

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
2nd	1. Chapter 1: Updated new modules AX-501LC10-0A, AX-502HC10-0A, AX-502PU01-0A, AX-500CPN00-0A, AX-500BC00-0A product information in section 1.1.1. Added UL information in section 1.2.1. Added related production information in section 1.3.4. 2. Chapter 2: Updated Power LED color and wiring information in section 2.1.3.2. Added AX-500CPN00-0A production information in section 2.2. 3. Chapter 3: Updated the wiring information. 4. Chapter 4: Updated the wiring information. Updated the attributes of the digital output value in Process Data. Updated the troubleshooting information. 5. Chapter 5: Updated hardware resolution, wiring, and the default values in 16#8001, 16#8004, 16#8014, 16#8016, 16#8030, and 16#8031. Updated the data types of 16#8004, 16#8005, 16#8006, 16#8014, 16#8015, and 16#8016. Updated the analog output information, the setting range of output value, troubleshooting information in sections 5.1 to 5.7. Updated the default values in 16#8001, 16#8004, 16#8005, and 16#8012. Updated the data types of 16#8003/16#8011/16#8012 in sections 5.8 to 5.11. 6. Added a new chapter, Chapter 6 Positioning Modules information. 7. Added a new chapter, Chapter 7 Load Cell Modules information.	2024/08/31
3rd	1. Added French translation for the precautions in section 1.3.4.1. 2. Corrected a typo (PE to FE) in section 1.1.1. 3. Corrected the diagram and description in section 3.6.3.1.	2024/10/15

AX-5 Series Module Manual

Table of Contents

Chapter 1 Product Introduction

1.1 Overview 1-2
1.1.1 Table of Models and Descriptions 1-2

1.2 Technical Specifications 1-3
1.2.1 Certifications and Standards 1-3
1.2.2 Electromagnetic Compatibility 1-3
1.2.3 Transport and Storage 1-4
1.2.4 Protection Class 1-5

1.3 Hardware Installation 1-6
1.3.1 Installing Modules 1-6
1.3.2 Installing and Removing a Terminal Block 1-11
1.3.3 Replacing a Module 1-15
1.3.4 Precautions 1-16

1.4 Software Installation 1-18
1.4.1 Installing and Uninstalling DIADesigner-AX 1-19

Chapter 2 Coupler

2.1 AX-500CEC00-0A 2-2
2.1.1 Specification 2-2
2.1.2 Dimensions and Parts 2-3
2.1.3 Arrangement of Terminals, LED Indicators and Wiring 2-4
2.1.4 Settings in DIADesigner-AX 2-7
2.1.5 EtherCAT Operation Modes 2-11
2.1.6 Process Data 2-11
2.1.7 Troubleshooting 2-11

2.2 AX-500CPN00-0A 2-12
2.2.1 Specification 2-12
2.2.2 Dimensions and Parts 2-13
2.2.3 Arrangement of Terminals, LED Indicators and Wiring 2-14
2.2.4 Settings in the DIADesigner-AX 2-18
2.2.5 Troubleshooting 2-33

Chapter 3 Power Supply Modules and Connector Modules

3.1 AX-502PS11-0A 3-2

3.1.1 Specifications 3-2

3.1.2 Dimensions and Parts 3-2

3.1.3 Arrangement of Terminals, LED Indicators and Wiring 3-4

3.1.4 Settings in DIADesigner-AX 3-7

3.1.5 Process Data 3-11

3.1.6 Troubleshooting 3-11

3.2 AX-510PS12-0A 3-12

3.2.1 Specifications 3-12

3.2.2 Dimensions and Parts 3-12

3.2.3 Arrangement of Terminals, LED Indicators and Wiring 3-14

3.3 AX-516PC10-0A 3-17

3.3.1 Specifications 3-17

3.3.2 Dimensions and Parts 3-17

3.3.3 Arrangement of Terminals, LED Indicators and Wiring 3-19

3.4 AX-516PC20-0A 3-21

3.4.1 Specifications 3-21

3.4.2 Dimensions and Parts 3-21

3.4.3 Arrangement of Terminals, LED Indicators and Wiring 3-23

3.5 AX-516PC30-0A 3-25

3.5.1 Specifications 3-25

3.5.2 Dimensions and Parts 3-25

3.5.3 Arrangement of Terminals, LED Indicators and Wiring 3-27

3.6 AX-514PC40-0A 3-29

3.6.1 Specifications 3-29

3.6.2 Dimensions and Parts 3-29

3.6.3 Arrangement of Terminals, LED Indicators and Wiring 3-31

Chapter 4 Digital Input / Output Modules

4.1 AX-516AM10-0A 4-3

4.1.1 Specifications 4-3

4.1.2 Dimensions and Parts 4-4

4.1.3 Arrangement of Terminals, LED Indicators and Wiring 4-5

4.1.4 Settings in DIADesigner-AX 4-8
4.1.5 Parameter Descriptions 4-16
4.1.6 EtherCAT Operation Modes 4-20
4.1.7 Process Data 4-21
4.1.8 Troubleshooting 4-23

4.2 AX-516AM20-0A 4-24
4.2.1 Specifications 4-24
4.2.2 Dimensions and Parts 4-25
4.2.3 Arrangement of Terminals, LED Indicators and Wiring 4-26
4.2.4 Settings in DIADesigner-AX 4-29
4.2.5 Parameter Descriptions 4-38
4.2.6 EtherCAT Operation Modes 4-41
4.2.7 Process Data 4-42
4.2.8 Troubleshooting 4-43

4.3 AX-516AN01-0A 4-44
4.3.1 Specifications 4-44
4.3.2 Dimensions and Parts 4-45
4.3.3 Arrangement of Terminals, LED Indicators and Wiring 4-46
4.3.4 Settings in DIADesigner-AX 4-49
4.3.5 Parameter Descriptions 4-57
4.3.6 EtherCAT Operation Modes 4-61
4.3.7 Process Data 4-62
4.3.8 Troubleshooting 4-63

4.4 AX-516AN02-0A 4-64
4.4.1 Specifications 4-64
4.4.2 Dimensions and Parts 4-65
4.4.3 Arrangement of Terminals, LED Indicators and Wiring 4-66
4.4.4 Settings in DIADesigner-AX 4-69
4.4.5 Parameter Descriptions 4-77
4.4.6 EtherCAT Operation Modes 4-80
4.4.7 Process Data 4-81
4.4.8 Troubleshooting 4-82

4.5 AX-516AP11-0A 4-83
4.5.1 Specifications 4-83
4.5.2 Dimensions and Parts 4-84
4.5.3 Arrangement of Terminals, LED Indicators and Wiring 4-85

4.5.4 Settings in DIADesigner-AX 4-88
4.5.5 Parameter Descriptions 4-96
4.5.6 EtherCAT Operation Modes 4-100
4.5.7 Process Data 4-101
4.5.8 Troubleshooting 4-102

4.6 AX-516AP22-0A 4-103
4.6.1 Specifications 4-103
4.6.2 Dimensions and Parts 4-104
4.6.3 Arrangement of Terminals, LED Indicators and Wiring 4-105
4.6.4 Settings in DIADesigner-AX 4-108
4.6.5 Parameter Descriptions 4-116
4.6.6 EtherCAT Operation Modes 4-120
4.6.7 Process Data 4-121
4.6.8 Troubleshooting 4-122

Chapter 5 Analog Input / Output Modules

5.1 AX-504AD10-0A 5-4
5.1.1 Specifications 5-4
5.1.2 Dimensions and Parts 5-5
5.1.3 Arrangement of Terminals, LED Indicators and Wiring 5-7
5.1.4 Settings in DIADesigner-AX 5-10
5.1.5 Parameter Descriptions 5-19
5.1.6 EtherCAT Operation Modes 5-28
5.1.7 Process Data 5-29
5.1.8 Troubleshooting 5-31

5.2 AX-504AD20-0A 5-32
5.2.1 Specifications 5-32
5.2.2 Dimensions and Parts 5-33
5.2.3 Arrangement of Terminals, LED Indicators and Wiring 5-34
5.2.4 Settings in DIADesigner-AX 5-37
5.2.5 Parameter Descriptions 5-46
5.2.6 EtherCAT Operation Modes 5-54
5.2.7 Process Data 5-55
5.2.8 Troubleshooting 5-57

5.3 AX-508AD10-0A 5-58
5.3.1 Specifications 5-58
5.3.2 Dimensions and Parts 5-59
5.3.3 Arrangement of Terminals, LED Indicators and Wiring 5-61
5.3.4 Settings in DIADesigner-AX 5-64
5.3.5 Parameter Descriptions 5-73
5.3.6 EtherCAT Operation Modes 5-84
5.3.7 Process Data 5-85
5.3.8 Troubleshooting 5-87

5.4 AX-508AD20-0A 5-88
5.4.1 Specifications 5-88
5.4.2 Dimensions and Parts 5-89
5.4.3 Arrangement of Terminals, LED Indicators and Wiring 5-91
5.4.4 Settings in DIADesigner-AX 5-94
5.4.5 Parameter Descriptions 5-103
5.4.6 EtherCAT Operation Modes 5-114
5.4.7 Process Data 5-115
5.4.8 Troubleshooting 5-117

5.5 AX-504DA01-0A 5-118
5.5.1 Specifications 5-118
5.5.2 Dimensions and Parts 5-119
5.5.3 Arrangement of Terminals, LED Indicators and Wiring 5-121
5.5.4 Settings in DIADesigner-AX 5-124
5.5.5 Parameter Descriptions 5-133
5.5.6 EtherCAT Operation Modes 5-140
5.5.7 Process Data 5-141
5.5.8 Troubleshooting 5-142

5.6 AX-504DA02-0A 5-143
5.6.1 Specifications 5-143
5.6.2 Dimensions and Parts 5-144
5.6.3 Arrangement of Terminals, LED Indicators and Wiring 5-146
5.6.4 Settings in DIADesigner-AX 5-149
5.6.5 Parameter Descriptions 5-158
5.6.6 EtherCAT Operation Modes 5-165
5.6.7 Process Data 5-166
5.6.8 Troubleshooting 5-167

5.7 AX-508DA01-0A 5-168
5.7.1 Specifications 5-168
5.7.2 Dimensions and Parts 5-169
5.7.3 Arrangement of Terminals, LED Indicators and Wiring 5-171
5.7.4 Settings in DIADesigner-AX 5-174
5.7.5 Parameter Descriptions 5-183
5.7.6 EtherCAT Operation Modes 5-193
5.7.7 Process Data 5-194
5.7.8 Troubleshooting 5-195

5.8 AX-502TC10-0B 5-196
5.8.1 Specifications 5-196
5.8.2 Dimensions and Parts 5-197
5.8.3 Arrangement of Terminals, LED Indicators and Wiring 5-198
5.8.4 Settings in DIADesigner-AX 5-201
5.8.5 Parameter Descriptions 5-210
5.8.6 EtherCAT Operation Modes 5-217
5.8.7 Process Data 5-217
5.8.8 Troubleshooting 5-220

5.9 AX-504TC10-0B 5-221
5.9.1 Specifications 5-221
5.9.2 Dimensions and Parts 5-222
5.9.3 Arrangement of Terminals, LED Indicators and Wiring 5-224
5.9.4 Settings in DIADesigner-AX 5-227
5.9.5 Parameter Descriptions 5-236
5.9.6 EtherCAT Operation Modes 5-244
5.9.7 Process Data 5-245
5.9.8 Troubleshooting 5-248

5.10 AX-502PT10-0B 5-249
5.10.1 Specifications 5-249
5.10.2 Dimensions and Parts 5-250
5.10.3 Arrangement of Terminals, LED Indicators and Wiring 5-252
5.10.4 Settings in DIADesigner-AX 5-255
5.10.5 Parameter Descriptions 5-264
5.10.6 EtherCAT Operation Modes 5-270
5.10.7 Process Data 5-270
5.10.8 Troubleshooting 5-272

5.11 AX-504PT10-0B 5-273
5.11.1 Specifications 5-273
5.11.2 Dimensions and Parts 5-274
5.11.3 Arrangement of Terminals, LED Indicators and Wiring 5-276
5.11.4 Settings in DIADesigner-AX 5-279
5.11.5 Parameter Descriptions 5-288
5.11.6 EtherCAT Operation Modes 5-296
5.11.7 Process Data 5-296
5.11.8 Troubleshooting 5-298

Chapter 6 Positioning Modules

6.1 AX-502PU01-0A 6-2
6.1.1 Specifications 6-2
6.1.2 Dimensions and Parts 6-3
6.1.3 Arrangement of Terminals, LED Indicators and Wiring 6-5
6.1.4 Settings in DIADesigner-AX 6-8
6.1.5 CiA402 Drive Profile 6-17
6.1.6 Functions and Descriptions of Objects 6-22
6.1.7 EtherCAT Operation Modes 6-75
6.1.8 Process Data 6-76
6.1.9 Example of Hardware Configuration and Software Operation 6-78
6.1.10 Troubleshooting 6-86

6.2 AX-502HC10-0A 6-89
6.2.1 Specifications 6-89
6.2.2 Dimensions and Parts 6-90
6.2.3 Arrangement of Terminals, LED Indicators and Wiring 6-92
6.2.4 Settings in DIADesigner-AX 6-96
6.2.5 System Architecture 6-104
6.2.6 Description of Objects 6-106
6.2.7 EtherCAT Synchronization Modes 6-128
6.2.8 Process Data 6-129
6.2.9 Example of Hardware Configuration and Software Operation 6-133
6.2.10 Troubleshooting 6-139

Chapter 7 Load Cell Modules

7.1 AX-501LC10-0A 7-3
7.1.1 Specifications 7-3
7.1.2 Dimensions and Parts 7-4
7.1.3 Arrangement of Terminals, LED Indicators and Wiring 7-5
7.1.4 Settings in DIADesigner-AX 7-9
7.1.5 Parameter Descriptions 7-17
7.1.6 Gross Weight, Net Weight and Tare Weight 7-27
7.1.7 Calibration 7-28
7.1.8 EtherCAT Operation Modes 7-33
7.1.9 Process Data 7-34
7.1.10 Troubleshooting 7-36

Appendix A Maintenance and Inspection

A.1 Cautions A-2
A.2 Daily Maintenance A-3
A.2.1 Daily Inspection A-3
A.3 Periodic Maintenance A-4
A.3.1 Periodic Inspection A-4

⚠ 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.

Chapter 1 Product Introduction

Table of Contents

1.1 Overview 1-2

1.1.1 Table of Models and Descriptions 1-2

1.2 Technical Specifications 1-3

1.2.1 Certifications and Standards 1-3

1.2.2 Electromagnetic Compatibility 1-3

1.2.3 Transport and Storage 1-4

1.2.4 Protection Class 1-5

1.3 Hardware Installation 1-6

1.3.1 Installing Modules 1-6

1.3.2 Installing and Removing a Terminal Block 1-11

1.3.3 Replacing a Module 1-15

1.3.4 Precautions  1-16

1.4 Software Installation 1-20

1.4.1 Installing and Uninstalling DIADesigner-AX 1-20

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 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 FE
Digital input / output module	AX-516AM10-0A	16 DI, 24 VDC, 2.5 mA,1 ms, Source Input (NPN)
	AX-516AM20-0A	16 DI, 24 VDC, 2.5 mA,1 ms, Sink Input (PNP)
	AX-516AN01-0A	16 DO, 24 VDC, 0.5 A,1 ms, Sink Output (NPN)
	AX-516AN02-0A	16 DO, 24 VDC, 0.5 A,1 ms, Source Output (PNP)
	AX-516AP11-0A	8 DI, 24 VDC, 2.5 mA,1 ms, Source Input (NPN) 8 DO, 24 VDC, 0.5 A,1 ms, Sink Output (NPN)
	AX-516AP22-0A	8 DI, 24 VDC, 2.5 mA,1 ms, Sink Input (PNP) 8 DO, 24 VDC, 0.5 A,1 ms, Source Output (PNP)
Analog input / output module	AX-504AD10-0A	4 AI, ±10V, 16 bits, 100 μs
	AX-504AD20-0A	4 AI, ±20mA, 16 bits, 100 μs
	AX-508AD10-0A	8 AI, ±10V, 16 bits, 100 μs
	AX-508AD20-0A	8 AI, ±20mA, 16 bits , 100 μs
	AX-504DA01-0A	4 AO, ±10V, 16 bits, 100 μs
	AX-504DA02-0A	4 AO, 0–20mA, 16 bits, 100 μs
	AX-508DA01-0A	8 AO, ±10V, 16 bits, 100 μs
Temperature measurement module	AX-502TC10-0B	2 TC, J, K, T, E, L, U, N, R, S, B, C (WRe5-26), PLII, ±130 mV, 24 bits
	AX-504TC10-0B	4 TC, J, K, T, E, L, U, N, R, S, B, C (WRe5-26), PLII, ±130 mV, 24 bits
	AX-502PT10-0B	2 RTD, PT100, PT1000, Ni100, Ni1000, 0 to 300 Ω, 24 bits
	AX-504PT10-0B	4 RTD, PT100, PT1000, Ni100, Ni1000, 0 to 300 Ω, 24 bits
Load cell module	AX-501LC10-0A	1 CH Load cell, 5 V
Positioning module	AX-502HC10-0A	2-channel high-speed counter module, OC, 500 kHz, Sourcing Input (NPN)
	AX-502PU01-0A	2-channel positioning module, OC, 500 kHz, Sinking Output (NPN)
Coupler	AX-500CEC00-0A	EtherCAT coupler
	AX-500CPN00-0A	PROFINET coupler
Accessory	AX-500BC00-0A	Bus cover - End cover

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
UL listed	UL CERTIFIED SAFETY US·CA E206327	UL 61010-1 UL 61010-2-201 CAN/CSA-C22.2 No. 61010-1-12 CAN/CSA-C22.2 No. 61010-2-201

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 > 30 m

- **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

Sinusoidal Disturbance	Test Condition
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 to +60°C
Ambient Temperature for Transport and Storage	-40 to +85°C
Atmospheric Pressure	Operating: 1013 to 795 hPa (altitude: 0 to 2000 m) Storage: 1013 to 660 hPa (altitude: 0 to 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 1 g 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.

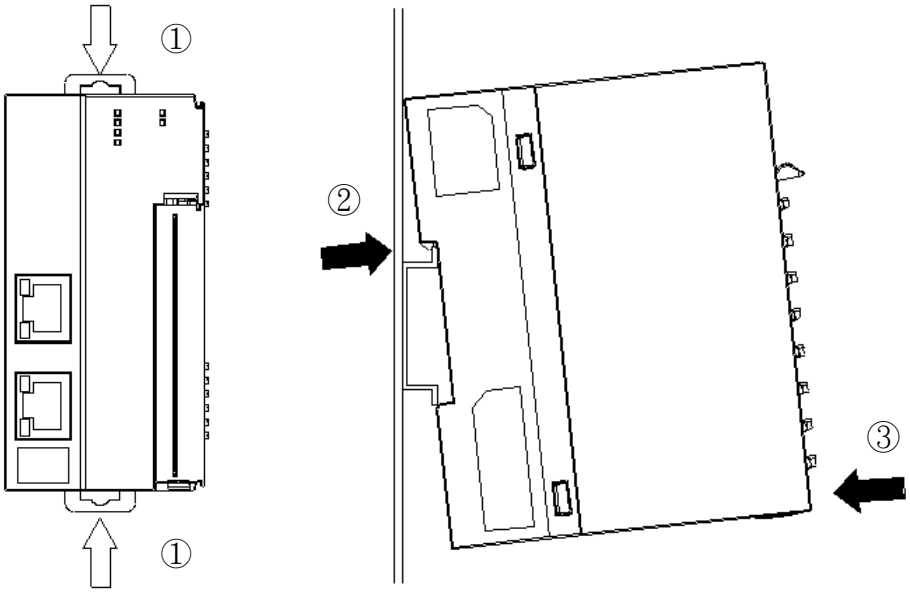
Type	Description
Insulation	Designed in accordance with IEC/EN 61131-2, IEC/EN 61010-1 and IEC/EN 61010-2-201.
DC Input Power Supply	24 VDC (20.4 to 28.8 VDC) (-15 to +20%) (In accordance with IEC/EN 61131-2)
DC Power Source	The 24 VDC SELV or PELV power supply is recommended.
Pollution Degree	2 (In 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

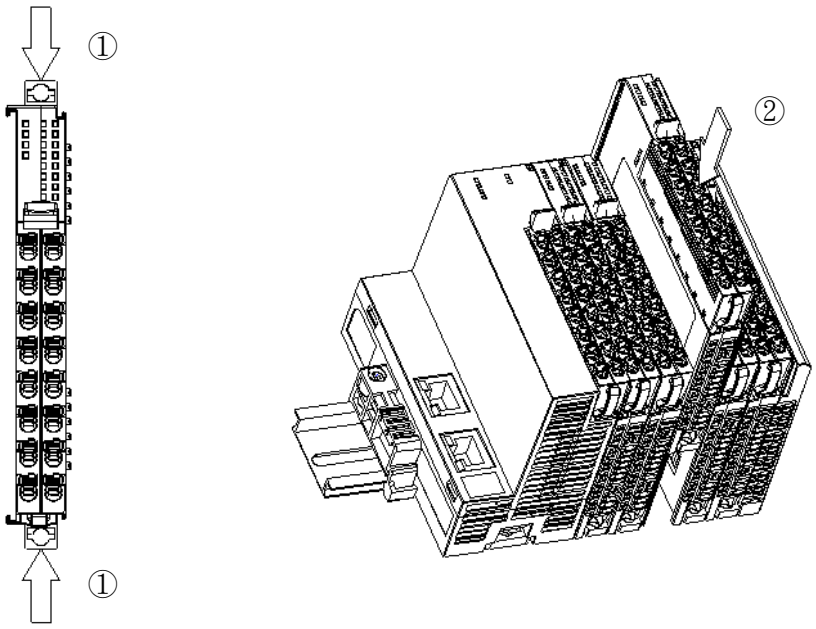
1.3.1 Installing Modules

Steps for installing modules are shown below:

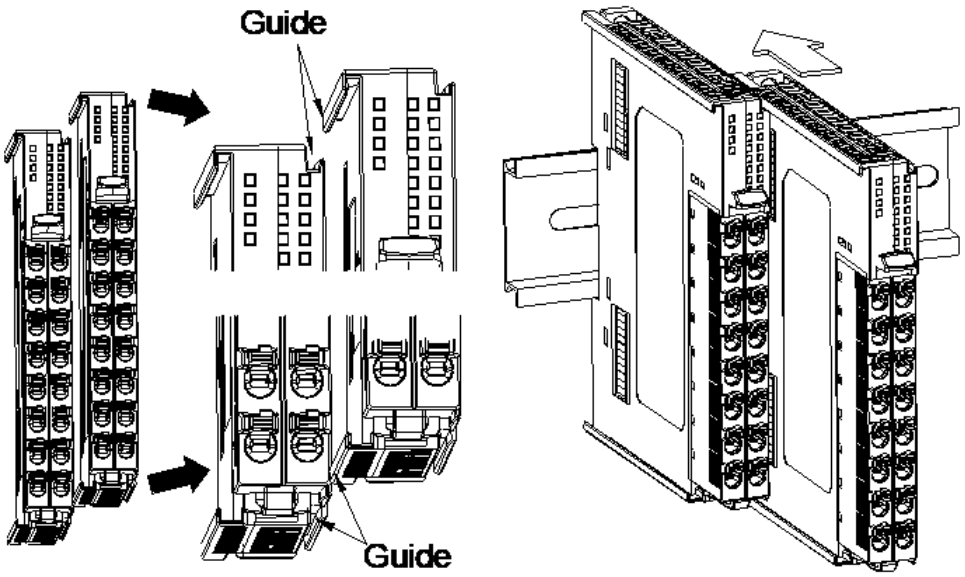
1. Push the two DIN rail clips on the top and bottom of the CPU or coupler towards the middle as shown by the arrows ① in the following figure until you hear a click. Then hang it onto the DIN rail as indicated by the arrow ② and press it towards the DIN rail as indicated by the arrow ③ until another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



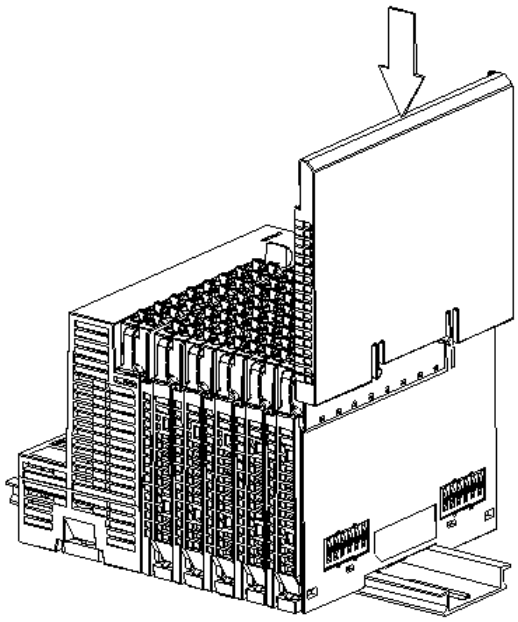
2. Before connecting respective I/O modules to the right side of the CPU or coupler in sequence, first push the upper and lower clips of each module towards the middle as indicated by the arrows ① in the following figure, and then press the module towards the DIN rail as indicated by the arrow ② until 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.



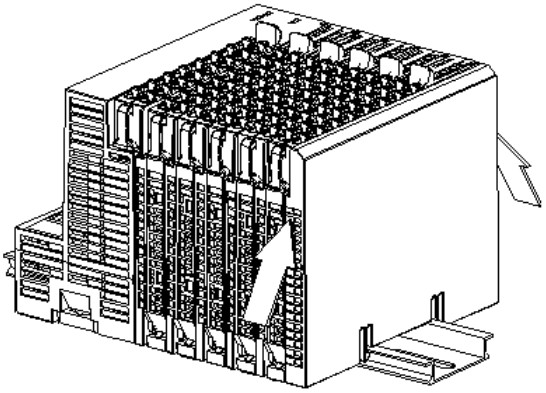
3. Please first align the upper and lower guides before pushing the module towards the rail when installing an I/O module.



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.

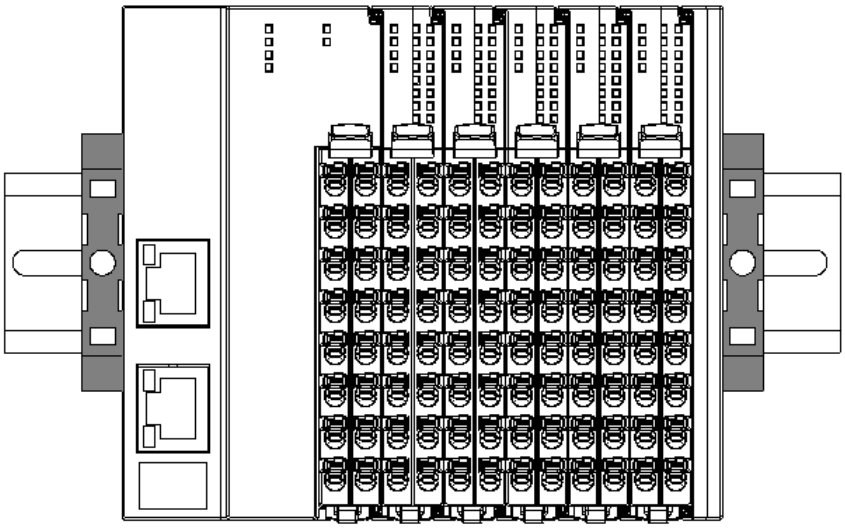


5. Remove the protective cover by taking it out in the upward direction.



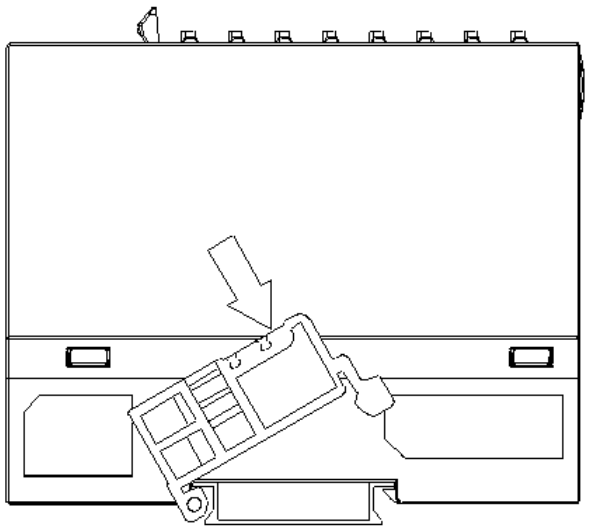
Note:

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.

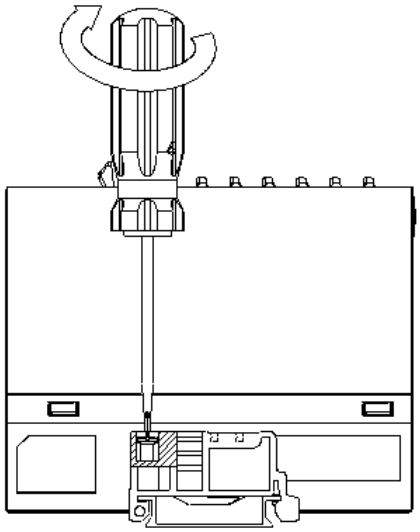


Install the baffles:

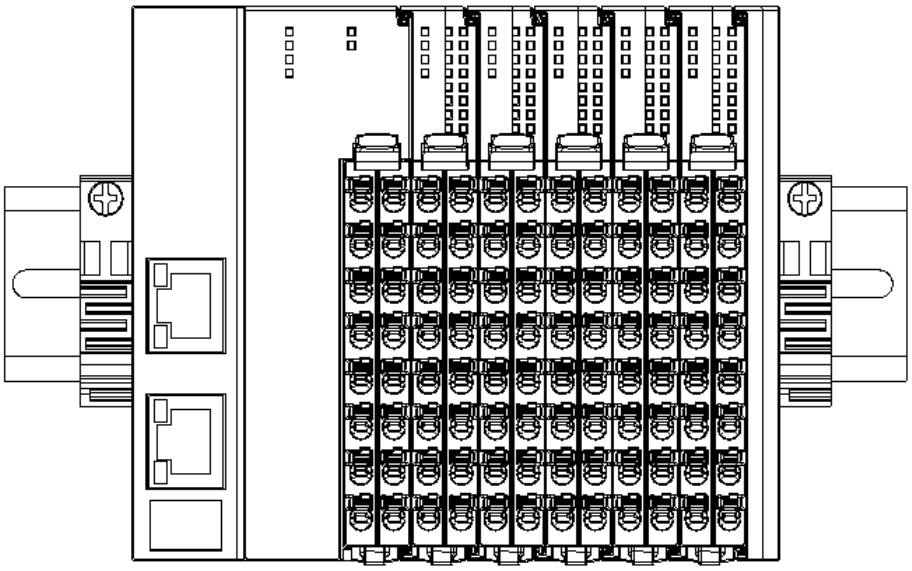
1. Hook the baffle onto the DIN rail and press it down as the directional arrow shows below.



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



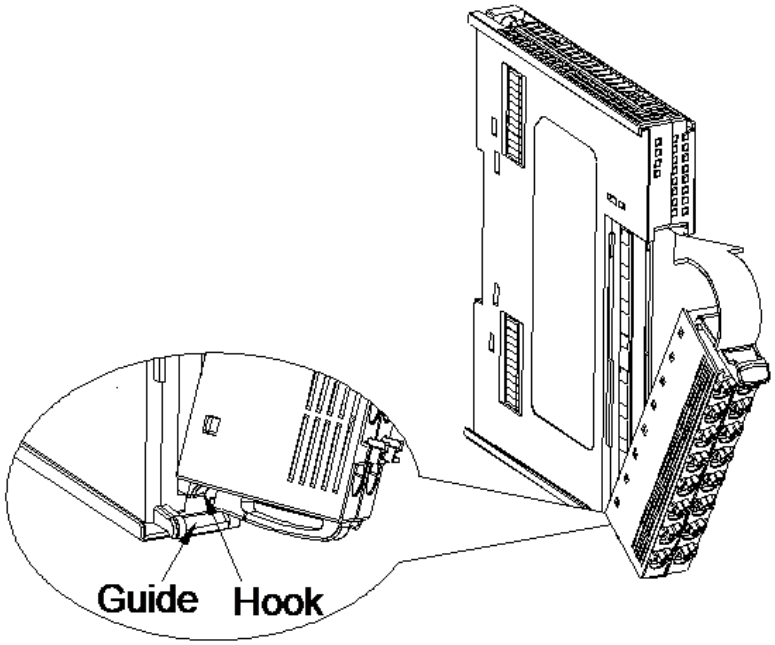
3. The completed baffle installation is as shown below.



1.3.2 Installing and Removing a Terminal Block

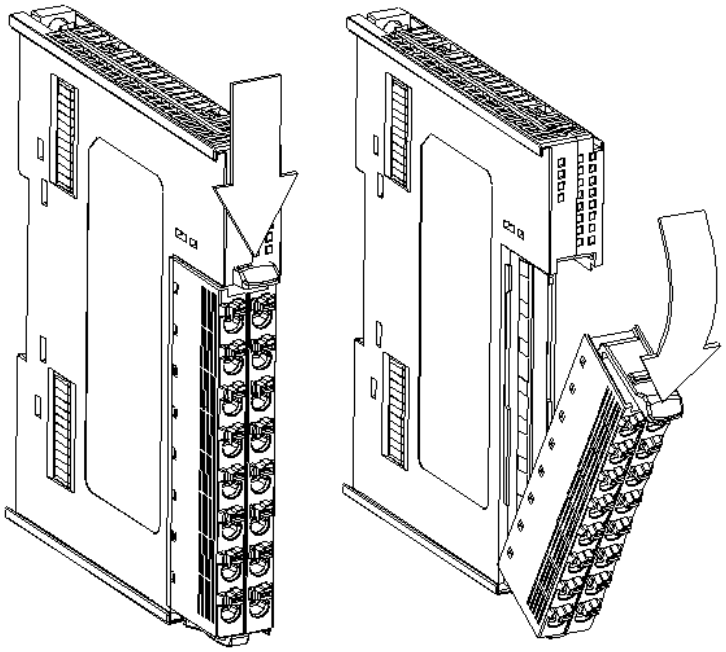
1. Installation

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



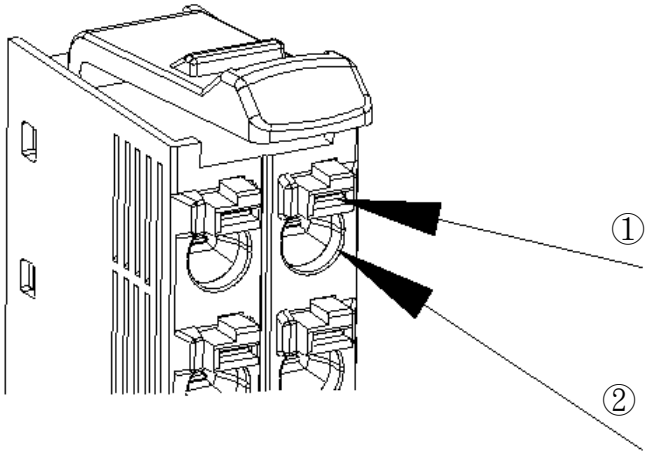
2. Removal

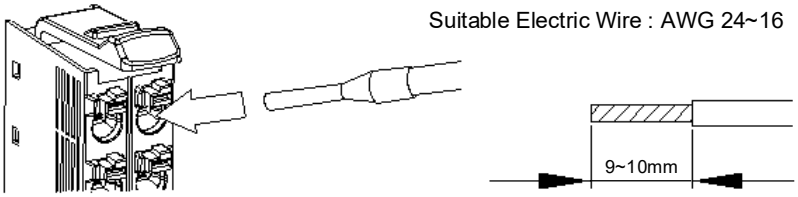
Press down the clip at the top of the removable terminal block and move it outward.



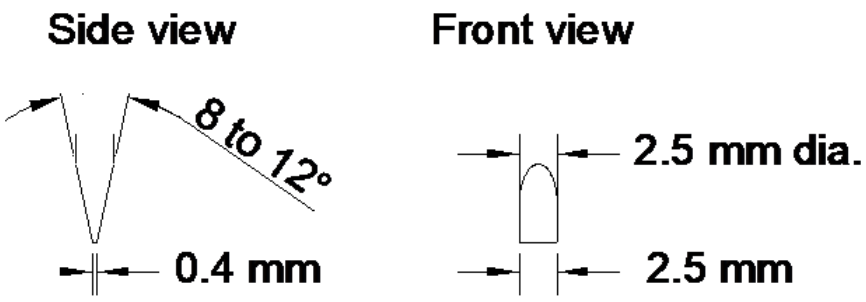
3. Keeping the cable secured into a terminal hole of the terminal block:

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



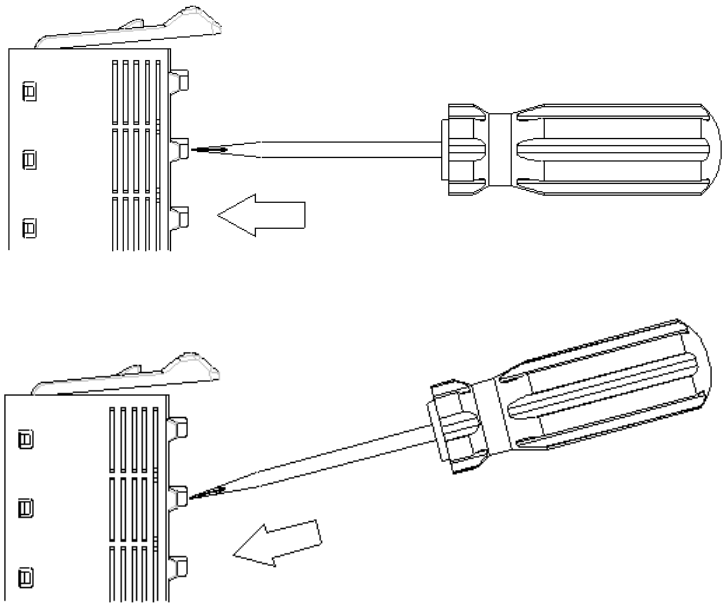


Note 1: Specifications of screwdriver

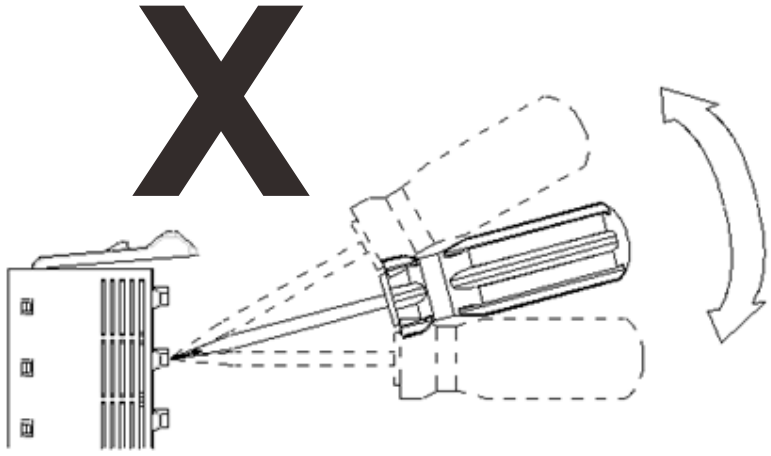


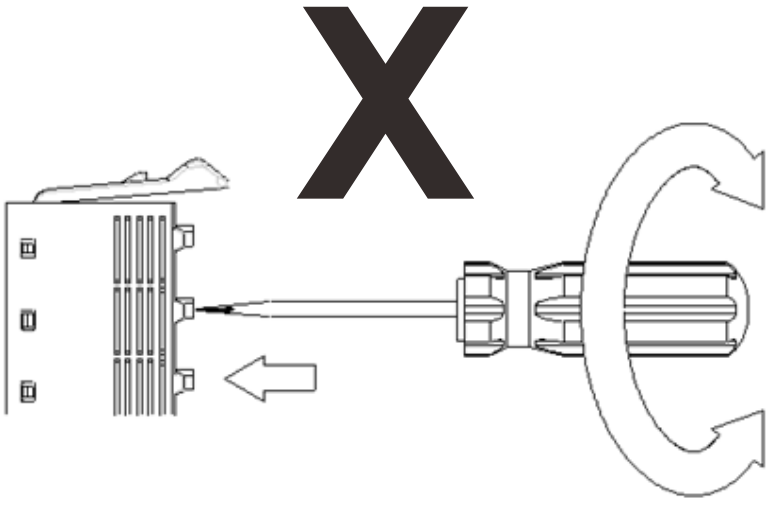
Note 2: Operation of screwdriver:

- Correct operation

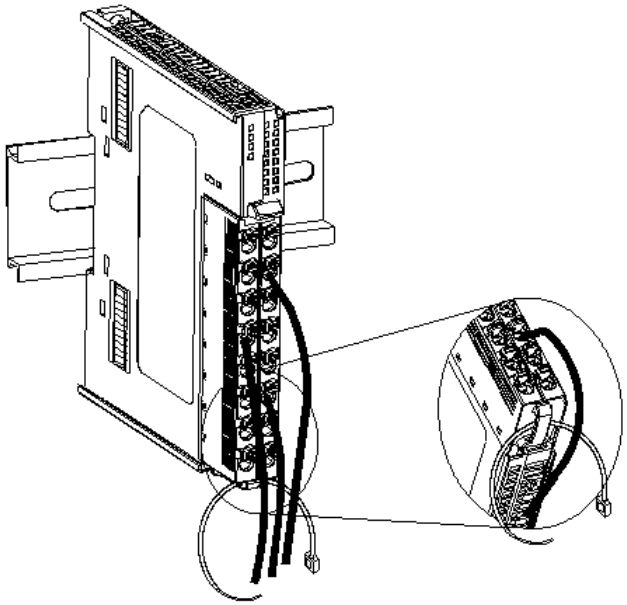


- Incorrect operation

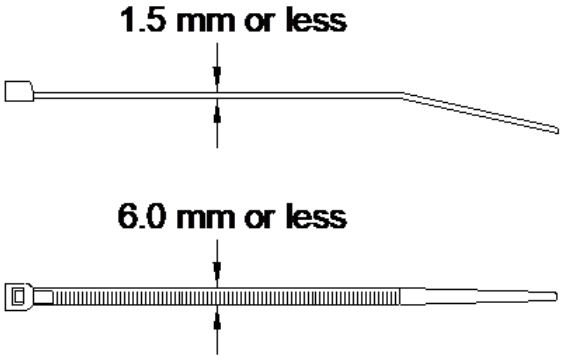




4. After wiring terminal blocks is completed, you can organize the cables by fastening them with a plastic cable tie through the cable tie hole below each terminal block.

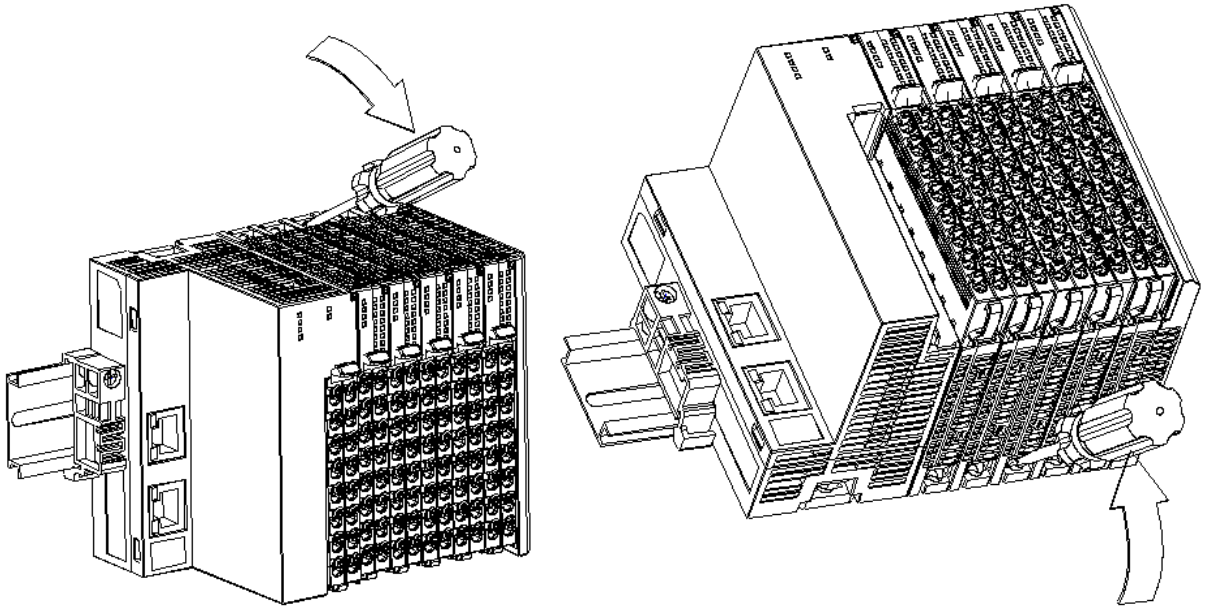


Note: Specifications of cable tie

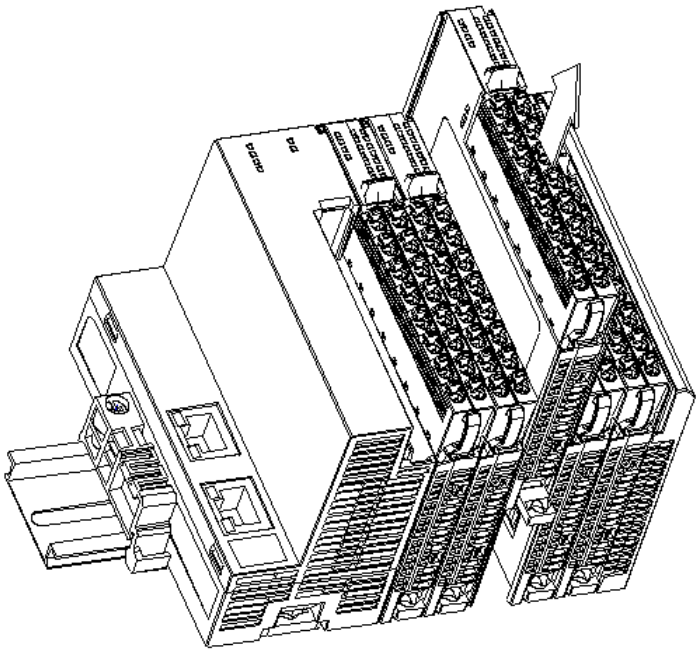


1.3.3 Replacing a Module

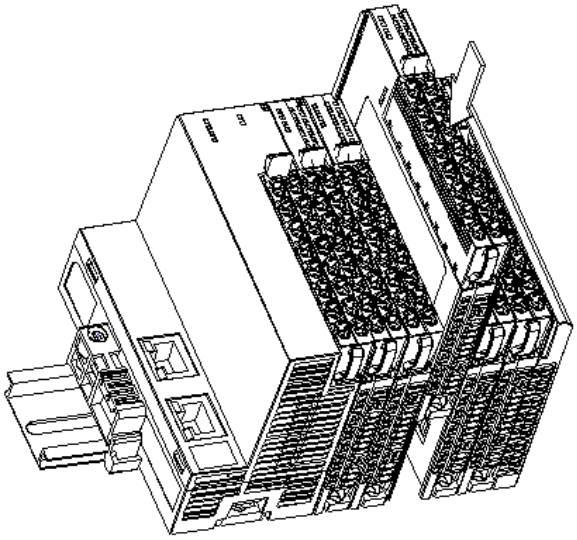
1. Remove the terminal block from a module, and then pull out the upper and lower clips of the module as shown below.



2. Remove the module.



3. Slide a new module in as shown below.



1.3.4 Precautions

1.3.4.1 General Notes

- EN: System assemblers should take the responsibility for the system security of installed and assembled equipment.

  FR: Lors de l'installation, la sécurité de tout système incorporant l'équipement est de la responsabilité de l'intégrateur du système.

- EN: 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.

  FR: Ce produit est un module de TYPE OUVERT et doit donc être installé dans une enceinte exempte de poussière en suspension, d'humidité, de chocs électriques et de vibrations. L'enceinte doit empêcher le personnel non qualifié d'utiliser l'appareil (par exemple, une clé ou des outils spécifiques sont nécessaires pour ouvrir l'enceinte.) afin d'éviter tout danger et dommage à l'appareil.

- EN: Only the manufacturer-specified power modules can be used for power supply. Refer to this manual or contact the manufacturer for details.

  FR: Seuls les d'alimentations spécifiées par le fabricant peuvent être utilisés pour l'alimentation électrique. Consultez ce manuel où contactez le fabricant pour plus de détails.

- EN: 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.

  FR: Pour bien dissiper la chaleur produite par les modules, veuillez installer le produit dans un boîtier de contrôle ouvert. S'il est installé dans un boîtier de contrôle fermé, des persiennes ou des ventilateurs doivent être installés sur les côtés du boîtier pour assurer une convection d'air suffisante pour le refroidissement.

- EN: 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.

  FR: Pour l'installation à l'intérieur du boîtier de contrôle, laissez au moins 10 cm d'espace autour du produit pour assurer une convection d'air suffisante. Sinon, cela pourrait entraîner une surchauffe et une défaillance du produit.

- EN: To prevent the product from overheating and failure, do NOT block and cover the heat dissipation holes on the top of the product.

  FR: Pour éviter la surchauffe et la défaillance du produit, ne bloquez pas et ne couvrez pas les trous de dissipation de chaleur situés sur le dessus du produit.

- EN: Do NOT place any objects on the top of the product.

  FR: Ne placez aucun objet sur le dessus du produit.

- EN: There is no battery or fuses that need be replaced inside the product.

  FR: Il n'y a ni batterie ni fusibles à remplacer à l'intérieur du produit.

- EN: Users are prohibited from disassembling the product. Only the manufacturer or its distributors can open the outer case for inspection or provide any parts.

  FR: Les utilisateurs ne sont pas autorisés à démonter le produit. Seul le fabricant ou ses distributeurs peuvent ouvrir le boîtier extérieur pour inspection ou fournir des pièces.

- EN: If the device is not used in the manufacturer-specified manner, it may weaken the protection provided by the product.

  FR: Si l'équipement est utilisé d'une manière non spécifiée par le fabricant, la protection fournie par l'équipement pourrait être compromise.

- EN: 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.

  FR: Lors de l'installation ou du câblage, il est impératif de s'assurer que toutes les sources d'alimentation externes soient éteintes. Le non-respect de cette consigne pourrait entraîner un risque de choc électrique pour les utilisateurs ou des dommages au produit.

- EN: 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.

  FR: Avant d'installer ou de câbler un module, vous devez vérifier que l'alimentation électrique externe est coupée. Si l'alimentation électrique n'est pas coupée, vous risquez de recevoir un choc électrique ou d'endommager le produit.

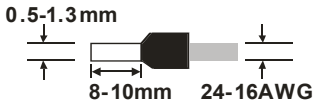
- EN: Use special tools for folding, crimping, and welding during external wiring. Poor wiring may result in a short circuit, fire, or operational errors.

  FR: Les connexions externes doivent être serties, soudées à la presse au moyen d'outils spécifiques ou soudées correctement. Des connexions incorrectes peuvent entraîner un court-circuit, un incendie ou un dysfonctionnement.

- EN: Make sure that there are no foreign objects such as wiring residues left in each module to avoid the fire, damage, or operational errors.

FR: Il est crucial de s'assurer que chaque module est exempt de corps étrangers tels que des limailles de fer ou des résidus de câblage. Ces objets étrangers peuvent provoquer des incendies, des dommages ou des erreurs opérationnelles.

- EN: Please wire the input line, output line, and power line separately to prevent noise interfering with the I/O signals.
  FR: Gardez les câbles d'entrée, les câbles de sortie et le câble d'alimentation séparés les uns des autres.
- EN: Use single-core or twin-core copper cables with a diameter of 24 to 16 AWG (0.5 to 1.3 mm) and minimum temperature rating of 105 ºC. The pin-type connector with an insulation tube is recommended as below.
  FR: Utilisez des câbles monobrins ou des câbles en cuivre à deux conducteurs d'un diamètre de 24 à 16 AWG (0,5 à 1,3 mm) et d'une température minimale de 105 °C. Un connecteur de type broche isolé est recommandé comme indiqué ci-dessous.



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 ohms 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. I/O signal cables for digital modules
   - 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. I/O signal cables for analog modules
   - 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.
   - 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 and 7 for the wiring of analog input/output modules.
3. I/O signal cables for positioning modules
   - Supports a cable length of up to 3 m with the impedance less than 1 ohm.
   - Supports shielded cables.
   - The rated current for digital output points is 30 mA.
   - The high-speed output signal from the PU and HC module should be linked to an external 470 ohm/3 W pull-up resistor.
   - Refer to Chapter 6 for the wiring of positioning module.
4. Communication cables

   Supported maximum length:
   - EtherCAT: 100 m
   - Ethernet: 100 m
   - CANopen: 100 m
   - RS-485: 100 m
   - RS-232: 3 m
5. 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 1.8 GHz 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.

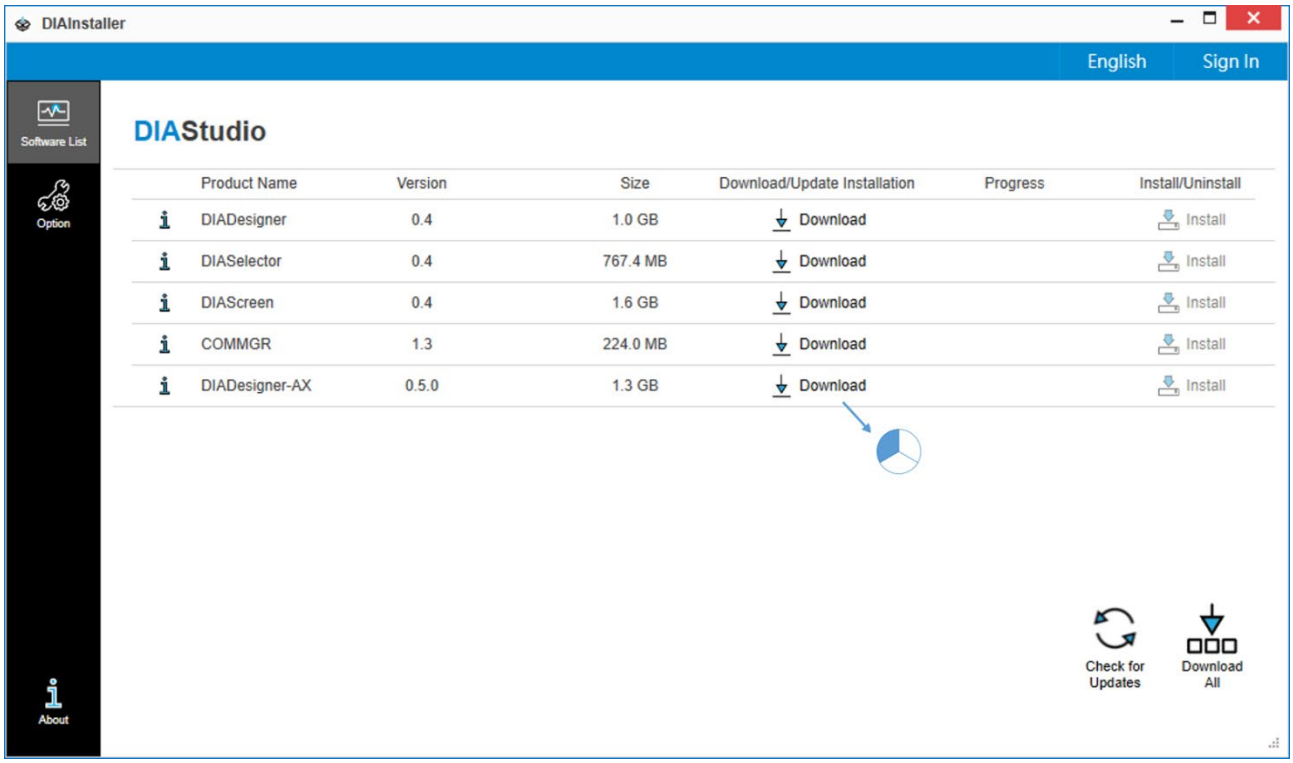
After login, click DIAStudio download icon to download **DIAStudio** for installation as shown below.

Software

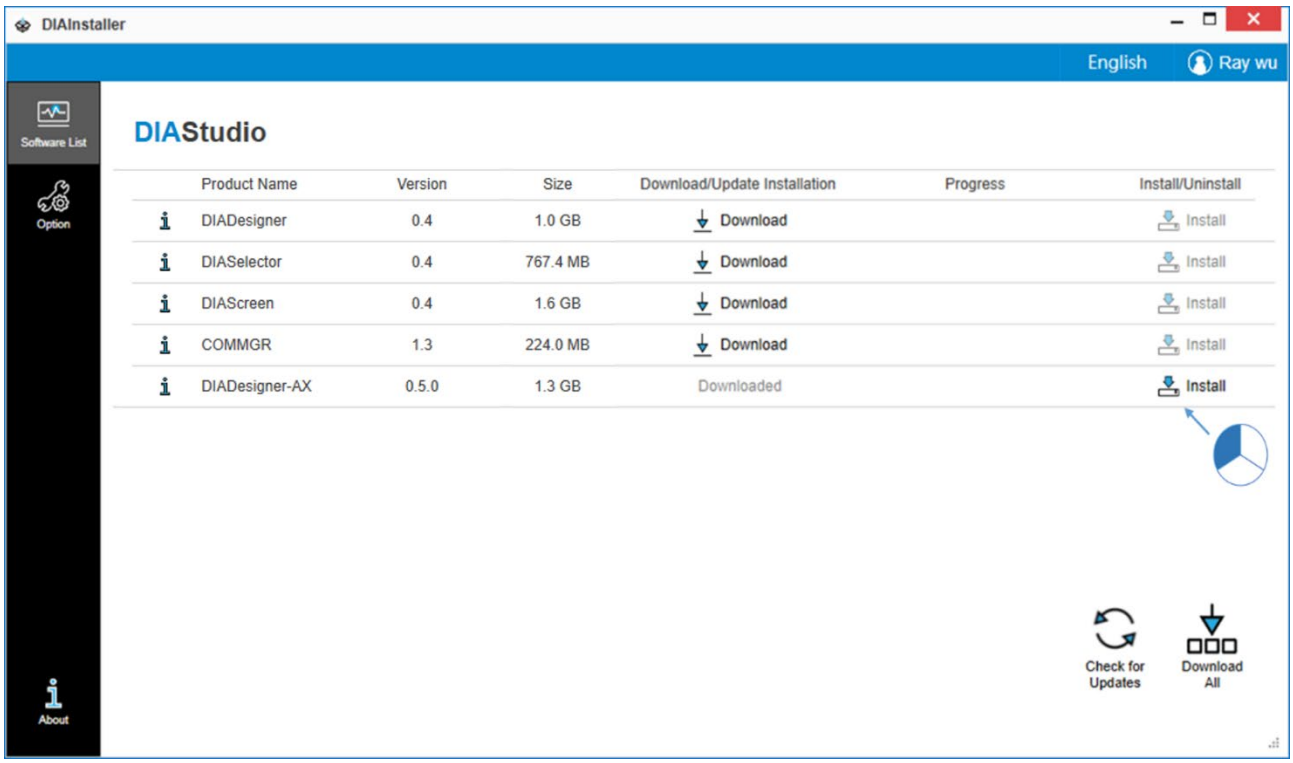
Software Name	Description	OS	Issue Date	File
DIASelector App V0.4 (Early Access!)	DIASelector Mobile App	Android Lollipop (5.0) and above	2020/05/06	
DIAStudio V0.4 (Early Access!)	DIAStudio Software download and Installation Tool	Windows 7 / 8.1 / 10 / Server 2012 R2 32/64 bit	2020/05/06	

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

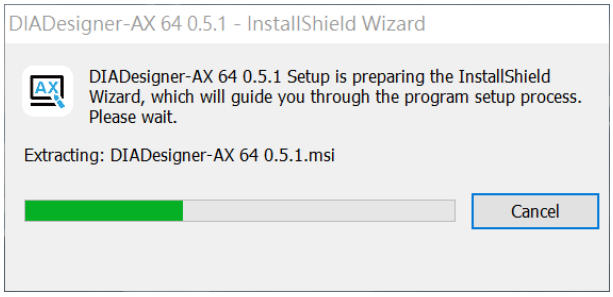
1. Open DIAInstaller to see the latest version of DIADesigner-AX.
2. Click **Download** to download the setup file of DIADesigner-AX.

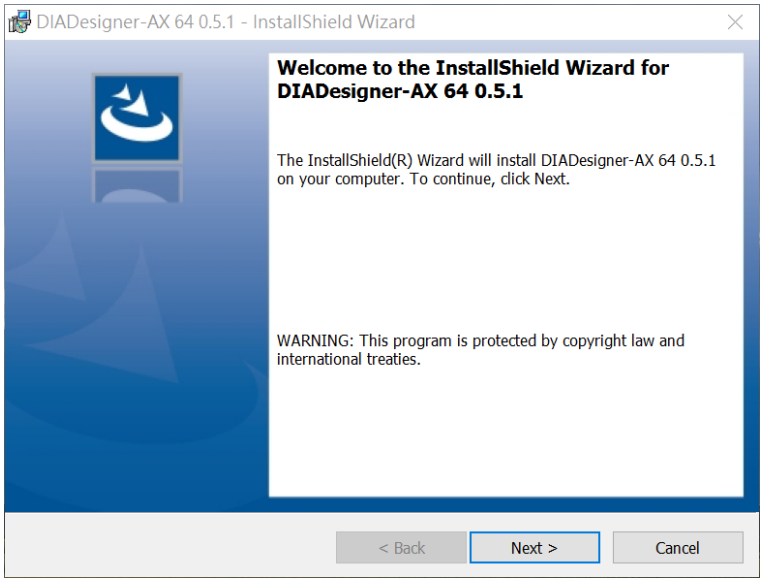


3. After DIADesigner-AX is downloaded, click **Install** to install the software.

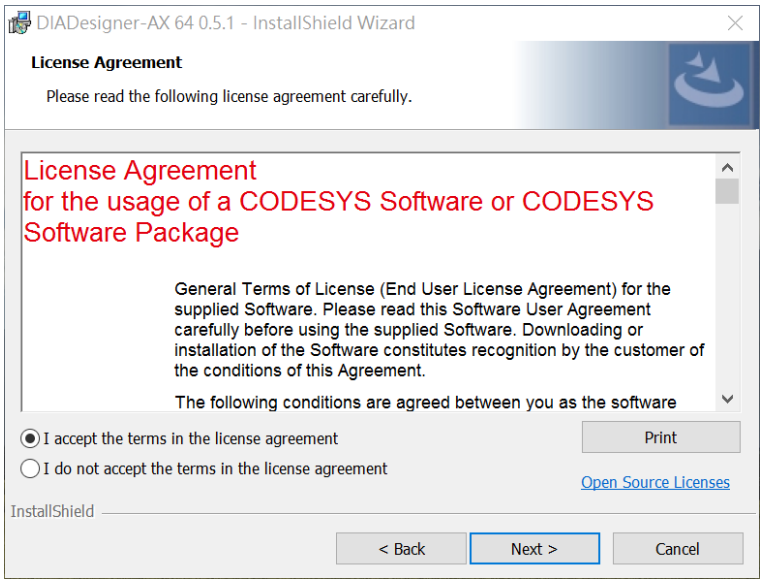


An **InstallShied Wizard** shows up and installing starts. Click **Next**.

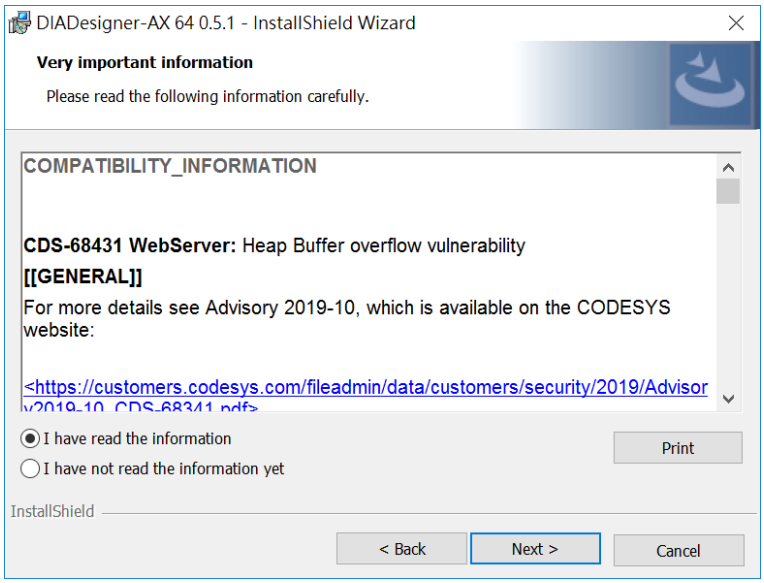




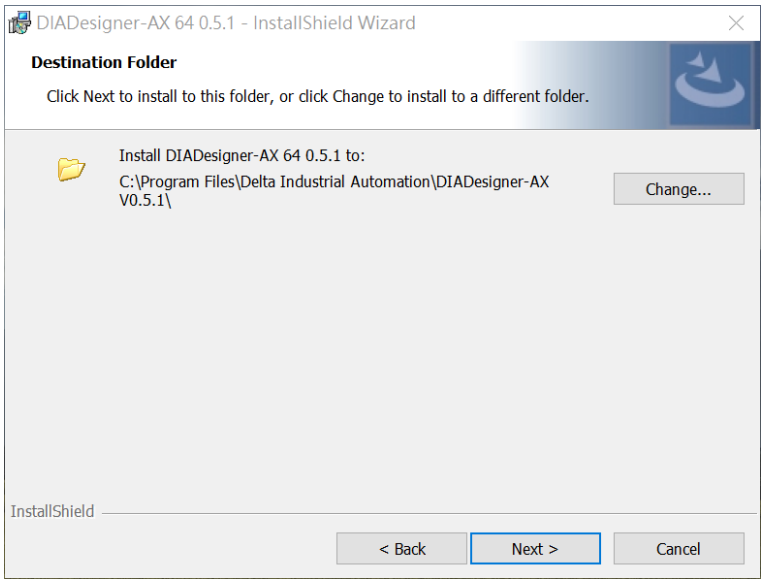
4. The window of License Agreement shows up. Select “I accept the terms in the license agreement” option and then click **Next**.



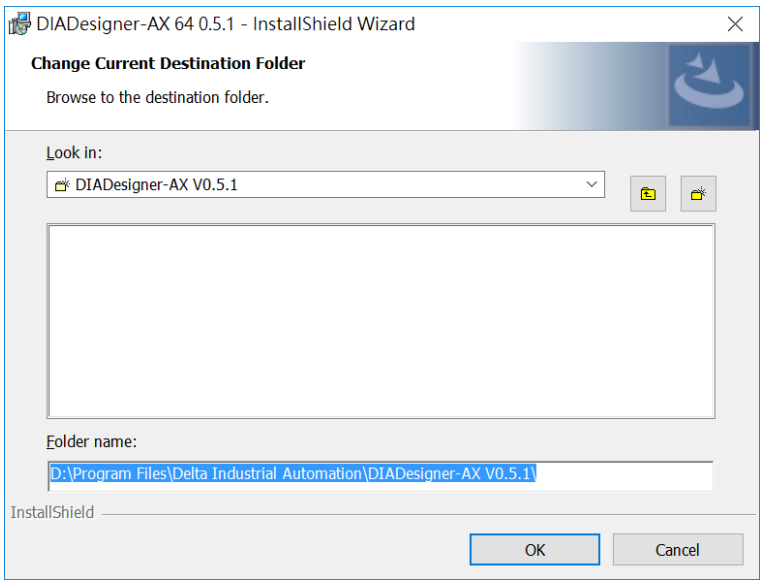
5. After that, the **Very important information** page comes up. Select “I have read the information” option and then click **Next**.



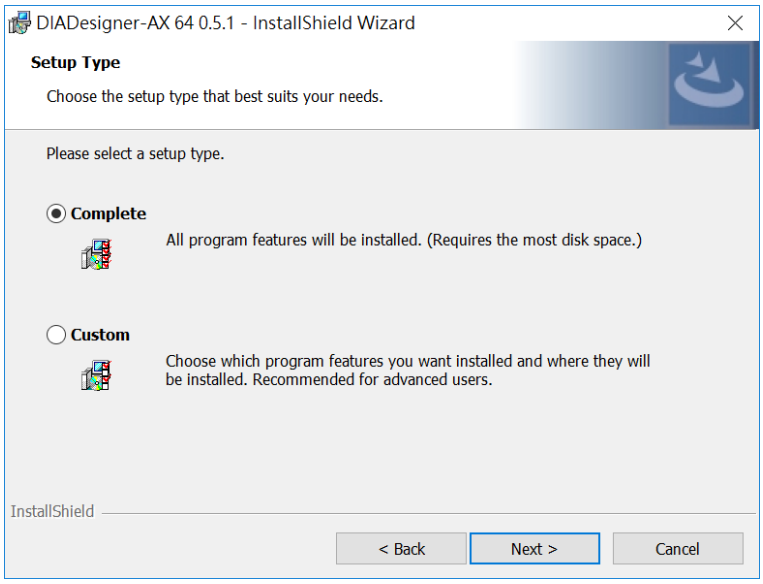
6. Next comes the **Destination Folder** page. If you leave the default path unchanged, click **Next**.



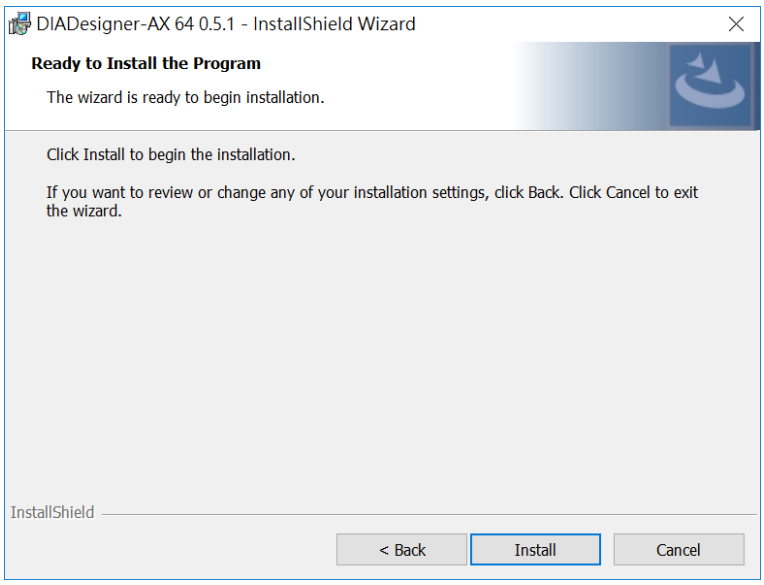
Or click **Change…** to change the path to destination folder.



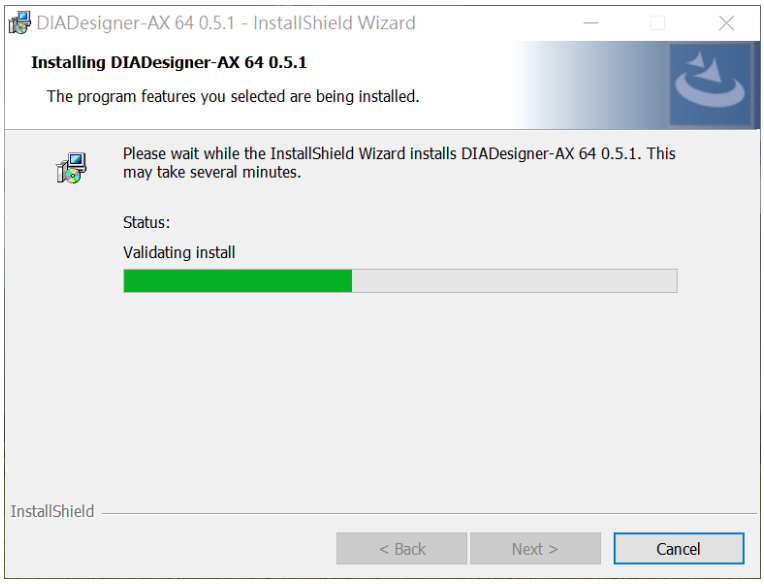
7. The window of **Setup Type** shows up as shown below. Select a setup type you need and then click **Next**.



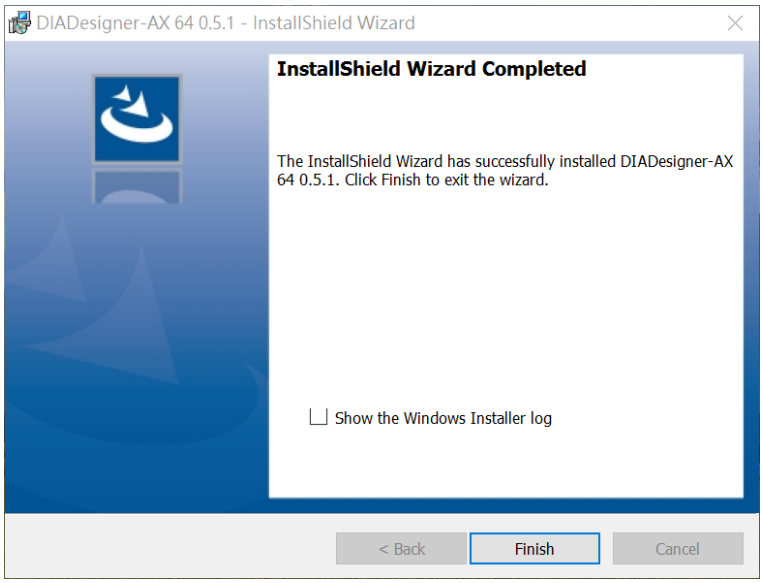
8. The window of **Ready to Install the Program** appears as below and then click **Install**.



It may take some time to have the installation done.



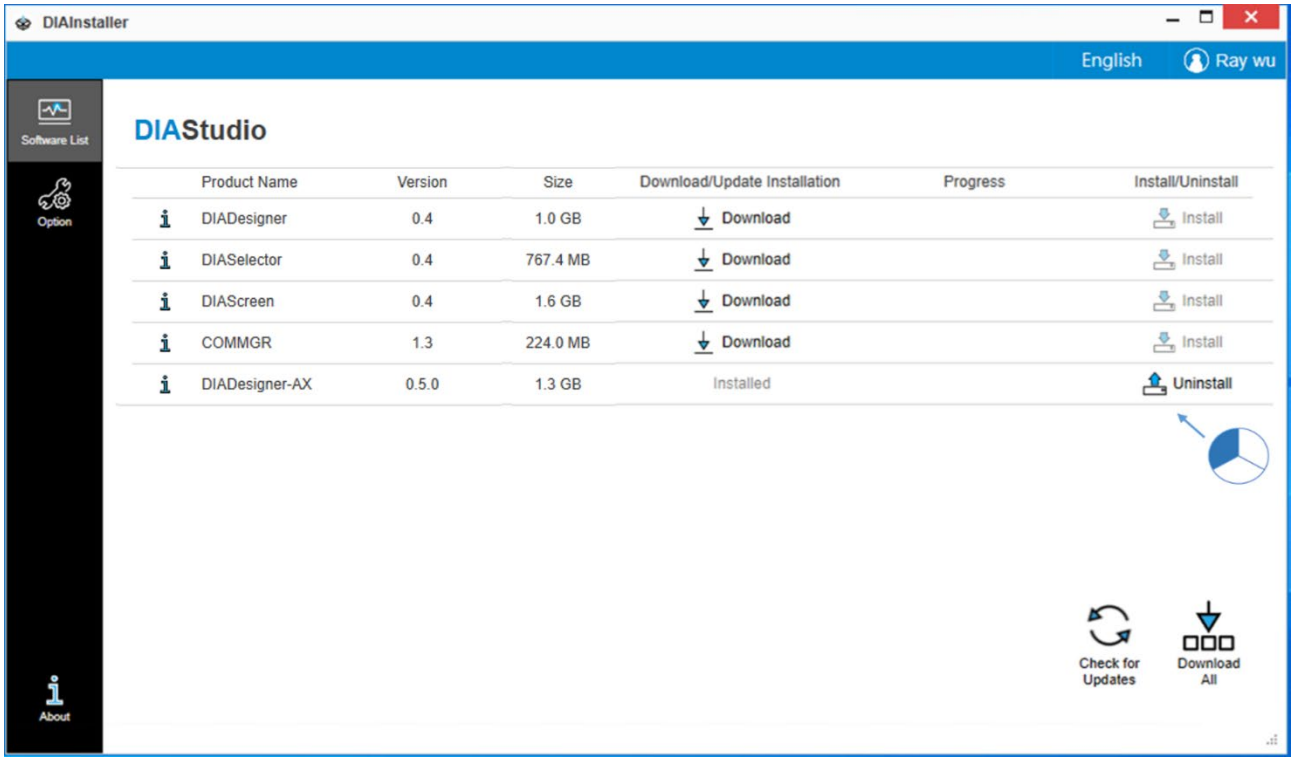
9. After installation, the window of **InstallShield Wizard Completed** appears. Click **Finish** to complete the installation.



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

2

Chapter 2 Coupler

Table of Contents

2.1 AX-500CEC00-0A 2-2
2.1.1 Specification 2-2
2.1.2 Dimensions and Parts 2-3
2.1.3 Arrangement of Terminals, LED Indicators and Wiring 2-4
2.1.4 Settings in DIADesigner-AX 2-7
2.1.5 EtherCAT Operation Modes 2-11
2.1.6 Process Data 2-11
2.1.7 Troubleshooting 2-11
2.2 AX-500CPN00-0A 2-12
2.2.1 Specification 2-12
2.2.2 Dimensions and Parts 2-13
2.2.3 Arrangement of Terminals, LED Indicators and Wiring 2-14
2.2.4 Settings in DIADesigner-AX 2-18
2.2.5 Troubleshooting 2-33

2.1 AX-500CEC00-0A

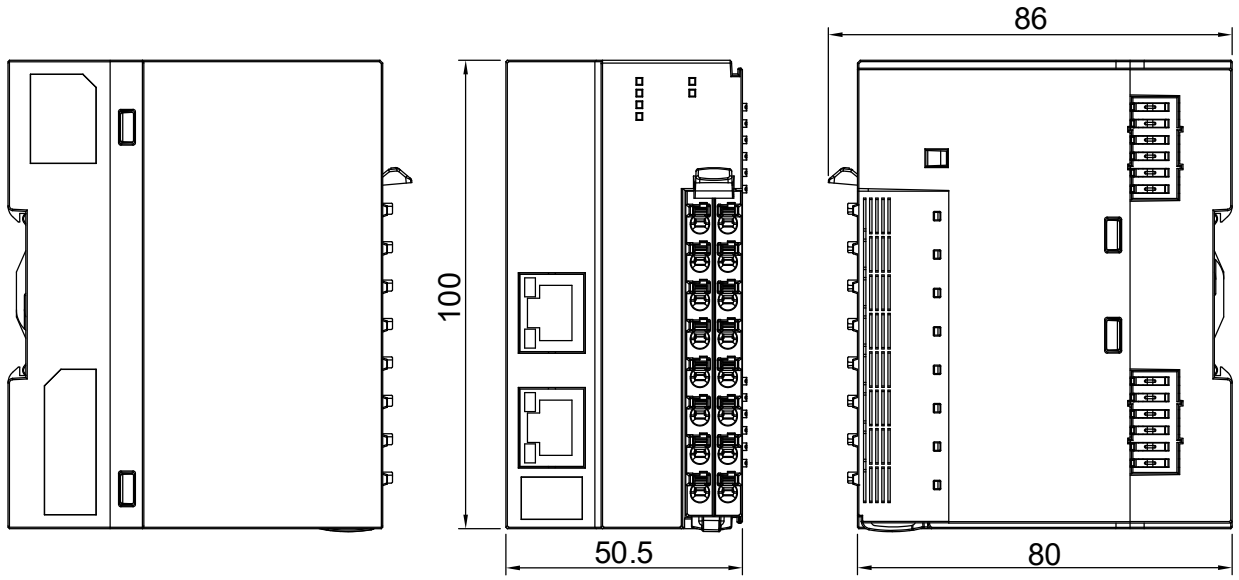
AX500CEC00-0A is an EtherCAT coupler. This section introduces its specifications, operations, and wirings.

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% to 20%) /16 W
	I/O power input voltage/power	24 VDC (-15% to 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

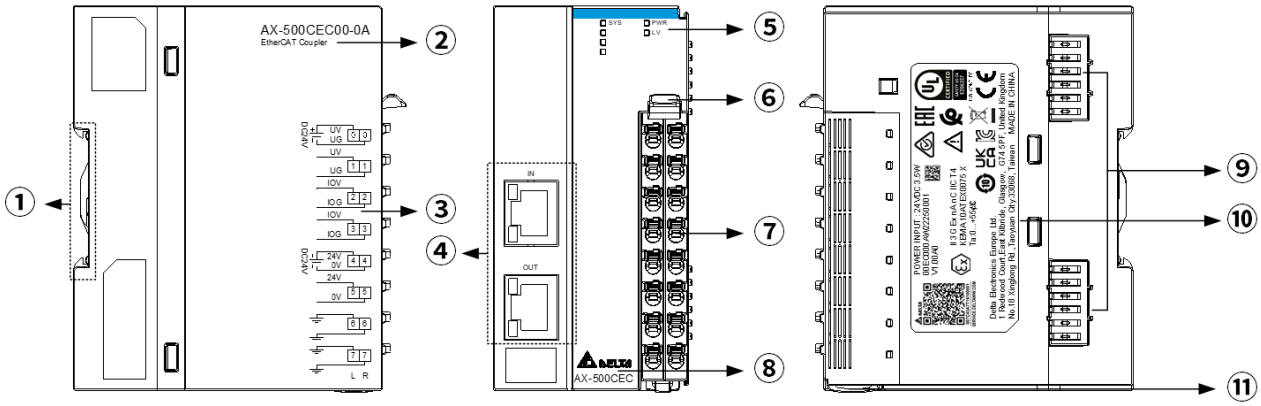
2.1.2 Dimensions and Parts

- **Dimensions**



Unit：mm

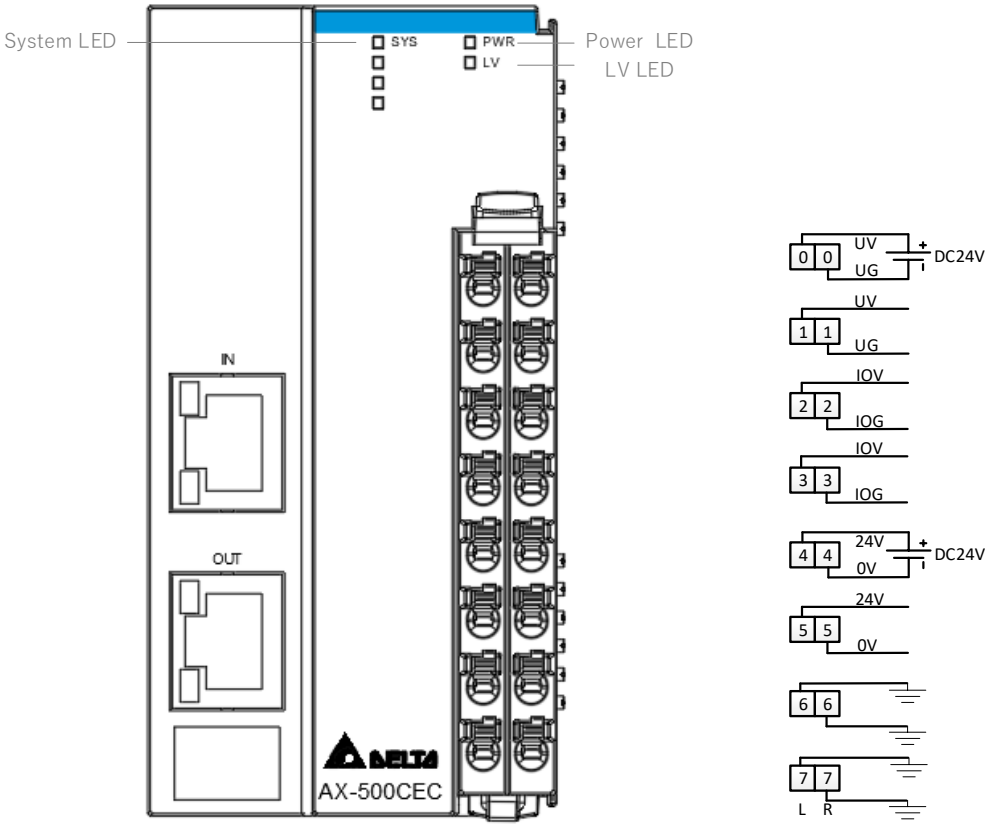
- **Parts**



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



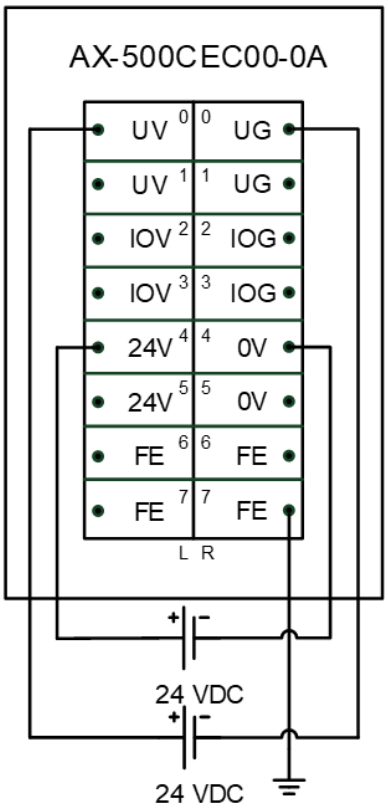
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	UV	Module unit power input: DC 24 V	R0	UG	Module unit power input: DC 0 V
L1	UV	Module unit power input: DC 24 V	R1	UG	Module unit power input: DC 0 V
L2	IOV	I/O power output: DC 24 V	R2	IOG	I/O power output: DC 0 V
L3	IOV	I/O power output: DC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

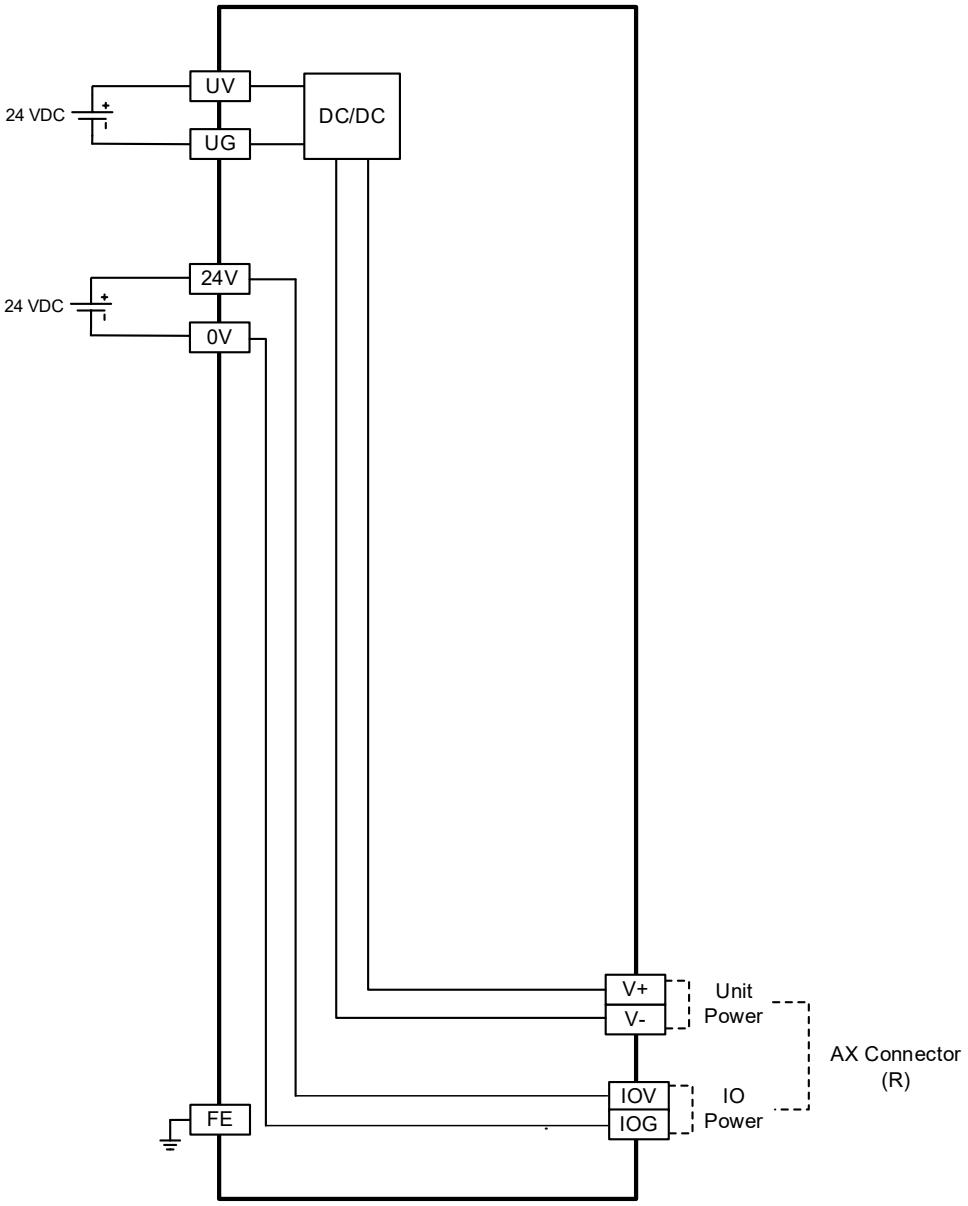
2.1.3.2 LED Indicators

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	Blue		OFF	Not supplied with power
			ON	Power on

2.1.3.3 Wiring and Loop Configuration

- **Wiring**





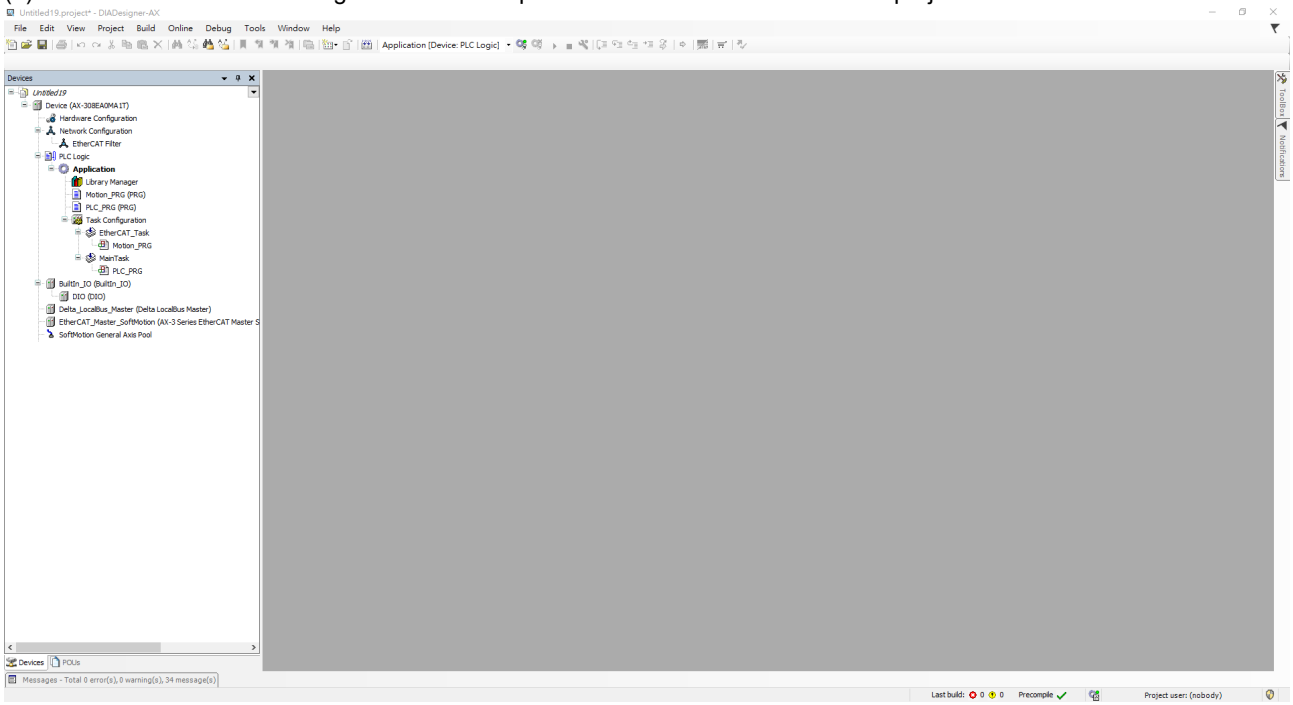
⚠	● This product shall be powered by a certified SELV/PELV power supply unit with operating temperature of minimum 60 °C, which meets the requirements of IEC 61010-1:2010 or latest edition. ● With the SELV/PELV power supply connected to 24V/0V terminals of the removable terminal block, the output rating 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.

2.1.4 Settings in DIADesigner-AX

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

2.1.4.1 Basic Operation

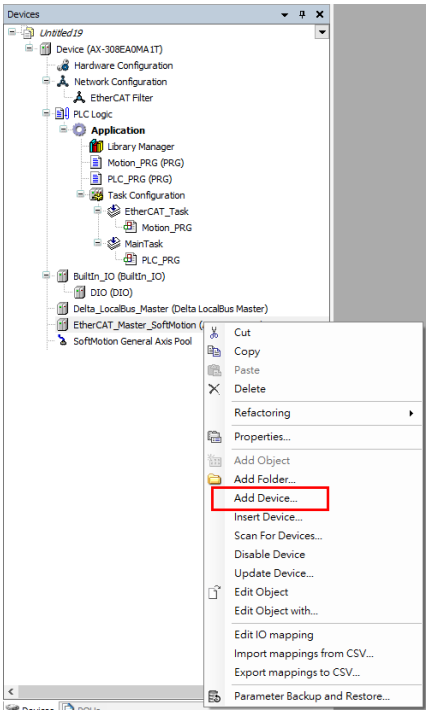
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



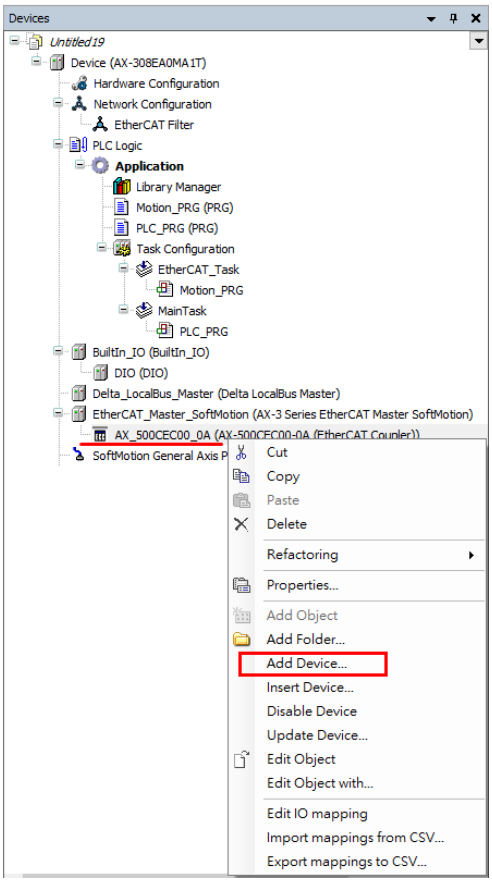
(2) Add Modules in

- 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.

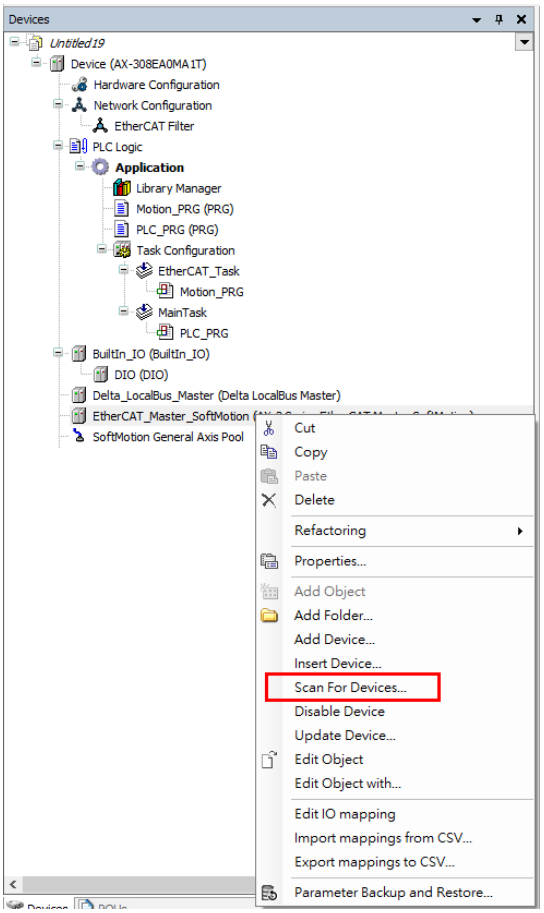


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

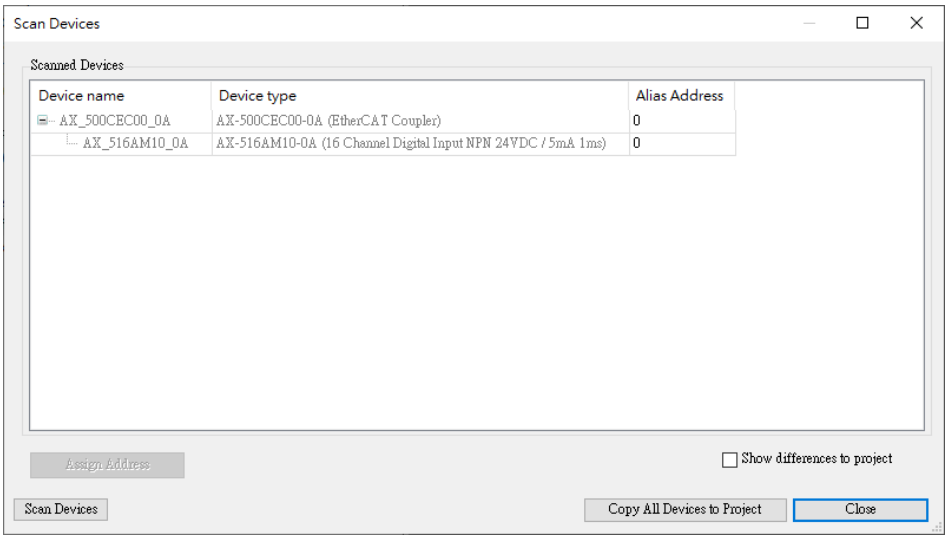


- Method 2: Scan to add the modules in.

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

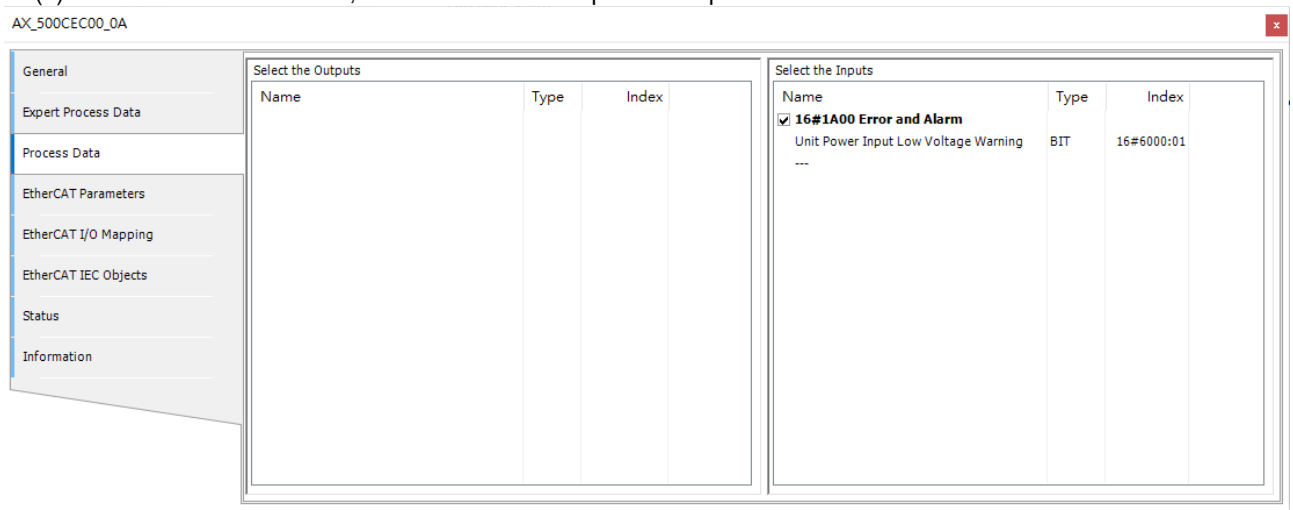


After the auto-scan is over, the actually connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.

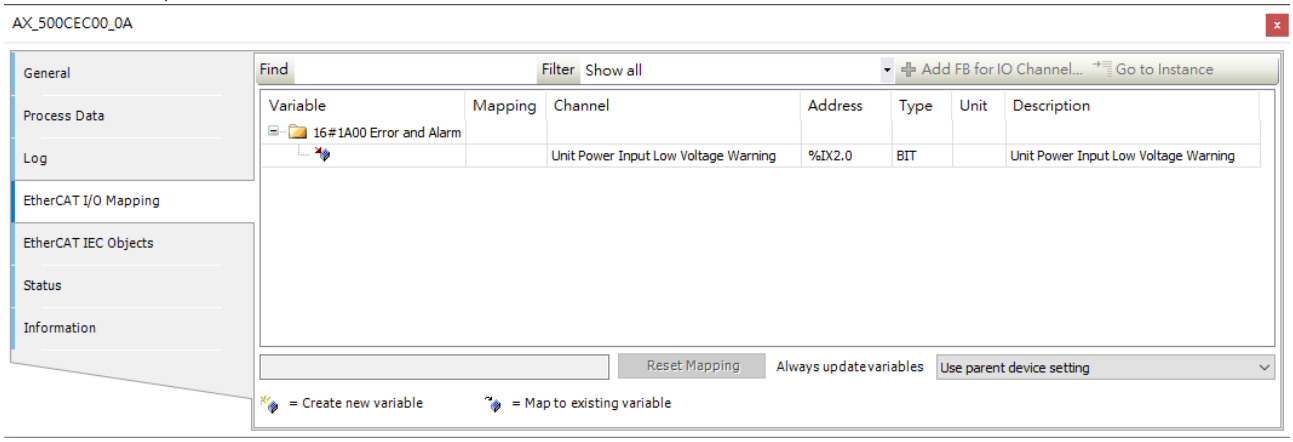


2.1.4.2 Process Data

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

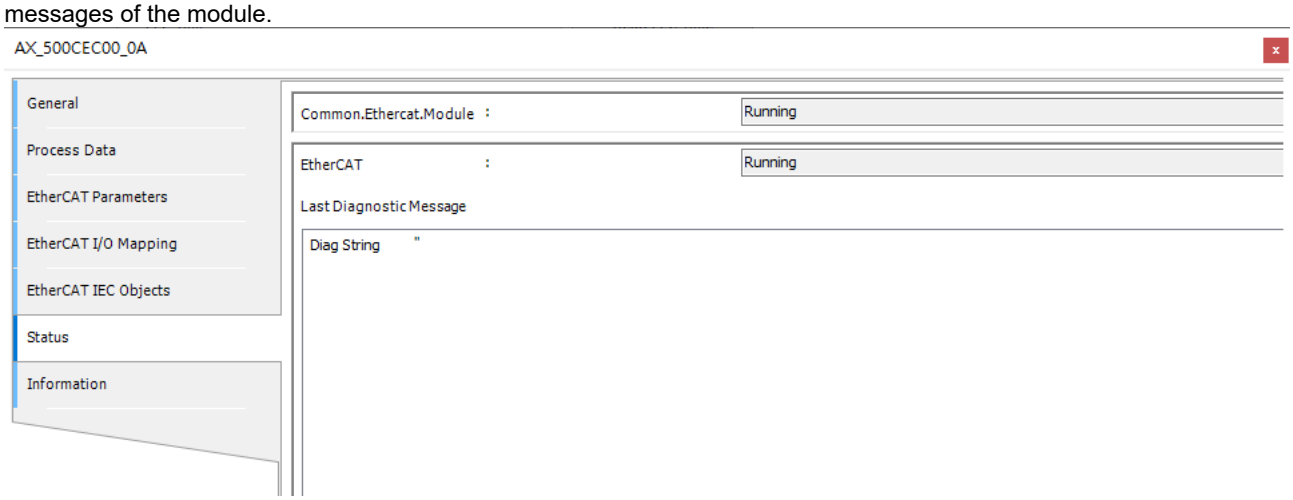


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, status, and error codes for each channel.



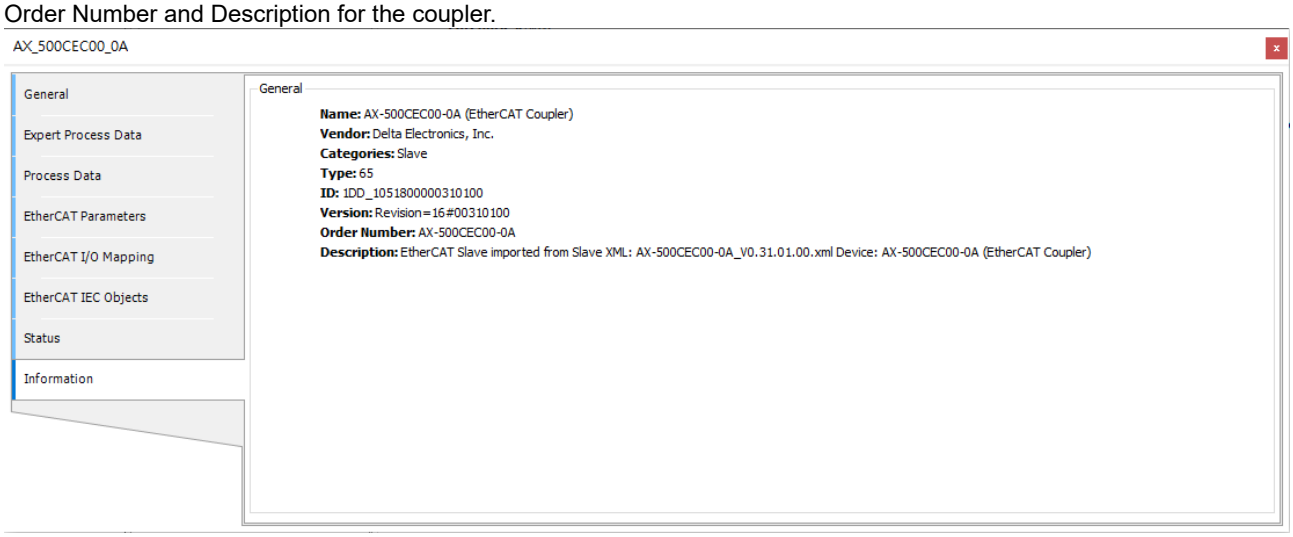
2.1.4.3 Status

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.



2.1.4.4 Information

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



2.1.5 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.

2.1.5.1 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.

2.1.6 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

2.1.7 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.

2.2 AX-500CPN00-0A

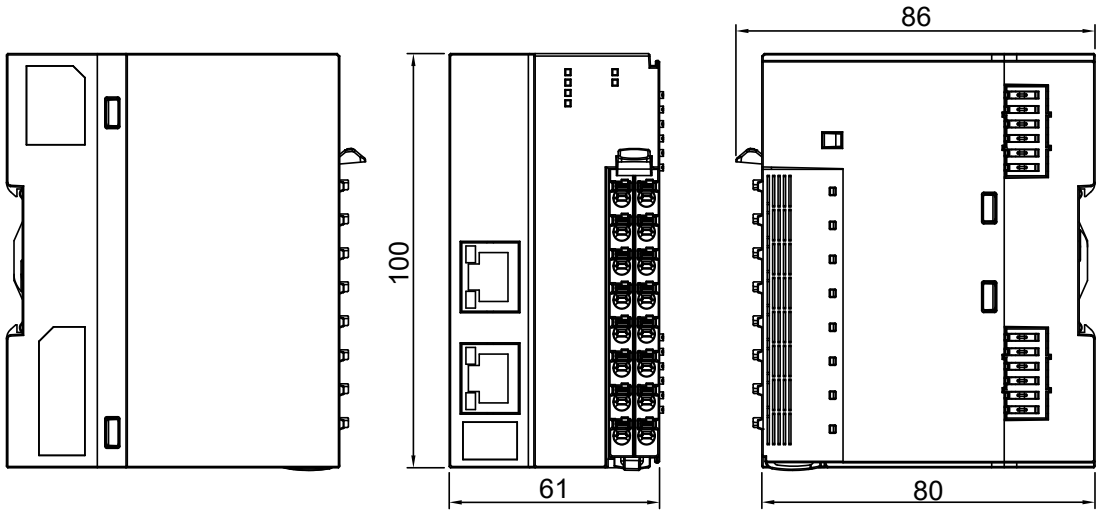
AX500CEC00-0A is a PROFINET coupler. This section introduces its specifications, operations, and wirings.

2.2.1 Specification

Item		Specification
External connectors		One spring-clamp terminal block (16 terminals)
		RJ45 x 2 IN: PROFINET input port / OUT: PROFINET output port
Dimension(mm)		61 (W) × 100 (H) × 80 (D)
Weight		185 g
Electrical specification	Unit power input voltage/power	24 VDC (-15 to 20%)/ 20 W
	I/O power input voltage/power	24 VDC (-15 to 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)	200 mA (4.8 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.)
		PROFINET port: 500 VAC
Others	Input power protection (UV/UG)	Voltage / current protection, under-voltage warning
	Unit power protection	Voltage / current protection
Communication specification	Communication protocol	PROFINET Device RT
	Number of Ethernet switch	2 Switches
	Transmission rate	100/1000 Mbps Auto-Detection
	Supported topology	Linear topology, star topology
	Diagnosis	LED, Error Message, Error Code
	Conformance Class	A
	Maximum number of supported modules	64
	Maximum data length	1440 Bytes
	Minimum cycle time	4 ms

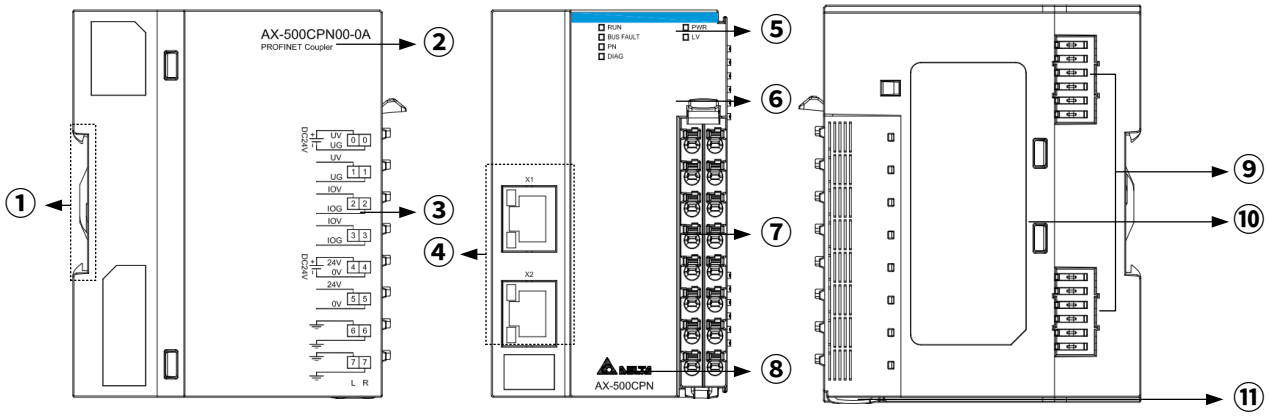
2.2.2 Dimensions and Parts

- **Dimensions**



Unit: mm

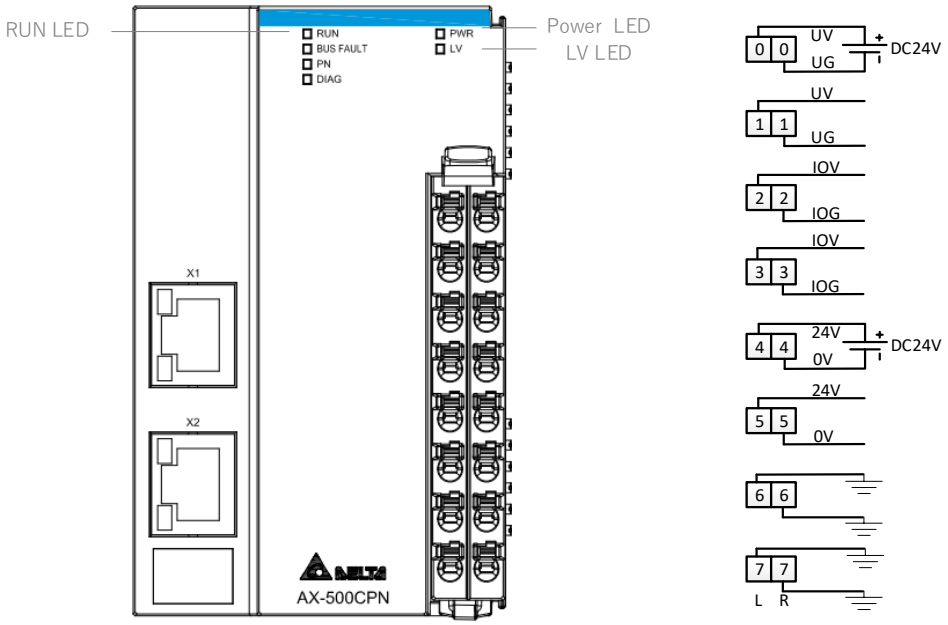
- **Parts**



No.	Name
1	DIN rail clip
2	Model number and model description
3	Wiring
4	PROFINET 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

2.2.3 Arrangement of Terminals, LED Indicators and Wiring

2.2.3.1 Arrangement of Terminals



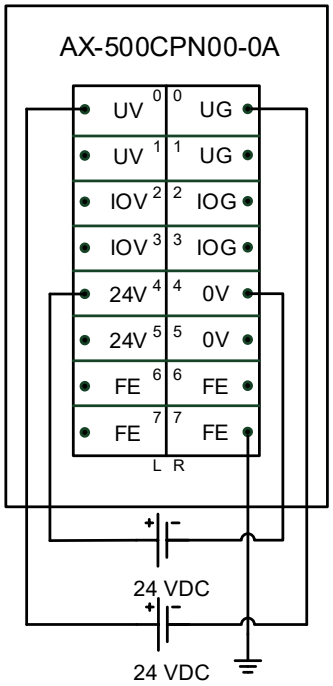
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	UV	Module unit power input: 24 VDC	R0	UG	Module unit power input: 0 VDC
L1	UV	Module unit power input: 24 VDC	R1	UG	Module unit power input: 0 VDC
L2	IOV	I/O power output: 24 VDC	R2	IOG	I/O power output: 0 VDC
L3	IOV	I/O power output: 24 VDC	R3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

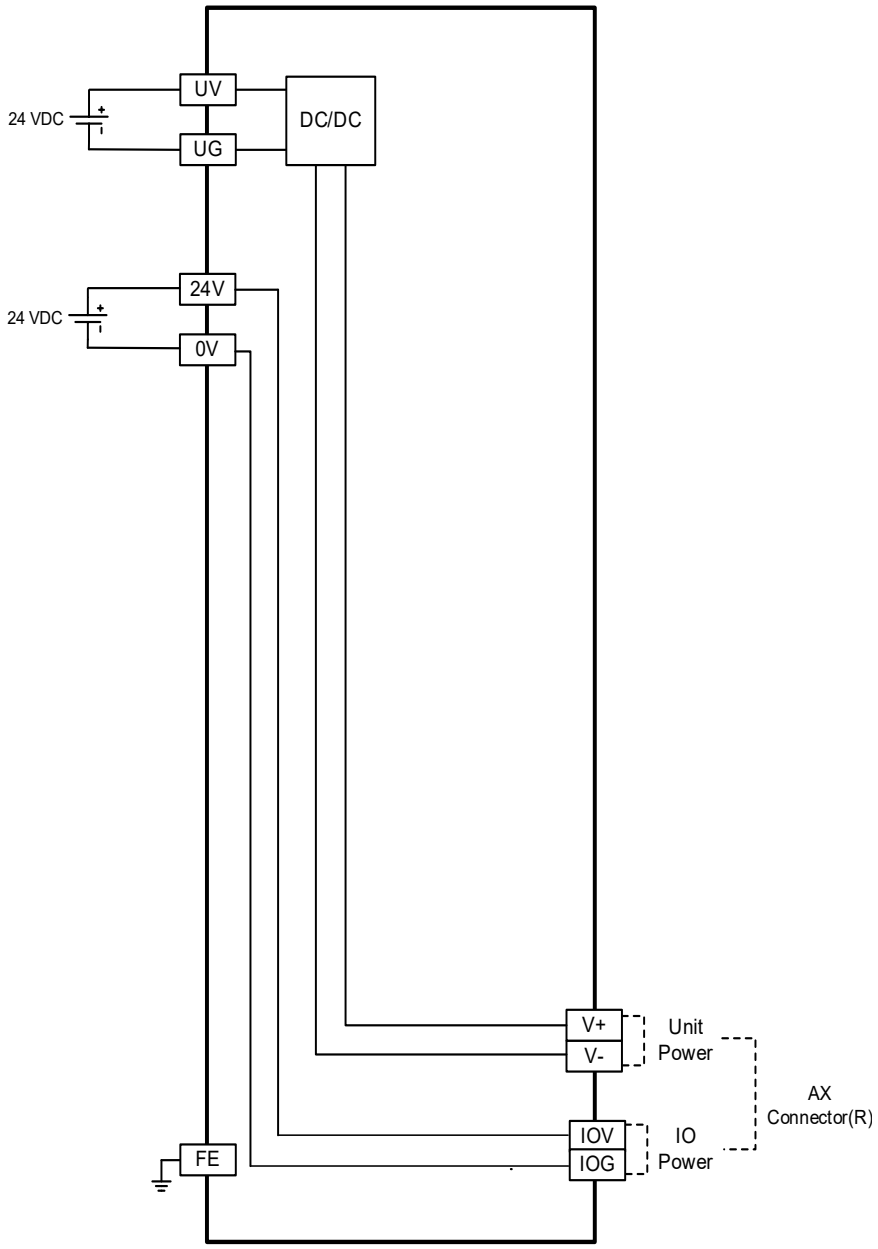
2.2.3.2 LED Indicators

Name	Color	Status		Description
RUN	Green		OFF	PLC CPU STOP
			Blinking (0.5s)	During the boot-up process
			ON	PLC CPU RUN
BUS FAULT	Red		OFF	I/O module communication is working normally
			Blinking (0.5s)	1. Error codes occurred in I/O modules 2. No response from I/O module 3. Device identification function (continuously for 3 seconds)
PN	Green/Red		ON	PN connection established
			Blinking (0.5s)	1. Connection timeout 2. No application relation established
DIAG	Green/Red		OFF	No error
			Blinking (0.5s)	1. I/O module configuration mismatch 2. Unsupported I/O module type
RUN DIAG	Green/Red		Blinking (0.5s)	Access to Backup operating system Firmware update
LV	Red		OFF	No under-voltage warning
			ON	Under-voltage warning
Power	Blue		OFF	Not supplied with power
			ON	Power on

2.2.3.3 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.

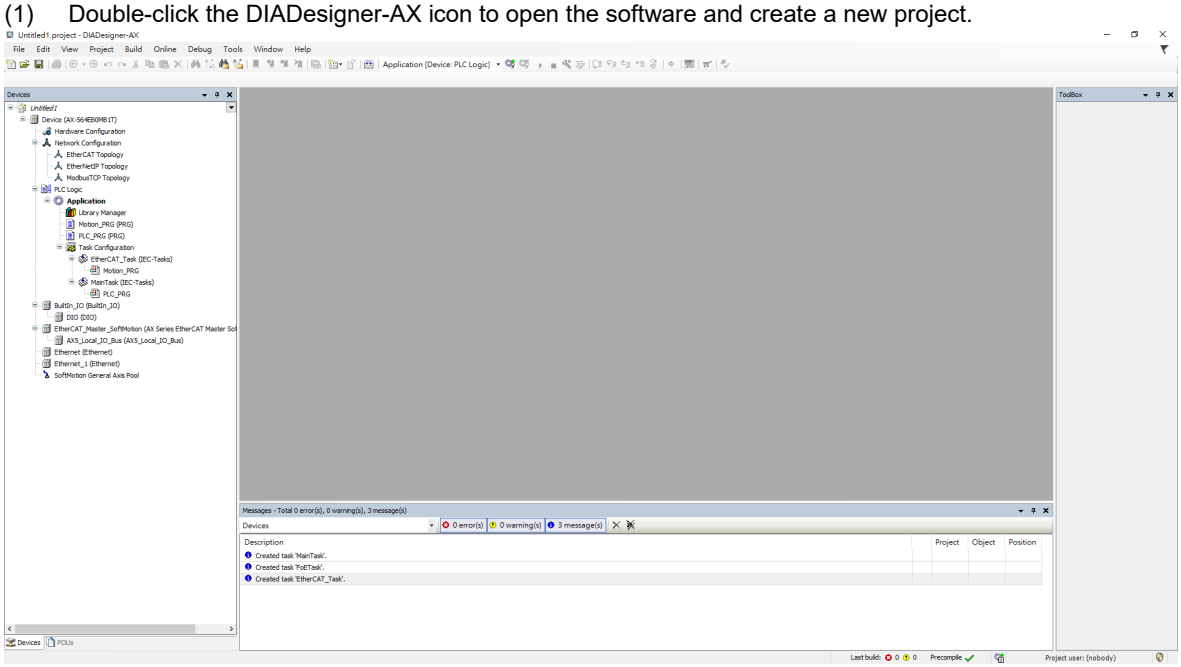
2.2.4 Settings in DIADesigner-AX

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

2.2.4.1 DIADesigner-AX

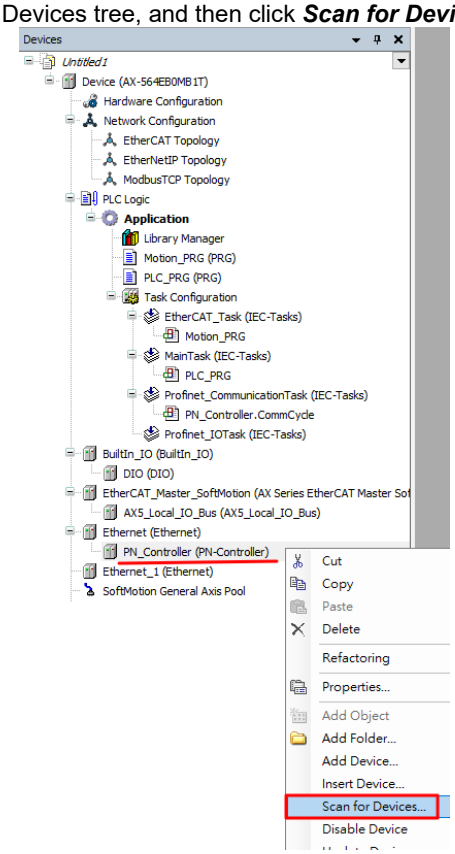
2.2.4.1.1 Scan for Devices

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



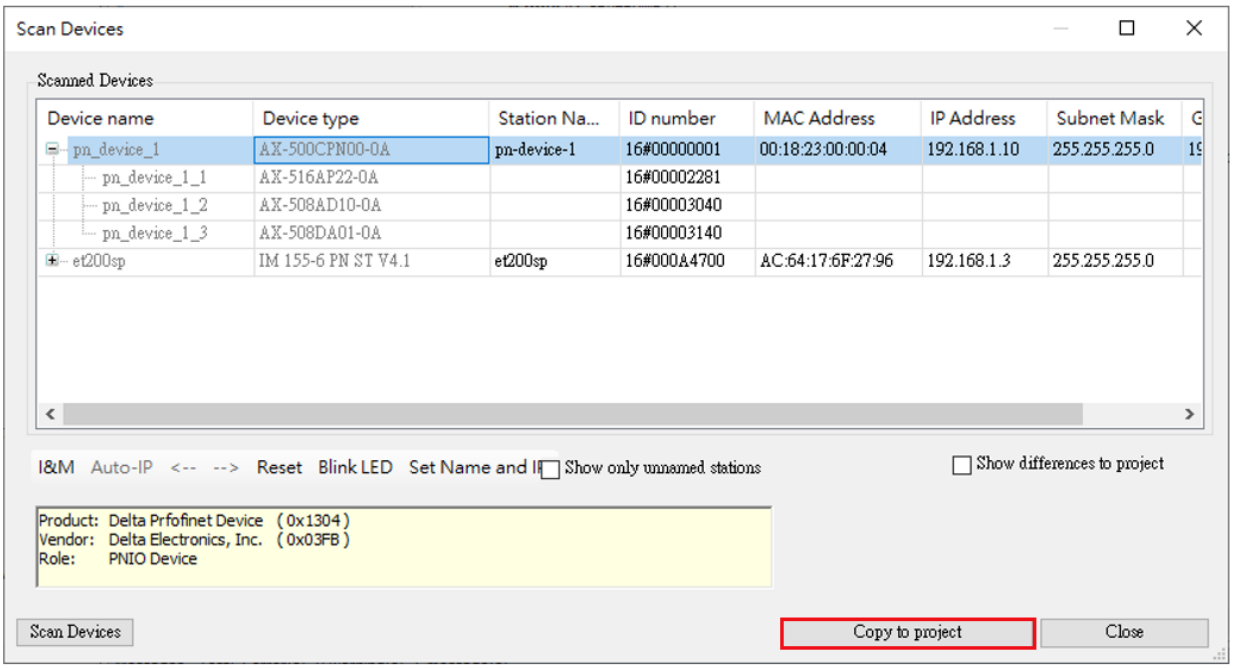
(2) Scan to add the modules in.

Right-click ***PN Controller*** in the Devices tree, and then click ***Scan for Devices...***.

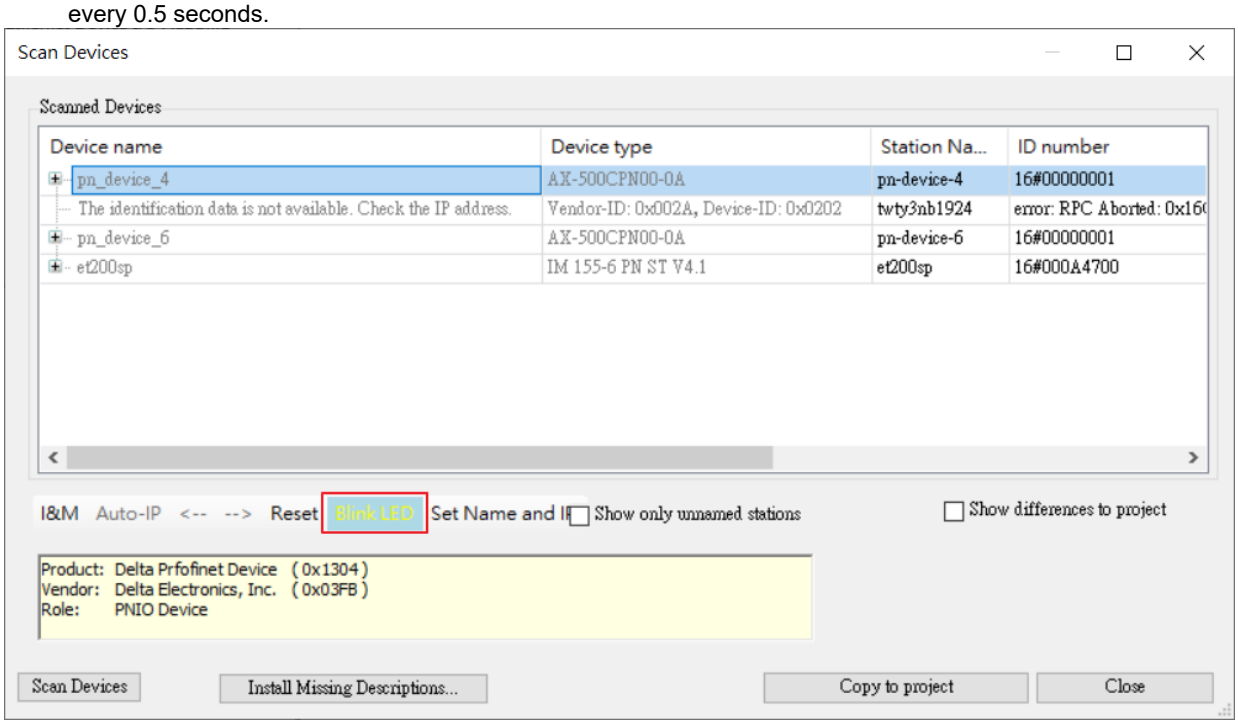


(3) Once the scanning is complete, the actual system design will be generated as depicted in the figure below. Simply click the **Copy to project** button to add the device under **PN Controller**.

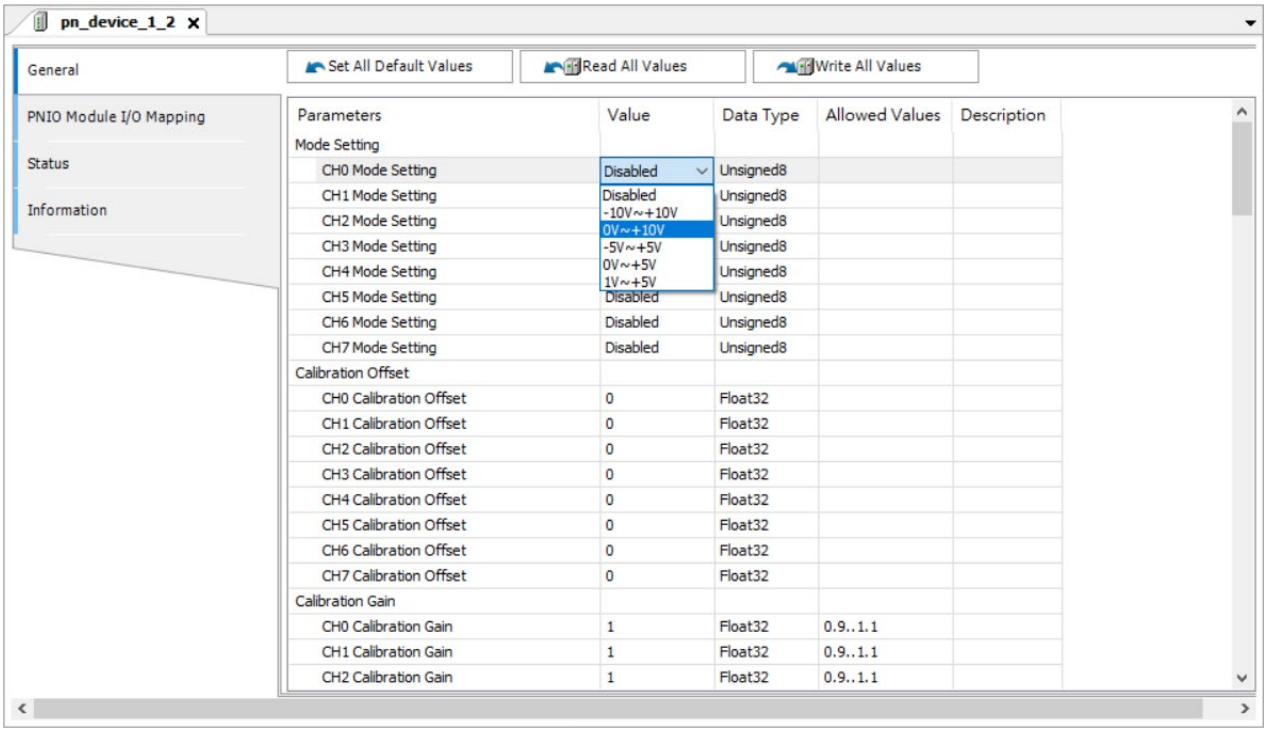
The system design is as below:
On the right-side of AX-500CPN00-0A, the following modules are connected, AX-516AP22-0A (Input Data: 2 bytes; Output Data: 1 byte), AX-508AD10-0A (Input Data: 34 bytes) and AX-508DA01-0A (Input Data: 1 byte; Output Data: 32 bytes); the total input data is 37 bytes while the total output data is 33 bytes.



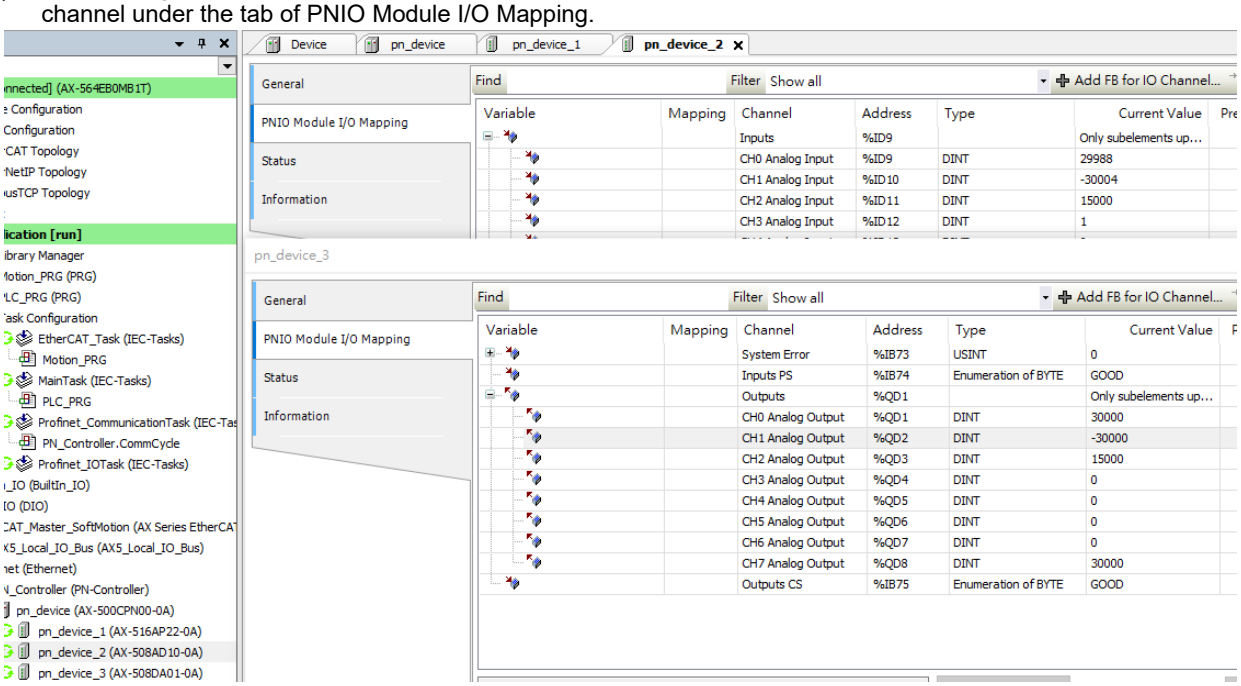
(4) When there are more than one ProfNet Coupler, you can identify the selected device in DIADesigner-AX by checking the blinking LED buttons. The LEDs of RUN, BUS FAULT, PN and DIAG of the chosen ProfNet Coupler will blink every 0.5 seconds.



(5) Configure the values under General Tab for AX-508AD10-0A and AX-508DA01-0A. The following example uses 0 V to +10 V.

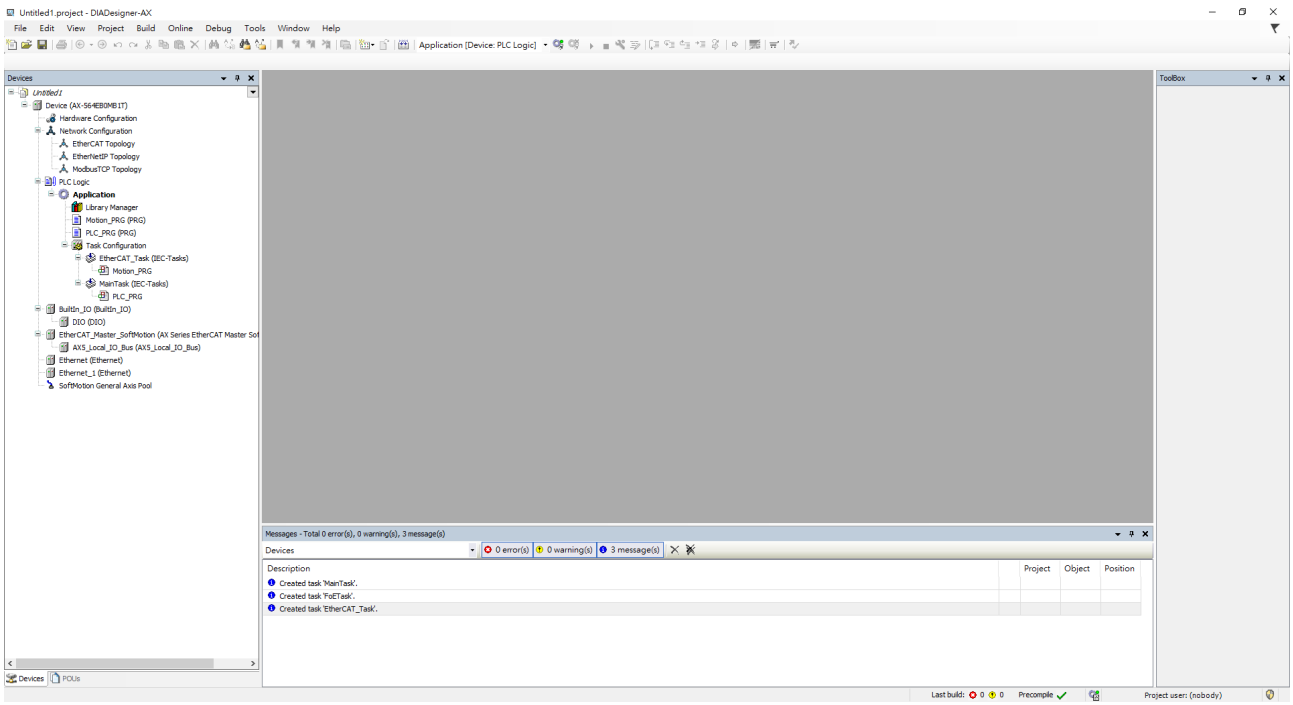


(6) After settings are complete, click  on the toolbar to enter the online mode. You can find the values for each channel under the tab of PNIO Module I/O Mapping.

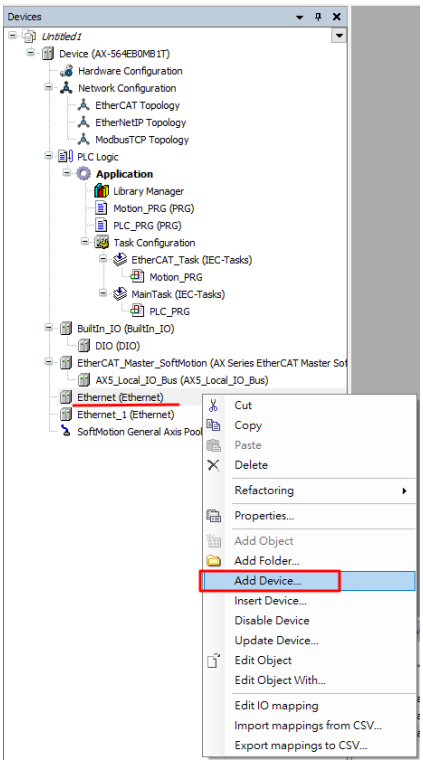


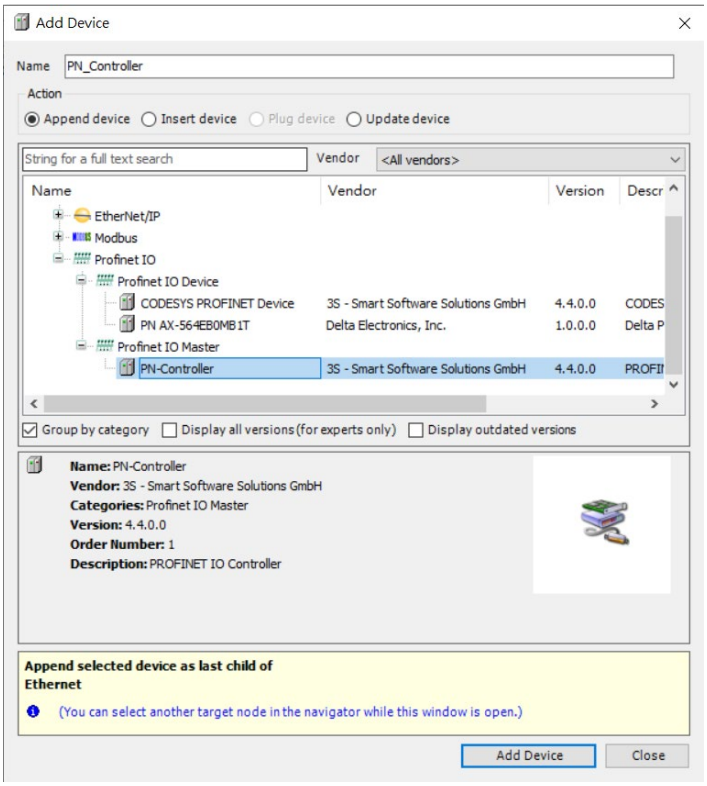
2.2.4.1.2 Add Modules in Manually

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

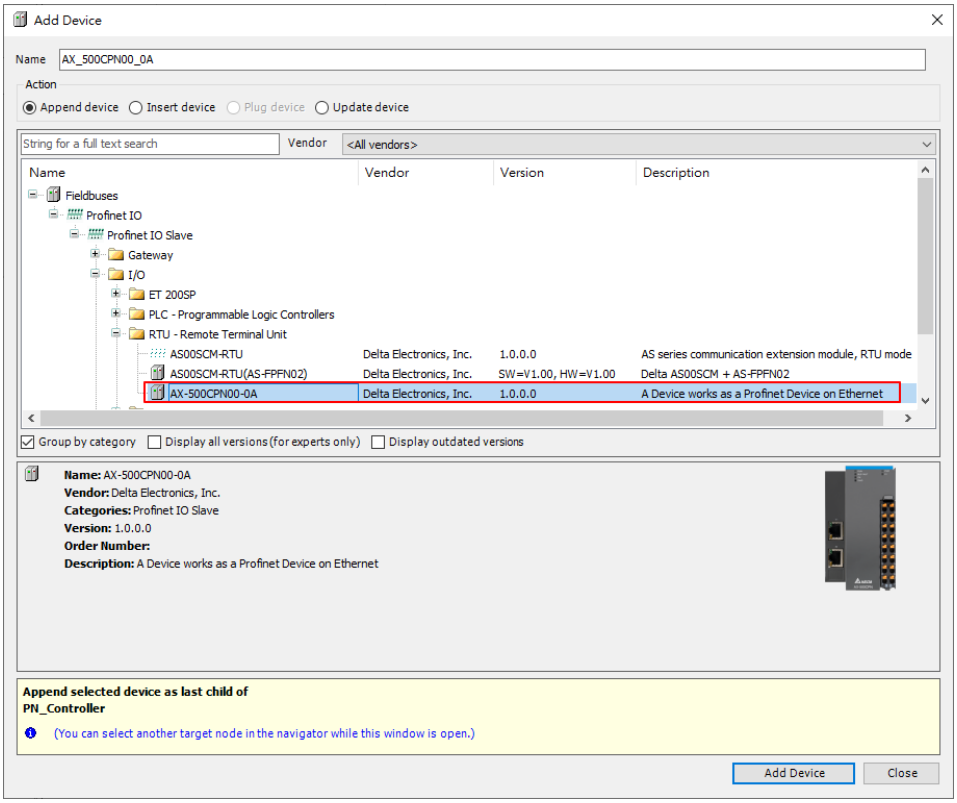


(2) Right-click ***Ethernet*** in the Devices tree, and then click ***Add Device... -> Profinet IO -> Profinet IO*** Master to add PN Coupler.

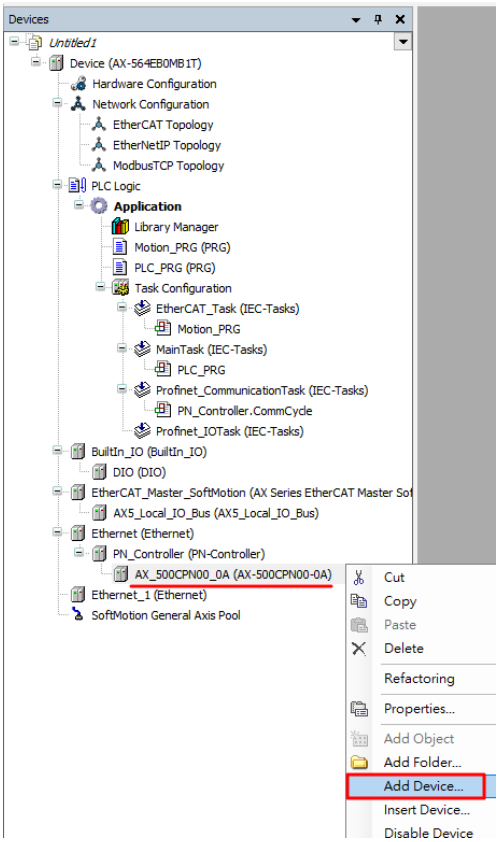


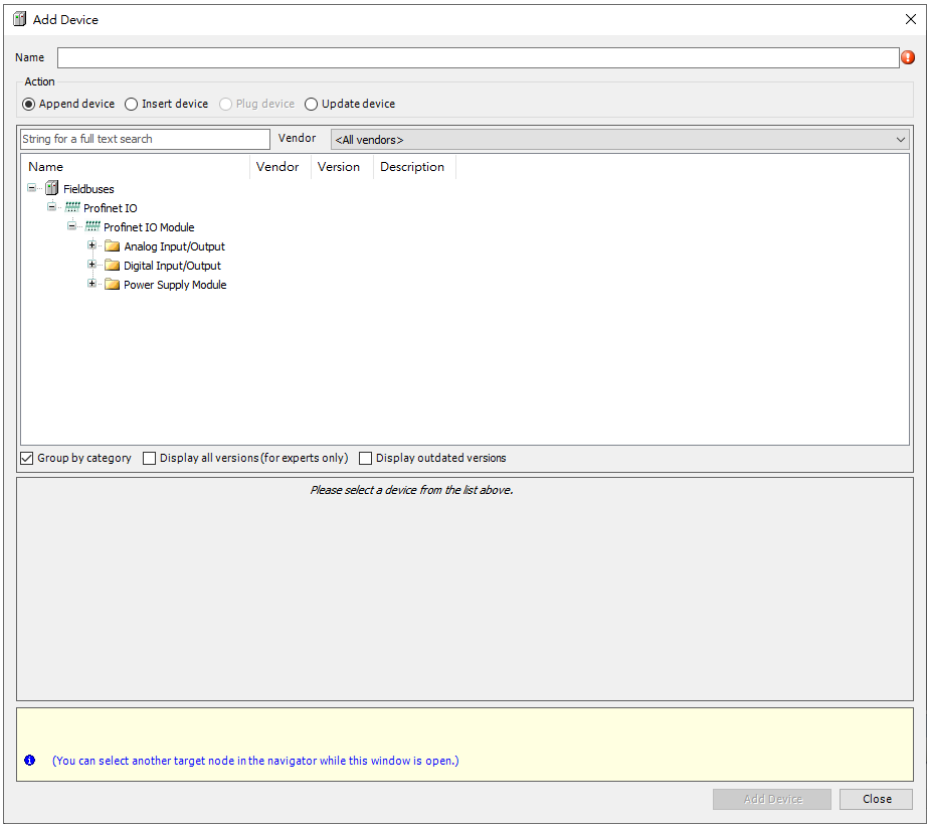


(3) Find **PN Controller** in the Devices tree. Right-click it and select ***Add Device***… to add Profinet Coupler (AX-500CPN).



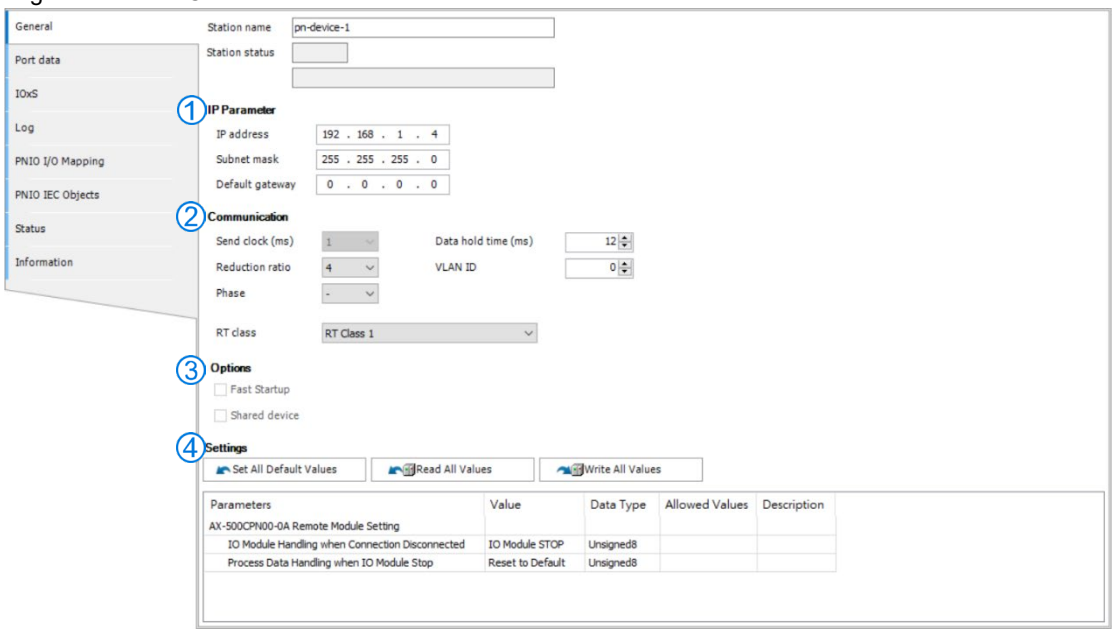
(4) Right-click the added Profinet Coupler (AX-500CPN) and click **Add Device...**.





- Before adding the devices in manually, make sure that the domain of the IP address in the IP Parameter (under the General tab of Profinet Coupler) and the domain of the network interface are the same.

- Settings for Profinet Controller:



① IP Parameter: Set up the network for Profinet Coupler.
- IP address, Subnet mask and Default gateway

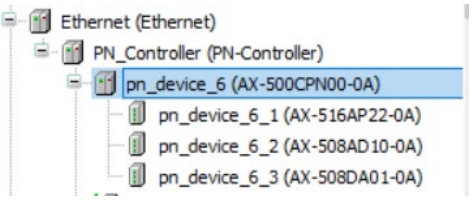
② Communication
- Send clock: How often the data is sent.
- Reduction ratio: Modify the transmission frequency, with a higher number resulting in a longer interval between packet transmissions.
- Data hold time: Timeout time.
- VLAN ID: Fixed to 0.
- Phase: Time to send the packet.

③ Options: This feature is not supported by AX5.

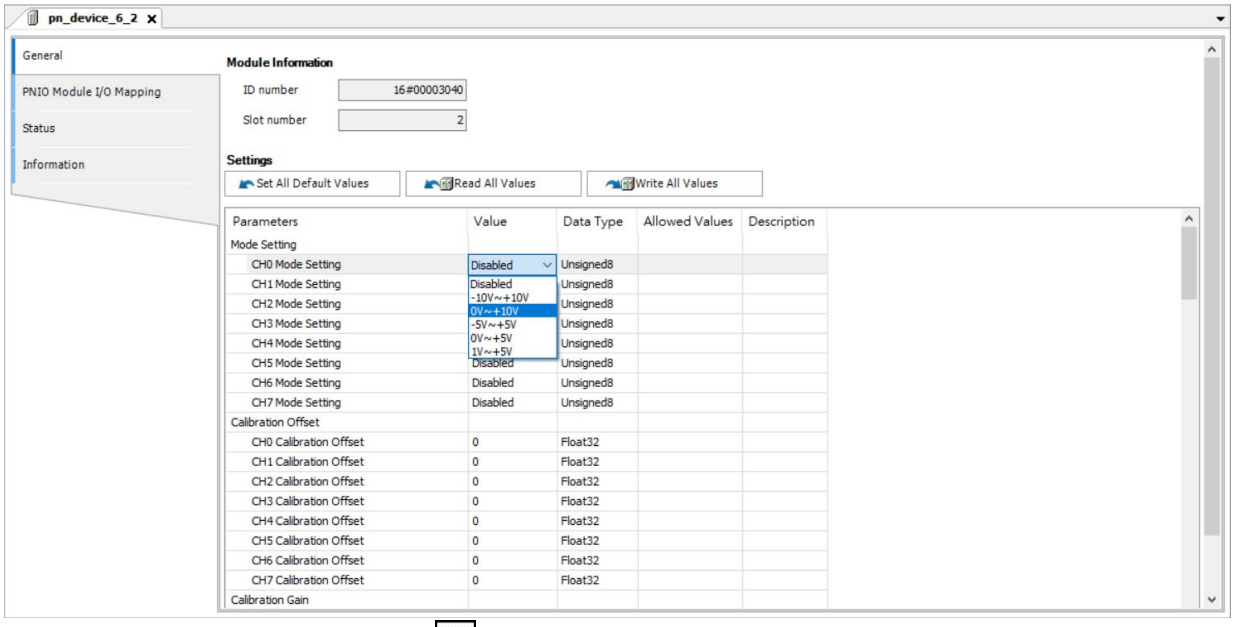
④ Settings
- IO Module Handing when Connection Disconnected: The IO module's processing when the connection is not connected.
- Process Data Handling when IO Module Stop: The handling of data processing when the IO module stops.

(1) The system design is as below:

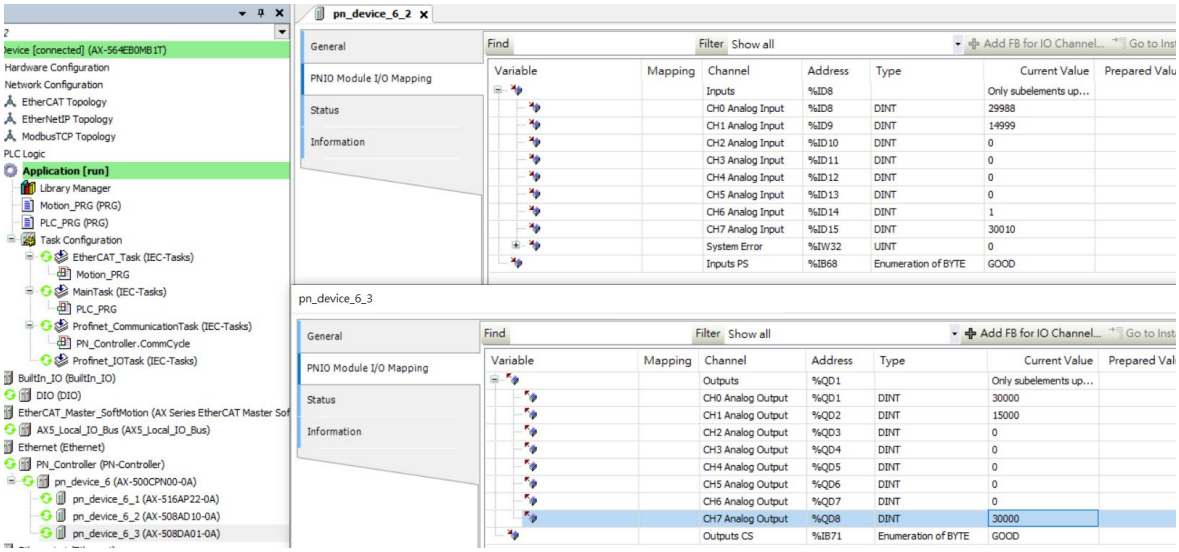
On the right-side of AX-500CPN00-0A, the following modules are connected, AX-516AP22-0A (Input Data: 2 bytes; Output Data: 1 byte), AX-508AD10-0A (Input Data: 34 bytes) and AX-508DA01-0A (Input Data: 1 byte; Output Data: 32 bytes); the total input data is 37 bytes while the total output data is 33 bytes.



(2) Configure the values under General Tab for AX-508AD10-0A and AX-508DA01-0A. The following example uses 0 V to +10 V.

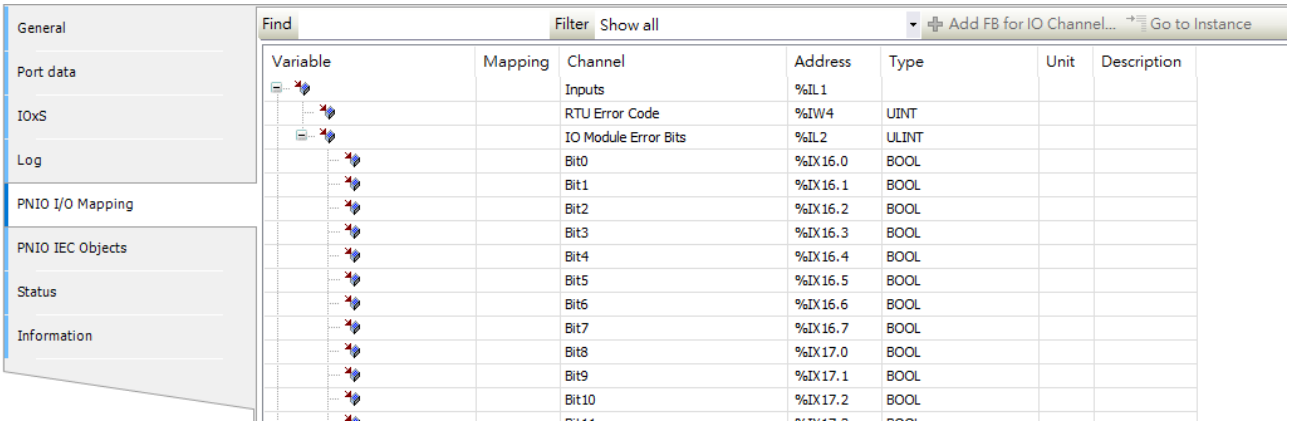


(3) After settings are complete, click  on the toolbar to enter the online mode. You can find the values for each channel under the tab of PNIO Module I/O Mapping.



2.2.4.1.3 PNIO I/O Mapping

This part provides an explanation of the settings under PNIO I/O Mapping tab.



This model reserves 10 bytes of space for Input Data to store the error codes of the coupler and the status of its connected IO modules.

Name	Bytes	Description
RTU Error Code	2	Error codes of the Coupler
IO Module Error Bits	8	If the IO module has encountered an error: If the value is 0, the device is functioning normally; if the value is 1, an error has occurred in the device. Bit0 to Bit63: 64 bits in total: This indicates the status of modules from the 1st to the 64th units that are connected to the coupler's right side.

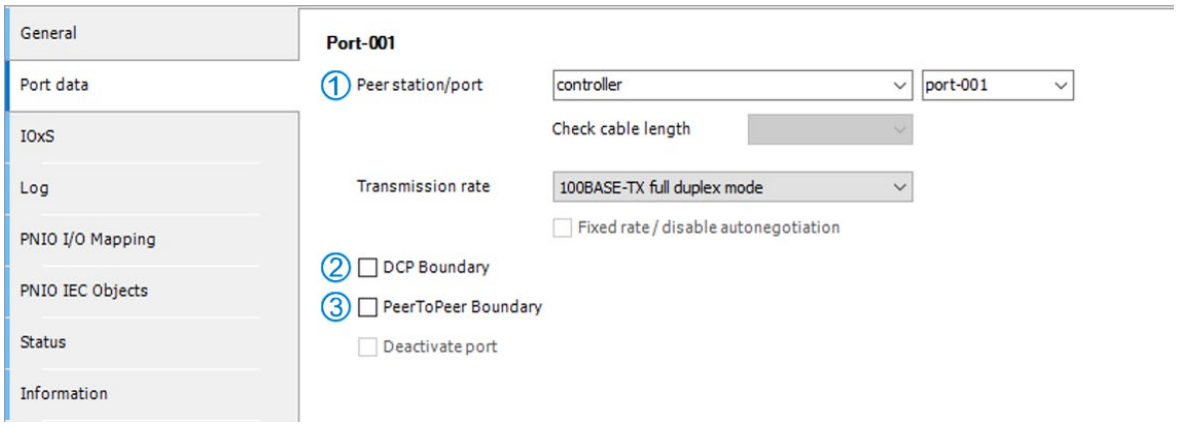
The maximum data exchange limit for this model is 1440 bytes for Input Data and Output Data respectively.

The following table shows the required data lengths for each module. You can use this table to calculate the total data exchange length used by the currently configured modules.

Module	Input Data Length (bytes)	Output Data Length (bytes)
AX-516AM10-0A	3	0
AX-516AM20-0A	3	0
AX-516AN01-0A	1	2
AX-516AN02-0A	1	2
AX-516AP11-0A	2	1
AX-516AP22-0A	2	1
AX-504AD10-0A	17	0
AX-504AD20-0A	17	0
AX-508AD10-0A	34	0
AX-508AD20-0A	34	0
AX-504DA01-0A	1	16
AX-504DA02-0A	1	16
AX-508DA01-0A	1	32
AX-502TC10-0B	10	8
AX-504TC10-0B	18	16
AX-502PT10-0B	10	0
AX-504PT10-0B	18	0

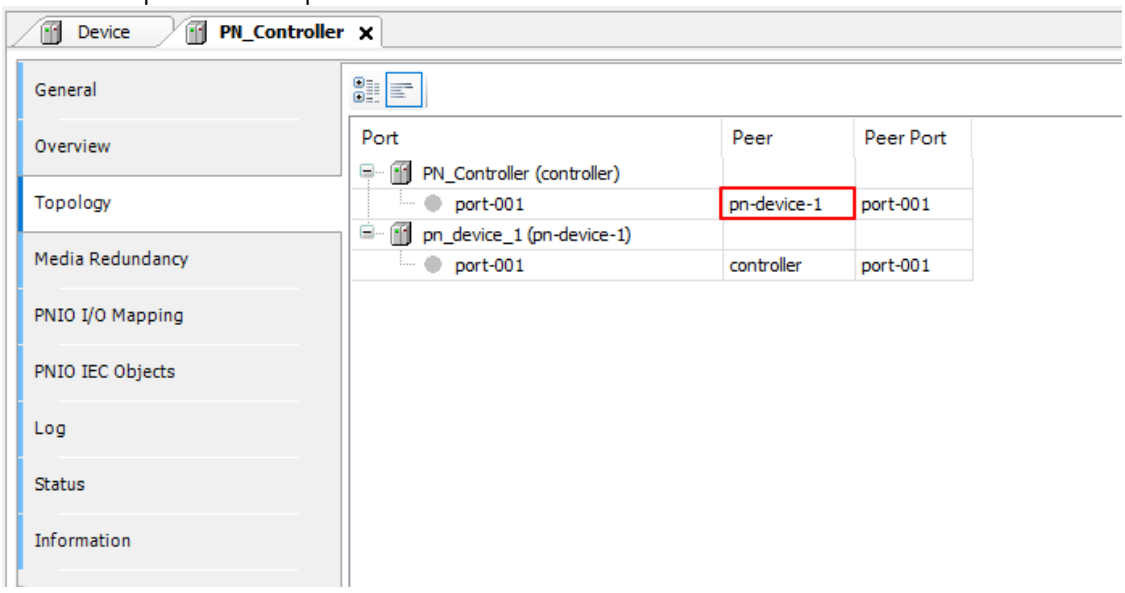
2.2.4.1.4 Port Setting

This part provides an explanation of the settings under Port data tab.



① Peer station/port: Select its corresponding PN main station and port.

- Before selecting the Peer station/port, you need to go to the Topology tab of this PN Controller and select the device and port that correspond to its main station.

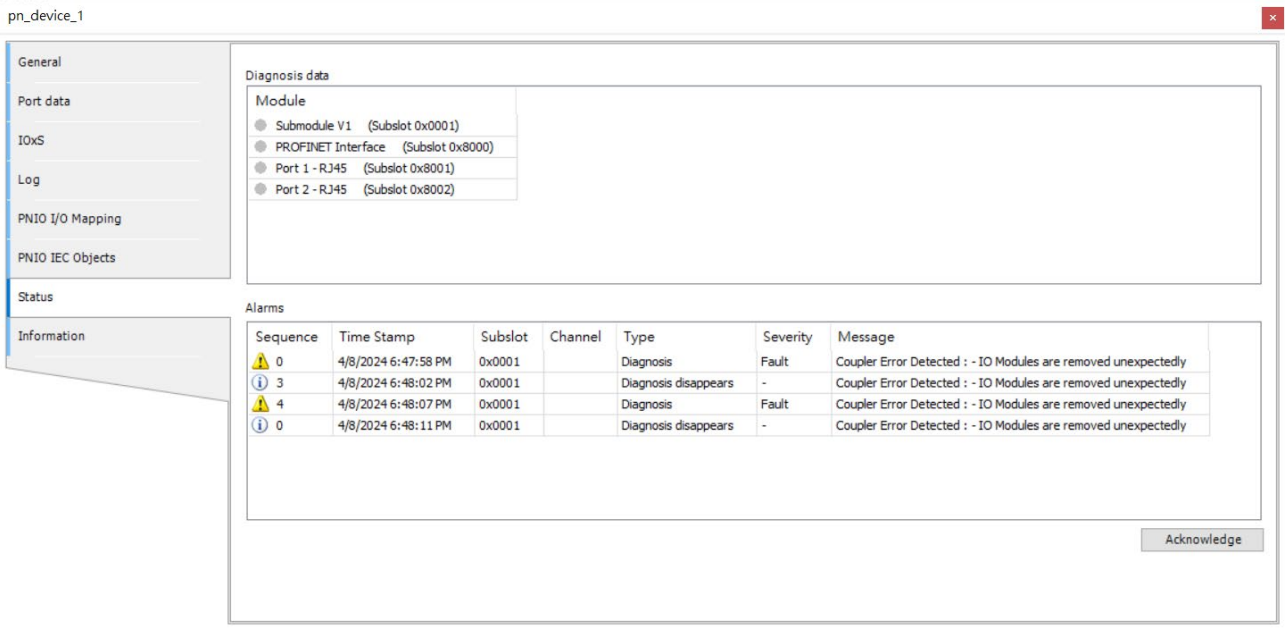


② DCP Boundary: Forward the DCP broadcast packets or not?

③ PeerToPeer Boundary: LLDP packet is not available for the AX5 series now.

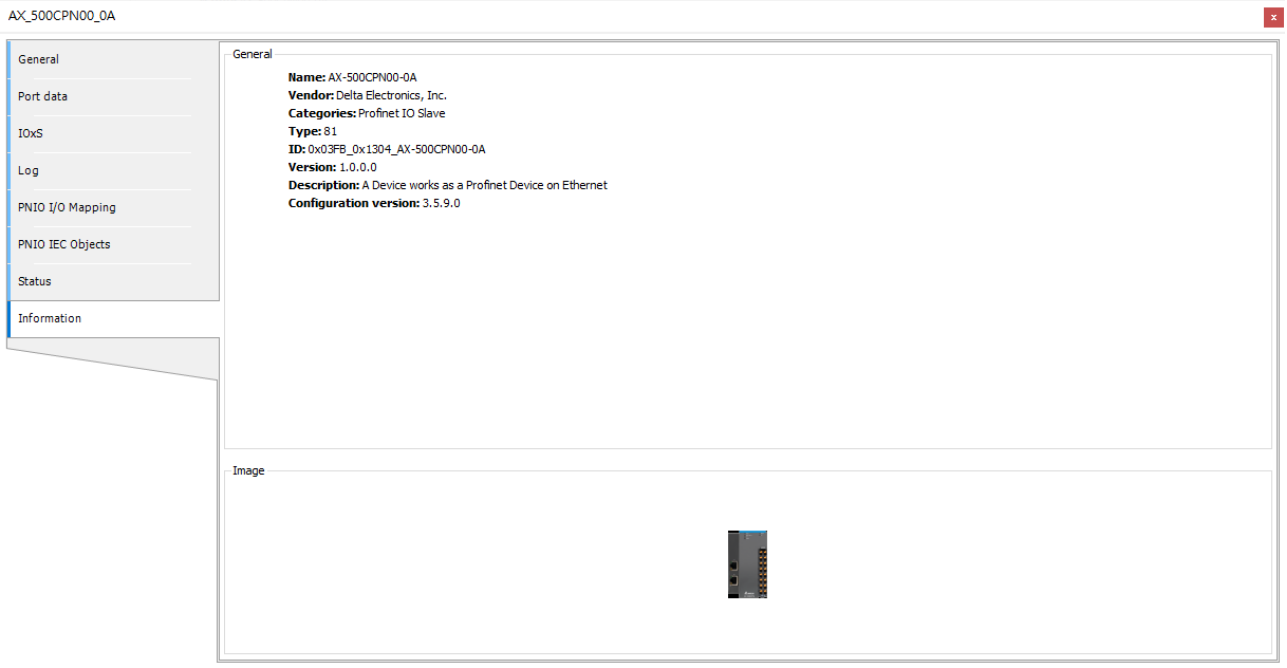
2.2.4.1.5 Status

Click  on the toolbar to enter the online mode. You can check the current status and any error messages of the modules in the Status tab.



2.2.4.1.6 Information

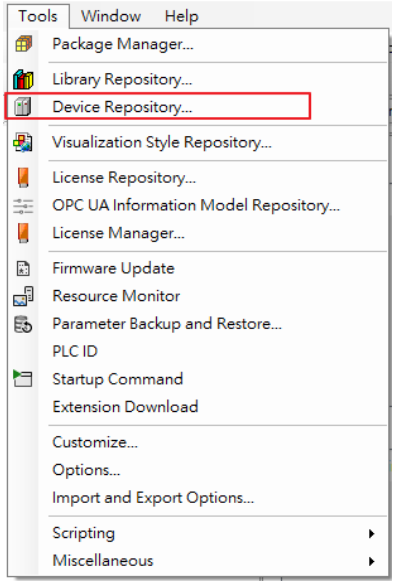
You can see information related to the module in the Information Tab.

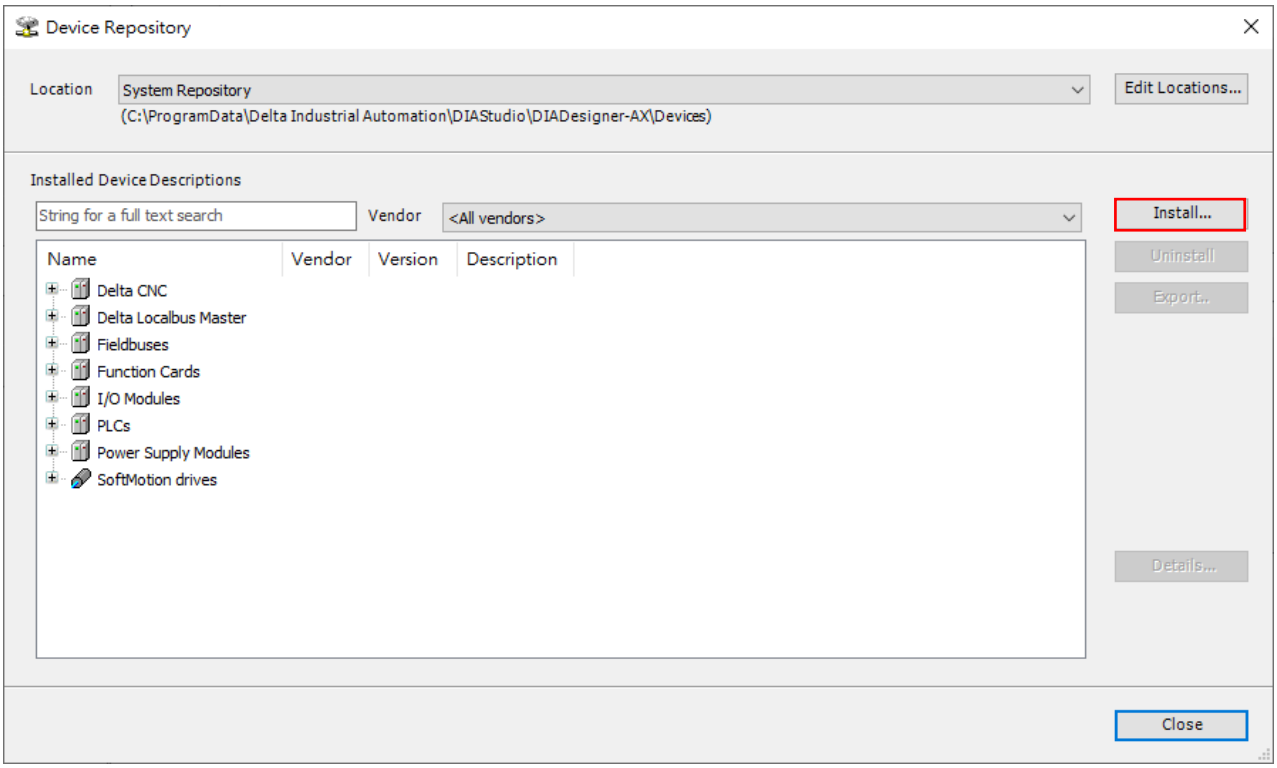


2.2.4.1.7 Install a GSD File

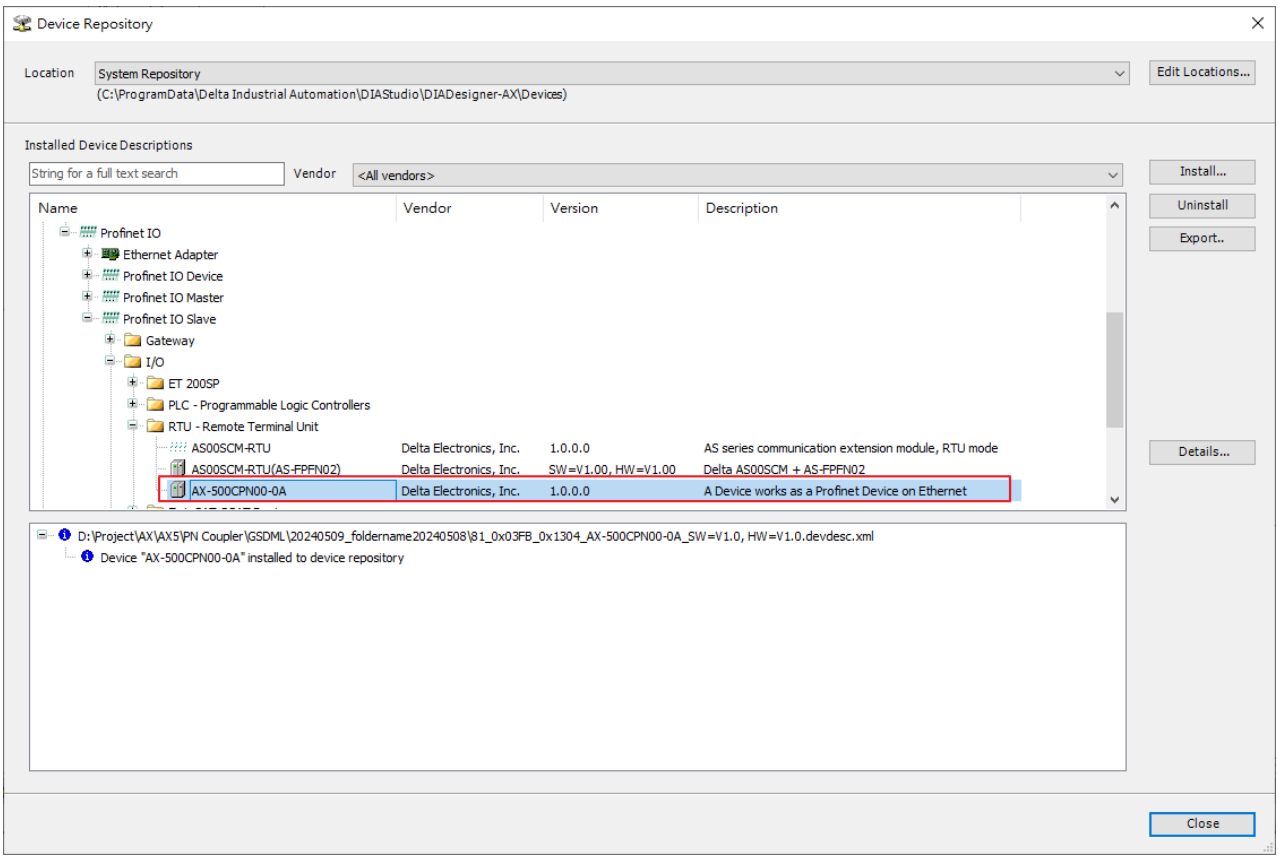
DIADesigner-AX comes with a Profinet Coupler (AX-500CPN) by default, eliminating the need for any manual installation. However, if you prefer to perform a manual update, you can do so using the following method.

(1) Click ***Tools -> Device Repository…-> Install…*** and then select the GSD file to install.





(2) After installation, you can see the manually added AX-500CPN00-0A as the image shown below.



2.2.4.2 TIA Portal

2.2.4.2.1 Steps to Install GSD Files

Import GSDML files of AX-500CPN00-0A into TIA portal.

1. Open TIA Portal and then go to **Options** in the toolbar.
2. Go to Manage general station description files (GSD) and select the GSD file.
3. Click on **Install**.

2.2.4.2.2 Search to Add

(1) Open TIA Portal and create a new project.

(2) Click **Online** in the toolbar. Go to **Hardware detection** -> **PROFINET devices from network…**

(3) Click on **Start search** and select AX-500CPN00-0A and click **Add devices**.

(4) After the device is added, you can find it on the topology view page.



(5) You can see the device configuration for AX-500CPN00-0A and the module on the Device view page.

...	Module	Rack	Slot	I address	Q address	Type
	pn-device-6	0	0	68...77	68	AX-500CPN00-0A
	PROFINET Interface	0	0 X1			PN-Device
	AX-516AP22-0A_1	0	1	2...3	2	AX-516AP22-0A
	AX-508AD10-0A_1	0	2	78...111		AX-508AD10-0A
	AX-508DA01-0A_1	0	3	4	3...34	AX-508DA01-0A

(6) For module settings, go to **Module -> General tab -> Module parameter**s.

(7) Once the setup is complete, click on **Download to device** in the toolbar and switch to online mode. In the Watch table, you will be able to view and modify the current values of each channel.

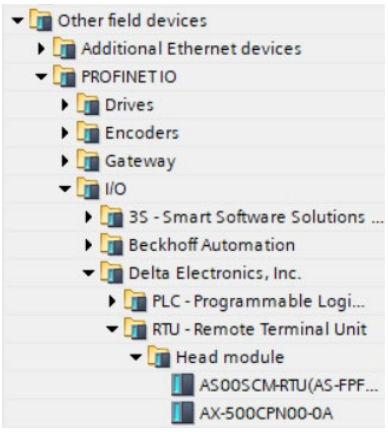
2.2.4.2.3 Add Modules in Manually

(1) Open TIA Portal and create a new project.

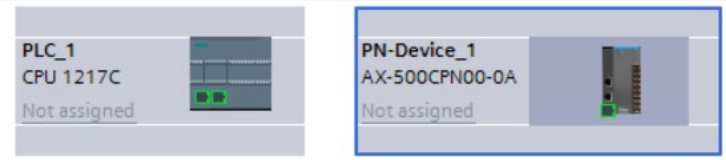
(2) Click **Other field devices** under **Hardware catalog**.

(3) Go to **PROFINET IO** -> **I/O** > **Delta Electronics, Inc.** -> **RTU – Remote Terminal Unit** -> **Head module**

(4) Select AX-500CPN00-0A.



(5) After the device is added, you can find it on the topology view page.



(6) You can add the module configurations for AX-500CPN00-0A on the Device view page.

(7) For module settings, go to **Module -> General tab -> Module parameter**s.

(8) Once the setup is complete, click on **Download to device** in the toolbar and switch to online mode. In the Watch table, you will be able to view and modify the current values of each channel.

2.2.5 Troubleshooting

There are two categories of error codes: IO Error and Diagnosis Error.

If an error occurs, the register **RTU Error Code** will store the latest error code. And the Log page will record all the error messages that have occurred.

Refer to the table below for error descriptions and troubleshooting methods. If the error codes are not found in the table, refer to the troubleshooting section of each module and check the value in the register **IO Module Error Bits** to identify which module is experiencing the error.

Type	Error code	Description	LED		Solution
			BUS FAULT LED	DIAG LED	
IO Error	16#FF01	Unit Power Error	Every 0.5 seconds blinking	OFF	Check the power supply.
	16#FF02	EtherCAT Connection Lost	Every 0.5 seconds blinking	OFF	Check if the connections for the modules are secured.
	16#FF03	ESC or EEPROM Error	Every 0.5 seconds blinking	OFF	If the problem persists, contact the local authorized distributors.
	16#FF04	Flash Error	Every 0.5 seconds blinking	OFF	If the problem persists, contact the local authorized distributors.
	16#FF05	Analog IC Error	Every 0.5 seconds blinking	OFF	If the problem persists, contact the local authorized distributors.
	16#FF06	Analog Power Error	Every 0.5 seconds blinking	OFF	If the problem persists, contact the local authorized distributors.
Diagnosis Error	16#9000	Unknown Modules	OFF	Red LED blinking every 0.5 seconds	Check if IO module is compatible.
	16#9001	Topology Mismatch	OFF	Red LED blinking every 0.5 seconds	Verify if the settings in DIADesigner-AX aligns with the current module configuration.
	16#9002	IO Modules are removed unexpectedly	OFF	Red LED blinking every 0.5 seconds	Check if the modules are secured.

MEMO

3

Chapter 3 Power Supply Modules and Connector Modules

Table of Contents

3.1 AX-502PS11-0A....3-2

3.1.1 Specifications....3-2
3.1.2 Dimensions and Parts....3-2
3.1.3 Arrangement of Terminals, LED Indicators and Wiring....3-4
3.1.4 Settings in DIADesigner-AX....3-7
3.1.5 Process Data....3-11
3.1.6 Troubleshooting....3-11

3.2 AX-510PS12-0A....3-12

3.2.1 Specifications....3-12
3.2.2 Dimensions and Parts....3-12
3.2.3 Arrangement of Terminals, LED Indicators and Wiring....3-14

3.3 AX-516PC10-0A....3-17

3.3.1 Specifications....3-17
3.3.2 Dimensions and Parts....3-17
3.3.3 Arrangement of Terminals, LED Indicators and Wiring....3-19

3.4 AX-516PC20-0A....3-21

3.4.1 Specifications....3-21
3.4.2 Dimensions and Parts....3-21
3.4.3 Arrangement of Terminals, LED Indicators and Wiring....3-23

3.5 AX-516PC30-0A....3-25

3.5.1 Specifications....3-25
3.5.2 Dimensions and Parts....3-25
3.5.3 Arrangement of Terminals, LED Indicators and Wiring....3-27

3.6 AX-514PC40-0A....3-29

3.6.1 Specifications....3-29
3.6.2 Dimensions and Parts....3-29
3.6.3 Arrangement of Terminals, LED Indicators and Wiring....3-31

3.1 AX-502PS11-0A

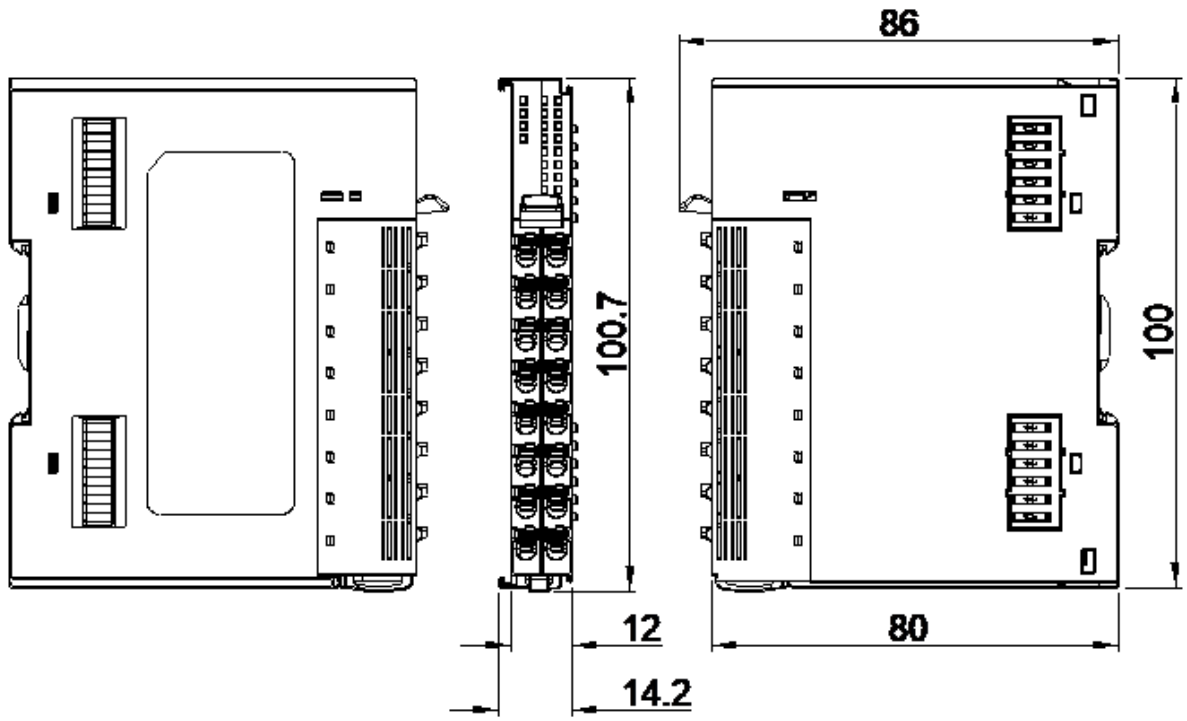
AX-502PS11-0A is a unit power supply module. This section introduces its specifications, operations and wirings.

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 to 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

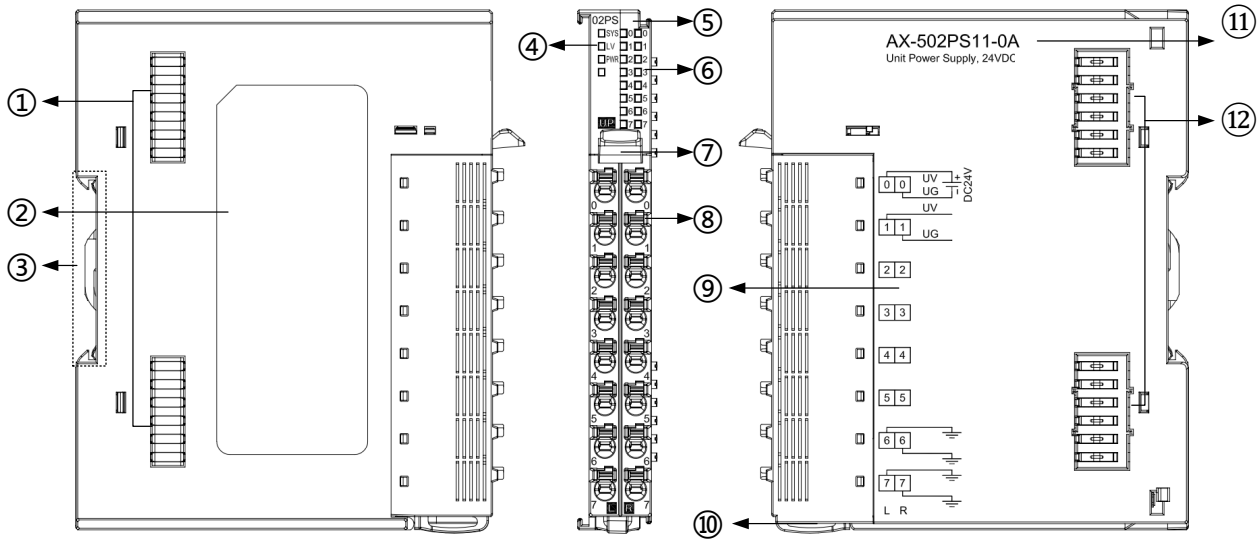
3.1.2 Dimensions and Parts

- **Dimensions**



Unit：mm

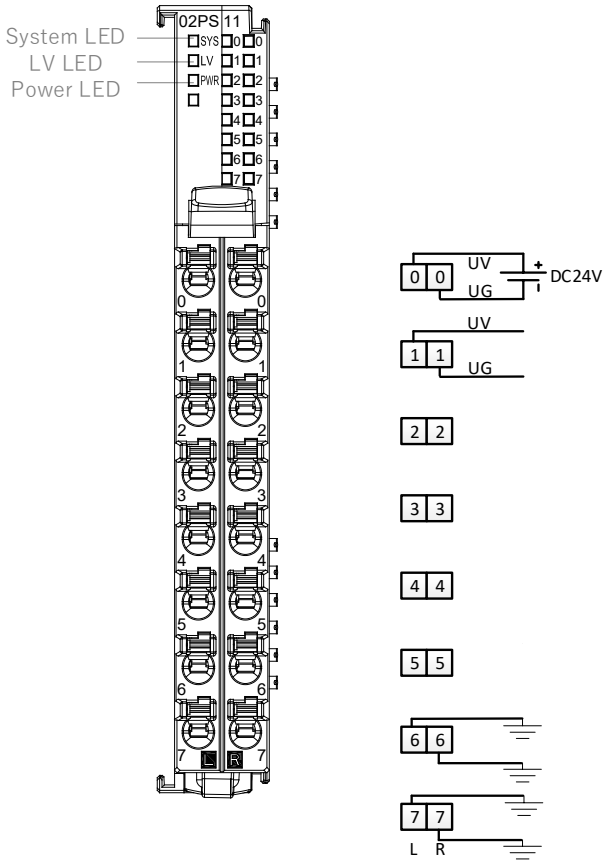
- **Parts**



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



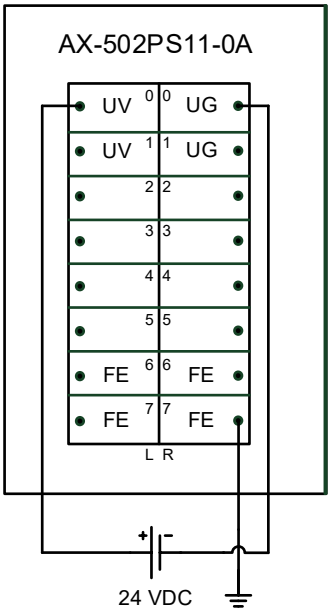
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	UV	Module unit power input: 24 VDC	R0	UG	Module unit power input: 0 VDC
L1	UV	Module unit power input: 24 VDC	R1	UG	Module unit power input: 0 VDC
L2	NA	NA	R2	NA	NA
L3	NA	NA	R3	NA	NA
L4	NA	NA	R4	NA	NA
L5	NA	NA	R5	NA	NA
L6	⏚	Grounding	R6	⏚	Grounding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

3.1.3.2 LED Indicators

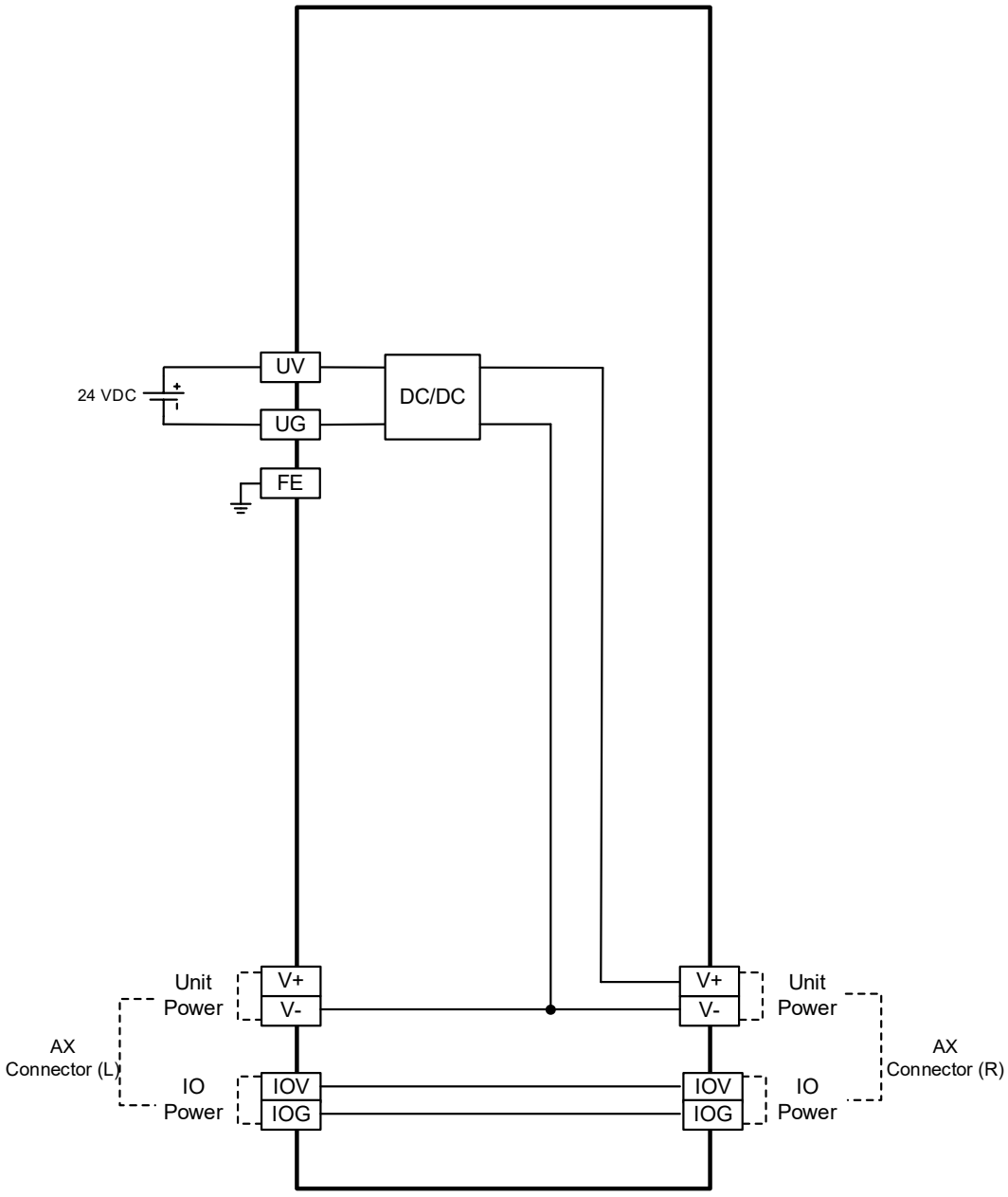
Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	Normal (OP)
LV	Red		OFF	No under-voltage warning
			ON	Under-voltage warning
Power	Green		OFF	Not supplied with power
			ON	Power on

3.1.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



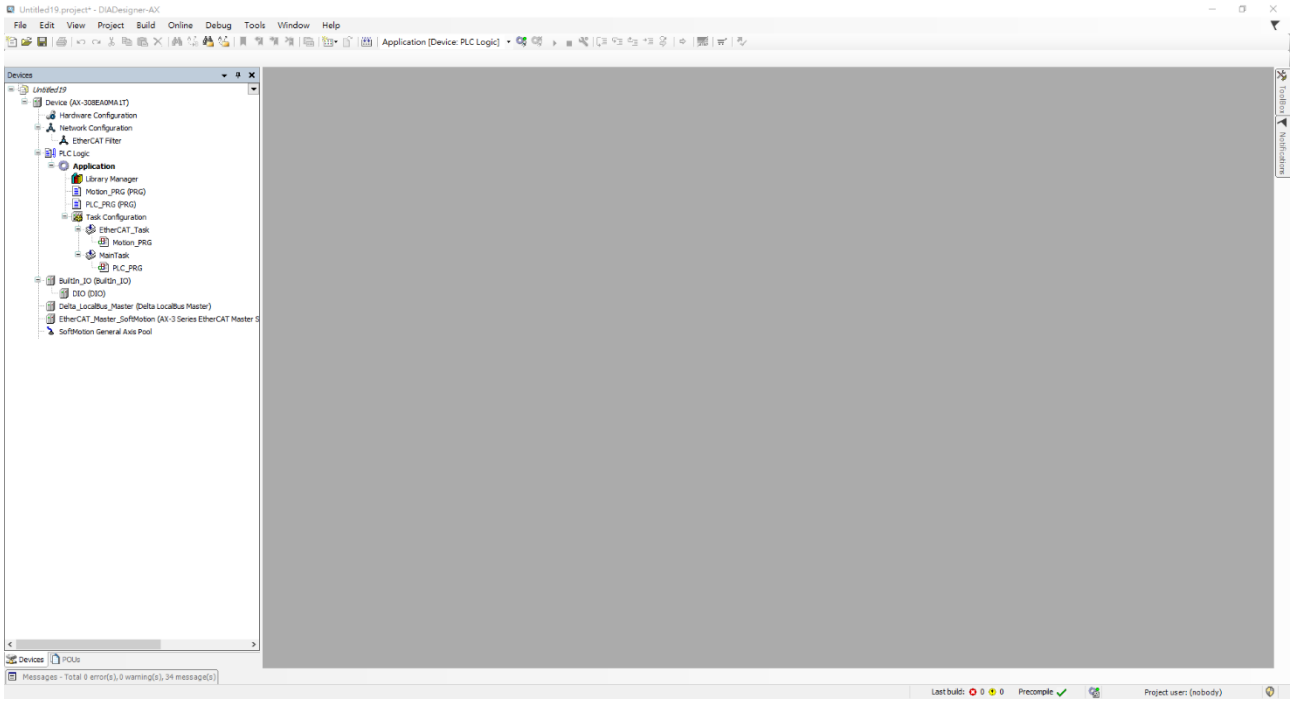
⚠	• This product shall be powered by a certified SELV/PELV power supply unit with operating temperature of minimum 60°C, which meets the requirements of IEC 61010-1:2010 or latest edition. • With the SELV/PELV power supply connected to UV/UG terminals of the removable terminal block, the output rating 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

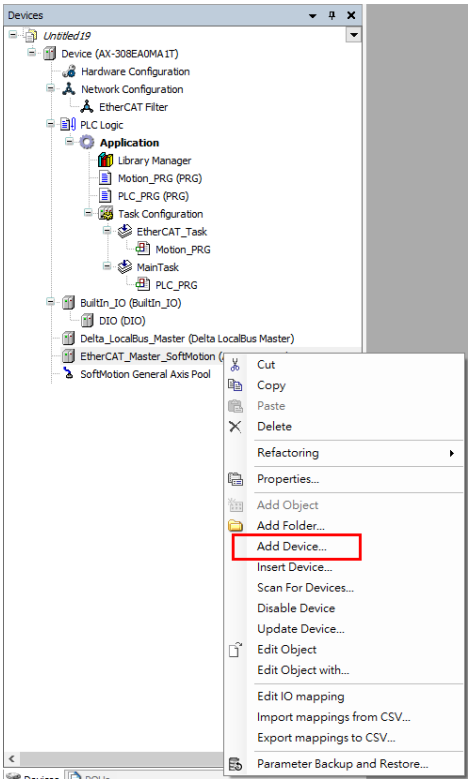
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



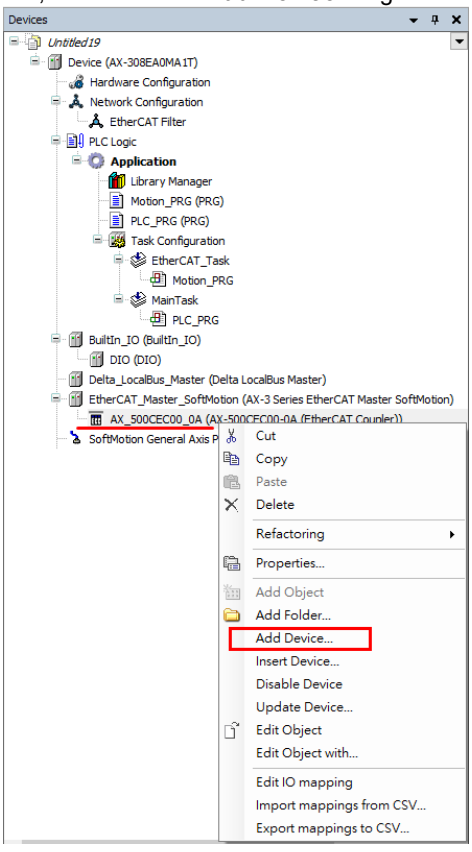
(2) Add Modules in

- 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.

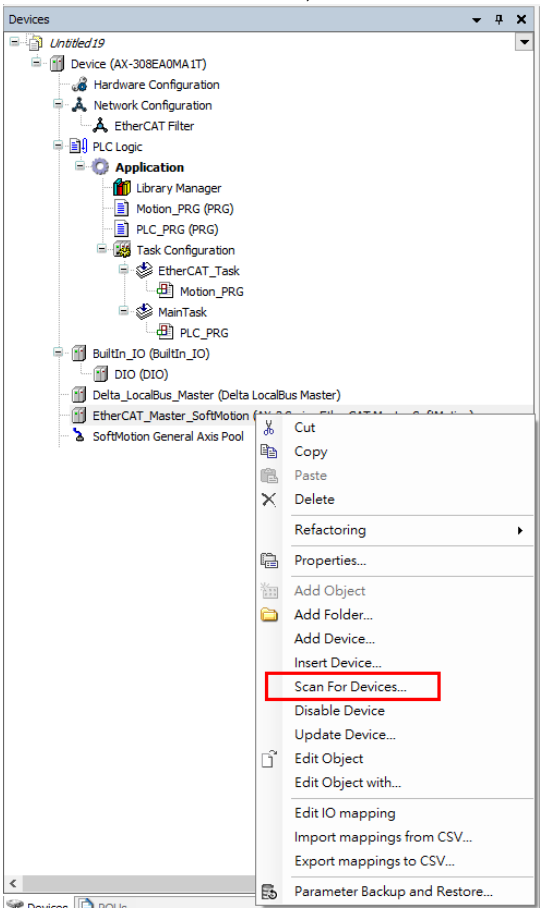


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

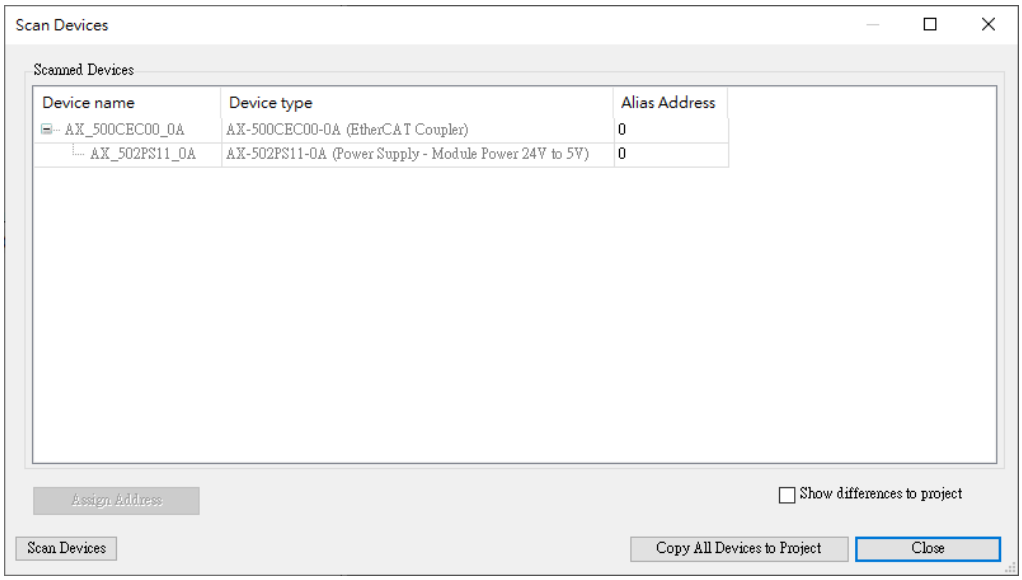


- Method 2: Scan to add the modules in.

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

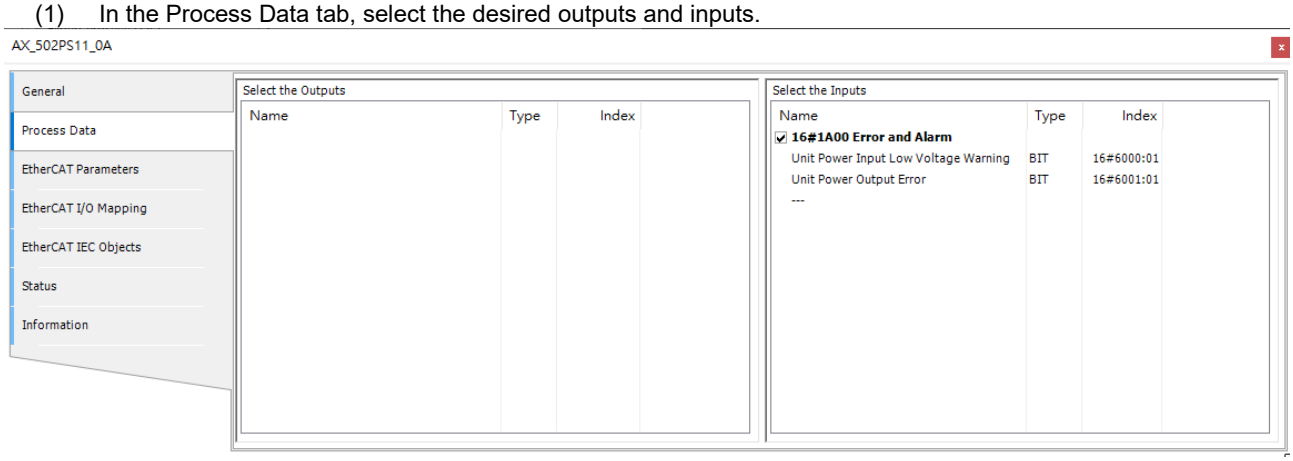


After the auto-scan is over, the actually connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.

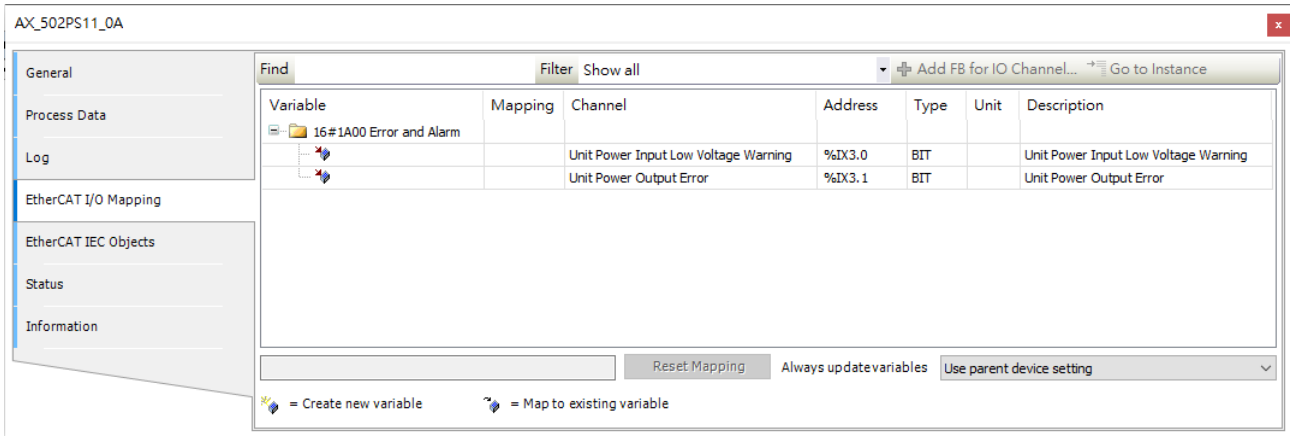


3.1.4.2 Process Data

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

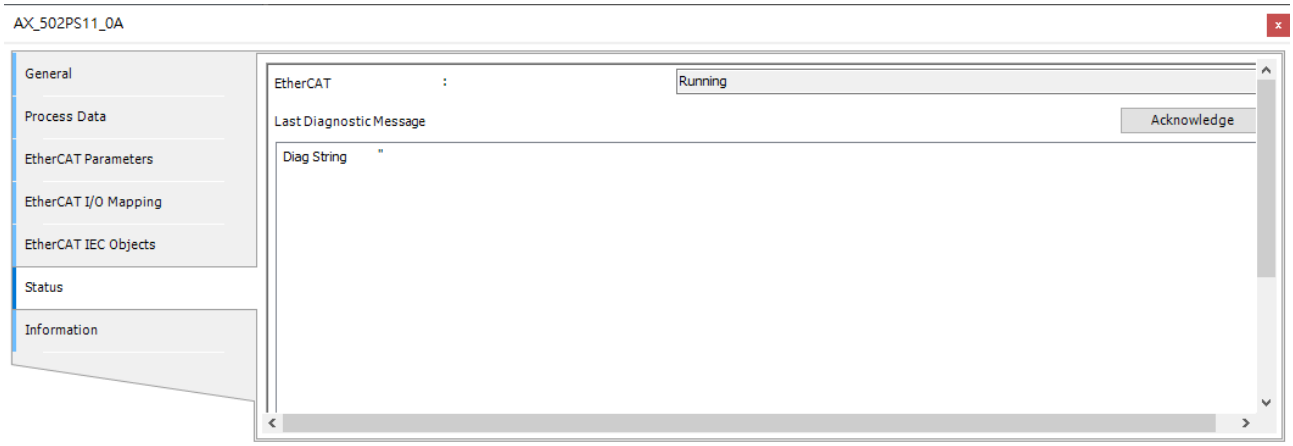


(2) Click  on the toolbar to go into online mode. In the I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



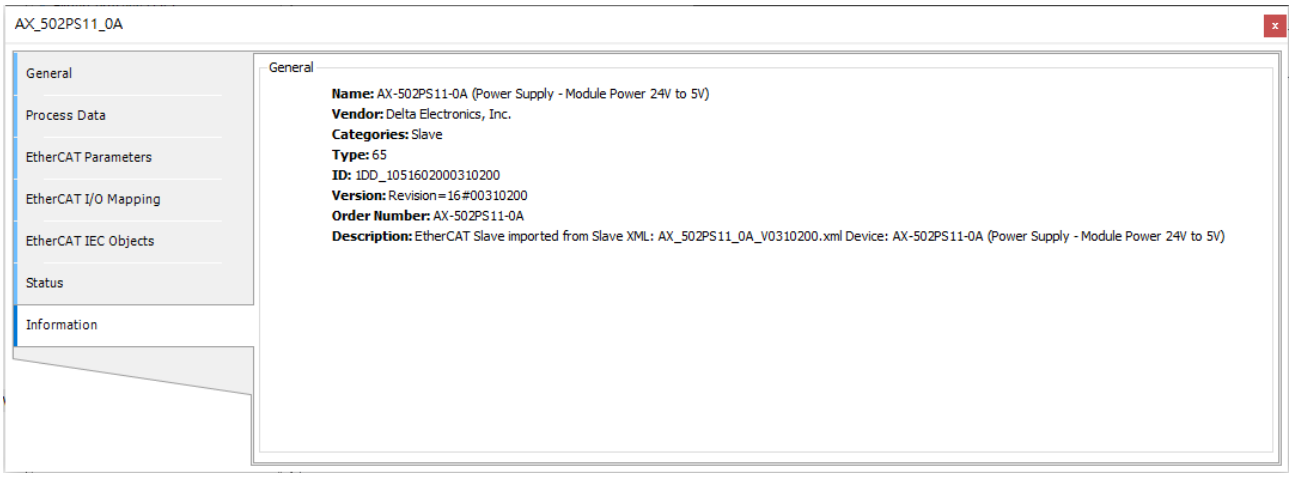
3.1.4.3 Status

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

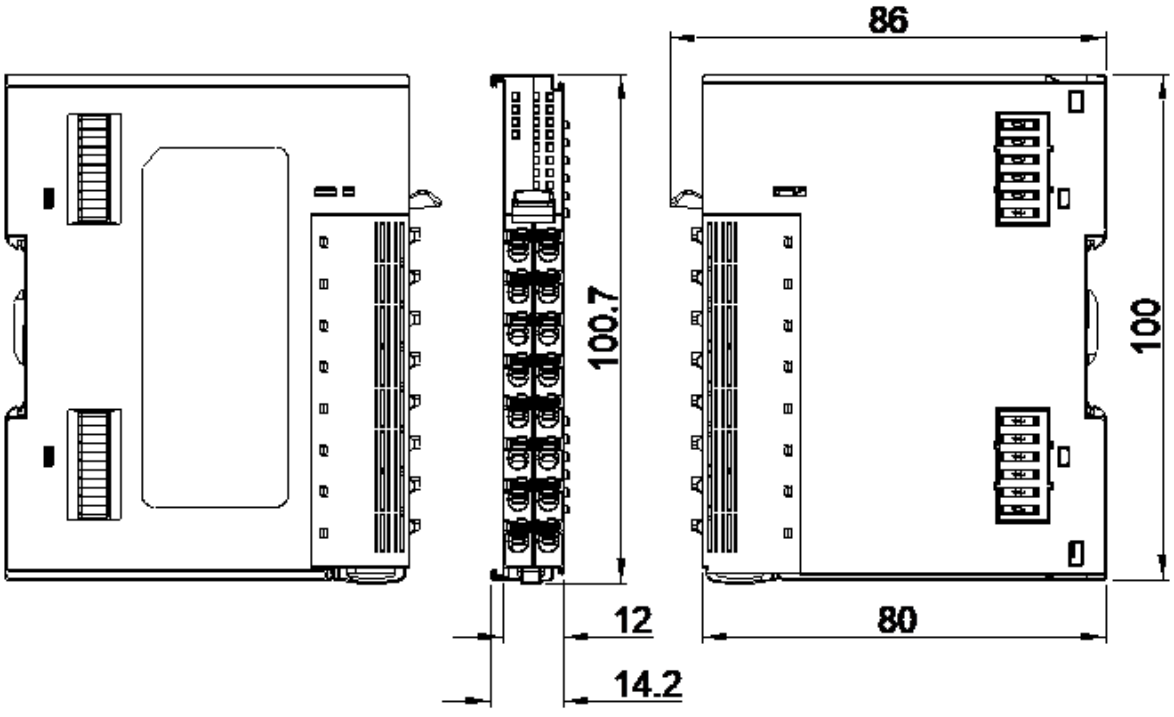
AX-510PS12-0A is an I/O power supply module. This section introduces its specifications, operations and wirings.

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 to 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.)

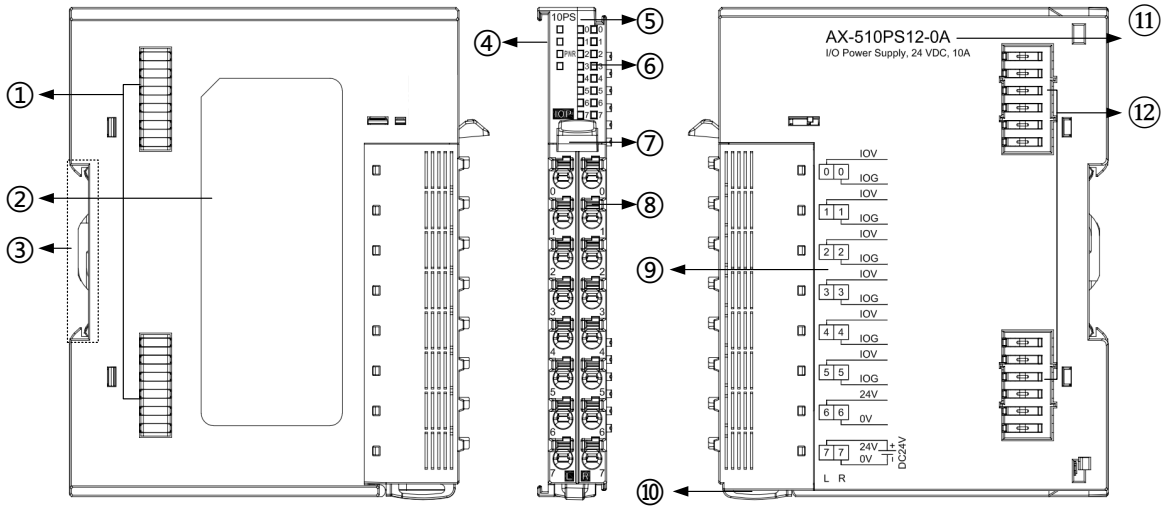
3.2.2 Dimensions and Parts

- **Dimensions**



Unit：mm

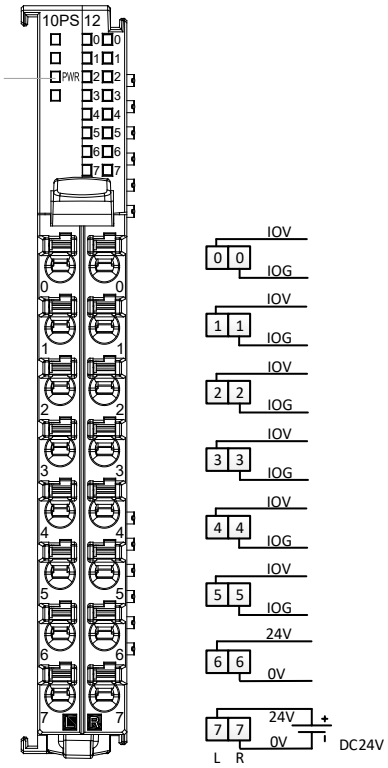
- **Parts**



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



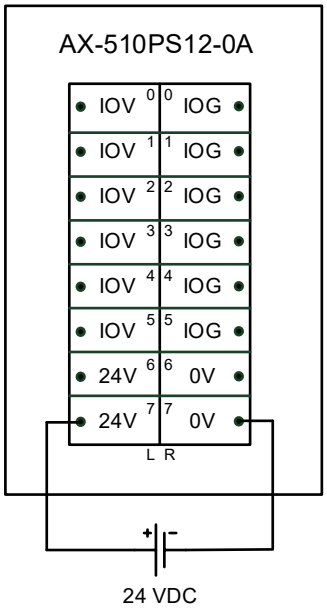
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	IOV	I/O power output: 24 VDC	R0	IOG	I/O power output: 0 VDC
L1	IOV	I/O power output: 24 VDC	R1	IOG	I/O power output: 0 VDC
L2	IOV	I/O power output: 24 VDC	R2	IOG	I/O power output: 0 VDC
L3	IOV	I/O power output: 24 VDC	R3	IOG	I/O power output: 0 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

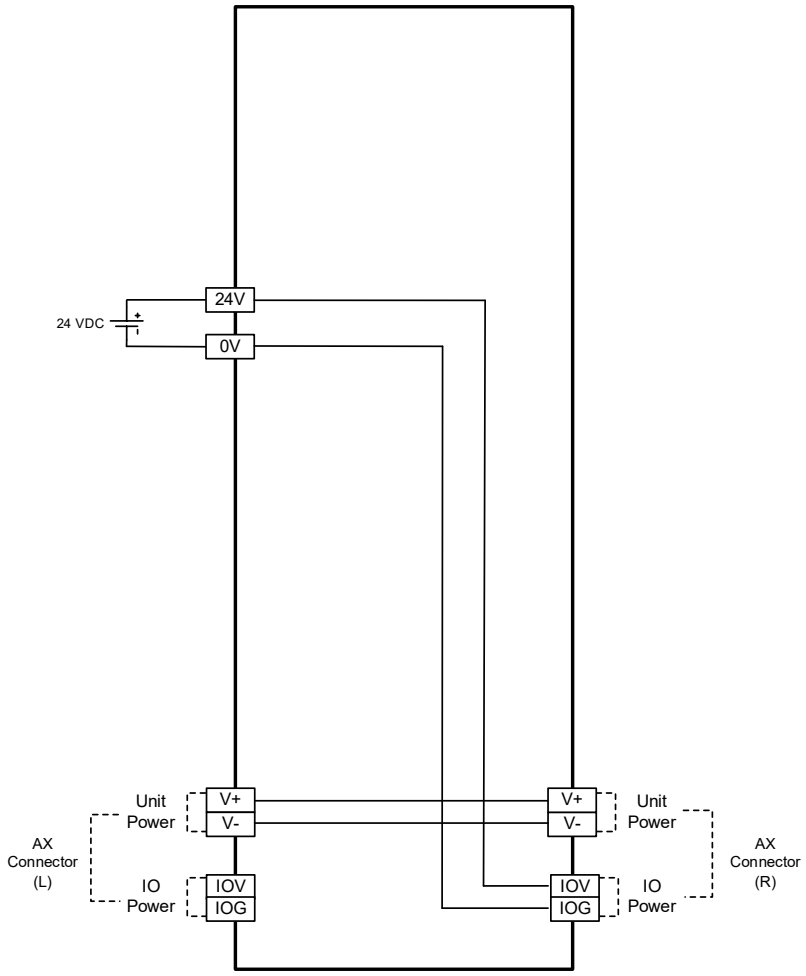
Name	Color	Status		Description
Power	Green		OFF	Not supplied with power
			ON	Power on

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

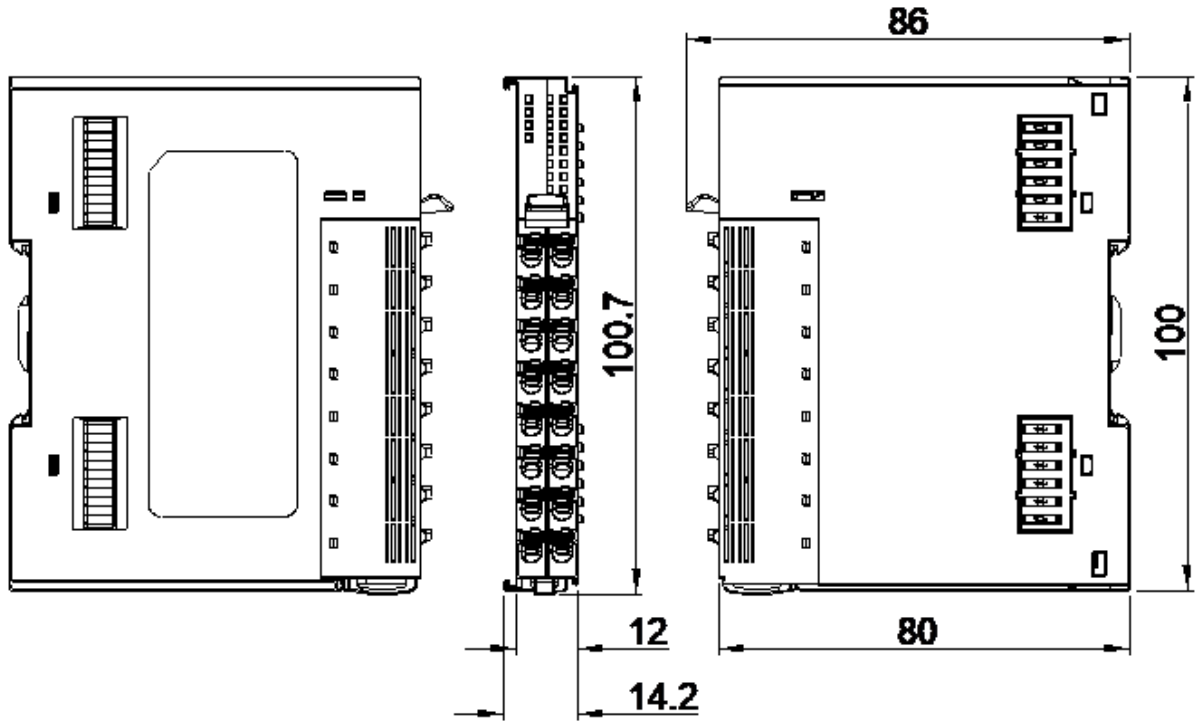
AX-516PC10-0A is an I/O power connector module. This section introduces its specifications, operations and wirings.

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.)

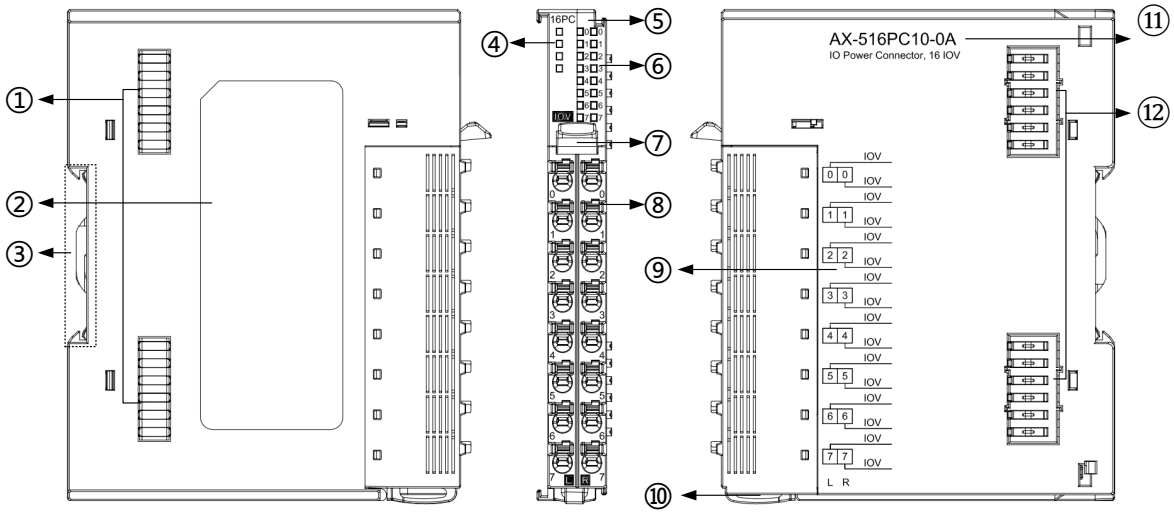
3.3.2 Dimensions and Parts

- **Dimensions**



Unit：mm

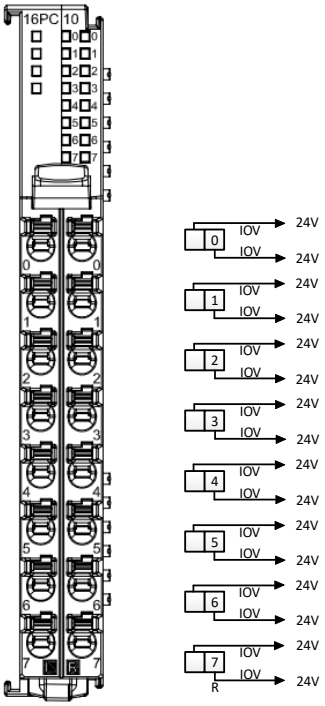
- **Parts**



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



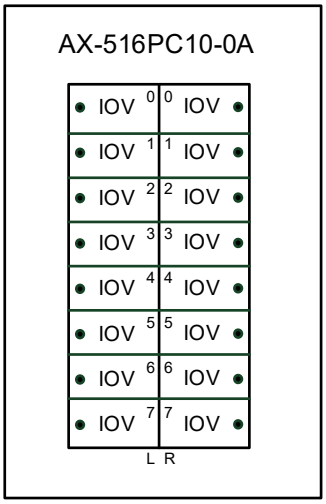
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	IOV	I/O power output: 24 VDC	R0	IOV	I/O power output: DC 24 V
L1	IOV	I/O power output: 24 VDC	R1	IOV	I/O power output: DC 24 V
L2	IOV	I/O power output: 24 VDC	R2	IOV	I/O power output: DC 24 V
L3	IOV	I/O power output: 24 VDC	R3	IOV	I/O power output: 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

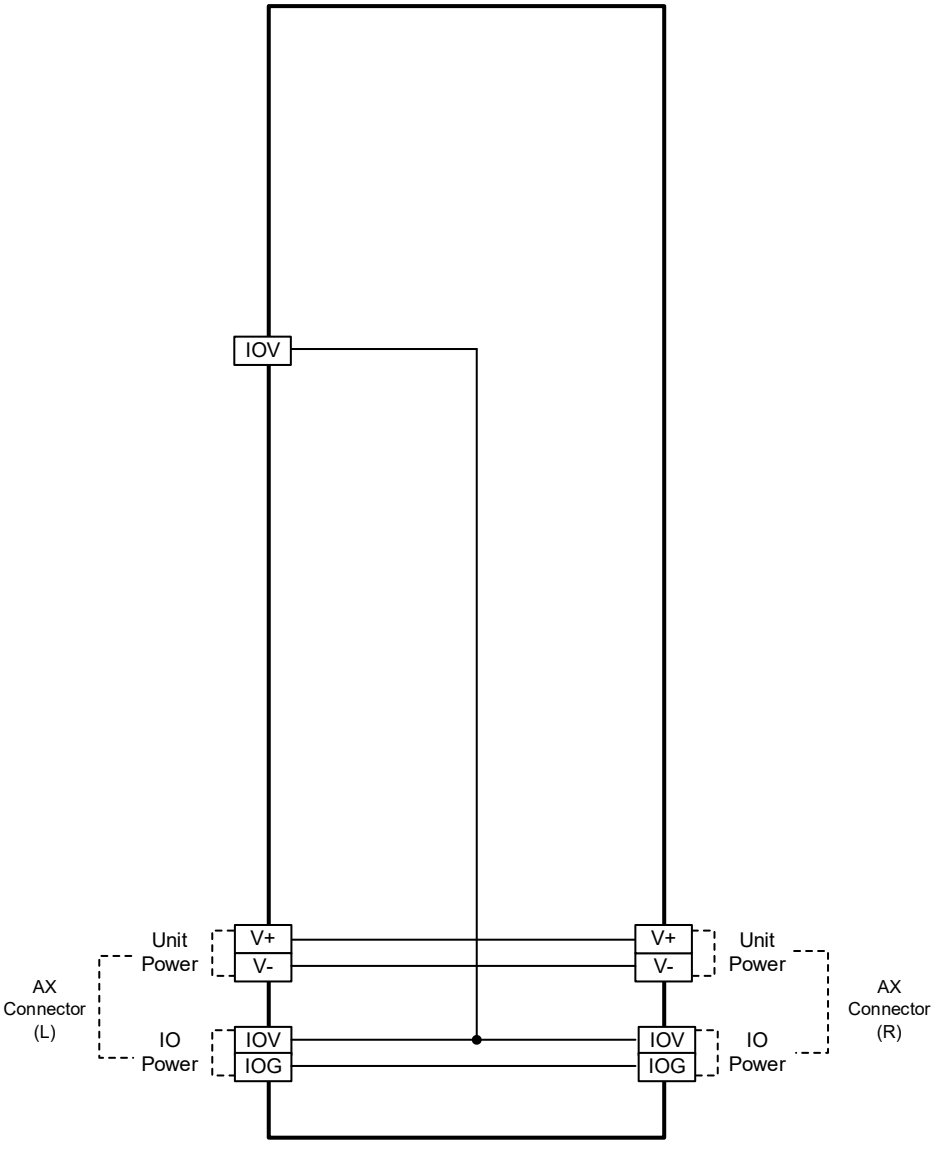
Name	Description
NA	No LED indicator

3.3.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



3.4 AX-516PC20-0A

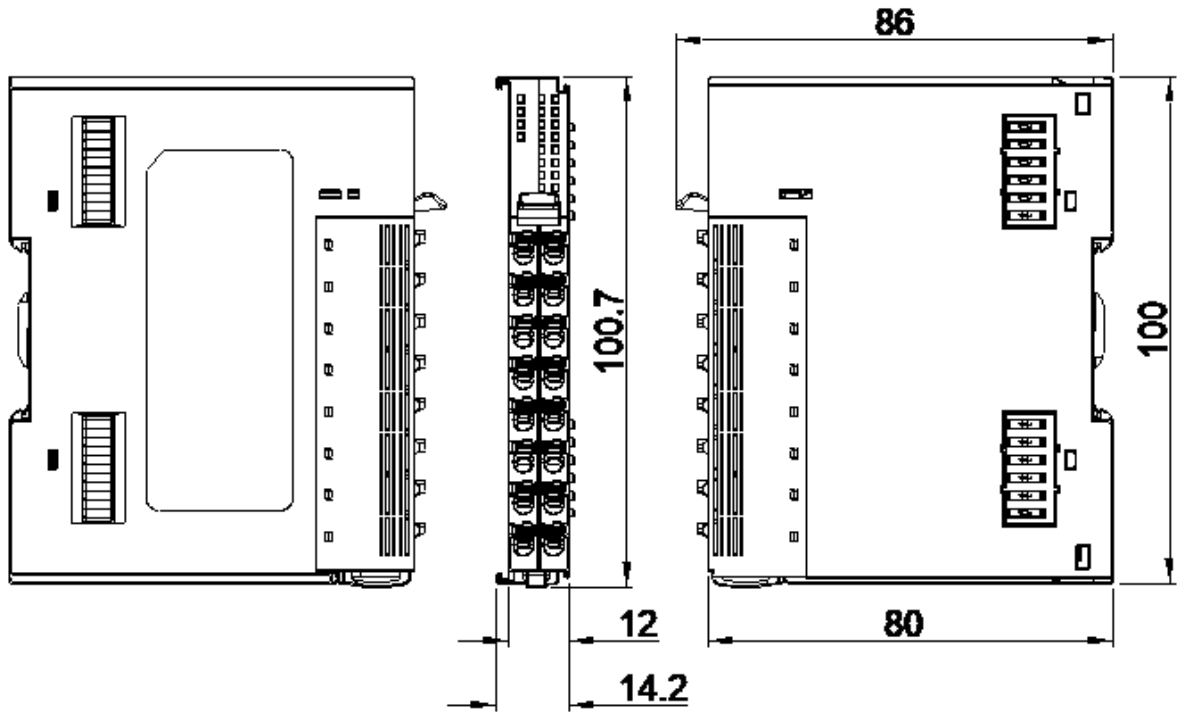
AX-516PC20-0A is an I/O power connector module. This section introduces its specifications, operations and wirings.

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.)

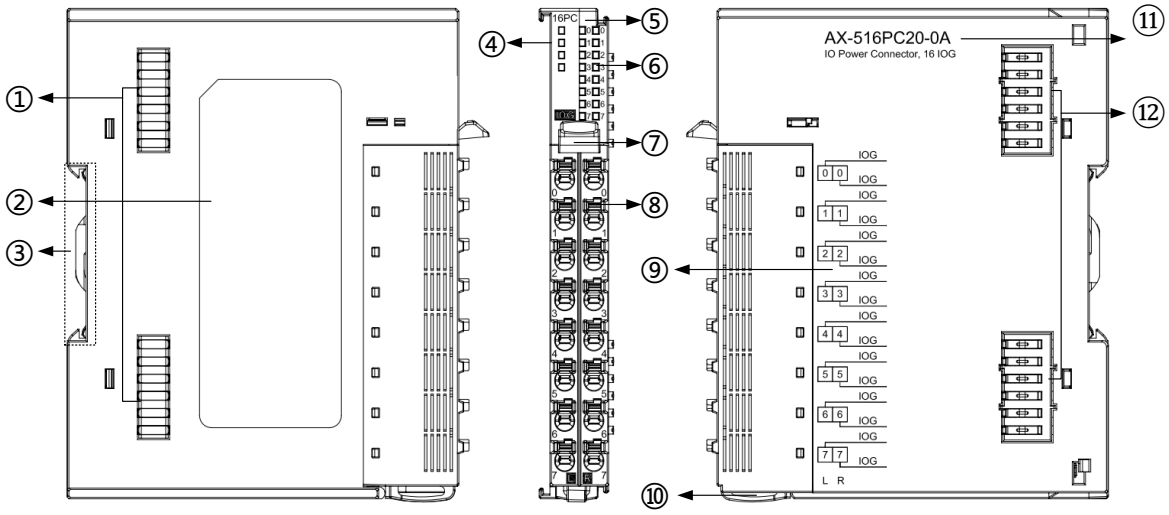
3.4.2 Dimensions and Parts

- **Dimensions**



Unit：mm

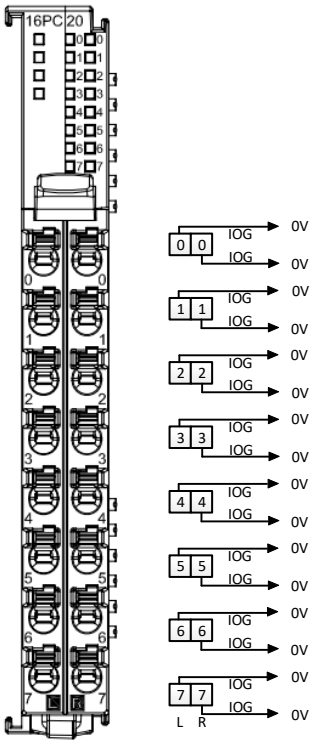
- **Parts**



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



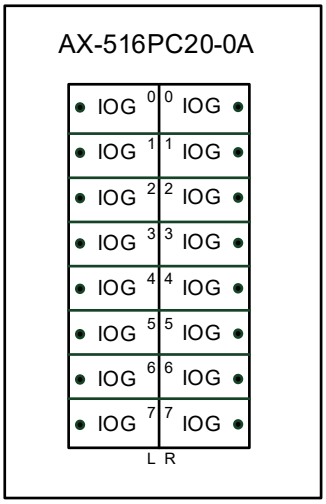
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	IOG	I/O power output: 0 VDC	R0	IOG	I/O power output: 0 VDC
L1	IOG	I/O power output: 0 VDC	R1	IOG	I/O power output: 0 VDC
L2	IOG	I/O power output: 0 VDC	R2	IOG	I/O power output: 0 VDC
L3	IOG	I/O power output: 0 VDC	R3	IOG	I/O power output: 0 VDC
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

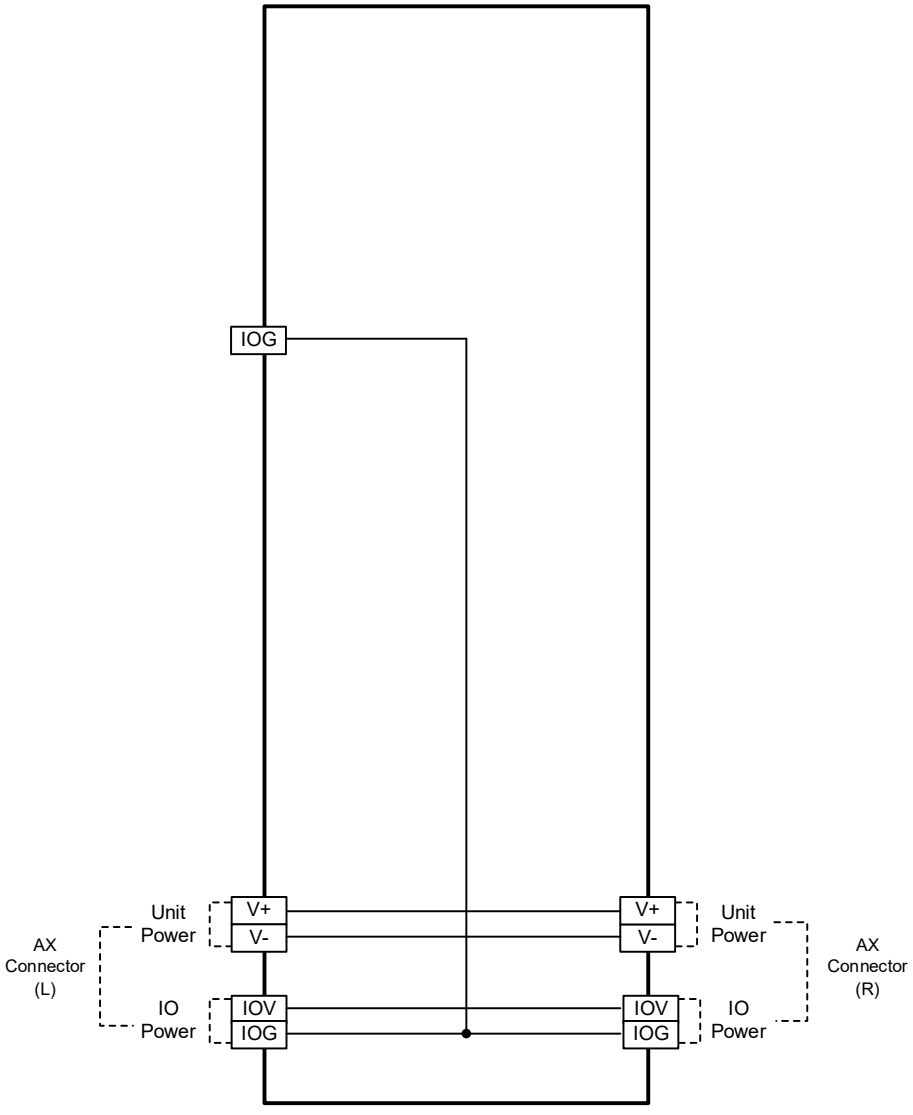
Name	Description
NA	No LED indicator

3.4.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



3.5 AX-516PC30-0A

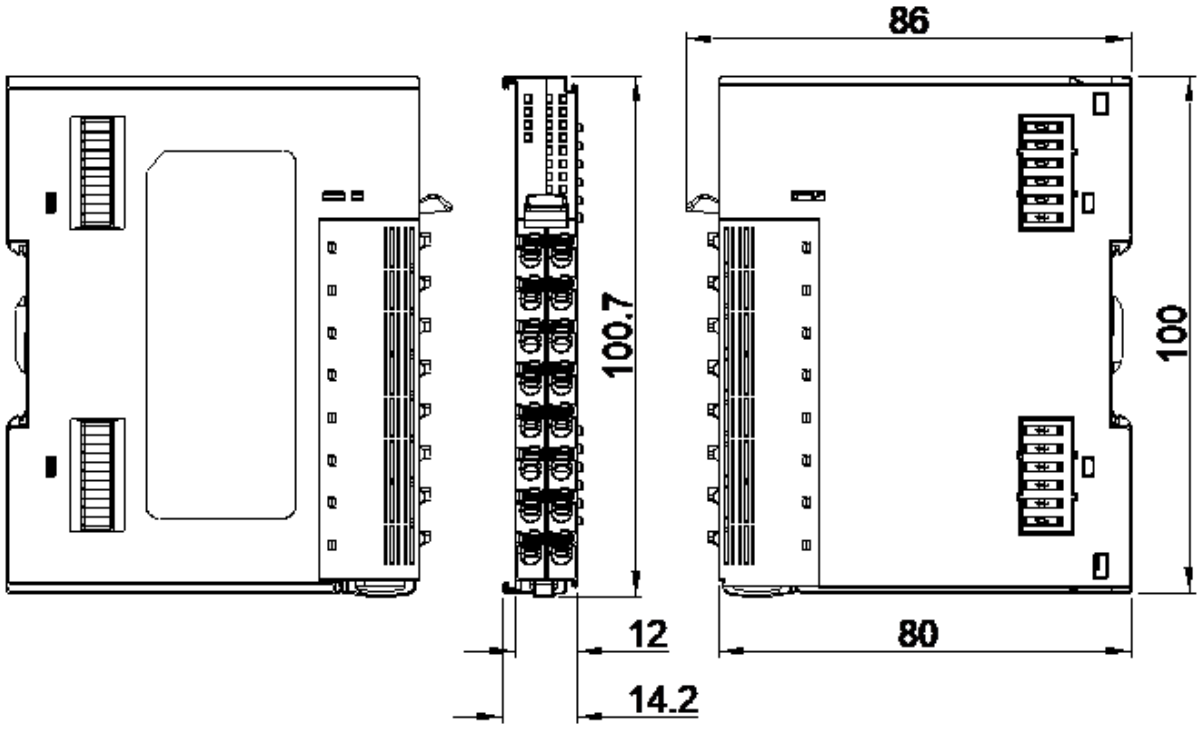
AX-516PC30-0A is an I/O power connector module. This section introduces its specifications, operations and wirings.

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.)

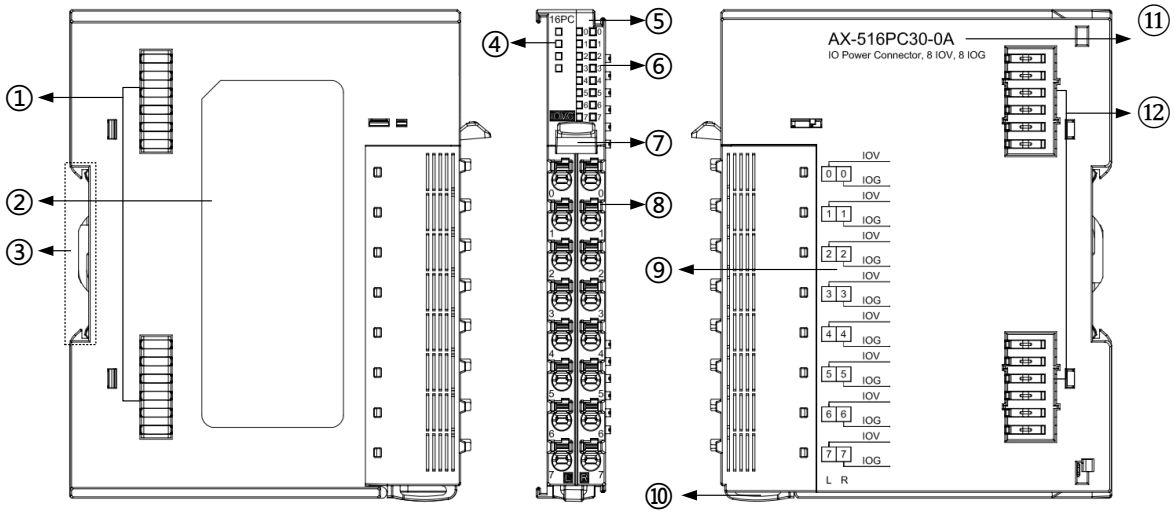
3.5.2 Dimensions and Parts

- **Dimensions**



Unit：mm

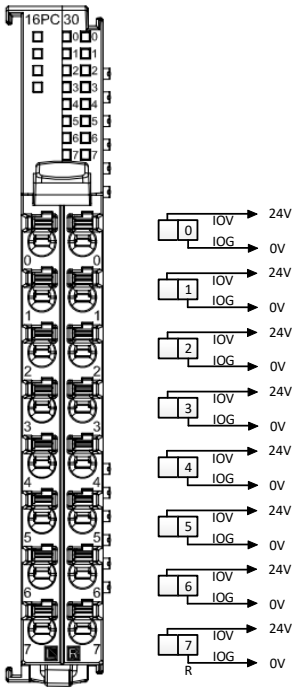
- **Parts**



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



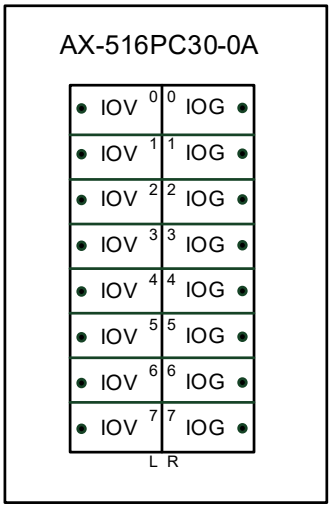
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	IOV	I/O power output: 24 VDC	R0	IOG	I/O power output: 0 VDC
L1	IOV	I/O power output: 24 VDC	R1	IOG	I/O power output: 0 VDC
L2	IOV	I/O power output: 24 VDC	R2	IOG	I/O power output: 0 VDC
L3	IOV	I/O power output: 24 VDC	R3	IOG	I/O power output: 0 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

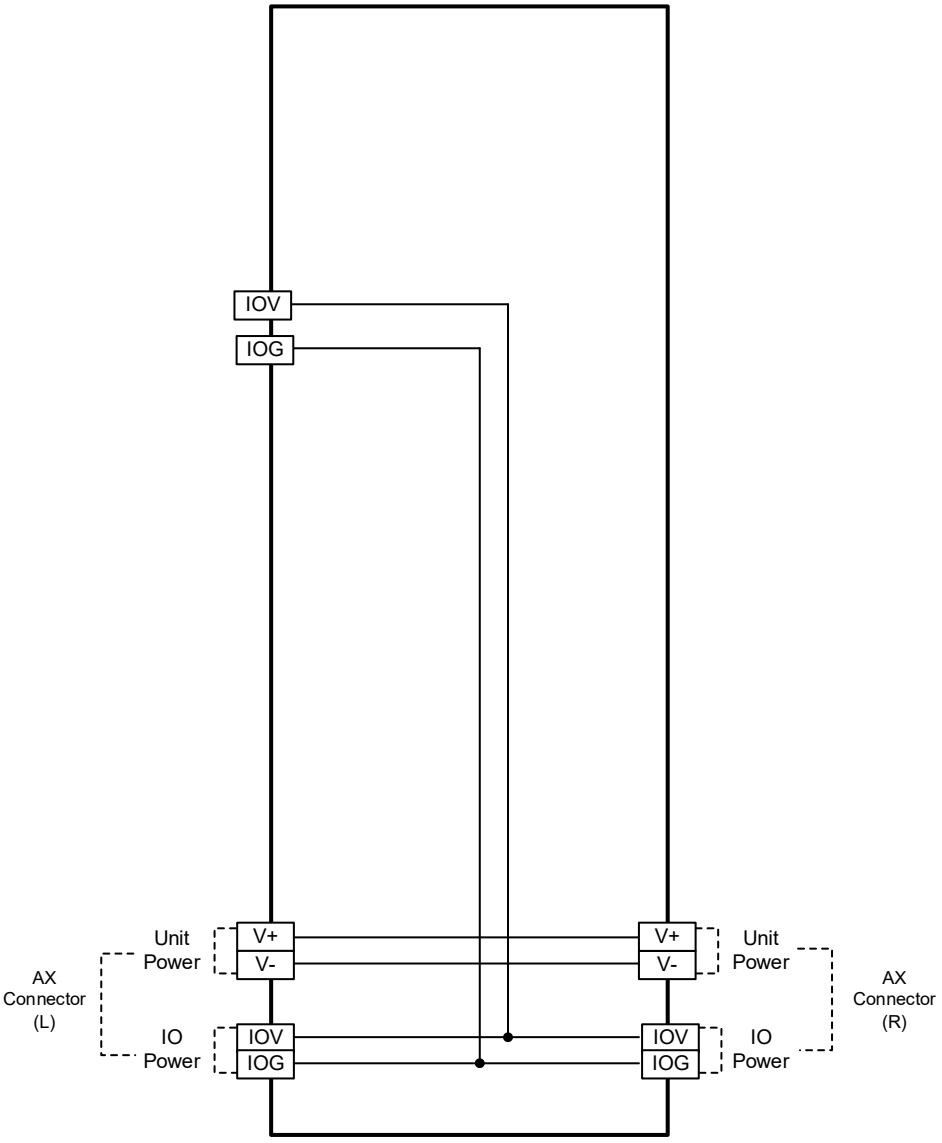
Name	Description
NA	No LED indicator

3.5.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



3.6 AX-514PC40-0A

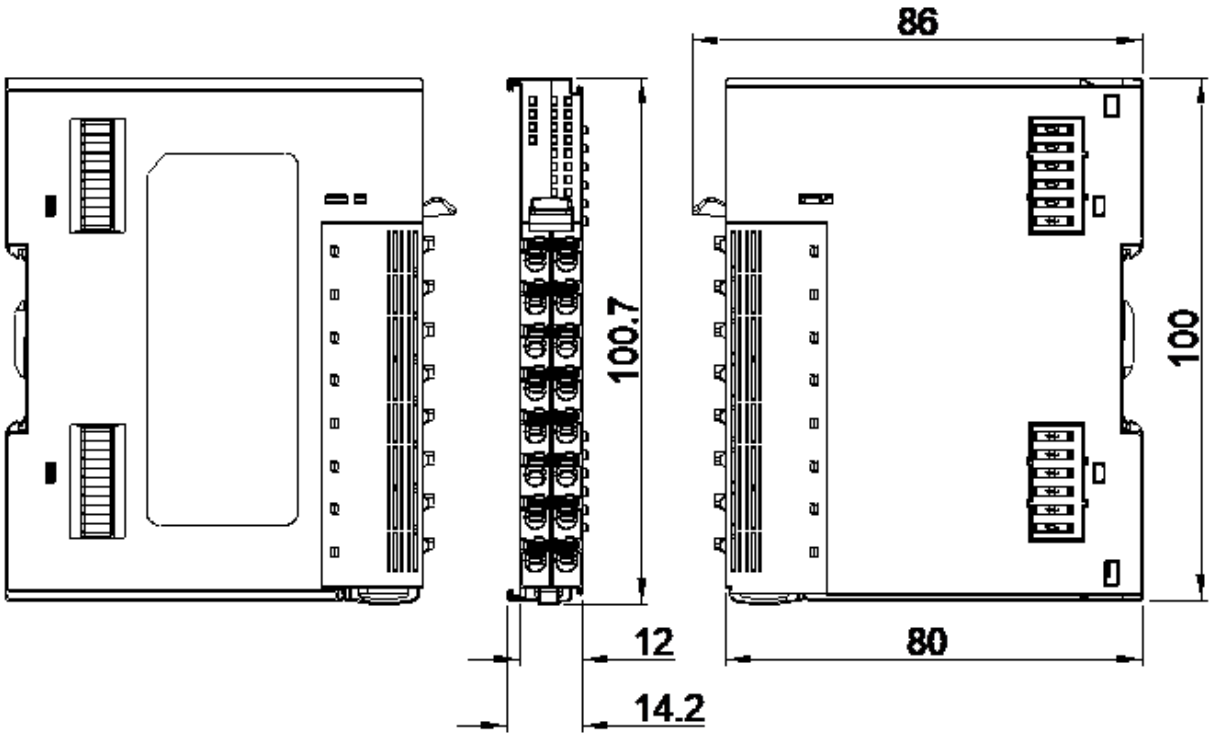
AX-514PC40-0A is an I/O power connector module. This section introduces its specifications, operations and wirings.

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.)

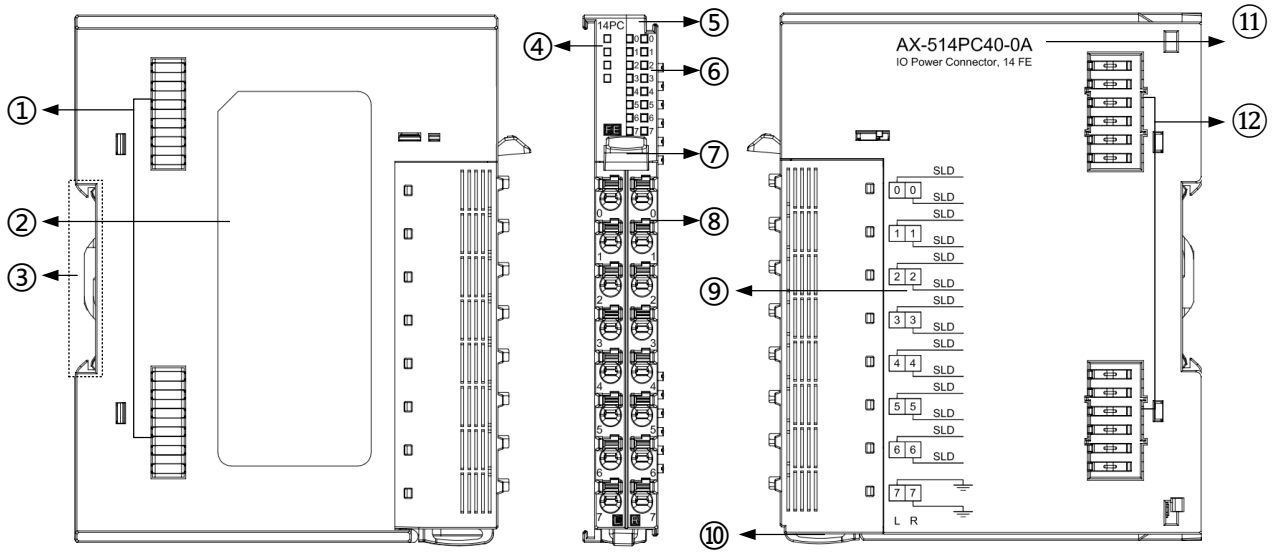
3.6.2 Dimensions and Parts

- **Dimensions**



Unit：mm

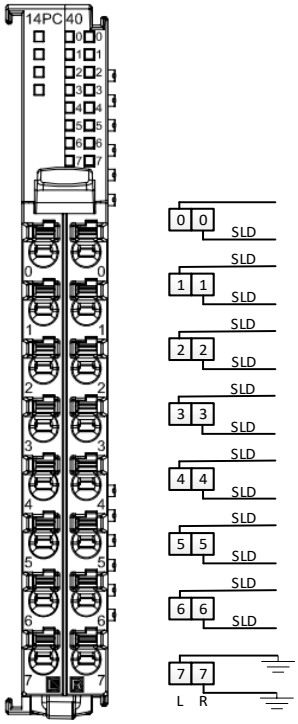
- **Parts**



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



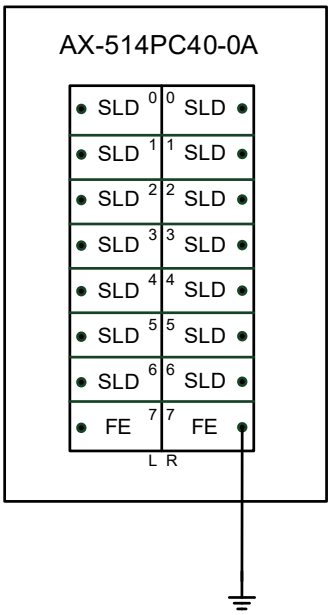
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	SLD	For shielding	R0	SLD	For shielding
L1	SLD	For shielding	R1	SLD	For shielding
L2	SLD	For shielding	R2	SLD	For shielding
L3	SLD	For shielding	R3	SLD	For shielding
L4	SLD	For shielding	R4	SLD	For shielding
L5	SLD	For shielding	R5	SLD	For shielding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

3.6.3.2 LED Indicators

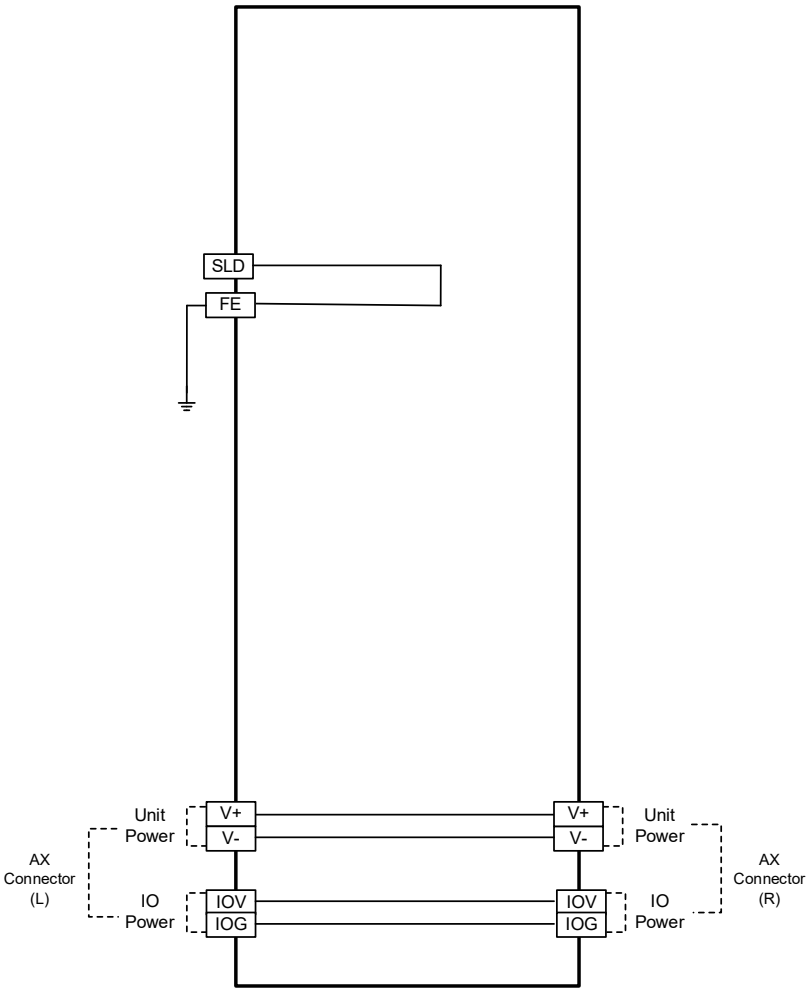
Name	Description
NA	No LED indicator

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 4-3

4.1.1 Specifications 4-3
4.1.2 Dimensions and Parts 4-4
4.1.3 Arrangement of Terminals, LED Indicators and Wiring 4-5
4.1.4 Settings in DIADesigner-AX 4-8
4.1.5 Parameter Descriptions 4-16
4.1.6 EtherCAT Operation Modes 4-20
4.1.7 Process Data 4-21
4.1.8 Troubleshooting 4-23

4.2 AX-516AM20-0A 4-24

4.2.1 Specifications 4-24
4.2.2 Dimensions and Parts 4-25
4.2.3 Arrangement of Terminals, LED Indicators and Wiring 4-26
4.2.4 Settings in DIADesigner-AX 4-29
4.2.5 Parameter Descriptions 4-38
4.2.6 EtherCAT Operation Modes 4-41
4.2.7 Process Data 4-42
4.2.8 Troubleshooting 4-43

4.3 AX-516AN01-0A 4-44

4.3.1 Specifications 4-44
4.3.2 Dimensions and Parts 4-45
4.3.3 Arrangement of Terminals, LED Indicators and Wiring 4-46
4.3.4 Settings in DIADesigner-AX 4-49
4.3.5 Parameter Descriptions 4-57
4.3.6 EtherCAT Operation Modes 4-61
4.3.7 Process Data 4-62
4.3.8 Troubleshooting 4-63

4.4 AX-516AN02-0A 4-64

4.4.1 Specifications 4-64
4.4.2 Dimensions and Parts 4-65
4.4.3 Arrangement of Terminals, LED Indicators and Wiring 4-66
4.4.4 Settings in DIADesigner-AX 4-69
4.4.5 Parameter Descriptions 4-77
4.4.6 EtherCAT Operation Modes 4-80
4.4.7 Process Data 4-81
4.4.8 Troubleshooting 4-82

4.5 AX-516AP11-0A 4-83

4.5.1 Specifications 4-83

4.5.2 Dimensions and Parts 4-84
4.5.3 Arrangement of Terminals, LED Indicators and Wiring 4-85
4.5.4 Settings in DIADesigner-AX 4-88
4.5.5 Parameter Descriptions 4-96
4.5.6 EtherCAT Operation Modes 4-100
4.5.7 Process Data 4-101
4.5.8 Troubleshooting 4-102

4.6 AX-516AP22-0A 4-103

4.6.1 Specifications 4-103
4.6.2 Dimensions and Parts 4-104
4.6.3 Arrangement of Terminals, LED Indicators and Wiring 4-105
4.6.4 Settings in DIADesigner-AX 4-108
4.6.5 Parameter Descriptions 4-116
4.6.6 EtherCAT Operation Modes 4-120
4.6.7 Process Data 4-121
4.6.8 Troubleshooting 4-122

4.1 AX-516AM10-0A

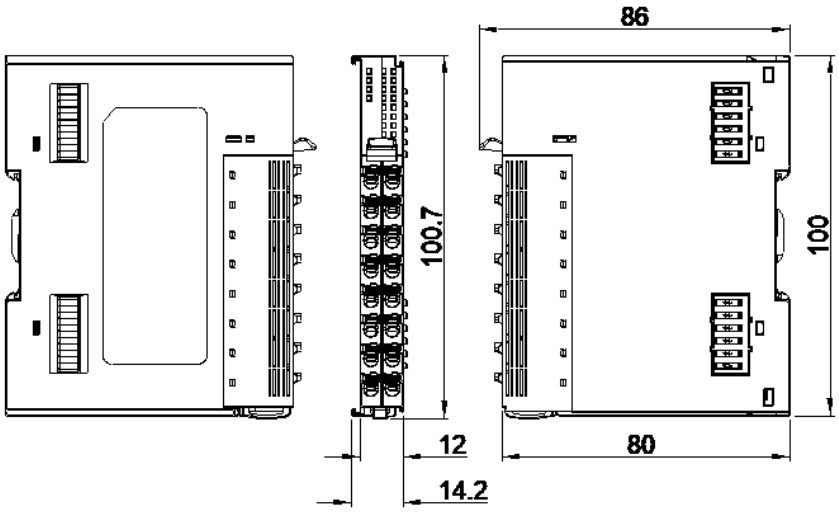
AX-516AM10-0A, a digital input module, receives external 16-point digital signals (NPN). This section introduces its specifications, operations, and wirings.

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 to 30 V (EN 61131-2, type 3)
	OFF (voltage)	-3 to +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 Detection	N/A
	Short Circuit Detection (SCD)	N/A
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	Current limiting
	Filter function	Input filter time: 0 to 255 ms; (default: 3 ms)

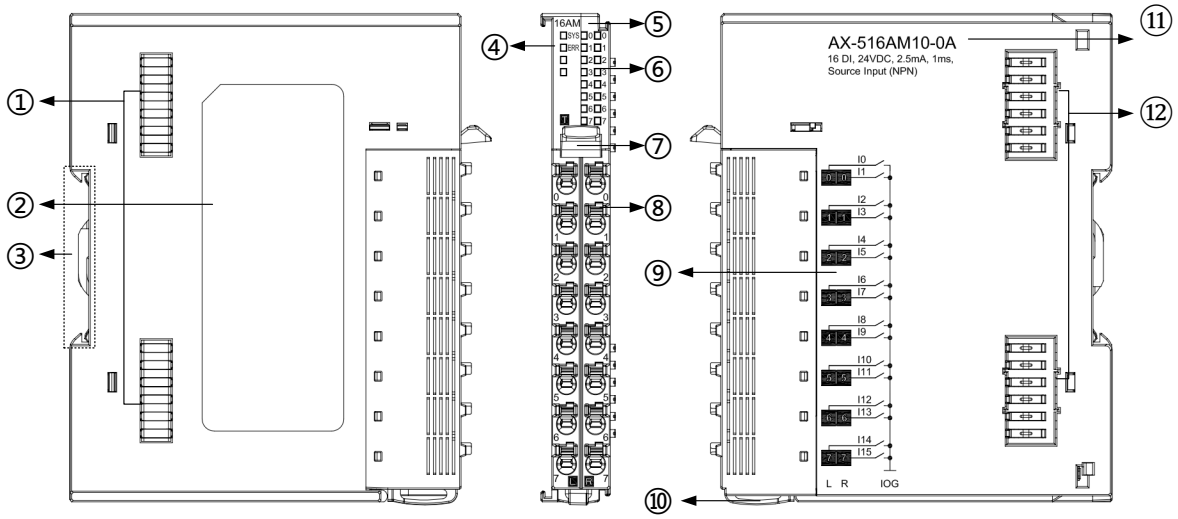
4.1.2 Dimensions and Parts

- **Dimensions**



Unit : mm

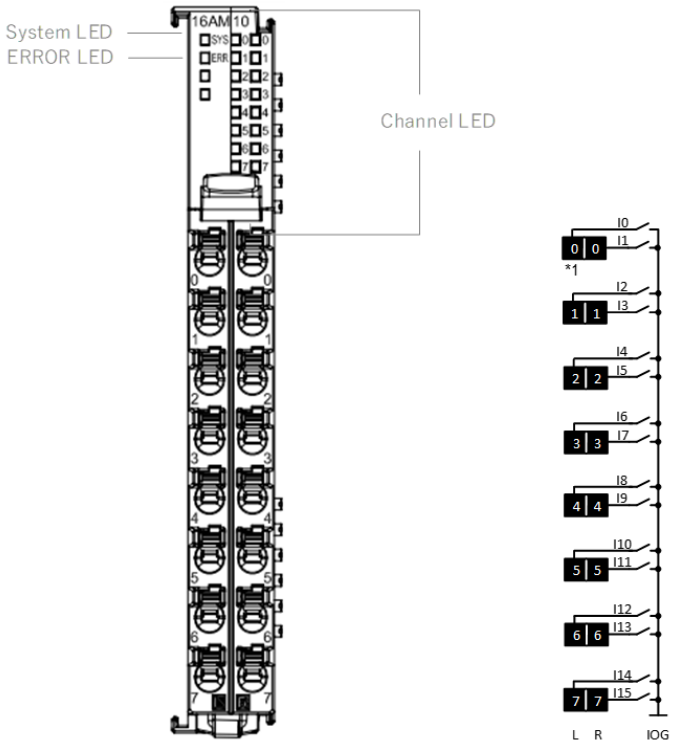
- **Parts**



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.

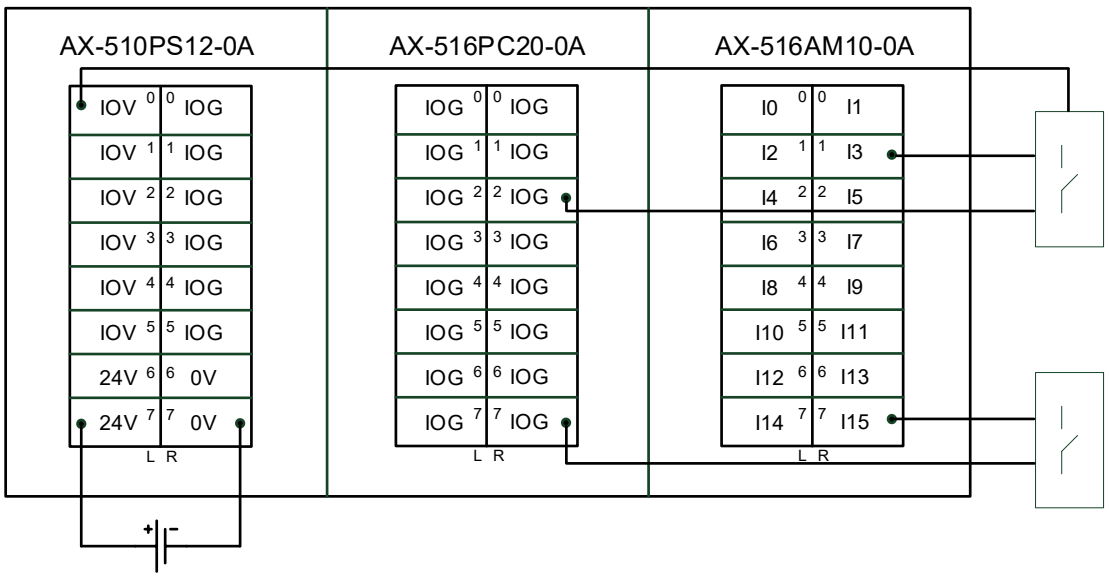
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0	Digital input channel 0	R0	I1	Digital input channel 1
L1	I2	Digital input channel 2	R1	I3	Digital input channel 3
L2	I4	Digital input channel 4	R2	I5	Digital input channel 5
L3	I6	Digital input channel 6	R3	I7	Digital input channel 7
L4	I8	Digital 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

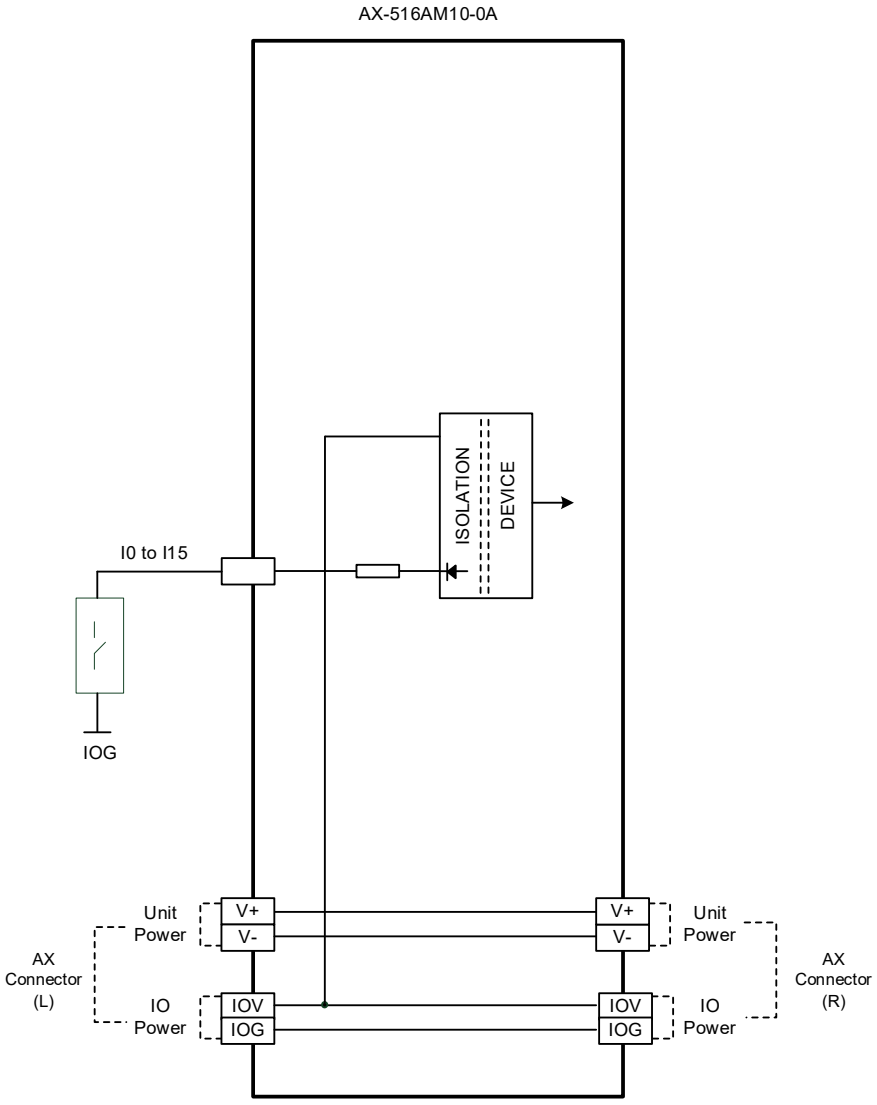
Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	Normal (OP)
Error	Red		OFF	Module is functioning correctly.
			ON	A severe error occurs on the module.
Channel	Green		OFF	The channel is OFF.
			ON	The channel is ON.

4.1.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**

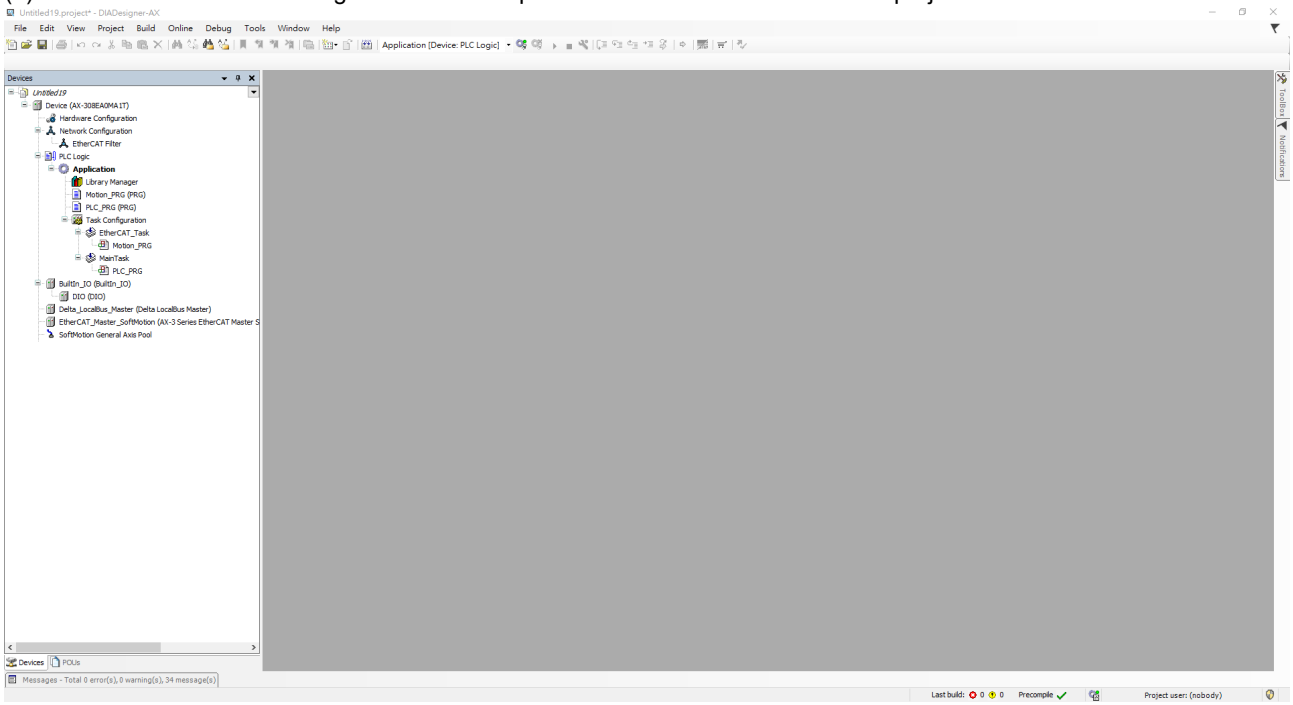


4.1.4 Settings in DIADesigner-AX

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

4.1.4.1 Basic Operation

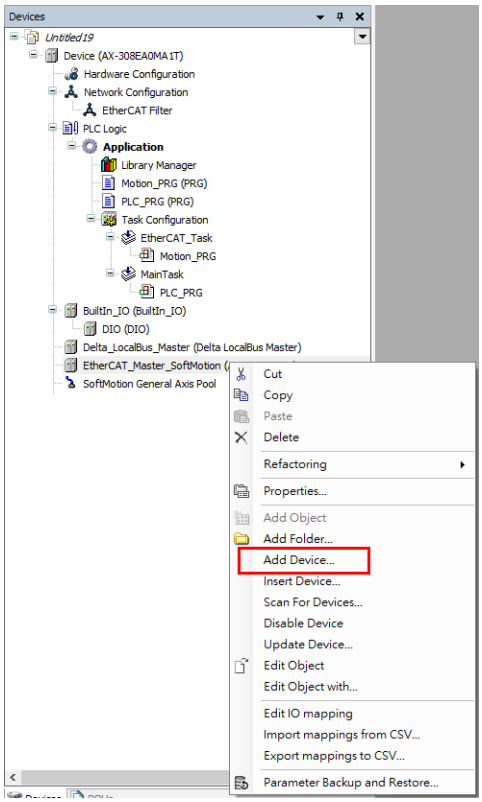
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



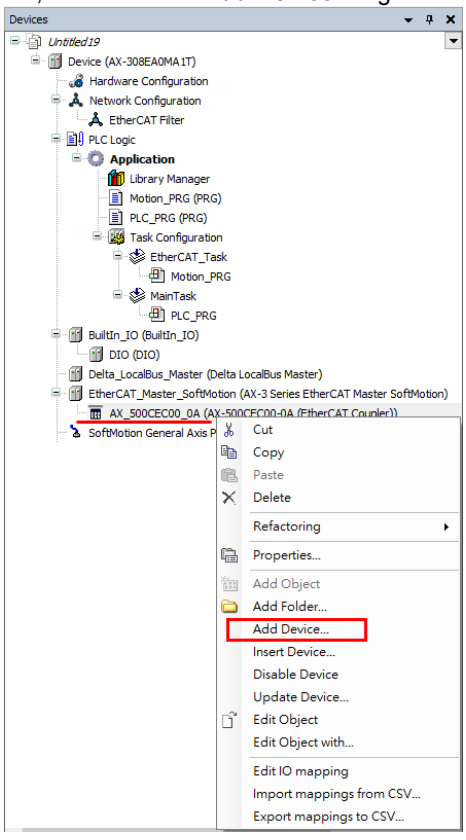
(1) Add Modules in

- 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.

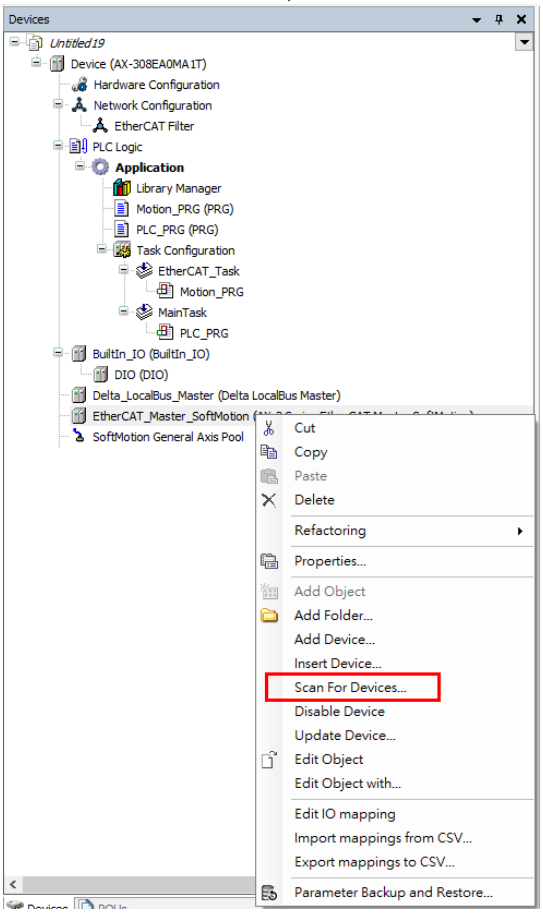


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

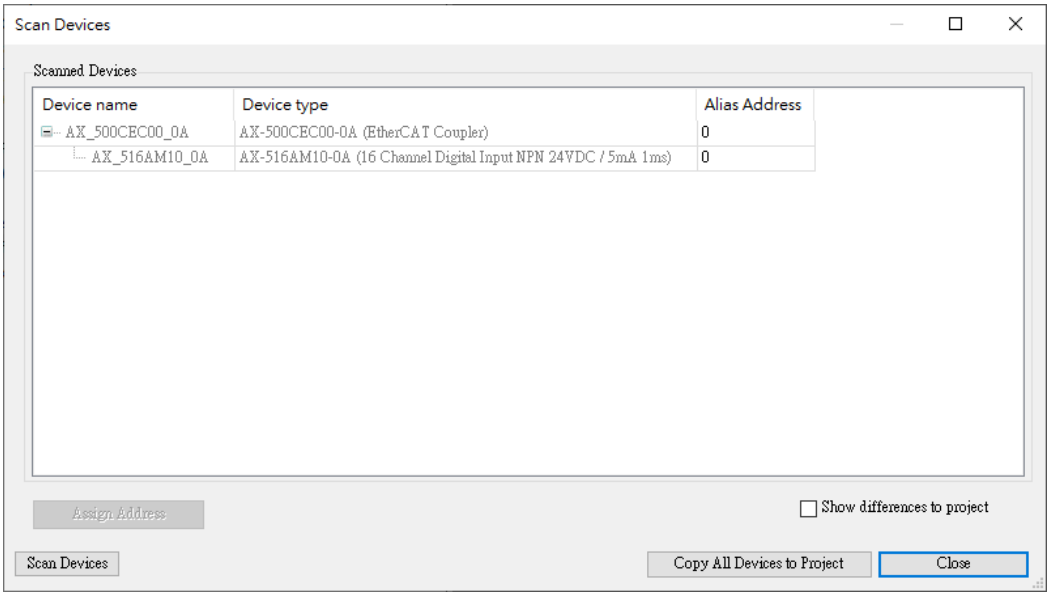


- Method 2: Scan to add the modules in.

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

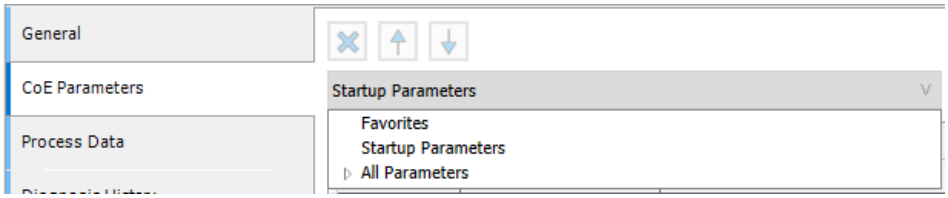


After the auto-scan is over, the actually connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.



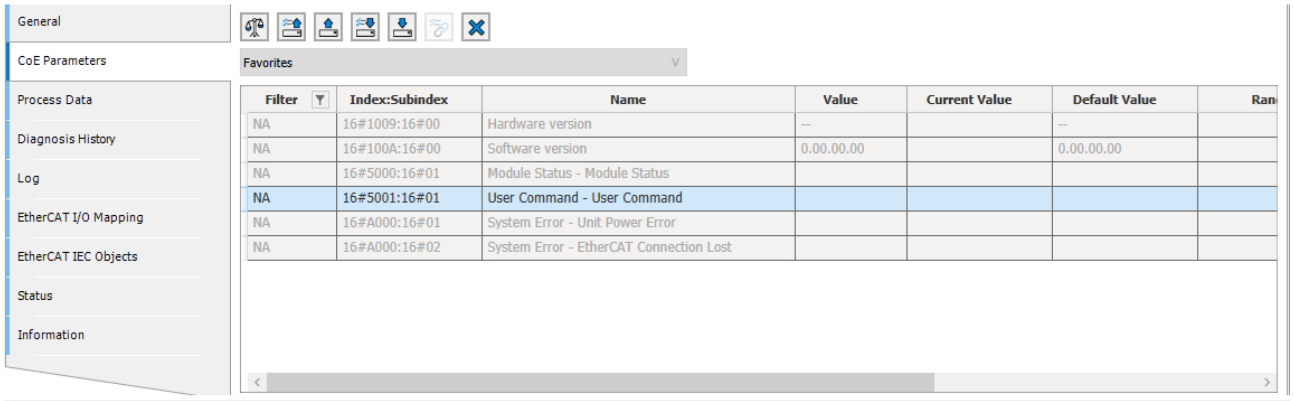
4.1.4.2 Parameter Settings

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



(1) Favorites

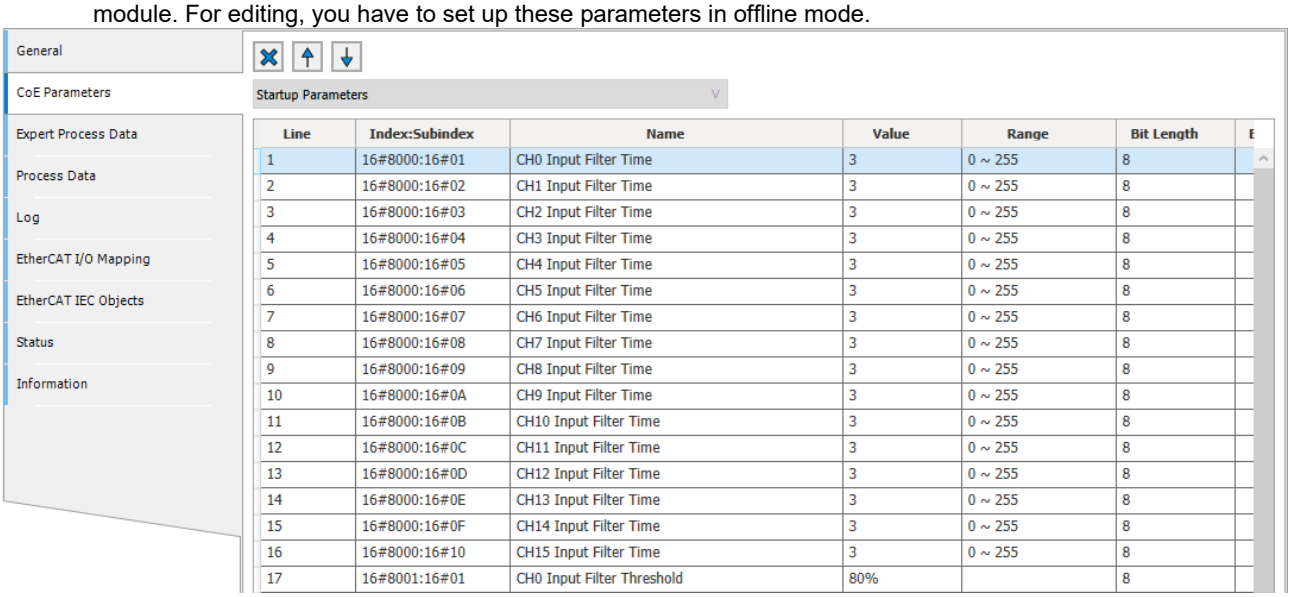
- You can add the desired parameters to the Favorites list. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

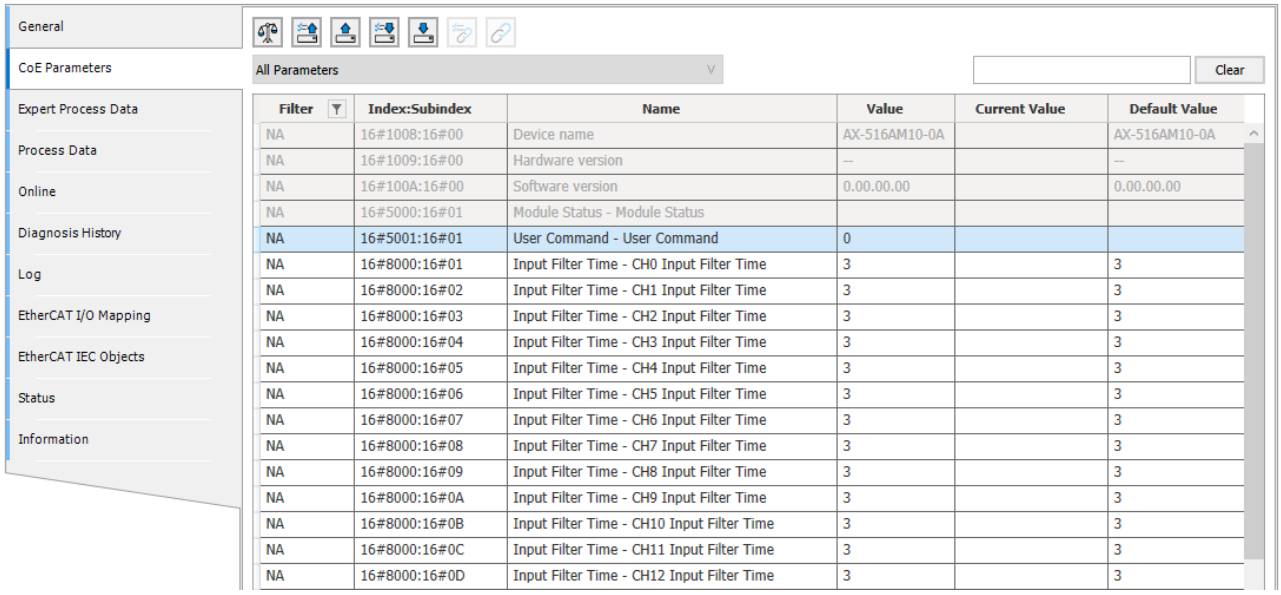


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Input Filter Time	3	0 ~ 255	8
2	16#8000:16#02	CH1 Input Filter Time	3	0 ~ 255	8
3	16#8000:16#03	CH2 Input Filter Time	3	0 ~ 255	8
4	16#8000:16#04	CH3 Input Filter Time	3	0 ~ 255	8
5	16#8000:16#05	CH4 Input Filter Time	3	0 ~ 255	8
6	16#8000:16#06	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

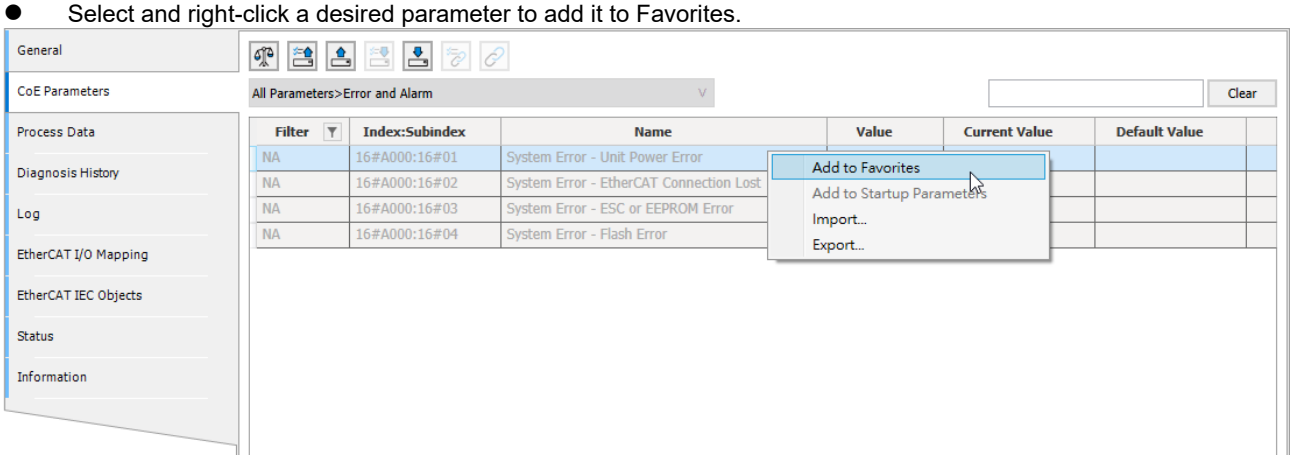
- You can find all the CoE parameters here. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values of parameters in Current Value column.
- You can edit the values of parameters in 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.

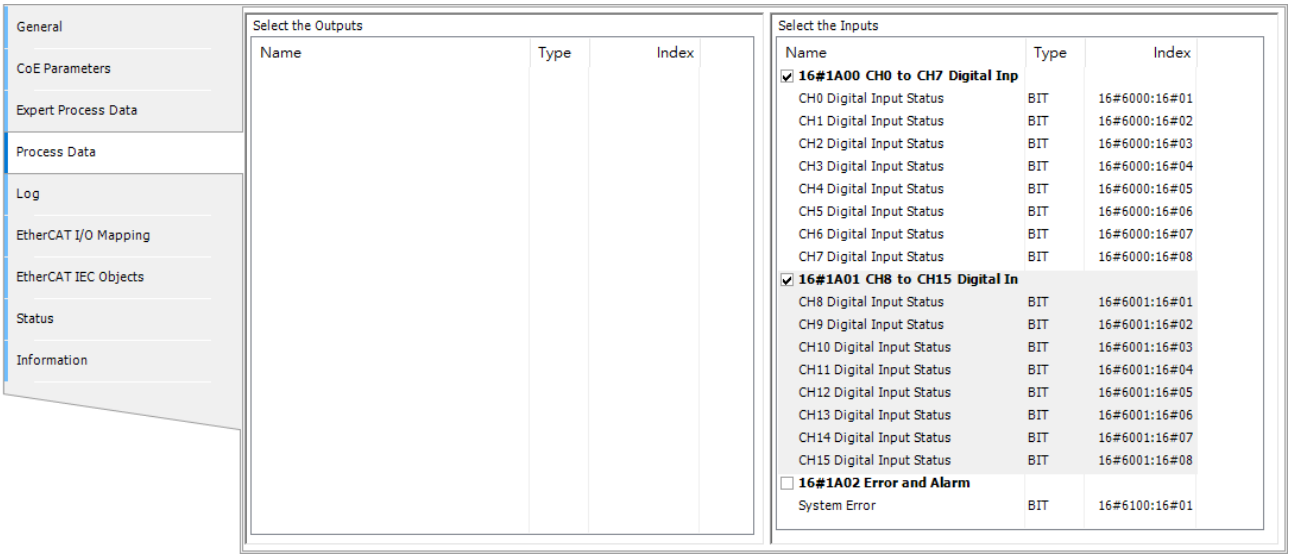
- Select and right-click a desired parameter to add it to Favorites.



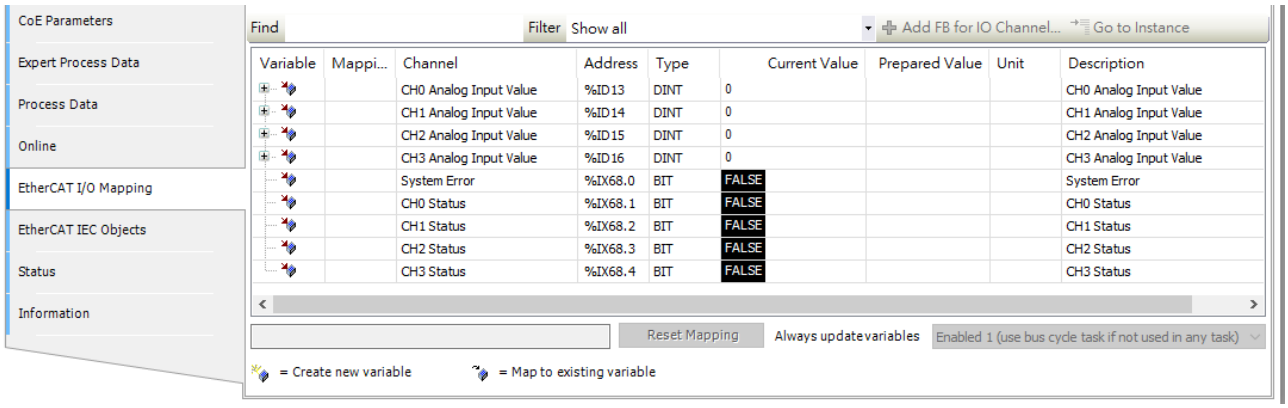
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

4.1.4.3 Process Data

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

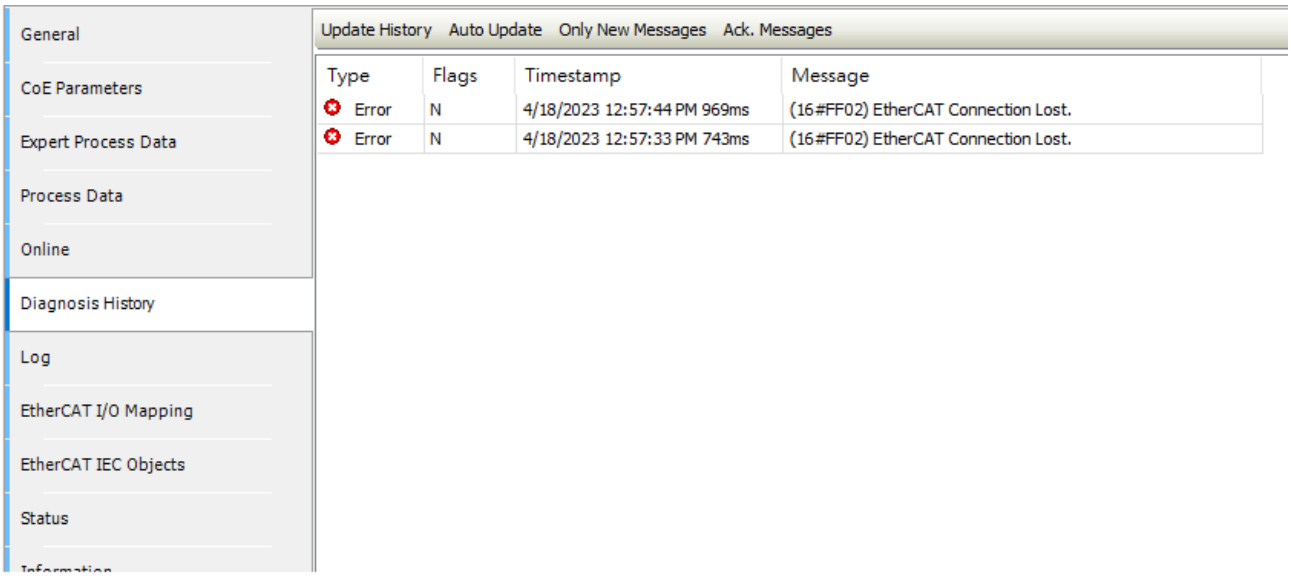


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



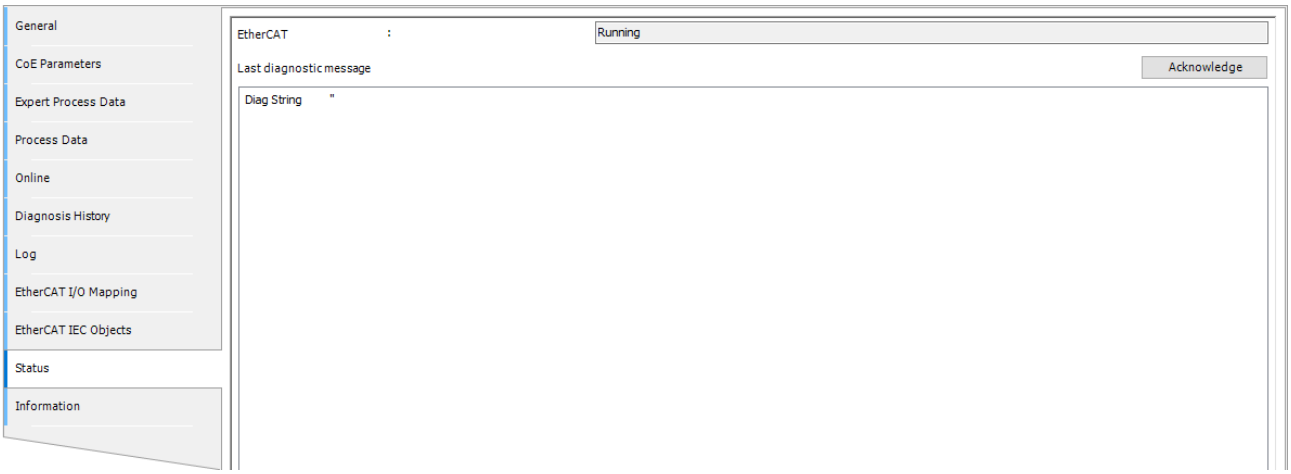
4.1.4.4 Diagnosis History

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.



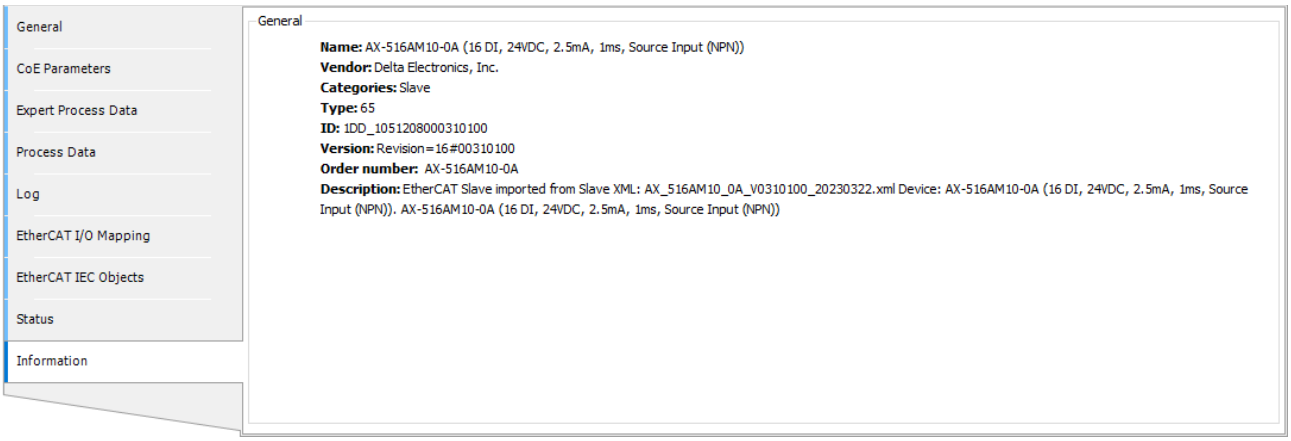
4.1.4.5 Status

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**

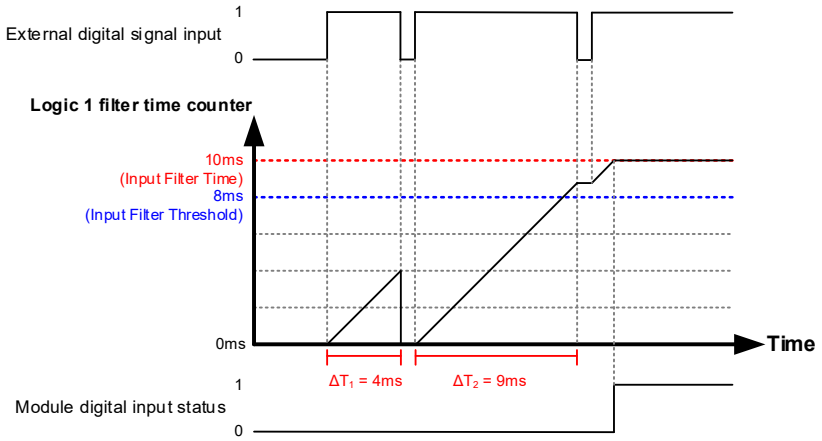
The parameter set is to set the filtering threshold for the inputs so as to suppress the digital noise interference.

- **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

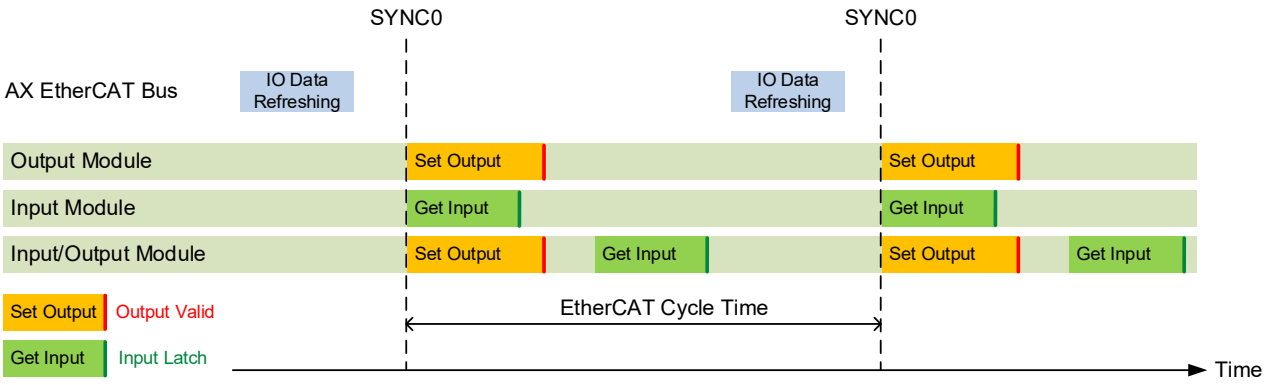
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

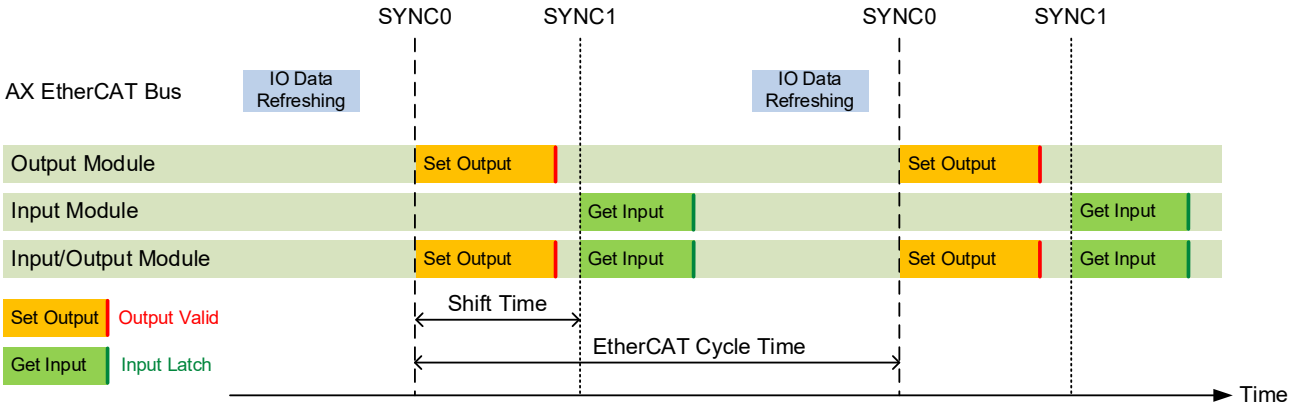
- **SYNC0**

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

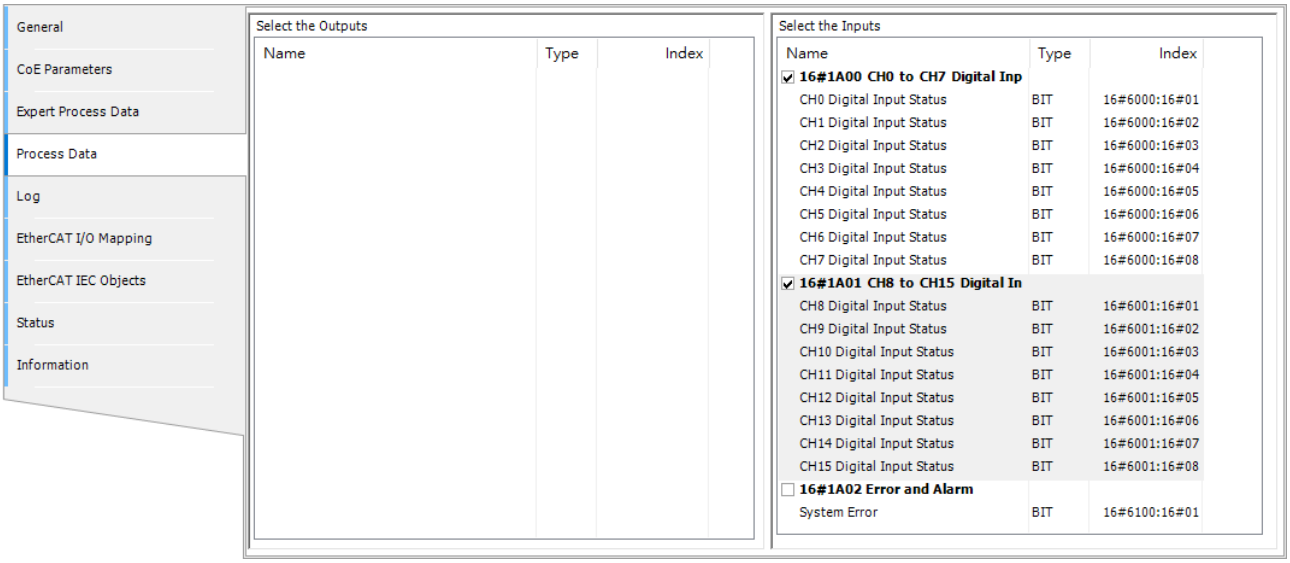
This section introduces the settings and monitoring of PDO data exchange.

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

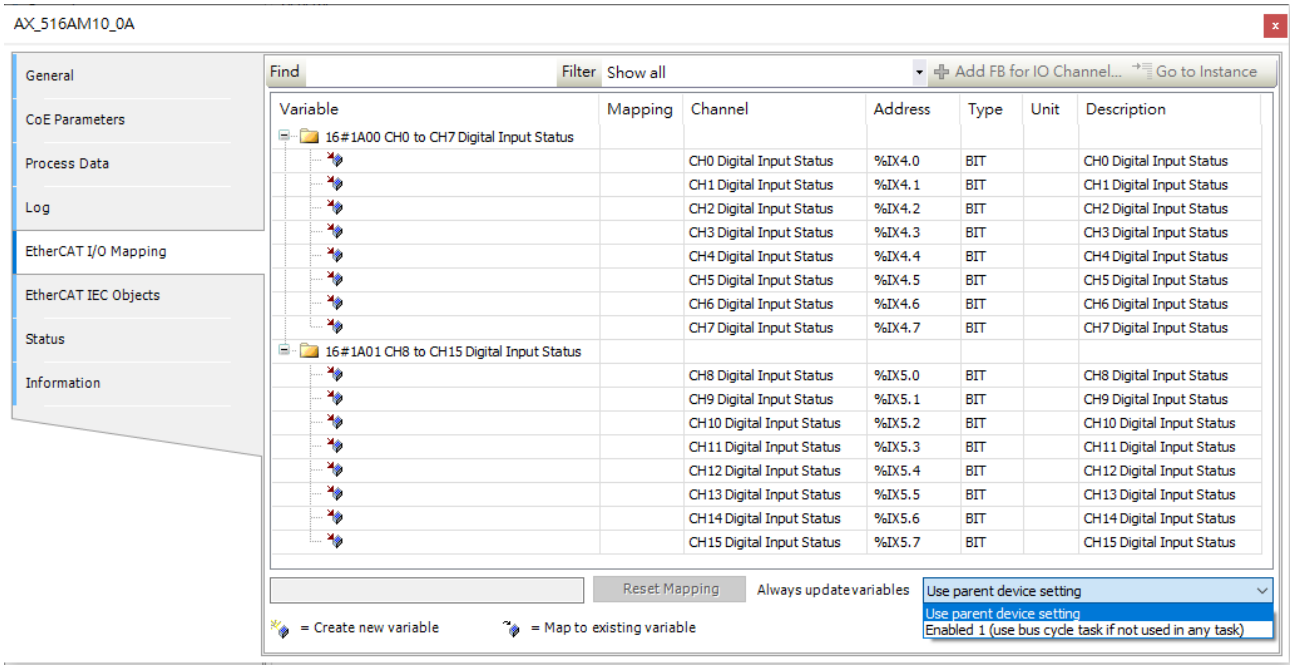
Go to the Process Data tab and select the data that you'd like to monitor.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status
	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

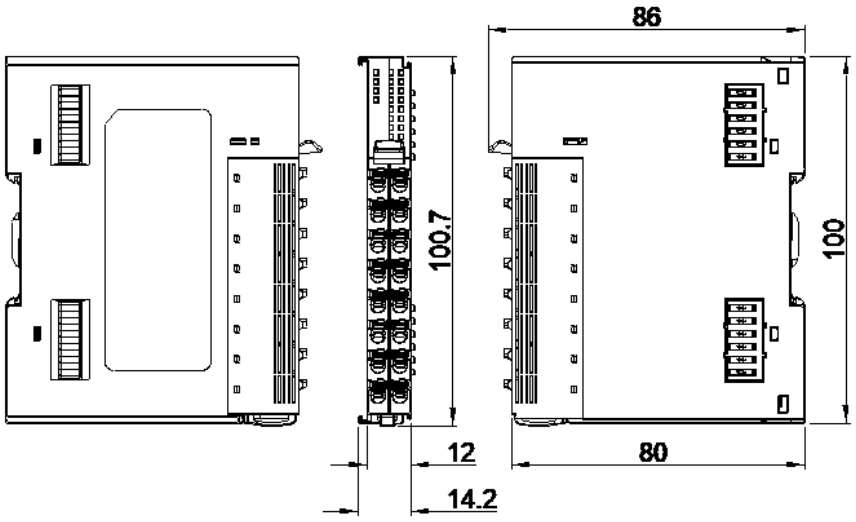
AX-516AM20-0A, a digital input module, receives external 16-point digital signals (PNP). This section introduces its specifications, operations and wirings.

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 to 30 V (EN 61131-2, type 3)
	OFF (voltage)	-3 to +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 Detection	N/A
	Short Circuit Detection (SCD)	N/A
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	Current limiting
	Filter function	Firmware filtering time: 0 to 255 ms; (default: 3 ms)

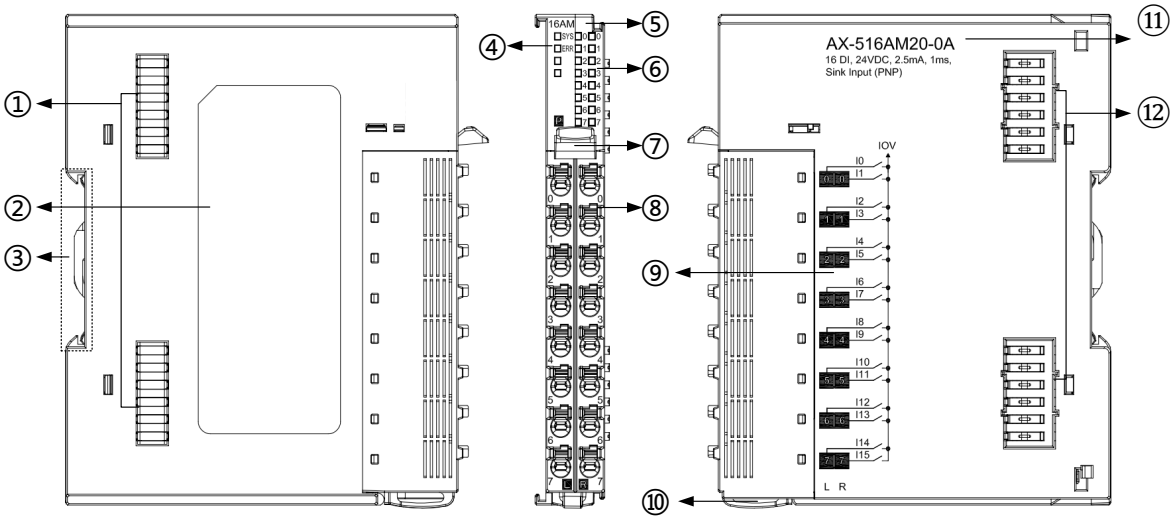
4.2.2 Dimensions and Parts

- **Dimensions**



Unit : mm

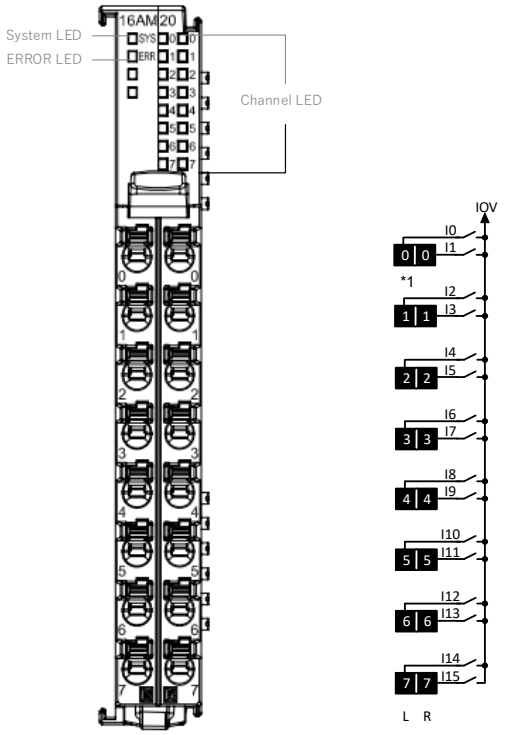
- **Parts**



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.

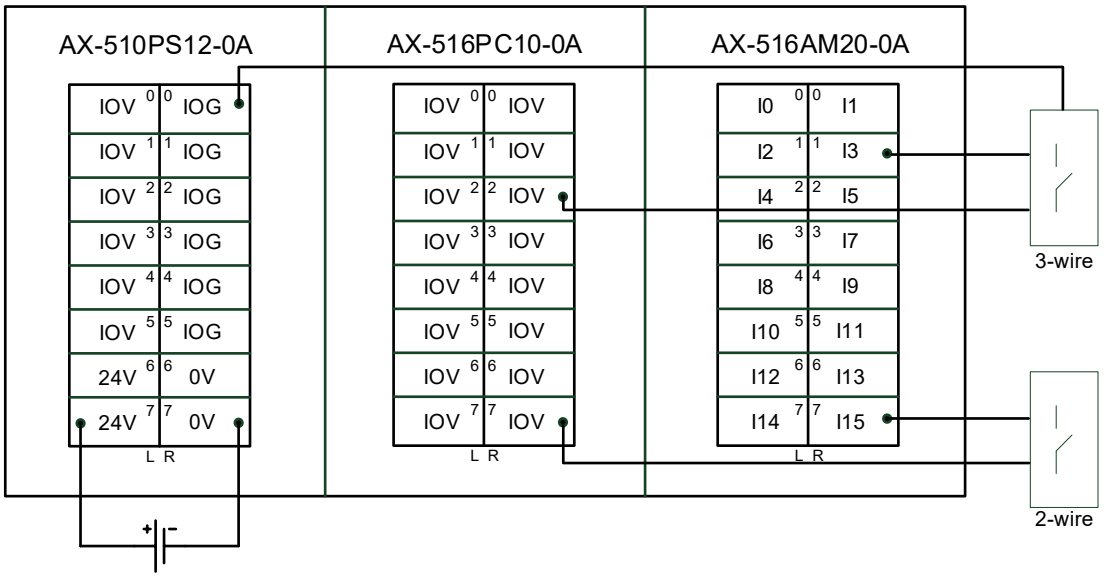
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0	Digital input channel 0	R0	I1	Digital input channel 1
L1	I2	Digital input channel 2	R1	I3	Digital input channel 3
L2	I4	Digital input channel 4	R2	I5	Digital input channel 5
L3	I6	Digital input channel 6	R3	I7	Digital input channel 7
L4	I8	Digital 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

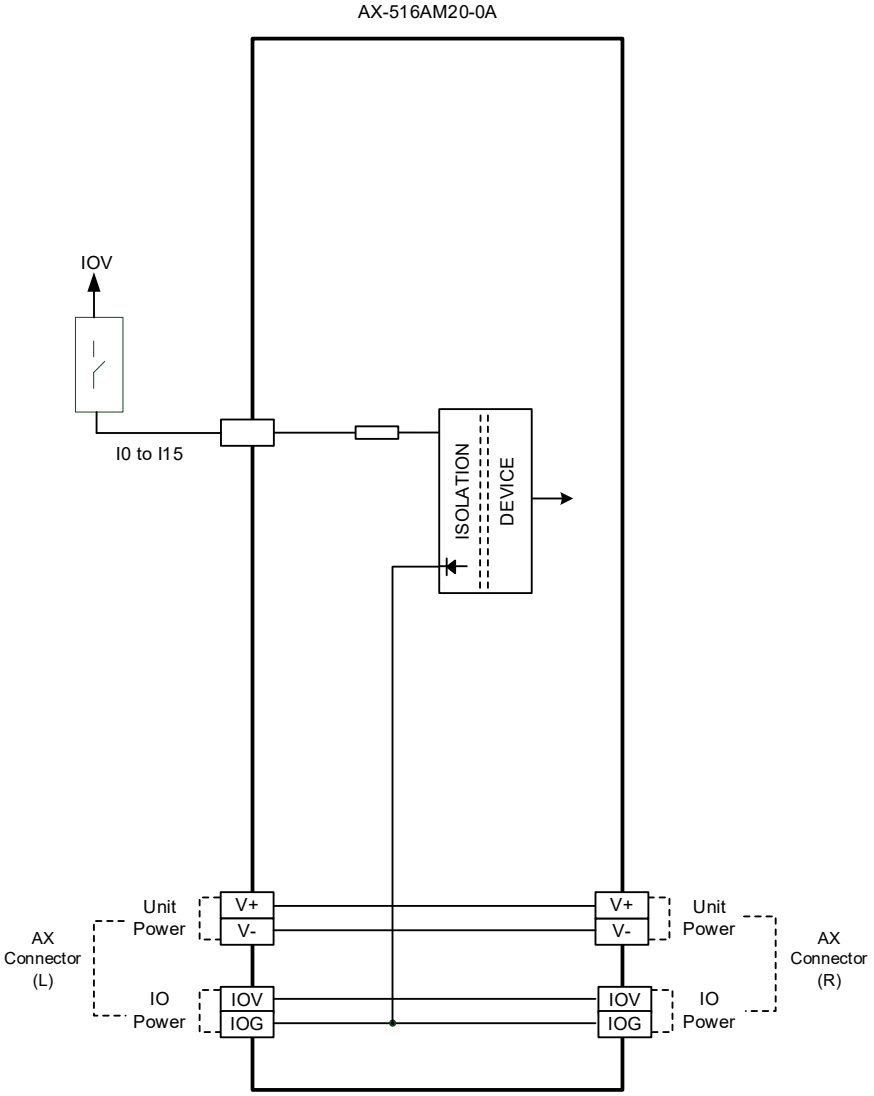
Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	Normal (OP)
Error	Red		OFF	Module is functioning correctly.
			ON	A severe error occurs on the module.
Channel	Green		OFF	The channel is OFF.
			ON	The channel is ON.

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

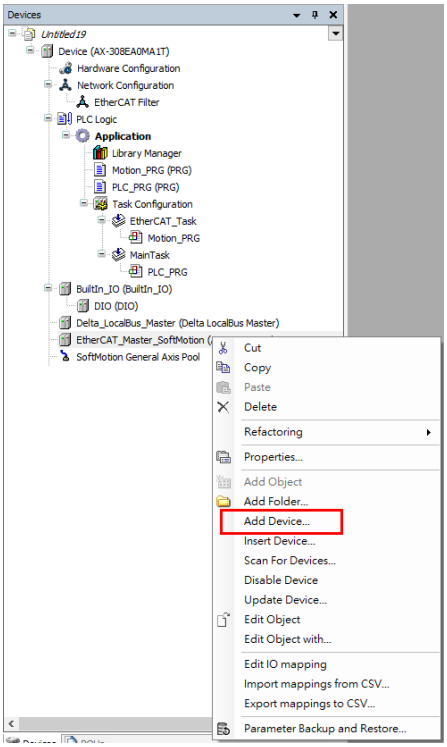
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



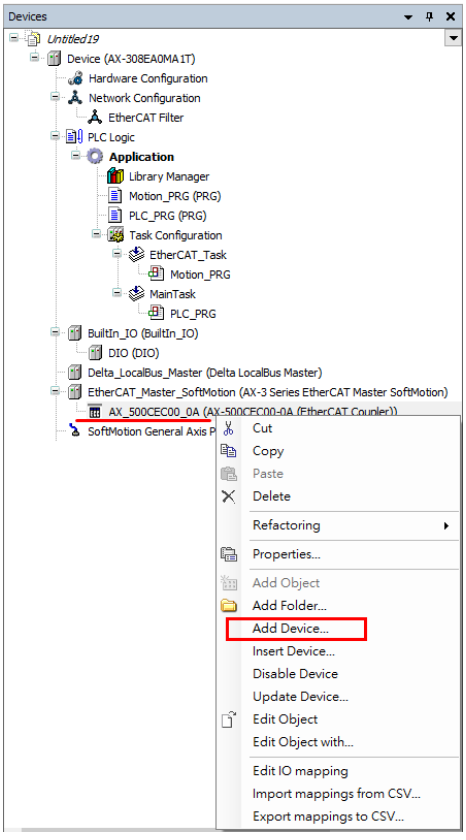
(2) Add Modules in

- 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.

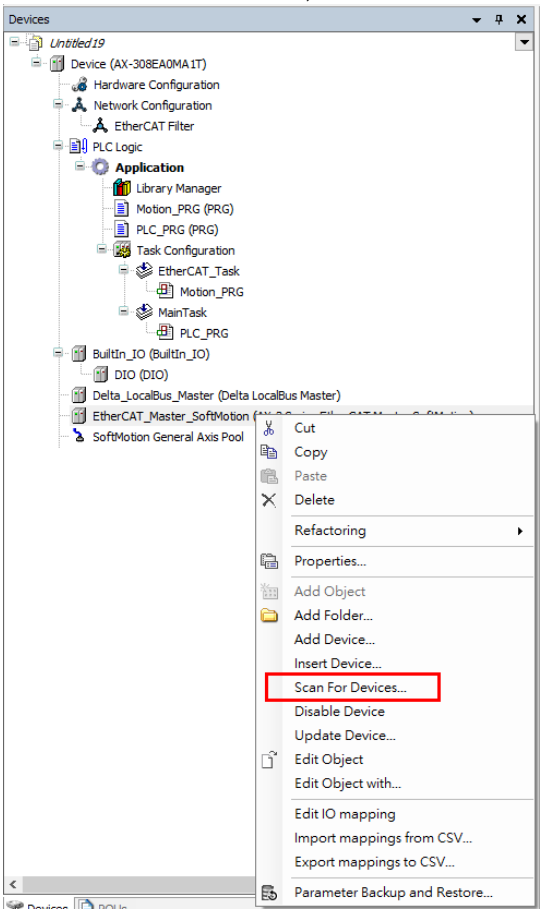


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

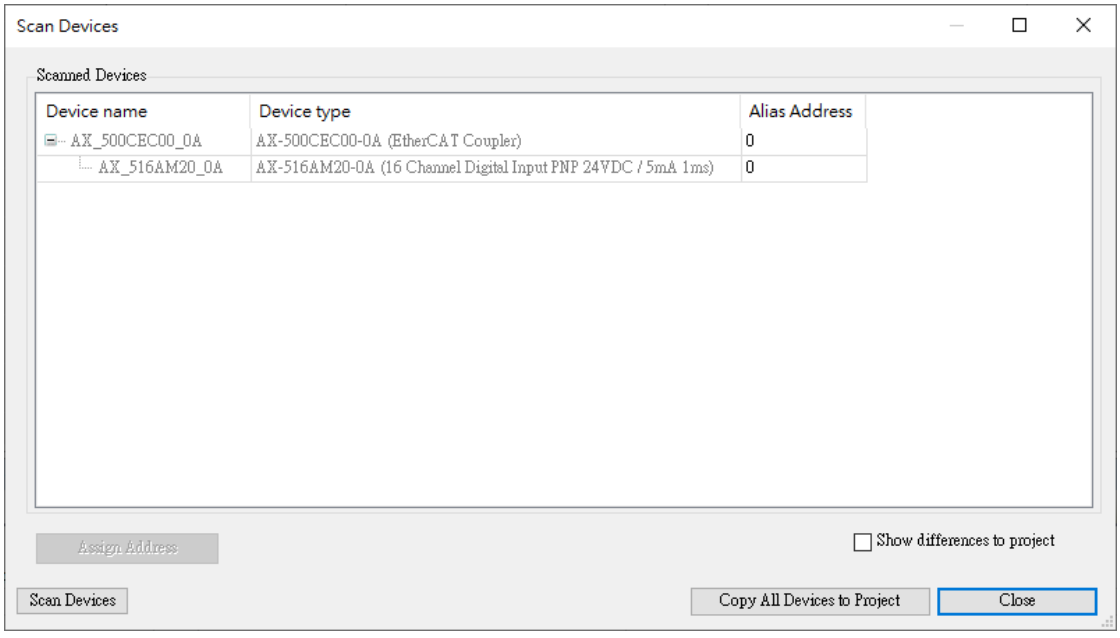


- Method 2: Scan to add the modules in.

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

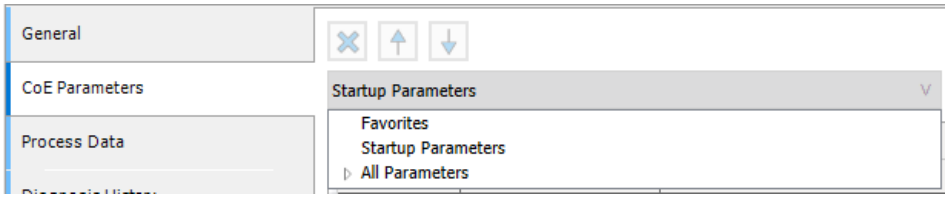


After the auto-scan is over, the actually connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.



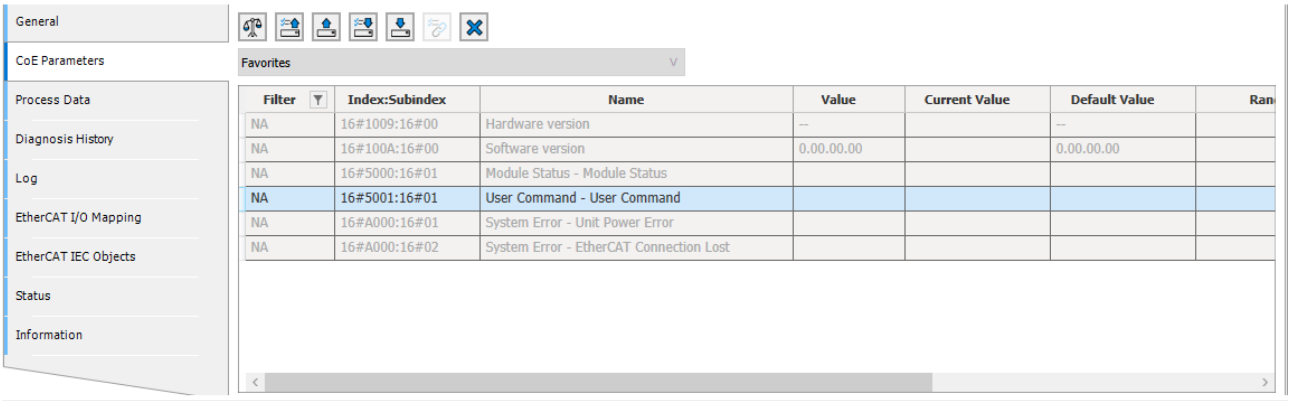
4.2.4.2 Parameter Settings

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



(1) Favorites

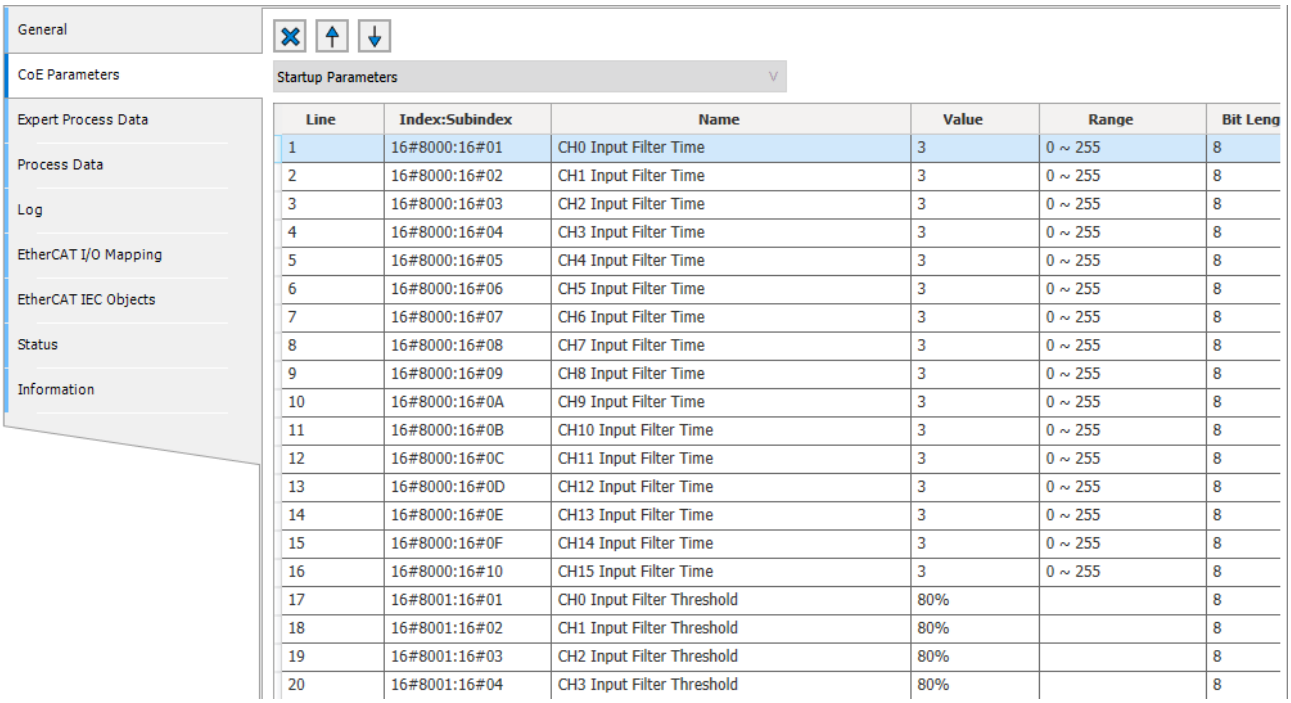
- You can add the selected parameter to Favorites according to your preference. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

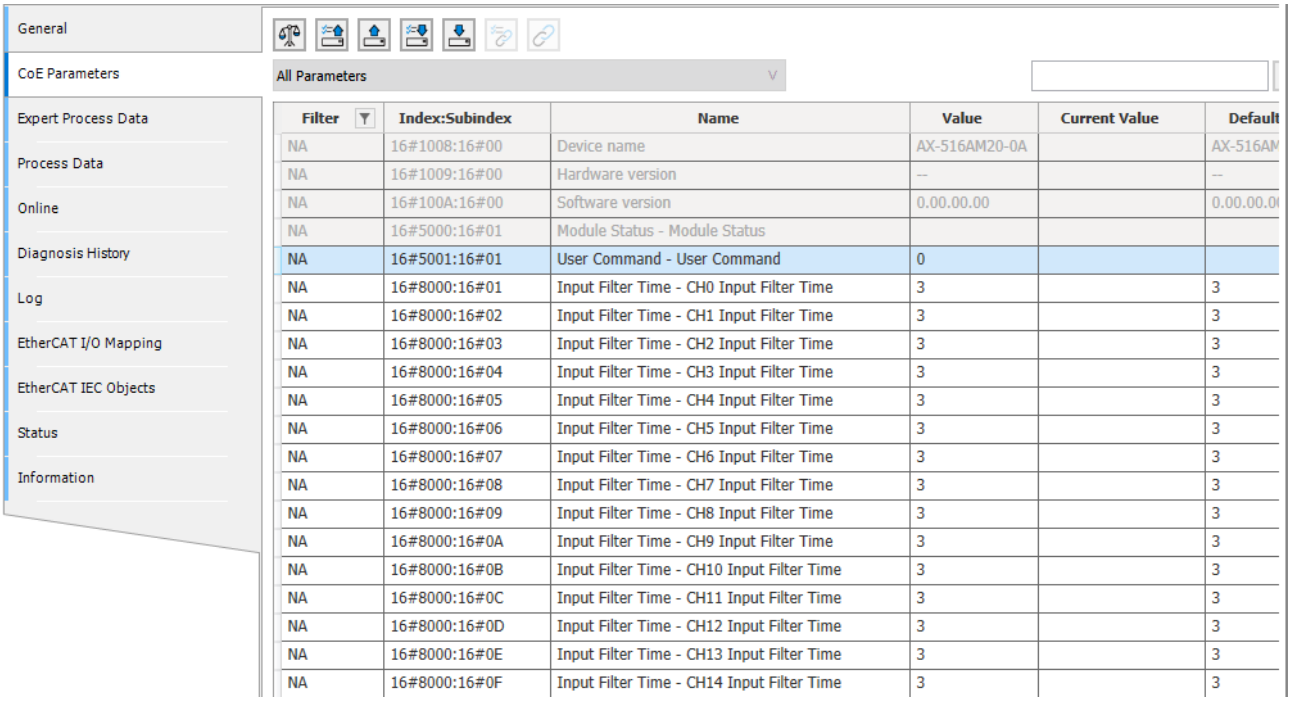


Line	Index:Subindex	Name	Value	Range	Bit Leng
1	16#8000:16#01	CH0 Input Filter Time	3	0 ~ 255	8
2	16#8000:16#02	CH1 Input Filter Time	3	0 ~ 255	8
3	16#8000:16#03	CH2 Input Filter Time	3	0 ~ 255	8
4	16#8000:16#04	CH3 Input Filter Time	3	0 ~ 255	8
5	16#8000:16#05	CH4 Input Filter Time	3	0 ~ 255	8
6	16#8000:16#06	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

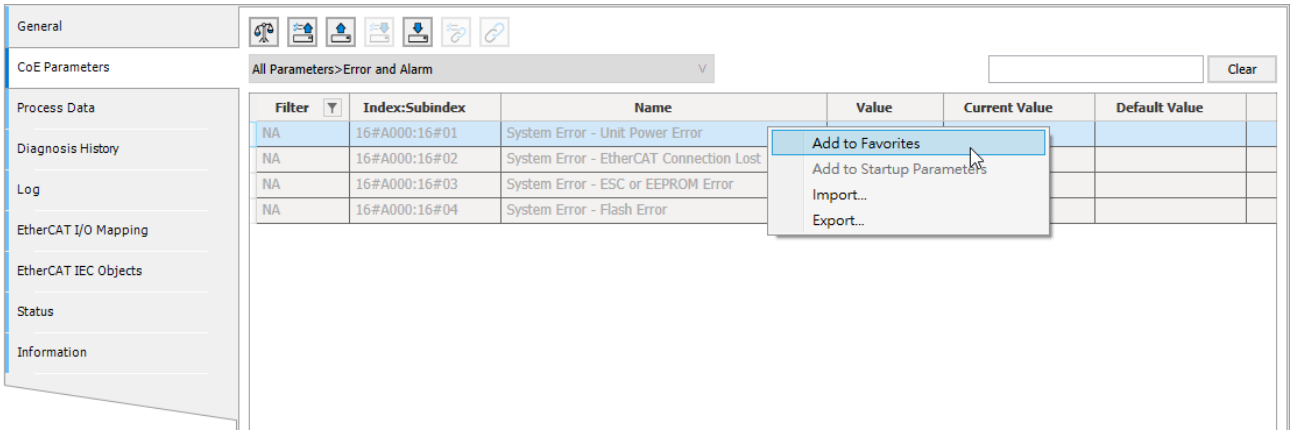
- You can find all the CoE parameters here. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values of parameters in Current Value column.
- You can edit the values of parameters in 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.

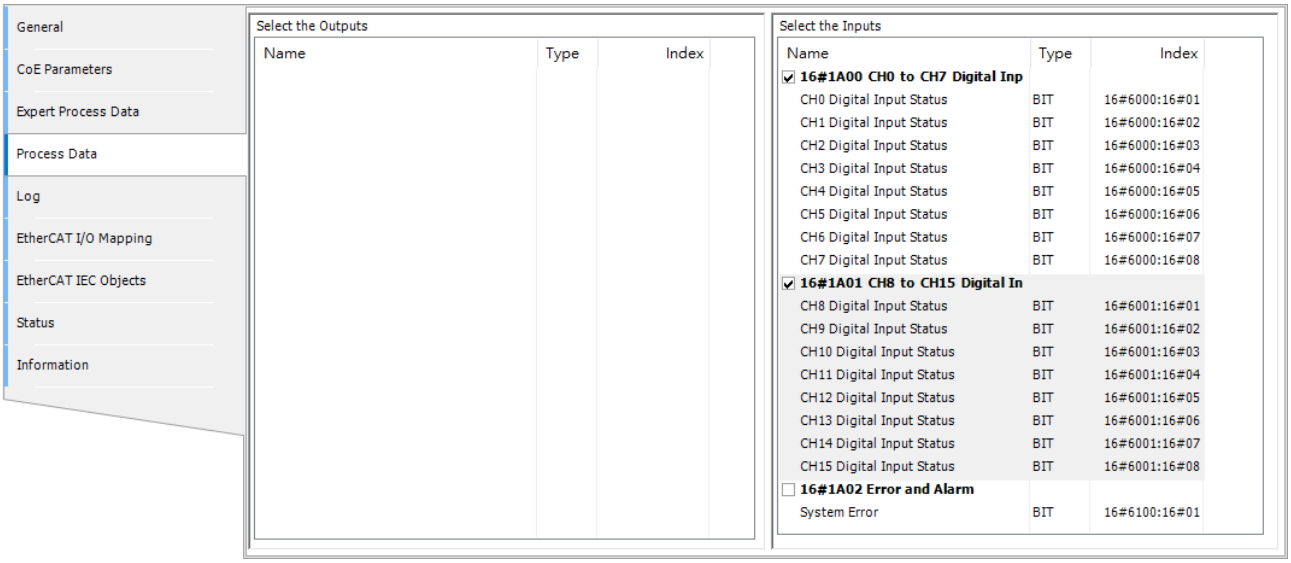
- You can select and right-click the parameter to add the selected parameter to Favorites.



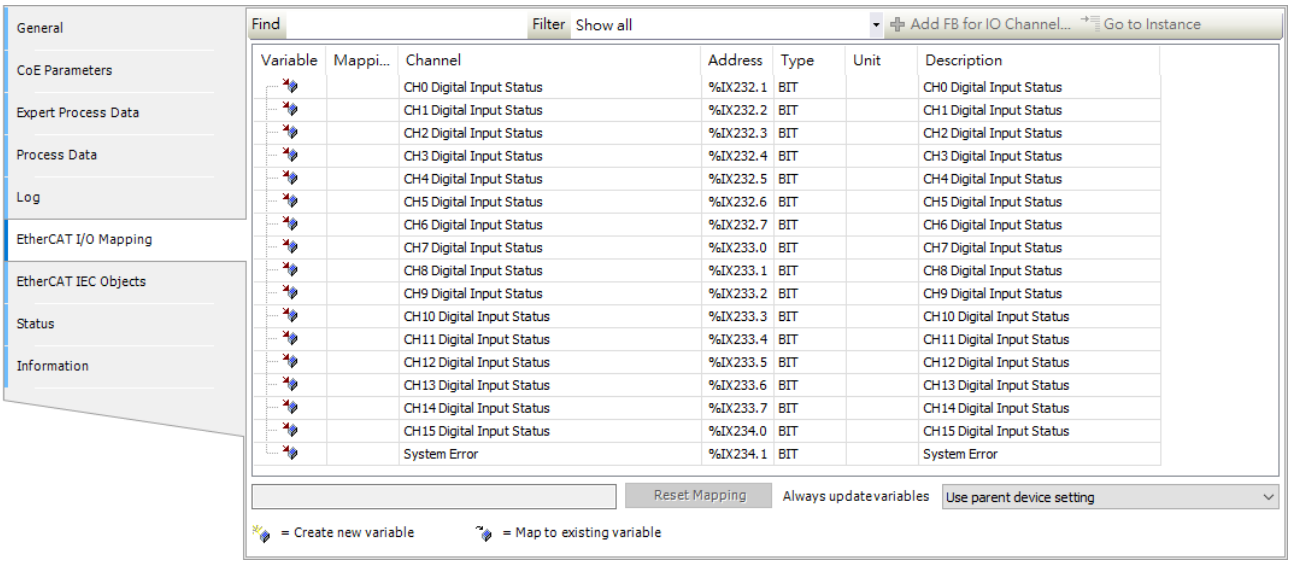
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

4.2.4.3 Process Data

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

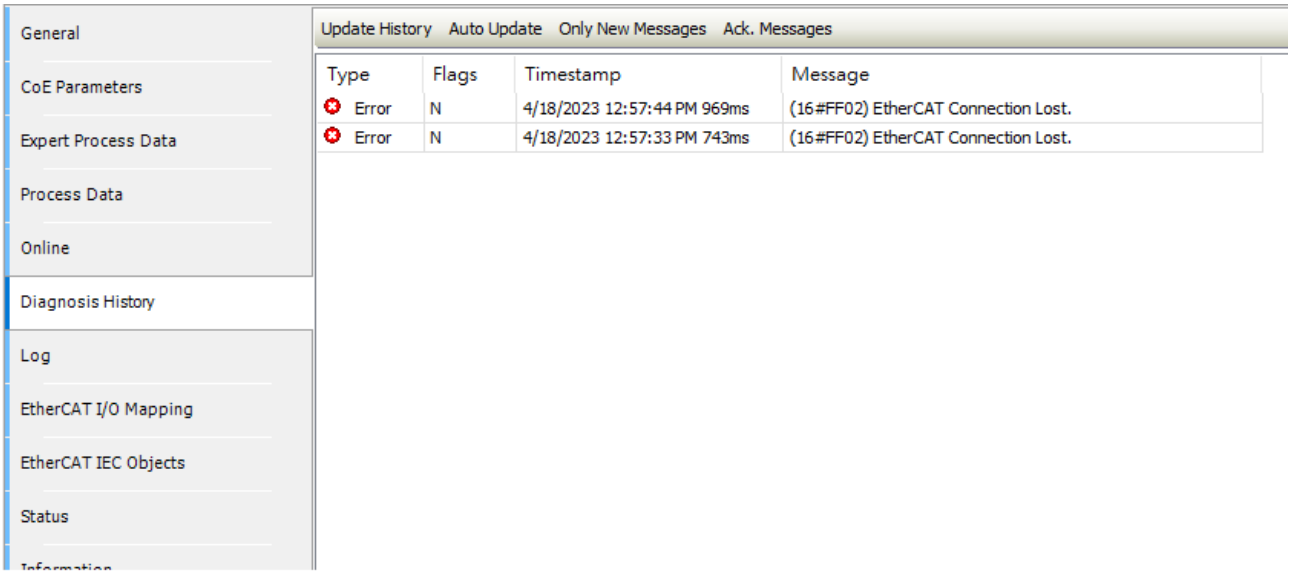


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



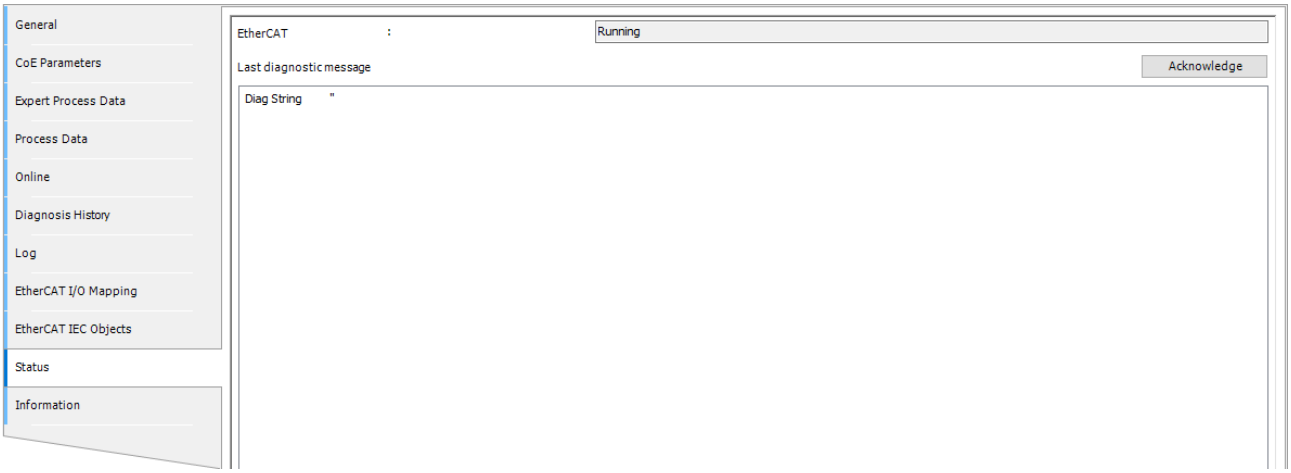
4.2.4.4 Diagnosis History

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.



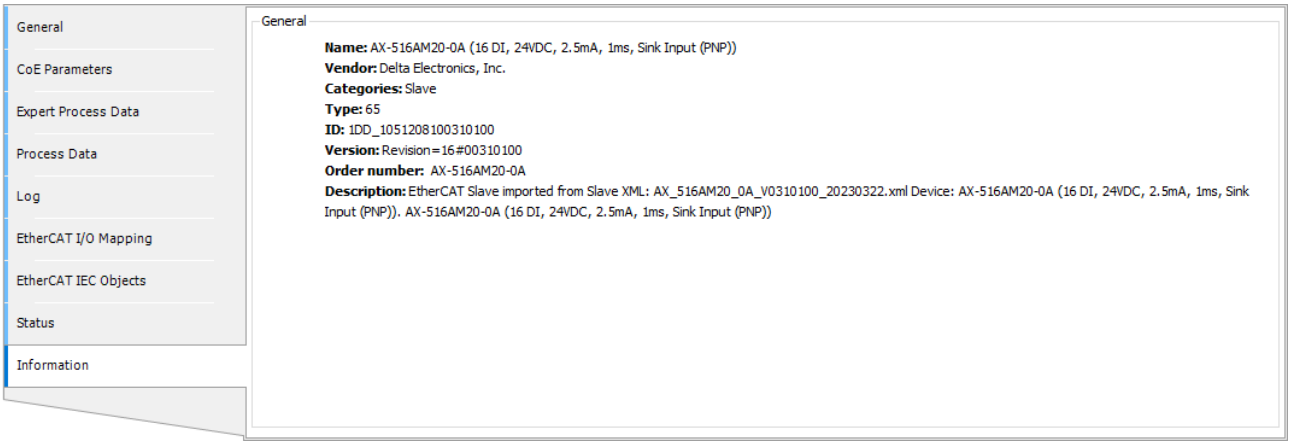
4.2.4.5 Status

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

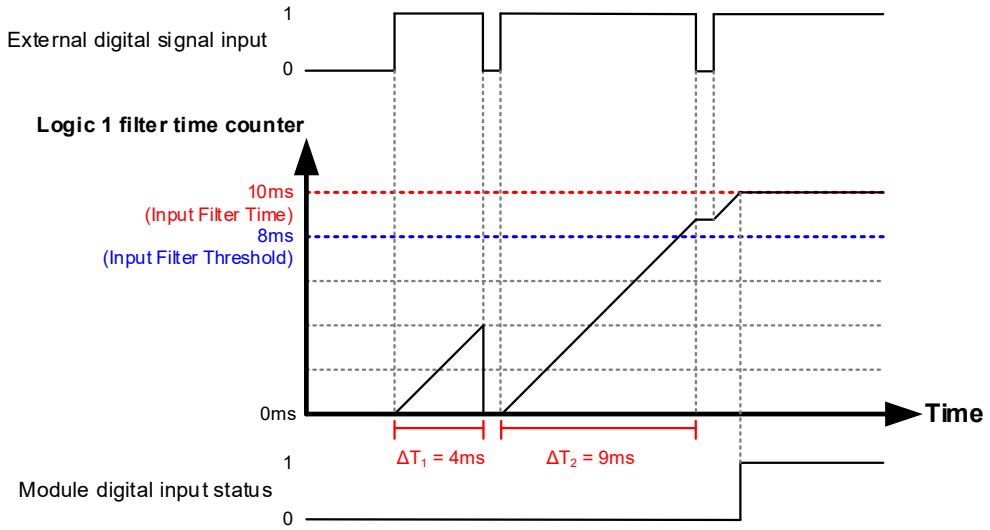
- **Parameter explanation**

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

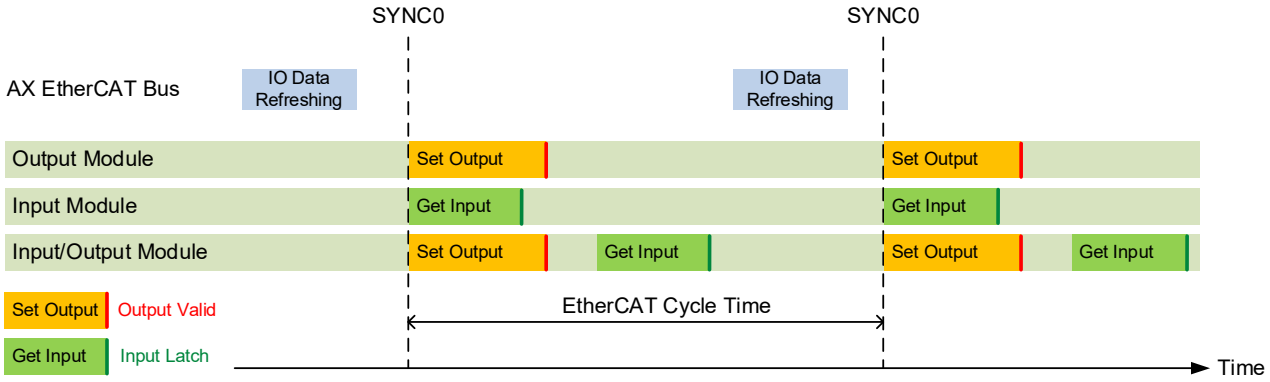
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

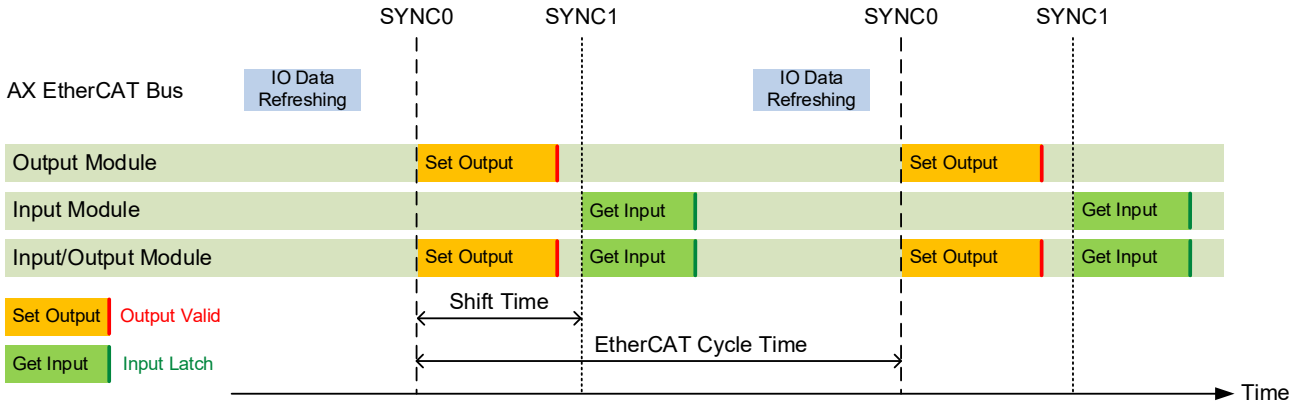
- **SYNC0**

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

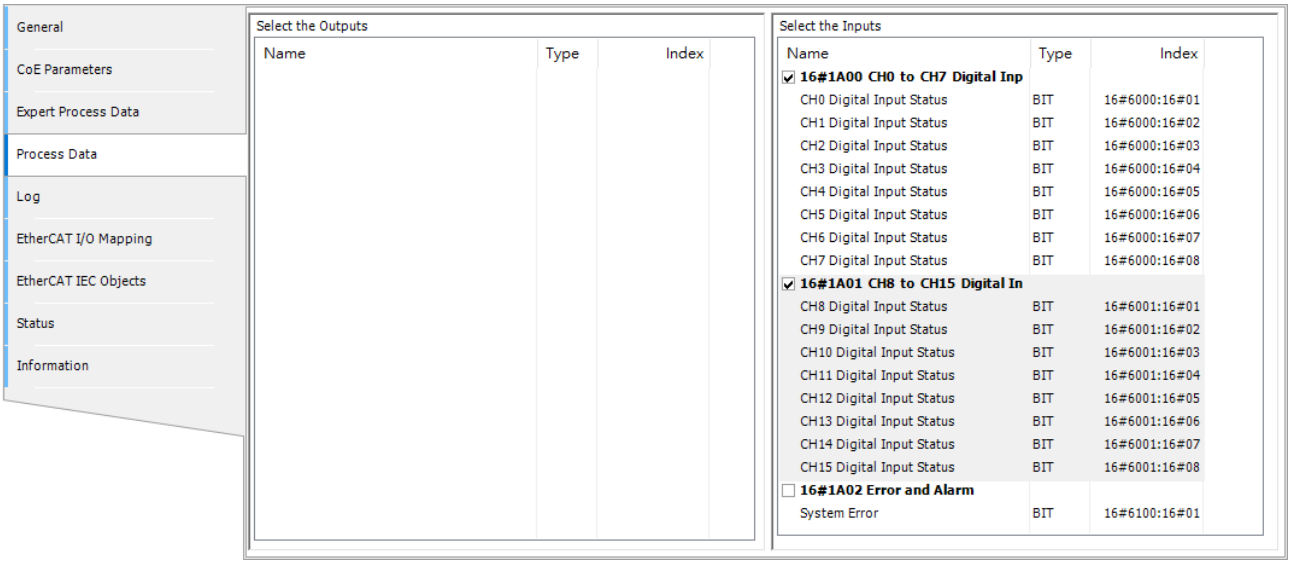
This section introduces the settings and monitoring of PDO data exchange.

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

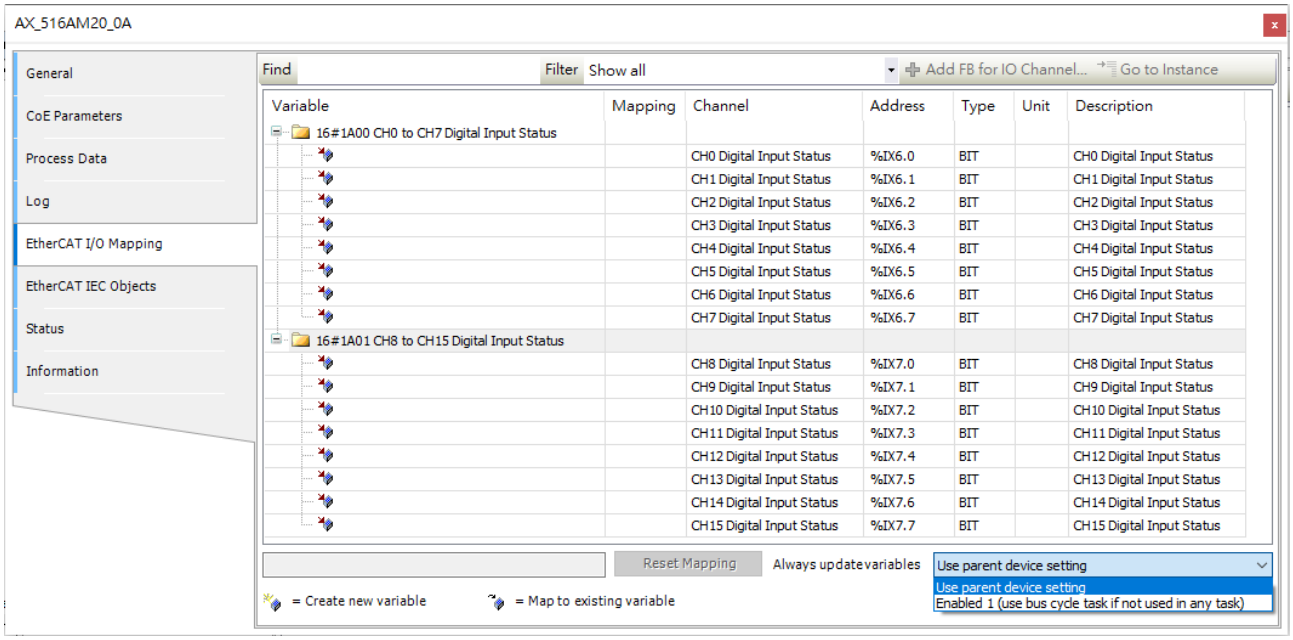
Go to the Process Data tab and select the data that you'd like to monitor.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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.

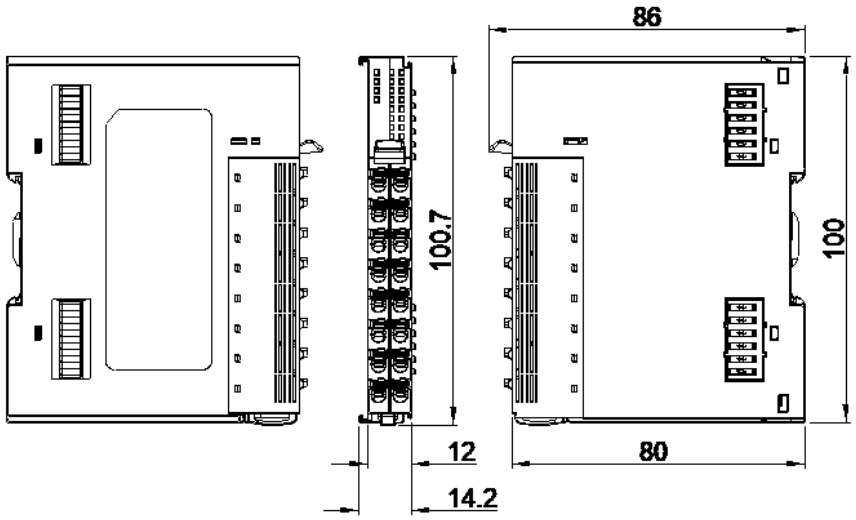
4.3.1 Specifications

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% to +20% ‧ 20.4 to 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	Connection Lost Detection	N/A
	Short Circuit Detection (SCD)	N/A
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	Yes

*1. Available for hardware A0 edition.

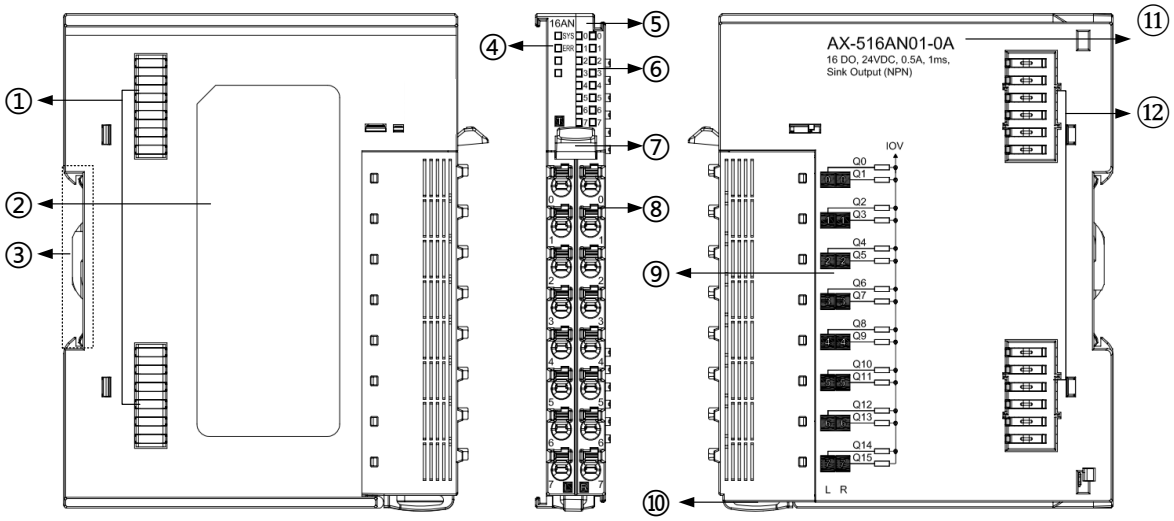
4.3.2 Dimensions and Parts

- **Dimensions**



Unit : mm

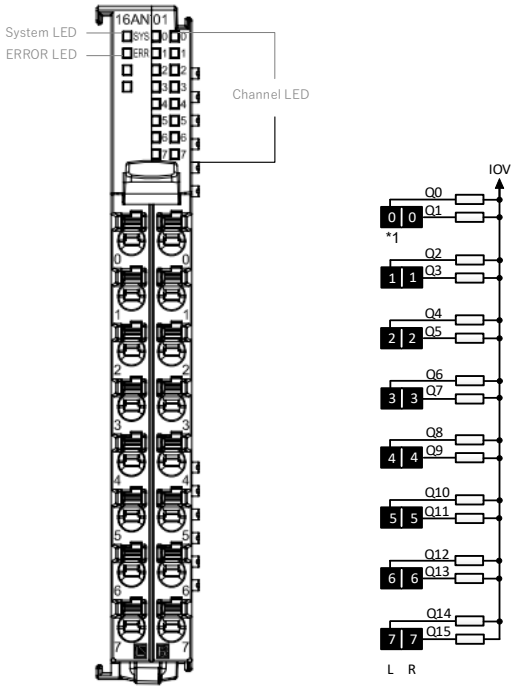
- **Parts**



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.

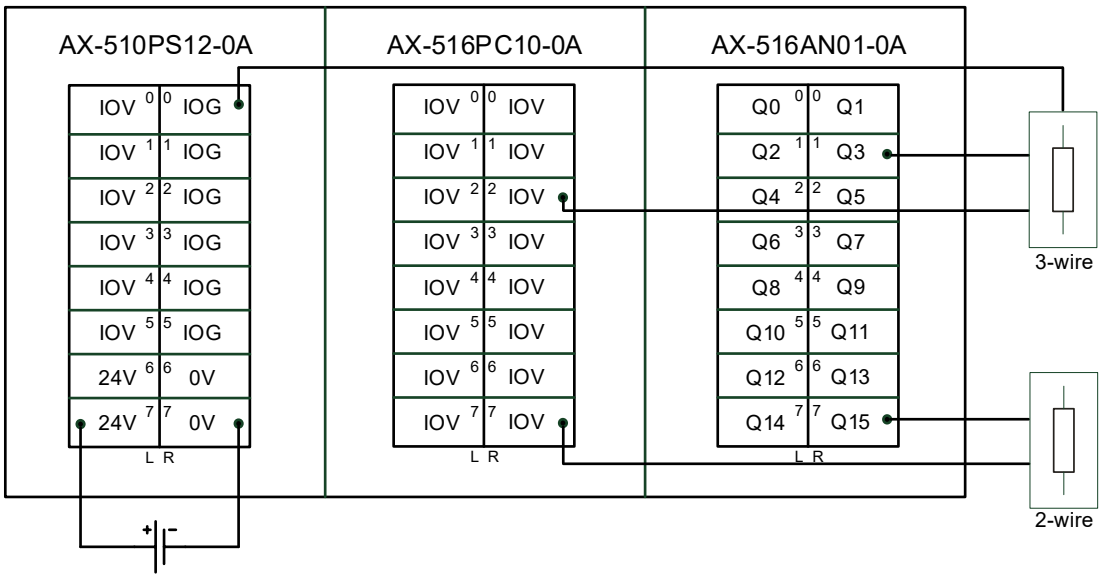
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	Q0	Digital output channel 0	R0	Q1	Digital output channel 1
L1	Q2	Digital output channel 2	R1	Q3	Digital output channel 3
L2	Q4	Digital output channel 4	R2	Q5	Digital output channel 5
L3	Q6	Digital output channel 6	R3	Q7	Digital output channel 7
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

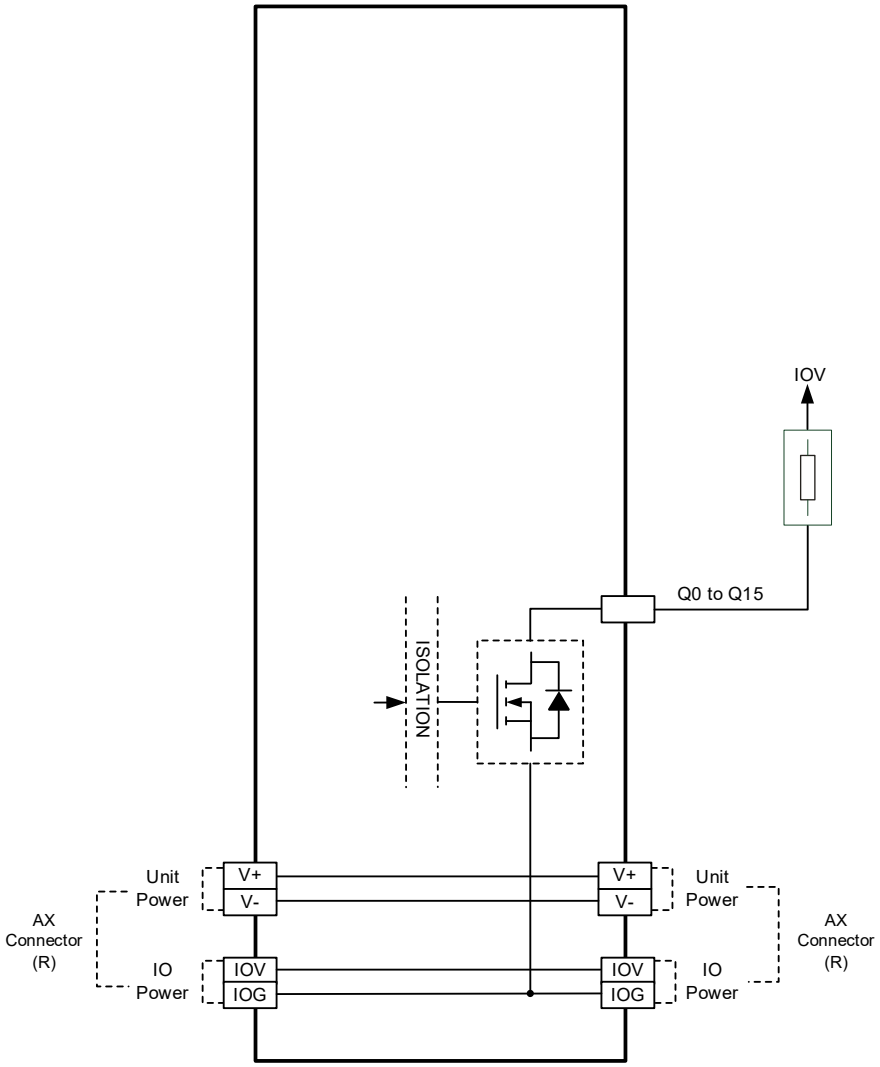
Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	**Normal (OP)**
Error	Red		OFF	Module is functioning correctly.
			ON	A severe error occurs on the module.
Channel	Green		OFF	The channel is OFF.
			ON	The channel is ON.

4.3.3.3 Wiring and Loop Configuration

- **Wiring**



- **Loop Configuration**



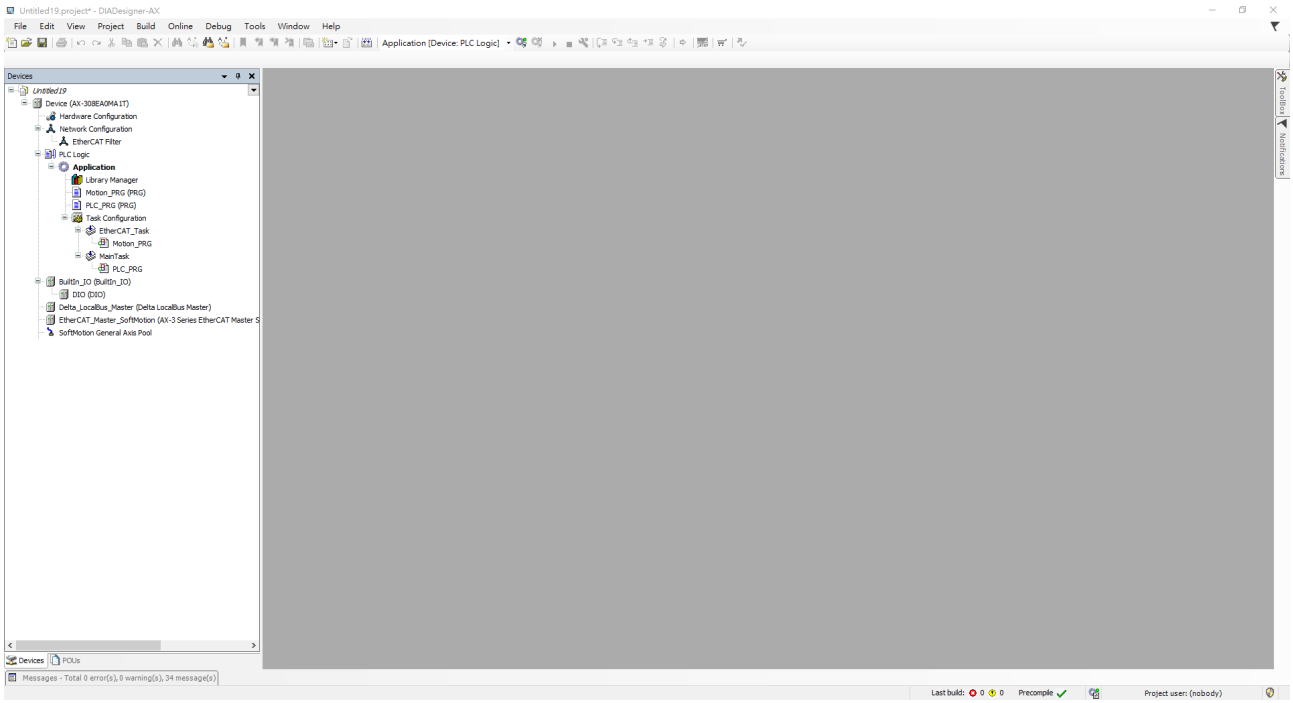
⚠	● The output circuit and internal circuit of this product are separated only by functional insulation. Therefore, to complete the installation of the product in the final system, double or reinforced insulation should be used between the product and hazardous live parts.

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

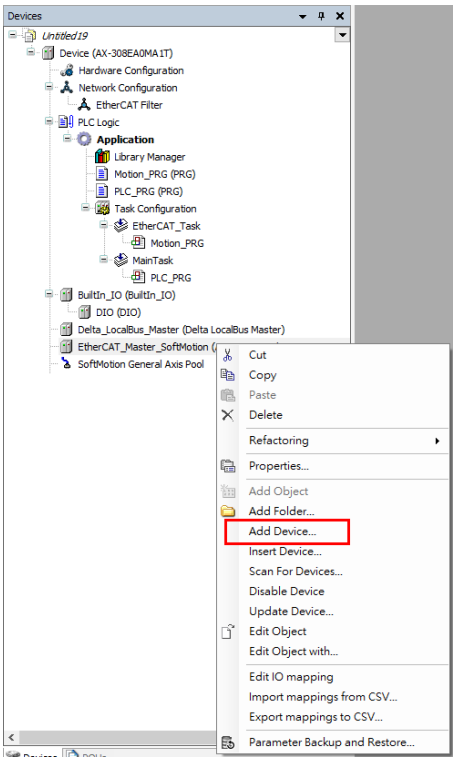
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



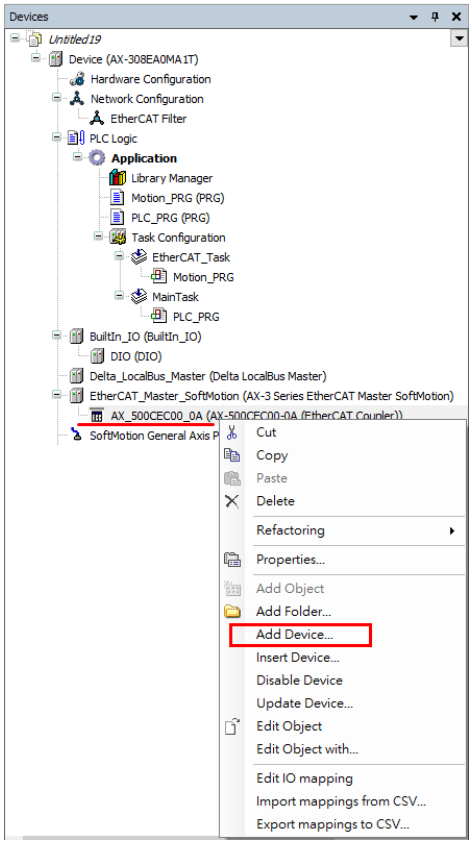
(2) Add Modules in

- 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.

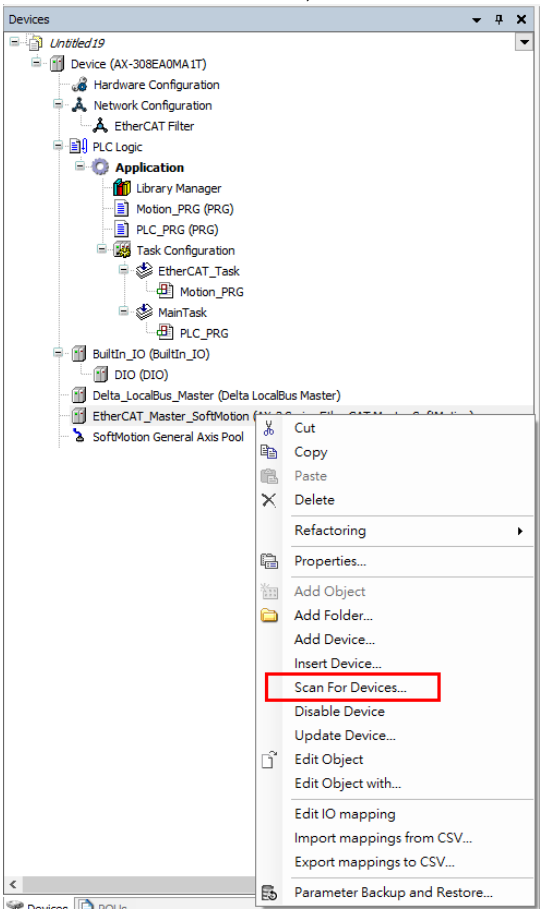


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

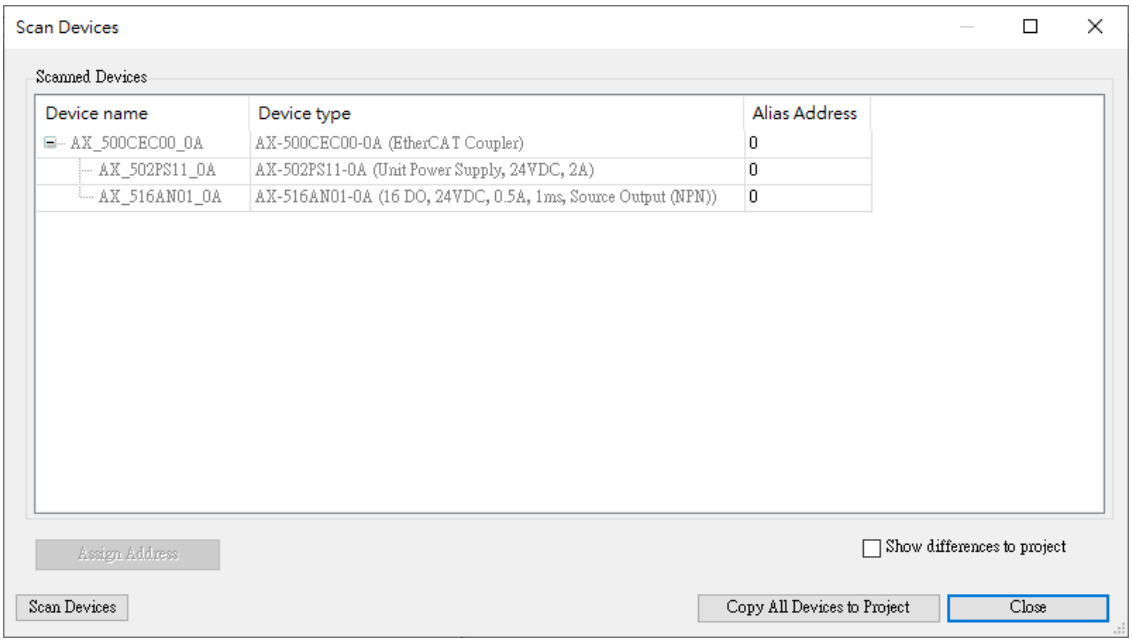


- Method 2: Scan to add the modules in.

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

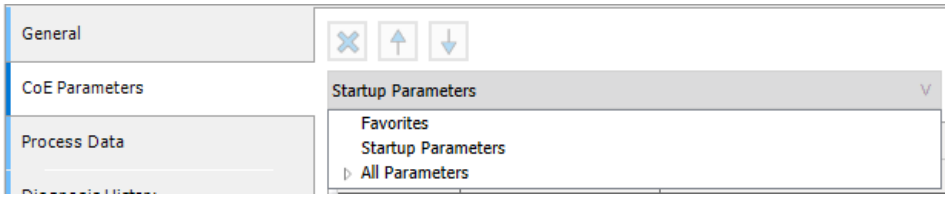


After the auto-scan is over, the actually connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.



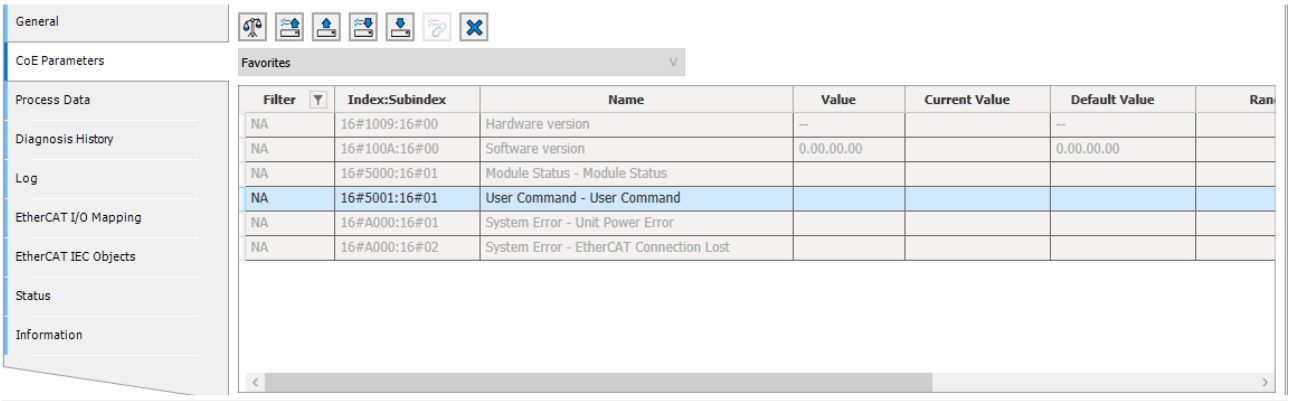
4.3.4.2 Parameter Settings

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



(1) Favorites

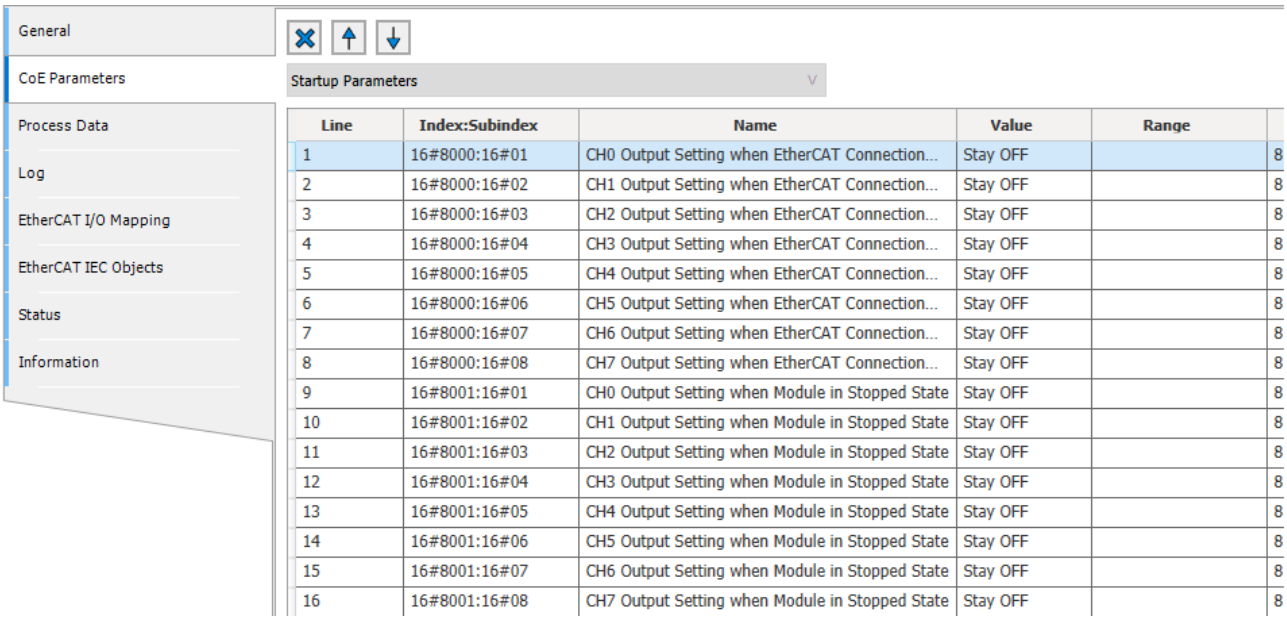
- You can add the selected parameter to Favorites according to your preference. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

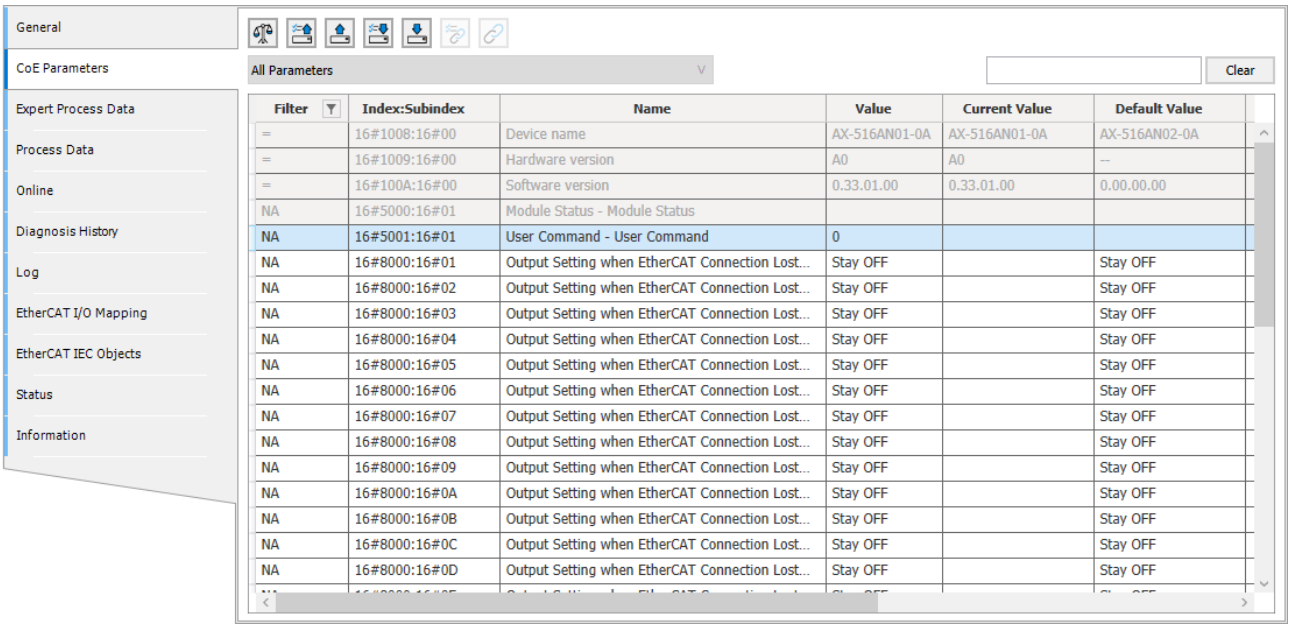


Line	Index:Subindex	Name	Value	Range
1	16#8000:16#01	CH0 Output Setting when EtherCAT Connection...	Stay OFF	
2	16#8000:16#02	CH1 Output Setting when EtherCAT Connection...	Stay OFF	
3	16#8000:16#03	CH2 Output Setting when EtherCAT Connection...	Stay OFF	
4	16#8000:16#04	CH3 Output Setting when EtherCAT 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

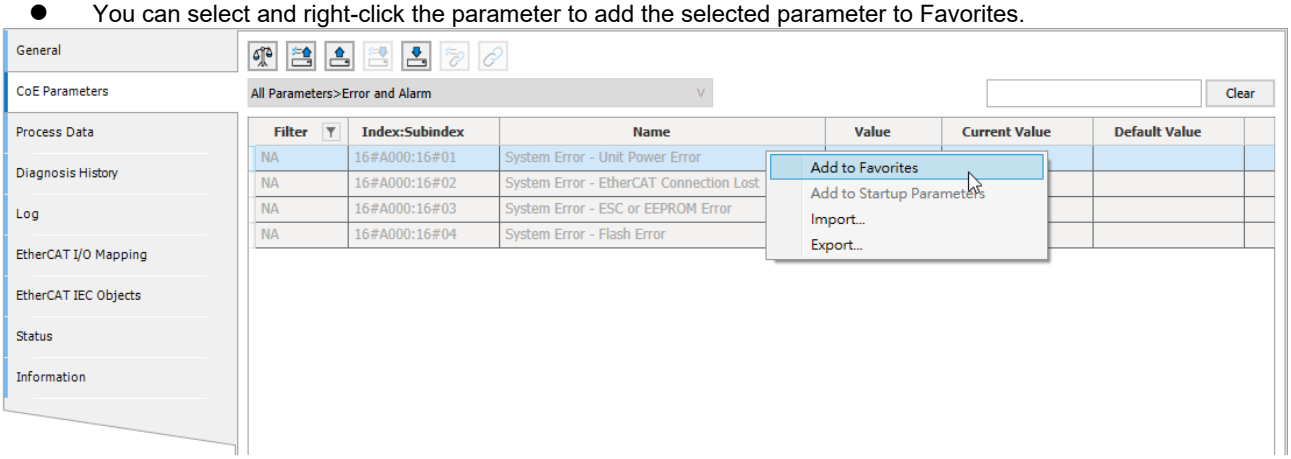
(3) All Parameters

- 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.

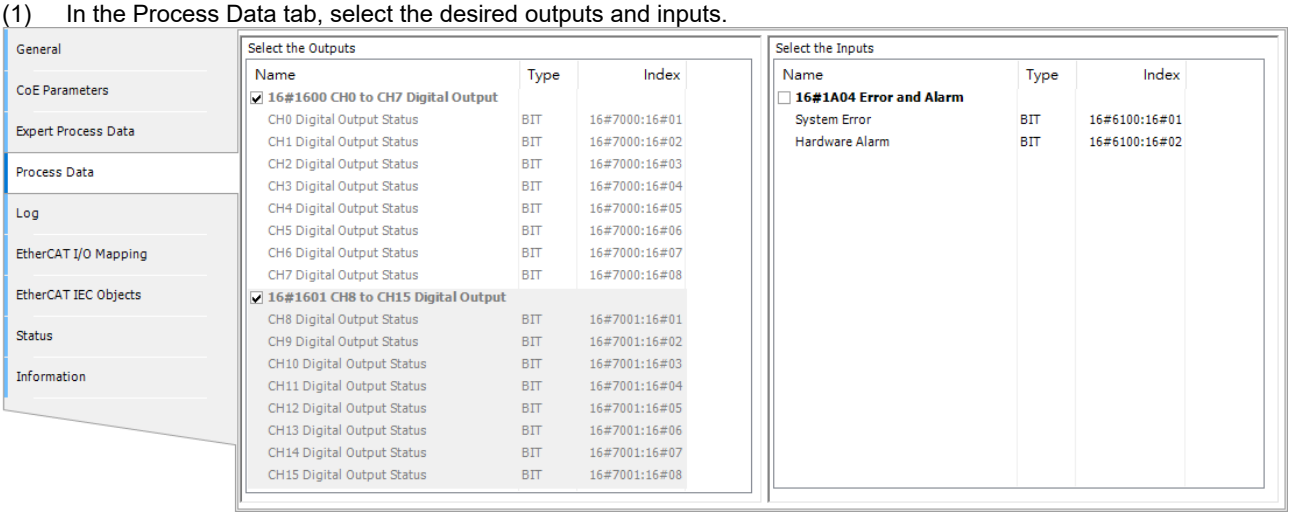


Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

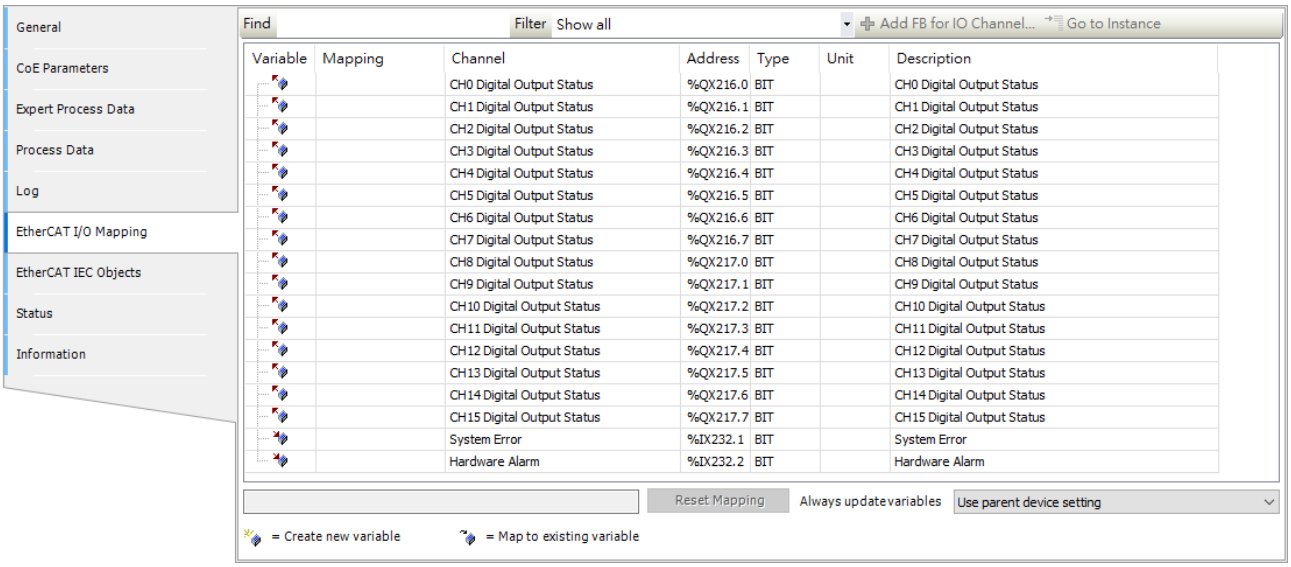
4

4.3.4.3 Process Data

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



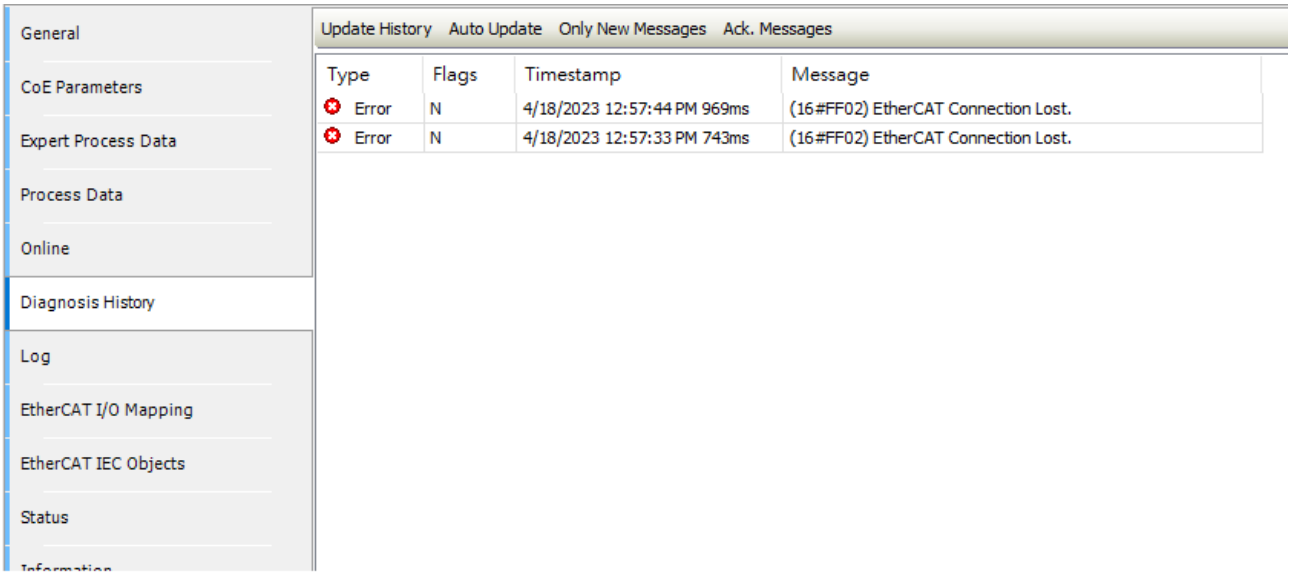
(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



4

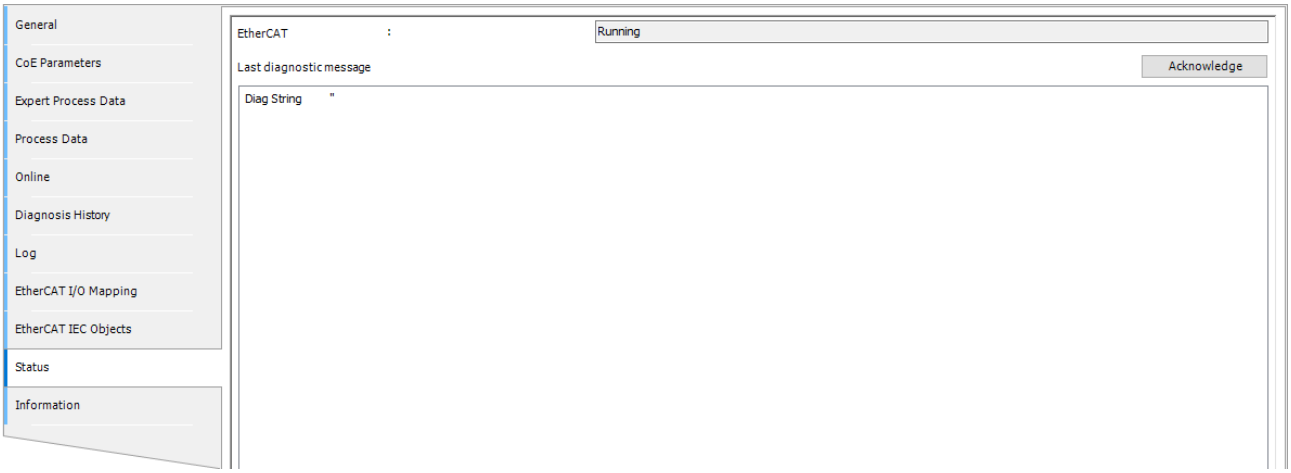
4.3.4.4 Diagnosis History

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.



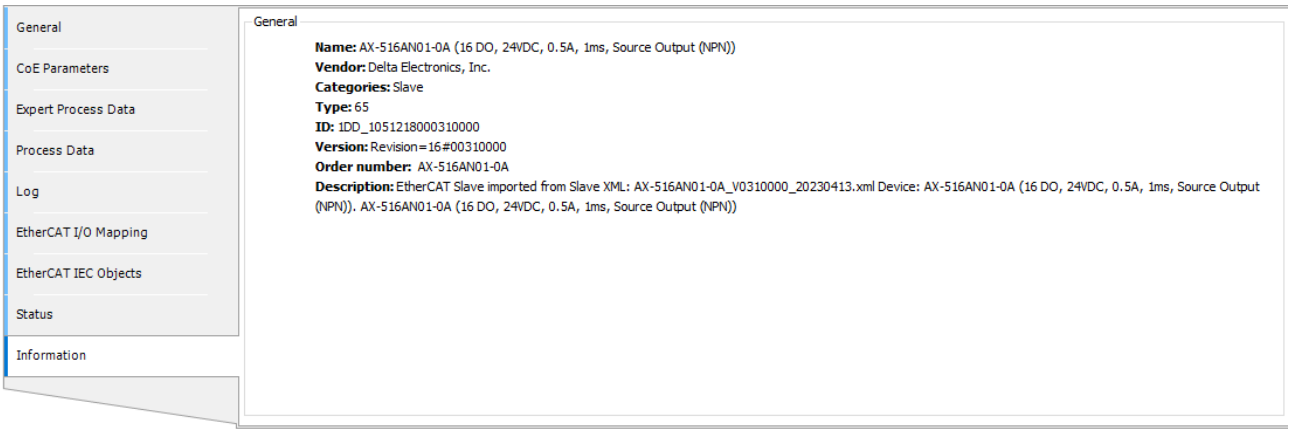
4.3.4.5 Status

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

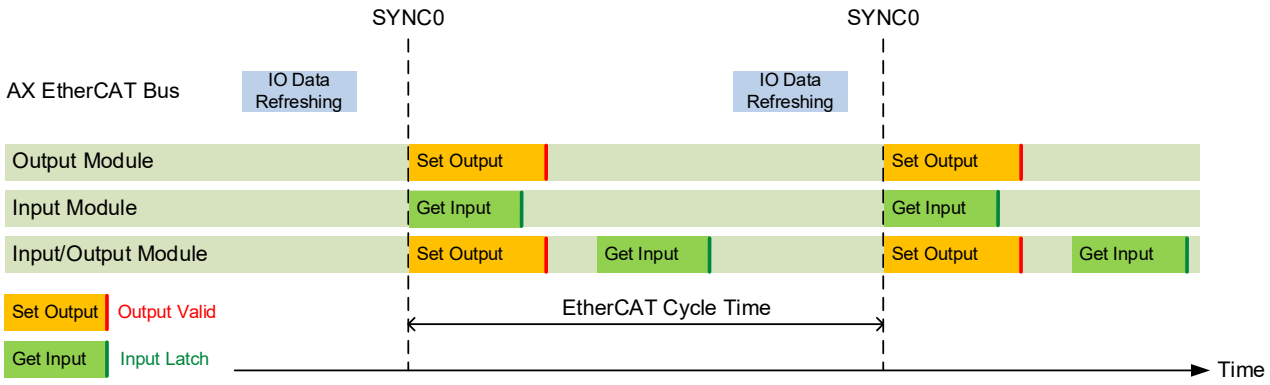
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

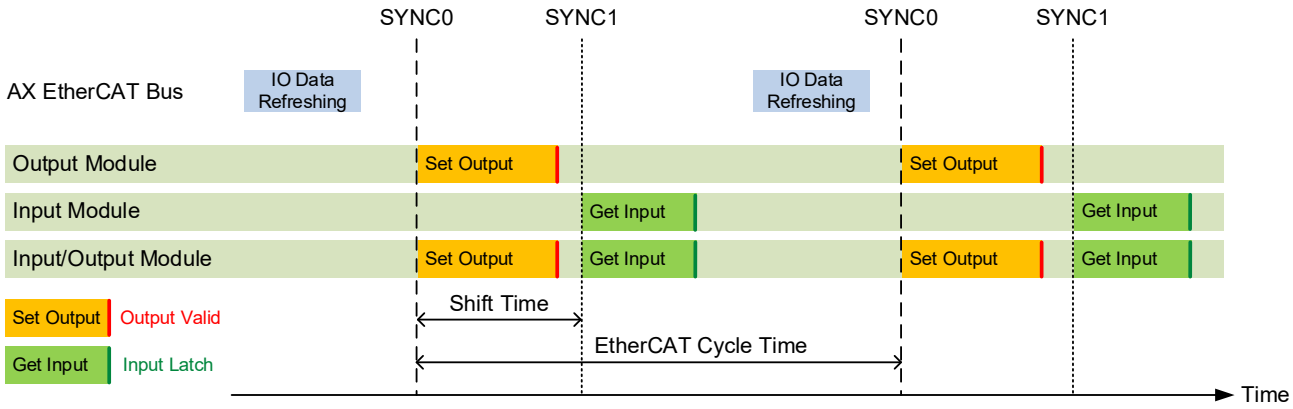
- **SYNC0**

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

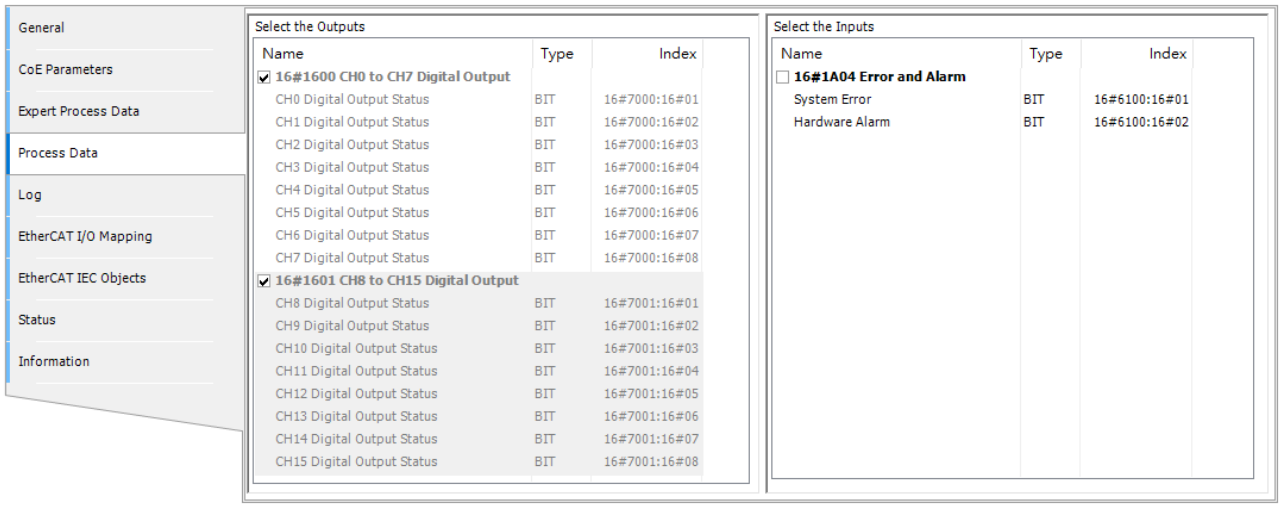
This section introduces the settings and monitoring of PDO data exchange.

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

4.3.7.1 Process Data

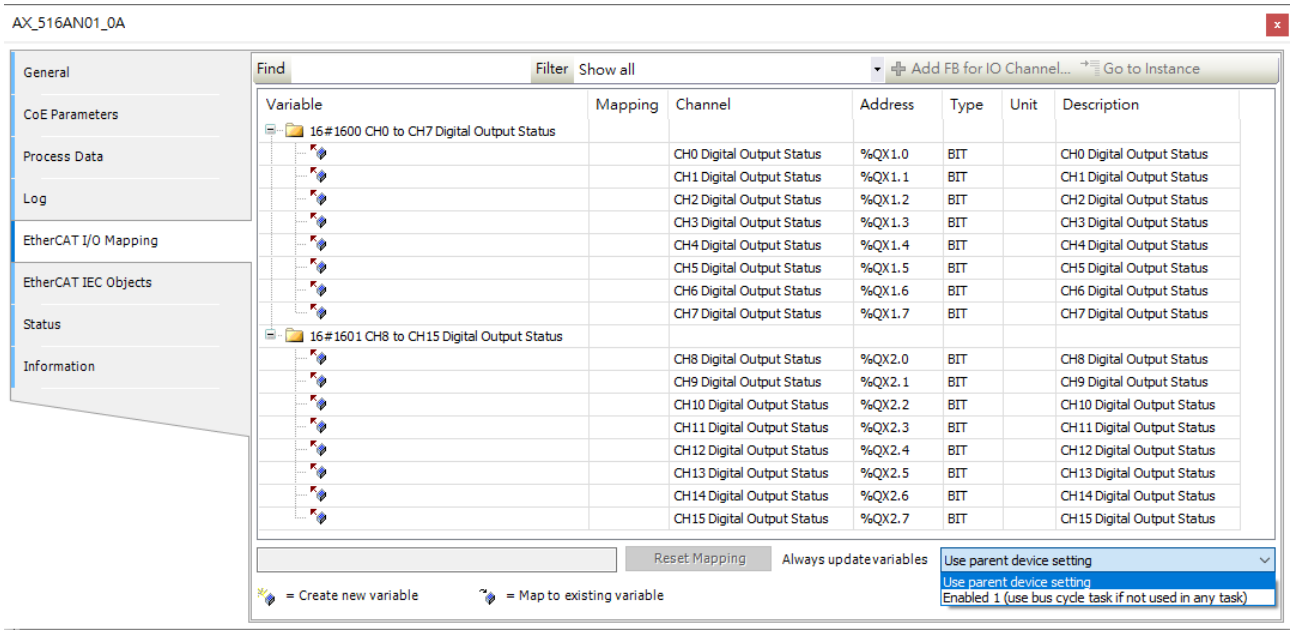
Go to the Process Data tab and select the data that you'd like to monitor.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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

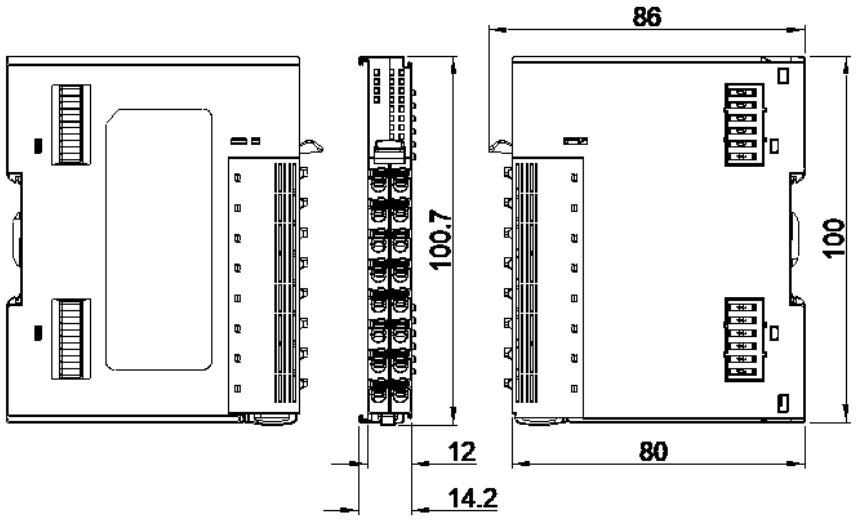
AX-516AN02-0A, a digital output module, outputs 16-point digital signals (PNP). This section introduces its specifications, operations and wirings.

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% to +20%, 20.4 to 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	Connection Lost Detection	NA
	Short Circuit Detection (SCD)	NA
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	Yes

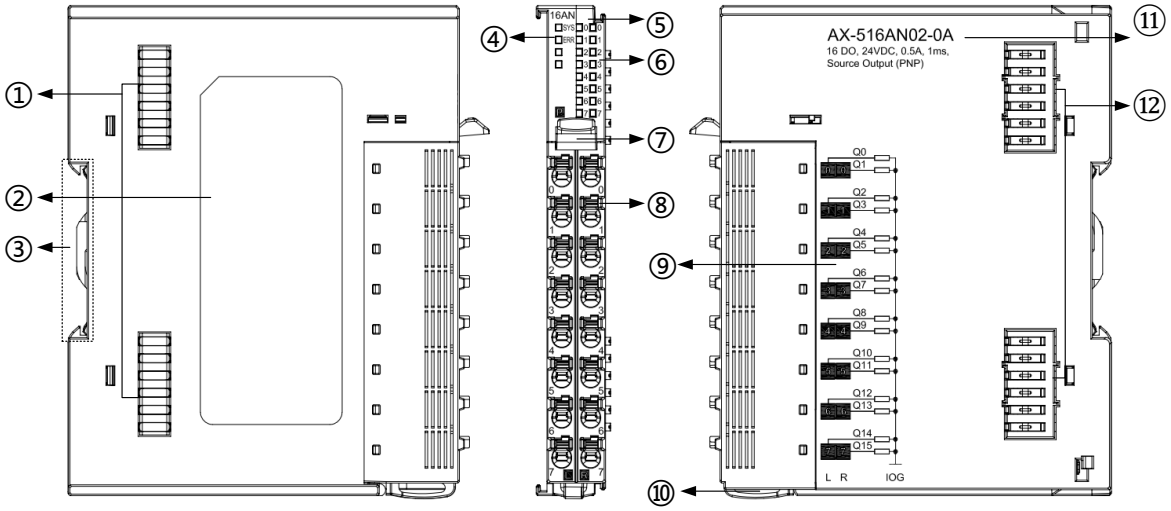
4.4.2 Dimensions and Parts

- **Dimensions**



Unit : mm

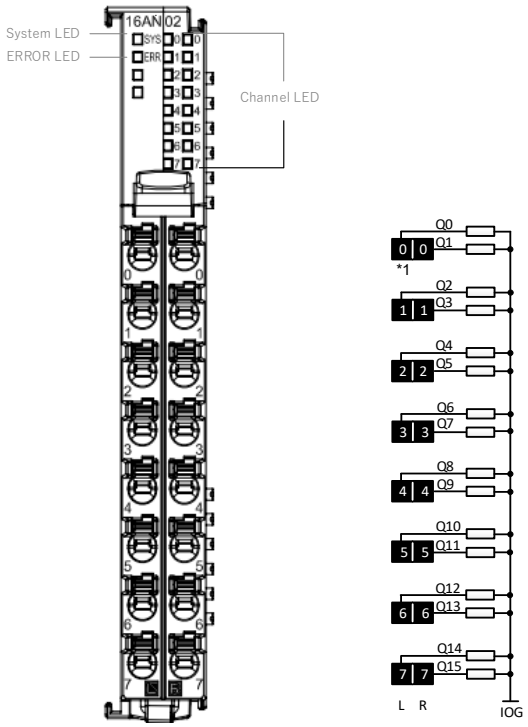
- **Parts**



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.

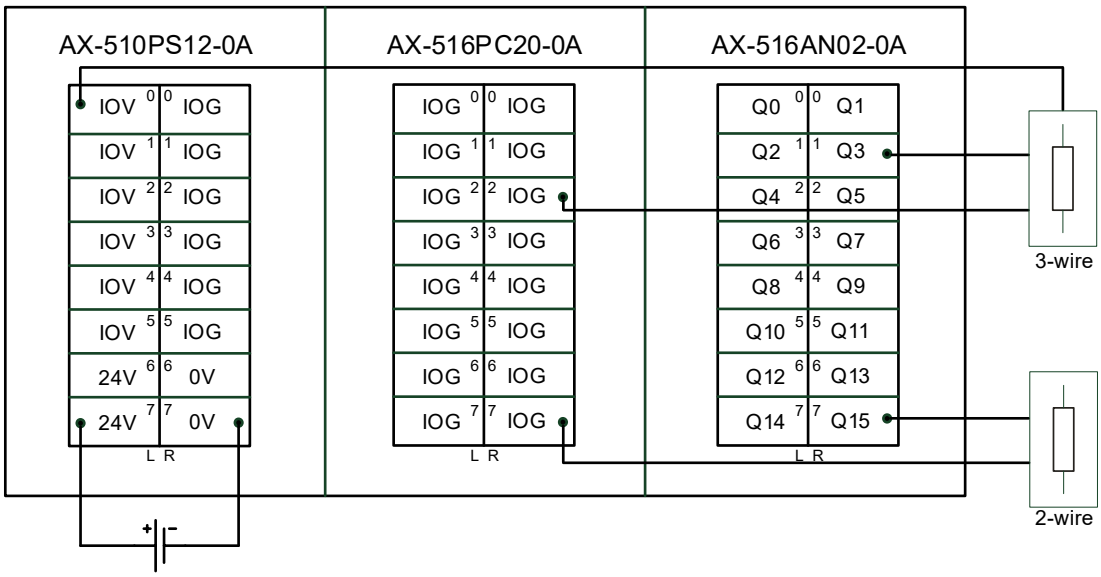
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	Q0	Digital output channel 0	R0	Q1	Digital output channel 1
L1	Q2	Digital output channel 2	R1	Q3	Digital output channel 3
L2	Q4	Digital output channel 4	R2	Q5	Digital output channel 5
L3	Q6	Digital output channel 6	R3	Q7	Digital output channel 7
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

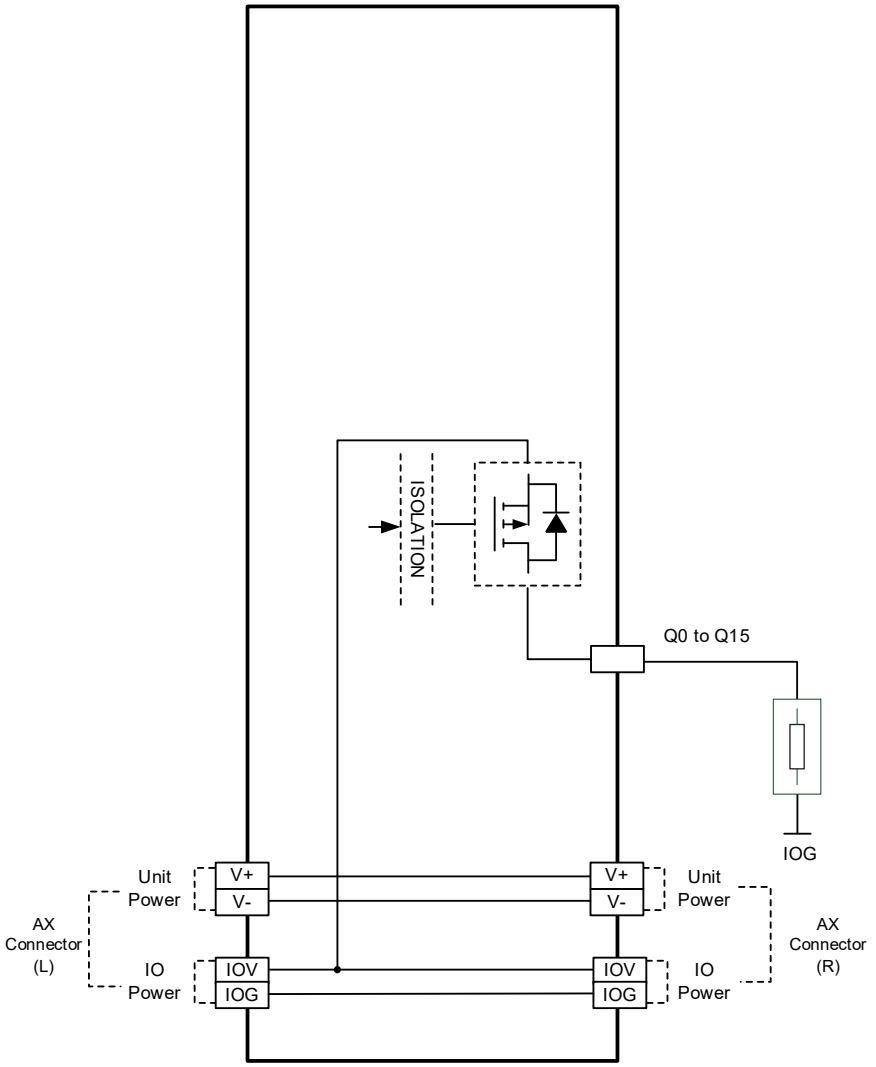
Name	Color	Status		Description
System	Blue		OFF	ECAT INIT
			Blinking (0.2s)	ECAT Pre OP
			Blinking(1s)	ECAT Safe OP
			ON	Normal (OP)
Error	Red		OFF	Module is functioning correctly.
			ON	A severe error occurs on the module.
Channel	Green		OFF	The channel is OFF.
			ON	The channel is ON.

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

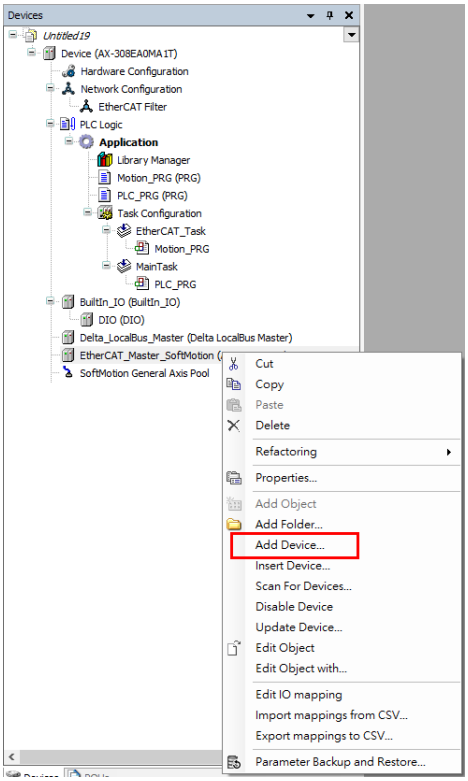
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



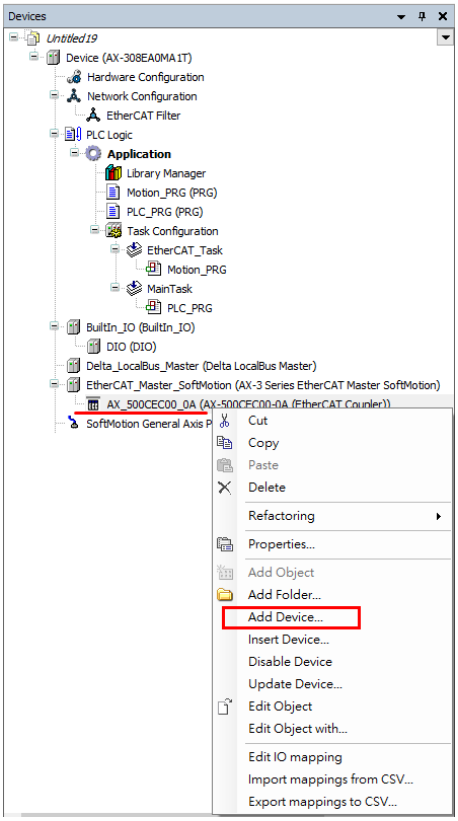
(2) Add Modules in

- 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.

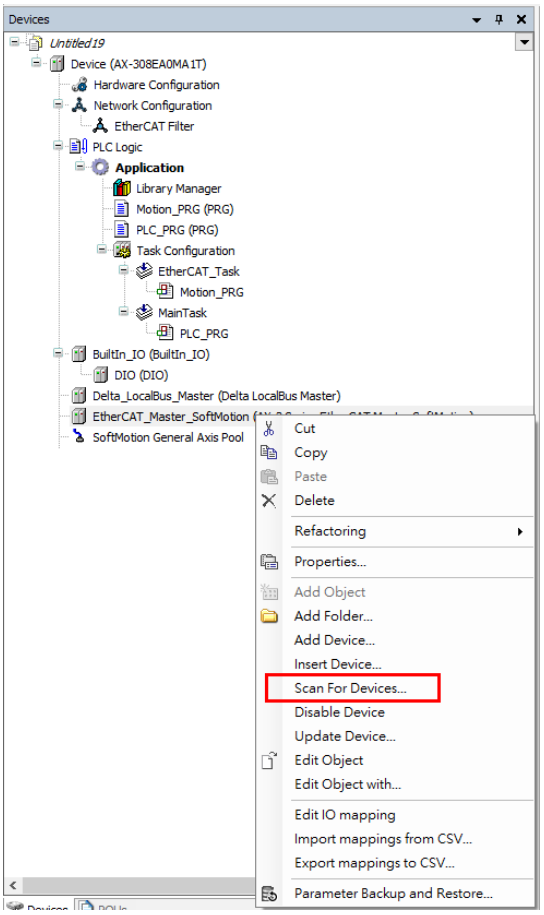


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

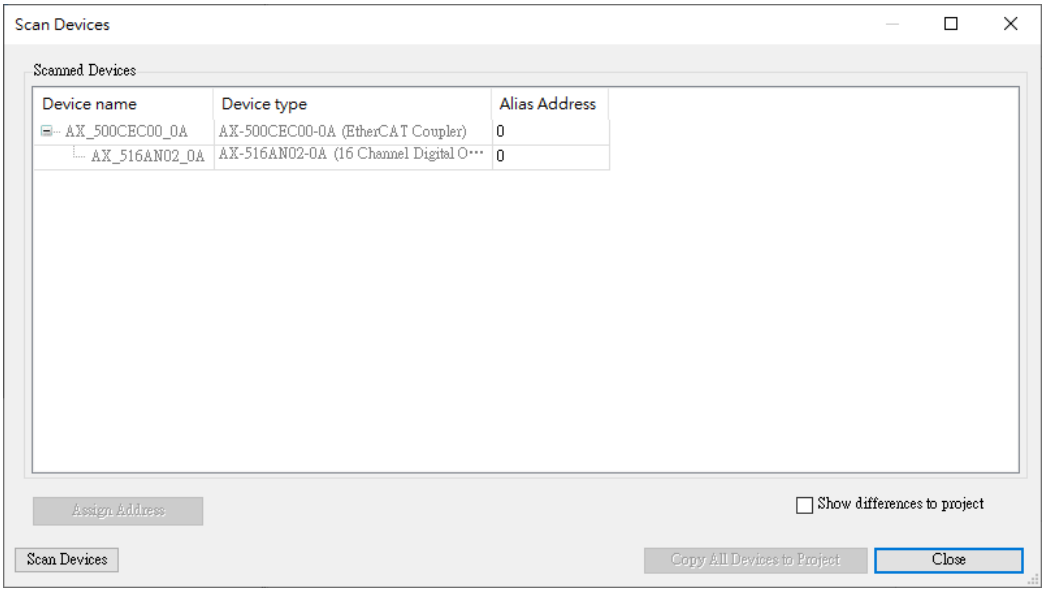


- Method 2: Scan to add the modules in.

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

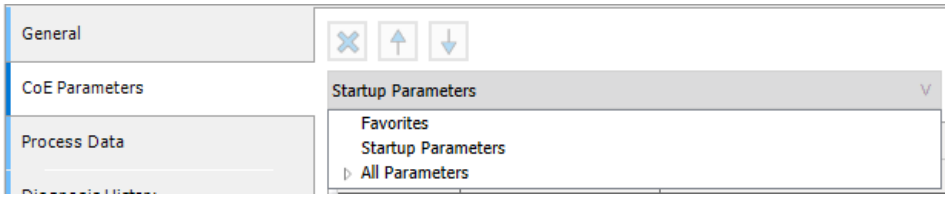


After the auto-scan is over, the actually connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.



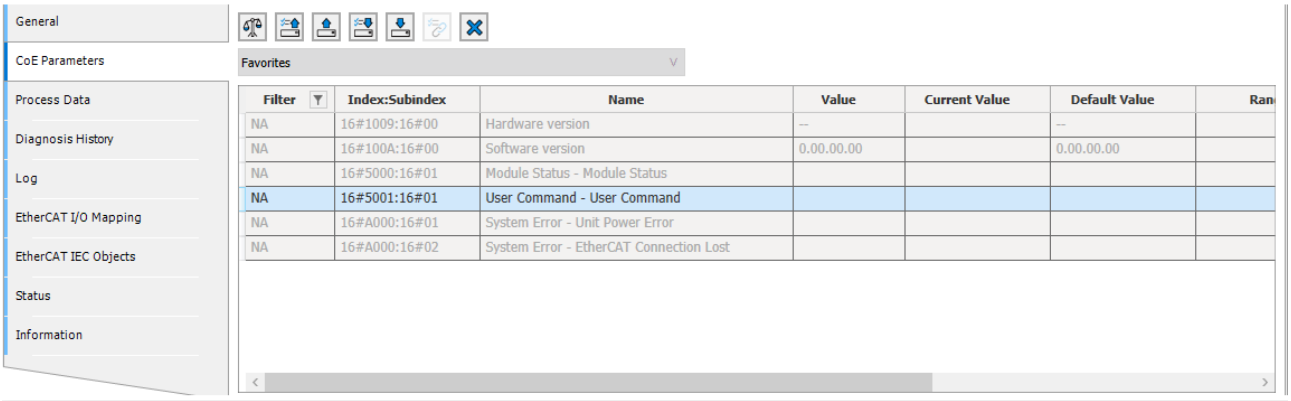
4.4.4.2 Parameter Settings

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



(1) Favorites

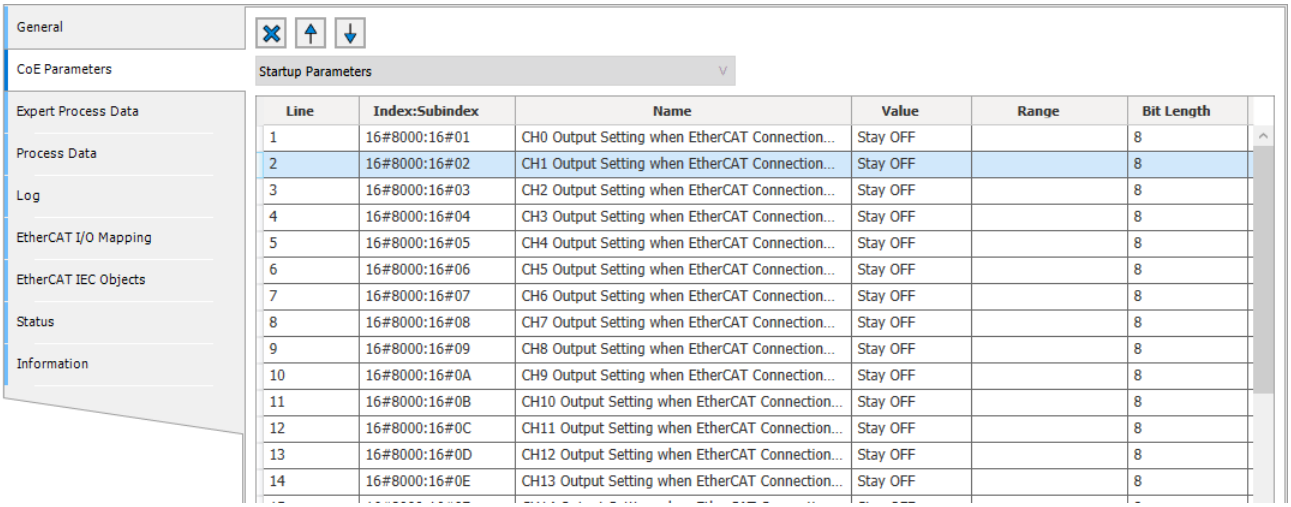
- You can add the selected parameter to Favorites according to your preference. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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

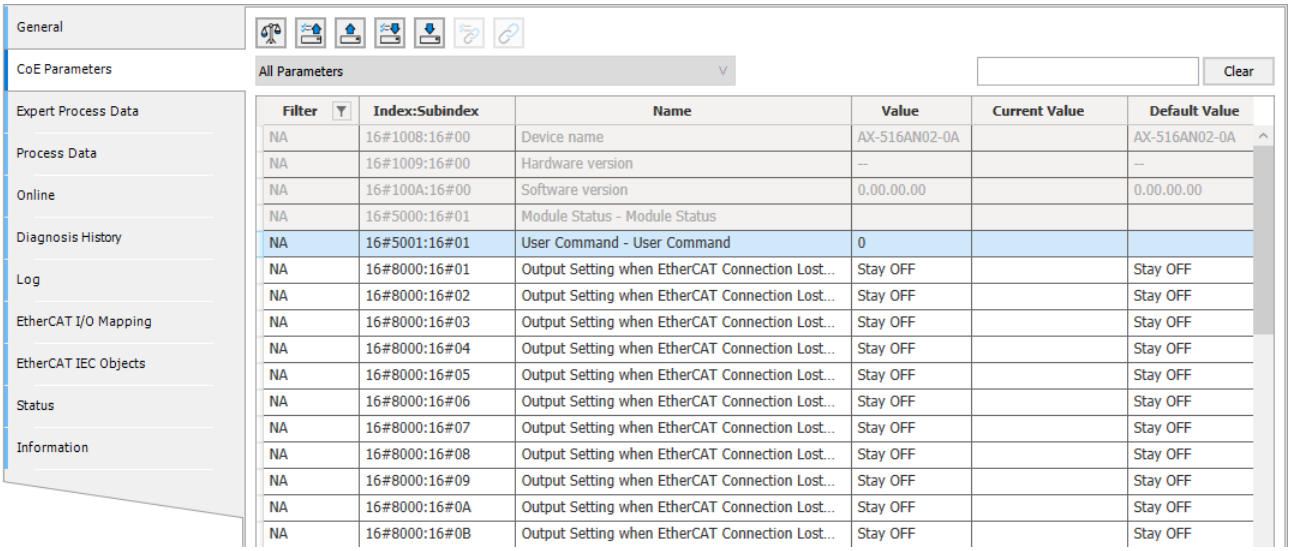
- Once the module is started up, the setting values of parameters in the Startup Parameters list are written to the module. For editing, you have to set up these parameters in offline mode.



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

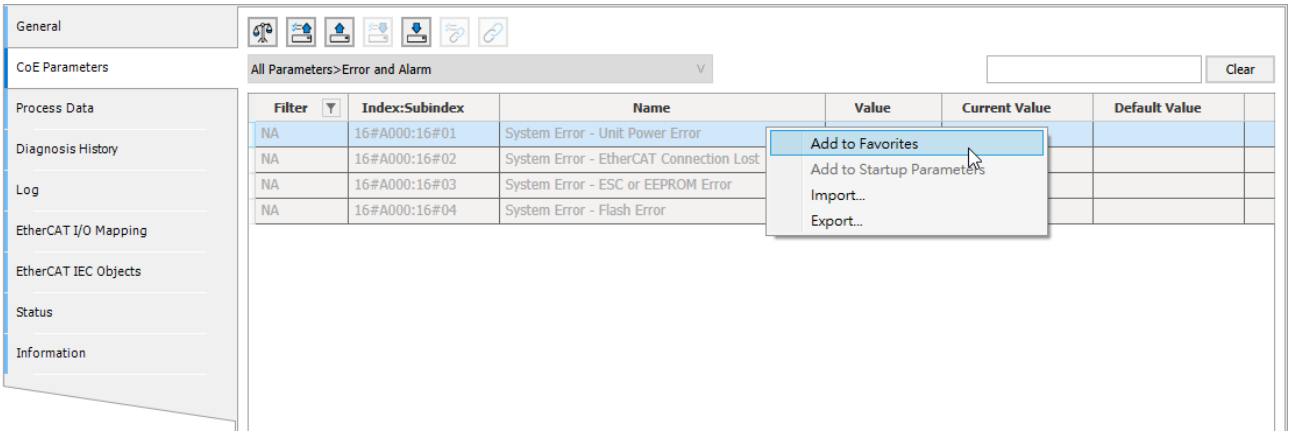
(3) All Parameters

- 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.

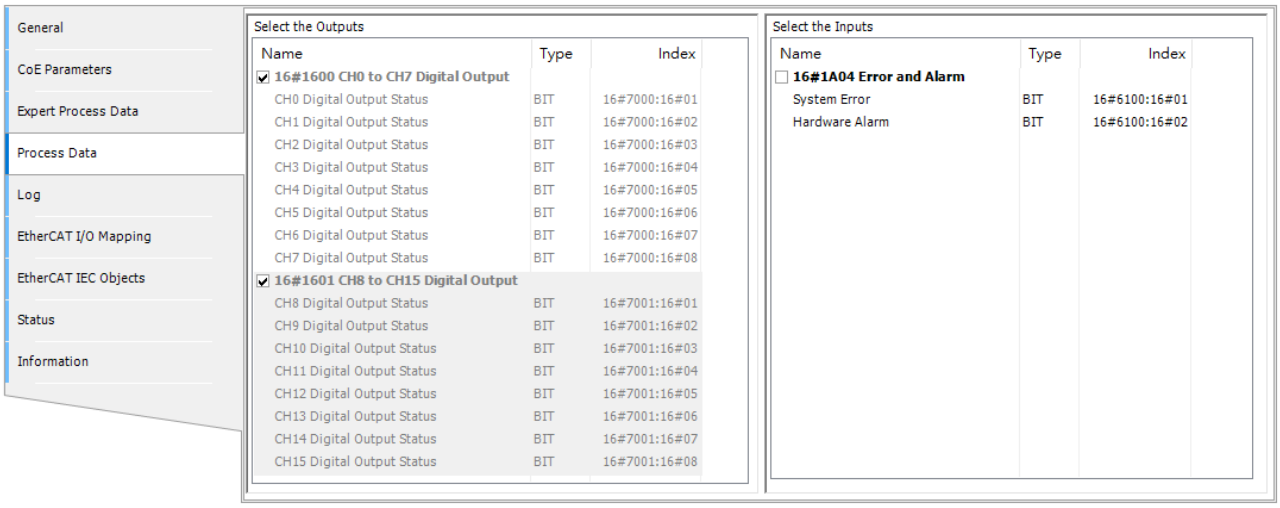
- You can select and right-click the parameter to add the selected parameter to the Favorites.



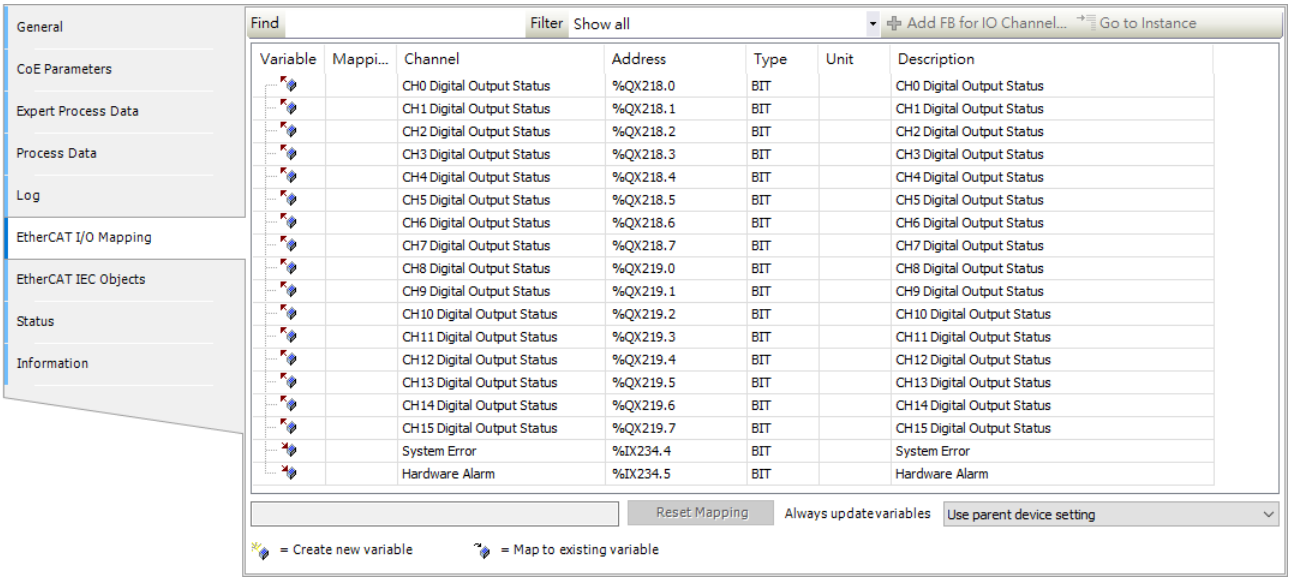
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

4.4.4.3 Process Data

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

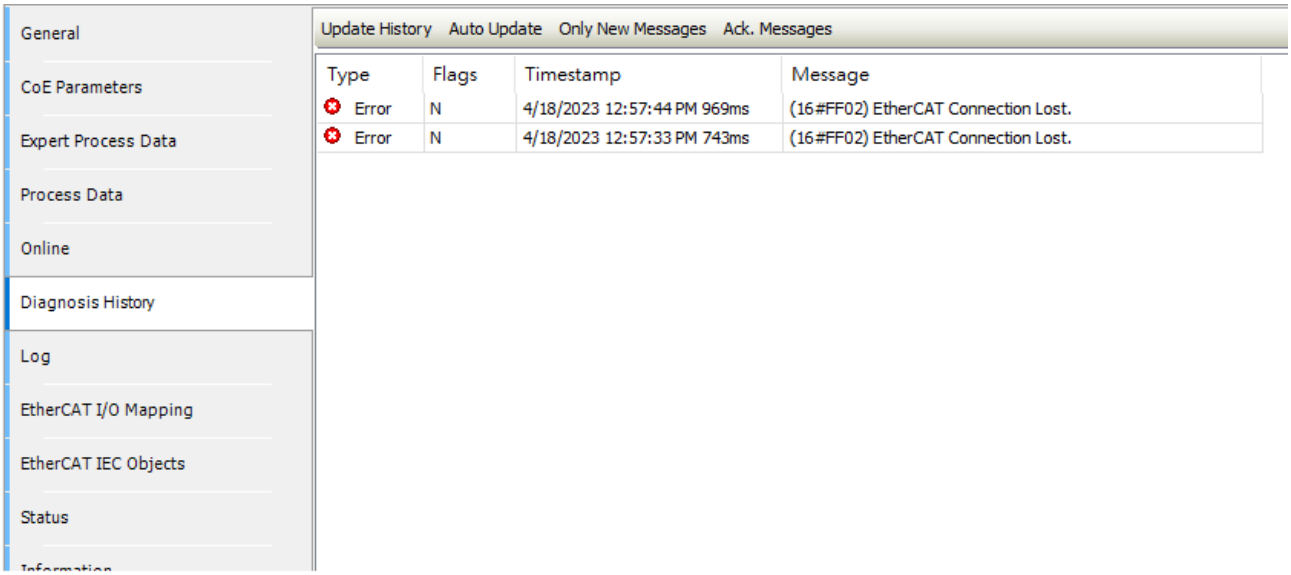


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



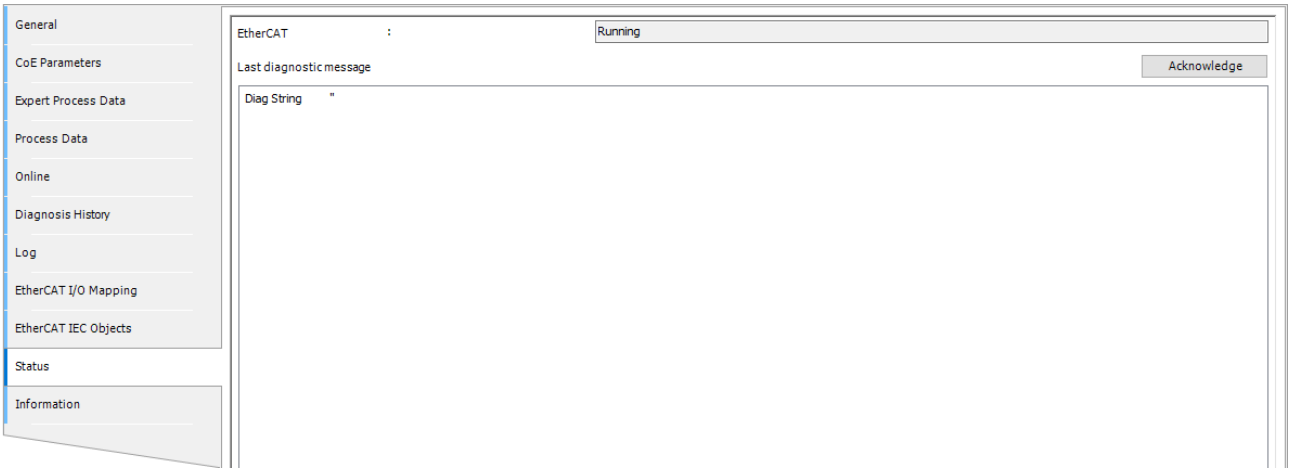
4.4.4.4 Diagnosis History

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.



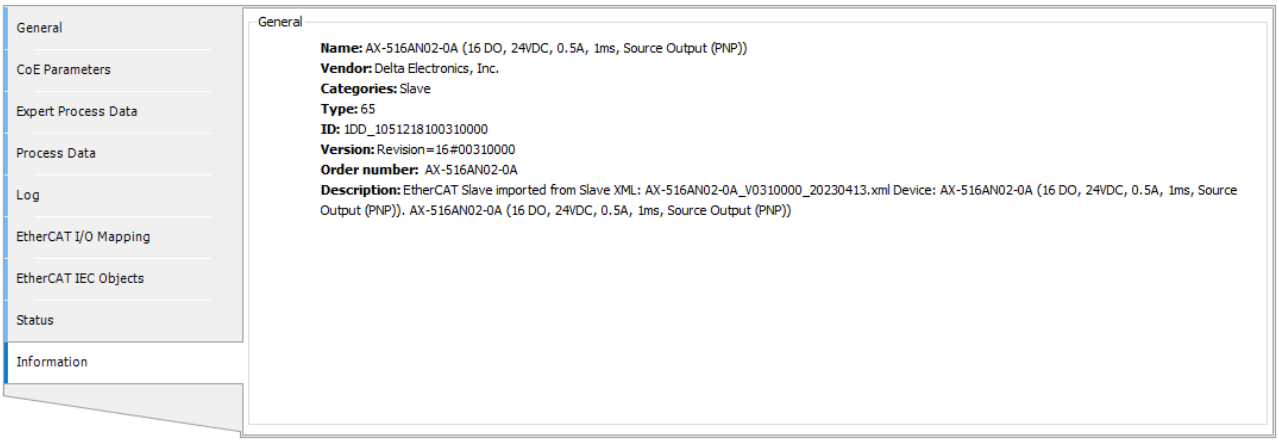
4.4.4.5 Status

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

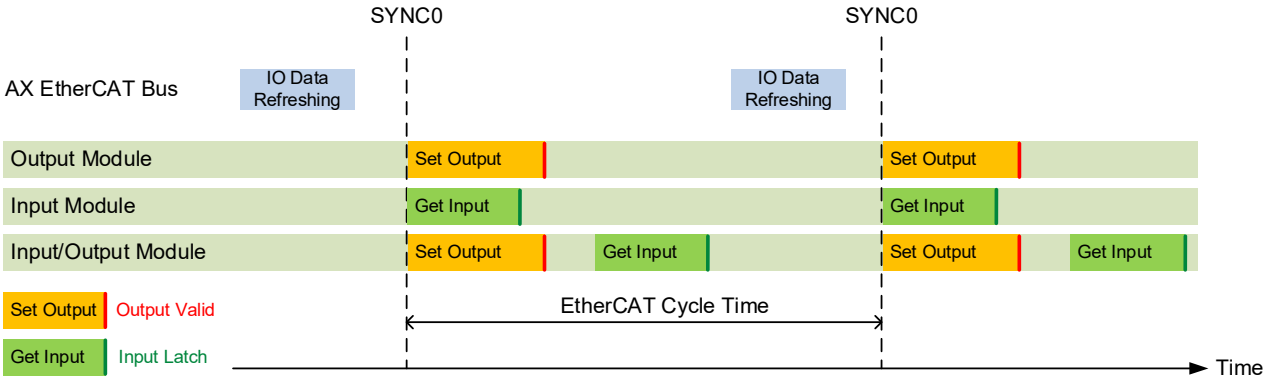
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

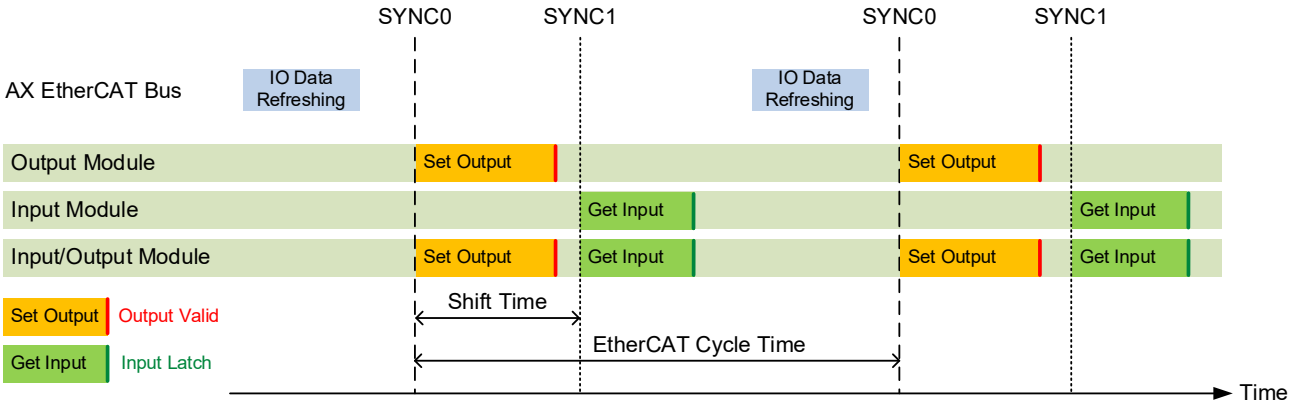
- **SYNC0**

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

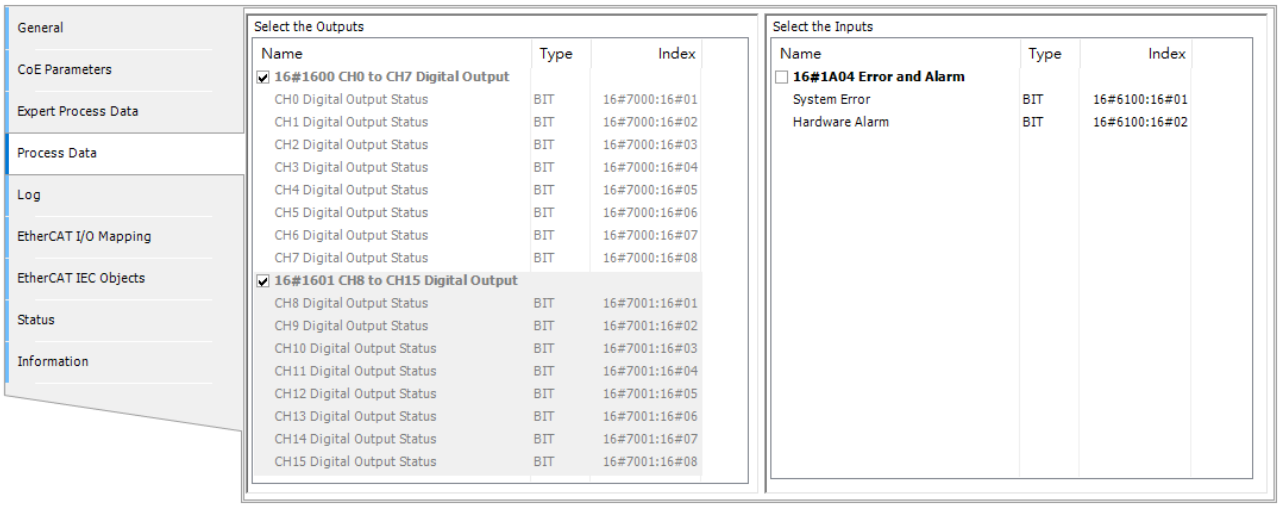
This section introduces the settings and monitoring of PDO data exchange.

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

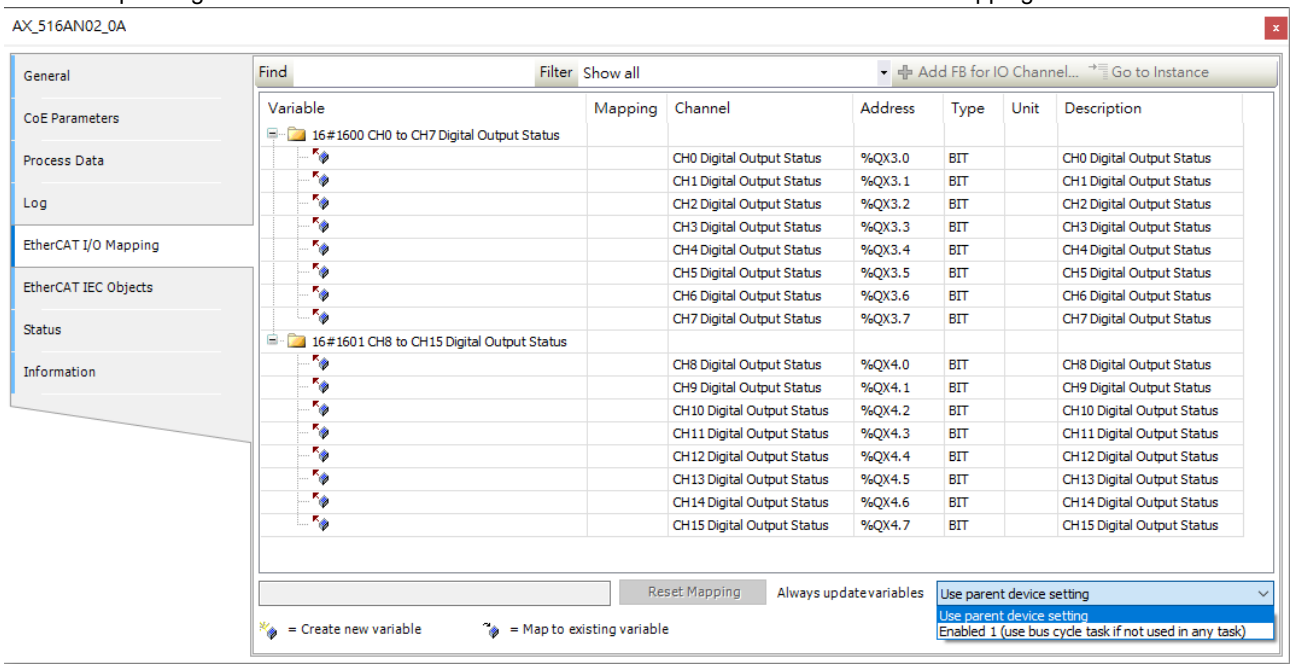
Go to the Process Data tab and select the data that you'd like to monitor. There are two types of data here.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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.

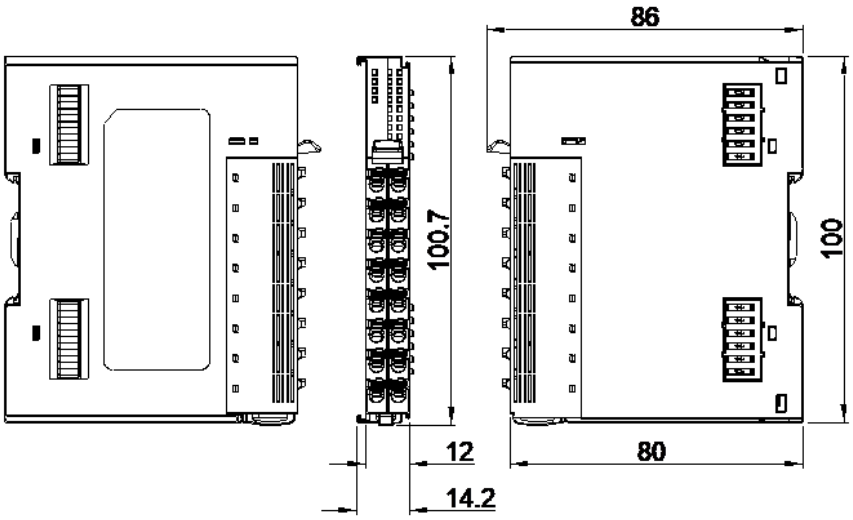
4.5.1 Specifications

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 to 30 V (EN 61131-2, type 3)
		OFF voltage	-3 to +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% to +20%, 20.4 to 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 Detection	N/A
		Short Circuit Detection (SCD)	N/A
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	Current limiting
		Filter function	Firmware filtering time: 0 to 255 ms (default: 3 ms)
	Digital output	Connection Lost Detection	N/A
		Short Circuit Detection (SCD)	N/A
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	Yes

*1. Available for hardware A0 edition.

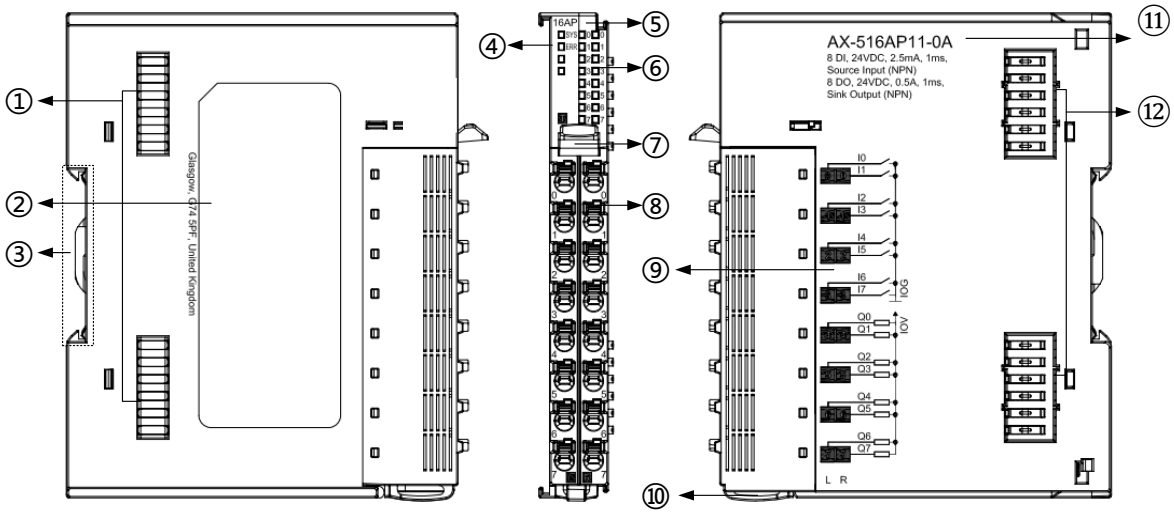
4.5.2 Dimensions and Parts

- **Dimensions**



Unit : mm

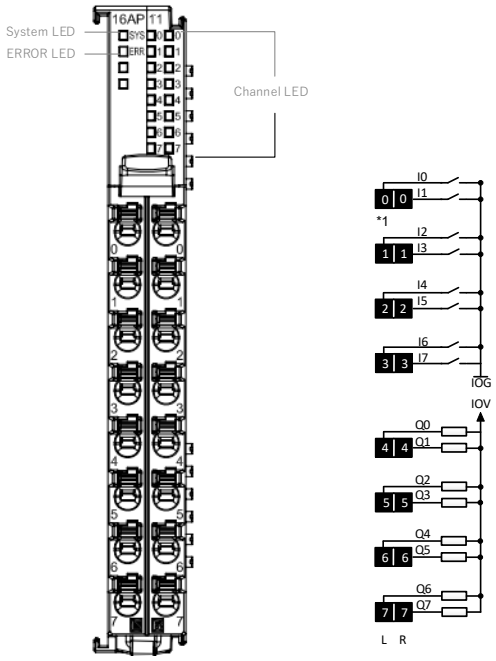
- **Parts**



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.

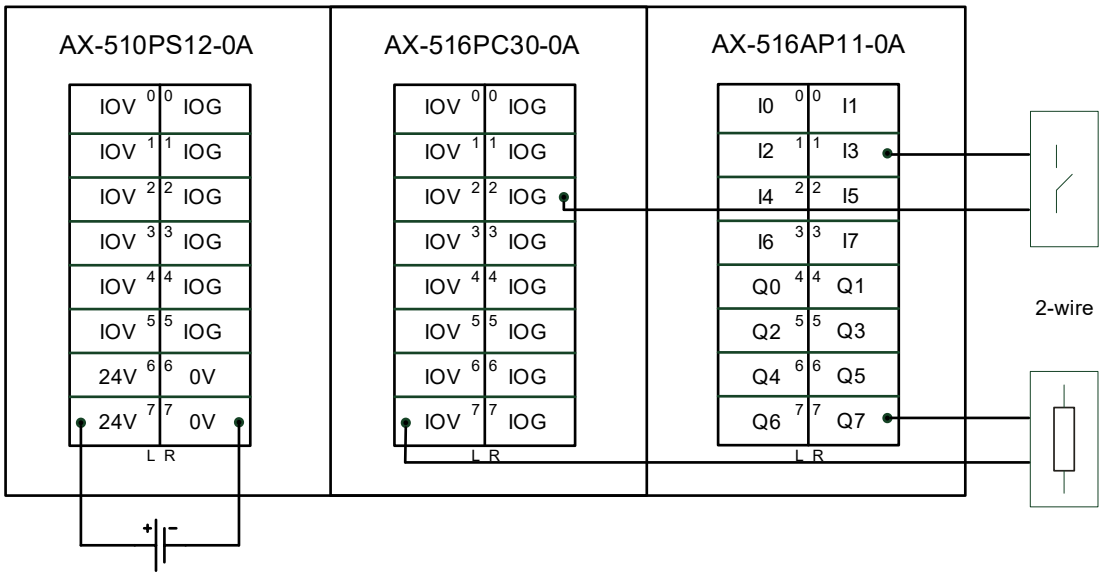
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0	Digital input channel 0	R0	I1	Digital input channel 1
L1	I2	Digital input channel 2	R1	I3	Digital input channel 3
L2	I4	Digital input channel 4	R2	I5	Digital input channel 5
L3	I6	Digital input channel 6	R3	I7	Digital input channel 7
L4	Q0	Digital 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

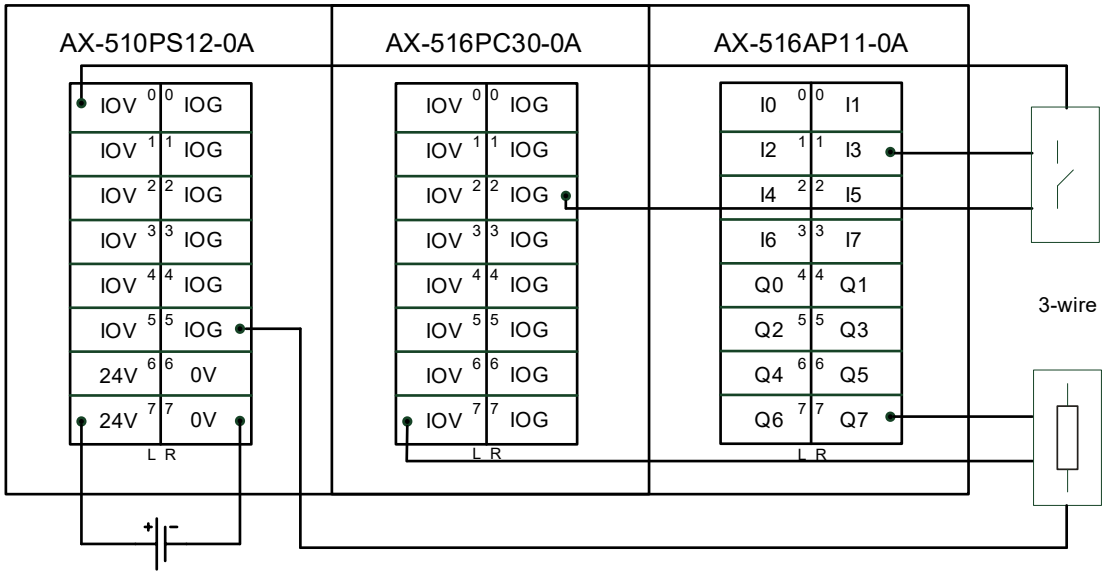
4.5.3.2 LED Indicators

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.

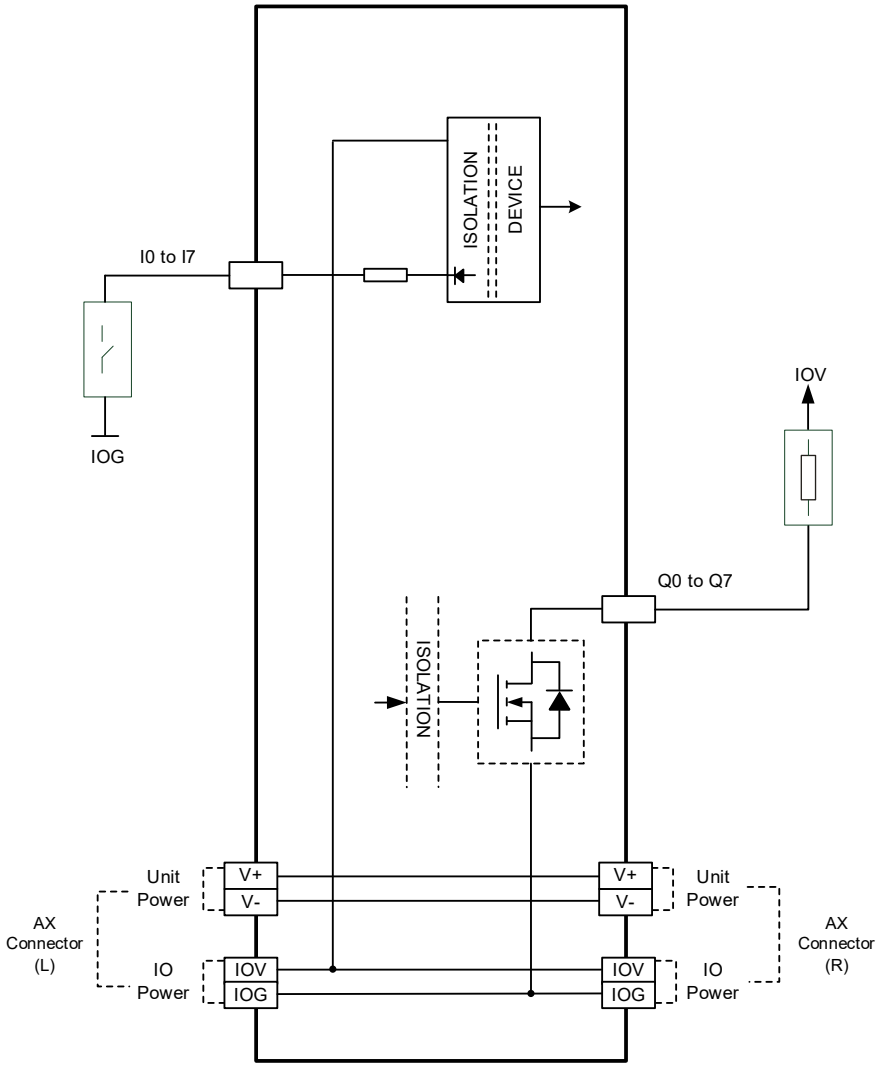
4.5.3.3 Wiring and Loop Configuration

- **Wiring**





- **Loop Configuration**



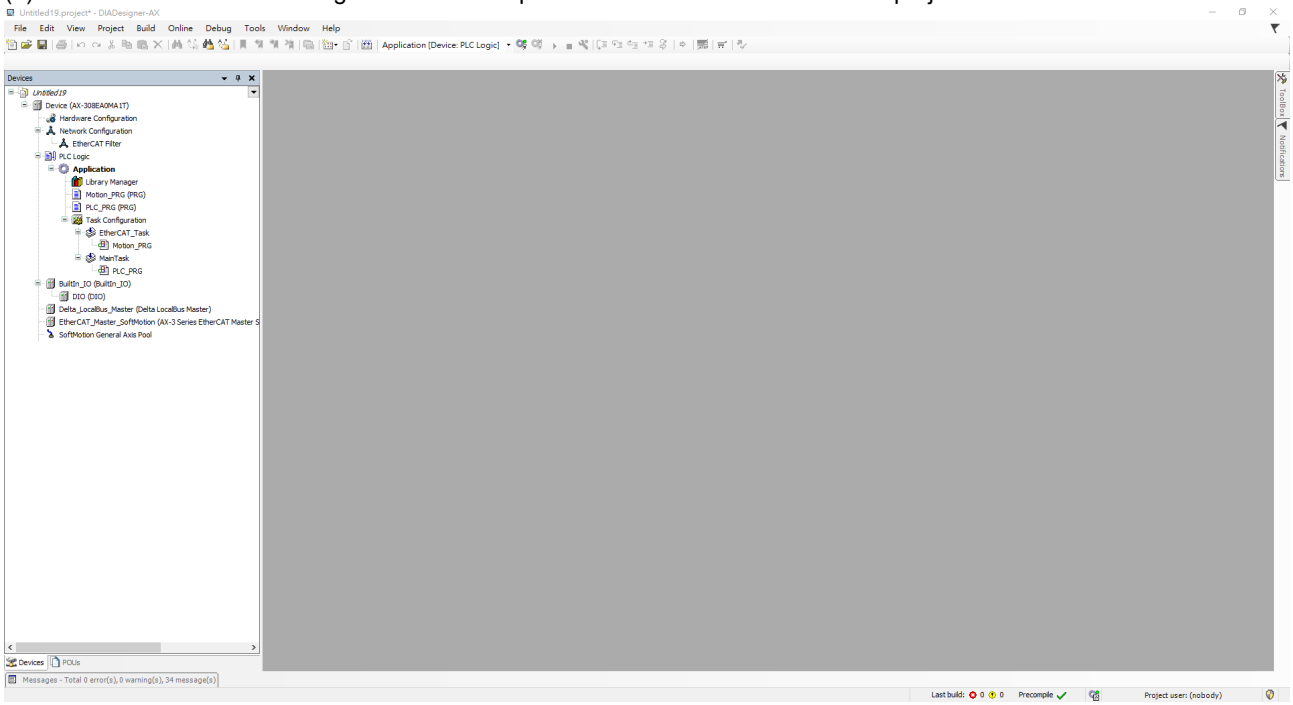
⚠	● The output circuit and internal circuit of this product are separated only by functional insulation. Therefore, to complete the installation of the product in the final system, double or reinforced insulation should be used between the product and hazardous live parts.

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

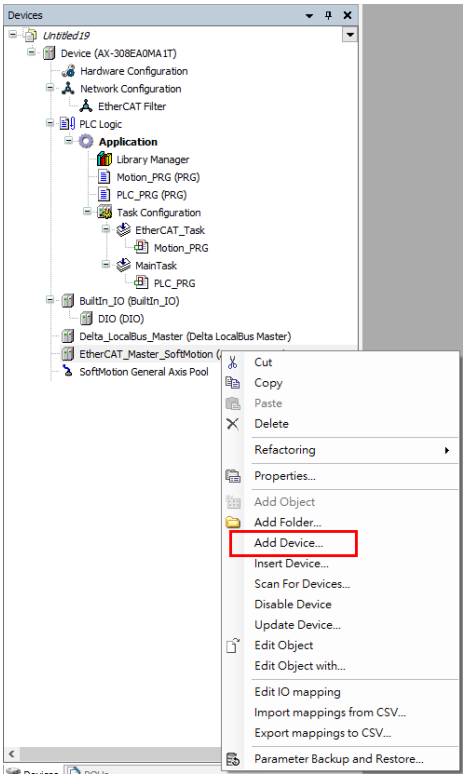
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



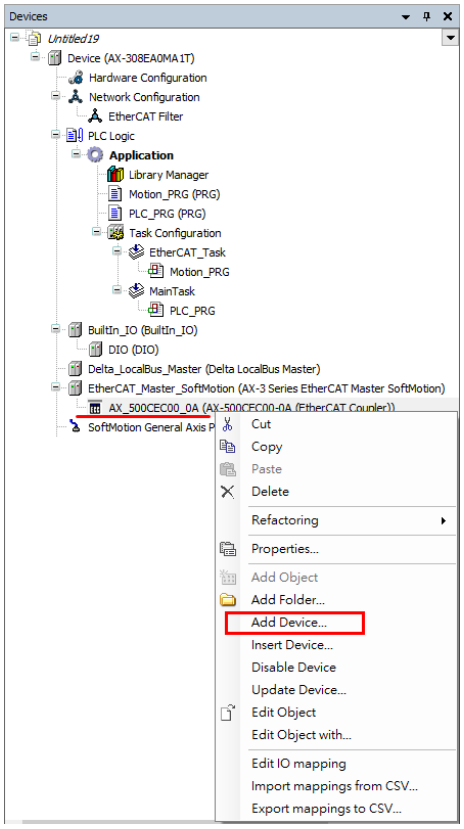
(2) Add Modules in

- 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.

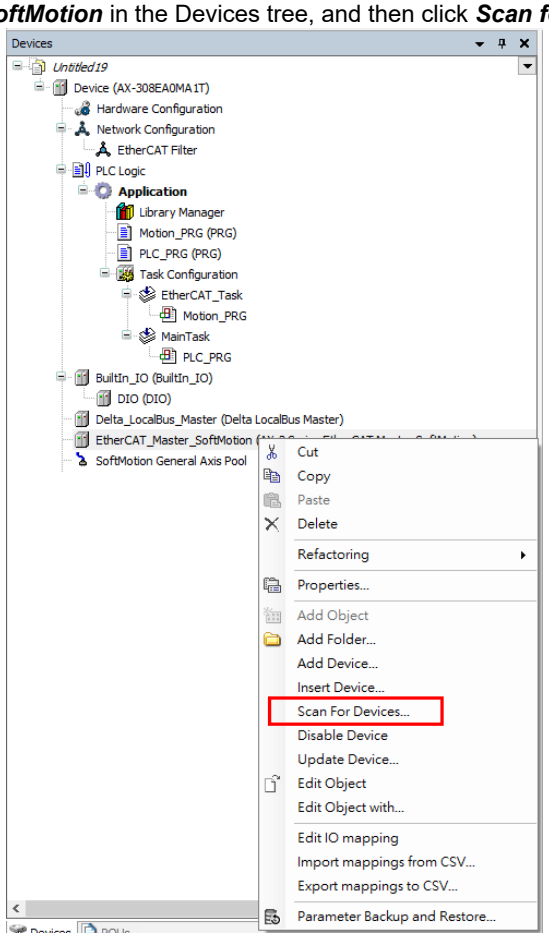


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

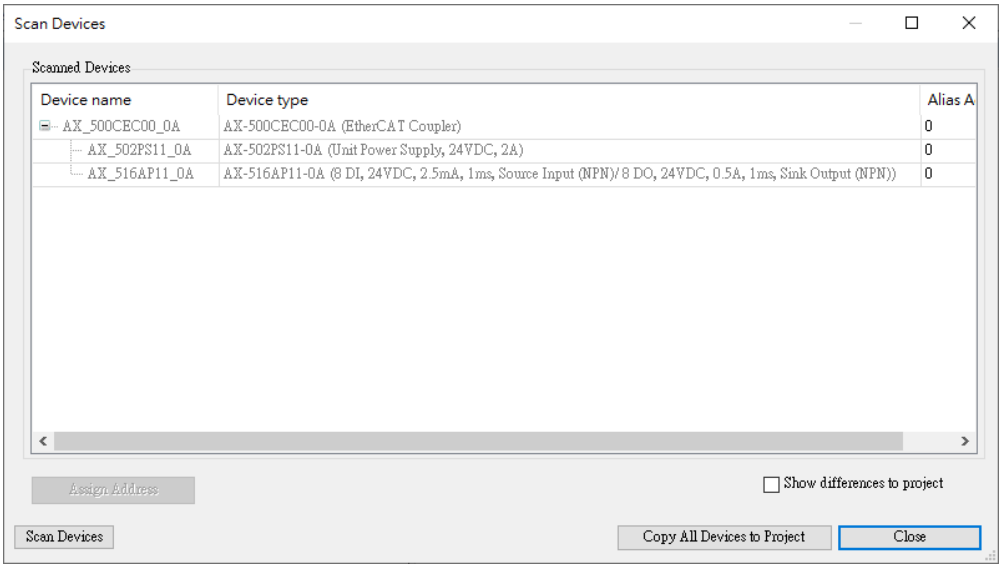


- Method 2: Scan to add the modules in.

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

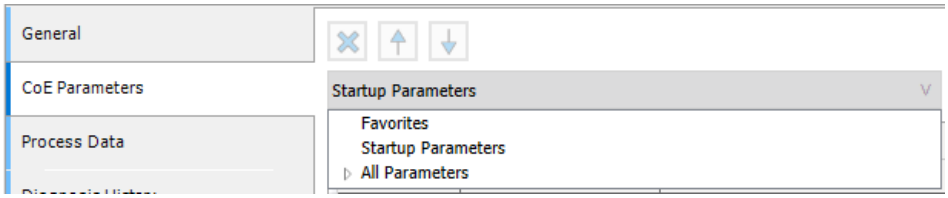


After the auto-scan is over, the actually connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.



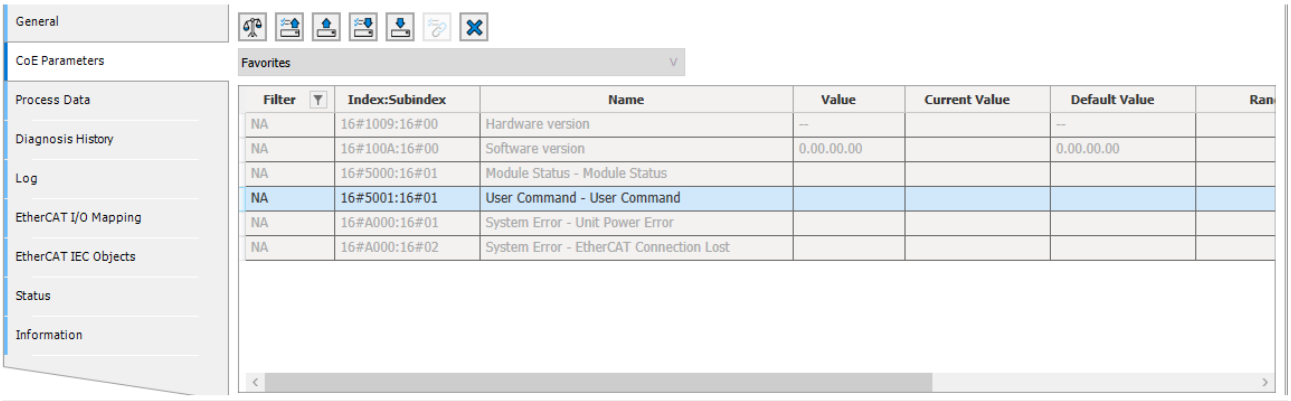
4.5.4.2 Parameter Settings

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



(1) Favorites

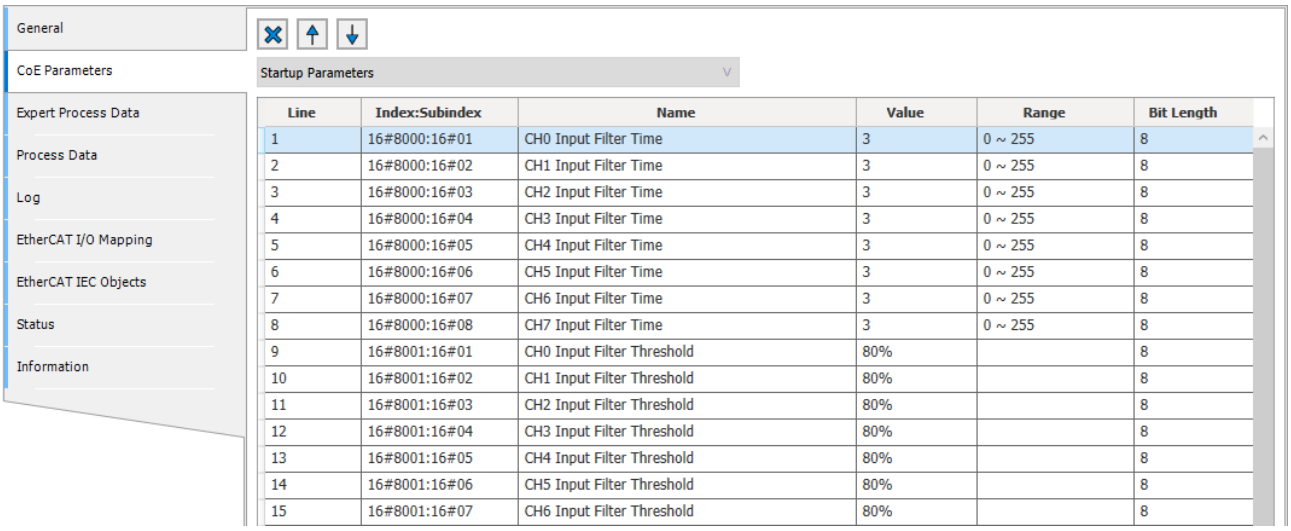
- You can add the selected parameter to Favorites according to your preference. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

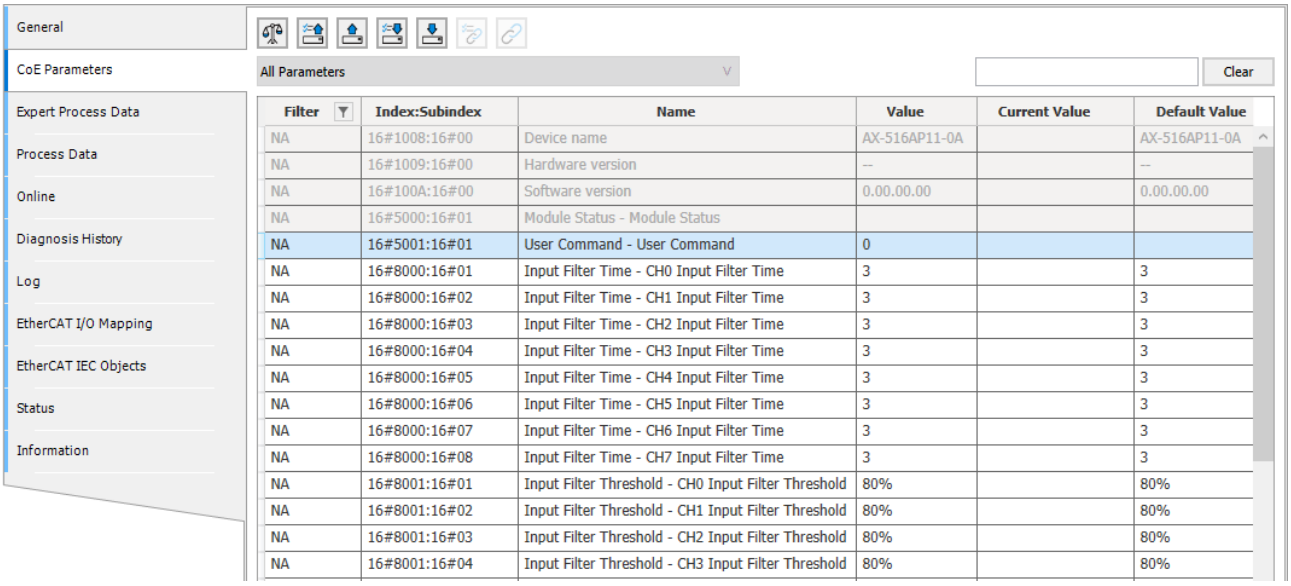


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Input Filter Time	3	0 ~ 255	8
2	16#8000:16#02	CH1 Input Filter Time	3	0 ~ 255	8
3	16#8000:16#03	CH2 Input Filter Time	3	0 ~ 255	8
4	16#8000:16#04	CH3 Input Filter Time	3	0 ~ 255	8
5	16#8000:16#05	CH4 Input Filter Time	3	0 ~ 255	8
6	16#8000:16#06	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

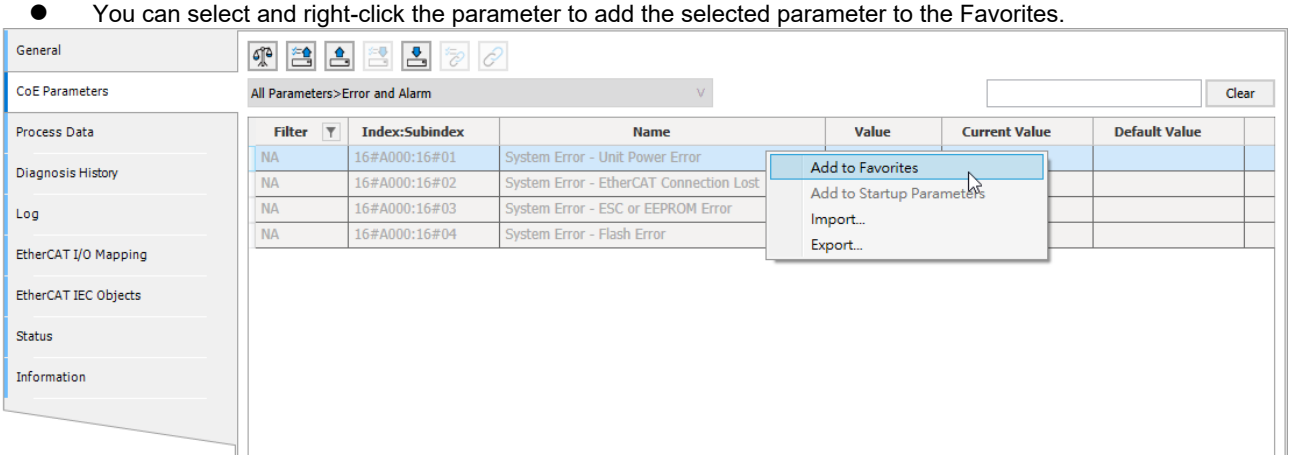
- You can find all the CoE parameters here. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values of parameters in Current Value column.
- You can edit the values of parameters in 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.

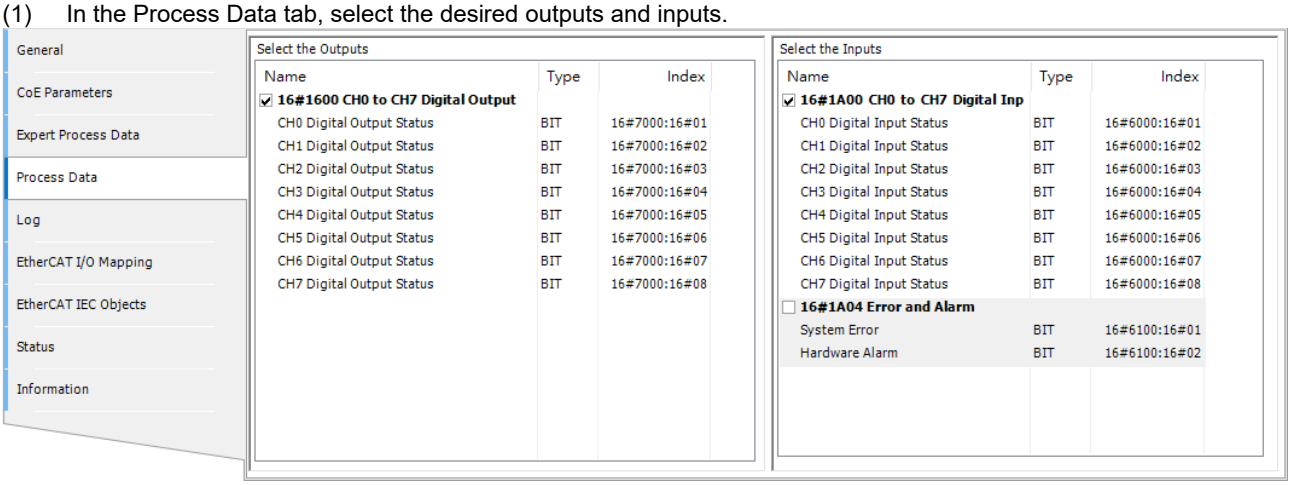
- You can select and right-click the parameter to add the selected parameter to the Favorites.



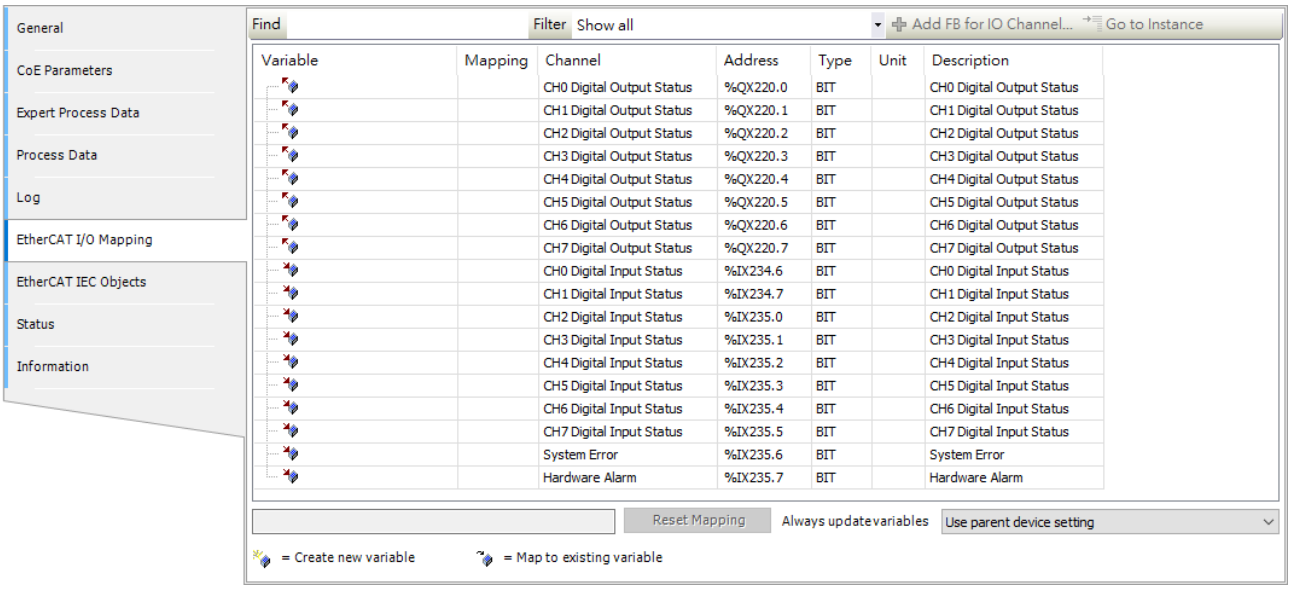
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

4.5.4.3 Process Data

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

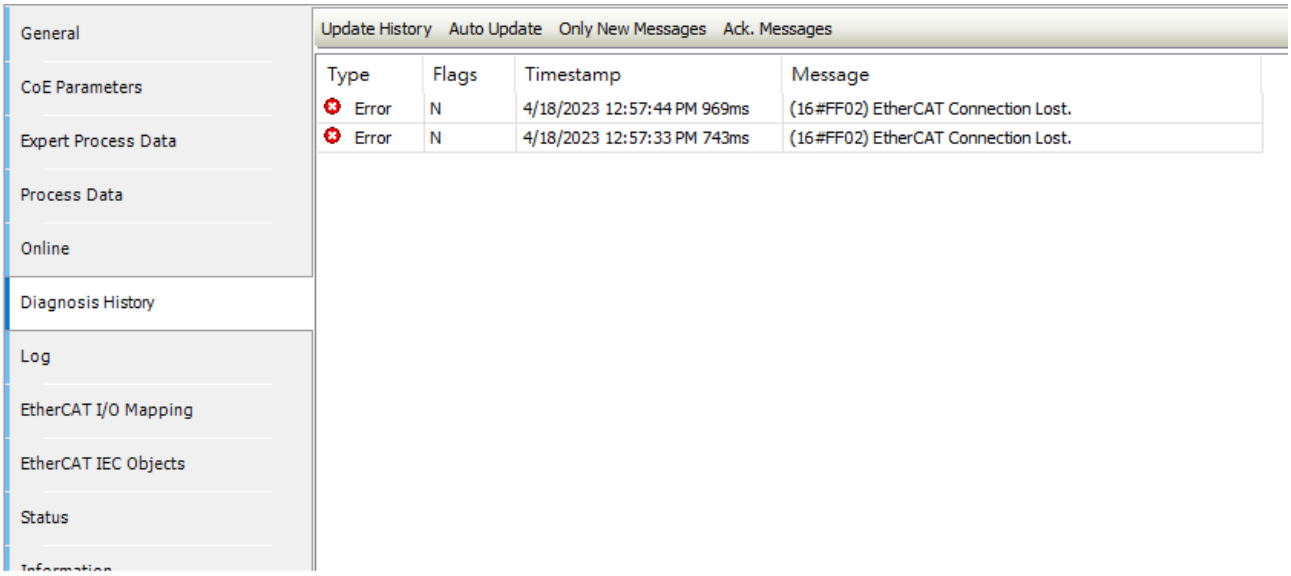


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



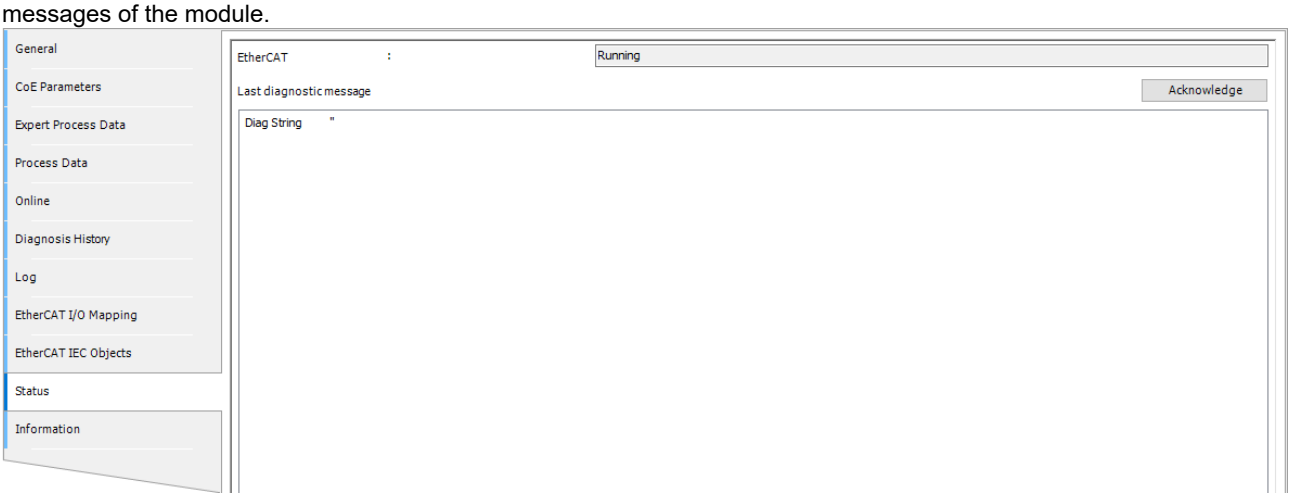
4.5.4.4 Diagnosis History

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.



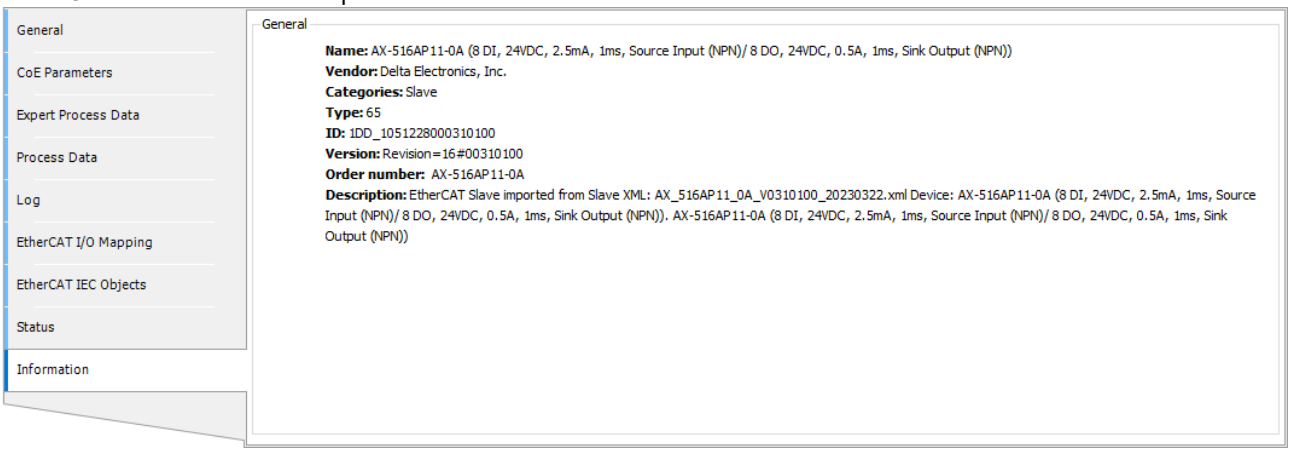
4.5.4.5 Status

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

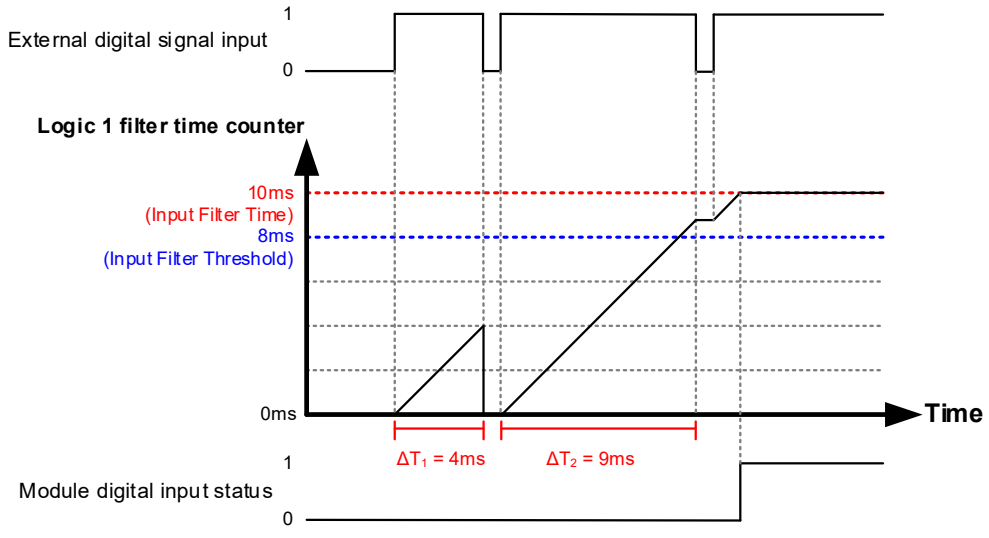
- **Parameter explanation**

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

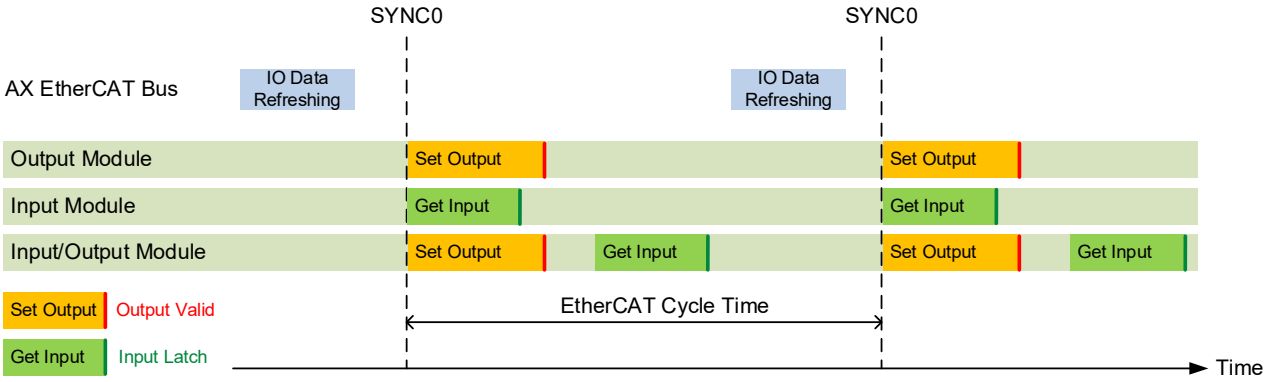
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

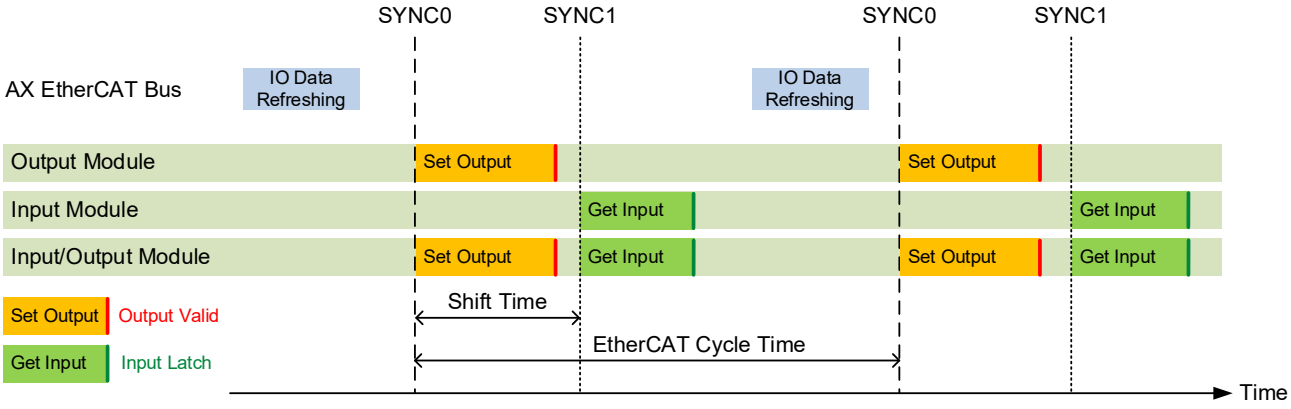
- **SYNC0**

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

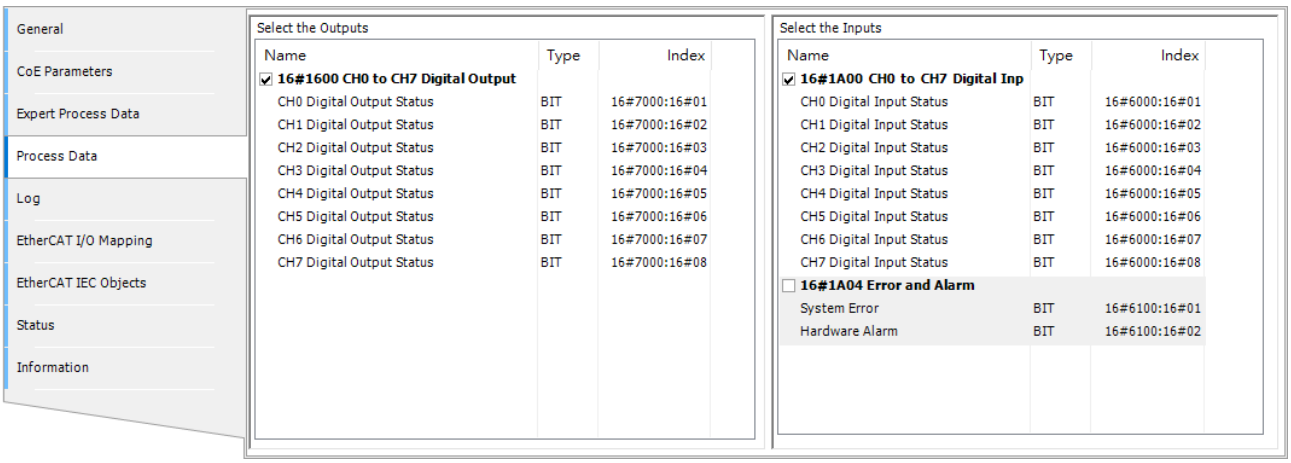
This section introduces the settings and monitoring of PDO data exchange.

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	RW	0
	16#02	CH1 Digital Output Status		BOOL	RW	0
	16#03	CH2 Digital Output Status		BOOL	RW	0
	16#04	CH3 Digital Output Status		BOOL	RW	0
	16#05	CH4 Digital Output Status		BOOL	RW	0
	16#06	CH5 Digital Output Status		BOOL	RW	0
	16#07	CH6 Digital Output Status		BOOL	RW	0
	16#08	CH7 Digital Output Status		BOOL	RW	0

4.5.7.1 Process Data

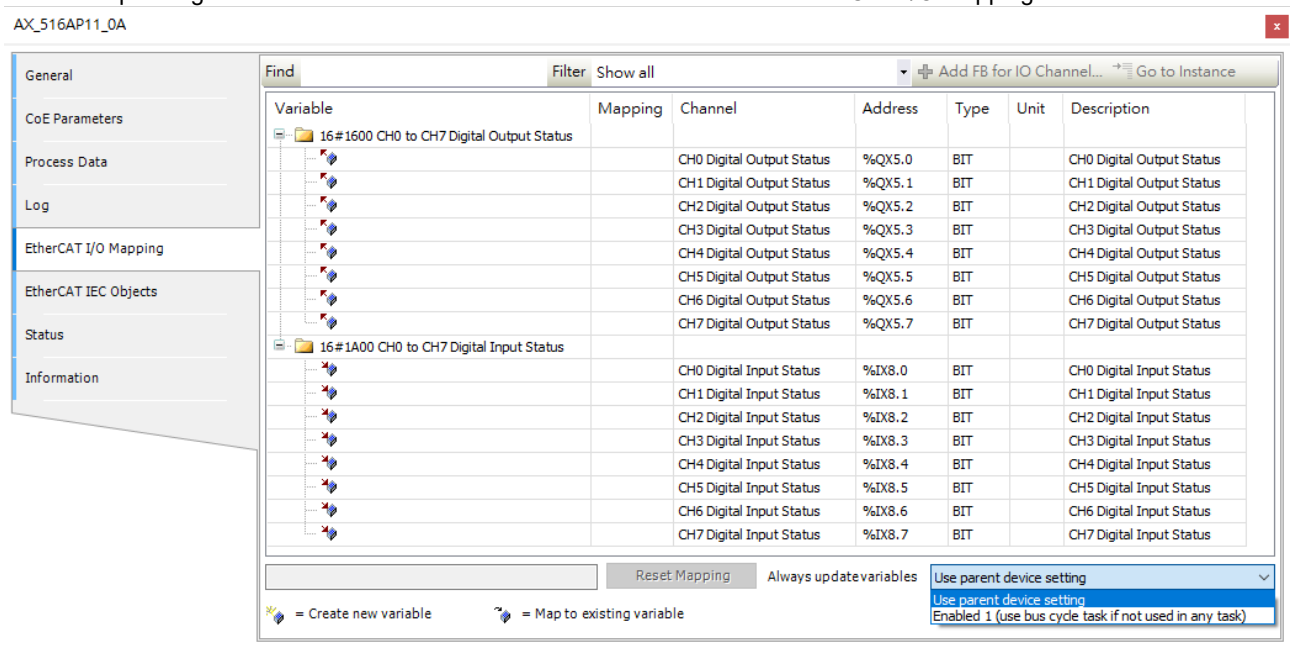
Go to the Process Data tab and select the data that you'd like to monitor. There are two types of data here.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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

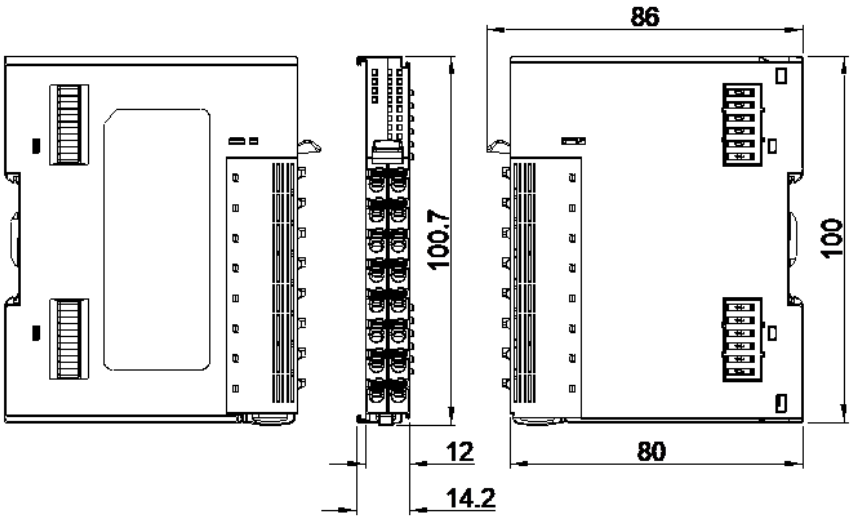
AX-516AP22-0A, a digital input/ output module, inputs 8-point digital signals and outputs 8-point digital signals (PNP). This section introduces its specifications, operations and wirings.

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 to 30 V (EN 61131-2, type 3)
		OFF voltage	-3 to +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% to +20%, 20.4 to 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 Detection	N/A
		Short Circuit Detection (SCD)	N/A
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	Current limiting
		Filtering function	Firmware filtering time: 0 to 255 ms (default: 3 ms)
	Digital output	Connection Lost Detection	N/A
		Short Circuit Detection (SCD)	N/A
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	Yes

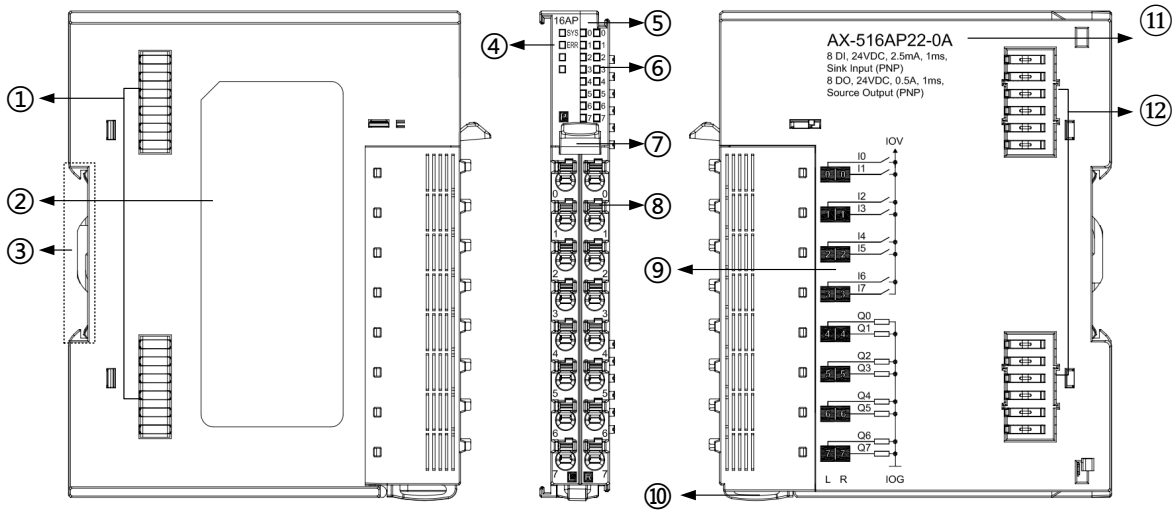
4.6.2 Dimensions and Parts

- **Dimensions**



Unit : mm

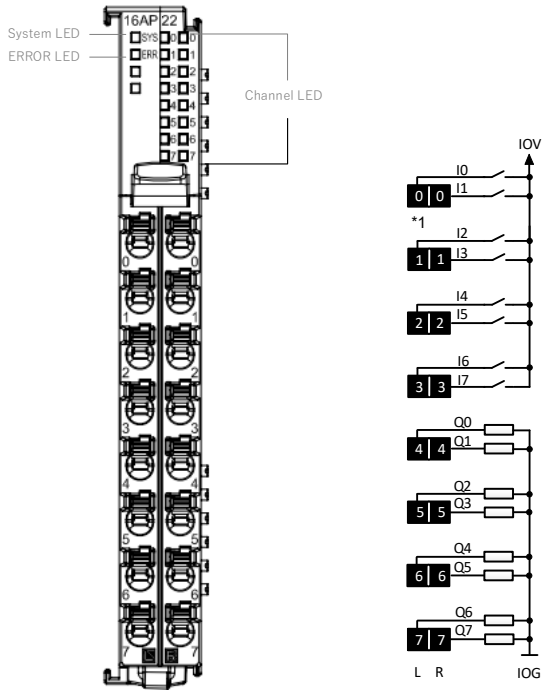
- **Parts**



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.

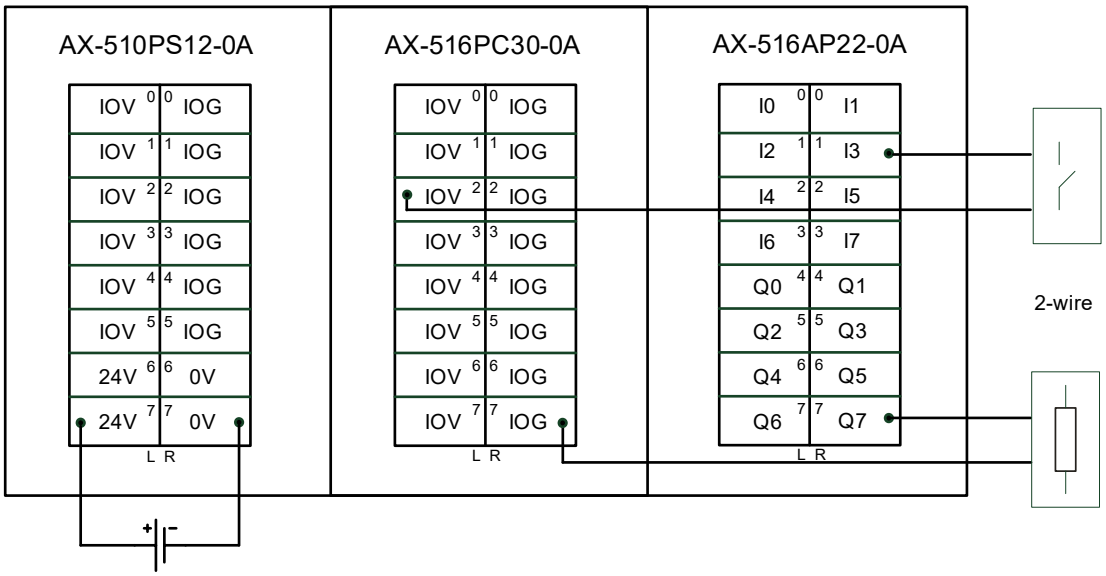
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0	Digital input channel 0	R0	I1	Digital input channel 1
L1	I2	Digital input channel 2	R1	I3	Digital input channel 3
L2	I4	Digital input channel 4	R2	I5	Digital input channel 5
L3	I6	Digital input channel 6	R3	I7	Digital input channel 7
L4	Q0	Digital 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

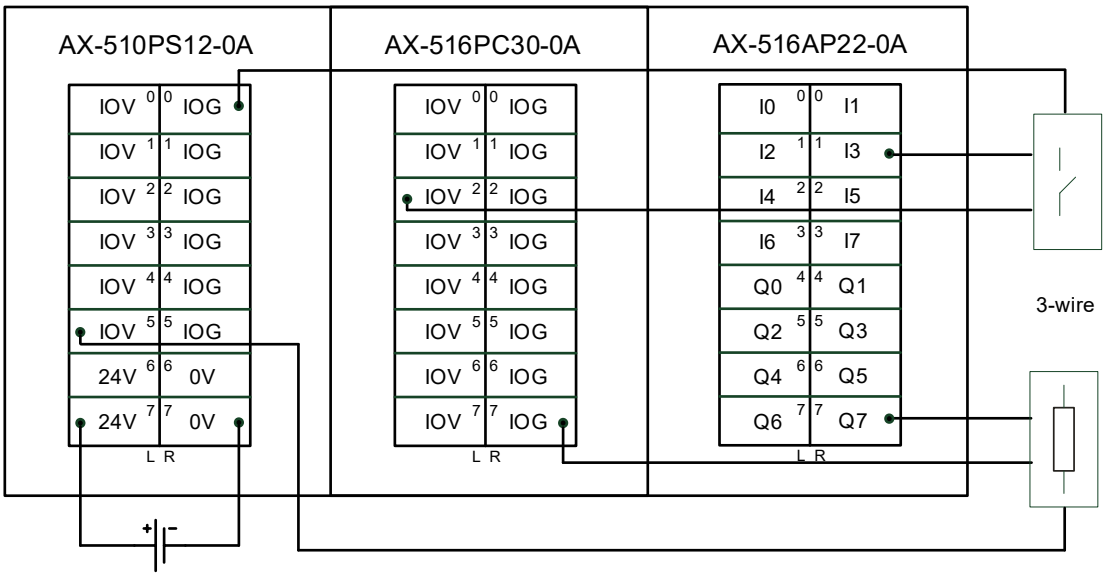
4.6.3.2 LED Indicators

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.

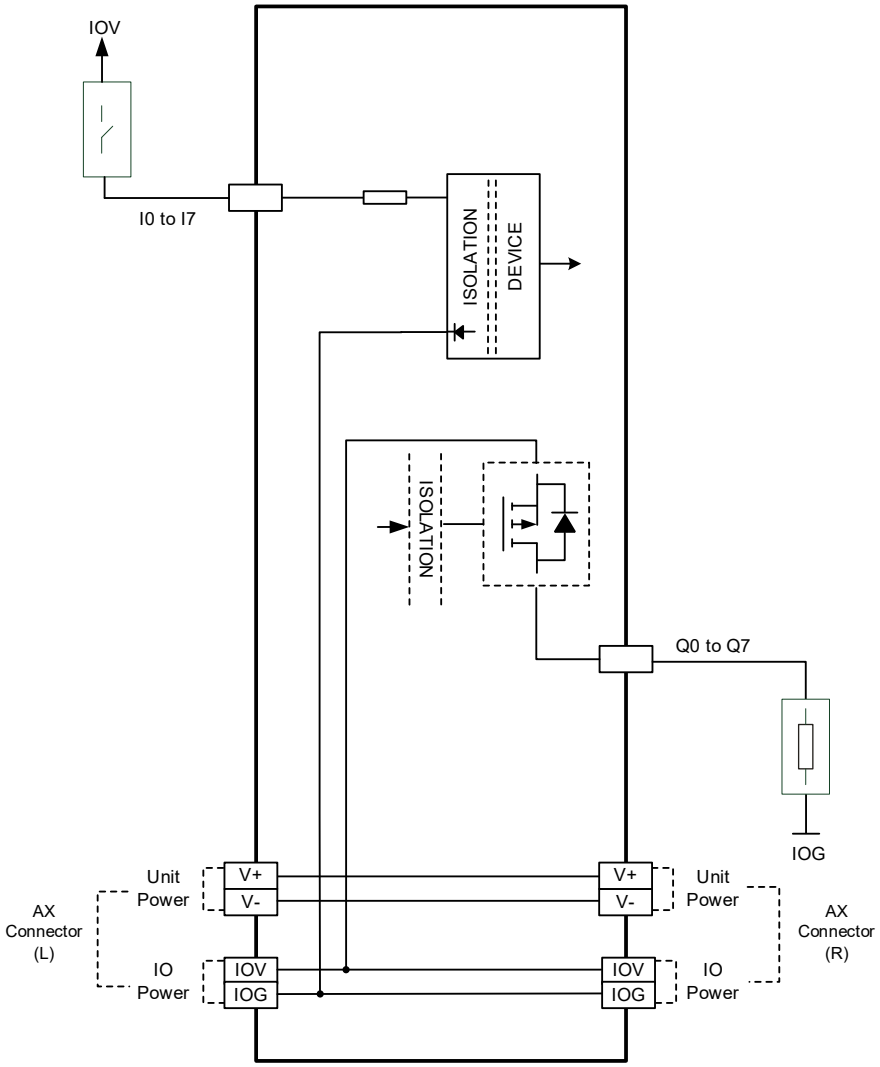
4.6.3.3 Wiring and Loop Configuration

- **Wiring**





- **Loop Configuration**



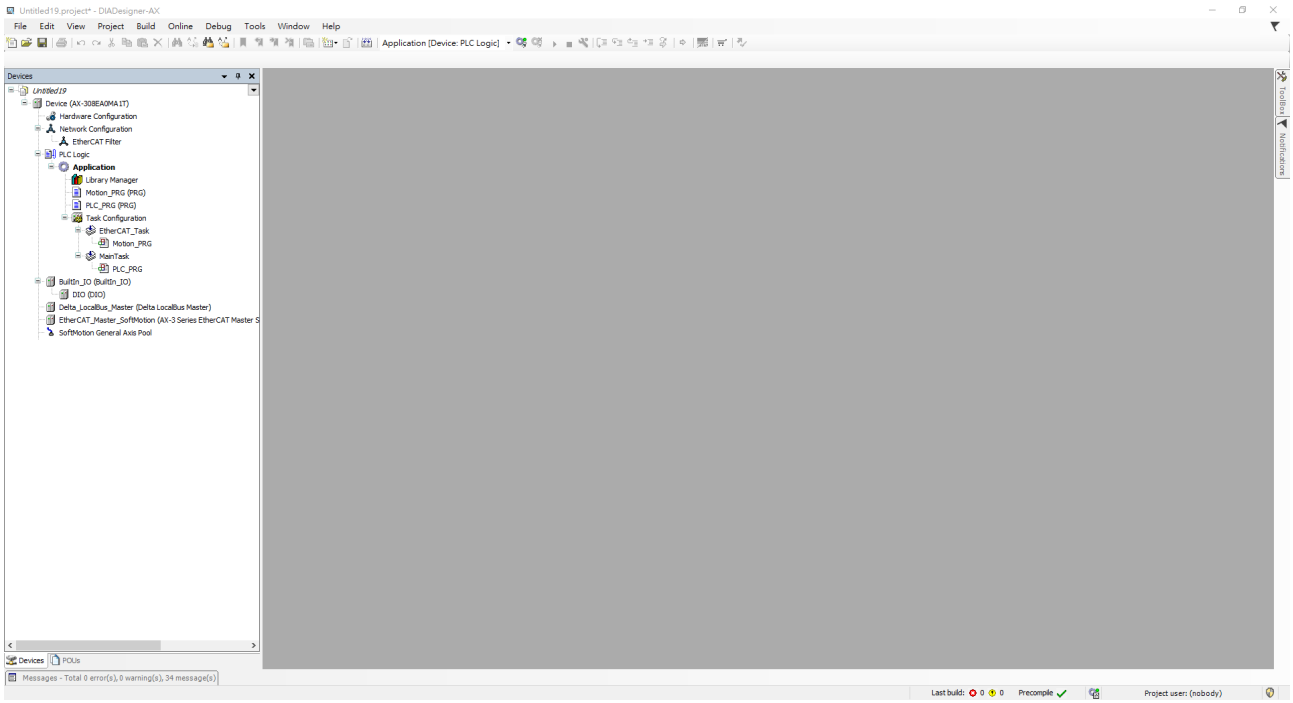
⚠	● The output circuit and internal circuit of this product are separated only by functional insulation. Therefore, to complete the installation of the product in the final system, double or reinforced insulation should be used between the product and hazardous live parts.

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

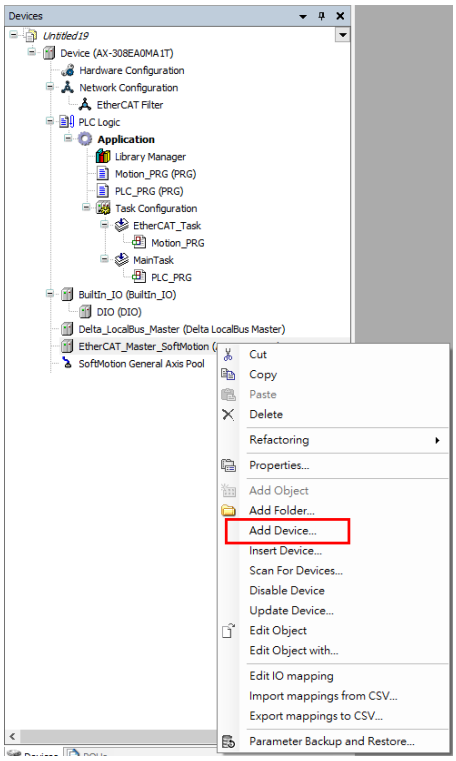
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



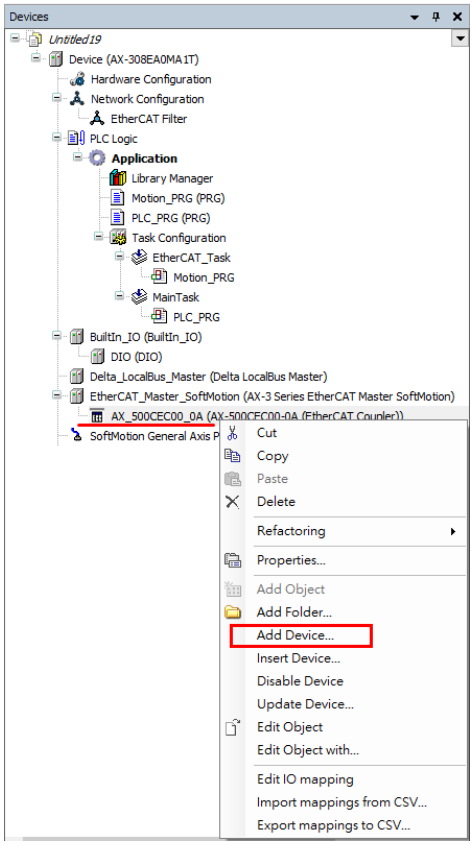
(2) Add Modules in

- 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.

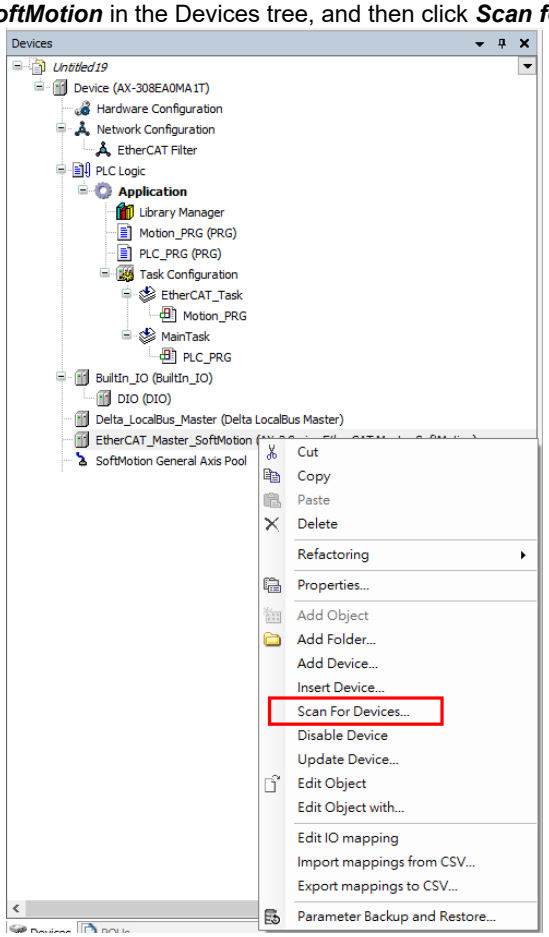


Right-click ***System Coupler*** you added, and then click ***Add Device…*** again to select and add modules in.

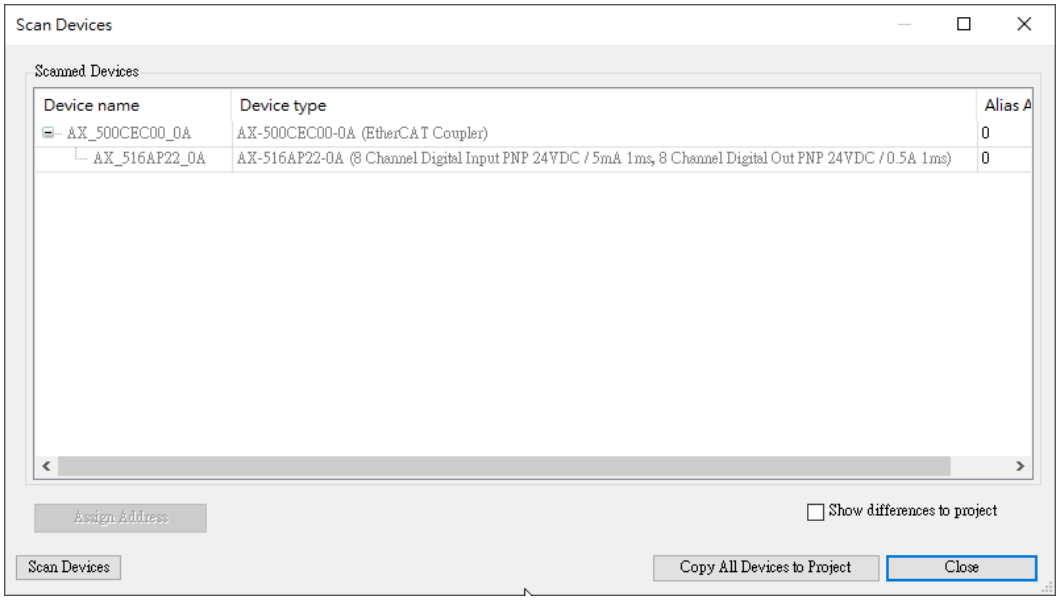


- Method 2: Scan to add the modules in.

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

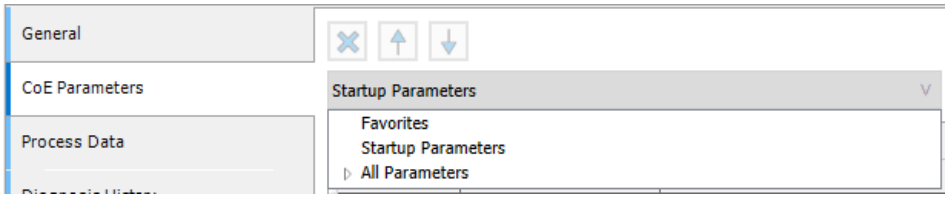


After the auto-scan is over, the actually connected devices will appear. Click ***Copy All Devices to Project*** button to add them to the list under ***EtherCAT Master SoftMotion***.



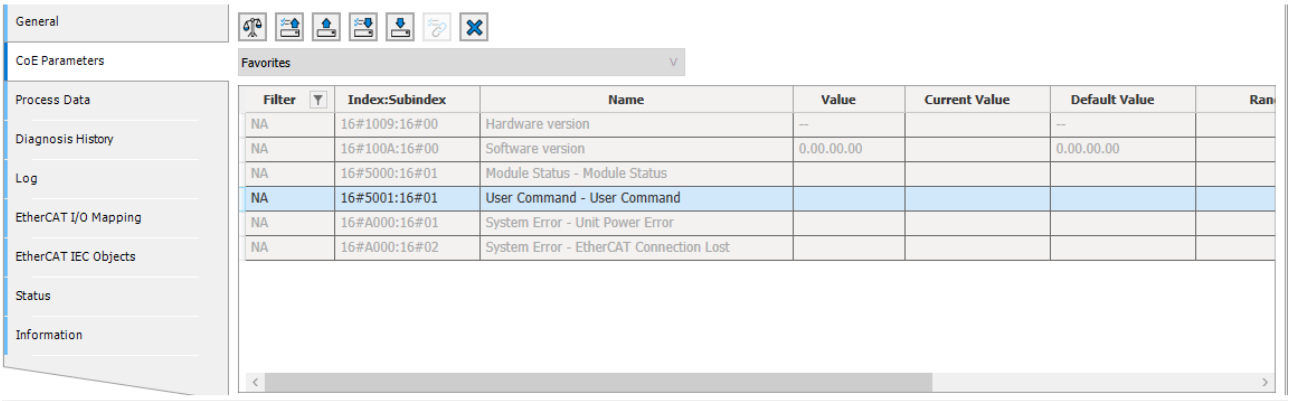
4.6.4.2 Parameter Settings

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



(1) Favorites

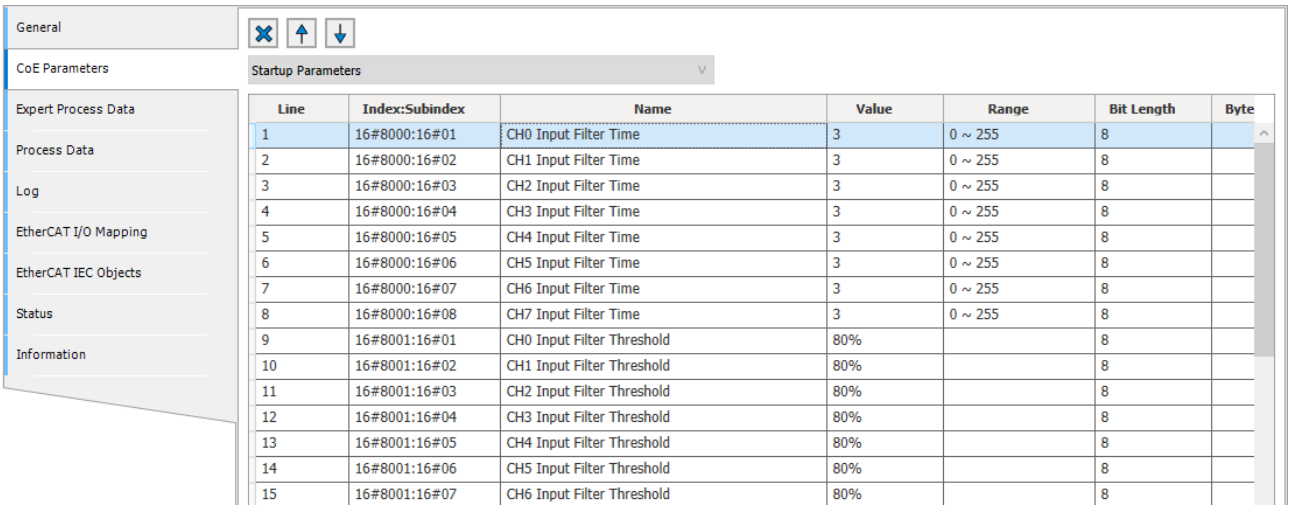
- You can add the selected parameter to Favorites according to your preference. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

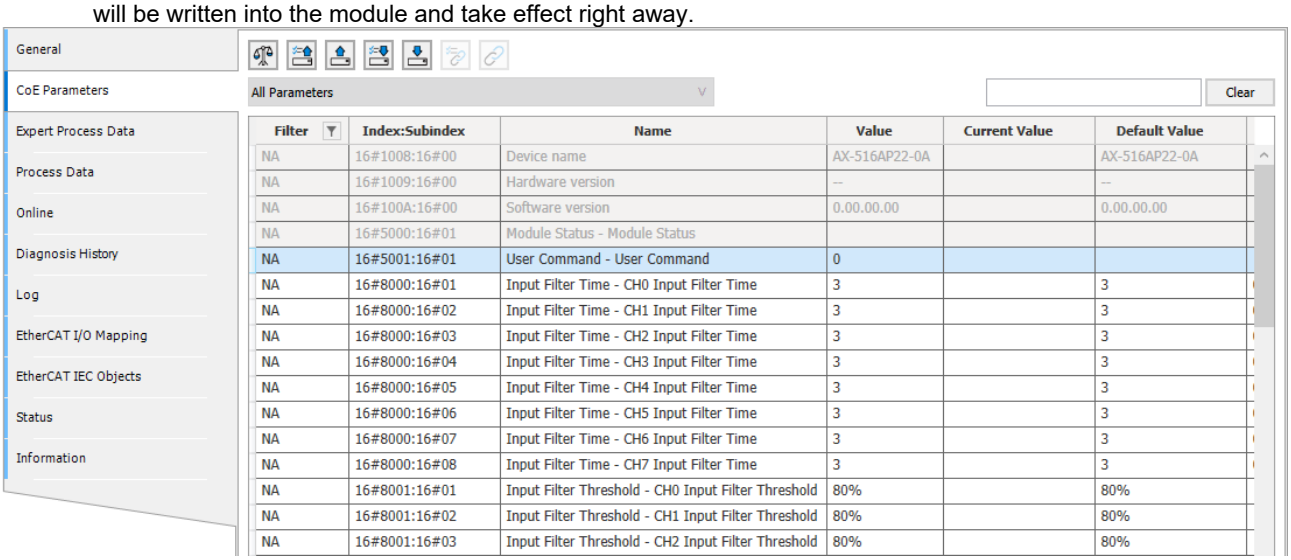


Line	Index:Subindex	Name	Value	Range	Bit Length	Byte
1	16#8000:16#01	CH0 Input Filter Time	3	0 ~ 255	8	
2	16#8000:16#02	CH1 Input Filter Time	3	0 ~ 255	8	
3	16#8000:16#03	CH2 Input Filter Time	3	0 ~ 255	8	
4	16#8000:16#04	CH3 Input Filter Time	3	0 ~ 255	8	
5	16#8000:16#05	CH4 Input Filter Time	3	0 ~ 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

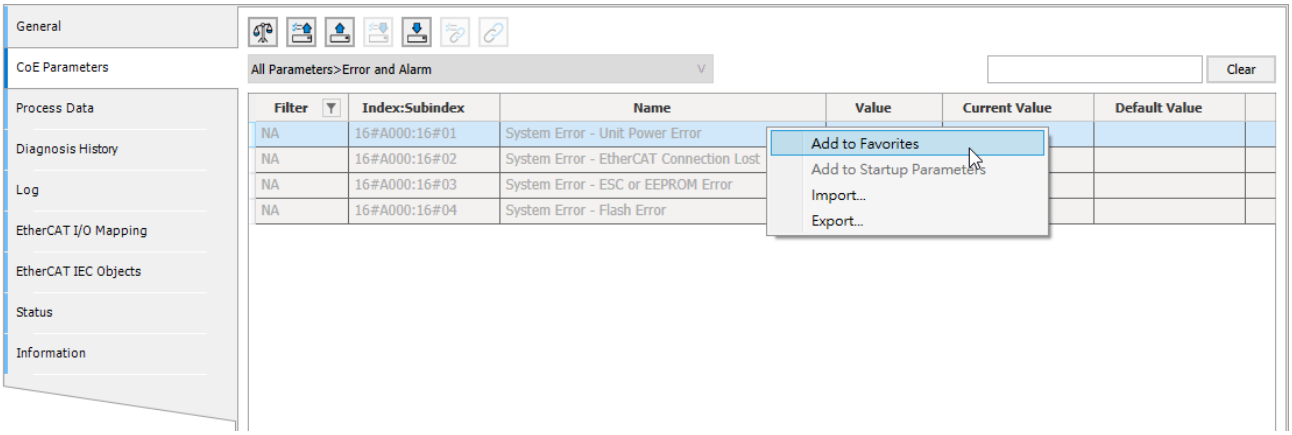
- You can find all the CoE parameters here. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values of parameters in Current Value column.
- You can edit the values of parameters in 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

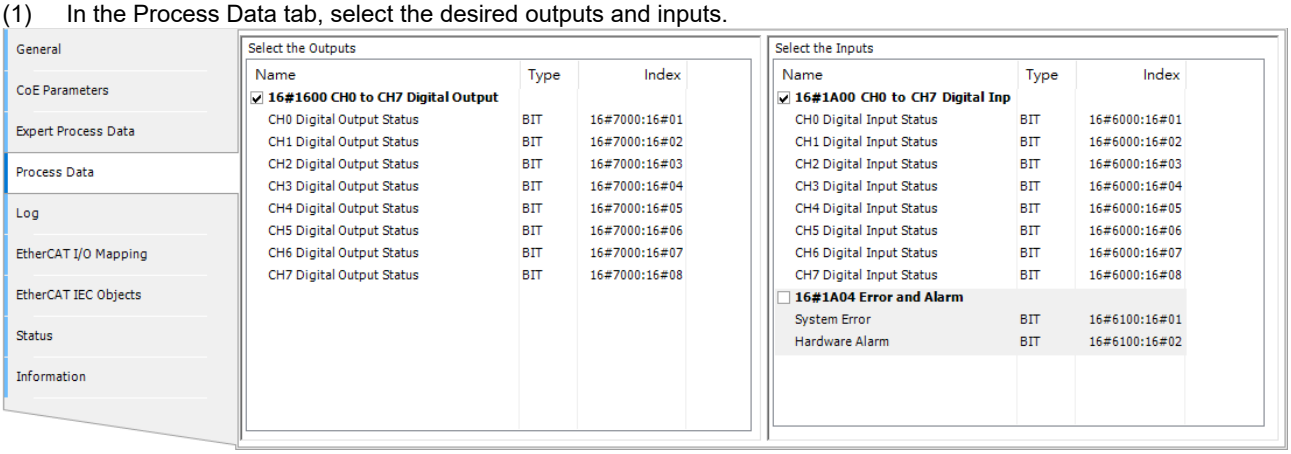
- You can select and right-click the parameter to add the selected parameter to the Favorites.



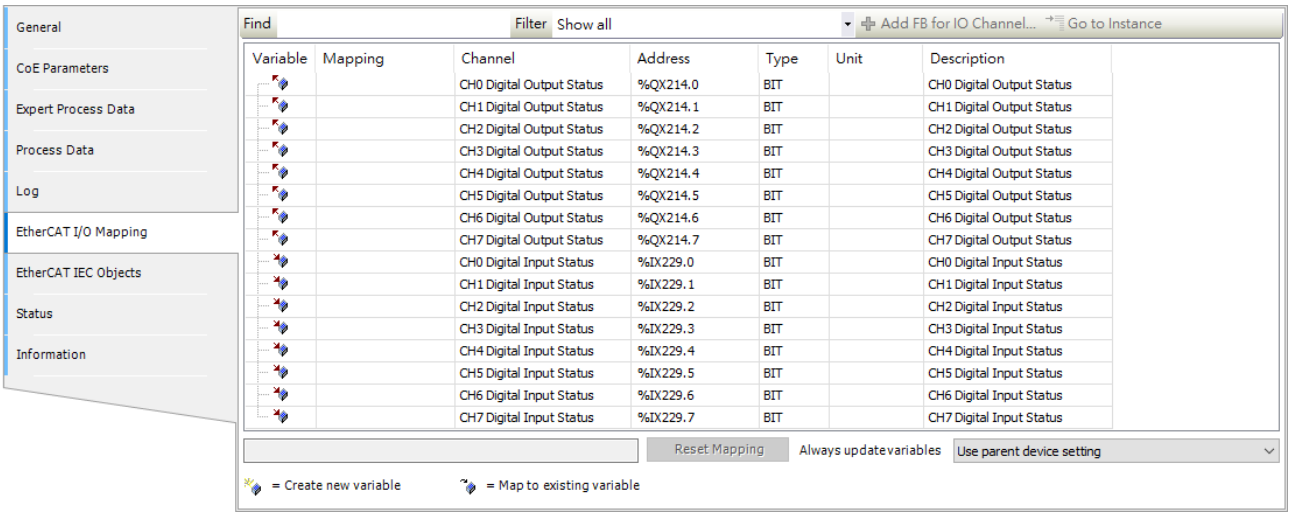
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

4.6.4.3 Process Data

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

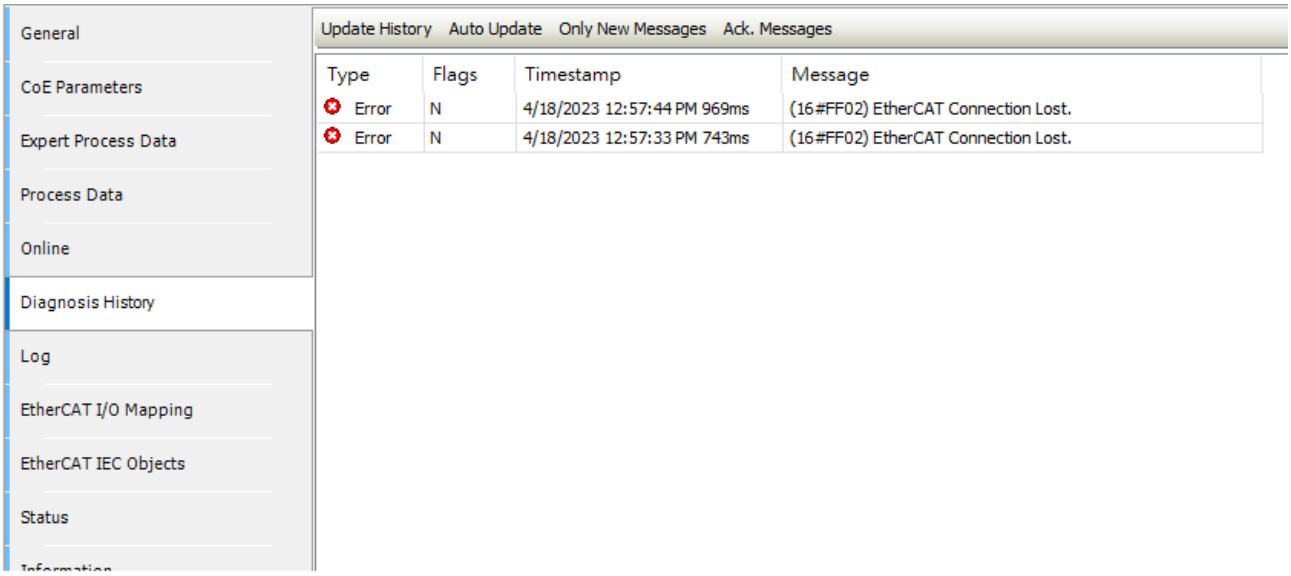


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



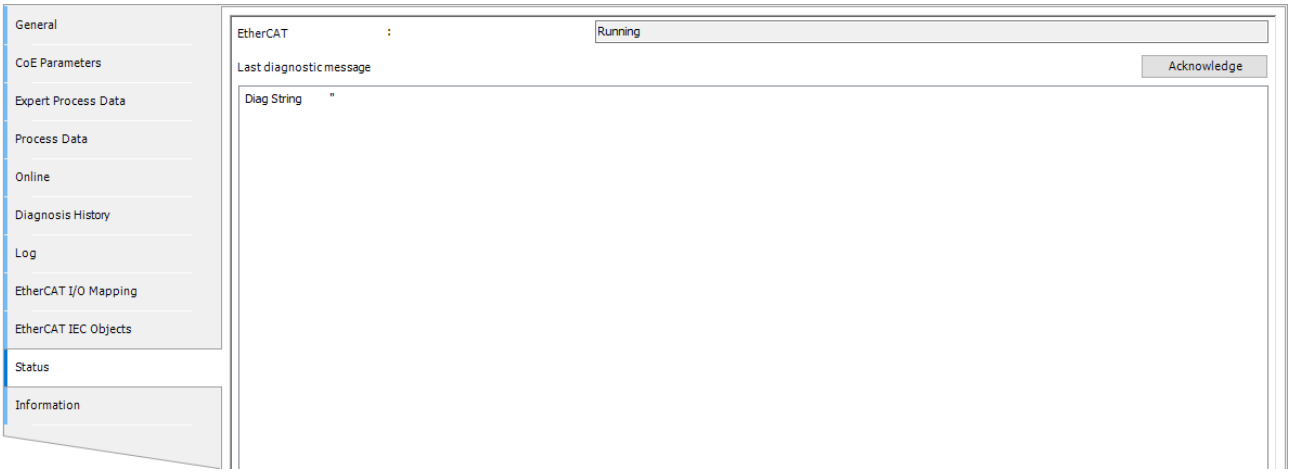
4.6.4.4 Diagnosis History

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.



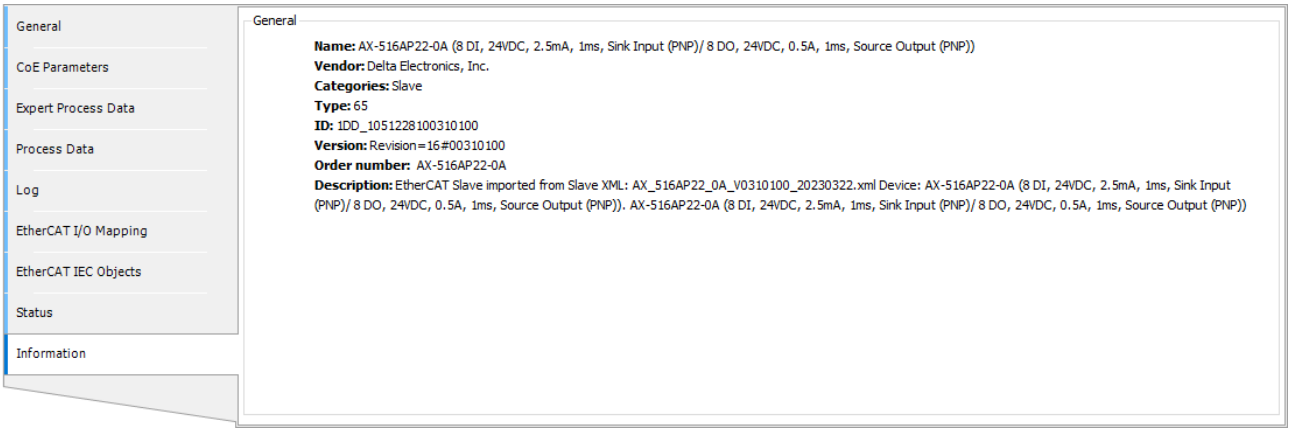
4.6.4.5 Status

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**

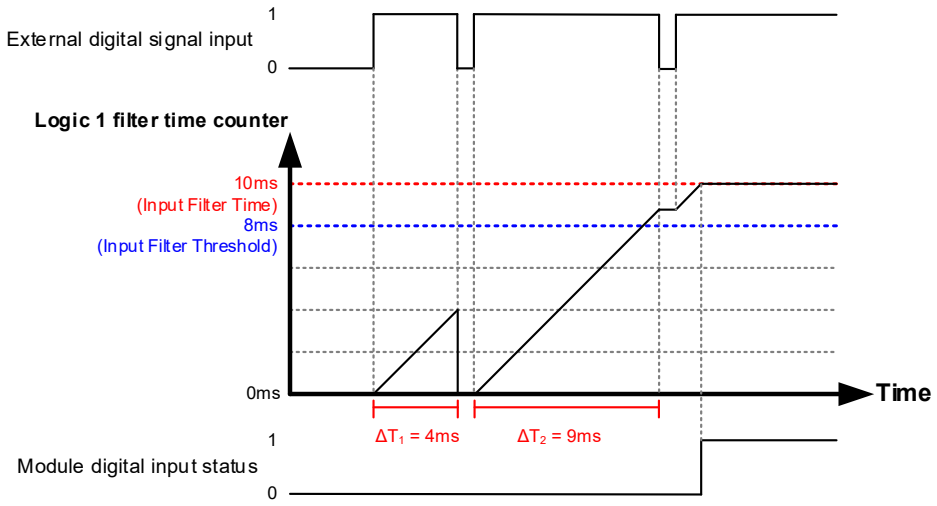
The parameter set is to set the filtering threshold for the inputs so as to suppress the digital noise interference.

- **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

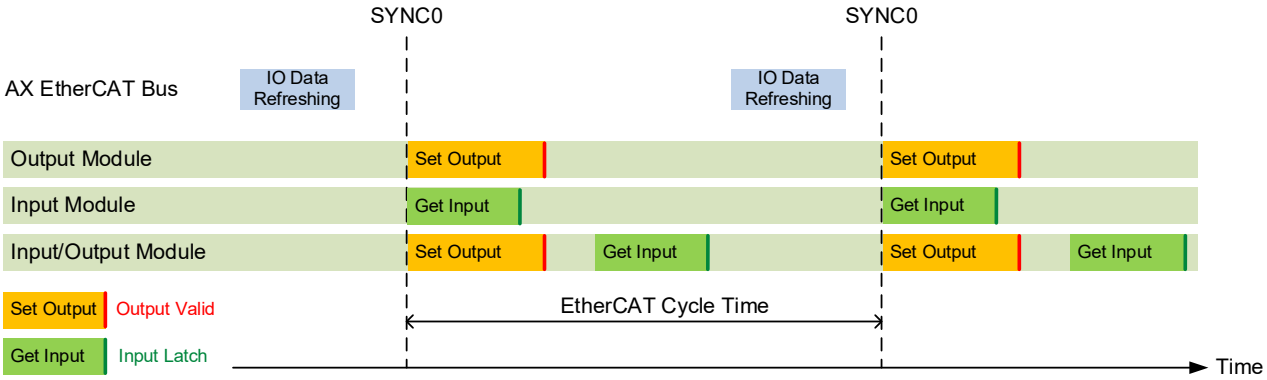
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

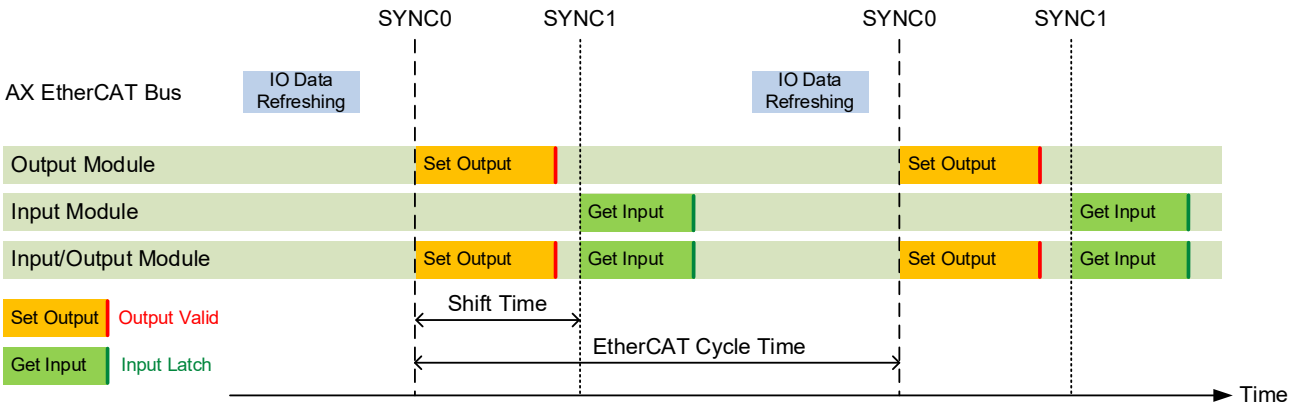
- **SYNC0**

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

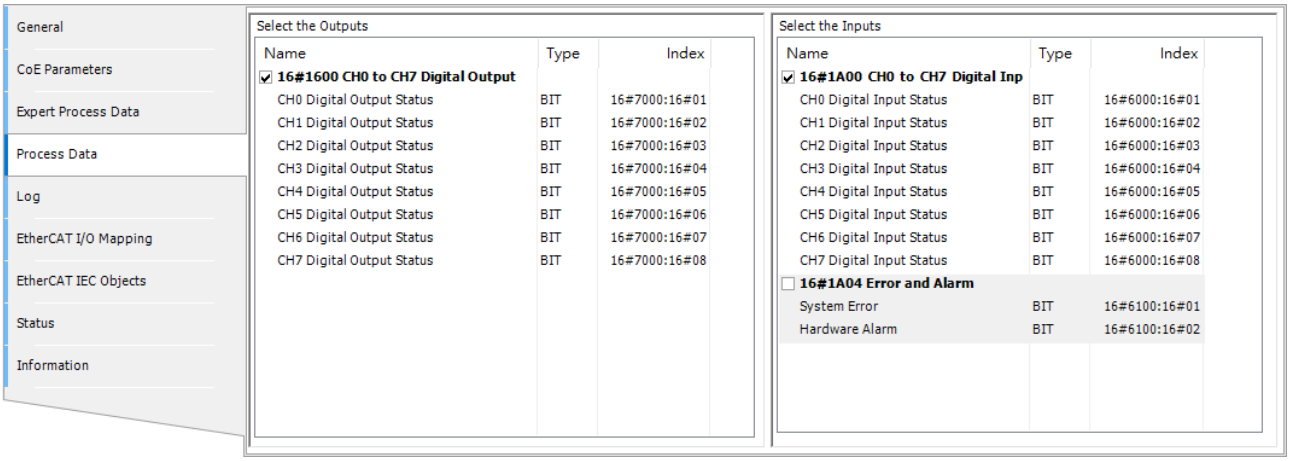
This section introduces the settings and monitoring of PDO data exchange.

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	RW	0
	16#02	CH1 Digital Output Status		BOOL	RW	0
	16#03	CH2 Digital Output Status		BOOL	RW	0
	16#04	CH3 Digital Output Status		BOOL	RW	0
	16#05	CH4 Digital Output Status		BOOL	RW	0
	16#06	CH5 Digital Output Status		BOOL	RW	0
	16#07	CH6 Digital Output Status		BOOL	RW	0
	16#08	CH7 Digital Output Status		BOOL	RW	0

4.6.7.1 Process Data

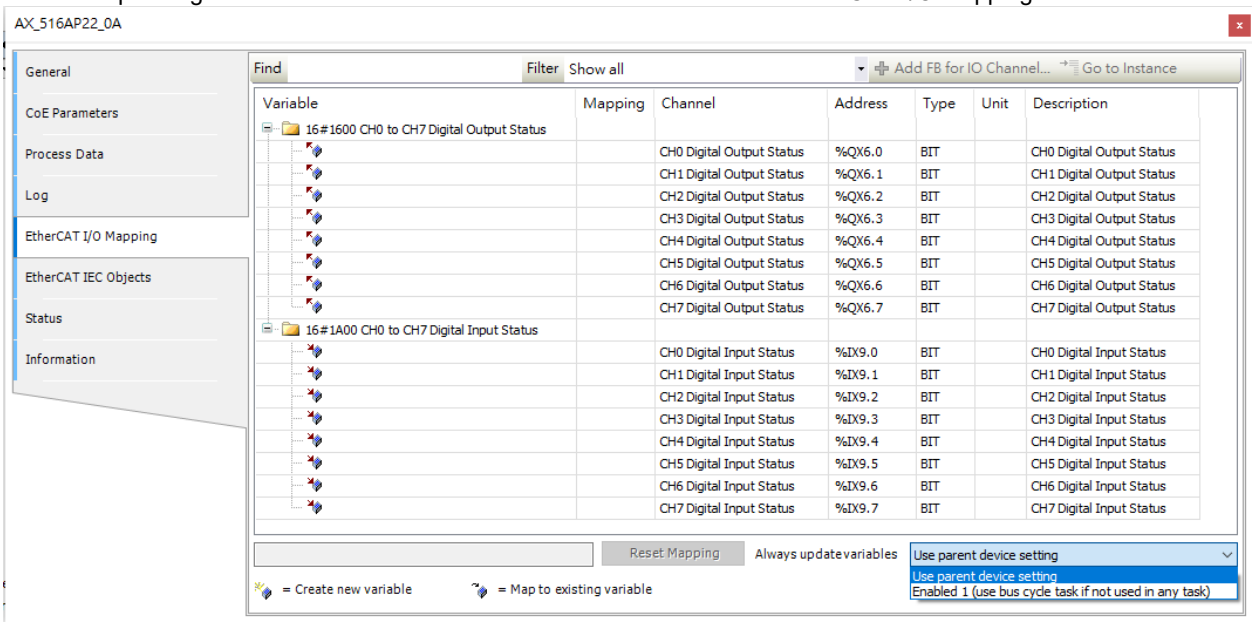
Go to the Process Data tab and select the data that you'd like to monitor.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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 5-4

5.1.1 Specifications 5-4
5.1.2 Dimensions and Parts 5-5
5.1.3 Arrangement of Terminals, LED Indicators and Wiring 5-7
5.1.4 Settings in DIADesigner-AX 5-10
5.1.5 Parameter Descriptions 5-19
5.1.6 EtherCAT Operation Modes 5-28
5.1.7 Process Data 5-29
5.1.8 Troubleshooting 5-31

5.2 AX-504AD20-0A 5-32

5.2.1 Specifications 5-32
5.2.2 Dimensions and Parts 5-33
5.2.3 Arrangement of Terminals, LED Indicators and Wiring 5-34
5.2.4 Settings in DIADesigner-AX 5-37
5.2.5 Parameter Descriptions 5-46
5.2.6 EtherCAT Operation Modes 5-54
5.2.7 Process Data 5-55
5.2.8 Troubleshooting 5-57

5.3 AX-508AD10-0A 5-58

5.3.1 Specifications 5-58
5.3.2 Dimensions and Parts 5-59
5.3.3 Arrangement of Terminals, LED Indicators and Wiring 5-61
5.3.4 Settings in DIADesigner-AX 5-64
5.3.5 Parameter Descriptions 5-73
5.3.6 EtherCAT Operation Modes 5-84
5.3.7 Process Data 5-85
5.3.8 Troubleshooting 5-87

5.4 AX-508AD20-0A 5-88

5.4.1 Specifications 5-88
5.4.2 Dimensions and Parts 5-89
5.4.3 Arrangement of Terminals, LED Indicators and Wiring 5-91
5.4.4 Settings in DIADesigner-AX 5-94
5.4.5 Parameter Descriptions 5-103
5.4.6 EtherCAT Operation Modes 5-114
5.4.7 Process Data 5-115
5.4.8 Troubleshooting 5-117

5.5 AX-504DA01-0A 5-118

5.5.1 Specifications 5-118
5.5.2 Dimensions and Parts 5-119

5.5.3 Arrangement of Terminals, LED Indicators and Wiring 5-121
5.5.4 Settings in DIADesigner-AX 5-124
5.5.5 Parameter Descriptions 5-133
5.5.6 EtherCAT Operation Modes 5-140
5.5.7 Process Data 5-141
5.5.8 Troubleshooting 5-142

5.6 AX-504DA02-0A 5-143

5.6.1 Specifications 5-143
5.6.2 Dimensions and Parts 5-144
5.6.3 Arrangement of Terminals, LED Indicators and Wiring 5-146
5.6.4 Settings in DIADesigner-AX 5-149
5.6.5 Parameter Descriptions 5-158
5.6.6 EtherCAT Operation Modes 5-165
5.6.7 Process Data 5-166
5.6.8 Troubleshooting 5-167

5.7 AX-508DA01-0A 5-168

5.7.1 Specifications 5-168
5.7.2 Dimensions and Parts 5-169
5.7.3 Arrangement of Terminals, LED Indicators and Wiring 5-171
5.7.4 Settings in DIADesigner-AX 5-174
5.7.5 Parameter Descriptions 5-183
5.7.6 EtherCAT Operation Modes 5-193
5.7.7 Process Data 5-194
5.7.8 Troubleshooting 5-195

5.8 AX-502TC10-0B 5-196

5.8.1 Specifications 5-196
5.8.2 Dimensions and Parts 5-197
5.8.3 Arrangement of Terminals, LED Indicators and Wiring 5-198
5.8.4 Settings in DIADesigner-AX 5-201
5.8.5 Parameter Descriptions 5-210
5.8.6 EtherCAT Operation Modes 5-217
5.8.7 Process Data 5-217
5.8.8 Troubleshooting 5-220

5.9 AX-504TC10-0B 5-221

5.9.1 Specifications 5-221
5.9.2 Dimensions and Parts 5-222
5.9.3 Arrangement of Terminals, LED Indicators and Wiring 5-224
5.9.4 Settings in DIADesigner-AX 5-227
5.9.5 Parameter Descriptions 5-236
5.9.6 EtherCAT Operation Modes 5-244
5.9.7 Process Data 5-245
5.9.8 Troubleshooting 5-248

5.10 AX-502PT10-0B 5-249

5.10.1 Specifications 5-249
5.10.2 Dimensions and Parts 5-250
5.10.3 Arrangement of Terminals, LED Indicators and Wiring 5-252
5.10.4 Settings in DIADesigner-AX 5-255
5.10.5 Parameter Descriptions 5-264
5.10.6 EtherCAT Operation Modes 5-270
5.10.7 Process Data 5-270

5.10.8 Troubleshooting 5-272

5.11 AX-504PT10-0B 5-273

5.11.1 Specifications 5-273
5.11.2 Dimensions and Parts 5-274
5.11.3 Arrangement of Terminals, LED Indicators and Wiring 5-276
5.11.4 Settings in DIADesigner-AX 5-279
5.11.5 Parameter Descriptions 5-288
5.11.6 EtherCAT Operation Modes 5-296
5.11.7 Process Data 5-296
5.11.8 Troubleshooting 5-298

5.1 AX-504AD10-0A

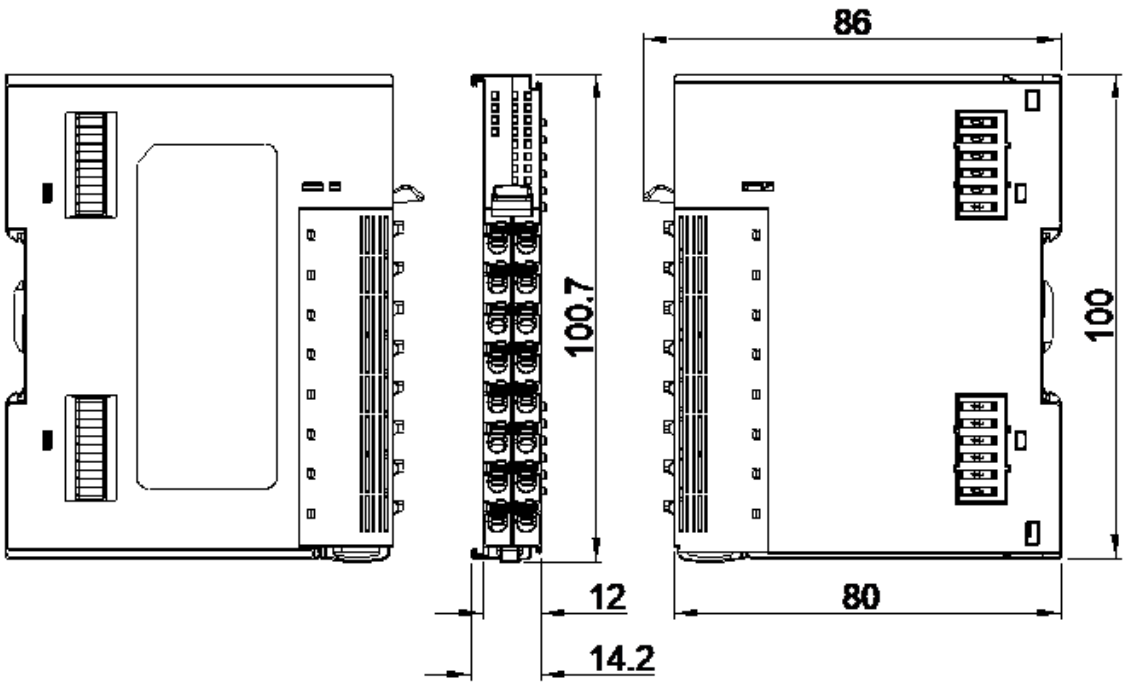
AX-504AD10-0A, an analog input module, receives analog voltage signals through 4 input points and converts the received signals to 16-bit digital signals. This section introduces its specifications, wirings and operations.

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 to +10 V
	Input conversion range	-5 to 105% (F.S.)
	Rated absolute input range	±15 V
	Input impedance	1 mΩ and more
	Resolution	-10 to 10 V: 16 bits; 0 to 10 V: 15 bits; -5 to 5 V: 15 bits; 0 to 5 V: 14 bits; 1 to 5 V: 14 bits
	Accuracy	25°C: ±0.2% (F.S.)
		-20 to 60 °C: ±0.6% (F.S.)
	Conversion time	100μs / 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 Detection	N/A
	Short Circuit Detection (SCD)	N/A
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	N/A
	Filter function	AVG, FIR, IIR

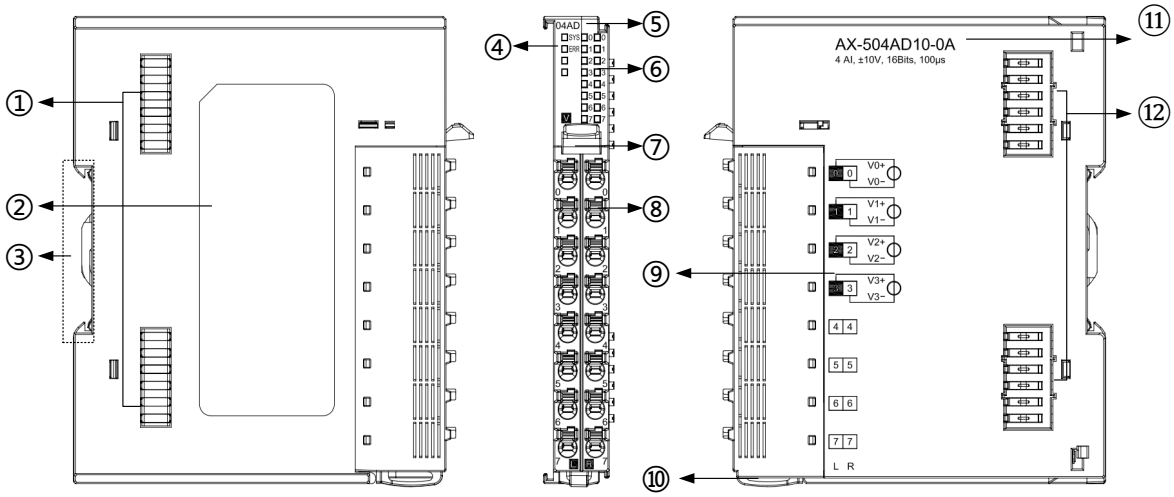
5.1.2 Dimensions and Parts

- **Dimensions**



Unit: mm

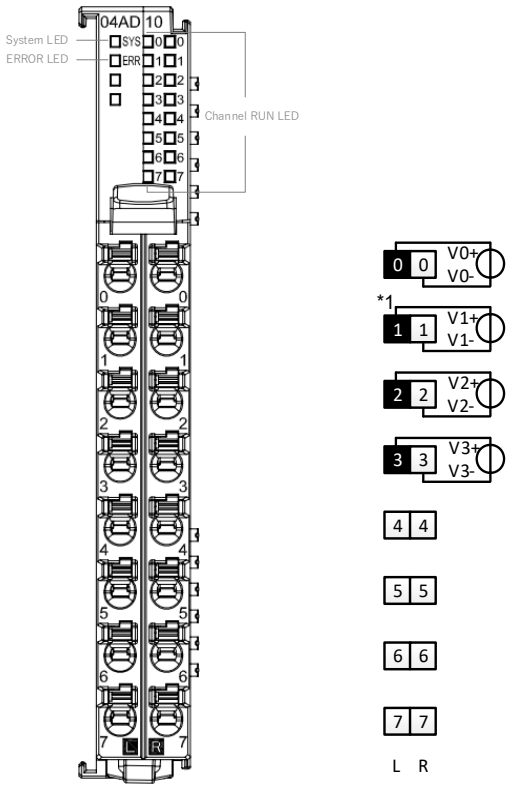
- **Parts**



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.

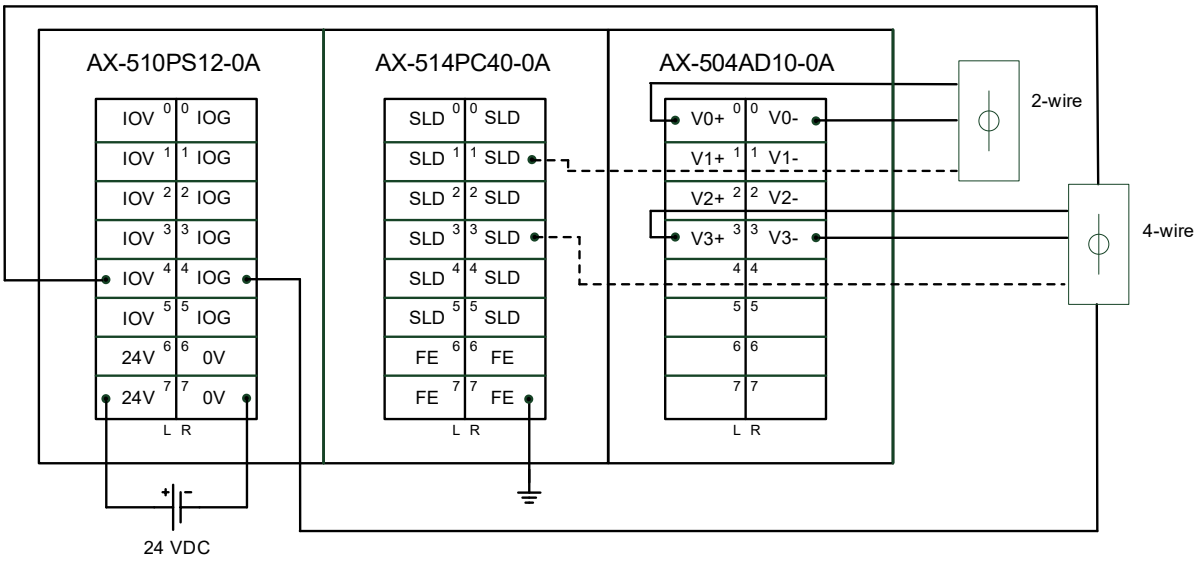
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	V0+	Channel 0: positive input voltage	R0	V0-	Channel 0: negative input voltage
L1	V1+	Channel 1: positive input voltage	R1	V1-	Channel 1: negative input voltage
L2	V2+	Channel 2: positive input voltage	R2	V2-	Channel 2: negative input voltage
L3	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

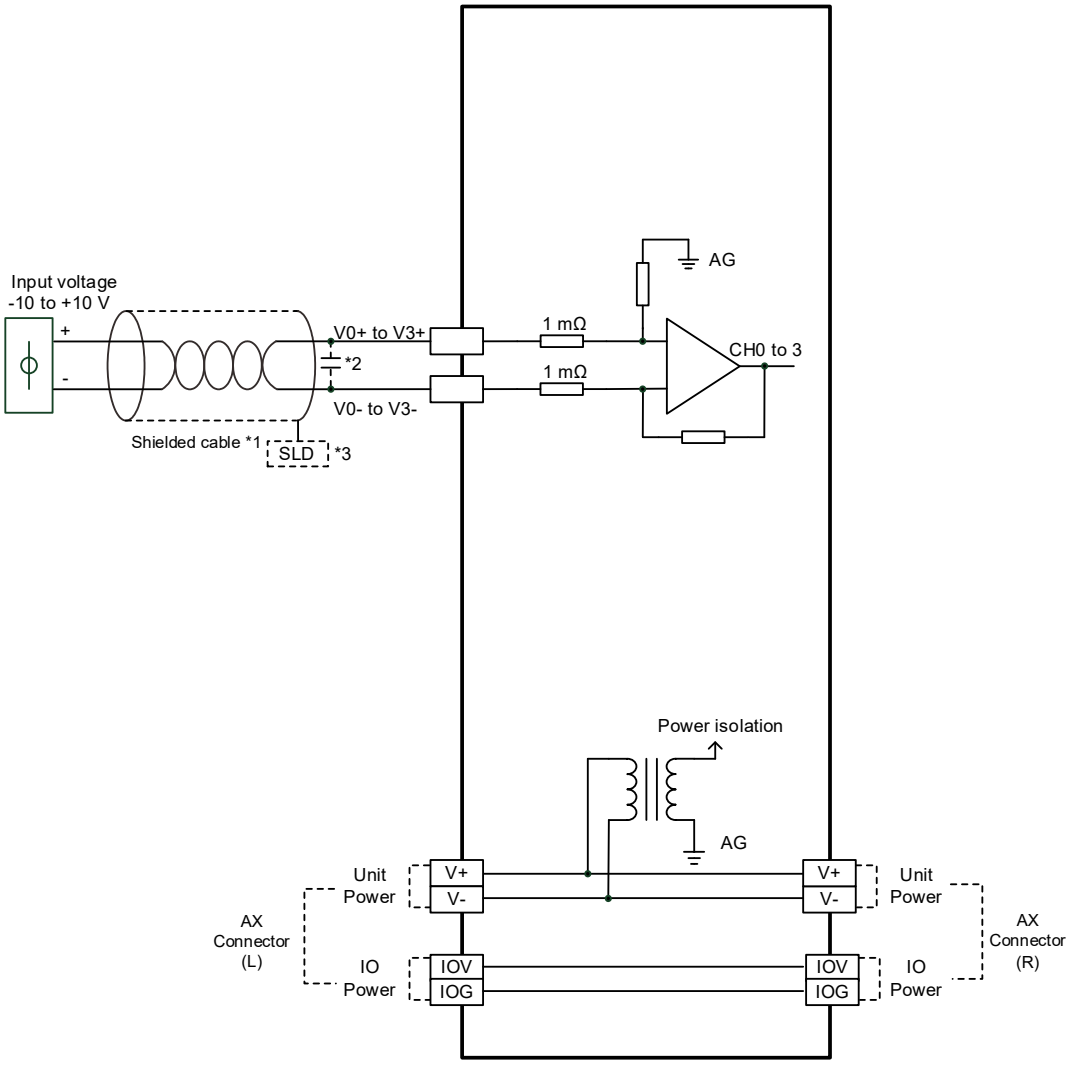
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2 s)	ECAT Pre OP
			Blinking (1 s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1 s)	An error occurs on the application.
			Blinking (0.2 s)	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 and 0.47 μF and a working voltage of 25 V.

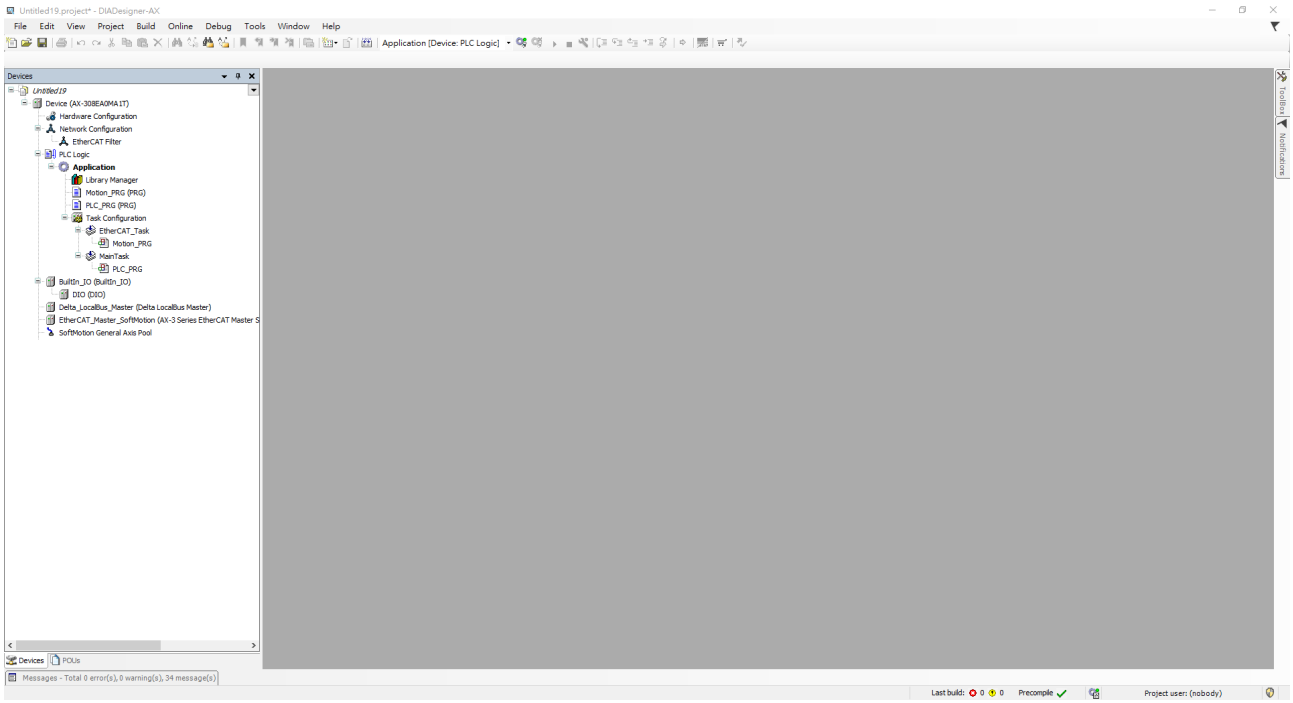
*3. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A.

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

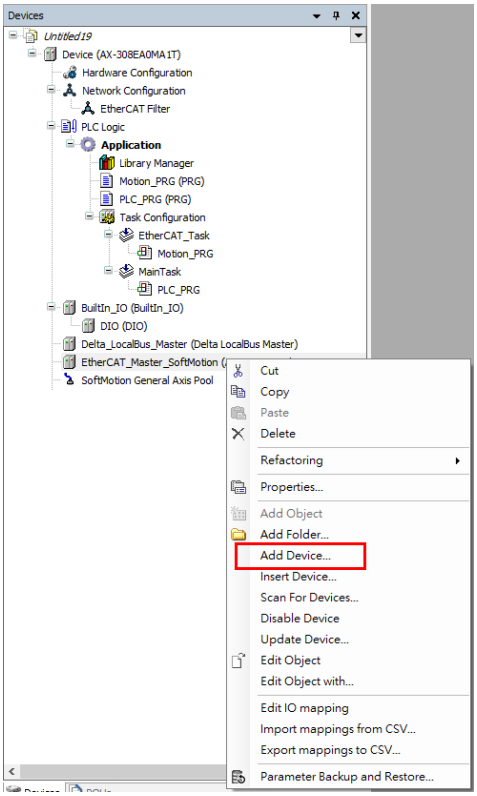
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



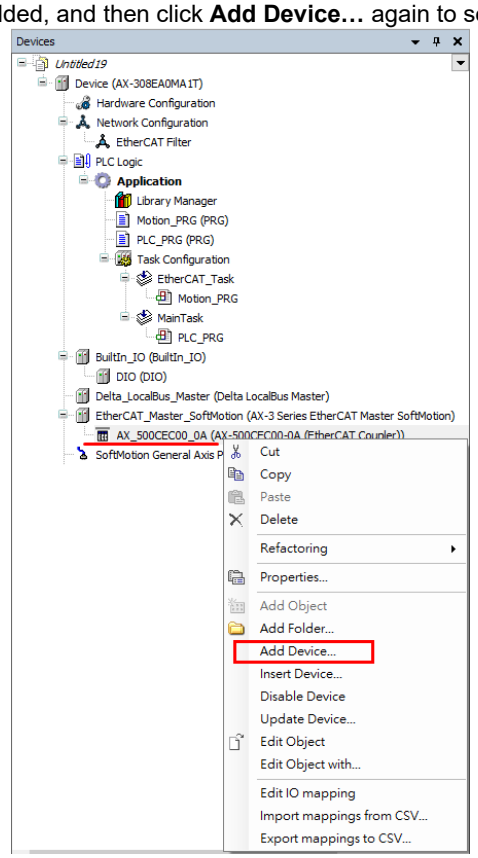
(2) Add Modules in

- 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.

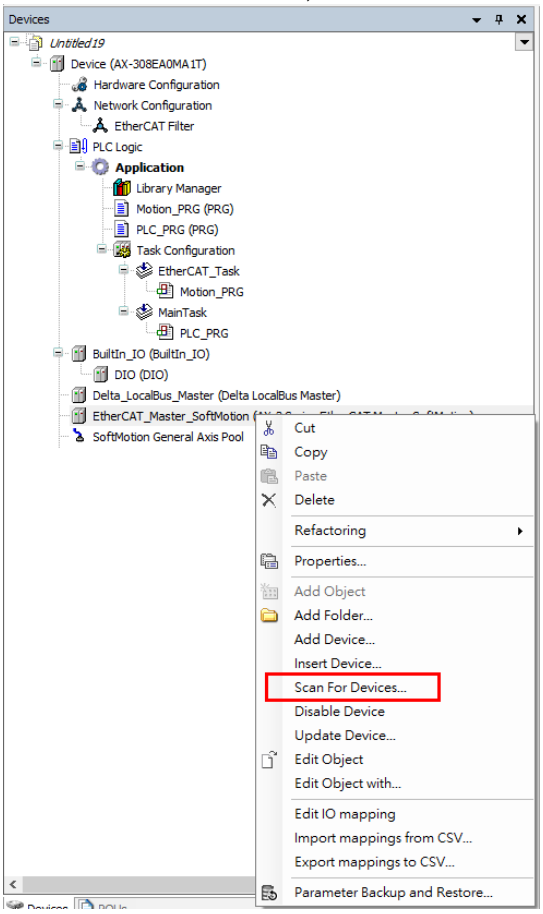


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

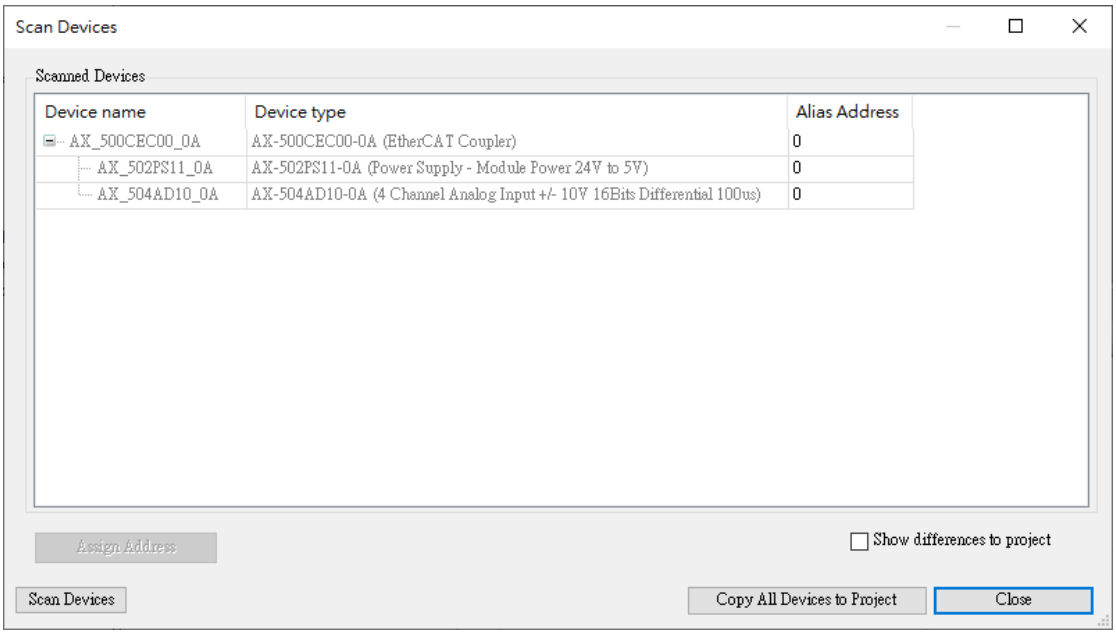


- Method 2: Scan to add the modules in.

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

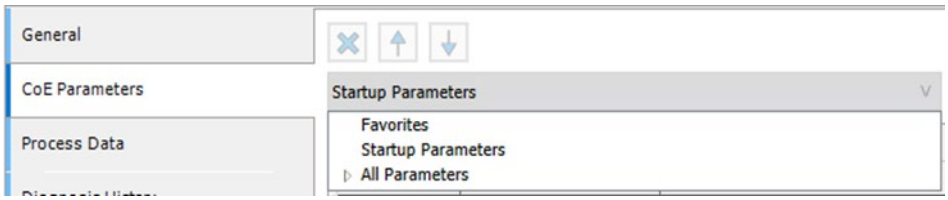


After the auto-scan is over, the actually connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



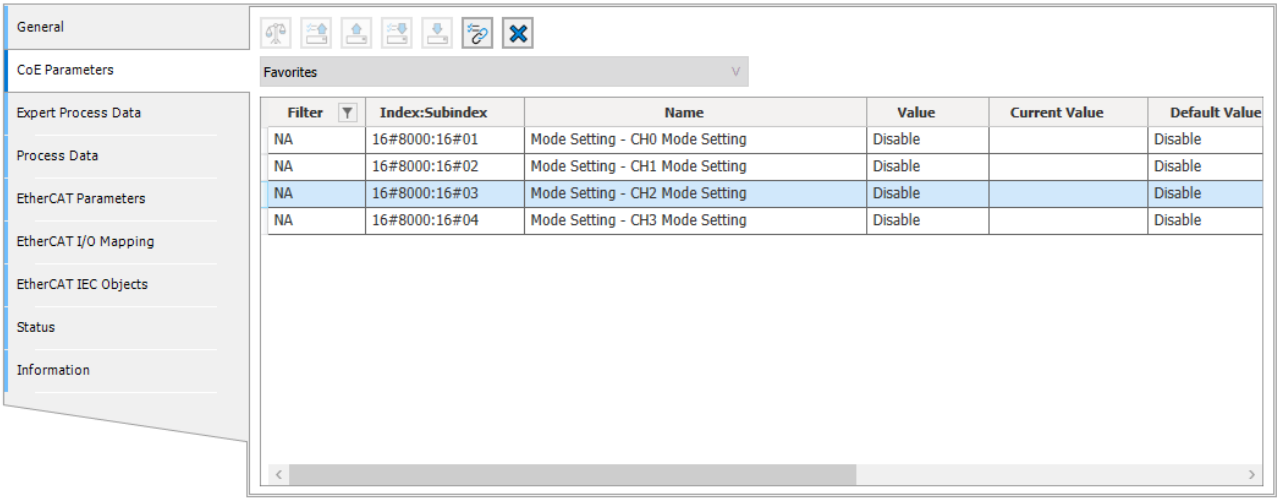
5.1.4.2 Parameter Settings

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



(1) Favorites

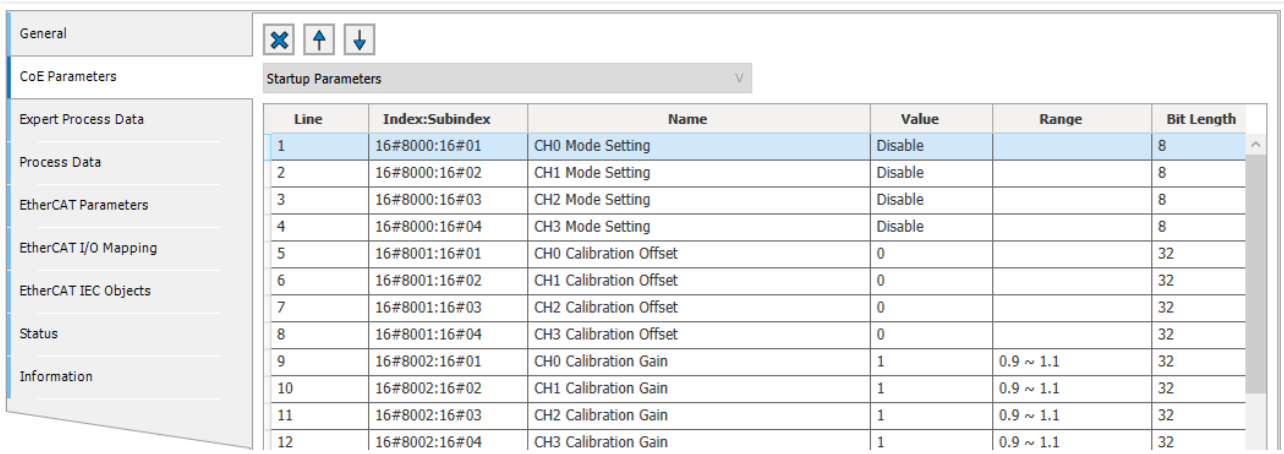
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

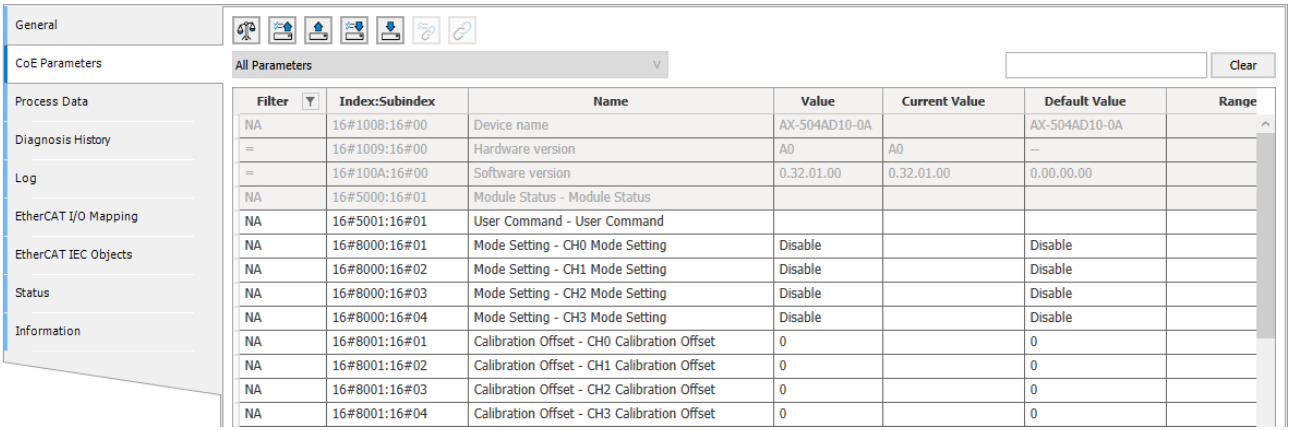


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8000:16#03	CH2 Mode Setting	Disable		8
4	16#8000:16#04	CH3 Mode Setting	Disable		8
5	16#8001:16#01	CH0 Calibration Offset	0		32
6	16#8001:16#02	CH1 Calibration 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

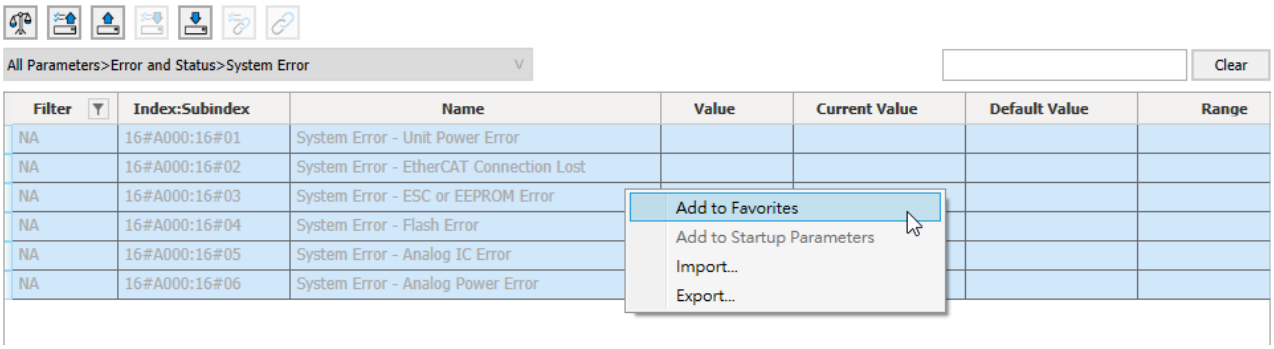
(3) All Parameters

- 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.

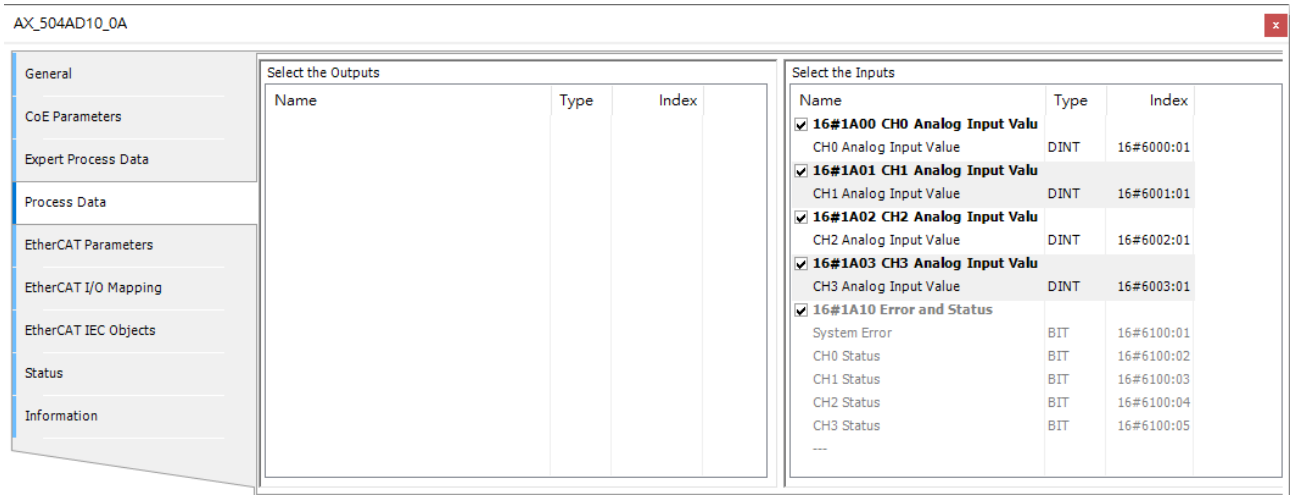


Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

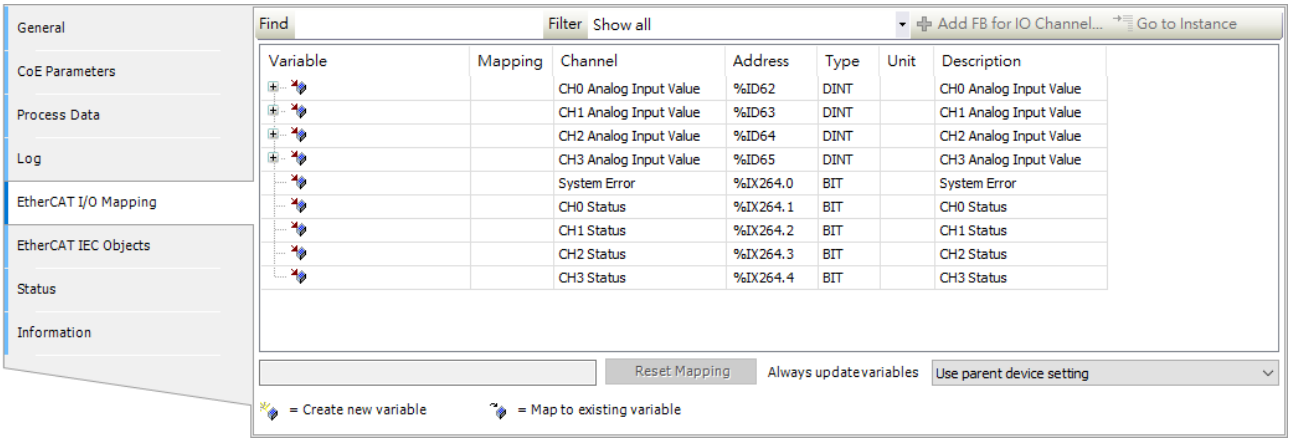
5

5.1.4.3 Process Data

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

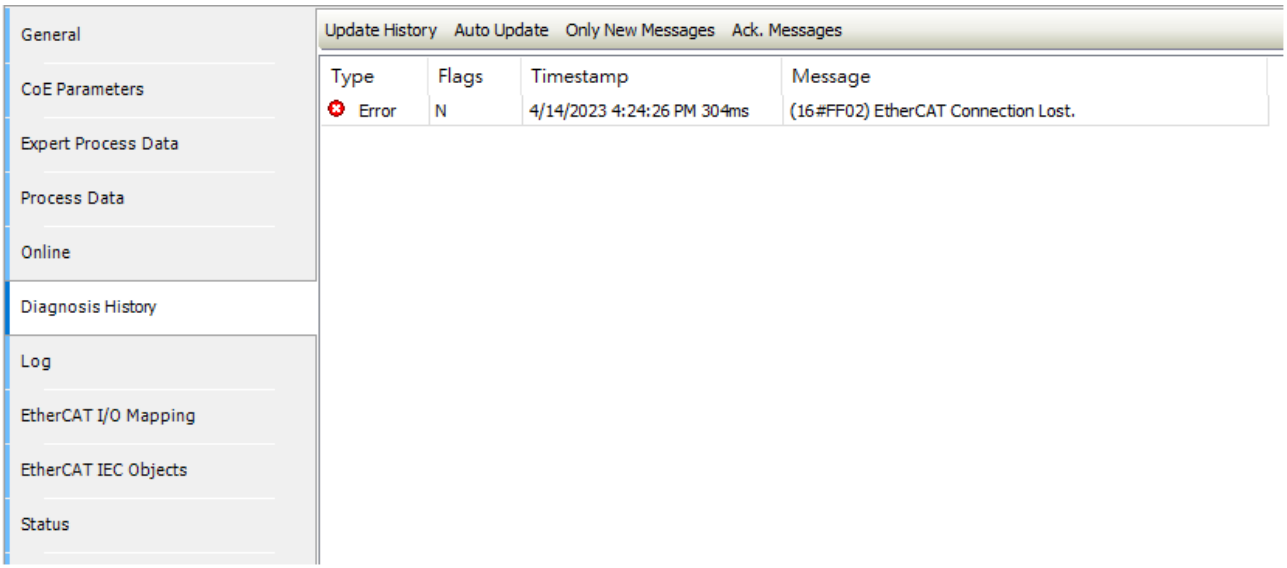


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



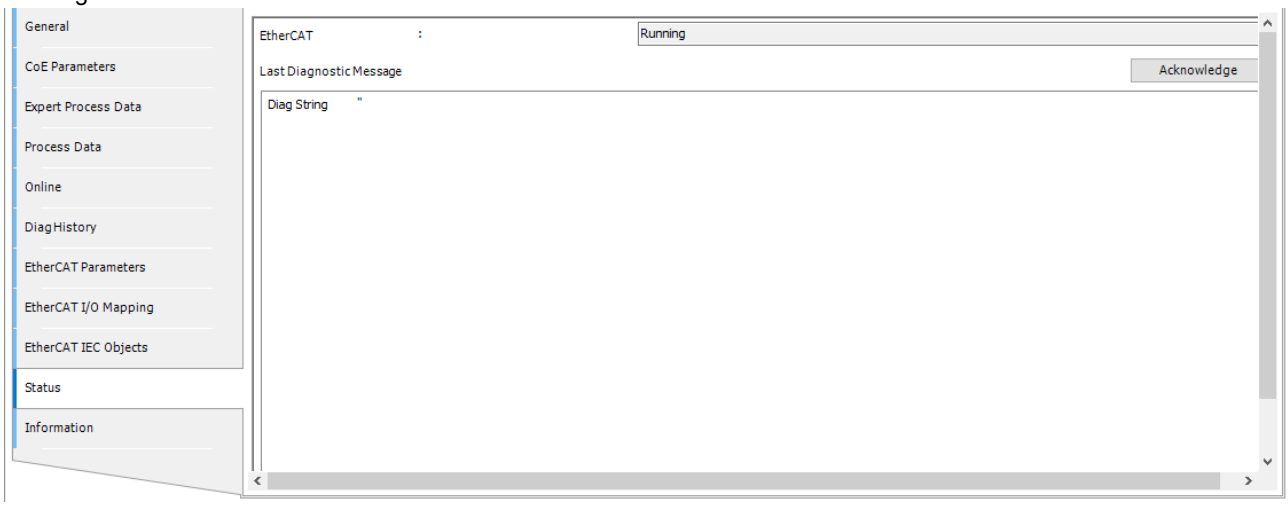
5.1.4.4 Diagnosis History

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.



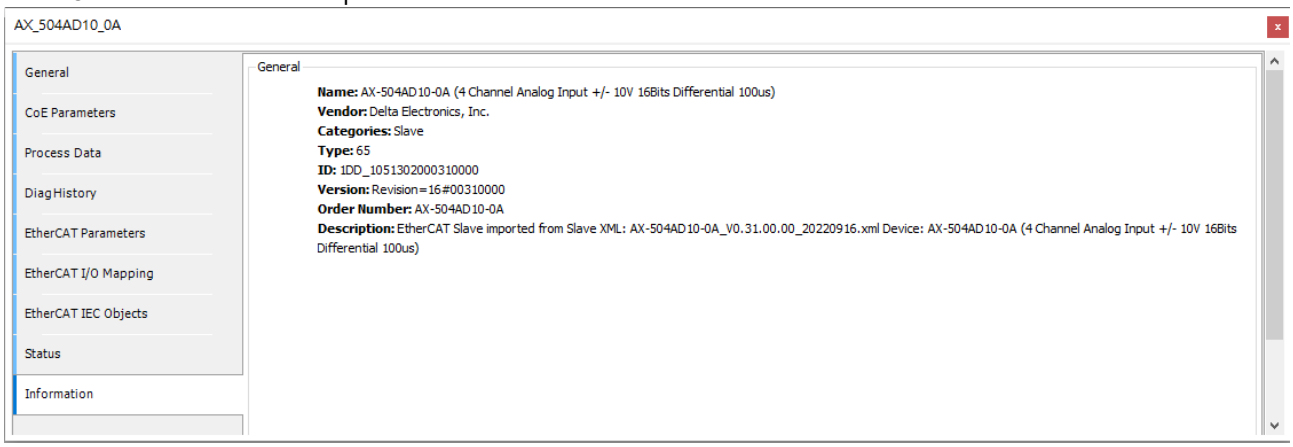
5.1.4.5 Status

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	N/A
1	-10 to 10 V	±30000
2	0 to 10 V	0 to 30000
3	-5 to 5 V	±30000
4	0 to 5 V	0 to 30000
5	1 to 5 V	0 to 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	0.0
	16#02	CH1 Calibration Offset		REAL	RW	0.0
	16#03	CH2 Calibration Offset		REAL	RW	0.0
	16#04	CH3 Calibration Offset		REAL	RW	0.0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9 to 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 to +10 V. Gain is 1 and Offset is 0 by default; the corresponding value range is -10.0 to 10.0 V. If Gain is set to 0.9 and Offset is set to 2, the value after calibration is -7.0 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 to 100 times	USINT	RW	10
	16#02	CH1 Moving Average Times		USINT	RW	10
	16#03	CH2 Moving Average Times		USINT	RW	10
	16#04	CH3 Moving Average Times		USINT	RW	10

- **Explanation**

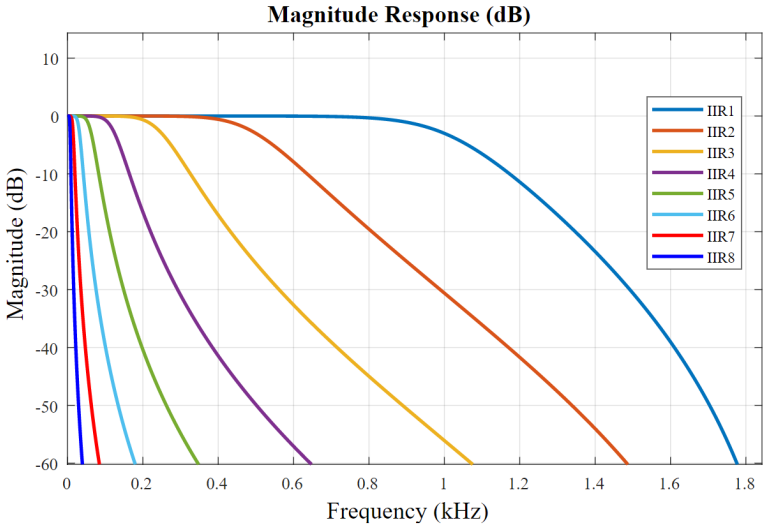
The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The filters can work only when the EtherCAT operation mode is the Free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

Moving Average Filter

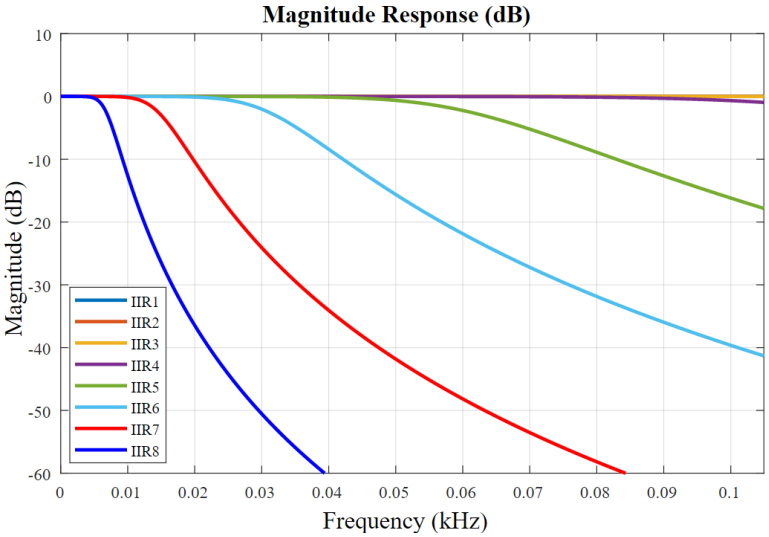
A moving average filter uses the latest pieces of sampled data to create a series of averages to smooth the data. Compared to other types of filters, a moving average filter is fast in computation and algorithm, without occupying the CPU processing time. But the filtering result of a moving average filter 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.



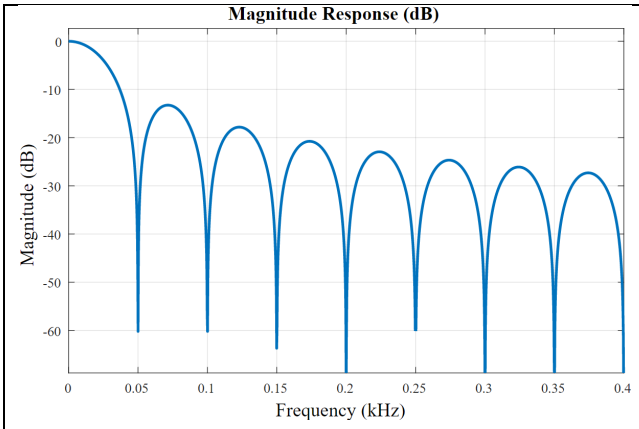
Frequency response of IIR filter



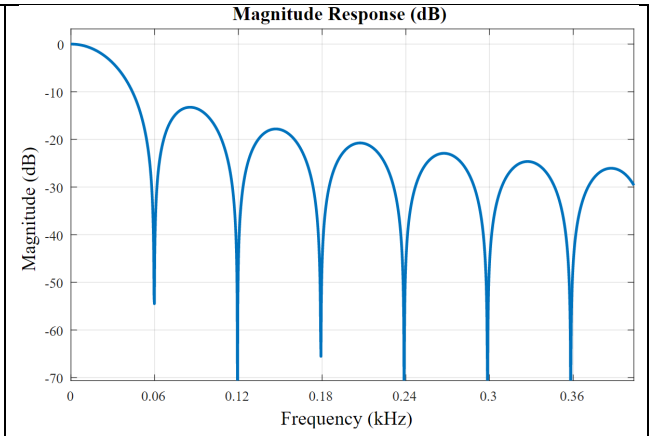
Frequency response of IIR filter (enlarged figure)

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

5

- **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	USINT	RW	0
	16#02	CH1 Enable User Limit Alarm DINT		USINT	RW	0
	16#03	CH2 Enable User Limit Alarm DINT		USINT	RW	0
	16#04	CH3 Enable User Limit Alarm DINT		USINT	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-point); 0: Disable (default) 1: Enable	USINT	RW	0
	16#02	CH1 Enable User Limit Alarm REAL		USINT	RW	0
	16#03	CH2 Enable User Limit Alarm REAL		USINT	RW	0
	16#04	CH3 Enable User Limit Alarm REAL		USINT	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**

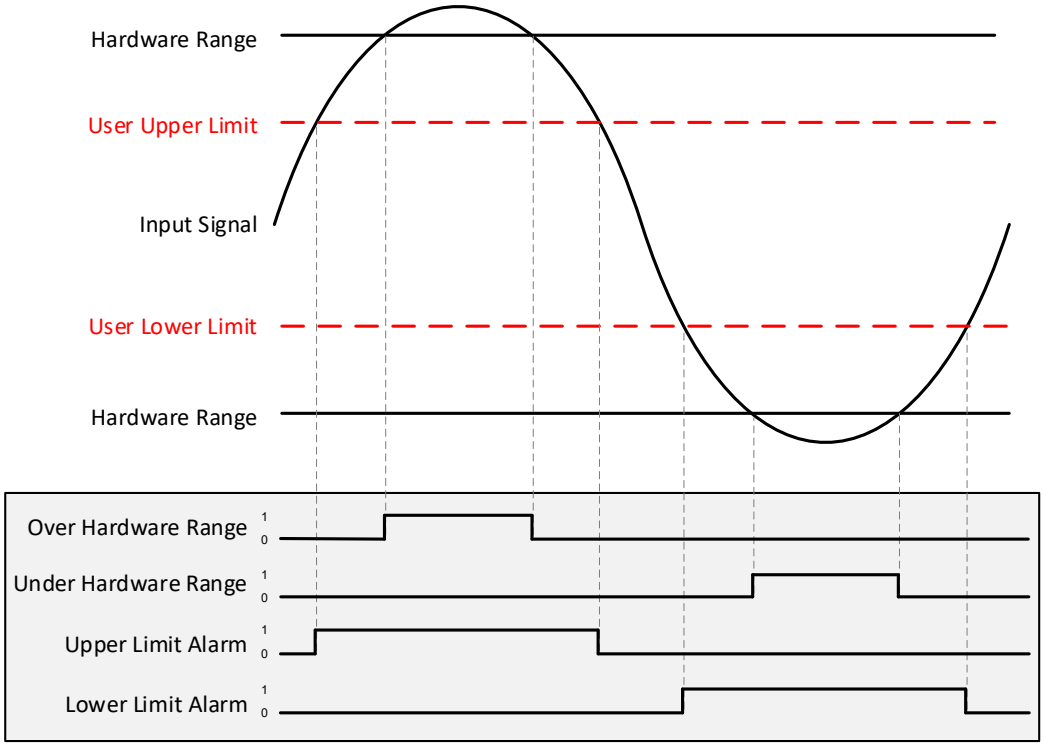
When the format is set to DINT, you can set

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.

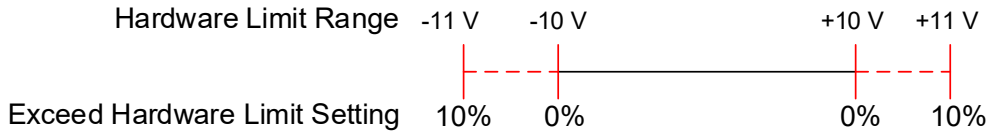


5.1.5.7 Exceed Hardware Limit

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8008	16#01	CH0 Exceed Hardware Limit Setting	Hardware limit setting; Setting range: 0 to 10 (0 to 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 to 10 V, the setting value is 5%. Its hardware limit range is -10.5 to 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 to 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

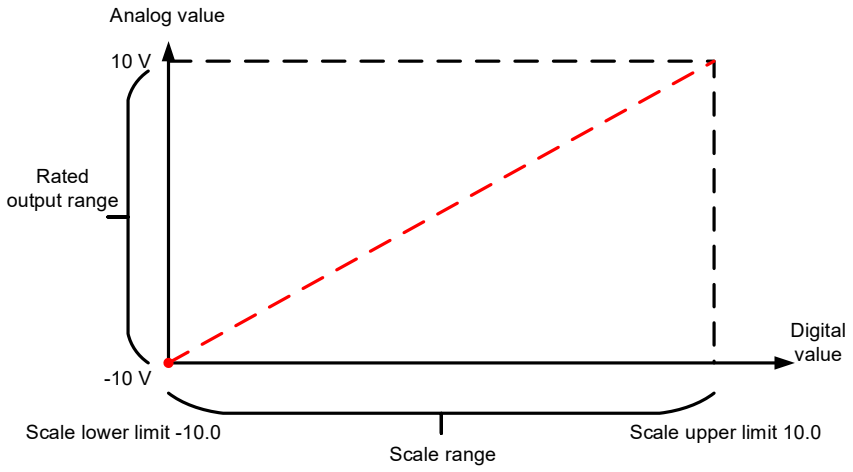
Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8030	16#01	CH0 Scale Upper Limit REAL	Scale upper limit setting; Setting range: no limit	REAL	RW	10.0
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	10.0
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	10.0
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	10.0
16#8031	16#01	CH0 Scale Lower Limit REAL	Scale lower limit setting; Setting range: no limit	REAL	RW	-10.0
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-10.0
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-10.0
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-10.0

- **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 to 10 V, the analog range is -10 to 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 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

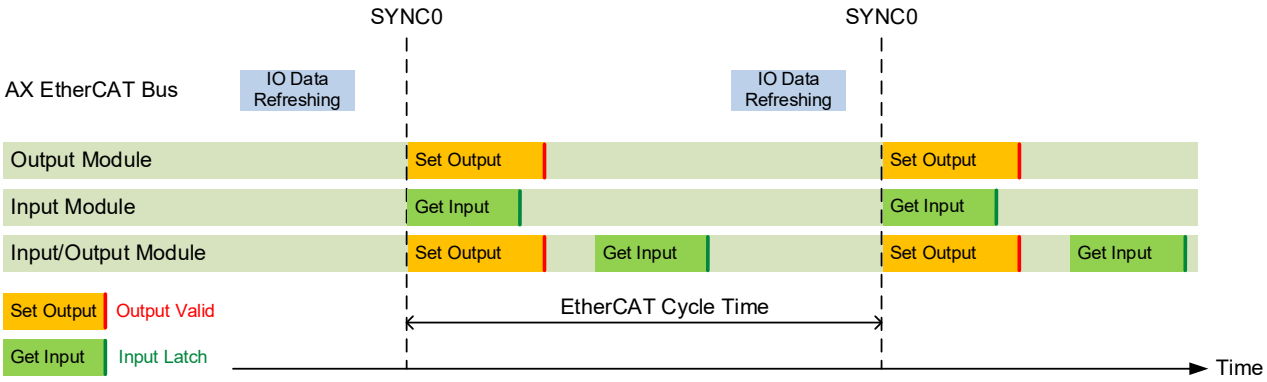
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

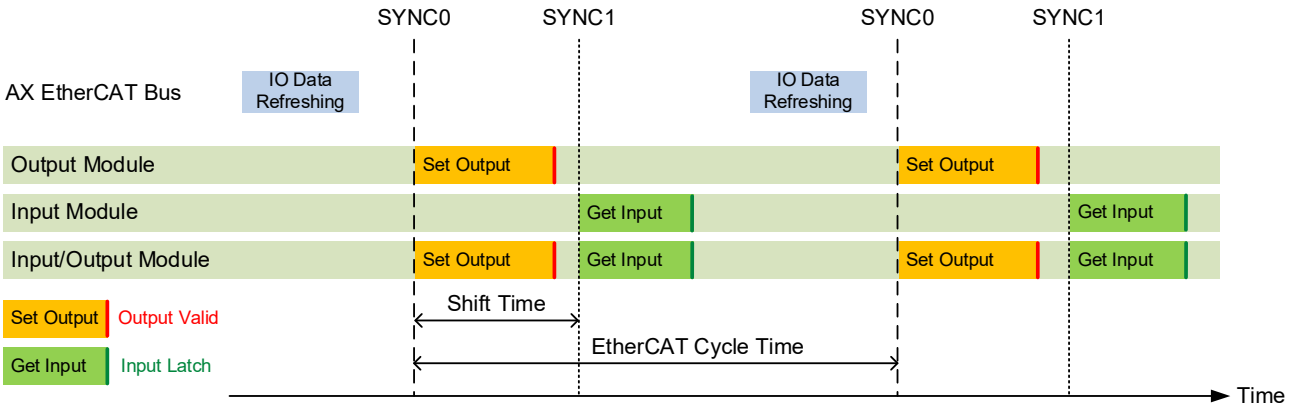
- **SYNC0**

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

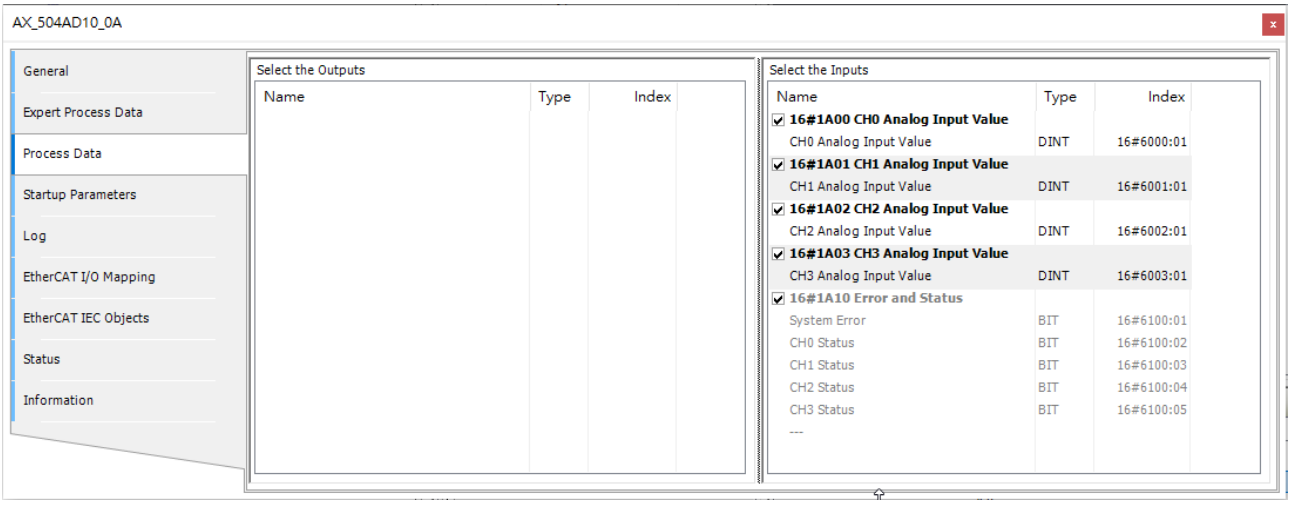
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Analog Input Value	Analog input value; Setting range: -30000 to 30000	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

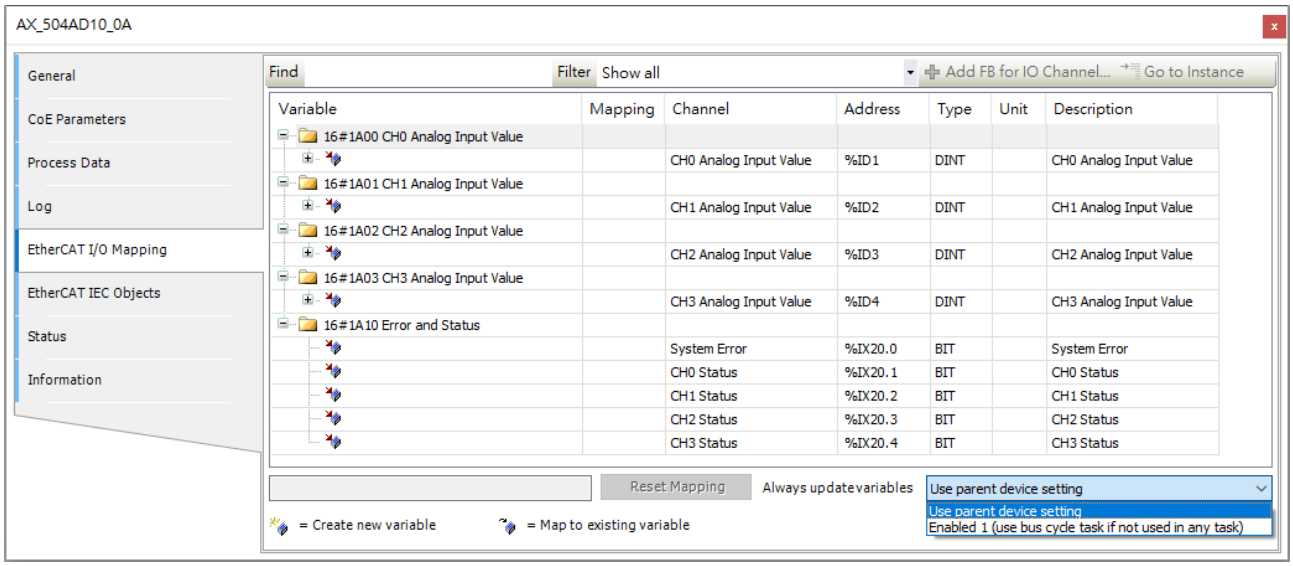
Go to the Process Data tab and select the data that you'd like to monitor.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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 (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.

*1. n =1 to 4

5.2 AX-504AD20-0A

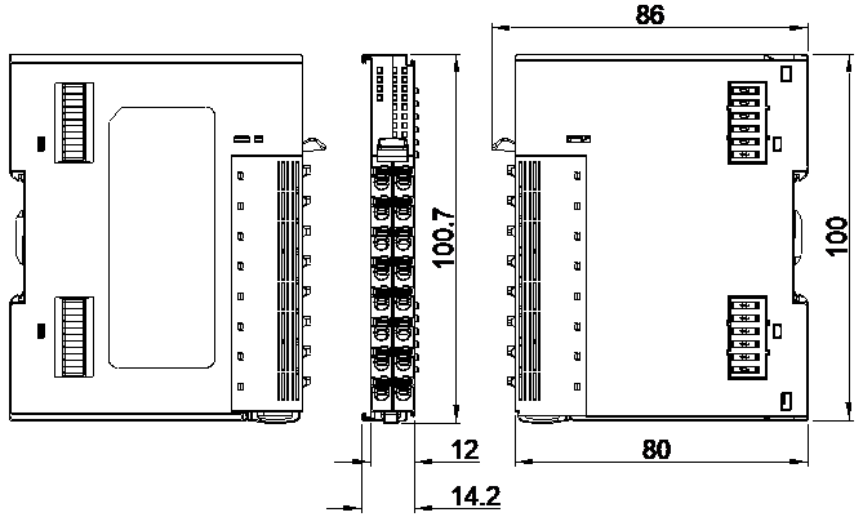
AX-504AD20-0A, an analog input module, receives analog current signals through 4 input points and converts the received signals to 16-bit digital signals. This section introduces its specifications, wirings and operations.

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 to +20 mA
	Input conversion range	-5 to 105% (F.S.)
	Rated absolute input range	±32 mA
	Input impedance	Less than 300 Ω
	Resolution	-20 to +20 mA: 16 bits; 0 to 20 mA: 15 bits; 4 to 20 mA: 15 bits
	Accuracy	25°C: ±0.2% (F.S.) -20 to 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 400 mA (2W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Detection	N/A
	Short Circuit Detection (SCD)	N/A
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	N/A
	Filter function	AVG, FIR, IIR

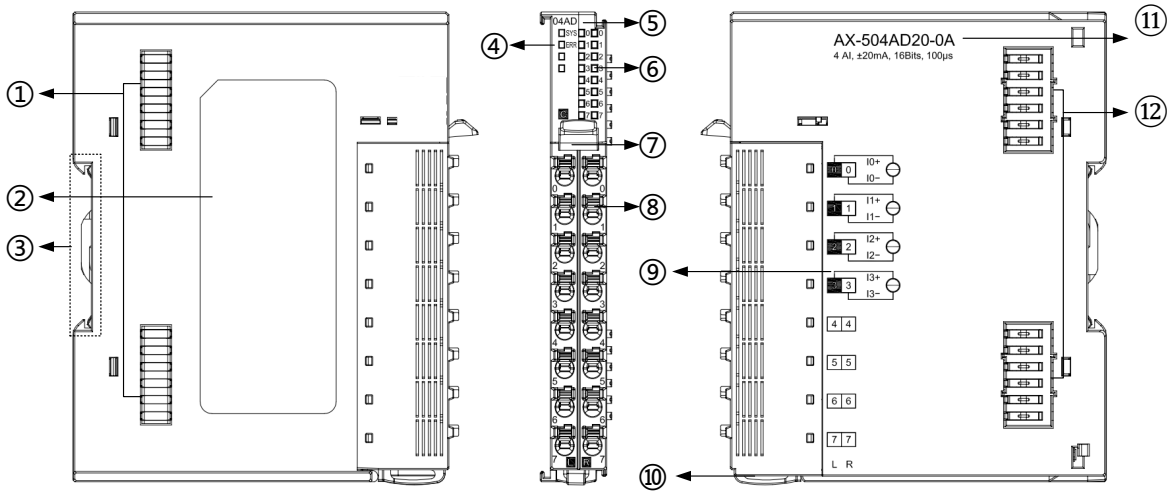
5.2.2 Dimensions and Parts

- **Dimensions**



Unit: mm

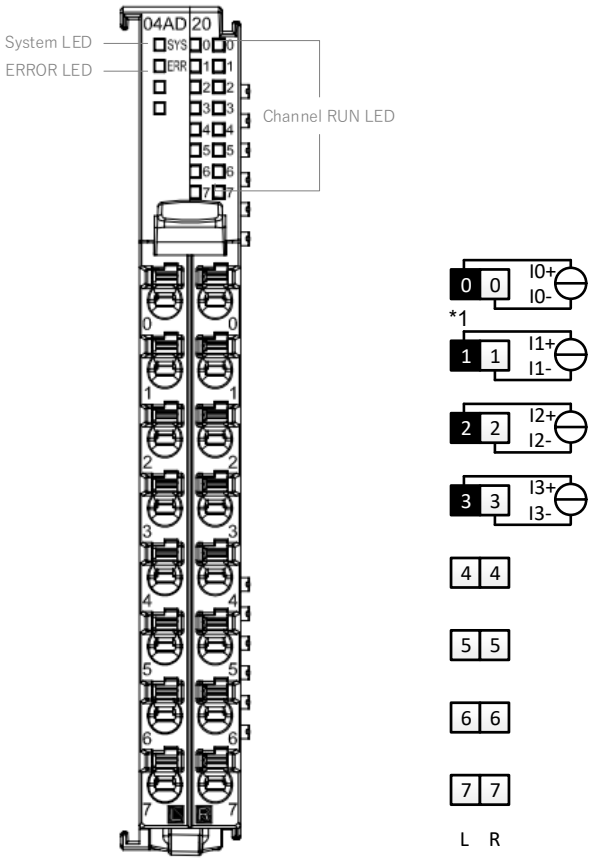
- **Parts**



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.

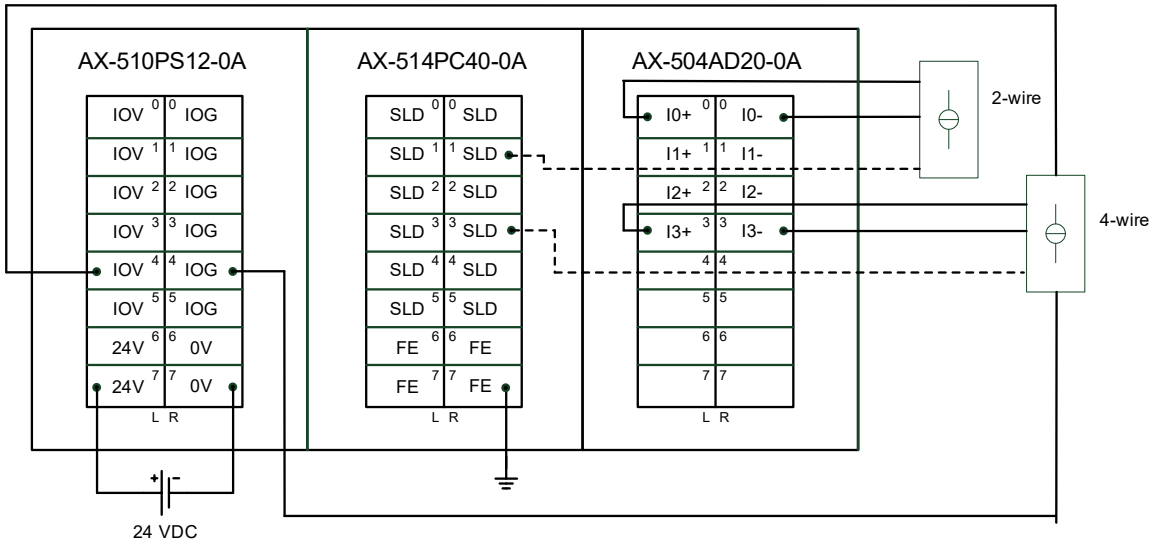
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0+	Channel 0: positive input current	R0	I0-	Channel 0: negative input current
L1	I1+	Channel 1: positive input current	R1	I1-	Channel 1: negative input current
L2	I2+	Channel 2: positive input current	R2	I2-	Channel 2: negative input current
L3	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

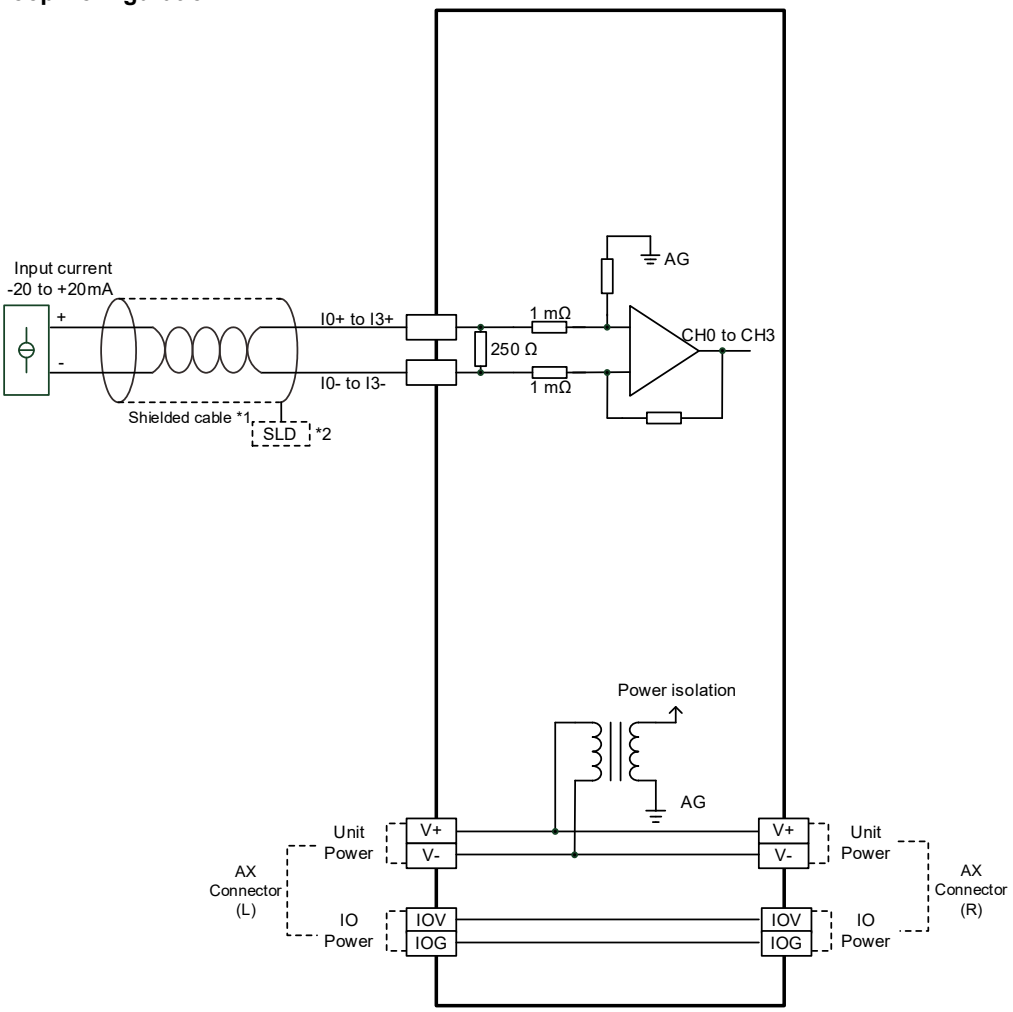
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2 s)	ECAT Pre OP
			Blinking (1 s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1 s)	An error occurs on the application.
			Blinking (0.2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

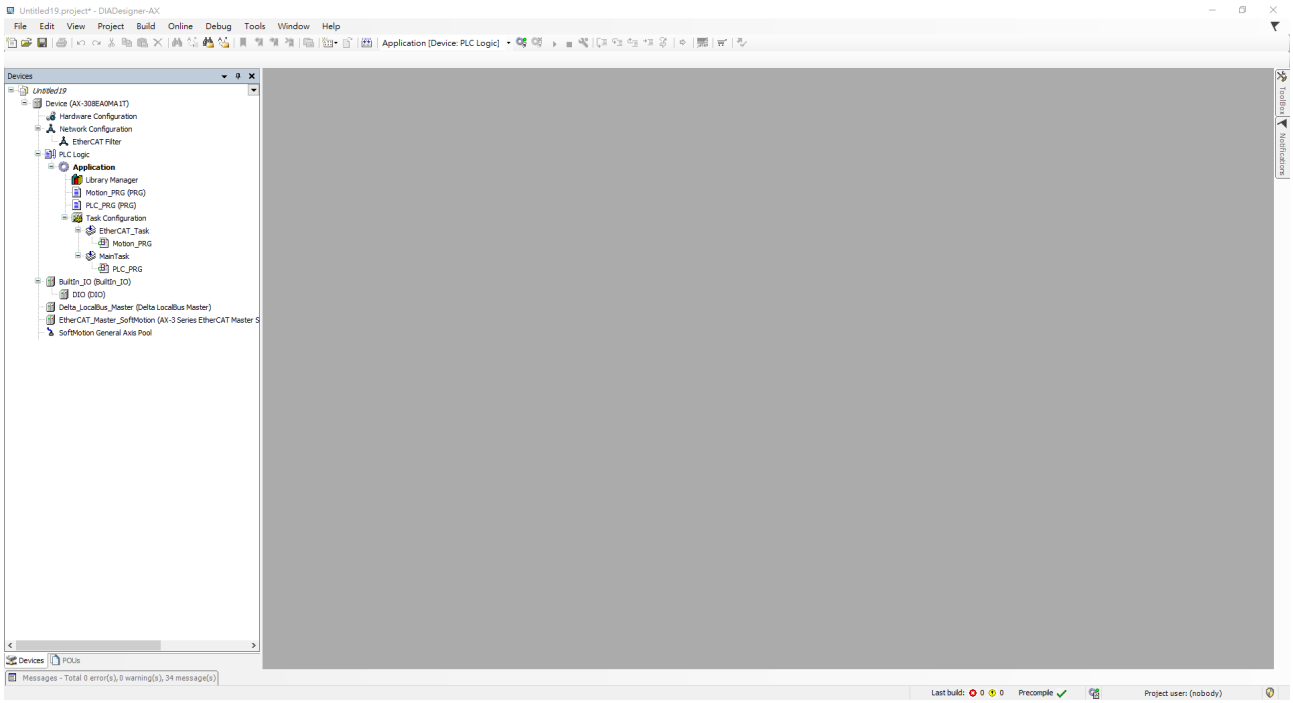
*2. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A.

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

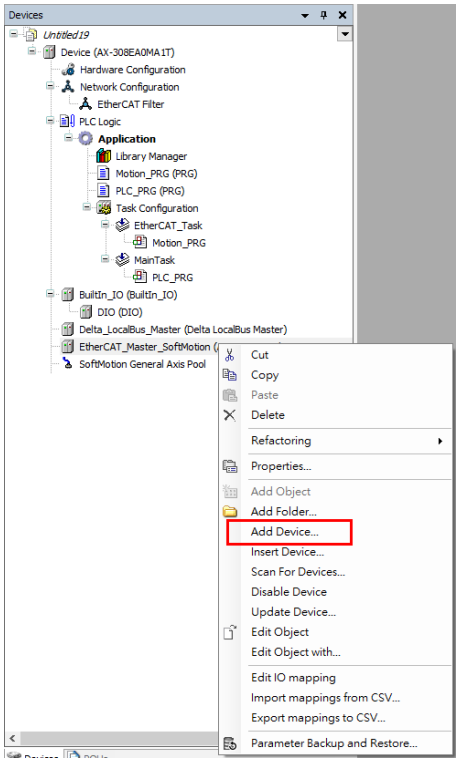
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



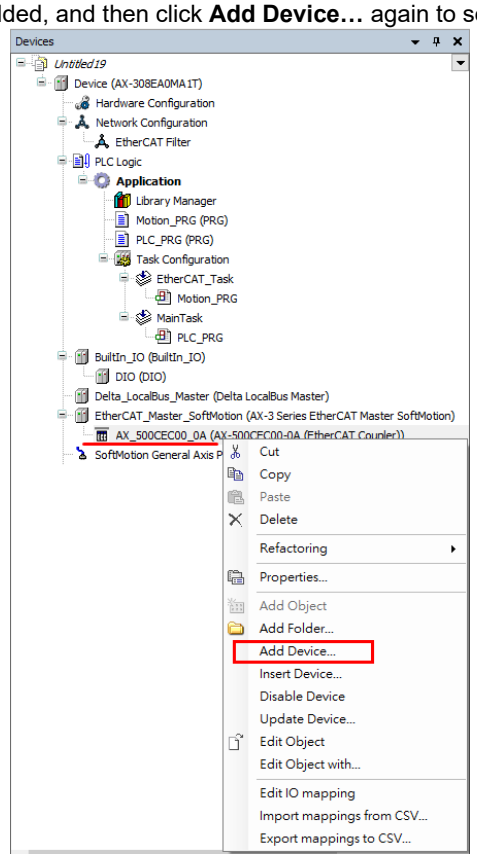
(2) Add Modules in

- 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.

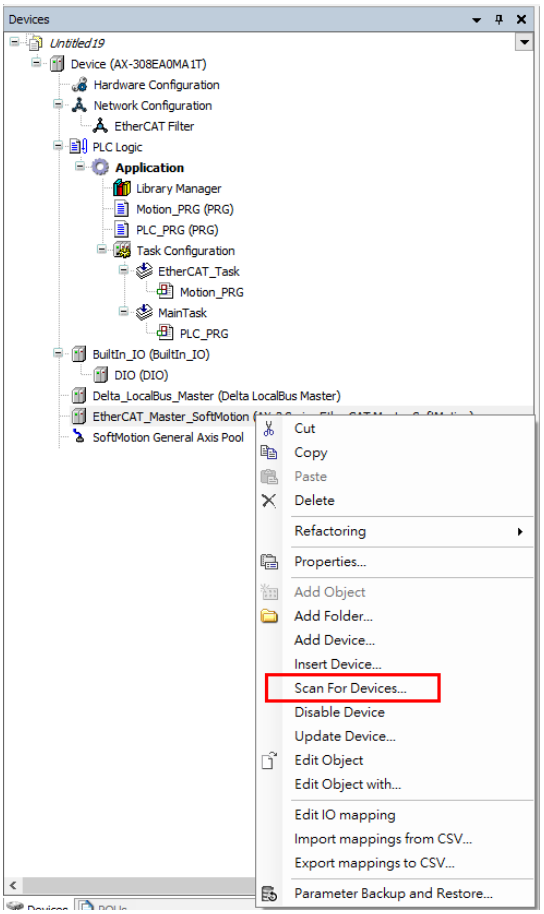


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.



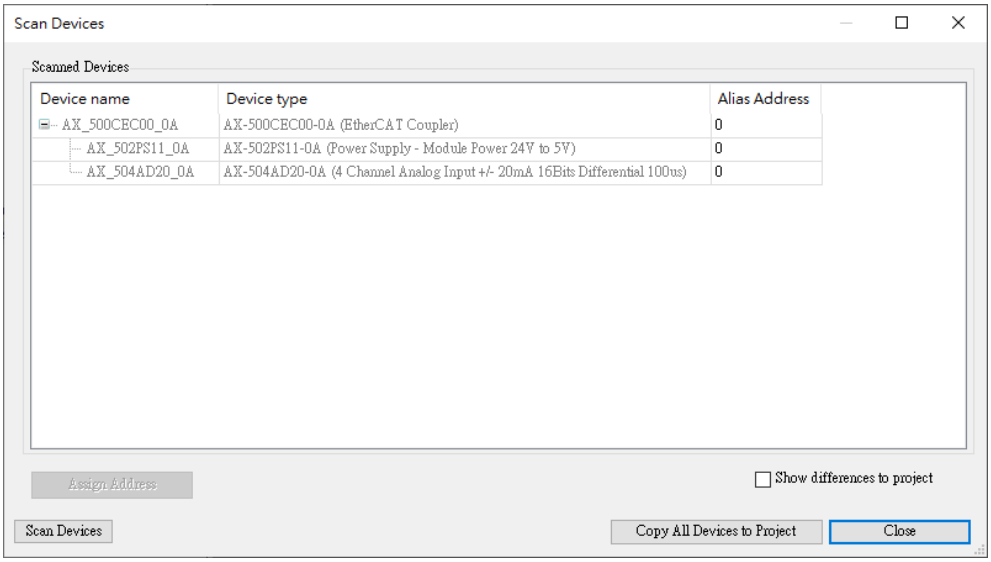
- Method 2: Scan to add the modules in.

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



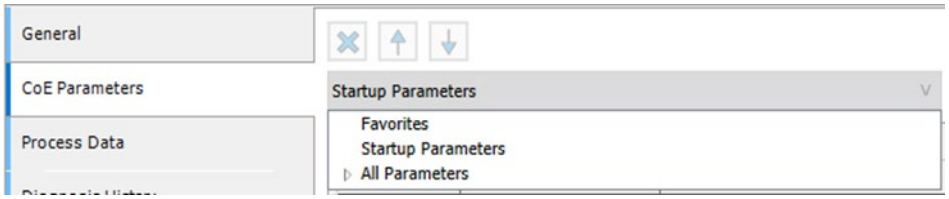
After the auto-scan is over, the actually connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.

.



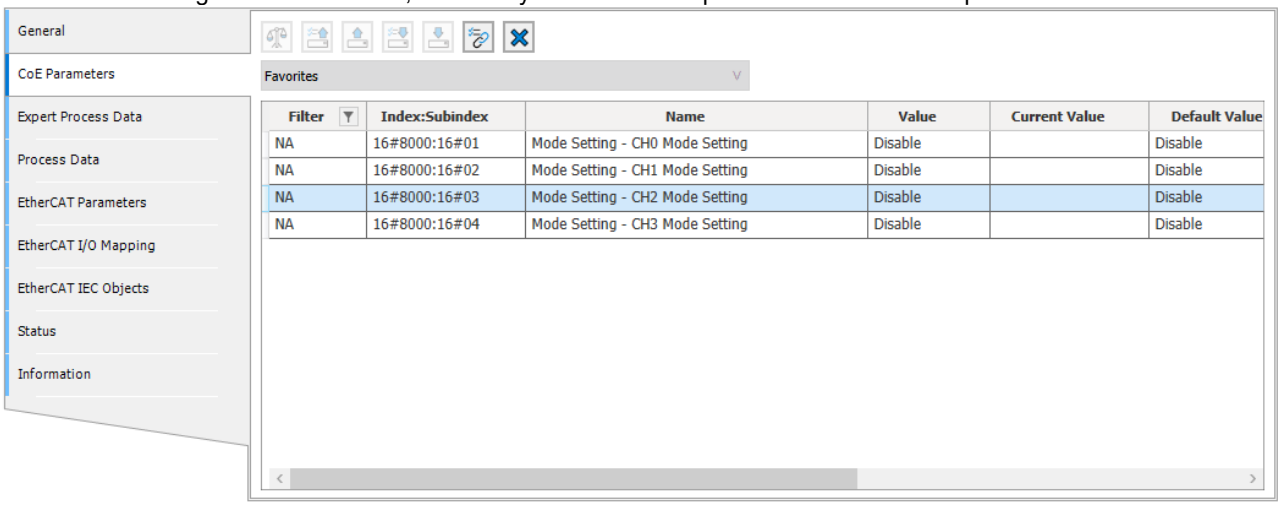
5.2.4.2 Parameter Settings

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



(1) Favorites

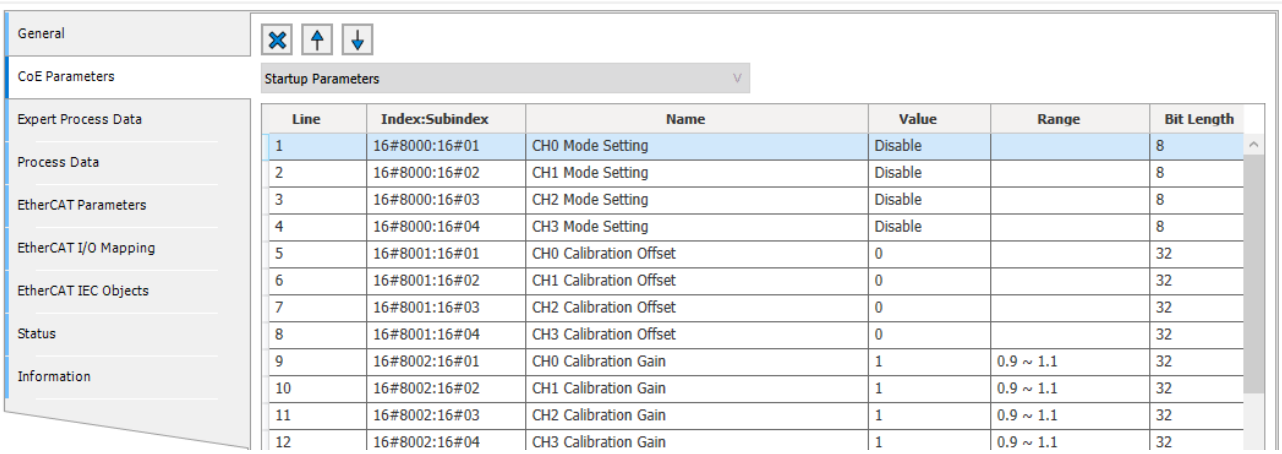
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

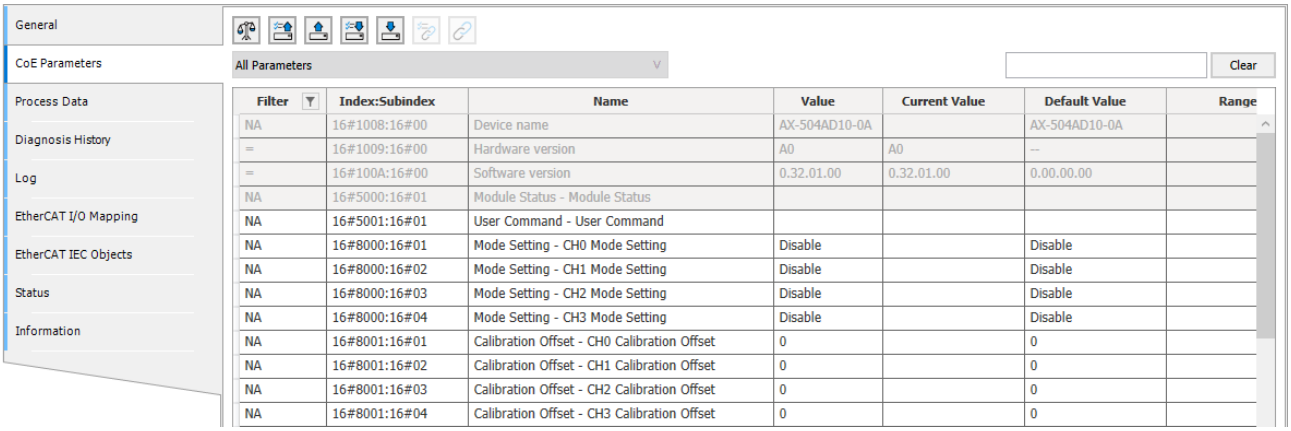


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8000:16#03	CH2 Mode Setting	Disable		8
4	16#8000:16#04	CH3 Mode Setting	Disable		8
5	16#8001:16#01	CH0 Calibration Offset	0		32
6	16#8001:16#02	CH1 Calibration 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

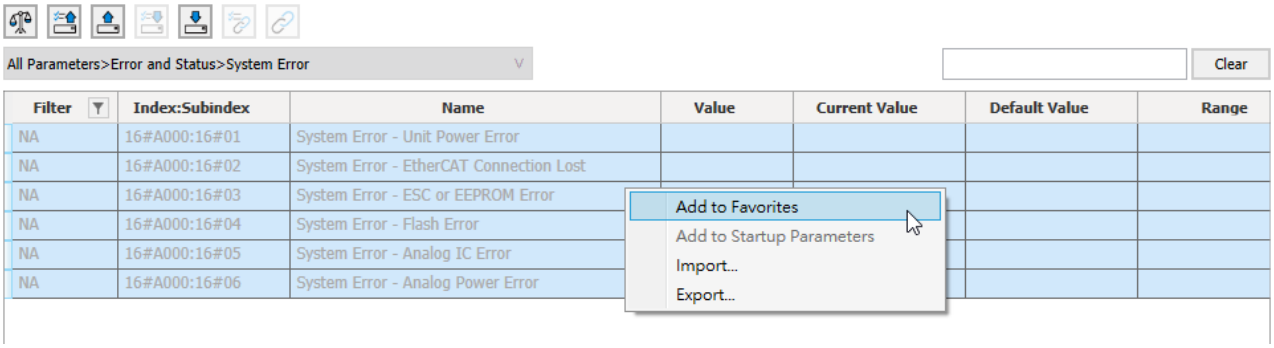
(3) All Parameters

- 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.

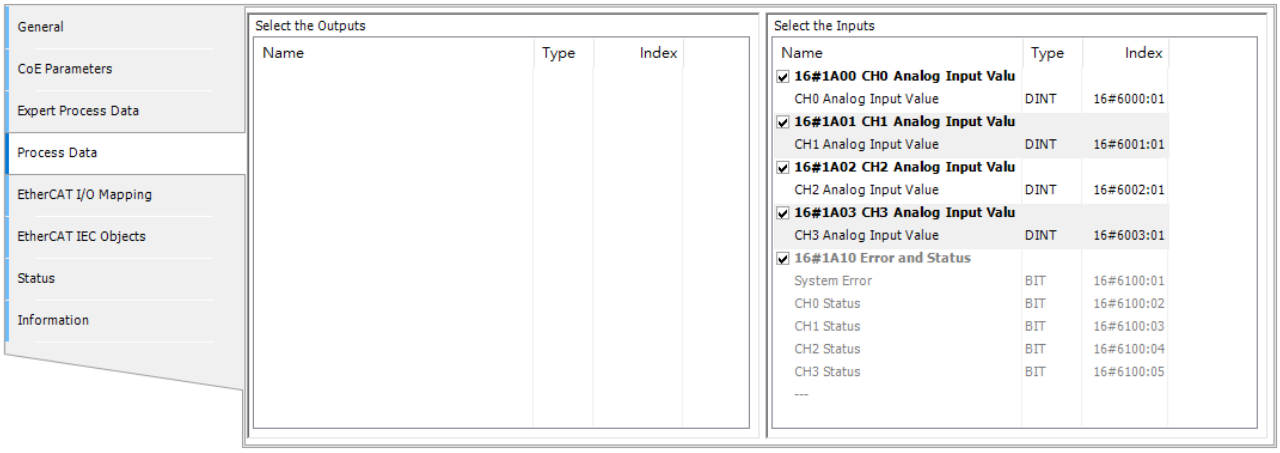
- You can select and right-click the parameter to add the selected parameter to the Favorites.



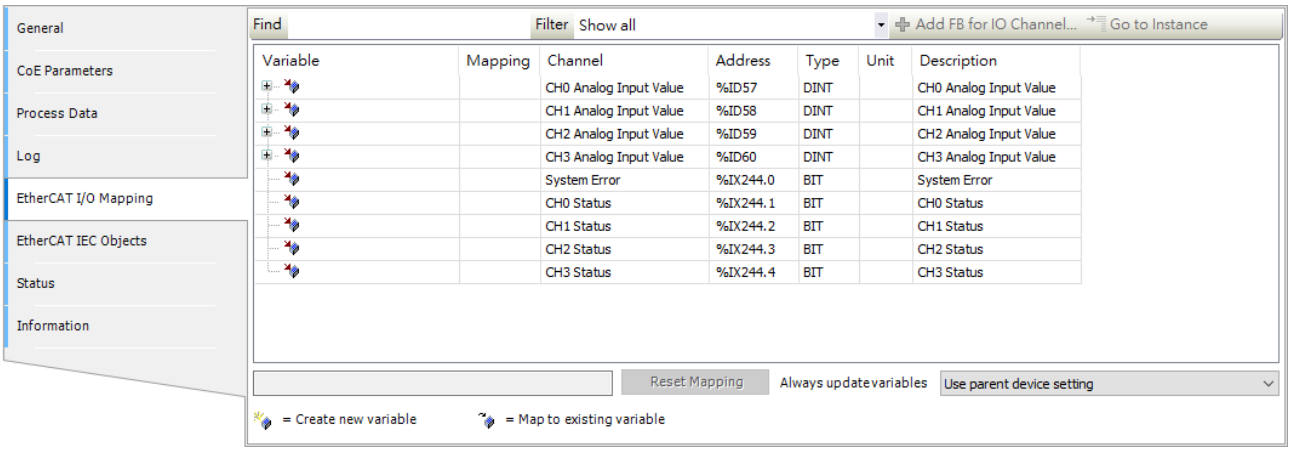
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.2.4.3 Process Data

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

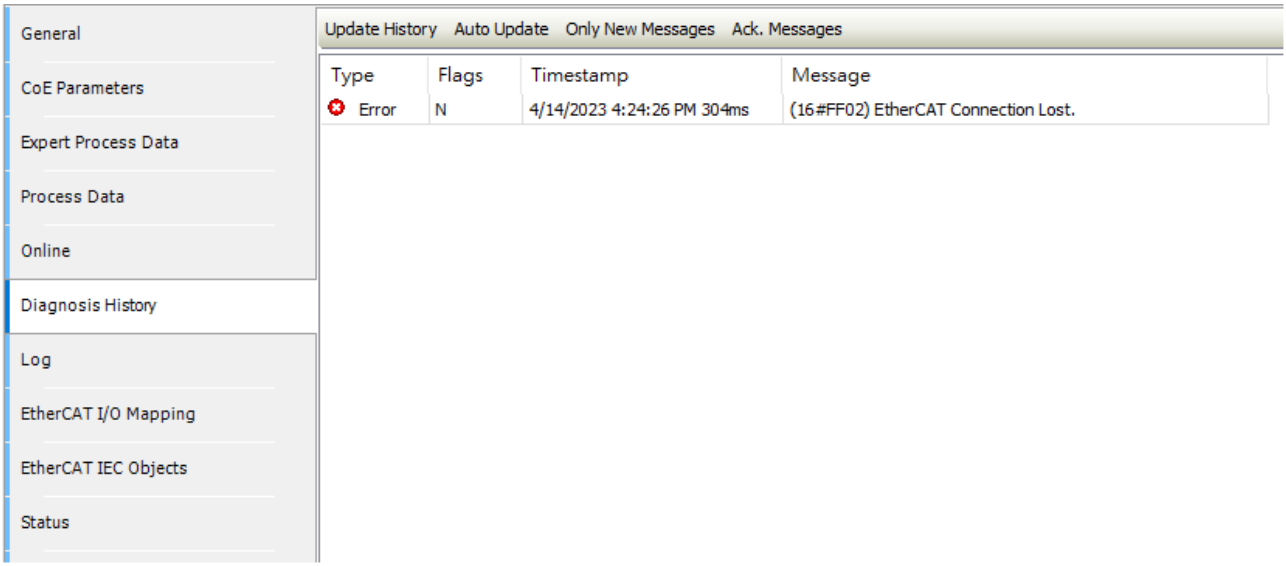


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



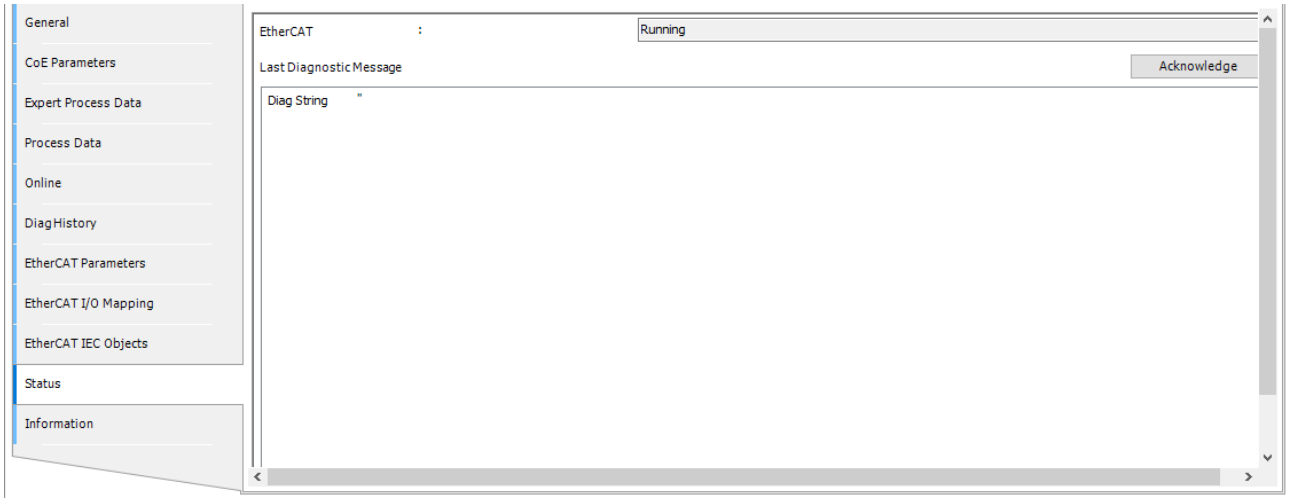
5.2.4.4 Diagnosis History

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.



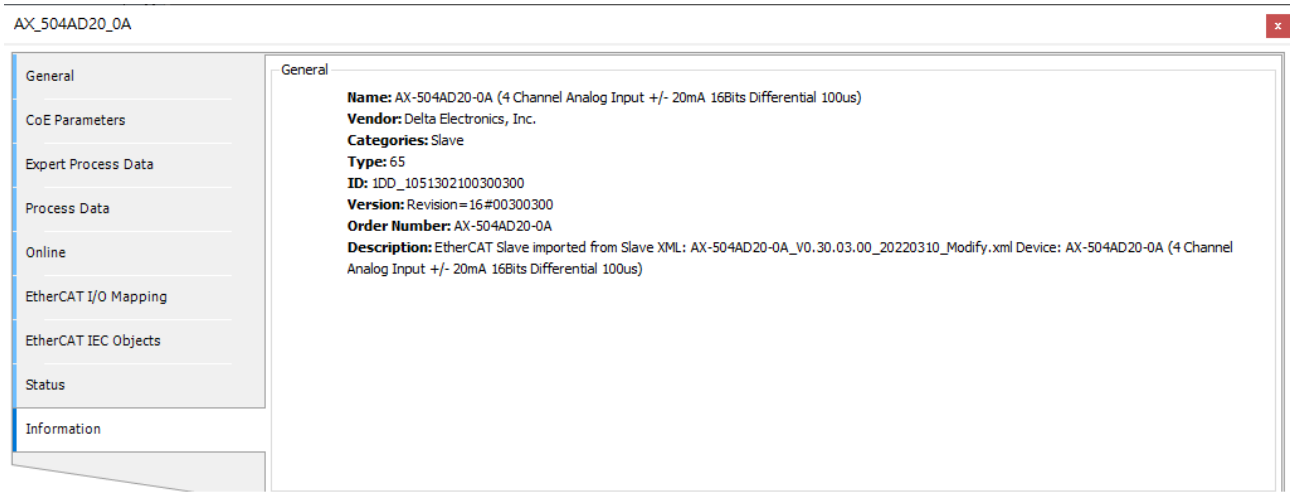
5.2.4.5 Status

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 to 20 mA	±30000
2	0 mA to 20 mA	0 to 30000
3	4 mA to 20 mA	0 to 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	0.0
	16#02	CH1 Calibration Offset		REAL	RW	0.0
	16#03	CH2 Calibration Offset		REAL	RW	0.0
	16#04	CH3 Calibration Offset		REAL	RW	0.0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9 to 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 to +20.0 mA. Gain is 1 and Offset is 0 by default, and the corresponding value is -20.0 to +20.0 mA. If you change the gain to 0.9 and the offset to 3, the value after calibration is -15 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 to 100 times	USINT	RW	10
	16#02	CH1 Moving Average Times		USINT	RW	10
	16#03	CH2 Moving Average Times		USINT	RW	10
	16#04	CH3 Moving Average Times		USINT	RW	10

- **Explanation**

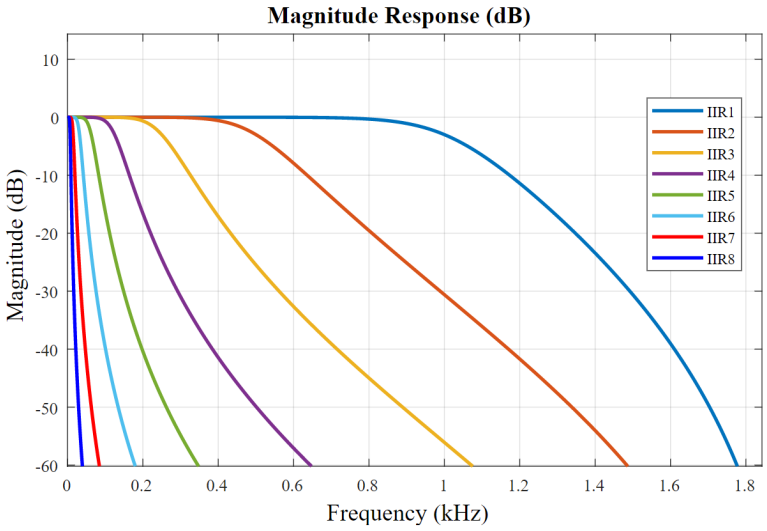
The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The filters can work only when the EtherCAT operation mode is the Free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

Moving Average Filter

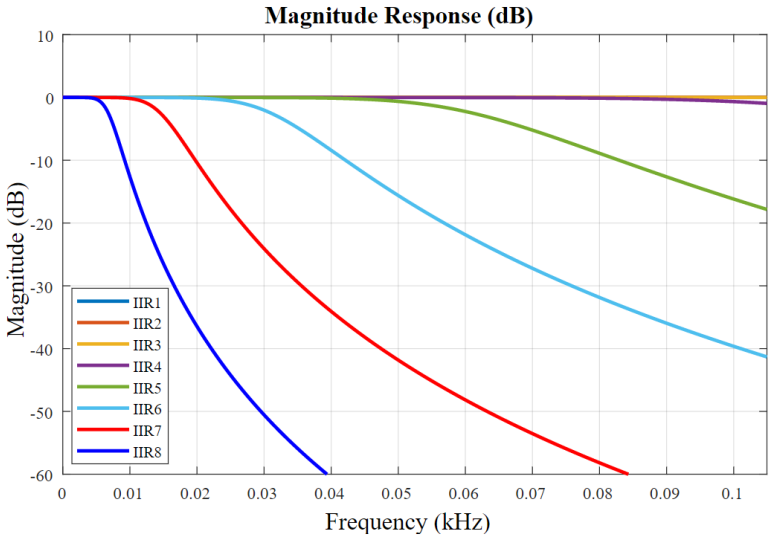
A moving average filter uses the latest pieces of sampled data to create a series of averages to smooth the data. Compared to other types of filters, a moving average filter is fast in computation and algorithm, without occupying the CPU processing time. But the filtering result of a moving average filter 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.



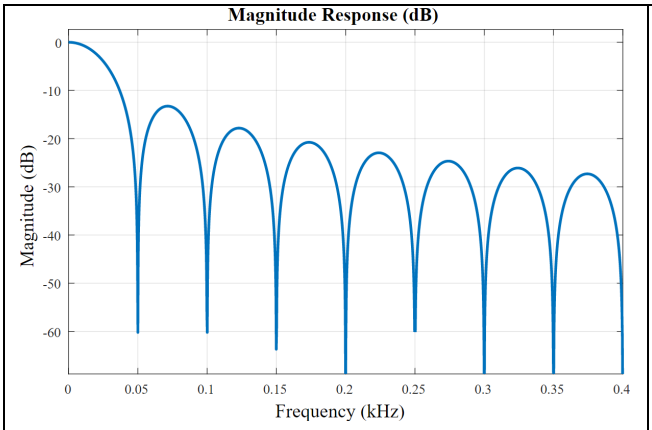
Frequency response of IIR filter



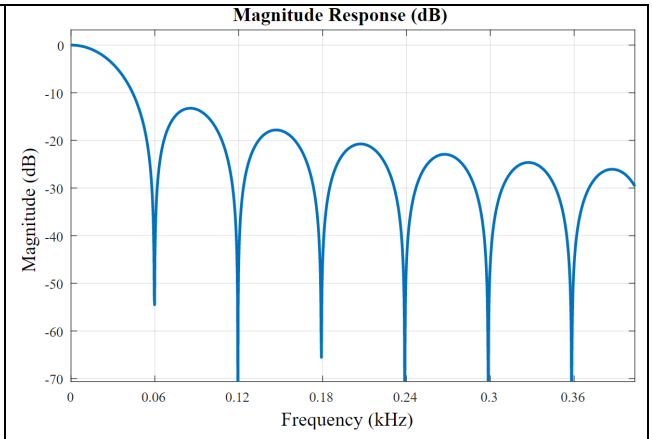
Frequency response of IIR filter (enlarged figure)

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	USINT	RW	0
	16#02	CH1 Enable User Limit Alarm DINT		USINT	RW	0
	16#03	CH2 Enable User Limit Alarm DINT		USINT	RW	0
	16#04	CH3 Enable User Limit Alarm DINT		USINT	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-	USINT	RW	0
	16#02	CH1 Enable User Limit Alarm REAL		USINT	RW	0

Index	Subindex	Name	Description	Data Type	Attr.	Default
	16#03	CH2 Enable User Limit Alarm REAL	point); 0: Disable(default) 1: Enable	USINT	RW	0
	16#04	CH3 Enable User Limit Alarm REAL		USINT	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**

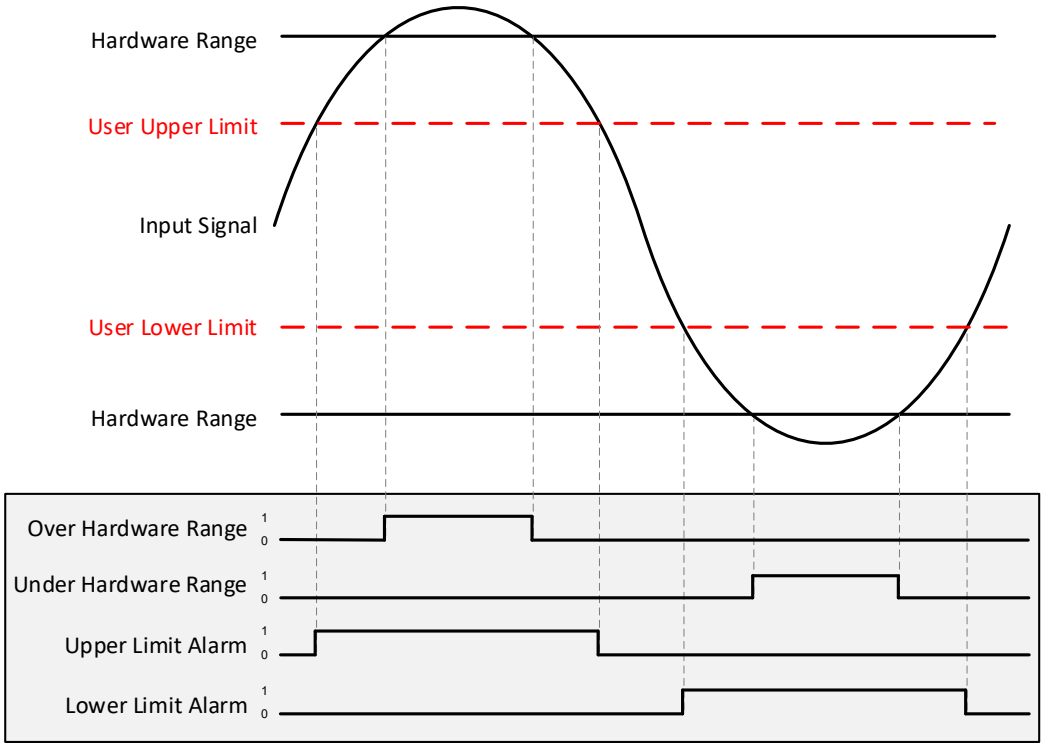
When the format is set to DINT, you can set:

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.

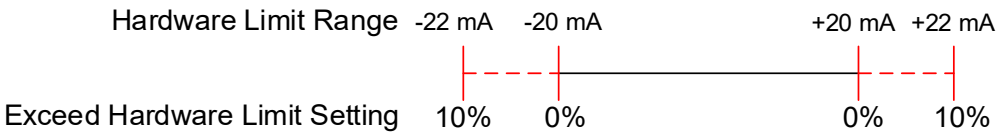


5.2.5.7 Exceed Hardware Limit

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8008	16#01	CH0 Exceed Hardware Limit Setting	Hardware limit setting; Setting range: 0 to 10 (0 to 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 to 20 mA, the setting value is 5%. Its hardware limit range is -21 to 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 to 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

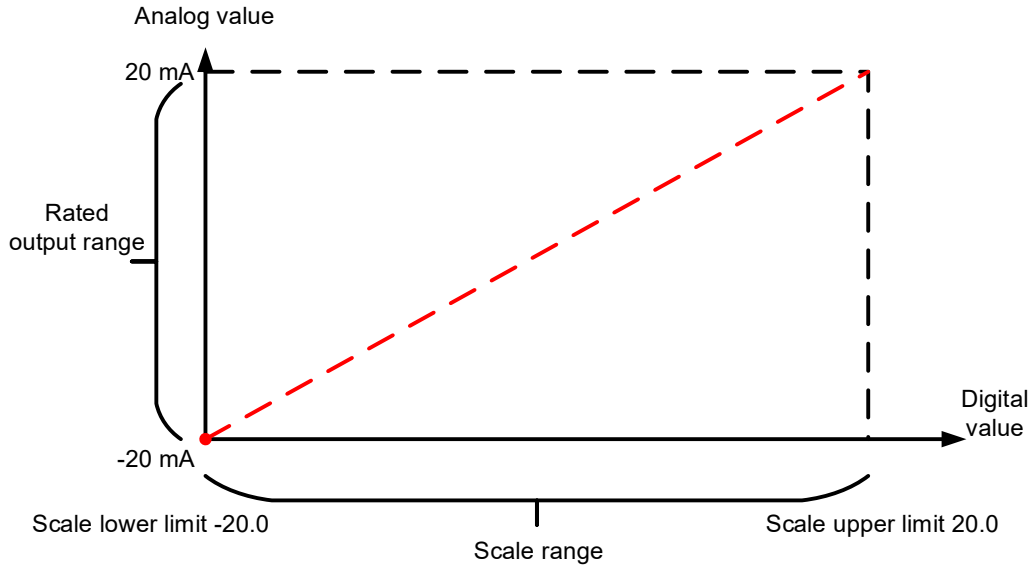
Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8030	16#01	CH0 Scale Upper Limit REAL	Scale upper limit setting; Setting range: no limit	REAL	RW	20.0
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	20.0
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	20.0
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	20.0
16#8031	16#01	CH0 Scale Lower Limit REAL	Scale lower limit setting; Setting range: no limit	REAL	RW	-20.0
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-20.0
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-20.0
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-20.0

- **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 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 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

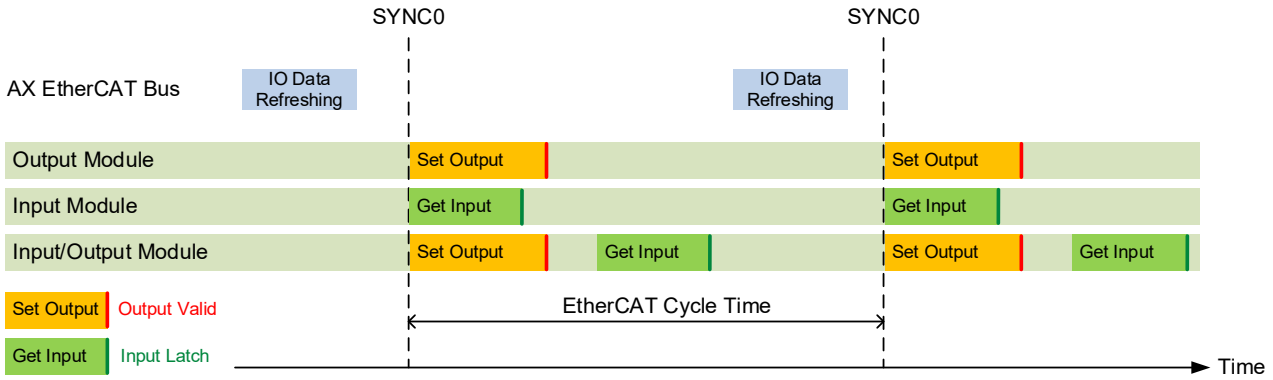
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

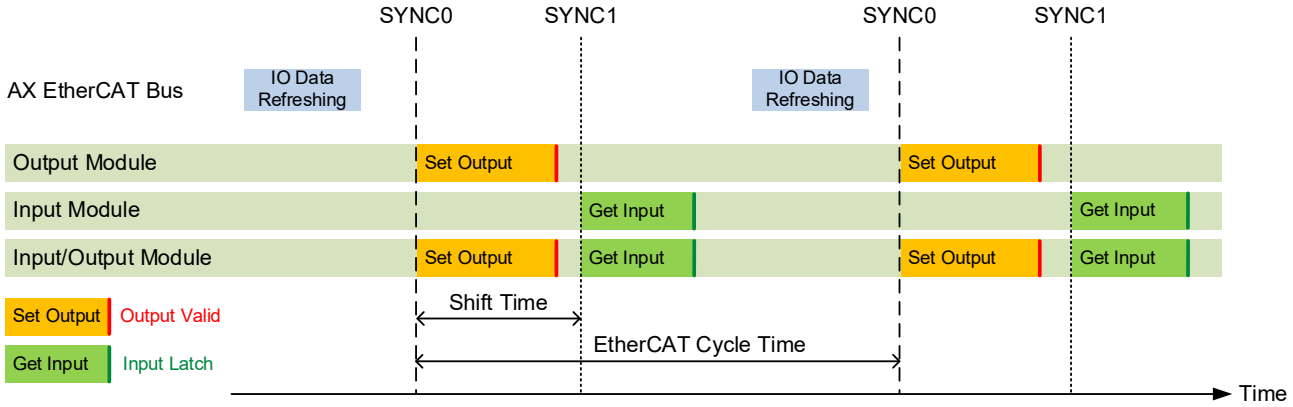
- **SYNC0**

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

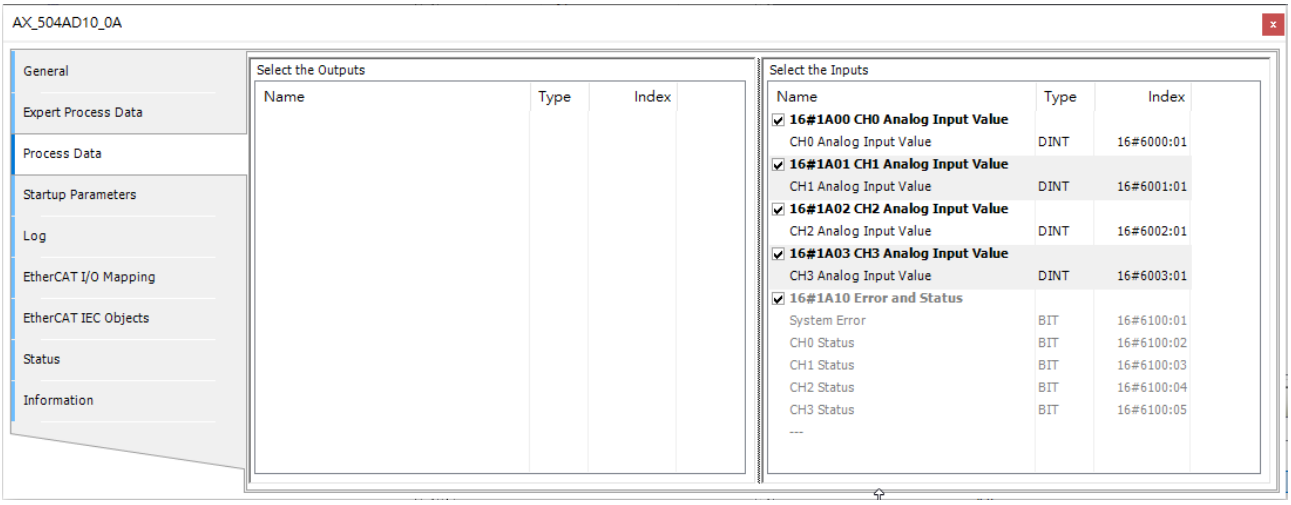
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Analog Input Value	Analog input value; Setting range: -30000 to 30000	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

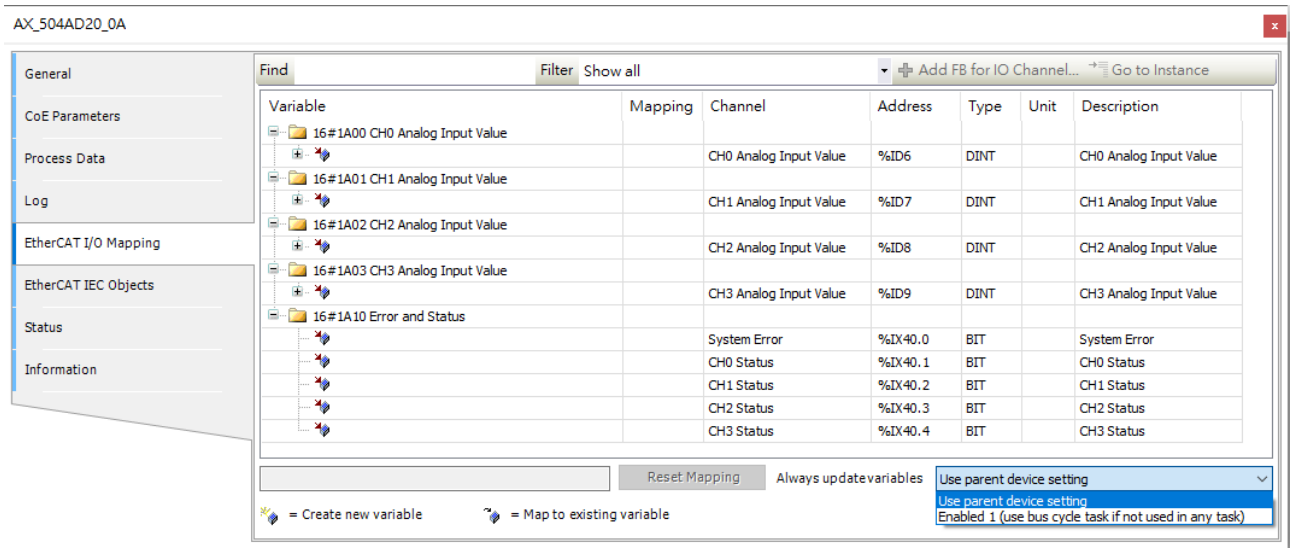
Go to the Process Data tab and select the data that you'd like to monitor.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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 (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.

*1. n =1 to 4

5.3 AX-508AD10-0A

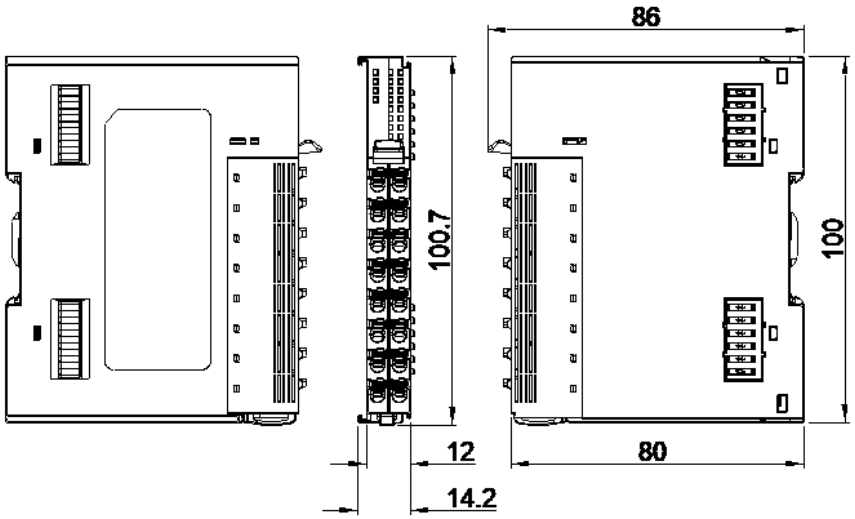
AX-508AD10-0A, an analog input module, receives analog voltage signals through 8 input points and converts the received signals to 16-bit digital signals. This section introduces its specifications, wirings and operations.

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 to 10 V
	Input conversion range	-5 to 105% (F.S.)
	Rated absolute input range	±15 V
	Input impedance	1 mΩ and more
	Resolution	-10 to 10 V: 16 bits; 0 to 10 V: 15 bits; -5 to 5 V: 15 bits; 0 to 5 V: 14 bits; 1 to 5 V: 14 bits;
	Accuracy	25°C: ±0.2% (F.S.)
		-20 to 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 (2.2 W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Detection	N/A
	Short Circuit Detection (SCD)	N/A
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	N/A
	Filter function	AVG, FIR, IIR

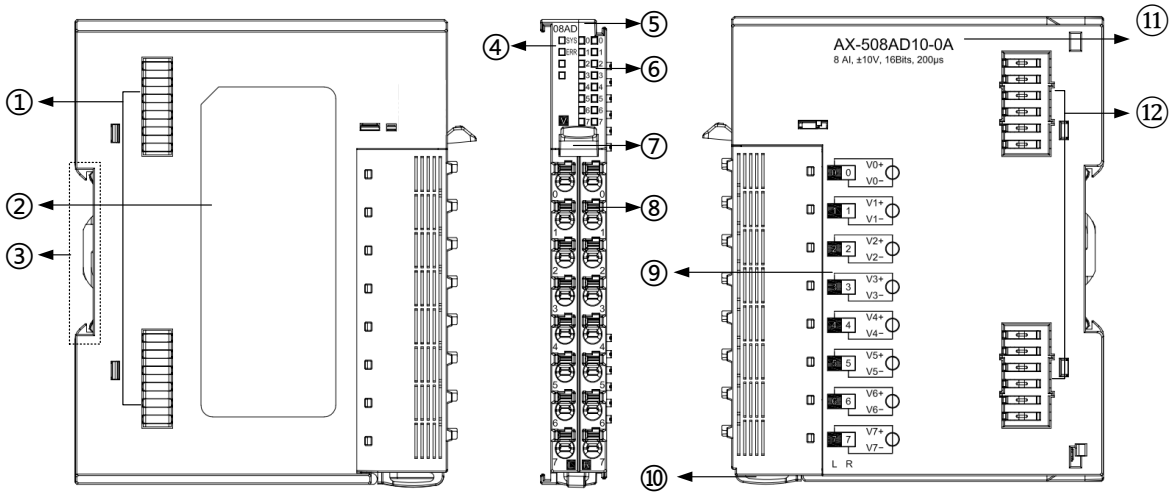
5.3.2 Dimensions and Parts

- **Dimensions**



Unit: mm

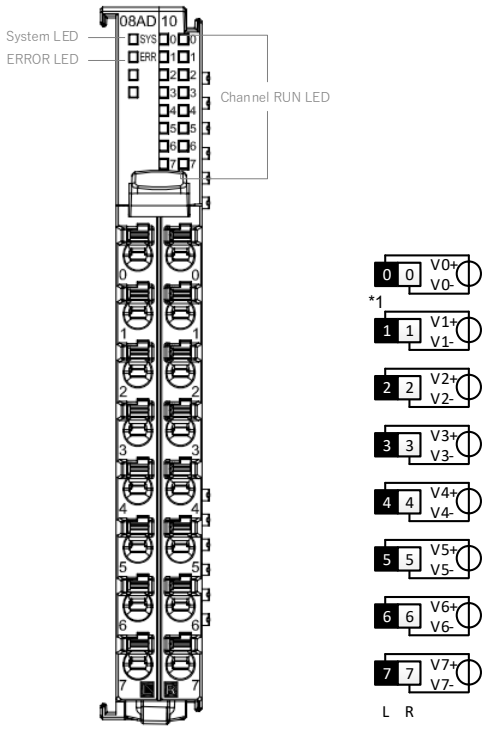
- **Parts**



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.

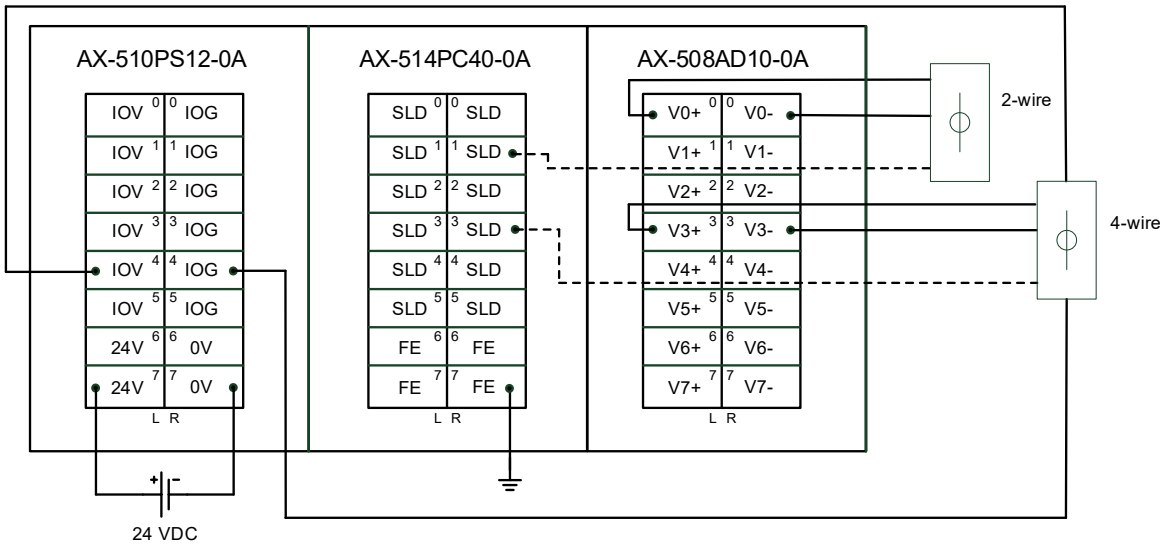
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	V0+	Channel 0: positive input voltage	R0	V0-	Channel 0: negative input voltage
L1	V1+	Channel 1: positive input voltage	R1	V1-	Channel 1: negative input voltage
L2	V2+	Channel 2: positive input voltage	R2	V2-	Channel 2: negative input voltage
L3	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

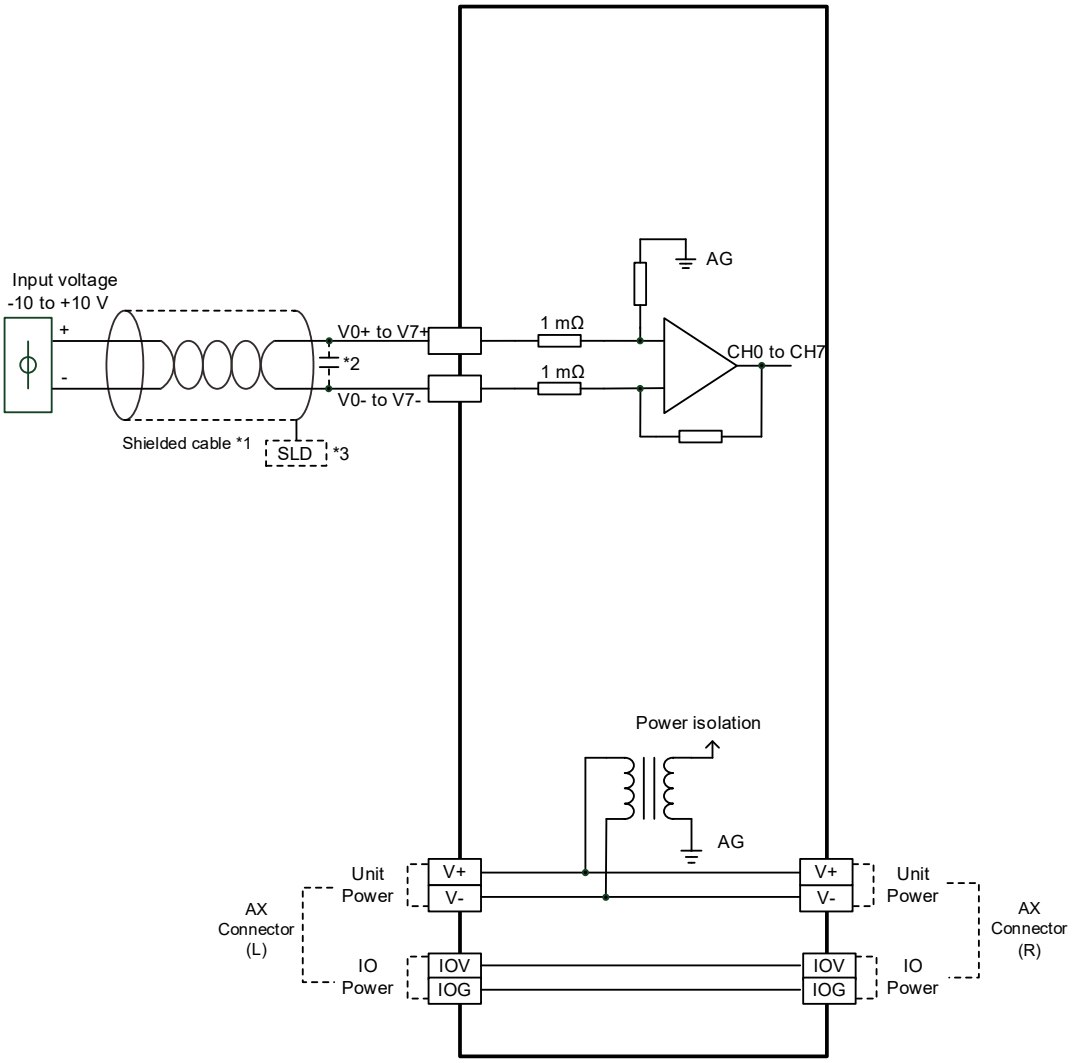
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2 s)	ECAT Pre OP
			Blinking (1 s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1 s)	An error occurs on the application.
			Blinking (0.2 s)	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 and 0.47 µF and a working voltage of 25 V.

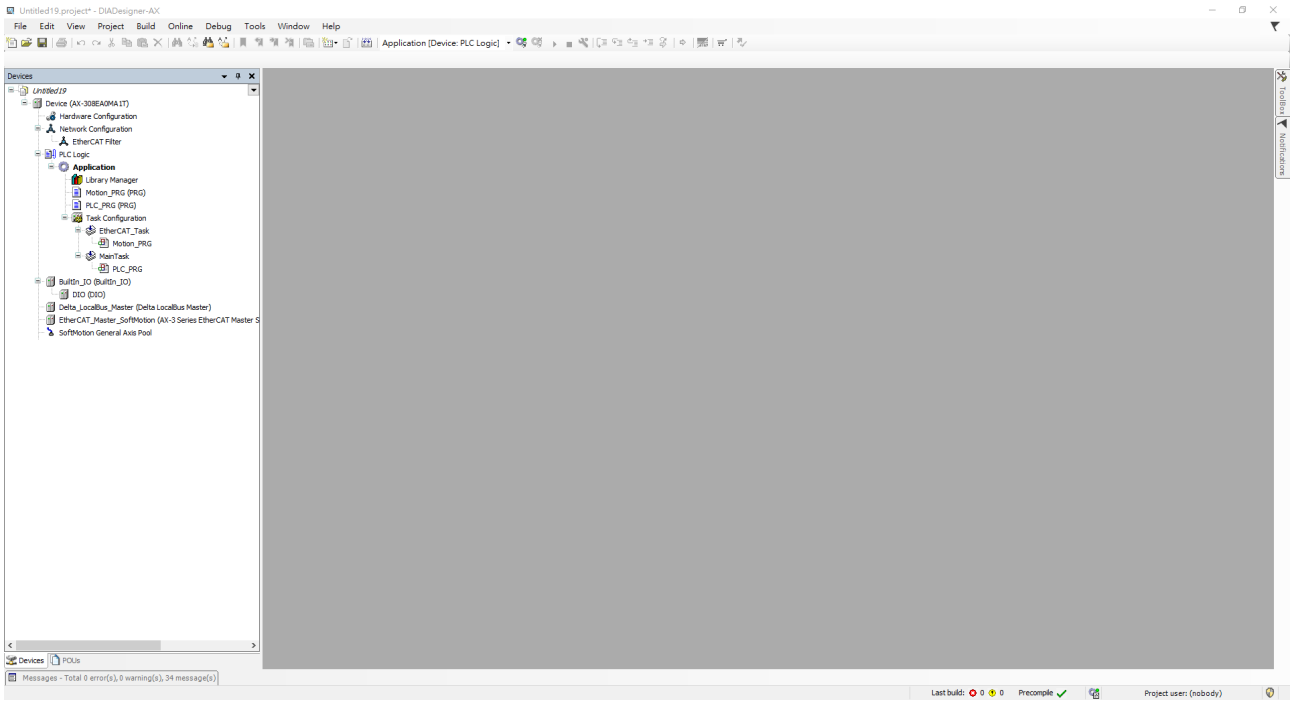
*3. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A.

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

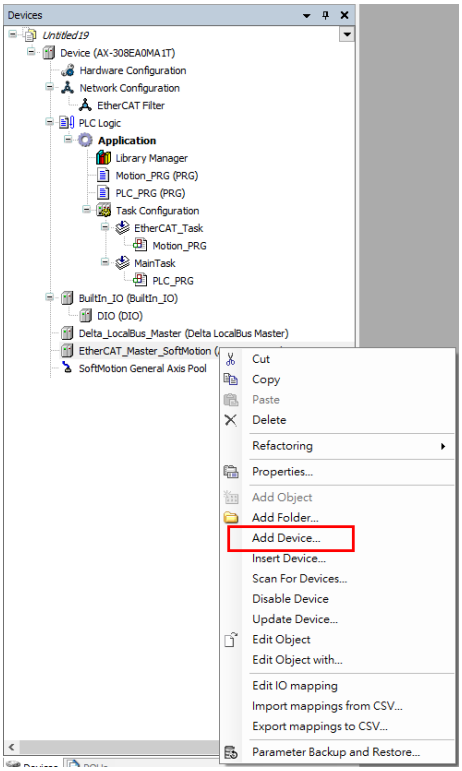
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



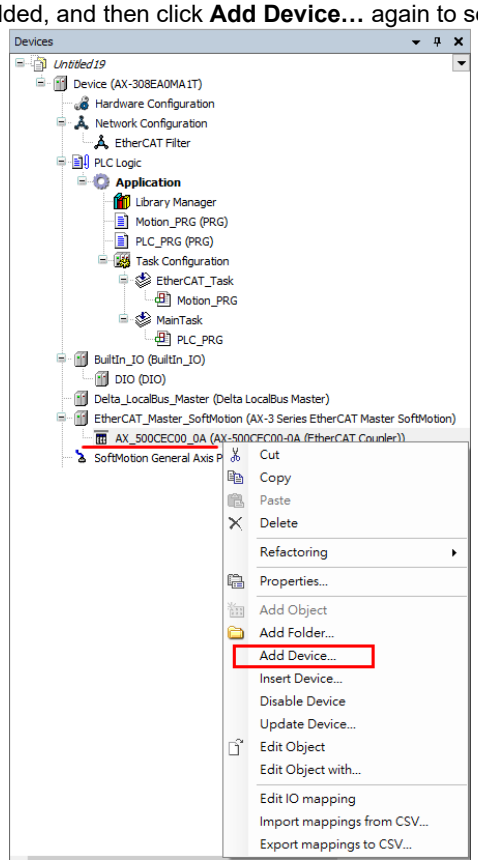
(2) Add Modules in

- 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.

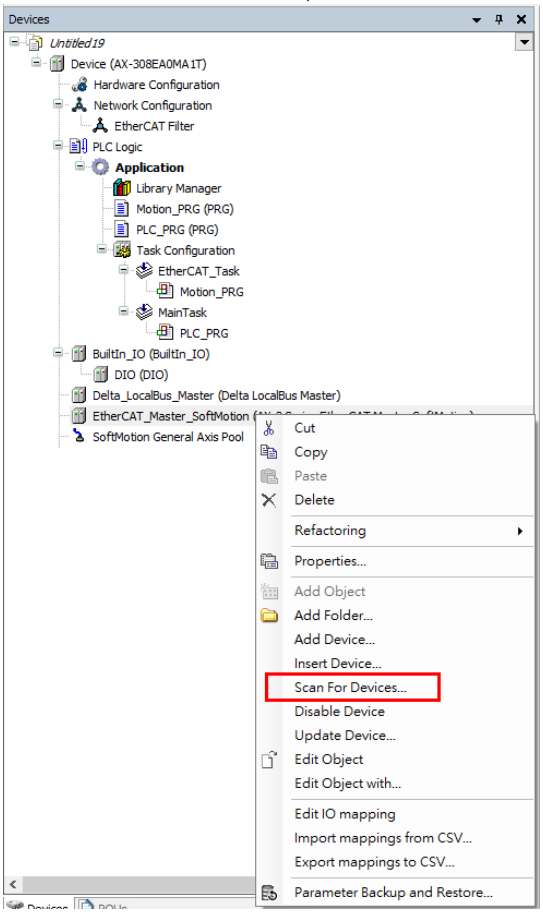


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

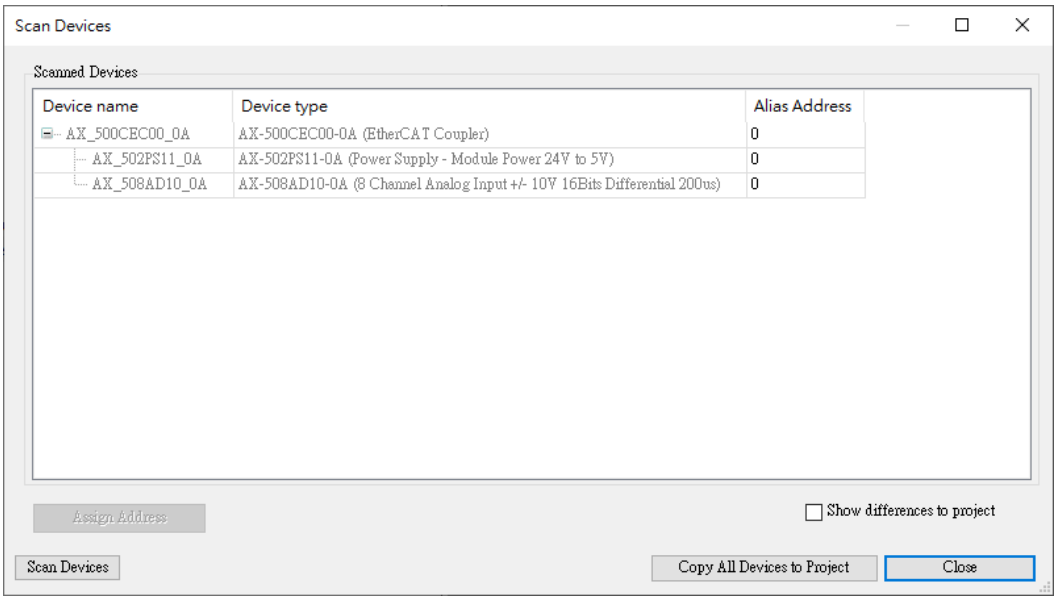


- Method 2: Scan to add the modules in

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

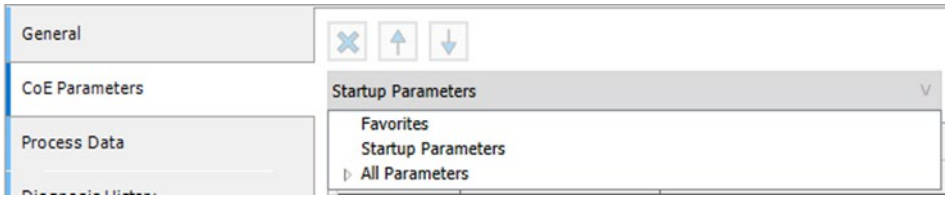


After the auto-scan is over, the actually connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



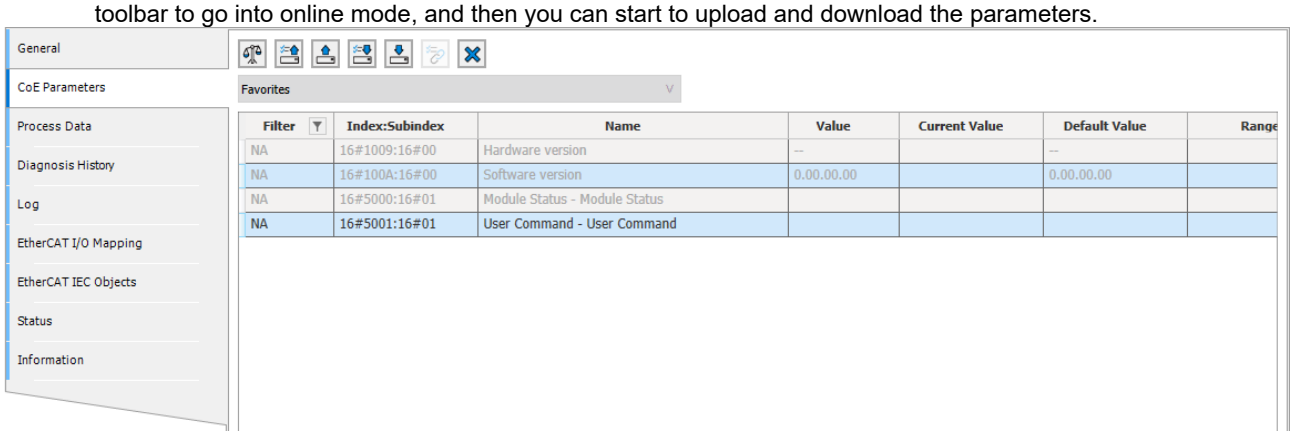
5.3.4.2 Parameter Settings

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



(1) Favorites

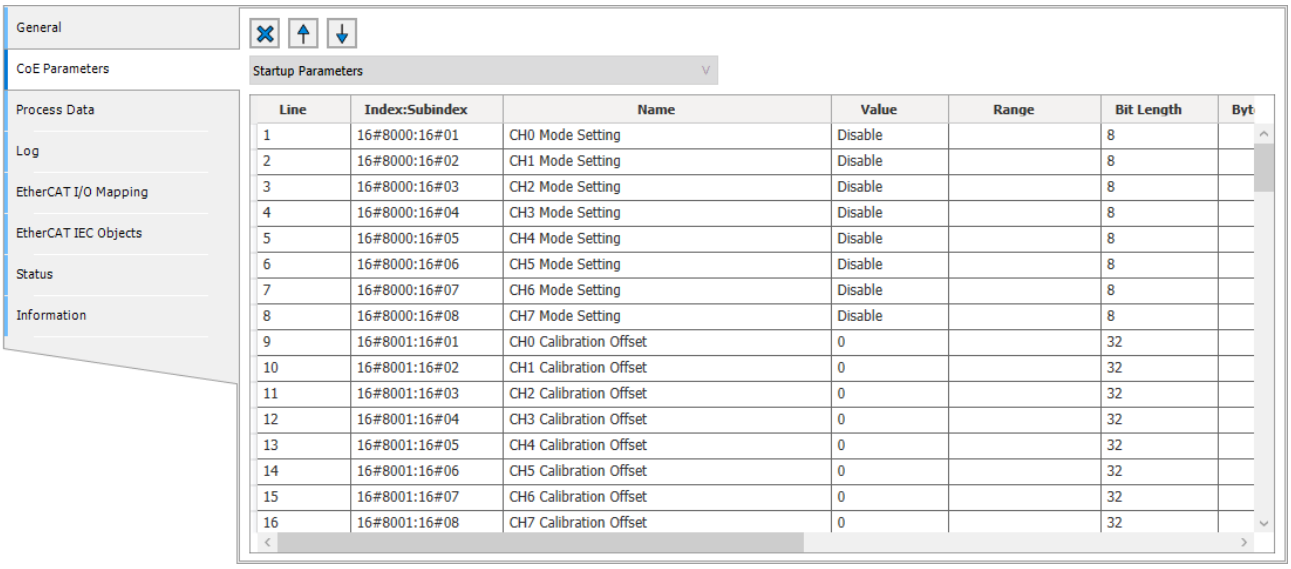
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

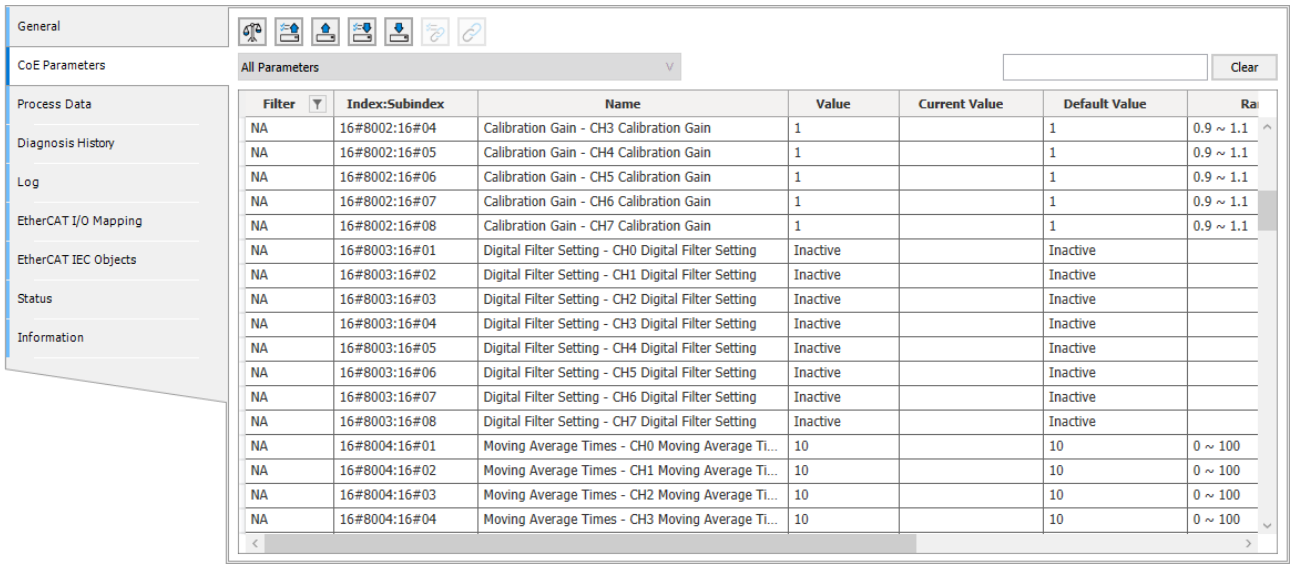


Line	Index:Subindex	Name	Value	Range	Bit Length	Byt
1	16#8000:16#01	CH0 Mode Setting	Disable		8	
2	16#8000:16#02	CH1 Mode Setting	Disable		8	
3	16#8000:16#03	CH2 Mode Setting	Disable		8	
4	16#8000:16#04	CH3 Mode Setting	Disable		8	
5	16#8000:16#05	CH4 Mode Setting	Disable		8	
6	16#8000:16#06	CH5 Mode 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

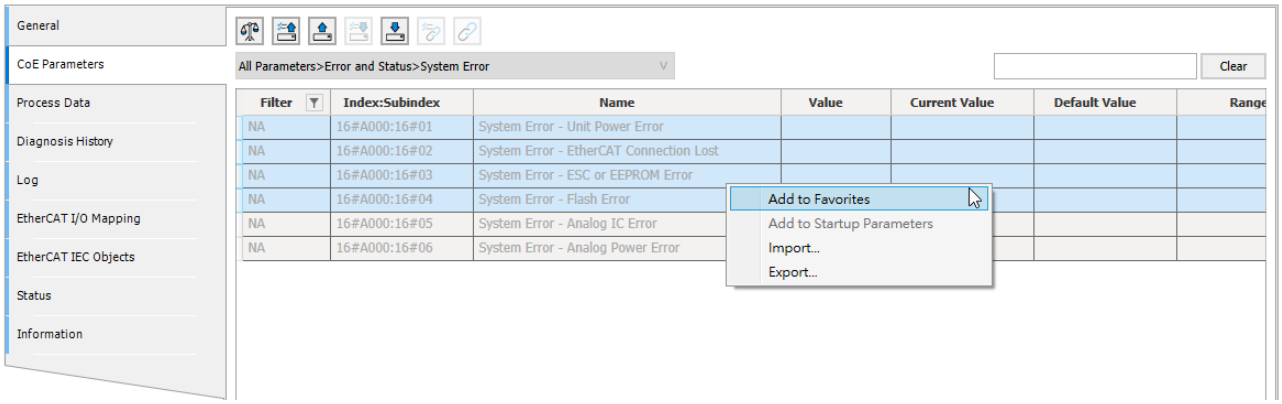
(3) All Parameters

- 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.

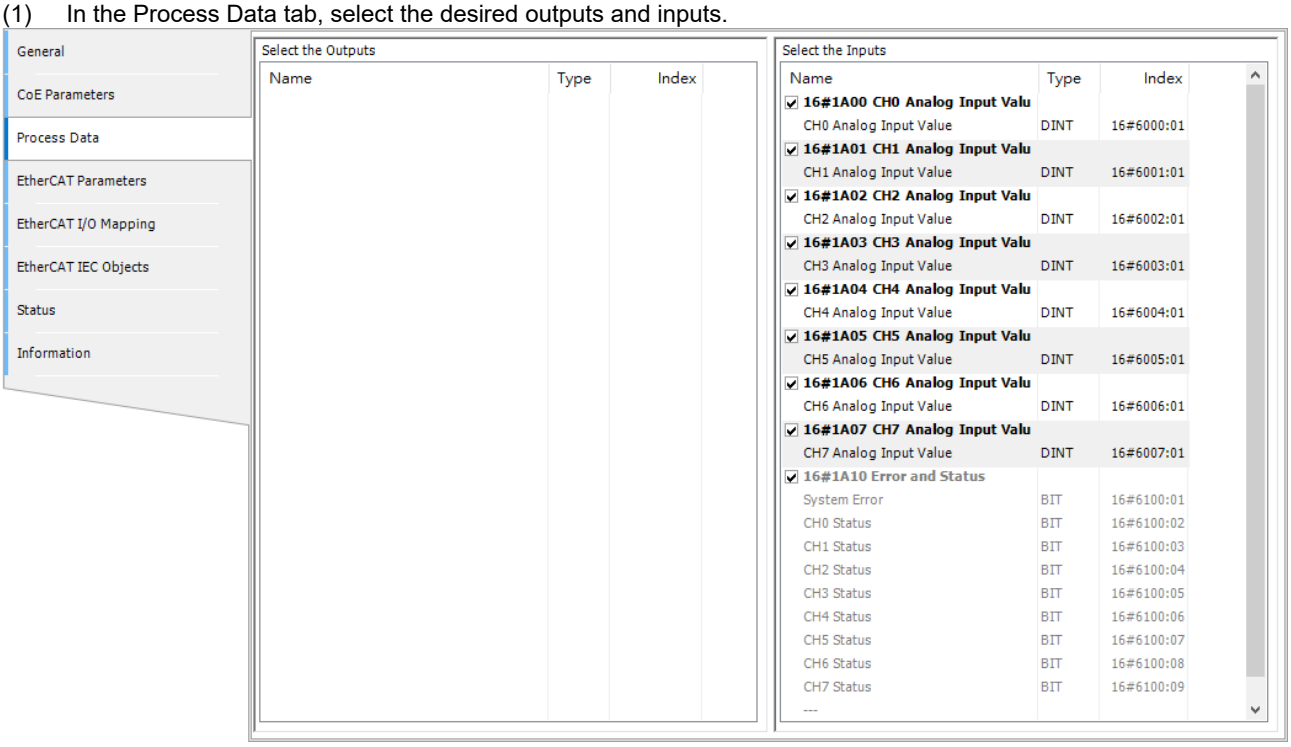
- You can select and right-click the parameter to add the selected parameter to the Favorites.



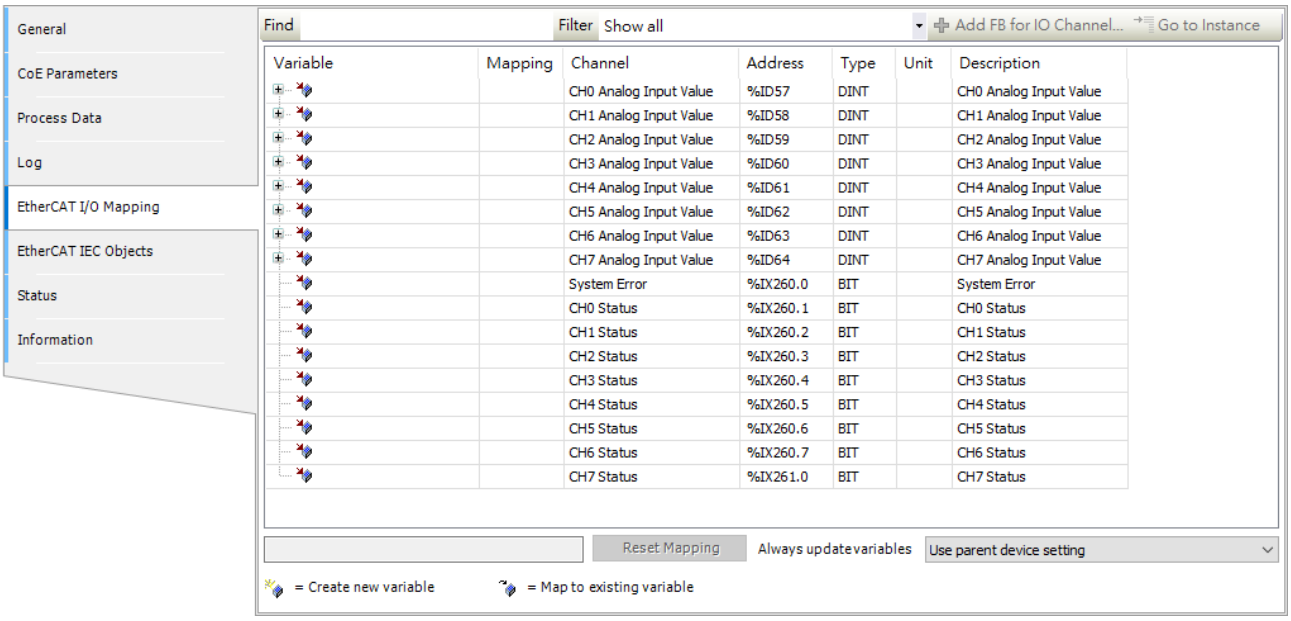
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.3.4.3 Process Data

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

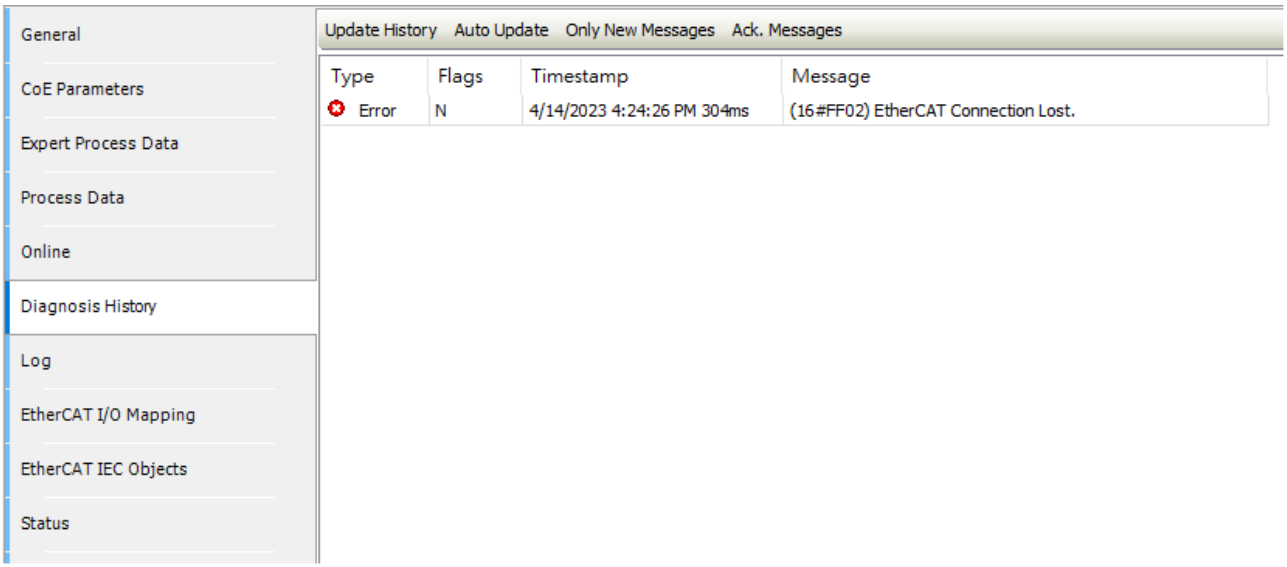


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



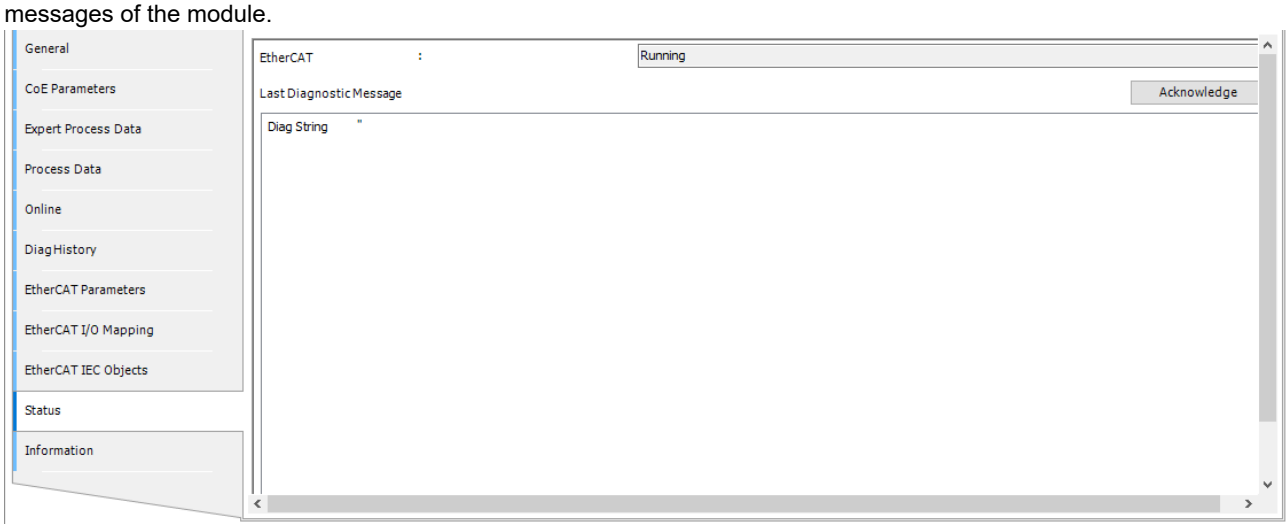
5.3.4.4 Diagnosis History

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



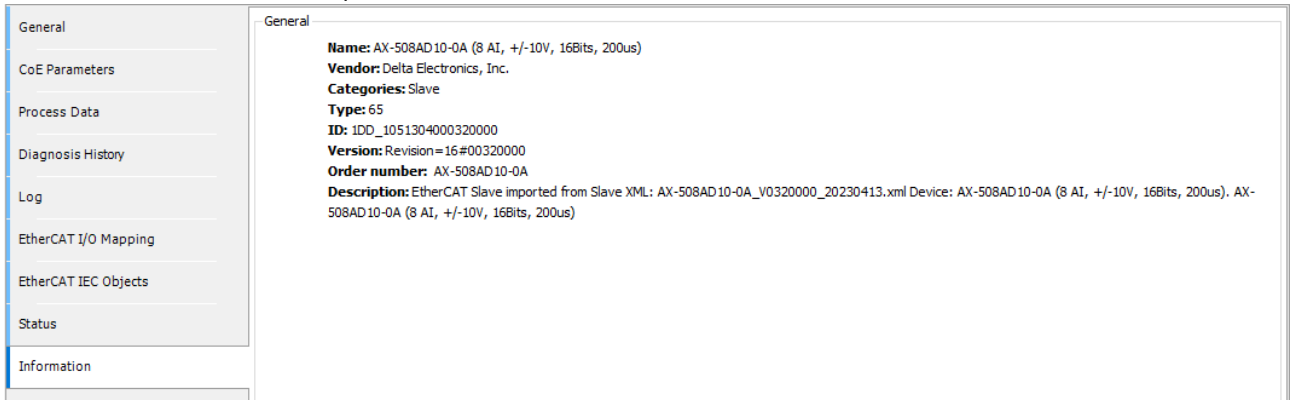
5.3.4.5 Status

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 to 10 V	±30000
2	0 to 10 V	0 to 30000
3	-5 to 5 V	±30000
4	0 to 5 V	0 to 30000
5	1 to 5 V	0 to 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	0.0
	16#02	CH1 Calibration Offset		REAL	RW	0.0
	16#03	CH2 Calibration Offset		REAL	RW	0.0
	16#04	CH3 Calibration Offset		REAL	RW	0.0
	16#05	CH4 Calibration Offset		REAL	RW	0.0
	16#06	CH5 Calibration Offset		REAL	RW	0.0
	16#07	CH6 Calibration Offset		REAL	RW	0.0
	16#08	CH7 Calibration Offset		REAL	RW	0.0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9 to 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 to +10.0 V. Gain is 1 and Offset is 0 by default; the corresponding value is -10.0 to +10.0 V. If Gain is set to 0.9 and Offset is set to 2, the value after calibration is -7.0 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 to 100 times	USINT	RW	10
	16#02	CH1 Moving Average Times		USINT	RW	10
	16#03	CH2 Moving Average Times		USINT	RW	10
	16#04	CH3 Moving Average Times		USINT	RW	10
	16#05	CH4 Moving Average Times		USINT	RW	10
	16#06	CH5 Moving Average Times		USINT	RW	10
	16#07	CH6 Moving Average Times		USINT	RW	10
	16#08	CH7 Moving Average Times		USINT	RW	10

- **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.

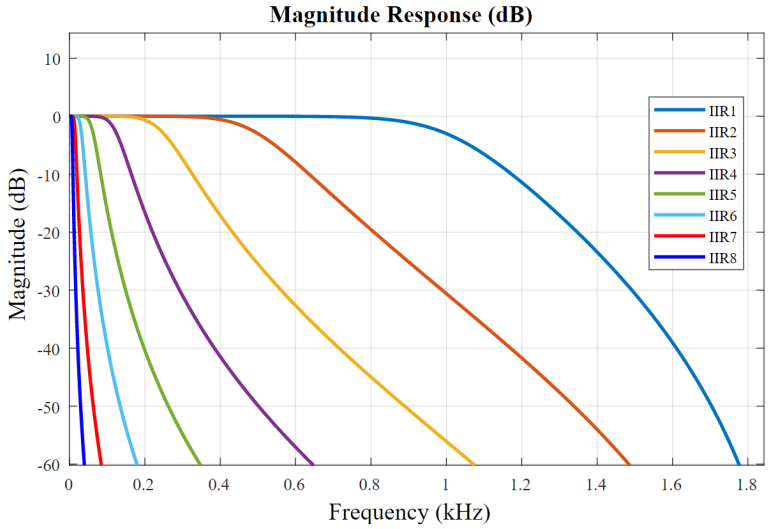
Moving Average Filter

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.

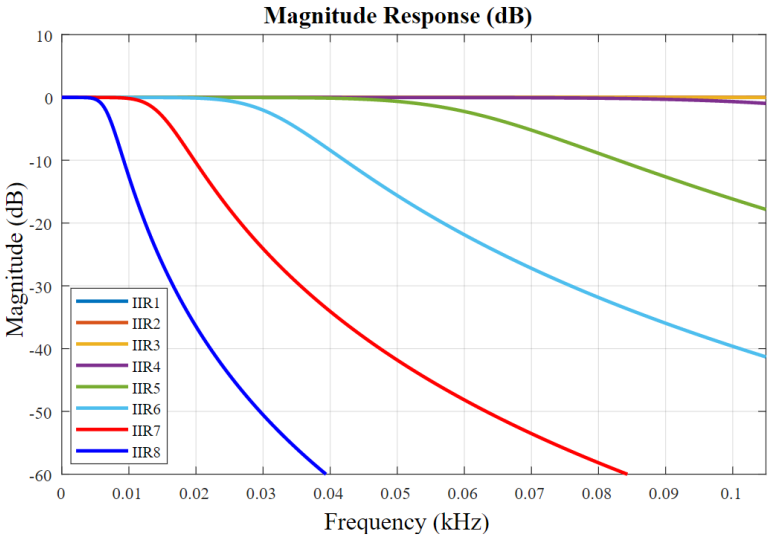
IIR (Infinite Impulse Response) Filter

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.



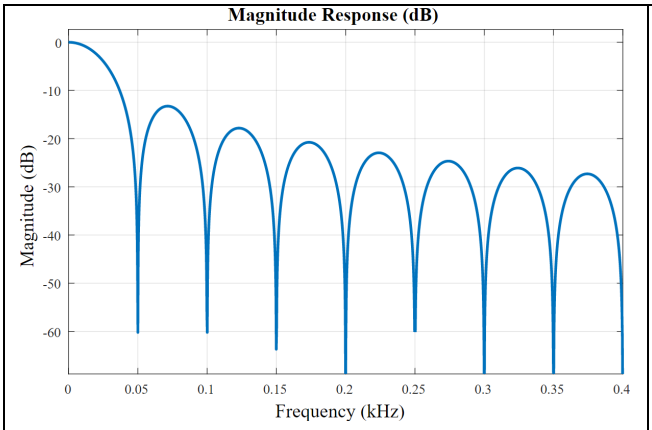
Frequency response of IIR filter



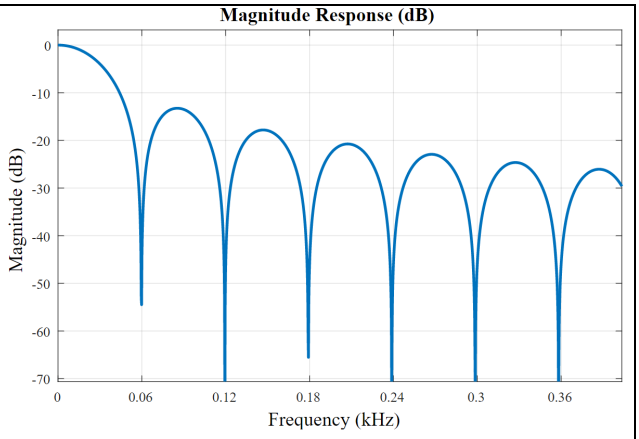
Frequency response of IIR filter (enlarged figure)

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	USINT	RW	0
	16#02	CH1 Enable User Limit Alarm DINT		USINT	RW	0
	16#03	CH2 Enable User Limit Alarm DINT		USINT	RW	0
	16#04	CH3 Enable User Limit Alarm DINT		USINT	RW	0
	16#05	CH4 Enable User Limit Alarm DINT		USINT	RW	0
	16#06	CH5 Enable User Limit Alarm DINT		USINT	RW	0
	16#07	CH6 Enable User Limit Alarm DINT		USINT	RW	0
	16#08	CH7 Enable User Limit Alarm DINT		USINT	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	USINT	RW	0
	16#02	CH1 Enable User Limit Alarm REAL		USINT	RW	0
	16#03	CH2 Enable User Limit Alarm REAL		USINT	RW	0
	16#04	CH3 Enable User Limit Alarm REAL		USINT	RW	0
	16#05	CH4 Enable User Limit Alarm REAL		USINT	RW	0
	16#06	CH5 Enable User Limit Alarm REAL		USINT	RW	0
	16#07	CH6 Enable User Limit Alarm REAL		USINT	RW	0
	16#08	CH7 Enable User Limit Alarm REAL		USINT	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**

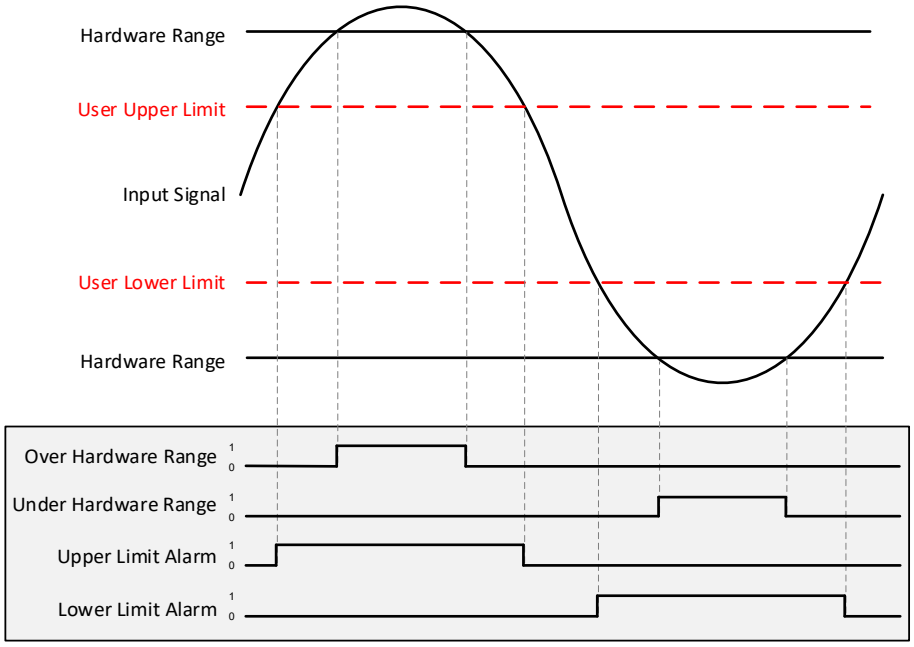
When the format is set to DINT, you can set:

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.

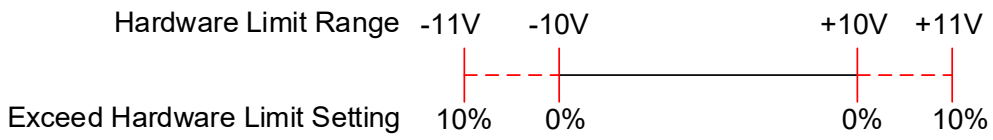


5.3.5.7 Exceed Hardware Limit

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8008	16#01	CH0 Exceed Hardware Limit Setting	Hardware limit setting; Setting range: 0 to 10 (0 to 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 -10 to10V, the setting value is 5%. Its hardware limit range is -10.5 to 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 to 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	10.0
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	10.0
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	10.0
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	10.0
	16#05	CH4 Scale Upper Limit REAL		REAL	RW	10.0
	16#06	CH5 Scale Upper Limit REAL		REAL	RW	10.0
	16#07	CH6 Scale Upper Limit REAL		REAL	RW	10.0
	16#08	CH7 Scale Upper Limit REAL		REAL	RW	10.0
16#8031	16#01	CH0 Scale Lower Limit REAL	Moving average setting; Setting range: no limit	REAL	RW	-10.0
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-10.0
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-10.0
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-10.0
	16#05	CH0 Scale Lower Limit REAL		REAL	RW	-10.0
	16#06	CH1 Scale Lower Limit REAL		REAL	RW	-10.0
	16#07	CH2 Scale Lower Limit REAL		REAL	RW	-10.0
	16#08	CH3 Scale Lower Limit REAL		REAL	RW	-10.0

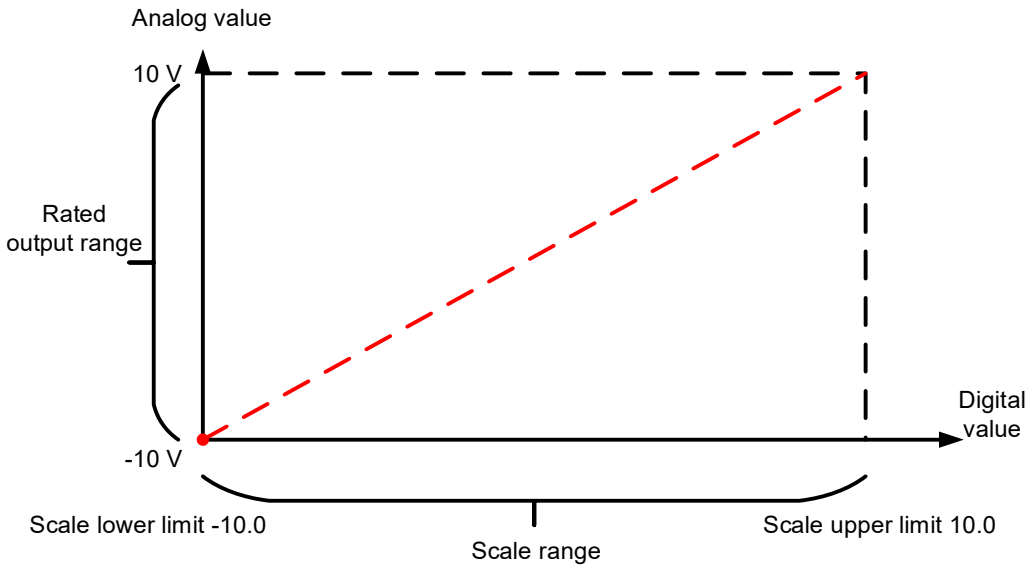
5

- **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 mode setting of channels is -10 to 10 V, the analog range is -10 to 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 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

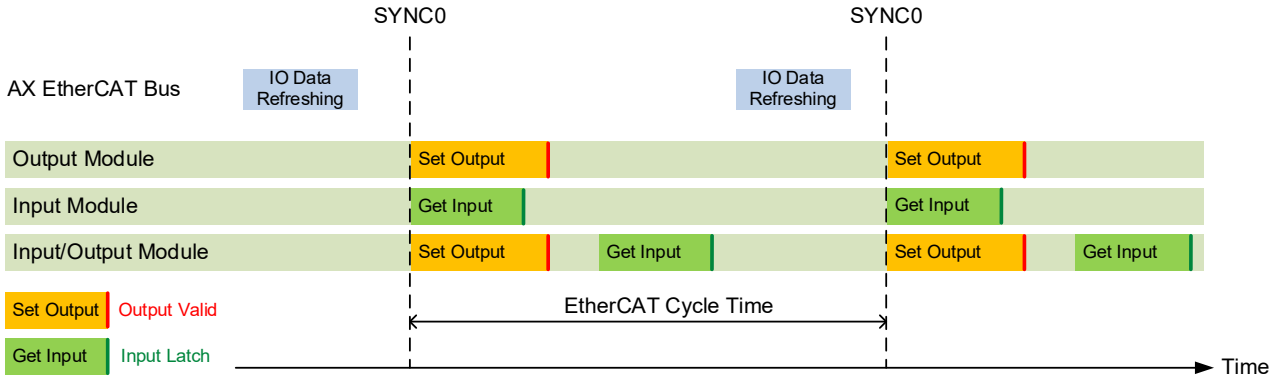
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

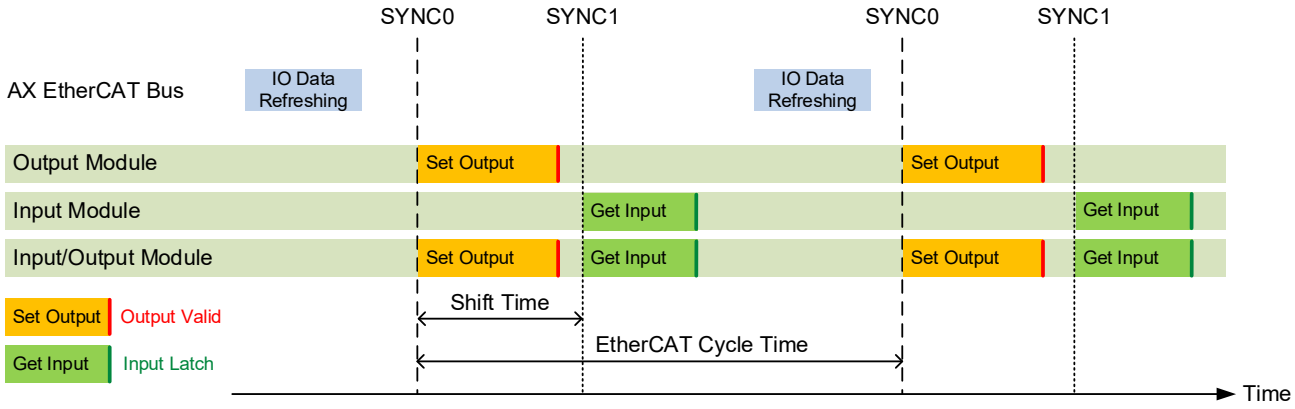
- **SYNC0**

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

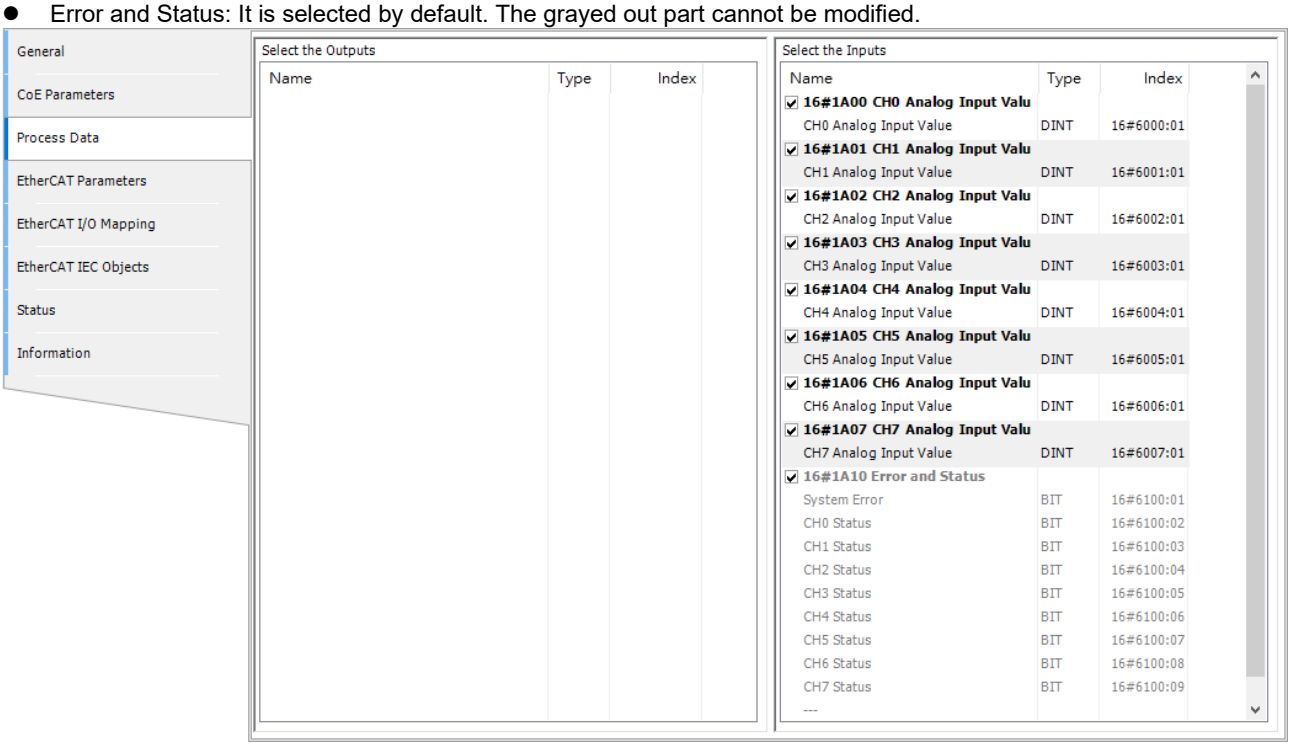
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Analog Input Value	Analog input value; Setting range: -30000 to 30000	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

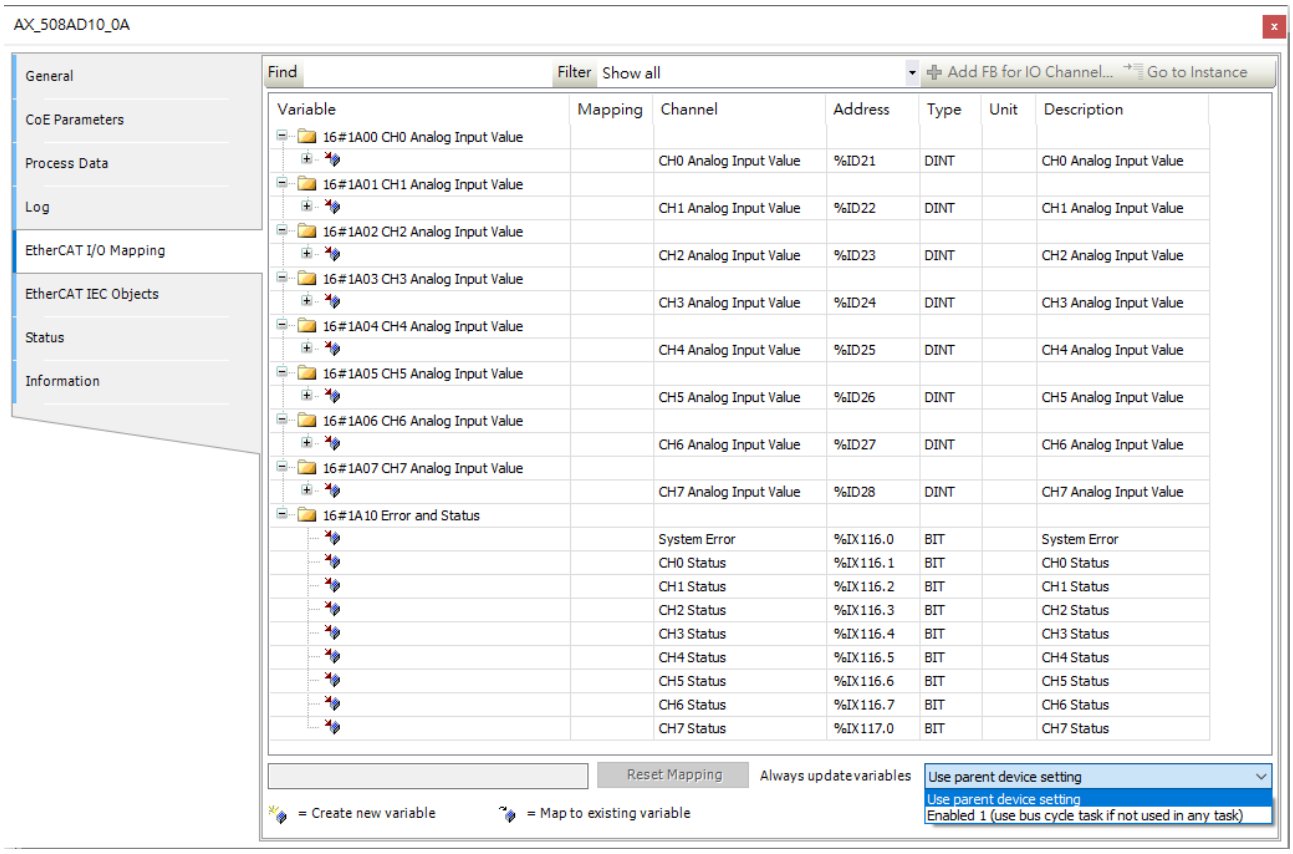
Go to the Process Data tab and select the data that you'd like to monitor.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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 (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.

*1. n =1 to 8

5.4 AX-508AD20-0A

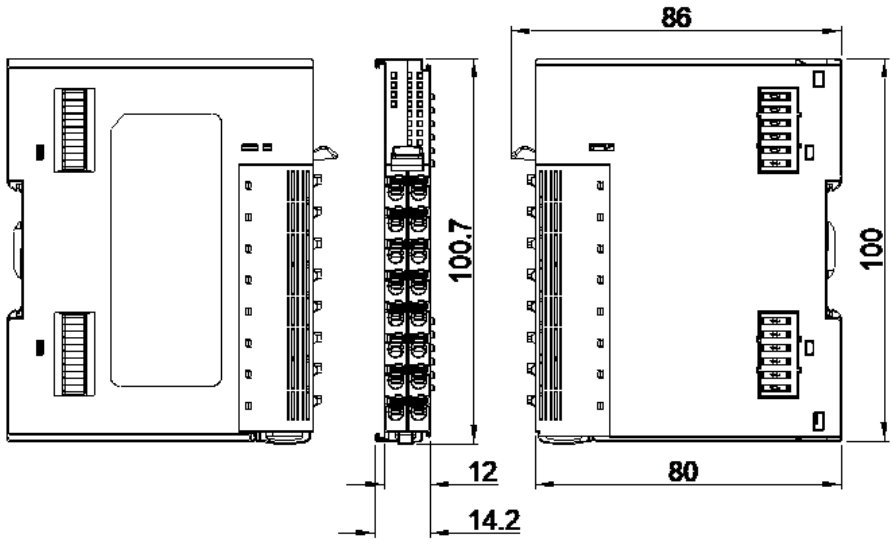
AX-508AD20-0A, an analog input module, receives analog current signals through 8 input points and converts the received signals to 16-bit digital signals. This section introduces its specifications, wirings and operations.

5.4.1 Specifications

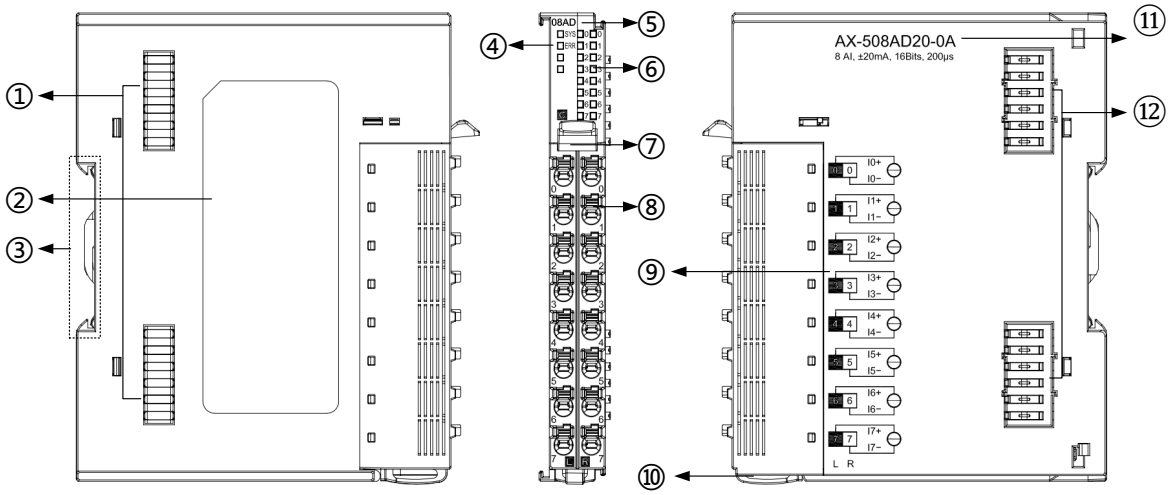
Item		Specification
Input points		8
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		74 g
Electrical specification	Input form	Differential input
	Input range	-20 to 20 mA
	Input conversion range	-5 to 105% (F.S.)
	Rated absolute input range	±32 mA
	Input impedance	Less than 300 Ω
	Resolution	-20 to 20 mA: 16 bits; 0 to 20 mA: 15 bits; 4 to 20 mA: 15 bits
	Accuracy	25°C: ±0.2% (F.S.) -20 to 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 (2.2 W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Detection	N/A
	Short Circuit Detection (SCD)	N/A
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	N/A
	Filter function	AVG, FIR, IIR

5.4.2 Dimensions and Parts

- **Dimensions**



Unit: mm

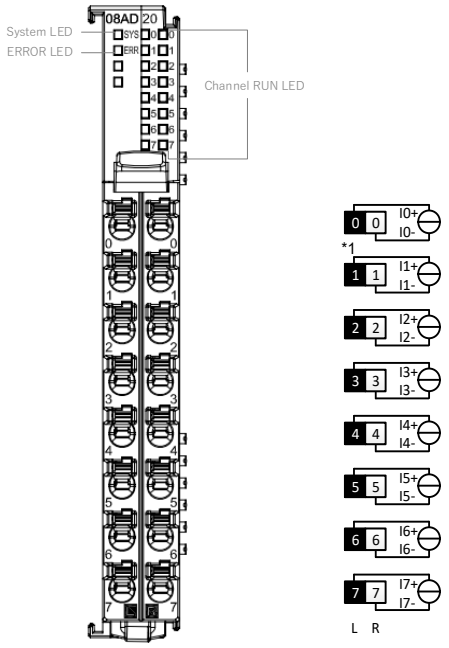


- **Parts**

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.

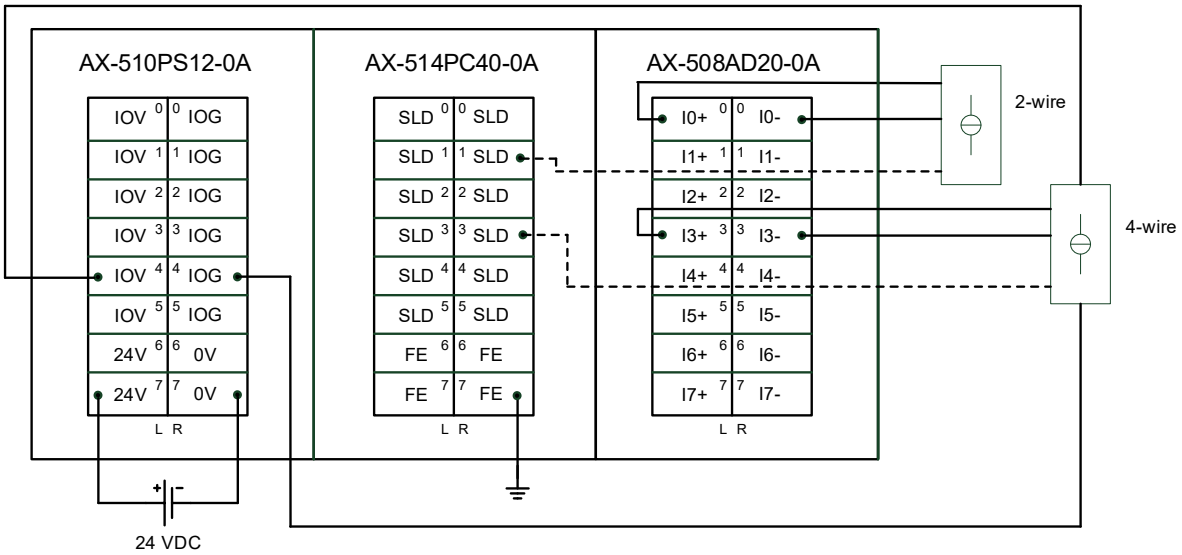
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0+	Channel 0: positive input current	R0	I0-	Channel 0: negative input current
L1	I1+	Channel 1: positive input current	R1	I1-	Channel 1: negative input current
L2	I2+	Channel 2: positive input current	R2	I2-	Channel 2: negative input current
L3	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

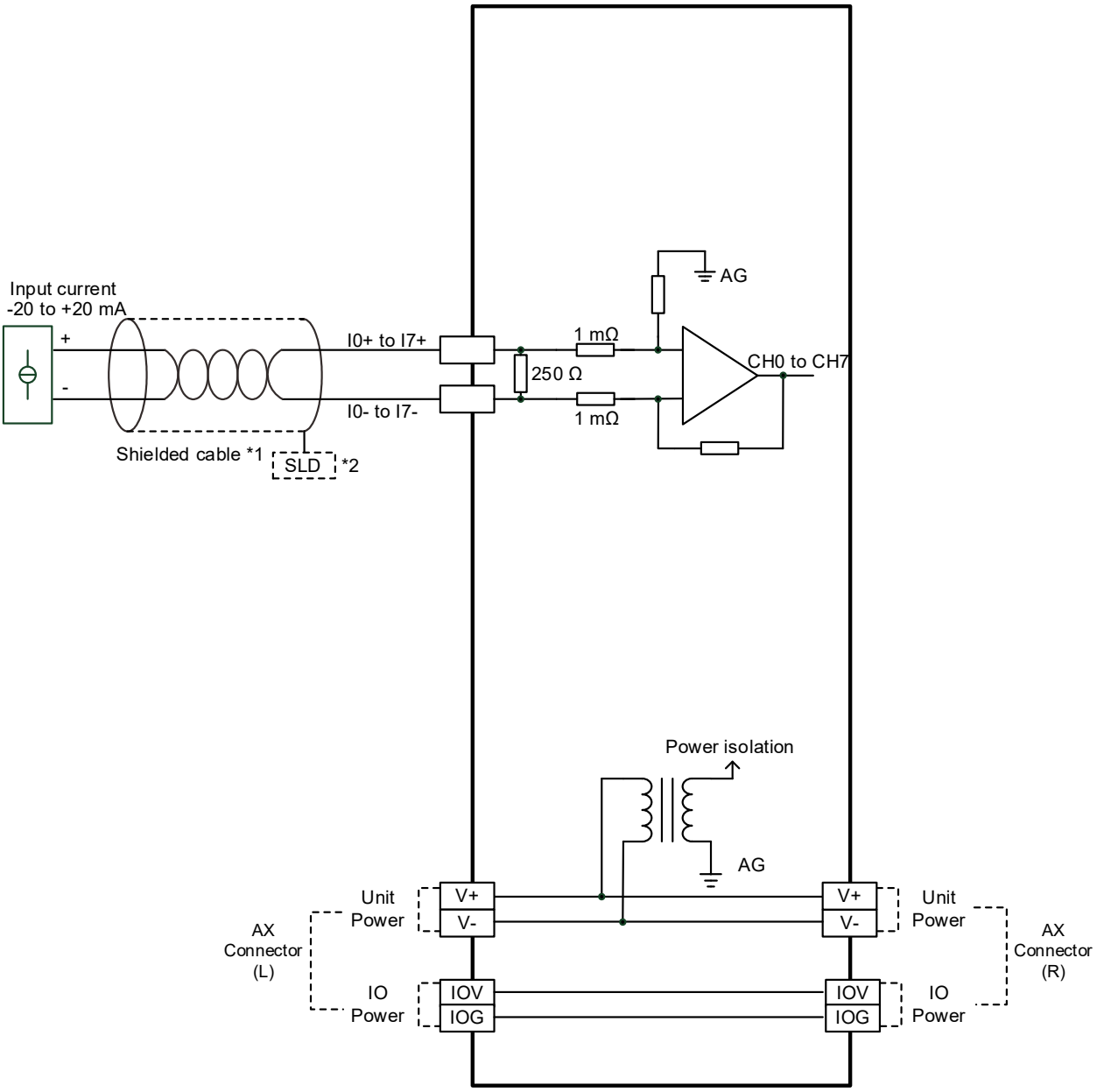
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2 s)	ECAT Pre OP
			Blinking (1 s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1 s)	An error occurs on the application.
			Blinking (0.2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



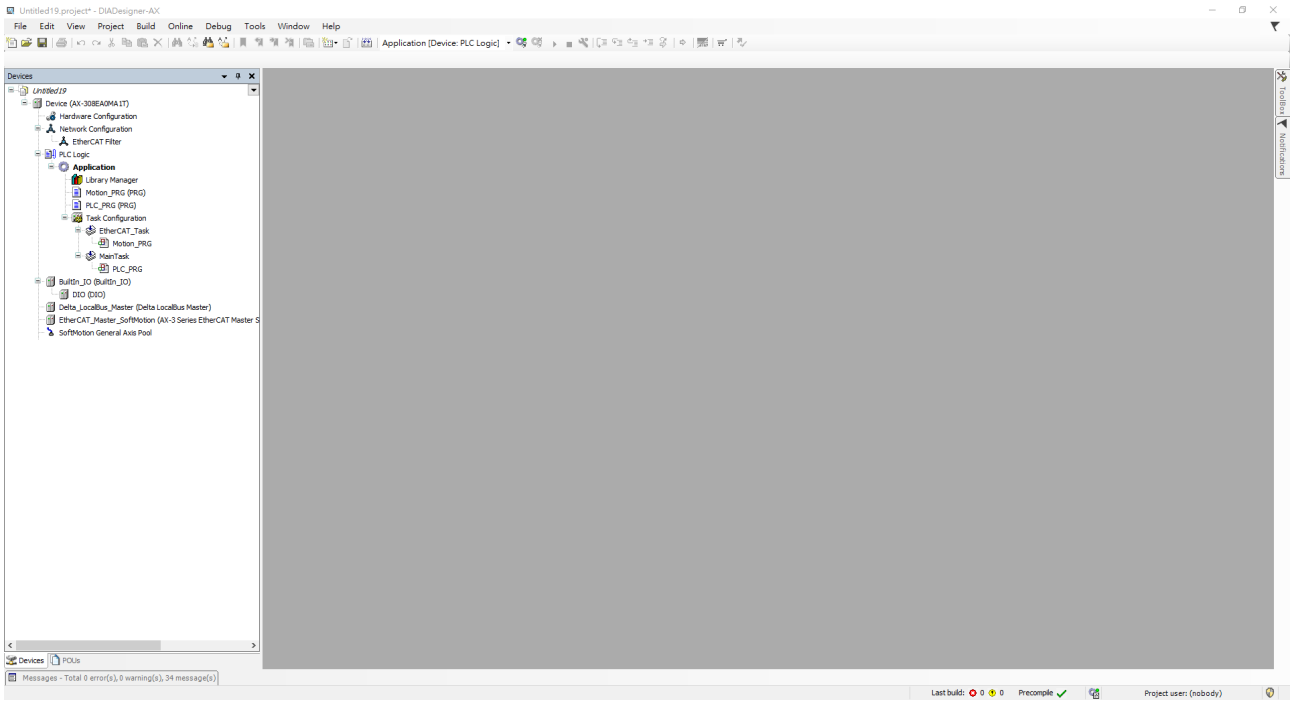
*1. Use shielded cables to isolate the analog input signal cable from other power cables.
*2. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A.

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

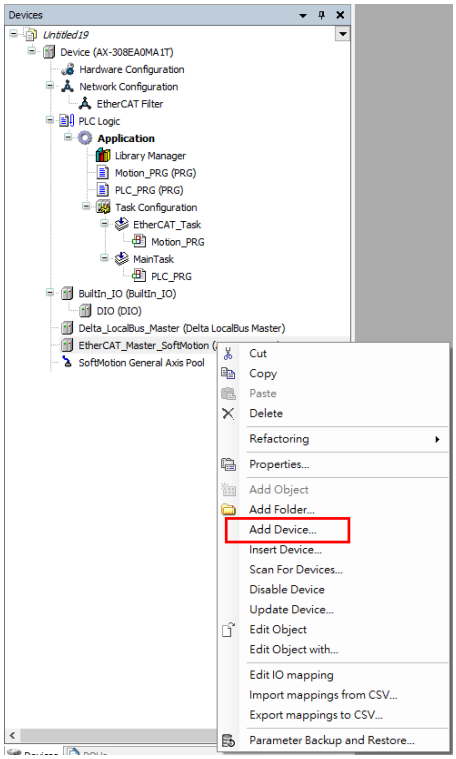
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



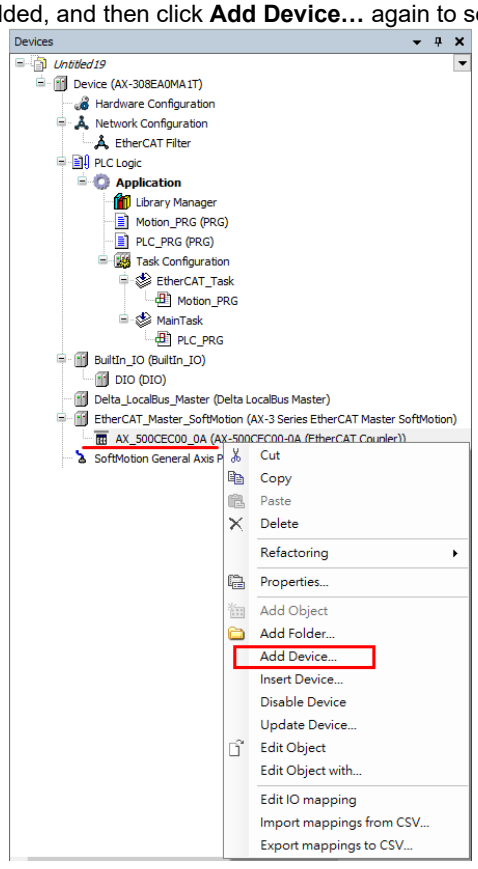
(2) Add Modules in

- 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.

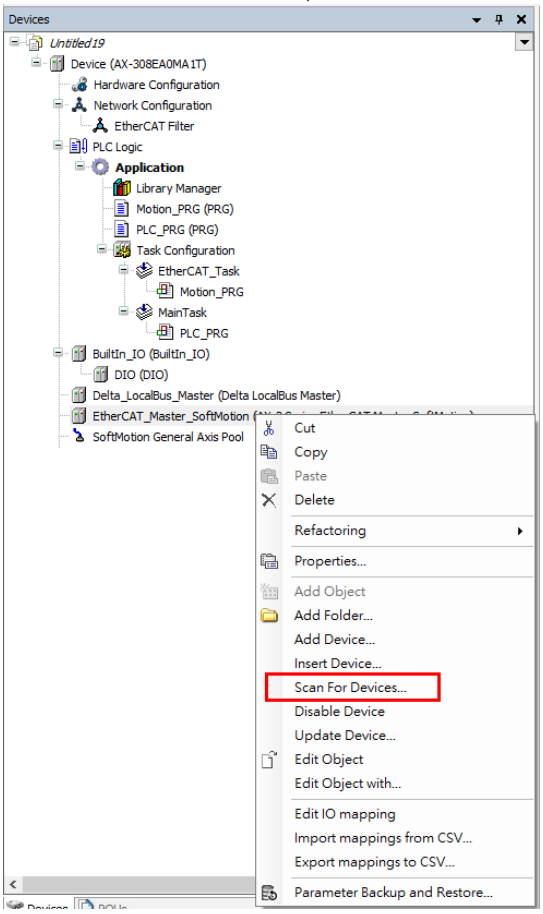


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

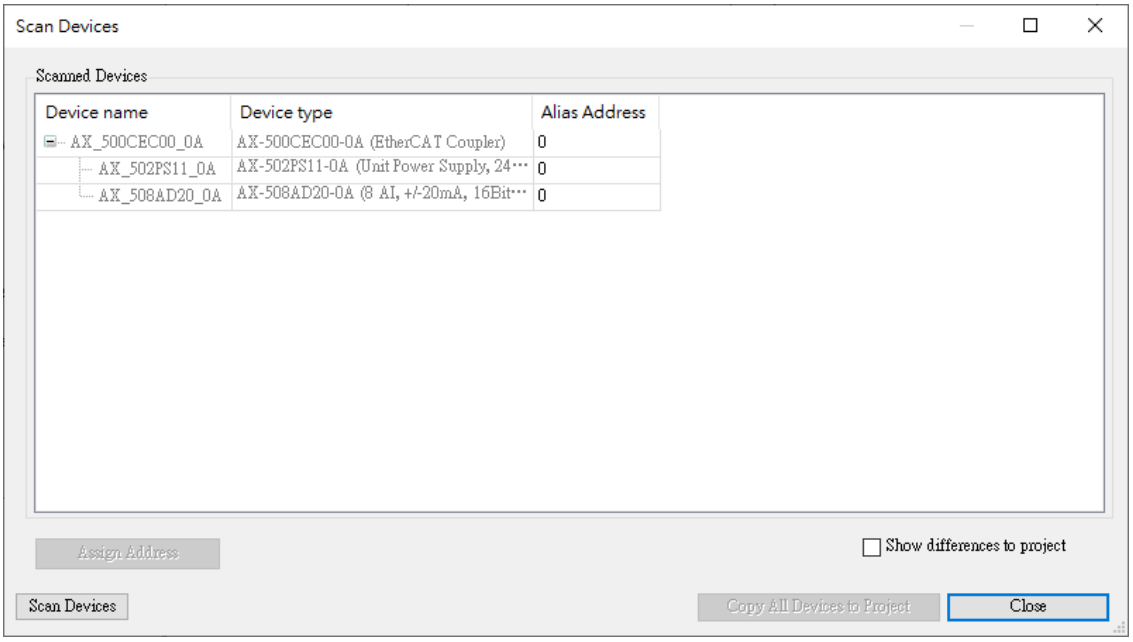


- Method 2: Scan to add the modules in.

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

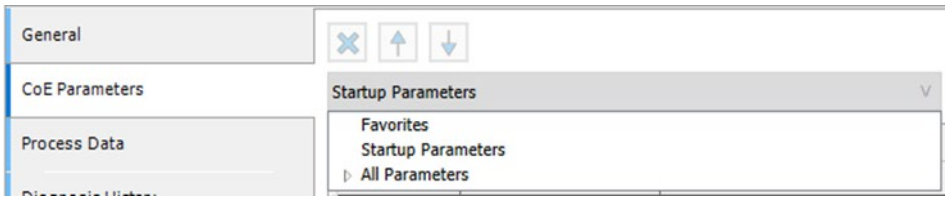


After the auto-scan is over, the actually connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



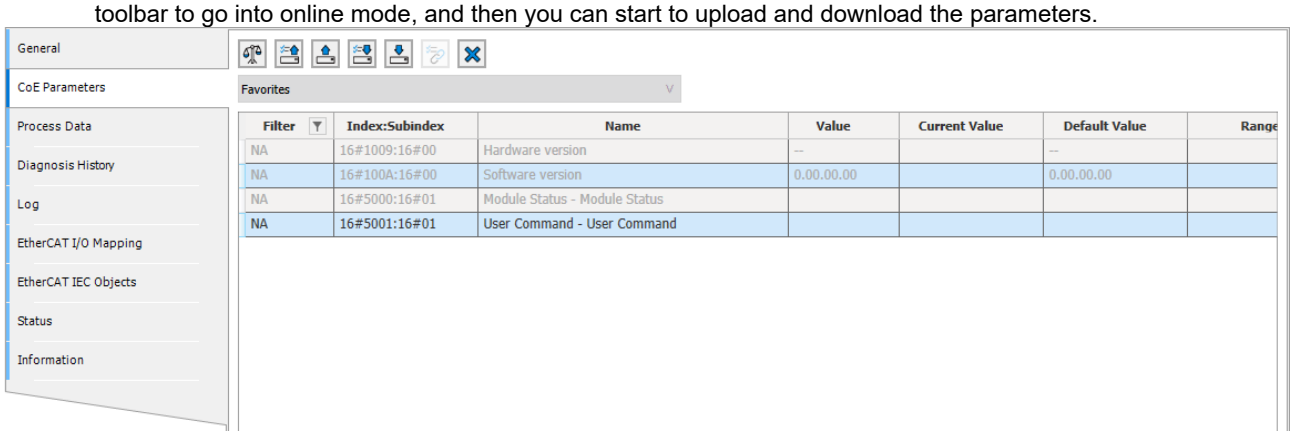
5.4.4.2 Parameter Settings

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



(1) Favorites

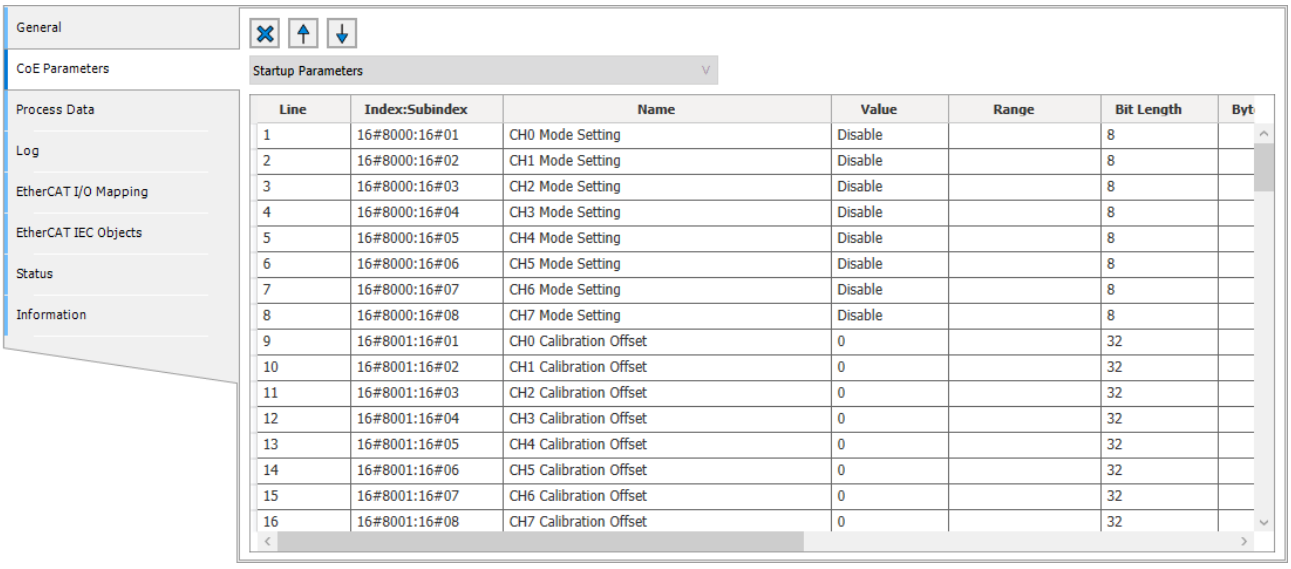
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

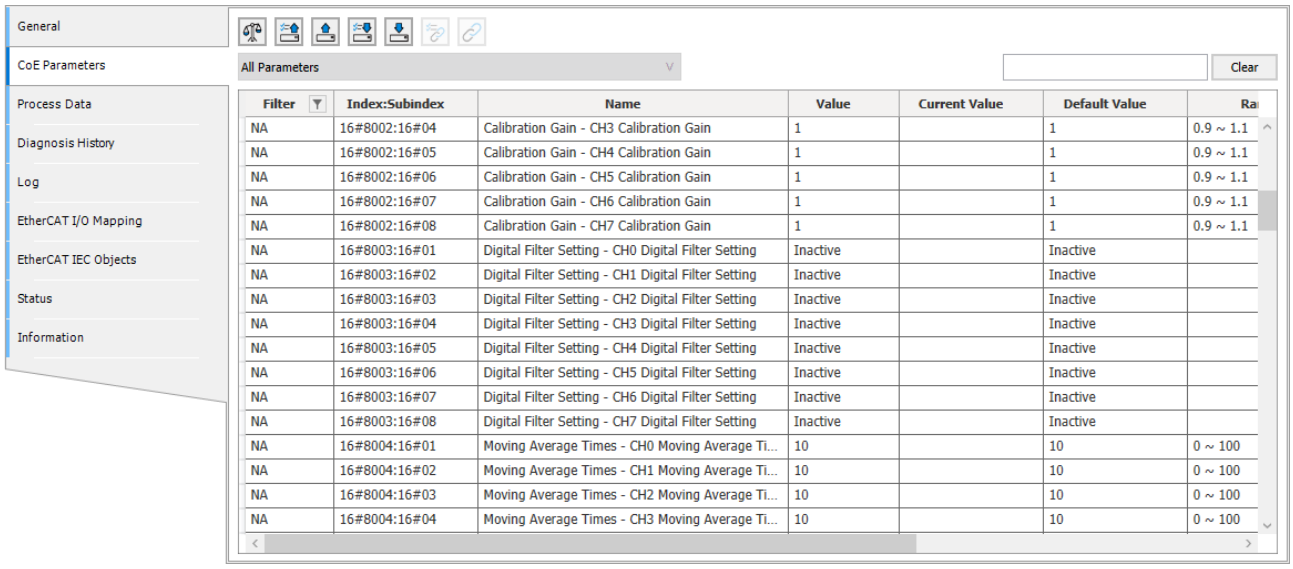


Line	Index:Subindex	Name	Value	Range	Bit Length	Byt
1	16#8000:16#01	CH0 Mode Setting	Disable		8	
2	16#8000:16#02	CH1 Mode Setting	Disable		8	
3	16#8000:16#03	CH2 Mode Setting	Disable		8	
4	16#8000:16#04	CH3 Mode Setting	Disable		8	
5	16#8000:16#05	CH4 Mode Setting	Disable		8	
6	16#8000:16#06	CH5 Mode 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

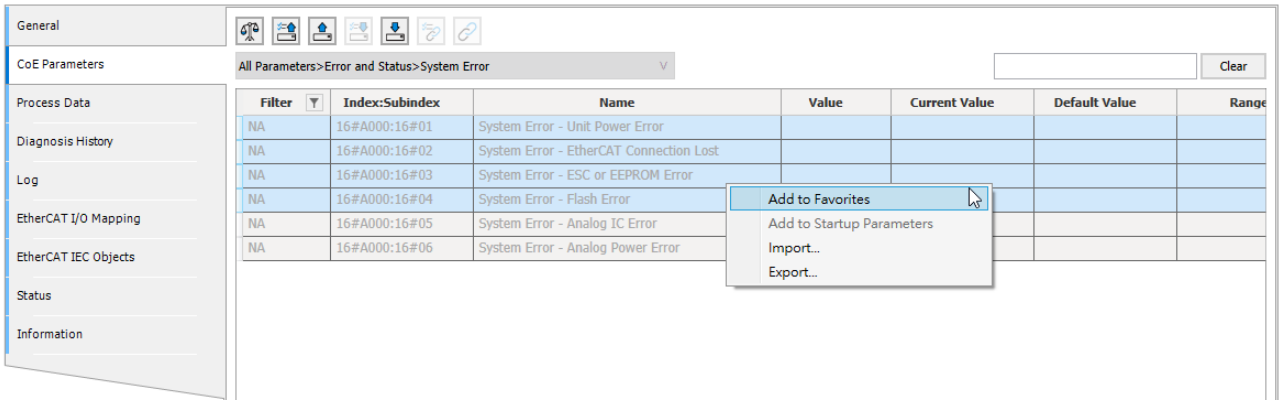
(3) All Parameters

- 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.



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.

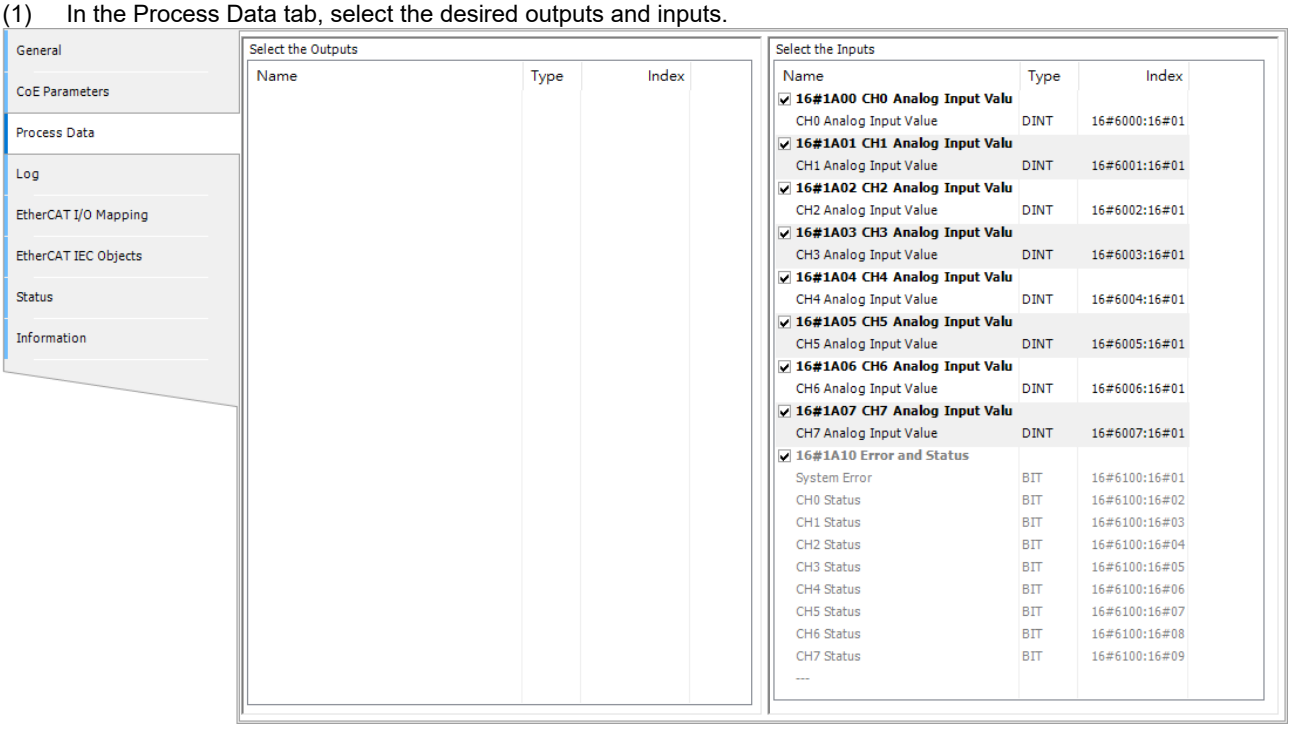
- You can select and right-click the parameter to add the selected parameter to the Favorites.



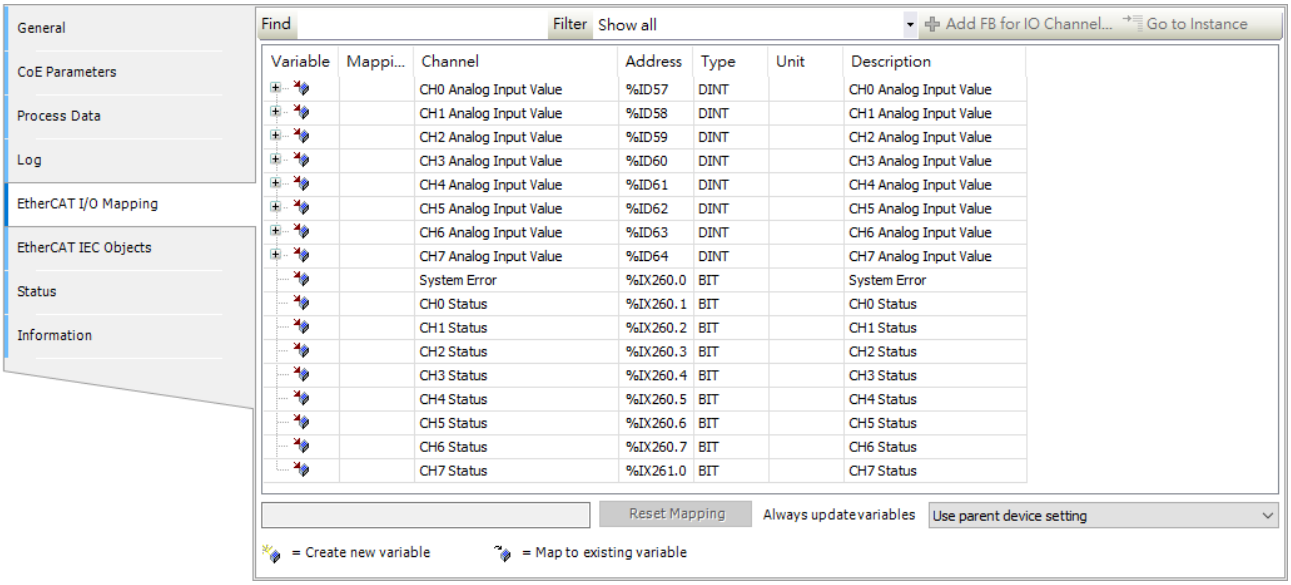
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.4.4.3 Process Data

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

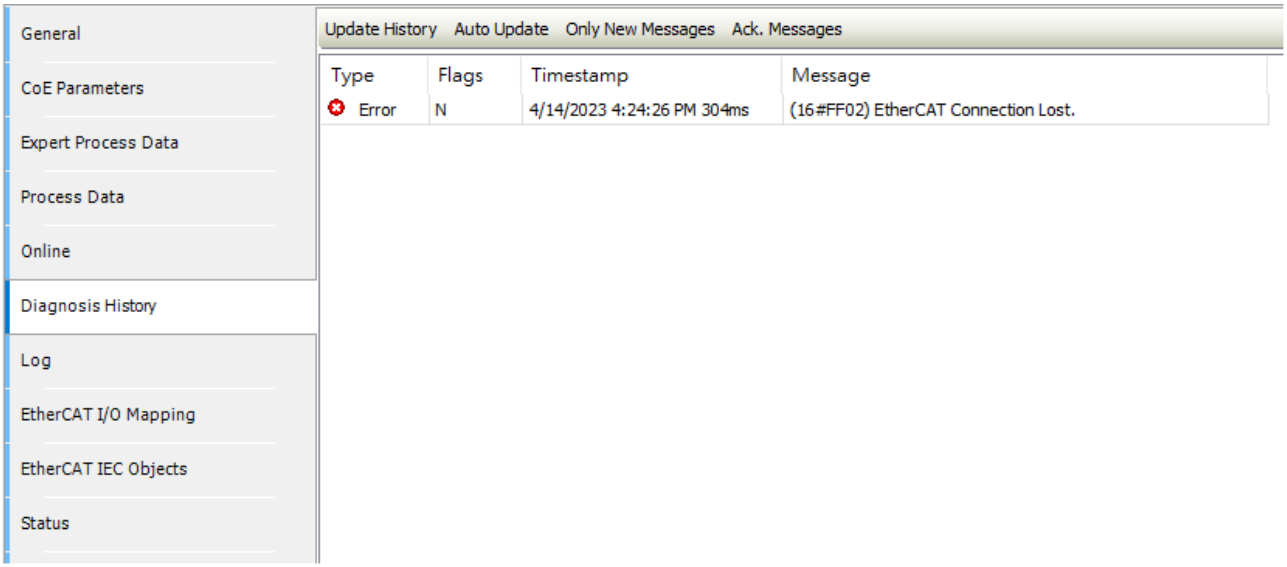


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



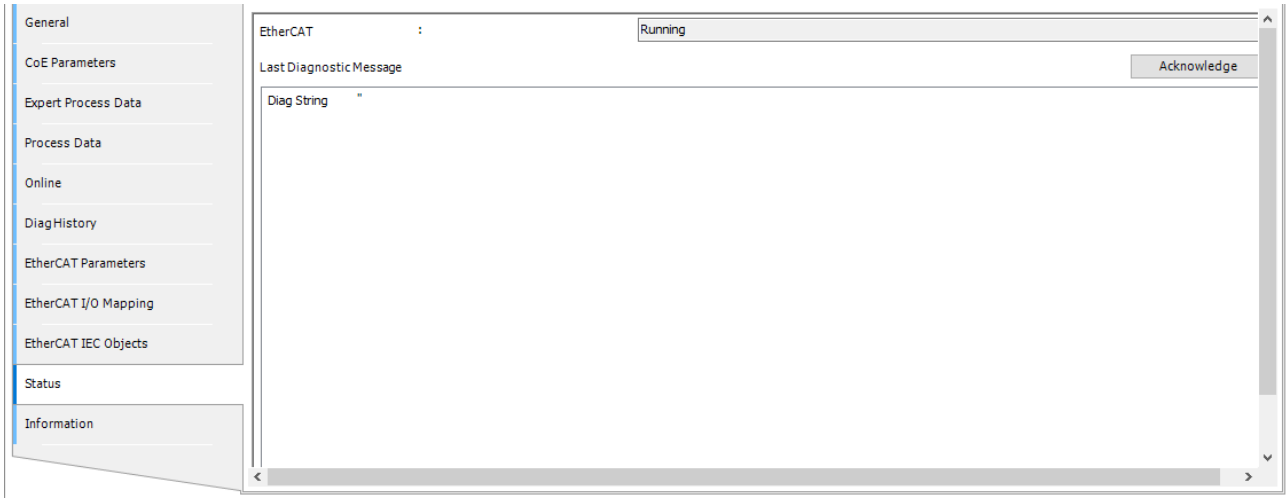
5.4.4.4 Diagnosis History

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



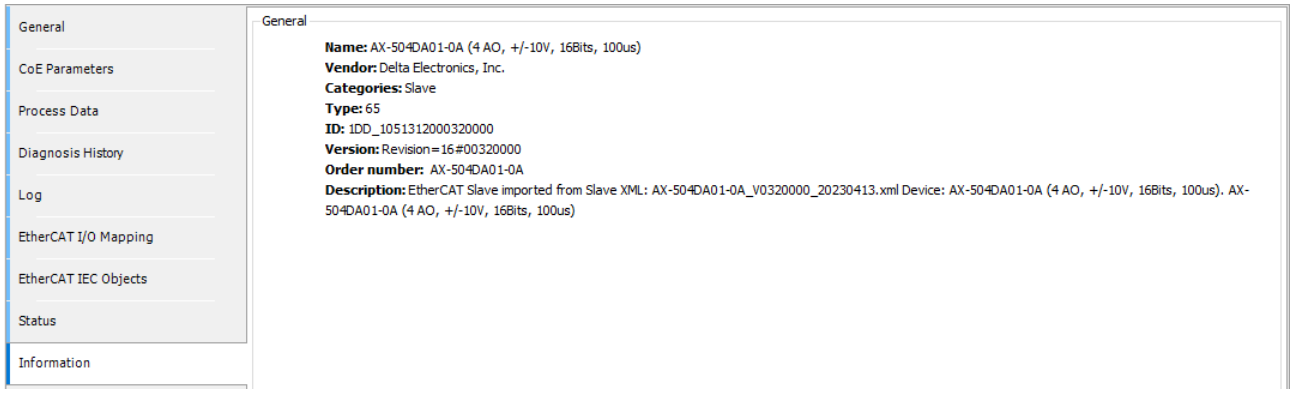
5.4.4.5 Status

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 to 20 mA	±30000
2	0 to 20 mA	0 to 30000
3	4 to 20 mA	0 to 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	0.0
	16#02	CH1 Calibration Offset		REAL	RW	0.0
	16#03	CH2 Calibration Offset		REAL	RW	0.0
	16#04	CH3 Calibration Offset		REAL	RW	0.0
	16#05	CH4 Calibration Offset		REAL	RW	0.0
	16#06	CH5 Calibration Offset		REAL	RW	0.0
	16#07	CH6 Calibration Offset		REAL	RW	0.0
	16#08	CH7 Calibration Offset		REAL	RW	0.0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9 to 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 to +20.0 mA. Gain is 1 and Offset is 0 by default, and the corresponding value is -20.0 to +20.0 mA. If you change the gain to 0.9 and the offset to 3, the value after calibration is -15 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 to 100 times	USINT	RW	10
	16#02	CH1 Moving Average Times		USINT	RW	10
	16#03	CH2 Moving Average Times		USINT	RW	10
	16#04	CH3 Moving Average Times		USINT	RW	10
	16#05	CH4 Moving Average Times		USINT	RW	10
	16#06	CH5 Moving Average Times		USINT	RW	10
	16#07	CH6 Moving Average Times		USINT	RW	10
	16#08	CH7 Moving Average Times		USINT	RW	10

- **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.

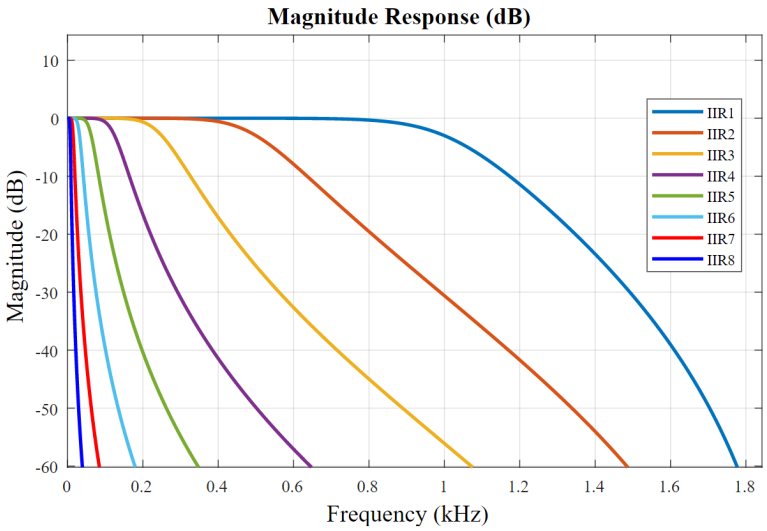
Moving Average Filter

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.

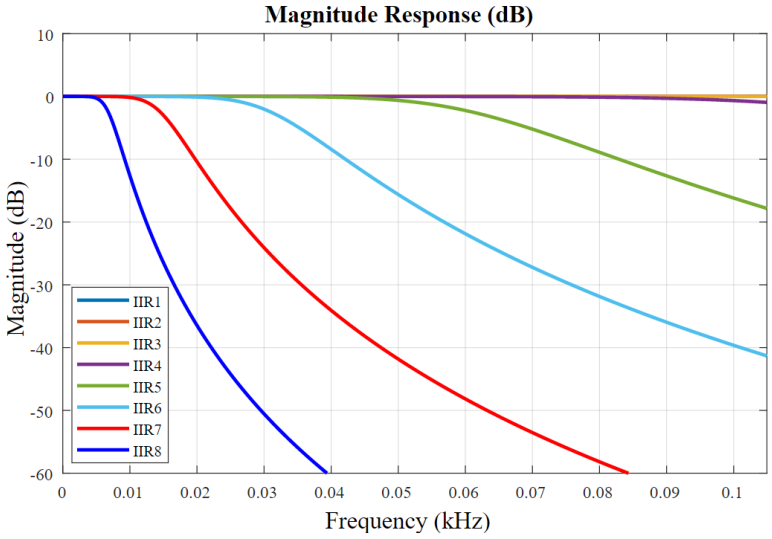
IIR (Infinite Impulse Response) Filter

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.



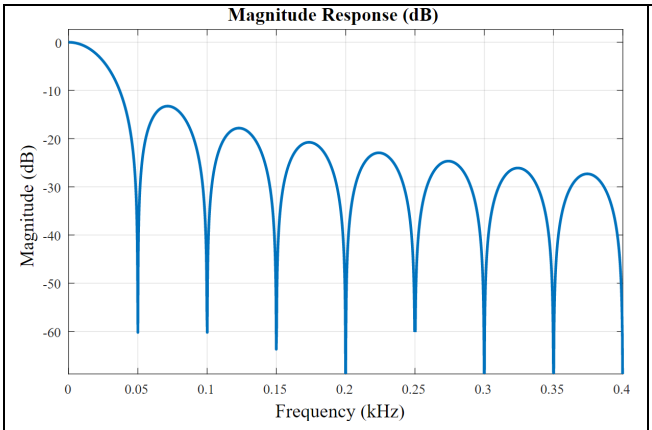
Frequency response of IIR filter



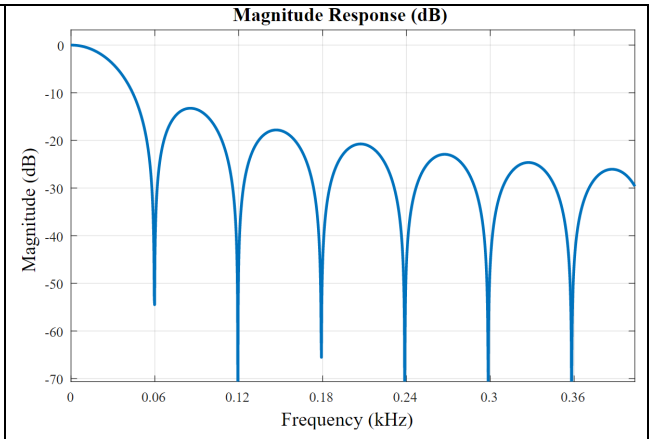
Frequency response of IIR filter (enlarged figure)

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	USINT	RW	0
	16#02	CH1 Enable User Limit Alarm DINT		USINT	RW	0
	16#03	CH2 Enable User Limit Alarm DINT		USINT	RW	0
	16#04	CH3 Enable User Limit Alarm DINT		USINT	RW	0
	16#05	CH4 Enable User Limit Alarm DINT		USINT	RW	0
	16#06	CH5 Enable User Limit Alarm DINT		USINT	RW	0
	16#07	CH6 Enable User Limit Alarm DINT		USINT	RW	0
	16#08	CH7 Enable User Limit Alarm DINT		USINT	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	USINT	RW	0
	16#02	CH1 Enable User Limit Alarm REAL		USINT	RW	0
	16#03	CH2 Enable User Limit Alarm REAL		USINT	RW	0
	16#04	CH3 Enable User Limit Alarm REAL		USINT	RW	0
	16#05	CH4 Enable User Limit Alarm REAL		USINT	RW	0
	16#06	CH5 Enable User Limit Alarm REAL		USINT	RW	0
	16#07	CH6 Enable User Limit Alarm REAL		USINT	RW	0
	16#08	CH7 Enable User Limit Alarm REAL		USINT	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**

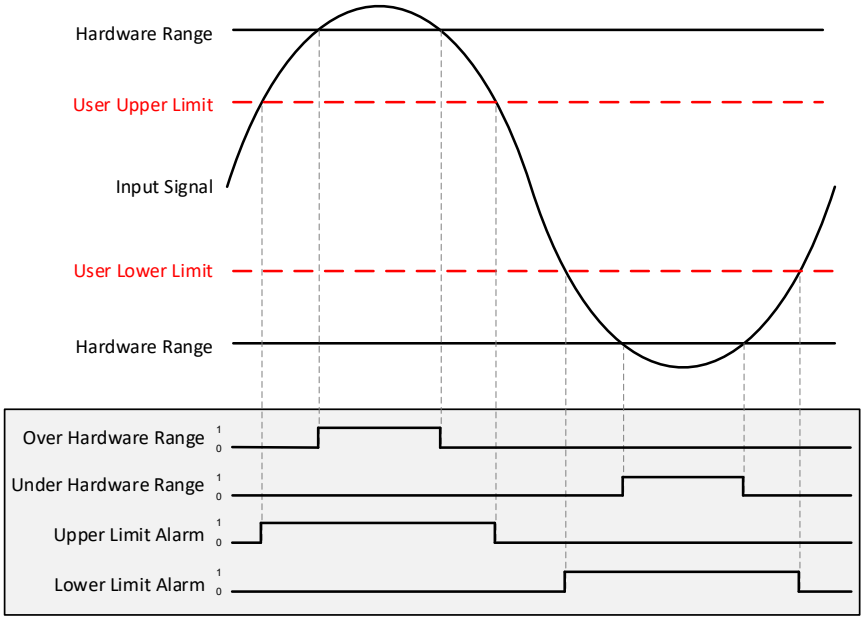
When the format is set to DINT, you can set:

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.

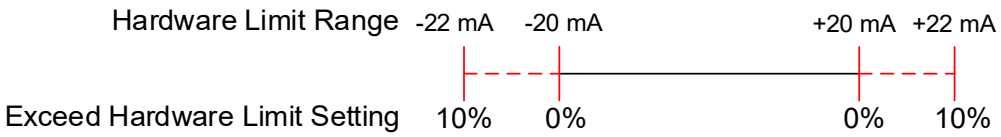


5.4.5.7 Exceed Hardware Limit

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8008	16#01	CH0 Exceed Hardware Limit Setting	Hardware limit setting; Setting range: 0 to 10 (0 to 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 to 20 mA, the setting value is 5%. Its hardware limit range is -21 to 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 to 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	20.0
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	20.0
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	20.0
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	20.0
	16#05	CH4 Scale Upper Limit REAL		REAL	RW	20.0
	16#06	CH5 Scale Upper Limit REAL		REAL	RW	20.0
	16#07	CH6 Scale Upper Limit REAL		REAL	RW	20.0
	16#08	CH7 Scale Upper Limit REAL		REAL	RW	20.0
16#8031	16#01	CH0 Scale Lower Limit REAL	Scale lower limit setting; Setting range: no limit	REAL	RW	-20.0
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-20.0
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-20.0
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-20.0
	16#05	CH4 Scale Lower Limit REAL		REAL	RW	-20.0
	16#06	CH5 Scale Lower Limit REAL		REAL	RW	-20.0
	16#07	CH6 Scale Lower Limit REAL		REAL	RW	-20.0
	16#08	CH7 Scale Lower Limit REAL		REAL	RW	-20.0

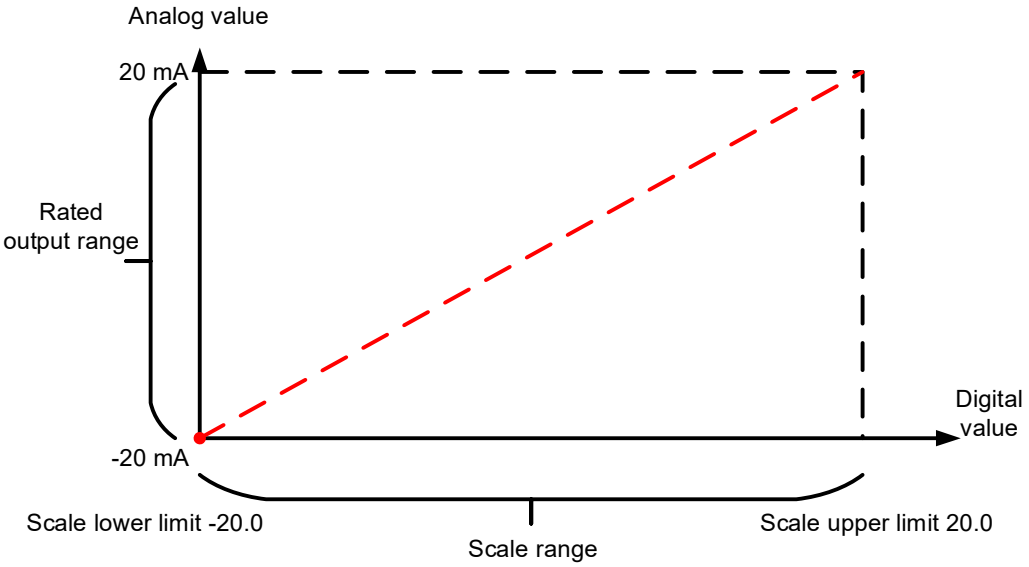
5

- **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 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 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

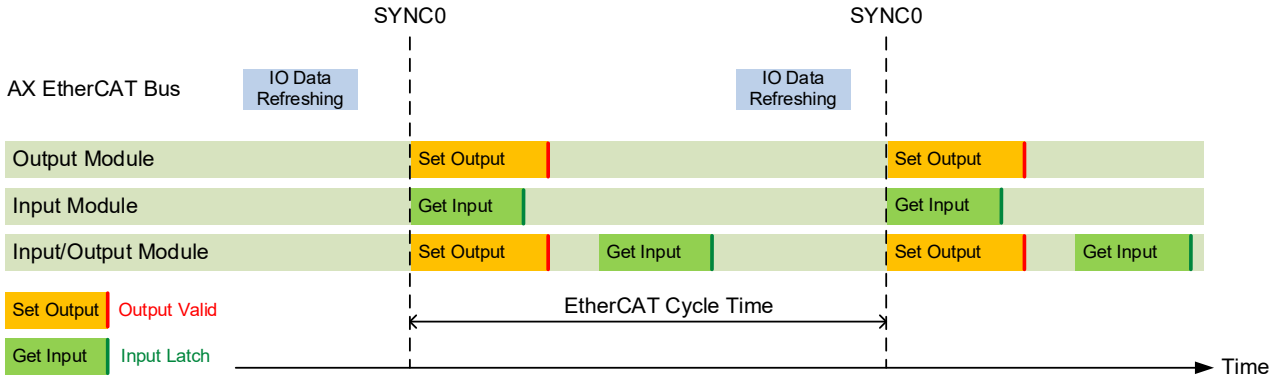
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

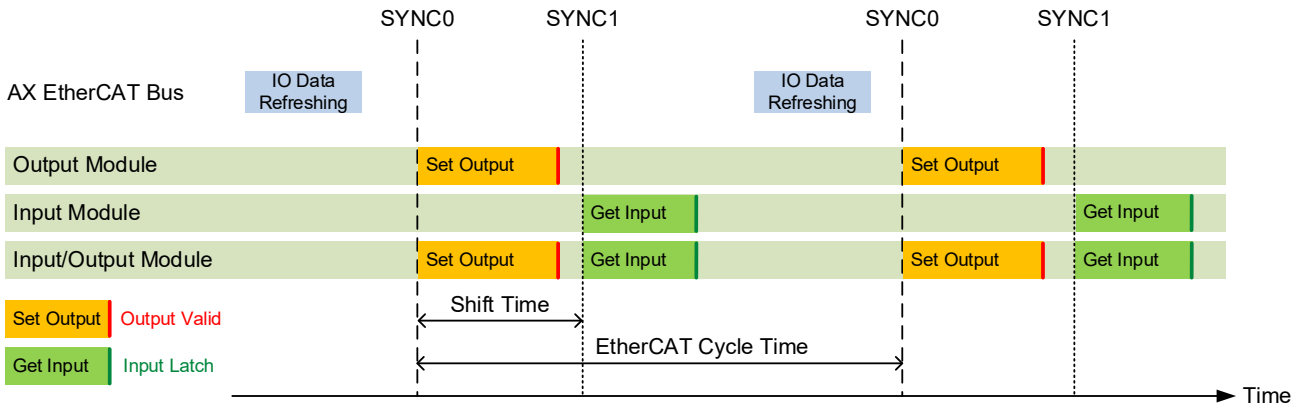
- **SYNC0**

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

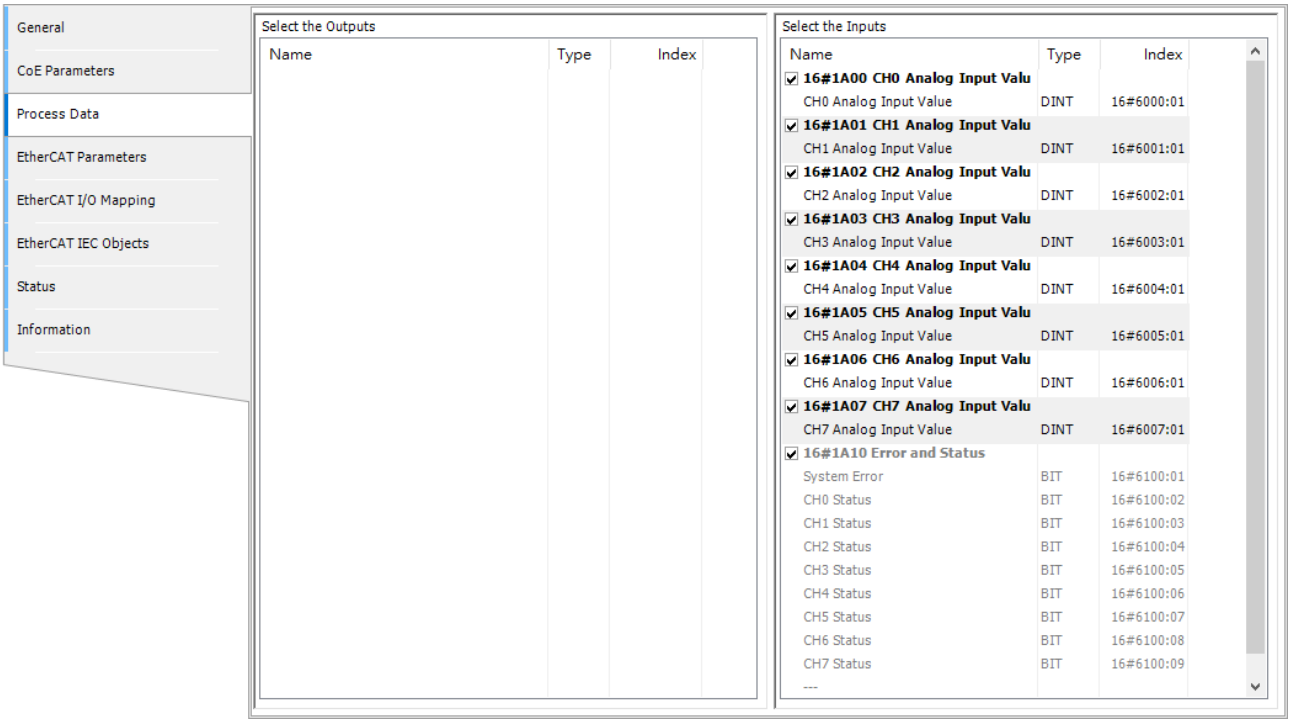
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#6000	16#01	CH0 Analog Input Value	Analog input value; Setting range: -30000 to 30000	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

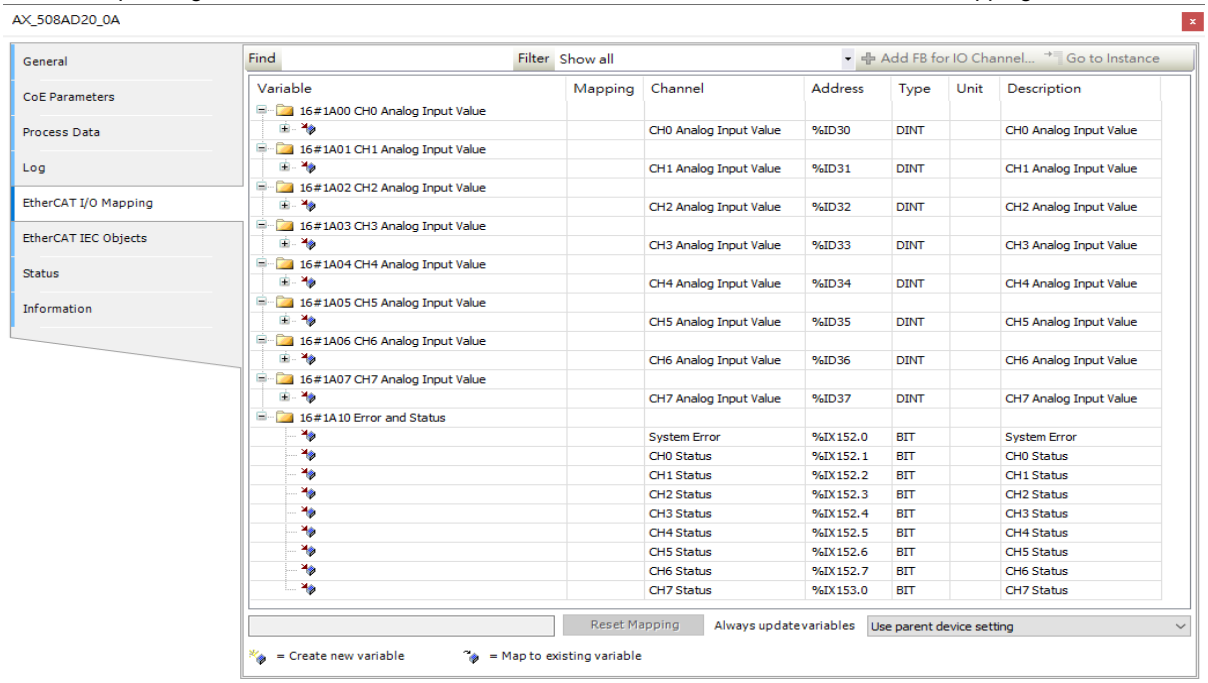
Go to the Process Data tab and select the data that you'd like to monitor.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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(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.

*1. n =1 to 8

5.5 AX-504DA01-0A

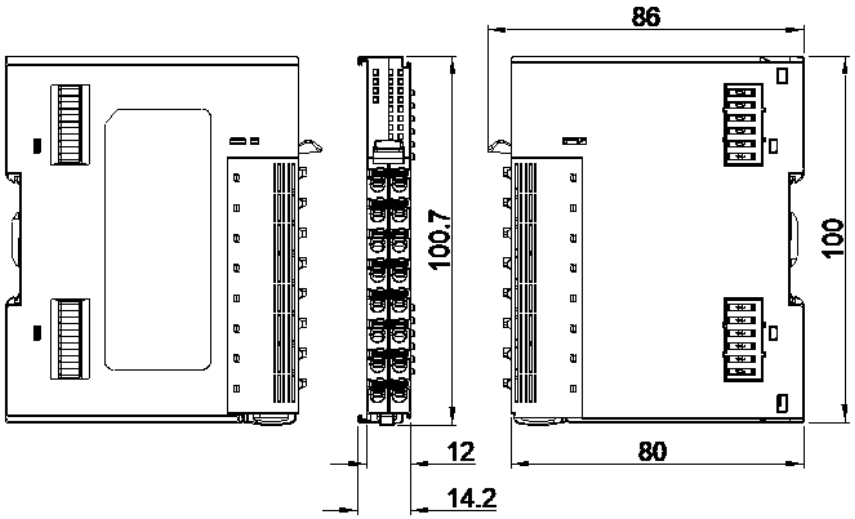
AX-504DA01-0A, an analog output module, receives 4 sets of 16-bit digital data from the PLC and converts the received digital signals into analog voltage signals which are output through 4 output points. This section introduces its specifications, wirings and operations.

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 to +10 V
	Output conversion range	-5 to 105% (F.S.)
	Load impedance	1 kΩ to 2 mΩ
	Resolution	-10 to 10 V: 16 bits; 0 to 10 V: 15 bits; -5 to 5 V: 15 bits; 0 to 5 V: 14 bits; 1 to 5 V: 14 bits
	Accuracy	25°C: ±0.2% (F.S.) -20 to 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 Detection	N/A
	Short Circuit Detection (SCD)	N/A
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	N/A
	Filter function	N/A

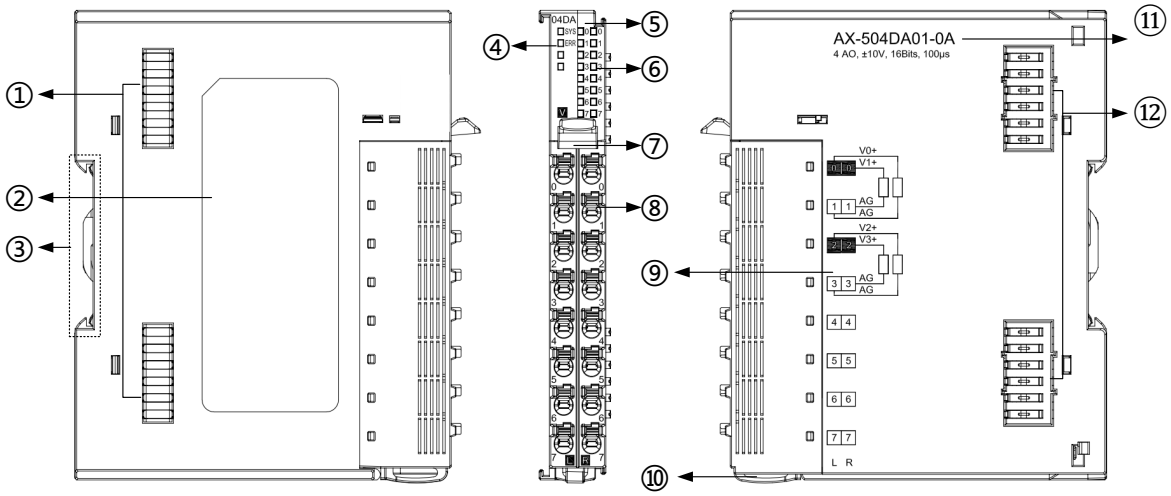
5.5.2 Dimensions and Parts

- **Dimensions**



Unit: mm

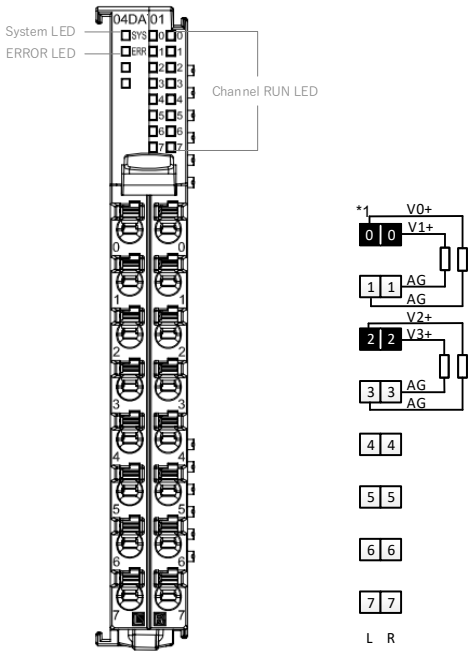
- **Parts**



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.

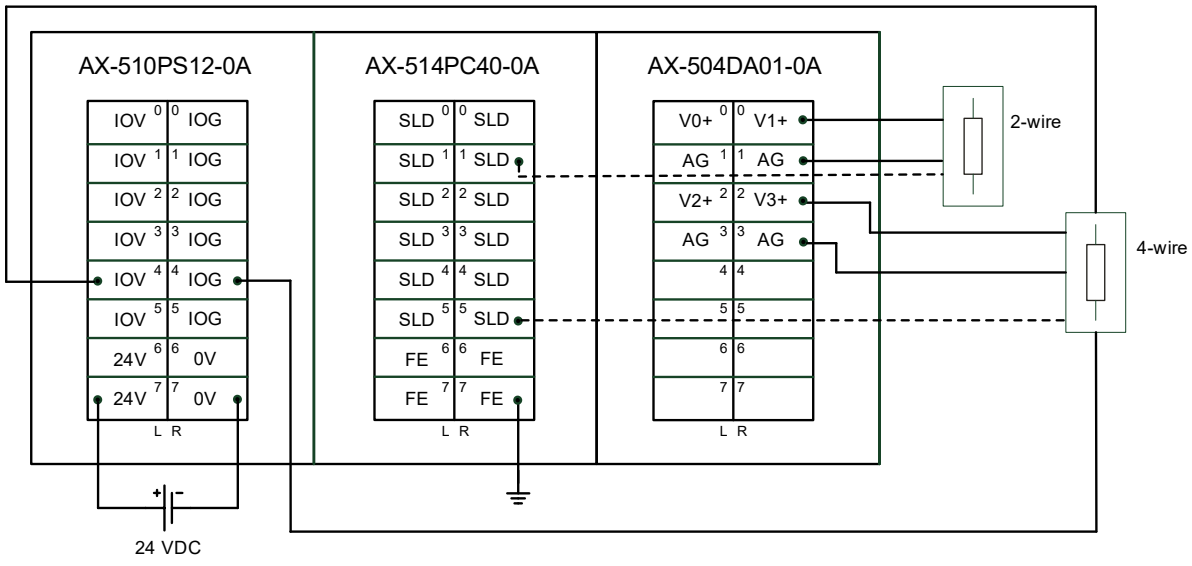
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	V0+	Channel 0: output voltage	R0	V1+	Channel 1: output voltage
L1	AG		R1	AG	
L2	V2+	Channel 2: output voltage	R2	V3+	Channel 3: output voltage
L3	AG		R3	AG	
L4	--	--	R4	--	--
L5	--	--	R5	--	--
L6	--	--	R6	--	--
L7	--	--	R7	--	--

5.5.3.2 LED Indicators

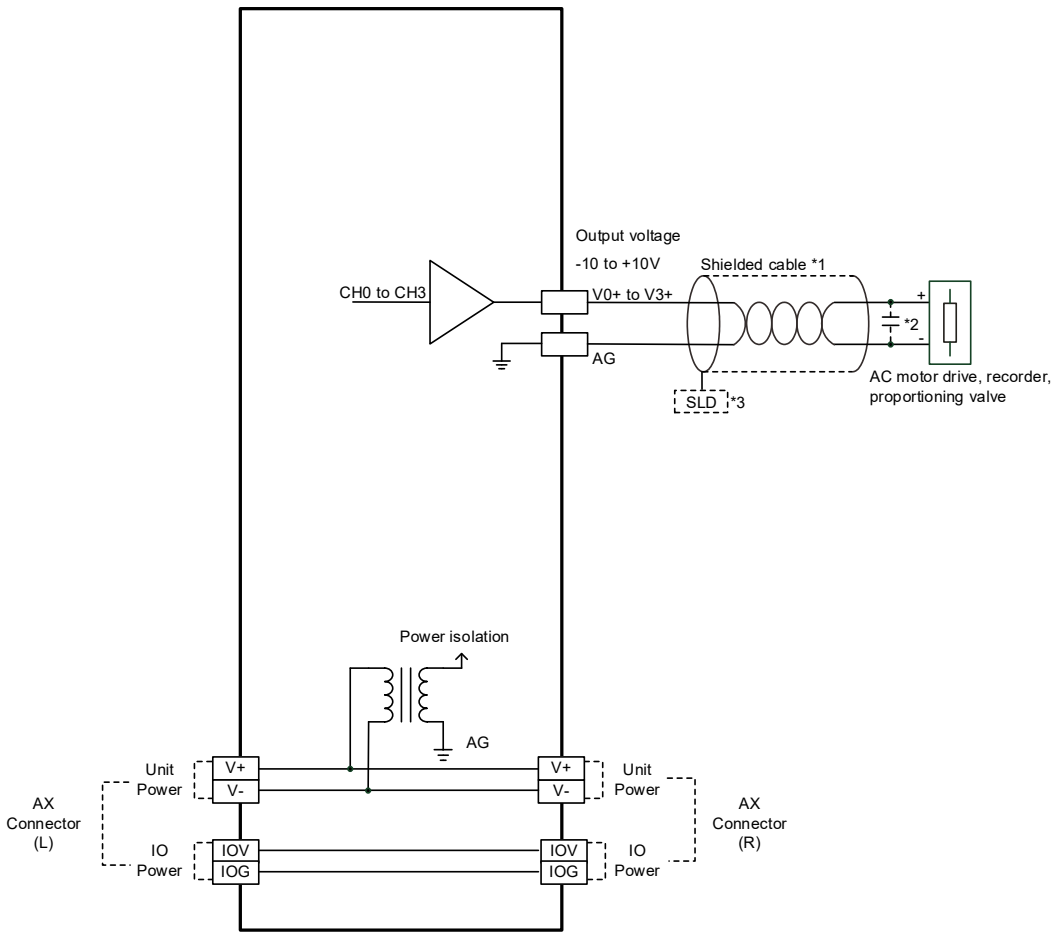
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2 s)	ECAT Pre OP
			Blinking (1 s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1 s)	An error occurs on the application.
			Blinking (0.2 s)	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 and 0.47 μF and a working voltage of 25 V.

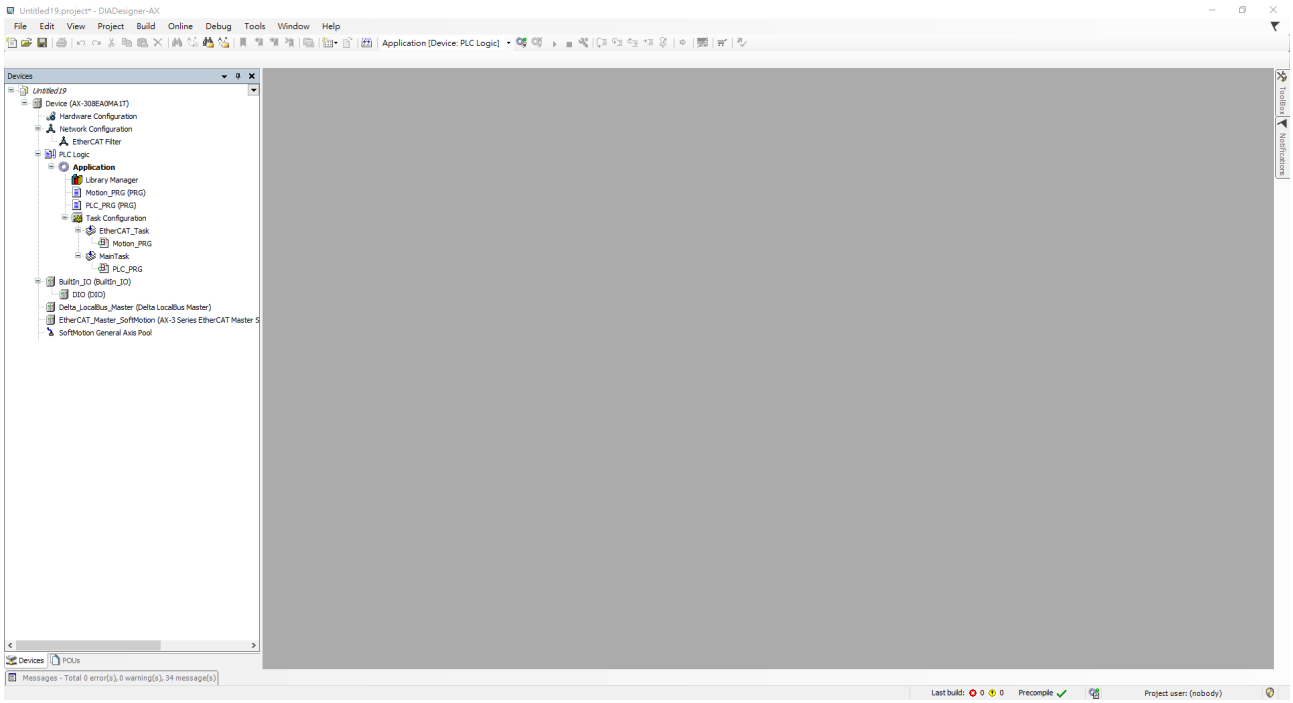
*3. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A.

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

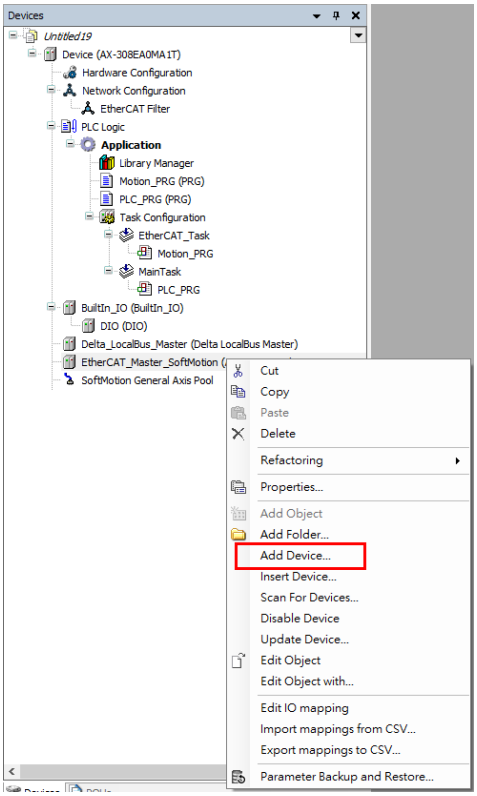
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



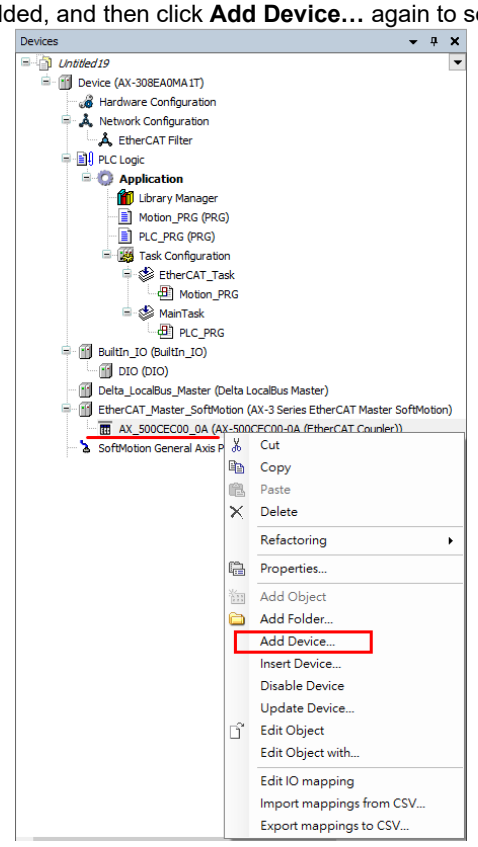
(2) Add Modules in

- 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.

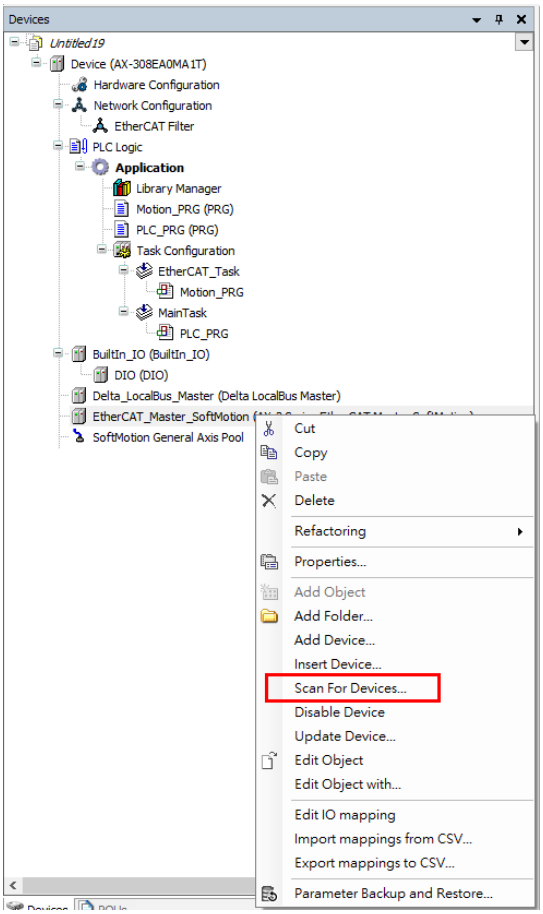


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

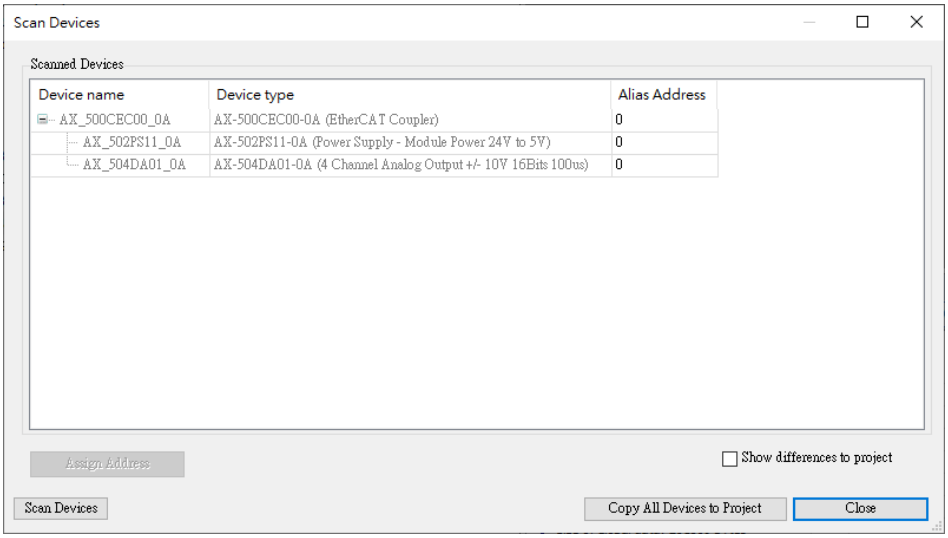


- Method 2: Scan to add the modules in.

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

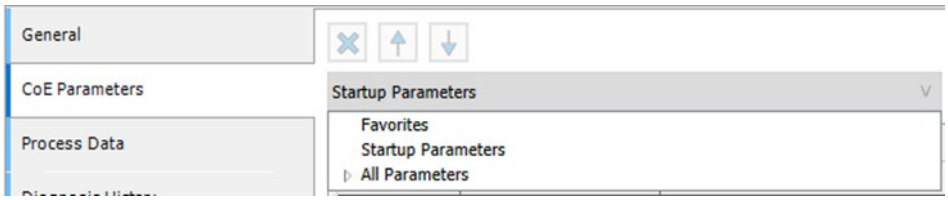


After the auto-scan is over, the actually connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



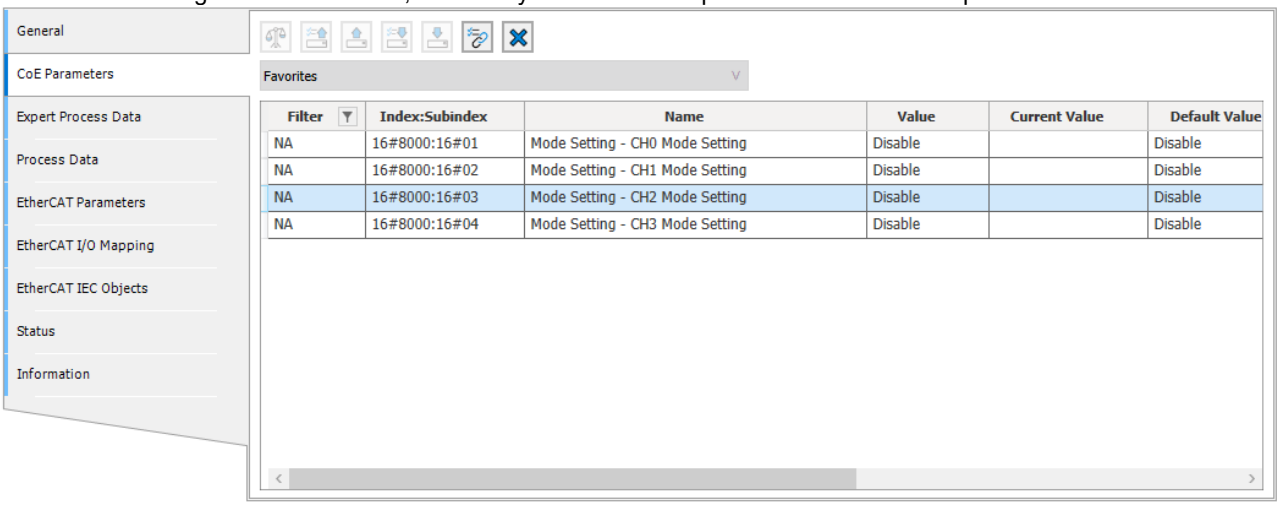
5.5.4.2 Parameter Settings

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



(1) Favorites

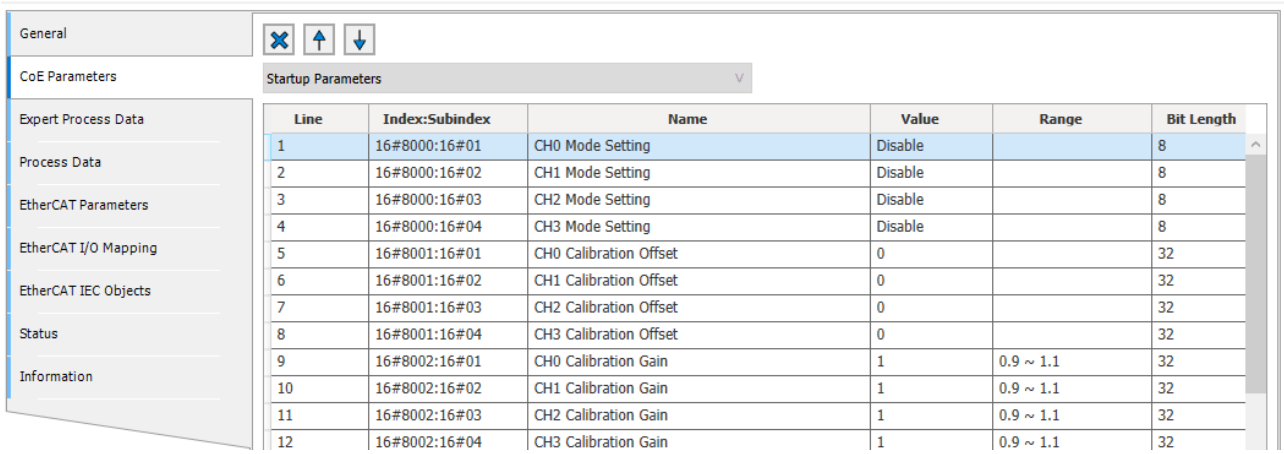
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

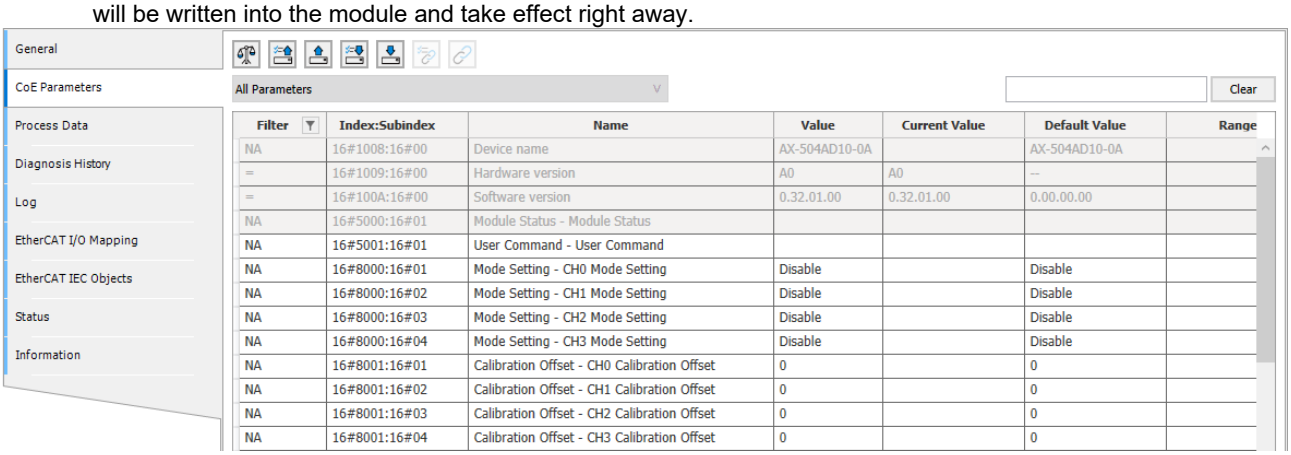


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8000:16#03	CH2 Mode Setting	Disable		8
4	16#8000:16#04	CH3 Mode Setting	Disable		8
5	16#8001:16#01	CH0 Calibration Offset	0		32
6	16#8001:16#02	CH1 Calibration 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

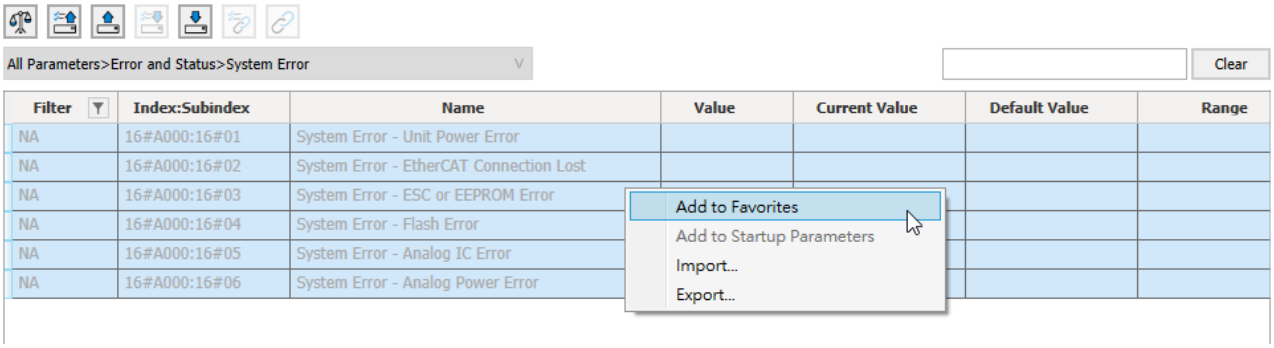
(3) All Parameters

- 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.

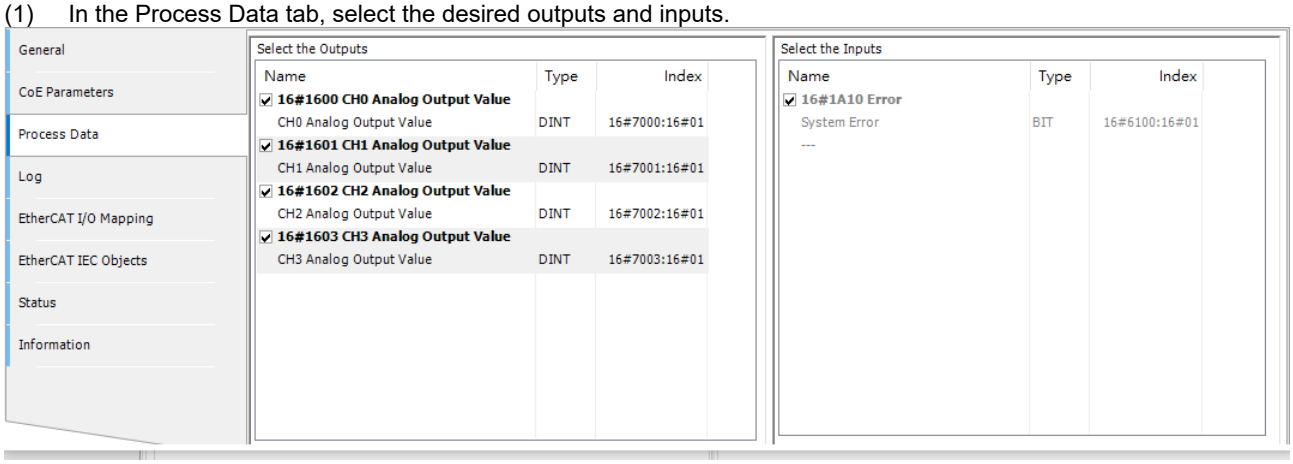
- You can select and right-click the parameter to add the selected parameter to the Favorites.



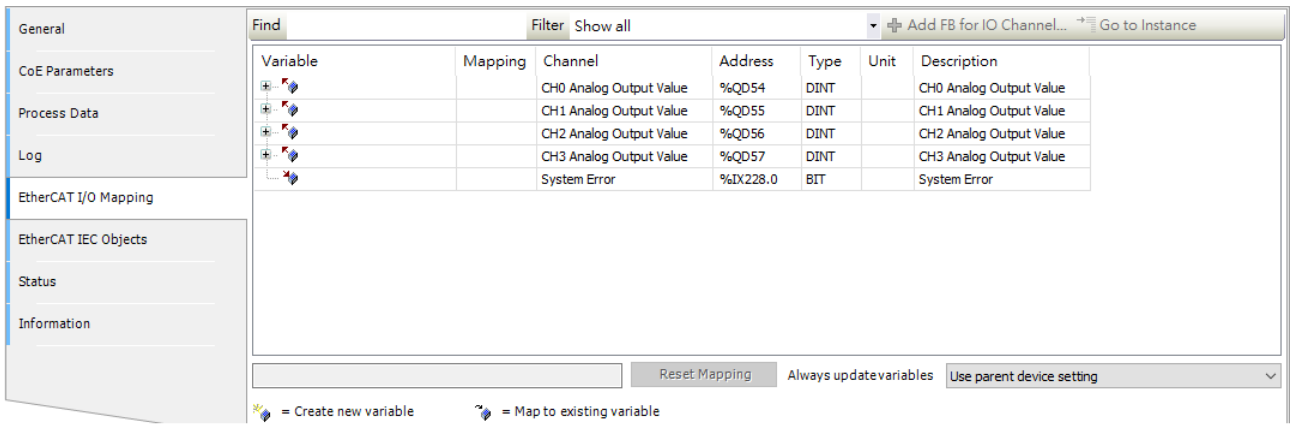
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.5.4.3 Process Data

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

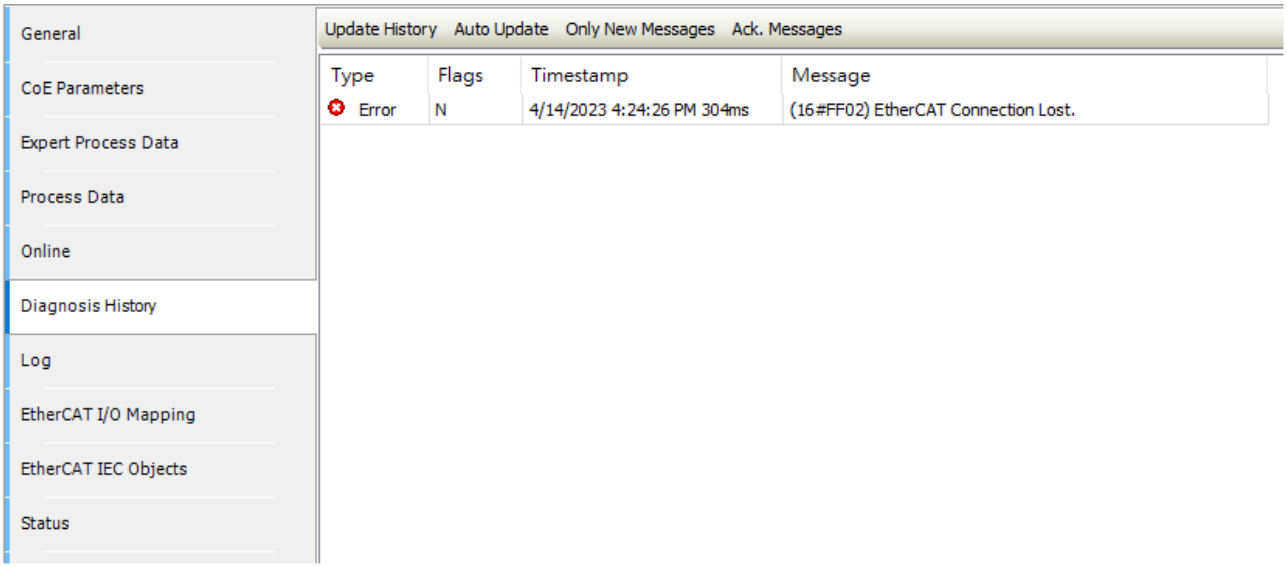


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



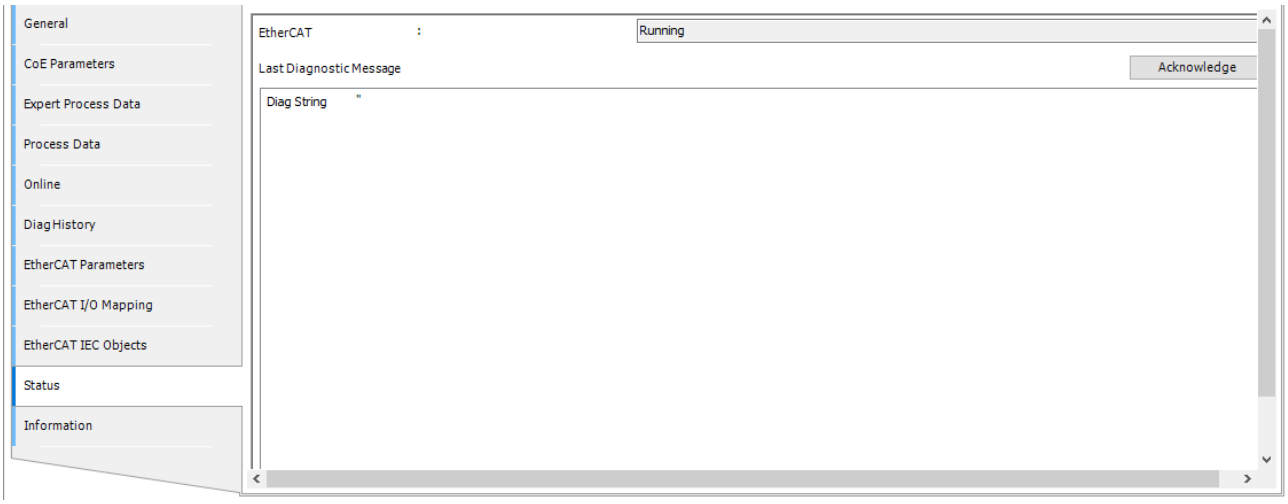
5.5.4.4 Diagnosis History

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



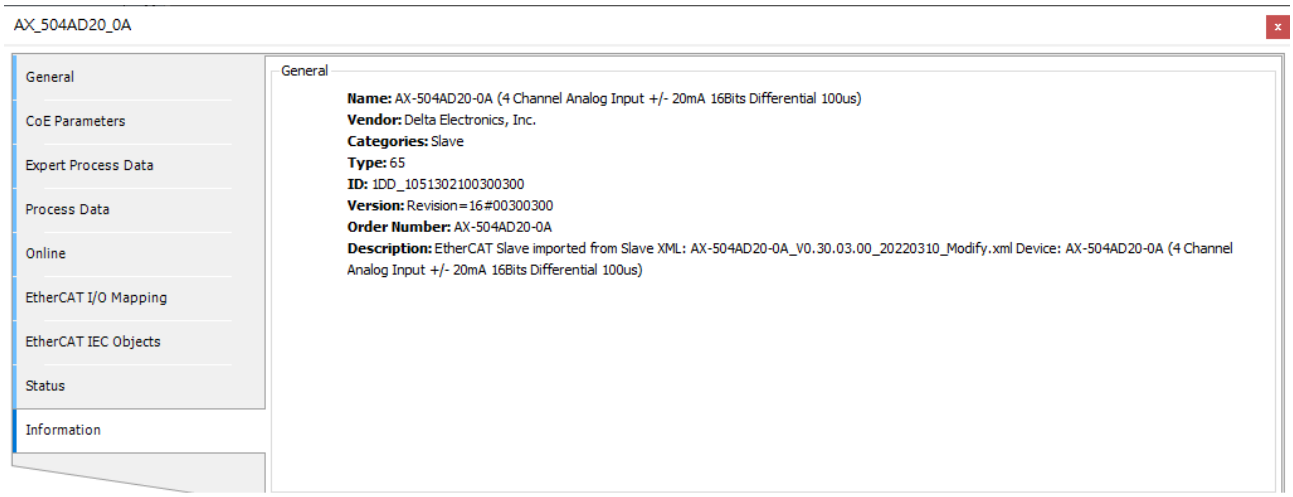
5.5.4.5 Status

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.

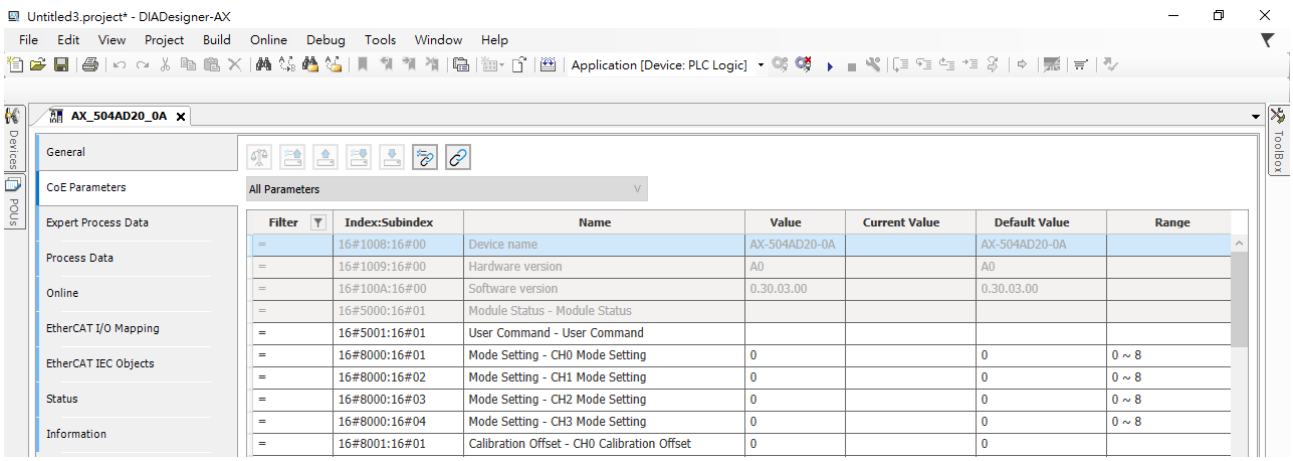


5.5.4.6 Information

(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 to 10 V	±30000
2	0 to 10 V	0 to 30000
3	-5 to 5 V	±30000
4	0 to 5 V	0 to 30000
5	1 to 5 V	0 to 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	0.0
	16#02	CH1 Calibration Offset		REAL	RW	0.0
	16#03	CH2 Calibration Offset		REAL	RW	0.0
	16#04	CH3 Calibration Offset		REAL	RW	0.0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9 to 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 to 30000	DINT	RW	0
	16#02	CH1 Output Value Setting when EtherCAT Connection Lost DINT		DINT	RW	0
	16#03	CH2 Output Value Setting when EtherCAT Connection Lost DINT		DINT	RW	0
	16#04	CH3 Output Value Setting when EtherCAT Connection Lost DINT		DINT	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	REAL	RW	0.0
	16#02	CH1 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0
	16#03	CH2 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0
	16#04	CH3 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0

- **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 to 30000	DINT	RW	0
	16#02	CH1 Output Value Setting when Module in Stopped State DINT		DINT	RW	0
	16#03	CH2 Output Value Setting when Module in Stopped State DINT		DINT	RW	0
	16#04	CH3 Output Value Setting when Module in Stopped State DINT		DINT	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	REAL	RW	0.0
	16#02	CH1 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0
	16#03	CH2 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0
	16#04	CH3 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0

- **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

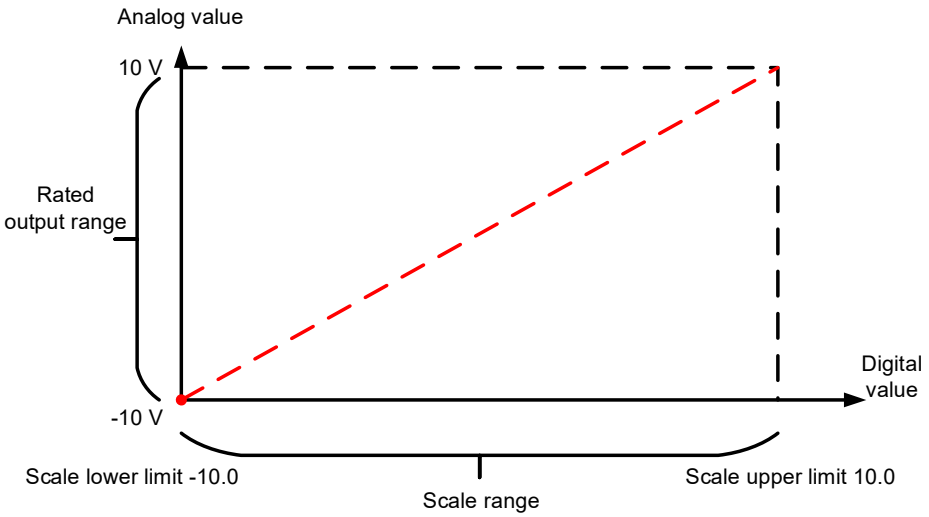
Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8030	16#01	CH0 Scale Upper Limit REAL	Scale upper limit setting; Setting range: no limit	REAL	RW	10.0
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	10.0
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	10.0
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	10.0
16#8031	16#01	CH0 Scale Lower Limit REAL	Scale lower limit setting; Setting range: no limit	REAL	RW	-10.0
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-10.0
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-10.0
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-10.0

- **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 to +10 V, the analog range is -10 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 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

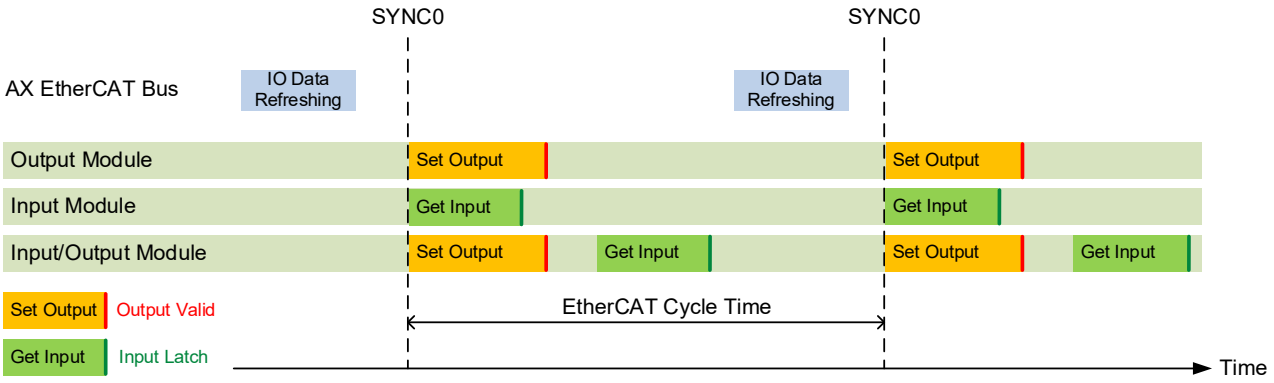
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

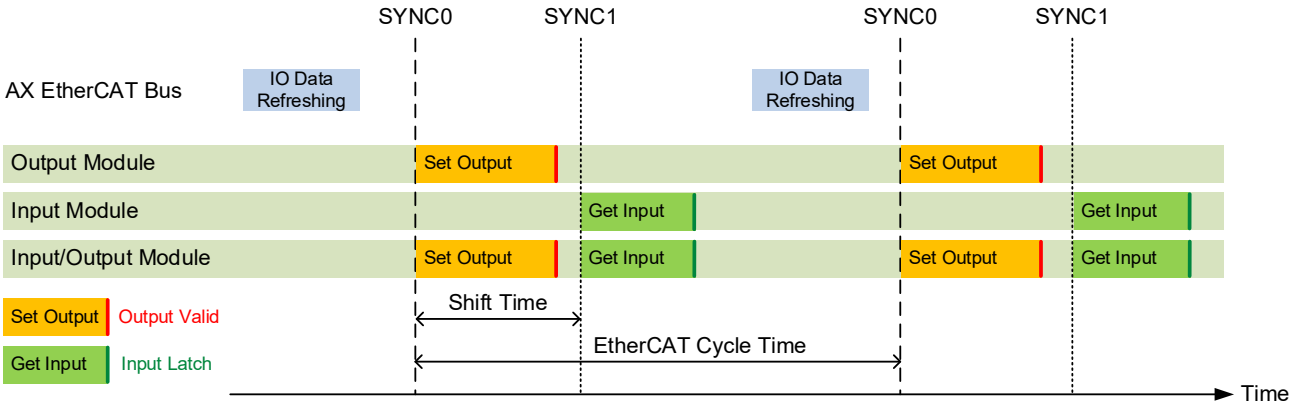
- **SYNC0**

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

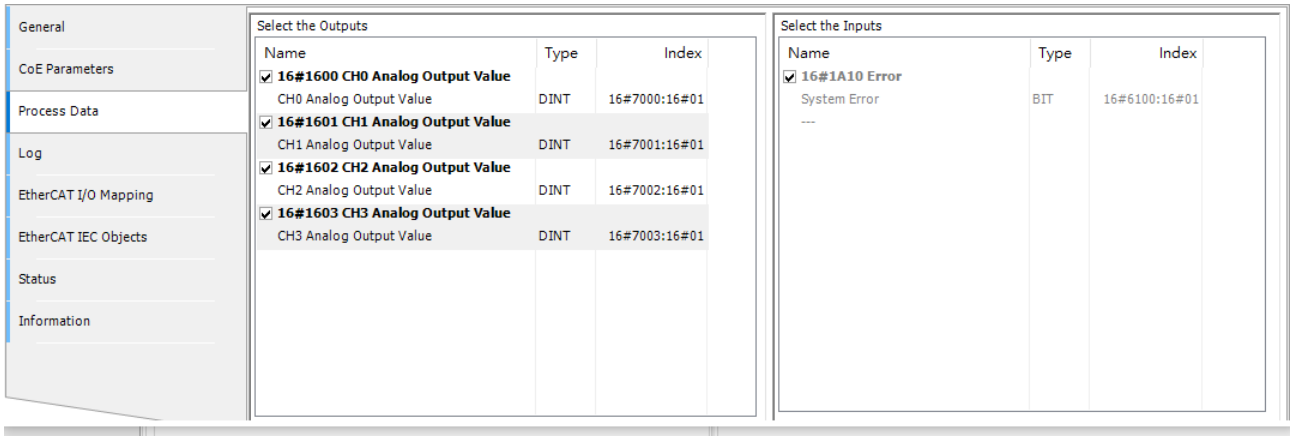
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#7000	16#01	CH0 Analog Output Value	Analog output value; Setting range: -30000 to 30000	DINT	RW	0
16#7001	16#01	CH1 Analog Output Value		DINT	RW	0
16#7002	16#01	CH2 Analog Output Value		DINT	RW	0
16#7003	16#01	CH3 Analog Output Value		DINT	RW	0
16#6100	16#01	System Error	System error	BOOL	RO	0

5.5.7.1 Process Data

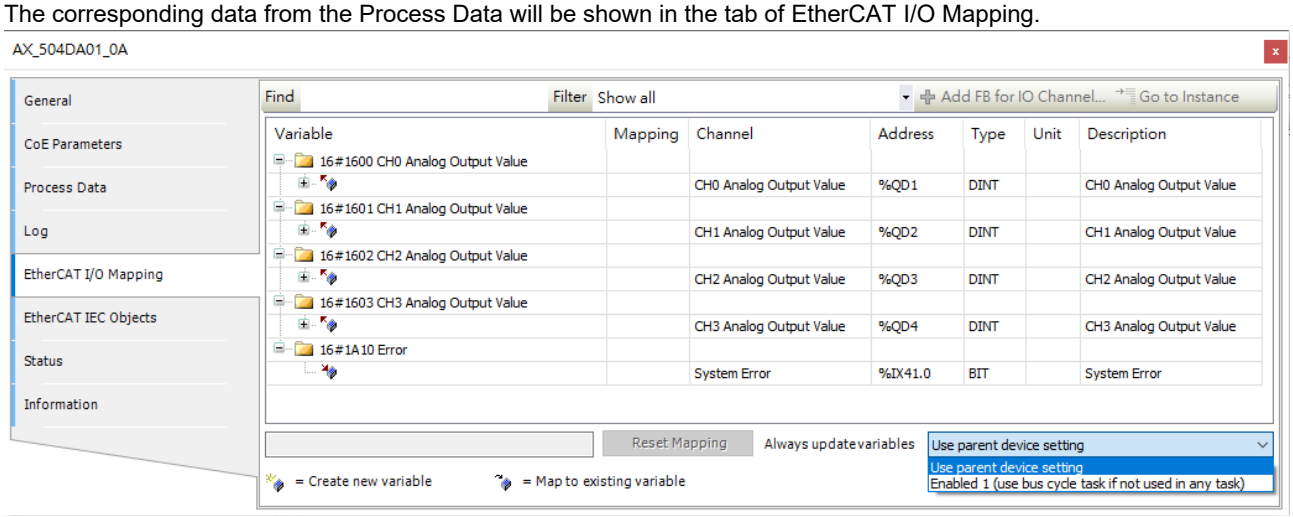
Go to the Process Data tab and select the data that you'd like to monitor.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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

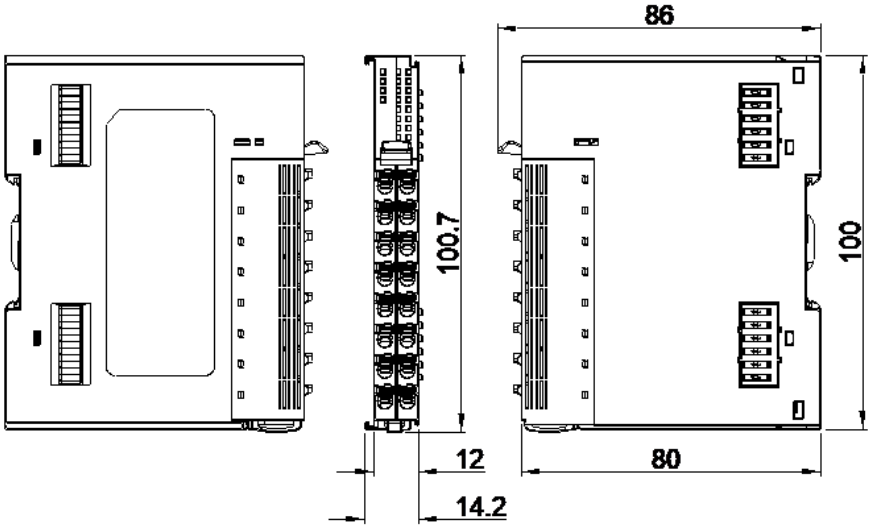
AX-504DA02-0A, an analog output module, receives 4 sets of 16-bit digital data from the PLC and converts the received digital signals to analog current signals, which are output through 4 output points. This section introduces its specifications, wirings and operations.

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 to 20 mA
	Output conversion range	0 to 105% (F.S.)
	Maximum load impedance	550 Ω
	Resolution	0 to 20 mA: 15 bits; 4 to 20 mA: 15 bits;
	Accuracy	25°C: ±0.2% (F.S.) -20 to 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 Detection	N/A
	Short Circuit Detection (SCD)	N/A
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	N/A
	Filter function	N/A

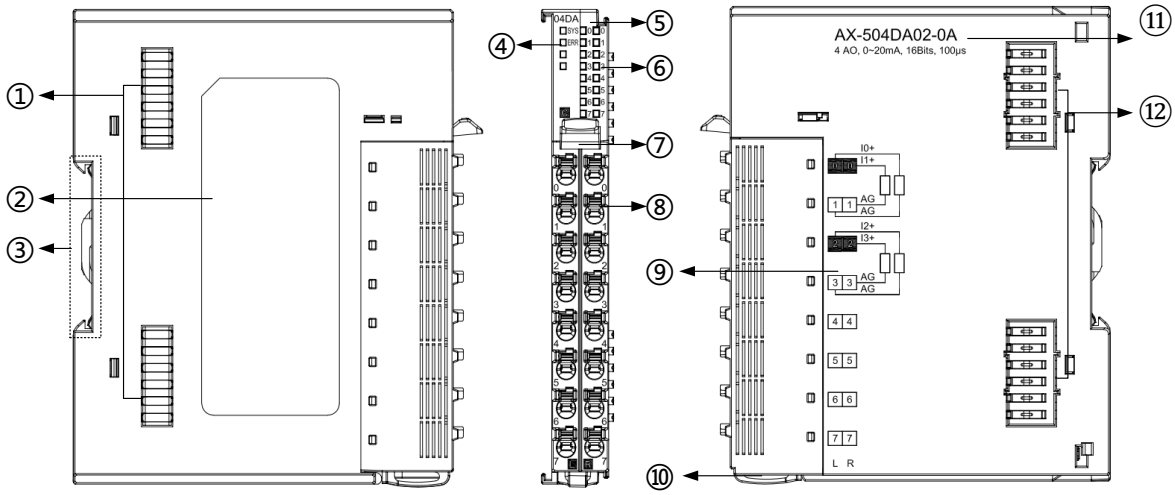
5.6.2 Dimensions and Parts

- **Dimensions**



Unit: mm

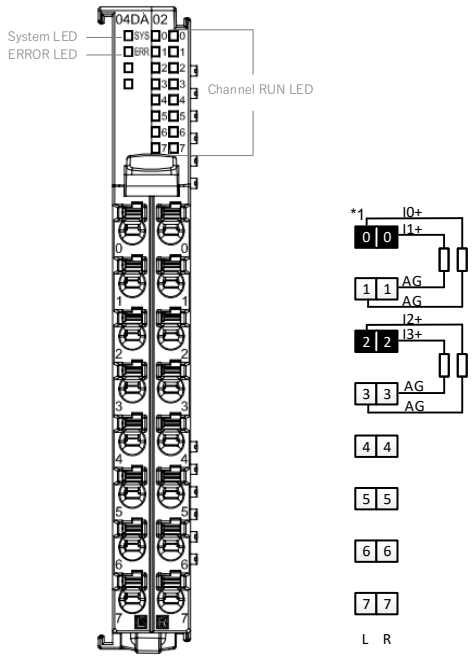
- **Parts**



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.

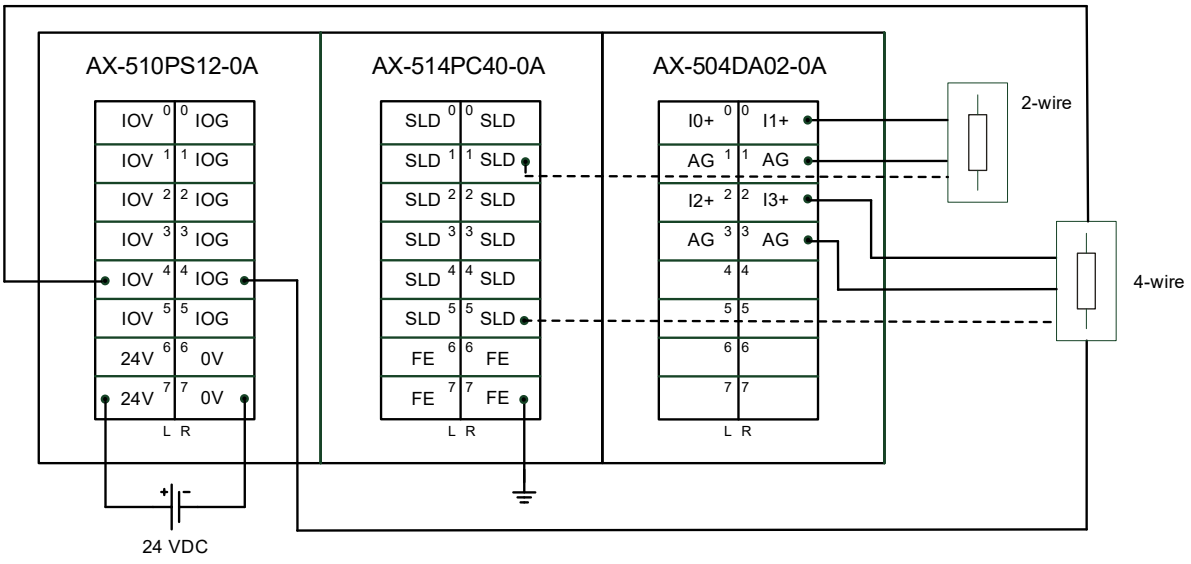
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0+	Channel 0: output current	R0	I1+	Channel 1: output current
L1	AG		R1	AG	
L2	I2+	Channel 2: output current	R2	I3+	Channel 3: output current
L3	AG		R3	AG	
L4	--	--	R4	--	--
L5	--	--	R5	--	--
L6	--	--	R6	--	--
L7	--	--	R7	--	--

5.6.3.2 LED Indicators

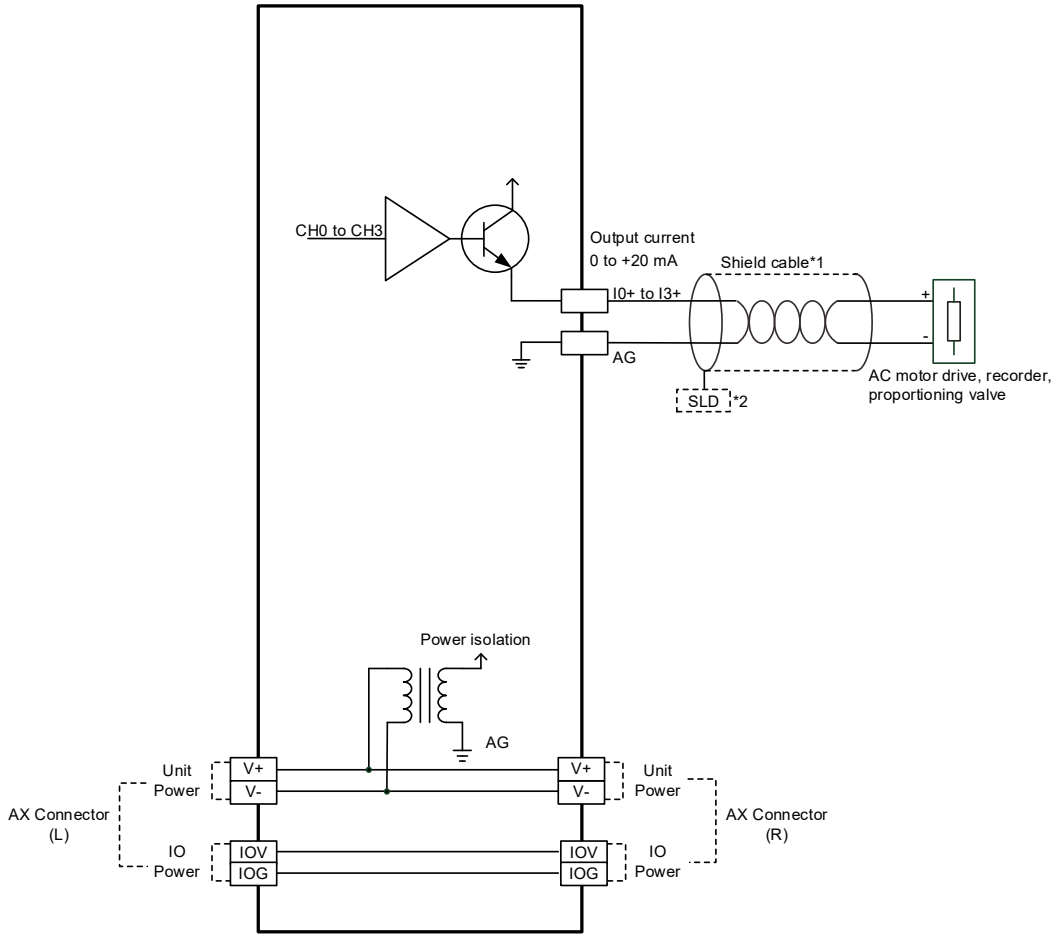
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2 s)	ECAT Pre OP
			Blinking (1 s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1 s)	An error occurs on the application.
			Blinking (0.2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

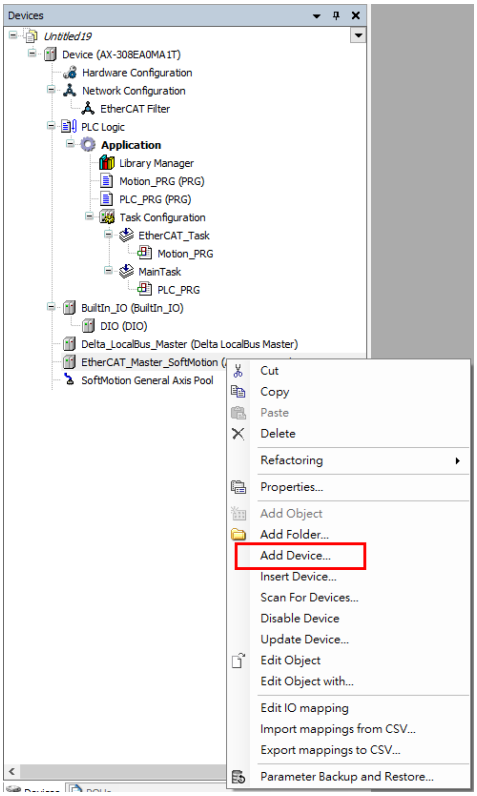
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



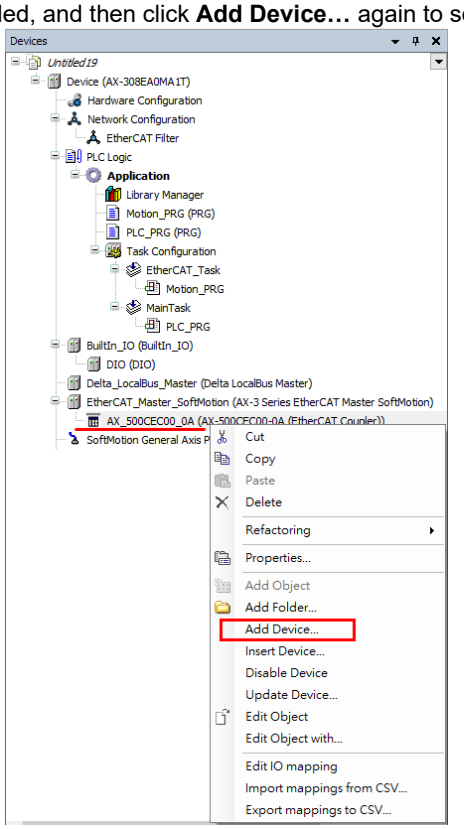
(2) Add Modules in

- 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.

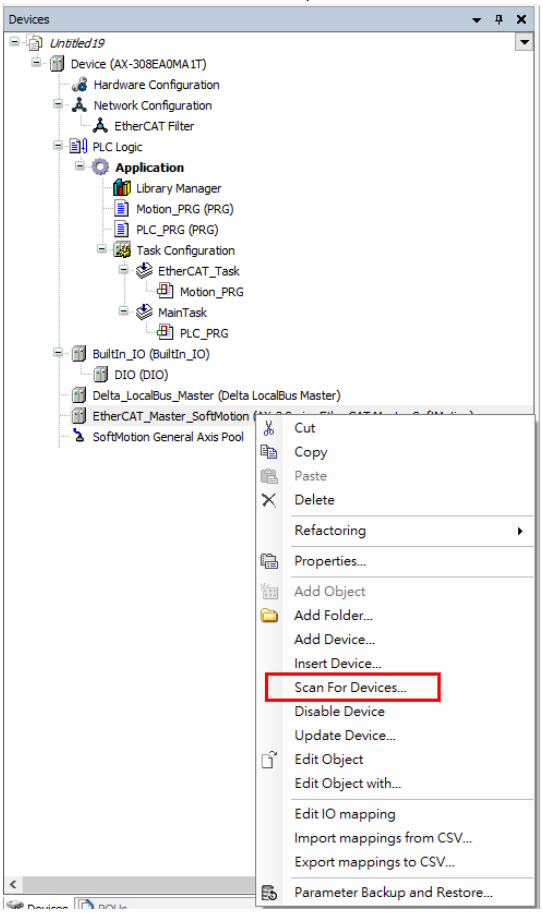


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

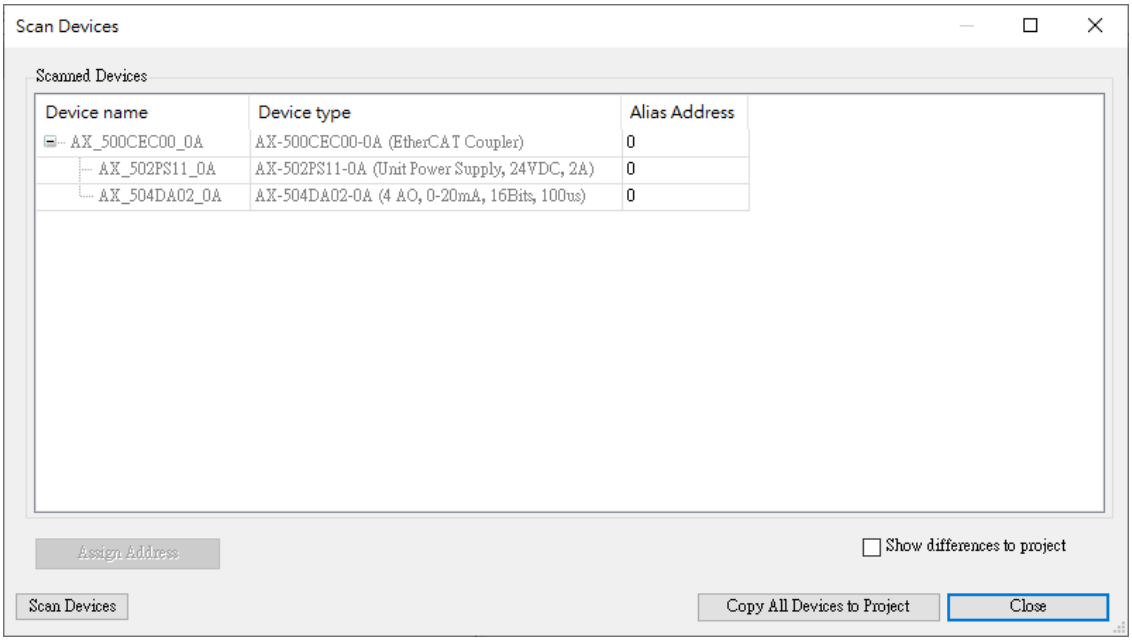


- Method 2: Scan to add the modules in.

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

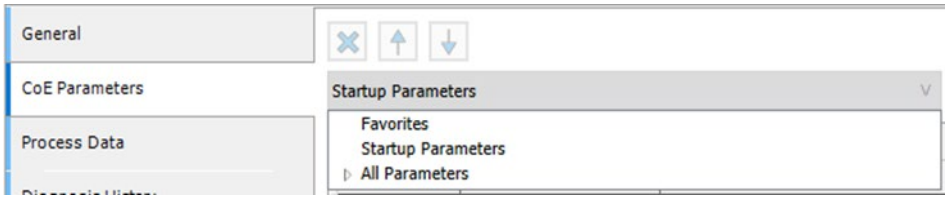


After the auto-scan is over, the actually connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



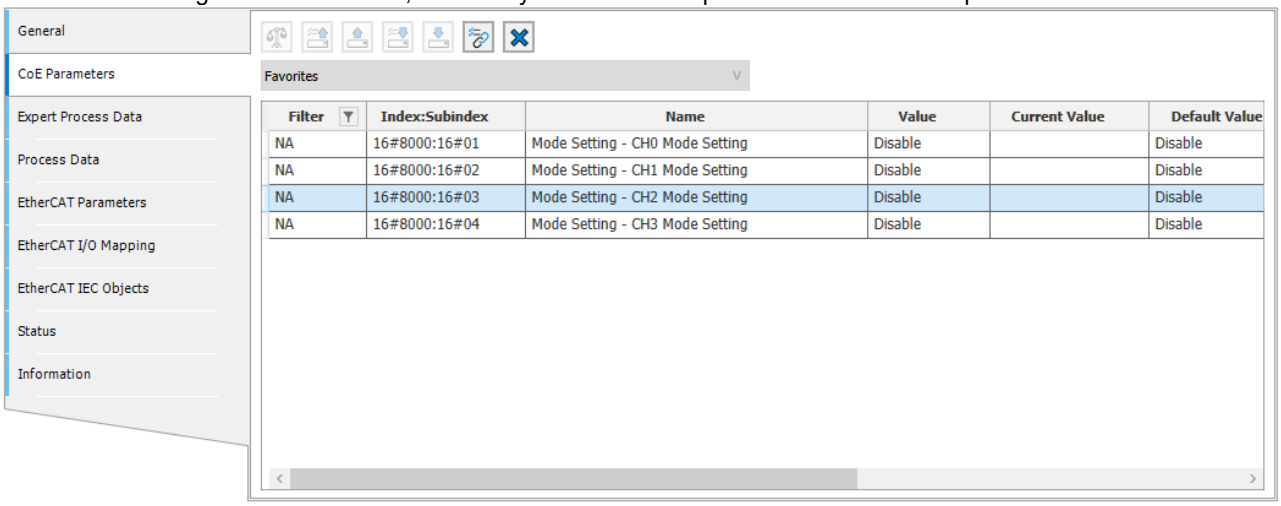
5.6.4.2 Parameter Settings

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



(1) Favorites

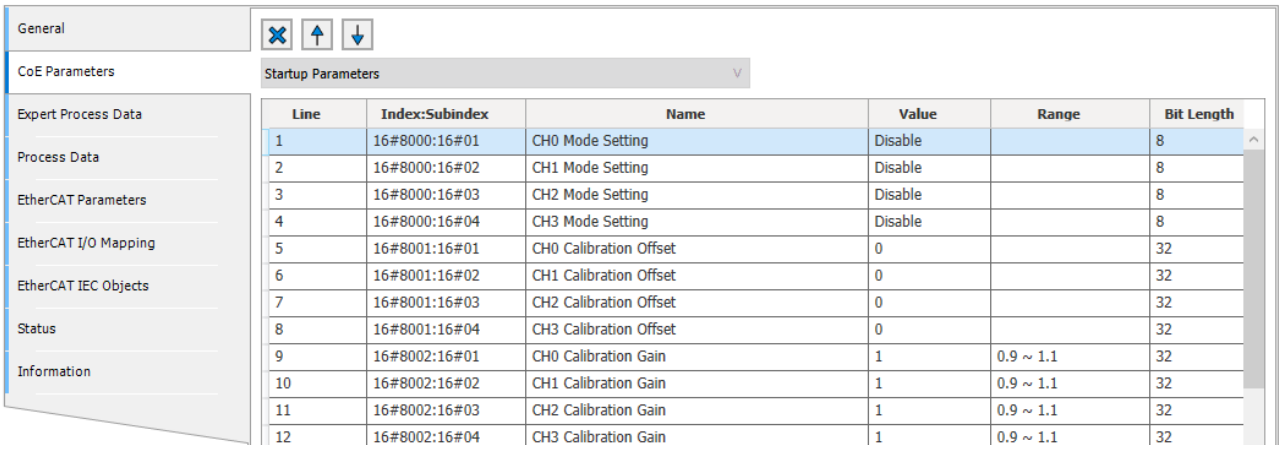
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

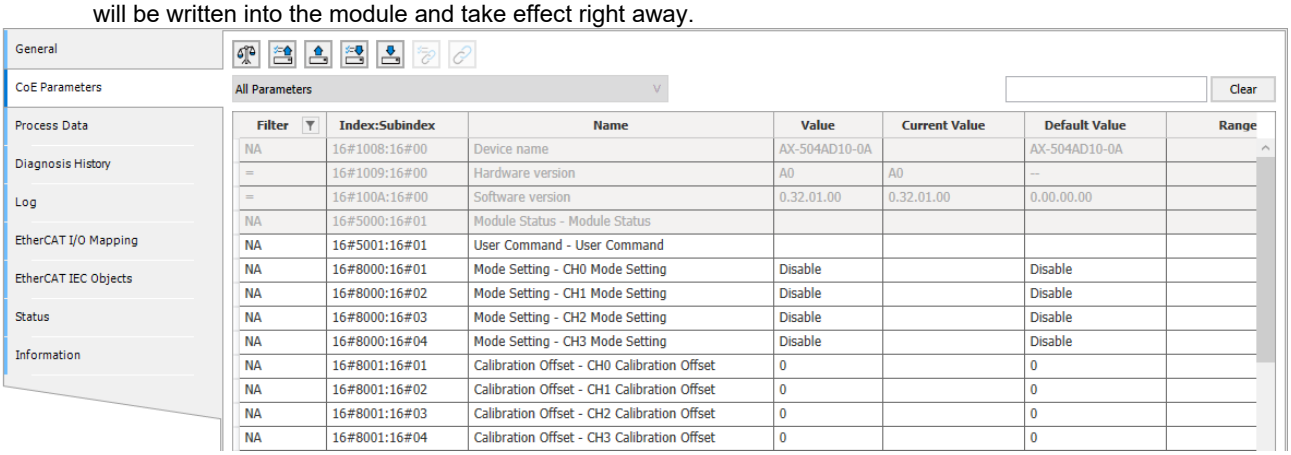


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8000:16#03	CH2 Mode Setting	Disable		8
4	16#8000:16#04	CH3 Mode Setting	Disable		8
5	16#8001:16#01	CH0 Calibration Offset	0		32
6	16#8001:16#02	CH1 Calibration 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

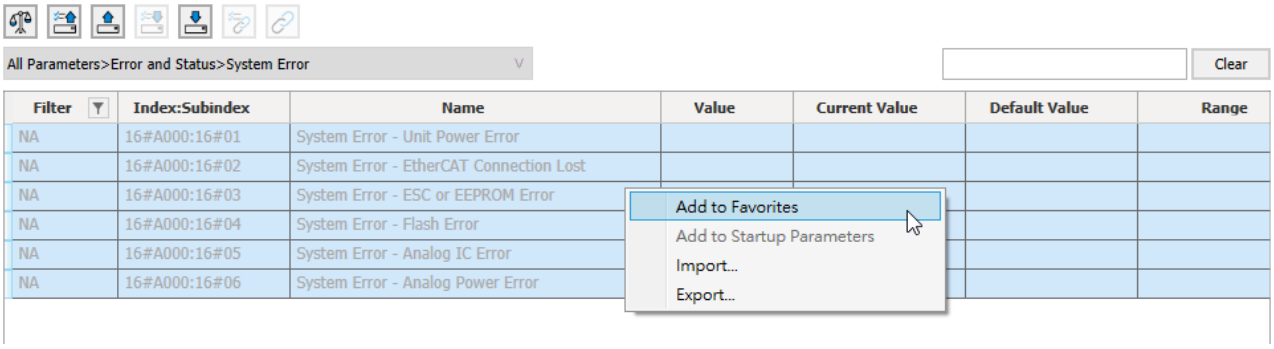
(3) All Parameters

- 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.

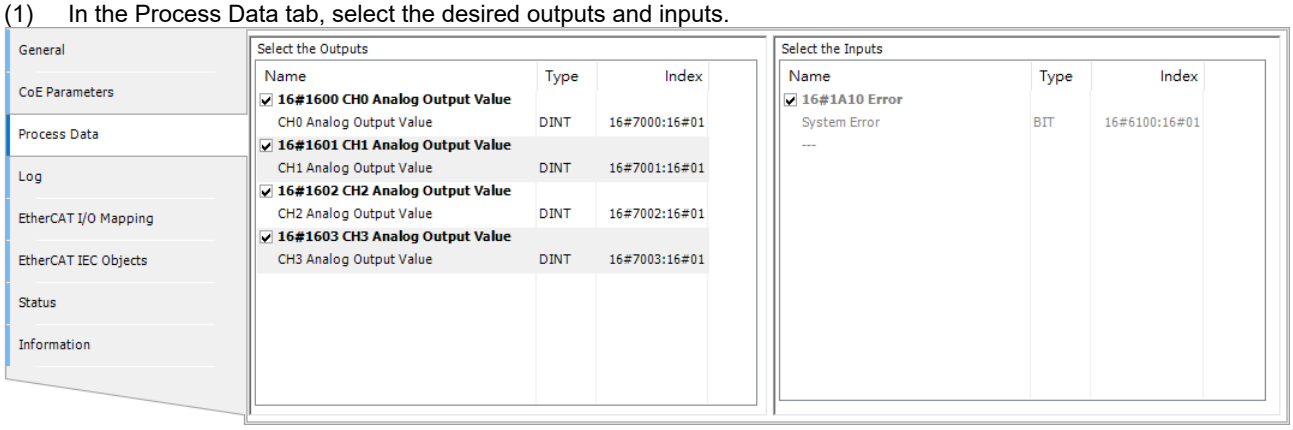
- You can select and right-click the parameter to add the selected parameter to the Favorites.



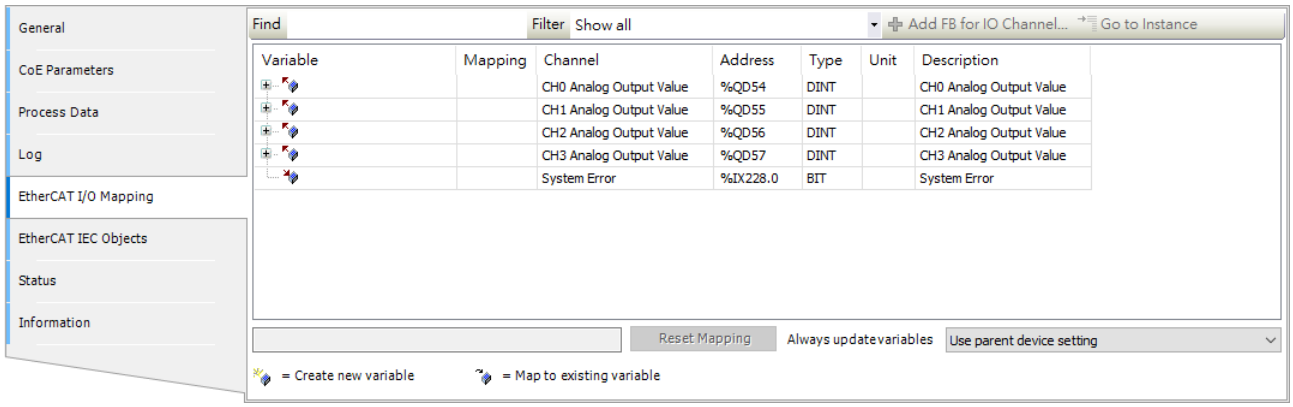
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.6.4.3 Process Data

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

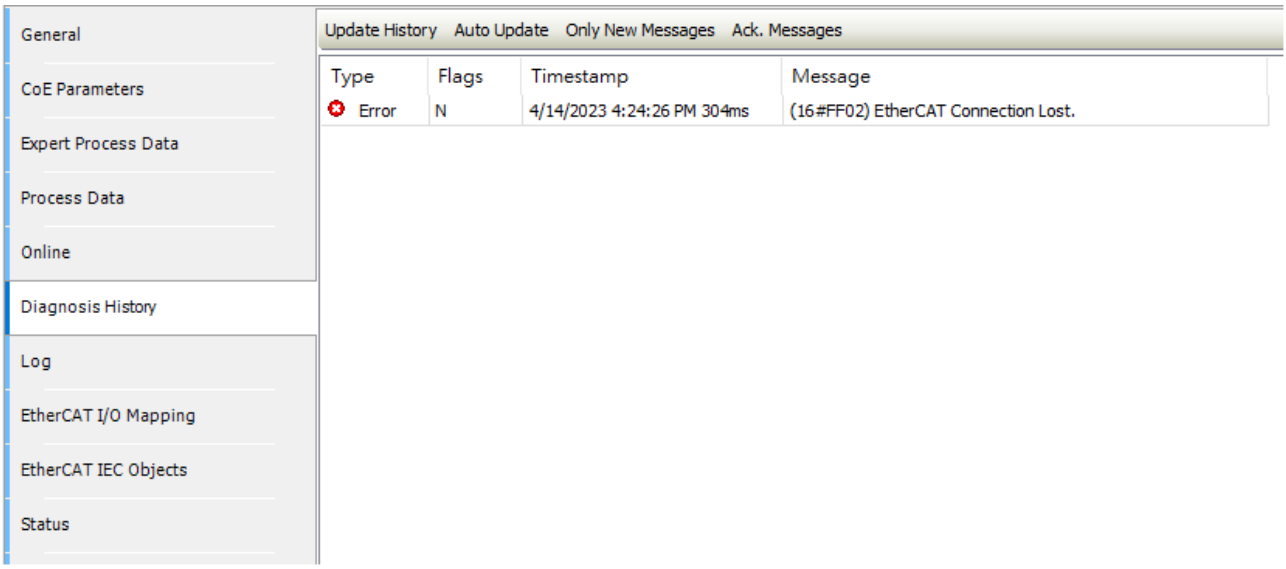


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



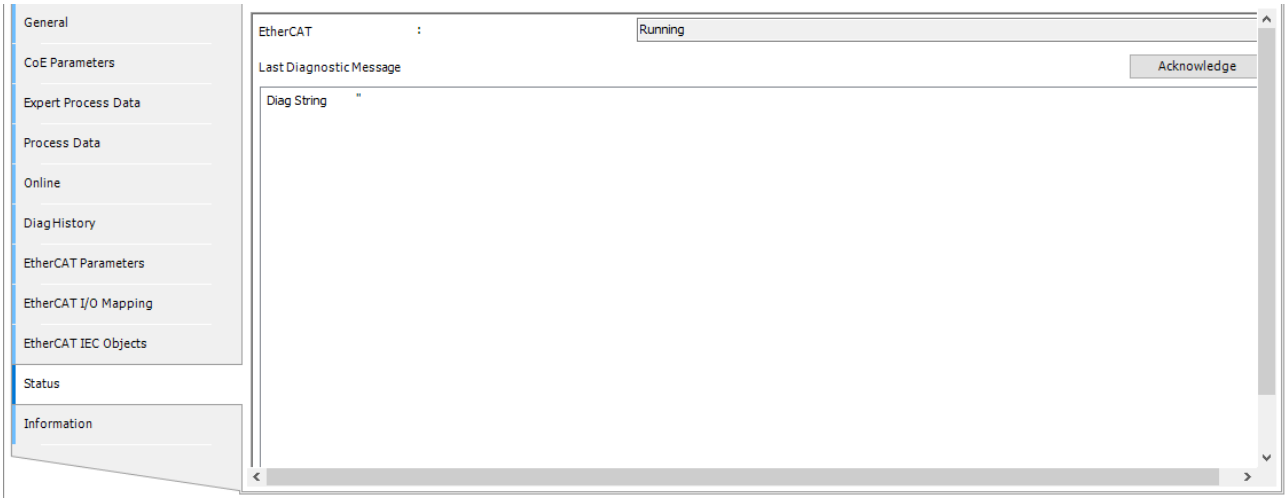
5.6.4.4 Diagnosis History

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



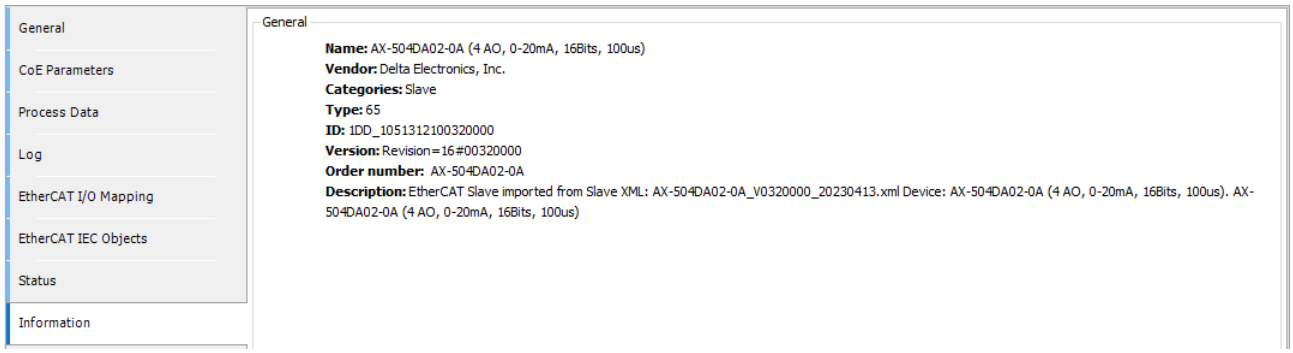
5.6.4.5 Status

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	0 to 20 mA	0 to 30000
2	4 to 20 mA	0 to 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	0.0
	16#02	CH1 Calibration Offset		REAL	RW	0.0
	16#03	CH2 Calibration Offset		REAL	RW	0.0
	16#04	CH3 Calibration Offset		REAL	RW	0.0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9 to 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 to 30000	DINT	RW	0
	16#02	CH1 Output Value Setting when EtherCAT Connection Lost DINT		DINT	RW	0
	16#03	CH2 Output Value Setting when EtherCAT Connection Lost DINT		DINT	RW	0
	16#04	CH3 Output Value Setting when EtherCAT Connection Lost DINT		DINT	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	REAL	RW	0.0
	16#02	CH1 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0
	16#03	CH2 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0
	16#04	CH3 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0

- **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 to 30000	DINT	RW	0
	16#02	CH1 Output Value Setting when Module in Stopped State DINT		DINT	RW	0
	16#03	CH2 Output Value Setting when Module in Stopped State DINT		DINT	RW	0
	16#04	CH3 Output Value Setting when Module in Stopped State DINT		DINT	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	REAL	RW	0.0
	16#02	CH1 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0
	16#03	CH2 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0
	16#04	CH3 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0

- **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

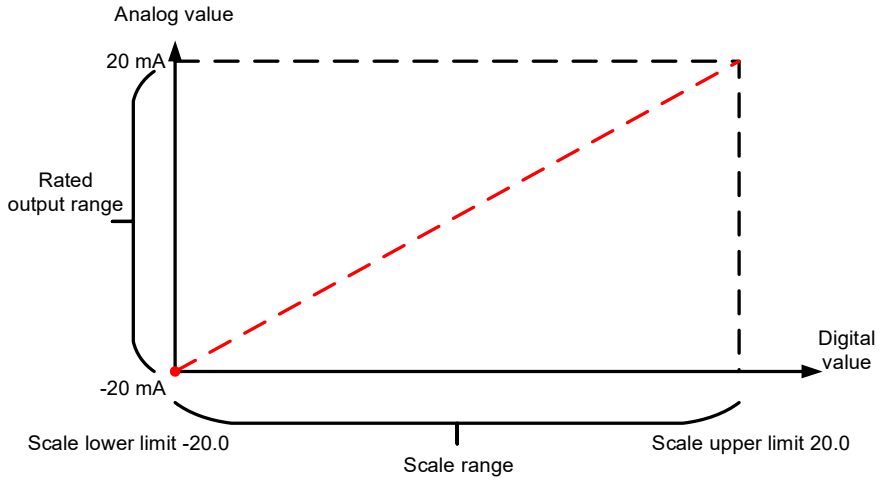
Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8030	16#01	CH0 Scale Upper Limit REAL	Scale upper limit setting; Setting range: no limit	REAL	RW	10.0
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	10.0
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	10.0
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	10.0
16#8031	16#01	CH0 Scale Lower Limit REAL	Scale lower limit setting; Setting range: no limit	REAL	RW	-10.0
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-10.0
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-10.0
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-10.0

- **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

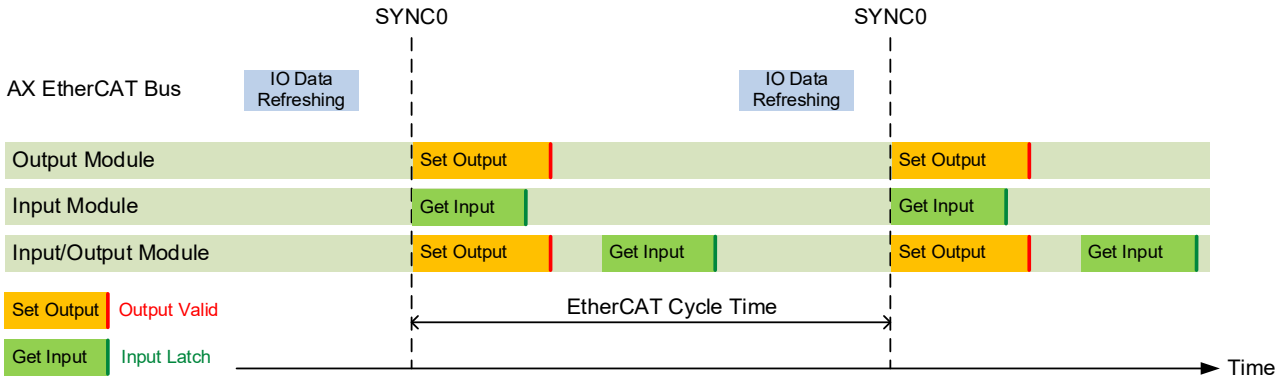
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

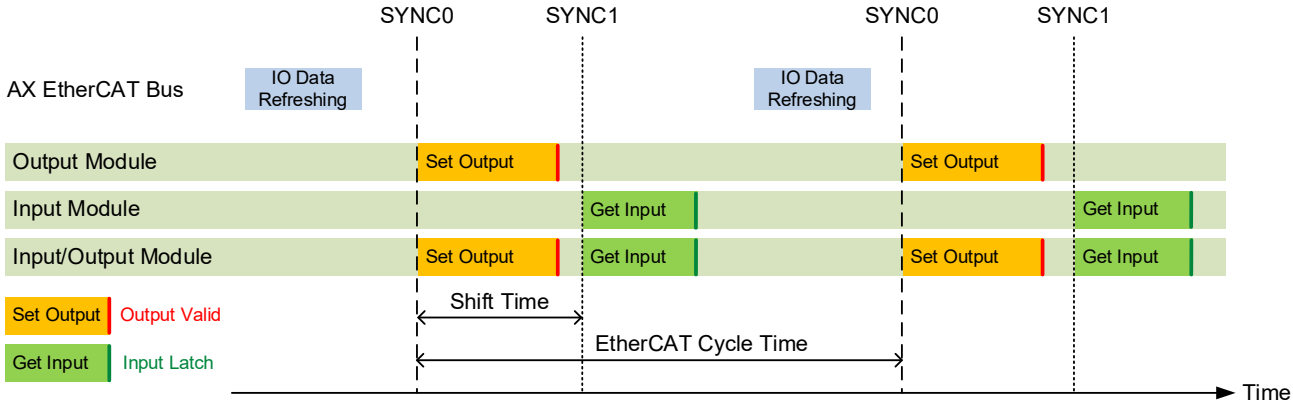
- **SYNC0**

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

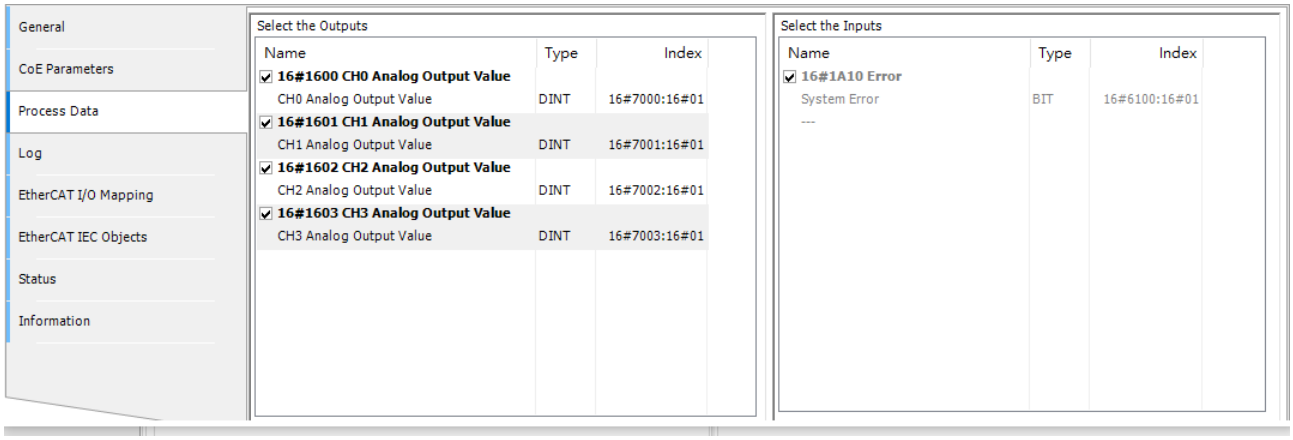
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#7000	16#01	CH0 Analog Output Value	Analog output value; Setting range: 0 to 30000	DINT	RW	0
16#7001	16#01	CH1 Analog Output Value		DINT	RW	0
16#7002	16#01	CH2 Analog Output Value		DINT	RW	0
16#7003	16#01	CH3 Analog Output Value		DINT	RW	0
16#6100	16#01	System Error	System error	BOOL	RO	0

5.6.7.1 Process Data

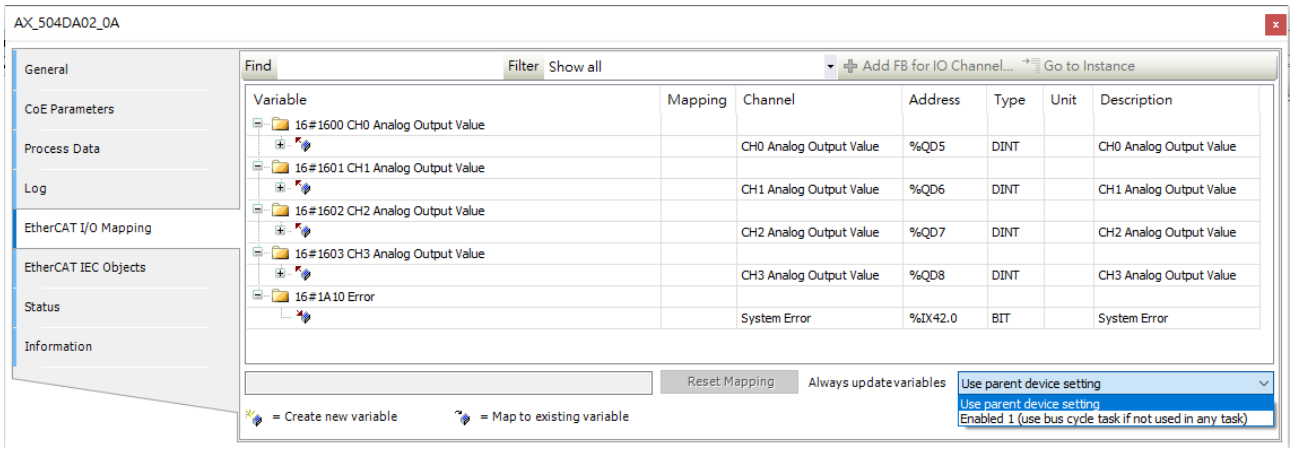
Go to the Process Data tab and select the data that you'd like to monitor.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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

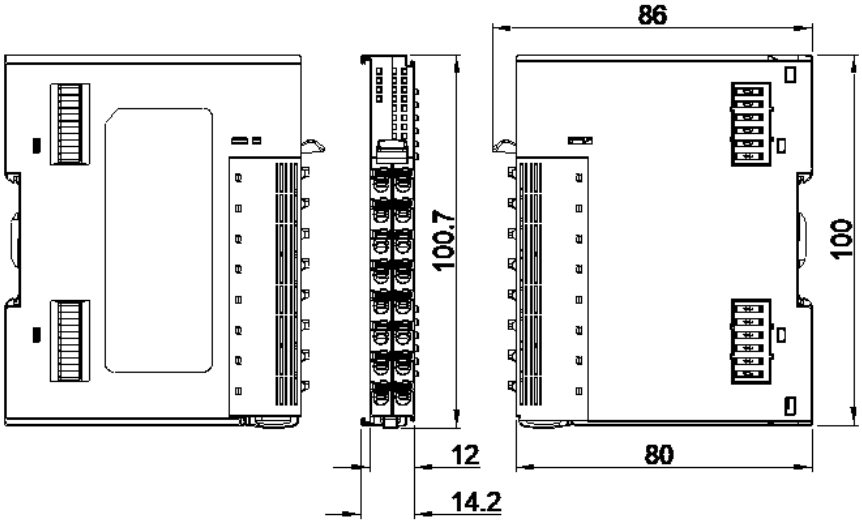
AX-508DA01-0A, an analog output module, receives 8 sets of 16-bit digital data from the PLC and converts the received digital signals into analog voltage signals, which are output through 8 output points. This section introduces its specifications, wirings and operations.

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 to 10 V
	Output conversion range	-5 to 105% (F.S.)
	Maximum load impedance	1 kΩ to 2 mΩ.
	Resolution	-10 to 10 V: 16 bits; 0 to 10 V: 15 bits; -5 to 5 V: 15 bits; 0 to 5 V: 14 bits; 1 to 5 V: 14 bits
	Accuracy	25°C: ±0.2% (F.S.) -20 to 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 640 mA (3.2 W)
	Minimum power consumption (I/O Power)	No power consumed
Others	Connection Lost Detection	N/A
	Short Circuit Detection (SCD)	N/A
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	N/A
	Filter function	N/A

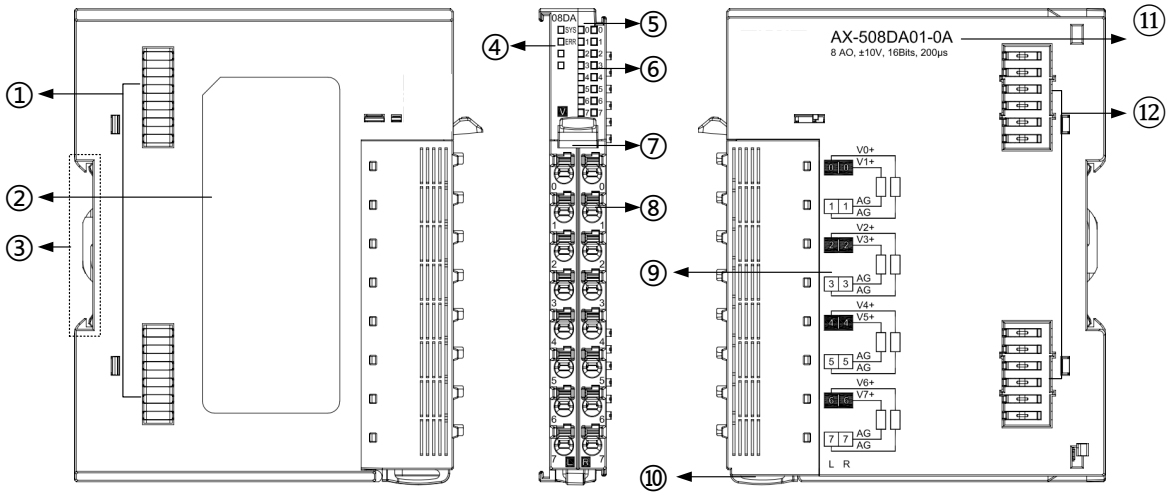
5.7.2 Dimensions and Parts

- **Dimensions**



Unit: mm

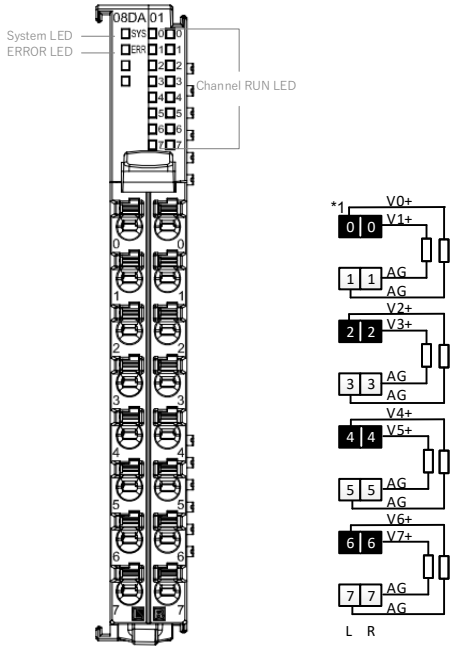
- **Parts**



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.

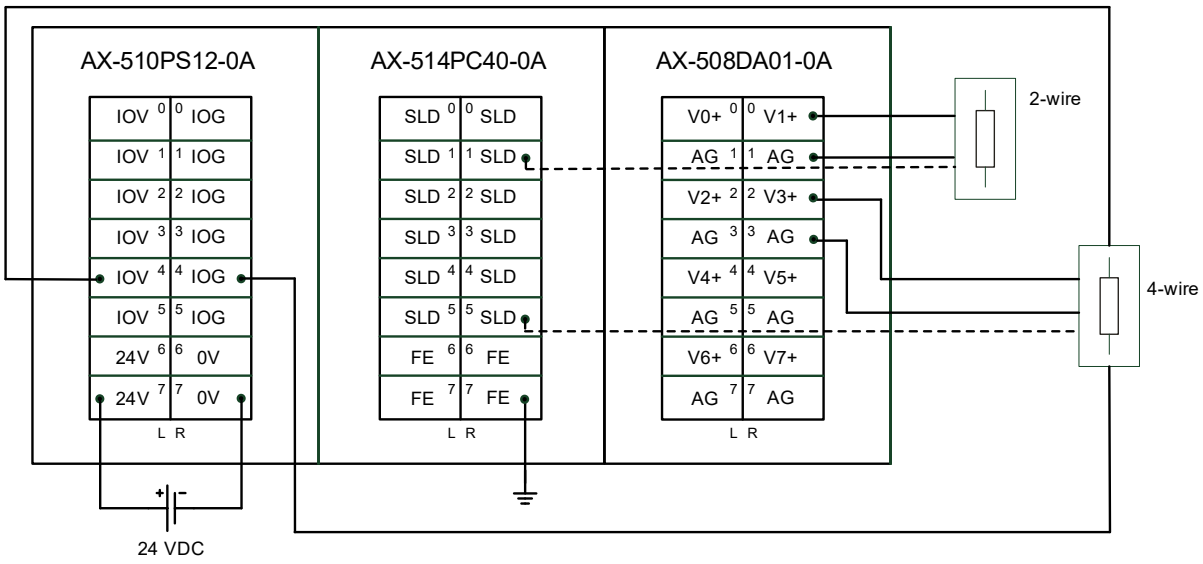
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	V0+	Channel 0: output voltage	R0	V1+	Channel 1: output voltage
L1	AG		R1	AG	
L2	V2+	Channel 2: output voltage	R2	V3+	Channel 3: output voltage
L3	AG		R3	AG	
L4	V4+	Channel 4: output voltage	R4	V5+	Channel 5: output voltage
L5	AG	--	R5	AG	--
L6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

5.7.3.2 LED Indicators

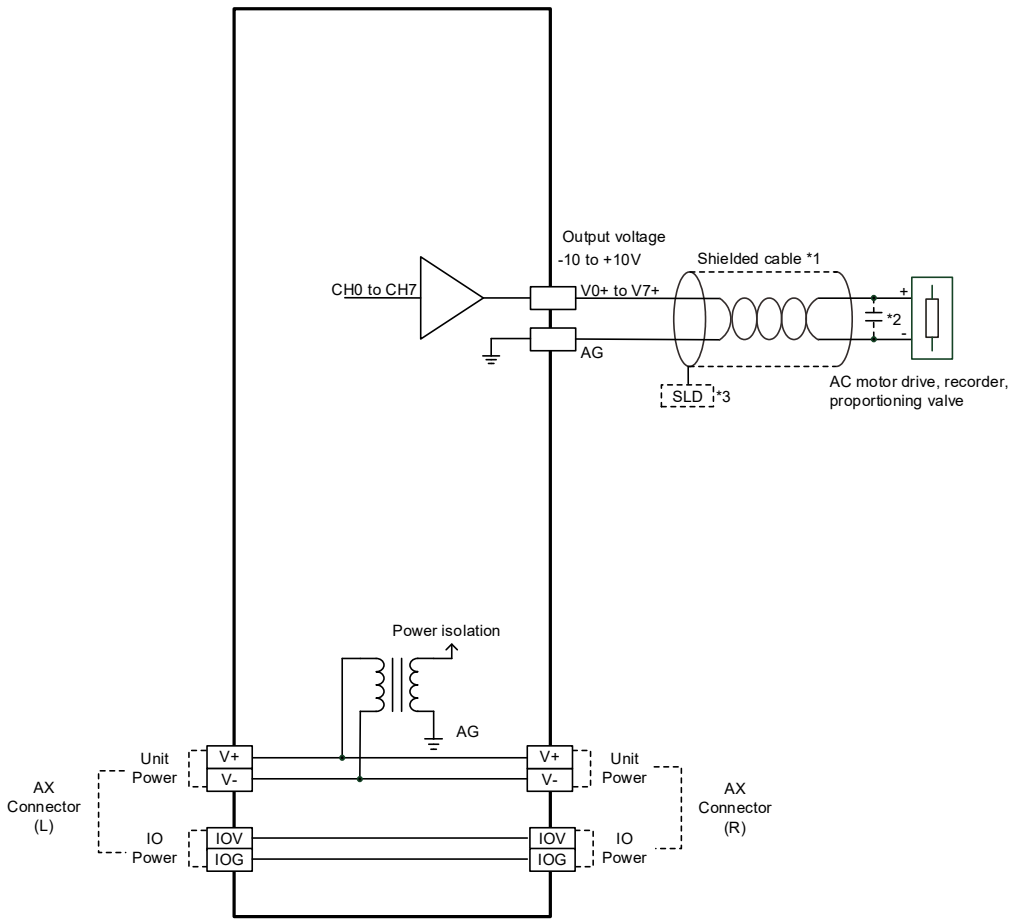
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2 s)	ECAT Pre OP
			Blinking (1 s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1 s)	An error occurs on the application.
			Blinking (0.2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

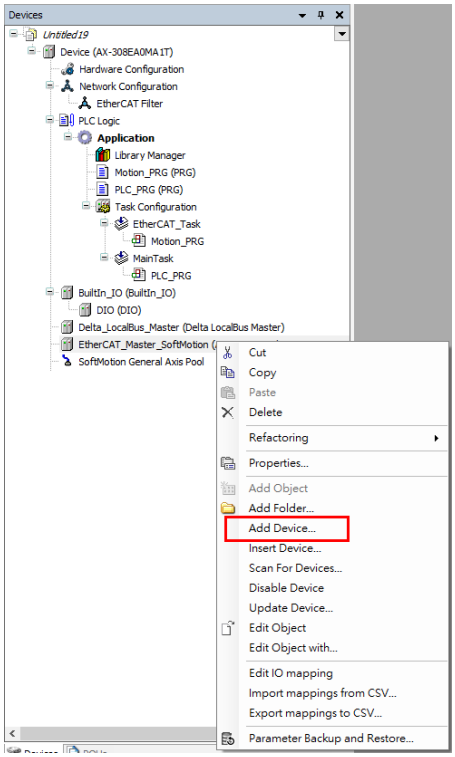
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



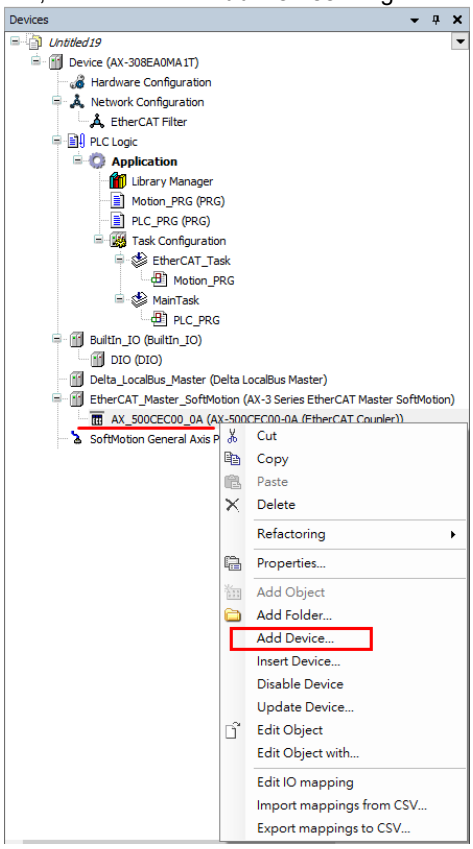
(2) Add Modules in

- 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.

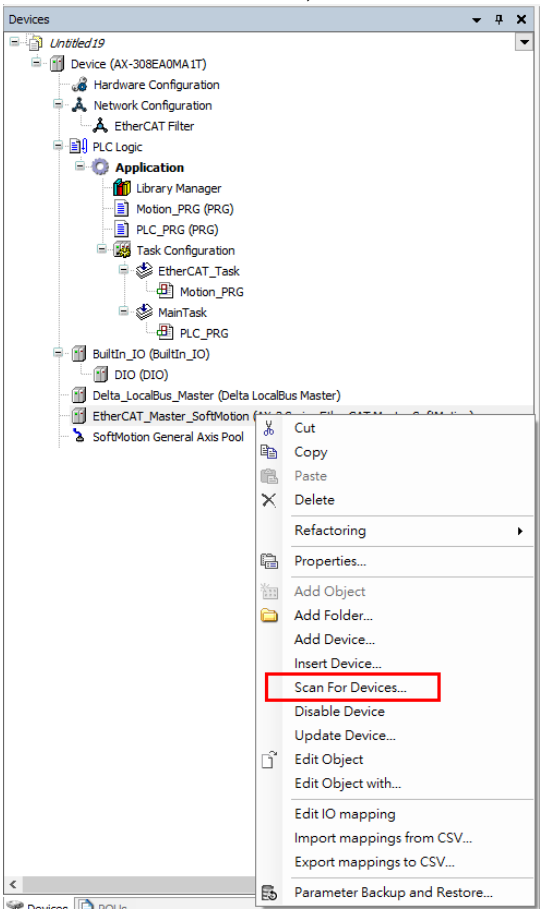


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

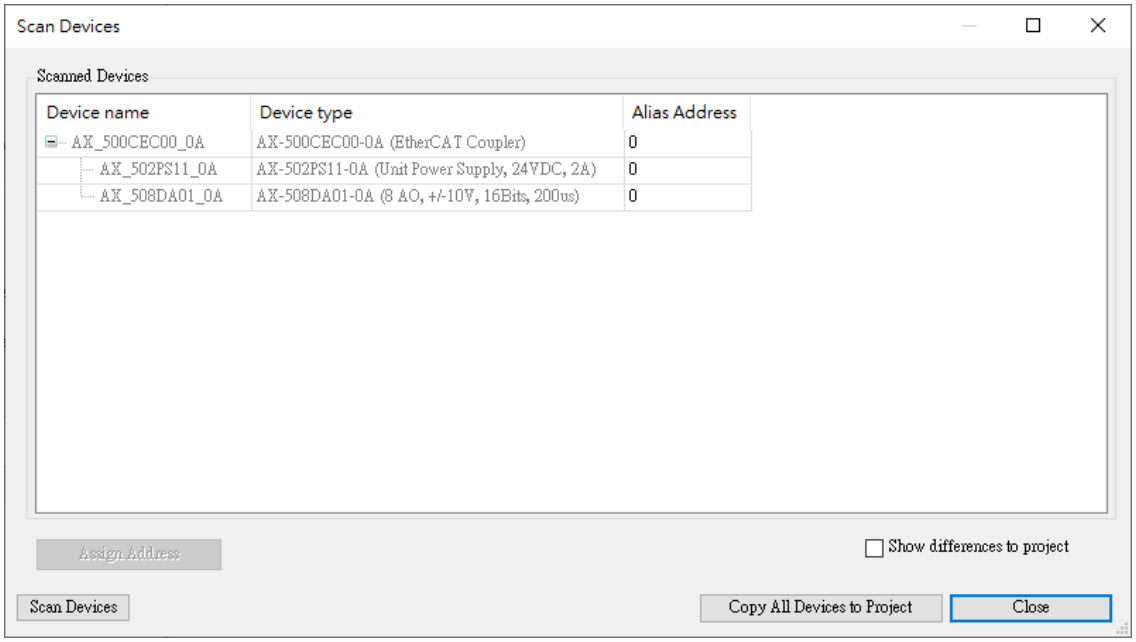


- Method 2: Scan to add the modules in.

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

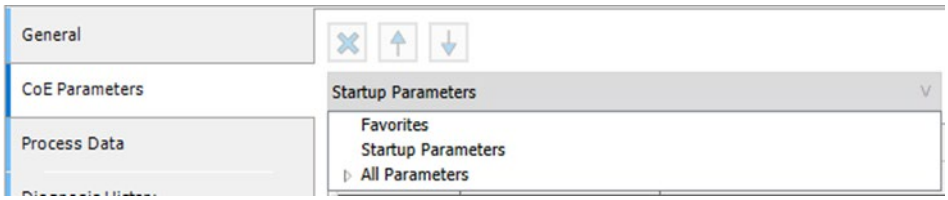


After the auto-scan is over, the actually connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



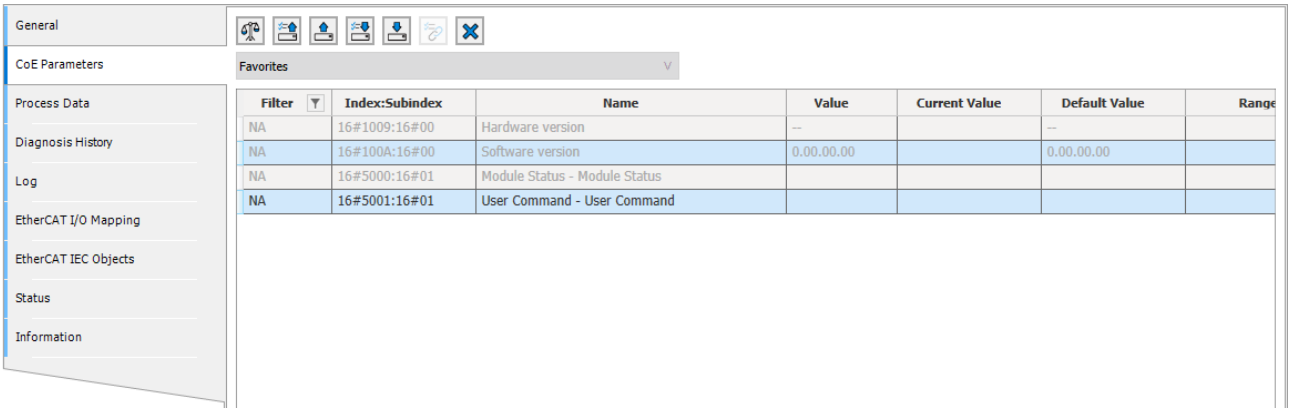
5.7.4.2 Parameter Settings

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



(1) Favorites

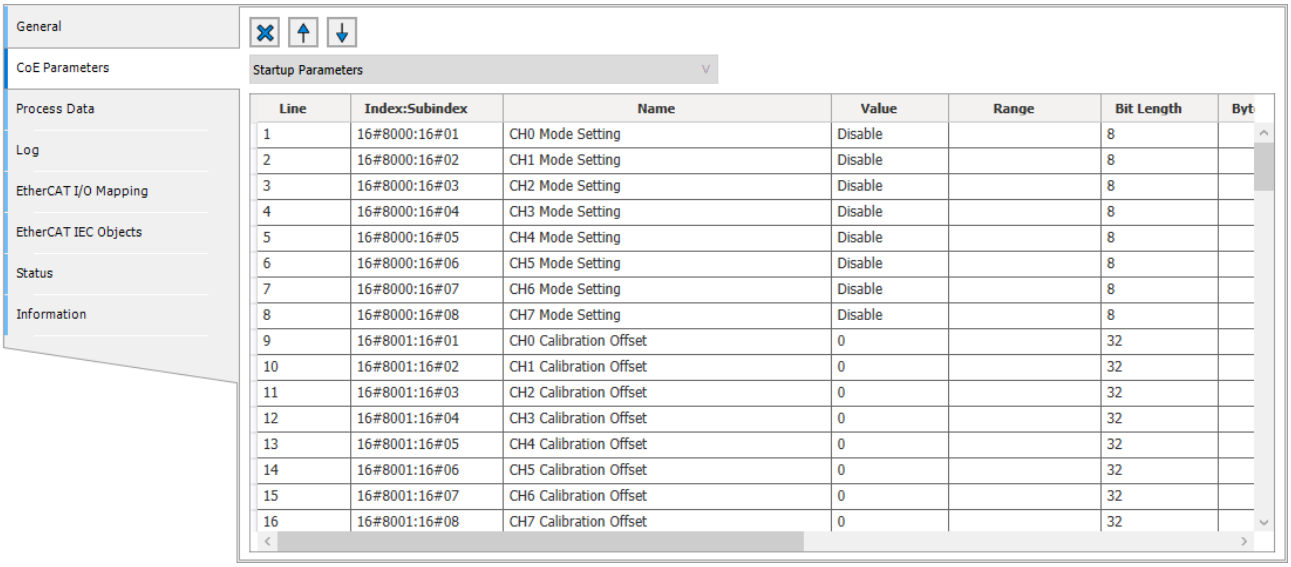
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

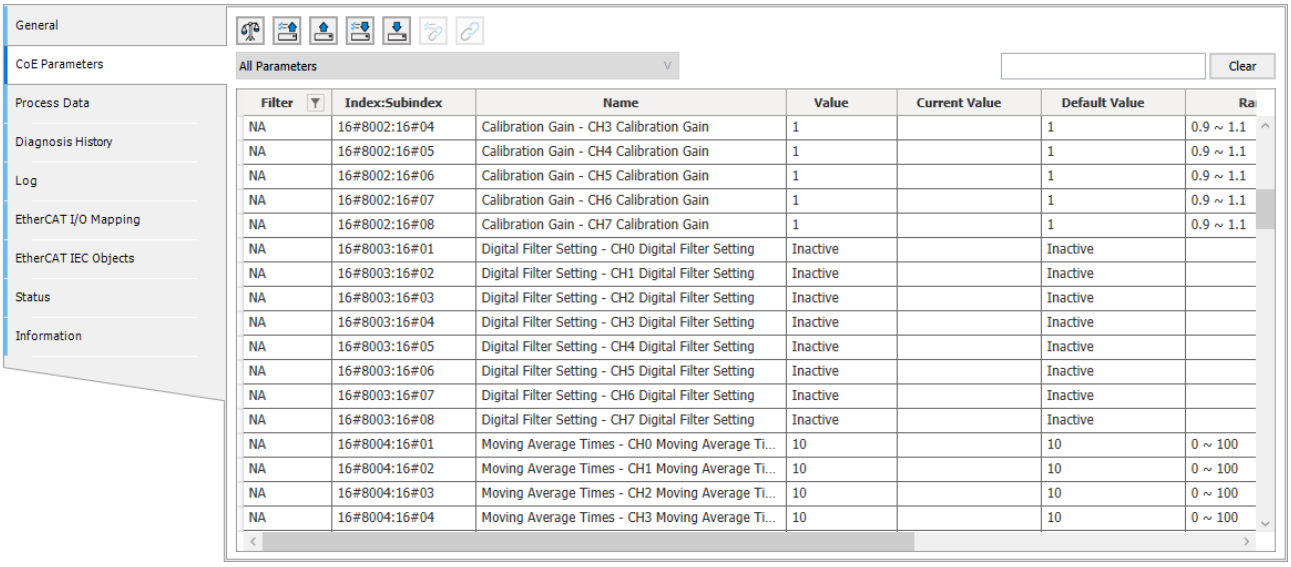


Line	Index:Subindex	Name	Value	Range	Bit Length	Byt
1	16#8000:16#01	CH0 Mode Setting	Disable		8	
2	16#8000:16#02	CH1 Mode Setting	Disable		8	
3	16#8000:16#03	CH2 Mode Setting	Disable		8	
4	16#8000:16#04	CH3 Mode Setting	Disable		8	
5	16#8000:16#05	CH4 Mode Setting	Disable		8	
6	16#8000:16#06	CH5 Mode 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

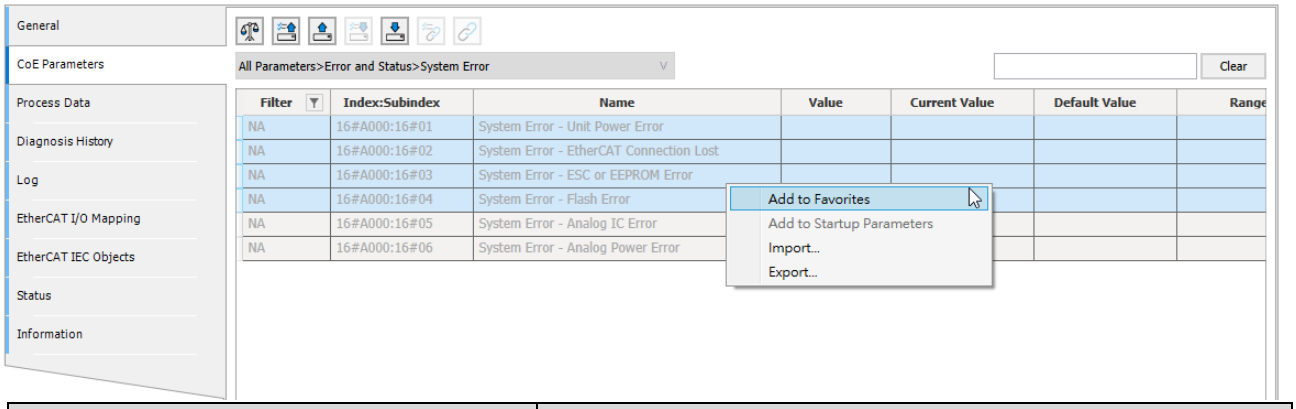
(3) All Parameters

- 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.



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.

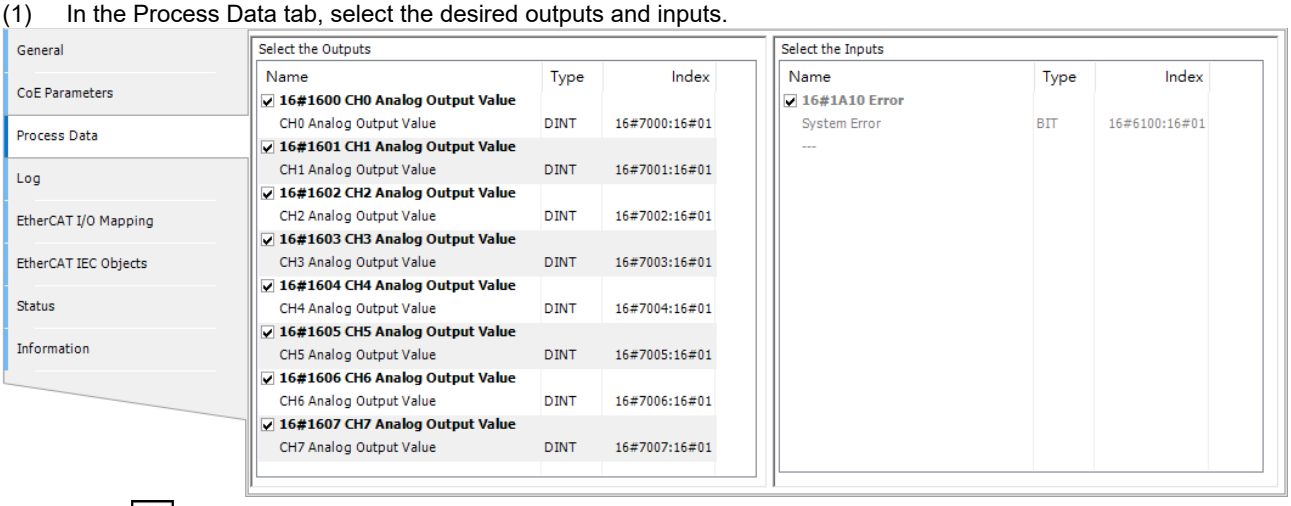
- You can select and right-click the parameter to add the selected parameter to the Favorites.



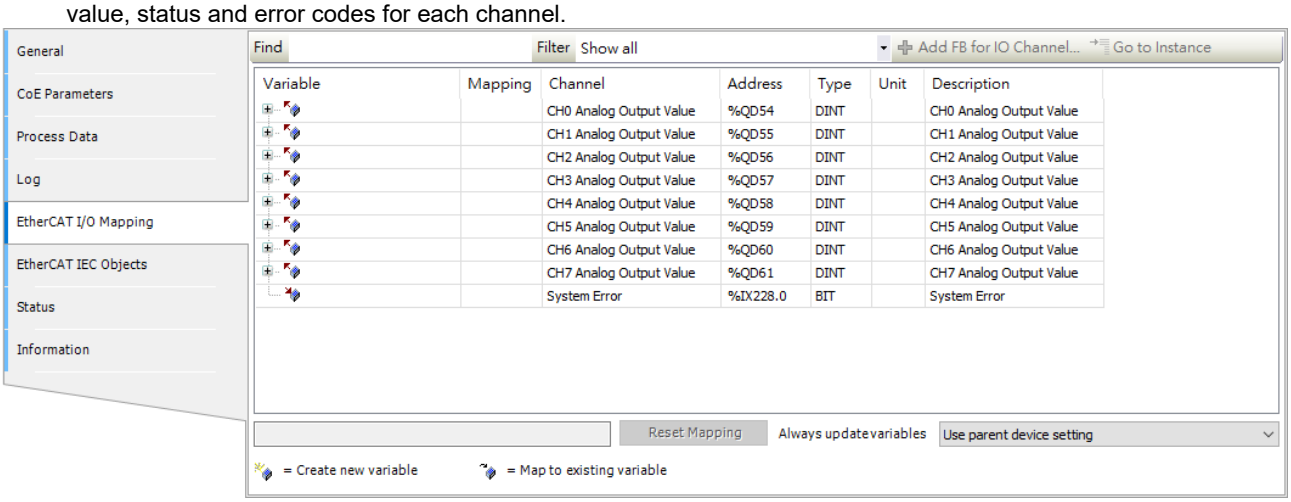
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.7.4.3 Process Data

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

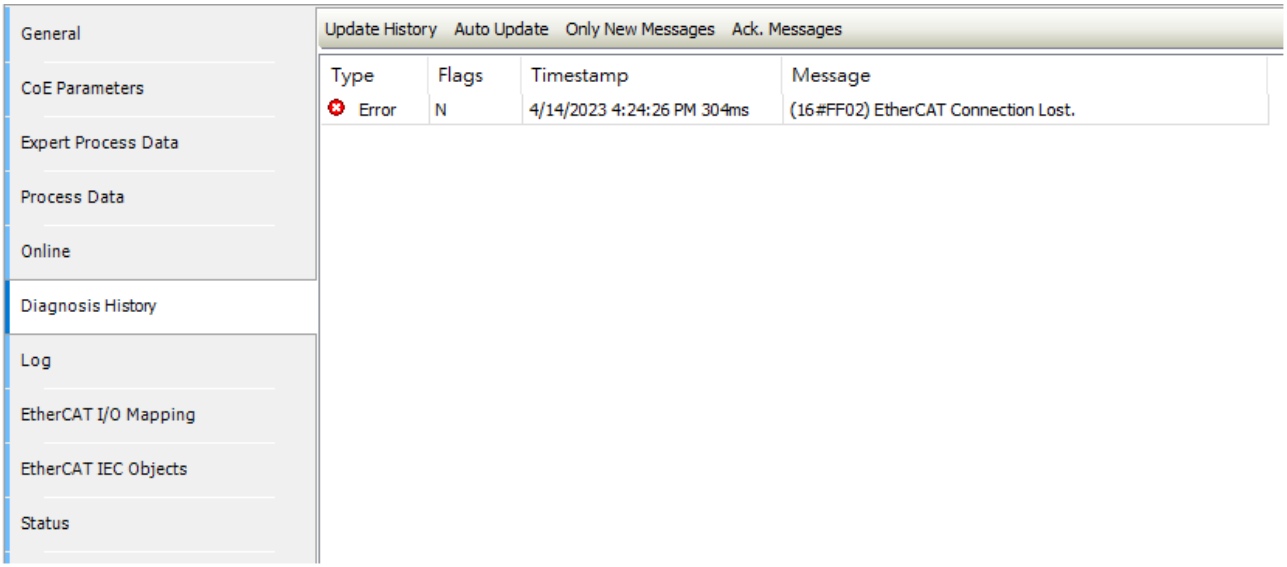


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



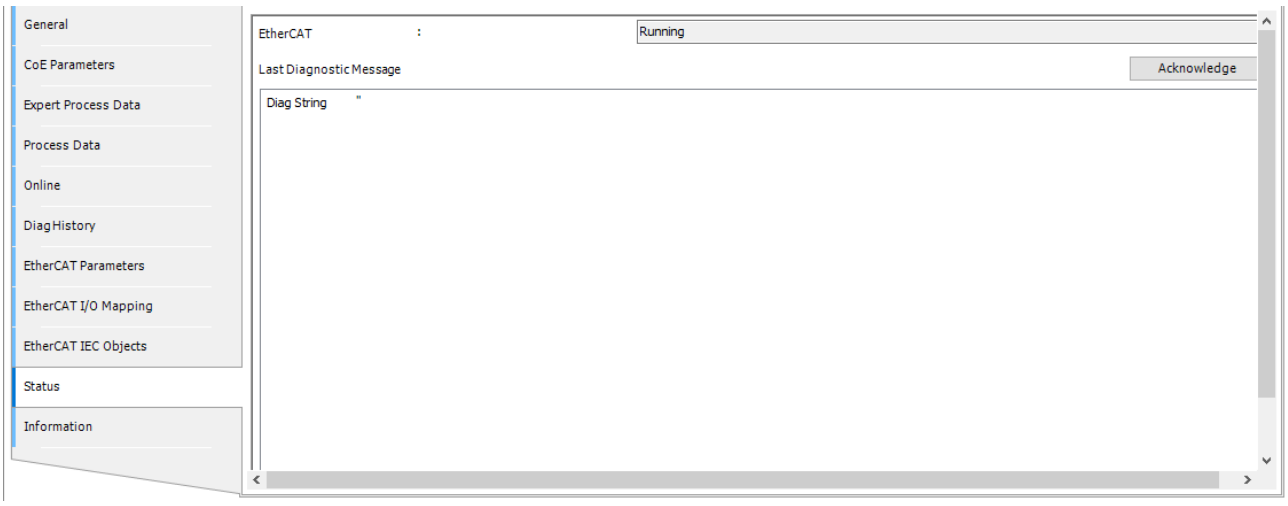
5.7.4.4 Diagnosis History

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



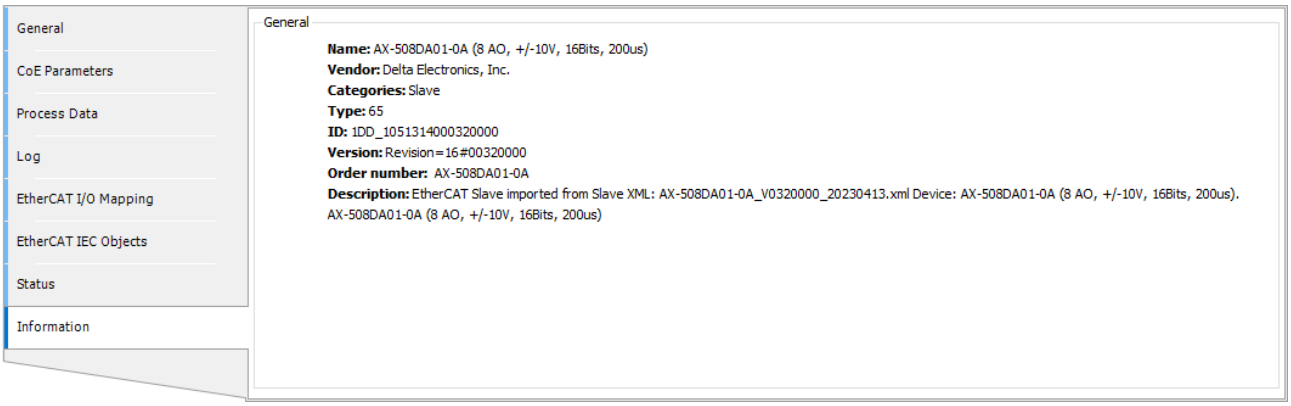
5.7.4.5 Status

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 to 10 V	±30000
2	0 to 10 V	0 to 30000
3	-5 to 5 V	±30000
4	0 to 5 V	0 to 30000
5	1 to 5 V	0 to 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	0.0
	16#02	CH1 Calibration Offset		REAL	RW	0.0
	16#03	CH2 Calibration Offset		REAL	RW	0.0
	16#04	CH3 Calibration Offset		REAL	RW	0.0
	16#05	CH4 Calibration Offset		REAL	RW	0.0
	16#06	CH5 Calibration Offset		REAL	RW	0.0
	16#07	CH6 Calibration Offset		REAL	RW	0.0
	16#08	CH7 Calibration Offset		REAL	RW	0.0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9 to 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 to 30000	DINT	RW	0
	16#02	CH1 Output Value Setting when EtherCAT Connection Lost DINT		DINT	RW	0
	16#03	CH2 Output Value Setting when EtherCAT Connection Lost DINT		DINT	RW	0
	16#04	CH3 Output Value Setting when EtherCAT Connection Lost DINT		DINT	RW	0
	16#05	CH4 Output Value Setting when EtherCAT Connection Lost DINT		DINT	RW	0
	16#06	CH5 Output Value Setting when EtherCAT Connection Lost DINT		DINT	RW	0
	16#07	CH6 Output Value Setting when EtherCAT Connection Lost DINT		DINT	RW	0
	16#08	CH7 Output Value Setting when EtherCAT Connection Lost DINT		DINT	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	REAL	RW	0.0
	16#02	CH1 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0
	16#03	CH2 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0
	16#04	CH3 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0

Index	Subindex	Name	Description	Data Type	Attr.	Default
	16#05	CH4 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0
	16#06	CH5 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0
	16#07	CH6 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0
	16#08	CH7 Output Value Settings when EtherCAT Connection Lost REAL		REAL	RW	0.0

- **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 to 30000	DINT	RW	0
	16#02	CH1 Output Value Setting when Module in Stopped State DINT		DINT	RW	0
	16#03	CH2 Output Value Setting when Module in Stopped State DINT		DINT	RW	0
	16#04	CH3 Output Value Setting when Module in Stopped State DINT		DINT	RW	0
	16#05	CH4 Output Value Setting when Module in Stopped State DINT		DINT	RW	0
	16#06	CH5 Output Value Setting when Module in Stopped State DINT		DINT	RW	0
	16#07	CH6 Output Value Setting when Module in Stopped State DINT		DINT	RW	0
	16#08	CH7 Output Value Setting when Module in Stopped State DINT		DINT	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	REAL	RW	0.0
	16#02	CH1 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0
	16#03	CH2 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0
	16#04	CH3 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0

Index	Subindex	Name	Description	Data Type	Attr.	Default
	16#05	CH0 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0
	16#06	CH1 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0
	16#07	CH2 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0
	16#08	CH3 Output Value Settings when Module in Stopped State REAL		REAL	RW	0.0

- **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

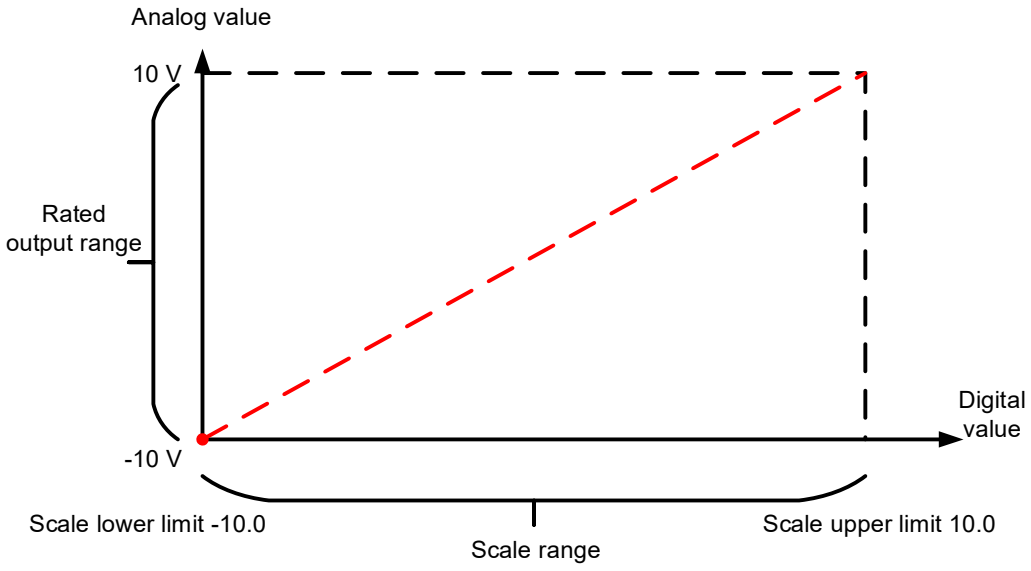
Index	Subindex	Name	Description	Data Type	Attr.	Default
16#8030	16#01	CH0 Scale Upper Limit REAL	Scale upper limit setting; Setting range: no limit	REAL	RW	10.0
	16#02	CH1 Scale Upper Limit REAL		REAL	RW	10.0
	16#03	CH2 Scale Upper Limit REAL		REAL	RW	10.0
	16#04	CH3 Scale Upper Limit REAL		REAL	RW	10.0
	16#05	CH4 Scale Upper Limit REAL		REAL	RW	10.0
	16#06	CH5 Scale Upper Limit REAL		REAL	RW	10.0
	16#07	CH6 Scale Upper Limit REAL		REAL	RW	10.0
	16#08	CH7 Scale Upper Limit REAL		REAL	RW	10.0
16#8031	16#01	CH0 Scale Lower Limit REAL	Scale lower limit setting; Setting range: no limit	REAL	RW	-10.0
	16#02	CH1 Scale Lower Limit REAL		REAL	RW	-10.0
	16#03	CH2 Scale Lower Limit REAL		REAL	RW	-10.0
	16#04	CH3 Scale Lower Limit REAL		REAL	RW	-10.0
	16#05	CH0 Scale Lower Limit REAL		REAL	RW	-10.0
	16#06	CH1 Scale Lower Limit REAL		REAL	RW	-10.0
	16#07	CH2 Scale Lower Limit REAL		REAL	RW	-10.0
	16#08	CH3 Scale Lower Limit REAL		REAL	RW	-10.0

- **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 to +10 V, the analog range is -10 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 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

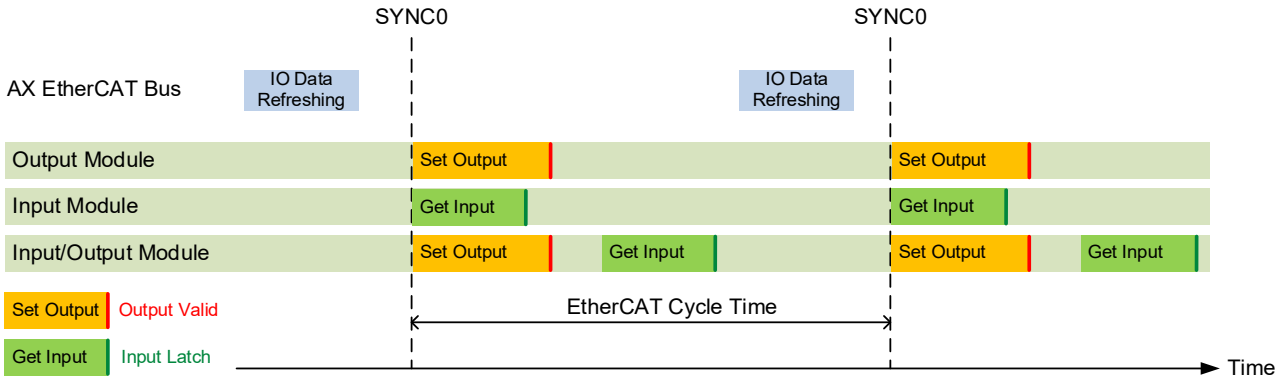
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

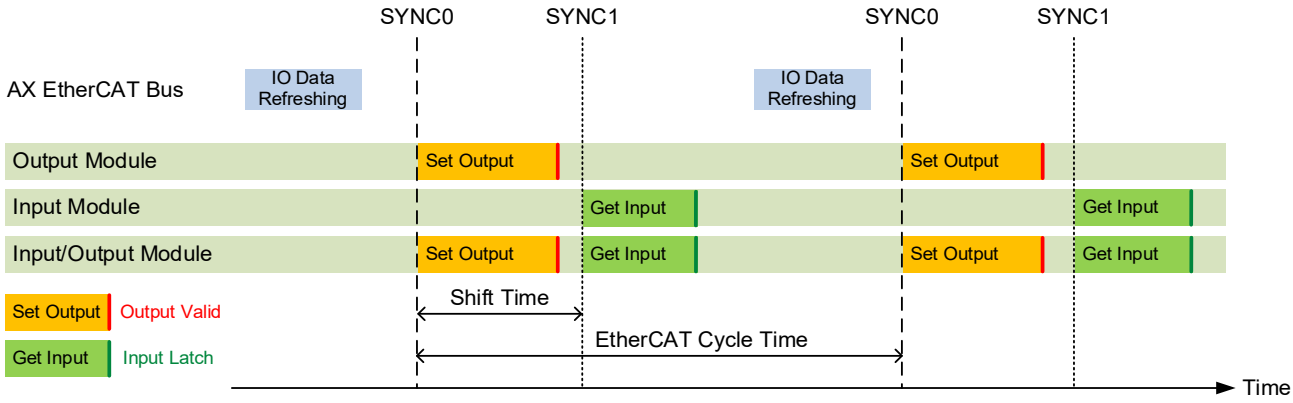
- **SYNC0**

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

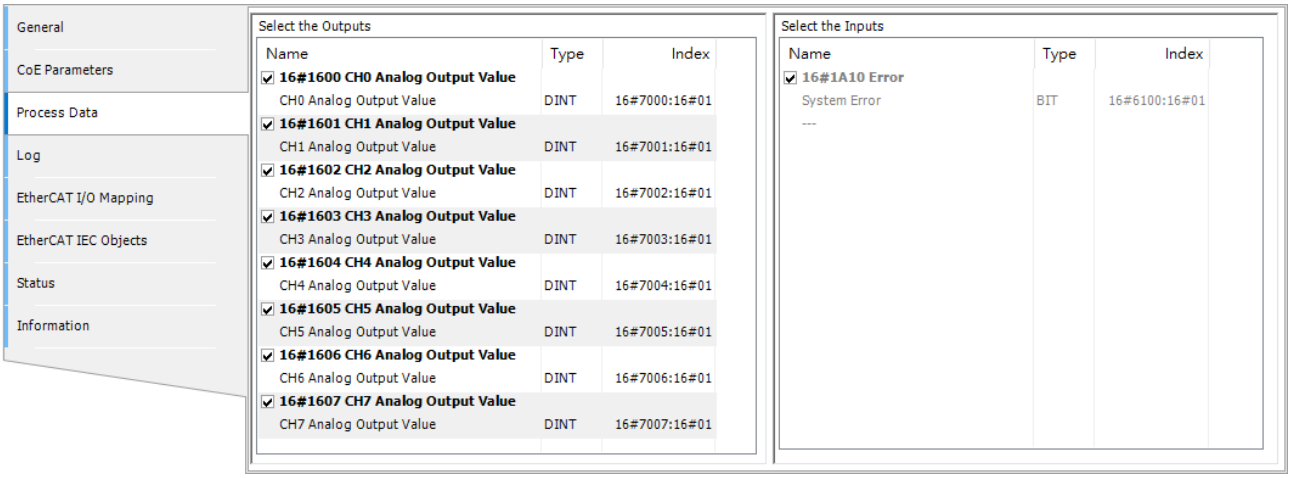
This section introduces the settings and monitoring of PDO data exchange.

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#7000	16#01	CH0 Analog Output Value	Analog output value; Setting range: -30000 to 30000	DINT	RW	0
16#7001	16#01	CH1 Analog Output Value		DINT	RW	0
16#7002	16#01	CH2 Analog Output Value		DINT	RW	0
16#7003	16#01	CH3 Analog Output Value		DINT	RW	0
16#7004	16#01	CH4 Analog Output Value		DINT	RW	0
16#7005	16#01	CH5 Analog Output Value		DINT	RW	0
16#7006	16#01	CH6 Analog Output Value		DINT	RW	0
16#7007	16#01	CH7 Analog Output Value		DINT	RW	0
16#6100	16#01	System Error	System error	BOOL	RO	0

5.7.7.1 Process Data

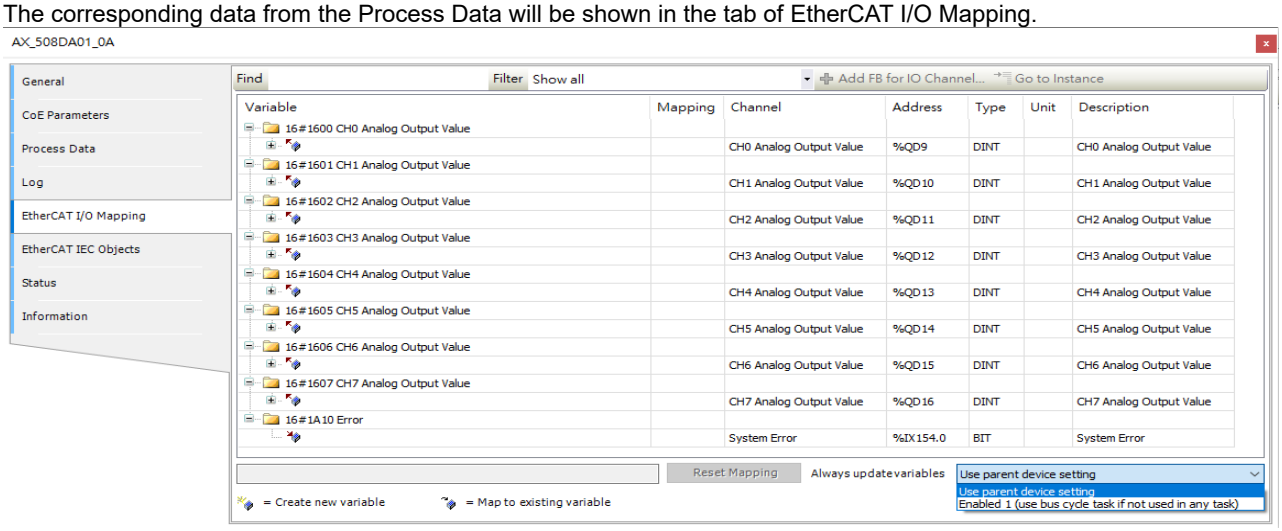
Go to the Process Data tab and select the data that you'd like to monitor.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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%: 25ºC (F.S.) ([*2], [*3]) ±0.5%: 0 to 60ºC (F.S.) ±1%: <-20 to 0ºC (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	±1.2ºC
	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 Detection	Yes
	Short Circuit Detection (SCD)	N/A
	Input power protection (voltage range)	±30 V
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	N/A
	Filter function	AVG, FIR, IIR

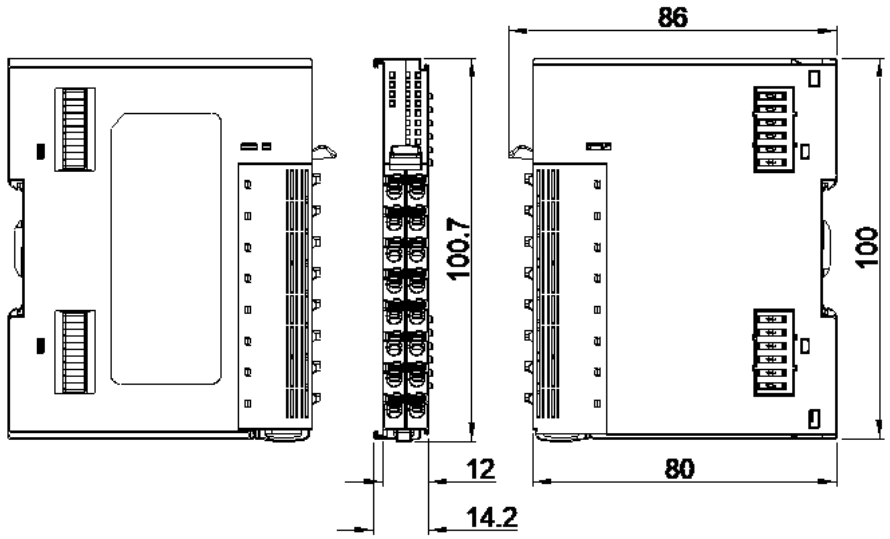
*1. The temperature unit is 0.1°C/0.18°F. If Fahrenheit is selected as the temperature unit, the second decimal place is not displayed.

*2. T: -200°C to 100°C (±0.35%)

*3. B: 200°C to 300°C (±0.4%)

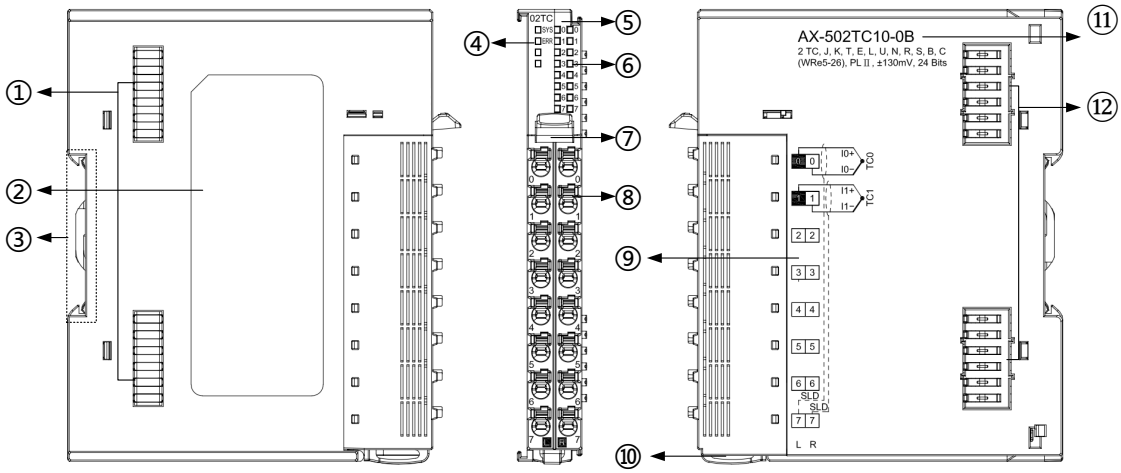
5.8.2 Dimensions and Parts

- **Dimensions**



Unit: mm

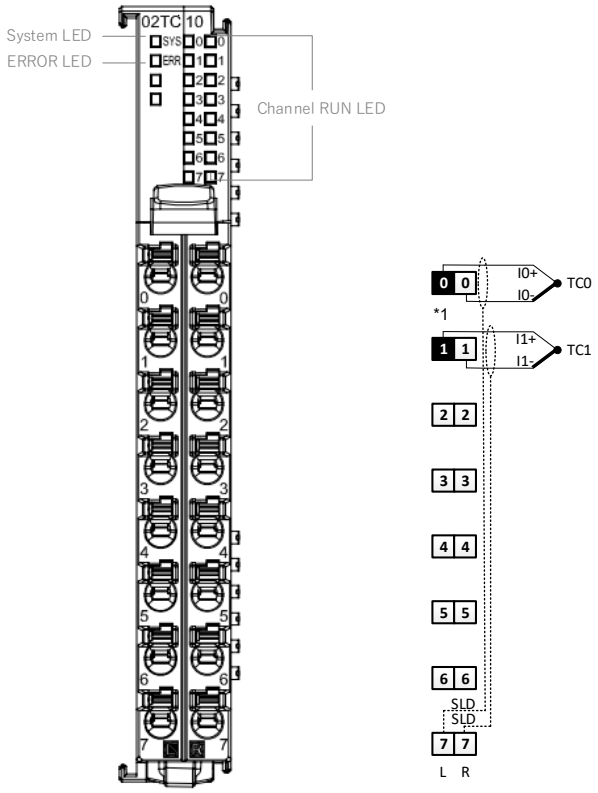
- **Parts**



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.

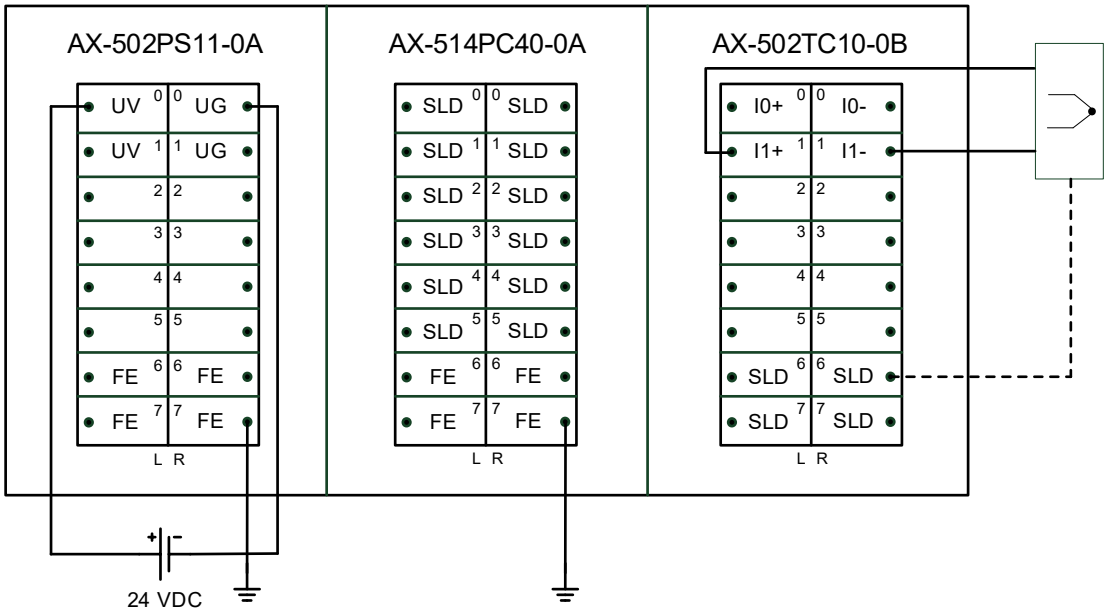
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0+	Channel 0: sensor positive input	R0	I0-	Channel 0: sensor negative input
L1	I1+	Channel 1: sensor positive input	R1	I1-	Channel 1: sensor negative input
L2	--	--	R2	--	--
L3	--	--	R3	--	--
L4	--	--	R4	--	--
L5	--	--	R5	--	--
L6	--	--	R6	--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

5.8.3.2 LED Indicators

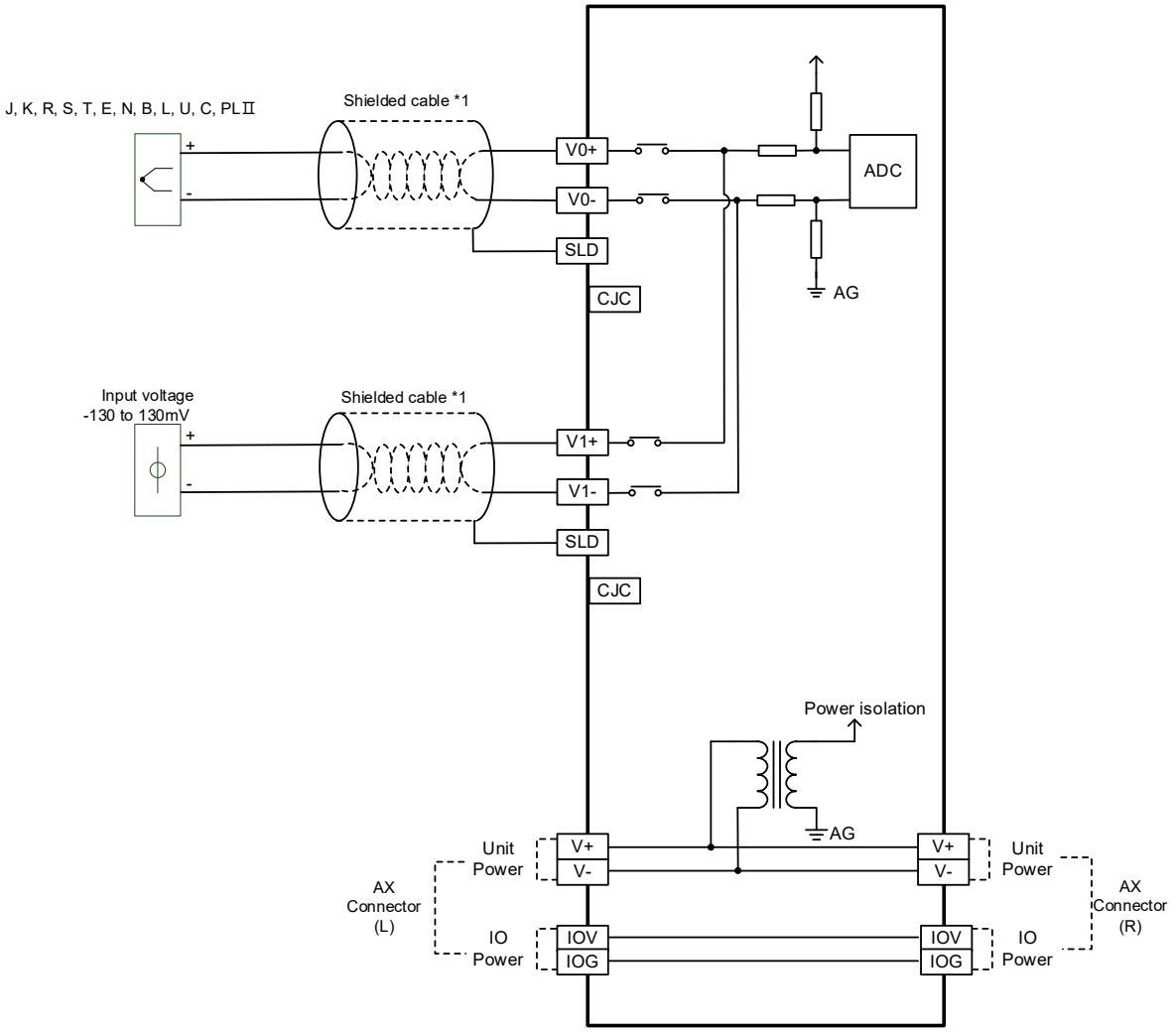
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2 s)	ECAT Pre OP
			Blinking (1 s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1 s)	An error occurs on the application.
			Blinking (0.2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

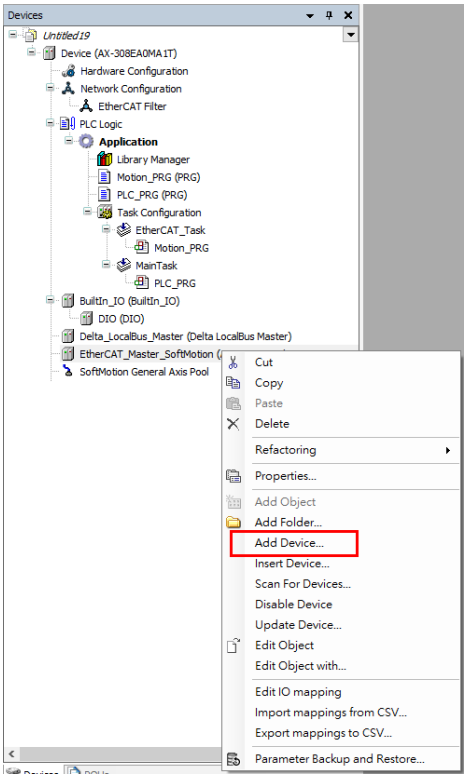
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



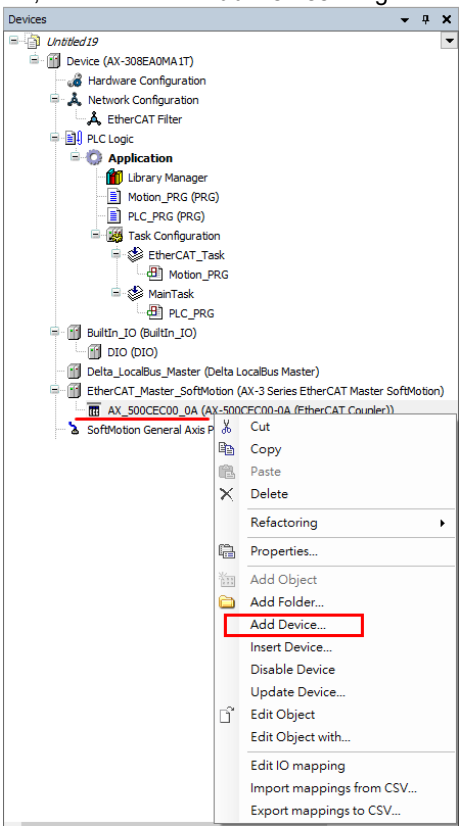
(2) Add Modules in

- 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.

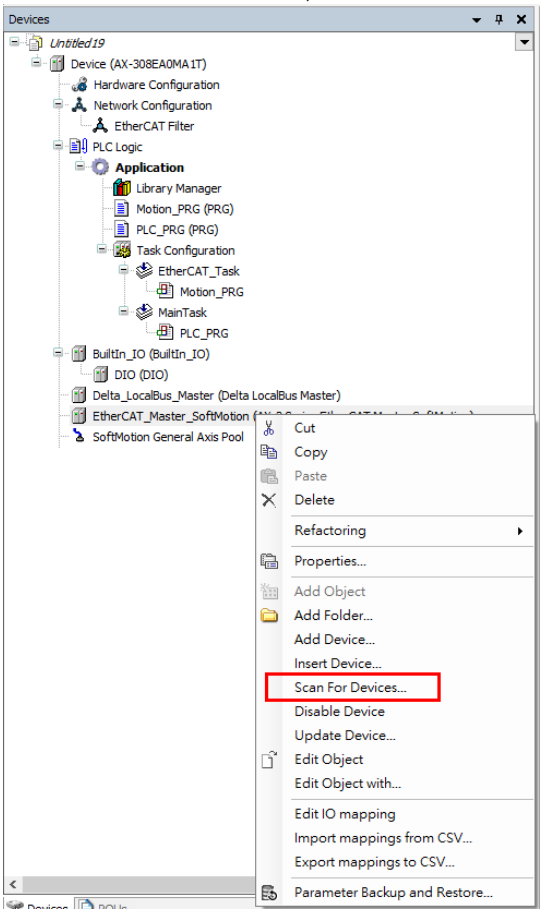


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

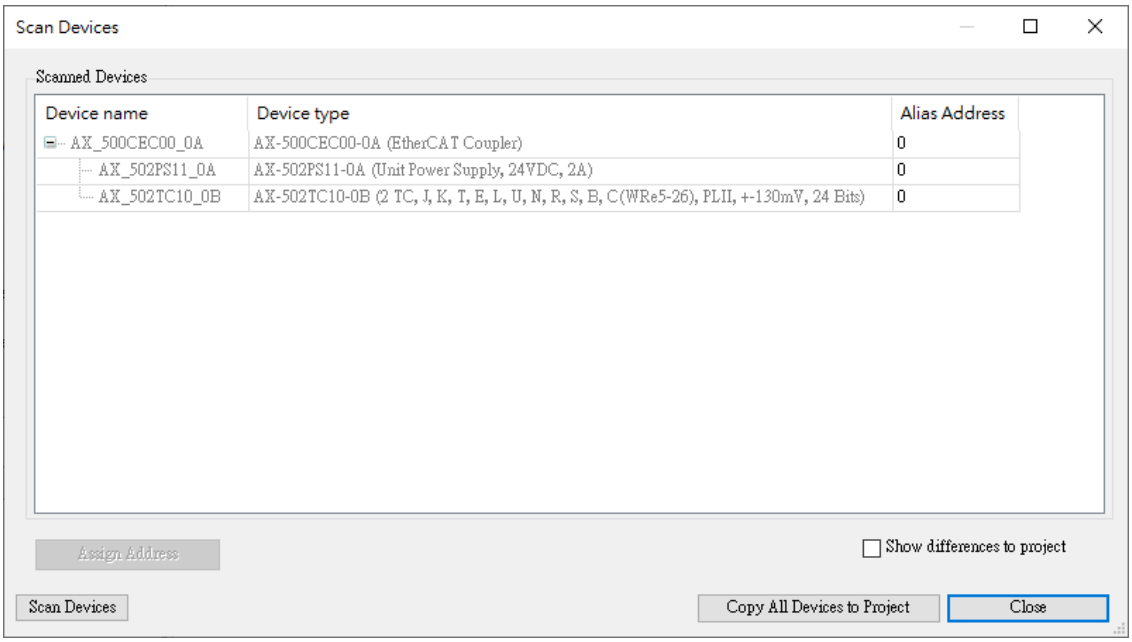


- Method 2: Scan to add the modules in.

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

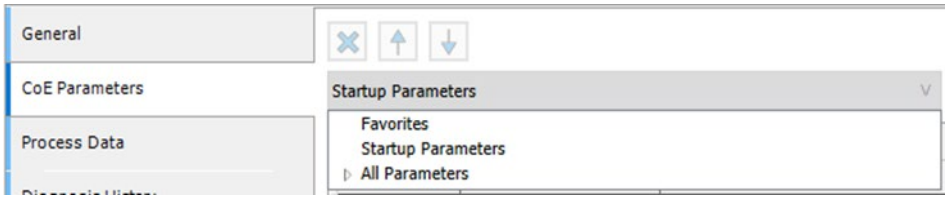


After the auto-scan is over, the actually connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



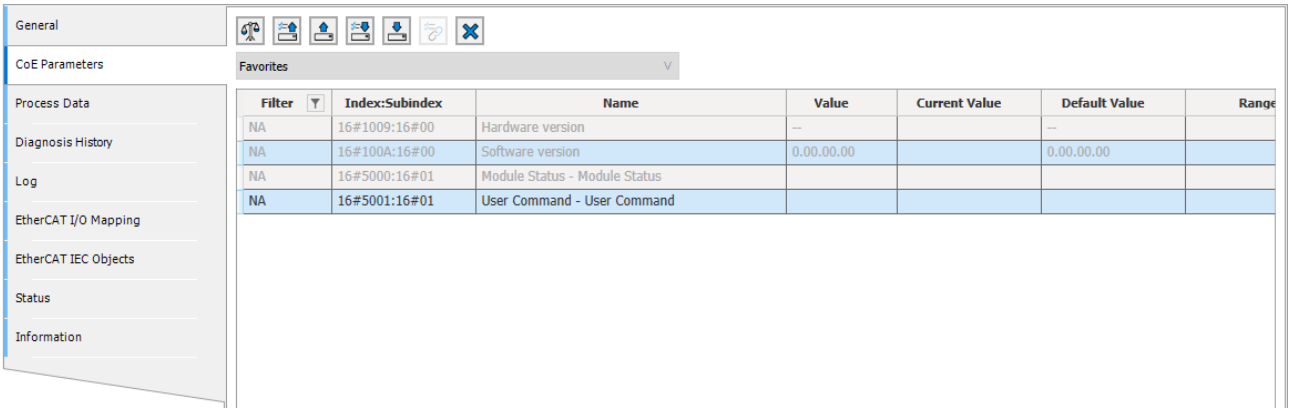
5.8.4.2 Parameter Settings

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



(1) Favorites

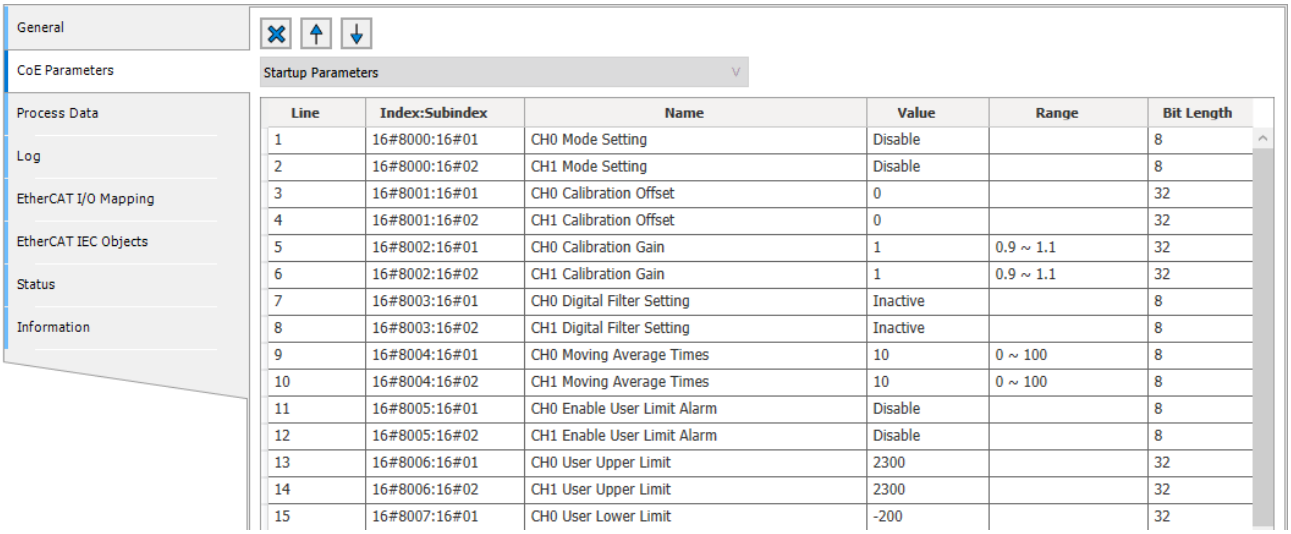
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

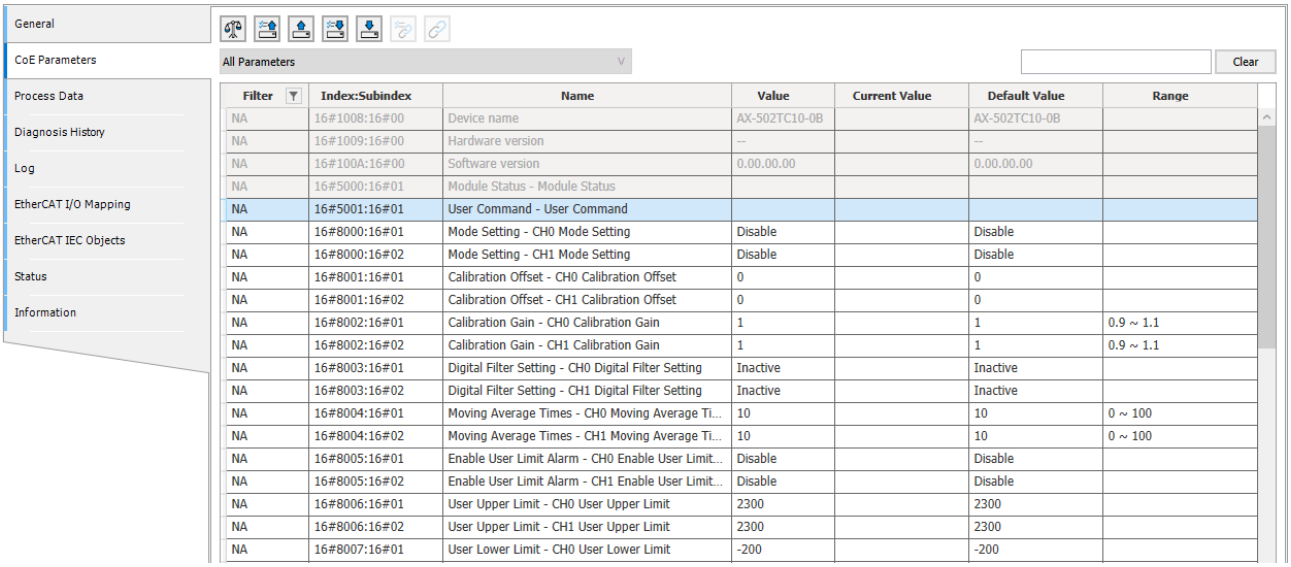


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8001:16#01	CH0 Calibration Offset	0		32
4	16#8001:16#02	CH1 Calibration Offset	0		32
5	16#8002:16#01	CH0 Calibration Gain	1	0.9 ~ 1.1	32
6	16#8002:16#02	CH1 Calibration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

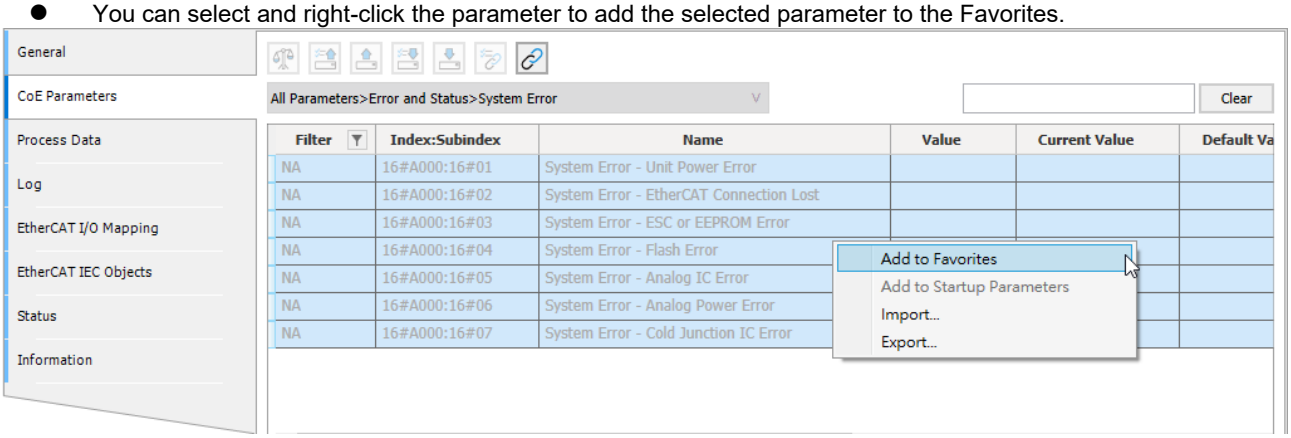
(3) All Parameters

- 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.

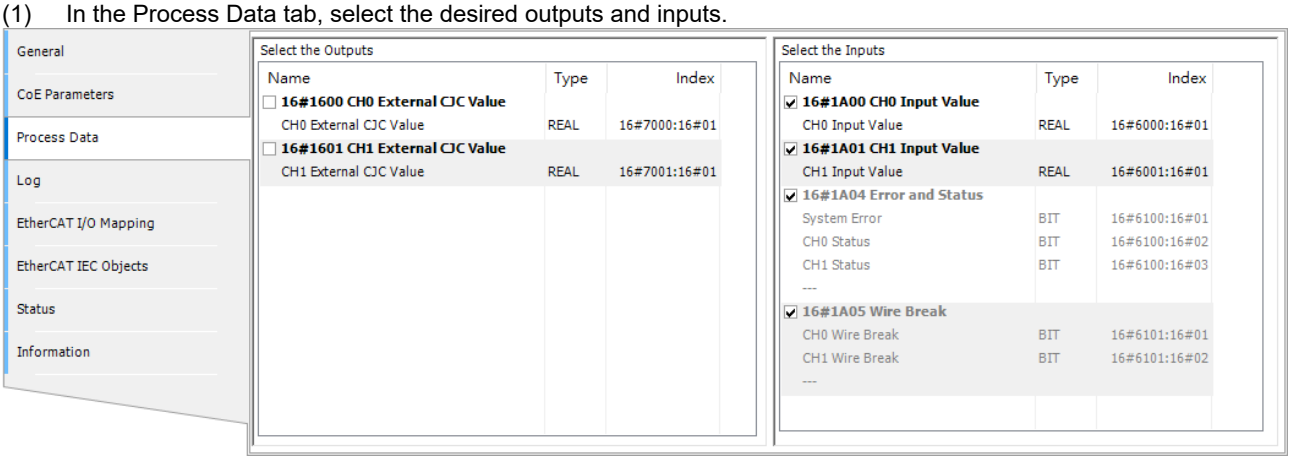
- You can select and right-click the parameter to add the selected parameter to the Favorites.



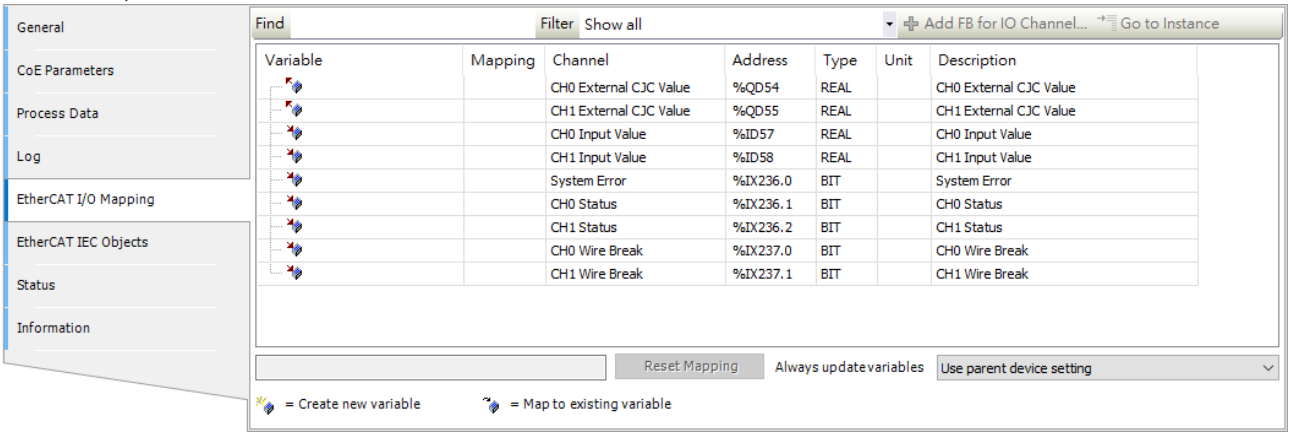
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.8.4.3 Process Data

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

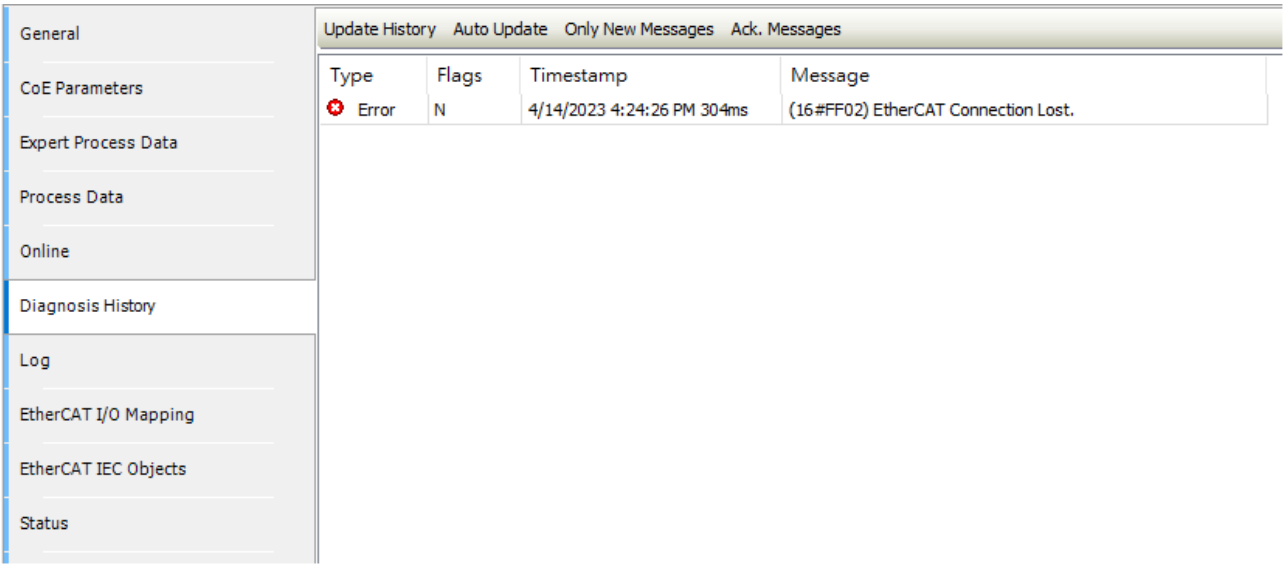


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



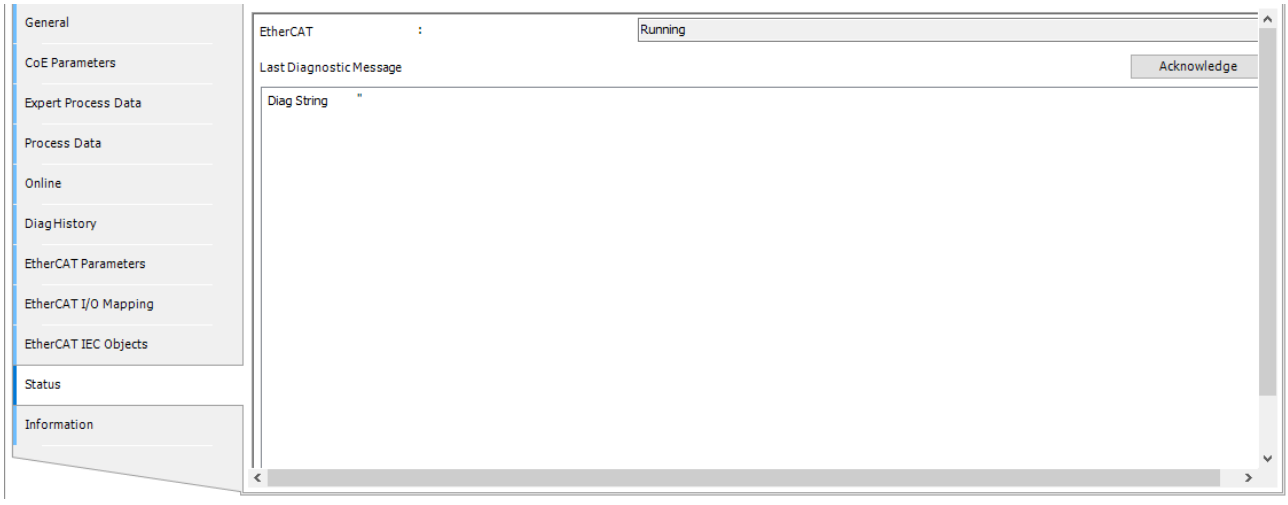
5.8.4.4 Diagnosis History

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



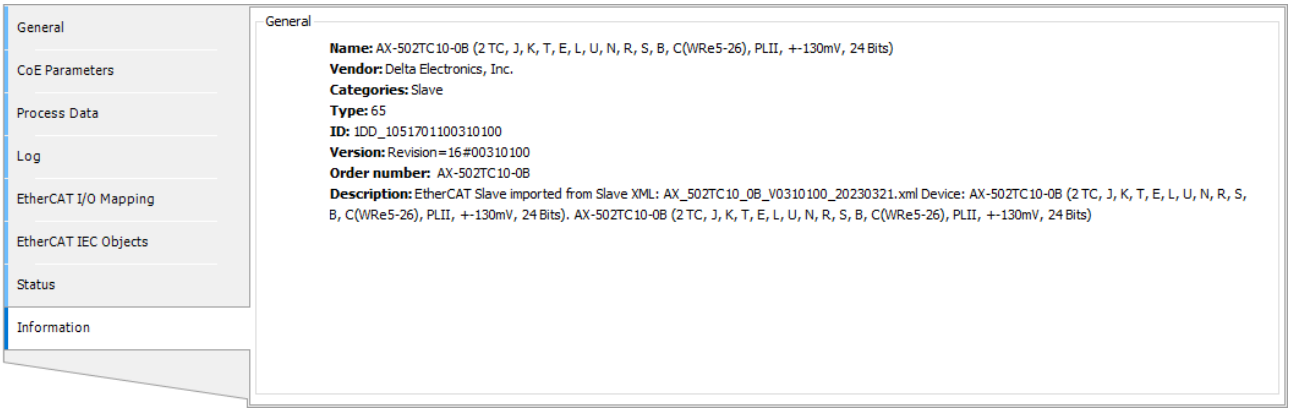
5.8.4.5 Status

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 to 1200°C	-328 to 2192°F
2	K	-200 to 1360°C	-328 to 2480°F
3	T	-200 to 400°C	-328 to 752°F
4	E	-200 to 1000°C	-328 to 1832°F
5	L	-200 to 900°C	-328 to 1652°F
6	U	-200 to 600°C	-328 to 1112°F
7	N	-150 to 1300°C	-238 to 2372°F
8	R	-50 to 1760°C	-58 to 3200°F
9	S	-50 to 1760°C	-58 to 3200°F
10	B	200 to 1800°C	392 to 3272°F
11	C (WRe5-26)	20 to 2300°C	68 to 4172°F
12	PLII	0 to 1300°C	32 to 2372°F
13	±130mV	-130 to 130mV	-130 to 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	0.0
	16#02	CH1 Calibration Offset		REAL	RW	0.0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9 to 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 to 100 times	USINT	RW	10
	16#02	CH1 Moving Average Times		USINT	RW	10

- **Explanation**

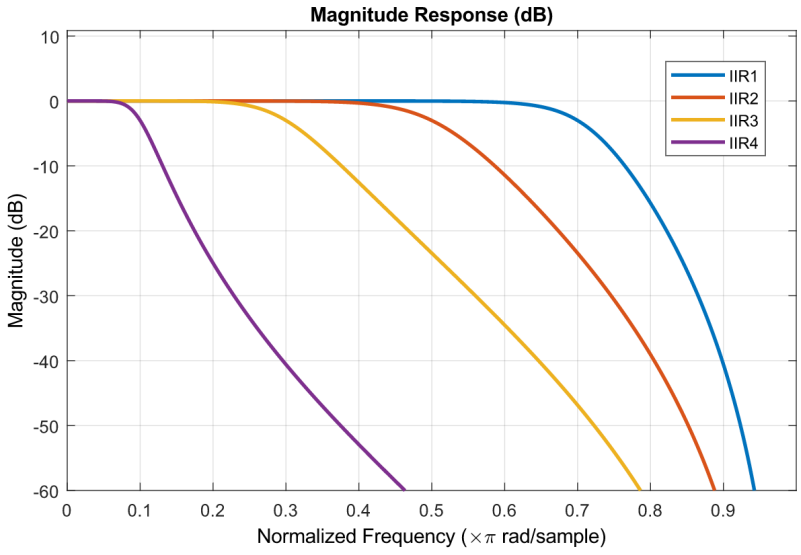
The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The conversion time will not be affected when the digital filter is enabled.

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

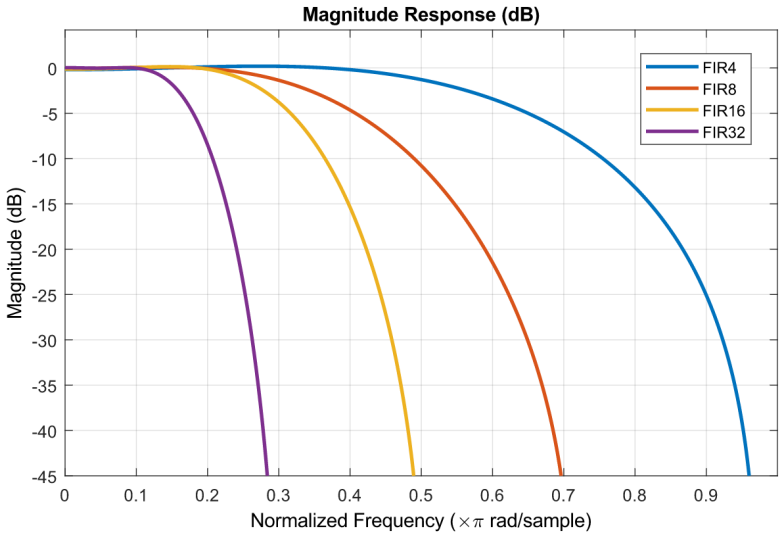
An infinite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, an IIR filter works more efficiently than a moving average filter does. This IIR filter is a low-pass filter. The advantage of an IIR filter is that within the same length of operation 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	USINT	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	2300.0
	16#02	CH1 User Upper Limit				2300.0
16#8005	16#01	CH0 User Lower Limit	User-defined lower limit; Setting range: no limit	REAL	RW	-200.0
	16#02	CH1 User Lower Limit				-200.0

- **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**

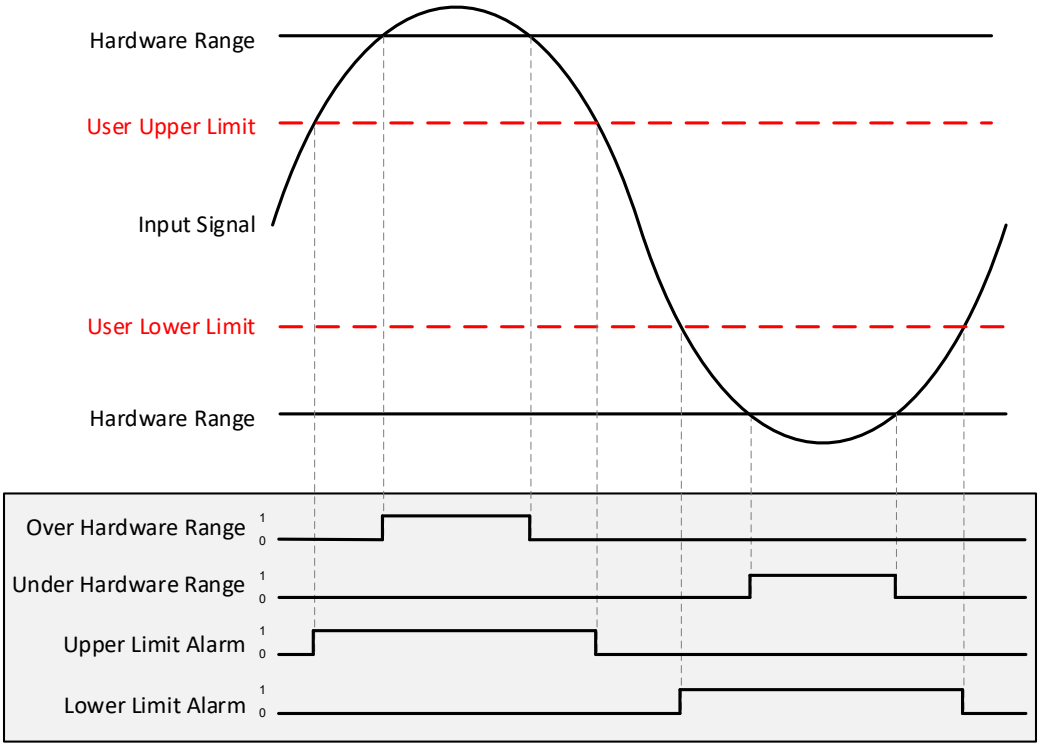
Set the parameters as follows:

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 to 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	USINT	RW	1
	16#02	CH1 CJC Function		USINT	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

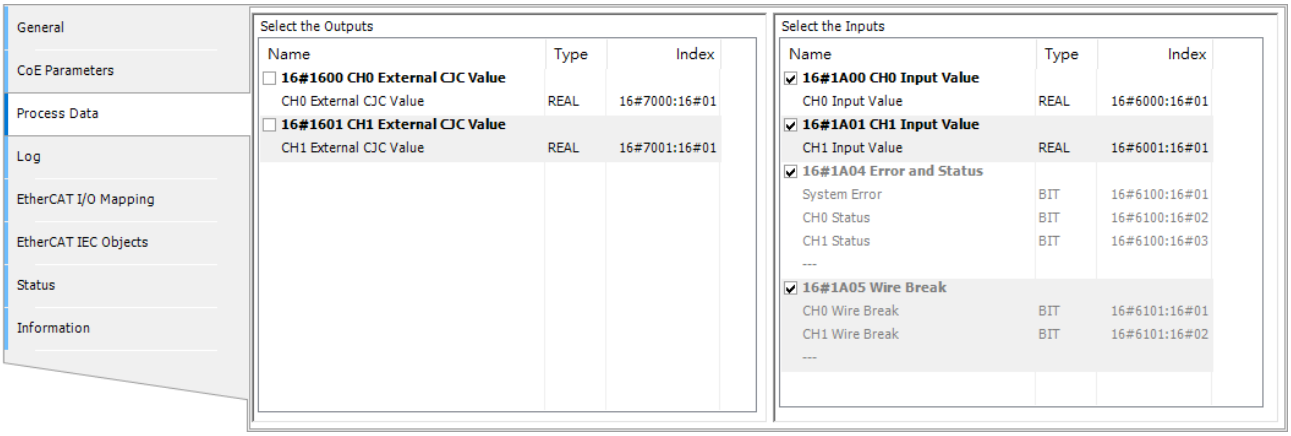
This section introduces the settings and monitoring of PDO data exchange.

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.



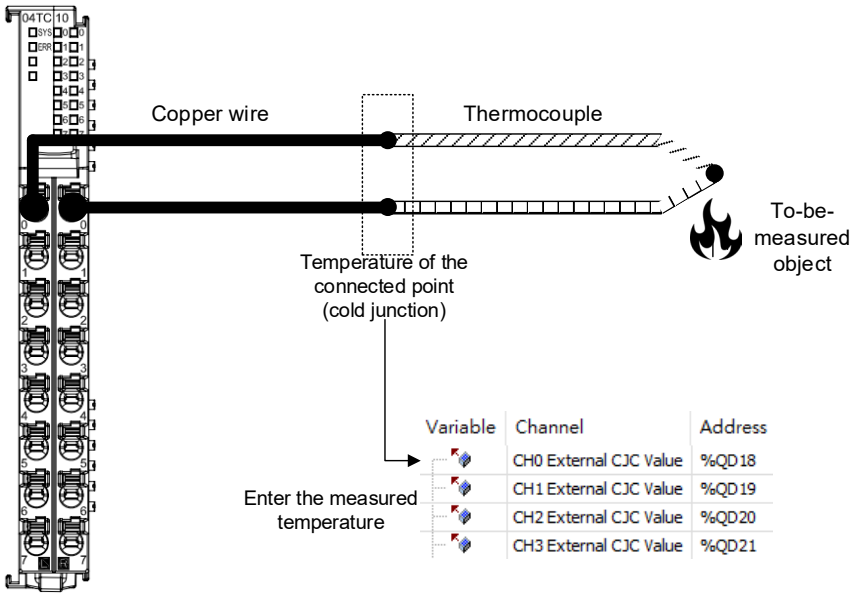
5

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.

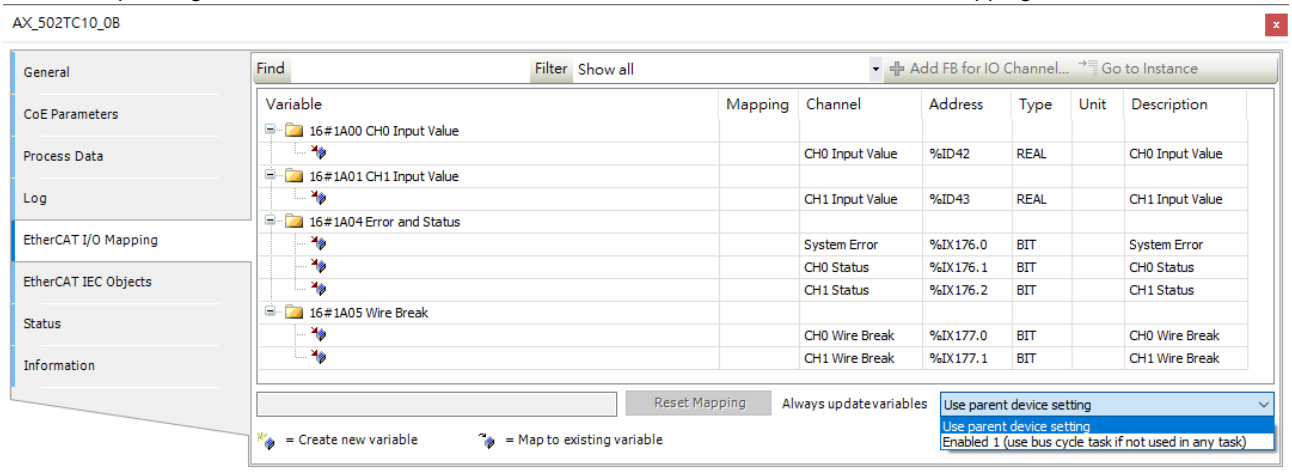
Method:

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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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 to 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

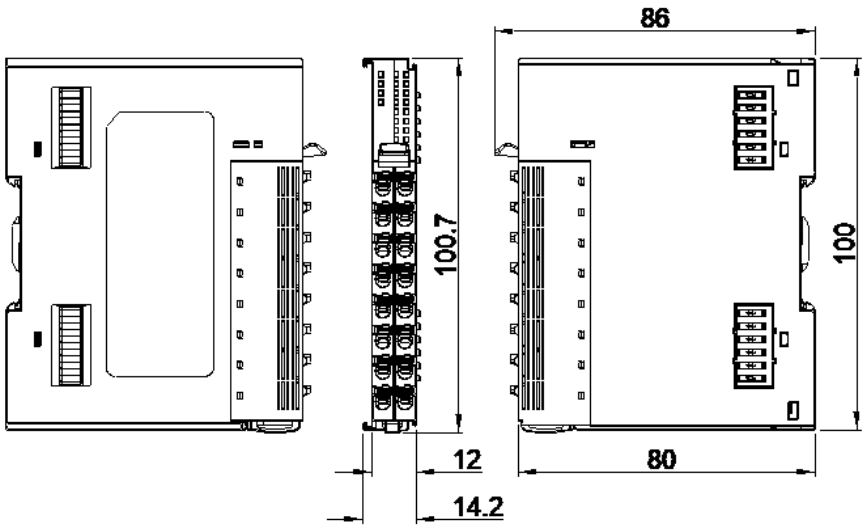
Item		Specification
Input points		4
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		Free Run mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		70 g
Electrical specification	Input form	Differential input
	Sensor type	J, K, T, E, L, U, N, R, S, B, C (WRe5-26), 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%: 25ºC (F.S.) (*2, *3) ±0.5%: 0 to 60ºC (F.S.) ±1%: <-20 to 0ºC (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	±1.2ºC
	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 Detection	Yes
	Short Circuit Detection (SCD)	N/A
	Input power protection (voltage range)	±30 V
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	N/A
	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 to 100°C (±0.35%)
*3. B: 200 to 300°C (±0.4%)

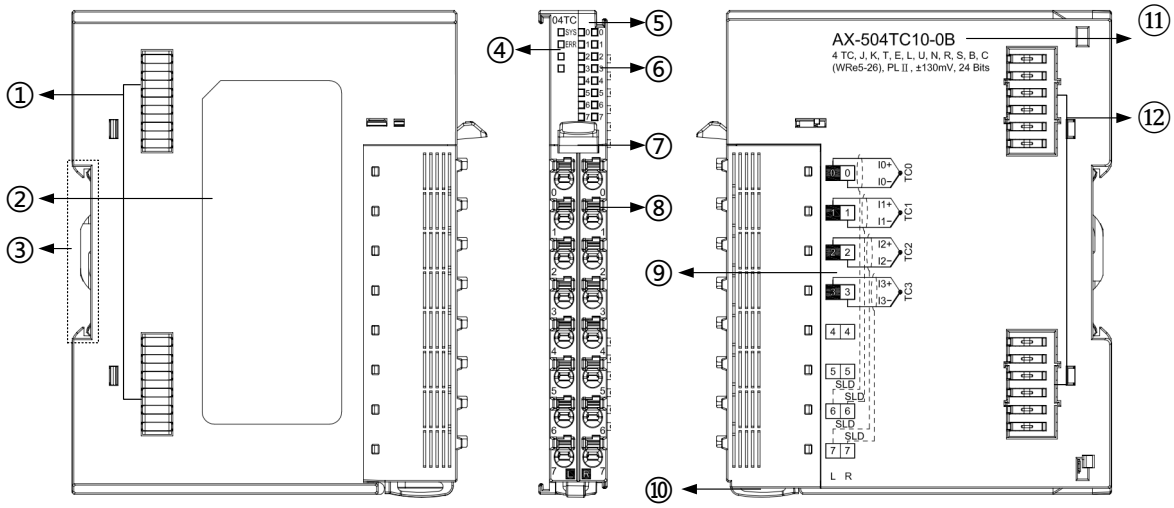
5.9.2 Dimensions and Parts

- **Dimensions**



Unit: mm

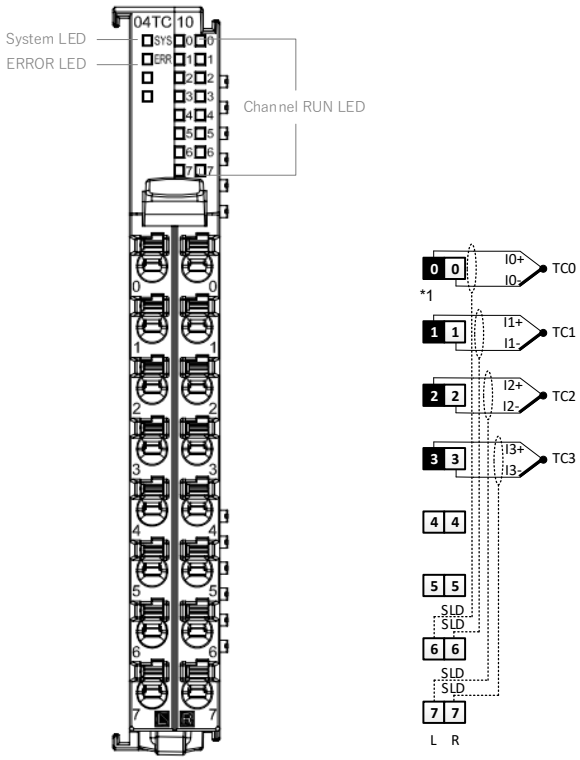
- **Parts**



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.

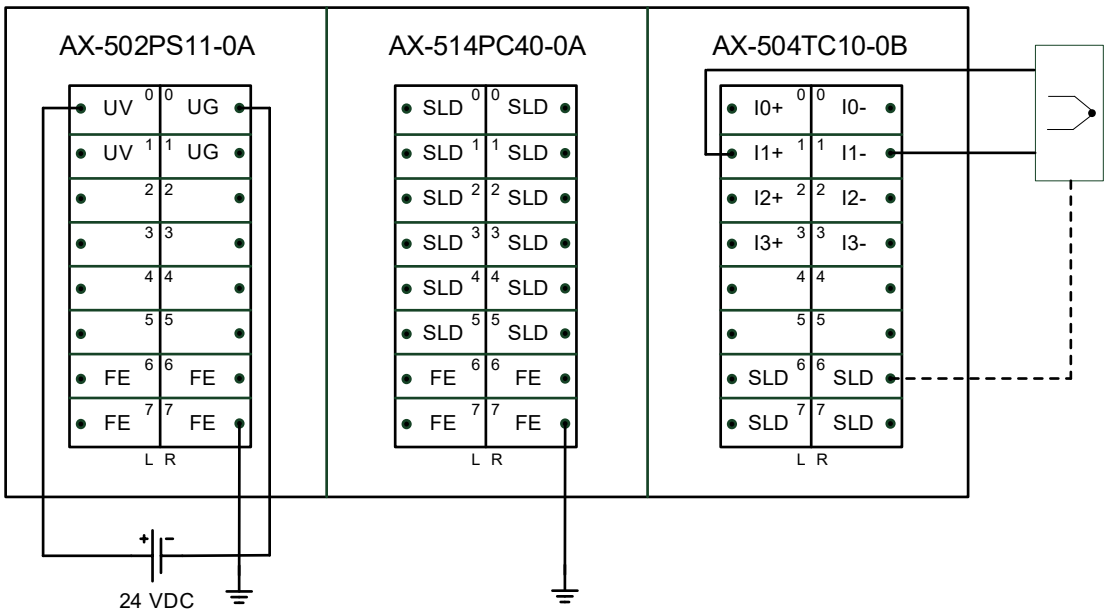
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0+	Channel 0: sensor positive input	R0	I0-	Channel 0: sensor negative input
L1	I1+	Channel 1: sensor positive input	R1	I1-	Channel 1: sensor negative input
L2	I2+	Channel 2: sensor positive input	R2	I2-	Channel 2: sensor negative input
L3	I3+	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

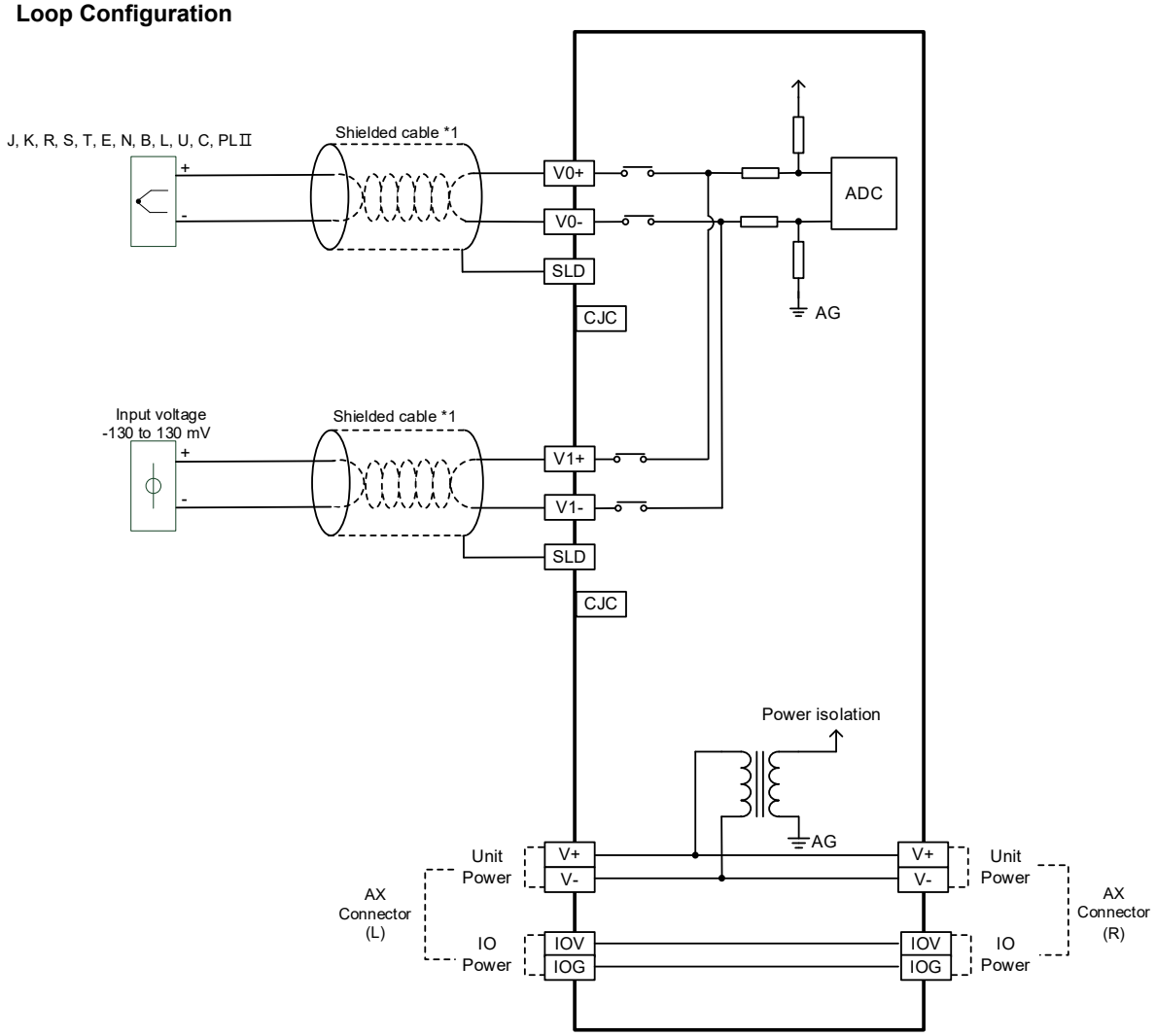
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2 s)	ECAT Pre OP
			Blinking (1 s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1 s)	An error occurs on the application.
			Blinking (0.2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

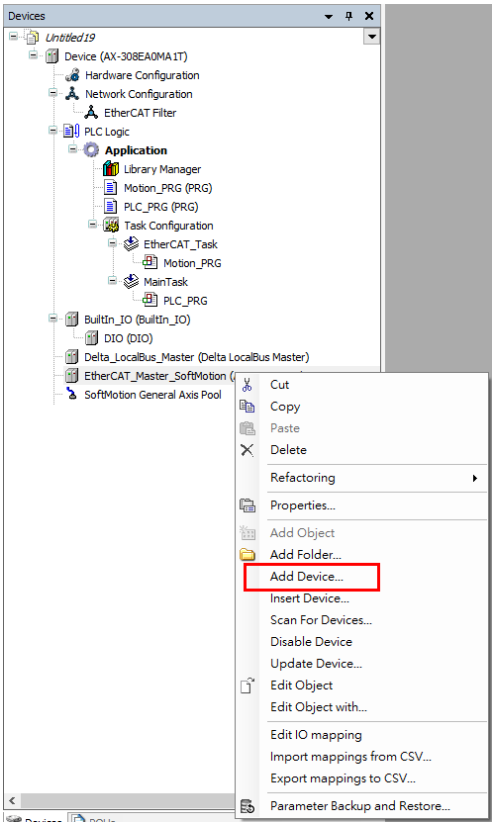
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



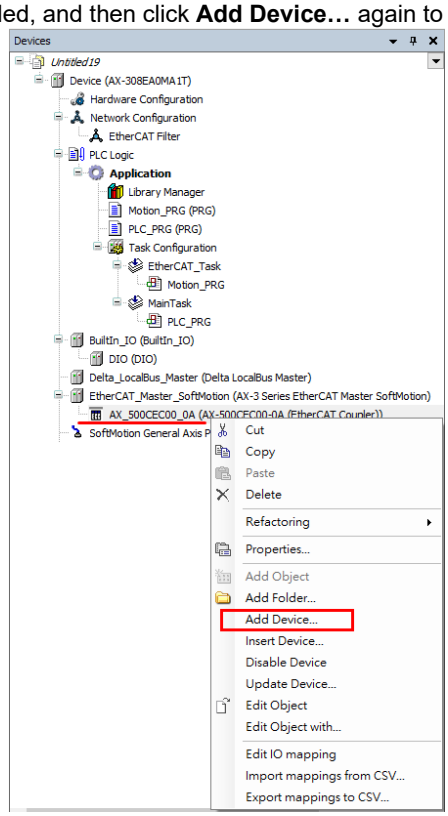
(2) Add Modules in

- 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.

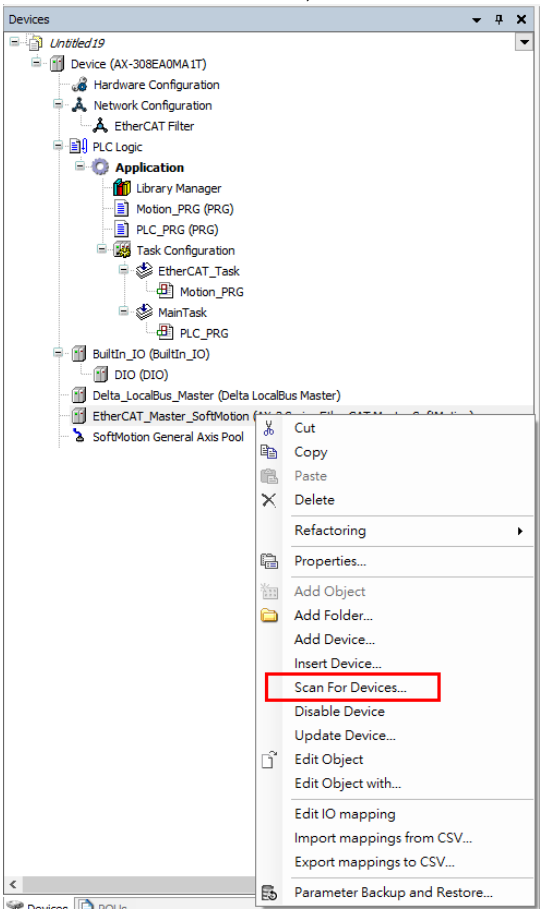


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

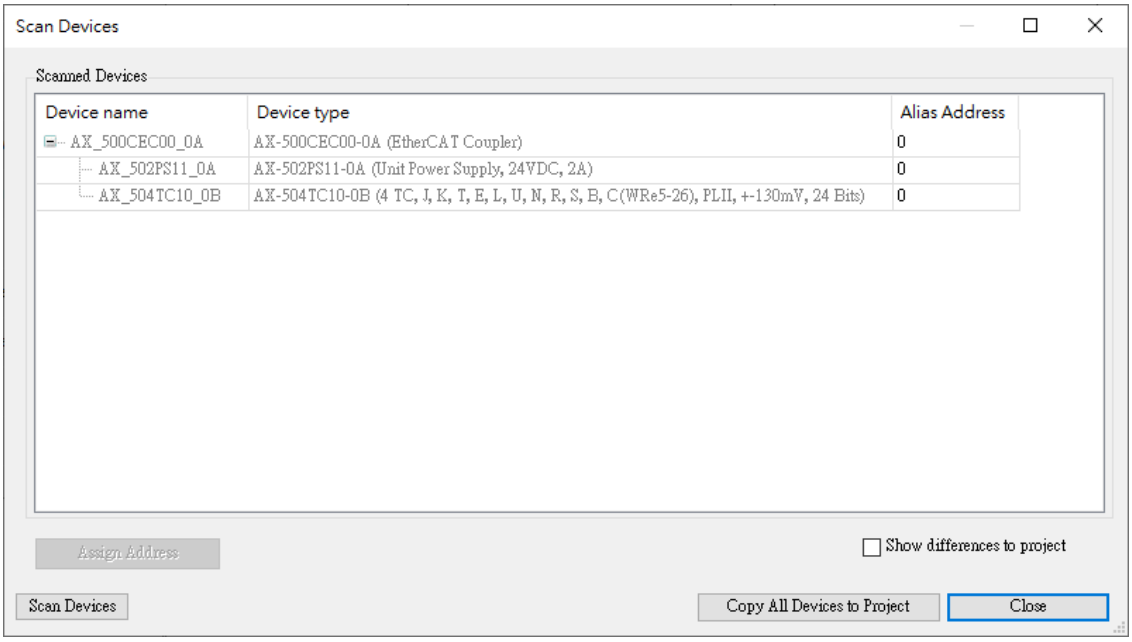


- Method 2: Scan to add the modules in.

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

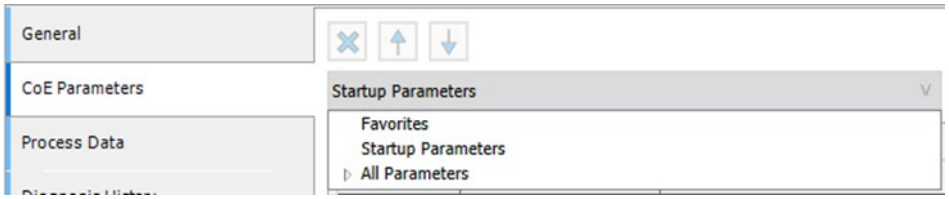


After the auto-scan is over, the actually connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



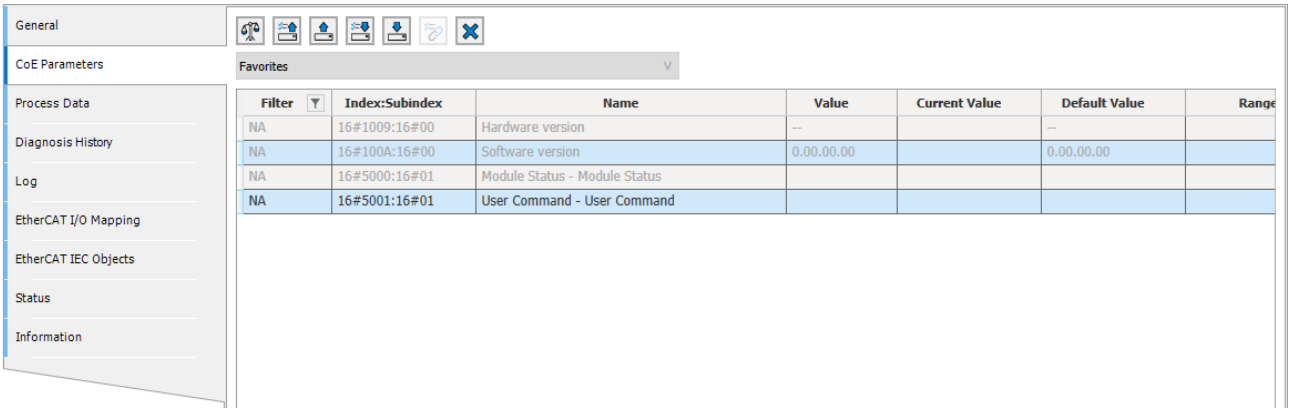
5.9.4.2 Parameter Settings

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



(1) Favorites

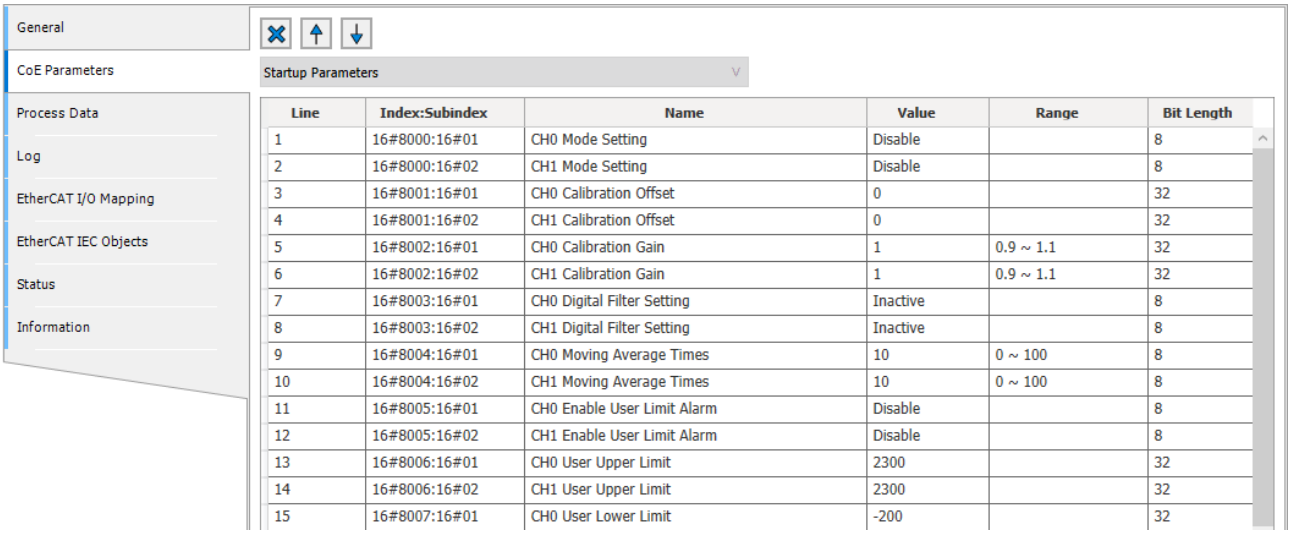
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

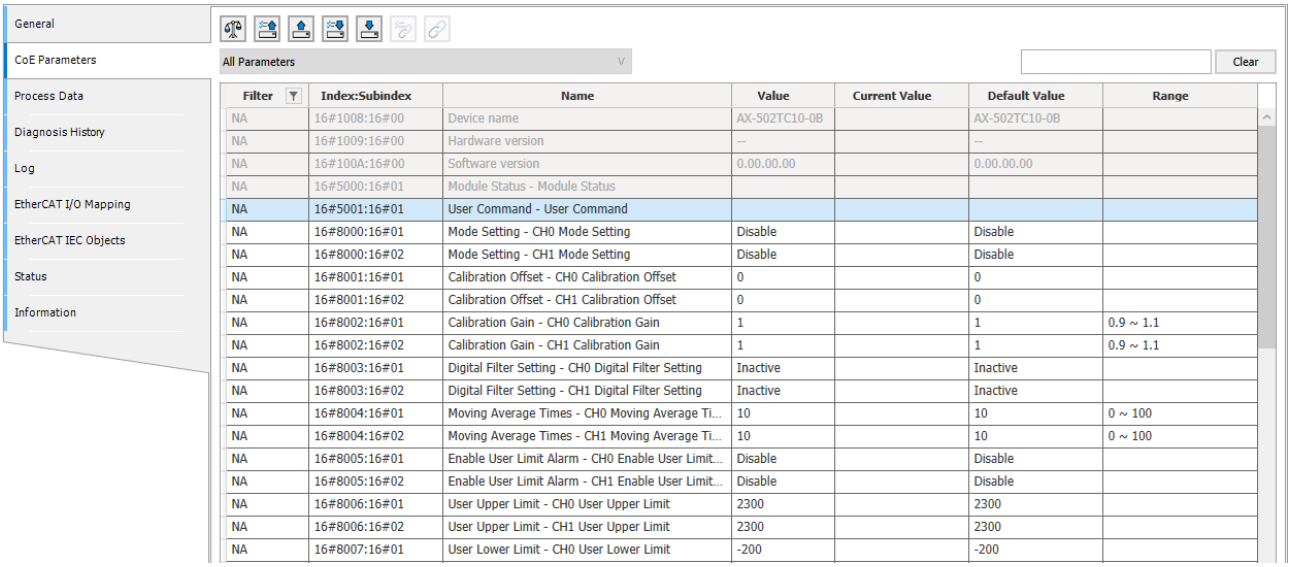


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8001:16#01	CH0 Calibration Offset	0		32
4	16#8001:16#02	CH1 Calibration Offset	0		32
5	16#8002:16#01	CH0 Calibration Gain	1	0.9 ~ 1.1	32
6	16#8002:16#02	CH1 Calibration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

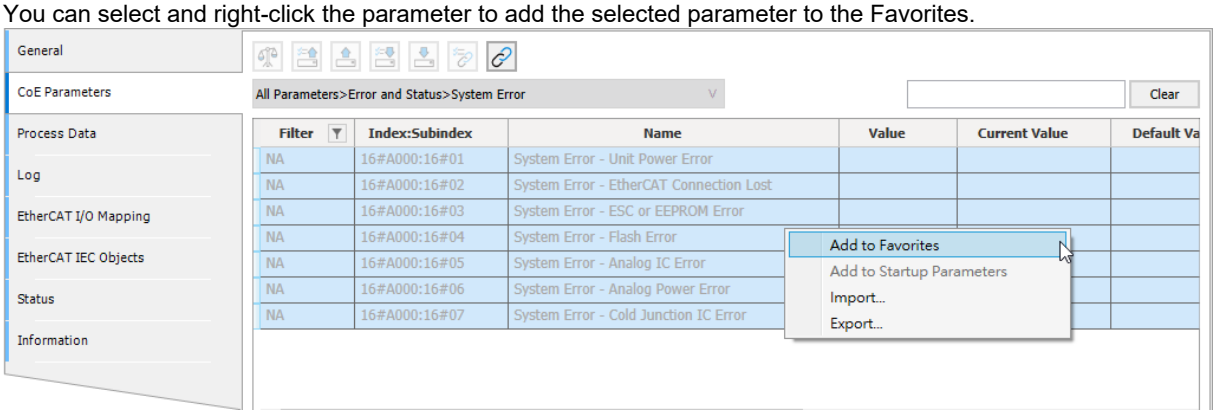
(3) All Parameters

- 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.

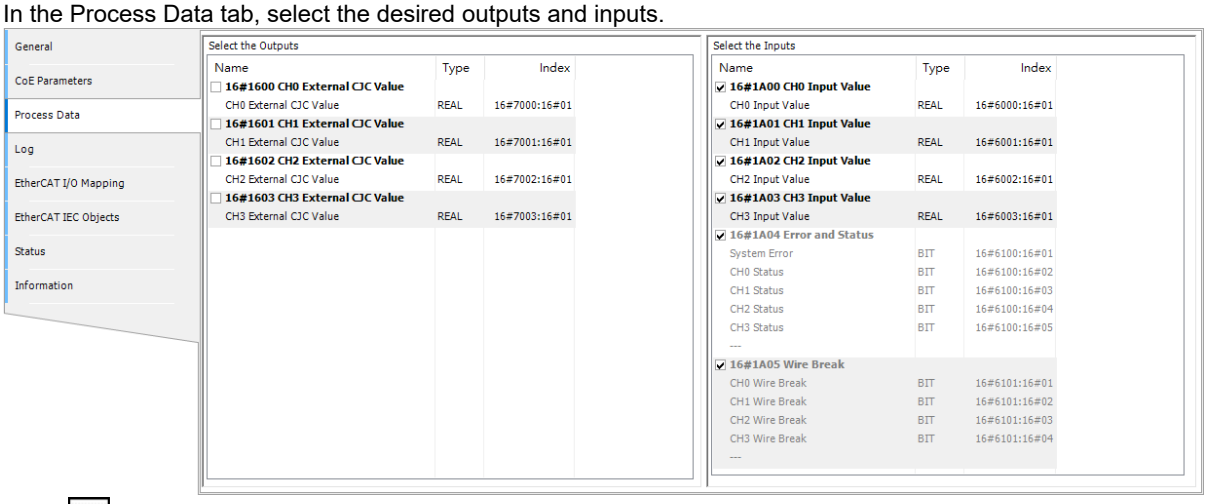
- You can select and right-click the parameter to add the selected parameter to the Favorites.



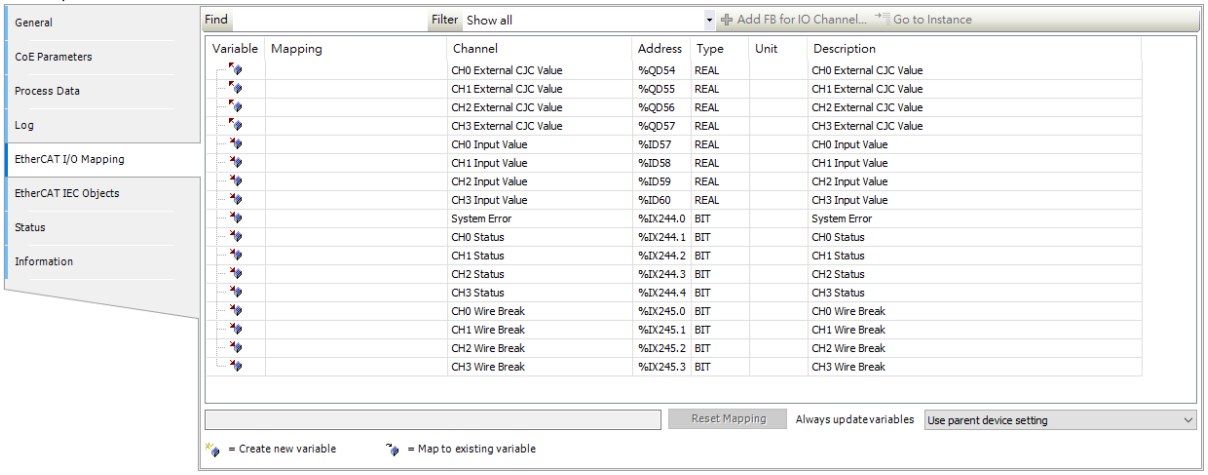
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.9.4.3 Process Data

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

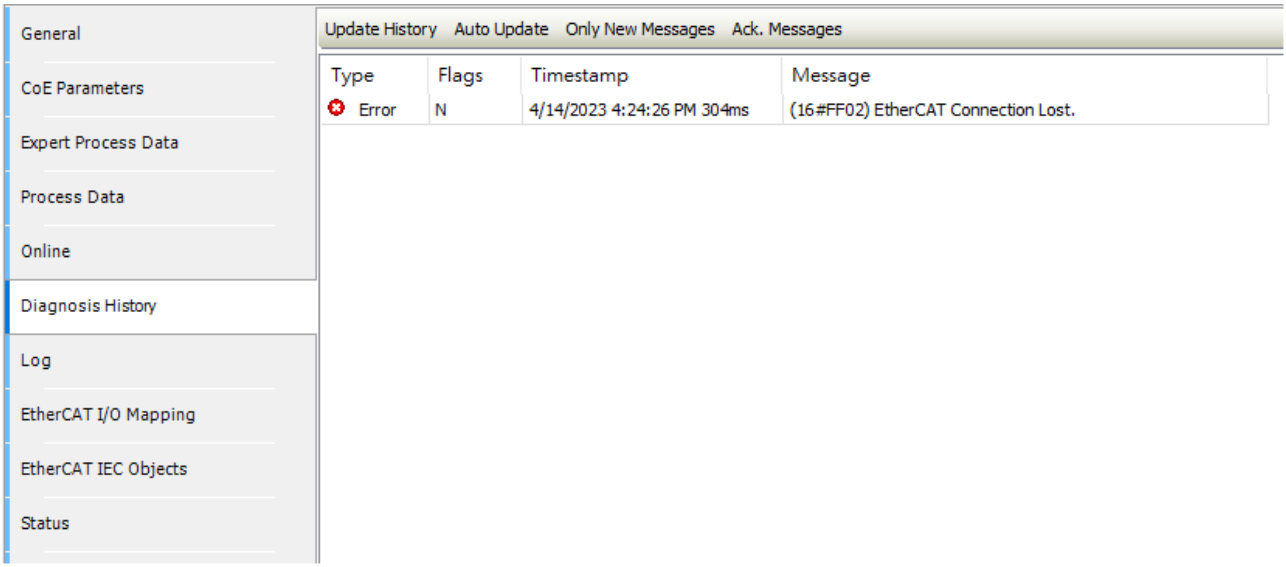


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



5.9.4.4 Diagnosis History

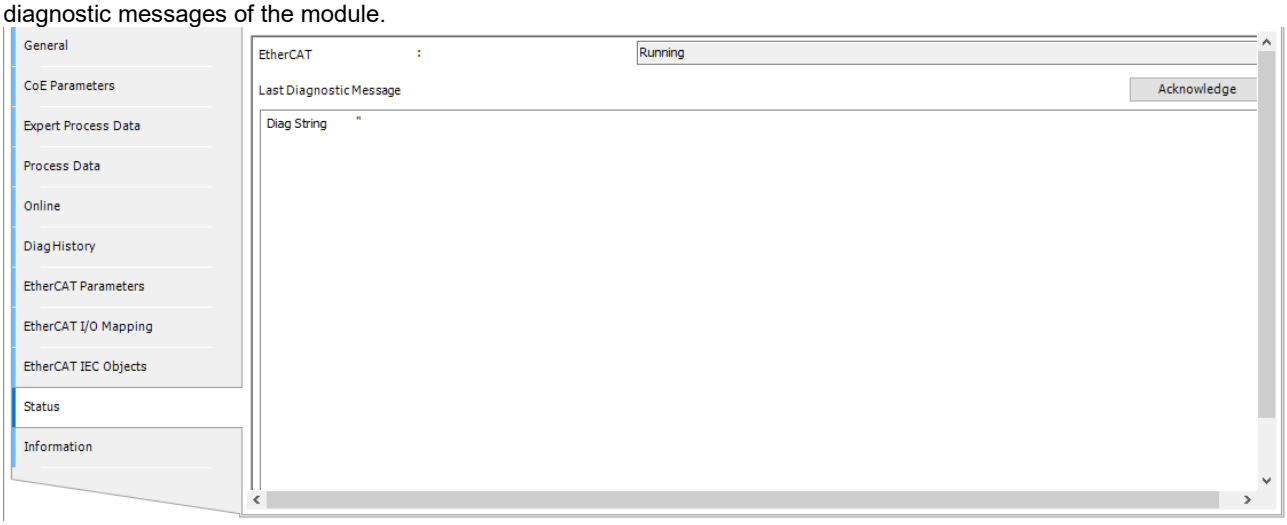
Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors



5

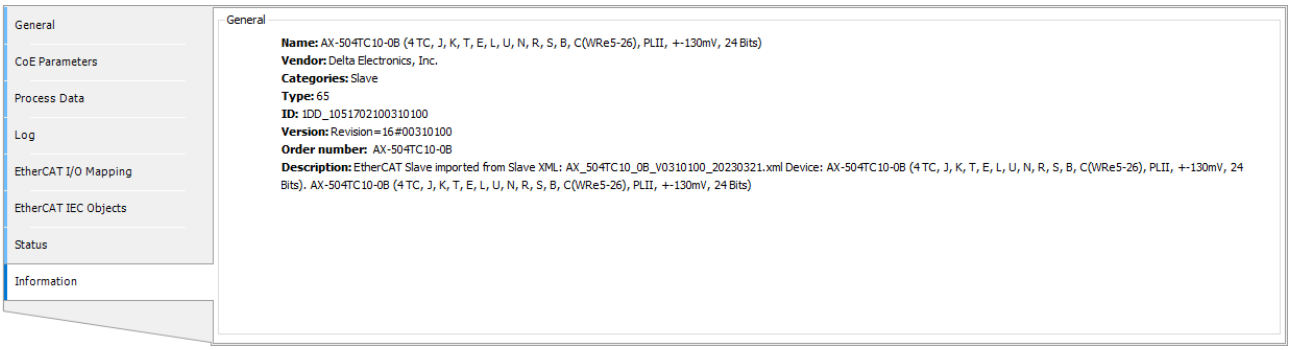
5.9.4.5 Status

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 – 1800 °C	392 – 3272 °F
11	C (WRe5-26)	20 – 2300 °C	68 – 4172 °F
12	PLII	0 – 1300 °C	32 – 2372 °F
13	±130 mV	-130 – 130 mV	-130 – 130 mV

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	0.0
	16#02	CH1 Calibration Offset		REAL	RW	0.0
	16#03	CH2 Calibration Offset		REAL	RW	0.0
	16#04	CH3 Calibration Offset		REAL	RW	0.0
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**

5

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 °C. If Gain is set to 0.9 and Offset is set to 2, the value after calibration is -178 to 1082 °C.

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 to 100 times	USINT	RW	10
	16#02	CH1 Moving Average Times		USINT	RW	10
	16#03	CH2 Moving Average Times		USINT	RW	10
	16#04	CH3 Moving Average Times		USINT	RW	10

- **Explanation**

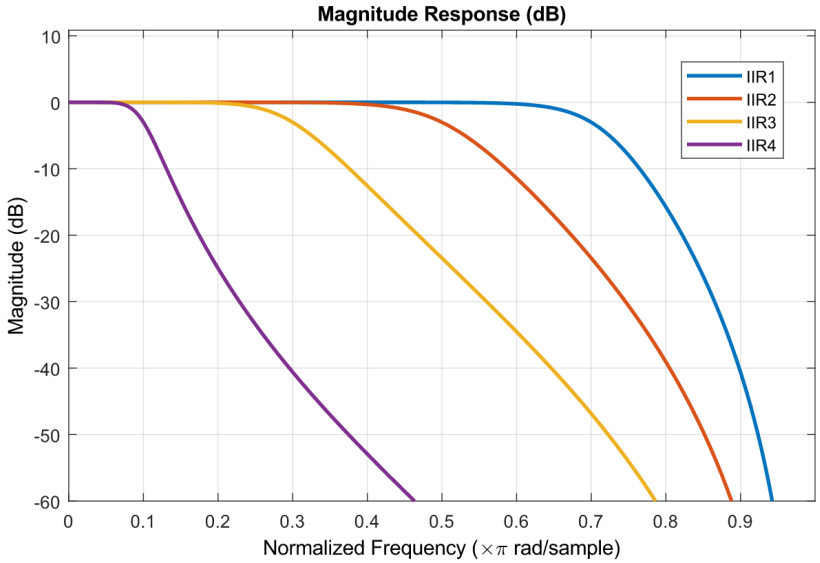
The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The conversion time will not be affected when the digital filter is enabled.

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

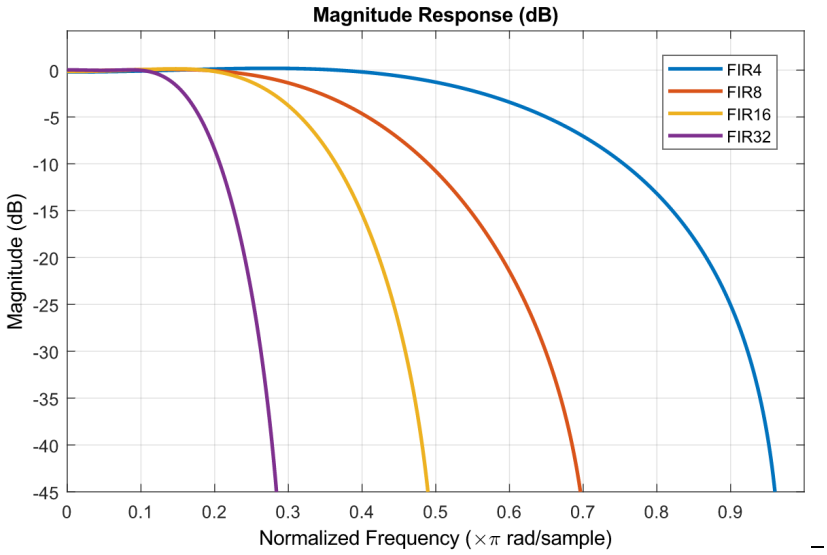
An infinite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, an IIR filter works more efficiently than a moving average filter does. This IIR filter is a low-pass filter. The advantage of an IIR filter is that within the same length of operation 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

5

- **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	USINT	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	2300.0
	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	-200.0
	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**

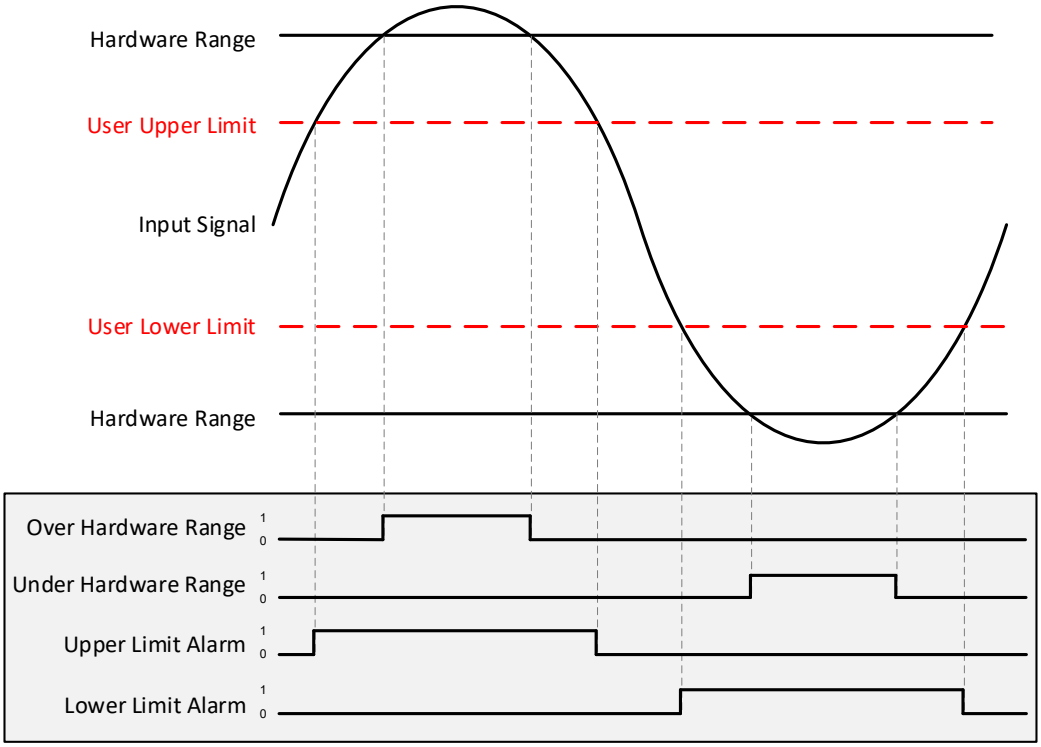
Set the parameters as follows:

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 to 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	USINT	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

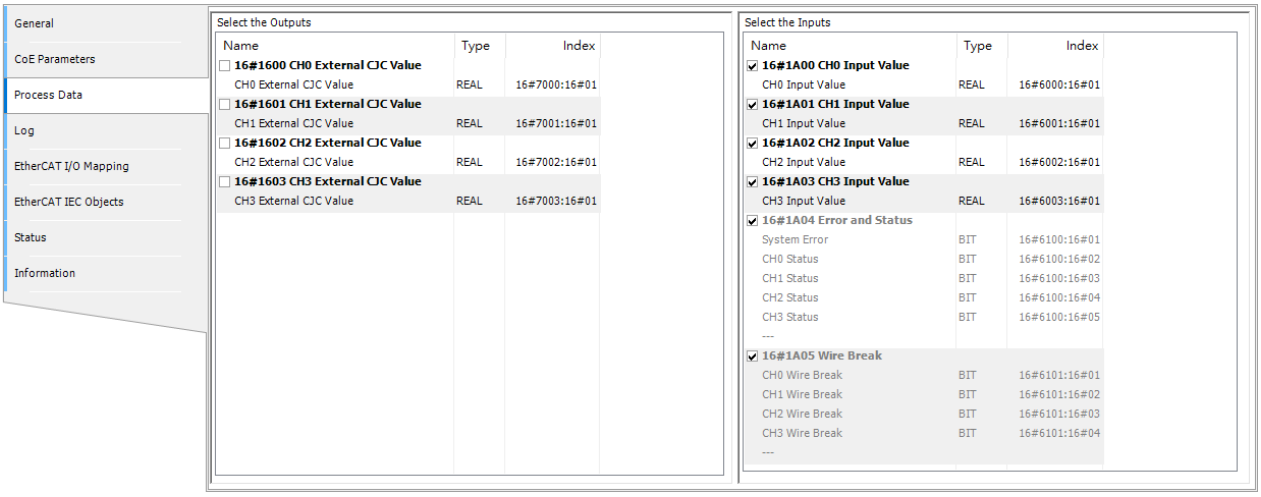
This section introduces the settings and monitoring of PDO data exchange.

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.



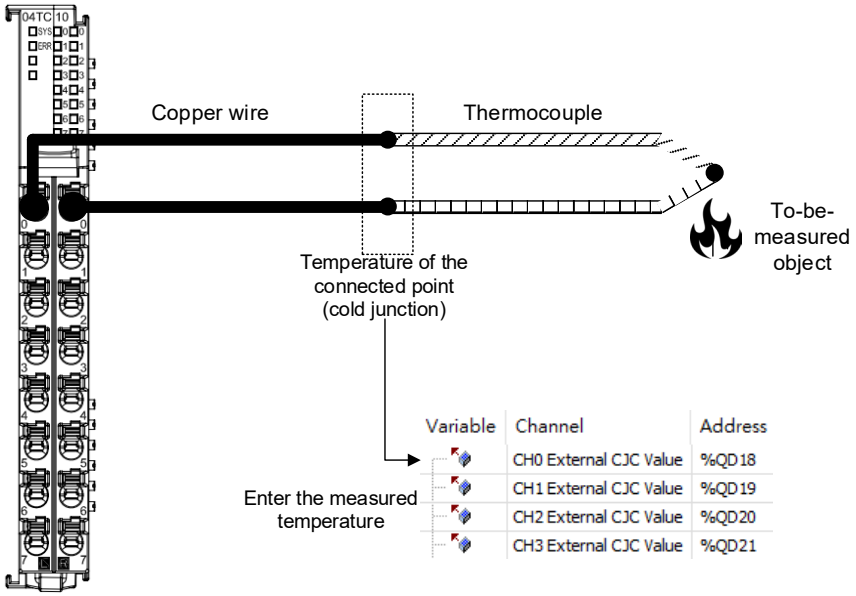
5

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.

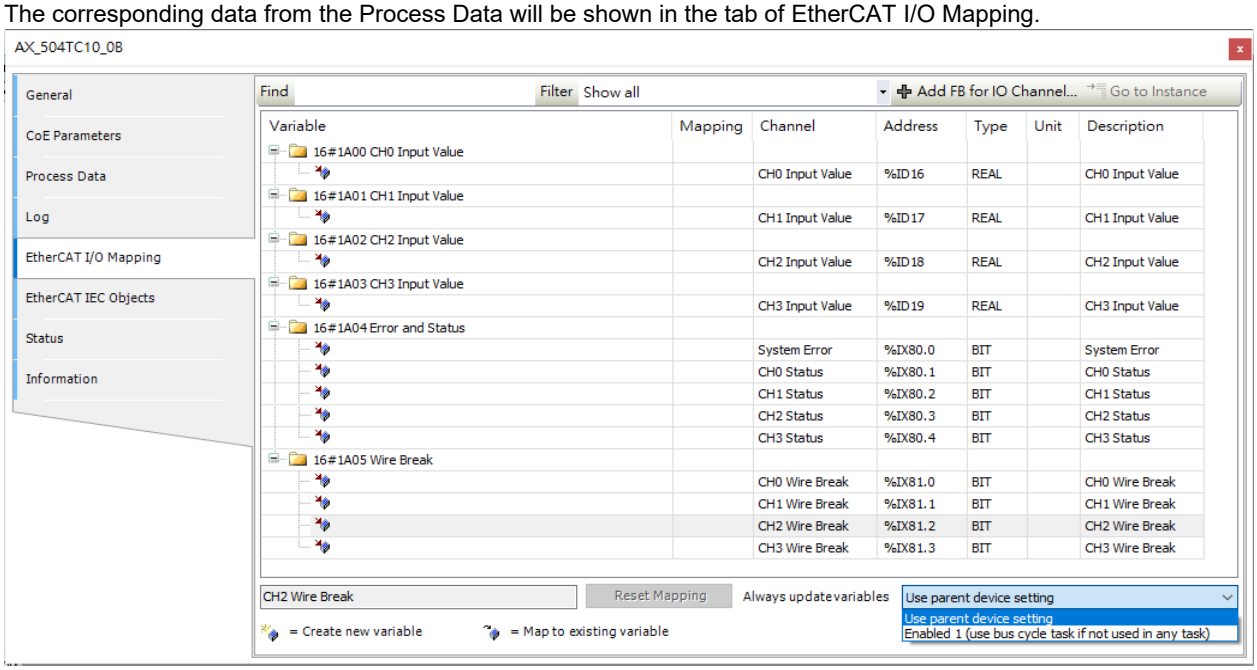
Method:

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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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 setting 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 setting 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 to 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.

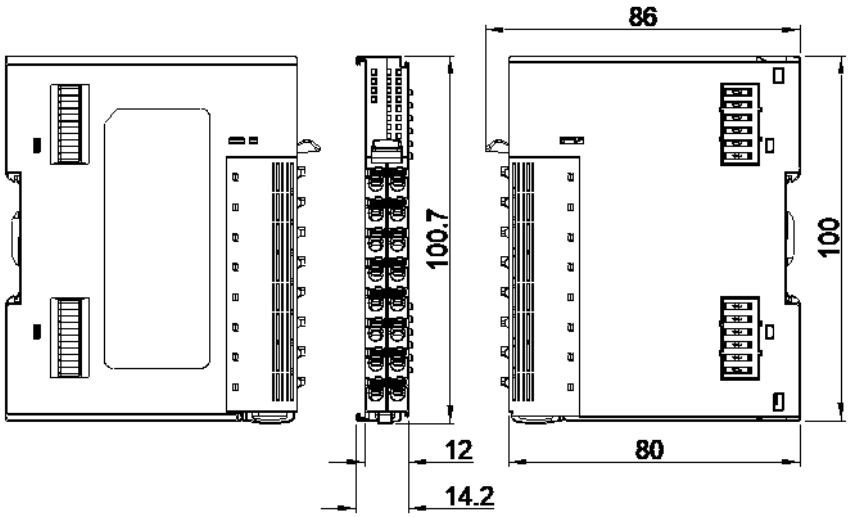
5.10.1 Specifications

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, 100 Ω 3850 PPM/°C Pt1000: DIN EN60751, 1 kΩ 3850 PPM/°C Ni100, Ni1000: DIN 43760 0 to 300 Ω
	Connection type	2-, 3-, 4-Wire
	Resolution	0.001°C/0.0018°F*1
	Temperature measurement accuracy	±0.3%: 25 ºC (F.S.) ±0.5%: 0 to 60 ºC (F.S.) ±1%: <-20 to 0 ºC (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 to 300 Ω: 500 μA PT1000, Ni1000: 250 μA 3-wire: PT100, PT1000, Ni100, Ni1000, 0 to 300 Ω: 250 μA
Others	Connection Lost Detection	Yes
	Short Circuit Detection (SCD)	N/A
	Input power protection (voltage range)	±30 V
	Over Voltage Protection (OVP) / Over Current Protection (OCP)	N/A
	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.

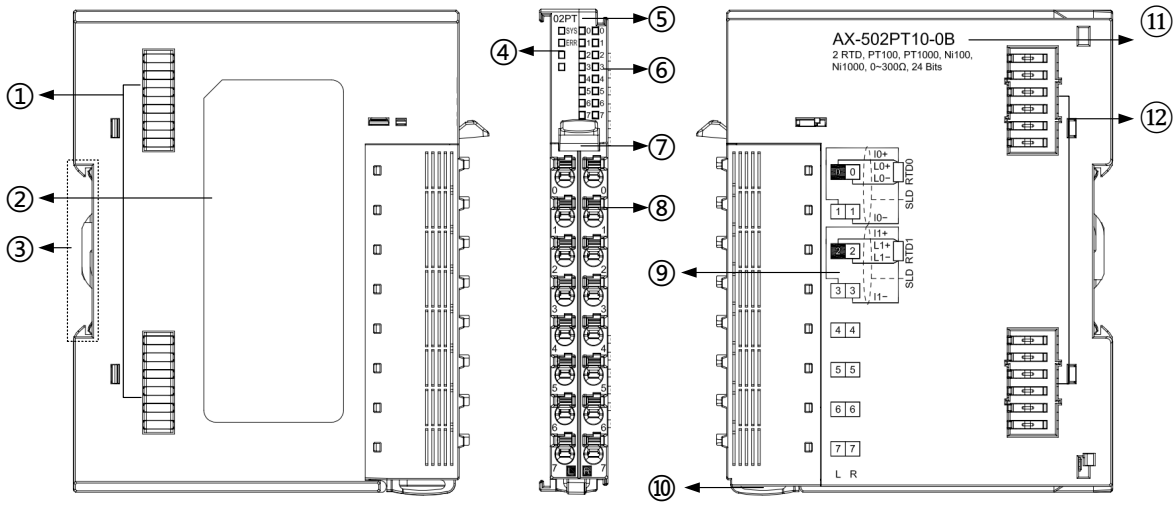
5.10.2 Dimensions and Parts

- **Dimensions**



Unit: mm

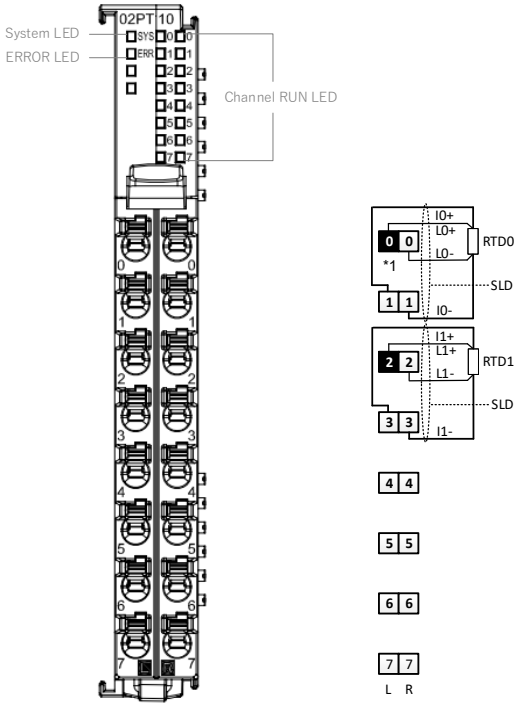
- **Parts**



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.

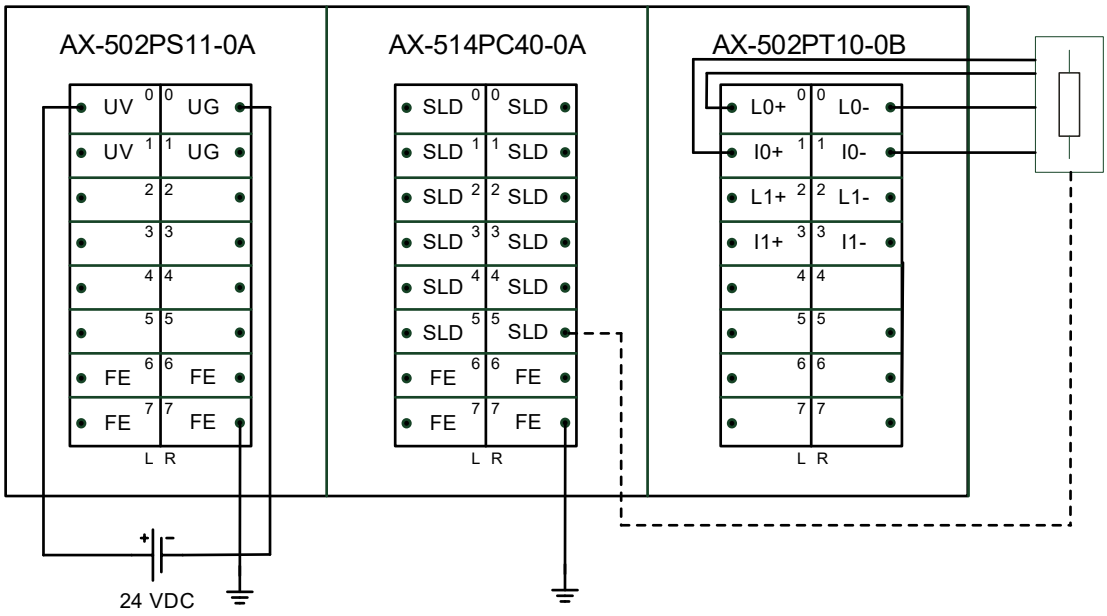
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	L0+	Channel 0: sensor positive input	R0	L0-	Channel 0: sensor negative input
L1	I0+	Channel 0: power positive output	R1	I0-	Channel 0: power negative output
L2	L1+	Channel 1: sensor positive input	R2	L1-	Channel 1: sensor negative input
L3	I1+	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

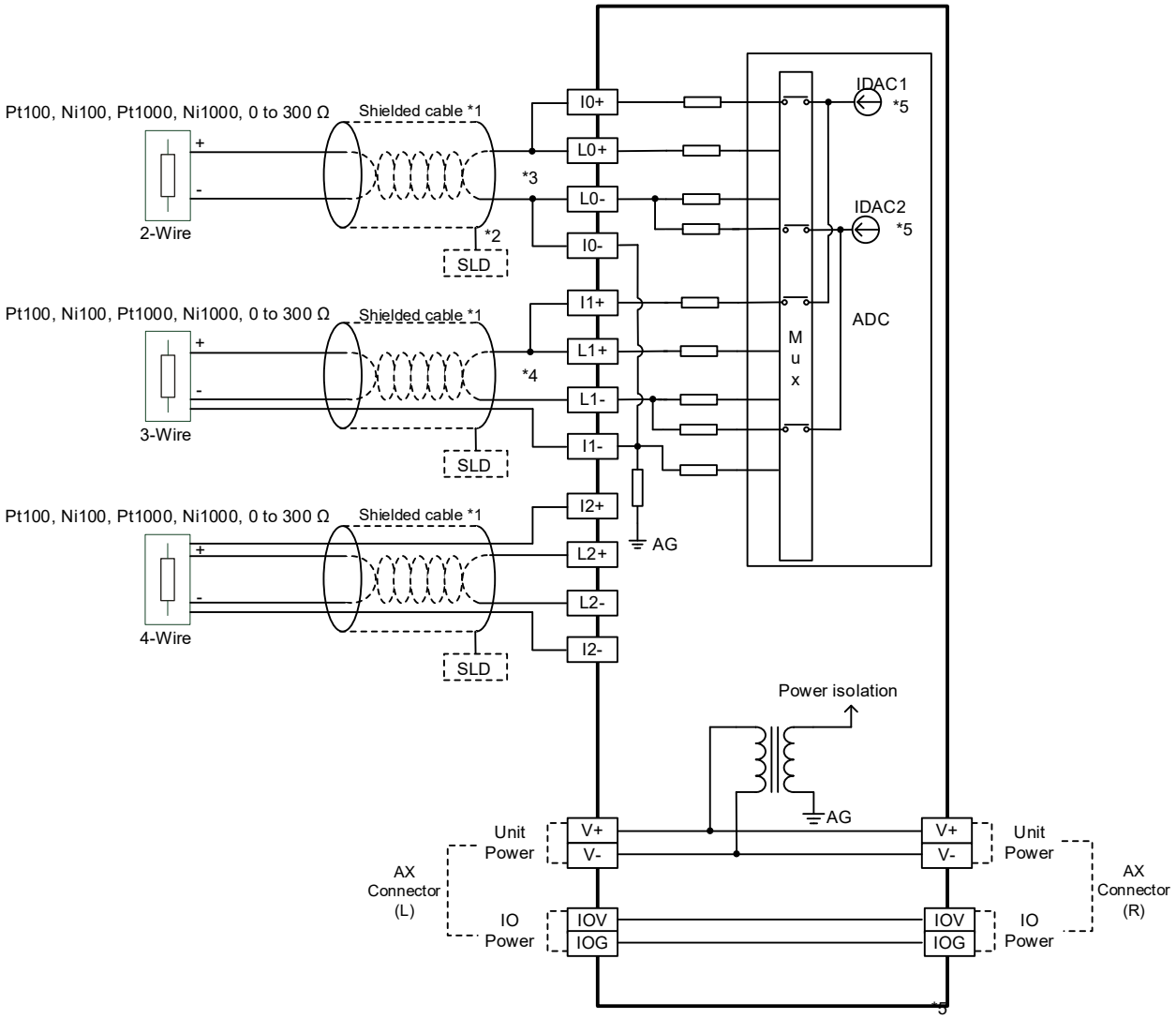
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2 s)	ECAT Pre OP
			Blinking (1 s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1 s)	An error occurs on the application.
			Blinking (0.2 s)	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 and 4).
*4. If you use three-wire temperature sensors, In+ & Ln+ must be short-circuited (where n is between 1 and 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.

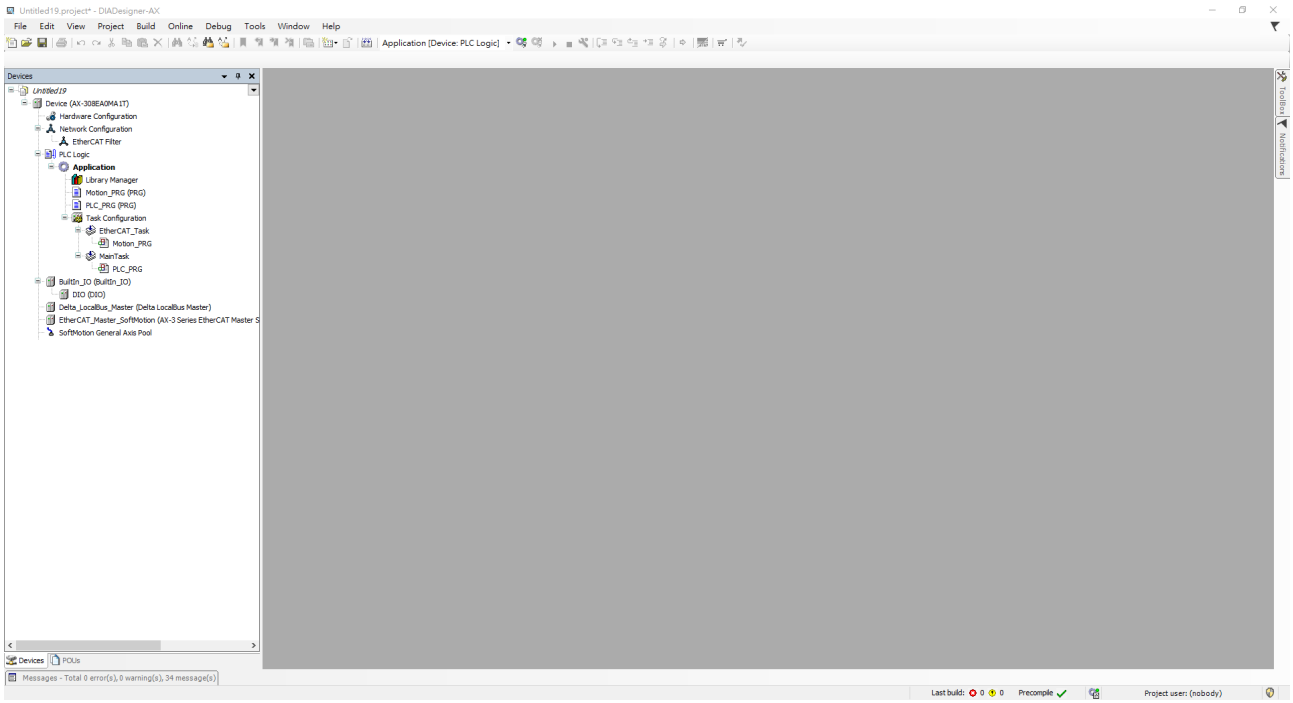
Wiring Mode	Sensor	IDAC1	IDAC2
2/4 Wire	PT100, Ni100, 0 to 300 Ω	500 μA	OFF
	PT1000, Ni1000	250 μA	
3 Wire	PT100, Ni100, 0 to 300 Ω	250 μA	250 μA
	PT1000, Ni1000		

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

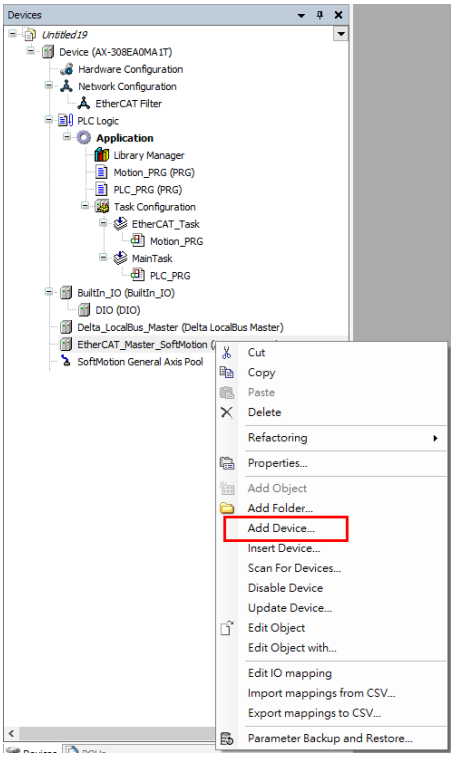
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



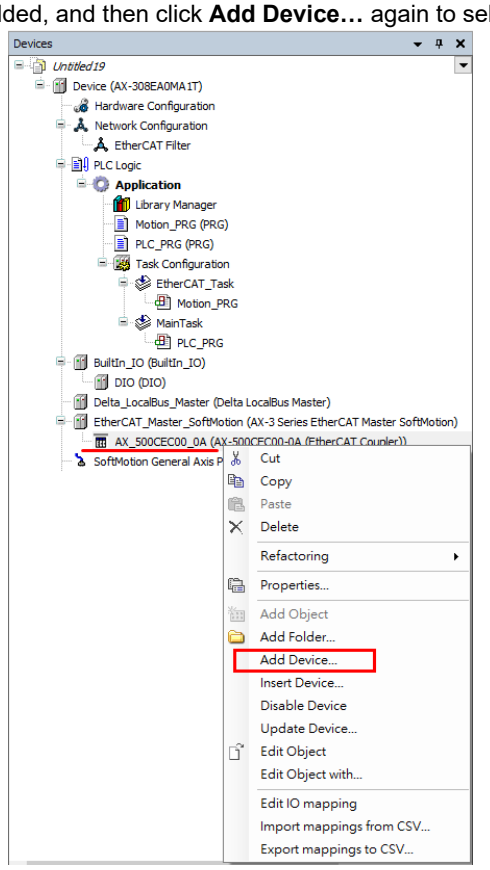
(2) Add Modules in

- 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.

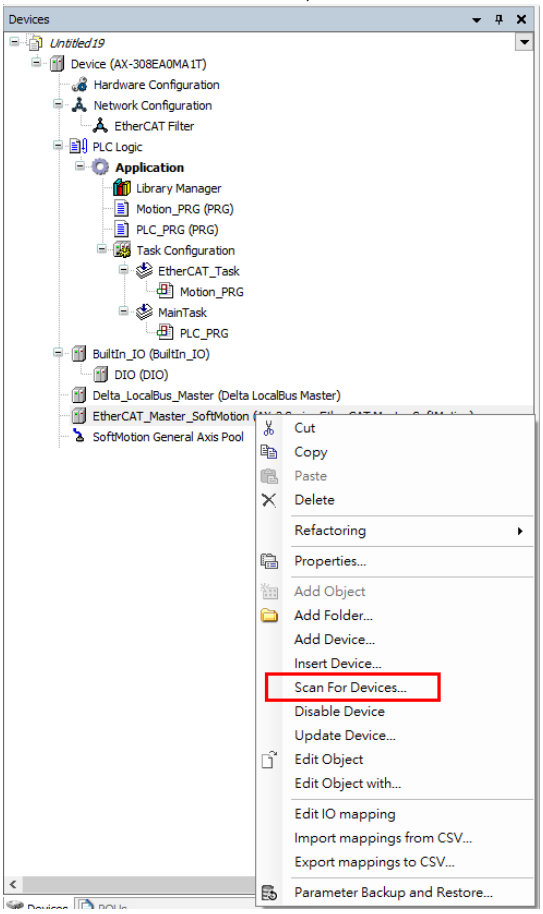


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

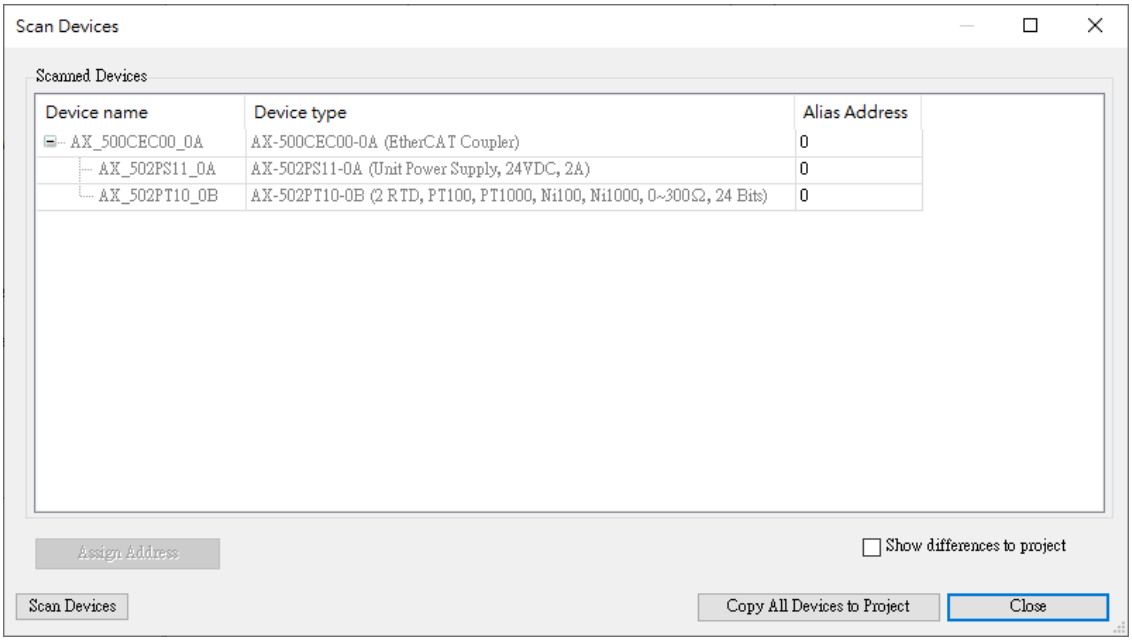


- Method 2: Scan to add the modules in.

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

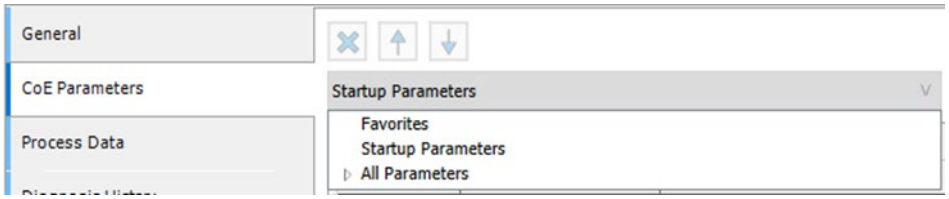


After the auto-scan is over, the actually connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



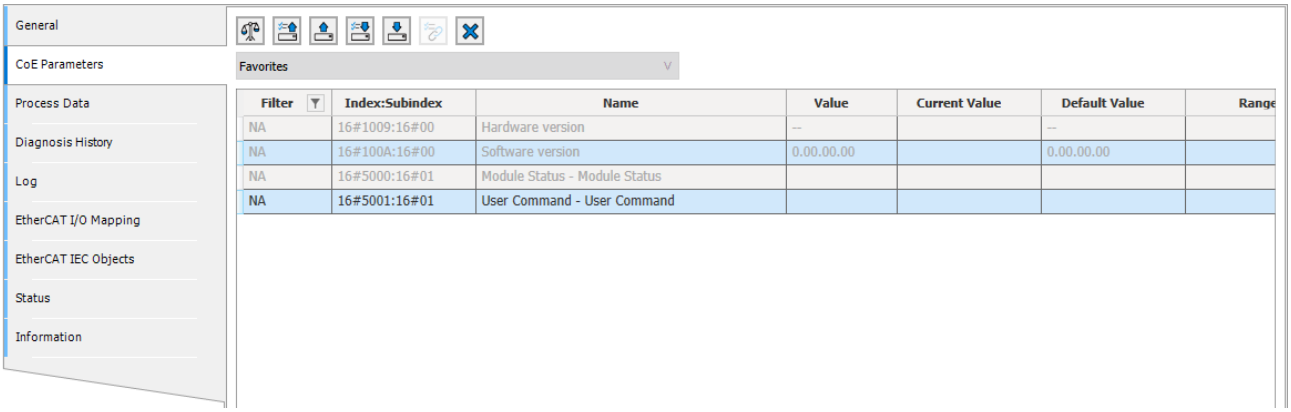
5.10.4.2 Parameter Settings

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



(1) Favorites

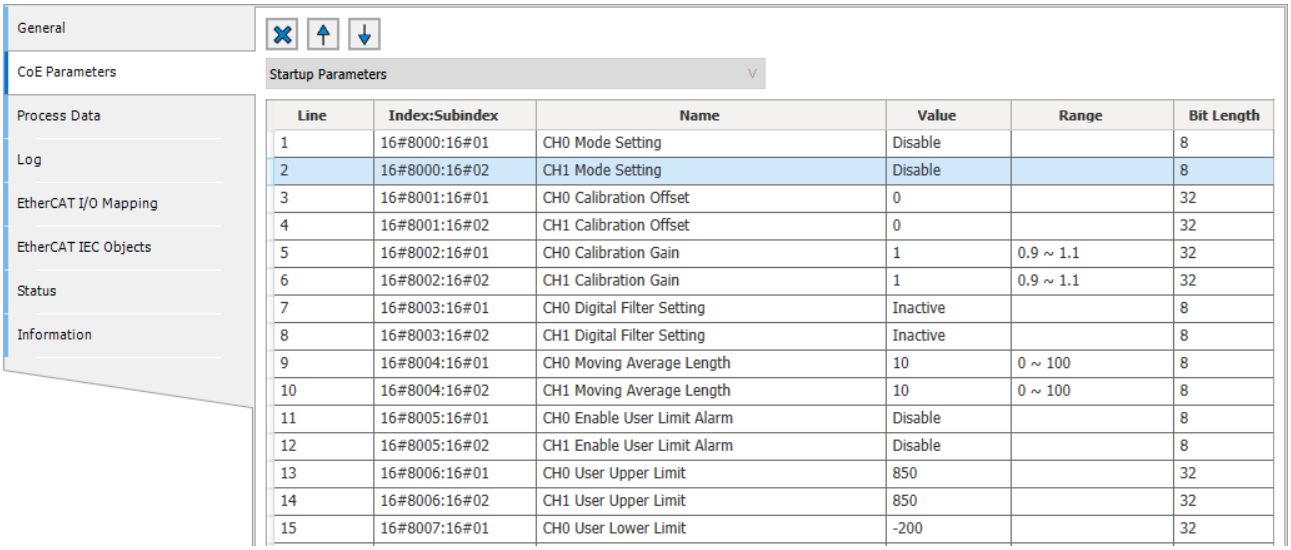
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

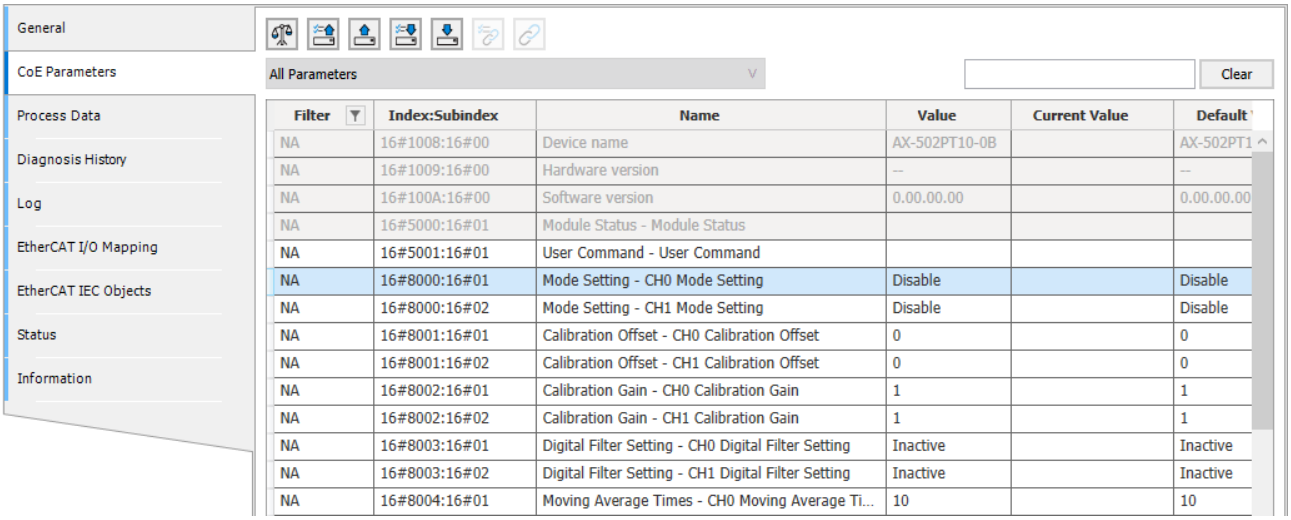


Line	Index:Subindex	Name	Value	Range	Bit Length
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8001:16#01	CH0 Calibration Offset	0		32
4	16#8001:16#02	CH1 Calibration Offset	0		32
5	16#8002:16#01	CH0 Calibration Gain	1	0.9 ~ 1.1	32
6	16#8002:16#02	CH1 Calibration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

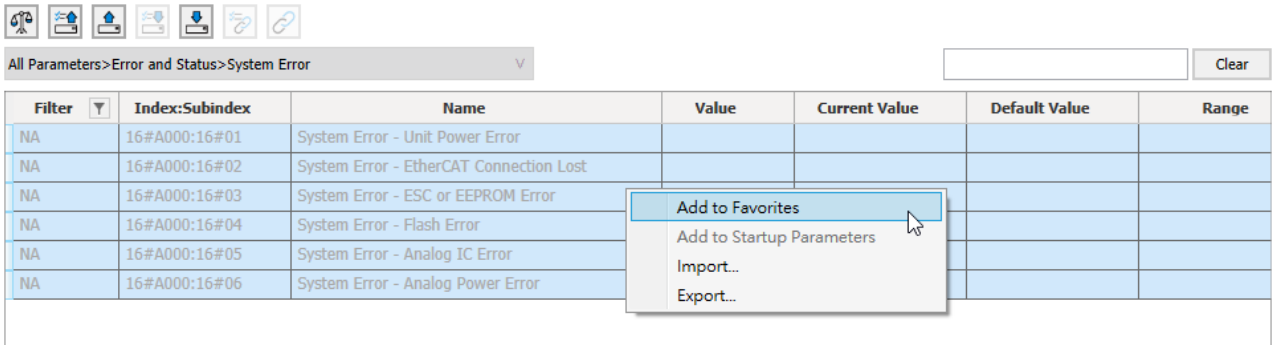
(3) All Parameters

- 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.

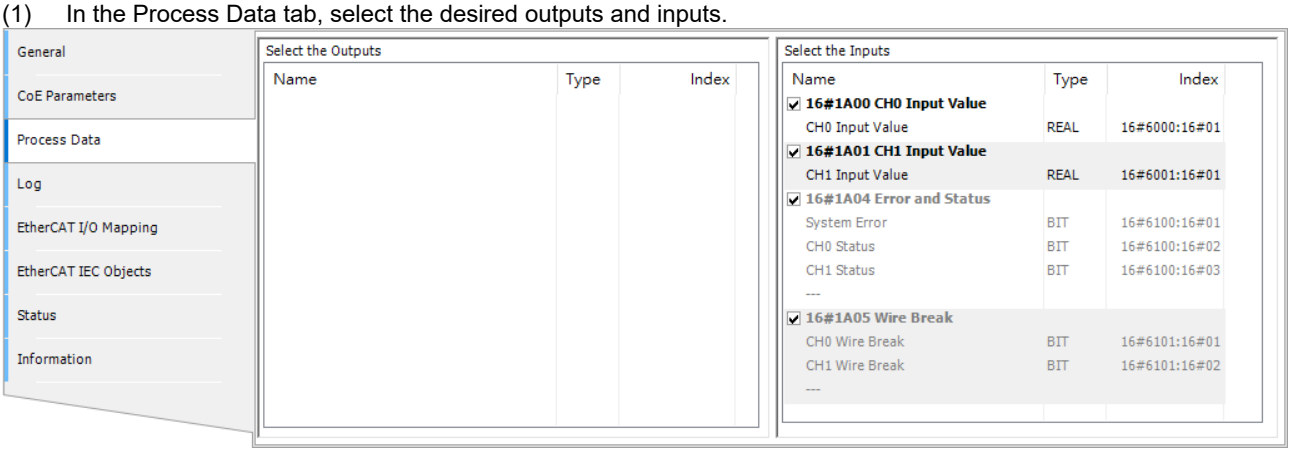
- You can select and right-click the parameter to add the selected parameter to the Favorites.



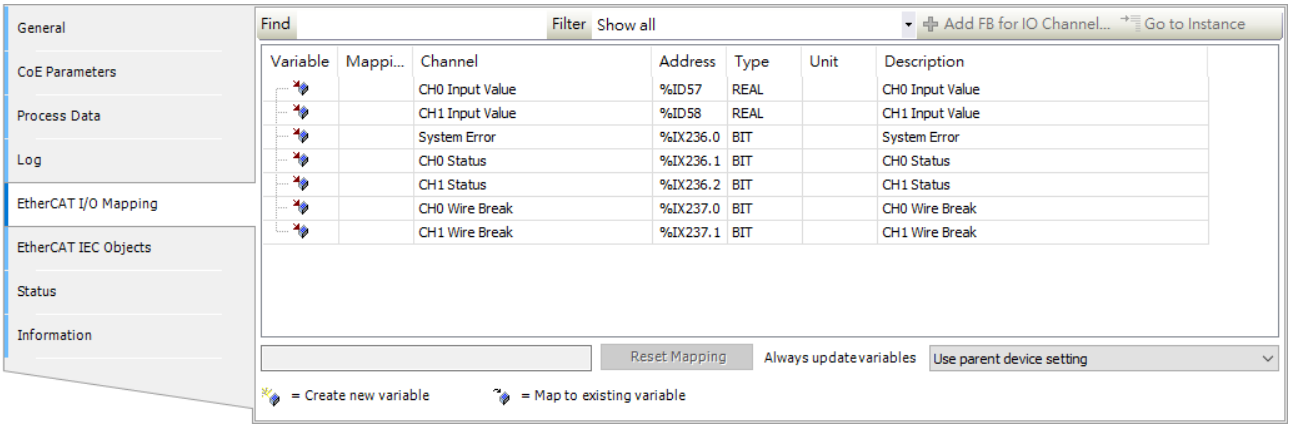
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.10.4.3 Process Data

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

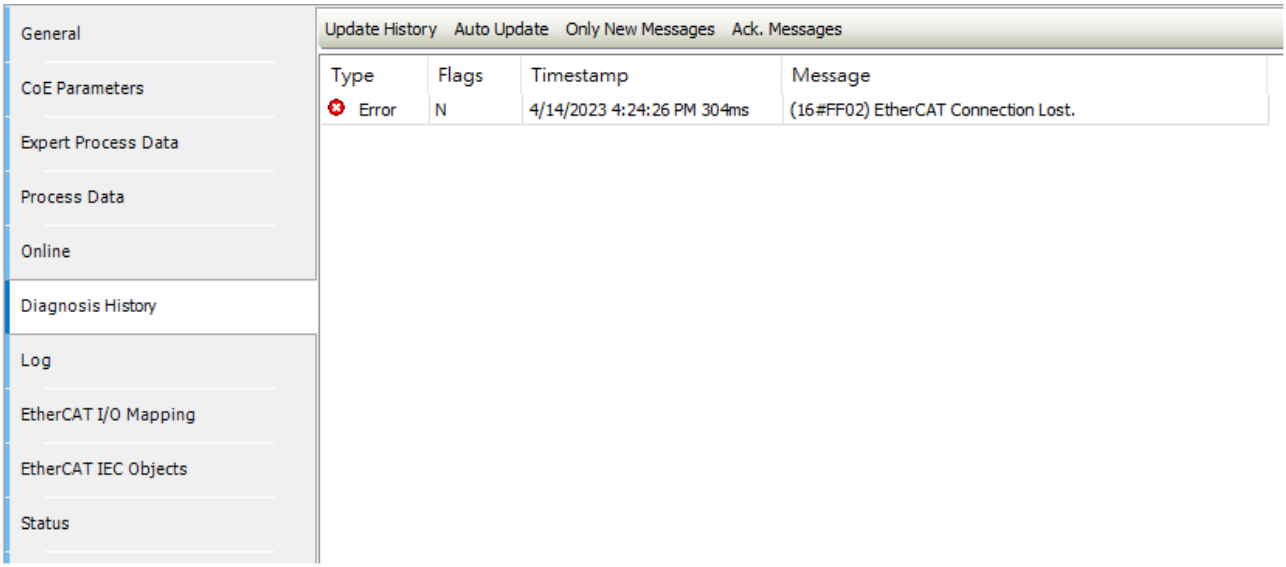


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



5.10.4.4 Diagnosis History

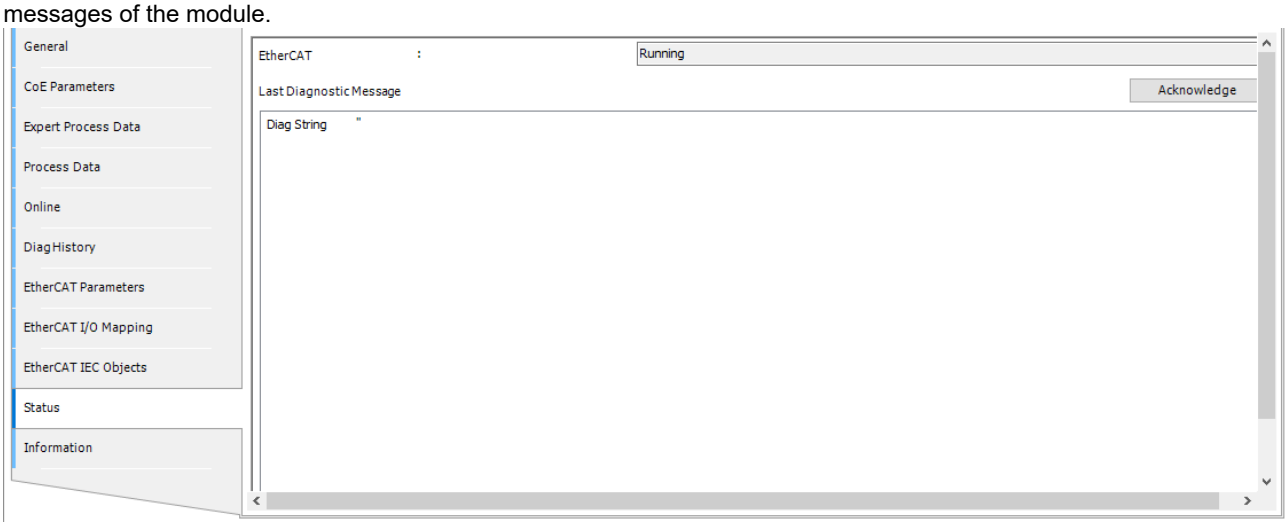
Click  on the toolbar to go into online mode. The Diagnosis History tab records all error information that occurred on the module. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors



5

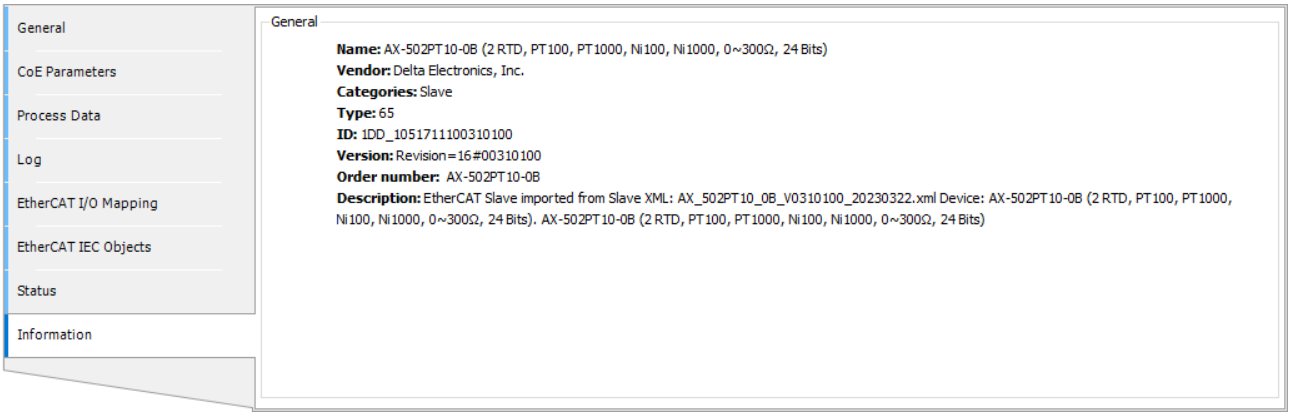
5.10.4.5 Status

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 to 850 °C	-328 to 1562 °F
2	Pt100 (3 Wire)		
3	Pt100 (4 Wire)		
4	Pt1000 (2 Wire)		
5	Pt1000 (3 Wire)		
6	Pt1000 (4 Wire)		

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	0.0
	16#02	CH1 Calibration Offset		REAL	RW	0.0
16#8002	16#01	CH0 Calibration Gain	Gain Setting range: 0.9 to 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 to 100 times	USINT	RW	10
	16#02	CH1 Moving Average Times		USINT	RW	10

- **Explanation**

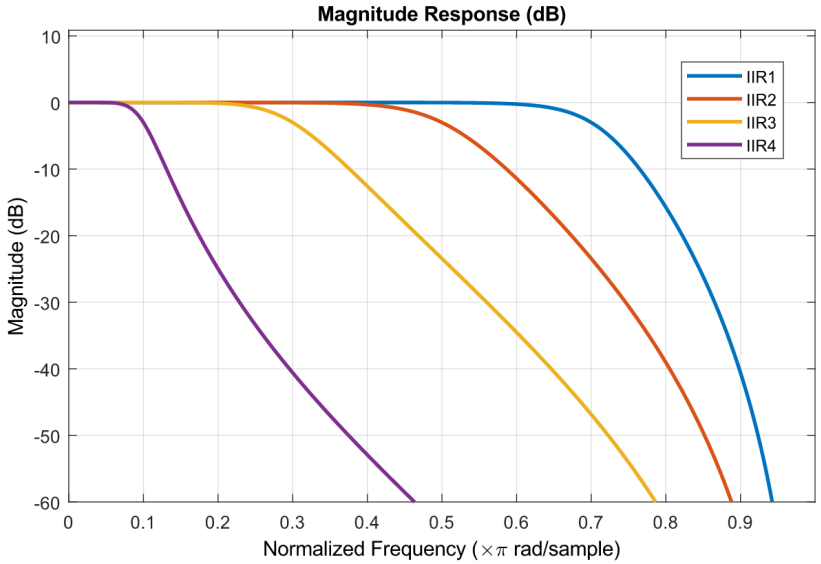
The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The conversion time will not be affected when the digital filter is enabled.

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

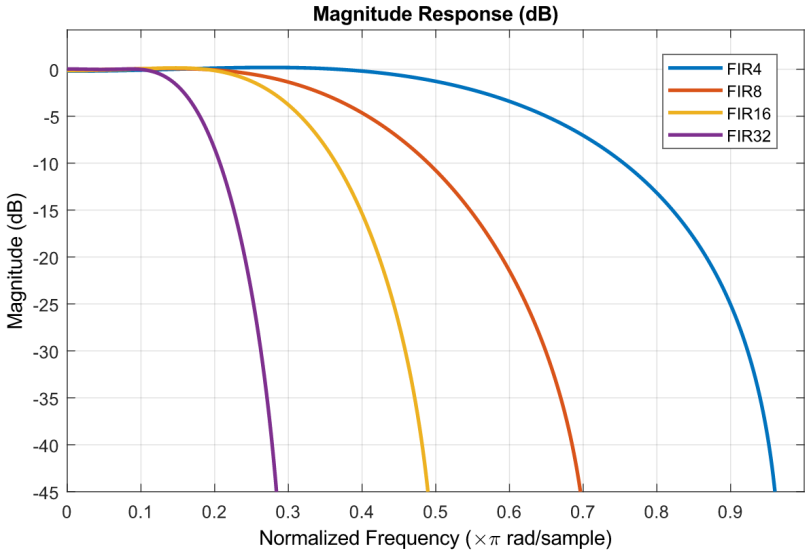
An infinite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, an IIR filter works more efficiently than a moving average filter does. This IIR filter is a low-pass filter. The advantage of an IIR filter is that within the same length of operation 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 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: 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	USINT	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	850.0
	16#02	CH1 User Upper Limit				
16#8005	16#01	CH0 User Lower Limit	User-defined lower limit; Setting range: no limit	REAL	RW	-200.0
	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**

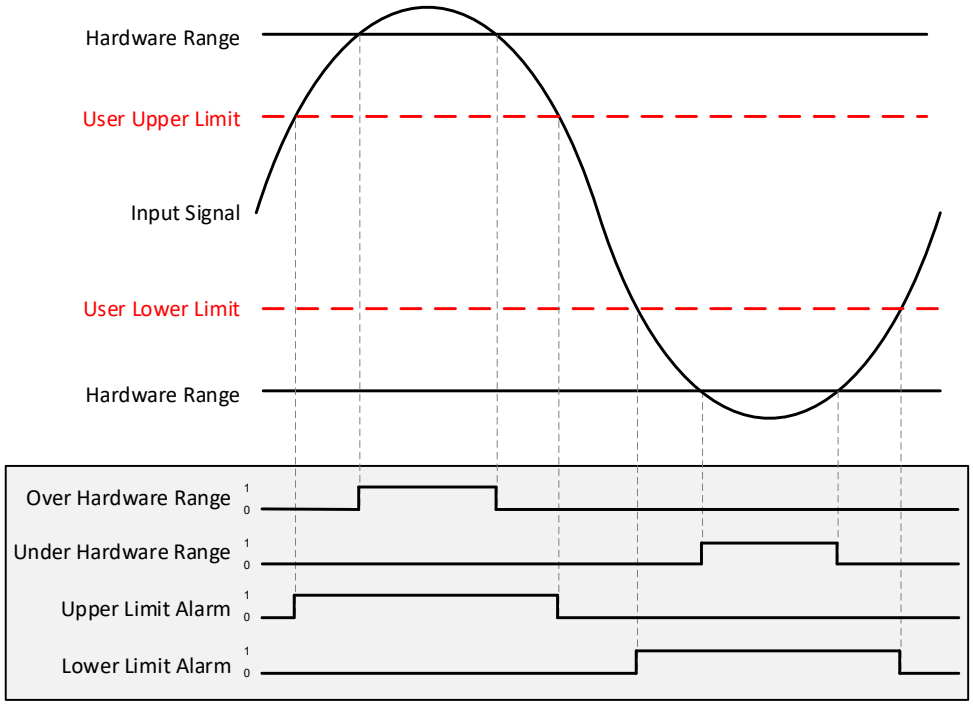
Set the parameters as follows:

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 to 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	0
	16#02	CH1 Unit of Temperature		USINT	RW	0

- **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

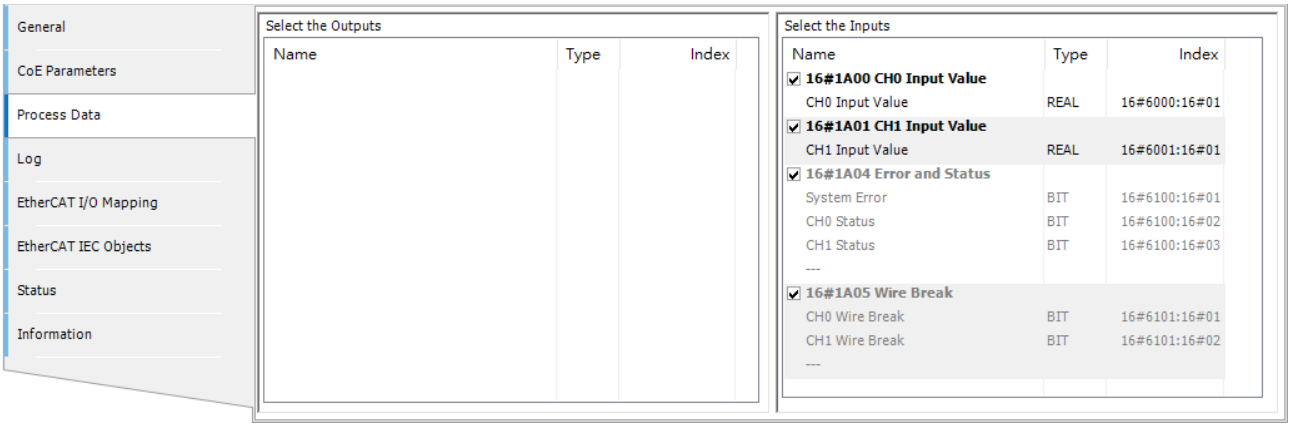
This section introduces the settings and monitoring of PDO data exchange.

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

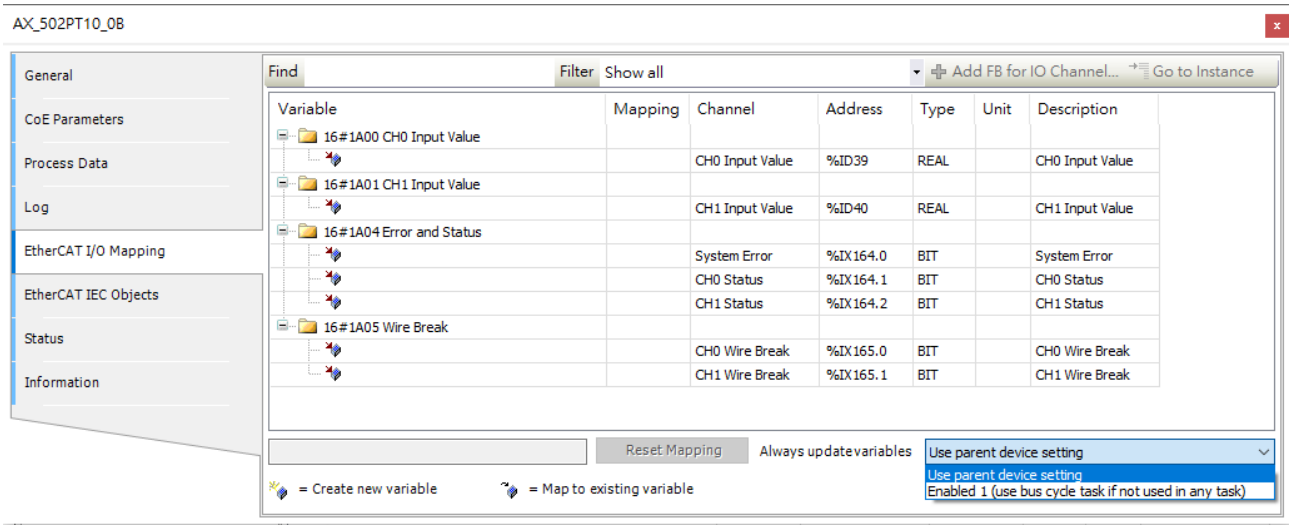
Go to the Process Data tab and select the data that you'd like to monitor.

- 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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 (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 to 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.

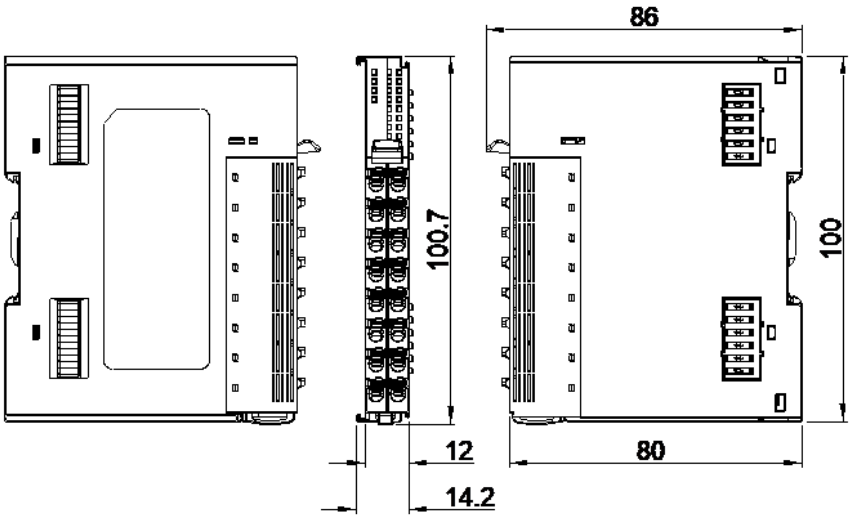
5.11.1 Specifications

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, 100 Ω 3850 PPM/°C Pt1000: DIN EN60751, 1 kΩ 3850 PPM/°C Ni100, Ni1000: DIN 43760 0 to 300 Ω
	Connection type	2-wire, 3-wire, 4-wire
	Resolution	0.001°C/0.0018°F*1
	Temperature measurement accuracy	±0.3%: 25ºC (F.S.) ±0.5%: 0 to 60ºC (F.S.) ±1%: <-20 to 0ºC (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	2/4-wire: PT100, Ni100, 0 to 300Ω: 500 μA PT1000, Ni1000: 250 μA 3-wire: PT100, PT1000, Ni100, Ni1000, 0 to 300 Ω: 250 μA
Others	Connection Lost Detection	Yes
	Short Circuit Detection (SCD)	N/A
	Input power protection (voltage range)	± 30 V
	Over Voltage Protection (OVP) /Over Current Protection (OCP)	N/A
	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.

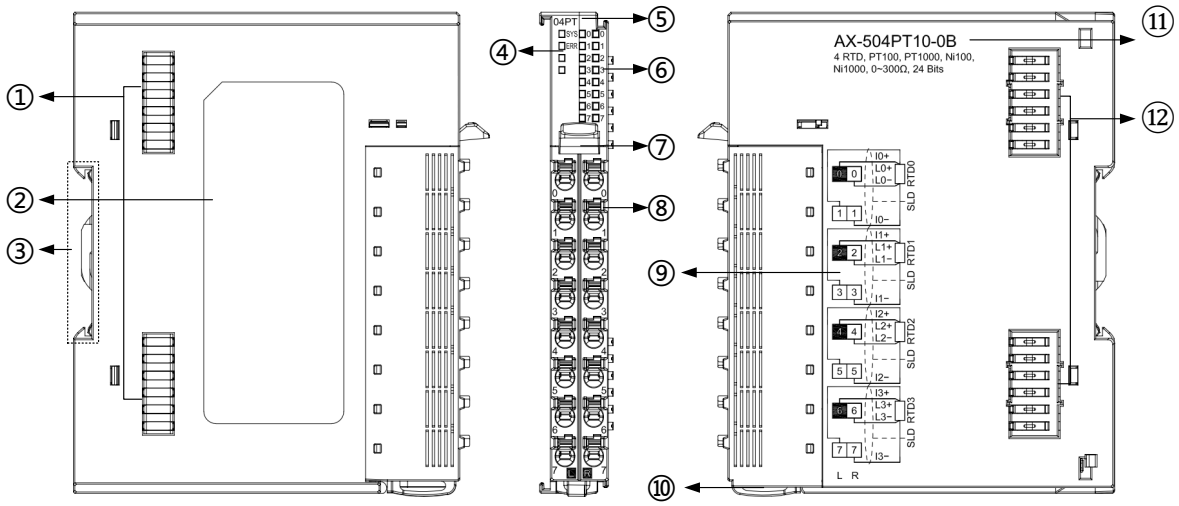
5.11.2 Dimensions and Parts

- **Dimensions**



Unit: mm

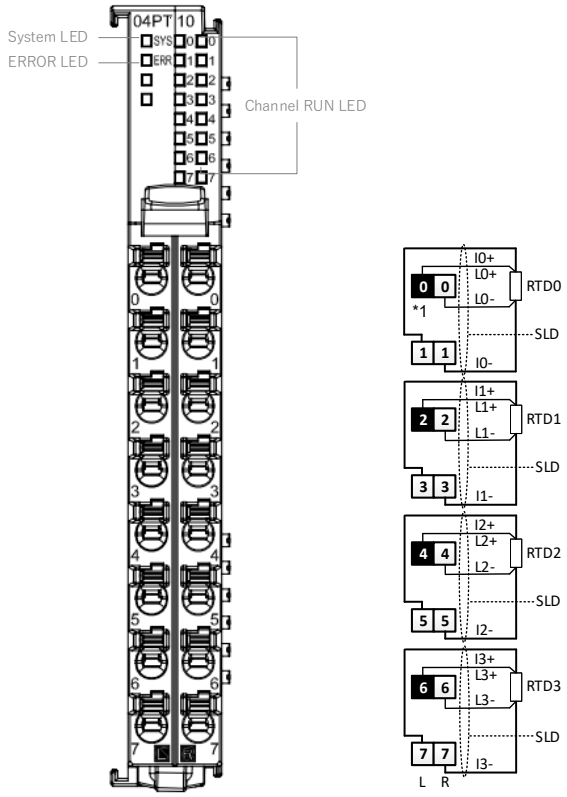
- **Parts**



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.

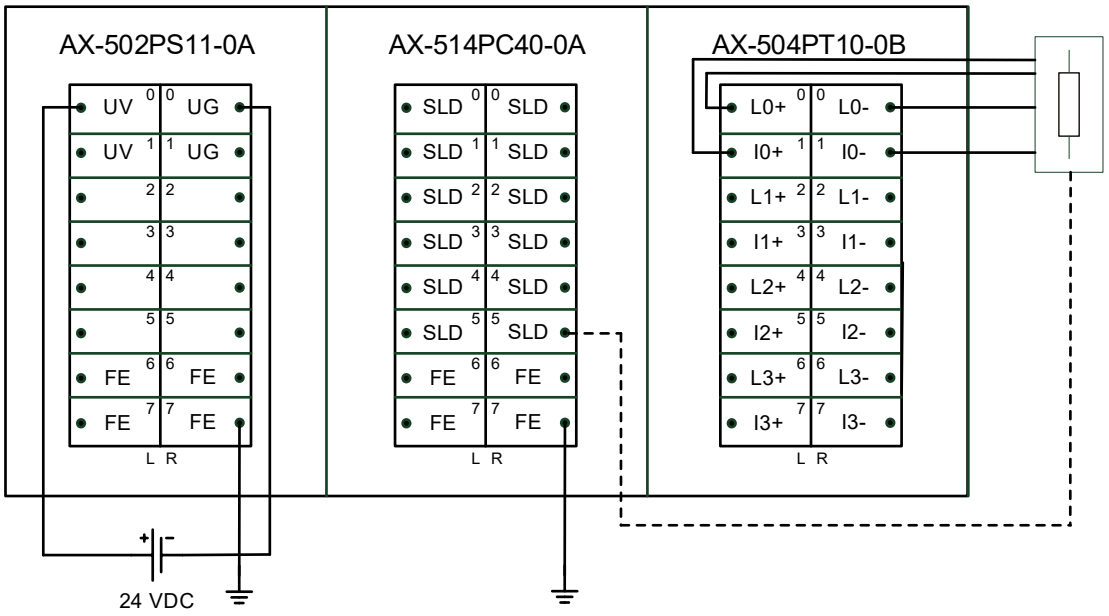
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	L0+	Channel 0: sensor positive input	R0	L0-	Channel 0: sensor negative input
L1	I0+	Channel 0: power positive output	R1	I0-	Channel 0: power negative output
L2	L1+	Channel 1: sensor positive input	R2	L1-	Channel 1: sensor negative input
L3	I1+	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

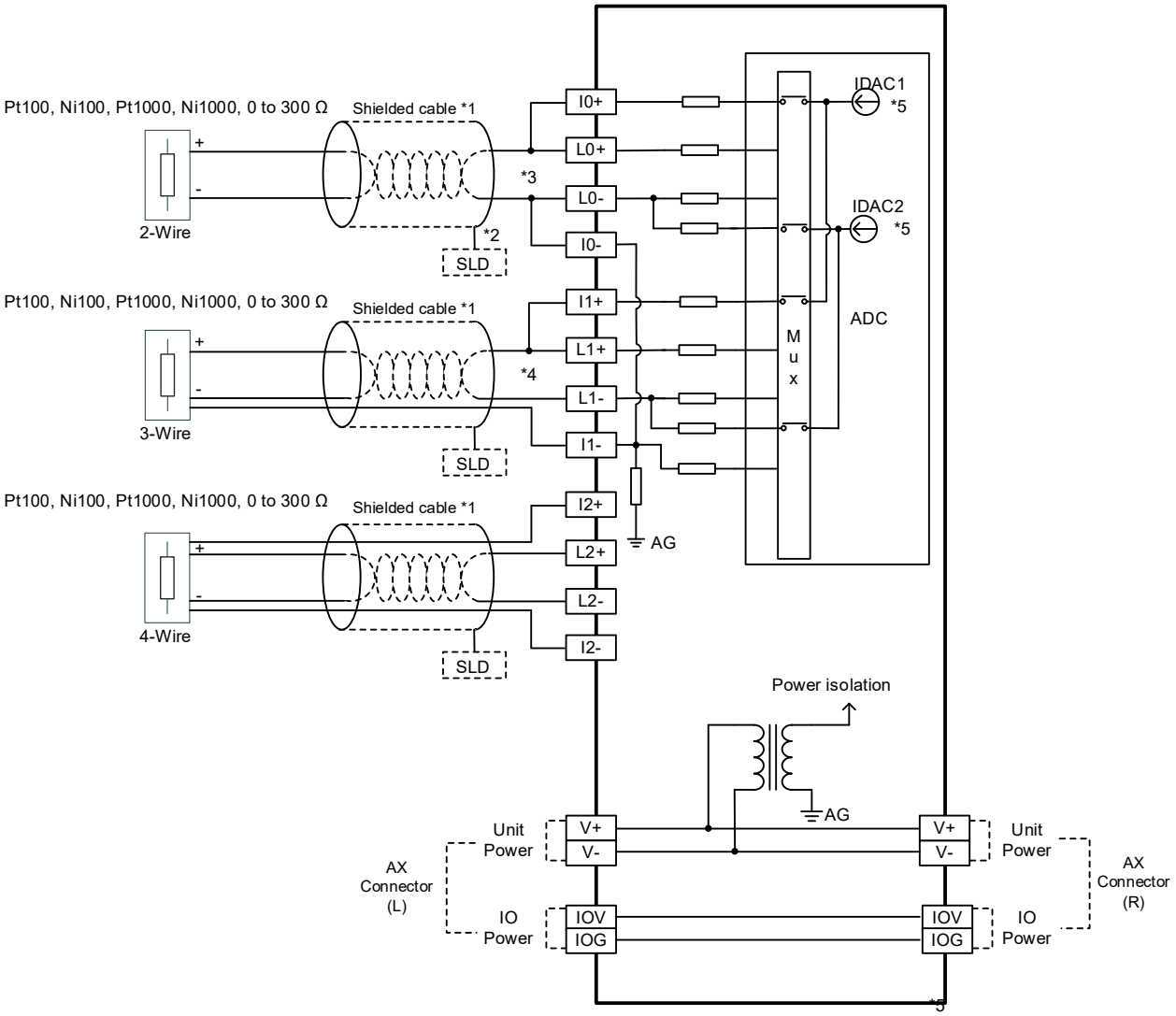
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2 s)	ECAT Pre OP
			Blinking (1 s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1 s)	An error occurs on the application.
			Blinking (0.2 s)	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 and 4).
*4. If you use three-wire temperature sensors, In+ & Ln+ must be short-circuited (where n is between 1 and 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.

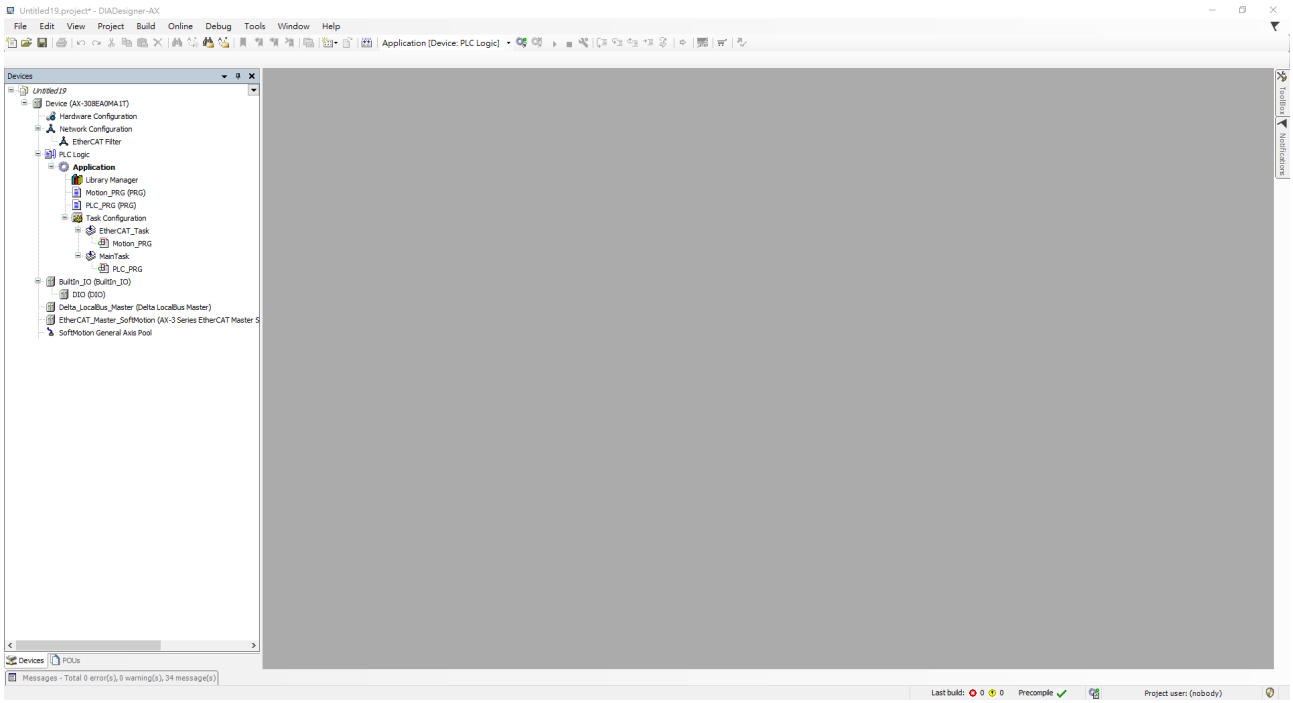
Wiring Mode	Sensor	IDAC1	IDAC2
2/4 Wire	PT100, Ni100, 0 to 300 Ω	500 μA	OFF
	PT1000, Ni1000	250 μA	
3 Wire	PT100, Ni100, 0 to 300 Ω	250 μA	250 μA
	PT1000, Ni1000		

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

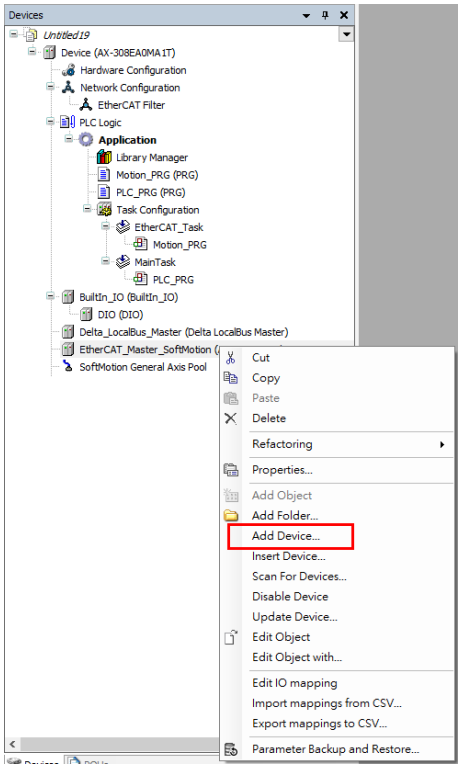
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



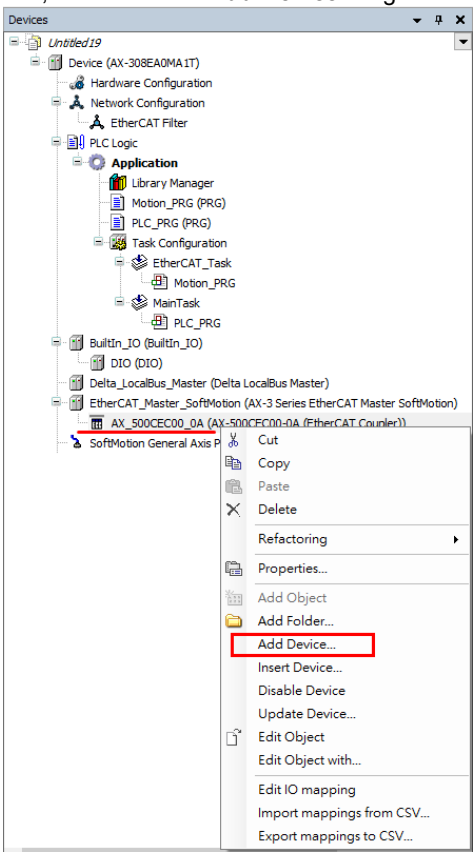
(2) Add Modules in

- 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.

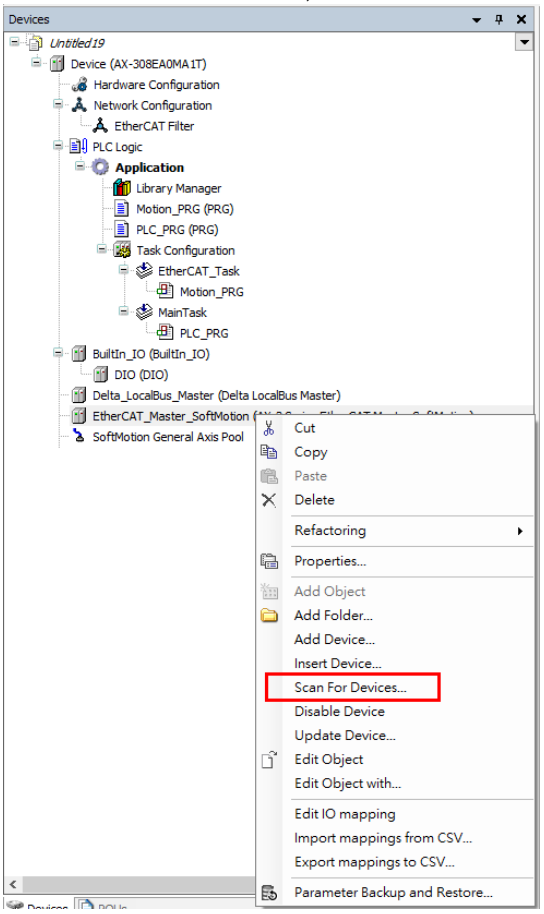


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

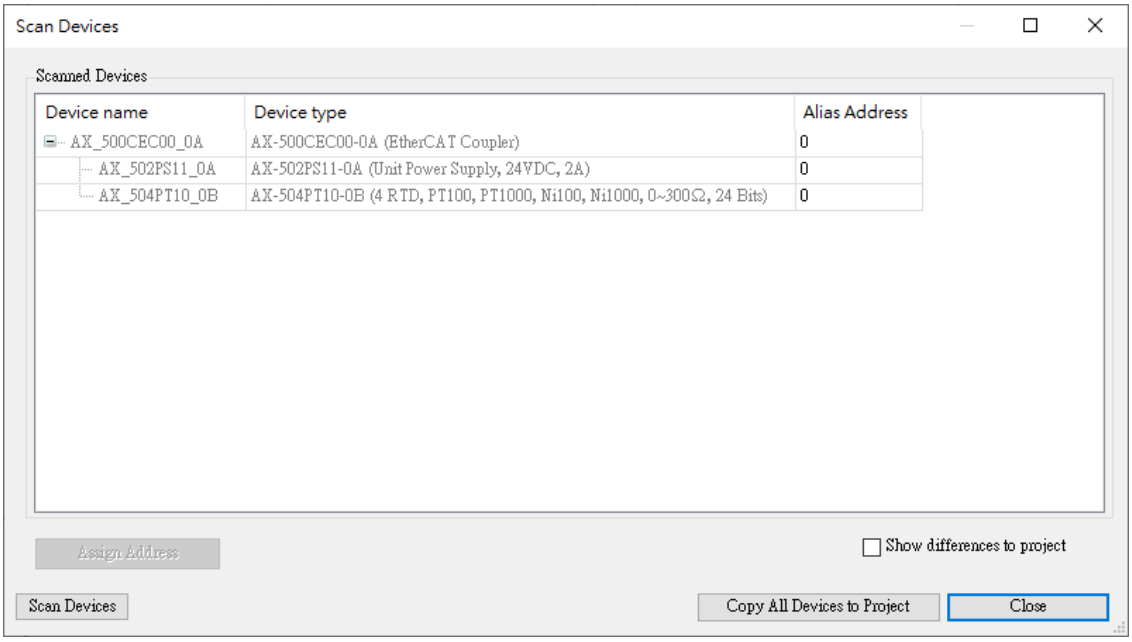


- Method 2: Scan to add the modules in.

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

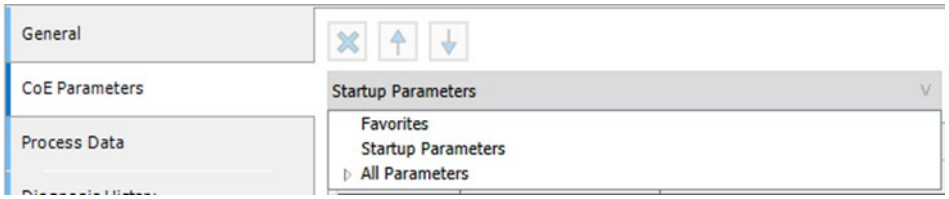


After the auto-scan is over, the actually connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



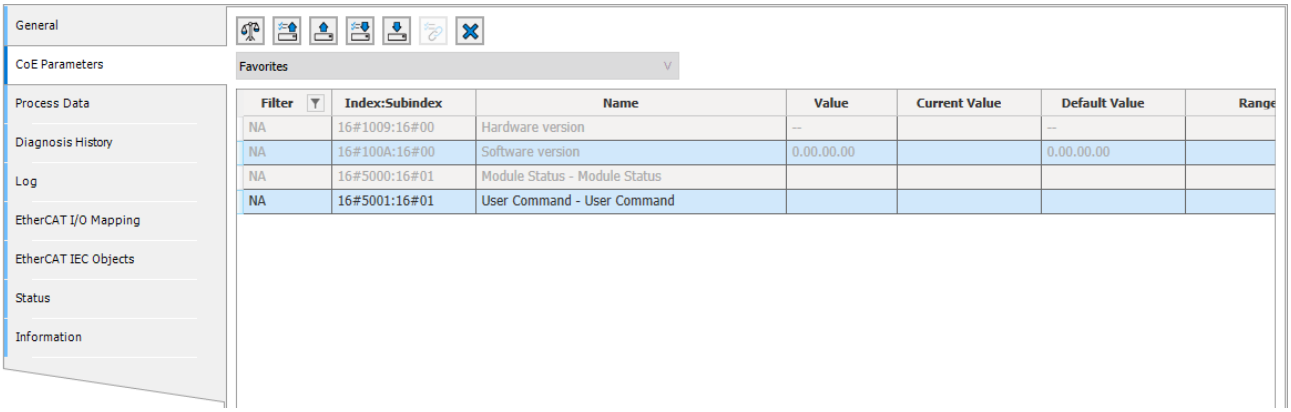
5.11.4.2 Parameter Settings

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



(1) Favorites

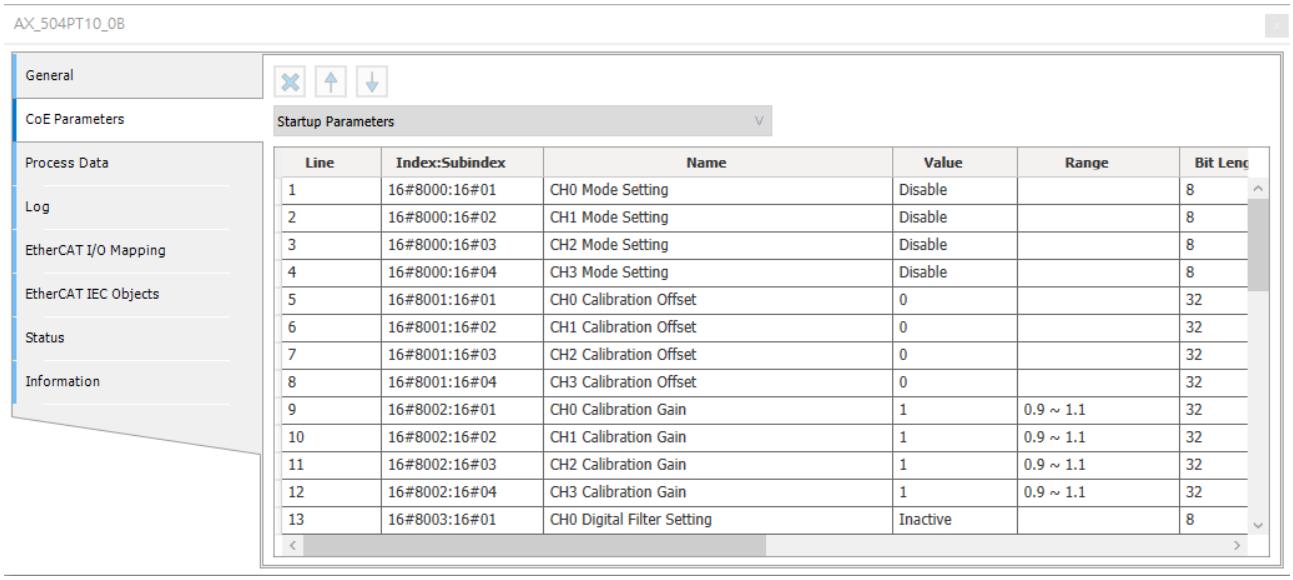
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

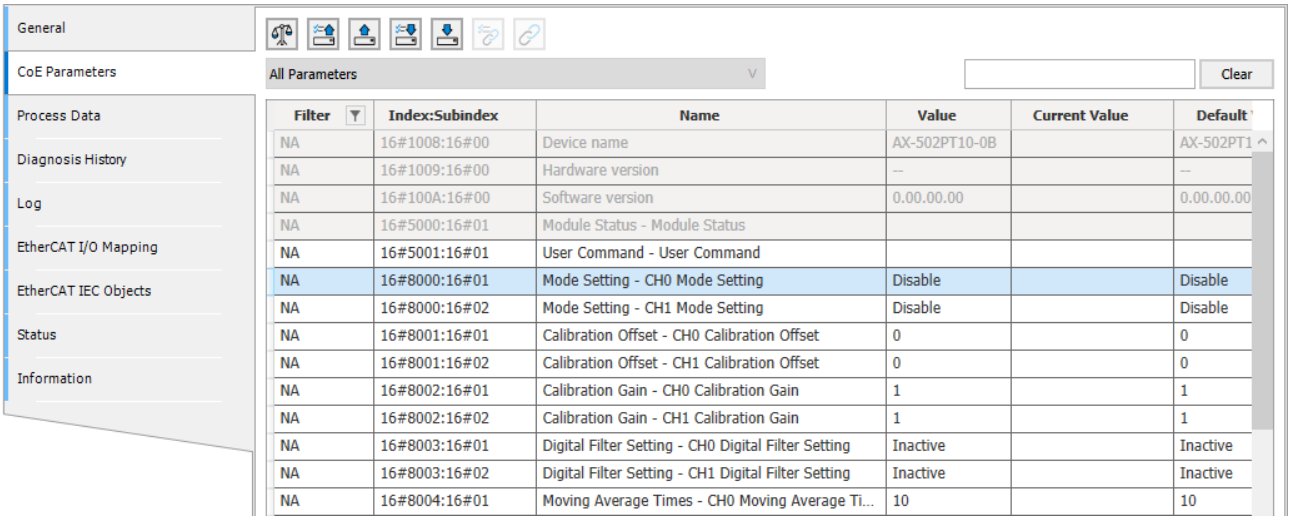


Line	Index:Subindex	Name	Value	Range	Bit Lenc
1	16#8000:16#01	CH0 Mode Setting	Disable		8
2	16#8000:16#02	CH1 Mode Setting	Disable		8
3	16#8000:16#03	CH2 Mode Setting	Disable		8
4	16#8000:16#04	CH3 Mode Setting	Disable		8
5	16#8001:16#01	CH0 Calibration Offset	0		32
6	16#8001:16#02	CH1 Calibration Offset	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

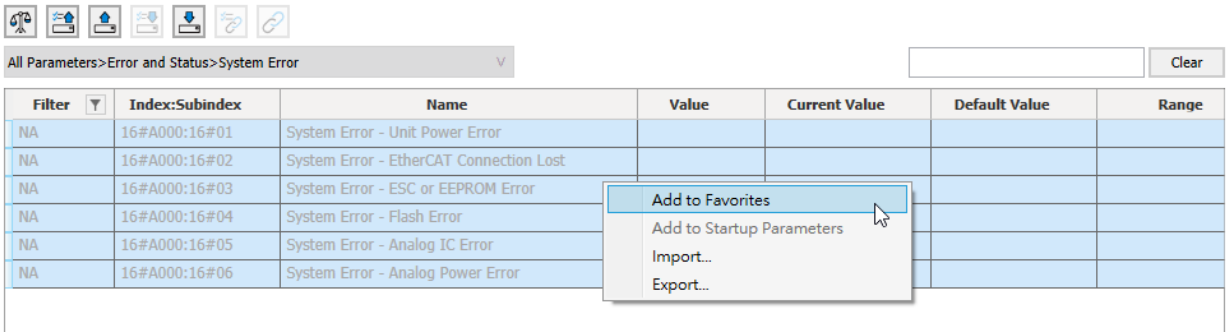
(3) All Parameters

- 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.

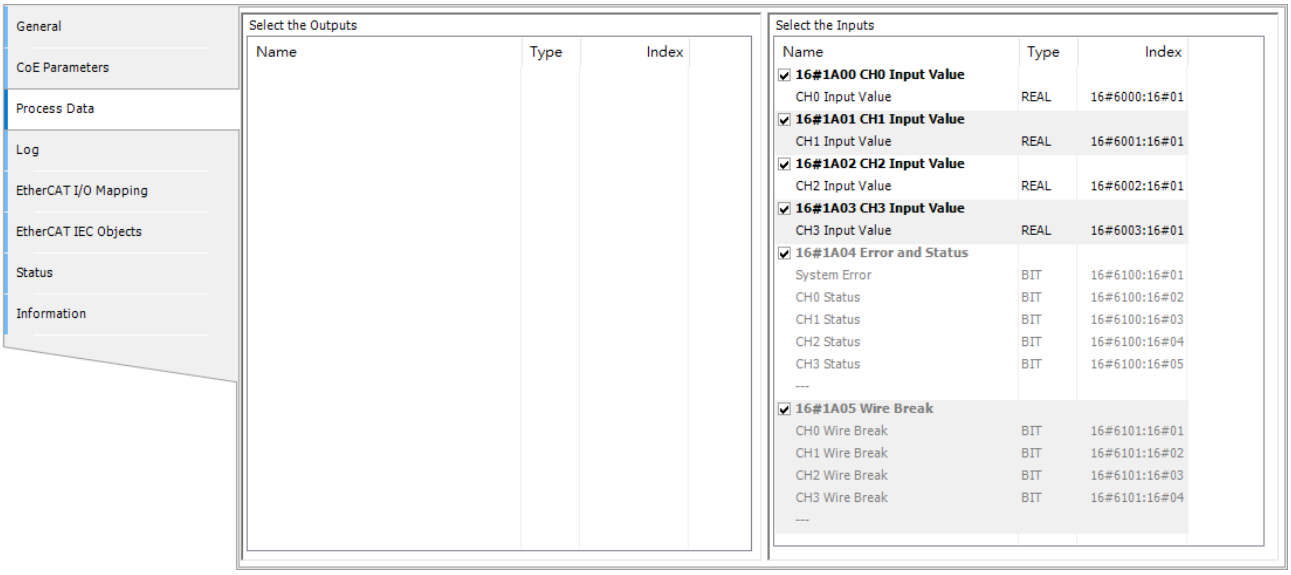
- You can select and right-click the parameter to add the selected parameter to the Favorites.



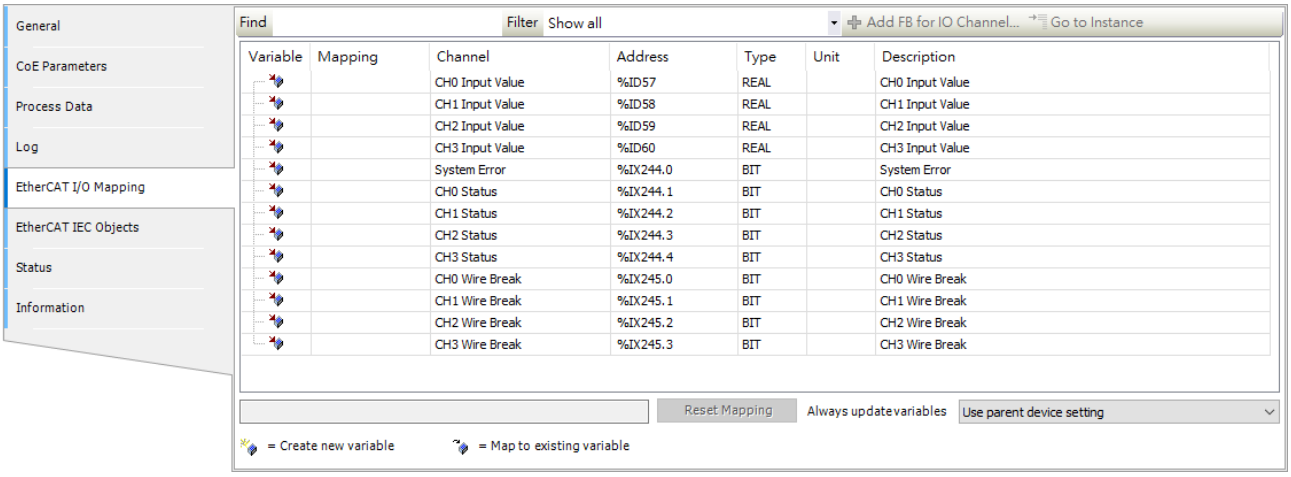
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

5.11.4.3 Process Data

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

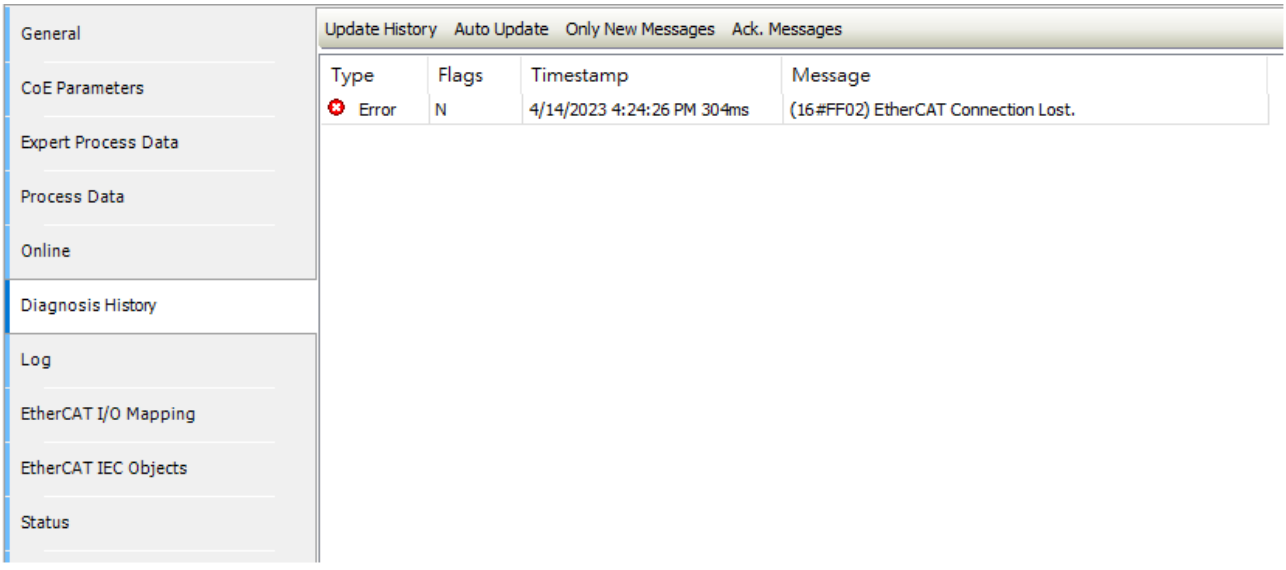


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



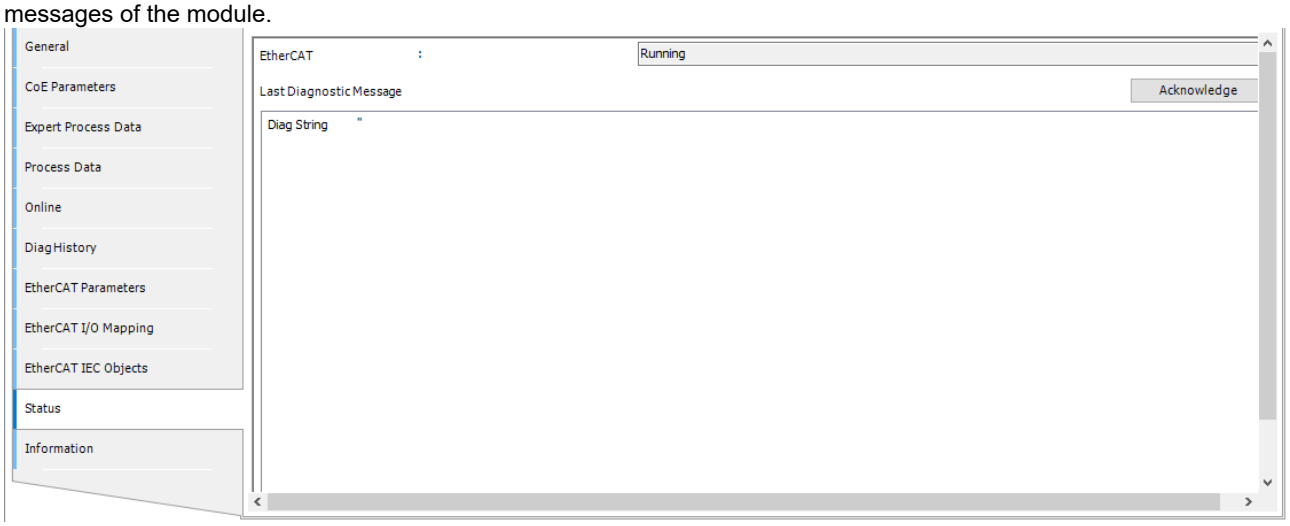
5.11.4.4 Diagnosis History

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.



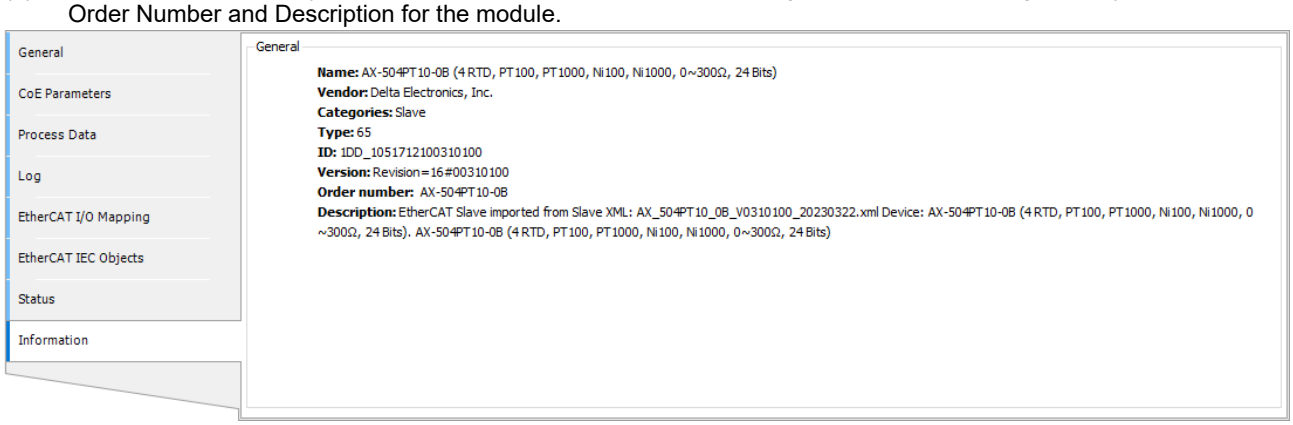
5.11.4.5 Status

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	100 ms
OFF	ON	100 ms
ON	ON	200 ms

CH2 Mode	CH3 Mode	Conversion Time
ON	OFF	100 ms
OFF	ON	100 ms
ON	ON	200 ms

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 ºC	-328 –1562 ºF
2	Pt100 (3 Wire)	-200 – 850 ºC	-328 –1562 ºF
3	Pt100 (4 Wire)	-200 – 850 ºC	-328 –1562 ºF
4	Pt1000 (2 Wire)	-200 – 850 ºC	-328 –1562 ºF
5	Pt1000 (3 Wire)	-200 – 850 ºC	-328 –1562 ºF
6	Pt1000 (4 Wire)	-200 – 850 ºC	-328 –1562 ºF
7	Ni100 (2 Wire)	-100 – 260 ºC	-148 – 500 ºF
8	Ni100 (3 Wire)	-100 – 260 ºC	-148 – 500 ºF
9	Ni100 (4 Wire)	-100 – 260 ºC	-148 – 500 ºF
10	Ni1000 (2 Wire)	-100 – 260 ºC	-148 – 500 ºF
11	Ni1000 (3 Wire)	-100 – 260 ºC	-148 – 500 ºF
12	Ni1000 (4 Wire)	-100 – 260 ºC	-148 – 500 ºF
13	0 – 300 Ω	0 – 300 Ω	0 – 300 Ω

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	0.0
	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 to 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 to 100 times	USINT	RW	10
	16#02	CH1 Moving Average Times		USINT	RW	10
	16#03	CH2 Moving Average Times		USINT	RW	10
	16#04	CH3 Moving Average Times		USINT	RW	10

- **Explanation**

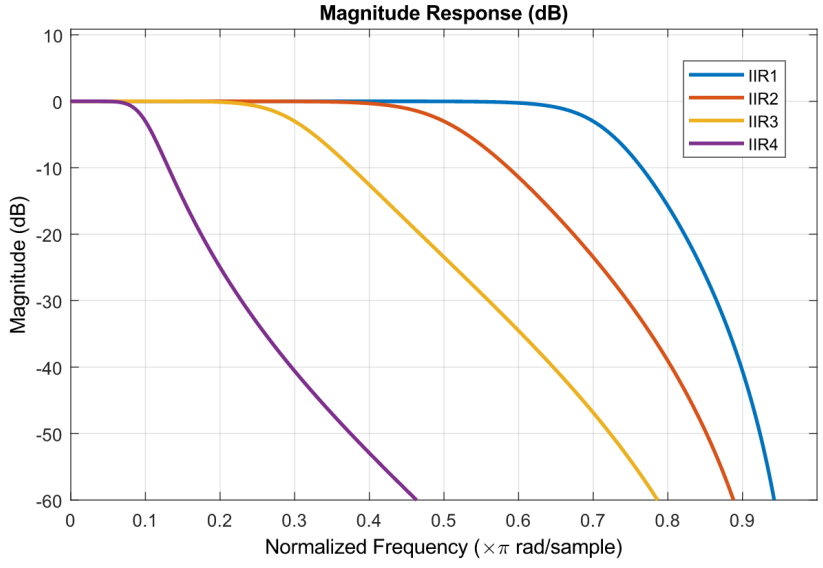
The parameters here are for setting digital filter function. The module provides 3 types of filters, Moving Average Filter, Infinite Impulse Response (IIR) Filter and Finite Impulse Response (FIR) Filter for users to choose from. The conversion time will not be affected when the digital filter is enabled.

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

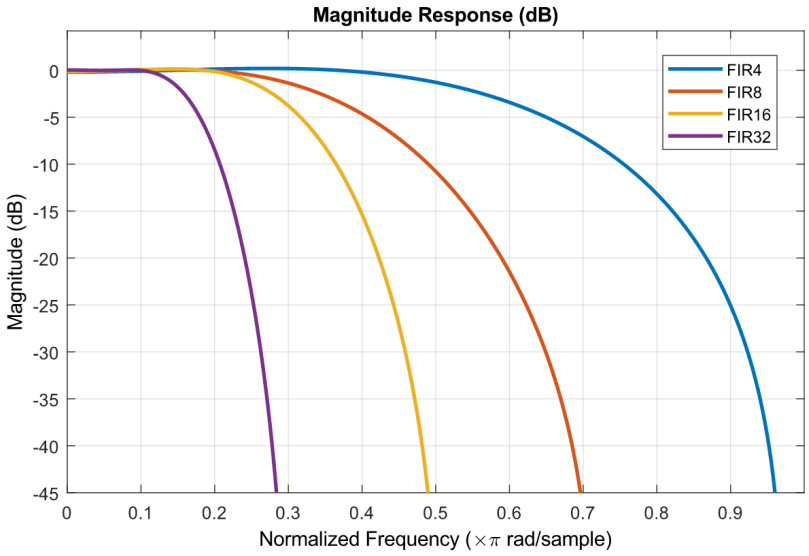
An infinite impulse response filter attenuates unwanted frequency from the input signals. In terms of attenuating noises, an IIR filter works more efficiently than a moving average filter does. This IIR filter is a low-pass filter. The advantage of an IIR filter is that within the same length of operation 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	USINT	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	850.0
	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	-200.0
	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**

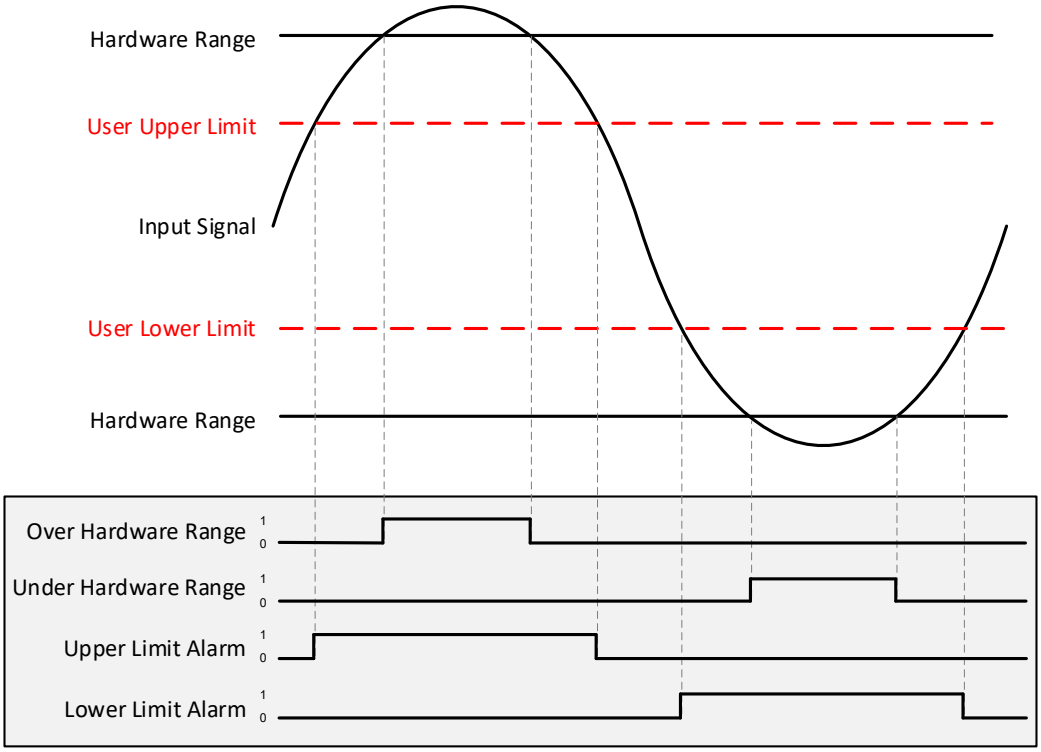
Set the parameters as follows:

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 to 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	0.0
	16#02	CH1 Compensation in two-wire mode		REAL	RW	0.0
	16#03	CH2 Compensation in two-wire mode		REAL	RW	0.0
	16#04	CH3 Compensation in two-wire mode		REAL	RW	0.0

- **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

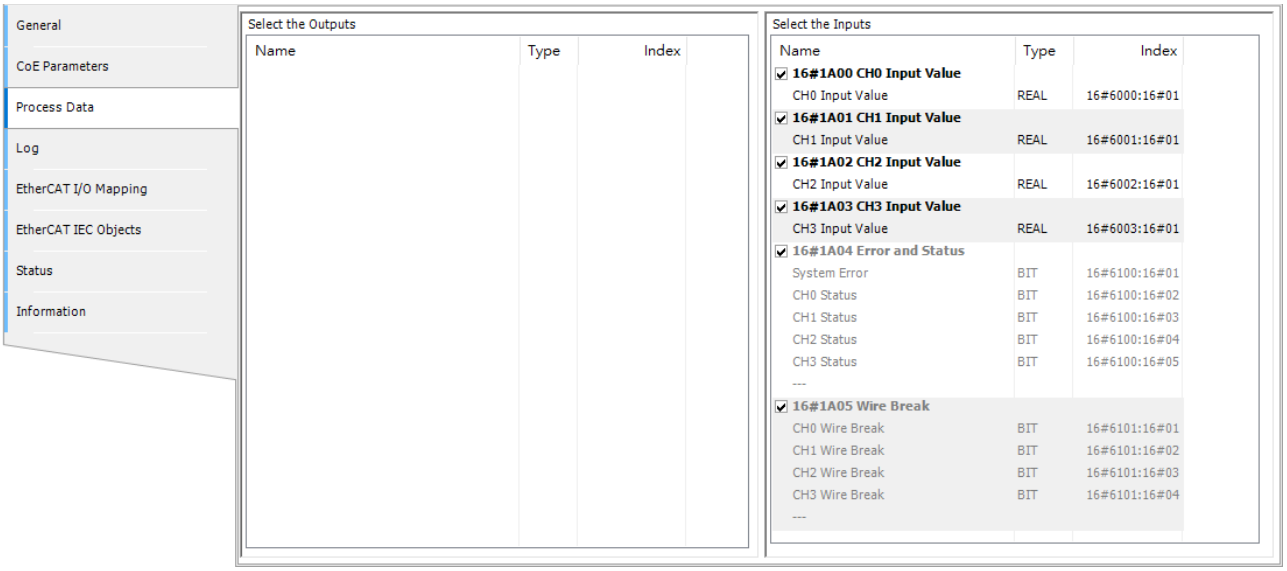
This section introduces the settings and monitoring of PDO data exchange.

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

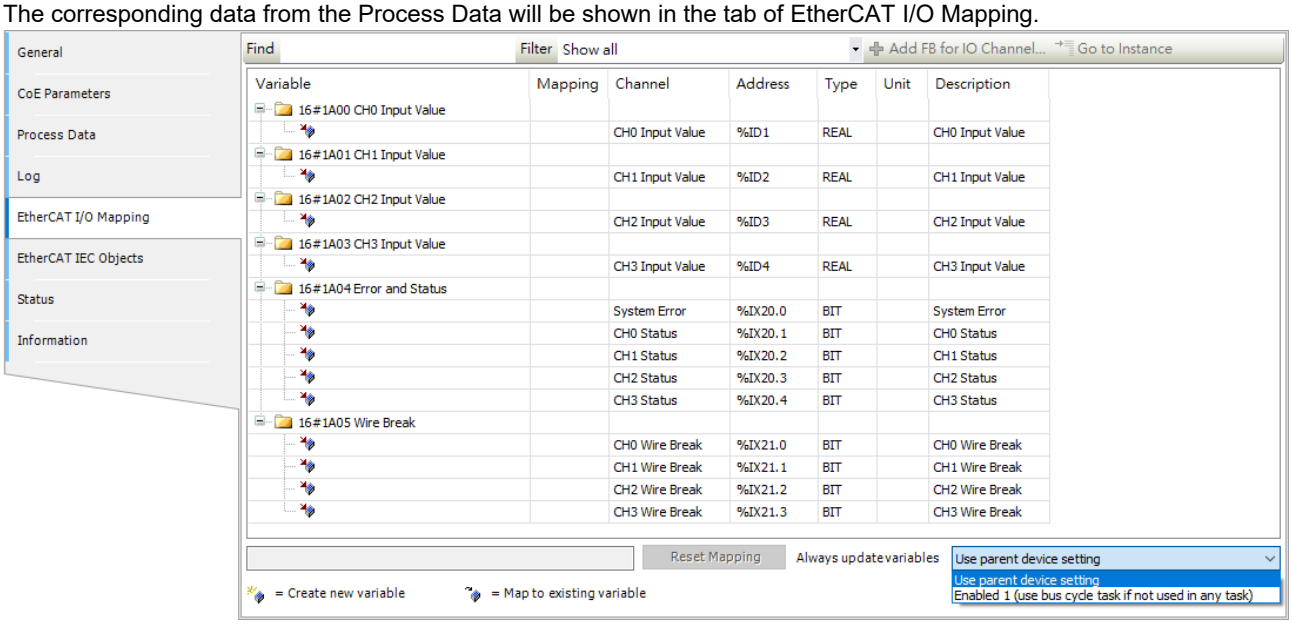
Go to the Process Data tab and select the data that you'd like to monitor.

- 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.



5.11.7.2 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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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 (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 to 4

6

Chapter 6 Positioning Modules

Table of Contents

6.1 AX-502PU01-0A 6-2

6.1.1 Specifications 6-2
6.1.2 Dimensions and Parts 6-3
6.1.3 Arrangement of Terminals, LED Indicators and Wiring 6-5
6.1.4 Settings in DIADesigner-AX 6-8
6.1.5 CiA402 Drive Profile 6-17
6.1.6 Functions and Descriptions of Objects 6-22
6.1.7 EtherCAT Operation Modes 6-75
6.1.8 Process Data 6-76
6.1.9 Example of Hardware Configuration and Software Operation 6-78
6.1.10 Troubleshooting 6-86

6.2 AX-502HC10-0A 6-89

6.2.1 Specifications 6-89
6.2.2 Dimensions and Parts 6-90
6.2.3 Arrangement of Terminals, LED Indicators and Wiring 6-92
6.2.4 Settings in DIADesigner-AX 6-96
6.2.5 System Architecture 6-104
6.2.6 Description of Objects 6-106
6.2.7 EtherCAT Synchronization Modes 6-128
6.2.8 Process Data 6-129
6.2.9 Example of Hardware Configuration and Software Operation 6-133
6.2.10 Troubleshooting 6-139

6.1 AX-502PU01-0A

AX-502PU01-0A, a pulse output module, sends 2-axis pulse signals, driving corresponding pulse-type servos. This section introduces its specifications, wirings and operations.

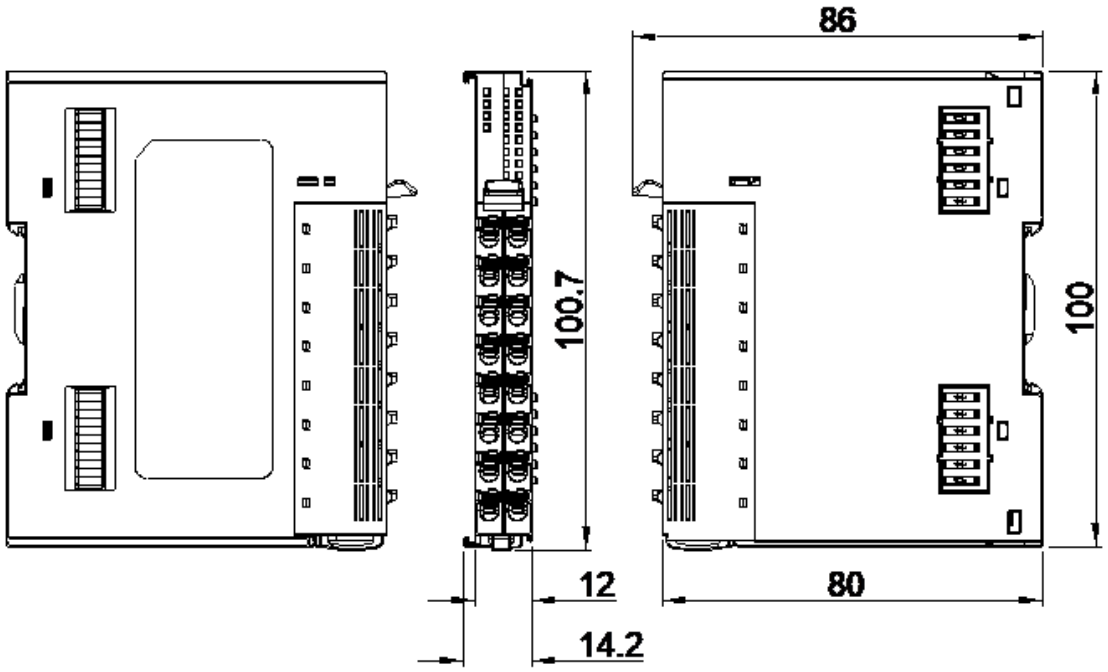
6.1.1 Specifications

Item			Specification
Number of Axes			2
External connector type			Spring-clamp terminal block (16 terminals)
I/O refresh modes			1. Free Run mode 2. DC
Dimension (mm)			12 (W) × 100 (H) × 80 (D)
Weight			70 g
Motion functions		Position control	Absolute positioning, relative positioning
		Velocity control	Constant speed control, variable speed control
		Synchronized control	E-Cam, E-Gear
		Auxiliary function	Homing, Immediate Stop and Smooth Stop
		Manual operation	JOG
Electrical specification	Digital input	Input form	Sourcing input (NPN)
		Input current	2.5 mA TYP. (DC 24 V)
		ON voltage /ON current	11 to 30 V (EN 61131-2, type 3)
		OFF voltage /OFF current	-3 to +5 V (EN 61131-2, type 3)
		Maximum ON/OFF response time	I0-I5: 20 μs / 40 μs I6-I9: 1 μs / 2 μs
	Digital output	Output form	Sinking output (NPN)
		Load voltage	24 VDC (-15 % to +20 %)
		Maximum load current	30 mA /point
		Maximum surge current	0.5 A /point, 10 ms
		Maximum leakage current	0.1 mA
		Maximum frequency (QA0/QB0/QA1/QB1)	500 kHz
		Maximum ON/OFF response time (Q0/Q1)	1 μs / 2 μs
	Maximum cable length		3 m
	Power insulation		-
	Signal insulation		Digital isolator (2.5 kVAC)
	Insulation between channels		-
	Maximum power consumption (UV, UG)		300 mA (1.5 W)
	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

Item			Specification
	Digital output	Connection Lost Protection	-
		Short Circuit Protection (SCP)	-
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	YES

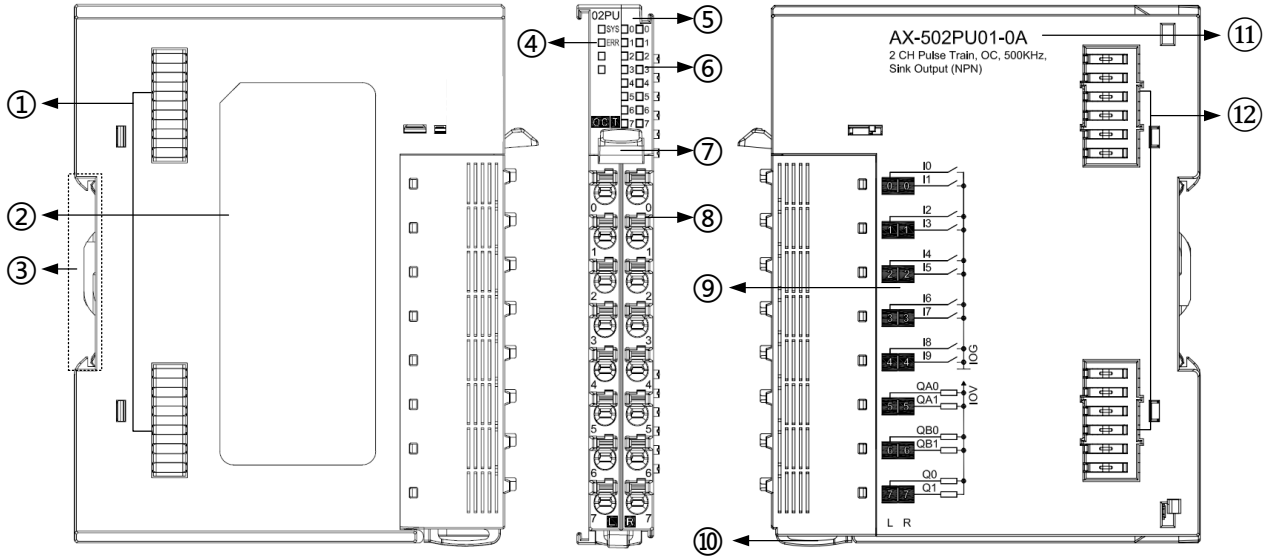
6.1.2 Dimensions and Parts

- **Dimensions**



Unit: mm

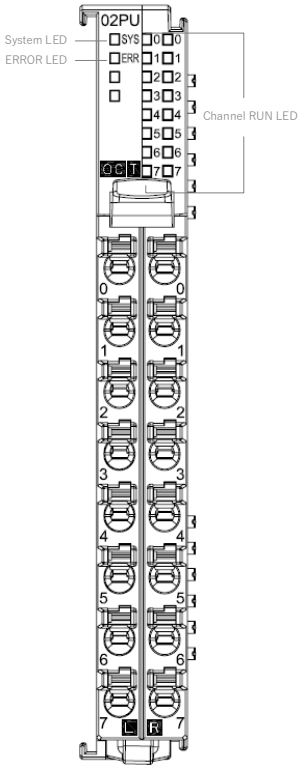
- **Parts**



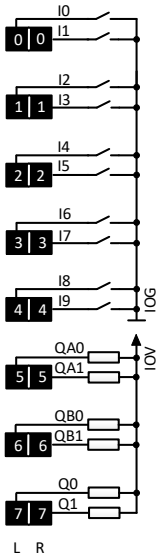
No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener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

6.1.3 Arrangement of Terminals, LED Indicators and Wiring

6.1.3.1 Arrangement of Terminals



AX-502PU01-0A



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

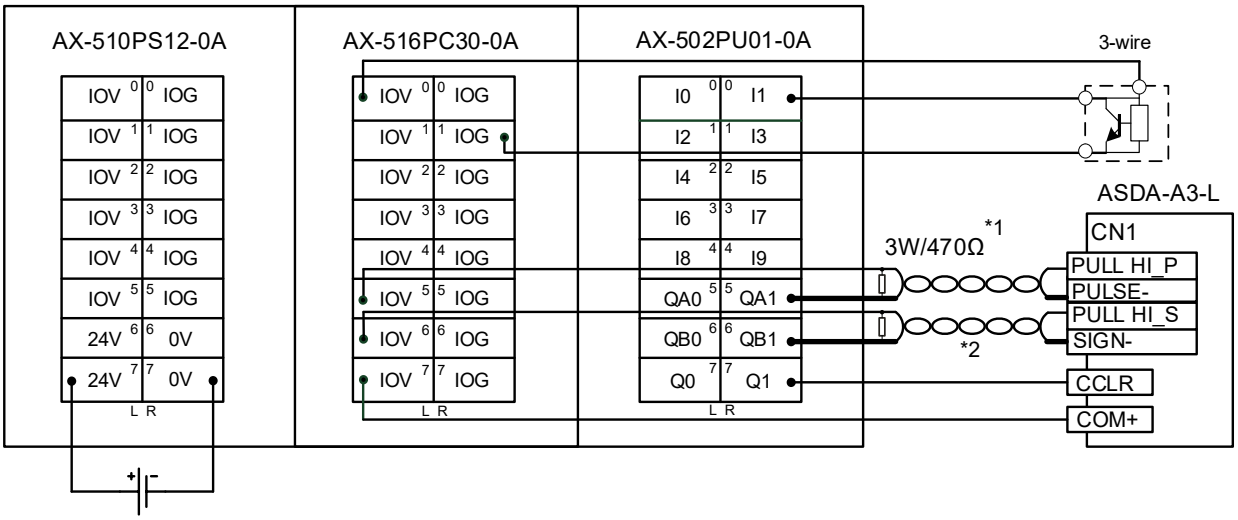
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	I0	Digital input DI0	R0	I1	Digital input DI1
L1	I2	Digital input DI2	R1	I3	Digital input DI3
L2	I4	Digital input DI4	R2	I5	Digital input DI5
L3	I6	Digital input DI6	R3	I7	Digital input DI7
L4	I8	Digital input DI8	R4	I9	Digital input DI9
L5	QA0	Pulse output A0	R5	QA1	Pulse output A1
L6	QB0	Pulse output B0	R6	QB1	Pulse output B1
L7	Q0	Digital output DQ0	R7	Q1	Digital output DQ1

6.1.3.2 LED Indicators

Name	Color	Status		Description
System	Blue		OFF	No power supplied or INIT
			Blinking (0.2s)	EtherCAT Pre OP
			Blinking (1s)	EtherCAT Safe OP
			ON	Normal (OP)
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (0.2s)	An error occurs on the application.
			Blinking (2s)	A warning occurs.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

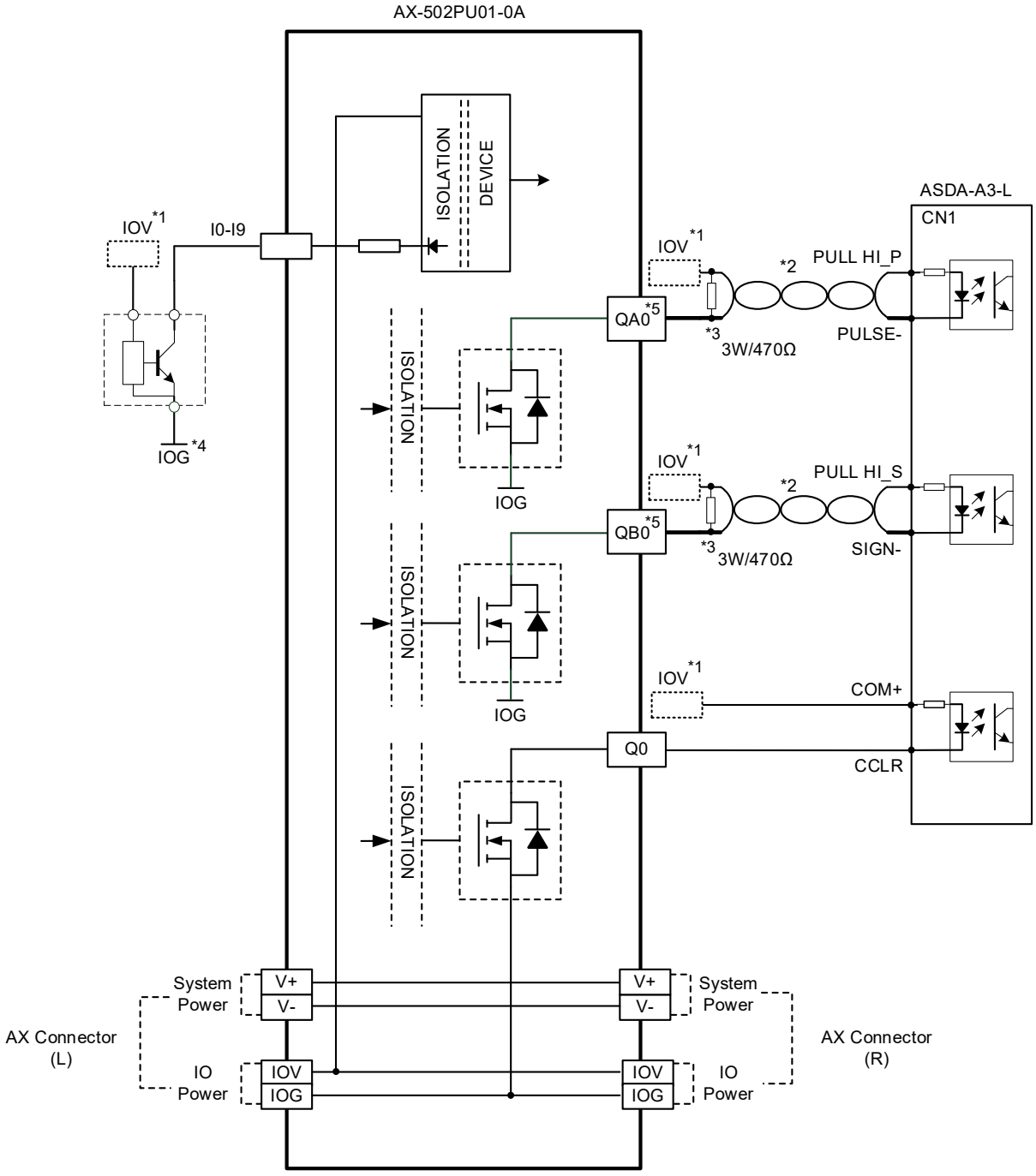
6.1.3.3 Wiring and Loop Configuration

- **Wiring**



*1. An external pull-up resistor of 3W/470 Ω is required for each of QA and QB output points.
*2. Keep QA and QB signal lines away from the power lines and the devices that generate noise.

- **Loop Configuration**



*1 When ASDA-A3-L is in the open-collector NPN form, use the external power supply, and the power supply for COM+, PULL HI-P, and PULL HI-S is from IOV.
*2 Keep QA and QB signal lines away from both the power lines and the devices that generate noise.
*3 An external pull-up resistor of 3W/470 Ω is required for each of QA and QB output points.
*4 The 0 V of the sensor for digital input is connected to IOG common point.
*5 Please wire QA1 and QB1 to use the second set of pulse outputs.

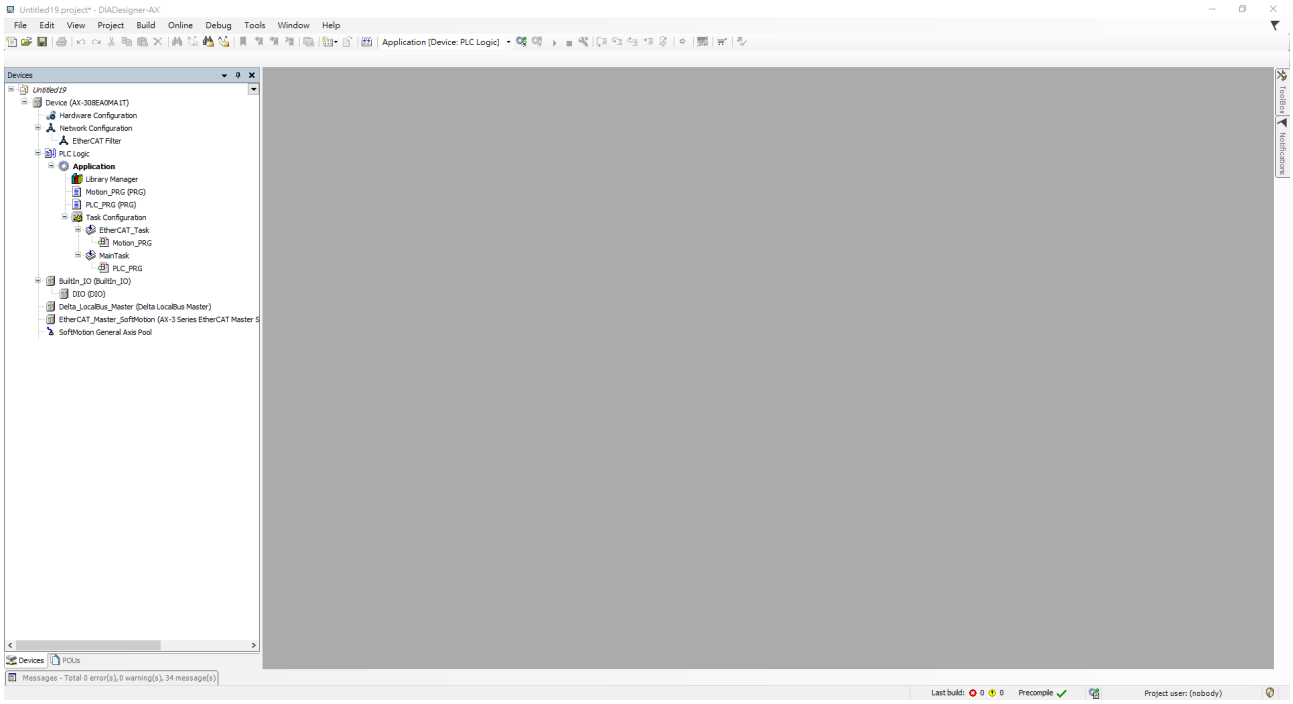
⚠	● The output circuit and internal circuit of this product are separated only by functional insulation. Therefore, to complete the installation of the product in the final system, double or reinforced insulation should be used between the product and hazardous live parts.

6.1.4 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.

6.1.4.1 Basic Operation

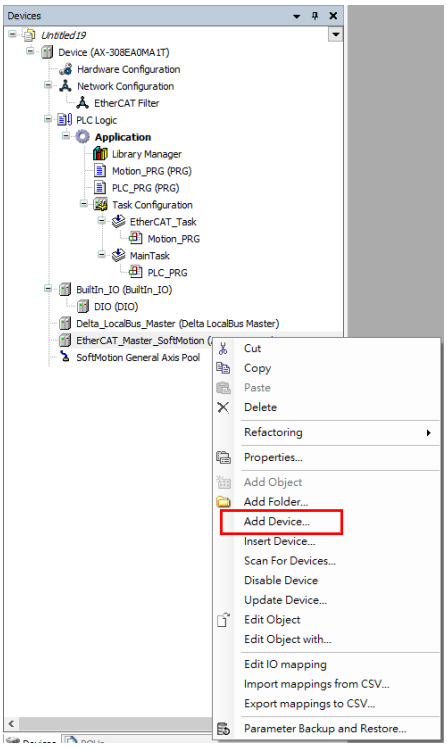
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



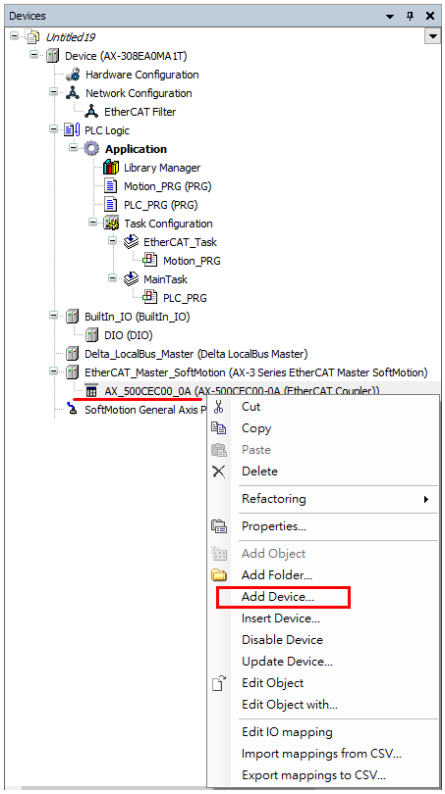
(2) Add modules in

- 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**.

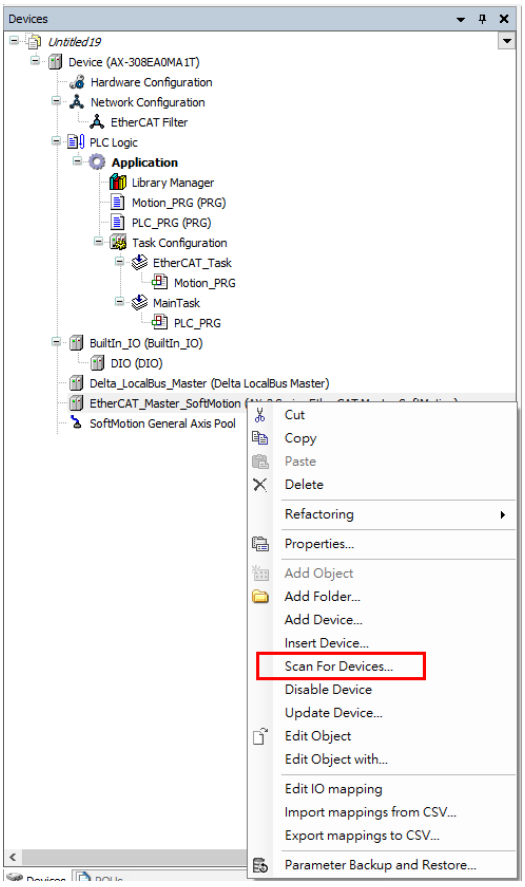


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

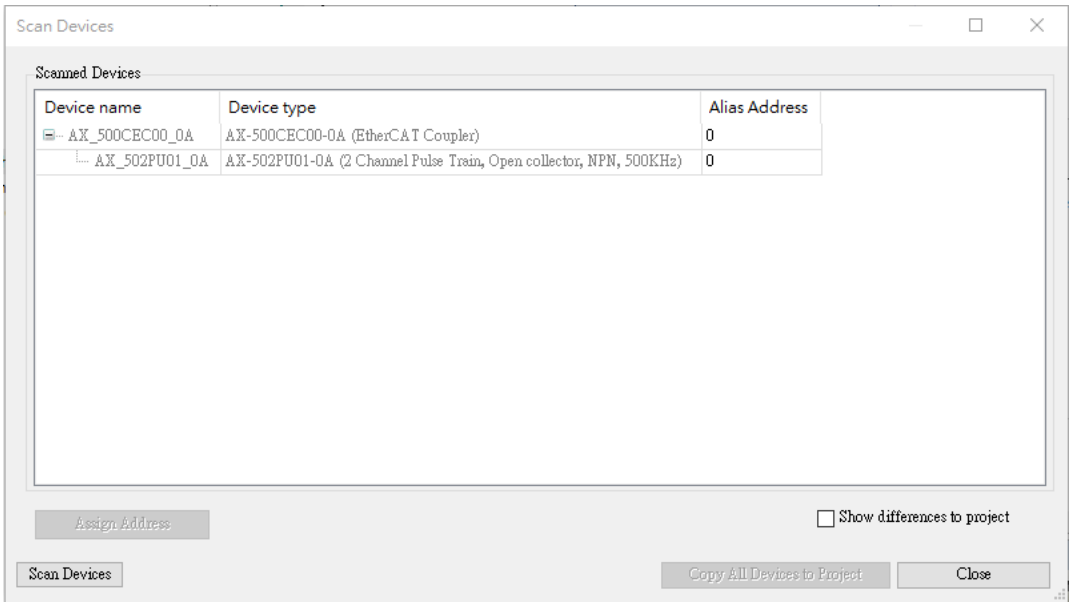


- Method 2: Scan to add the modules in.

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

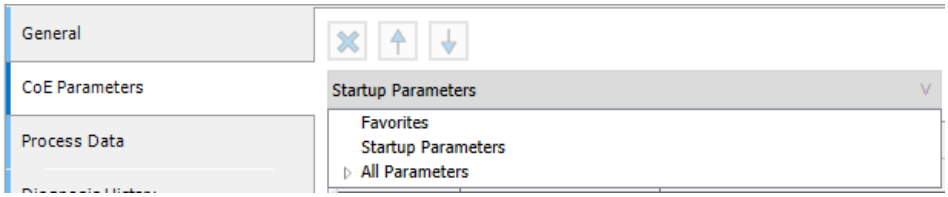


After the auto-scan, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



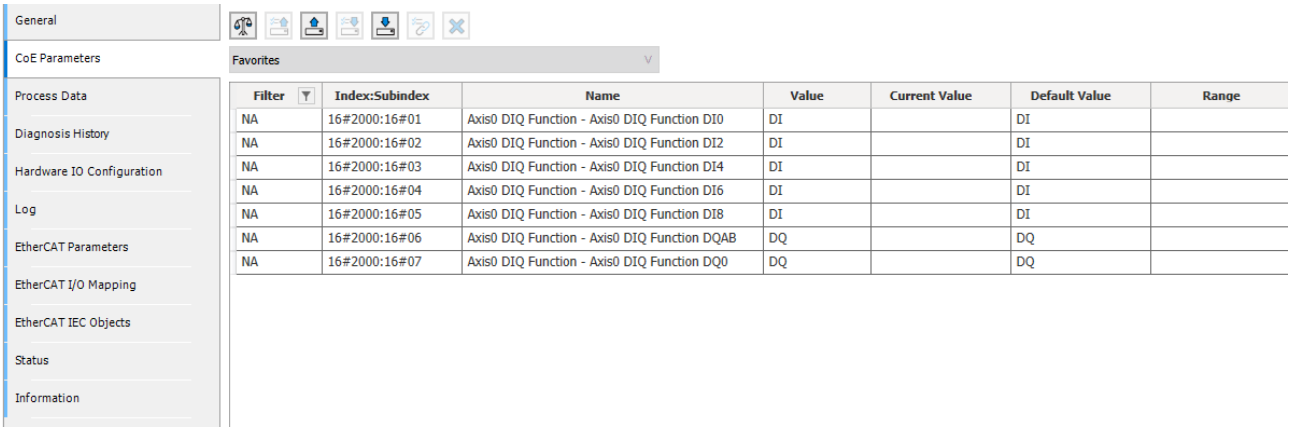
6.1.4.2 Parameter Settings

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



(1) Favorites

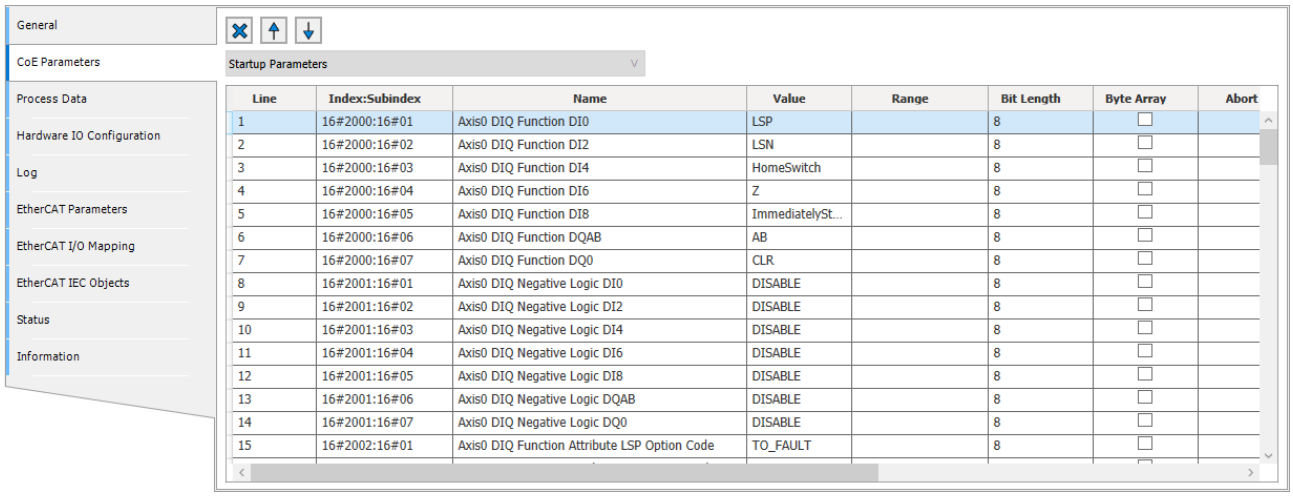
- You can select and right-click the parameter to add the selected parameter to the **Favorites**. Click  on the toolbar to go into the online mode, and then you can start to upload and download the parameters.



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

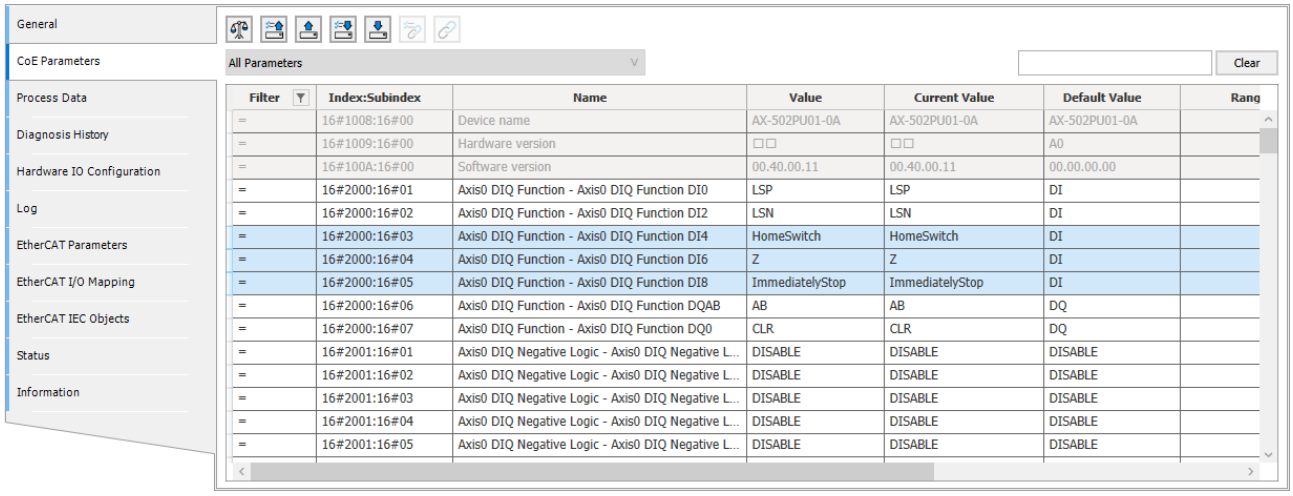
- Once the module is started up, the setting values of parameters in the **Startup Parameters** list are written to the module. For editing, you have to set up these parameters in the offline mode.



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

(3) All Parameters

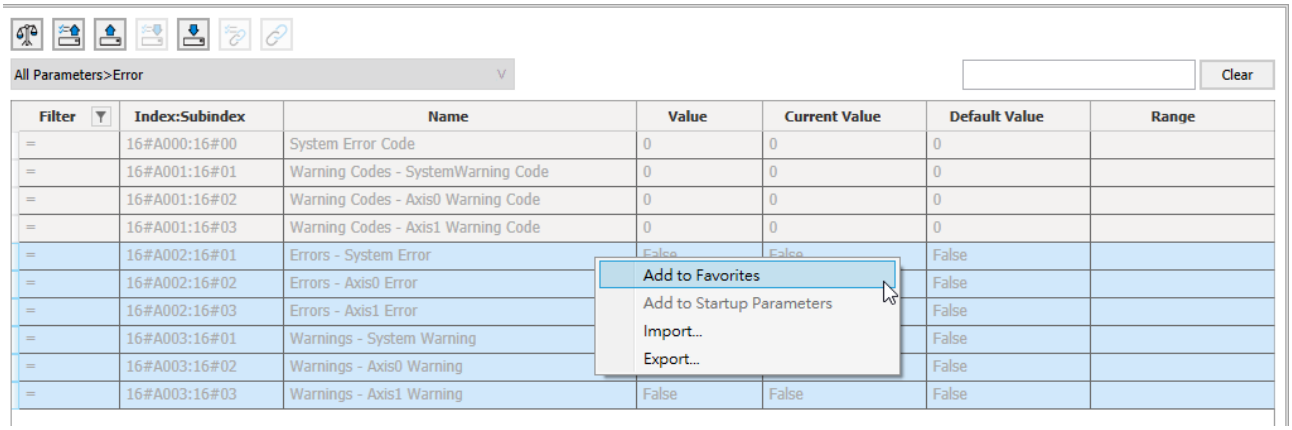
- You can find all the CoE parameters here. Click  on the toolbar to go into the online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in **Current Value** column.
- You can edit the values of parameters in **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.

Icon	Function	Description
	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.

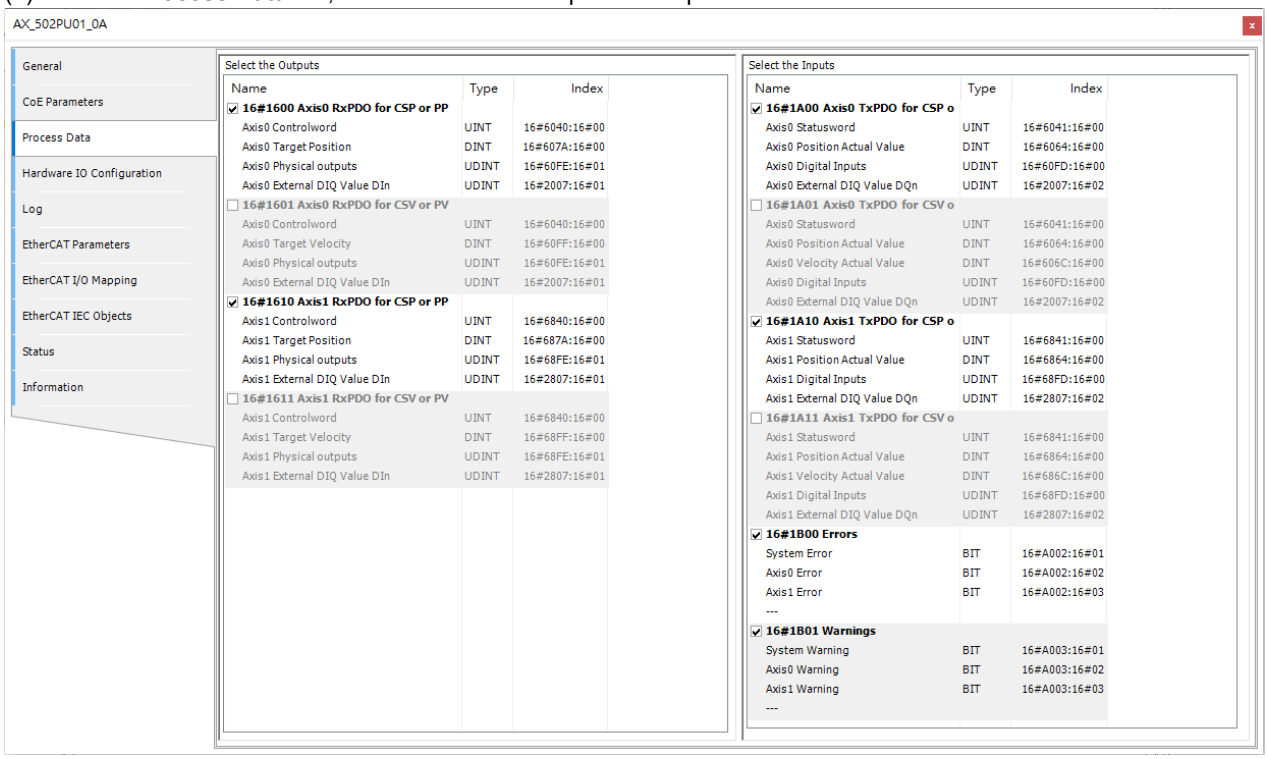
- You can select and right-click the parameter to add the selected parameter to the **Favorites**.



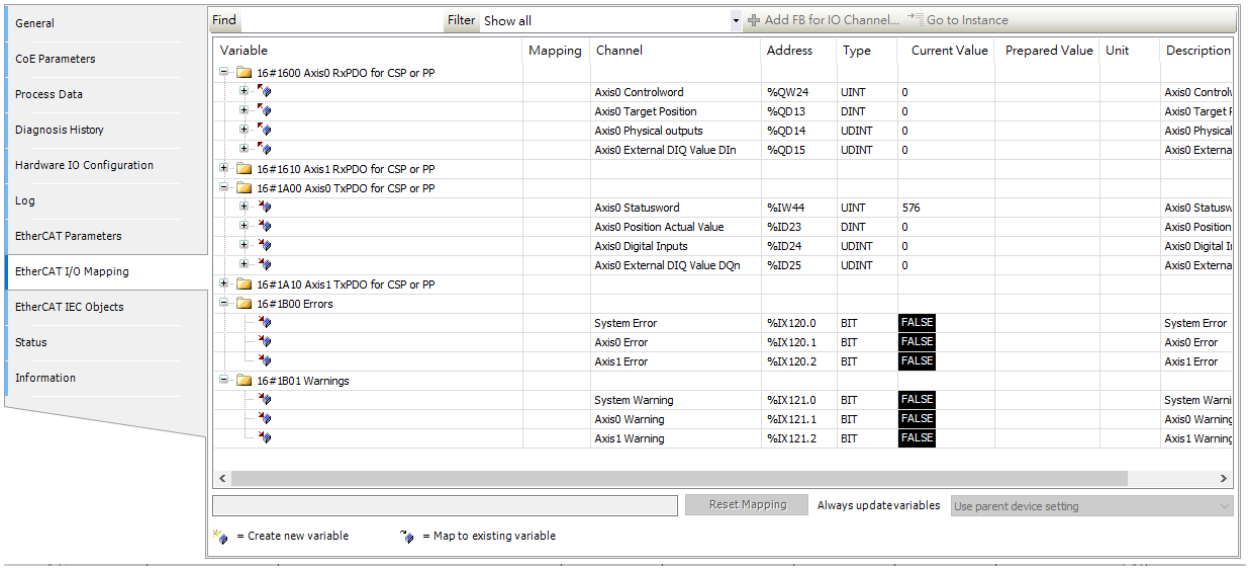
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

6.1.4.3 Process Data

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

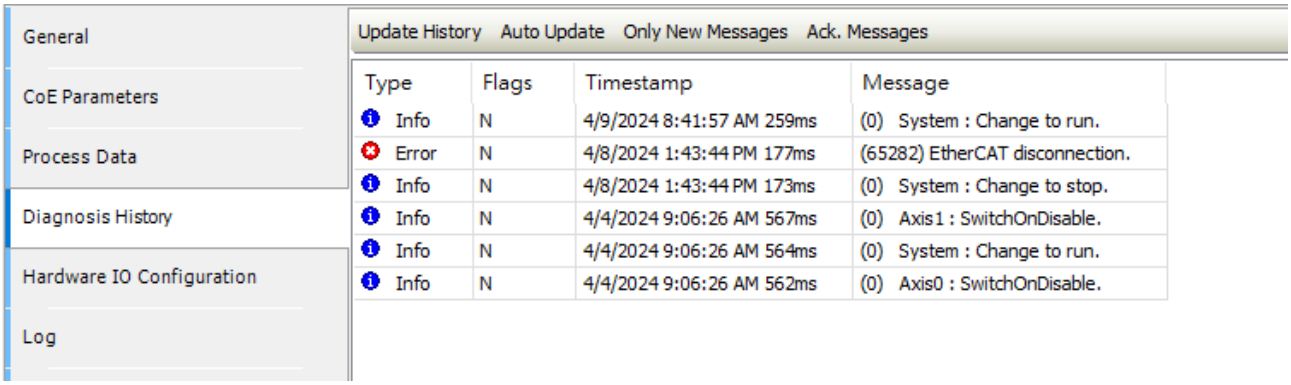


(2) Click  on the toolbar to go into the online mode. In the **EtherCAT I/O Mapping** tab, you can find the variables, current value, status and error codes for each channel.



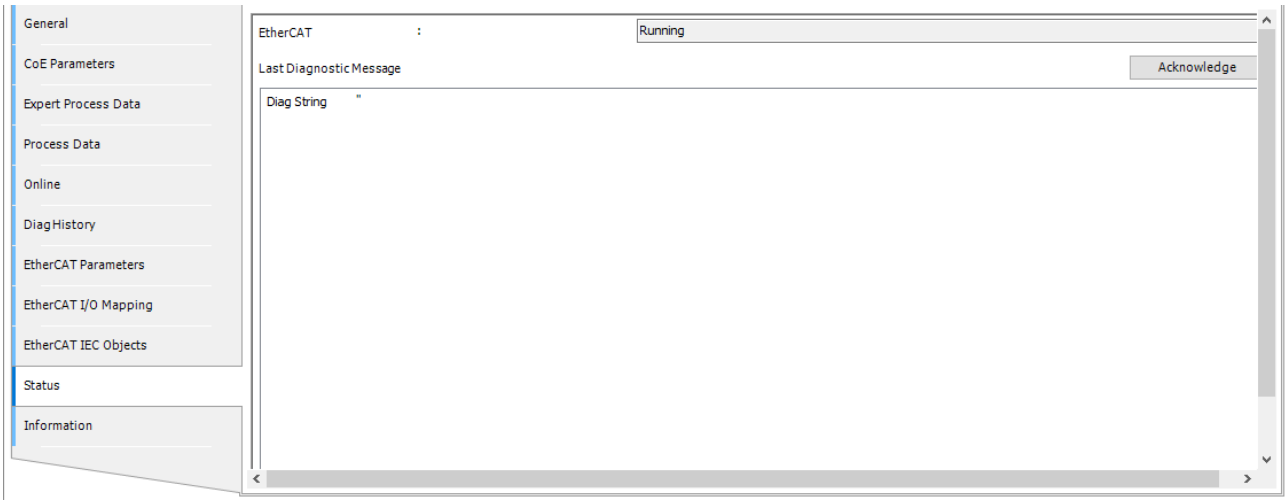
6.1.4.4 Diagnosis History

Click  on the toolbar to go into the online mode. In the **Diagnosis History** tab, all error information that occurred on the module is recorded. Message column shows the TEXT ID plus error description. Please refer to the troubleshooting section for details on errors. **Info** lines present the system status and the states of the axis state machines for the PU module.



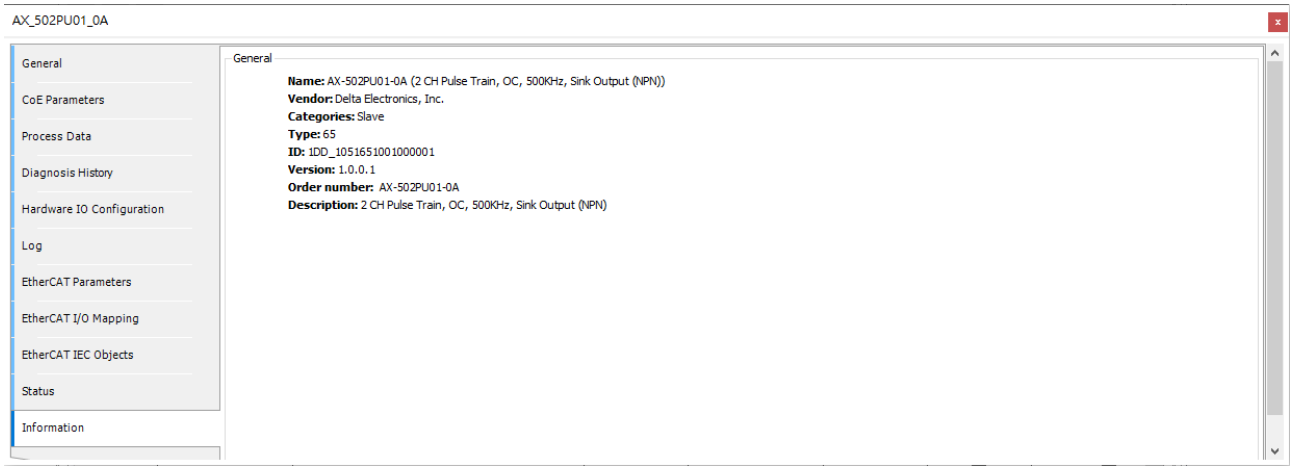
6.1.4.5 Status

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



6.1.4.6 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 the 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#1008:16#00	Device name	AX-502PU01-0A	AX-502PU01-0A	AX-502PU01-0A
=	16#1009:16#00	Hardware version	□□	□□	A0
=	16#100A:16#00	Software version	00.40.00.11	00.40.00.11	00.00.00.00

6.1.5 CiA402 Drive Profile

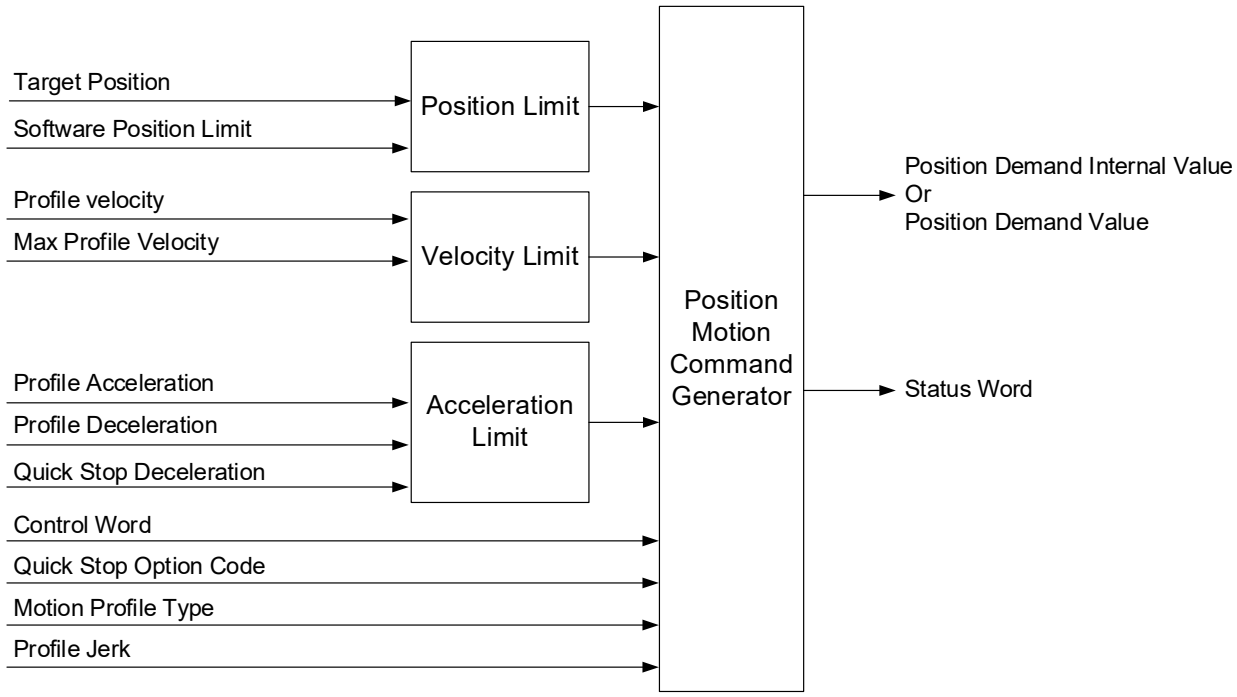
This section is an introduction to various standardized modes of operation for AX-502PU01 in EtherCAT mode following the CiA 402 protocol, including basic operation settings and description of objects when.

Axis0 is taken as an example for explanation here. If you want to do the settings for Axis1, please give the indexes of the objects for Axis0 an offset of 16#800 and then set them.

6.1.5.1 Profile Position Mode

In this mode, the velocities and acceleration/deceleration are set up to allow the motor to run from the starting position to the target position.

The architecture for Profile Position mode:



List of related objects:

Index	Subindex	Name	Attr.	PDO mapping	Unit	Data type
16#6040	16#00	Axis0 ControlWord	RW	Yes	-	UINT
16#6041	16#00	Axis0 StatusWord	RO	Yes	-	UINT
16#605A	16#00	Axis0 Quick Stop Option Code	RW	Yes	-	INT
16#6062	16#00	Axis0 Position Demand Value	RO	Yes	-	DINT
16#607A	16#00	Axis0 Target Position	RW	Yes	Pulse/s	DINT
16#607D	-	Axis0 Software Position Limit	-	-	-	-
	16#01	Axis0 Min Position Limit	RW	Yes	Pulse/s	DINT
	16#02	Axis0 Max Position Limit	RW	Yes	Pulse/s	DINT
16#607F	16#00	Axis0 Max Profile Velocity	RW	Yes	Pulse/s	UDINT
16#6081	16#00	Axis0 Profile Velocity	RW	Yes	Pulse/s	UDINT

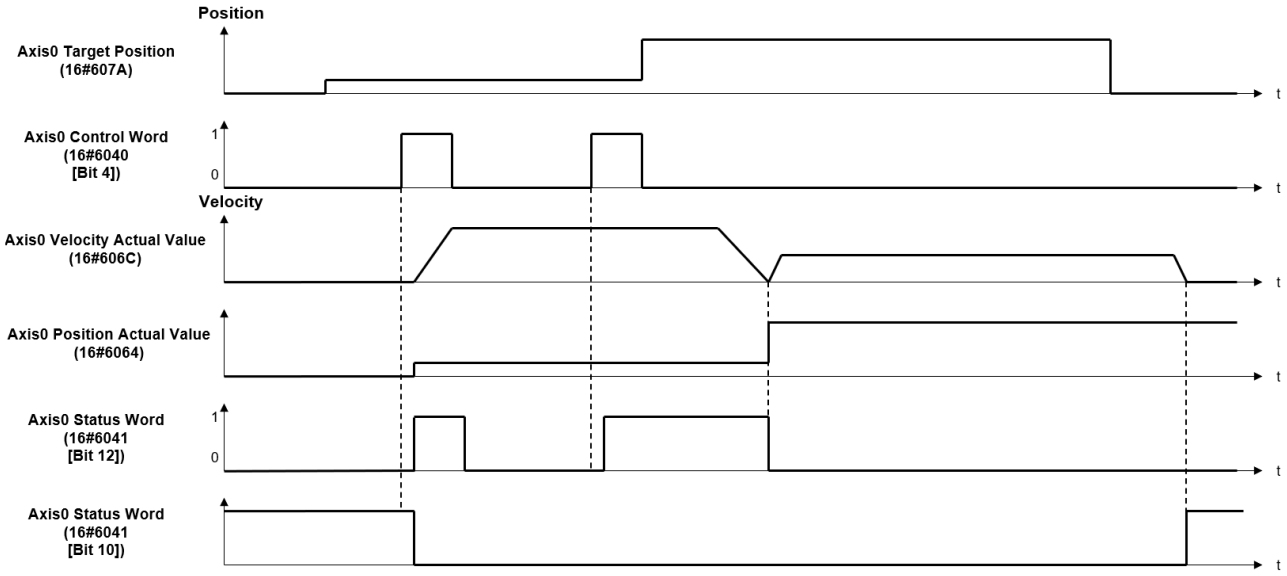
Index	Subindex	Name	Attr.	PDO mapping	Unit	Data type
16#6083	16#00	Axis0 Profile Acceleration	RW	Yes	Pulse/s^2	UDINT
16#6084	16#00	Axis0 Profile Deceleration	RW	Yes	Pulse/s^2	UDINT
16#6085	16#00	Axis0 Quick Stop Deceleration	RW	Yes	Pulse/s^2	UDINT
16#6086	16#00	Axis0 Motion Profile Type	RW	Yes	-	INT
16#60A4	-	Axis0 Profile Jerk	-	-	-	-
	16#01	Axis0 Jerk1	RW	Yes	Pulse/s^3	UDINT
	16#02	Axis0 Jerk2	RW	Yes	Pulse/s^3	UDINT
16#60FC	16#00	Axis0 Position Demand Internal Value	RO	Yes	Pulse/sec	DINT

The command-immediately-effective function

In Profile Position mode, the command-immediately-effective function can be set to be enabled immediately or disabled through 16#6040[Bit 5].

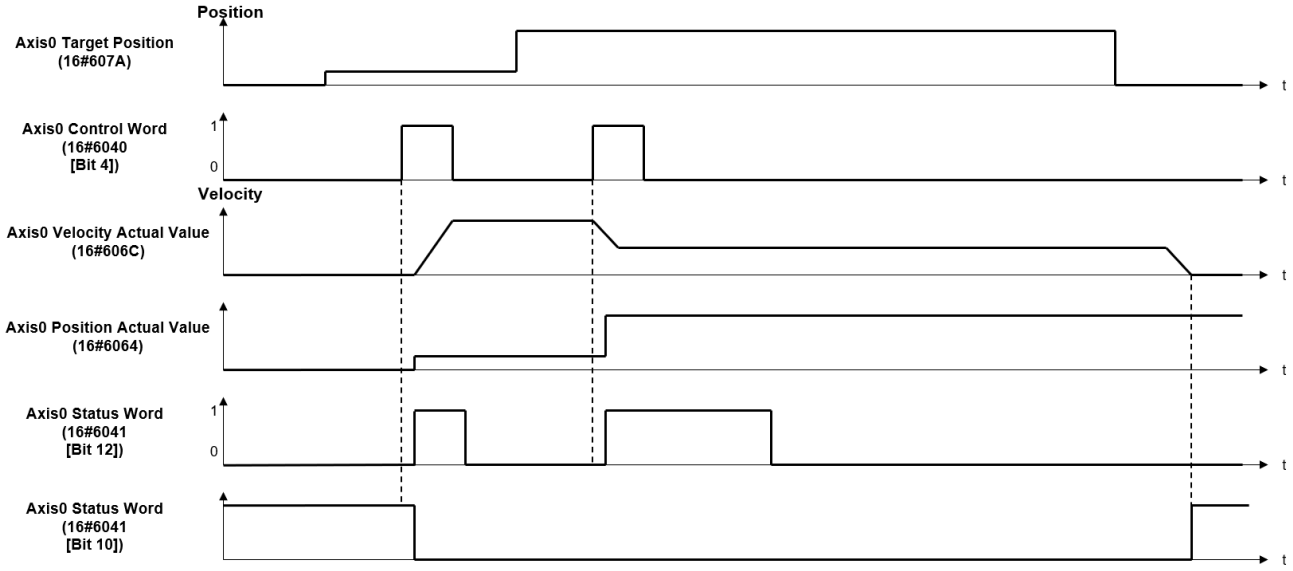
- **If 16#6040 [Bit 5] is set to 0, the command-immediately-effective function is disabled.**

When the immediately effective function is disabled, even if a new command is triggered during the execution of the current command, the servo will keep executing the current motion command, and the new command will not take effect and not be executed until the current command execution is completed.



- **If 16#6040 [Bit 5] is set to 1, the command-immediately-effective function is enabled.**

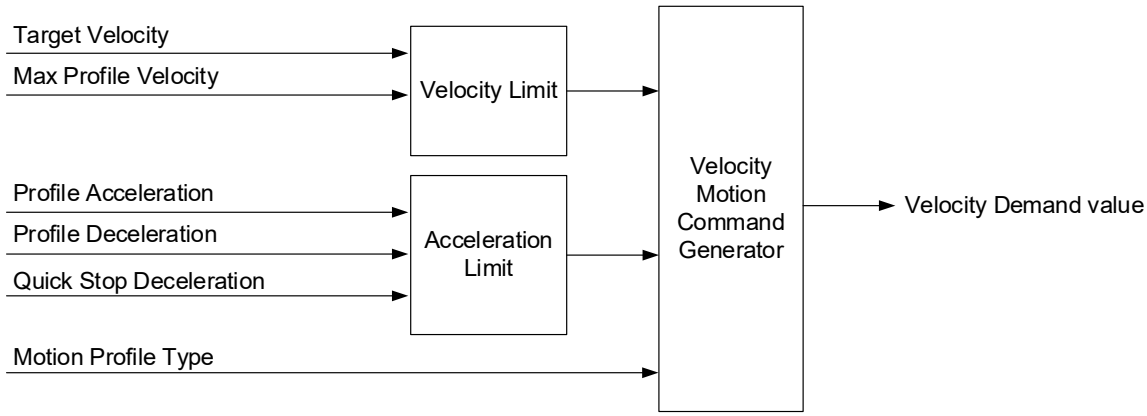
When the immediately effective function is enabled, if a new command trigger is received during the execution of the current command, the current motion command will be interrupted and the new command is executed immediately.



6.1.5.2 Profile Velocity Mode

In this mode, the target velocity, max. profile velocity and acceleration/deceleration are specified in the upper device, and then the motion command generator of AX-502PU01 plans the motion trajectory based on given conditions.

The architecture for Profile Velocity mode:



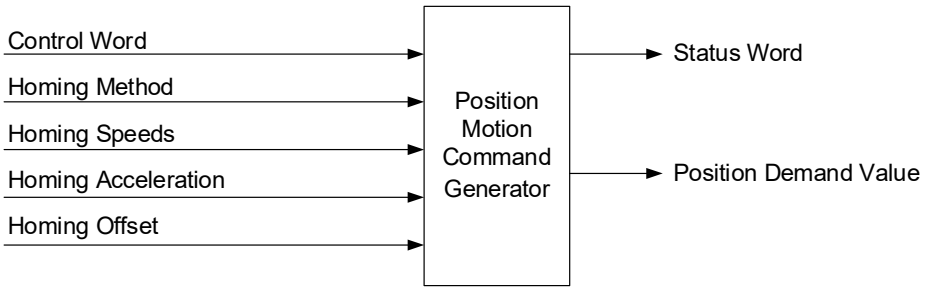
List of related objects:

Index	Subindex	Name	Attr.	PDO mapping	Unit	Data type
16#6040	16#00	Axis0 ControlWord	RW	Yes	-	UINT
16#607F	16#00	Axis0 Max Profile Velocity	RW	Yes	Pulse/s	UDINT
16#6083	16#00	Axis0 Profile Acceleration	RW	Yes	Pulse/s^2	UDINT
16#6084	16#00	Axis0 Profile Deceleration	RW	Yes	Pulse/s^2	UDINT
16#6085	16#00	Axis0 Quick Stop Deceleration	RW	Yes	Pulse/s^2	UDINT
16#6086	16#00	Axis0 Motion Profile Type	RW	Yes	-	INT
16#60FF	16#00	Axis0 Target Velocity	RW	Yes	Pulse/s	DINT

6.1.5.3 Homing Mode

In this mode, the speed, acceleration and homing mode are specified through input and output objects.

The architecture for Homing Mode:



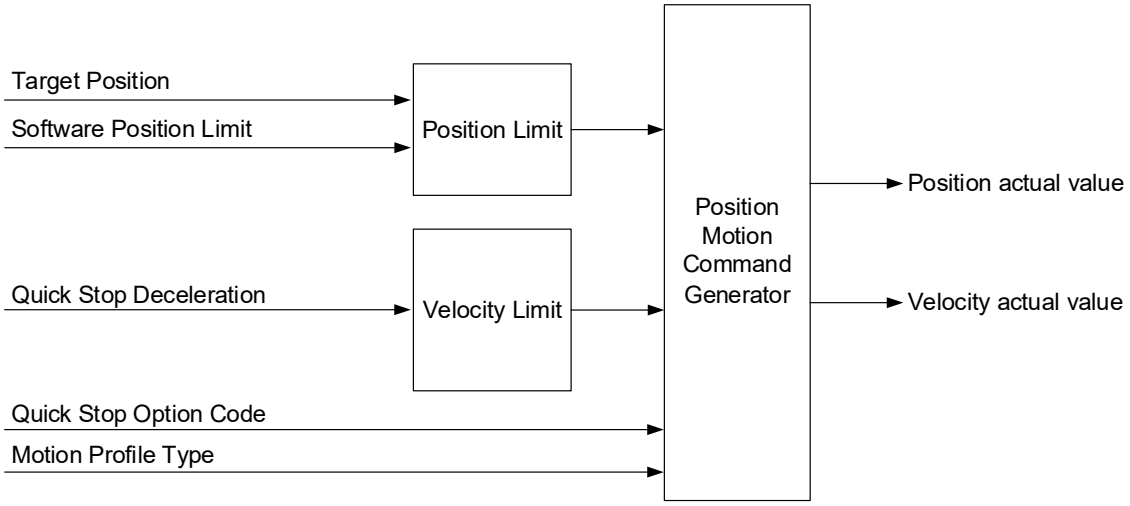
List of related objects:

Index	Subindex	Name	Attr.	PDO mapping	Unit	Data type
16#6040	16#00	Axis0 ControlWord	RW	Yes	-	UINT
16#6041	16#00	Axis0 StatusWord	RO	Yes	-	UINT
16#607C	16#00	Axis0 Homing Offset	RW	Yes	Pulse/s	DINT
16#6098	16#00	Axis0 Homing Method	RW	Yes	-	SINT
16#6099	-	Axis0 Homing Speeds	-	-	-	-
	16#01	Axis0 Speed During Search For Switch	RW	Yes	Pulse/s	UDINT
	16#02	Axis0 Speed During Search For Zero	RW	Yes	Pulse/s	UDINT
16#609A	16#00	Axis0 Homing Acceleration	RW	Yes	Pulse/s^2	UDINT
16#60FC	16#00	Axis0 Position Demand Internal Value	RO	Yes	Pulse/s	DINT

6.1.5.4 Cyclic Synchronous Position Mode

In this mode, the multi-axis synchronous interpolation motion is achieved by controlling periodic displacements of axes according to the set SYNC cycle.

The architecture for Cyclic Synchronous Position Mode:



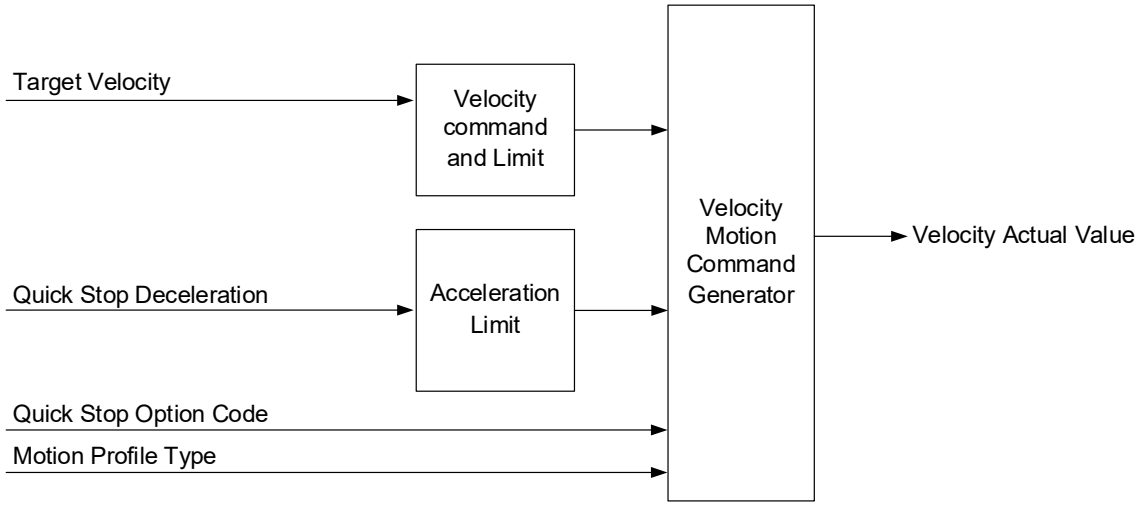
List of related objects:

Index	Subindex	Name	Attr.	PDO mapping	Unit	Data type
16#605A	16#00	Axis0 Quick Stop Option Code	RW	Yes	-	INT
16#6064	16#00	Axis0 Position Actual Value	RO	Yes	Pulse/s	DINT
16#606C	16#00	Axis0 Velocity Actual Value	RO	Yes	Pulse/s	DINT
16#607A	16#00	Axis0 Target Position	RW	Yes	Pulse/s	DINT
16#607D	-	Axis0 Software Position Limit	-	-	-	-
	16#01	Axis0 Min Position Limit	RW	Yes	Pulse/s	DINT
	16#02	Axis0 Max Position Limit	RW	Yes	Pulse/s	DINT
16#6085	16#00	Axis0 Quick Stop Deceleration	RW	Yes	Pulse/s^2	UDINT
16#6086	16#00	Axis0 Motion Profile Type	RW	Yes	-	INT

6.1.5.5 Cyclic Synchronous Velocity Mode

In this mode, the synchronous velocity control is achieved by regularly sending the planned velocity according to the set synchronization cycle.

The architecture for Cyclic Synchronous Velocity Mode:



List of related objects:

Index	Subindex	Name	Attr.	PDO mapping	Unit	Data type
16#605A	16#00	Axis0 Quick Stop Option Code	RW	Yes	-	INT
16#606C	16#00	Axis0 Velocity Actual Value	RO	Yes	Pulse/s	DINT
16#6085	16#00	Axis0 Quick Stop Deceleration	RW	Yes	Pulse/s^2	UDINT
16#6086	16#00	Axis0 Motion Profile Type	RW	Yes	-	INT
16#60FF	16#00	Axis0 Target Velocity	RW	Yes	Pulse/s	DINT

6.1.6 Functions and Descriptions of Objects

In this section, Axis0 is taken as an example for explanation of objects. To set up for Axis1, please give the index of each object for Axis0 an offset of 16#800 and then set them. For instance, 16#2800 is the object for the module's local pin function selection of Axis1.

The objects that the module supports and their discriptions are listed in the following table.

- **Objects: 16#2000 – 16#2FFF**

Index	Function	Description
16#2000	Axis0 DIQ Function	Function selections of module's local pins for Axis 0
16#2001	Axis0 DIQ Negative Logic	Polarity settings of module's local pins for Axis 0
16#2002	Axis0 DIQ Function Attribute	Attribute settings of module's local pins for Axis 0
16#2003	Axis0 DIQ Value	Status of module's local pins for Axis 0
16#2004	Axis0 External DIQ Function	Function selections of module's external pins for Axis 0
16#2006	Axis0 External DIQ Function Attribute	Attribute setting of module's external pins for Axis 0
16#2007	Axis0 External DIQ Value	Status of module's external pins for Axis 0
16#2008	Axis0 Position Demand Value For LREAL	Real-time internal command position of Axis 0
16#2009	Axis0 Velocity Demand Value For LREAL	Real-time internal command velocity of Axis 0
16#200A	Axis0 Acceleration Demand Value For LREAL	Real-time internal command acceleration of Axis 0
16#200B	Axis0 Jerk Demand Value For LREAL	Real-time internal command jerk value of Axis 0
16#200C	Axis0 Motion Actual Value Source	Actual position source of Axis 0 (Reserved)
16#200D	Axis0 Feed Encoder Value	Encoder feedback value of Axis 0 (Reserved)

- **Objects: 16#5000 – 16#5FFF**

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

- **Objects: 16#6000 – 16#6FFF**

The parameters of 16#6000 series below are designed in accordance with the CiA 402 protocol (CANopen device profile for drives and motion control). In the following table, Axis0 is taken as an example for description of objects. To set up for Axis 1, please give the index of each object for Axis0 an offset of 16#800 and then set them. For instance, 16#683F is the object for Axis1 Error Code.

Index	Function	Description
16#603F	Axis0 Error Code	Error code of Axis 0

Index	Function	Description
16#6040	Axis0 ControlWord	Control word of Axis 0
16#6041	Axis0 StatusWord	Status word of Axis 0
16#605A	Axis0 Quick Stop Option Code	Behavior option of Axis 0 for a quick stop
16#605B	Axis0 Shutdown Option Code	Behavior option of Axis 0 for a shutdown
16#605C	Axis0 Disable Operation Option Code	Behavior option of Axis 0 for Disable operation
16#605D	Axis0 Halt Option Code	Behavior option of Axis 0 for a halt
16#605E	Axis0 Fault Reaction Option Code	Behavior option of Axis 0 for the reaction to a fault
16#6060	Axis0 Modes Of Operation	Operation mode of Axis 0
16#6061	Axis0 Modes Of Operation Display	Displays the curren operation mode of Axis 0
16#6062	Axis0 Position Demand Value	Real-time command position of Axis 0
16#6064	Axis0 Position Actual Value	Actual position of Axis 0
16#606B	Axis0 Velocity Demand Value	Real-time command velocity of Axis 0
16#606C	Axis0 Velocity Actual Value	Actual velocity of axis 0
16#607A	Axis0 Target Position	Target position of Axis 0
16#607C	Axis0 Homing Offset	Homing position offset of Axis 0
16#607D	Axis0 Software Position Limit	Software position limit of Axis 0
16#607F	Axis0 Max Profile Velocity	Maximum profile velocity of Axis 0
16#6081	Axis0 Profile Velocity	Profile velocity of Axis 0
16#6082	Axis0 End Velocity	End profile velocity of Axis 0
16#6083	Axis0 Profile Acceleration	Profile acceleration of Axis 0
16#6084	Axis0 Profile Deceleration	Profile deceleration of Axis 0
16#6085	Axis0 Quick Stop Deceleration	Deceleration of Axis 0 for quick stop
16#6086	Axis0 Motion Profile Type	Expected profile type of Axis 0
16#6093	Axis0 Position Factor	Position factor of Axis 0 (Reserved)
16#6094	Axis0 Velocity Encoder Factor	Velocity encoder factor of Axis 0 (Reserved)
16#6097	Axis0 Acceleration Factor	Acceleration factor of Axis 0 (Reserved)
16#6098	Axis0 Homing Method	Homing mode of Axis 0
16#6099	Axis0 Homing Speeds	Homing speed of Axis 0
16#609A	Axis0 Homing Acceleration	Homing acceleration of Axis 0
16#60A3	Axis0 Profile Jerk Use	Jerk-used profile section of Axis 0
16#60A4	Axis0 Profile Jerk	Profile jerk setting of Axis 0
16#60FC	Axis0 Position Demand Internal Value	Real-time internal command position of Axis 0
16#60FD	Axis0 Digital Inputs	Digital inputs of Axis 0
16#60FE	Axis0 Digital Outputs	Digital outputs of Axis 0
16#60FF	Axis0 Target Velocity	Target velocity of Axis 0
16#6502	Axis0 Supported Drive Modes	Motion mode supported by Axis 0

- **Objects: 16#A000 – 16#AFFF**

Index	Function	Description
16#A000	System Error Codes	Error code set of the module
16#A001	Warning Codes	Warning code set of the module

Index	Function	Description
16#A002	Errors	Error flag set of the module
16#A003	Warnings	Warning flag set of the module

- **Objects: 16#F000 – 16#FFFF**

Index	Function	Description
16#F000	Factory Action	Factory mode

6.1.6.1 Manufacturer Specific Objects

6.1.6.1.1 Axis DIQ Function (16#2000 and 16#2800)

Set up the functions for the module's local pins.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2000	16#01	Axis0 DIQ Function DI0	Function selection for the module's local pins	USINT	RW	1
	16#02	Axis0 DIQ Function DI2		USINT	RW	1
	16#03	Axis0 DIQ Function DI4		USINT	RW	1
	16#04	Axis0 DIQ Function DI6		USINT	RW	1
	16#05	Axis0 DIQ Function DI8		USINT	RW	1
	16#06	Axis0 DIQ Function DQAB		USINT	RW	0
	16#07	Axis0 DIQ Function DQ0		USINT	RW	1
16#2800	16#01	Axis1 DIQ Function DI1		USINT	RW	1
	16#02	Axis1 DIQ Function DI3		USINT	RW	1
	16#03	Axis1 DIQ Function DI5		USINT	RW	1
	16#04	Axis1 DIQ Function DI7		USINT	RW	1
	16#05	Axis1 DIQ Function DI9		USINT	RW	1
	16#06	Axis1 DIQ Function DQAB		USINT	RW	0
	16#07	Axis1 DIQ Function DQ1		USINT	RW	1

The settings of parameters above are shown below.

- Axis0 DIQ Function DI0 and Axis1 DIQ Function DI1

Mode	Name	Description
0	DI	General digital input
1	LSP	Positive position limit

- Axis0 DIQ Function DI2 and Axis1 DIQ Function DI3

Mode	Name	Description
0	DI	General digital input
2	LSN	Negative position limit

- Axis0 DIQ Function DI4 and Axis1 DIQ Function DI5

Mode	Name	Description
0	DI	General digital input
4	Home Switch	Home switch

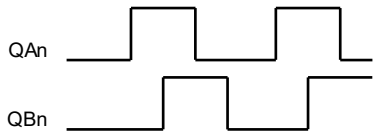
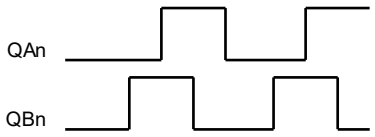
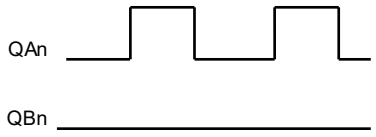
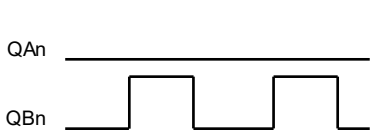
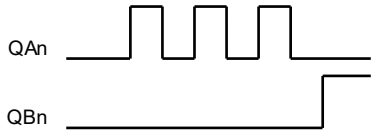
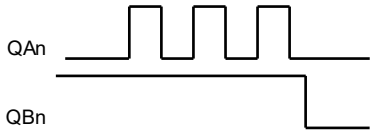
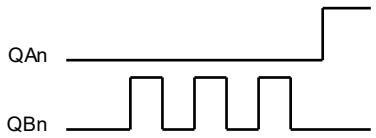
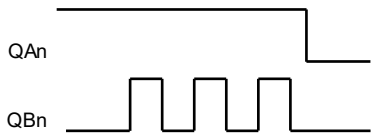
- Axis0 DIQ Function DI6 and Axis1 DIQ Function DI7

Mode	Name	Description
0	DI	General digital input
3	Z	Encoder Z pulse for homing

- Axis0 DIQ Function DI8 and Axis1 DIQ Function DI9

Mode	Name	Description
0	DI	General digital input
5	IMSTOP	The immediate-stop switch

- Axis0/Axis1 DIQ Function DQAB

Mode	Name	Description	Pulse output	
			Forward rotation	Reverse rotation
0	DQ	General digital output	N/A	N/A
1	AB	A phase+ B phase*		
2	UP_DN	Count up or count down*		
3	PLS_DIR	Pulse + direction*		
4	DIR_PLS	Direction + pulse *		

Note: n refers to an axis number, 0 or 1.

- Axis0 DIQ Function DQ0 and Axis1 DIQ Function DQ1

Mode	Name	Description
0	DQ	General digital output
6	CLR	Trigger for homing Clear

6.1.6.1.2 Axis DIQ Negative Logic (16#2001 and 16#2801)

Set up the logic polarity of the module's local pins.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2001	16#01	Axis0 DIQ Negative Logic DI0	Logic polarity of module's local pins	USINT	RW	0
	16#02	Axis0 DIQ Negative Logic DI2		USINT	RW	0
	16#03	Axis0 DIQ Negative Logic DI4		USINT	RW	0
	16#04	Axis0 DIQ Negative Logic DI6		USINT	RW	0

Index	Subindex	Name	Description	Data type	Attr.	Default
	16#05	Axis0 DIQ Negative Logic DI8		USINT	RW	0
	16#06	Axis0 DIQ Negative Logic DQAB		USINT	RW	0
	16#07	Axis0 DIQ Negative Logic DQ0		USINT	RW	0
16#2801	16#01	Axis1 DIQ Negative Logic DI1		USINT	RW	0
	16#02	Axis1 DIQ Negative Logic DI3		USINT	RW	0
	16#03	Axis1 DIQ Negative Logic DI5		USINT	RW	0
	16#04	Axis1 DIQ Negative Logic DI7		USINT	RW	0
	16#05	Axis1 DIQ Negative Logic DI9		USINT	RW	0
	16#06	Axis1 DIQ Negative Logic DQAB		USINT	RW	0
	16#07	Axis1 DIQ Negative Logic DQ1		USINT	RW	0

The settings of parameters above are shown below.

Mode	Name	Description
0	FALSE	Negative logic OFF (N.O.)
1	TRUE	Negative logic ON (N.C.)

6.1.6.1.3 Axis DIQ Function Attribute (16#2002 and 16#2802)

Set up the attributes of the module's local pins.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2002	16#01	Axis0 DIQ Function Attribute LSP Option Code	Attributes of module's local pins	USINT	RW	0
	16#02	Axis0 DIQ Function Attribute LSN Option Code		USINT	RW	0
	16#03	Axis0 DIQ Function Attribute IMSTOP Option Code		USINT	RW	0
	16#04	Axis0 DIQ Function Attribute CLR Pulse Length		UINT	RW	0
16#2802	16#01	Axis1 DIQ Function Attribute LSP Option Code		USINT	RW	0
	16#02	Axis1 DIQ Function Attribute LSN Option Code		USINT	RW	0
	16#03	Axis1 DIQ Function Attribute IMSTOP Option Code		USINT	RW	0
	16#04	Axis1 DIQ Function Attribute CLR Pulse Length		UINT	RW	0

The settings of parameters above are shown below.

- Axis0/Axis1 DIQ Function Attribute LSP Option Code

Mode	Name	Description
0	LSP_OP_QuickStopActive	When LSP is triggered, the CiA402 state of the axis enters QuickStopActive.
1	LSP_OP_Fault	When LSP is triggered, the CiA402 state of the axis enters Fault.

- Axis0/Axis1 DIQ Function Attribute LSN Option Code

Mode	Name	Description
0	LSN_OP_QuickStopActive	When LSN is triggered, the CiA402 state of the axis enters QuickStopActive.
1	LSN_OP_Fault	When LSN is triggered, the CiA402 state of the axis enters Fault.

- Axis0/Axis1 DIQ Function Attribute IMSTOP Option Code

Mode	Name	Description
0	IMSTOP_OP_QuickStopActive	When IMSTOP is triggered, the CiA402 state of the axis enters QuickStopActive.
1	IMSTOP_OP_Fault	When IMSTOP is triggered, the CiA402 state of the axis enters Fault.

- Axis0/Axis1 DIQ Function Attribute CLR Pulse Length

Setting range	Description
0 to 16#FFFF	The length of time that the CLR output logic lasts. Unit: ECAT communication cycle (in DC mode) / milliseconds (in SM mode).

6.1.6.1.4 Axis DIQ Value (16#2003 and 16#2803)

Read the status of module's local input and output pins.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2003	16#01	Axis0 DIQ Value DIn	Status of module's local input pins for Axis 0	UDINT	RO	0
	16#02	Axis0 DIQ Value DQn	Status of module's local output pins for Axis 0	UDINT	RO	0
16#2803	16#01	Axis1 DIQ Value DIn	Status of module's local input pins for Axis 1	UDINT	RO	0
	16#02	Axis1 DIQ Value DQn	Status of module's local output pins for Axis 0	UDINT	RO	0

The settings of parameters above are shown below.

- Axis0 DIQ Value DIn

Bit	Name	Description
Bit 0	DI0	Status of module's local input pin DI0 for Axis 0
Bit 1	DI2	Status of module's local input pin DI2 for Axis 0
Bit 2	DI4	Status of module's local input pin DI4 for Axis 0
Bit 3	DI6	Status of module's local input pin DI6 for Axis 0
Bit 4	DI8	Status of module's local input pin DI8 for Axis 0
Bit 5-Bit 31	Reserve	Reserved

- Axis1 DIQ Value DIn

Bit	Name	Description
Bit 0	DI1	Status of module's local input pin DI1 for Axis 1
Bit 1	DI3	Status of module's local input pin DI3 for Axis 1
Bit 2	DI5	Status of module's local input pin DI5 for Axis 1
Bit 3	DI7	Status of module's local input pin DI7 for Axis 1
Bit 4	DI9	Status of module's local input pin DI9 for Axis 1
Bit 5-Bit 31	Reserve	Reserved

- Axis0 DIQ Value DQn

Bit	Name	Description
Bit 0	DQ0	Status of module's local output pin DQ0 for Axis 0
Bit 1- Bit 29	Reserve	Reserved
Bit30	DQA0	Status of module's local output pin DQA0 for Axis 0
Bit31	DQB0	Status of module's local output pin DQB0 for Axis 0

- Axis1 DIQ Value DQn

Bit	Name	Description
Bit 0	DQ1	Status of module's local output pin DQ1 for Axis 1
Bit 1- Bit 29	Reserve	Reserved
Bit30	DQA1	Status of module's local output pin DQA1 for Axis 1
Bit31	DQB1	Status of module's local output pin DQB1 for Axis 1

6.1.6.1.5 Axis External DIQ Function (16#2004 and 16#2804)

Set up the functions of module's external pins.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2004	16#01	Axis0 External DIQ Function DI SRD	Function selections of module's external pins	USINT	RW	0
	16#02	Axis0 External DIQ Function DI ALM		USINT	RW	0
	16#03	Axis0 External DIQ Function DQ SVON		USINT	RW	0
	16#04	Axis0 External DIQ Function DQ ALMCLR		USINT	RW	0
16#2804	16#01	Axis1 External DIQ Function DI SRD		USINT	RW	0
	16#02	Axis1 External DIQ Function DI ALM		USINT	RW	0
	16#03	Axis1 External DIQ Function DQ SVON		USINT	RW	0

Index	Subindex	Name	Description	Data type	Attr.	Default
	16#04	Axis1 External DIQ Function DQ ALMCLR		USINT	RW	0

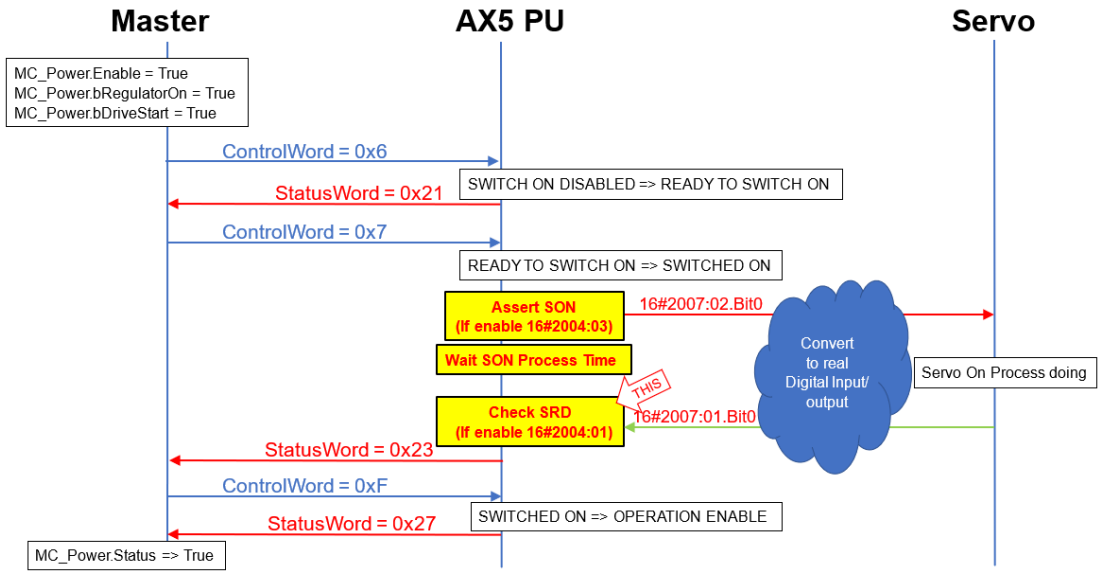
The settings of the parameters above are described as below.

- Axis0/ Axis1 External DIQ Function DI SRD

Mode	Name	Description
0	SRD_DISABLE	Servo Ready (SRD) Bit is not the judgment condition for the CiA402 state machine to enter OperationEnable, which needs to work with 16#2007: 01: Bit0.
1	SRD_ENABLE	Servo Ready (SRD) Bit serves as the judgment condition for the CiA402 state machine to enter OperationEnable, which needs to work with 16#2007: 01: Bit0.

The function decides whether to enable EtherCAT module's other DI as the judgment condition for Servo Ready. The default is DISABLE. If the function is enabled, all motion functions cannot be executed until the signal of the DI is ON.

Take Delta AX series PLC as a master in the following figure:

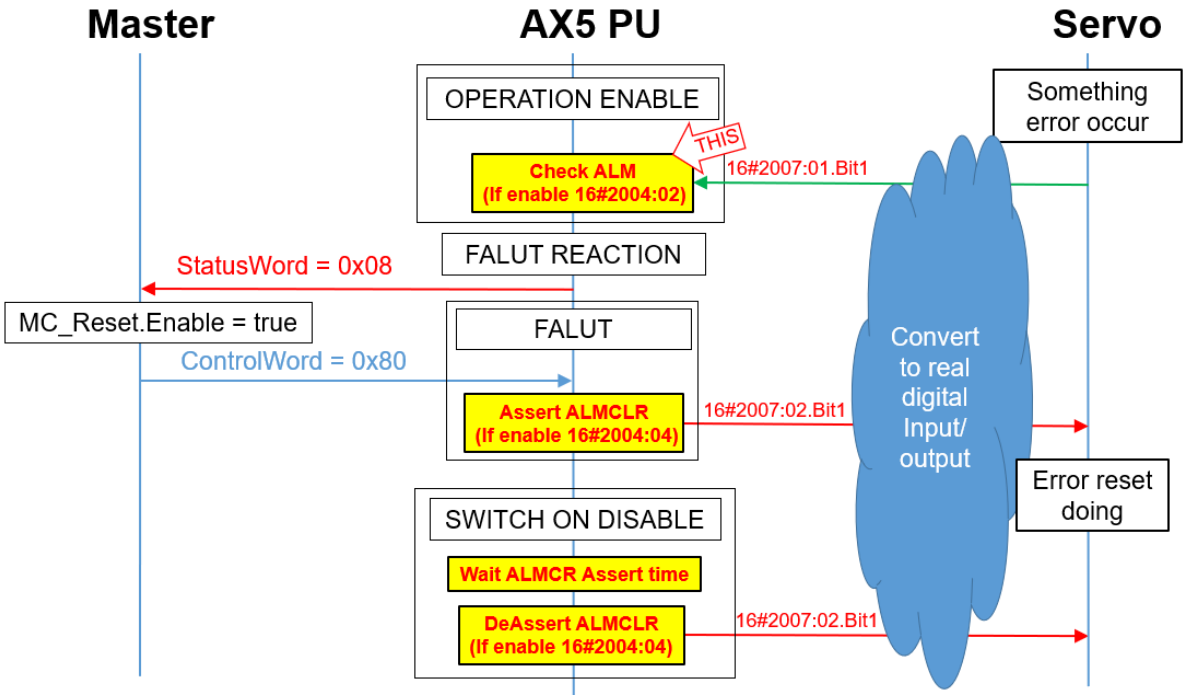


- Axis0/Axis1 External DIQ Function DI ALM

Mode	Name	Description
0	ALM_DISABLE	Servo Alarm (ALM) Bit cannot be the trigger for the CiA402 state machine of the axis to enter Fault, which works with 16#2007: 01: Bit1)
1	ALM_ENABLE	Servo Alarm ALM Bit can be the trigger for the CiA402 state machine of the axis to enter Fault, which works with 16#2007: 01: Bit1)

The function decides whether to enable EtherCAT module's other DI as the judgment condition for Alarm. If the signal of the DI is ON after the function is enabled, the state machine of the axis enters Fault.

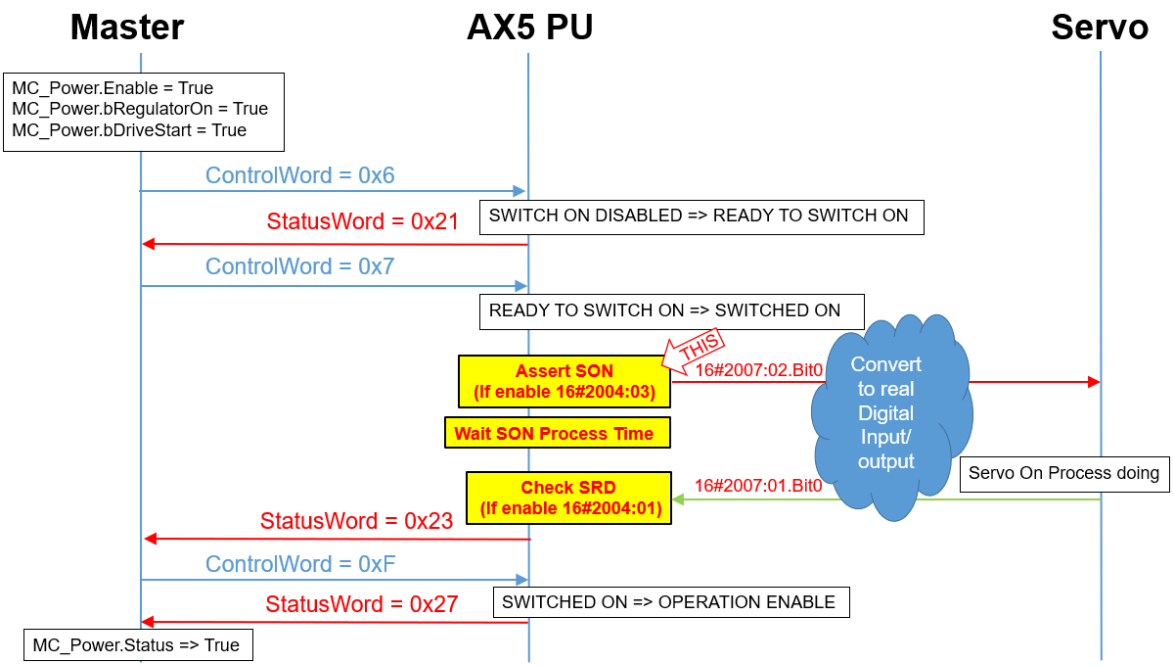
Take Delta AX series PLC as a master in the following figure:



- Axis0/Axis1 External DIQ Function DQ SON

Mode	Name	Description
0	SON_DISABLE	The value of Servo On (SON) Bit is always 0, which works with 16#2007: 02: Bit0)
1	SON _ENABLE	If the CiA402 state machine of the axis is ready to enter Switch On, the Servo On (SON) Bit will change to 1, which works with 16#2007: 02: Bit0.

The modes above sets whether to enable the Servo ON signal output function using EtherCAT module's other DO.
Take Delta AX series PLC as a master in the following figure.

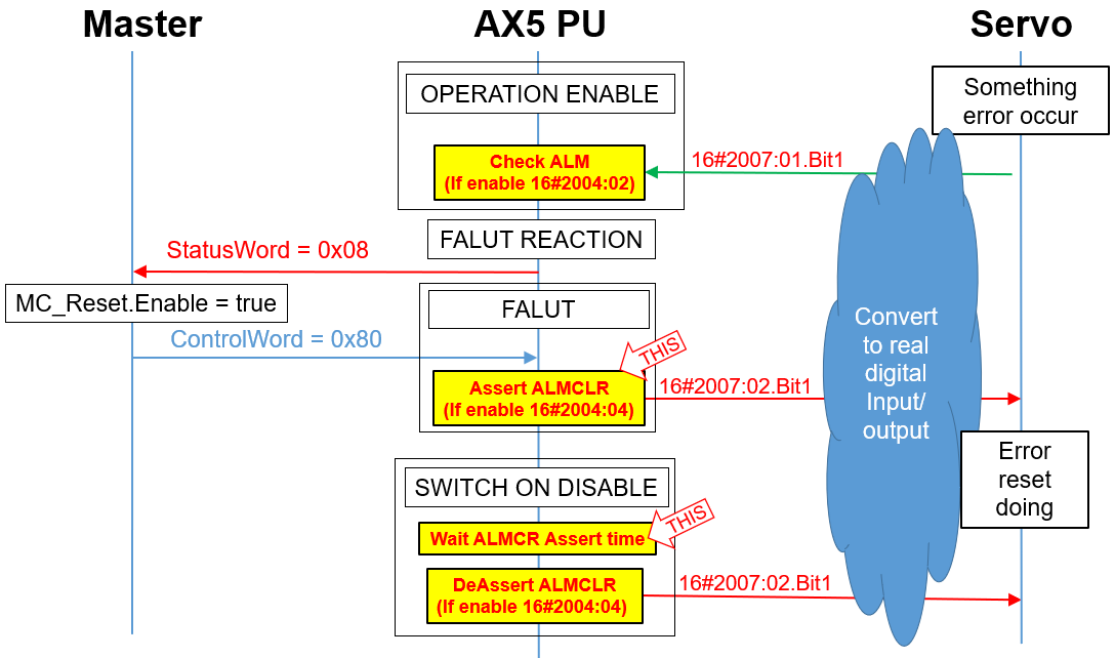


- Axis0/Axis1 External DIQ Function DQ ALMCLR

Mode	Name	Description
0	ALMCLR_DISABLE	If the CiA402 state machine leaves Fault, the Servo Alarm Clear (ALMCLR) Bit will remain 0, which works with 16#2007: 02: Bit1.
1	ALMCLR _ENABLE	If the CiA402 state machine leaves Fault, the Servo On (ALMCLR) Bit will change to 1 and then return to 0 after the time set in 16#2006:02 goes by, which works with 16#2007:02: Bit1.

The modes above sets whether to enable the Alarm Clear function using EtherCAT module's other DO so as to clear servo errors.

Take Delta AX series PLC as a master in the following figure.



6.1.6.1.6 Axis External DIQ Function Attribute (16#2006 and 16#2806)

Set up the attributes of the module's external pins.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2006	16#01	Axis0 External DIQ Function Attribute SON Option Code	Attributes of module's external pins	USINT	RW	0
	16#02	Axis0 External DIQ Function Attribute SON Process Time		UINT	RW	0
	16#03	Axis0 External DIQ Function Attribute ALMCLR Pulse Length		UINT	RW	2
16#2806	16#01	Axis1 External DIQ Function Attribute SON Option Code		USINT	RW	0
	16#02	Axis1 External DIQ Function Attribute SON Process Time		UINT	RW	0
	16#03	Axis1 External DIQ Function Attribute ALMCLR Pulse Length		UINT	RW	2

The settings of parameters above are shown below.

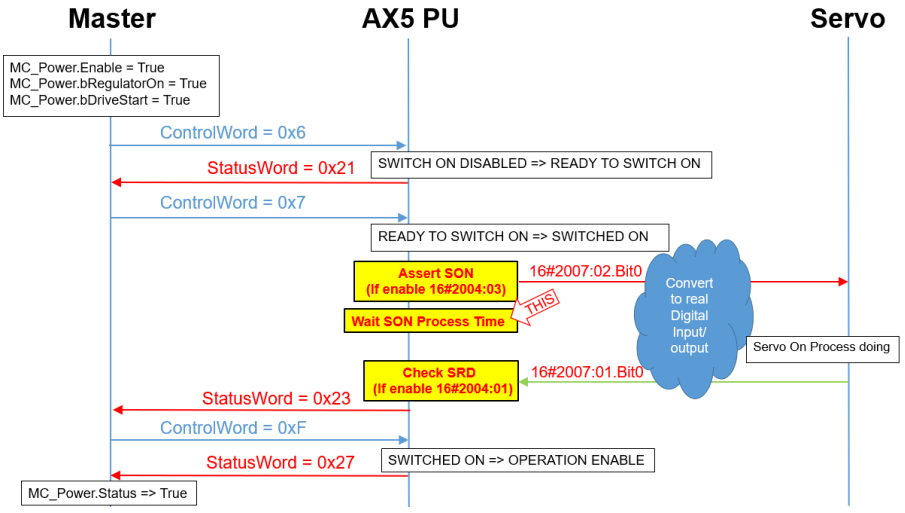
SON Option Code Mode (Axis0/Axis1 External DIQ Function Attribute)	Name	Description
0	SON_OP_ServoOnAtFault	If the CiA402 state machine enters Fault, SON Bit (16#2007: 02: Bit0) will be always 1.
1	SON_OP_ServoOffAtFault	If the CiA402 state machine enters Fault, SON Bit (16#2007: 02: Bit0) will be cleared to 0.

- Axis0/Axis1 External DIQ Function Attribute SON Process Time

Setting range	Description
0 to 16#FFFF	The delay time to enter the OperationEnable state. Unit: ECAT communication cycle (for DC mode) or milliseconds (for SM mode).

This function sets the judgement time for Servo ON using EtherCAT module's other DI. If the Servo ON is done within the set time length, the Servo ON process is completed.

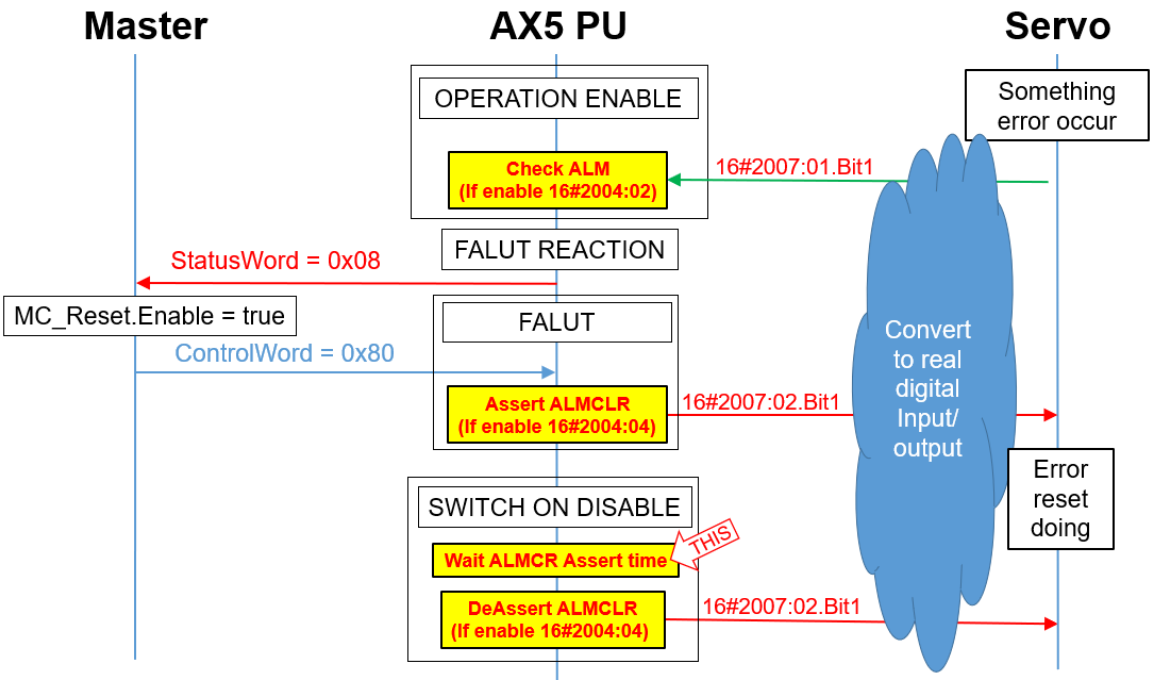
Take Delta AX series PLC as a master in the following figure:



- Axis0/Axis1 External DIQ Function Attribute ALMCLR Pulse Length.

Setting range	Description
0 to 16#FFFF	The length of time that the output logic 1 from ALMCLR Bit lasts, which works with 16# 2007:02: Bit1 (unit: ms)

Take Delta AX series PLC as a master in the following figure:



6.1.6.1.7 Axis External DIQ Value (16#2007 and 16#2807)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2007	16#01	Axis0 External DIQ Value DIn	Status of module's external input pin for Axis 0	UDINT	RW	0
	16#02	Axis0 External DIQ Value DQn	Status of module's external output pin for Axis 0	UDINT	RO	0
16#2807	16#01	Axis1 External DIQ Value DIn	Status of module's external input pin for Axis 1	UDINT	RW	0
	16#02	Axis1 External DIQ Value DQn	Status of module's external output pin for Axis 1	UDINT	RO	0

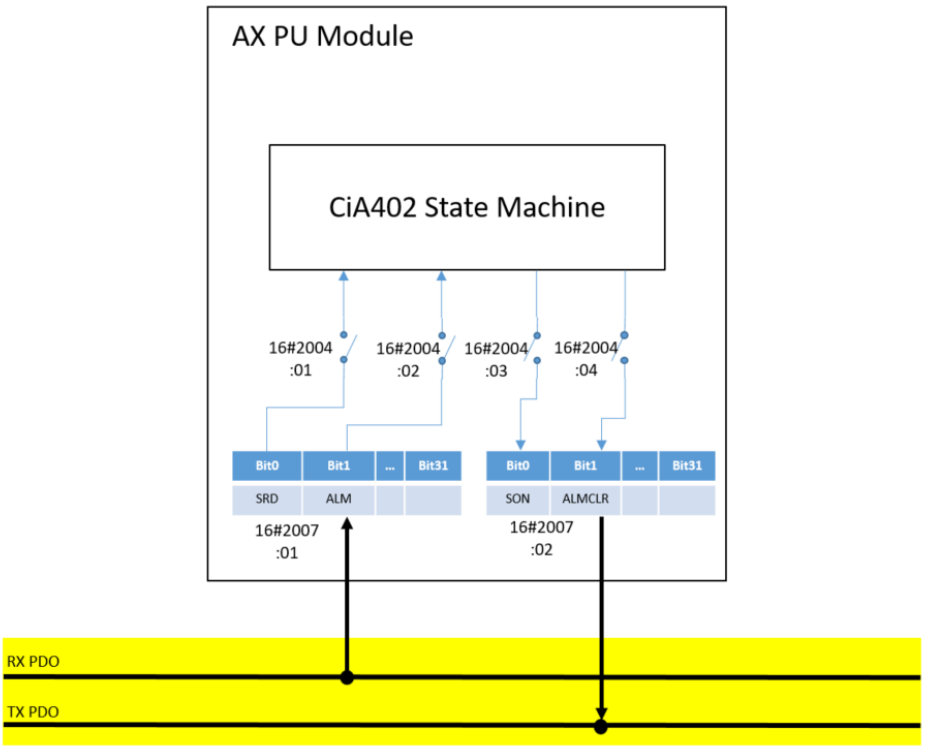
The settings of parameters above are shown below.

- Axis0/Axis1 External DIQ Value DIn

Bit	Name	Description
Bit 0	DI SRD	Receive the singal of Servo On done from the servo.
Bit 1	DI ALM	Receive the Alarm singal from the servo.
Bit 2-Bit 31	Reserve	Reserved

- Axis0/Axis1 External DIQ Value DQn

Bit	Name	Description
Bit 0	DI SON	Send the request signal of Servo On to the servo.
Bit 1	DI ALMCLR	Send the request signal of Alarm Reset to the servo.
Bit 2-Bit 31	Reserve	Reserved



6.1.6.1.8 Axis Position Demand Value for LREAL (16#2008 and 16#2808)

Internal real-time command position value with the unit: Pulse

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2008	16#00	Axis0 Position Demand Value for LREAL	Real-time command position value	LREAL	RO	0
16#2808	16#00	Axis1 Position Demand Value for LREAL		LREAL	RO	0

6.1.6.1.9 Axis Velocity Demand Value For LREAL (16#2009 and 16#2809)

Internal real-time command velocity value with the unit: pulse/sec

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2009	16#00	Axis0 Velocity Demand Value For LREAL	Real-time command velocity value	LREAL	RO	0
16#2809	16#00	Axis1 Velocity Demand Value For LREAL		LREAL	RO	0

6.1.6.1.10 Axis Acceleration Demand Value For LREAL (16#200A and 16#280A)

Internal real-time command acceleration value with the unit: pulse/sec^2

Index	Subindex	Name	Description	Data type	Attr.	Default
16#200A	16#00	Axis0 Demand Acceleration For LREAL	Real-time command acceleration value	LREAL	RO	0
16#280A	16#00	Axis1 Demand Acceleration For LREAL		LREAL	RO	0

6.1.6.1.11 Axis Jerk Demand Value for LREAL (16#200B and 16#280B)

Internal real-time command jerk value with the unit: pulse/sec^3

Index	Subindex	Name	Description	Data type	Attr.	Default
16#200B	16#00	Axis0 Jerk Demand Value For LREAL	Real-time command jerk value	LREAL	RO	0
16#280B	16#00	Axis1 Jerk Demand Value For LREAL		LREAL	RO	0

6.1.6.1.12 Axis Motion Actual Value Source (16#200C and 16#280C)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#200C	16#00	Axis0 Motion Actual Value Source	Actual position source (Reserved)	USINT	RW	0
16#280C	16#00	Axis1 Motion Actual Value Source		USINT	RW	0

6.1.6.1.13 Axis Feed Encoder Value (16#200D and 16#280D)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#200D	16#00	Axis0 Feed Encoder Value	Encoder feedback value (Reserved)	DINT	RW	0
16#280D	16#00	Axis1 Feed Encoder Value		DINT	RW	0

6.1.6.1.14 Module Status (16#5000)

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

- **Explanation**

When the Delta AX-5 PLC is used as the controller, the module status will be synchronized with the current status of the PLC, 1 (Run) or 2 (Stop). When the PLC is switched to Stop, the output module will behave differently according to the parameter settings for the module, but the input module will not be affected.

When other PLC is used, there is no Run/Stop state for the module, and its state is 0, which is controlled by the EtherCAT state machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	When the module is controlled by the EtherCAT state machine
1	Controlled by Controller (Run)	When the module is controlled by the PLC and the PLC is in Run state.
2	Controlled by Controller (Stop)	When the module is controlled by the PLC and the PLC is in Stop state.

6.1.6.1.15 User Command (16#5001)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#5001	16#00	User Command	Commands for users to use (Reserved)	UINT	RO	0

6.1.6.1.16 System Error Codes (16#A000)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#A000	16#00	System Error Code	System error code	UINT	RO	0

- **Explanation**

A system error message. Refer to section 6.1.10.1 for details.

6.1.6.1.17 Warning Codes (16#A001)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#A001	16#01	System Warning Code	System warning code	UINT	RO	0

- **Explanation**

A warning message. Refer to section 6.1.10.1 for details.

6.1.6.1.18 Errors (16#A002)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#A002	16#01	System Error	System error flag	BOOL	RO	0
	16#02	Axis0 Error	Axis0 error flag	BOOL	RO	0
	16#03	Axis1 Error	Axis1 error flag	BOOL	RO	0

- **Explanation**

Error flags. When the value of 16#A002 is 1, an error occurs.

6.1.6.1.19 Warnings (16#A003)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#A003	16#01	System Warning	System warning flag	BOOL	RO	0
	16#02	Axis0 Warning	Axis0 warning flag	BOOL	RO	0
	16#03	Axis1 Warring	Axis1 warning flag	BOOL	RO	0

- **Explanation**

Warning flags. When the value of 16#A003 is 1, a warning occurs.

6.1.6.1.20 Module Information (16#F001)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#F001	16#01	Product Serial Number	Product serial number	STRING (18)	RO	0
	16#02	Product Name	Product name	STRING (14)	RO	0
	16#03	Hardware Version	Hardware version	STRING (3)	RO	0
	16#04	Reserved	Reserved	STRING (12)	RO	0
	16#05	Runtime Version	Runtime version	STRING (12)	RO	0
	16#06	Reserved	Reserved	STRING (12)	RO	0
	16#07	Reserved	Reserved	STRING (12)	RO	0
	16#08	Reserved	Reserved	STRING (12)	RO	0
	16#09	Reserved	Reserved	STRING (12)	RO	0
	16#10	Reserved	Reserved	STRING (12)	RO	0
	16#11	Reserved	Reserved	STRING (12)	RO	0
	16#12	Reserved	Reserved	UDINT	RO	0
	16#13	Reserved	Reserved	UINT	RO	0
	16#14	Reserved	Reserved	UINT	RO	0
	16#15	Reserved	Reserved	UINT	RO	0
	16#16	Reserved	Reserved	UINT	RO	0
	16#17	Reserved	Reserved	UINT	RO	0
	16#18	Reserved	Reserved	UINT	RO	0
	16#19	Reserved	Reserved	UINT	RO	0
	16#20	Reserved	Reserved	UINT	RO	0
	16#21	Reserved	Reserved	UINT	RO	0
	16#22	Reserved	Reserved	UINT	RO	0
	16#23	Reserved	Reserved	UINT	RO	0
	16#24	Reserved	Reserved	UINT	RO	0
	16#25	Reserved	Reserved	UINT	RO	0

Index	Subindex	Name	Description	Data type	Attr.	Default
	16#26	Reserved	Reserved	UINT	RO	0
	16#27	Reserved	Reserved	UINT	RO	0
	16#28	Reserved	Reserved	UINT	RO	0
	16#29	Reserved	Reserved	UINT	RO	0
	16#30	Reserved	Reserved	UINT	RO	0
	16#31	Reserved	Reserved	UINT	RO	0

6.1.6.2 Device Control

6.1.6.2.1 Axis0 Error Code (16#603F)

This parameter displays an axis error code.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#603F	16#00	Axis0 Error Code	Error code of Axis0	UINT	RO	0

6.1.6.2.2 Axis0 ControlWord (16#6040)

This parameter stands for the control of module status, including Operating Modes.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6040	16#00	Axis0 ControlWord	Control word of Axis0	UINT	RW	0

- **Explanation**

Bit	Function	Description
Bit 0	Switch On	See the explanation of bits 0-3 below.
Bit 1	Enable voltage	
Bit 2	Quick stop	
Bit 3	Enable operation	
Bit 4-Bit 6	Operation mode specific	See the explanation of bits 4-8 below.
Bit 7	Fault reset	
Bit 8	Halt	
Bit 9-Bit 10	Reserved	-
Bit 11-Bit 15	Manufacturer Specific	-

■ Explanation of Bits 0-3 and Bit 7

Bits 0-3 and Bit 7: control commands for module states

Command	Bits of Control Word				
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0
Shutdown	0	-	1	1	0
Switch on	0	0	1	1	1
Switch on + Enable operation	0	1	1	1	1
Disable voltage	0	-	0	1	-
Quick stop	0	0	1	1	1
Disable operation	0	0	1	1	1
Enable operation	0	1	1	1	1
Fault reset	0 →1	-	-	-	-

■ Explanation of Bits 4-8.

Bit 4 and Bit 5: for Profile Position Mode

Bit 5	Bit 4	Description
0	0 → 1	Before the next command is executed, the positioning should be completed, the target position reached.
1	0 → 1	Start the next positioning.

Bit 6 and Bit 8: for Profile Position Mode

Bit	Value	Description
6	0	The target position is an absolute value.
	1	The target position is a relative value.
8	0	Positioning is executed or continued. The Halt function is not executed.
	1	The Halt function is executed. The axis shall be stopped according to the halt option code in16#605D.

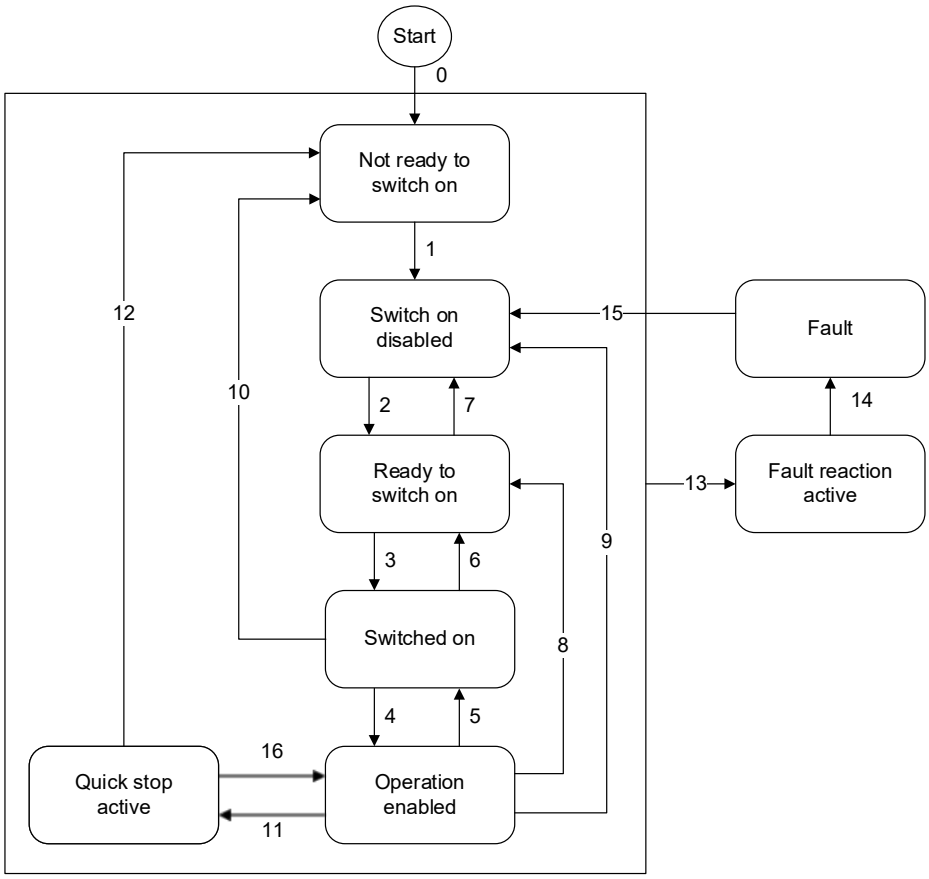
Bit 4 and Bit 8: for Homing Mode

Bit	Value	Description
4	0	Do not start homing procedure.
	1	Start or continue the homing procedure.
8	0	Enable bit 4 The Halt function is not executed.
	1	The Halt function is executed. The axis shall be stopped according to the halt option code in 16#605D.

Bit 8: for Profile Velocity Mode

Bit	Value	Description
8	0	The Halt function is not executed. The motion shall be executed or continued.
	1	The Halt function is executed. The axis shall be stopped according to the halt option code in 16#605D.

The Finite State Machine shown below defines how a drive behaves. Each state represents an internal or external behavior of the drive. For example, the point-to-point position movement can be allowed to perform only in the **Operation enabled** state.



The state changes can be achieved by issuing a command in 16#6040. See the detailed operations as follows.

16#6040					Command	State change
Bit 7	Bit 3	Bit 2	Bit 1	Bit 0		
0	-	1	1	0	Shutdown	2, 6, 8
0	0	1	1	1	Switch on	3
0	1	1	1	1	Switch on + Enable operation	3, 4
0	-	-	0	-	Disable voltage	7, 9, 10, 12
0	-	0	1	-	Quick stop	7, 10, 11
0	0	1	1	1	Disable operation	5
0	1	1	1	1	Enable operation	4, 16
0 →1	-	-	-	-	Fault reset	15

6.1.6.2.3 Axis0 StatusWord (16#6041)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6041	16#00	Axis0 StatusWord	Status word of Axis0	UINT	RO	0

- **Explanation**

Explanation of the status word:

Bit	Function	Description
Bit 0	Ready to switch on	Indicates the current status of the drive. See details in the table below.
Bit 1	Switched on	
Bit 2	Operation enabled	
Bit 3	Fault	
Bit 4	Voltage enabled	
Bit 5	Quick stop	
Bit 6	Switch on disabled	
Bit 7	Warning	Outputs the warning
Bit 8	Reserved	-
Bit 9	Remote	-
Bit 10	Target reached	-
Bit 11	Reserved	-
Bit 12-Bit 13	Operation mode specific	Depends on operation modes. See details in the table below
Bit 14-Bit 15	Reserved	-

■ Explanation of Bits 0-3, and Bits 5 and 6

Bits 0-3, Bit 5 and Bit 6: for the current status of the module

Bit 6	Bit 5	Bit 3	Bit 2	Bit 1	Bit 0	Description
0	-	0	0	0	0	Not ready to switch on
1	-	0	0	0	0	SwitchON disabled
0	1	0	0	0	1	Ready to switch on
0	1	0	0	1	1	Switched on
0	1	0	1	1	1	Operation enabled (Servo On)
0	0	0	1	1	1	Quick stop active
0	-	1	1	1	1	Fault reaction active
0	-	1	0	0	0	Fault

■ Explanation of Bits 10-13

Bits 10 and 12: Profile Position Mode

Bit	Name	Value	Halt (ControlWord.bit 8)	Description
10	Target reached	0	0	Target position is not reached.
			1	Axis decelerates.
		1	0	Target position is reached
			1	The velocity of the axis is 0
12	Set-point acknowledge	0	-	Previous set-point already processed, waiting for the new set-point.
		1	-	Previous set-point still in process, set-point overwriting shall be accepted.

Bit 10: Profile Velocity Mode

Bit	Name	Value	Halt (ControlWord.bit 8)	Description
10	Target reached	0	0	Target position is not reached.
			1	Axis decelerates.
		1	0	Target position is reached.
			1	The velocity of the axis is 0.

Bits 13, 12 and 10: Homing Mode

Bit	Bit 13	Bit 12	Bit 10	Description
Name	Homing	Homing attained	Target reached	
Value	0	0	0	Homing procedure is in progress.
	0	0	1	Homing procedure is interrupted or not started.
	0	1	1	Homing procedure is completed successfully.
	1	0	0	Homing error occurred, and the velocity is not 0.
	1	0	1	Homing error occurred, and the velocity is 0.

6.1.6.2.4 Axis0 Quick Stop Option Code (16#605A)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#605A	16#00	Axis0 Quick Stop Option Code	Axis 0 behavior selection for a quick stop	INT	RW	2

- **Explanation**

Axis 0 behavior selection for a quick stop:

Setting value	Description
0	The axis immediately stops and the axis status in 16#6041 switches to “Switch on disabled”.
1	With the Axis0 Profile Deceleration in 16#6084 as the deceleration, the axis status in 16#6041 switches to “Switch on disabled” when the axis stops.

Setting value	Description
2	With the Axis0 Quick Stop Deceleration in 16#6085 as the deceleration, the axis status in 16#6041 switches to "Switch on disabled" when the axis stops.
5	With the Axis0 Profile Deceleration in 16#6084 as the deceleration, the axis status in 16#6041 remains "Quick stop active" when the axis stops.
6	With the Axis0 Quick Stop Deceleration in 16#6085) as the deceleration, the axis status in 16#6041 remains "Quick stop active" when the axis stops.

6.1.6.2.5 Axis0 Shutdown Option Code (16#605B)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#605B	16#00	Axis0 Shutdown Option Code	Axis 0 behavior selection for a shutdown	INT	RW	0

- **Explanation**

Axis 0 behavior selection for a shutdown:

Setting value	Description
0	No function.
1	The axis decelerates to stop when in Servo Off state.

6.1.6.2.6 Axis0 Disable Operation Option Code (16#605C)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#605C	16#00	Axis0 Disable Operation Option Code	Axis 0 behavior selection for Disable operation	INT	RW	1

- **Explanation**

Axis 0 behavior selection for Disable operation:

Setting value	Description
0	No function.
1	The axis decelerates to stop.

6.1.6.2.7 Axis0 Halt Option Code (16#605D)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#605D	16#00	Axis0 Halt Option Code	Axis 0 behavior selection for a halt	INT	RW	1

- **Explanation**

Axis 0 behavior selection for a halt:

Setting value	Description
0	Reserved.
1	The axis decelerates to stop.
2	The axis stops immediately.

6.1.6.2.8 Axis0 Fault Reaction Option Code (16#605E)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#605E	16#00	Axis0 Fault Reaction Option Code	Axis 0 behavior selection for the reaction to a fault	INT	RW	0

- **Explanation**

Axis 0 behavior selection for the reaction to a fault:

Setting value	Description
0	No function.
1	The axis decelerates to stop.
2	The axis stops immediately.

6.1.6.2.9 Axis0 Modes Of Operation (16#6060)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6060	16#00	Axis0 Modes Of Operation	Operation mode of Axis 0	SINT	RW	0

- **Explanation**

Operation mode of Axis 0:

Setting value	Description
0	Reserved
1	Profile Position Mode
2	Reserved
3	Profile Velocity Mode
4	Reserved
5	Reserved
6	Homing Mode
7	Reserved
8	Cyclic Synchronous Position Mode
9	Cyclic Synchronous Velocity Mode
10	Reserved

6.1.6.2.10 Axis0 Modes Of Operation Display (16#6061)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6061	16#00	Axis0 Modes Of Operation Display	Displays the current operation mode of Axis 0	SINT	RO	0

- **Explanation**

Displays the current operation mode of Axis 0. Refer to the object 16#6060 for more.

6.1.6.2.11 Axis0 End Velocity (16#6082)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6082	16#00	Axis0 End Velocity	End profile velocity of Axis0	UDINT	RW	0

- **Explanation**

The parameter sets the end profile velocity of axis 0 when the position is reached during movement (unit: pulse/sec).

6.1.6.2.12 Axis0 Profile Jerk Use (16#60A3)

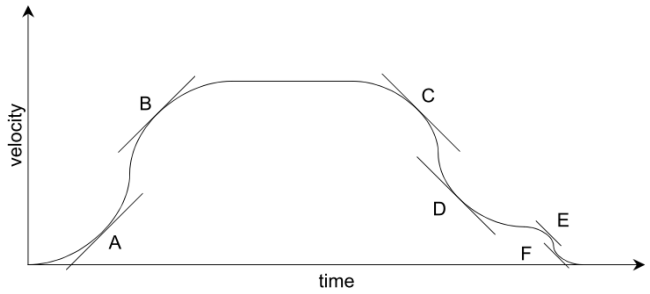
Index	Subindex	Name	Description	Data type	Attr.	Default
16#60A3	16#00	Axis0 Profile Jerk Use	Velocity sections where Axis 0 profile jerk is used	USINT	RW	2

- **Explanation**

The object presents the velocity sections where the profile jerk of Axis 0 is used.

Setting value	Description
16#01	Profile Jerk in 16#60A4: 01 works in the following velocity sections A*1, B*1, C*1, D*1, E*1 and F*1.
16#02	Profile Jerk in 16#60A4: 01 works in the following velocity sections A*1 and B*1. Profile Jerk in 16#60A4: 02 works in the following velocity sections C*1, D*1, E*1 and F*1.
16#FF	Neither of Profile Jerk in 16#60A4: 01 and Profile Jerk in 16#60A4: 02 takes effect.

*1.



6.1.6.2.13 Axis0 Profile Jerk (16#60A4)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#60A4	16#01	Axis0 Jerk1	Profile jerks of Axis 0 (unit: pulse/sec^3)	UDINT	RW	0
	16#02	Axis0 Jerk2		UDINT	RW	0

- **Explanation**

Sets the profile jerks of Axis 0 (unit: pulse/sec^3), which are available only in Profile Position Mode, Profile Velocity Mode, and Homing Mode.

6.1.6.2.14 Axis0 Supported Drive Modes (16#6502)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6502	16#00	Axis0 Supported Drive Modes	The motion mode that Axis0 supports	UDINT	RO	421

- **Explanation**

The motion modes that Axis 0 supports are shown in the table below:

Bit	Description
Bit 0	Profile Position Mode
Bit 1	N/A
Bit 2	Profile Velocity Mode
Bit 3	N/A
Bit 4	N/A
Bit 5	Homing Mode
Bit 6	N/A
Bit 7	Cyclic Synchronous Position Mode
Bit 8	Cyclic Synchronous Velocity Mode
Bit 9	N/A
Bit 10-Bit 31	Reserved

6.1.6.3 Profile Position Mode

6.1.6.3.1 Axis0 Position Demand Value (16#6062)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6062	16#00	Axis0 Position Demand Value	Real-time command position of Axis 0	DINT	RO	0

- **Explanation**

Real-time command position of Axis 0 (unit: Pulse).

6.1.6.3.2 Axis0 Target Position (16#607A)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#607A	16#00	Axis0 Target Position	Target position of Axis 0	DINT	RW	0

- **Explanation**

This object is only available for Profile Position Mode and Periodic Synchronous Position Mode (unit: Pulse).

6.1.6.3.3 Axis0 Software Position Limit (16#607D)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#607D	16#01	Axis0 Min Position Limit	Minimum software position of Axis 0	DINT	RW	-2147483648
	16#02	Axis0 Max Position Limit	Maximum software position of Axis 0	DINT	RW	2147483647

- **Explanation**

The maximum and minimum software limits for positions are absolute coordinate positions. When setting the target position, please ensure that the limits are not exceeded (unit: Pulse).

6.1.6.3.4 Axis0 Max Profile Velocity (16#607F)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#607F	16#00	Axis0 Max Profile Velocity	Maximum profile velocity of Axis 0	UDINT	RW	500000

- **Explanation**

The allowed maximum profile velocity of axis 0 during movement (unit: Pulse/sec)

6.1.6.3.5 Axis0 Profile Velocity (16#6081)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6081	16#00	Axis0 Profile Velocity	Profile velocity of Axis 0	UDINT	RW	0

- **Explanation**

The allowed profile velocity of Axis 0 during movement (unit: Pulse/sec).

6.1.6.3.6 Axis0 Profile Acceleration (16#6083)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6083	16#00	Axis0 Profile Acceleration	Profile acceleration of Axis 0	UDINT	RW	10000

- **Explanation**

The allowed profile acceleration of Axis 0 (unit: Pulse/sec^2) is available only for Profile Position Mode and Profile Velocity Mode.

6.1.6.3.7 Axis0 Profile Deceleration (16#6084)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6084	16#00	Axis0 Profile Deceleration	Profile deceleration of Axis 0	UDINT	RW	10000

- **Explanation**

The allowed profile deceleration of Axis 0 (unit: Pulse/sec^2) is available only for Profile Position Mode and Profile Velocity Mode.

6.1.6.3.8 Axis0 Quick Stop Deceleration (16#6085)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6085	16#00	Axis0 Quick Stop Deceleration	Deceleration of Axis 0 for a quick stop	UDINT	RW	4294967295

- **Explanation**

The deceleration of Axis 0 for a quick stop (unit: Pulse/sec^2).

6.1.6.3.9 Axis0 Motion Profile Type (16#6086)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6086	16#00	Axis0 Motion Profile Type	Motion profile type of Axis 0	INT	RW	0

- **Explanation**

Motion profile types:

Setting value	Description
-4	JerkFreeVelocityGuarantee (Jerk free curve with the velocity meeting the guarantee)
-3	JerkFreeAccelerationGuarantee (Jerk free curve with the acceleration meeting the guarantee)
-2	LinearRampTrapezoidalVelocityGuarantee (Trapezoidal curve with the velocity meeting the guarantee)
-1	LinearRampTrapezoidalAccelerationGuarantee (Trapezoidal curve with the acceleration meeting the guarantee)
0	LinearRampTrapezoidal (Trapezoidal curve)
2	JerkFree (Jerk free curve)
3	JerkLimited (Jerk limited curve)

6.1.6.3.10 Axis0 Position Demand Internal Value (16#60FC)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#60FC	16#00	Axis0 Position Demand Internal Value	Real-time internal command position of Axis 0	DINT	RO	0

- **Explanation**

The real-time internal command position of Axis 0 (unit: Pulse).

6.1.6.4 Homing Mode

6.1.6.4.1 Axis0 Position Actual Value (16#6064)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6064	16#00	Axis0 Position Actual Value	Actual position of Axis 0	DINT	RO	0

- **Explanation**

The actual position of Axis 0 (unit: Pulse)

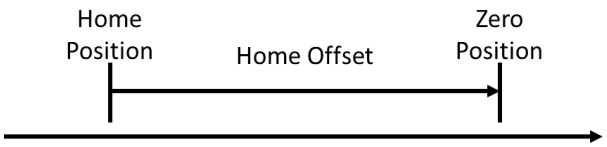
6.1.6.4.2 Axis0 Homing Offset (16#607C)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#607C	16#00	Axis0 Homing Offset	Home offset of Axis 0	DINT	RW	0

- **Explanation**

The reference home point to search for when performing the homing motion is the **Home Position**, such as the home sensor and Z pulse. After the reference point is reached, the position where an offset of the point is completed is the user-defined **Zero Position**, and the offset value is **Home Offset**.

Zero Position = Home Position + Home Offset



6.1.6.4.3 Axis0 Homing Method (16#6098)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6098	16#00	Axis0 Homing Method	Homing mode of Axis 0	SINT	RW	0

- **Explanation**

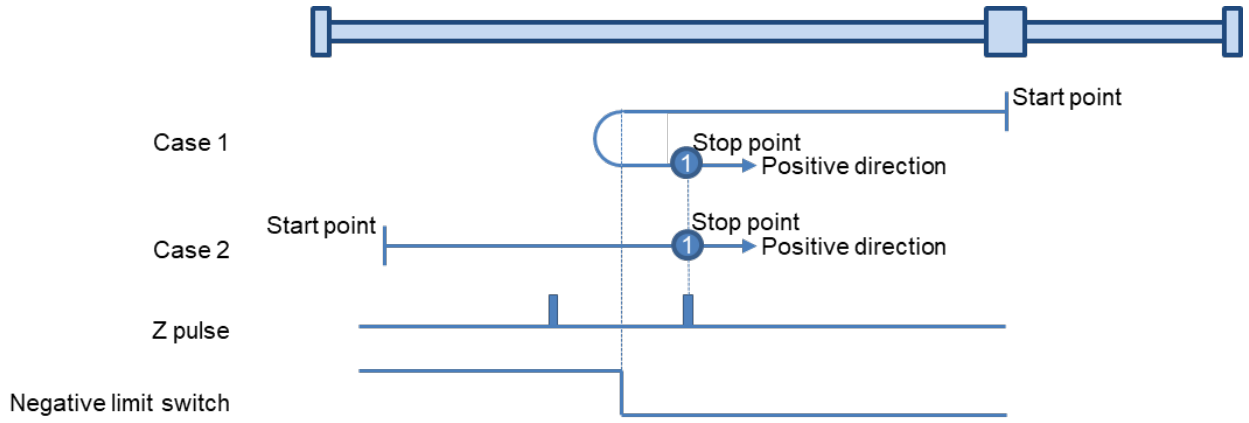
There are a total of 35 modes for users to set up for axis 0 to perform homing.

In modes 1-16, the axis needs to look for the Z pulse after homing is performed; in modes 17-34, the axis does not look for the Z pulse, and in mode 35, the current position is regarded as the home position.

- **Mode 1: Depending on the negative limit switch and Z pulse**

Case 1: The homing instruction is executed when the negative limit switch is OFF and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the axis encounters that the negative limit switch is ON. Where the first Z pulse is met is the home position while the negative limit switch is OFF.

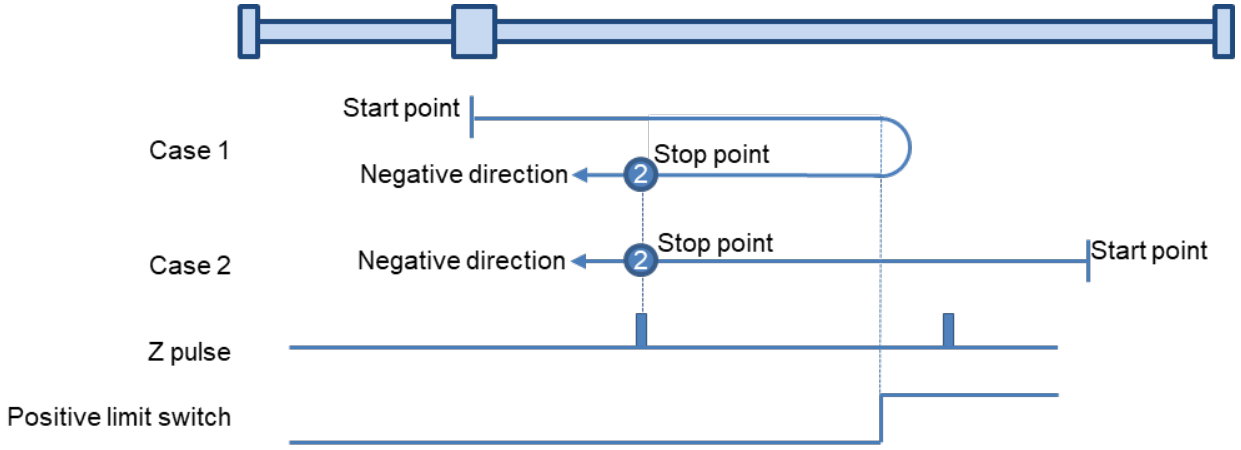
Case 2: The homing instruction is executed when the negative limit switch is ON and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). Where the first Z pulse is met is the home position while the negative limit switch is OFF.



- **Mode 2: Depending on the positive limit switch and Z pulse**

Case 1: The homing instruction is executed when the positive limit switch is OFF and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse) when the axis encounters that the positive limit switch is ON. Where the first Z pulse is met is the home position while the positive limit switch is OFF.

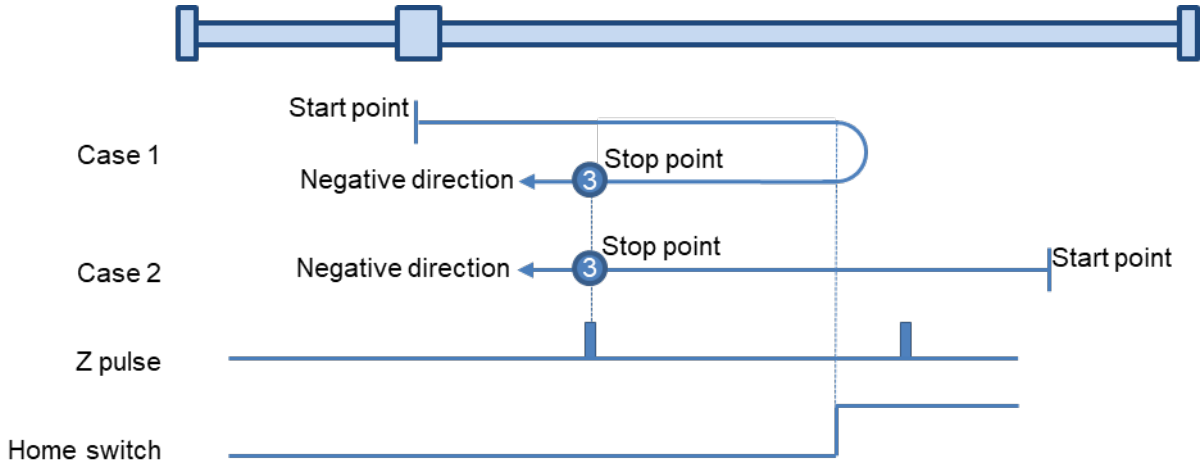
Case 2: The homing instruction is executed when the positive limit switch is ON and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). Where the first Z pulse is met is the home position while the positive limit switch is OFF.



- **Mode 3: Depending on the home switch and Z pulse**

Case 1: When the home switch is OFF, the homing instruction is executed and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). When the axis encounters that the home switch is ON, the motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse). Where the first Z pulse is met is the home position while the home switch is OFF.

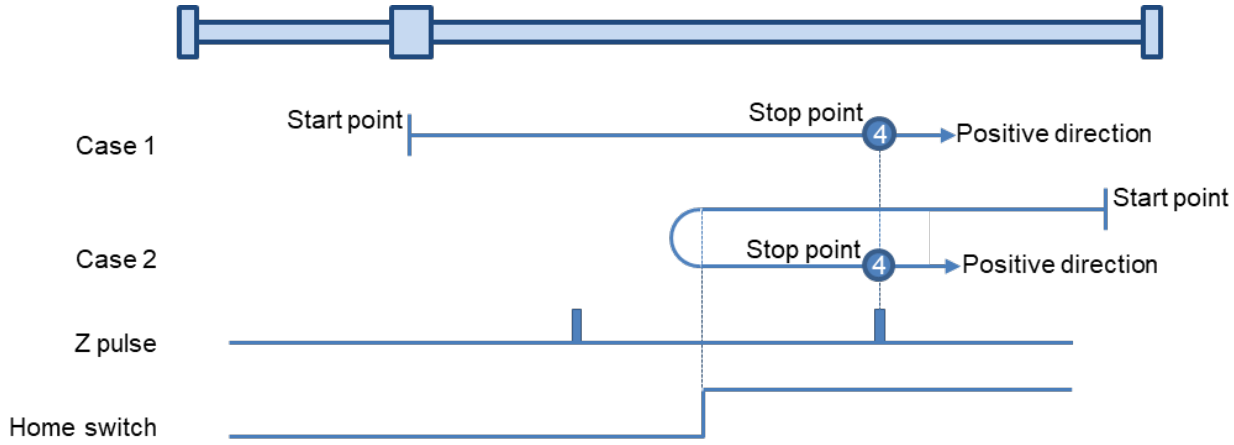
Case 2: When the home switch is ON, the homing instruction is executed and the axis directly moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). Where the first Z pulse is met is the home position while the home switch is OFF.



- **Mode 4: Depending on the home switch and Z pulse**

Case 1: When the home switch is OFF, the homing instruction is executed and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The axis still moves in the positive direction but at the second-phase speed (homing speed during the search for Z pulse) when the axis encounters that the home switch is ON. Where the first Z pulse is met is the home position while the home switch is ON.

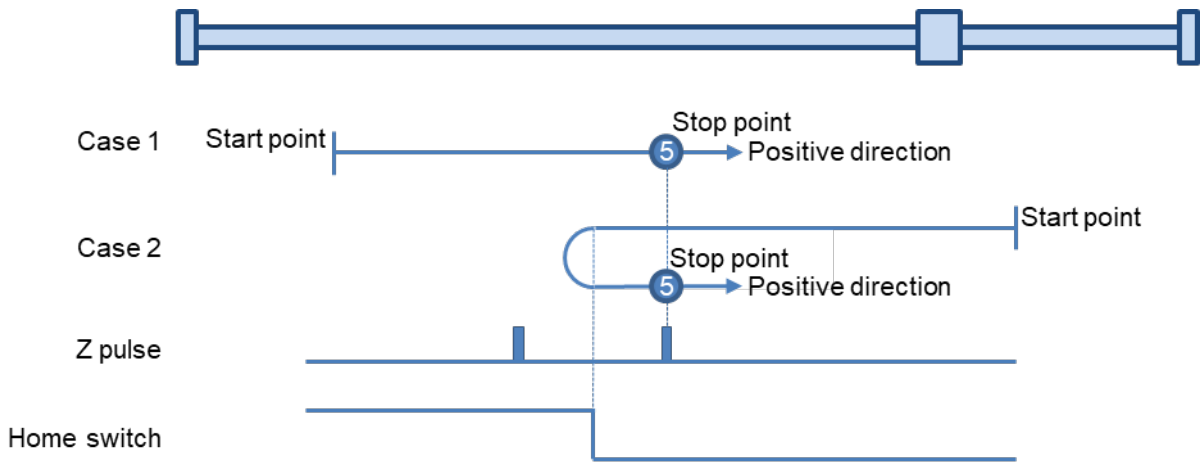
Case 2: When the home switch is ON, the homing instruction is executed and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). When the axis encounters that the home switch is OFF, the motion direction changes and the axis starts to move at the second-phase speed (homing speed during the search for Z pulse). Where the first Z pulse is met is the home position while the home switch is ON.



- **Mode 5: Depending on the home switch and Z pulse**

Case 1: When the home switch is ON, the homing instruction is executed and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). Where the first Z pulse is met is the home position while the home switch is OFF.

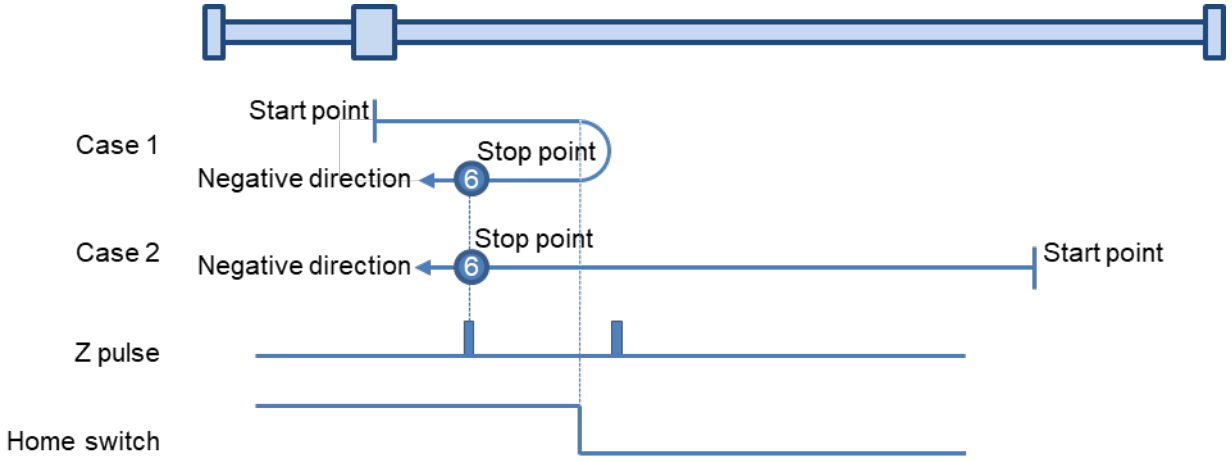
Case 2: When the home switch is OFF, the homing instruction is executed and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). When the home switch is ON, the motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse). Where the first Z pulse is met is the home position while the home switch is OFF.



- **Mode 6: Depending on the home switch and Z pulse**

Case 1: When the home switch is ON, the homing instruction is executed and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). When the home switch is OFF, the motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse). Where the first Z pulse is met is the home position.

Case 2: When the home switch is OFF, the homing instruction is executed and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). While the home switch is ON, the axis still moves in the negative direction but at the second-phase speed (homing speed during the search for Z pulse) and then where the first Z pulse is met is the home position.

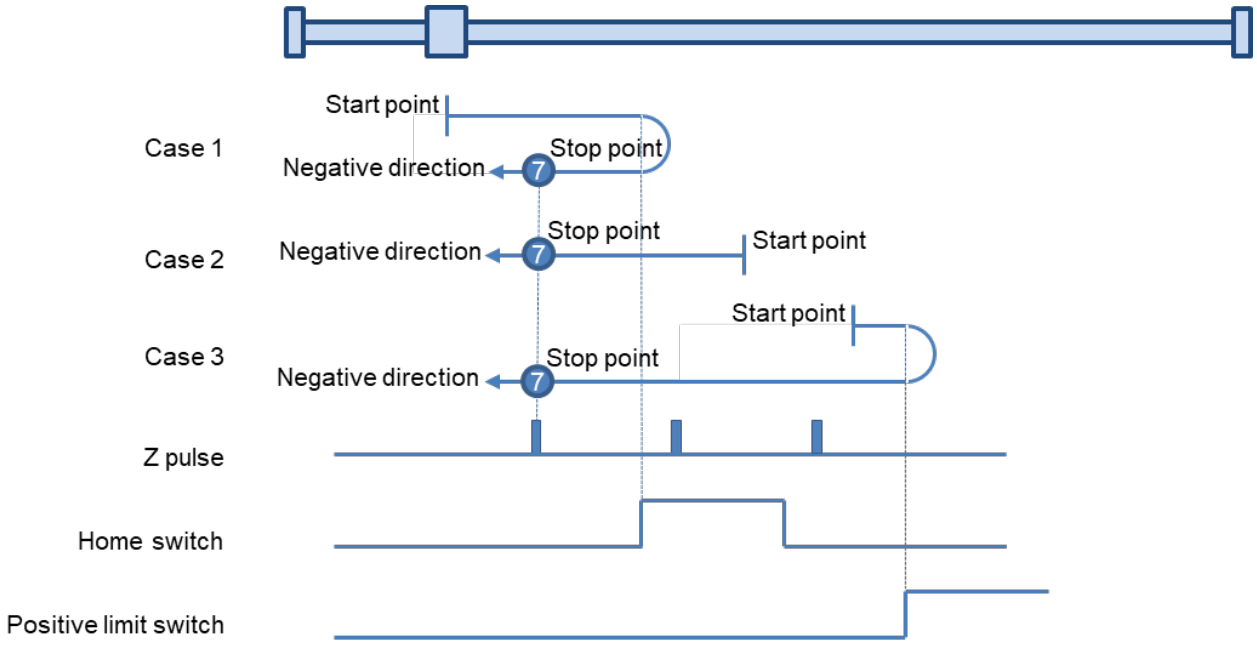


- **Mode 7: Depending on the home switch, positive limit switch and Z pulse**

Case 1: When the home switch is OFF, the homing instruction is executed and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is ON. Where the first Z pulse is met is the home position when the home switch is OFF.

Case 2: When the home switch is ON, the homing instruction is executed and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). Where the first Z pulse is met is the home position when the home switch is OFF.

Case 3: When the home switch is OFF, the homing instruction is executed and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the positive limit switch is ON with the home switch OFF. The axis starts to move at the second-phase speed (homing speed during the search for Z pulse) when the home switch becomes ON with the positive limit switch OFF. Where the first Z pulse is met is the home position while the home switch is OFF.

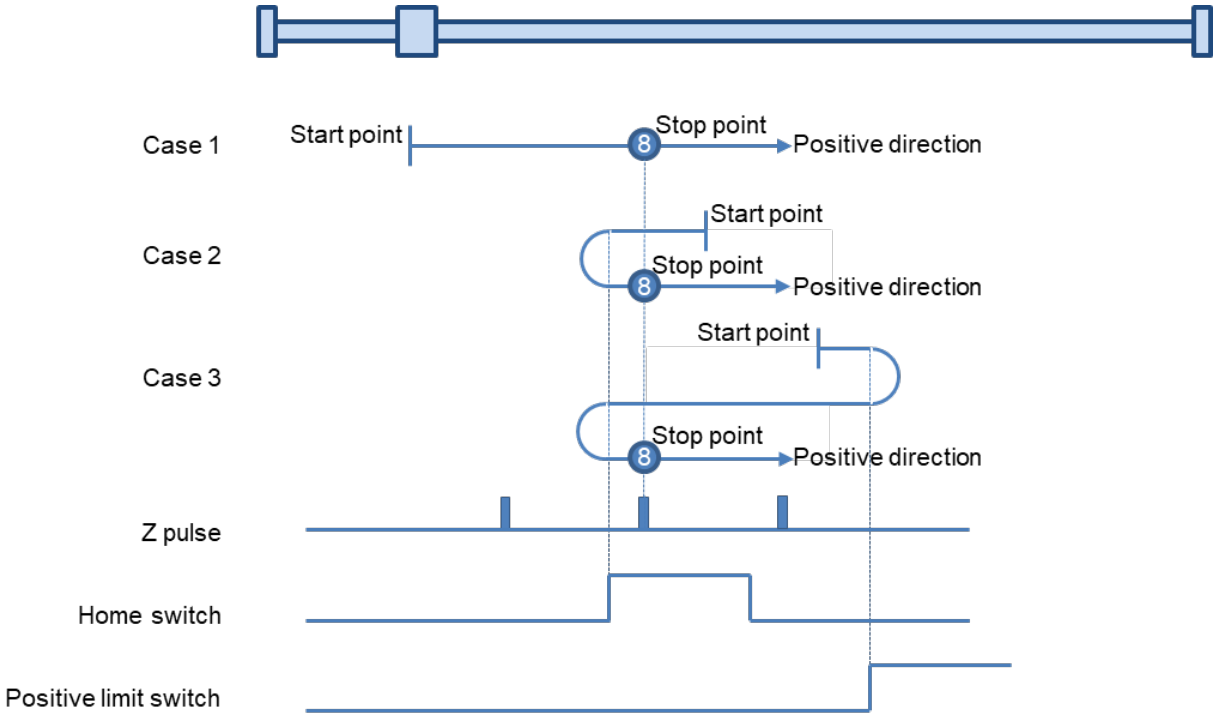


- **Mode 8: Depending on the home switch, positive limit switch and Z pulse**

Case 1: When the home switch is OFF, the homing instruction is executed and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is ON and where the first Z pulse is met is the home position.

Case 2: When the home switch is ON, the homing instruction is executed and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is OFF. When the home switch is ON, where the first Z pulse is met is the home position.

Case 3: When the home switch is OFF, the homing instruction is executed and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). When the positive limit switch is ON with the home switch OFF, the motion direction changes and the axis starts to move at the first-phase speed (homing speed during the search for a switch). When the home switch is ON with the positive limit switch OFF, the axis still moves at the first-phase speed (homing speed during the search for a switch). When the home switch is OFF, the motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch). When the home switch is ON, the axis moves at the second-phase speed (homing speed during the search for Z pulse) and where the first Z pulse is met is the home position.

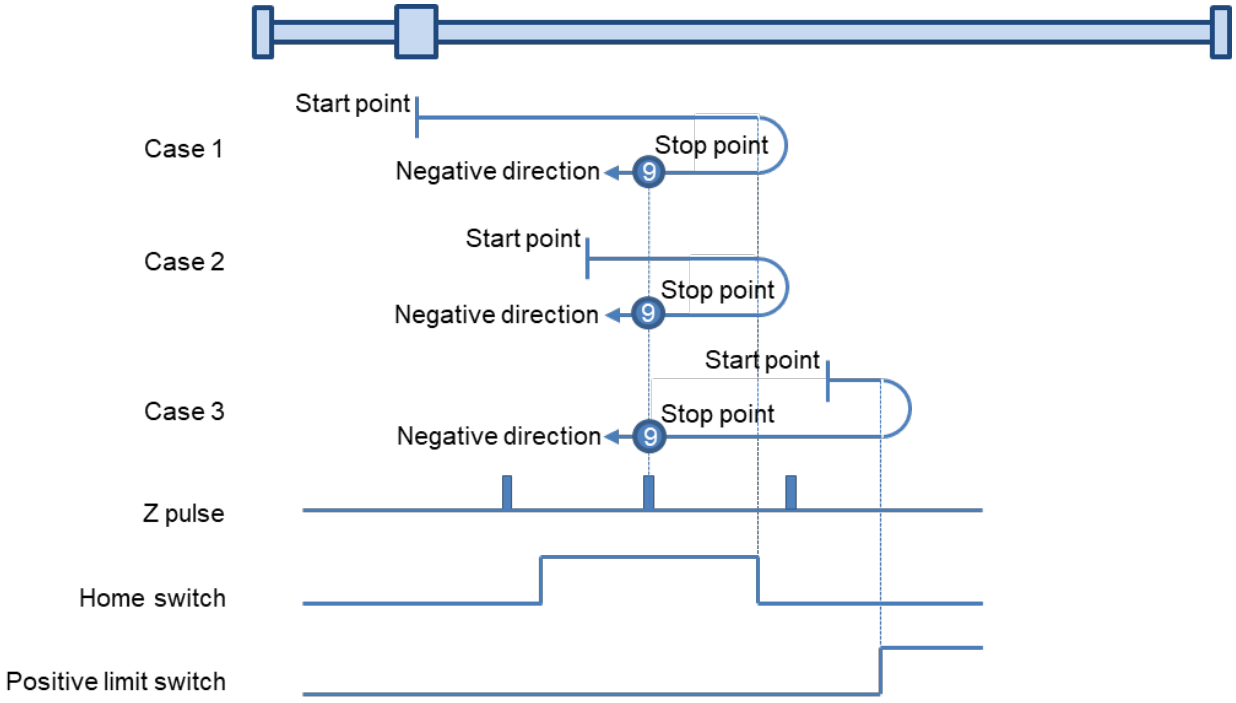


- **Mode 9: Depending on the home switch, positive limit switch and Z pulse**

Case 1: When the home switch is OFF, the homing instruction is executed and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is ON. The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is OFF. And then where the first Z pulse is met is the home position.

Case 2: When the home switch is ON, the homing instruction is executed and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is OFF. And then where the first Z pulse is met is the home position.

Case 3: When the home switch is OFF, the homing instruction is executed and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the positive limit switch is ON with the home switch OFF. The axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is ON with the positive limit switch OFF. And then where the first Z pulse is met is the home position.

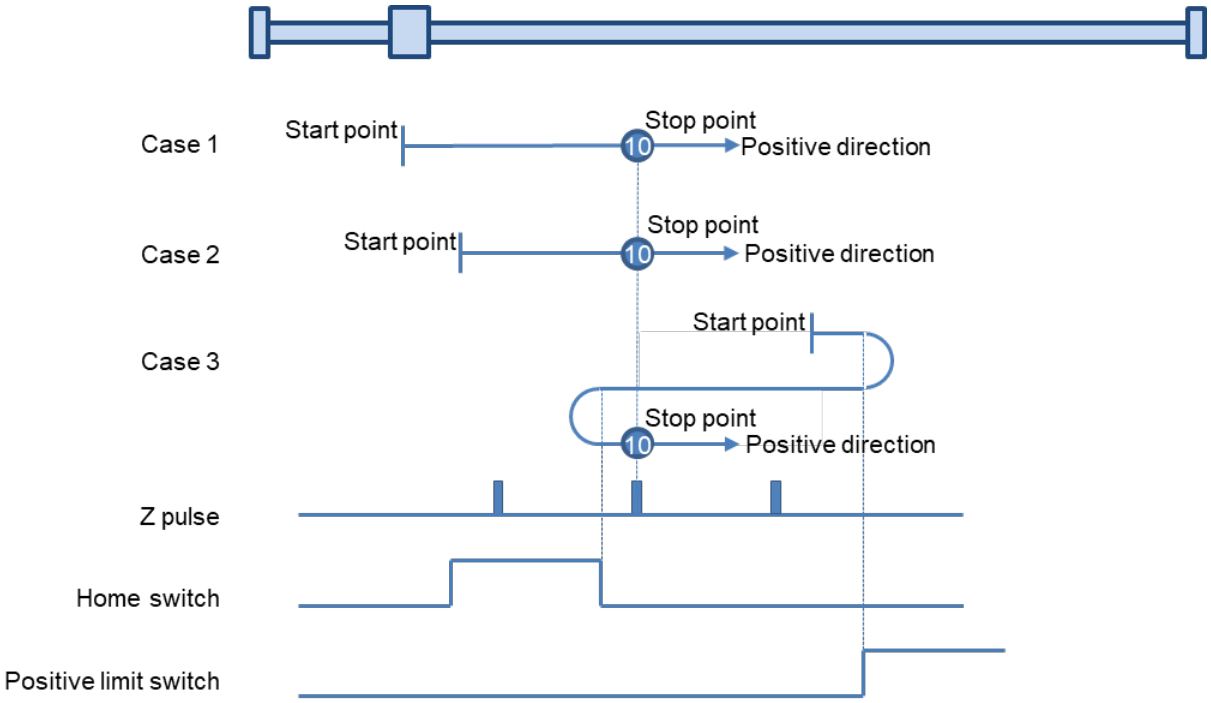


- **Mode 10: Depending on the home switch, positive limit switch and Z pulse**

Case 1: When the home switch is OFF, the homing instruction is executed and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The axis starts to move at the second-phase speed (homing speed during the search for Z pulse) when it encounters that the home switch is ON. And where the first Z pulse is met is the home position while the home switch is OFF.

Case 2: When the home switch is ON, the homing instruction is executed and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). And where the first Z pulse is met is the home position while the home switch is OFF.

Case 3: When the home switch is OFF, the homing instruction is executed and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the positive limit switch is ON with the home switch OFF. The motion direction changes again and the axis starts to move at the second-phase speed (homing speed during the search for Z pulse) when it encounters that the home switch is ON with the positive limit switch OFF. And then where the first Z pulse is met is the home position.



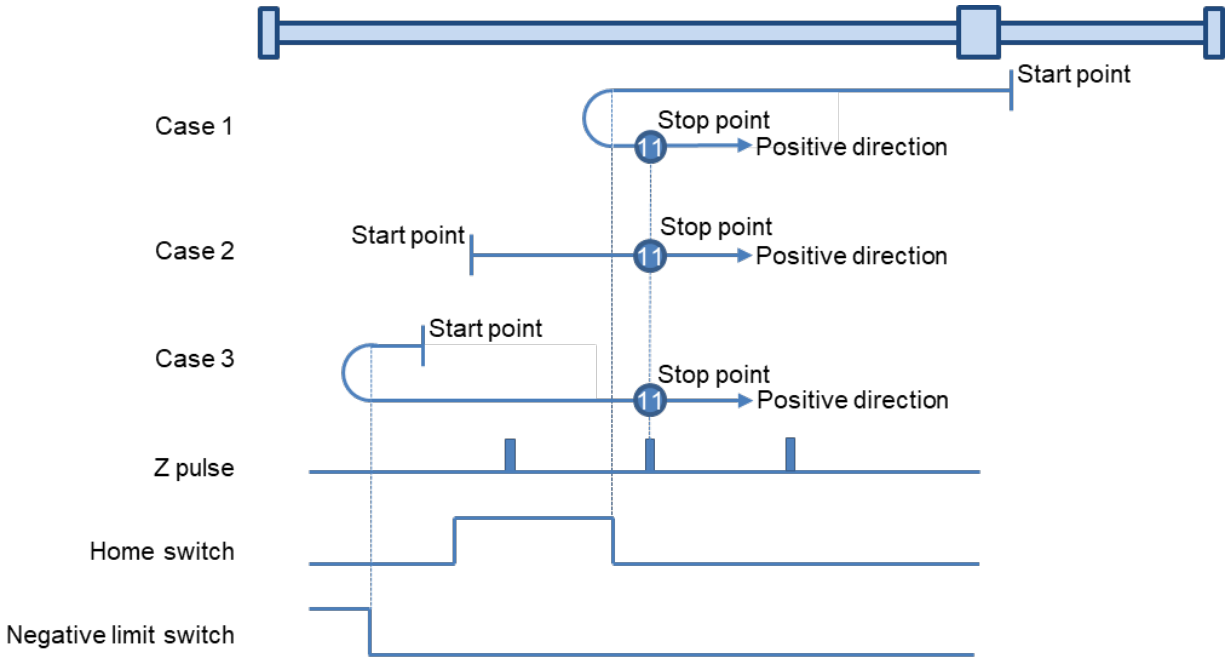
Mode 11 to mode 14: Depending on the home switch, negative limit switch and Z pulse

- **Mode 11: Depending on the home switch, negative limit switch and Z pulse**

Case 1: When the home switch is OFF, the homing instruction is executed and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when it encounters that the home switch is ON. And where the first Z pulse is met is the home position while the home switch is OFF.

Case 2: When the home switch is ON, the homing instruction is executed and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). And where the first Z pulse is met is the home position while the home switch is OFF.

Case 3: When the home switch is OFF, the homing instruction is executed and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the negative limit switch is ON with the home switch OFF. The axis moves at the second-phase speed (homing speed during the search for Z pulse) while the home switch is ON and the negative limit switch is OFF. Where the first Z pulse is met is the home position while the home switch is OFF.

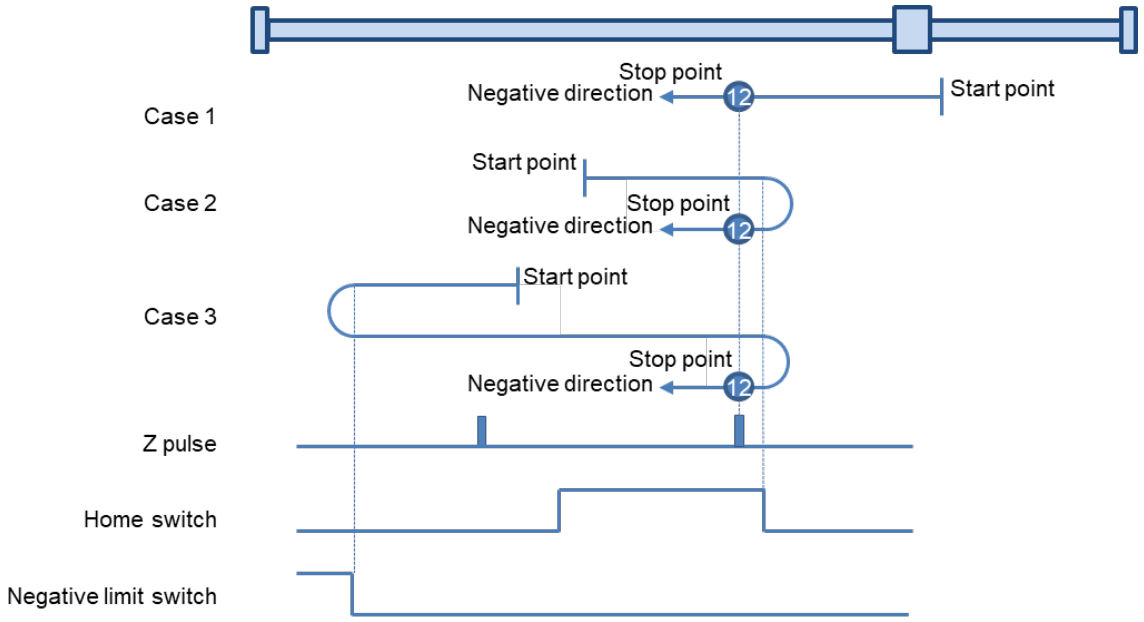


- **Mode 12: Depending on the home switch, negative limit switch and Z pulse**

Case 1: When the home switch is OFF, the homing instruction is executed and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The axis moves at the second-phase speed (homing speed during the search for Z pulse) when it encounters that the home switch is ON. Where the first Z pulse is met is the home position.

Case 2: When the home switch is ON, the homing instruction is executed and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) while the home switch is OFF. Where the first Z pulse is met is the home position when the home switch is ON.

Case 3: When the home switch is OFF, the homing instruction is executed and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis starts to move at the first-phase speed (homing speed during the search for a switch) when the negative limit switch becomes ON with the home switch OFF. The axis still moves at the first-phase speed (homing speed during the search for a switch) when the home switch is ON with the negative limit switch OFF. The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the home switch is OFF. The axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is ON. Where the first Z pulse is met is the home position.

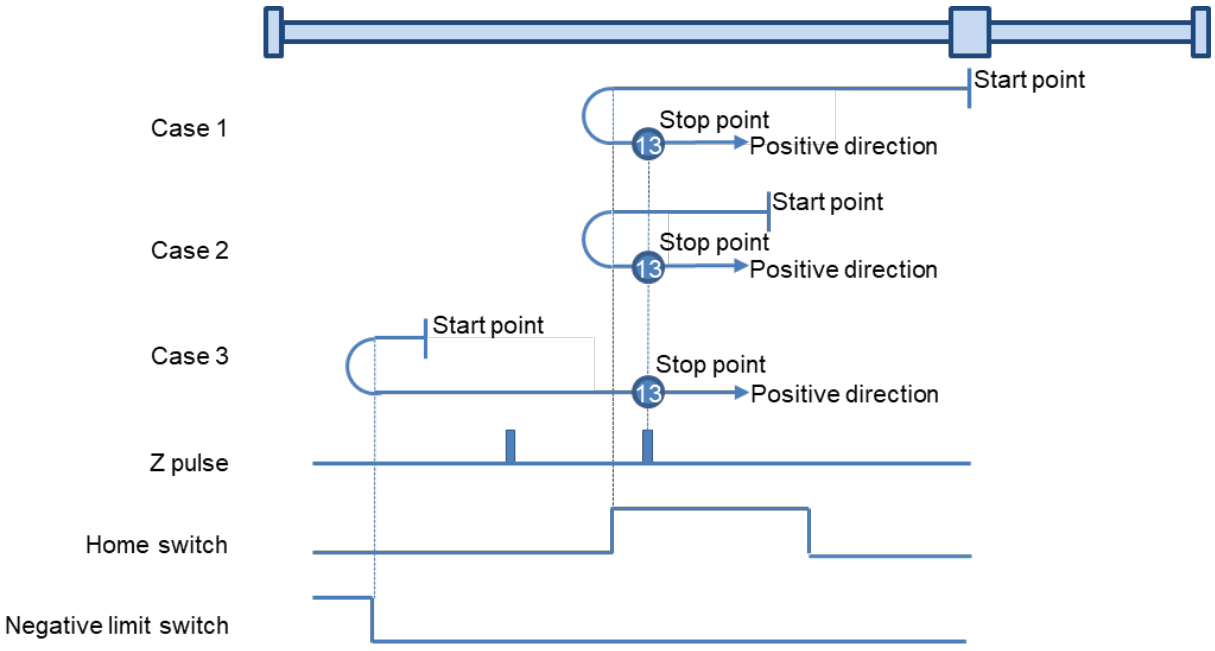


- **Mode 13: Depending on the home switch, negative limit switch and Z pulse**

Case 1: When the home switch is OFF, the homing instruction is executed and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The axis moves at the second-phase speed (homing speed during the search for Z pulse) while it encounters that the home switch is ON. The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) while the home switch is OFF. And where the first Z pulse is met is the home position.

Case 2: When the home switch is ON, the homing instruction is executed and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) while the home switch is OFF. And where the first Z pulse is met is the home position.

Case 3: When the home switch is OFF, the homing instruction is executed and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis starts to move at the first-phase speed (homing speed during the search for a switch) when the negative limit switch becomes ON with the home switch OFF. When the home switch is ON with the negative limit switch OFF, the axis moves at the second-phase speed (homing speed during the search for Z pulse) and where the first Z pulse is met is the home position.

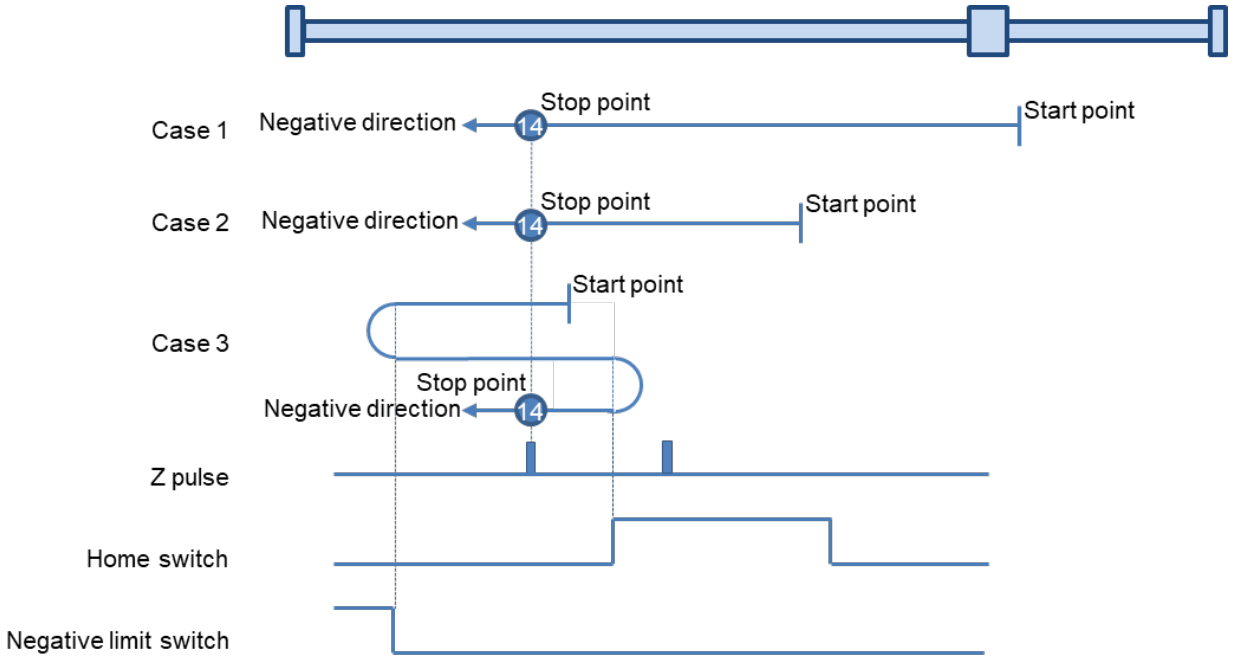


- **Mode 14: Depending on the home switch, negative limit switch and Z pulse**

Case 1: While the home switch is OFF, the homing instruction is executed and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The axis moves at the second-phase speed (homing speed during the search for Z pulse) once the home switch is ON. And where the first Z pulse is met is the home position while the home switch is OFF.

Case 2: While the home switch is ON, the homing instruction is executed and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). Where the first Z pulse is met is the home position while the home switch is OFF.

Case 3: While the home switch is OFF, the homing instruction is executed and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis starts to move at the first-phase speed (homing speed during the search for a switch) when the negative limit switch becomes ON with the home switch OFF. The motion direction changes again and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is ON with the negative limit switch OFF, and where the first Z pulse is met is the home position.



Mode 15 and mode 16: Reserved

Modes 15-16 are reserved for future development.

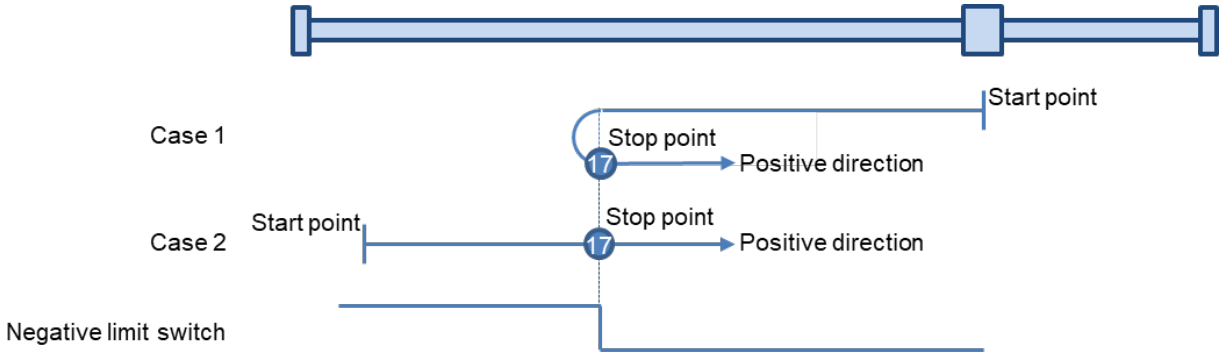
Mode 17 to mode 30: No Z pulse is required.

In modes 17-30 which are similar to modes 1-14, the home positioning is achieved simply based on the state of a home switch or/and a limit switch (positive or negative), with no Z pulse required.

- **Mode 17: Similar to mode 1, it depends on the negative limit switch only, not considering the Z pulse.**

Case 1: The homing instruction is executed when the negative limit switch is OFF and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse) when the negative limit switch becomes ON. Where the negative limit switch becomes OFF is the home position.

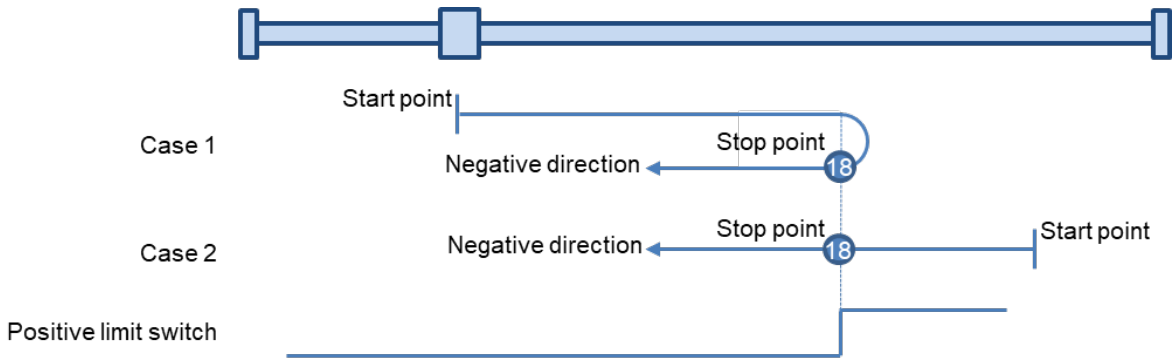
Case 2: The homing instruction is executed when the negative limit switch is ON and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). Where the negative limit switch becomes OFF is the home position.



- **Mode 18: Similar to mode 2, it depends on the positive limit switch only, not considering the Z pulse.**

Case 1: The homing instruction is executed when the positive limit switch is OFF and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). When the positive limit switch becomes ON, the motion direction changes and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). Where the positive limit switch becomes OFF is the home position.

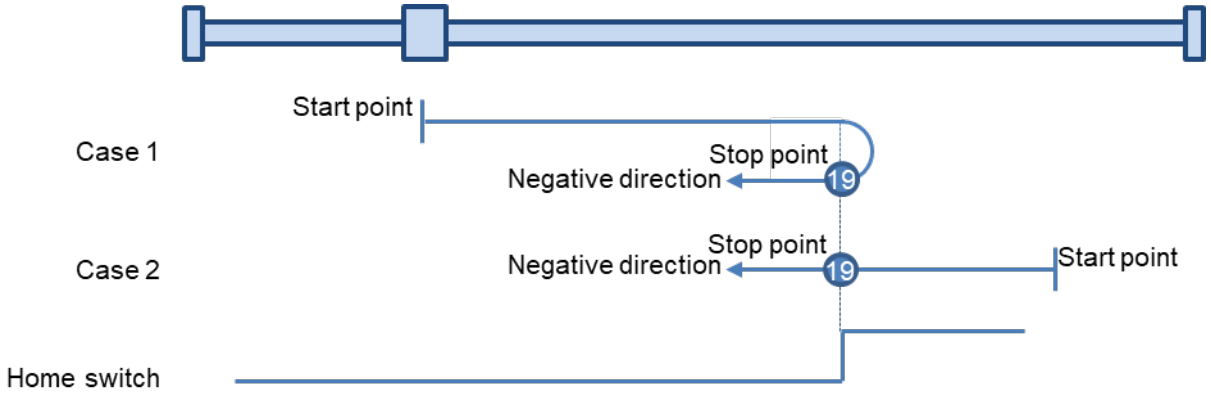
Case 2: The homing instruction is executed when the positive limit switch is ON and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). Where the positive limit switch becomes OFF is the home position.



- **Mode 19: Similar to mode 3, it depends on the home switch only, not considering the Z pulse.**

Case 1: While the home switch is OFF, the homing instruction is executed and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) once the home switch is ON. And where the home switch becomes OFF is the home position.

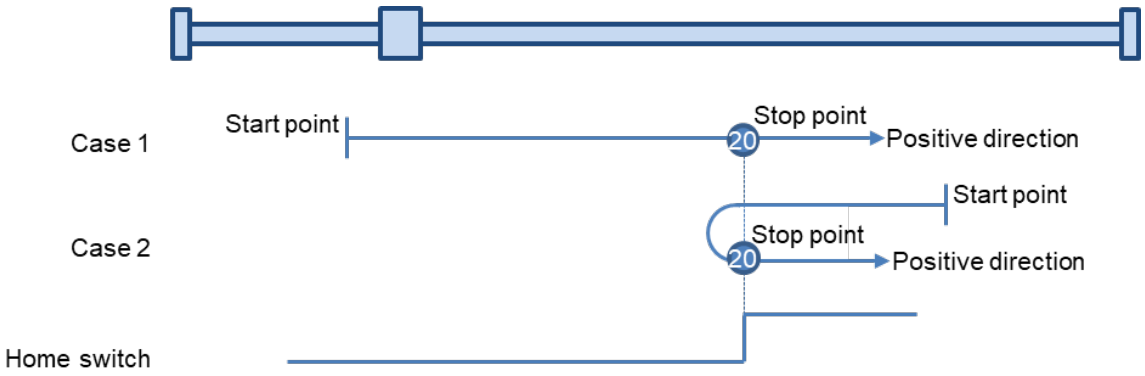
Case 2: While the home switch is ON, the homing instruction is executed and the axis directly moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). And where the home switch becomes OFF is the home position.



- **Mode 20: Similar to mode 4, it depends on the home switch only, not considering the Z pulse.**

Case 1: The homing instruction is executed when the home switch is OFF and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). Where the home switch becomes ON is the home position.

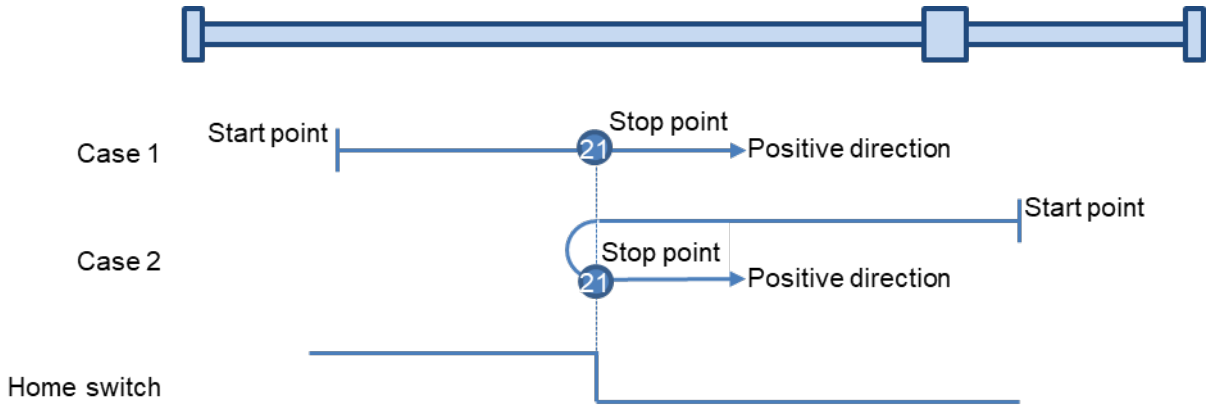
Case 2: The homing instruction is executed when the home switch is ON and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) once the home switch is OFF. Where the home switch becomes ON is the home position.



- **Mode 21: Similar to mode 5, it depends on the home switch only, not considering the Z pulse.**

Case 1: While the home switch is ON, the homing instruction is executed and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). And where the home switch becomes OFF is the home position.

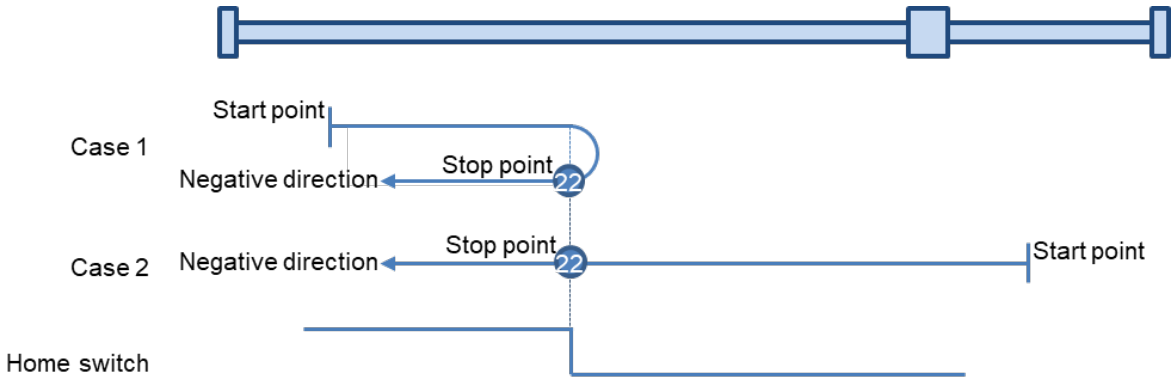
Case 2: While the home switch is OFF, the homing instruction is executed and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) once the home switch is ON. And where the home switch becomes OFF is the home position.



- **Mode 22: Similar to mode 6, it depends on the home switch only, not considering the Z pulse.**

Case 1: The homing instruction is executed while the home switch is ON and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) once the home switch is OFF. Where the home switch becomes ON is the home position.

Case 2: The homing instruction is executed while the home switch is OFF and the axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). Where the home switch becomes ON is the home position.

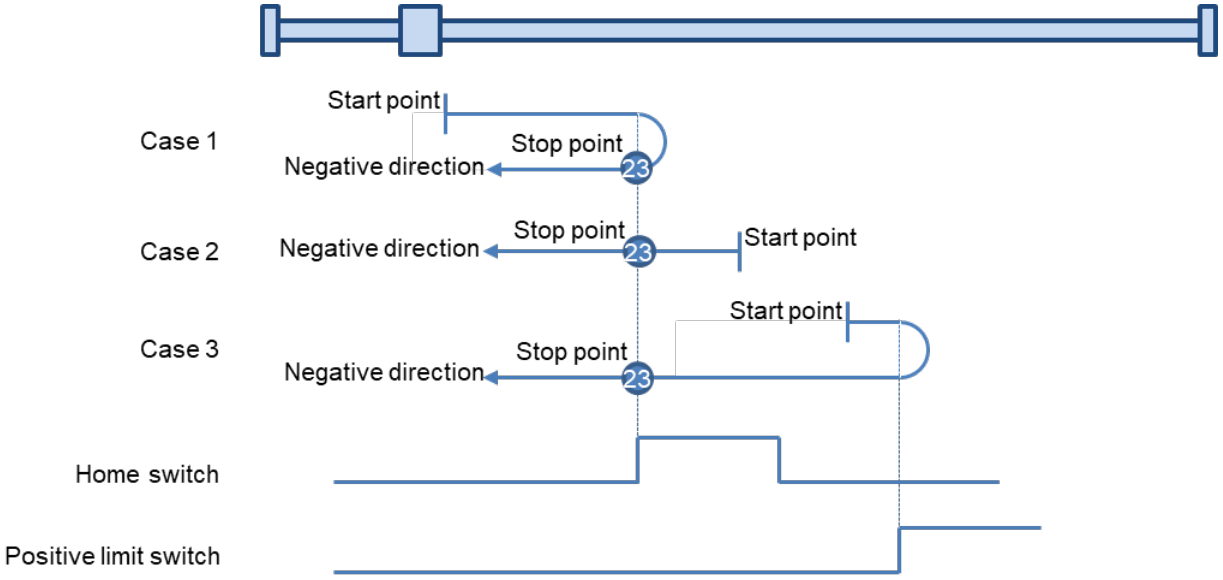


- **Mode 23: Similar to mode 7, it depends on the home switch and the positive limit switch, not considering the Z pulse.**

Case 1: The homing instruction is executed while the home switch is OFF and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) once the home switch becomes ON. Where the home switch becomes OFF is the home position.

Case 2: The homing instruction is executed while the home switch is ON and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). Where the home switch becomes OFF is the home position.

Case 3: The homing instruction is executed while the home switch is OFF. The axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). When the home switch is OFF and the positive limit switch is ON, the motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch). When the home switch is ON and the positive limit switch is OFF, the axis starts to move at the second-phase speed (homing speed during the search for Z pulse). Where the home switch becomes OFF is the home position.

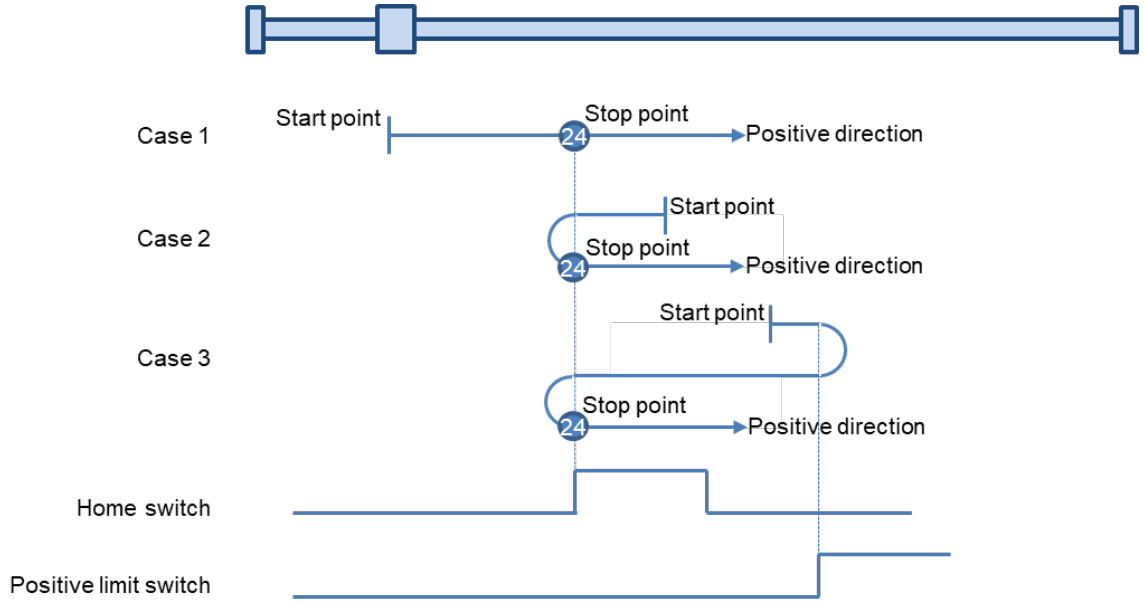


- **Mode 24: Similar to mode 8, it depends on the home switch and the positive limit switch, but not considering the Z pulse.**

Case 1: The homing instruction is executed while the home switch is OFF and the axis starts to move in the positive direction at the first-phase speed (homing speed during the search for a switch). Where the home switch becomes ON is the home position.

Case 2: The homing instruction is executed while the home switch is ON and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is OFF. Where the home switch becomes ON is the home position.

Case 3: The homing instruction is executed while the home switch is OFF, and the axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the home switch is OFF and the positive limit switch is ON. When the home switch is ON and the positive limit switch is OFF, the axis still moves at the first-phase speed (homing speed during the search for a switch). When the home switch becomes OFF, the motion direction changes and the axis starts to move at the second-phase speed (homing speed during the search for Z pulse). Where the home switch becomes ON is the home position.

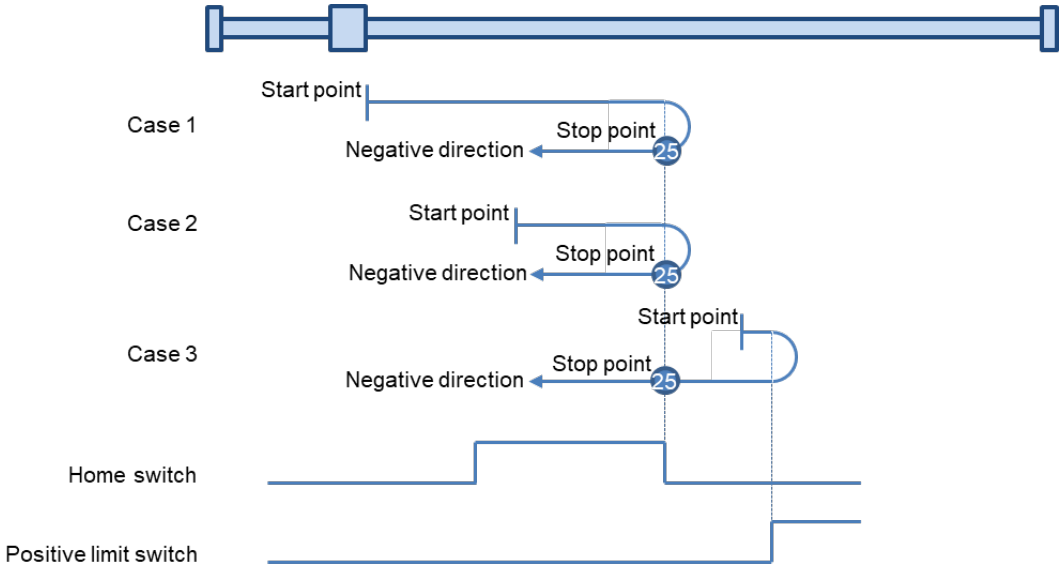


- **Mode 25: Similar to mode 9, it depends on the home switch and the positive limit switch, not considering the Z pulse.**

Case 1: The homing instruction is executed while the home switch is OFF and the axis starts to move in the positive direction at the first-phase speed (homing speed during the search for a switch). The axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is ON. The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is OFF. Where the home switch becomes ON is the home position.

Case 2: The homing instruction is executed while the home switch is ON, and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is OFF. Where the home switch becomes ON is the home position.

Case 3: The homing instruction is executed while the home switch is OFF. The axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the home switch is OFF and the positive limit switch is ON. Where the home switch becomes ON with the positive limit switch OFF is the home position.

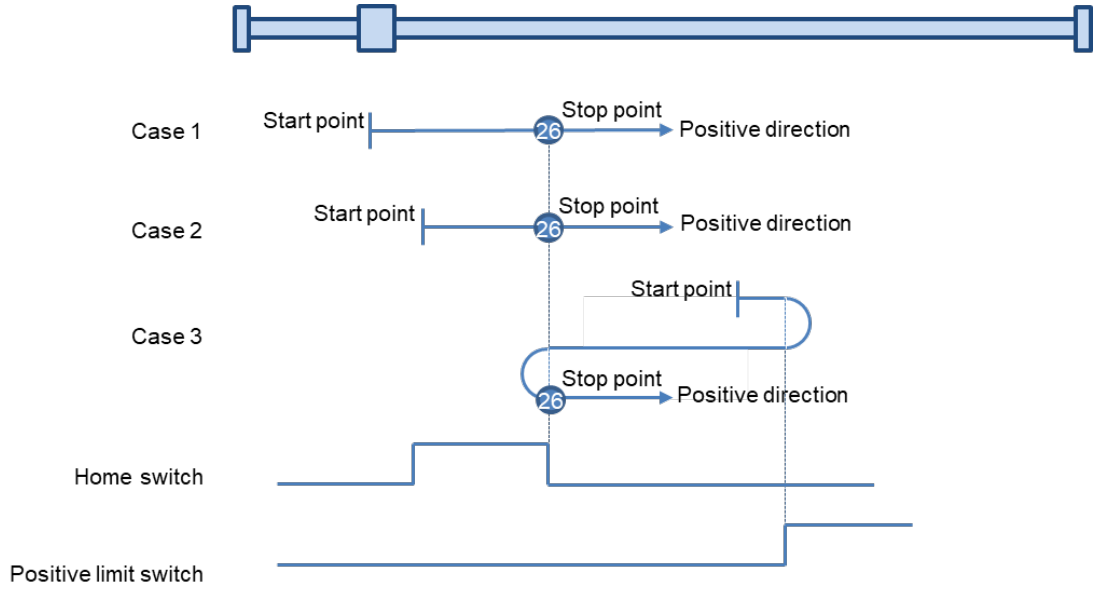


- **Mode 26: Similar to mode 10, it depends on the home switch and the positive limit switch, not considering the Z pulse.**

Case 1: The homing instruction is executed while the home switch is OFF and the axis starts to move in the positive direction at the first-phase speed (homing speed during the search for a switch). The axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is ON. Where the home switch becomes OFF is the home position.

Case 2: The homing instruction is executed while the home switch is ON and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). Where the home switch becomes OFF is the home position.

Case 3: The homing instruction is executed while the home switch is OFF. The axis moves in the positive direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the positive limit switch is ON with the home switch OFF. The motion direction changes again and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is ON. Where the home switch becomes OFF is the home position.

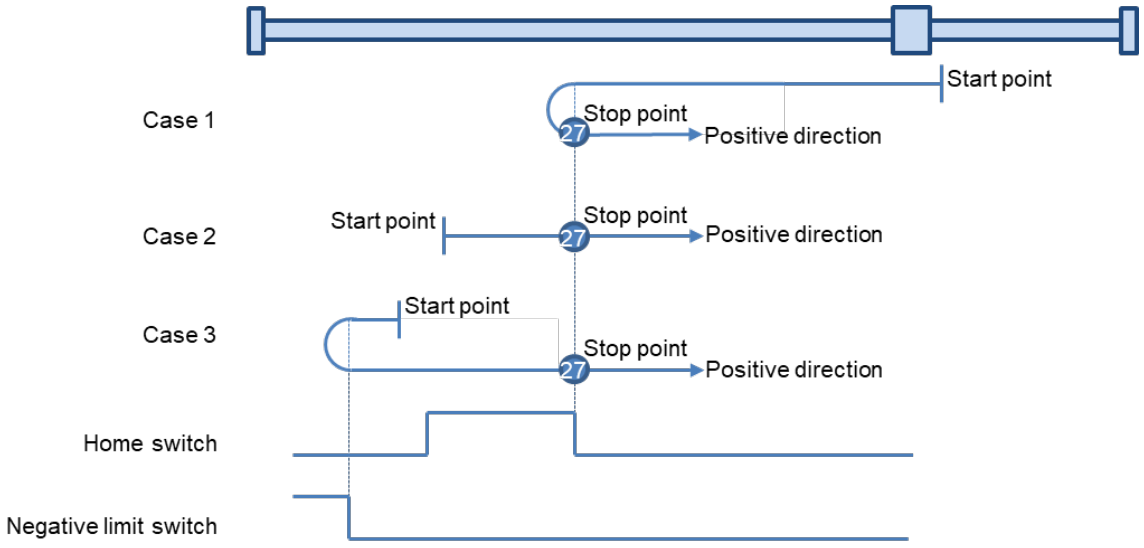


- **Mode 27: Similar to mode 11, it depends on the home switch and the negative limit switch, not considering the Z pulse.**

Case 1: The homing instruction is executed while the home switch is OFF and the axis starts to move in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is ON. Where the home switch becomes OFF is the home position.

Case 2: The homing instruction is executed while the home switch is ON and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). Where the home switch becomes OFF is the home position.

Case 3: The homing instruction is executed while the home switch is OFF. The axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the negative limit switch is ON with the home switch OFF. When the home switch is ON, the axis starts to move at the second-phase speed (homing speed during the search for Z pulse). Where the home switch becomes OFF is the home position.

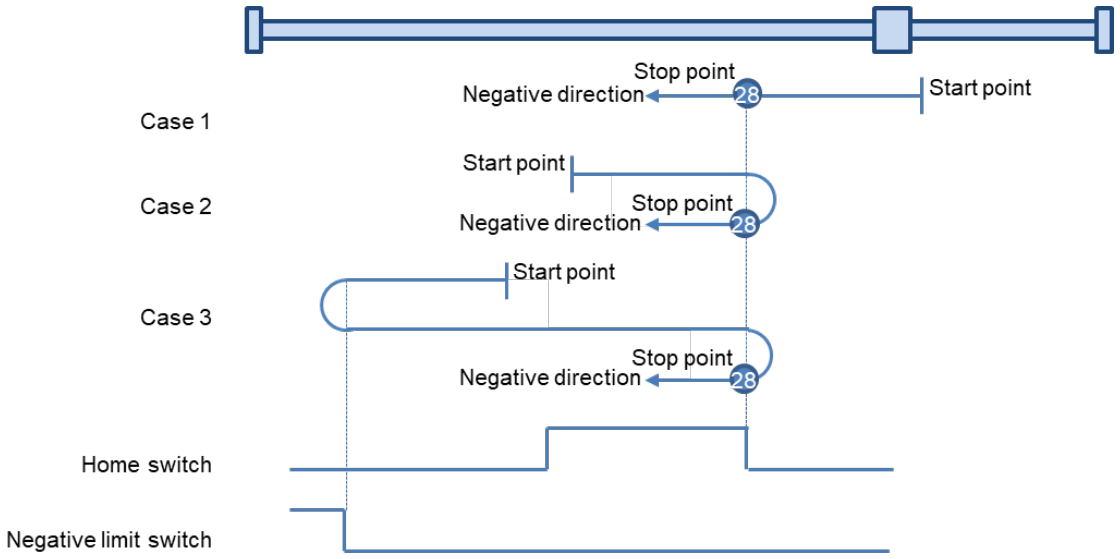


- **Mode 28: Similar to mode 12, it depends on the home switch and the negative limit switch, not considering the Z pulse.**

Case 1: The homing instruction is executed while the home switch is OFF and the axis starts to move in the negative direction at the first-phase speed (homing speed during the search for a switch). Where the home switch becomes ON is the home position.

Case 2: The homing instruction is executed while the home switch is ON and the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is OFF. Where the home switch becomes ON is the home position.

Case 3: The homing instruction is executed while the home switch is OFF. The axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the negative limit switch is ON with the home switch OFF. When the home switch is ON, the axis still moves at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the home switch is OFF. Where the home switch becomes ON is the home position.

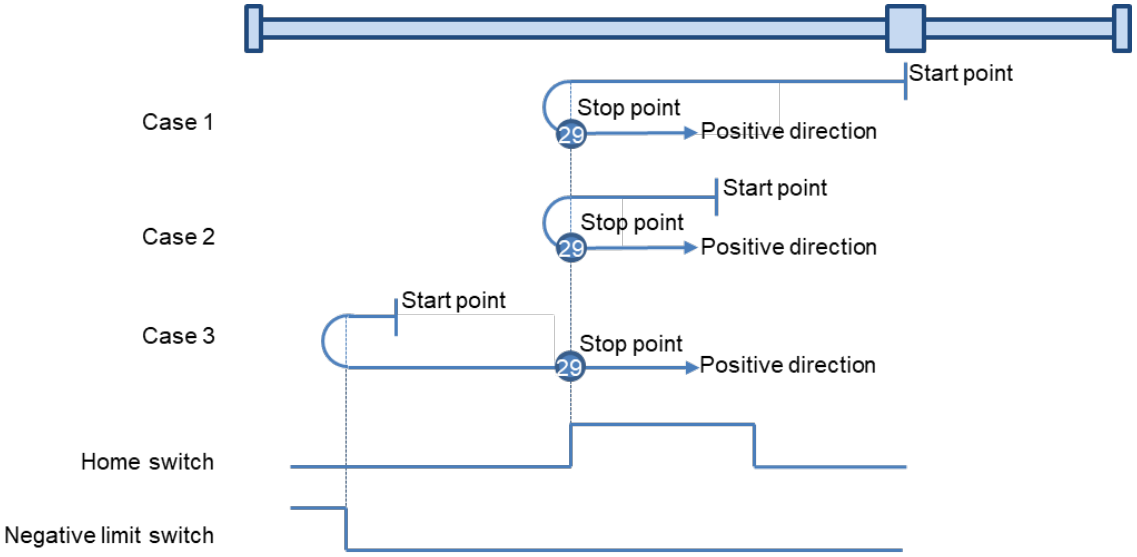


- **Mode 29: Similar to mode 13, it depends on the home switch and the negative limit switch, not considering the Z pulse.**

Case 1: The homing instruction is executed while the home switch is OFF and the axis starts to move in the negative direction at the first-phase speed (homing speed during the search for a switch). When the home switch is ON, the axis starts to move at the second-phase speed (homing speed during the search for Z pulse). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is OFF. Where the home switch becomes ON is the home position.

Case 2: The homing instruction is executed while the home switch is ON and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). The motion direction changes and the axis moves at the second-phase speed (homing speed during the search for Z pulse) when the home switch is OFF. Where the home switch becomes ON is the home position.

Case 3: The homing instruction is executed while the home switch is OFF. The axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the negative limit switch is ON with the home switch OFF. Where the home switch becomes ON is the home position.

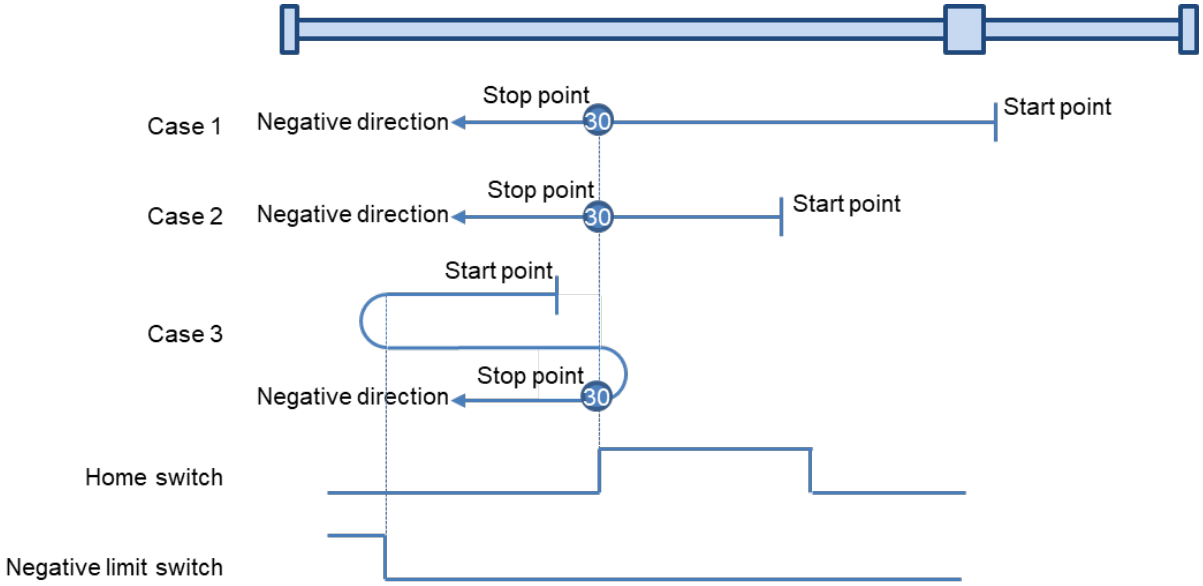


- **Mode 30: Similar to mode 14, it depends on the home switch and the negative limit switch, not considering the Z pulse**

Case 1: The homing instruction is executed while the home switch is OFF and the axis starts to move in the negative direction at the first-phase speed (homing speed during the search for a switch). When the home switch is ON, the axis starts to move at the second-phase speed (homing speed during the search for Z pulse). Where the home switch becomes OFF is the home position.

Case 2: The homing instruction is executed while the home switch is ON and the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). Where the home switch becomes OFF is the home position.

Case 3: The homing instruction is executed while the home switch is OFF. The axis moves in the negative direction at the first-phase speed (homing speed during the search for a switch). The motion direction changes and the axis moves at the first-phase speed (homing speed during the search for a switch) when the negative limit switch is ON with the home switch OFF. When the home switch is ON, the motion direction changes again and the axis moves at the second-phase speed (homing speed during the search for Z pulse). Where the home switch becomes OFF is the home position.



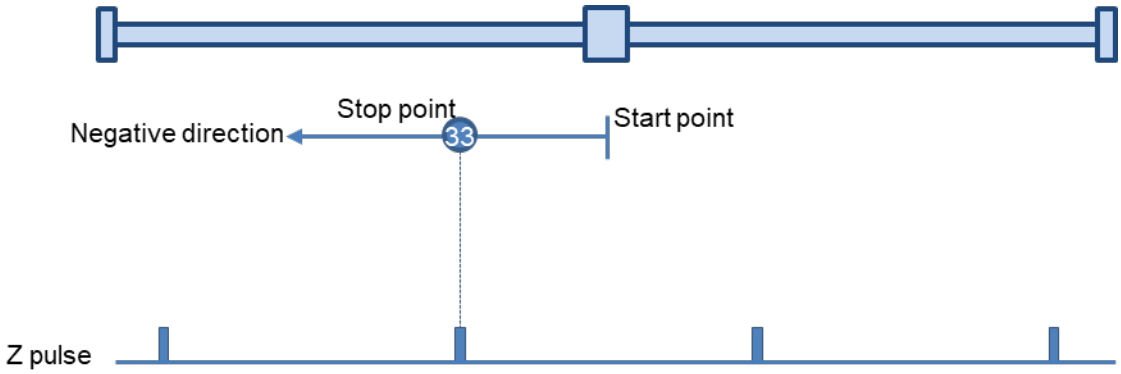
Mode 31 and mode 32: Reserved

Modes 31-32 are reserved for future development.

Mode 33 and mode 34: Only the Z pulse is required.

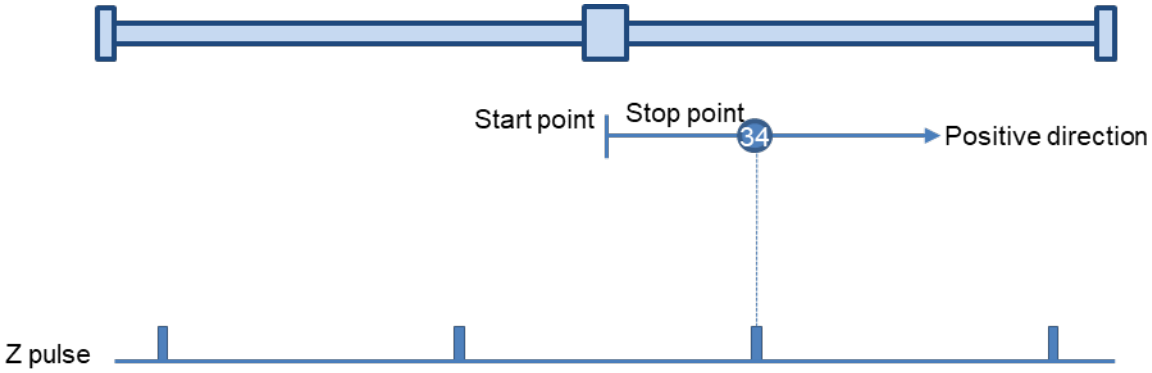
- **Mode 33: Depending on the Z pulse, in the negative direction**

In mode 33, the homing instruction is executed and then the axis moves in the negative direction at the second-phase speed (homing speed during the search for Z pulse). Where the first Z pulse is met is the home position.



- **Mode 34: Depending on the Z pulse, in the positive direction**

In mode 34, the homing instruction is executed and then the axis moves in the positive direction at the second-phase speed (homing speed during the search for Z pulse). Where the first Z pulse is met is the home position.



- **Mode 35: Depending on the current position**

In mode 35, the homing instruction is executed, the axis does not move and its current position is regarded as the home position.

6.1.6.4.4 Axis0 Homing Speeds (16#6099)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6099	16#01	Axis0 Speed During Search For Switch	Homing speed of Axis 0 during the search for Switch	UDINT	RW	1
	16#02	Axis0 Speed During Search For Zero	Homing speed of Axis 0 during the search for Zero	UDINT	RW	1

- **Explanation**

Axis0 homing speeds include the homing speed of Axis 0 during the search for Switch and the homing speed of Axis 0 during the search for Zero, with the unit: Pulse/sec.

6.1.6.4.5 Axis0 Homing Acceleration (16#609A)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#609A	16#00	Axis0 Homing Acceleration	Homing acceleration of Axis 0	UDINT	RW	1000

- **Explanation**

It is the homing acceleration of Axis 0 with the unit of Pulse/sec^2.

6.1.6.5 Profile Velocity Mode

6.1.6.5.1 Axis0 Velocity Actual Value (16#606C)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#606C	16#00	Axis0 Velocity Actual Value	Actual velocity of Axis 0	DINT	RO	0

- **Explanation**

It is the actual velocity of Axis 0 with the unit of Pulse/sec.

6.1.6.5.2 Axis0 Target Velocity (16#60FF)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#60FF	16#00	Axis0 Target Velocity	Target velocity of Axis 0	DINT	RW	0

- **Explanation**

It is the target velocity of Axis 0 (unit: Pulse/sec), available only for Profile Velocity Mode and Cyclic Synchronous Velocity Mode.

6.1.6.5.3 Axis0 Velocity Demand Value (16#606B)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#606B	16#00	Axis0 Velocity Demand Value	Real-time command velocity of Axis 0	DINT	RO	0

- **Explanation**

It is the real-time command velocity of Axis 0 with the unit of Pulse/sec.

6.1.6.6 Digital Inputs/Outputs

6.1.6.6.1 Axis0 Digital Inputs (16#60FD)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#60FD	16#00	Axis0 Digital Inputs	Digital inputs of Axis 0	UDINT	RO	0

- **Explanation**

Bits for digital inputs of Axis 0:

Bit	Description
Bit 0	Negative limit signal
Bit 1	Positive limit signal
Bit 2	Home signal
Bit 3 to Bit 15	Reserved
Bit 16	DI0
Bit 17	DI2
Bit 18	DI4
Bit 19	DI6
Bit 20	DI8

Note: Bit 16-Bit 20 above correspnd to the states of DI inputs of Axis 0. Refer to section 6.1.5.1 for details.

6.1.6.6.2 Axis0 Digital Outputs (16#60FE)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#60FE	16#01	Axis0 Physical outputs	Digital outputs of Axis0	UDINT	RW	1
	16#02	Axis0 Bit mask	Digital output mask of Axis0	UDINT	RW	1

- **Explanation**

Bits for digital outputs of Axis 0:

Bit	Description
Bit 0-Bit 15	Reserved
Bit 16	DQ0
Bit 17-Bit 29	Reserved
Bit 30	DQA0
Bit 31	DQB0

Bits for the digital output mask of Axis 0:

Bit	Description
Bit 0-Bit 15	Reserved
Bit 16	DQ0
Bit 17-Bit 29	Reserved
Bit 30	DQA0
Bit 31	DQB0

6.1.7 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.

6.1.7.1 FreeRun Mode

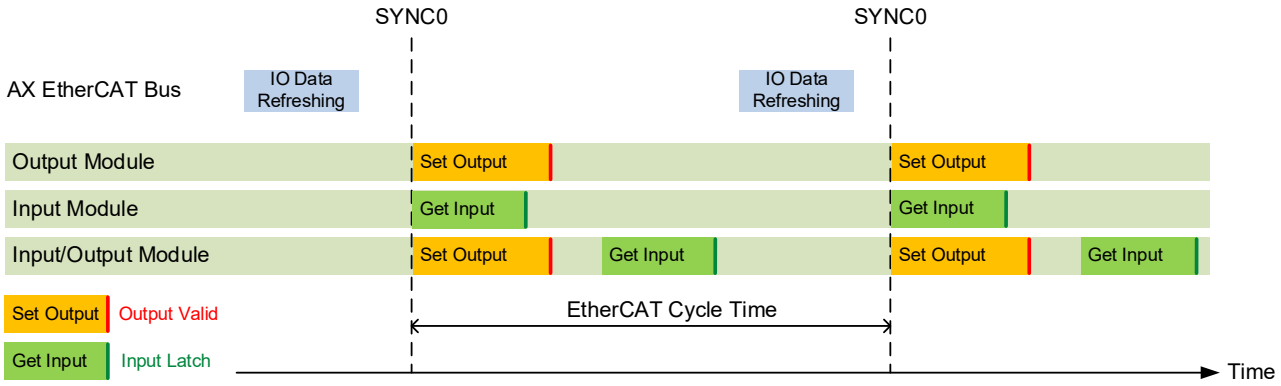
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

6.1.7.2 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.

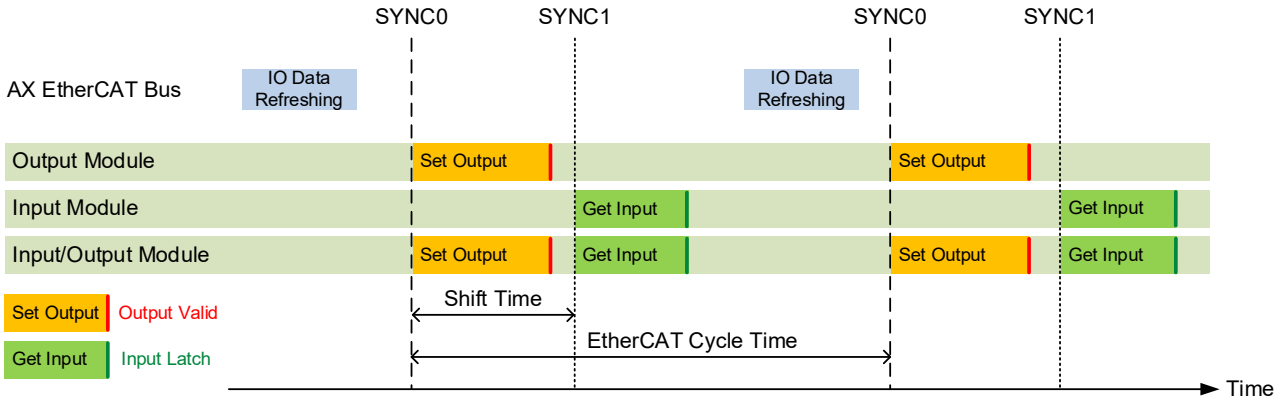
- SYNC0

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



- SYNC0 + SYNC1

SYNC0 is used to refresh values of output channels and SYNC1 is used 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.



6.1.8 Process Data

Under CSP or PP mode, the following objects are included in the RxPDO.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6040	16#00	Axis0 ControlWord	Control word of Axis0	UINT	RW	0
16#607A	16#00	Axis0 Target Position	Target position of Axis0	DINT	RW	0
16#60FE	16#01	Axis0 Digital Outputs	Digital output of Axis0	UDINT	RW	0
16#2007	16#01	Axis0 External DIQ Value DI	Module's external input pin status of Axis0	UDINT	RW	0

Under CSP or PP mode, the following objects are included in the TxPDO.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6041	16#00	Axis0 StatusWord	Status word of Axis0	UINT	RO	0
16#6064	16#00	Axis0 Position Actual Value	Actual position of Axis0	DINT	RO	0
16#60FD	16#00	Axis0 Digital Inputs	Digital input of Axis0	UDINT	RO	0
16#2007	16#02	Axis0 External DIQ Value DQ	Module's external output pin status of Axis0	UDINT	RO	0

Under CSV or PV mode, the following objects are included in the RxPDO.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6040	16#00	Axis0 ControlWord	Control word of Axis0	UINT	RW	0
16#60FF	16#00	Axis0 Target Velocity	Target velocityt of Axis0	DINT	RW	0
16#60FE	16#01	Axis0 Digital Outputs	Digital output of Axis0	UDINT	RW	0
16#2007	16#01	Axis0 External DIQ Value DI	Module's external input pin status of Axis0	UDINT	RW	0

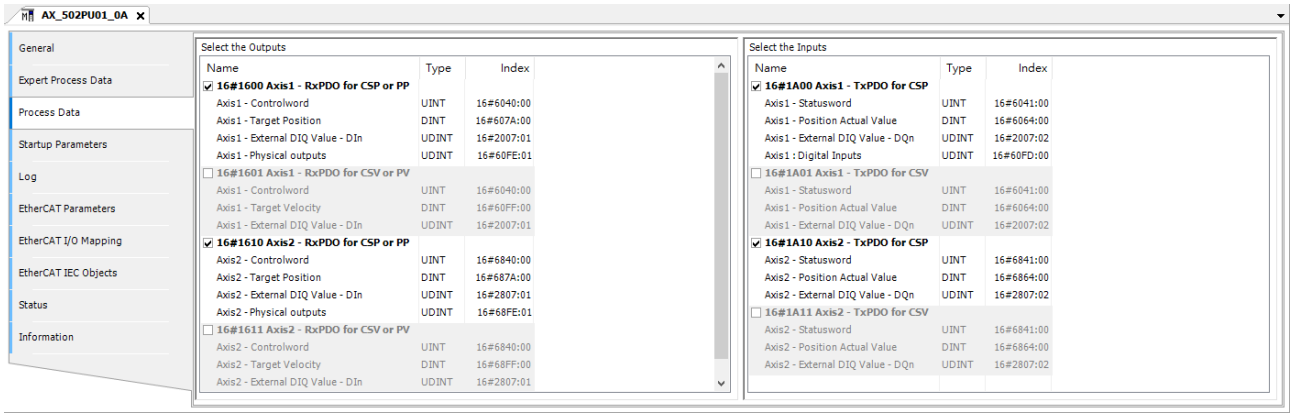
Under CSV or PV mode, the following objects are included in the TxPDO.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6041	16#00	Axis0 StatusWord	Status word of Axis0	UINT	RO	0
16#606C	16#00	Axis0 Velocity Actual Value	Actual velocity of Axis0	DINT	RO	0
16#60FD	16#00	Axis0 Digital Inputs	Digital input of Axis0	UDINT	RO	0
16#2007	16#02	Axis0 External DIQ Value DQ	Module's external output pin status of Axis0	UDINT	RO	0

6.1.8.1 Process Data

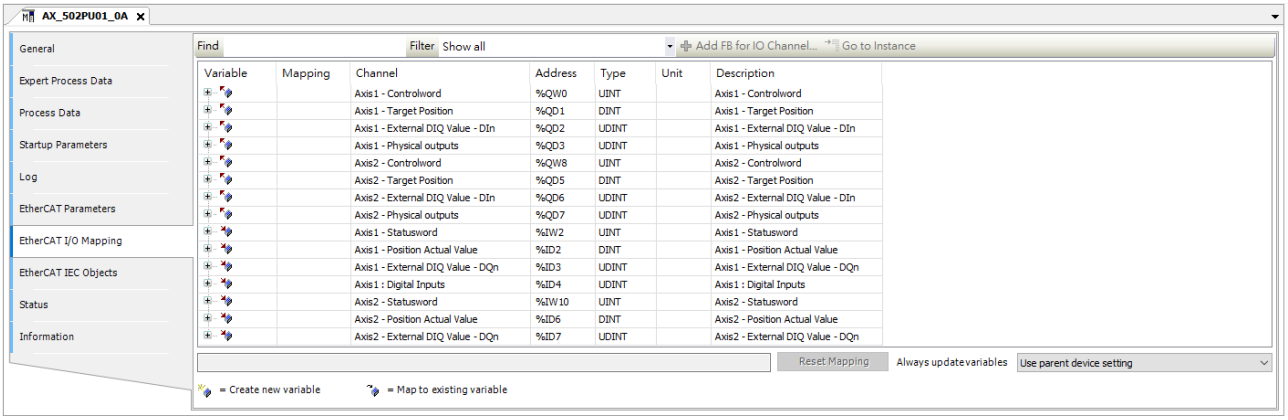
Go to the **Process Data** tab and select the data that you'd like to monitor.

- You can monitor the data for the selected PDOs, and deselect the unused PDOs to save cycle time.



6.1.8.2 EtherCAT I/O Mapping

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



6.1.8.3 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.

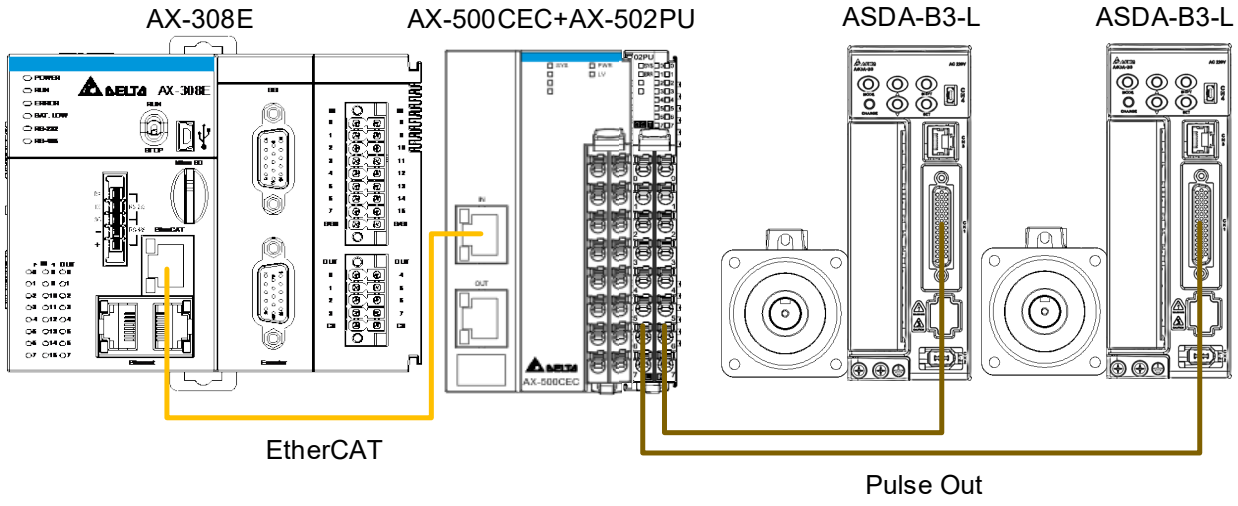
Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other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

6.1.9 Example of Hardware Configuration and Software Operation

In this section, the AX-502PU module combined with the AX-5 coupler is controlled by AX-3 series PLC.

6.1.9.1 System Hardware Configuration

The AX-308E PLC makes a connection with AX-500CEC plus AX-502PU through the EtherCAT port, controlling the pulse servo via AX-502PU.

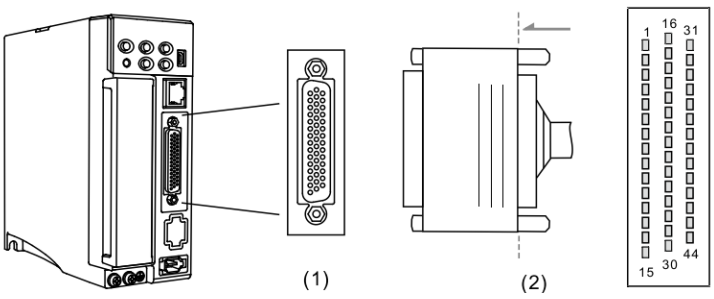


- **Hardware preparation**

No.	Name	Model	Quantity
1	AX3 series PLC	AX-308EA0MA1T	1
2	AX-5 coupler	AX-500CEC00-0A	1
3	AX-5 positioning module	AX-502PU01-0A	1
4	Pulse-type servo drive	ASD-B3-0421-L	2
5	Servo motor	ECM-B3M-C20604RS1	2
6	Servo power cable	ACS3-CAPW1103	2
7	Servo encoder cable	ACS3-CAEN0103	2
8	CN1 terminal block	ACS3-MDTB4400	2

- **Hardware configuration of ASD-B3-0421-L**

  To use the pulse output, please configure the hardware wiring for the servo and get its hardware limits configured on the controller end.



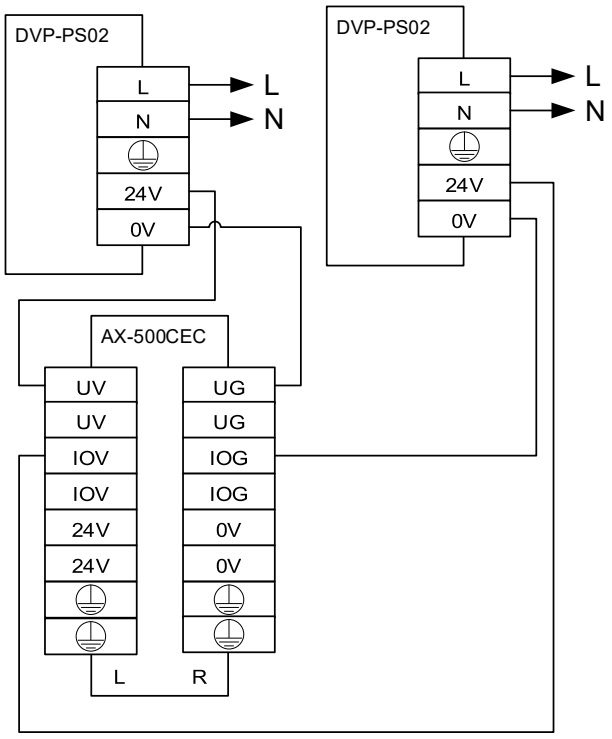
(1): CN1 port, (2): CN1 connector pins

■ CN1 pin signals:

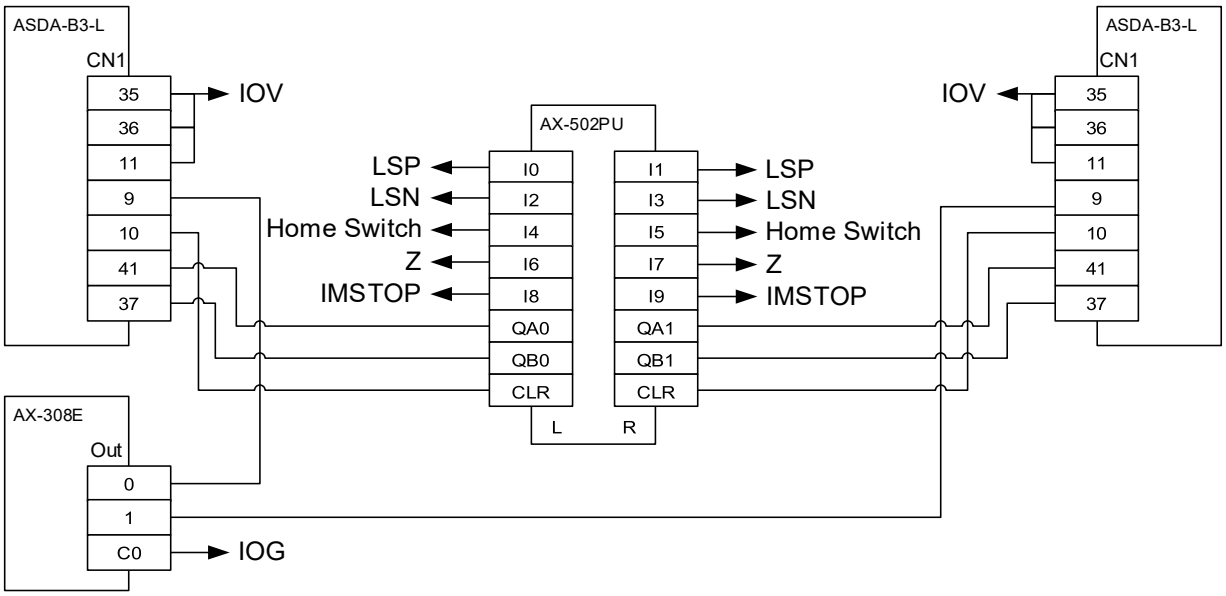
Signal		Pin No.	Function
Position pulse command (Input)	PULSE+	43	Position pulses can be input by Line Driver (maximum single-phase pulse frequency of 4 MHz), or the open-collector input (maximum single-phase pulse frequency of 200 kHz. Three command types: CW/CCW pulse, pulse train+sign, A phase + B phase, can be selected by servo parameter P1.000.
	PULSE-	41	
	SIGN+	39	
	SIGN-	37	
	PULL HI_P	36	If position pulses are input by using the open-collector type, ensure to connect an external power supply (24 ± 10%).
	PULL HI_S	35	
Position pulse command (Output)	OCZ	44	Open-collector output for the encoder Z pulse.
Power supply	COM+	11	NPN: COM+ is the positive terminal of the voltage source for DI, and an external power supply (24V ± 10%) must be provided. PNP: COM+ is the negative terminal of the voltage source for DI, and an external power supply (24V ± 10%) must be provided.
	GND	19, 29, 40	The ground pins for analog signals and differential output signals
Digital input	DI1-	9	When the pin signal is ON, the servo circuit is activated and the motor coil is energized.
	DI2-	10	To clear the deviation counter.

- **Hardware wiring**

  ■ The wiring diagram for AX-500CEC



■ The wiring diagram for AX-308E, AX-502PU and ASDA-B3-L



Note:

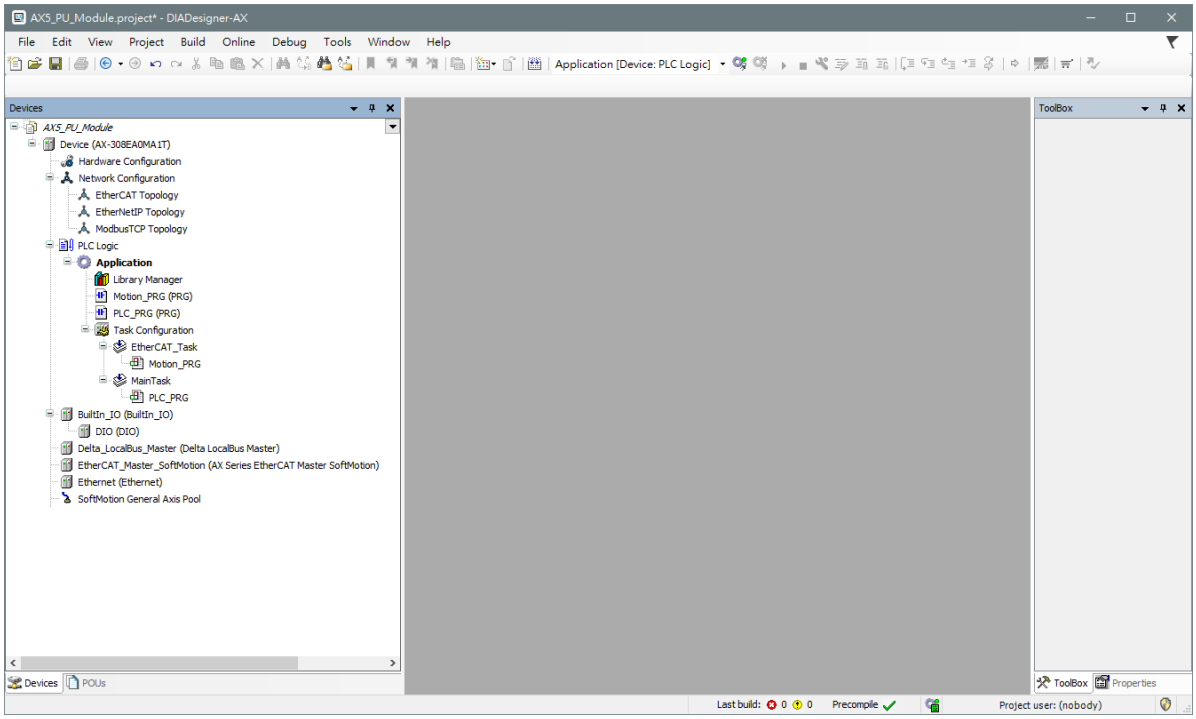
For more information on ASDA-B3-L's DI/DO signal configuration, refer to *Delta ASDA-B3 Series Servo Drive User Manual.*

6.1.9.2 Project Creation and Programming

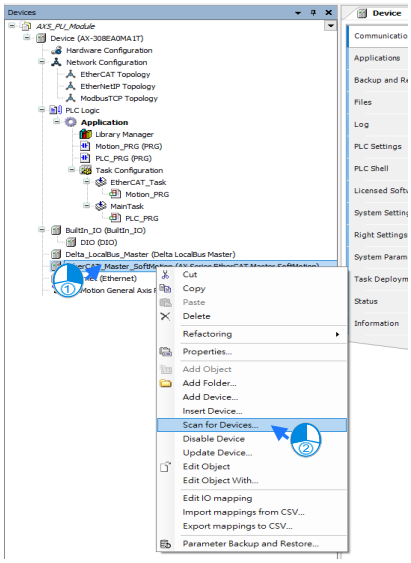
1. Start the DIADesigner-AX software.



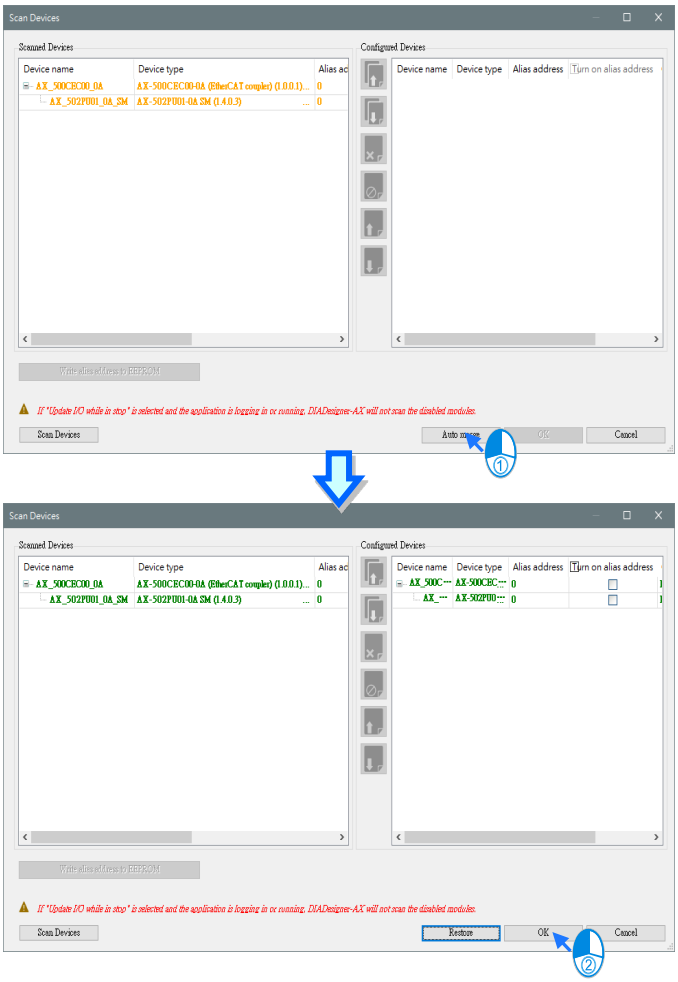
2. Open a new project for AX-308E.



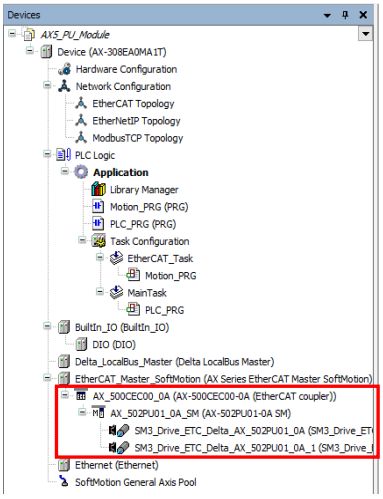
3. Right-click **EtherCAT_Master_SoftMotion** in the Devices tree, and then click **Scan for Devices…**. from the context menu.



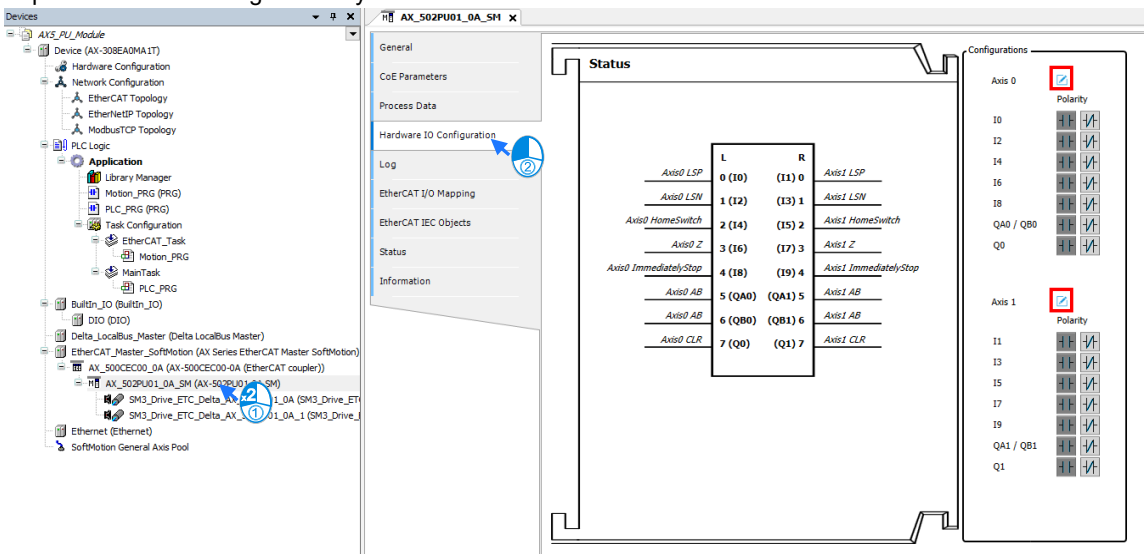
4. After entering the **Scan Devices** window, click **Auto Merge** and then **OK** in the following figures.



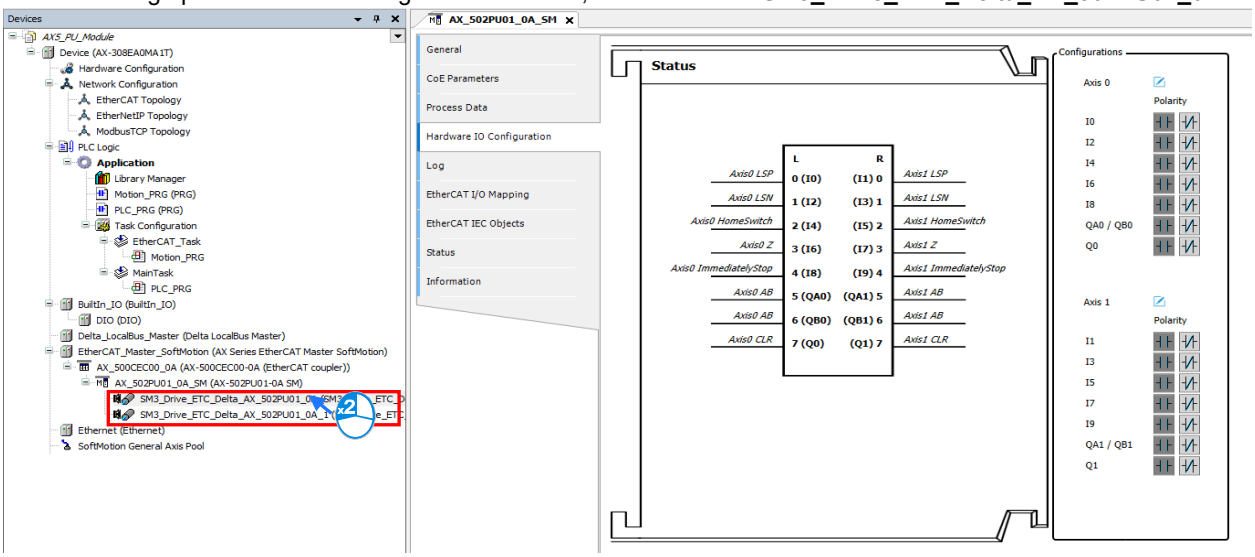
5. After adding devices is completed, the AX-502PU module will be added to the device tree.



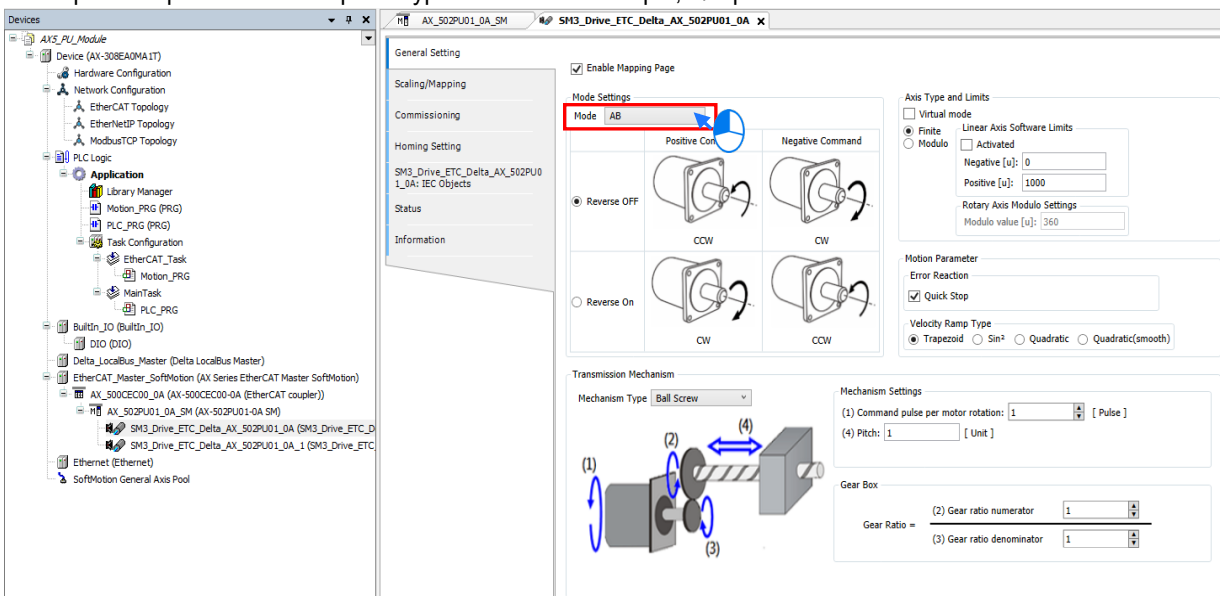
6. In the device tree, double-click **AX_502PU01_0A_SM**, and then in its **Hardware IO Configuration** tab, click to set up the hardware configurations you need.



7. After setting up the hardware configurations is done, double-click on **SM3_Drive_ETC_Delta_AX_502PU01_0A**.

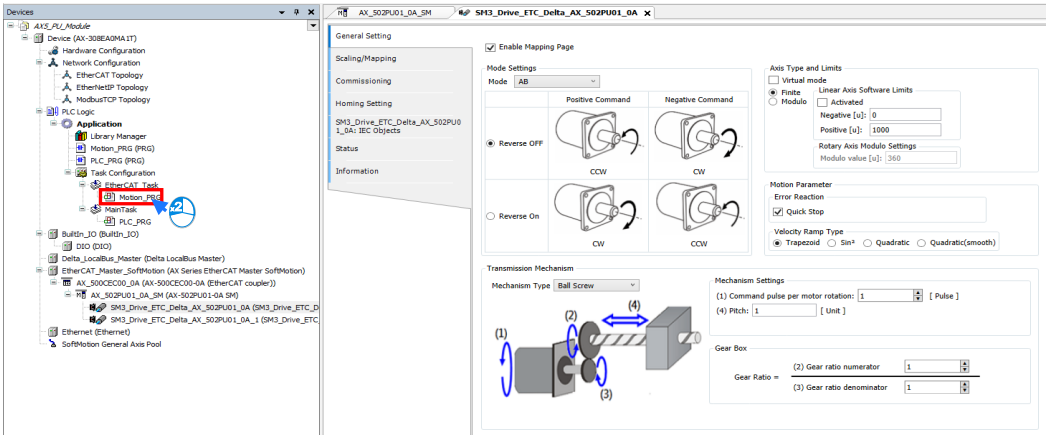


8. Set up the output mode of the pulse-type axis. In this example, A/B phase mode is used.

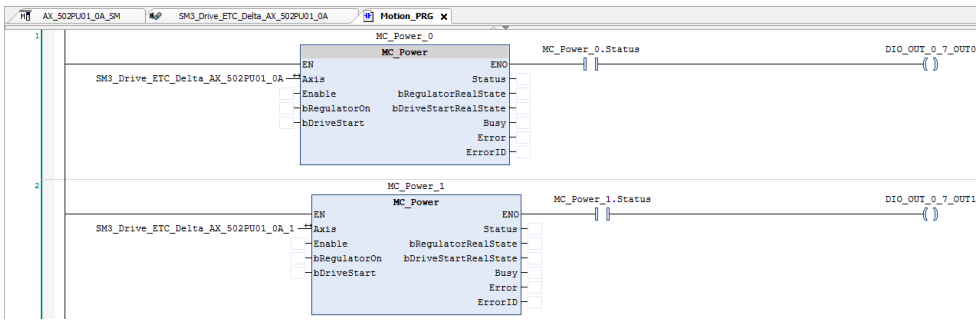


Note: For more about pulse outputs, refer to section 6.1.6.1.1 Axis DIQ Function (16#2000 and 16#2800).

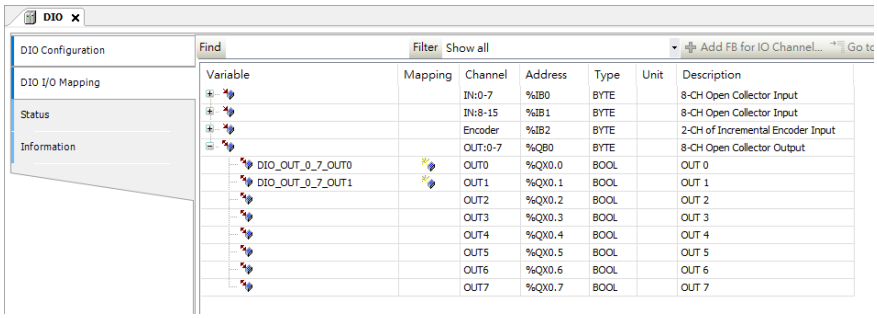
9. After setting the required parameters for both axes is done, double-click **Motion-PRG**.



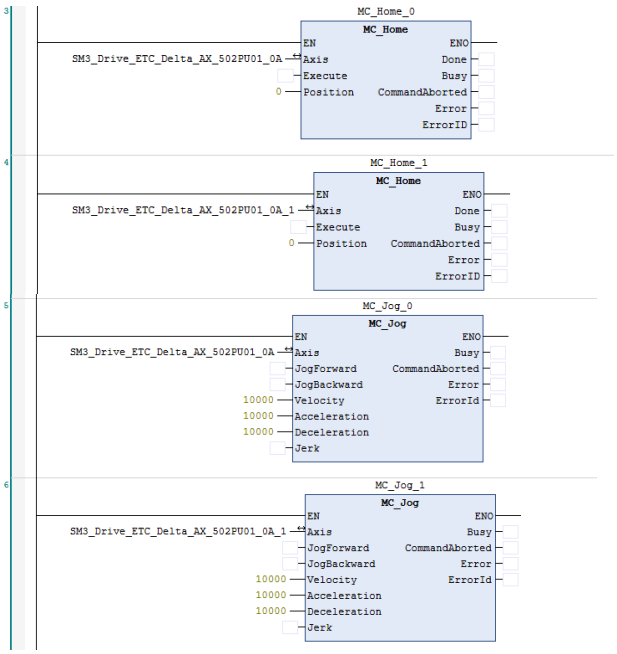
10. Enter the **Motion-PRG** page, where you can write a MC-Power program with the output value of its **Status** transmitted to **DIO_OUT_0_7_OUT0** so as to enable or disable the motor.



Note: The outputs to be used must be set up in the DIO page for AX-3.



11. After the axes are enabled, MC_Home is used to make them go back to home positions. Once the homing is done, axis motions can be performed.



6.1.10 Troubleshooting

In the **Diagnosis History** tab, the system errors (16#A000) and axis errors (16#603F+16#800***n**[*1]) that occurred in the module are recorded.

In the **Status** tab, only the current error information of System Error (16#A000) is recorded.

From the **All Parameters** list in the **CoE Parameters** tab, find 16#A000 for system errors or 16#603F+16#800***n**[*1] for axis errors to view their error codes.

Warning message:

Warning messages are presented not only in the **Diagnosis History** tab, but also in 16#A001: 01 for system alarms.

Index	SubIndex	ErrorCode	Name	Description	Emergency
16#A001	16#01	16#FF81	Channel Hardware Alarm	Abnormal output points	N/A

Error message:

Error messages are presented not only in the **Diagnosis History** tab, but also in 16#A000 for system errors, 16#603F for Axis0 errors and16#683F for Axis1 errors.

System Error (16#A000):

Index	SubIndex	ErrorCode	Name	Description	Emergency
16#A000	16#00	16#FF01	Unit Power Error	Abnormal power supply	V
		16#FF02	EtherCAT Connection Lost	EtherCAT connection is lost.	N/A
		16#FF03	ESC or EEPROM Error	ESC error	V
		16#FF04	Flash Error	Error in Flash	V
16#603F (Axis 0 error code)	16#00	16#6320	PARAMETER_ERROR	Input parameter error	N/A
		16#7120	MOTOR_ERROR	Error in the motor drive	N/A
		16#7500	COMMUNICATION	While the CiA 402 state machine of the slave is in Operation enabled state, the EtherCAT module leaves the OP state.	V
		16#FF20	OverMaxFreq	The maximum frequency is exceeded.	N/A
		16#FF21	LSPOccur	The negative limit is triggered.	N/A
		16#FF22	LSNOccur	The positive limit is triggered.	N/A
		16#FF23	IMSTOPOccur	The immediate stop is triggered.	N/A
		16#FF24	ServoOnAtFactoryMode	Servo is ON in factory mode	V

Index	SubIndex	ErrorCode	Name	Description	Emergency
16#683F (Axis 1 error code)	16#00	16#6320	PARAMETER_ERROR	Input parameter error	N/A
		16#7120	MOTOR_ERROR	Error in the motor drive	N/A
		16#7500	COMMUNICATION	While the CiA 402 state machine of the slave is in Operation enabled state, the EtherCAT module leaves the OP state.	V
		16#FF20	OverMaxFreq	The maximum frequency is exceeded.	N/A
		16#FF21	LSPOccur	The negative limit is triggered.	N/A
		16#FF22	LSNOccur	The positive limit is triggered.	N/A
		16#FF23	IMSTOPOccur	The immediate stop is triggered.	N/A
		16#FF24	ServoOnAtFactoryMode	Servo is ON in factory mode	V

6.1.10.1 Causes of Error LED Indicator ON/Blinking and Their Solutions

6.1.10.1.1 ERROR LED Indicator: ON

- **Error message**

Index	SubIndex	ErrorCode	Description	Error Indicator	Solution
16#A000	16#01	16#FF01	Unit Power Error	ON	Check the power supply.
	16#02	16#FF02	EtherCAT Connection Lost	ON	1. Make sure that the module is well connected. 2. Reset the EtherCAT status of the module through the master after step 1 is done.
	16#03	16#FF03	ESC or EEPROM Error	ON	If the problem persists, contact the local authorized distributors.
	16#04	16#FF04	Flash Error	ON	If the problem persists, contact the local authorized distributors.

6.1.10.1.2 ERROR LED Indicator: Blinking

- **Warning message**

Index	SubIndex	ErrorCode	Description	Error Indicator	Solution
16#A001	16#01	16#FF81	Channel Hardware Alarm	Blinking every 2 seconds	1. Make sure that the I/O power supply to the module is normal. 2. Check if the outputs of the module are short-circuited. 3. If the warning persists, contact the local authorized distributors after steps 1-2 are done.

- **Error message**

Index	SubIndex	ErrorCode	Description	Error Indicator	Solution
16#603F 16#683F	16#00	16#6320	PARAMETER_ERROR	Blinking every 0.2 seconds	Check if the input parameters required for the axis are correct.
		16#7120	MOTOR_ERROR	Blinking every 0.2 seconds	Check if the motor drive of the axis is abnormal (ALM bit is triggered).
		16#7500	COMMUNICATION	Blinking every 0.2 seconds	1. Make sure that the module is well connected. 2. Reset the EtherCAT status of the module through the master after step 1.
		16#FF20	OverMaxFreq	Blinking every 0.2 seconds	Ensure that the setting value of pulse frequency of the axis is within the allowed range.
		16#FF21	LSPOccur	Blinking every 0.2 seconds	Check the negative position limit of the mechanism driven by the axis
		16#FF22	LSNOccur	Blinking every 0.2 seconds	Check the positive position limit of the mechanism driven by the axis.
		16#FF23	IMSTOPOccur	Blinking every 0.2 seconds	Check if an immediate stop of the axis is triggered.
		16#FF24	ServoOnAtFactory Mode	Blinking every 0.2 seconds	Check if the axis enters the factory mode.

6.2 AX-502HC10-0A

AX-502HC10-0A, a high-speed counter module, receives pulse signals for counting with two built-in channels. This section introduces its specifications, wirings and operations.

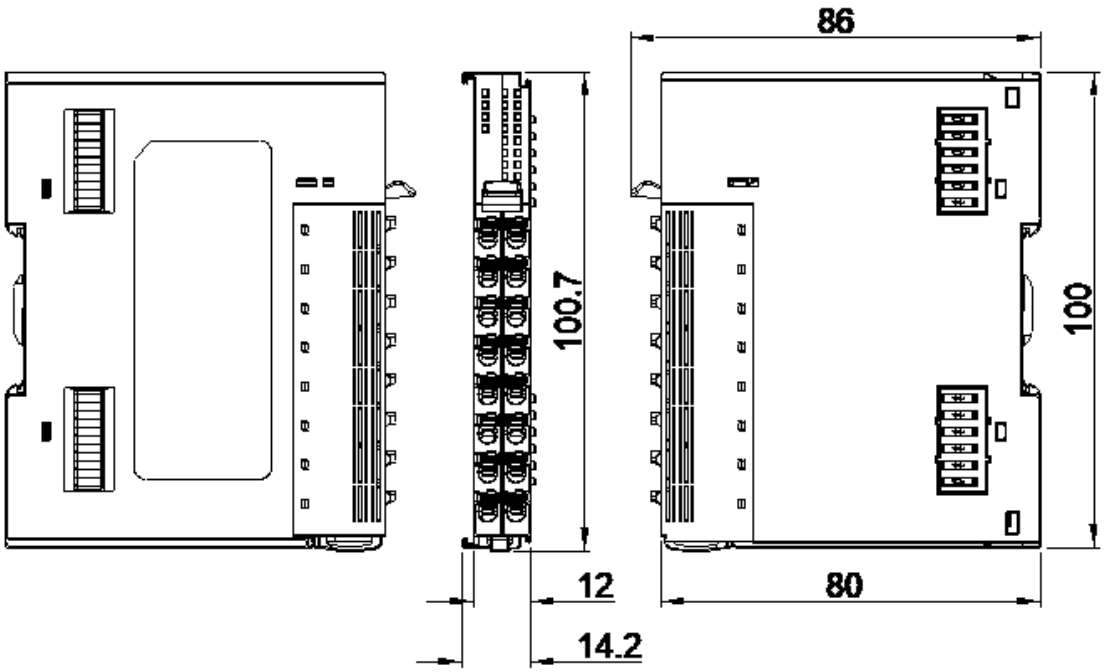
6.2.1 Specifications

Item			Specification
Number of channels			2
External connector type			Spring-clamp terminal block (16 terminals)
I/O refresh modes			1. Free Run mode 2. DC
Dimension (mm)			12 (W) × 100 (H) × 80 (D)
Weight			70g
Counter functions		Pulse input method	Phase differential pulse (multiplication x4)
		Counter range	-2147483648 to +2147483647
		Counter type	Ring counter
		Counter controls	Counter reset, counter preset
		Latch funcion	2 external input latches and 1 internal latch for each channel
		Measurements	Pulse rate measurement
Electrical specification	Digital input	I/O form	Sourcing input (NPN)
		Input current	2.5 mA TYP. (DC 24 V)
		ON voltage / ON current	11 to 30 V (EN 61131-2, type 3)
		OFF voltage / OFF current	-3 to +5 V (EN 61131-2, type 3)
		Maximum frequency (IA0/IB0/IA1/IB1)	2 MHz (500 kHz x 4)
		Maximum ON/OFF response time (I0-I3/IZ0/IZ1)	1μs /2 μs
	Digital output	I/O form	Sinking output (NPN)
		Load voltage	24 VDC (-15 %/ + 20 %)
		Maximum load current	30 mA /point
		Maximum surge current	0.5A /point, 10 ms
		Maximum leakage current	0.1 mA
		Maximum ON/OFF response time	1 μs / 2 μs
	Maximum cable length		3 m
	Power insulation		-
	Signal insulation		Digital isolator (2.5 kVAC)
	Insulation between channels		-
	Maximum power consumption (UV, UG)		300 mA (1.5W)
	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

Item			Specification
		Filtering function	Digital filter
	Digital output	Connection Lost Protection	-
		Short Circuit Protection (SCP)	-
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	YES

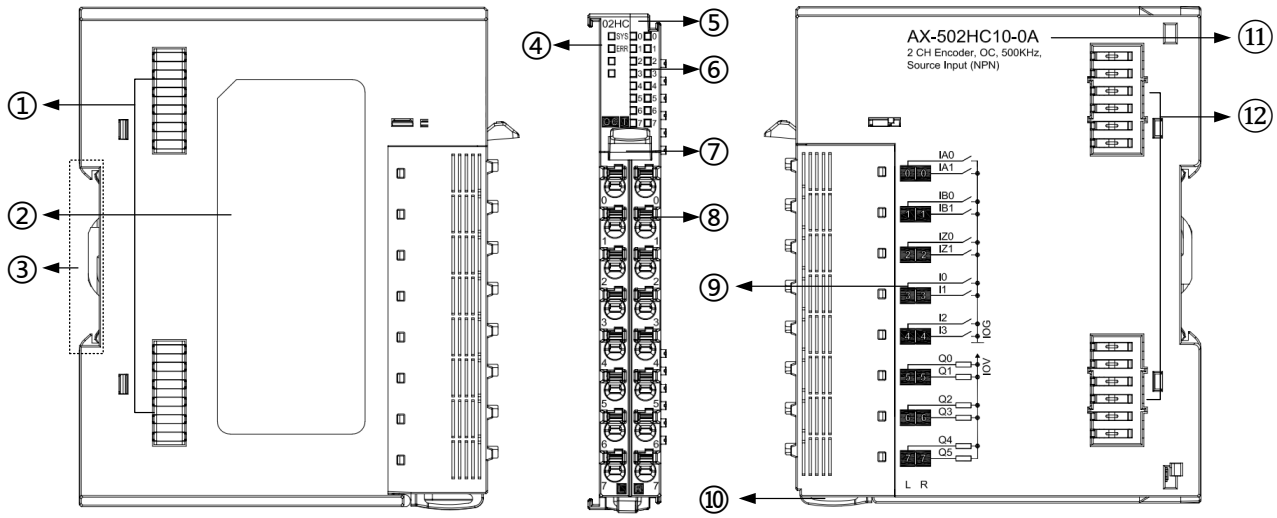
6.2.2 Dimensions and Parts

- **Dimensions**



Unit: mm

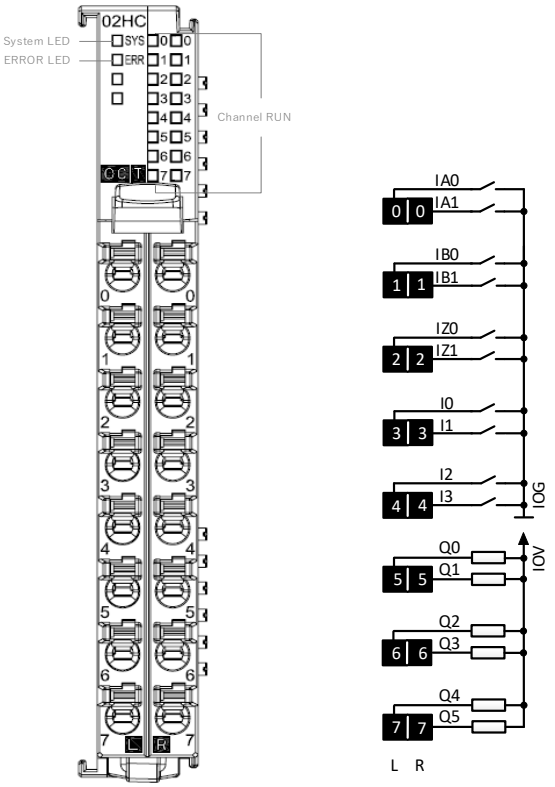
- **Parts**



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)

6.2.3 Arrangement of Terminals, LED Indicators and Wiring

6.2.3.1 Arrangement of Terminals



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

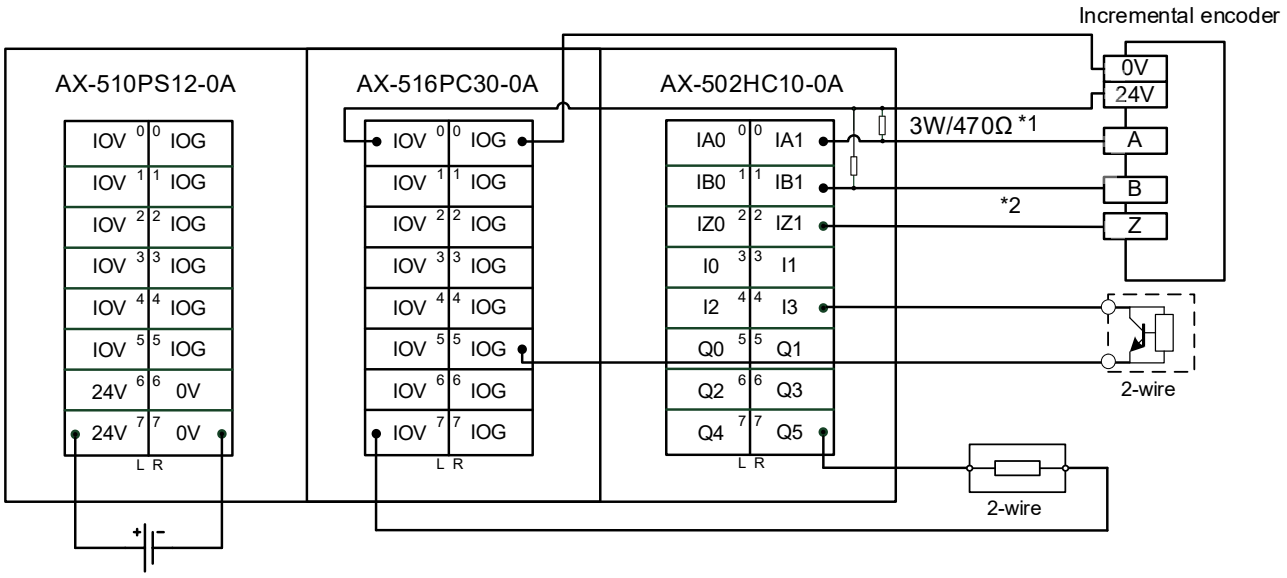
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	IA0	CH0 counter phase A	R0	IA1	CH1 counter phase A
L1	IB0	CH0 counter phase B	R1	IB1	CH1 counter phase B
L2	IZ0	CH0 counter phase Z	R2	IZ1	CH1 counter phase Z
L3	I0	CH0 digital input point 0	R3	I1	CH1 digital input point 0
L4	I2	CH0 digital input point 1	R4	I3	CH1 digital input point 1
L5	Q0	CH0 digital output point 0	R5	Q1	CH1 digital output point 0
L6	Q2	CH0 digital output point 1	R6	Q3	CH1 digital output point 1
L7	Q4	CH0 digital output point 2	R7	Q5	CH1 digital output point 2

6.2.3.2 LED Indicators

Name	Color	Status		Description
System	Blue		OFF	No power supplied or INIT
			Blinking (0.2s)	EtherCAT Pre OP
			Blinking (1s)	EtherCAT Safe OP
			ON	Normal (OP)
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (0.2s)	An error occurs on the application.
			Blinking (2s)	A warning occurs.
			ON	An error occurs on the system.
Channel	Green		OFF	No power supplied or the channel is OFF.
			ON	The channel is ON.

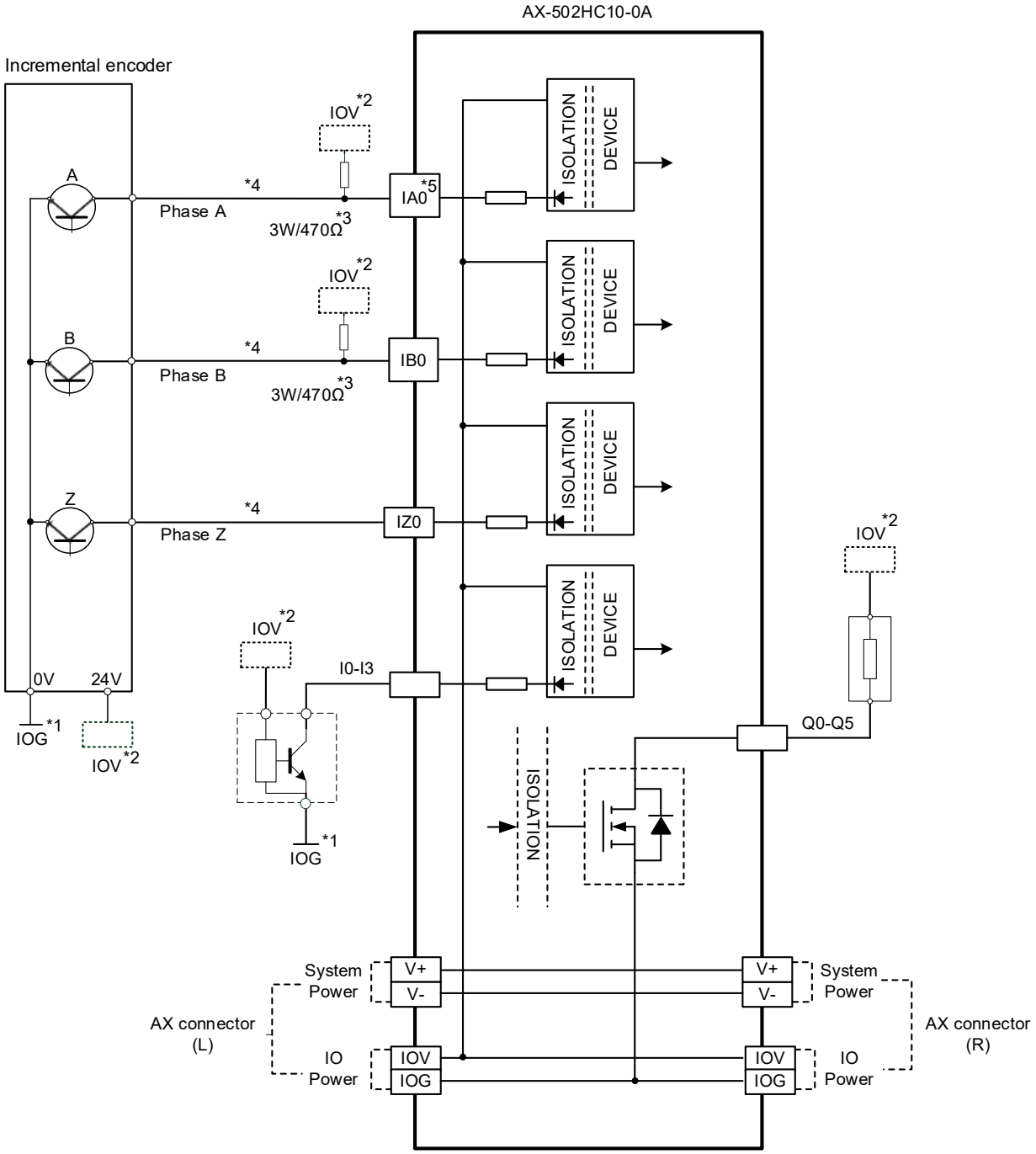
6.2.3.3 Wiring and Loop Configuration

- **Wiring**



*1. An external pull-up resistor of 3W/470 Ω is required for each of IA and IB input points.
*2. Keep IA and IB signal lines away from the power lines and the devices that generate noise.

● Loop Configuration



*1 Connect the encoder's 0V to IOG of AX-516PC30-0A, AX-516PS20-0A, etc.
*2 Connect the encoder's or sensor's 24V to IOV of AX-516PC30-0A, AX-516PS10-0A, etc.
*3. An external pull-up resistor of 3W/470 Ω is required for each of IA and IB input points.
*4. Keep IA, IB and IZ signal lines away from the power lines and the devices that generate noise.
*5 Please wire IA1 and IB1 to use the channel 1 counter for high-speed counting.

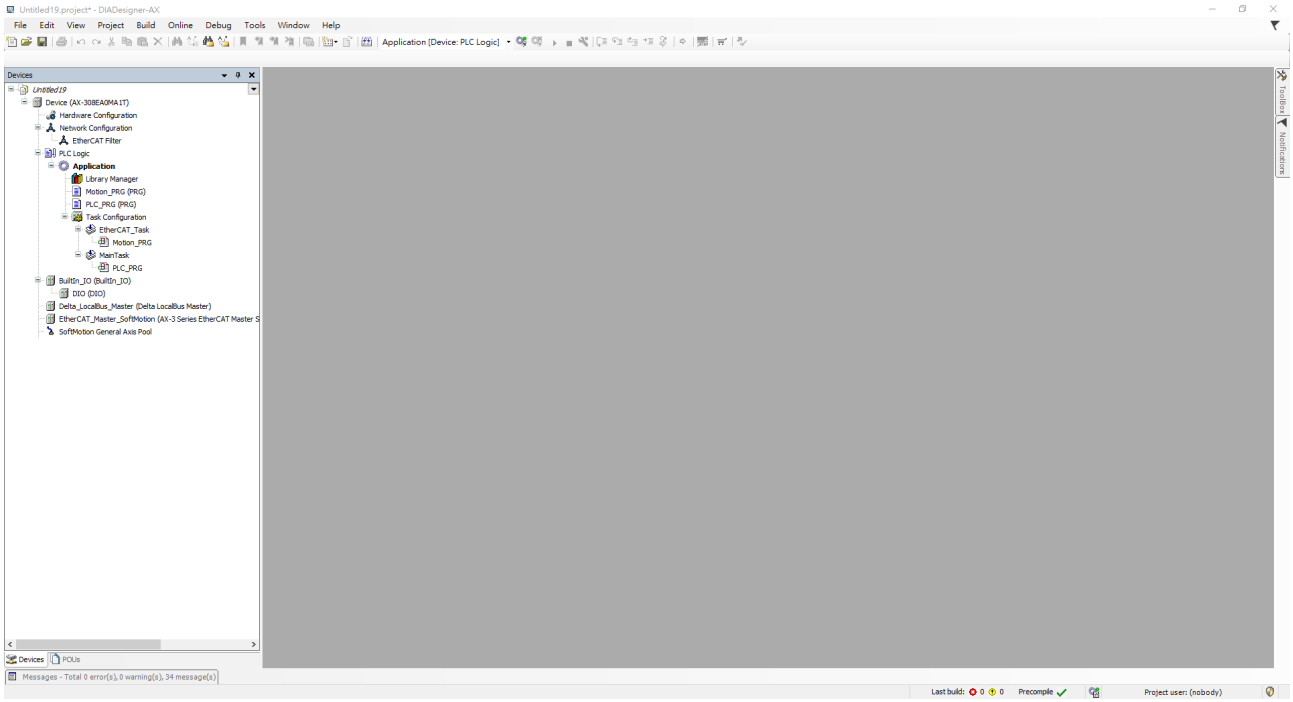
⚠	● The output circuit and internal circuit of this product are separated only by functional insulation. Therefore, to complete the installation of the product in the final system, double or reinforced insulation should be used between the product and hazardous live parts.

6.2.4 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.

6.2.4.1 Basic Operation

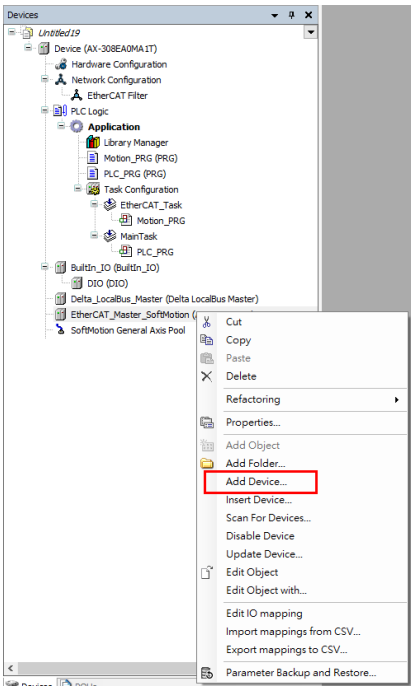
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



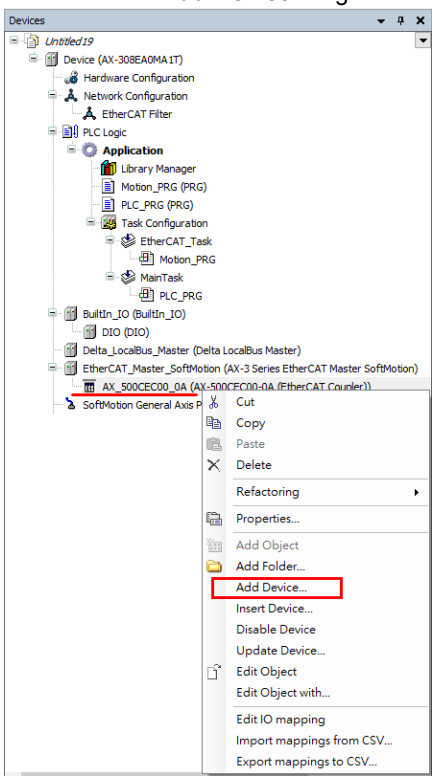
(2) Add modules in

- 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**.

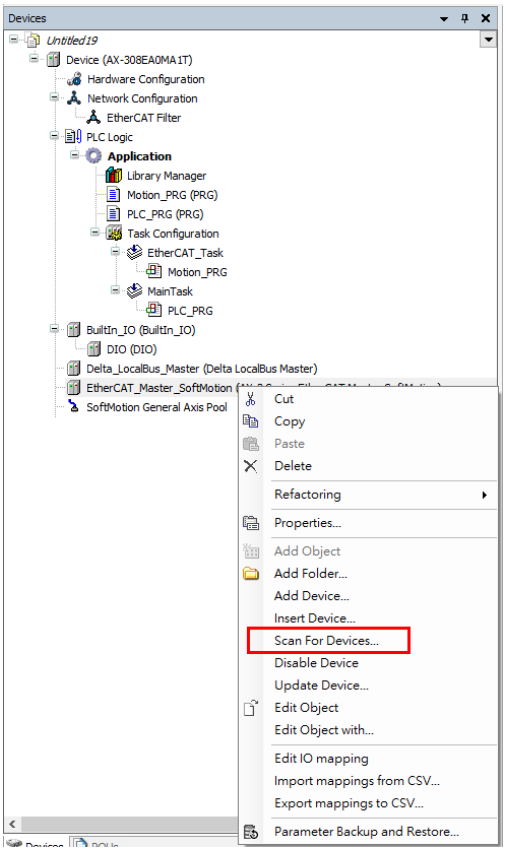


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

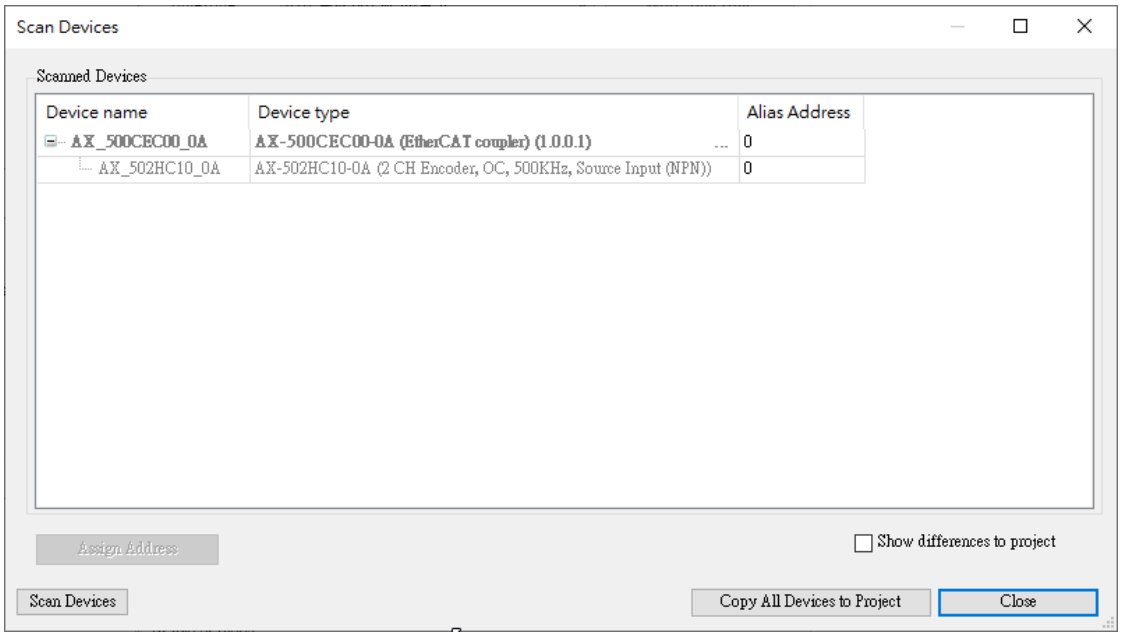


- Method 2: Scan to add the modules in.

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

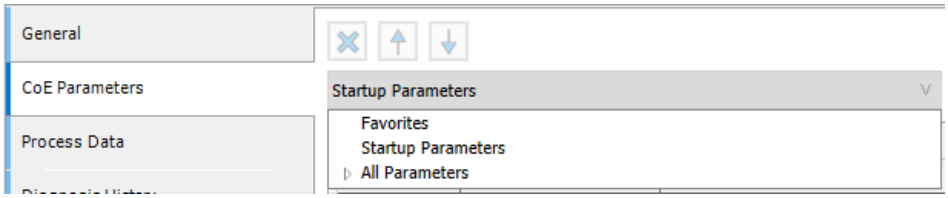


After the auto-scan, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



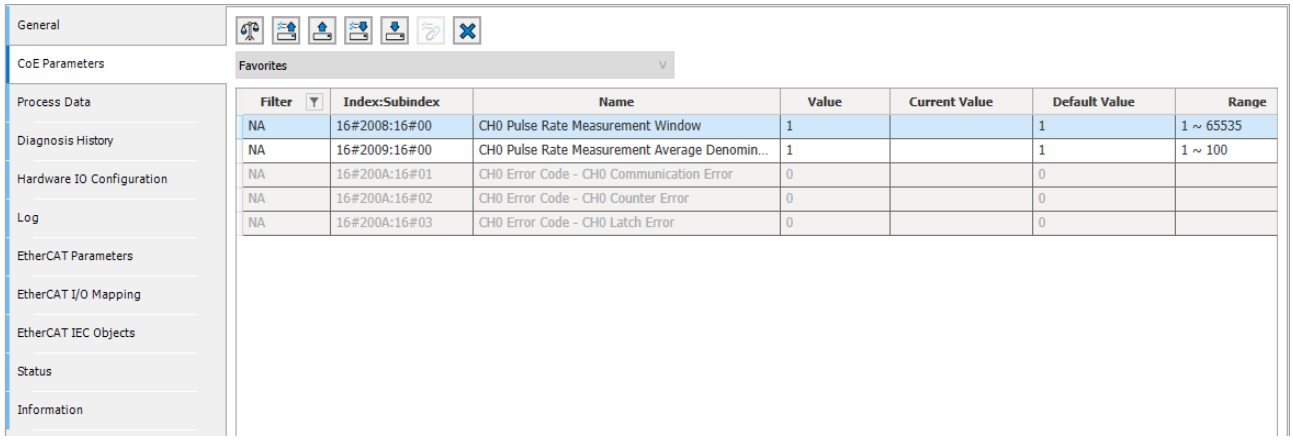
6.2.4.2 Parameter Settings

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



(1) Favorites

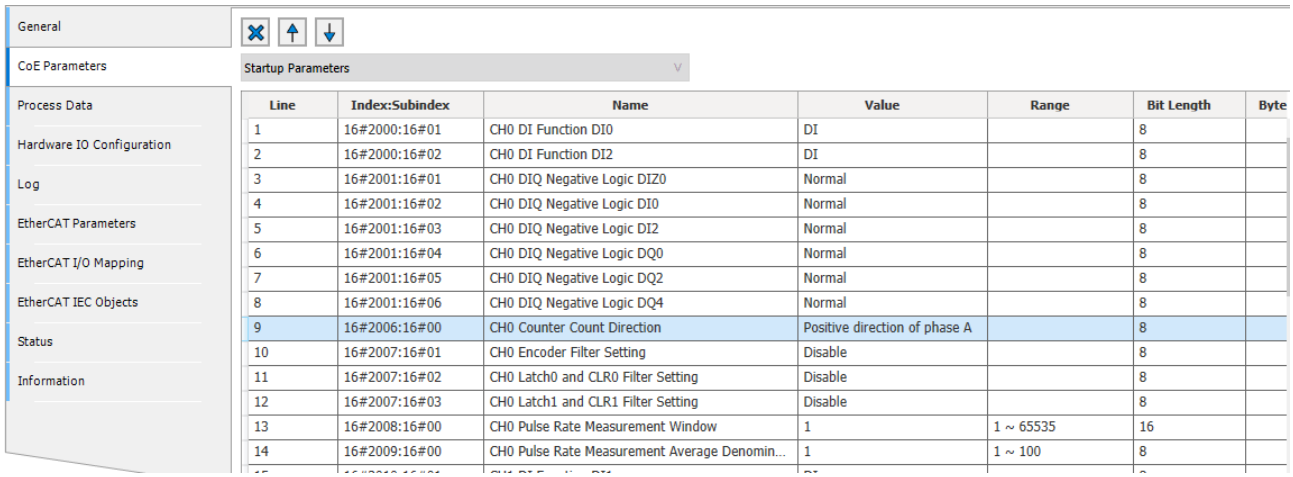
- You can select and right-click the parameter to add the selected parameter to the **Favorites**. Click  on the toolbar to go into the online mode, and then you can start to upload and download the parameters.



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 the offline mode.

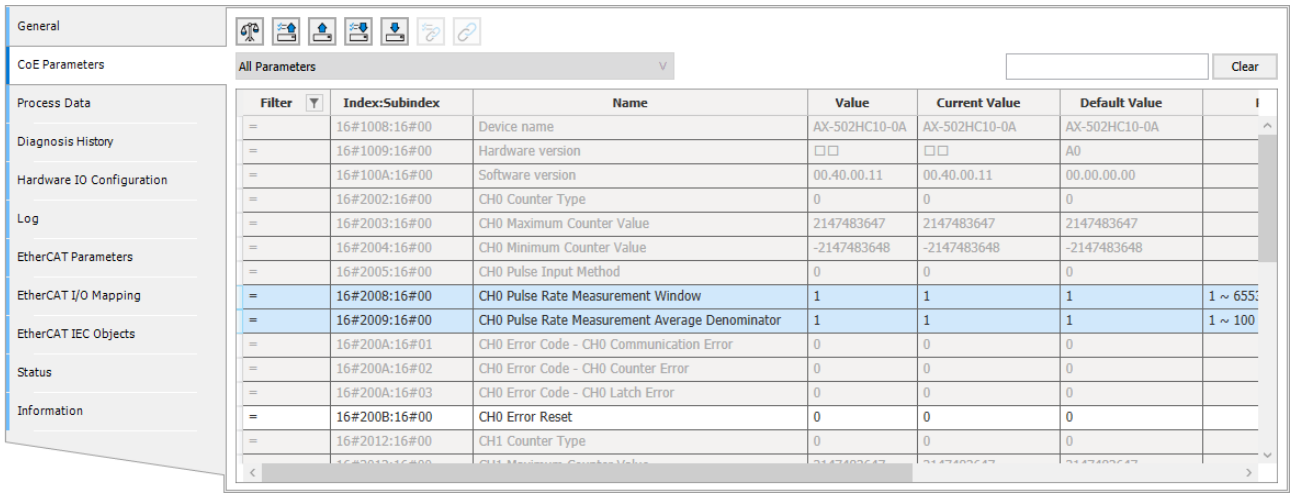


Line	Index:Subindex	Name	Value	Range	Bit Length	Byte
1	16#2000:16#01	CH0 DI Function DI0	DI		8	
2	16#2000:16#02	CH0 DI Function DI2	DI		8	
3	16#2001:16#01	CH0 DIQ Negative Logic DIZ0	Normal		8	
4	16#2001:16#02	CH0 DIQ Negative Logic DI0	Normal		8	
5	16#2001:16#03	CH0 DIQ Negative Logic DI2	Normal		8	
6	16#2001:16#04	CH0 DIQ Negative Logic DQ0	Normal		8	
7	16#2001:16#05	CH0 DIQ Negative Logic DQ2	Normal		8	
8	16#2001:16#06	CH0 DIQ Negative Logic DQ4	Normal		8	
9	16#2006:16#00	CH0 Counter Count Direction	Positive direction of phase A		8	
10	16#2007:16#01	CH0 Encoder Filter Setting	Disable		8	
11	16#2007:16#02	CH0 Latch0 and CLR0 Filter Setting	Disable		8	
12	16#2007:16#03	CH0 Latch1 and CLR1 Filter Setting	Disable		8	
13	16#2008:16#00	CH0 Pulse Rate Measurement Window	1	1 ~ 65535	16	
14	16#2009:16#00	CH0 Pulse Rate Measurement Average Denomin...	1	1 ~ 100	8	

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

(3) All Parameters

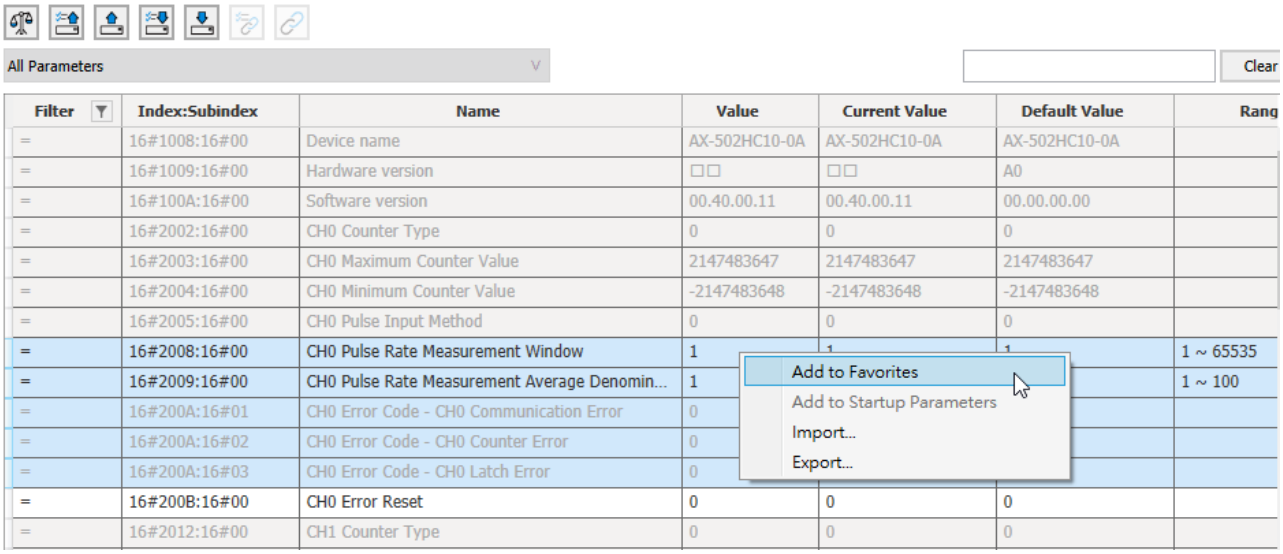
- You can find all the CoE parameters here. Click  on the toolbar to go into the online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in **Current Value** column.
- You can edit the values of parameters in **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
=	16#1008:16#00	Device name	AX-502HC10-0A	AX-502HC10-0A	AX-502HC10-0A
=	16#1009:16#00	Hardware version	□□	□□	A0
=	16#100A:16#00	Software version	00.40.00.11	00.40.00.11	00.00.00.00
=	16#2002:16#00	CH0 Counter Type	0	0	0
=	16#2003:16#00	CH0 Maximum Counter Value	2147483647	2147483647	2147483647
=	16#2004:16#00	CH0 Minimum Counter Value	-2147483648	-2147483648	-2147483648
=	16#2005:16#00	CH0 Pulse Input Method	0	0	0
=	16#2008:16#00	CH0 Pulse Rate Measurement Window	1	1	1
=	16#2009:16#00	CH0 Pulse Rate Measurement Average Denominator	1	1	1
=	16#200A:16#01	CH0 Error Code - CH0 Communication Error	0	0	0
=	16#200A:16#02	CH0 Error Code - CH0 Counter Error	0	0	0
=	16#200A:16#03	CH0 Error Code - CH0 Latch Error	0	0	0
=	16#200B:16#00	CH0 Error Reset	0	0	0
=	16#2012:16#00	CH1 Counter Type	0	0	0

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.

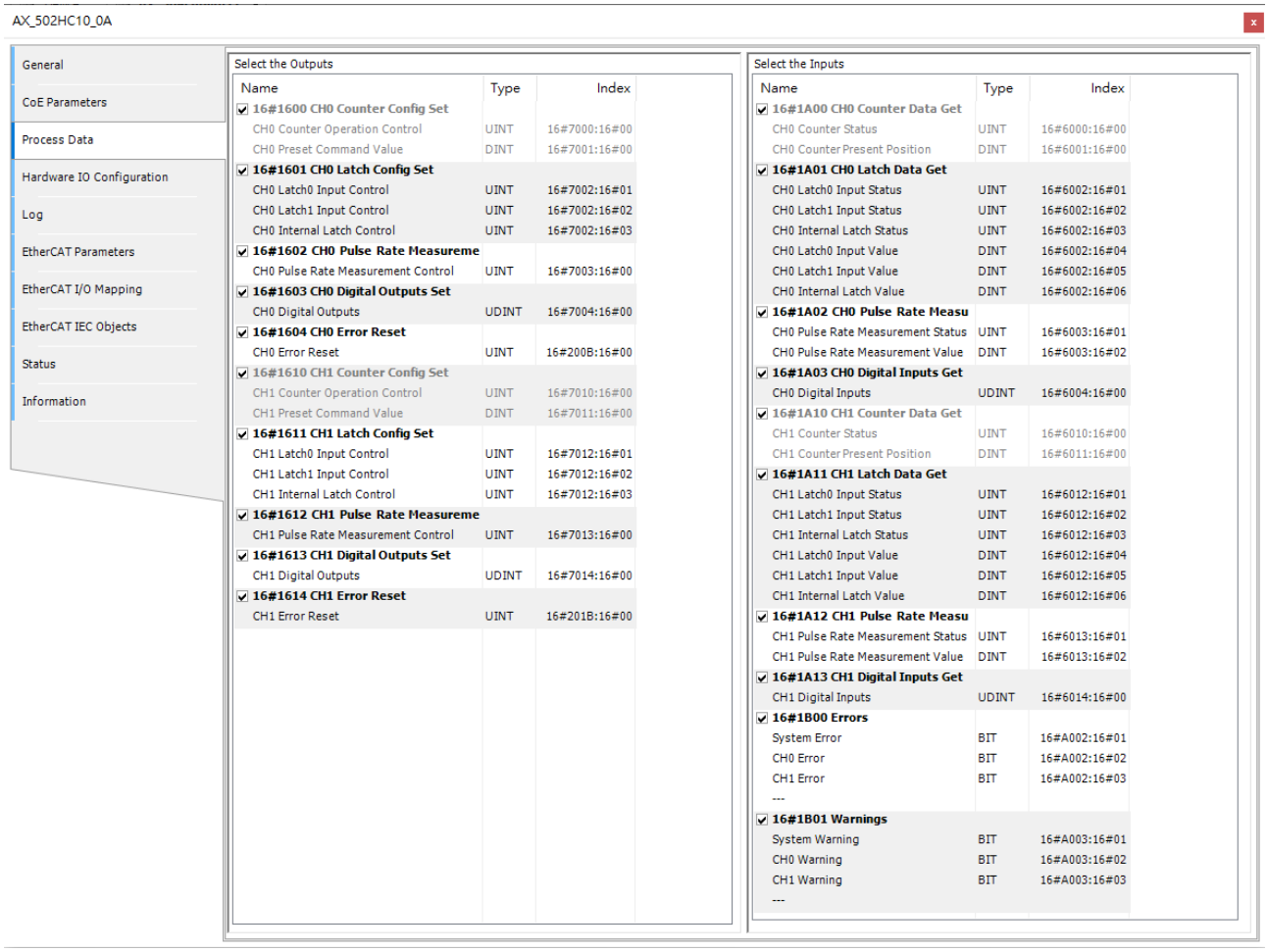
- You can select and right-click the parameter to add the selected parameter to the Favorites.



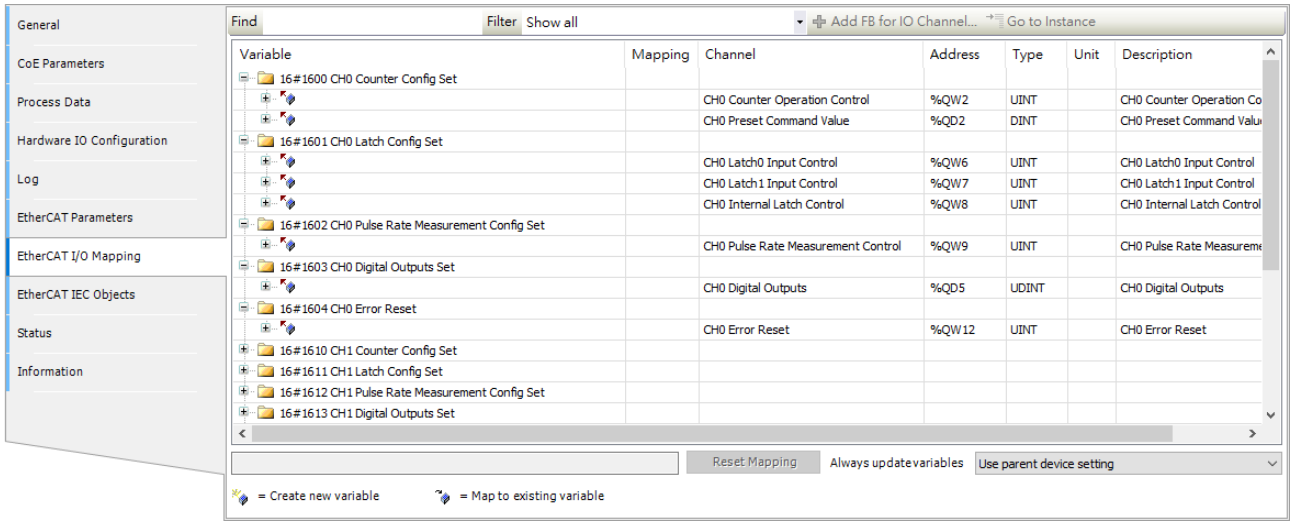
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

6.2.4.3 Process Data

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

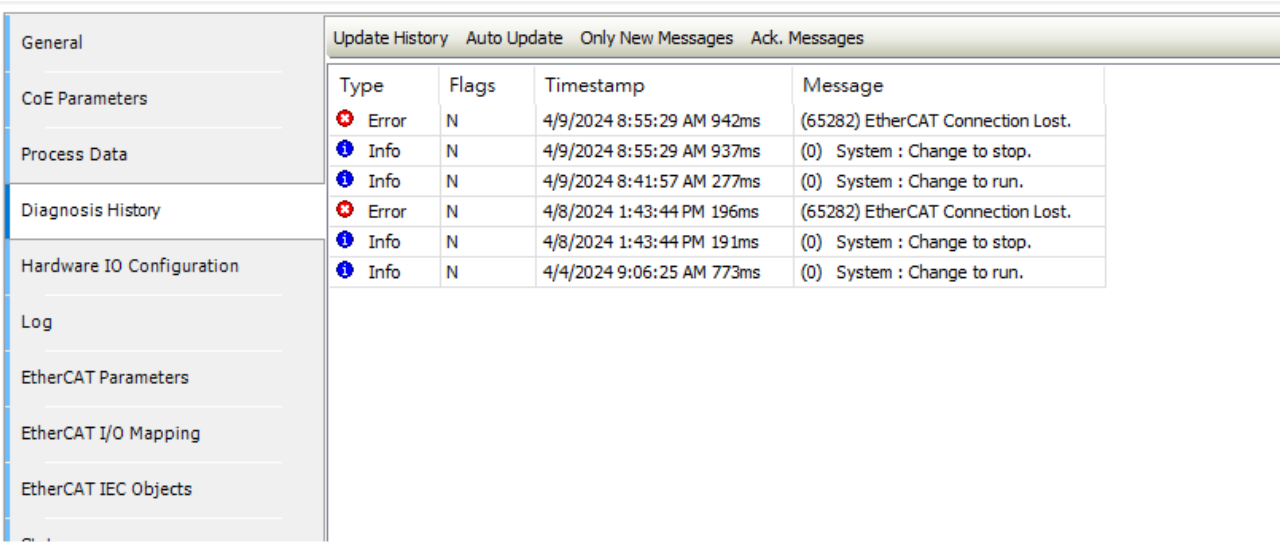


(2) Click  on the toolbar to go into the online mode. In the **EtherCAT I/O Mapping** tab, you can find the variables, current value, status and error codes for each channel.



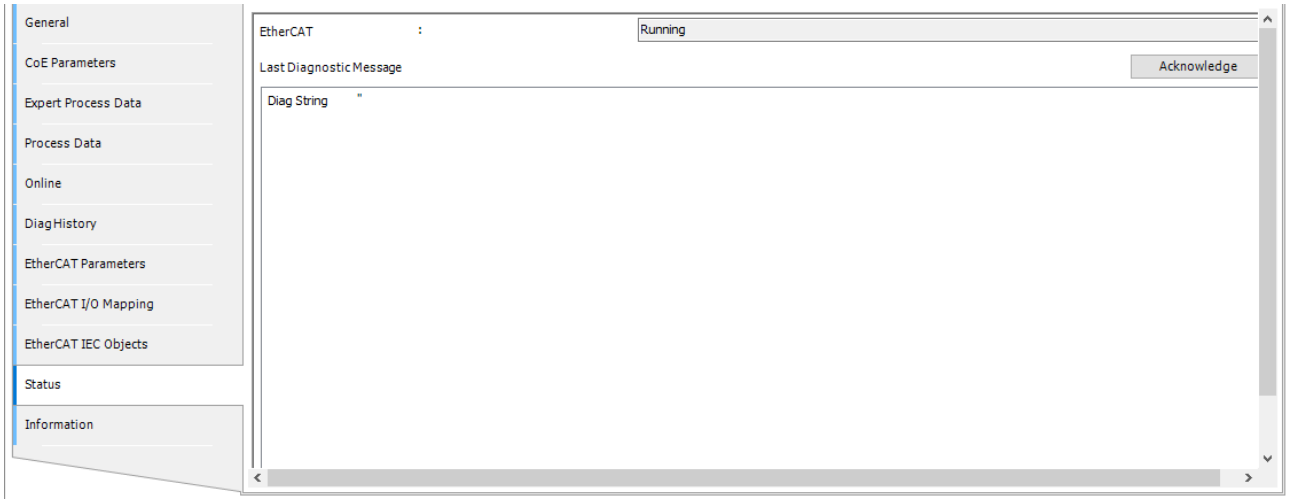
6.2.4.4 Diagnosis History

Click  on the toolbar to go into the online mode. In the **Diagnosis History** tab, all error information that occurred on the module is recorded. The TEXT ID plus error description is displayed in the **Message** column. Please refer to the troubleshooting section for details on errors. **Info** lines present the system status of the high-speed counter module and the state changes of the state machines of axes.



6.2.4.5 Status

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



6.2.4.6 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 the 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

6.2.5 System Architecture

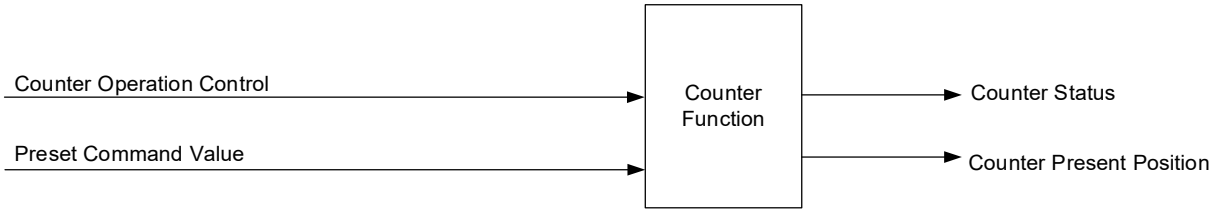
In this section, the contents include basic operation settings and object descriptions of AX-502HC10 in EtherCAT mode, which is Delta user-defined mode.

CH0 is taken as an example for explanation here. To set up for CH1, please make an offset of 16#10 for the index of each object and then set them.

6.2.5.1 Counter Function

Through the Counter Function, counter values are obtained after external input pulses are received, and two Counter Functions are supported.

The architecture of Counter Function:



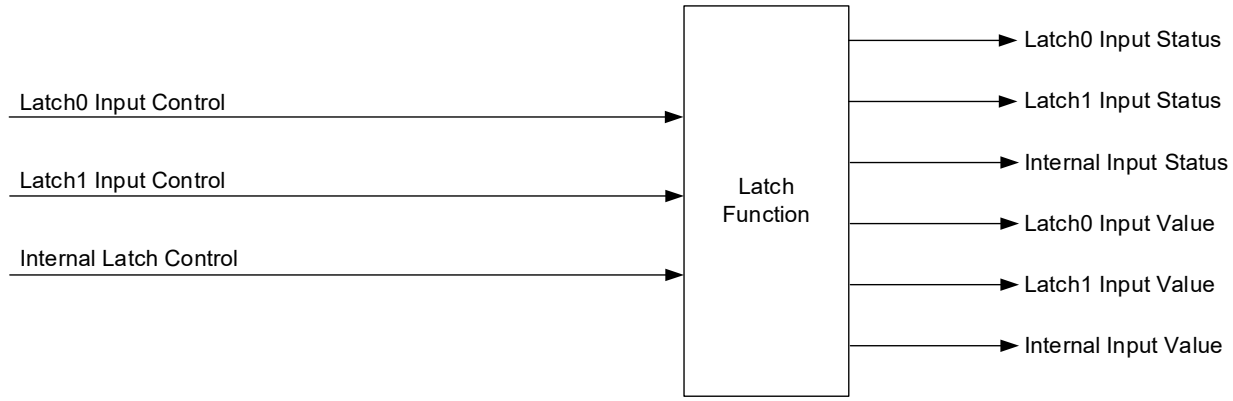
List of related objects:

Index	Subindex	Name	Attr.	PDO mapping	Unit	Data type
16#7000	16#00	CH0 Counter Operation Control	RW	Yes	-	UINT
16#7001	16#00	CH0 Preset Command Value	RW	Yes	-	DINT
16#6000	16#00	CH0 Counter Status	RO	Yes	-	UINT
16#6001	16#00	CH0 Counter Present Position	RO	Yes		DINT

6.2.5.2 Latch Function

Latch Function is triggered by the high-speed DI signal to obtain high-speed counter values, with each Counter Function supporting two Latches, Latch0 and Latch1.

The architecture of Latch Function:



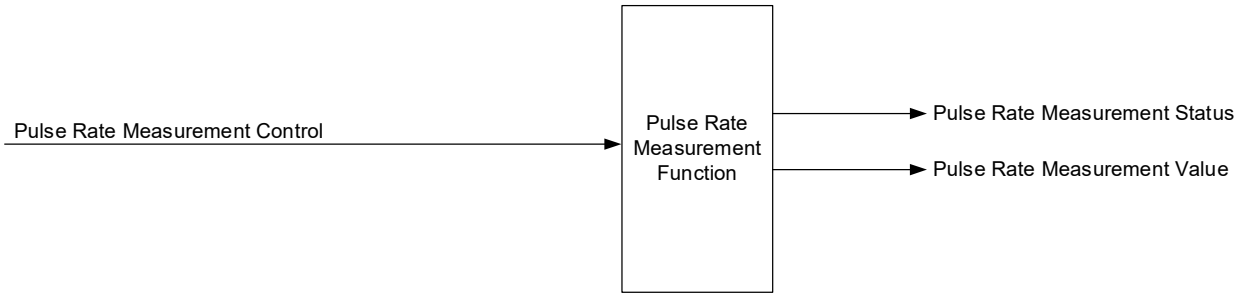
List of related objects:

Index	Subindex	Name	Attr.	PDO mapping	Unit	Data type
16#7002	16#01	CH0 Latch0 Input Control	RW	Yes	-	UINT
	16#02	CH0 Latch1 Input Control	RW	Yes	-	UINT
	16#03	CH0 Internal Latch Control	RW	Yes	-	UINT
16#6002	16#01	CH0 Latch0 Input Status	RO	Yes	-	UINT
	16#02	CH0 Latch1 Input Status	RO	Yes	-	UINT
	16#03	CH0 Internal Input Status	RO	Yes	-	UINT
	16#04	CH0 Latch0 Input Value	RO	Yes	-	DINT
	16#05	CH0 Latch1 Input Value	RO	Yes	-	DINT
	16#06	CH0 Internal Input Value	RO	Yes	-	DINT

6.2.5.3 Pulse Rate Measurement Function

The Pulse Rate Measurement Function measures the average pulse rate value by receiving external input pulses, and only CH0 Pulse is supported.

The architecture of Pulse Rate Measurement Function:



List of related objects:

Index	Subindex	Name	Attr.	PDO mapping	Unit	Data type
16#7003	16#00	CH0 Pulse Rate Measurement Control	RW	Yes	-	UINT
16#6003	16#01	CH0 Pulse Rate Measurement Status	RO	Yes	-	UINT
	16#02	CH0 Pulse Rate Measurement Value	RO	Yes	-	DINT

6.2.6 Description of Objects

The objects that the module supports and their discriptions are listed in the following table.

- Objects: 16#2000–16#2FFF

Index	Function	Description
16#2000	CH0 DI Function	CH0 DI function selection
16#2001	CH0 DIQ Negative Logic	CH0 DIQ logic polarity selection
16#2002	CH0 Counter Type	CH0 counter type
16#2003	CH0 Maximum Counter Value	CH0 maximum counter value
16#2004	CH0 Minimum Counter Value	CH0 minimum counter value
16#2005	CH0 Pulse Input Method	CH0 pulse input method
16#2006	CH0 Counter Count Direction	CH0 counter count direction selection
16#2007	CH0 Filter Depth Config	CH0 filter configuration setting
16#2008	CH0 Pulse Rate Measurement Window	CH0 pulse rate measurement window
16#2009	CH0 Pulse Rate Measurement Average Denominator	CH0 pulse rate measurement average times
16#200A	CH0 Error Code	CH0 error code
16#200B	CH0 Error Reset	CH0 error reset
16#2010	CH1 DI Function	CH1 DI function selection
16#2011	CH1 DIQ Negative Logic	CH1 DIQ logic polarity selection
16#2012	CH1 Counter Type	CH1 counter type
16#2013	CH1 Maximum Counter Value	CH1 maximum counter value
16#2014	CH1 Minimum Counter Value	CH1 minimum counter value
16#2015	CH1 Pulse Input Method	CH1 pulse input method

Index	Function	Description
16#2016	CH1 Counter Count Direction	CH1 counter count direction selection
16#2017	CH1 Filter Depth Config	CH1 filter configuration setting
16#2018	CH1 Pulse Rate Measurement Window	CH1 pulse rate measurement window
16#2019	CH1 Pulse Rate Measurement Average Denominator	CH1 pulse rate measurement average times
16#201A	CH1 Error Code	CH1 error code
16#201B	CH1 Error Reset	CH1 error reset

- Objects: 16#5000–16#5FFF

Index	Name	Description
16#5000	Module Status	Status of the module
16#5001	User Command	Commands for users to use (Reserved)

- Objects: 16#6000–16#6FFF

Index	Name	Description
16#6000	CH0 Counter Status	Counter status of CH0
16#6001	CH0 Counter Present Position	Present counter value of CH0
16#6002	CH0 Latch Status and Value	Latch status and value of CH0
16#6003	CH0 Pulse Rate Measurement Status and Value	Pulse rate measurement status and value of CH0
16#6004	CH0 Digital Inputs	Status of digital inputs of CH0
16#6010	CH1 Counter Status	Counter status of CH1
16#6011	CH1 Counter Present Position	Present counter value of CH1
16#6012	CH1 Latch Status and Value	Latch status and value of CH1
16#6013	CH1 Pulse Rate Measurement Status and Value	Pulse rate measurement status and value of CH1
16#6014	CH1 Digital Inputs	Status of digital inputs of CH1

- Objects: 16#7000–16#7FFF

Index	Name	Description
16#7000	CH0 Counter Operation Control	Counter operation control of CH0
16#7001	CH0 Preset Command Value	Preset command value of CH0 counter
16#7002	CH0 Latch Control	Latch input control of CH0
16#7003	CH0 Pulse Rate Measurement Control	Pulse rate measurement control of CH0
16#7004	CH0 Digital Outputs	Digital outputs of CH0
16#7010	CH1 Counter Operation Control	Counter operation control of CH1
16#7011	CH1 Preset Command Value	Preset command value of CH1 counter
16#7012	CH1 Latch Control	Latch input control of CH1

Index	Name	Description
16#7013	CH1 Pulse Rate Measurement Control	Pulse rate measurement control of CH1
16#7014	CH1 Digital Outputs	Digital outputs of CH1

- Objects: 16#A000–16#AFFF

Index	Function	Description
16#A000	System Error Codes	Error code set of the module
16#A001	Warning Codes	Warning code set of the module
16#A002	Errors	Error flag set of the module
16#A003	Warnings	Warning flag set of the module

- Objects: 16#F000–16#FFFF

Index	Function	Description
16#F000	Factory Action	Factory mode
16#F001	Module Information	Information about the module

6.2.6.1 Manufacturer Specific Objects

In this section, the following four parameters among the 16#2000 series of objects with the attribute of RW (read/write) can be modified in Startup Parameters or modified when the slave is in OP state. The rest of the 16#2000 series with the attribute of RW can only be modified in Startup Parameters.

1. (16#2008: 16#00) CH0 Pulse Rate Measurement Window
2. (16#2009: 16#00) CH0 Pulse Rate Measurement Average Denominator
3. (16#2018: 16#00) CH1 Pulse Rate Measurement Window
4. (16#2019: 16#00) CH1 Pulse Rate Measurement Average Denominator

6.2.6.1.1 DI Function (16#2000 and 16#2010)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2000	16#01	CH0 DI Function DI0	0: DI 10: LATCH0 20: CLR0	USINT	RW	0
	16#02	CH0 DI Function DI2	0: DI 11: LATCH1 21: CLR1	USINT	RW	0
16#2010	16#01	CH1 DI Function DI1	0: DI 10: LATCH0 20: CLR0	USINT	RW	0
	16#02	CH1 DI Function DI3	0: DI 11: LATCH1 21: CLR1	USINT	RW	0

- **Explanation**

The functions of DI0-DI3 can be selected as:

1. DI (General Digital Input)
2. LATCH (The CH0/CH1 counter value is captured after the input is triggered.)
3. CLR (The CH0/CH1 counter value is cleared after the input is triggered.)

Note:

*1. If DI Function is set to DI and CLR, corresponding logic polarity and filter settings will not take effect until the Counter is enabled next time.

*2. If DI Function is set to Latch, corresponding logic polarity and filter settings will not take effect until the Latch is enabled next time.

6.2.6.1.2 DIQ Negative Logic (16#2001 and 16#2011)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2001	16#01	CH0 DIQ Negative Logic DIZ0	DI logic polarity selection	USINT	RW	0
	16#02	CH0 DIQ Negative Logic DI0		USINT	RW	0
	16#03	CH0 DIQ Negative Logic DI2		USINT	RW	0
	16#04	CH0 DIQ Negative Logic DQ0		USINT	RW	0
	16#05	CH0 DIQ Negative Logic DQ2		USINT	RW	0
	16#06	CH0 DIQ Negative Logic DQ4		USINT	RW	0
16#2011	16#01	CH1 DIQ Negative Logic DIZ1		USINT	RW	0
	16#02	CH1 DIQ Negative Logic DI1		USINT	RW	0
	16#03	CH1 DIQ Negative Logic DI3		USINT	RW	0
	16#04	CH1 DIQ Negative Logic DQ1		USINT	RW	0
	16#05	CH1 DIQ Negative Logic DQ3		USINT	RW	0
	16#06	CH1 DIQ Negative Logic DQ5		USINT	RW	0

- **Explanation**

The logic polarity of DI (digital input) and DQ (digital output) can be selected as:

Polarity	Voltage between Connector In and IOG	Digital input bits (16#6004 and 16#6014)	DI LED
0: Normal	0 V	TRUE	ON
	24 V	FALSE	OFF
1: Inverse	0 V	FALSE	ON
	24 V	TRUE	OFF

Polarity	Digital output bits (16#7004 and 16#7014)	Voltage between Connector Qn and IOG	DQ LED
0: Normal	TRUE	0 V	ON
	FALSE	24 V	OFF
1: Inverse	TRUE	24 V	OFF
	FALSE	0 V	ON

Note:

*1. If DI Function is set to DI and CLR, corresponding logic polarity and filter settings will not take effect until the Counter is enabled next time.

*2. If DI Function is set to Latch, corresponding logic polarity and filter settings will not take effect until the Latch is enabled next time.

*3. The polarity setting of DIZ will not take effect until the Counter is enabled next time.

6.2.6.1.3 Counter Type (16#2002 and 16#2012)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2002	16#00	CH0 Counter Type	Counter type	USINT	RO	0
16#2012	16#00	CH1 Counter Type		USINT	RO	0

- **Explanation**

The value of Counter Type is fixed at 0 (Ring Counter), its attribute is RO (Read Only) and it cannot be modified.

6.2.6.1.4 Maximum Counter Value (16#2003 and 16#2013)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2003	16#00	CH0 Maximum Counter Value	Maximum counter value	DINT	RO	0
16#2013	16#00	CH1 Maximum Counter Value		DINT	RO	0

- **Explanation**

The maximum counter value is fixed at 2147483647, and the object, a Read-Only object, cannot be modified.

If the counter continues counting up after the counter value reaches the maximum value of 2147483647, it will switch to the minimum counter value of -2147483648.

6.2.6.1.5 Minimum Counter Value (16#2004 and 16#2014)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2004	16#00	CH0 Minimum Counter Value	Minimum counter value	DINT	RO	0
16#2014	16#00	CH1 Minimum Counter Value		DINT	RO	0

- **Explanation**

The minimum counter value is fixed at -2147483648, and the object, a Read-Only object, cannot be modified.

If the counter continues counting down after the counter value reaches the minimum value of -2147483648, it will switch to the maximum counter value of 2147483647.

6.2.6.1.6 Pulse Input Method (16#2005 and 16#2015)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2005	16#00	CH0 Pulse Input Method	Pulse input method	USINT	RO	0

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2015	16#00	CH1 Pulse Input Method		USINT	RO	0

- **Explanation**

The value of Pulse Input Method is fixed at 0 (Phase Differential Pulse x4), and the object, a Read-Only object, cannot be modified.

6.2.6.1.7 Counter Count Direction (16#2006 and 16#2016)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2006	16#00	CH0 Counter Count Direction	Select the count direction determined by phase A leading or lagging behind phase B.	USINT	RW	0
16#2016	16#00	CH1 Counter Count Direction		USINT	RW	0

- **Explanation**

Counter's Count Direction can be set to 0 for phase A leading phase B or 1 for phase B leading phase A, as the counter's positive count direction.

0: Phase A leads phase B, as the counter's positive count direction.

1: Phase B leads phase A, as the counter's positive count direction.

Note:

The counter's count direction setting will not take effect until the counter is enabled next time.

6.2.6.1.8 Filter Depth Config (16#2007 and 16#2017)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2007	16#01	CH0 Encoder Filter Setting	Filter settings for CH0 Encoder, Latch and CLR 0: Disable 3: 0.04us 6: 0.48us 9: 1.28us	USINT	RW	0
	16#02	CH0 Latch0 and CLR0 Filter Setting		USINT	RW	0
	16#03	CH0 Latch1 and CLR1 Filter Setting		USINT	RW	0
16#2017	16#01	CH1 Encoder Filter Setting		USINT	RW	0
	16#02	CH1 Latch0 and CLR0 Filter Setting		USINT	RW	0
	16#03	CH1 Latch1 and CLR1 Filter Setting		USINT	RW	0

- **Explanation**

The filter setting of Encoder, Latch or CLR with the unit of us. It is defined as High when the signal is continuously high and the High signal time exceeds the filter setting value. It is defined as Low when the signal is continuously low and the Low signal time exceeds the filter setting value.

Note:

*1. The filter setting of Encoder takes effect after the Counter is enabled.

*2. If DI Function is set to CLR, the filter setting takes effect after the Counter is enabled.

*3. If DI Function is set to Latch, the filter setting takes effect after the Latch is enabled.

6.2.6.1.9 Pulse Rate Measurement Window (16#2008 and 16#2018)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2008	16#00	CH0 Pulse Rate Measurement Window	Number of times for pulse rate measurement time interval	UINT	RW	0
16#2018	16#00	CH1 Pulse Rate Measurement Window		UINT	RW	0

- **Explanation**

The setting value of Pulse Rate Measurement Window ranges from 1 to 65535. If the HC module works in DC mode, the unit is a multiple of the EtherCAT cycle; if the slave works in FreeRun mode, the unit is a multiple of 0.5 ms.

Example:

1. If the setting value of Pulse Rate Measurement Window is 2 and the HC module is in DC mode with the EtherCAT cycle of 1 ms, the time interval for the capture of the pulse number from the counter is 2 ms (2 * 1 ms).
2. If the setting value of Pulse Rate Measurement Window is 2 and the HC module works in FreeRun mode, the time interval for the capture of the pulse number from the counter is 1 ms (2 * 0.5).

6.2.6.1.10 Pulse Rate Measurement Average Denominator (16#2009 and 16#2019)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2009	16#00	CH0 Pulse Rate Measurement Average Denominator	Average times of pulse rate measurement	USINT	RW	0
16#2019	16#00	CH1 Pulse Rate Measurement Average Denominator		USINT	RW	0

- **Explanation**

The setting value of Pulse Rate Measurement Average Denominator ranges from 1 to 100 with the unit: time (s).

Example:

1. If Pulse Rate Measurement Window is set to 2 and the HC module is in DC mode with the ECAT cycle of 1 ms, the time interval for the capture of the counter's pulse number is 2 ms (2 * 1 ms). If Pulse Rate Measurement Average Denominator is set to 4, the measurement result is the average value by diving by 4 the sum of the 2 ms counter values for 4 captures, which is filled in the Pulse Rate Measurement Value.
2. If Pulse Rate Measurement Window is set to 2 and the HC module is in FreeRun mode, the time interval for the capture of the counter's pulse number is 1 ms (2 * 0.5 ms). If Pulse Rate Measurement Average Denominator is set to 4, the measurement result is the average value by diving the sum of the 1 ms counter values for 4 captures by 4, which is filled in the Pulse Rate Measurement Value.

6.2.6.1.11 Error Code (16#200A and 16#201A)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#200A	16#01	CH0 Communication Error	CH0 communication error	UINT	RO	0
	16#02	CH0 Counter Error	CH0 counter error	UINT	RO	0
	16#03	CH0 Latch Error	CH0 latch error	UINT	RO	0
16#201A	16#01	CH1 Communication Error	CH1 communication error	UINT	RO	0
	16#02	CH1 Counter Error	CH1 counter error	UINT	RO	0
	16#03	CH1 Latch Error	CH1 latch error CH1	UINT	RO	0

Communication error:

When a communication error occurs in AX-502HC10-0A,

- (16#200A: 16#01) and (16#201A: 16#01): Display communication error codes.
- (16#A000: 16#00): Displays the module error message.
- (16#A002: 16#01): Displays 1 for System Error.
- (16#A002: 16#02) and (16#A002: 16#03): Display 1 for Error flags of CH0 and CH1.

- When the EtherCAT status of AX-502HC10-0A changes from SafeOP to OP, both the communication errors and the system error in16#A000 are automatically cleared.

Counter error:

When a counter error occurs in AX-502HC10-0A, based on the channel where the error exists:

- (16#200A: 16#02) or (16#201A: 16#02): Displays the counter error code.
- (16#A002: 16#02) or (16#A003: 16#03): Displays 1 for the CH0 Error flag or CH1 Error flag.
- When the EtherCAT status of AX-502HC10-0A changes from SafeOP to OP, the counter flags and counter errors of CH0 and CH1 are automatically cleared.

Latch error:

When a latch error occurs in AX-502HC10-0A, based on the channel where the error exists:

1. (16#200A: 16#03) or (16#201A: 16#03): Displays the latch error code.
2. (16#A002: 16#02) or (16#A002: 16#03): Displays 1 for the CH0 Error flag or CH1 Error flag.
3. When the EtherCAT status of AX-502HC10-0A changes from SafeOP to OP, the latch flags and latch errors of CH0 and CH1 are automatically cleared.

To clear the channel errors of AX-502HC10-0A, use Error Reset (16#200B or 16#201B) of CH0 or CH1 by setting its value from 0 to 1 to clear the errors of CH0 or CH1 respectively.

To clear the system error of AX-502HC10-0A, reset its EtherCAT status.

16#A000 for System Error only displays the latest error code. But in the Diagnosis History tab, all the error messages that occurred in the module are recorded. Please refer to section 6.2.10 for details on error codes and corresponding error LED indicator blinkings.

6.2.6.1.12 Module Status (16#5000)

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

- **Explanation**

When the Delta AX-5 PLC is used as the controller, the module status will be synchronized with the current status of the PLC, 1 (Run) or 2 (Stop). When the PLC is switched to Stop, the output module will behave differently according to the parameter settings for the module, but the input module will not be affected.

When other PLC is used, there is no Run/Stop state for the module, and its state is 0, which is controlled by the EtherCAT state machine.

- **Status of the module**

Value	Status	Description
0	Controlled by EtherCAT State Machine	When the module is controlled by the EtherCAT state machine
1	Controlled by Controller (Run)	When the module is controlled by the PLC and the PLC is in Run state.
2	Controlled by Controller (Stop)	When the module is controlled by the PLC and the PLC is in Stop state.

6.2.6.1.13 User Command (16#5001)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#5001	16#00	User Command	Commands for users to use (Reserved)	UINT	RO	0

6.2.6.1.14 System Error (16#A000)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#A000	16#00	System Error	System error	UINT	RO	0

- **Explanation**

A system error message. Refer to section 6.2.10.1 for details.

6.2.6.1.15 Warning Codes (16#A001)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#A001	16#01	System Warning Code	System warning code	UINT	RO	0

- **Explanation**

A warning message. Refer to section 6.2.10.1 for details.

6.2.6.1.16 Errors (16#A002)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#A002	16#01	System Error	System error	BOOL	RO	0
	16#02	CH0 Error	CH0 error	BOOL	RO	0
	16#03	CH1 Error	CH1 error	BOOL	RO	0

- **Explanation**

Error flags. Refer to section 6.2.10.1 for details.

6.2.6.1.17 Warnings (16#A003)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#A003	16#01	System Warning	System warning	BOOL	RO	0
	16#02	CH0 Warning	CH0 warning	BOOL	RO	0
	16#03	CH1 Warning	CH1 warning	BOOL	RO	0

- **Explanation**

Warning flags. Refer to section 6.2.10.1 for details.

6.2.6.1.18 Module Information (16#F001)

Index	Subindex	Name	Description	Data type	Attr.	Default
16#F001	16#01	Product Serial Number	Product serial number	STRING (18)	RO	0
	16#02	Product Name	Product name	STRING (14)	RO	0
	16#03	Hardware Version	Hardware version	STRING (3)	RO	0
	16#04	Reserved	Reserved	STRING (12)	RO	0
	16#05	Runtime Version	Runtime version	STRING (12)	RO	0
	16#06	Reserved	Reserved	STRING (12)	RO	0
	16#07	Reserved	Reserved	STRING (12)	RO	0

Index	Subindex	Name	Description	Data type	Attr.	Default
	16#08	Reserved	Reserved	STRING (12)	RO	0
	16#09	Reserved	Reserved	STRING (12)	RO	0
	16#10	Reserved	Reserved	STRING (12)	RO	0
	16#11	Reserved	Reserved	STRING (12)	RO	0
	16#12	Reserved	Reserved	UDINT	RO	0
	16#13	Reserved	Reserved	UINT	RO	0
	16#14	Reserved	Reserved	UINT	RO	0
	16#15	Reserved	Reserved	UINT	RO	0
	16#16	Reserved	Reserved	UINT	RO	0
	16#17	Reserved	Reserved	UINT	RO	0
	16#18	Reserved	Reserved	UINT	RO	0
	16#19	Reserved	Reserved	UINT	RO	0
	16#20	Reserved	Reserved	UINT	RO	0
	16#21	Reserved	Reserved	UINT	RO	0
	16#22	Reserved	Reserved	UINT	RO	0
	16#23	Reserved	Reserved	UINT	RO	0
	16#24	Reserved	Reserved	UINT	RO	0
	16#25	Reserved	Reserved	UINT	RO	0
	16#26	Reserved	Reserved	UINT	RO	0
	16#27	Reserved	Reserved	UINT	RO	0
	16#28	Reserved	Reserved	UINT	RO	0
	16#29	Reserved	Reserved	UINT	RO	0
	16#30	Reserved	Reserved	UINT	RO	0
	16#31	Reserved	Reserved	UINT	RO	0

6.2.6.2 Applications

Applications can be used in Process Data, with the following five categories:

1. Counter Function
2. Latch Function
3. Pulse Rate Measurement Function
4. Digital Inputs/Outputs
5. Error Reset/Error

6.2.6.2.1 Counter Function (16#7000, 16#7001, 16#6000 and 16#6001)

This section describes counter-related settings and status.

Below is an introdution to Output (RxPDO) of Counter Function.

Counter Operation Control:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#7000	16#00	CH0 Counter Operation Control	CH0/CH1 counter operation control setting	UINT	RW	0
16#7010	16#00	CH1 Counter Operation Control		UINT	RW	0

- **Explanation**

Each bit of Counter Operation Control has a different function. Taking CH0 as an example, the functions of its bits are described as follows:

Parameter	Function
Bit0: Counter Enable	When the value of the bit changes from 0 to 1, the Counter function is enabled.
Bit1: Internal Reset Execution	When the value of the bit changes from 0 to 1, the value of Counter Present Position is reset to 0.
Bit2: Preset Execution	When the value of the bit changes from 0 to 1, the setting of Preset Command Value can be written into Counter Present Position.
Bit3: External Reset Enable	1. If I0 or I2 is set as CLR in DI Function and the value of bit3 changes from 0 to 1, then based on the settings of I0 and I2 in DIQ Negative Logic, the value of Counter Present Position is reset to 0 when the actual inputs of I0 and I2 are triggered by changing their values from 0 to 1 or 1 to 0. 2. If the triggering for corresponding status is successful, Bit5: External Reset Completed Flag Clear is required to be triggered before the next triggerring of I0 and I2 can reset the value of Counter Present Position to 0.
Bit4: Phase Z Reset Enable	1. If the value of Bit4 changes from 0 to 1, based on the setting of IZ0 in DIQ Negative Logic, the seting of Counter Present Position is reset to 0 when the actual input of IZ0 is triggered by changing its value from 0 to 1 or 1 to 0. 2. If the triggering for corresponding status is successful, Bit6: Phase Z Reset Completed Flag Clear is required to be triggered before the next triggerring of IZ0 can reset the value of Counter Present Position to 0.

Parameter	Function
Bit5: External Reset Completed Flag Clear	If the value of the bit changes from 0 to 1, Bit4 of Counter Status: External Reset Completed Flag is reset to 0.
Bit6: Phase Z Reset Completed Flag Clear	If the value of the bit changes from 0 to 1, Bit5 of Counter Status: Phase Z Reset Completed Flag is reset to 0.
Bit7-Bit15: Reserved	Bit7-Bit15 are reserved.

Preset Command Value:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#7001	16#00	CH0 Preset Command Value	CH0/CH1 counter preset command value	DINT	RW	0
16#7011	16#00	CH1 Preset Command Value		DINT	RW	0

- **Explanation**

Fill a setting value in Preset Command Value, which is the value you wish to set in Counter Present Position. Once you change Bit2 of Counter Operation Control: Preset Execution from 0 to 1, and Bit2 of Counter Status: Preset Completed also changes from 0 to 1, it means that the setting action is done.

Below is an introduction to the Input (TxPDO) of Counter Function:

Counter Status:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6000	16#00	CH0 Counter Status	Counter status of CH0/CH1	UINT	RO	0
16#6010	16#00	CH1 Counter Status		UINT	RO	0

- **Explanation**

Each bit of Counter Status has a different function. Taking CH0 as an example, the functions of its bits are described as follows:

Parameter	Function
Bit0: Counter Enabled	1. Once Bit0 of Counter Operation Control: Counter Enable is enabled, Bit0 of Counter Status: Counter Enabled will immediately change from 0 to 1. 2. Once Bit0 of Counter Operation Control: Counter Enable is disabled, Bit0 of Counter Status: Counter Enabled will immediately change from 1 to 0.
Bit1: Internal Reset Completed	1. Once Bit1 of Counter Operation Control: Internal Reset Execution is enabled, Bit1 of Counter Status: Internal Reset Completed will immediately change from 0 to 1. 2. Once Bit1 of Counter Operation Control: Internal Reset Execution is disabled, Bit1 of Counter Status: Internal Reset Completed will immediately change from 1 to 0.
Bit2: Preset Completed	1. Once Bit2 of Counter Operation Control: Preset Execution is enabled, Bit2 of Counter Status: Preset Completed will immediately change from 0 to 1. 2. Once Bit2 of Counter Operation Control: Preset Execution is disabled, Bit2 of Counter Status: Preset Completed will immediately change from 1 to 0.
Bit3: Count Direction Flag	If Bit0 of Counter Operation Control: Counter Enable is enabled, Bit 3: Count Direction Flag representing the count direction is 0 for the positive direction, or 1 for the negative direction.

Parameter	Function
Bit4: External Reset Enabled	1. Once Bit3 of Counter Operation Control: External Reset Enable is enabled, Bit4 of Counter Status: External Reset Enabled will immediately change from 0 to 1 and then the system will wait for the CLR signal trigger to reset the value of Counter Present Position to 0. 2. Once Bit3 of Counter Operation Control: External Reset Enable is disabled, Bit4 of Counter Status: External Reset Enabled will immediately change from 1 to 0.
Bit5: Phase Z Reset Enabled	1. Once Bit4 of Counter Operation Control: Phase Z Reset Enable is enabled, Bit5 of Counter Status: PhaseZ Reset Enabled will immediately change from 0 to 1 and then the system will wait for the PhaseZ signal trigger to reset the value of Counter Present Position to 0. 2. Once Bit4 of Counter Operation Control: Phase Z Reset Enable is disabled, Bit5 of Counter Status: PhaseZ Reset Enabled will immediately change from 1 to 0.
Bit6: External Reset Completed Flag	1. If I0 or I2 is set as CLR in DI Function and Bit5 of Counter Operation Control: External Reset Completed Flag Clear changes from 0 to 1, then based on the settings of I0 and I2 in DIQ Negative Logic, the value of Counter Present Position is reset to 0 when the actual inputs of I0 and I2 are triggered by changing their values from 0 to 1 or 1 to 0, and meanwhile Bit 6: External Reset Completed Flag is triggered successfully, changing from 0 to 1. 2. If the External Reset Completed Flag has been triggered successfully, Bit5 of Counter Operation Control: External Reset Completed Flag Clear must be triggered to reset the External Reset Completed Flag before the next triggerring of I0 and I2 can reset the value of Counter Present Position to 0.
Bit7: Phase Z Reset Completed Flag	1. If Bit6 of Counter Operation Control: Phase Z Reset Completed Flag Clear changes from 0 to 1, then based on the setting of IZ0 in DIQ Negative Logic, the value of Counter Present Position is reset to 0 when the actual input of IZ0 is triggered by changing its value from 0 to 1 or 1 to 0, and meanwhile Bit 7: Phase Z Reset Completed Flag is triggered successfully, changing from 0 to 1. 2. If the Phase Z Reset Completed Flag has been triggered successfully, Bit6 of Counter Operation Control: Phase Z Reset Completed Flag Clear must be triggered to reset the Phase Z Reset Completed Flag before the next triggerring of IZ0 can reset the value of Counter Present Position to 0.
Bit8-Bit15: Reserved	Bit8-Bit15 are reserved.

Counter Present Position:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6001	16#00	CH0 Counter Present Position	Present counter value of CH0/CH1	DINT	RO	0
16#6011	16#00	CH1 Counter Present Position		DINT	RO	0

- **Explanation**

After the counter function is successfully enabled, Counter Present Position displays the current count value of the channel 0/channel 1 counter. See Maximum Counter Value and Minimum Counter Value for upper and lower limits.

6.2.6.2.2 Latch Function (16#7002, 16#7012, 16#6002 and 16#6012)

This section describes latch-related settings and status.

Below is an introdution to Output (RxPDO) of Latch Function.

Latch Control:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#7002	16#01	CH0 Latch0 Input Control	Latch0 input control of CH0	UINT	RW	0
	16#02	CH0 Latch1 Input Control	Latch1 input control of CH0	UINT	RW	0
	16#03	CH0 Internal Latch Control	Internal latch control of CH0	UINT	RW	0
16#7012	16#01	CH1 Latch0 Input Control	Latch0 input control of CH1	UINT	RW	0
	16#02	CH1 Latch1 Input Control	Latch1 input control of CH1	UINT	RW	0
	16#03	CH1 Internal Latch Control	Internal latch control of CH1	UINT	RW	0

- **Explanation**

Each bit of Latch0 Input Control has a different function. Taking CH0 as an example, the functions of its bits are described as follows:

Parameter	Function
Bit0: Latch0 Input Enable	1. Before using the Latch0 function, please first set Latch0 for the desired channel in Startup Parameters. ● CH0 DI Function DI0 is set to 1 (LATCH0). 2. Bit1: Latch0 Input Trigger Condition (Oneshot Mode/Continuous Mode) can be 0: Oneshot Mode, which represents that Latch0 will only be effectively triggered once, and the Latch function will no longer be performed when it is triggered again, unless Bit0: Latch0 Input Enable changes from 0 to 1 once again. Bit1: Latch0 Input Trigger Condition (Oneshot Mode/Continuous Mode) can also be 1: Continuous Mode, which means that the Latch0 hardware signal can continuously trigger Latch without any upper limit on the number of times even if the Latch0 Input Completed Flag is 1. 3. If Bit0: Latch0 Input Enable changes from 0 to 1, the Latch0 function is enabled, the setting value of Bit1: Latch0 Input Trigger Condition (Oneshot Mode/Continuous Mode) takes effect, and Bit0 of Latch0 Input Status: Latch0 Input Enabled change from 0 to 1, which indicates the setting is enabled. 4. If the Latch0 hardware input is triggered, then the value of Counter Present Position is copied to Latch0 Input Value and Bit1 of Latch0 Input Status: Latch0 Input Completed Flag changes from 0 to 1, indicating a successful capture by Latch. 5. If Bit0: Latch0 Input Enable changes from 1 to 0, then Latch0 Input Value, and Bit0: Latch0 Input Enabled and Bit1: Latch0 Input Completed Flag of Latch0 Input Status are all reset to 0.
Bit1: Latch0 Input Trigger Condition (Oneshot Mode/Continuous Mode)	
Bit2-Bit15: Reserved	Bit2-Bit15 are reserved.

Each bit of Latch1 Input Control has a different function. Taking CH0 as an example, the functions of its bits are described as follows:

Parameter	Function
Bit0: Latch1 Input Enable	1. Before using the Latch1 function, please first set Latch1 for the desired channel in Startup Parameters. ● CH0 DI Function DI2 is set to 1 (LATCH1). 2. Bit1: Latch1 Input Trigger Condition (Oneshot Mode/Continuous Mode) can be 0: Oneshot Mode, which represents that Latch1 will only be effectively triggered once, and the Latch function will no longer be performed when it is triggered again unless Bit0: Latch1 Input Enable changes from 0 to 1 once again. Bit1: Latch1 Input Trigger Condition (Oneshot Mode/Continuous Mode) can also be 1: Continuous Mode, which means that the Latch1 hardware signal can continuously trigger Latch without any upper limit on the number of times even if the Latch1 Input Completed Flag is 1. 3. If Bit0: Latch1 Input Enable changes from 0 to 1, the Latch1 function is enabled, the setting value of Bit1: Latch1 Input Trigger Condition (Oneshot Mode/Continuous Mode) takes effect, and Bit0 of Latch1 Input Status: Latch1 Input Enabled change from 0 to 1, which indicates the setting is enabled. 4. If the Latch1 hardware input is triggered, then the value of Counter Present Position is copied to Latch1 Input Value and Bit1 of Latch1 Input Status: Latch1 Input Completed Flag changes from 0 to 1, indicating a successful capture by Latch. 5. If Bit0: Latch1 Input Enable changes from 1 to 0, then Latch1 Input Value and Bit0: Latch1 Input Enabled and Bit1: Latch1 Input Completed Flag of Latch1 Input Status are all reset to 0.
Bit1: Latch1 Input Trigger Condition (Oneshot Mode/Continuous Mode)	
Bit2-Bit15: Reserved	Bit2-Bit15 are reserved.

Each bit of Internal Latch Control has a different function. Taking CH0 as an example, the functions of its bits are described as follows:

Parameter	Function
Bit0: Internal Latch Enable	1. If Bit0: Internal Latch Enable changes from 0 to 1, the Internal Latch function is enabled, the current value of Counter Present Position is copied to Internal Latch Value, Bit0 of Internal Latch Status: Internal Latch Enabled changes from 0 to 1, and Bit1 of 16#6002: 16#01: Internal Latch Completed Flag changes from 0 to 1, indicating a successful capture by Latch. 2. If Bit0: Internal Latch Enable changes from 1 to 0, then Internal Latch Value, Bit0 of Internal Latch Status: Latch0 Input Enabled and Bit1 of 16#6002: 16#01: Internal Latch Completed Flag are all reset to 0. 3. It should be noted that the performance of Internal Latch is relatively less timely than that of the Latch0 or Latch1 using hardware signal triggers. To get more timely Latch performance, please use Latch0 or Latch1.
Bit1-Bit15: Reserved	Bit1-Bit15 are reserved.

Below is an introdution to Input (TxPDO) of Latch Function.

Latch Status and Input Value:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6002	16#01	CH0 Latch0 Input Status	Latch0 input status of CH0	UINT	RO	0
	16#02	CH0 Latch1 Input Status	Latch1 input status of CH0	UINT	RO	0
	16#03	CH0 Internal Latch Status	Internal latch status of CH0	UINT	RO	0
	16#04	CH0 Latch0 Input Value	Latch0 input value of CH0	DINT	RO	0
	16#05	CH0 Latch1 Input Value	Latch1 input value of CH0	DINT	RO	0
	16#06	CH0 Internal Latch Value	Internal latch value of CH0	DINT	RO	0
16#6012	16#01	CH1 Latch0 Input Status	Latch0 input status of CH1	UINT	RO	0
	16#02	CH1 Latch1 Input Status	Latch1 input status of CH1	UINT	RO	0
	16#03	CH1 Internal Latch Status	Internal latch status of CH1	UINT	RO	0
	16#04	CH1 Latch0 Input Value	Latch0 input value of CH1	DINT	RO	0
	16#05	CH1 Latch1 Input Value	Latch1 input value of CH1	DINT	RO	0
	16#06	CH1 Internal Latch Value	Internal latch value of CH1	DINT	RO	0

- **Explanation**

Each bit of Latch0 Input Status has a different function. Taking CH0 as an example, the functions of its bits are described as follows:

Parameter	Function
Bit0: Latch0 Input Enabled	1. When Bit0 of Latch0 Input Control: Latch0 Input Enable changes from 0 to 1, the Latch0 function is enabled, meanwhile the setting value of Bit1: Latch0 Input Trigger Condition (Oneshot Mode/Continuous Mode) takes effect and Bit0 of Latch0 Input Status: Latch0 Input Enabled changes from 0 to 1, indicating the setting is enabled. After the Latch0 hardware function is triggered, the value of Counter Present Position is copied to Latch0 Input Value. 2. When Bit0 of Latch0 Input Control: Latch0 Input Enable changes from 1 to 0, then Latch0 Input Value, and Bit0: Latch0 Input Enabled and Bit1: Latch0 Input Completed Flag of Latch0 Input Status are all reset to 0.

Parameter	Function
Bit1: Latch0 Input Completed Flag	1. When Bit0 of Latch0 Input Status: Latch0 Input Enabled is 1, the Latch0 hardware function is triggered and the value of Counter Present Position is copied to Latch0 Input Value, and then Bit1: Latch0 Input Completed Flag changes from 0 to 1, indicating that the capture is a success. 2. If Bit1 of Latch0 Input Control: Latch0 Input Trigger Condition is Continuous Mode, and this flag is not manually reset, Bit1: Latch0 Input Completed Flag will remain 1 when Latch0 is continuously triggered after capturing the value for the first time succeeds. 3. If Bit0: Latch0 Input Enable of Latch0 Input Control changes from 1 to 0, then Bit0: Latch0 Input Enabled and Bit1: Latch0 Input Completed Flag of Latch0 Input Status and Latch0 Input Value will be reset to 0.
Bit2-Bit15: Reserved	Bit2-Bit15 are reserved.

Each bit of Latch1 Input Status has a different function. Taking CH0 as an example, the functions of its bits are described as follows:

Parameter	Function
Bit0: Latch1 Input Enabled	1. When Bit0 of Latch1 Input Control: Latch1 Input Enable changes from 0 to 1, the Latch1 function is enabled, meanwhile the setting value of Bit1: Latch1 Input Trigger Condition (Oneshot Mode/Continuous Mode) takes effect and Bit0 of Latch1 Input Status: Latch1 Input Enabled changes from 0 to 1, indicating the setting is enabled. After the Latch1 hardware function is triggered, the value of Counter Present Position is copied to Latch1 Input Value. 2. When Bit0 of Latch1 Input Control: Latch1 Input Enable changes from 1 to 0, then Latch1 Input Value, and Bit0: Latch1 Input Enabled and Bit1: Latch1 Input Completed Flag of Latch1 Input Status are all reset to 0.
Bit1: Latch1 Input Completed Flag	1. When Bit0 of Latch1 Input Status: Latch1 Input Enabled is 1, the Latch1 hardware function is triggered and the value of Counter Present Position is copied to Latch1 Input Value, and then Bit1: Latch1 Input Completed Flag changes from 0 to 1, indicating that the capture is a success. 2. If Bit1 of Latch1 Input Control: Latch1 Input Trigger Condition is Continuous Mode, and this flag is not manually reset, Bit1: Latch1 Input Completed Flag will remain 1 when Latch1 is continuously triggered after capturing the value for the first time succeeds. 3. If Bit0 of Latch1 Input Control: Latch1 Input Enable changes from 1 to 0, then Bit0: Latch1 Input Enabled and Bit1: Latch1 Input Completed Flag of Latch1 Input Status and Latch1 Input Value will all be reset to 0.
Bit2-Bit15: Reserved	Bit2-Bit15 are reserved.

Each bit of Internal Latch Status has a different function. Taking CH0 as an example, the functions of its bits are described as follows:

Parameter	Function
Bit0: Internal Latch Enabled	1. When Bit0 of Internal Latch Control: Internal Latch Enable changes from 0 to 1, the Internal Latch function is enabled, the value of Counter Present Position is copied to Internal Latch Value, and both Bit0: Internal Latch Enabled and Bit1: Internal Latch Completed Flag of Internal Latch Status change from 0 to 1, indicating that the Latch capture is a success. 2. If Bit0 of Internal Latch Control: Internal Latch Enable changes from 1 to 0, then Bit0: Internal Latch Enabled and Bit1: Internal Latch Completed Flag of Internal Latch Status and Internal Latch Value will all be reset to 0.
Bit1: Internal Latch Completed Flag	
Bit2-Bit15: Reserved	Bit2-Bit15 are reserved.

Latch0 Input Value:

When the Latch0 hardware is triggered, the value of Counter Present Position is copied to and saved in Latch0 Input Value, and Bit1: Latch0 Input Completed Flag of Latch0 Input Status is set to 1 indicating that the capture is done.

Latch1 Input Value:

When the Latch1 hardware is triggered, the value of Counter Present Position is copied to and saved in Latch1 Input Value, and Bit1: Latch1 Input Completed Flag of Latch1 Input Status is set to 1 indicating that the capture is done.

Internal Latch Value:

When the Latch1 hardware is triggered, the value of Counter Present Position is copied to and saved in Internal Latch Value, and then Bit1: Internal Latch Completed Flag of Internal Latch Status is set to 1 indicating that the capture is done.

6.2.6.2.3 Pulse Rate Measurement Function (16#7003, 16#7013, 16#6003 and 16#6013)

This section describes relevant settings and status for pulse rate measurement.

Below is an introdution to Output (RxPDO) of Pulse Rate Measurement Function.

Pulse Rate Measurement Control:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#7003	16#00	CH0 Pulse Rate Measurement Control	CH0/CH1 Pulse rate measurement control	UINT	RW	0
16#7013	16#00	CH1 Pulse Rate Measurement Control		UINT	RW	0

- **Explanation**

Each bit of Pulse Rate Measurement Control has a different function. Taking CH0 as an example, the functions of its bits are described as follows:

Parameter	Function
Bit0: Pulse Rate Measurement Enable	1. If Bit0: Pulse Rate Measurement Enable changes from 0 to 1, then Bit0 of Pulse Rate Measurement Status: Pulse Rate Measurement Enabled will change from 0 to 1. 2. According to the settings of Pulse Rate Measurement Window and Pulse Rate Measurement Average Denominator, fill the measurement value in Pulse Rate Measurement Value by referring to the Counter value, and then Bit2: Pulse Rate Measurement Completed of Pulse Rate Measurement Status changes from 0 and 1 indicating that the measurement is complete.

Parameter	Function
Bit1: Pulse Rate Measurement Value Clear	If Bit1: Pulse Rate Measurement Value Clear changes from 0 to 1, then Pulse Rate Measurement Value will be cleared to 0 and Bit1 of Pulse Rate Measurement Status: Pulse Rate Measurement Value Clear Completed changes from 0 to 1 indicating that clearing the measurement value is complete.
Bit2-Bit15: Reserved	Bit2-Bit15 are reserved.

Below is an introdution to Input (TxPDO) of Pulse Rate Measurement Function

Pulse Rate Measurement Status and Value:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6003	16#01	CH0 Pulse Rate Measurement Status	CH0 pulse rate measurement status	UINT	RO	0
16#6003	16#02	CH0 Pulse Rate Measurement Value	CH0 pulse rate measurement value	DINT	RO	0
16#6013	16#01	CH1 Pulse Rate Measurement Status	CH1 pulse rate measurement status	UINT	RO	0
16#6013	16#02	CH1 Pulse Rate Measurement Value	CH1 pulse rate measurement value	DINT	RO	0

- **Explanation**

Each bit of Pulse Rate Measurement Status has a different function. The functions of bits are described as follows:

Parameter	Function
Bit0: Pulse Rate Measurement Enabled	If Bit0: Pulse Rate Measurement Enable of Pulse Rate Measurement Control changes from 0 to 1, then Bit0: Pulse Rate Measurement Enabled of Pulse Rate Measurement Status changes from 0 to 1 indicating that the pulse measurement is enabled.
Bit1: Pulse Rate Measurement Value Clear Completed	If Bit1: Pulse Rate Measurement Value Clear of Pulse Rate Measurement Control changes from 0 to 1, Pulse Rate Measurement Value will be cleared to 0, and then Bit1: Pulse Rate Measurement Value Clear Completed of Pulse Rate Measurement Status will change from 0 to 1 indicating that clearing the value is complete.
Bit2: Pulse Rate Measurement Completed	1. If Bit0: Pulse Rate Measurement Enable of Pulse Rate Measurement Control changes from 0 to 1, Bit0: Pulse Rate Measurement Enabled of Pulse Rate Measurement Status will change from 0 to 1. 2. According to the settings of Pulse Rate Measurement Window and Pulse Rate Measurement Average Denominator, the measurement value is filled in Pulse Rate Measurement Value and Bit2: Pulse Rate Measurement Completed of Pulse Rate Measurement Status changes from 0 and 1 indicating that the measurement is complete.
Bit3-Bit15: Reserved	Bit3-Bit15 are reserved.

Example

- When AX-502HC10-0A receives 200,000 pulses which are output at a constant velocity, you want to use the high-speed counter modules Pulse Rate Measurement function .
- Set **Channel- Pulse Rate Measurement Window** to 2.
- Set **Channel- Pulse Rate Measurement Average Denominator** to 4.
- Enable the Pulse Rate Measurement function.

1. If AX-502HC10-0A is in DC mode with the EtherCAT cycle set to 0.001 sec (1ms), via **Pulse Rate Measurement Value** you can get the value 1600 after a successful trigger and measurement, which is the average value by dividing the sum of four captured-consecutively EtherCAT-cycle counter values by four. The actual calculation for the measurement frequency is (1600/2)/0.001=800,000 (4 times the frequency of 200,000).
2. If AX-502HC10-0A is in FreeRun mode with the internal calculation time interval of fixed 0.0005 sec (0.5 ms), via **Pulse Rate Measurement Value** you can get the value 800 after a successful trigger and measurement, which is the average value by dividing the sum of four captured-consecutively 0.0005-second counter values by four. The actual calculation for the measurement frequency is (800/2)/0.0005=800,000 (4 times the frequency of 200,000).
3. For DC mode, the measurement result value is close to 1600, but it may not be exactly equal. Similarly, for FreeRun mode, the measurement result value is close to 800, but it may not be exactly equal.

6.2.6.2.4 Digital Outputs/Inputs (16#7004, 16#7014, 16#6004 and 16#6014)

This section describes the settings of Digital Outputs as well as the status of Digital Inputs.

Below is an introdution to Output (RxPDO) of Digital Outputs.
Digital Outputs:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#7004	16#00	CH0 Digital Outputs	CH0 digital outputs	UDINT	RW	0
16#7014	16#00	CH1 Digital Outputs	CH1 digital outputs	UDINT	RW	0

- **Explanation**

Each bit of CH0 Digital Outputs has a different function. The functions of its bits are described as follows:
The following table is presented in the case of the polarity set to Normal. If the polarity is set to Inverse, the logic in Function description need be inverted. For details, please refer to Explanation in the DIQ Negative Logic section.

Parameter	Function
Bit0: Pin DQ0 setting	0: Pin DQ0 OFF 1: Pin DQ0 ON
Bit1: Pin DQ2 setting	0: Pin DQ2 OFF 1: Pin DQ2 ON
Bit2: Pin DQ4 setting	0: Pin DQ4 OFF 1: Pin DQ4 ON
Bit3-Bit15: Reserved	Bit3-Bit15 are reserved.

Each bit of CH1 Digital Outputs has a different function. The functions of its bits are described as follows:
The following table is presented in the case of the polarity set to Normal. If the polarity is set to Inverse, the logic in Function description need be inverted. For details, please refer to Explanation in the DIQ Negative Logic section.

Parameter	Function
Bit0: Pin DQ1 setting	0: Pin DQ1 OFF 1: Pin DQ1 ON
Bit1: Pin DQ3 setting	0: Pin DQ3 OFF 1: Pin DQ3 ON
Bit2: Pin DQ5 setting	0: Pin DQ5 OFF 1: Pin DQ5 ON
Bit3-Bit15: Reserved	Bit3-Bit15 are reserved.

Below is an introdution to Input (TxPDO) of Digital Inputs.

Digital Inputs:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6004	16#00	CH0 Digital Inputs	Status of digital inputs of CH0	UDINT	RO	0
16#6014	16#00	CH1 Digital Inputs	Status of digital inputs of CH1	UDINT	RO	0

- **Explanation**

Each bit of CH0 Digital Inputs has a different function. The functions of its bits are described as follows:

The following table is presented in the case of the polarity set to Normal. If the polarity is set to Inverse, the logic in Function description need be inverted. For details, please refer to Explanation in the DIQ Negative Logic section.

Parameter	Function
Bit0: Pin DIZ0 status	0: Pin DIZ0 OFF 1: Pin DIZ0 ON
Bit1: Pin DI0 status	0: Pin DI0 OFF 1: Pin DI0 ON
Bit2: Pin DI2 status	0: Pin DI2 OFF 1: Pin DI2 ON
Bit3-Bit15: Reserved	Bit3-Bit15 are reserved.

Each bit of CH1 Digital Inputs has a different function. The functions of its bits are described as follows:

The following table is presented in the case of the polarity set to Normal. If the polarity is set to Inverse, the logic in Function description need be inverted. For details, please refer to Explanation in the DIQ Negative Logic section.

Parameter	Function
Bit0: Pin DIZ1 status	0: Pin DIZ1 OFF 1: Pin DIZ1 ON
Bit1: Pin DI1 status	0: Pin DI1 OFF 1: Pin DI1 ON
Bit2: Pin DI3 status	0: Pin DI3 OFF 1: Pin DI3 ON
Bit3-Bit15: Reserved	Bit3-Bit15 are reserved.

6.2.6.2.5 Error Reset/Error (16#200B, 16#201B and 16#A001)

This section describes the error reset setting in Error Reset and error code in Error Code.

Below is an introdution to Output (RxPDO) of Error Reset.

Error Reset:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#200B	16#00	CH0 Error Reset	CH0 error reset	UINT	RW	0
16#201B	16#00	CH1 Error Reset	CH1 error reset	UINT	RW	0

- **Explanation**

Error Reset:

When Bit0 of Error Reset: Error Reset changes from 0 to 1, it indicates an error reset. Be noted that AX-502HC10-0A can clear the communication error only when the EtherCAT slave is in OP state when the error reset setting is executed.

Parameter	Function
Bit0: Error Reset	0 -> 1: Execute the Error Reset command.
Bit1-Bit15: Reserved	Bit1-Bit15 are reserved.

Below is an introdution to Input (TxPDO) of Error.

Error flags:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#A002	16#00	System Error	System error flag	BOOL	RO	0
	16#02	CH0 Error	CH0 error flag	BOOL	RO	0
	16#03	CH1 Error	CH1 error flag	BOOL	RO	0

- **Explanation**

System Error:

Once a system error occurs, System Error for 16#A002: 16#01 will become 1, and System Error Code for 16#A000 will display the system error code. You can also read System Error Code through SDO communication.

CH0 Error:

Once a CH0 error occurs, CH0 Error for 16#A002: 16#02 will become 1, and CH0 Error Code for 16#200A: 16#1 to 3 will display respective error codes for the CH0 communication error, counter error, and latch error. You can also read CH0 Error Code through SDO communication.

CH1 Error:

Once a CH1 error occurs, CH1 Error for 16#A002: 16#03 will become 1, and CH1 Error Code for 16#201A: 16#1 to 3 will display respective error codes for CH1 communication error, counter error, and latch error. You can also read CH1 Error Code through SDO communication.

6.2.7 EtherCAT Synchronization 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.

6.2.7.1 FreeRun Mode

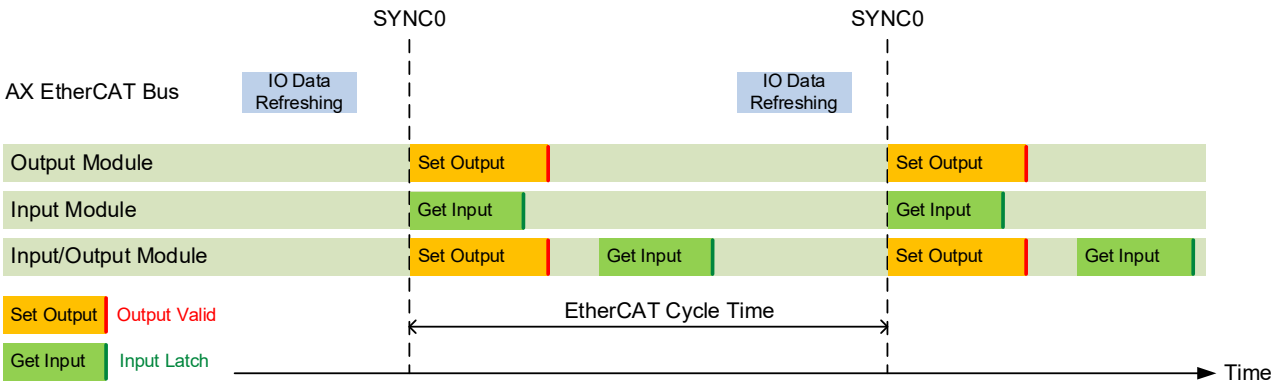
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

6.2.7.2 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.

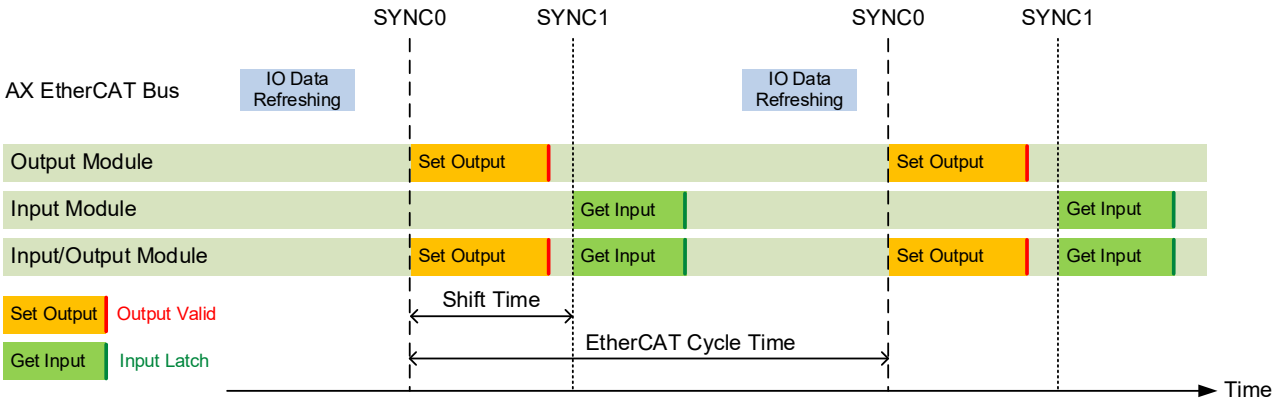
- SYNC0

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



- SYNC0 + SYNC1

SYNC0 is used to refresh values of output channels and SYNC1 is used 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.



6.2.8 Process Data

This section introduces the PDOs for normal data exchanges, and the setting and monitoring of them.

Outputs (RxPDO):

Index	Subindex	Name	Description	Data type	Attr.	Default
16#7000	16#00	CH0 Counter Operation Control	Counter operation control of CH0	UINT	RW	0
16#7001	16#00	CH0 Preset Command Value	Preset command value of CH0 counter	DINT	RW	0
16#7002	16#01	CH0 Latch0 Input Control	Latch0 input control of CH0	UINT	RW	0
	16#02	CH0 Latch1 Input Control	Latch1 input control of CH0	UINT	RW	0
	16#03	CH0 Internal Latch Control	Internal latch input control of CH0	UINT	RW	0
16#7003	16#00	CH0 Pulse Rate Measurement Control	Pulse rate measurement control of CH0	UINT	RW	0
16#7004	16#00	CH0 Digital Outputs	Digital outputs of CH0	UDINT	RW	0
16#200B	16#00	CH0 Error Reset	Error reset of CH0	UINT	RW	0
16#7010	16#00	CH1 Counter Operation Control	Counter operation control of CH1	UINT	RW	0
16#7011	16#00	CH1 Preset Command Value	Preset command value of CH1 counter	DINT	RW	0
16#7012	16#01	CH1 Latch0 Input Control	Latch0 input control of CH1	UINT	RW	0
	16#02	CH1 Latch1 Input Control	Latch1 input control of CH1	UINT	RW	0
	16#03	CH1 Internal Latch Control	Internal latch input control of CH1	UINT	RW	0
16#7013	16#00	CH1 Pulse Rate Measurement Control	Pulse rate measurement control of CH1	UINT	RW	0
16#7014	16#00	CH1 Digital Outputs	Digital outputs of CH1	UDINT	RW	0
16#201B	16#00	CH1 Error Reset	Error reset of CH1	UINT	RW	0

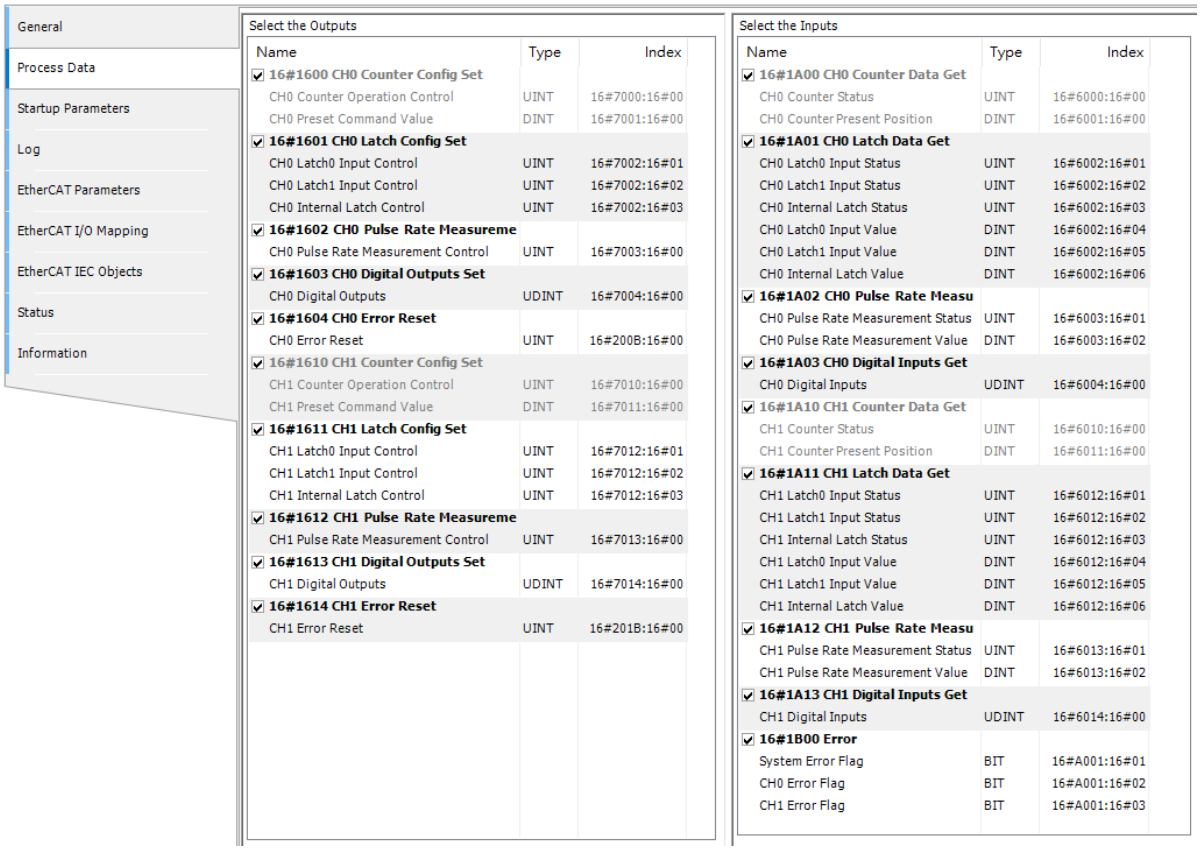
Inputs (TxPDO):

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6000	16#00	CH0 Counter Status	Counter status of CH0	UINT	RO	0
16#6001	16#00	CH0 Counter Present Position	Present counter value of CH0	DINT	RO	0
16#6002	16#01	CH0 Latch0 Input Status	Latch0 input status of CH0	UINT	RO	0
	16#02	CH0 Latch1 Input Status	Latch1 input status of CH0	UINT	RO	0
	16#03	CH0 Internal Latch Status	Internal latch status of CH0	UINT	RO	0
	16#04	CH0 Latch0 Input Value	Latch0 input value of CH0	DINT	RO	0
	16#05	CH0 Latch1 Input Value	Latch1 input value of CH0	DINT	RO	0
	16#06	CH0 Internal Latch Value	Internal latch value of CH0	DINT	RO	0
16#6003	16#01	CH0 Pulse Rate Measurement Status	Pulse rate measurement status of CH0	UINT	RO	0
	16#02	CH0 Pulse Rate Measurement Value	Pulse rate measurement value of CH0	DINT	RO	0
16#6004	16#00	CH0 Digital Inputs	Status of digital inputs of CH0	UDINT	RO	0
16#6010	16#00	CH1 Counter Status	Counter status of CH1	UINT	RO	0
16#6011	16#00	CH1 Counter Present Position	Present counter value of CH1	DINT	RO	0
16#6012	16#01	CH1 Latch0 Input Status	Latch0 input status of CH1	UINT	RO	0
	16#02	CH1 Latch1 Input Status	Latch1 input status of CH1	UINT	RO	0
	16#03	CH1 Internal Latch Status	Internal latch status of CH1	UINT	RO	0
	16#04	CH1 Latch0 Input Value	Latch0 input value of CH1	DINT	RO	0
	16#05	CH1 Latch1 Input Value	Latch1 input value of CH1	DINT	RO	0
	16#06	CH1 Internal Latch Value	Internal latch value of CH1	DINT	RO	0
16#6013	16#01	CH1 Pulse Rate Measurement Status	Pulse rate measurement status of CH1	UINT	RO	0
	16#02	CH1 Pulse Rate Measurement Value	Pulse rate measurement value of CH1	DINT	RO	0
16#6014	16#00	CH1 Digital Inputs	Status of digital inputs of CH1	UDINT	RO	0
16#A002	16#01	System Error Flag	System error flag	BOOL	RO	0
	16#02	CH0 Error Flag	Error flag of CH0	BOOL	RO	0
	16#03	CH1 Error Flag	Error flag of CH1	BOOL	RO	0

6.2.8.1 Process Data

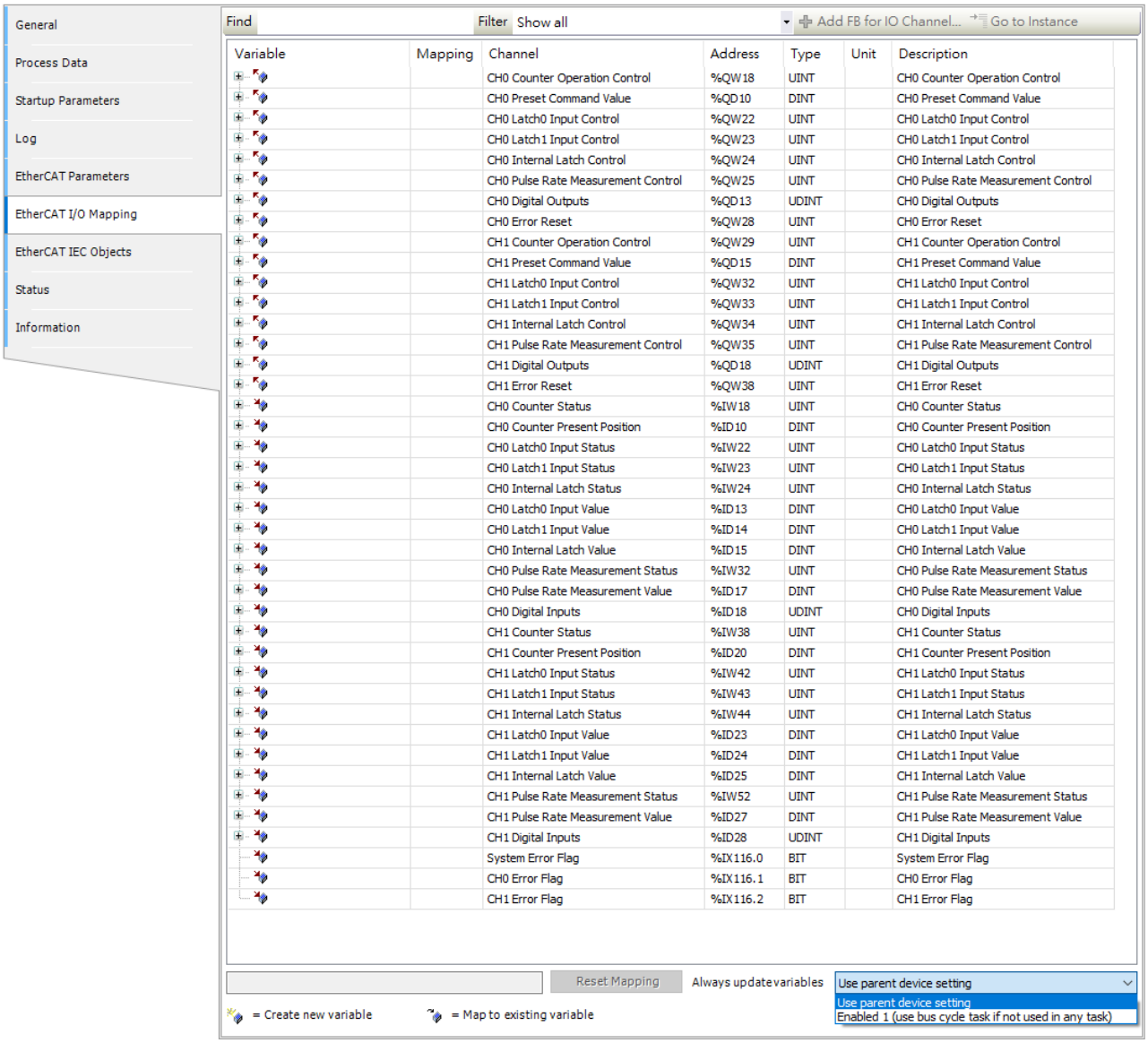
Go to the **Process Data** tab and select the data that you'd like to monitor.

- You can set the desired PDOs for CH0/CH1 in **Outputs** and **Inputs**, and deselect the unused PDOs to save the cycle time.
- CH0/CH1 **Counter Config Set** and **Counter Data Get** are selected by default and can not be deselected.
- The PDOs for CH0/CH1 in **Outputs** and **Inputs** are all selected by default.
- **Error** in **Inputs** is selected by default.



6.2.8.2 EtherCAT I/O Mapping

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



6.2.8.3 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.

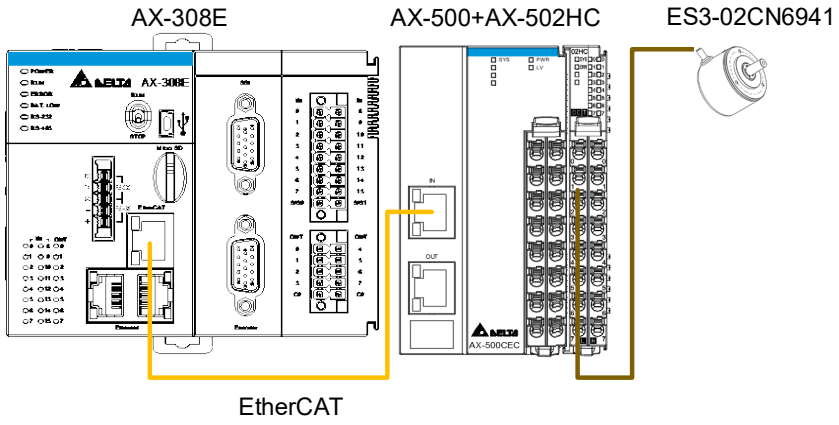
Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the Always update variables in the CPU.
Enabled1 (use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any other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

6.2.9 Example of Hardware Configuration and Software Operation

In this section, the AX-502HC module combined with the AX-5 coupler is controlled by AX-3 series PLC.

6.2.9.1 System Hardware Configuration

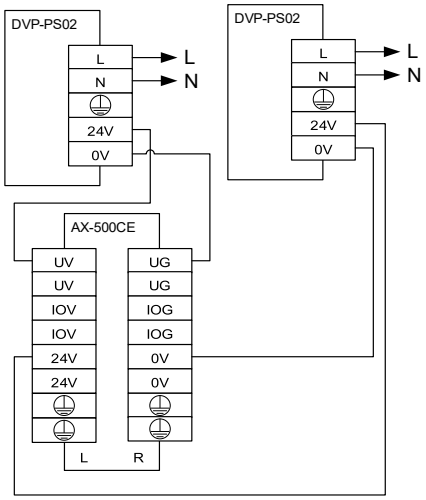
The AX-308E PLC makes a connection with AX-500 plus AX-502HC through the EtherCAT port, reading the encoder via AX-502HC.



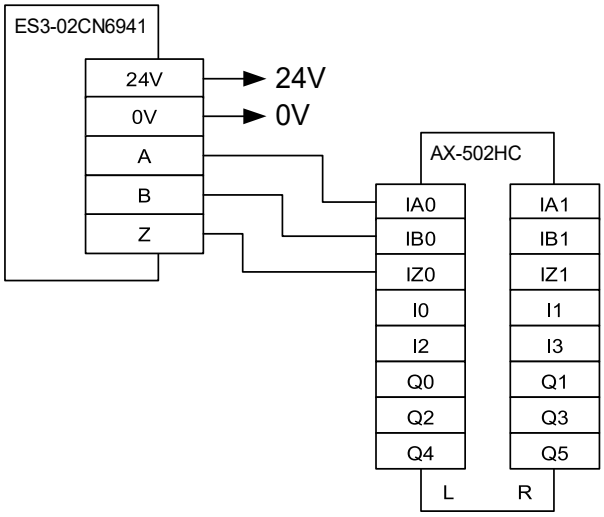
- **Hardware preparation**

No.	Name	Model	Quantity
1	AX3 series PLC	AX-308EA0MA1T	1
2	AX-5 coupler	AX-500CEC00-0A	1
3	AX-5 positioning module	AX-502HC10-0A	1
4	Incremental encoder	ES3-02CN6941	1

- **Hardware wiring**
  - The wiring diagram for AX-500CE



■ The wiring diagram for AX-502HC and ES3-02CN6941

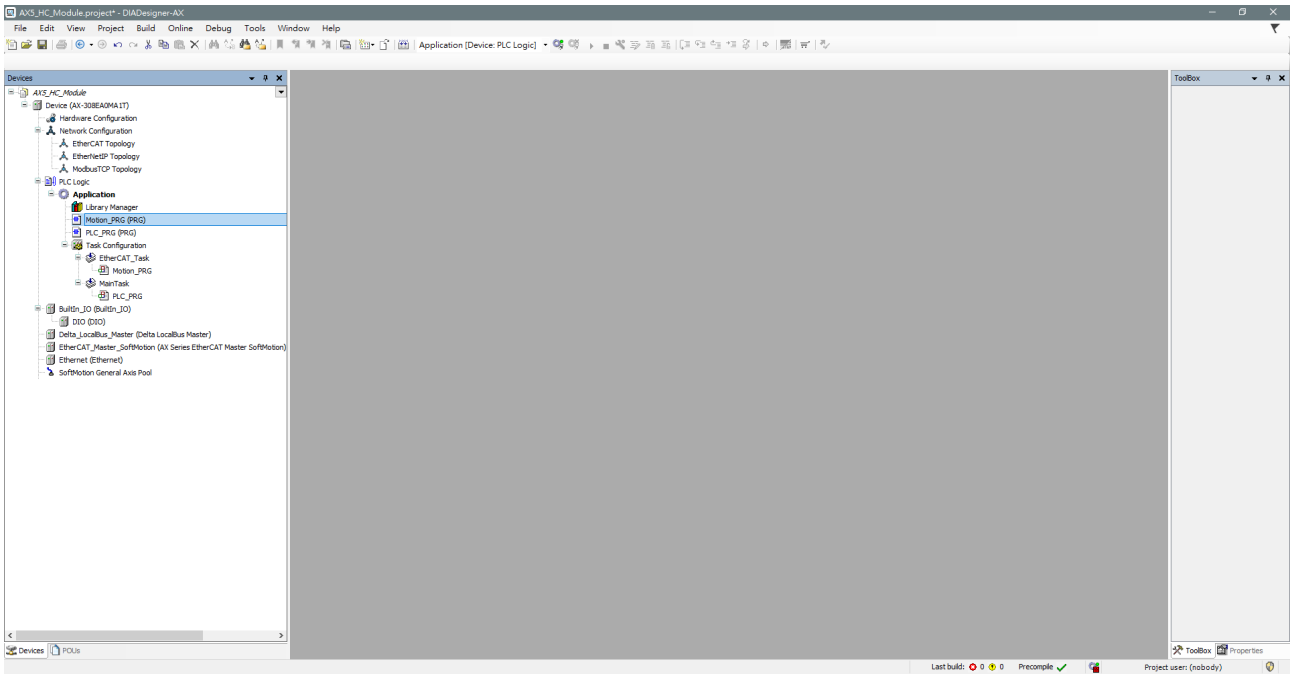


6.2.9.2 Creat a Project and Write a Programm

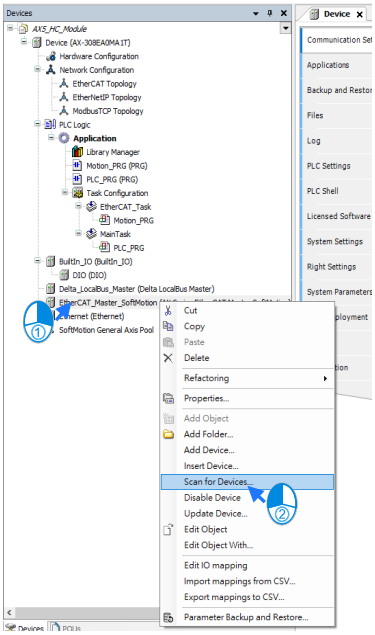
1. Start the DIADesigner-AX software.



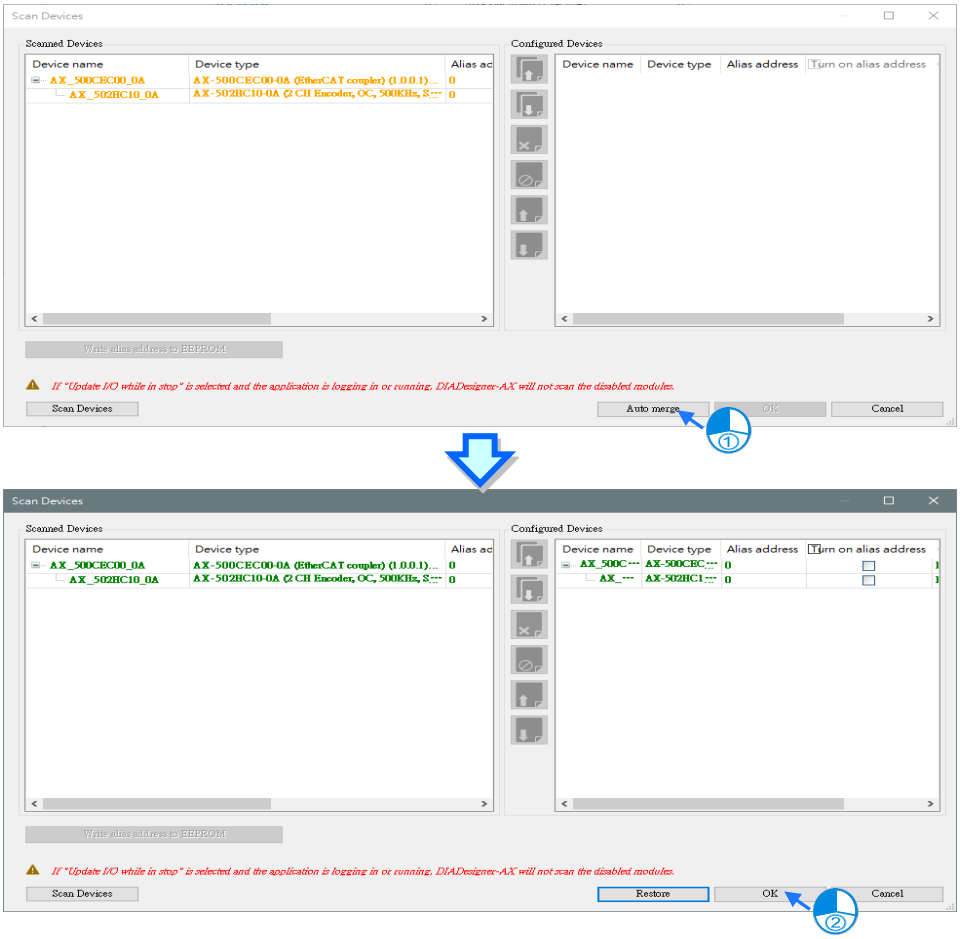
2. Open a new project for AX-308E.



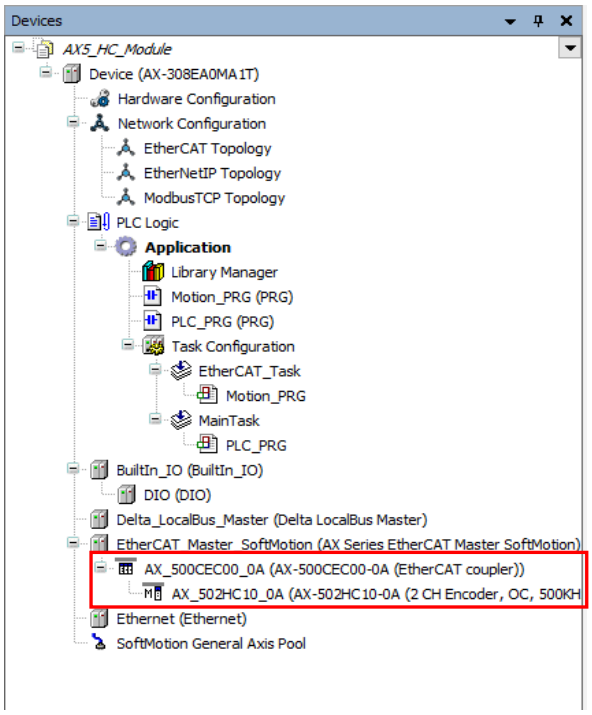
3. Right-click **EtherCAT_Master_SoftMotion** in the Devices tree, and then click **Scan for Devices….** from the context menu.



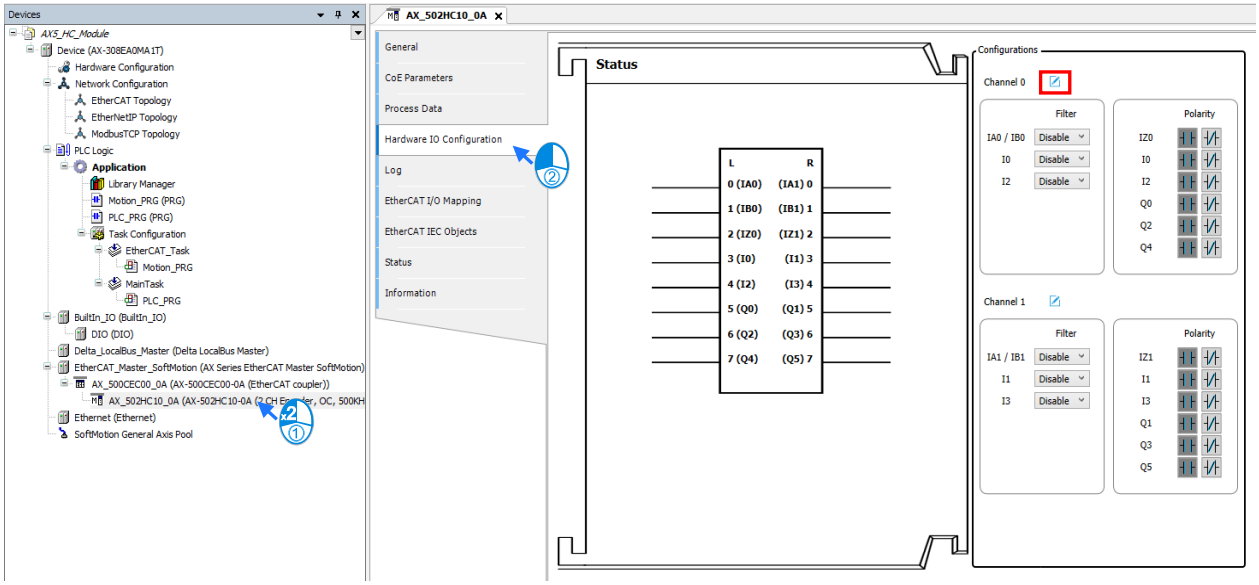
4. After entering the **Scan Devices** window, click **Auto Merge** and then **OK** in the following figures.



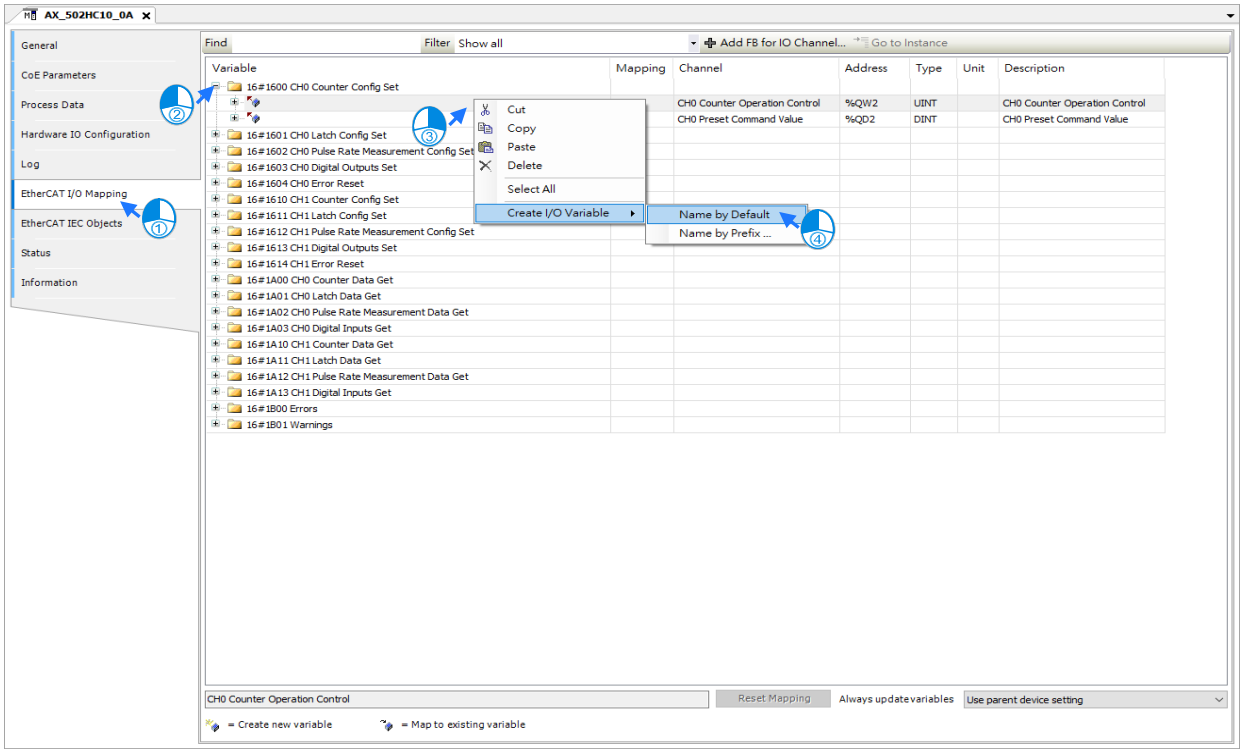
5. After adding devices is completed, the AX-502HC module will be added to the device tree.



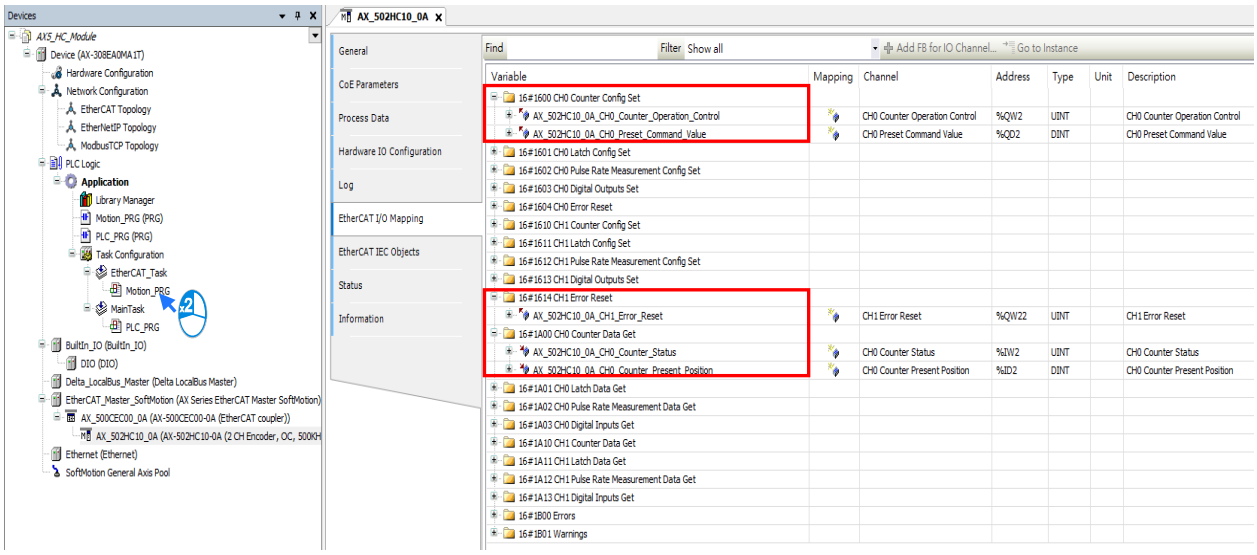
6. In the device tree, double-click **AX_502HC10_0A** and then in its **Hardware IO Configuration** tab, click to set up the configurations you need.



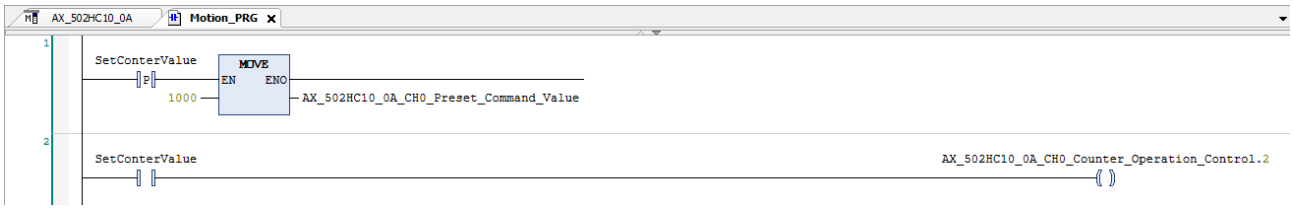
7. After setting up the hardware configurations is done, click the **EtherCAT I/O Mapping** tab to declare the variables to be used.



8. Double-click on **Motion_PRG** after the declaration of variables for parameters.



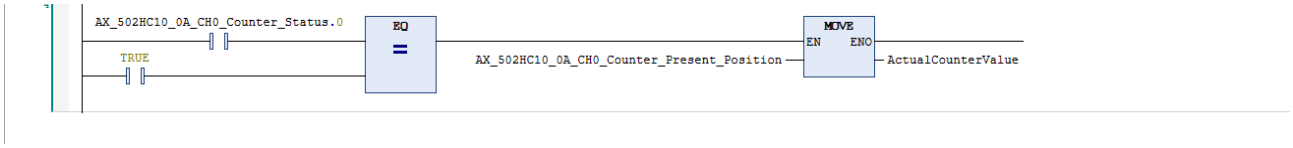
9. Enter the **Motion-PRG** page, where you can start programming with the initial counter value set to 1000 and execute the program.



10. The high-speed counter function is started.



11. The counter value is moved to the corresponding variable after the counter function is started.



See section 6.2.6 for details on the parameters above.

6.2.10 Troubleshooting

In the **Diagnosis History** tab, the warnings and errors that occurred in the module are recorded.

In the **Status** tab, only the current error information of System Error (16#A000), CH0 Error (16#200A) and CH1 Error (16#201A) is recorded.

From the **All Parameters** list in the **CoE Parameters** tab, find the corresponding Index/SubIndex to view an error.

Warning message:

Warning messages are presented not only in the **Diagnosis History** tab, but also in 16#A001: 01 for system warning.

Index	SubIndex	ErrorCode	Name	Description	Emergency
16#A001	16#01	16#FF81	Channel Hardware Alarm	Abnormal output points	N/A

Error message:

Error messages are presented not only in the **Diagnosis History** tab, but also in 16#A000 for system errors, 16#200A for CH0 errors and16#201A for CH1 errors.

Index	SubIndex	ErrorCode	Name	Description	Emergency
16#A000	16#00	16#FF01	Unit Power Error	Abnormal power supply	V
		16#FF02	EtherCAT Connection Lost	EtherCAT connection is lost.	N/A
		16#FF03	ESC or EEPROM Error	ESC error	V
		16#FF04	Flash Error	Error in Flash	V
16#200A (CH0 Error)	16#01	16#FF02	EtherCAT Connection Lost	EtherCAT connection is lost.	N/A
	16#02	16#FF20	CH0 Counter is not enabled	CH0 Counter function has not been enabled before any of the counter-related functions is used.	V
		16#FF23	CH0 DI Function is not set to CLR	CLR0 or CLR1 of CH0 DI Function has not been selected before ExternalReset is triggered.	V
	16#03	16#FF21	CH0 DI Function is not set to LATCH0	Latch0 of CH0 DI Function has not been selected before Latch0 is triggered.	V
		16#FF22	CH0 DI Function is not set to LATCH1	Latch1 of CH0 DI Function has not been selected before Latch1 is triggered.	V
16#201A (CH1 Error)	16#01	16#FF02	EtherCAT Connection Lost	EtherCAT connection is lost.	N/A
	16#02	16#FF20	CH1 Counter is not enabled	CH1 Counter function has not been enabled before any of the counter-related functions is used.	V

Index	SubIndex	ErrorCode	Name	Description	Emergency
		16#FF23	CH1 DI Function is not set to CLR	CLR0 or CLR1 of CH1 DI Function has not been selected before ExternalReset is triggered.	V
	16#03	16#FF21	CH1 DI Function is not set to LATCH0	Latch0 of CH1 DI Function has not been selected before Latch0 is triggered.	V
		16#FF22	CH1 DI Function is not set to LATCH1	Latch1 of CH1 DI Function has not been selected before Latch1 is triggered.	V

6.2.10.1 Causes of Error LED Indicator ON/Blinking and Their Solutions

6.2.10.1.1 ERROR LED Indicator: ON

- **Error message**

Index	SubIndex	ErrorCode	Description	Error LED	Solution
16#A000	16#01	16#FF01	Unit Power Error	ON	Check the power supply.
	16#02	16#FF02	EtherCAT Connection Lost	ON	1. Make sure that the module is well connected. 2. Reset the EtherCAT status of the module through the master after step 1 is done.
	16#03	16#FF03	ESC or EEPROM Error	ON	If the problem persists, contact the local authorized distributors.
	16#04	16#FF04	Flash Error	ON	If the problem persists, contact the local authorized distributors.
16#200A 16#201A	16#01	16#FF02	EtherCAT Connection Lost	ON	1. Make sure that the module is well connected. 2. Reset the EtherCAT status of the module through the master after step 1 is done.

6.2.10.1.2 ERROR LED Indicator: Blinking

- **Warning message**

Index	SubIndex	ErrorCode	Description	Error LED	Solution
16#A001	16#01	16#FF81	Channel Hardware Alarm	Blinking every 2 seconds	1. Make sure that the I/O power supply to the module is normal. 2. Check if the outputs of the module are short-circuited. 3. If the problem persists, contact the local authorized distributors after steps 1-2 are done.

- **Error message**

Index	SubIndex	ErrorCode	Description	Error LED	Solution
16#200A	16#02	16#FF20	CH0 Counter is not enabled	Blinking every 0.2 seconds	1. Make sure that CH0 Counter function has been enabled before the counter-related functions are used. 2. After step 1 is done, please clear CH0 Counter Operation Control to 0, and then execute ErrorReset or use the master to reset the EtherCAT status of the module.
		16#FF23	CH0 DI Function is not set to CLR	Blinking every 0.2 seconds	1. Make sure that CH0 DI Function DI0 has been set to CLR0 or CH0 DI Function DI2 has been set to CLR1 before CH0 CounterExternalReset function is used. 2. After step 1 is done, clear CH0 Counter Operation Control to 0, and then execute ErrorReset or use the master to reset the EtherCAT status of the module.
	16#03	16#FF21	CH0 DI Function is not set to LATCH0	Blinking every 0.2 seconds	1. Make sure that CH0 DI Function DI0 has been set to LATCH0 before using the module's DI0 for Latch. 2. After step 1 is done, clear CH0 Latch0 Input Control to 0, and then execute ErrorReset or use the master to reset the EtherCAT status of the module.
		16#FF22	CH0 DI Function is not set to LATCH1	Blinking every 0.2 seconds	1. Make sure that CH0 DI Function DI2 has been set to LATCH1 before using the modules DI 2 for Latch. 2. After step 1 is done, clear CH0 Latch1 Input Control to 0, and then execute ErrorReset or use the master to reset the EtherCAT status of the module.
16#201A	16#02	16#FF20	CH1 Counter is not enabled	Blinking every 0.2 seconds	1. Make sure that CH1 Counter function has been enabled before the counter-related functions are used. 2. After step 1 is done, please clear CH1 Counter Operation Control to 0, and then execute ErrorReset or use the master to reset the EtherCAT status of the module.

Index	SubIndex	ErrorCode	Description	Error LED	Solution
		16#FF23	CH1 DI Function is not set to CLR	Blinking every 0.2 seconds	1. Make sure that CH1 DI Function DI1 has been set to CLR0 or CH1 DI Function DI3 has been set to CLR1 before CH1 CounterExternalReset function is used. 2. After step 1 is done, clear CH1 Counter Operation Control to 0, and then execute ErrorReset or use the master to reset the ECAT status of the module.
	16#03	16#FF21	CH1 DI Function is not set to LATCH0	Blinking every 0.2 seconds	1. Make sure that CH1 DI Function DI1 has been set to LATCH0 before using the module's DI1 for Latch. 2. After step 1 is done, clear CH1 Latch0 Input Control to 0, and then execute ErrorReset or use the master to reset the EtherCAT status of the module.
		16#FF22	CH1 DI Function is not set to LATCH1	Blinking every 0.2 seconds	1. Make sure that CH1 DI Function DI3 has been set to LATCH1 before using the module's DI3 for Latch. 2. After step 1 is done, clear CH1 Latch1 Input Control to 0, and then execute ErrorReset or use the master to reset the EtherCAT status of the module.

7

Chapter 7 Load Cell Module

Table of Contents

7.1 AX-501LC10-0A 7-2
7.1.1 Specifications..... 7-2
7.1.2 Dimensions and Parts 7-3
7.1.3 Arrangement of Terminals, LED Indicators and Wiring..... 7-4
7.1.4 Settings in DIADesigner-AX 7-8
7.1.5 Parameter Descriptions 7-16
7.1.6 Gross Weight, Net Weight and Tare Weight 7-25
7.1.7 Calibration.....7-26
7.1.8 EtherCAT Operation Modes 7-31
7.1.9 Process Data 7-32
7.1.10 Troubleshooting 7-34

7.1 AX-501LC10-0A

AX-501LC10-0A, an analog input module, receives analog signals through 1 input points and converts the received signals to 24-bit digital signals. This section introduces its specifications, wirings and operations.

7.1.1 Specifications

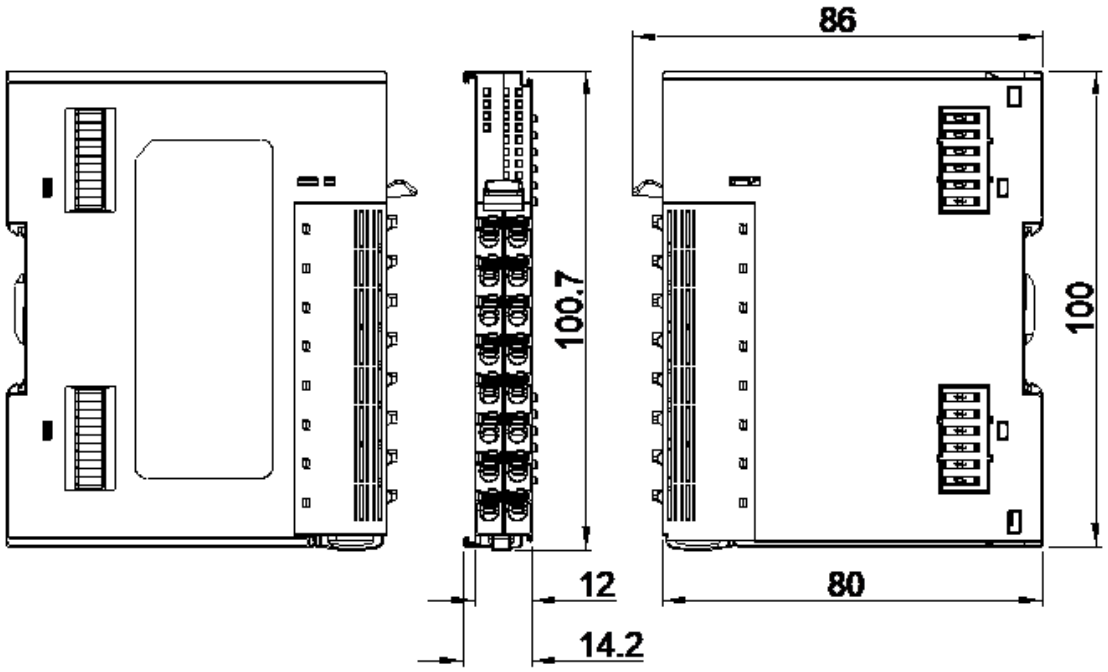
Item		Specification
Input point		1
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh modes		1. Free Run mode 2. DC mode
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		70 g
Electrical specification	Characteristic value range	±1 to 80 mV/V
	Maximum conversion range	±102%
	Allowable load	>50 Ω
	Load cell excitation voltage	5 VDC ± 10%
	Sensor type	4 Wire, 6 Wire Load Cell Sensor
	Resolution	24 bits
	Accuracy	25 °C: ±0.01% (F.S.)[1]
		-20 to 60 °C: ±0.04% (F.S.)[1]
		Gain drift: ±50 ppm/ °C
		Zero drift: ±2 uV/ °C
	Conversion time	500 μs/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
	Maximum power consumption (unit power)	Less than 400 mA (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	Low-Pass Filter/ moving average filter

*1. The value for when the Load Cell module is used under the following conditions.

- Full scale: 0.0 to 10.0 mV/V
- Setting of digital filtering: Default
- I/O refresh mode: Free Run mode

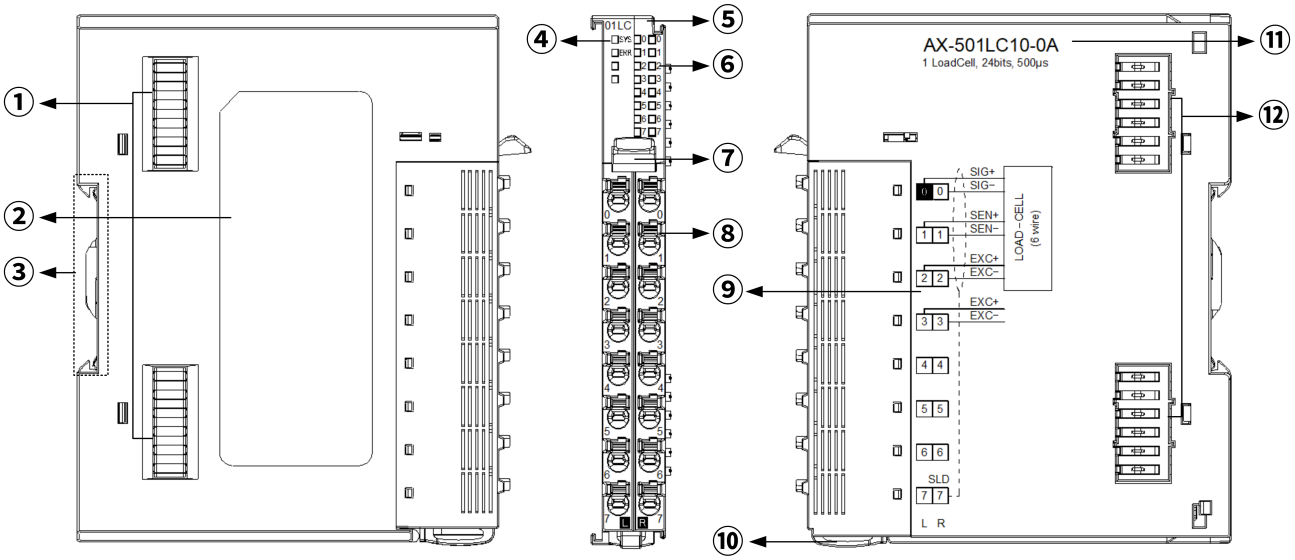
7.1.2 Dimensions and Parts

- Dimensions



Unit: mm

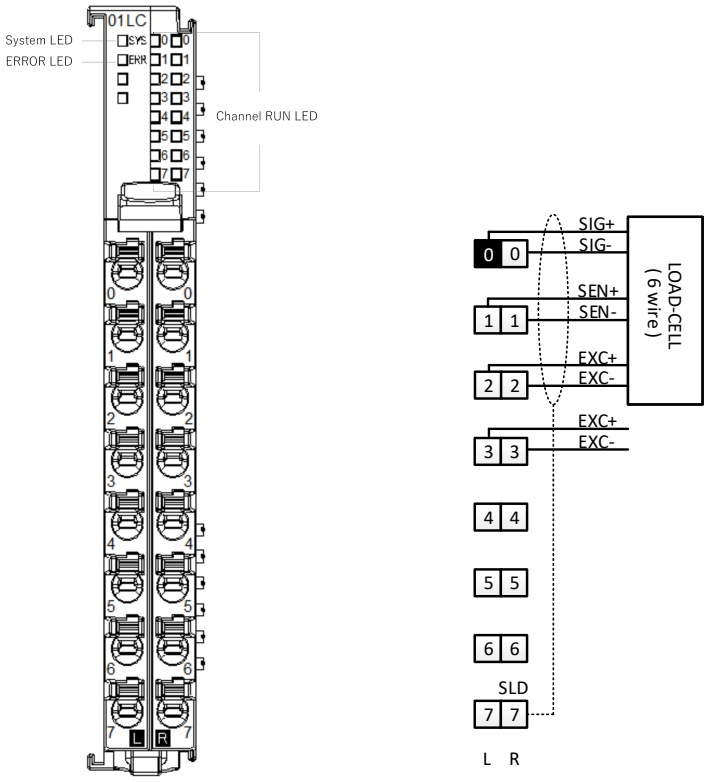
- Parts



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

7.1.3 Arrangement of Terminals, LED Indicators and Wiring

7.1.3.1 Arrangement of Terminals



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

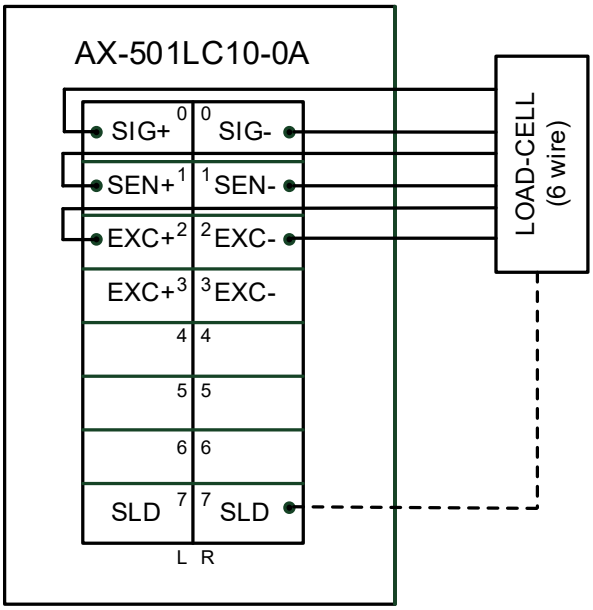
Pin No.	Symbol	Description	Pin No.	Symbol	Description
L0	SIG+	Sensor positive input	R0	SIG-	Sensor negative input
L1	SEN+	Sensor positive voltage input	R1	SEN-	Sensor negative voltage input
L2	EXC+	Positive excitation voltage output	R2	EXC-	Negative excitation voltage output
L3	EXC+	Positive excitation voltage output	R3	EXC-	Negative excitation voltage output
L4	--	--	R4	--	--
L5	--	--	R5	--	--
L6	--	--	R6	--	--
L7	SLD	--	R7	SLD	--

7.1.3.2 LED Indicators

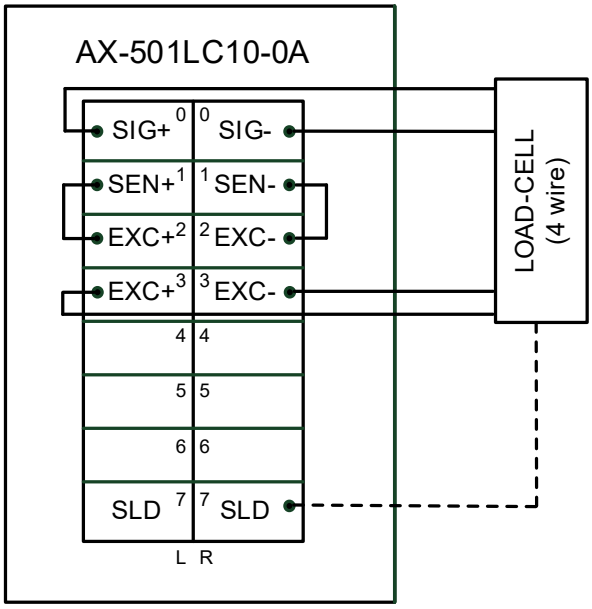
Name	Color	Status		Description
System	Blue		OFF	No power supplied or ECAT INIT
			Blinking (0.2 s)	ECAT Pre OP
			Blinking (1 s)	ECAT Safe OP
			ON	Normal OP
Error	Red		OFF	No power supplied or the module is functioning correctly.
			Blinking (1 s)	An error occurs on the application.
			Blinking (0.2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

7.1.3.3 Wiring and Loop Configuration

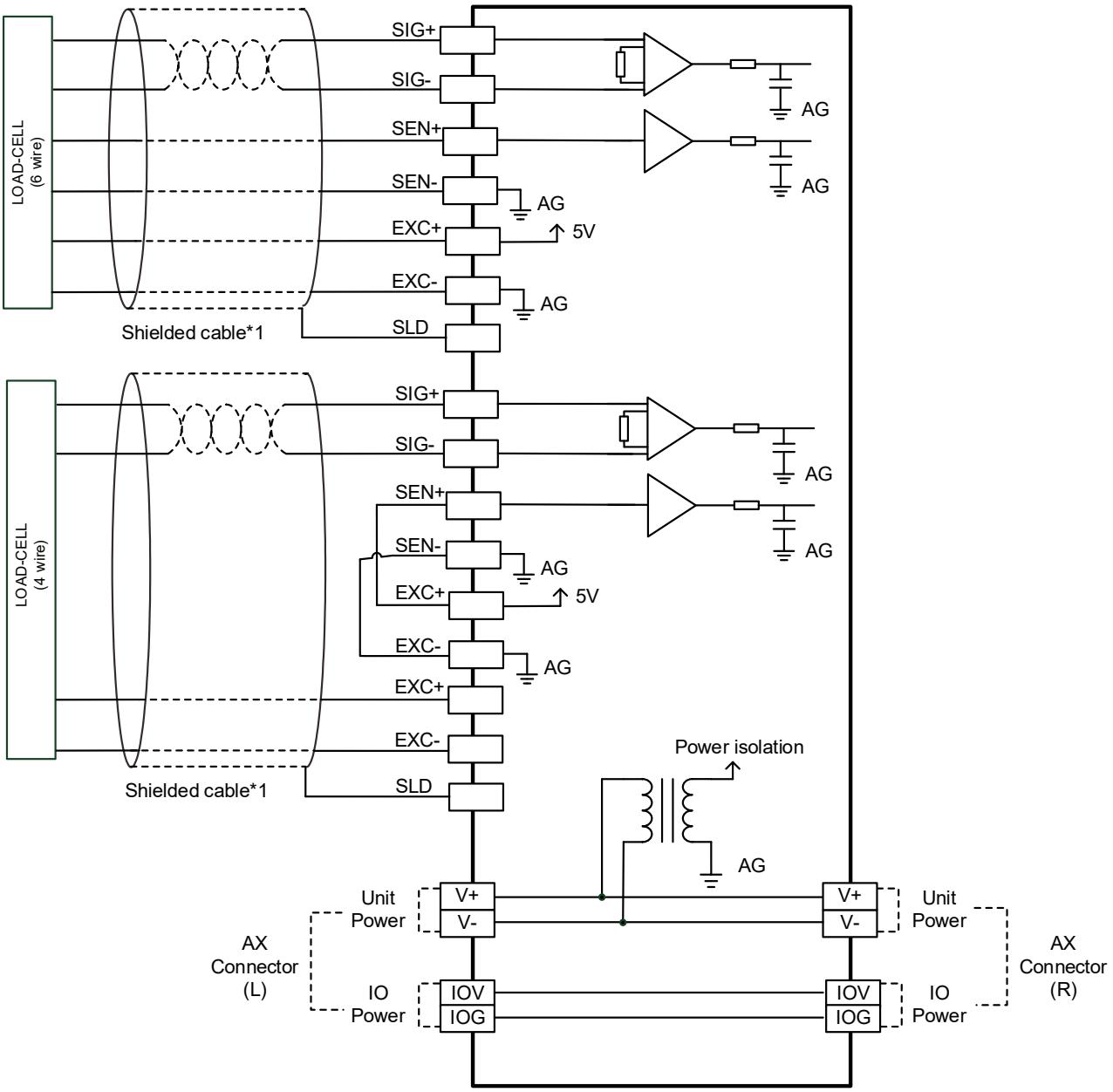
- Wiring
  - 6-wire sensor



  - 4-wire sensor



- **Loop Configuration**



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

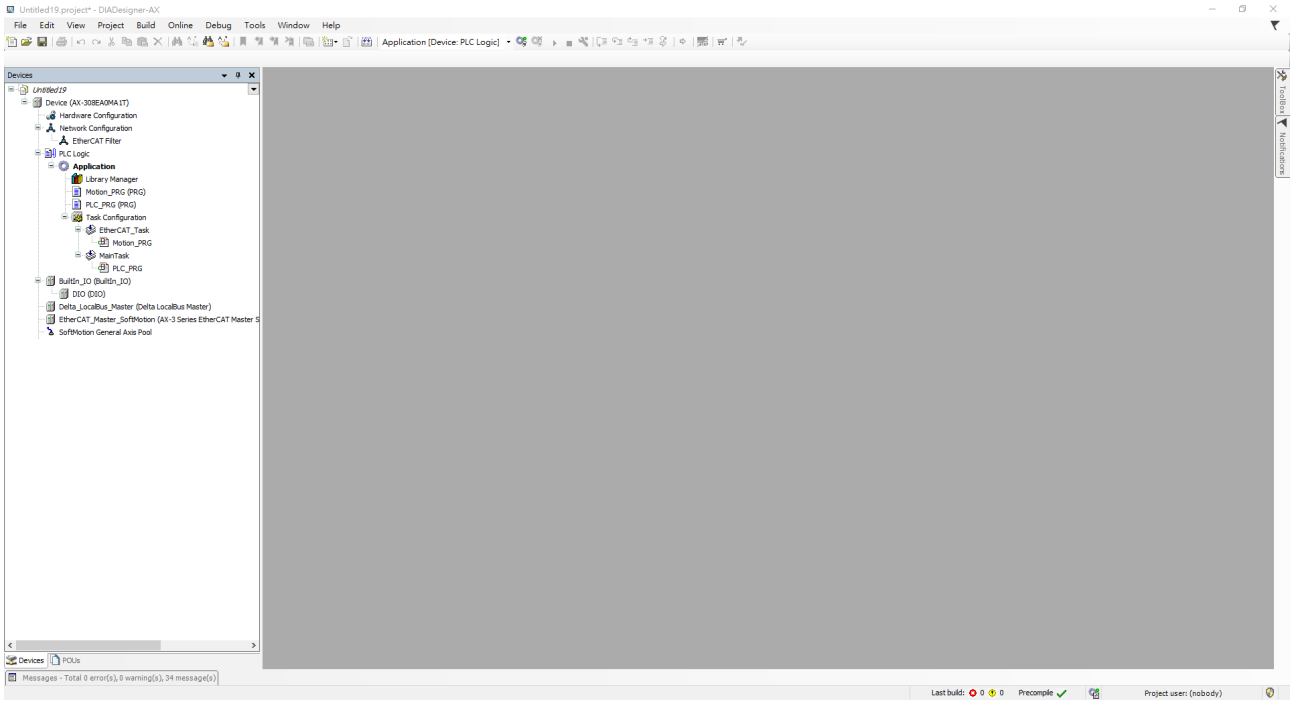
*2. Please wire this shielded cable to the SLD pin of the I/O power connector module AX-514PC40-0A

7.1.4 Settings in DIADesigner-AX

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

7.1.4.1 Basic Operation

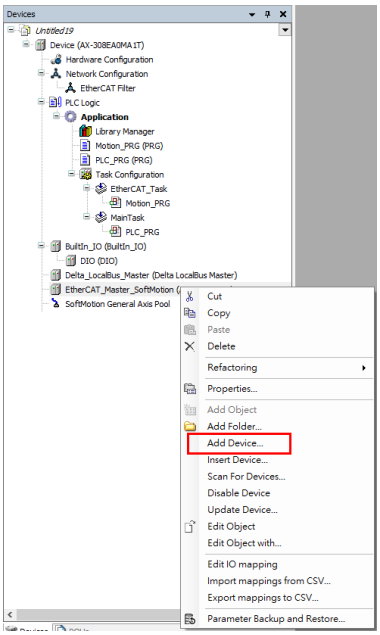
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



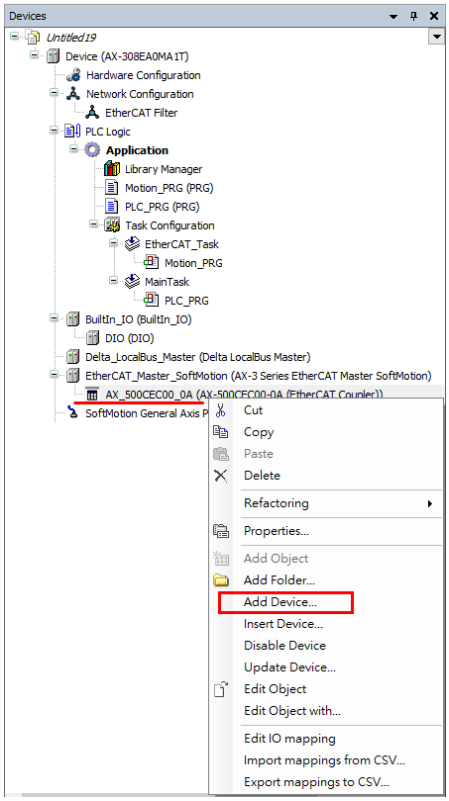
(2) Add Modules in

- 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.

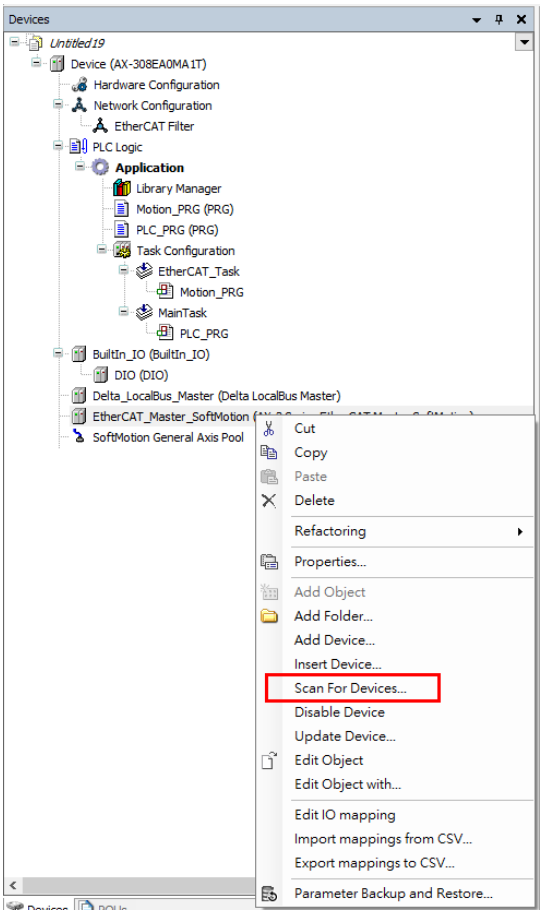


Right-click **System Coupler** you added, and then click **Add Device…** again to select and add modules in.

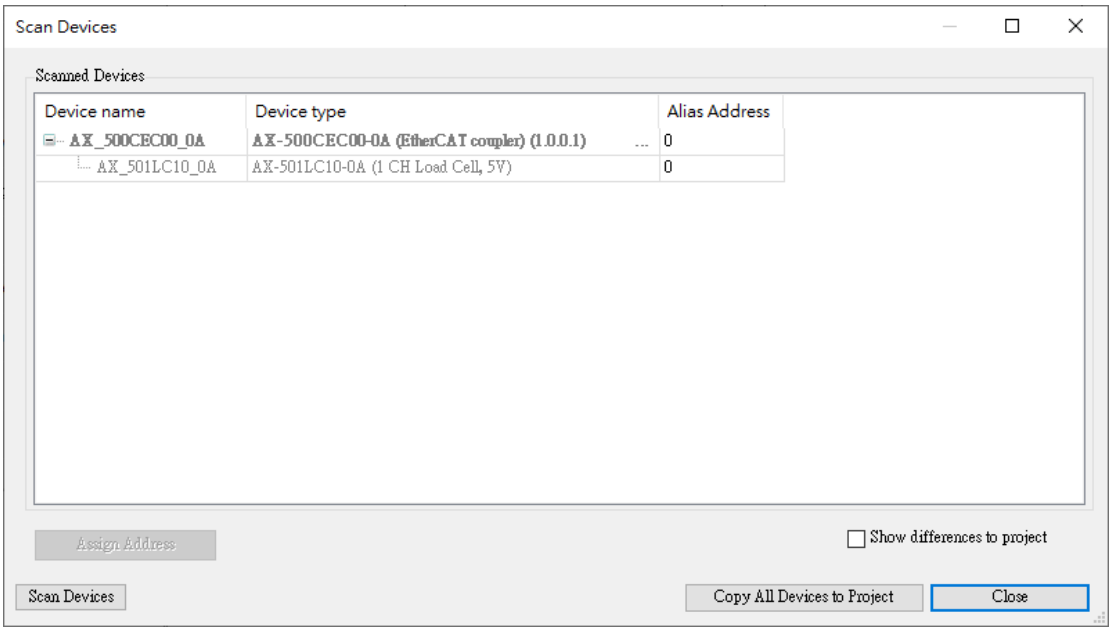


- Method 2: Scan to add the modules in

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

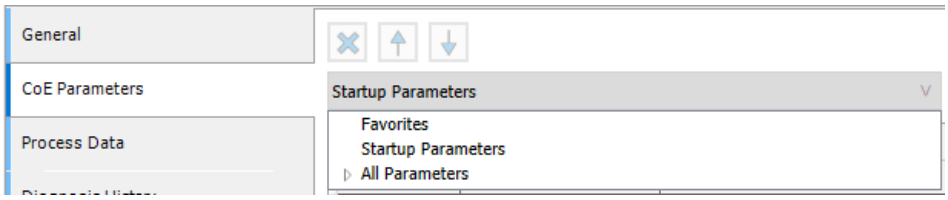


After the auto-scan is over, the connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion.**



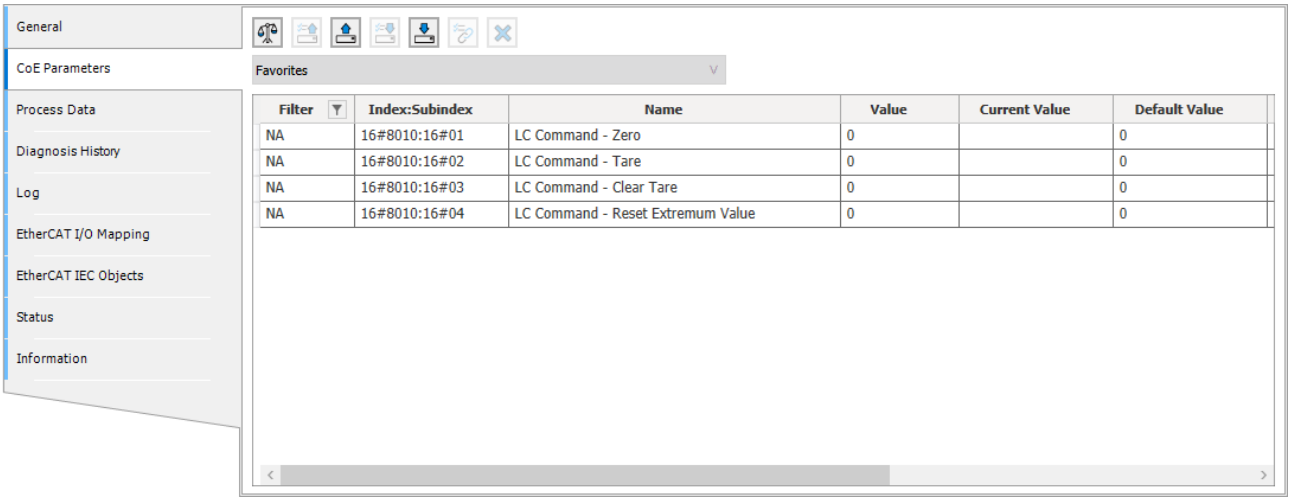
7.1.4.2 Parameter Settings

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



(1) Favorites

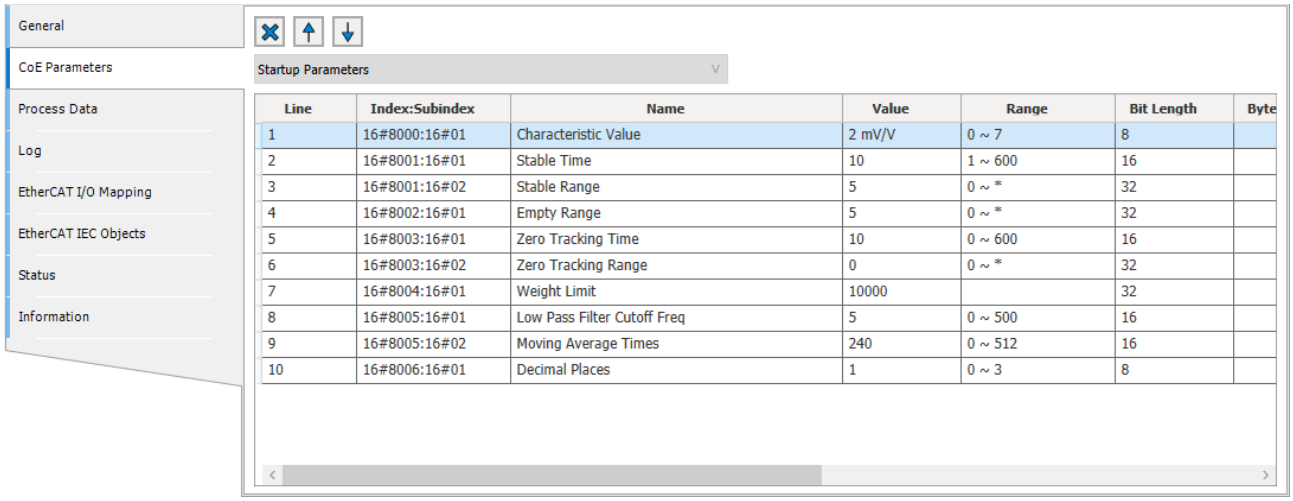
- You can select and right-click the parameter to add the selected parameter to the Favorites. Click  on the toolbar to go into online mode, and then you can start to upload and download the parameters.



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.

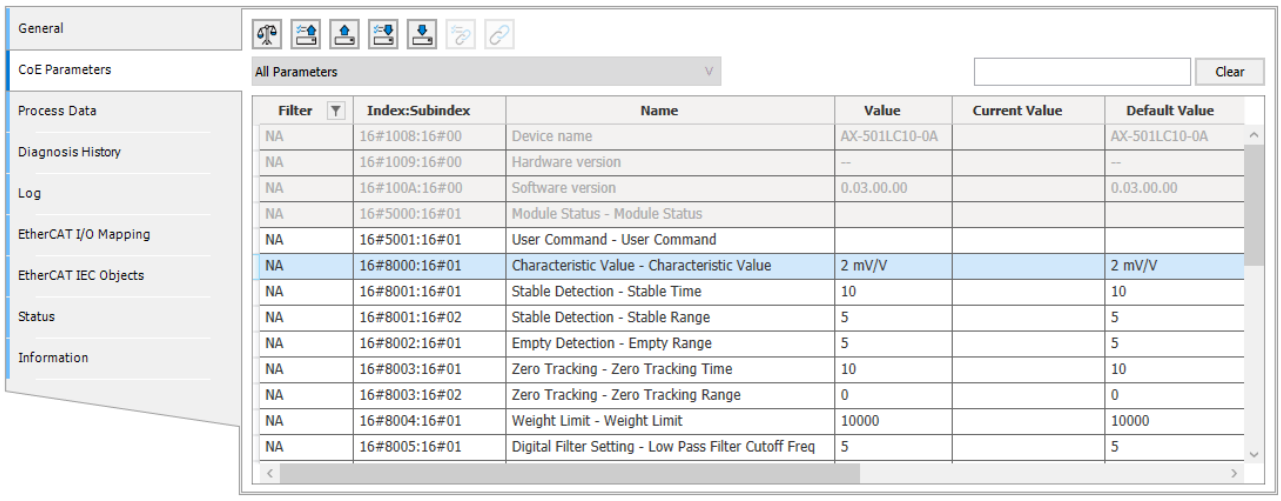


Line	Index:Subindex	Name	Value	Range	Bit Length	Byte
1	16#8000:16#01	Characteristic Value	2 mV/V	0 ~ 7	8	
2	16#8001:16#01	Stable Time	10	1 ~ 600	16	
3	16#8001:16#02	Stable Range	5	0 ~ *	32	
4	16#8002:16#01	Empty Range	5	0 ~ *	32	
5	16#8003:16#01	Zero Tracking Time	10	0 ~ 600	16	
6	16#8003:16#02	Zero Tracking Range	0	0 ~ *	32	
7	16#8004:16#01	Weight Limit	10000		32	
8	16#8005:16#01	Low Pass Filter Cutoff Freq	5	0 ~ 500	16	
9	16#8005:16#02	Moving Average Times	240	0 ~ 512	16	
10	16#8006:16#01	Decimal Places	1	0 ~ 3	8	

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

(3) All Parameters

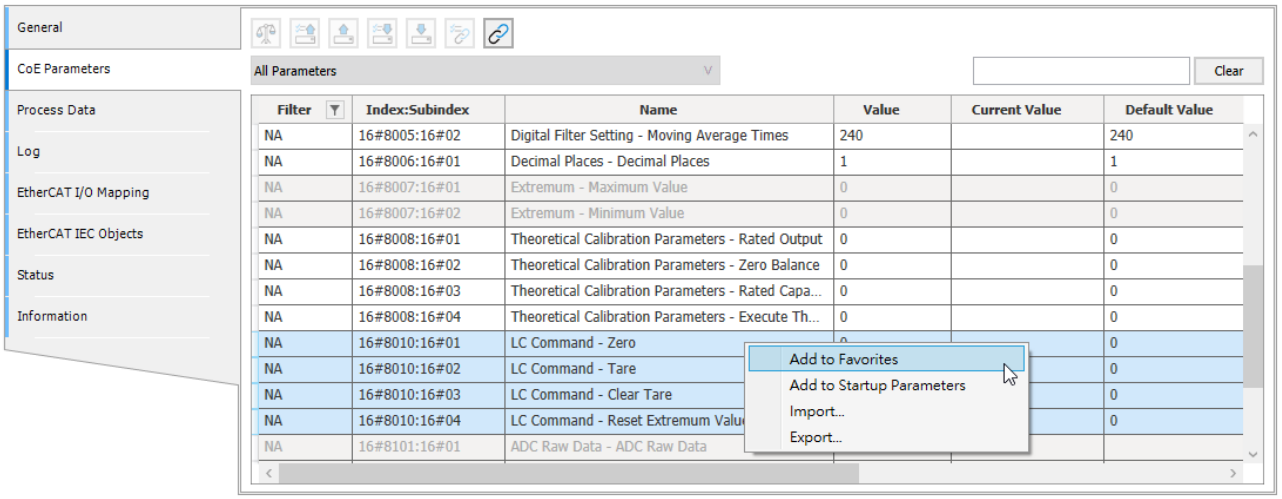
- You can find all the CoE parameters here. Click  on the toolbar to go into online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in Current Value column.
- You can edit the values of parameters in Value column.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



Filter	Index:Subindex	Name	Value	Current Value	Default Value
NA	16#1008:16#00	Device name	AX-501LC10-0A		AX-501LC10-0A
NA	16#1009:16#00	Hardware version	--		--
NA	16#100A:16#00	Software version	0.03.00.00		0.03.00.00
NA	16#5000:16#01	Module Status - Module Status			
NA	16#5001:16#01	User Command - User Command			
NA	16#8000:16#01	Characteristic Value - Characteristic Value	2 mV/V		2 mV/V
NA	16#8001:16#01	Stable Detection - Stable Time	10		10
NA	16#8001:16#02	Stable Detection - Stable Range	5		5
NA	16#8002:16#01	Empty Detection - Empty Range	5		5
NA	16#8003:16#01	Zero Tracking - Zero Tracking Time	10		10
NA	16#8003:16#02	Zero Tracking - Zero Tracking Range	0		0
NA	16#8004:16#01	Weight Limit - Weight Limit	10000		10000
NA	16#8005:16#01	Digital Filter Setting - Low Pass Filter Cutoff Freq	5		5

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.

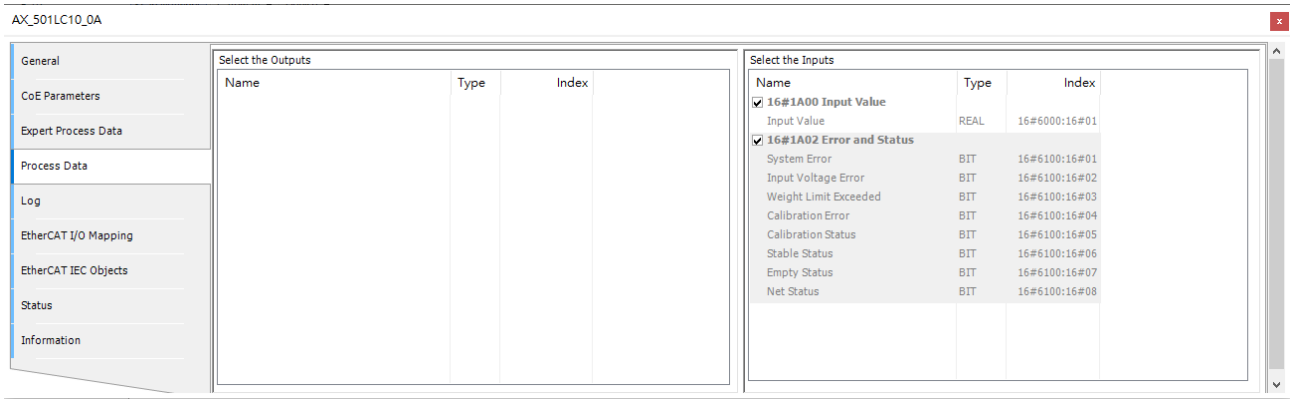
- You can select and right-click the parameter to add the selected parameter to the Favorites.



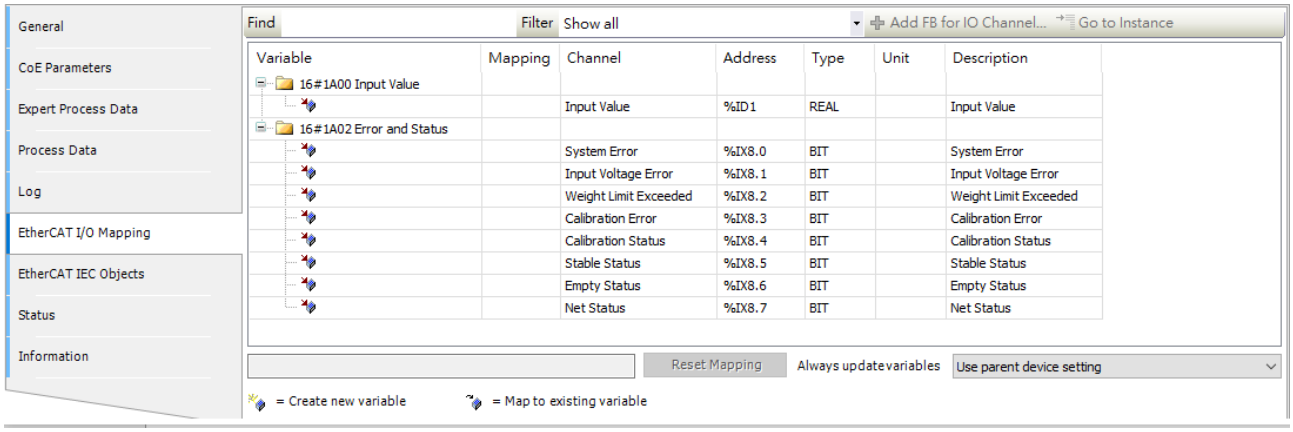
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import...	Import the selected
Export...	Export the selected

7.1.4.3 Process Data

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

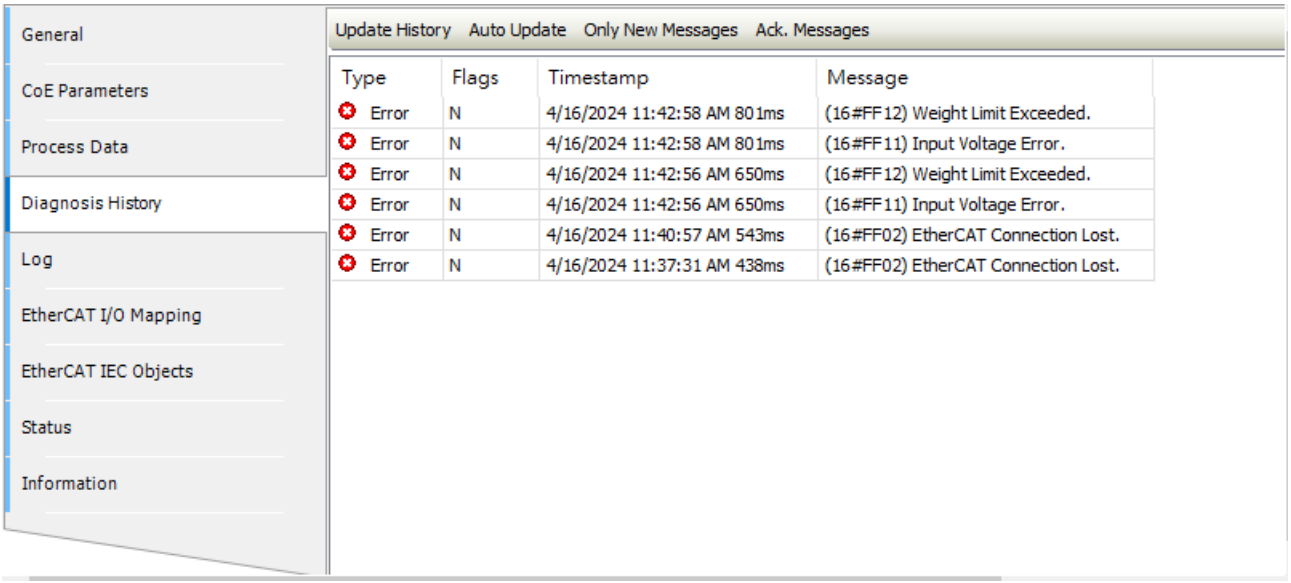


(2) Click  on the toolbar to go into online mode. In the EtherCAT I/O Mapping tab, you can find the variables, current value, status and error codes for each channel.



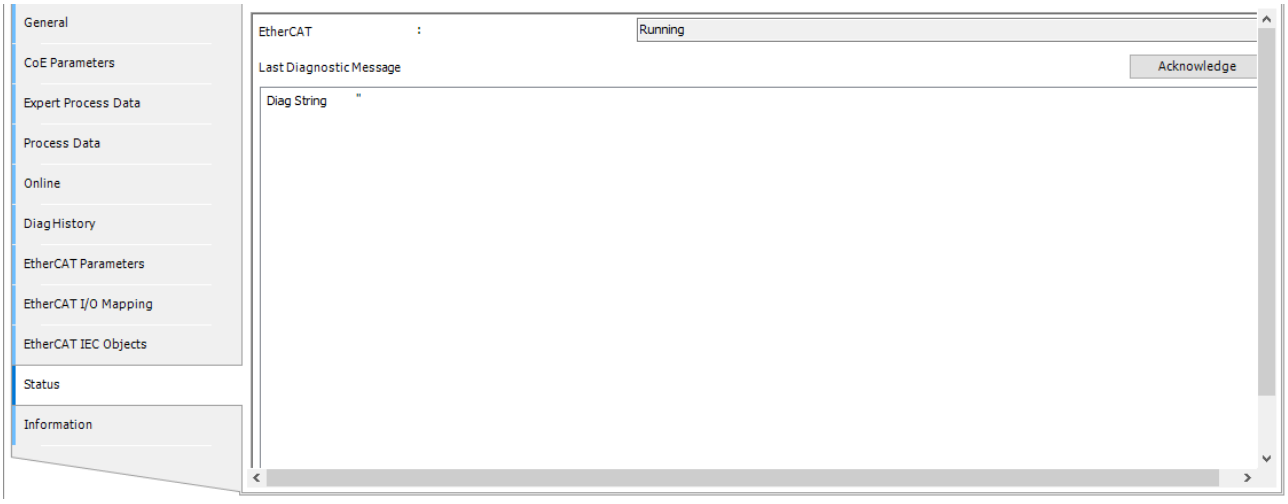
7.1.4.4 Diagnosis History

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.



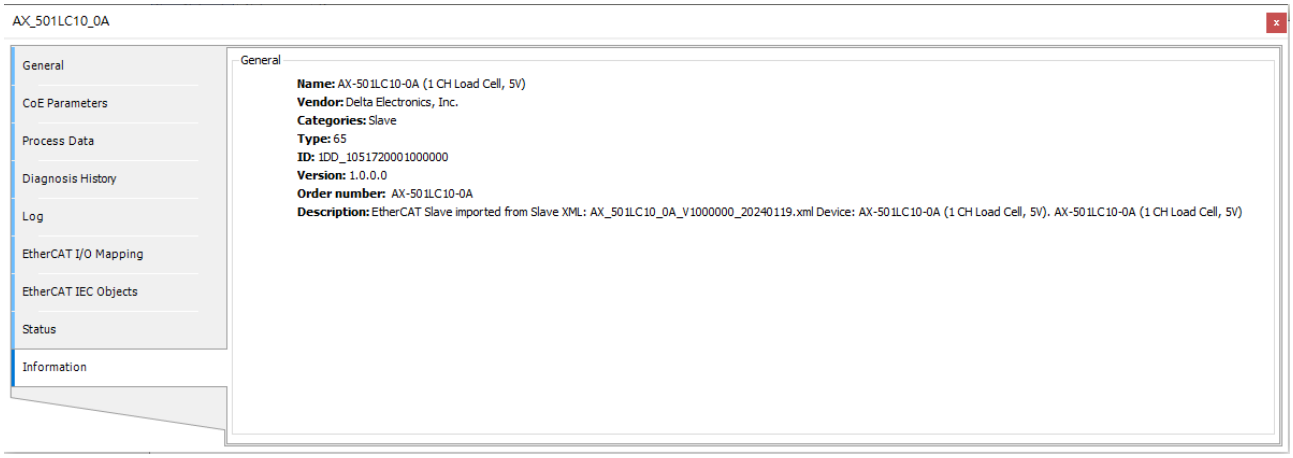
7.1.4.5 Status

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.



7.1.4.6 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	Range
=	16#1009:16#00	Hardware version	A0	A0	--	
=	16#100A:16#00	Software version	0.31.00.02	0.31.00.02	0.03.00.00	

7.1.5 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 7.1.4 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	Characteristic Value	Input characteristic value setting	
16#8001	Stable Detection	Stable status detection setting	
16#8002	Empty Detection	Empty status detection setting	
16#8003	Zero Tracking	Zero tracking setting	
16#8004	Weight Limit	Weight upper limit setting	
16#8005	Digital Filter Setting	Digital filter setting	
16#8006	Decimal Places	Decimal places setting	
16#8007	Extremum	Extremum value records	
16#8008	Theoretical Calibration Parameters	Theoretical calibration parameters setting	

Index	Function	Description	Function block
16#8010	LC Command	Load cell application command	DFB_LC_Zero DFB_LC_Tare DFB_LC_ClearTare DFB_LC_ResetExtremum
16#8100	Tare Weight	Tare Weight	DFB_LC_RD_TareWeight DFB_LC_WR_TareWeight
16#8101	ADC Raw Data	ADC Raw Data	

7.1.5.1 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 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	When the module is controlled by EtherCAT State Machine
1	Controlled by Controller (Run)	When the module is controlled by Controller and the controller is in RUN state
2	Controlled by Controller (Stop)	When the module is controlled by Controller and the controller is in Stop state

7.1.5.2 User Command

Index	Subindex	Name	Description	Data Type	Attr.	Default
16#5001	16#01	User Command	Commands for users	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.

7.1.5.3 Characteristic Value

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8000	16#01	Characteristic Value	Input characteristic value setting	USINT	RW	1

- Explanation

Based on the specification of used sensor, select a characteristic value setting that exceeds the specifications.

For example, if the characteristic value specification of used sensor is 1.5 mV/V, please select the 2 mV/V mode.

- Supported modes

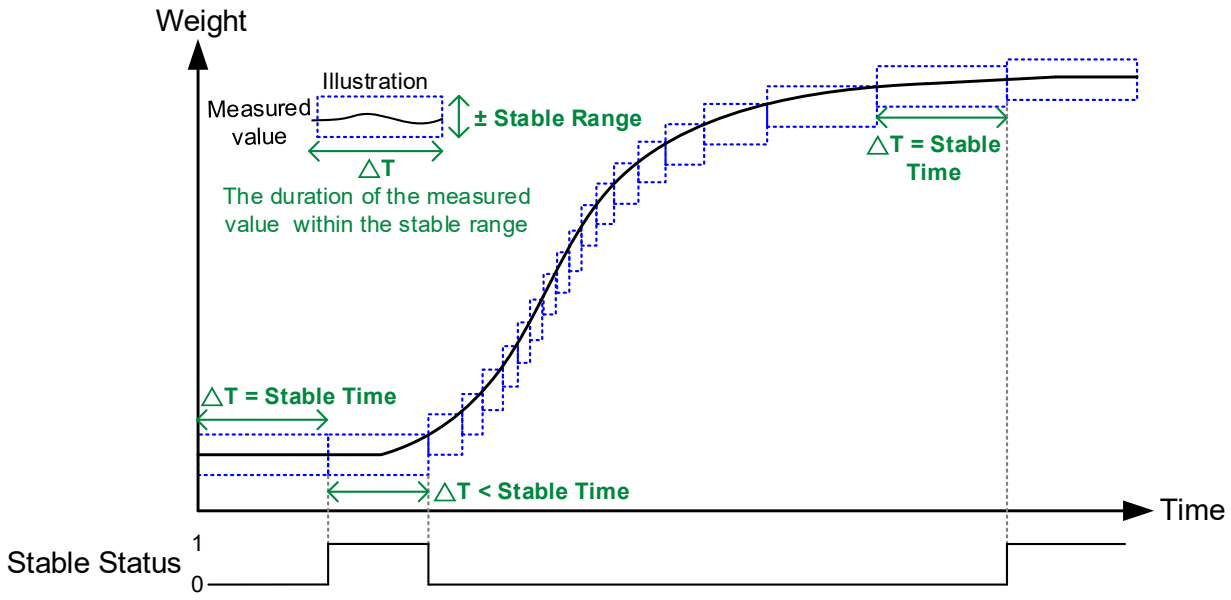
Mode	Characteristic Value
0	1 mV/V
1	2 mV/V
2	4 mV/V
3	5 mV/V
4	10 mV/V
5	20 mV/V
6	40 mV/V
7	80 mV/V

7.1.5.4 Stable Detection

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8001	16#01	Stable Time	Stable time setting range: 1 to 600 (unit: 0.1s)	UINT	RW	10
	16#02	Stable Range	Stable range setting range: ≧0	REAL	RW	5.0

- Explanation

Module will detect whether the current input value is stable, if yes, the Stable Status value in the PDO data exchange will be 1; otherwise, it will be 0.
To determine whether the current input value is stable or not, the module will calculate based on the parameters of Stable Time and Stable Range.
When the variation of the input value within Stable Time is within the Stable Range, it is considered to be in a stable state, and the Stable Status value is 1.
When the variation of the input value within Stable Time exceeds the Stable Range, it is considered to be in an unstable state, and the Stable Status value is 0.



7.1.5.5 Empty Detection

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8002	16#01	Empty Range	Empty Range setting range: ≧0	REAL	RW	5.0

- Explanation

Module will detect whether it's currently in an empty state, if yes, the Empty Status value in the PDO data exchange will be 1; otherwise, it will be 0.

To determine whether it's currently in an empty state or not, the module will calculate based on the parameters of Stable Status and Empty Range.

When the input value is in a stable state and within the 0± Empty Range, it is considered to be in an empty state, and the Empty Status value will be 1.

If any of the above conditions are not met, it is considered to be in a non-empty status, Empty Status will be 0.

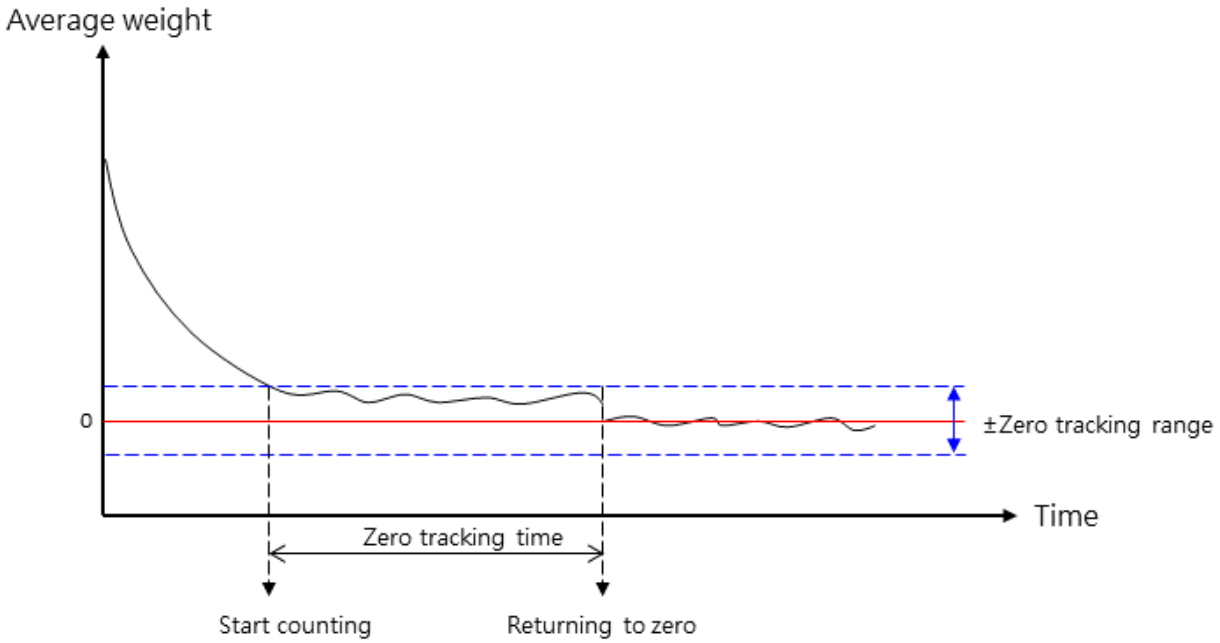
7.1.5.6 Zero Tracking

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8003	16#01	Zero Tracking Time	Zero Tracking Time, setting range: 0 to 600, (unit: 0.1 s) 0 indicates that the function is disabled.	UINT	RW	10
	16#02	Zero Tracking Range	Zero Tracking Range, setting range: ≧0, 0 indicates that the function is disabled.	REAL	RW	0

- Explanation

Zero tracking is the automatic zeroing function. After the sensor has been loaded for a long time, its elasticity will fatigue, resulting in a residual weight value even after the load is removed. At this time, the zero tracking function can be set to automatically return to zero when the conditions are met. The triggered conditions for Zero Tracking are calculated using two parameters: Zero Tracking Time and Zero Tracking Range:

When the variation of the input value within Zero Tracking Time is within Zero Tracking Range, the module will automatically execute the zeroing command. The command will only trigger once, until the input value exits and re-enters the Zero Tracking Range.



It is suggested that the parameters for the zero tracking function be set in accordance with the Stable Detection parameters or be even more stringent.

If either Zero Tracking Time or Zero Tracking Range is set to 0, the function will be disabled.

7.1.5.7 Weight Limit

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8004	16#01	Weight Limit	Upper weight limit	REAL	RW	10000.0

- Explanation

When the input value exceeds the upper weight limit, the Weight Limit Exceeded value in the PDO data exchange will be 1, and Error LED will start blinking.

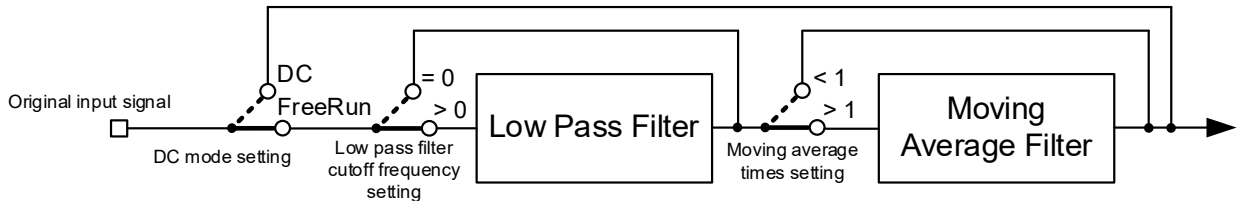
7.1.5.8 Digital Filter Setting

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8005	16#01	Low Pass Filter Cutoff Freq	Low pass filter cutoff frequency Setting range: 0 to 500 (unit: Hz), 0 indicates the function is disabled.	UINT	RW	5
	16#02	Moving Average Times	Moving average times Setting range: 0 to 512, 0 or 1 indicates the function is disabled.	UINT	RW	240

- Explanation

In FreeRun mode, to filter out noise, the input values will sequentially pass through two filters: Low Pass Filter and Moving Average. Each filter has corresponding parameters to set its filtering intensity.

In DC mode, in which real-time accuracy of the values is prioritized, the input value will not pass through any filters.



Low Pass Filter Cutoff Freq:

Set the low pass filter cutoff frequency, which indicates that noise at this frequency will be diminished by 3 dbs. For example, if the setting value is 5, means that noise at 5Hz will be diminished by 3 dbs, with higher frequencies being decreased even more.

The smaller this parameters value is set, the stronger the filtering effect will be, but it will also slow down the response time. Setting it to 0 will disable the function.

Please refer to the response time explanation below.

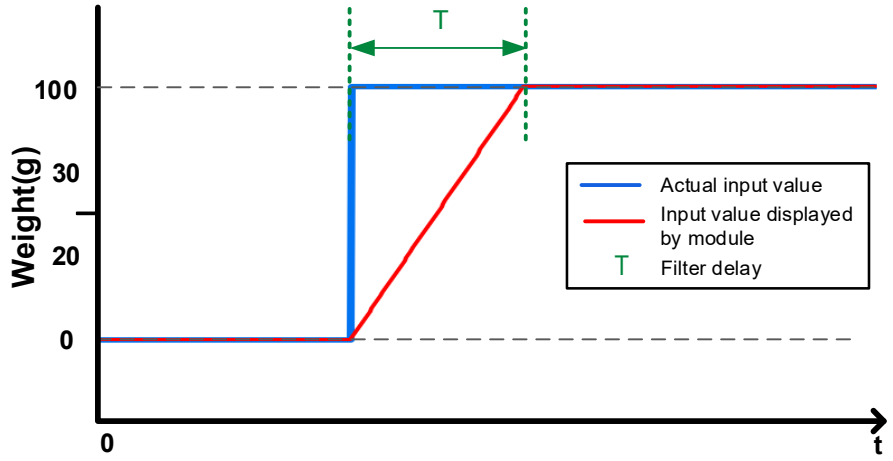
Moving Average Times:

Set the times of moving average. A higher value indicates more average times, resulting in a strong filtering effect, but it will also slow down the response time. Setting it to 0 or 1 will disable the function.

Please refer to the response time explanation below.

- Filter Delay Time explanation

After passing through the filter, the input signal will experience a time delay before stabilizing. Image below uses step response to explain the corresponding delay times for various setting.



When only Low Pass Filter is set, and Moving Average Times is turned off, the filter delay corresponding to the cutoff frequency setting is shown in the table below:

Cutoff Frequency setting (Hz)	Filter Delay Time (ms)
1	1000
2	527
4	263
8	133
16	69
32	37
64	21
128	13
256	11
500	10

When only Moving Average Times is set, and Low Pass Filter is turned off, the calculation for filter delay time is: Moving Average Times×416 us.

For example, if Moving Average Times is set to 100, the filter delay time is: 100×416 us = 41.6 ms.

If both filters are enabled, the filter delay time is the sum of the delay times from each filter, the example are as follows:

Cutoff Frequency setting (Hz)	Moving Average Times setting (times)	Filter Delay Time (ms)
1	512	1000 ms + (512×416 us) = 1213 ms
32	240	37 ms + (240×416 us) = 99.8 ms
500	100	10 ms + (100×416 us) = 51.6 ms

7.1.5.9 Decimal Places

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8006	16#01	Decimal Places	Decimal Places setting Setting range: 0 to 3	USINT	RW	1

- Explanation

Choose the number of decimal places based on your needs.

7.1.5.10 Extremum

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8007	16#01	Maximum Value	Maximum Value	REAL	RO	N/A
	16#02	Minimum Value	Minimum Value	REAL	RO	N/A

- Explanation

Record the maximum and minimum values that the input value has reached. You can reset the extremum setting by using **LC Command: Reset Extremum Value (16#8010: 16#04)**, and the record will start anew from that moment.

7.1.5.11 Theoretical Calibration Parameters

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8008	16#01	Rated Output	Sensor characteristic value specification, which must be a positive number (unit: mV/V)	REAL	RW	0.0
	16#02	Zero Balance	Sensor zero balance specification (unit: mV/V)	REAL	RW	0.0
	16#03	Rated Capacity	Sensor maximum capacity specification	REAL	RW	0.0
	16#04	Execute Theoretical Calibration	Write 16#0100 into module to execute theoretical calibration	UINT	RW	0

- Explanation

This parameter is used when executing theoretical calibration; it does not need to be set if not used.

- Characteristic Value (16#8000: 16#01): needs to be adjusted to match the corresponding sensor.
- Rated Output: write the characteristic value of the sensor. For example, if the sensor's characteristic value is 2.3 mV/V, write in 2.3.
- Zero Balance: write the zero balance of the sensor. For example, if the sensor's zero balance value is 0.5 mV/V, write in 0.5. If not provided, write in 0.0.
- Rated Capacity: write the maximum load of the sensor. For example, if the sensor's rated capacity value is 150 kg, write in 150, or write in 150000 if the unit is gram.
- Execute Theoretical Calibration: after setting all the required parameters, write 16#0100 to execute. If SDO reads 16#FFFF after execution, it means an error in the parameters or command.

7.1.5.12 LC Command

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8010	16#01	Zero	Zeroing	BOOL	WO	0
	16#02	Tare	Tare	BOOL	WO	0
	16#03	Clear Tare	Clear tare	BOOL	WO	0
	16#04	Reset Extremum Value	Reset extremum value	BOOL	WO	0

- Explanation

Zero: Set the current input value as zero, zero the input value.

Tare: Set the current input value as tare, store it in Tare Weight (16#8100), and zero the input value.

Clear Tare: Clear the tare weight to 0.

Reset Extremum Value: Reset the maximum and minimum value, start recording anew from the current moment.

For the detailed explanation on gross weight, net weight, and tare weight, please refer to section 7.1.6.

7.1.5.13 Tare Weight

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8100	16#01	Tare Weight	Tare Weight	REAL	RW	0.0

- Explanation

Display the current tare weight. When the parameter changes, the value will be automatically stored, and the data will not disappear when the module is powered off.

Both Tare and Clear tare command will automatically change the value of this parameter, you can also use function block **DFB_LC_WR_TareWeight** to change the parameters.

For the detailed explanation on gross weight, net weight, and tare weight, please refer to section 7.1.6.

7.1.5.14 ADC Raw Data

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8008	16#01	ADC Raw Data	ADC raw data	REAL	RO	0.0

- Explanation

Unprocessed raw data from analog to digital values.

7.1.6 Gross Weight, Net Weight and Tare Weight

The meaning of gross weight, net weight, and tare weight is to identify the total weight, the package weight, and the content weight, the definitions are as follows:

- Tare Weight: A tare is the weight of a package.
- Net Weight: A net weight is the weight of a product, that is, the actual weight of a product without its package.
- Gross Weight: A gross weight is a total weight, namely the weight of a product itself (a net weight) plus the weight of a package (a tare).
- Gross weight = Net weight + Tare weight

  Example: A product weighs 10 kilograms, and the carton in which the product is packed weighs 0.2 kilograms. The total weight gotten is 10.2 kilograms.

  Net weight=10 kg

  Tare=0.2 kg

  Gross weight=10.2 kg

- Relevant parameters

  1. PDO data exchange: Net Status
  2. Tare (16#8010:02)
  3. Clear Tare (16#8010:03)
  4. Tare Weight (16#8100:01)

- Application

  - Input value explanation

  The input value displayed in PDO data exchange is the gross minus the tare weight. Therefore, if the tare is 0, the input value represents the gross weight. If the tare value is not 0, the input value represents the net weight. You can also determine it by using Net Status in PDO data exchange, if Net Status is 1, it indicates the current input value is net weight, if Net Status is 0, it indicates the current input value is gross weight.

  - Tare weight setting

  Tare weight value will not be lost due to a power outage, and there is no need to reset the tare weight after the module restarts. Below are two methods for setting the tare weight.

  1. Use Tare, Clear Tare command

  First, place the packaging that you want to remove on the scale, use Tare command to set the current input value as the tare weight, the module will automatically fill in the tare weight register, and the input value will reset to zero. Subsequently the measured input value will be the net weight. If you use the Clear Tare command, the tare register will be reset to zero, and the weight of packaging will be included in the input value. Subsequently, the measured input value will be the gross weight.

  2. Directly set the tare weight register

  If you already knew the weight of packaging, you could directly use function block **DFB_LC_WR_TareWeight** to write the tare weight, which has the same effect as using Tare command. Alternatively, you can set the tare weight register to 0, which has the same effect as using Clear Tare command.

7.1.7 Calibration

The module receives the signal from the load cell sensor as a voltage signal. However, the module does not know how much weight corresponds to the voltage signal. Therefore, the module needs to match the actual weight with the input value displayed by the module, calibrating the current input value to the corresponding weight.

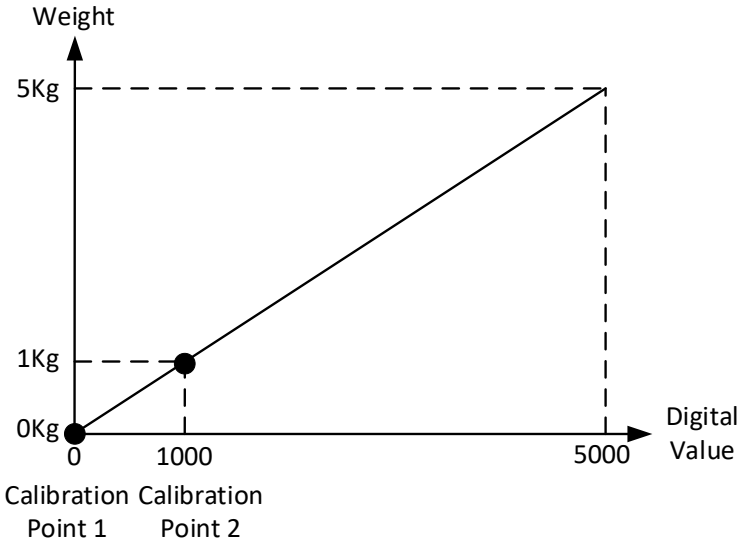
This module supports two calibration methods: calibration using actual weight, or theoretical calibration based on the sensor's specification.

7.1.7.1 Actual Weight Calibration

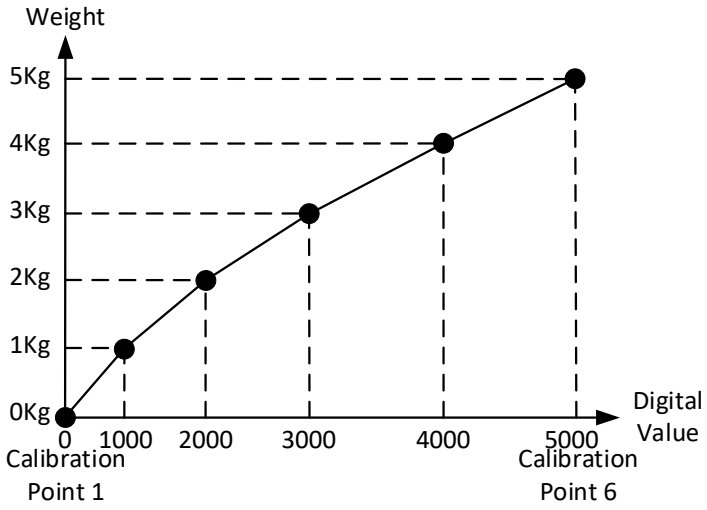
- Introduction

The calibration method involves applying an actual force to the sensor. Generally, the sensors are linear and can be calibrated using two points: the zero point and a calibration point. After setting up the system, the zero point is established when there is no load on the scale. Then, place an object with a known weight on the scale and calibrate the system to the value of this know weight.

For example, using a load cell sensor with a maximum rated capacity of 5 kg, and having a 1 kg object, you want the module to display the unit in grams, meaning 1 kg corresponds to a value of 1000, the curve is shown below:



If the sensor's linearity is inferior, you can use multiple calibration points, this module supports up to 20 points.



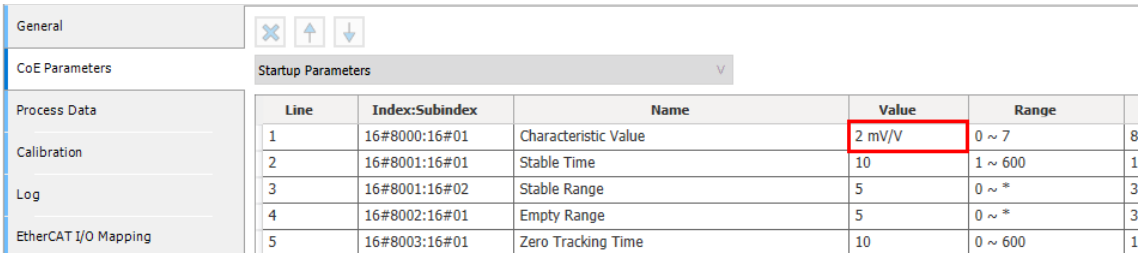
- **Calibration methods**

The following are three calibration methods, it is suggested to maximize the filter's strength during the calibration and to perform the process in FreeRun Mode. The tare weight will automatically reset to zero after starting the calibration.

A. DIADesigner-AX UI Calibration

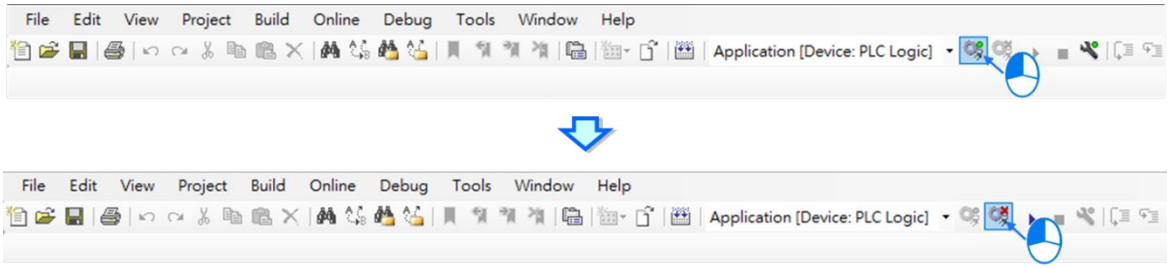
(1) Configure the module.

(2) Set the related parameters, such as the characteristic value.

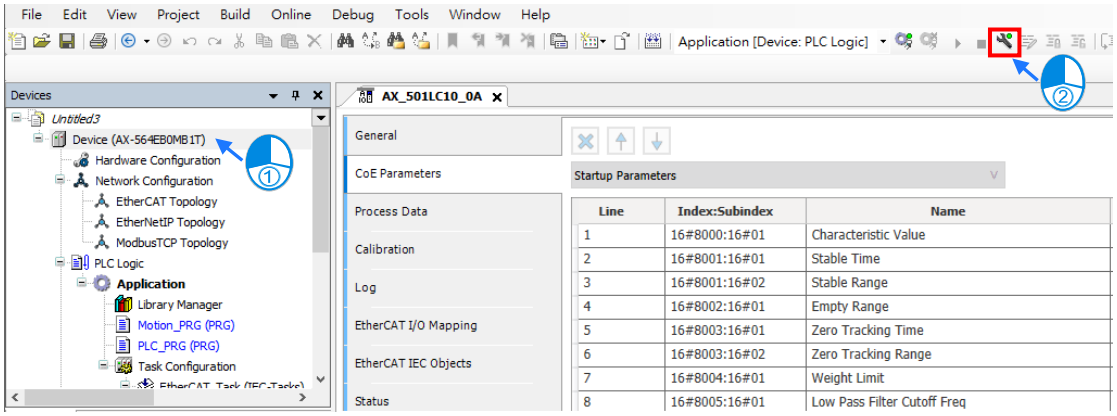


Line	Index:Subindex	Name	Value	Range	
1	16#8000:16#01	Characteristic Value	2 mV/V	0 ~ 7	8
2	16#8001:16#01	Stable Time	10	1 ~ 600	1
3	16#8001:16#02	Stable Range	5	0 ~ *	3
4	16#8002:16#01	Empty Range	5	0 ~ *	3
5	16#8003:16#01	Zero Tracking Time	10	0 ~ 600	1

(3) Click "Login" to download the program to the PLC, then click "Logout."

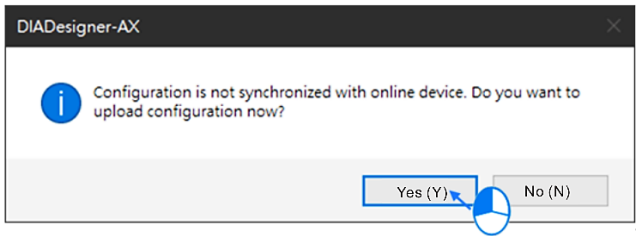


(4) Enter Online Config Mode.

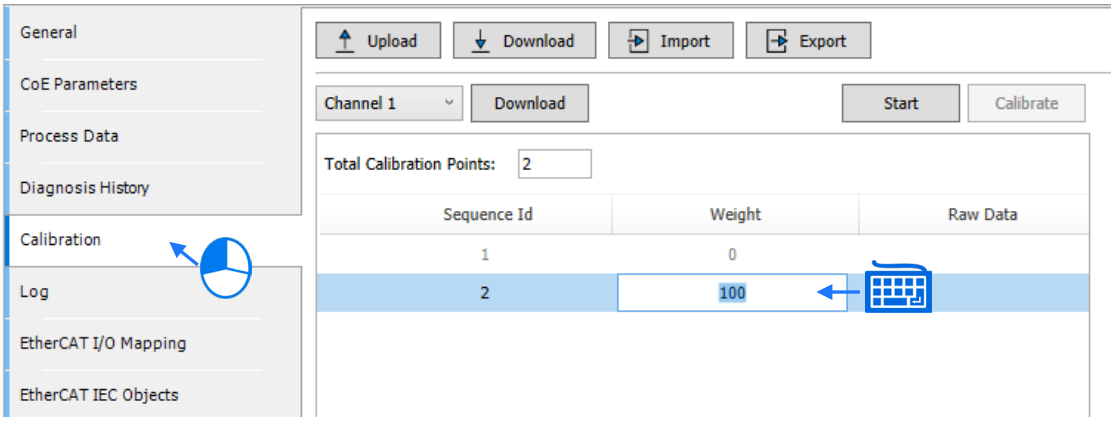


Line	Index:Subindex	Name
1	16#8000:16#01	Characteristic Value
2	16#8001:16#01	Stable Time
3	16#8001:16#02	Stable Range
4	16#8002:16#01	Empty Range
5	16#8003:16#01	Zero Tracking Time
6	16#8003:16#02	Zero Tracking Range
7	16#8004:16#01	Weight Limit
8	16#8005:16#01	Low Pass Filter Cutoff Freq

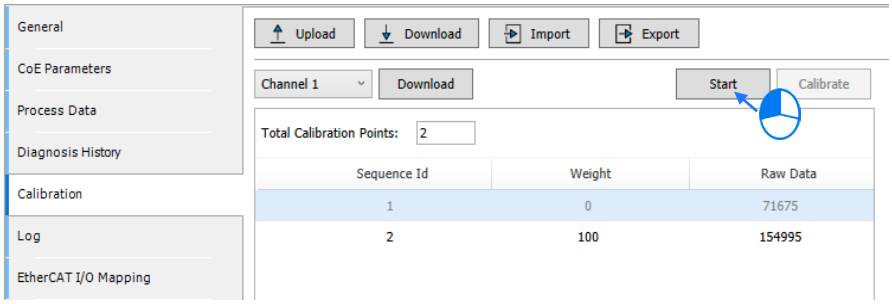
(5) Enter Online Config Mode and click "Yes."



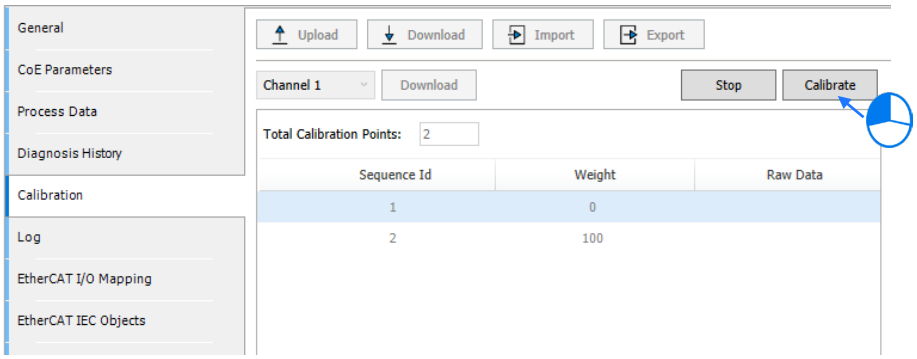
(6) Set the points to be calibrated and their corresponding value. In this example, the total calibration points are 2 points, the first one is zero, and the second point is 100 g corresponding to value 100, as the setting below.



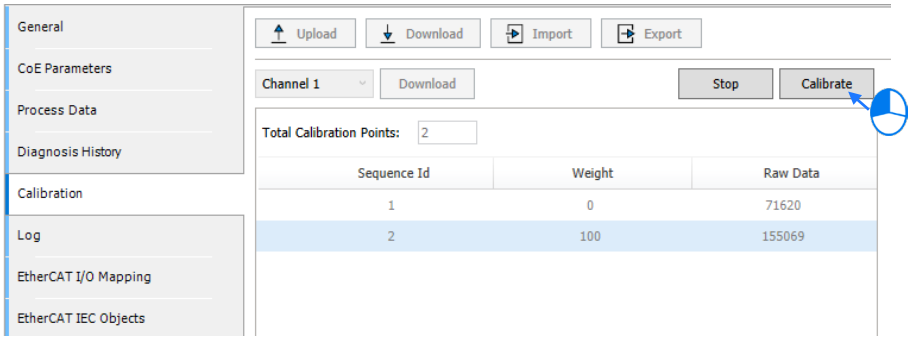
(7) After completing the settings, click “Start.”



(8) Keep the load cell sensor unloaded, without placing any weight, and click “Calibrate.”



(9) Place the actual weight corresponding to the second point on the load cell sensor. In this example, put a weight of 100 g, then click “Calibrate”. Repeat this step if it is a multi-point calibration.



(10) Click “Stop” to complete the weight calibration. The actual weight and the corresponding weight value are shown in the figure below.

B. PLC Function Block Calibration

Library: DL_ModuleControl_AX5

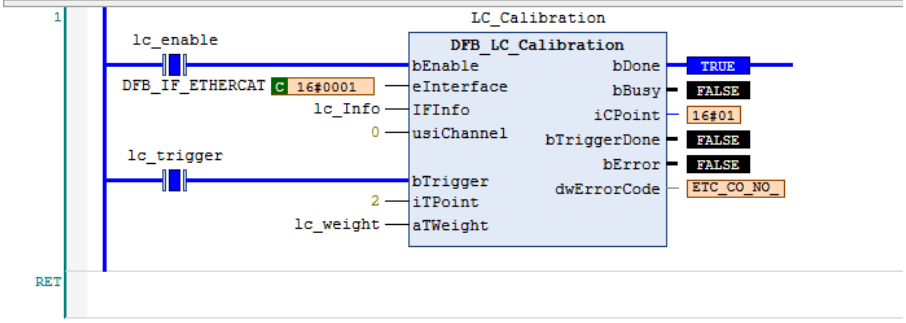
DFB_LC_Calibration: AX-501LC10-0Aload cell module calibration command

FB/FC	Command	Function block diagram	ST syntax
FB	DFB_LC_Calibration		DFB_LC_Calibration(bEnable:= , eInterface:= , IFInfo:= , usiChannel:= , bTrigger:= , iTPoint:= , aTWeight:= , bDone=> , bBusy=> , iCPoint=> , bTriggerDone=> , bError=> , dwErrorCode=>);

Example

This example uses FB command (DFB_LC_Calibration) to perform two-point calibration on the first module to the right side of the EtherCAT Coupler

Expression	Type	Value	Prepared value	Address
LC_Calibration	DFB_LC_Calibration			
lc_enable	BOOL	TRUE		
lc_info	DFB_APP_IF_TYPE			
lc_trigger	BOOL	TRUE		
lc_weight	ARRAY [0..19] OF R...			
lc_weight[0]	REAL	0		
lc_weight[1]	REAL	100		
lc_weight[2]	REAL	0		
lc_weight[3]	REAL	0		
lc_weight[4]	REAL	0		
lc_weight[5]	REAL	0		



1. Set lc_enable to TRUE.
2. After confirming that the scale is unloaded, set lc_trigger to TRUE, at this point, iCPoint will be 1 and bTriggerDone will be TRUE, indicating that the first point calibration is complete.
3. Place a 100.0 g weight on the scale and ensure the scale is stable, then set **lc_trigger** to TRUE, at this point, **iCPoint** will be 2 and **bDone** will be TRUE, indicating that all calibration is complete. After the third line condition is met, immediately turn off the function block "**DFB_DLCCAL"** to complete the calibration.

Note: Please refer to AX-5 Instruction Manual for more detailed information about this function block.

7

C. Third-party calibration method

Read/write EtherCAT SDO through PLC program to calibrate. The following are SDOs related to the calibration.

Index	Subindex	Name	Description	Data type	Attr.	Default
16#8110	16#01	Calibration Point Number	Calibration Point	USINT	RW	2
16#8111	16#01	Calibration Point Weight 1	The digital value of calibration point 1	REAL	RW	0
	16#02	Calibration Point Weight 2	The digital value of calibration point 2			1000
	:	:	:			:
	16#14	Calibration Point Weight 20	The digital value of calibration point 20			19000
16#8120	16#01	Calibration Command	Calibration command ■ The value 1 to 20 correspond to calibration commands for calibration point 1 to 20. ■ Value 16#00FF stores the calibration results.	UINT	RW	0

Steps:

1. Set the calibration point number.

2. Set the calibration point weight corresponding to the numbers.

3. The sensor remains unloaded.

4. Write value 1 into the calibration command SDO to perform the first point calibration.

5. Place the weight of Calibration Point Weight 2 on the sensor.

6. Write value 2 into the calibration command SDO to perform the second point calibration.

7. Repeat steps 5 and 6 until all calibration points are completed.

8. Write value 16#00FF into the calibration command SDO to save the calibration results and exit the calibration mode.

7.1.7.2 Theoretical Calibration

- Introduction

Theoretical calibration uses the specifications provided by the sensor, which includes Rated Capacity, Characteristic Value, Zero Balance value, to calculate the digital value corresponding to the weight. Theoretical calibration does not require the actual weight as a reference. However, if the sensor's qualified is not well, the calibration results may be inaccurate.

- Method

Please refer to section 7.1.5.11 for calibration parameters.

7.1.8 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.

7.1.8.1 FreeRun Mode

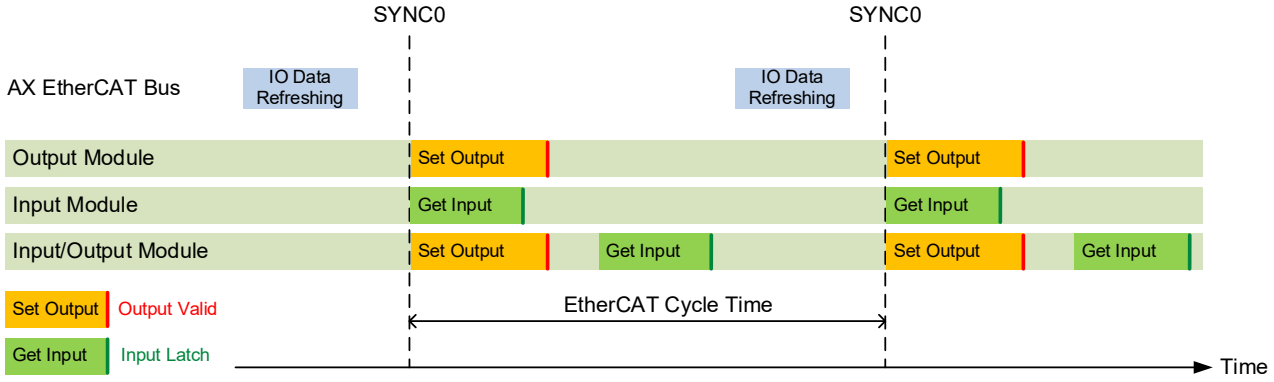
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

7.1.8.2 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.

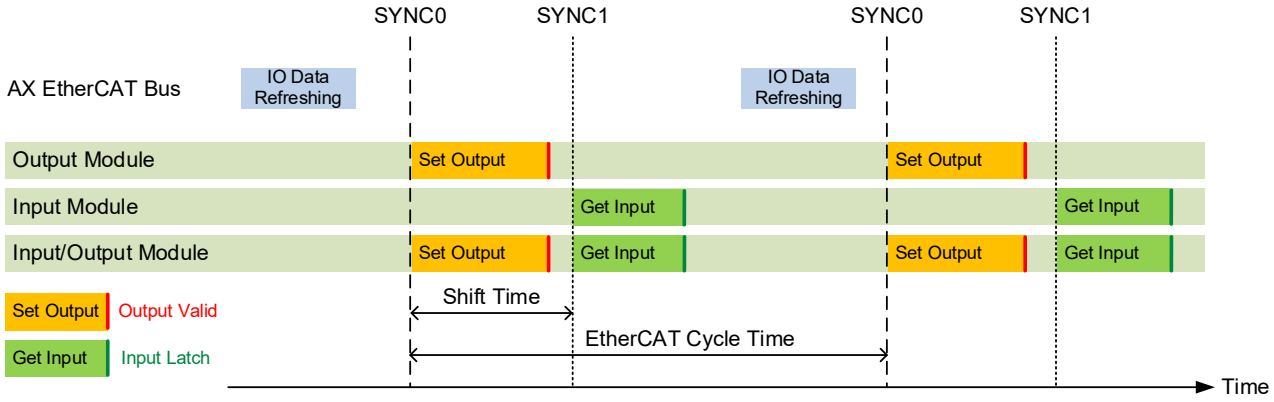
- **SYNC0**

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.



7

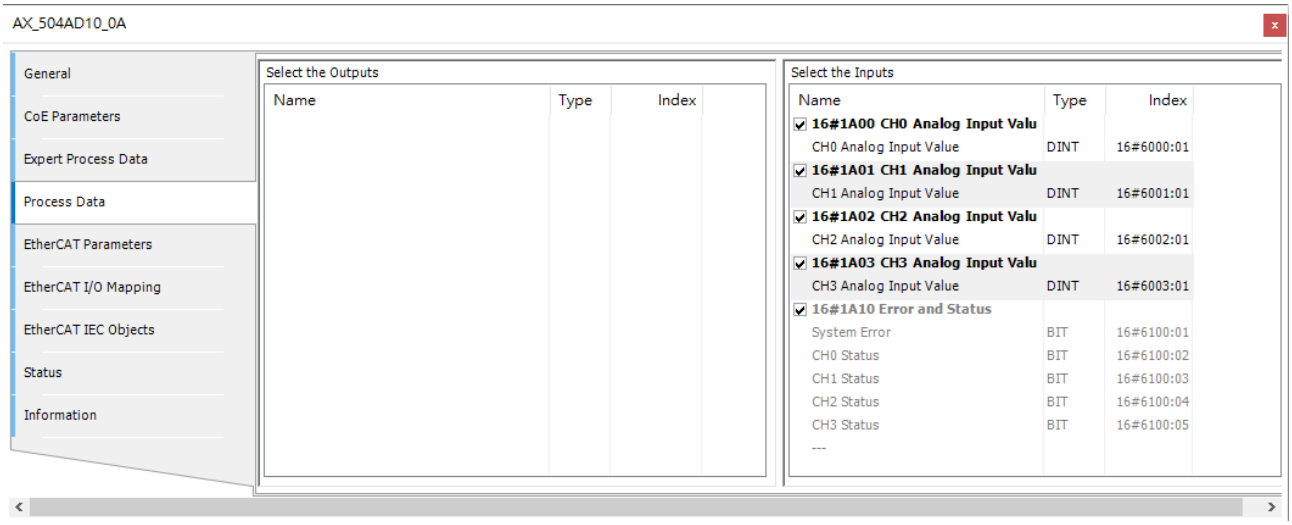
7.1.9 Process Data

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

Index	Subindex	Name	Description	Data type	Attr.	Default
16#6000	16#01	Input Value	Channel input value	REAL	RO	0
16#6100	16#01	System Error	FALSE: system is normal TRUE: system is abnormal	BOOL	RO	0
	16#02	Input Voltage Error	FALSE: input voltage is normal TRUE: input voltage is abnormal	BOOL	RO	0
	16#03	Weight Limit Exceeded	FALSE: input value is normal TRUE: input value exceeds limit	BOOL	RO	0
	16#04	Calibration Error	FALSE: calibration is normal TRUE: calibration error	BOOL	RO	0
	16#05	Calibration Status	FALSE: non-calibration status TRUE: calibration status	BOOL	RO	0

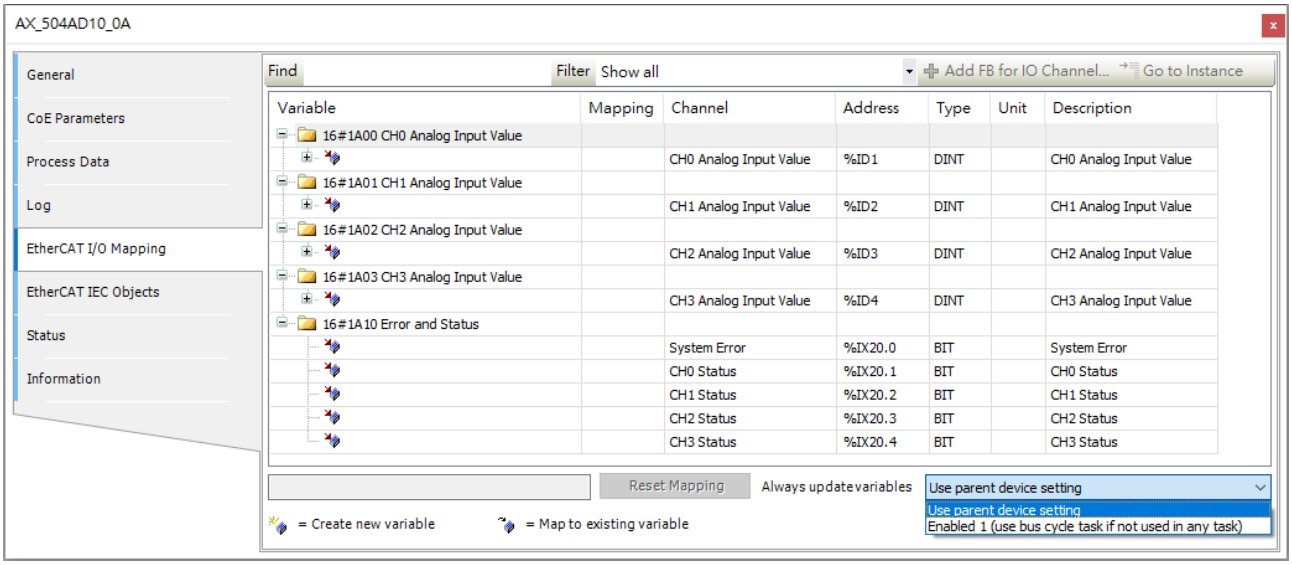
	16#06	Stable Status	FALSE: input value is unstable TRUE: input value is stable	BOOL	RO	0
	16#07	Empty Status	FALSE: non-empty status TRUE: empty status	BOOL	RO	0
	16#08	Net Status	FALSE: the input value is gross weight TRUE: the input value is net weight	BOOL	RO	0

7.1.9.1 Process Data Setting



7.1.9.2 EtherCAT I/O Mapping

Process Data will display in the EtherCAT I/O Mapping.



7.1.9.3 Always Update Variables

Global setting, define whether to update the I/O variables of bus cycle task.

Option	Description
Use parent device setting	Always update variables setting based on CPU.
Enabled1 (use bus cycle task if not used in any task)	If not used in any other tasks, it will be updated in bus cycle task.

7.1.10 Troubleshooting

In Diagnosis History Tab, the past error messages of the module are recorded. In Status Tab, the error messages at the time of a system error (16#A000) are recorded. In CoE Parameters Tab → ALL Parameter, the corresponding Index/Subindex can be checked for error status.

Index	Subindex	Description	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	1. Check if the connections for the modules are secured. 2. After checking the connection, reset the module's ECAT status through CPU module.
	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#6100 *1	16#02	(16#FF11) Input Voltage Error	Blinking every 0.2 seconds	OFF	Check if the channel signal meets the module specifications.
	16#03	(16#FF12) Weight Limit Exceeded	Blinking every 1 second	ON	Check if the weight exceeds the upper weight limit.
	16#04	(16#FF13) Calibration Error	Blinking every 1 second	ON	Recalibrate

*1. In EtherCAT I/O Mapping as well.

Appendix A Maintenance and Inspection

Table of Contents

A.1 Cautions A-2
A.2 Daily Maintenance A-3
A.2.1 Daily Inspection A-3
A.3 Periodic Maintenance A-4
A.3.1 Periodic Inspection A-4

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.

Smarter. Greener. Together.

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AX-5-0379820-03
2024/10/15