



Q-series Programmable Logic Controller

Hardware Manual

Introduction

Thank you for purchasing Q series PLCs and the extension modules.

This manual gives the necessary information for the use of HCFA Q series PLCs and extension modules, please read this manual carefully before use and make the correct operation with full attention to safety. Store this manual in a safe place so that it can be taken out and read whenever necessary.

Applicable readers

For the users of HCFA Q series PLC, refer to this manual to perform the wiring, installation, diagnosis and maintenance and requires the users to have the certain knowledge of electrical and automation.

Main contents

Safety precautions : The following notation is used in this user's manual to provide precautions required to ensure safe usage of Q series PLCs.

Version description : Check the version of PLCs on the nameplate

Chapter 1 mainly introduces Q series PLCs system configuration and startup process.

Chapter 2 mainly introduces model name of Q series PLCs and the extension modules.

Chapter 3 mainly introduces the specifications of Q series PLCs and the extension modules.

Chapter 4 mainly introduces the assembly, wiring and installation for Q series PLCs and the extension modules.

Chapter 5 mainly introduces the operation, maintenance and diagnosis of Q series PLCs.

The appendix mainly introduces the specifications for customized cables and screwdriver.

Safety Precautions

Before use

Before use, read this manual fully to acquire proficiency in the mounting, wiring, operation, maintenance and troubleshooting of the product. And, store this manual in a safe place so that it can be taken out and read whenever necessary.

Symbol description

Before use, read this manual and manuals of relevant products fully to acquire proficiency in the handling and operating the product. The safety precautions that are provided are extremely important to safety. Always read and heed the information provided in all safety precautions.

The following notation is used as below :


	<p>⊘ indicates operations that you must not do</p> <p>The specific operation is shown after ⊘ and explained in text.</p> <p>This symbol indicates prohibiting disassembly.</p>
	<p>The triangle symbol indicates precautions (including warnings)</p> <p>The specific operation is shown in the triangle and explained in text</p> <p>This symbol indicates a general precaution.</p>
	<p>The triangle symbol indicates precautions (including warnings)</p> <p>The specific operation is shown in the triangle and explained in text</p> <p>This symbol indicates a precaution for electric shock</p>
	<p>The triangle symbol indicates precautions (including warnings)</p> <p>The specific operation is shown in the triangle and explained in text</p> <p>This symbol indicates high temperature.</p>
	<p>● indicates operations that you must do.</p> <p>The specific operation is shown in the circle and explained in text.</p> <p>This symbol shows a general precaution for something that you must do</p>

This manual classify the safety precautions into two categories: "WARNING" and "CAUTION" :

 DANGER	<p>Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury or significant property damage</p>
 WARNING	<p>Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight personal injury or physical damage.</p>









Other symbols are explained as follows :

- Tips**
- A warning that an error is likely to occur.

 "Indicates the reference page"

Depending on circumstances, procedures indicated by WARNING may also be linked to serious results. In any case, it is important to follow the directions for usage as they are very important for personal safety. Failure to do so may cause damage to the equipment, or death or severe injury or significant property damage.

Store this manual in a safe place so that you can take it out and read it whenever necessary. Always forward it to the end user.

Control system design	
❖ WARNING	
<ul style="list-style-type: none"> • Make sure to have the following safety circuits outside of the PLC to ensure safe system operation even during external power supply problems or PLC failure. 	
<ul style="list-style-type: none"> • In case of excessive current of the system for a long time in the output circuit due to exceeding the rated load current or short circuit of the load, the module may emit smoke or catch fire, install the safety devices externally such as fuse or circuit breaker. 	
❖ CAUTION	
<ul style="list-style-type: none"> • Make sure to have the following: an emergency stop circuit, a protection circuit, an interlock circuit for opposite movements (such as normal vs. reverse rotation), and an interlock circuit (to prevent damage to the equipment at the upper and lower positioning limits) 	
<ul style="list-style-type: none"> • For output signals that may lead to serious accidents, external circuits and mechanisms should be designed to ensure safe machinery operation in such a case 	
<ul style="list-style-type: none"> • Note that when the PLC CPU detects an error, all outputs are turned off. External circuits and mechanisms should be designed to ensure safe machinery operation in such a case. 	
<ul style="list-style-type: none"> • Note that when an error occurs in a relay, triac or transistor output device, the output could be held either on or off. 	
<ul style="list-style-type: none"> • The PLC is designed to be used indoors and in electrical environment with overvoltage level II. The power system should have lightning protection devices, to ensure that the lightning overvoltage is not applied to the power input/ signal input/control output ports to avoid damage to the equipment. 	
Disassembly and fall	
❖ WARNING	
<ul style="list-style-type: none"> • Do not disassemble or modify the PLC. Doing so may cause fire, equipment failures, or malfunctions. 	












<ul style="list-style-type: none"> Do not drop the PLC or add excessive vibration or shock to the device. Doing so may cause failure or malfunctions. 	
--	--




For installation






❖ WARNING	
<ul style="list-style-type: none"> For the installation, wiring, maintenance and inspection of this product, only professional technical personnel who have received relevant training on electrical equipment are qualified . 	
<ul style="list-style-type: none"> Make sure to cut off all phases of the power supply externally before attempting installation or wiring work. Failure to do so may cause electric shock or damage to the product. 	
<ul style="list-style-type: none"> Do not operate or store the Units in the following locations: Dust, oil mist, corrosive or flammable gases; exposure to high temperature, condensation, direct sunlight or vibration/shock. 	
<ul style="list-style-type: none"> The PLC is an open device and should be installed in control cabinet with protection level above IP 20. Only the qualified and authorized specialist can open the control cabinet. 	
<ul style="list-style-type: none"> In order to ensure that the working temperature of PLC is within the specified ambient temperature range, there should be enough ventilation space. If the ambient temperature exceeds 55°C, install additional fans to force ventilation. 	
❖ CAUTION	
<ul style="list-style-type: none"> When the PLC is installed vertically, it is necessary to prevent wire chips and iron powder from falling into the ventilation. Failure to do so may cause malfunction, misoperation or fire. 	
<ul style="list-style-type: none"> After installing the PLC , make sure there is no foreign matter on the ventilation surface. Otherwise it may not dissipate heat normally during operation, causing misoperation, malfunction or fire. 	
<ul style="list-style-type: none"> When installing the modules, they should be firmly connected to each other. If the module is not installed properly, it may cause module misoperation, failure or falling off. 	
<ul style="list-style-type: none"> In order to avoid electromagnetic interference from other peripheral devices, the PLC should be kept as far away from the high-voltage cable and equipment. At least 200mm should be kept between the PLC and the power cable, 	


For wiring


❖ WARNING	
<ul style="list-style-type: none"> For the installation, wiring, maintenance and inspection of this product, only professional technical personnel who have received relevant training on electrical equipment are qualified . 	
<ul style="list-style-type: none"> Make sure to cut off all phases of the power supply externally before attempting installation or wiring work. Failure to do so may cause electric shock or damage to the product. 	

<ul style="list-style-type: none"> ● The cable terminals should be well insulated to ensure that the insulation distance between the cables will not decrease after the cables are installed on the terminal block, otherwise it will cause electric shock, equipment failure, and damage 	
<ul style="list-style-type: none"> ● Appropriate protection devices should be installed on the input cables, such as the circuit breaker or external fuse with fusing and detection characteristics. When selecting protection devices, the rated current of equipment, overload capacities and short-circuit should be considered. 	
<ul style="list-style-type: none"> ● After installation and wiring completion, install the terminal block on the product during power-on and operation. Otherwise it will cause electric shock, equipment failure, and damage 	
<ul style="list-style-type: none"> ● Do not twist or pull the cable forcibly, otherwise it will cause electric shock, equipment failure and damage. 	
<ul style="list-style-type: none"> ● If the dust-proof label attached on the modules, make sure to remove the label before power-ON. Otherwise, the device may not be able to dissipate heat normally, causing malfunction, misoperation and damage. 	
❖ CAUTION	
<ul style="list-style-type: none"> ● In order to ensure the safety of the equipment and operators, the equipment needs cables of sufficient diameter and size for reliable grounding. For details, please refer to Chapter Wiring. 	
<ul style="list-style-type: none"> ● The specifications and installation methods of external wiring should comply with the local power distribution regulation. For details, please refer to Chapter Wiring. 	
<ul style="list-style-type: none"> ● Make the wiring after confirming the interface type. If connecting to the wrong port or making incorrect wiring, it may cause misoperation or damage to the equipment. 	
<ul style="list-style-type: none"> ● Tightening torque should follow the specifications in this manual. Loosen tightening may cause misoperation, short-circuit or fire; Overtight tightening may damage the screws or modules, causing falling off, misoperation, short-circuit or fire. 	
<ul style="list-style-type: none"> ● Do not bundle the control line together with or lay it close to the main circuit or power line. As a guideline, lay the control line at least 100mm (3.94") or more away from the main circuit or power line. 	
<ul style="list-style-type: none"> ● For applications with severe interference, please select shielded cables for the I/O cables to improve the anti-interference capacity. 	

For operation	
❖ WARNING	
<ul style="list-style-type: none"> ● For the installation, wiring, maintenance and inspection of this product, only professional technical personnel who have received relevant training on electrical equipment are qualified. 	
<ul style="list-style-type: none"> ● Do not apply voltage or current exceeding the specified range to the slave or terminal module, otherwise it may cause equipment failure or damage. 	
<ul style="list-style-type: none"> ● Do not touch the terminal at power-ON, Failure to do so may cause electric shock or misoperation. 	

<ul style="list-style-type: none"> ● Make sure to cut off all phases of the power supply externally before rearrange, replace and install the modules. Failure to do so may cause electric shock. 	
<ul style="list-style-type: none"> ● Turn of the power to the PLC before attaching or detaching the modules or communication cables. Failure to do so may cause electric shock. 	
❖ CAUTION	
<ul style="list-style-type: none"> ● Have the operation after confirming the security before online modification, forced output, operation and stop. 	
<ul style="list-style-type: none"> ● Do not touch the device during power-on or immediately after power-off. Failure to do so may cause burns. 	
<ul style="list-style-type: none"> ● Make sure to replace the button battery after power-off. If the battery needs to be replaced during operation , it must be operated by professional electrical technicians after wearing insulating gloves, and the replacement should be completed as soon as possible, otherwise it may cause data loss. 	

Disposal	
❖ CAUTION	
<ul style="list-style-type: none"> ● Please contact a certified electronic waste disposal company for the environmentally safe recycling and disposal of your device. 	

Transportation	
❖ CAUTION	
<ul style="list-style-type: none"> ● During transportation, avoid impacts larger than those specified in this manual. Failure to do so may cause failures in the PLC 	

Terminology

Terminology	Description
PLC	Programmable Logic Controller
IDE	Integrated Development Environment
POU	Program Organization Unit
I/O	Input/Output
CPU unit	Q series Programmable Logic Controller
Extension module	Extension I/O module, special module
ESC	EtherCAT Slave Controller

Table of Contents

Introduction.....	1
Applicable readers.....	1
Main contents.....	1
Safety Precautions.....	1
Before use	1
Symbol description	1
Terminology	5
Chapter 1 System Configuration	8
1-1 Q series PLC introduction	8
1-1-1 System configuration.....	8
1-1-2 Module overview	9
1-1-3 System startup procedures.....	10
Chapter 2 Part Names and Functions	11
2-1 CPU unit	11
2-1-1 Model name for CPU unit	11
2-1-2 Part names.....	13
2-2 AC power module (to be supported)	18
2-3 EC coupler	18
2-3-1 EC coupler model name and part names.....	19
2-3-2 EtherCAT introduction.....	22
2-3-3 EtherCAT slave controller (ESC).....	24
2-4 Digital I/O modules (ID/OD)	25
2-4-1 Digital input module model name and part names	25
2-4-2 Digital output module model name and part names	28
2-4-3 Digital I/O module model name and part names	31
2-5 Analog I/O (AD/DA) module	33
2-5-1 Analog input module model name and part names	33
2-5-2 Analog output module model name and part names	37
2-6 Terminal module (Not updated)	40
Chapter 3 Specifications.....	41
3-1 General specifications	41
3-1-1 Electrical specifications	41
3-1-2 Environment specifications	41
3-2 Performance specifications.....	42
3-2-1 CPU unit specifications	42
3-2-2 AC power module specifications (not updated)	43
3-2-3 EC coupler module specifications.....	43
3-2-4 Digital input module specifications.....	44
3-2-5 Digital output module specifications	45
3-2-6 Digital I/O module specifications.....	46
3-2-7 Analog (voltage) input module specifications.....	48
3-2-8 Analog (voltage) output module specifications.....	55
3-2-9 Terminal module specifications (not updated)	60

Chapter 4 Installation and wiring	61
4-1 Module connection.....	61
4-1-1 Installing moduels.....	61
4-1-2 Precautions for module correction.....	62
4-2 Module wiring	62
4-2-1 Precautions on wiring.....	62
4-2-2 Precautions on module grounding.....	63
4-2-3 Connector installation and wiring	64
4-3 Module wiring	68
4-3-1 CPU unit high-speed I/O wiring.....	68
4-3-2 EC coupler wiring.....	71
4-3-3 Digital input module wiring	71
4-3-4 Digital output module wiring.....	72
4-3-5 Digital I/O module wiring	72
4-3-6 Analog input module wiring	73
4-3-7 Analog output module wiring.....	74
4-4 Module installation	75
4-4-1 Installation environment.....	75
4-4-2 Installation places	75
4-4-3 Installation procedures.....	77
4-4-4 DIN rail mounting	77
4-4-5 Removal from DIN rail.....	79
4-4-6 Replace modules.....	79
Chapter 5 Maintenance and operation	81
5-1 RUN/STOP.....	81
5-2 Troubleshooting	81
5-2-1 CPU unit and extension module error	81
5-3 Periodic inspections	83
5-3-1 Periodic inspections	83
5-3-2 Requirements for replacing units.....	84
Appendices	86
Appendix 1 Screwdriver specifications description.....	86
Appendix 2 Customized network cable for EC module.....	86

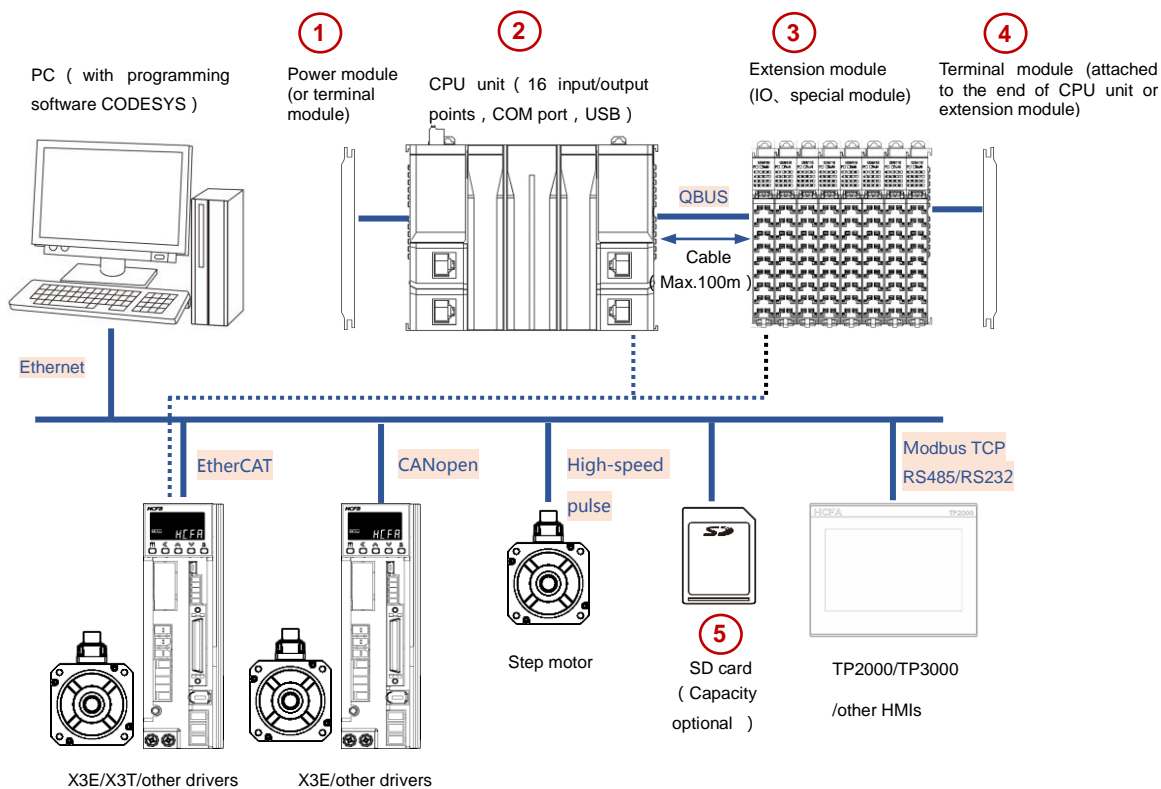
Chapter 1 System Configuration

1-1 Q series PLC introduction

Q-series PLC is a safe, reliable and easy-to-maintain standard PLC with modular structure design. Q-series PLC contains the functions of the traditional PLC, supporting multiple remote I/O modules extensions, and will support local extension in the near future. Various functions of motion control can be realized through SoftMotion provided by PLC. It is a device that integrates the high-speed EtherCAT communication, vision, motion control, I/O functions, and supports multiple bus communications (including Modbus TCP, CANopen, serial communication, etc.) Q-series PLC provides the standard EtherCAT interface, which can be used with the EtherCAT slave and CODESYS for best performance. It can also be connected to a third-party EtherCAT slave.

1-1-1 System configuration

Building a typical control system with Q-series PLC, the connection between the PLC and setup support software/I/O module are as follows:



Tips


- The PC needs to meet the installation environment requirements of CODESYS programming software. For details, please refer to the Q1 Software Manual or CODESYS website
- The main unit has 16 points high-speed I/O, 4 RJ45 ports and 2 network ports for EtherCAT master. Additional features are optional(excluding customized models)
- The power supply of extension module is provided by EC coupler. Now only 10 slave stations are supported. If more slave stations are needed, add the EC coupler.
- The slave module end needs to cooperate with the terminal module to protect the slave module. CPU unit metal sheet from external disturbance. Failure to do so may cause equipment failure or module damage.

1-1-2 Module overview

1) Power module

- By 100~240VAC (to be supported)

When operating at 100~240VAC, user need to connect the power module to the left side of CPU unit. Each CPU unit can only be equipped with one power module. After selecting the power module, no need to connect the terminal module.

 "AC power module"


- By 24VDC

When Q-series PLC operates at 24VDC, it does not use an AC power supply module. Therefore, it is necessary to connect a terminal module to the left side of CPU unit to protect the metal sheets. At this time, the CPU unit inputs by DC power.


 "3-2-1 CPU unit specification"

2) CPU unit

Connect the AC power module to the left side of CPU unit and the extension I/O module or special function module to the right side. When no module connected, you must connect the terminal module.

 "2-1 CPU unit"


The CPU unit is equipped with a memory card with optional size to store user's data. The built-in 16 high-speed I/O can help realize the high-speed counter and motor control function. And the CPU unit has multiple COM ports, such as Modbus TCP (default setting), RS 232/RS485 (optional), CANopen (optional) and Modbus RTU (optional) .


 "CPU internal function"


3) Extension module

Up to 10 I/O extension modules or special function modules can be connected to the right side of CPU unit. If exceeding this number, some modules may not work due to insufficient power(excluding some special extension modules). The terminal module must be connected to the right side of extension modules.

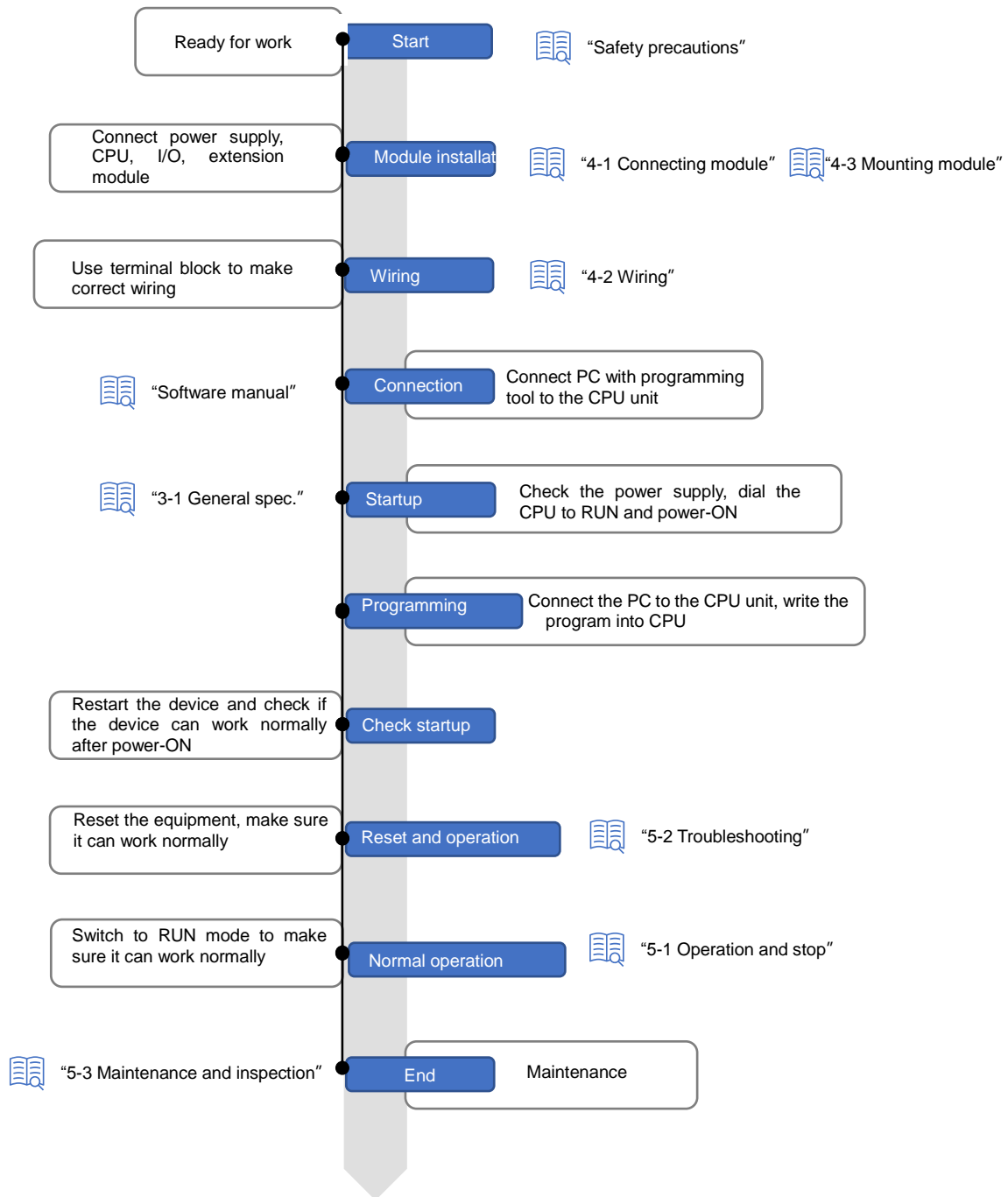
Besides connecting the extension module directly on the right side of CPU unit, users can also conduct EtherCAT slave station extension through the EC coupler module provided by HCFA. A single EC coupler can connect up to 10 extension modules. If exceeding this number, some modules may not work due to insufficient power(excluding some special extension modules). The terminal module must be connected to the right side of extension modules.

 "3-2-4 Digital input module specifications "

 "3-2-5 Digital output module specifications "

 "Special function modules"

1-1-3 System startup procedures



Chapter 2 Part Names and Functions

2-1 CPU unit

This section describes the model name, part names and functions for the CPU units.

2-1-1 Model name for CPU unit

Packaging

After purchasing HCFA Q-series PLC, check if there's the following device and accessories before unpacking.

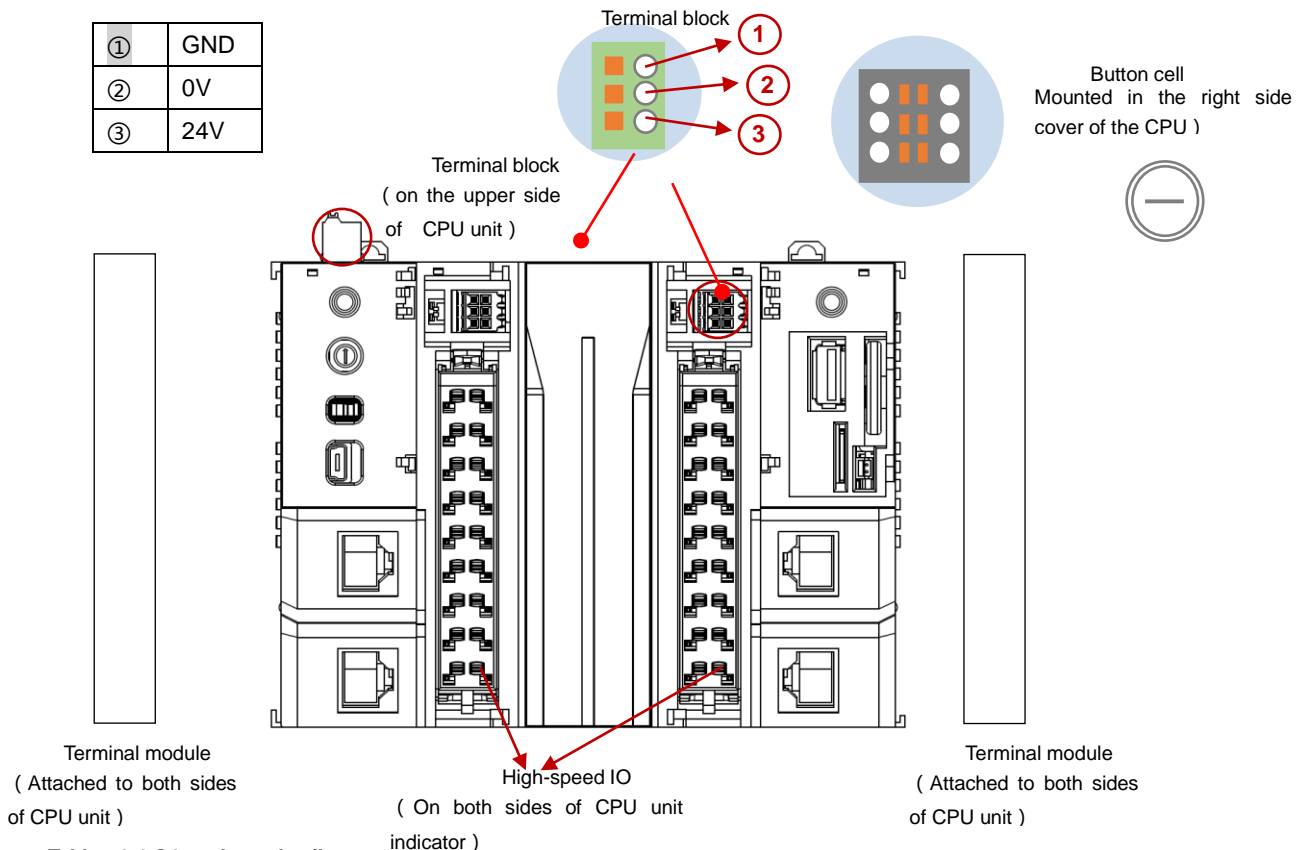








Table 0-1 Q1 package details

Items	Quantity	Description
 CPU unit	*1	Q1 series CPU unit
 User Manual	*1	Q1 series user manual
 Screwdriver	*1	For wiring  "Appendix1 Screwdriver spec."
 COM port Terminal block	*2	For RS232/RS485/CANopen wiring
	*1	For providing 24VDC power

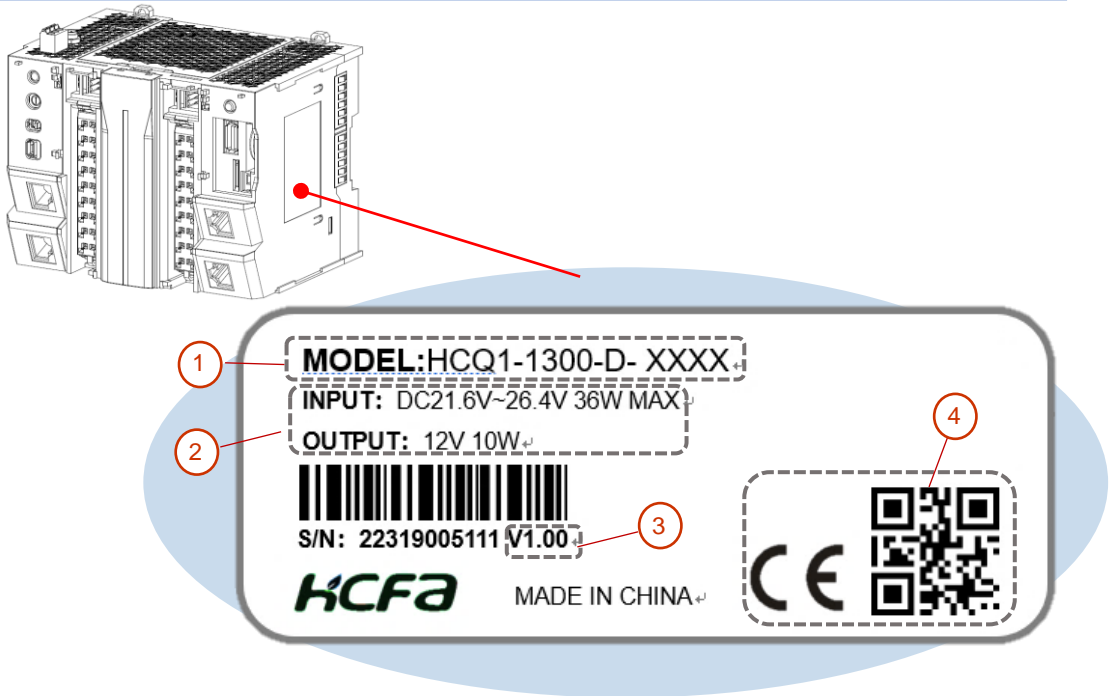
 DC power terminal block		
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Please check whether the packaging is damaged or anything missing. Anything wrong, contact HCFA distributor.

■ **When first power on**

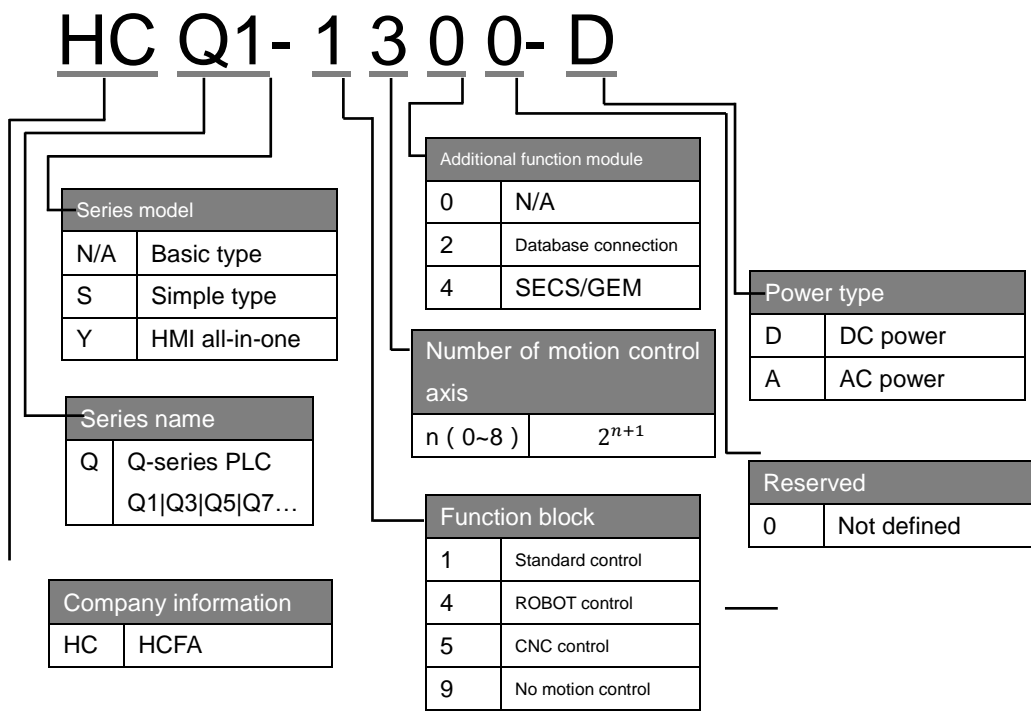
Check whether the button cell is installed correctly

Model name description for CPU unit



Nameplae descriptions as follows :

① Model name description for main unit and modules :



- ② Rated input voltage, power and output voltage , power
- ③ Software version number, updated with IDE version in CPU unit
- ④ CE certificate and QR code for the device

Model name	Type	Description	Applicable modules
HCQ1-1300-D	CPU unit	16MB user storage space (including program and data storage space); 2-ch RS485; 1-ch RS232; 1-ch CANOpen; Supporting Modbus TCP, EtherCAT, built-in 8-ch high-speed inputs and 8-ch high-speed outputs	Q-series CPU units and extension modules

2-1-2 Part names

Part names asnd functions

■ CPU unit from the right side

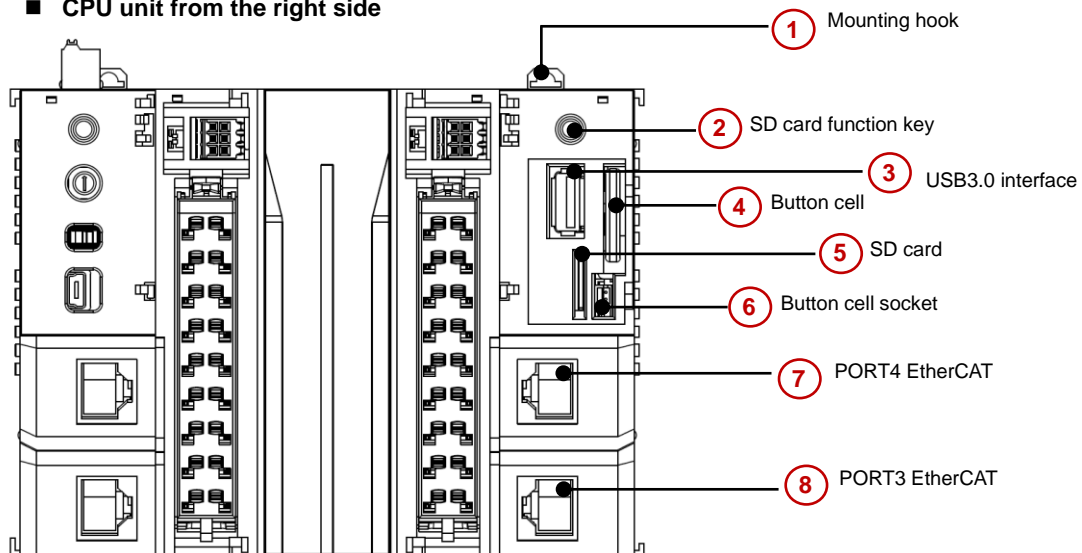


Table 0-2 Part names and function -1

Item	Name	Functions
(1)	Mounting hook	Install controller onto the DIN rail mounting hook
(2)	SD card function key	Not defined
(3)	USB3.0 interface	USB3.0 interface, will support U-disk data storage, 4G and WIFI modules
(4)	Button cell	Save system time
(5)	SD card	Device firmware upgrade
(6)	Button cell socket	Insert correctly when using button cell
(7)	PORT3 EtherCAT	Gigabit Ethernet support EtherCAT, FPGA control will be supported.
(8)	PORT4 EtherCAT	Gigabit Ethernet support EtherCAT,

■ CPU unit viewed from the left side

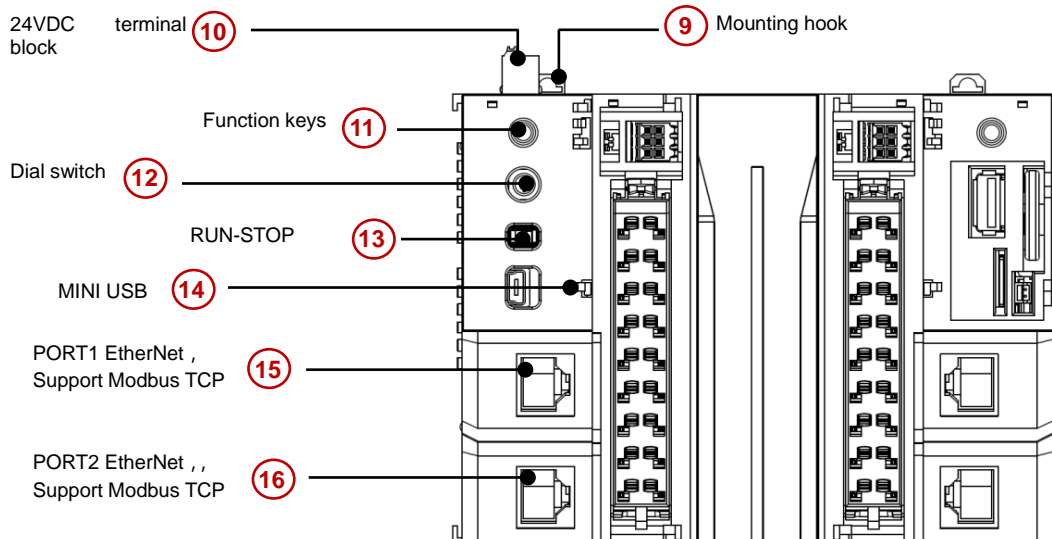
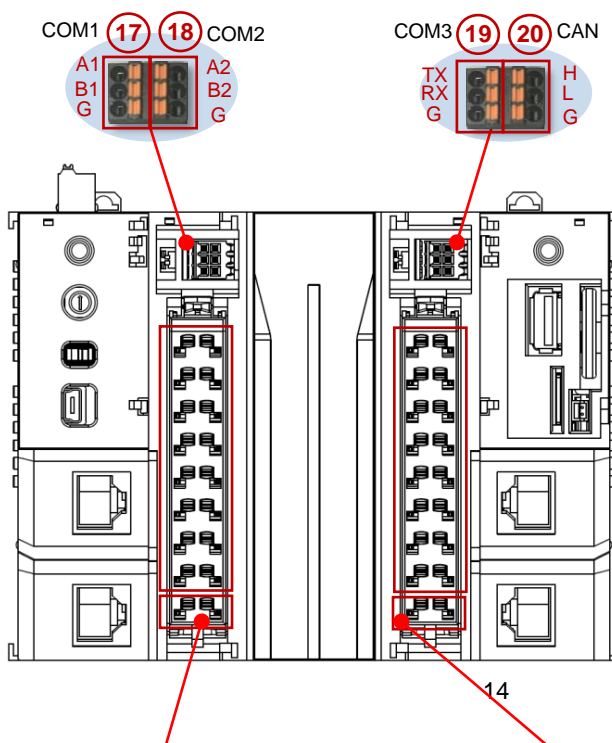


Table 0-3 Part names and function -2

Item	Name	Functions
(9)	Mounting hook	Install controller onto the DIN rail mounting hook
(10)	24VDC terminal block	24V DC power supply interface for CPU unit
(11)	Function keys	Used with dial switch
(12)	Dial switch	Used with function keys
(13)	RUN-STOP	Start or stop the CPU unit. Turn to the left to be off, turn to the right to be on
(14)	MINI USB	USB2.0 interface, will support the connection with PLC to monitor and download user program
(15)	PORT1 EtherNet ,	Gigabit Ethernet support Modbus TCP
(16)	PORT2 EtherNet ,	Gigabit Ethernet support Modbus TCP

■ **CPU unit high-speed I/O interface and communication interface**

This unit is built-in high-speed I/O to realize the basic positioning function of single-axis. The frequency can reach up to 200K.



"485/232/CAN spec."

Serial indicator description"

Table 0-4 Part names and function -3

Item	Name	Function
(17)	COM1	Support RS 485
(18)	COM2	Support RS 485
(19)	COM3	Support RS 232
(20)	CAN	Support CAN

"3-2-1 CP unit spec."

"CPU unit indicatordescription"

16-ch high-speed input terminal arrangements

HSInput	0	8
HSInput	1	9
HSInput	2	10
HSInput	3	11
HSInput	4	12
HSInput	5	13
HSInput	6	14
HSInput	7	15
COM port	SS	SS

16-ch high-speed output terminal arrangements 1

HSOutput	0	8
HSOutput	1	9
HSOutput	2	10
HSOutput	3	11
HSOutput	4	12
HSOutput	5	13
HSOutput	6	14
HSOutput	7	15
COM port	COM	COM

■ CPU unit indicator description

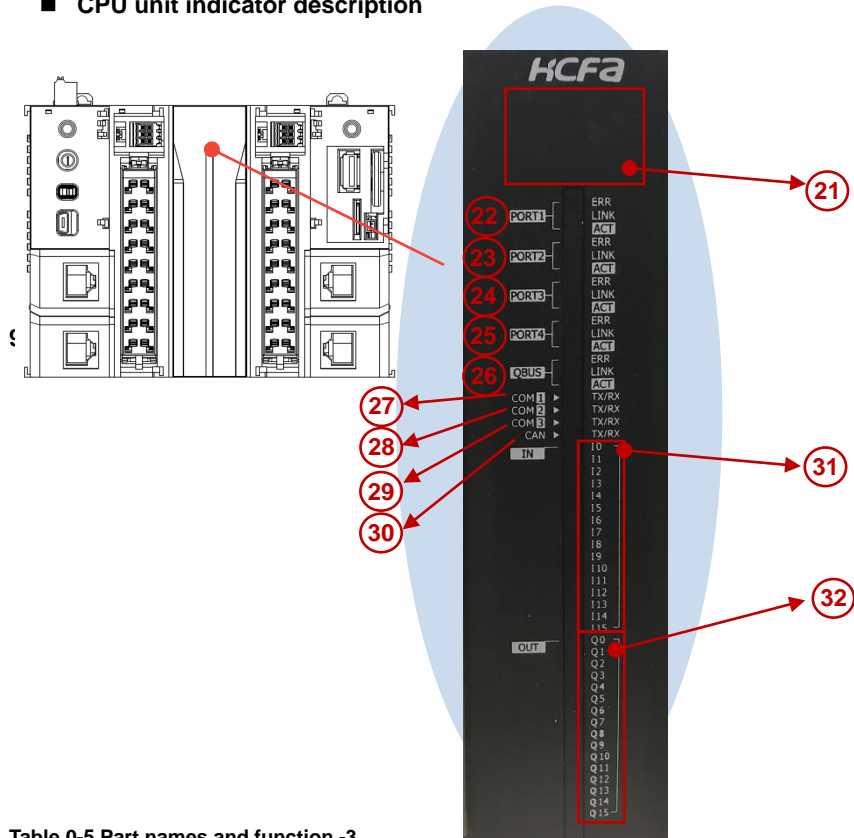


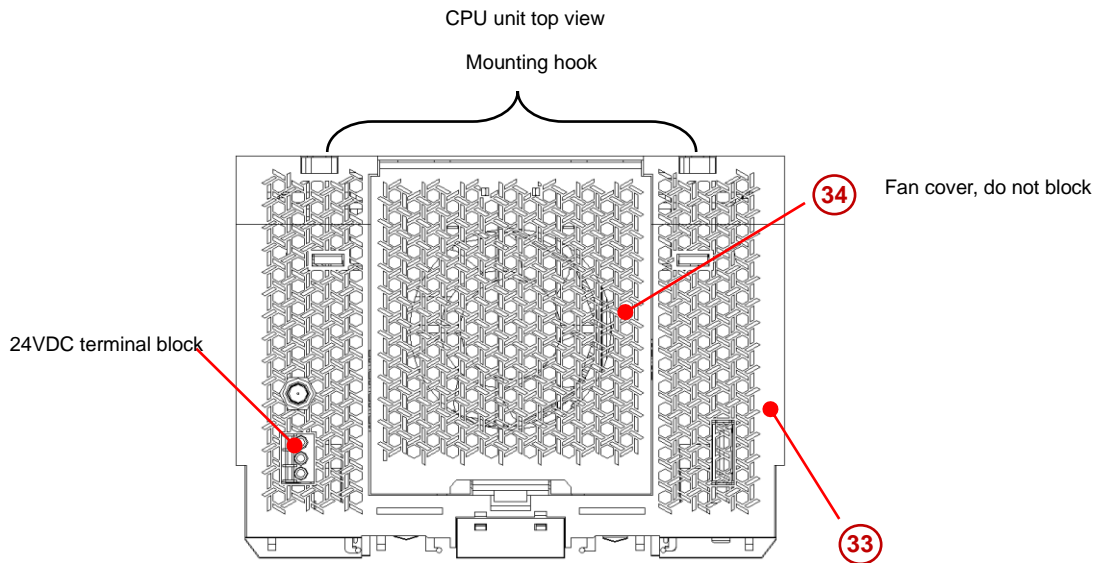
Table 0-5 Part names and function -3

Items	Port	Color	Function	
			Current status	Panel display
(21)	LED	White	Upon power-on	"HCFA"
			Operation status	Rotating rectangular strip
			Stop status	Static rectangular strip
			No program inside PLC	"00"
			Over-temperature warning	"0E"

			CPU downtime	"0F"
			Firmware update completion	"OK"
(22)	PORT1	Red	RJ45 Ethernet interface ERR indicator, red indicates communication error or failure to communicate normally	
		Green	RJ45 Ethernet interface LINK indicator, green indicates communication has been established.	
		Orange	RJ45 Ethernet interface ACT indicator, Orange flashing indicates data exchange on the network port.	
(23)	PORT2	Red	RJ45 Ethernet interface ERR indicator, red indicates communication error or failure to communicate normally	
		Green	RJ45 Ethernet interface LINK indicator, green indicates communication has been established.	
		Orange	RJ45 Ethernet interface ACT indicator, Orange flashing indicates data exchange on the network port.	
(24)	PORT3	Red	RJ45 Ethernet interface ERR indicator, red indicates communication error or failure to communicate normally	
		Green	RJ45 Ethernet interface LINK indicator, green indicates communication has been established.	
		Orange	RJ45 Ethernet interface ACT indicator, Orange flashing indicates data exchange on the network port.	
(25)	PORT4	Red	RJ45 Ethernet interface ERR indicator, red indicates communication error or failure to communicate normally	
		Green	RJ45 Ethernet interface LINK indicator, green indicates communication has been established.	
		Orange	RJ45 Ethernet interface ACT indicator, Orange flashing indicates data exchange on the network port.	
(26)	QBUS (To be supported)	Red	QBUS ERR indicator , red indicates communication error or failure to communicate normally	
		Green	QBUS LINK indicator , green indicates communication has been established.	
		Orange	QBUS ACT indicator , Orange flashing indicates data exchange on the network port.	
(27)	COM1	Green/orange	Serial communication TX/RX indicator, green indicates normal communication, and the orange light indicates disconnected or communication failure	
(28)	COM2	Green/orange	Serial communication TX/RX indicator, green indicates normal communication, and the orange light indicates disconnected or communication failure	
(29)	COM3	Green/orange	Serial communication TX/RX indicator, green indicates normal communication, and the orange light indicates disconnected or communication failure	
(30)	CAN	Green/orange	CANOpen communication TX/RX indicator , green indicates normal communication, and the orange light indicates disconnected or communication failure	


(31)	High-speed DI	Red	Port DI0 detects signal input
		Red	Port DI1 detects signal input
		Red	Port DI2 detects signal input
		Red	Port DI3 detects signal input
		Red	Port DI4 detects signal input
		Red	Port DI5 detects signal input
		Red	Port DI6 detects signal input
		Red	Port DI7 detects signal input
		Red	Port DI8 detects signal input
		Red	Port DI9 detects signal input
		Red	Port DI10 detects signal input
		Red	Port DI11 detects signal input
		Red	Port DI12 detects signal input
		Red	Port DI13 detects signal input
		Red	Port DI14 detects signal input
Red	Port DI15 detects signal input		
(32)	High-speed DO	Orange	Port DO0 detects signal output
		Orange	Port DO1 detects signal output
		Orange	Port DO2 detects signal output
		Orange	Port DO3 detects signal output
		Orange	Port DO4 detects signal output
		Orange	Port DO5 detects signal output
		Orange	Port DO6 detects signal output
		Orange	Port DO7 detects signal output
		Orange	Port DO8 detects signal output
		Orange	Port DO9 detects signal output
		Orange	Port DO10 detects signal output
		Orange	Port DO11 detects signal output
		Orange	Port DO12 detects signal output
		Orange	Port DO13 detects signal output
		Orange	Port DO14 detects signal output
Orange	Port DO15 detects signal output		


■ CPU unit top view



Items	Name	Function
(33)	Extension modules connection	Connect the CPU unit and extension modules
(34)	Fan cover	Removable, easy to attach or detach the fan

- Tips**
- Due to the influence of noise, the communication may be interrupted when the USB is not stable in the communication state. At this time, please pull out the USB cable, and then reinsert
- In case the communication state is very unstable (the noise is quite serious), in order to protect the PC , please wrap the ferrite around the cable

 WARNING	Do not open the back cover of the fan during power-on, otherwise it will cause electric shock, equipment damage and other serious situations; Only qualified technical personnel are allowed to operate in accordance with the regulations.
---	---

 CAUTION	Do not connect USB cable to serial port or Ethernet port (may cause port damage)
---	--

2-2 AC power module (to be supported)

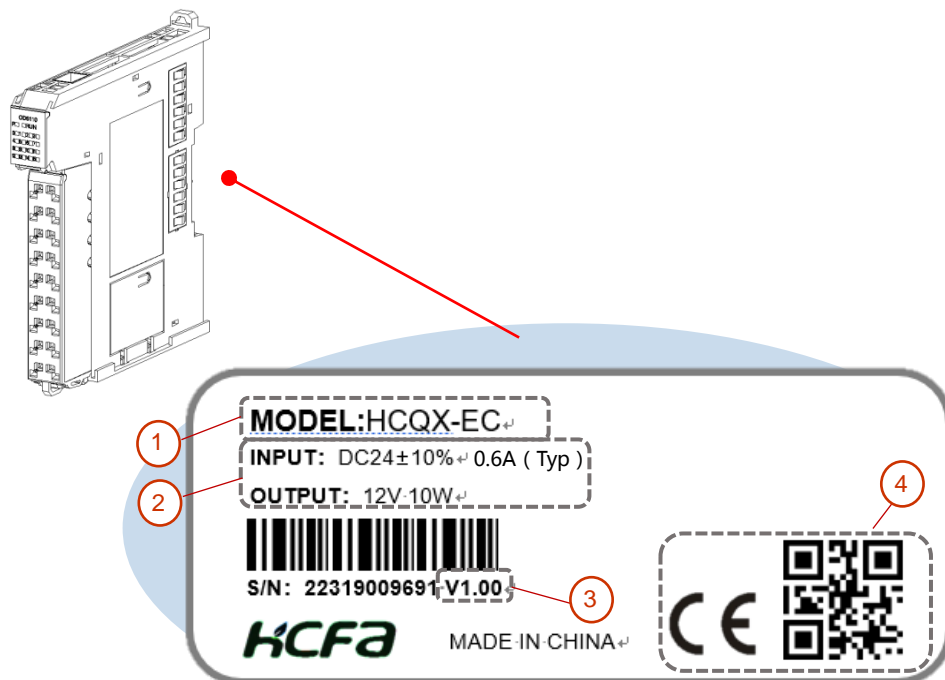
This section will be updated when the power module is launched.

2-3 EC coupler

This section describes EC coupler model name and functions.

2-3-1 EC coupler model name and part names

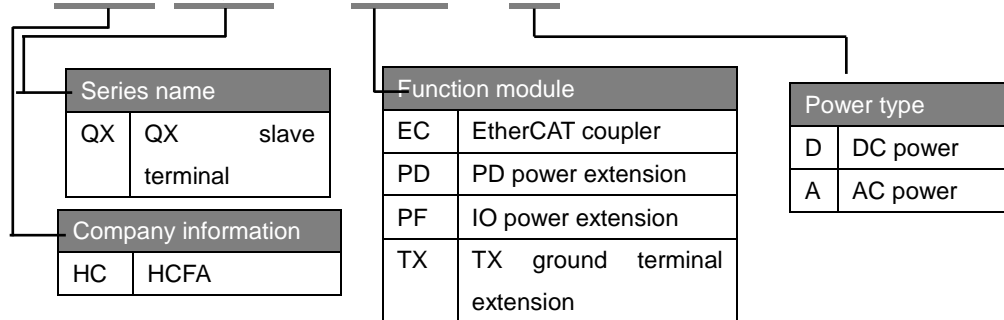
EC coupler model name description



EC coupler nameplate description :

- ① Main unit or module model name description :

HC QX – EC - D



- ② Rated input voltage and power & output voltage and power
- ③ Software version number, upsated with IDE version within the CPU unit
- ④ CE certificate and QR code

EC coupler part names and functions

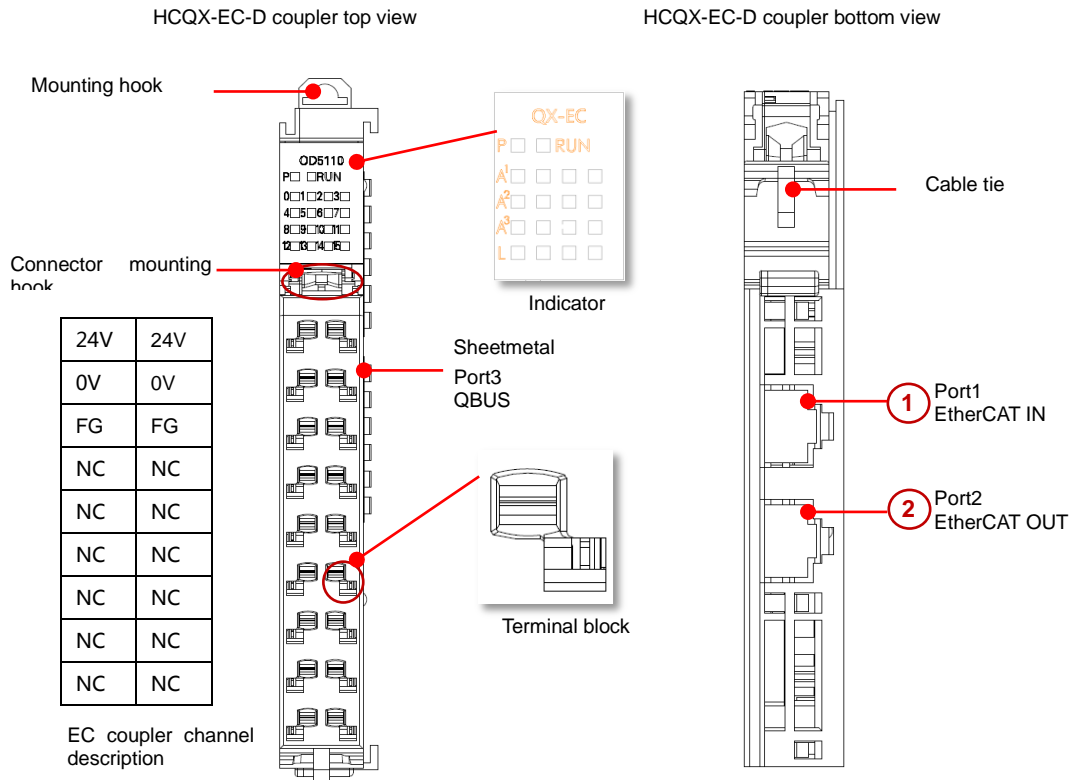


Table 0-6 Indicator description

Symbol	Color	Description
P	Green	The indicator show the current power supply status of the module.
RUN	Red	EC module running state. Lit means the module is in normal running state
A1	Red	Channel ACT/LINK indicator of PORT1
A2	Red	Channel ACT indicator of PORT2
A3	Red	Channel ACT/LINK indicator of PORT3
L	Red	Channel LINK indicator of PORT2

Table 0-7 Channel description

Symbol	Description	Symbol	Description
0	24V	9	24V
1	0V	10	0V
2	FG	11	FG
3	Not defined	12	Not defined
4	Not defined	13	Not defined
5	Not defined	14	Not defined
6	Not defined	15	Not defined
7	Not defined	16	Not defined

8	Not defined	17	Not defined
---	-------------	----	-------------

Table 0-8 EC coupler network port description

Items	Name	Description
①	EtherCAT IN slave network port	EtherCAT slave input port , Data inputs from this port in EtherCAT topology
②	EtherCAT OUT slave network port	EtherCAT slave output port , Data passed from this port in EtherCAT topology

Tips

- EC coupler needs specified network cable or adapter, which is sent for free by HCFA.



“Appendix 2 Specified network cable for EC coupler”



“EtherCAT introduction”

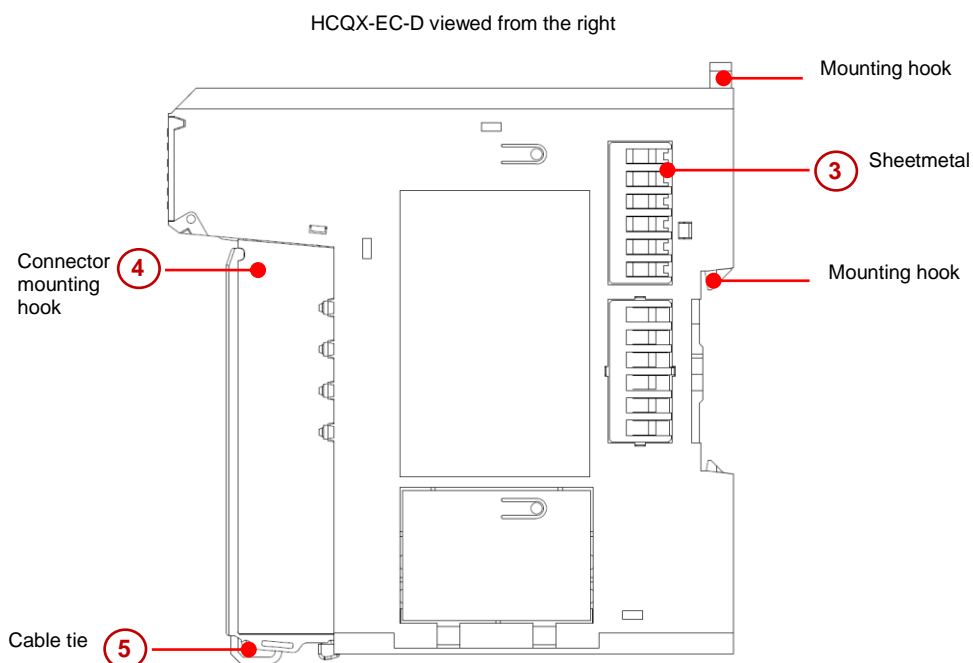


Table 0-9 Coupler structure description

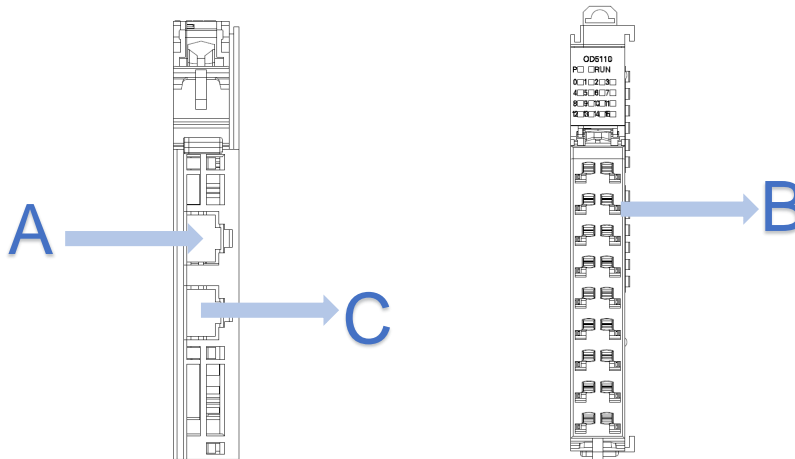
Item	Name	Description
③	Sheetmetal	Transmits QBUS signal and control circuit current. Do not support hot swap.
④	Connector mounting hook	Provide wiring device for easy wiring and module replacement
⑤	Cable tie	Pass the cables through and fix them to make the wiring more neat and convenient for future maintenance.

EC coupler signal transmission direction

The direction of EtherCAT data frame transmission in an EC coupler depends on the ESC (EtherCAT Slave Controller). Check the diagram below, the data frame transmission direction is A→B→C.

HCQX-EC-D bottom view

HCQX-EC-D front view



2-3-2 EtherCAT introduction

EtherCAT is chosen as the main bus communication protocol of the master for HCFA Q-series controllers. EtherCAT is a real-time industrial Ethernet technology proposed by Beckhoff Automation in 2003. It is also an Ethernet-based real-time industrial fieldbus communication protocol and international standard. It has the characteristics of openness, high compatibility, and fast transmission speed, and supports multiple device connection topologies. The slave node uses a dedicated control chip, and the master station uses a standard Ethernet controller.

EtherCAT protocol characteristics

- Excellent network performance. For 1500 devices, the throughput can reach 10kb/ms. The refresh cycle of 1000 distributed I/O data is only 30μs, and the communication with 100 servo axes only needs 100μs. Distributed clock technology ensures that the synchronization time deviation between these axes is less than 1μs. Compared with other Ethernet-based fieldbus protocols, they have good openness and compatibility.

	PROFINET	EtherNet/IP	EtherCAT
Stack time	Profinet IO	Ethernet/IP	EtherCAT
Average value	0.58 ms	1.89 ms	0.11 ms
Max. value	0.74 ms	2.96 ms	0.18 ms
Mini. value	0.54 ms	1.23 ms	0.05 ms

- Flexible topology. EtherCAT supports almost all topological structures, such as bus, tree, or star type. Therefore, the bus structure from the fieldbus can also be used for the EtherCAT bus. For EtherCAT, different topology structures will not affect the bus communication time (ignoring the communication time of the signal in the network cable or optical fiber), and the user can design the

topology according to their own requirements.

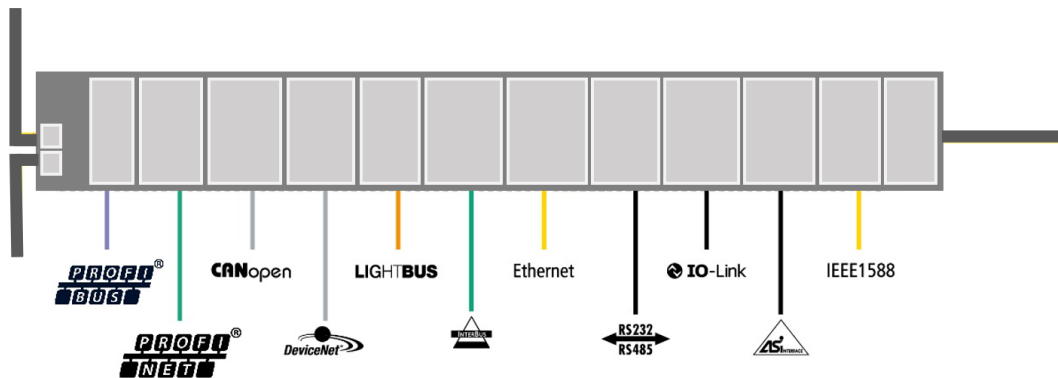
- Different transmission methods can be used for signal transmission, and different transmission methods have different requirements for the max. transmission distance between slave stations. See the table below for details:

Table 0-10 Max. transmission distance for transmission methods

Transmission method	Max. transmission distance
Industrial Ethernet (100BASE-TX)	MAX.100m
QBUS	MAX.10m
Optical fiber	50-20000m

- Good compatibility. EtherCAT is compatible with all the main bus protocols on the market today.

Diagram 0-1 EtherCAT protocol compatibility



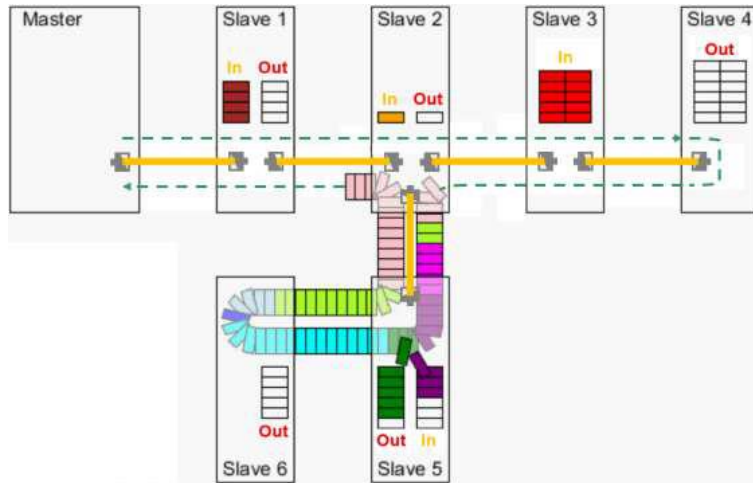
- The network size is almost unlimited, and can support 65,535 nodes theoretically. The user needs to consider the power supply of a single controller or coupler and add the appropriate number of couplers according to the number of slave stations.
- Based on Ethernet, all standard Ethernet devices can be used without additional chips and devices.

EtherCAT signal transmission

In the EtherCAT network, information is exchanged through Ethernet messages, and each Ethernet frame contains one or more sub-messages. Regardless of the topology (line type, bus type, star type), the data frame is sent by the master station, passes through all the slave stations and finally returns to the master station (ring full duplex), completing the "logical loop".

Data carried by Ethernet frames is processed by the slave station "on the fly".

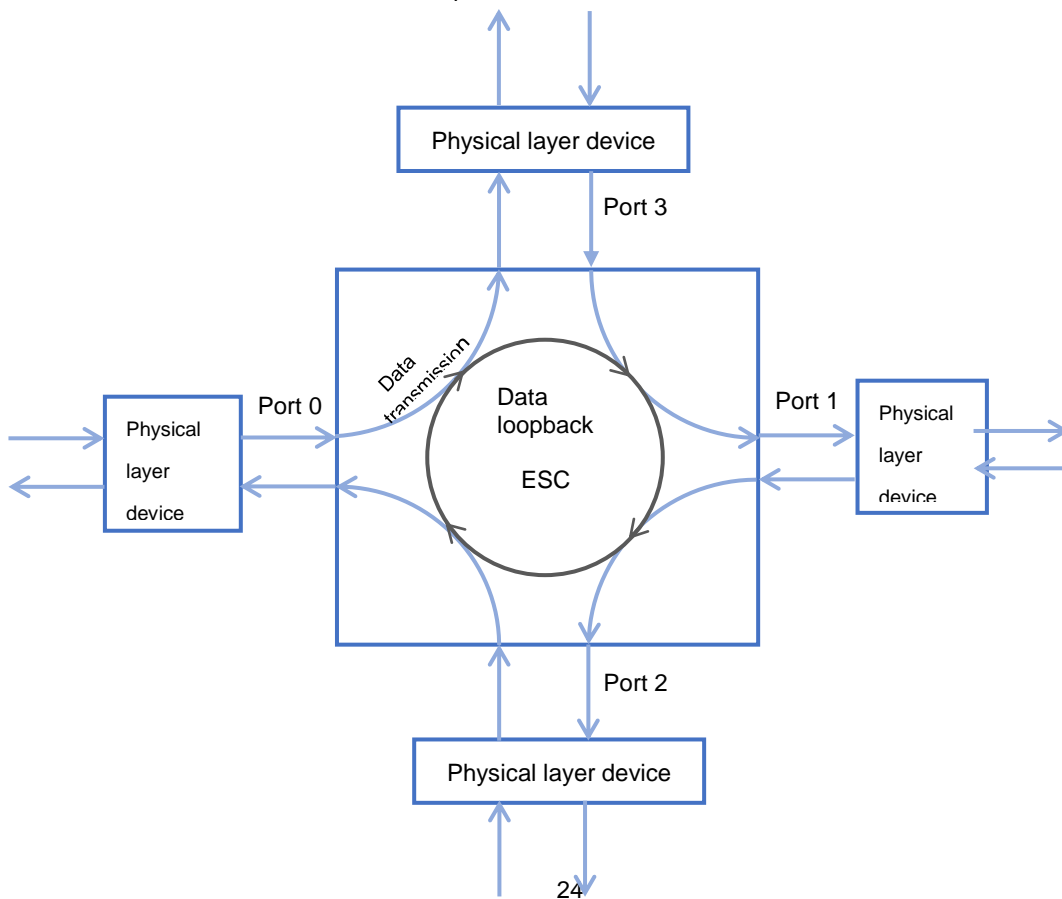
Figure 0-2 EtherCAT data frame transmission



2-3-3 EtherCAT slave controller (ESC)

The EtherCAT slave communication controller chip ESC is responsible for processing EtherCAT data frames, and uses the dual-port storage area to realize the data exchange between the EtherCAT master and the local application of the slave. Each slave ESC shifts read and write data frames according to their physical position on the loop

ESC has four ports, and each port can send and receive Ethernet data frames. The transmission of data frames within ESC is fixed, as shown in the figure below. Typically, data enters ESC from port 0, and then transmitted to port 3, port 1, port 2, port 0. If ESC detects that a port has no external link, it will automatically close this port, and the data will automatically transmit to the next port. An EtherCAT slave device uses at least two data ports, and multiple data ports can form a variety of physical topologies. Take the HCFA module as an example, the EC coupler module uses three ESC data ports, and the extension IO module uses two ESC data ports.

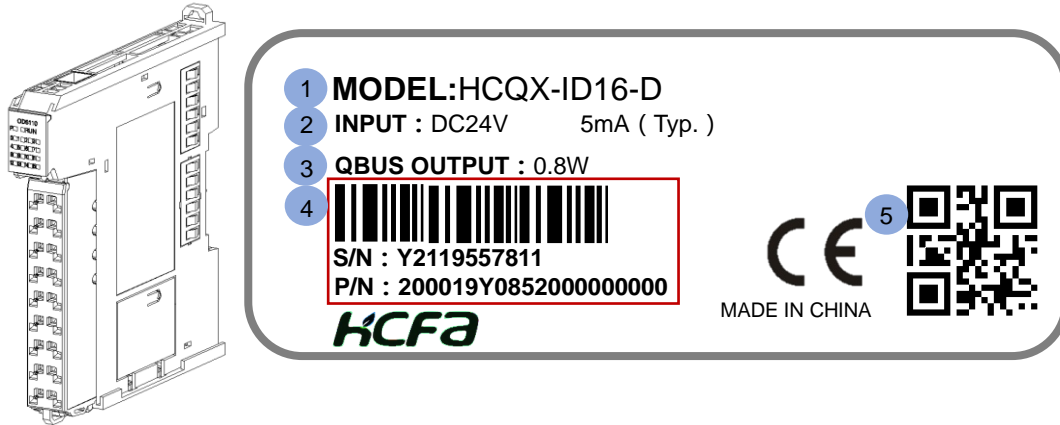


2-4 Digital I/O modules (ID/OD)

This section describes digital I/O model name and functions.

2-4-1 Digital input module model name and part names

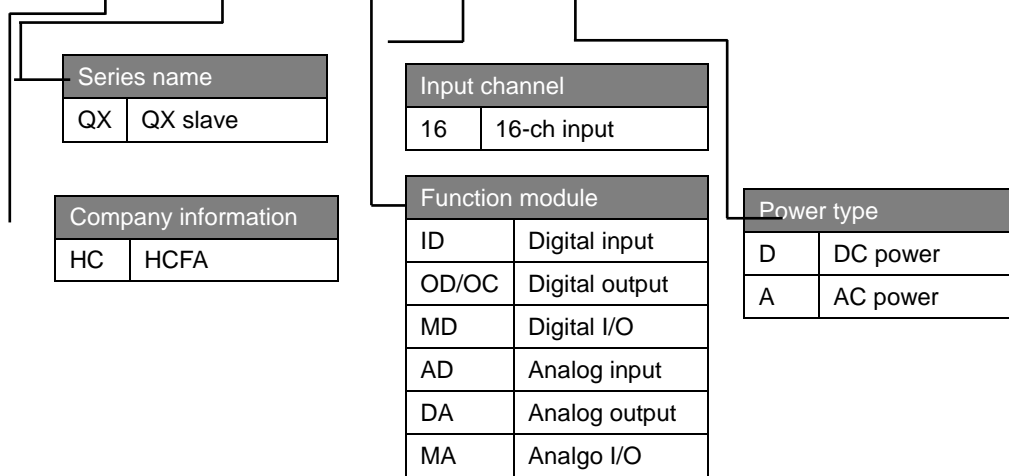
Digital input module model name



Digital input module nameplate description :

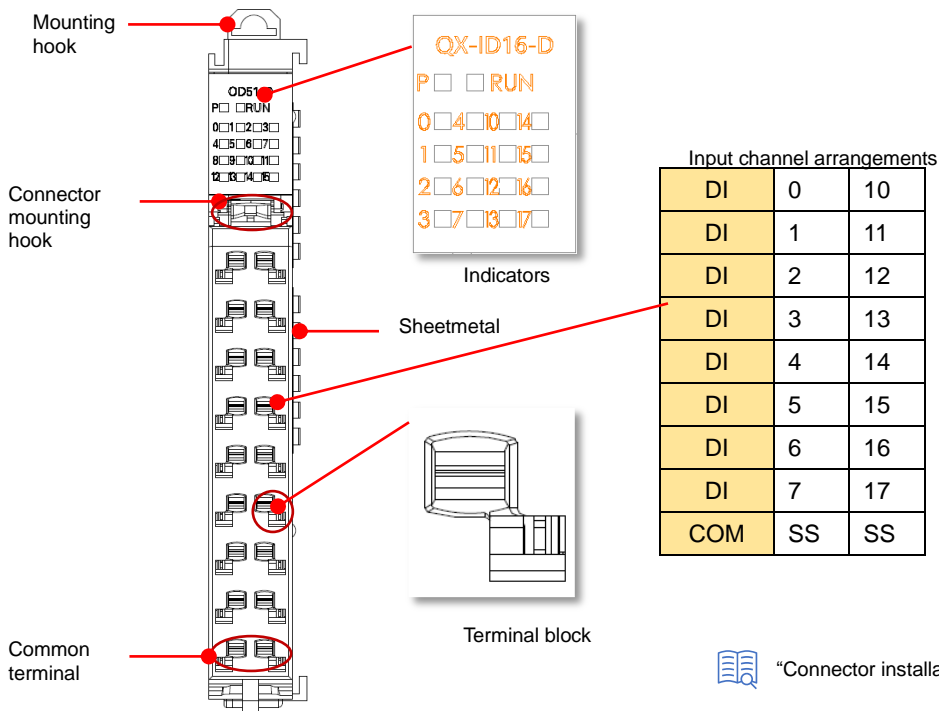
- ① Main unit or module model name description :

HC QX - ID 16- D



- ② Working voltage and input/output current for normal operation
 ③ Output power
 ④ Barcode, S/N &P/N
 ⑤ QR code(model name, serial number)

Part names for digital input module
HCQX-ID16-D module front view



"Connector installation and wiring"

Table 0-11 Digital input module indicators description

Symbol	Color	Description
P	Green	The indicator show the current power supply status of the module.
RUN	Red	ID module running state. Lit means the module is in normal running state
0	Red	Input signal is detected by input channel 0.
1	Red	Input signal is detected by input channel 1.
2	Red	Input signal is detected by input channel 2.
3	Red	Input signal is detected by input channel 3.
4	Red	Input signal is detected by input channel 4.
5	Red	Input signal is detected by input channel 5.
6	Red	Input signal is detected by input channel 6.
7	Red	Input signal is detected by input channel 7.
8	Red	Input signal is detected by input channel 10.
9	Red	Input signal is detected by input channel 11.
10	Red	Input signal is detected by input channel 12.
11	Red	Input signal is detected by input channel 13.
12	Red	Input signal is detected by input channel 14.
13	Red	Input signal is detected by input channel 15.
14	Red	Input signal is detected by input channel 16.
15	Red	Input signal is detected by input channel 17.

SS	No indicator	S/S input common terminal
SS	No indicator	S/S input common terminal

HCQX-ID16-D viewed from the right side

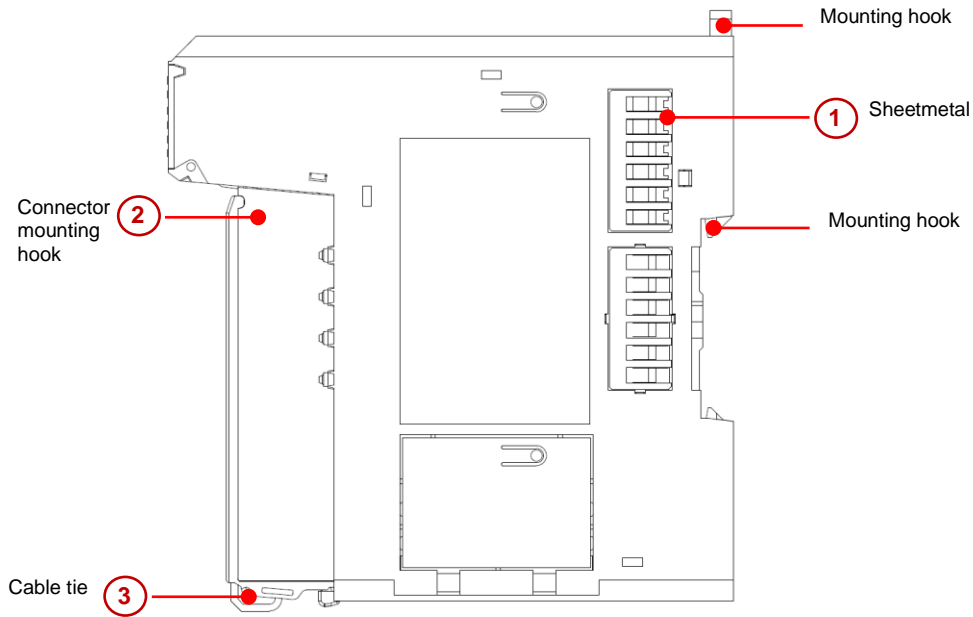


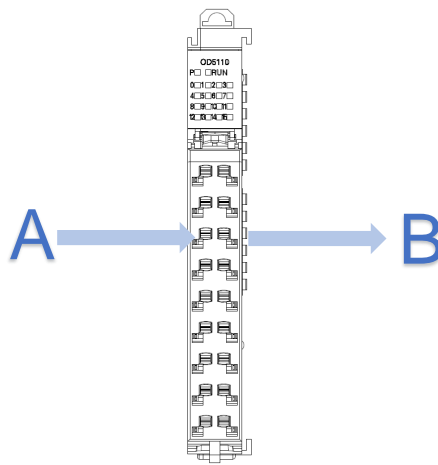
Table 0-12 Digital input module structure description

Item	Name	Description
①	Sheetmetal	Transmits QBUS signal and control circuit current. Do not support hot swap.
②	Connector connection	Provide wiring device for easy wiring and module replacement
③	Cable tie	Pass the cables through and fix them to make the wiring more neat and convenient for future maintenance.

Digital input module signal transmission direction

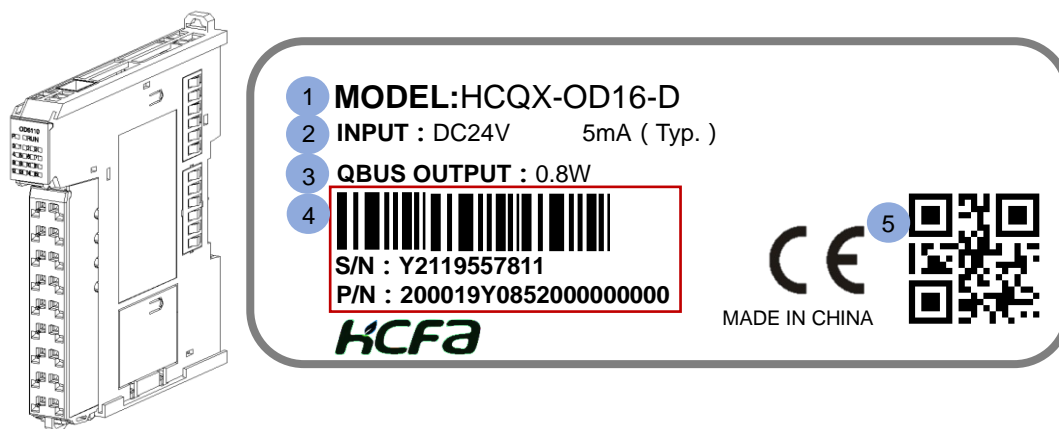
The direction of EtherCAT data frame transmission in the digital input module depends on the ESC (EtherCAT Slave Controller). Check the diagram below, the data frame transmission direction is A→B.

HCQX-ID16-D Front view



2-4-2 Digital output module model name and part names

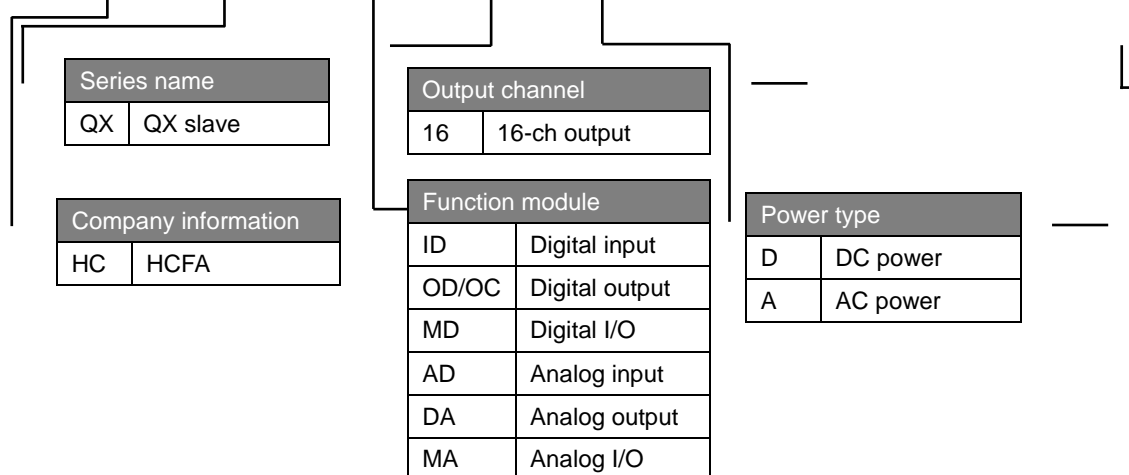
Digital output module model name



Digital output module nameplate description :

① Main unit or module model name description :

HC QX - OD 16- D



② Working voltage and input/output current for normal operation

③ Output power

④ Barcode, S/N &P/N

⑤ QR code(model name, serial number)

Part names for digital output module

HCQX-OD16-D Front view

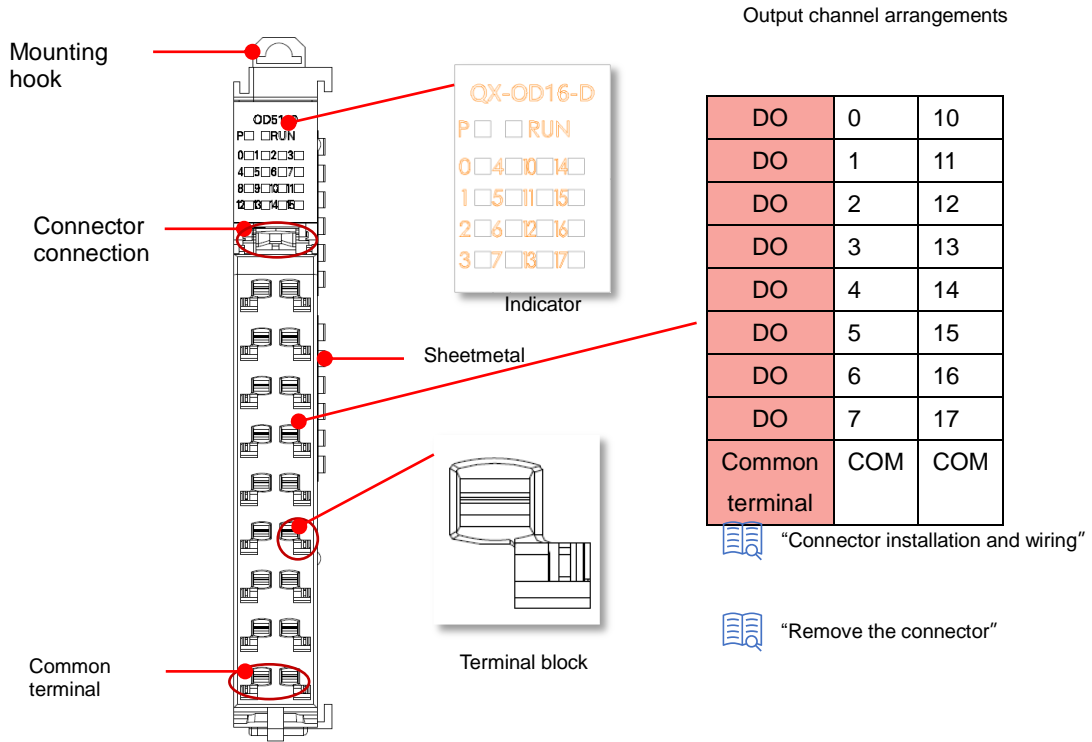


Table 0-13 Digital output module indicator description

Symbol	Color	Description
P	Green	The indicator show the current power supply status of the module.
RUN	Red	OD module running state. Lit means the module is in normal running state
0	Red	Output signal is detected by output channel 0
1	Red	Output signal is detected by output channel 1
2	Red	Output signal is detected by output channel 2
3	Red	Output signal is detected by output channel 3
4	Red	Output signal is detected by output channel 4
5	Red	Output signal is detected by output channel 5
6	Red	Output signal is detected by output channel 6
7	Red	Output signal is detected by output channel 7
8	Red	Output signal is detected by output channel 10
9	Red	Output signal is detected by output channel 11
10	Red	Output signal is detected by output channel 12
11	Red	Output signal is detected by output channel 13
12	Red	Output signal is detected by output channel 14
13	Red	Output signal is detected by output channel 15
14	Red	Output signal is detected by output channel 16
15	Red	Output signal is detected by output channel 17
COM	No indicator	Output common terminal

COM	No indicator	Output common terminal
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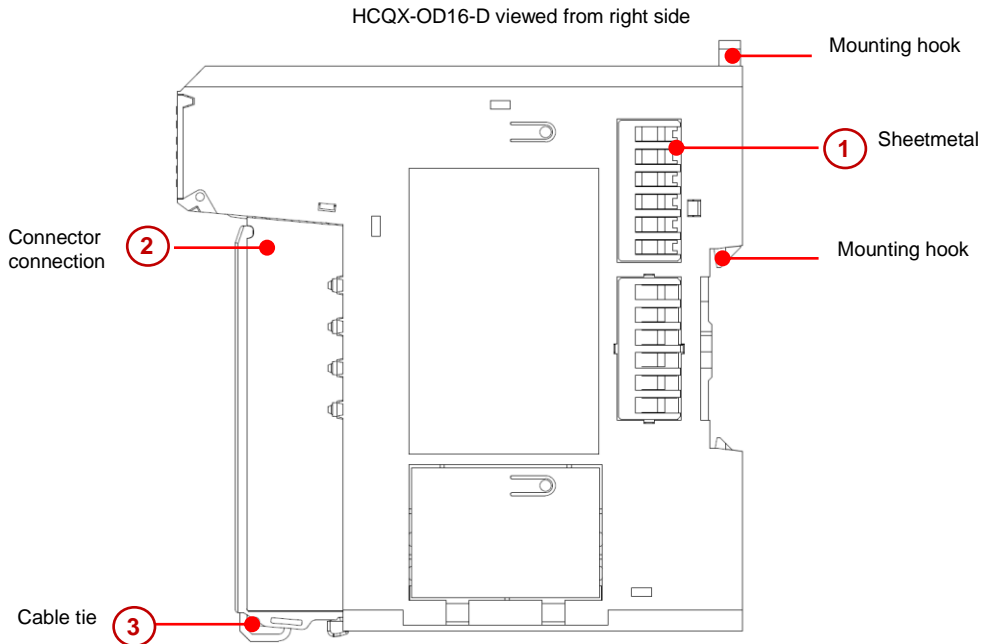
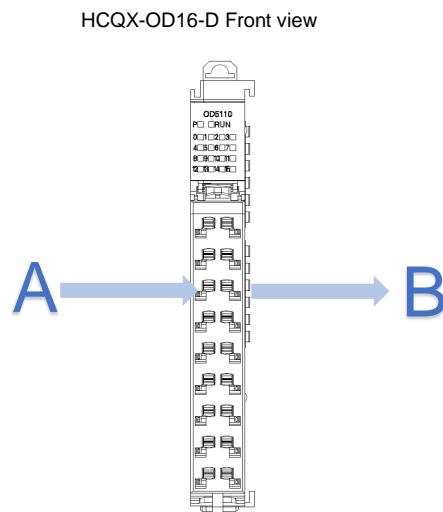


Table 0-14 Digital output module structure description

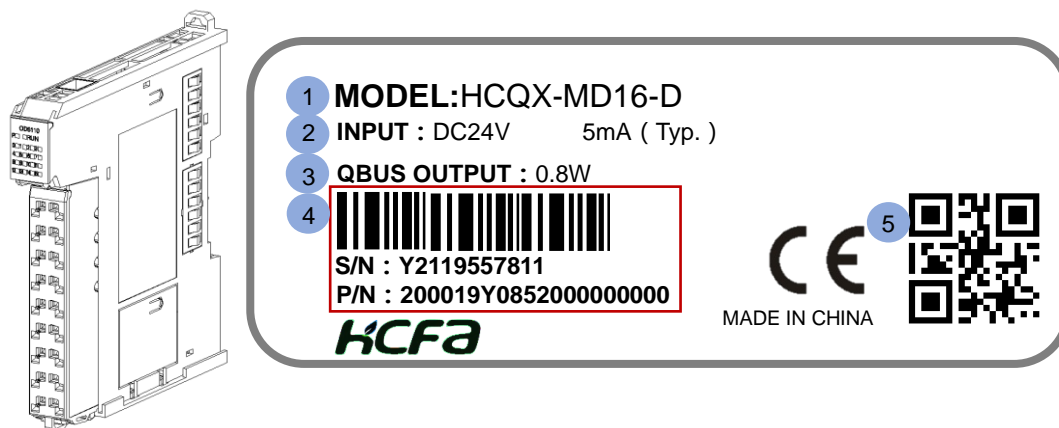
Item	Name	Description
①	Sheetmetal	Transmits QBUS signal
②	Connector connection	Provide wiring device for easy wiring and module replacement
③	Cable tie	Pass the cables through and fix them to make the wiring more neat and convenient for future maintenance.

Digital output module signal transmission direction

The direction of EtherCAT data frame transmission in the digital output module depends on the ESC (EtherCAT Slave Controller). Check the diagram below, the data frame transmission direction is A→B



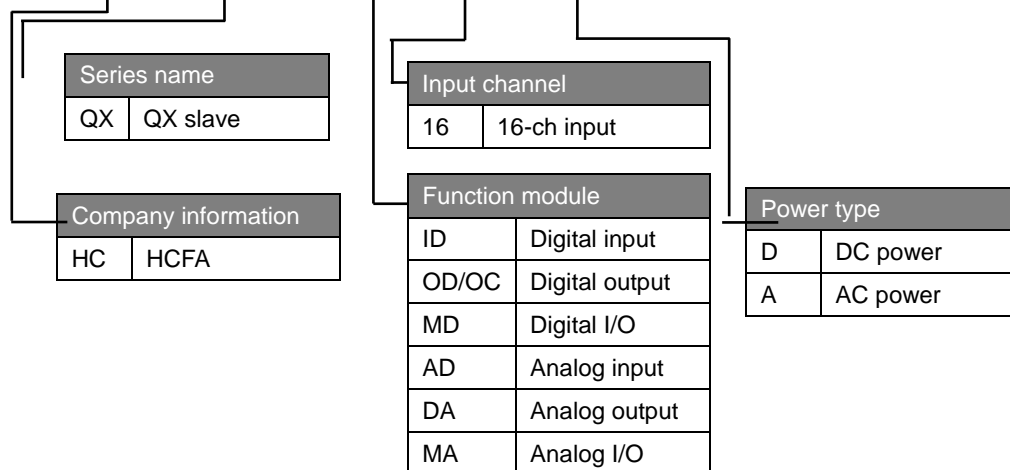
2-4-3 Digital I/O module model name and part names



Digital I/O module nameplate description :

① Main unit or module model name description :

HC QX - MD 16- D



- ② Working voltage and input/output current for normal operation
- ③ Output power
- ④ Barcode, S/N &P/N
- ⑤ QR code(model name, serial number)

Part names for digital I/O module

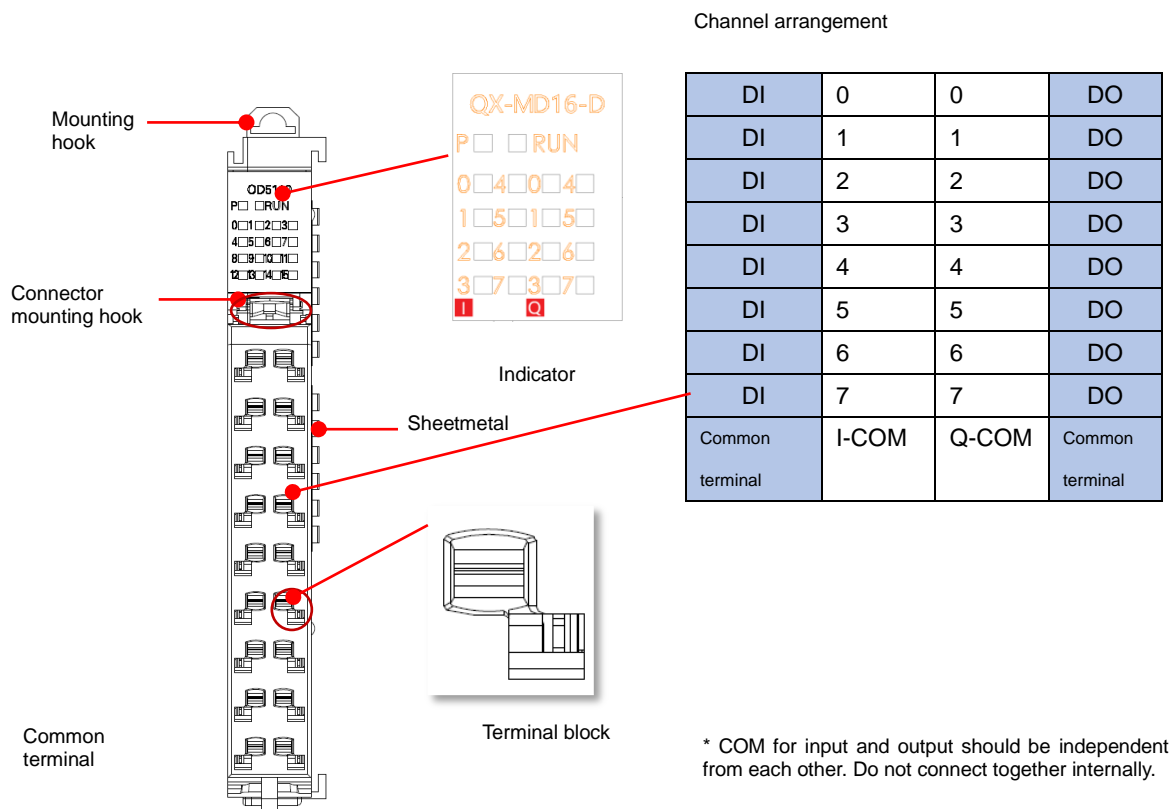


Table 0-15 Digital I/O module indicator description

Symbol	Color	Description
P	Green	The indicator show the current power supply status of the module.
RUN	Red	MD module running state. Lit means the module is in normal running state
I0	Red	Input signal is detected by input channel 0.
I1	Red	Input signal is detected by input channel 1.
I2	Red	Input signal is detected by input channel 2.
I3	Red	Input signal is detected by input channel 3.
I4	Red	Input signal is detected by input channel 4.
I5	Red	Input signal is detected by input channel 5.
I6	Red	Input signal is detected by input channel 6.
I7	Red	Input signal is detected by input channel 7.
Q0	Red	Output signal is detected by output channel 0.
Q1	Red	Output signal is detected by output channel 1.
Q2	Red	Output signal is detected by output channel 2.
Q3	Red	Output signal is detected by output channel 3.
Q4	Red	Output signal is detected by output channel 4.
Q5	Red	Output signal is detected by output channel 5.
Q6	Red	Output signal is detected by output channel 6.
Q7	Red	Output signal is detected by output channel 7.

I-COM	No indicator	I-COM input common terminal
Q-COM	No indicator	Q-COM output common terminal

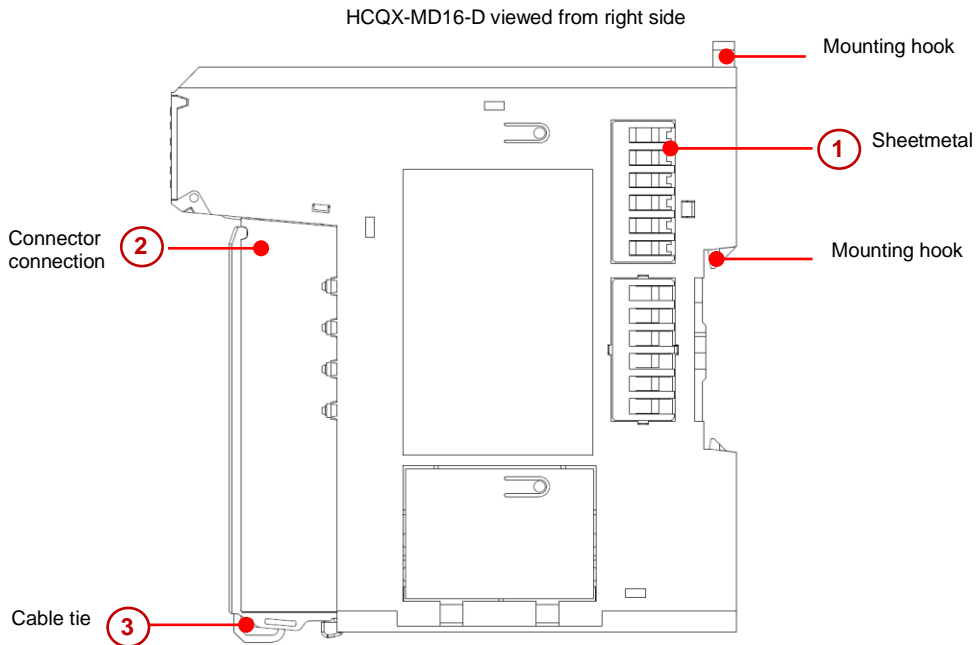


Table 0-16 Digital I/O module structure description

Items	Name	Description
④	Sheetmetal	Transmits QBUS signal
⑤	Connector connection	Provide wiring device for easy wiring and module replacement
⑥	Cable tie	Pass the cables through and fix them to make the wiring more neat and convenient for future maintenance.

2-5 Analog I/O (AD/DA) module

2-5-1 Analog input module model name and part names

Analog input module model name description

① **MODEL:HCQX-AD04-D**

② **INPUT : DC24V 5mA (Typ.)**

③ **QBUS OUTPUT : 0.8W**

④ **S/N : Y2119557811**
P/N : 200019Y085200000000

HCFA

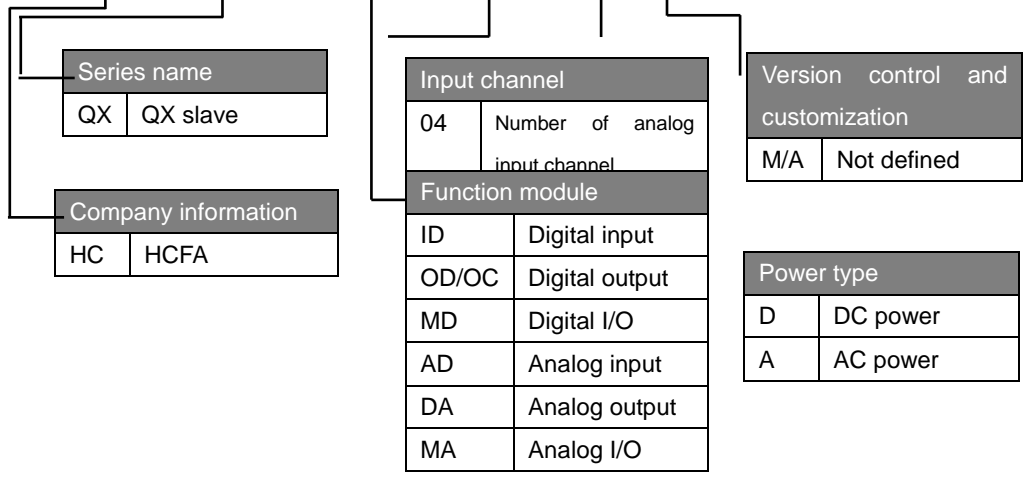
MADE IN CHINA

⑤

Analog input module nameplate description :

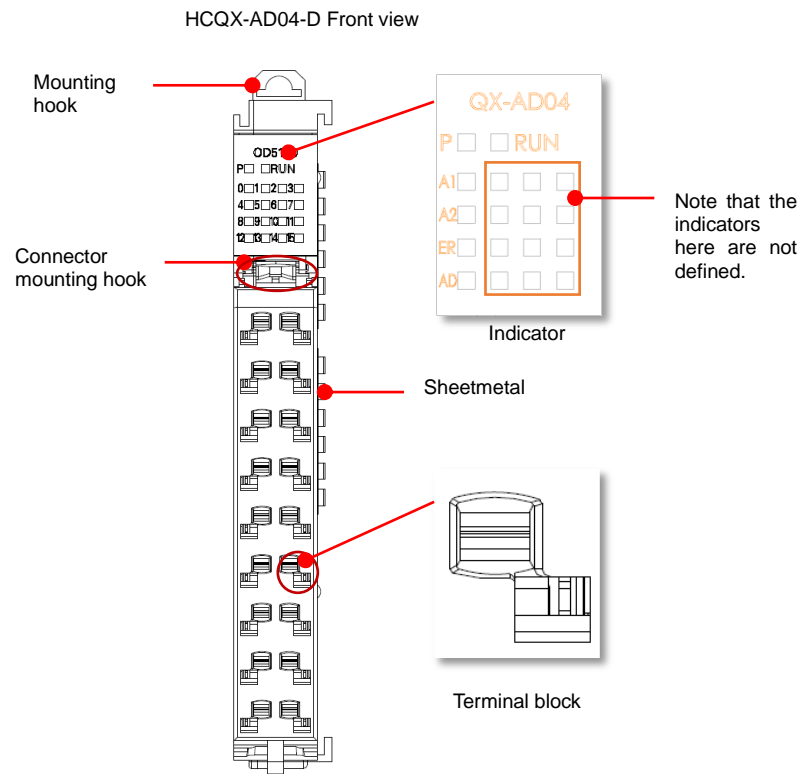
① Main unit or module model name description :

HC QX - AD 04- D-x x x x



- ② Working voltage and input/output current for normal operation
- ③ Output power
- ④ Barcode, S/N &P/N
- ⑤ QR code(model name, serial number)

Part names and function for analog input module



• **Analog input module terminal arrangements**

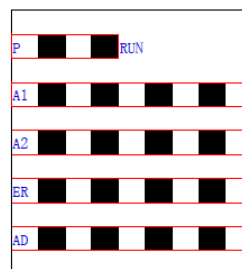
Table 0-15 Terminal arrangements

Name	Terminal	Name
V1-	0	9 V1+
G	1	10 I1
V2-	2	11 V2+
G	3	12 I2
V3-	4	13 V3+
G	5	14 I3
V4-	6	15 V4+
G	7	16 I4
G	8	17 G

Terminal name	Description
V1-	Voltage input (negative) of channel 1
V1+	Voltage input (positive) of channel 1
V2-	Voltage input (negative) of channel 2
V2+	Voltage input (positive) of channel 2
V3-	Voltage input (negative) of channel 3
V3+	Voltage input (positive) of channel 3
V4-	Voltage input (negative) of channel 4
V4+	Voltage input (positive) of channel 4
I1	Current input of channel 1
I2	Current input of channel 2
I3	Current input of channel 3
I4	Current input of channel 4
G	AGND (Analog grounding , 1、 3、 5、 7、 8、 17 internal short-circuited)

- For current input, there is no need to short-circuit V+ and I, only connect I and G.

LED indicator arrangements for analog input module



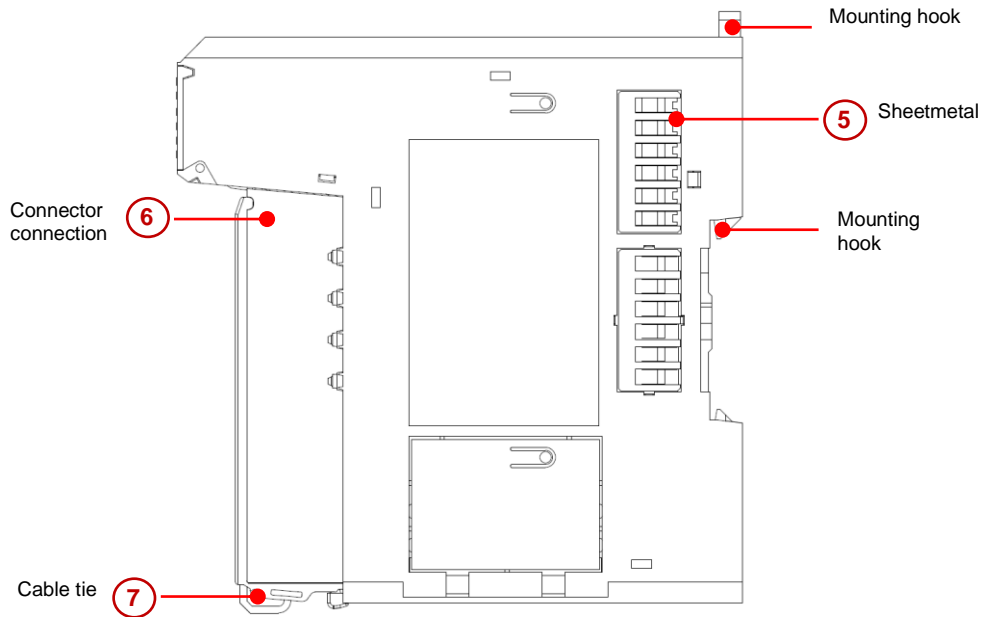
"2-3-3 EtherCAT slave controller"

Table 0-16 LED indicator description

Symbol	Color	Description
P	Green	The indicator shows the current power supply status of the module.
RUN	Red	Analog module running state. Lit means the module is in normal running state
A1	Red	Whether ESC channel 1 of analog input module can respond normally.
A2	Red	Whether ESC channel 2 of analog input module can respond normally.
ER	Red	AD operation failure indication
AD	Red	Connection failure indication between AD module and MCU

Tips • When the ESC channel in the indicator respond normally, it does not correspond to the specific channel of analog input.

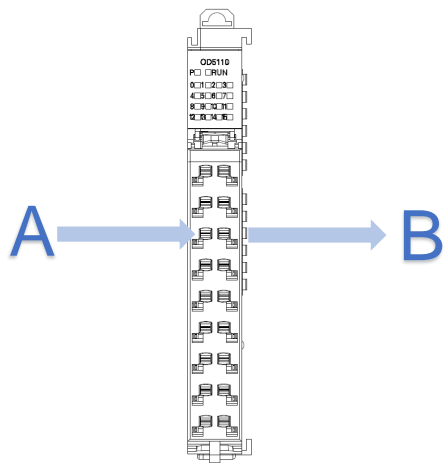
HCQX-AD04-D viewed from right side



Items	Name	Description
②	Sheetmetal	Transmits QBUS signal
③	Connector connection	Provide wiring device for easy wiring and module replacement
④	Cable tie	Pass the cables through and fix them to make the wiring more neat and convenient for future maintenance.

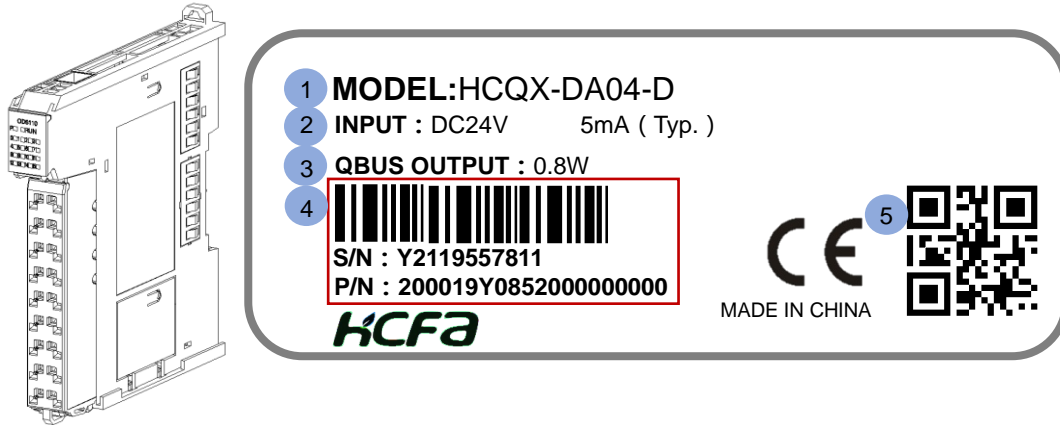
Analog input module signal transmission direction

The direction of EtherCAT data frame transmission in the digital output module depends on the ESC (EtherCAT Slave Controller). Check the diagram below, the data frame transmission direction is A→B
 HCQX-AD04-D Front view



2-5-2 Analog output module model name and part names

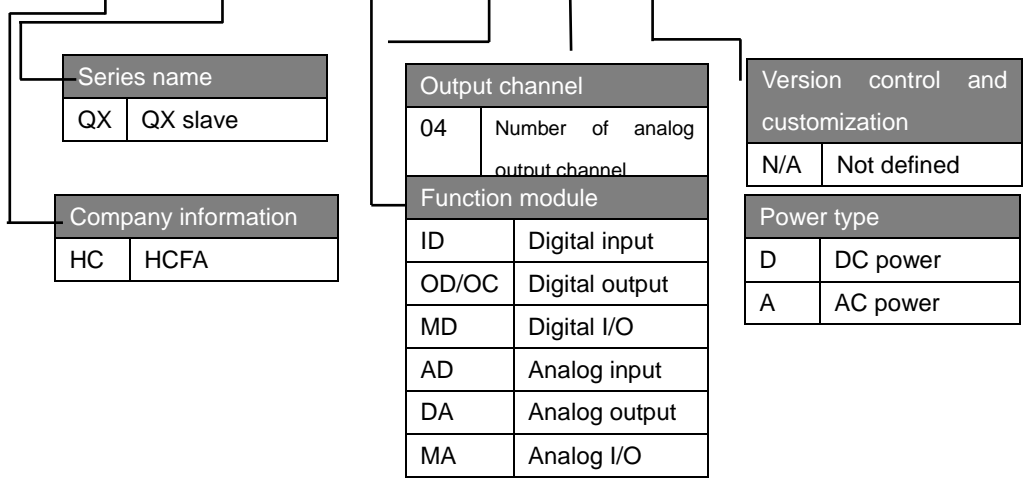
Analog output module model name description



Analog output module nameplate description :

① Main unit or module model name description :

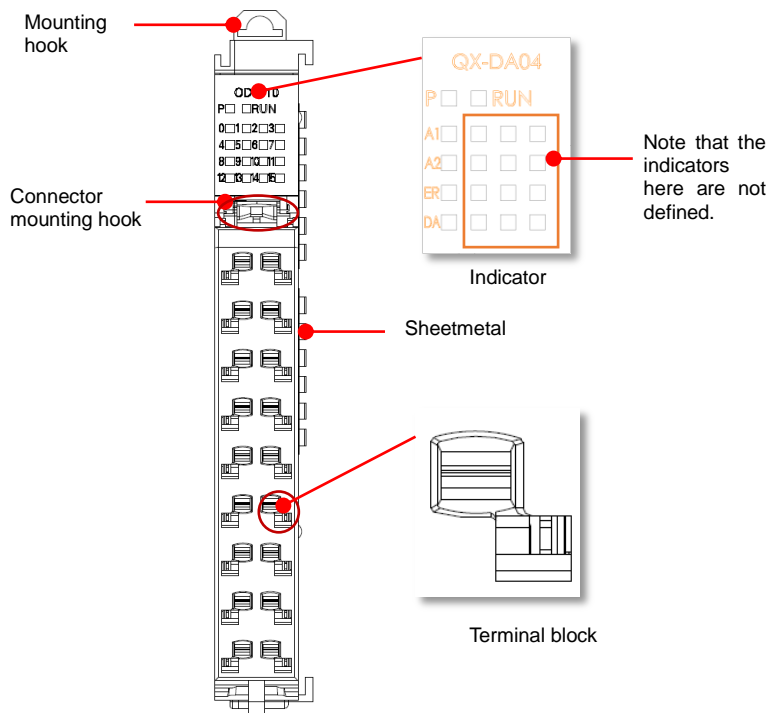
HC QX - DA 04-D- x x x x



- ② Working voltage and input/output current for normal operation
- ③ Output power
- ④ Barcode, S/N & P/N
- ⑤ QR code(model name, serial number)

Part names and function for analog output module

HCQX-DA04-D Front view



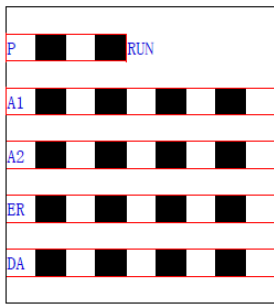
• **Analog output module terminal arrangements**

Table 0-17 Terminal arrangements

Name	Terminal	Name
V1	0	9 G
I1	1	10 G
V2	2	11 G
I2	3	12 G
V3	4	13 G
I3	5	14 G
V4	6	15 G
I4	7	16 G
G	8	17 G

Terminal name	Description
V1	Channel 1 voltage output
I1	Channel 1 current output
V2	Channel 2 voltage output
I2	Channel 2 current output
V3	Channel 3 voltage output
I3	Channel 3 current output
V4	Channel 4 voltage output
I4	Channel 4 current output
G	AGND (Internal short circuit at analog grounding G port)

LED indicators arrangements for analog output module



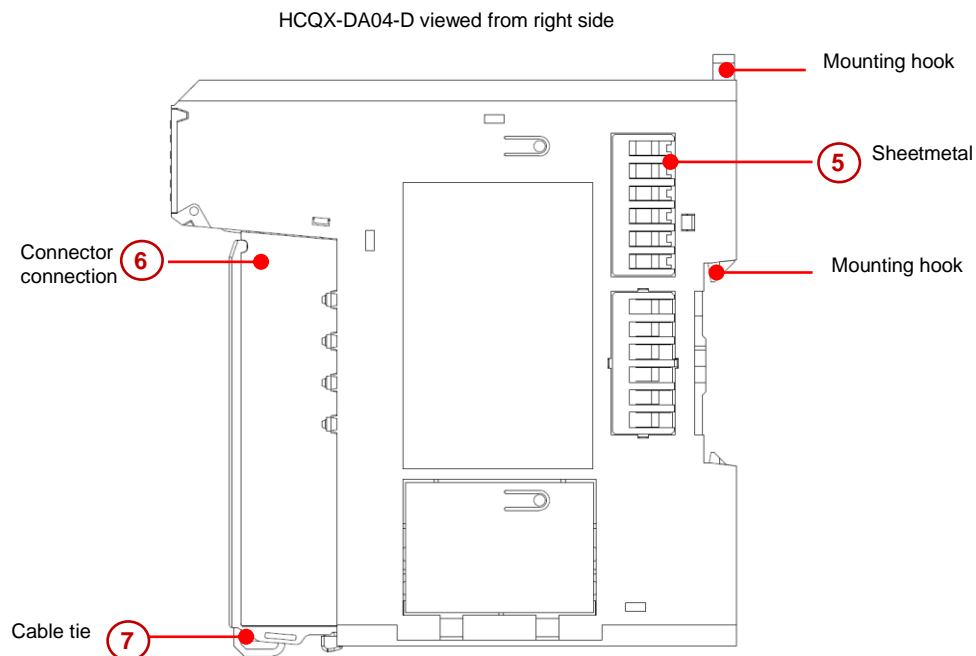
 "2-3-3 EtherCAT slave controller"

Table 0-18 LED indicator description

Symbol	Color	Description
P	Green	The indicator shows the current power supply status of the module.
RUN	Red	Analog module running state. Lit means the module is in normal running state
A1	Red	Whether ESC channel 1 of analog output module can respond normally.
A2	Red	Whether ESC channel 2 of analog output module can respond normally.
ER	Red	DA operation failure indication
DA	Red	Connection failure indication between DA module and MCU

- When the ESC channel in the indicator respond normally, it does not correspond to the specific channel of analog output.

Tips



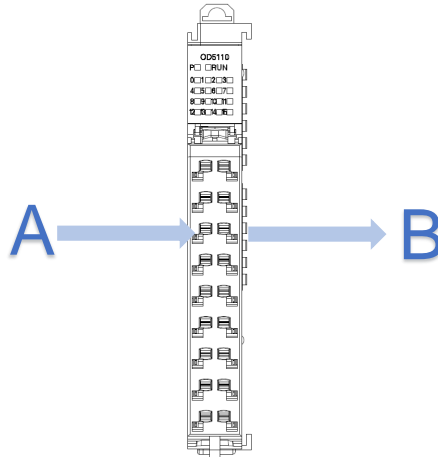
Item	Name	Description
②	Sheetmetal	Transmits QBUS signal
③	Connector	Provide wiring device for easy wiring and module replacement

	connection	
④	Cable tie	Pass the cables through and fix them to make the wiring more neat and convenient for future maintenance.

Analog output module signal transmission direction

The direction of EtherCAT data frame transmission in the digital output module depends on the ESC (EtherCAT Slave Controller). Check the diagram below, the data frame transmission direction is A→B

HCQX-DA04-D Front view



2-6 Terminal module (Not updated)

Chapter 3 Specifications

3-1 General specifications

This section mainly describes the electrical specifications and application environment specifications.

3-1-1 Electrical specifications

Items	Technical specifications				
Dielectric withstand voltage	AC1000V for 1 min Between power terminal and I/O terminal, between external terminal and shell				
Noise resistance	1500Vp-p or more , Noise width 1 μ s , 50ns (based on noise simulator) , comply with (IEC61000-4-2/3/4/6)				
Vibration resistance	Installation	Frequency(Hz)	Acceleration (m/s^2)	Single amplitude (mm)	10 times of testing in each direction (X-, Y-, and Z-axis directions) (Total: 80 min, each)
	DIN rail mounting	10~57	—	0.035	
		57~150	4.9	—	
	Direct mounting	10~57	—	0.075	
57~150		9.8	—		
Insulation resistance	5 M Ω or more using 500 V DC insulation resistance meter (Between all terminals and ground terminal)				
IP protection level	IP20				
Working atmosphere	Max. 55 $^{\circ}$ C , free from excessive dust and corrosive gas				
Working altitude	2000m (80kPa)				
Degree of pollution	2				
Weight	About 530g				

3-1-2 Environment specifications

Classification	Type	Working environment	Transporation environment	Storage temperature
Environment parameter (IEC60721-3)	Level	IE33	IE22	IE12
	Temperature	0~55 $^{\circ}$ C (no freezing)	-40~75 $^{\circ}$ C	-25~75 $^{\circ}$ C
	Humidity	5-95%RH (no condensation)		
	Shock (collision)	Acceleration 150m/s ² , action time 11ms , twice in X, Y, Z direction		
	Altitude/pressure	Max.2000m	Max.3000m (>70kPa)	

Tips

- IEC60721-3 is the classification of environmental conditions. Section 3: Classification of environmental parameter groups and their severity
- Ambient temperature refers to the temperature around the module or unit, not the internal temperature of the module

3-2 Performance specifications

This section will mainly describe the specifications and dimension for CPU unit and extension modules.

3-2-1 CPU unit specifications

CPU unit performance specifications

Items	Technical specifications
Programming method	IEC61131-3 programming language (IL, LD, FBD, ST, CFC, SFC)
Program execution method	Compile execution
I/O control method	Bus refresh mode
Max. number of I/O units	10 (Refer to the max. I/O points when connecting extension modules)
Max. number of I/O points	65535points (excluding special function modules)
Dimension (L*W*H)	About 132mm*100mm*100mm
Program storage space	100MB , can be extended
Flash hold space after power-failure	1MB
RAM	1GB
ROM	4GB
Program hold method after power-failure	Flash hold
Interruption mode	16 points input interruption (CPU built-in high-speed DI) , supporting risingedge and falling edge interruption
CPU unit high-speed I/O	Input : 16 points Output 16 points
Self-diagnosis function	CPU error , data frame transmission error, etc.

CPU unit high-speed I/O specifications

- High-speed input specifications

Items	Technical specification
Signal name	High-speed input (DI0-DI15)
Rated input voltage	DC24 (+20%~-15% , pulse ripple within 10%)
Rated input current	3.65mA
ON-current	>4.14mA
OFF-current	<3.88mA
Input impedance	1.5K
Max. counting speed	100KHZ (Version 2.XX.XX) 200KHz (Version 3.XX.XX or more)
2-phase input worst duty ratio	(40% : 60%) ~ (60% : 40%)
Common method	Evey 8 points share a common terminal.

- High-speed output specifications

Items	Technical specification
Signal name	Output (DO0-DO15)
Output polarity	Sink output (NPN)

Control circuit voltage	DC5V~24V
Rated load current	250mA
Max. voltage drop at power-ON	0.05V
Leakage current at power-OFF	<0.1mA
Output frequency	100KHZ (Version 2.XX.XX) 200KHz (Version 3.XX.XXor more)
Common method	Evey 8 points share a common terminal.

CPU unit dimensions

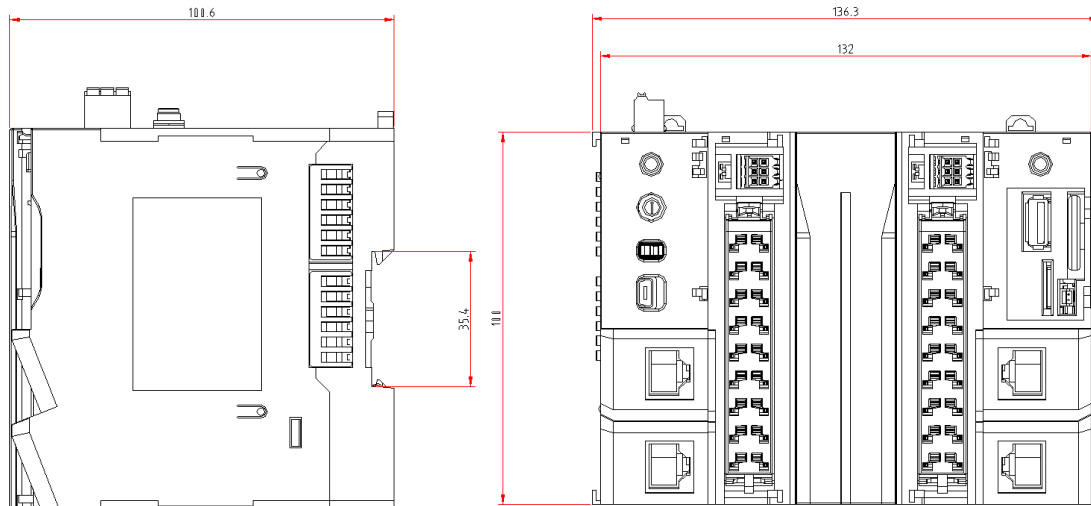


Figure 0-1 CPU unit dimension diagram

3-2-2 AC power module specifications (not updated)

3-2-3 EC coupler module specifications

ECcoupler module basic specifications

Functions	Connect terminal module to 100BASE-TX EtherCAT network
Data transmission	EtherNet/EtherCAT (at least CAT5) , shielded
Distance between stations	Up to 100m
Transmission protocol/transmission rate	EtherCAT/100Mbaud
Bus interface	2 x RJ45
Power supply	DC24V (-10%~+10%)
Power consumption	0.6A (Typ)
QBUS load power	8W (Typ)
Electrical isolation	500V (backboard/input power)
Dimensions	About 15 mm x 100 mm x 70 mm (Width alignment: 12 mm)
Weight	About 90g

Working /storage temperature	0°C~+55°C/-25°C~+75°C
Relative humidity	95% , no condensation
Protection level/Installation	IP20/ Not specified
Certificate	CE

EC coupler module dimensions

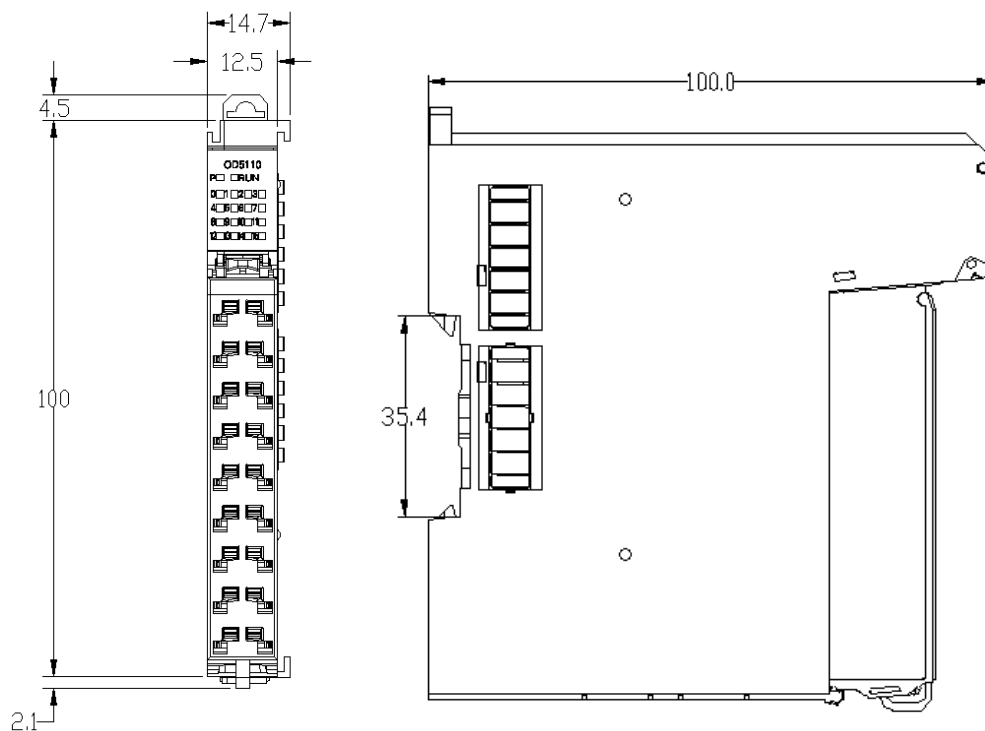


Figure 0-2 EC coupler module dimensions

3-2-4 Digital input module specifications

Digital input module basic specifications

Items	Technical specifications
Number of input channels	16
Input type	Source/sink input
Isolation method	Photocoupler isolation
Input voltage	DC24 V (-15% / +20%)
"0" signal voltage	-3 V ... 5 V (EN 61131-2, Typ 1)3.6mA
"1" signal voltage	15 V ... 30 V (EN 61131-2, Typ 1)1.7mA
Input response speed	1 ms
Input current	typ. 5 mA (EN 61131-2, Typ 1)
QBUS power consumption	0.8W (Typ)
Electrical isolation	500 V _{eff} (Backboard/Input interface)
Weight	About 90g
Working temperature	0 °C ... + 55 °C

Storage temperature	-25 °C ... + 85 °C
Relative humidity	95%, no condensation
Dimensions	About 15 mm x 100 mm x 70 mm (Width alignment : 12 mm)
Installation method	On 35 mm DIN rail Comply with EN 50022
Vibration/shock resistance	Comply with EN 60068-2-6/EN 60068-2-27/29
Anti-electromagnetic interference	Comply with EN 61000-6-2/EN 61000-6-4
Protection level	IP 20
Installation location	Not specified
Certificate	CE

Dimensions

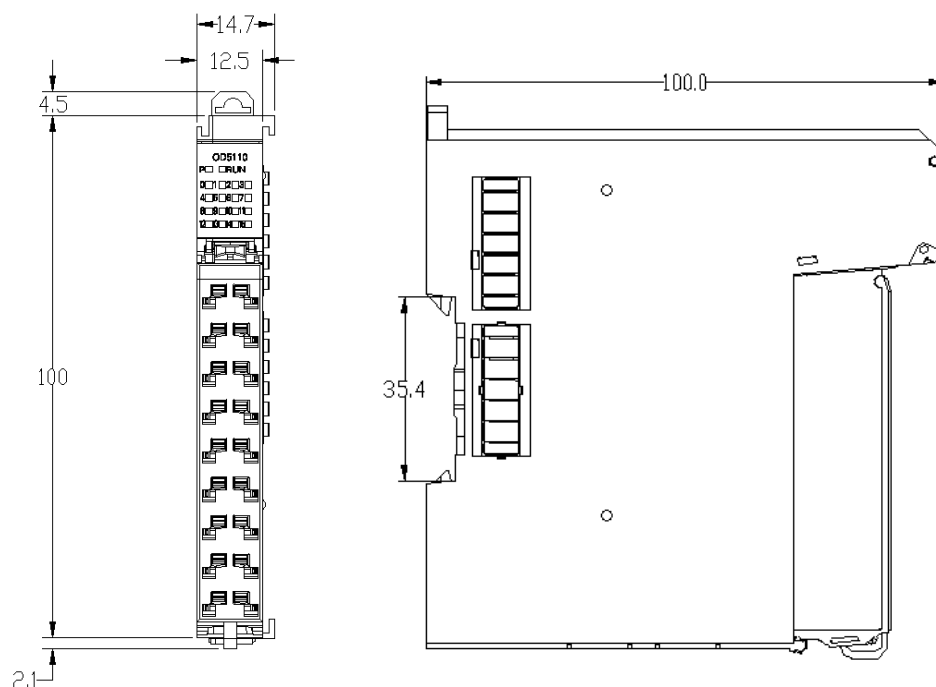


Figure 0-3 Digital input module dimensions

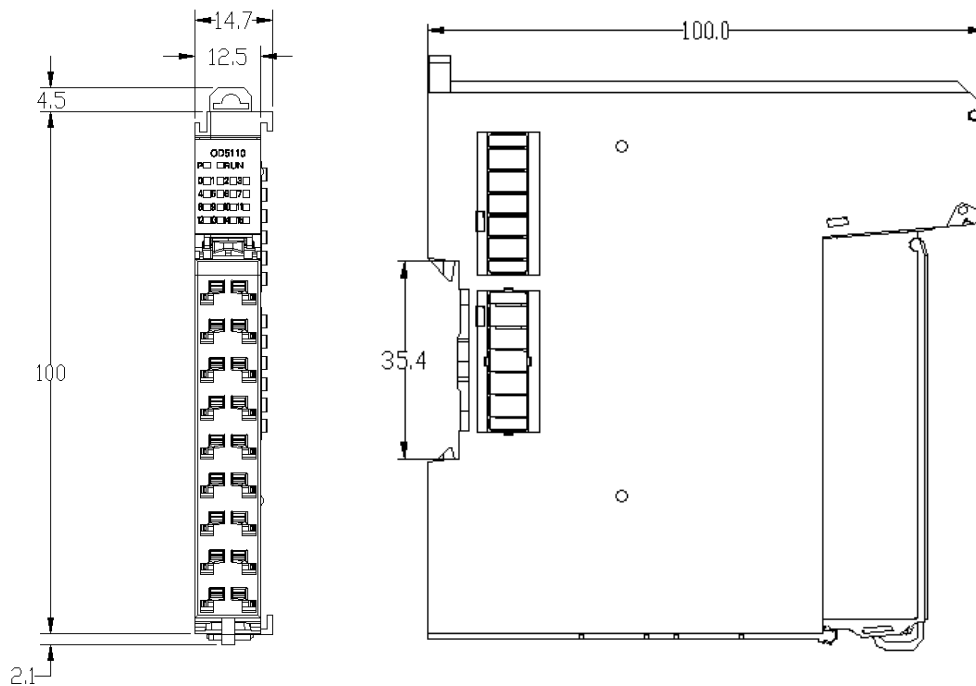
3-2-5 Digital output module specifications

Digital output module basic specifications

Item	Technical specifications
Output points	16
Output type	Sink output
Isolation method	Photocoupler isolation
Load type	Resistive, inductive, lighting load
Rated load voltage	DC24 V (-15% / +20%)
Low-level output voltage	1V

Switching time(cycle)	1ms
Max. output current (per channel)	250mA
QBUS power consumption	1.4W (Typ)
Electrical isolation	500 V _{eff} (Backboard/input interface)
Weight	About 90g
Working temperature	0 °C ... + 55 °C
Storage temperature	-25 °C ... + 85 °C
Relative humidity	95%, no condensation
Dimensions	About 15 mm x 100 mm x 70 mm (Width alignment : 12 mm)
Installation method	On 35 mm DIN rail Comply with EN 50022
Vibration/shock resistance	Comply with EN 60068-2-6/EN 60068-2-27/29
Anti-electromagnetic interference	Comply with EN 61000-6-2/EN 61000-6-4
Protection level	IP 20
Installation location	Not specified
Certificate	CE

Digital output module dimensions



3-2-6 Digital I/O module specifications

Digital I/O module basic specifications

Item	HCQX-MD16-D technical specifications
Number of channels	8 input channels+8 output channels
Input type	Source/sink input
Output type	Sink output
Isolation method	Photocoupler isolation
Load type	Resistive, inductive, lighting load
Input/output voltage	DC24 V (-15% / +20%)
Input "0" signal voltage	-3 V ... 5 V (EN 61131-2, Typ 1) 3.6mA
Input "1" signal voltage	15 V ... 30 V (EN 61131-2, Typ 1) 1.7mA
Input response speed	1ms
Switching time(cycle)	1ms
Input current	typ. 5 mA (EN 61131-2, Typ 1)
Max. output current	250mA
QBUS power consumption	1W (Typ.)
Electrical isolation	500 V _{eff} (Backboard/input interface))
Weight	About 90g
Working temperature	0 °C ... + 55 °C
Storage temperature	-25 °C ... + 85 °C
Relative humidity	95%, no condensation
Dimensions	About 15 mm x 100 mm x 70 mm (Width alignment : 12 mm)
Installation method	On 35 mm DIN rail Comply with EN 50022
Vibration/shock resistance	Comply with EN 60068-2-6/EN 60068-2-27/29
Anti-electromagnetic interference	Comply with EN 61000-6-2/EN 61000-6-4
Protection level	IP 20
Installation location	Not specified
Certificate	CE

Digital I/O module dimensions

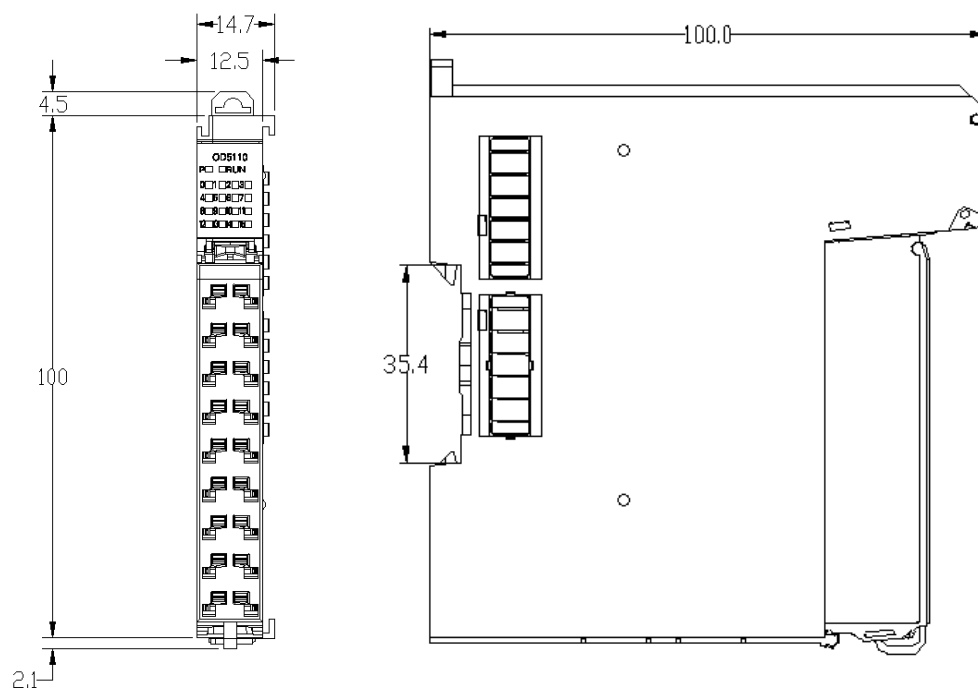


Figure 0-5 Digital I/O module dimensions

3-2-7 Analog (voltage) input module specifications

This module is a 16-bit analog input module based on the EtherCAT, which can perform peak value monitoring, limit value monitoring, disconnection detection, user scale adjustment, auto tuning and input filtering setting.

Analog input module basic specifications

Items	Technical specifications
Input channel	4(differential)
Signal voltage	0~10V、 -10~10V、 -5~5V、 0~5V、 1~5V
Voltage input resistance	> 200 kΩ
Signal current	0~20mA、 4~20mA
Current input resistance	250Ω
Input filter limit frequency	5Khz (second-order filter)
Common-mode voltage U_{CM}	Up to 35 V
Resolution	24 bit
Channel data refresh time	About four channels take 1ms
Measurement error (Total error range)	$< \pm 0,3 \%$ (full scale)0.8%(current)
QBUS power consumption	1W (Typ)
Electrical isolation	500 V_{eff} (Backboard/Input interface)
Setting	No need to set the address, can be configured through CODESYS
Weight	About 90g
Working temperature	0 °C ... + 55 °C
Storage temperature	-25 °C ... + 85 °C

Relative humidity	95%, no condensation
Dimension	About 15 mm x 100 mm x 70 mm (Width alignment: 12 mm)
Installation	On 35 mm DIN rail Comply with EN 50022
Vibration/shock resistance	Comply with EN 60068-2-6/EN 60068-2-27/29
Anti-electromagnetic interference	Comply with EN 61000-6-2/EN 61000-6-4
Protection level	IP 20
Installation location	Not specified
Certificate	CE

Analog input module dimensions

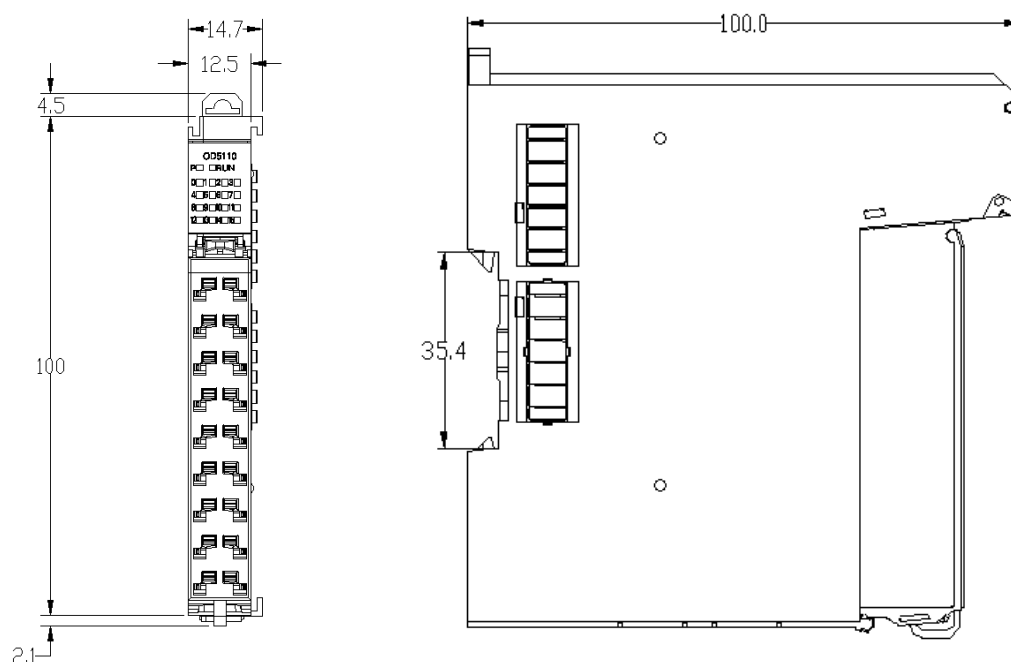


Figure 0-6 Analog input module dimensions

Analog input configuration and parameter mapping

- **PDO mapping**

Index	Name	Index	Name
1A00	Channel 1 Status	1A08	Channel 3 Status
1A01	Channel 1 Data (bipolar effective)	1A09	Channel 3 Data (bipolar effective)
1A02	Channel 1 Max. value (bipolar effective)	1A0A	Channel 3 Max. value (bipolar effective)
1A03	Channel 1 Mini. value (bipolar effective)	1A0B	Channel 3 Mini. value (bipolar effective)
1A04	Channel 2 Status	1A0C	Channel 4 Status

1A05	Channel 2 Data (bipolar effective)	1A0D	Channel 4 Data (bipolar effective)
1A06	Channel 2 Max. value (bipolar effective)	1A0E	Channel 4 Max. value (bipolar effective)
1A07	Channel 2 Mini. value (bipolar effective)	1A0F	Channel 4 Mini. value (bipolar effective)

• **Status bit description**

1	2	3	4	5	6	7	8..13	14	15	16
Within range	Over range	Limit 1		Limit 2		Error	Reserved	Reserved	Reserved	Reserved

• **Parameter setting**

Index (HEX)	Sub-index (HEX)	Description	R/W	Type	Default(HEX)	Notes
1000		Device type	RO	UDINT	5001	
1001		Error register	RO	USINT	0	Reserved
1008		Device name	RO	STRING(20)	HCQX-AD-04	
1009		Hardware version	RO	STRING(5)		
100A		Software version	RO	STRING(5)		
1011		Restore default settings				
	1	Sub-index 1	RW	BOOL	FLASE	
1C00		Sync manager type				
	1	Sub-index 1	RO	USINT	1	Master → slave Mailbox data communication
	2	Sub-index 2	RO	USINT	2	Slave → master Mailbox data communication
	3	Sub-index 3	RO	USINT	3	Master → slave Process data communication
	4	Sub-index 4	RO	USINT	4	Slave → master Process data communication
1C13		TxPDO assignment				
	1	Sub-index 1	RO	UINT	1A00	
	2	Sub-index 2	RO	UINT	1A01	
	3	Sub-index 3	RO	UINT	1A02	
	4	Sub-index 4	RO	UINT	1A03	
	5	Sub-index 5	RO	UINT	1A04	
	6	Sub-index 6	RO	UINT	1A05	
	7	Sub-index 7	RO	UINT	1A06	
	8	Sub-index 8	RO	UINT	1A07	

	9	Sub-index 9	RO	UINT	1A08	
	A	Sub-index 10	RO	UINT	1A09	
	B	Sub-index 11	RO	UINT	1A0A	
	C	Sub-index 12	RO	UINT	1A0B	
	D	Sub-index 13	RO	UINT	1A0C	
	E	Sub-index 14	RO	UINT	1A0D	
	F	Sub-index 15	RO	UINT	1A0E	
	10	Sub-index 16	RO	UINT	1A0F	
1C33		SM input parameter				
	1	Sync. mode	RW	UINT	01	
	2	Cycle time	RO	UDINT	7122000 (DEC)	SM communication cycle time (ns)
	4	Supported sync mode	RO	UINT	3	Supported sync mode : 0x0001 : FREE RUN 0x0002 : SM
	5	Mini. Cycle time	RO	UDINT	100000 (DEC)	(ns)
	6	Calculation and copy time	RO	UDINT	0	
	8	Obtain cycle time	RW	UINT	0	
	9	Delay time	RO	UDINT	0	
	A	SYNC0 cycle time	RW	UDINT	0	
	B	SM event loss	RO	UINT	0	
	C	Cycle time too small	RO	UINT	0	
	20	SYNC error	RO	BOOL	FALSE	
6000		Channel 1 status				
	1	Within range	RO	BOOL	FALSE	
	2	Over range	RO	BOOL	FALSE	
	3	Limit 1	RO	BOOL	FALSE	
	5	Limit 2	RO	BOOL	FALSE	
	7	Error	RO	BOOL	FALSE	
6010		Digital value	RO	INT	0	
6020		Max. value	RO	INT	0	
6030		Mini. value	RO	INT	0	
6040		Channel 2 status				
	1	Within range	RO	BOOL	FALSE	
	2	Over range	RO	BOOL	FALSE	
	3	Limit 1	RO	BOOL	FALSE	
	5	Limit 2	RO	BOOL	FALSE	
	7	Error	RO	BOOL	FALSE	
6050		Digital value	RO	INT	0	

6060		Max. value	RO	INT	0	
6070		Mini. value	RO	INT	0	
6080		Channel 3 status				
	1	Within range	RO	BOOL	FALSE	
	2	Over range	RO	BOOL	FALSE	
	3	Limit 1	RO	BOOL	FALSE	
	5	Limit 2	RO	BOOL	FALSE	
	7	Error	RO	BOOL	FALSE	
6090		Digital value	RO	INT	0	
60A0		Max. value	RO	INT	0	
60B0		Mini. value	RO	INT	0	
60C0		Channel 4 status				
	1	Within range	RO	BOOL	FALSE	
	2	Over range	RO	BOOL	FALSE	
	3	Limit 1	RO	BOOL	FALSE	
	5	Limit 2	RO	BOOL	FALSE	
	7	Error	RO	BOOL	FALSE	
60D0		Digital value	RO	INT	0	
60E0		Max. value	RO	INT	0	
60F0		Mini. value	RO	INT	0	
80n0		Channel n input setting				N=0、1、2、3
	1	Input mode selection		USINT	01	Setting value : Mode 0 : 0~10V、 Mode 1 : -10~10V、 Mode 2 : -5~5V、 Mode 3 : 0~5V、 Mode 4 : 1~5V、 Mode 5 : 0~20mA、 Mode 6 : 4~20mA
	9	Enabled channel		BOOL	FALSE	Setting value : True, False
	A	Enabled proportion adjustment		BOOL	FALSE	Setting value : True, False
	B	Enabled peak monitoring		BOOL	FALSE	Setting value : True, False
	C	Enabled filter		BOOL	FALSE	Setting value : True, False
	D	Enabled limit 1		BOOL	FALSE	Setting value : True, False
	E	Enabled limit 2		BOOL	FALSE	Setting value : True, False
	11	User scale offset		INT	00	Setting value : Mode 0 : 0 ;

						<p>Mode 1 : Disabled user scale mode: 0、 Enabled user scale mode: 0~User Scale Gain-1000 ;</p> <p>Mode 2 : 0 ;</p> <p>Mode 3 : 0 ;</p> <p>Mode 4 : 1000 ;</p> <p>Mode 5 : Disabled user scale mode : 0、 Enabled user scale mode : 0~User Scale Gain-3000 ;</p> <p>Mode 6 : 4000 ;</p>
	12	User scale gain		INT	5000	<p>Setting value :</p> <p>Mode 0 : 5000 ;</p> <p>Mode 1 : Disabled user scale mode:: 5000、 Enabled user scale mode : User Scale Offset+1000~10000 ;</p> <p>Mode 2 : 5000 ;</p> <p>Mode 3 : 5000 ;</p> <p>Mode 4 : 3000 ;</p> <p>Mode 5 : Disabled user scale mode : 20000、 Enabled user scale mode : User Scale Offset+3000~20000 ;</p> <p>Mode 6 : 20000 ;</p>
	13	Limit 1		INT	-32	<p>Setting value :</p> <p>Mode 0 : -32~Limit2-1 ;</p> <p>Mode 1 : -32768~Limit2-1 ;</p> <p>Mode 2 : -16384~Limit2-1 ;</p> <p>Mode 3 : -16~ Limit2-1 ;</p> <p>Mode 4 : -16~ Limit2-1 ;</p> <p>Mode 5 : -32~ Limit2-1 ;</p> <p>Mode 6 : -32~ Limit2-1 ;</p>
	14	Limit 2		INT	32767	<p>Setting value :</p> <p>Mode 0 : Limit1+1~32767 ;</p> <p>Mode 1 : Limit1+1~32767 ;</p> <p>Mode 2 :</p>

						Limit1+1~16383 ; Mode 3 : Limit1+1~16383 ; Mode 4 : Limit1+1~16383 ; Mode 5 : Limit1+1~32767 ; Mode 6 : Limit1+1~32767 ;
	15	Filtering setting		INT	0001	Setting value : 0~4096 ;

◆ **0x80n0:0A\0x80n0:1\0x80n0:11 User scale adjustment description**

0x80n0:0A user scale adjustment enabled

0x80n0:11 user scale offset

0x80n0:12 user scale gain

Example1: [0x80n0:01:1] [0x80n0:11:1000] [0x80n0:12:5000] [0x80n0:0A:TRUE]

In AD mode, the user's actual measurement range is (0x80n0:11/1000) 1~5V (0x80n0:12/1000). The value collected by the user in the corresponding analog channel can be calculated by the following formula:

$$\text{Value} := \left(V_{\text{actual}} - \frac{\text{offset}}{1000} \right) * \left(\frac{16000}{(\text{Gain} - \text{offset})/1000} \right)$$

Convert Value to V_{measure}

$$V_{\text{measure}} := \left(\frac{16000}{(\text{Gain} - \text{offset})} \right) * (\text{value} - \text{offset})$$

Value : Value collected by the analog input

V_{actual} : Actual voltage value of measured object

V_{measure} : Measure voltage value of measured object

offset : Set offset value in 0x80n0:11

Gain : Set gain value in 0x80n0:12

◆ **0x80n0:15\0x80n0:0C filter setting**

Example1: Set m to [0x80n0:0C:TRUE] [0x80n0:15:m]

The default filtering mode of the AD module is mean filtering. After enabling the filter at 0x80n0:0C, according to the average filter value set in 0x80n0:15, the measured value can be calculated by the following formula:

$$V_{\text{measure}} := \left(\frac{V_{\text{actual}1} + \dots + V_{\text{actual}m}}{m} \right)$$

• **User display**

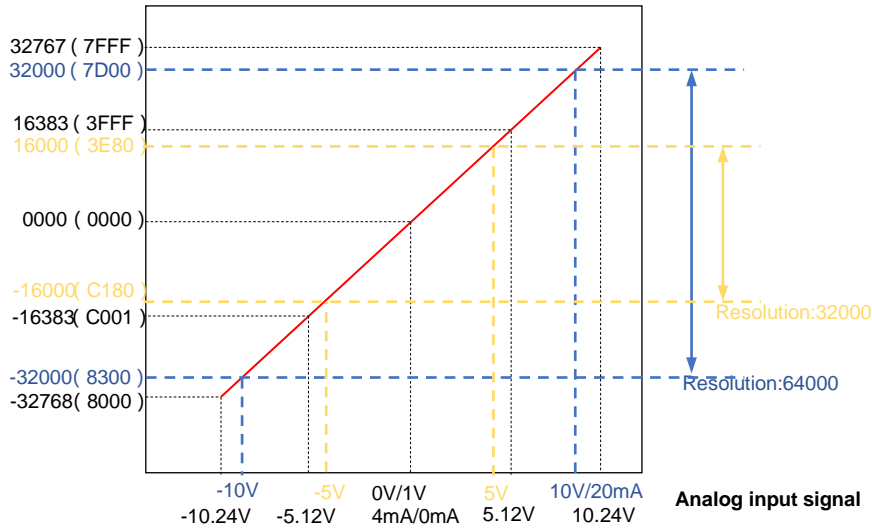
The user display configuration is determined by index 0x80n0:01, where the user can modify the working mode of the channel to display values in different measurement ranges

The analog module has a 16-bit resolution and the maximum display range is -[[32768]]_dec to +[[32767]]_dec. The measured and displayed values in different modes are as follows:

Table 0-1 Relationship between I/O signal and value display

I/O signal								Value	
HCQX-AD04-D				HCQX-DA04-D				Decimal	Hexadecimal
10V		20mA		10V		20mA		32000	0x7D00
5V				5V				16000	0x3E80
									0x0001
0V	1V	0mA	4mA	0V	1V	0mA	4mA	0	0x0000
									0x0001
-5V				-5V				-16000	0xC180
-10V				-10V				-32000	0x8300

The graph shown as below :
Conversion value
DEC (HEX)



3-2-8 Analog (voltage) output module specifications

Analog output module basic specifications

Items	Technical specifications
Output channels	4
Signal voltage	0~10V、-10~10V、-5~5V、0~5V
Signal current	0~20mA、4~20mA
Accuracy	± 0.3 % , relative to full scale
Resolution	16bit
Channel data refresh time	1ms
Voltage load	> 5 kΩ
Current load	< 350Ω
QBUS power consumption	1W (Typ)
Electrical isolation	500 V _{eff} (Backboard/input interface)
Process image bit width	Output 4 x 16 bit data

Setting	No need to set the address, can be configured through CODESYS
Weight	About 90 g
Working temperature	0 °C ... + 55 °C
Storage temperature	-25 °C ... + 85 °C
Relative humidity	95%, no condensation
Dimensions	About 15 mm x 100 mm x 70 mm (Width alignment: 12 mm)
Installation	On 35 mm DIN rail Comply with EN 50022
Vibration/shock resistance	Comply with EN60068-2-6/EN 60068-2-27/29
EMC resistance burst/static resistance	Comply with EN 61000-6-2/EN 61000-6-4
Protection level	IP 20
Installation	Not specified
Certificate	CE

Analog output module dimensions

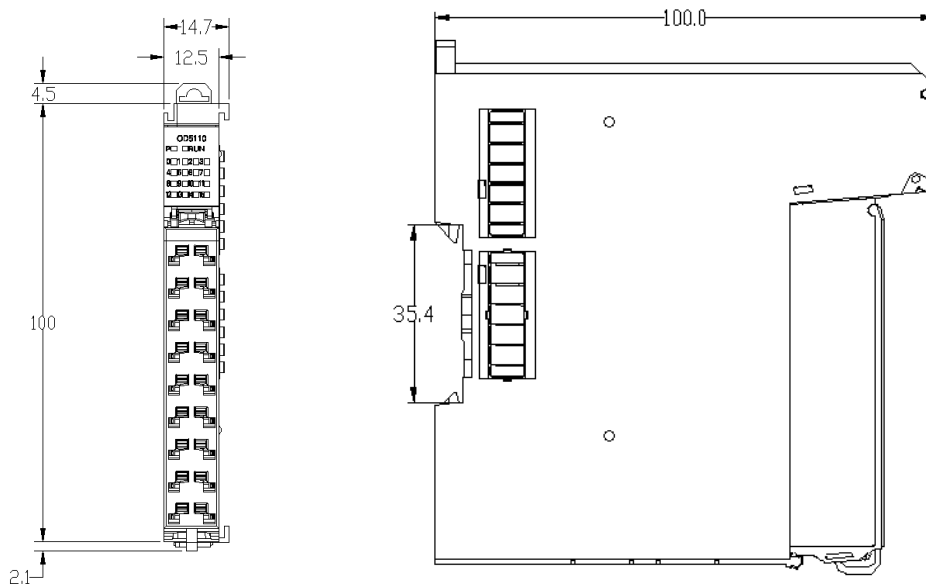


Figure 0-7 Analog output module dimensions

Analog output configuration and parameter mapping

- **PDO mapping**

Index	Name
1600	Channel 1 output
1601	Channel 2 output
1602	Channel 3 output
1603	Channel 4 output

• **Parameter setting**

Index (HEX)	Sub-index (HEX)	Description	R/W	Type	Default (HEX)	Notes
1000		Device type	RO	UDINT	5001	
1001		Error register	RO	USINT	0	Reserved
1008		Device name	RO	STRING(20)	HCQX-DA-04	
1009		Hardware version	RO	STRING(5)		
100A		Software version	RO	STRING(5)		
1011		Restore default settings	RW	BOOL	FALSE	
	1	Sub-index 1	RW	BOOL	FALSE	
1C00		Sync manager type				
	1	Sub-index 1	RO	USINT	1	Master → slave Mailbox data communication
	2	Sub-index 2	RO	USINT	2	Slave → master Mailbox data communication
	3	Sub-index 3	RO	USINT	3	Master → slave Process data communication
	4	Sub-index 4	RO	USINT	4	Slave → Master Process data communication
1C12		RxPDO assignment				
	1	Sub-index 1	RO	UINT	1600	Channel 1 data output mapping
	2	Sub-index 2	RO	UINT	1601	Channel 2 data output mapping
	3	Sub-index 3	RO	UINT	1602	Channel 3 data output mapping
	4	Sub-index 4	RO	UINT	1603	Channel 4 data output mapping
1C32		SM output parameter				
	1	Sync mode	RW	UINT	1	
	2	Cycle time	RO	UDINT	7122000 (DEC)	
	4	Supported sync mode	RO	UINT	3	
	5	Mini. Cycle time	RO	UDINT	100000 (DEC)	
	6	Calculation and copy time	RO	UDINT	0	
	8	Obtain cycle time	RW	UINT	0	
	9	Delay time	RO	UDINT	0	
	A	SYNC0 time	RW	UDINT	0	

	B	SM event loss counting	RO	UINT	0	
	C	Cycle time	RO	UINT	0	
	20	Sync error	RO	BOOL	FALSE	
	1600	Channel 1 parameter				
	1	Sub-index 1	RO	UDINT	70100110	Output data mapping
	1601	Channel 2 parameter				
	1	Sub-index 1	RO	UDINT	70100210	Output data mapping
	1602	Channel 3 parameter				
	1	Sub-index 1	RO	UDINT	70100310	Output data mapping
	1603	Channel 4 parameter				
	1	Sub-index 1	RO	UDINT	70100410	Output data mapping
	7010	Output value				
	1	Channel 1	RW	INT	00	Channel 1 output data
	2	Channel 2	RW	INT	00	Channel 2 output data
	3	Channel 3	RW	INT	00	Channel 3 output data
	4	Channel 4	RW	INT	00	Channel 4 output data
	80n0	Chanel n output setting				N=0、1、2、3
	1	Output mode selection	RW	USINT	1	Setting value : Mode 0 : 0~10V、 Mode 1 : -10~10V、 Mode 2 : -5~5V、 Mode 3 : 0~5V、 Mode 4 : 1~5V、 Mode 5 : 0~20mA、 Mode 6 : 4~20mA
	2	Channel enabled	RW	BOOL	TRUE	
	3	User calibration enabled	RW	BOOL	FALSE	Not supported
	4	Scale adjustment enabled	RW	BOOL	FALSE	Not supported
	6	Watchdog	RW	UINT	0	Not supported
	7	Error/stop output mode	RW	UINT	0	Not supported
	8	Output value	RW	UINT	0	Not supported
	9	User scale offset	RW	INT	10000	Not supported
	A	User scale gain	RW	DINT	0	Not supported
	B	User correction value	RW	INT	16000	Not supported
	C	Error/stop output	RW	INT	0	Not supported

		mode				
--	--	------	--	--	--	--

◆ **Relationship between the value in 0x7010 and the output voltage**

0x7010:0n (N=1, 2, 3, 4): Setting value of corresponding output channel

After selecting the required working mode for DA modules in channel [0x80n0:01:=TRUE], the setting value can be converted to V_{output}

$$V_{output} := \left(\frac{Value}{M_{max} - M_{min}} \right) * (V_{max} - V_{min})$$

Value : Analog output value set by users

M_{max} : Max. output range, refer to Table 3.1.10

M_{min} : Mini. Output range, refer to Table 3.1.10

V_{max} : Max. voltage of output range

V_{min} : Mini. Voltage of output range

V_{output} : Output voltage value

• **User display**

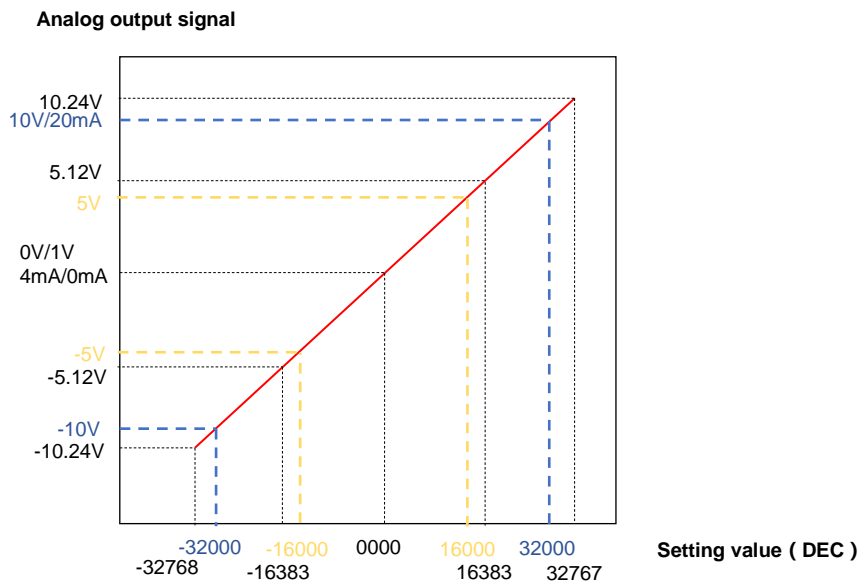
The user display configuration is determined by index 0x80n0:01, where the user can modify the working mode of the channel to display values in different measurement ranges

The analog module has a 16-bit resolution and the maximum display range is -[[32768]]_dec to +[[32767]]_dec. The measured and displayed values in different modes are as follows :

Table 0-2 Relationship between I/O signal and value display

I/O signal								Value	
HCQX-AD04-D				HCQX-DA04-D				Decimal	Hexadecimal
10V	20mA			10V	20mA			32000	0x7D00
5V				5V				16000	0x3E80
									0x0001
0V	1V	0mA	4mA	0V	1V	0mA	4mA	0	0x0000
									0x0001
-5V				-5V				-16000	0xC180
-10V				-10V				-32000	0x8300

Figure as shown below :



3-2-9 Terminal module specifications (not updated)

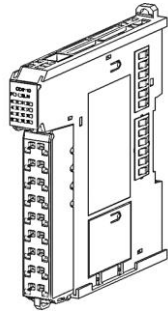
Chapter 4 Installation and wiring

4-1 Module connection

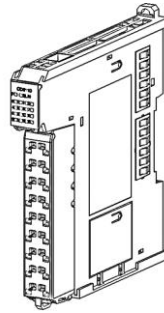
This section describes how to install the modules and DIN rail mounting.

4-1-1 Installing modules

Take the installation of EC coupler and I/O module as the example:



Right view of EC coupler module

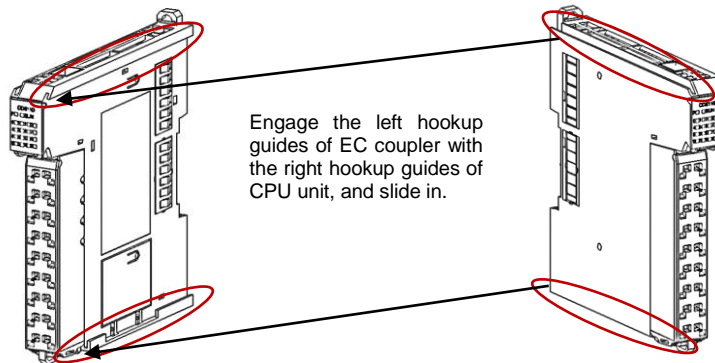


Left view of I/O module

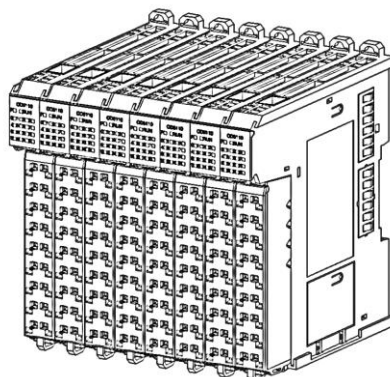
Tips


- Make sure to turn OFF the power supply before installing the units and modules.

1 Engage the right hookup guides of EC coupler with the left hookup guides of IO module and slide the unit in on the hookup guides.



2 After installation completed, follow the same step to install other modules.

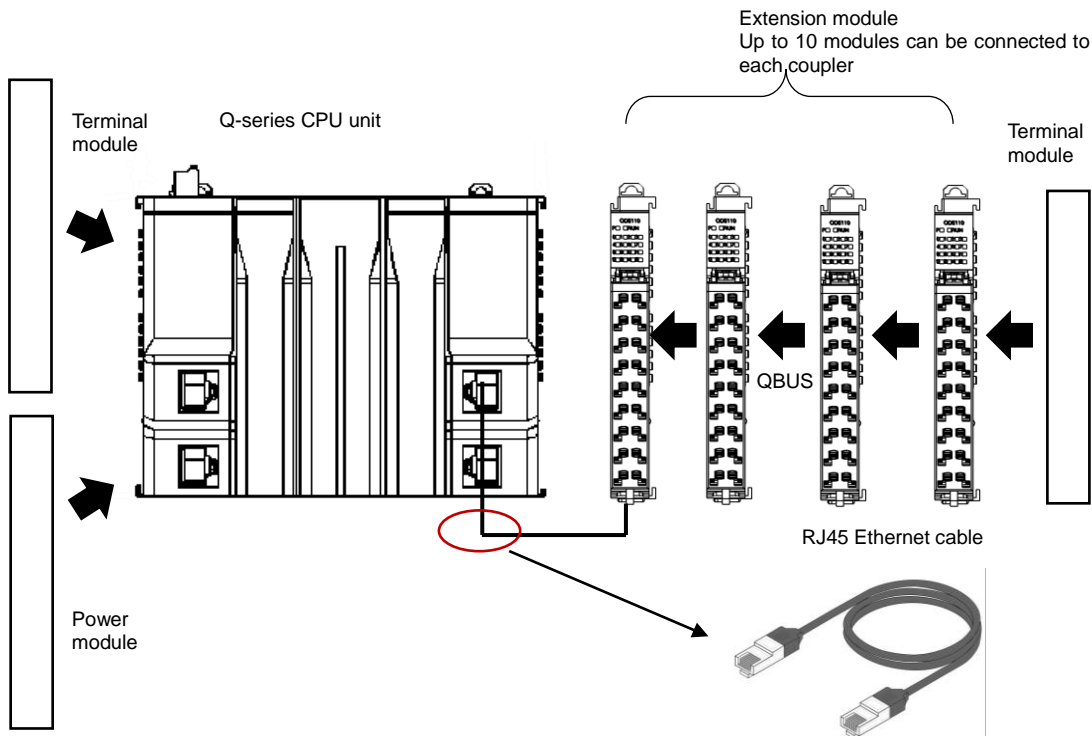


	<ul style="list-style-type: none"> • After connecting the modules together according to the above steps, please check the contact between the modules. Bad contact may cause failure, electric shock and module damage.
---	--

4-1-2 Precautions for module correction

Observe the following precautions when connecting unit or modules :

- Make sure to turn off the power supply before connecting units or modules ;
- The AC power module must be installed on the left side of CPU unit and the metal sheet of module or CPU unit must be connected to the terminal module.





- IO modules cannot be directly mounted to the right side of CPU unit, you need to add an EC coupler.

4-2 Module wiring

This section mainly describes the precautions and operation instructions about how to wire the CPU unit, I/O devices and extension I/O modules.

4-2-1 Precautions on wiring

	<p>Do not touch the module or CPU unit immediately after cutting off the power. Failure to do so may cause electric shock or burn.</p>
---	--

	<p>Make sure that the voltages and currents that are input to the Units and modules are within the specified ranges. Failure to do so may cause accidents or fire.</p>
---	--

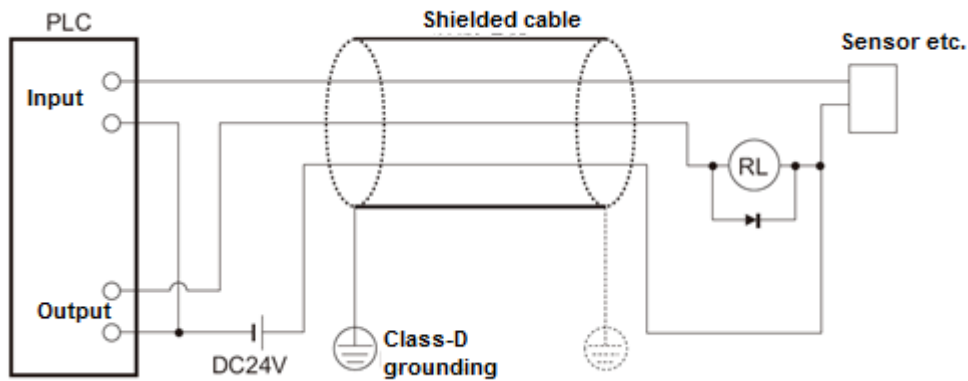
■ **Precautions for I/O module wiring**

- Input and output cables should be separated.
- If the power cable is close to the I/O cable, error may occur due to the high voltage and current. Please keep the I/O cable from the power cable at a distance of more than 100mm.
- 24VDC I/O cable should be kept separately from the AC power cable.
- When wiring using duct, make sure grounding is well-performed.

When cannot be laid separately from power cables...

All the cables can use shielded cables and be grounded on the PLC side.

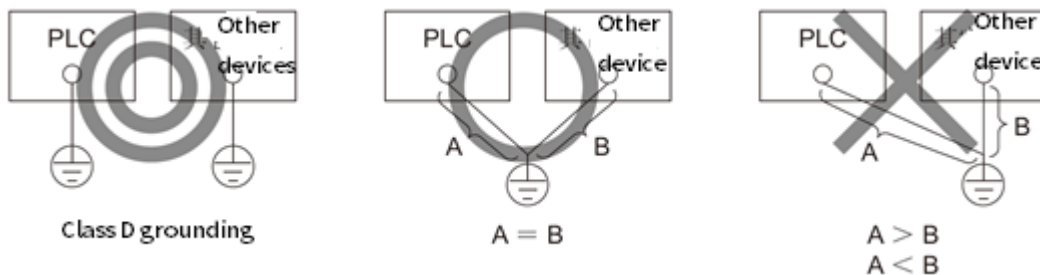
(Depending on the environment, it is sometimes necessary to ground on the opposite side of the PLC)



The cables of extension modules should be separated from the power cable.

4-2-2 Precautions on module grounding

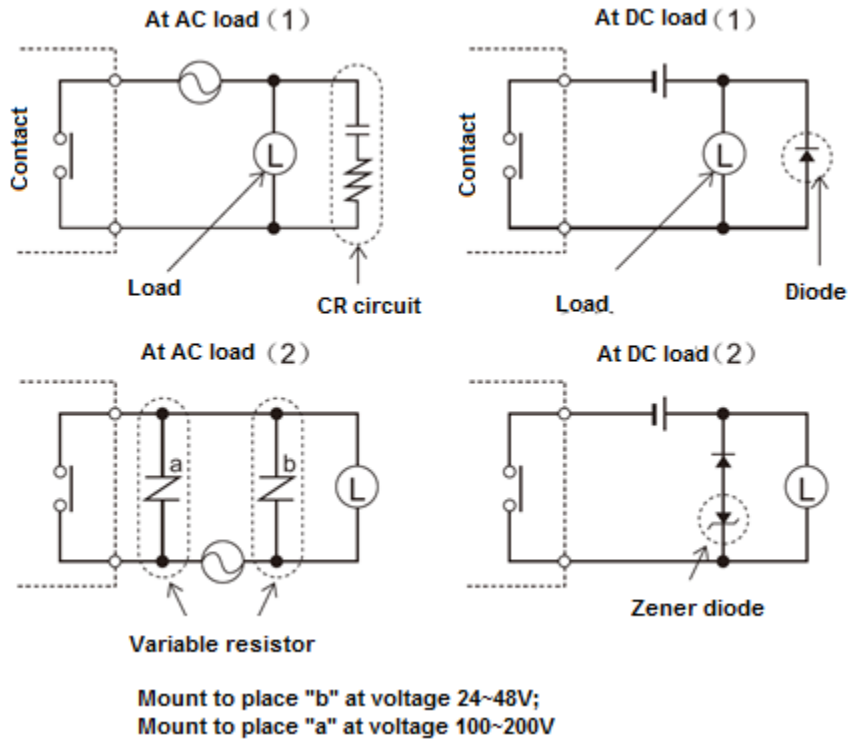
- Perform class-D grounding and the grounding resistance should be 100Ω or less.
- When independent grounding is not possible, take the shared grounding. But the cable length must be the same.



■ **About the contact protection**

When using clutches, motors, electromagnetic coils or other inductive load, surge current will occur at power-on, and inverter voltage will occur at power-off. Surge current and inverter voltage drop significantly shorten the life of short contacts. To suppress this, please set the contact protection circuit.

Contact protection circuit examples



- The load coil rating should be less than the contact capacity.
- The reverse withstand voltage of the diode should be 10 times greater than circuit voltage, and the positive current should be greater than load current.
- The diode, nonlinear resistor and CR circuit should be installed directly on the relay coil terminal.

4-2-3 Connector installation and wiring

■ **Connector cable requirement**

Pay attention to the following precautions before connector wiring :

- Use the cables that meet the following requirements

Table 0-1 Connector cable requirements

Items		Specifications
Mounting method		Push-in
Pushing force (single contact)		10N
Cable type		Copper wire only (aluminum wire cannot be used)
Cable length		7-9 mm
Cross section	Single stranded wire	0.08-1.50 mm ² /28-16 AWG
	Multiple stranded wire	0.25-1.50 mm ² /24-16 AWG
	Wiring sleeve	0.25-0.75 mm ² /24-20 AWG

- After wiring, make sure that the connector contacts fully clamp the cable

- Make sure that the cutting part of cables have been properly handled.



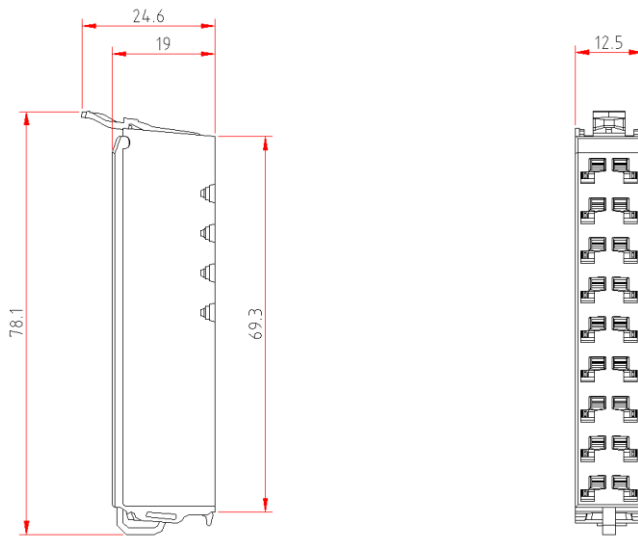
The module is made of synthetic resin and may melt when contact with solvent such as acetone, trichloroethylene and gasoline

■ About connectors

For HCFA Q-series PLC, you can add the connector to the modules /units, which is easy for customers to make wiring and maintenance. In case of module damage, users only need to replace the module and install the connector to the new module, and then it can operate normally. This section will mainly describe the wiring, installation and removal of the connector.

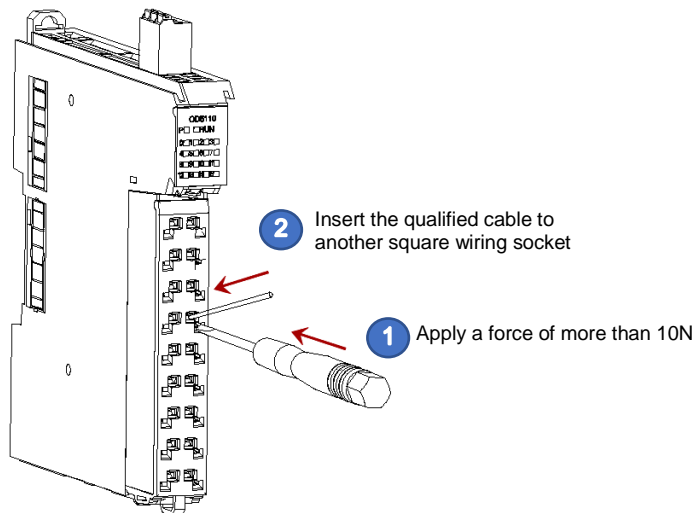
Connector module dimension :

Figure 0-1 Connector dimension

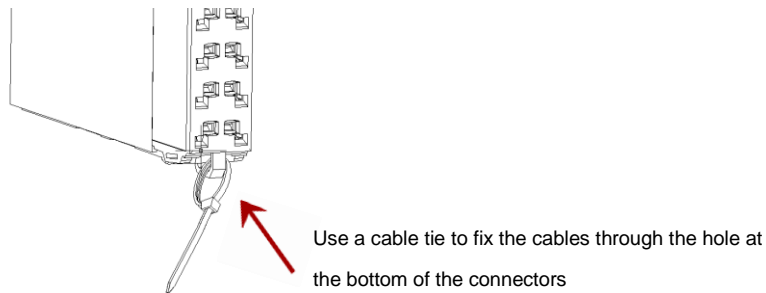


■ Connector wiring

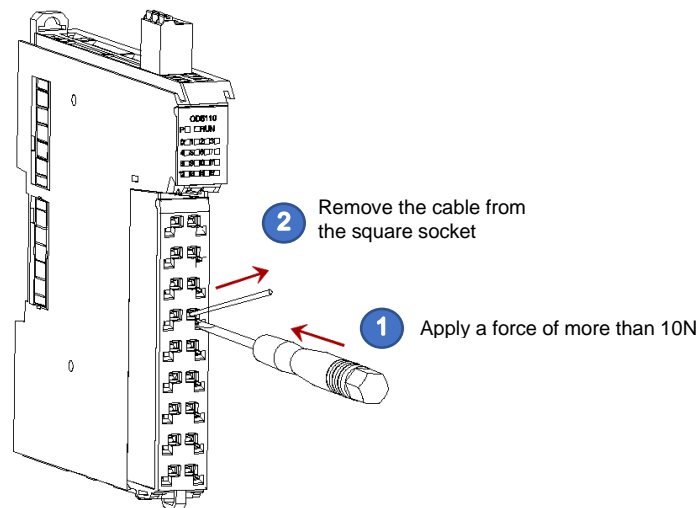
- 1 Take out the small screwdriver in the package and insert it into the square socket of the connector, applying a force of more than 10N . And then insert the qualified cable from another square wiring socket (located inside the module) to the bottom, loosen the screwdriver, gently pull the cable up and down until the cable is clamped



2 After completing the wiring of the connector, use a cable tie to fix the cables through the hole at the bottom of the connectors and cut off the excess cable tie.

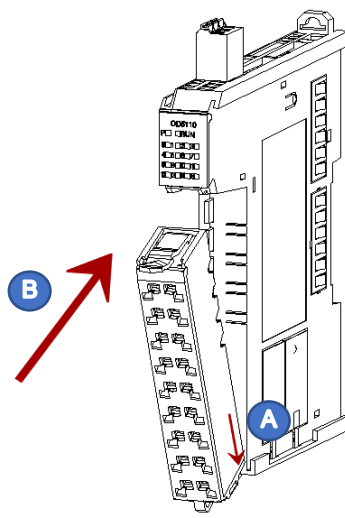


3 To remove the cable from the connector, insert the small screwdriver into the outside square socket as Step 1, and then remove the cable from the corresponding square socket.

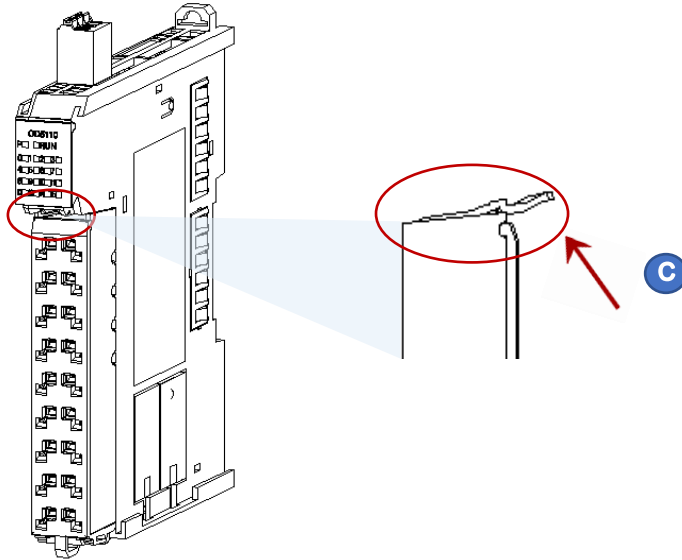


■ Connector installation

1 Align the connector end with the extension module bottom. After aligning and inserting, press the terminal down in the B direction as shown below.

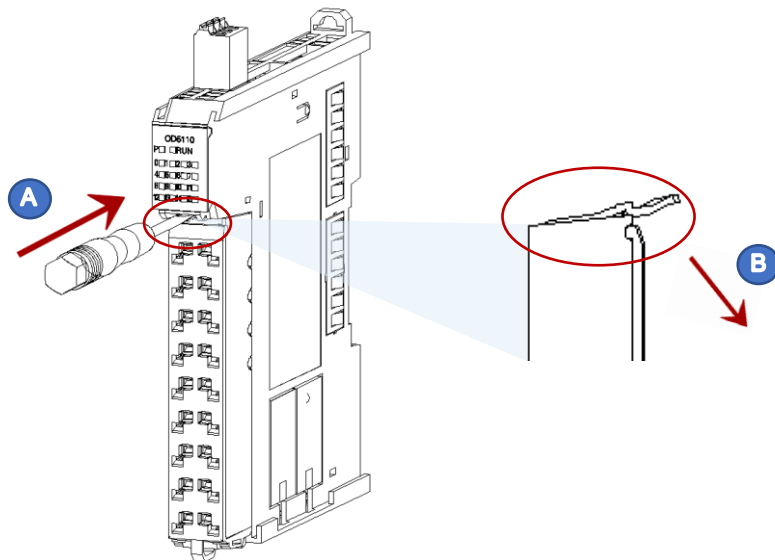


2 After inserting the connector successfully, press it in the “C” direction until you hear the “click”, then connector installation has been completed.

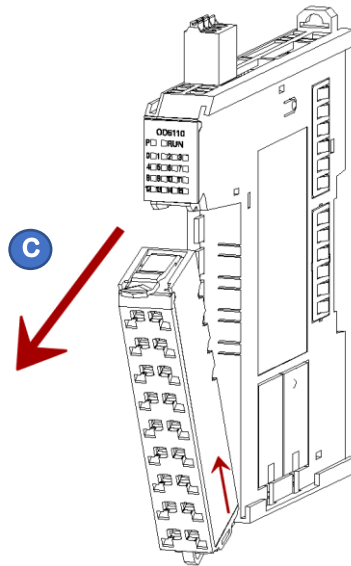


1 Remove the connector

Insert the screwdriver into the upper side of the connector in the “A” direction, and gently push it downward in the “B” direction to unlock the buckle



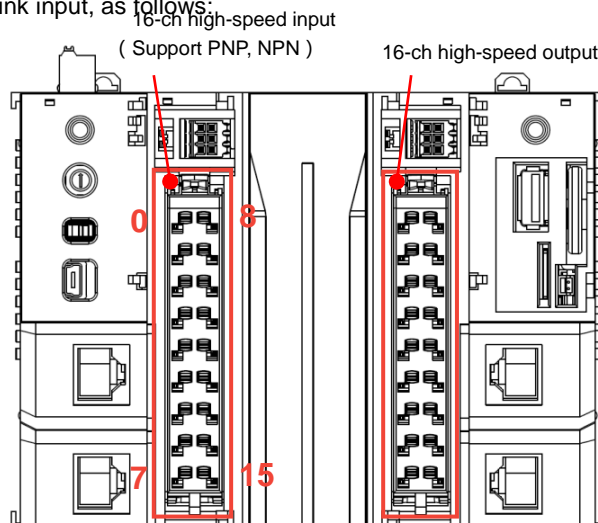
2 After unlocking the connector, remove the connector from the module in the “C” direction.



4-3 Module wiring

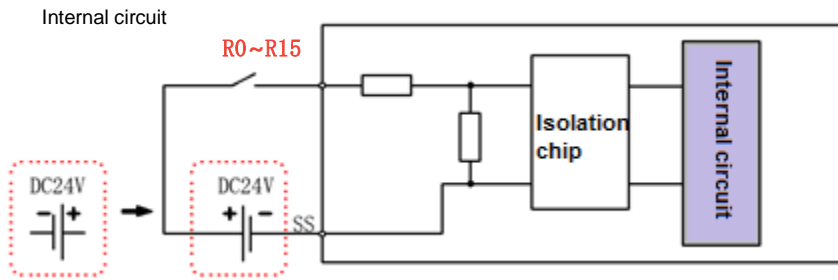
4-3-1 CPU unit high-speed I/O wiring

Q1 CPU unit is built-in 16-ch high-speed input and 16-ch high-speed output. And high-speed input support source and sink input, as follows:

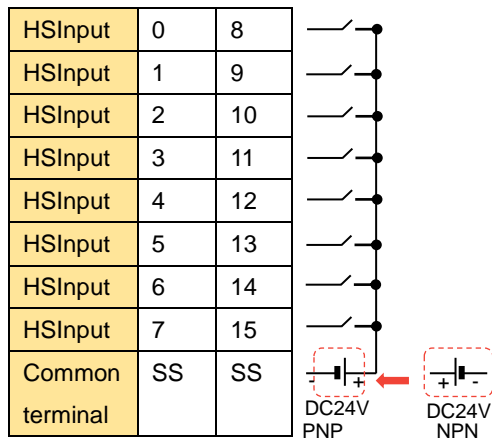


The I/O provided by the Q series CPU unit can be used either as high-speed input and output or as general input and output. When the I/O is used as general input and output, it has both 16-point input and 16-point output. The wiring method is similar to that of general digital input and output. When the I/O is used as high-speed input and output, the number of channels can be up to 8-ch input and 8-ch output. Now the high-speed I/O provided by Q1 series PLC only support single-ended input and output. The differential signal is under development in the following Q series PLC. Of course, the I/O wiring method will affect the max. number of channels that are available. For detailed wiring mode, please refer to the following instructions.

Internal/external circuit diagram of general inputs



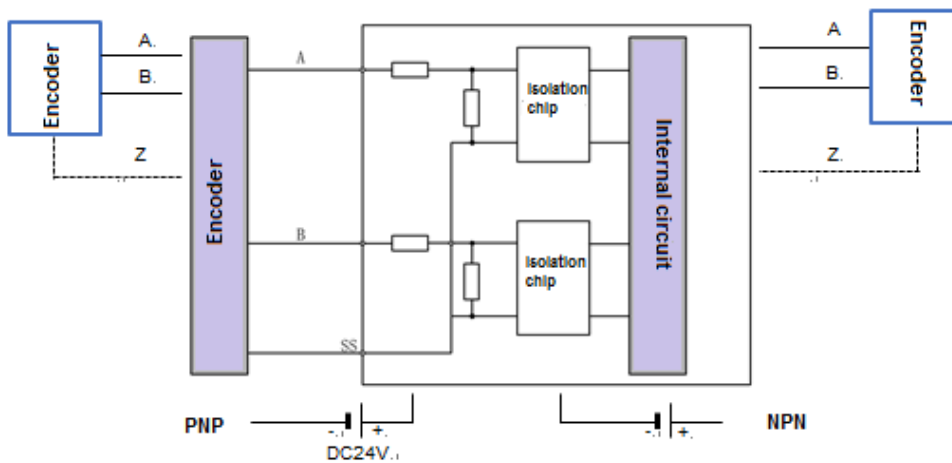
Wiring diagram



*S/S is internal short-circuit, other channels are not connected, such the example of I8-I15

Internal/external circuit diagram of high-speed inputs

Internal circuit



*S/S is internal short-circuit, other channels are not connected, take the single-channel as the example.

Channel	Port	Port	Channel
hsi_cnt	X0	X8	hsi_cnt4
	X1	X9	

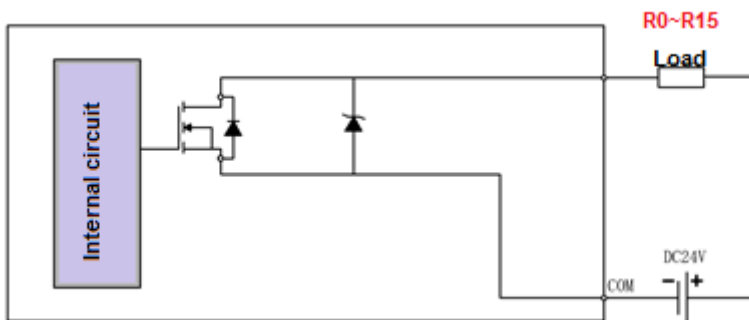
hsi_cnt1	X2	X10	hsi_cnt5
	X3	X11	
hsi_cnt2	X4	X12	hsi_cnt6
	X5	X13	
hsi_cnt3	X6	X14	hsi_cnt7
	X7	X15	
COM terminal	S/S	S/S	COM terminal



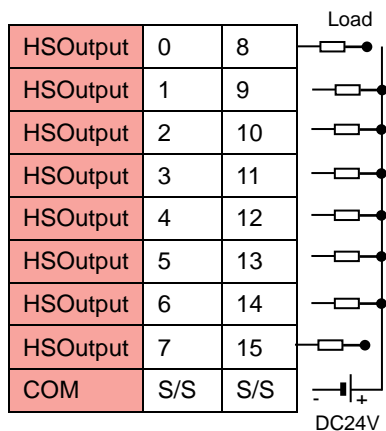
- The encoder Z-phase can be connected to any ports except AB high-speed input channels, which requires corresponding setting in the software.
- The total extension distance of high-speed IO extension cables should be within 3m.
- For extension cables, the minimum bending radius of the cable is 76mm or more. If the bending radius is 76mm, it may cause malfunction due to poor performance, disconnection, etc.

■ High-speed output internal circuit and external wiring diagram

Internal circuit diagram



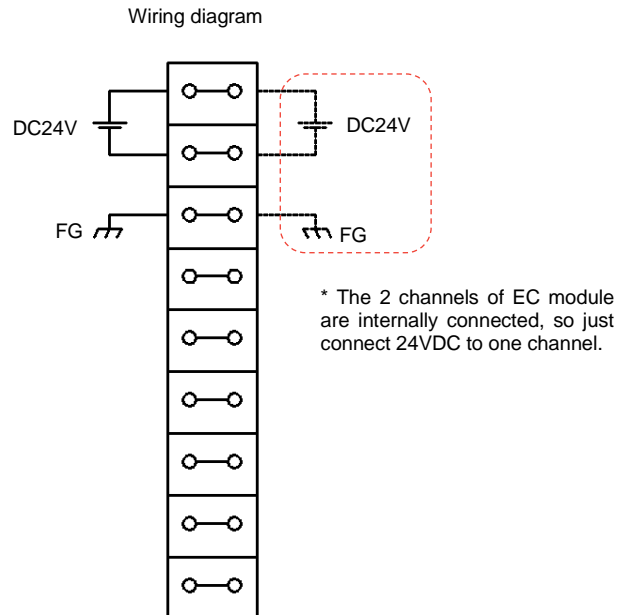
Wiring diagram



*COM is short-circuited internally, and other channels are not connected. Take the channel 8-15 as the example.

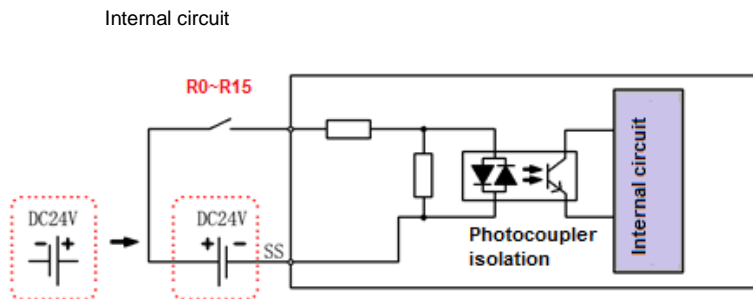
4-3-2 EC coupler wiring

As a remote extension coupler of Q series PLC, EC module provides 24V power supply for other extension modules through its side metal sheet. Unlike other remote extension I/O modules, it's not necessary for EC module to use all the ports. The wiring diagram is shown as below:

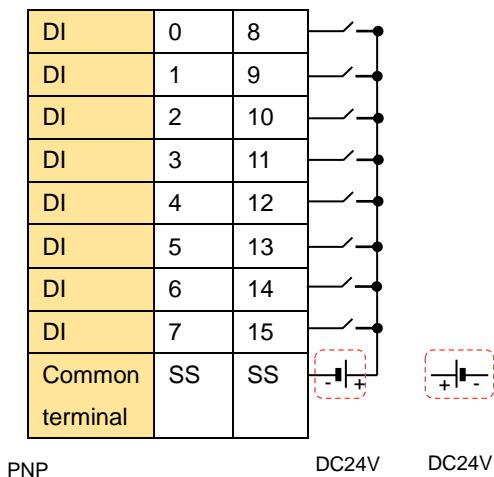


4-3-3 Digital input module wiring

As the remote extension module of Q-series CPU unit, the module cannot work alone and needs to be connected to the EC coupler or the right side of CPU unit. The wiring diagram is shown below:



Wiring diagram

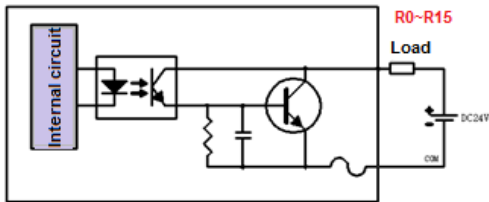


*SS is short-circuited internally, and other channels are not connected. Take the channel I8-I15 as the example

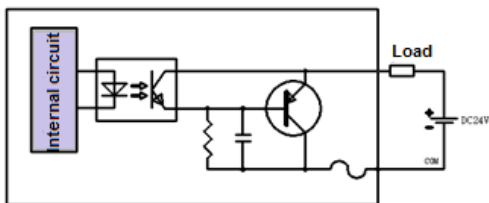
4-3-4 Digital output module wiring

As the remote extension module of Q-seires CPU unit, the module cannot work alone and needs to be connected to the EC coupler or the right side of CPU unit. The wiring diagram is shown below:

Internal circuit

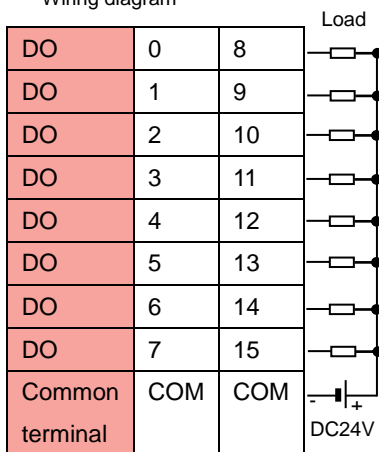


NPN wiring diagram
Sink output , low level is effective



PNP wiring diagram
Source output , high level is effective

Wiring diagram



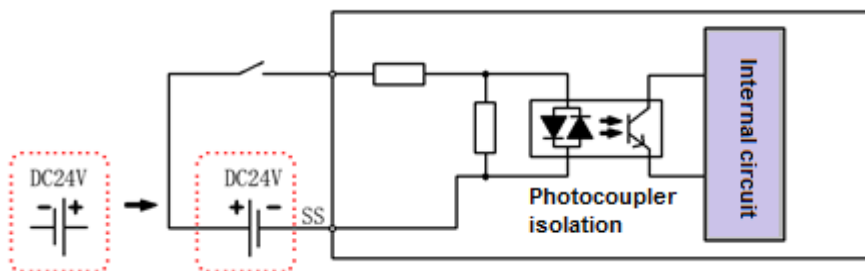
Tips

- The digital output module(PNP) needs to be customized. If necessary, pls contact HCFA distributor.

*COM is short-circuited internally, and other channels are not connected. Take the channel 8-15 as the example

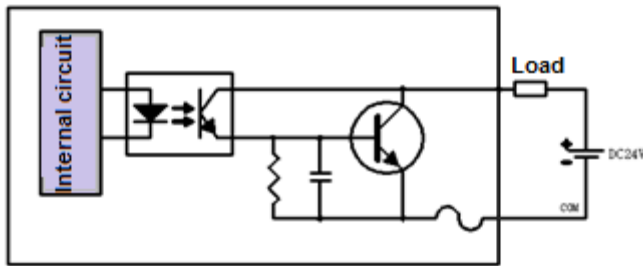
4-3-5 Digital I/O module wiring

As the remote extension module of Q-seires CPU unit, the module cannot work alone and needs to be connected to the EC coupler or the right side of CPU unit. The wiring diagram is shown below:



NPN wiring

PNP wiring



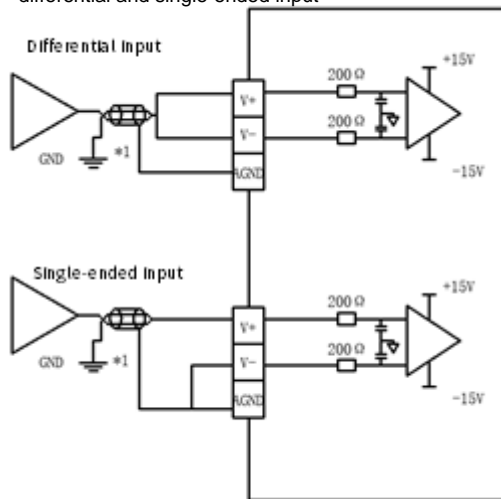
NPN wiring
Sink output , low level is effective.

Digital I/O module output wiring

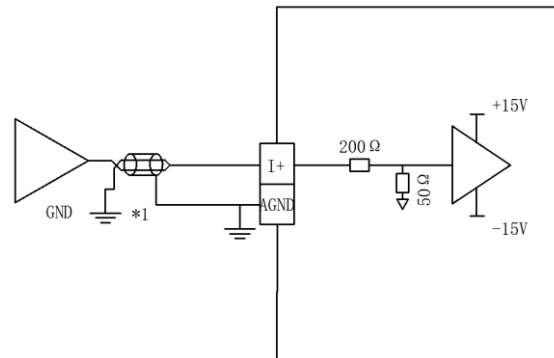
4-3-6 Analog input module wiring

The analog input module, as the remote extension module of the Q series CPU unit, cannot work alone and needs to be connected to the EC coupler or the right side of the CPU unit. It supports both current and voltage input. HCFA offers varieties of input ranges and the working range can be modified online through SDO or COE, where voltage input supports single –ended and differential input.

Internal circuit diagram for voltage differential and single-ended input

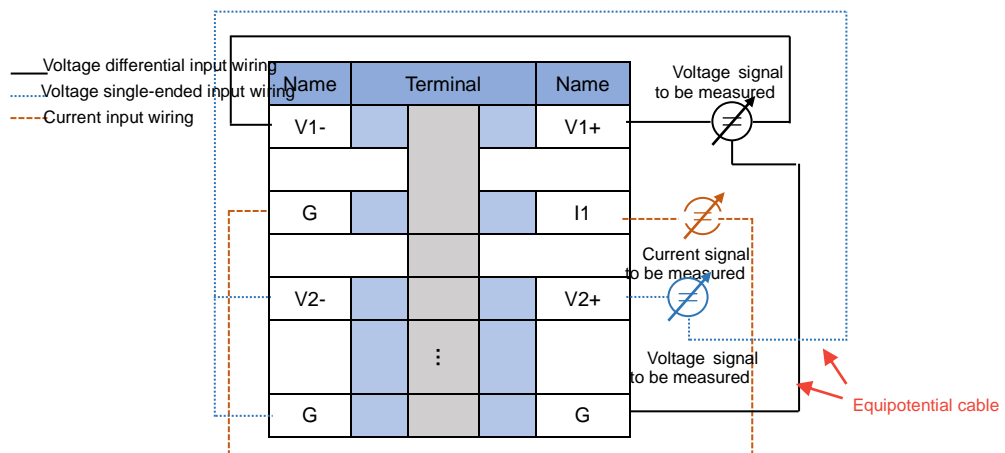


Internal circuit diagram for current input



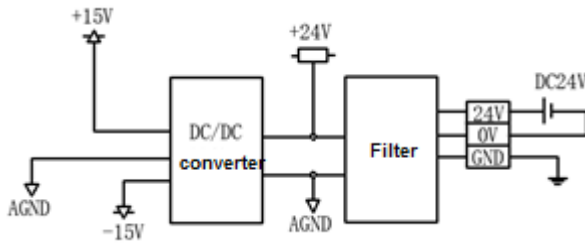
*1 Equipotential bonding

Wiring diagram



* In analog differential input, for inputs, take channel 1 as the example; for single-ended input, take channel 2 as the example; for current inputs, take channel 1 as the example.

At the top of analog I/O module, 24VDC needed to be connected. The wiring diagram shown as below:

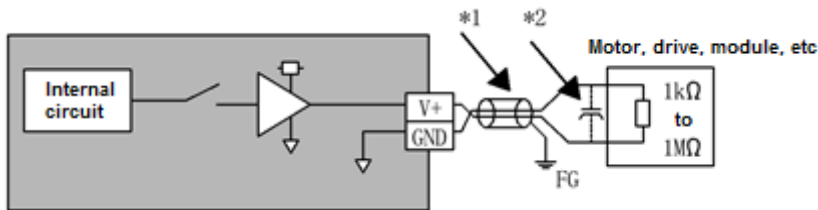


- Tips**
- The analog signal cable adopts twisted-pair shielded wire
 - Equipotential is needed for the signal to be measured and “AGND”

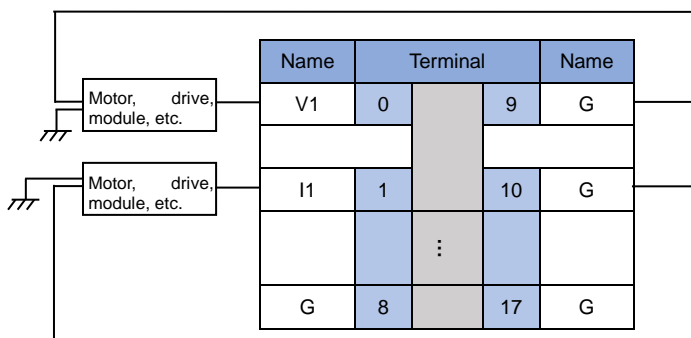
4-3-7 Analog output module wiring

The analog output module, as the remote extension module of the Q series CPU unit, cannot work alone and needs to be connected to the EC coupler or the right side of the CPU unit. It supports both current and voltage output. HCFA offers varieties of output ranges and the working range can be modified online through SDO or COE, where the output signal can be directly used as the control signal of the motor or drive.

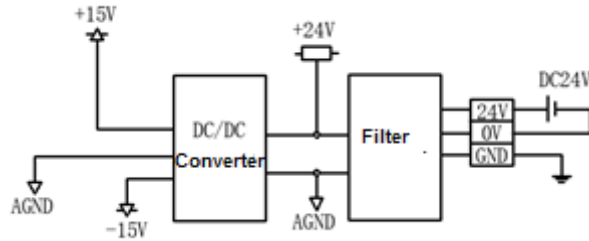
Internal circuit diagram of voltage output



Wiring diagram



At the top of analog I/O module, 24VDC needed to be connected. The wiring diagram shown as below:



4-4 Module installation

4-4-1 Installation environment

When installing CPU units and modules, users need to consider operability and maintainability. Do not install the module in the following environment:

- The ambient temperature exceeds the range of -5~55°C ;
- The humidity exceeds 5%~95%RH ;
- The environment temperature changes sharply ;
- Corrosive gas or flammable gas ;
- The occasions of dust, iron powder and other conductive powder, oil mist, salt, organic solvent ;
- Direct sunlight ;
- Places with strong electric and electromagnetic fields ;
- Occasions where the equipment is subjected to direct vibration and conductive impact

Direct sunlight	Temperature exceeds 0~+50°C	Humidity exceeds 10~95% RH
Condensation due to sharp temperature change	Corrosive and flammable gases	Places with dust, salt, iron powder and oil mist
Direct shock and impact	Places with water, oil and medicine	Strong electric and electromagnetic fields

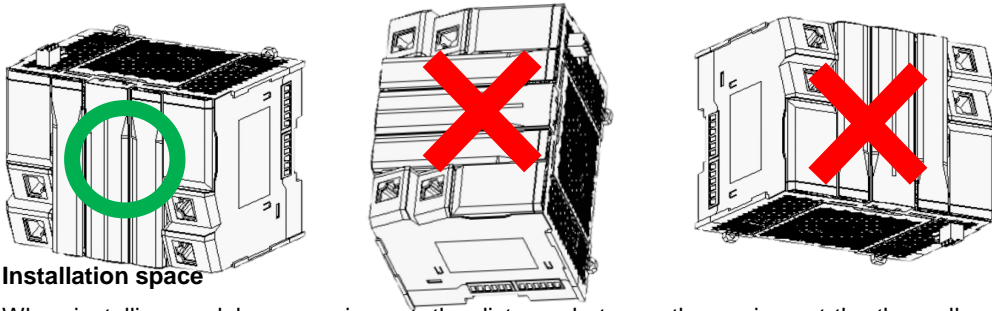
4-4-2 Installation places

When installing CPU units and modules, users need to consider operability and maintainability.

■ **Installation direction**

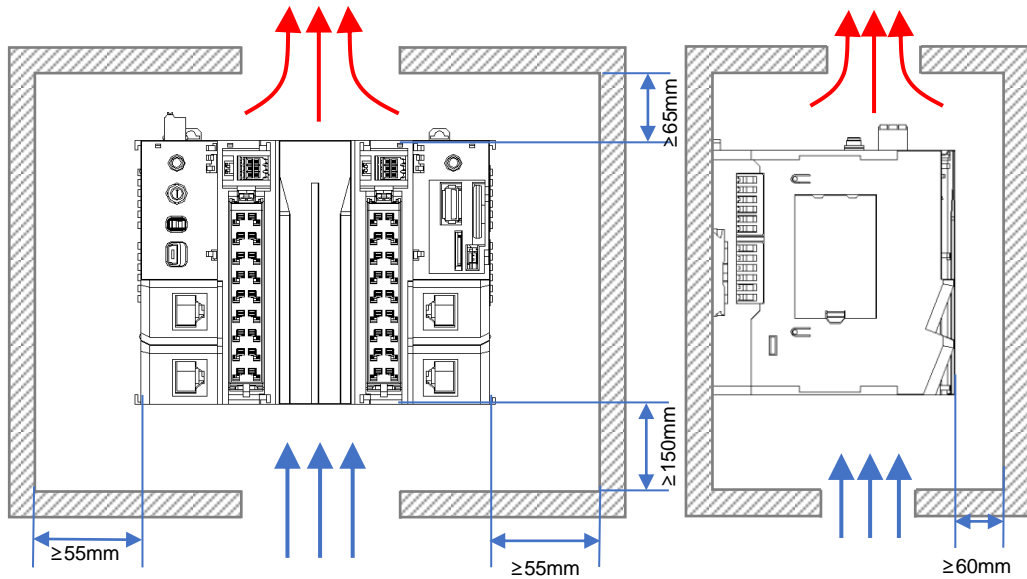
When installing, the CPU unit and I/O extension modules must be installed vertically with the

interface or panel facing forward, as shown below :



■ **Installation space**

When installing modules or equipment, the distance between the equipment the the wall or other equipment must be more than 50mm to facilitate the ventilation and replacement of the modules and equipment.

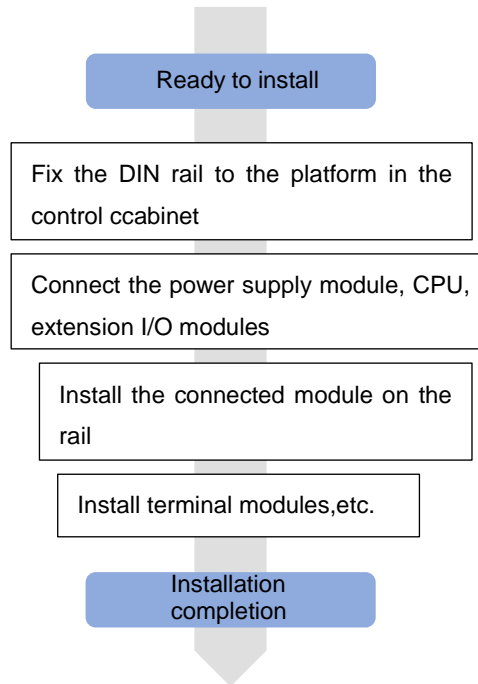


Tips

- When the temperature inside the panel (the temperature under the CPU unit or the module) exceeds the ambient temperature, please use forced air cooling or expand the interval with the surroundings, or improve ventilation, etc. to reduce the temperature
- When using extension modules (I/O special function modules, etc), dut to the heat dissipation and moduel replacement, the distance between the upper and lower units should be at least 60mm.

4-4-3 Installation procedures

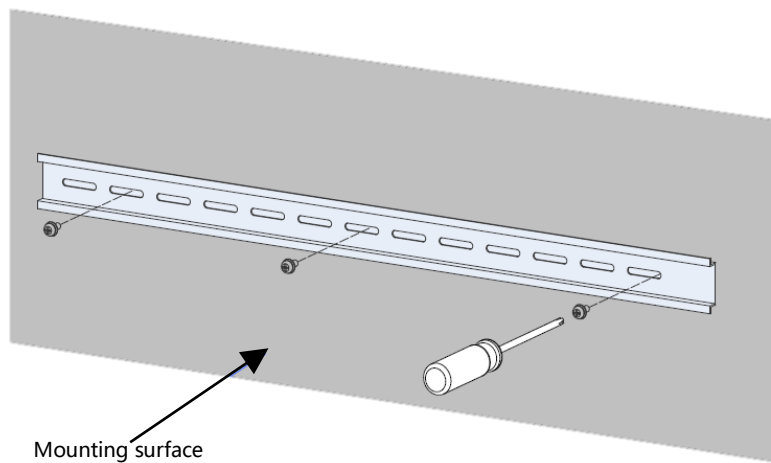
For the initial installation, the user can refer to the following process to complete the module installation.



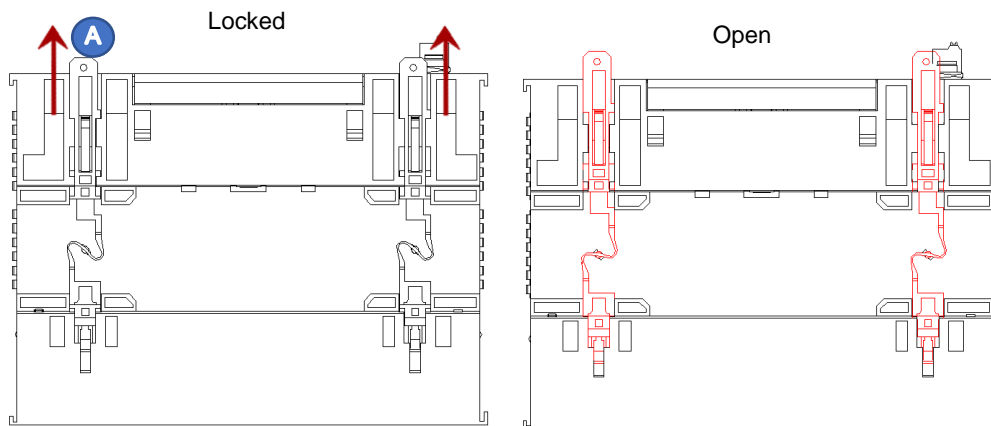
4-4-4 DIN rail mounting

This section describes how to install the connected units to DIN rail and how to remove it.

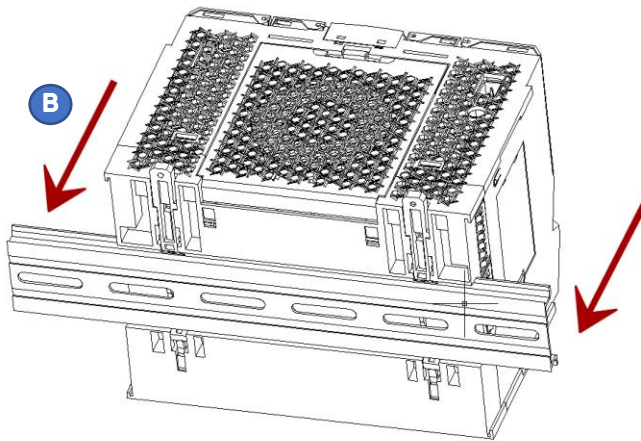
- 1 First, fix the DIN rail to the control cabinet or on the mounting surface using M4 screw



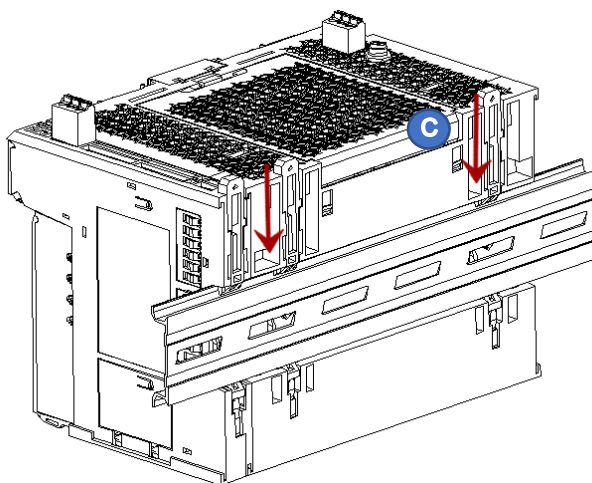
2 After connecting the CPU units and modules, unlock the mounting hook of the CPU unit and pull it upward in the direction A as shown below.



3 Insert the DIN rail mounting hook into the DIN rail in the direction B as shown below.



4 Push down the DIN rail mounting hook of the CPU unit in the direction C. When you hear a “click”, the mounting hook is locked on the rail.



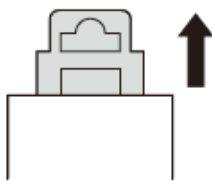


Do not insert the module at the beginning of the DIN rail and then slide it into the installation. This installation method will damage the mounting hook and cause problems such as unstable installation.

5 Q series CPU units and its extension modules are equipped with front and rear connecting ports. In order to avoid direct exposure of the connecting ports, terminal modules should be installed at the beginning or end units for protection.

4-4-5 Removal from DIN rail

1 Pull up the DIN rail mounting hook



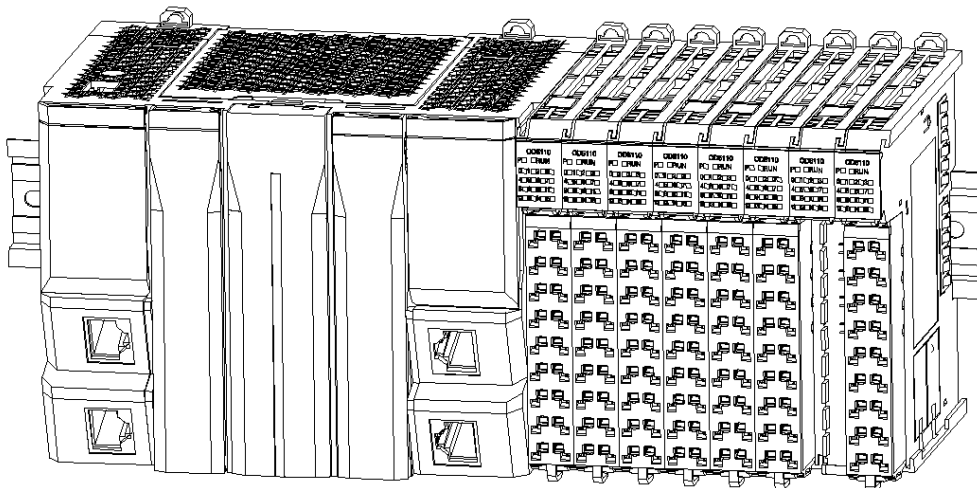
Unlocked


2 Remove the module from the DIN rail

4-4-6 Replace modules

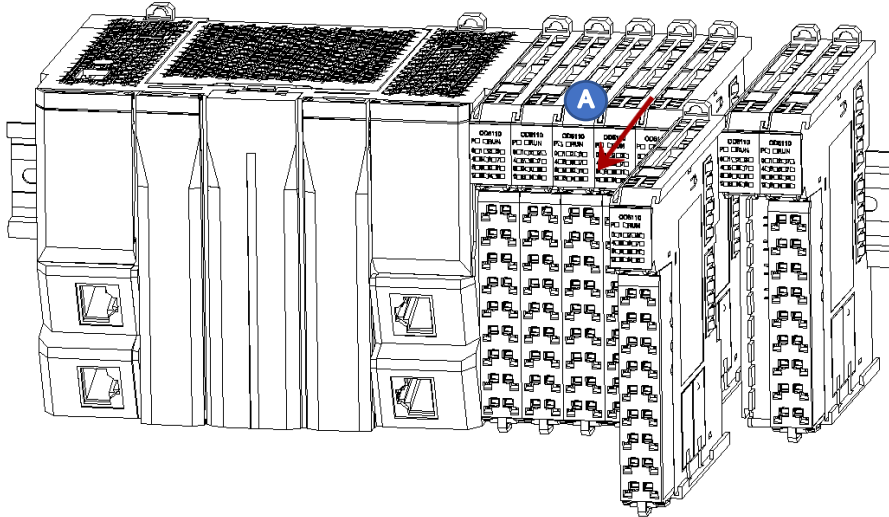
This section will introduce how to replace a module which has been installed.

1 For CPU units and modules that have been installed onto the DIN rail, if need to replace them, remove the connectors on the modules first.



 "4-2-3 Connector installation and wiring"

2 Unlock the mounting hook of CPU units or modules and pull them out in the direction A.



3 Install the new modules as describes above.




Chapter 5 Maintenance and operation

5-1 RUN/STOP

This section will introduce the RUN and STOP operation of Q-series PLCs.

After writing the program to the controller, it is necessary to check the status of RUN/STOP dial switch, to make sure that the CPU unit can work.

Table 0-1 RUN/STOP

	<p>Make sure that the dial switch is on the right side and the CPU is in the RUN state, otherwise it cannot work.</p>
	<p>In the RUN state, the LED rotates like a rectangle. In the stop state, the LED stands still.</p>
	<p>Dial the RUN/STOP switch to the left side to stop the CPU operation. Users can stop the CPU operation by the upper program.</p>

5-2 Troubleshooting

5-2-1 CPU unit and extension module error

When some error occurs, the CPU unit cannot work and it cannot be connected to the CODESYS online or communicate with HMI.

Table 0-2 CPU error and corresponding solutions

Items	Error description	Solutions
Power supply error (DC24V/AC power module)	Power not provided	Connect the power correctly
	Exceed the specified voltage range	Connect the suitable power
	Power unit error	Replace the power unit
CPU unit error	LED display 0E , overtemperature	Add the fan or ari-conditioner to reduce the ambient temperature
	LED display 0F , CPU down	Series CPU error and cannot be solved. Contact HCFA distributor.
	LED display 00 , No program downloaded in CPU	Re-download the user program

	unit						
	CPU hardware error						Contact HCFA distributor and replace the equipment
EC module error (A1: network port light on the upper side; A2: network port light on the lower side; A3: communication port)	P	RUN	A1	A2	A3	L	Port definition
							No power, supply 24VDC to the module
							Not operate, the ports are not connected.
							Not operate, only A2 is connected to the module
							Not operate, only A3 is connected to the module
							Not operate , A1 and A2 are connected to the module.
							Not operate , A1 , A2 and A3 are connected to the module.
							Not operate , A1 and A3 are connected to the module.
							Not operate , A2 and A3 are connected to the module.
							Only A1 is connected to the network.
							A1 is connected to the network, A2 is connected to the module.
							A1 is connected to the network, A2 and A3 is connected to the module.
							EC module work normally, all the ports are connected to the network.
						A1 is connected to the network, A3 is connected to the module.	
						A1 is connected to the network, A3 is connected to the module and communicate.	
Digital module error	P lit, RUN not lit, channel indicator not lit						No power, supply 24VDC to the module ; Make sure the modules are tightly connected with each other ; Whether the module is outside the power supply range of the coupler or CPU unit, add a coupler module ;
	P lit, RUN not lit, channel indicator not lit						Not operate, re-operate the CPU unit or check the communication
	P lit, RUN lit, some channel indicator not lit						The current channel is not used, there is no power supply to the common terminal, or the channel failure.
Analog module error	P not lit, RUN not lit, ER indicator not lit, AD(DA) not lit						No power, supply 24VDC to the module ; Make sure the modules are tightly connected with each other ; Whether the module is outside the power supply range of the coupler or CPU unit, add a coupler module ;

	P lit, RUN not lit, ER indicator not lit, AD(DA) not lit	Module not operate, Check the host controller or whether the module channel is enabled (80n0:09), or the load power supply is normally connected
	P lit, RUN lit, ER indicator not lit, AD(DA) lit	Communication failure between AD(DA) and MCU, restart the module or restore the default, If cannot be solbed, replace the module or contact HCFA distributor.
	P lit, RUN lit, ER indicator lit, AD(DA) not lit	AD(DA) operation error. Check if the module has high temperature, data error, watchdog error or outside the specified range.

5-3 Periodic inspections

In order to deliver the best performance for Q-series PLCs, please take the daily or periodic inspection.

5-3-1 Periodic inspections

The Q series has almost no parts with limited lifespan, but due to environmental conditions and irregular operations, component aging may occur, so regular inspections are required. It is recommended at least once every 6 months to a year.

■ Periodic inspection items and actions

Table 0-3 Periodic inspection items and actions

No.	Items	Inspection	Criteria	Actions
1	Power supply	Make sure the voltage fluctuation measured at the terminal block is within the specified range	Voltage range (-15%~+20%)	Use a voltage tester to check the power supply at the terminals, Take necessary steps to make the voltage within the fluctuation range.
2	I/O power supply	Make sure the voltage fluctuation measured at the I/O terminal block is within the specified range	The voltage must be within the I/O specifications for each unit	Use a voltage tester to check the power supply at the terminals, Take necessary steps to make the voltage within the fluctuation range.
3	Ambient temperature	Check the ambient temperature(if in control cabinet, check the temperature inside the cabinet)	0~55°C	Use a thermometer to check the temperature and ensure that the ambient temperature remains within the specified range of 0 to 55 C
		Check the ambient humidity (If in control cabinet, check the humidity inside the cabinet)	5~95%RH, no condensation	Use a hygrometer to check the humidity within the 5~95%RH. Make sure that no condensation occurs due to rapid changes in temperature.
		Direct sunlight	Not in direct sunlight	Protect the unit if necessary.
		Water, oil, or chemical sprays	No spray	Clean and protect the unit if necessary
		Corrosive or flammable gases	No corrosive or flammable gases	Take the corresponding steps to make sure the module will not

				contact these gases
		Whether the vibration or shock occur	Within the specified range	Install cushioning or shock absorbing equipment if necessary
		Check for noise sources	No significant noise sources	Far away from the noise sources or take anti-interference measures
		Check for accumulation of dirt, dust, salt, or metal powder.	No accumulation	Clean and protect the unit
4	Installation and wiring	Check if the modules are fully inserted and connected	No looseness	Properly inserted and make sure that no gap between modules
		Check if the cable connectors are fully inserted and locked	No looseness	Fully insert and lock all cables securely
		Check if crimp terminals are loosened	No looseness	Fully insert the terminal block until you cannot pull
		Check if the external wiring cables are damaged	No visible damage	Replace the cables if necessary
5	Components with the service life-span	Button cell	5 years at 25°C, but also determined by models and ambient temperature. Generally between 0.75 and 5 years.	Even if there is no abnormality for the battery, it is recommended to replace the battery when it reaches the specified service life.

■ **Tools required for inspections**

- Appropriate screwdriver
- Industrial alcohol and clean cotton cloth
- Multimeter
- Oscilloscope
- Thermometer and hygrometer

5-3-2 Requirements for replacing units

Please follow the precautions when you find the module faulty and needs to be replaced.

- Replace the unit after cut off the power supply
- Before replacement, make sure that the new module can work normally.
- For poor contact, clean the module with a clean cotton cloth dipped in industrial alcohol and insert the module and press it tightly.

Tips

- If CPU unit has been replaced, set the user program and variables for restart operation (holding variables at power-failure, and then restart the unit.
 - The routing tables, network parameters, and system Settings for the CPU bus unit have been saved to the CPU unit. If the CPU unit is changed, you need to reset the above data.
 - If the slave module is replaced, it is necessary to refer to the corresponding manual and modify the necessary Settings.



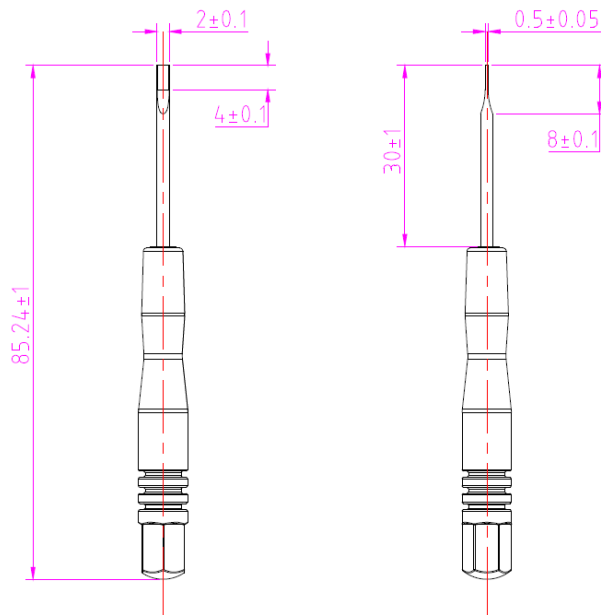
Due to the relationship between the holding variables state at power-failure and program, the accidents may occur. Please confirm the relative data or program before power-ON.

Appendix

Appendix 1 Screwdriver specifications description

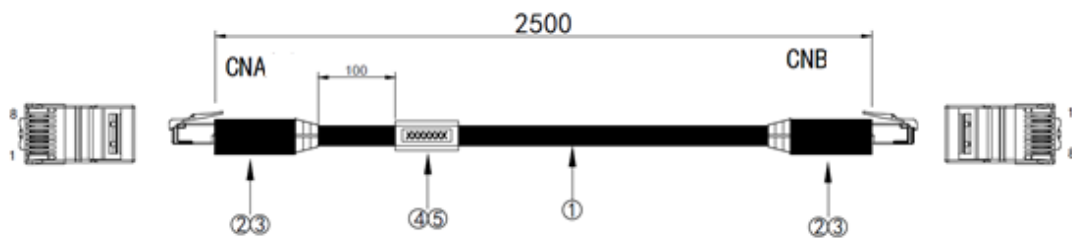
Users need the suitable screwdriver to make the wiring for Q-series PLC. The screwdriver will be attached with the package by HCFA. And the users can also choose the screwdriver according to the specifications for wiring.

The specifications of the screwdriver provided with the package are as follows, the same or similar screwdriver can also be used for wiring work:



Appendix 2 Customized network cable for EC module

HCFA Q-Series EC module will provide 2 customized cables and 2 adapters for system assembly. The customized cable is described below :



Customized network cable specifications for EC module

Item	Name	Description	Quantity
1	Cable	CAT5e 568C 4P*26AWG, blue	1
2	Connector	RJ45-8P8C,8-core gold-plated crystal connector, short type	2
3	Connector shell	RJ45-8P8C, black	2
4	Label protection sleeve	CAN side, transparent, 8*40mm , 105°C	1
5	Label	33*9 , black text on white background , two lines , first line: model name , second line: manufacture date	1