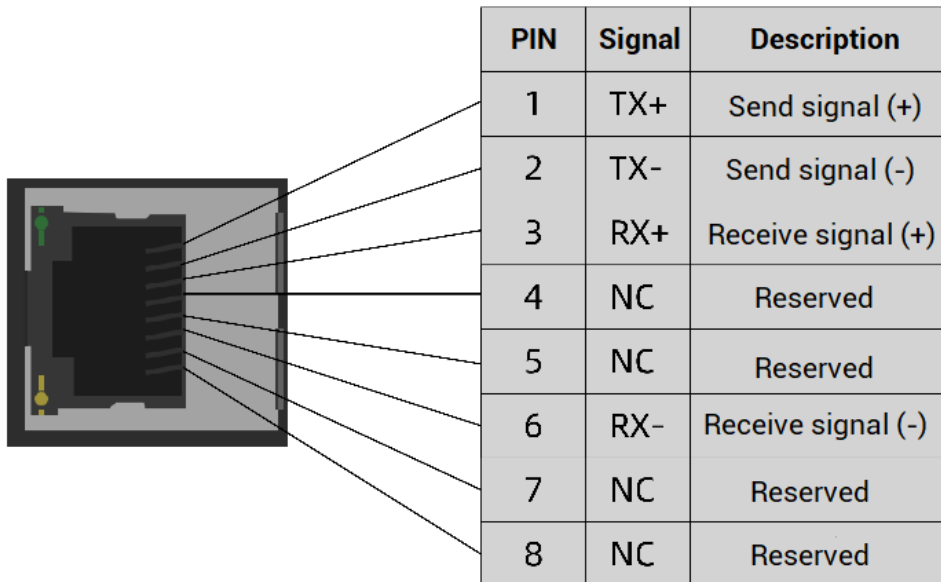
→ Specification

Item	Specification
Communication protocol	EtherCAT protocol
Valid service	CoE(PDO, SDO), FoE
Synchronization method	IO adopts input and output synchronization / DC-distributed clock
Physical level	100BASE-TX
Duplex mode	Full duplex
Topology	linear topology

Transfer media	Cable
Transfer distance	It is less than 100M between 2 nodes
Process data	Maximum 1486 bytes of one single frame
Synchronization shaking of two slave stations	<1us
Refresh	For 1000 digital inputs and outputs, it is about 30us

→ Communication Cable Requirements

Both ETHERNET communication interface and EtherCAT communication interface adopt standard Ethernet RJ45 interface.

The network cable adopts Category 5e STP, and the crystal head has a metal shell to reduce interference and to prevent information from being eavesdropped. As shown below:
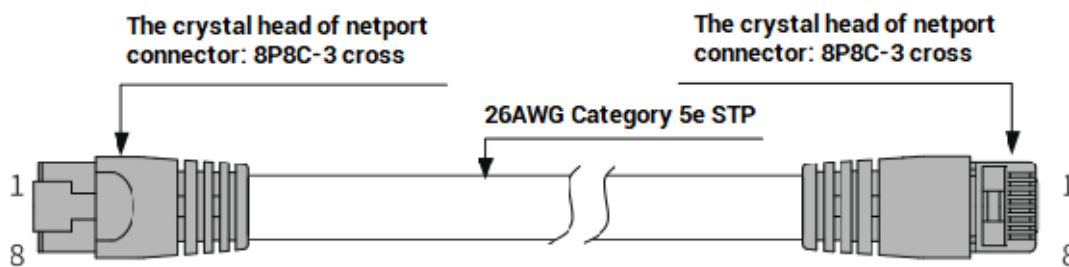
Item	Specification
Cable type	Flexible crossover cable, Category 5e
traverse	twisted pair
Line pairs	4
Isolation	cross skeleton
Connector	Crystal head with iron shell
Cable material	PVC
Cable length	Less than 100m

Use RJ45 network cable connection method:

● When installing, hold the crystal head that is with the cable and insert it into the RJ45 interface until it makes a "click" sound (kada).

● In order to ensure the stability of communication, please fix the cables with cable ties.

● When disassembling, press the tail mechanism of the crystal head, and pull out the

connector and the module in a horizontal direction.

● Please use tube-type pre-insulated terminals and cables with appropriate wire diameters to connect the user terminals.

● Please don't mix EtherCAT IN and EtherCAT OUT interface. EtherCAT IN interface is used to connect with EtherCAT of master station (the controller) or EtherCAT OUT interface of front-level slave station (servo/ECAT communication module), EtherCAT OUT interface is used to connect to EtherCAT IN interface of behind level station (servo / ECAT / communication module).

3.1.5. Terminal Definition

→ Main power terminal

Number	Mark	Type	Function
1	+24V	Positive pole of power	Positive pole to input 24V power
2	NC	-	Reserved
3	EARTH	-	Shield
4	NC	-	Reserved
5	GND	Negative pole of power	Negative pole to input 24V power

→ Terminal Wiring

(Please use tubular pre-insulated terminals and wire cable that is suitable to wire path to do user terminal wiring)

→Cable production steps:

➢ Strip the cable insulation, the exposed copper part depends on the size of the tube-type pre-insulated terminal.

➢ Pass the conductor part of the cable into the tubular pre-insulated terminal and crimp it with a crimping pliers.

→Wire cable connection steps:

➢ Press the spring of the terminal to insert the cable with the tubular pre-insulated terminal into the port.

➢ Loosen the spring of the terminal, pull the cable lightly to check whether the cable is

firmly connected.

3.1.6. Malfunction Indication and Solution

Status Indication Light			Reason	Solution
POW	RUN	ERR		
ON	twinkle alternately and slowly		The communication between EtherCAT master station and coupler module breaks	♣ Check if crystal head is loosened or not ♣ Check the net cable is damaged or not ♣ Restart the power.
ON	twinkle alternately and rapidly		The pre-scanned sub module and actual continuation sub module are not totally matched.	♣ Check if the continuation submodule is lost, or be in malfunction ♣ Check if appears hot plug or discharger ♣ Restart the power.

3.2.ZMIO310-CAN Communication Module

3.2.1.Interface Definition

Mark	Interface	Number	Description
POW	The led that indicates the current state.	1	Power state: green, it lights when power is conducted.
RUN		1	Run state: green, it lights when runs normally
ALM		1	Error state: red, it lights when runs incorrectly
DIP Switch	DIP Switch	1	8 dial codes, CAN address, CAN speed and conduction of CAN120 ohm terminal resistor can be selected.
Local expansion behind level interface		1	Connect to expansion submodules, plug in and pull out when in hot are unsupported.
User terminal		1	Power terminal

3.2.2.Performance & Specification

Item	Specification
Power Voltage	24V DC

Communication interface	CAN Bus interface
The number can be connected	16 CAN slave station modules can be connected at most
Transfer Distance	Less than 40m
Address Setting	DIP
Continuation Sub Module Expansion	Up to 6 input / 6 output modules are expanded, or 3 AD/DA modules, the total number can be up to 16, the actual number depends on each module's power.
Power	0.6W
Internal power for behind level	7.9W
Service	Firmware upgrade
Note: new version updated module program, it added the alarm function when the number of submodules exceeds the limitation of coupler.	

3.2.3.Installation Size
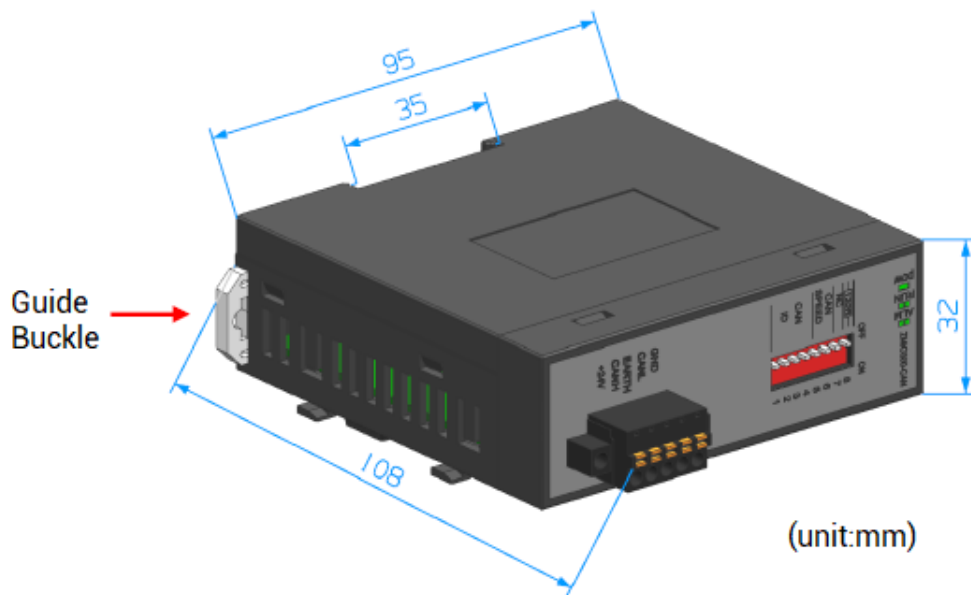
(unit:mm)

→ Installation Step:

➢ Please use 35mm standard DIN guide rail.

➢ Open guide rail buckle of CAN communication module, then embed CAN communication module in the DIN guide rail.

➢ Press fit guide rail buckle of CAN communication module, then fix CAN communication module in the DIN guide rail.

3.2.4. DIP Switch Description
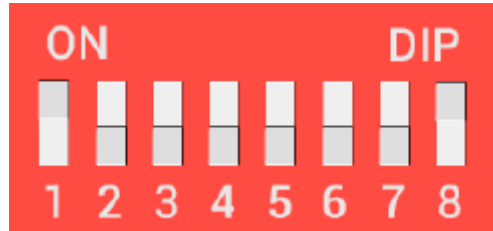
The ZMIO310-CAN expansion module generally has an 8-bit DIP switch, dial ON to take effect, and the meaning of the DIP is as follows:

1-4: these are CAN ID, used to map IO address of CAN expansion module, the corresponding values are 0-15, different codes relate to different IO starting No.

5-6: CAN communication speed, corresponding values are 0-3, there are four different speeds.

7: reserved.

8: 120 ohm resistor, dial ON means a 120 ohm resistor is connected between CANL and CANH.

More details of expansion IO address mapping and communication speed, please refer to 5.2.2 CAN Bus Expansion Description.

3.2.5. Terminal Definition

→ CAN Bus & Main power terminal

Number	Mark	Type	Function
1	+24V	Positive pole of power	Positive pole to input 24V power
2	CANH	CAN Bus	CAN differential data H
3	EARTH	Shield	Shield
4	CANL	CAN Bus	CAN differential data L
5	GND	Power ground	Negative pole to input 24V power

→ CAN Bus Wiring Method
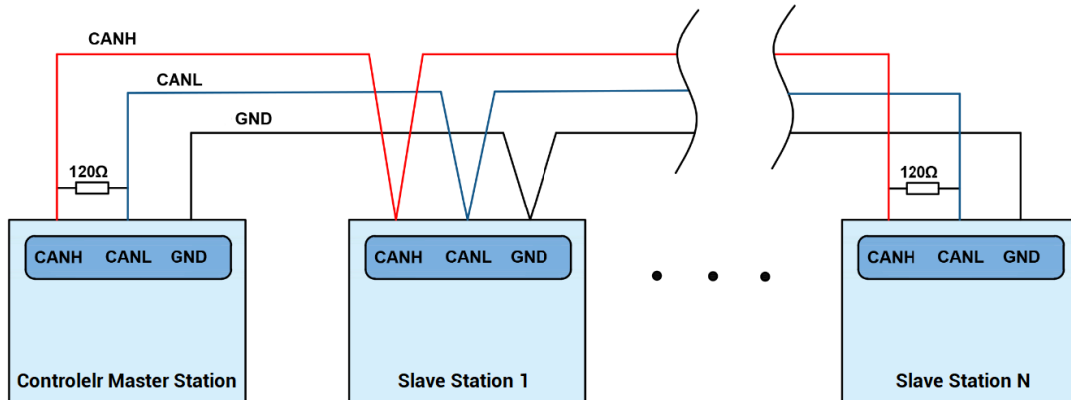
➢ The CAN bus communication parties must ensure that the corresponding GND is connected, or the main power supply of the communication parties uses the same power supply, otherwise the CAN may be burned.

➢ When connecting multiple CAN expansion modules, all CANH terminals, all CANL terminals should be connected, and then dial ON for the eighth digit of the last expansion module, which means please do not dial bit-8 of other modules.

→ Terminal Wiring

➢ When expand through CAN, it is recommended to use STP, and the shield layer is grounded.

➢ Please use tubular pre-insulated terminals and wire cable that is suitable to wire path to do user terminal wiring

→Cable production steps:

➢ Strip the cable insulation, the exposed copper part depends on the size of the tube-type pre-insulated terminal.

➢ Pass the conductor part of the cable into the tubular pre-insulated terminal and crimp it with a crimping pliers.

→Wire cable connection steps:

➢ Press the spring of the terminal to insert the cable with the tubular pre-insulated terminal into the port.

➢ Loosen the spring of the terminal, pull the cable lightly to check whether the cable is firmly connected.

3.2.6. Malfunction Indication and Solution

Status Indication Light			Reason	Solution
POW	RUN	ERR		
ON	ON	ON	CAN communicate abnormally.	➕ Check whether CAN bus terminal wiring is correct. ➕ Check whether 120ohm resistor is connected. ➕ Check whether the same hardware ID is used by multiple CAN communication modules.

Chapter IV Expansion Sub-Module

4.1.ZMIO310-16DI: Digital Input Module

4.1.1.Interface Definition

Mark	Interface	Number	Description
RUN	The light indicates states.	1	Run state: green, it lights when runs normally
ERR		1	Error state: red, it lights when runs incorrectly
Local expansion front level interface		1	Connect to coupler modules or expansion submodules, plug in and pull out when in hot are unsupported.
Local expansion behind level interface		1	Connect to expansion submodules, plug in and pull out when in hot are unsupported.
Signal indicator	IO signal indicator	1	Correspond to each signal indicator.
User terminal		1	16 digital inputs/power terminal

4.1.2.Performance Description

Item	Specification
Power Voltage	24V DC
The number of inputs	16

Type of input	Digital input
Voltage input method (power supplied by IO)	PNP (COM1 is connected to 24V power -, COM2 is connected to 24V power +) or NPN (COM1 is connected to 24V power +, COM2 is connected to 24V power -)
Current (input)(typical)	NPN type (-4.8mA), PNP type (+4.8mA)
Impedance (input)	4.7KΩ
Frequency (input)	<5kHz
Action showing (input)	When input is ON, the input indication led will be ON.
Voltage when ON	PNP Type >7.2V or NPN type <14.5V
Voltage when OFF	PNP Type >6.8V or NPN type <14.7V
Internal Power	0.3W
Power	1.9W
Isolation	Optocoupler isolation

4.1.3. Installation Size
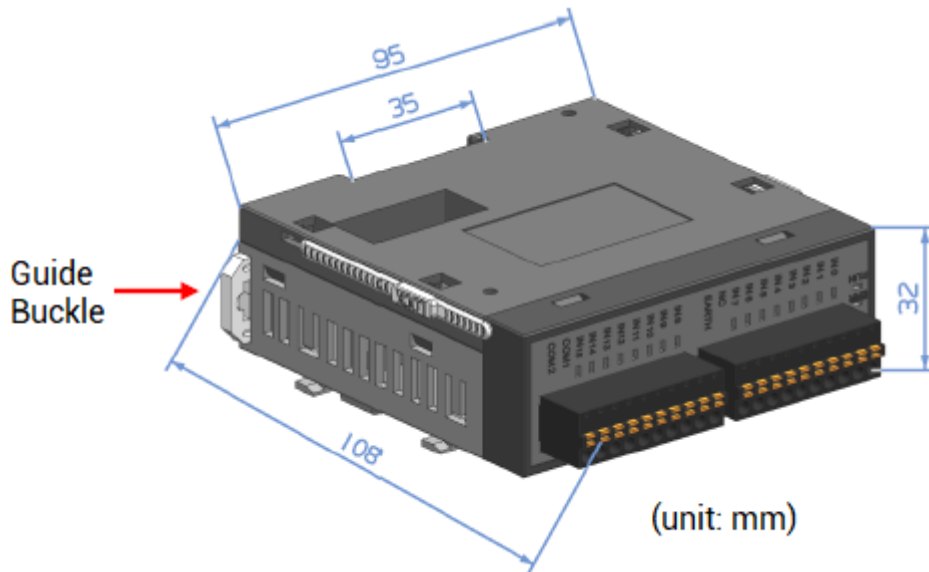
(unit: mm)

→ Installation Step:

➢ Please use 35mm standard DIN guide rail.

➢ Open guide rail buckle of input module, then embed input module in the DIN guide rail.

➢ Press fit guide rail buckle of input module, then fix input module in the DIN guide rail.

4.1.4. Terminal Definition

→ 16 Digital Inputs / IO Power Terminal

Number	Mark	Type	Function
1	IN0	Input	Input 0
2	IN1	Input	Input 1
3	IN2	Input	Input 2
4	IN3	Input	Input3
5	IN4	Input	Input 4
6	IN5	Input	Input 5
7	IN6	Input	Input 6
8	IN7	Input	Input 7
9	NC	Input	Input 8
10	EARTH	Input	Input 9
11	IN8	-	Reserved
12	IN9	-	Shield
13	IN10	Input	Input 10
14	IN11	Input	Input 11
15	IN12	Input	Input 12
16	IN13	Input	Input 13
17	IN14	Input	Input 14
18	IN15	Input	Input 15
19	COM1	Power supply	Power terminal 1
20	COM2	Power supply	Power terminal 2

→ Terminal Wiring

➢ Please use tubular pre-insulated terminals and wire cable that is suitable to wire path to do user terminal wiring

→Cable production steps:

➢ Strip the cable insulation, the exposed copper part depends on the size of the tube-type pre-insulated terminal.

➢ Pass the conductor part of the cable into the tubular pre-insulated terminal and crimp

it with a crimping pliers.

➢ Press the spring of the terminal to insert the cable with the tubular pre-insulated terminal into the port.

➢ Loosen the spring of the terminal, pull the cable lightly to check whether the cable is firmly connected.

➢ When routing terminal cables, avoid bundling them with cables with strong interference signals such as power cables, and route them separately.

➢ In the case of serious electromagnetic interference on site, shielded cables should be selected to improve the anti-interference ability.

➢ It is not recommended to use the same power supply for the coupler module and the expansion sub-module. Especially in the case of severe electromagnetic interference on site, different power supplies must be used and they must not share the same ground.

4.1.5.Wiring Method

→ Input Terminal NPN Wiring:
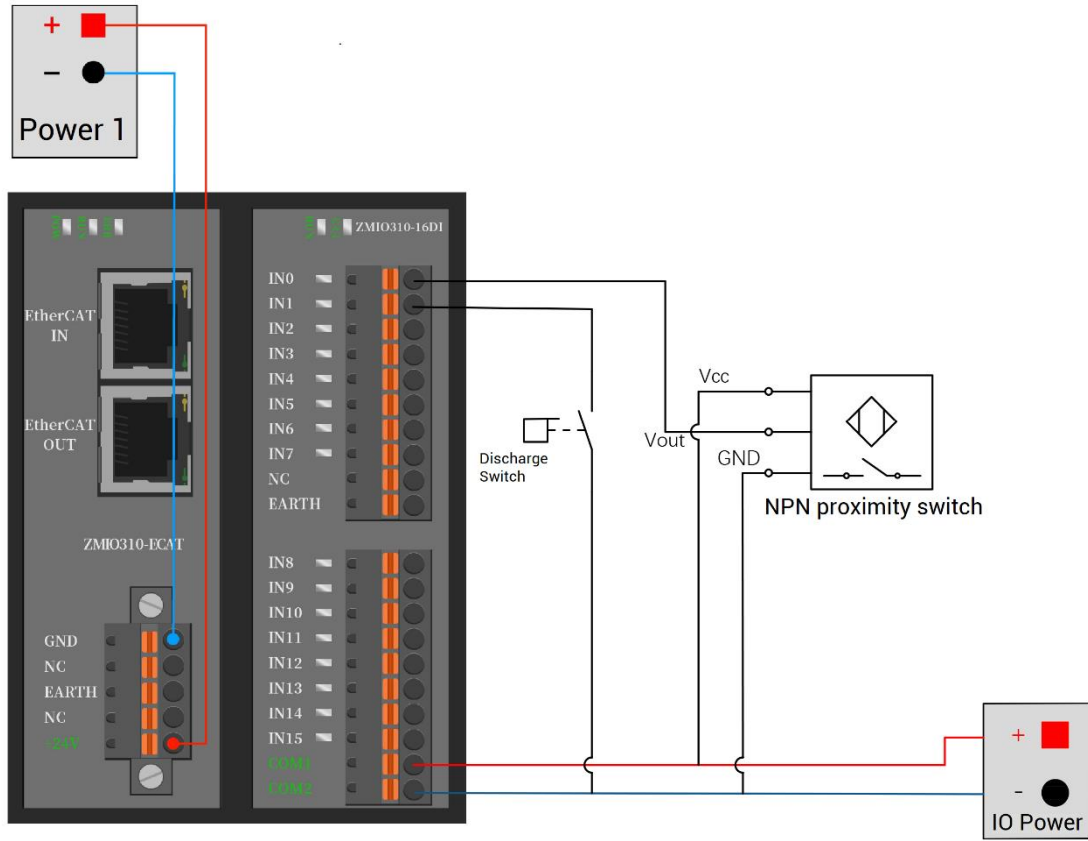
→ Input Terminal PNP Wiring:

4.1.6.Malfunction Indication and Solution

Status Indication Light		Reason	Solution
RUN	ERR		
ON	ON	CAN communicate abnormally.	✦ Check whether CAN bus terminal wiring is correct. ✦ Check whether 120ohm resistor is connected. ✦ Check whether the same hardware ID is used by multiple CAN communication modules.
OF	OFF	The pre-scanned sub module and actual continuation sub module are not totally matched.	✦ Check if the continuation submodule is lost, or be in malfunction ✦ Check if appears hot plug or discharger ✦ Restart the power.

4.2.ZMIO310-16DO/DOP: Digital Output Module

There are two types of digital output modules, NPN and PNP. Please note their power input wiring and IO wiring are different.

4.2.1.Interface Definition

| Mark	Interface	Number	Description
RUN	The light indicates states.	1	Run state: green, it lights when runs normally
ERR		1	Error state: red, it lights when runs incorrectly
Local expansion front level interface		1	Connect to coupler modules or expansion submodules, plug in and pull out when in hot are unsupported.
Local expansion behind level interface		1	Connect to expansion submodules, plug in and pull out when in hot are unsupported.
Signal indicator	IO signal indicator	1	Correspond to each signal indicator.
User terminal		1	16 digital outputs / power terminal

4.2.2. Performance & Specification

Item	Specification	
	ZMIO310-16DO	ZMIO310-16DOP
Power voltage	24VDC	
The number of outputs	16	
The type of output	Digital output	
The method of output	Leakage (NPN, it is low electric level when there is output)	Source (PNP, it is high electric level when there is output)
Output overcurrent protection	Max is 300mA, and the max tripping current is 600mA.	
The max leakage current when OFF	25μA	25μA
Respond time when OFF	12μs	12μs
Respond time when ON	80μs	60μs
Internal power	0.3W	
Power	1.3W	
Isolation	Coupler isolation	
Frequency (output)	<8kHz	
Action showing (output)	When the output is ON, output indication led will be ON.	
Service	Firmware upgrade	

4.2.3. Installation Size
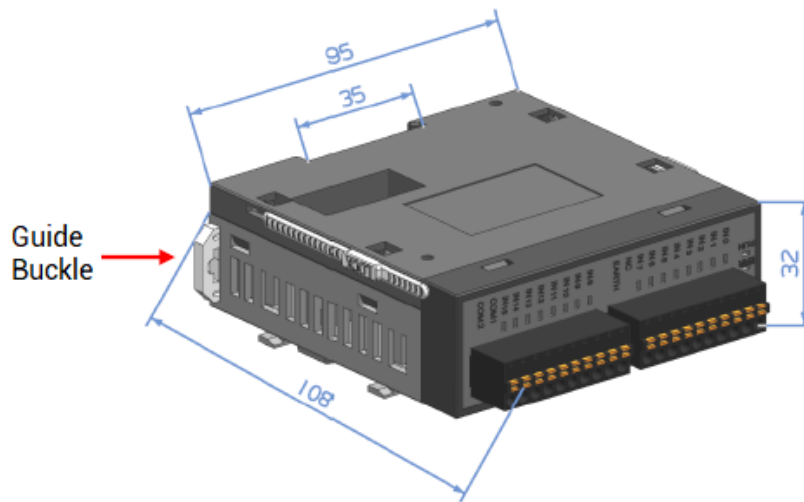
→ Installation Step:

➢ Please use 35mm standard DIN guide rail.

➢ Open guide rail buckle of output module, then embed output module in the DIN guide rail.

➢ Press fit guide rail buckle of output module, then fix output module in the DIN guide rail.

4.2.4. Terminal Definition

→ 16 Digital Outputs / IO Power Terminal

Number	Mark	Type	Function
1	OUT0	Output	Output 0
2	OUT1	Output	Output 1
3	OUT2	Output	Output 2
4	OUT3	Output	Output 3
5	OUT4	Output	Output 4
6	OUT5	Output	Output 5
7	OUT6	Output	Output 6
8	OUT7	Output	Output 7
9	NC	Output	Output 8

10	EARTH	Output	Output 9
11	OUT8	-	Reserved
12	OUT9	-	Shield
13	OUT10	Output	Output 10
14	OUT11	Output	Output 11
15	OUT12	Output	Output 12
16	OUT13	Output	Output 13
17	OUT14	Output	Output 14
18	OUT15	Output	Output 15
19	E+24V	Power supply (+)	24V power input (+)
20	EGND	Power supply (-)	24V power input (-)

→ Terminal Wiring

➤ Please use tubular pre-insulated terminals and wire cable that is suitable to wire path to do user terminal wiring

→Cable production steps:

➤ Strip the cable insulation, the exposed copper part depends on the size of the tube-type pre-insulated terminal.

➤ Pass the conductor part of the cable into the tubular pre-insulated terminal and crimp it with a crimping pliers.

→Wire cable connection steps:

➤ Press the spring of the terminal to insert the cable with the tubular pre-insulated terminal into the port.

➤ Loosen the spring of the terminal, pull the cable lightly to check whether the cable is firmly connected.

→Note:

➤ When routing terminal cables, avoid bundling them with cables with strong interference signals such as power cables, and route them separately.

➤ In the case of serious electromagnetic interference on site, shielded cables should be selected to improve the anti-interference ability.

➤ It is not recommended to use the same power supply for the coupler module and the
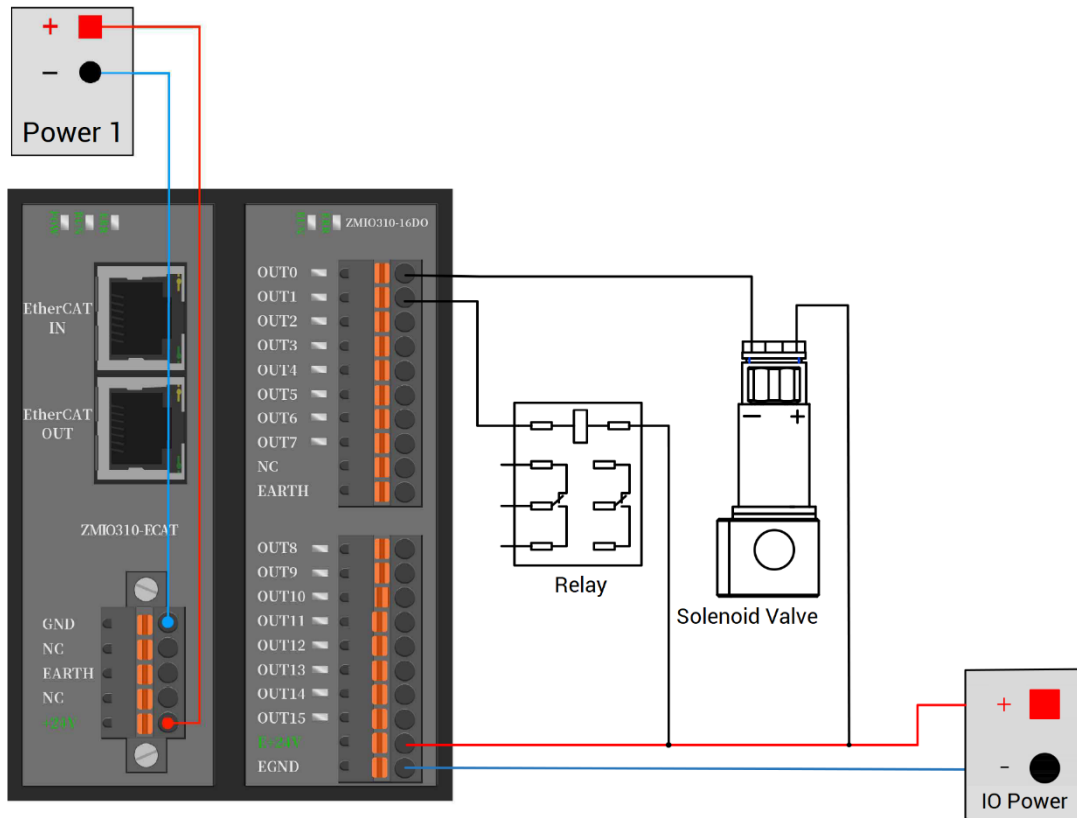
expansion sub-module. Especially in the case of severe electromagnetic interference on site, different power supplies must be used and they must not share the same ground.

4.2.5.Wiring Method

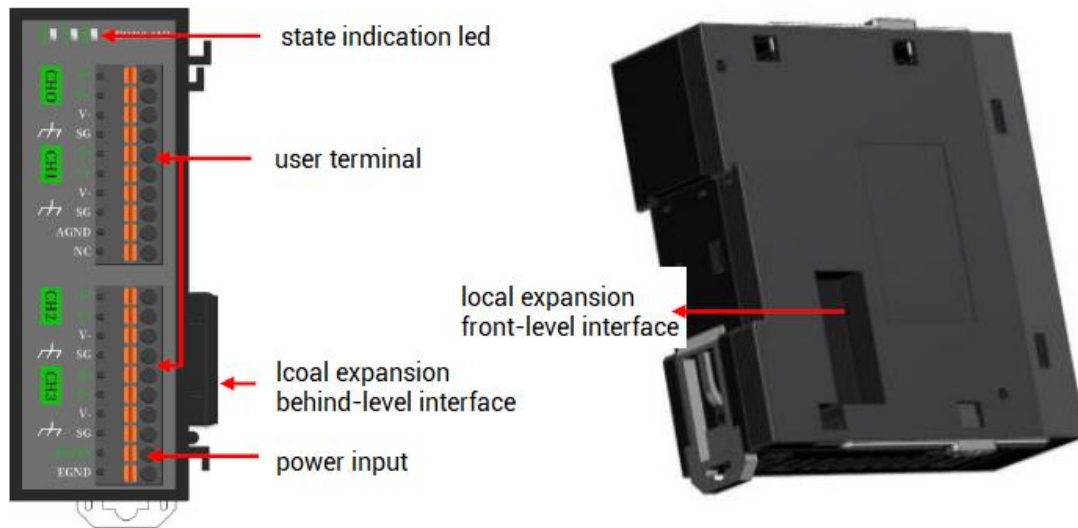### → Output Terminal NPN Wiring:
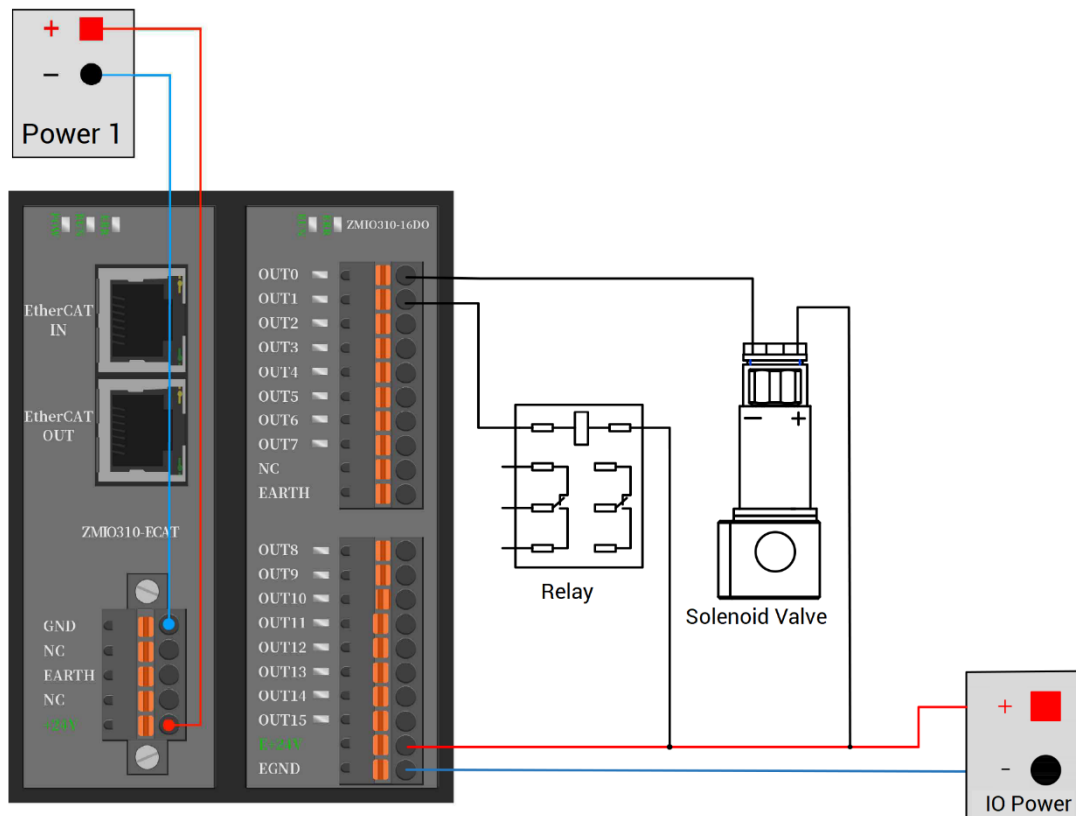
→ Output Terminal PNP Wiring:

4.2.6.Malfunction Indication and Solution

Status Indication Light		Reason	Solution
RUN	**ERR**		
ON	ON	Communication between coupler and expansion submodule breaks.	♣ Check whether the local expansion behind level interface is loosened. ♣ Restart the power.
OF	OFF	The pre-scanned sub module and actual continuation sub module are not totally matched.	♣ Check if the continuation submodule is lost, or be in malfunction ♣ Check if appears hot plug or discharger ♣ Restart the power.

4.3. ZMIO310-4AD: Analog Input Module

4.3.1. Interface Definition

Mark	Interface	Number	Description
RUN	The light indicates states.	1	Run state: green, it lights when runs normally
POW		1	Power state: green, it lights when power is conducted.
ERR		1	Error state: red, it lights when runs incorrectly
Local expansion front level interface		1	Connect to coupler modules or expansion submodules, plug in and pull out when in hot are unsupported.
Local expansion behind level interface		1	Connect to expansion submodules, plug in and pull out when in hot are unsupported.
Signal indicator	IO signal indicator	1	Correspond to each signal indicator.
User terminal		1	4-channel analog inputs/power terminal

4.3.2. Performance & Specification

Item	Specification
Power Voltage	24V DC
The number of channel inputs	4

Impedance of voltage (input)	>1MΩ
Range of voltage (input)	Dual-pole: -5V~5V, -10V~10V. Single-pole: 0~5V, 0~10V.
Range of current (input)	0~20mA, 4~20mA
Resolution	16-bit
Sample time	1ms/channel
Precision (common temperature 25°C)	Voltage ± 0.1%, current ± 0.1% (full range)
Precision (environmental temperature 0~55°C)	Voltage ± 0.3%, current ± 0.8%
Internal Power	0.4W
Power	0.7W
Isolation	Coupler isolation
Service	Firmware upgrade

4.3.3.Installation Size
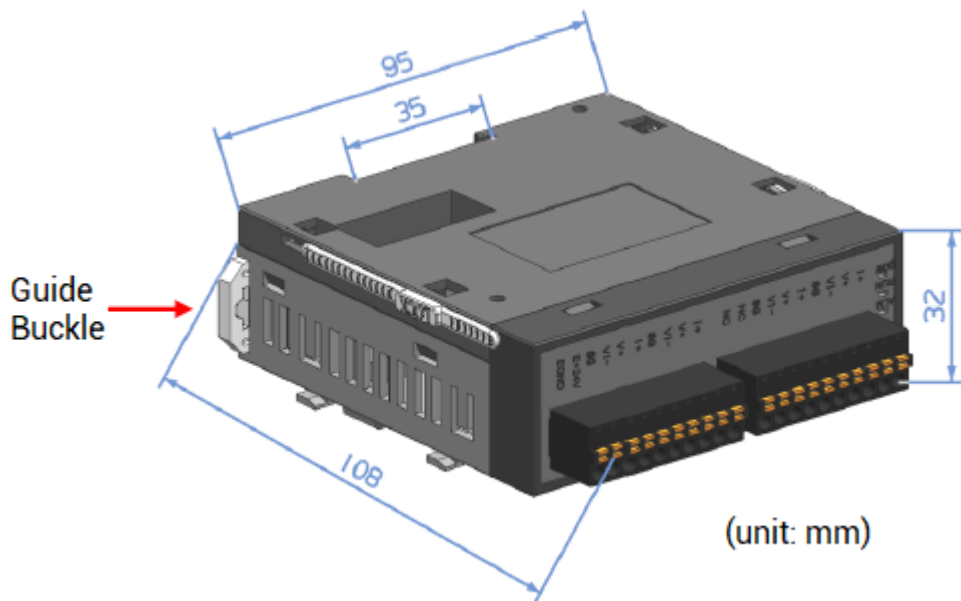
(unit: mm)

→ Installation Step:

➢ Please use 35mm standard DIN guide rail.

➢ Open guide rail buckle of AD module, then embed AD module in the DIN guide rail.

➢ Press fit guide rail buckle of AD module, then fix AD module in the DIN guide rail.

4.3.4. Terminal Definition

→ 4-Channel Analog Inputs / IO Power Terminal

Number	Mark	Type	Function
1	I+	Current input (+)	Channel 0 current input (+)
2	V+	Voltage input (+)	Channel 0 voltage input (+)
3	V-	Voltage input (-)	Channel 0 voltage input (-)
4	SG	-	Shield
5	I+	Current input (+)	Channel 1 current input (+)
6	V+	Voltage input (+)	Channel 1 voltage input (+)
7	V-	Voltage input (-)	Channel 1 voltage input (-)
8	SG	-	Shield
9	AGND	Current input (-)	Public current input (-)
10	NC	-	Reserved
11	I+	Current input (+)	Channel 2 current input (+)
12	V+	Voltage input (+)	Channel 2 voltage input (+)
13	V-	Voltage input (-)	Channel 2 voltage input (-)
14	SG	-	Shield
15	I+	Current input (+)	Channel 3 current input (+)
16	V+	Voltage input (+)	Channel 3 voltage input (+)
17	V-	Voltage input (-)	Channel 3 voltage input (-)
18	SG	-	Shield
19	E+24V	Power supply (+)	24V power supply input (+)
20	EGND	Power supply (-)	24V power supply input (-)

→ Terminal Wiring

➢ Please use tubular pre-insulated terminals and wire cable that is suitable to wire path to do user terminal wiring

→Cable production steps:

➢ Strip the cable insulation, the exposed copper part depends on the size of the tube-type pre-insulated terminal.

➢ Pass the conductor part of the cable into the tubular pre-insulated terminal and crimp

it with a crimping pliers.

→Wire cable connection steps:

➤ Press the spring of the terminal to insert the cable with the tubular pre-insulated terminal into the port.

➤ Loosen the spring of the terminal, pull the cable lightly to check whether the cable is firmly connected.
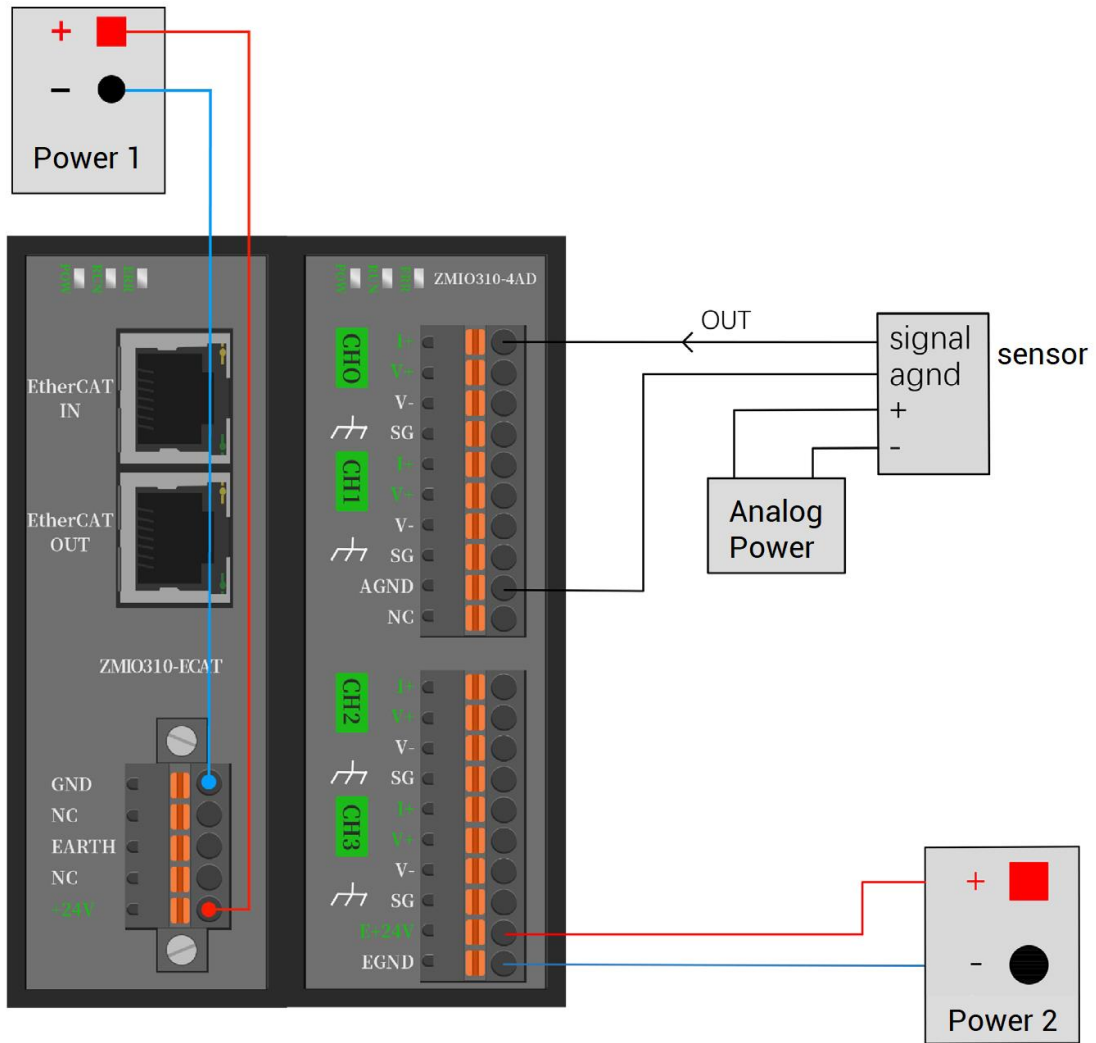
→Note:

➤ When routing terminal cables, avoid bundling them with cables with strong interference signals such as power cables, and route them separately.

➤ In the case of serious electromagnetic interference on site, shielded cables should be selected to improve the anti-interference ability.

➤ It is not recommended to use the same power supply for the coupler module and the expansion sub-module. Especially in the case of severe electromagnetic interference on site, different power supplies must be used and they must not share the same ground.

4.3.5. Wiring Method

→ Voltage Input Terminal Wiring:
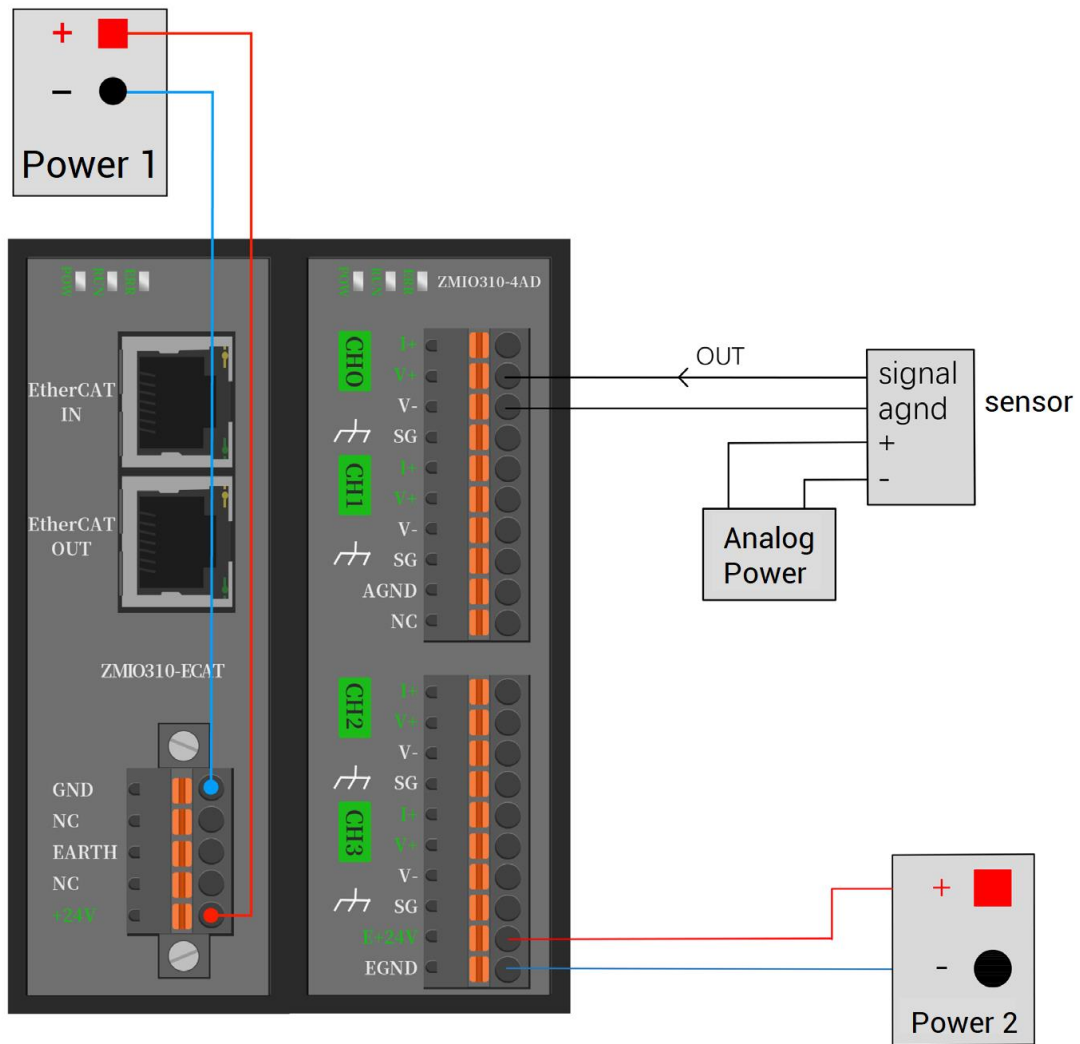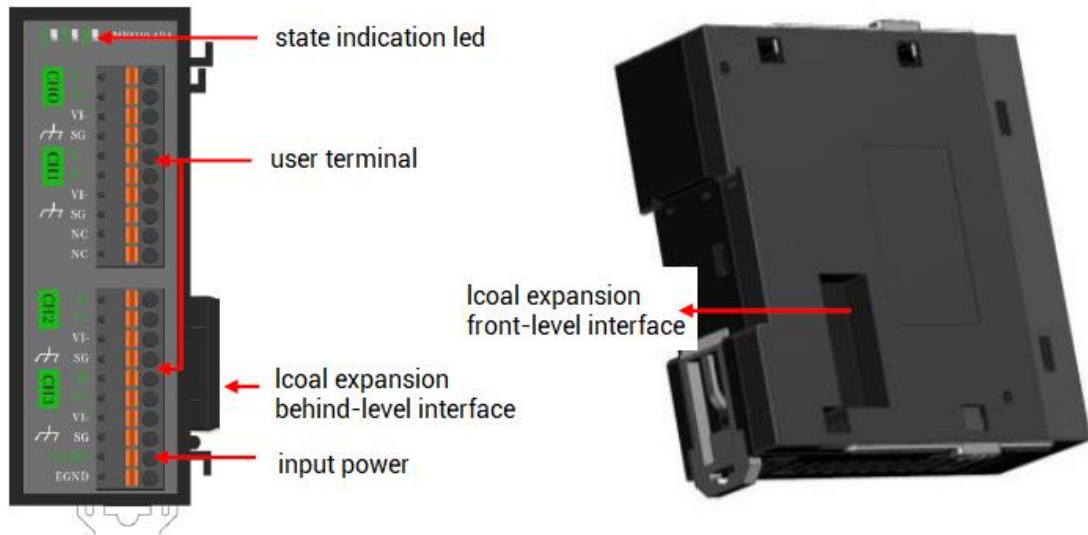
→ **Current Input Terminal Wiring:**

4.3.6. Malfunction Indication and Solution

Status Indication Light			Reason	Solution
POW	RUN	ERR		
ON	ON	ON	Communication between coupler and expansion sub-module breaks.	↓ Check whether local expansion behind-level interface is loosened.
ON	OFF		The pre-scanned sub module and actual continuation sub module are not totally matched.	↓ Check if the continuation submodule is lost, or be in malfunction ↓ Check if appears hot plug or discharger ↓ Restart the power.

4.4.ZMIO310-4DA: Analog Output Module

4.4.1.Interface Definition

Mark	Interface	Number	Description
RUN	The light indicates states.	1	Run state: green, it lights when runs normally
POW		1	Power state: green, it lights when power is conducted.
ERR		1	Error state: red, it lights when runs incorrectly
Local expansion front level interface		1	Connect to coupler modules or expansion submodules, plug in and pull out when in hot are unsupported.
Local expansion behind level interface		1	Connect to expansion submodules, plug in and pull out when in hot are unsupported.
User terminal		1	4-channel analog outputs/power terminal

4.4.2.Performance & Specification

Item	Specification
Power Voltage	24V DC
The number of channel outputs	4
Impedance of voltage (output)	>10KΩ

Range of voltage (output)	Dual-pole: -5V~5V, -10V~10V. Single-pole: 0~5V, 0~10V.
Range of current (output)	0~20mA, 4~20mA
Resolution	16-bit
Transfer time	1ms/channel
Precision (common temperature 25°C)	Voltage ± 0.1%, current ± 0.1% (full range)
Precision (environmental temperature 0~55°C)	Voltage ± 0.3%, current ± 0.8%
Internal Power	0.3W
Power	0.9W
Isolation	Coupler isolation
Service	Firmware upgrade

4.4.3. Installation Size
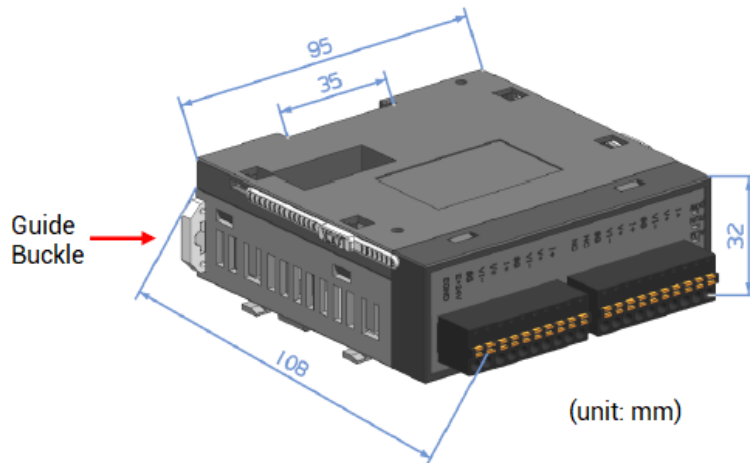
(unit: mm)

→ Installation Step:

➢ Please use 35mm standard DIN guide rail.

➢ Open guide rail buckle of DA module, then embed DA module in the DIN guide rail.

➢ Press fit guide rail buckle of DA module, then fix DA module in the DIN guide rail.

4.4.4. Terminal Definition

→ 4-Channel Analog Outputs / IO Power Terminal

Number	Mark	Type	Function

1	I+	Current Output (+)	Channel 0 current Output (+)
2	V+	Voltage Output (+)	Channel 0 voltage Output (+)
3	V-	Voltage/current Output (-)	Channel 0 voltage/current Output (-)
4	SG	-	Shield
5	I+	Current Output (+)	Channel 1 current Output (+)
6	V+	Voltage Output (+)	Channel 1 voltage Output (+)
7	V-	Voltage/current Output (-)	Channel 1 voltage/current Output (-)
8	SG	-	Shield
9	NC	-	Reserved
10	NC	-	Reserved
11	I+	Current Output (+)	Channel 2 current Output (+)
12	V+	Voltage Output (+)	Channel 2 voltage Output (+)
13	V-	Voltage/current Output (-)	Channel 2 voltage/current Output (-)
14	SG	-	Shield
15	I+	Current Output (+)	Channel 3 current Output (+)
16	V+	Voltage Output (+)	Channel 3 voltage Output (+)
17	V-	Voltage/current Output (-)	Channel 3 voltage/current Output (-)
18	SG	-	Shield
19	E+24V	Power supply (+)	24V power supply input (+)
20	EGND	Power supply (-)	24V power supply input (-)

→ Terminal Wiring

➤ Please use tubular pre-insulated terminals and wire cable that is suitable to wire path to do user terminal wiring

→Cable production steps:

➤ Strip the cable insulation, the exposed copper part depends on the size of the tube-type pre-insulated terminal.

➤ Pass the conductor part of the cable into the tubular pre-insulated terminal and crimp it with a crimping pliers.

→Wire cable connection steps:

➤ Press the spring of the terminal to insert the cable with the tubular pre-insulated terminal into the port.

➢ Loosen the spring of the terminal, pull the cable lightly to check whether the cable is firmly connected.
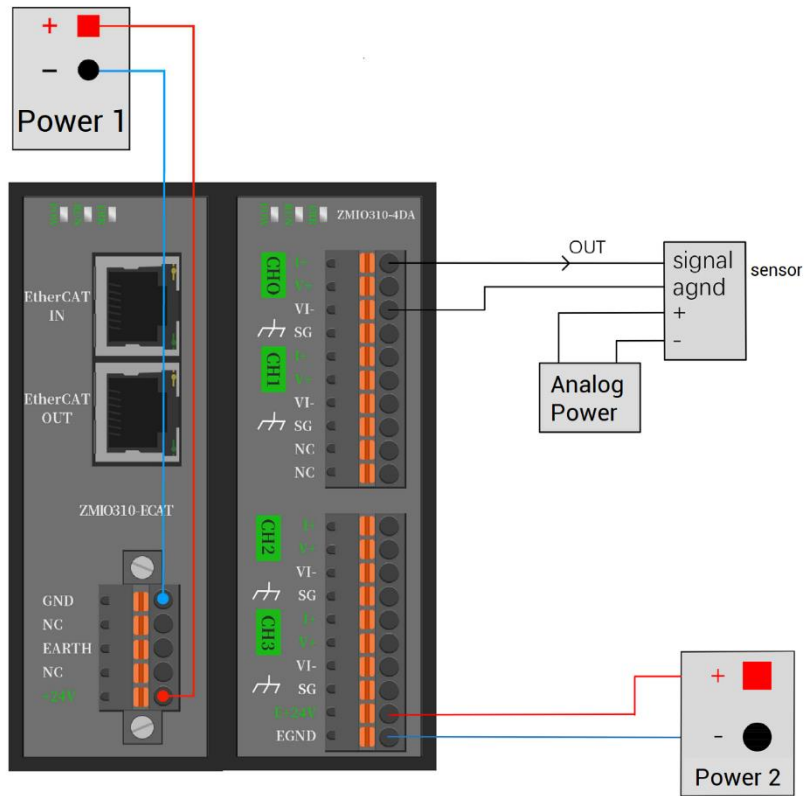
→Note:

➢ When routing terminal cables, avoid bundling them with cables that are with strong interference signals such as power cables, that is, please must route them separately.

➢ In the case of serious electromagnetic interference on site, shielded cables should be used to improve the anti-interference ability.

➢ It is not recommended to use the same power supply for the coupler module and the expansion sub-module. Especially in the case of severe electromagnetic interference on site, different power supplies must be used and they must not share the same ground.

4.4.5. Wiring Method

→ Voltage Output Terminal Wiring:
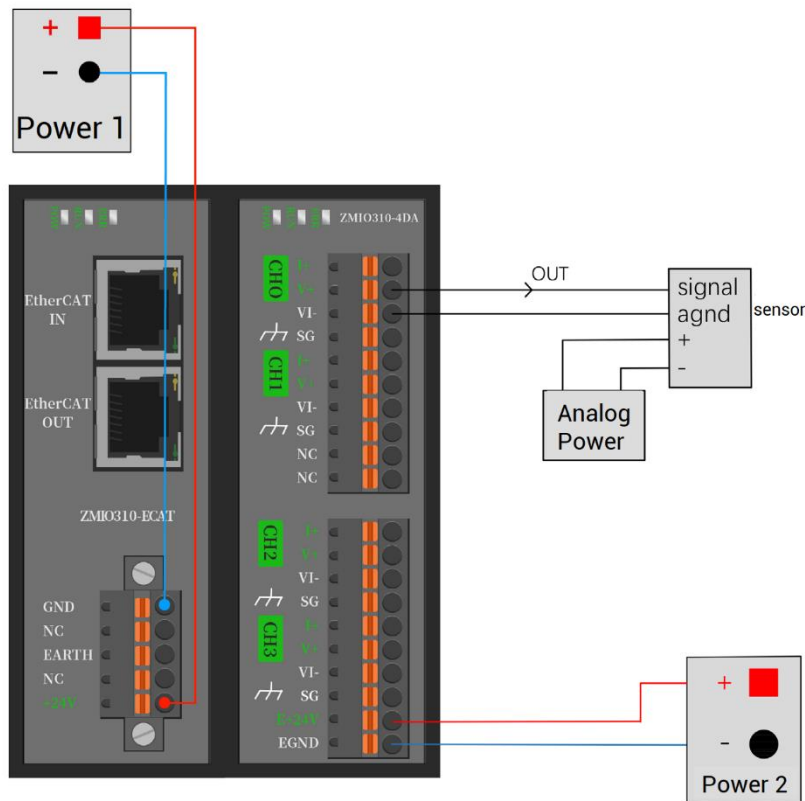
→ Current Output Terminal Wiring:

4.4.6. Malfunction Indication and Solution

Status Indication Light			Reason	Solution
POW	RUN	ERR		
ON	ON	ON	Communication between coupler and expansion sub-module breaks.	✦ Check whether local expansion behind-level interface is loosened.
ON	OFF		The pre-scanned sub module and actual continuation sub module are not totally matched.	✦ Check if the continuation submodule is lost, or be in malfunction ✦ Check if appears hot plug or discharger ✦ Restart the power.

Chapter V Usage Description

5.1.Power Consumption Calculation Example

For coupler module, here, take ZMIO310-ECAT communication module as the example.

External ECAT communication module is supplied by DC24V, internal coupler supplies 5V power for each module, the max output current is 2A. Except itself internal power consumption 1.6W, and it supplies 8.4W power for each expansion submodule. Please see below form for reference.

Model	Description
ZMIO310-ECAT	ECAT communication module 1.6W
ZMIO310-16DI	Input module 0.3W
ZMIO310-16DO	Output module (NPN) 0.3W
ZMIO310-16DOP	Output module (PNP) 0.3W
ZMIO310-4AD	AD module 0.4W
ZMIO310-4DA	DA module 0.3W
...	...

5.2.IO Starting Number Configuration

5.2.1.EtherCAT Bus Expansion

If coupler uses ECAT communication module, IO starting numbers of IN input module and DO/DOP output modules are configured through "NODE_IO" command, AIO starting numbers of AD module and DA module are configured through "NODE_AIO" command.

NODE_IO			
Grammar	NODE_IO (slot, node) = iobase		
Parameters	slot	Controller bus slot No.	Default is 0
	node	Device No.	Start from 0, 0-

	iobase	IO start No.	Expanded input and output start numbers are the same
Example	NODE_IO (0,0) = 32 'expanded IO start No. of Node 0 is 32		
Notes	♣ IO start number only can be set as multiples of 8, like, 0, 8, 16, etc. If the IO start number is 30, which means it should be set as 24. ♣ Firstly, check the controller status to know the local IO maximum value of controller exactly, then use NODE_IO for avoid repetition. If expanded IO No. and local IO repeat, they are valid simultaneously, so it is not recommended.		

NODE_AIO		
Grammar	NODE_IO (slot, node) = aiobase	
Parameters	slot	Controller bus slot No.	Default is 0
	node	Device No.	Start from 0, 0-
	aiobase	AIO start No.	Expanded AD and DA start numbers are the same
Example	NODE_AIO (0,0) = 32 'expanded AIO start No. of Node 0 is 32	
Notes	♣ Firstly, check the controller status to know the local AIO maximum value of controller exactly, then use NODE_AIO for avoid repetition. If expanded AIO number and local AIO repeat, they are valid simultaneously, so it is not recommended.	

5.2.2. CAN Bus Expansion

If coupler uses CAN communication module, IO starting No. of input module and output module and AIO starting No. of AD module and DA module are configured through DIP (dial code switch). Dial 1-4 to set IO address, dial 5-6 to set CAN communication speed.

→ Digital IO Starting No. Configuration

The CAN expansion module uses bit1-4 of the DIP switch to set address combination value. Then, refer to current IO No., controller sets corresponding IO and AIO starting numbers o according to the address combination values. Dial each bit to OFF, the corresponding value is 0, when dial to ON, the corresponding value is 1. Address

combination value = dial code 4 × 8 + dial code 3 × 4 + dial code 2 × 2 + dial code 1.

If the controller itself contains 28 INs and 16 OPs, then the starting address of the first expansion module should exceed the maximum value of 28. According to below rule, the dial code should be set to the combination value 1 (binary combination value 0001, from right to left, dial code 1-4, at this time, dial 1 is set to ON, and the others are set to OFF), the IO No. on the expansion board = the expansion board No. value + the starting IO No. value, among them, the IOs that are vacant from 29-31 are not used. And subsequent extended boards continue to dial according to the IO points in turn.

The starting digital IO mapping No. starts from 16 and increases in multiples of 16. The distribution of digital IO numbers corresponding to different dial IDs is as follows.

DIP 1-4 combination value	Starting IO number	End IO number
0	16	31
1	32	47
2	48	63
3	64	79
4	80	95
5	96	111
6	112	127
7	128	143
8	144	159
9	160	175
10	176	191
11	192	207
12	208	223
13	224	239
14	240	255
15	256	271

→ Analog AD/DA Starting No. Configuration

The starting IO mapping No. of the analog AD starts from 8 and increases in multiples of 8. The starting IO mapping No. of the analog DA starts from 4 and increases in multiples of 4. The allocation of digital IO numbers corresponding to different dial code IDs is as follows:

DIP 1-4 combination value	Starting AD number	End AD number	Starting DA number	End DA number
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

→ Communication Speed Configuration

Dial code 5-6 to select CAN bus communication speed, speed combination value=dial code 6 × 2 + dial code 5×1, the combined value range is 0-3.

The corresponding speeds are as follows:

DIP 5-6 combination value	CANIO_ADDRESS high 8-bit value	CAN communication speed
0	0 (corresponds to decimal 128)	500KBPS (default value)
1	1 (corresponds to decimal 256)	250KBPS
2	2 (corresponding to decimal 512)	125KBPS
3	3 (corresponding to decimal 768)	1MBPS

● Please select CAN communication speed ratio according to actual application. There are some elements should be considered, such as, transfer distance, delay time, etc. It is recommended to use 500K for Baud rate.

5.3. Read & Write Digital, Analog

Expanded IO, AD and DA can be operated through input and output instructions, like, IN, OP, AIN, AOUT.

Type	Relative Module	Exact model	Instruction	Permission	View
Input	DI module	ZMIO310-16DI	IN	Read Only	IN
Output	DO / DOP module	ZMIO310-16DO ZMIO310-16DOP	OP	Read & Write	OUT
AD	AD module	ZMIO310-4AD	AIN	Read Only	AD/DA
DA	DA module	ZMIO310-4DA	AOUT	Read & Write	AD/DA

Check and set AD, DA module range through CANIO_INFO (can id, 17, submodule address), for more details, please refer to Basic Manuals.

5.4. Local Behind-level Expansion Address Description

After coupler module is power-on, it will scan local back-level expansion interface, and it will assign one expansion address for each scanned expansion submodule.

→Expansion example:

Like, the local back-level interface of ECAT communication module (ZMIO310-ECAT) connects to 3 input modules (ZMIO310-16DI), 2 output modules (ZMIO310-16DO / ZMIO310-16DOP), 1 AD module (ZMIO310-4AD) and 1 DA module (ZMIO310-4DA) in turn.

ECAT communication module starts to scan and assigns address when it is power-on. The submodule address is assigned starting from 0, then assign the address according to the connection sequence, that is, the expansion address of the first input module is 0, the expand address of DA module is 6.

Module sequence	Model name	Assigned address
ECAT Coupler	ZMIO310-ECAT	/
The first submodule	ZMIO310-16DI	0

The second submodule	ZMIO310-16DI	1
The third submodule	ZMIO310-16DI	2
The fourth submodule	ZMIO310-16DO	3
The fifth submodule	ZMIO310-16DOP	4
The sixth submodule	ZMIO310-4AD	5
The seventh submodule	ZMIO310-4DA	6

➢ This expand address is used to build data dictionary, and the address assign is not influenced by expansion submodule type.

➢ For CAN communication module, the address assigned is only for internal control.

5.5. Function Configuration

The function configuration is only valid when coupler uses ECAT communication module to expand, and needs to use bus instruction SDO_WRITE to write SDO message, use SDO_READ instruction to read message.

→ Write Data Dictionary

SDO_WRITE			
Grammar	SDO_WRITE(slot, node, index, subindex, type, value)		
Parameter List	Slot	Bus slot No.	Default is 0
	Node	Device No.	Start from 0, 0
	Index	Data dictionary No.	-
	Subindex	Sub module No.	-
	Type	Data type	Refer to below form
	Value	Data value	-

→ Read Data Dictionary

SDO_READ			
Grammar	SDO_READ(slot, node, index, subindex, type, tablenum)		
Parameter List	Slot	Bus slot No.	Default is 0
	Node	Device No.	Start from 0, 0
	Index	Data dictionary No.	-

	Subindex	Sub No.	-
	Type	Data type	Refer to below form
	tablenum	Read the TABLE position that saves data	-

➢ For configurable functions, instruction usage and module function configuration, please refer to 6.4-expansion example.

→ Type: data type

Fill "type" value according to data type described by data dictionary.

"type" value	Corresponding Data Type
1	boolean
2	integer 8
3	integer 16
4	integer 32
5	unsigned 8
6	unsigned 16
7	unsigned 32

Chapter VI Data Dictionary Description

The data dictionary description only can be built by ECAT communication module, CAN module doesn't have data dictionary.

6.1. Format Description

Index (hex)	Subindex (hex)	Object name	Default value	Data range	Data type	Permission

- ✧ Index (hex): the index No. of object, a 4-bit hexadecimal system number.
- ✧ Subindex (hex): the subindex No. of object, a 2-bit hexadecimal system number.
- ✧ Object name: the name of object. For subindex, it is the name of subindex.
- ✧ Default value: the value is configured by default.
- ✧ Data range: for the object that only can be read, it is the read range. For the object that can be read and written, it is the configuration range.
- ✧ Data type: data type of object
- ✧ Permission: it is used to determine the object that only can read or be read and written.

6.2. Data Dictionary Overview

Below form shows all dictionary overviews of ZMIO310-ECAT communication module.

Note: the address of the expansion sub-module is numbered from 0 according to the order of access to the coupler, for example, the first expansion sub-module connected to the coupler has an address of 0, the second expansion sub-module has an address of 1, and so on.

Index	Subindex	Description
5000h	-	Ser work mode for equipment.
	00h	The category of work modes.
	01h	Recover to initial state when power off, or hold the state when power off.

	02h	Work mode: normal mode or update mode.
(5001+expansion submodule address) h	-	Control dictionary.
	00h	The number of configured types.
	01h	Configure or get the type of AD/DA analog range.
	02h	Configure AD analog channel switch.
(6000+10*expansion submodule address) h	-	Status dictionary.
	00h	The number of state dictionary subindex of DI module.
	01h	Get the input state value of DI module channel.
(7000+10*expansion submodule address) h	-	Control dictionary.
	00h	The number of control dictionary subindex of DO/DOP module.
	01h	Configure DO/DOP module output value or get DO/DOP module output state
(6001+10*expansion submodule address) h	-	Status dictionary.
	00h	The number of status dictionary subindex of AD module.
	01h	Get the input status value of AD module channel 0.
	02h	Get the input status value of AD module channel 1.
	03h	Get the input status value of AD module channel 2.
	04h	Get the input status value of AD module channel 3.
(7001+10*expansion submodule address) h	-	Control dictionary.
	00h	The number of control dictionary subindex of DA module.
	01h	Configure the output value of DA module channel 0.
	02h	Configure the output value of DA module channel 1.
	03h	Configure the output value of DA module channel 2.
	04h	Configure the output value of DA module channel 3.

●   For expansion submodule address allocation, please refer to 6.4 example.

6.3. Data Dictionary Details

Index	Subindex	Object	Default	Data Range	Data Type	Permission
5000h	00h	CANFIG_DATA	2	2	UNSIGND8	RO
		● It indicates the category of work mode, namely, the number of default subindex.				

		● The fixed value is 2.				
	01h	CANFIG_1_INDENT	2	1 or 2	UNSIGND16	RW

		● In indicates the state after power off, resume initial state or keep state.
		 ● The usage of data value:
		    1. After communication breaks, output states of DO/DOP module and DA module recover initial values.
		    2. After communication breaks, output states of DO/DOP module and DA module keep current states.				

	02h	CONFIG_2_INDENT	0	0 or 5678	UNSIGND16	RW
		● Configure work mode ● The usage of data value: 0: normal mode 5678: update mode. ● Note: after entered update mode, if not to update, please power-on again, it will exit automatically, this update mode is used to update firmware of ECAT communication module.				
(5001 + expansion submodule address) h	00h	CONFIG_DATA	2	2	UNSIGND8	RO
		● The number of default subindex, the fixed value is 2. ● Expansion submodule address: the nearest expansion submodule address to coupler is 0, addresses of following other modules accumulate in order, namely, 0, 1, 2, 3…				
	01h	CONFIG_1_INDENT	2	2~7 or 10~15	UNSIGND16	RW
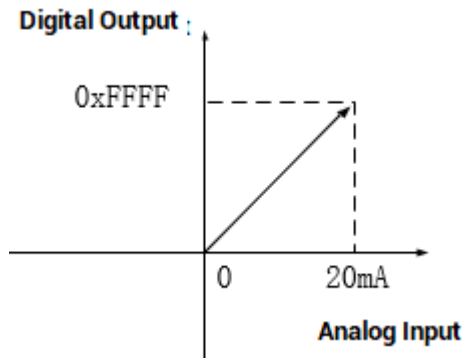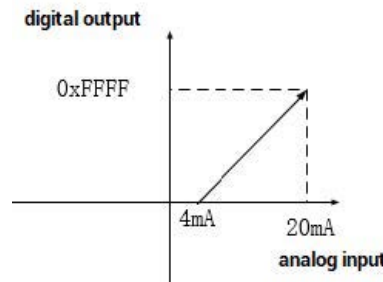
- Configure the range type of analog module, or read range type value
- The meaning of data values:

Module Type	Data Value	Range Type
AD	2	0~10V
	3	-10V~10V
	4	4~20mA
	5	0~20mA
	6	0~5V
	7	-5~5V
DA	10	0~10V
	11	-10V~10V
	12	4~20mA
	13	0~20mA
	14	0~5V
	15	-5~5V

02h	CONFIG_2_INDENT	15	0~15	UNSIGND16	RW

- Configure AD module channel data.

- Data value model, namely, correspond to 4 channels of AD module.

AD Module	CH3	CH2	CH1	CH0
Value (16 hexadecimal)	8	4	2	1

- The meaning of each data value:

Data Value	Range Type
0	All channels are OFF.
1	Channel 0 is ON.
2	Channel 1 is ON.
3	Channel 0 and channel 1 are ON.
4	Channel 2 is ON.
5	Channel 0 and channel 2 are ON.
6	Channel 1 and channel 2 are ON.
7	Channel 0, 1, 2 are ON.
8	Channel 3 is ON.
9	Channel 0 and channel 3 are ON.
10	Channel 1 and channel 3 are ON.
11	Channel 0, 1, 3 are ON.
12	Channel 2 and channel 3 are ON.
13	Channel 0, 2, 3 are ON.
14	Channel 1, 2, 3 are ON.
15	All channels are ON.

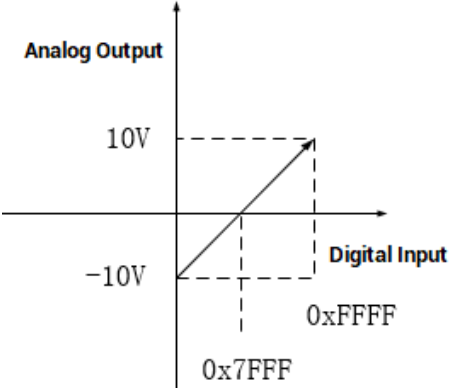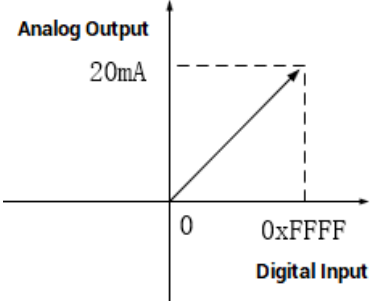| (6000 + 10* expansion submodule address) h	00h	IN_GENERIC	1	1	UNSIGND8	RO
		• The number of default subindex, the fixed value is 1. • Expansion submodule address: the nearest expansion submodule address to coupler is 0, addresses of following other modules accumulate in order, namely, 0, 1, 2, 3…				
	01h	IN_GENE_INT1	0	0x0000 ~0xFFFF	UNSIGND16	RO

- Get the input state value of DI module channel.
- The usage of data value: 4-digit hexadecimal number is converted into 16-bit binary number, each 1-bit represents the input status of each channel.

  For example: the obtained input value is 0x0FF0, and the content of the channel status is as follows:

Channel	CH 15	CH 14	CH 13	CH 12	CH 11	CH 10	CH 9	CH 8
Bit (binary)	0	0	0	0	1	1	1	1
Hexadecimal	0				F			
Channel	CH 7	CH 6	CH 5	CH 4	CH 3	CH 2	CH 1	CH 0
Bit (binary)	1	1	1	1	0	0	0	0
Hexadecimal	F				0			

(7000 + 10* expansion submodule address) h	00h	OUT_GENERIC	1	1	UNSIGND8	RO
		- The number of default subindex, the fixed value is 1. - Expansion submodule address: the nearest expansion submodule address to coupler is 0, addresses of following other modules accumulate in order, namely, 0, 1, 2, 3…				
	01h	OUT_GEN_INT1	0	0x0000 ~0xFFFF	UNSIGND16	RW

- Configure the output value of DO/DOP module channel, or get the output state of DO/DOP module channel.
- The usage of data value: 4-digit hexadecimal number is converted into 16-bit binary number, each 1-bit represents the output status of each channel.

For example: the configured output value is 0x1FF1, and the content of the channel status is as follows:

Channel	CH 15	CH 14	CH 13	CH 12	CH 11	CH 10	CH 9	CH 8
Bit (binary)	0	0	0	0	1	1	1	1
Hexadecimal	1				F			
Channel	CH 7	CH 6	CH 5	CH 4	CH 3	CH 2	CH 1	CH 0
Bit (binary)	1	1	1	1	0	0	0	0
Hexadecimal	F				1			

(6001 + 10* expansion submodule address) h	00h	IN_GENERIC	4	4	UNSIGND8	RO

- The number of default subindex, the fixed value is 4.
- Expansion submodule address: the nearest expansion submodule address to coupler is 0, addresses of following other modules accumulate in order, namely, 0, 1, 2, 3…

	01h	IN_GEN_INT1	0	0x0000 ~0xFFFF	UNSIGND16	RO

- Get input state value of AD module channel 0.
- The meaning of date value:

0x0000~0xFFFF means the scale value of analog, which is converted from gained analog AD.

For example: if the current range of AD module is 0~5V:

		Digital converted from AD is represented by Y. Analog gained from DA is represented by X. And AD input value can be calculated from the above graphic: (Y-0)/ (0xFFFF-0) = (X-0) / (5V-0), namely, Y = 0xFFFF*X / 5V. Value X is the gained known condition of current AD module, value Y is converted from AD through PC side. Same, value Y is gained from PC, then X value can be calculated reversely.				
	02H	IN_GEN_INT2	0	0x0000 ~0xFFFF	UNSIGND16	RO
		● Get the input state value of AD channel 1. ● The meaning of date value: 0x0000~0xFFFF means the scale value of analog, which is converted from gained analog from AD. For example: if the current range of AD module is -5~5V: Digital converted from AD is represented by Y. Analog gained from DA is represented by X. And AD input value can be calculated from the above graphic: (Y-0)/ (0xFFFF-0) = [X-(5V)] / [5-(-5V)], namely, Y = 0xFFFF* [X-(5V)] / [5V-(-5V)]. Value X is the gained known condition of current AD module, value Y is converted from AD through PC side. Same, value Y is gained from PC, then X value can be calculated reversely.				
	03h	IN_GEN_INT3	0	0x0000 ~0xFFFF	UNSIGND16	RO
		● Get the input state value of AD channel 2. ● The meaning of date value: 0x0000~0xFFFF means the scale value of analog, which is converted from gained analog from AD.				

For example: if the current range of AD module is 0~20mA:

Digital converted from AD is represented by Y.

Analog gained from DA is represented by X.

And AD input value can be calculated from the above graphic: (Y-0)/ (0xFFFF-0) = [X-0] / (20mA-0)], namely, Y = 0xFFFF* / 20mA.

Value X is the gained known condition of current AD module, value Y is converted from AD through PC side. Same, value Y is gained from PC, then X value can be calculated reversely.

		IN_GEN_IN4	0	0x0000 ~0xFFFF	UNSIGND16	RO

04h

- Get the input state value of AD channel 3.
- The meaning of date value:

  0x0000~0xFFFF means the scale value of analog, which is converted from gained analog from AD.

  For example: if the current range of AD module is 4~20mA:

Digital converted from AD is represented by Y.

Analog gained from DA is represented by X.

And AD input value can be calculated from the above graphic: (Y-0)/ (0xFFFF-0) = [X-4mA] / (20mA-4mA)], namely, Y = 0xFFFF* / (X-4Ma) / (20mA-4mA).

Value X is the gained known condition of current AD module, value Y is converted from AD through PC side. Same, value Y is gained from PC, then

		X value can be calculated reversely.				
(7001 + 10* expansion submodule address) h	00h	OUT_GENERIC	4	4	UNSIGND8	RO
		● The number of default subindex, the fixed value is 4. ● Expansion submodule address: the nearest expansion submodule address to coupler is 0, addresses of following other modules accumulate in order, namely, 0, 1, 2, 3…				
	01h	OUT_GEN_INT1	0	0x0000 ~0xFFFF	UNSIGND16	RW
		● Get the input state value of DA channel 0. ● The meaning of date value: 0x0000~0xFFFF means the scale value of analog, input scale values from PC output analogs converted from DA. For example: if the current range of DA module is 0~10V: Analog converted from DA is represented by Y. Digital input from PC, namely, the scale value is represented by X. And DA output value can be calculated from the above graphic: (Y-0)/ (10V-0) = (X-0)/ (0xFFFF -0), namely, Y = 10*X / 0xFFFF. Value X is the known condition of current PC side, then value Y can be gained through DA conversion. Same, get DA output value firstly, then calculate value X reversely.				
	02h	OUT_GEN_INT2	0	0x0000 ~0xFFFF	UNSIGND16	RW
		● Get the output state value of DA channel 1. ● The meaning of date value: 0x0000~0xFFFF means the scale value of analog, input scale values from PC output analogs converted from DA. For example: if the current range of DA module is -10~10V:				

Analog converted from DA is represented by Y.

Digital input from PC, namely, the scale value is represented by X.

And DA output value can be calculated from the above graphic: Y-(-10V)]/ [10V-(-10V)] = (X-0)/ (0xFFFF -0), namely, Y = [10V-(-10V)] *X / 0xFFFF − 10V.

Value X is the known condition of current PC side, then value Y can be gained through DA conversion. Same, get DA output value firstly, then calculate value X reversely.

			0x0000 ~0xFFFF		
03h	OUT_GEN_INT3	0	0x0000 ~0xFFFF	UNSIGND16	RW

- Get the output state value of DA channel 2.

- The meaning of date value:

  0x0000~0xFFFF means the scale value of analog, input scale values from PC output analogs converted from DA.

  For example: if the current range of DA module is 0~20mA:

Analog converted from DA is represented by Y.

Digital input from PC, namely, the scale value is represented by X.

And DA output value can be calculated from the above graphic: (Y-0)/ (20mA-0) = (X-0)/ (0xFFFF -0), namely, Y = 20mA *X / 0xFFFF.

Value X is the known condition of current PC side, then value Y can be gained through DA conversion. Same, get DA output value firstly, then

		calculate value X reversely.				
04h		OUT_GEN_INT4	0	0x0000 ~0xFFFF	UNSIGND16	RW

- Get the output state value of DA channel 3.
- The meaning of date value:

  0x0000~0xFFFF means the scale value of analog, input scale values from PC output analogs converted from DA.

  For example: if the current range of DA module is 4~20mA:

Analog converted from DA is represented by Y.

Digital input from PC, namely, the scale value is represented by X.

And DA output value can be calculated from the above graphic: (Y-4mA)/ (20mA-4mA) = (X-0)/ (0xFFFF -0), namely, $Y = (20mA-4mA)*X / 0xFFFF + 4mA$.

Value X is the known condition of current PC side, then value Y can be gained through DA conversion. Same, get DA output value firstly, then calculate value X reversely.

6.4. Expansion Example

The data dictionary 5000h must be created, others are created or not according to connected extended sub-modules.

An extended sub-module is connected each time, a corresponding state value data dictionary will be created. For AD module and DA module, the corresponding control data dictionary will also be created.

6.4.1.Expansion Submodule Address Allocation

For example: the local post-level interface of the ECAT communication module (ZMIO310-ECAT) is sequentially connected to 3 input modules (ZMIO310-16DI), 2 output modules (ZMIO310-16DO or ZMIO310-16DOP), 1 AD module (ZMIO310-4AD) and 1 DA module (ZMIO310-4DA), and the slot No. and device No. are both 0 by default.

The address of the expansion sub-module is numbered from 0, and the address of the expansion sub-module closest to the coupler module is 0, the addresses of other sub-modules are sequentially accumulated by 1, that is, the addresses of the DI modules are 0, 1, and 2 respectively, and the addresses of the DO modules are respectively 3, 4, AD address is 5, DA address is 6.

Then, data dictionary is created according to above:

Address	Remark	Dictionary description	
		Rule	**Dictionary**
-	-	-	5000h
0	The first DI module	Status dictionary: (6000+10*expansion submodule address) h	6000h
1	The second DI module		6010h
2	The third DI module		6020h
3	The first DO module	Control dictionary: (7000+10*expansion submodule address) h	7030h
4	The second DO module		7040h
5	The first AD module	Status dictionary: (6001+10*expansion submodule address) h	6051h
		Control dictionary: (5001+expansion submodule address) h	5006h
6	The first DA module	Control dictionary: (7001+10*expansion submodule address) h	7061h
		Control dictionary: (5001+expansion submodule address) h	5007h

● Please refer to Chapter 6.3 for dictionary details.

● The data dictionary corresponding to the address 0~6 will only be created when the corresponding expansion module is connected, that is, it will not be created when other modules are connected.

6.4.2. Output State Configuration after Communication Breaks

Function description	This function is used to keep the output state of DA/DO/DOP after the master-slave station communication is interrupted. There are two modes, and the default is mode 2. Mode 1: After the communication breaks, the output state is the initial value (the output is 0, DA is the minimum value of the current range). Mode 2: After the communication breaks, the output state is the state when it was disconnected.
Object to use	Digital output module: ZMIO310-16DO, ZMIO310-16DOP. Analog output module: ZMIO310-4DA.
Data dictionary	5000h (refer to 6.3 for details)
Examples	SDO_WRITE(0,0,$5000,1,6,1) 'configure as mode 1 SDO_WRITE(0,0,$5000,1,6,2) 'configure as mode 2

● This function is valid for output and DA expanded by the current coupler.

6.4.3. Channel Enable Configuration

Function description	This function is used to control whether the input channel of the AD module is enabled or not. There are 16 channel enabling modes, and the default is to enable all channels. A four-bit binary number represents the enable status of four channels, each bit is a channel, the lowest bit is channel 0, and the highest bit is channel 3.
Object to use	Analog input module: ZMIO310-4AD.
Data dictionary	5006h: 5001h + extension No. of the corresponding AD module, please refer to Chapter 6.4.1 for sub-module address assignment
Examples	'5006h is AD module control dictionary SDO_WRITE(0,0,$5006,2,6,0) 'full channels are OFF. SDO_WRITE(0,0,$5006,2,6,3) 'channel 0, 1 are ON.

| | SDO_WRITE(0,0,$5006,2,6,12)   'channel 2, 3 are ON. |
| | SDO_WRITE(0,0,$5006,2,6,15)   'full channels are ON. |

● This function is valid for current AD module.

6.4.4. Range-Switch Configuration

Function description	This function is used to switch the range of the input channel of the AD module (or the output channel of the DA module), and the default value of both modules is the range of 0~10V The measuring range corresponds to the type number of the expansion sub-module, please refer to the table below.
Object to use	Analog input module: ZMIO310-4AD. Analog output module: ZMIO310-4DA.
Data dictionary	5007h, 5006h: 5001h + extension No. of the corresponding AD module or DA module, please refer to Chapter 6.4.1 for sub-module address assignment.
Examples	'5007h is the DA module control dictionary, 5006h is the AD module control dictionary. SDO_WRITE(0,0,$5006,1,6,3) 'AD module is switched to -10~10V range SDO_WRITE(0,0,$5006,1,6,5) 'AD module is switched to 0~20mA range SDO_WRITE(0,0,$5007,1,6,11) 'DA module is switched to -10~10V range SDO_WRITE(0,0,$5007,1,6,13) 'DA module is switched to 0~20mA range

Type number description:

Type No.	Type name	Module type	Corresponding range
1	ZM1111	Input module	--
2	ZM1112	AD module	0~10V
3	ZM1113	AD module	-10~10V
4	ZM1114	AD module	4~20mA

5	ZM1115	AD module	0~20mA
6	ZM1116	AD module	0~5V
7	ZM1117	AD module	-5~5V
9	ZM2111	Output module	--
10	ZM2112	DA module	0~10V
11	ZM2113	DA module	-10~10V
12	ZM2114	DA module	4~20mA
13	ZM2115	DA module	0~20mA
14	ZM2116	DA module	0~5V
15	ZM2117	DA module	-5~5V

● This function is valid for current AD module (or DA module).

● One AD module (or DA module) cannot use multiple ranges, and all channels use the same one range, different modules can match with multi-range.

● Type No.1 and No.9 are fixedly used by input module and output module. Type No.2~No.7 are used only by AD module, Type No.10~No.15 are used only by DA module.

● When using AD module, if input voltage (or current) exceeds the range, then it will keep with the maximum value.

6.4.5. Get Channel Input State Value of AD Module

Function description	This function is only used to read channel input state value of AD module, and one of AD module has 4 channels, they are channel 0, channel 1, channel 2 and channel 3.
Object to use	Analog input module: ZMIO310-4AD.
Data dictionary	6051h: 6001h + extension No. of corresponding AD module * 10, please refer to Chapter 6.4.1 for sub-module address assignment.
Examples	'6051h is AD module state dictionary 'read data are saved into TABLE, then get the data through TABLE command SDO_READ (0,0,$6051,1,6,100) 'get input state of channel 0

	? TABLE(100)	'print read data of channel 0
	SDO_READ (0,0,$6051,2,6,100)	'get input state of channel 1
	? TABLE(100)	'print read data of channel 1
	SDO_READ (0,0,$6051,3,6,100)	'get input state of channel 2
	? TABLE(100)	'print read data of channel 2
	SDO_READ (0,0,$6051,4,6,100)	'get input state of channel 3
	? TABLE(100)	'print read data of channel 3

6.4.6. Get Channel Input State Value of DI Module

Function description	This function is only used to read channel input state value of DI module, and one of DA module has 16 channels (channel 0-15). Four hexadecimal numbers are converted to sixteen binary numbers, each bit represents the input status of each channel.
Object to use	Analog input module: ZMIO310-16DI.
Data dictionary	6000h, 6010h, 6020h: 6000h + extension No. of corresponding DI module * 10, please refer to Chapter 6.4.1 for sub-module address assignment.
Examples	'6000h, 6010h, 6020h are DI module status dictionary 'The read data is stored in the TABLE, you need to use the TABLE command to get the content. SDO_READ(0,0,$6000h,1,6,100) 'get the 16 channel input status of the first DI module ? TABLE(100) 'print the channel status of the first DI module SDO_READ(0,0,$6010h,1,6,100) 'get the 16 channel input status of the second DI module ? TABLE(100) 'print the channel status of the second DI module SDO_READ(0,0,$6020h,1,6,100) 'get the 16 channel input status of the third DI module ? TABLE(100) 'print the channel status of the third DI module

6.4.7.Configure Channel Output Value of DO Module

Function description	This function is only used to configure the channel output value of DO module, and one of DO module has 16 channels (channel 0-15). Four hexadecimal numbers are converted to sixteen binary numbers, each bit represents the output status of each channel.
Object to use	Analog output module: ZMIO310-16DO
Data dictionary	7030h, 7040h: 7000h + extension No. of corresponding DO module * 10, please refer to Chapter 6.4.1 for sub-module address assignment.
Examples	'7030h, 7040h are the DO module control dictionary 'configure the channel state of the first DO module's high 8 bits to ON, and the low 8 bits to OFF SDO_WRITE(0,0,$7030h,1,6, 0xFF00) 'configure the channel state of the second DO module's high 8 bits to OFF, and the low 8 bits to ON. SDO_WRITE(0,0,$7040h,1,6, 0x00FF)

Note: if SDO command is used to configure DO output, it is only valid before EtherCAT START, because after EtherCAT START, controller will open PDO command to configure DO channel output automatically, PDO real-time is high, and it covers DO channel data of SDO configuration. PDO command corresponds to OP in ZBasic, please refer to ZBasic manual for specific usage of OP.

6.4.8.Configure Channel Output Value of DA Module

Function description	This function is only used to configure the channel output value of DA module, and one of DA module has 4 channels, they are channel 0, channel 1, channel 2, and channel 3.
Object to use	Analog output module: ZMIO310-4DA.
Data dictionary	7061h: 7001h + extension No. of corresponding DA module * 10, please refer to Chapter 6.4.1 for sub-module address

	assignment.
Examples	'7061h is the DA module control dictionary SDO_WRITE(0,0,$7061,1,6,65535) 'configure output value of channel 0 as 0xFFFF SDO_WRITE(0,0,$7061,2,6,65535) 'configure output value of channel 1 as 0xFFFF SDO_WRITE(0,0,$7061,3,6,65535) 'configure output value of channel 2 as 0xFFFF SDO_WRITE(0,0,$7061,4,6,65535) 'configure output value of channel 3 as 0xFFFF

Note: if SDO command is used to configure DA output, it is only valid before EtherCAT START, because after EtherCAT START, controller will open PDO command to configure DA channel output automatically, PDO real-time is high, and it covers DA channel data of SDO configuration. PDO command corresponds to AOUT in ZBasic, please refer to ZBasic manual for specific usage of AOUT.

Chapter VII Run and Maintain

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

7.1. Regular Inspection and Maintenance

The working environment has an impact on the controller. Therefore, it is usually inspected regularly based on the inspection cycle of 6 months to 1 year. The inspection cycle of the motion controller 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 24 V（-10%~10%）
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 explosive gases or articles	No

	Whether the controller 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

Problems	Suggestions
No signal comes to the input.	1. Check whether the limit sensor works 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 public end of the controller.
Ethernet can't connect	1. Check whether the led of Ethernet is ON or not. 2. Check whether the network cable suits the requirements. 3. Check whether the correct ethernet port is inserted.
The output does not work.	1. Check whether IO power is needed. 2. Check whether the output No. is consistent with operated one.
No voltage and current	1. Check whether IO power is needed.

signal for input channel	2. Check whether the output No. is consistent with operated one.
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 separately, and restart the controller after adjustment. 2. Check whether the ALM light flickers regularly (hardware problem).
RUN led is ON, ERR led is ON.	1. Program running error, please check ZDevelop 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. 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)