6.2 AX-502HC10-0A/ AX-502HC20-0A / AX-502HC70-0A

AX-502HC10-0A / AX-502HC20-0A / AX-502HC70-0A, high-speed counter modules, receive pulse signals for counting with two built-in channels. This section introduces their specifications, wirings and operations.

Differences between high-speed counter modules:

	AX-502HC10-0A	AX-502HC20-0A	AX-502HC70-0A
Pulse input form	NPN	PNP	Differential
Number of pulse input channels	2	2	2
Maximum frequency	2 MHz (500 kHz x 4)	800 kHz (200 kHz x 4)	4 MHz (1 MHz x 4)
Digital input/output form	NPN	PNP	PNP
Number of DI points	4*2	4*2	4*2
Z input point	DIZ0, DIZ1	DIZ0, DIZ1	DI Function*1
Number of DO points	6*2	6*2	2*2

*1 Refer to sections 6.2.6.1.1 DI Function and 6.2.6.1.2 DIQ Negative Logic for settings.

*2 Refer to section 6.2.6.2.4 for DI/DO settings.

6.2.1 Specifications

6.2.1.1 AX-502HC10-0A

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			70 g
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 function	2 external input latches and 1 internal latch for each channel
		Measurements	Pulse rate measurement
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 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	Output form	Sinking output (NPN)

Item			Specification
		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)		240 mA (1.2 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
		Filtering function	Digital filter
	Digital output	Connection Lost Protection	-
		Short Circuit Protection (SCP)	-
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	YES

6.2.1.2 AX-502HC20-0A

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			70 g
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 function	2 external input latches and 1 internal latch for each channel
		Measurements	Pulse rate measurement
Electrical specification	Digital input	Input form	Sinking input (PNP)
		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	800 kHz (200 kHz x 4)

Item			Specification
		(IA0/IB0/IA1/IB1)	
		Maximum ON/OFF response time (I0-I3/IZ0/IZ1)	5 μs /10 μs
	Digital output	Output form	Sourcing output (PNP)
		Load voltage	24 VDC (-15 %/ + 20 %)
		Maximum load current	30 mA /point
		Maximum surge current	0.5 A /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)		240 mA (1.2 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
		Filtering function	Digital filter
	Digital output	Connection Lost Protection	-
		Short Circuit Protection (SCP)	-
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	YES

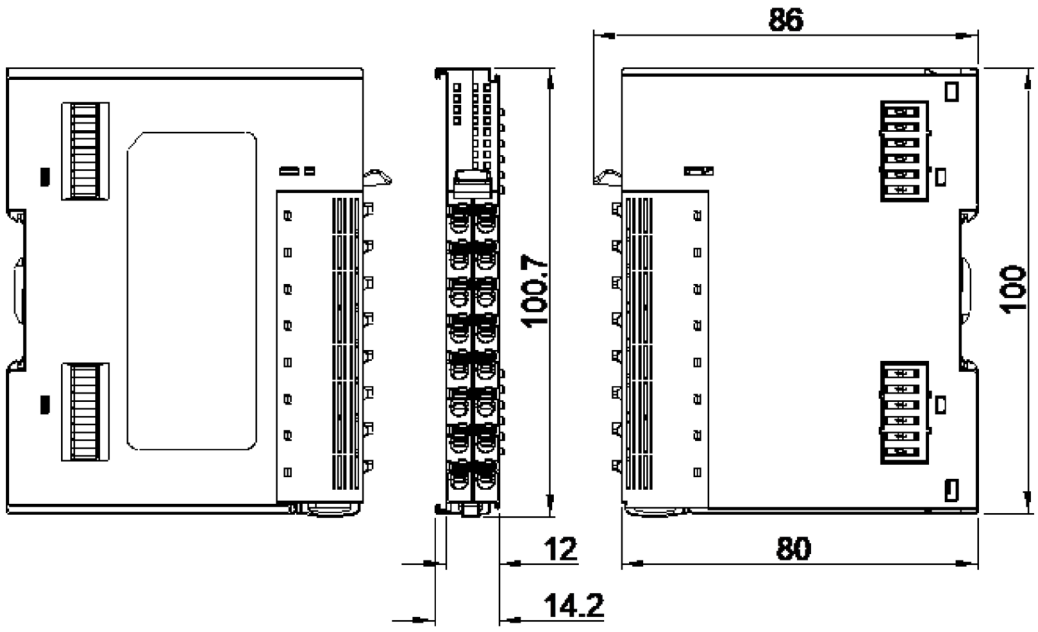
6.2.1.3 AX-502HC70-0A

Item		Specification
Number of channels		2
External connector type		Spring-clamp terminal block (16 terminals)
I/O refresh mode		1. Free Run mode 2. DC
Dimension (mm)		12 (W) × 100 (H) × 80 (D)
Weight		70 g
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 function	1 external input latch and 1 internal latch for each channel
	Measurement	Pulse rate measurement

Item			Specification
Electrical specification	Digital input	Differential input (IA0+, IA0-, IB0+, IB0-, IA1+, IA1-, IB1+, IB1-)	
		Input signal	RS-422
		Input voltage	5V±20%
		Input impedance	120 Ω ± 5%
		Maximum frequency	4 MHz (1 MHz x 4)
		General digital input (I0, I1, I2, I3)	
		Input form	Sinking input (PNP)
		Input current (I0-I3)	2.5 mA TYP. (DC 24 V)
		ON voltage / ON current (I0-I3)	11 to 30 V (EN 61131-2, type 3)
		OFF voltage / OFF current (I0-I3)	-3 to +5 V (EN 61131-2, type 3)
		Maximum ON/OFF response time (I0-I3)	5 μs /10 μs
	Digital output	Output form	Sourcing output (PNP)
		Load voltage	24 VDC (-15 %/ + 20 %)
		Maximum load current	30 mA /point
		Maximum surge current	0.5 A /point, 10 ms
		Maximum leakage current	0.1 mA
		Maximum ON/OFF response time	1 μs / 2 μs
	Maximum cable length		3 m (open collector circuit)
	Power insulation		-
	Signal insulation		Digital isolator (2.5 kVAC)
	Insulation between channels		-
	Maximum power consumption (UV, UG)		240 mA (1.2 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
		Filtering function	Digital filter
	Digital output	Connection Lost Protection	-
		Short Circuit Protection (SCP)	-
		Over Voltage Protection (OVP) / Over Current Protection (OCP)	YES

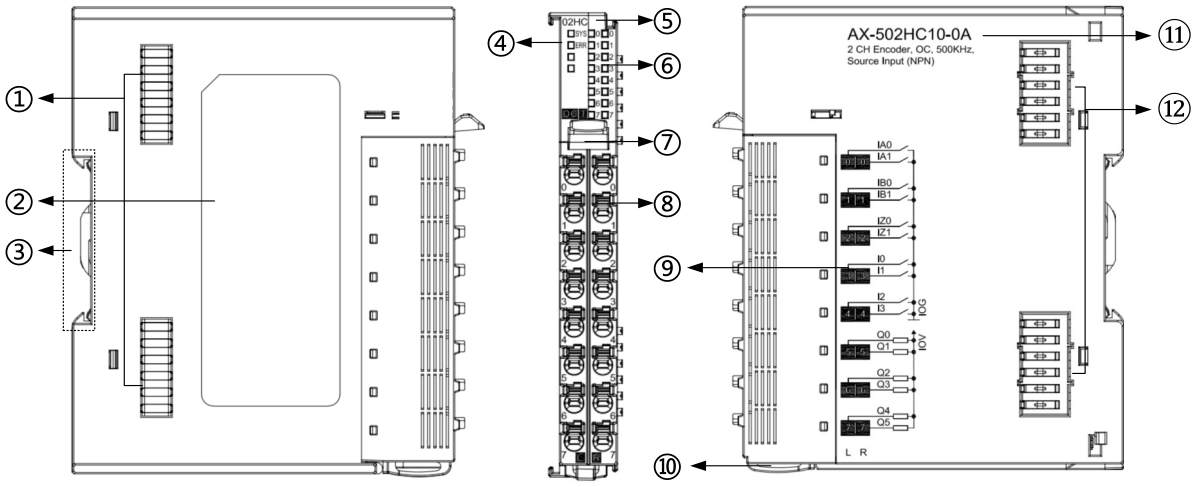
6.2.2 Dimensions and Parts

- Dimensions



Unit: mm

- **Parts**

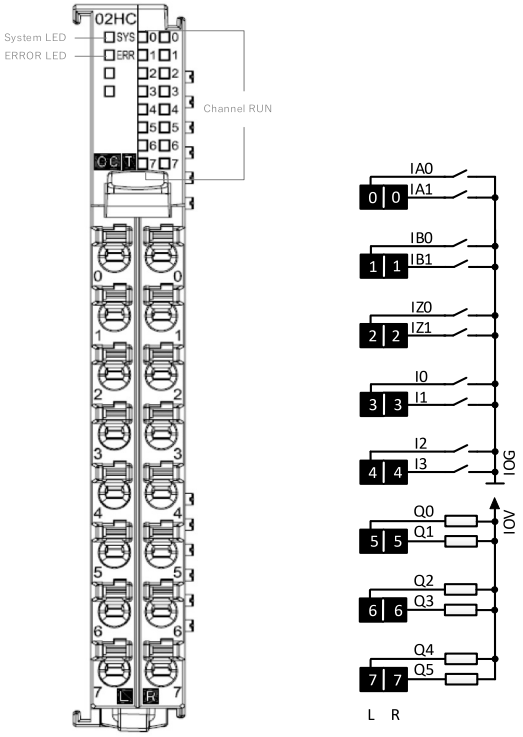


No.	Name
1	AX connector (L)
2	Label (manufacturer information, service information, safety, serial number, firmware/hardware version)
3	DIN rail clip
4	System status indicator
5	Model code
6	Channel status indicator
7	Spring to hold the connection
8	Spring-clamp terminal block
9	Wiring
10	Wire fastener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

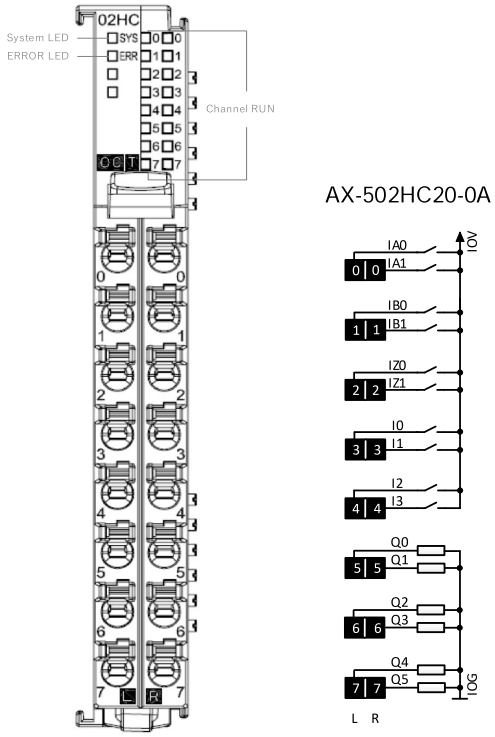
6.2.3.1.1 AX-502HC10-0A



*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

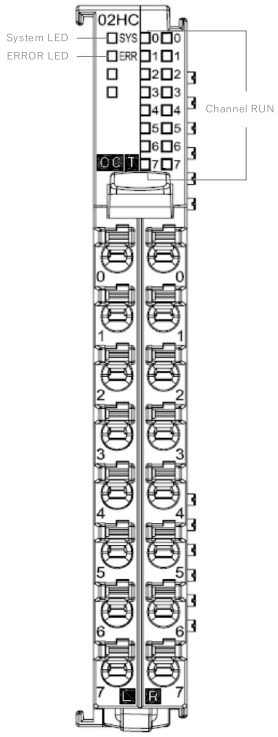
6.2.3.1.2 AX-502HC20-0A



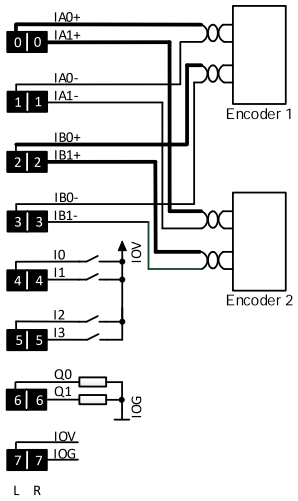
*1. The marked black areas are terminals with LED indicators. Refer to the table below to see their corresponding channels.

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

6.2.3.1.3 AX-502HC70-0A



AX-502HC70-0A



*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	IA0-	CH0 counter phase A-	R1	IA1-	CH1 counter phase A-
L2	IB0+	CH0 counter phase B+	R2	IB1+	CH1 counter phase B+
L3	IB0-	CH0 counter phase B-	R3	IB1-	CH1 counter phase B-
L4	I0	CH0 digital input point 0	R4	I1	CH0 digital input point 1
L5	I2	CH0 digital input point 2	R5	I3	CH0 digital input point 3
L6	Q0	CH0 digital output point 0	R6	Q1	CH1 digital output point 1
L7	IOV	I/O power output: 24 VDC	R7	IOG	I/O power output: 0 VDC

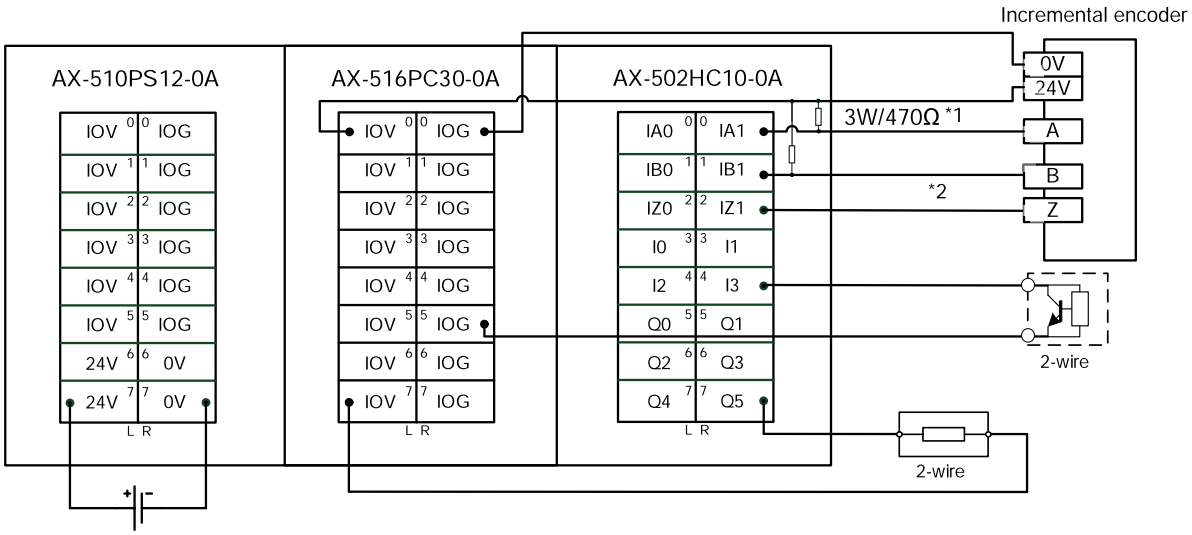
6.2.3.2 LED Indicators

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

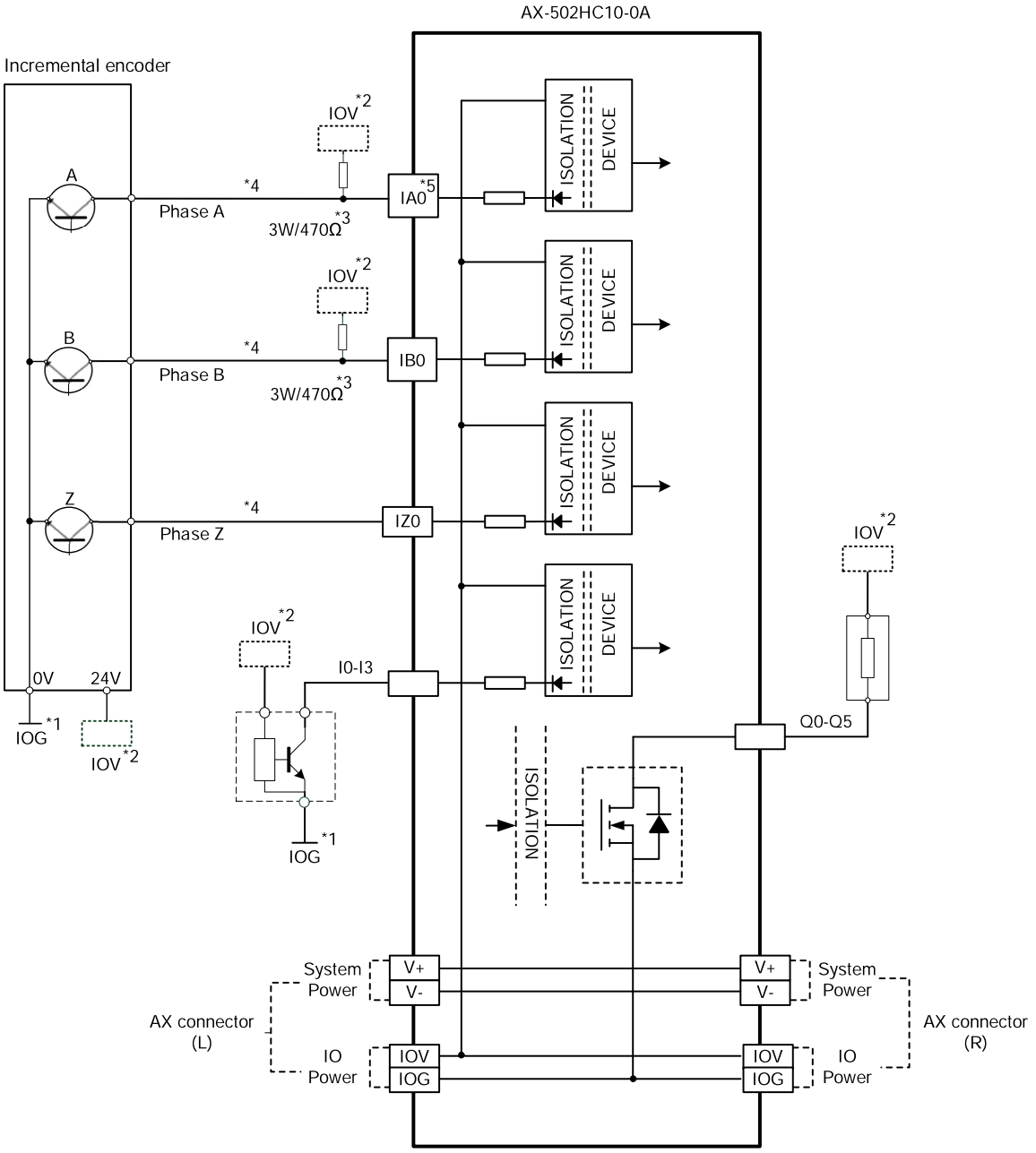
6.2.3.3.1 AX-502HC10-0A

- 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

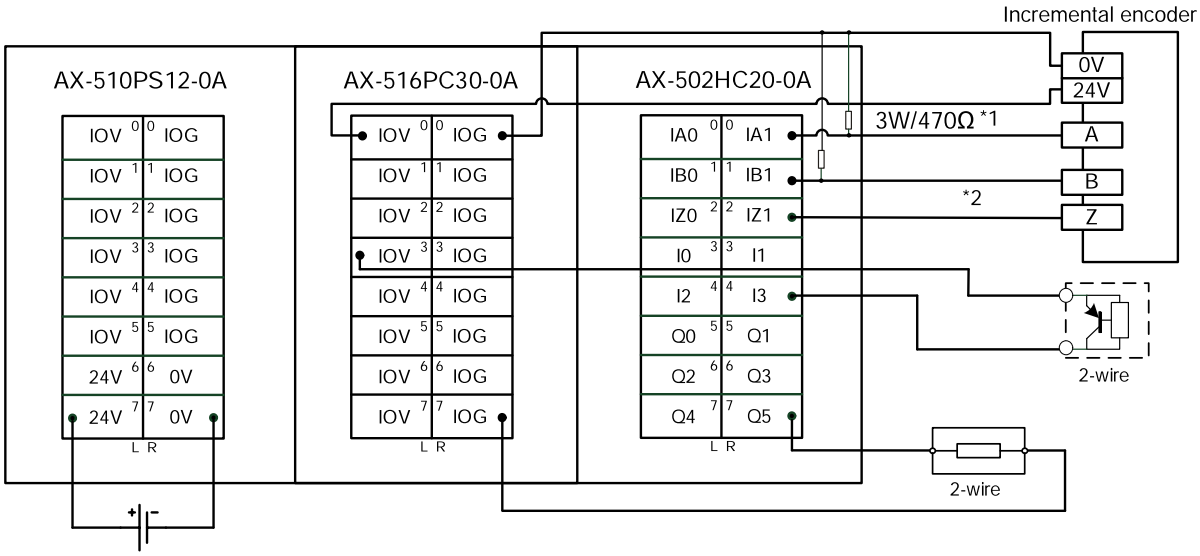


*1: Connect the encoder's 0 V to IOG of AX-516PC30-0A, AX-516PS20-0A, etc.
*2: Connect the encoder's or sensor's 24 V to IOV of AX-516PC30-0A, AX-516PS10-0A, etc.
*3: An external pull-up resistor of 3W/470 Ω is required for each of IA and IB input points.
*4: Keep IA, IB and IZ signal lines away from 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.

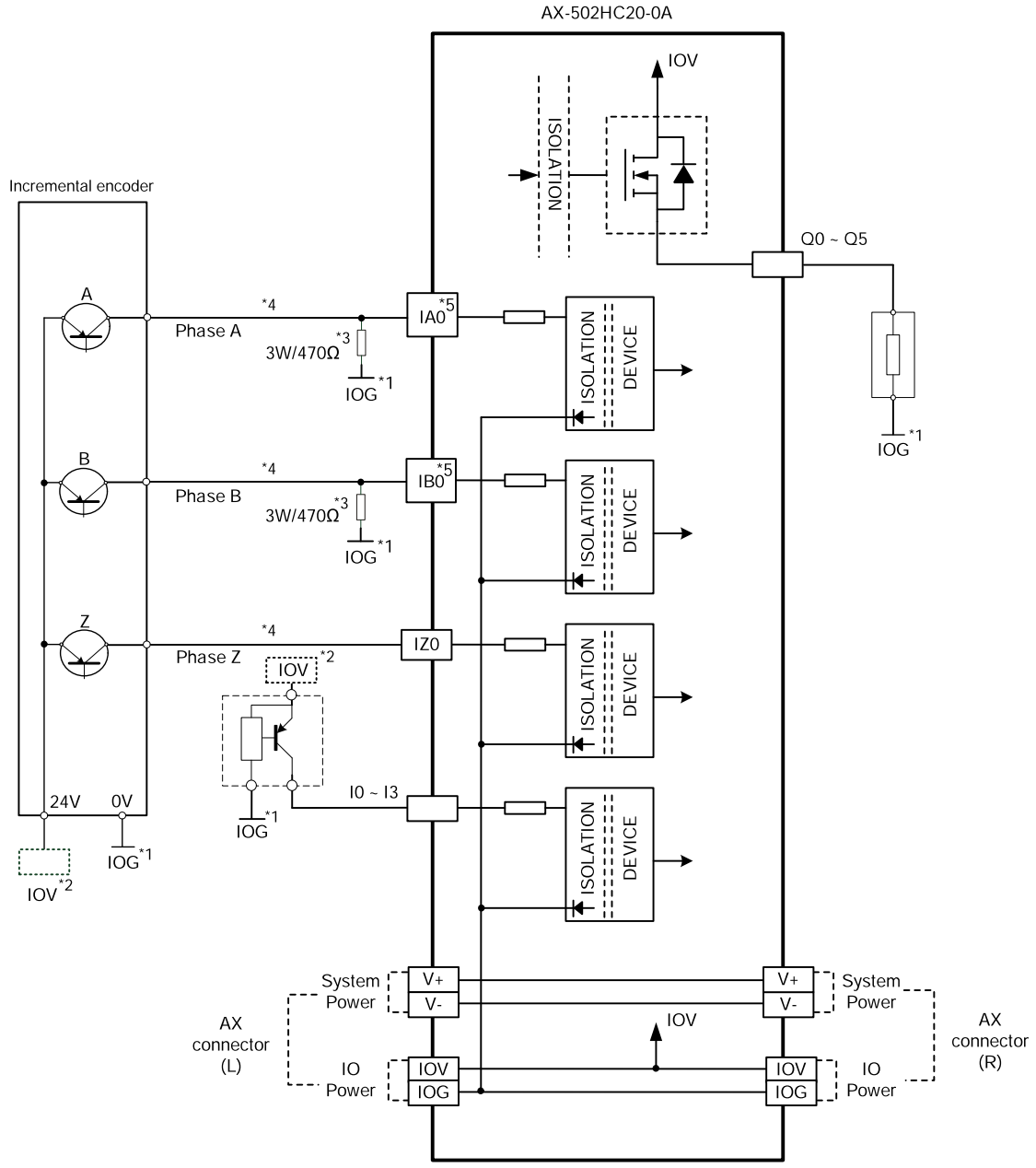
6.2.3.3.2 AX-502HC20-0A

- **Wiring**



*1: An external pull-down 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

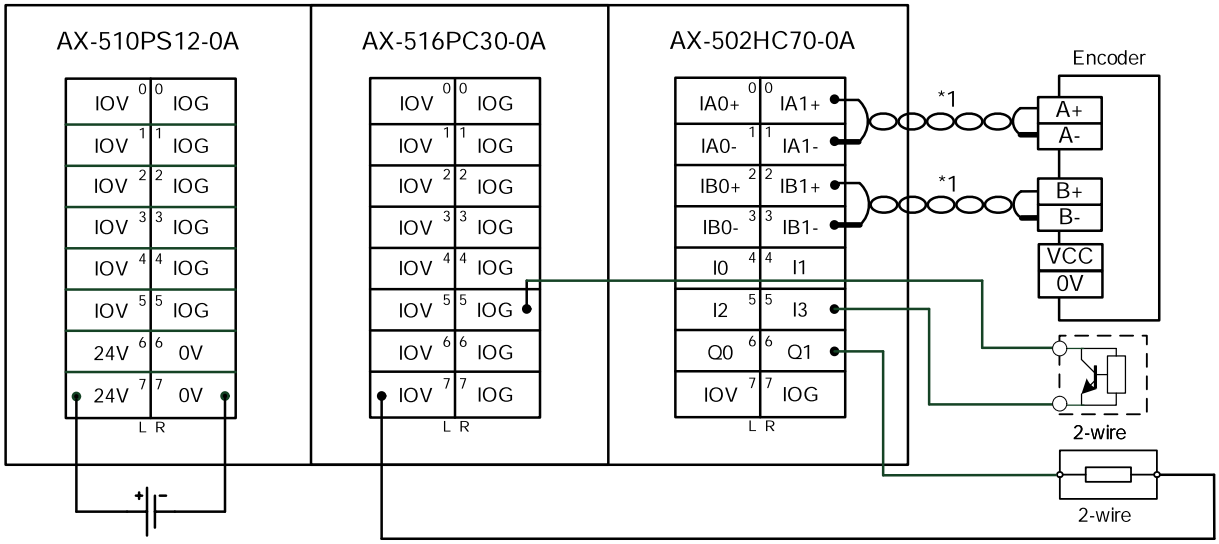


*1: Connect the encoder's or sensor' 0 V to IOG of AX-516PC30-0A, AX-516PS20-0A, etc.
*2: Connect the encoder's or sensor's 24 V to IOV of AX-516PC30-0A, AX-516PS10-0A, etc.
*3: An external pull-down resistor of 3W/470 Ω is required for each of IA and IB input points.
*4: Keep IA, IB and IZ signal lines 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.

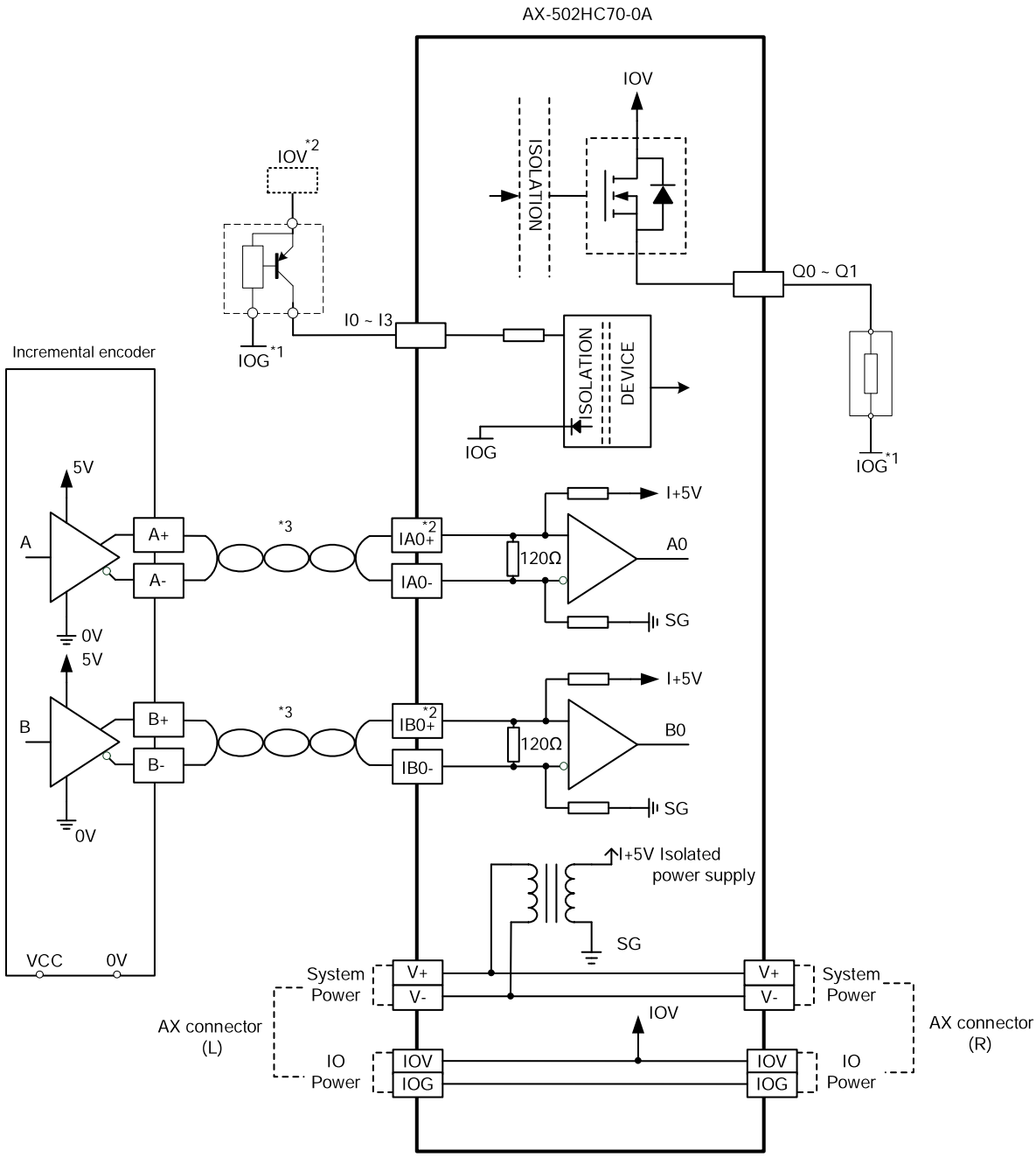
6.2.3.3.3 AX-502HC70-0A

- **Wiring**



*1: Keep IA and IB signal lines away from the power lines and the devices that generate noise.

- **Loop Configuration**



*1: Connect the sensor's 0 V to IOG of AX-516PC30-0A, AX-516PS20-0A, etc.
*2: Connect the sensor's 24 V to IOV of AX-516PC30-0A, AX-516PS10-0A, etc.
*3: Keep IA, IB and IZ signal lines away from the power lines and the devices that generate noise.
*4: Please wire IA1 and IB1 to use the channel 1 counter for high-speed counting.

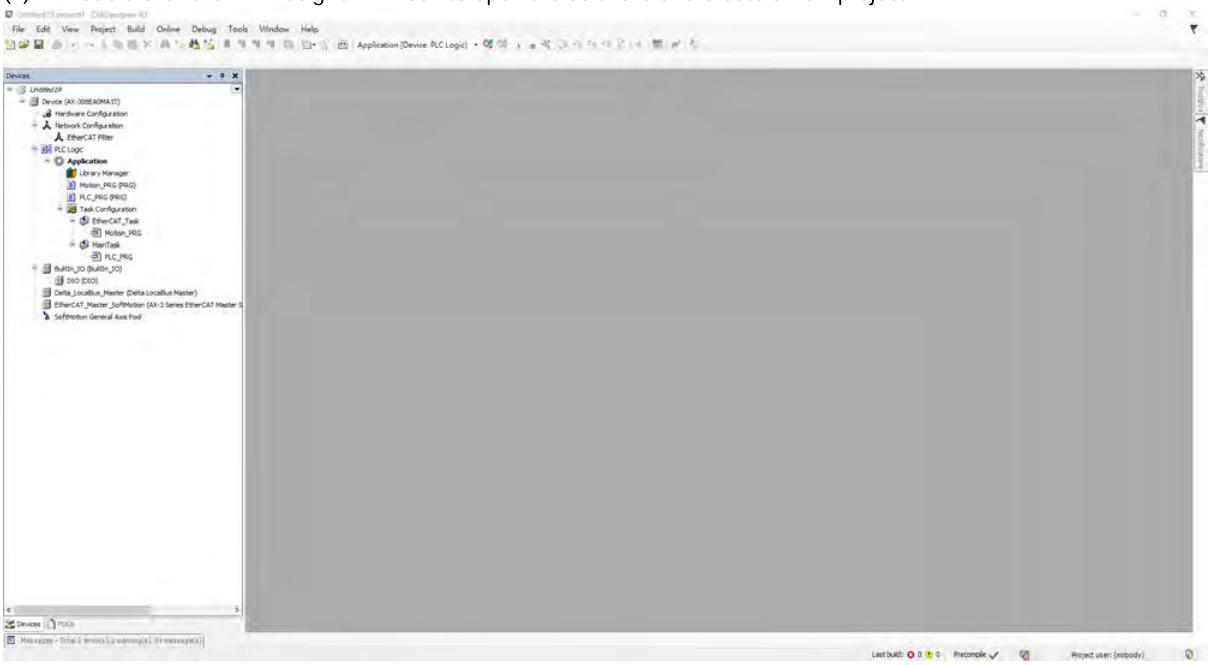
⚠	● The output circuit and internal circuit of this product are separated only by functional insulation. Therefore, to complete the installation of the product in the final system, double or reinforced insulation should be used between the product and hazardous live parts.

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

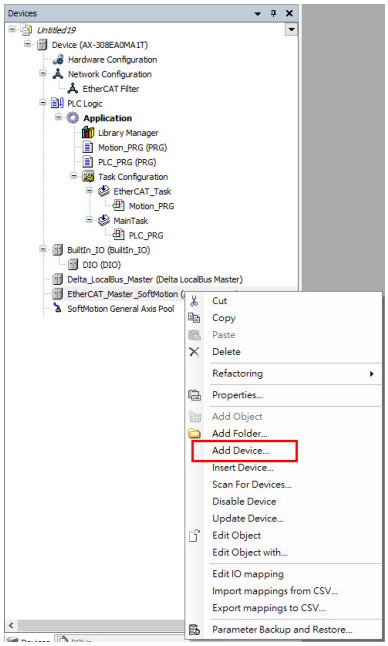
(1) Double-click the DIADesigner-AX icon to open the software and create a new project.



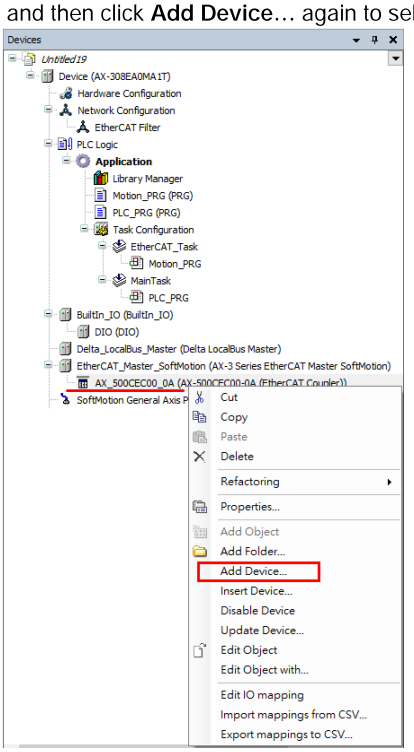
(2) Add modules in

- 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**.

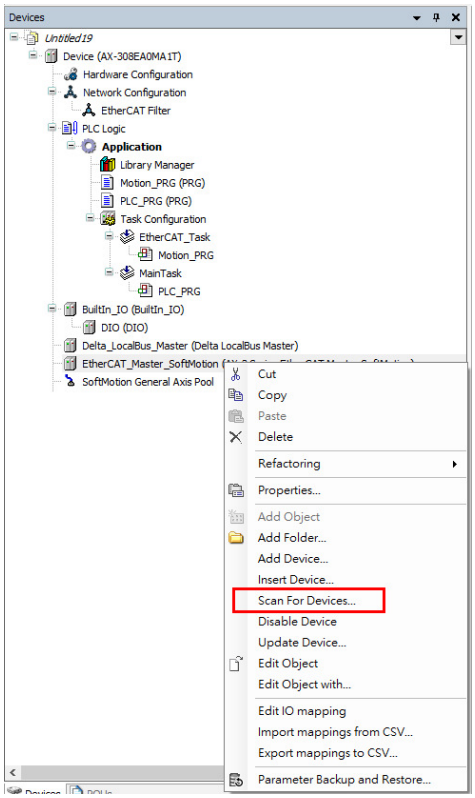


Right-click **System Coupler** you added, and then click **Add Device**... again to select and add modules in.

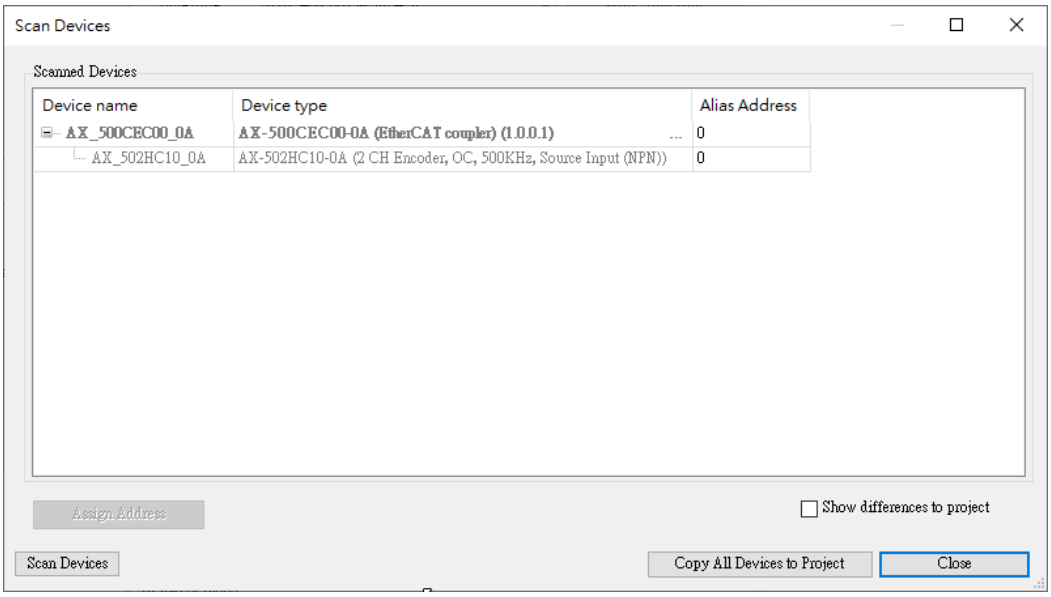


- Method 2: Scan to add the modules in.

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

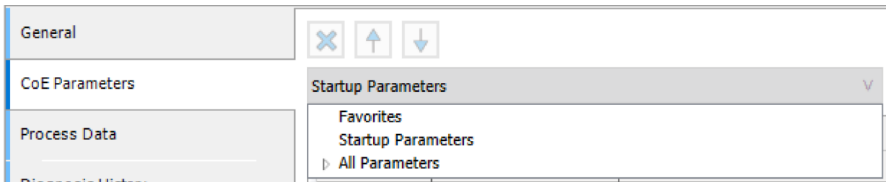


After the auto-scan, the actually-connected devices will appear. Click **Copy All Devices to Project** button to add them to the list under **EtherCAT Master SoftMotion**.



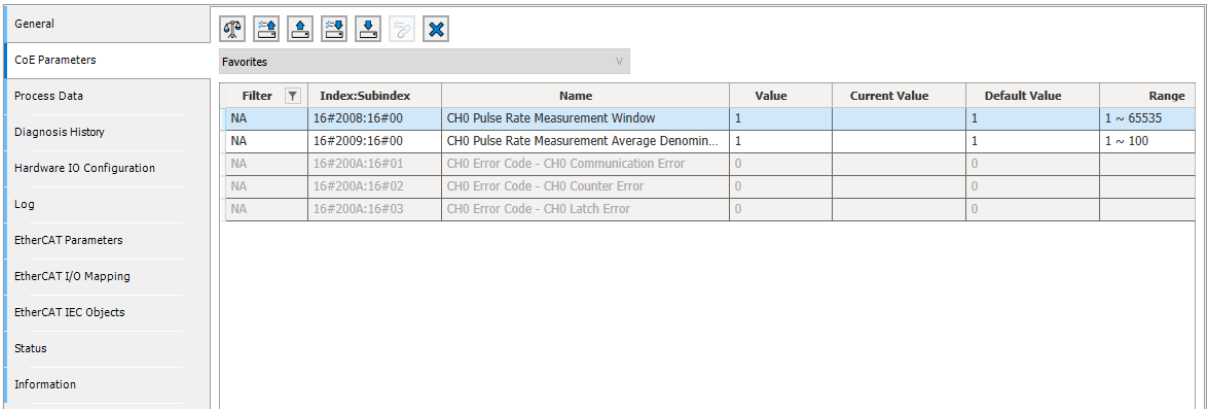
6.2.4.2 Parameter Settings

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



(1) Favorites

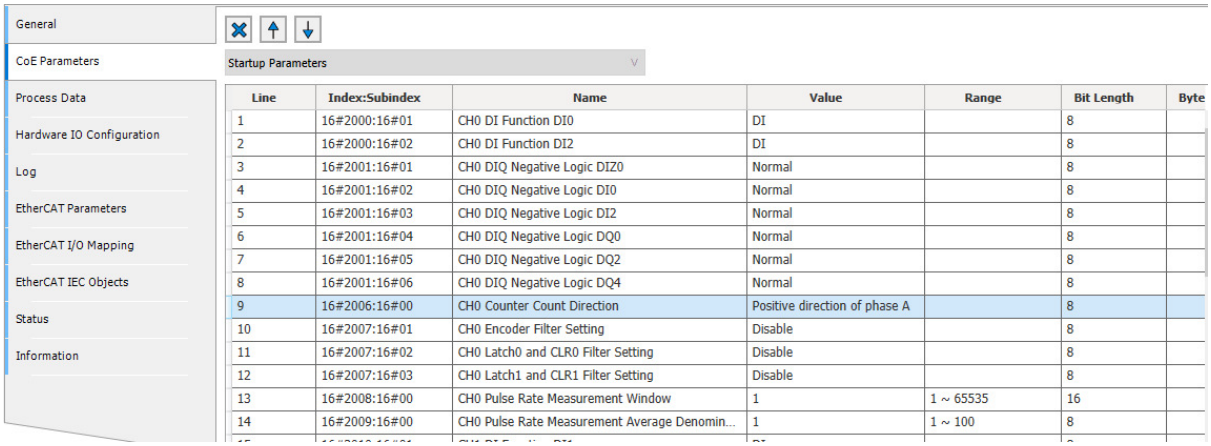
- You can select and right-click the parameter to add the selected parameter to the **Favorites**. Click  on the toolbar to go into the online mode, and then you can start to upload and download the parameters.



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.

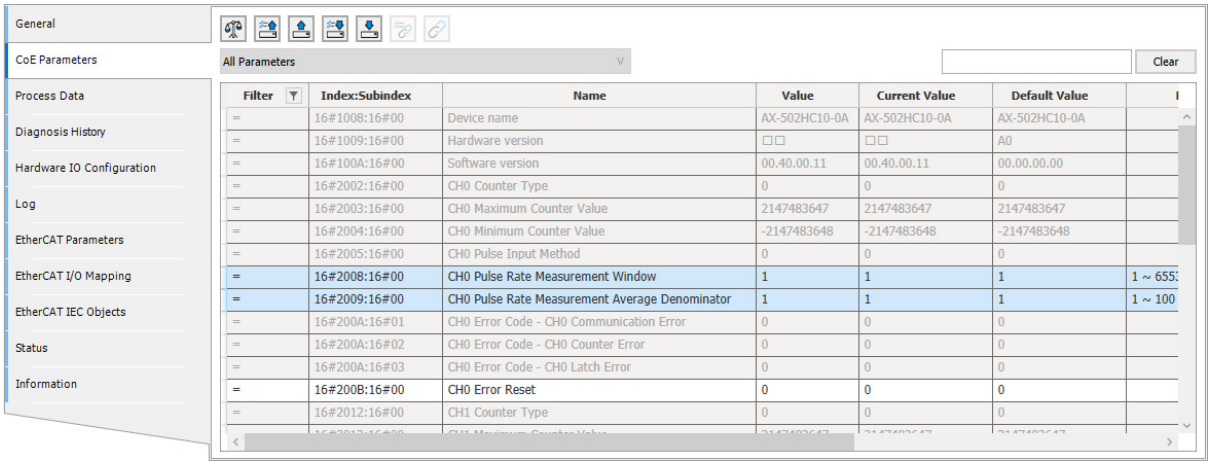


Line	Index:Subindex	Name	Value	Range	Bit Length	Byte
1	16#2000:16#01	CH0 DI Function DI0	DI		8	
2	16#2000:16#02	CH0 DI Function DI2	DI		8	
3	16#2001:16#01	CH0 DIQ Negative Logic DIZ0	Normal		8	
4	16#2001:16#02	CH0 DIQ Negative Logic DI0	Normal		8	
5	16#2001:16#03	CH0 DIQ Negative Logic DI2	Normal		8	
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

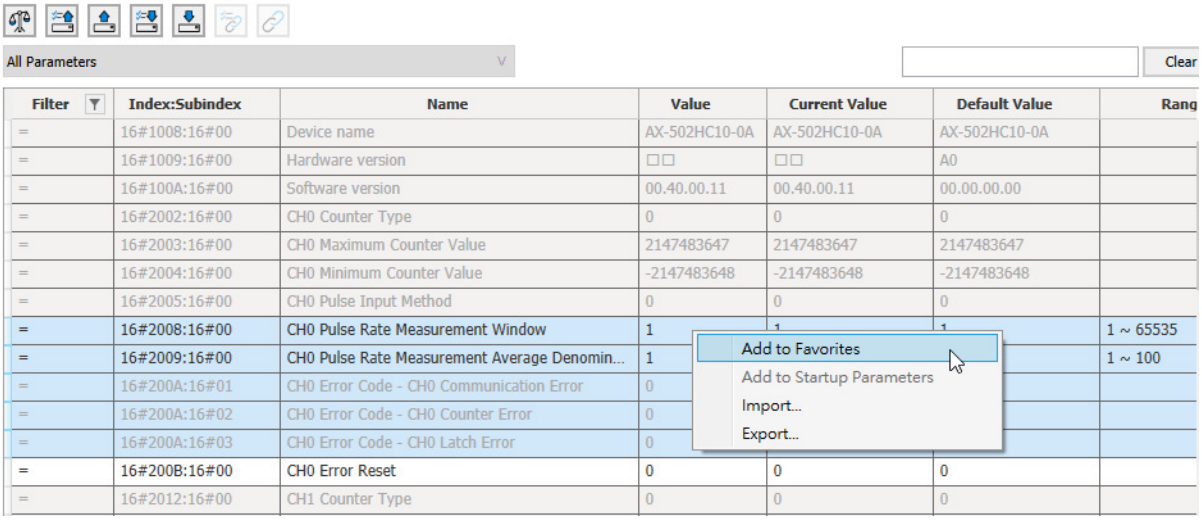
- You can find all the CoE parameters here. Click  on the toolbar to go into the online mode first, and then you can start to upload and download the parameters.
- After clicking the upload button, you can see the current values in **Current Value** column.
- You can edit the values of parameters in **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	1 ~ 655
=	16#2009:16#00	CH0 Pulse Rate Measurement Average Denominator	1	1	1	1 ~ 100
=	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.

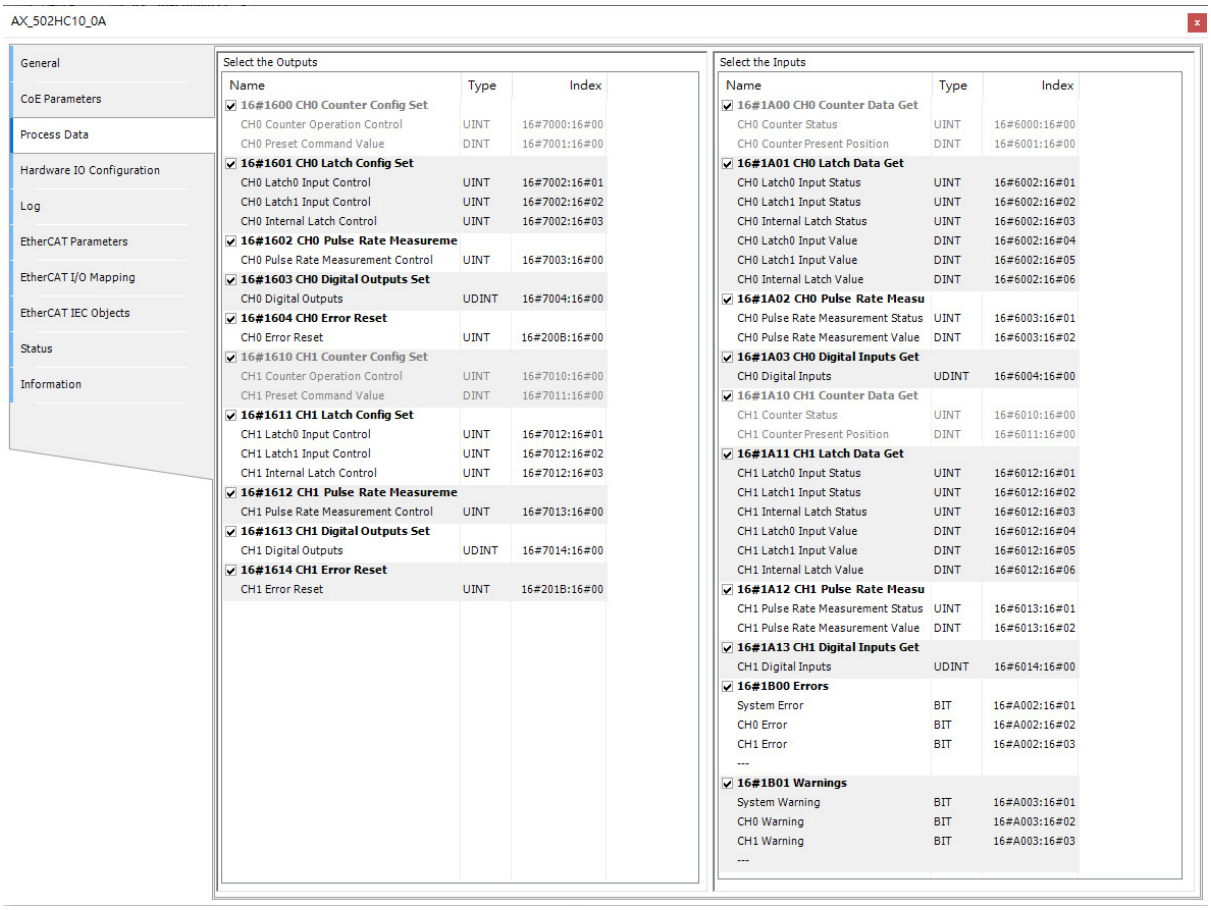
- You can select and right-click the parameter to add the selected parameter to the Favorites.



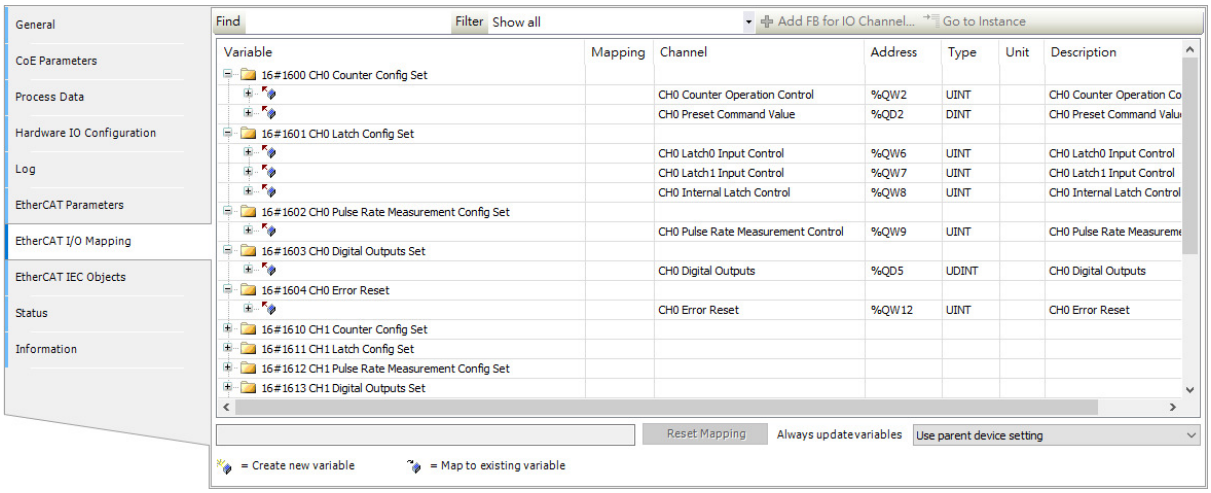
Function	Description
Add to Favorites	Add the selected to Favorites
Add to Startup Parameters	Add the selected to Startup Parameters
Import…	Import the selected
Export…	Export the selected

6.2.4.3 Process Data

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

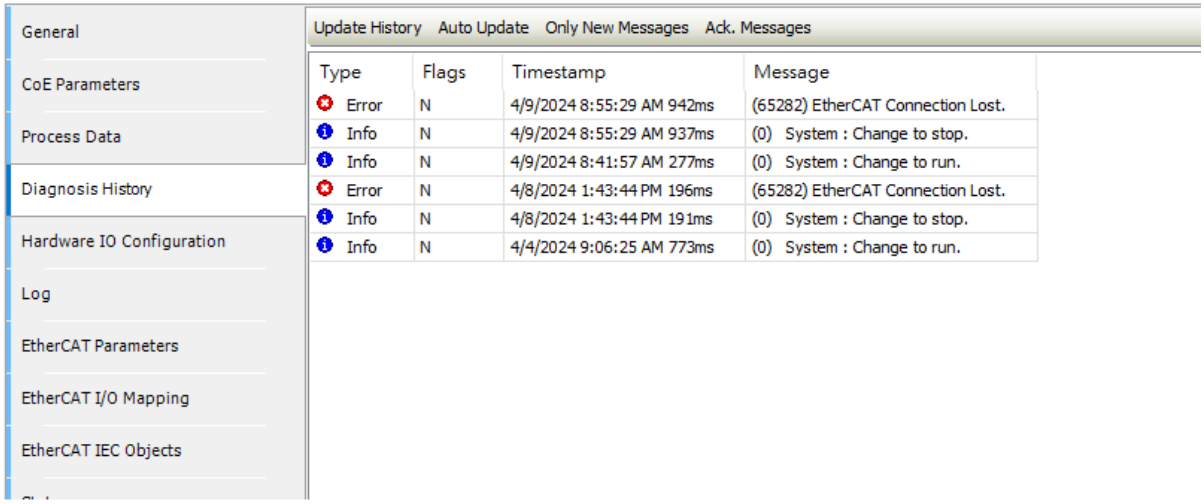


(2) Click  on the toolbar to go into the online mode. In the **EtherCAT I/O Mapping** tab, you can find the variables, current value, status and error codes for each channel.



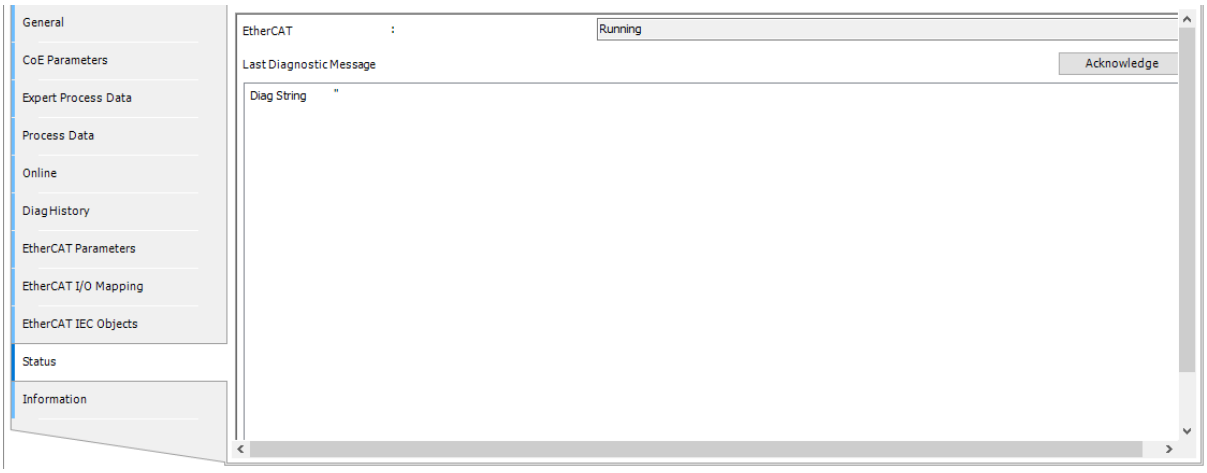
6.2.4.4 Diagnosis History

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

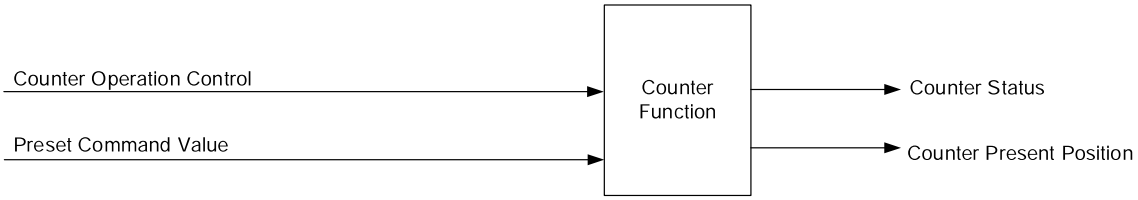
In this section, the contents include basic operation settings and object descriptions of the high-speed counter modules in EtherCAT mode, which is Delta user-defined mode.

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:



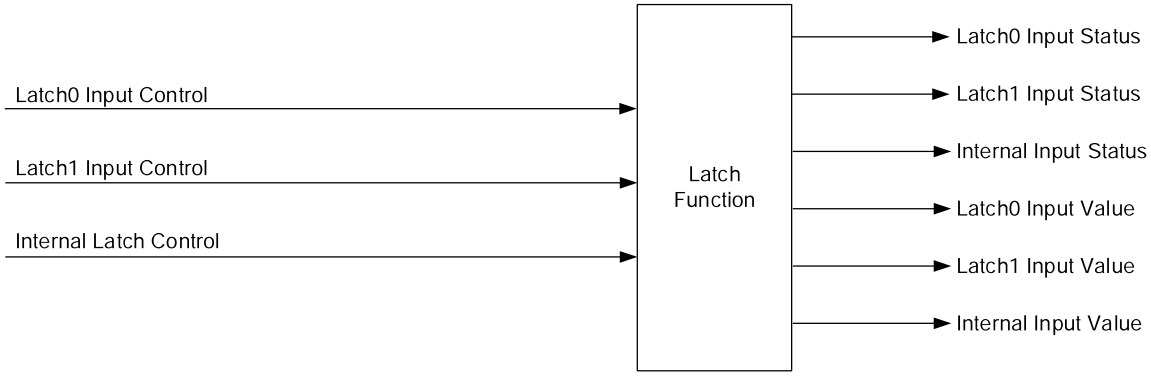
List of related objects:

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, and each Counter Function supports two sets of Latches.

The architecture of Latch Function:



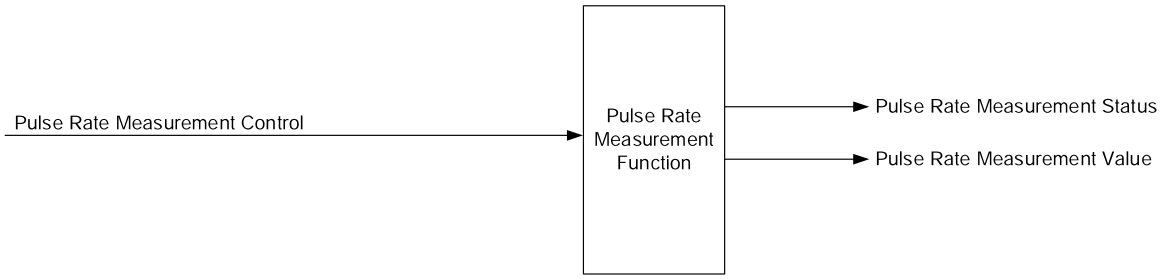
List of related objects:

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 descriptions 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 3: Z*1 10: LATCH0 20: CLR0	USINT	RW	0
	16#02	CH0 DI Function DI2	0: DI 3: Z*1 11: LATCH1 21: CLR1	USINT	RW	0
16#2010	16#01	CH1 DI Function DI1	0: DI 3: Z*1 10: LATCH0 20: CLR0	USINT	RW	0
	16#02	CH1 DI Function DI3	0: DI 3: Z*1 11: LATCH1 21: CLR1	USINT	RW	0

*1: Only available for AX-502HC70-0A.

- **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.) *2
3. CLR (The CH0/CH1 counter value is cleared after the input is triggered.) *3
4. Phase Z (The CH0/CH1 counter value is cleared after the input is triggered) *3

*2: If DI Function is set to Latch, corresponding logic polarity and filter settings will not take effect until the Latch function is enabled next time. See section 6.2.6.2.2 for more information.

*3: If DI Function is set to DI/CLR/Z, corresponding logic polarity and filter settings will not take effect until the Counter function is enabled next time. See section 6.2.6.2.1 for more information.

6.2.6.1.2 DIQ Negative Logic (16#2001 and 16#2011)

The following parameters are applicable to AX-502HC10-0A and AX-502HC20-0A:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2001	16#01	CH0 DIQ Negative Logic DIZ0	DIQ 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

The following parameters are applicable to AX-502HC70-0A:

Index	Subindex	Name	Description	Data type	Attr.	Default
16#2001	16#01	CH0 DIQ Negative Logic DI0	DIQ logic polarity selection	USINT	RW	0
	16#02	CH0 DIQ Negative Logic DI2		USINT	RW	0
	16#03	CH0 DIQ Negative Logic DQ0		USINT	RW	0
16#2011	16#01	CH1 DIQ Negative Logic DI1		USINT	RW	0
	16#02	CH1 DIQ Negative Logic DI3		USINT	RW	0
	16#03	CH1 DIQ Negative Logic DQ1		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
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: 0.04 us 6: 0.48 us 9: 1.28 us	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	UINT	RO	0

Communication error:

When a communication error occurs in high-speed counter modules,

- (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 high-speed counter modules 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 high-speed counter modules, 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 high-speed counter modules 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 high-speed counter modules, 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 high-speed counter modules changes from SafeOP to OP, the latch flags and latch errors of CH0 and CH1 are automatically cleared.

To clear the channel errors of high-speed counter modules, 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 high-speed counter modules, 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

Index	Subindex	Name	Description	Data type	Attr.	Default
	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
	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

Index	Subindex	Name	Description	Data type	Attr.	Default
	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 introduction 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 the 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 triggering 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 setting 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 triggering 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: Halt Enable	If the value of the bit changes from 0 to 1, the Counter function is halted.
Bit8-Bit15: Reserved	Bit8-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	Status of CH0/CH1 counter	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 the 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.

Parameter	Function
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.
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 triggering 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 triggering of IZ0 can reset the value of Counter Present Position to 0.
Bit8: Halt Enabled	Once Bit8 of Counter Operation Control: Halt Enable is enabled, then Bit8 of Counter Status: Halt Enabled will immediately change from 0 to 1.
Bit9-Bit15: Reserved	Bit9-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 introduction 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 the 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.

Parameter	Function
Bit1: Latch0 Input Trigger Condition (Oneshot Mode/Continuous Mode)	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.
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 the 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.
Bit1: Latch1 Input Trigger Condition (Oneshot Mode/Continuous Mode)	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.
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 the 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 introduction 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 the 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.
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 the 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.

Parameter	Function
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 the 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 introduction 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 the 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.
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 introduction 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 the 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.

Parameter	Function
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 a high-speed counter module receives 200,000 pulses which are output at a constant velocity, you want to use the module's 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 the high-speed counter module is in DC mode with the EtherCAT cycle of 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 the high-speed counter module is in FreeRun mode with the fixed internal calculation time interval of 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 introduction 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 the 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*1	0: Pin DQ2 OFF 1: Pin DQ2 ON
Bit2: Pin DQ4 setting*1	0: Pin DQ4 OFF 1: Pin DQ4 ON
Bit3-Bit15: Reserved	Bit3-Bit15 are reserved.

*1: Only available for AX-502HC10-0A and AX-502HC20-0A.

Each bit of CH1 Digital Outputs has a different function. The functions of the 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 *1	0: Pin DQ3 OFF 1: Pin DQ3 ON
Bit2: Pin DQ5 setting *1	0: Pin DQ5 OFF 1: Pin DQ5 ON
Bit3-Bit15: Reserved	Bit3-Bit15 are reserved.

*1: Only available for AX-502HC10-0A and AX-502HC20-0A.

Below is an introduction 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 the bits are described as follows:

The following tables are 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.

The table below is applicable to AX-502HC10-0A and AX-502HC20-0A:

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.

The table below is applicable to AX-502HC70-0A:

Parameter	Function
Bit0: Pin DI0 status	0: Pin DI0 OFF 1: Pin DI0 ON
Bit1: Pin DI2 status	0: Pin DI2 OFF 1: Pin DI2 ON
Bit2-Bit15: Reserved	Bit2-Bit15 are reserved.

Each bit of CH1 Digital Inputs has a different function. The functions of the bits are described as follows:

The following tables are 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.

The table below is applicable to AX-502HC10-0A and AX-502HC20-0A:

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.

The table below is applicable to AX-502HC70-0A:

Parameter	Function
Bit0: Pin DI1 status	0: Pin DI1 OFF 1: Pin DI1 ON

Parameter	Function
Bit1: Pin DI3 status	0: Pin DI3 OFF 1: Pin DI3 ON
Bit2-Bit15: Reserved	Bit2-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 introduction 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 the high-speed counter module can clear the communication error only when the EtherCAT slave is in OP state when the error reset is executed.

Parameter	Function
Bit0: Error Reset	0 -> 1: Execute the Error Reset command.
Bit1-Bit15: Reserved	Bit1-Bit15 are reserved.

Below is an introduction 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 to16#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 16#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

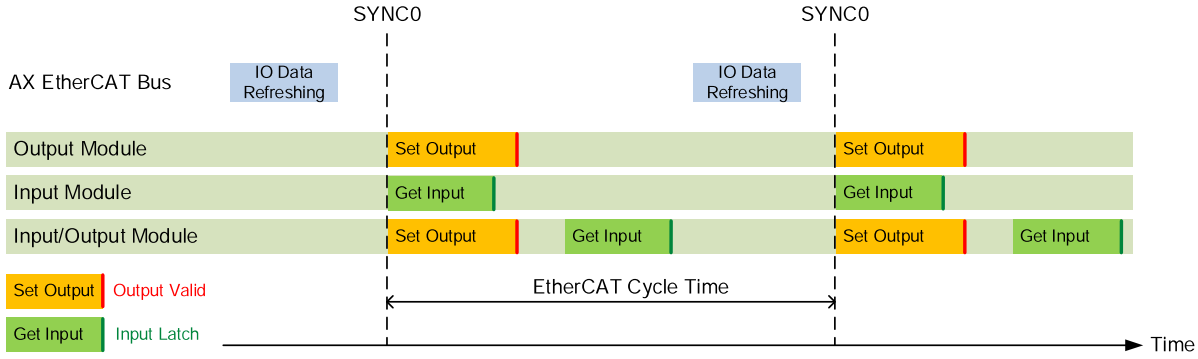
The I/O values of each module are refreshed based on its own cycle. There is no synchronization among modules.

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.

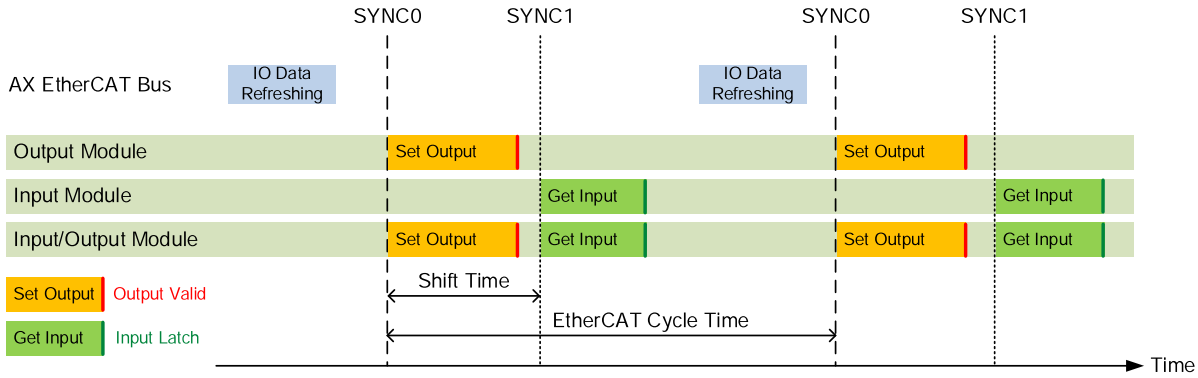
- SYNC0

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 PDO parameters.

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

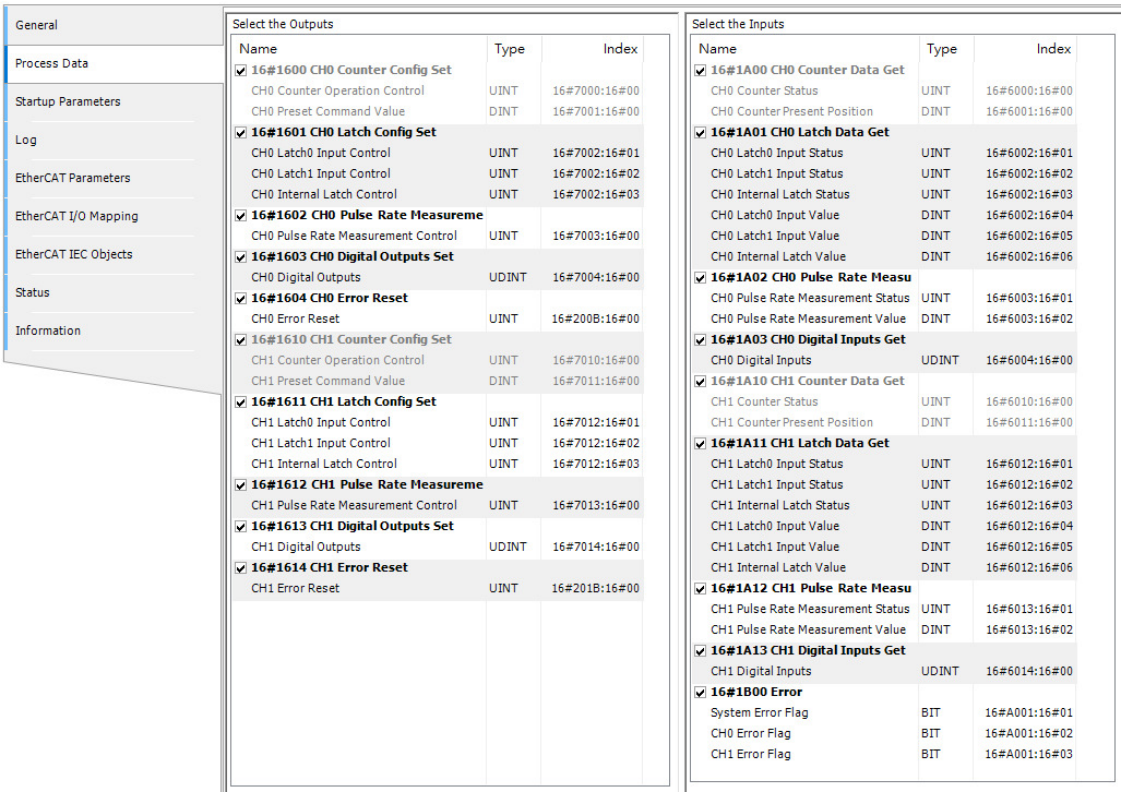
Inputs (TxPDO):

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

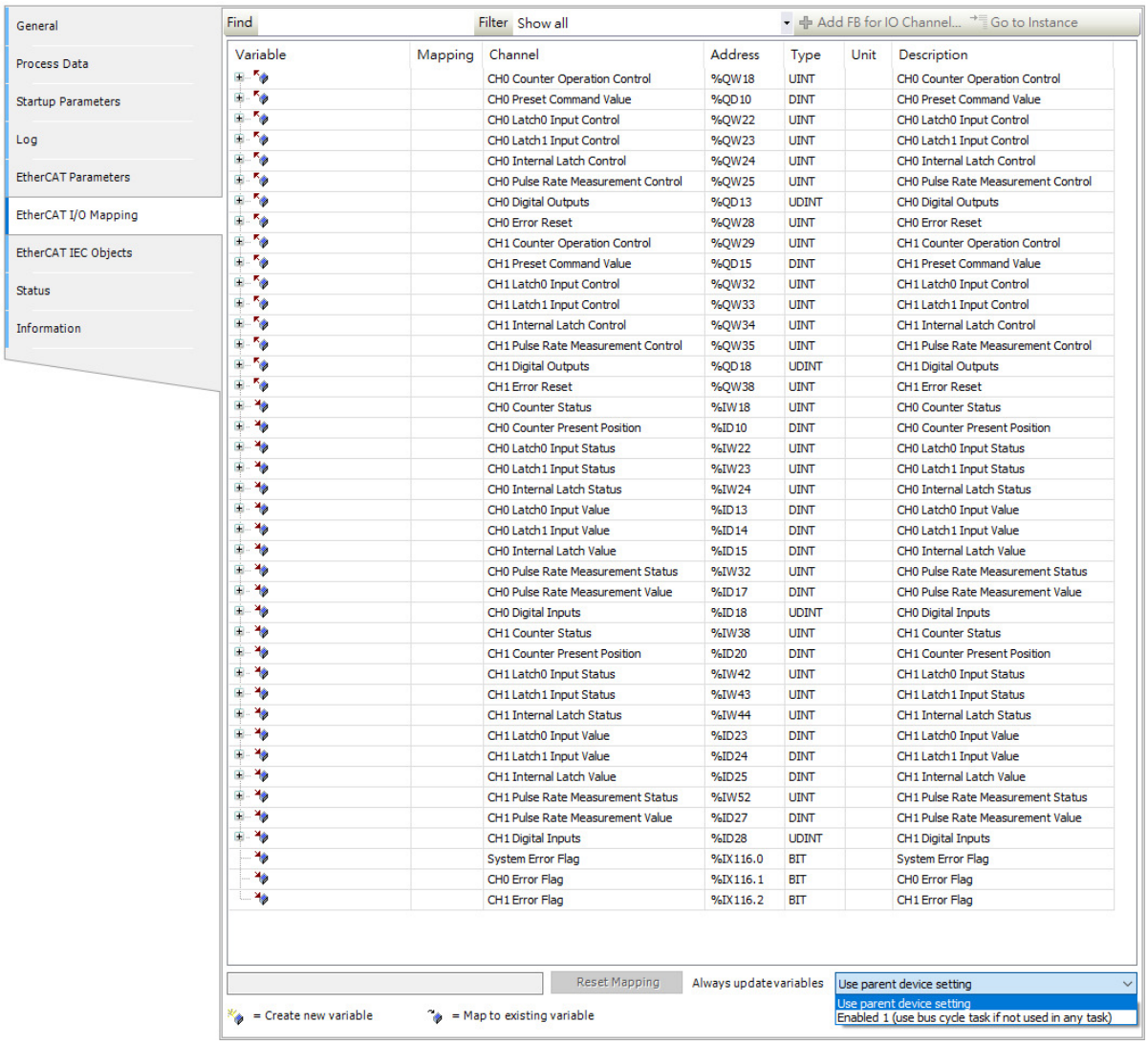
Go to the **Process Data** tab and select the data that you'd like to monitor.

- 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 defines whether or not the I/O variables in the bus cycle task are updated.

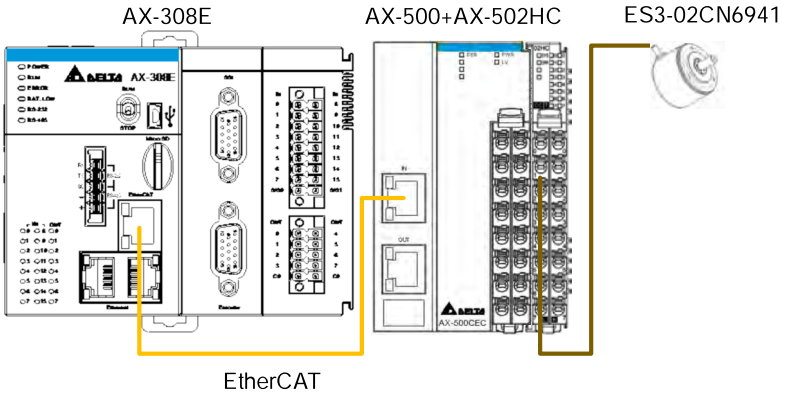
Option	Description
Use parent device setting	DIADesigner-AX updates the I/O variables according to the setting for the "Always update variables" in the CPU.
Enabled1 (use bus cycle task if not used in any task)	DIADesigner-AX updates the I/O variables in the bus cycle task if they are not used in any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

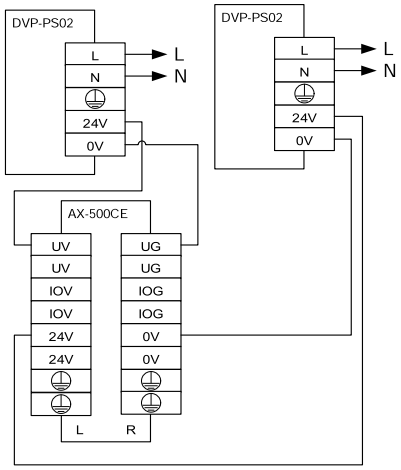
The AX-308E PLC makes a connection with AX-500 plus AX-502HC through the EtherCAT port, reading the encoder via AX-502HC.



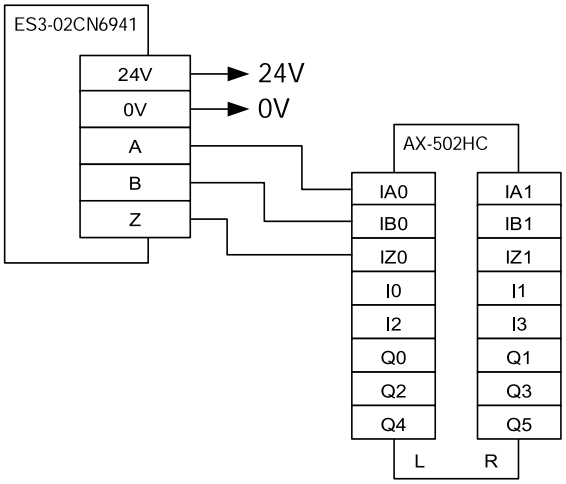
- **Hardware preparation**

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



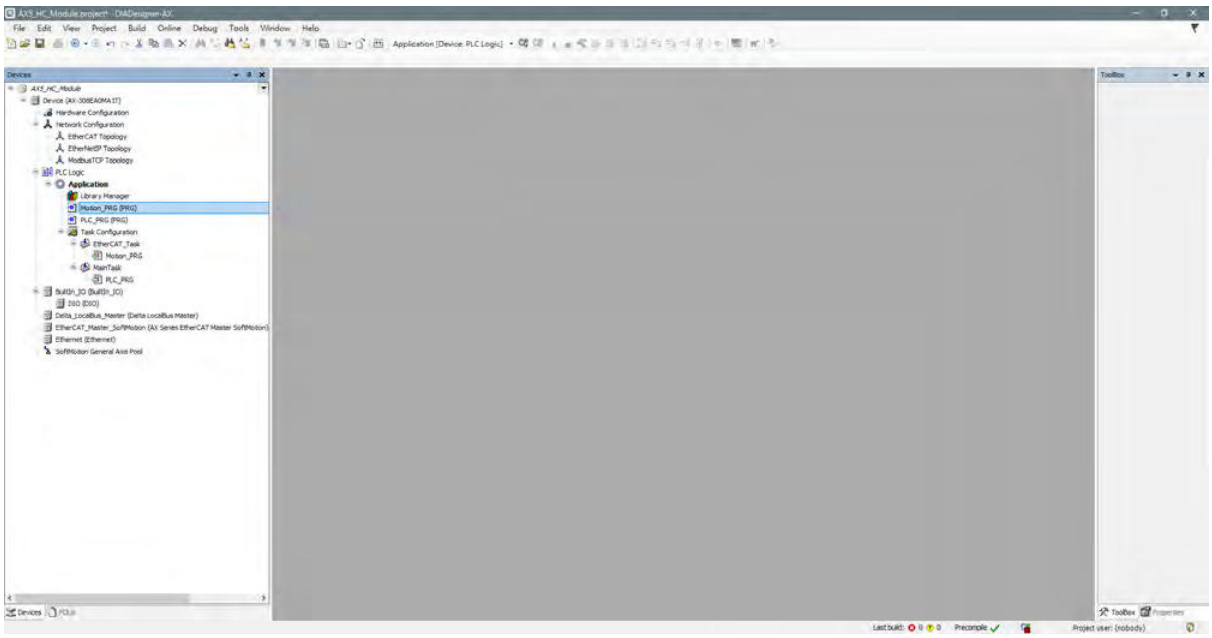
- The wiring diagram for AX-502HC and ES3-02CN6941



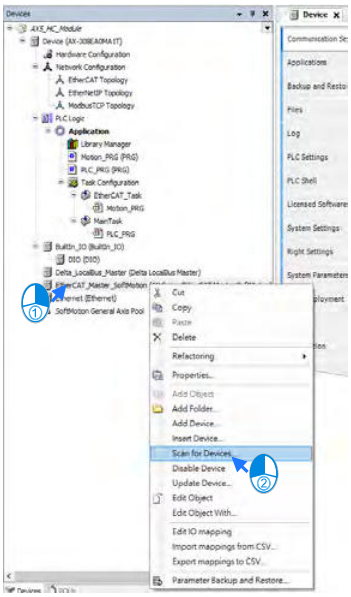
6.2.9.2 Create a Project and Write a Program

1. Start the DIADesigner-AX software.

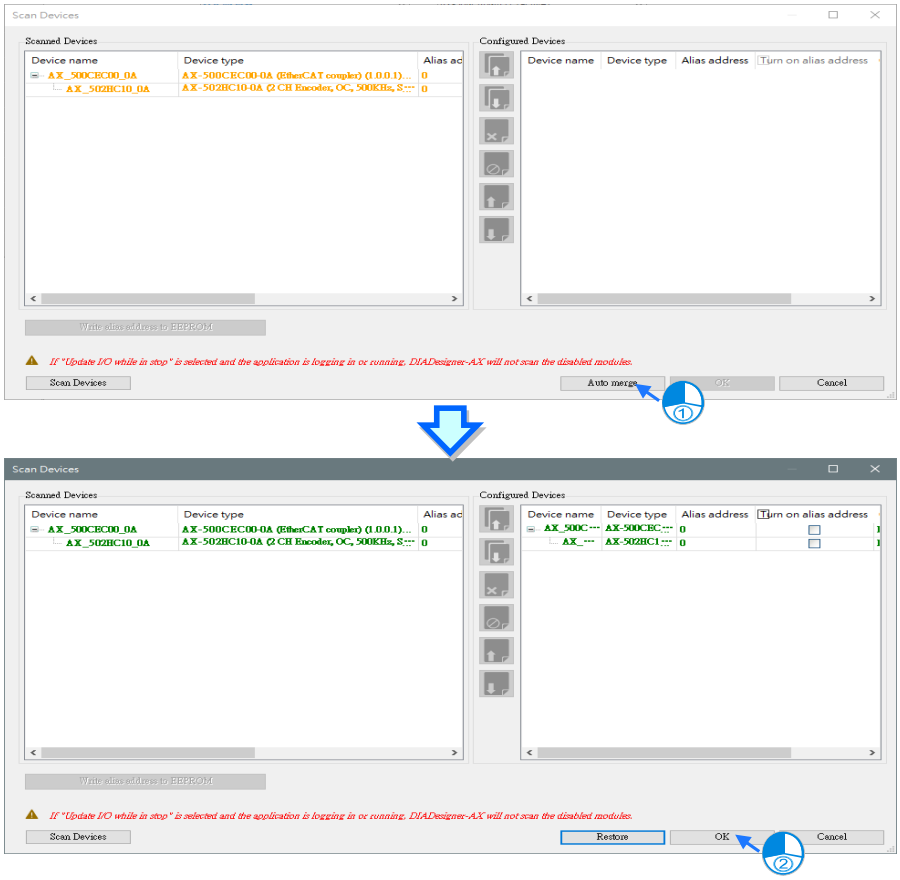
2. Open a new project for AX-308E.



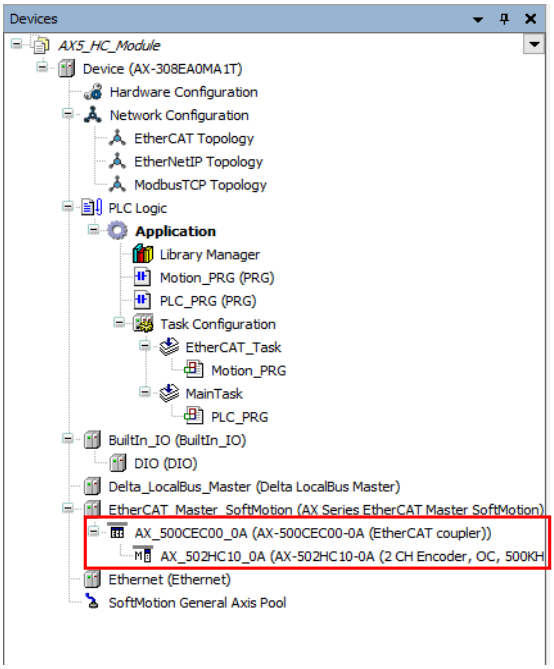
3. Right-click **EtherCAT_Master_SoftMotion** in the Devices tree, and then click **Scan for Devices**.... from the context menu.



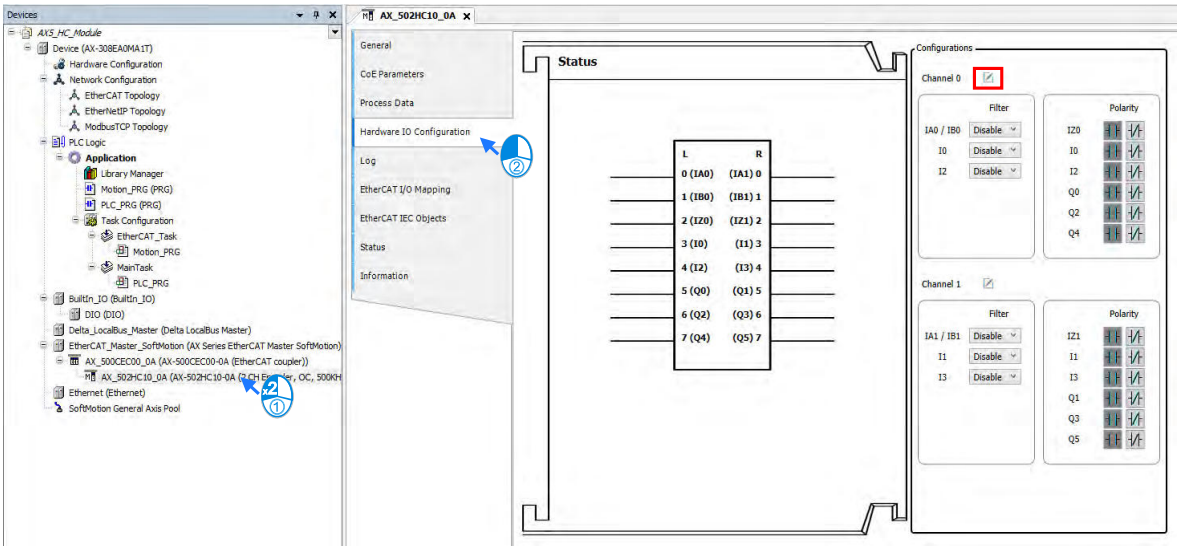
4. After entering the **Scan Devices** window, click **Auto Merge** and then **OK** in the following figures.



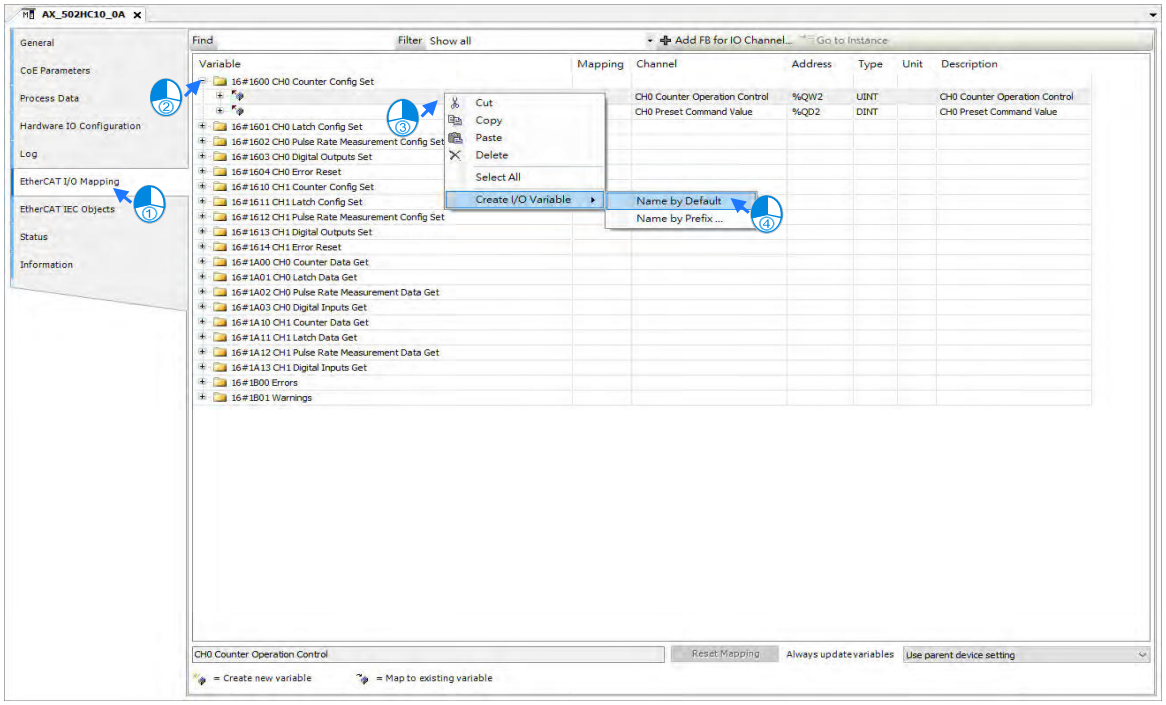
5. After adding devices is completed, the AX-502HC module will be added to the device tree.



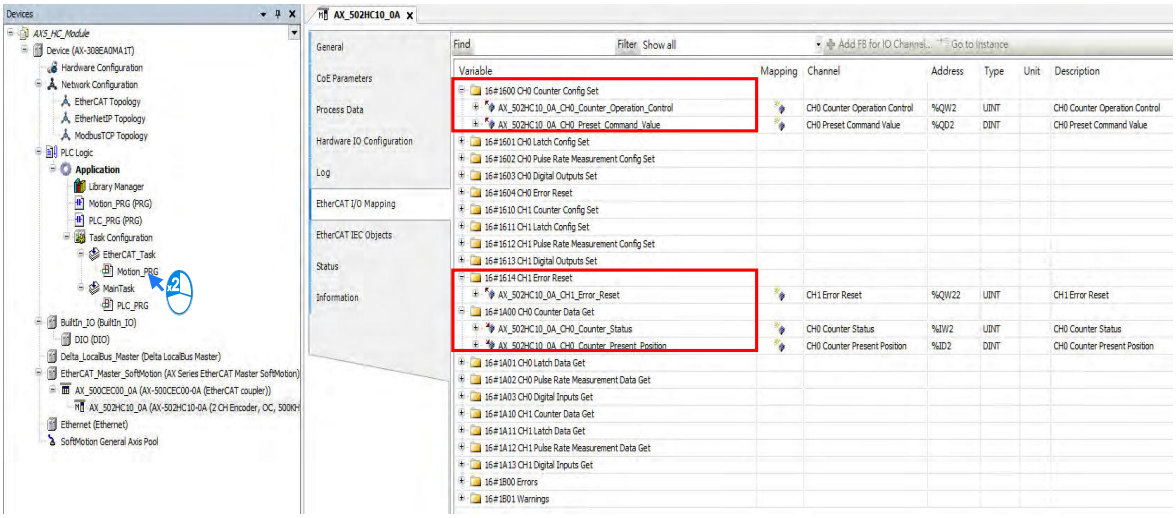
6. In the device tree, double-click **AX_502HC10_0A** and then in its **Hardware IO Configuration** tab, click to set up the configurations you need.



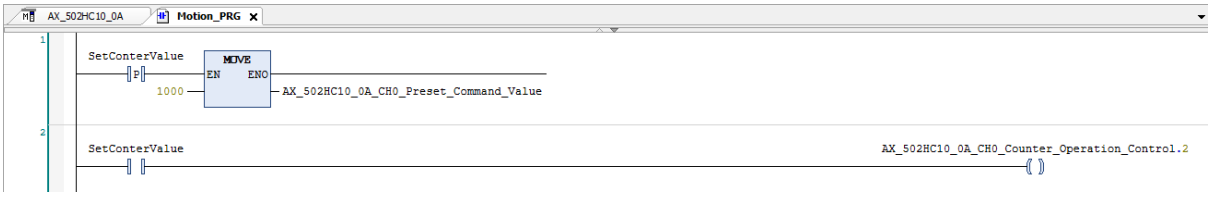
7. After setting up the hardware configurations is done, click the **EtherCAT I/O Mapping** tab to declare the variables to be used.



8. Double-click on **Motion_PRG** after the declaration of variables for parameters.

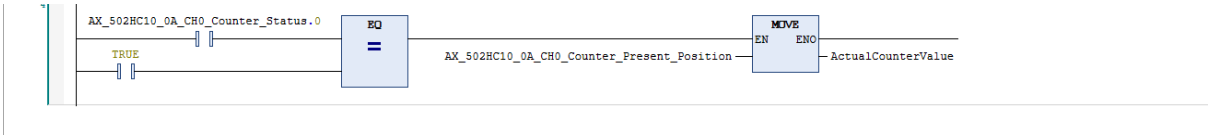


9. Enter the **Motion-PRG** page, where you can start programming with the initial counter value set to 1000 and execute the program.



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 module's DI2 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.