Digitized Automation for a Changing World

AX-5 Series Module Manual

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AX-5 Series Module Manual

Revision History

Version	Revision	Date
1st	The first version was published.	2024/01/31

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Caution

- ✓ This is an OPEN TYPE module and therefore should be installed in an enclosure free of airborne dust, humidity, electric shock and vibration. The enclosure should prevent non-maintenance staff from operating the device (e.g. key or specific tools are required for operating the enclosure) in case danger and damage on the device may occur.
- ✓ Please read this manual carefully and follow the instructions in the manual for operations, especially those marked with the safety warnings  in order to prevent injuries to personnel or damage to products.

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Chapter 1 Product Introduction

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1.1 Overview

This manual introduces the AX-5 series modules including their functions, electrical specifications, troubleshooting, as well as appearances, dimensions, and so forth.

1.1.1 Table of Models and Descriptions

Classification	Model Name	Description
Unit power supply module	AX-502PS11-0A	Unit power supply module - Unit power supply 24 V to 5 V, 2 A output
I/O power supply / connector module	AX-510PS12-0A	I/O power supply module - I/O power supply 24 VDC
	AX-516PC10-0A	IO power connector - 16 IOV
	AX-516PC20-0A	IO power connector - 16 IOG
	AX-516PC30-0A	IO power connector - 8 IOV / 8 IOG
	AX-514PC40-0A	IO power connector - 14 PE
Digital input / ouput module	AX-516AM10-0A	16 DI, 24VDC, 2.5mA,1ms, Source Input (NPN)
	AX-516AM20-0A	16 DI, 24VDC, 2.5mA,1ms, Sink Input (PNP)
	AX-516AN01-0A	16 DO, 24VDC, 0.5A,1ms, Sink Output (NPN)
	AX-516AN02-0A	16 DO, 24VDC, 0.5A,1ms, Source Output (PNP)
	AX-516AP11-0A	8 DI, 24VDC, 2.5mA,1ms, Source Input (NPN) 8 DO, 24VDC, 0.5A,1ms, Sink Output (NPN)
	AX-516AP22-0A	8 DI, 24VDC, 2.5mA,1ms, Sink Input (PNP) 8 DO, 24VDC, 0.5A,1ms, Source Output (PNP)
Analog input / output module	AX-504AD10-0A	4 AI, ±10V, 16Bits, 100μs
	AX-504AD20-0A	4 AI, ±20mA, 16Bits, 100μs
	AX-508AD10-0A	8 AI, ±10V, 16Bits, 100μs
	AX-508AD20-0A	8 AI, ±20mA, 16Bits, 100μs
	AX-504DA01-0A	4 AO, ±10V, 16Bits, 100μs
	AX-504DA02-0A	4 AO, 0–20mA, 16Bits, 100μs
	AX-508DA01-0A	8 AO, ±10V, 16Bits, 100μs
Temperature measurement module	AX-502TC10-0B	2 TC, J, K, T, E, L, U, N, R, S, B, C (WRe5-26), PLII, ±130mV, 24 Bits
	AX-504TC10-0B	4 TC, J, K, T, E, L, U, N, R, S, B, C (WRe5-26), PLII, ±130mV, 24 Bits
	AX-502PT10-0B	2 RTD, PT100, PT1000, Ni100, Ni1000, 0–300Ω, 24 Bits
	AX-504PT10-0B	4 RTD, PT100, PT1000, Ni100, Ni1000, 0–300Ω, 24 Bits
Coupler	AX-500CEC00-0A	EtherCAT coupler

1.2 Technical Specifications

In this section, you can find applicable technical specifications, compliances, and certifications for AX-5 series products.

1.2.1 Certifications and Standards

AX-5 series products have obtained the following certificate of compliances and met the safety, health, environment and other requirements.

Certification	Listing mark	Standard
CE	CE	2014/35/EU: Low Voltage directive 2014/30/EU: Electromagnetic Compatibility (EMC) directive, including: EN 61131-2, EN 61010-1, EN 61010-2-201, EN IEC 61000-6-1, EN IEC 61000-6-2, EN IEC 61000-6-4, EN IEC 61000-3-2, EN IEC 61000-3-3

1.2.2 Electromagnetic Compatibility

AX-5 series products are in conformity with IEC/EN 61131-2 (Zone B) specified electromagnetic compatibility requirements for Pulse-Shaped Disturbances, Radio-Frequency Sinusoidal Disturbances and Radio-Frequency Emission Interference.

- **Pulse-Shaped Disturbances**

Pulse-Shaped Disturbance	Test Condition
IEC 61000-4-2 Electrostatic Discharge	Air discharge: ±8 kV Contact discharge: ±6 kV
IEC 61000-4-4 Electrical Fast Transient / Burst	Power supply line: ±2 kV Signal line: ±1 kV Communication line: ±1 kV
IEC 61000-4-5 high-energy Surge Immunity	AC power supply cable: ±2 kV CM; ±1 kV DM Tested with external AC input terminals DC power supply cable: ±0.5 kV CM/DM Tested with AX-5 series DC input terminals Data cable: ±1 kV CM, cable length > 30 m Communication cable: ±1 kV CM, cable length > 30m

- **Radio-Frequency Sinusoidal Disturbances**

Sinusoidal Disturbance	Test Condition
IEC 61000-4-3 Radio-Frequency Electro-magnetic field amplitude modulation	80 to 1000 MHz: 10 V/m 1.4 to 2.0 GHz: 3 V/m 2.0 to 2.7 GHz: 3 V/m 2.7 to 6.0 GHz: 3 V/m 80% AM 1kHz Sinusoidal
IEC 61000-4-6 Radio-Frequency Interference	Power cable: 10 V Signal cable: 10 V Communication cable: 10 V

- **Radio-Frequency Emission Interference**

Emission Interference	Test Condition
IEC 61000-6-4 Radiated Emission	30 to 230 MHz : < 40 dB (μV/m) quasi-peak 230 to 1000 MHz : < 47 dB (μV/m) quasi-peak
IEC 61000-6-4 Conducted Emission	0.15 to 0.5 MHz : < 79 dB (μV) quasi-peak < 66 dB (μV) average 0.5 to 30 MHz : < 73 dB (μV) quasi-peak < 60 dB (μV) average

1.2.3 Transport and Storage

The original packaging of AX-5 series is in compliant with IEC (EN) 61131-2 standard, in terms of transport and storage. The conditions and specifications are listed in the table below.

Condition	Specification
Free Fall	≤ 1 m
Ambient Temperature for Operation	-20 °C to +60 °C
Ambient Temperature for Transport and Storage	-40 °C to +85 °C
Atmospheric Pressure	Operating: 1013–795hPa (altitude: 0–2000 m) Storage: 1013–660hPa (altitude: 0–3500 m)
Relative Humidity	5 to 95% (without condensation)
Vibration Resistance	Tested with: 5 Hz ≦ f ≦ 8.4 Hz, constant amplitude 3.5 mm; 8.4 Hz ≦ f ≦ 150 Hz, constant acceleration 1g Duration of oscillation: 10 sweep cycles per axis on each direction of the 3 mutually perpendicular axes International Standard IEC 61131-2 & IEC 60068-2-6 (TEST Fc)
Shock Resistance	Tested with: Half-sine wave: Strength of shock 15 g peak value, 11 ms duration; Shock direction: The shocks in each in direction per axis, on 3 mutually perpendicular axes (total of 18 shocks) International Standard IEC 61131-2 & IEC 60068-2-27 (TEST Ea)

1.2.4 Protection Class

The following table shows the information related to protection class for AX-5 series modules.

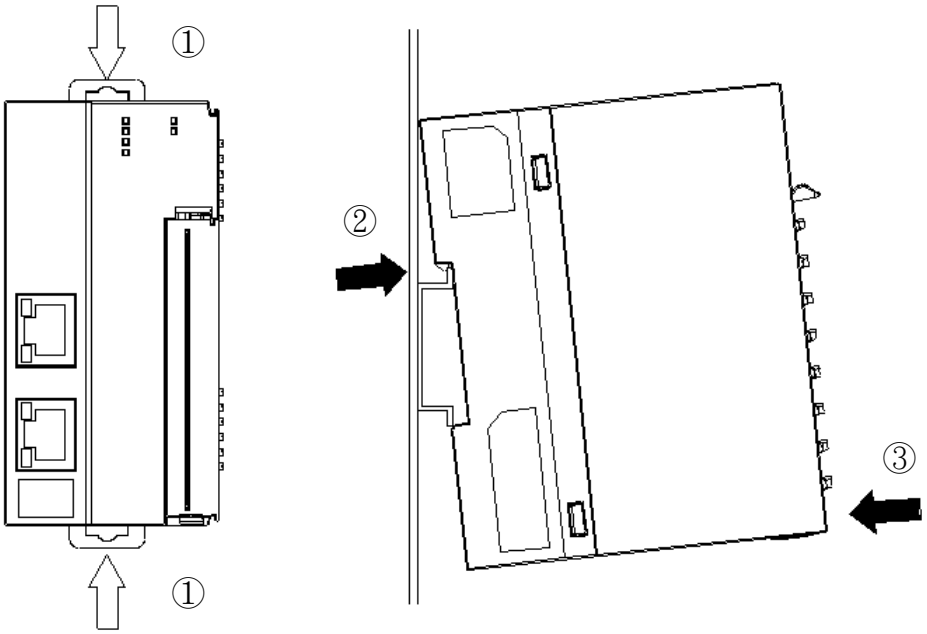
Type	Description
Insulation	Designed in accordance with IEC/EN 61131-2, IEC/EN 61010-1 and IEC/EN 61010-2-201.
DC Input Power Supply	24 VDC (20.4 VDC–28.8 VDC) (-15%–+20%) (In accordance with IEC/EN 61131-2)
DC Power Source	The 24 VDC SELV or PELV power supply is recommended.
Pollution Degree	2 (In accordance with IEC/EN 61131-2, IEC/EN 61010-2-201)
Overvoltage Category	II (In accordance with IEC/EN 61131-2, IEC/EN 61010-2-201)
Ingress Protection (IP Ratings)	IP20 (IEC 60529) • Protection against contacting hazardous parts by operator's fingers. • Protection against solid objects of diameter 12.5 mm or greater • No protection against ingress of water
Flammability Rating of Plastics	UL94V-0

1.3 Hardware Installation

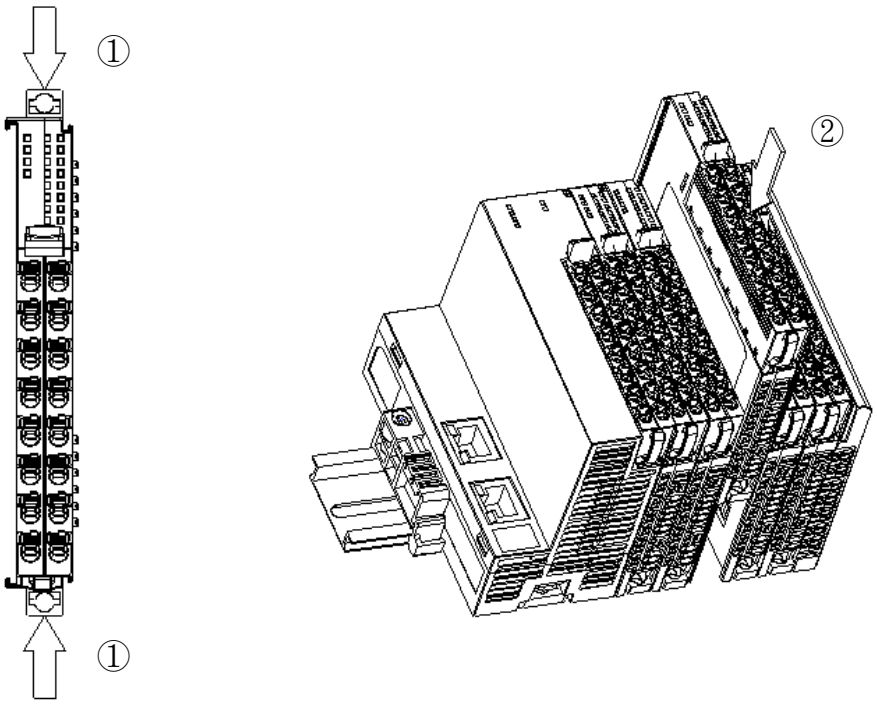
1.3.1 Installing Modules

Steps for installing modules are shown below:

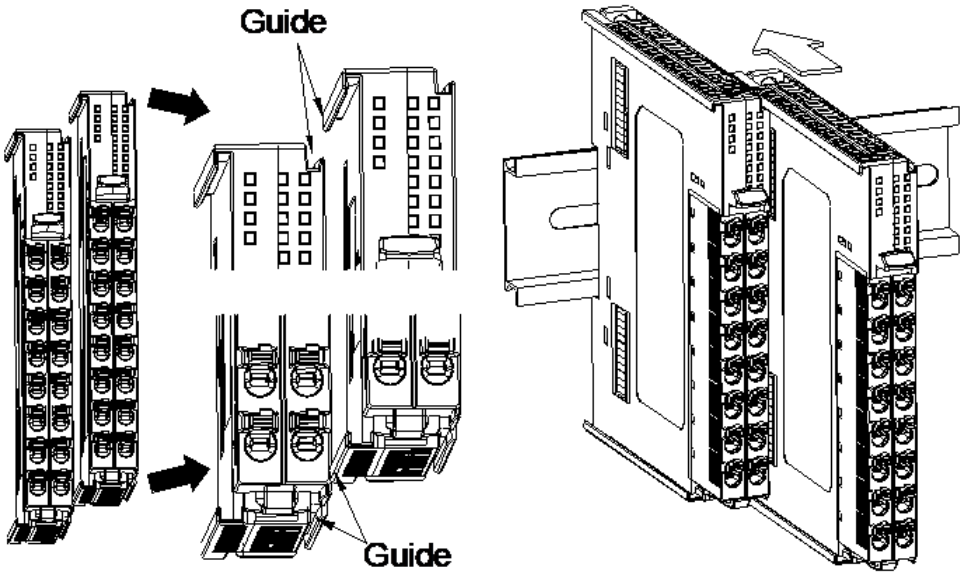
1. Push the two DIN rail clips on the top and bottom of the CPU or coupler towards the middle as shown by the arrows ① in the following figure until you hear a click. Then hang it onto the DIN rail as indicated by the arrow ② and press it towards the DIN rail as indicated by the arrow ③ until another click is heard, which means the module has been secured on the rail.



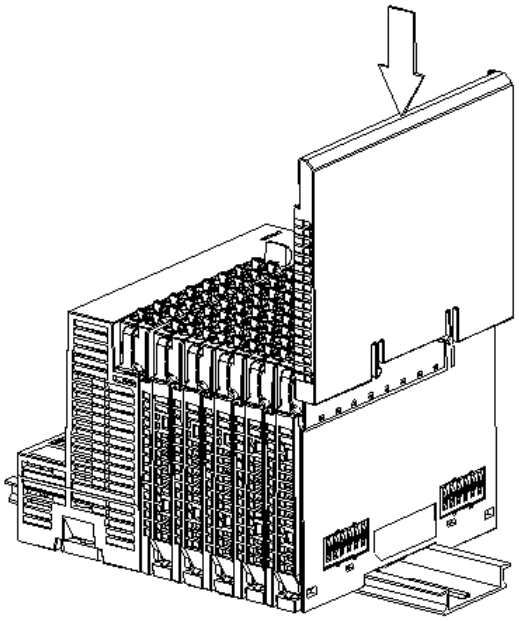
2. Before connecting respective I/O modules to the right side of the CPU or coupler in sequence, first push the upper and lower clips of each module towards the middle as indicated by the arrows ① in the following figure, and then press the module towards the DIN rail as indicated by the arrow ② until you hear a click, which means that the module has been clipped up on the rail and well connected to the CPU or the coupler.



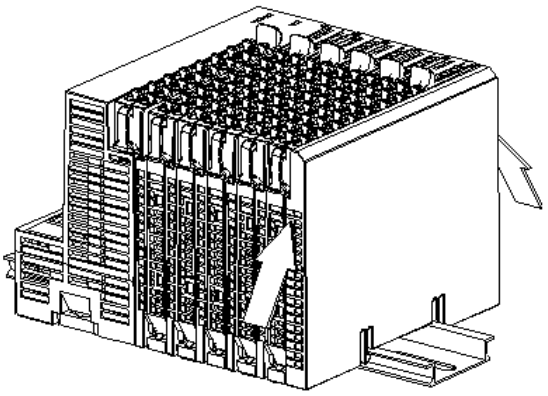
3. Please first align the upper and lower guides before pushing the module towards the rail when installing an I/O module.



4. Install the protective cover at the end position, just like installing a module, by aligning the cover and then pushing it towards the rail.

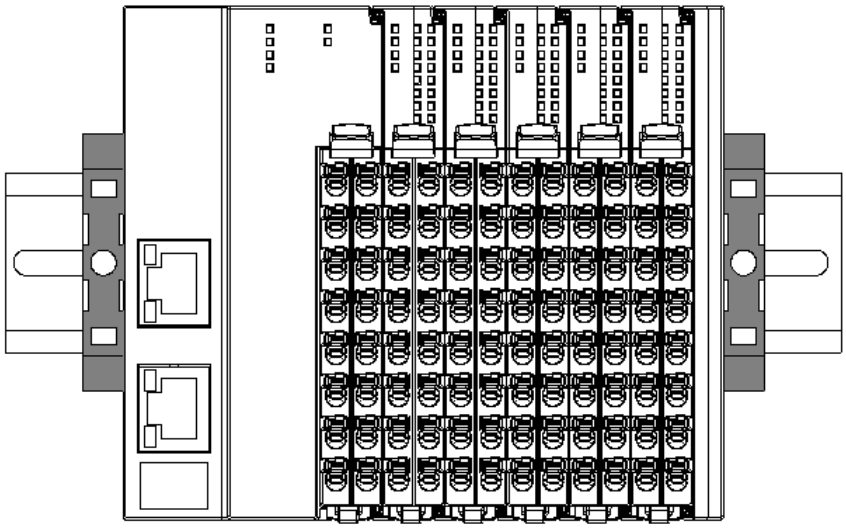


5. Remove the protective cover by taking it out in the upward direction.



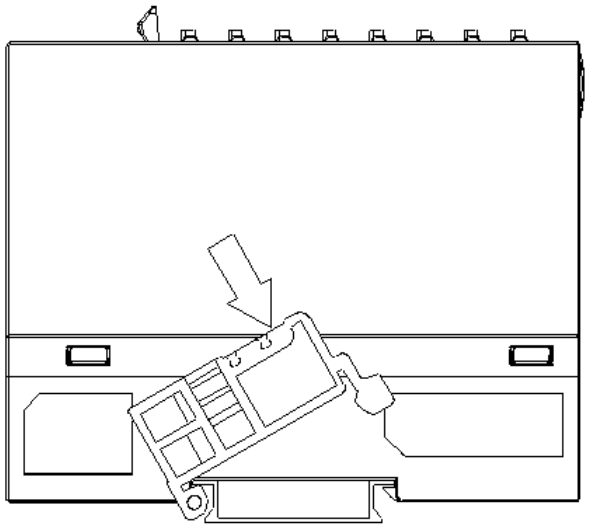
Note:

If there is a vibration source on the installation site, installing anti-vibration baffles on both the leftmost and rightmost sides of the AX-5 series modules is recommended to stabilize all modules. See the gray baffles on the two sides in the following figure.

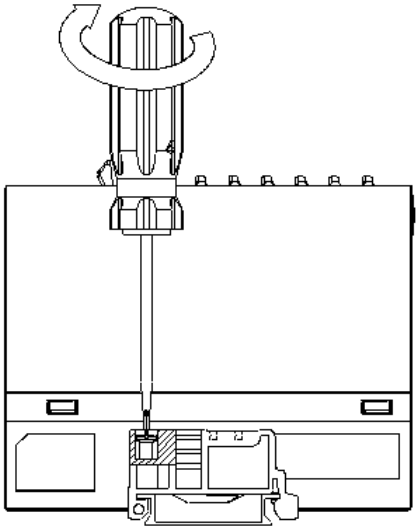


Install the baffles:

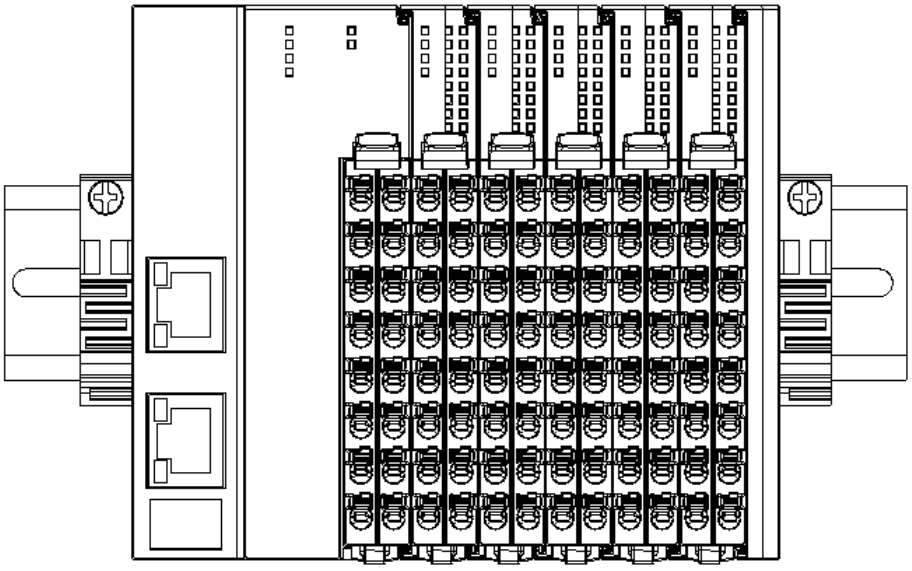
1. Hook the baffle onto the DIN rail and press it down as the directional arrow shows below.



2. Use a screwdriver to tighten the screw of the baffle after the baffle is clipped up on the rail.



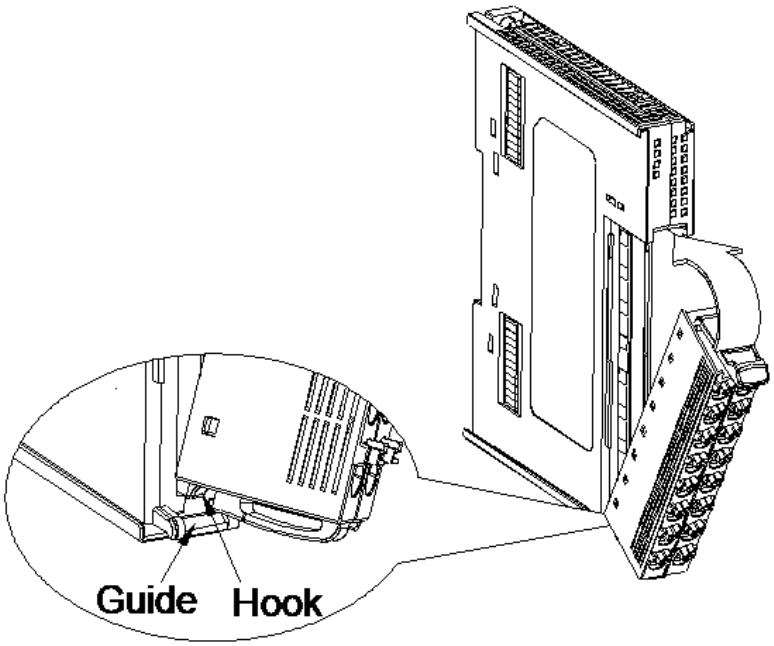
3. The completed baffle installation is as shown below.



1.3.2 Installing and Removing a Terminal Block

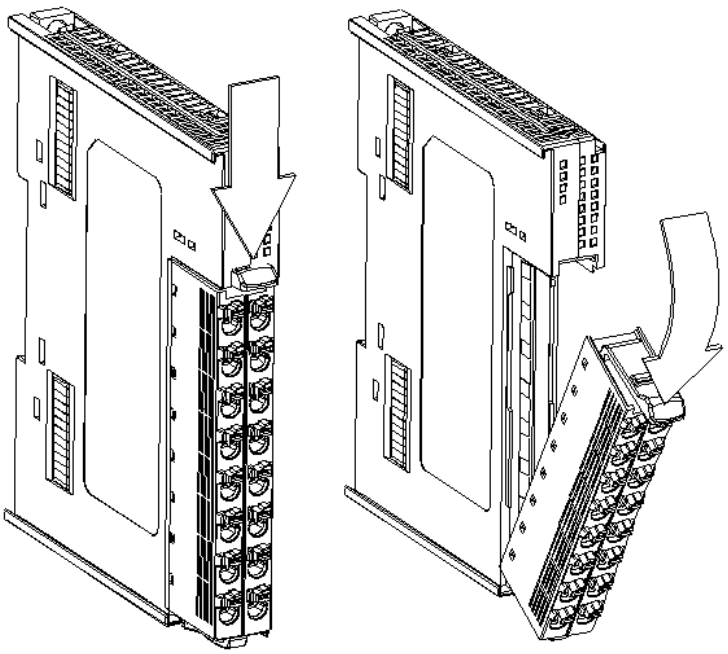
1. Installation

Hook the terminal block onto the guide at the bottom of the module, and press it up into the module.



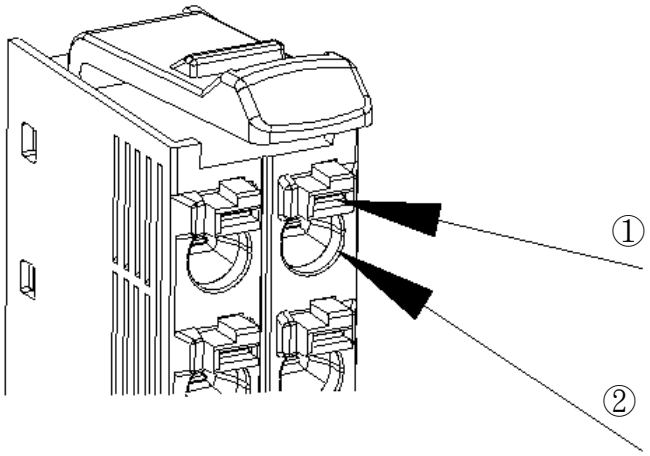
2. Removal

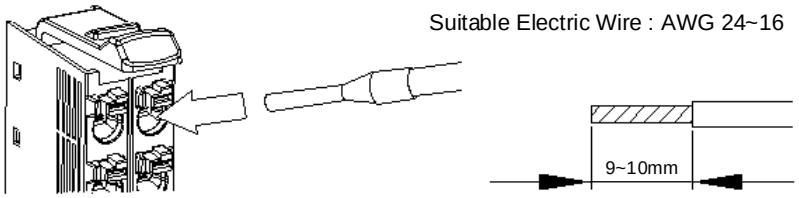
Press down the clip at the top of the removable terminal block and move it outward.



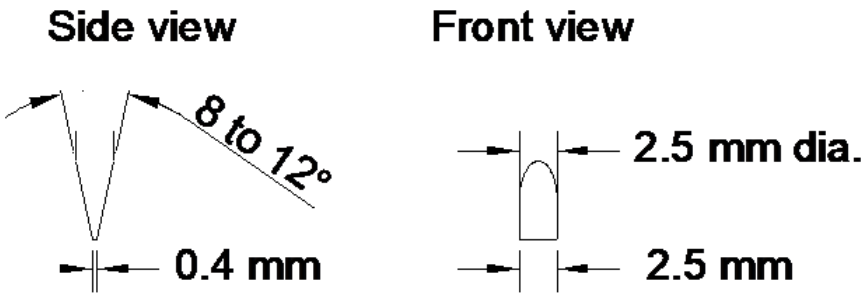
3. Keeping the cable secured into a terminal hole of the terminal block:

Press down the part ① above a terminal hole with a screwdriver, and then insert a suitable cable into the hole ② below.



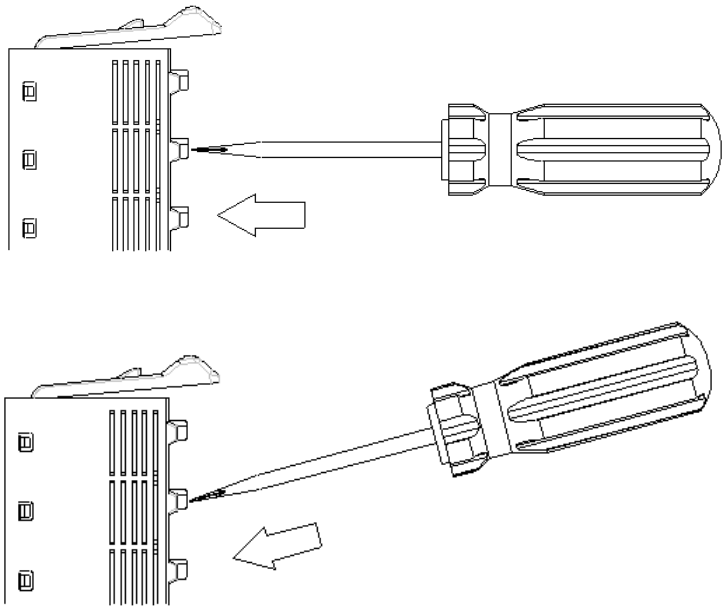


Note 1: Specifications of screwdriver

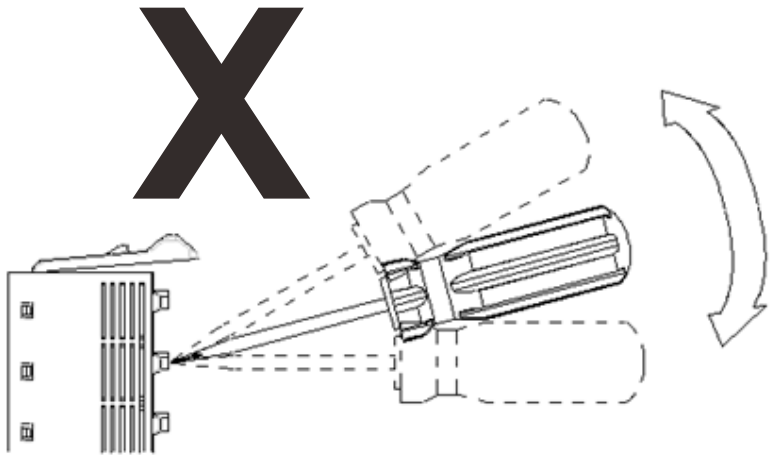


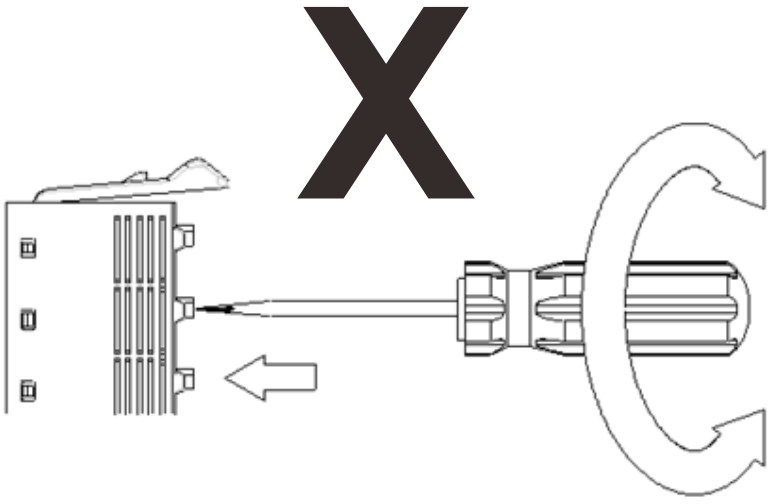
Note 2: Operation of screwdriver:

- Correct operation

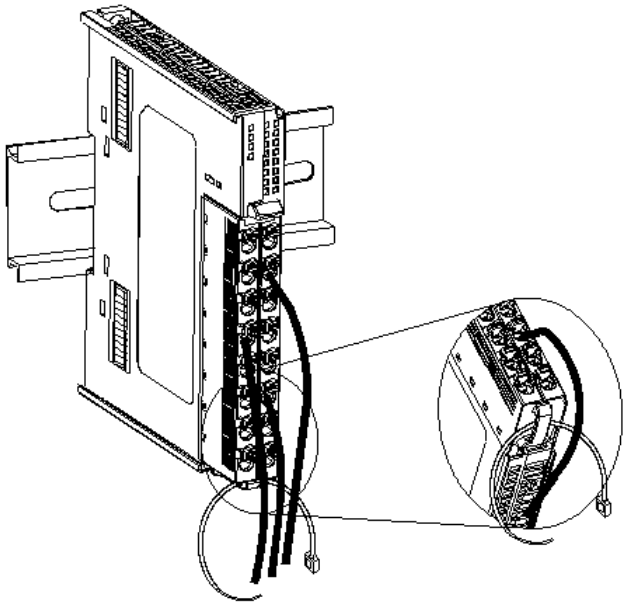


- Incorrect operation

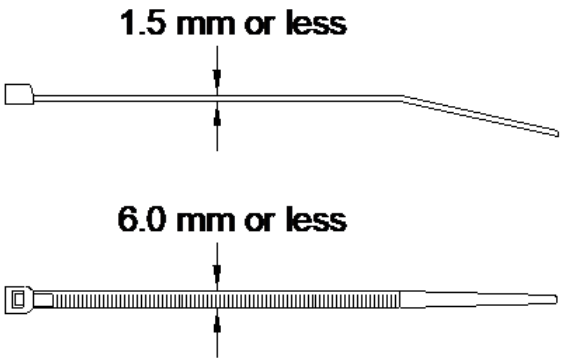




4. After wiring terminal blocks is completed, you can organize the cables by fastening them with a plastic cable tie through the cable tie hole below each terminal block.

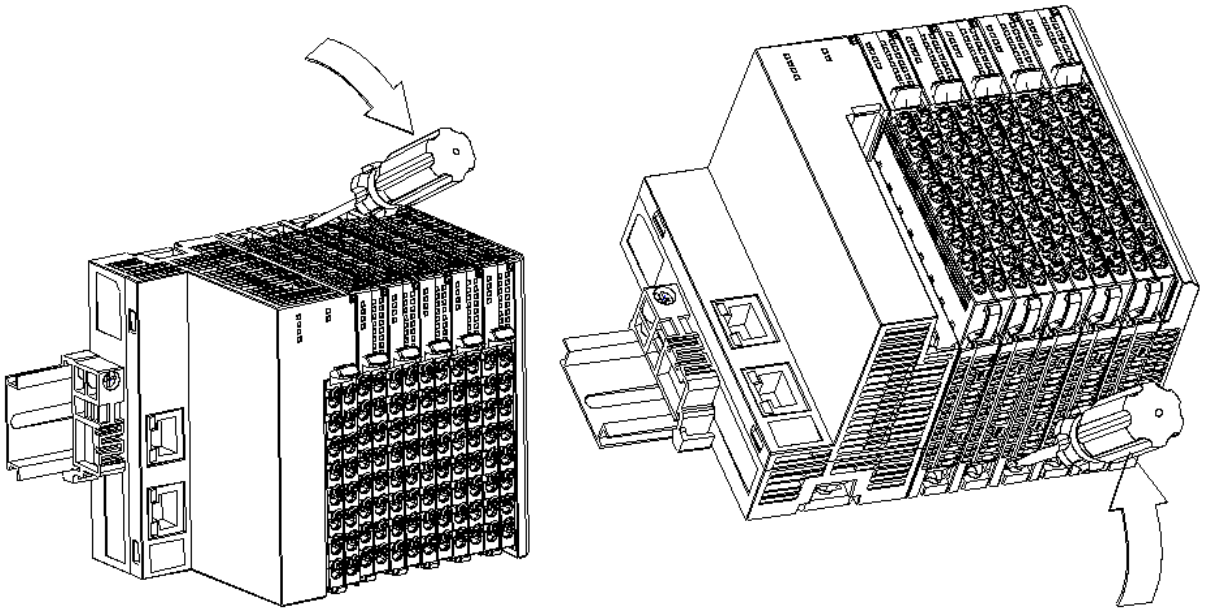


Note: Specifications of cable tie

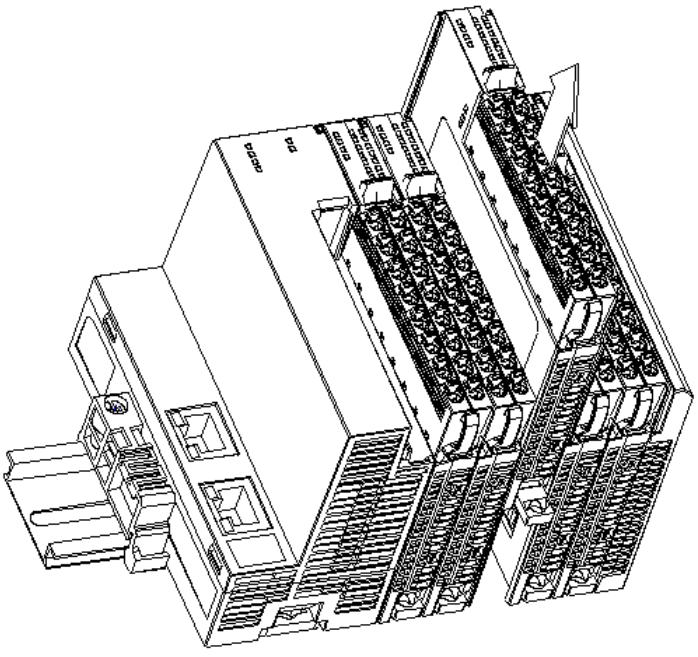


1.3.3 Replacing a Module

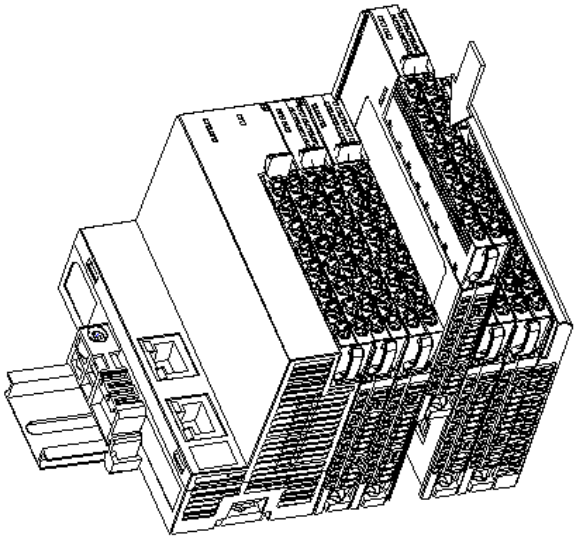
1. Remove the terminal block from a module, and then pull out the upper and lower clips of the module as shown below.



2. Remove the module.



3. Slide a new module in as shown below.

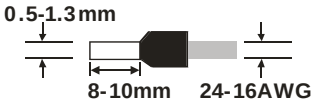


1.3.4 Precautions

1.3.4.1 General Notes

- System assemblers should take the responsibility for the system security of installed and assembled equipment.
- This product is an OPEN TYPE module and therefore should be installed in an enclosure free of airborne dust, humidity, electric shock and vibration. The enclosure should prevent non-maintenance staff from operating the device (e.g. key or specific tools are required for operating the enclosure) in case danger and damage on the device may occur.
- Only the manufacturer-specified power modules can be used for power supply. Refer to this manual or contact the manufacturer for details.
- To well dissipate the heat produced by modules, please install the product in an open-type control box. If it is installed in a closed control box, louvers or fans should be installed on the sides of the box to ensure enough air convection for cooling.
- For the installation inside the control box, keep at least 10cm space around the product to ensure sufficient air convection. Otherwise it may cause the product overheating and failure.
- To prevent the product from overheating and failure, do NOT block and cover the heat dissipation holes on the top of the product.
- Do NOT place any objects on the top of the product.
- There is no battery or fuses that need be replaced inside the product.
- Users are prohibited from disassembling the product. Only the manufacturer or its distributors can open the outer case for inspection or provide any parts.
- If the device is not used in the manufacturer-specified manner, it may weaken the protection provided by the product.
- When installing or wiring, make sure that all the external power is turned off. Otherwise, it may cause an electric shock to personnel or damage to the product.

- To ensure correct and safe wiring, please check the rated voltage and terminal configuration based on product specifications for PLC wiring. Connecting to the power supply that does not match the rated value or incorrect product wiring may lead to dangerous situations such as fire or damage.
- Use special tools for folding, crimping, and welding during external wiring. Poor wiring may result in a short circuit, fire, or operational errors.
- Make sure that there are no foreign objects such as wiring residues left in each module to avoid the fire, damage, or operational errors.
- Please wire the input line, output line, and power line separately to prevent noise interfering with the I/O signals.
- Use single-core cables or twin-core cables with a diameter of 24–16 AWG (0.5 mm–1.3 mm). The pin-type connector with an insulation tube is recommended as below.



1.3.4.2 Control Box, Power Cable and Ground

The PLC must be installed in a control box mainly for safety reasons. In addition, the control box also isolates electromagnetic interference generated by the PLC.

1. Control box
   - Use a conductive control box.
   - Remove the paint on the plate bolts to ensure good contact between the inner plate and the control box.
   - Ensure that the control box is well earthed even if there is high-frequency noise interference.
   - Minimize the size of gaps of the control box to prevent radio waves leaking from the gaps. You can also put EMI gaskets on the painted surface to avoid leaking radio waves.
2. Connecting the power cable and the ground

   Connect the power cable for PLC system and the ground as described below.
   - In AX-5 series modules, the coupler module (See Chapter 2 in this manual.) and some power modules (See Chapter 3 in this manual.) are equipped with terminals for grounding.
   - Users can ground any point on the aluminum rail, and the modules with ground terminals mentioned above.
   - Use the 16 AWG wire with the impedance <100 ohm for grounding.
   - You can add a magnetic core for the external AC/DC power cable to suppress radio frequency noise interference.
   - Wire the 24V DC input and AC input cables separately.
   - Twist the ground and the power wires together; the interference flowing through the power cable is then passed to the ground. The ground and the power wires do not need to be twisted if you install a filter on the power cable.

1.3.4.3 Signal Cable, Communication Cable and Shielded Cable

1. Digital I/O signal cables
   - Supports a cable length of up to 100 m with the impedance less than 2 ohms.
   - Supports shielded cables.
   - The rated current for digital output points is 0.5 A. The cable impedance of 2 ohms will cause the voltage drop of 1 V and power loss of 0.5 W on the cable.
   - Refer to Chapter 4 for the wiring of the digital input/output modules.
2. Analog I/O signal cables
   - Supports a cable length of 3 m.
   - Supports shielded cables.
   - Two-wire and three-wire sensors (passive sensors), and four-wire sensors (active sensors) for analog input and output. See Chapter 5 for the wiring of analog input/output modules.
   - It is suggested the active sensor should use the power supply alone, not sharing the power with the AX-5 system.
   - The signal cables of the same channel for analog input and output needs to be equal in length to prevent signal interference, but the length of signal cables for different channels does not need to be the same.
   - Refer to Chapter 5 for the wiring of analog input/output modules.
3. Communication cables

   Supported maximum length:
   - EtherCAT: 100 m
   - Ethernet: 100 m
   - CANopen: 100 m
   - RS-485: 100 m
   - RS-232: 3 m
4. Shielded cables
   - Shielded cables are recommended for connecting digital I/O modules and analog I/O modules including temperature modules.
   - Shielded cables are recommended for connection of communication interfaces of the PLC and the coupler module, such as EtherCAT, Ethernet, CANopen, RS-485, and RS-232 ports.
   - Use the shielded cable to do the single-point grounding.

1.4 Software Installation

1.4.1 Installing and Uninstalling DIADesigner-AX

- **System requirements**

The system environment for DIADesigner-AX is required as shown in the table below. Please install the software based on the information in the table.

Item	System Requirement
Software Platform	DIADesigner-AX V1.0.0 or later
Operating System	Windows 7 / 8.1 / 10 32/64 bits
CPU	Intel Celeron 540 1.8GHz or above Intel Core i5 M520 2.4 GHz or above
Memory	At least 2 GB (4 GB or more is recommended.)
Hard Disk Drive	At least 10 GB
Monitor Resolution	1920 x 1080 is recommended.
Keyboard/Mouse	An ordinary keyboard and mouse or other Windows compatible devices
Communication Interface	Ethernet, USB, or Serial port (depending on the CPU module interface)
Software	Net Framework 4.6.2 should be installed on your PC.

1.4.1.1 Installing DIADesigner-AX

Before installation begins, make sure the computer used for installing DIADesigner-AX meets the minimum system requirements listed above and DIAInstaller has been running in it.

The **DIAInstaller** is a software installer which assists you to manage all Delta industrial automation software. You can check for the status of software download, installation, and update via **DIAInstaller**.

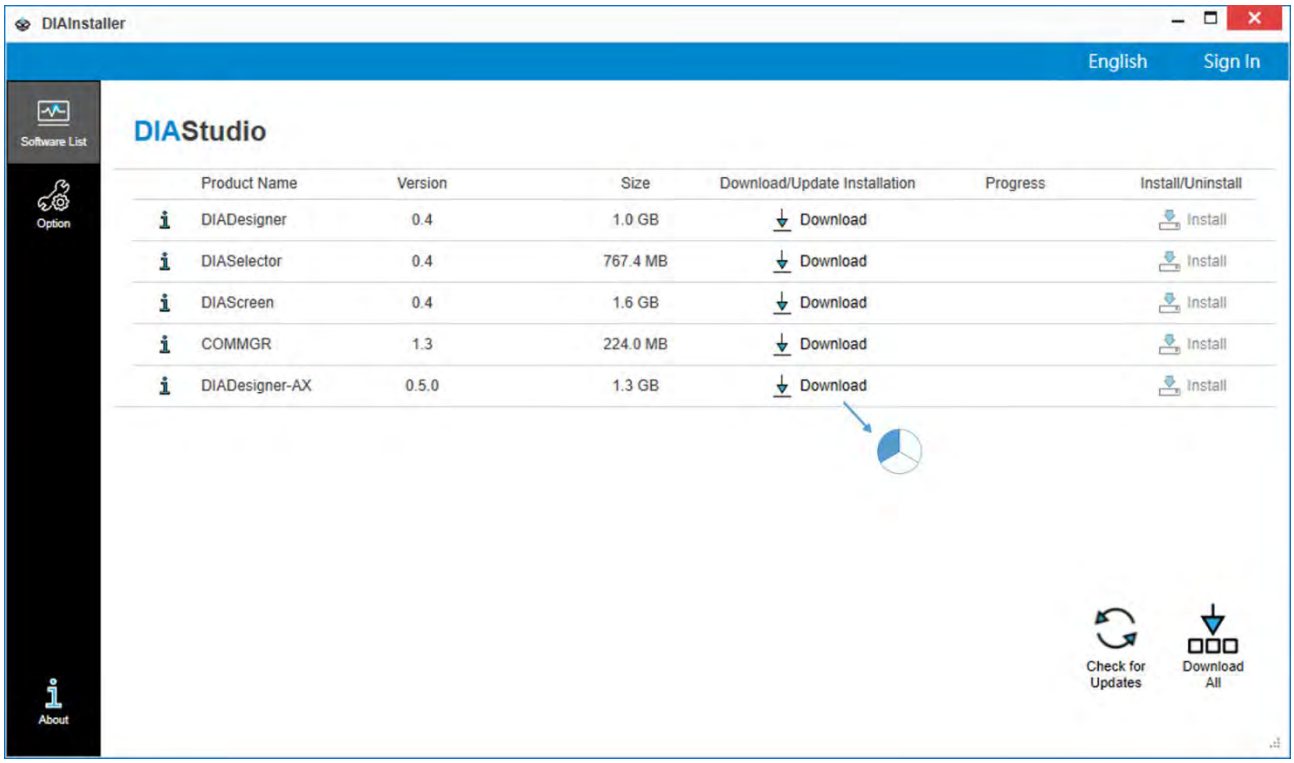
Go to https://diastudio.deltaww.com/home/downloads to download the **DIAStudio** for DIAInstaller.

To enter the download page of Delta official website, you need to sign in first. Please apply for a user account if you log in for the first time.

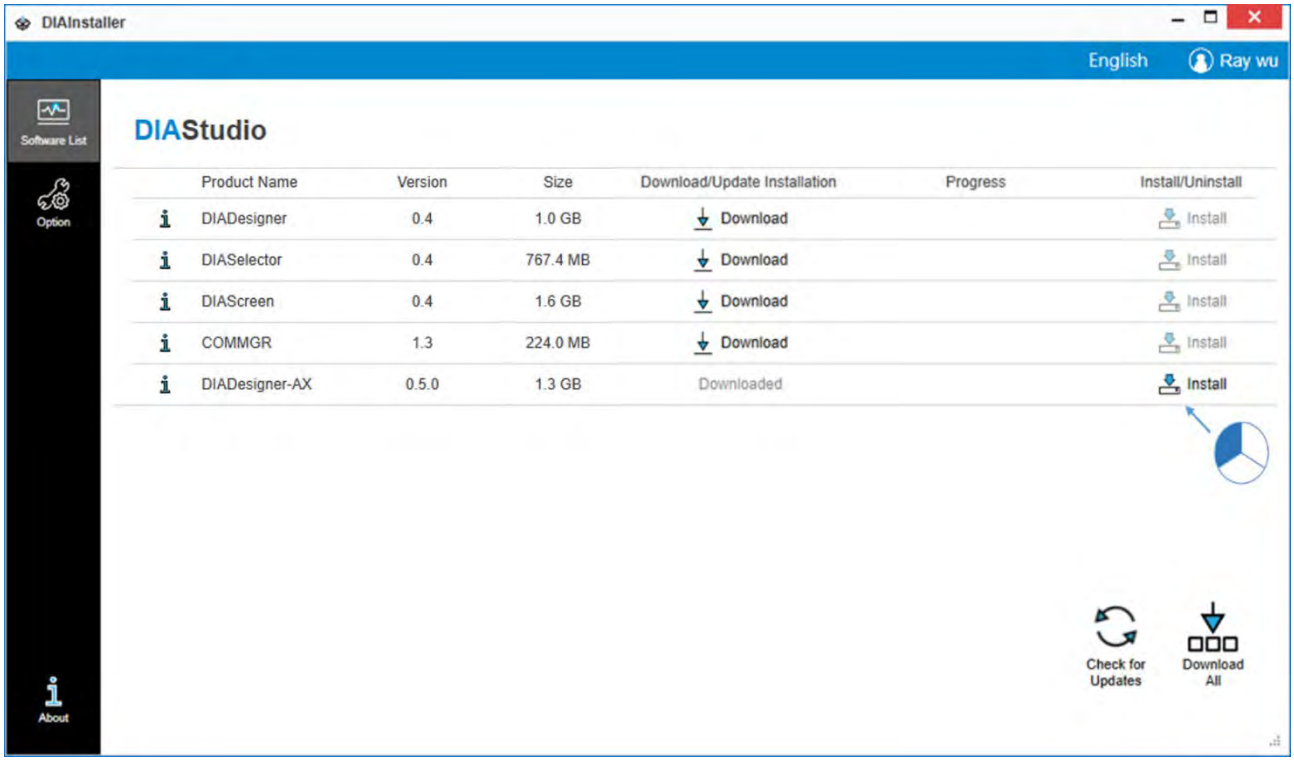
After login, click DIAStudio download icon to download **DIAStudio** for installation as shown below.

Follow the steps below to install DIADesigner-AX after the above installation is finished.

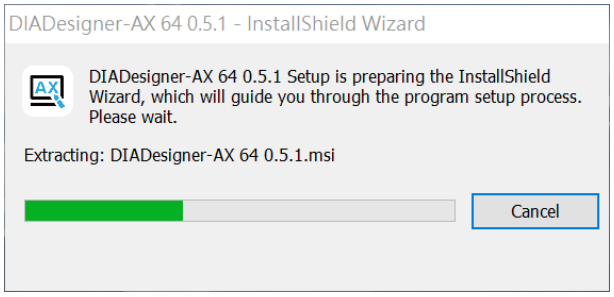
1. Open DIAInstaller to see the latest version of DIADesigner-AX.
2. Click **Download** to download the setup file of DIADesigner-AX.

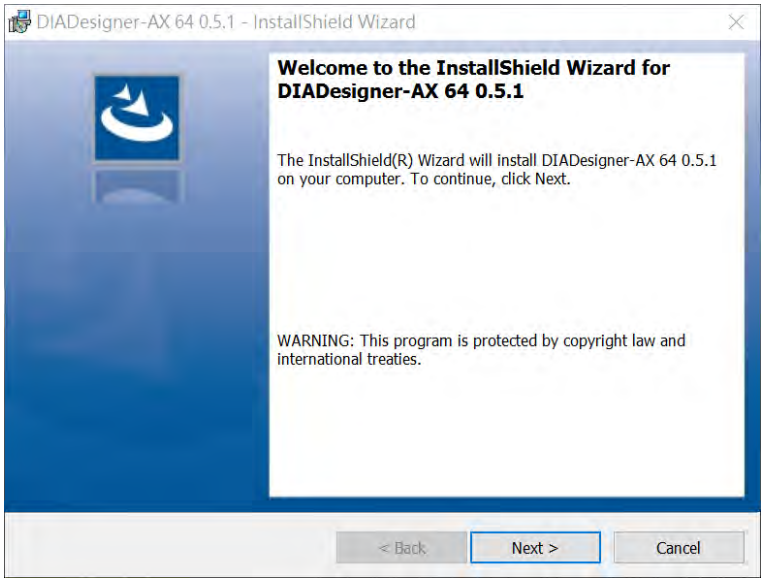


3. After DIADesigner-AX is downloaded, click **Install** to install the software.

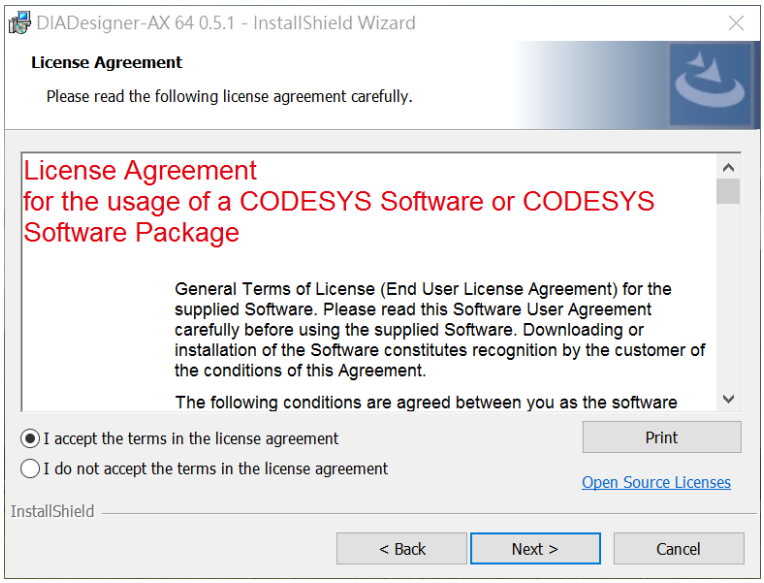


An **InstallShied Wizard** shows up and installing starts. Click **Next**.

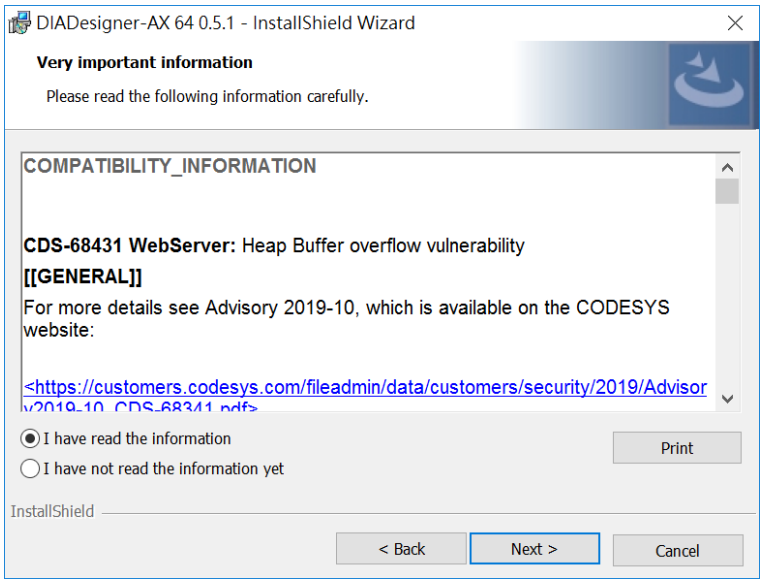




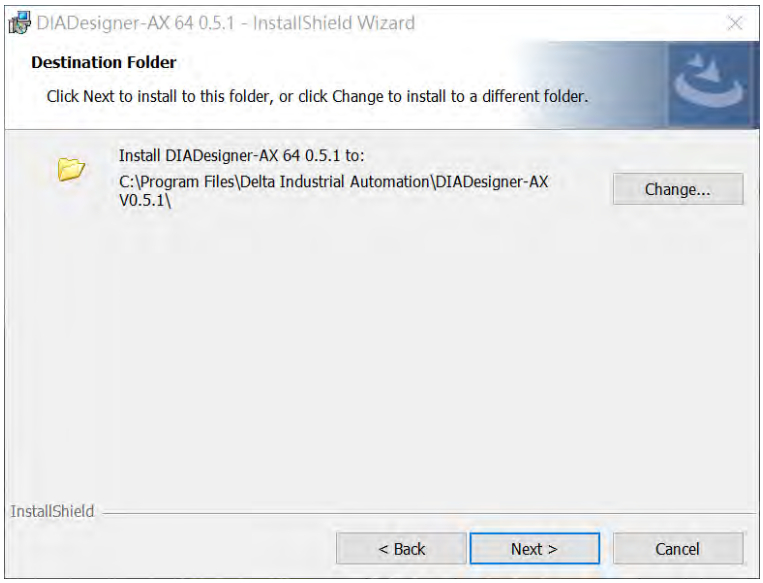
4. The window of License Agreement shows up. Select “I accept the terms in the license agreement” option and then click **Next**.



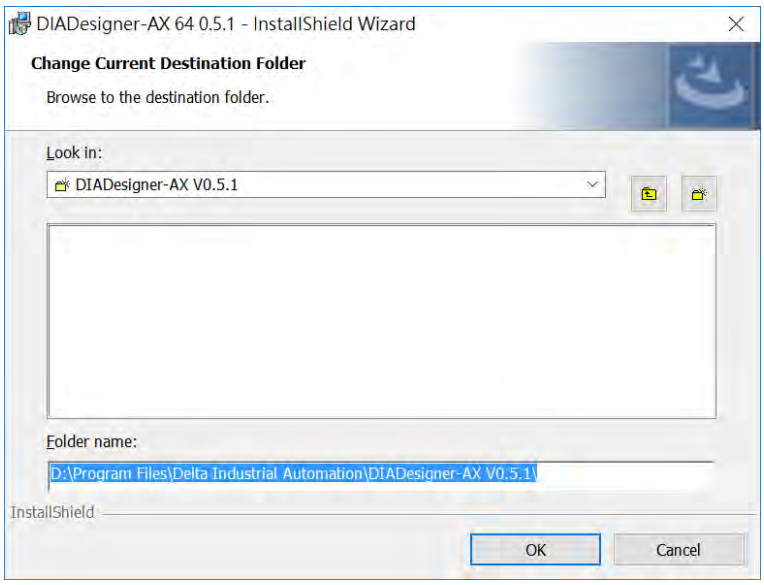
5. After that, the **Very important information** page comes up. Select “I have read the information” option and then click **Next**.



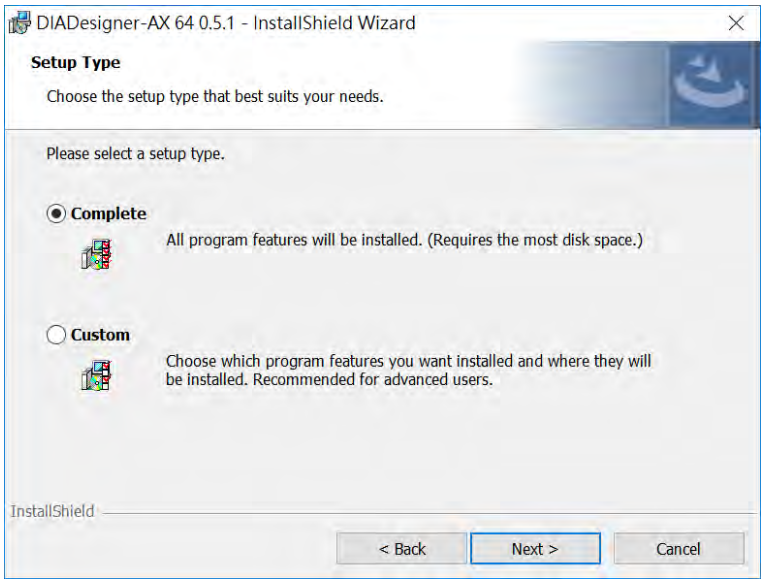
6. Next comes the **Destination Folder** page. If you leave the default path unchanged, click **Next**.



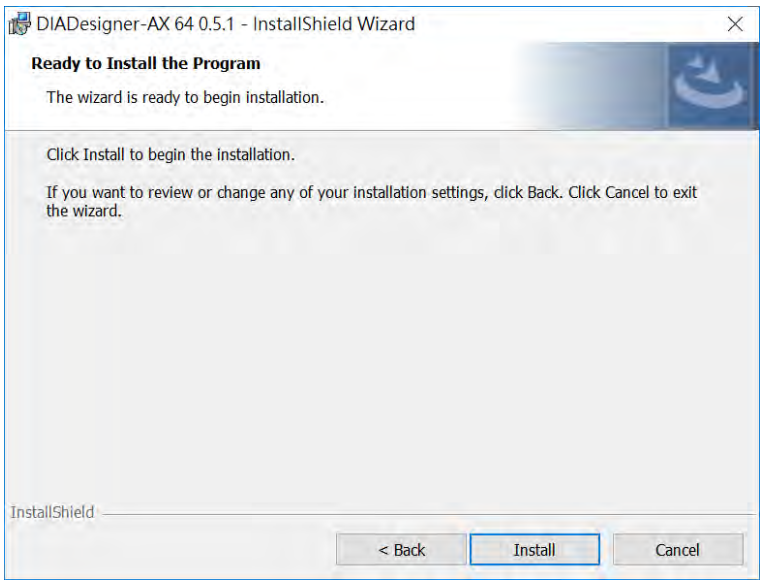
Or click **Change…** to change the path to destination folder.



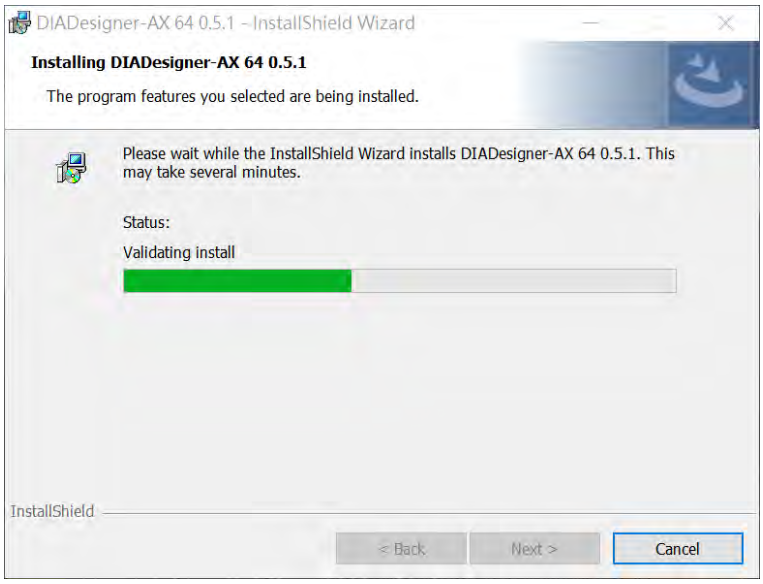
7. The window of **Setup Type** shows up as shown below. Select a setup type you need and then click **Next**.



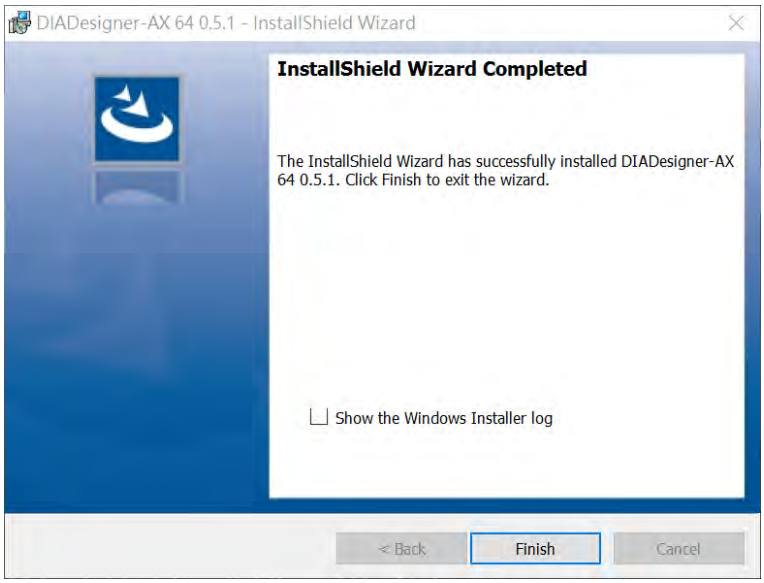
8. The window of **Ready to Install the Program** appears as below and then click **Install**.



It may take some time to have the installation done.



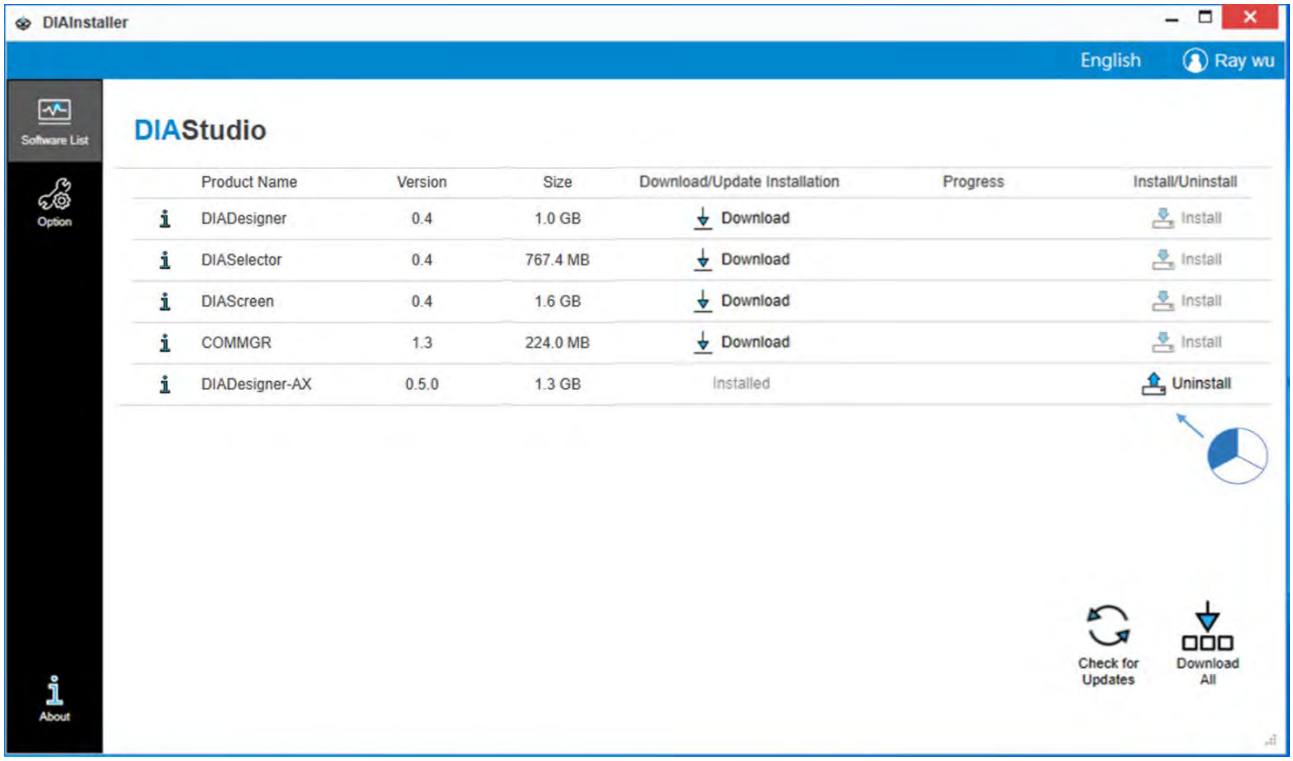
9. After installation, the window of **InstallShield Wizard Completed** appears. Click **Finish** to complete the installation.



1.4.1.2 Uninstalling DIADesigner-AX

Follow the steps below to uninstall DIADesigner-AX.

1. Open DIAInstaller, and then click **Uninstall** icon of DIADesigner-AX to remove the software.



2. The system executes the removal of DIADesigner-AX from your computer in the background. In the end, the DIADesigner-AX software is removed.

MEMO

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Chapter 2 Coupler

Table of Contents

2.1 AX-500CEC00-0A

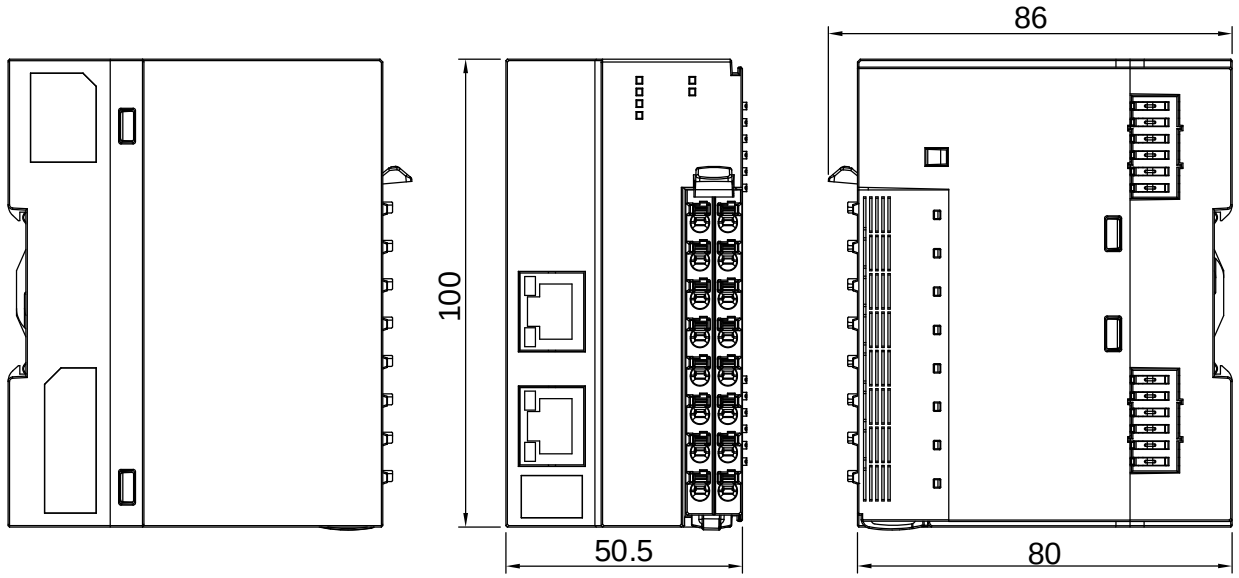
AX500CEC00-0A is an EtherCAT coupler. This section introduces its specifications, operations and wirings.

2.1.1 Specification

Item		Specification
External connectors		One spring-clamp terminal block (16 terminals)
		Two RJ45 IN: EtherCAT input port; OUT: EtherCAT output port
Dimension (mm)		50.5 (W) × 100 (H) × 80 (D)
Weight		165 g
Electrical specification	Unit power input voltage/power	24 VDC (-15% – 20%) /16 W
	I/O power input voltage/power	24 VDC (-15% – 20%) /under 240 W, depending on external power output
	Maximum unit power supply	2 A (10 W)
	Maximum I/O power supply	Under 10 A (240 W), depending on external power output
	Current capacity for spring-clamp terminal block	Less than 5 A per terminal
	Maximum power consumption (UV/UG)	50 mA (1.2 W)
	Isolation method	Between unit power and external power: no isolation Between I/O power and external power: no isolation. Between unit power and I/O power: 500 VAC (20 MΩ min.) EtherCAT port: 500 VAC
Others	Input power protection (UV/UG)	Voltage / current protection, under-voltage warning
	Unit power protection	Voltage / current protection

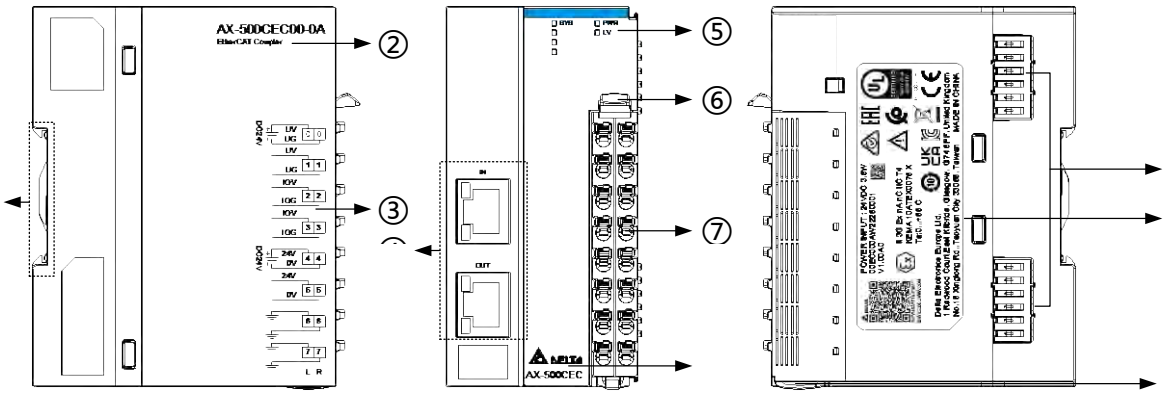
2.1.2 Dimensions and Parts

- **Dimensions**



Unit：mm

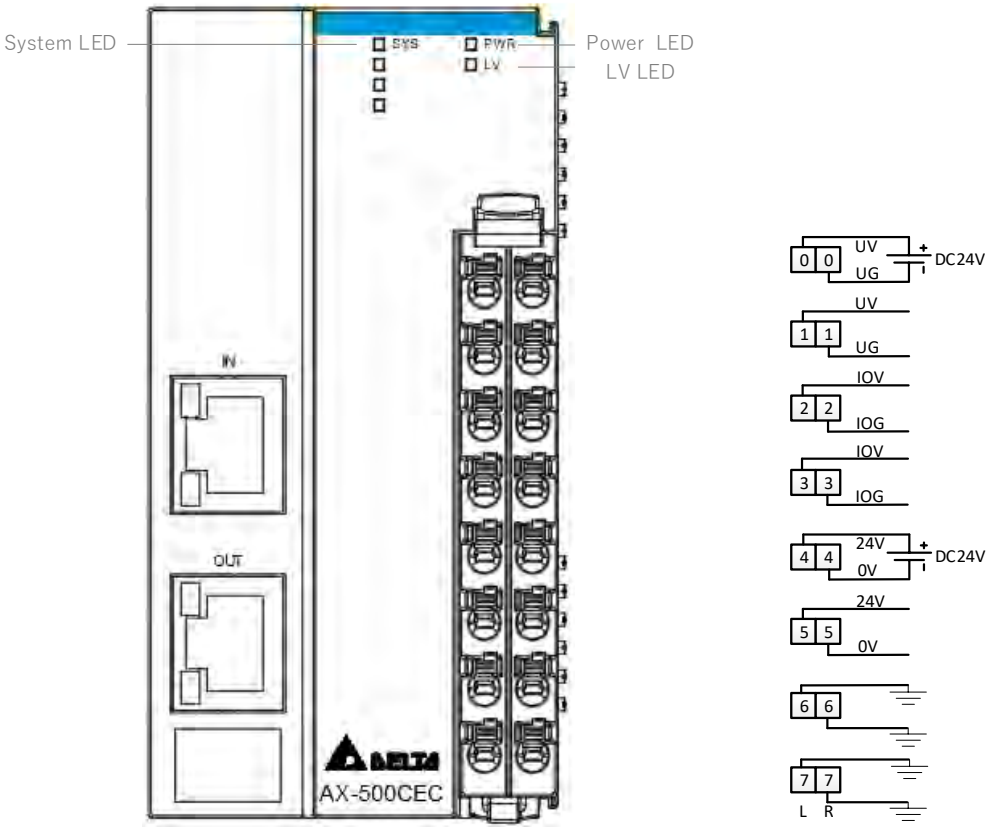
- **Parts**



No.	Name
1	DIN rail clip
2	Model number and model description
3	Wiring
4	EtherCAT communication port
5	System status indicator
6	Spring to hold the connection
7	Spring-clamp terminal block
8	Model code
9	AX connector (R)
10	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
11	Wire fastener

2.1.3 Arrangement of Terminals, LED Indicators and Wiring

2.1.3.1 Arrangement of Terminals



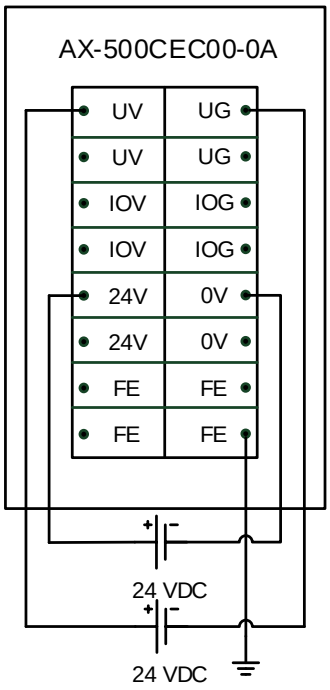
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	UV	Module unit power input: DC 24 V	R0	UG	Module unit power input: DC 0 V
L1	UV	Module unit power input: DC 24 V	R1	UG	Module unit power input: DC 0 V
L2	IOV	I/O power output: DC 24 V	R2	IOG	I/O power output: DC 0 V
L3	IOV	I/O power output: DC 24 V	R3	IOG	I/O power output: DC 0 V
L4	24V	I/O power input: DC 24 V	R4	0V	I/O power input: DC 0 V
L5	24V	I/O power input: DC 24 V	R5	0V	I/O power input: DC 0 V
L6	⏚	Grounding	R6	⏚	Grounding
L7	⏚	Grounding	R7	⏚	Grounding

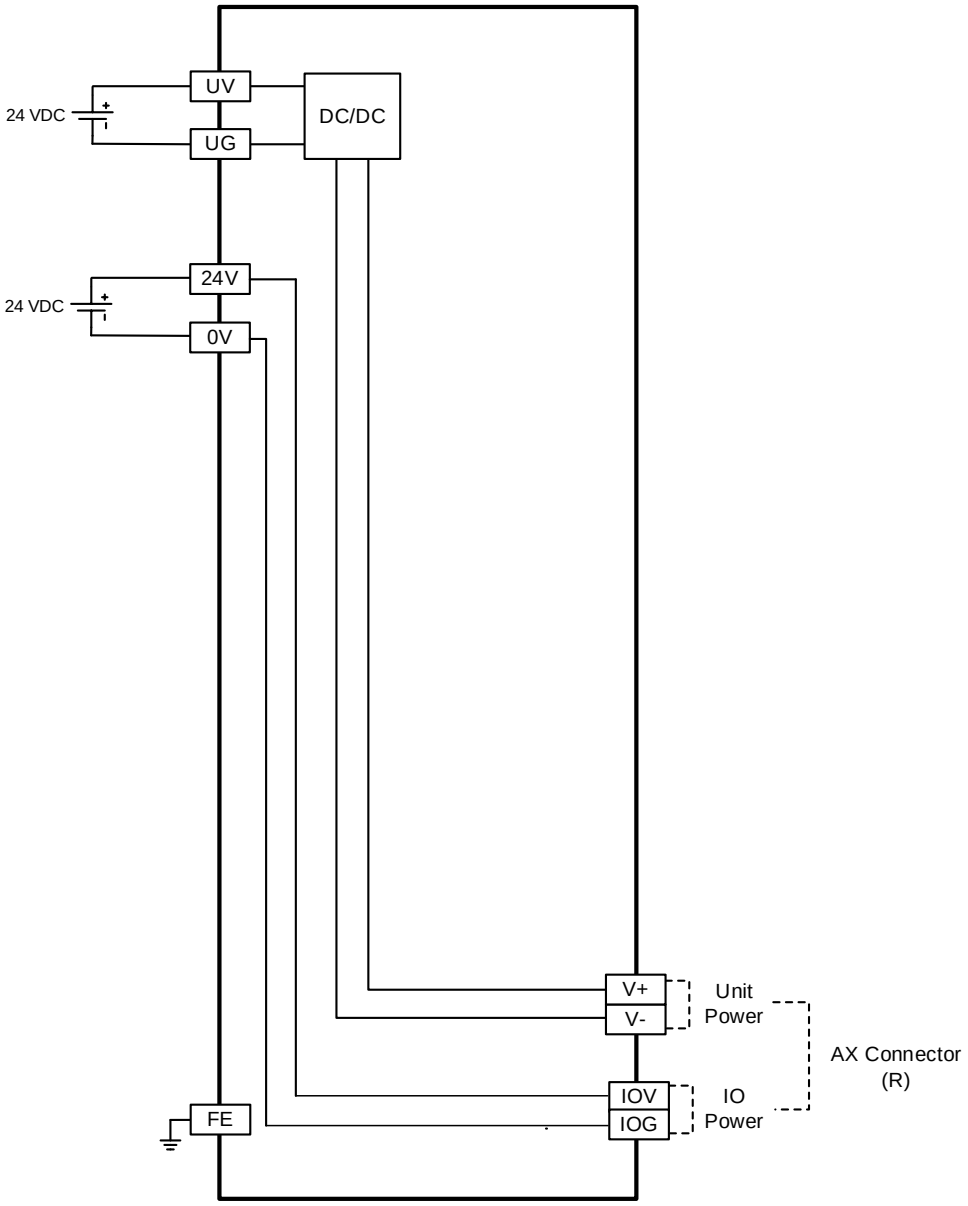
2.1.3.2 LED Indicators

Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	Normal (OP)
LV	Red		OFF	No under-voltage warning
			ON	Under-voltage warning
Power	Green		OFF	Not supplied with power
			ON	Power on

2.1.4 Wiring and Loop Configuration

- **Wiring**





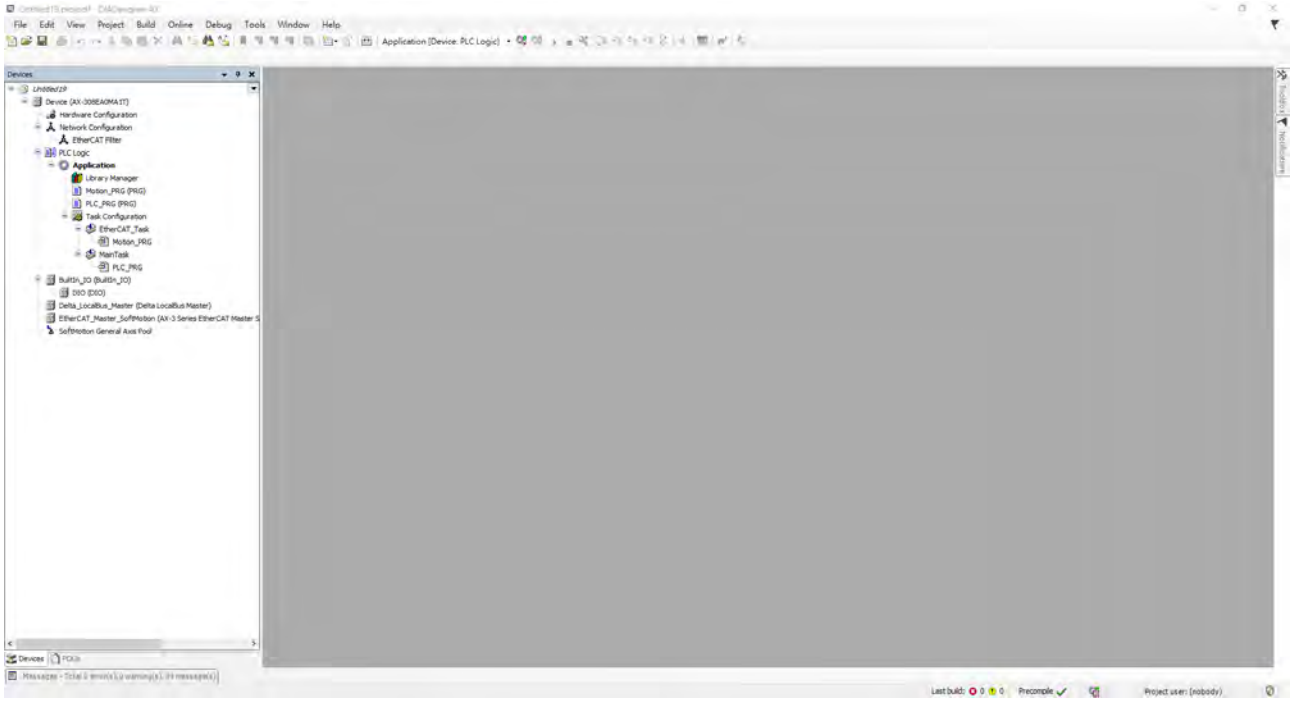
- This product shall be powered by a certified SELV/PELV power supply unit with operating temperature of minimum 60 °C, which meets the requirements of IEC 61010-1:2010 or latest edition.
- With the SELV/PELV power supply connected to 24V/0V terminals of the removable terminal block, the output rating of the power supply is 24V DC/10A, and the power is supplied to the right-side module for I/O power use via IOV/IOG of the AX connector. There are no current limiting components on the current paths from 24V/0V to IOV/IOG.
- With the SELV/PELV power supply connected to UV/UG terminals of the removable terminal block, the output rating of the power supply is 24V DC/1A. After the voltage conversion is made by the DC/DC unit with the current limiting function, the power is supplied to the right-side module for unit power use through V+/V - of the AX connector.
- SELV/PELV power supply units for I/O power and Unit power have different output ratings. Thus do NOT have them share the same power supply unit.

2.1.5 Settings in DIADesigner-AX

This section introduces some basic operations and settings in the DIADesigner-AX software.

2.1.5.1 Basic Operation

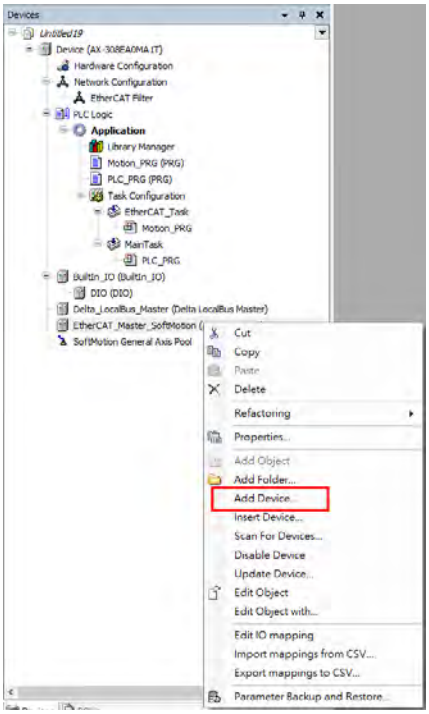
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



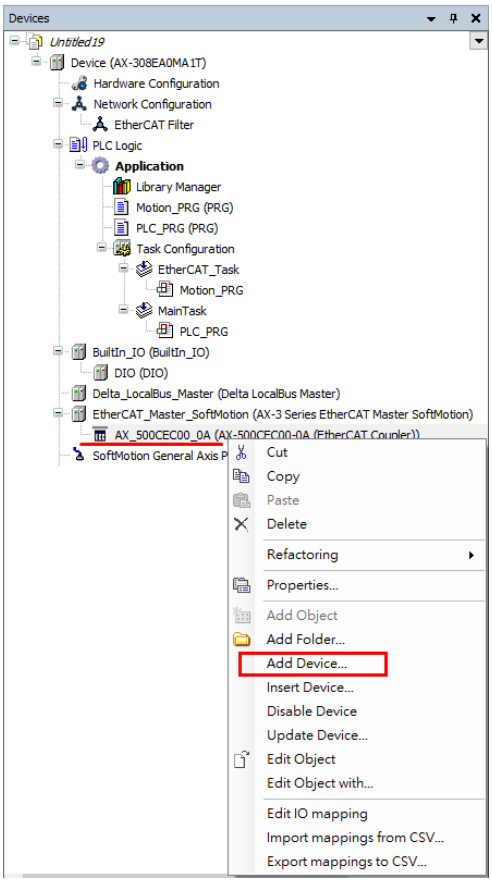
(2) Add Modules in

- Method 1: Add the modules in manually

  Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Add Device…*** to select and add System Coupler.

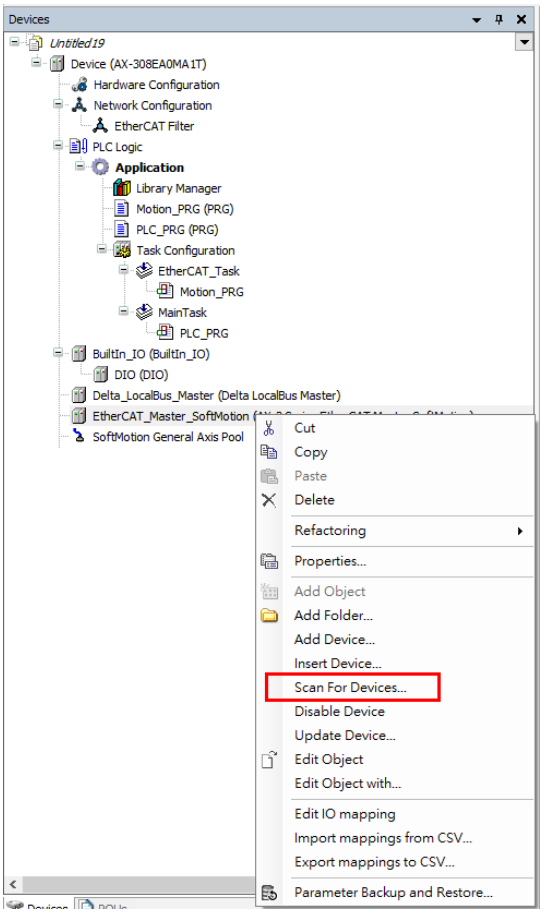


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

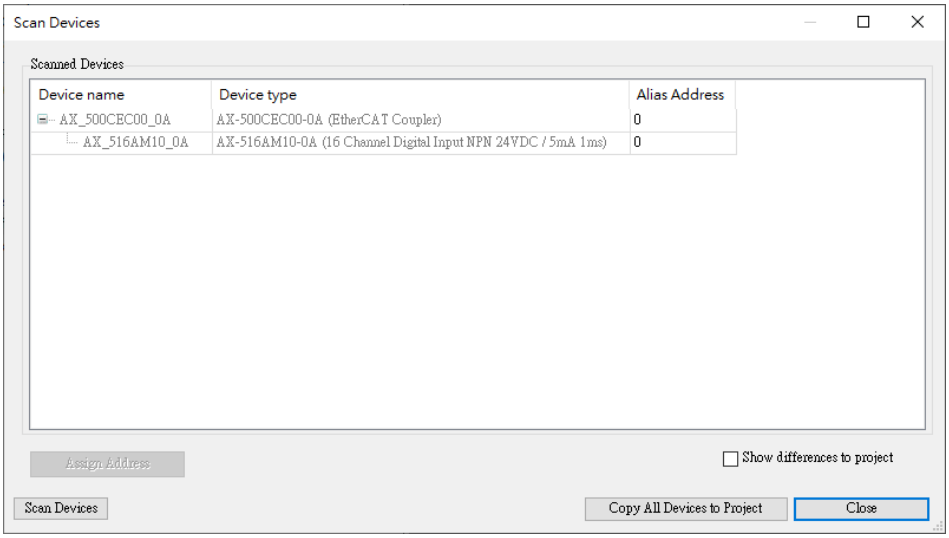


- Method 2: Scan to add the modules in.

  Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Scan for Devices…***.

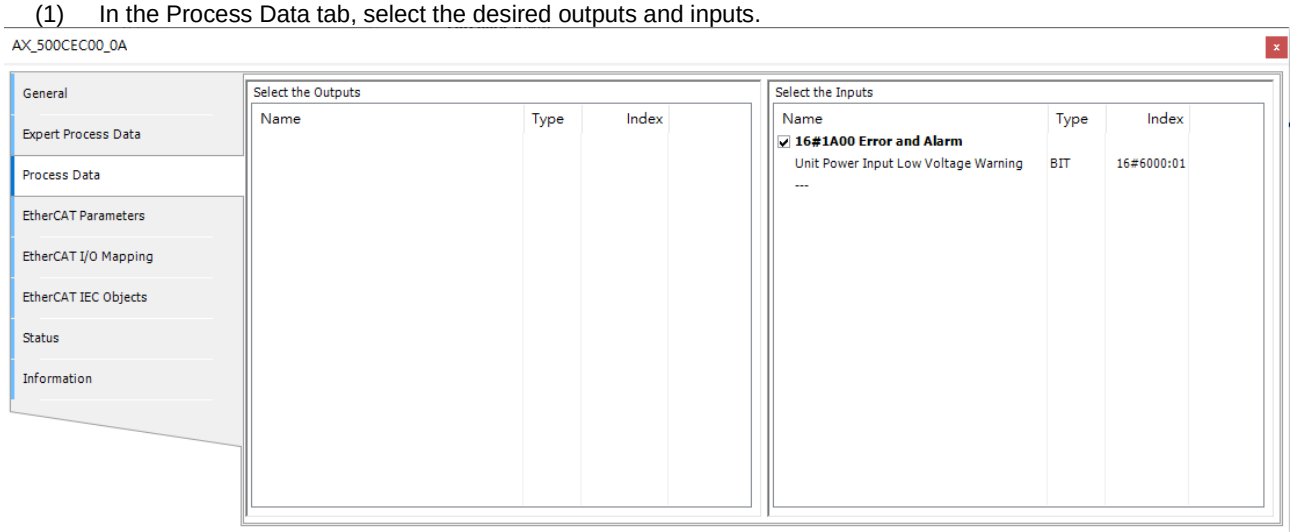


After the auto-scan is over, the actually-connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.

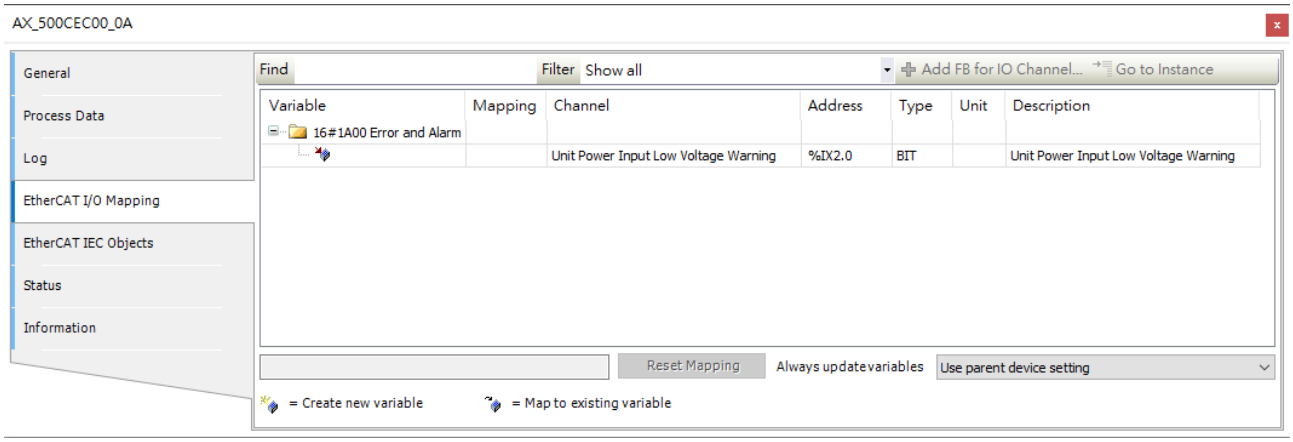


2.1.5.2 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

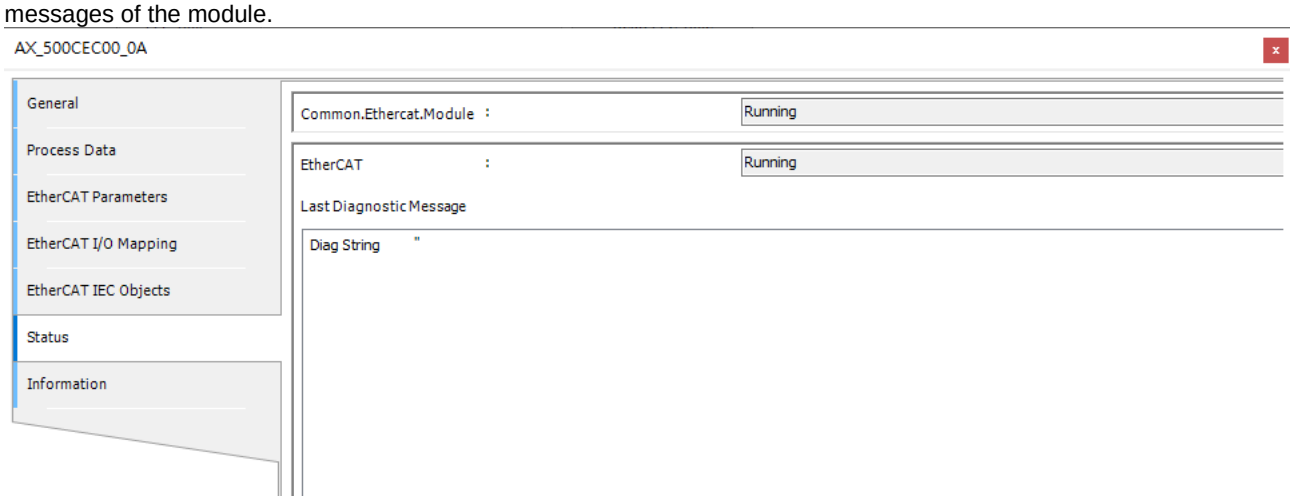


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, status and error codes for each channel.



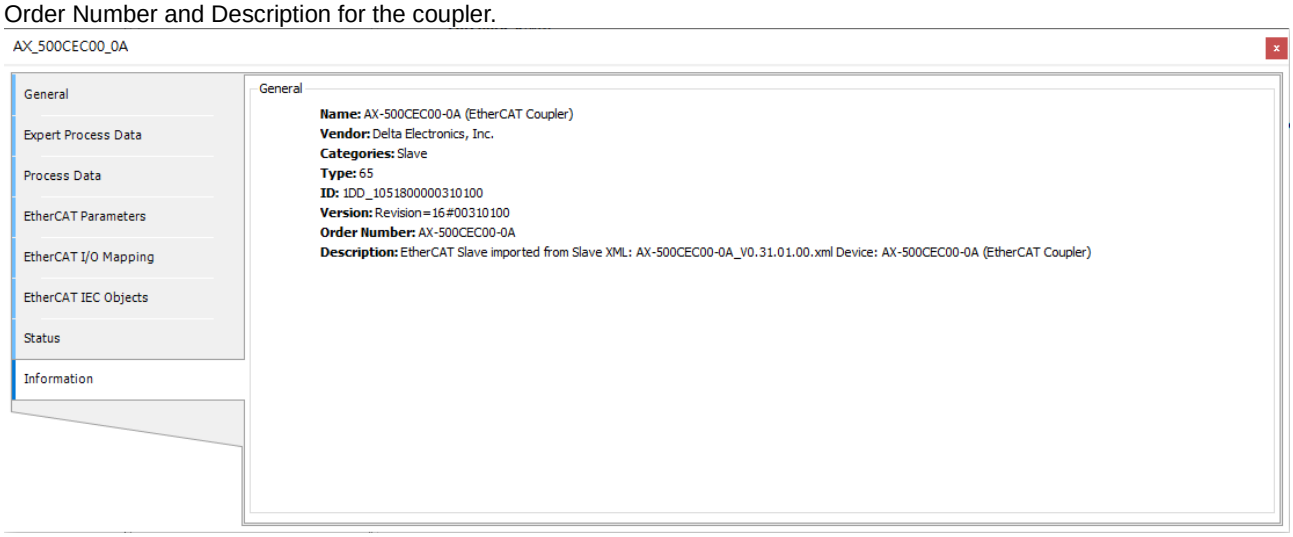
2.1.5.3 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



2.1.5.4 Information

In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the coupler.



2.1.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different modules in the same system can use different modes. However, the EtherCAT coupler supports the FreeRun mode only.

2.1.6.1 FreeRun Mode

The I/O values of each module are refreshed based on its own cycle time in FreeRun mode. There is no synchronization among modules.

2.1.7 Process Data

This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	Unit power input low voltage warning	Under-voltage warning (Unit power input)	BOOL	RO	0

2.1.8 Troubleshooting

Index	Subindex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#6000	16#01	Unit power input low voltage warning	ON	OFF	Check the power supply.

MEMO

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Chapter 3 Power Supply Modules and Connector Modules

Table of Contents

3.1 AX-502PS11-0A

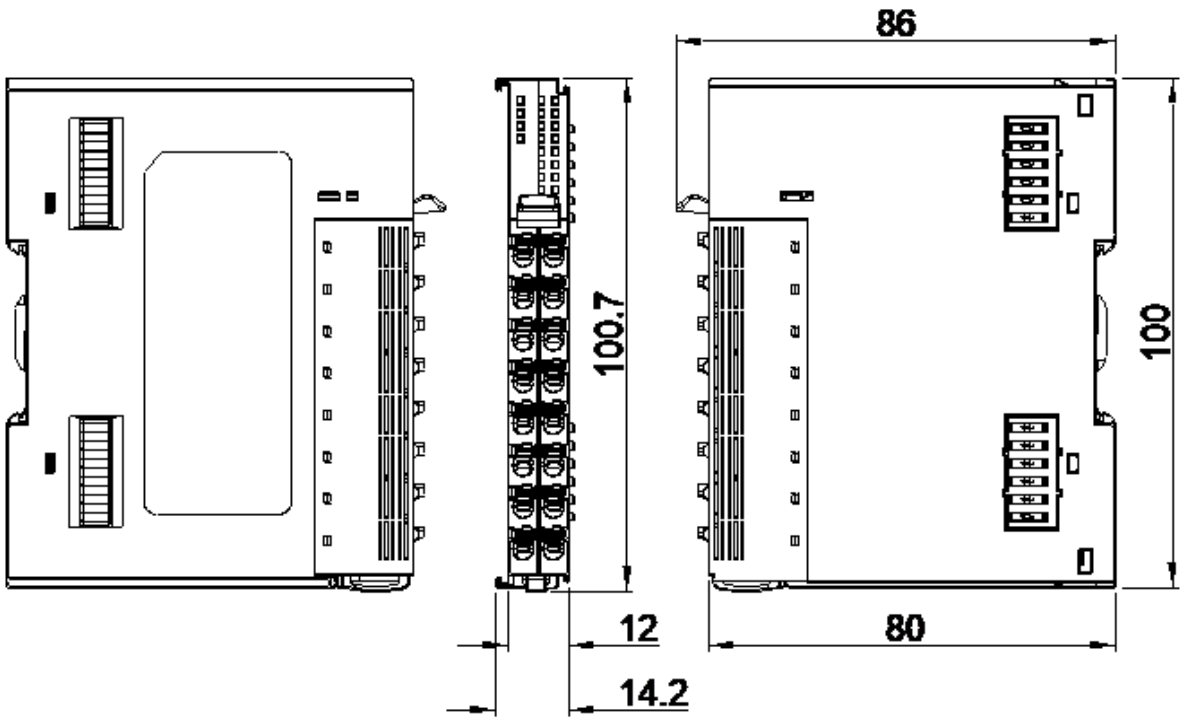
AX-502PS11-0A is a unit power supply module. This section introduces its specifications, operations and wirings.

3.1.1 Specifications

Item		Specification
External connector		Spring-clamp terminal block (16 terminals)
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		75 g
Electrical specification	Unit power input voltage/power	24 VDC (-15%~20%) / 14W
	Maximum unit power supply	2 A (10 W)
	Maximum I/O power supply	N/A
	Current capacity for spring-clamp terminal block	Less than 5 A / terminal; less than 10A / module
	Maximum power consumption for module (UV/UG)	42 mA (1W)
	Minimum power consumption (I/O power)	No power consumed
	Isolation method	Between unit power and external power: no isolation Between unit power and I/O power: 500 VAC (20 MΩ min.)
Others	Input power protection (UV/UG)	Voltage / current protection, under-voltage warning
	Unit power protection	Voltage / current protection

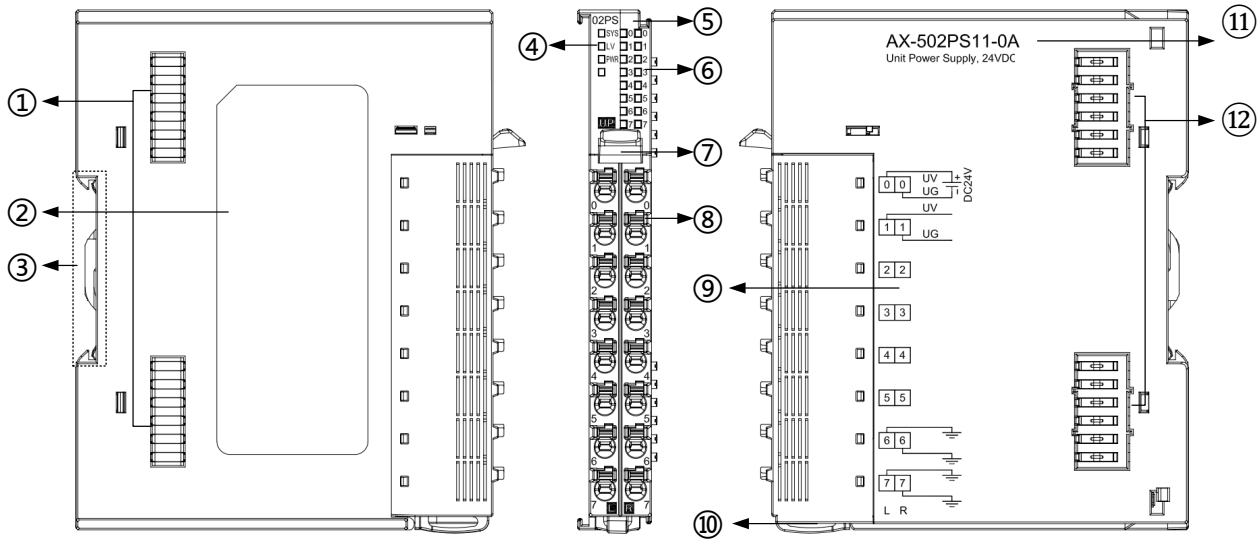
3.1.2 Dimensions and Parts

- **Dimensions**



Unit：mm

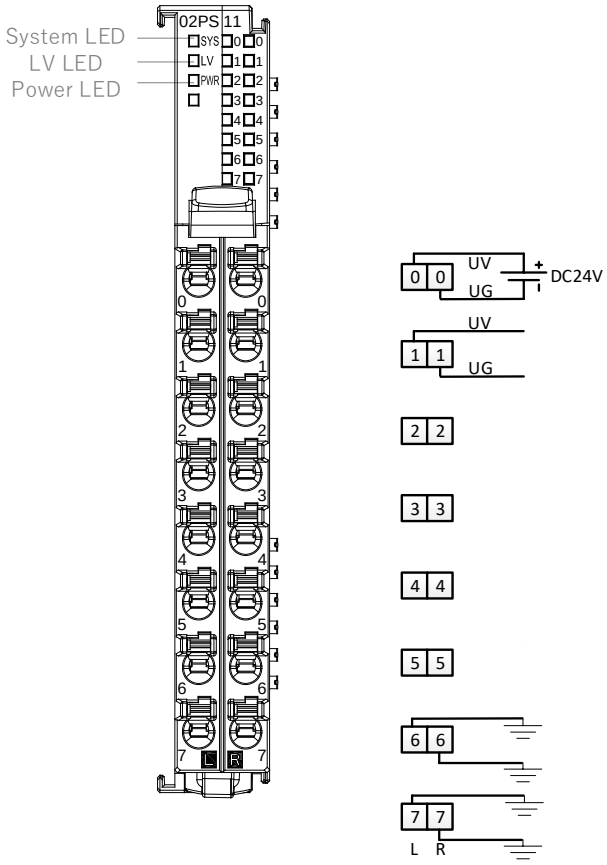
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

3.1.3 Arrangement of Terminals, LED Indicators and Wiring

3.1.3.1 Arrangement of Terminals



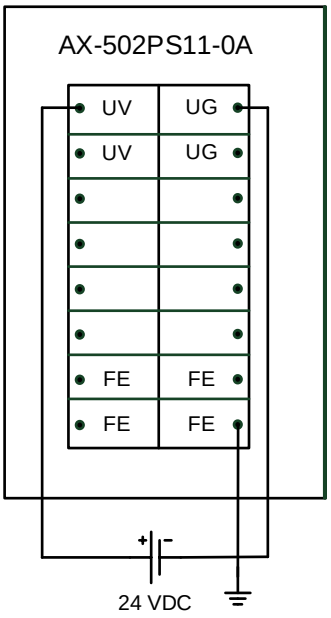
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	UV	Module unit power input: 24 VDC	R0	UG	Module unit power input: 0 VDC
L1	UV	Module unit power input: 24 VDC	R1	UG	Module unit power input: 0 VDC
L2	NA	NA	R2	NA	NA
L3	NA	NA	R3	NA	NA
L4	NA	NA	R4	NA	NA
L5	NA	NA	R5	NA	NA
L6	⏚	Grounding	R6	⏚	Grounding
L7	⏚	Grounding	R7	⏚	Grounding

3.1.3.2 LED Indicators

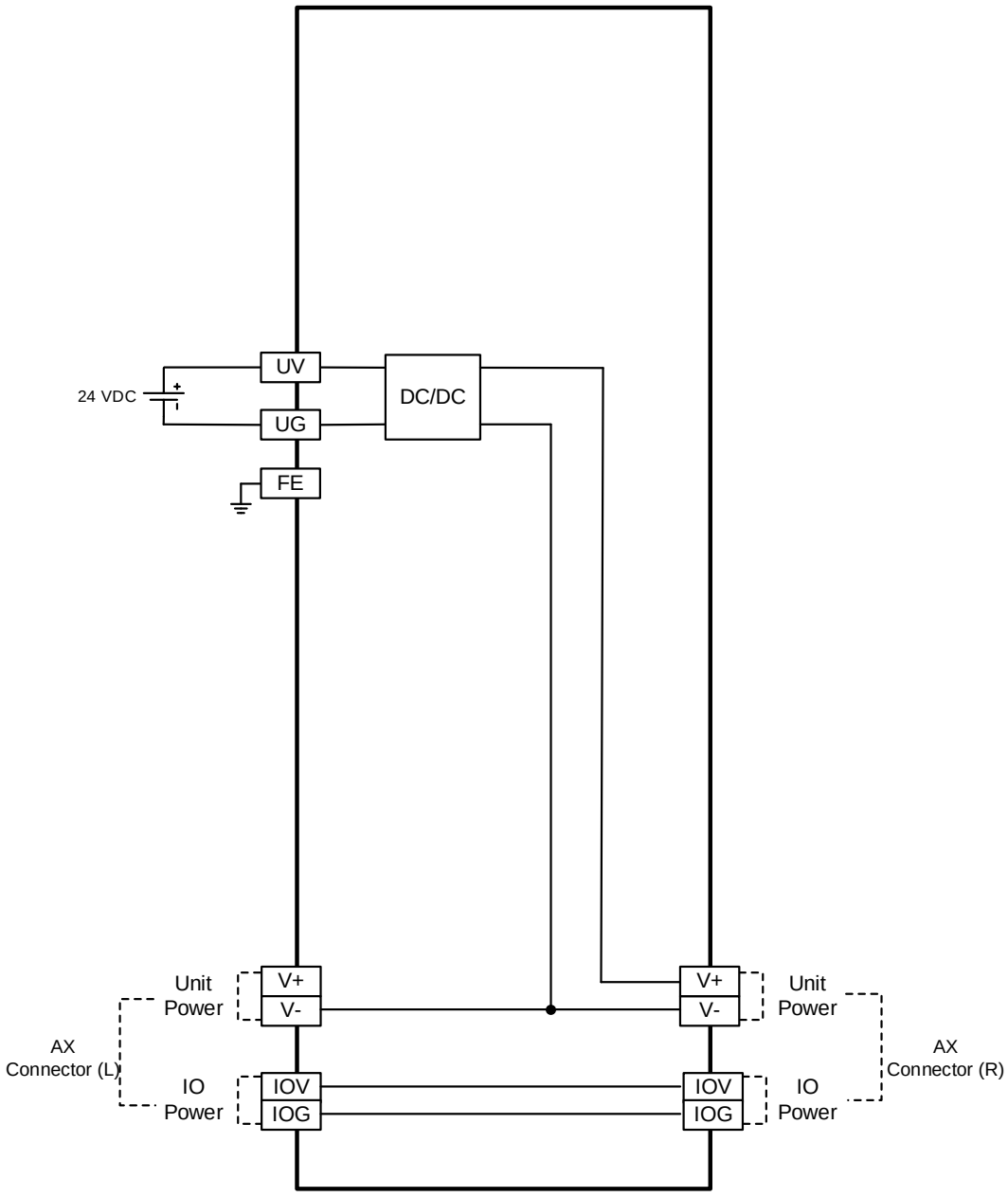
Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	Normal (OP)
LV	Red		OFF	No under-voltage warning
			ON	Under-voltage warning
Power	Green		OFF	Not supplied with power
			ON	Power on

3.1.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



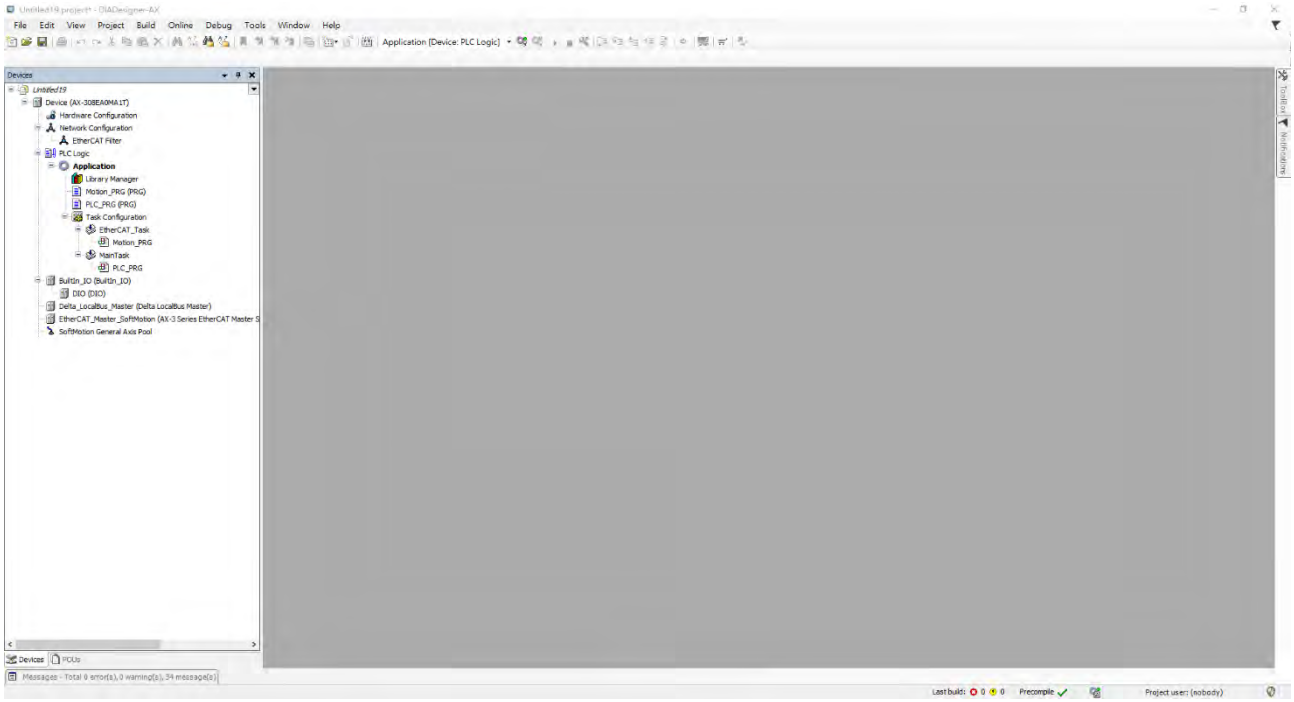
⚠	• This product shall be powered by a certified SELV/PELV power supply unit with operating temperature of minimum 60 °C, which meets the requirements of IEC 61010-1:2010 or latest edition. • With the SELV/PELV power supply connected to UV/UG terminals of the removable terminal block, the output rating of the power supply is 24V DC/1A. After the voltage conversion is made by the DC/DC unit with the current limiting function, the power is supplied to the right-side module for unit power use through V+/V- of the AX connector. • SELV/PELV power supply units for AX-502PS11-0A and AX-510PS12-0A have different output ratings. Thus do NOT have them share the same power supply unit.

3.1.4 Settings in DIADesigner-AX

This section introduces some basic operations and settings in the DIADesigner-AX software.

3.1.4.1 Basic Operation

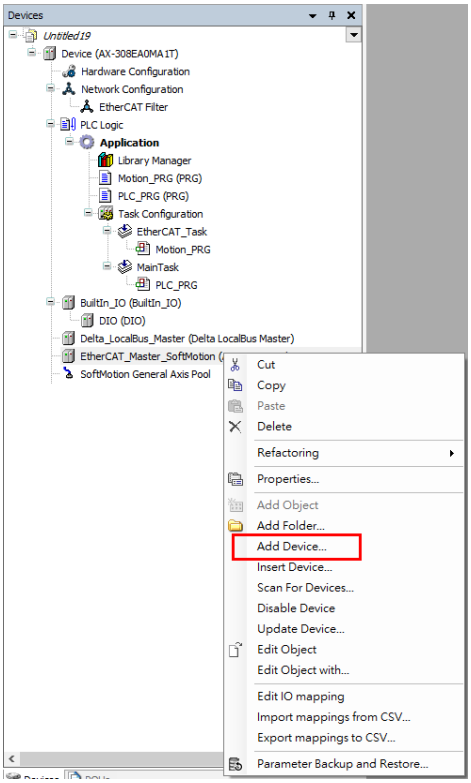
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



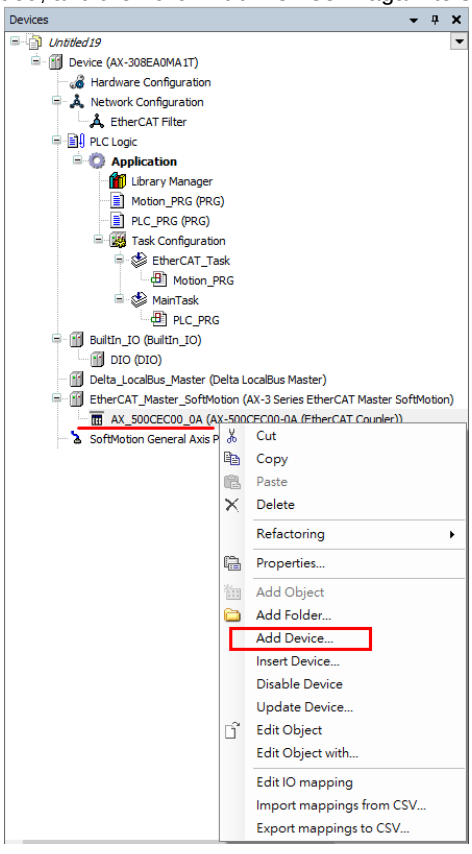
(2) Add Modules in

- Method 1: Add the modules in manually.

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Add Device…*** to select and add System Coupler.

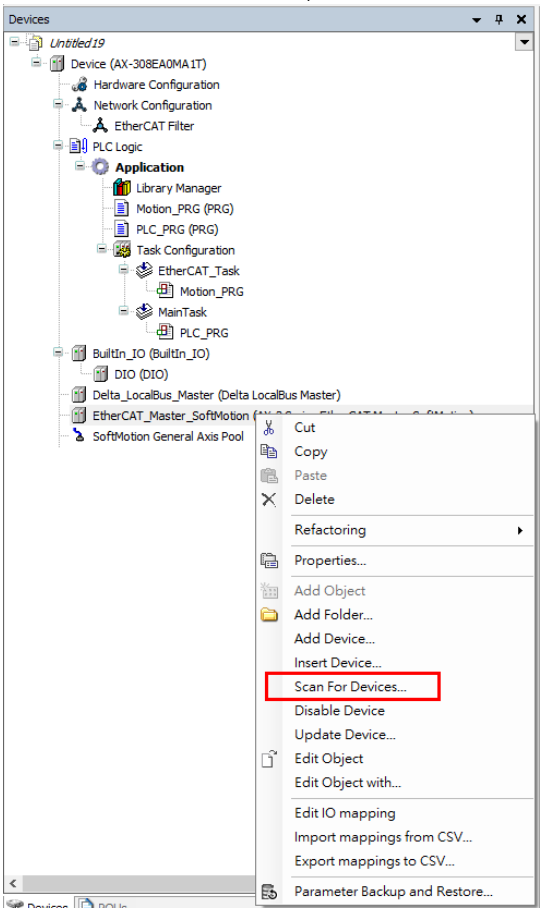


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

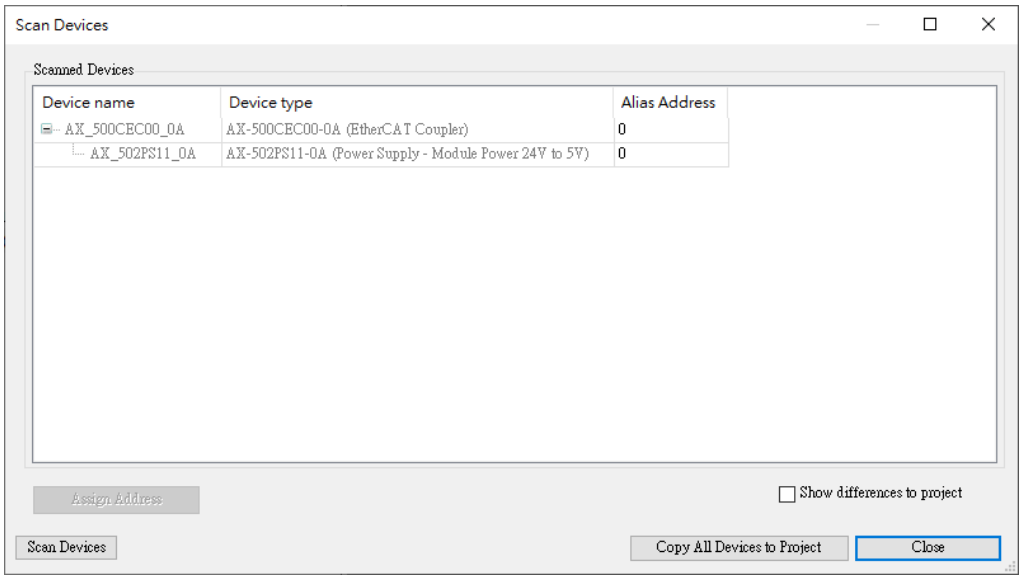


- Method 2: Scan to add the modules in.

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Scan for Devices…***.

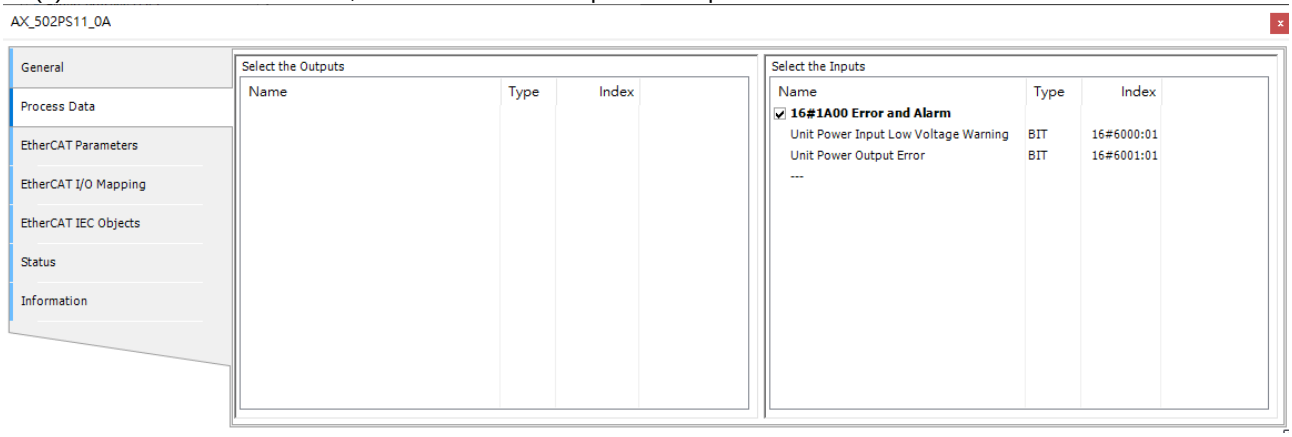


After the auto-scan is over, the actually-connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.

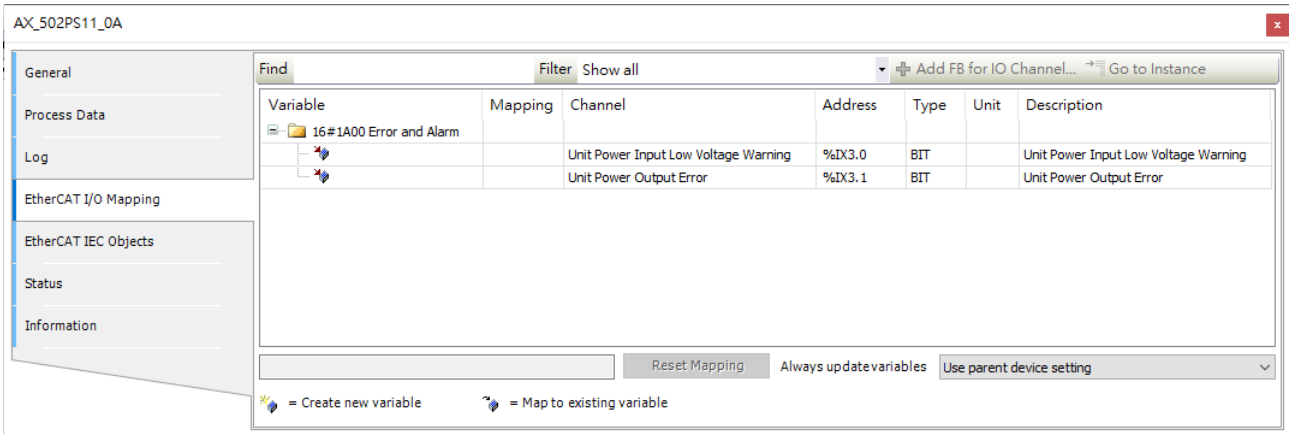


3.1.4.2 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

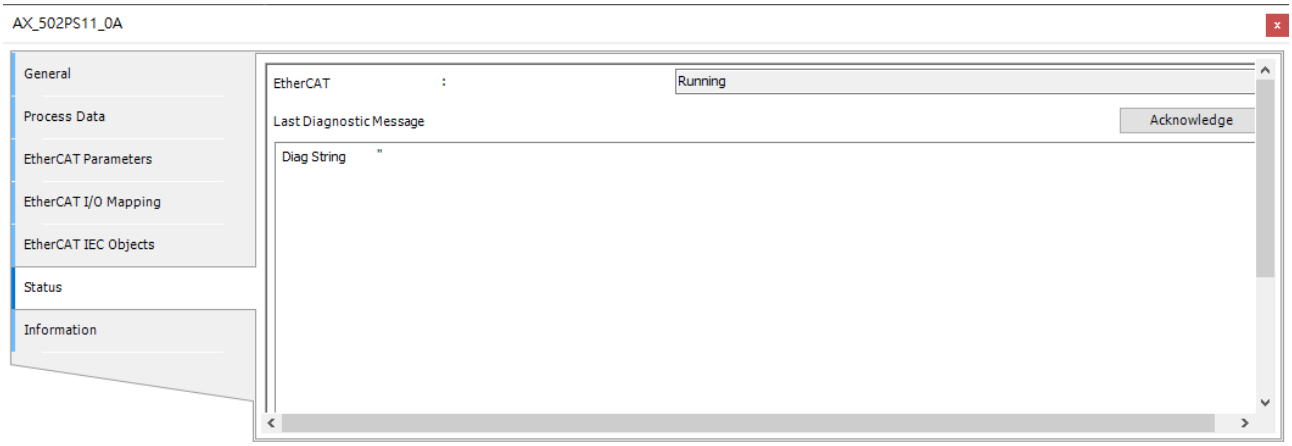


(2) Click  on the toolbar to go into online mode. In the I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



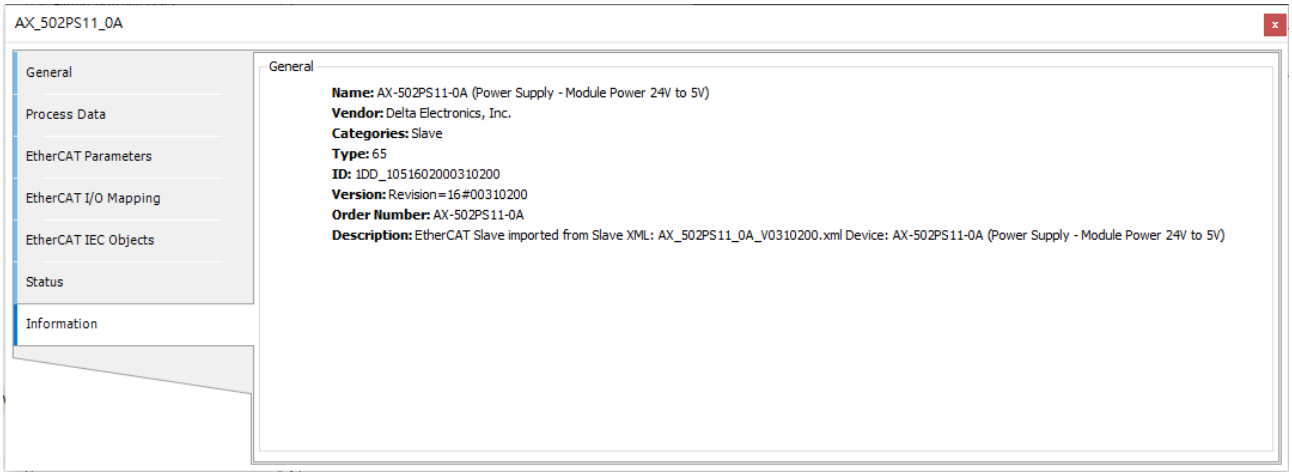
3.1.4.3 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



3.1.4.4 Information

In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the power supply module.



3.1.5 Process Data

This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	Unit power input low voltage warning	Under voltage warning (Unit power input)	BOOL	RO	0
16#6001	16#01	Unit power output error	Abnormal output power (Unit power)	BOOL	RO	0

3.1.6 Troubleshooting

Error code (16#)	Name	LED indicator		Solution
		LV LED	Channel LED	
NA	Unit power input low voltage warning	ON	NA	Check the input voltage.
NA	Unit power output error	OFF	NA	Check if the load current is exceeding 2A. If the output voltage is abnormal, contact the local authorized distributors.

3.2 AX-510PS12-0A

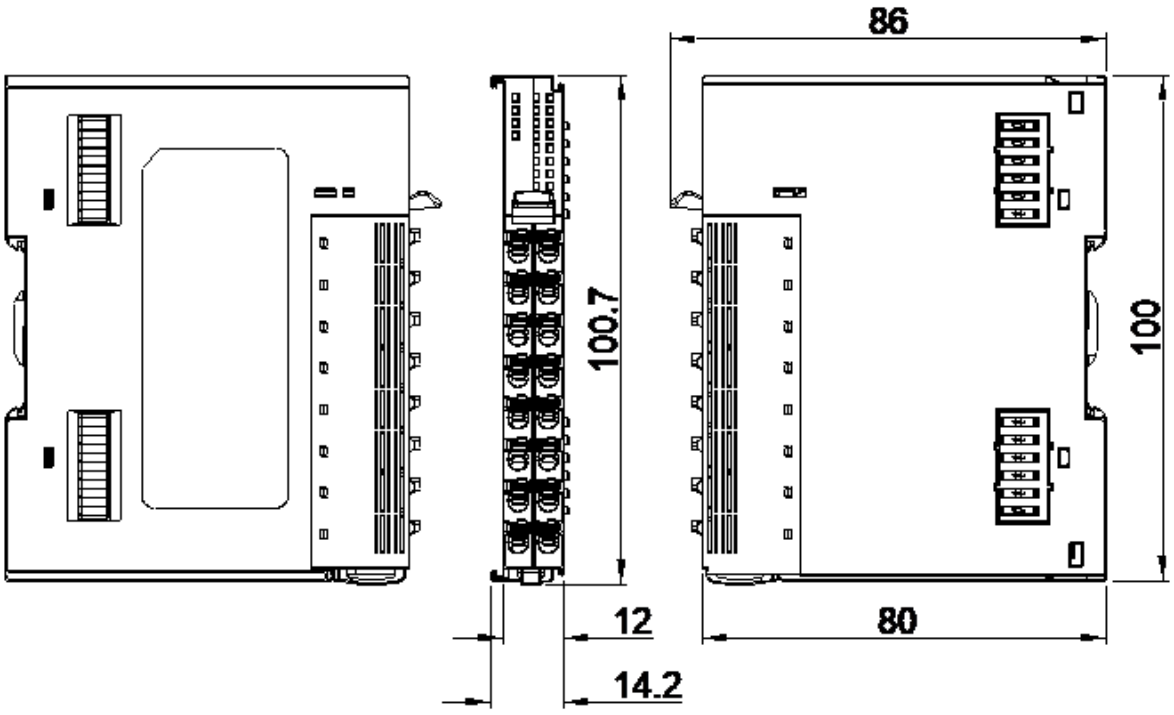
AX-510PS12-0A is an I/O power supply module. This section introduces its specifications, operations and wirings.

3.2.1 Specifications

Item		Specification
External connector		Spring-clamp terminal block (16 terminals)
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		60 g
Electrical specification	Input voltage/power (I/O power)	24 VDC (-15%~20%) / under 240 W, depending on external power output
	Maximum unit power supply	N/A
	Maximum I/O power supply	Less than 10 A (240 W), depending on the external power output
	Current capacity for spring-clamp terminal block	Less than 5 A / terminal; less than 10 A / module
	Maximum power consumption for module (I/O power)	1 mA (0.024 W)
	Minimum power consumption (unit power)	No power consumed
	Isolation method	Between I/O power and external power: no isolation Between unit power and I/O power: 500 VAC (20 MΩ min.)

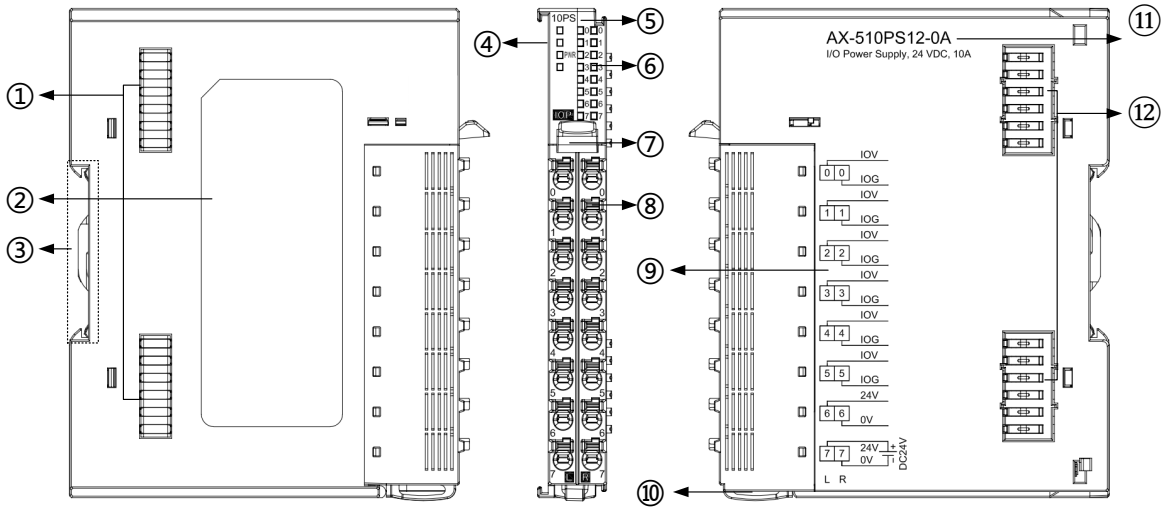
3.2.2 Dimensions and Parts

- **Dimensions**



Unit：mm

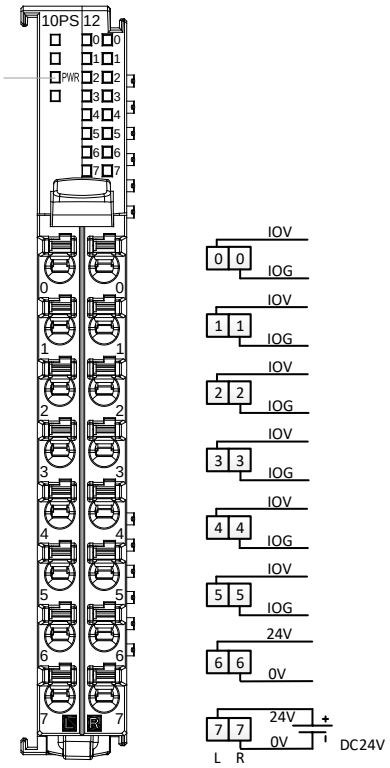
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

3.2.3 Arrangement of Terminals, LED Indicators and Wiring

3.2.3.1 Arrangement of Terminals



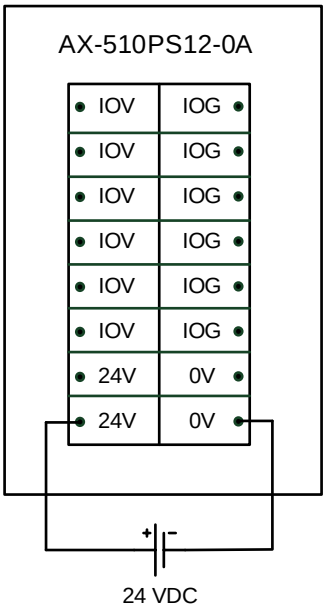
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	IOV	I/O power output: 24 VDC	R0	IOG	I/O power output: 0 VDC
L1	IOV	I/O power output: 24 VDC	R1	IOG	I/O power output: 0 VDC
L2	IOV	I/O power output: 24 VDC	R2	IOG	I/O power output: 0 VDC
L3	IOV	I/O power output: 24 VDC	R3	IOG	I/O power output: 0 VDC
L4	IOV	I/O power output: 24 VDC	R4	IOG	I/O power output: 0 VDC
L5	IOV	I/O power output: 24 VDC	R5	IOG	I/O power output: 0 VDC
L6	24V	I/O power input: 24 VDC	R6	0V	I/O power input: 0 VDC
L7	24V	I/O power input: 24 VDC	R7	0V	I/O power input: 0 VDC

3.2.3.2 LED Indicators

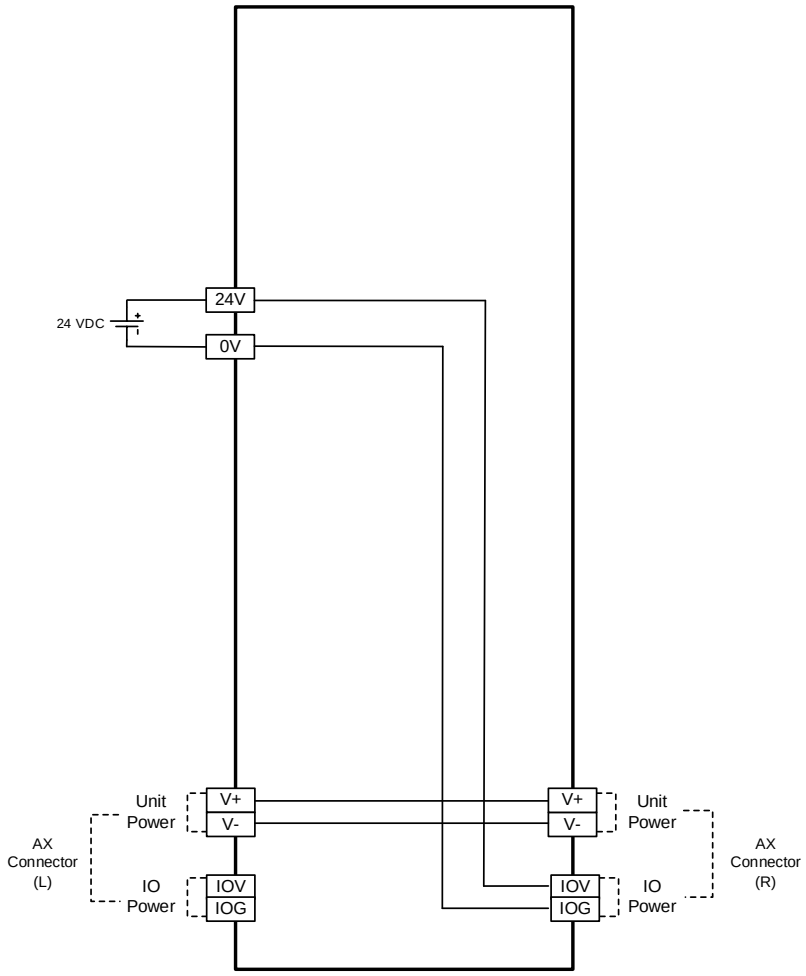
Name	Color	Status		Description
Power	Green	☐	OFF	Not supplied with power
		■	ON	Power on

3.2.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



⚠	• This product shall be powered by a certified SELV/PELV power supply unit with operating temperature of minimum 60 °C, which meets the requirements of IEC 61010-1:2010 or latest edition. • With the SELV/PELV power supply connected to 24V/0V terminals of the removable terminal block, the output rating of the power supply is 24V DC/10A, and the power is supplied to the right-side module for I/O power use via IOV/IOG of the AX connector. There are no current limiting components on the current paths from 24V/0V to IOV/IOG. • SELV/PELV power supply units for AX-502PS11-0A and AX-510PS12-0A have different output ratings. Thus do NOT have them share the same power supply unit.

3.3 AX-516PC10-0A

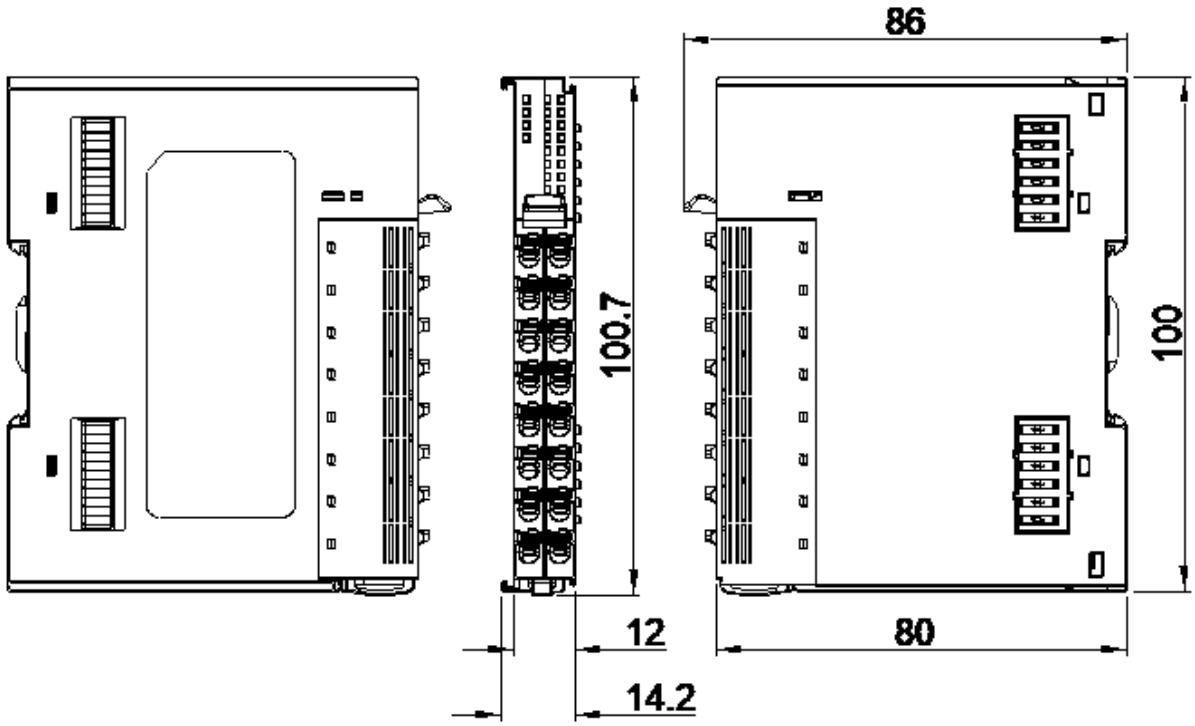
AX-516PC10-0A is an I/O power connector module. This section introduces its specifications, operations and wirings.

3.3.1 Specifications

Item		Specification
External connector		Spring-clamp terminal block (16 terminals)
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		60 g
Electrical specification	Maximum unit power supply	N/A
	Maximum power supply (I/O power)	N/A
	Current capacity for spring-clamp terminal block	Less than 5 A / terminal; less than 10 A / module
	Isolation method	Between I/O power and external power: no isolation Between unit power and I/O power: 500 VAC (20 MΩ min.)

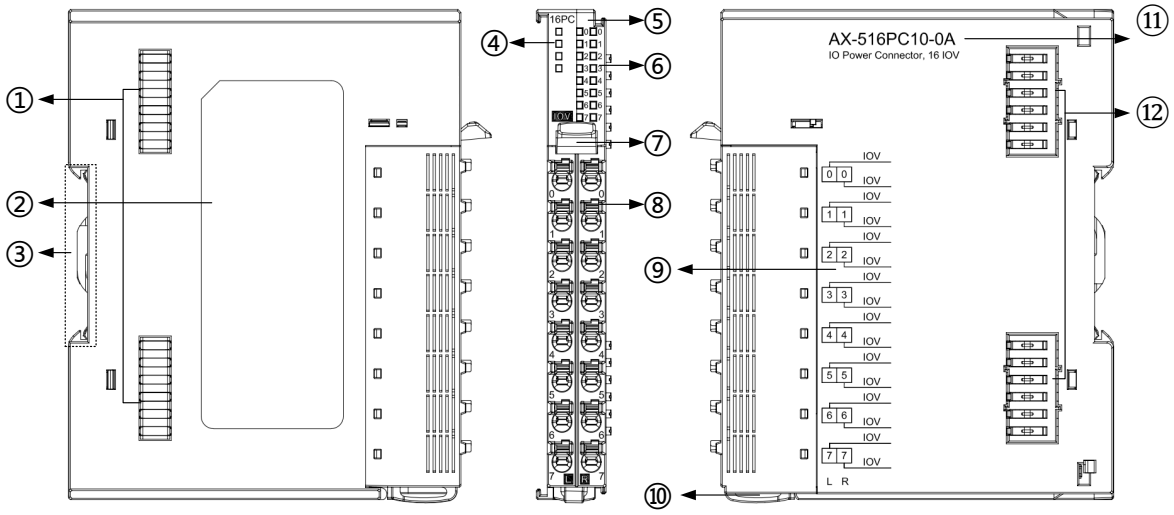
3.3.2 Dimensions and Parts

- **Dimensions**



Unit：mm

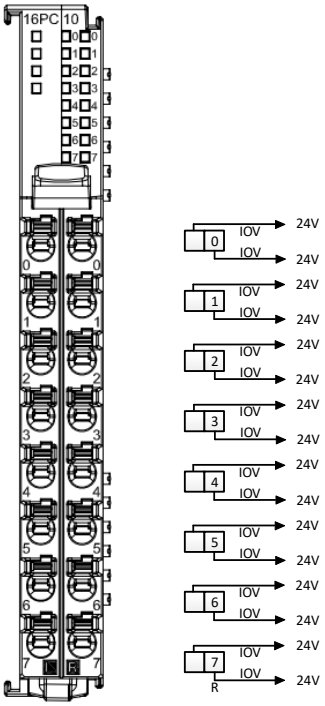
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

3.3.3 Arrangement of Terminals, LED Indicators and Wiring

3.3.3.1 Arrangement of Terminals



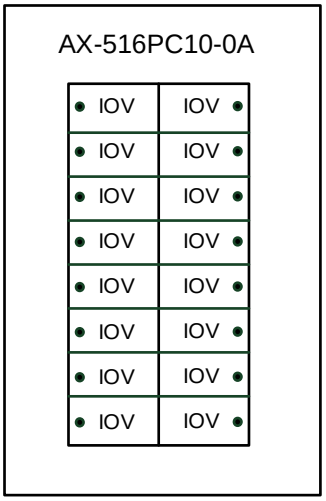
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	IOV	I/O power output: 24 VDC	R0	IOV	I/O power output: DC 24 V
L1	IOV	I/O power output: 24 VDC	R1	IOV	I/O power output: DC 24 V
L2	IOV	I/O power output: 24 VDC	R2	IOV	I/O power output: DC 24 V
L3	IOV	I/O power output: 24 VDC	R3	IOV	I/O power output: DC 24 V
L4	IOV	I/O power output: 24 VDC	R4	IOV	I/O power output: 24 VDC
L5	IOV	I/O power output: 24 VDC	R5	IOV	I/O power output: 24 VDC
L6	IOV	I/O power output: 24 VDC	R6	IOV	I/O power output: 24 VDC
L7	IOV	I/O power output: 24 VDC	R7	IOV	I/O power output: 24 VDC

3.3.3.2 LED Indicators

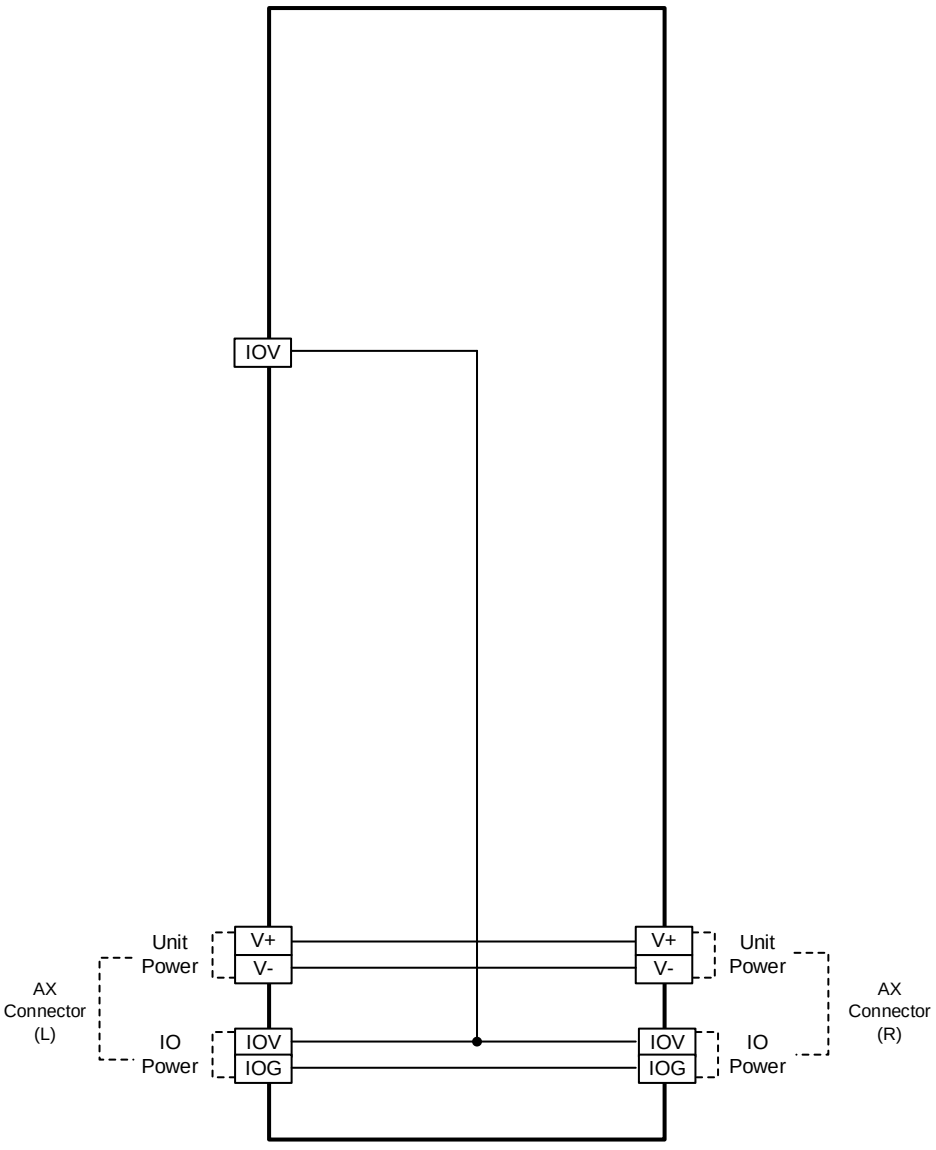
Name	Description
NA	No LED indicator

3.3.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



3.4 AX-516PC20-0A

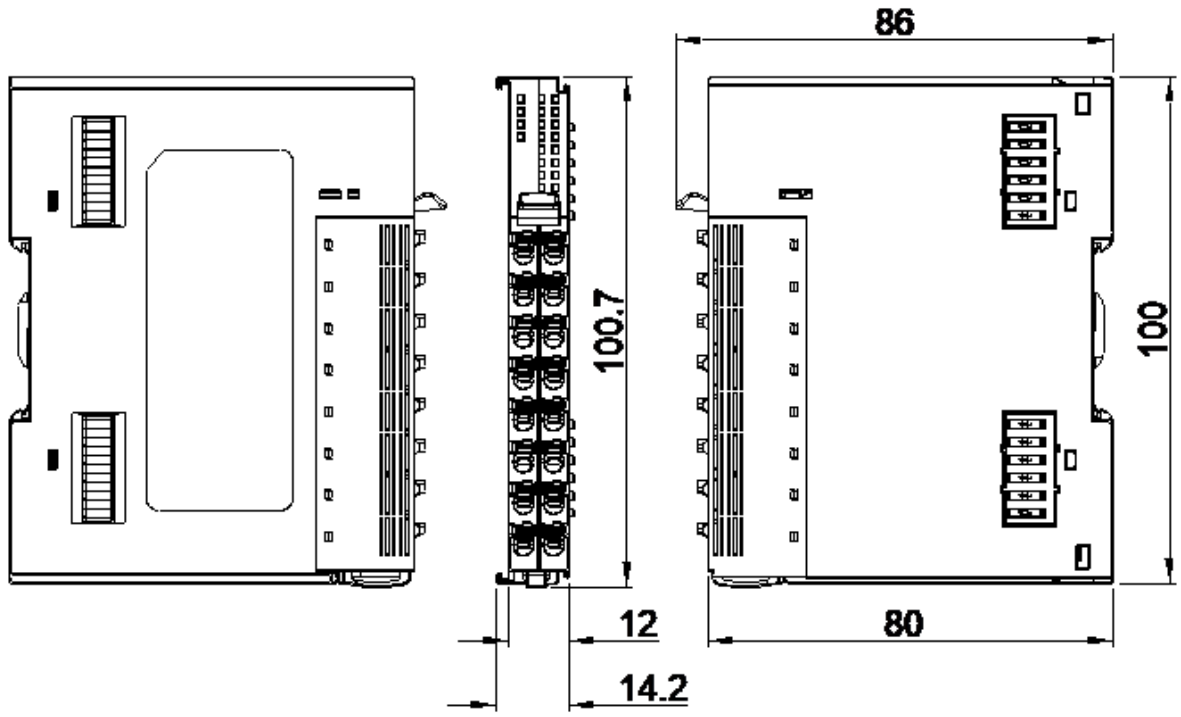
AX-516PC20-0A is an I/O power connector module. This section introduces its specifications, operations and wirings.

3.4.1 Specifications

Item		Specification
External connector		Spring-clamp terminal block (16 terminals)
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		60 g
Electrical specification	Maximum unit power supply	N/A
	Maximum I/O power supply	N/A
	Current capacity for spring-clamp terminal block	Less than 5 A / terminal; less than 10 A / module
	Isolation method	Between I/O power and external power: no isolation Between unit power and I/O power: 500 VAC (20 MΩ min.)

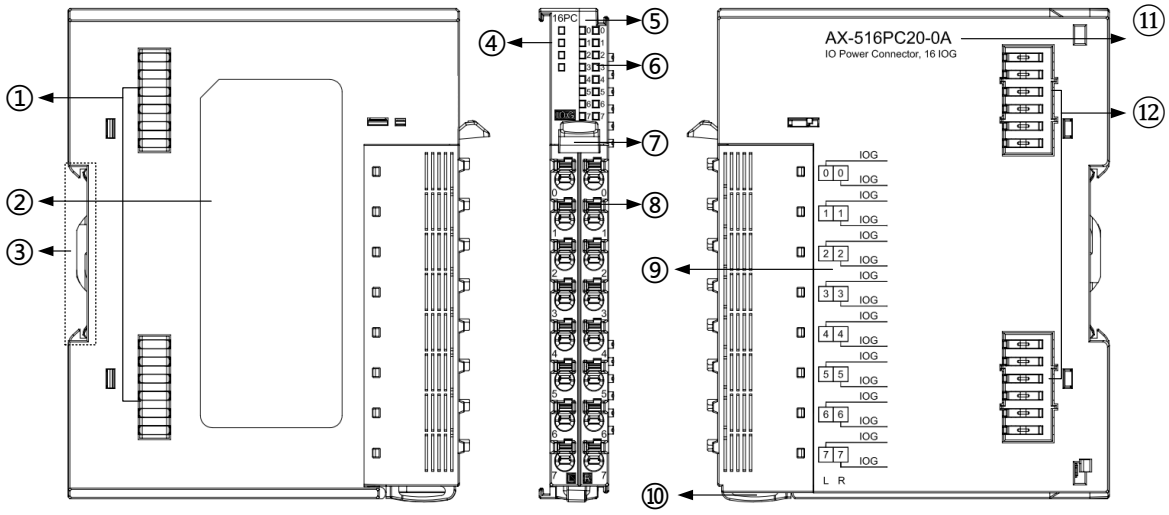
3.4.2 Dimensions and Parts

- **Dimensions**



Unit：mm

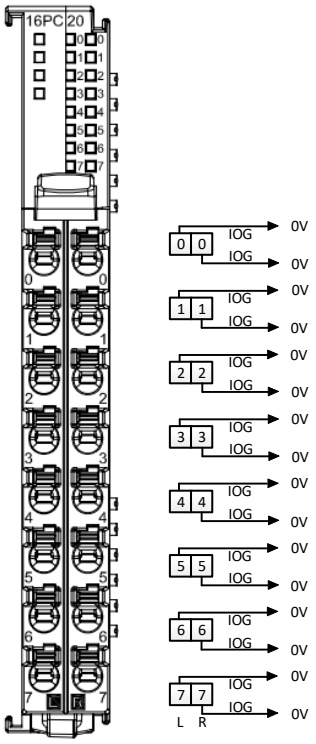
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

3.4.3 Arrangement of Terminals, LED Indicators and Wiring

3.4.3.1 Arrangement of Terminals



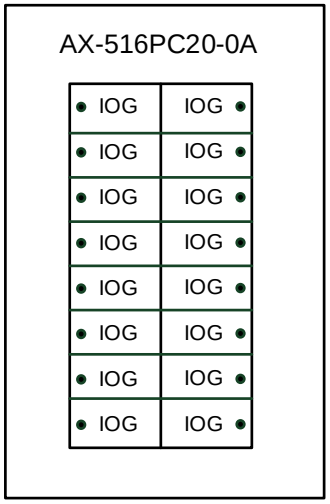
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	IOG	I/O power output: 0 VDC	R0	IOG	I/O power output: 0 VDC
L1	IOG	I/O power output: 0 VDC	R1	IOG	I/O power output: 0 VDC
L2	IOG	I/O power output: 0 VDC	R2	IOG	I/O power output: 0 VDC
L3	IOG	I/O power output: 0 VDC	R3	IOG	I/O power output: 0 VDC
L4	IOG	I/O power output: 0 VDC	R4	IOG	I/O power output: 0 VDC
L5	IOG	I/O power output: 0 VDC	R5	IOG	I/O power output: 0 VDC
L6	IOG	I/O power output: 0 VDC	R6	IOG	I/O power output: 0 VDC
L7	IOG	I/O power output: 0 VDC	R7	IOG	I/O power output: 0 VDC

3.4.3.2 LED Indicators

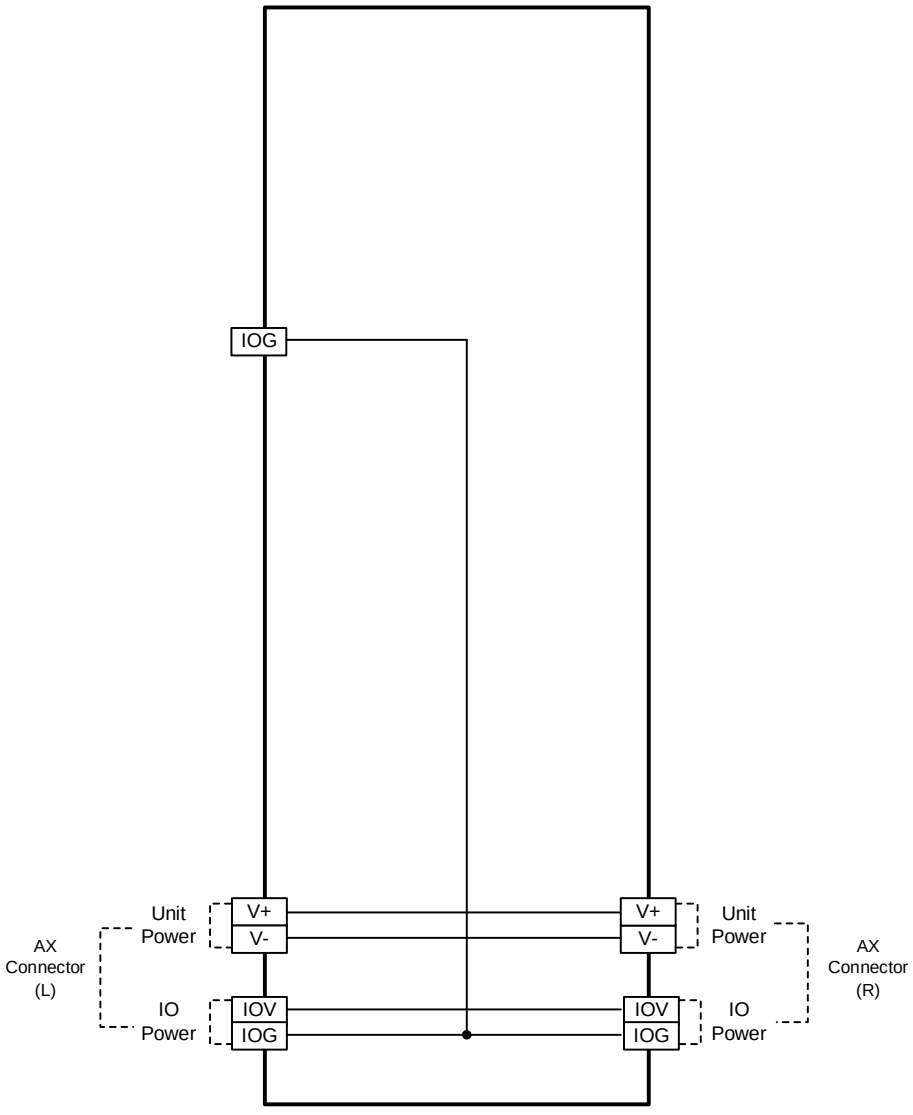
Name	Description
NA	No LED indicator

3.4.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



3.5 AX-516PC30-0A

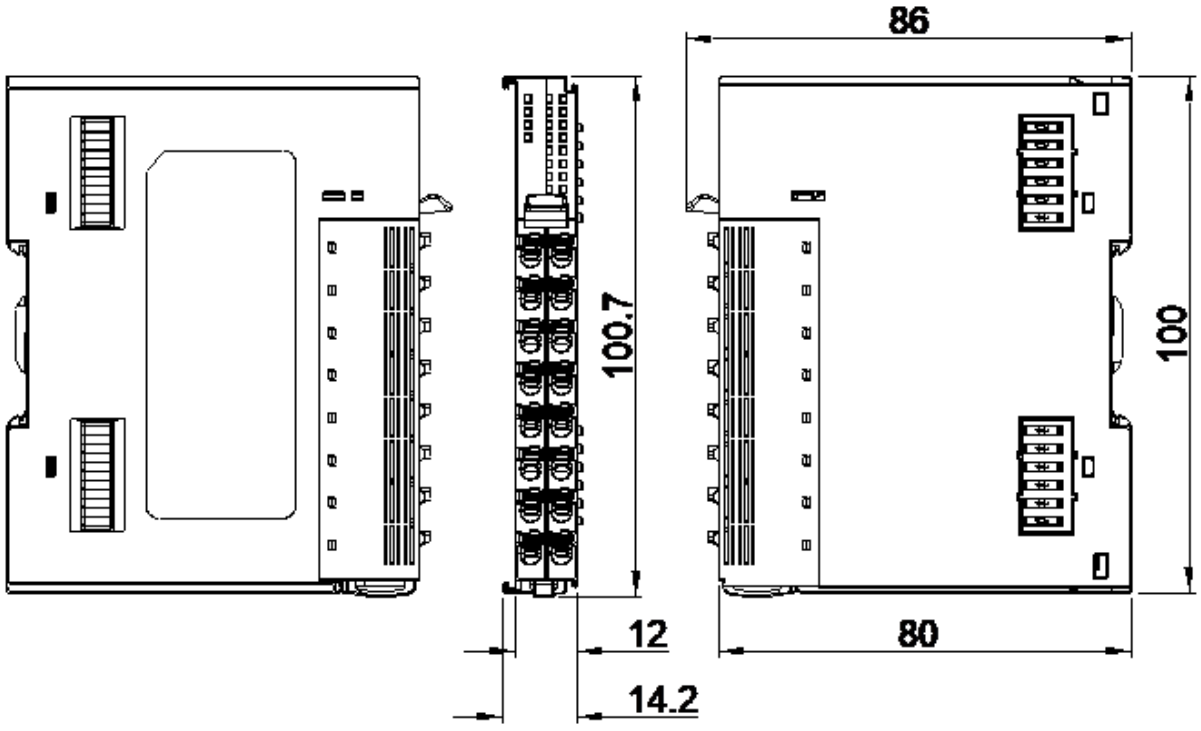
AX-516PC30-0A is an I/O power connector module. This section introduces its specifications, operations and wirings.

3.5.1 Specifications

Item		Specification
External connector		Spring-clamp terminal block (16 terminals)
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		60 g
Electrical specification	Maximum unit power supply	N/A
	Maximum I/O power supply	N/A
	Current capacity for spring-clamp terminal block	Less than 5 A / terminal; less than 10 A / module
	Isolation method	Between I/O power and external power: no isolation Between unit power and I/O power: 500 VAC (20 MΩ min.)

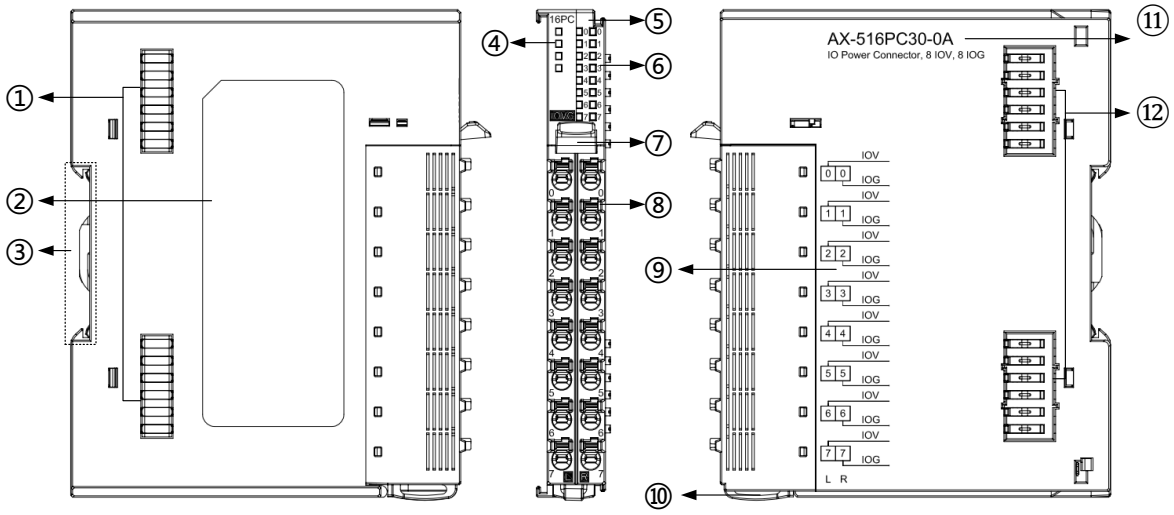
3.5.2 Dimensions and Parts

- **Dimensions**



Unit：mm

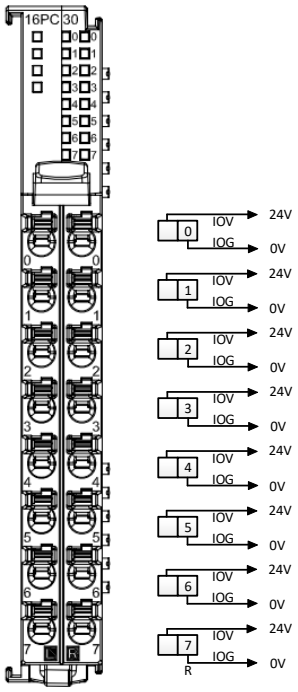
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

3.5.3 Arrangement of Terminals, LED Indicators and Wiring

3.5.3.1 Arrangement of Terminals



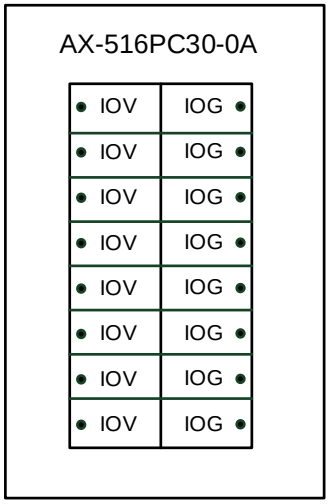
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	IOV	I/O power output: 24 VDC	R0	IOG	I/O power output: 0 VDC
L1	IOV	I/O power output: 24 VDC	R1	IOG	I/O power output: 0 VDC
L2	IOV	I/O power output: 24 VDC	R2	IOG	I/O power output: 0 VDC
L3	IOV	I/O power output: 24 VDC	R3	IOG	I/O power output: 0 VDC
L4	IOV	I/O power output: 24 VDC	R4	IOG	I/O power output: 0 VDC
L5	IOV	I/O power output: 24 VDC	R5	IOG	I/O power output: 0 VDC
L6	IOV	I/O power output: 24 VDC	R6	IOG	I/O power output: 0 VDC
L7	IOV	I/O power output: 24 VDC	R7	IOG	I/O power output: 0 VDC

3.5.3.2 LED Indicators

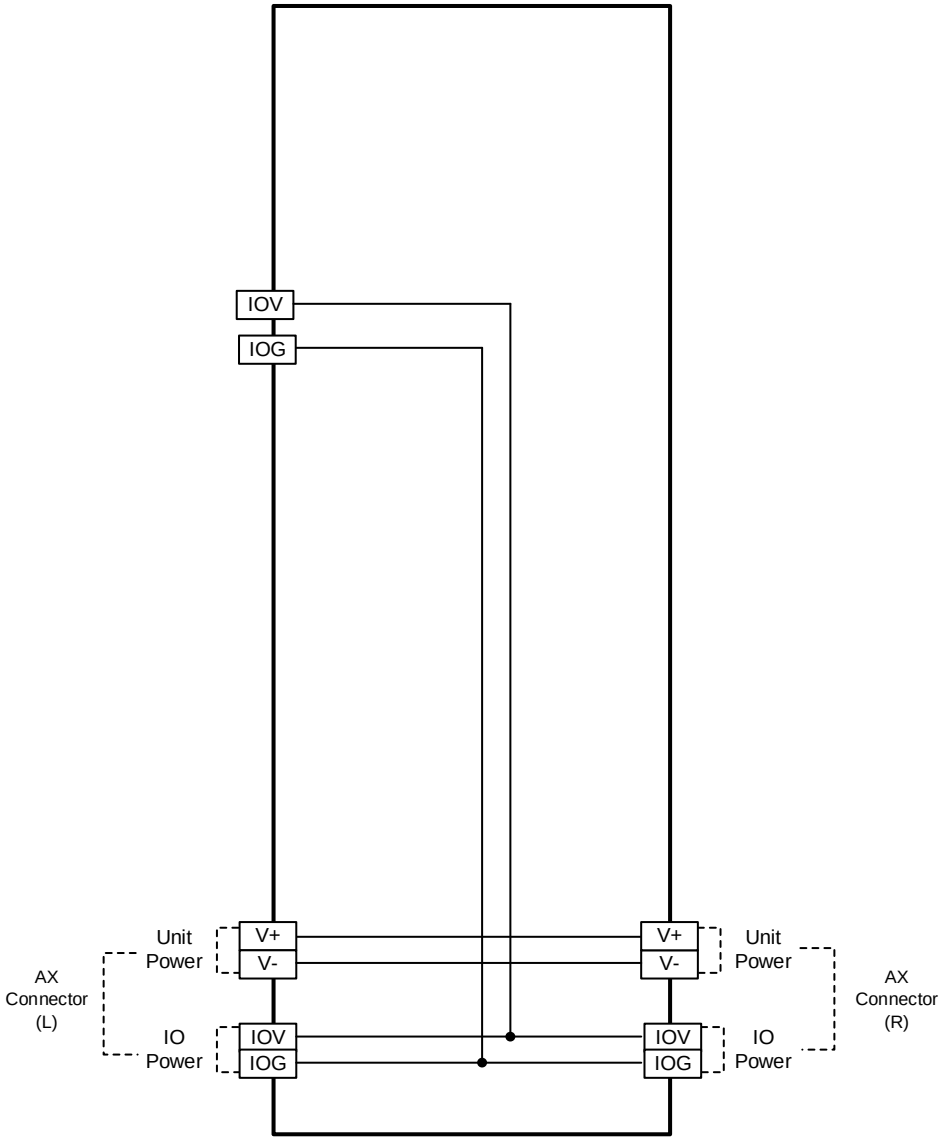
Name	Description
NA	No LED indicator

3.5.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



3.6 AX-514PC40-0A

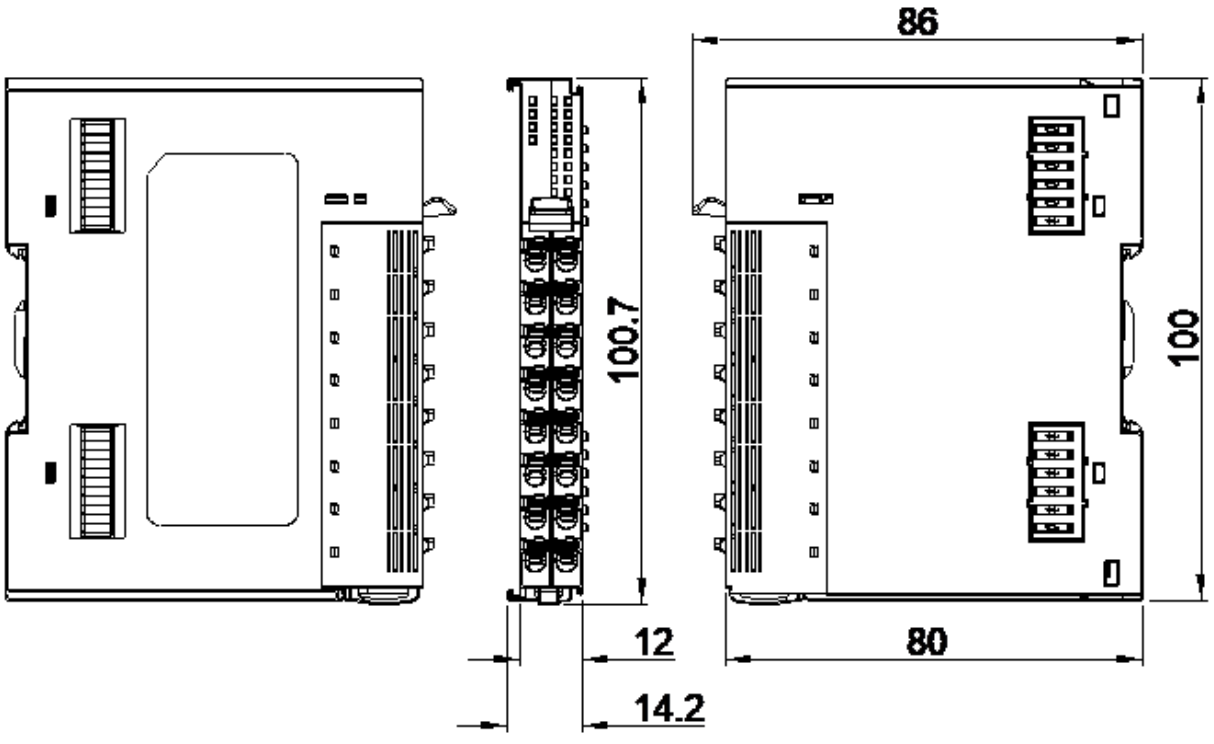
AX-514PC40-0A is an I/O power connector module. This section introduces its specifications, operations and wirings.

3.6.1 Specifications

Item		Specification
External connector		Spring-clamp terminal block (16 terminals)
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		60 g
Electrical specification	Maximum unit power supply	N/A
	Maximum I/O power supply	N/A
	Current capacity for spring-clamp terminal block	Less than 5 A / terminal; less than 10A / module
	Isolation method	Between I/O power and external power: no isolation Between unit power and I/O power: 500 VAC (20 MΩ min.)

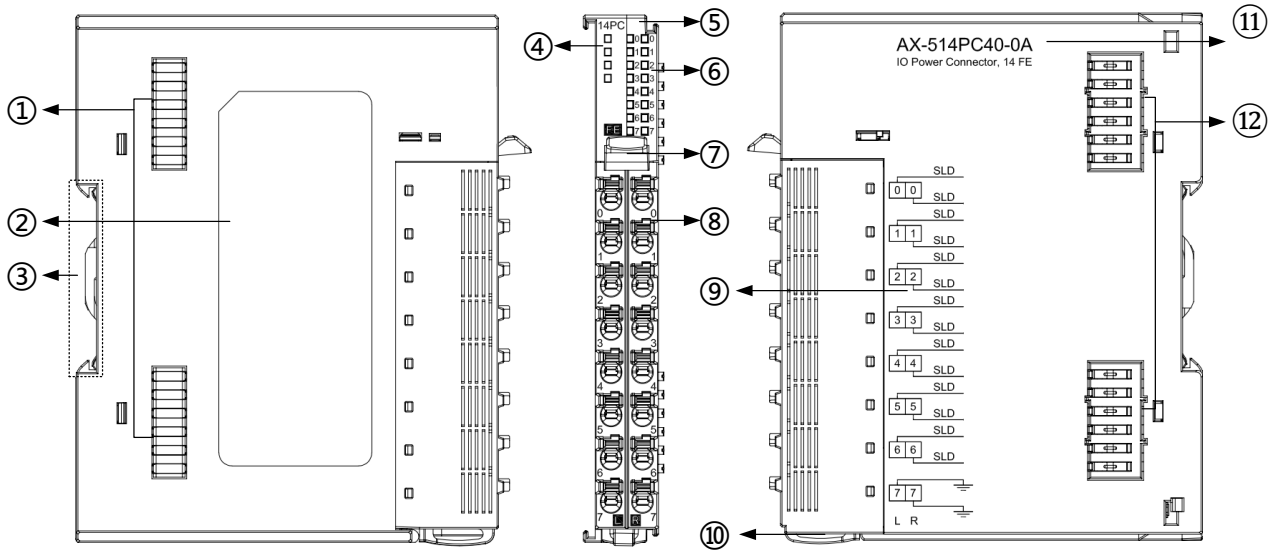
3.6.2 Dimensions and Parts

- **Dimensions**



Unit：mm

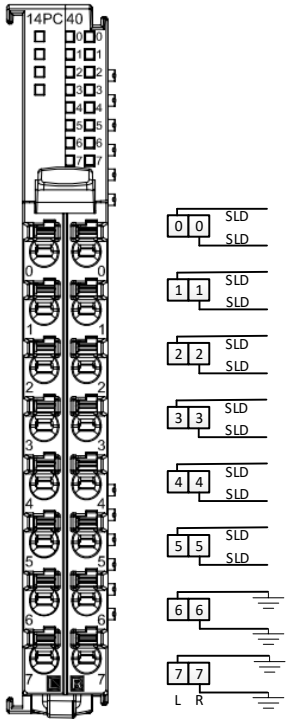
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

3.6.3 Arrangement of Terminals, LED Indicators and Wiring

3.6.3.1 Arrangement of Terminals



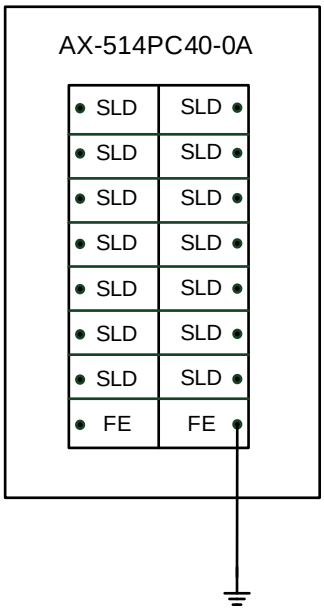
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	SLD	For shielding	R0	SLD	For shielding
L1	SLD	For shielding	R1	SLD	For shielding
L2	SLD	For shielding	R2	SLD	For shielding
L3	SLD	For shielding	R3	SLD	For shielding
L4	SLD	For shielding	R4	SLD	For shielding
L5	SLD	For shielding	R5	SLD	For shielding
L6	⏚	Grounding	R6	⏚	Grounding
L7	⏚	Grounding	R7	⏚	Grounding

3.6.3.2 LED Indicators

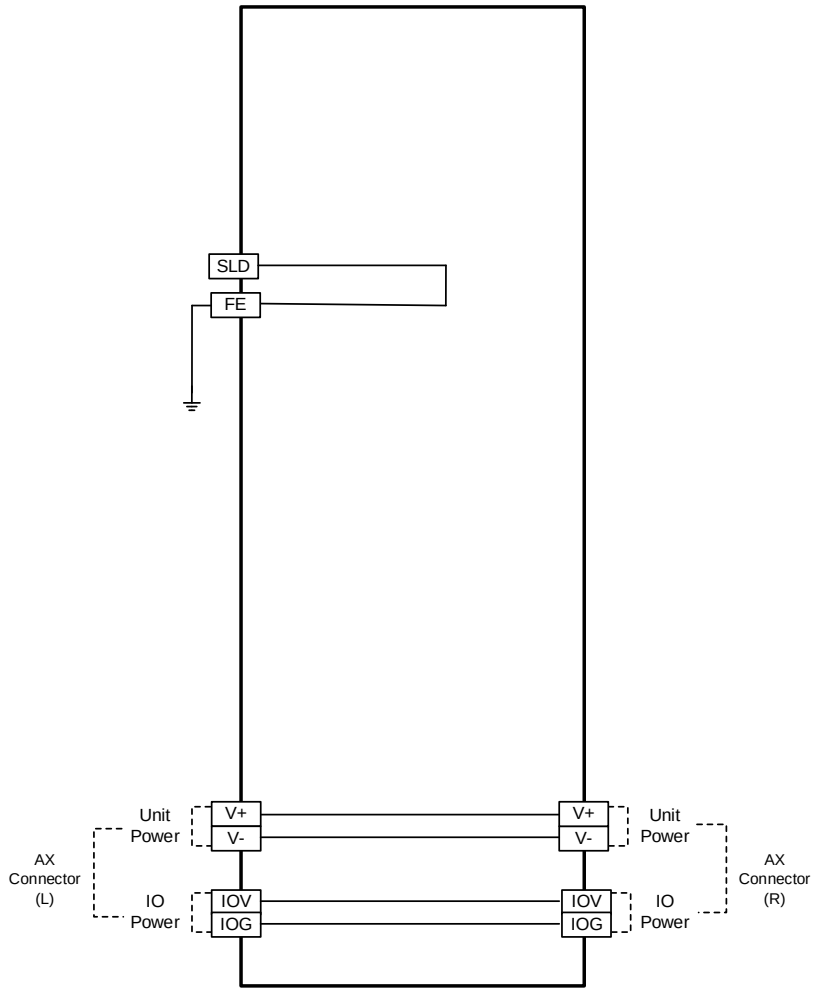
Name	Description
NA	No LED indicator

3.6.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



4

Chapter 4 Digital Input / Output Modules

Table of Contents

4.1 AX-516AM10-0A

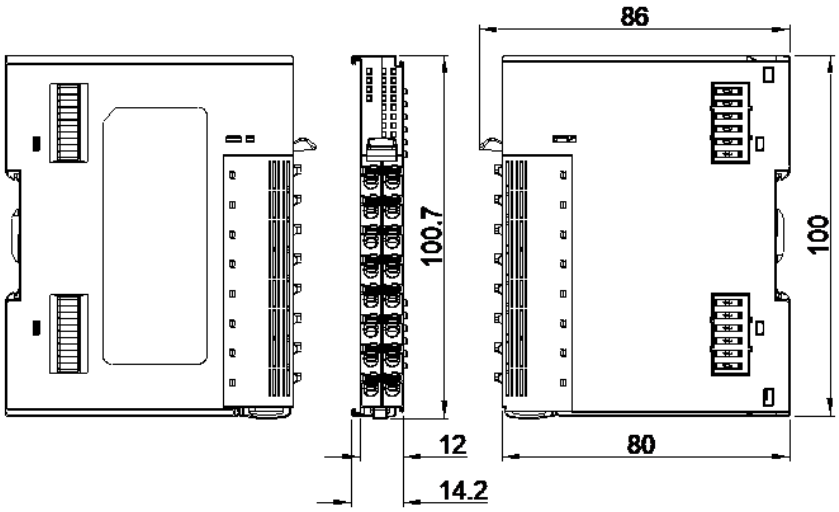
AX-516AM10-0A, a digital input module, receives external 16-point digital signals (NPN). This section introduces its specifications, operations and wirings.

4.1.1 Specifications

Item		Specification
Input points		16
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		69 g
Electrical specification	I/O form	Sourcing input (NPN)
	Input current	2.5 mA TYP. (24 VDC), constant current
	ON (voltage)	11–30 V (EN 61131-2, type 3)
	OFF(voltage)	-3 – +5 V (EN 61131-2, type 3)
	Maximum ON / OFF response time	150 µs /150 µs
	Isolation method	Between unit power and external power: no isolation Between digital signal and internal signal: 500 VAC Between channels: no isolation
	Maximum power consumption (unit power)	200 mA (1W)
	Maximum power consumption (I/O power)	24 VDC/40 mA
	Minimum power consumption (I/O power)	No power consumed
Others	Connection Lost Protection	--
	Short Circuit Protection (SCP)	--
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	Current limiting
	Filter function	Input filter time: 0-255 ms; (default: 3 ms)

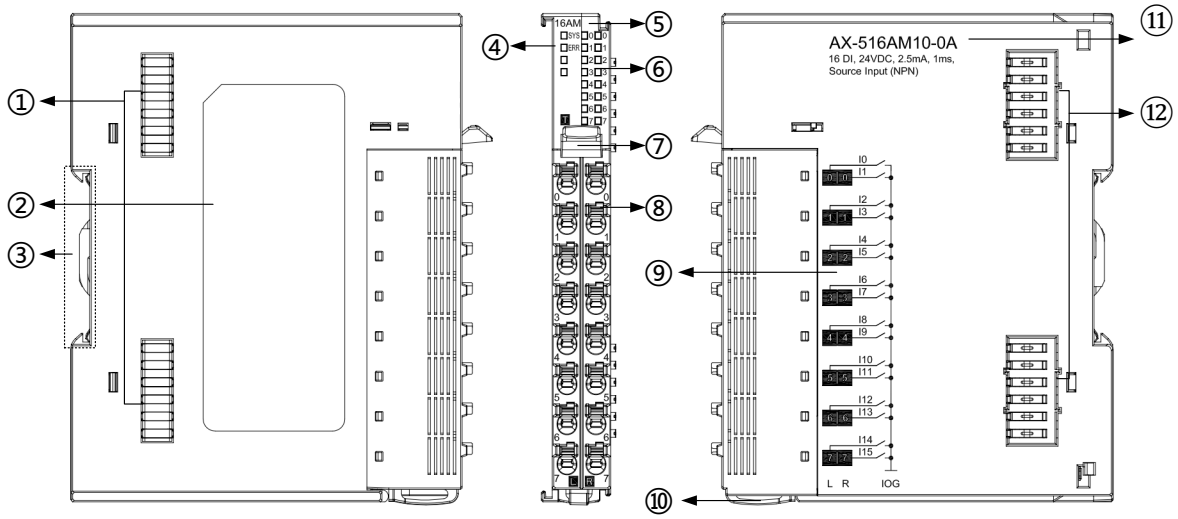
4.1.2 Dimensions and Parts

- **Dimensions**



Unit：mm

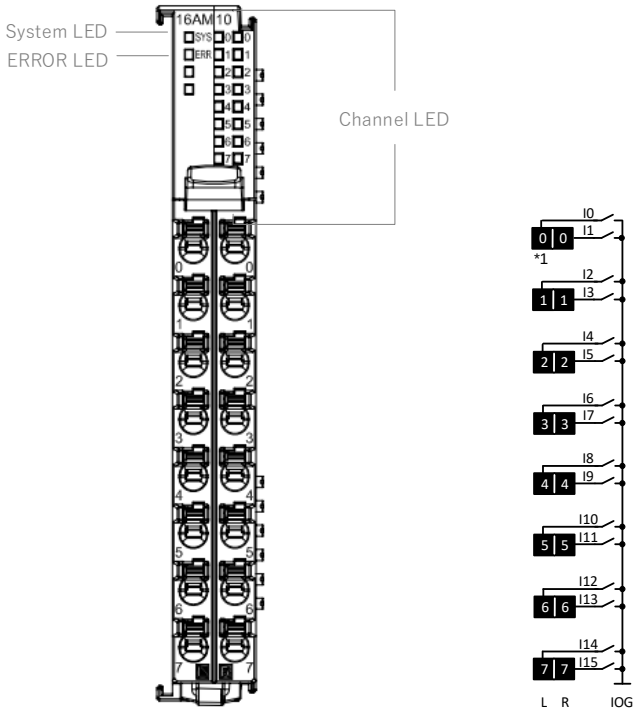
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

4.1.3 Arrangement of Terminals, LED Indicators and Wiring

4.1.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators.

Refer to the table below to see the terminals and corresponding symbols and channels.

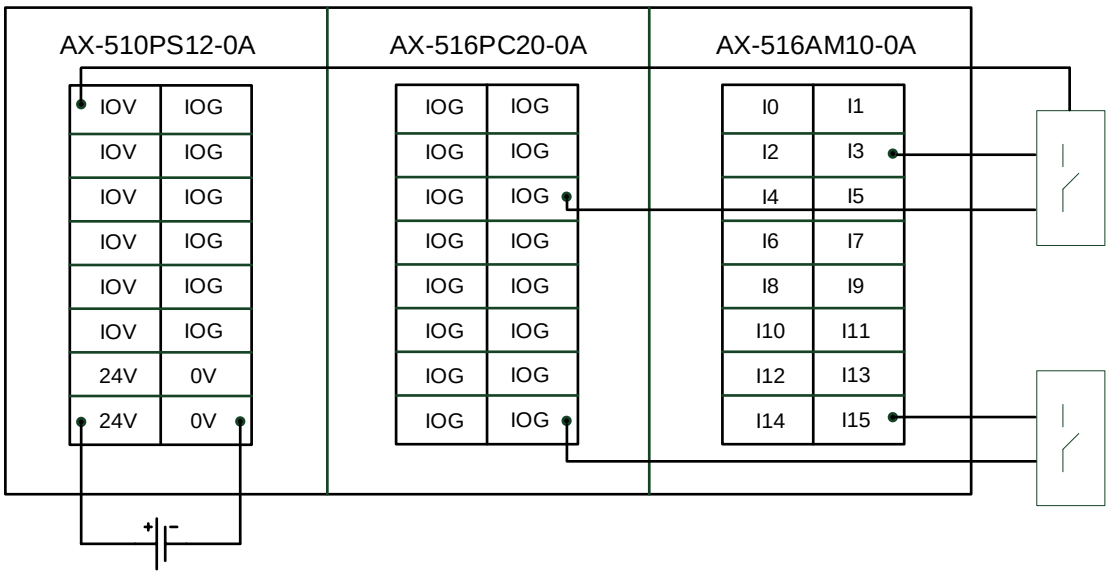
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0	Digital input channel 0	R0	I1	Digital input channel 1
L1	I2	Digital input channel 2	R1	I3	Digital input channel 3
L2	I4	Digital input channel 4	R2	I5	Digital input channel 5
L3	I6	Digital input channel 6	R3	I7	Digital input channel 7
L4	I8	Digital input channel 8	R4	I9	Digital input channel 9
L5	I10	Digital input channel 10	R5	I11	Digital input channel 11
L6	I12	Digital input channel 12	R6	I13	Digital input channel 13
L7	I14	Digital input channel 14	R7	I15	Digital input channel 15

4.1.3.2 LED Indicators

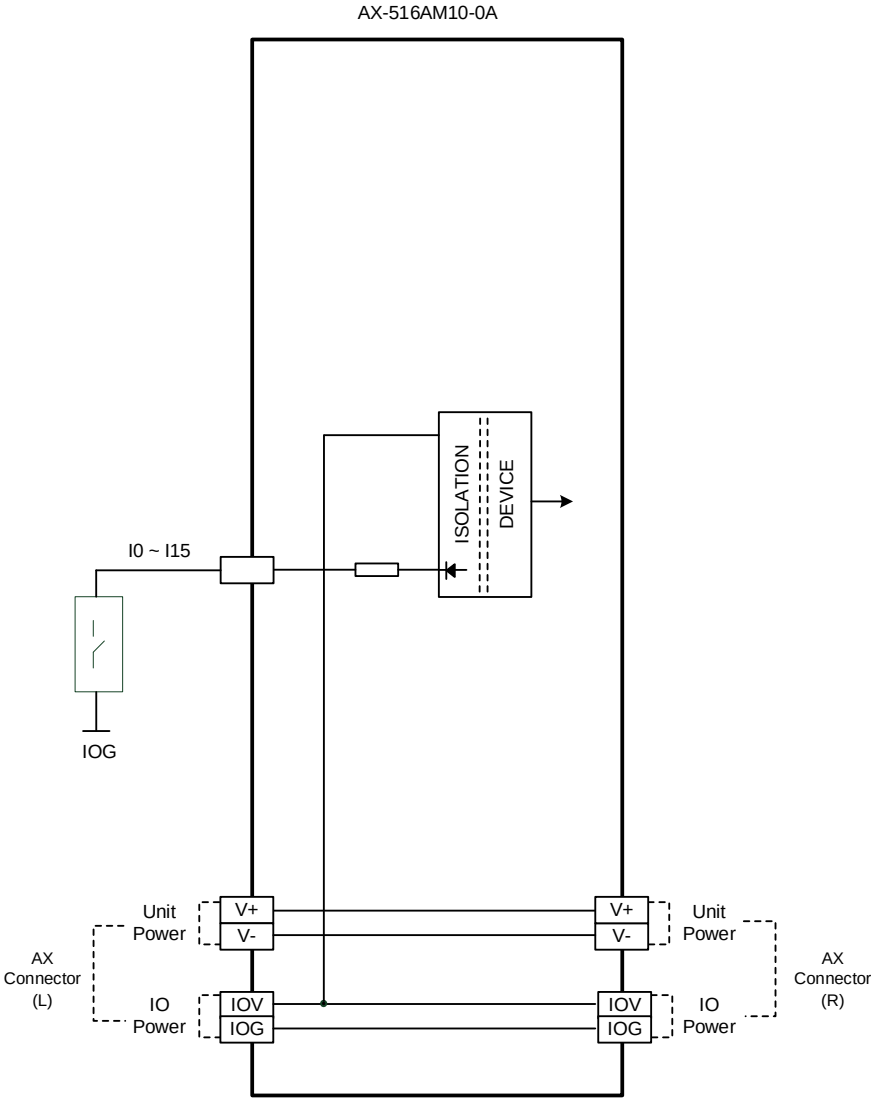
Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	Normal (OP)
Error	Red		OFF	Module is functioning correctly.
			ON	A severe error occurs on the module.
Channel	Green		OFF	The channel is OFF.
			ON	The channel is ON.

4.1.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



4.1.4 Settings in DIADesigner-AX

This section introduces some basic operations and settings in the DIADesigner-AX software.

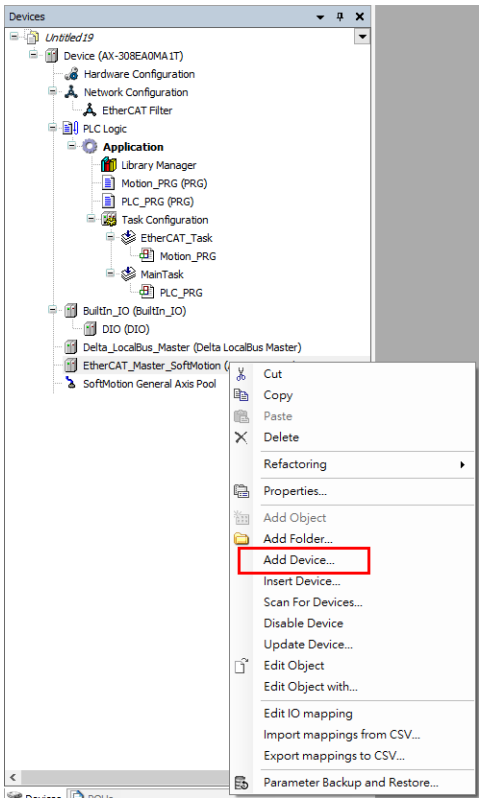
4.1.4.1 Basic Operation

(1) Double-click the DIADesigner-AX icon to open the software and create a new project.

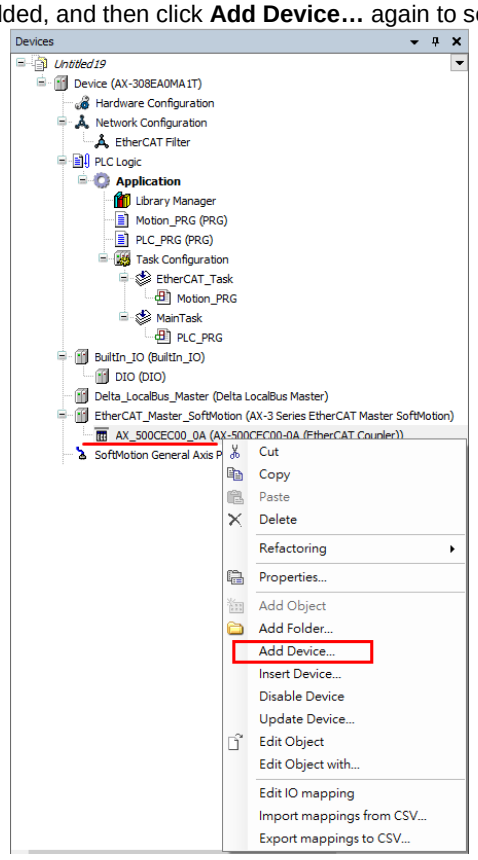
(1) Add Modules in

- Method 1: Add the modules in manually

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Add Device…*** to select and add System Coupler.

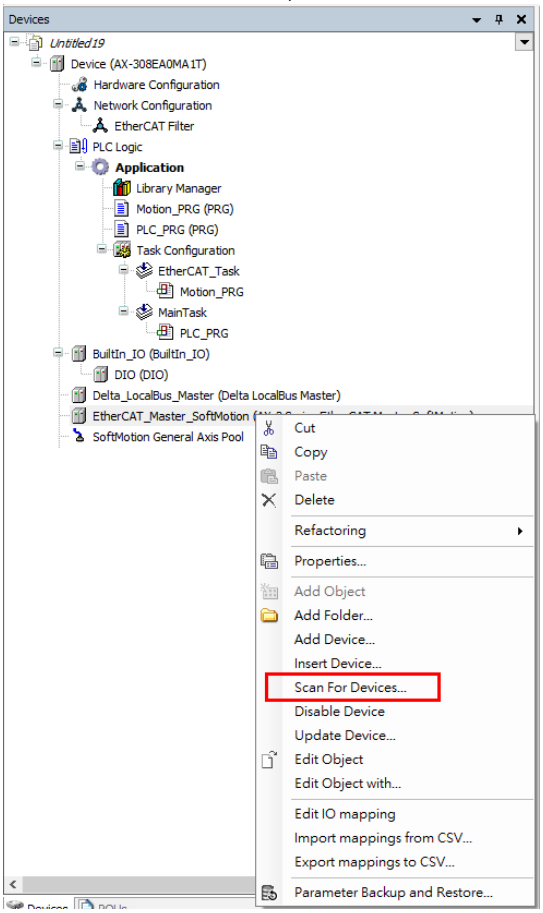


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

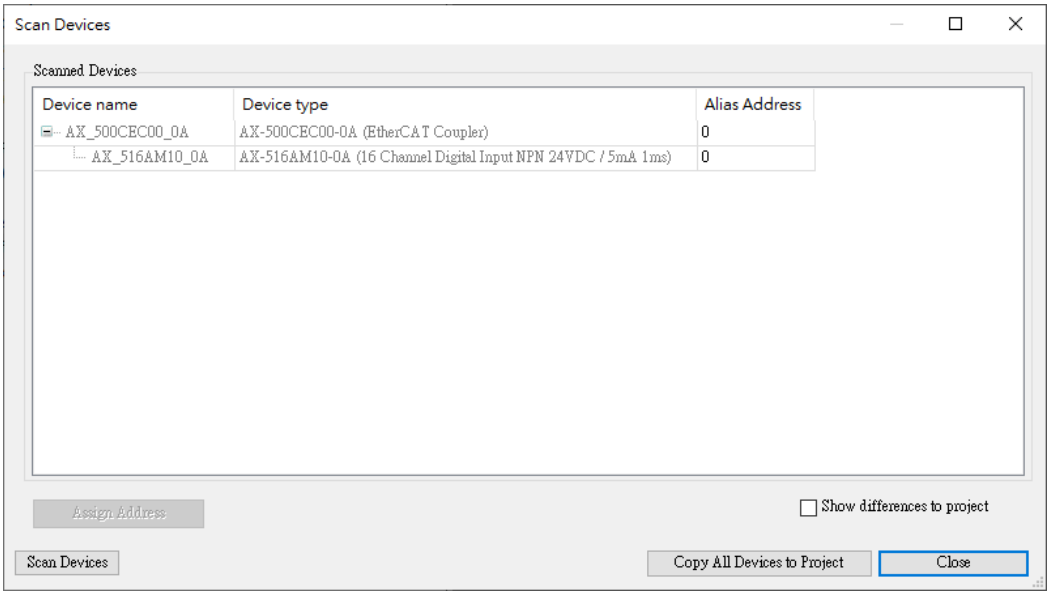


- Method 2: Scan to add the modules in.

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Scan for Devices….***

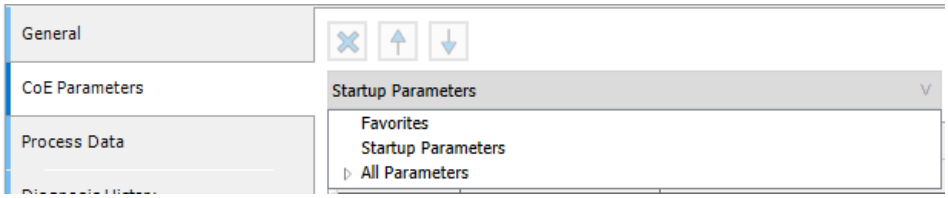


After the auto-scan is over, the actually-connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.



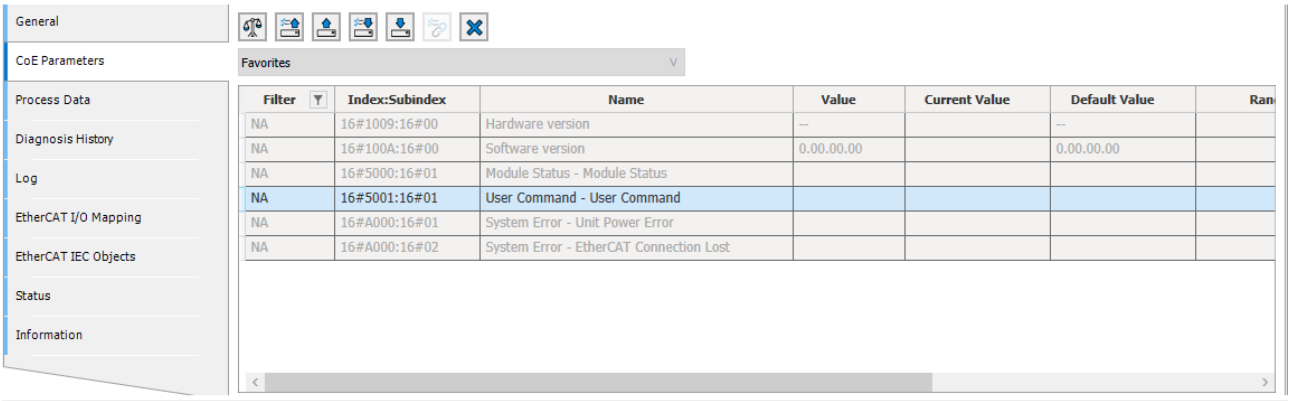
4.1.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.



(1) Favorites

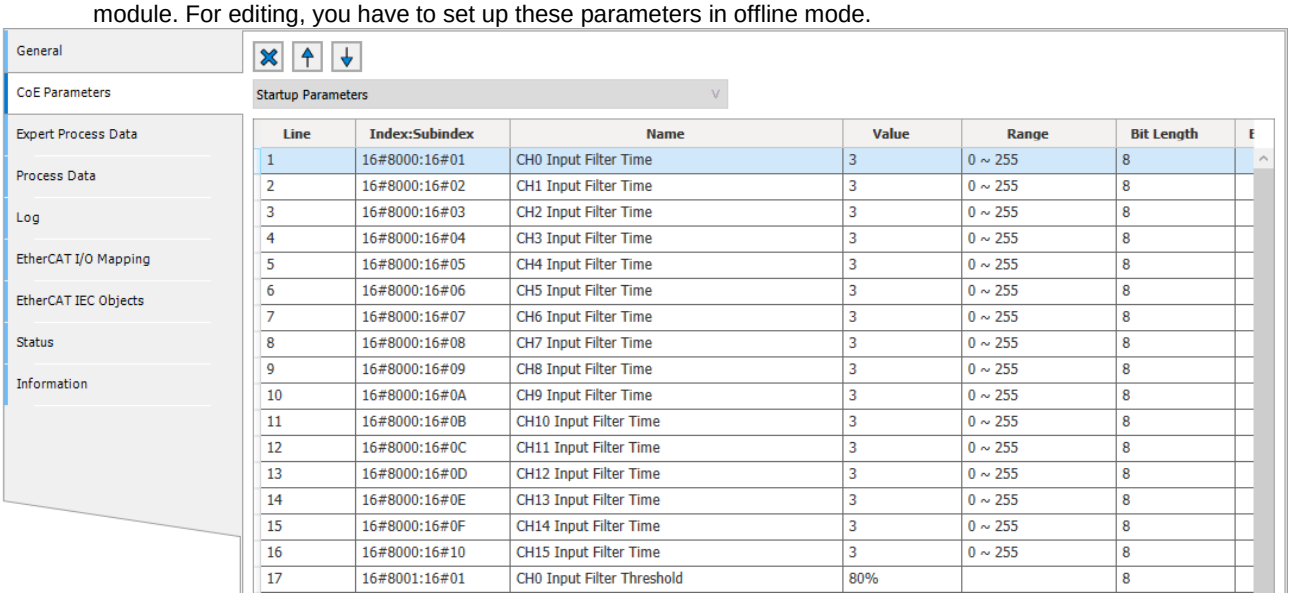
- You can add the desired parameters to the Favorites list. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

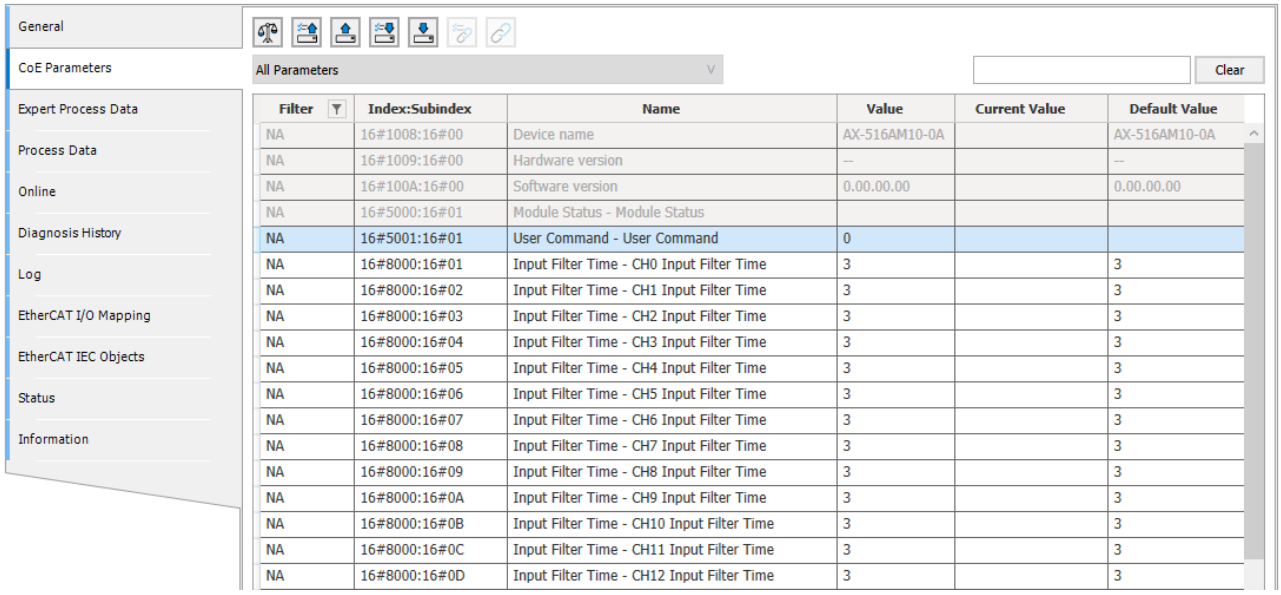


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Input Filter Time	3	0 ~ 255	8
2	16#8000:16#02	CH1 Input Filter Time	3	0 ~ 255	8
3	16#8000:16#03	CH2 Input Filter Time	3	0 ~ 255	8
4	16#8000:16#04	CH3 Input Filter Time	3	0 ~ 255	8
5	16#8000:16#05	CH4 Input Filter Time	3	0 ~ 255	8
6	16#8000:16#06	CH5 Input Filter Time	3	0 ~ 255	8
7	16#8000:16#07	CH6 Input Filter Time	3	0 ~ 255	8
8	16#8000:16#08	CH7 Input Filter Time	3	0 ~ 255	8
9	16#8000:16#09	CH8 Input Filter Time	3	0 ~ 255	8
10	16#8000:16#0A	CH9 Input Filter Time	3	0 ~ 255	8
11	16#8000:16#0B	CH10 Input Filter Time	3	0 ~ 255	8
12	16#8000:16#0C	CH11 Input Filter Time	3	0 ~ 255	8
13	16#8000:16#0D	CH12 Input Filter Time	3	0 ~ 255	8
14	16#8000:16#0E	CH13 Input Filter Time	3	0 ~ 255	8
15	16#8000:16#0F	CH14 Input Filter Time	3	0 ~ 255	8
16	16#8000:16#10	CH15 Input Filter Time	3	0 ~ 255	8
17	16#8001:16#01	CH0 Input Filter Threshold	80%		8

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

(3) All Parameters

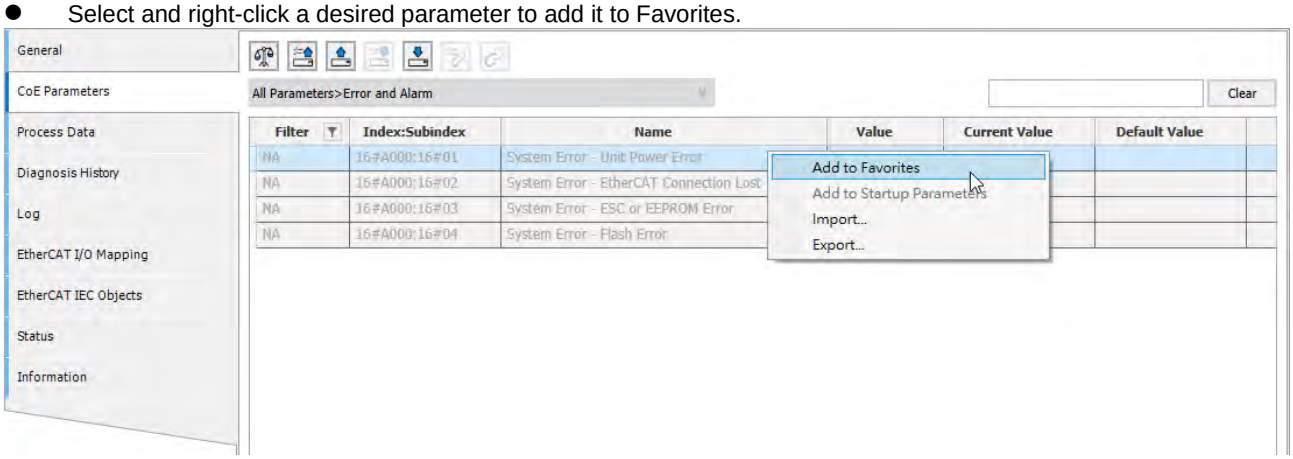
- You can find all the CoE parameters here. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values of parameters in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Filter	Index:Subindex	Name	Value	Current Value	Default Value
NA	16#1008:16#00	Device name	AX-516AM10-0A		AX-516AM10-0A
NA	16#1009:16#00	Hardware version	--		--
NA	16#100A:16#00	Software version	0.00.00.00		0.00.00.00
NA	16#5000:16#01	Module Status - Module Status			
NA	16#5001:16#01	User Command - User Command	0		
NA	16#8000:16#01	Input Filter Time - CH0 Input Filter Time	3		3
NA	16#8000:16#02	Input Filter Time - CH1 Input Filter Time	3		3
NA	16#8000:16#03	Input Filter Time - CH2 Input Filter Time	3		3
NA	16#8000:16#04	Input Filter Time - CH3 Input Filter Time	3		3
NA	16#8000:16#05	Input Filter Time - CH4 Input Filter Time	3		3
NA	16#8000:16#06	Input Filter Time - CH5 Input Filter Time	3		3
NA	16#8000:16#07	Input Filter Time - CH6 Input Filter Time	3		3
NA	16#8000:16#08	Input Filter Time - CH7 Input Filter Time	3		3
NA	16#8000:16#09	Input Filter Time - CH8 Input Filter Time	3		3
NA	16#8000:16#0A	Input Filter Time - CH9 Input Filter Time	3		3
NA	16#8000:16#0B	Input Filter Time - CH10 Input Filter Time	3		3
NA	16#8000:16#0C	Input Filter Time - CH11 Input Filter Time	3		3
NA	16#8000:16#0D	Input Filter Time - CH12 Input Filter Time	3		3

Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

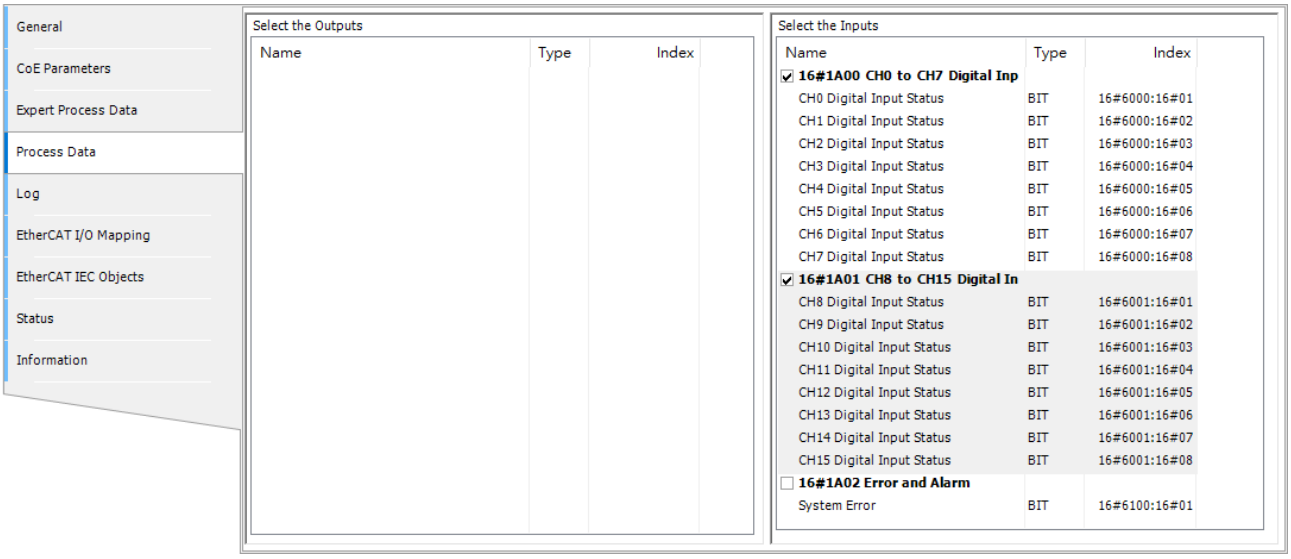
- Select and right-click a desired parameter to add it to Favorites.



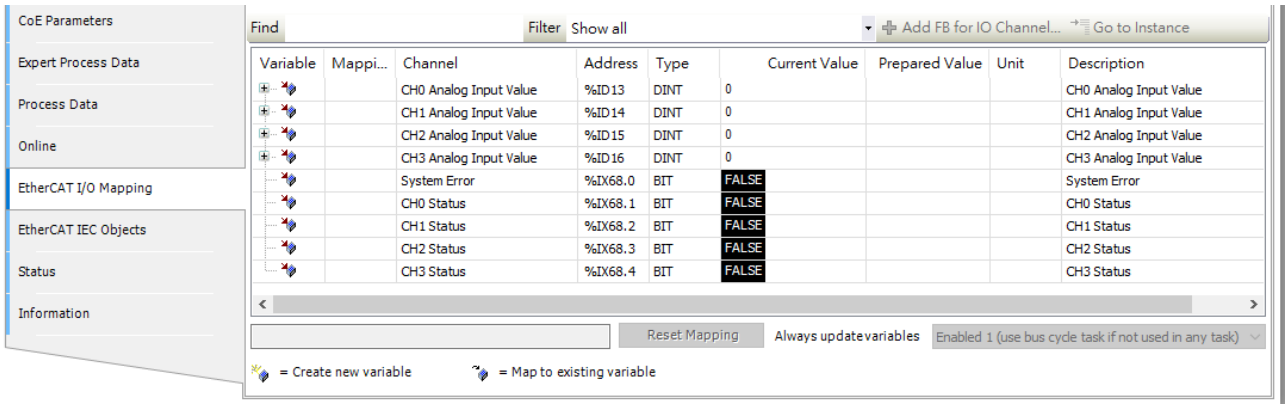
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

4.1.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

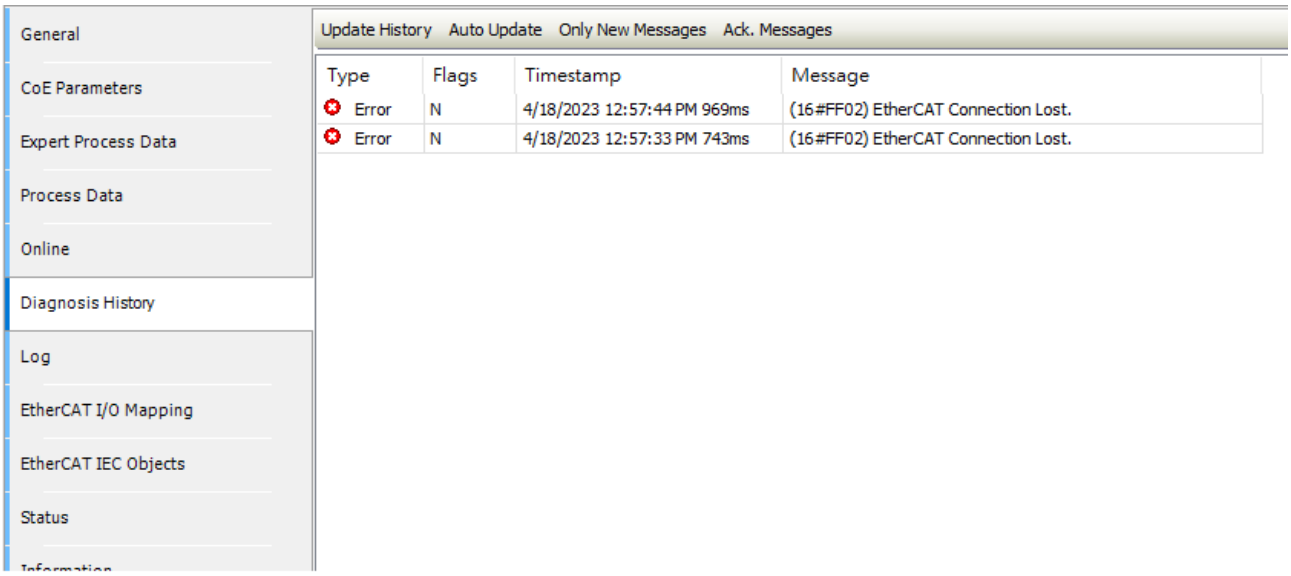


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



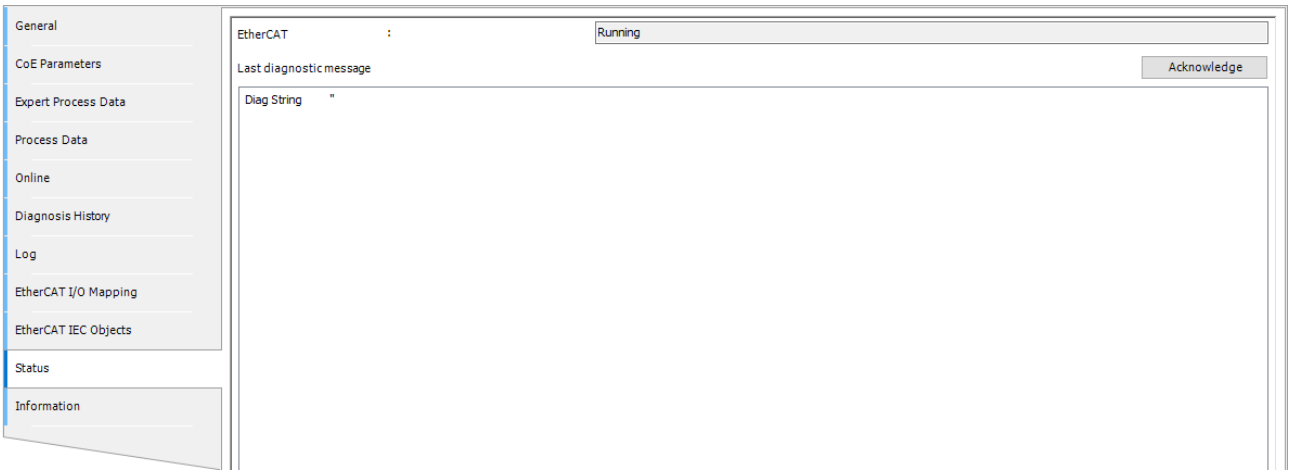
4.1.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. The Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors.



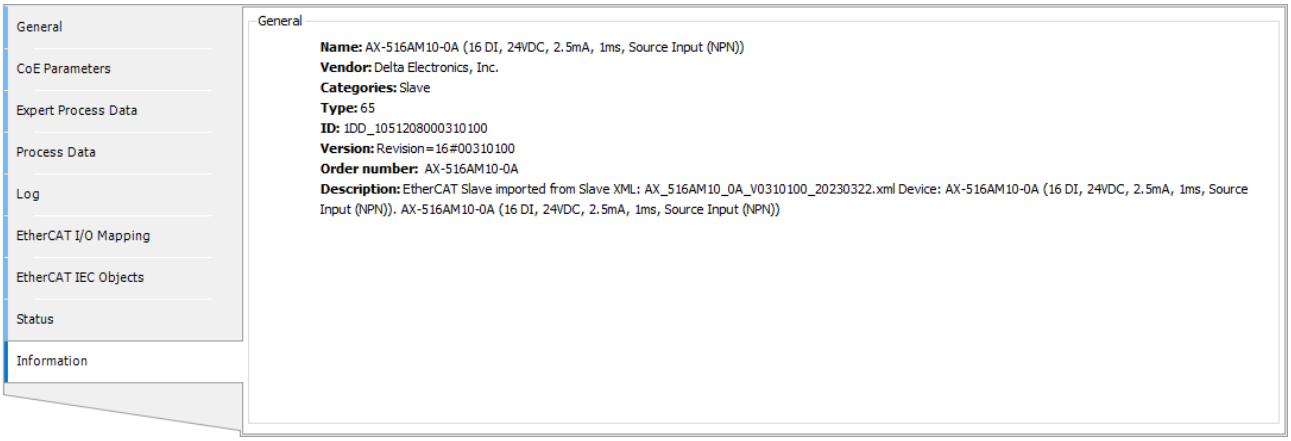
4.1.4.5 Status

Click  on the toolbar to go into online mode. In the Status Tab, you can monitor the current status and latest diagnostic messages of the module.



4.1.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version of the module.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.33.01.00	0.33.01.00	0.00.00.00

4.1.5 Parameter Descriptions

You can use DIADesigner-AX to set up functions for the module. For software operation, refer to section 4.1.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Input Filter Time	Filtering time for inputs	DFB_AM_RD_FilterTime DFB_AM_WR_FilterTime
16#8001	Input Filter Threshold	Filtering threshold for inputs	DFB_AM_RD_FilterThreshold DFB_AM_WR_FilterThreshold

4.1.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Parameter explanation**

This parameter displays the current control status of the module.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

4.1.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Parameter explanation**

Users write the commands into the module and the module will execute accordingly. After execution, the module will send back a corresponding value which indicates that the execution is success or failure.

- **User command**

Command	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

4.1.5.3 Input Filter Time

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Input Filter Time	Filtering time for inputs Setting range: 0–255 (ms)	USINT	RW	3
	16#02	CH1 Input Filter Time		USINT	RW	3
	16#03	CH2 Input Filter Time		USINT	RW	3
	16#04	CH3 Input Filter Time		USINT	RW	3
	16#05	CH4 Input Filter Time		USINT	RW	3
	16#06	CH5 Input Filter Time		USINT	RW	3
	16#07	CH6 Input Filter Time		USINT	RW	3
	16#08	CH7 Input Filter Time		USINT	RW	3
	16#09	CH8 Input Filter Time		USINT	RW	3
	16#0A	CH9 Input Filter Time		USINT	RW	3
	16#0B	CH10 Input Filter Time		USINT	RW	3
	16#0C	CH11Input Filter Time		USINT	RW	3
	16#0D	CH12 Input Filter Time		USINT	RW	3
	16#0E	CH13 Input Filter Time		USINT	RW	3
	16#0F	CH14 Input Filter Time		USINT	RW	3
	16#10	CH15 Input Filter Time		USINT	RW	3

- **Parameter explanation**

The parameter set is to set the filtering time for the inputs of the module. If the duration time for received signals is shorter than the set filtering time, the signals received will be seen as noises and will be filtered out. The default filtering value is 3 ms. But you can set the filtering time for the inputs according to your application environment.

4.1.5.4 Input Filter Threshold

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Input Filter Threshold	Filtering threshold for inputs	USINT	RW	80
	16#02	CH1 Input Filter Threshold		USINT	RW	80
	16#03	CH2 Input Filter Threshold		USINT	RW	80
	16#04	CH3 Input Filter Threshold		USINT	RW	80
	16#05	CH4 Input Filter Threshold		USINT	RW	80
	16#06	CH5 Input Filter Threshold		USINT	RW	80
	16#07	CH6 Input Filter Threshold		USINT	RW	80
	16#08	CH7 Input Filter Threshold		USINT	RW	80
	16#09	CH8 Input Filter Threshold		USINT	RW	80
	16#0A	CH9 Input Filter Threshold		USINT	RW	80
	16#0B	CH10 Input Filter Threshold		USINT	RW	80
	16#0C	CH11 Input Filter Threshold		USINT	RW	80
	16#0D	CH12 Input Filter Threshold		USINT	RW	80
	16#0E	CH13 Input Filter Threshold		USINT	RW	80
	16#0F	CH14 Input Filter Threshold		USINT	RW	80
	16#10	CH15 Input Filter Threshold		USINT	RW	80

- **Parameter explanation**

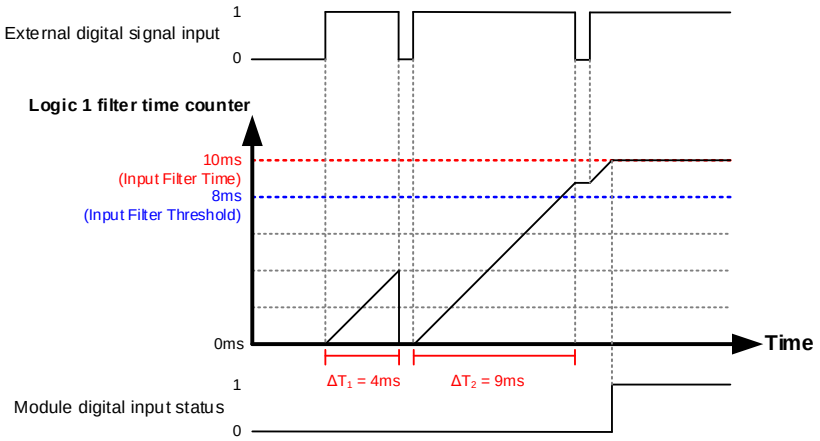
The parameter set is to set the filtering threshold for the inputs so as to suppress the digital noise interference.

- **Input filter threshold**

Setting in function block	Threshold
0	20%
1	40%
2	60%
3	80%
4	100%

Example: Set the input filter threshold to 80%

Set the input filter time to 10 ms and the input filter threshold to 80%, which means that the threshold time is 8 ms (10ms * 80%). The signal of duration time less than 8 ms is seen as a noise and filtered out (Δ T1). But the signal of duration time greater than 8 ms is seen as a valid signal, and then the cumulative time (Δ T2) for such a signal input is not reset when a brief noise signal occurs subsequently.



In the system, there are filter time counters logic 0 and logic 1, which have opposite logics but the same operation principle.

4.1.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

4.1.6.1 FreeRun Mode

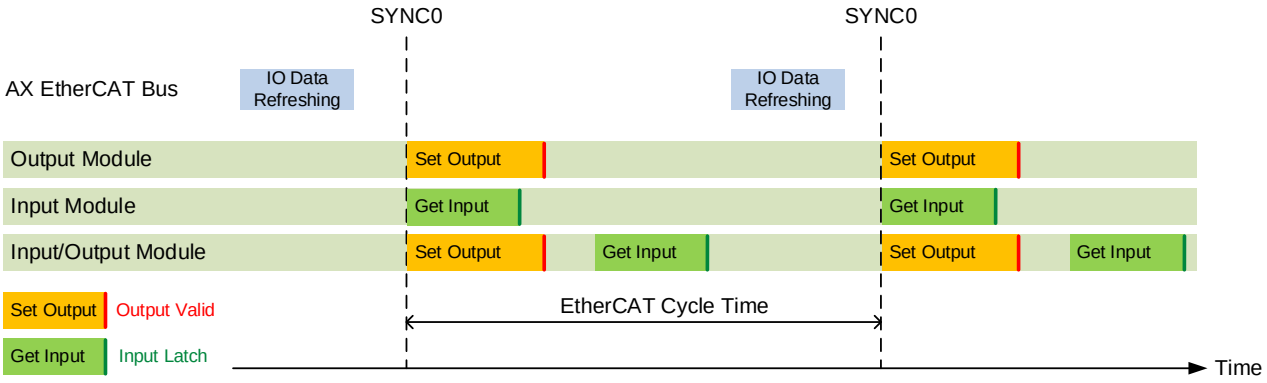
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

4.1.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

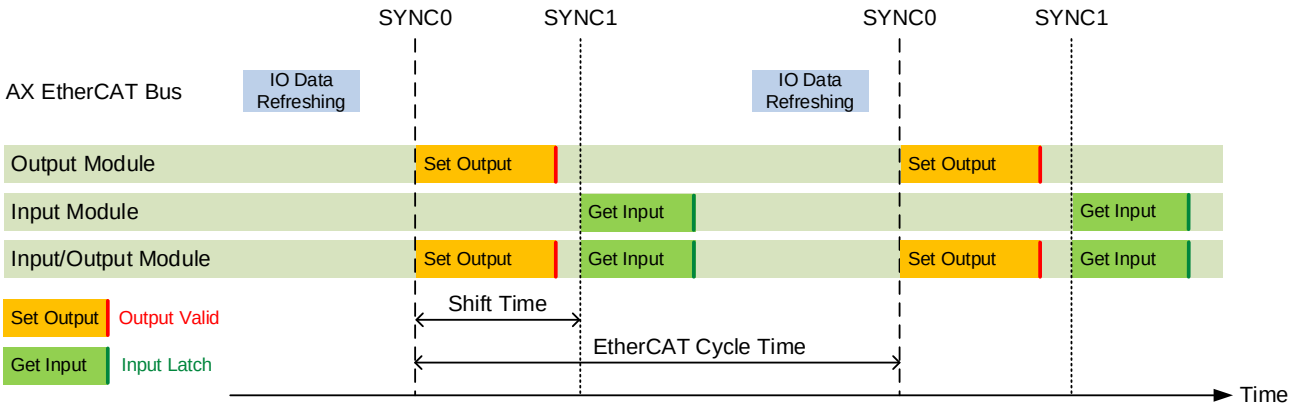
- **SYNC0**

Using the SYNC signal SYNC0 to refresh the values of output channels among modules at the same time



- **SYNC0 + SYNC1**

Using SYNC0 to refresh the values of outptut channels among modules at the same time and using SYNC1 to refresh the values of input channels among modules at the same time. The shift time between SYNC0 and SYNC1 can be modified with DIADesigner-AX.



4.1.7 **Process Data**

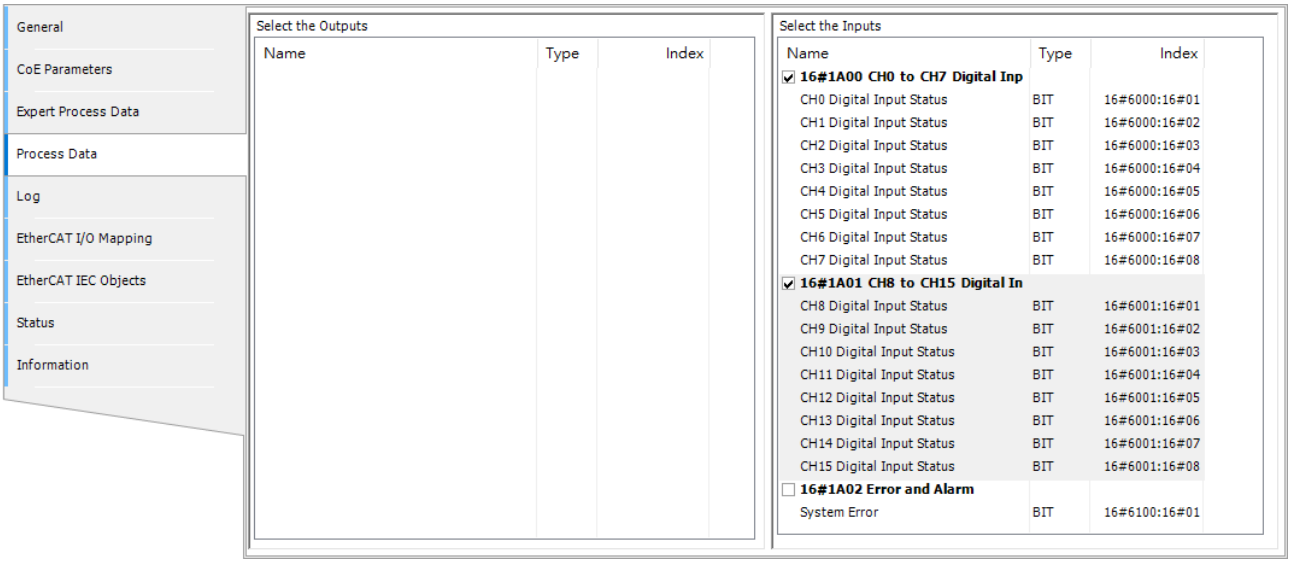
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Digital Input Status	Digital input values of CH0–CH7	BOOL	RO	0
	16#02	CH1 Digital Input Status		BOOL	RO	0
	16#03	CH2 Digital Input Status		BOOL	RO	0
	16#04	CH3 Digital Input Status		BOOL	RO	0
	16#05	CH4 Digital Input Status		BOOL	RO	0
	16#06	CH5 Digital Input Status		BOOL	RO	0
	16#07	CH6 Digital Input Status		BOOL	RO	0
	16#08	CH7 Digital Input Status		BOOL	RO	0
16#6001	16#01	CH8 Digital Input Status	Digital input values of CH8–CH15	BOOL	RO	0
	16#02	CH9 Digital Input Status		BOOL	RO	0
	16#03	CH10 Digital Input Status		BOOL	RO	0
	16#04	CH11 Digital Input Status		BOOL	RO	0
	16#05	CH12 Digital Input Status		BOOL	RO	0
	16#06	CH13 Digital Input Status		BOOL	RO	0
	16#07	CH14 Digital Input Status		BOOL	RO	0
	16#08	CH15 Digital Input Status		BOOL	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0

4.1.7.1 Process Data

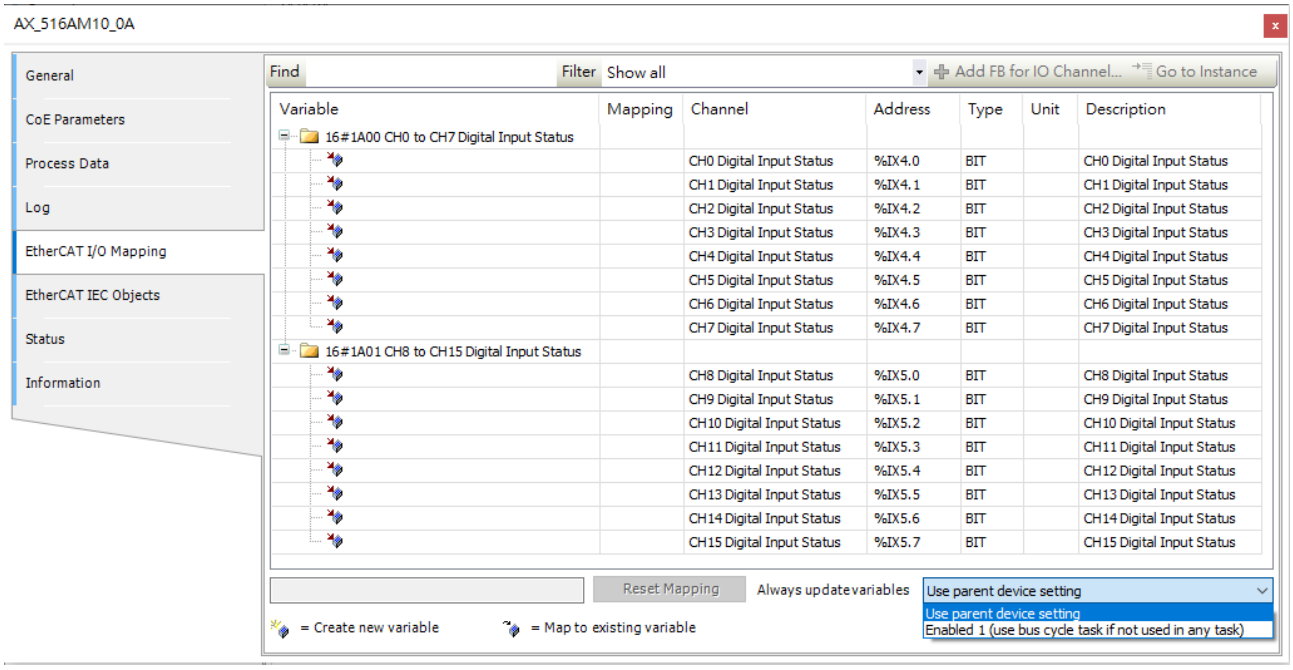
Go to the Process Data tab and select the data that you'd like to monitor.

- Digital Input Value: You can monitor the selected channels and deselect the unused channels to save the cycle time.
- Error and Alarm: It is not selected by default.



4.1.7.2 EtherCAT I/O Mapping

The ticked items in the Process Data tab are all shown in the tab of EtherCAT I/O Mapping.



4.1.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

4.1.8 Troubleshooting

The Diagnosis History tab records error messages that occurred on the module. The Status tab shows current error messages. In the All Parameters page of the CoE Parameters tab, you can view the error status via corresponding Index/SubIndex.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Disconnection	ON	OFF	Check the module connection if the connection is securely connected or arrange the module placement again.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.

4.2 AX-516AM20-0A

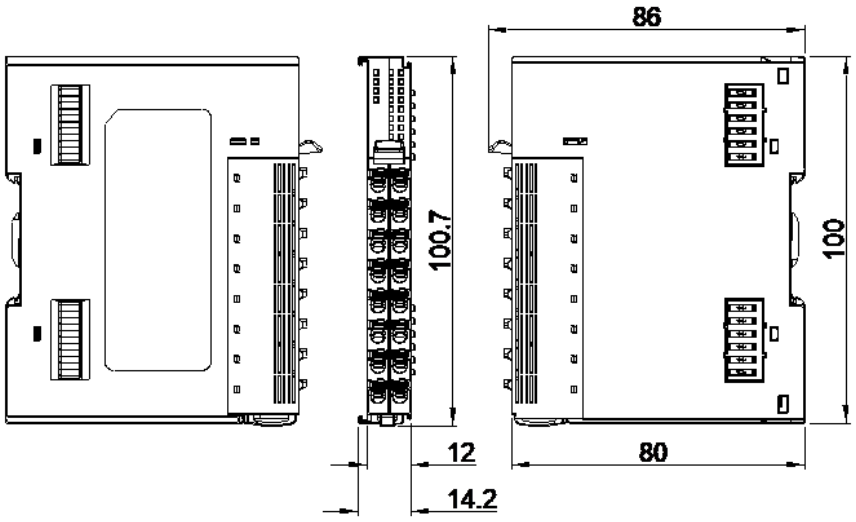
AX-516AM20-0A, a digital input module, receives external 16-point digital signals (PNP). This section introduces its specifications, operations and wirings.

4.2.1 Specifications

Item		Specification
Input points		16
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		69 g
Electrical specification	I/O form	Sinking input (PNP)
	Input current	2.5 mA TYP. (24 VDC), constant current
	ON (voltage)	11–30 V (EN 61131-2, type 3)
	OFF(voltage)	-3 – +5 V (EN 61131-2, type 3)
	Maximum ON / OFF response time	150 µs /150 µs
	Isolation method	Between unit power and external power: no isolation Between digital signal and internal signal: 500 VAC Between channels: no isolation
	Maximum power consumption (unit power)	200 mA (1W)
	Maximum power consumption (I/O power)	24 VDC/40 mA
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Protection	--
	Short Circuit Protection (SCP)	--
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	Current limiting
	Filter function	Firmware filtering time: 0-255 ms; (default: 3 ms)

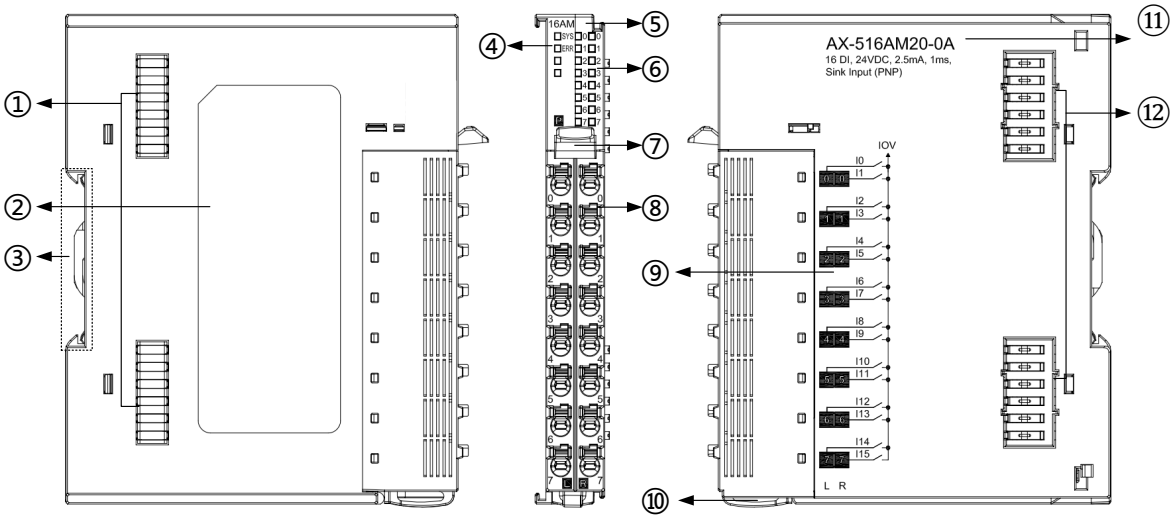
4.2.2 Dimensions and Parts

- **Dimensions**



Unit：mm

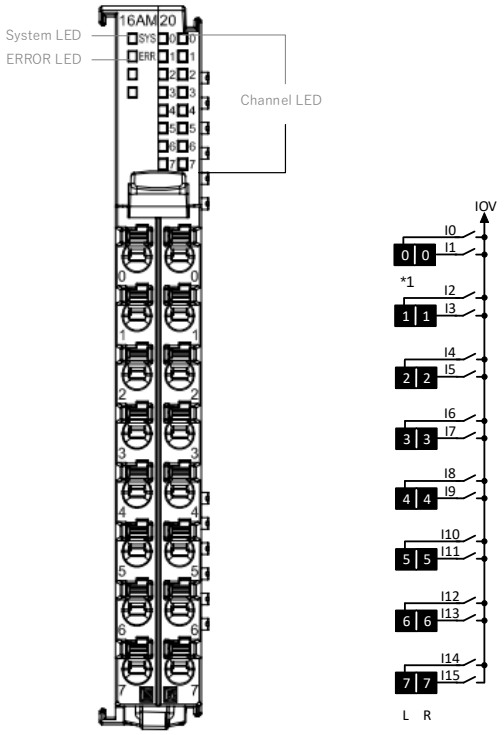
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

4.2.3 Arrangement of Terminals, LED Indicators and Wiring

4.2.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

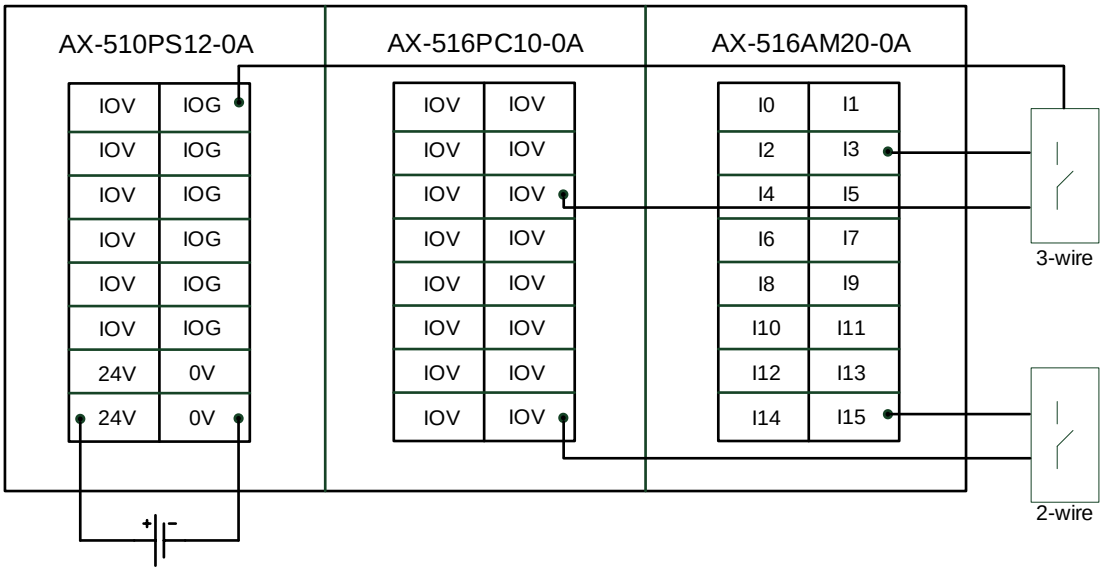
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0	Digital input channel 0	R0	I1	Digital input channel 1
L1	I2	Digital input channel 2	R1	I3	Digital input channel 3
L2	I4	Digital input channel 4	R2	I5	Digital input channel 5
L3	I6	Digital input channel 6	R3	I7	Digital input channel 7
L4	I8	Digital input channel 8	R4	I9	Digital input channel 9
L5	I10	Digital input channel 10	R5	I11	Digital input channel 11
L6	I12	Digital input channel 12	R6	I13	Digital input channel 13
L7	I14	Digital input channel 14	R7	I15	Digital input channel 15

4.2.3.2 LED Indicators

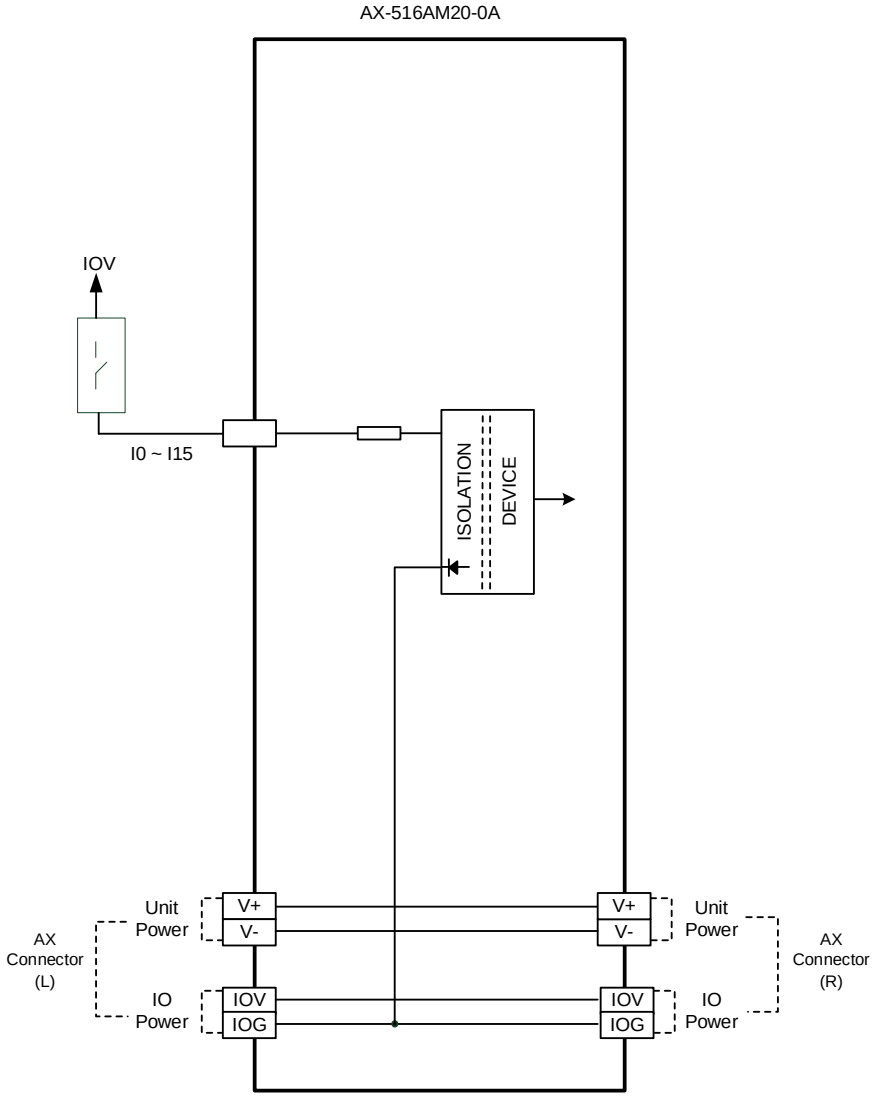
Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	Normal (OP)
Error	Red		OFF	Module is functioning correctly.
			ON	A severe error occurs on the module.
Channel	Green		OFF	The channel is OFF.
			ON	The channel is ON.

4.2.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



4.2.4 Settings in DIADesigner-AX

This section introduces some basic operations and settings in the DIADesigner-AX software.

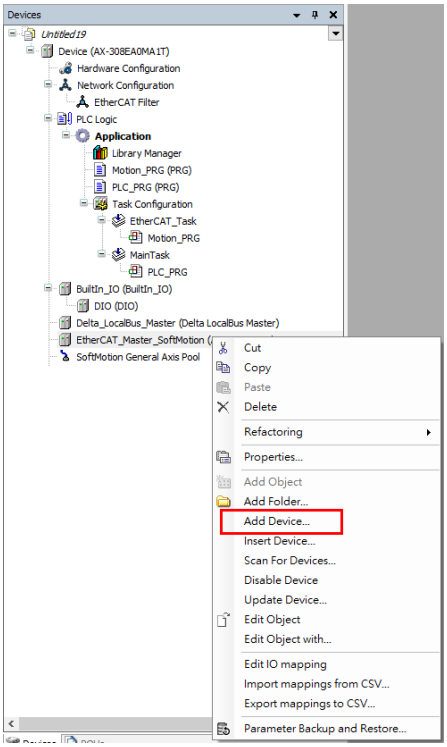
4.2.4.1 Basic Operation

(1) Double-click the DIADesigner-AX icon to open the software and create a new project.

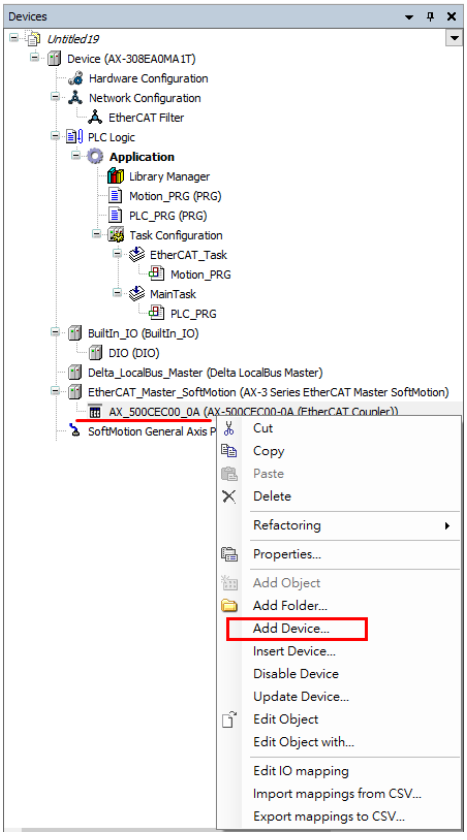
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Add Device…*** to select and add System Coupler.

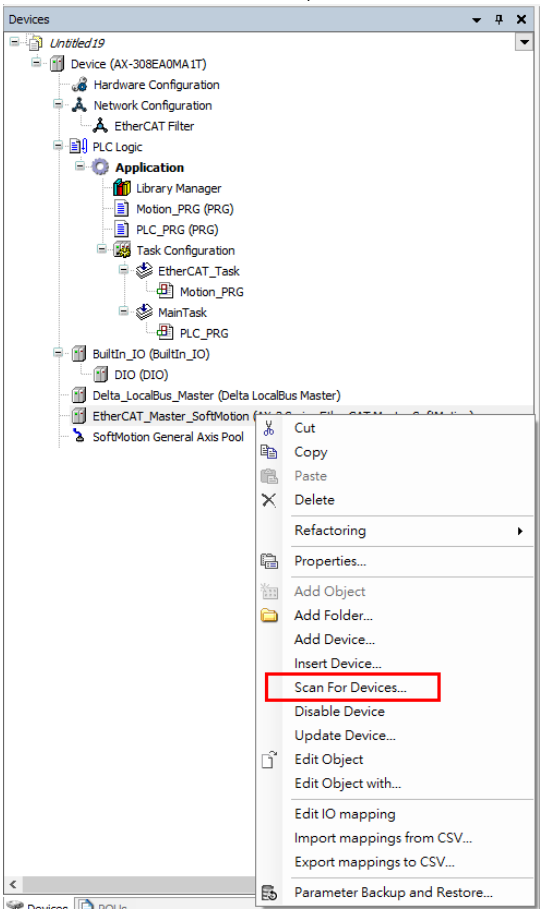


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

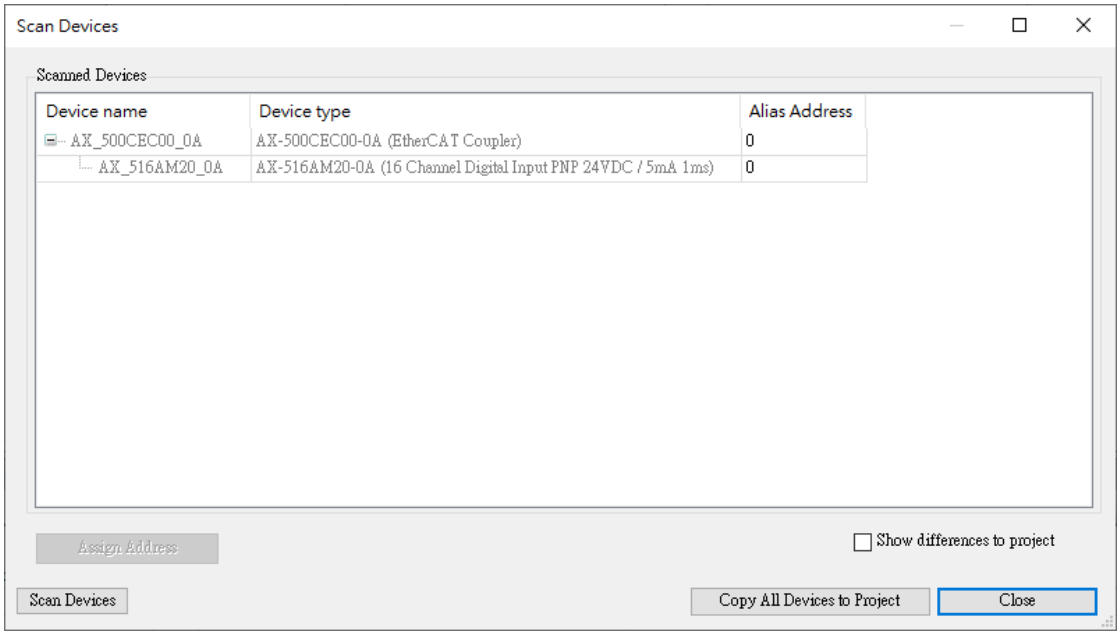


- Method 2: Scan to add the modules in.

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Scan for Devices…***.

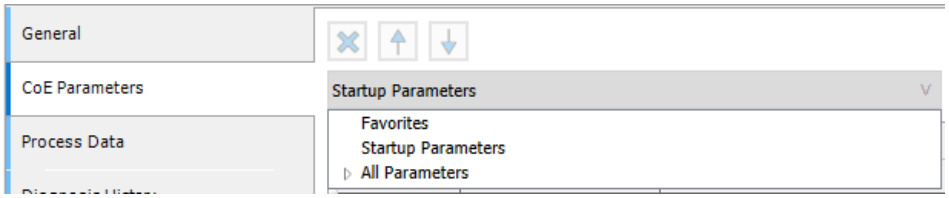


After the auto-scan is over, the actually-connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.



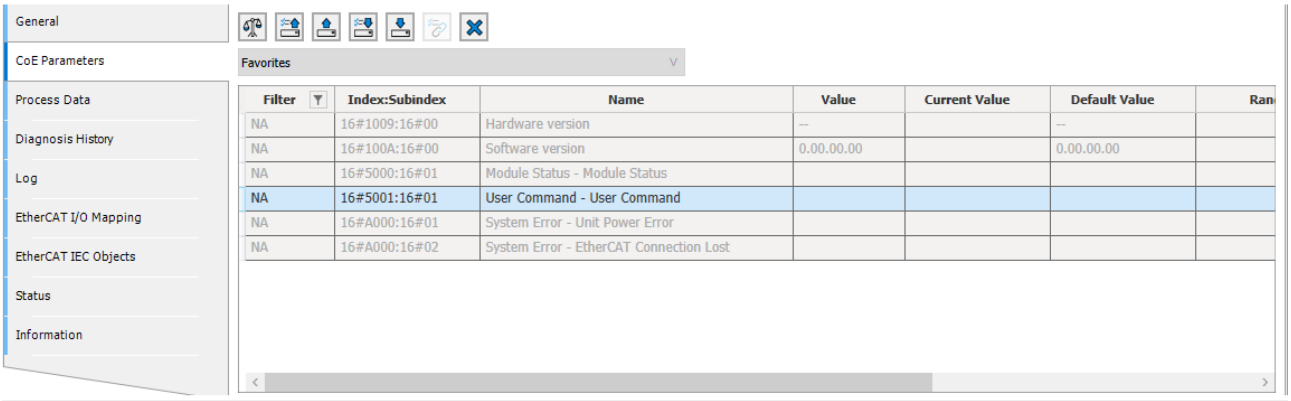
4.2.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.



(1) Favorites

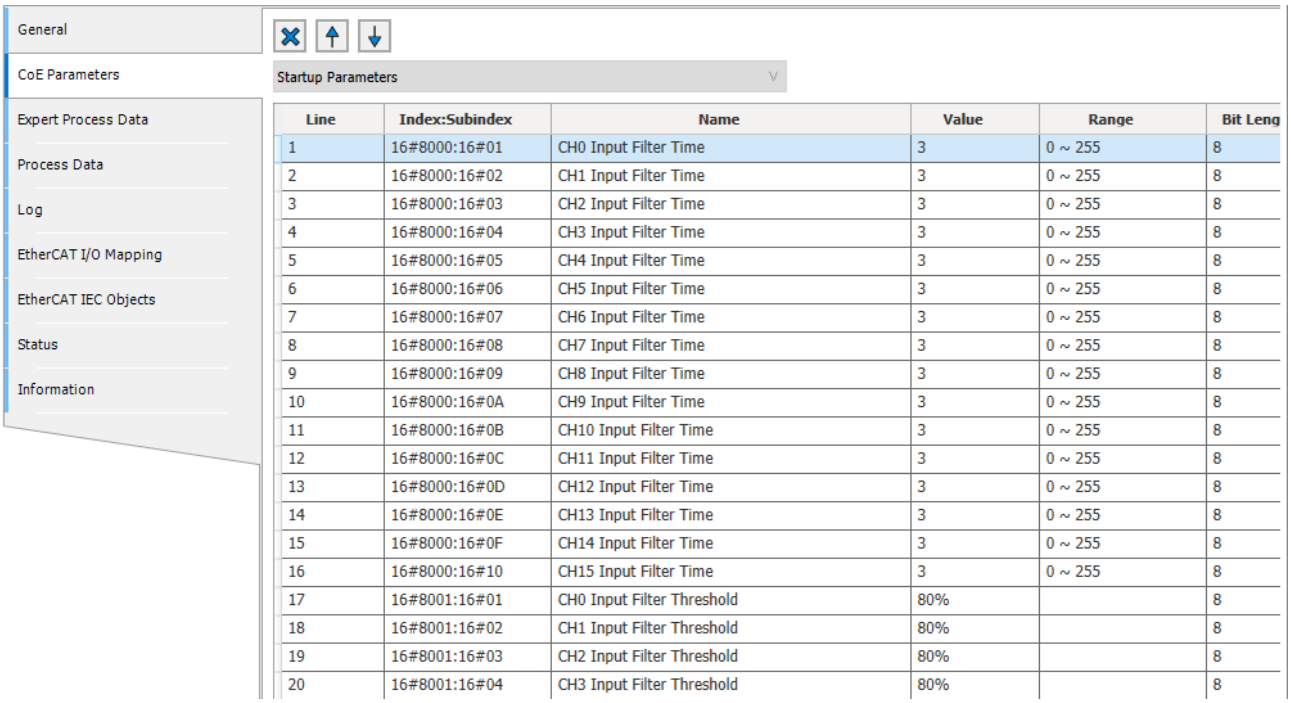
- You can add the selected parameter to Favorites according to your preference. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

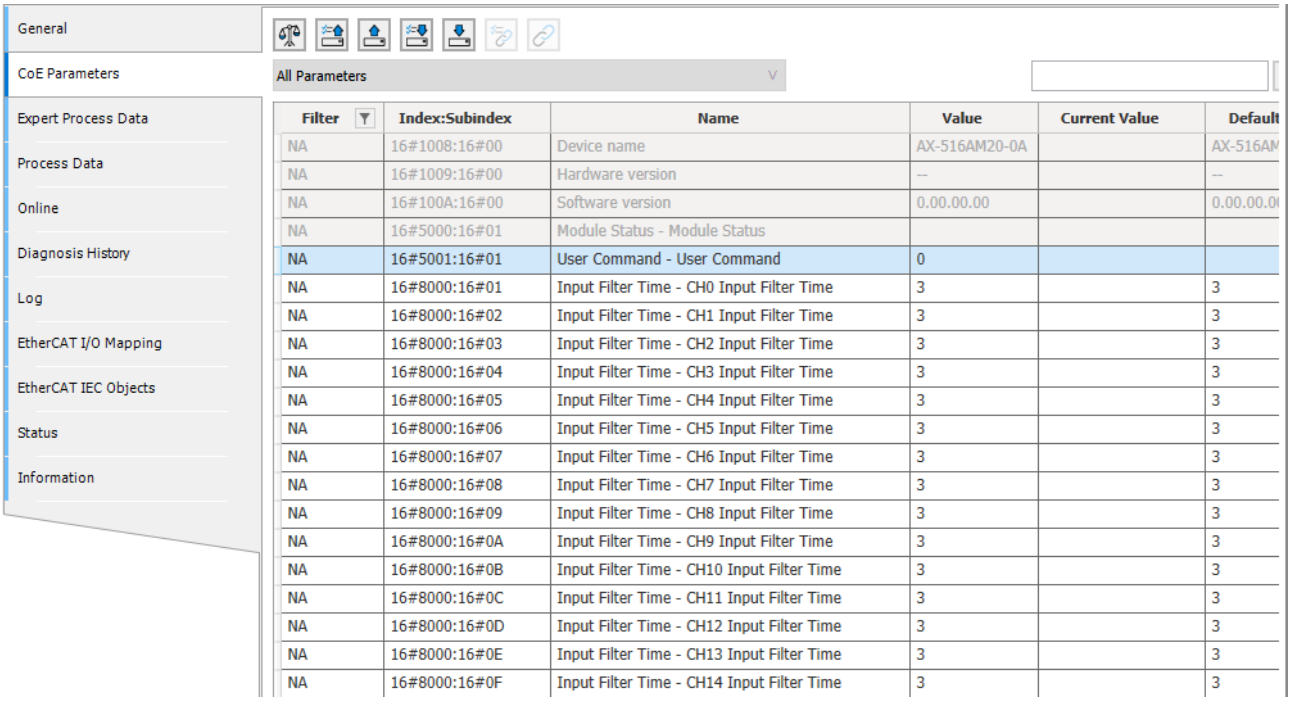


Line	Index:Subindex	Name	Value	Range	Bit Leng
1	16#8000:16#01	CH0 Input Filter Time	3	0 ~ 255	8
2	16#8000:16#02	CH1 Input Filter Time	3	0 ~ 255	8
3	16#8000:16#03	CH2 Input Filter Time	3	0 ~ 255	8
4	16#8000:16#04	CH3 Input Filter Time	3	0 ~ 255	8
5	16#8000:16#05	CH4 Input Filter Time	3	0 ~ 255	8
6	16#8000:16#06	CH5 Input Filter Time	3	0 ~ 255	8
7	16#8000:16#07	CH6 Input Filter Time	3	0 ~ 255	8
8	16#8000:16#08	CH7 Input Filter Time	3	0 ~ 255	8
9	16#8000:16#09	CH8 Input Filter Time	3	0 ~ 255	8
10	16#8000:16#0A	CH9 Input Filter Time	3	0 ~ 255	8
11	16#8000:16#0B	CH10 Input Filter Time	3	0 ~ 255	8
12	16#8000:16#0C	CH11 Input Filter Time	3	0 ~ 255	8
13	16#8000:16#0D	CH12 Input Filter Time	3	0 ~ 255	8
14	16#8000:16#0E	CH13 Input Filter Time	3	0 ~ 255	8
15	16#8000:16#0F	CH14 Input Filter Time	3	0 ~ 255	8
16	16#8000:16#10	CH15 Input Filter Time	3	0 ~ 255	8
17	16#8001:16#01	CH0 Input Filter Threshold	80%		8
18	16#8001:16#02	CH1 Input Filter Threshold	80%		8
19	16#8001:16#03	CH2 Input Filter Threshold	80%		8
20	16#8001:16#04	CH3 Input Filter Threshold	80%		8

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

(3) All Parameters

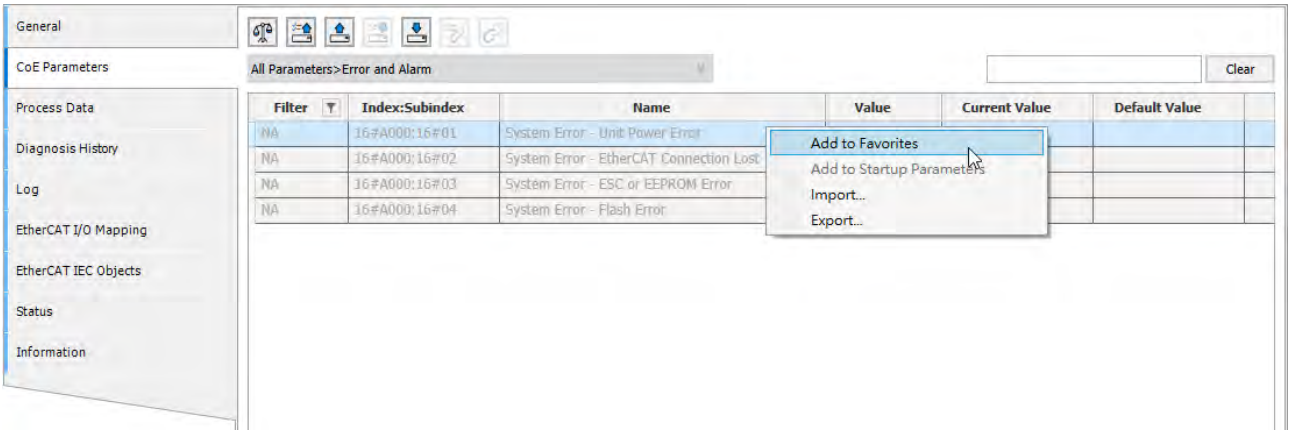
- You can find all the CoE parameters here. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values of parameters in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Filter	Index:Subindex	Name	Value	Current Value	Default
NA	16#1008:16#00	Device name	AX-516AM20-0A		AX-516AM
NA	16#1009:16#00	Hardware version	--		--
NA	16#100A:16#00	Software version	0.00.00.00		0.00.00.0
NA	16#5000:16#01	Module Status - Module Status			
NA	16#5001:16#01	User Command - User Command	0		
NA	16#8000:16#01	Input Filter Time - CH0 Input Filter Time	3		3
NA	16#8000:16#02	Input Filter Time - CH1 Input Filter Time	3		3
NA	16#8000:16#03	Input Filter Time - CH2 Input Filter Time	3		3
NA	16#8000:16#04	Input Filter Time - CH3 Input Filter Time	3		3
NA	16#8000:16#05	Input Filter Time - CH4 Input Filter Time	3		3
NA	16#8000:16#06	Input Filter Time - CH5 Input Filter Time	3		3
NA	16#8000:16#07	Input Filter Time - CH6 Input Filter Time	3		3
NA	16#8000:16#08	Input Filter Time - CH7 Input Filter Time	3		3
NA	16#8000:16#09	Input Filter Time - CH8 Input Filter Time	3		3
NA	16#8000:16#0A	Input Filter Time - CH9 Input Filter Time	3		3
NA	16#8000:16#0B	Input Filter Time - CH10 Input Filter Time	3		3
NA	16#8000:16#0C	Input Filter Time - CH11 Input Filter Time	3		3
NA	16#8000:16#0D	Input Filter Time - CH12 Input Filter Time	3		3
NA	16#8000:16#0E	Input Filter Time - CH13 Input Filter Time	3		3
NA	16#8000:16#0F	Input Filter Time - CH14 Input Filter Time	3		3

Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

- You can select and right-click the parameter to add the selected parameter to Favorites.

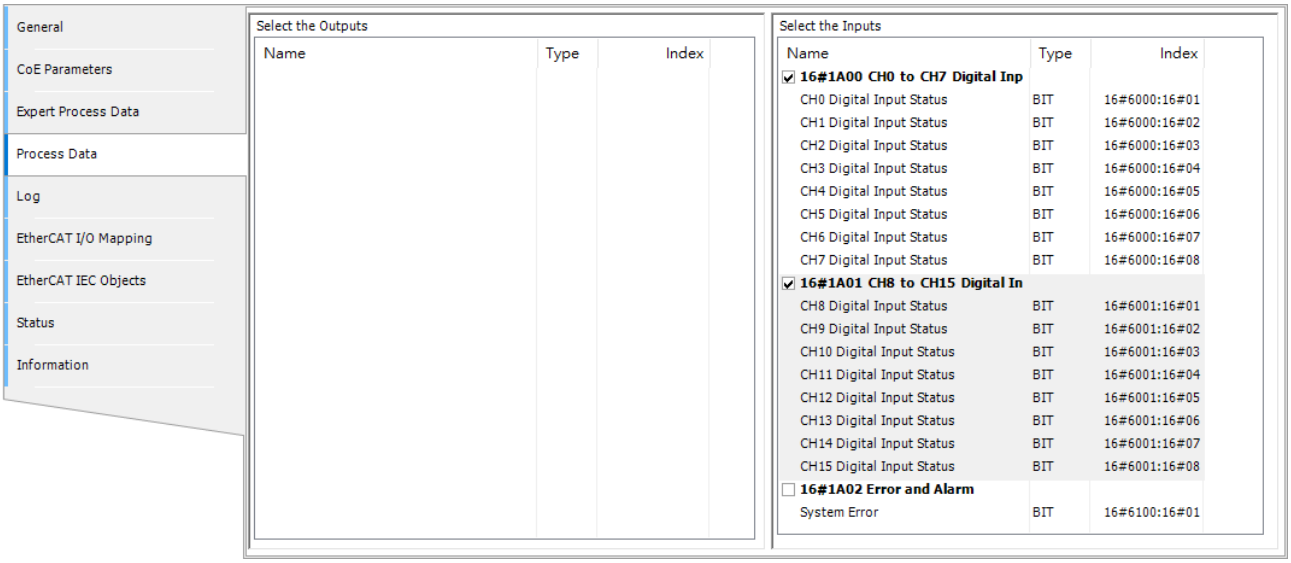


Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

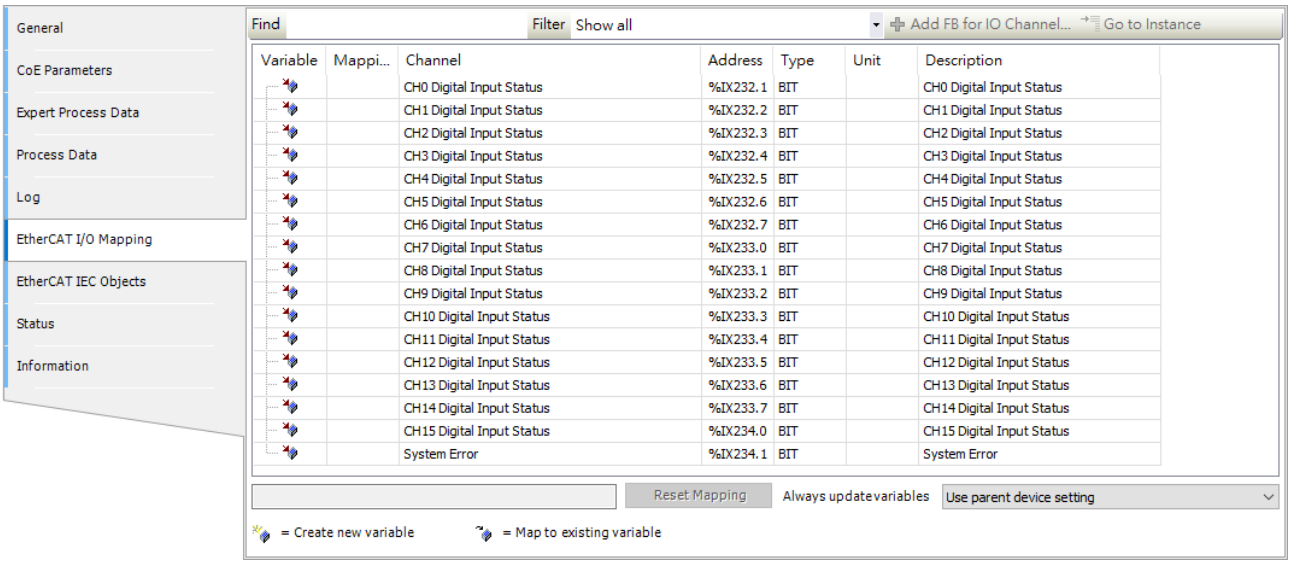
4

4.2.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

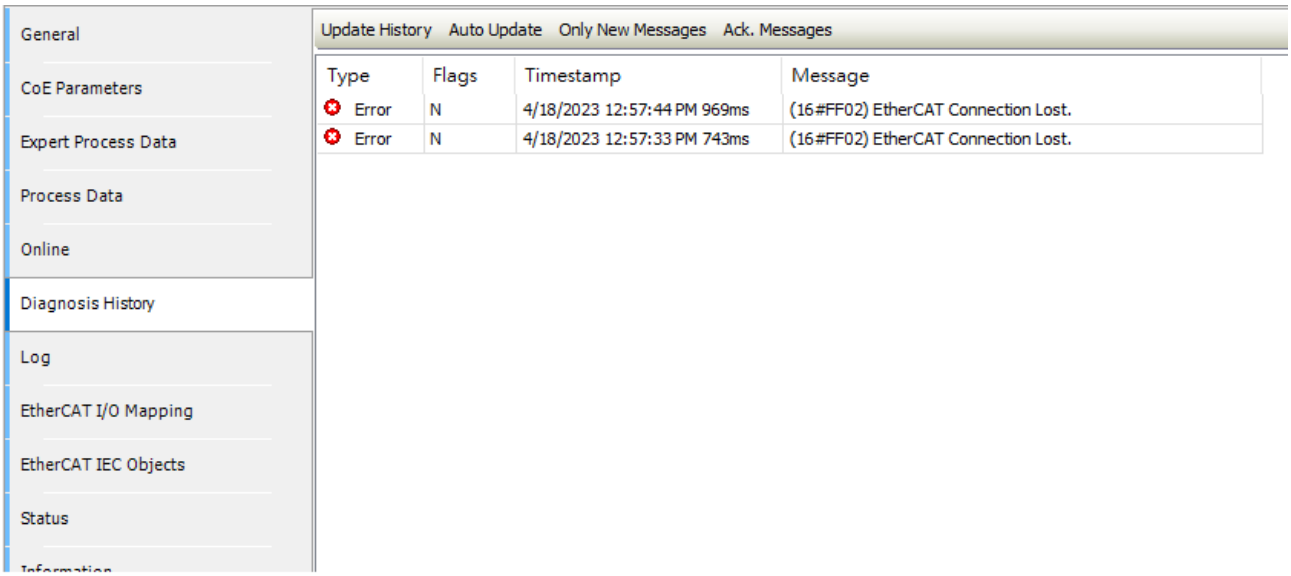


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



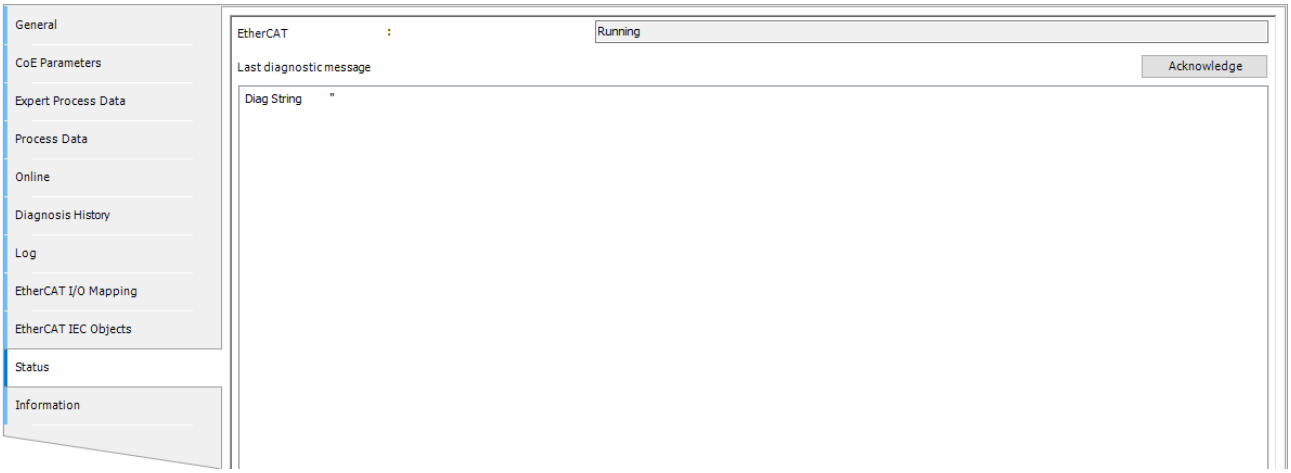
4.2.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors.



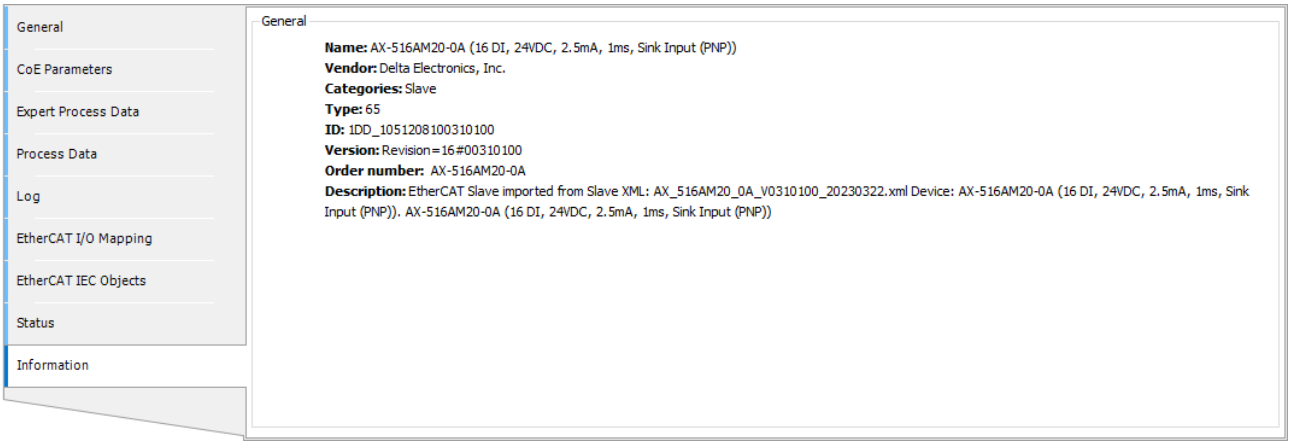
4.2.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



4.2.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version of the module.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.33.01.00	0.33.01.00	0.00.00.00

4.2.5 Parameter Descriptions

You can use DIADesigner-AX to set up the module. For software operation, refer to section 4.2.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function Block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Input Filter Time	Filtering time for inputs	DFB_AM_RD_FilterTime DFB_AM_WR_FilterTime
16#8001	Input Filter Threshold	Filtering threshold for inputs	DFB_AM_RD_FilterThreshold DFB_AM_WR_FilterThreshold

4.2.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Parameter explanation**

This parameter displays the current control status of the module.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

4.2.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Parameter explanation**

Users write the commands into the module and the module will execute accordingly. After execution, the module will send back a corresponding value which indicates that the execution is success or failure.

- **User command**

Command	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

4.2.5.3 Input Filter Time

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Input Filter Time	Filtering time for inputs Setting range: 0–255 (ms)	USINT	RW	3
	16#02	CH1 Input Filter Time		USINT	RW	3
	16#03	CH2 Input Filter Time		USINT	RW	3
	16#04	CH3 Input Filter Time		USINT	RW	3
	16#05	CH4 Input Filter Time		USINT	RW	3
	16#06	CH5 Input Filter Time		USINT	RW	3
	16#07	CH6 Input Filter Time		USINT	RW	3
	16#08	CH7 Input Filter Time		USINT	RW	3
	16#09	CH8 Input Filter Time		USINT	RW	3
	16#0A	CH9 Input Filter Time		USINT	RW	3
	16#0B	CH10 Input Filter Time		USINT	RW	3
	16#0C	CH11Input Filter Time		USINT	RW	3
	16#0D	CH12 Input Filter Time		USINT	RW	3
	16#0E	CH13 Input Filter Time		USINT	RW	3
	16#0F	CH14 Input Filter Time		USINT	RW	3
	16#10	CH15 Input Filter Time		USINT	RW	3

- **Parameter explanation**

The parameter set is to set the filtering time for the inputs of the module. If the duration time for received signals is shorter than the set filtering time, the signals received will be seen as noises and will be filtered out. The default filtering value is 3 ms. But you can set the filtering time for the inputs according to your application environment.

4.2.5.4 Input Filter Threshold

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Input Filter Threshold	Filtering threshold for inputs Setting value: 60% / 80% / 100%	USINT	RW	80
	16#02	CH1 Input Filter Threshold		USINT	RW	80
	16#03	CH2 Input Filter Threshold		USINT	RW	80
	16#04	CH3 Input Filter Threshold		USINT	RW	80
	16#05	CH4 Input Filter Threshold		USINT	RW	80
	16#06	CH5 Input Filter Threshold		USINT	RW	80
	16#07	CH6 Input Filter Threshold		USINT	RW	80
	16#08	CH7 Input Filter Threshold		USINT	RW	80
	16#09	CH8 Input Filter Threshold		USINT	RW	80
	16#0A	CH9 Input Filter Threshold		USINT	RW	80
	16#0B	CH10 Input Filter Threshold		USINT	RW	80
	16#0C	CH11 Input Filter Threshold		USINT	RW	80
	16#0D	CH12 Input Filter Threshold		USINT	RW	80

Index	Subindex	Name	Description	Data Type	Attr.	Default
	16#0E	CH13 Input Filter Threshold		USINT	RW	80
	16#0F	CH14 Input Filter Threshold		USINT	RW	80
	16#10	CH15 Input Filter Threshold		USINT	RW	80

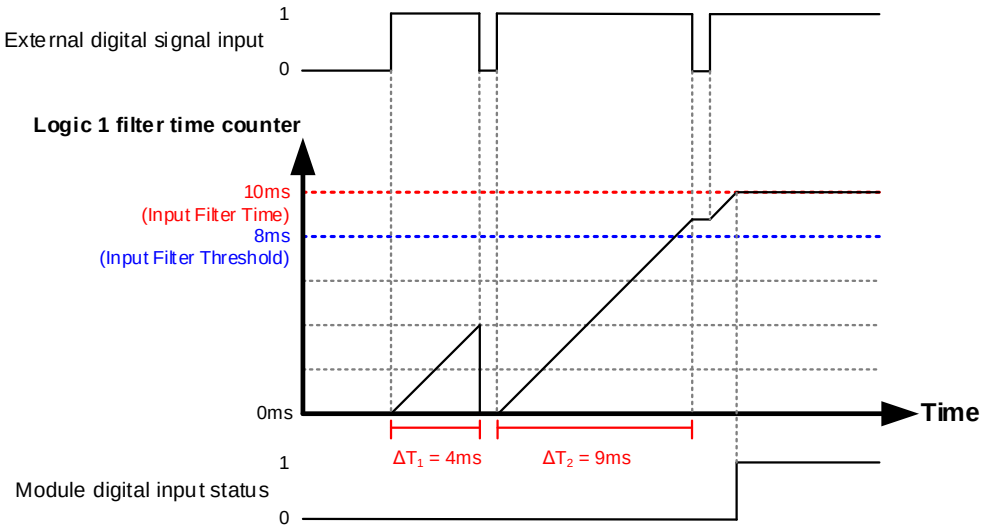
- **Parameter explanation**

The parameter set is to set the filtering threshold for the inputs so as to suppress the digital noise interference.

- **Input filter threshold**

Setting in function block	Threshold
0	20%
1	40%
2	60%
3	80%
4	100%

Example: Set the input filter time to 10 ms and the input filter threshold to 80%, which means that the threshold time is 8 ms (10ms * 80%). The signal of duration time less than 8 ms is seen as a noise and filtered out (Δ T1). But the signal of duration time greater than 8 ms is seen as a valid signal, and then the cumulative time (Δ T2) for such a signal input is not reset when a brief noise signal occurs subsequently.



In the system, there are filter time counters logic 0 and logic 1, which have opposite logics but the same operation principle.

4.2.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

4.2.6.1 FreeRun Mode

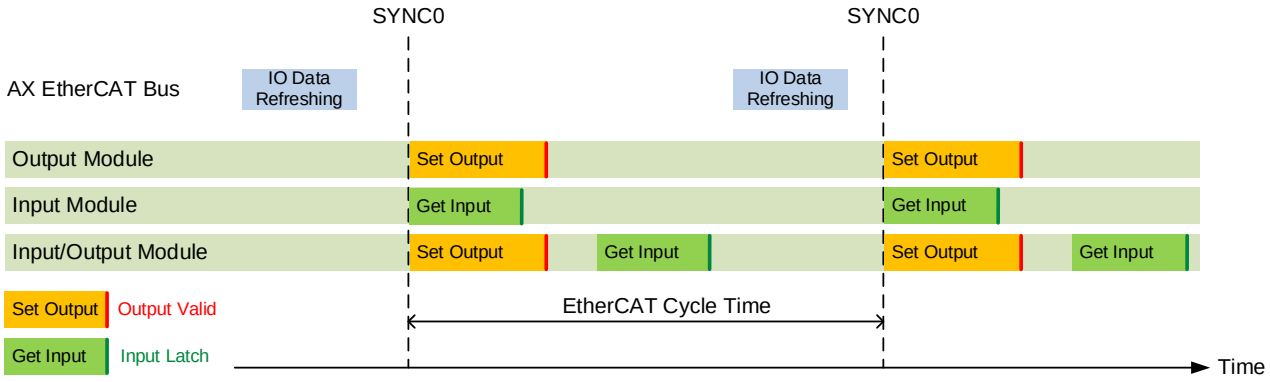
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

4.2.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

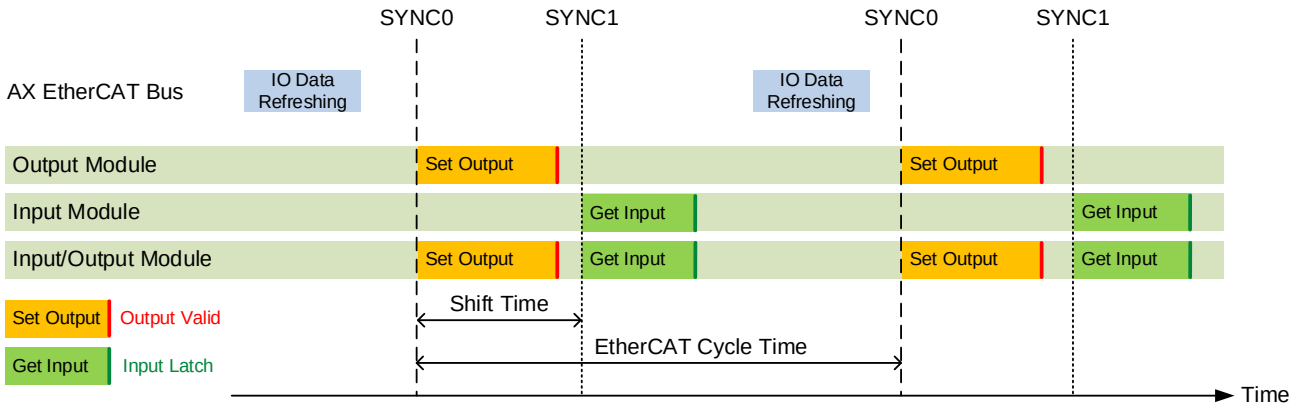
- **SYNC0**

Using SYNC0 to refresh values of output channels among modules at the same time.



- **SYNC0 + SYNC1**

Using SYNC0 to refresh values of output channels and using SYNC1 to refresh values of input channels among modules at the same time. The shift time between SYNC0 and SYNC1 can be modified with DIADesigner-AX.



4.2.7 Process Data

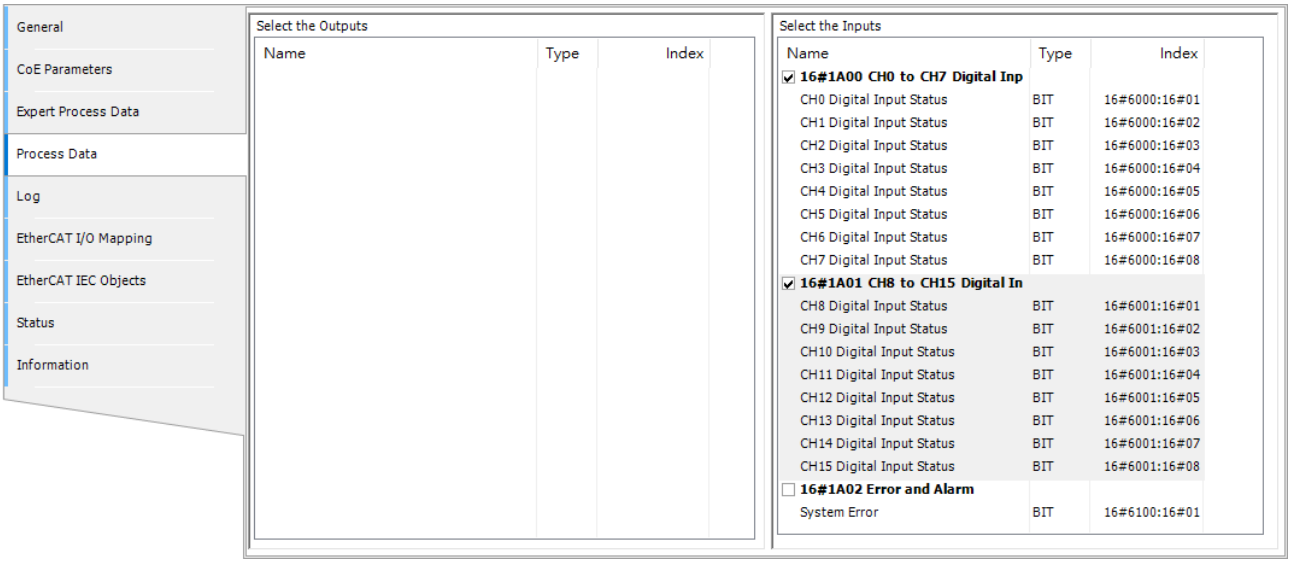
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Digital Input Status	Digital input values of CH0–CH7	BOOL	RO	0
	16#02	CH1 Digital Input Status		BOOL	RO	0
	16#03	CH2 Digital Input Status		BOOL	RO	0
	16#04	CH3 Digital Input Status		BOOL	RO	0
	16#05	CH4 Digital Input Status		BOOL	RO	0
	16#06	CH5 Digital Input Status		BOOL	RO	0
	16#07	CH6 Digital Input Status		BOOL	RO	0
	16#08	CH7 Digital Input Status		BOOL	RO	0
16#6001	16#01	CH8 Digital Input Status	Digital input values of CH8–CH15	BOOL	RO	0
	16#02	CH9 Digital Input Status		BOOL	RO	0
	16#03	CH10 Digital Input Status		BOOL	RO	0
	16#04	CH11 Digital Input Status		BOOL	RO	0
	16#05	CH12 Digital Input Status		BOOL	RO	0
	16#06	CH13 Digital Input Status		BOOL	RO	0
	16#07	CH14 Digital Input Status		BOOL	RO	0
	16#08	CH15 Digital Input Status		BOOL	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0

4.2.7.1 Process Data

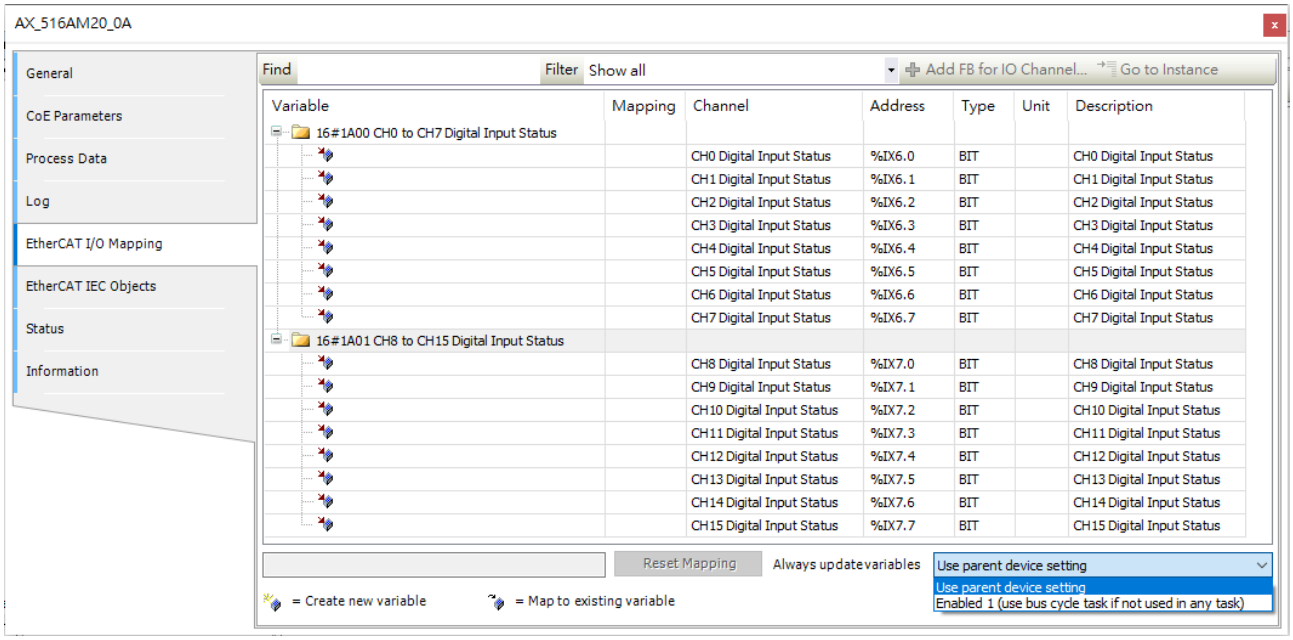
Go to the Process Data tab and select the data that you'd like to monitor.

- Digital Input Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Alarm: It is not selected by default.



4.2.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



4.2.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

4.2.8 Troubleshooting

The Diagnosis History tab records error messages that occurred on the module. The Status tab shows current error messages. In the All Parameters page of the CoE Parameters tab, you can view the error status via corresponding Index/SubIndex.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Disconnection	ON	OFF	Check the module connection if the connection is securely connected or arrange the module placement again.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.

4.3 AX-516AN01-0A

AX-516AN01-0A, a digital output module, outputs 16-point digital signals (NPN). This section introduces its specifications, operations and wirings.

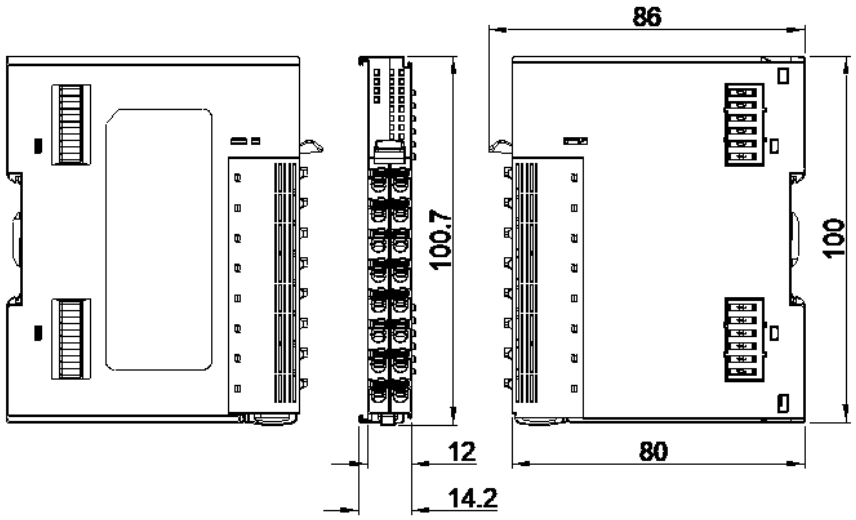
4.3.1 Specifications

Item		Specification
Output points		16
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		70 g
Electrical specification	I/O form	Sinking output (NPN)
	Load voltage	24 VDC (error range: -15%–+20% · 20.4–28.8 VDC)
	Maximum load current	0.5 A/point, 1A/8 points[*1], 2A/16 points[*1]
	Leakage current	Less than 0.1 mA
	Maximum ON / OFF response time	150 µs /150 µs
	Isolation method	Between unit power and external power: no isolation Between digital signal and internal signal: 500 VAC Between channels: no isolation
	Maximum power consumption (unit power)	200 mA (1W)
	Maximum power consumption (I/O power)	24 VDC/2A[*1]
	Minimum power consumption (I/O Power)	10 mA
Others	Short Circuit Protection (SCP)	--
	Connection Lost Protection	--
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	Yes

*1. Available for hardware A0 edition.

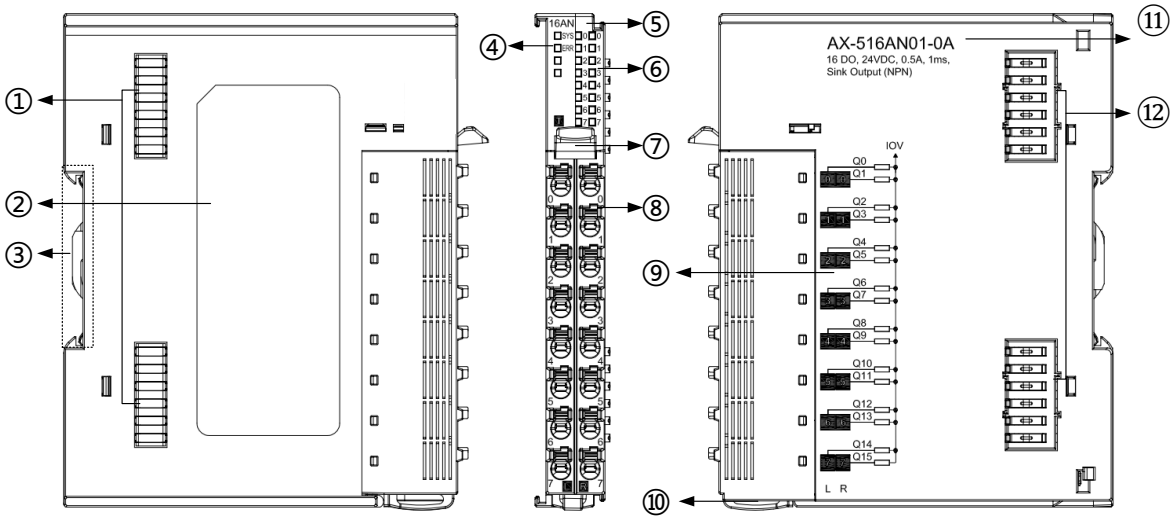
4.3.2 Dimensions and Parts

- **Dimensions**



Unit：mm

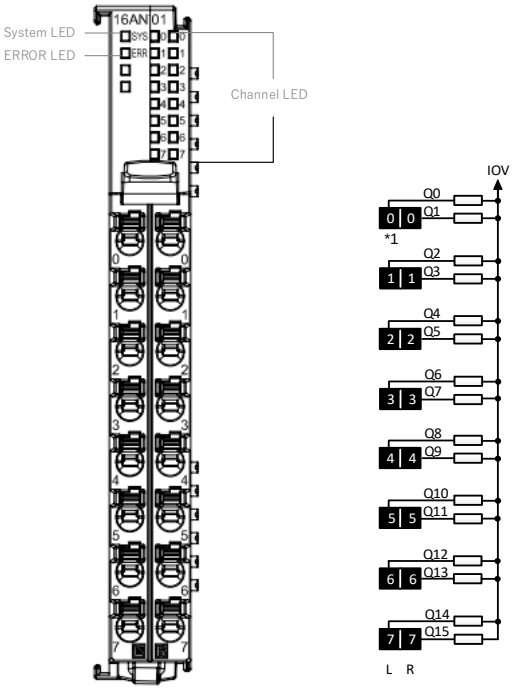
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

4.3.3 Arrangement of Terminals, LED Indicators and Wiring

4.3.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

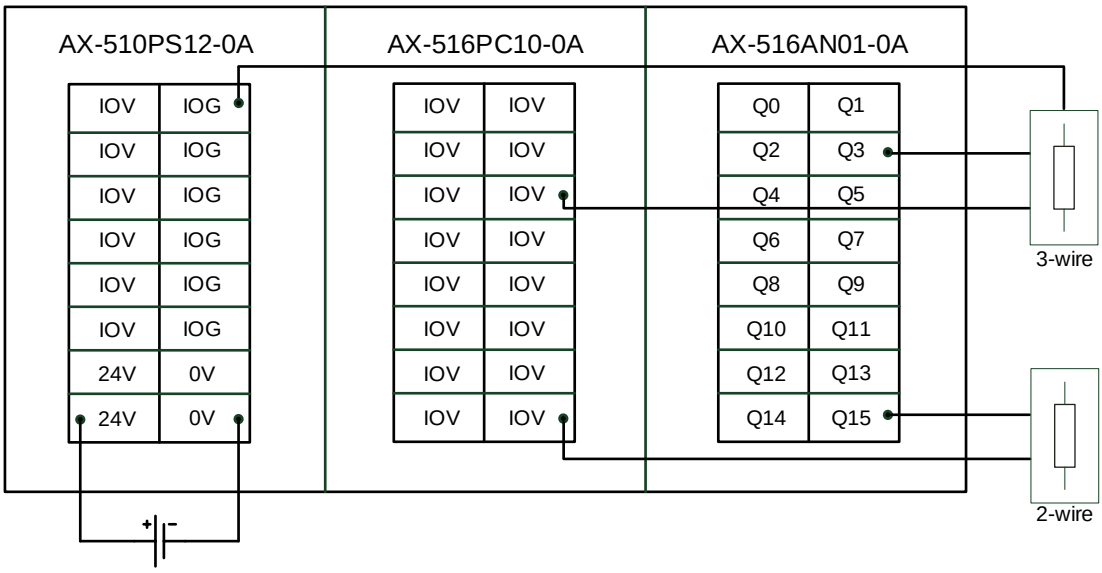
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	Q0	Digital output channel 0	R0	Q1	Digital output channel 1
L1	Q2	Digital output channel 2	R1	Q3	Digital output channel 3
L2	Q4	Digital output channel 4	R2	Q5	Digital output channel 5
L3	Q6	Digital output channel 6	R3	Q7	Digital output channel 7
L4	Q8	Digital output channel 8	R4	Q9	Digital output channel 9
L5	Q10	Digital output channel 10	R5	Q11	Digital output channel 11
L6	Q12	Digital output channel 12	R6	Q13	Digital output channel 13
L7	Q14	Digital output channel 14	R7	Q15	Digital output channel 15

4.3.3.2 LED Indicators

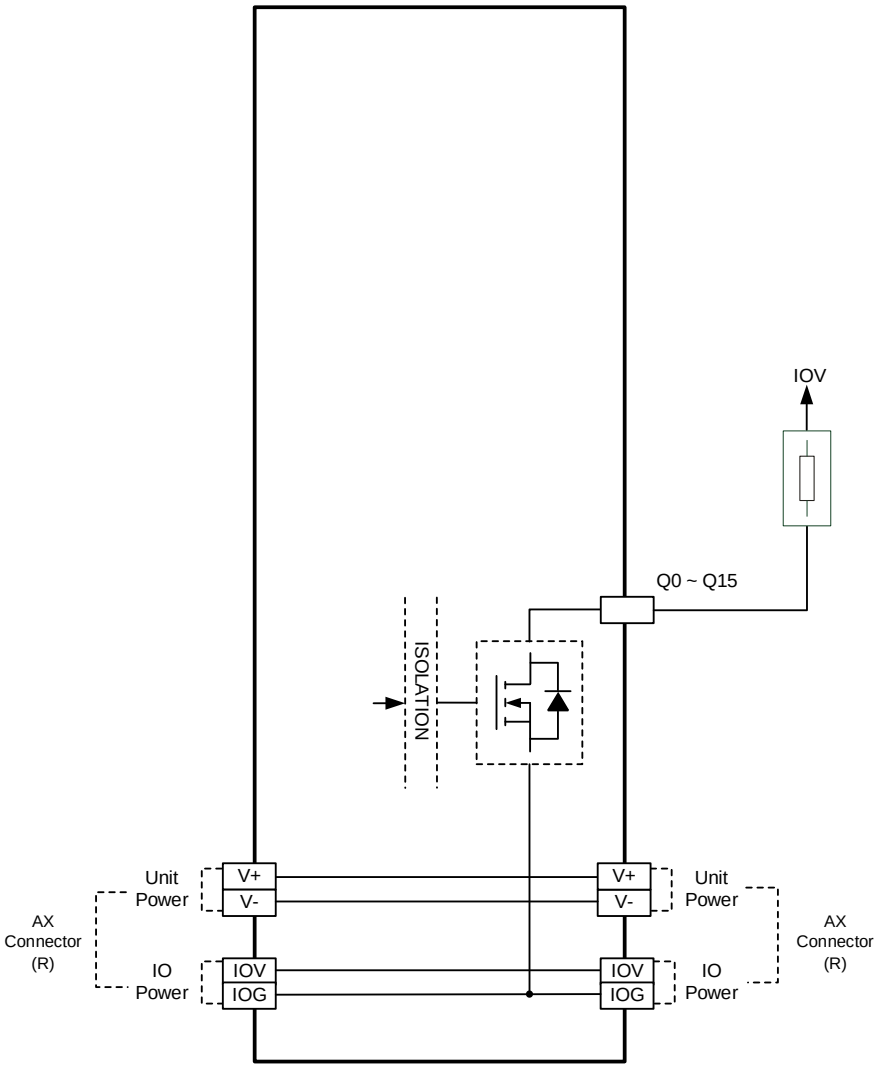
Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	**Normal (OP)**
Error	Red		OFF	Module is functioning correctly.
			ON	A severe error occurs on the module.
Channel	Green		OFF	The channel is OFF.
			ON	The channel is ON.

4.3.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



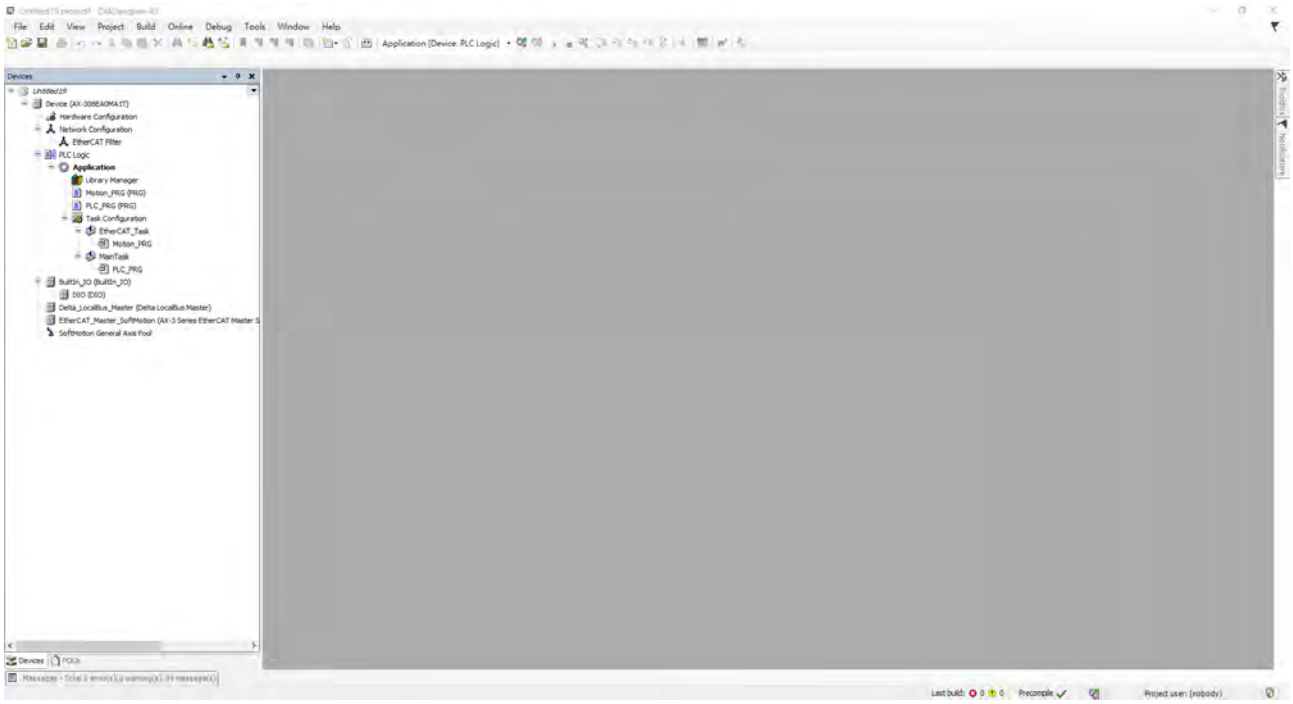
⚠	● The output circuit and internal circuit of this product are separated only by functional insulation. Therefore, to complete the installation of the product in the final system, double or reinforced insulation should be used between the product and hazardous live parts.

4.3.4 Settings in DIADesigner-AX

This section introduces some basic operations and settings in the DIADesigner-AX software.

4.3.4.1 Basic Operation

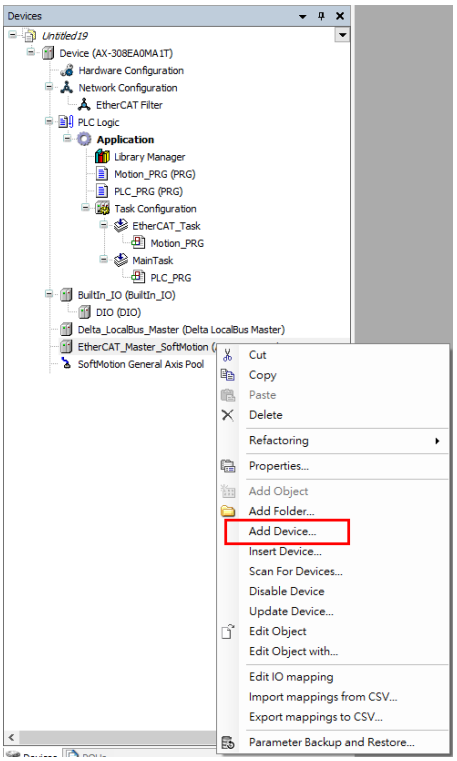
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



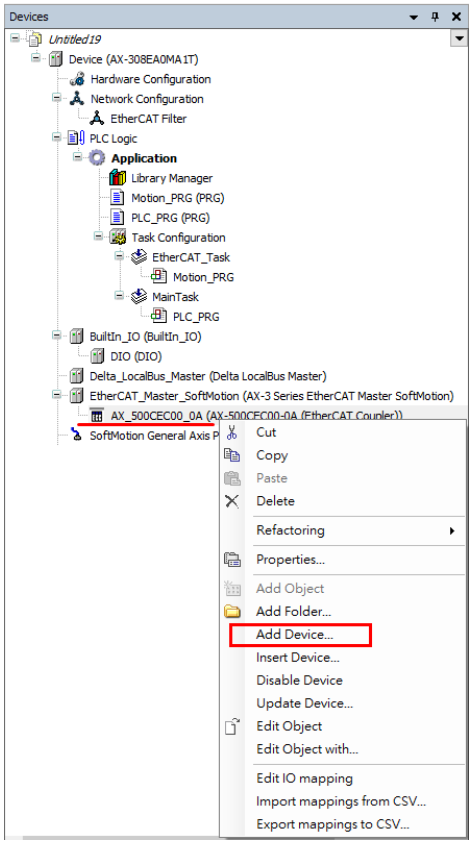
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Add Device…*** to select and add System Coupler.

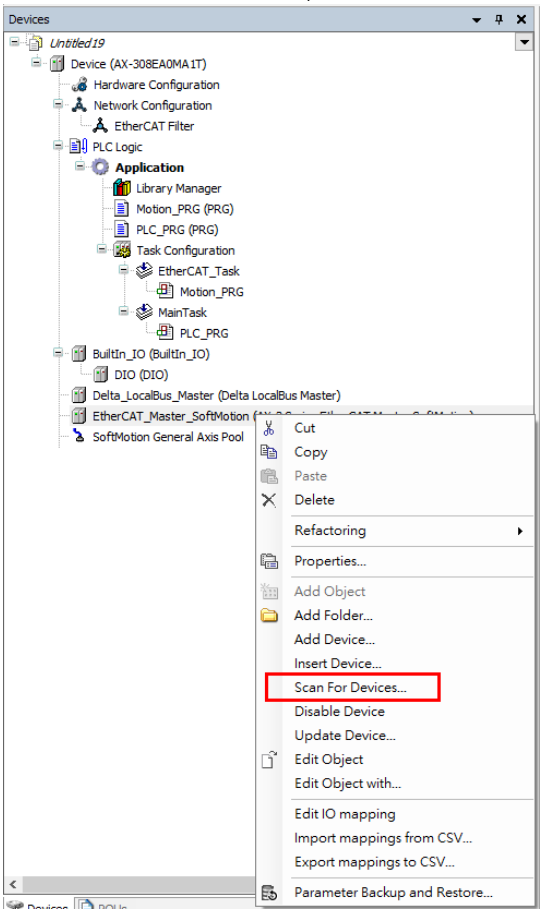


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

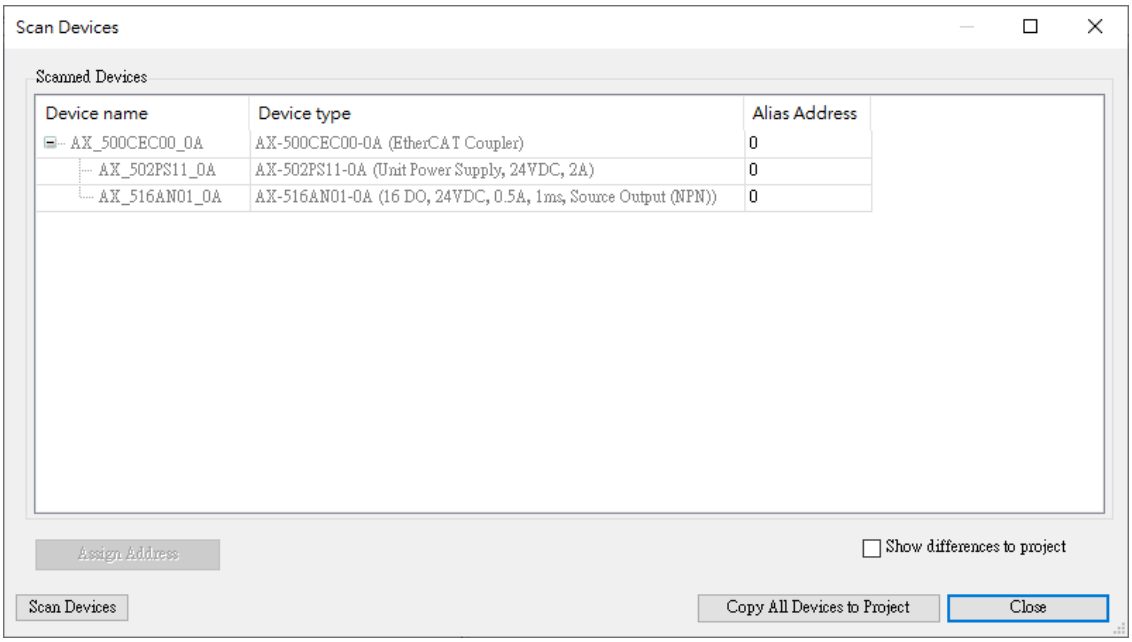


- Method 2: Scan to add the modules in.

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Scan for Devices…***.

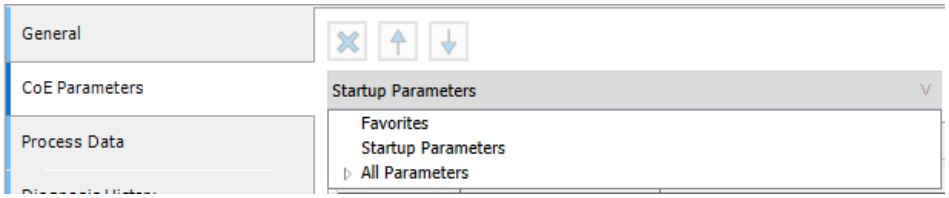


After the auto-scan is over, the actually-connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.



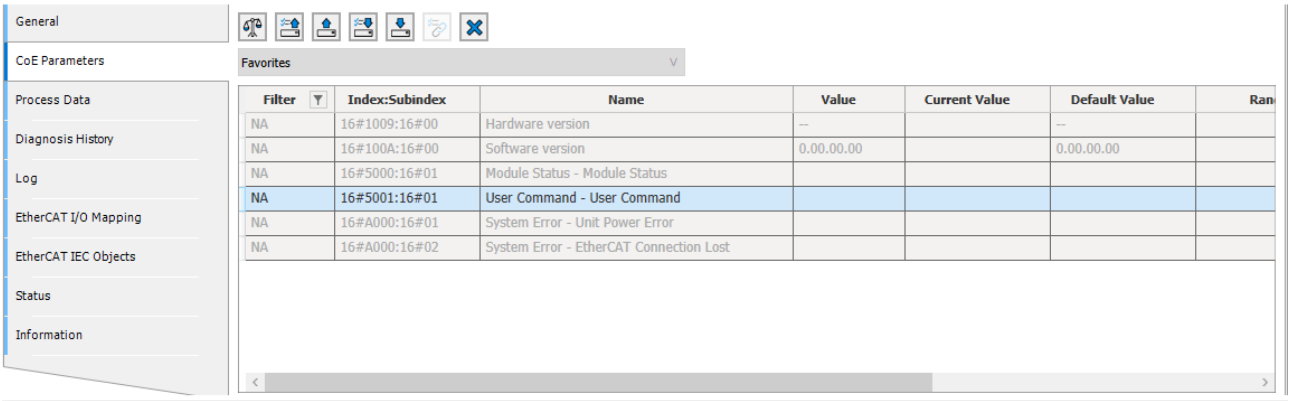
4.3.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.



(1) Favorites

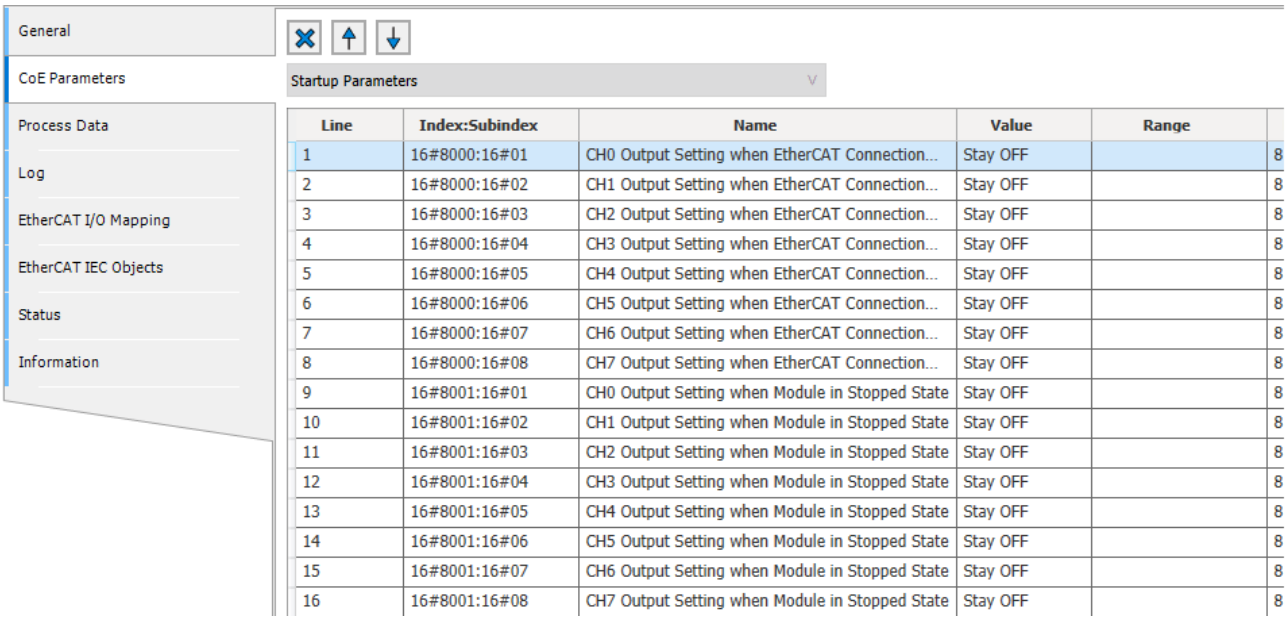
- You can add the selected parameter to Favorites according to your preference. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

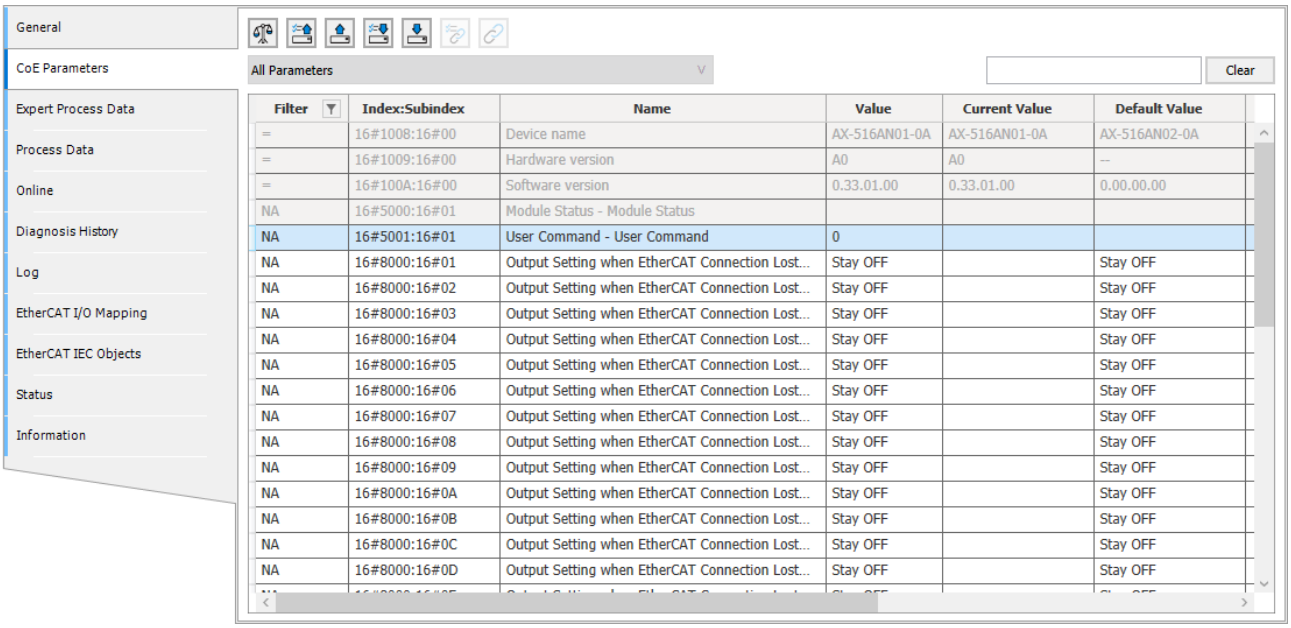


Line	Index:Subindex	Name	Value	Range
1	16#8000:16#01	CH0 Output Setting when EtherCAT Connection...	Stay OFF	
2	16#8000:16#02	CH1 Output Setting when EtherCAT Connection...	Stay OFF	
3	16#8000:16#03	CH2 Output Setting when EtherCAT Connection...	Stay OFF	
4	16#8000:16#04	CH3 Output Setting when EtherCAT Connection...	Stay OFF	
5	16#8000:16#05	CH4 Output Setting when EtherCAT Connection...	Stay OFF	
6	16#8000:16#06	CH5 Output Setting when EtherCAT Connection...	Stay OFF	
7	16#8000:16#07	CH6 Output Setting when EtherCAT Connection...	Stay OFF	
8	16#8000:16#08	CH7 Output Setting when EtherCAT Connection...	Stay OFF	
9	16#8001:16#01	CH0 Output Setting when Module in Stopped State	Stay OFF	
10	16#8001:16#02	CH1 Output Setting when Module in Stopped State	Stay OFF	
11	16#8001:16#03	CH2 Output Setting when Module in Stopped State	Stay OFF	
12	16#8001:16#04	CH3 Output Setting when Module in Stopped State	Stay OFF	
13	16#8001:16#05	CH4 Output Setting when Module in Stopped State	Stay OFF	
14	16#8001:16#06	CH5 Output Setting when Module in Stopped State	Stay OFF	
15	16#8001:16#07	CH6 Output Setting when Module in Stopped State	Stay OFF	
16	16#8001:16#08	CH7 Output Setting when Module in Stopped State	Stay OFF	

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

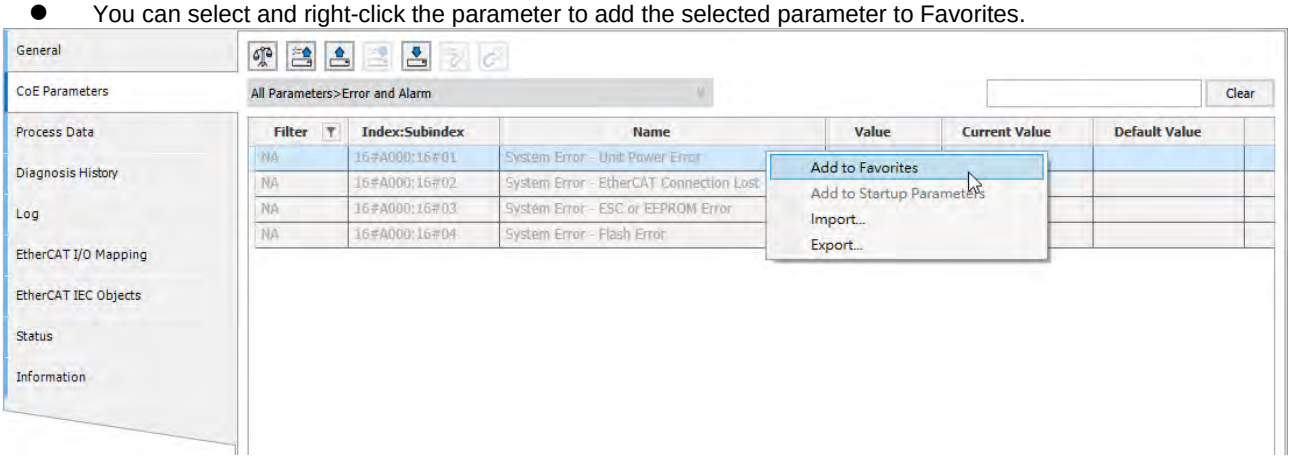
(3) All Parameters

- You can find all the CoE parameters here. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values of parameters in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

- You can select and right-click the parameter to add the selected parameter to Favorites.

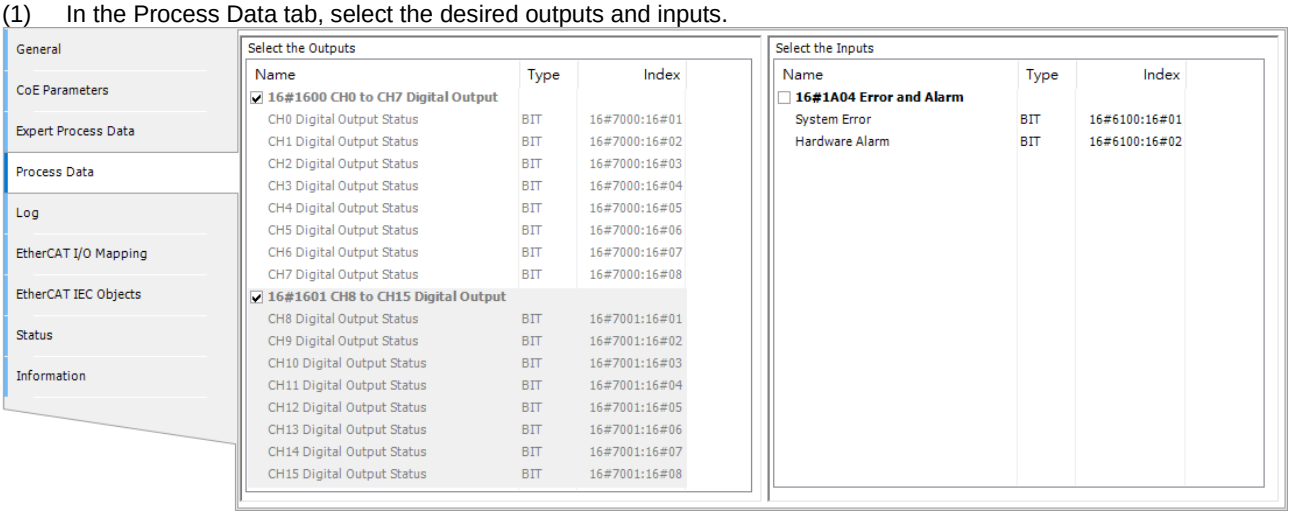


Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

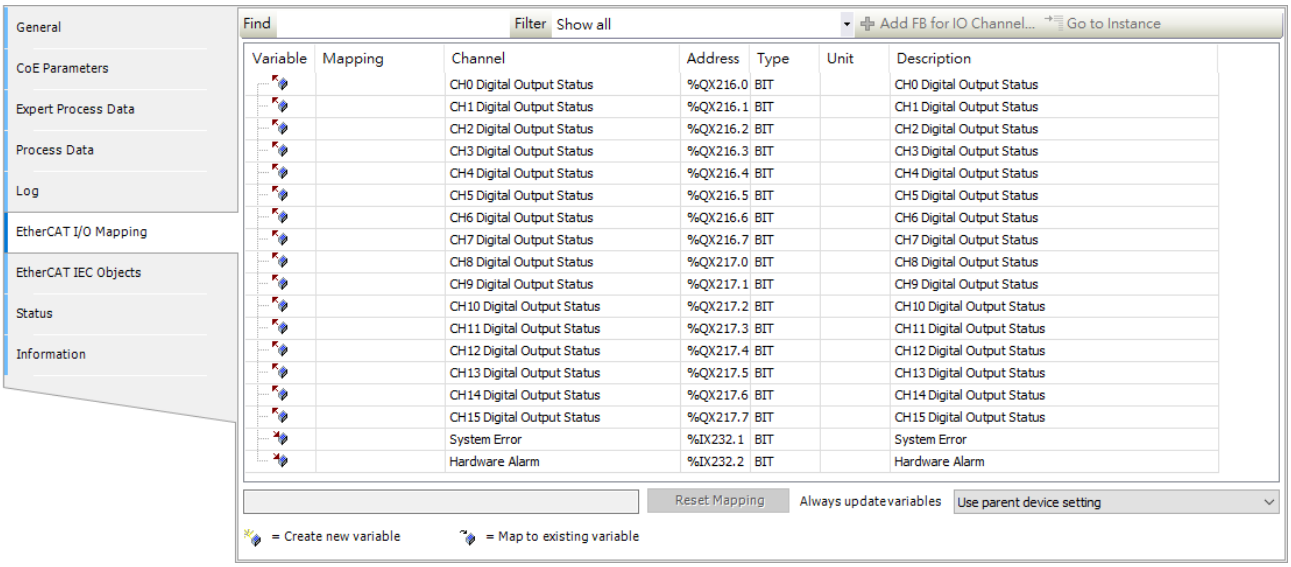
4

4.3.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.



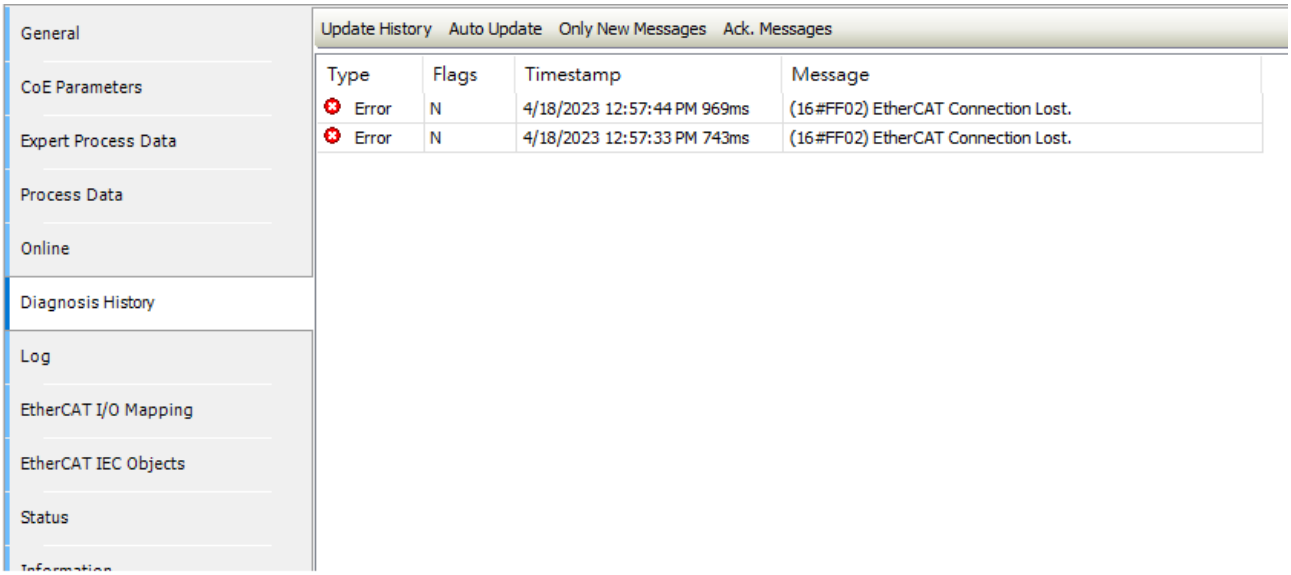
(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



4

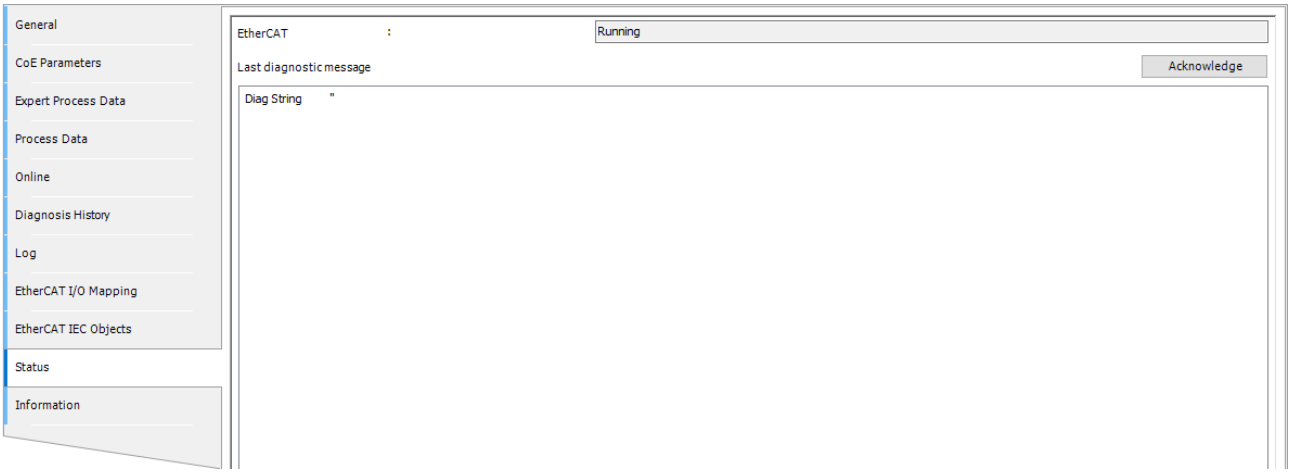
4.3.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors.



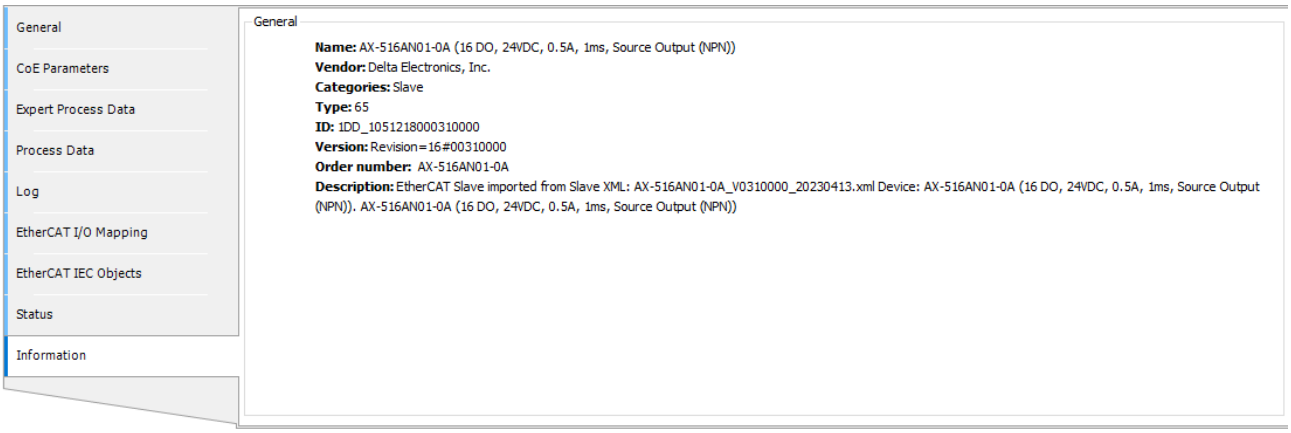
4.3.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



4.3.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version of the module.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.33.01.00	0.33.01.00	0.00.00.00

4.3.5 Parameter Descriptions

You can use DIADesigner-AX to set up the module. For software operation, refer to section 4.3.4 for more information.

Index	Function	Description
16#5000	Module Status	Status of the module
16#5001	User Command	Commands for users to use

Index	Function	Description
16#8000	Output Settings when EtherCAT Connection Lost	The setting for the output when the EtherCAT connection is lost.
16#8001	Output Settings when Module in Stopped State	The setting for the output when the module is in the stopped state.

4.3.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Parameter explanation**

This parameter displays the current control status of the module.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

4.3.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Parameter explanation**

Users write the commands into the module and the module will execute accordingly. After execution, the module will send back a corresponding value which indicates that the execution is success or failure.

- **User command**

Command	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

4.3.5.3 Output Settings when EtherCAT Connection Lost

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Output Settings when EtherCAT Connection Lost	Output behavior setting	USINT	RW	0
	16#02	CH1 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#03	CH2 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#04	CH3 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#05	CH4 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#06	CH5 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#07	CH6 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#08	CH7 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#09	CH8 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#0A	CH9 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#0B	CH10 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#0C	CH11 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#0D	CH12 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#0E	CH13 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#0F	CH14 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#10	CH15 Output Settings when EtherCAT Connection Lost		USINT	RW	0

- **Parameter explanation**

The parameter set is for setting the output behavior of output points when the EtherCAT connection is lost.

- **Output behavior settings**

Setting value	Name	Description
0	Stay OFF	The channel stays OFF.
1	Stay ON	The channel stays ON.
2	Keep Last Status	The channel keeps as the last status is.

4.3.5.4 Output Settings when Module in Stopped State

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Output Settings when Module in Stopped State	Output behavior setting	USINT	RW	0
	16#02	CH1 Output Settings when Module in Stopped State		USINT	RW	0
	16#03	CH2 Output Settings when Module in Stopped State		USINT	RW	0
	16#04	CH3 Output Settings when Module in Stopped State		USINT	RW	0
	16#05	CH4 Output Settings when Module in Stopped State		USINT	RW	0
	16#06	CH5 Output Settings when Module in Stopped State		USINT	RW	0
	16#07	CH6 Output Settings when Module in Stopped State		USINT	RW	0
	16#08	CH7 Output Settings when Module in Stopped State		USINT	RW	0
	16#09	CH8 Output Settings when Module in Stopped State		USINT	RW	0
	16#0A	CH9 Output Settings when Module in Stopped State		USINT	RW	0
	16#0B	CH10 Output Settings when Module in Stopped State		USINT	RW	0
	16#0C	CH11 Output Settings when Module in Stopped State		USINT	RW	0
	16#0D	CH12 Output Settings when Module in Stopped State		USINT	RW	0
	16#0E	CH13 Output Settings when Module in Stopped State		USINT	RW	0
	16#0F	CH14 Output Settings when Module in Stopped State		USINT	RW	0
	16#10	CH15 Output Settings when Module in Stopped State		USINT	RW	0

- **Parameter explanation**

The parameter set is for setting the output behavior of output points when the module is in the Stopped state.

- **Output behavior settings**

Setting value	Name	Description
0	Stay OFF	The channel stays OFF.
1	Stay ON	The channel stays ON.
2	Keep Update	The channel keeps updating the output.

4.3.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

4.3.6.1 FreeRun Mode

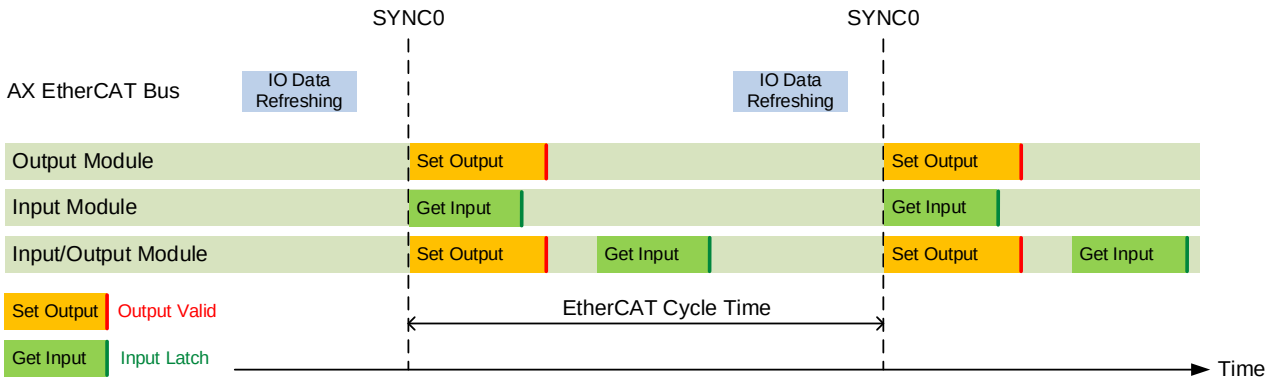
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

4.3.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

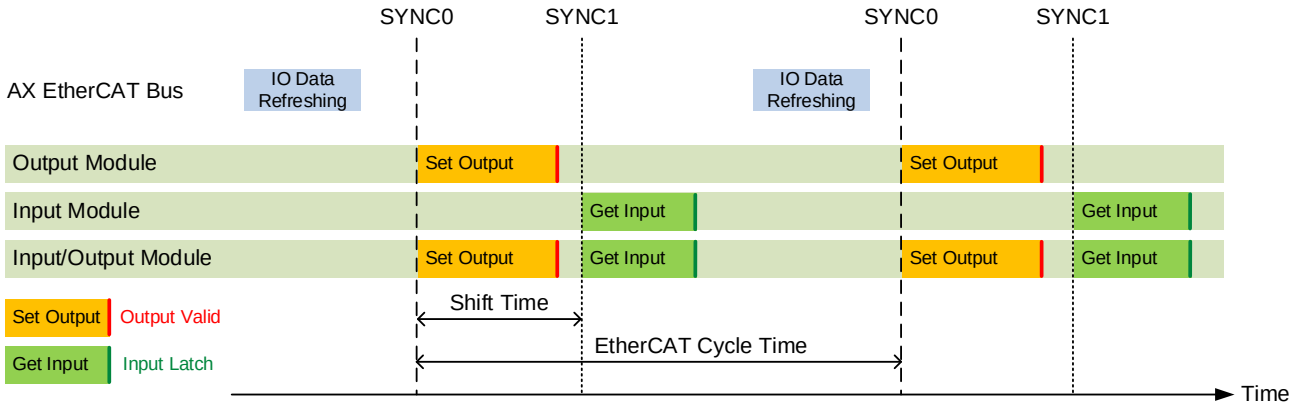
- **SYNC0**

Using SYNC0 to refresh values of output channels among modules at the same time.



- **SYNC0 + SYNC1**

Using SYNC0 to refresh values of outptut channels and using SYNC1 to refresh values of input channels among modules at the same time. The shift time between SYNC0 and SYNC1 can be modified with DIADesigner-AX.



4.3.7 Process Data

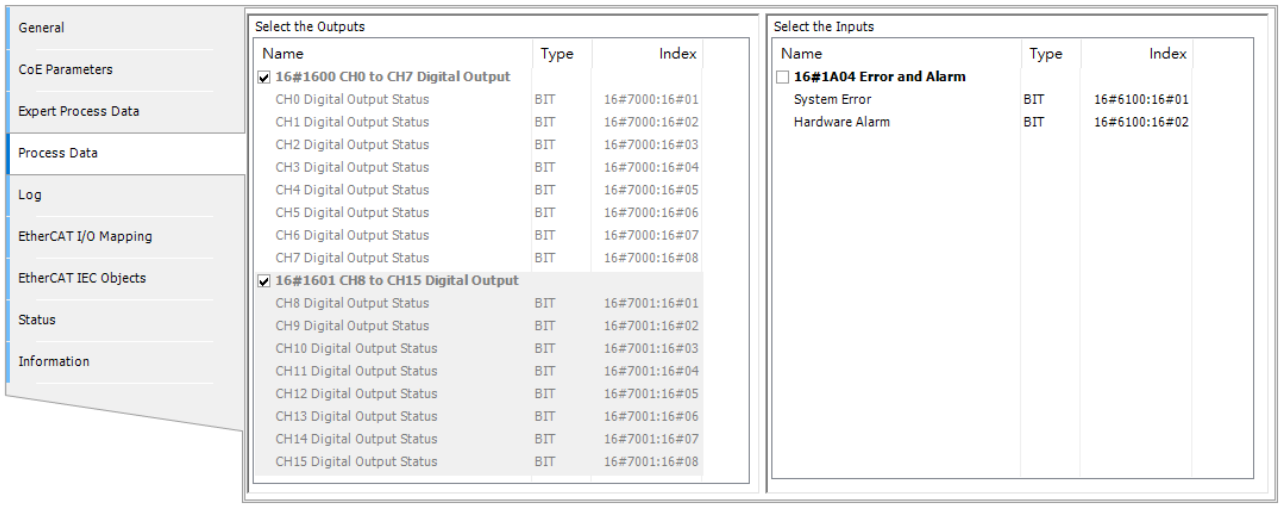
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#7000	16#01	CH0 Digital Output Status	Digital output values of CH0–CH7	BOOL	RO	0
	16#02	CH1 Digital Output Status		BOOL	RO	0
	16#03	CH2 Digital Output Status		BOOL	RO	0
	16#04	CH3 Digital Output Status		BOOL	RO	0
	16#05	CH4 Digital Output Status		BOOL	RO	0
	16#06	CH5 Digital Output Status		BOOL	RO	0
	16#07	CH6 Digital Output Status		BOOL	RO	0
	16#08	CH7 Digital Output Status		BOOL	RO	0
16#7001	16#01	CH8 Digital Output Status	Digital output values of CH8–CH15	BOOL	RO	0
	16#02	CH9 Digital Output Status		BOOL	RO	0
	16#03	CH10 Digital Output Status		BOOL	RO	0
	16#04	CH11 Digital Output Status		BOOL	RO	0
	16#05	CH12 Digital Output Status		BOOL	RO	0
	16#06	CH13 Digital Output Status		BOOL	RO	0
	16#07	CH14 Digital Output Status		BOOL	RO	0
	16#08	CH15 Digital Output Status		BOOL	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0
	16#02	Hardware Alarm	Hardware error alarm	BOOL	RO	0

4.3.7.1 Process Data

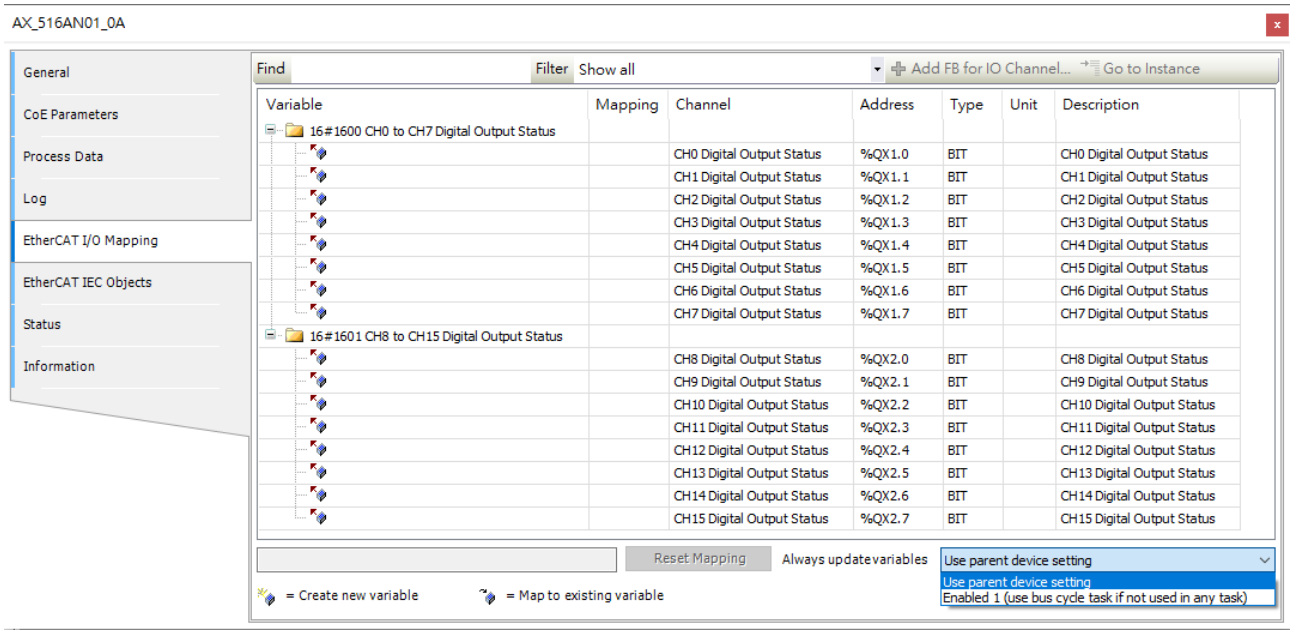
Go to the Process Data tab and select the data that you'd like to monitor.

- Digital Output Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Alarm: It is not selected by default.



4.3.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



4.3.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

4.3.8 Troubleshooting

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Disconnection	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
16#A001	16#01	(16#FF11) Channel Hardware Alarm	Blinking	Same as before	Check if the wiring for the channels is short-circuit or overcurrent

4.4 AX-516AN02-0A

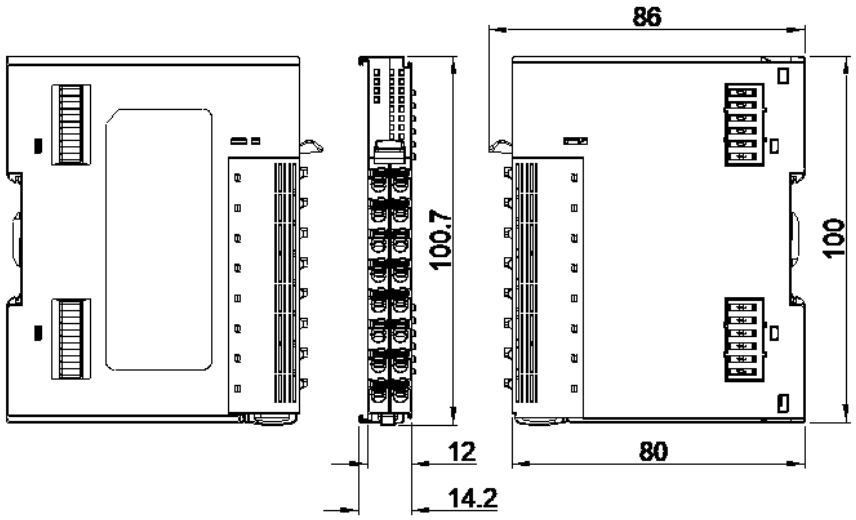
AX-516AN02-0A, a digital output module, outputs 16-point digital signals (PNP). This section introduces its specifications, operations and wirings.

4.4.1 Specifications

Item		Specification
Output points		16
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		70 g
Electrical specification	I/O form	Sourcing output (PNP)
	Load voltage	24 VDC (error range: -15%–+20%, 20.4–28.8 VDC)
	Maximum load current	0.5 A /point
	Leakage current	Less than 0.1 mA
	Maximum ON / OFF response time	150 µs /150 µs
	Isolation method	Between unit power and external power: no isolation Between digital signal and internal signal: 500 VAC Between channels: no isolation
	Maximum power consumption (unit power)	200 mA (1W)
	Maximum power consumption (I/O power)	24 VDC/8A
	Minimum power consumption (I/O Power)	10 mA
Others	Short Circuit Protection (SCP)	--
	Connection Lost Protection	--
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	Yes

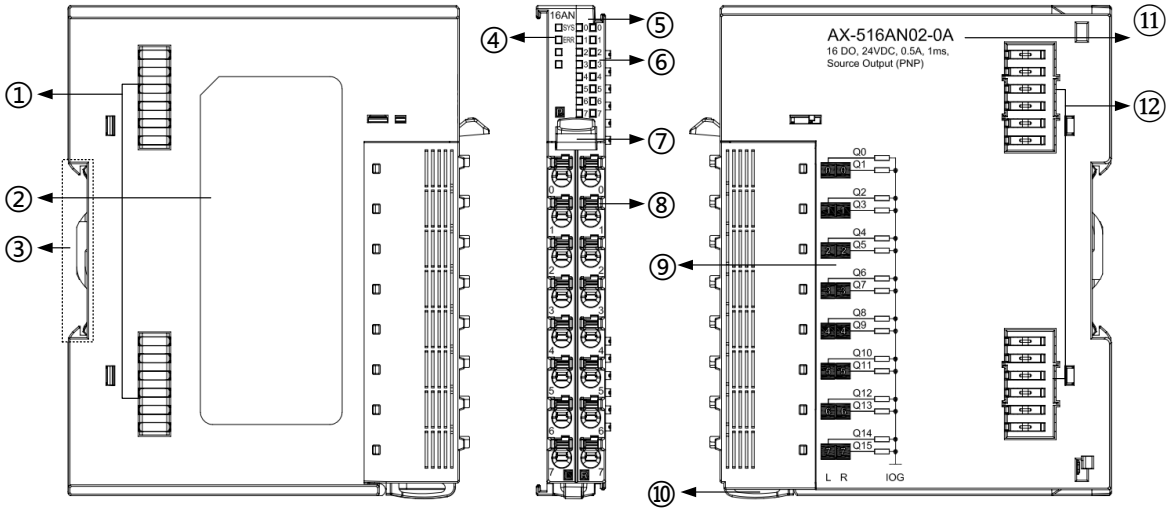
4.4.2 Dimensions and Parts

- **Dimensions**



Unit：mm

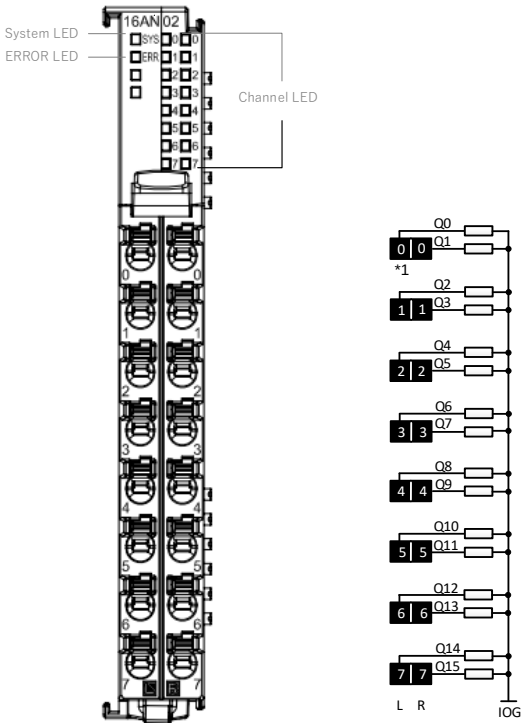
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

4.4.3 Arrangement of Terminals, LED Indicators and Wiring

4.4.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

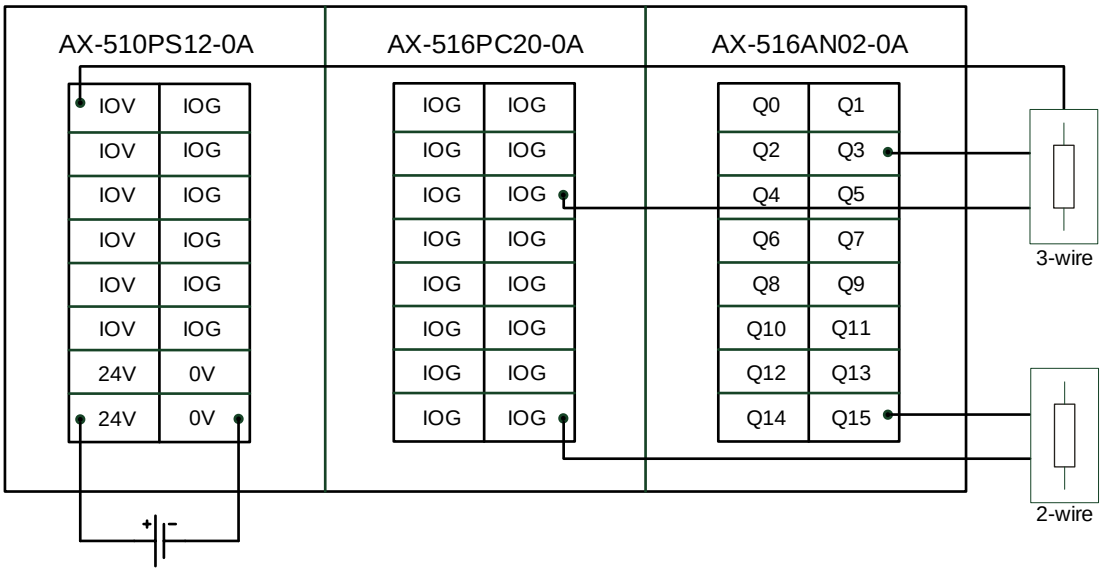
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	Q0	Digital output channel 0	R0	Q1	Digital output channel 1
L1	Q2	Digital output channel 2	R1	Q3	Digital output channel 3
L2	Q4	Digital output channel 4	R2	Q5	Digital output channel 5
L3	Q6	Digital output channel 6	R3	Q7	Digital output channel 7
L4	Q8	Digital output channel 8	R4	Q9	Digital output channel 9
L5	Q10	Digital output channel 10	R5	Q11	Digital output channel 11
L6	Q12	Digital output channel 12	R6	Q13	Digital output channel 13
L7	Q14	Digital output channel 14	R7	Q15	Digital output channel 15

4.4.3.2 LED Indicators

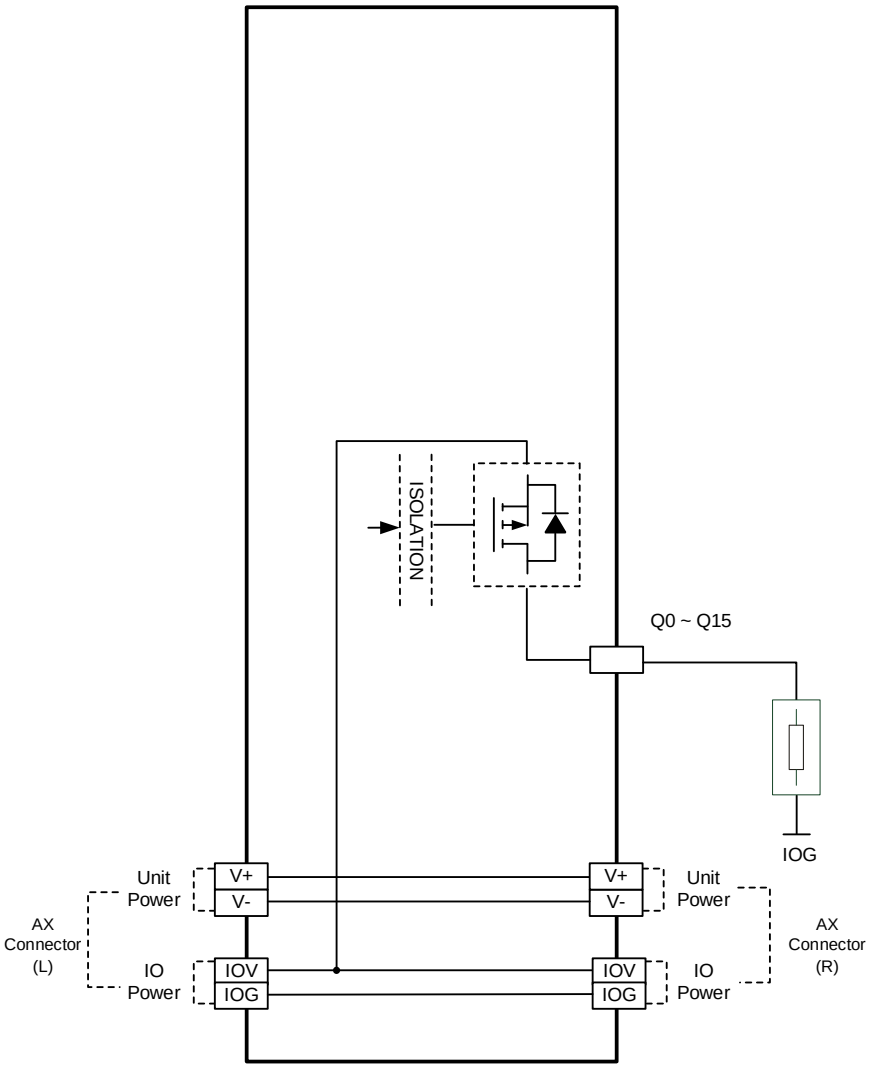
Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	Normal (OP)
Error	Red		OFF	Module is functioning correctly.
			ON	A severe error occurs on the module.
Channel	Green		OFF	The channel is OFF.
			ON	The channel is ON.

4.4.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



⚠	● The output circuit and internal circuit of this product are separated only by functional insulation. Therefore, to complete the installation of the product in the final system, double or reinforced insulation should be used between the product and hazardous live parts.

4.4.4 Settings in DIADesigner-AX

This section introduces some basic operations and settings in the DIADesigner-AX software.

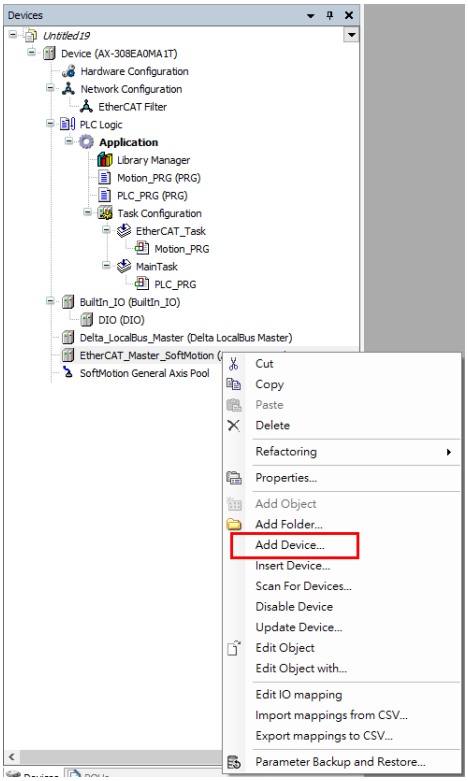
4.4.4.1 Basic Operation

(1) Double-click the DIADesigner-AX icon to open the software and create a new project.

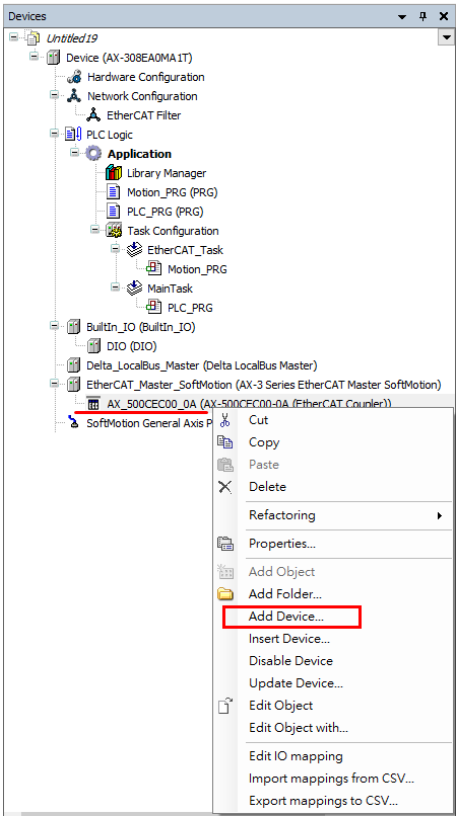
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Add Device…*** to select and add System Coupler.

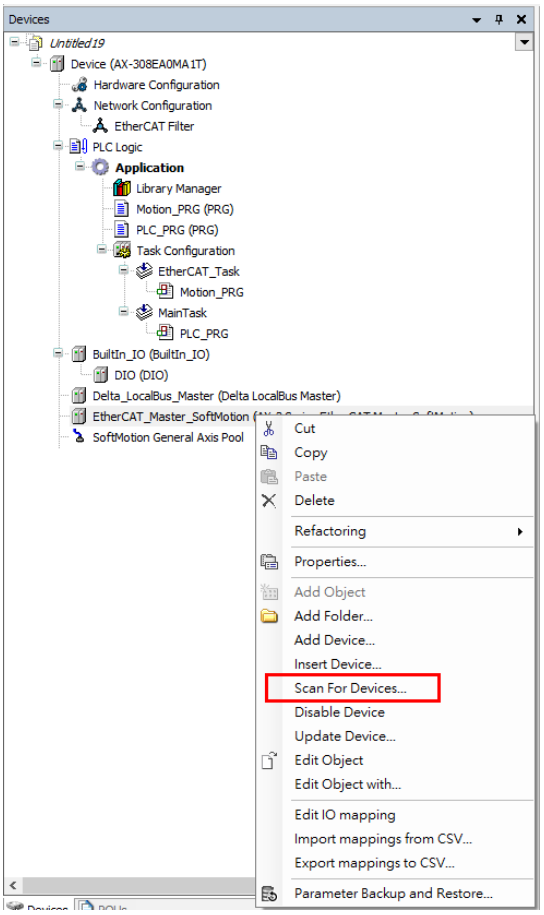


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

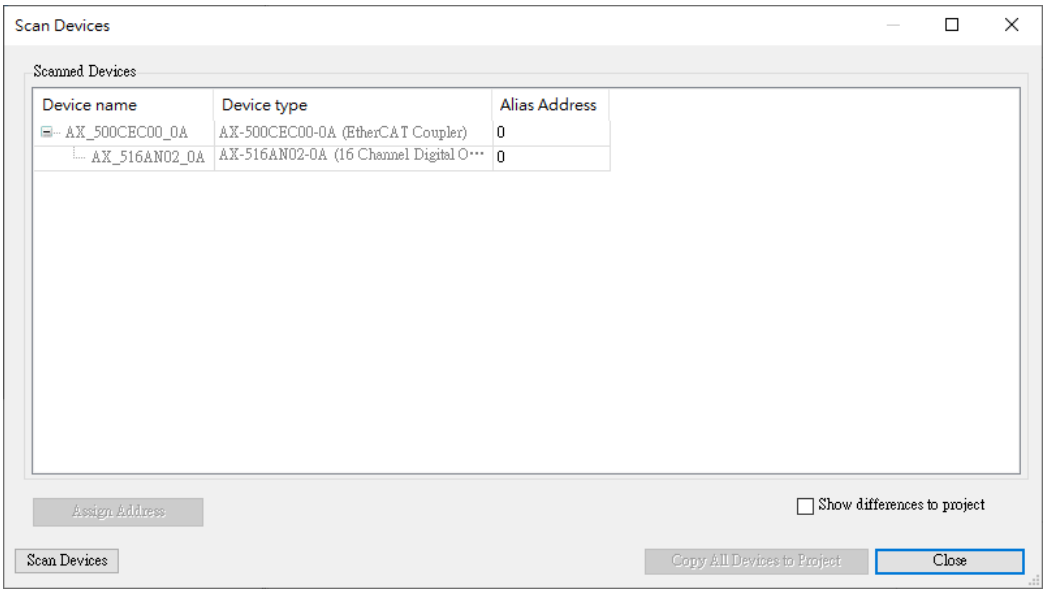


- Method 2: Scan to add the modules in.

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Scan for Devices…***.

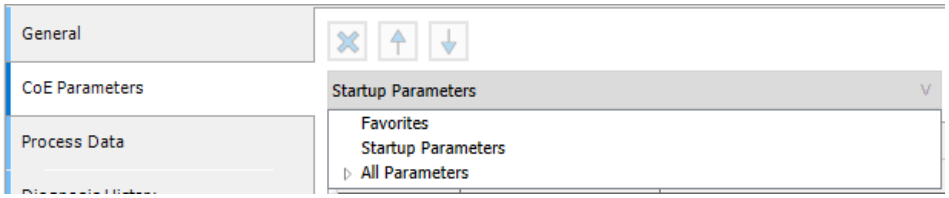


After the auto-scan is over, the actually-connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.



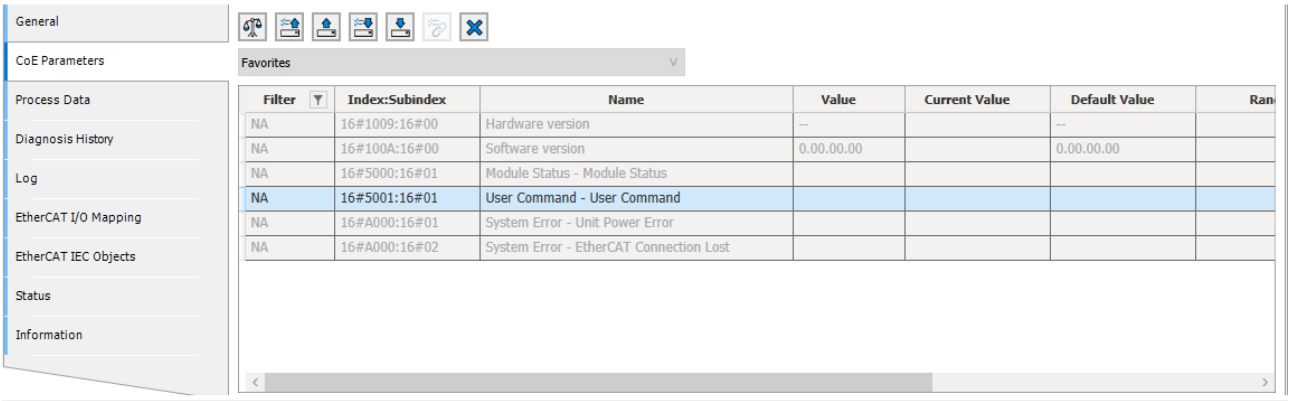
4.4.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.



(1) Favorites

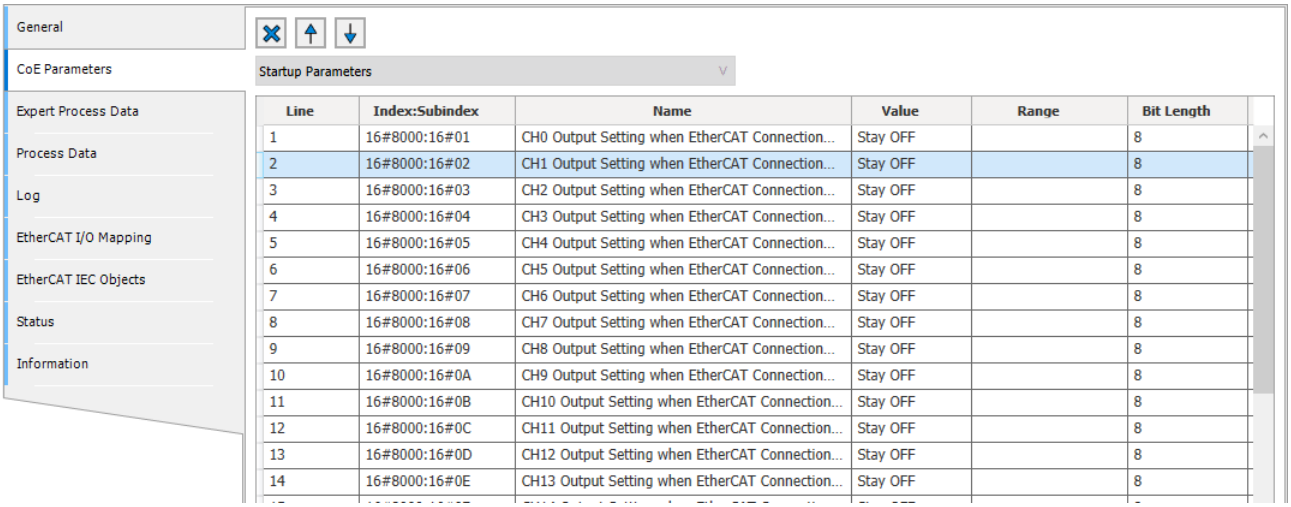
- You can add the selected parameter to Favorites according to your preference. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

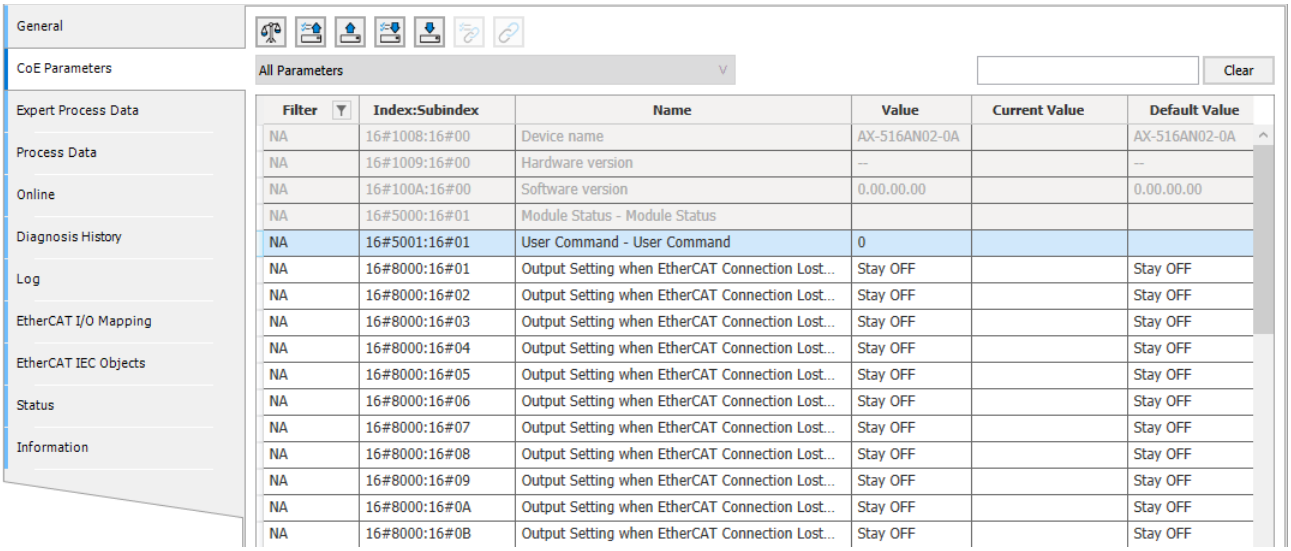


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Output Setting when EtherCAT Connection...	Stay OFF		8
2	16#8000:16#02	CH1 Output Setting when EtherCAT Connection...	Stay OFF		8
3	16#8000:16#03	CH2 Output Setting when EtherCAT Connection...	Stay OFF		8
4	16#8000:16#04	CH3 Output Setting when EtherCAT Connection...	Stay OFF		8
5	16#8000:16#05	CH4 Output Setting when EtherCAT Connection...	Stay OFF		8
6	16#8000:16#06	CH5 Output Setting when EtherCAT Connection...	Stay OFF		8
7	16#8000:16#07	CH6 Output Setting when EtherCAT Connection...	Stay OFF		8
8	16#8000:16#08	CH7 Output Setting when EtherCAT Connection...	Stay OFF		8
9	16#8000:16#09	CH8 Output Setting when EtherCAT Connection...	Stay OFF		8
10	16#8000:16#0A	CH9 Output Setting when EtherCAT Connection...	Stay OFF		8
11	16#8000:16#0B	CH10 Output Setting when EtherCAT Connection...	Stay OFF		8
12	16#8000:16#0C	CH11 Output Setting when EtherCAT Connection...	Stay OFF		8
13	16#8000:16#0D	CH12 Output Setting when EtherCAT Connection...	Stay OFF		8
14	16#8000:16#0E	CH13 Output Setting when EtherCAT Connection...	Stay OFF		8

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

(3) All Parameters

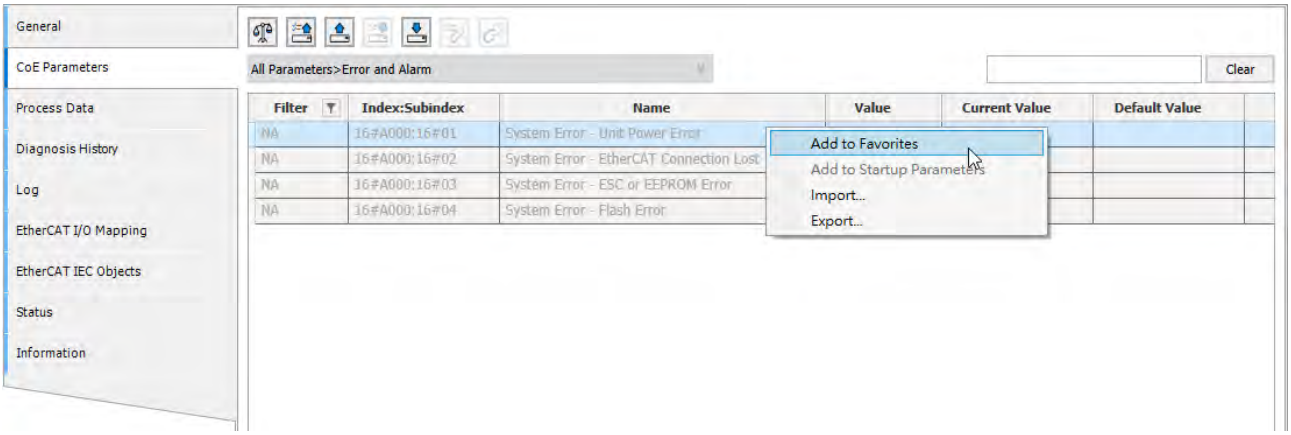
- You can find all the CoE parameters here. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values of parameters in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Filter	Index:Subindex	Name	Value	Current Value	Default Value
NA	16#1008:16#00	Device name	AX-516AN02-0A		AX-516AN02-0A
NA	16#1009:16#00	Hardware version	--		--
NA	16#100A:16#00	Software version	0.00.00.00		0.00.00.00
NA	16#5000:16#01	Module Status - Module Status			
NA	16#5001:16#01	User Command - User Command	0		
NA	16#8000:16#01	Output Setting when EtherCAT Connection Lost...	Stay OFF		Stay OFF
NA	16#8000:16#02	Output Setting when EtherCAT Connection Lost...	Stay OFF		Stay OFF
NA	16#8000:16#03	Output Setting when EtherCAT Connection Lost...	Stay OFF		Stay OFF
NA	16#8000:16#04	Output Setting when EtherCAT Connection Lost...	Stay OFF		Stay OFF
NA	16#8000:16#05	Output Setting when EtherCAT Connection Lost...	Stay OFF		Stay OFF
NA	16#8000:16#06	Output Setting when EtherCAT Connection Lost...	Stay OFF		Stay OFF
NA	16#8000:16#07	Output Setting when EtherCAT Connection Lost...	Stay OFF		Stay OFF
NA	16#8000:16#08	Output Setting when EtherCAT Connection Lost...	Stay OFF		Stay OFF
NA	16#8000:16#09	Output Setting when EtherCAT Connection Lost...	Stay OFF		Stay OFF
NA	16#8000:16#0A	Output Setting when EtherCAT Connection Lost...	Stay OFF		Stay OFF
NA	16#8000:16#0B	Output Setting when EtherCAT Connection Lost...	Stay OFF		Stay OFF

Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

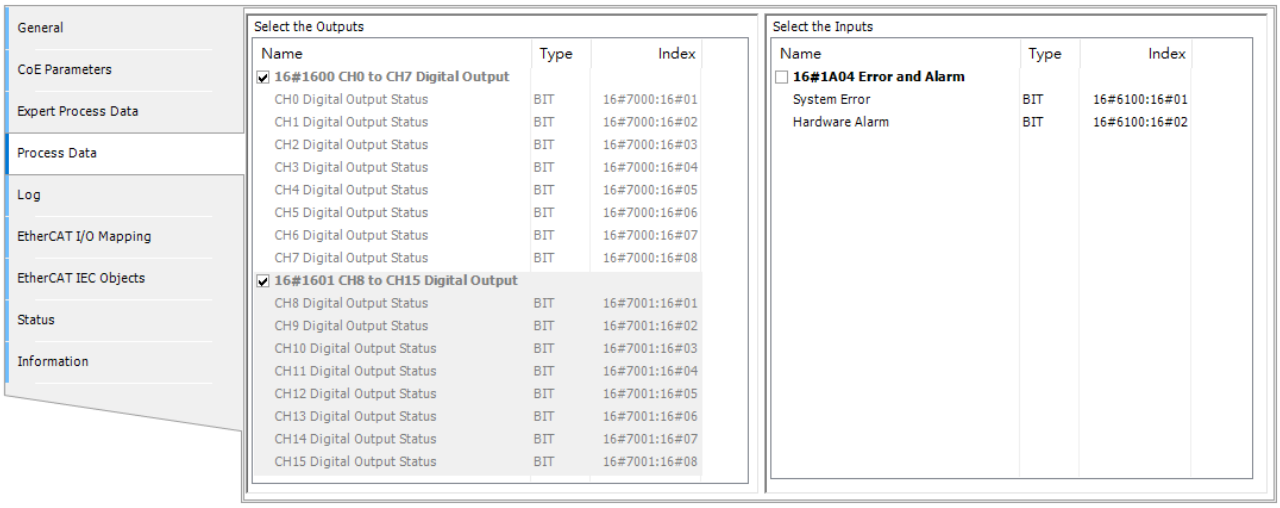
- You can select and right-click the parameter to add the selected parameter to the Favorites.



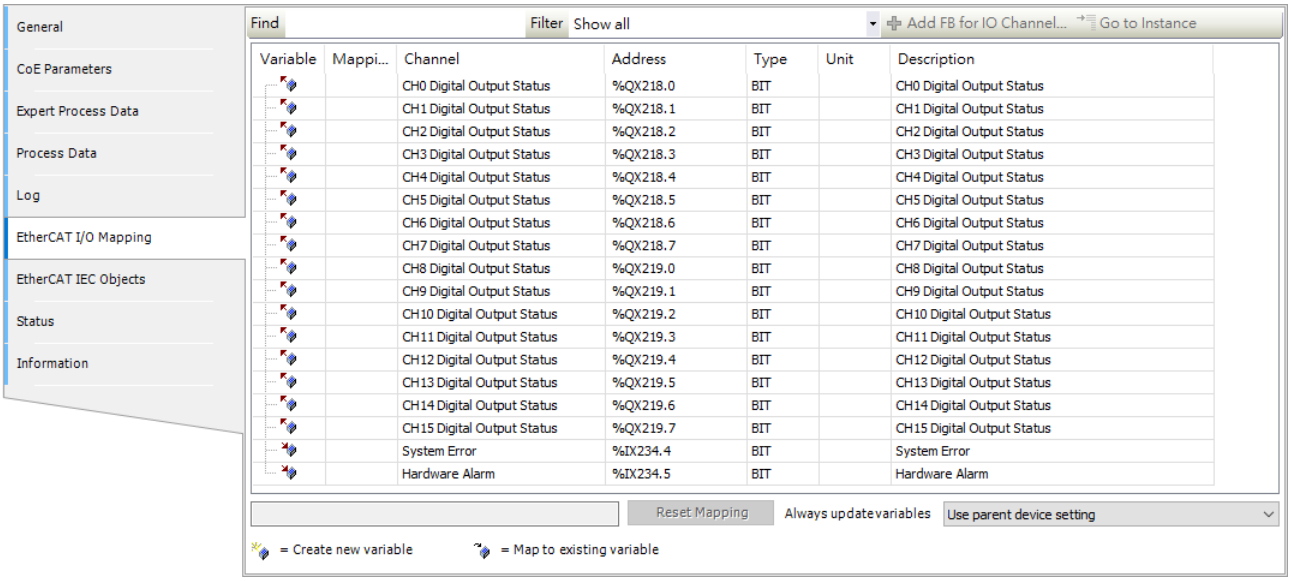
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

4.4.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

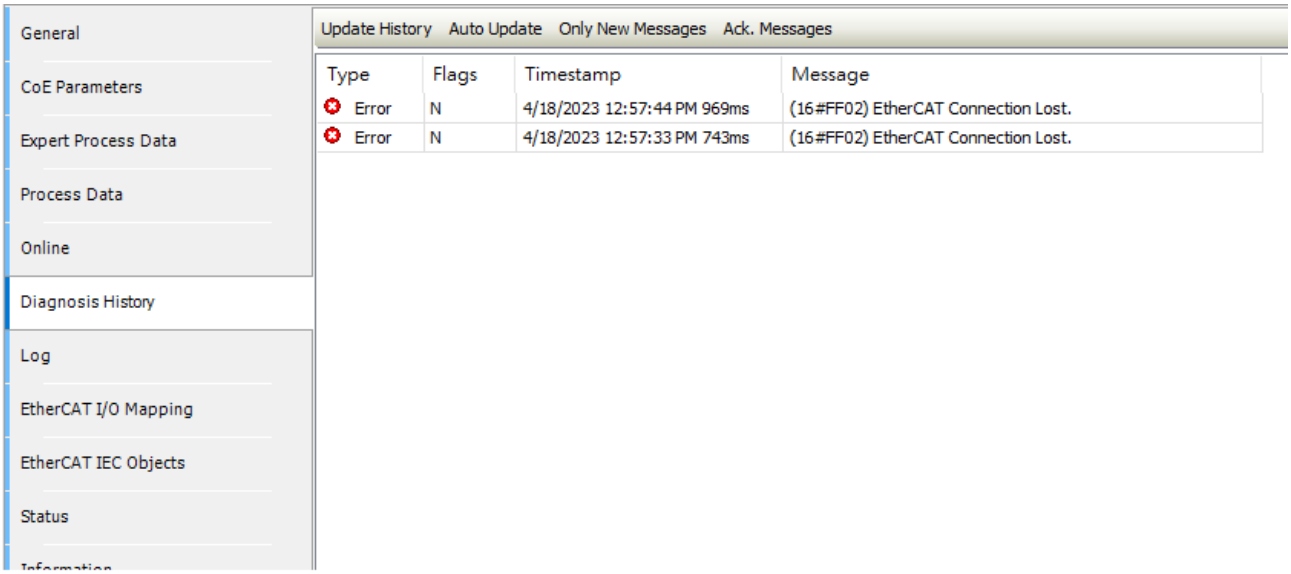


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



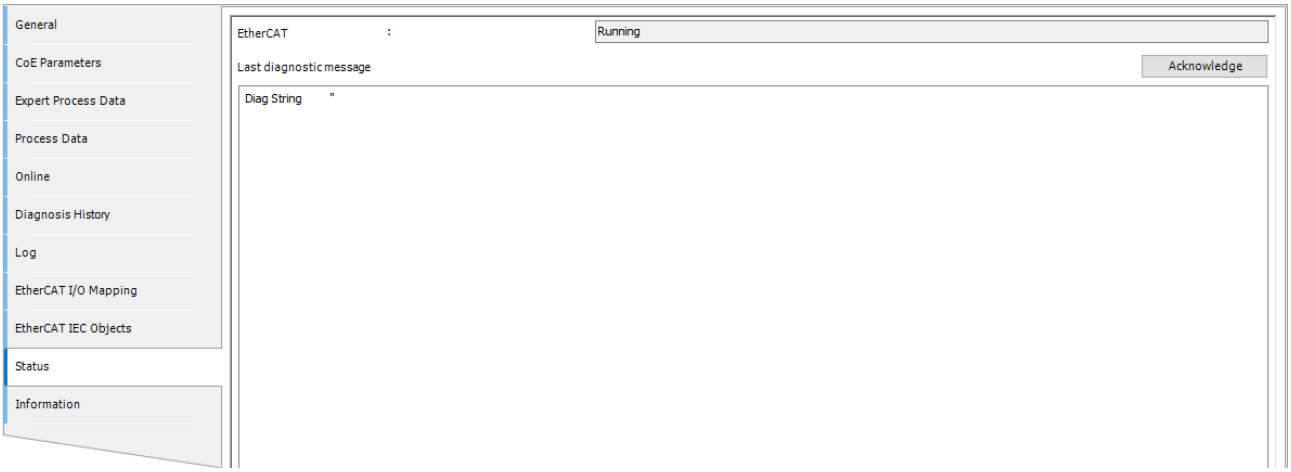
4.4.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors.



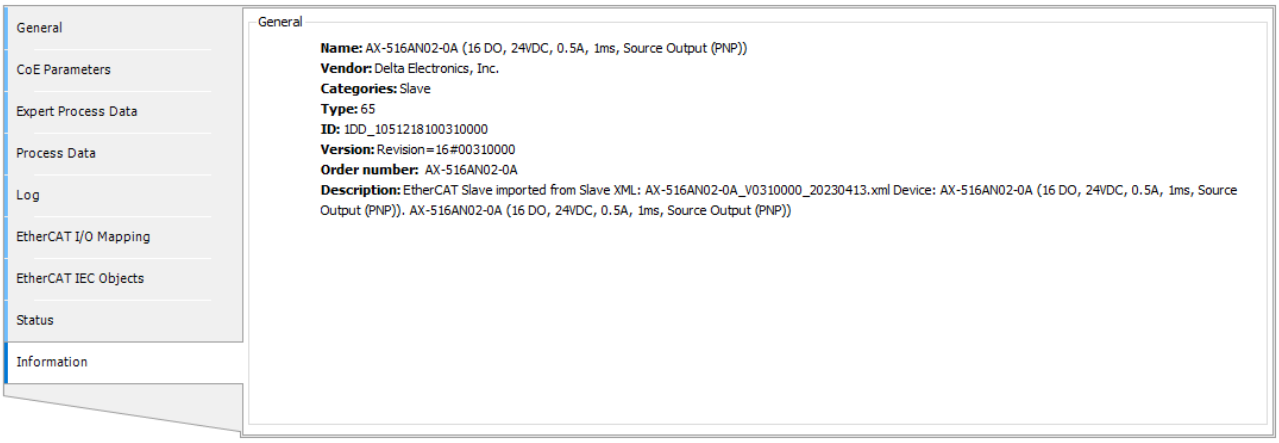
4.4.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



4.4.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version of the module.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.33.01.00	0.33.01.00	0.00.00.00

4.4.5 Parameter Descriptions

You can use DIADesigner-AX to set up the module. For software operation, refer to section 4.4.4 for more information.

Index	Function	Description
16#5000	Module Status	Status of the module
16#5001	User Command	Commands for users to use
16#8000	Output Settings when EtherCAT Connection Lost	The setting for the output when the EtherCAT connection is lost.
16#8001	Output Settings when Module in Stopped State	The setting for the output when the module is in the stopped state.

4.4.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Parameter explanation**

This parameter displays the current control status of the module.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.

Value	Status	Description
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

4.4.5.2 User Command

Users write the commands into the module and the module will execute accordingly. After execution, the module will respond with a corresponding value to show if the execution is success or not.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Parameter explanation**

Users write the commands into the module and the module will execute accordingly. After execution, the module will send back a corresponding value which indicates that the execution is success or failure.

- **User command**

Command	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

4.4.5.3 Output Settings when EtherCAT Connection Lost

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Output Settings when EtherCAT Connection Lost	Output behavior setting	USINT	RW	0
	16#02	CH1 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#03	CH2 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#04	CH3 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#05	CH4 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#06	CH5 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#07	CH6 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#08	CH7 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#09	CH8 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#0A	CH9 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#0B	CH10 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#0C	CH11 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#0D	CH12 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#0E	CH13 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#0F	CH14 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#10	CH15 Output Settings when EtherCAT Connection Lost		USINT	RW	0

- **Parameter explanation**

The parameter set is for setting the output behavior of output points when the EtherCAT connection is lost.

- **Output behavior settings**

Setting value	Name	Description
0	Stay OFF	The channel stays OFF.
1	Stay ON	The channel stays ON.
2	Keep Last Status	The channel keeps as the last status is.

4.4.5.4 Output Settings when Module in Stopped State

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Output Settings when Module in Stopped State	Output behavior setting	USINT	RW	0
	16#02	CH1 Output Settings when Module in Stopped State		USINT	RW	0
	16#03	CH2 Output Settings when Module in Stopped State		USINT	RW	0
	16#04	CH3 Output Settings when Module in Stopped State		USINT	RW	0
	16#05	CH4 Output Settings when Module in Stopped State		USINT	RW	0
	16#06	CH5 Output Settings when Module in Stopped State		USINT	RW	0
	16#07	CH6 Output Settings when Module in Stopped State		USINT	RW	0
	16#08	CH7 Output Settings when Module in Stopped State		USINT	RW	0
	16#09	CH8 Output Settings when Module in Stopped State		USINT	RW	0
	16#0A	CH9 Output Settings when Module in Stopped State		USINT	RW	0
	16#0B	CH10 Output Settings when Module in Stopped State		USINT	RW	0
	16#0C	CH11 Output Settings when Module in Stopped State		USINT	RW	0
	16#0D	CH12 Output Settings when Module in Stopped State		USINT	RW	0
	16#0E	CH13 Output Settings when Module in Stopped State		USINT	RW	0
	16#0F	CH14 Output Settings when Module in Stopped State		USINT	RW	0
	16#10	CH15 Output Settings when Module in Stopped State		USINT	RW	0

- **Parameter explanation**

The parameter set is for setting the output behavior of output points when the module is in the Stopped state.

- **Output behavior settings**

Setting value	Name	Description
0	Stay OFF	The channel stays OFF.
1	Stay ON	The channel stays ON.
2	Keep Update	The channel keeps updating the output.

4.4.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

4.4.6.1 FreeRun Mode

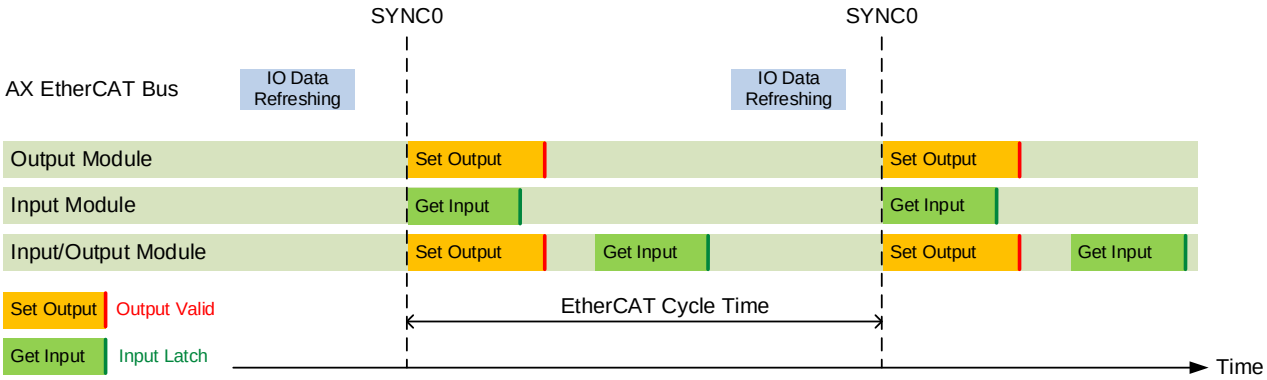
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

4.4.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

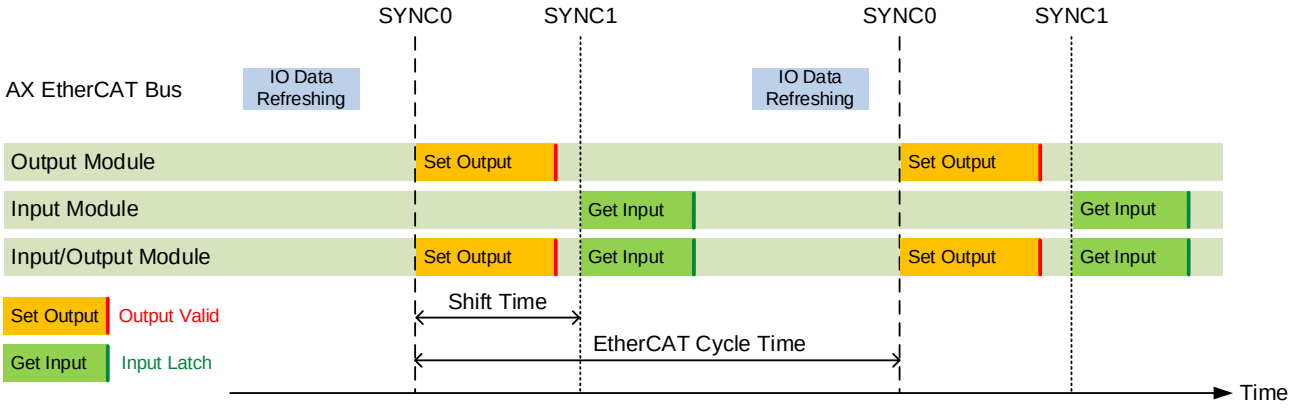
- **SYNC0**

Using SYNC0 to refresh values of output channels among modules at the same time.



- **SYNC0 + SYNC1**

Using SYNC0 to refresh values of outptut channels and using SYNC1 to refresh values of input channels among modules at the same time. The shift time between SYNC0 and SYNC1 can be modified with DIADesigner-AX.



4.4.7 Process Data

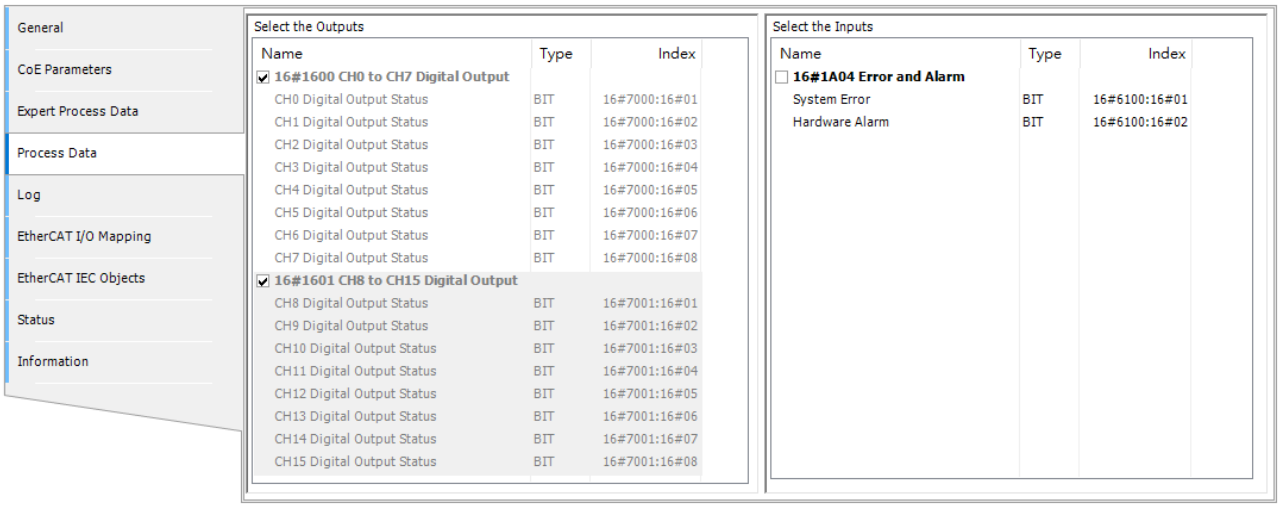
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#7000	16#01	CH0 Digital Output Status	Digital output values of CH0–CH7	BOOL	RO	0
	16#02	CH1 Digital Output Status		BOOL	RO	0
	16#03	CH2 Digital Output Status		BOOL	RO	0
	16#04	CH3 Digital Output Status		BOOL	RO	0
	16#05	CH4 Digital Output Status		BOOL	RO	0
	16#06	CH5 Digital Output Status		BOOL	RO	0
	16#07	CH6 Digital Output Status		BOOL	RO	0
	16#08	CH7 Digital Output Status		BOOL	RO	0
16#7001	16#01	CH8 Digital Output Status	Digital output values of CH8–CH15	BOOL	RO	0
	16#02	CH9 Digital Output Status		BOOL	RO	0
	16#03	CH10 Digital Output Status		BOOL	RO	0
	16#04	CH11 Digital Output Status		BOOL	RO	0
	16#05	CH12 Digital Output Status		BOOL	RO	0
	16#06	CH13 Digital Output Status		BOOL	RO	0
	16#07	CH14 Digital Output Status		BOOL	RO	0
	16#08	CH15 Digital Output Status		BOOL	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0
	16#02	Hardware Alarm	Hardware error alarm	BOOL	RO	0

4.4.7.1 Process Data

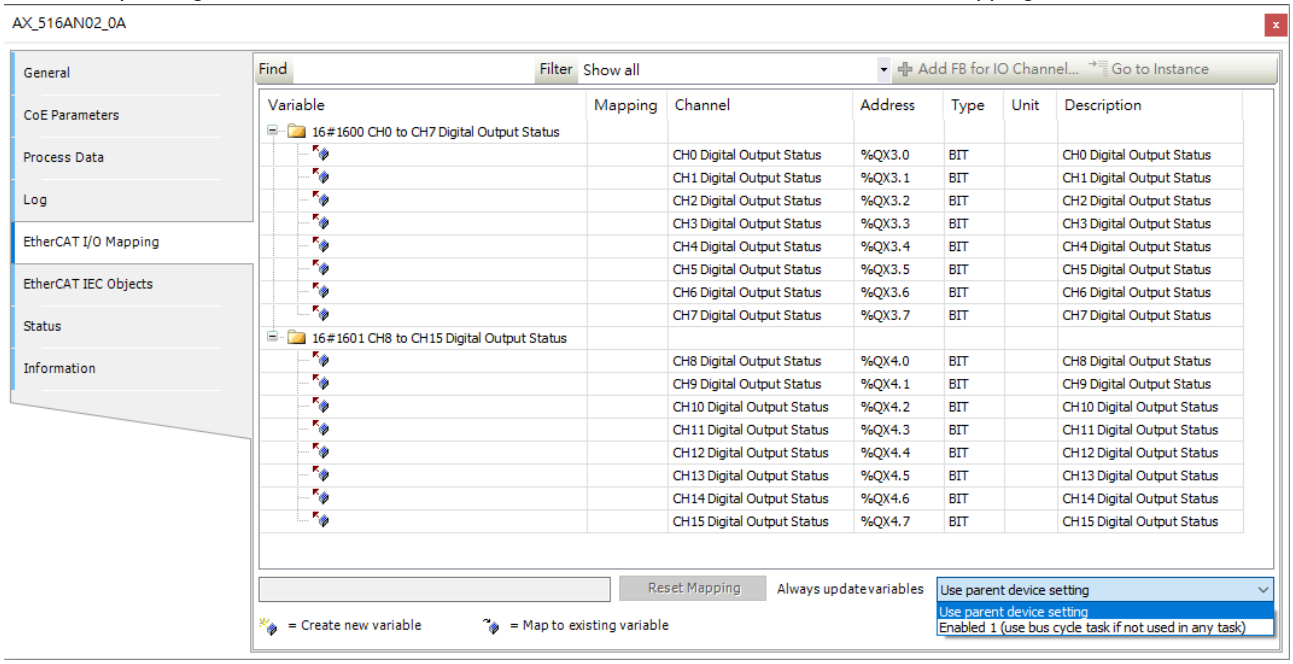
Go to the Process Data tab and select the data that you'd like to monitor. There are two types of data here.

- Digital Output Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Alarm: It is not selected by default.



4.4.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



4.4.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

4.4.8 Troubleshooting

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Disconnection	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
16#A001	16#01	(16#FF11) Channel Hardware Alarm	Blinking	Same as before	Check if the wiring for the channels is short-circuit or overcurrent

4.5 AX-516AP11-0A

AX-516AP11-0A, a digital input / output module, inputs 8-point digital signals and outputs 8-point digital signals (NPN). This section introduces its specifications, operations and wirings.

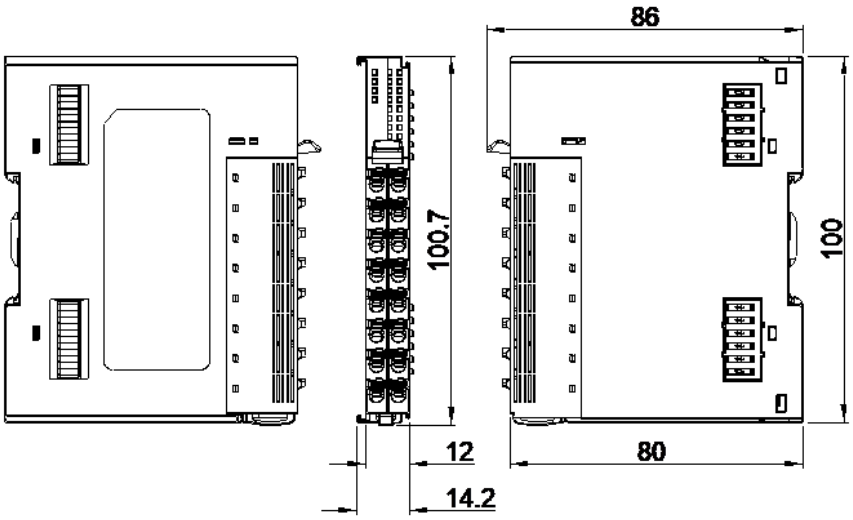
4.5.1 Specifications

Item			Specification
Input / output points			8 / 8
External connector type			Spring-clamp terminal block (16 terminals)
I/O refresh modes			1. Free Run mode 2. DC mode
Dimension (mm)			12(W) × 100 (H) × 80 (D)
Weight			70 g
Electrical specification	Digital input	I/O form	Sourcing input (NPN)
		Input current	2.5 mA TYP. (24 VDC), constant current
		ON voltage	11–30 V (EN 61131-2, type 3)
		OFF voltage	-3–+5 V (EN 61131-2, type 3)
		Maximum ON / OFF response time	150 μs /150 μs
	Digital output	I/O form	Sinking output (NPN)
		Load voltage	24 VDC (error range: -15%–+20%, 20.4–28.8 VDC)
		Maximum load current	0.5 A /point, 1A/8 points*1
		Leakage current	Less than 0.1 mA
		Maximum ON / OFF response time	150 μs /150 μs
	Isolation method		Between unit power and external power: no isolation Between digital signal and internal signal: 500 VAC Between channels: no isolation
	Maximum power consumption (unit power)		200 mA (1W)
	Maximum power consumption (I/O power)		24 VDC/1A
	Minimum power consumption (I/O Power)		10 mA
Others	Digital input	Connection Lost Protection	--
		Short Circuit Protection (SCP)	--
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	Current limiting
		Filter function	Firmware filtering time: 0-255 ms (default: 3 ms)
	Digital output	Connection Lost Protection	--
		Short Circuit Protection (SCP)	--
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	Yes

*1. Available for hardware A0 edition.

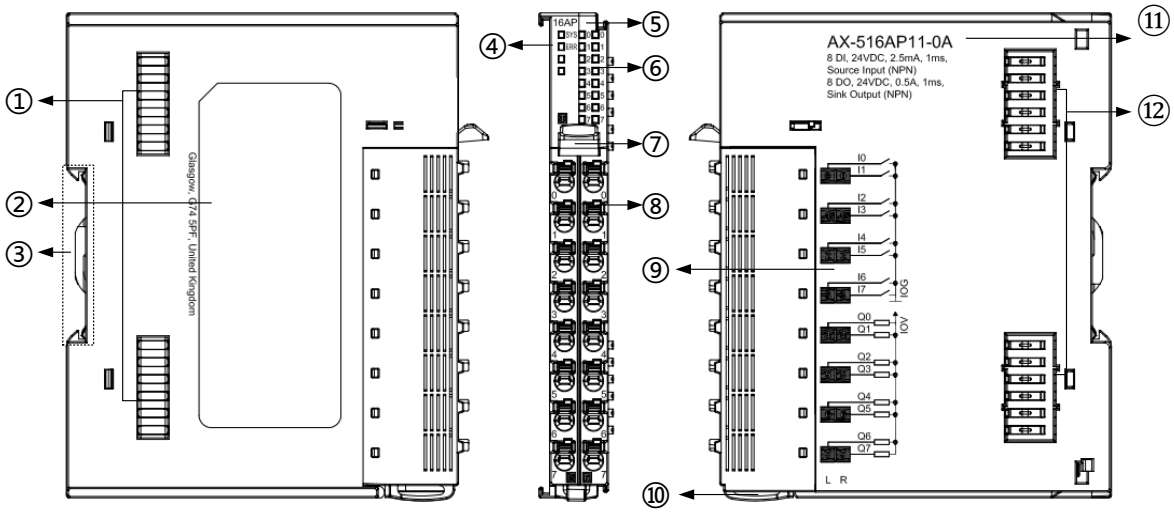
4.5.2 Dimensions and Parts

- **Dimensions**



Unit : mm

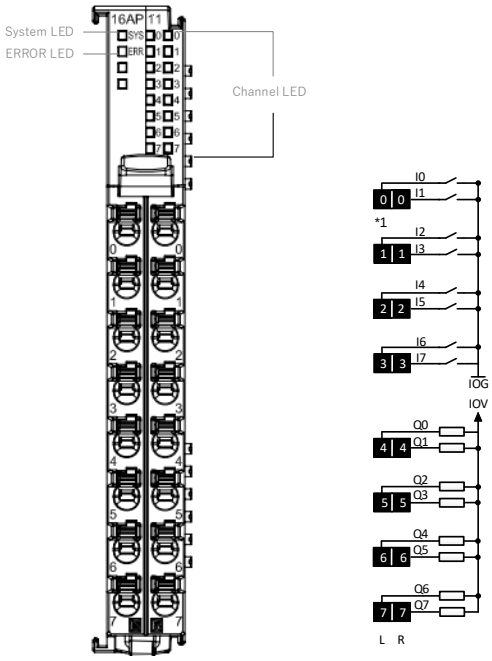
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

4.5.3 Arrangement of Terminals, LED Indicators and Wiring

4.5.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

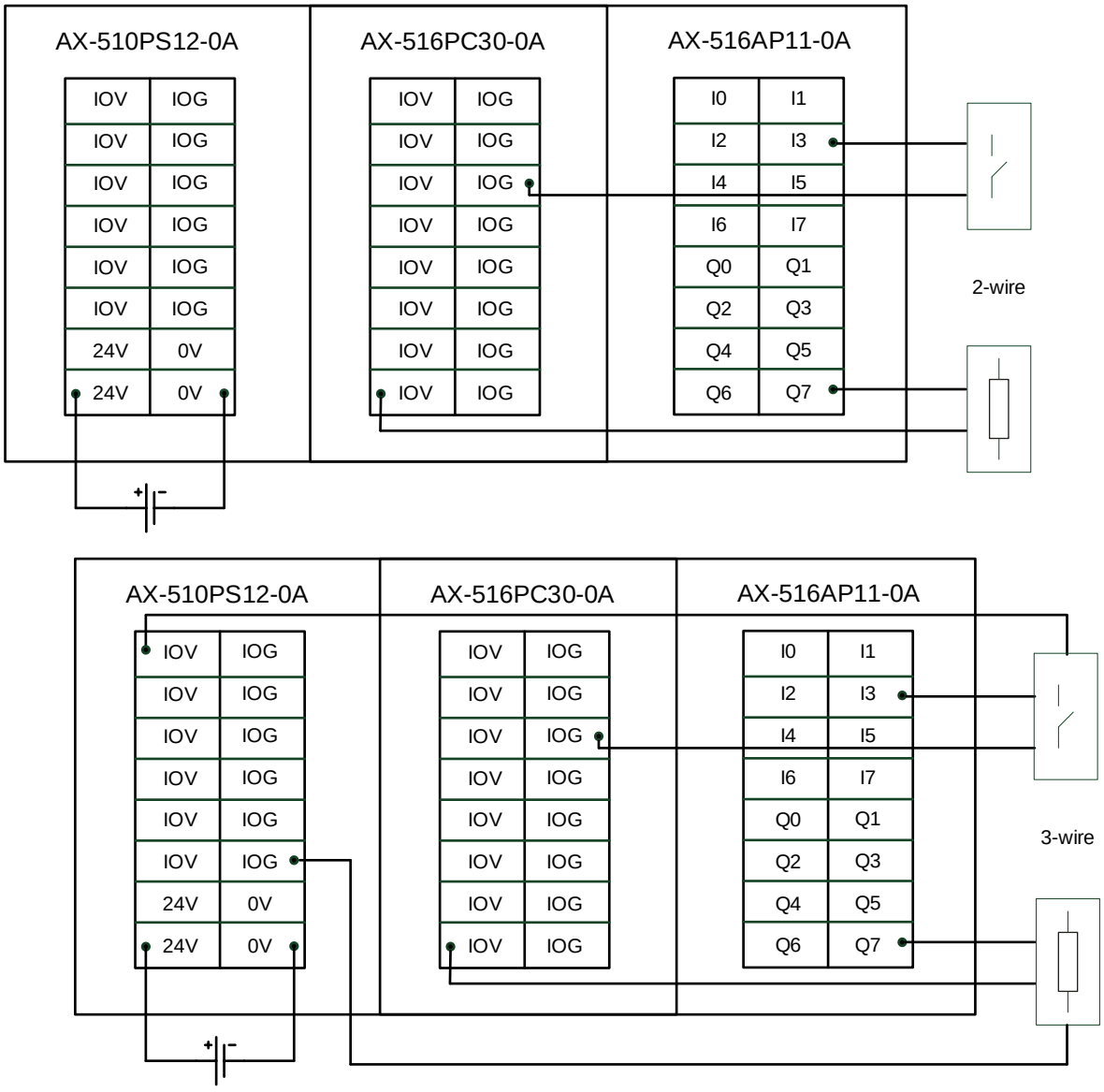
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0	Digital input channel 0	R0	I1	Digital input channel 1
L1	I2	Digital input channel 2	R1	I3	Digital input channel 3
L2	I4	Digital input channel 4	R2	I5	Digital input channel 5
L3	I6	Digital input channel 6	R3	I7	Digital input channel 7
L4	Q0	Digital output channel 0	R4	Q1	Digital output channel 1
L5	Q2	Digital output channel 2	R5	Q3	Digital output channel 3
L6	Q4	Digital output channel 4	R6	Q5	Digital output channel 5
L7	Q6	Digital output channel 6	R7	Q7	Digital output channel 7

4.5.3.2 LED Indicators

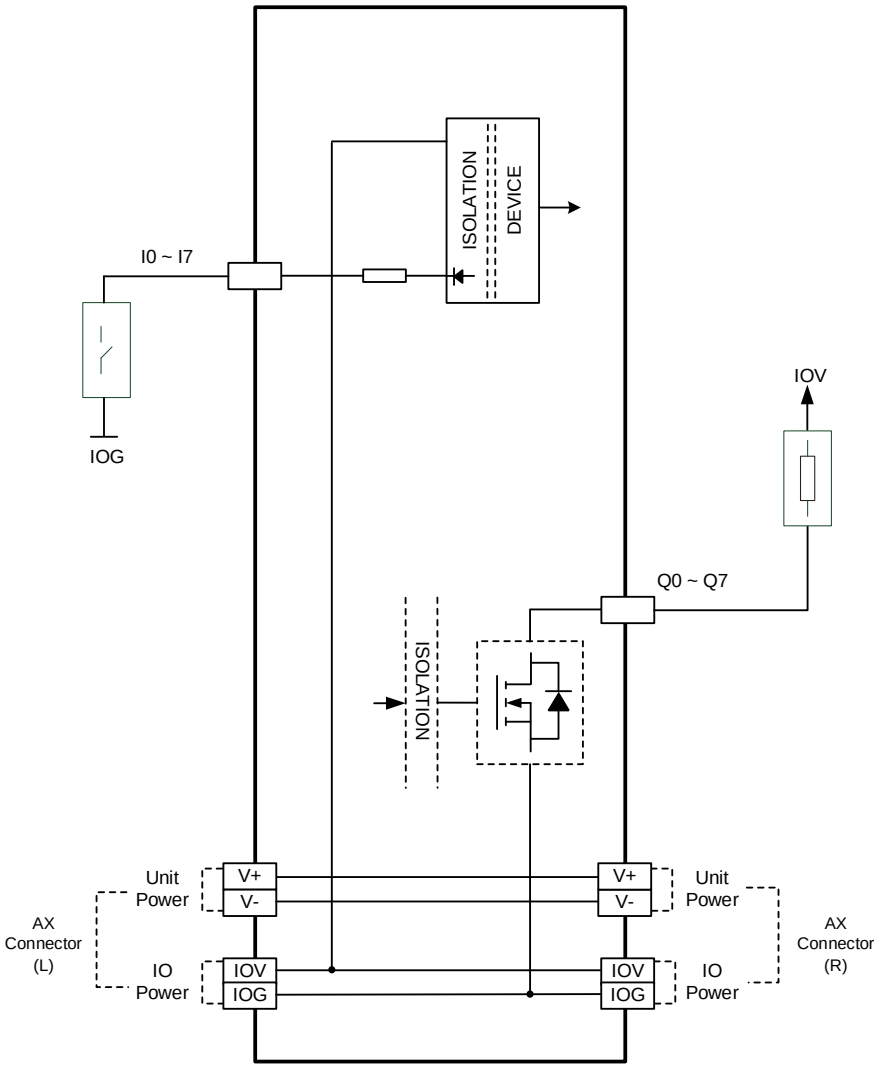
Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	**Normal (OP)**
Error	Red		OFF	Module is functioning correctly.
			ON	A severe error occurs on the module.
Channel	Green		OFF	The channel is OFF.
			ON	The channel is ON.

4.5.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



⚠	● The output circuit and internal circuit of this product are separated only by functional insulation. Therefore, to complete the installation of the product in the final system, double or reinforced insulation should be used between the product and hazardous live parts.

4.5.4 Settings in DIADesigner-AX

This section introduces some basic operations and settings in the DIADesigner-AX software.

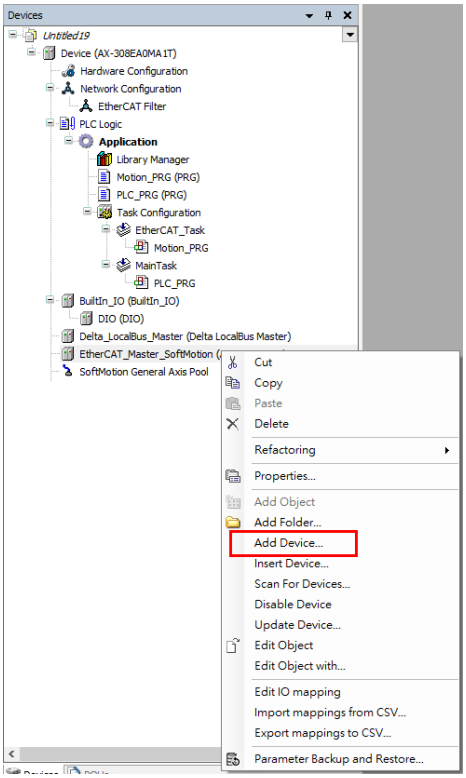
4.5.4.1 Basic Operation

(1) Double-click the DIADesigner-AX icon to open the software and create a new project.

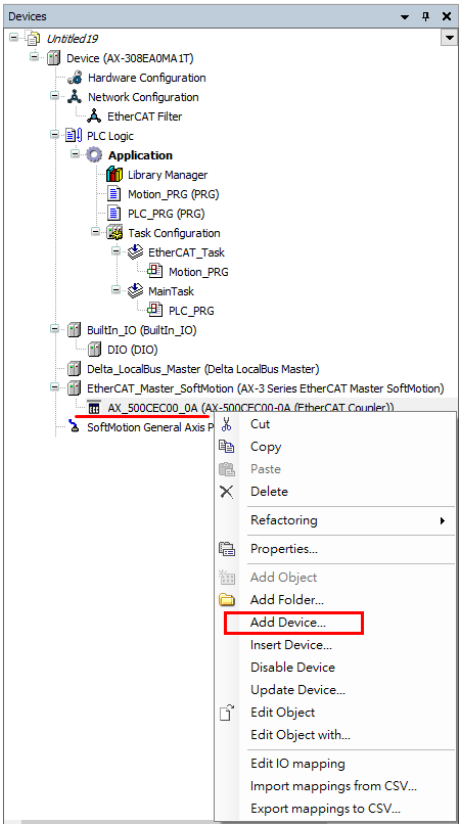
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Add Device…*** to select and add System Coupler.

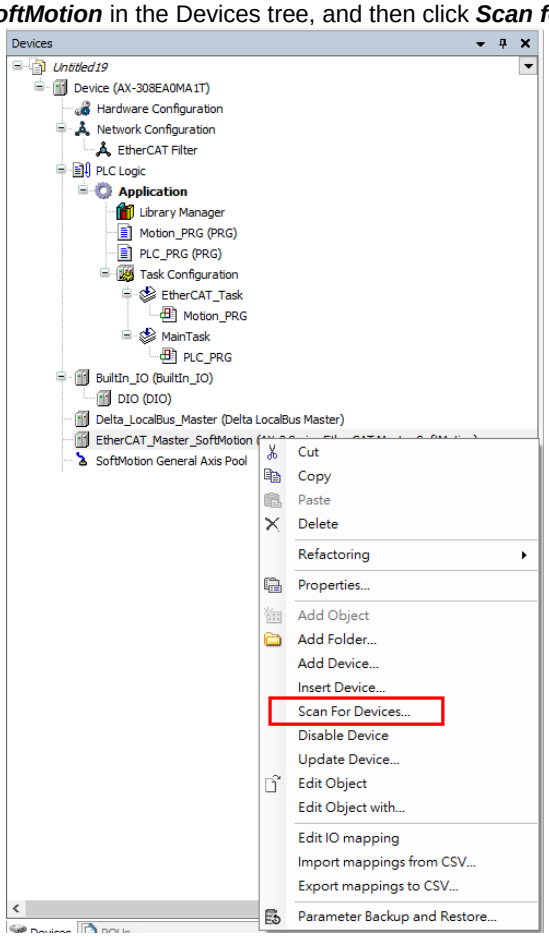


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

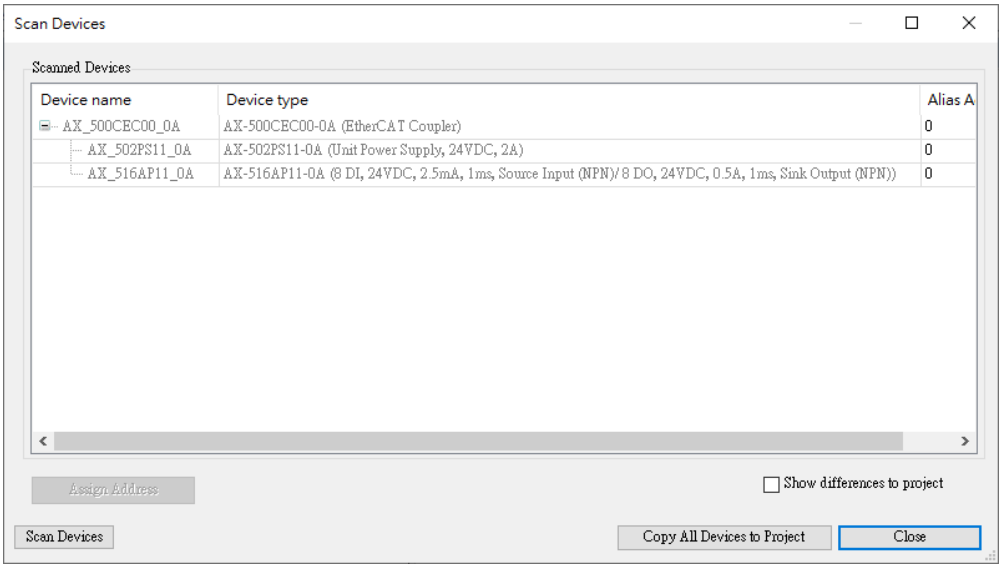


- Method 2: Scan to add the modules in.

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Scan for Devices…***.

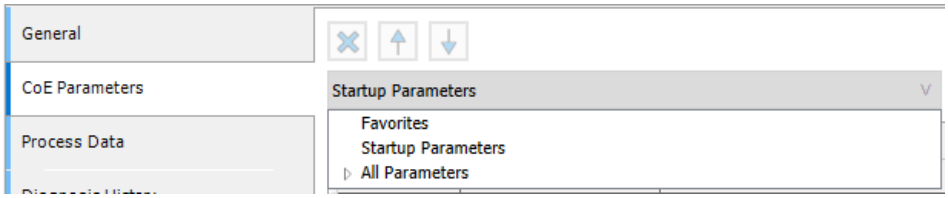


After the auto-scan is over, the actually-connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.



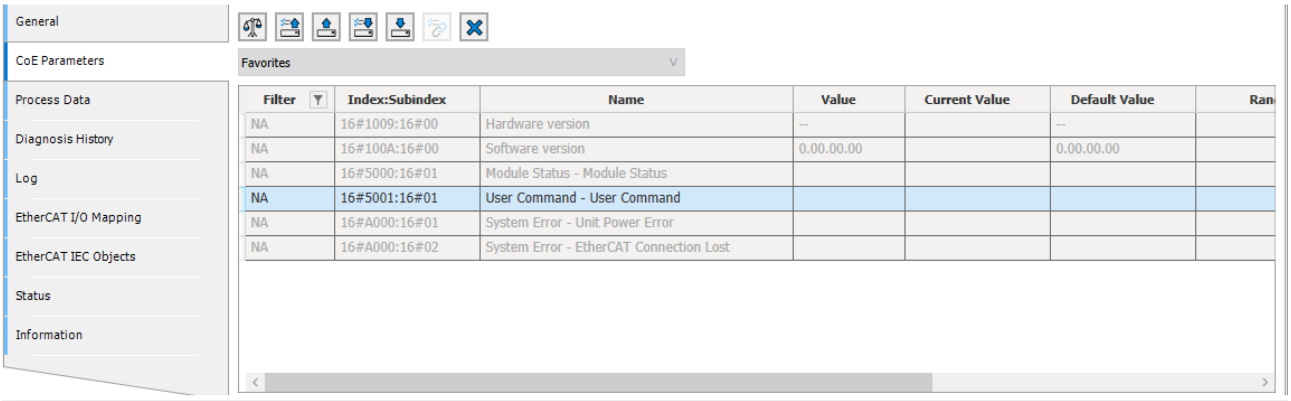
4.5.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.



(1) Favorites

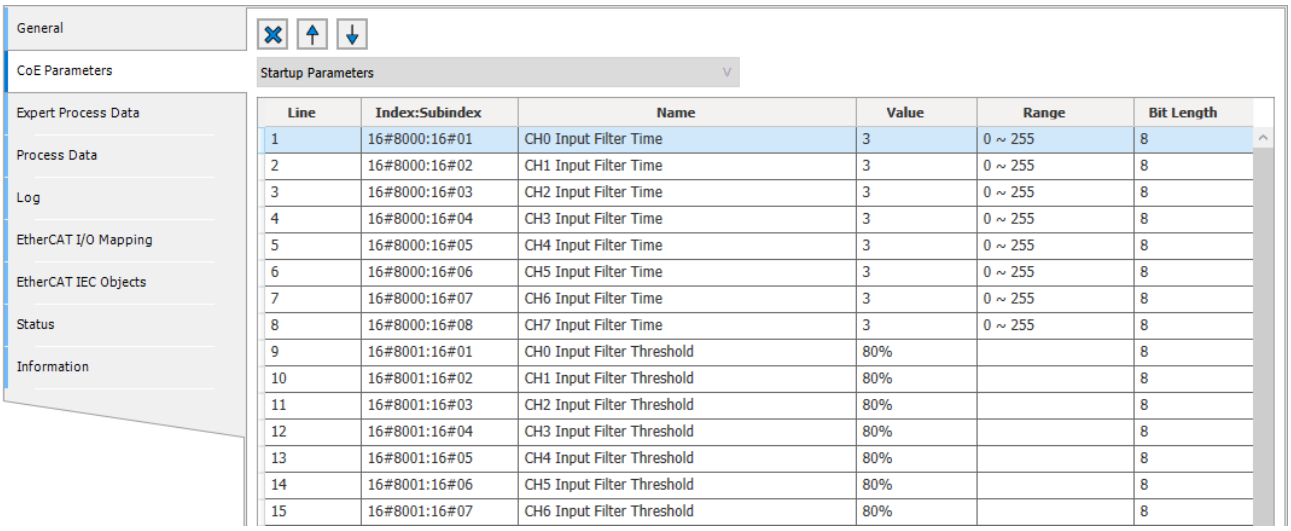
- You can add the selected parameter to Favorites according to your preference. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

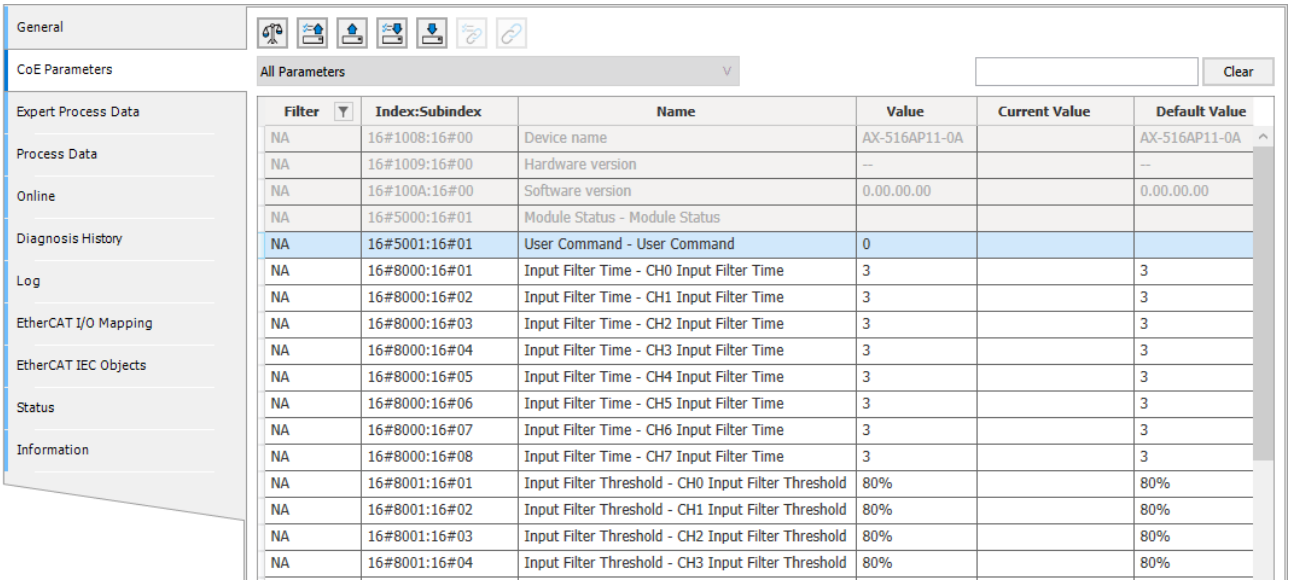


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Input Filter Time	3	0 ~ 255	8
2	16#8000:16#02	CH1 Input Filter Time	3	0 ~ 255	8
3	16#8000:16#03	CH2 Input Filter Time	3	0 ~ 255	8
4	16#8000:16#04	CH3 Input Filter Time	3	0 ~ 255	8
5	16#8000:16#05	CH4 Input Filter Time	3	0 ~ 255	8
6	16#8000:16#06	CH5 Input Filter Time	3	0 ~ 255	8
7	16#8000:16#07	CH6 Input Filter Time	3	0 ~ 255	8
8	16#8000:16#08	CH7 Input Filter Time	3	0 ~ 255	8
9	16#8001:16#01	CH0 Input Filter Threshold	80%		8
10	16#8001:16#02	CH1 Input Filter Threshold	80%		8
11	16#8001:16#03	CH2 Input Filter Threshold	80%		8
12	16#8001:16#04	CH3 Input Filter Threshold	80%		8
13	16#8001:16#05	CH4 Input Filter Threshold	80%		8
14	16#8001:16#06	CH5 Input Filter Threshold	80%		8
15	16#8001:16#07	CH6 Input Filter Threshold	80%		8

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

(3) All Parameters

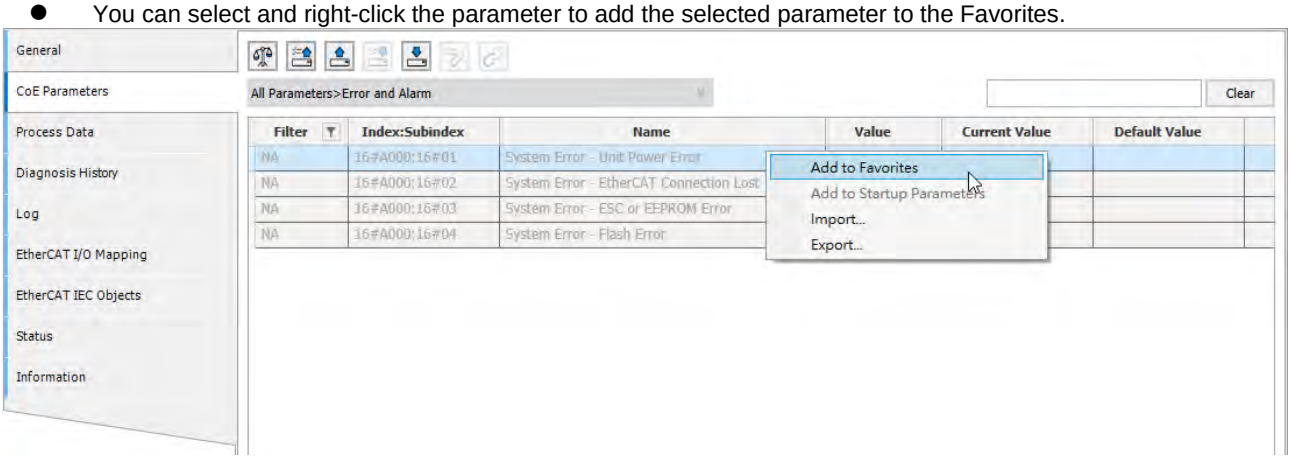
- You can find all the CoE parameters here. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values of parameters in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Filter	Index:Subindex	Name	Value	Current Value	Default Value
NA	16#1008:16#00	Device name	AX-516AP11-0A		AX-516AP11-0A
NA	16#1009:16#00	Hardware version	--		--
NA	16#100A:16#00	Software version	0.00.00.00		0.00.00.00
NA	16#5000:16#01	Module Status - Module Status			
NA	16#5001:16#01	User Command - User Command	0		
NA	16#8000:16#01	Input Filter Time - CH0 Input Filter Time	3		3
NA	16#8000:16#02	Input Filter Time - CH1 Input Filter Time	3		3
NA	16#8000:16#03	Input Filter Time - CH2 Input Filter Time	3		3
NA	16#8000:16#04	Input Filter Time - CH3 Input Filter Time	3		3
NA	16#8000:16#05	Input Filter Time - CH4 Input Filter Time	3		3
NA	16#8000:16#06	Input Filter Time - CH5 Input Filter Time	3		3
NA	16#8000:16#07	Input Filter Time - CH6 Input Filter Time	3		3
NA	16#8000:16#08	Input Filter Time - CH7 Input Filter Time	3		3
NA	16#8001:16#01	Input Filter Threshold - CH0 Input Filter Threshold	80%		80%
NA	16#8001:16#02	Input Filter Threshold - CH1 Input Filter Threshold	80%		80%
NA	16#8001:16#03	Input Filter Threshold - CH2 Input Filter Threshold	80%		80%
NA	16#8001:16#04	Input Filter Threshold - CH3 Input Filter Threshold	80%		80%

Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

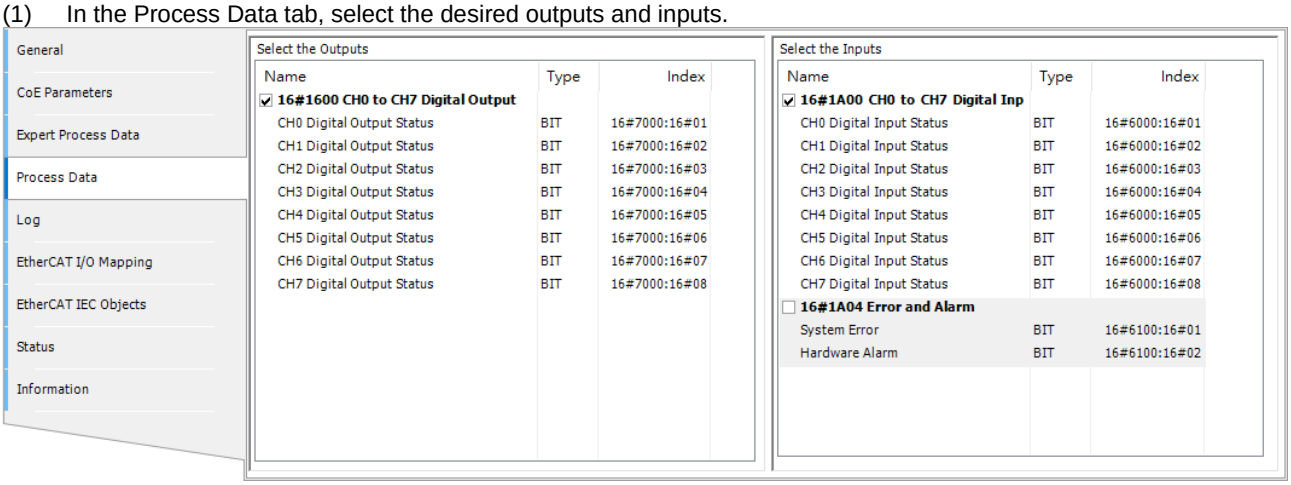
- You can select and right-click the parameter to add the selected parameter to the Favorites.



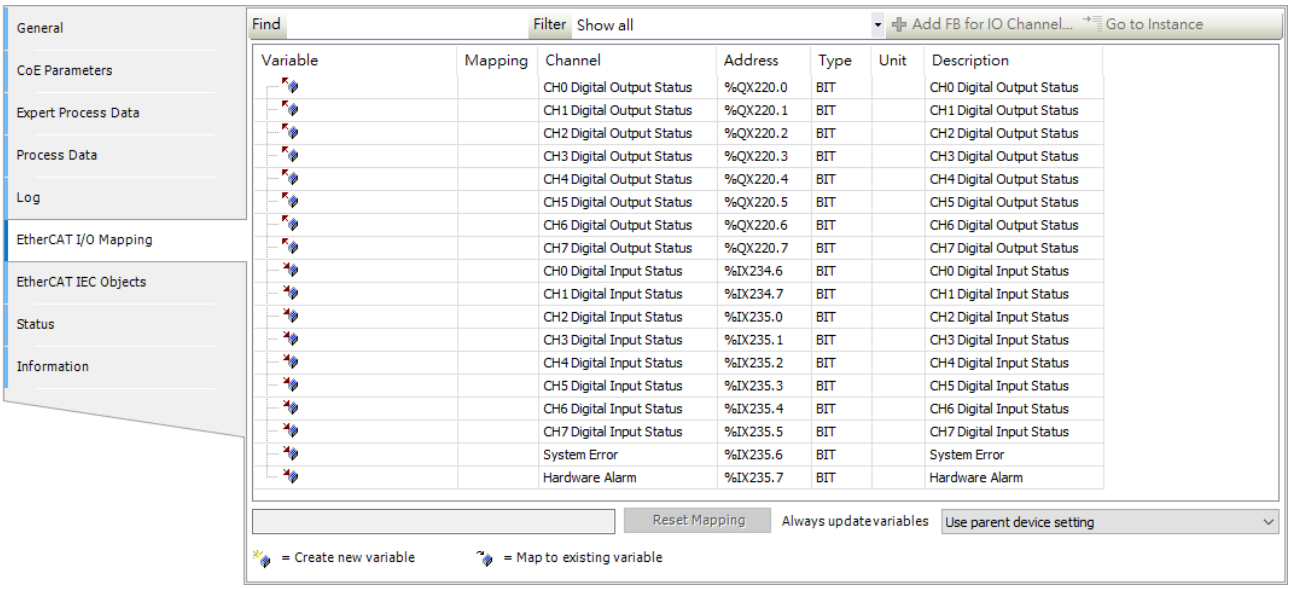
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

4.5.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

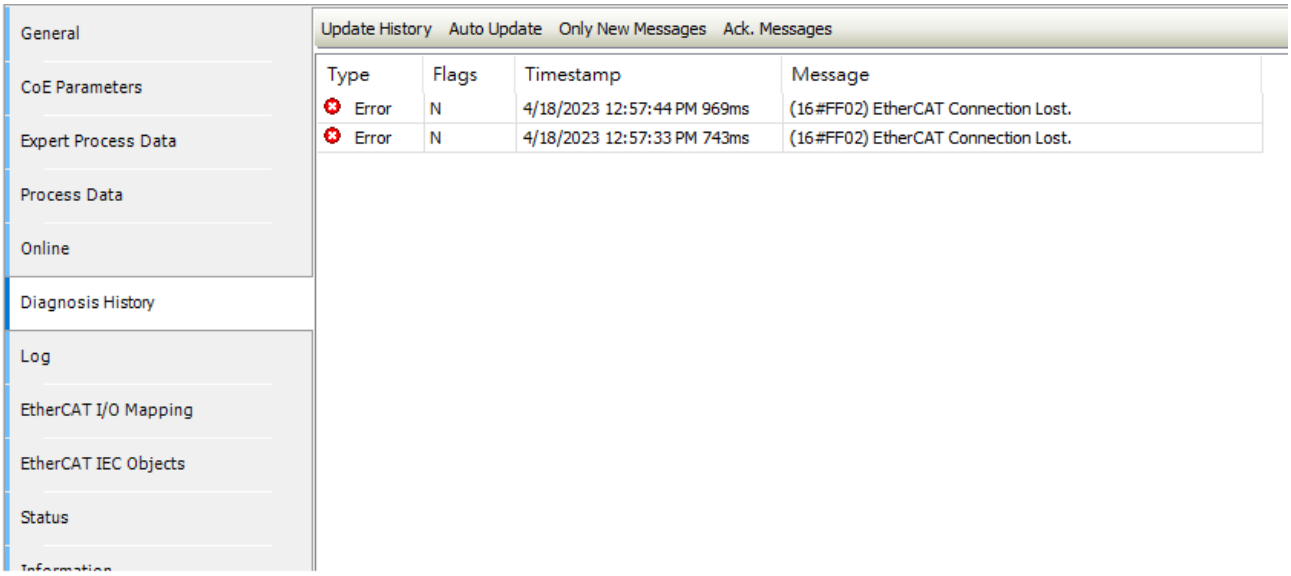


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



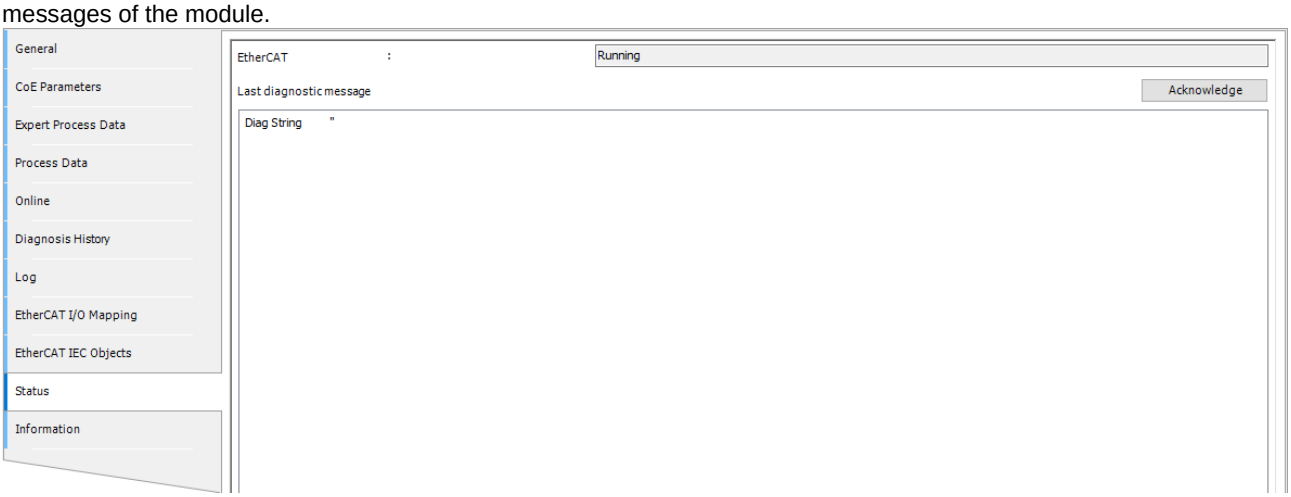
4.5.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors.



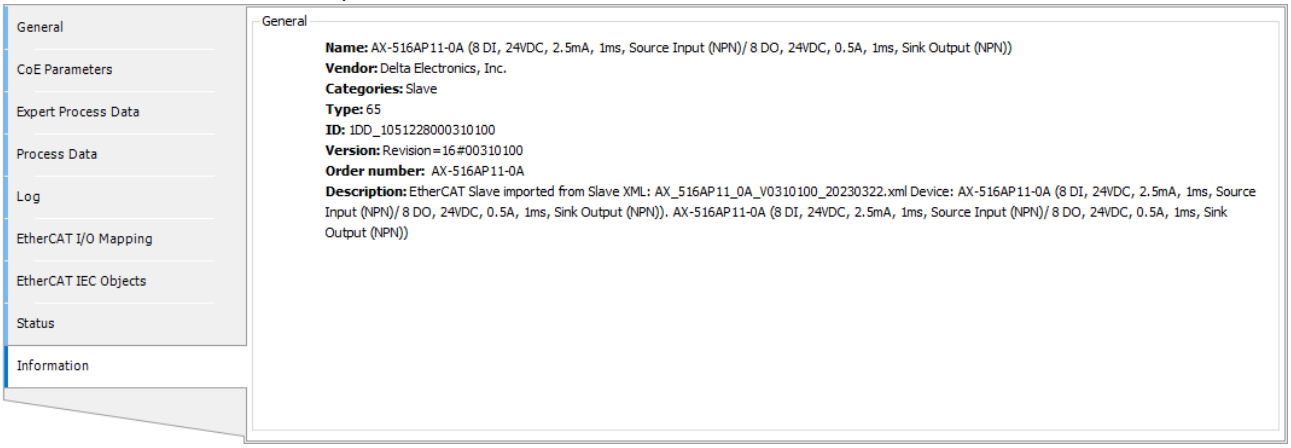
4.5.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



4.5.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version of the module.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.33.01.00	0.33.01.00	0.00.00.00

4.5.5 Parameter Descriptions

You can use DIADesigner-AX to set up the module. For software operation, refer to section 4.5.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function Block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Input Filter Time	Filtering time for inputs	DFB_AM_RD_FilterTime DFB_AM_WR_FilterTime
16#8001	Input Filter Threshold	Filtering threshold for inputs	DFB_AM_RD_FilterThreshold DFB_AM_WR_FilterThreshold
16#8002	Output Settings when EtherCAT Connection Lost	The setting for the output when the EtherCAT connection is lost.	
16#8003	Output Settings when Module in Stopped State	The setting for the output when the module is in the stopped state.	

4.5.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Parameter explanation**

This parameter displays the current control status of the module.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

4.5.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Parameter explanation**

Users write the commands into the module and the module will execute accordingly. After execution, the module will send back a corresponding value which indicates that the execution is success or failure.

- **User command**

Command	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

4.5.5.3 Input Filter Time

Setting up the filtering time for the inputs of the module. If the receiving signals are shorter than the set filtering time, the signals received will be seen as noises and will be filtered out. The default filtering value is 3 ms. Set the filtering time for the inputs according to your applications.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Input Filter Time	Filtering time for inputs Setting range: 0–255 (ms)	USINT	RW	3
	16#02	CH1 Input Filter Time		USINT	RW	3
	16#03	CH2 Input Filter Time		USINT	RW	3
	16#04	CH3 Input Filter Time		USINT	RW	3
	16#05	CH4 Input Filter Time		USINT	RW	3
	16#06	CH5 Input Filter Time		USINT	RW	3
	16#07	CH6 Input Filter Time		USINT	RW	3
	16#08	CH7 Input Filter Time		USINT	RW	3

- **Parameter explanation**

The parameter set is to set the filtering time for the inputs of the module. If the duration time for received signals is shorter than the set filtering time, the signals received will be seen as noises and will be filtered out. The default filtering value is 3 ms. But you can set the filtering time for the inputs according to your application environment.

4.5.5.4 Input Filter Threshold

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Input Filter Threshold	Filtering threshold for inputs Setting value: 60% / 80% / 100%	USINT	RW	80
	16#02	CH1 Input Filter Threshold		USINT	RW	80
	16#03	CH2 Input Filter Threshold		USINT	RW	80
	16#04	CH3 Input Filter Threshold		USINT	RW	80
	16#05	CH4 Input Filter Threshold		USINT	RW	80
	16#06	CH5 Input Filter Threshold		USINT	RW	80
	16#07	CH6 Input Filter Threshold		USINT	RW	80
	16#08	CH7 Input Filter Threshold		USINT	RW	80

4

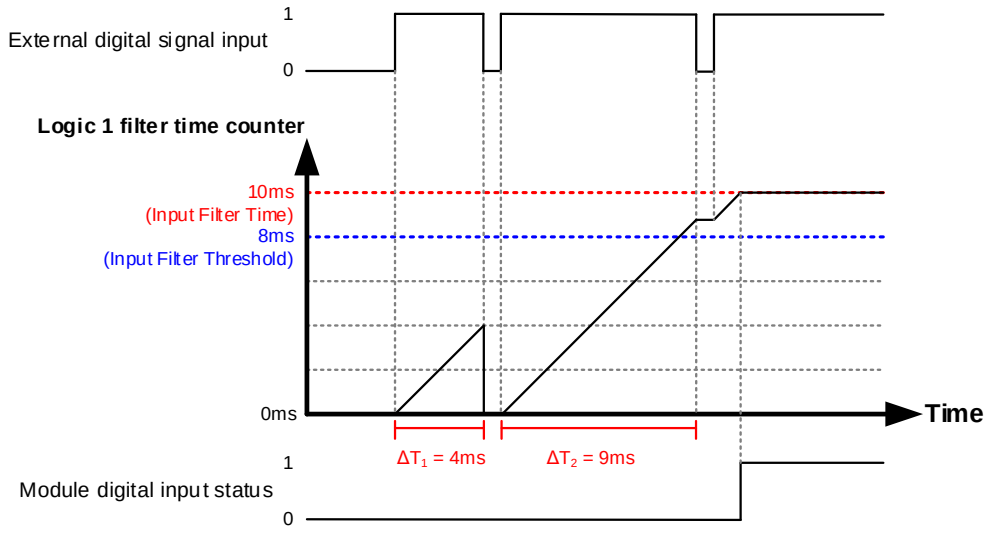
- **Parameter explanation**

The parameter set is to set the filtering threshold for the inputs so as to suppress the digital noise interference.

- **Input filter threshold**

Setting in function block	Threshold
0	20%
1	40%
2	60%
3	80%
4	100%

Example: Set the input filter time to 10 ms and the input filter threshold to 80%, which means that the threshold time is 8 ms (10ms * 80%). The signal of duration time less than 8 ms is seen as a noise and filtered out (Δ T1). But the signal of duration time greater than 8 ms is seen as a valid signal, and then the cumulative time (Δ T2) for such a signal input is not reset when a brief noise signal occurs subsequently.



In the system, there are filter time counters logic 0 and logic 1, which have opposite logics but the same operation principle.

4.5.5.5 Output Settings when EtherCAT Connection Lost

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8002	16#01	CH0 Output Settings when EtherCAT Connection Lost	Output behavior setting	USINT	RW	0
	16#02	CH1 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#03	CH2 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#04	CH3 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#05	CH4 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#06	CH5 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#07	CH6 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#08	CH7 Output Settings when EtherCAT Connection Lost		USINT	RW	0

- **Parameter explanation**

The parameter set is for setting the output behavior of output points when the EtherCAT connection is lost

- **Output behavior settings**

Setting value	Name	Description
0	Stay OFF	The channel stays OFF.
1	Stay ON	The channel stays ON.
2	Keep Last Status	The channel keeps as the last status is.

4.5.5.6 Output Settings when Module in Stopped State

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Output Settings when Module in Stopped State	Output behavior setting	USINT	RW	0
	16#02	CH1 Output Settings when Module in Stopped State		USINT	RW	0
	16#03	CH2 Output Settings when Module in Stopped State		USINT	RW	0
	16#04	CH3 Output Settings when Module in Stopped State		USINT	RW	0
	16#05	CH4 Output Settings when Module in Stopped State		USINT	RW	0
	16#06	CH5 Output Settings when Module in Stopped State		USINT	RW	0
	16#07	CH6 Output Settings when Module in Stopped State		USINT	RW	0
	16#08	CH7 Output Settings when Module in Stopped State		USINT	RW	0

- **Parameter explanation**

The parameter set is for setting the output behavior of output points when the module is in the Stopped state.

- **Output behavior settings**

Setting value	Name	Description
0	Stay OFF	The channel stays OFF.
1	Stay ON	The channel stays ON.
2	Keep Update	The channel keeps updating the output.

4.5.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

4.5.6.1 FreeRun Mode

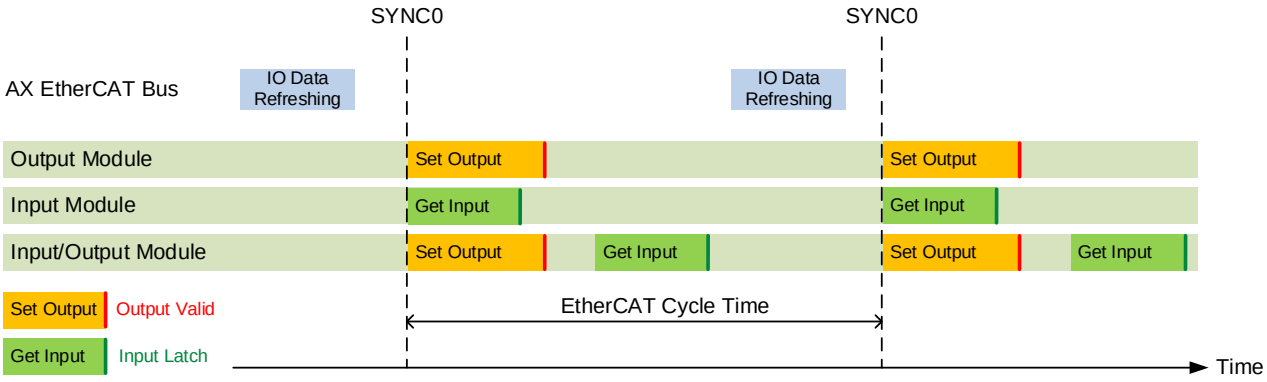
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

4.5.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

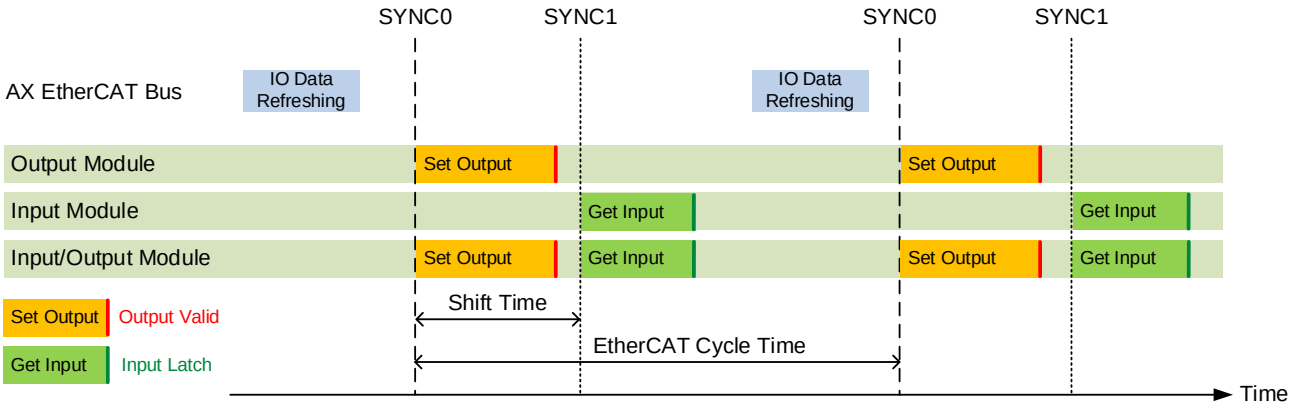
- **SYNC0**

Using SYNC0 to refresh values of output channels among modules at the same time.



- **SYNC0 + SYNC1**

Using SYNC0 to refresh values of outptut channels and using SYNC1 to refresh values of input channels among modules at the same time. The shift time between SYNC0 and SYNC1 can be modified with DIADesigner-AX.



4.5.7 Process Data

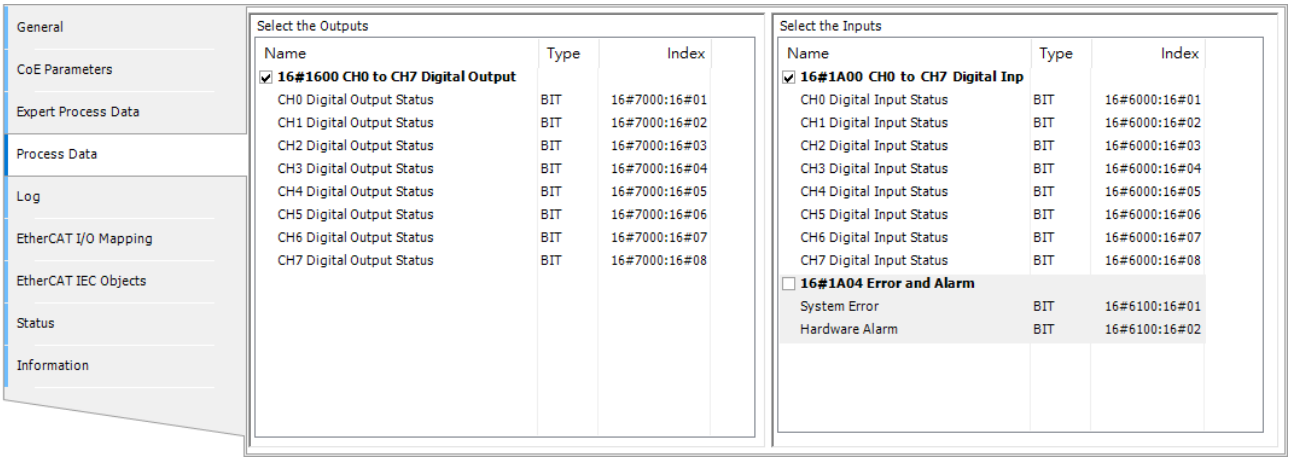
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Digital Input Status	Digital input values of CH0–CH7	BOOL	RO	0
	16#02	CH1 Digital Input Status		BOOL	RO	0
	16#03	CH2 Digital Input Status		BOOL	RO	0
	16#04	CH3 Digital Input Status		BOOL	RO	0
	16#05	CH4 Digital Input Status		BOOL	RO	0
	16#06	CH5 Digital Input Status		BOOL	RO	0
	16#07	CH6 Digital Input Status		BOOL	RO	0
	16#08	CH7 Digital Input Status		BOOL	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0
	16#02	Hardware Alarm	Hardware error alarm	BOOL	RO	0
16#7000	16#01	CH0 Digital Output Status	Digital output values of CH0–CH7	BOOL	RO	0
	16#02	CH1 Digital Output Status		BOOL	RO	0
	16#03	CH2 Digital Output Status		BOOL	RO	0
	16#04	CH3 Digital Output Status		BOOL	RO	0
	16#05	CH4 Digital Output Status		BOOL	RO	0
	16#06	CH5 Digital Output Status		BOOL	RO	0
	16#07	CH6 Digital Output Status		BOOL	RO	0
	16#08	CH7 Digital Output Status		BOOL	RO	0

4.5.7.1 Process Data

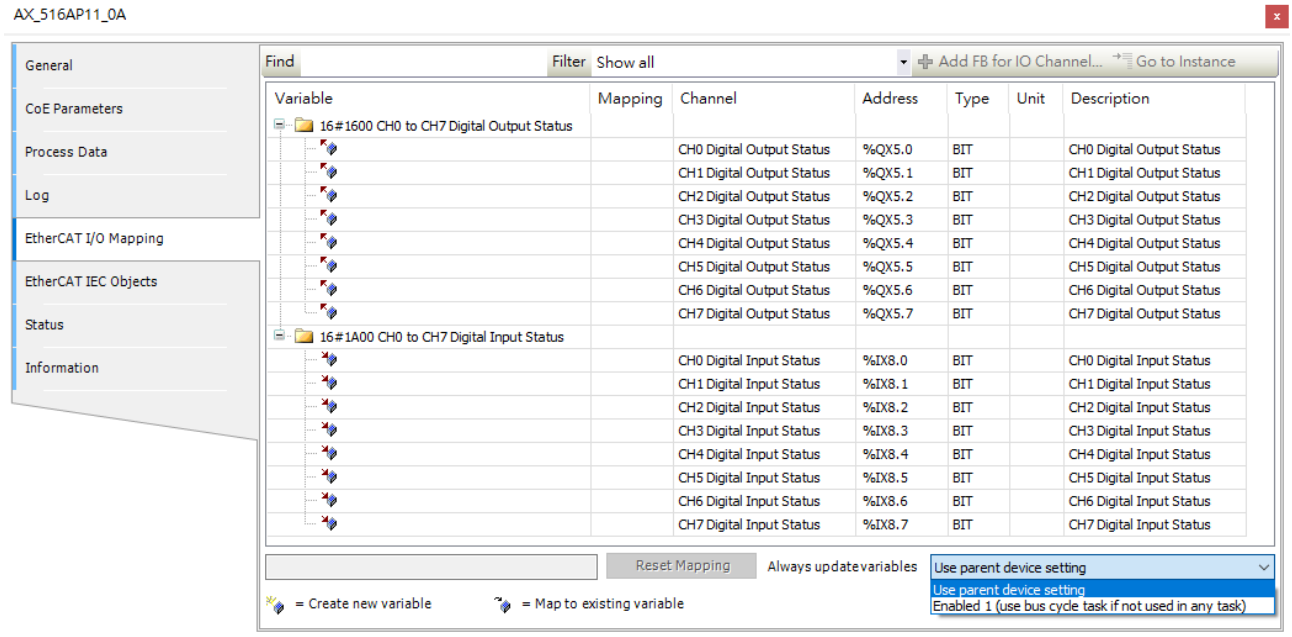
Go to the Process Data tab and select the data that you'd like to monitor. There are two types of data here.

- Digital Input/Output Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Alarm: It is not selected by default.



4.5.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



4.5.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

4.5.8 Troubleshooting

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Disconnection	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
16#A001	16#01	(16#FF11) Channel Hardware Alarm	Blinking	Same as before	Check if the wiring for the channels is short-circuit or overcurrent

4.6 AX-516AP22-0A

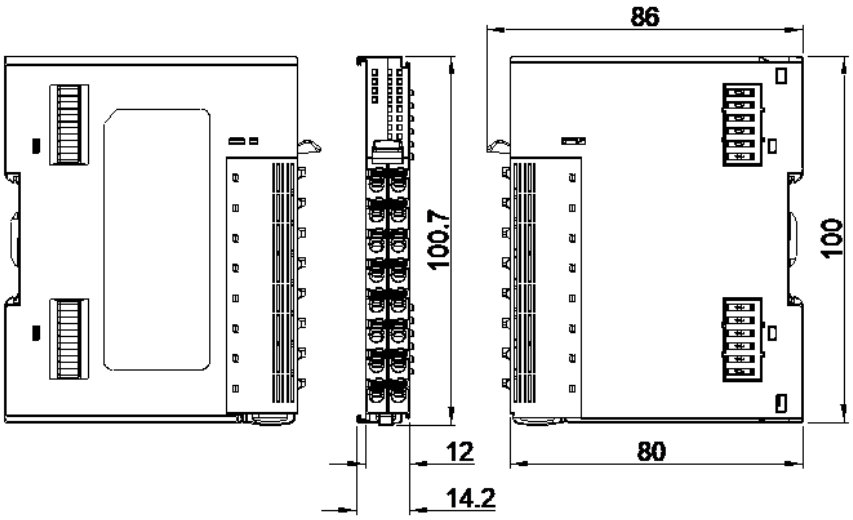
AX-516AP22-0A, a digital input/ output module, inputs 8-point digital signals and outputs 8-point digital signals (PNP). This section introduces its specifications, operations and wirings.

4.6.1 Specifications

Item			Specification
Input / output points			8 / 8
External connector type			Spring-clamp terminal block (16 terminals)
I/O refresh modes			1. Free Run mode 2. DC mode
Dimension (mm)			12(W) × 100 (H) × 80 (D)
Weight			71 g
Electrical specification	Digital input	I/O form	Sinking input (PNP)
		Input current	2.5 mA TYP. (24 VDC), constant current
		ON voltage	11–30 V (EN 61131-2, type 3)
		OFF voltage	-3–+5 V (EN 61131-2, type 3)
		Maximum ON / OFF response time	150 μs /150 μs
	Digital output	I/O form	Sourcing output (PNP)
		Load voltage	24 VDC (error range: -15%–+20%, 20.4–28.8 VDC)
		Maximum load current	0.5 A /point
		Leakage current	Less than 0.1 mA
		Maximum ON / OFF response time	150 μs/ 150 μs
	Isolation method		Between unit power and external power: no isolation Between digital signal and internal signal: 500 VAC Between channels: no isolation
	Maximum power consumption (unit power)		200 mA (1W)
	Maximum power consumption (I/O power)		24 VDC /4A
	Minimum power consumption (I/O Power)		10 mA
Others	Digital input	Connection Lost Protection	--
		Short Circuit Protection (SCP)	--
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	Current limiting
		Filtering function	Firmware filtering time: 0-255 ms; (default: 3 ms)
	Digital output	Connection Lost Protection	--
		Short Circuit Protection (SCP)	--
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	Yes

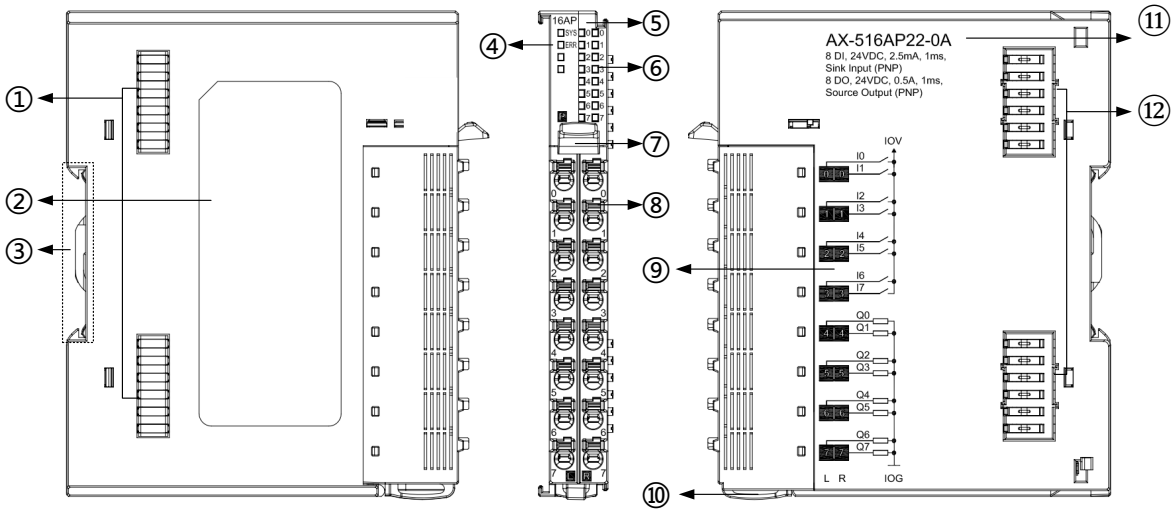
4.6.2 Dimensions and Parts

- **Dimensions**



Unit : mm

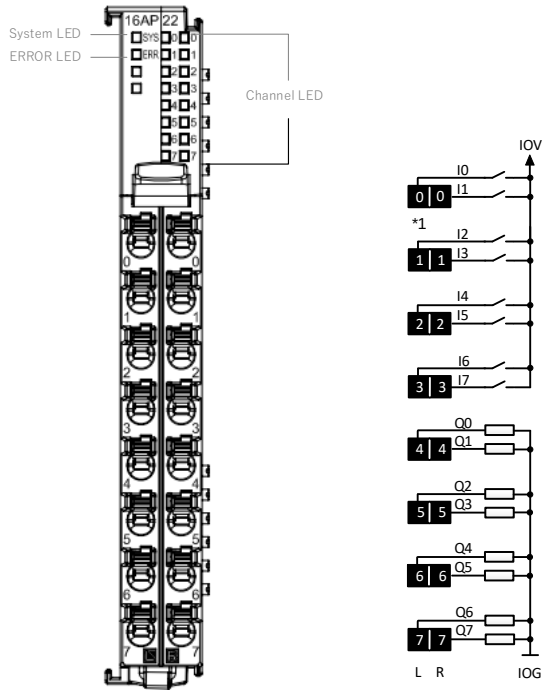
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

4.6.3 Arrangement of Terminals, LED Indicators and Wiring

4.6.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

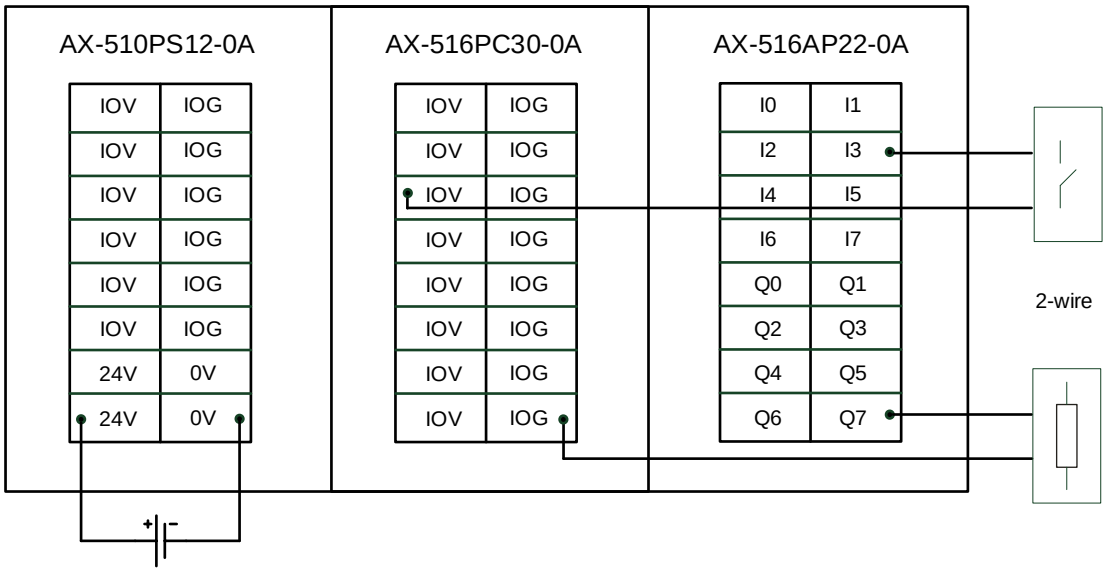
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0	Digital input channel 0	R0	I1	Digital input channel 1
L1	I2	Digital input channel 2	R1	I3	Digital input channel 3
L2	I4	Digital input channel 4	R2	I5	Digital input channel 5
L3	I6	Digital input channel 6	R3	I7	Digital input channel 7
L4	Q0	Digital output channel 0	R4	Q1	Digital output channel 1
L5	Q2	Digital output channel 2	R5	Q3	Digital output channel 3
L6	Q4	Digital output channel 4	R6	Q5	Digital output channel 5
L7	Q6	Digital output channel 6	R7	Q7	Digital output channel 7

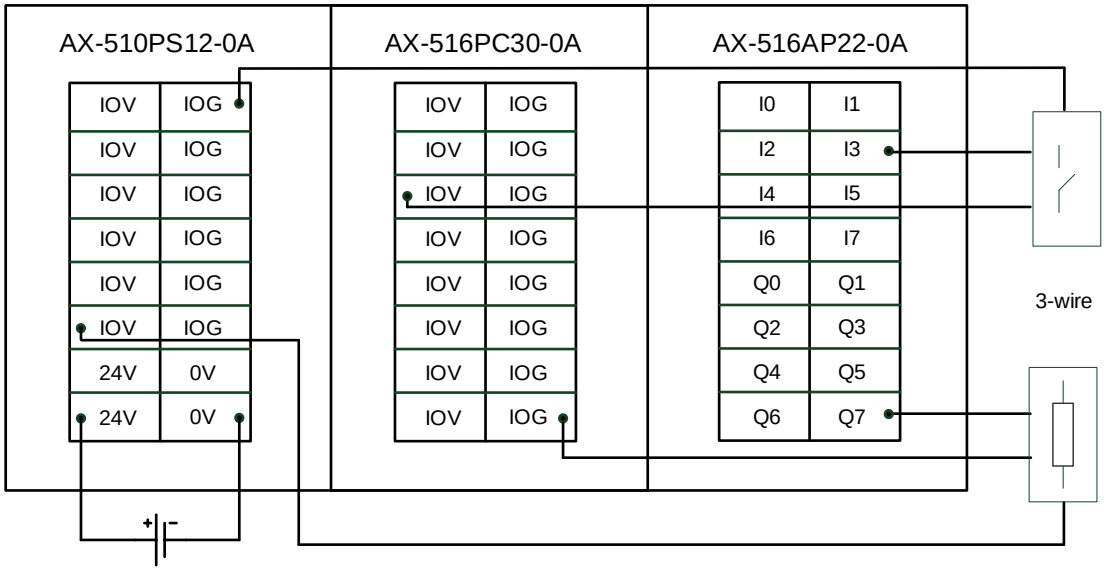
4.6.3.2 LED Indicators

Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	Normal (OP)
Error	Red		OFF	Module is functioning correctly.
			ON	A severe error occurs on the module.
Channel	Green		OFF	The channel is OFF.
			ON	The channel is ON.

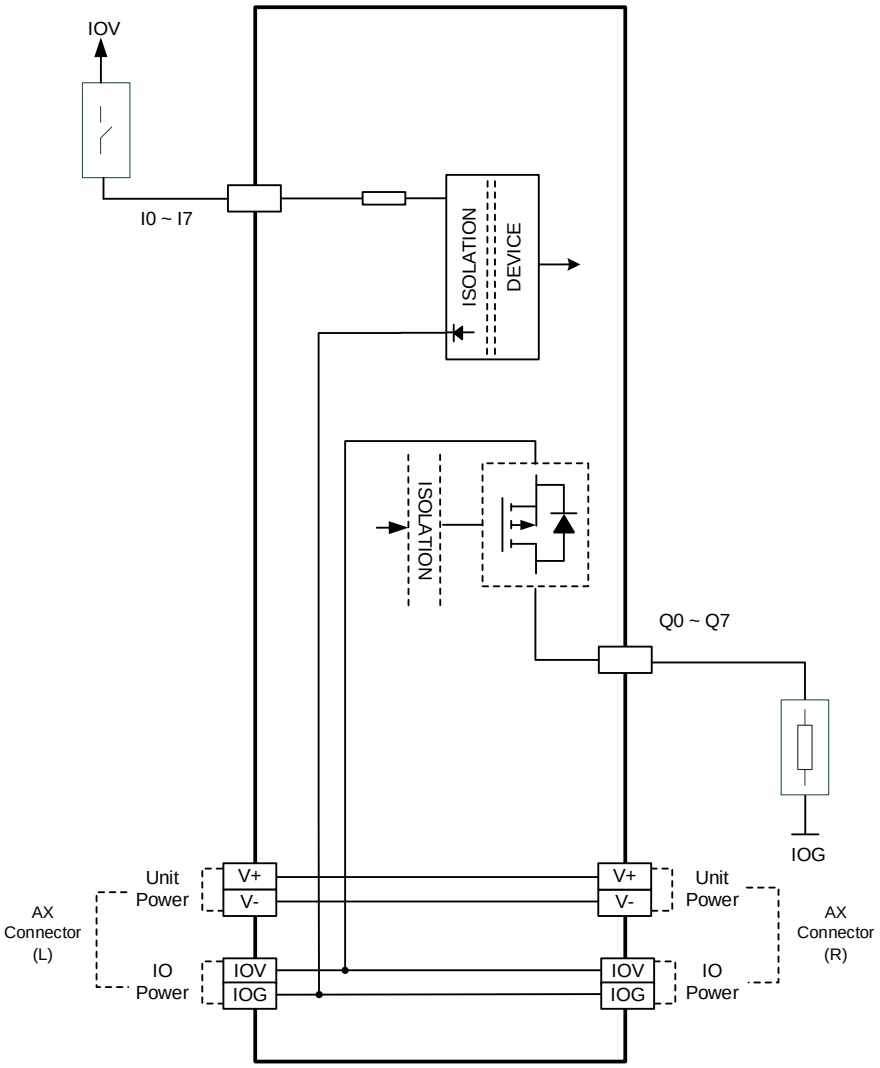
4.6.3.3 Wiring and Loop Configuration

- **Wiring**





- **Loop Configuration**



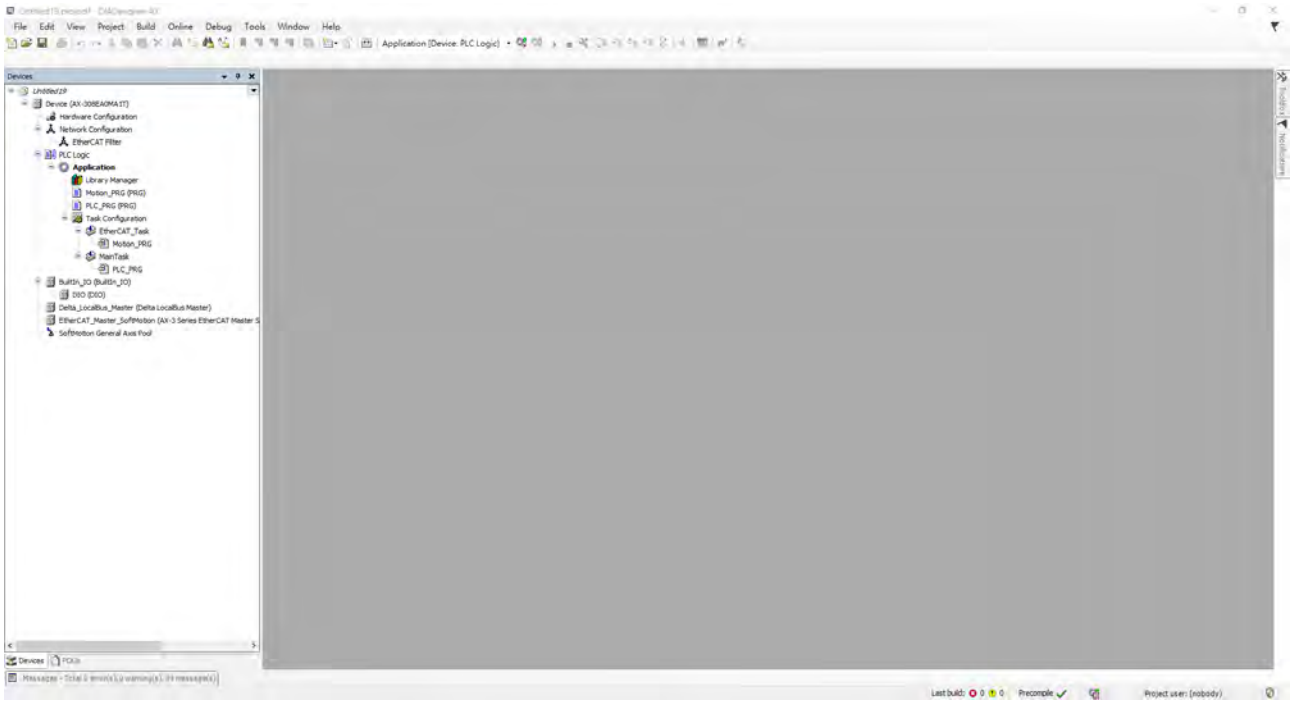
⚠	● The output circuit and internal circuit of this product are separated only by functional insulation. Therefore, to complete the installation of the product in the final system, double or reinforced insulation should be used between the product and hazardous live parts.

4.6.4 Settings in DIADesigner-AX

This section introduces some basic operation and settings in the DIADesigner-AX software.

4.6.4.1 Basic Operation

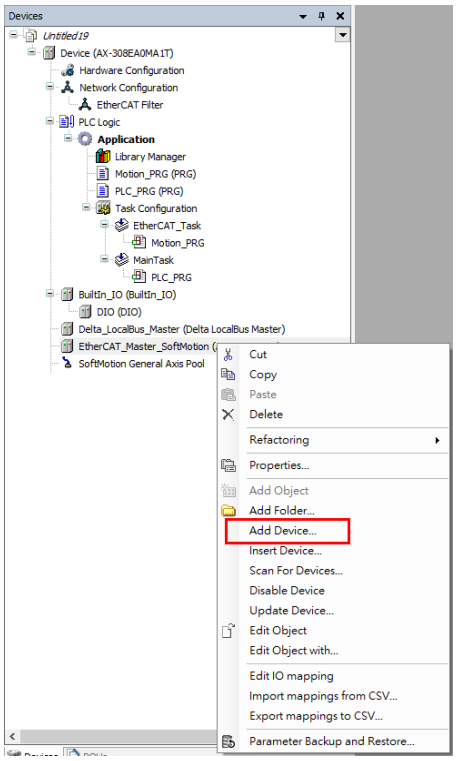
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



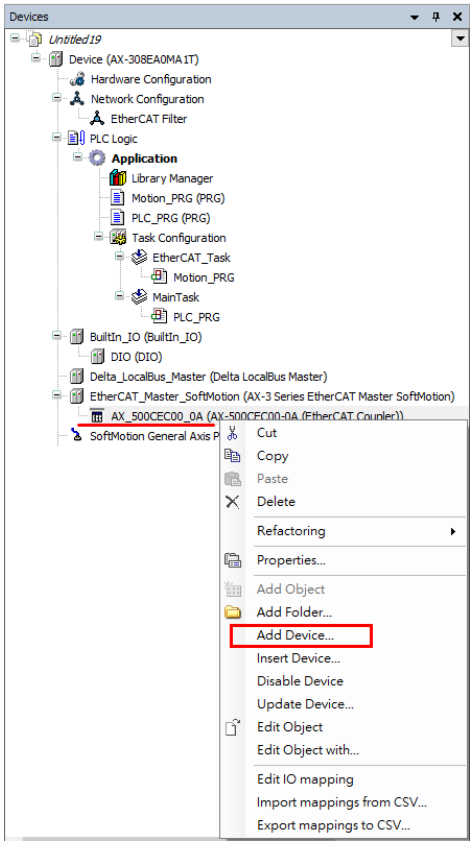
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Add Device…*** to select and add System Coupler.

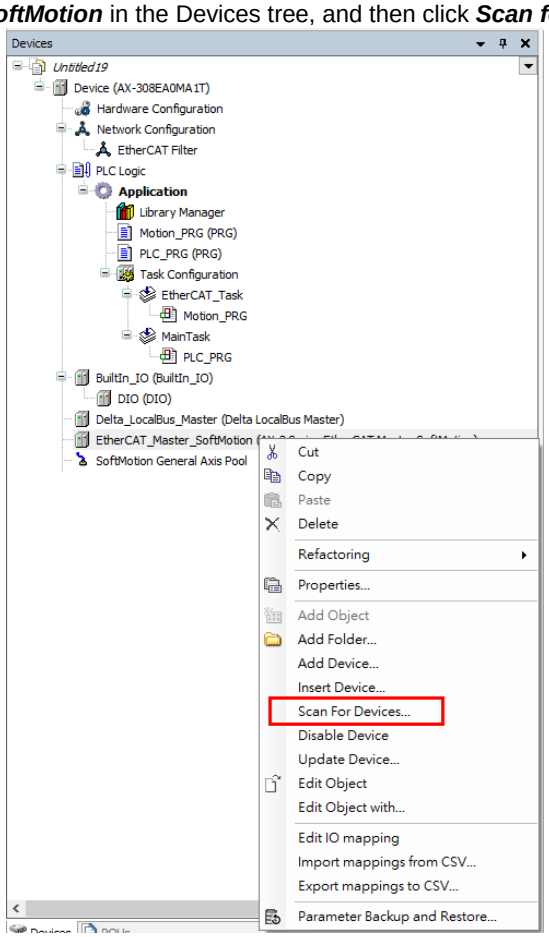


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

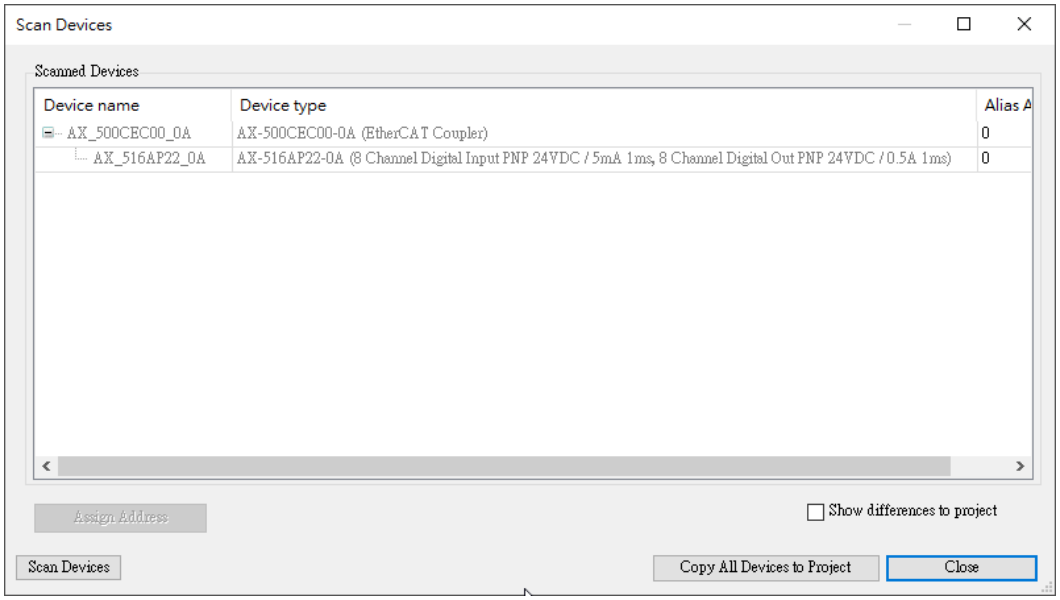


- Method 2: Scan to add the modules in.

Right-click ***EtherCAT Master SoftMotion*** in the Devices tree, and then click ***Scan for Devices…***.

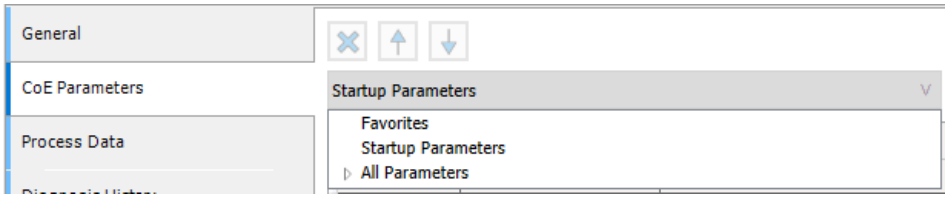


After the auto-scan is over, the actually-connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.



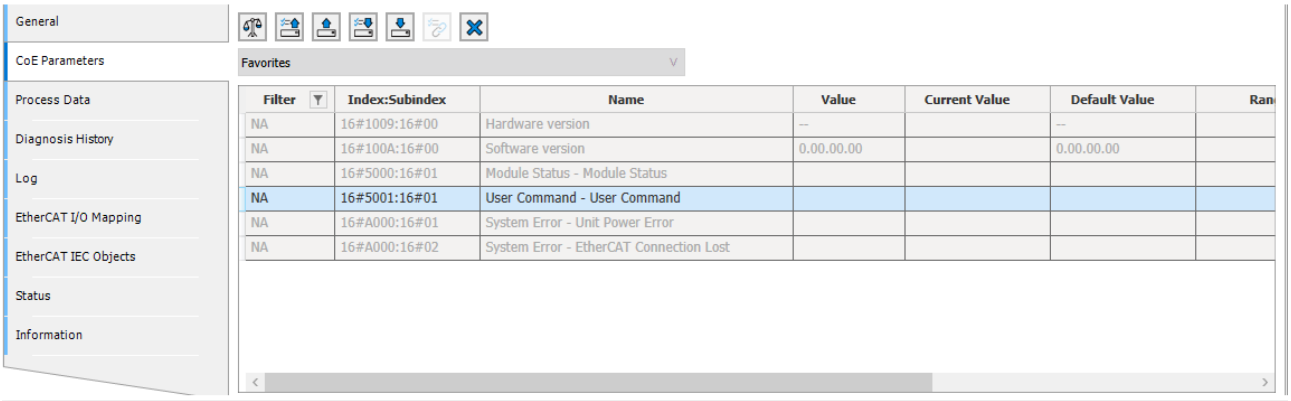
4.6.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.



(1) Favorites

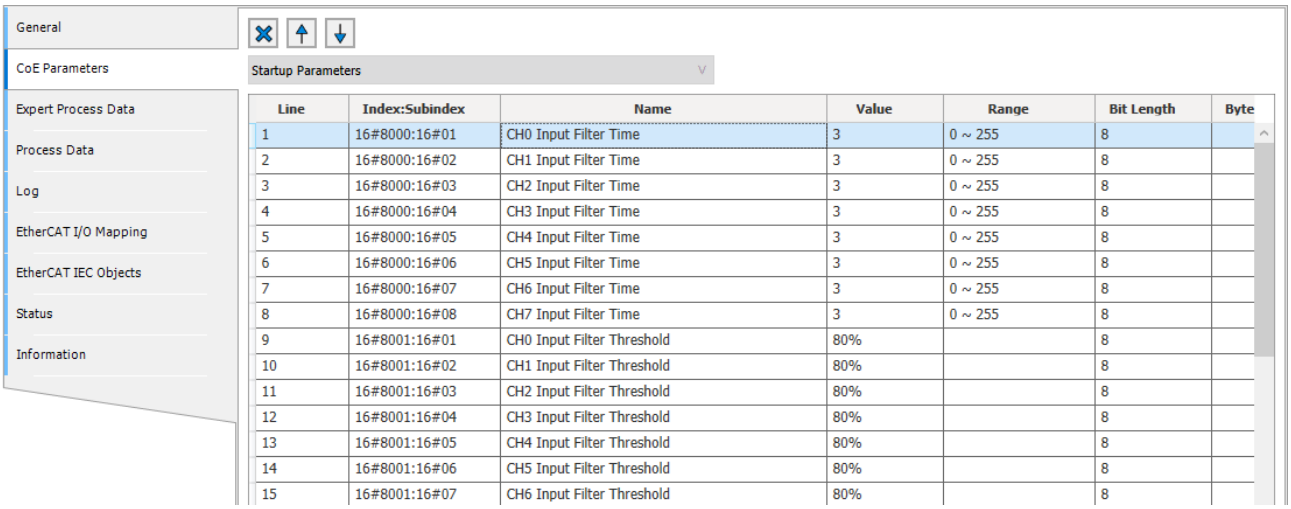
- You can add the selected parameter to Favorites according to your preference. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

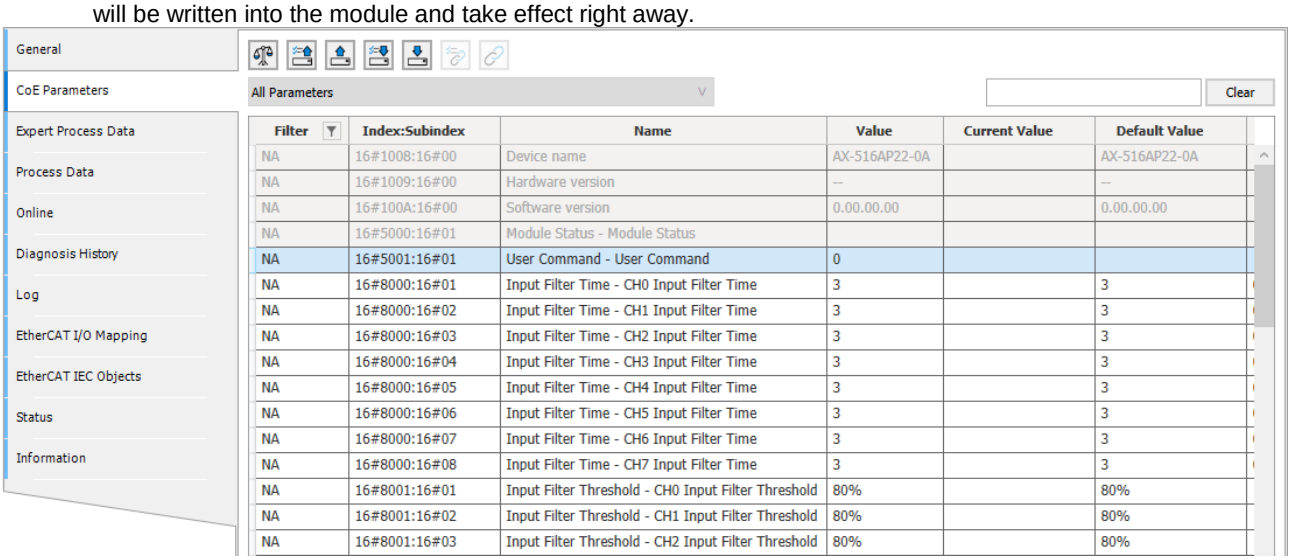


Line	Index:Subindex	Name	Value	Range	Bit Length	Byte
1	16#8000:16#01	CH0 Input Filter Time	3	0 ~ 255	8	
2	16#8000:16#02	CH1 Input Filter Time	3	0 ~ 255	8	
3	16#8000:16#03	CH2 Input Filter Time	3	0 ~ 255	8	
4	16#8000:16#04	CH3 Input Filter Time	3	0 ~ 255	8	
5	16#8000:16#05	CH4 Input Filter Time	3	0 ~ 255	8	
6	16#8000:16#06	CH5 Input Filter Time	3	0 ~ 255	8	
7	16#8000:16#07	CH6 Input Filter Time	3	0 ~ 255	8	
8	16#8000:16#08	CH7 Input Filter Time	3	0 ~ 255	8	
9	16#8001:16#01	CH0 Input Filter Threshold	80%		8	
10	16#8001:16#02	CH1 Input Filter Threshold	80%		8	
11	16#8001:16#03	CH2 Input Filter Threshold	80%		8	
12	16#8001:16#04	CH3 Input Filter Threshold	80%		8	
13	16#8001:16#05	CH4 Input Filter Threshold	80%		8	
14	16#8001:16#06	CH5 Input Filter Threshold	80%		8	
15	16#8001:16#07	CH6 Input Filter Threshold	80%		8	

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

(3) All Parameters

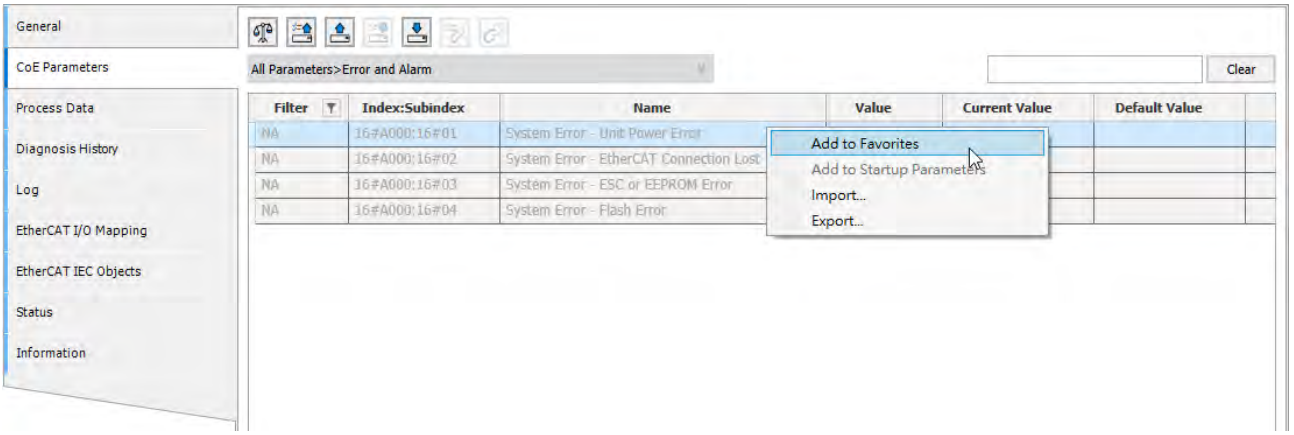
- You can find all the CoE parameters here. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values of parameters in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Filter	Index:Subindex	Name	Value	Current Value	Default Value
NA	16#1008:16#00	Device name	AX-516AP22-0A		AX-516AP22-0A
NA	16#1009:16#00	Hardware version	--		--
NA	16#100A:16#00	Software version	0.00.00.00		0.00.00.00
NA	16#5000:16#01	Module Status - Module Status			
NA	16#5001:16#01	User Command - User Command	0		
NA	16#8000:16#01	Input Filter Time - CH0 Input Filter Time	3		3
NA	16#8000:16#02	Input Filter Time - CH1 Input Filter Time	3		3
NA	16#8000:16#03	Input Filter Time - CH2 Input Filter Time	3		3
NA	16#8000:16#04	Input Filter Time - CH3 Input Filter Time	3		3
NA	16#8000:16#05	Input Filter Time - CH4 Input Filter Time	3		3
NA	16#8000:16#06	Input Filter Time - CH5 Input Filter Time	3		3
NA	16#8000:16#07	Input Filter Time - CH6 Input Filter Time	3		3
NA	16#8000:16#08	Input Filter Time - CH7 Input Filter Time	3		3
NA	16#8001:16#01	Input Filter Threshold - CH0 Input Filter Threshold	80%		80%
NA	16#8001:16#02	Input Filter Threshold - CH1 Input Filter Threshold	80%		80%
NA	16#8001:16#03	Input Filter Threshold - CH2 Input Filter Threshold	80%		80%

Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

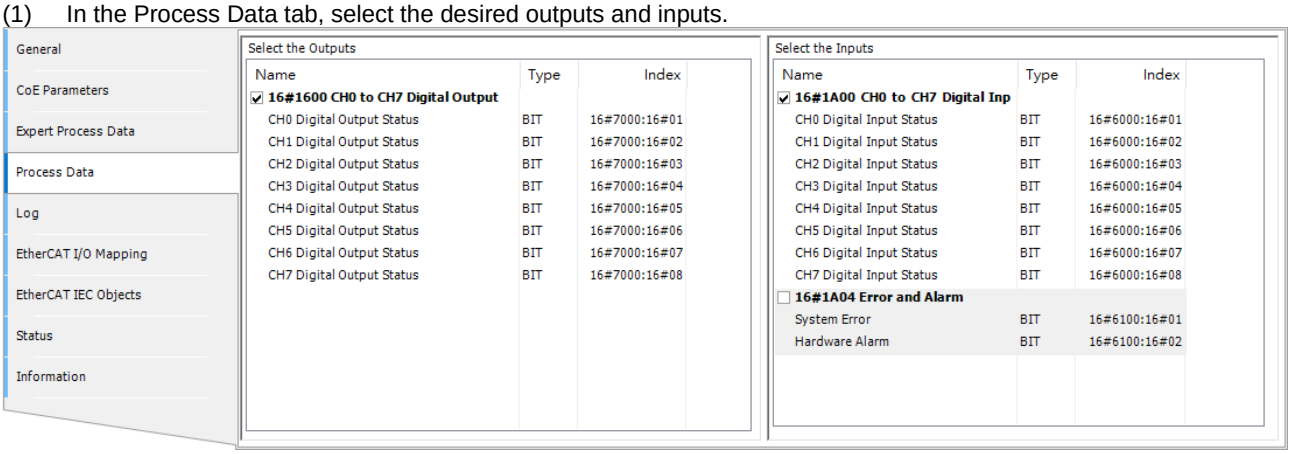
- You can select and right-click the parameter to add the selected parameter to the Favorites.



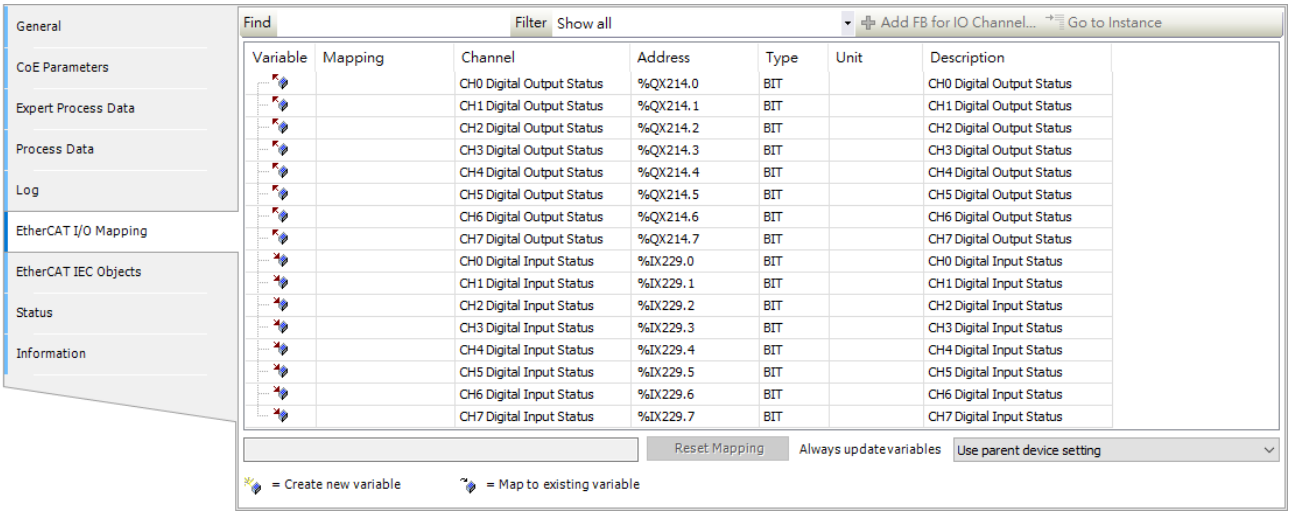
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

4.6.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

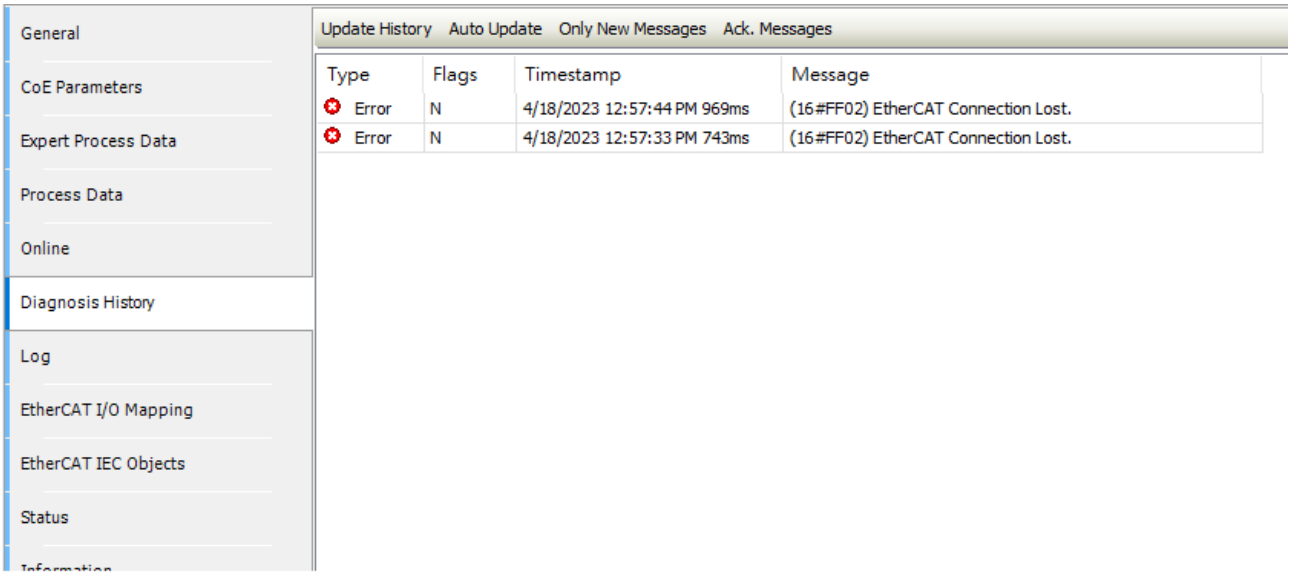


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



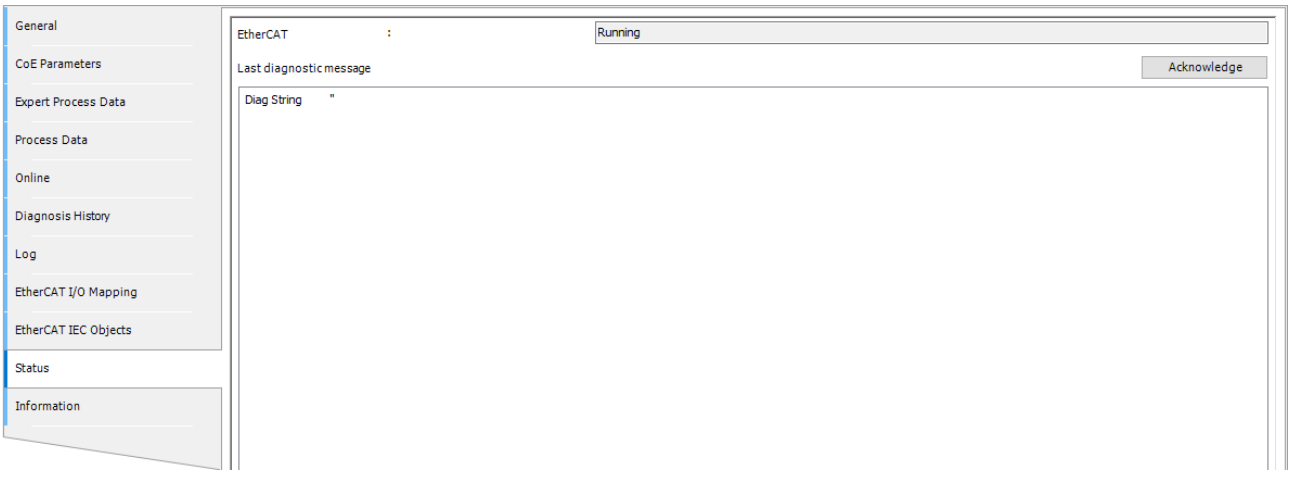
4.6.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors.



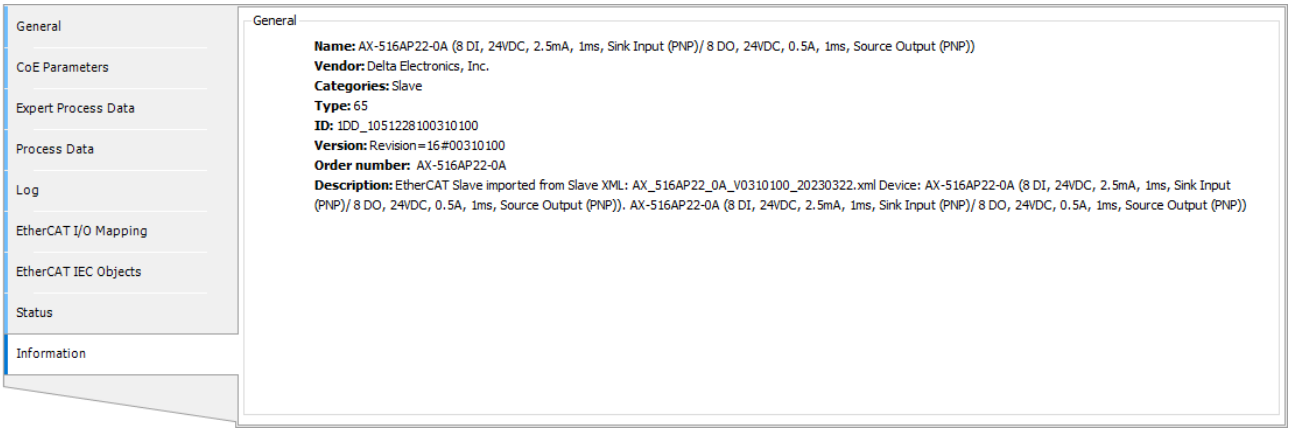
4.6.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



4.6.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version of the module.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.33.01.00	0.33.01.00	0.00.00.00

4.6.5 Parameter Descriptions

You can use DIADesigner-AX to set up the module. For software operation, refer to section 4.6.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function Block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Input Filter Time	Filtering time for inputs	DFB_AM_RD_FilterTime DFB_AM_WR_FilterTime
16#8001	Input Filter Threshold	Filtering threshold for inputs	DFB_AM_RD_FilterThreshold DFB_AM_WR_FilterThreshold
16#8002	Output Settings when EtherCAT Connection Lost	The setting for the output when the EtherCAT connection is lost.	
16#8003	Output Settings when Module in Stopped State	The setting for the output when the module is in the stopped state.	

4.6.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Parameter explanation**

This parameter displays the current control status of the module.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

4.6.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Parameter explanation**

Users write the commands into the module and the module will execute accordingly. After execution, the module will send back a corresponding value which indicates that the execution is success or failure.

- **User command**

Command	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

4.6.5.3 Input Filter Time

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Input Filter Time	Filtering time for inputs Setting range: 0–255 (ms)	USINT	RW	3
	16#02	CH1 Input Filter Time		USINT	RW	3
	16#03	CH2 Input Filter Time		USINT	RW	3
	16#04	CH3 Input Filter Time		USINT	RW	3
	16#05	CH4 Input Filter Time		USINT	RW	3
	16#06	CH5 Input Filter Time		USINT	RW	3
	16#07	CH6 Input Filter Time		USINT	RW	3
	16#08	CH7 Input Filter Time		USINT	RW	3

- **Parameter explanation**

The parameter set is to set the filtering time for the inputs of the module. If the duration time for received signals is shorter than the set filtering time, the signals received will be seen as noises and will be filtered out. The default filtering value is 3 ms. But you can set the filtering time for the inputs according to your application environment.

4.6.5.4 Input Filter Threshold

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Input Filter Threshold	Filtering threshold for inputs	USINT	RW	80
	16#02	CH1 Input Filter Threshold		USINT	RW	80
	16#03	CH2 Input Filter Threshold		USINT	RW	80
	16#04	CH3 Input Filter Threshold		USINT	RW	80
	16#05	CH4 Input Filter Threshold		USINT	RW	80
	16#06	CH5 Input Filter Threshold		USINT	RW	80
	16#07	CH6 Input Filter Threshold		USINT	RW	80
	16#08	CH7 Input Filter Threshold		USINT	RW	80

- **Parameter explanation**

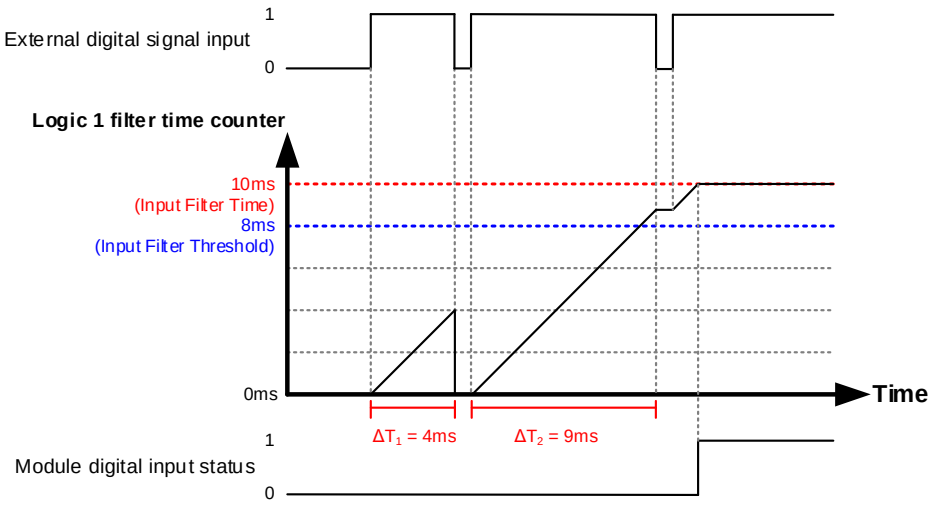
The parameter set is to set the filtering threshold for the inputs so as to suppress the digital noise interference.

- **Input filter threshold**

Setting in function block	Threshold
0	20%
1	40%
2	60%
3	80%
4	100%

Example: Set Input Filter Threshold to 80%

Set the input filter time to 10 ms and the input filter threshold to 80%, which means that the threshold time is 8 ms (10ms * 80%). The signal of duration time less than 8 ms is seen as a noise and filtered out (Δ T1). But the signal of duration time greater than 8 ms is seen as a valid signal, and then the cumulative time (Δ T2) for such a signal input is not reset when a brief noise signal occurs subsequently.



In the system, there are filter time counters logic 0 and logic 1, which have opposite logics but the same operation principle.

4.6.5.5 Output Settings when EtherCAT Connection Lost

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8002	16#01	CH0 Output Settings when EtherCAT Connection Lost	Output behavior setting	USINT	RW	0
	16#02	CH1 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#03	CH2 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#04	CH3 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#05	CH4 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#06	CH5 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#07	CH6 Output Settings when EtherCAT Connection Lost		USINT	RW	0
	16#08	CH7 Output Settings when EtherCAT Connection Lost		USINT	RW	0

- **Parameter explanation**

The parameter set is for setting the output behavior of output points when the EtherCAT connection is lost

- **Output behavior settings**

Setting value	Name	Description
0	Stay OFF	The channel stays OFF.
1	Stay ON	The channel stays ON.
2	Keep Last Status	The channel keeps as the last status is.

4.6.5.6 Output Settings when Module in Stopped State

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Output Settings when Module in Stopped State	Output behavior setting	USINT	RW	0
	16#02	CH1 Output Settings when Module in Stopped State		USINT	RW	0
	16#03	CH2 Output Settings when Module in Stopped State		USINT	RW	0
	16#04	CH3 Output Settings when Module in Stopped State		USINT	RW	0
	16#05	CH4 Output Settings when Module in Stopped State		USINT	RW	0
	16#06	CH5 Output Settings when Module in Stopped State		USINT	RW	0
	16#07	CH6 Output Settings when Module in Stopped State		USINT	RW	0
	16#08	CH7 Output Settings when Module in Stopped State		USINT	RW	0

- **Parameter explanation**

The parameter set is for setting the output behavior of output points when the module is in the Stopped state.

- **Output behavior settings**

Setting value	Name	Description
0	Stay OFF	The channel stays OFF.
1	Stay ON	The channel stays ON.
2	Keep Update	The channel keeps updating the output.

4.6.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

4.6.6.1 FreeRun Mode

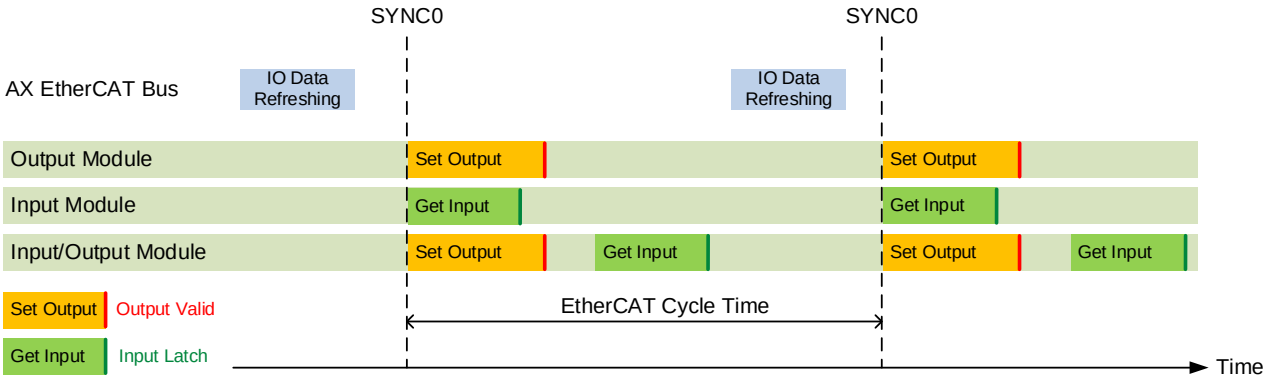
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

4.6.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

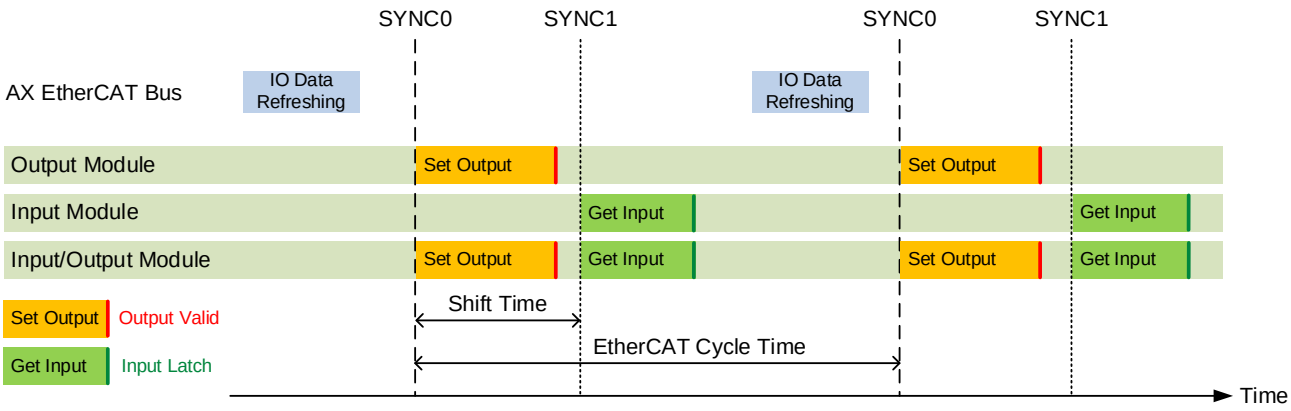
- **SYNC0**

Using SYNC0 to refresh values of output channels among modules at the same time.



- **SYNC0 + SYNC1**

Using SYNC0 to refresh values of outptut channels and using SYNC1 to refresh values of input channels among modules at the same time. The shift time between SYNC0 and SYNC1 can be modified with DIADesigner-AX.



4.6.7 Process Data

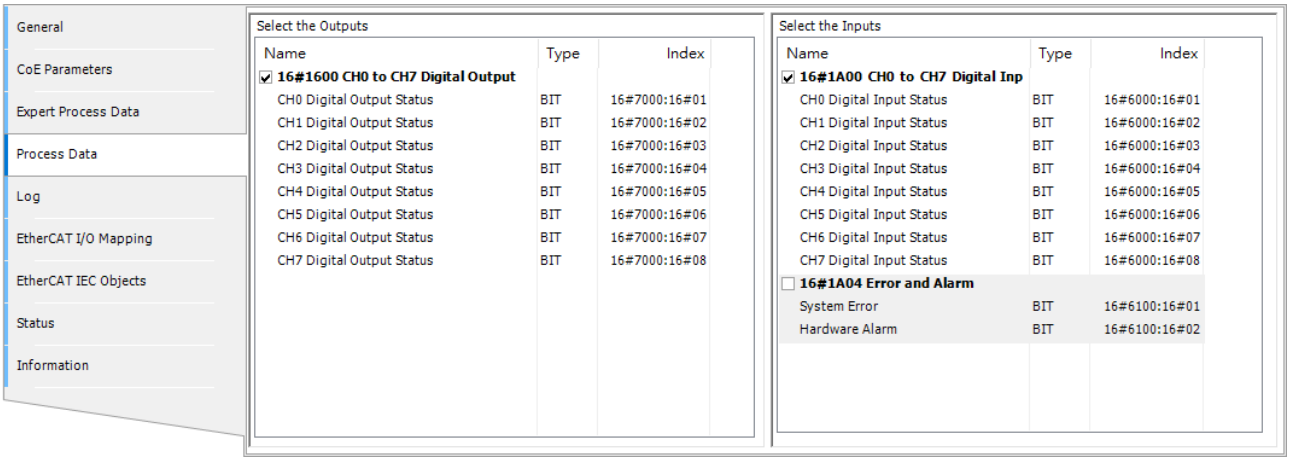
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Digital Input Status	Digital input values of CH0–CH7	BOOL	RO	0
	16#02	CH1 Digital Input Status		BOOL	RO	0
	16#03	CH2 Digital Input Status		BOOL	RO	0
	16#04	CH3 Digital Input Status		BOOL	RO	0
	16#05	CH4 Digital Input Status		BOOL	RO	0
	16#06	CH5 Digital Input Status		BOOL	RO	0
	16#07	CH6 Digital Input Status		BOOL	RO	0
	16#08	CH7 Digital Input Status		BOOL	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0
	16#02	Hardware Alarm	Hardware error alarm	BOOL	RO	0
16#7000	16#01	CH0 Digital Output Status	Digital output values of CH0–CH7	BOOL	RO	0
	16#02	CH1 Digital Output Status		BOOL	RO	0
	16#03	CH2 Digital Output Status		BOOL	RO	0
	16#04	CH3 Digital Output Status		BOOL	RO	0
	16#05	CH4 Digital Output Status		BOOL	RO	0
	16#06	CH5 Digital Output Status		BOOL	RO	0
	16#07	CH6 Digital Output Status		BOOL	RO	0
	16#08	CH7 Digital Output Status		BOOL	RO	0

4.6.7.1 Process Data

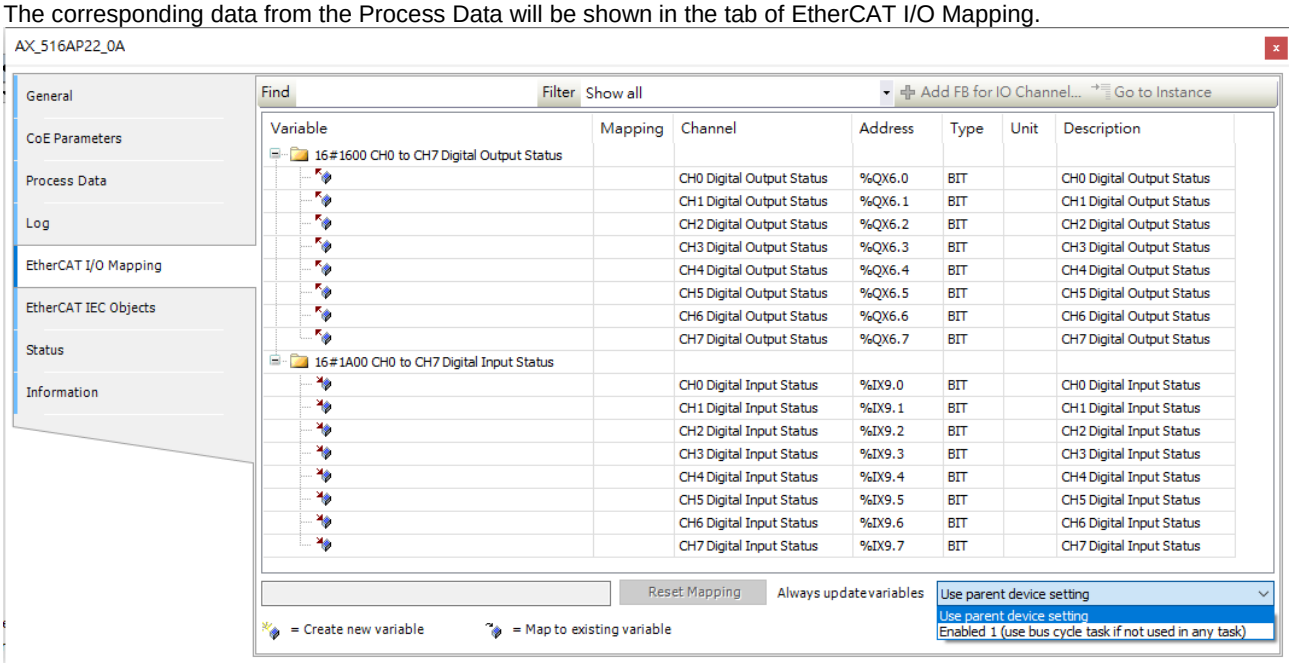
Go to the Process Data tab and select the data that you'd like to monitor.

- Digital Input/Output Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Alarm: It is not selected by default.



4.6.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



4.6.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

4.6.8 Troubleshooting

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Disconnection	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
16#A001	16#01	(16#FF11) Channel Hardware Alarm	Blinking	Same as before	Check if the wiring for the channels is short-circuit or overcurrent

5

Chapter 5 Analog Input / Output Modules

Table of Contents

5.1 AX-504AD10-0A

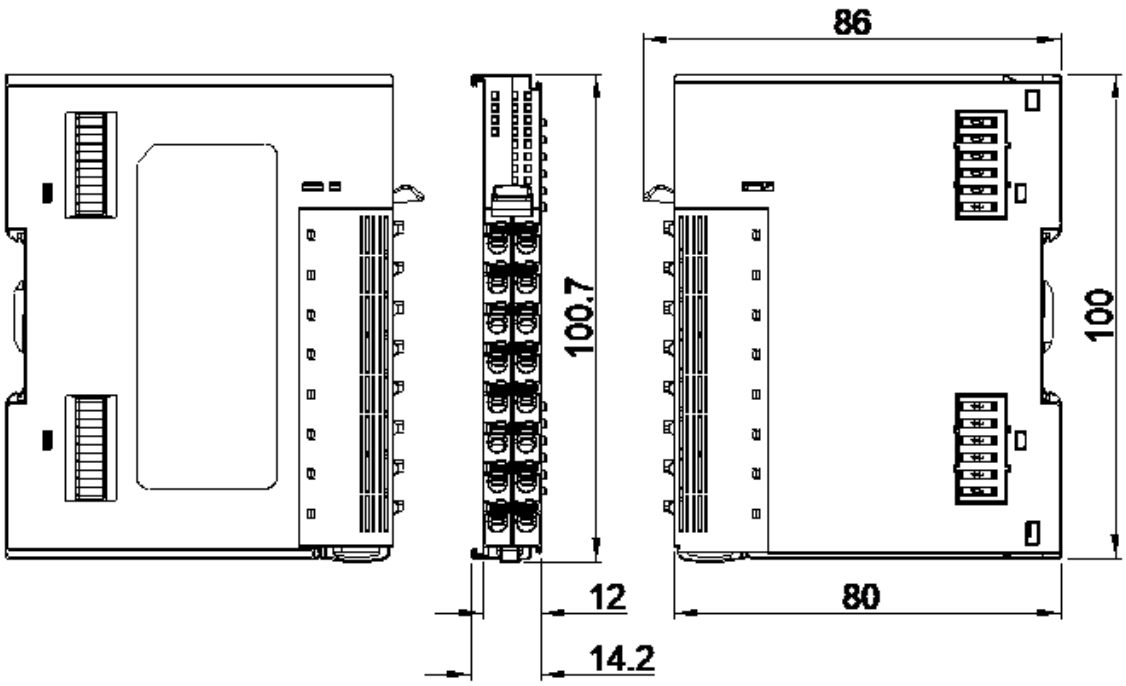
AX-504AD10-0A, an analog input module, receives analog voltage signals through 4 input points and converts the received signals to 16-bit digital signals. This section introduces its specifications, wirings and operations.

5.1.1 Specifications

Item		Specification
Input points		4
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		73 g
Electrical specification	Input form	Differential input
	Input range	-10 – +10 V
	Input conversion range	-5 – 105 % (F.S.)
	Rated absolute input range	±15 V
	Input impedance	1 MΩ and more
	Resolution	-10 – +10 V : -30000–30000
	Accuracy	25 ºC: ±0.2 % (F.S.)
		-20 – 60 ºC: ±0.6 % (F.S.)
	Conversion time	100 μs / 4 points
	Isolation method	Between unit power and external power: no isolation Between digital power and analog power: 500 VAC Between digital signal and analog signal: 500 VAC Between analog channels: no isolation
	Maximum power consumption (unit power)	Less than 400mA (2W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Protection	--
	Short Circuit Protection (SCP)	--
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	--
	Filter function	AVG / FIR / IIR

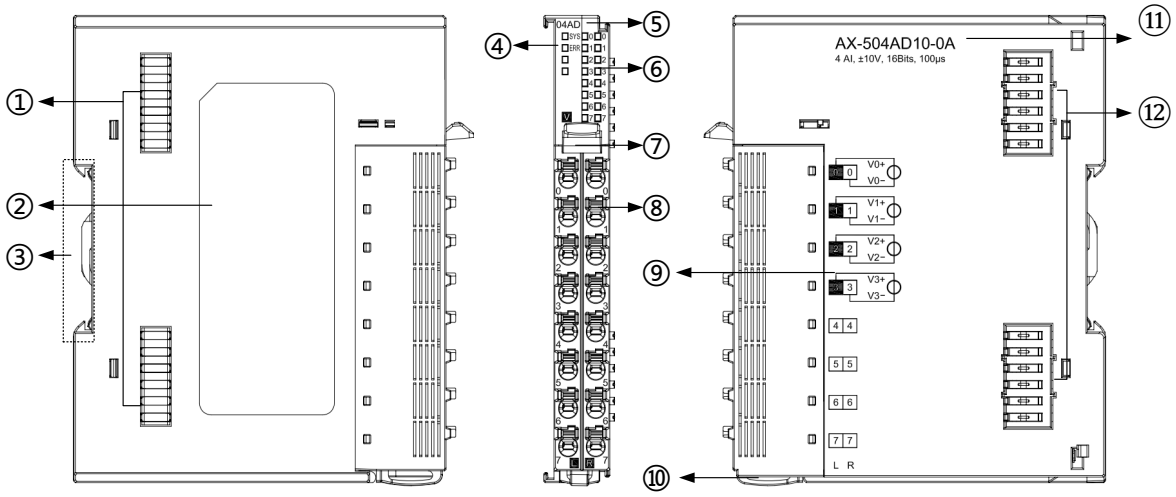
5.1.2 Dimensions and Parts

- **Dimensions**



Unit: mm

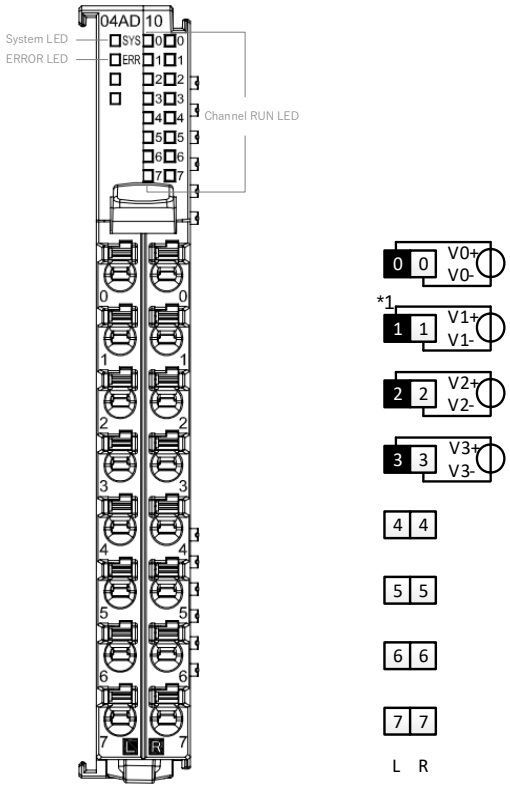
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

5.1.3 Arrangement of Terminals, LED Indicators and Wiring

5.1.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

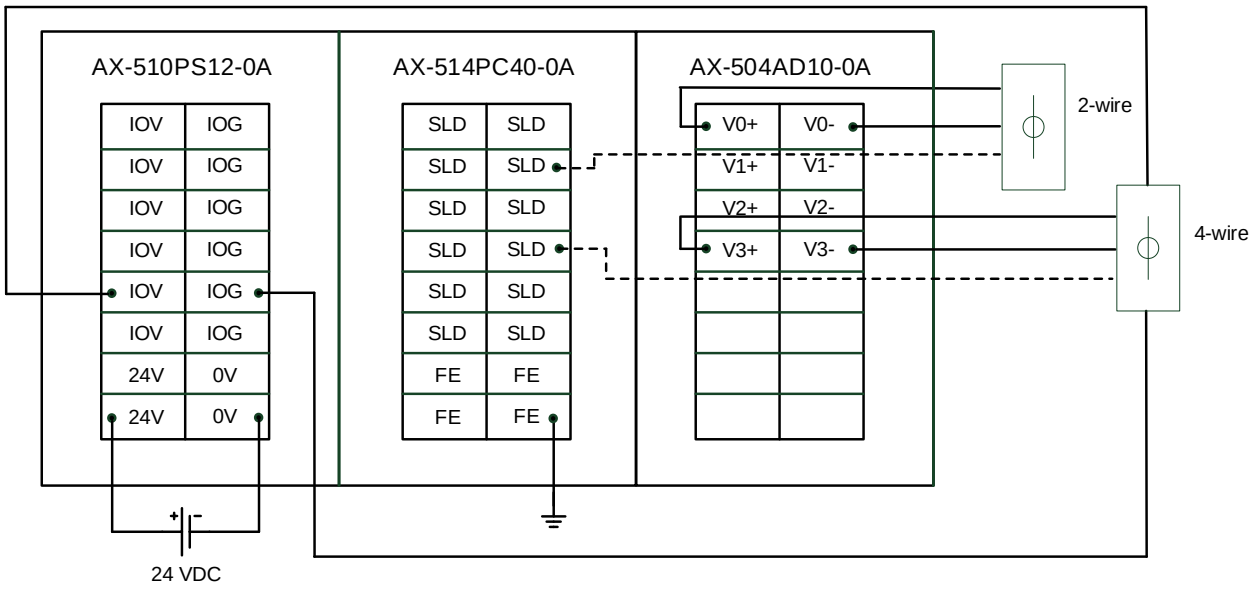
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	V0+	Channel 0: positive input voltage	R0	V0-	Channel 0: negative input voltage
L1	V1+	Channel 1: positive input voltage	R1	V1-	Channel 1: negative input voltage
L2	V2+	Channel 2: positive input voltage	R2	V2-	Channel 2: negative input voltage
L3	V3+	Channel 3: positive input voltage	R3	V3-	Channel 3: negative input voltage
L4	--	--	R4	--	--
L5	--	--	R5	--	--
L6	--	--	R6	--	--
L7	--	--	R7	--	--

5.1.3.2 LED Indicators

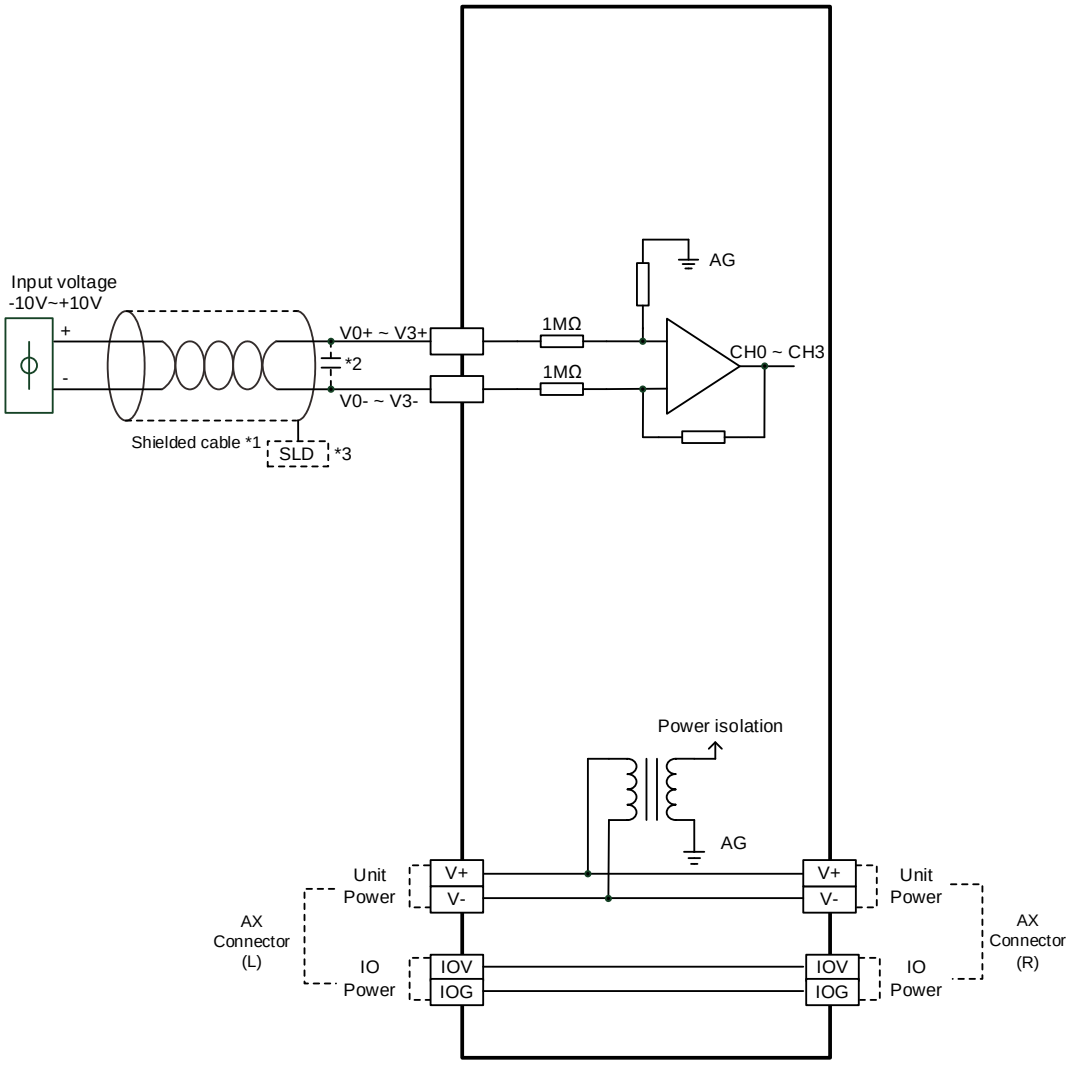
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking (1s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1s)	An error occurs on the application.
			Blinking (0.2s)	An error occurs on the hardware.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

5.1.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



*1. Use shielded cables to isolate the analog input signal cable from other power cables.

*2. If variability in the input voltage results in interference within the wiring, connect the module to a capacitor with a capacitance between 0.1–0.47 µF and a working voltage of 25 V.

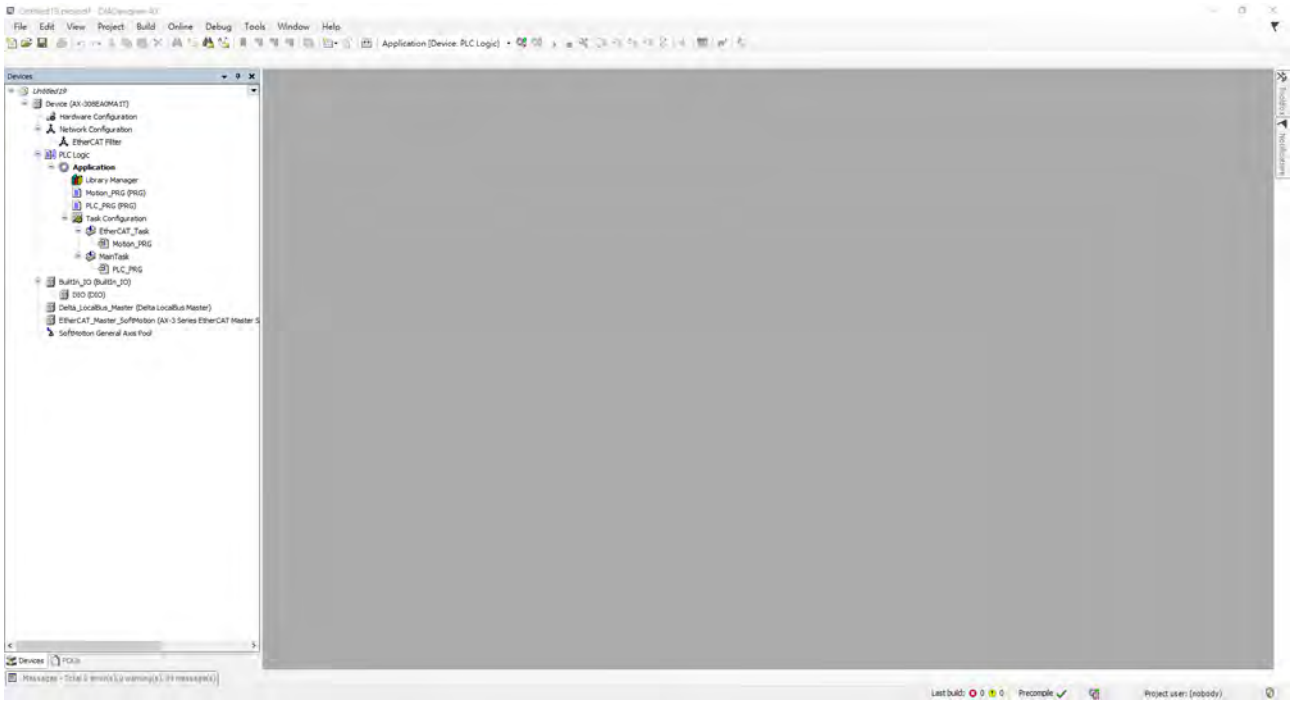
*3. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A.

5.1.4 Settings in DIADesigner-AX

The software DIADesigner-AX is the programming tool for the AX Series PLCs. This section introduces some basic operations and settings.

5.1.4.1 Basic Operation

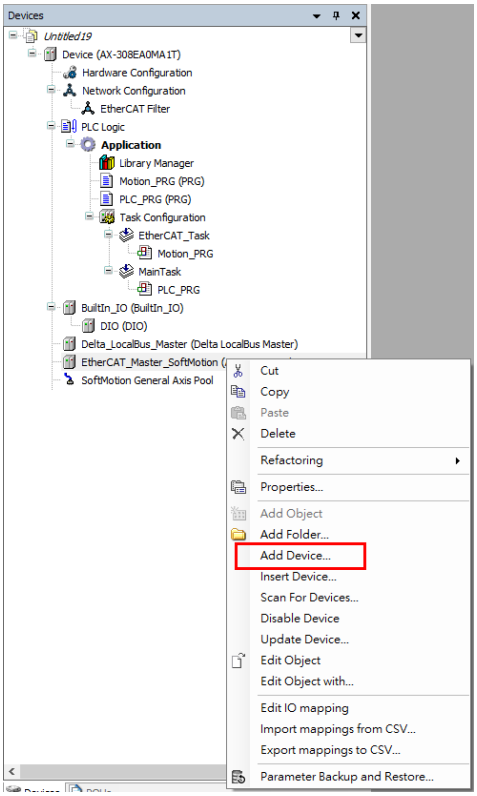
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



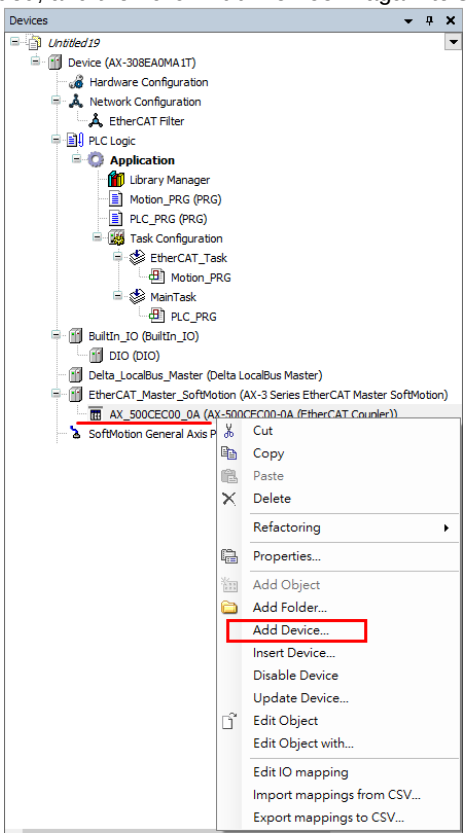
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Add Device…** to select and add System Coupler.

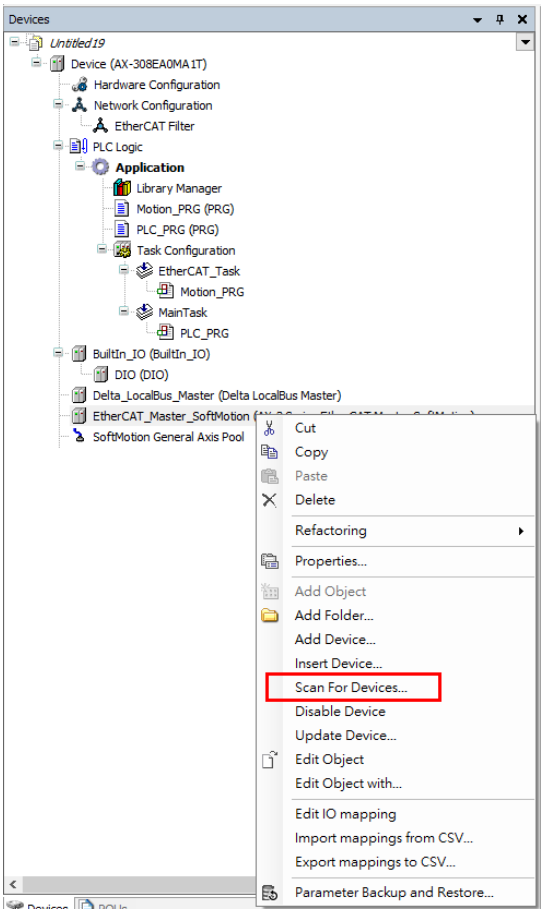


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

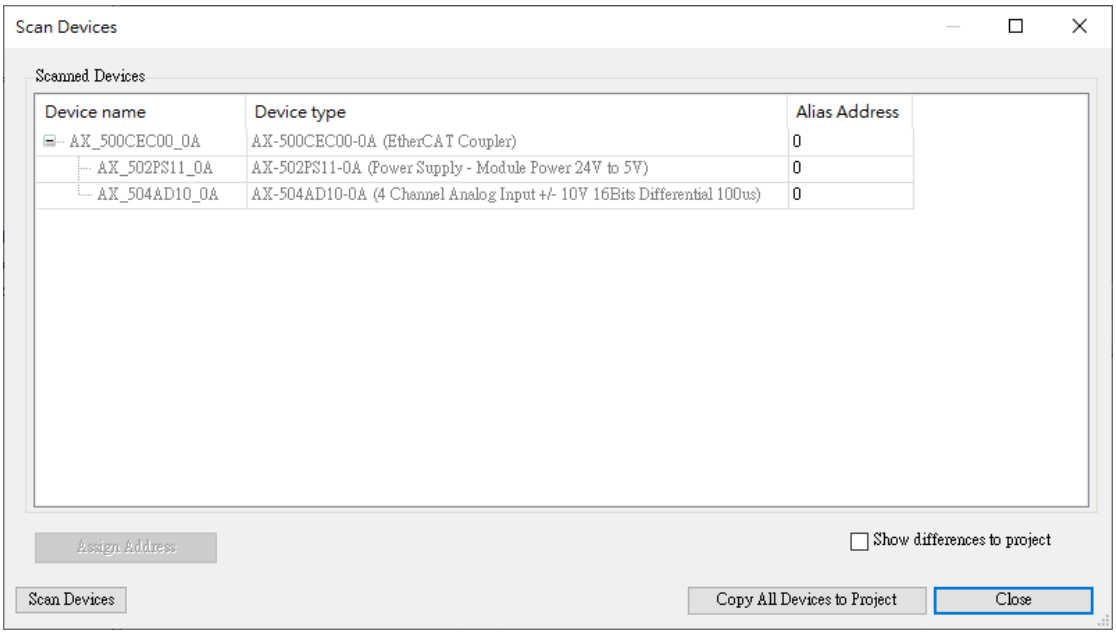


- Method 2: Scan to add the modules in.

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Scan for Devices…**.



After the auto-scan is over, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.

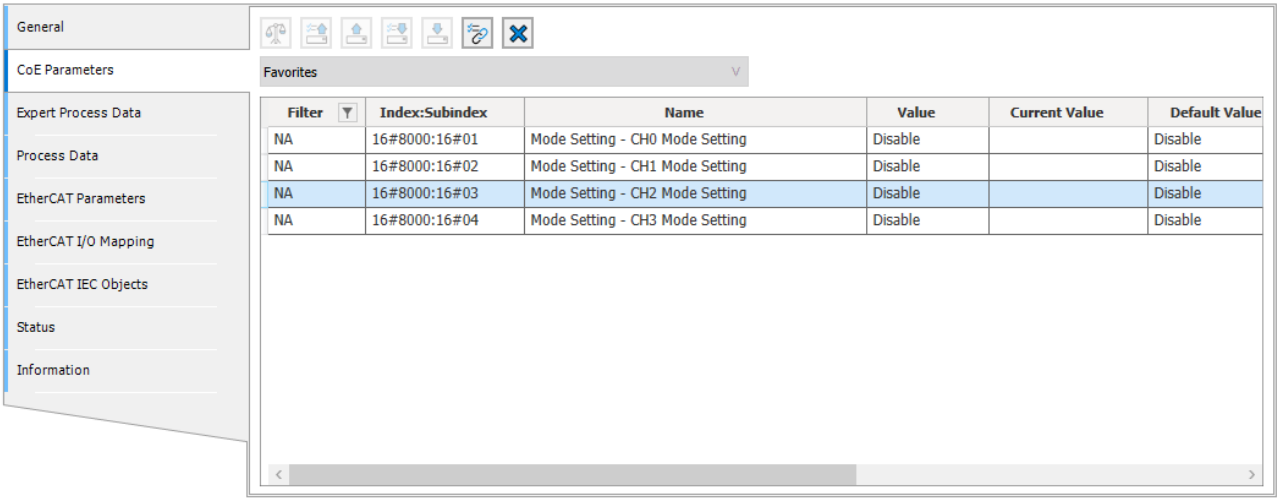


5.1.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.

(1) Favorites

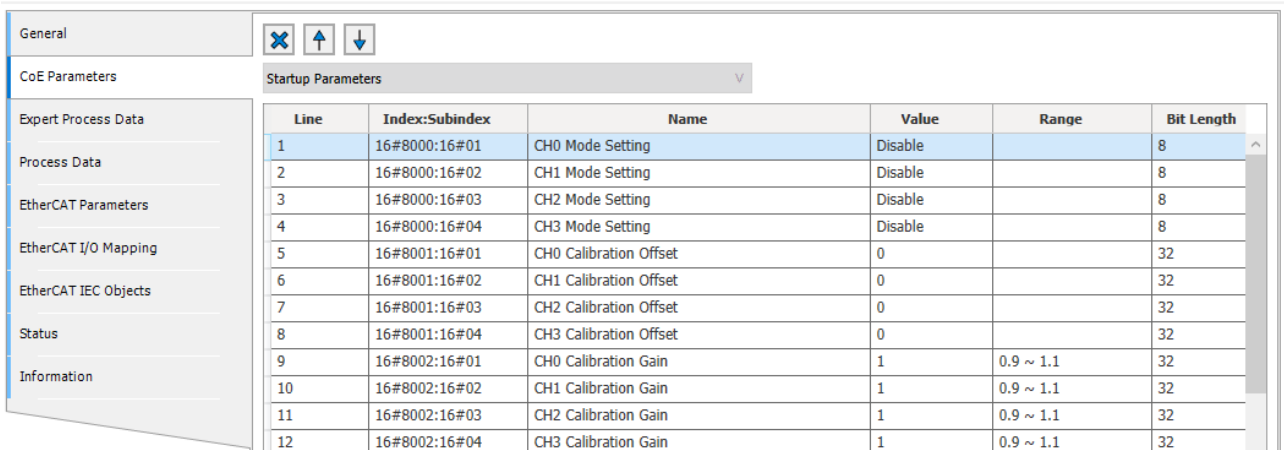
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

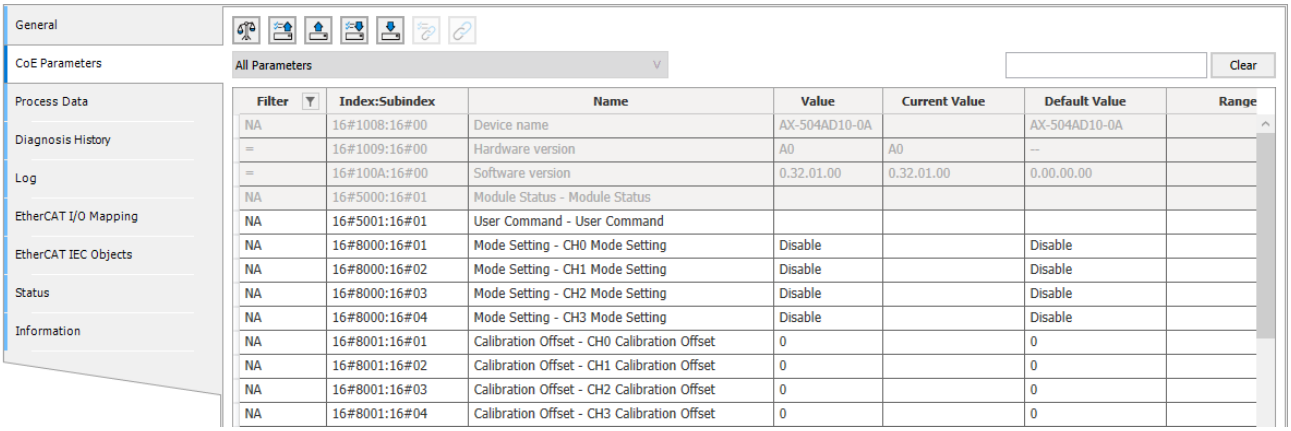


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8000:16#03	CH2 Mode Setting	Disable		8
4	16#8000:16#04	CH3 Mode Setting	Disable		8
5	16#8001:16#01	CH0 Calibration Offset	0		32
6	16#8001:16#02	CH1 Calibration Offset	0		32
7	16#8001:16#03	CH2 Calibration Offset	0		32
8	16#8001:16#04	CH3 Calibration Offset	0		32
9	16#8002:16#01	CH0 Calibration Gain	1	0.9 ~ 1.1	32
10	16#8002:16#02	CH1 Calibration Gain	1	0.9 ~ 1.1	32
11	16#8002:16#03	CH2 Calibration Gain	1	0.9 ~ 1.1	32
12	16#8002:16#04	CH3 Calibration Gain	1	0.9 ~ 1.1	32

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

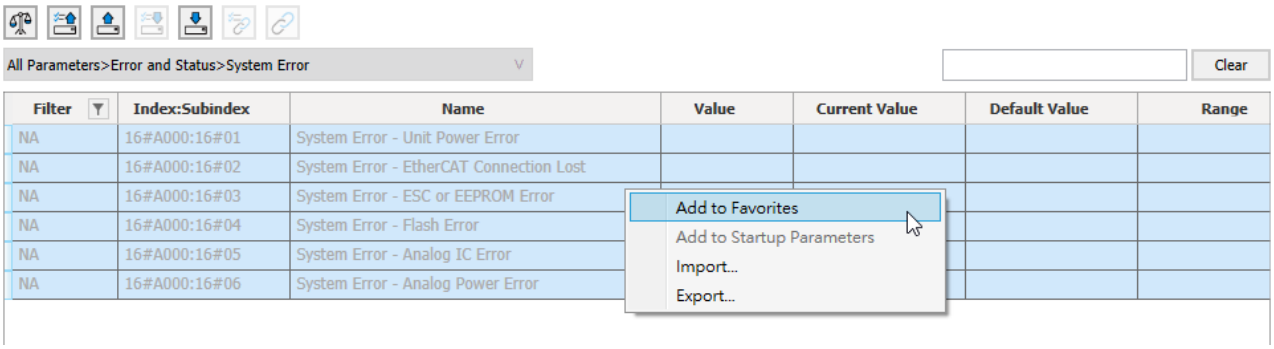
(3) All Parameters

- You can find all the CoE parameters here. Click  on the toolbar to go into online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

- You can select and right-click the parameter to add the selected parameter to the Favorites.

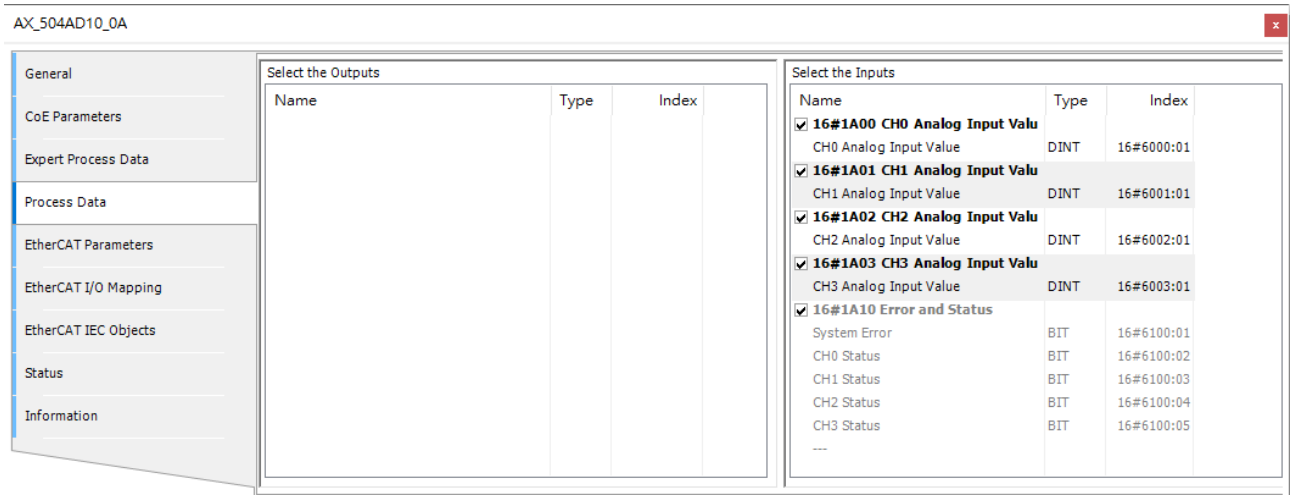


Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

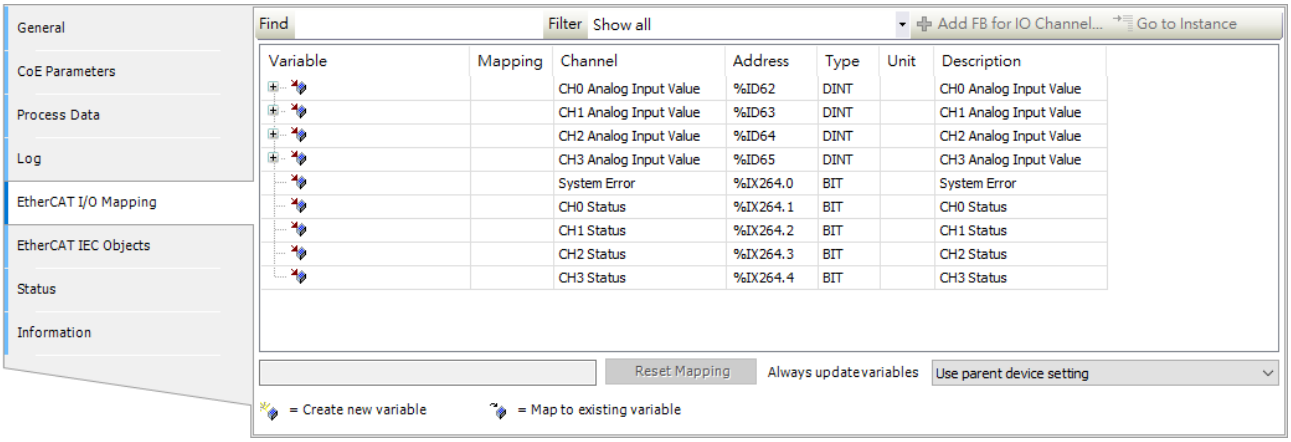
5

5.1.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

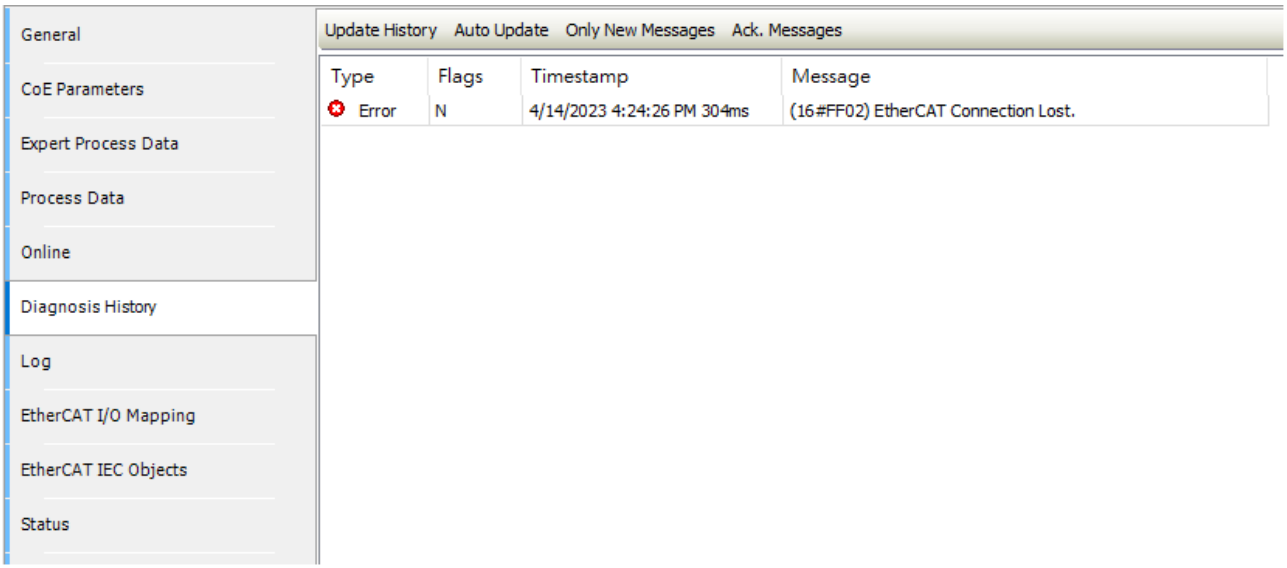


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



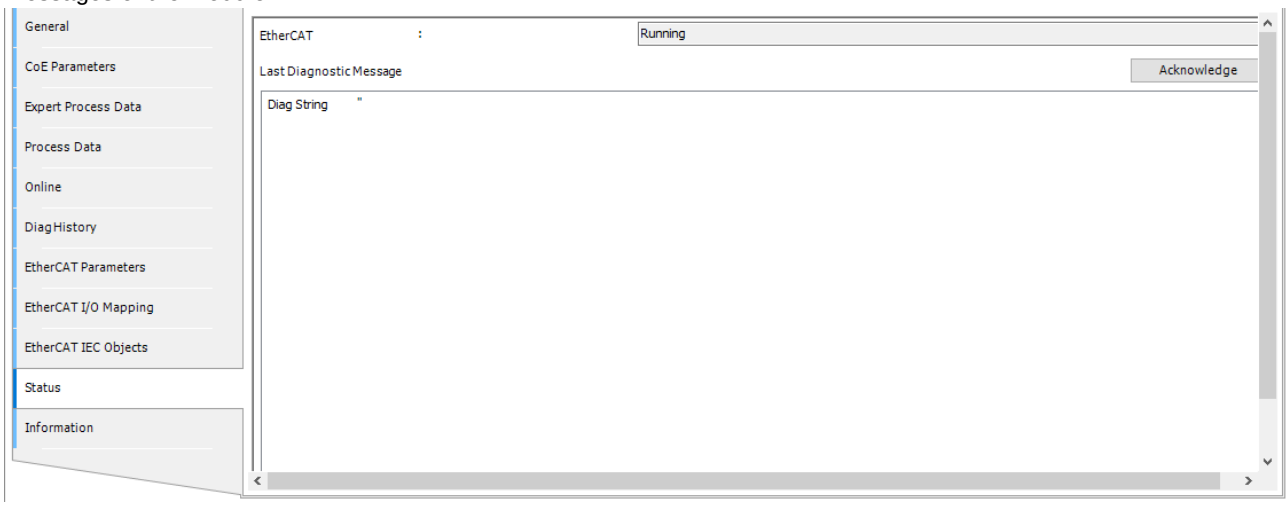
5.1.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors.



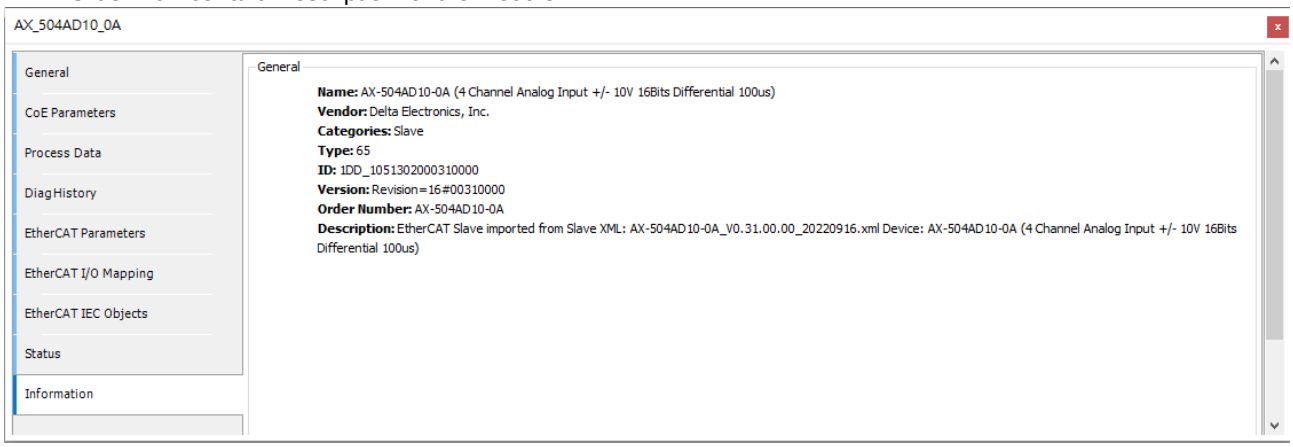
5.1.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



5.1.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.32.01.00	0.32.01.00	0.00.00.00

5.1.5 Parameter Descriptions

You can use DIADesigner-AX to set up the functions for the module by directly selecting the setting mode and parameters. For software operation, refer to section 5.1.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Mode Setting	Mode setting or the channel is OFF.	DFB_AD_RD_ModeSetting DFB_AD_WR_ModeSetting
16#8001	Calibration Offset	Calibration - offset	DFB_AD_RD_CalOffset DFB_AD_WR_CalOffset
16#8002	Calibration Gain	Calibration - gain	DFB_AD_RD_CalGain DFB_AD_WR_CalGain
16#8003	Digital Filter Setting	Digital filter setting	DFB_AD_RD_FilterSetting DFB_AD_WR_FilterSetting
16#8004	Moving Average Times	Moving average times	DFB_AD_RD_AverageTimes DFB_AD_WR_AverageTimes
16#8005	Enable User Limit Alarm DINT	Enable / disable the alarm of exceeding the user-defined limit (DINT)	
16#8006	User Upper Limit DINT	User-defined upper limit (DINT)	
16#8007	User Lower Limit DINT	User-defined lower limit (DINT)	
16#8008	Exceed Hardware Limit Setting	Hardware limit setting	
16#8010	Format	Data format setting	
16#8015	Enable User Limit Alarm REAL	Enable / disable the alarm of exceeding the user-defined limit (floating-point)	
16#8016	User Upper Limit REAL	User-defined upper limit (floating-point)	
16#8017	User Lower Limit REAL	User-defined lower limit (floating-point)	
16#8030	Scale Upper Limit REAL	Scale upper limit setting (floating-point)	DFB_AD_RD_ScaleUpperLimit DFB_AD_WR_ScaleUpperLimit
16#8031	Scale Lower Limit REAL	Scale lower limit setting (floating-point)	DFB_AD_RD_ScaleLowerLimit DFB_AD_WR_ScaleLowerLimit
16#8100	ADC Raw Data	Raw data	

5.1.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Explanation**

When AX5 series PLC CPU is used, the module status is synchronized with the status of AX5 series PLC CPU and it will be either 1 (Run) or 2 (Stop). When the status of AX5 series PLC CPU is Stop, the output modules will act according to the parameter settings. As for the input modules, they are not affected. If you use other PLC (NOT AX5 Series PLC) as the controller, the module status will be 0 indicating it is controlled by EtherCAT State Machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

5.1.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Explanation**

Users write a command value into the module and the module will execute the command accordingly. After execution, the module will respond with a corresponding value to show if the execution is success or not.

- **User command**

Command value	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

5.1.5.3 Mode Setting

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Mode Setting	Voltage mode setting	USINT	RW	0
	16#02	CH1 Mode Setting		USINT	RW	0
	16#03	CH2 Mode Setting		USINT	RW	0
	16#04	CH3 Mode Setting		USINT	RW	0

- **Explanation**

Select the mode to set the channel to ON. The conversion time is 100 μs / 4 channels.

- **Supported modes:**

Mode	Mode range	DINT range
0	Disable	NA
1	-10 V–10 V	±30000
2	0 V–10 V	0–30000
3	-5 V–5 V	±30000
4	0 V–5 V	0–30000
5	1 V–5 V	0–30000

5.1.5.4 Calibration

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Calibration Offset	Offset Setting range: no limit	REAL	RW	0
	16#02	CH1 Calibration Offset		REAL	RW	0
	16#03	CH2 Calibration Offset		REAL	RW	0
	16#04	CH3 Calibration Offset		REAL	RW	0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9–1.1	REAL	RW	1.0
	16#02	CH1 Calibration Gain		REAL	RW	1.0
	16#03	CH2 Calibration Gain		REAL	RW	1.0
	16#04	CH3 Calibration Gain		REAL	RW	1.0

- **Explanation**

When there is an obvious difference between input values and actual values, you can change Offset and Gain to correct the input curve. The formula is

$$Output = (Input \times Gain) + Offset$$

Example

The mode of channels is -10 V to +10 V. Gain is 1 and Offset is 0 by default; the corresponding value range is -10.0 V to 10.0 V. If Gain is set to 0.9 and Offset is set to 2, the value after calibration is -7.0 V to 11.0 V.

5.1.5.5 Digital Filter

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Digital Filter Setting	Digital filter setting	USINT	RW	0
	16#02	CH1 Digital Filter Setting		USINT	RW	0
	16#03	CH2 Digital Filter Setting		USINT	RW	0
	16#04	CH3 Digital Filter Setting		USINT	RW	0
16#8004	16#01	CH0 Moving Average Times	Moving average times Setting range: 1–100 times	USINT	RW	0
	16#02	CH1 Moving Average Times		USINT	RW	0
	16#03	CH2 Moving Average Times		USINT	RW	0
	16#04	CH3 Moving Average Times		USINT	RW	0

- **Explanation**

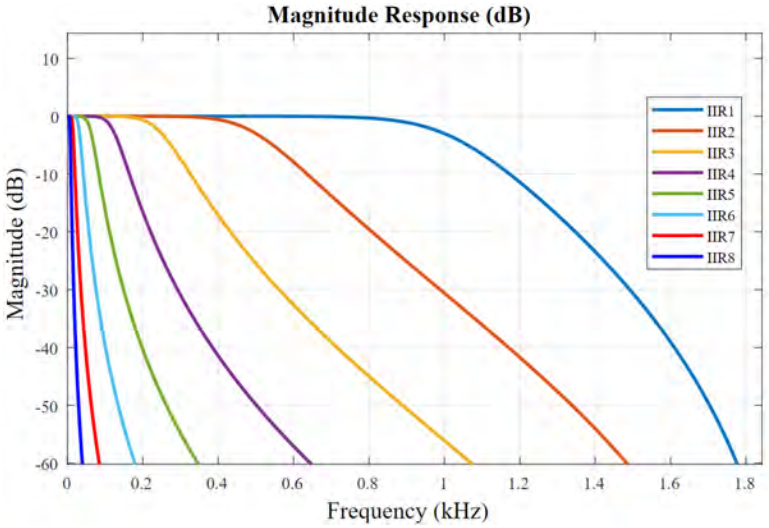
The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The filters can work only when the EtherCAT operation mode is the Free Run mode. The conversion time for FIR filter and IIR filter is 250μs / 4 channels.

Moving Average Filter

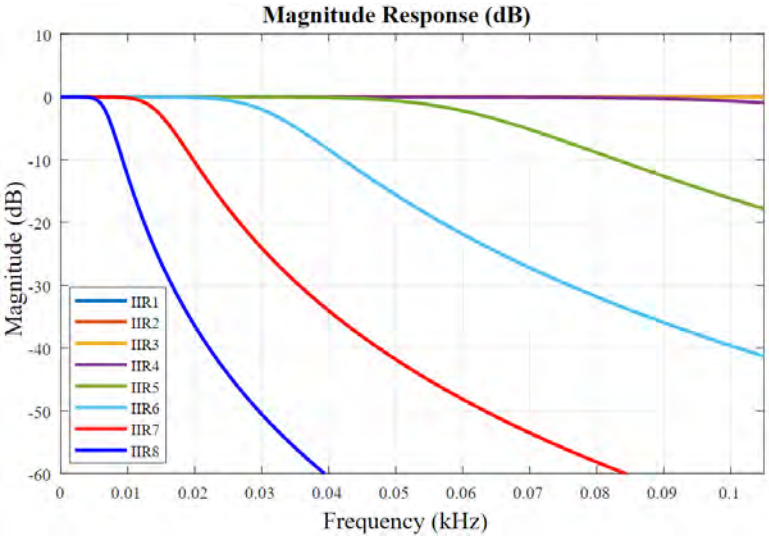
A moving average filter uses the latest pieces of sampled data to create a series of averages to smooth the data. Compared to other types of filters, a moving average filter is fast in computation and algorithm, without occupying the CPU processing time. But the filtering result of a moving average filter is not as effective as an IIR filter or a FIR filter.

IIR (Infinite Impulse Response) Filter

An infinite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, an IIR filter works more efficiently than a moving average filter does. This IIR filter is a low-pass filter. The advantage of an IIR filter is that within the same length of operation time, the filtering result of an IIR filter is better than what a FIR filter can offer. Since the IIR filter can only have a non-linear phase response, it has an inconsistent output delay at every frequency, the input signals may be distorted and the stability issue may be raised. So the IIR filter may not be suitable for applications such as oscilloscope waveforms and electrocardiography that require demanding waveforms.



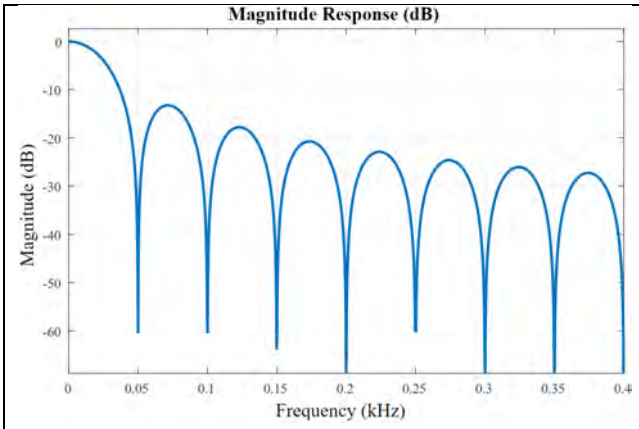
Frequency response of IIR filter



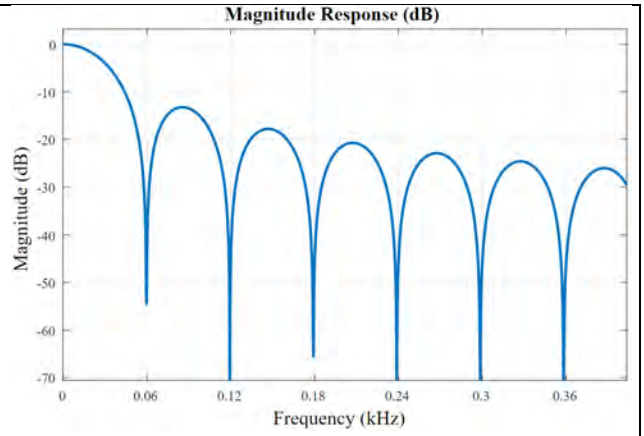
Frequency response of IIR filter (enlarged figure)

FIR (Finite impulse response) Filter

A finite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, a FIR filter works more effectively than a moving average filter does. The FIR filter that the module provides is a low-pass filter; it works tremendously well for attenuation of 50/60 Hz signals (> 40 dB). The advantage of a FIR filter is that it has a linear phase response which means a FIR filter has a consistent output delay at all frequencies while an IIR filter has an unequal delay at different frequencies. A FIR filter is ideal for a wide range of applications. However within the same length of operation time, the filtering result of a FIR filter is not as good as what an IIR filter can deliver.



50 Hz low-pass FIR filter



60 Hz low-pass FIR filter

- **Digital filter modes**

Mode	Name of digital filter	Cut-off frequency (-3 dB)
0	Inactive	
1	Moving Average	Works with Moving Average Time
2	IIR1	1000 Hz
3	IIR2	500 Hz
4	IIR3	250 Hz
5	IIR4	125 Hz
6	IIR5	63 Hz
7	IIR6	32 Hz
8	IIR7	15 Hz
9	IIR8	7 Hz
10	FIR 50Hz	22 Hz (attenuation: multiples of 50 Hz: > 40dB)
11	FIR 60Hz	26 Hz (attenuation: multiples of 60 Hz: > 40dB)

5.1.5.6 User Limit Alarm

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8005	16#01	CH0 Enable User Limit Alarm DINT	Enable / disable the alarm of exceeding the user-defined limit (DINT) 0: Disable (default) 1: Enable	BOOL	RW	0
	16#02	CH1 Enable User Limit Alarm DINT		BOOL	RW	0
	16#03	CH2 Enable User Limit Alarm DINT		BOOL	RW	0
	16#04	CH3 Enable User Limit Alarm DINT		BOOL	RW	0

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8006	16#01	CH0 User Upper Limit DINT	User-defined upper limit (DINT); Setting range: no limit	DINT	RW	30000
	16#02	CH1 User Upper Limit DINT		DINT	RW	30000
	16#03	CH2 User Upper Limit DINT		DINT	RW	30000
	16#04	CH3 User Upper Limit DINT		DINT	RW	30000
16#8007	16#01	CH0 User Lower Limit DINT	User-defined lower limit (DINT); Setting range: no limit	DINT	RW	-30000
	16#02	CH1 User Lower Limit DINT		DINT	RW	-30000
	16#03	CH2 User Lower Limit DINT		DINT	RW	-30000
	16#04	CH3 User Lower Limit DINT		DINT	RW	-30000
16#8015	16#01	CH0 Enable User Limit Alarm REAL	Enable / disable the alarm of exceeding the user-defined limit (floating-point); 0: Disable(default) 1: Enable	BOOL	RW	0
	16#02	CH1 Enable User Limit Alarm REAL		BOOL	RW	0
	16#03	CH2 Enable User Limit Alarm REAL		BOOL	RW	0
	16#04	CH3 Enable User Limit Alarm REAL		BOOL	RW	0
16#8016	16#01	CH0 User Upper Limit REAL	User-defined upper limit (floating-point); Setting range: no limit	REAL	RW	10.0
	16#02	CH1 User Upper Limit REAL		REAL	RW	10.0
	16#03	CH2 User Upper Limit REAL		REAL	RW	10.0
	16#04	CH3 User Upper Limit REAL		REAL	RW	10.0
16#8017	16#01	CH0 User Lower Limit For REAL	User-defined lower limit (floating-point); Setting range: no limit	REAL	RW	-10.0
	16#02	CH1 User Lower Limit For REAL		REAL	RW	-10.0
	16#03	CH2 User Lower Limit For REAL		REAL	RW	-10.0
	16#04	CH3 User Lower Limit For REAL		REAL	RW	-10.0

- **Explanation**

Users can define the upper and lower limits and enable the alarm of exceeding the limits. Set the format to DINT or REAL (floating-point).

- **Example**

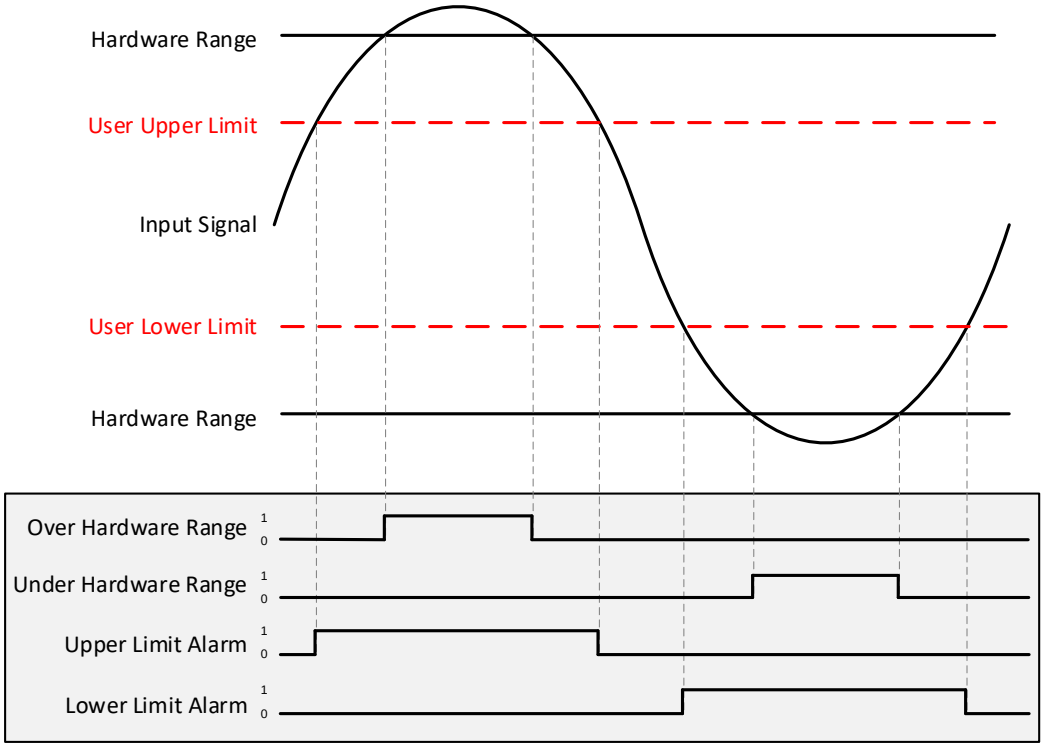
When the format is set to DINT, you can set

16#8005 Enable User Limit Alarm DINT: Enable

16#8006 User Upper Limit DINT: 28000

16#8007 User Lower Limit DINT: -28000

When the input signal exceeds the user-defined upper or lower limit, an error occurs. See section 5.1.8 for more information on troubleshooting.

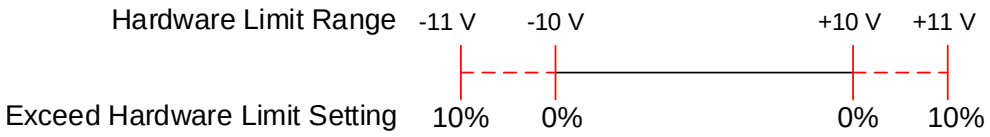


5.1.5.7 Exceed Hardware Limit

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8008	16#01	CH0 Exceed Hardware Limit Setting	Hardware limit setting; Setting range: 0–10 (0%–10%)	USINT	RW	5
	16#02	CH1 Exceed Hardware Limit Setting		USINT	RW	5
	16#03	CH2 Exceed Hardware Limit Setting		USINT	RW	5
	16#04	CH3 Exceed Hardware Limit Setting		USINT	RW	5

- **Explanation**

Users can define the hardware limit range.



- **Example**

When the mode is -10 V–10 V, the setting value is 5%. Its hardware limit range is -10.5 V – 10.5 V. When the input signal exceeds the hardware upper or lower limit, an error occurs. See section 5.1.8 for more information on troubleshooting.

5.1.5.8 Format

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8010	16#01	Format	0: DINT Format 1: REAL Format	USINT	RW	0
	16#02	Decimal Places	Setting value: 0–5	USINT	RW	2

- **Explanation**

You can set the format and the decimal places according to your demand.

When the data format is set to DINT Format, set up the DINT parameters which are with “DINT” following a parameter name. When the data format is set to REAL Format, set up the REAL parameters which are with “REAL” following a parameter name.

5.1.5.9 Scale

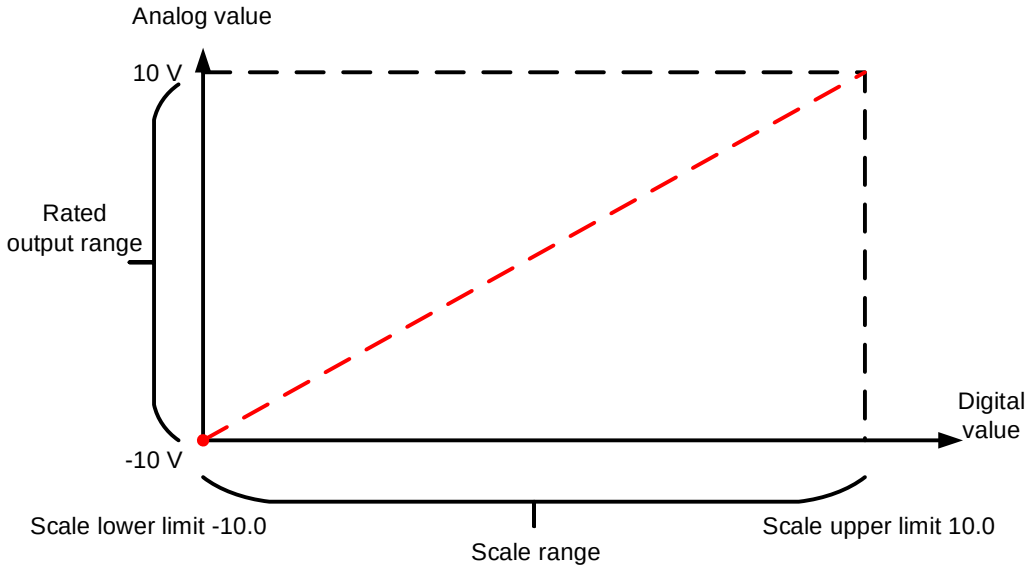
Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8030	16#01	CH0 Scale Upper Limit REAL	Scale upper limit setting; Setting range: no limit	REAL	RW	10
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	10
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	10
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	10
16#8031	16#01	CH0 Scale Lower Limit REAL	Scale lower limit setting; Setting range: no limit	REAL	RW	-10
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-10
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-10
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-10

- **Explanation**

You can set the scale range based on the analog specification for channels when the data format is REAL (floating-point).

- **Example**

If the mode setting of channels is -10 V–10 V, the analog range is -10 V–10 V; and the scale upper limit is set to 10.0 and lower limit is set to -10.0. The digital values -10.0 to +10.0 correspond to the analog values -10 V to +10 V, as the example below shows.



5.1.5.10 ADC Raw Data

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8100	16#01	CH0 ADC Raw data	Raw data	DINT	RO	0
	16#02	CH1 ADC Raw data		DINT	RO	0
	16#03	CH2 ADC Raw data		DINT	RO	0
	16#04	CH3 ADC Raw data		DINT	RO	0

- **Explanation**

Raw data is the source data that has not been processed or converted from analog to digital.

5.1.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

5.1.6.1 FreeRun Mode

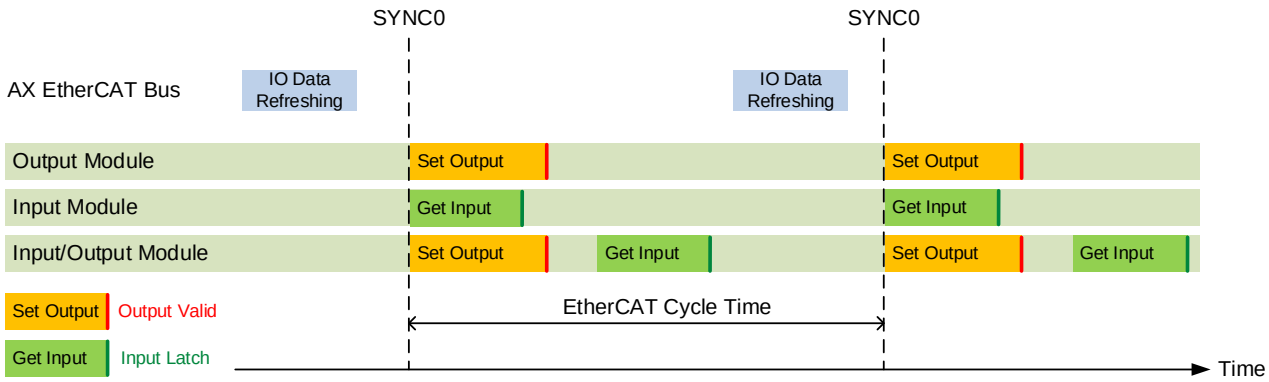
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

5.1.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

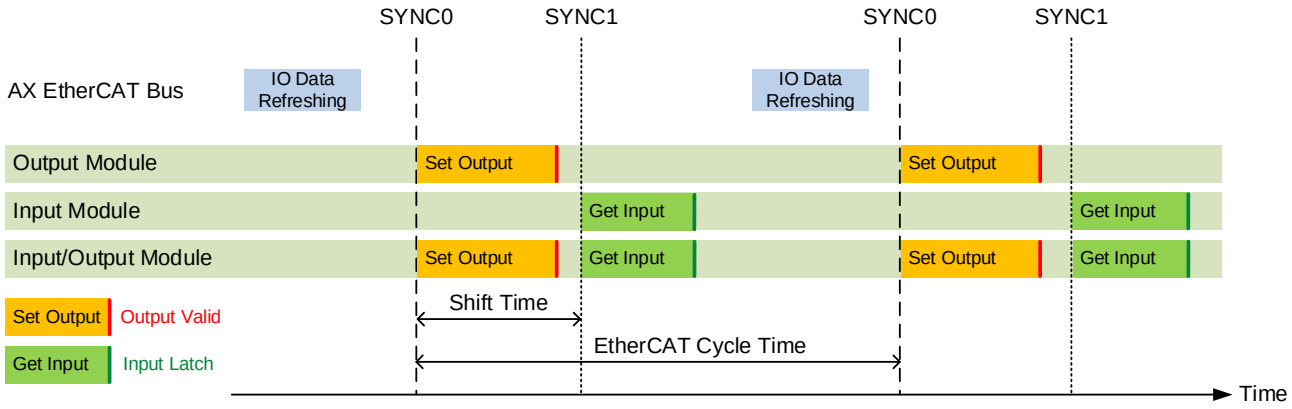
- **SYNC0**

Using the SYNC signal SYNC0 to refresh the values of output channels among modules at the same time.



- **SYNC0 + SYNC1**

Using SYNC0 to refresh values of output channels and using SYNC1 to refresh values of input channels among modules at the same time. The shift time of SYNC0 and SYNC1 can be modified with DIADesigner-AX.



5.1.7 Process Data

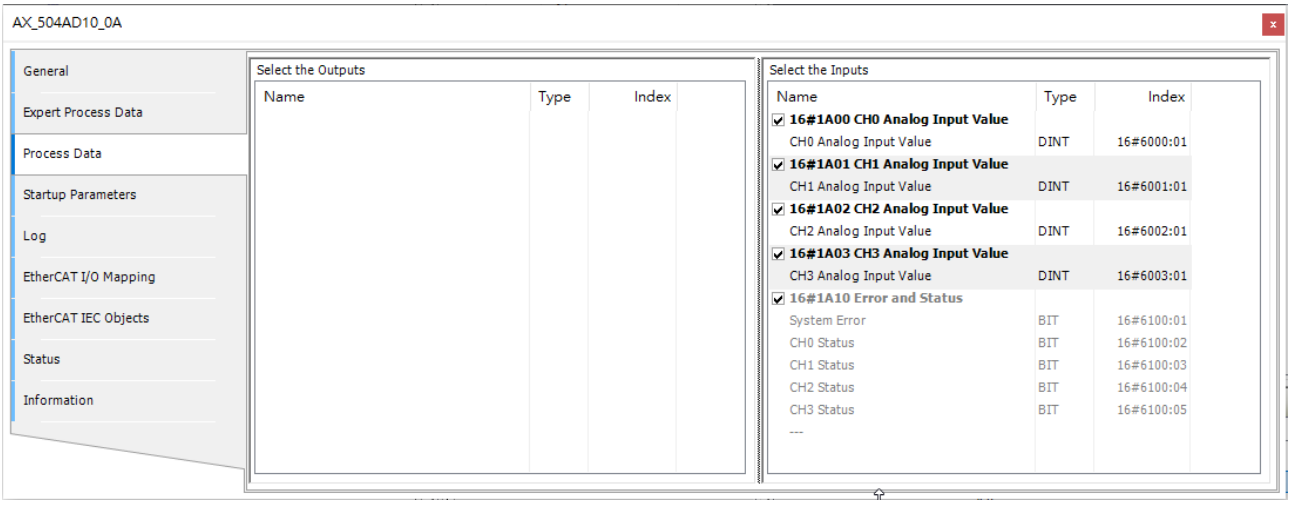
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Analog Input Value	Analog input value; Setting range: -33000–33000	DINT	RO	0
16#6001	16#01	CH1 Analog Input Value		DINT	RO	0
16#6002	16#01	CH2 Analog Input Value		DINT	RO	0
16#6003	16#01	CH3 Analog Input Value		DINT	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0
	16#02	CH0 Status	CH0: error or warning	BOOL	RO	0
	16#03	CH1 Status	CH1: error or warning	BOOL	RO	0
	16#04	CH2 Status	CH2: error or warning	BOOL	RO	0
	16#05	CH3 Status	CH3: error or warning	BOOL	RO	0

5.1.7.1 Process Data

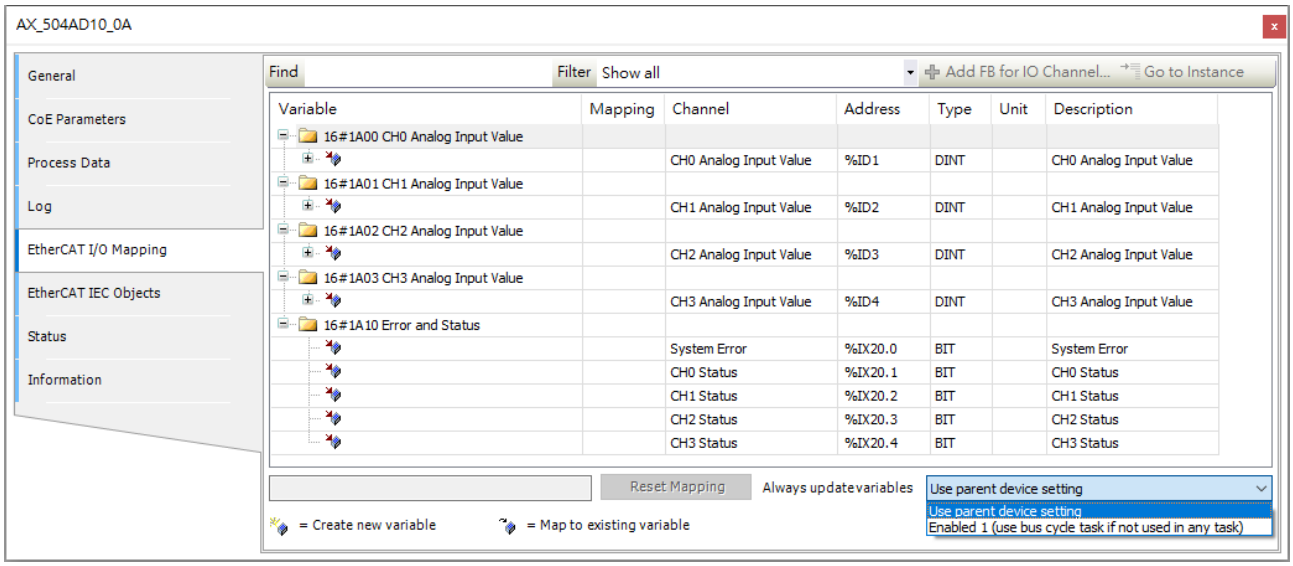
Go to the Process Data tab and select the data that you'd like to monitor.

- Analog Input Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Status: It is selected by default. The grayed out part cannot be modified.



5.1.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



5.1.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

5.1.8 Troubleshooting

In the Diagnosis History tab, the error information that has occurred on the module is recorded. In the Status tab, the current information of system error (16#A000) is displayed. In the CoE Parameters tab, you can view the error status through Index/SubIndex of the All Parameter list.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Connection Lost	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#05	(16#FF05) Analog IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#06	(16#FF06) Analog Power Error	ON	OFF	If the problem persists, contact the local authorized distributors.
16#A00**n**[*1]	16#01	(16#FF11) CH(**n**-1) Upper Limit Alarm	Blinking (1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user upper limit.
	16#02	(16#FF12) CH(**n**-1) Lower Limit Alarm	Blinking (1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user lower limit.
	16#03	(16#FF13) CH(**n**-1) Over Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed hardware range.
	16#04	(16#FF14) CH(**n**-1) Under Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed hardware range.

*1. n = 1–4

5.2 AX-504AD20-0A

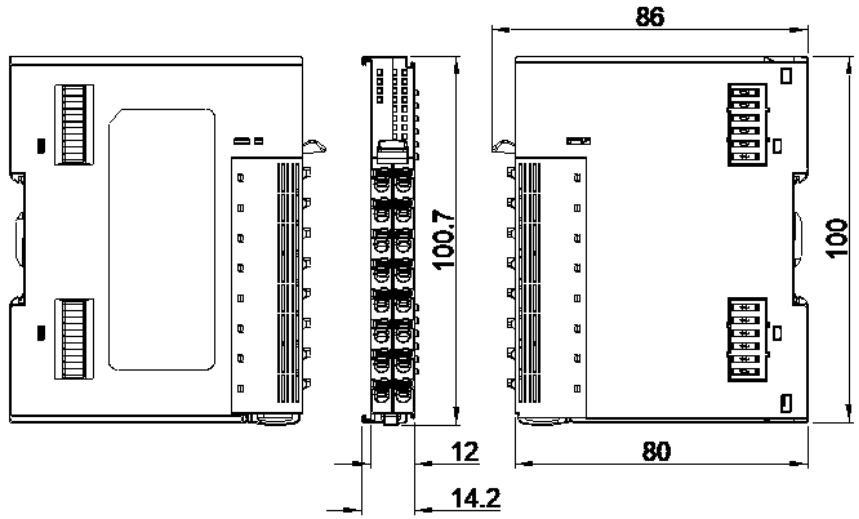
AX-504AD20-0A, an analog input module, receives analog current signals through 4 input points and converts the received signals to 16-bit digital signals. This section introduces its specifications, wirings and operations.

5.2.1 Specifications

Item		Specification
Input points		4
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		Less than 74 g
Electrical specification	Input form	Differential input
	Input range	-20 – +20 mA
	Input conversion range	-5 – 105 % (F.S.)
	Rated absolute input range	±32 mA
	Input impedance	Less than 300 Ω
	Resolution	-20 – +20 mA: -30000–30000 0 – +20 MA: 0–30000
	Accuracy	25 ºC: ±0.2 % (F.S.) -20 – 60 ºC: ±0.6 % (F.S.)
	Conversion time	100 μs / 4 points
	Isolation method	Between unit power and external power: no isolation Between digital power and analog power: 500 VAC Between digital signal and analog signal: 500 VAC Between analog channels: no isolation
	Maximum power consumption (unit power)	Less than 400 mA (2W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Protection	--
	Short Circuit Protection (SCP)	--
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	--
	Filter function	AVG / FIR / IIR

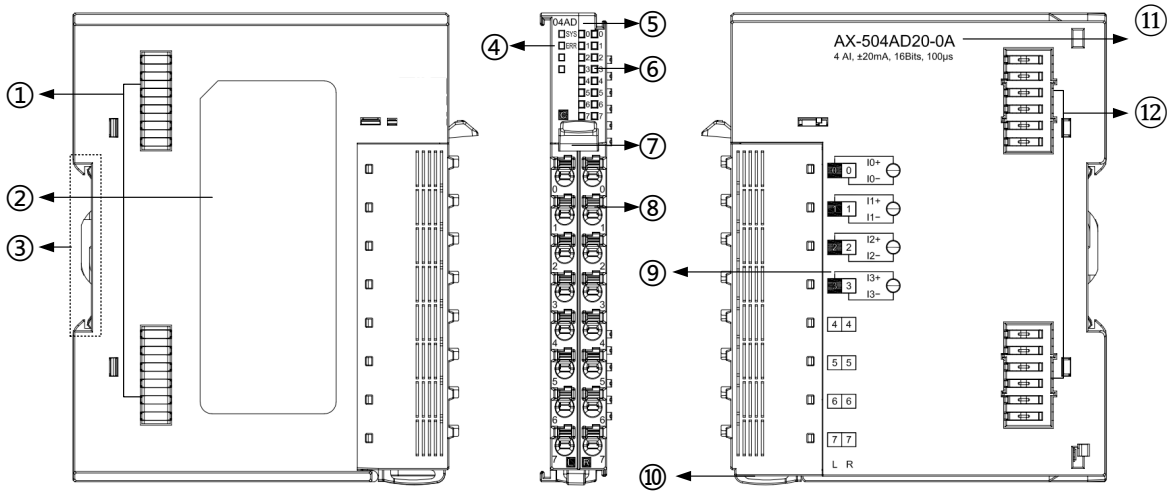
5.2.2 Dimensions and Parts

- **Dimensions**



Unit: mm

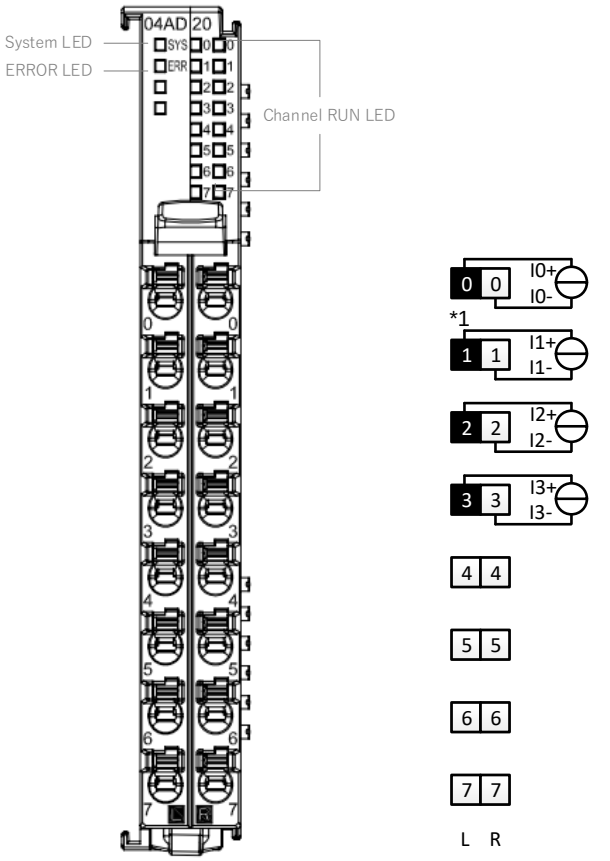
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

5.2.3 Arrangement of Terminals, LED Indicators and Wiring

5.2.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

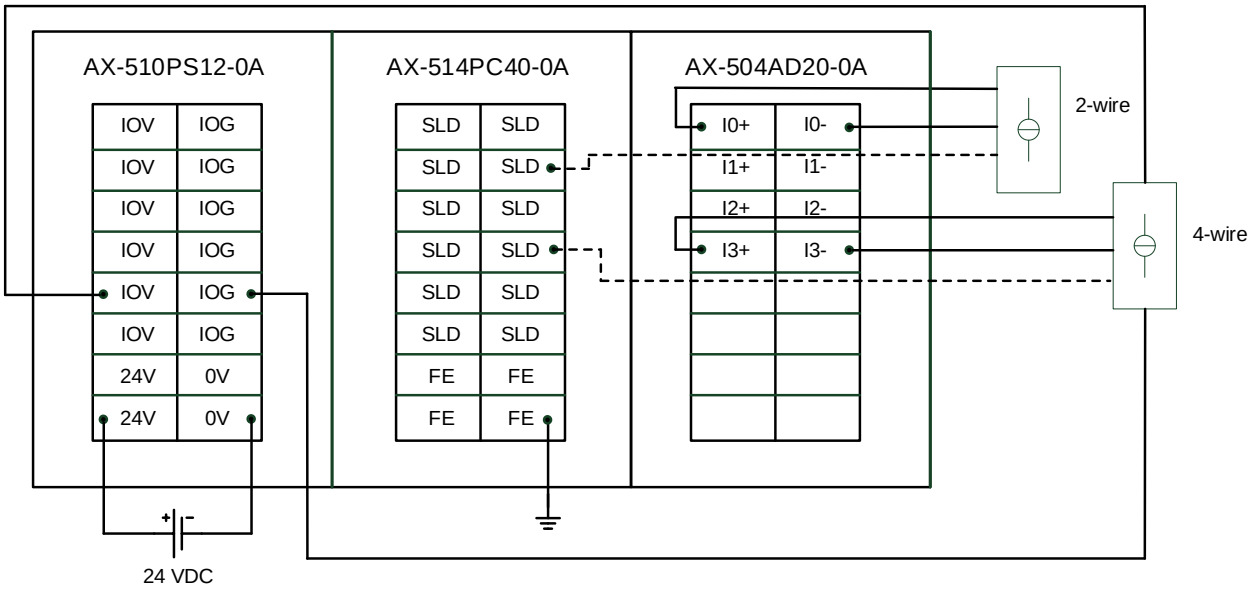
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0+	Channel 0: positive input current	R0	I0-	Channel 0: negative input current
L1	I1+	Channel 1: positive input current	R1	I1-	Channel 1: negative input current
L2	I2+	Channel 2: positive input current	R2	I2-	Channel 2: negative input current
L3	I3+	Channel 3: positive input current	R3	I3-	Channel 3: negative input current
L4	--	--	R4	--	--
L5	--	--	R5	--	--
L6	--	--	R6	--	--
L7	--	--	R7	--	--

5.2.3.2 LED Indicators

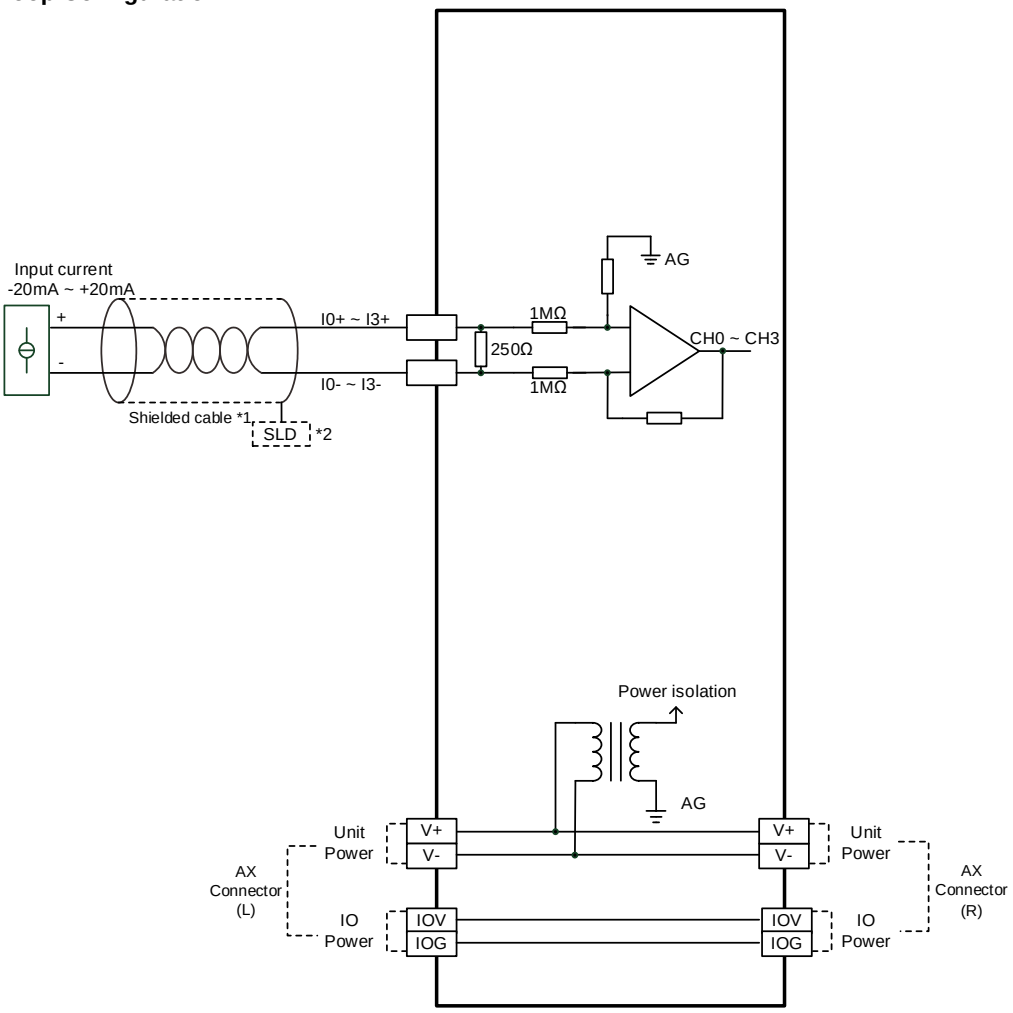
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking (1s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1s)	An error occurs on the application.
			Blinking (0.2s)	An error occurs on the hardware.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

5.2.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



*1. Use shielded cables to isolate the analog input signal cable from other power cables.

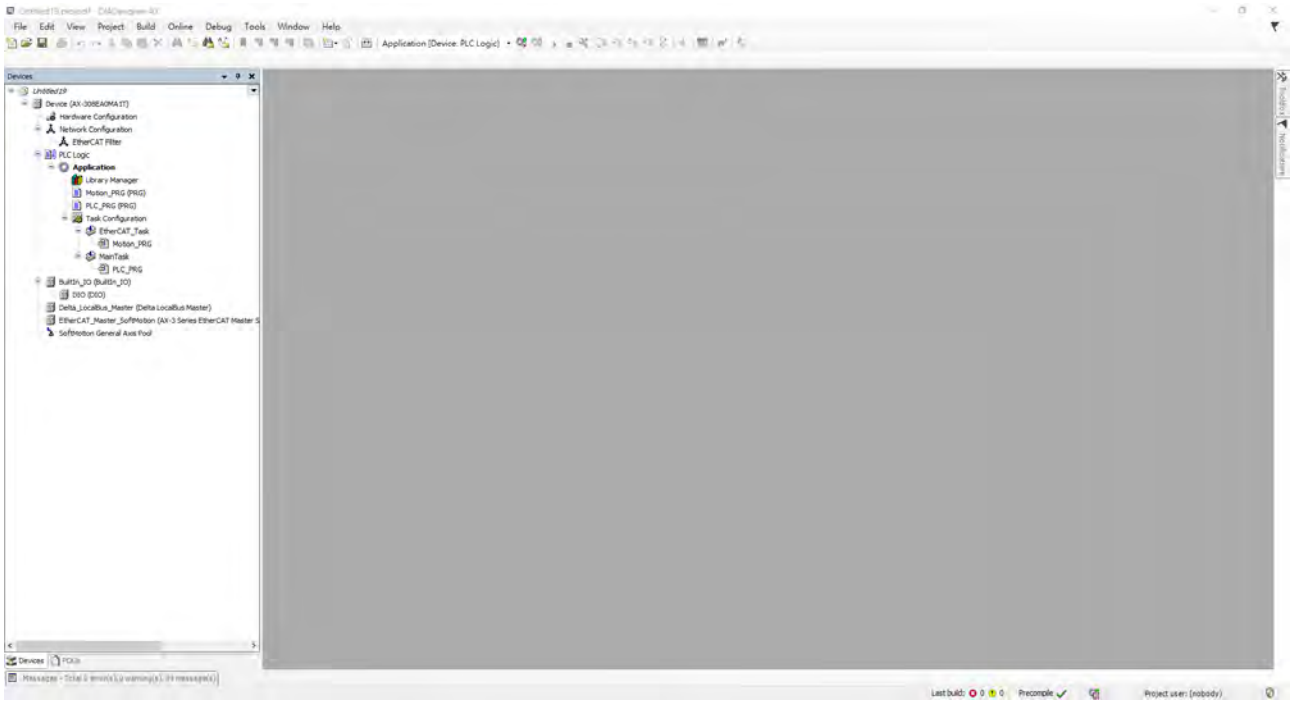
*2. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A.

5.2.4 Settings in DIADesigner-AX

The software DIADesigner-AX is the programming tool for the AX Series PLCs. This section introduces some basic operations and settings.

5.2.4.1 Basic Operation

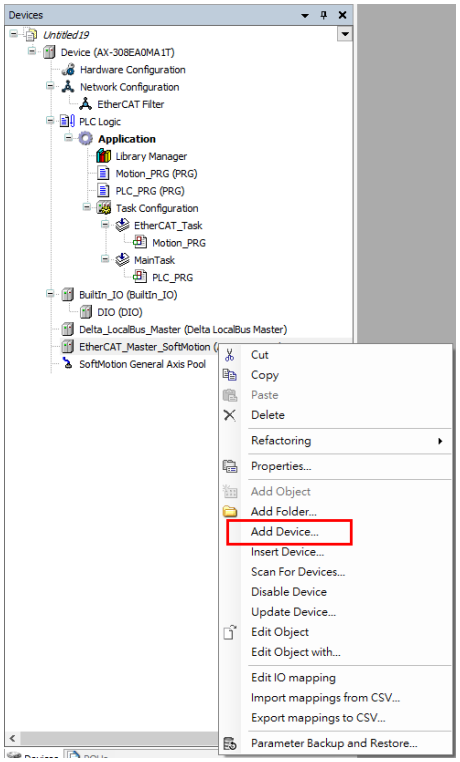
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



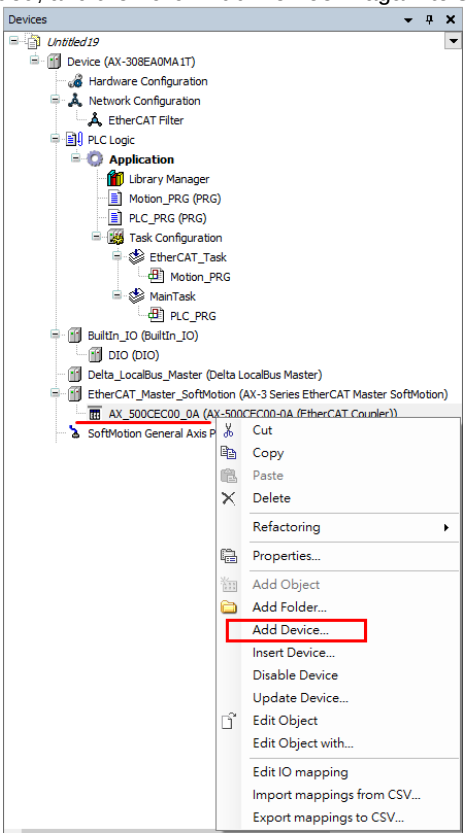
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Add Device…** to select and add System Coupler.

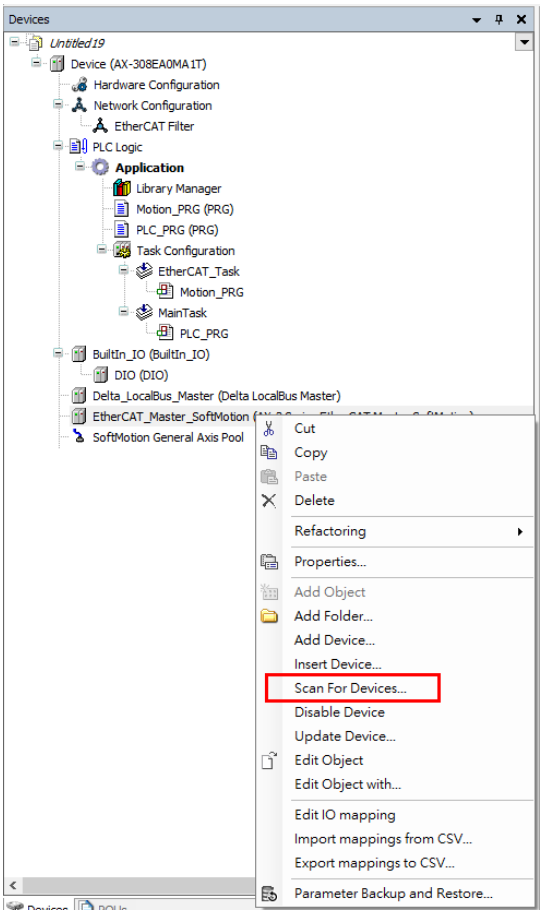


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.



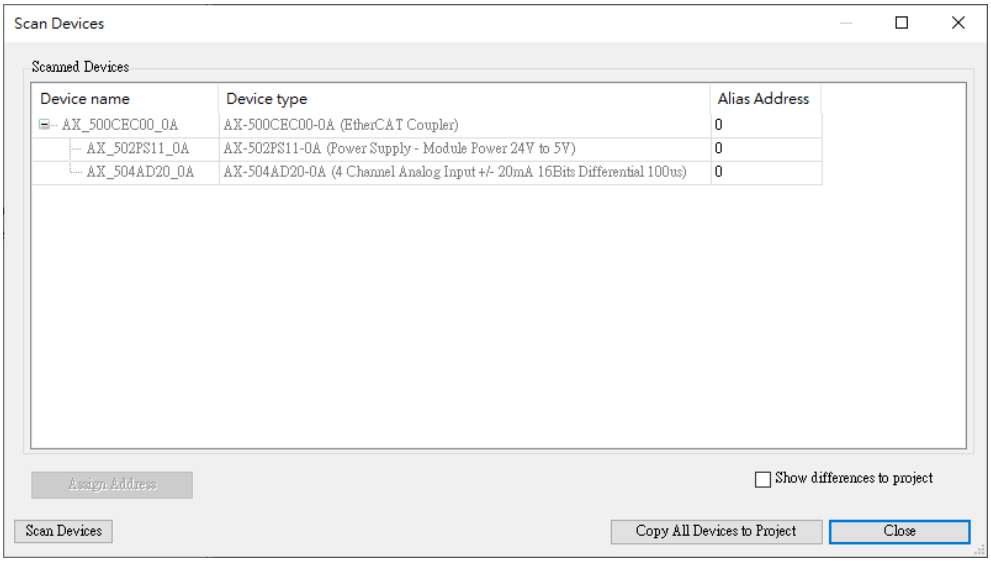
- Method 2: Scan to add the modules in.

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Scan for Devices…**.



After the auto-scan is over, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.

.

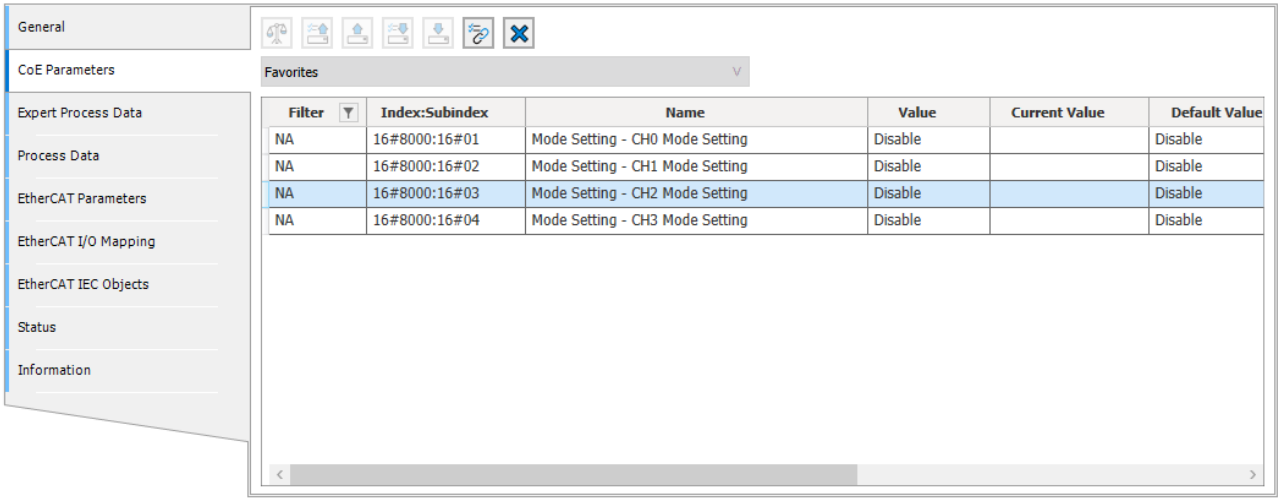


5.2.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.

(1) Favorites

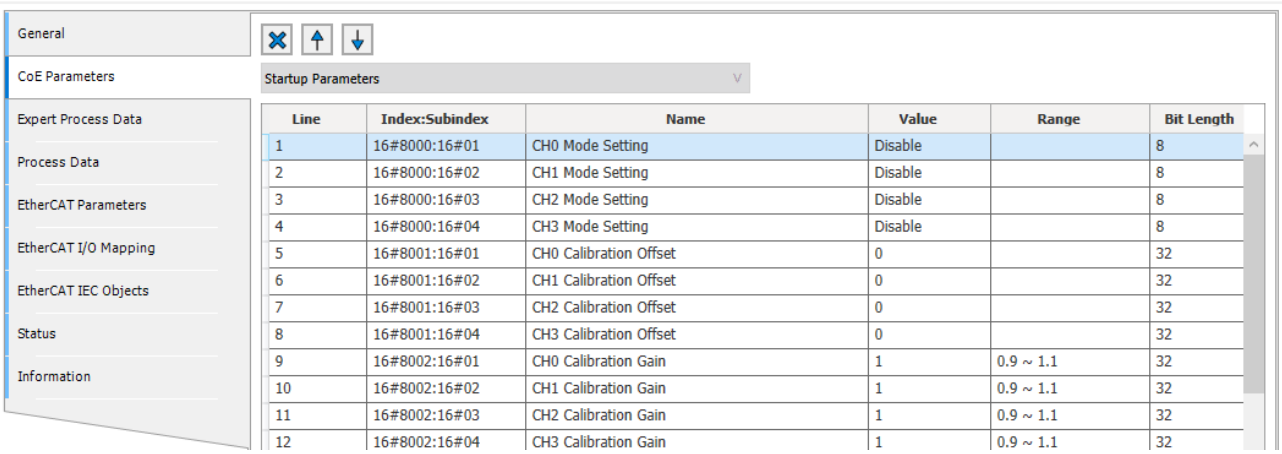
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

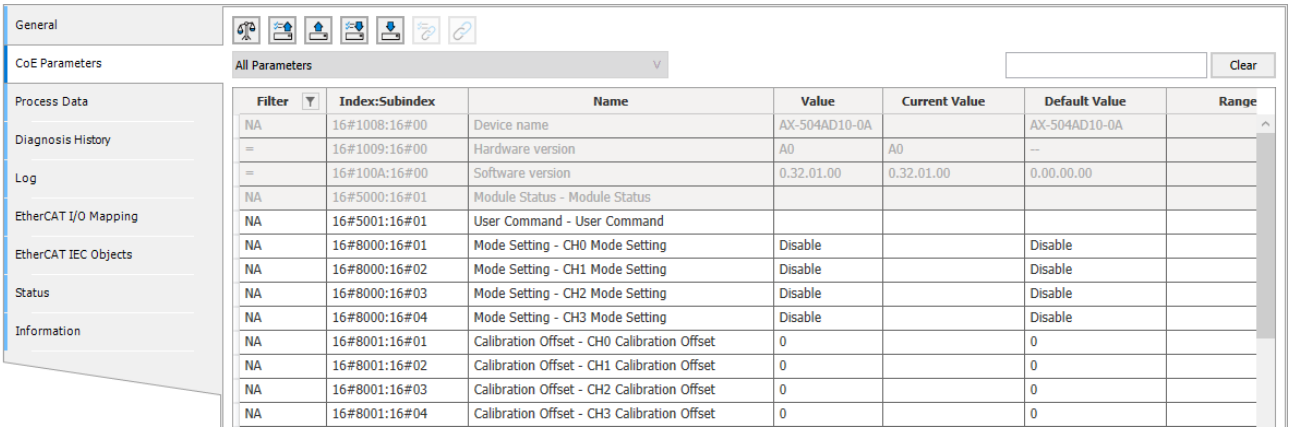


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8000:16#03	CH2 Mode Setting	Disable		8
4	16#8000:16#04	CH3 Mode Setting	Disable		8
5	16#8001:16#01	CH0 Calibration Offset	0		32
6	16#8001:16#02	CH1 Calibration Offset	0		32
7	16#8001:16#03	CH2 Calibration Offset	0		32
8	16#8001:16#04	CH3 Calibration Offset	0		32
9	16#8002:16#01	CH0 Calibration Gain	1	0.9 ~ 1.1	32
10	16#8002:16#02	CH1 Calibration Gain	1	0.9 ~ 1.1	32
11	16#8002:16#03	CH2 Calibration Gain	1	0.9 ~ 1.1	32
12	16#8002:16#04	CH3 Calibration Gain	1	0.9 ~ 1.1	32

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

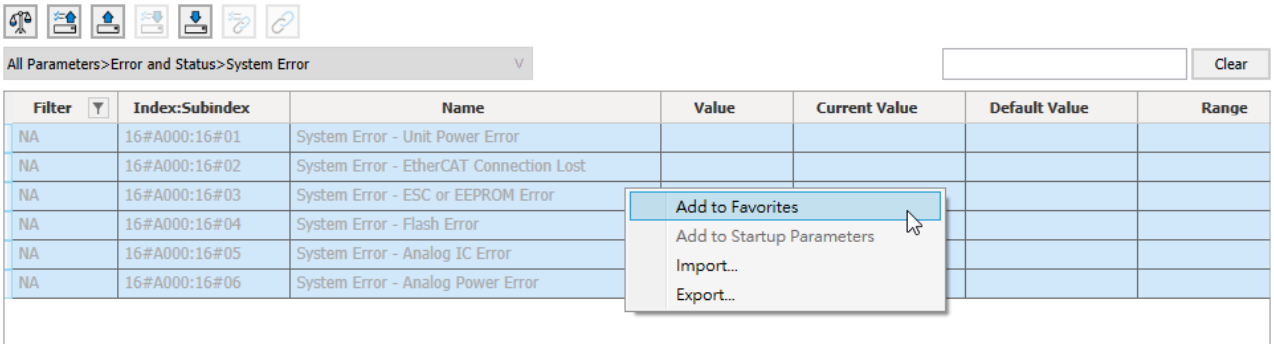
(3) All Parameters

- You can find all the CoE parameters here. Click  on the toolbar to go into online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

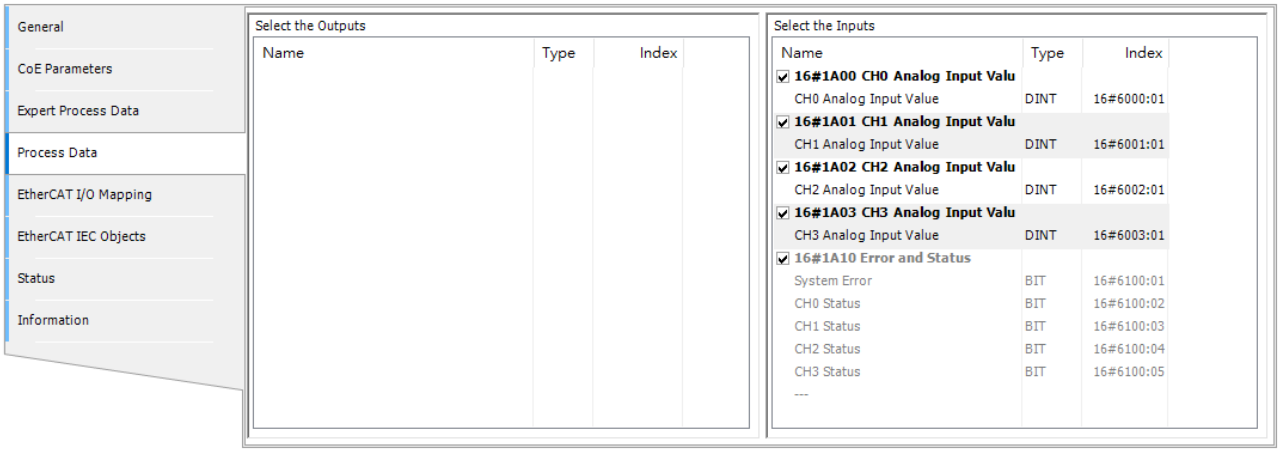
- You can select and right-click the parameter to add the selected parameter to the Favorites.



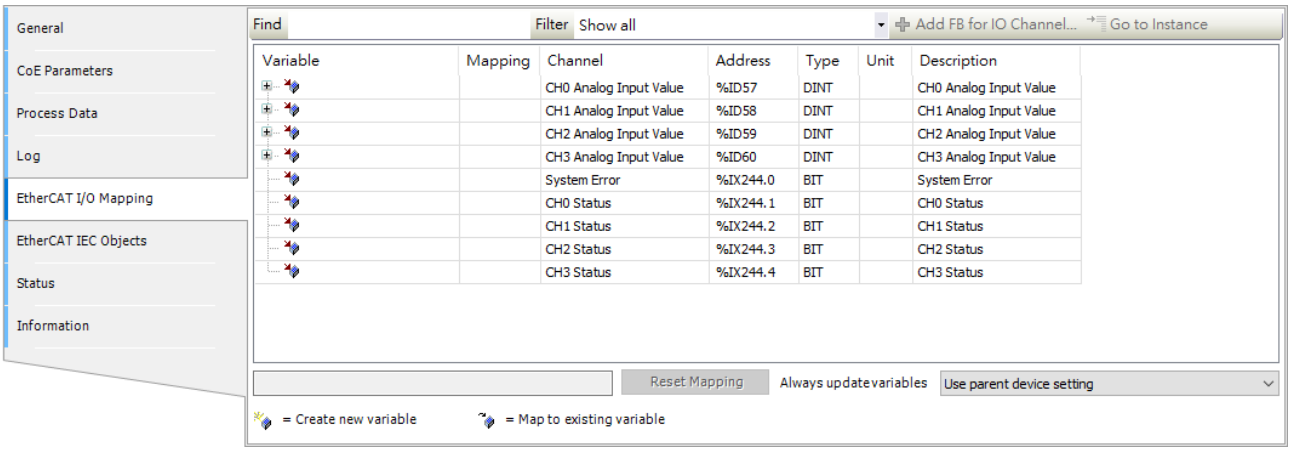
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.2.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

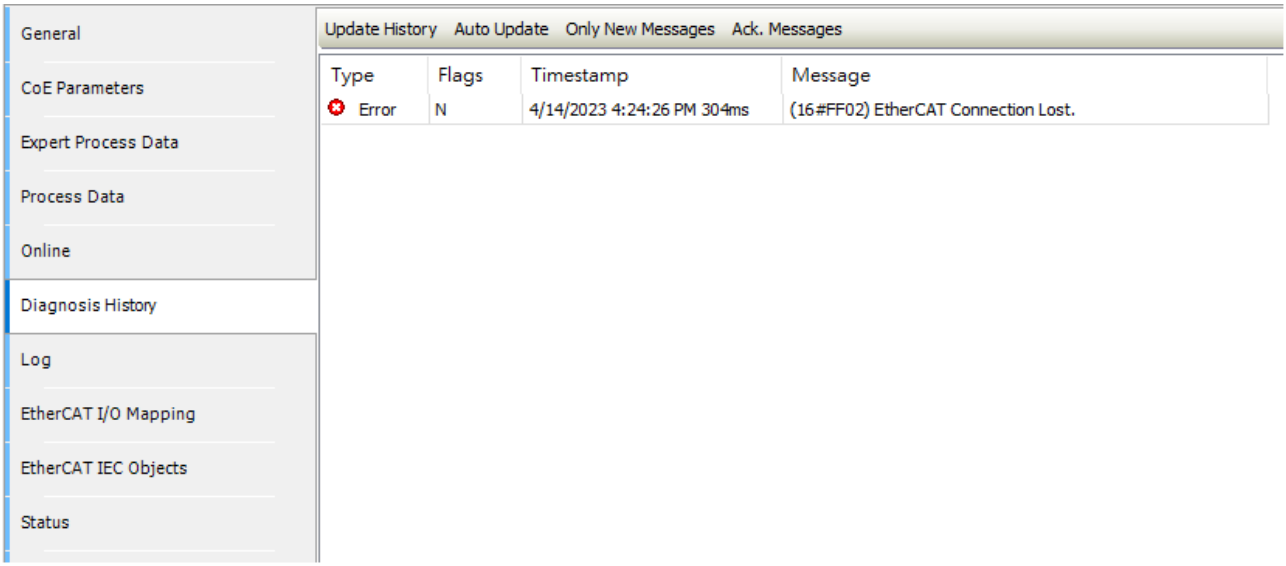


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



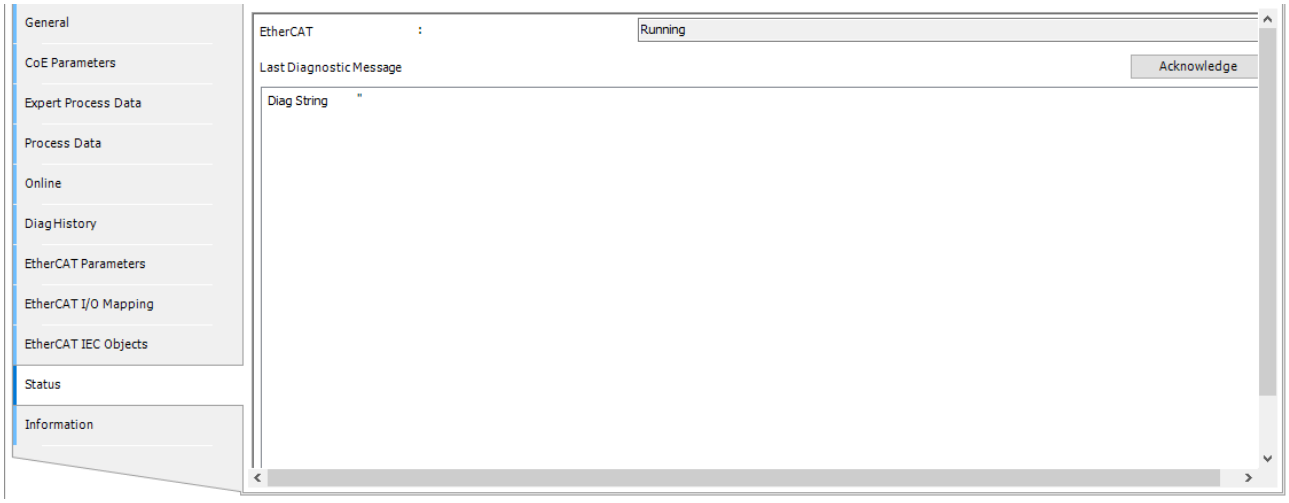
5.2.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors.



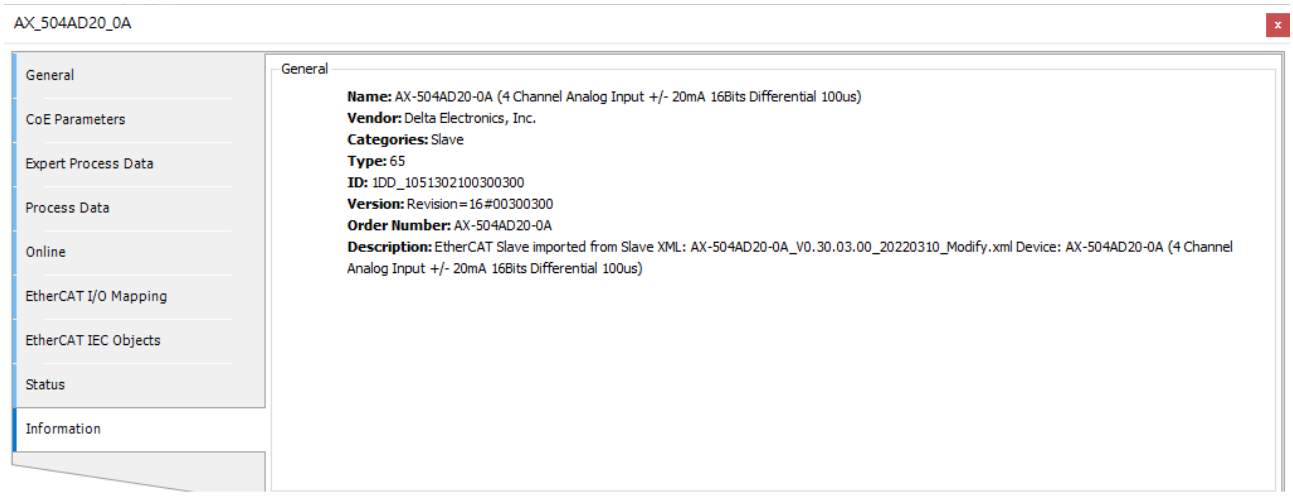
5.2.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



5.2.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.32.01.00	0.32.01.00	0.00.00.00

5.2.5 Parameter Descriptions

You can use DIADesigner-AX to set up the functions for the module by directly selecting the setting mode and parameters. For software operation, refer to section 5.2.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Mode Setting	Mode setting or the channel is OFF.	DFB_AD_RD_ModeSetting DFB_AD_WR_ModeSetting
16#8001	Calibration Offset	Calibration - offset	DFB_AD_RD_CalOffset DFB_AD_WR_CalOffset
16#8002	Calibration Gain	Calibration - gain	DFB_AD_RD_CalGain DFB_AD_WR_CalGain
16#8003	Digital Filter Setting	Digital filter setting	DFB_AD_RD_FilterSetting DFB_AD_WR_FilterSetting
16#8004	Moving Average Times	Moving average times	DFB_AD_RD_AverageTimes DFB_AD_WR_AverageTimes
16#8005	Enable User Limit Alarm DINT	Enable / disable the alarm of exceeding the user-defined limit (DINT)	
16#8006	User Upper Limit DINT	User-defined upper limit (DINT)	
16#8007	User Lower Limit DINT	User-defined lower limit (DINT)	
16#8008	Exceed Hardware Limit Setting	Hardware limit setting	
16#8010	Format	Data format setting	
16#8015	Enable User Limit Alarm REAL	Enable / disable the alarm of exceeding the user-defined limit (floating-point)	
16#8016	User Upper Limit REAL	User-defined upper limit (floating-point)	
16#8017	User Lower Limit REAL	User-defined lower limit (floating-point)	
16#8030	Scale Upper Limit REAL	Scale upper limit setting (floating-point)	DFB_AD_RD_ScaleUpperLimit DFB_AD_WR_ScaleUpperLimit
16#8031	Scale Lower Limit REAL	Scale lower limit setting (floating-point)	DFB_AD_RD_ScaleLowerLimit DFB_AD_WR_ScaleLowerLimit
16#8100	ADC Raw Data	Raw data	

5.2.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Explanation**

When the AX5 series PLC is used as the controller, the module status is synchronized with the status of AX5 series PLC CPU and it will be either 1 (Run) or 2 (Stop). When the status of AX5 series PLC CPU is Stop, the output modules will act according to the parameter settings, and as for the input modules, they are not affected. If you use other PLC (NOT AX5 Series PLC) as the controller, the module status value will be 0 indicating it is controlled by EtherCAT State Machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

5.2.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Explanation**

Users write a command value into the module and the module will execute the command accordingly. After execution, the module will respond with a corresponding value to show if the execution is success or not.

- **User command**

Command value	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

5.2.5.3 Mode Setting

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Mode Setting	Current mode setting	USINT	RW	0
	16#02	CH1 Mode Setting		USINT	RW	0
	16#03	CH2 Mode Setting		USINT	RW	0
	16#04	CH3 Mode Setting		USINT	RW	0

- **Explanation**

Select the mode to set the channel to ON. The conversion time is 100 μs / 4 channels.

- **Supported modes**

Mode	Mode range	DINT range
0	Disable	
1	-20 mA–20 mA	±30000
2	0 mA–20 mA	0–30000
3	4 mA–20 mA	±30000

5.2.5.4 Calibration

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Calibration Offset	Offset Setting range: no limit	REAL	RW	0
	16#02	CH1 Calibration Offset		REAL	RW	0
	16#03	CH2 Calibration Offset		REAL	RW	0
	16#04	CH3 Calibration Offset		REAL	RW	0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9–1.1	REAL	RW	1.0
	16#02	CH1 Calibration Gain		REAL	RW	1.0
	16#03	CH2 Calibration Gain		REAL	RW	1.0
	16#04	CH3 Calibration Gain		REAL	RW	1.0

- **Explanation**

When there is an obvious difference between input values and actual values, you can change Offset and Gain to correct the input curve. The formula is

$$Output = (Input \times Gain) + Offset$$

Example

The mode of channels is -20.0 mA to +20.0 mA. Gain is 1 and Offset is 0 by default, and the corresponding value is -20.0 mA to +20.0 mA. If you change the gain to 0.9 and the offset to 3, the value after calibration is -15 mA V to +21.0 mA.

5.2.5.5 Digital Filter

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Digital Filter Setting	Digital filter setting	USINT	RW	0
	16#02	CH1 Digital Filter Setting		USINT	RW	0
	16#03	CH2 Digital Filter Setting		USINT	RW	0
	16#04	CH3 Digital Filter Setting		USINT	RW	0
16#8004	16#01	CH0 Moving Average Times	Moving average times Setting range: 1–100 times	USINT	RW	0
	16#02	CH1 Moving Average Times		USINT	RW	0
	16#03	CH2 Moving Average Times		USINT	RW	0
	16#04	CH3 Moving Average Times		USINT	RW	0

- **Explanation**

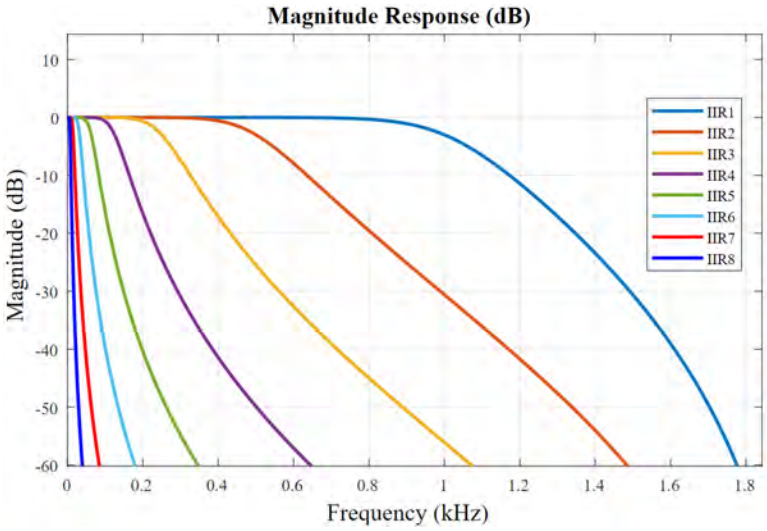
The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The filters can work only when the EtherCAT operation mode is the Free Run mode. The conversion time for FIR filter and IIR filter is 250μs / 4 channels.

Moving Average Filter

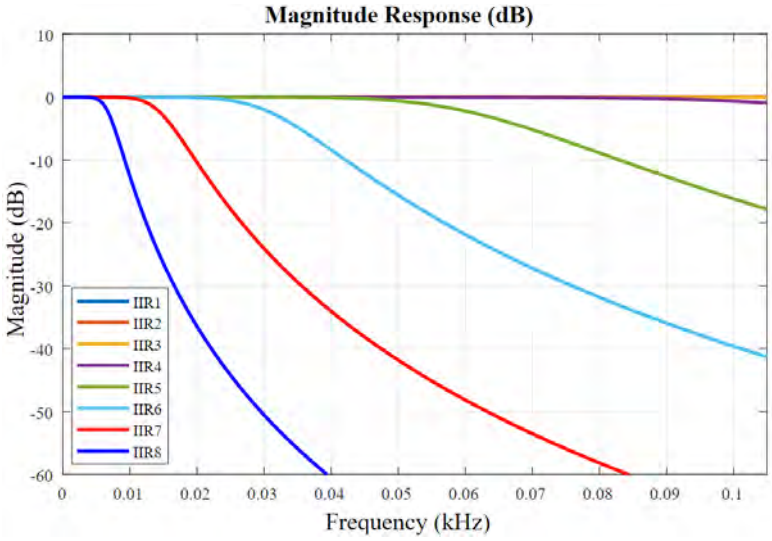
A moving average filter uses the latest pieces of sampled data to create a series of averages to smooth the data. Compared to other types of filters, a moving average filter is fast in computation and algorithm, without occupying the CPU processing time. But the filtering result of a moving average filter is not as effective as an IIR filter or a FIR filter.

IIR (Infinite Impulse Response) Filter

An infinite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, an IIR filter works more efficiently than a moving average filter does. This IIR filter is a low-pass filter. The advantage of an IIR filter is that within the same length of operation time, the filtering result of an IIR filter is better than what a FIR filter can offer. Since an IIR filter can only have a non-linear phase response, it has an inconsistent output delay at every frequency, the input signals may be distorted and the stability issue may be raised. So the IIR filter may not be suitable for applications such as oscilloscope waveform and electrocardiography that require demanding waveforms.



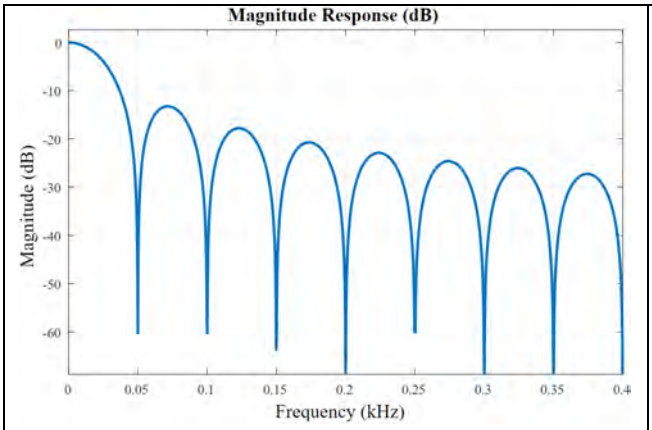
Frequency response of IIR filter



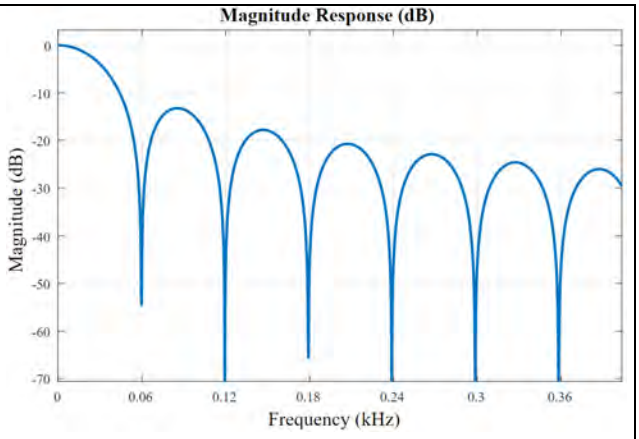
Frequency response of IIR filter (enlarged figure)

FIR (Finite impulse response) Filter

A finite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, a FIR filter works more efficiently than a moving average filter does. This FIR filter is a low-pass filter; it works tremendously well for attenuation of 50/60 Hz signals (> 40 dB). The advantage of a FIR filter is that it has a linear phase response which means a FIR filter has a consistent output delay at all frequencies while an IIR filter has an unequal delay at different frequencies. A FIR filter is ideal for a wide range of applications. However within the same length of operation time, the filtering result of a FIR filter is not as good as what an IIR filter can deliver.



50 Hz low-pass FIR filter



60 Hz low-pass FIR filter

- **Digital filter modes**

Mode	Name of digital filter	Cut-off frequency (-3 dB)
0	Inactive	
1	Moving Average	Works with Moving Average Time
2	IIR1	1000 Hz
3	IIR2	500 Hz
4	IIR3	250 Hz
5	IIR4	125 Hz
6	IIR5	63 Hz
7	IIR6	32 Hz
8	IIR7	15 Hz
9	IIR8	7 Hz
10	FIR 50Hz	22 Hz (attenuation: multiples of 50 Hz: > 40dB)
11	FIR 60Hz	26 Hz (attenuation: multiples of 60 Hz: > 40dB)

5.2.5.6 User Limit Alarm

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8005	16#01	CH0 Enable User Limit Alarm DINT	Enable / disable the alarm of exceeding the user-defined limit (DINT) 0: Disable (default) 1: Enable	BOOL	RW	0
	16#02	CH1 Enable User Limit Alarm DINT		BOOL	RW	0
	16#03	CH2 Enable User Limit Alarm DINT		BOOL	RW	0
	16#04	CH3 Enable User Limit Alarm DINT		BOOL	RW	0
16#8006	16#01	CH0 User Upper Limit DINT	User-defined upper limit (DINT); Setting range: no limit	DINT	RW	30000
	16#02	CH1 User Upper Limit DINT		DINT	RW	30000
	16#03	CH2 User Upper Limit DINT		DINT	RW	30000
	16#04	CH3 User Upper Limit DINT		DINT	RW	30000
16#8007	16#01	CH0 User Lower Limit DINT	User-defined lower limit (DINT); Setting range: no limit	DINT	RW	-30000
	16#02	CH1 User Lower Limit DINT		DINT	RW	-30000
	16#03	CH2 User Lower Limit DINT		DINT	RW	-30000
	16#04	CH3 User Lower Limit DINT		DINT	RW	-30000
16#8015	16#01	CH0 Enable User Limit Alarm REAL	Enable / disable the alarm of exceeding the user-defined limit (floating-	BOOL	RW	0
	16#02	CH1 Enable User Limit Alarm REAL		BOOL	RW	0

Index	Subindex	Name	Description	Data Type	Attr.	Default
	16#03	CH2 Enable User Limit Alarm REAL	point); 0: Disable(default) 1: Enable	BOOL	RW	0
	16#04	CH3 Enable User Limit Alarm REAL		BOOL	RW	0
16#8016	16#01	CH0 User Upper Limit REAL	User-defined upper limit (floating-point); Setting range: no limit	REAL	RW	20.0
	16#02	CH1 User Upper Limit REAL		REAL	RW	20.0
	16#03	CH2 User Upper Limit REAL		REAL	RW	20.0
	16#04	CH3 User Upper Limit REAL		REAL	RW	20.0
16#8017	16#01	CH0 User Lower Limit For REAL	User-defined lower limit (floating-point); Setting range: no limit	REAL	RW	-20.0
	16#02	CH1 User Lower Limit For REAL		REAL	RW	-20.0
	16#03	CH2 User Lower Limit For REAL		REAL	RW	-20.0
	16#04	CH3 User Lower Limit For REAL		REAL	RW	-20.0

- **Explanation**

Users can define the upper and lower limits and enable the alarm of exceeding the limits. Set the format to DINT or REAL (floating-point).

- **Example**

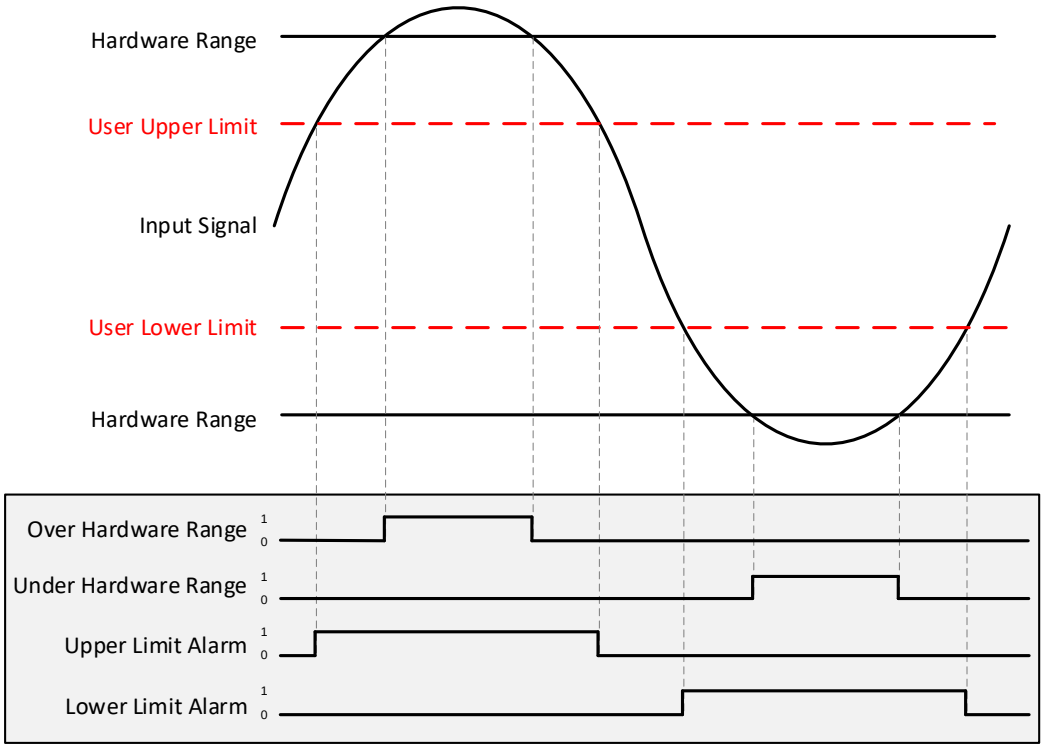
When the format is set to DINT, you can set:

16#8005 Enable User Limit Alarm DINT: Enable

16#8006 User Upper Limit DINT: 28000

16#8007 User Lower Limit DINT: -28000

When the input signal exceeds the user-defined upper or lower limit, an error occurs. See section 5.2.8 for more information on troubleshooting.

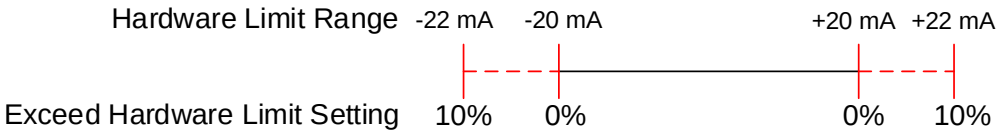


5.2.5.7 Exceed Hardware Limit

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8008	16#01	CH0 Exceed Hardware Limit Setting	Hardware limit setting; Setting range: 0–10 (0%–10%)	USINT	RW	5
	16#02	CH1 Exceed Hardware Limit Setting		USINT	RW	5
	16#03	CH2 Exceed Hardware Limit Setting		USINT	RW	5
	16#04	CH3 Exceed Hardware Limit Setting		USINT	RW	5

- **Explanation**

Users can define the hardware limit range.



- **Example**

When the mode is -20 mA–20 mA, the setting value is 5%. Its hardware limit range is -21 mA – 21mA. When the input signal exceeds the hardware upper or lower limit, an error occurs. See section 5.2.8 for more information on troubleshooting.

5.2.5.8 Format

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8010	16#01	Format	0: DINT Format 1: REAL Format	USINT	RW	0
	16#02	Decimal Places	Setting value: 0–5	USINT	RW	2

- **Explanation**

You can set the format and the decimal places according to your demand.

When the data format is set to DINT Format, set up the DINT parameters which are with “DINT” following a parameter name.

When the data format is set to REAL Format, set up the REAL parameters which are with “REAL” following a parameter name.

5.2.5.9 Scale

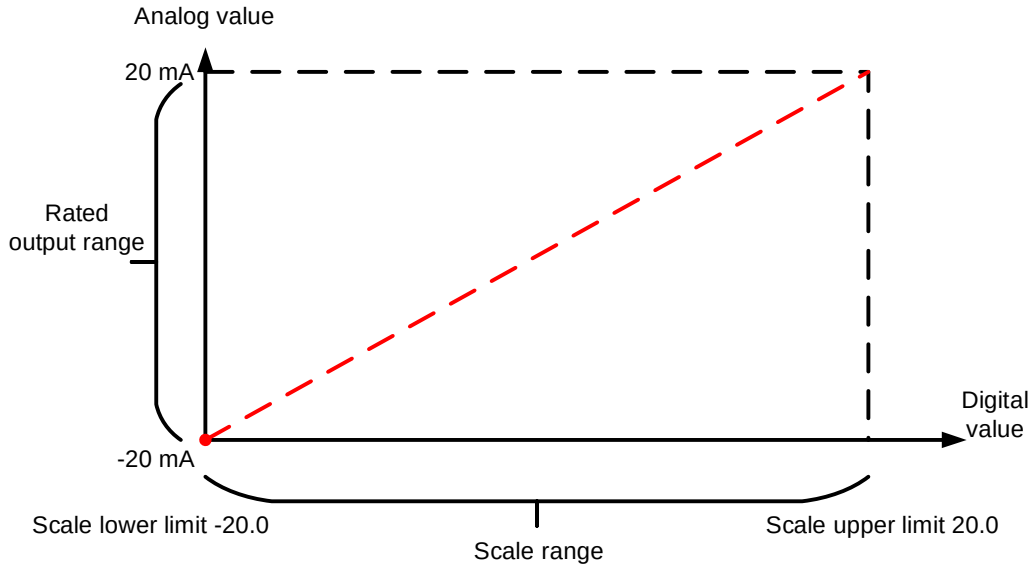
Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8030	16#01	CH0 Scale Upper Limit REAL	Scale upper limit setting; Setting range: no limit	REAL	RW	20
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	20
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	20
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	20
16#8031	16#01	CH0 Scale Lower Limit REAL	Scale lower limit setting; Setting range: no limit	REAL	RW	-20
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-20
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-20
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-20

- **Explanation**

You can set the scale range based on the analog specification for channels when the data format is REAL (floating-point).

- **Example**

If the mode setting of channels is ±20 mA, the analog range is -20 mA to +20 mA, the scale upper limit is 20.0 and the scale lower limit is -20.0. The digital values -20.0 to +20.0 correspond to the analog values -20 mA to +20 mA, as the example below shows.



5.2.5.10 ADC Raw Data

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8100	16#01	CH0 ADC Raw data	Raw data	DINT	RO	0
	16#02	CH1 ADC Raw data		DINT	RO	0
	16#03	CH2 ADC Raw data		DINT	RO	0
	16#04	CH3 ADC Raw data		DINT	RO	0

- **Explanation**

Raw data is the source data that has not been processed or converted from analog to digital.

5.2.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

5.2.6.1 FreeRun Mode

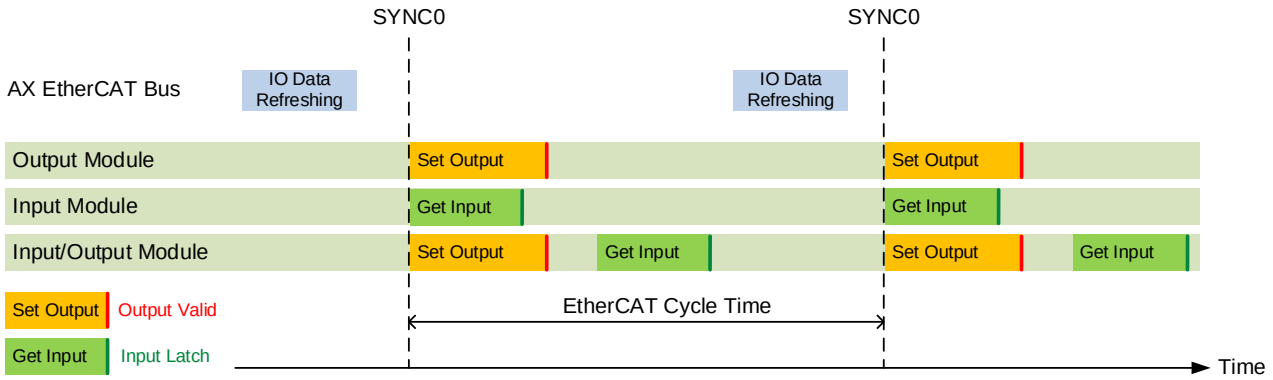
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

5.2.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

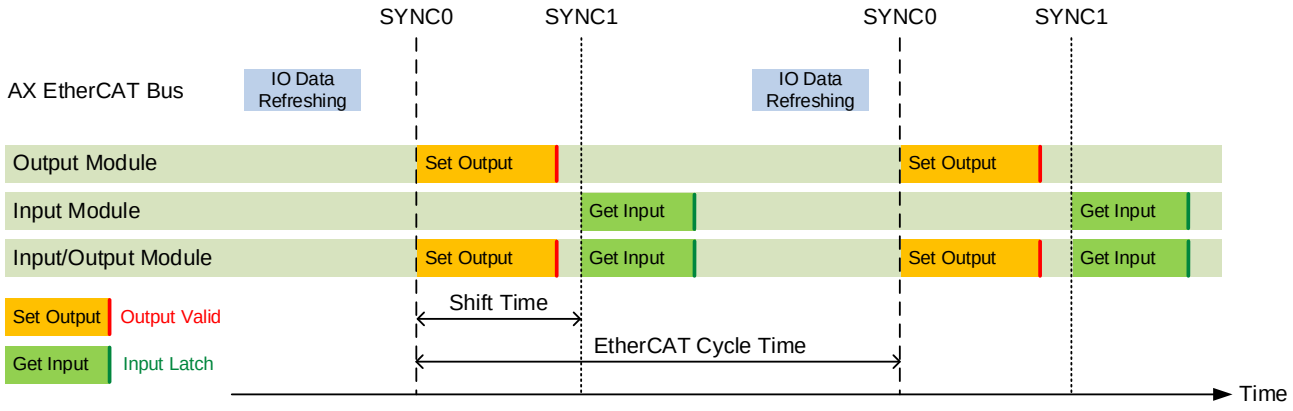
- **SYNC0**

Using the SYNC signal SYNC0 to refresh the values of output channels among modules at the same time.



- **SYNC0 + SYNC1**

Using SYNC0 to refresh values of output channels and using SYNC1 to refresh values of input channels among modules at the same time. The shift time of SYNC0 and SYNC1 can be modified with DIADesigner-AX.



5.2.7 Process Data

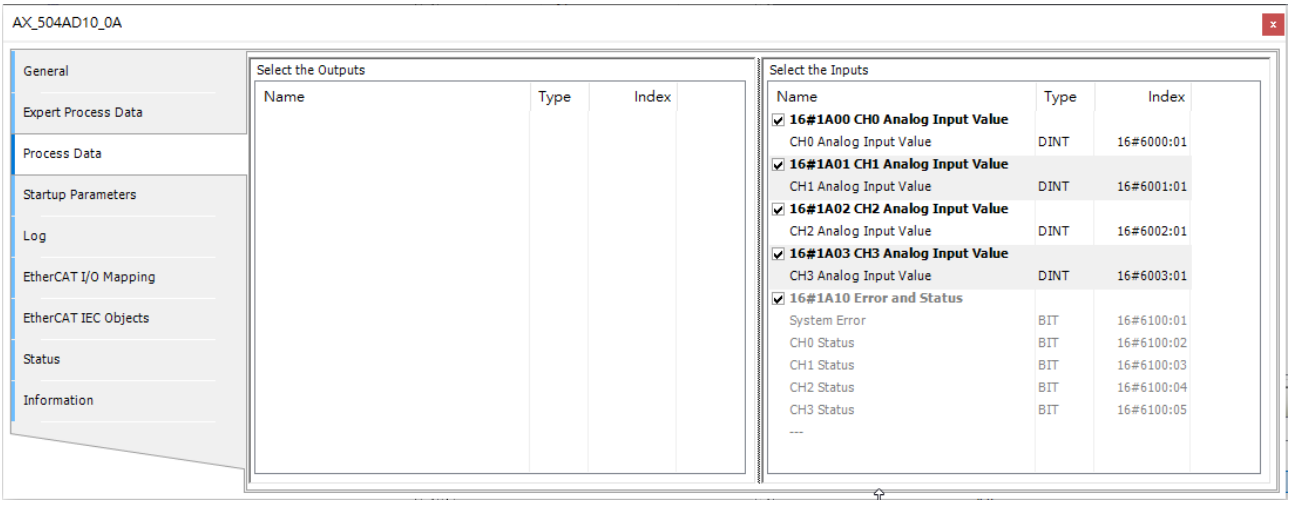
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Analog Input Value	Analog input value; Setting range: -33000–33000	DINT	RO	0
16#6001	16#01	CH1 Analog Input Value		DINT	RO	0
16#6002	16#01	CH2 Analog Input Value		DINT	RO	0
16#6003	16#01	CH3 Analog Input Value		DINT	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0
	16#02	CH0 Status	CH0: error or warning	BOOL	RO	0
	16#03	CH1 Status	CH1: error or warning	BOOL	RO	0
	16#04	CH2 Status	CH2: error or warning	BOOL	RO	0
	16#05	CH3 Status	CH3: error or warning	BOOL	RO	0

5.2.7.1 Process Data

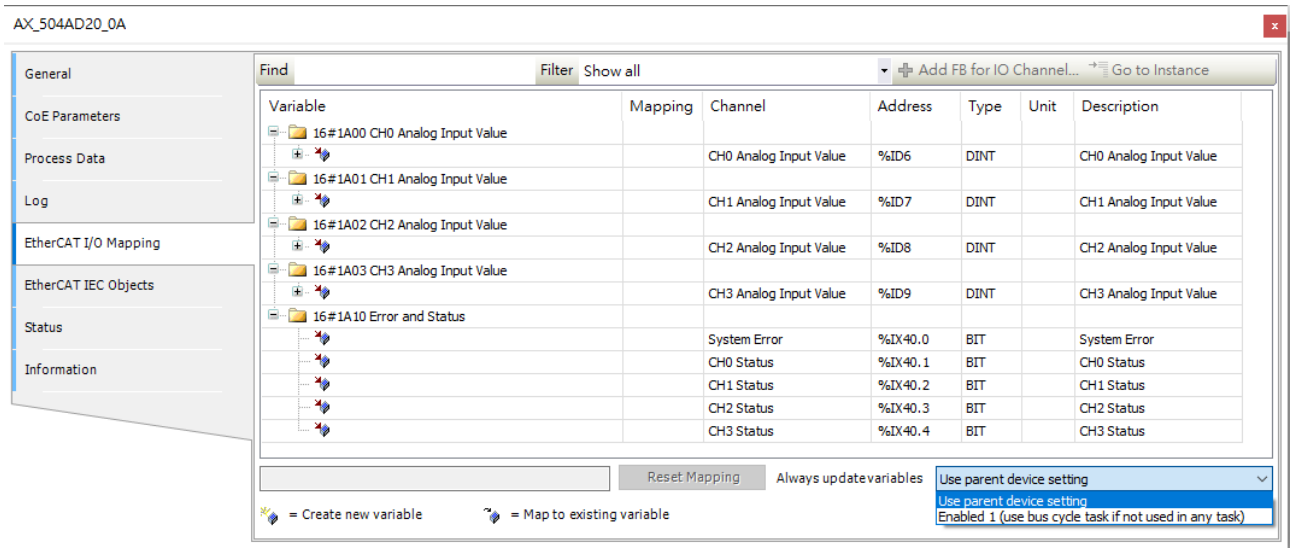
Go to the Process Data tab and select the data that you'd like to monitor.

- Analog Input Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Status: It is selected by default. The grayed out part cannot be modified.



5.2.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



5.2.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

5.2.8 Troubleshooting

In the Diagnosis History tab, the error information that has occurred on the module is recorded. In the Status tab, the current information of system error (16#A000) is displayed. In the CoE Parameters tab, you can view the error status through Index/SubIndex of the All Parameter list.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Connection Lost	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#05	(16#FF05) Analog IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#06	(16#FF06) Analog Power Error	ON	OFF	If the problem persists, contact the local authorized distributors.
16#A00**n**[*1]	16#01	(16#FF11) CH(**n**-1) Upper Limit Alarm	Blinking (1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user upper limit.
	16#02	(16#FF12) CH(**n**-1) Lower Limit Alarm	Blinking (1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user lower limit.
	16#03	(16#FF13) CH(**n**-1) Over Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed hardware range.
	16#04	(16#FF14) CH(**n**-1) Under Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed hardware range.

*1. n = 1–4

5.3 AX-508AD10-0A

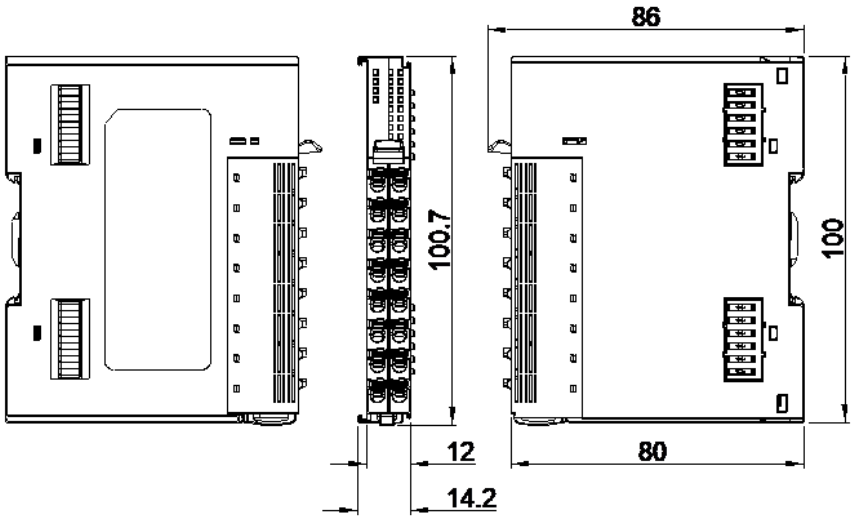
AX-508AD10-0A, an analog input module, receives analog voltage signals through 8 input points and converts the received signals to 16-bit digital signals. This section introduces its specifications, wirings and operations.

5.3.1 Specifications

Item		Specification
Input points		8
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		73 g
Electrical specification	Input form	Differential input
	Input range	-10 – +10 V
	Input conversion range	-5 – 105 % (F.S.)
	Rated absolute input range	±15 V
	Input impedance	1 MΩ and more
	Resolution	-10 – +10 V : -30000–30000
	Accuracy	25 ºC: ±0.2 % (F.S.)
		-20 – 60 ºC: ±0.6 % (F.S.)
	Conversion time	200 μs / 8 points
	Isolation method	Between unit power and external power: no isolation Between digital power and analog power: 500 VAC Between digital signal and analog signal: 500 VAC Between analog channels: no isolation
	Maximum power consumption (unit power)	Less than 440 mA (2.2W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Protection	--
	Short Circuit Protection (SCP)	--
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	--
	Filter function	AVG / FIR / IIR

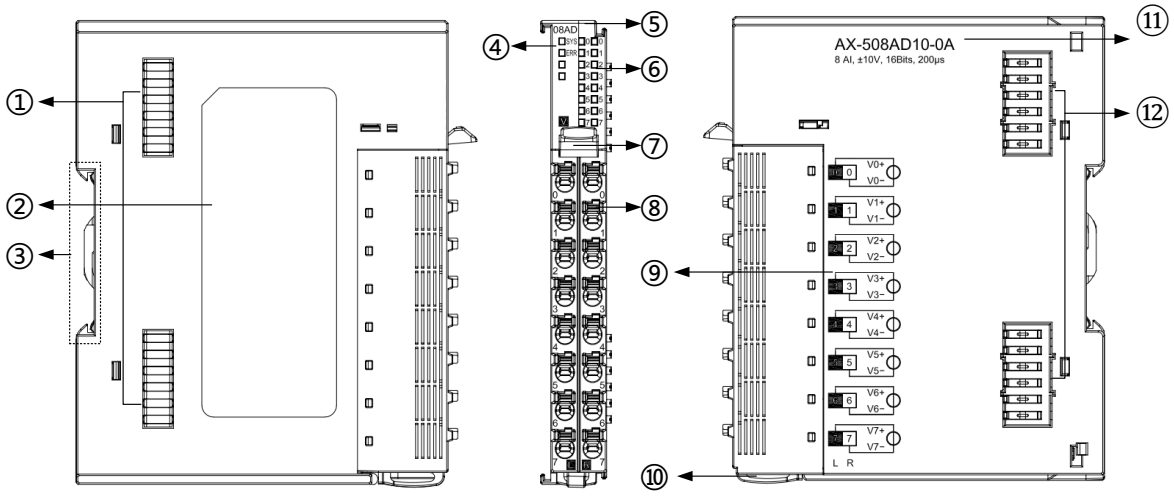
5.3.2 Dimensions and Parts

- **Dimensions**



Unit: mm

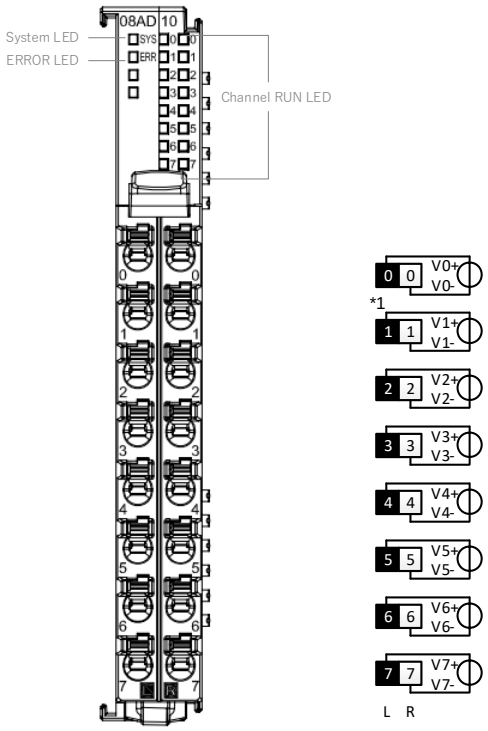
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

5.3.3 Arrangement of Terminals, LED Indicators and Wiring

5.3.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

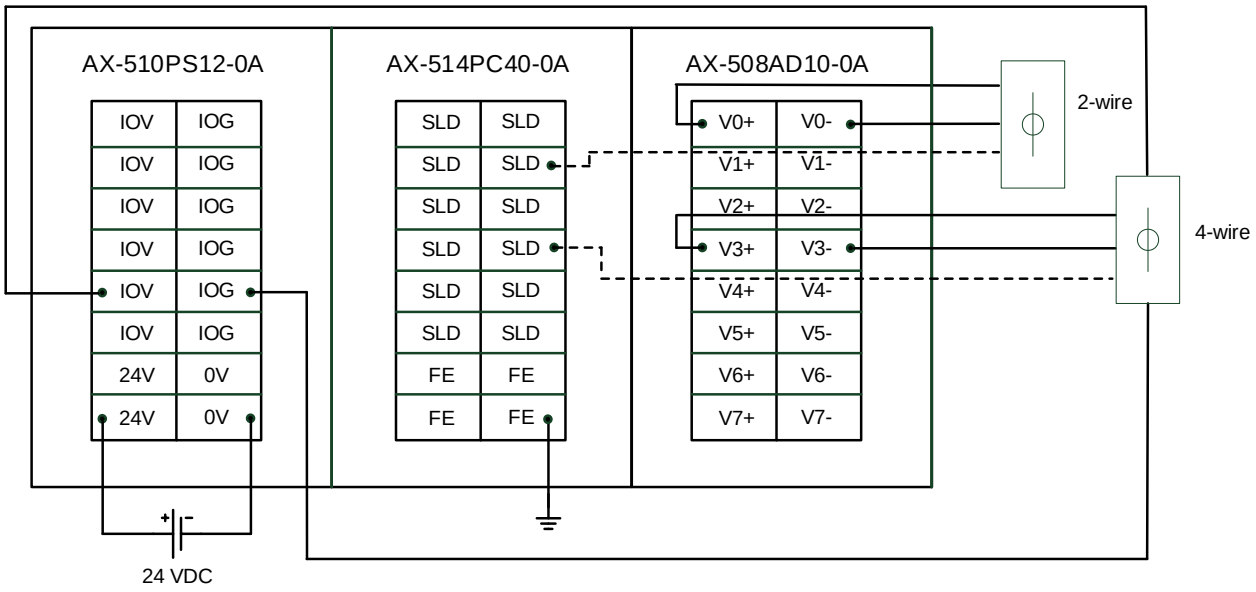
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	V0+	Channel 0: positive input voltage	R0	V0-	Channel 0: negative input voltage
L1	V1+	Channel 1: positive input voltage	R1	V1-	Channel 1: negative input voltage
L2	V2+	Channel 2: positive input voltage	R2	V2-	Channel 2: negative input voltage
L3	V3+	Channel 3: positive input voltage	R3	V3-	Channel 3: negative input voltage
L4	V4+	Channel 4: positive input voltage	R4	V4-	Channel 4: negative input voltage
L5	V5+	Channel 5: positive input voltage	R5	V5-	Channel 5: negative input voltage
L6	V6+	Channel 6: positive input voltage	R6	V6-	Channel 6: negative input voltage
L7	V7+	Channel 7: positive input voltage	R7	V7-	Channel 7: negative input voltage

5.3.3.2 LED Indicators

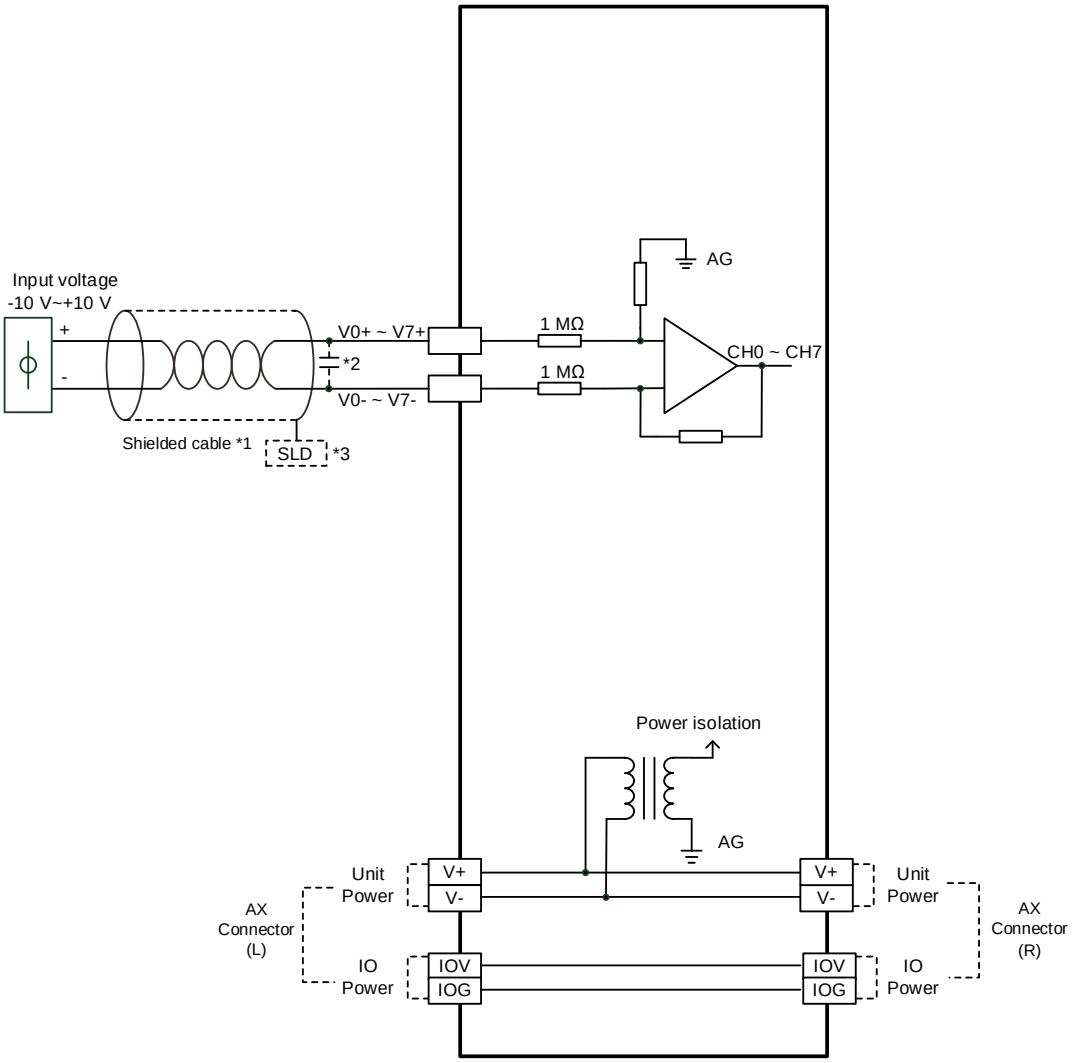
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking (1s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1s)	An error occurs on the application.
			Blinking (0.2s)	An error occurs on the hardware.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

5.3.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



*1. Use shielded cables to isolate the analog input signal cable from other power cables.

*2. If variability in the input voltage results in interference within the wiring, connect the module to a capacitor with a capacitance between 0.1–0.47 µF and a working voltage of 25 V.

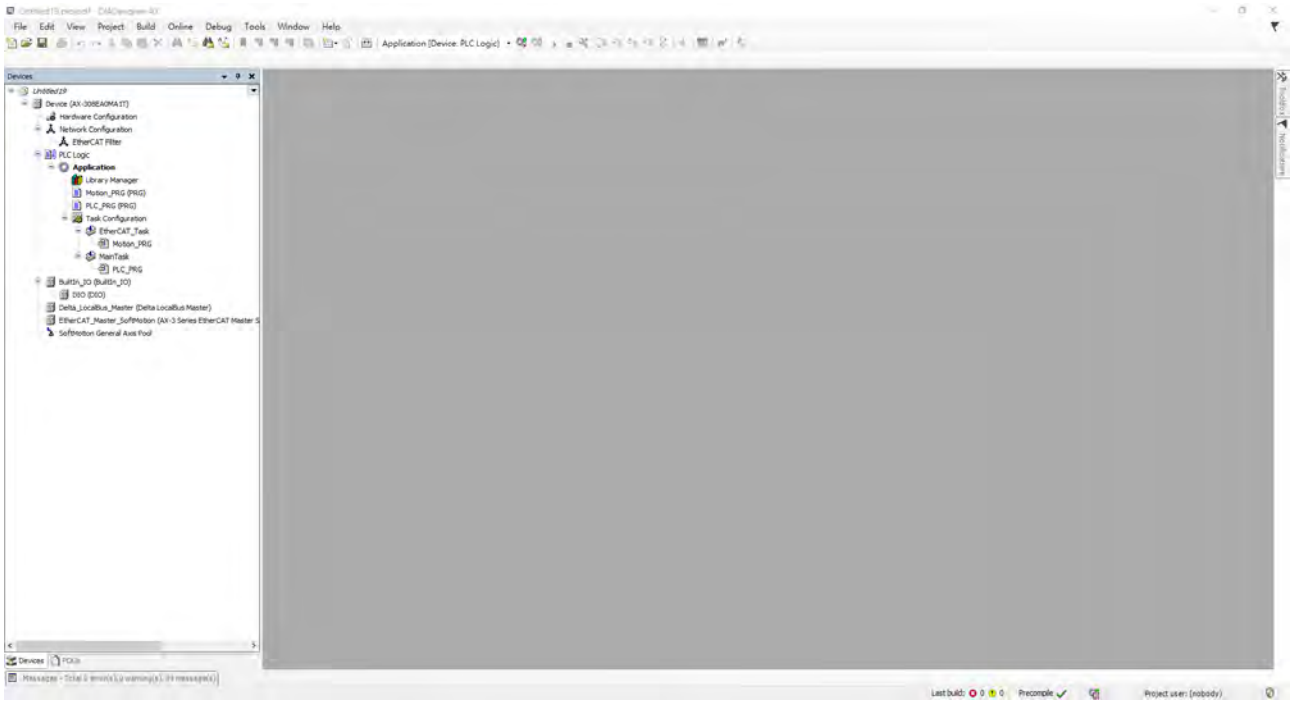
*3. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A.

5.3.4 Settings in DIADesigner-AX

The software DIADesigner-AX is the programming tool for the AX Series PLCs. This section introduces some basic operations and settings.

5.3.4.1 Basic Operation

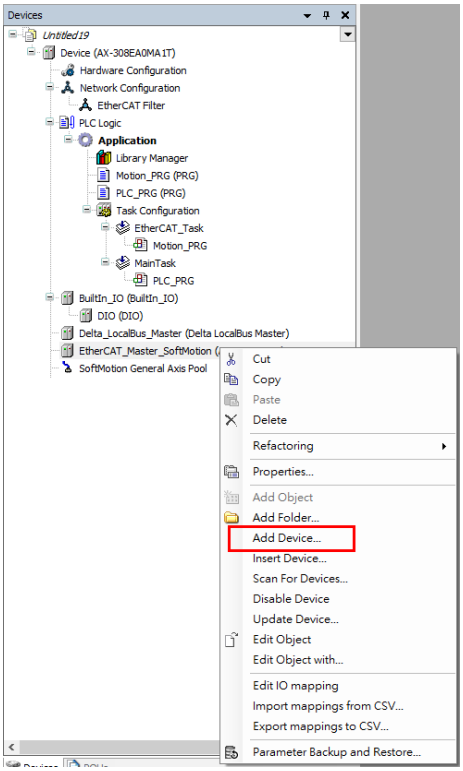
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



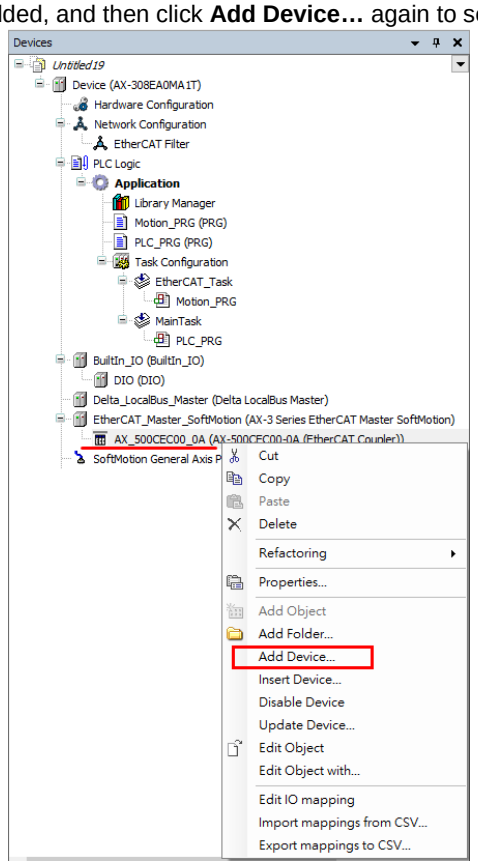
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Add Device…** to select and add System Coupler.

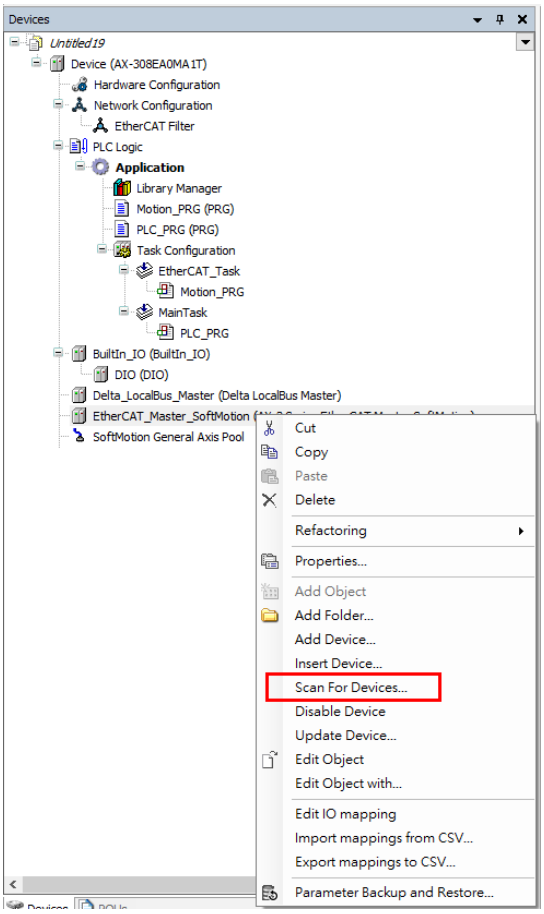


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

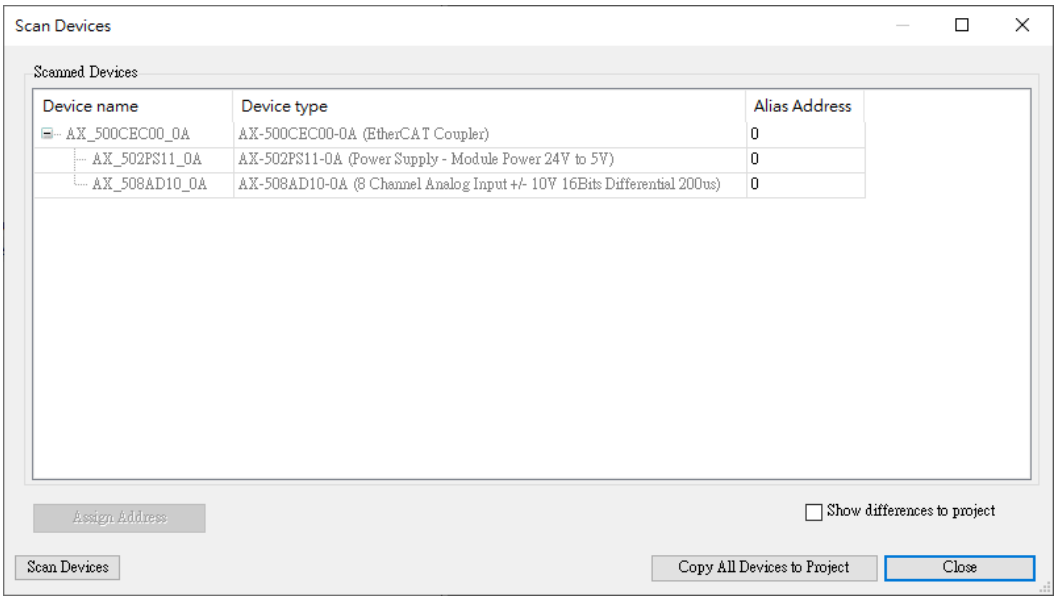


- Method 2: Scan to add the modules in

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Scan for Devices…**.



After the auto-scan is over, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.

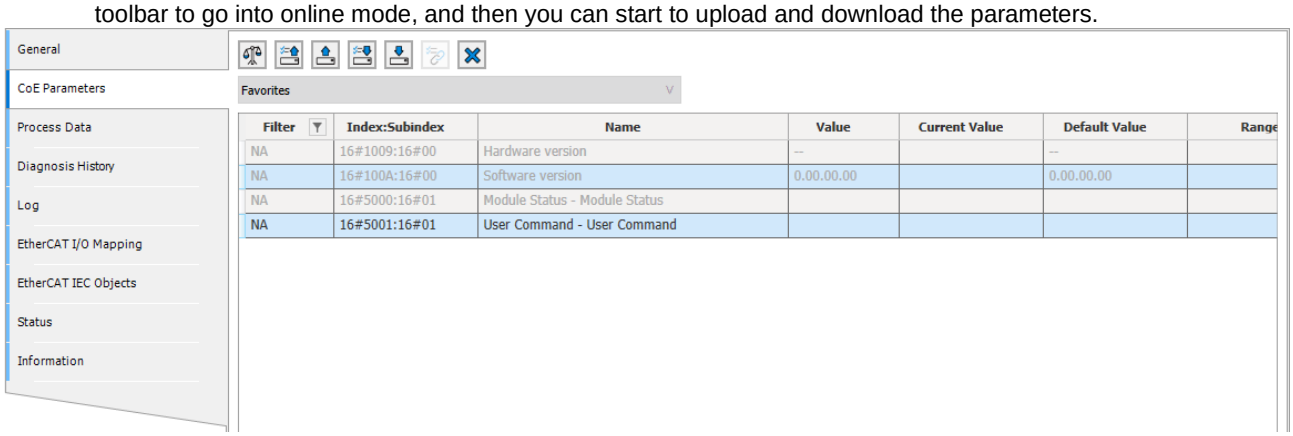


5.3.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.

(1) Favorites

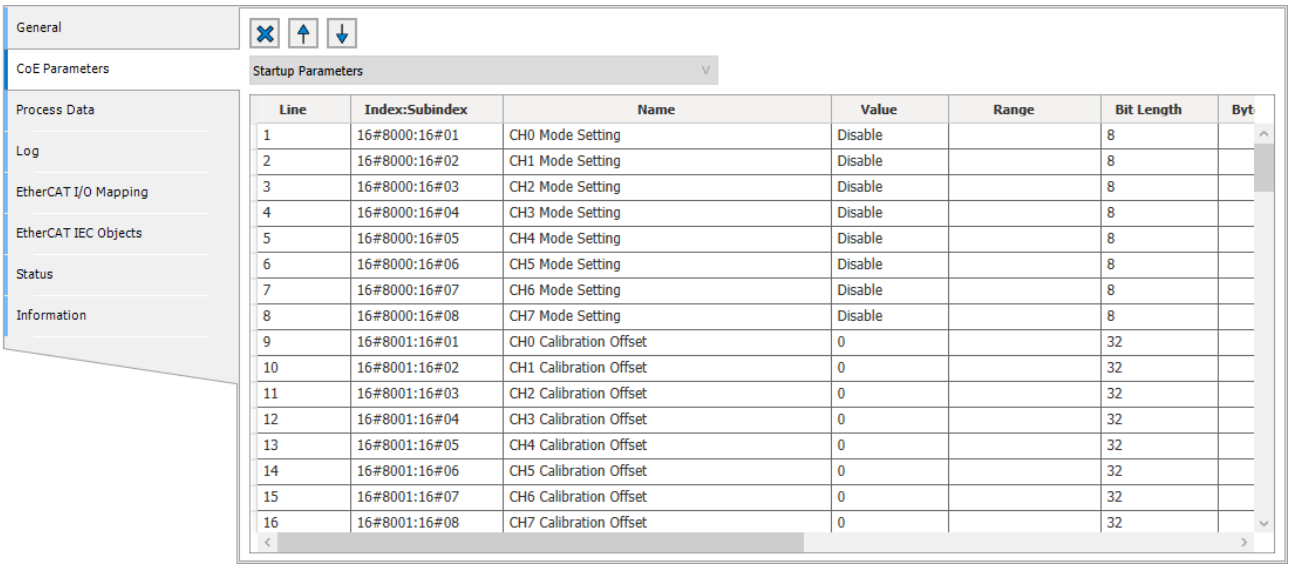
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

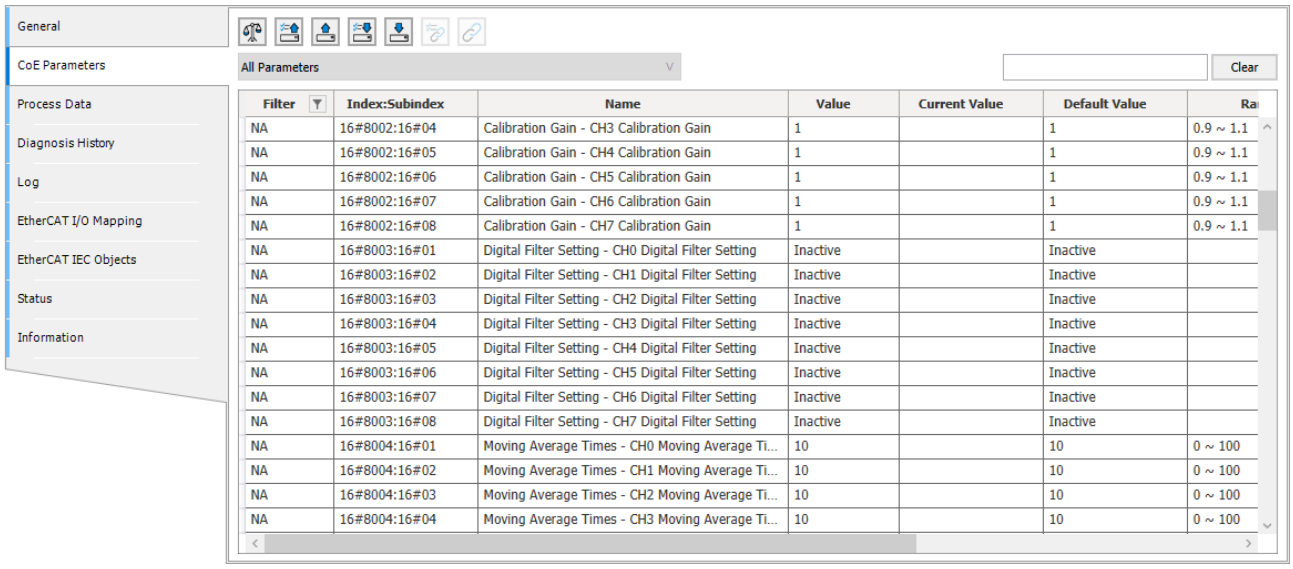


Line	Index:Subindex	Name	Value	Range	Bit Length	Byt
1	16#8000:16#01	CH0 Mode Setting	Disable		8	
2	16#8000:16#02	CH1 Mode Setting	Disable		8	
3	16#8000:16#03	CH2 Mode Setting	Disable		8	
4	16#8000:16#04	CH3 Mode Setting	Disable		8	
5	16#8000:16#05	CH4 Mode Setting	Disable		8	
6	16#8000:16#06	CH5 Mode Setting	Disable		8	
7	16#8000:16#07	CH6 Mode Setting	Disable		8	
8	16#8000:16#08	CH7 Mode Setting	Disable		8	
9	16#8001:16#01	CH0 Calibration Offset	0		32	
10	16#8001:16#02	CH1 Calibration Offset	0		32	
11	16#8001:16#03	CH2 Calibration Offset	0		32	
12	16#8001:16#04	CH3 Calibration Offset	0		32	
13	16#8001:16#05	CH4 Calibration Offset	0		32	
14	16#8001:16#06	CH5 Calibration Offset	0		32	
15	16#8001:16#07	CH6 Calibration Offset	0		32	
16	16#8001:16#08	CH7 Calibration Offset	0		32	

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

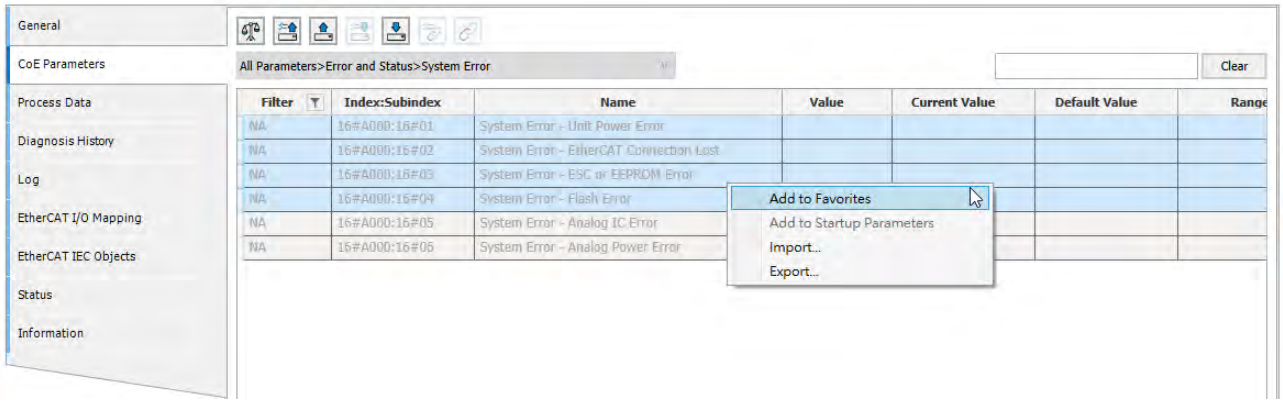
(3) All Parameters

- You can find all the CoE parameters here. Click on the toolbar to go into online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

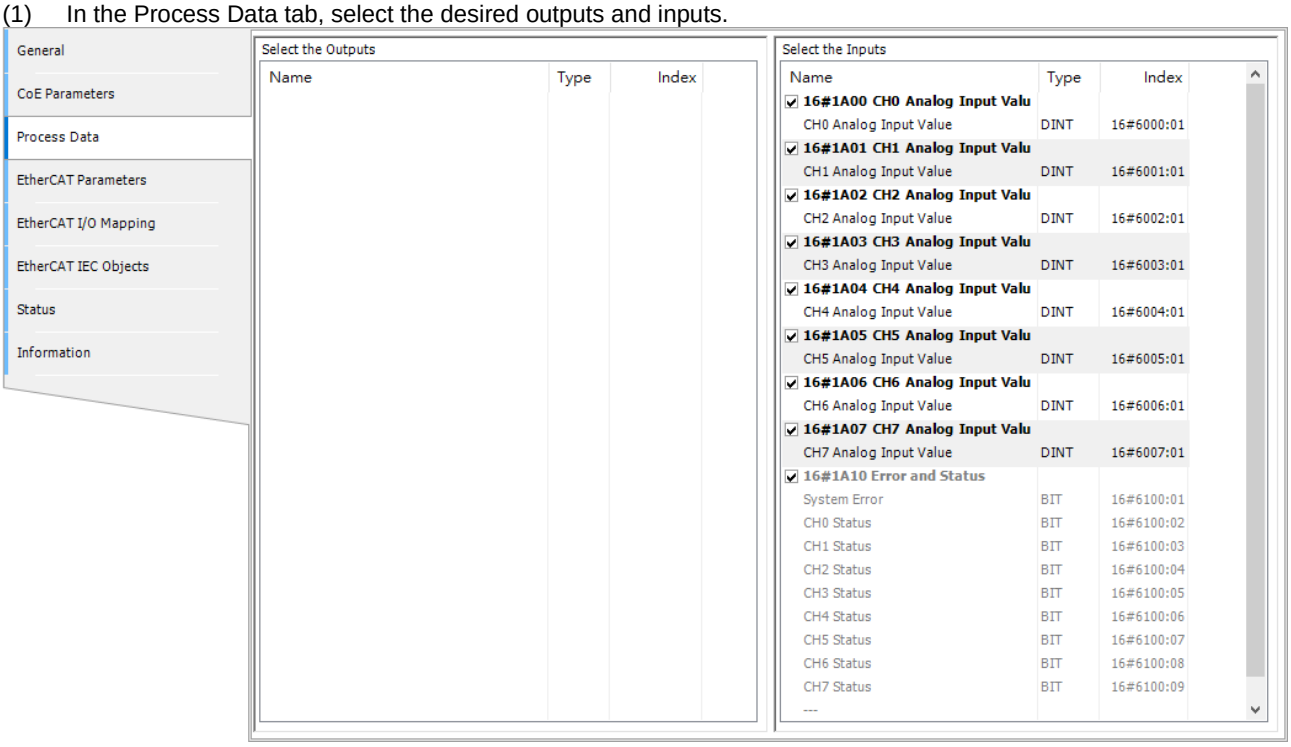
- You can select and right-click the parameter to add the selected parameter to the Favorites.



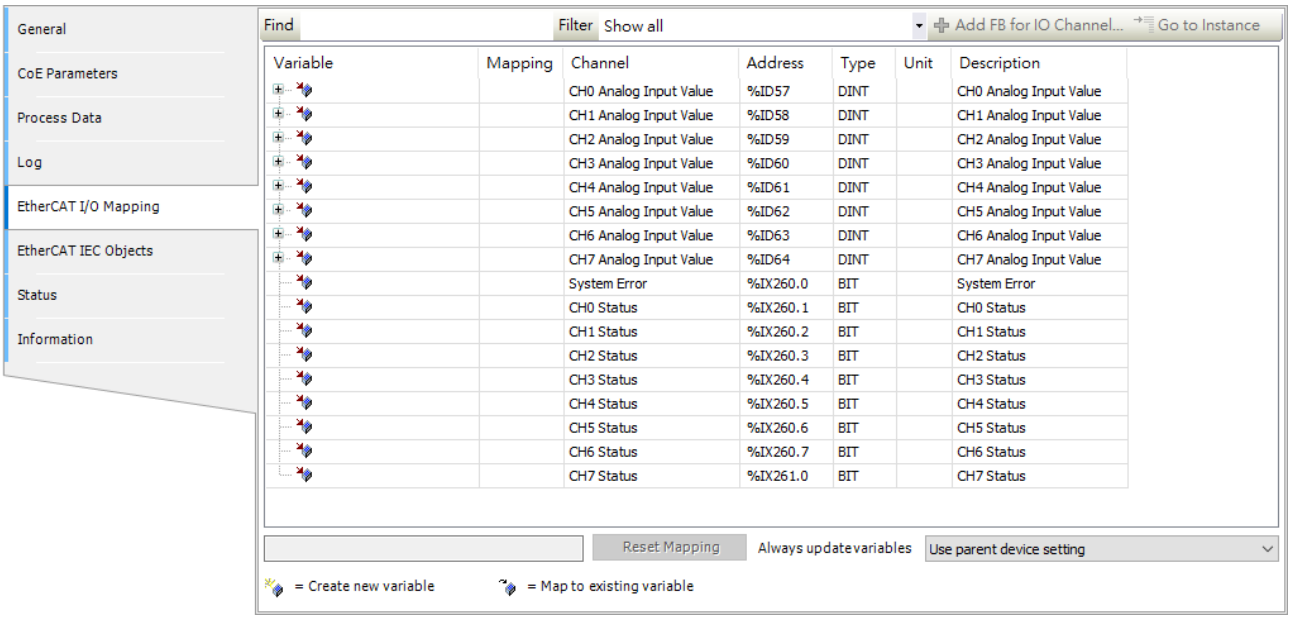
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.3.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

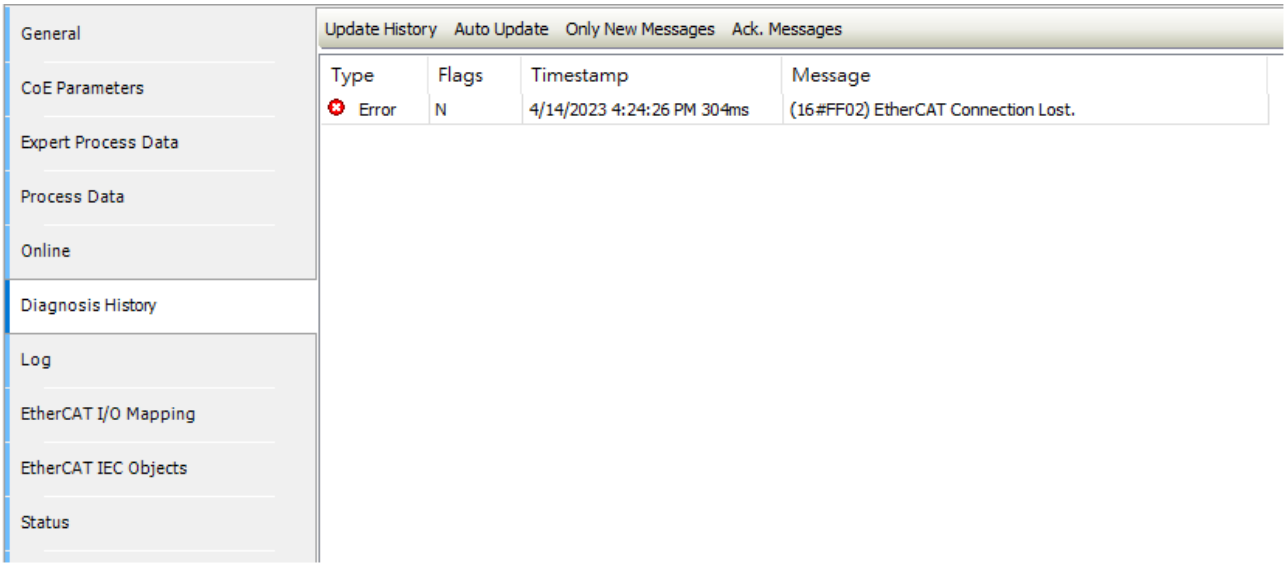


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



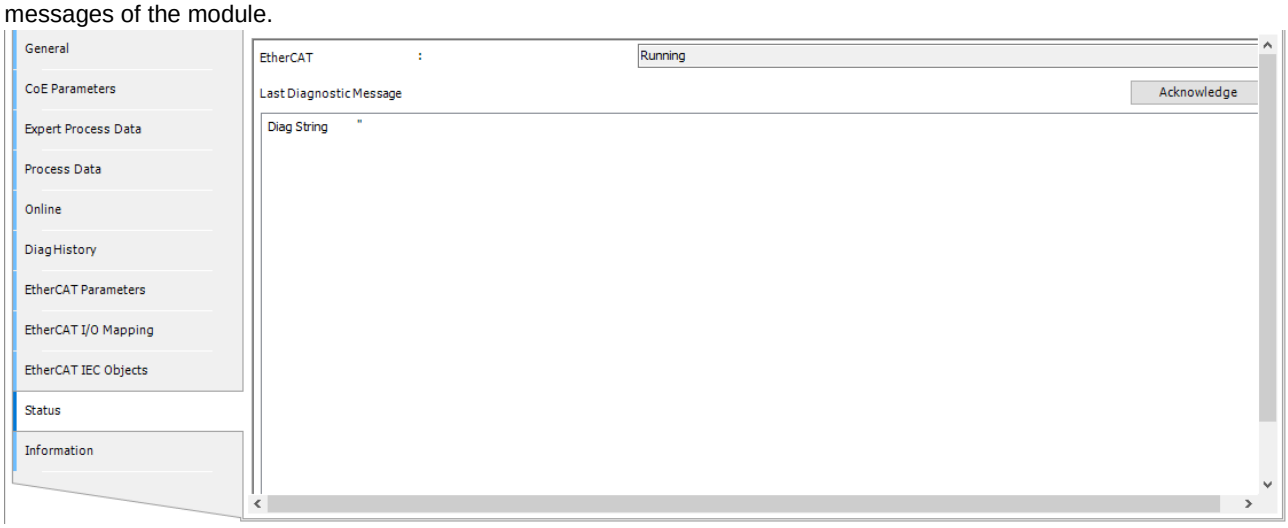
5.3.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors



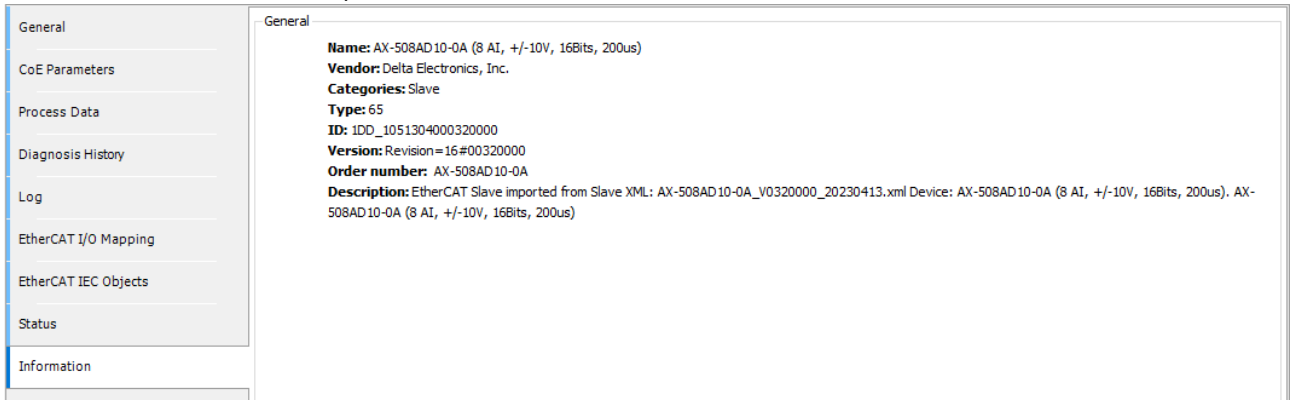
5.3.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



5.3.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.32.01.00	0.32.01.00	0.00.00.00

5.3.5 Parameter Descriptions

You can use DIADesigner-AX to set up the functions for the module by directly selecting the setting mode and parameters. For software operation, refer to section 5.3.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Mode Setting	Mode setting or the channel is OFF.	DFB_AD_RD_ModeSetting DFB_AD_WR_ModeSetting
16#8001	Calibration Offset	Calibration - offset	DFB_AD_RD_CalOffset DFB_AD_WR_CalOffset
16#8002	Calibration Gain	Calibration - gain	DFB_AD_RD_CalGain DFB_AD_WR_CalGain
16#8003	Digital Filter Setting	Digital filter setting	DFB_AD_RD_FilterSetting DFB_AD_WR_FilterSetting
16#8004	Moving Average Times	Moving average times	DFB_AD_RD_AverageTimes DFB_AD_WR_AverageTimes
16#8005	Enable User Limit Alarm DINT	Enable / disable the alarm of exceeding the user-defined limit (DINT)	
16#8006	User Upper Limit DINT	User-defined upper limit (DINT)	
16#8007	User Lower Limit DINT	User-defined lower limit (DINT)	
16#8008	Exceed Hardware Limit Setting	Hardware limit setting	
16#8010	Format	Data format setting	
16#8015	Enable User Limit Alarm REAL	Enable / disable the alarm of exceeding the user-defined limit (floating-point)	
16#8016	User Upper Limit REAL	User-defined upper limit (floating-point)	
16#8017	User Lower Limit REAL	User-defined lower limit (floating-point)	
16#8030	Scale Upper Limit REAL	Scale upper limit setting (floating-point)	DFB_AD_RD_ScaleUpperLimit DFB_AD_WR_ScaleUpperLimit
16#8031	Scale Lower Limit REAL	Scale lower limit setting (floating-point)	DFB_AD_RD_ScaleLowerLimit DFB_AD_WR_ScaleLowerLimit
16#8100	ADC Raw Data	Raw data	

5.3.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Explanation**

When the AX5 series PLC is used as the controller, the module status is synchronized with the status of AX5 series PLC CPU and it will be either 1 (Run) or 2 (Stop). When the status of AX5 series PLC CPU is Stop, the output modules will act according to the parameter settings. As for the input modules, they are not affected. If you use other PLC (NOT AX5 Series PLC) as the controller, the module status will be 0 indicating it is controlled by EtherCAT State Machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

5.3.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Explanation**

Users write a command value into the module and the module will execute the command accordingly. After execution, the module will respond with a corresponding value to show if the execution is success or not.

- **User command**

Command value	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

5.3.5.3 Mode Setting

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Mode Setting	Voltage mode setting	USINT	RW	0
	16#02	CH1 Mode Setting		USINT	RW	0
	16#03	CH2 Mode Setting		USINT	RW	0
	16#04	CH3 Mode Setting		USINT	RW	0
	16#05	CH4 Mode Setting		USINT	RW	0
	16#06	CH5 Mode Setting		USINT	RW	0
	16#07	CH6 Mode Setting		USINT	RW	0
	16#08	CH7 Mode Setting		USINT	RW	0

- **Explanation**

Select the mode to set the channel to ON. The conversion time is 200 μs / 8 channels.

- **Supported modes:**

Mode	Mode range	DINT range
0	Disable	NA
1	-10 V–10 V	±30000
2	0 V–10 V	0–30000
3	-5 V–5 V	±30000
4	0 V–5 V	0–30000
5	1 V–5 V	0–30000

5.3.5.4 Calibration

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Calibration Offset	Offset Setting range: no limit	REAL	RW	0
	16#02	CH1 Calibration Offset		REAL	RW	0
	16#03	CH2 Calibration Offset		REAL	RW	0
	16#04	CH3 Calibration Offset		REAL	RW	0
	16#05	CH4 Calibration Offset		REAL	RW	0
	16#06	CH5 Calibration Offset		REAL	RW	0
	16#07	CH6 Calibration Offset		REAL	RW	0
	16#08	CH7 Calibration Offset		REAL	RW	0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9–1.1	REAL	RW	1.0
	16#02	CH1 Calibration Gain		REAL	RW	1.0
	16#03	CH2 Calibration Gain		REAL	RW	1.0
	16#04	CH3 Calibration Gain		REAL	RW	1.0
	16#05	CH4 Calibration Gain		REAL	RW	1.0
	16#06	CH5 Calibration Gain		REAL	RW	1.0
	16#07	CH6 Calibration Gain		REAL	RW	1.0
	16#08	CH7 Calibration Gain		REAL	RW	1.0

- **Explanation**

When there is an obvious difference between input values and actual values, you can change Offset and Gain to correct the input curve. The formula is

$$Output = (Input \times Gain) + Offset$$

Example

The mode of channels is -10.0 V to +10.0 V. Gain is 1 and Offset is 0 by default; the corresponding value is -10.0 V to +10.0 V. If Gain is set to 0.9 and Offset is set to 2, the value after calibration is -7.0 V to 11.0 V.

5.3.5.5 Digital Filter

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Digital Filter Setting	Digital filter setting	USINT	RW	0
	16#02	CH1 Digital Filter Setting		USINT	RW	0
	16#03	CH2 Digital Filter Setting		USINT	RW	0
	16#04	CH3 Digital Filter Setting		USINT	RW	0
	16#05	CH4 Digital Filter Setting		USINT	RW	0
	16#06	CH5 Digital Filter Setting		USINT	RW	0
	16#07	CH6 Digital Filter Setting		USINT	RW	0
	16#08	CH7 Digital Filter Setting		USINT	RW	0
16#8004	16#01	CH0 Moving Average Times	Moving average times Setting range: 1–100 times	USINT	RW	0
	16#02	CH1 Moving Average Times		USINT	RW	0
	16#03	CH2 Moving Average Times		USINT	RW	0
	16#04	CH3 Moving Average Times		USINT	RW	0
	16#05	CH4 Moving Average Times		USINT	RW	0
	16#06	CH5 Moving Average Times		USINT	RW	0
	16#07	CH6 Moving Average Times		USINT	RW	0
	16#08	CH7 Moving Average Times		USINT	RW	0

- **Explanation**

The parameters here are for setting digital filter function. The module provides 3 types of digital filters, including Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The digital filter can work only when the EtherCAT operation mode is the Free Run mode. The conversion time for FIR filter and IIR filter is 350 μs / 8 channels.

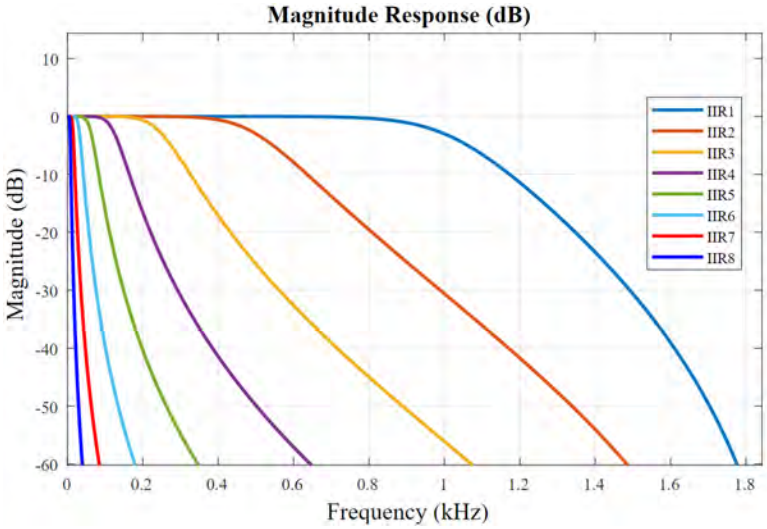
Moving Average Filter

A moving average filter uses the latest pieces of sampled data to create a series of averages to smooth the data. Compared to other types of digital filters, a moving average filter is fast in computation and algorithm, without occupying the CPU processing time. But the filtering result of a moving average filter is not as effective as an IIR filter or a FIR filter.

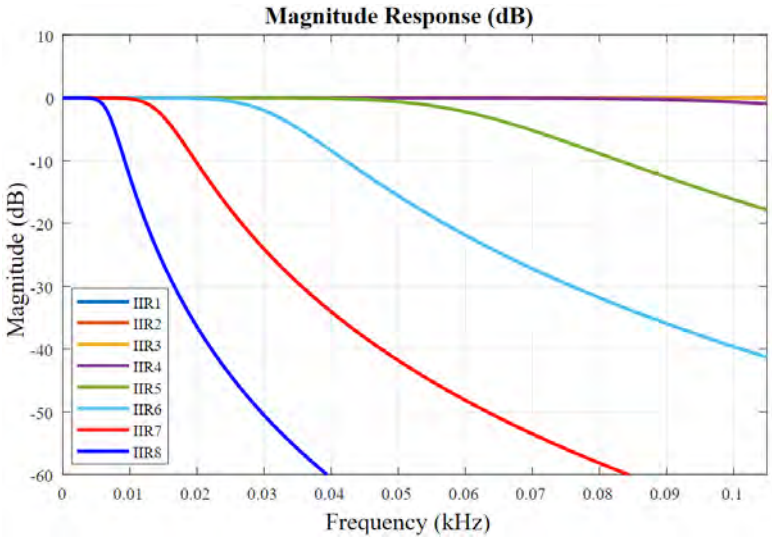
IIR (Infinite Impulse Response) Filter

An infinite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, an IIR filter works more efficiently than a moving average filter does. This IIR filter is a low-pass filter. The advantage of an IIR filter is that within the same length of operation time, the filtering result of an IIR filter is better than what a FIR filter can offer. Since an IIR filter can only have a non-linear phase response, it has an inconsistent output delay at every frequency, the input signals may be distorted and the stability issue may be raised. An IIR filter may be not suitable for applications

such as oscilloscope waveform and electrocardiography that require demanding waveforms.



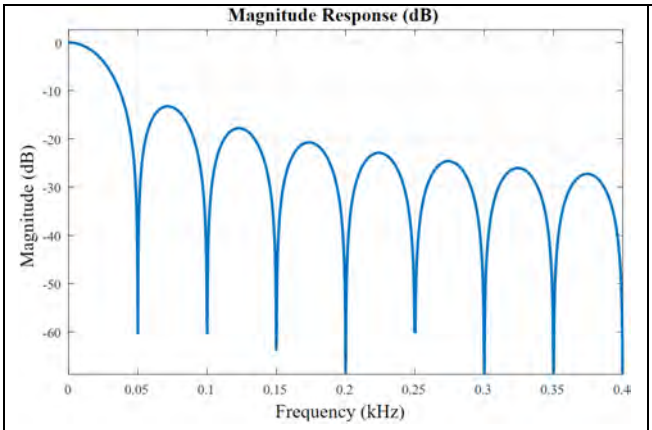
Frequency response of IIR filter



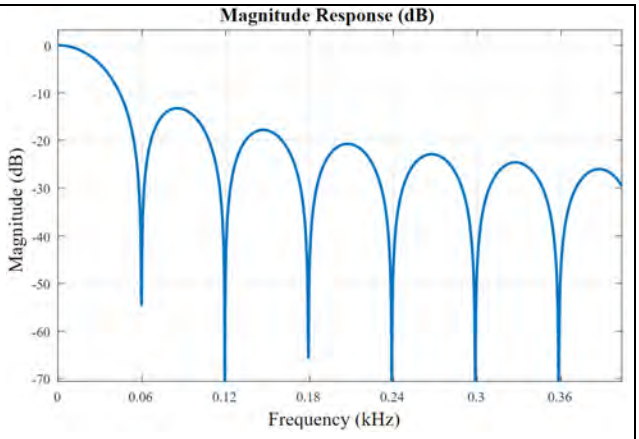
Frequency response of IIR filter (enlarged figure)

FIR (Finite impulse response) Filter

A finite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, a FIR filter works more efficiently than a moving average filter does. This FIR filter is a low-pass filter; it works tremendously well for attenuation of 50/60 Hz signals (> 40 dB). The advantage of a FIR filter is that it has a linear phase response which means a FIR filter has a consistent output delay at all frequencies while an IIR filter has an unequal delay at different frequencies. A FIR filter is ideal for a wide range of applications. However within the same length of operation time, the filtering result of a FIR filter is not as good as what an IIR filter can deliver.



50 Hz low-pass FIR filter



60 Hz low-pass FIR filter

- **Digital filter modes**

Mode	Name of digital filter	Cut-off frequency (-3 dB)
0	Inactive	
1	Moving Average	Works with Moving Average Time
2	IIR1	1000 Hz
3	IIR2	500 Hz
4	IIR3	250 Hz
5	IIR4	125 Hz
6	IIR5	63 Hz
7	IIR6	32 Hz
8	IIR7	15 Hz
9	IIR8	7 Hz
10	FIR 50Hz	22 Hz (attenuation: multiples of 50 Hz: > 40dB)
11	FIR 60Hz	26 Hz (attenuation: multiples of 60 Hz: > 40dB)

5.3.5.6 User Limit Alarm

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8005	16#01	CH0 Enable User Limit Alarm DINT	Enable / disable the alarm of exceeding the user-defined limit (DINT) 0: Disable (default) 1: Enable	BOOL	RW	0
	16#02	CH1 Enable User Limit Alarm DINT		BOOL	RW	0
	16#03	CH2 Enable User Limit Alarm DINT		BOOL	RW	0
	16#04	CH3 Enable User Limit Alarm DINT		BOOL	RW	0
	16#05	CH4 Enable User Limit Alarm DINT		BOOL	RW	0
	16#06	CH5 Enable User Limit Alarm DINT		BOOL	RW	0
	16#07	CH6 Enable User Limit Alarm DINT		BOOL	RW	0
	16#08	CH7 Enable User Limit Alarm DINT		BOOL	RW	0
16#8006	16#01	CH0 User Upper Limit DINT	User-defined upper limit (DINT); Setting range: no limit	DINT	RW	30000
	16#02	CH1 User Upper Limit DINT		DINT	RW	30000
	16#03	CH2 User Upper Limit DINT		DINT	RW	30000
	16#04	CH3 User Upper Limit DINT		DINT	RW	30000
	16#05	CH4 User Upper Limit DINT		DINT	RW	30000
	16#06	CH5 User Upper Limit DINT		DINT	RW	30000
	16#07	CH6 User Upper Limit DINT		DINT	RW	30000
	16#08	CH7 User Upper Limit DINT		DINT	RW	30000
16#8007	16#01	CH0 User Lower Limit DINT	User-defined lower limit (DINT); Setting range: no limit	DINT	RW	-30000
	16#02	CH1 User Lower Limit DINT		DINT	RW	-30000
	16#03	CH2 User Lower Limit DINT		DINT	RW	-30000
	16#04	CH3 User Lower Limit DINT		DINT	RW	-30000
	16#05	CH4 User Lower Limit DINT		DINT	RW	-30000
	16#06	CH5 User Lower Limit DINT		DINT	RW	-30000
	16#07	CH6 User Lower Limit DINT		DINT	RW	-30000
	16#08	CH7 User Lower Limit DINT		DINT	RW	-30000
16#8015	16#01	CH0 Enable User Limit Alarm REAL	Enable / disable the alarm of exceeding the user-defined limit (floating-point); 0: Disable(default) 1: Enable	BOOL	RW	0
	16#02	CH1 Enable User Limit Alarm REAL		BOOL	RW	0
	16#03	CH2 Enable User Limit Alarm REAL		BOOL	RW	0
	16#04	CH3 Enable User Limit Alarm REAL		BOOL	RW	0
	16#05	CH4 Enable User Limit Alarm REAL		BOOL	RW	0
	16#06	CH5 Enable User Limit Alarm REAL		BOOL	RW	0
	16#07	CH6 Enable User Limit Alarm REAL		BOOL	RW	0
	16#08	CH7 Enable User Limit Alarm REAL		BOOL	RW	0
16#8016	16#01	CH0 User Upper Limit REAL	User-defined upper limit (floating-point); Setting range: no limit	REAL	RW	10.0
	16#02	CH1 User Upper Limit REAL		REAL	RW	10.0
	16#03	CH2 User Upper Limit REAL		REAL	RW	10.0

Index	Subindex	Name	Description	Data Type	Attr.	Default
	16#04	CH3 User Upper Limit REAL		REAL	RW	10.0
	16#05	CH0 User Upper Limit REAL		REAL	RW	10.0
	16#06	CH1 User Upper Limit REAL		REAL	RW	10.0
	16#07	CH2 User Upper Limit REAL		REAL	RW	10.0
	16#08	CH3 User Upper Limit REAL		REAL	RW	10.0
16#8017	16#01	CH0 User Lower Limit For REAL	User-defined lower limit (floating-point); Setting range: no limit	REAL	RW	-10.0
	16#02	CH1 User Lower Limit For REAL		REAL	RW	-10.0
	16#03	CH2 User Lower Limit For REAL		REAL	RW	-10.0
	16#04	CH3 User Lower Limit For REAL		REAL	RW	-10.0
	16#05	CH4 User Lower Limit For REAL		REAL	RW	-10.0
	16#06	CH5 User Lower Limit For REAL		REAL	RW	-10.0
	16#07	CH6 User Lower Limit For REAL		REAL	RW	-10.0
	16#08	CH7 User Lower Limit For REAL		REAL	RW	-10.0

- **Explanation**

Users can define the upper and lower limits and enable the alarm of exceeding the limits. Set the format to DINT or REAL (floating-point).

- **Example**

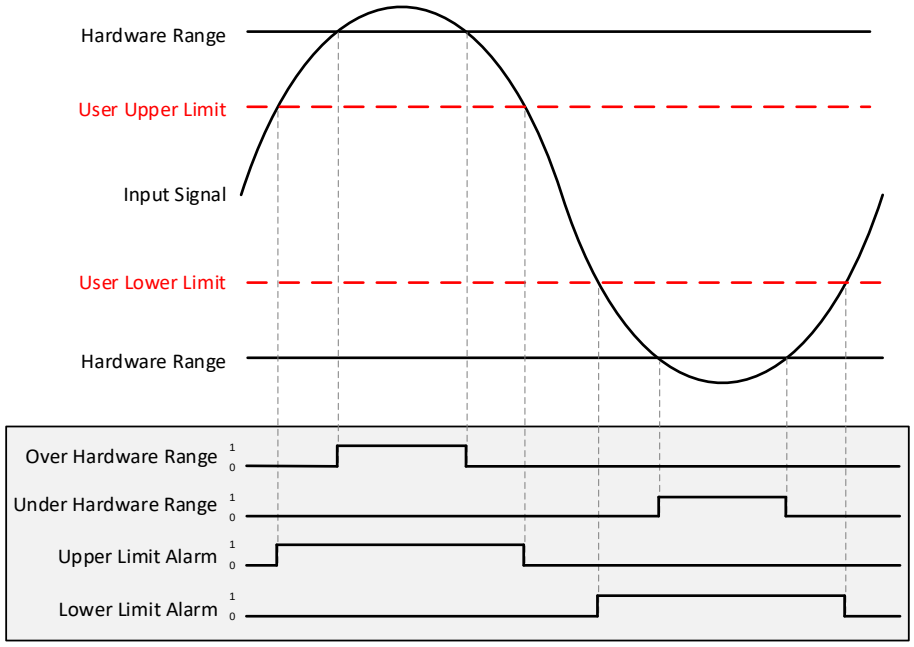
When the format is set to DINT, you can set:

16#8003 Enable User Limit Alarm DINT: Enable

16#8004 User Upper Limit DINT: 28000

16#8005 User Lower Limit DINT: -28000

When the input signal exceeds the user-defined upper or lower limit, an error occurs. See section 5.3.8 for more information on troubleshooting.

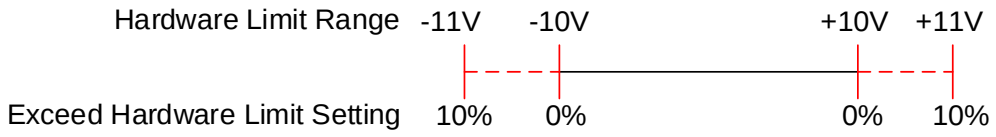


5.3.5.7 Exceed Hardware Limit

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8008	16#01	CH0 Exceed Hardware Limit Setting	Hardware limit setting; Setting range: 0–10 (0%–10%)	USINT	RW	5
	16#02	CH1 Exceed Hardware Limit Setting		USINT	RW	5
	16#03	CH2 Exceed Hardware Limit Setting		USINT	RW	5
	16#04	CH3 Exceed Hardware Limit Setting		USINT	RW	5
	16#05	CH4 Exceed Hardware Limit Setting		USINT	RW	5
	16#06	CH5 Exceed Hardware Limit Setting		USINT	RW	5
	16#07	CH6 Exceed Hardware Limit Setting		USINT	RW	5
	16#08	CH7 Exceed Hardware Limit Setting		USINT	RW	5

- **Explanation**

Users can define the hardware limit range.



- **Example**

When the mode is -10V–10V, the setting value is 5%. Its hardware limit range is -10.5V – 10.5V. When the input signal exceeds the hardware upper or lower limit, an error occurs. See section 5.3.8 for more information on troubleshooting.

5.3.5.8 Format

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8010	16#01	Format	0: DINT Format 1: REAL Format	USINT	RW	0
	16#02	Decimal Places	Setting value: 0–5	USINT	RW	2

- **Explanation**

You can set the format and the decimal places according to your demand.

When the data format is set to DINT Format, set up the DINT parameters which are with “DINT” following a parameter name.

When the data format is set to REAL Format, set up the REAL parameters which are with “REAL” following a parameter name.

5.3.5.9 Scale

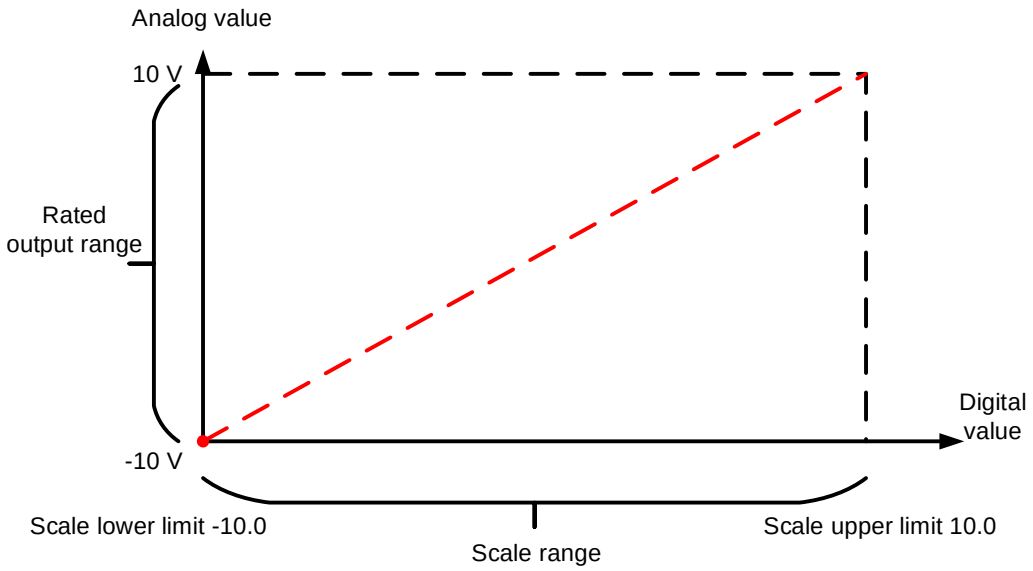
Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8030	16#01	CH0 Scale Upper Limit REAL	Scale upper limit setting; Setting range: no limit	REAL	RW	10
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	10
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	10
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	10
	16#05	CH4 Scale Upper Limit REAL		REAL	RW	10
	16#06	CH5 Scale Upper Limit REAL		REAL	RW	10
	16#07	CH6 Scale Upper Limit REAL		REAL	RW	10
	16#08	CH7 Scale Upper Limit REAL		REAL	RW	10
16#8031	16#01	CH0 Scale Lower Limit REAL	Moving average setting; Setting range: no limit	REAL	RW	-10
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-10
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-10
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-10
	16#05	CH0 Scale Lower Limit REAL		REAL	RW	-10
	16#06	CH1 Scale Lower Limit REAL		REAL	RW	-10
	16#07	CH2 Scale Lower Limit REAL		REAL	RW	-10
	16#08	CH3 Scale Lower Limit REAL		REAL	RW	-10

- **Explanation**

You can set the scale range based on the analog specification for channels when the data format is REAL (floating-point).

- **Example**

If the mode setting of channels is -10 V–10 V, the analog range is -10 V–10 V; and the scale upper limit is set to 10.0 and lower limit is set to -10.0. The digital values -10.0 to +10.0 correspond to the analog values -10 V to +10 V, as the example below shows.



5.3.5.10 ADC Raw Data

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8100	16#01	CH0 ADC Raw data	Raw data	DINT	RO	0
	16#02	CH1 ADC Raw data		DINT	RO	0
	16#03	CH2 ADC Raw data		DINT	RO	0
	16#04	CH3 ADC Raw data		DINT	RO	0
	16#05	CH4 ADC Raw data		DINT	RO	0
	16#06	CH5 ADC Raw data		DINT	RO	0
	16#07	CH6 ADC Raw data		DINT	RO	0
	16#08	CH7 ADC Raw data		DINT	RO	0

- **Explanation**

Raw data is the source data that has not been processed or converted from analog to digital.

5.3.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

5.3.6.1 FreeRun Mode

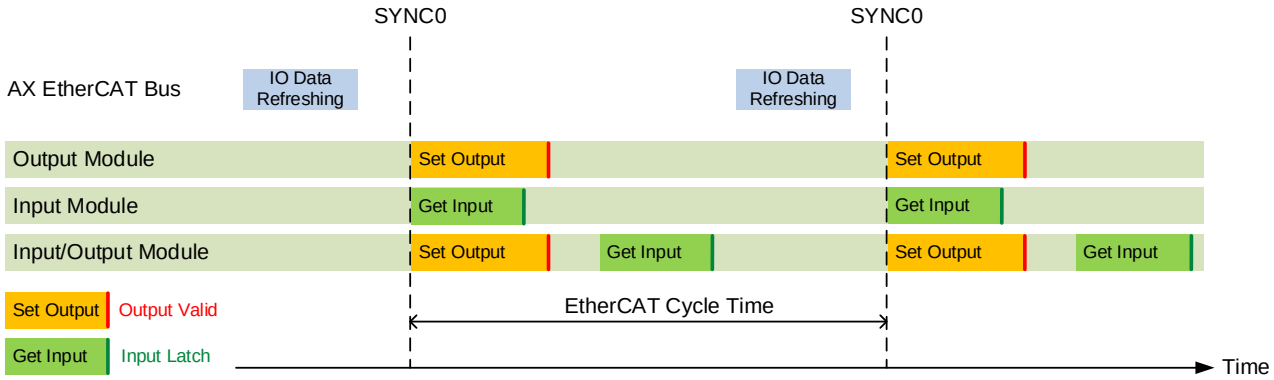
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

5.3.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

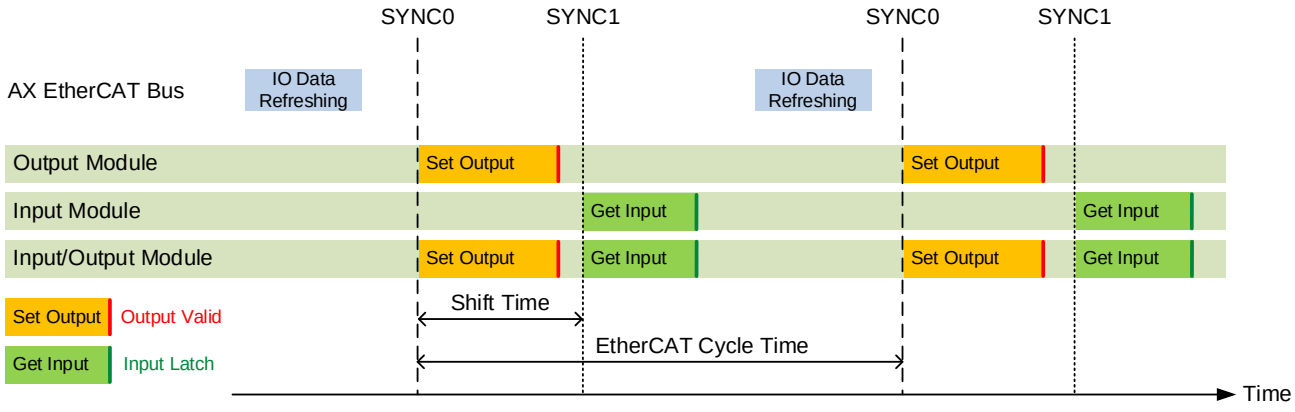
- **SYNC0**

Using the SYNC signal SYNC0 to refresh the values of output channels among modules at the same time.



- **SYNC0 + SYNC1**

Using SYNC0 to refresh values of output channels and using SYNC1 to refresh values of input channels among modules at the same time. The shift time of SYNC0 and SYNC1 can be modified with DIADesigner-AX.



5.3.7 Process Data

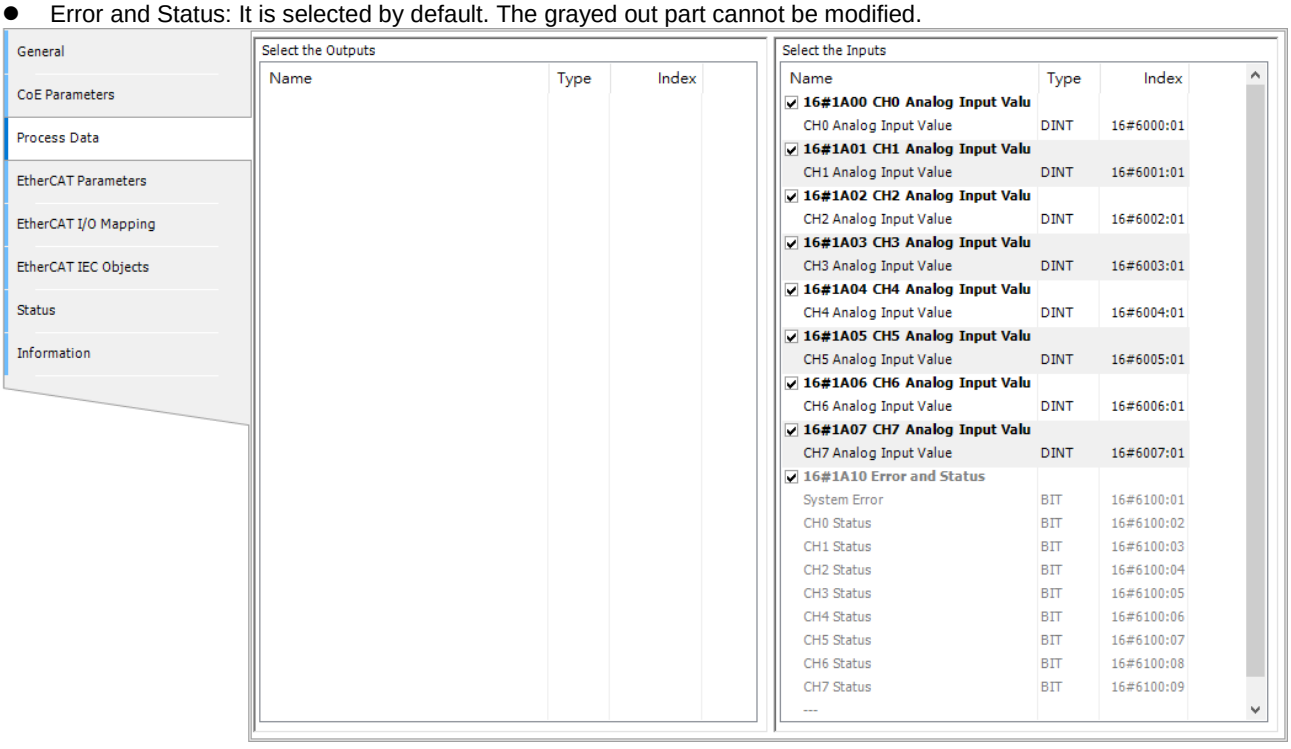
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Analog Input Value	Analog input value; Setting range: -33000–33000	DINT	RO	0
16#6001	16#01	CH1 Analog Input Value		DINT	RO	0
16#6002	16#01	CH2 Analog Input Value		DINT	RO	0
16#6003	16#01	CH3 Analog Input Value		DINT	RO	0
16#6004	16#01	CH4 Analog Input Value		DINT	RO	0
16#6005	16#01	CH5 Analog Input Value		DINT	RO	0
16#6006	16#01	CH6 Analog Input Value		DINT	RO	0
16#6007	16#01	CH7 Analog Input Value		DINT	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0
	16#02	CH0 Status	CH0: error or warning	BOOL	RO	0
	16#03	CH1 Status	CH1: error or warning	BOOL	RO	0
	16#04	CH2 Status	CH2: error or warning	BOOL	RO	0
	16#05	CH3 Status	CH3: error or warning	BOOL	RO	0
	16#06	CH4 Status	CH4: error or warning	BOOL	RO	0
	16#07	CH5 Status	CH5: error or warning	BOOL	RO	0
	16#08	CH6 Status	CH6: error or warning	BOOL	RO	0
	16#09	CH7 Status	CH7: error or warning	BOOL	RO	0

5.3.7.1 Process Data

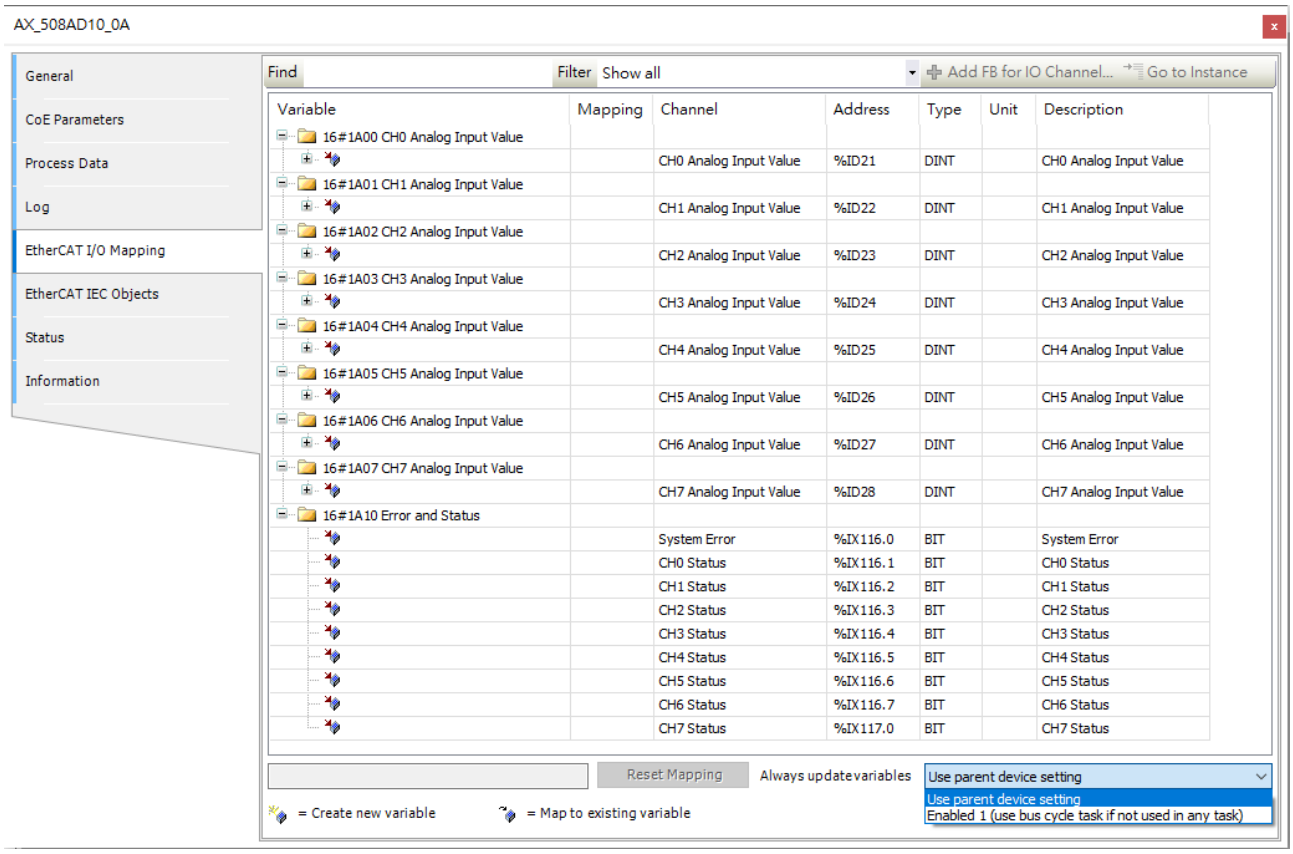
Go to the Process Data tab and select the data that you'd like to monitor.

- Analog Input Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Status: It is selected by default. The grayed out part cannot be modified.



5.3.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



5.3.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

5.3.8 Troubleshooting

In the Diagnosis History tab, the error information that has occurred on the module is recorded. In the Status tab, the current information of system error (16#A000) is displayed. In the CoE Parameters tab, you can view the error status through Index/SubIndex of the All Parameter list.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Connection Lost	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#05	(16#FF05) Analog IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#06	(16#FF06) Analog Power Error	ON	OFF	If the problem persists, contact the local authorized distributors.
16#A00**n**[*1]	16#01	(16#FF11) CH(**n**-1) Upper Limit Alarm	Blinking (1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user upper limit.
	16#02	(16#FF12) CH(**n**-1) Lower Limit Alarm	Blinking (1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user lower limit.
	16#03	(16#FF13) CH(**n**-1) Over Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed hardware range.
	16#04	(16#FF14) CH(**n**-1) Under Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed hardware range.

*1. n = 1–8

5.4 AX-508AD20-0A

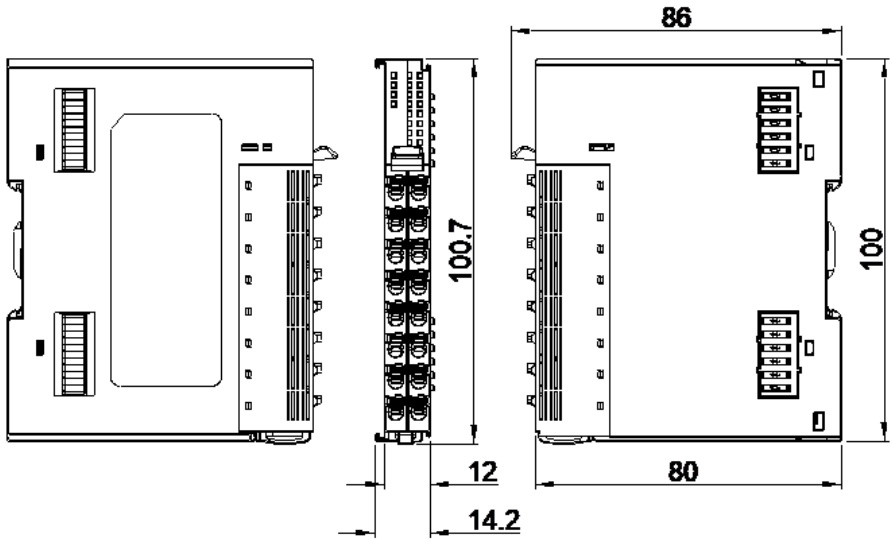
AX-508AD20-0A, an analog input module, receives analog current signals through 8 input points and converts the received signals to 16-bit digital signals. This section introduces its specifications, wirings and operations.

5.4.1 Specifications

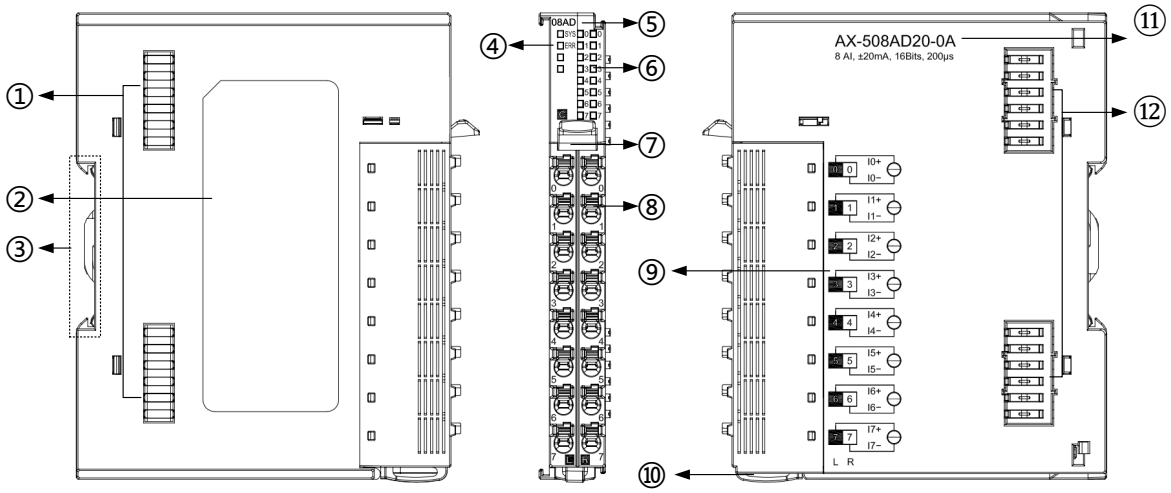
Item		Specification
Input points		8
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		74 g
Electrical specification	Input form	Differential input
	Input range	-20 – +20 mA
	Input conversion range	-5 – 105 % (F.S.)
	Rated absolute input range	±32 mA
	Input impedance	Less than 300 Ω
	Resolution	-20 – +20 mA: -30000–30000 0 – +20 mA: 0 – 3000
	Accuracy	25 °C: ±0.2 % (F.S.) -20 – 60 °C: ±0.6 % (F.S.)
	Conversion time	200 μs / 8 points
	Isolation method	Between unit power and external power: no isolation Between digital power and analog power: 500 VAC Between digital signal and analog signal: 500 VAC Between analog channels: no isolation
	Maximum power consumption (unit power)	Less than 440 mA (2.2W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Protection	--
	Short Circuit Protection (SCP)	--
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	--
	Filter function	AVG / FIR / IIR

5.4.2 Dimensions and Parts

- **Dimensions**



Unit: mm

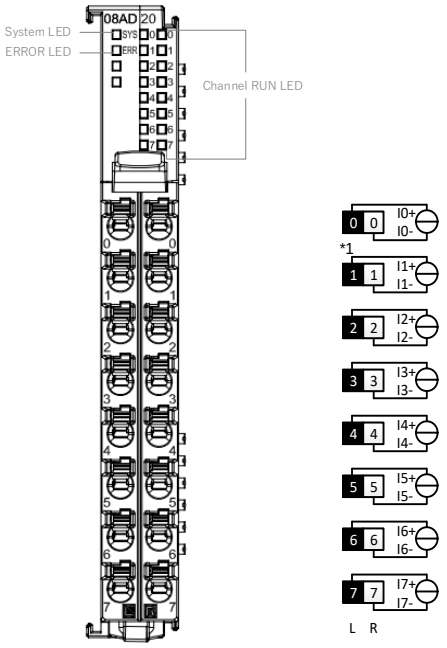


- **Parts**

No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

5.4.3 Arrangement of Terminals, LED Indicators and Wiring

5.4.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

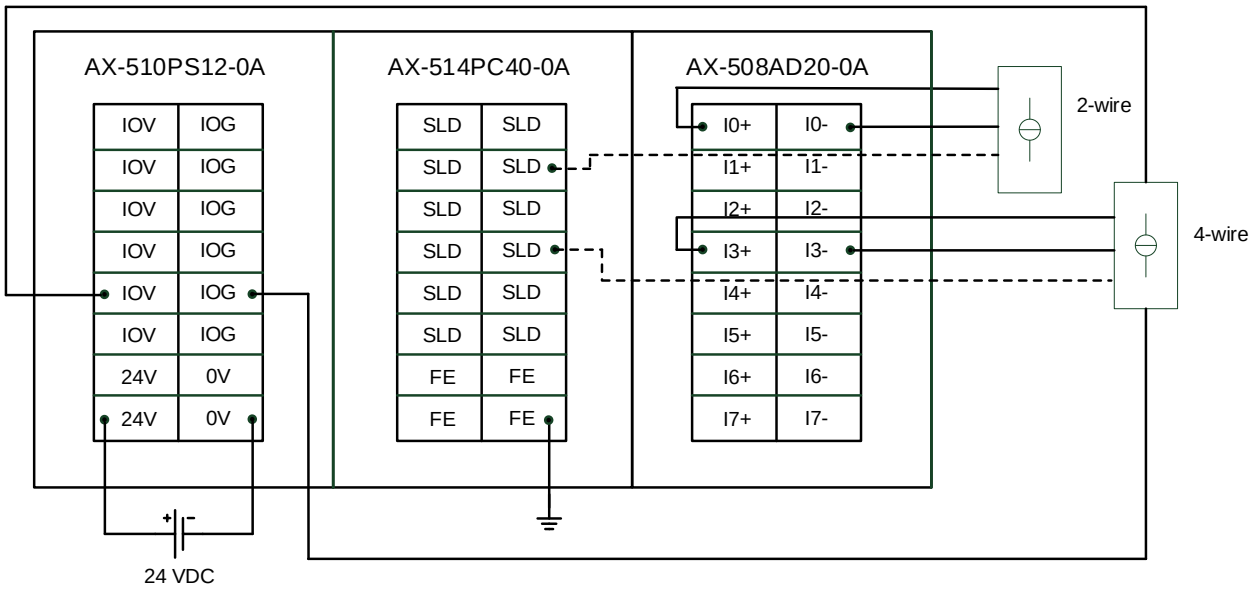
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0+	Channel 0: positive input current	R0	I0-	Channel 0: negative input current
L1	I1+	Channel 1: positive input current	R1	I1-	Channel 1: negative input current
L2	I2+	Channel 2: positive input current	R2	I2-	Channel 2: negative input current
L3	I3+	Channel 3: positive input current	R3	I3-	Channel 3: negative input current
L4	I4+	Channel 4: positive input current	R4	I4-	Channel 4: negative input current
L5	I5+	Channel 5: positive input current	R5	I5-	Channel 5: negative input current
L6	I6+	Channel 6: positive input current	R6	I6-	Channel 6: negative input current
L7	I7+	Channel 7: positive input current	R7	I7-	Channel 7: negative input current

5.4.3.2 LED Indicators

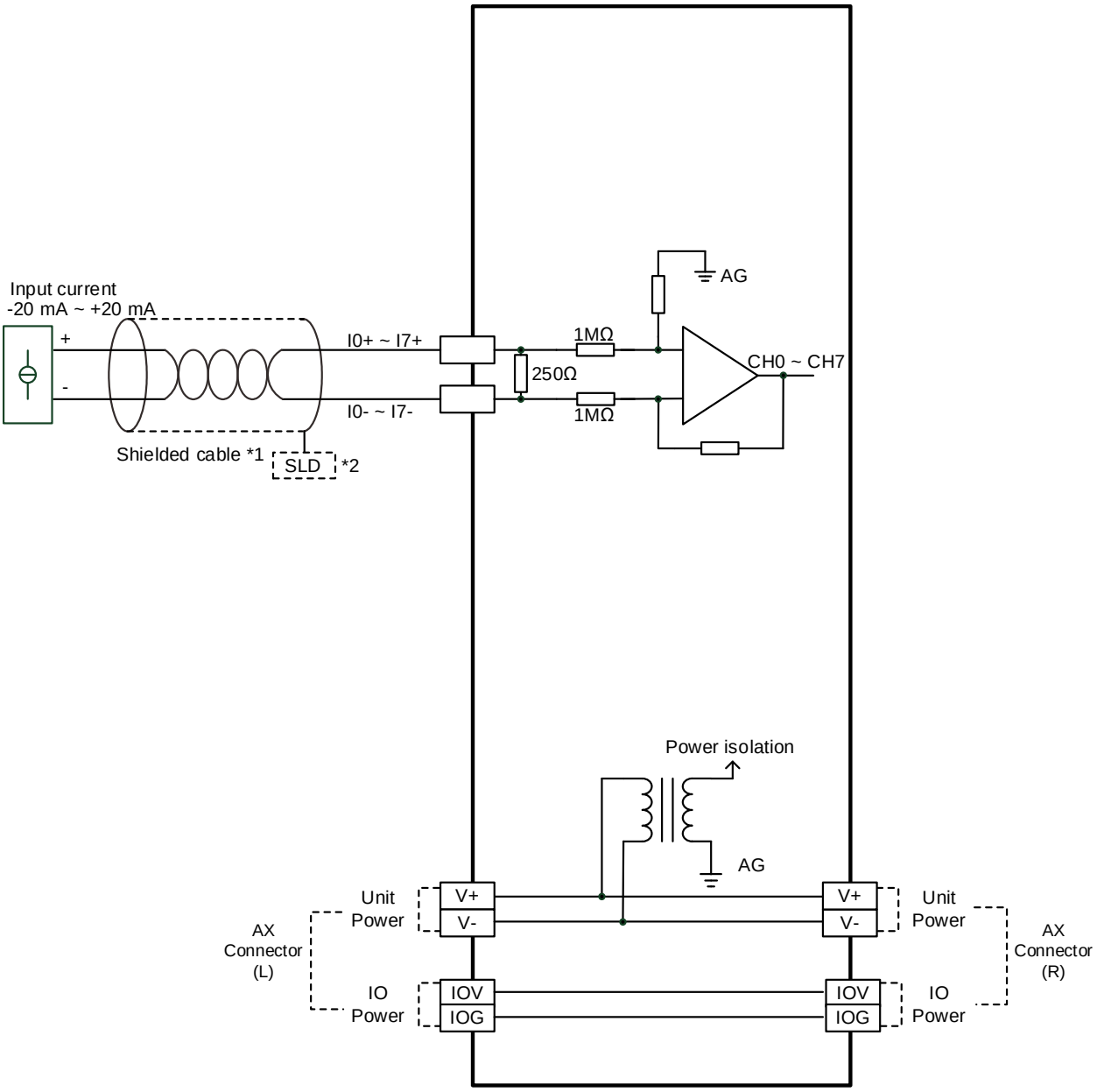
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking (1s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1s)	An error occurs on the application.
			Blinking (0.2s)	An error occurs on the hardware.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

5.4.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



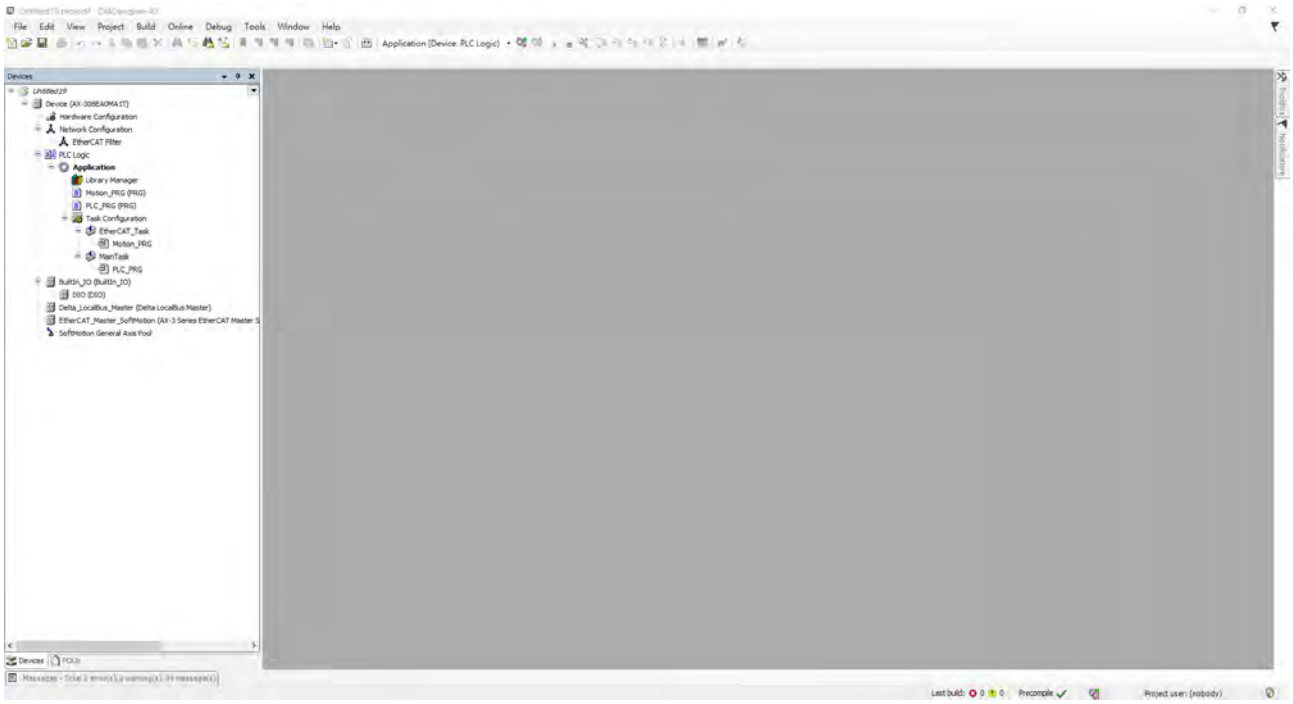
*1. Use shielded cables to isolate the analog input signal cable from other power cables.
*2. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A.

5.4.4 Settings in DIADesigner-AX

The software DIADesigner-AX is the programming tool for the AX Series PLCs. This section introduces some basic operations and settings.

5.4.4.1 Basic Operation

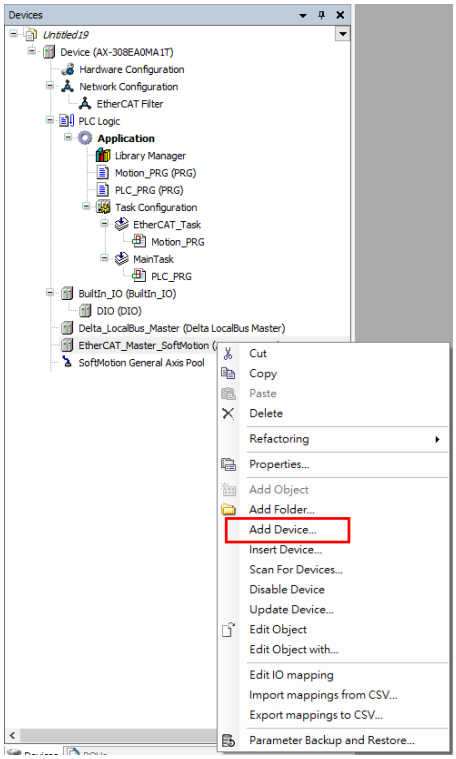
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



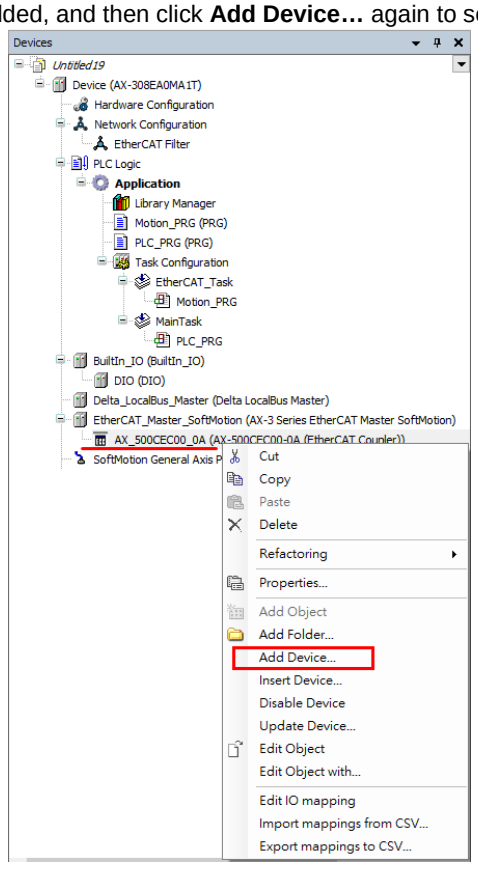
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Add Device…** to select and add System Coupler.

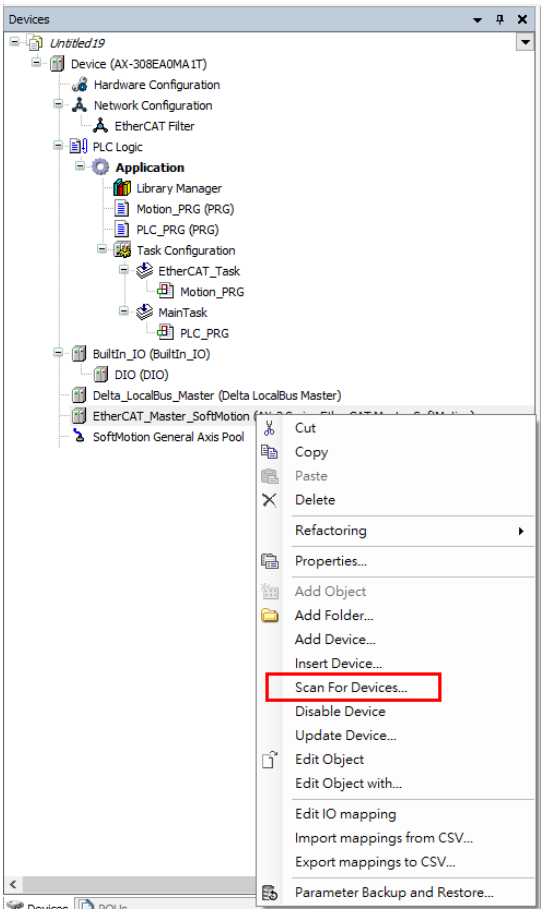


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

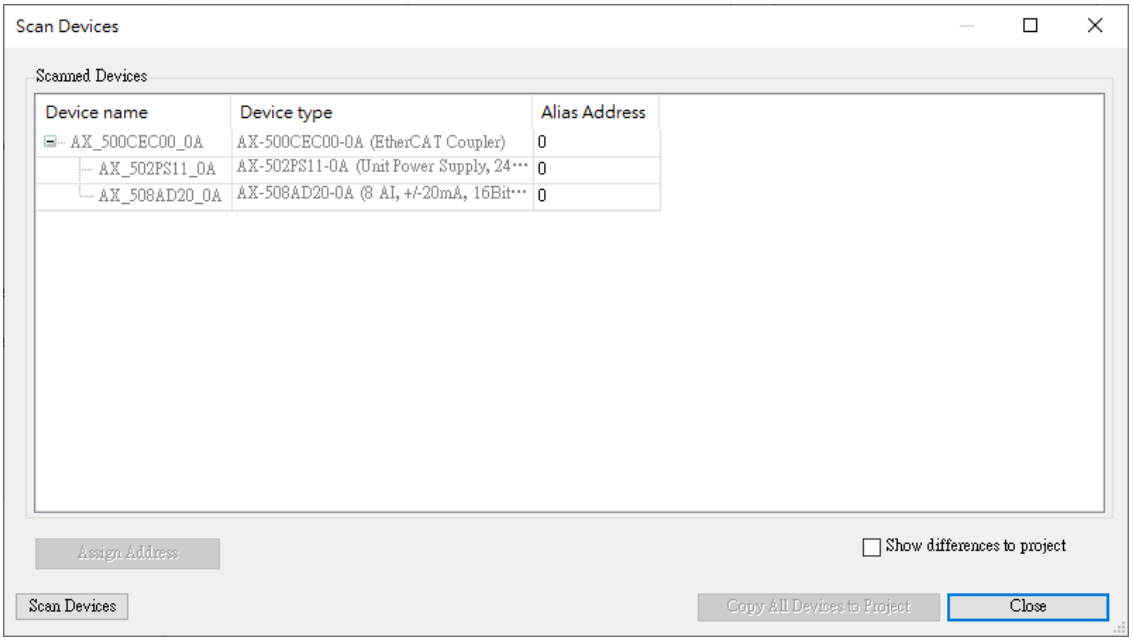


- Method 2: Scan to add the modules in.

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Scan for Devices…**.



After the auto-scan is over, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.

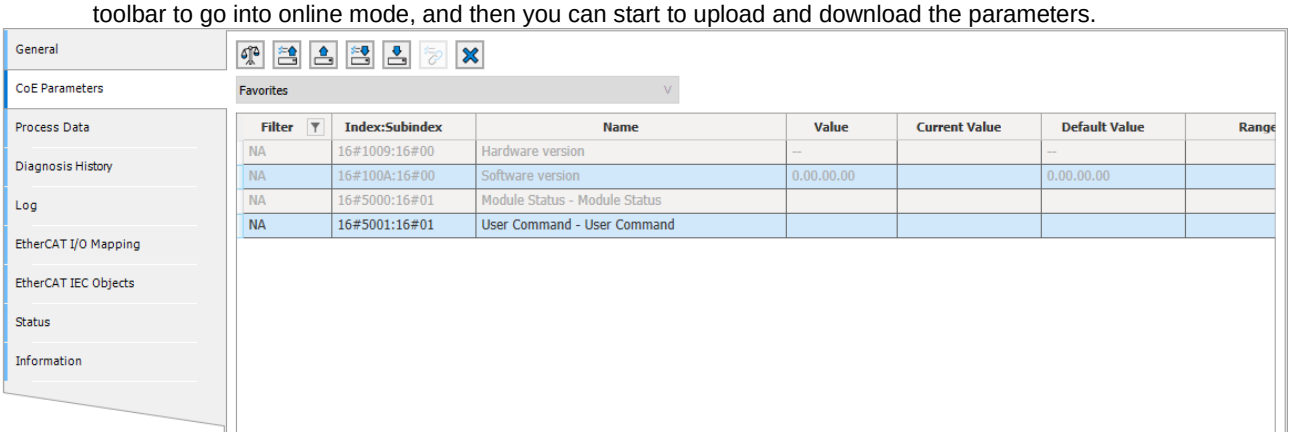


5.4.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.

(1) Favorites

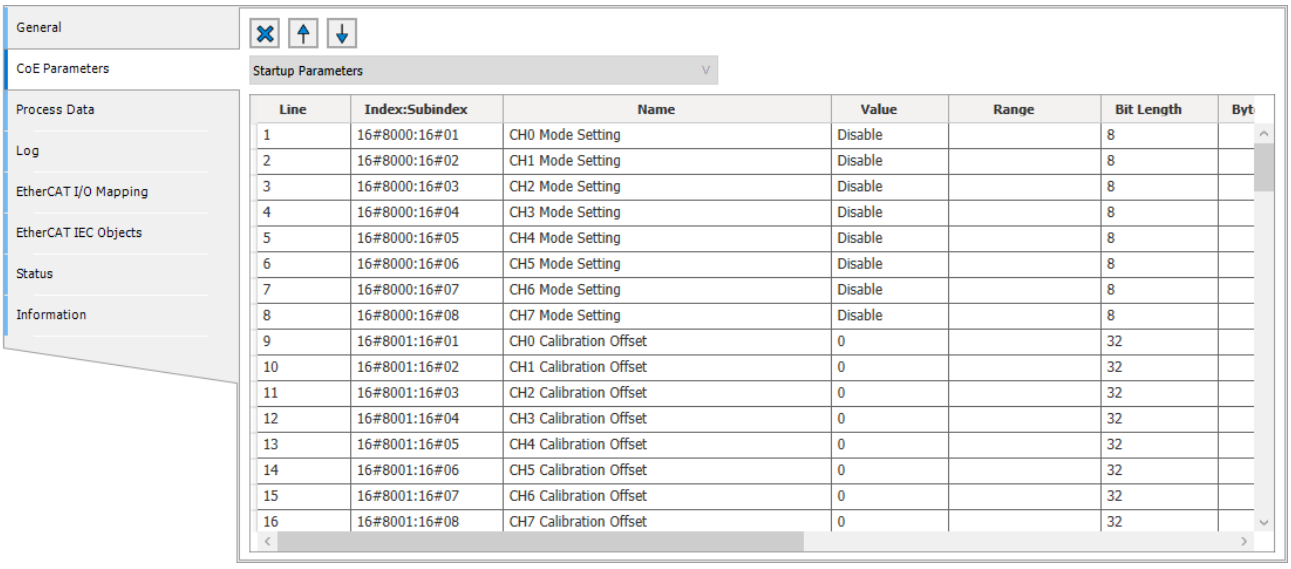
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

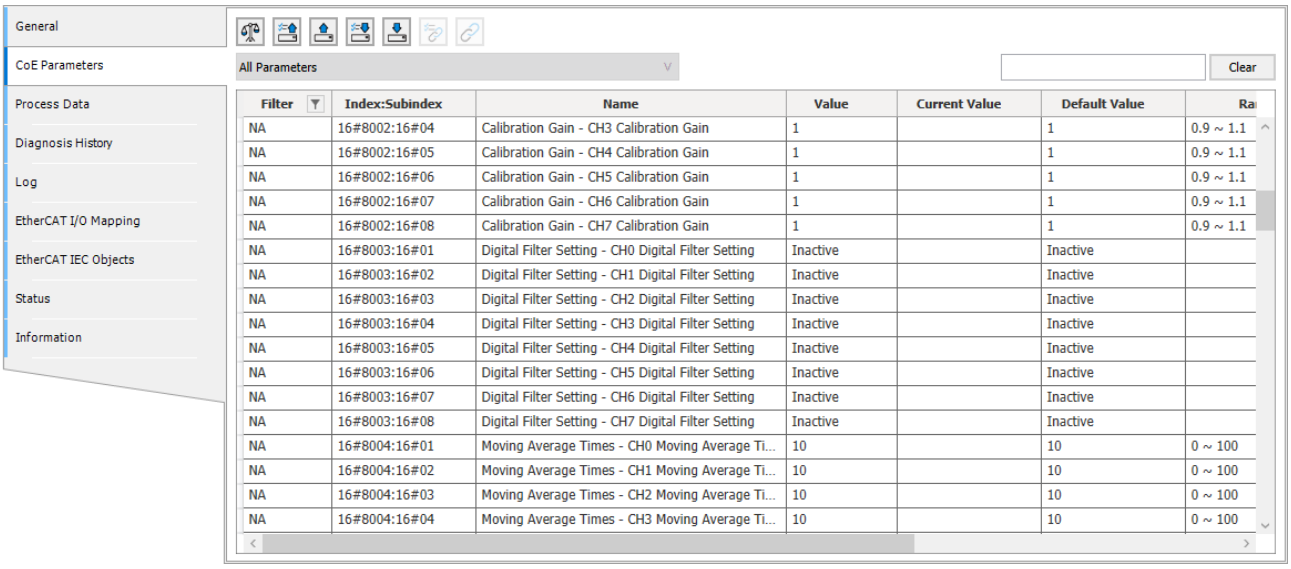


Line	Index:Subindex	Name	Value	Range	Bit Length	Byt
1	16#8000:16#01	CH0 Mode Setting	Disable		8	
2	16#8000:16#02	CH1 Mode Setting	Disable		8	
3	16#8000:16#03	CH2 Mode Setting	Disable		8	
4	16#8000:16#04	CH3 Mode Setting	Disable		8	
5	16#8000:16#05	CH4 Mode Setting	Disable		8	
6	16#8000:16#06	CH5 Mode Setting	Disable		8	
7	16#8000:16#07	CH6 Mode Setting	Disable		8	
8	16#8000:16#08	CH7 Mode Setting	Disable		8	
9	16#8001:16#01	CH0 Calibration Offset	0		32	
10	16#8001:16#02	CH1 Calibration Offset	0		32	
11	16#8001:16#03	CH2 Calibration Offset	0		32	
12	16#8001:16#04	CH3 Calibration Offset	0		32	
13	16#8001:16#05	CH4 Calibration Offset	0		32	
14	16#8001:16#06	CH5 Calibration Offset	0		32	
15	16#8001:16#07	CH6 Calibration Offset	0		32	
16	16#8001:16#08	CH7 Calibration Offset	0		32	

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

(3) All Parameters

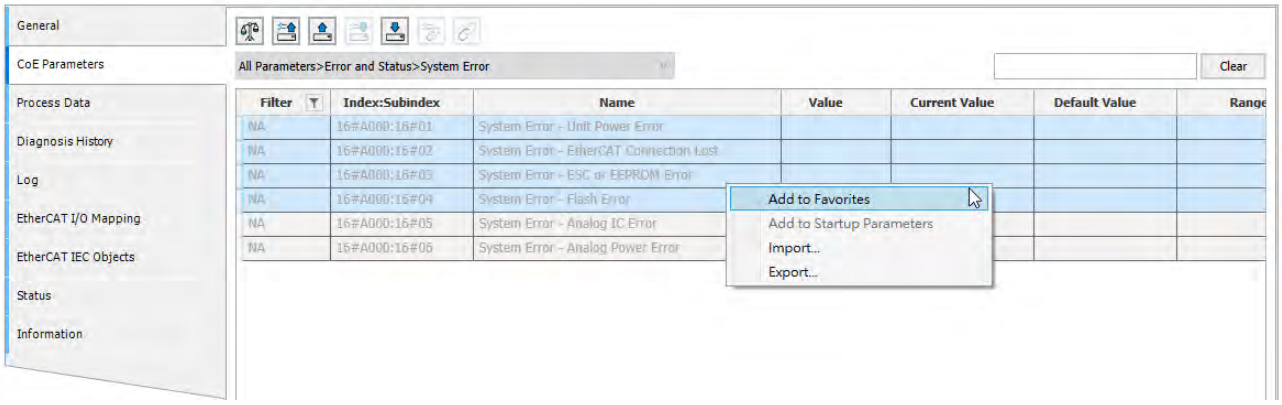
- You can find all the CoE parameters here. Click  on the toolbar to go into online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Filter	Index:Subindex	Name	Value	Current Value	Default Value	Ra
NA	16#8002:16#04	Calibration Gain - CH3 Calibration Gain	1		1	0.9 ~ 1.1
NA	16#8002:16#05	Calibration Gain - CH4 Calibration Gain	1		1	0.9 ~ 1.1
NA	16#8002:16#06	Calibration Gain - CH5 Calibration Gain	1		1	0.9 ~ 1.1
NA	16#8002:16#07	Calibration Gain - CH6 Calibration Gain	1		1	0.9 ~ 1.1
NA	16#8002:16#08	Calibration Gain - CH7 Calibration Gain	1		1	0.9 ~ 1.1
NA	16#8003:16#01	Digital Filter Setting - CH0 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#02	Digital Filter Setting - CH1 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#03	Digital Filter Setting - CH2 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#04	Digital Filter Setting - CH3 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#05	Digital Filter Setting - CH4 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#06	Digital Filter Setting - CH5 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#07	Digital Filter Setting - CH6 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#08	Digital Filter Setting - CH7 Digital Filter Setting	Inactive		Inactive	
NA	16#8004:16#01	Moving Average Times - CH0 Moving Average Ti...	10		10	0 ~ 100
NA	16#8004:16#02	Moving Average Times - CH1 Moving Average Ti...	10		10	0 ~ 100
NA	16#8004:16#03	Moving Average Times - CH2 Moving Average Ti...	10		10	0 ~ 100
NA	16#8004:16#04	Moving Average Times - CH3 Moving Average Ti...	10		10	0 ~ 100

Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

- You can select and right-click the parameter to add the selected parameter to the Favorites.

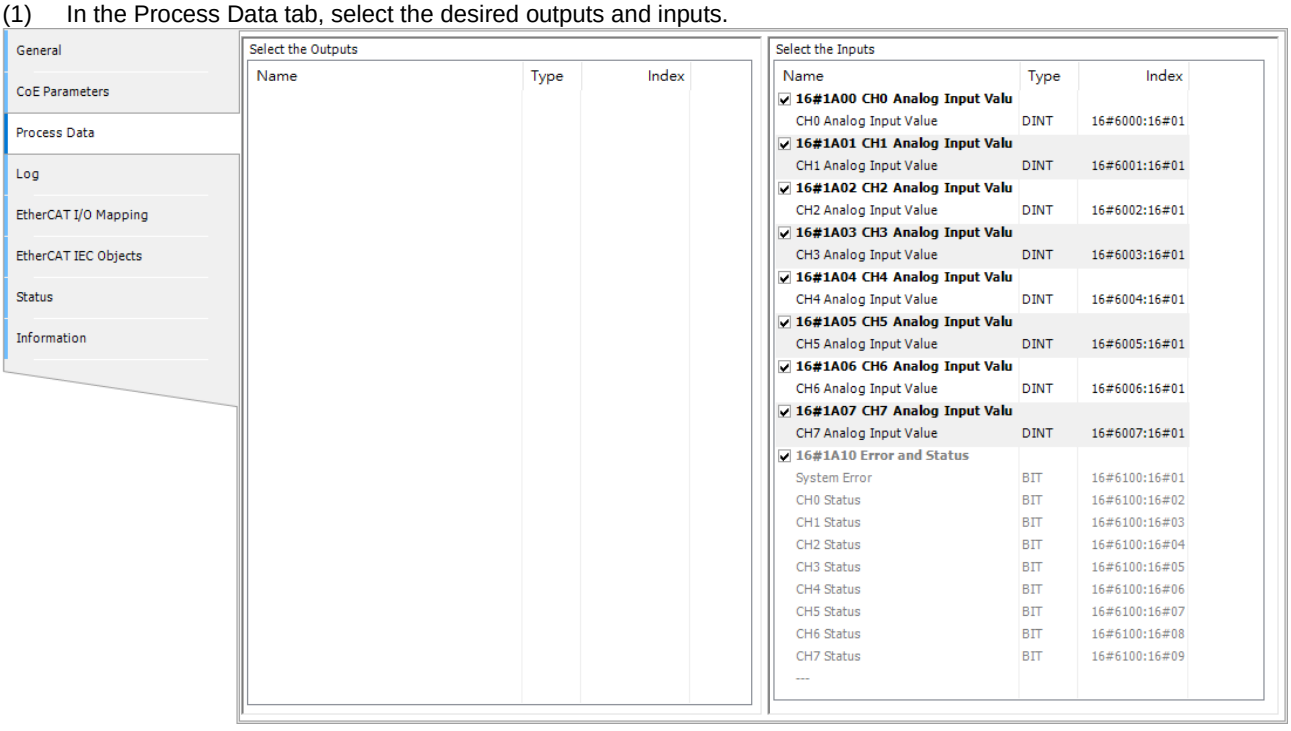


Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

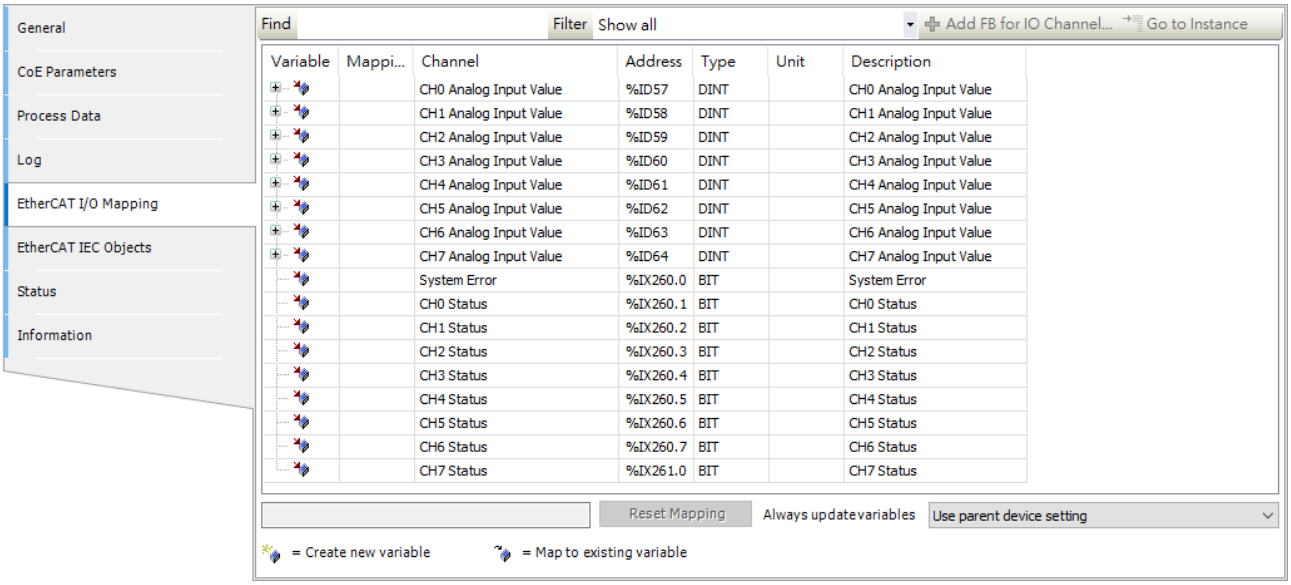
5.4.4.3 Process Data

5

(1) In the Process Data tab, select the desired outputs and inputs.

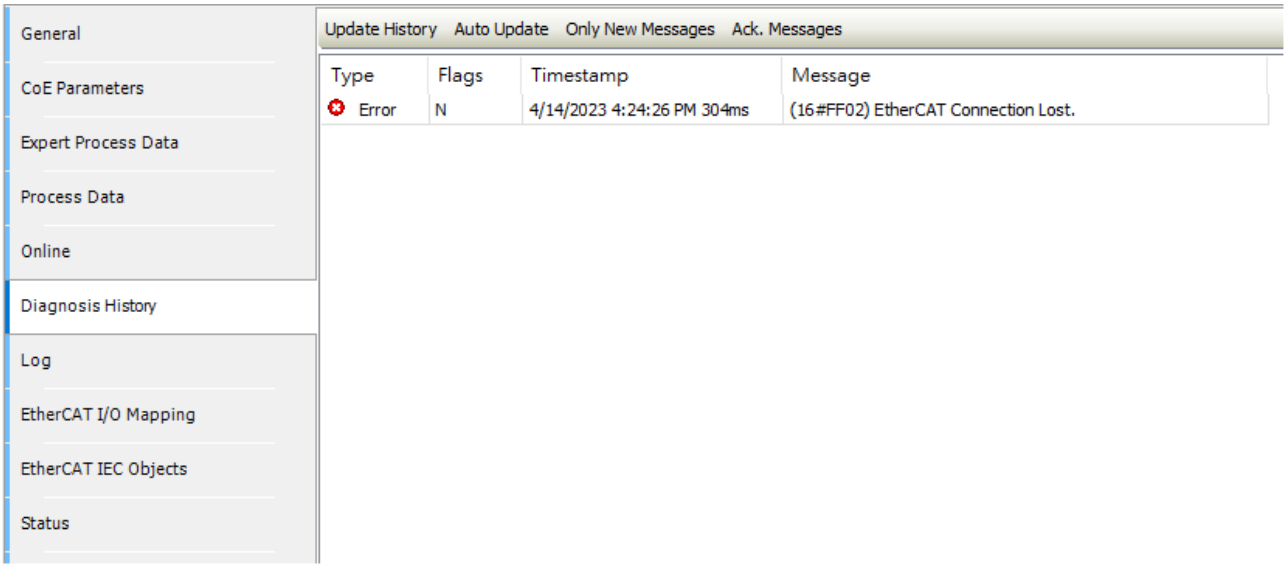


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



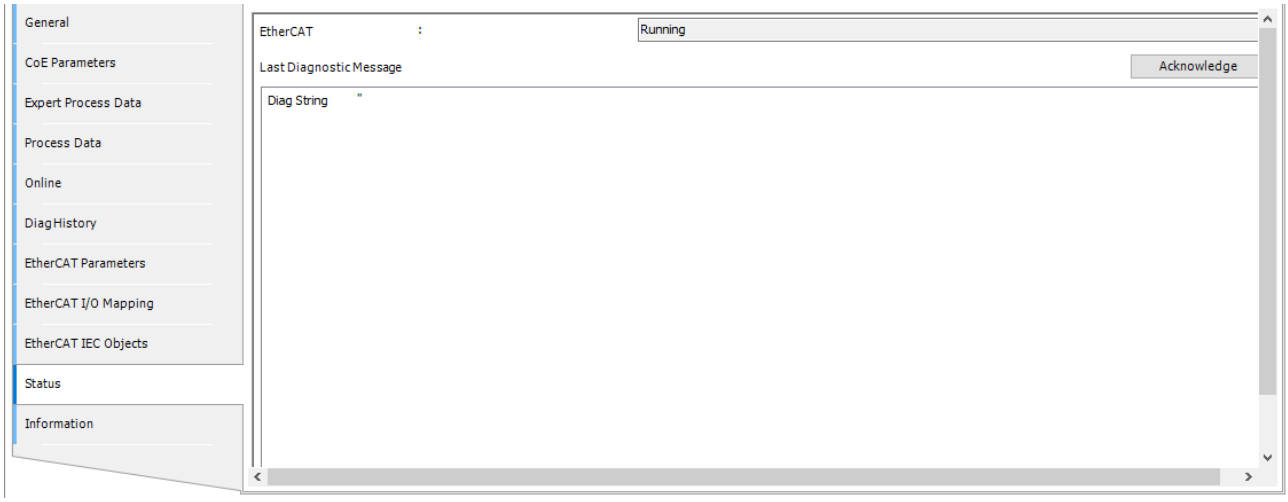
5.4.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors



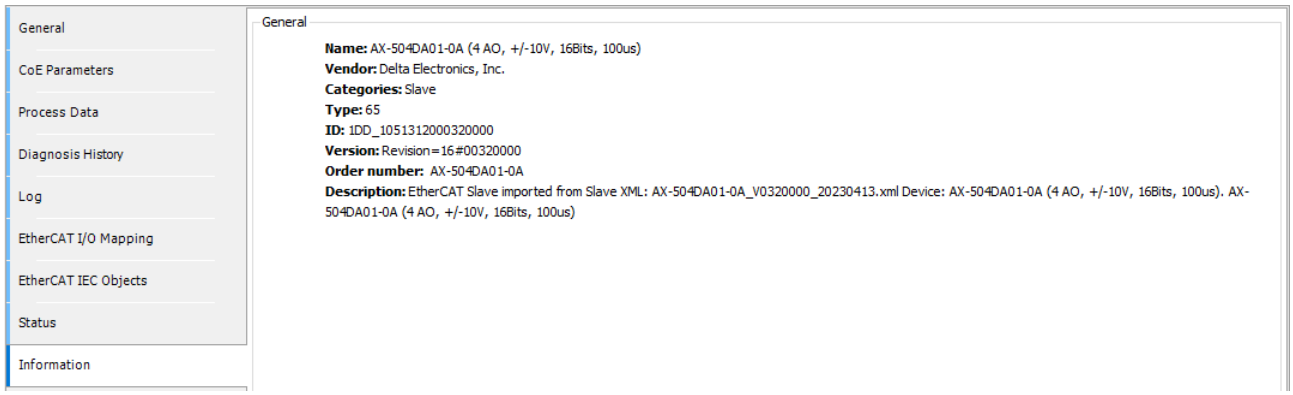
5.4.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



5.4.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.32.01.00	0.32.01.00	0.00.00.00

5.4.5 Parameter Descriptions

You can use DIADesigner-AX to set up the functions for the module by directly selecting the setting mode and parameters. For software operation, refer to section 5.4.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Mode Setting	Mode setting or the channel is OFF.	DFB_AD_RD_ModeSetting DFB_AD_WR_ModeSetting
16#8001	Calibration Offset	Calibration - offset	DFB_AD_RD_CalOffset DFB_AD_WR_CalOffset
16#8002	Calibration Gain	Calibration - gain	DFB_AD_RD_CalGain DFB_AD_WR_CalGain
16#8003	Digital Filter Setting	Digital filter setting	DFB_AD_RD_FilterSetting DFB_AD_WR_FilterSetting
16#8004	Moving Average Times	Moving average times	DFB_AD_RD_AverageTimes DFB_AD_WR_AverageTimes
16#8005	Enable User Limit Alarm DINT	Enable / disable the alarm of exceeding the user defined limit (DINT)	
16#8006	User Upper Limit DINT	User defined upper limit (DINT)	
16#8007	User Lower Limit DINT	User defined lower limit (DINT)	
16#8008	Exceed Hardware Limit Setting	Hardware limit setting	
16#8010	Format	Data format setting	
16#8015	Enable User Limit Alarm REAL	Enable / disable the alarm of exceeding the user defined limit (floating-point)	
16#8016	User Upper Limit REAL	User defined upper limit (floating-point)	
16#8017	User Lower Limit REAL	User defined lower limit (floating-point)	
16#8030	Scale Upper Limit REAL	Scale upper limit setting (floating-point)	DFB_AD_RD_ScaleUpperLimit DFB_AD_WR_ScaleUpperLimit
16#8031	Scale Lower Limit REAL	Scale lower limit setting (floating-point)	DFB_AD_RD_ScaleLowerLimit DFB_AD_WR_ScaleLowerLimit
16#8100	ADC Raw Data	Raw data	

5.4.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Explanation**

When the AX5 series PLC is used as the controller, the module status is synchronized with the status of AX5 series PLC CPU and it will be either 1 (Run) or 2 (Stop). When the status of AX5 series PLC CPU is Stop, the output modules will act according to the parameter settings. As for the input modules, they are not affected. If you use other PLC (NOT AX5 Series PLC) as the controller, the module status will be 0, which indicates it is controlled by EtherCAT State Machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

5.4.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Explanation**

Users write a command value into the module and the module will execute the command accordingly. After execution, the module will respond with a corresponding value to show if the execution is success or not.

- **User command**

Command value	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

5.4.5.3 Mode Setting

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Mode Setting	Current mode setting	USINT	RW	0
	16#02	CH1 Mode Setting		USINT	RW	0
	16#03	CH2 Mode Setting		USINT	RW	0
	16#04	CH3 Mode Setting		USINT	RW	0
	16#05	CH4 Mode Setting		USINT	RW	0
	16#06	CH5 Mode Setting		USINT	RW	0
	16#07	CH6 Mode Setting		USINT	RW	0
	16#08	CH7 Mode Setting		USINT	RW	0

- **Explanation**

Select the mode to set the channel to ON. The conversion time is 200 μs / 8 channels.

- **Supported modes**

Mode	Mode range	DINT range
0	Disable	
1	-20 mA–20 mA	±30000
2	0 mA–20 mA	0–30000
3	4 mA–20 mA	±30000

5.4.5.4 Calibration

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Calibration Offset	Offset Setting range: no limit	REAL	RW	0
	16#02	CH1 Calibration Offset		REAL	RW	0
	16#03	CH2 Calibration Offset		REAL	RW	0
	16#04	CH3 Calibration Offset		REAL	RW	0
	16#05	CH4 Calibration Offset		REAL	RW	0
	16#06	CH5 Calibration Offset		REAL	RW	0
	16#07	CH6 Calibration Offset		REAL	RW	0
	16#08	CH7 Calibration Offset		REAL	RW	0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9–1.1	REAL	RW	1.0
	16#02	CH1 Calibration Gain		REAL	RW	1.0
	16#03	CH2 Calibration Gain		REAL	RW	1.0
	16#04	CH3 Calibration Gain		REAL	RW	1.0
	16#05	CH4 Calibration Gain		REAL	RW	1.0
	16#06	CH5 Calibration Gain		REAL	RW	1.0
	16#07	CH6 Calibration Gain		REAL	RW	1.0
	16#08	CH7 Calibration Gain		REAL	RW	1.0

- **Explanation**

When there is an obvious difference between input values and actual values, you can change Offset and Gain to correct the input curve. The formula is

$$Output = (Input \times Gain) + Offset$$

Example

The mode of channels is -20.0 mA to +20.0 mA. Gain is 1 and Offset is 0 by default, and the corresponding value is -20.0 mA to +20.0 mA. If you change the gain to 0.9 and the offset to 3, the value after calibration is -15 mA V to +21.0 mA.

5.4.5.5 Digital Filter

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Digital Filter Setting	Digital filter setting	USINT	RW	0
	16#02	CH1 Digital Filter Setting		USINT	RW	0
	16#03	CH2 Digital Filter Setting		USINT	RW	0
	16#04	CH3 Digital Filter Setting		USINT	RW	0
	16#05	CH4 Digital Filter Setting		USINT	RW	0
	16#06	CH5 Digital Filter Setting		USINT	RW	0
	16#07	CH6 Digital Filter Setting		USINT	RW	0
	16#08	CH7 Digital Filter Setting		USINT	RW	0
16#8004	16#01	CH0 Moving Average Times	Moving average times Setting range: 1–100 times	USINT	RW	0
	16#02	CH1 Moving Average Times		USINT	RW	0
	16#03	CH2 Moving Average Times		USINT	RW	0
	16#04	CH3 Moving Average Times		USINT	RW	0
	16#05	CH4 Moving Average Times		USINT	RW	0
	16#06	CH5 Moving Average Times		USINT	RW	0
	16#07	CH6 Moving Average Times		USINT	RW	0
	16#08	CH7 Moving Average Times		USINT	RW	0

- **Explanation**

The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The filters can work only when the EtherCAT operation mode is the Free Run mode. The conversion time for FIR filter and IIR filter is 350 μs / 8 channels.

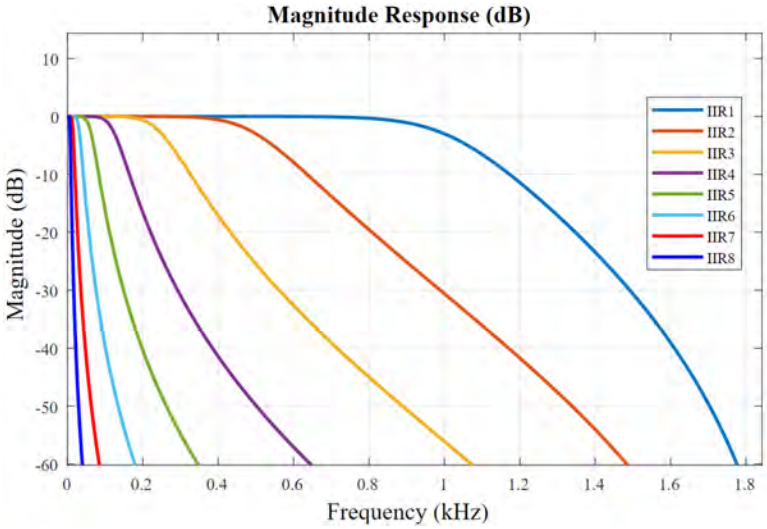
Moving Average Filter

A moving average filter uses the latest pieces of sampled data to create a series of averages to smooth the data. Though compared to other types of digital filters, a moving average filter is fast in computation and algorithm, the filtering result is not as effective as an IIR filter or a FIR filter.

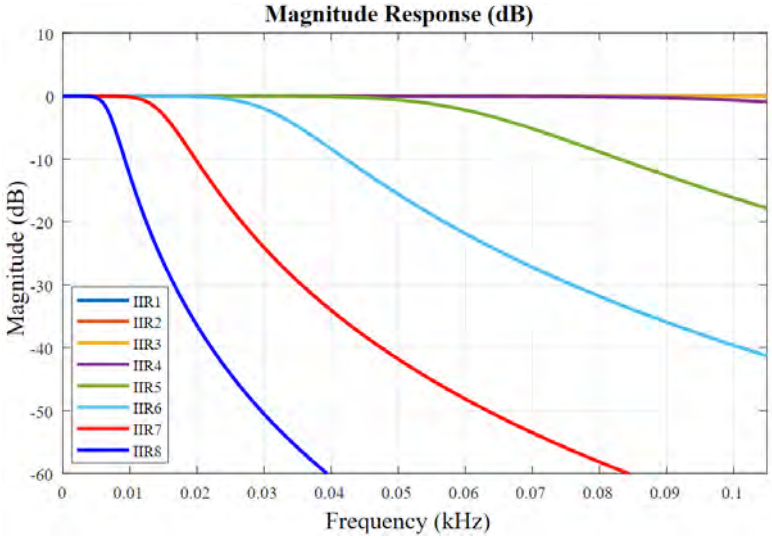
IIR (Infinite Impulse Response) Filter

An infinite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises,

an IIR filter works more efficiently than a moving average filter does. This IIR filter is a low-pass filter. The advantage of an IIR filter is that within the same length of operation time, the filtering result of an IIR filter is better than what a FIR filter can offer. Since an IIR filter can only have a non-linear phase response, it has an inconsistent output delay at every frequency, the input signals may be distorted and the stability issue may be raised. An IIR filter may be not suitable for applications such as oscilloscope waveform and electrocardiography that require demanding waveforms.



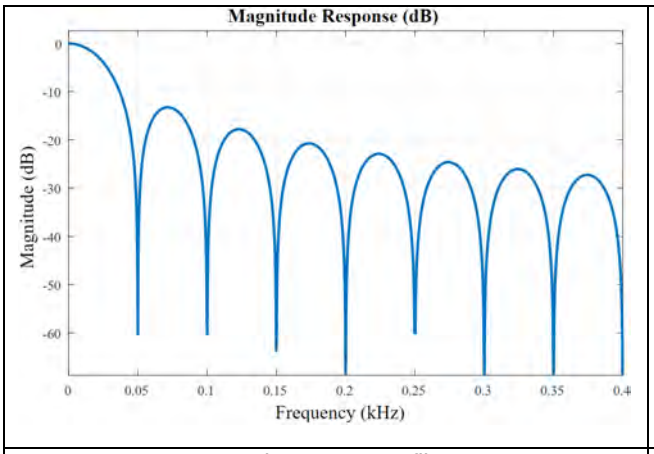
Frequency response of IIR filter



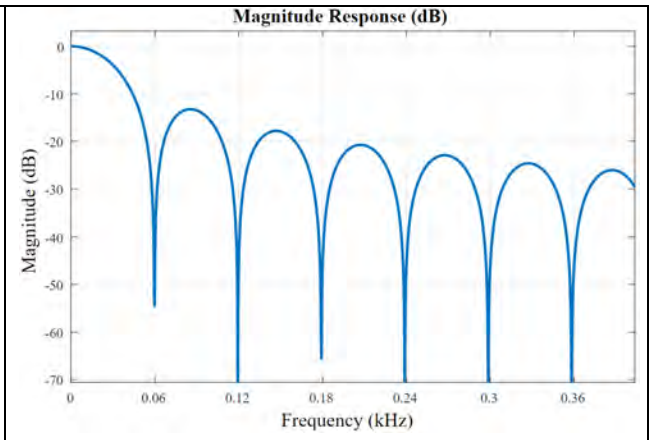
Frequency response of IIR filter (enlarged figure)

FIR (Finite impulse response) Filter

A finite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, a FIR filter works more efficiently than a moving average filter does. This FIR filter is a low-pass filter; it works tremendously well for attenuation of 50/60 Hz signals (> 40 dB). The advantage of a FIR filter is that it has a linear phase response which means a FIR filter has a consistent output delay at all frequencies while an IIR filter has an unequal delay at different frequencies. A FIR filter is ideal for a wide range of applications. However within the same length of operation time, the filtering result of a FIR filter is not as good as what an IIR filter can deliver.



50 Hz low-pass FIR filter



60 Hz low-pass FIR filter

- **Digital filter modes**

Mode	Name of digital filter	Cut-off frequency (-3 dB)
0	Inactive	
1	Moving Average	Works with Moving Average Time
2	IIR1	1000 Hz
3	IIR2	500 Hz
4	IIR3	250 Hz
5	IIR4	125 Hz
6	IIR5	63 Hz
7	IIR6	32 Hz
8	IIR7	15 Hz
9	IIR8	7 Hz
10	FIR 50Hz	22 Hz (attenuation: multiples of 50 Hz: > 40dB)
11	FIR 60Hz	26 Hz (attenuation: multiples of 60 Hz: > 40dB)

5.4.5.6 User Limit Alarm

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8005	16#01	CH0 Enable User Limit Alarm DINT	Enable / disable the alarm of exceeding the user-defined limit (DINT) 0: Disable (default) 1: Enable	BOOL	RW	0
	16#02	CH1 Enable User Limit Alarm DINT		BOOL	RW	0
	16#03	CH2 Enable User Limit Alarm DINT		BOOL	RW	0
	16#04	CH3 Enable User Limit Alarm DINT		BOOL	RW	0
	16#05	CH4 Enable User Limit Alarm DINT		BOOL	RW	0
	16#06	CH5 Enable User Limit Alarm DINT		BOOL	RW	0
	16#07	CH6 Enable User Limit Alarm DINT		BOOL	RW	0
	16#08	CH7 Enable User Limit Alarm DINT		BOOL	RW	0
16#8006	16#01	CH0 User Upper Limit DINT	User-defined upper limit (DINT); Setting range: no limit	DINT	RW	30000
	16#02	CH1 User Upper Limit DINT		DINT	RW	30000
	16#03	CH2 User Upper Limit DINT		DINT	RW	30000
	16#04	CH3 User Upper Limit DINT		DINT	RW	30000
	16#05	CH4 User Upper Limit DINT		DINT	RW	30000
	16#06	CH5 User Upper Limit DINT		DINT	RW	30000
	16#07	CH6 User Upper Limit DINT		DINT	RW	30000
	16#08	CH7 User Upper Limit DINT		DINT	RW	30000
16#8007	16#01	CH0 User Lower Limit DINT	User-defined upper limit (DINT); Setting range: no limit	DINT	RW	-30000
	16#02	CH1 User Lower Limit DINT		DINT	RW	-30000
	16#03	CH2 User Lower Limit DINT		DINT	RW	-30000
	16#04	CH3 User Lower Limit DINT		DINT	RW	-30000
	16#05	CH4 User Lower Limit DINT		DINT	RW	-30000
	16#06	CH5 User Lower Limit DINT		DINT	RW	-30000
	16#07	CH6 User Lower Limit DINT		DINT	RW	-30000
	16#08	CH7 User Lower Limit DINT		DINT	RW	-30000
16#8015	16#01	CH0 Enable User Limit Alarm REAL	Enable / disable the alarm of exceeding the user-defined limit (floating-point); 0: Disable(default) 1: Enable	BOOL	RW	0
	16#02	CH1 Enable User Limit Alarm REAL		BOOL	RW	0
	16#03	CH2 Enable User Limit Alarm REAL		BOOL	RW	0
	16#04	CH3 Enable User Limit Alarm REAL		BOOL	RW	0
	16#05	CH4 Enable User Limit Alarm REAL		BOOL	RW	0
	16#06	CH5 Enable User Limit Alarm REAL		BOOL	RW	0
	16#07	CH6 Enable User Limit Alarm REAL		BOOL	RW	0
	16#08	CH7 Enable User Limit Alarm REAL		BOOL	RW	0
16#8016	16#01	CH0 User Upper Limit REAL	User-defined upper limit (floating-point); Setting range: no limit	REAL	RW	10.0
	16#02	CH1 User Upper Limit REAL		REAL	RW	10.0
	16#03	CH2 User Upper Limit REAL		REAL	RW	10.0

Index	Subindex	Name	Description	Data Type	Attr.	Default
	16#04	CH3 User Upper Limit REAL		REAL	RW	10.0
	16#05	CH0 User Upper Limit REAL		REAL	RW	10.0
	16#06	CH1 User Upper Limit REAL		REAL	RW	10.0
	16#07	CH2 User Upper Limit REAL		REAL	RW	10.0
	16#08	CH3 User Upper Limit REAL		REAL	RW	10.0
16#8017	16#01	CH0 User Lower Limit For REAL	User-defined lower limit (floating-point); Setting range: no limit	REAL	RW	-10.0
	16#02	CH1 User Lower Limit For REAL		REAL	RW	-10.0
	16#03	CH2 User Lower Limit For REAL		REAL	RW	-10.0
	16#04	CH3 User Lower Limit For REAL		REAL	RW	-10.0
	16#05	CH4 User Lower Limit For REAL		REAL	RW	-10.0
	16#06	CH5 User Lower Limit For REAL		REAL	RW	-10.0
	16#07	CH6 User Lower Limit For REAL		REAL	RW	-10.0
	16#08	CH7 User Lower Limit For REAL		REAL	RW	-10.0

- **Explanation**

Users can define the upper and lower limits and enable the alarm of exceeding the limits. Set the format to DINT or REAL (floating-point).

- **Example**

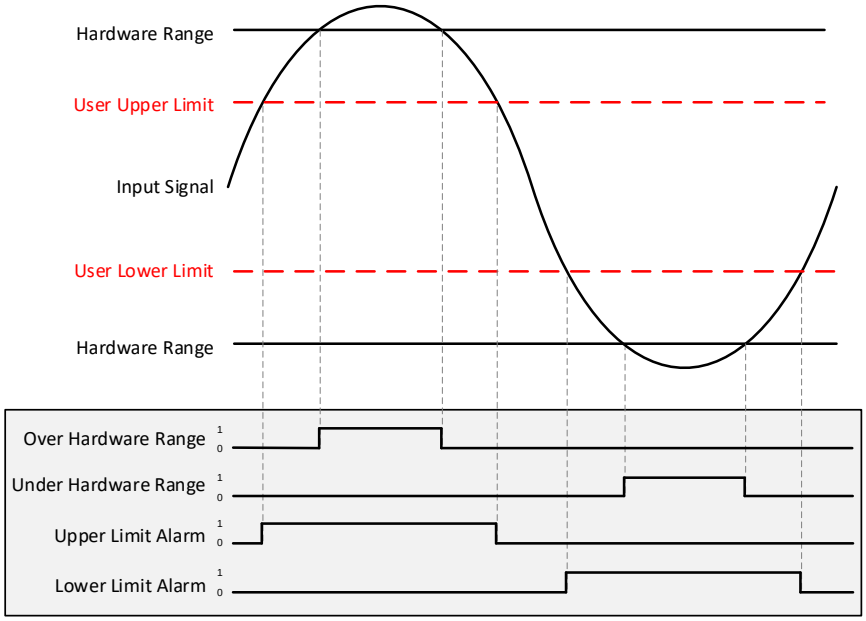
When the format is set to DINT, you can set:

16#8003 Enable User Limit Alarm DINT: Enable

16#8004 User Upper Limit DINT: 28000

16#8005 User Lower Limit DINT: -28000

When the input signal exceeds the user-defined upper or lower limit, an error occurs. See section 5.4.8 for more information on troubleshooting.

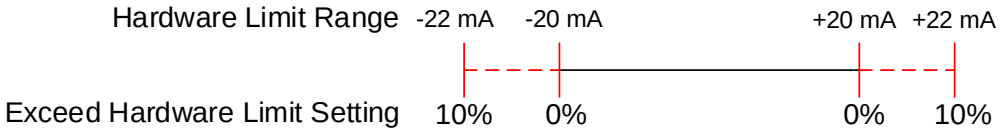


5.4.5.7 Exceed Hardware Limit

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8008	16#01	CH0 Exceed Hardware Limit Setting	Hardware limit setting; Setting range: 0–10 (0%–10%)	USINT	RW	5
	16#02	CH1 Exceed Hardware Limit Setting		USINT	RW	5
	16#03	CH2 Exceed Hardware Limit Setting		USINT	RW	5
	16#04	CH3 Exceed Hardware Limit Setting		USINT	RW	5
	16#05	CH4 Exceed Hardware Limit Setting		USINT	RW	5
	16#06	CH5 Exceed Hardware Limit Setting		USINT	RW	5
	16#07	CH6 Exceed Hardware Limit Setting		USINT	RW	5
	16#08	CH7 Exceed Hardware Limit Setting		USINT	RW	5

- **Explanation**

Users can define the hardware limit range.



- **Example**

When the mode is -20 mA–20 mA, the setting value is 5%. Its hardware limit range is -21 mA – 21mA. When the input signal exceeds the hardware upper or lower limit, an error occurs. See section 5.4.8 for more information on troubleshooting.

5.4.5.8 Format

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8010	16#01	Format	0: DINT Format 1: REAL Format	USINT	RW	0
	16#02	Decimal Places	Setting value: 0–5	USINT	RW	2

- **Explanation**

You can set the format and the decimal places according to your demand.

When the data format is set to DINT Format, set up the DINT parameters which are with “DINT” following a parameter name.

When the data format is set to REAL Format, set up the REAL parameters which are with “REAL” following a parameter name.

5.4.5.9 Scale

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8030	16#01	CH0 Scale Upper Limit REAL	Scale upper limit setting; Setting range: no limit	REAL	RW	10
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	10
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	10
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	10
	16#05	CH4 Scale Upper Limit REAL		REAL	RW	10
	16#06	CH5 Scale Upper Limit REAL		REAL	RW	10
	16#07	CH6 Scale Upper Limit REAL		REAL	RW	10
	16#08	CH7 Scale Upper Limit REAL		REAL	RW	10
16#8031	16#01	CH0 Scale Lower Limit REAL	Scale lower limit setting; Setting range: no limit	REAL	RW	-10
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-10
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-10
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-10
	16#05	CH4 Scale Lower Limit REAL		REAL	RW	-10
	16#06	CH5 Scale Lower Limit REAL		REAL	RW	-10
	16#07	CH6 Scale Lower Limit REAL		REAL	RW	-10
	16#08	CH7 Scale Lower Limit REAL		REAL	RW	-10

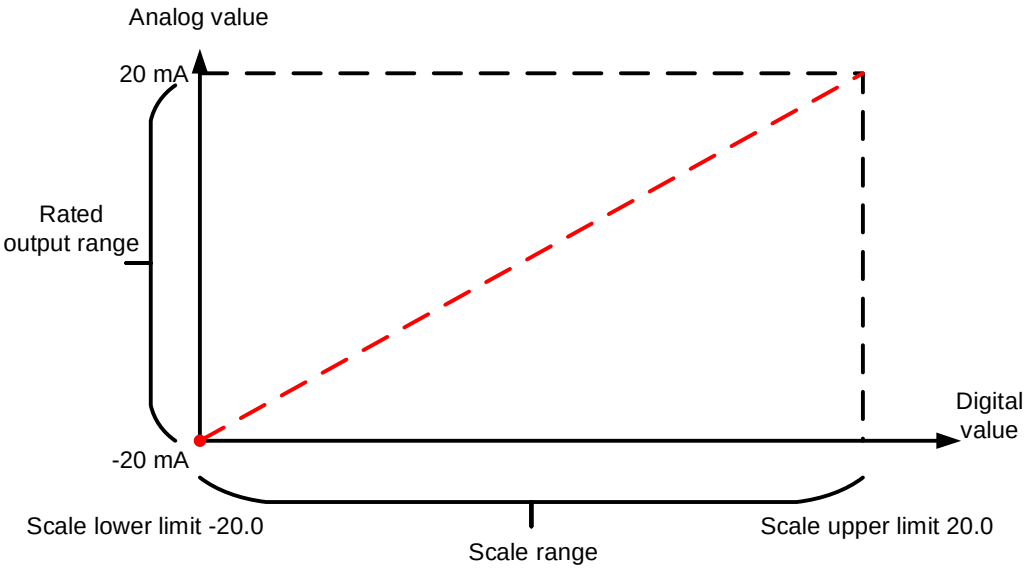
5

- **Explanation**

You can set the scale range based on the analog specification for channels when the data format is REAL (floating-point).

- **Example**

If the channel mode is ±20 mA, the analog range is -20 mA to +20 mA, the scale upper limit is 20.0 and the scale lower limit is -20.0. The digital values -20.0 to +20.0 correspond to the analog values -20 mA to +20 mA, as the example below shows.



5.4.5.10 ADC Raw Data

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8100	16#01	CH0 ADC Raw data	Raw data	DINT	RO	0
	16#02	CH1 ADC Raw data		DINT	RO	0
	16#03	CH2 ADC Raw data		DINT	RO	0
	16#04	CH3 ADC Raw data		DINT	RO	0
	16#05	CH4 ADC Raw data		DINT	RO	0
	16#06	CH5 ADC Raw data		DINT	RO	0
	16#07	CH6 ADC Raw data		DINT	RO	0
	16#08	CH7 ADC Raw data		DINT	RO	0

- **Explanation**

Raw data is the source data that has not been processed or converted from analog to digital.

5.4.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

5.4.6.1 FreeRun Mode

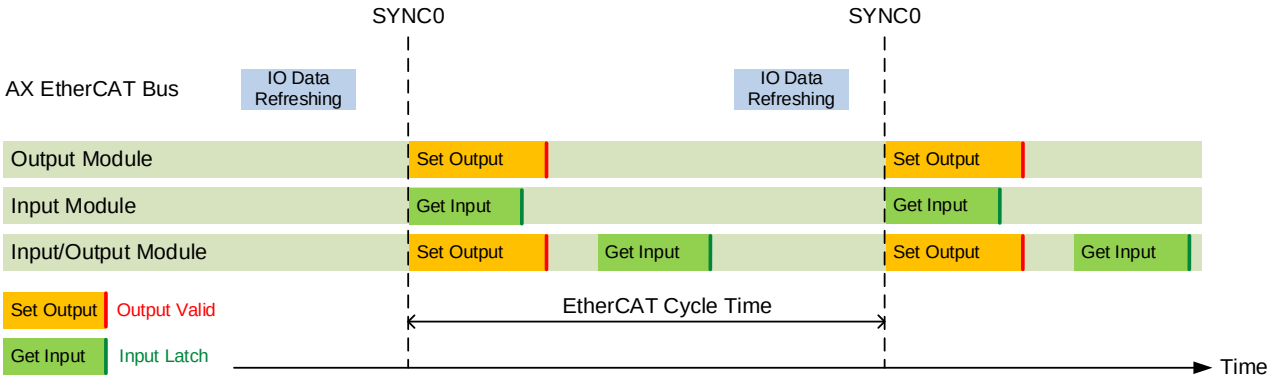
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

5.4.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

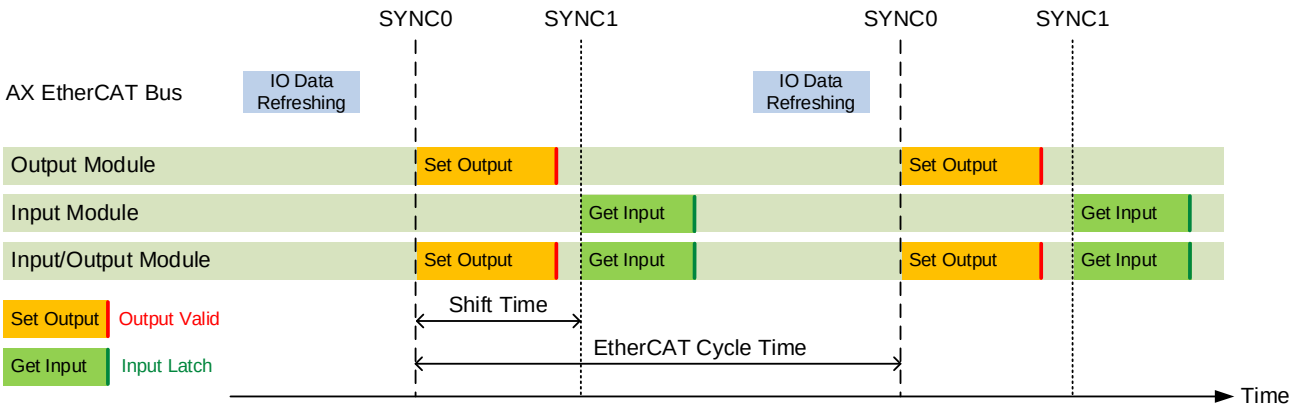
- **SYNC0**

Using the SYNC signal SYNC0 to refresh the values of output channels among modules at the same time.



- **SYNC0 + SYNC1**

Using SYNC0 to refresh values of output channels and using SYNC1 to refresh values of input channels among modules at the same time. The shift time of SYNC0 and SYNC1 can be modified with DIADesigner-AX.



5.4.7 Process Data

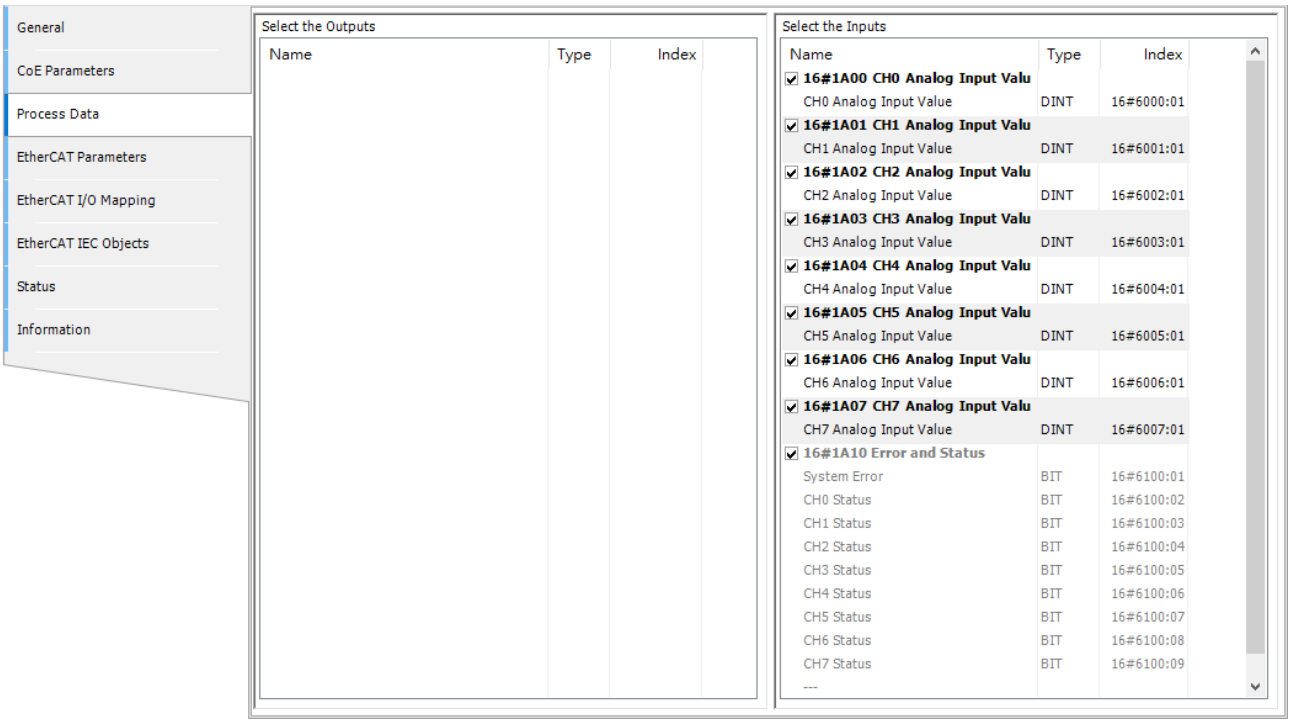
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Analog Input Value	Analog input value; Setting range: -33000–33000	DINT	RO	0
16#6001	16#01	CH1 Analog Input Value		DINT	RO	0
16#6002	16#01	CH2 Analog Input Value		DINT	RO	0
16#6003	16#01	CH3 Analog Input Value		DINT	RO	0
16#6004	16#01	CH4 Analog Input Value		DINT	RO	0
16#6005	16#01	CH5 Analog Input Value		DINT	RO	0
16#6006	16#01	CH6 Analog Input Value		DINT	RO	0
16#6007	16#01	CH7 Analog Input Value		DINT	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0
	16#02	CH0 Status	CH0: error or warning	BOOL	RO	0
	16#03	CH1 Status	CH1: error or warning	BOOL	RO	0
	16#04	CH2 Status	CH2: error or warning	BOOL	RO	0
	16#05	CH3 Status	CH3: error or warning	BOOL	RO	0
	16#06	CH4 Status	CH4: error or warning	BOOL	RO	0
	16#07	CH5 Status	CH5: error or warning	BOOL	RO	0
	16#08	CH6 Status	CH6: error or warning	BOOL	RO	0
	16#09	CH7 Status	CH7: error or warning	BOOL	RO	0

5.4.7.1 Process Data

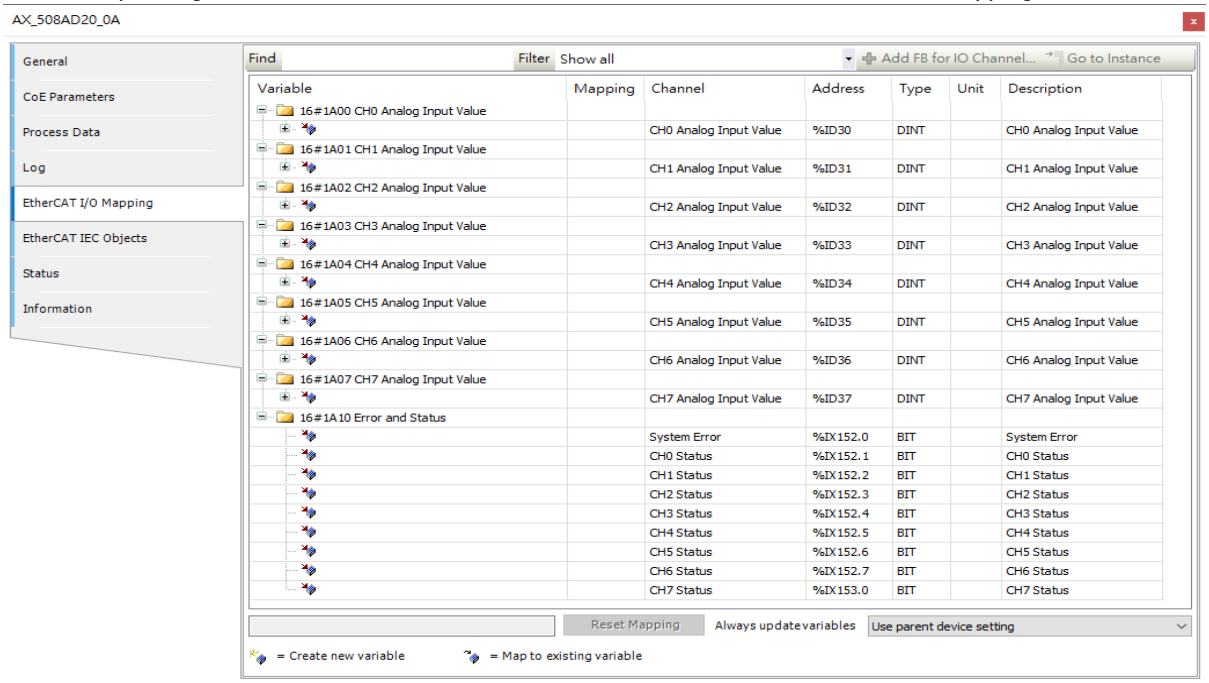
Go to the Process Data tab and select the data that you'd like to monitor.

- Analog Input Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Status: It is selected by default. The grayed out part cannot be modified.



5.4.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



5.4.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

5.4.8 Troubleshooting

In the Diagnosis History tab, the error information that has occurred on the module is recorded. In the Status tab, the current information of system error (16#A000) is displayed. In the CoE Parameters tab, you can view the error status through Index/SubIndex of the All Parameter list.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Connection Lost	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#05	(16#FF05) Analog IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#06	(16#FF06) Analog Power Error	ON	OFF	If the problem persists, contact the local authorized distributors.
16#A00**n**[*1]	16#01	(16#FF11) CH(**n**-1) Upper Limit Alarm	Blinking(1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user upper limit.
	16#02	(16#FF12) CH(**n**-1) Lower Limit Alarm	Blinking(1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user lower limit.
	16#03	(16#FF13) CH(**n**-1) Over Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed hardware range.
	16#04	(16#FF14) CH(**n**-1) Under Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed hardware range.

*1. n = 1–8

5.5 AX-504DA01-0A

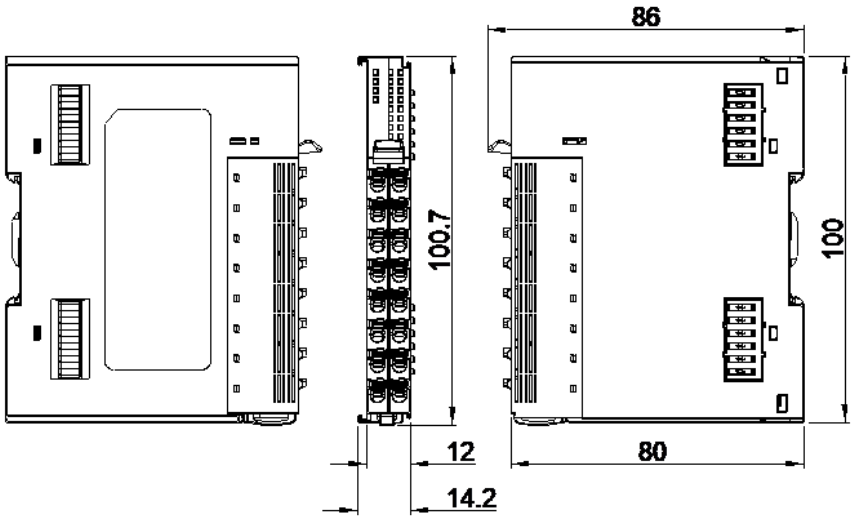
AX-504DA01-0A, an analog output module, receives 4 sets of 16-bit digital data from the PLC and converts the received digital signals into analog voltage signals which are output through 4 output points. This section introduces its specifications, wirings and operations.

5.5.1 Specifications

Item		Specification
Output points		4
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		73 g
Electrical specification	Output range	-10 – +10 V
	Output conversion range	-5 – 105 % (F.S.)
	Load impedance	1 kΩ – 2 MΩ
	Resolution	-10 – +10 V : -30000–30000 -5 – +5 V : -15000–15000
	Accuracy	25 °C: ±0.2 % (F.S.) -20 – 60 °C: ±0.6 % (F.S.)
	Conversion time	100 μs / 4 points
	Isolation method	Between unit power and external power: no isolation Between digital power and analog power: 500 VAC Between digital signal and analog signal: 500 VAC Between analog channels: no isolation
	Maximum power consumption (unit power)	Less than 500 mA (2.5 W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Protection	--
	Short Circuit Protection (SCP)	--
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	--
	Filter function	--

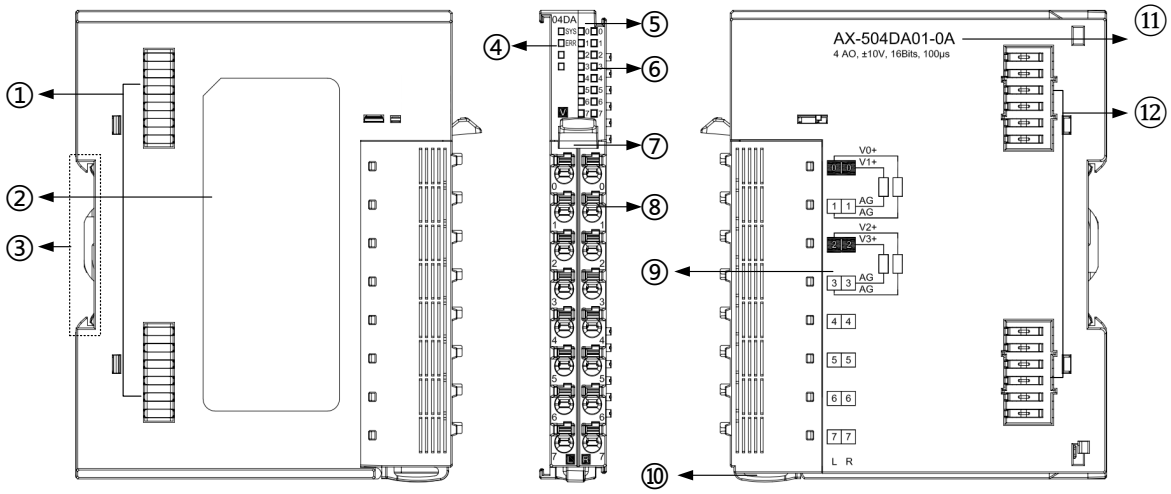
5.5.2 Dimensions and Parts

- **Dimensions**



Unit: mm

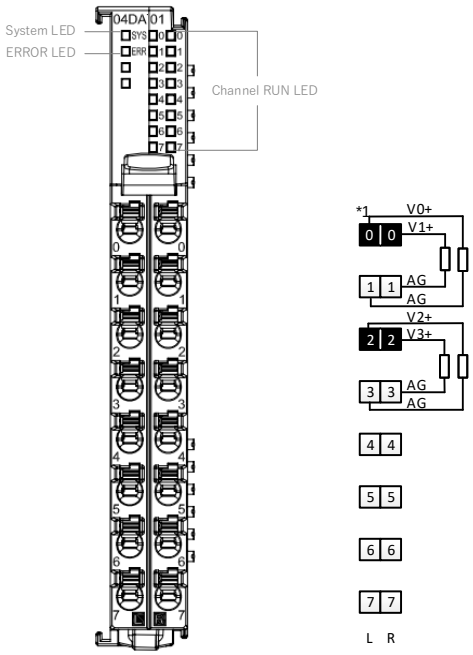
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

5.5.3 Arrangement of Terminals, LED Indicators and Wiring

5.5.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

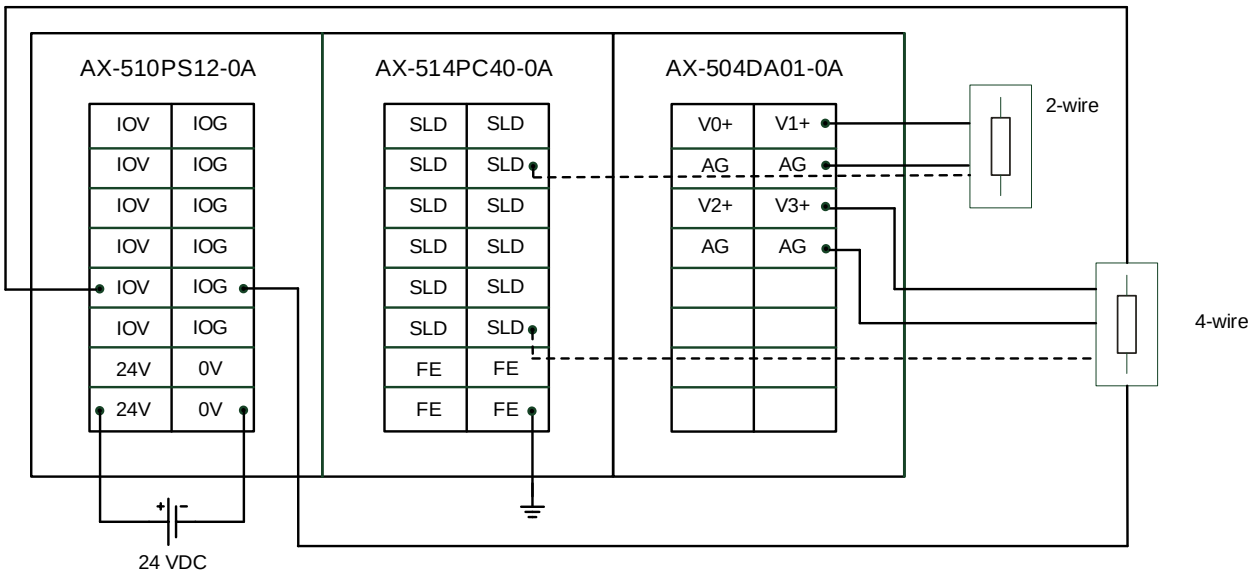
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	V0+	Channel 0: output voltage	R0	V1+	Channel 1: output voltage
L1	AG		R1	AG	
L2	V2+	Channel 2: output voltage	R2	V3+	Channel 3: output voltage
L3	AG		R3	AG	
L4	--	--	R4	--	--
L5	--	--	R5	--	--
L6	--	--	R6	--	--
L7	--	--	R7	--	--

5.5.3.2 LED Indicators

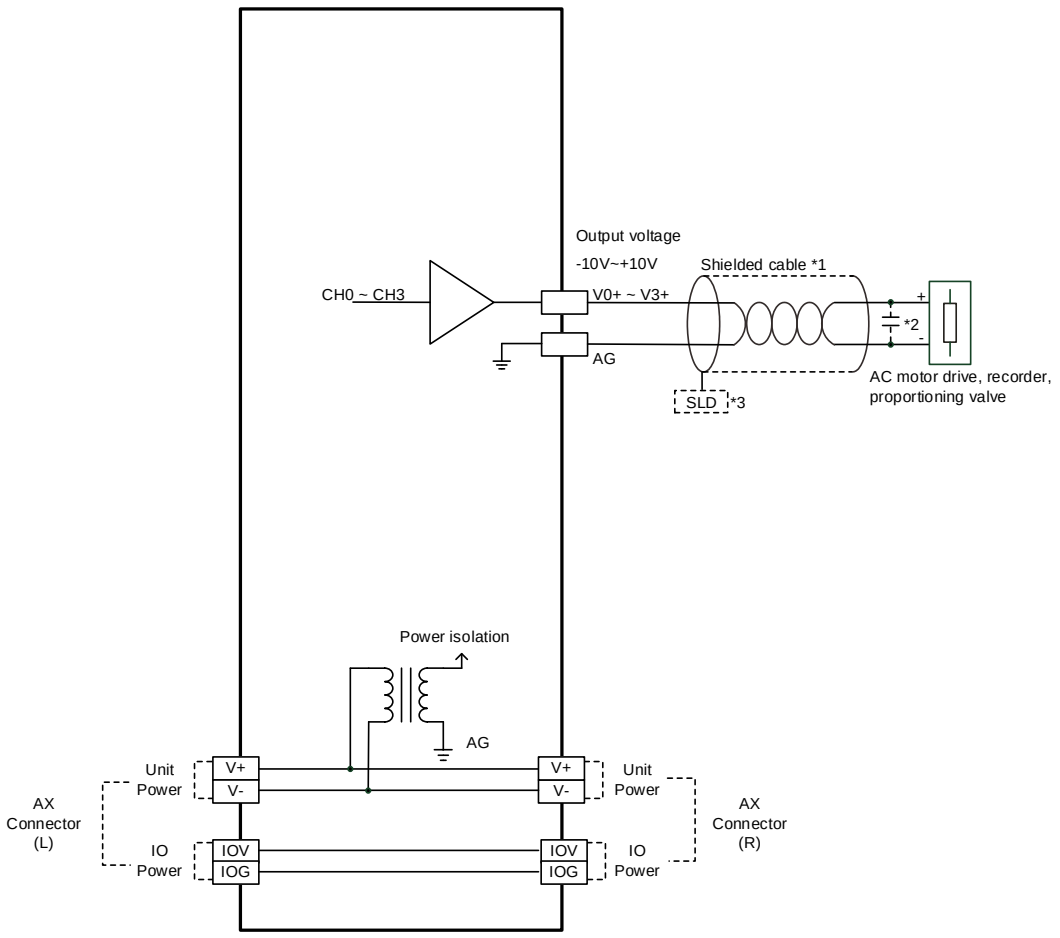
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking (1s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1s)	An error occurs on the application.
			Blinking (0.2s)	An error occurs on the hardware.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

5.5.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



*1. Use shielded cables to isolate the analog input signal cable from other power cables.

*2. If variability in the input voltage results in interference within the wiring, connect the module to a capacitor with a capacitance between 0.1–0.47 μF and a working voltage of 25 V.

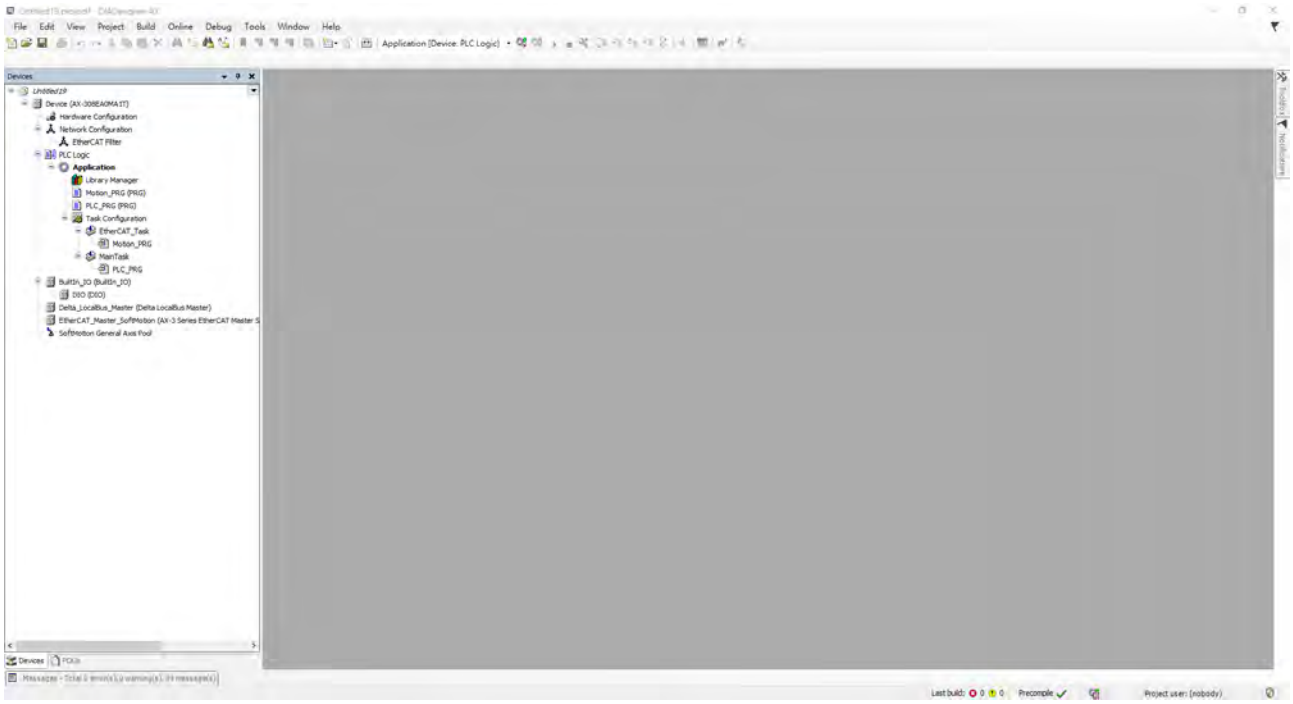
*3. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A.

5.5.4 Settings in DIADesigner-AX

The software DIADesigner-AX is the programming tool for the AX Series PLCs. This section introduces some basic operations and settings.

5.5.4.1 Basic Operation

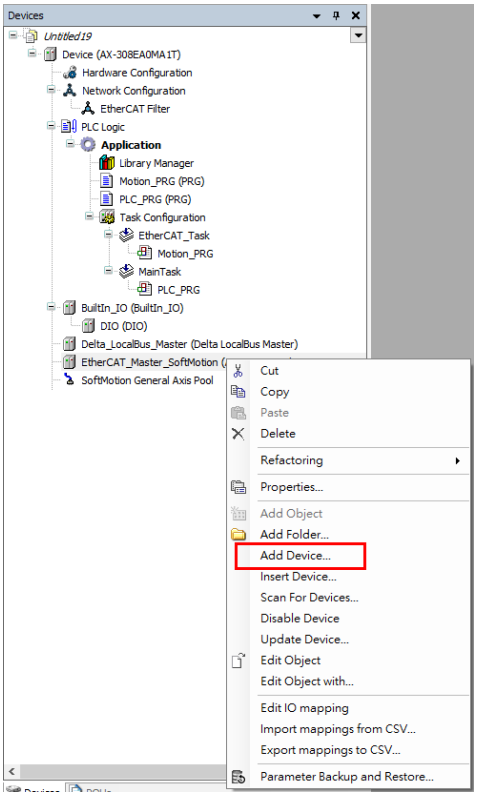
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



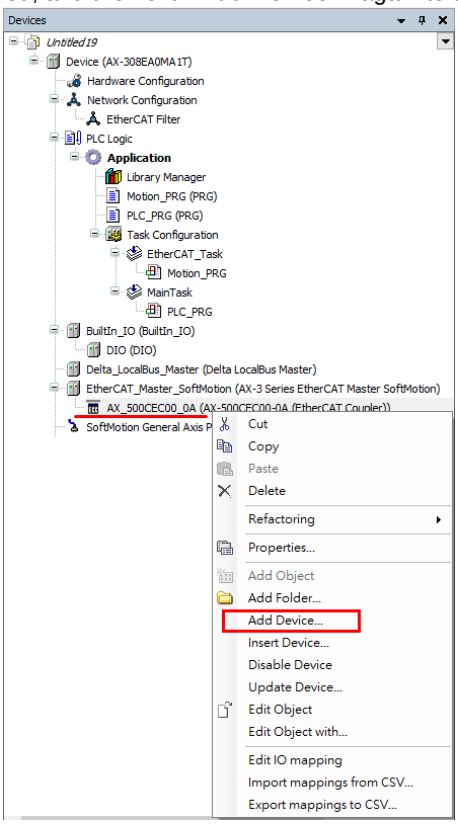
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click EtherCAT Master SoftMotion in the Devices tree, and then click Add Device… to select and add System Coupler.

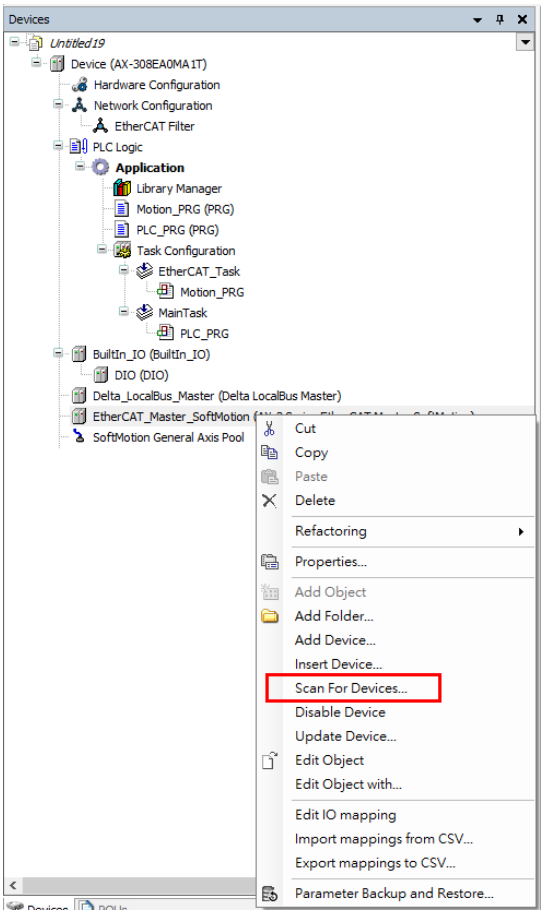


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

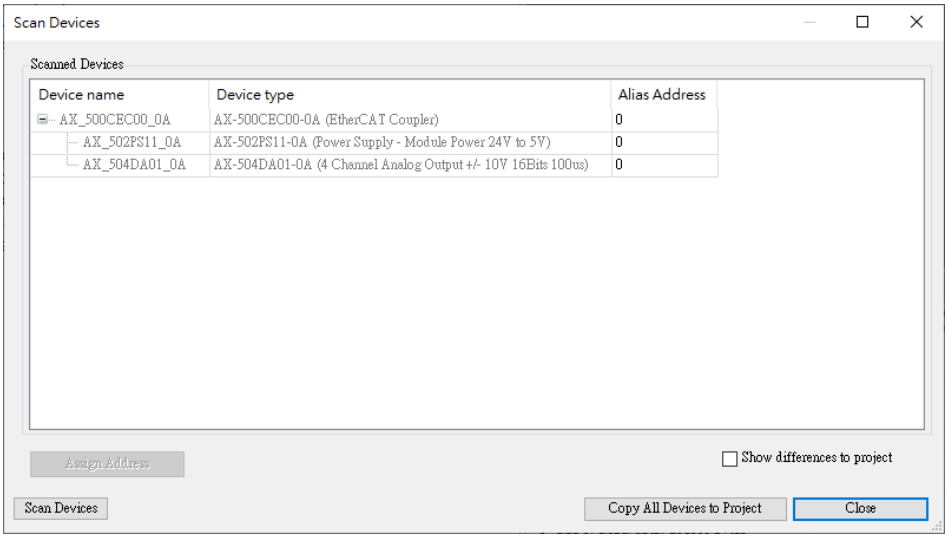


- Method 2: Scan to add the modules in.

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Scan for Devices…**.



After the auto-scan is over, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.

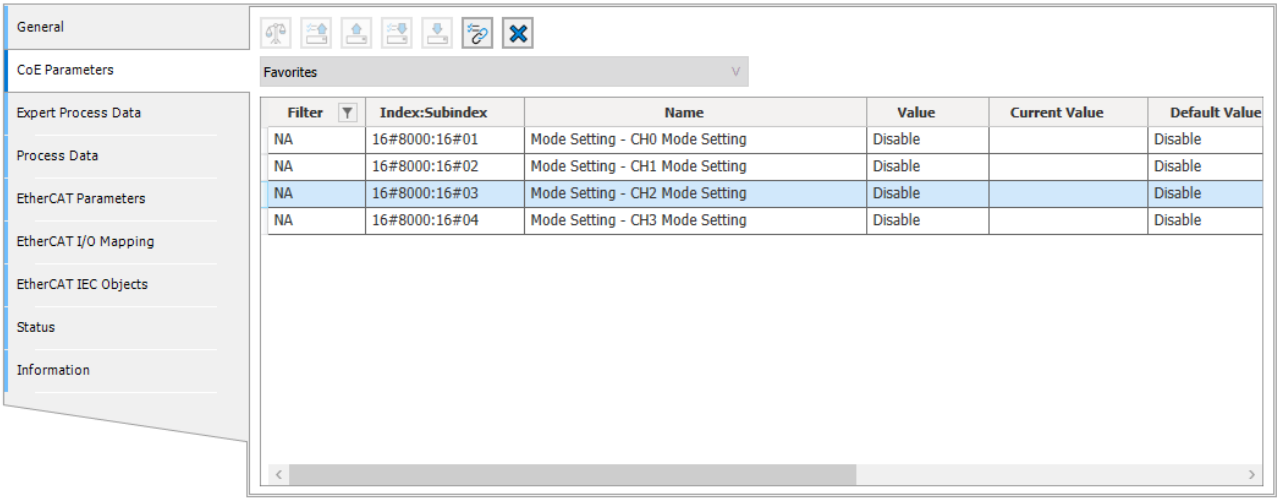


5.5.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.

(1) Favorites

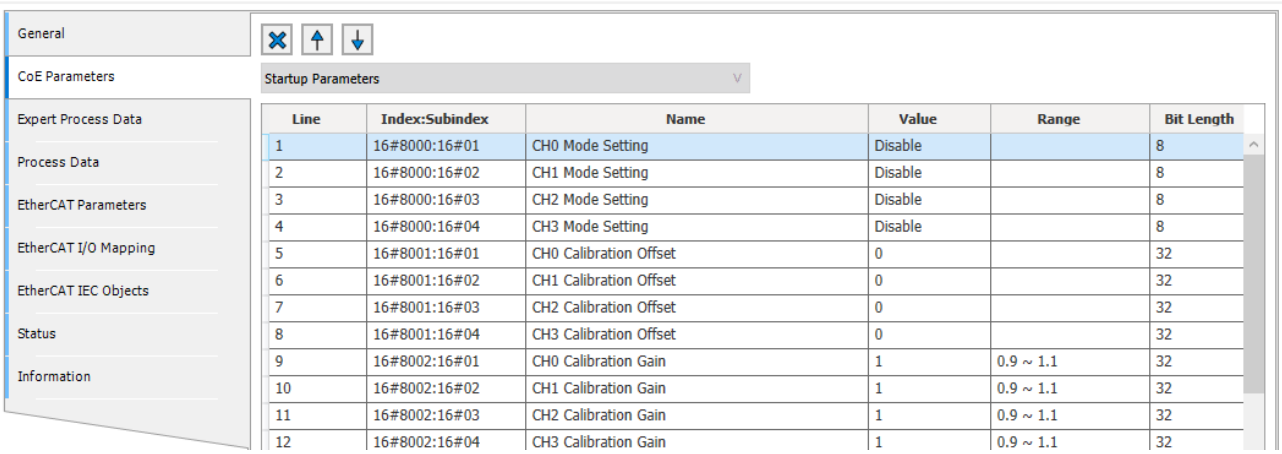
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

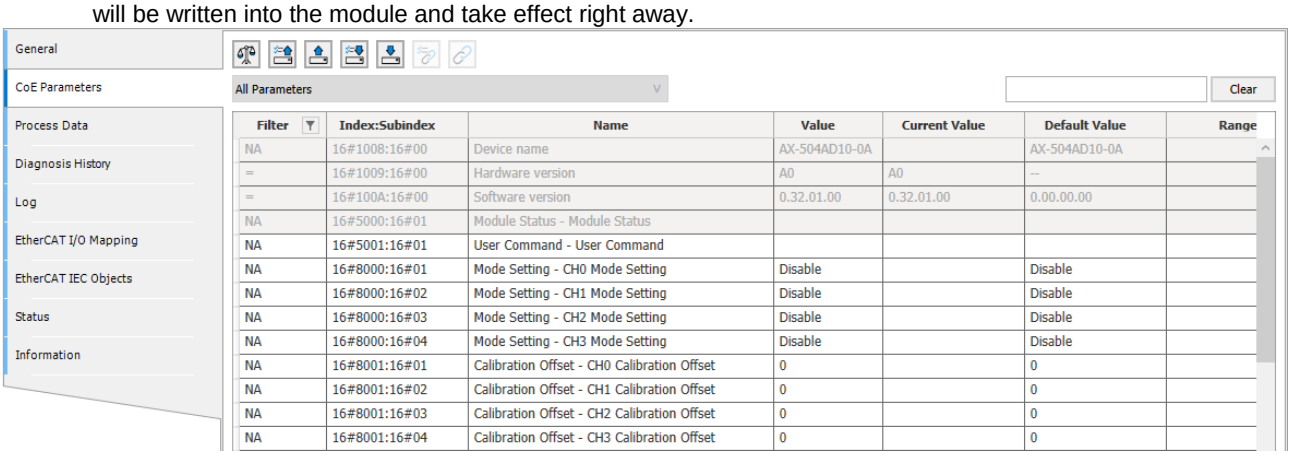


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8000:16#03	CH2 Mode Setting	Disable		8
4	16#8000:16#04	CH3 Mode Setting	Disable		8
5	16#8001:16#01	CH0 Calibration Offset	0		32
6	16#8001:16#02	CH1 Calibration Offset	0		32
7	16#8001:16#03	CH2 Calibration Offset	0		32
8	16#8001:16#04	CH3 Calibration Offset	0		32
9	16#8002:16#01	CH0 Calibration Gain	1	0.9 ~ 1.1	32
10	16#8002:16#02	CH1 Calibration Gain	1	0.9 ~ 1.1	32
11	16#8002:16#03	CH2 Calibration Gain	1	0.9 ~ 1.1	32
12	16#8002:16#04	CH3 Calibration Gain	1	0.9 ~ 1.1	32

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

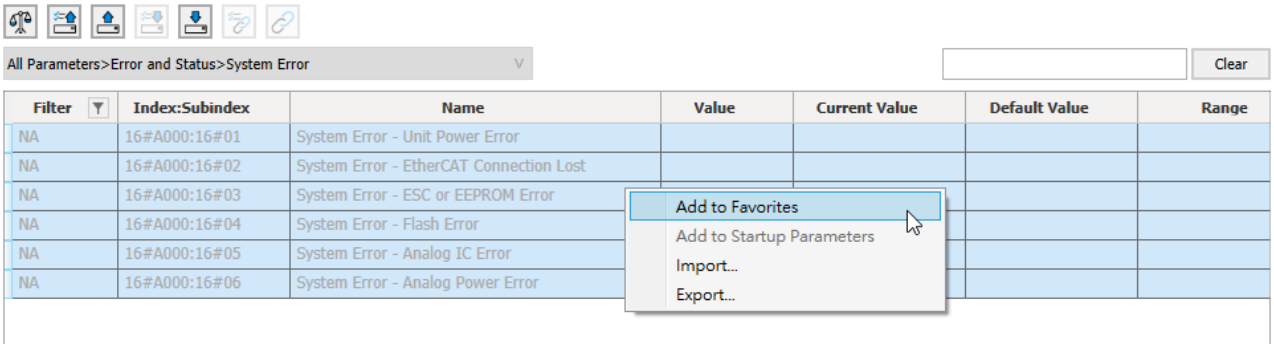
(3) All Parameters

- You can find all the CoE parameters here. Click  on the toolbar to go into online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

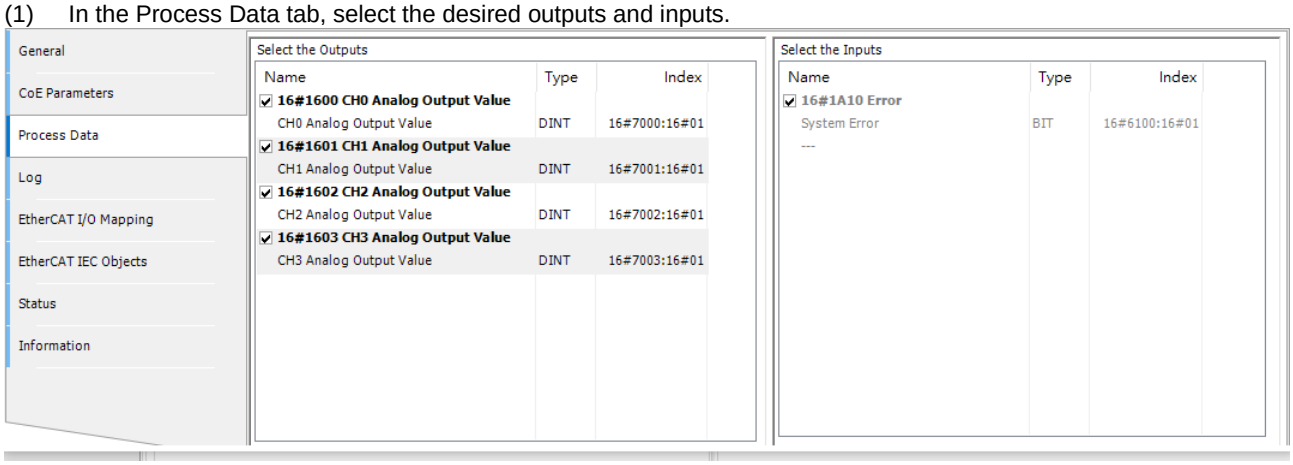
- You can select and right-click the parameter to add the selected parameter to the Favorites.



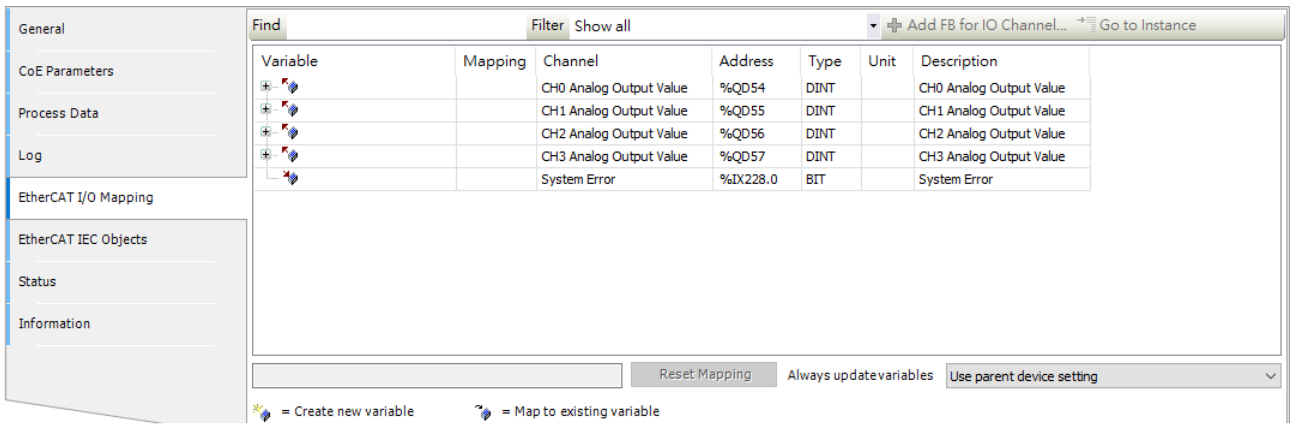
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.5.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

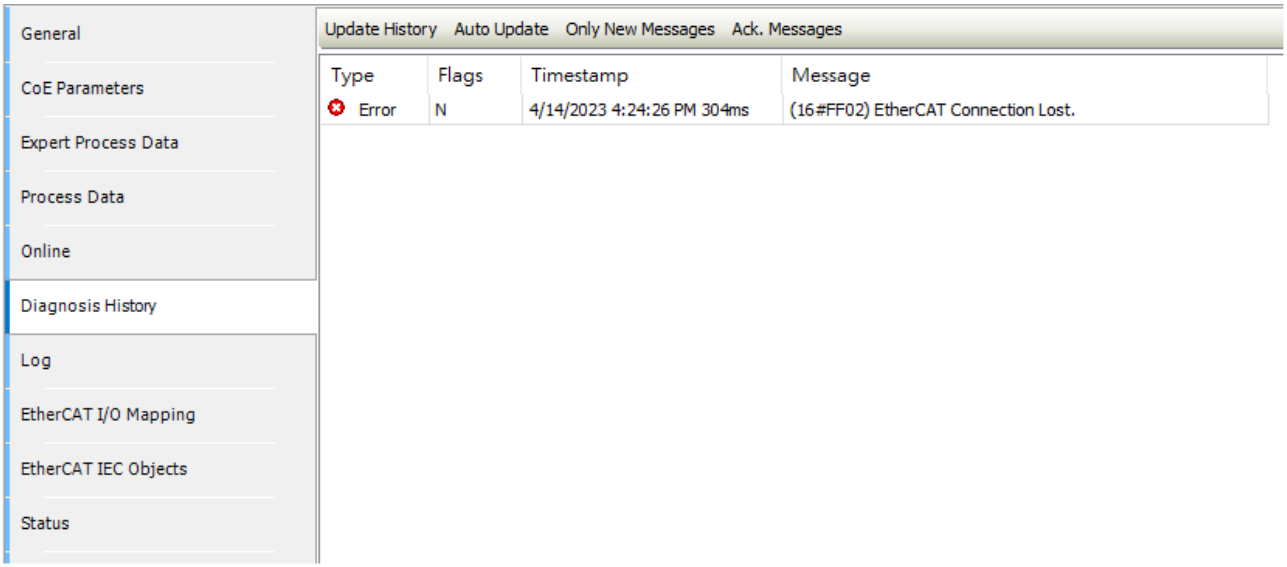


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



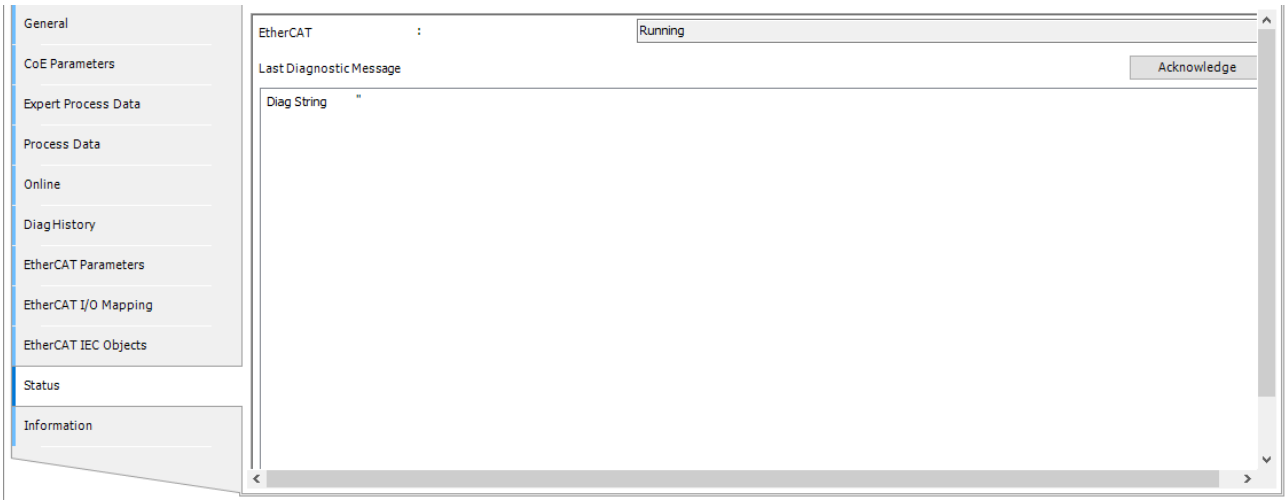
5.5.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors



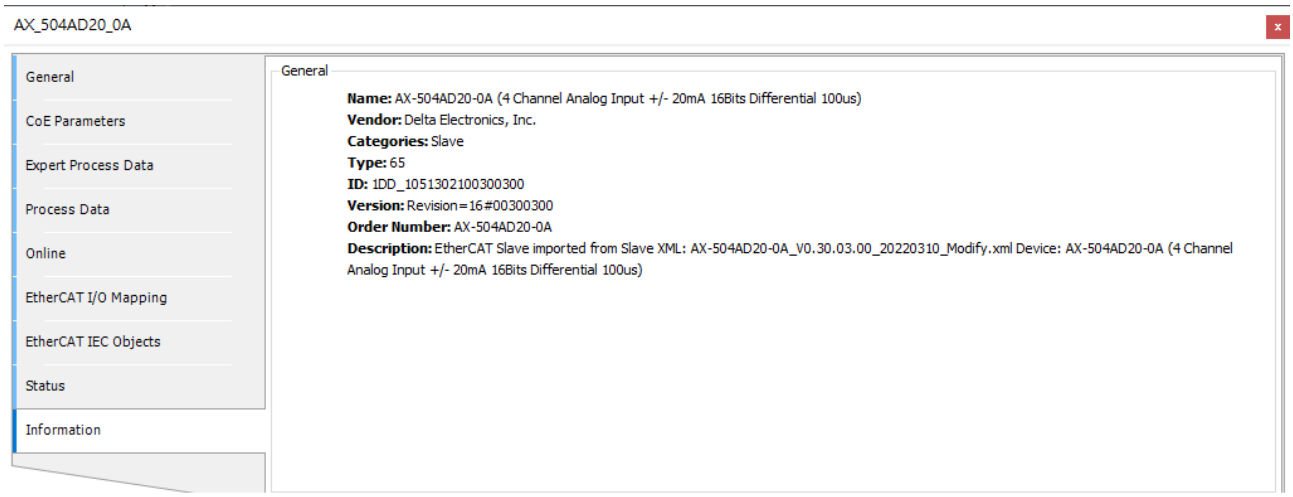
5.5.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.

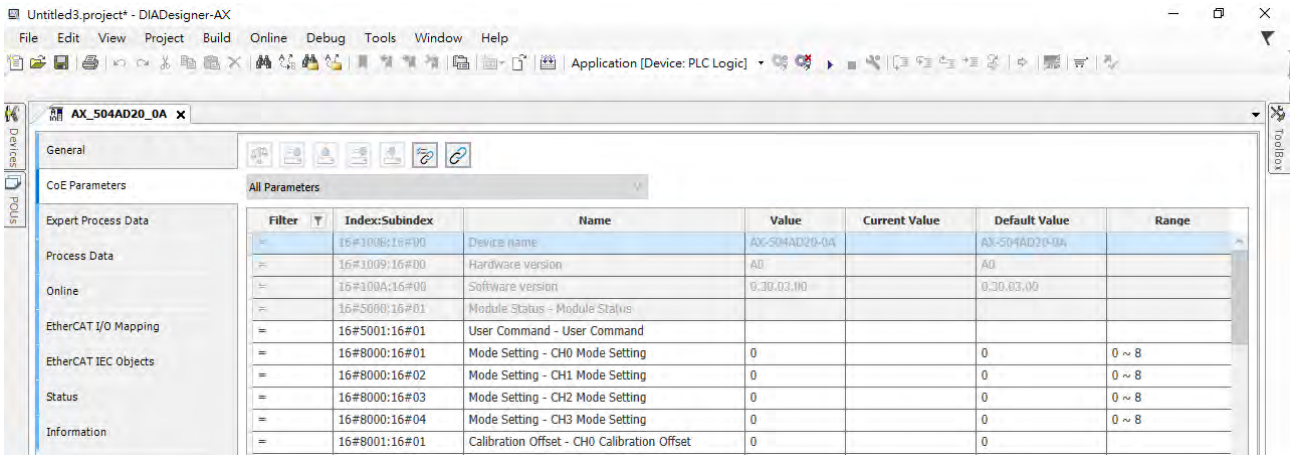


5.5.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version.



5.5.5 Parameter Descriptions

You can use DIADesigner-AX to set up the functions for the module by directly selecting the setting mode and parameters. For software operation, refer to section 5.5.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Mode Setting	Output mode setting or the channel is OFF.	DFB_DA_RD_ModeSetting DFB_DA_WR_ModeSetting
16#8001	Calibration Offset	Calibration - offset	DFB_DA_RD_CalOffset DFB_DA_WR_CalOffset
16#8002	Calibration Gain	Calibration - gain	DFB_DA_RD_CalGain DFB_DA_WR_CalGain
16#8003	Output Setting when EtherCAT Connection Lost DINT	Setting for output behavior when EtherCAT connection is lost (DINT)	
16#8004	Output Value Setting when EtherCAT Connection Lost DINT	Setting for output value when EtherCAT connection is lost (DINT)	
16#8005	Output Setting when Module in Stopped State DINT	Setting for output behavior when the module is in STOP state (DINT)	
16#8006	Output Value Setting when Module in Stopped State DINT	Setting for output value when the module is in STOP state (DINT)	
16#8010	Format	Data format setting	
16#8013	Output Setting when EtherCAT Connection Lost REAL	Setting for output behavior when EtherCAT connection is lost (REAL)	
16#8014	Output Value Settings when EtherCAT Connection Lost REAL	Setting for output value when EtherCAT connection is lost (REAL)	
16#8015	Output Settings when Module in Stopped State REAL	Setting for output behavior when the module is in STOP state (REAL)	
16#8016	Output Value Settings when Module in Stopped State REAL	Setting for output value when the module is in STOP state (REAL)	
16#8030	Scale Upper Limit REAL	Scale upper limit setting (REAL)	DFB_DA_RD_ScaleUpperLimit DFB_DA_WR_ScaleUpperLimit
16#8031	Scale Lower Limit REAL	Scale lower limit setting (REAL)	DFB_DA_RD_ScaleLowerLimit DFB_DA_WR_ScaleLowerLimit
16#8100	DAC Raw Data	Raw data	

5.5.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Explanation**

When the AX5 series PLC is used as the controller, the module status is synchronized with the status of AX5 series PLC CPU and it will be either 1 (Run) or 2 (Stop). When the status of AX5 series PLC CPU is Stop, the output modules will act according to the parameter settings. As for the input modules, they are not affected. If you use other PLC (NOT AX5 Series PLC) as the controller, the module status will be 0, which indicates it is controlled by EtherCAT State Machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

5.5.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Explanation**

Users write a command value into the module and the module will execute the command accordingly. After execution, the module will respond with a corresponding value to show if the execution is success or not.

- **User command**

Command value	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

5.5.5.3 Mode Setting

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Mode Setting	Voltage mode setting	USINT	RW	0
	16#02	CH1 Mode Setting		USINT	RW	0
	16#03	CH2 Mode Setting		USINT	RW	0
	16#04	CH3 Mode Setting		USINT	RW	0

- **Explanation**

Select the mode to set the channel to ON.

- **Supported modes**

Mode	Mode range	DINT range
0	Disable	NA
1	-10 V–10 V	±30000
2	0 V–10 V	0–30000
3	-5 V–5 V	±30000
4	0 V–5 V	0–30000
5	1 V–5 V	0–30000

5.5.5.4 Calibration

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Calibration Offset	Offset Setting range: no limit	REAL	RW	0
	16#02	CH1 Calibration Offset		REAL	RW	0
	16#03	CH2 Calibration Offset		REAL	RW	0
	16#04	CH3 Calibration Offset		REAL	RW	0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9–1.1	REAL	RW	1.0
	16#02	CH1 Calibration Gain		REAL	RW	1.0
	16#03	CH2 Calibration Gain		REAL	RW	1.0
	16#04	CH3 Calibration Gain		REAL	RW	1.0

- **Explanation**

When there is an obvious difference between output values and actual values, you can change Offset and Gain to correct the output curve. The formula is

$$Output = (Input \times Gain) + Offset$$

Example

The mode of channels is -10.0 V to +10.0 V. Gain is 1 and Offset is 0 by default, and the corresponding value is -10.0 V to +10.0 V. If Gain is set to 0.9 and Offset is set to 2, the value after calibration is -7.0 V to +11.0 V.

5.5.5.5 Output Setting and Value Setting when EtherCAT Connection Lost

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Output Setting when EtherCAT Connection Lost DINT	Setting for output behavior (DINT)	USINT	RW	0
	16#02	CH1 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#03	CH2 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#04	CH3 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
16#8004	16#01	CH0 Output Value Setting when EtherCAT Connection Lost DINT	Setting for output value (DINT); Setting value: -30000 – 30000	USINT	RW	0
	16#02	CH1 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#03	CH2 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#04	CH3 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
16#8013	16#01	CH0 Output Settings when EtherCAT Connection Lost REAL	Setting for output behavior (floating-point)	USINT	RW	0
	16#02	CH1 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#03	CH2 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#04	CH3 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
16#8014	16#01	CH0 Output Value Settings when EtherCAT Connection Lost REAL	Setting for output value (floating-point); Setting value: no limit	USINT	RW	0
	16#02	CH1 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#03	CH2 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#04	CH3 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0

- **Explanation**

When the EtherCAT connection is lost, the output channel will act according to the mode that user sets. When the mode is set to 1 (User-Define Value), the output channel will act according to the settings in “Output Value Settings when EtherCAT Connection Lost”.

- **Setting for output behavior**

Mode	Name	Description
0	Set to Default	The output sets to default.
1	User-Define Value	The output is as the settings in Output Value Settings when EtherCAT Connect Lost.
2	Lower Limit	The output sets to the minimum limit.
3	Higher Limit	The output sets to the maximum limit.
4	Keep Last Value	The output keeps the last value.

5.5.5.6 Output Setting and Value Setting when Module in Stopped State

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8005	16#01	CH0 Output Setting when Module in Stopped State DINT	Setting for output behavior (DINT)	USINT	RW	0
	16#02	CH1 Output Setting when Module in Stopped State DINT		USINT	RW	0
	16#03	CH2 Output Setting when Module in Stopped State DINT		USINT	RW	0
	16#04	CH3 Output Setting when Module in Stopped State DINT		USINT	RW	0
16#8006	16#01	CH0 Output Value Setting when Module in Stopped State DINT	Setting for output value (DINT); Setting value: -30000 – 30000	USINT	RW	0
	16#02	CH1 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
	16#03	CH2 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
	16#04	CH3 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
16#8015	16#01	CH0 Output Settings when Module in Stopped State REAL	Setting for output behavior (floating-point)	USINT	RW	0
	16#02	CH1 Output Settings when Module in Stopped State REAL		USINT	RW	0
	16#03	CH2 Output Settings when Module in Stopped State REAL		USINT	RW	0
	16#04	CH3 Output Settings when Module in Stopped State REAL		USINT	RW	0
16#8016	16#01	CH0 Output Value Settings when Module in Stopped State REAL	Setting for output value (floating-point); Setting value: no limit	USINT	RW	0
	16#02	CH1 Output Value Settings when Module in Stopped State REAL		USINT	RW	0
	16#03	CH2 Output Value Settings when Module in Stopped State REAL		USINT	RW	0
	16#04	CH3 Output Value Settings when Module in Stopped State REAL		USINT	RW	0

- **Explanation**

When the PLC makes the module enter STOP state, the output channel will act according to the mode that user sets. When the mode is set to 1 (User-Define Value), the output channel will act according to the settings in “Output Value Settings when EtherCAT Connection Lost”.

- **Setting for output behavior**

Mode	Name	Description
0	Set to Default	The output sets to default.
1	User-Define Value	The output is as the settings in Output Value Settings when EtherCAT Connect Lost.
2	Lower Limit	The output sets to the minimum limit.
3	Higher Limit	The output sets to the maximum limit.
4	Keep Last Value	The output keeps the last value.

5.5.5.7 Format

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8010	16#01	Format	0: DINT Format 1: REAL Format	USINT	RW	0

- **Explanation**

You can set the format and the decimal places according to your demand.

When the data format is set to DINT Format, set up the DINT parameters which are with “DINT” following a parameter name. When the data format is set to REAL Format, set up the REAL parameters which are with “REAL” following a parameter name.

5.5.5.8 Scale

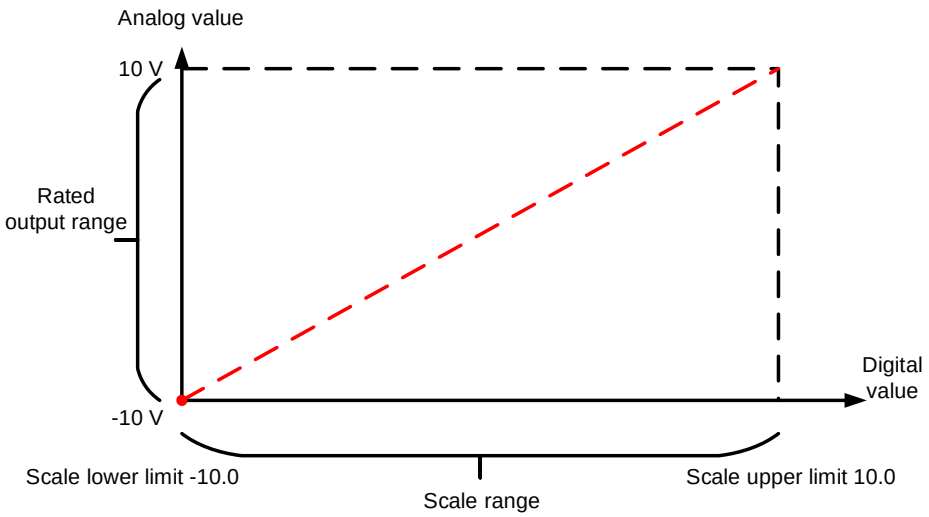
Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8030	16#01	CH0 Scale Upper Limit REAL	Scale upper limit setting; Setting range: no limit	REAL	RW	10
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	10
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	10
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	10
16#8031	16#01	CH0 Scale Lower Limit REAL	Scale lower limit setting; Setting range: no limit	REAL	RW	-10
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-10
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-10
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-10

- **Explanation**

You can set the scale range based on the analog specification for channels when the data format is REAL (floating-point).

- **Example**

If the mode of channels is -10 V to +10 V, the analog range is -10 V to +10 V; the scale upper limit is 10.0 and the scale lower limit is -10.0. The digital values -10.0 to +10.0 correspond to the analog values -10 V to +10 V, as the example below shows.



5.5.5.9 DAC Raw Data

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8100	16#01	CH0 DAC Raw data	Raw data	DINT	RO	0
	16#02	CH1 DAC Raw data		DINT	RO	0
	16#03	CH2 DAC Raw data		DINT	RO	0
	16#04	CH3 DAC Raw data		DINT	RO	0

- **Explanation**

Raw data is the source data that has not been processed or converted from analog to digital.

5.5.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

5.5.6.1 FreeRun Mode

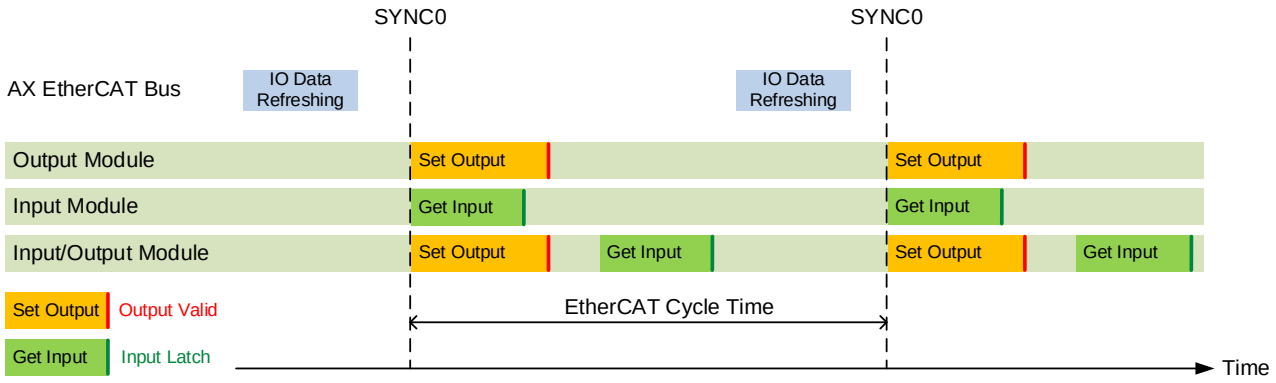
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

5.5.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

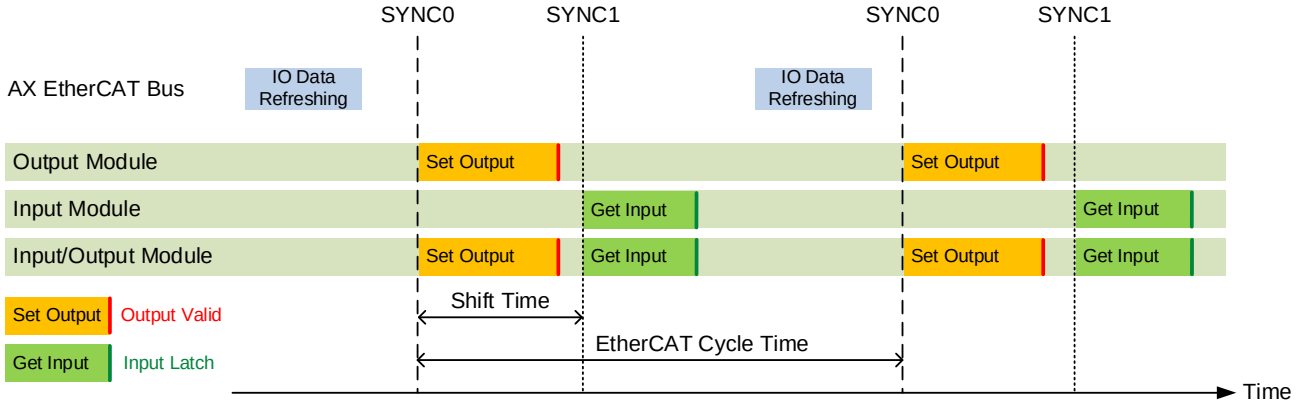
- **SYNC0**

Using the SYNC signal SYNC0 to refresh the values of output channels among modules at the same time.



- **SYNC0 + SYNC1**

Using SYNC0 to refresh values of output channels and using SYNC1 to refresh values of input channels among modules at the same time. The shift time of SYNC0 and SYNC1 can be modified with DIADesigner-AX.



5.5.7 Process Data

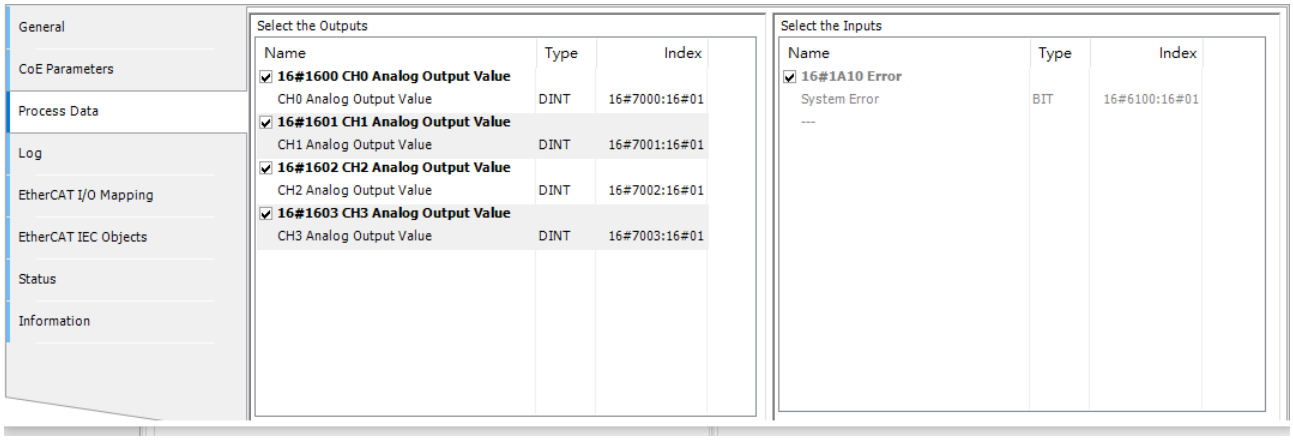
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#7000	16#01	CH0 Analog Output Value	Analog output value; Setting range: -33000–33000	DINT	RO	0
16#7001	16#01	CH1 Analog Output Value		DINT	RO	0
16#7002	16#01	CH2 Analog Output Value		DINT	RO	0
16#7003	16#01	CH3 Analog Output Value		DINT	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0

5.5.7.1 Process Data

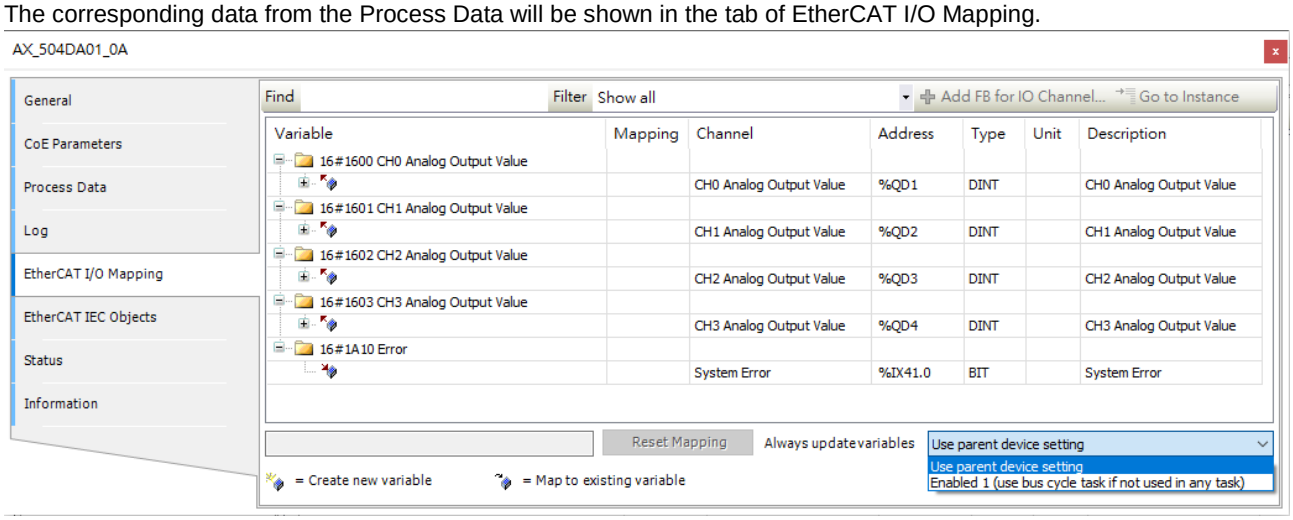
Go to the Process Data tab and select the data that you'd like to monitor.

- Analog Output Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error: It is selected by default. The grayed out part cannot be modified.



5.5.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



5.5.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

5.5.8 Troubleshooting

In the Diagnosis History tab, the error information that has occurred on the module is recorded. In the Status tab, the current information of system error (16#A000) is displayed. In the CoE Parameters tab, you can view the error status through Index/SubIndex of the All Parameter list.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Connection Lost	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#05	(16#FF05) Analog IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#06	(16#FF06) Analog Power Error	ON	OFF	If the problem persists, contact the local authorized distributors.

5.6 AX-504DA02-0A

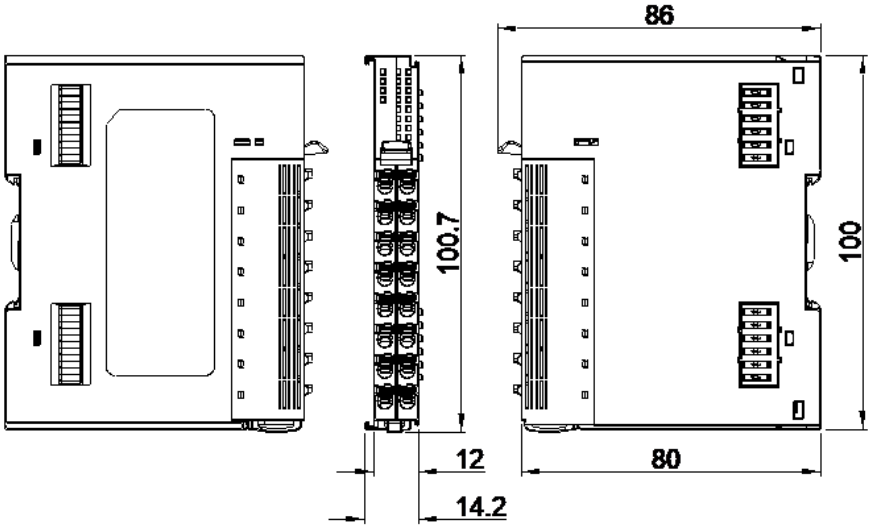
AX-504DA02-0A, an analog output module, receives 4 sets of 16-bit digital data from the PLC and converts the received digital signals to analog current signals, which are output through 4 output points. This section introduces its specifications, wirings and operations.

5.6.1 Specifications

Item		Specification
Output points		4
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		74 g
Electrical specification	Output range	0 – 20 mA
	Output conversion range	0 – 105 % (F.S.)
	Maximum load impedance	550 Ω
	Resolution	0 – +20 mA: 0–30000
	Accuracy	25 °C: ±0.2 % (F.S.) -20 – 60 °C: ±0.6 % (F.S.)
	Conversion time	100 μs / 4 points
	Isolation method	Between unit power and external power: no isolation Between digital power and analog power: 500 VAC Between digital signal and analog signal: 500 VAC Between analog channels: no isolation
	Maximum power consumption (unit power)	Less than 640 mA (3.2 W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Protection	--
	Short Circuit Protection (SCP)	--
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	--
	Filter function	--

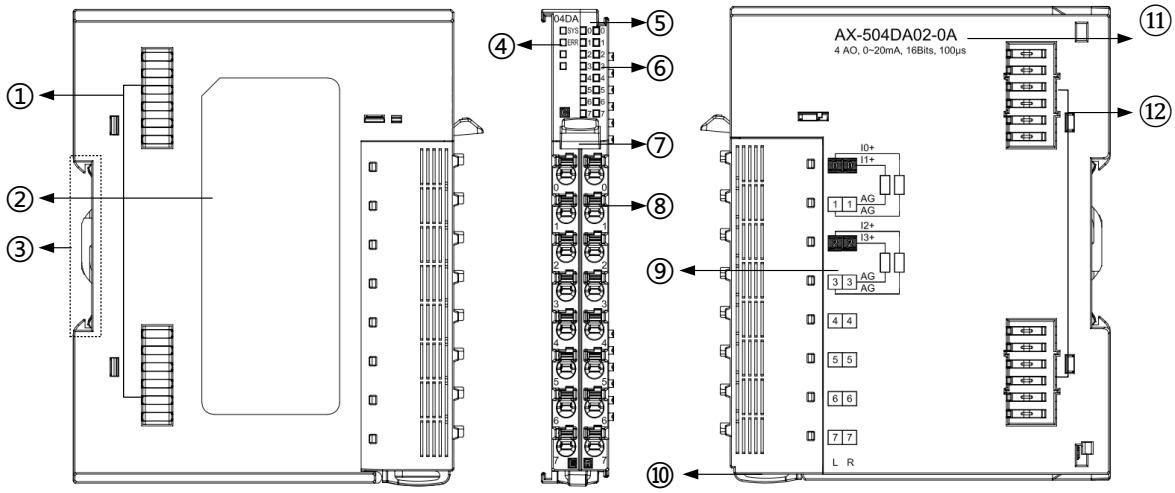
5.6.2 Dimensions and Parts

- **Dimensions**



Unit: mm

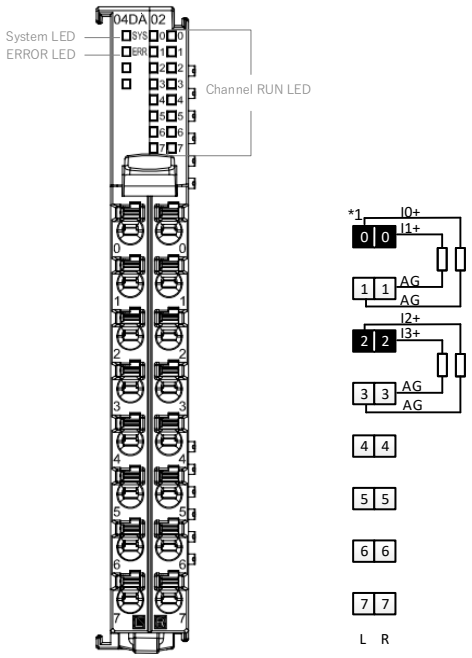
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

5.6.3 Arrangement of Terminals, LED Indicators and Wiring

5.6.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

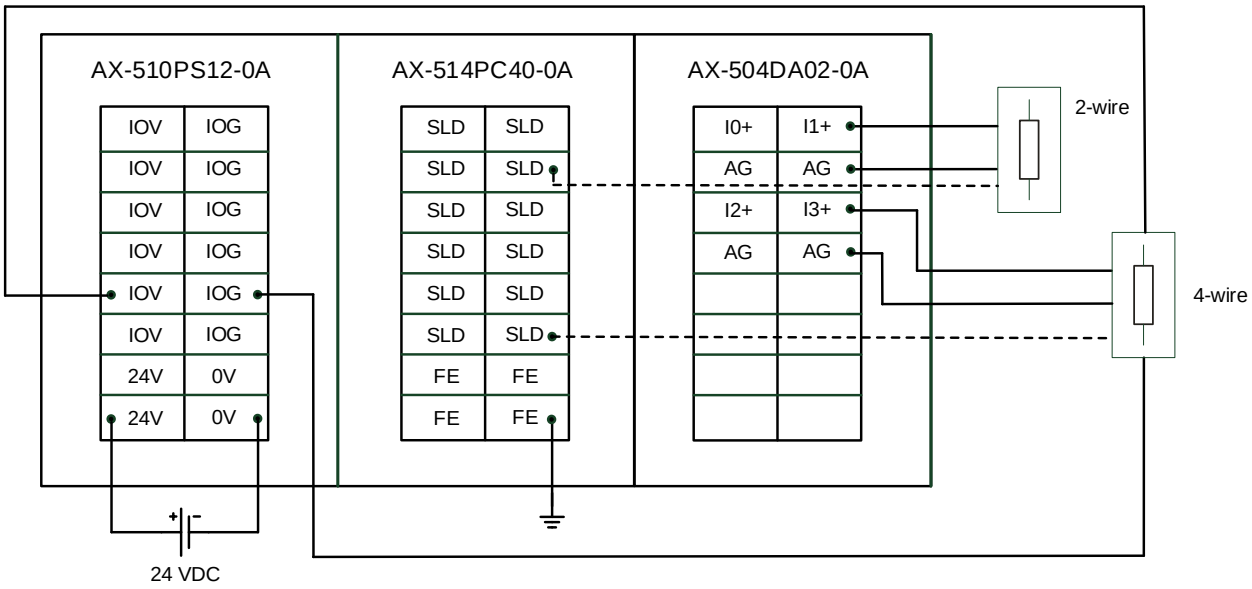
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0+	Channel 0: output current	R0	I1+	Channel 1: output current
L1	AG		R1	AG	
L2	I2+	Channel 2: output current	R2	I3+	Channel 3: output current
L3	AG		R3	AG	
L4	--	--	R4	--	--
L5	--	--	R5	--	--
L6	--	--	R6	--	--
L7	--	--	R7	--	--

5.6.3.2 LED Indicators

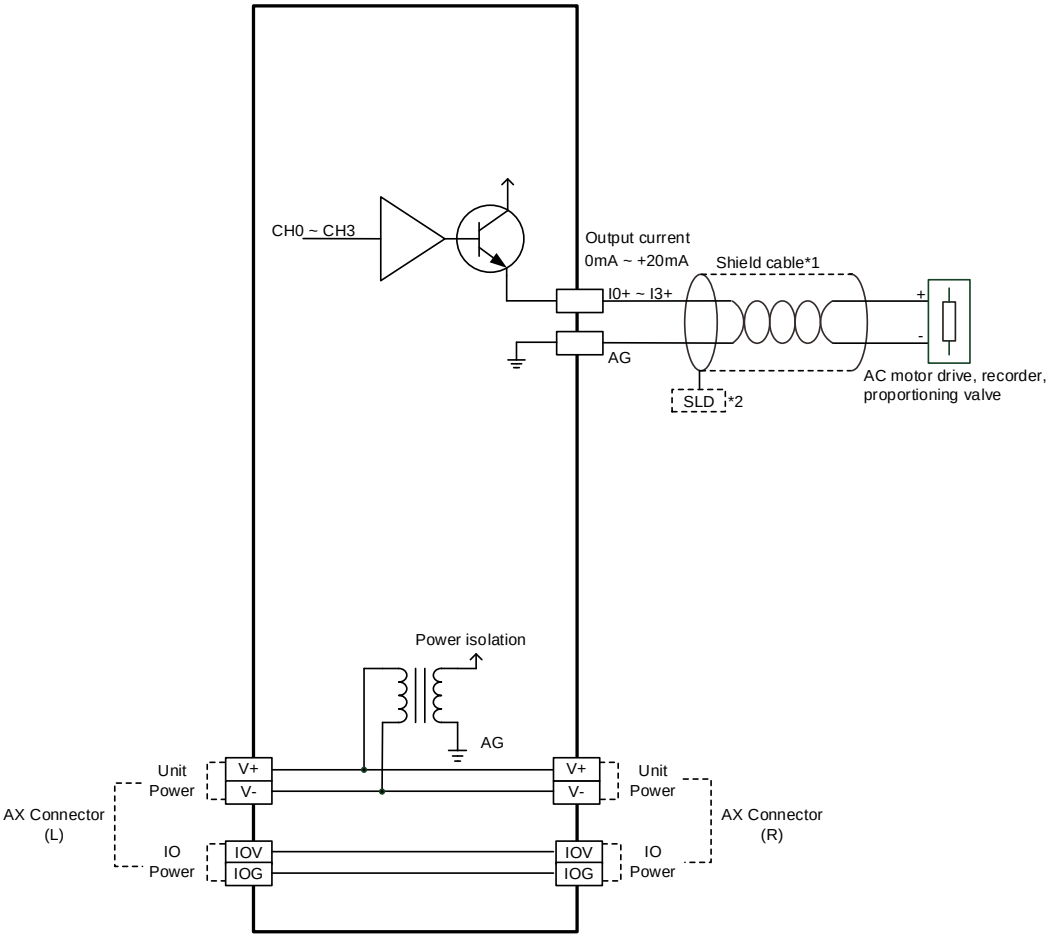
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking (1s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1s)	An error occurs on the application.
			Blinking (0.2s)	An error occurs on the hardware.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

5.6.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



*1. Use shielded cables to isolate the analog input signal cable from other power cables.

*2. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A.

5.6.4 Settings in DIADesigner-AX

The software DIADesigner-AX is the programming tool for the AX Series PLCs. This section introduces some basic operations and settings.

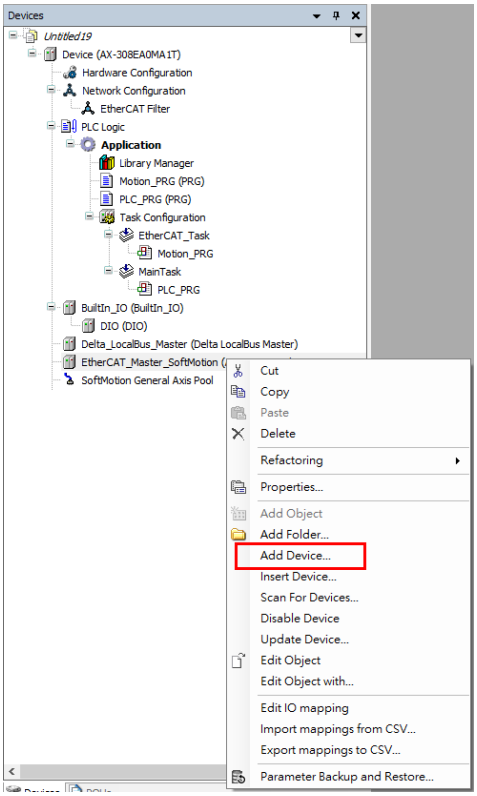
5.6.4.1 Basic Operation

(1) Double-click the DIADesigner-AX icon to open the software and create a new project.

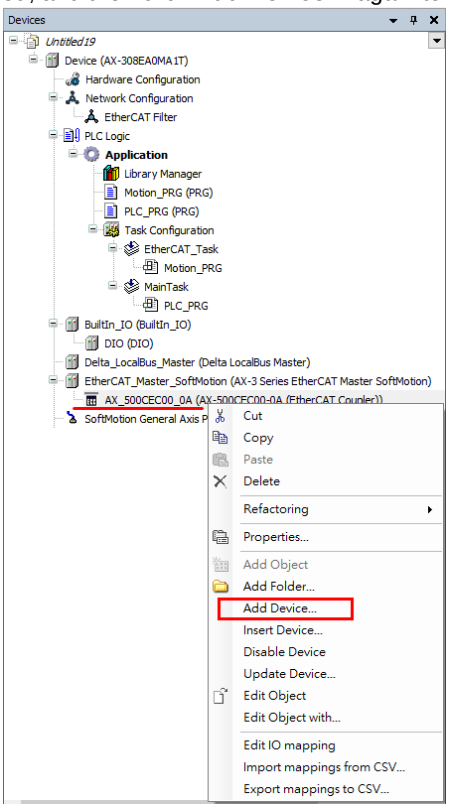
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Add Device…** to select and add System Coupler.

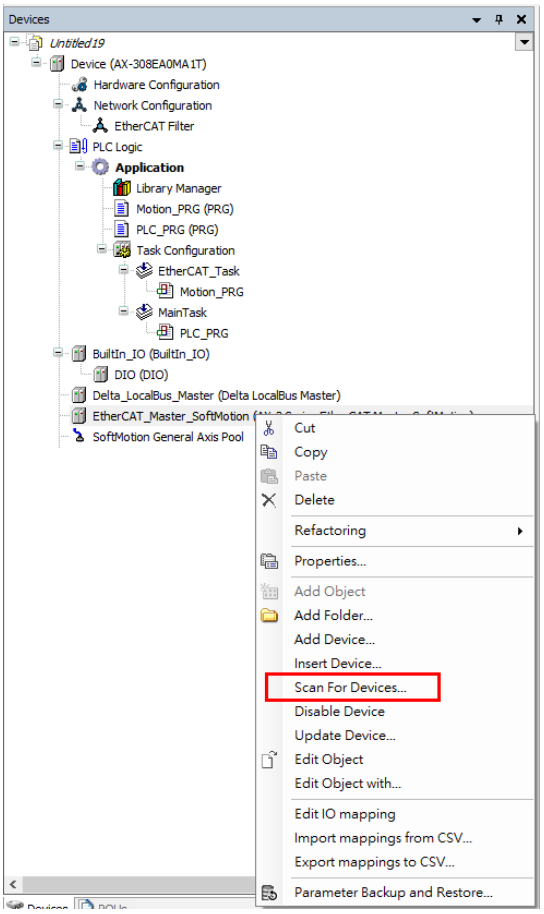


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

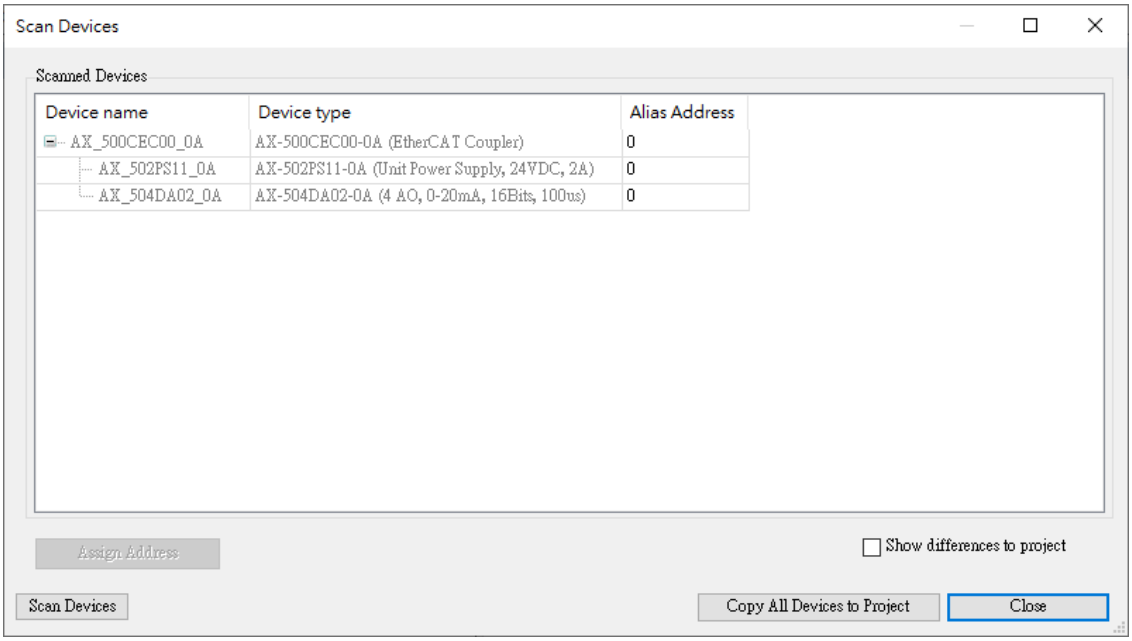


- Method 2: Scan to add the modules in.

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Scan for Devices…**.



After the auto-scan is over, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.

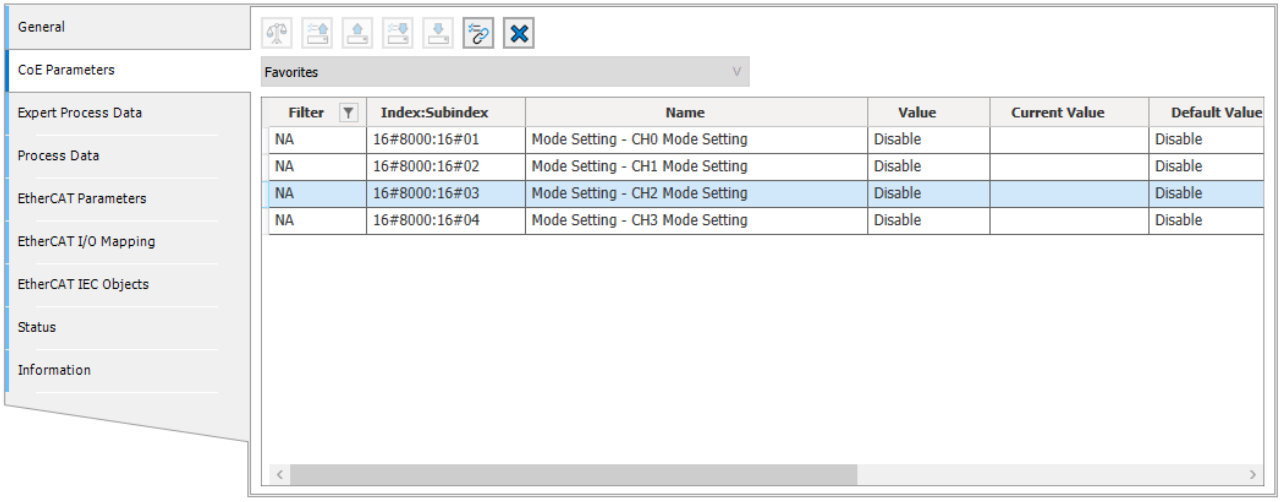


5.6.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.

(1) Favorites

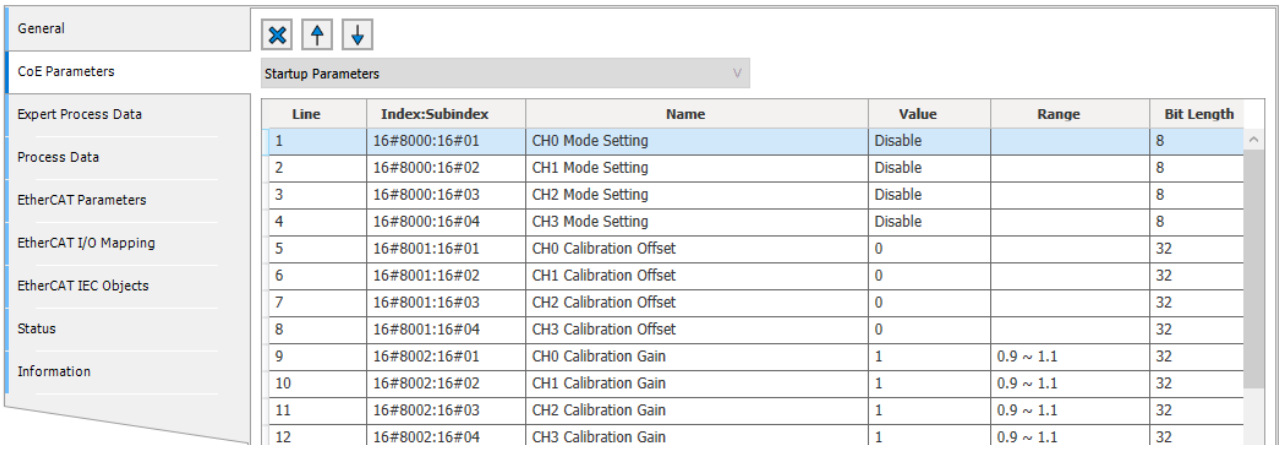
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

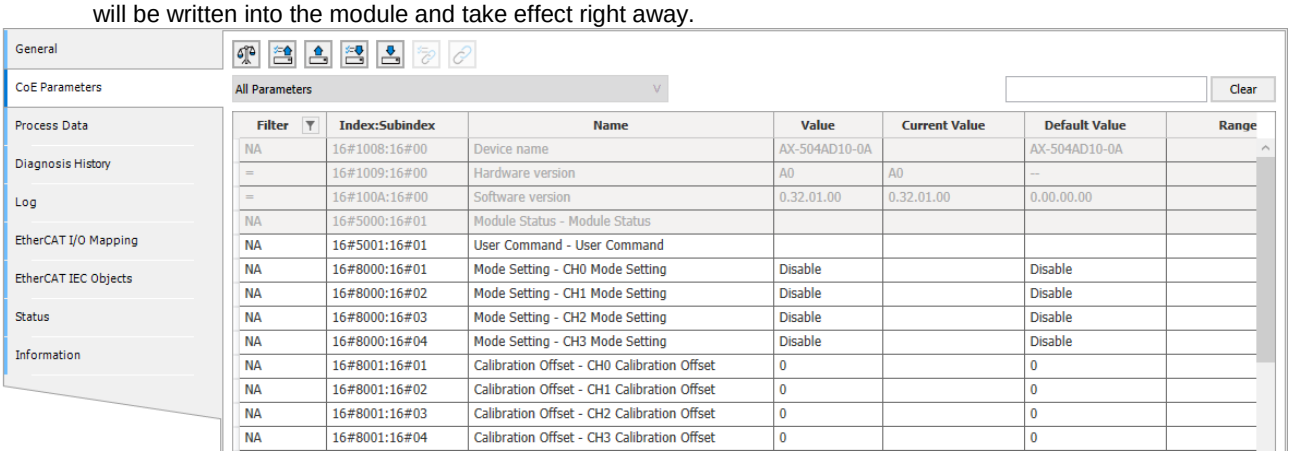


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8000:16#03	CH2 Mode Setting	Disable		8
4	16#8000:16#04	CH3 Mode Setting	Disable		8
5	16#8001:16#01	CH0 Calibration Offset	0		32
6	16#8001:16#02	CH1 Calibration Offset	0		32
7	16#8001:16#03	CH2 Calibration Offset	0		32
8	16#8001:16#04	CH3 Calibration Offset	0		32
9	16#8002:16#01	CH0 Calibration Gain	1	0.9 ~ 1.1	32
10	16#8002:16#02	CH1 Calibration Gain	1	0.9 ~ 1.1	32
11	16#8002:16#03	CH2 Calibration Gain	1	0.9 ~ 1.1	32
12	16#8002:16#04	CH3 Calibration Gain	1	0.9 ~ 1.1	32

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

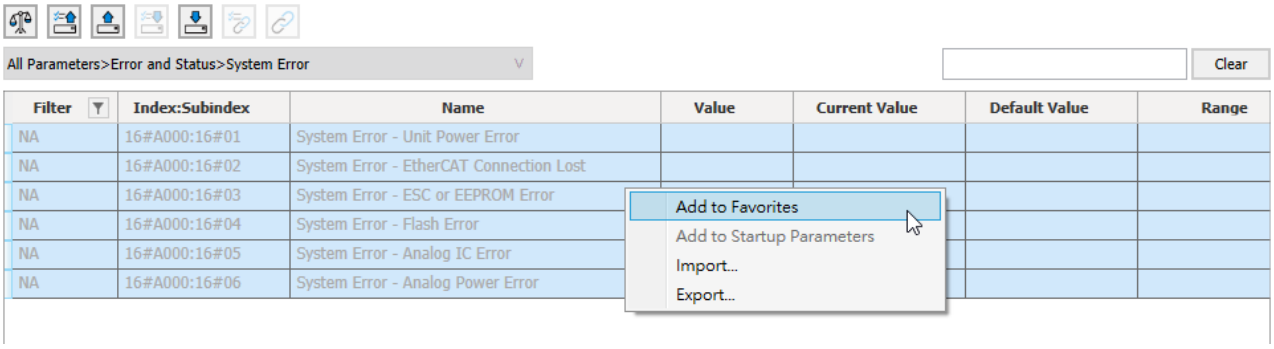
(3) All Parameters

- You can find all the CoE parameters here. Click  on the toolbar to go into online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

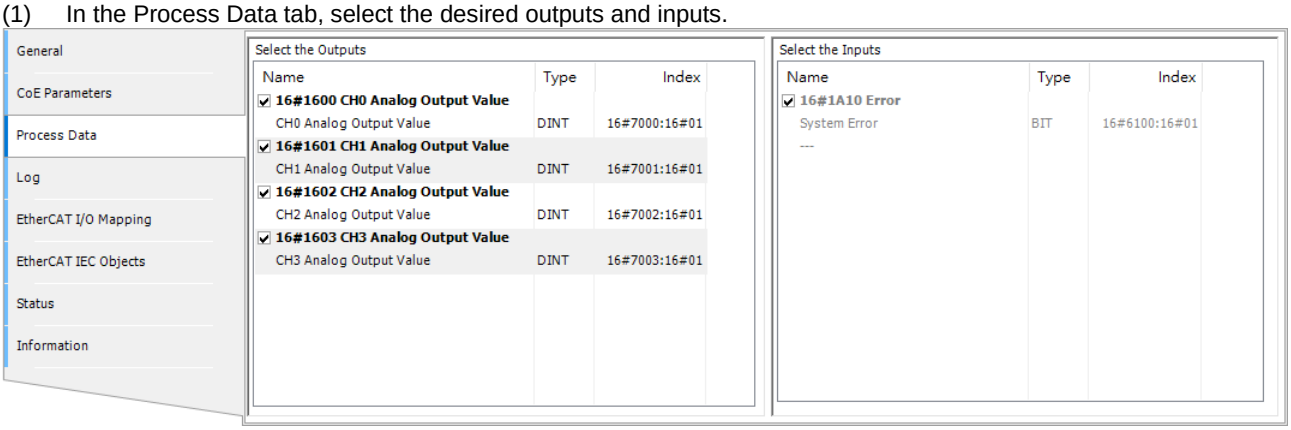
- You can select and right-click the parameter to add the selected parameter to the Favorites.



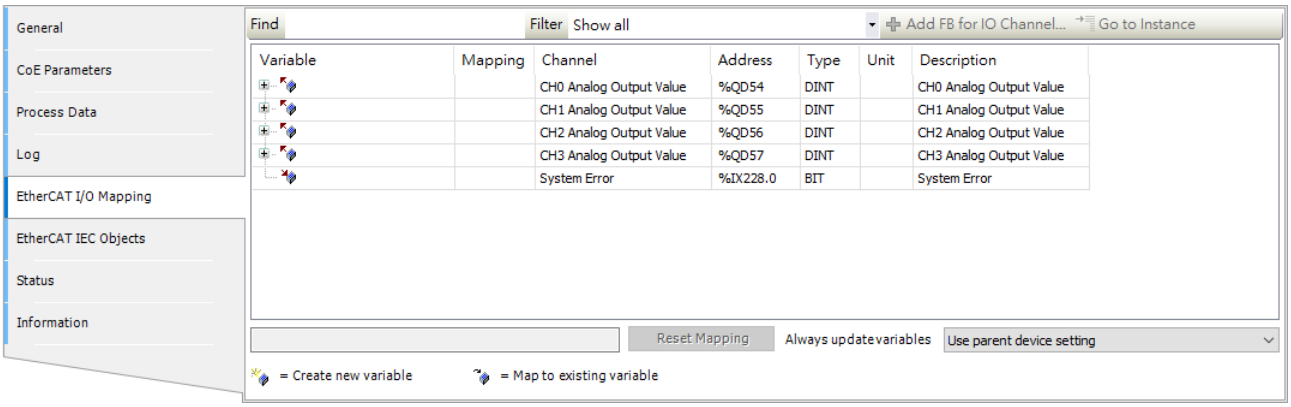
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.6.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

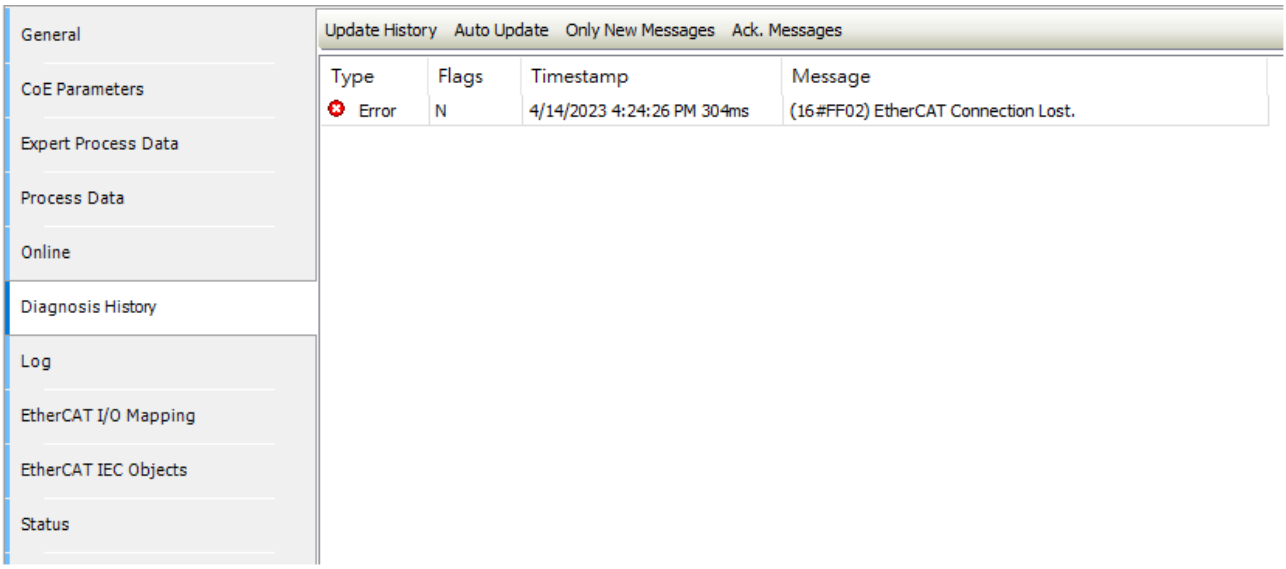


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



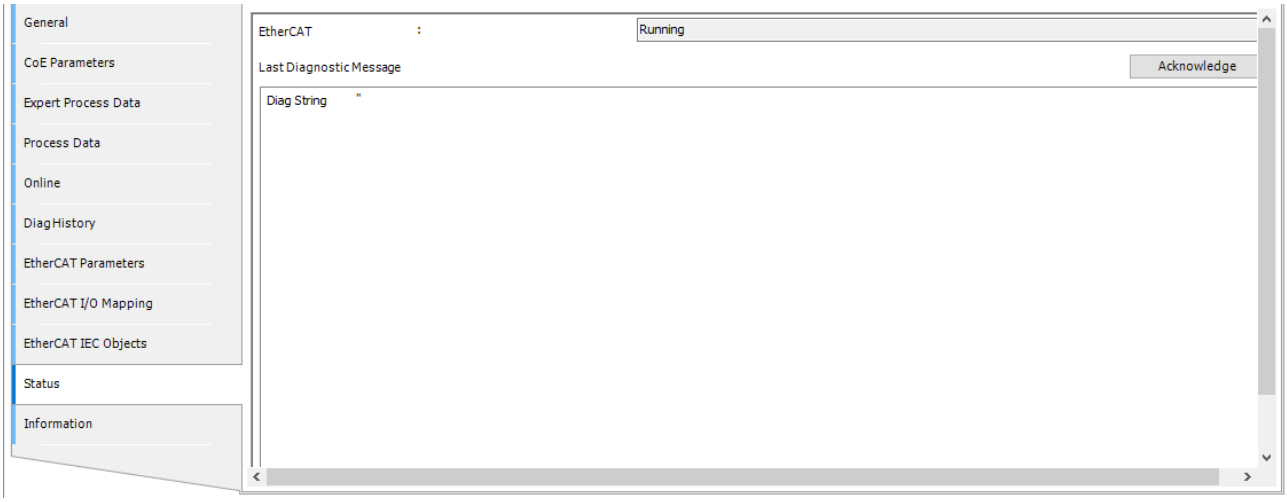
5.6.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors



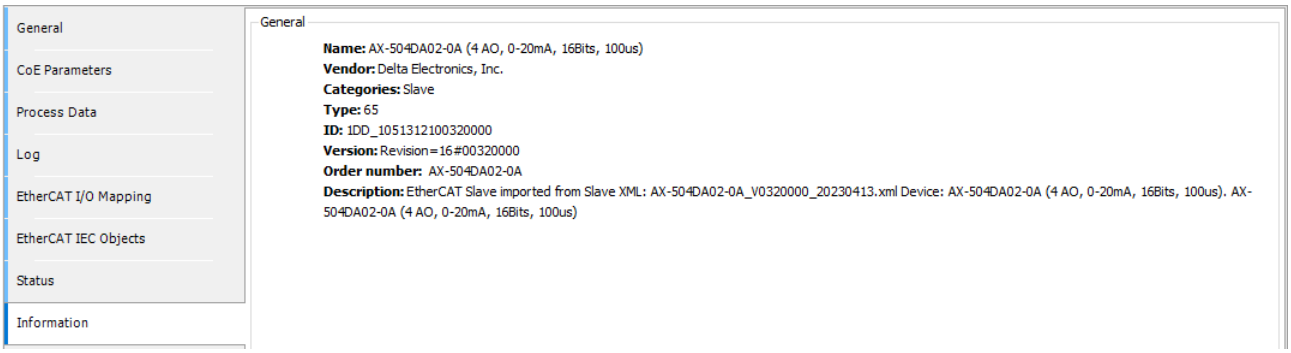
5.6.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



5.6.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.32.01.00	0.32.01.00	0.00.00.00

5.6.5 Parameter Descriptions

You can use DIADesigner-AX to set up the functions for the module by directly selecting the setting mode and parameters. For software operation, refer to section 5.6.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Mode Setting	Output mode setting or the channel is OFF.	DFB_DA_RD_ModeSetting DFB_DA_WR_ModeSetting
16#8001	Calibration Offset	Calibration - offset	DFB_DA_RD_CalOffset DFB_DA_WR_CalOffset
16#8002	Calibration Gain	Calibration - gain	DFB_DA_RD_CalGain DFB_DA_WR_CalGain
16#8003	Output Setting when EtherCAT Connection Lost DINT	Setting for output behavior when EtherCAT connection is lost (DINT)	
16#8004	Output Value Setting when EtherCAT Connection Lost DINT	Setting for output value when EtherCAT connection is lost (DINT)	
16#8005	Output Setting when Module in Stopped State DINT	Setting for output behavior when the PLC CPU is in STOP state (DINT)	
16#8006	Output Value Setting when Module in Stopped State DINT	Setting for output value when the PLC CPU is in STOP state (DINT)	
16#8010	Format	Data format setting	
16#8013	Output Setting when EtherCAT Connection Lost REAL	Setting for output behavior when EtherCAT connection is lost (floating-point)	
16#8014	Output Value Settings when EtherCAT Connection Lost REAL	Setting for output value when EtherCAT connection is lost (floating-point)	
16#8015	Output Settings when Module in Stopped State REAL	Setting for output behavior when the PLC CPU is in STOP state (floating-point)	
16#8016	Output Value Settings when Module in Stopped State REAL	Setting for output value when the PLC CPU is in STOP state (floating-point)	
16#8030	Scale Upper Limit REAL	Scale upper limit setting (floating-point)	DFB_DA_RD_ScaleUpperLimit DFB_DA_WR_ScaleUpperLimit
16#8031	Scale Lower Limit REAL	Scale lower limit setting (floating-point)	DFB_DA_RD_ScaleLowerLimit DFB_DA_WR_ScaleLowerLimit
16#8100	DAC Raw Data	Raw data	

5.6.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Explanation**

When the AX5 series PLC is used as the controller, the module status is synchronized with the status of AX5 series PLC CPU and it will be either 1 (Run) or 2 (Stop). When the status of AX5 series PLC CPU is Stop, the output modules will act according to the parameter settings. As for the input modules, they are not affected. If you use other PLC (NOT AX5 Series PLC) as the controller, the module status will be 0, which indicates it is controlled by EtherCAT State Machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

5.6.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Explanation**

Users write a command value into the module and the module will execute the command accordingly. After execution, the module will respond with a corresponding value to show if the execution is success or not.

- **User command**

Command value	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

5.6.5.3 Mode Setting

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Mode Setting	Current mode setting	USINT	RW	0
	16#02	CH1 Mode Setting		USINT	RW	0
	16#03	CH2 Mode Setting		USINT	RW	0
	16#04	CH3 Mode Setting		USINT	RW	0

- **Explanation**

Select the mode to set the channel to ON. The conversion time is 100 μs / 4 channels.

- **Supported modes**

Mode	Mode range	DINT range
0	Disable	
1	-20 mA–20 mA	±30000
2	0 mA–20 mA	0–30000
3	4 mA–20 mA	±30000

5.6.5.4 Calibration

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Calibration Offset	Offset Setting range: no limit	REAL	RW	0
	16#02	CH1 Calibration Offset		REAL	RW	0
	16#03	CH2 Calibration Offset		REAL	RW	0
	16#04	CH3 Calibration Offset		REAL	RW	0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9–1.1	REAL	RW	1.0
	16#02	CH1 Calibration Gain		REAL	RW	1.0
	16#03	CH2 Calibration Gain		REAL	RW	1.0
	16#04	CH3 Calibration Gain		REAL	RW	1.0

- **Explanation**

When there is an obvious difference between output values and actual values, you can change Offset and Gain to correct the output curve. The formula is

$$Output = (Input \times Gain) + Offset$$

Example

The mode of channels is -20.0 mA to +20.0 mA. Gain is 1 and Offset is 0 by default, and the corresponding value is -20.0 mA to +20.0 mA. If Gain is set to 0.9 and Offset is set to 3, the value after calibration is -15 mA V to +21.0 mA.

5.6.5.5 Output Setting and Value Setting when EtherCAT Connection Lost

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Output Setting when EtherCAT Connection Lost DINT	Setting for output behavior (DINT)	USINT	RW	0
	16#02	CH1 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#03	CH2 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#04	CH3 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
16#8004	16#01	CH0 Output Value Setting when EtherCAT Connection Lost DINT	Setting for output value (DINT); Setting value: -30000 – 30000	USINT	RW	0
	16#02	CH1 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#03	CH2 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#04	CH3 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
16#8013	16#01	CH0 Output Settings when EtherCAT Connection Lost REAL	Setting for output behavior (floating-point)	USINT	RW	0
	16#02	CH1 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#03	CH2 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#04	CH3 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
16#8014	16#01	CH0 Output Value Settings when EtherCAT Connection Lost REAL	Setting for output value (floating-point); Setting value: no limit	USINT	RW	0
	16#02	CH1 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#03	CH2 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#04	CH3 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0

- **Explanation**

When the EtherCAT connection is lost, the output channel will act according to the mode that user sets. When the mode is set to 1 (User-Define Value), the output channel will act according to the settings in “Output Value Settings when EtherCAT Connection Lost”.

- **Setting for output behavior**

Mode	Name	Description
0	Set to Default	The output sets to default.
1	User-Define Value	The output is as the settings in Output Value Settings when EtherCAT Connect Lost.
2	Lower Limit	The output sets to the minimum limit.
3	Higher Limit	The output sets to the maximum limit.
4	Keep Last Value	The output keeps the last value.

5.6.5.6 Output Setting and Value Setting when Module in Stopped State

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8005	16#01	CH0 Output Setting when Module in Stopped State DINT	Setting for output behavior (DINT)	USINT	RW	0
	16#02	CH1 Output Setting when Module in Stopped State DINT		USINT	RW	0
	16#03	CH2 Output Setting when Module in Stopped State DINT		USINT	RW	0
	16#04	CH3 Output Setting when Module in Stopped State DINT		USINT	RW	0
16#8006	16#01	CH0 Output Value Setting when Module in Stopped State DINT	Setting for output value (DINT); Setting value: -30000 – 30000	USINT	RW	0
	16#02	CH1 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
	16#03	CH2 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
	16#04	CH3 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
16#8015	16#01	CH0 Output Settings when Module in Stopped State REAL	Setting for output behavior (floating-point)	USINT	RW	0
	16#02	CH1 Output Settings when Module in Stopped State REAL		USINT	RW	0
	16#03	CH2 Output Settings when Module in Stopped State REAL		USINT	RW	0
	16#04	CH3 Output Settings when Module in Stopped State REAL		USINT	RW	0
16#8016	16#01	CH0 Output Value Settings when Module in Stopped State REAL	Setting for output value (floating-point); Setting value: no limit	USINT	RW	0
	16#02	CH1 Output Value Settings when Module in Stopped State REAL		USINT	RW	0
	16#03	CH2 Output Value Settings when Module in Stopped State REAL		USINT	RW	0
	16#04	CH3 Output Value Settings when Module in Stopped State REAL		USINT	RW	0

- **Explanation**

When the PLC makes the module enter STOP state, the output channel will act according to the mode that user sets. When the mode is set to 1 (User-Define Value), the output channel will act according to the settings in “Output Value Settings when EtherCAT Connection Lost”.

- **Setting for output behavior**

Mode	Name	Description
0	Set to Default	The output sets to default.
1	User-Define Value	The output is as the settings in Output Value Settings when EtherCAT Connect Lost.
2	Lower Limit	The output sets to the minimum limit.
3	Higher Limit	The output sets to the maximum limit.
4	Keep Last Value	The output keeps the last value.

5.6.5.7 Format

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8010	16#01	Format	0: DINT Format 1: REAL Format	USINT	RW	0

- **Explanation**

You can set the format and the decimal places according to your demand.
When the data format is set to DINT Format, set up the DINT parameters which are with “DINT” following a parameter name. When the data format is set to REAL Format, set up the REAL parameters which are with “REAL” following a parameter name.

5.6.5.8 Scale

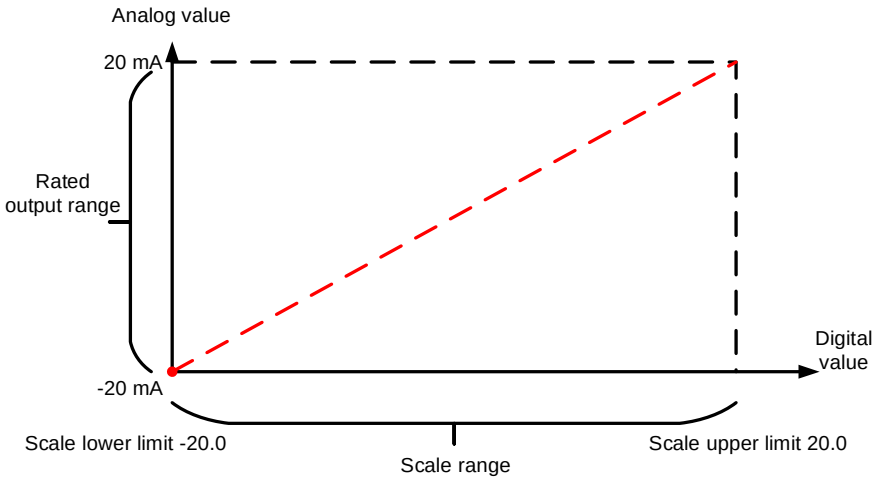
Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8030	16#01	CH0 Scale Upper Limit REAL	Scale upper limit setting; Setting range: no limit	REAL	RW	10
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	10
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	10
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	10
16#8031	16#01	CH0 Scale Lower Limit REAL	Scale lower limit setting ; Setting range: no limit	REAL	RW	-10
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-10
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-10
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-10

- **Explanation**

You can set the scale range based on the analog specification for channels when the data format is REAL (floating-point).

- **Example**

If the mode of channels is ±20 mA, the analog range is -20 mA to +20 mA, the scale upper limit is 20.0 and the scale lower limit is -20.0. The digital values -20.0 to +20.0 correspond to the analog values -20 mA to +20 mA, as the example below shows.



5.6.5.9 DAC Raw Data

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8100	16#01	CH0 DAC Raw data	Raw data	DINT	RO	0
	16#02	CH1 DAC Raw data		DINT	RO	0
	16#03	CH2 DAC Raw data		DINT	RO	0
	16#04	CH3 DAC Raw data		DINT	RO	0

- **Explanation**

Raw data is the source data that has not been processed or converted from analog to digital.

5.6.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

5.6.6.1 FreeRun Mode

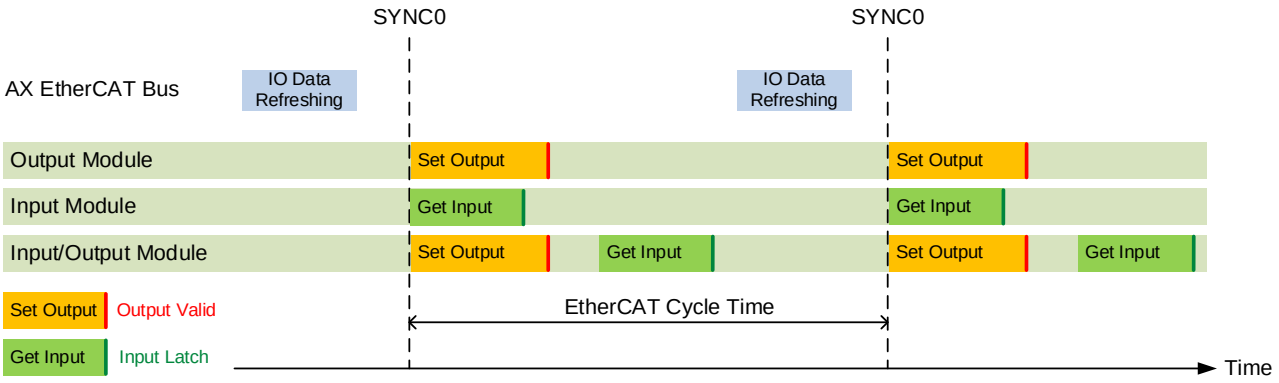
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

5.6.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

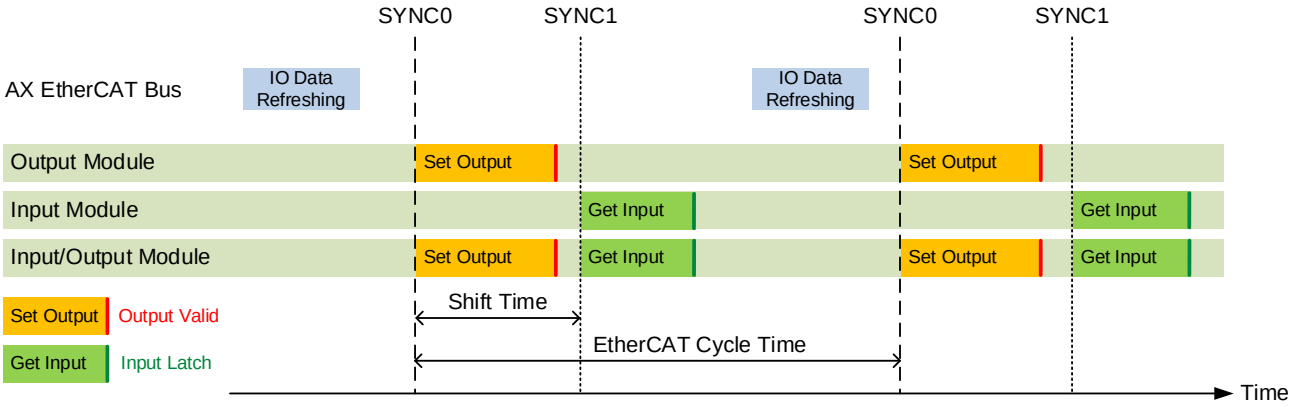
- **SYNC0**

Using the SYNC signal SYNC0 to refresh the values of output channels among modules at the same time.



- **SYNC0 + SYNC1**

Using SYNC0 to refresh values of output channels and using SYNC1 to refresh values of input channels among modules at the same time. The shift time of SYNC0 and SYNC1 can be modified with DIADesigner-AX.



5.6.7 Process Data

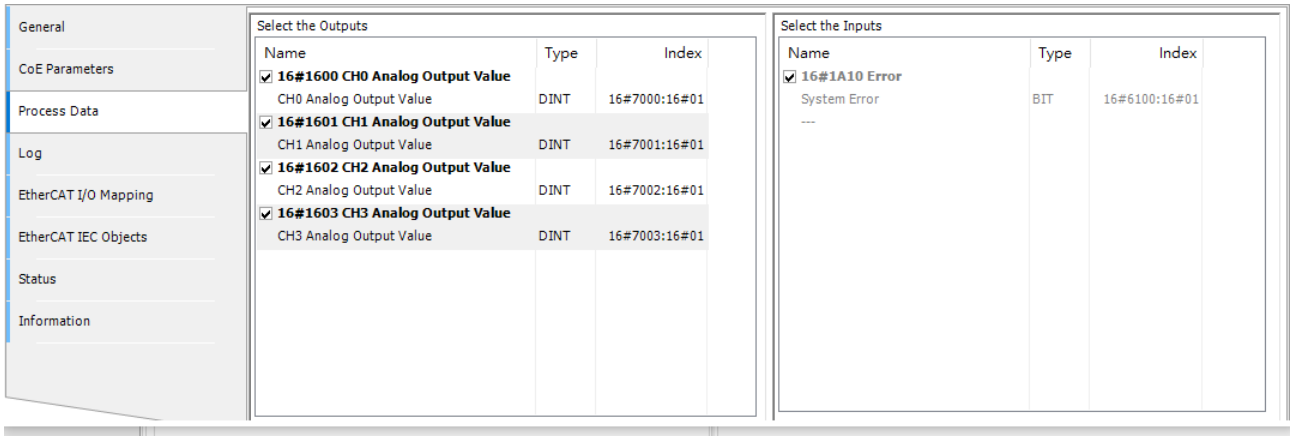
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#7000	16#01	CH0 Analog Output Value	Analog output value; Setting range: -33000–33000	DINT	RO	0
16#7001	16#01	CH1 Analog Output Value		DINT	RO	0
16#7002	16#01	CH2 Analog Output Value		DINT	RO	0
16#7003	16#01	CH3 Analog Output Value		DINT	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0

5.6.7.1 Process Data

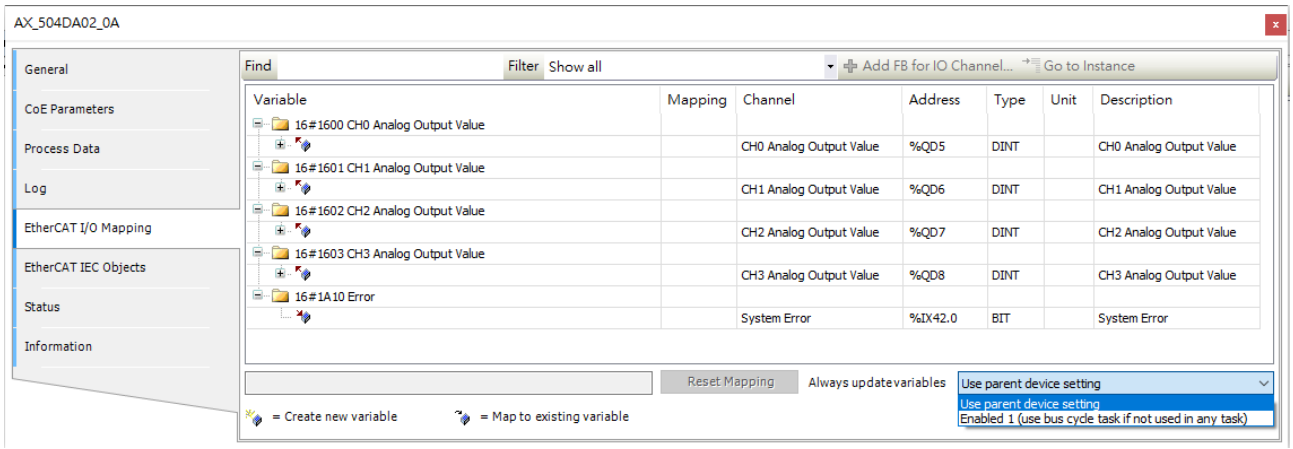
Go to the Process Data tab and select the data that you'd like to monitor.

- Analog Output Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error: It is selected by default. The grayed out part cannot be modified.



5.6.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



5.6.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

5.6.8 Troubleshooting

In the Diagnosis History tab, the error information that has occurred on the module is recorded. In the Status tab, the current information of system error (16#A000) is displayed. In the CoE Parameters tab, you can view the error status through Index/SubIndex of the All Parameter list.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Connection Lost	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#05	(16#FF05) Analog IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#06	(16#FF06) Analog Power Error	ON	OFF	If the problem persists, contact the local authorized distributors.

5.7 AX-508DA01-0A

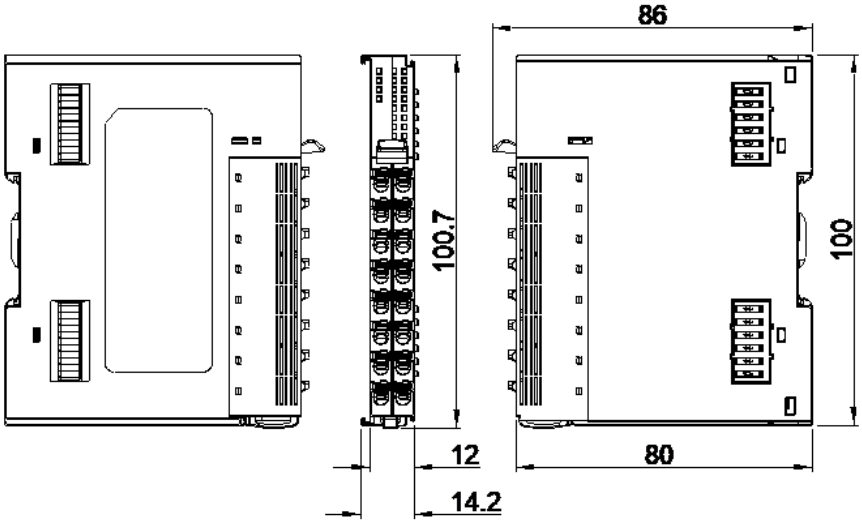
AX-508DA01-0A, an analog output module, receives 8 sets of 16-bit digital data from the PLC and converts the received digital signals into analog voltage signals, which are output through 8 output points. This section introduces its specifications, wirings and operations.

5.7.1 Specifications

Item		Specification
Output points		8
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		74 g
Electrical specification	Output range	-10– +10 V
	Output conversion range	-5 – 105 % (F.S.)
	Maximum load impedance	1 KΩ – 2 MΩ.
	Resolution	-10 – +10 V: -30000–30000 -5 – +5 V: -15000–15000
	Accuracy	25 ºC: ±0.2 % (F.S.) -20 – 60 ºC: ±0.6 % (F.S.)
	Conversion time	200 μs / 8 points
	Isolation method	Between unit power and external power: no isolation Between digital power and analog power: 500 VAC Between digital signal and analog signal: 500 VAC Between analog channels: no isolation
	Maximum power consumption (unit power)	Less than 640 mA (3.2 W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Protection	--
	Short Circuit Protection (SCP)	--
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	--
	Filter function	--

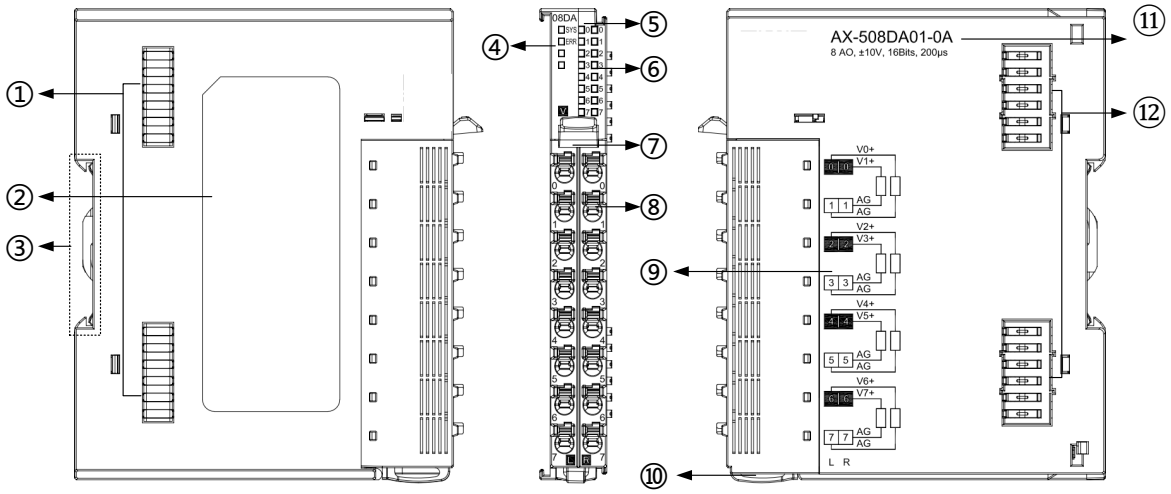
5.7.2 Dimensions and Parts

- **Dimensions**



Unit: mm

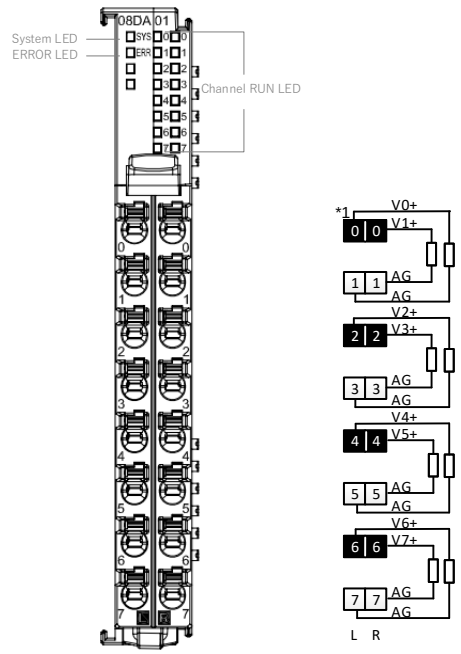
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

5.7.3 Arrangement of Terminals, LED Indicators and Wiring

5.7.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

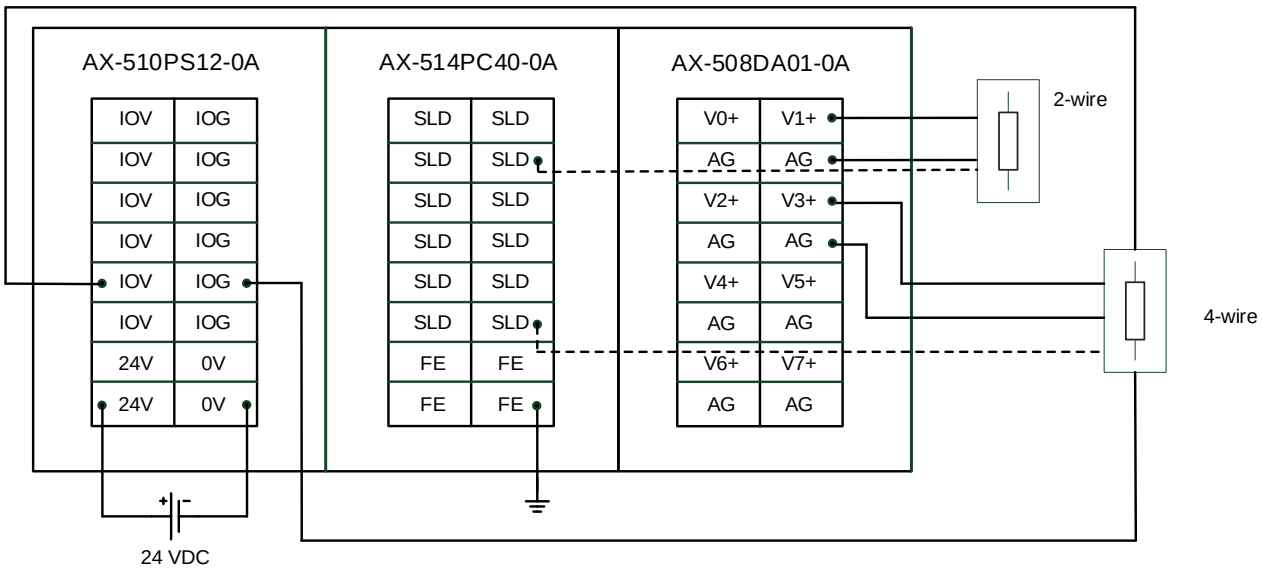
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	V0+	Channel 0: output voltage	R0	V1+	Channel 1: output voltage
L1	AG		R1	AG	
L2	V2+	Channel 2: output voltage	R2	V3+	Channel 3: output voltage
L3	AG		R3	AG	
L4	V4+	Channel 4: output voltage	R4	V5+	Channel 5: output voltage
L5	AG	--	R5	AG	--
L6	V6+	Channel 6: output voltage	R6	V7+	Channel 7: output voltage
L7	AG	--	R7	AG	--

5.7.3.2 LED Indicators

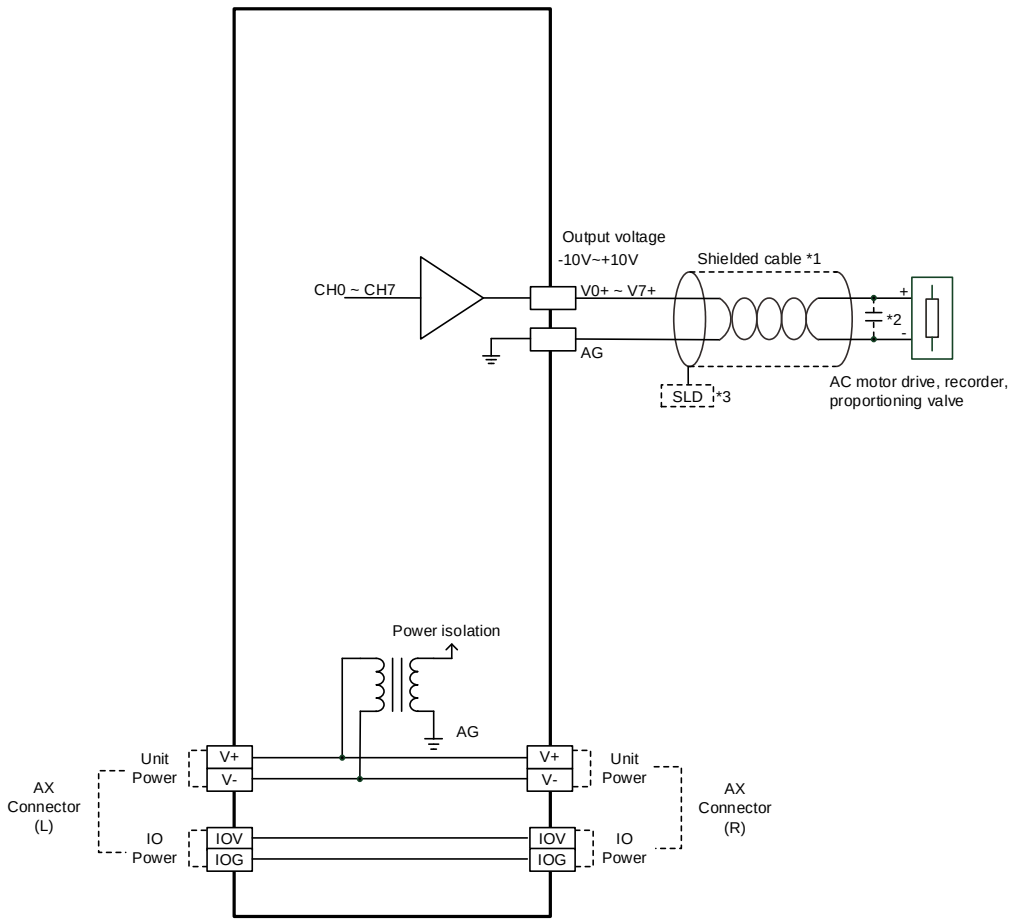
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking (1s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1s)	An error occurs on the application.
			Blinking (0.2s)	An error occurs on the hardware.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

5.7.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



*1. Use shielded cables to isolate the analog input signal cable from other power cables.

*2. If variability in the input voltage results in interference within the wiring, connect the module to a capacitor with a capacitance between 0.1–0.47 μF and a working voltage of 25 V.

*3. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A.

5.7.4 Settings in DIADesigner-AX

The software DIADesigner-AX is the programming tool for the AX Series PLCs. This section introduces some basic operations and settings.

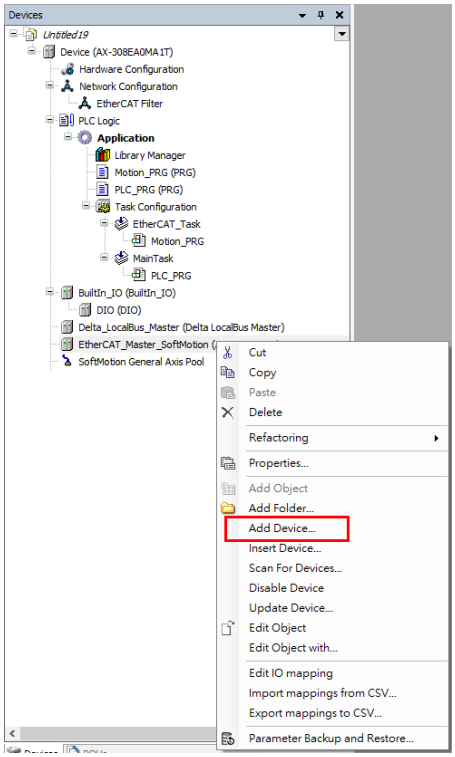
5.7.4.1 Basic Operation

(1) Double-click the DIADesigner-AX icon to open the software and create a new project.

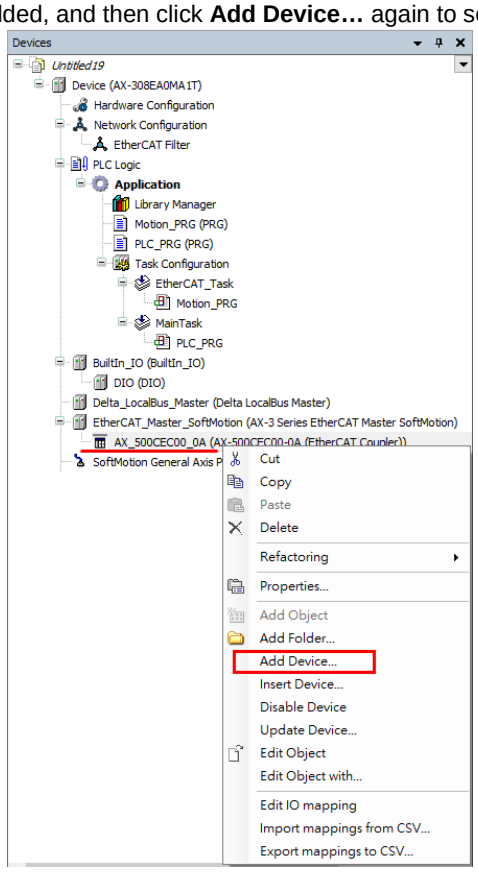
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Add Device…** to select and add System Coupler.

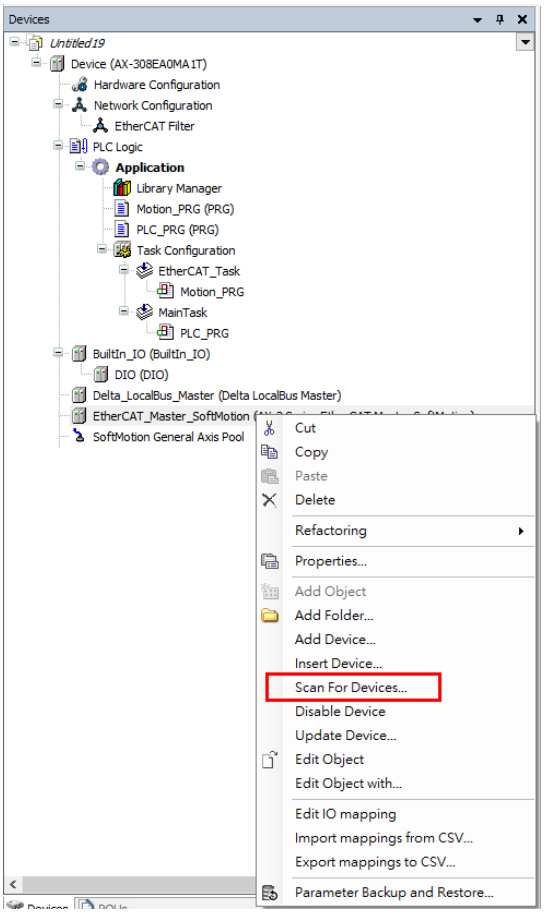


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

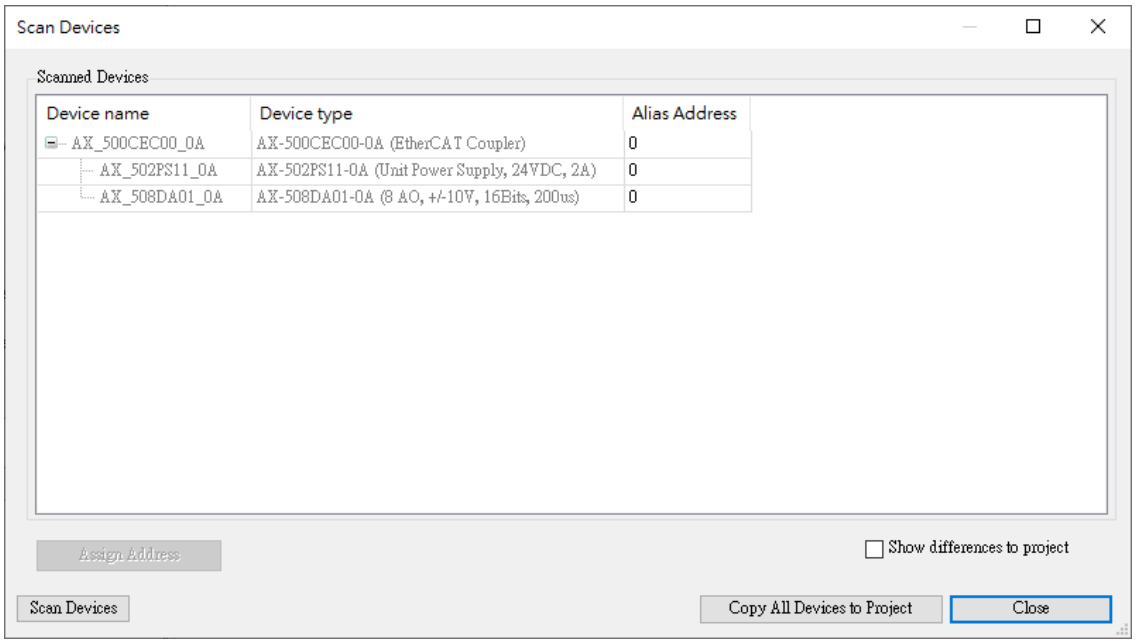


- Method 2: Scan to add the modules in.

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Scan for Devices…**.

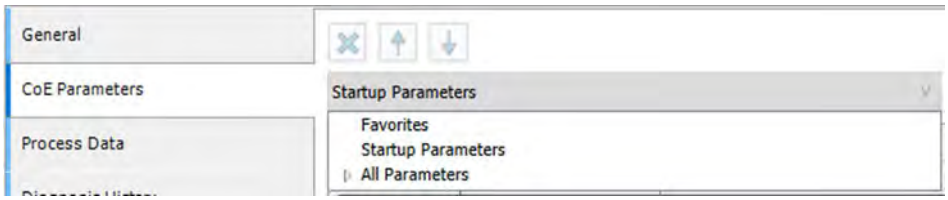


After the auto-scan is over, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



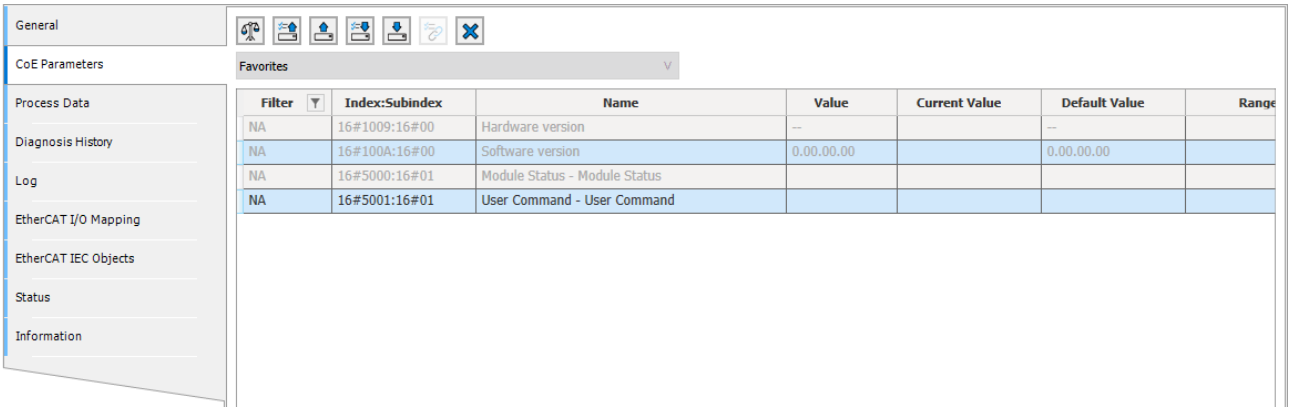
5.7.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.



(1) Favorites

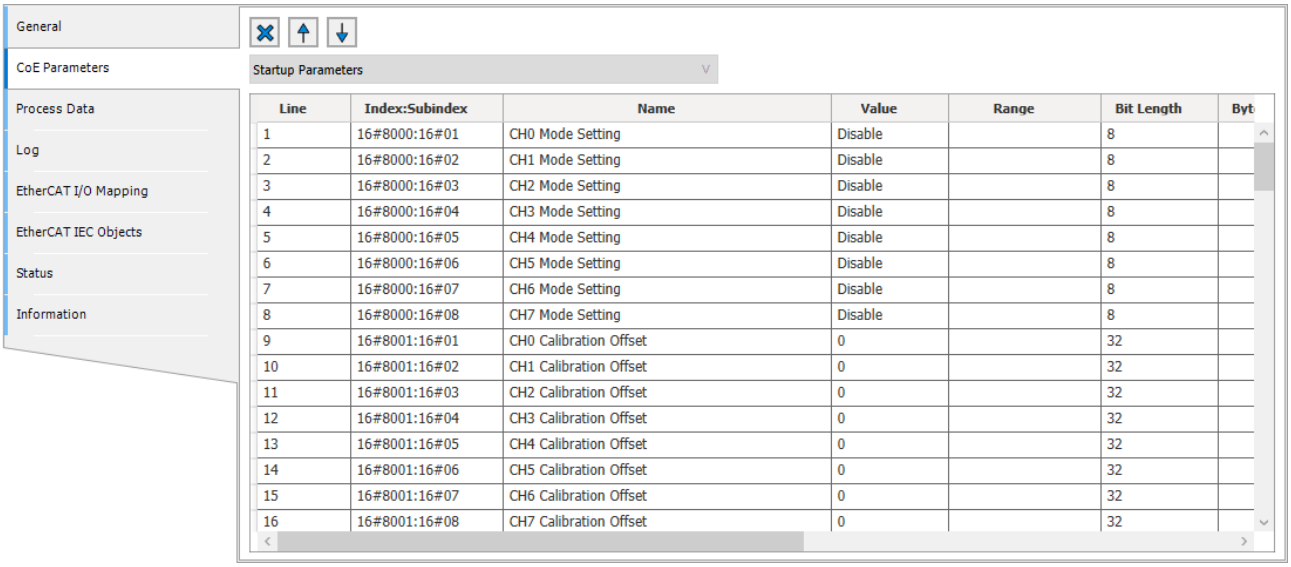
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

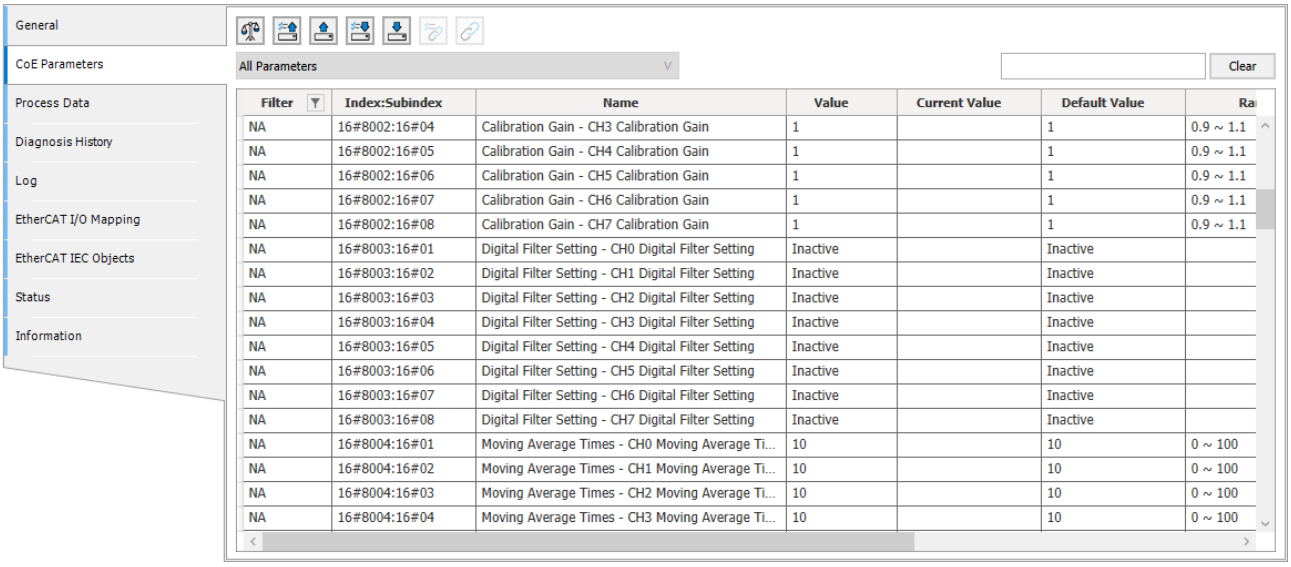


Line	Index:Subindex	Name	Value	Range	Bit Length	Byt
1	16#8000:16#01	CH0 Mode Setting	Disable		8	
2	16#8000:16#02	CH1 Mode Setting	Disable		8	
3	16#8000:16#03	CH2 Mode Setting	Disable		8	
4	16#8000:16#04	CH3 Mode Setting	Disable		8	
5	16#8000:16#05	CH4 Mode Setting	Disable		8	
6	16#8000:16#06	CH5 Mode Setting	Disable		8	
7	16#8000:16#07	CH6 Mode Setting	Disable		8	
8	16#8000:16#08	CH7 Mode Setting	Disable		8	
9	16#8001:16#01	CH0 Calibration Offset	0		32	
10	16#8001:16#02	CH1 Calibration Offset	0		32	
11	16#8001:16#03	CH2 Calibration Offset	0		32	
12	16#8001:16#04	CH3 Calibration Offset	0		32	
13	16#8001:16#05	CH4 Calibration Offset	0		32	
14	16#8001:16#06	CH5 Calibration Offset	0		32	
15	16#8001:16#07	CH6 Calibration Offset	0		32	
16	16#8001:16#08	CH7 Calibration Offset	0		32	

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

(3) All Parameters

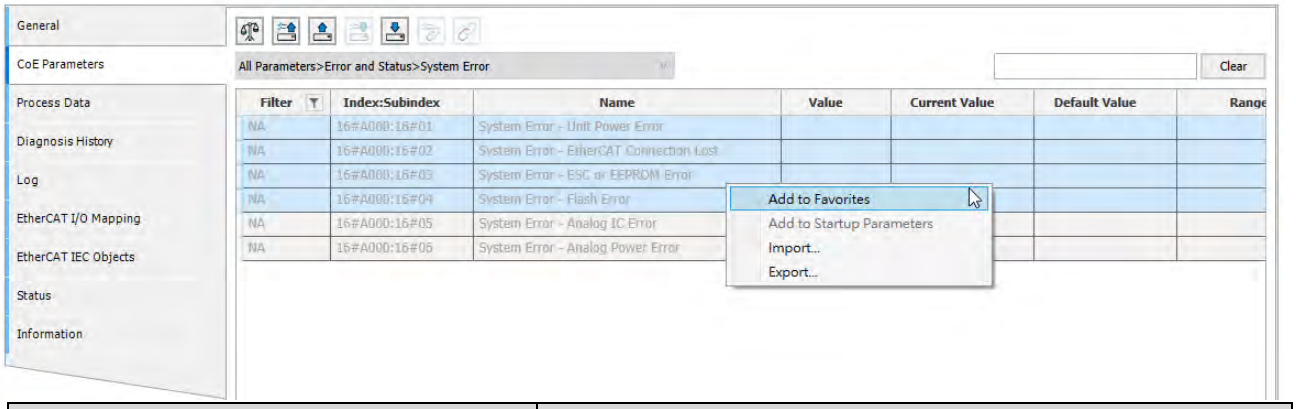
- You can find all the CoE parameters here. Click  on the toolbar to go into online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Filter	Index:Subindex	Name	Value	Current Value	Default Value	Ra
NA	16#8002:16#04	Calibration Gain - CH3 Calibration Gain	1		1	0.9 ~ 1.1
NA	16#8002:16#05	Calibration Gain - CH4 Calibration Gain	1		1	0.9 ~ 1.1
NA	16#8002:16#06	Calibration Gain - CH5 Calibration Gain	1		1	0.9 ~ 1.1
NA	16#8002:16#07	Calibration Gain - CH6 Calibration Gain	1		1	0.9 ~ 1.1
NA	16#8002:16#08	Calibration Gain - CH7 Calibration Gain	1		1	0.9 ~ 1.1
NA	16#8003:16#01	Digital Filter Setting - CH0 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#02	Digital Filter Setting - CH1 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#03	Digital Filter Setting - CH2 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#04	Digital Filter Setting - CH3 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#05	Digital Filter Setting - CH4 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#06	Digital Filter Setting - CH5 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#07	Digital Filter Setting - CH6 Digital Filter Setting	Inactive		Inactive	
NA	16#8003:16#08	Digital Filter Setting - CH7 Digital Filter Setting	Inactive		Inactive	
NA	16#8004:16#01	Moving Average Times - CH0 Moving Average Ti...	10		10	0 ~ 100
NA	16#8004:16#02	Moving Average Times - CH1 Moving Average Ti...	10		10	0 ~ 100
NA	16#8004:16#03	Moving Average Times - CH2 Moving Average Ti...	10		10	0 ~ 100
NA	16#8004:16#04	Moving Average Times - CH3 Moving Average Ti...	10		10	0 ~ 100

Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

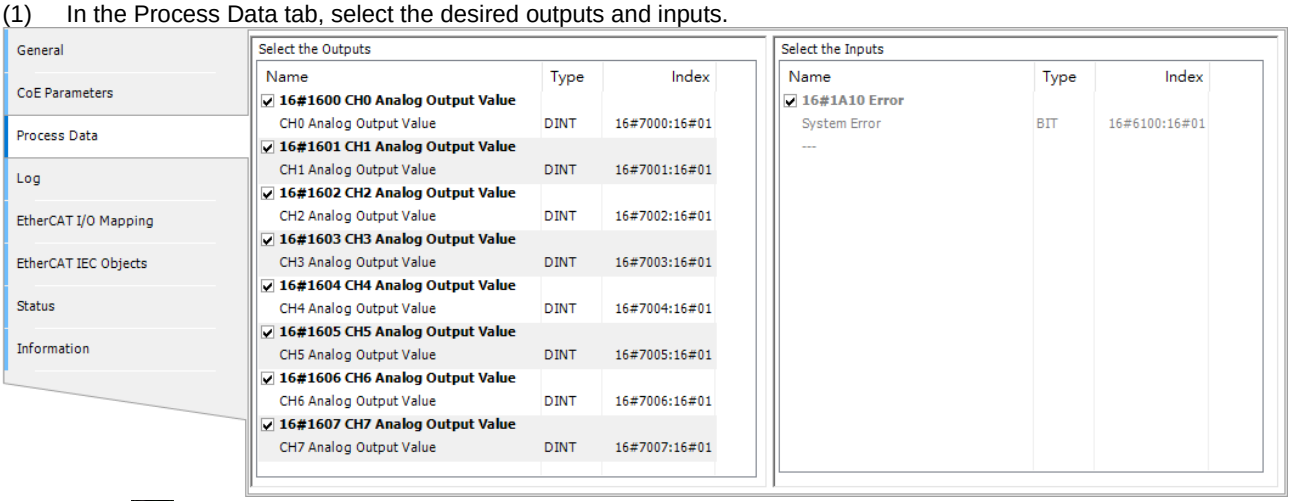
- You can select and right-click the parameter to add the selected parameter to the Favorites.



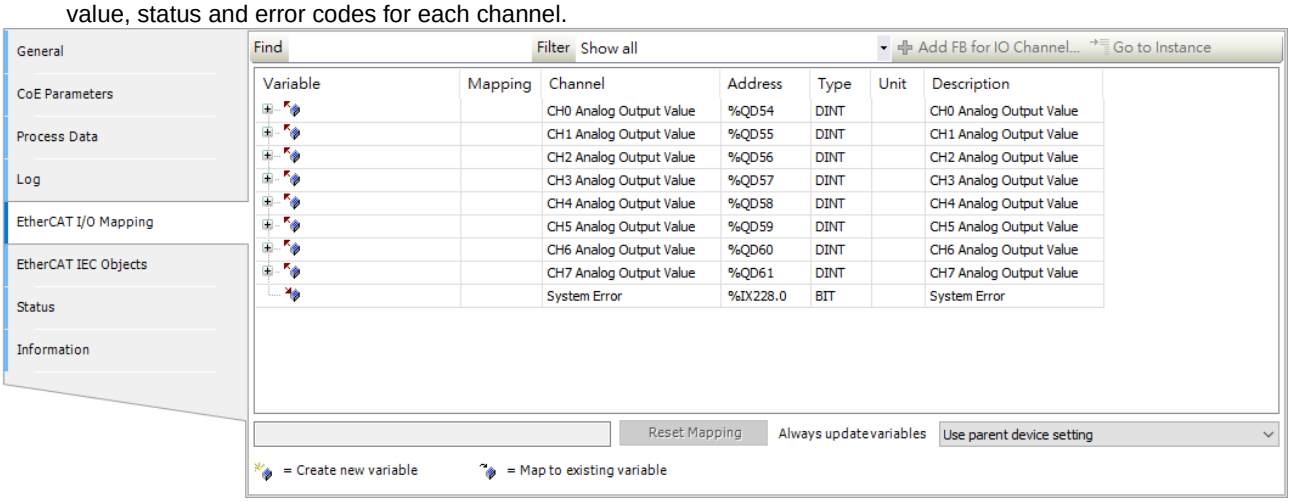
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.7.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

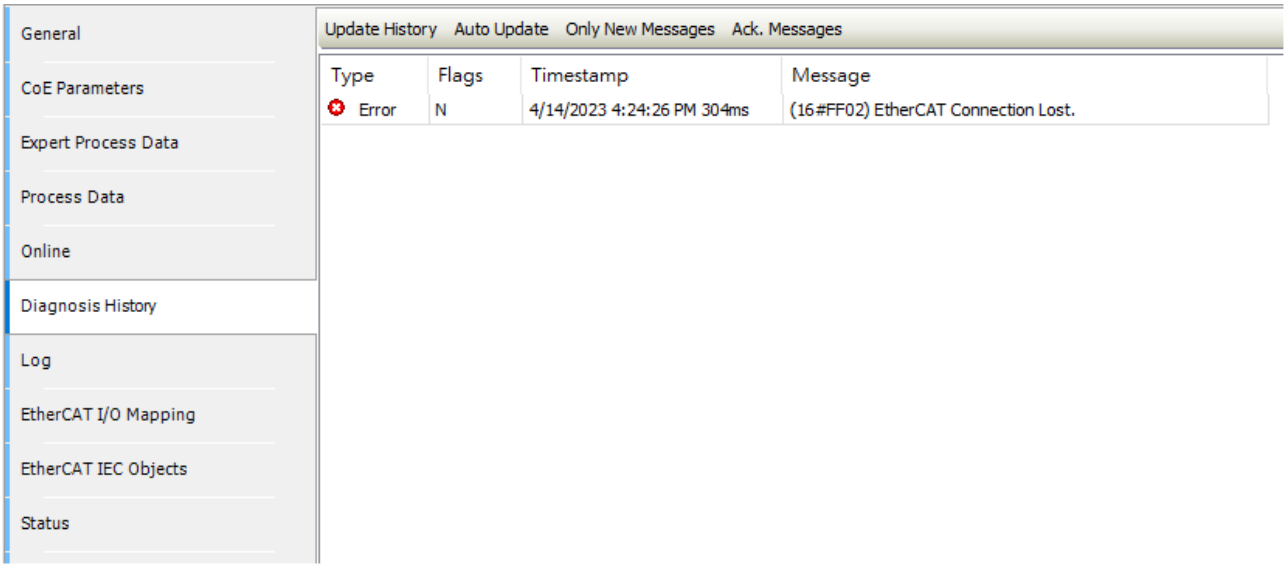


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



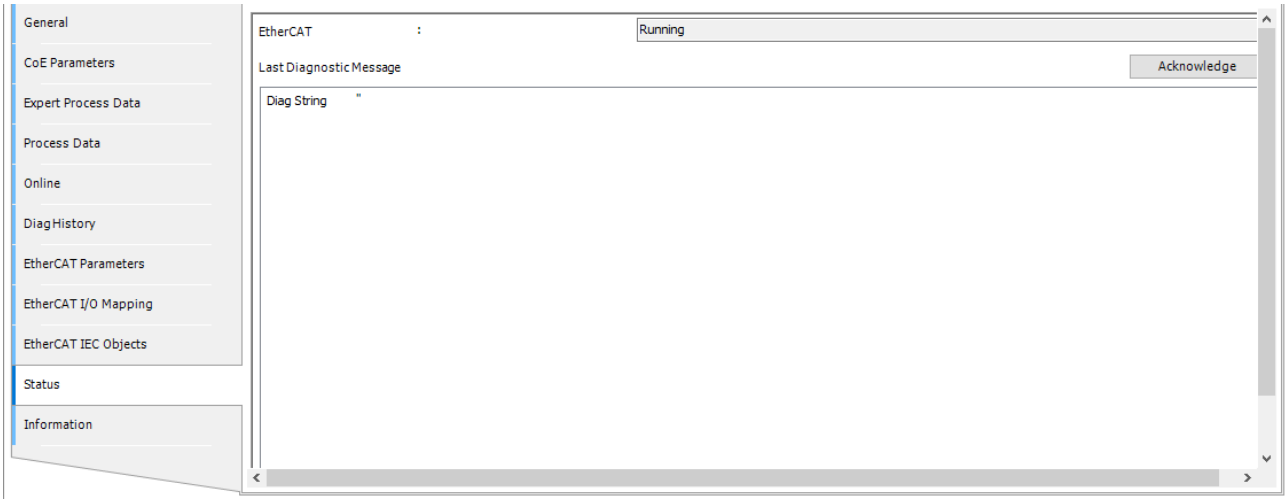
5.7.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors



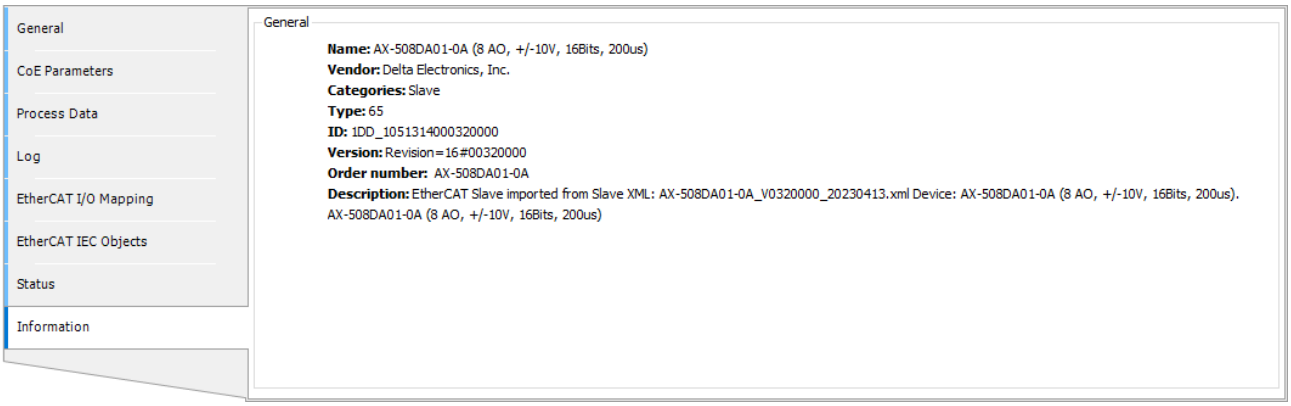
5.7.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



5.7.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.32.01.00	0.32.01.00	0.00.00.00

5.7.5 Parameter Descriptions

You can use DIADesigner-AX to set up the functions for the module by directly selecting the setting mode and parameters. For software operation, refer to section 5.7.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Mode Setting	Output mode setting or the channel is OFF.	DFB_DA_RD_ModeSetting DFB_DA_WR_ModeSetting
16#8001	Calibration Offset	Calibration - offset	DFB_DA_RD_CalOffset DFB_DA_WR_CalOffset
16#8002	Calibration Gain	Calibration - gain	DFB_DA_RD_CalGain DFB_DA_WR_CalGain
16#8003	Output Setting when EtherCAT Connection Lost DINT	Setting for output behavior when EtherCAT connection is lost (DINT)	
16#8004	Output Value Setting when EtherCAT Connection Lost DINT	Setting for output value when EtherCAT connection is lost (DINT)	
16#8005	Output Setting when Module in Stopped State DINT	Setting for output behavior when the PLC CPU is in STOP state (DINT)	
16#8006	Output Value Setting when Module in Stopped State DINT	Setting for output value when the PLC CPU is in STOP state (DINT)	
16#8010	Format	Data format setting	
16#8013	Output Setting when EtherCAT Connection Lost REAL	Setting for output behavior when EtherCAT connection is lost (floating-point)	
16#8014	Output Value Settings when EtherCAT Connection Lost REAL	Setting for output value when EtherCAT connection is lost (floating-point)	
16#8015	Output Settings when Module in Stopped State REAL	Setting for output behavior when the PLC CPU is in STOP state (floating-point)	
16#8016	Output Value Settings when Module in Stopped State REAL	Setting for output value when the PLC CPU is in STOP state (floating-point)	
16#8030	Scale Upper Limit REAL	Scale upper limit setting (floating-point)	DFB_DA_RD_ScaleUpperLimit DFB_DA_WR_ScaleUpperLimit
16#8031	Scale Lower Limit REAL	Scale lower limit setting (floating-point)	DFB_DA_RD_ScaleLowerLimit DFB_DA_WR_ScaleLowerLimit
16#8100	DAC Raw Data	Raw data	

5.7.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Explanation**

When the AX5 series PLC is used as the controller, the module status is synchronized with the status of AX5 series PLC CPU and it will be either 1 (Run) or 2 (Stop). When the status of AX5 series PLC CPU is Stop, the output modules will act according to the parameter settings. As for the input modules, they are not affected. If you use other PLC (NOT AX5 Series PLC) as the controller, the module status will be 0, which indicates it is controlled by EtherCAT State Machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

5.7.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Explanation**

Users write a command value into the module and the module will execute the command accordingly. After execution, the module will respond with a corresponding value to show if the execution is success or not.

- **User command**

Command value	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

5.7.5.3 Mode Setting

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Mode Setting	Voltage mode setting	USINT	RW	0
	16#02	CH1 Mode Setting		USINT	RW	0
	16#03	CH2 Mode Setting		USINT	RW	0
	16#04	CH3 Mode Setting		USINT	RW	0
	16#05	CH4 Mode Setting		USINT	RW	0
	16#06	CH5 Mode Setting		USINT	RW	0
	16#07	CH6 Mode Setting		USINT	RW	0
	16#08	CH7 Mode Setting		USINT	RW	0

- **Explanation**

Select the mode to set the channel to ON.

- **Supported modes**

Mode	Mode range	DINT range
0	Disable	NA
1	-10 V–10 V	±30000
2	0 V–10 V	0–30000
3	-5 V–5 V	±30000
4	0 V–5 V	0–30000
5	1 V–5 V	0–30000

5.7.5.4 Calibration

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Calibration Offset	Offset Setting range: no limit	REAL	RW	0
	16#02	CH1 Calibration Offset		REAL	RW	0
	16#03	CH2 Calibration Offset		REAL	RW	0
	16#04	CH3 Calibration Offset		REAL	RW	0
	16#05	CH4 Calibration Offset		REAL	RW	0
	16#06	CH5 Calibration Offset		REAL	RW	0
	16#07	CH6 Calibration Offset		REAL	RW	0
	16#08	CH7 Calibration Offset		REAL	RW	0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9–1.1	REAL	RW	1.0
	16#02	CH1 Calibration Gain		REAL	RW	1.0
	16#03	CH2 Calibration Gain		REAL	RW	1.0
	16#04	CH3 Calibration Gain		REAL	RW	1.0
	16#05	CH4 Calibration Gain		REAL	RW	1.0
	16#06	CH5 Calibration Gain		REAL	RW	1.0
	16#07	CH6 Calibration Gain		REAL	RW	1.0
	16#08	CH7 Calibration Gain		REAL	RW	1.0

- **Explanation**

When there is an obvious difference between output values and actual values, you can change Offset and Gain to correct the output curve. The formula is

$$Output = (Input \times Gain) + Offset$$

Example

The mode of channels is -10.0 V to +10.0 V. Gain is 1 and Offset is 0 by default, and the corresponding value is -10.0 V to +10.0 V. If Gain is set to 0.9 and Offset is set to 2, the value after calibration is -7.0 V to +11.0 V.

5.7.5.5 Output Setting and Value Setting when EtherCAT Connection Lost

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Output Setting when EtherCAT Connection Lost DINT	Setting for output behavior (DINT)	USINT	RW	0
	16#02	CH1 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#03	CH2 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#04	CH3 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#05	CH4 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#06	CH5 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#07	CH6 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#08	CH7 Output Setting when EtherCAT Connection Lost DINT		USINT	RW	0
16#8004	16#01	CH0 Output Value Setting when EtherCAT Connection Lost DINT	Setting for output value (DINT); Setting value: -30000 – 30000	USINT	RW	0
	16#02	CH1 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#03	CH2 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#04	CH3 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#05	CH4 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#06	CH5 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#07	CH6 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
	16#08	CH7 Output Value Setting when EtherCAT Connection Lost DINT		USINT	RW	0
16#8013	16#01	CH0 Output Settings when EtherCAT Connection Lost REAL	Setting for output behavior (floating-point)	USINT	RW	0
	16#02	CH1 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#03	CH2 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#04	CH3 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#05	CH4 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#06	CH5 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#07	CH6 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#08	CH7 Output Settings when EtherCAT Connection Lost REAL		USINT	RW	0
16#8014	16#01	CH0 Output Value Settings when EtherCAT Connection Lost REAL	Setting for output value (floating-point); Setting value: no limit	USINT	RW	0
	16#02	CH1 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#03	CH2 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#04	CH3 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0

Index	Subindex	Name	Description	Data Type	Attr.	Default
	16#05	CH4 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#06	CH5 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#07	CH6 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0
	16#08	CH7 Output Value Settings when EtherCAT Connection Lost REAL		USINT	RW	0

- **Explanation**

When the EtherCAT connection is lost, the output channel will act according to the mode that user sets. When the mode is set to 1 (User-Define Value), the output channel will act according to the settings in “Output Value Settings when EtherCAT Connection Lost”.

- **Setting for output behavior**

Mode	Name	Description
0	Set to Default	The output sets to default.
1	User-Define Value	The output is as the settings in Output Value Settings when EtherCAT Connect Lost.
2	Lower Limit	The output sets to the minimum limit.
3	Higher Limit	The output sets to the maximum limit.
4	Keep Last Value	The output keeps the last value.

5.7.5.6 Output Setting and Value Setting when Module in Stopped State

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8005	16#01	CH0 Output Setting when Module in Stopped State DINT	Setting for output behavior (DINT)	USINT	RW	0
	16#02	CH1 Output Setting when Module in Stopped State DINT		USINT	RW	0
	16#03	CH2 Output Setting when Module in Stopped State DINT		USINT	RW	0
	16#04	CH3 Output Setting when Module in Stopped State DINT		USINT	RW	0
	16#05	CH4 Output Setting when Module in Stopped State DINT		USINT	RW	0
	16#06	CH5 Output Setting when Module in Stopped State DINT		USINT	RW	0
	16#07	CH6 Output Setting when Module in Stopped State DINT		USINT	RW	0
	16#08	CH7 Output Setting when Module in Stopped State DINT		USINT	RW	0
16#8006	16#01	CH0 Output Value Setting when Module in Stopped State DINT	Setting for output value (DINT); Setting value: -30000 – 30000	USINT	RW	0
	16#02	CH1 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
	16#03	CH2 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
	16#04	CH3 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
	16#05	CH4 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
	16#06	CH5 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
	16#07	CH6 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
	16#08	CH7 Output Value Setting when Module in Stopped State DINT		USINT	RW	0
16#8015	16#01	CH0 Output Settings when Module in Stopped State REAL	Setting for output behavior (floating-point)	USINT	RW	0
	16#02	CH1 Output Settings when Module in Stopped State REAL		USINT	RW	0
	16#03	CH2 Output Settings when Module in Stopped State REAL		USINT	RW	0
	16#04	CH3 Output Settings when Module in Stopped State REAL		USINT	RW	0
	16#05	CH5 Output Settings when Module in Stopped State REAL		USINT	RW	0
	16#06	CH6 Output Settings when Module in Stopped State REAL		USINT	RW	0
	16#07	CH7 Output Settings when Module in Stopped State REAL		USINT	RW	0
	16#08	CH8 Output Settings when Module in Stopped State REAL		USINT	RW	0
16#8016	16#01	CH0 Output Value Settings when Module in Stopped State REAL	Setting for output value (floating-point); Setting value: no limit	USINT	RW	0
	16#02	CH1 Output Value Settings when Module in Stopped State REAL		USINT	RW	0
	16#03	CH2 Output Value Settings when Module in Stopped State REAL		USINT	RW	0
	16#04	CH3 Output Value Settings when Module in Stopped State REAL		USINT	RW	0

Index	Subindex	Name	Description	Data Type	Attr.	Default
	16#05	CH0 Output Value Settings when Module in Stopped State REAL		USINT	RW	0
	16#06	CH1 Output Value Settings when Module in Stopped State REAL		USINT	RW	0
	16#07	CH2 Output Value Settings when Module in Stopped State REAL		USINT	RW	0
	16#08	CH3 Output Value Settings when Module in Stopped State REAL		USINT	RW	0

- **Explanation**

When the PLC makes the module enter STOP state, the output channel will act according to the mode that user sets. When the mode is set to 1 (User-Define Value), the output channel will act according to the settings in “Output Value Settings when EtherCAT Connection Lost”.

- **Setting for output behavior**

Mode	Name	Description
0	Set to Default	The output sets to default.
1	User-Define Value	The output is as the settings in Output Value Settings when EtherCAT Connect Lost.
2	Lower Limit	The output sets to the minimum limit.
3	Higher Limit	The output sets to the maximum limit.
4	Keep Last Value	The output keeps the last value.

5.7.5.7 Format

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8010	16#01	Format	0: DINT Format 1: REAL Format	USINT	RW	0

- **Explanation**

You can set the format and the decimal places according to your demand.
When the data format is set to DINT Format, set up the DINT parameters which are with “DINT” following a parameter name. When the data format is set to REAL Format, set up the REAL parameters which are with “REAL” following a parameter name.

5.7.5.8 Scale

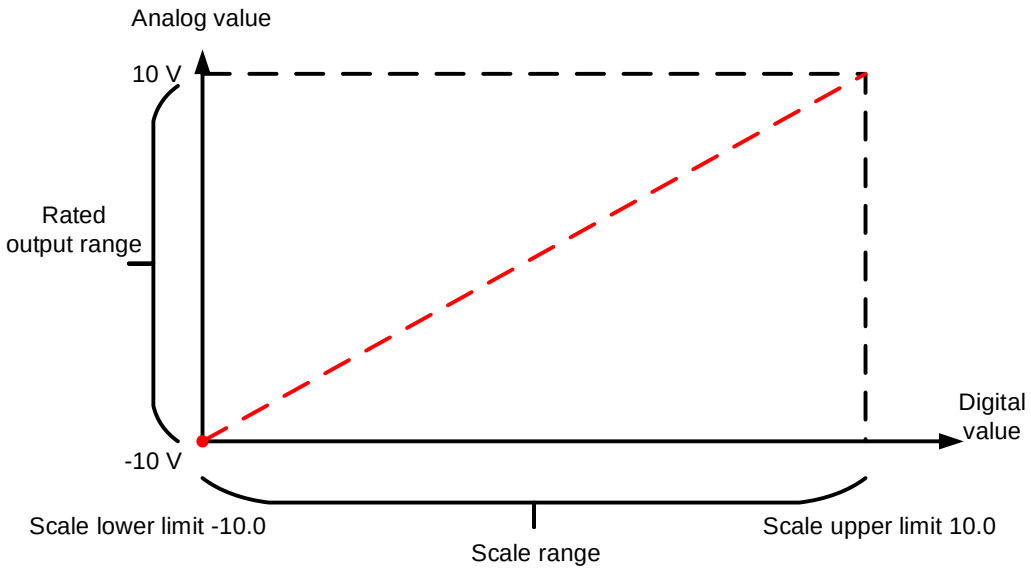
Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8030	16#01	CH0 Scale Upper Limit REAL	Scale upper limit setting; Setting range: no limit	REAL	RW	10
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	10
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	10
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	10
	16#05	CH4 Scale Upper Limit REAL		REAL	RW	10
	16#06	CH5 Scale Upper Limit REAL		REAL	RW	10
	16#07	CH6 Scale Upper Limit REAL		REAL	RW	10
	16#08	CH7 Scale Upper Limit REAL		REAL	RW	10
16#8031	16#01	CH0 Scale Lower Limit REAL	Scale lower limit setting; Setting range: no limit	REAL	RW	-10
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-10
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-10
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-10
	16#05	CH0 Scale Lower Limit REAL		REAL	RW	-10
	16#06	CH1 Scale Lower Limit REAL		REAL	RW	-10
	16#07	CH2 Scale Lower Limit REAL		REAL	RW	-10
	16#08	CH3 Scale Lower Limit REAL		REAL	RW	-10

- **Explanation**

You can set the scale range based on the analog specification for channels when the data format is REAL (floating-point).

- **Example**

If the mode of channels is -10 V to +10 V, the analog range is -10 V to +10 V; the scale upper limit is 10.0 and the scale lower limit is -10.0. The digital values -10.0 to +10.0 correspond to the analog values -10 V to +10 V, as the example below shows.



5.7.5.9 DAC Raw Data

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8100	16#01	CH0 DAC Raw data	Raw data	DINT	RO	0
	16#02	CH1 DAC Raw data		DINT	RO	0
	16#03	CH2 DAC Raw data		DINT	RO	0
	16#04	CH3 DAC Raw data		DINT	RO	0
	16#05	CH4 DAC Raw data		DINT	RO	0
	16#06	CH5 DAC Raw data		DINT	RO	0
	16#07	CH6 DAC Raw data		DINT	RO	0
	16#08	CH7 DAC Raw data		DINT	RO	0

- **Explanation**

Raw data is the source data that has not been processed or converted from analog to digital.

5.7.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system.

5.7.6.1 FreeRun Mode

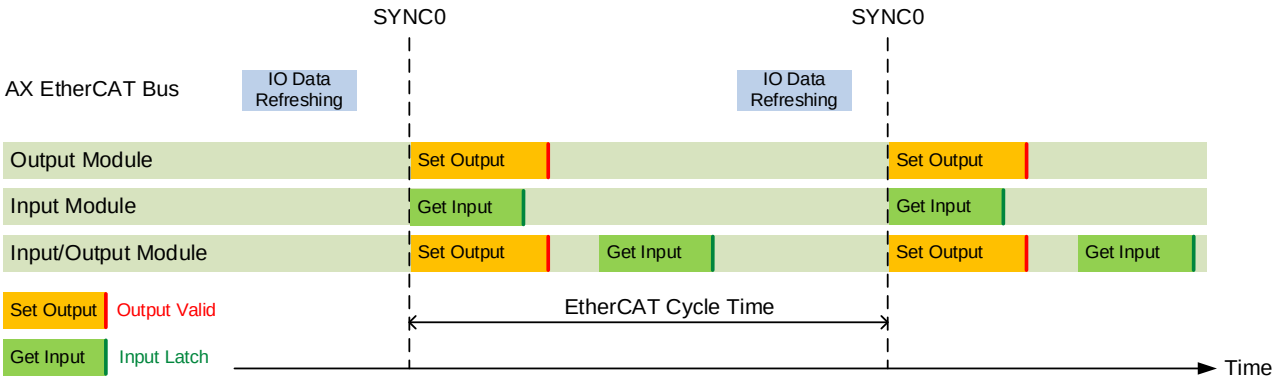
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

5.7.6.2 DC Mode

The I/O values of various modules are refreshed according to synchronization modes, SYNC0 as well as SYNC0 and SYNC1. However the actual output time for different modules varies, due to the differences of firmware versions and hardware.

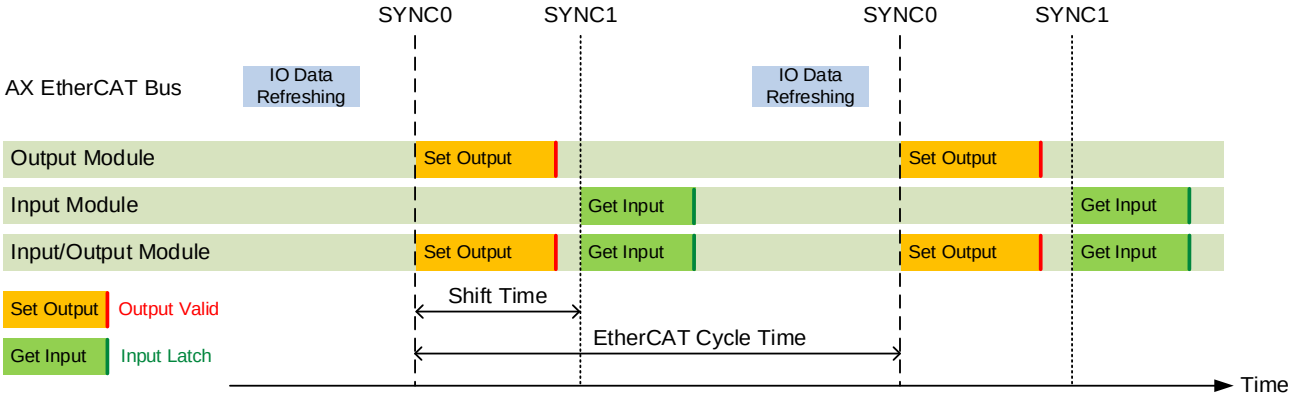
- **SYNC0**

Using the SYNC signal SYNC0 to refresh the values of output channels among modules at the same time.



- **SYNC0 + SYNC1**

Using SYNC0 to refresh values of output channels and using SYNC1 to refresh values of input channels among modules at the same time. The shift time of SYNC0 and SYNC1 can be modified with DIADesigner-AX.



5.7.7 Process Data

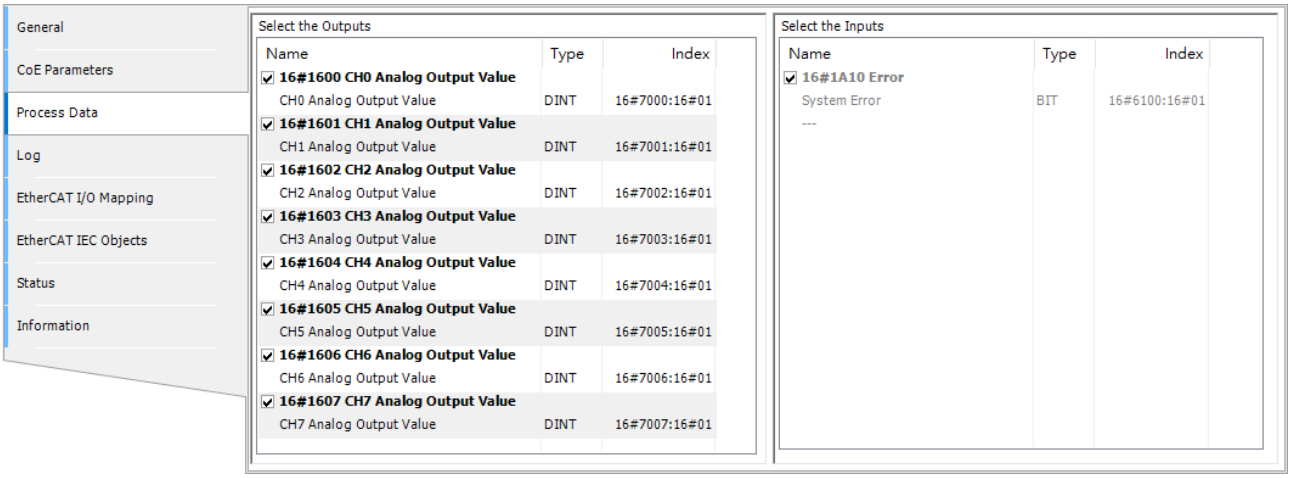
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#7000	16#01	CH0 Analog Output Value	Analog output value; Setting range: -33000–33000	DINT	RO	0
16#7001	16#01	CH1 Analog Output Value		DINT	RO	0
16#7002	16#01	CH2 Analog Output Value		DINT	RO	0
16#7003	16#01	CH3 Analog Output Value		DINT	RO	0
16#7004	16#01	CH4 Analog Output Value		DINT	RO	0
16#7005	16#01	CH5 Analog Output Value		DINT	RO	0
16#7006	16#01	CH6 Analog Output Value		DINT	RO	0
16#7007	16#01	CH7 Analog Output Value		DINT	RO	0
16#6100	16#01	System Error	System error	BOOL	RO	0

5.7.7.1 Process Data

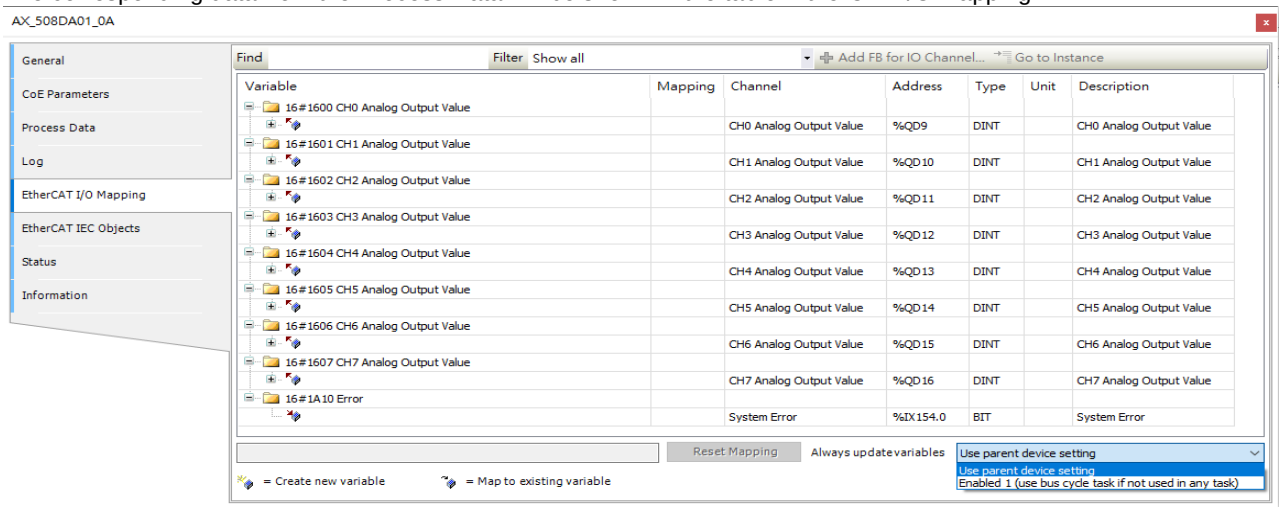
Go to the Process Data tab and select the data that you'd like to monitor.

- Analog Output Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error: It is selected by default. The grayed out part cannot be modified.



5.7.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



5.7.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

5.7.8 Troubleshooting

In the Diagnosis History tab, the error information that has occurred on the module is recorded. In the Status tab, the current information of system error (16#A000) is displayed. In the CoE Parameters tab, you can view the error status through Index/SubIndex of the All Parameter list.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Connection Lost	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#05	(16#FF05) Analog IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#06	(16#FF06) Analog Power Error	ON	OFF	If the problem persists, contact the local authorized distributors.

5.8 AX-502TC10-0B

AX-502TC10-0B, a temperature measurement module, converts the values received from the external thermocouple sensors into digital signals. You can select either Celsius or Fahrenheit as the unit of measurement. This section describes its specifications, wirings and operations.

5.8.1 Specifications

Item		Specification
Input points		2
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		Free Run mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		70 g
Electrical specification	Input form	Differential input
	Sensor type	J, K, T, E, L, U, N, R, S, B, C (WRe5-26), PLII, ±130 mV
	Connection type	2-Wire
	Resolution	TC mode: 0.1 °C/0.18°F[*1] ±130 mV mode: 0.1 mV
	Temperature measurement accuracy/error	±0.3%: 25℃(F.S.) ([*2], [*3]) ±0.5%: 0~60℃ (F.S.) ±1%: <-20~0℃ (F.S.)
	Rated input absolute range	±130 mV
	Input impedance	More than 20 KΩ
	Conversion time	100 ms / channel
	Warm-up time	30 minutes
	Cold junction compensation error	±1.2℃
	Isolation method	Between unit power and external power: no isolation Between digital power and analog power: 500 VAC Between digital signal and analog signal: 500 VAC Between analog channels: no isolation
	Maximum power consumption (unit power)	Less than 300 mA (1.5 W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Protection	Yes
	Short Circuit Protection (SCP)	--
	Input power protection (voltage range)	±30V
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	--
	Filter function	AVG, FIR, IIR

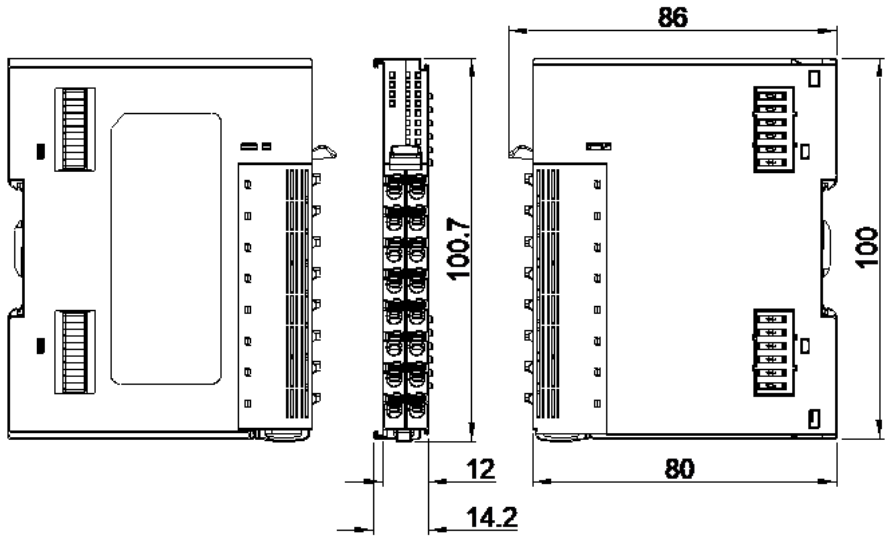
*1. The temperature unit is 0.1 °C/0.18 °F. If Fahrenheit is selected as the temperature unit, the second decimal place is not displayed.

*2. T: -200°C–100°C (±0.35%)

*3. B: 200°C–300°C (±0.4%)

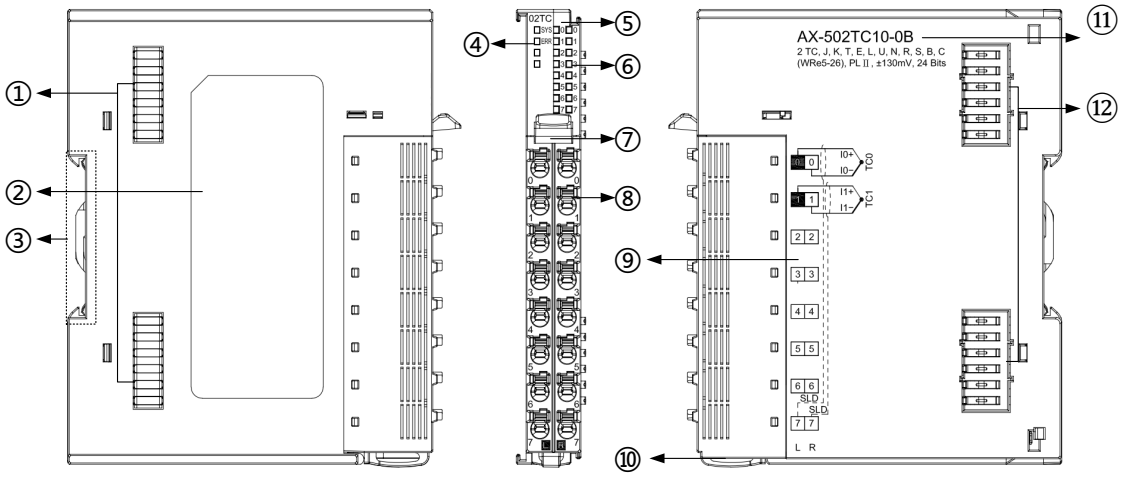
5.8.2 Dimensions and Parts

- **Dimensions**



Unit: mm

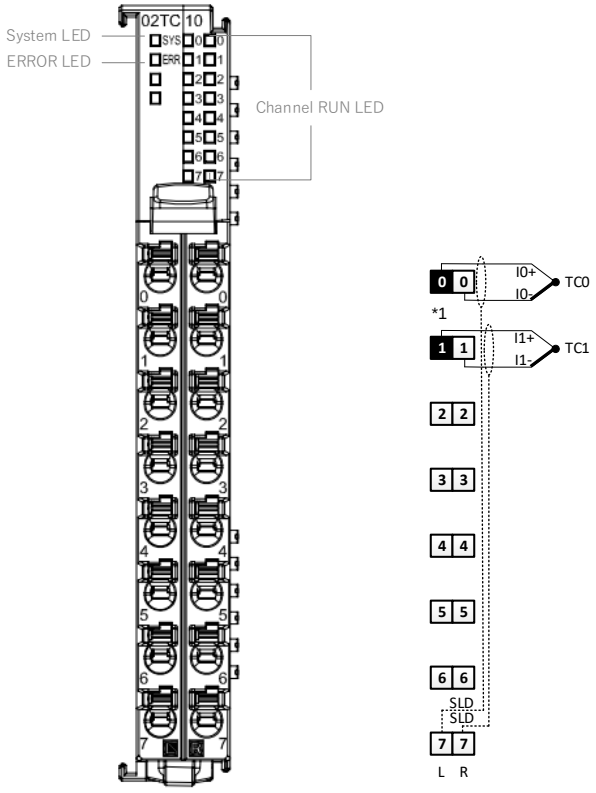
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

5.8.3 Arrangement of Terminals, LED Indicators and Wiring

5.8.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

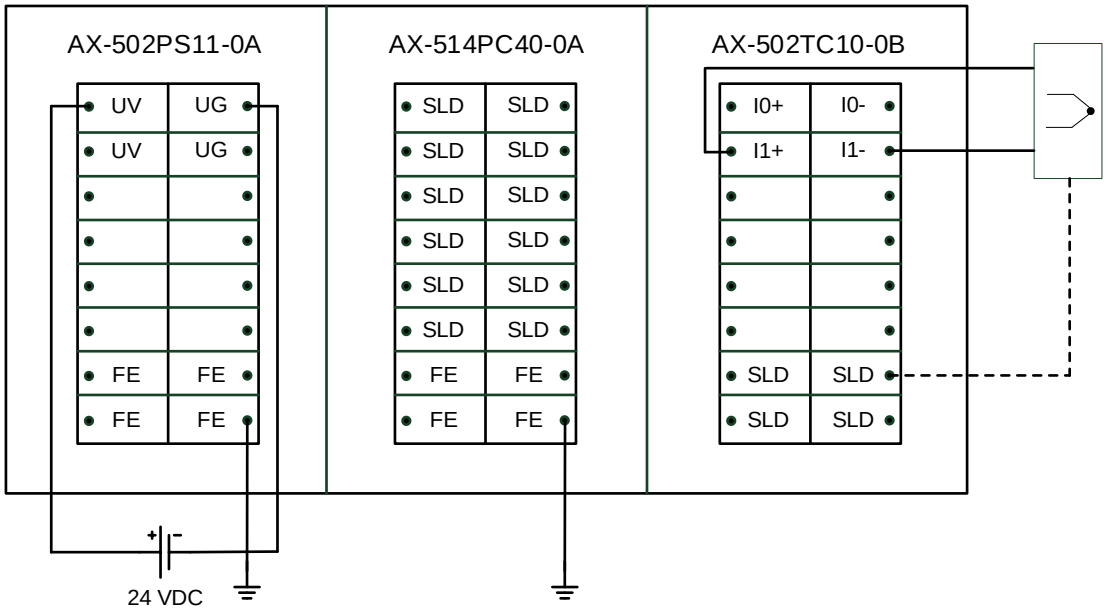
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0+	Channel 0: sensor positive input	R0	I0-	Channel 0: sensor negative input
L1	I1+	Channel 1: sensor positive input	R1	I1-	Channel 1: sensor negative input
L2	--	--	R2	--	--
L3	--	--	R3	--	--
L4	--	--	R4	--	--
L5	--	--	R5	--	--
L6	--	--	R6	--	--
L7	SLD	--	R7	SLD	--

5.8.3.2 LED Indicators

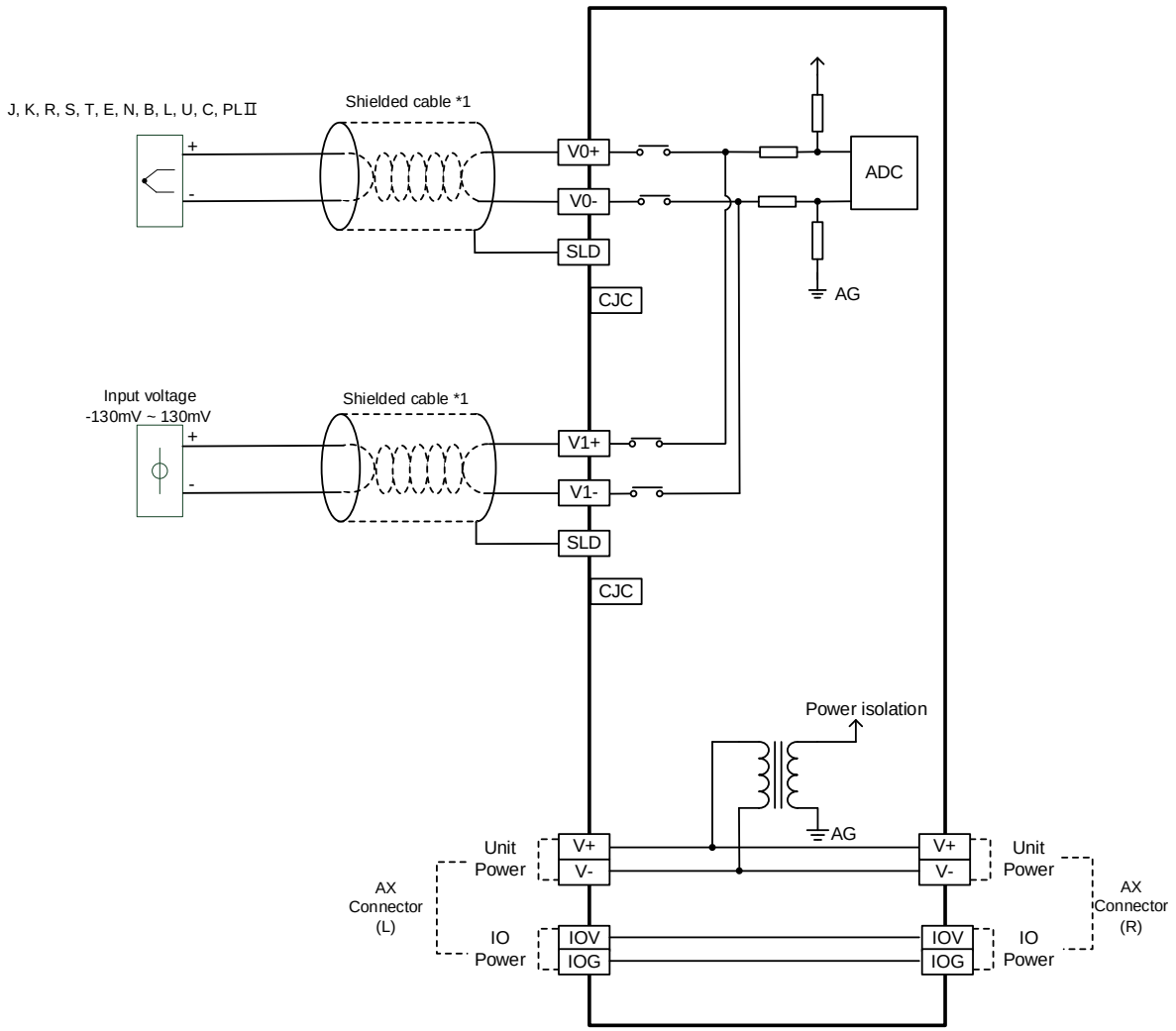
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking (1s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1s)	An error occurs on the application.
			Blinking (0.2s)	An error occurs on the hardware.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

5.8.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



*1. Use shielded twisted pair cables for Type .J, K, R, S, T, E, N, B, L, U, C, and PLⅡ thermocouples, and keep them separate from power cables and other cables which generate noise.

5.8.4 Settings in DIADesigner-AX

The software DIADesigner-AX is the programming tool for the AX Series PLCs. This section introduces some basic operations and settings.

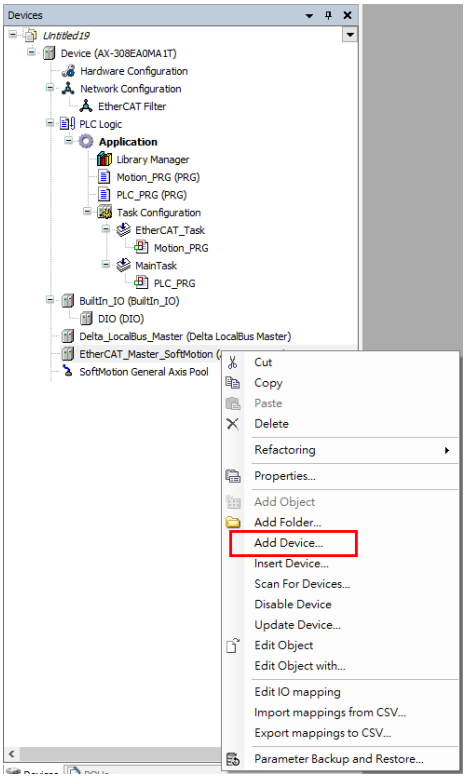
5.8.4.1 Basic Operation

(1) Double-click the DIADesigner-AX icon to open the software and create a new project.

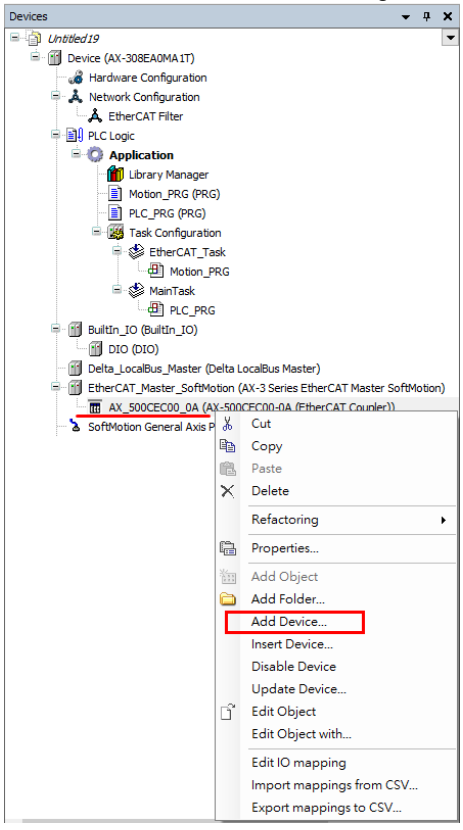
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Add Device…** to select and add System Coupler.

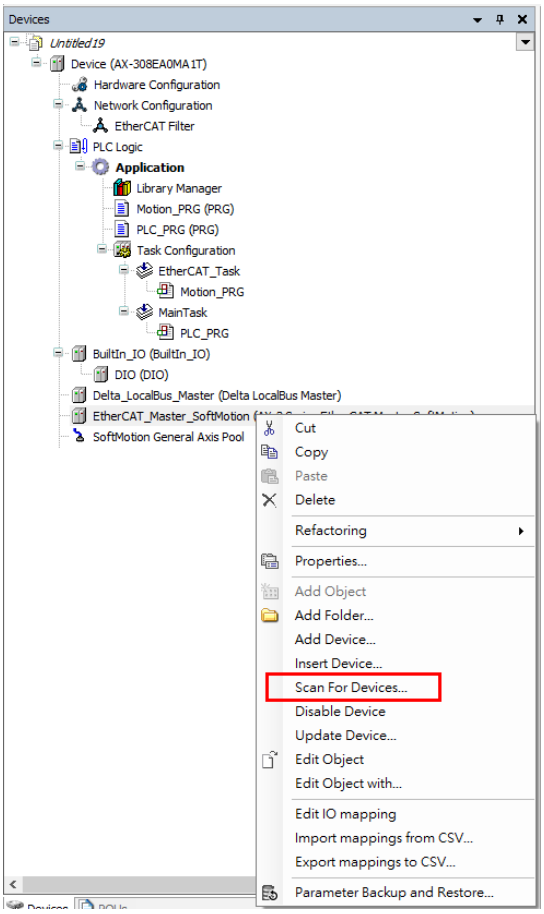


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

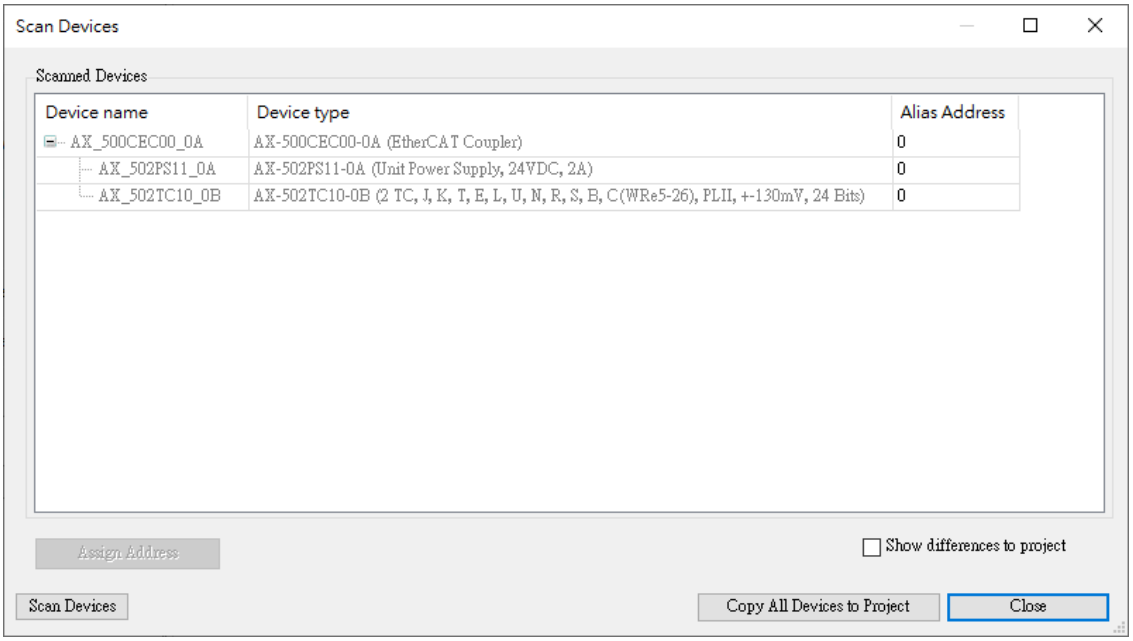


- Method 2: Scan to add the modules in.

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Scan for Devices…**.

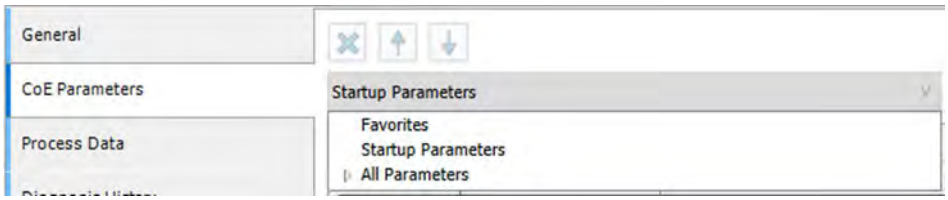


After the auto-scan is over, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



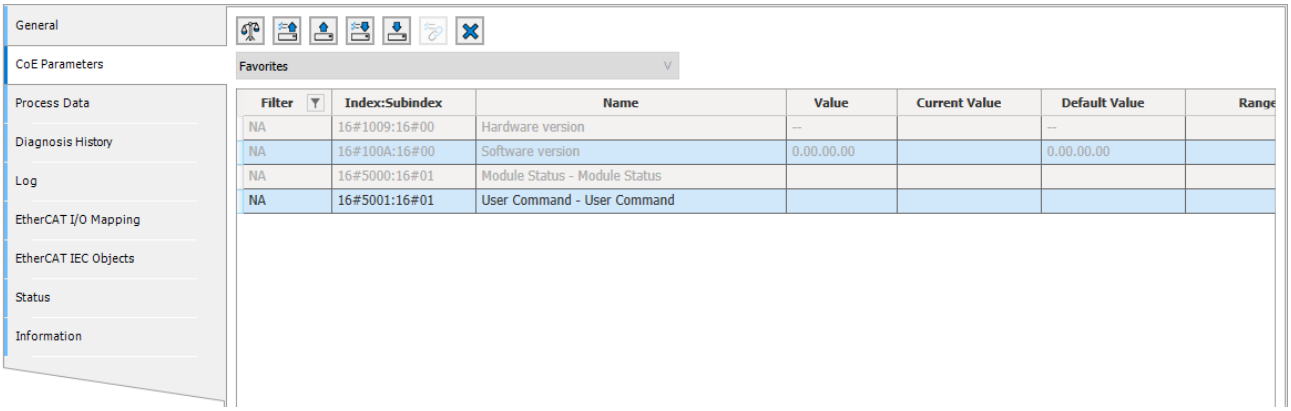
5.8.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.



(1) Favorites

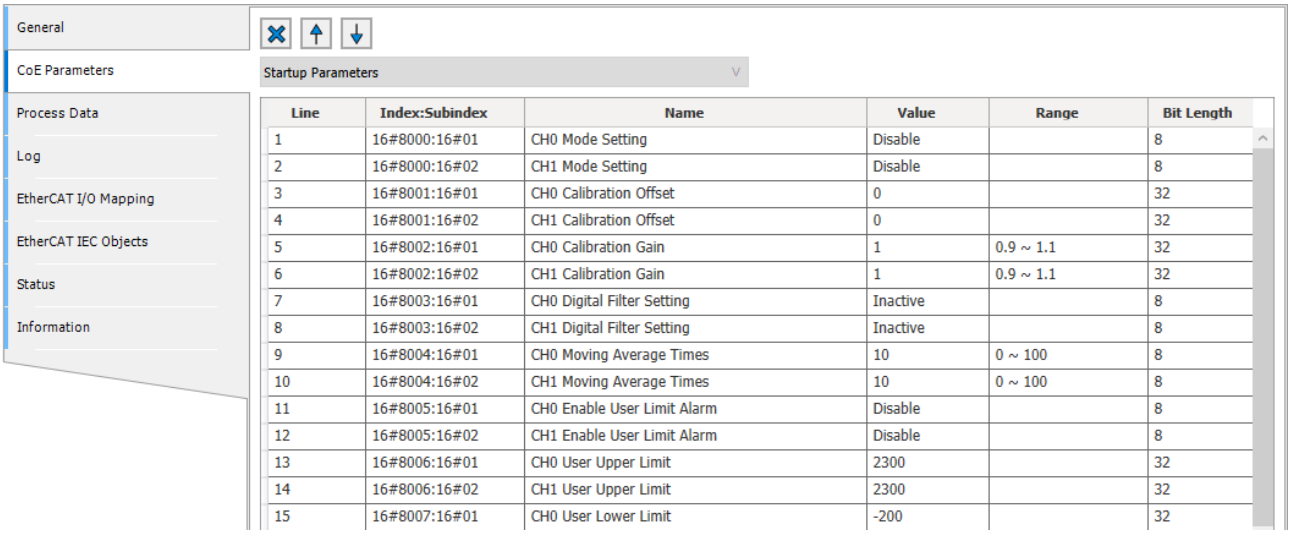
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

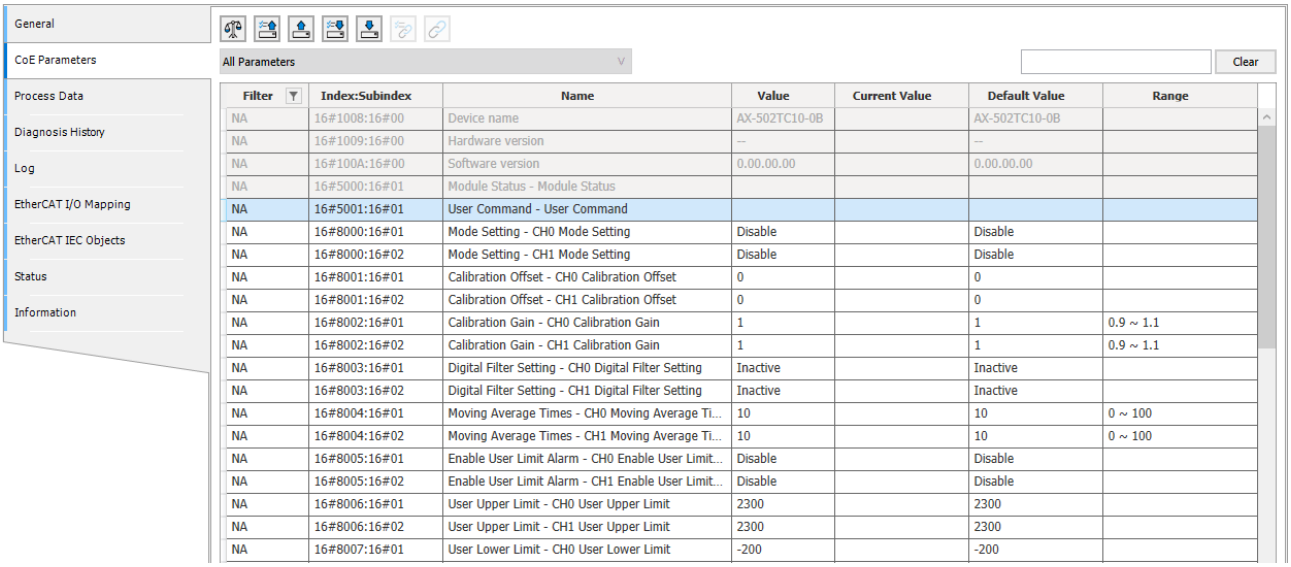


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8001:16#01	CH0 Calibration Offset	0		32
4	16#8001:16#02	CH1 Calibration Offset	0		32
5	16#8002:16#01	CH0 Calibration Gain	1	0.9 ~ 1.1	32
6	16#8002:16#02	CH1 Calibration Gain	1	0.9 ~ 1.1	32
7	16#8003:16#01	CH0 Digital Filter Setting	Inactive		8
8	16#8003:16#02	CH1 Digital Filter Setting	Inactive		8
9	16#8004:16#01	CH0 Moving Average Times	10	0 ~ 100	8
10	16#8004:16#02	CH1 Moving Average Times	10	0 ~ 100	8
11	16#8005:16#01	CH0 Enable User Limit Alarm	Disable		8
12	16#8005:16#02	CH1 Enable User Limit Alarm	Disable		8
13	16#8006:16#01	CH0 User Upper Limit	2300		32
14	16#8006:16#02	CH1 User Upper Limit	2300		32
15	16#8007:16#01	CH0 User Lower Limit	-200		32

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

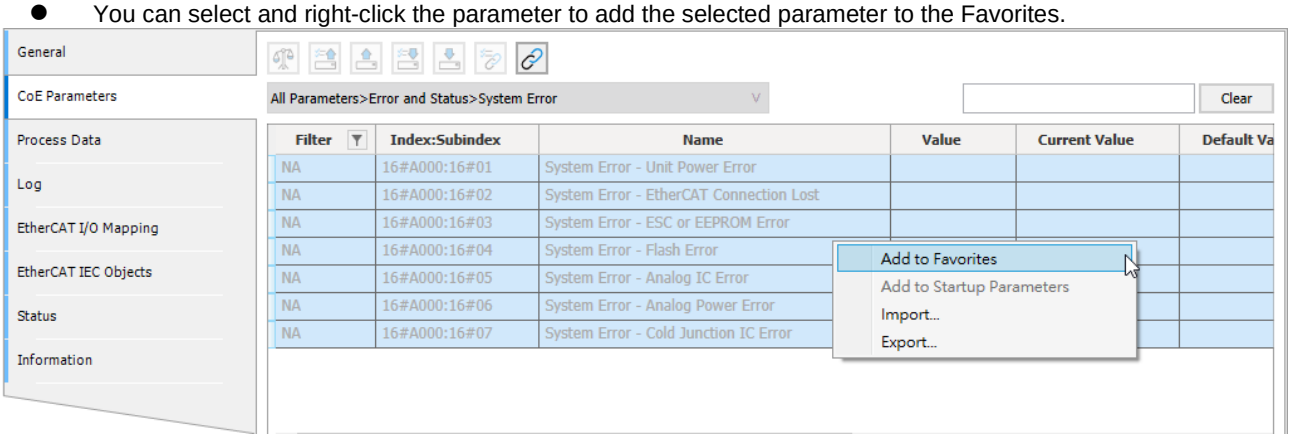
(3) All Parameters

- You can find all the CoE parameters here. Click  on the toolbar to go into online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

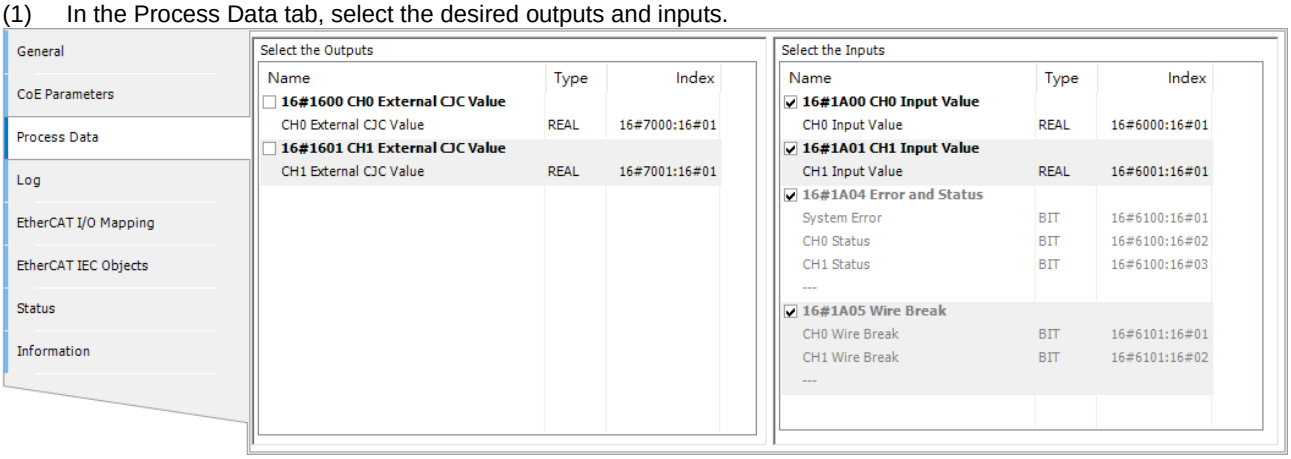
- You can select and right-click the parameter to add the selected parameter to the Favorites.



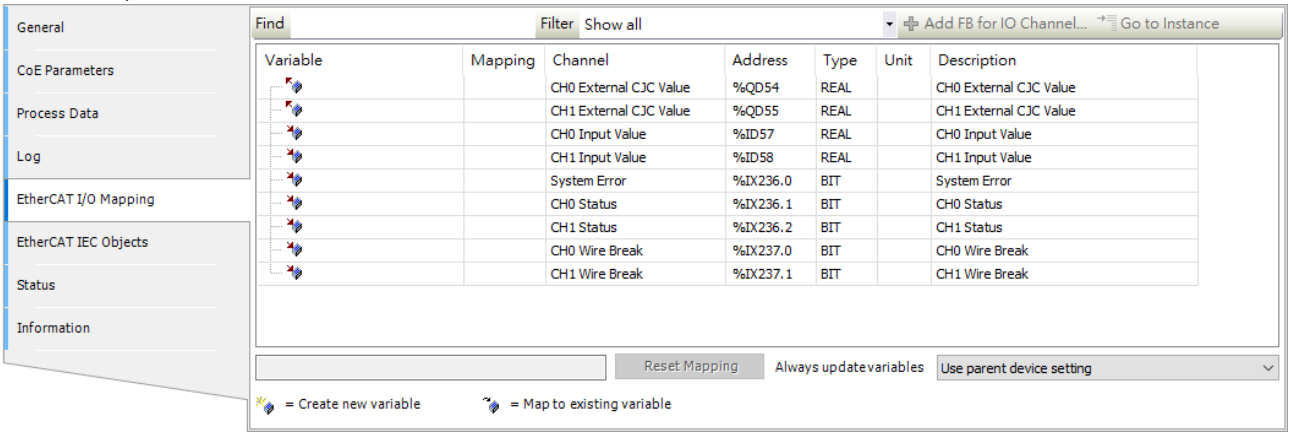
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.8.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

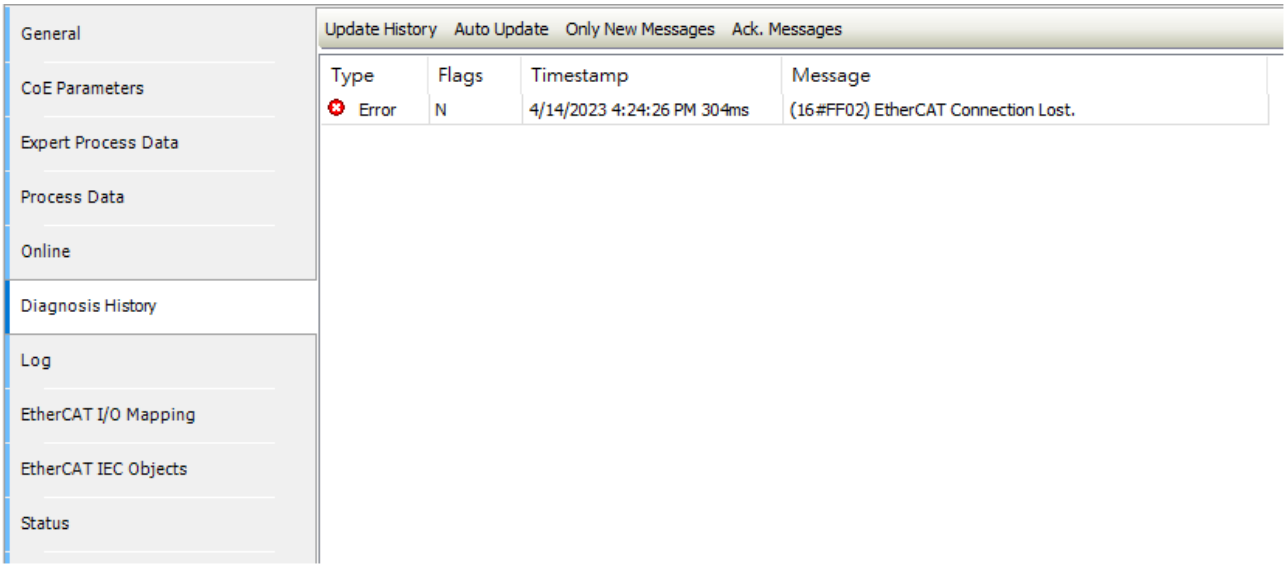


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



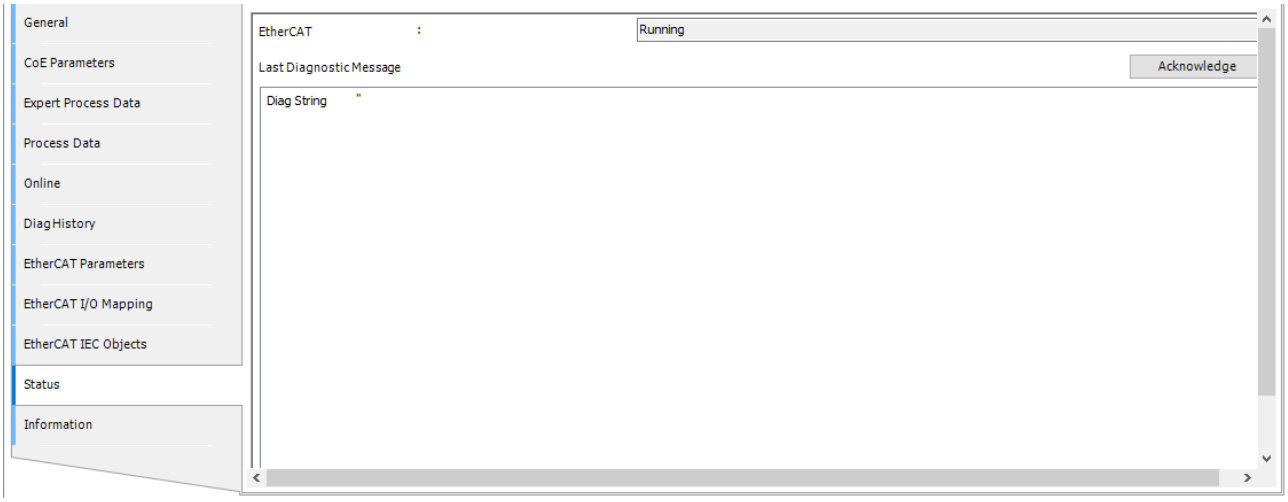
5.8.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors



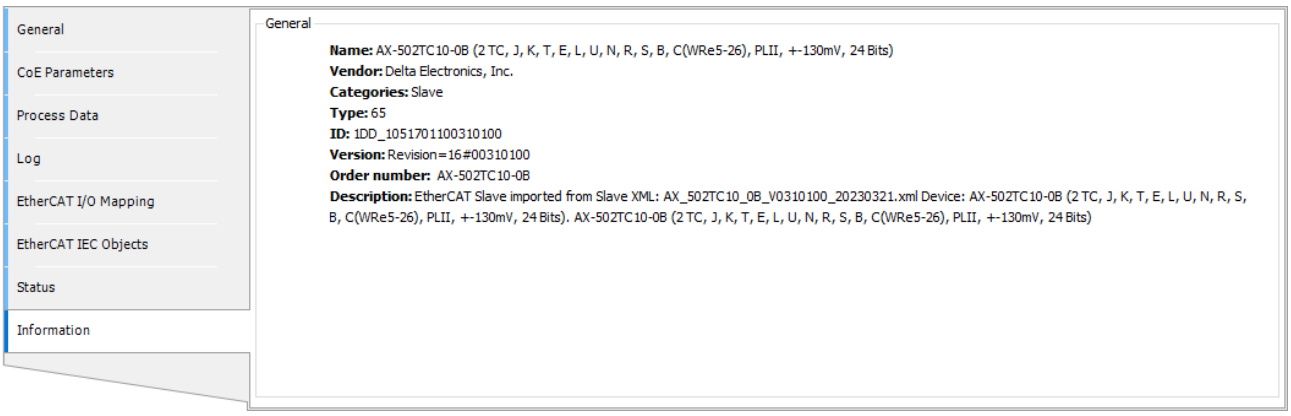
5.8.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



5.8.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.32.01.00	0.32.01.00	0.00.00.00

5.8.5 Parameter Descriptions

You can use DIADesigner-AX to set up the functions for the module by directly selecting the setting mode and parameters. For software operation, refer to section 5.8.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Mode Setting	Mode setting or the channel is OFF.	DFB_TC_RD_ModeSetting DFB_TC_WR_ModeSetting
16#8001	Calibration Offset	Calibration - offset	DFB_TC_RD_CalOffset DFB_TC_WR_CalOffset
16#8002	Calibration Gain	Calibration - gain	DFB_TC_RD_CalGain DFB_TC_WR_CalGain
16#8003	Digital Filter Setting	Digital filter setting	DFB_TC_RD_FilterSetting DFB_TC_WR_FilterSetting
16#8004	Moving Average Times	Moving average times	DFB_TC_RD_AverageTimes DFB_TC_WR_AverageTimes
16#8005	Enable User Limit Alarm DINT	Enable / disable the alarm of exceeding the user-defined limit	
16#8006	User Upper Limit DINT	User-defined upper limit	
16#8007	User Lower Limit DINT	User-defined lower limit	
16#8010	Decimal Places	Decimal places	
16#8011	Unit of Temperature	Unit of temperature	
16#8012	CJC Function	Cold junction compensation function	
16#8100	ADC Raw Data	ADC raw data	
16#8101	CJ Temperature	Temperature of cold junction	

5.8.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Explanation**

When the AX5 series PLC is used as the controller, the module status is synchronized with the status of AX5 series PLC CPU and it will be either 1 (Run) or 2 (Stop). When the status of AX5 series PLC CPU is Stop, the output modules will act according to the parameter settings. As for the input modules, they are not affected. If you use other PLC (NOT AX5 Series PLC) as the controller, the module status will be 0, which indicates it is controlled by EtherCAT State Machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

5.8.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Explanation**

Users write a command value into the module and the module will execute the command accordingly. After execution, the module will respond with a corresponding value to show if the execution is success or not.

- **User command**

Command value	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

5.8.5.3 Mode Setting

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Mode Setting	Temperature mode setting	USINT	RW	0
	16#02	CH1 Mode Setting		USINT	RW	0

- **Explanation**

Select the mode to set the channel to ON. The conversion time = Number of channels that are enabled x 100 ms.

- **Supported modes**

Setting value	Mode	Setting range (°C)	Setting range (°F)
0	Disable	-	-
1	J	-200°C – 1200°C	-328°F – 2192°F
2	K	-200°C – 1360°C	-328°F – 2480°F
3	T	-200°C – 400°C	-328°F – 752°F
4	E	-200°C – 1000°C	-328°F – 1832°F
5	L	-200°C – 900°C	-328°F – 1652°F
6	U	-200°C – 600°C	-328°F – 1112°F
7	N	-150°C – 1300°C	-238°F – 2372°F
8	R	-50°C – 1760°C	-58°F – 3200°F
9	S	-50°C – 1760°C	-58°F – 3200°F
10	B	200°C – 1800°C	392°F – 3272°F
11	C (WRe5-26)	20°C – 2300°C	68°F – 4172°F
12	PLII	0°C – 1300°C	32°F – 2372°F
13	±130mV	-130mV – 130mV	-130mV – 130mV

5.8.5.4 Calibration

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Calibration Offset	Offset Setting range: no limit	REAL	RW	0
	16#02	CH1 Calibration Offset		REAL	RW	0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9–1.1	REAL	RW	1.0
	16#02	CH1 Calibration Gain		REAL	RW	1.0

- **Explanation**

When there is an obvious difference between input values and actual values, you can change Offset and Gain to correct the input curve. The formula is

$$Output = (Input \times Gain) + Offset$$

Example

The mode for the channel is J-Type. Gain is 1 and Offset is 0 by default. The signal ranges from -200℃ to 1200℃. If Gain is set to 0.9 and Offset is set to 2, the value after calibration is -178℃ to 1082℃.

5.8.5.5 Digital Filter

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Digital Filter Setting	Digital filter setting	USINT	RW	0
	16#02	CH1 Digital Filter Setting		USINT	RW	0
16#8004	16#01	CH0 Moving Average Times	Moving average times Setting range: 1–100 times	USINT	RW	0
	16#02	CH1 Moving Average Times		USINT	RW	0

- **Explanation**

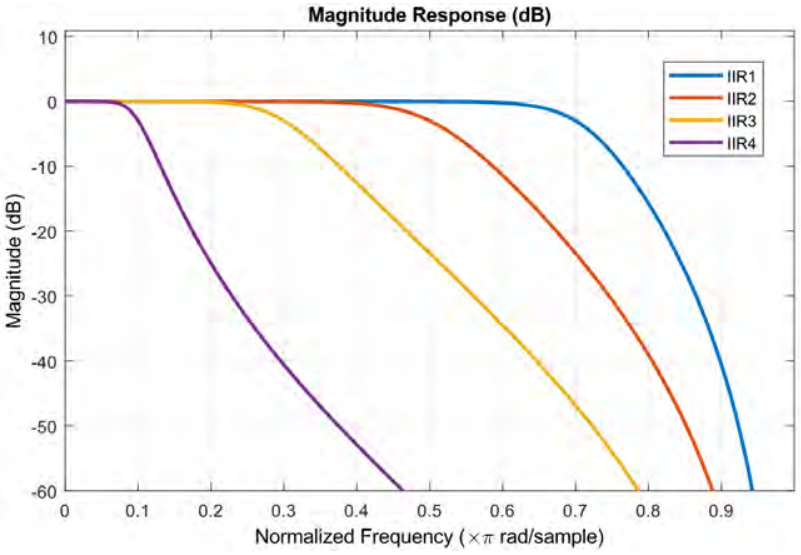
The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The conversion time will not be affected when the digital filter is enabled.

Moving Average Filter

A moving average filter uses the latest pieces of sampled data to create a series of averages to smooth the data. Compared to other types of digital filters, a moving average filter is fast in computation and algorithm, without occupying the CPU processing time. But the filtering result of a moving average filter is not as effective as an IIR filter or a FIR filter.

IIR (Infinite Impulse Response) Filter

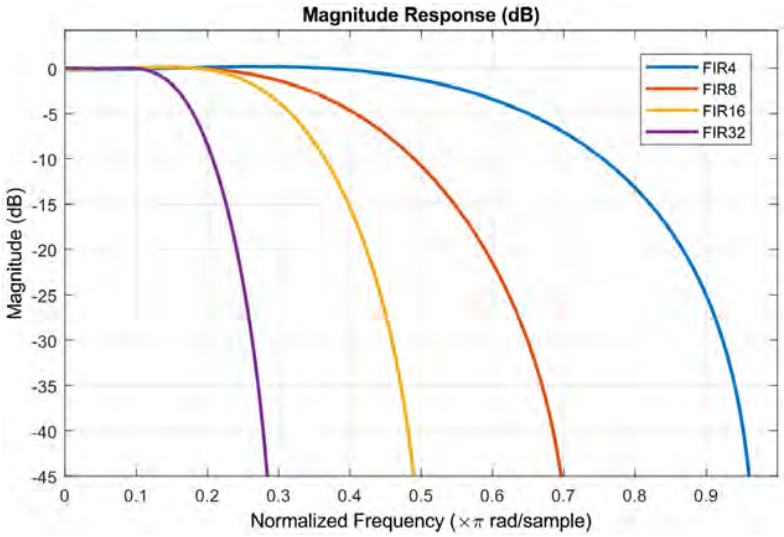
An infinite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, an IIR filter works more efficiently than a moving average filter does. This IIR filter is a low-pass filter. The advantage of an IIR filter is that within the same length of operation time, the filtering result of an IIR filter is better than what a FIR filter can offer. Since an IIR filter can only have a non-linear phase response, it has an inconsistent output delay at every frequency, the input signals may be distorted and the stability issue may be raised. An IIR filter may be not suitable for applications such as oscilloscope waveform and electrocardiography that require demanding waveforms.



Frequency response of IIR filter

FIR (Finite impulse response) Filter

A finite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, a FIR filter works more efficiently than a moving average filter does. This FIR filter is a low-pass filter. The advantage of a FIR filter is that it has a linear phase response which means a FIR filter has a consistent output delay at all frequencies while an IIR filter has an unequal delay at different frequencies. A FIR filter is ideal for a wide range of applications. However within the same length of operation time, the filtering result of a FIR filter is not as good as what an IIR filter can deliver.



Frequency response of FIR filter

- **Digital filter modes**

Mode	Name of digital filter
0	Inactive
1	Moving Average
2	IIR1
3	IIR2
4	IIR3
5	IIR4
6	FIR4
7	FIR8
8	FIR16
9	FIR32

- **Conversion time for enabled channels and corresponding cut-off frequency of filters**

Number of channels that are ON	Conversion time	Cut-off frequency							
		IIR1	IIR2	IIR3	IIR4	FIR4	FIR8	FIR16	FIR32
1	100ms	3.5Hz	2.5Hz	1.5Hz	0.5Hz	2.92Hz	1.79Hz	1.44Hz	0.82Hz
2	200ms	1.75Hz	1.25Hz	0.75Hz	0.25Hz	1.46Hz	0.9Hz	0.72Hz	0.41Hz

Note: For the channel conversion time, refer to section 5.8.5.3 Mode Setting.

5.8.5.6 User Limit Alarm

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Enable User Limit Alarm	Enable / disable the alarm of exceeding the user-defined limit 0: Disable (default) 1: Enable	BOOL	RW	0
	16#02	CH1 Enable User Limit Alarm				0
16#8004	16#01	CH0 User Upper Limit	User-defined upper limit; Setting range: no limit	REAL	RW	2300
	16#02	CH1 User Upper Limit				2300
16#8005	16#01	CH0 User Lower Limit	User-defined lower limit; Setting range: no limit	REAL	RW	-200
	16#02	CH1 User Lower Limit				-200

- **Explanation**

Users can define the upper and lower limits and enable the alarm of exceeding the limits. If the Enable User Limit Alarm is enabled, when the input temperature exceeds the user upper/lower limit, the Upper/Lower Limit Alarm error will occur. (See section 5.8.8 for more information on troubleshooting.) When the temperature exceeds the hardware limit, the Over/Under Hardware Range error will occur.

- **Example**

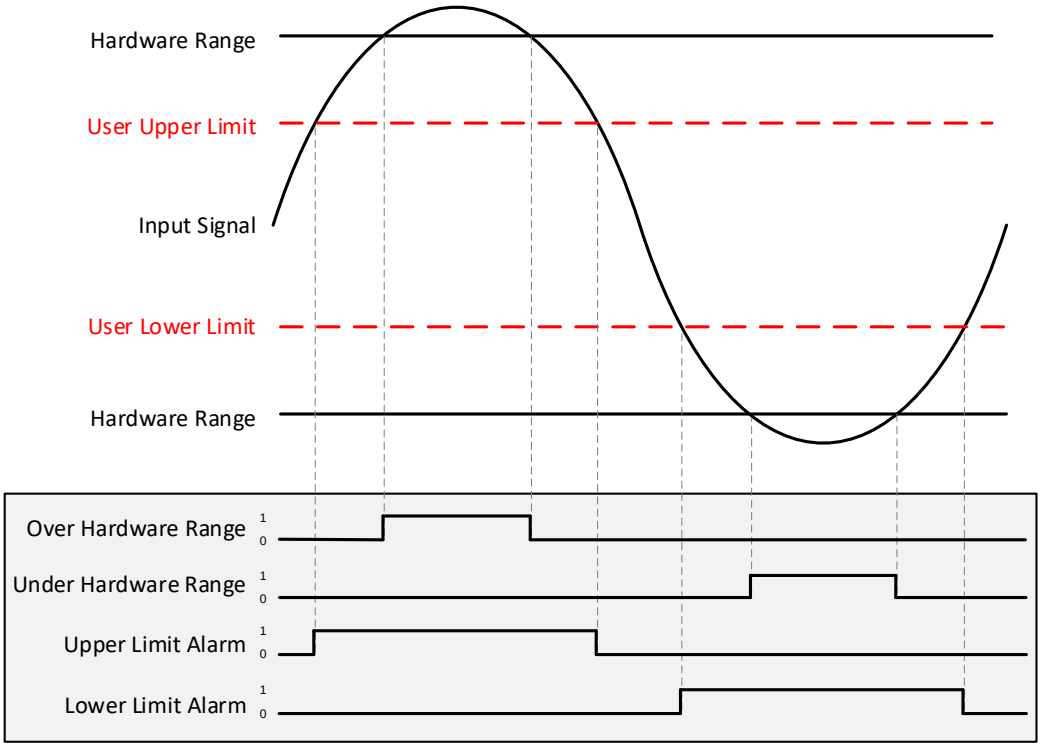
Set the parameters as follows:

16#8003 Enable User Limit Alarm: Enable

16#8004 User Upper Limit: 2300

16#8005 User Lower Limit: -200

When the input signal exceeds the user-defined upper or lower limit, an error occurs.



5.8.5.7 Decimal Places

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8010	16#01	CH0 Decimal Places	Decimal places; setting value: 0–1	USINT	RW	1
	16#02	CH1 Decimal Places		USINT	RW	1

- **Explanation**

You can set the decimal places according to your demand.

5.8.5.8 Unit of Temperature

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8011	16#01	CH0 Unit of Temperature	Unit of temperature; 0: °C 1: °F	USINT	RW	1
	16#02	CH1 Unit of Temperature		USINT	RW	1

- **Explanation**

You can set the unit of temperature to °C or °F according to your demand.

5.8.5.9 CJC Function

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8012	16#01	CH0 CJC Function	0: Disable 1: Enable	BOOL	RW	1
	16#02	CH1 CJC Function		BOOL	RW	1

- **Explanation**

You can enable/disable the internal cold junction compensation (CJC) function. The default value is enabled. Once it is enabled, the cold junction temperature difference will be compensated through the module. You can read the internal compensated temperature in the parameter 16#8101.

Note:

You can also select to enable the external cold junction compensation (CJC) function and edit the compensated temperature through the External CJC Value parameter in the Process Data setting page.

If both the internal and external cold junction compensations are enabled, the internal cold junction compensation will be ignored.

5.8.5.10 ADC Raw Data

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8100	16#01	CH0 ADC Raw data	Raw data	DINT	RO	0
	16#02	CH1 ADC Raw data		DINT	RO	0

- **Explanation**

Raw data is the source data that has not been processed or converted from analog to digital.

5.8.5.11 CJ Temperature

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8101	16#01	CH0 CJ Temperature	Temperature of the internal cold junction (CJ)	DINT	RO	0
	16#02	CH1 CJ Temperature		DINT	RO	0

- **Explanation**

Setting for the current temperature of the internal cold junction.

5.8.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system. For temperature measurement modules, only FreeRun mode is supported.

5.8.6.1 FreeRun Mode

The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

5.8.7 Process Data

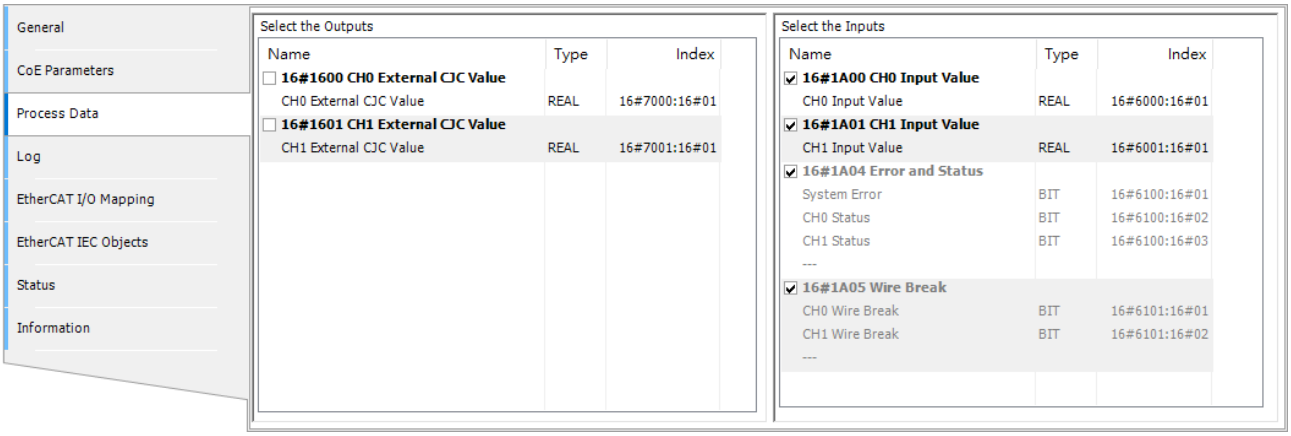
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Analog Input Value	Analog input value	REAL	RO	0.0
16#6001		CH1 Analog Input Value				
16#6100	16#01	System Error	System error	BOOL	RO	0
	16#02	CH0 Status	CH0: error or warning			
	16#03	CH1 Status	CH1: error or warning			
16#6101	16#01	CH0 Wire Break	Channel connection loss 0: Normal 1: Error	BOOL	RO	0
	16#02	CH1 Wire Break				
16#7000	16#01	CH0 External CJC Value	External cold junction compensation (CJC) value	REAL	RO	0.0
16#7001		CH1 External CJC Value				

5.8.7.1 Process Data

Go to the Process Data tab and select the data that you'd like to monitor.

- Analog Input Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Status: It is selected by default. The grayed out part cannot be modified.
- Wire Break: It is selected by default. The grayed out part cannot be modified.
- External CJC Value: It is deselected by default. You need to select this option to enable this function.

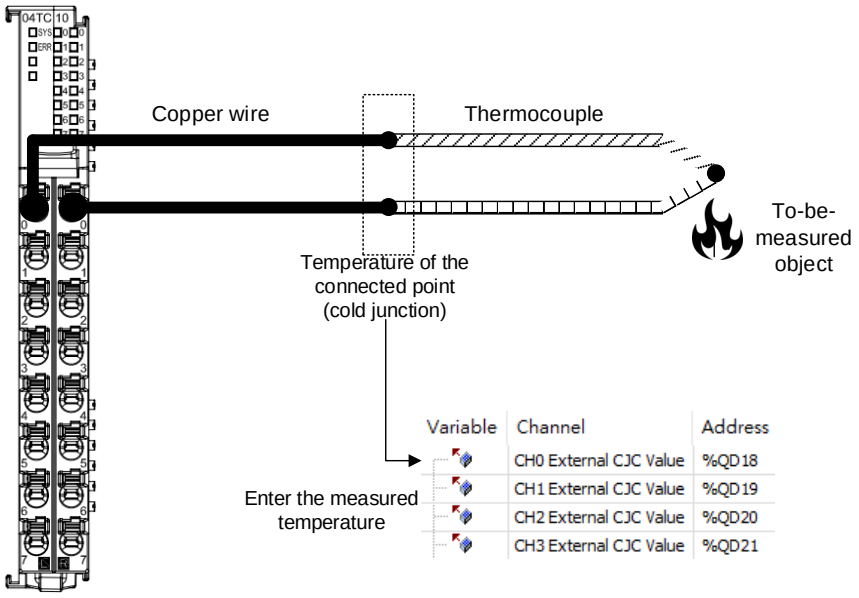


5.8.7.2 External CJC Usage

If the location of the to-be-measured object is far from where the module is or if you need a higher accuracy in the measurement, you can enable the external CJC (cold junction compensation) function by selecting the External CJC Value PDO for the External CJC channel in the Process Data setting page. At the moment, the internal cold junction compensation of the channel will be ignored.

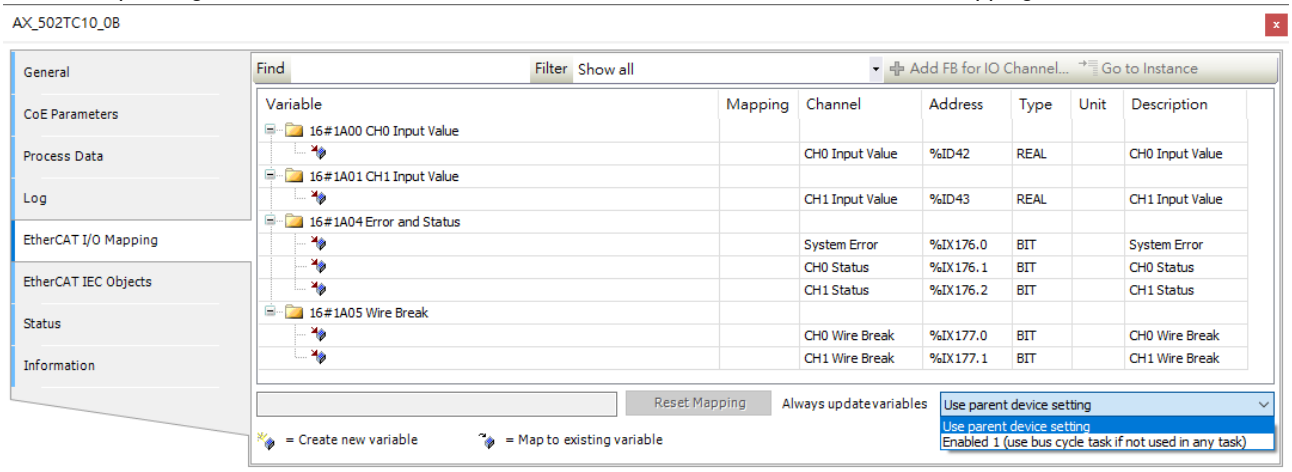
Method:

Use a copper wire to connect to the thermocouple. You need to measure the temperature at the point where the copper wire and the thermocouple are connected, and enter the measured temperature value in the PDO of External CJC Value. And then you can find that the value in the field of Input Value is the temperature at the target measurement point.



5.8.7.3 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



5.8.7.4 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

5.8.8 Troubleshooting

In the Diagnosis History tab, the error information that has occurred on the module is recorded. In the Status tab, the current error information is displayed. In the CoE Parameters tab, you can view the error status through Index/SubIndex of the All Parameter list.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Connection Lost	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#05	(16#FF05) Analog IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#06	(16#FF06) Analog Power Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#07	(16#FF07) Cold Junction IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
16#A00**n**[*1]	16#01	(16#FF11) CH(**n**-1) Upper Limit Alarm	Blinking (1 s)	ON	Check if the input signal of the channel is within the allowed setting range of the user upper limit.
	16#02	(16#FF12) CH(**n**-1) Lower Limit Alarm	Blinking (1 s)	ON	Check if the input signal of the channel is within the allowed setting range of the user lower limit.
	16#03	(16#FF13) CH(**n**-1) Over Hardware range	Blinking (0.2 s)	OFF	Check if the input signal of the channel is within the allowed hardware range.
	16#04	(16#FF14) CH(**n**-1) Under Hardware range	Blinking (0.2 s)	OFF	Check if the input signal of the channel is within the allowed hardware range.
	16#05	(16#FF15) CH(**n**-1) Wire Break	Blinking (0.2 s)	OFF	Check if the sensor is securely connected.

*1. n =1–2

5.9 AX-504TC10-0B

AX-504TC10-0B, a temperature measurement module, converts the values received from the external thermocouple sensors into digital signals. You can select either Celsius or Fahrenheit as the unit of measurement. This section describes its specifications, wirings and operations.

5.9.1 Specifications

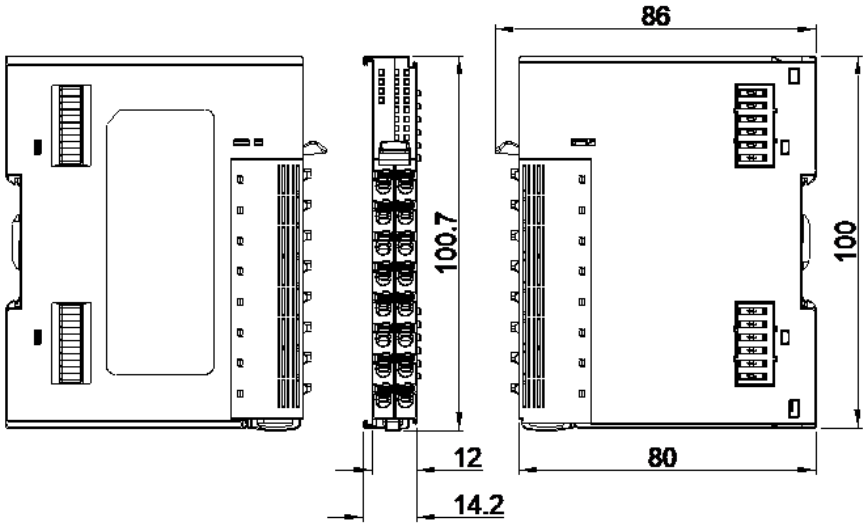
Item		Specification
Input points		4
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		Free Run mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		70 g
Electrical specification	Input form	Differential input
	Sensor type	J, K, T, E, L, U, N, R, S, B, C (WRe5-26), PLII, ±130 mV
	Connection type	2-Wire
	Resolution	TC mode: 0.1 °C/0.18°F*1 ±130 mV mode: 0.1 mV
	Temperature measurement accuracy	±0.3%: 25℃ (F.S.) (*2, *3) ±0.5%: 0–60 ℃ (F.S.) ±1%: <-20–0 ℃ (F.S.)
	Rated input absolute range	±130 mV
	Input impedance	More than 20 KΩ
	Conversion time	100 ms / channel
	Warm-up time	30 minutes
	Cold junction compensation error	±1.2 ℃
	Isolation method	Between unit power and external power: no isolation Between digital power and analog power: 500 VAC Between digital signal and analog signal: 500 VAC Between analog channels: no isolation
	Maximum power consumption (unit power)	Less than 360 mA (1.8 W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Protection	Yes
	Short Circuit Protection (SCP)	--
	Input power protection (voltage range)	±30V
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	--
	Filter function	AVG, FIR, IIR

*1. The temperature unit is 0.1 °C/0.18 °F. If Fahrenheit is selected as the temperature unit, the second decimal place is not displayed.

*2. T: -200°C–100°C (±0.35%)
*3. B: 200°C–300°C (±0.4%)

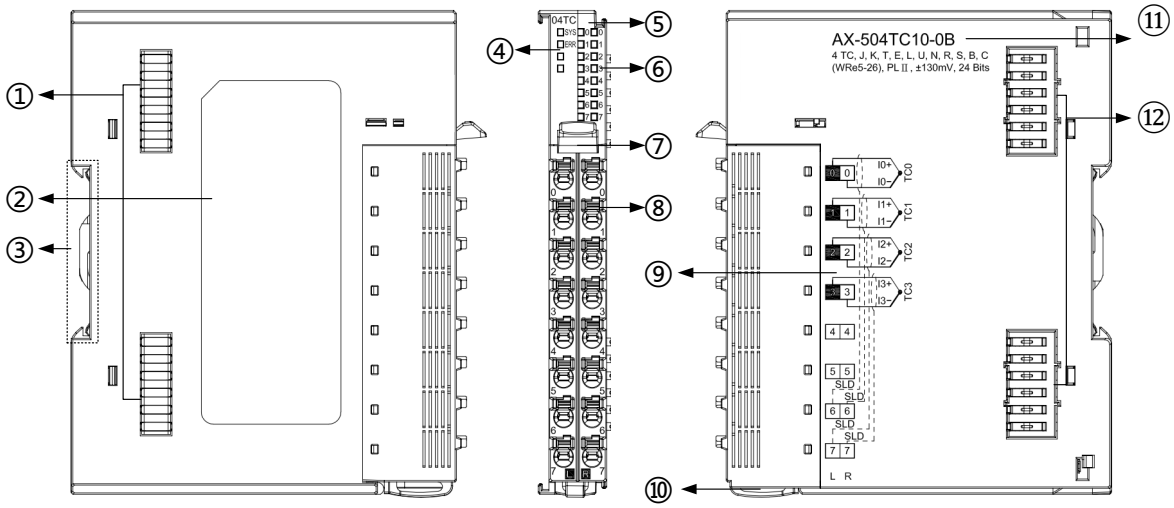
5.9.2 Dimensions and Parts

- **Dimensions**



Unit: mm

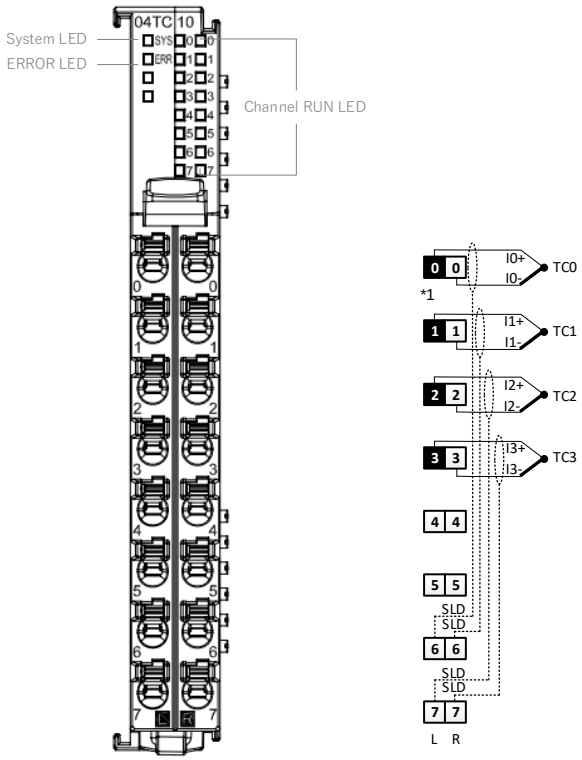
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

5.9.3 Arrangement of Terminals, LED Indicators and Wiring

5.9.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

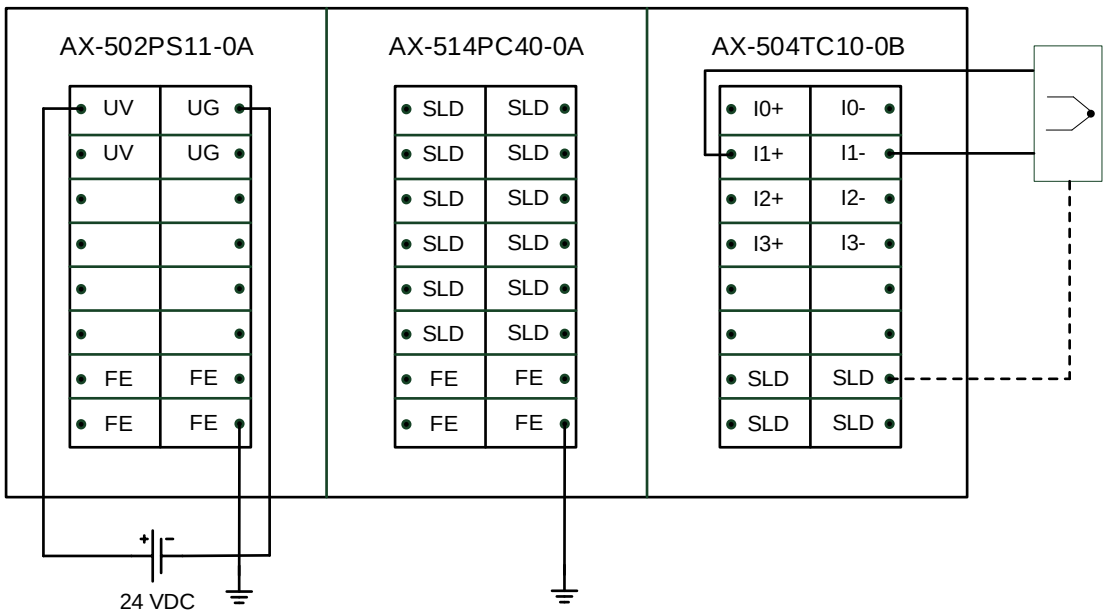
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0+	Channel 0: sensor positive input	R0	I0-	Channel 0: sensor negative input
L1	I1+	Channel 1: sensor positive input	R1	I1-	Channel 1: sensor negative input
L2	I2+	Channel 2: sensor positive input	R2	I2-	Channel 2: sensor negative input
L3	I3+	Channel 3: sensor positive input	R3	I3-	Channel 3: sensor negative input
L4	--	--	R4	--	--
L5	--	--	R5	--	--
L6	SLD	--	R6	SLD	--
L7	SLD	--	R7	SLD	--

5.9.3.2 LED Indicators

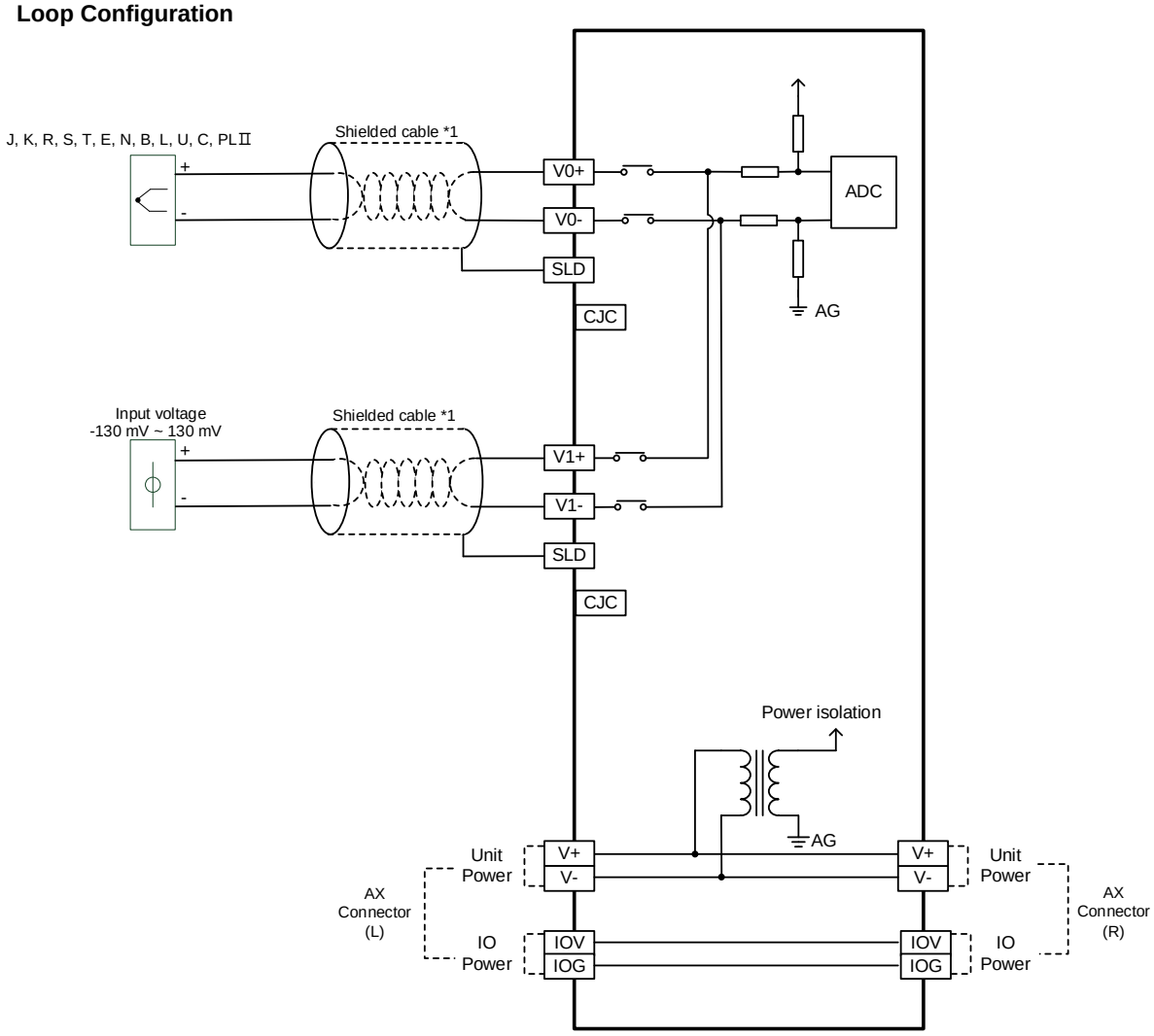
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking (1s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1s)	An error occurs on the application.
			Blinking (0.2s)	An error occurs on the hardware.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

5.9.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



*1. Use shielded twisted pair cables for Type .J, K, R, S, T, E, N, B, L, U, C, and PLⅡ thermocouples, and keep them separate from power cables and other cables which generate noise.

5.9.4 Settings in DIADesigner-AX

The software DIADesigner-AX is the programming tool for the AX Series PLCs. This section introduces some basic operations and settings.

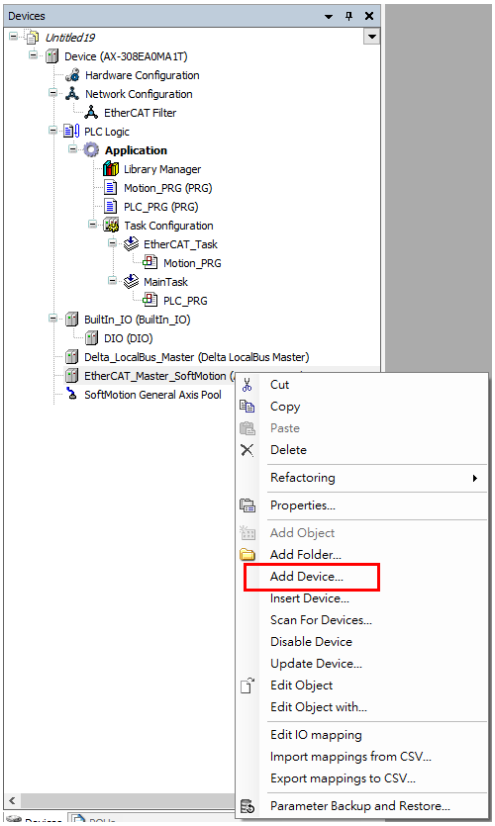
5.9.4.1 Basic Operation

(1) Double-click the DIADesigner-AX icon to open the software and create a new project.

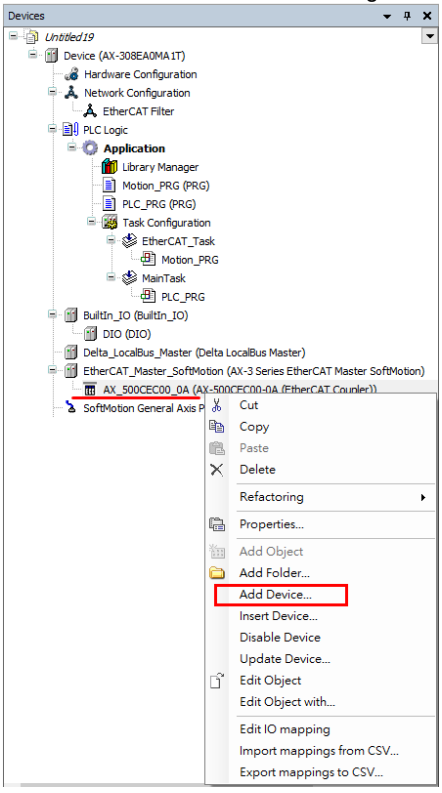
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Add Device…** to select and add System Coupler.

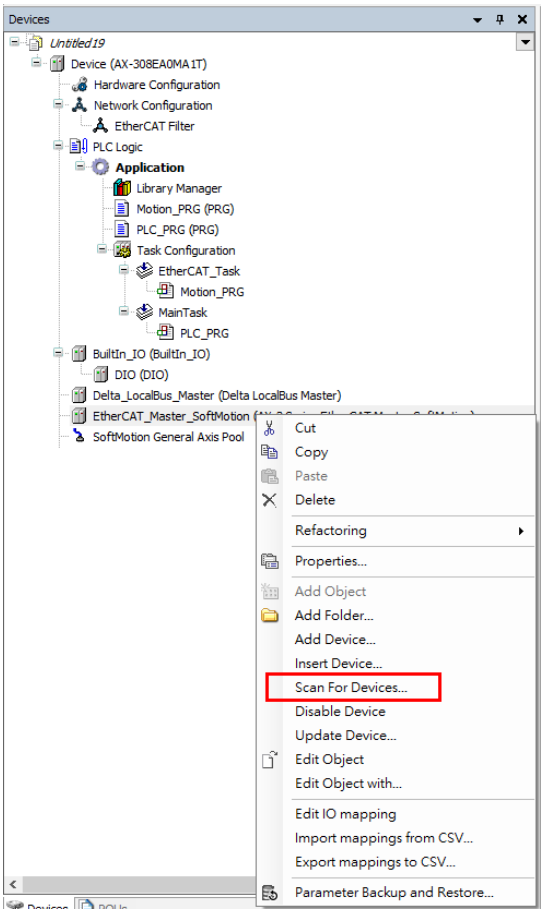


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

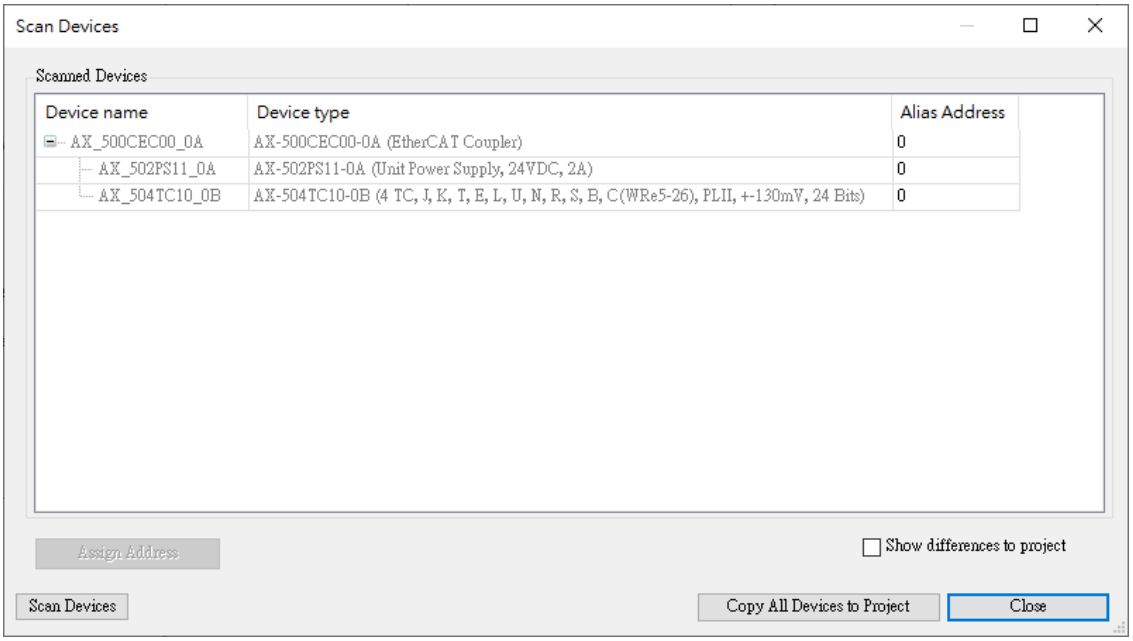


- Method 2: Scan to add the modules in.

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Scan for Devices…**.

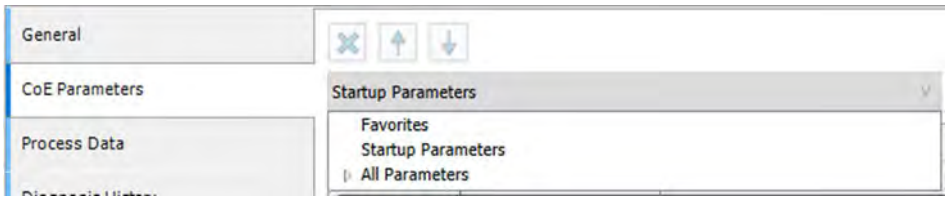


After the auto-scan is over, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



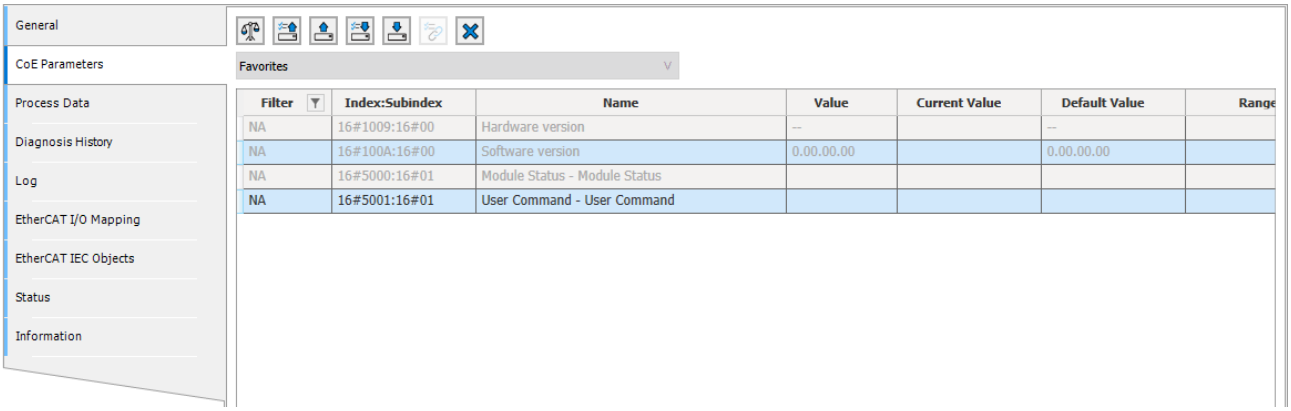
5.9.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.



(1) Favorites

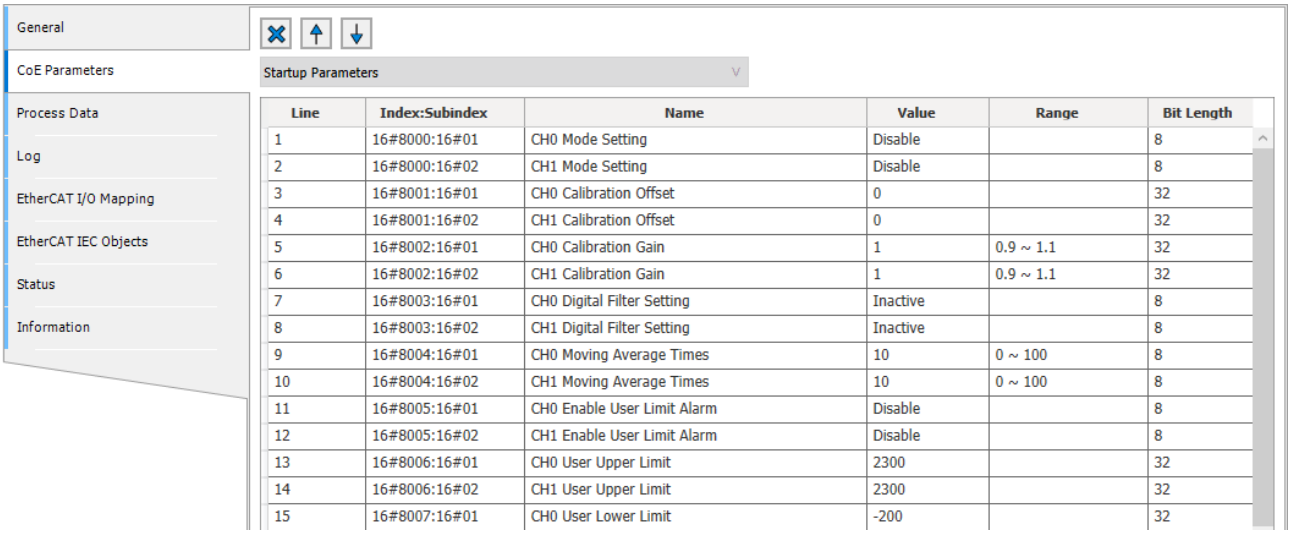
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

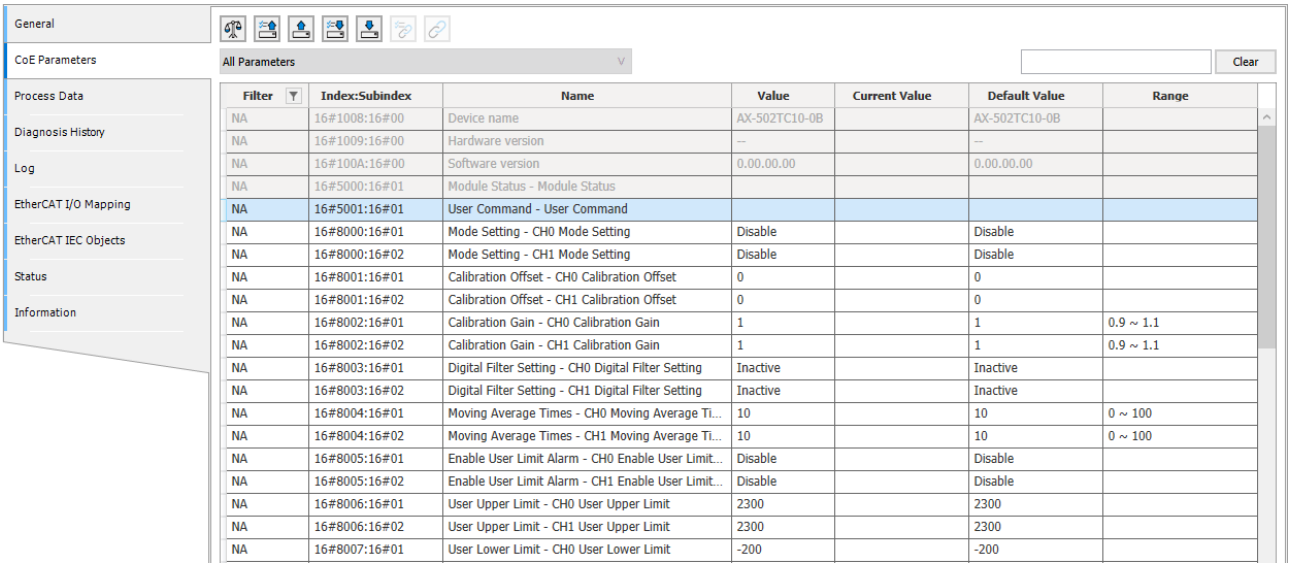


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8001:16#01	CH0 Calibration Offset	0		32
4	16#8001:16#02	CH1 Calibration Offset	0		32
5	16#8002:16#01	CH0 Calibration Gain	1	0.9 ~ 1.1	32
6	16#8002:16#02	CH1 Calibration Gain	1	0.9 ~ 1.1	32
7	16#8003:16#01	CH0 Digital Filter Setting	Inactive		8
8	16#8003:16#02	CH1 Digital Filter Setting	Inactive		8
9	16#8004:16#01	CH0 Moving Average Times	10	0 ~ 100	8
10	16#8004:16#02	CH1 Moving Average Times	10	0 ~ 100	8
11	16#8005:16#01	CH0 Enable User Limit Alarm	Disable		8
12	16#8005:16#02	CH1 Enable User Limit Alarm	Disable		8
13	16#8006:16#01	CH0 User Upper Limit	2300		32
14	16#8006:16#02	CH1 User Upper Limit	2300		32
15	16#8007:16#01	CH0 User Lower Limit	-200		32

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

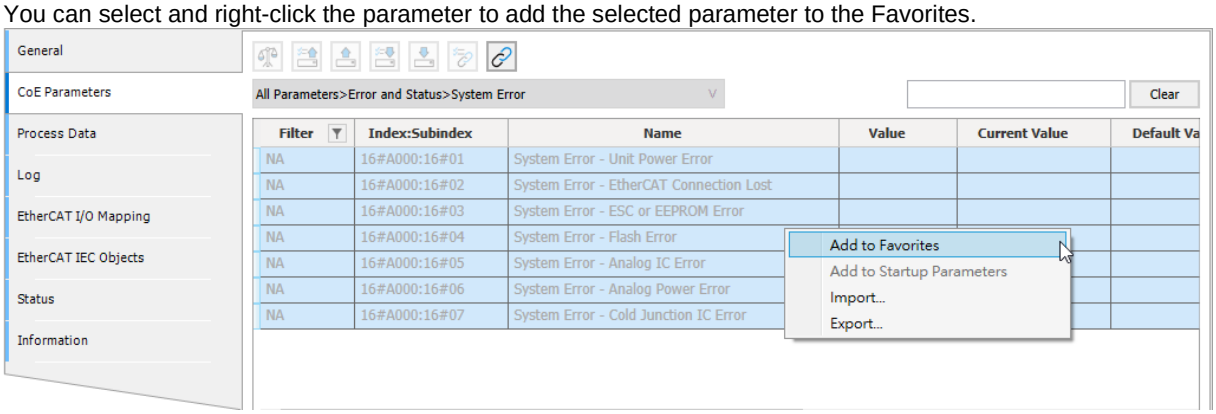
(3) All Parameters

- You can find all the CoE parameters here. Click  on the toolbar to go into online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

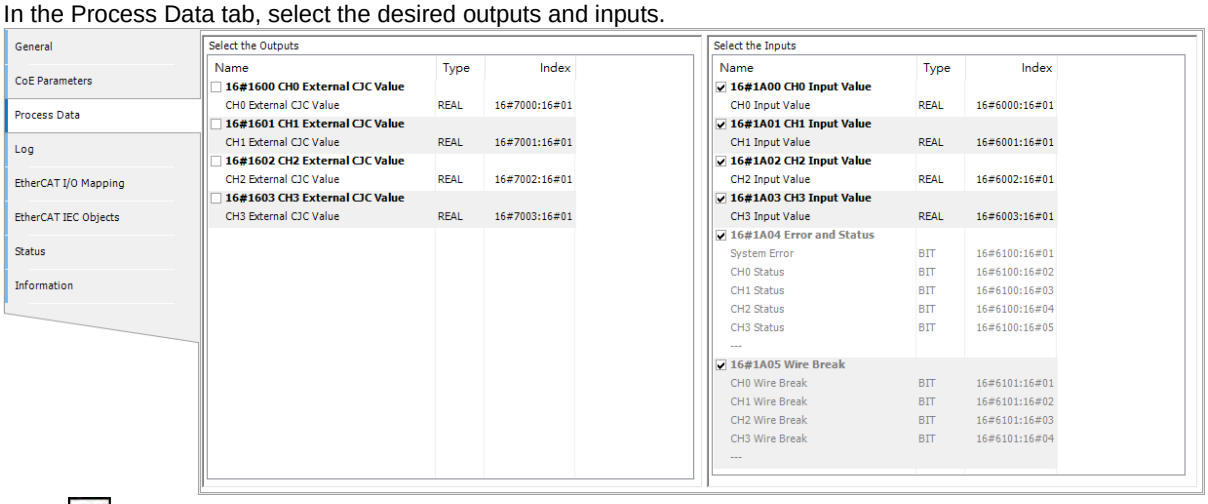
- You can select and right-click the parameter to add the selected parameter to the Favorites.



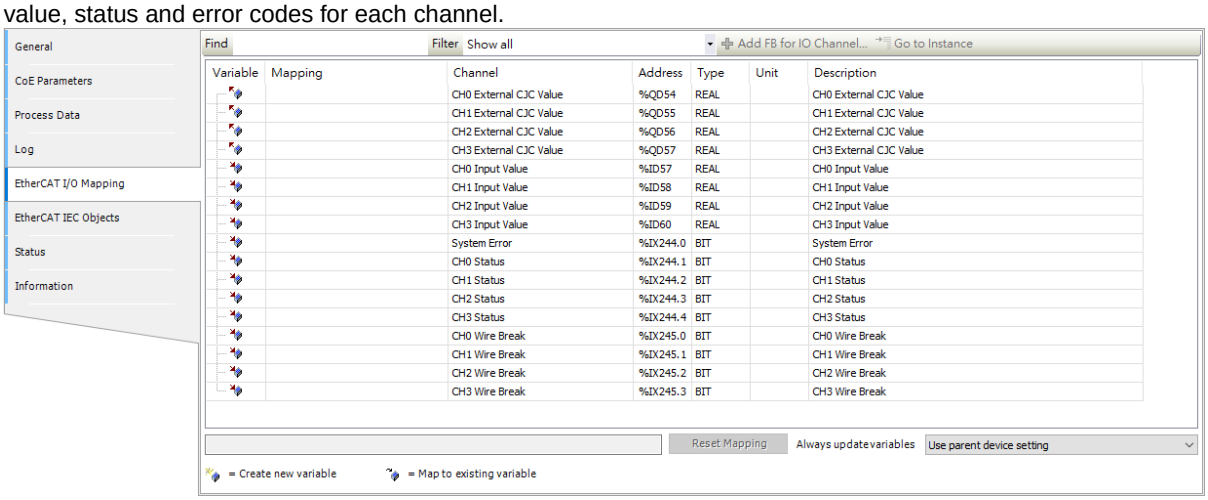
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.9.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

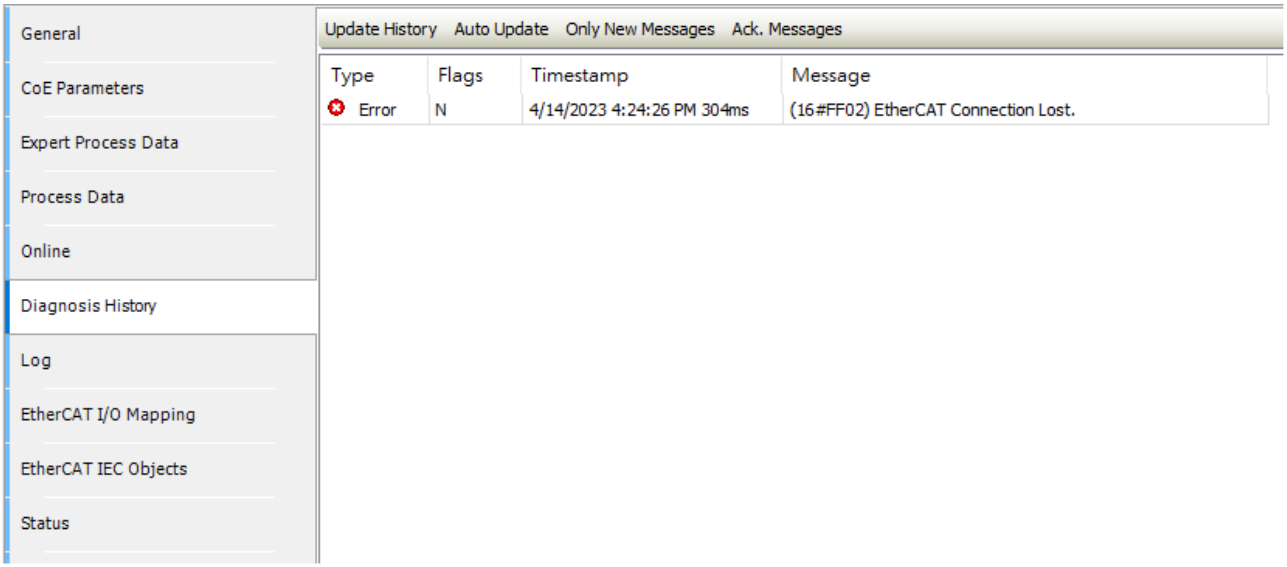


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



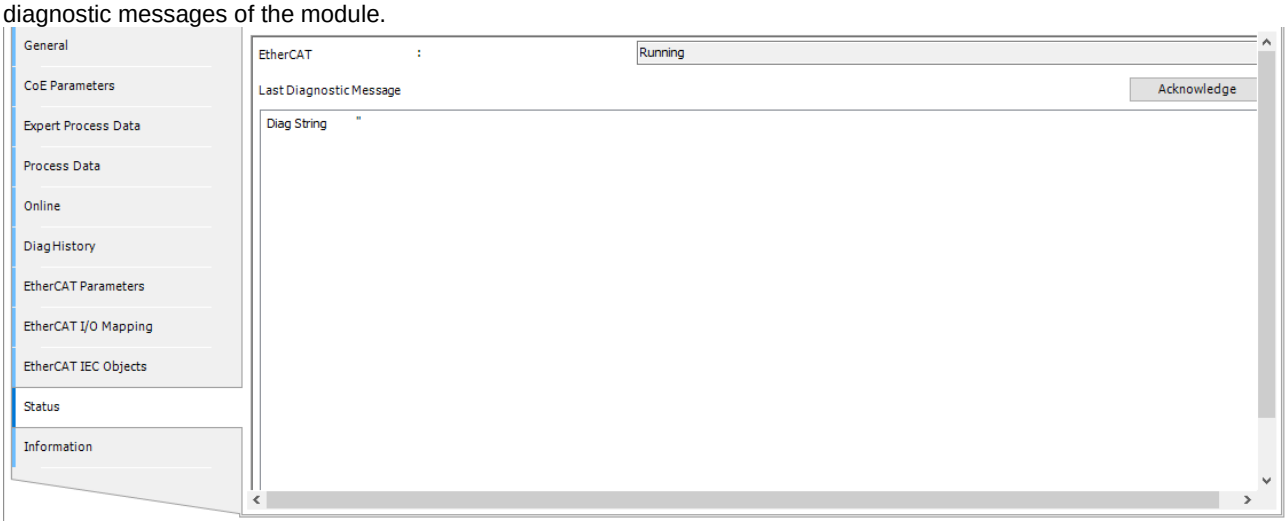
5.9.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors



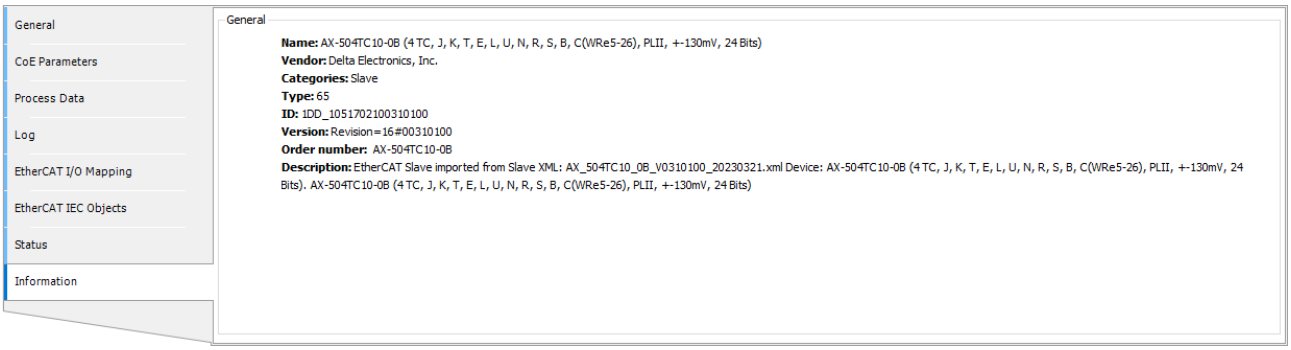
5.9.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



5.9.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.32.01.00	0.32.01.00	0.00.00.00

5.9.5 Parameter Descriptions

You can use DIADesigner-AX to set up the functions for the module by directly selecting the setting mode and parameters. For software operation, refer to section 5.9.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Mode Setting	Mode setting or the channel is OFF.	DFB_TC_RD_ModeSetting DFB_TC_WR_ModeSetting
16#8001	Calibration Offset	Calibration - offset	DFB_TC_RD_CalOffset DFB_TC_WR_CalOffset
16#8002	Calibration Gain	Calibration - gain	DFB_TC_RD_CalGain DFB_TC_WR_CalGain
16#8003	Digital Filter Setting	Digital filter setting	DFB_TC_RD_FilterSetting DFB_TC_WR_FilterSetting
16#8004	Moving Average Times	Moving average times	DFB_TC_RD_AverageTimes DFB_TC_WR_AverageTimes
16#8005	Enable User Limit Alarm DINT	Enable / disable the alarm of exceeding the user-defined limit	
16#8006	User Upper Limit DINT	User-defined upper limit	
16#8007	User Lower Limit DINT	User-defined lower limit	
16#8010	Decimal Places	Decimal places	
16#8011	Unit of Temperature	Unit of temperature	
16#8012	CJC Function	Cold junction compensation function	
16#8100	ADC Raw Data	ADC raw data	
16#8101	CJ Temperature	Temperature of cold junction	

5.9.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Explanation**

When the AX5 series PLC is used as the controller, the module status is synchronized with the status of AX5 series PLC CPU and it will be either 1 (Run) or 2 (Stop). When the status of AX5 series PLC CPU is Stop, the output modules will act according to the parameter settings. As for the input modules, they are not affected. If you use other PLC (NOT AX5 Series PLC) as the controller, the module status will be 0, which indicates that it is controlled by EtherCAT State Machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

5.9.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Explanation**

Users write a command value into the module and the module will execute the command accordingly. After execution, the module will respond with a corresponding value to show if the execution is success or not.

- **User command**

Command value	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

5.9.5.3 Mode Setting

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Mode Setting	Temperature mode setting	USINT	RW	0
	16#02	CH1 Mode Setting		USINT	RW	0
	16#03	CH2 Mode Setting		USINT	RW	0
	16#04	CH3 Mode Setting		USINT	RW	0

- **Explanation**

Select the mode to set the channel to ON. The conversion time = Number of channels that are enabled x 100 ms.

- **Supported modes**

Setting value	Mode	Setting range (°C)	Setting range (°F)
0	Disable	-	-
1	J	-200°C – 1200°C	-328°F – 2192°F
2	K	-200°C – 1360°C	-328°F – 2480°F
3	T	-200°C – 400°C	-328°F – 752°F
4	E	-200°C – 1000°C	-328°F – 1832°F
5	L	-200°C – 900°C	-328°F – 1652°F
6	U	-200°C – 600°C	-328°F – 1112°F
7	N	-150°C – 1300°C	-238°F – 2372°F
8	R	-50°C – 1760°C	-58°F – 3200°F
9	S	-50°C – 1760°C	-58°F – 3200°F

Setting value	Mode	Setting range (°C)	Setting range (°F)
10	B	200°C – 1800°C	392°F – 3272°F
11	C(WRe5-26)	20°C – 2300°C	68°F – 4172°F
12	PLII	0°C – 1300°C	32°F – 2372°F
13	±130mV	-130mV – 130mV	-130mV – 130mV

5.9.5.4 Calibration

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Calibration Offset	Offset Setting range: no limit	REAL	RW	0
	16#02	CH1 Calibration Offset		REAL	RW	0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9–1.1	REAL	RW	1.0
	16#02	CH1 Calibration Gain		REAL	RW	1.0

- **Explanation**

When there is an obvious difference between input values and actual values, you can change Offset and Gain to correct the input curve. The formula is

$$Output = (Input \times Gain) + Offset$$

Example

The mode for the channel is J-Type. Gain is 1 and Offset is 0 by default. The signal ranges from -200℃ to 1200℃. If Gain is set to 0.9 and Offset is set to 2, the value after calibration is -178℃ to 1082℃.

5.9.5.5 Digital Filter

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Digital Filter Setting	Digital filter setting	USINT	RW	0
	16#02	CH1 Digital Filter Setting		USINT	RW	0
	16#03	CH2 Digital Filter Setting		USINT	RW	0
	16#04	CH3 Digital Filter Setting		USINT	RW	0
16#8004	16#01	CH0 Moving Average Times	Moving average Setting range: 1–100 times	USINT	RW	0
	16#02	CH1 Moving Average Times		USINT	RW	0
	16#03	CH2 Moving Average Times		USINT	RW	0
	16#04	CH3 Moving Average Times		USINT	RW	0

- **Explanation**

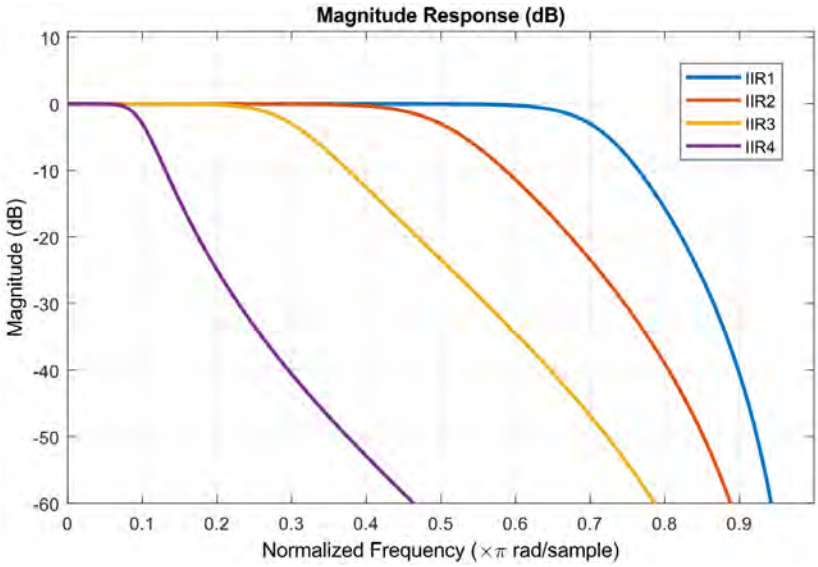
The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The conversion time will not be affected when the digital filter is enabled.

Moving Average Filter

A moving average filter uses the latest pieces of sampled data to create a series of averages to smooth the data. Compared to other types of digital filters, a moving average filter is fast in computation and algorithm, without occupying the CPU processing time. But the filtering result of a moving average filter is not as effective as an IIR filter or a FIR filter.

IIR (Infinite Impulse Response) Filter

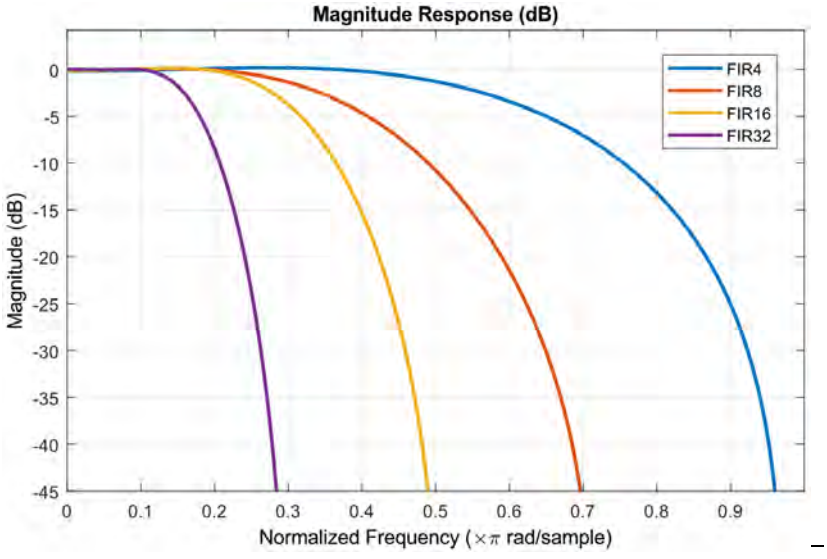
An infinite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, an IIR filter works more efficiently than a moving average filter does. This IIR filter is a low-pass filter. The advantage of an IIR filter is that within the same length of operation time, the filtering result of an IIR filter is better than what a FIR filter can offer. Since an IIR filter can only have a non-linear phase response, it has an inconsistent output delay at every frequency, the input signals may be distorted and the stability issue may be raised. An IIR filter may be not suitable for applications such as oscilloscope waveform and electrocardiography that require demanding waveforms.



Frequency response of IIR filter

FIR (Finite impulse response) Filter

A finite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, a FIR filter works more efficiently than a moving average filter does. This FIR filter is a low-pass filter. The advantage of a FIR filter is that it has a linear phase response which means a FIR filter has a consistent output delay at all frequencies while an IIR filter has an unequal delay at different frequencies. A FIR filter is ideal for a wide range of applications. However within the same length of operation time, the filtering result of a FIR filter is not as good as what an IIR filter can deliver.



Frequency response of FIR filter

- **Digital filter modes**

Mode	Name of digital filter
0	Inactive
1	Moving Average
2	IIR1
3	IIR2
4	IIR3
5	IIR4
6	FIR4
7	FIR8
8	FIR16
9	FIR32

- **Conversion time for enabled channels and corresponding cut-off frequency of filters**

Number of channels that are ON	Conversion time	Cut-off frequency							
		IIR1	IIR2	IIR3	IIR4	FIR4	FIR8	FIR16	FIR32
1	100ms	3.5Hz	2.5Hz	1.5Hz	0.5Hz	2.92Hz	1.79Hz	1.44Hz	0.82Hz
2	200ms	1.75Hz	1.25Hz	0.75Hz	0.25Hz	1.46Hz	0.9Hz	0.72Hz	0.41Hz
3	300ms	1.17Hz	0.83Hz	0.5Hz	0.17Hz	0.97Hz	0.6Hz	0.48Hz	0.27Hz
4	400ms	0.88Hz	0.63Hz	0.38Hz	0.13Hz	0.73Hz	0.45Hz	0.36Hz	0.2Hz

Note: For the channel conversion time, refer to section 5.9.5.3 Mode Setting

5.9.5.6 User Limit Alarm

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Enable User Limit Alarm	Enable / disable the alarm of exceeding the user-defined limit 0: Disable (default) 1: Enable	BOOL	RW	0
	16#02	CH1 Enable User Limit Alarm				
	16#03	CH2 Enable User Limit Alarm				
	16#04	CH3 Enable User Limit Alarm				
16#8004	16#01	CH0 User Upper Limit	User-defined upper limit; Setting range: no limit	REAL	RW	2300
	16#02	CH1 User Upper Limit				
	16#03	CH2 User Upper Limit				
	16#04	CH3 User Upper Limit				
16#8005	16#01	CH0 User Lower Limit	User-defined lower limit; Setting range: no limit	REAL	RW	-200
	16#02	CH1 User Lower Limit				
	16#03	CH2 User Lower Limit				
	16#04	CH3 User Lower Limit				

-

- **Explanation**

Users can define the upper and lower limits and enable the alarm of exceeding the limits. If the Enable User Limit Alarm is enabled, when the input temperature exceeds the user upper/lower limit, a user upper/lower limit error will occur. (See section 5.9.8 for more information on troubleshooting.) When the temperature exceeds the hardware limit, an over/under hardware range error will occur.

- **Example**

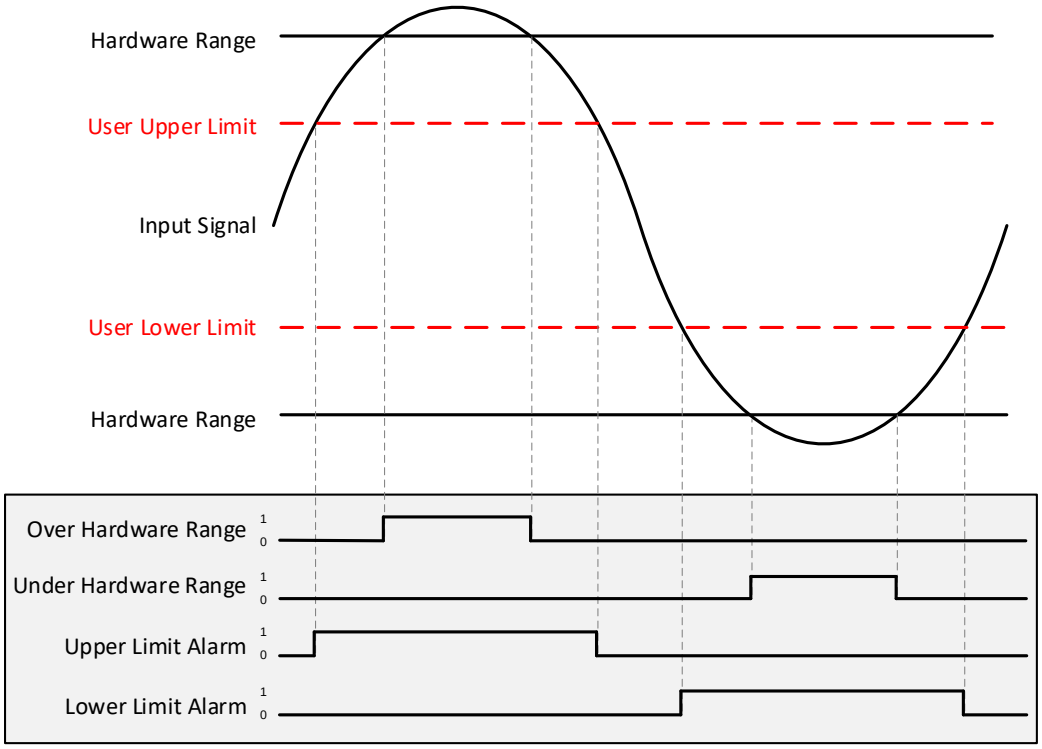
Set the parameters as follows:

16#8003 Enable User Limit Alarm: Enable

16#8004 User Upper Limit: 2300

16#8005 User Lower Limit: -200

When the input signal exceeds the user-defined upper or lower limit, an error occurs.



5.9.5.7 Decimal Places

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8010	16#01	CH0 Decimal Places	Decimal places; setting value: 0–1	USINT	RW	1
	16#02	CH1 Decimal Places				
	16#03	CH2 Decimal Places				
	16#04	CH3 Decimal Places				

- **Explanation**

You can set the decimal places according to your demand.

5.9.5.8 Unit of Temperature

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8011	16#01	CH0 Unit of Temperature	Unit of temperature; 0: °C 1: °F	USINT	RW	1
	16#02	CH1 Unit of Temperature				
	16#03	CH2 Unit of Temperature				
	16#04	CH3 Unit of Temperature				

- **Explanation**

You can set the unit of temperature to °C or °F according to your demand.

5.9.5.9 CJC Function

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8012	16#01	CH0 CJC Function	0: Disable 1: Enable	BOOL	RW	1
	16#02	CH1 CJC Function				
	16#03	CH2 CJC Function				
	16#04	CH3 CJC Function				

- **Explanation**

You can enable/disable the internal cold junction compensation (CJC) function. The default value is enabled. Once it is enabled, the cold junction temperature difference will be compensated through the module. You can read the internal compensated temperature in the parameter 16#8101.

Note:

You can also select to enable the external cold junction compensation (CJC) function and edit the compensated temperature through the External CJC Value parameter in the Process Data setting page.

If both the internal and external cold junction compensations are enabled, the internal cold junction compensation will be ignored.

5.9.5.10 ADC Raw Data

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8100	16#01	CH0 ADC Raw data	Raw data	DINT	RO	0
	16#02	CH1 ADC Raw data				
	16#03	CH2 ADC Raw data				
	16#04	CH3 ADC Raw data				

- **Explanation**

Raw data is the source data that has not been processed or converted from analog to digital.

5.9.5.11 CJ Temperature

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8101	16#01	CH0 CJ Temperature	Temperature of the cold junction	DINT	RO	0
	16#02	CH1 CJ Temperature				
	16#03	CH2 CJ Temperature				
	16#04	CH3 CJ Temperature				

- **Explanation**

Setting for the current temperature of the internal cold junction.

5.9.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system. For temperature measurement modules, only FreeRun mode is supported.

5.9.6.1 FreeRun Mode

The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

5.9.7 Process Data

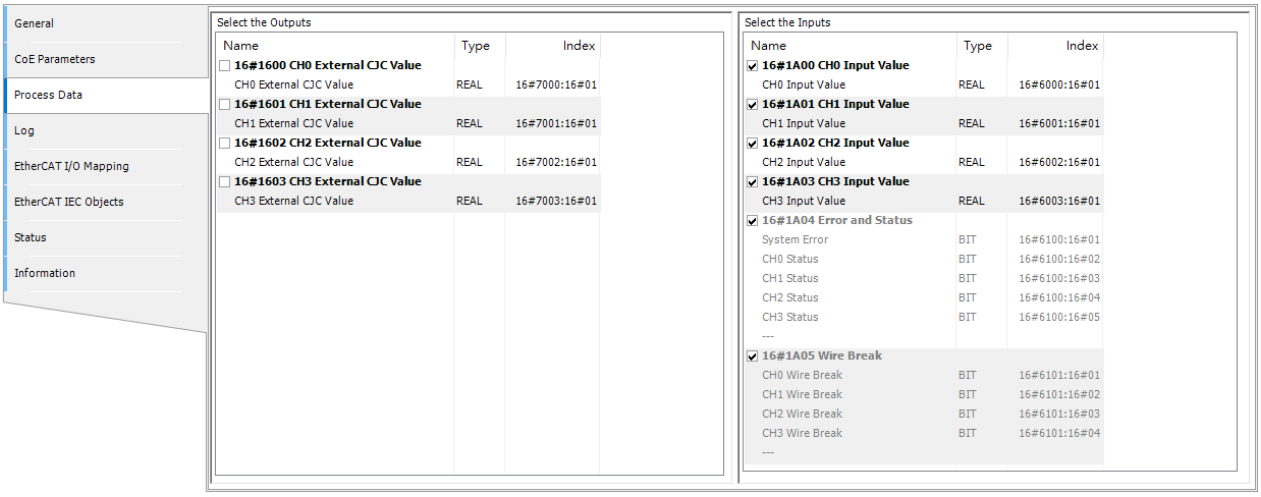
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Analog Input Value	Analog input value	REAL	RO	0.0
16#6001		CH1 Analog Input Value				
16#6002		CH2 Analog Input Value				
16#6003		CH3 Analog Input Value				
16#6100	16#01	System Error	System error	BOOL	RO	0
	16#02	CH0 Status	CH0: error or warning			
	16#03	CH1 Status	CH1: error or warning			
	16#04	CH2 Status	CH2: error or warning			
	16#05	CH3 Status	CH3: error or warning			
16#6101	16#01	CH0 Wire Break	Channel connection loss 0: Normal 1: Error	BOOL	RO	0
	16#02	CH1 Wire Break				
	16#03	CH2 Wire Break				
	16#04	CH3 Wire Break				
16#7000	16#01	CH0 External CJC Value	External cold junction compensation value	REAL	RO	0.0
16#7001		CH1 External CJC Value				
16#7002		CH2 External CJC Value				
16#7003		CH3 External CJC Value				

5.9.7.1 Process Data

Go to the Process Data tab and select the data that you'd like to monitor.

- Analog Input Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Status: It is selected by default. The grayed out part cannot be modified.
- Wire Break: It is selected by default. The grayed out part cannot be modified.
- External CJC Value: The default is deselected. You need to select this option to enable this function.

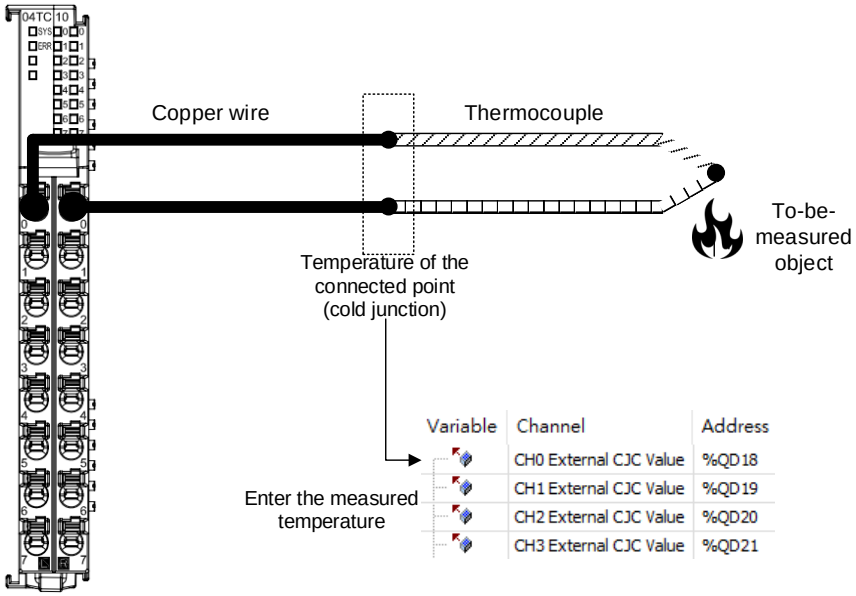


5.9.7.2 External CJC Usage

If the location of the to-be-measured object is far from where the module is or if you need a higher accuracy in the measurement, you can enable the external CJC (cold junction compensation) function by selecting the External CJC Value PDO for the External CJC channel in the Process Data setting page. At the moment, the internal cold junction compensation of the channel will be ignored.

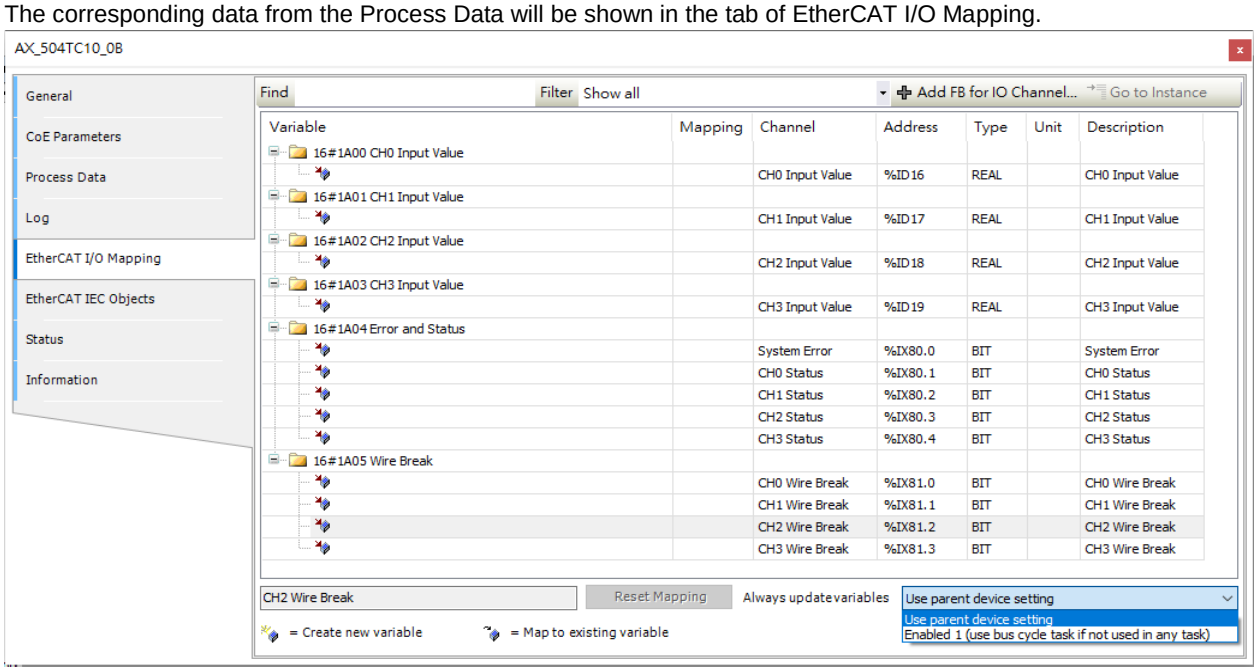
Method:

Use a copper wire to connect to the thermocouple. You need to measure the temperature of the point where the copper wire and the thermocouple are connected and enter the measured temperature value in the PDO of External CJC Value. And then you can find the value in the field of Input Value is the temperature at the target measurement point.



5.9.7.3 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



5.9.7.4 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

5.9.8 Troubleshooting

In the Diagnosis History tab, the error information that has occurred on the module is recorded. In the Status tab, the current error information is displayed. In the CoE Parameters tab, you can view the error status through Index/SubIndex of the All Parameter list.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Connection Lost	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#05	(16#FF05) Analog IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#06	(16#FF06) Analog Power Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#07	(16#FF07) Cold Junction IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
16#A00**n**[*1]	16#01	(16#FF11) CH(**n**-1) Upper Limit Alarm	Blinking (1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user upper limit.
	16#02	(16#FF12) CH(**n**-1) Lower Limit Alarm	Blinking (1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user lower limit.
	16#03	(16#FF13) CH(**n**-1) Over Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed setting range.
	16#04	(16#FF14) CH(**n**-1) Under Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed setting range.
	16#05	(16#FF15) CH(**n**-1) Wire Break	Blinking (0.2s)	OFF	Check if the sensor is securely connected.

*1. n =1–4

5.10 AX-502PT10-0B

AX-502PT10-0B, a temperature measurement module, converts the values received from the RTD sensors into digital signals. You can select either Celsius or Fahrenheit as the unit of measurement. This section describes its specifications, wirings and operations.

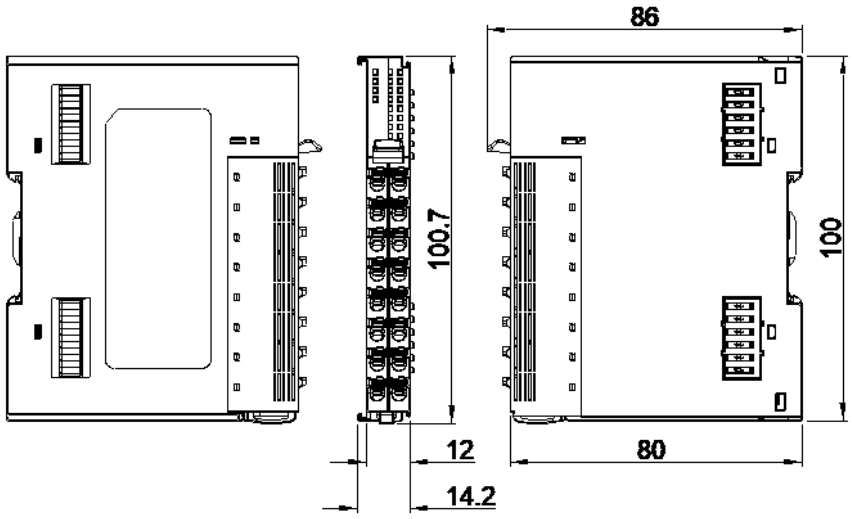
5.10.1 Specifications

Item		Specification
Input points		2
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		Free Run mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		70 g
Electrical specification	Input form	Differential input
	Sensor type	Pt100: DIN 43760-1980 JIS C1604-1989, 100Ω 3850 PPM/°C Pt1000: DIN EN60751, 1 kΩ 3850 PPM/°C Ni100/Ni1000: DIN 43760 0~300Ω
	Connection type	2-, 3-, 4-Wire
	Resolution	0.001°C/0.0018°F*1
	Temperature measurement accuracy	±0.3%: 25℃ (F.S.) ±0.5%: 0~60℃ (F.S.) ±1%: <-20~0℃ (F.S.)
	Input impedance	More than 10 KΩ
	Conversion time	100ms / channel
	Isolation method	Between unit power and external power: no isolation Between digital power and analog power: 500 VAC Between digital signal and analog signal: 500 VAC Between analog channels: no isolation
	Maximum power consumption (unit power)	Less than 360 mA (1.8 W)
	Minimum power consumption (I/O Power)	No power consumed
	Excitation current	2/4-wire: PT100 / Ni100 / 0–300Ω: 500uA PT1000 / Ni1000: 250uA 3-wire: PT100 / PT1000 / Ni100 / Ni1000 / 0–300Ω: 250uA
Others	Connection Lost Protection	Yes
	Short Circuit Protection (SCP)	--
	Input power protection (voltage range)	±30V
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	--
	Filter function	AVG, FIR, IIR

*1. The temperature unit is 0.001°C/0.0018°F. If Fahrenheit is selected as the temperature unit, the fourth decimal place is not displayed.

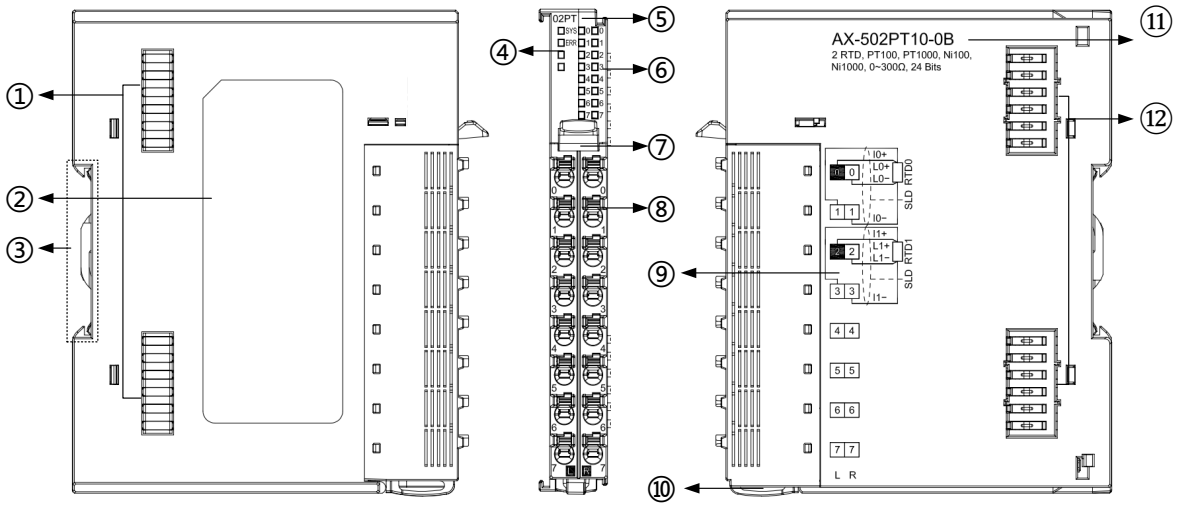
5.10.2 Dimensions and Parts

- **Dimensions**



Unit: mm

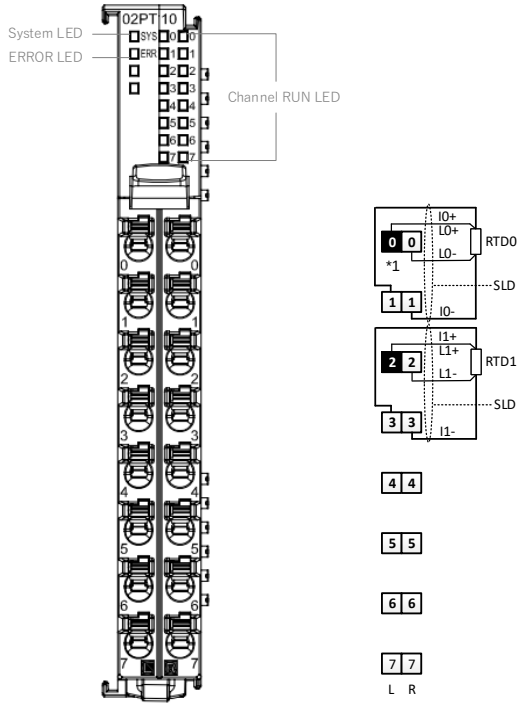
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

5.10.3 Arrangement of Terminals, LED Indicators and Wiring

5.10.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

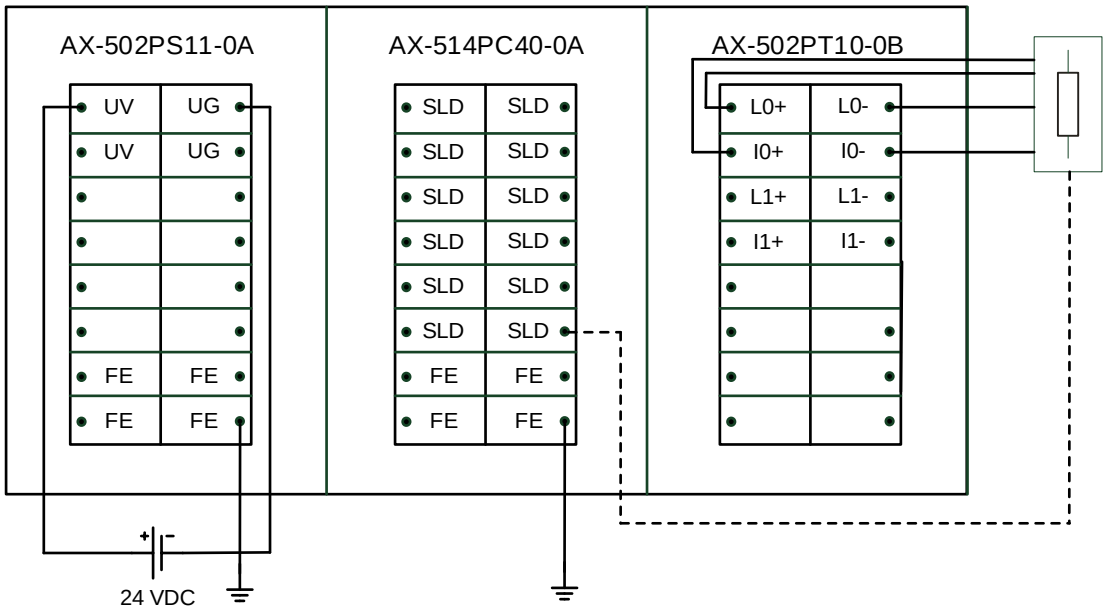
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	L0+	Channel 0: sensor positive input	R0	L0-	Channel 0: sensor negative input
L1	I0+	Channel 0: power positive output	R1	I0-	Channel 0: power negative output
L2	L1+	Channel 1: sensor positive input	R2	L1-	Channel 1: sensor negative input
L3	I1+	Channel 1: power positive output	R3	I1-	Channel 1: power negative output
L4	--	--	R4	--	--
L5	--	--	R5	--	--
L6	--	--	R6	--	--
L7	--	--	R7	--	--

5.10.3.2 LED Indicators

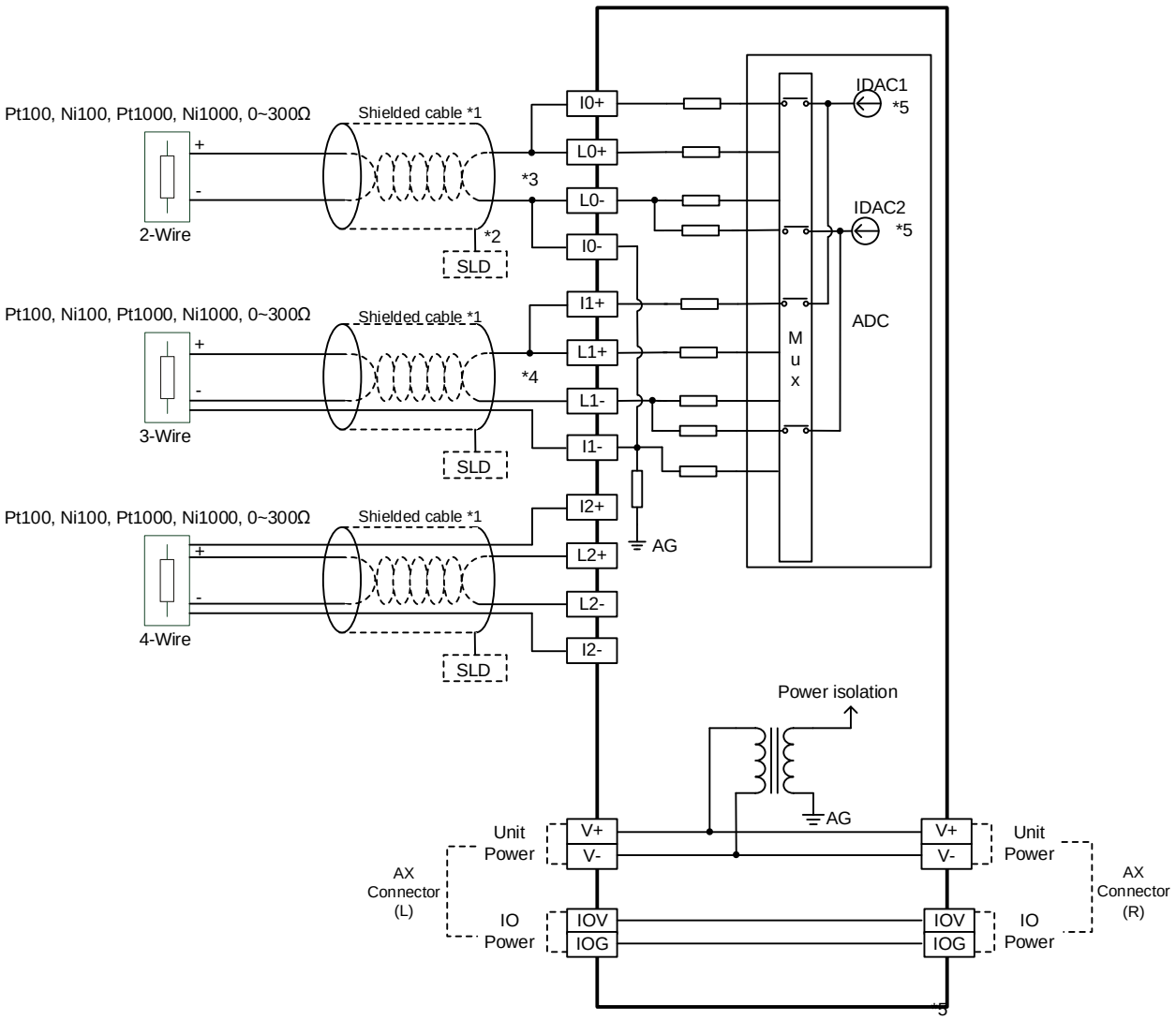
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking (1s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1s)	An error occurs on the application.
			Blinking (0.2s)	An error occurs on the hardware.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

5.10.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



*1. Use shielded twisted pair cables for temperature sensors, and keep them away from power cables and other cables that generate noise.
*2. Please wire this shielded cable to the SLD pin of the power module AX-514PC40-0A.
*3. If you use two-wire temperature sensors, In+ & Ln+ and In- & Ln- must be short-circuited (where n is between 1–4).
*4. If you use three-wire temperature sensors, In+ & Ln+ must be short-circuited (where n is between 1–4).
*5. Different internal excitation current will be applied according to their modes and selected sensors for the channel automatically.

NOTE: Use cables with the same length (less than 200 m) and use wire resistance of less than 200 ohm for 3-wire and 4-wire sensors.

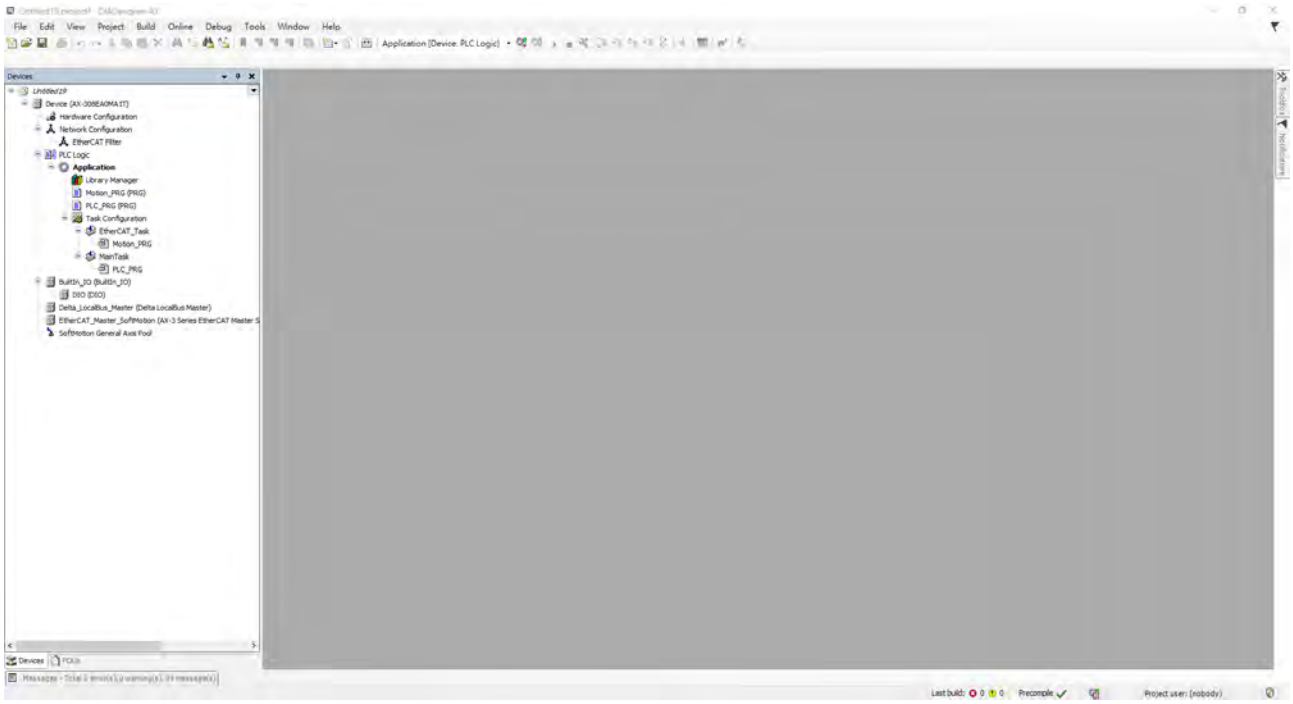
Wiring Mode	Sensor	IDAC1	IDAC2
2/4 Wire	PT100/Ni100/0–300Ω	500μA	OFF
	PT1000/Ni1000	250μA	
3 Wire	PT100/Ni100/0–300Ω	250μA	250μA
	PT1000/Ni1000		

5.10.4 Settings in DIADesigner-AX

The software DIADesigner-AX is the programming tool for the AX Series PLCs. This section introduces some basic operations and settings.

5.10.4.1 Basic Operation

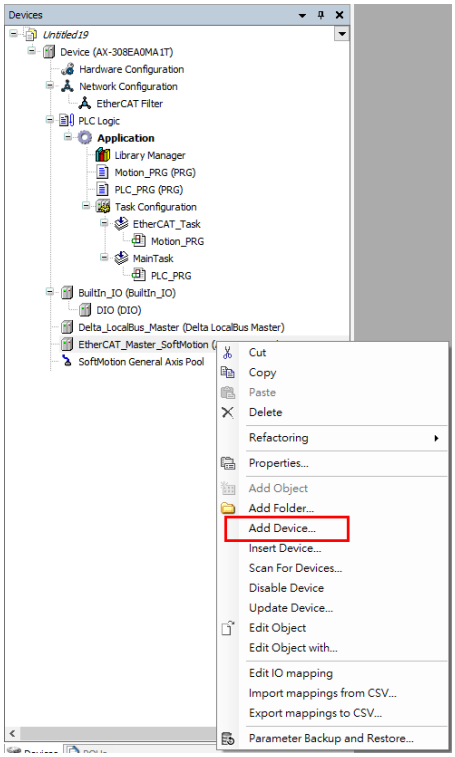
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



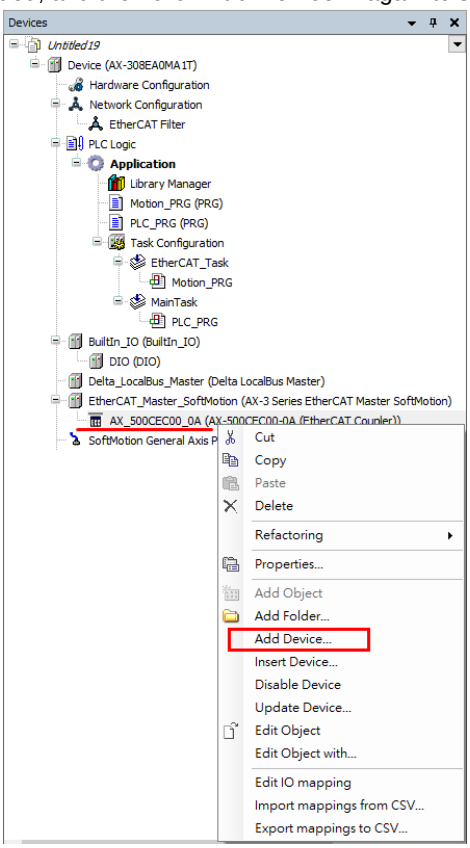
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Add Device…** to select and add System Coupler.

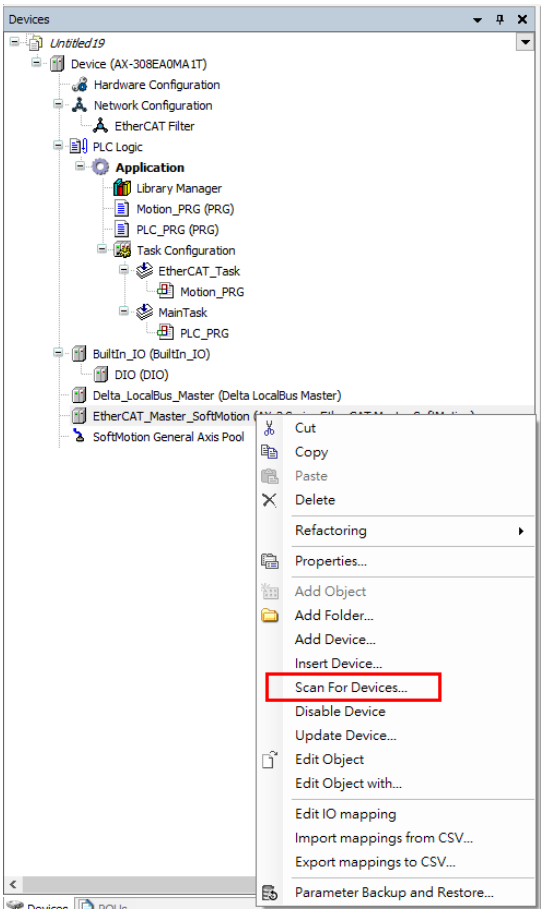


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

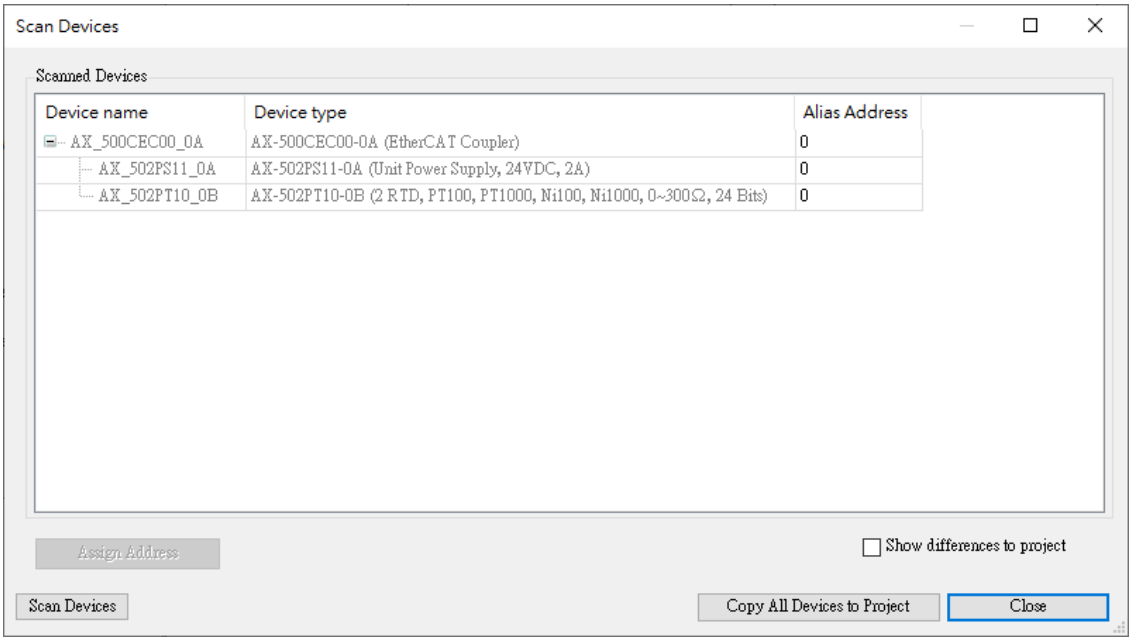


- Method 2: Scan to add the modules in.

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Scan for Devices…**.

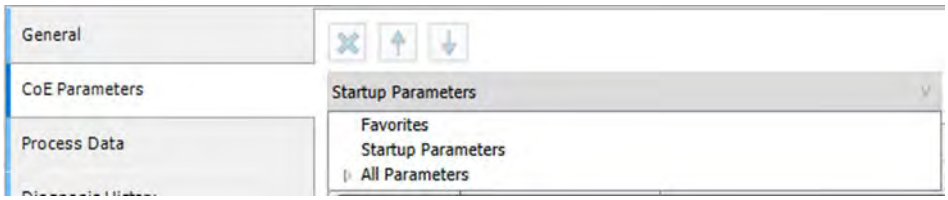


After the auto-scan is over, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



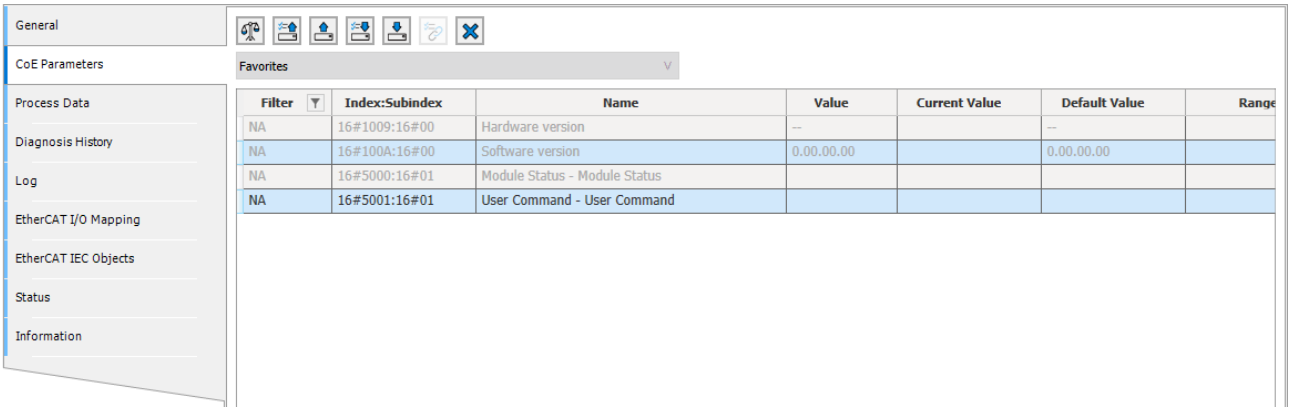
5.10.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.



(1) Favorites

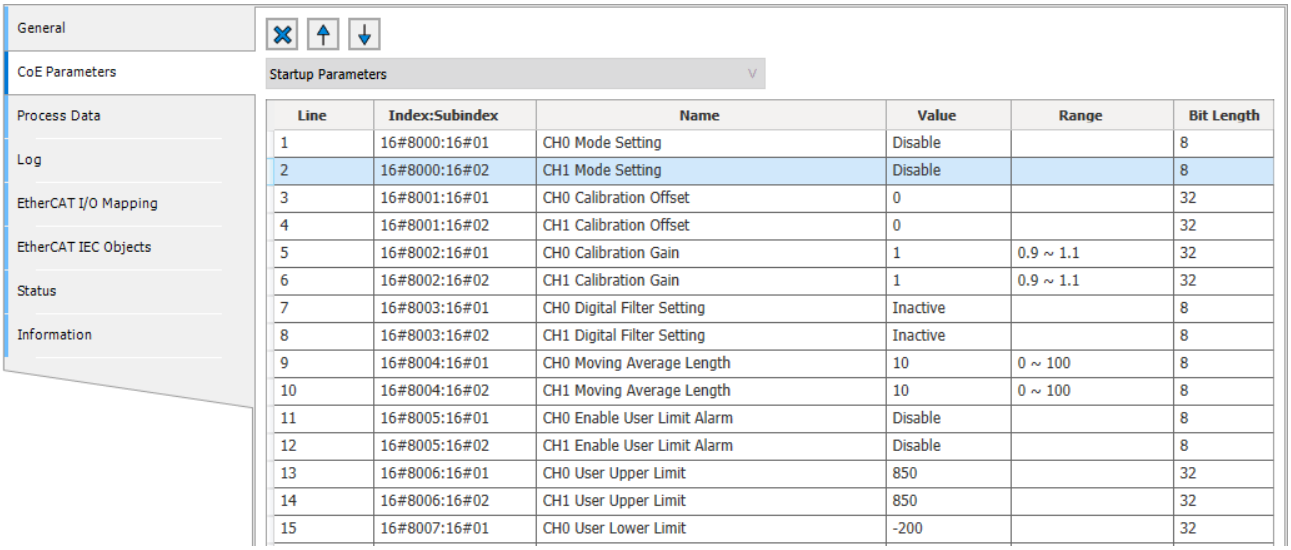
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

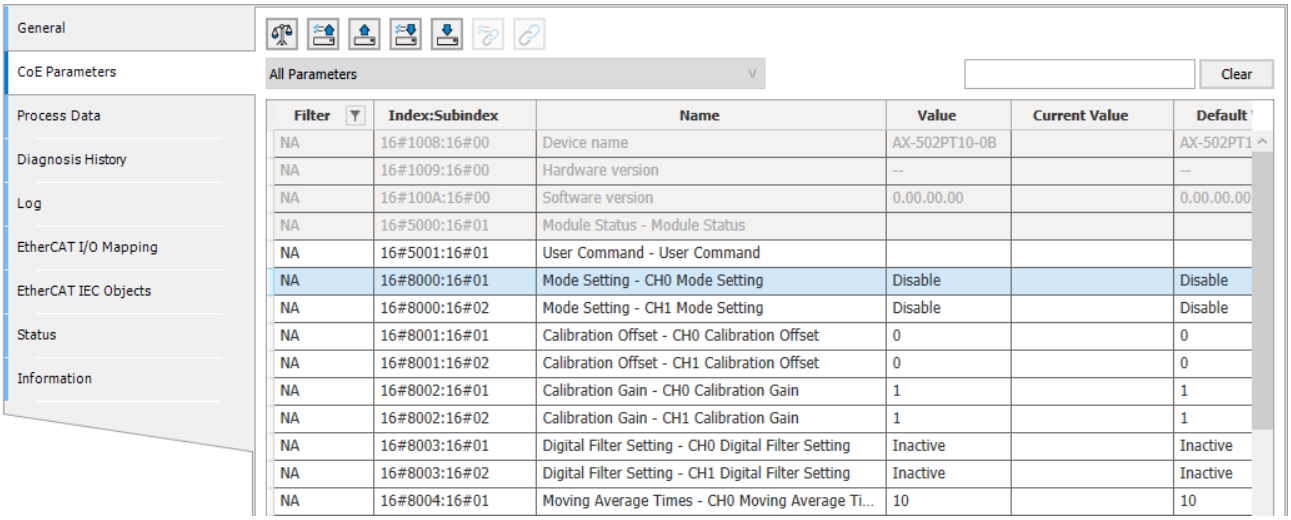


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8001:16#01	CH0 Calibration Offset	0		32
4	16#8001:16#02	CH1 Calibration Offset	0		32
5	16#8002:16#01	CH0 Calibration Gain	1	0.9 ~ 1.1	32
6	16#8002:16#02	CH1 Calibration Gain	1	0.9 ~ 1.1	32
7	16#8003:16#01	CH0 Digital Filter Setting	Inactive		8
8	16#8003:16#02	CH1 Digital Filter Setting	Inactive		8
9	16#8004:16#01	CH0 Moving Average Length	10	0 ~ 100	8
10	16#8004:16#02	CH1 Moving Average Length	10	0 ~ 100	8
11	16#8005:16#01	CH0 Enable User Limit Alarm	Disable		8
12	16#8005:16#02	CH1 Enable User Limit Alarm	Disable		8
13	16#8006:16#01	CH0 User Upper Limit	850		32
14	16#8006:16#02	CH1 User Upper Limit	850		32
15	16#8007:16#01	CH0 User Lower Limit	-200		32

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

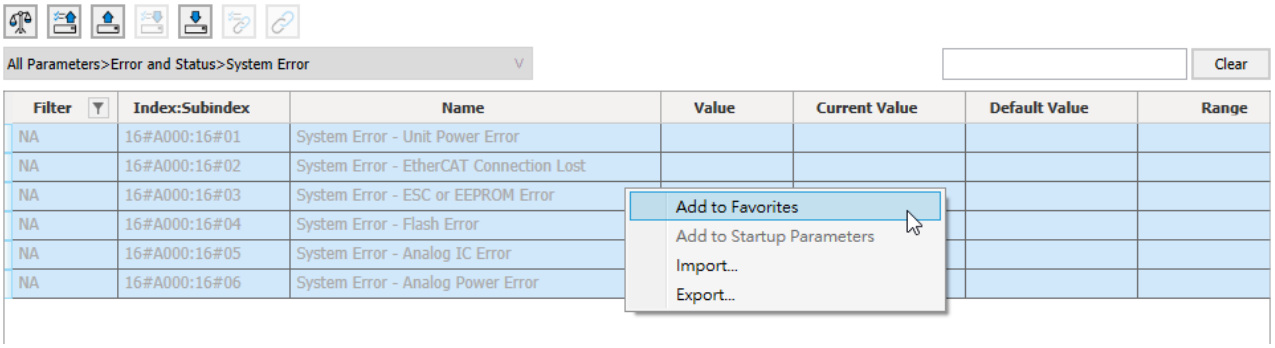
(3) All Parameters

- You can find all the CoE parameters here. Click  on the toolbar to go into online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

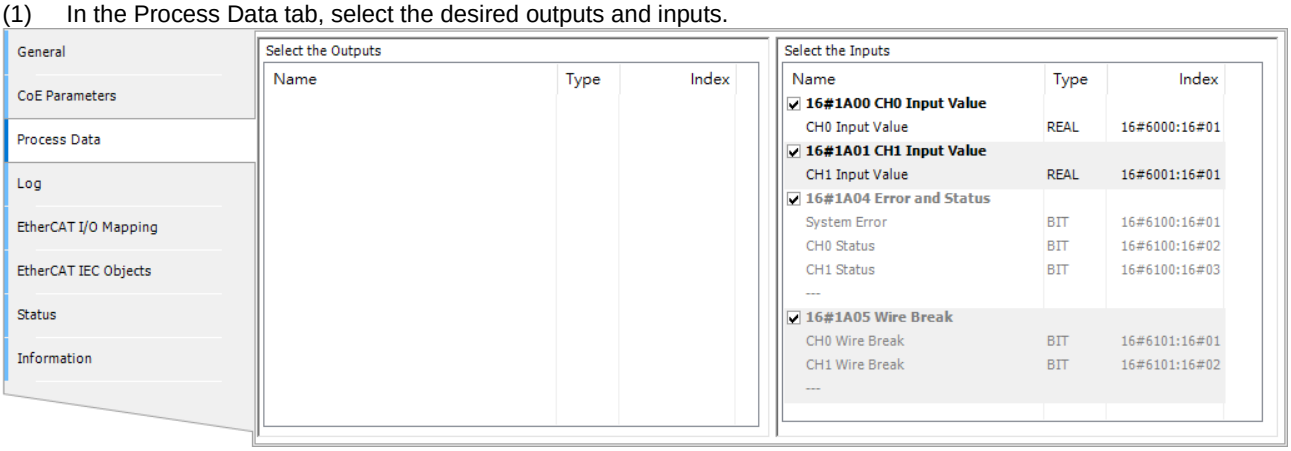
- You can select and right-click the parameter to add the selected parameter to the Favorites.



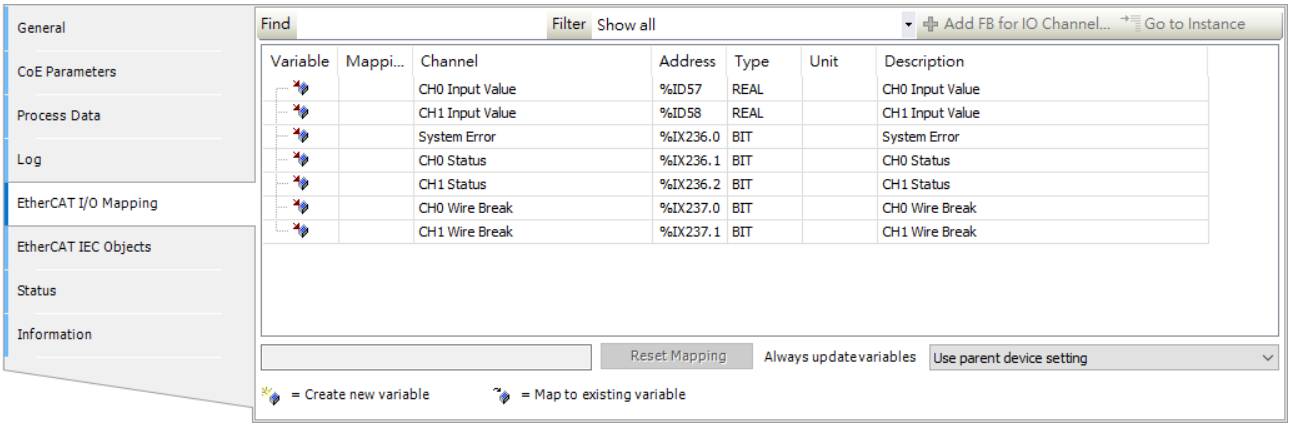
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.10.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

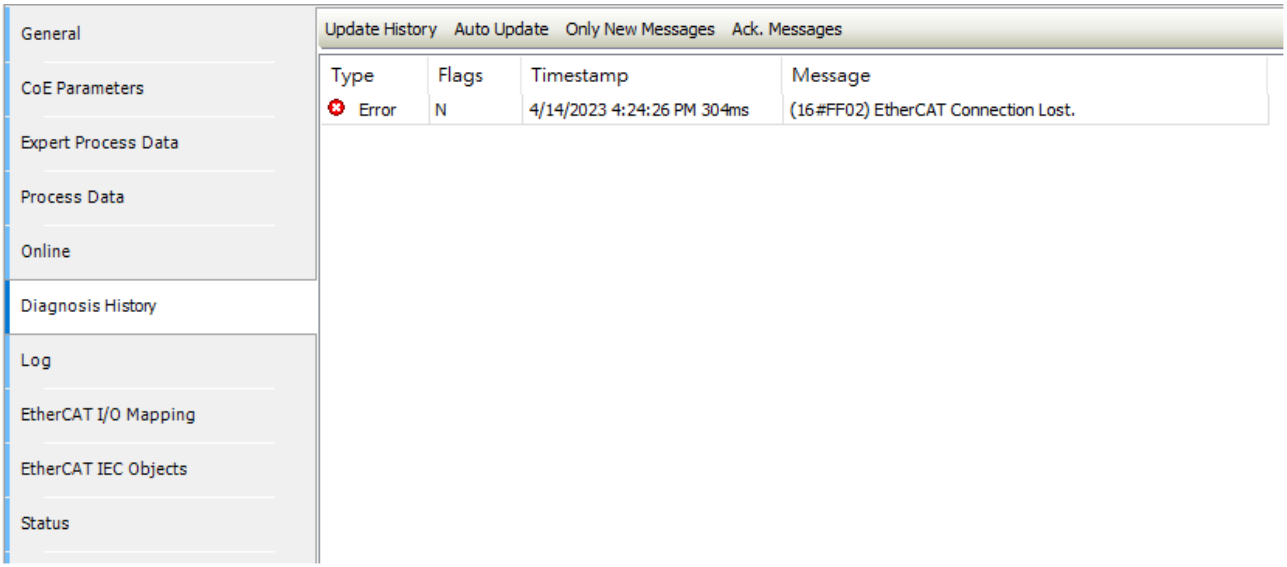


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



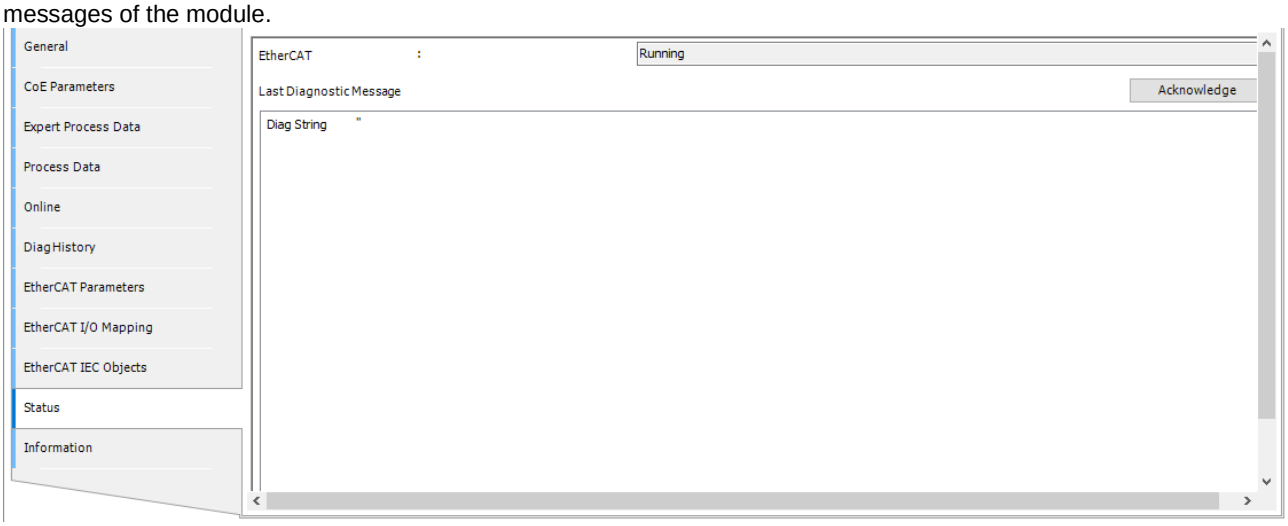
5.10.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors



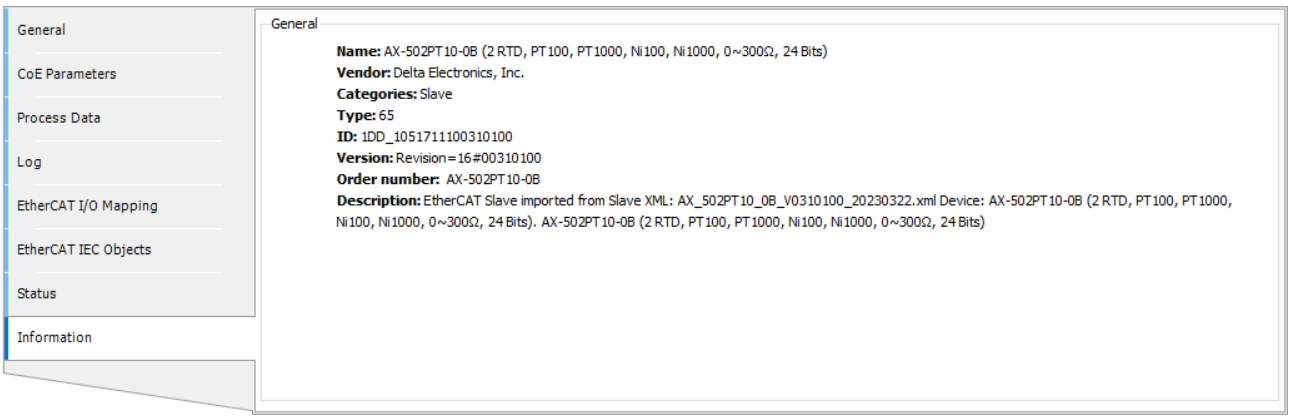
5.10.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



5.10.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.32.01.00	0.32.01.00	0.00.00.00

5.10.5 Parameter Descriptions

You can use DIADesigner-AX to set up the functions for the module by directly selecting the setting mode and parameters. For software operation, refer to section 5.10.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Mode Setting	Mode setting or the channel is OFF.	DFB_PT_RD_ModeSetting DFB_PT_WR_ModeSetting
16#8001	Calibration Offset	Calibration - offset	DFB_PT_RD_CalOffset DFB_PT_WR_CalOffset
16#8002	Calibration Gain	Calibration - gain	DFB_PT_RD_CalGain DFB_PT_WR_CalGain
16#8003	Digital Filter Setting	Digital filter setting	DFB_PT_RD_FilterSetting DFB_PT_WR_FilterSetting
16#8004	Moving Average Times	Moving average times	DFB_PT_RD_AverageTimes DFB_PT_WR_AverageTimes
16#8005	Enable User Limit Alarm DINT	Enable / disable the alarm of exceeding the user-defined limit	
16#8006	User Upper Limit DINT	User-defined upper limit	
16#8007	User Lower Limit DINT	User-defined lower limit	
16#8010	Decimal Places	Decimal places	
16#8011	Unit of Temperature	Unit of temperature	
16#8012	Compensation in two-wire mode	Compensation in two-wire mode	
16#8100	ADC Raw Data	ADC raw data	

5.10.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Explanation**

When the AX5 series PLC is used as the controller, the module status is synchronized with the status of AX5 series PLC CPU and it will be either 1 (Run) or 2 (Stop). When the status of AX5 series PLC CPU is Stop, the output modules will act according to the parameter settings. As for the input modules, they are not affected. If you use other PLC (NOT AX5 Series PLC) as the controller, the module status will be 0, which indicates that it is controlled by EtherCAT State Machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

5.10.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Explanation**

Users write a command value into the module and the module will execute the command accordingly. After execution, the module will respond with a corresponding value to show if the execution is success or not.

- **User command**

Command value	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

5.10.5.3 Mode Setting

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Mode Setting	Temperature mode setting	USINT	RW	0
	16#02	CH1 Mode Setting		USINT	RW	0

- **Explanation**

Select the mode to set the channel to ON.

The channel conversion time

CH0 Mode	CH1 Mode	Conversion Time
ON	OFF	100 ms
OFF	ON	100 ms
ON	ON	200 ms

- **Supported modes**

Setting value	Mode	Setting range (°C)	Setting range (°F)
0	Disable		
1	Pt100 (2 Wire)	-200℃–850℃	-328℉–1562℉
2	Pt100 (3 Wire)	-200℃–850℃	-328℉–1562℉
3	Pt100 (4 Wire)	-200℃–850℃	-328℉–1562℉
4	Pt1000 (2 Wire)	-200℃–850℃	-328℉–1562℉
5	Pt1000 (3 Wire)	-200℃–850℃	-328℉–1562℉
6	Pt1000 (4 Wire)	-200℃–850℃	-328℉–1562℉

Setting value	Mode	Setting range (°C)	Setting range (°F)
7	Ni100 (2 Wire)	-100℃–260℃	-148℉–500℉
8	Ni100 (2 Wire)	-100℃–260℃	-148℉–500℉
9	Ni100 (2 Wire)	-100℃–260℃	-148℉–500℉
10	Ni1000 (2 Wire)	-100℃–260℃	-148℉–500℉
11	Ni1000 (2 Wire)	-100℃–260℃	-148℉–500℉
12	Ni1000 (2 Wire)	-100℃–260℃	-148℉–500℉
13	0–300Ω	0–300Ω	0–300Ω

5.10.5.4 Calibration

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Calibration Offset	Offset Setting range: no limit	REAL	RW	0
	16#02	CH1 Calibration Offset		REAL	RW	0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9–1.1	REAL	RW	1.0
	16#02	CH1 Calibration Gain		REAL	RW	1.0

- **Explanation**

When there is an obvious difference between input values and actual values, you can change Offset and Gain to correct the input curve. The formula is

$$Output = (Input \times Gain) + Offset$$

Example

The mode for the channel is PT100. Gain is 1 and Offset is 0 by default. The signal ranges from -200℃ to 850℃. If Gain is set to 0.9 and Offset is set to 2, the value after calibration is -178℃ to 767℃.

5.10.5.5 Digital Filter

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Digital Filter Setting	Digital filter setting	USINT	RW	0
	16#02	CH1 Digital Filter Setting		USINT	RW	0
16#8004	16#01	CH0 Moving Average Times	Moving average Setting range: 1–100 times	USINT	RW	0
	16#02	CH1 Moving Average Times		USINT	RW	0

- **Explanation**

The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The conversion time will not be affected when the digital filter is enabled.

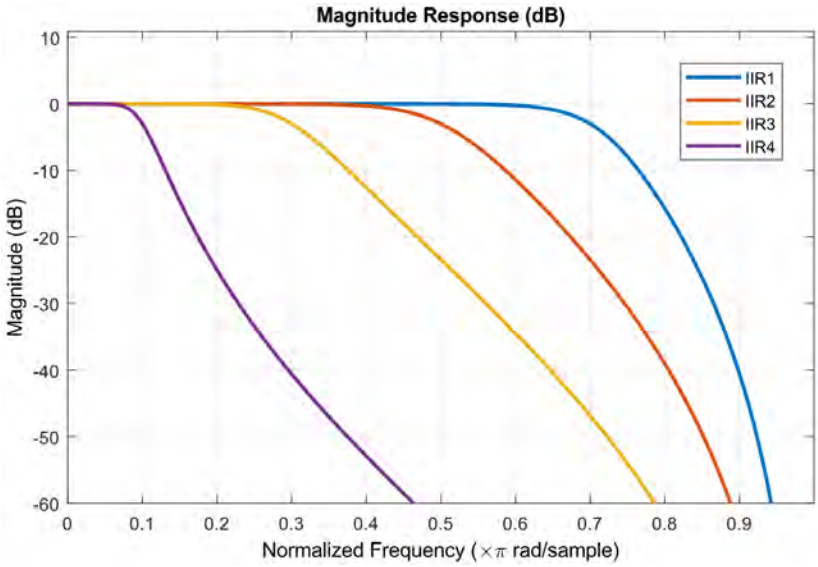
Moving Average Filter

A moving average filter uses the latest pieces of sampled data to create a series of averages to smooth the data. Compared to other types of digital filters, a moving average filter is fast in computation and algorithm, without occupying the CPU processing time. But the filtering result of a moving average filter is not as effective as an IIR filter or a FIR filter.

IIR (Infinite Impulse Response) Filter

An infinite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises,

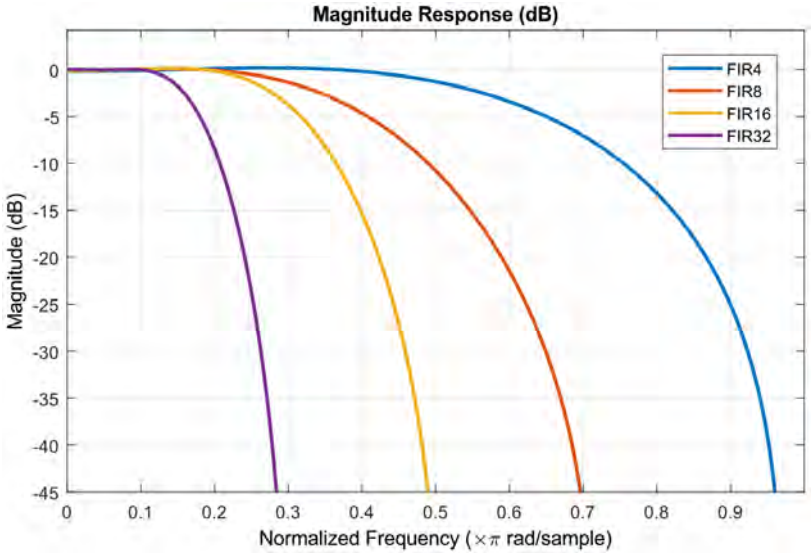
an IIR filter works more efficiently than a moving average filter does. This IIR filter is a low-pass filter. The advantage of an IIR filter is that within the same length of operation time, the filtering result of an IIR filter is better than what a FIR filter can offer. Since an IIR filter can only have a non-linear phase response, it has an inconsistent output delay at every frequency, the input signals may be distorted and the stability issue may be raised. An IIR filter may be not suitable for applications such as oscilloscope waveform and electrocardiography that require demanding waveforms.



Frequency response of IIR filter

FIR (Finite impulse response)

A finite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, a FIR filter works more efficiently than a moving average filter does. This FIR filter is a low-pass filte. The advantage of a FIR filter is that it has a linear phase response which means a FIR filter has a consistent output delay at all frequencies while an IIR filter has an unequal delay at different frequencies. A FIR filter is ideal for a wide range of applications. However within the same length of operation time, the filtering result of a FIR filter is not as good as what an IIR filter can deliver.



Frequency response of FIR filter

- **Digital filter modes**

Mode	Name of digital filter
0	Inactive
1	Moving Average
2	IIR1
3	IIR2
4	IIR3
5	IIR4
6	FIR4
7	FIR8
8	FIR16
9	FIR32

- **Conversion time for enabled channels and corresponding cut-off frequency of filters**

Number of channels that are ON	Conversion time	Cut-off frequency							
		IIR1	IIR2	IIR3	IIR4	FIR4	FIR8	FIR16	FIR32
1	100ms	3.5Hz	2.5Hz	1.5Hz	0.5Hz	2.92Hz	1.79Hz	1.44Hz	0.82Hz
2	200ms	1.75Hz	1.25Hz	0.75Hz	0.25Hz	1.46Hz	0.9Hz	0.72Hz	0.41Hz

Note: Refer to Mode Setting section for the channel conversion time.

5.10.5.6 User Limit Alarm

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Enable User Limit Alarm	Enable / disable the alarm of exceeding the user-defined limit 0: Disable (default) 1: Enable	BOOL	RW	0
	16#02	CH1 Enable User Limit Alarm				
16#8004	16#01	CH0 User Upper Limit	User-defined upper limit; Setting range: no limit	REAL	RW	850
	16#02	CH1 User Upper Limit				
16#8005	16#01	CH0 User Lower Limit	User-defined lower limit; Setting range: no limit	REAL	RW	-200
	16#02	CH1 User Lower Limit				

- **Explanation**

Users can define the upper and lower limits and enable the alarm of exceeding the limits. If the Enable User Limit Alarm is enabled, when the input temperature exceeds the user upper/lower limit, a user upper/lower limit error will occur. (See section 5.10.8 for more information on troubleshooting.) When the temperature exceeds the hardware limit, an over/under hardware range error will occur.

- **Example**

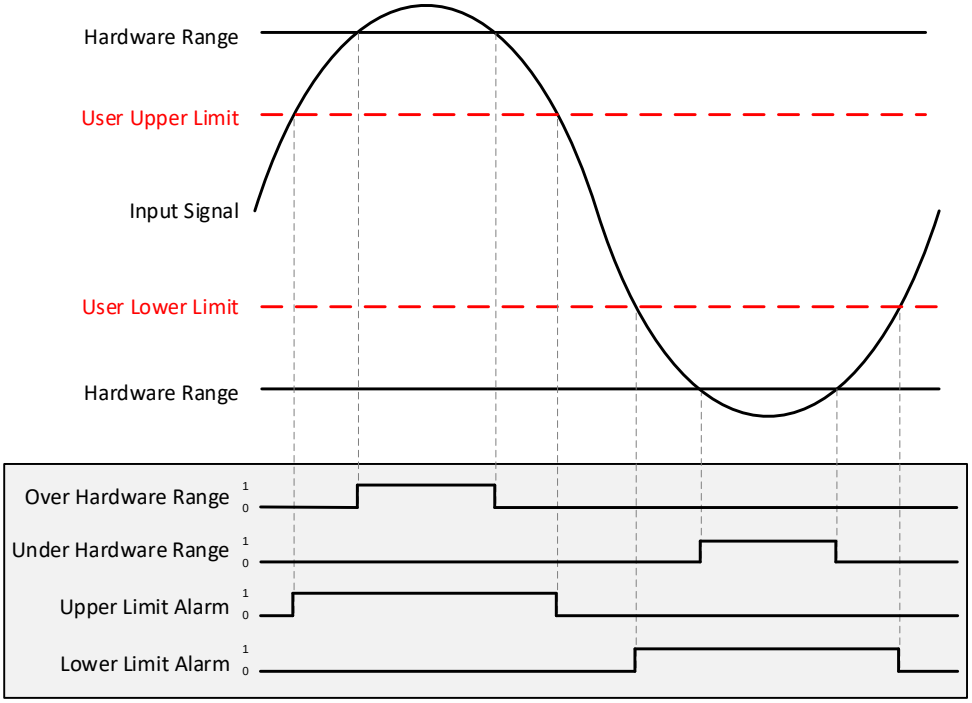
Set the parameters as follows:

16#8003 Enable User Limit Alarm: Enable

16#8004 User Upper Limit: 850

16#8005 User Lower Limit: -200

When the input signal exceeds the user-defined upper or lower limit, an error occurs.



5.10.5.7 Decimal Places

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8010	16#01	CH0 Decimal Places	Decimal places; setting value: 0–1	USINT	RW	1
	16#02	CH1 Decimal Places		USINT	RW	1

- **Explanation**

You can set the decimal places according to your demand.

5.10.5.8 Unit of Temperature

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8011	16#01	CH0 Unit of Temperature	Unit of temperature; 0: °C 1: °F	USINT	RW	1
	16#02	CH1 Unit of Temperature		USINT	RW	1

- **Explanation**

You can set the unit of temperature to °C or °F according to your demand.

5.10.5.9 Compensation in two-wire mode

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8012	16#01	CH0 Compensation in two-wire mode	Compensation in two-wire mode Unit: Ω	REAL	RW	0
	16#02	CH1 Compensation in two-wire mode		REAL	RW	0

- **Explanation**

You can use this parameter to set the temperature compensation when you select the two-wire mode.

- **Example**

The mode of CH0 is set to Pt100 (2 Wire) and the wire resistance for the 2-wire sensor is measured as 12.34 Ω. You can enter the number 12.34 in this parameter (CH0 Compensation in two-wire mode), and the measurement error caused by the impedance will be deducted automatically.

5.10.5.10 ADC Raw Data

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8100	16#01	CH0 ADC Raw data	Raw data	DINT	RO	0
	16#02	CH1 ADC Raw data		DINT	RO	0

- **Explanation**

Raw data is the source data that has not been processed or converted from analog to digital.

5.10.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system. For temperature measurement modules, only FreeRun mode is supported.

5.10.6.1 FreeRun Mode

The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

5.10.7 Process Data

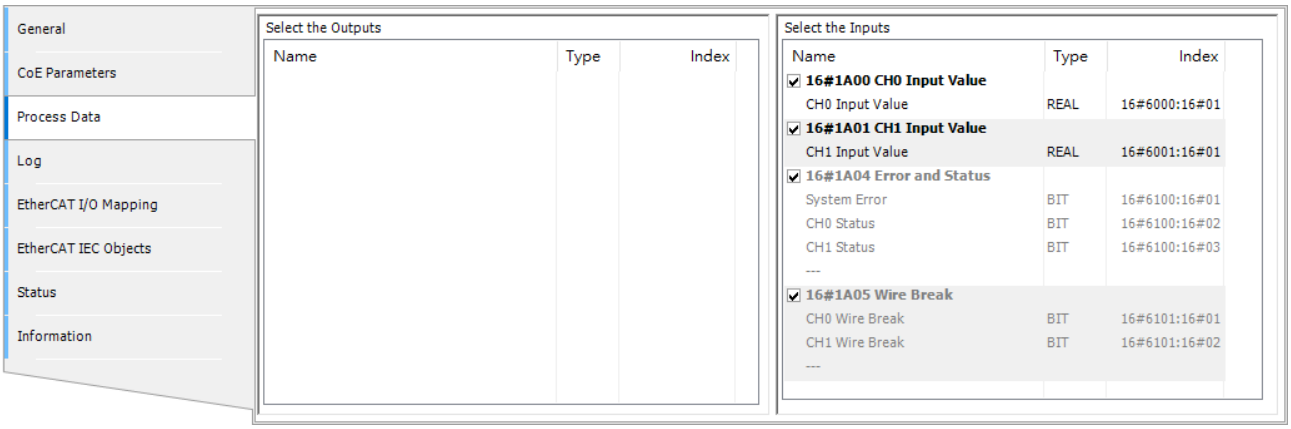
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Analog Input Value	Analog input value	REAL	RO	0.0
16#6001		CH1 Analog Input Value				
16#6100	16#01	System Error	System error	BOOL	RO	0
	16#02	CH0 Status	CH0: error or warning			
	16#03	CH1 Status	CH1: error or warning			
16#6101	16#01	CH0 Wire Break	Channel connection loss 0: Normal 1: Error	BOOL	RO	0
	16#02	CH1 Wire Break				

5.10.7.1 Process Data

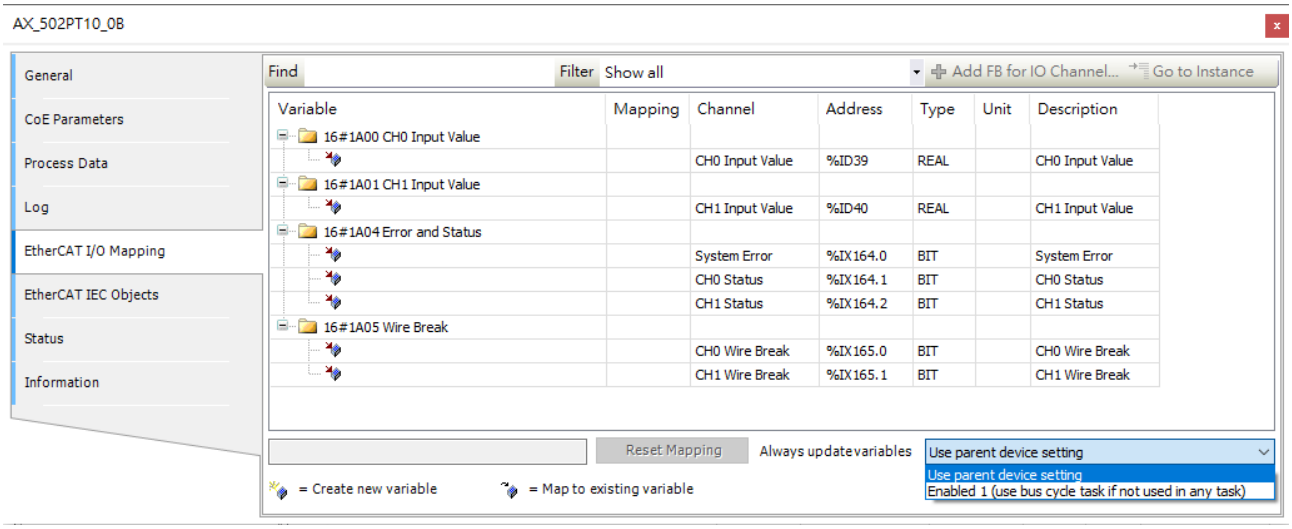
Go to the Process Data tab and select the data that you'd like to monitor.

- Analog Input Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Status: It is selected by default. The grayed out part cannot be modified.
- Wire Break: It is selected by default. The grayed out part cannot be modified.



5.10.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



5.10.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

5.10.8 Troubleshooting

In the Diagnosis History tab, the error information that has occurred on the module is recorded. In the Status tab, the current error information is displayed. In the CoE Parameters tab, you can view the error status through Index/SubIndex of the All Parameter list.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Connection Lost	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#05	(16#FF05) Analog IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#06	(16#FF06) Analog Power Error	ON	OFF	If the problem persists, contact the local authorized distributors.
16#A00**n**[*1]	16#01	(16#FF11) CH(**n**-1) Upper Limit Alarm	Blinking (1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user upper limit.
	16#02	(16#FF12) CH(**n**-1) Lower Limit Alarm	Blinking (1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user lower limit.
	16#03	(16#FF13) CH(**n**-1) Over Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed hardware range.
	16#04	(16#FF14) CH(**n**-1) Under Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed hardware range.
	16#05	(16#FF15) CH(**n**-1) Wire Break	Blinking (0.2s)	OFF	Check if the sensor is securely connected.

*1. n =1–2

5.11 AX-504PT10-0B

The AX-504PT10-0B, a temperature measurement module, converts the values received from the RTD sensors into digital signals. You can select either Celsius or Fahrenheit as the unit of measurement. This section describes its specifications, wirings and operations.

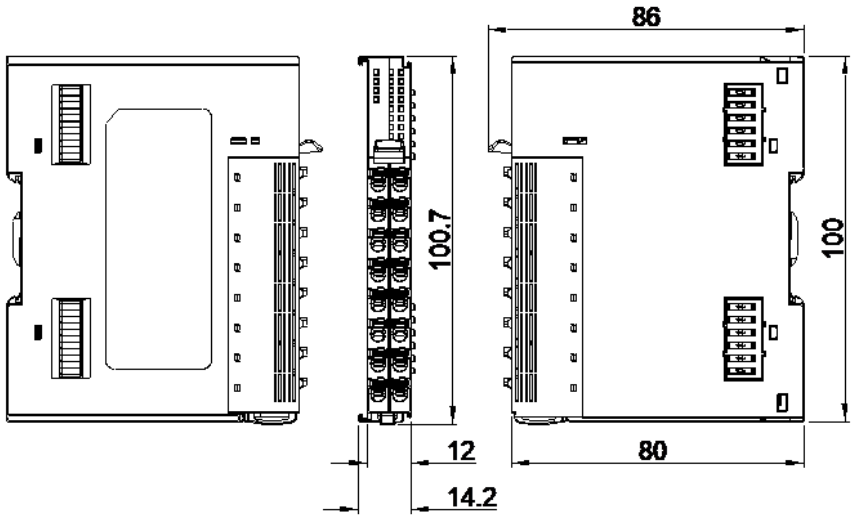
5.11.1 Specifications

Item		Specification
Input points		4
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		Free Run mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		71 g
Electrical specification	Input form	Differential input
	Sensor type	Pt100: DIN 43760-1980 JIS C1604-1989, 100Ω 3850 PPM/°C Pt1000: DIN EN60751, 1 kΩ 3850 PPM/°C Ni100/Ni1000: DIN 43760 0–300Ω
	Connection type	2-wire, 3-wire, 4-wire
	Resolution	0.001°C/0.0018°F[*1]
	Temperature measurement accuracy	±0.3%: 25℃ (F.S.) ±0.5%: 0–60 ℃ (F.S.) ±1%: <-20–0 ℃ (F.S.)
	Input impedance	More than 10 KΩ
	Conversion time	100 ms / channel
	Isolation method	Between unit power and external power: no isolation Between digital power and analog power: 500 VAC Between digital signal and analog signal: 500 VAC Between analog channels: no isolation
	Maximum power consumption (unit power)	Less than 400 mA (2 W)
	Minimum power consumption (I/O Power)	No power consumed
	Excitation current	2-wire, 4-wire: PT100 / Ni100 / 0–300Ω: 500uA PT1000 / Ni1000: 250uA 3-wire: PT100 / PT1000 / Ni100 / Ni1000 / 0–300 Ω: 250 uA
Others	Connection Lost Protection	Yes
	Short Circuit Protection (SCP)	--
	Input power protection (voltage range)	± 30 V
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	--
	Filter function	AVG, FIR, IIR

*1. The temperature unit is 0.001°C/0.0018°F. If Fahrenheit is selected as the temperature unit, the fourth decimal place is not displayed.

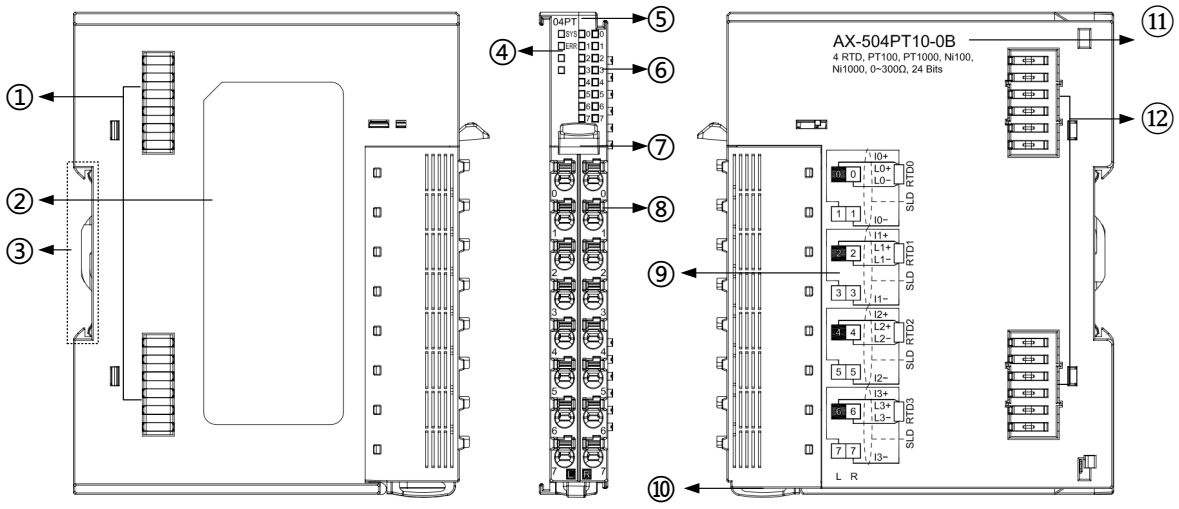
5.11.2 Dimensions and Parts

- **Dimensions**



Unit: mm

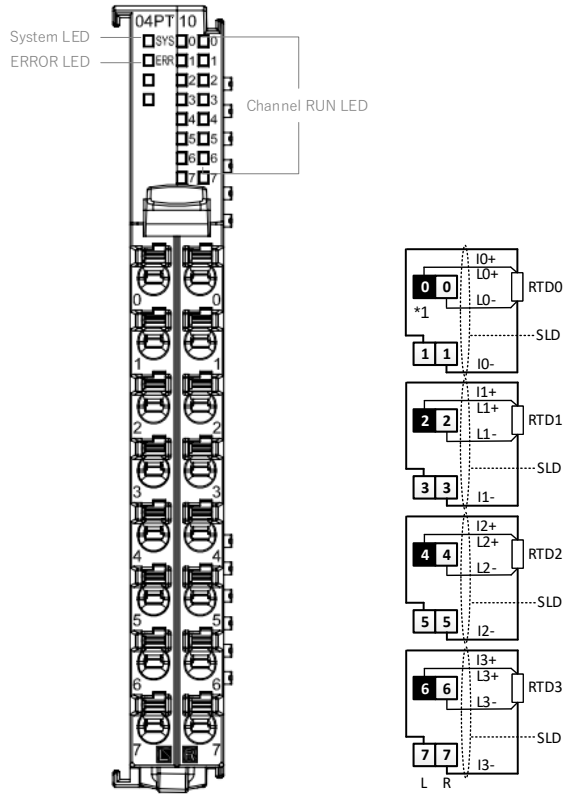
- **Parts**



No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener
11	Model number and model description
12	AX connector (R)

5.11.3 Arrangement of Terminals, LED Indicators and Wiring

5.11.3.1 Arrangement of Terminals



*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

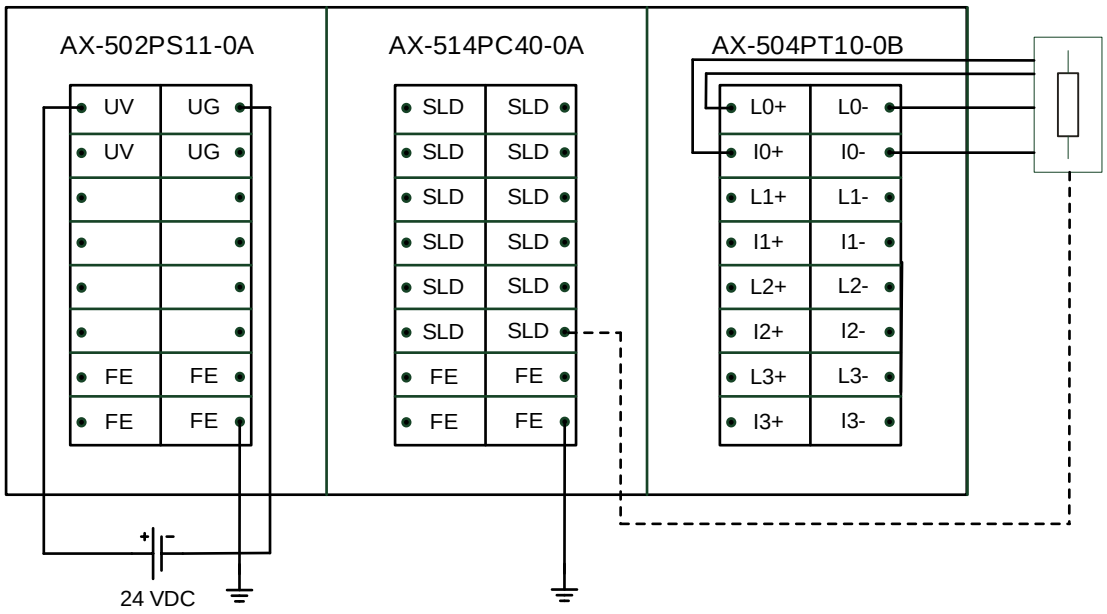
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	L0+	Channel 0: sensor positive input	R0	L0-	Channel 0: sensor negative input
L1	I0+	Channel 0: power positive output	R1	I0-	Channel 0: power negative output
L2	L1+	Channel 1: sensor positive input	R2	L1-	Channel 1: sensor negative input
L3	I1+	Channel 1: power positive output	R3	I1-	Channel 1: power negative output
L4	L2+	Channel 2: sensor positive input	R4	L2-	Channel 2: sensor negative input
L5	I2+	Channel 2: power positive output	R5	I2-	Channel 2: power negative output
L6	L3+	Channel 3: sensor positive input	R6	L3-	Channel 3: sensor negative input
L7	I3+	Channel 3: power positive output	R7	I3-	Channel 3: power negative output

5.11.3.2 LED Indicators

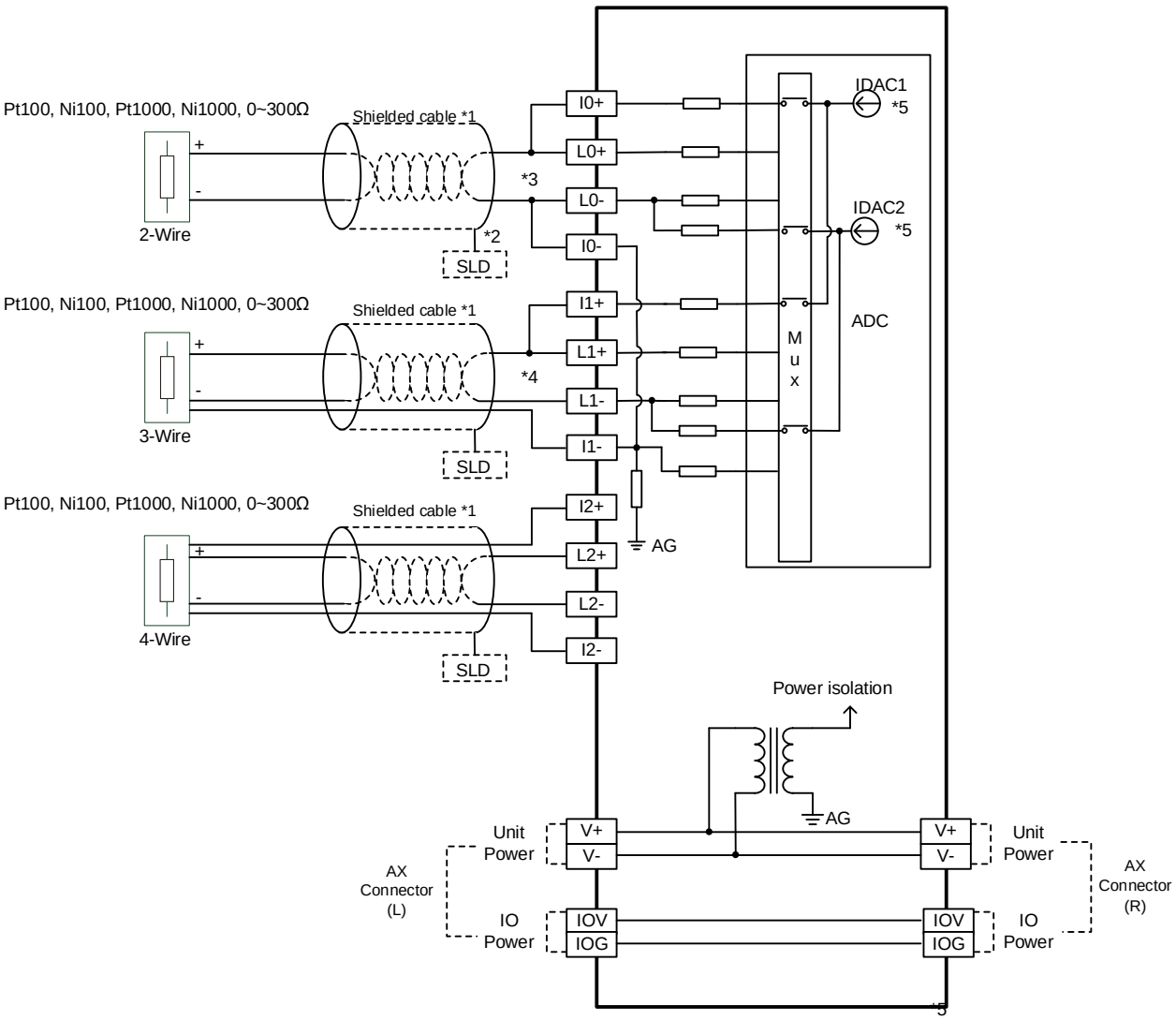
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking (1s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1s)	An error occurs on the application.
			Blinking (0.2s)	An error occurs on the hardware.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

5.11.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



*1. Use shielded twisted pair cables for temperature sensors, and keep them away from power cables and other cables that generate noise.
*2. Please wire this shielded cable to the SLD pin of the power module AX-514PC40-0A.
*3. If you use two-wire temperature sensors, In+ & Ln+ and In- & Ln- must be short-circuited (where n is between 1–4).
*4. If you use three-wire temperature sensors, In+ & Ln+ must be short-circuited (where n is between 1–4).
*5. Different internal excitation current will be applied according to their modes and selected sensors for the channel automatically.

NOTE: Use cables with the same length (less than 200 m) and use wire resistance of less than 200 ohm for 3-wire and 4-wire sensors.

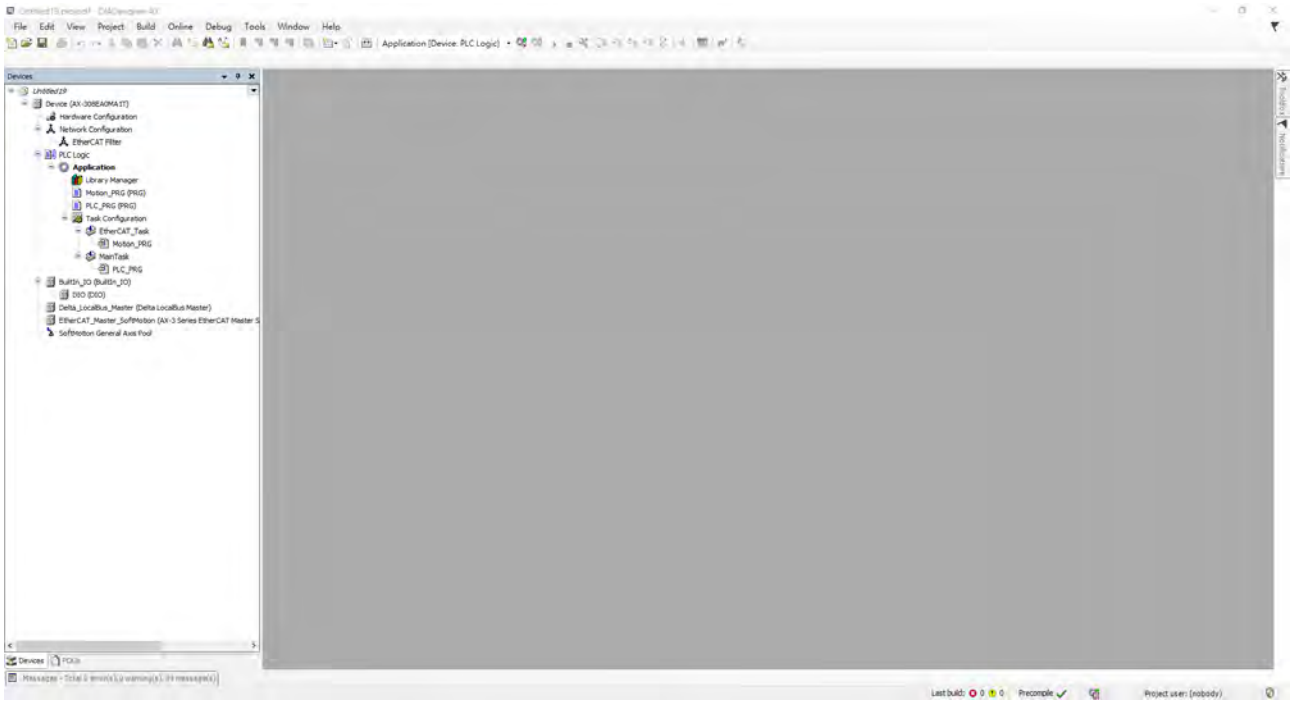
Wiring Mode	Sensor	IDAC1	IDAC2
2/4 Wire	PT100/Ni100/0–300Ω	500μA	OFF
	PT1000/Ni1000	250μA	
3 Wire	PT100/Ni100/0–300Ω	250μA	250μA
	PT1000/Ni1000		

5.11.4 Settings in DIADesigner-AX

The software DIADesigner-AX is the programming tool for the AX Series PLCs. This section introduces some basic operations and settings.

5.11.4.1 Basic Operation

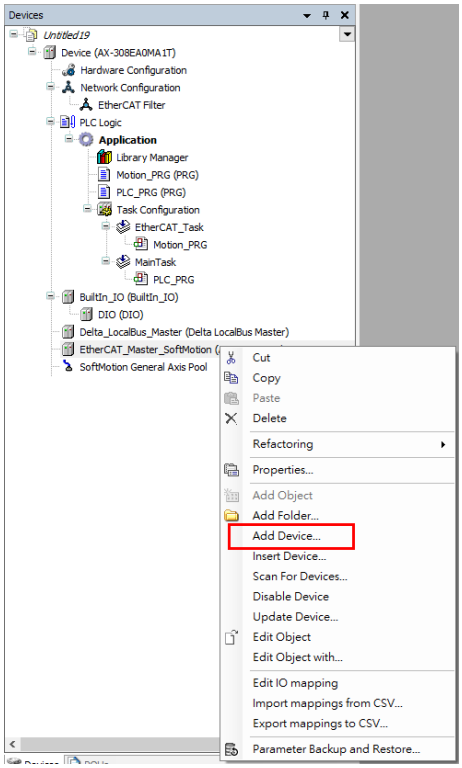
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



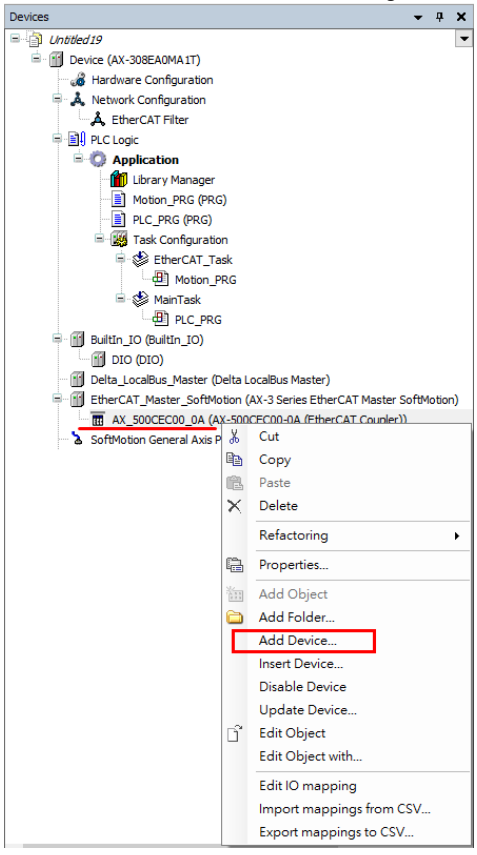
(2) Add Modules in

- Method 1: Add the modules in manually

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Add Device…** to select and add System Coupler.

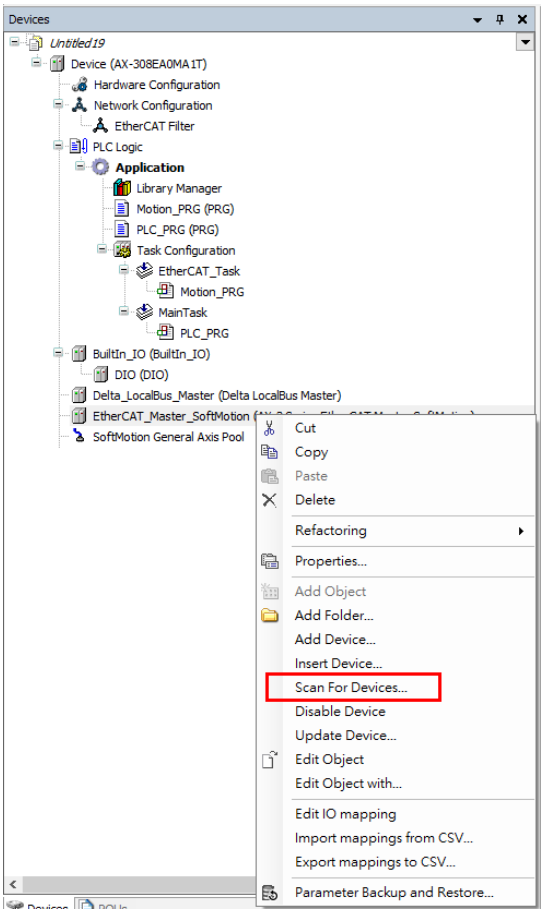


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

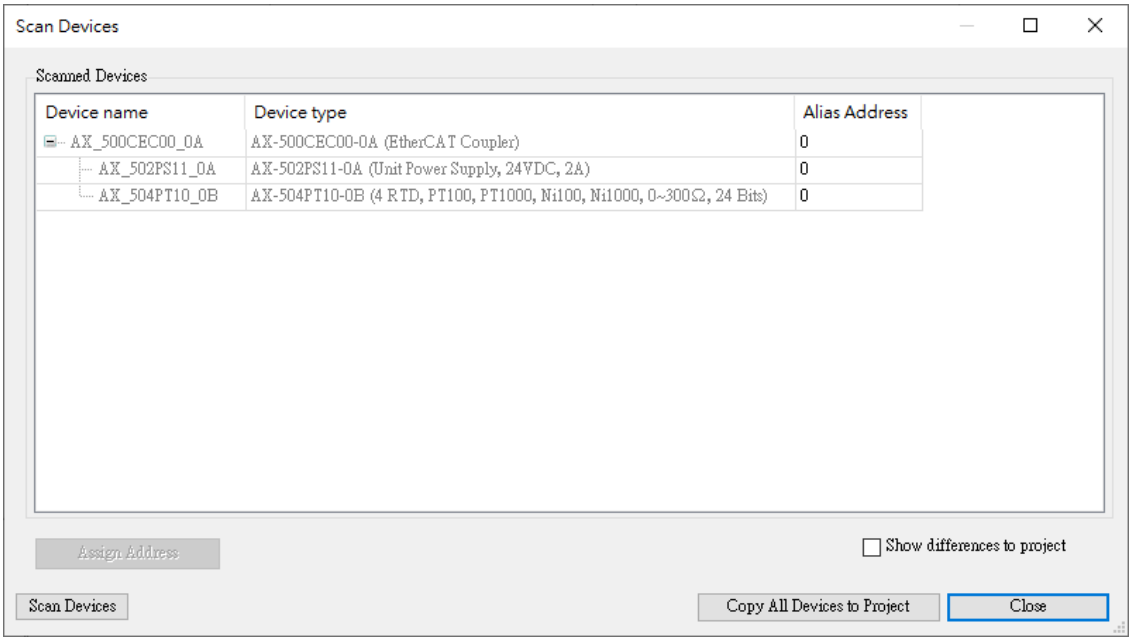


- Method 2: Scan to add the modules in.

Right-click **EtherCAT Master SoftMotion** in the Devices tree, and then click **Scan for Devices…**.



After the auto-scan is over, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.

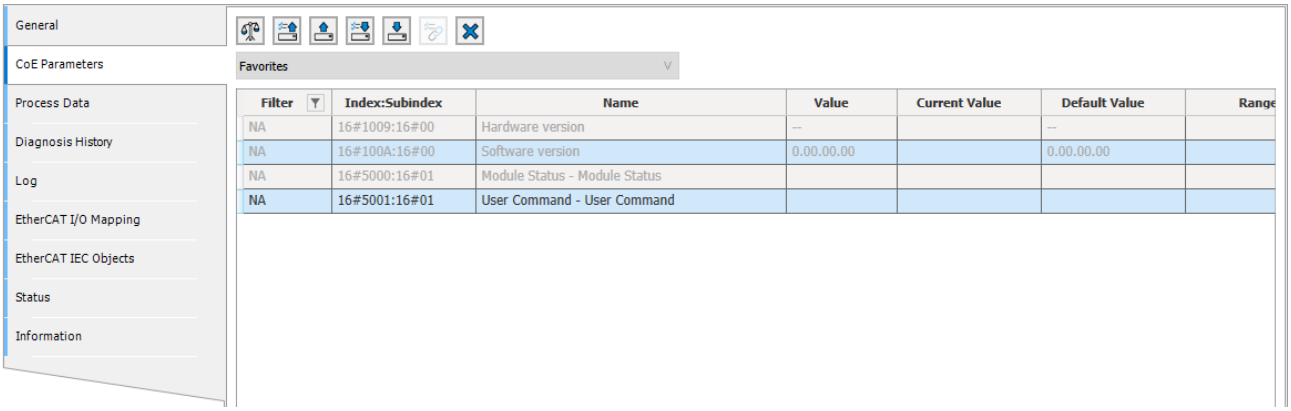


5.11.4.2 Parameter Settings

In the CoE Parameters tab, you can do the following settings of parameters.

(1) Favorites

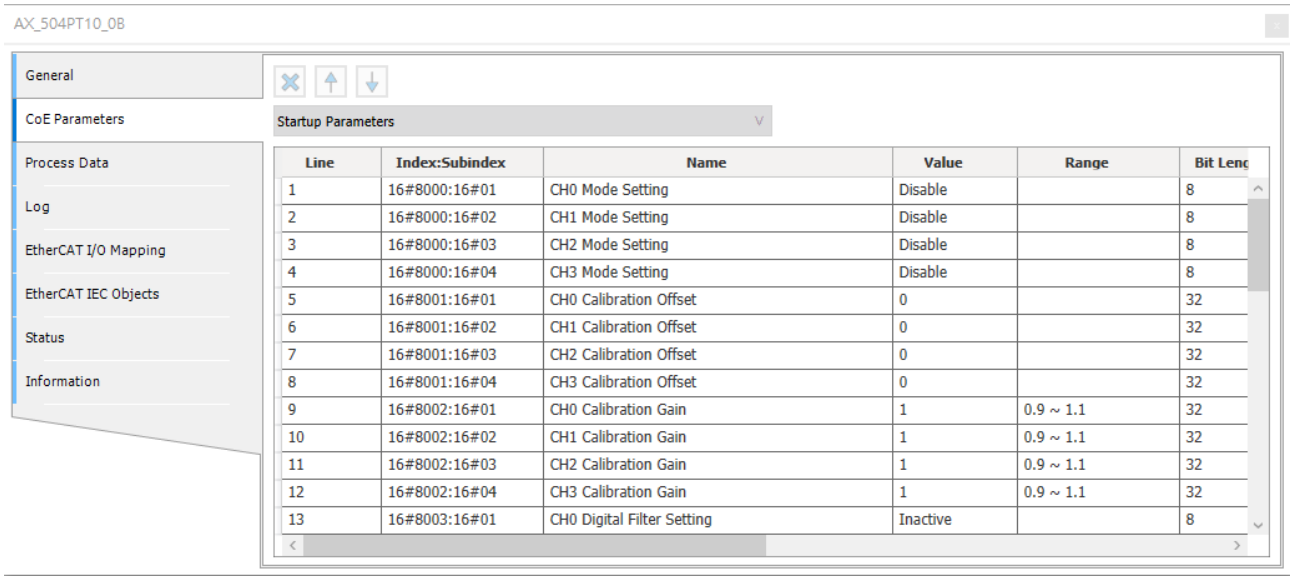
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.
	Delete	Delete

(2) Startup Parameters

- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.

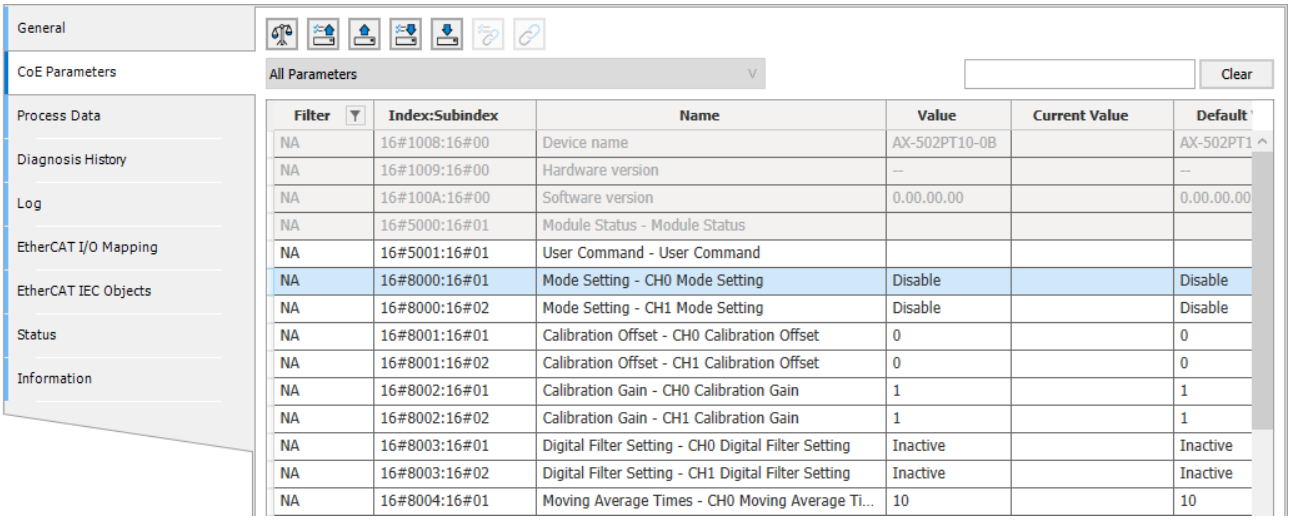


Line	Index:Subindex	Name	Value	Range	Bit Lenc
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8000:16#03	CH2 Mode Setting	Disable		8
4	16#8000:16#04	CH3 Mode Setting	Disable		8
5	16#8001:16#01	CH0 Calibration Offset	0		32
6	16#8001:16#02	CH1 Calibration Offset	0		32
7	16#8001:16#03	CH2 Calibration Offset	0		32
8	16#8001:16#04	CH3 Calibration Offset	0		32
9	16#8002:16#01	CH0 Calibration Gain	1	0.9 ~ 1.1	32
10	16#8002:16#02	CH1 Calibration Gain	1	0.9 ~ 1.1	32
11	16#8002:16#03	CH2 Calibration Gain	1	0.9 ~ 1.1	32
12	16#8002:16#04	CH3 Calibration Gain	1	0.9 ~ 1.1	32
13	16#8003:16#01	CH0 Digital Filter Setting	Inactive		8

Icon	Function	Description
	Delete	Delete
	Move up	Move up
	Move down	Move down

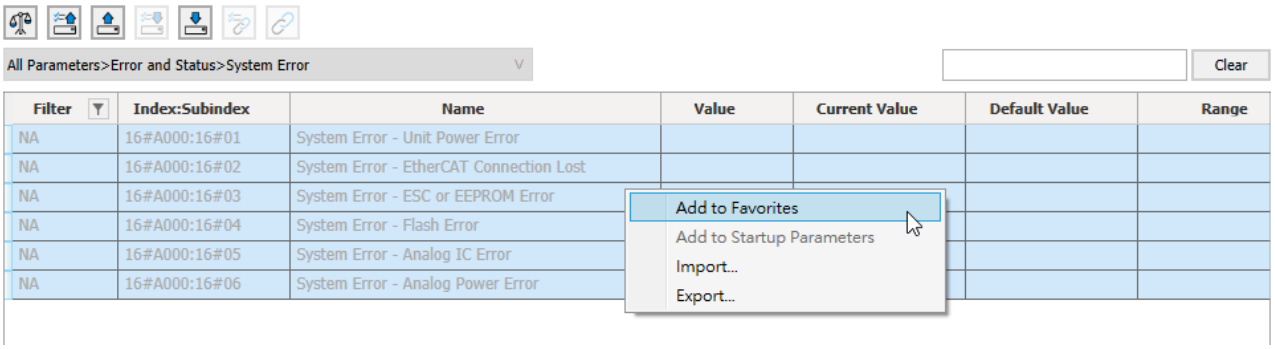
(3) All Parameters

- You can find all the CoE parameters here. Click  on the toolbar to go into online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in Current Value column.
- You can edit the values of parameters in Value column. Once you click the download button, the setting values will be written into the module and take effect right away.



Icon	Function	Description
	Compare	Compare
	Upload Selection from Device	Upload the selected parameters from the module to DIADesigner-AX.
	Upload All from Device	Upload all the parameters from the module to DIADesigner-AX.
	Download Selection to Device	Download the selected parameters from DIADesigner-AX to the module.
	Download All to Device	Download all the parameters from DIADesigner-AX to the module.
	Synchronize to Selection Startup Parameter(s)	Synchronize the selected parameters to the startup parameters.
	Synchronize to All Startup Parameter(s)	Synchronize all the parameters to the startup parameters.

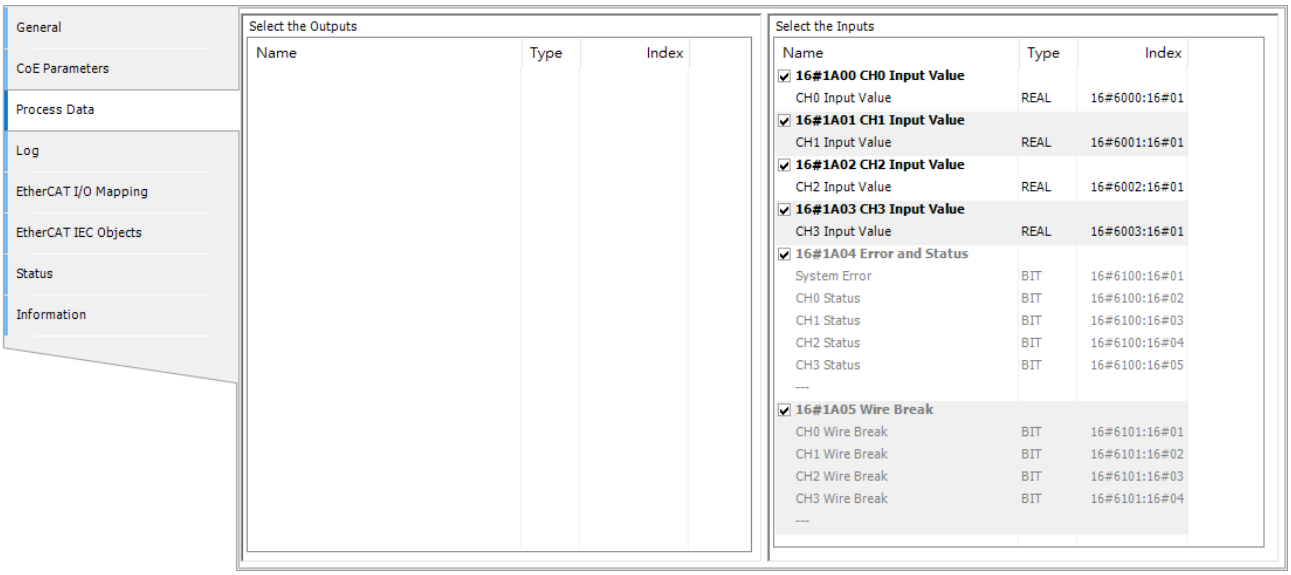
- You can select and right-click the parameter to add the selected parameter to the Favorites.



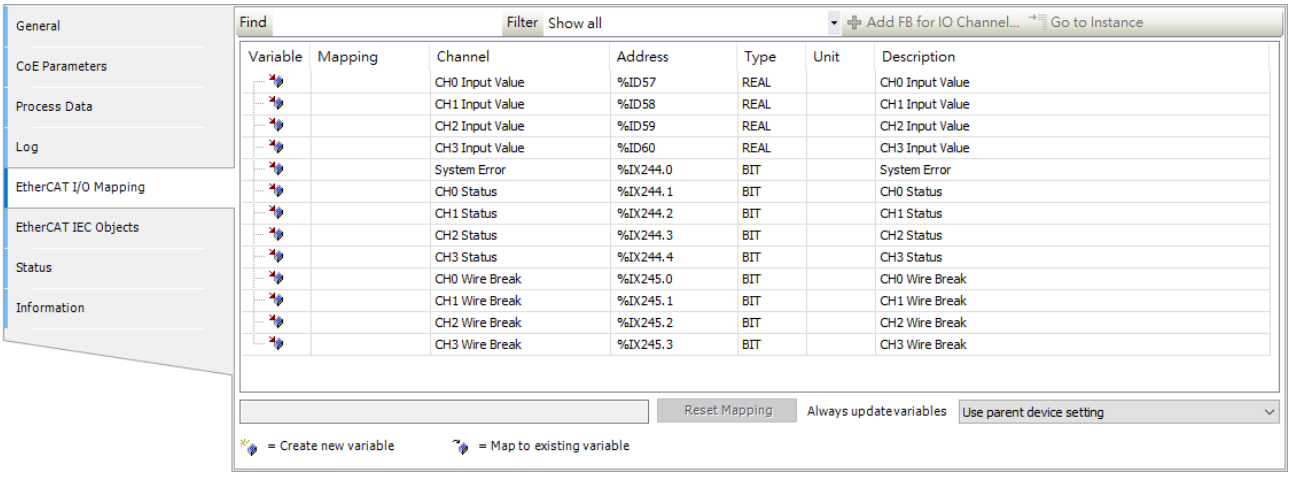
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.11.4.3 Process Data

(1) In the Process Data tab, select the desired outputs and inputs.

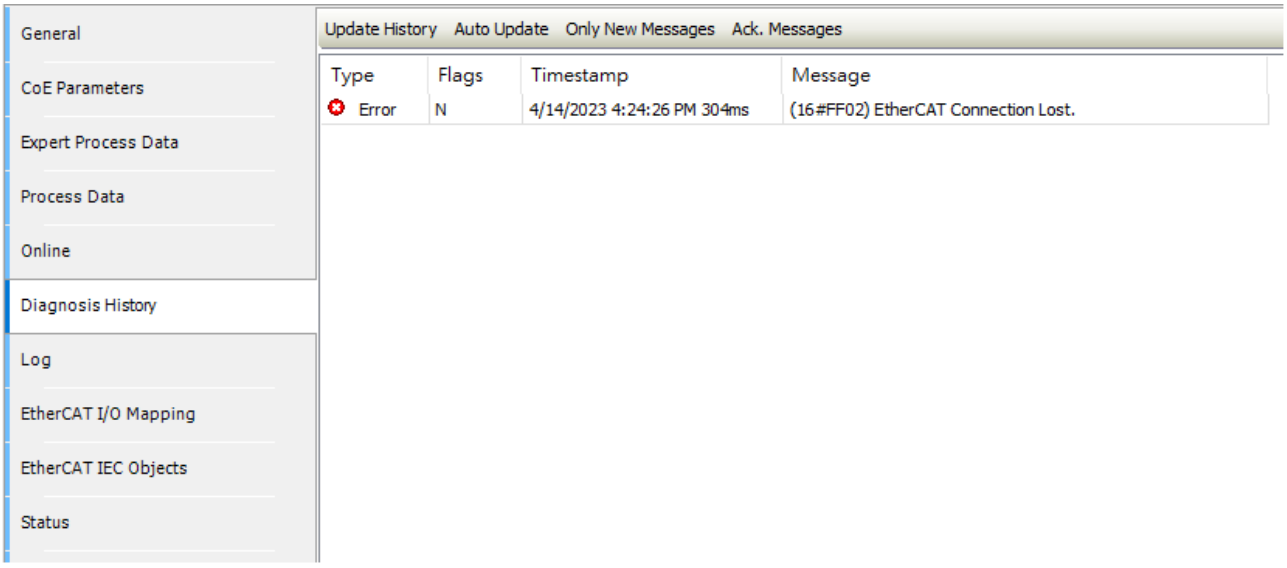


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



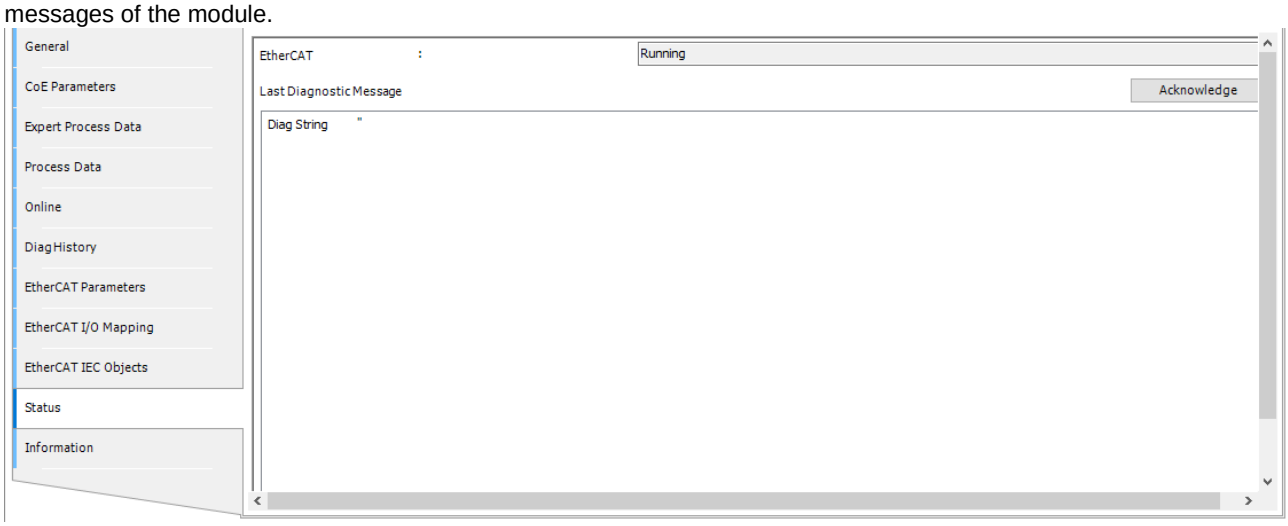
5.11.4.4 Diagnosis History

Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors.



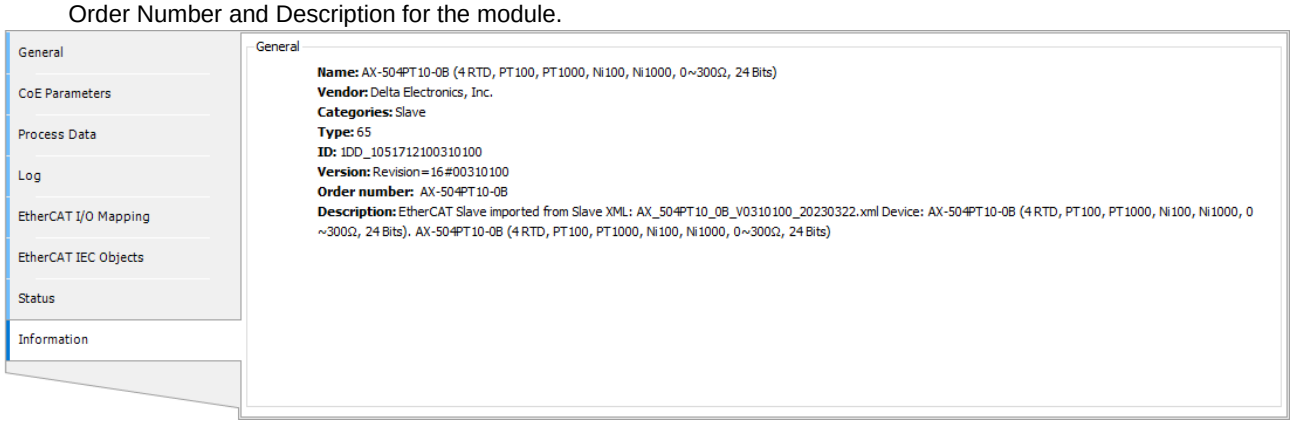
5.11.4.5 Status

Click  on the toolbar to go into online mode. In the Status tab, you can monitor the current status and latest diagnostic messages of the module.



5.11.4.6 Information

(1) In the Information tab, you can find the module information, including Name, Vendor, Categories, Type, ID, Version, Order Number and Description for the module.



(2) Click  on the toolbar to go into online mode. Go to the All Parameters page in the CoE Parameters tab, and then you can find the hardware version and software version.

Filter	Index:Subindex	Name	Value	Current Value	Default Value
=	16#1009:16#00	Hardware version	A0	A0	--
=	16#100A:16#00	Software version	0.32.01.00	0.32.01.00	0.00.00.00

5.11.5 Parameter Descriptions

You can use DIADesigner-AX to set up the functions for the module by directly selecting the setting mode and parameters. For software operation, refer to section 5.9.4 for more information. The function blocks in the software are available for you to set relevant parameters. Please refer to the function block manual for the usage of function blocks.

Index	Function	Description	Function block
16#5000	Module Status	Status of the module	
16#5001	User Command	Commands for users to use	
16#8000	Mode Setting	Mode setting or the channel is OFF.	DFB_PT_RD_ModeSetting DFB_PT_WR_ModeSetting
16#8001	Calibration Offset	Calibration - offset	DFB_PT_RD_CalOffset DFB_PT_WR_CalOffset
16#8002	Calibration Gain	Calibration - gain	DFB_PT_RD_CalGain DFB_PT_WR_CalGain
16#8003	Digital Filter Setting	Digital filter setting	DFB_PT_RD_FilterSetting DFB_PT_WR_FilterSetting
16#8004	Moving Average Times	Moving average times	DFB_PT_RD_AverageTimes DFB_PT_WR_AverageTimes
16#8005	Enable User Limit Alarm DINT	Enable / disable the alarm of exceeding the user-defined limit	
16#8006	User Upper Limit DINT	User-defined upper limit	
16#8007	User Lower Limit DINT	User-defined lower limit	
16#8010	Decimal Places	Decimal places	
16#8011	Unit of Temperature	Unit of temperature	
16#8012	Compensation in two-wire mode	Compensation in two-wire mode	
16#8100	ADC Raw Data	ADC raw data	

5.11.5.1 Module Status

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5000	16#01	Module Status	Status of the module	UINT	RO	0

- **Explanation**

When the AX5 series PLC is used as the controller, the module status is synchronized with the status of AX5 series PLC CPU and it will be either 1 (Run) or 2 (Stop). When the status of AX5 series PLC CPU is Stop, the output modules will act according to the parameter settings. As for the input modules, they are not affected. If you use other PLC (NOT AX5 Series PLC) as the controller, the module status will be 0, which indicates that it is controlled by EtherCAT State Machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	The module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	The module is controlled by the controller and the status of the controller is Run.
2	Controlled by Controller (Stop)	The module is controlled by the controller and the status of the controller is Stop.

5.11.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users to use	UINT	RW	0

- **Explanation**

Users write a command value into the module and the module will execute the command accordingly. After execution, the module will respond with a corresponding value to show if the execution is success or not.

- **User command**

Command value	Description	Success	Failure
16#0C01	Restore to default values	16#0000	16#FFFF
16#0C02	Save the current setting values *1	16#0000	16#FFFF
16#0C03	Read the parameter settings	16#0000	16#FFFF

*1 If there are no startup parameters, the save command can be used to save the parameter setting values to the memory of the module.

5.11.5.3 Mode Setting

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8000	16#01	CH0 Mode Setting	Temperature mode setting	USINT	RW	0
	16#02	CH1 Mode Setting		USINT	RW	0
	16#03	CH2 Mode Setting		USINT	RW	0
	16#04	CH3 Mode Setting		USINT	RW	0

- **Explanation**

Select the mode to set the channel to ON.

The channel conversion time:

CH0 Mode	CH1 Mode	Conversion Time
ON	OFF	100ms
OFF	ON	100ms
ON	ON	200ms

CH2 Mode	CH3 Mode	Conversion Time
ON	OFF	100ms
OFF	ON	100ms
ON	ON	200ms

Note: The conversion time of CH0 and CH1 and the conversion time of CH2 and CH3 are independent and will NOT be affected with each other.

- **Supported modes**

Setting value	Mode	Setting range (°C)	Setting range (°F)
0	Disable		
1	Pt100 (2 Wire)	-200℃–850℃	-328℉–1562℉
2	Pt100 (3 Wire)	-200℃–850℃	-328℉–1562℉
3	Pt100 (4 Wire)	-200℃–850℃	-328℉–1562℉
4	Pt1000 (2 Wire)	-200℃–850℃	-328℉–1562℉
5	Pt1000 (3 Wire)	-200℃–850℃	-328℉–1562℉
6	Pt1000 (4 Wire)	-200℃–850℃	-328℉–1562℉
7	Ni100 (2 Wire)	-100℃–260℃	-148℉–500℉
8	Ni100 (3 Wire)	-100℃–260℃	-148℉–500℉
9	Ni100 (4 Wire)	-100℃–260℃	-148℉–500℉
10	Ni1000 (2 Wire)	-100℃–260℃	-148℉–500℉
11	Ni1000 (3 Wire)	-100℃–260℃	-148℉–500℉
12	Ni1000 (4 Wire)	-100℃–260℃	-148℉–500℉
13	0~300Ω	0–300Ω	0–300Ω

5.11.5.4 Calibration

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8001	16#01	CH0 Calibration Offset	Offset Setting range: no limit	REAL	RW	0
	16#02	CH1 Calibration Offset				
	16#03	CH2 Calibration Offset				
	16#04	CH3 Calibration Offset				
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9–1.1	REAL	RW	1.0
	16#02	CH1 Calibration Gain				
	16#03	CH2 Calibration Gain				
	16#04	CH3 Calibration Gain				

- **Explanation**

When there is an obvious difference between input values and actual values, you can change Offset and Gain to correct the input curve. The formula is

$$Output = (Input \times Gain) + Offset$$

Example

The mode for the channels is Pt100. Gain is 1 and Offset is 0 by default. The signal ranges from -200℃ to 850℃. If Gain is set to 0.9 and Offset is set to 2, the value after calibration is -178℃ to 767℃.

5.11.5.5 Digital Filter

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Digital Filter Setting	Digital filter setting	USINT	RW	0
	16#02	CH1 Digital Filter Setting		USINT	RW	0
	16#03	CH2 Digital Filter Setting		USINT	RW	0
	16#04	CH3 Digital Filter Setting		USINT	RW	0
16#8004	16#01	CH0 Moving Average Times	Moving average times Setting range: 1–100 times	USINT	RW	0
	16#02	CH1 Moving Average Times		USINT	RW	0
	16#03	CH2 Moving Average Times		USINT	RW	0
	16#04	CH3 Moving Average Times		USINT	RW	0

- **Explanation**

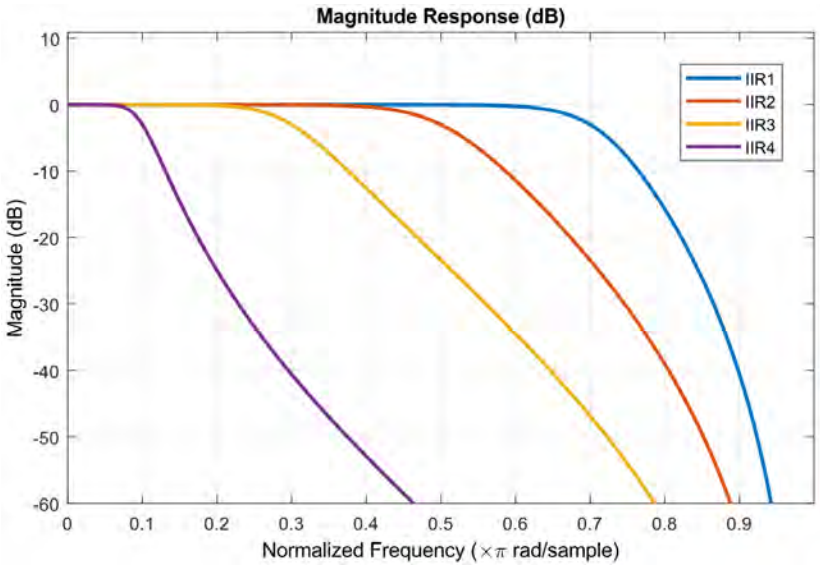
The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The conversion time will not be affected when the digital filter is enabled.

Moving Average Filter

A moving average filter uses the latest pieces of sampled data to create a series of averages to smooth the data. Compared to other types of digital filters, a moving average filter is fast in computation and algorithm, without occupying the CPU processing time. But the filtering result of a moving average filter is not as effective as an IIR filter or a FIR filter.

IIR (Infinite Impulse Response) Filter

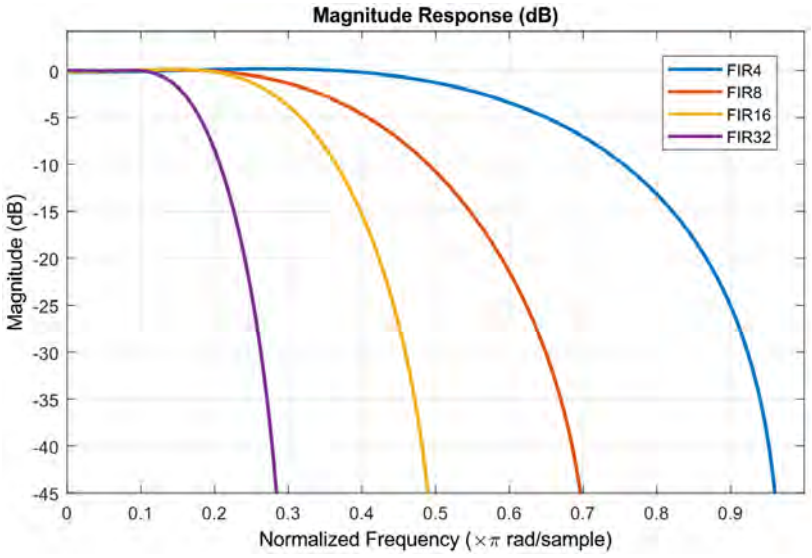
An infinite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, an IIR filter works more efficiently than a moving average filter does. This IIR filter is a low-pass filter. The advantage of an IIR filter is that within the same length of operation time, the filtering result of an IIR filter is better than what a FIR filter can offer. Since an IIR filter can only have a non-linear phase response, it has an inconsistent output delay at every frequency, the input signals may be distorted and the stability issue may be raised. An IIR filter may be not suitable for applications such as oscilloscope waveform and electrocardiography that require demanding waveforms.



Frequency response of IIR filter

FIR (Finite impulse response)

Finite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, a FIR filter works more efficiently than a moving average filter does. This FIR filter is a low-pass filter; it works tremendously well. The advantage of a FIR filter is that it has a linear phase response which means a FIR filter has a consistent output delay at all frequencies while an IIR filter has an unequal delay at different frequencies. A FIR filter is ideal for a wide range of applications. However within the same length of operation time, the filtering result of a FIR filter is not as good as what an IIR filter can deliver.



Frequency response of FIR filter

- **Digital filter modes**

Mode	Name of digital filter
0	Inactive
1	Moving Average
2	IIR1
3	IIR2
4	IIR3
5	IIR4
6	FIR4
7	FIR8
8	FIR16
9	FIR32

Number of channels that are ON	Conversion time	Cut-off frequency							
		IIR1	IIR2	IIR3	IIR4	FIR4	FIR8	FIR16	FIR32
1	100ms	3.5Hz	2.5Hz	1.5Hz	0.5Hz	2.92Hz	1.79Hz	1.44Hz	0.82Hz
2	200ms	1.75Hz	1.25Hz	0.75Hz	0.25Hz	1.46Hz	0.9Hz	0.72Hz	0.41Hz

Note: For the channel conversion time, refer to section 5.11.5.3 Mode Setting

5.11.5.6 User Limit Alarm

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8003	16#01	CH0 Enable User Limit Alarm	Enable / disable the alarm of exceeding the user-defined limit 0: Disable (default) 1: Enable	BOOL	RW	0
	16#02	CH1 Enable User Limit Alarm				
	16#03	CH2 Enable User Limit Alarm				
	16#04	CH3 Enable User Limit Alarm				
16#8004	16#01	CH0 User Upper Limit	User-defined upper limit; Setting range: no limit	REAL	RW	850
	16#02	CH1 User Upper Limit				
	16#03	CH2 User Upper Limit				
	16#04	CH3 User Upper Limit				
16#8005	16#01	CH0 User Lower Limit	User-defined lower limit; Setting range: no limit	REAL	RW	-200
	16#02	CH1 User Lower Limit				
	16#03	CH2 User Lower Limit				
	16#04	CH3 User Lower Limit				

- **Explanation**

Users can define the upper and lower limits and enable the alarm of exceeding the limits. If the Enable User Limit Alarm is enabled, when the input temperature exceeds the user upper/lower limit, a user upper/lower limit error will occur. (See section 5.11.8 for more information on troubleshooting.) When the temperature exceeds the hardware limit, an over/under hardware range error will occur.

- **Example**

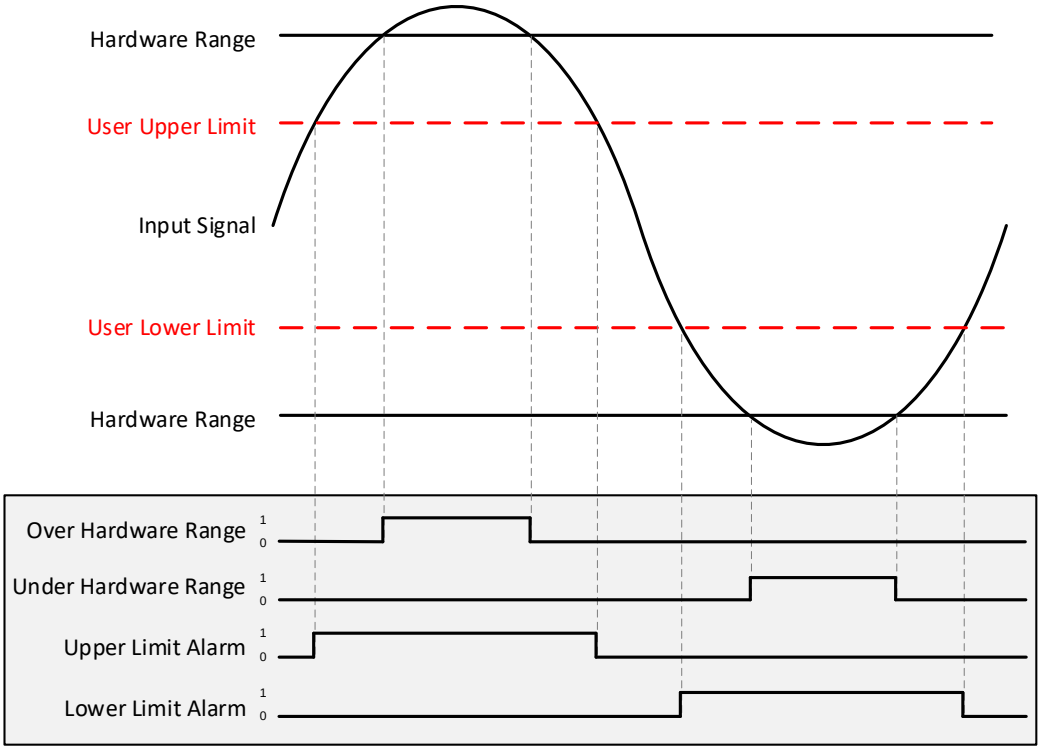
Set the parameters as follows:

16#8003 Enable User Limit Alarm: Enable

16#8004 User Upper Limit: 850

16#8005 User Lower Limit: -200

When the input signal exceeds the user-defined upper or lower limit, an error occurs.



5.11.5.7 Decimal Places

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8010	16#01	CH0 Decimal Places	Decimal places; setting value: 0–1	USINT	RW	1
	16#02	CH1 Decimal Places				
	16#03	CH2 Decimal Places				
	16#04	CH3 Decimal Places				

- **Explanation**

You can set the decimal places according to your demand.

5.11.5.8 Unit of Temperature

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8011	16#01	CH0 Unit of Temperature	Unit of temperature; 0: °C 1: °F	USINT	RW	1
	16#02	CH1 Unit of Temperature				
	16#03	CH2 Unit of Temperature				
	16#04	CH3 Unit of Temperature				

- **Explanation**

You can set the unit of temperature to °C or °F according to your demand.

5.11.5.9 Compensation in two-wire mode

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8012	16#01	CH0 Compensation in two-wire mode	Compensation in two-wire mode Unit: Ω	REAL	RW	0
	16#02	CH1 Compensation in two-wire mode		REAL	RW	0
	16#03	CH2 Compensation in two-wire mode		REAL	RW	0
	16#04	CH3 Compensation in two-wire mode		REAL	RW	0

- **Explanation**

You can use this parameter to set the temperature compensation when you select the two-wire mode.

- **Example**

The mode of CH0 is set to Pt100 (2 Wire) and the wire impedance for the 2-wire sensor is measured as 12.34 Ω. You can enter the number 12.34 in this parameter (CH0 Compensation in two-wire mode), and the measurement error caused by the impedance will be deducted automatically.

5.11.5.10 ADC Raw Data

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8100	16#01	CH0 ADC Raw data	Raw data	DINT	RO	0
	16#02	CH1 ADC Raw data				
	16#03	CH2 ADC Raw data				
	16#04	CH3 ADC Raw data				

- **Explanation**

Raw data is the source data that has not been processed or converted from analog to digital.

5.11.6 EtherCAT Operation Modes

There are two modes for EtherCAT modules to run during operation, FreeRun mode (non-synchronization mode) and DC mode (synchronization mode). Different synchronization modes can be applied to different modules in the same system. For temperature measurement modules, only FreeRun mode is supported.

5.11.6.1 1. FreeRun Mode

The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

5.11.7 Process Data

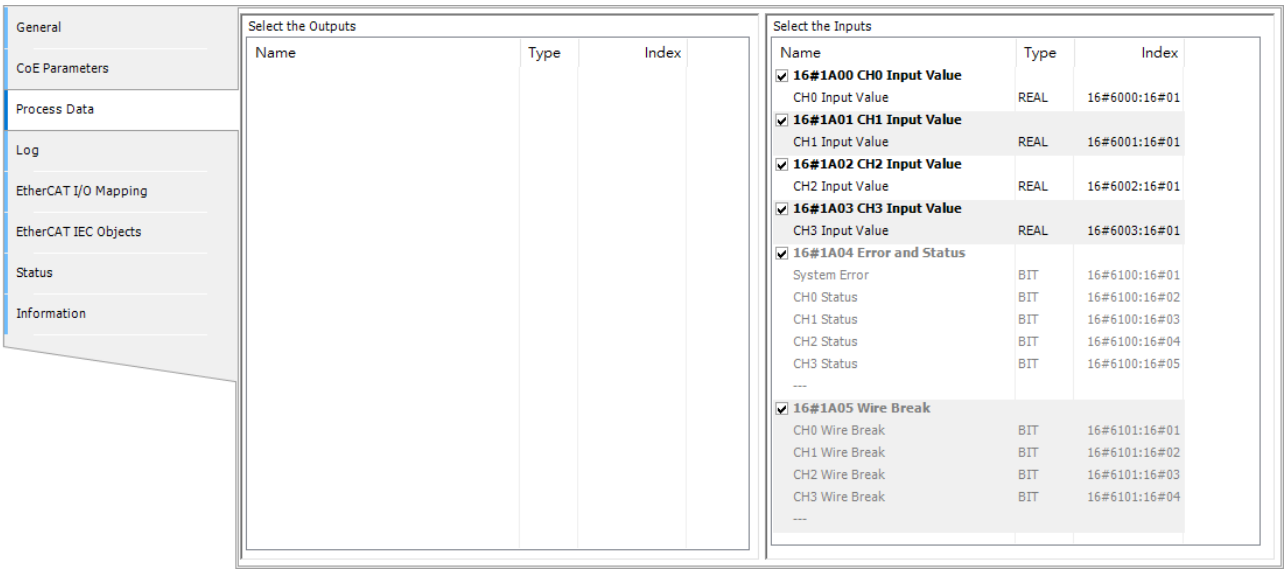
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Analog Input Value	Analog input value	REAL	RO	0.0
16#6001		CH1 Analog Input Value				
16#6002		CH2 Analog Input Value				
16#6003		CH3 Analog Input Value				
16#6100	16#01	System Error	System error	BOOL	RO	0
	16#02	CH0 Status	CH0: error or warning			
	16#03	CH1 Status	CH1: error or warning			
	16#04	CH2 Status	CH2: error or warning			
	16#05	CH3 Status	CH3: error or warning			
16#6101	16#01	CH0 Wire Break	Channel connection loss 0: Normal 1: Error	BOOL	RO	0
	16#02	CH1 Wire Break				
	16#03	CH2 Wire Break				
	16#04	CH3 Wire Break				

5.11.7.1 Process Data

Go to the Process Data tab and select the data that you'd like to monitor.

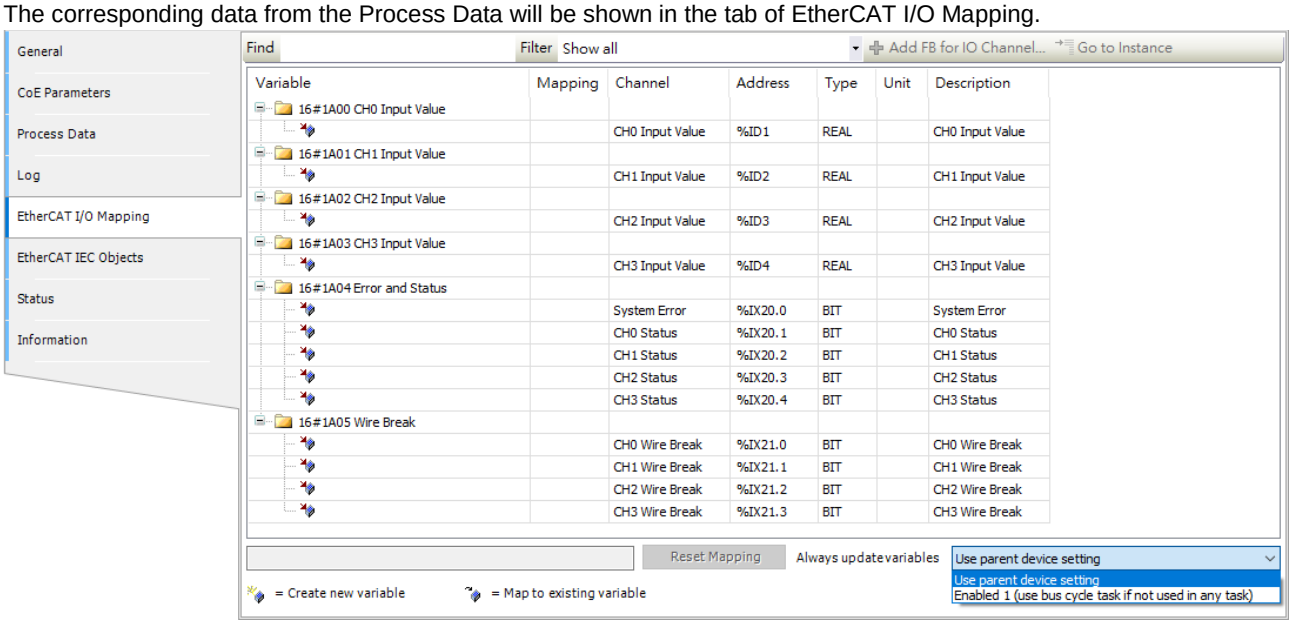
- Analog Input Value: You can monitor the selected channels and deselect the unused channels to save cycle time.
- Error and Status: It is selected by default. The grayed out part cannot be modified.
- Wire Break: It is selected by default. The grayed out part cannot be modified.



5

5.11.7.2 EtherCAT I/O Mapping

The corresponding data from the Process Data will be shown in the tab of EtherCAT I/O Mapping.



5.11.7.3 Always Update Variables

This field is for global setting to define whether or not the I/O variables in the bus cycle task are updated.

Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (Use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other task.

5.11.8 Troubleshooting

In the Diagnosis History tab, the error information that has occurred on the module is recorded. In the Status tab, the current error information is displayed. In the CoE Parameters tab, you can view the error status through Index/SubIndex of the All Parameter list.

Index	SubIndex	Name	LED indicator		Solution
			Error LED	Channel LED	
16#A000	16#01	(16#FF01) Unit Power Error	ON	OFF	Check the power supply.
	16#02	(16#FF02) EtherCAT Connection Lost	ON	OFF	Check the module connection if the connection is securely connected.
	16#03	(16#FF03) ESC or EEPROM Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#04	(16#FF04) Flash Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#05	(16#FF05) Analog IC Error	ON	OFF	If the problem persists, contact the local authorized distributors.
	16#06	(16#FF06) Analog Power Error	ON	OFF	If the problem persists, contact the local authorized distributors.
16#A00**n**[*1]	16#01	(16#FF11) CH(n-1) Upper Limit Alarm	Blinking (1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user upper limit.
	16#02	(16#FF12) CH(n-1) Lower Limit Alarm	Blinking (1s)	ON	Check if the input signal of the channel is within the allowed setting range of the user lower limit.
	16#03	(16#FF13) CH(n-1) Over Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed hardware range.
	16#04	(16#FF14) CH(n-1) Under Hardware range	Blinking (0.2s)	OFF	Check if the input signal of the channel is within the allowed hardware range.
	16#05	(16#FF15) CH(n-1) Wire Break	Blinking (0.2s)	OFF	Check if the sensor is securely connected.

*1. n =1–4

MEMO

A

Appendix A Maintenance and Inspection

Table of Contents

A.1 Cautions

Observe the following precautions before performing maintenance and inspection. **Incorrect or careless operation will lead to injury or equipment damage.**

- To prevent a breakdown of the system or a fire, ensure that the ambient environment does not contain corrosive substances such as chloride gas, sulfide gas or flammable substances such as oil mist, cutting powder, or dirt.

- To prevent the connectors from oxidizing and to prevent an electric shock, do not touch the connectors.

- To prevent an electric shock, turn off the power before pulling the connectors or loosening the screws.

- To prevent cable damage, and to prevent the connectors from being loosened, do not put weight on the cables or pull on them.

- Ensure that the input voltage is within the rated range.

- To prevent product breakdown, fire, or injury, do not disassemble or alter the modules.

- To prevent a controlled element from malfunctioning after the CPU module is replaced, ensure that the program and parameters are written into the new CPU module before restarting the system.
- To prevent incorrect output or equipment damage, refer to the related manuals for more information about operating the modules.
- To prevent damage to the modules, touch grounded metal or wear an antistatic wrist strap to release static electricity from your body before working on a module.
- To prevent noise from causing system breakdown, keep a proper distance from the system when using a cell phone or communication device.
- Do not install the system in direct sun or in a humid environment.
- To prevent the temperature of an element from being too high, maintain a proper distance between the system and heat sources such as coils, heating devices, and resistors.
- To protect the system, install an emergency stop switch and an overcurrent protection device.
- To prevent an unexpected shock from resulting in damage to the system and a controlled element, ensure that the modules are correctly and firmly installed.

A.2 Daily Maintenance

To keep the system operating normally, ensure that the ambient environment and the system conform to the cautions listed in Section A.1. You can then perform the daily inspection described below. If you find any problems, follow the solution and perform any necessary maintenance.

A.2.1 Daily Inspection

No.	Item	Inspection	Criterion	Remedy
1	Appearance	Check visually.	Dirt must not be present.	Remove the dirt.
2	Installing of a DIN rail	Check whether the DIN rail is securely installed.	The DIN rail must be installed firmly.	Tighten the screws.
3	Installing of modules	Check whether any of the modules is loose. Check if the clips is securely installed on the DIN rail.	The clips should be securely installed on the DIN rail.	Install the modules firmly.
4	Connection	Check whether any of the removable terminal blocks is loose.	The removable terminal blocks must not be loose.	Install the terminal blocks firmly.
		Check whether any of the connectors is loose.	The connectors must not be loose.	Installing the connectors securely or tighten the screws on them.
5	LED indicators on Power supply module	Check the POWER LED indicator.	Refer to each module's descriptions on LED indicators.	Refer to each module's troubleshooting section.
	LED indicators on CPU module	Check the CPU LED indicator.		
	LED indicators on extension module	Check the Extension Module LED indicator.		

A.3 Periodic Maintenance

In addition to daily inspection, you should perform periodic maintenance depending on the actual operating environment. After making sure that the ambient environment and the system conform to the cautions listed in Section A.1, perform the periodic inspection described below. If you find any problems, follow the solution and perform any necessary maintenance.

A.3.1 Periodic Inspection

No.	Item		Inspection	Criterion	Remedy
1	Ambient environment	Ambient temperature/ humidity	The ambient temperature and the ambient humidity are measured by a thermometer and a hygrometer.	The ambient temperature and the ambient humidity must conform to the specifications for the modules. If the specifications are different, the strictest specifications have priority.	To ensure that the system operates in a stable environment, determine why the environment varies, and resolve the issue.
		Atmosphere	Measure corrosive gas.	Corrosive gas must NOT be present.	
2	Supply voltage		Measure the AC power supply.	The power supply should meet the specifications for the power supply module.	Check the power supply system.
3	Installation	Looseness	Check whether any of the modules is loose.	The modules must be installed firmly.	Refer to information on module installation.
		Adhesion of dirt	Check the appearance.	Dirt must not be present.	Remove the dust and dirt.
4	Connection	Looseness of terminal screws	Tighten the screws with a screwdriver.	The screws must not be loose.	Tighten the screws.
		Looseness of connectors	Pull the connectors to check for looseness.	The connectors must not be loose.	Tighten the screws on the connectors.
5	PLC system diagnosis		Check the error logs.	No new error occurs.	Refer to each module's troubleshooting section.
6	Maximum scan time			The maximum scan cycle must be within the range specified in the system specifications.	Determine why the scan time exceeds specifications.

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*We reserve the right to change the information in this manual without prior notice.

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