CMC-EC01

EtherCAT Operation Manual

Applicable Products:

CMC-EC01 (C2000 Plus / CH2000 Option Card)

http://www.deltaww.com/

DELTA_IA-MDS_VFD-C2000 Series_CMM-EC01_OM_EN_20230221

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Caution

- ✓ This operation manual provides information on specifications, installation instructions, basic operations/configurations, and details on network communication protocols.
- ✓ The AC motor drive is a sophisticated electronic device. For the safety of the operator and your mechanical equipment, only qualified electrical engineers are allowed to perform the installation/trial runs and make parameter adjustments. If you have any question or concern, please contact your local Delta distributor. Our professional staff will be very glad to help you.
- ✓ Please read this manual carefully and follow the instructions to avoid device damage or personal injury.

Application	Drive Firmware Version: C2000 Plus V3.07 / CH2000 V2.07 or above CMC-EC01 Option Card Firmware Version: V3.00 or above

Table of Contents

Issued Edition: 02
Issued Date: February, 2023

1. Introduction to Option Card

1.1 Communication Specification

■ Ethernet Specifications

Item	Specification
Interface	RJ45
Port Number	2
Communication Mode	IEEE802.3, IEEE802.3u
Cable	Category 5e shielding 100 M
Transmission Speed	10 / 100 Mbps Auto-Defect
Communication Protocol	EtherCAT
Synchronization Mode	DC Mode: Distributed Clock Mode Free Run mode (Asynchronous)
Communication Object	Process Data Object (PDO) Service Data Object (SDO) Emergency Object (EMCY)
Application Layer Specifications	CiA402 Drive Profile
Supported CiA402 Operation Mode	Profile Position Mode Profile Torque Mode Velocity Mode Homing Mode Cyclic Synchronous Position Mode Cyclic Synchronous Torque Mode

■ Environment Conditions

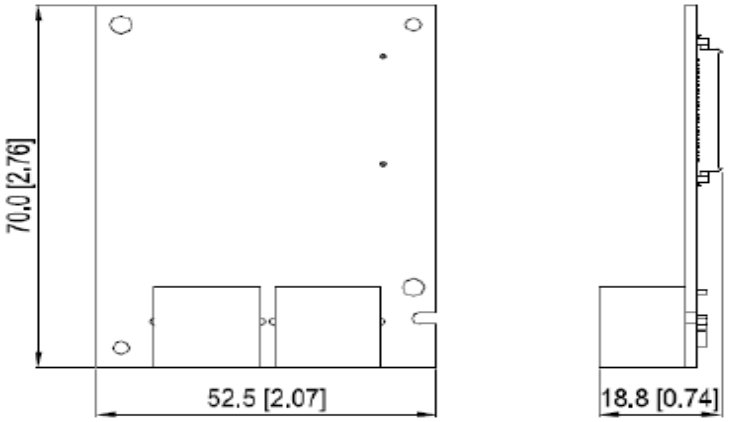
Item	Specification
Noise Immunity	ESD (IEC 61800-5-1, IEC 6100-4-2) EFT (IEC 61800-5-1, IEC 6100-4-4) Surge Test (IEC 61800-5-1, IEC 6100-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 6100-4-6)
Operating Temperature	-10–50°C (temperature), 90% (humidity)
Storage Temperature	-25–70°C (temperature), 95% (humidity)
Vibration/Shock Resistance	International Standard Specification IEC 61800-5-1, IEC 60068-2-6 / IEC 61800-5-1, IEC 60068-2-27

■ Electrical Specifications

Item	Specification
Power Voltage	15 V_{DC} (supplied by the drive)
Power Consumption	0.8 W
Insulation Voltage	500 V_{DC}
Weight (approx.)	27 g

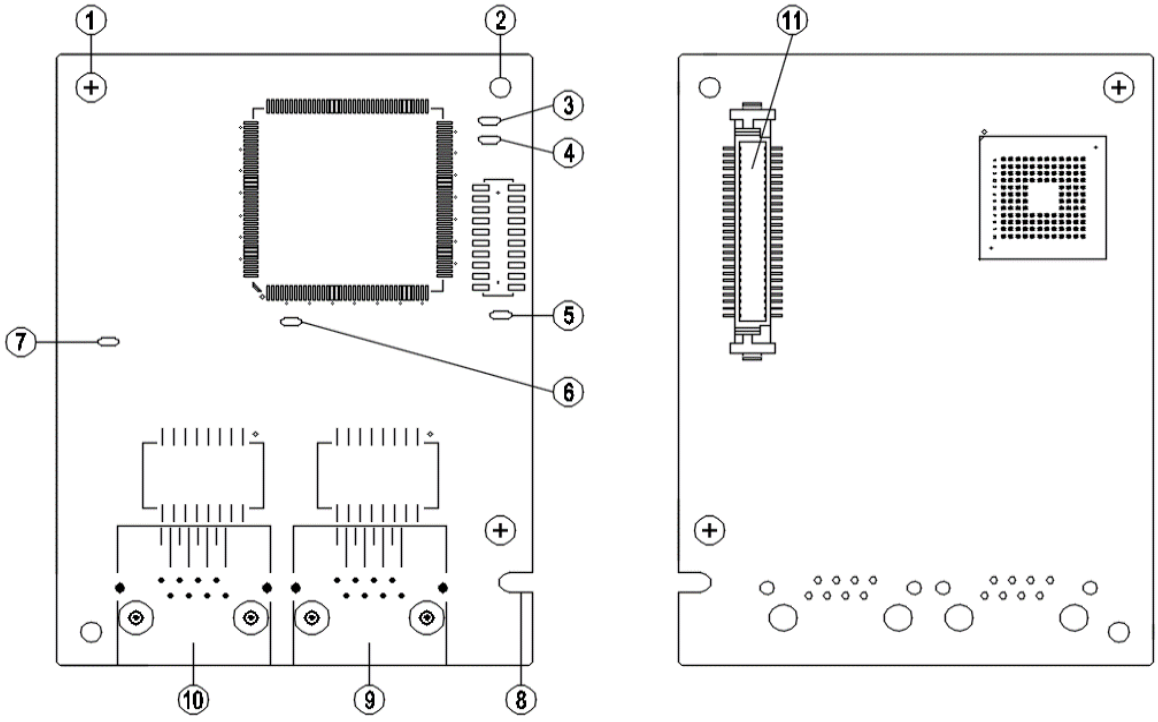
1.2 Product Profile

1.2.1 Dimension



Umit: mm [inch]

1.2.2 Components Overview

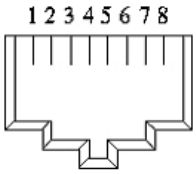


① Screw fixing hole	⑦ IN LINK indicator
② Option card positioning hole	⑧ Fool-proof groove
③ RUN indicator	⑨ RJ45 port
④ ERR indicator	⑩ RJ45 port
⑤ POWER indicator	⑪ Control board port
⑥ OUT LINK indicator	

1.3 LED Indicators

Name	Indicator Status		Indication
RUN	Green Light	Always ON	Normal operation
		Flashes	Pre-operation (ON/OFF 200 ms)
			Safe mode operation (ON 200 ms / OFF 1000 ms)
		OFF	Initial state
ERROR	Red Light	Flashes	Basic configuration error (ON/OFF 200 ms)
			State switching error (ON 200 ms / OFF 1000 ms)
			Time-out (ON 200 ms twice / OFF 1000 ms)
		OFF	No error
IN LINK	Green Light	Always ON	Internet connection is normal
		Flashes	Network in operation
		OFF	Not connected to the Internet
OUT LINK	Green Light	Always ON	Internet connection is normal
		Flashes	Network in operation
		OFF	Not connected to the Internet

1.4 RJ45 PIN Definition

RJ45 Diagram	PIN No.	Definition	Description
	1	Tx+	Positive pole for data transmission
	2	Tx-	Negative pole for data transmission
	3	Rx+	Positive pole for data reception
	4	--	N / C
	5	--	N / C
	6	Rx-	Negative pole for data reception
	7	--	N / C
	8	--	N / C

1.5 Applicable Models

1.5.1 Applicable Model Versions

Drive Firmware Version	C2000 Plus V3.07 / CH2000 V2.07 or above
Communication Card Firmware Version	CMC-EC01 V3.00 or above

NOTE: This manual is applicable to C2000 Plus and CH2000 (hereinafter "C2000 series")

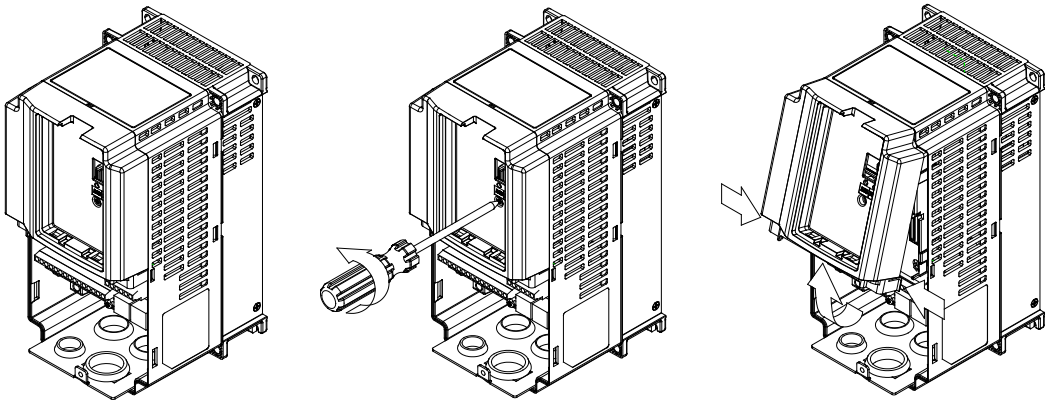
2. Installation

This chapter introduces how CMC-EC01 is connected with C2000 series, and how it is connected to the network.

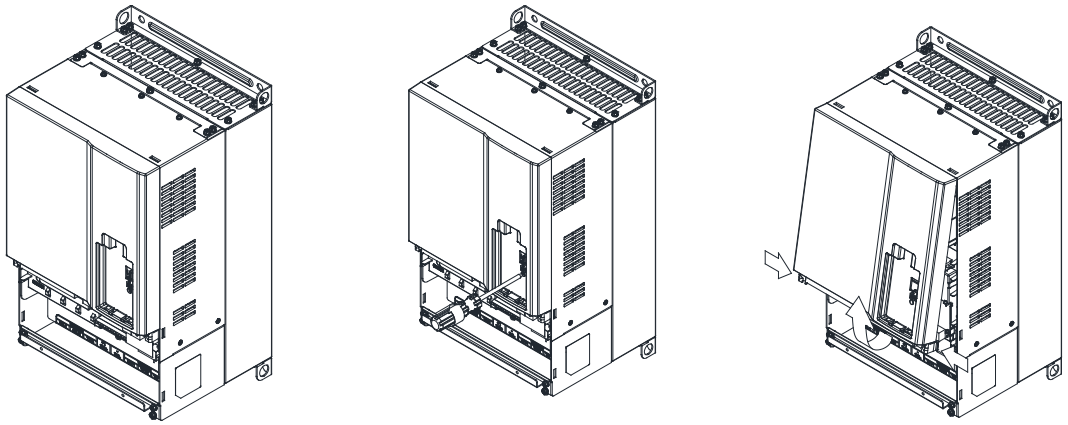
2.1 Mounting Position of Option Card

Before mounting the option card, remove the digital keypad and top cover. Be sure to follow the steps below to prevent damage to the drive during installation.

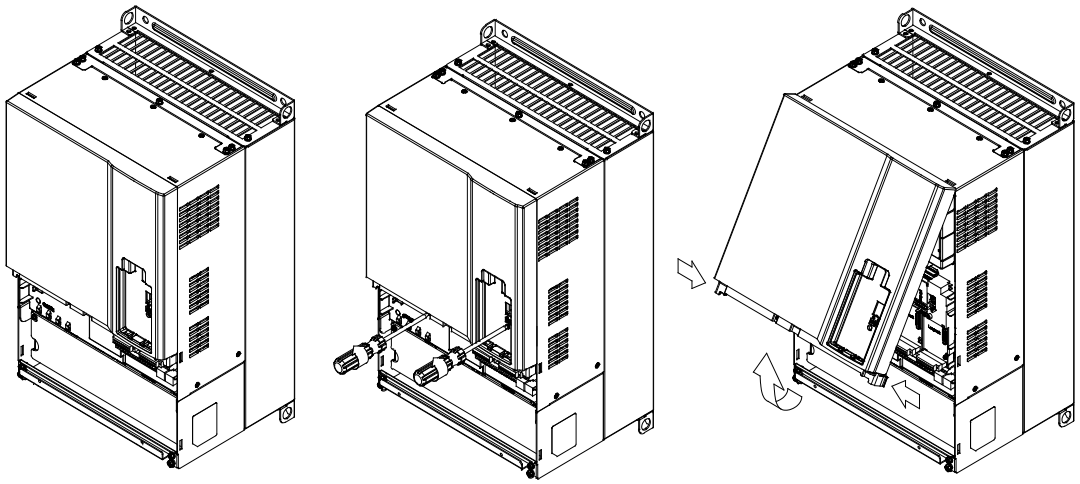
Frame A–C Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.8–1.0 Nm)



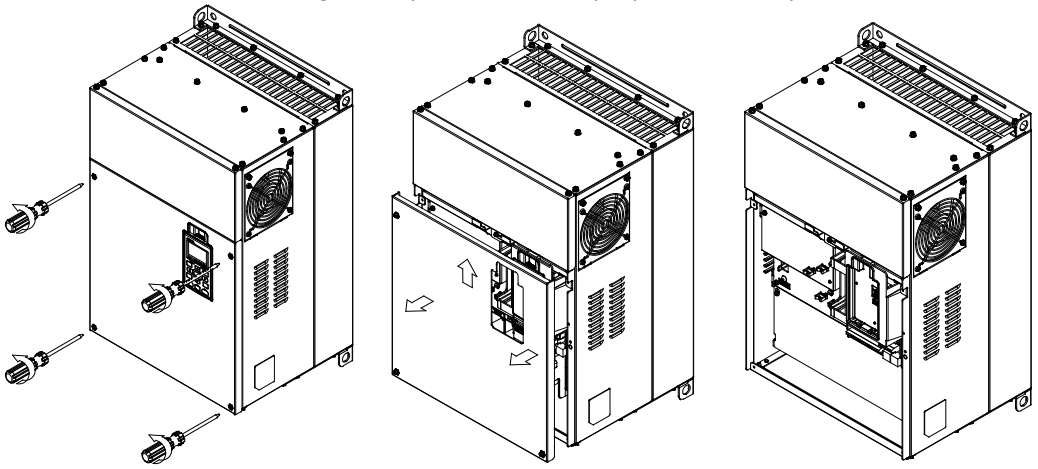
Frame D0 Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.8–1.0 Nm)



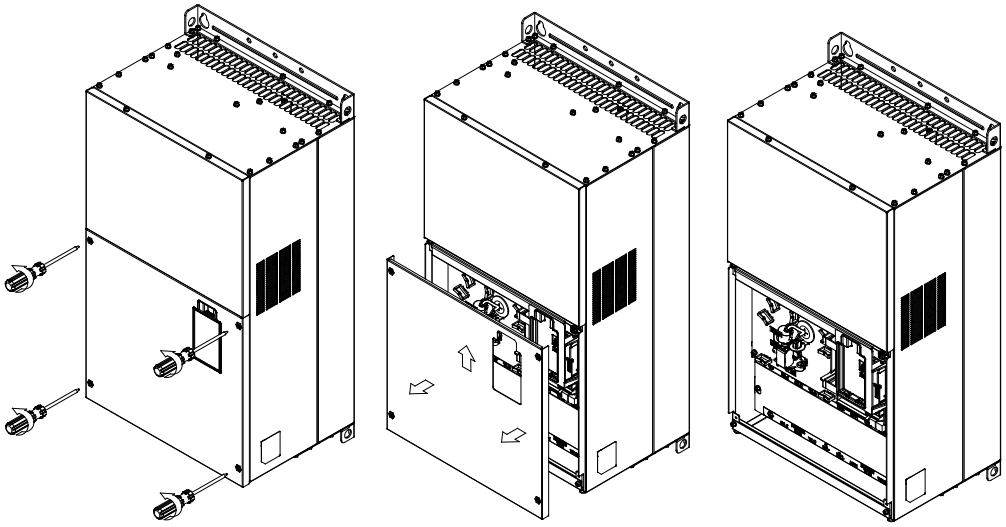
Frame D Screw torque: 8–10 kg-cm / (6.9–8.7 lb-in.) / (0.8–1.0 Nm)



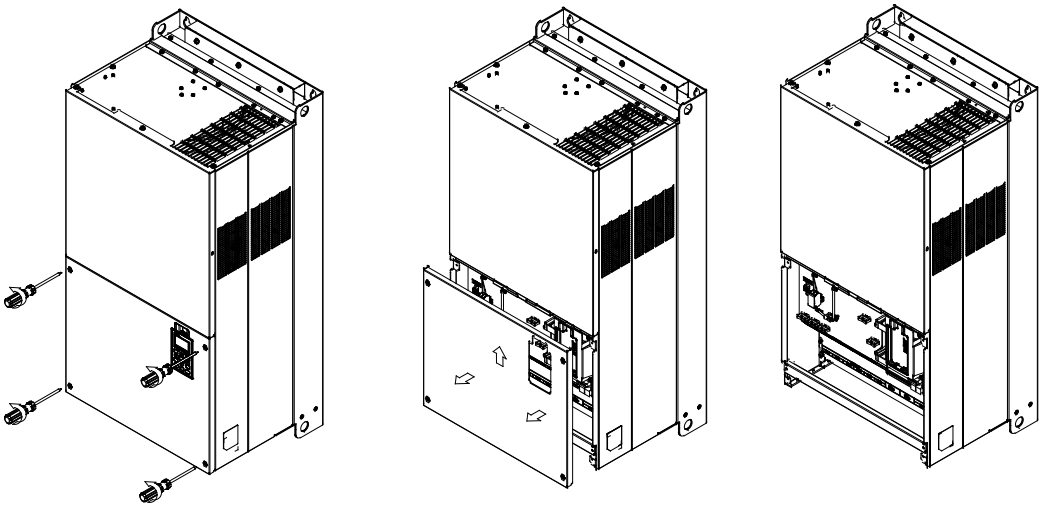
Frame E Screw Torque: 12–15 kg-cm / (10.4–13 lb-in.) / (1.2–1.5 Nm)

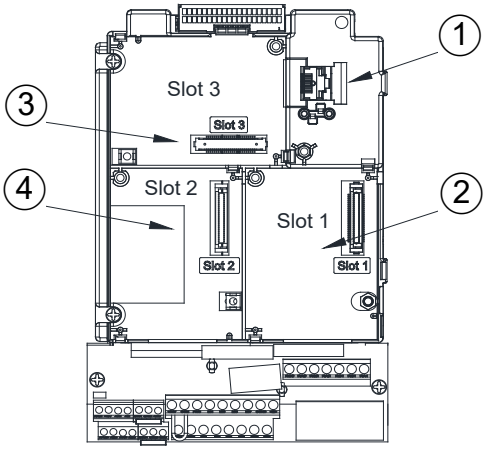


Frame F Screw Torque: 12–15 kg-cm / (10.4–13 lb-in.) / (1.2–1.5 Nm)



Frame G Screw Torque: 12–15 kg-cm / (10.4–13 lb-in.) / (1.2–1.5 Nm)





No.	Description
①	RJ45 (Socket) for digital keypad KPC-CC01 ● For details on digital keypad, see chapter 10 Digital Keypad in C2000 series user manuals. ● For details on optional accessory RJ45 extension cable, see chapter 10 Ditigal Keypad in C2000 series user manuals.
②	Communication extension card (Slot 1) CMC-PD01; CMC-DN01; CMC-EIP01; EMC-COP01; CMC-EC01; CMC-PN01
③	I/O & relay extension card (Slot 3) EMC-D42A; EMC-D611A; EMC-A22A; EMC-R6AA; EMC-BPS01
④	PG card (Slot 2) EMC-PG01L; EMC-PG02L; EMC-PG01O; EMC-PG02O; EMC-PG01U; EMC-PG02U; EMC-PG01R; EMC-PG01H

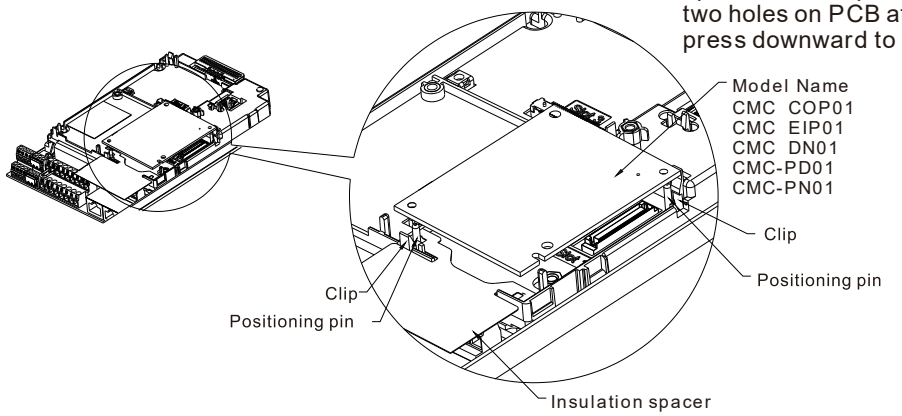
Screw specification for option card terminals

EMC-D42A; EMC-D611A; EMC-BPS01	Wire guage	0.2–0.5 mm^2 (26–20 AWG)
	Torque	5 kg-cm / (4.4 lb-in.) / (0.5 Nm)
EMC-R6AA	Wire guage	0.2–0.5 mm^2 (26–20 AWG)
	Torque	8 kg-cm / (7 lb-in.) / (0.8 Nm)
EMC-A22A	Wire guage	0.2–4 mm^2 (24–12 AWG)
	Torque	5 kg-cm / (4.4 lb-in.) / (0.5 Nm)
EMC-PG01L; EMC-PG02L; EMC-PG01O; EMC-PG02O; EMC-PG01U; EMC-PG02U; EMC-PG01R; EMC-PG01H	Wire guage	0.2–0.5 mm^2 (26–20 AWG)
	Torque	2 kg-cm / (1.73 lb-in.) / (0.2 Nm)

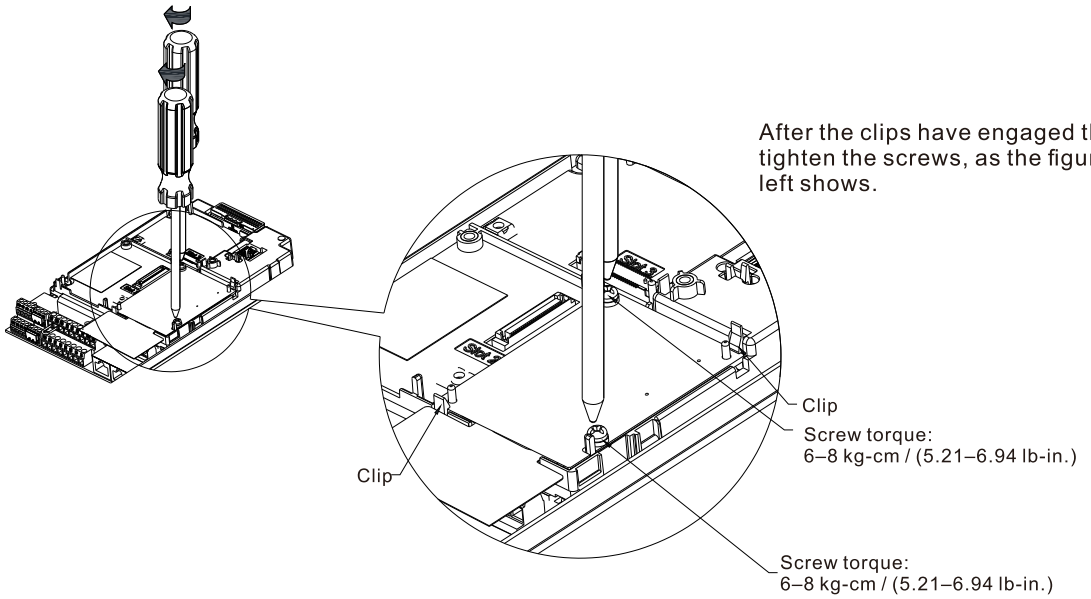
2.2 Mounting and Detatching Option Card

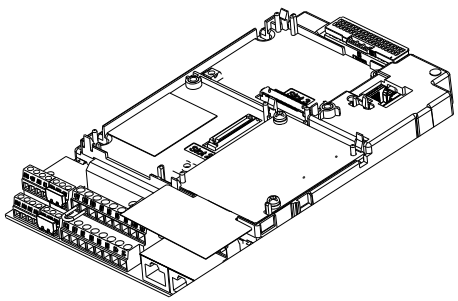
2.2.1 Moutning the Option Card

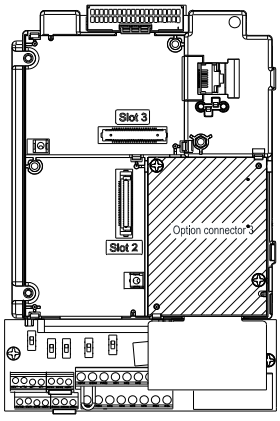
As the figure on the left shows, place the insulation spacer into the positioning pin first. Next, aim the two holes on PCB at the positioning pins, and then press downward to have the two clips engage the PCB.



After the clips have engaged the PCB, tighten the screws, as the figure on the left shows.

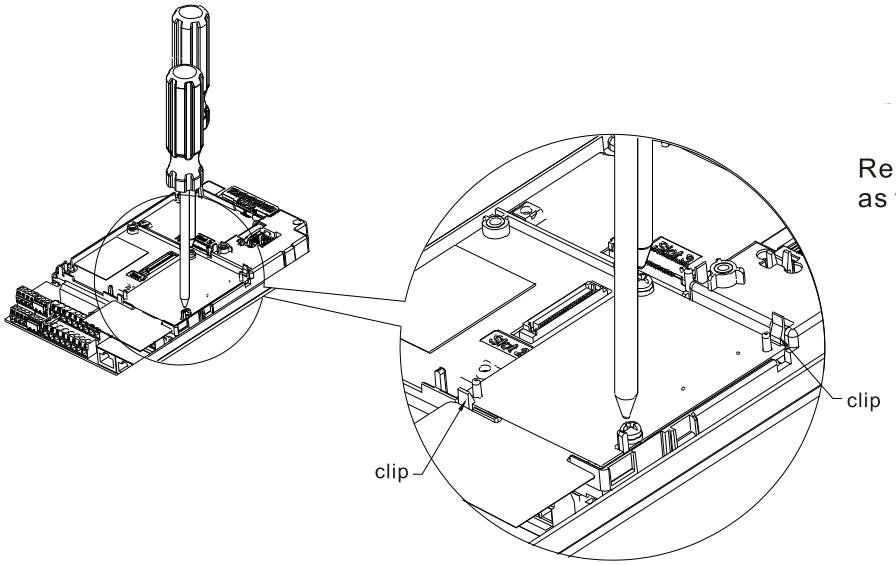




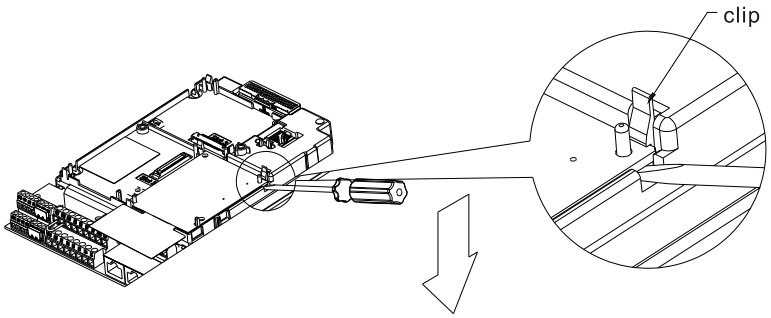


Assembly is completed, as the figure on the left shows.

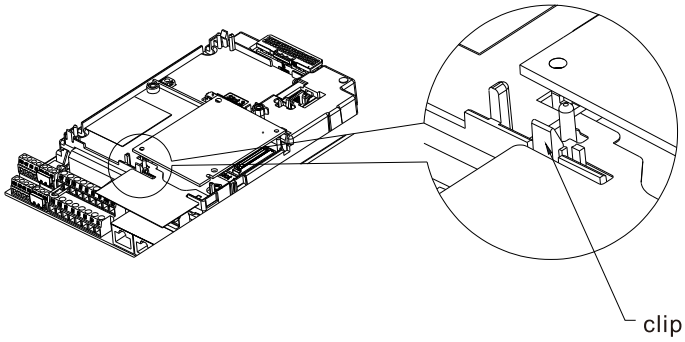
2.2.2 Detaching the Option Card



Remove the two screws,
as the figure on the left shows.



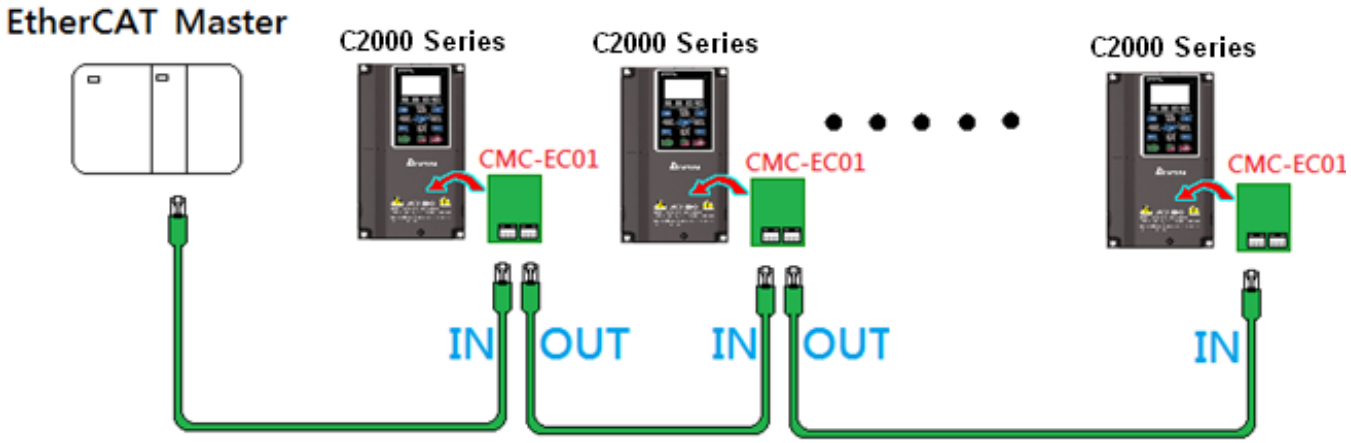
Pull open the clip. Then, use a slotted screwdriver to prize the PCB off the clip, as the figure on the left shows.



Pull open the other clip to detach the PCB,
as the figure on the left shows.

2.3 Network Connection

Pay attention to the connection method for EtherCAT because its packet delivery is directional. When front-mounting the communication card, the delivery direction for CMC-EC01 is from left (IN) to right (OUT). The diagram below shows the correct wiring for front-mounting CMC-EC01.



After connecting CMC-EC01 with C2000 series is finished, check if Pr.09-60 is displayed as "6" (EtherCAT). If not, verify the drive version and check if CMC-EC01 is correctly installed.

2.4 Drive Parameter Setting

When operating C2000 series using CMC-EC01, verify the following parameter settings:

Parameter No.	Settings / Displayed ValueDisplayed Value	Function Description
00-20	8	Set communication card as the source of Frequency command.
00-21	5	Set communication card as the control source.
11-33	5	Set communication card as the source of torque command
11-40	5	Set communication card as the source of position control command
09-60	6	Communication card identification: When CMC-EC01 communication card is connected, this parameter value is displayed as 6 (EtherCAT Slave)
09-30	1	Communication decoding method: EtherCAT only supports decoding method 2 (60xx)

2.5 ESI

- The CMC-EC01 ESI file can be downloaded from Deltas official download center: https://downloadcenter.deltaww.com/en-US/DownloadCenter

- The file name for C2000 series description files is:
  C2000 Plus: DELTA_IA-MDS_C2000Plus_CMC-EC01_Vx-xx_EC_EP_yyyymmdd.xml
  CH2000: DELTA_IA-MDS_CH2000_CMC-EC01_Vx-xx_EC_EP_yyyymmdd.xml

  NOTE:
  - Vx-xx is the firmware version of the EtherCAT card.
  - yyyymmdd is the released date (year/month/day).

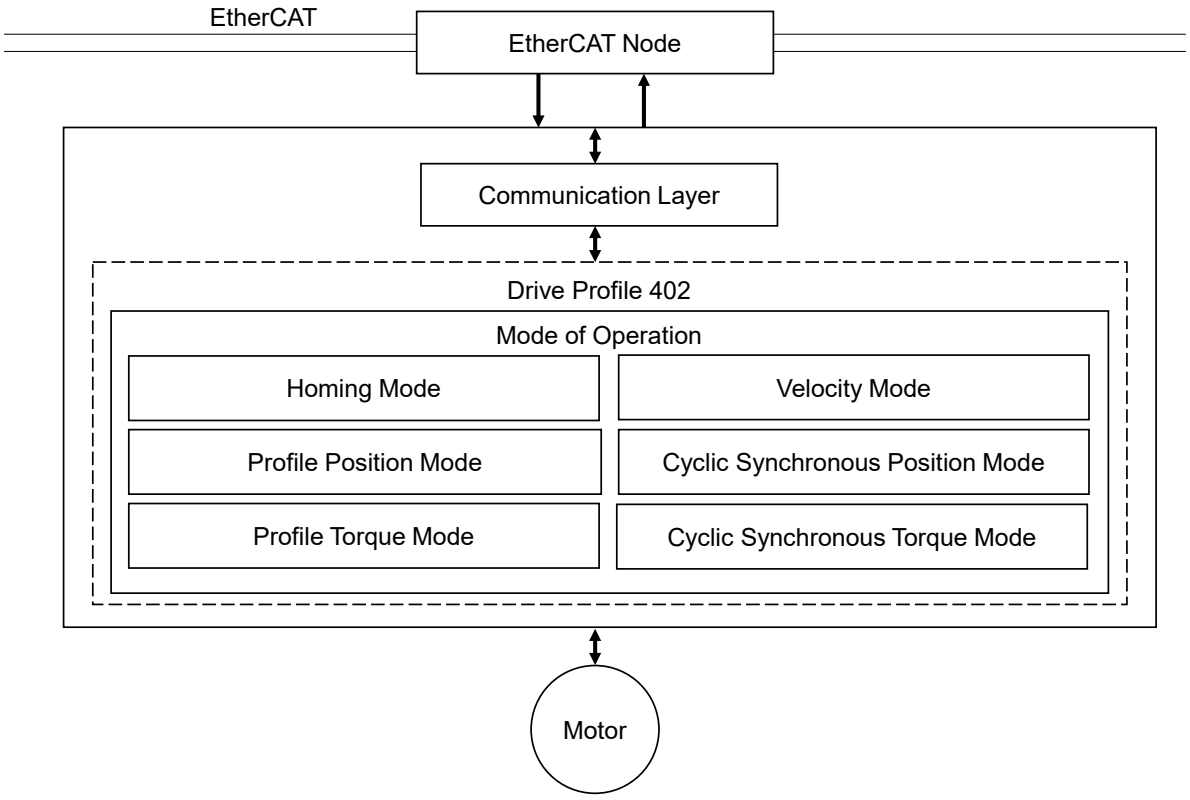
3. Introduction to EtherCAT

3.1 Protocol

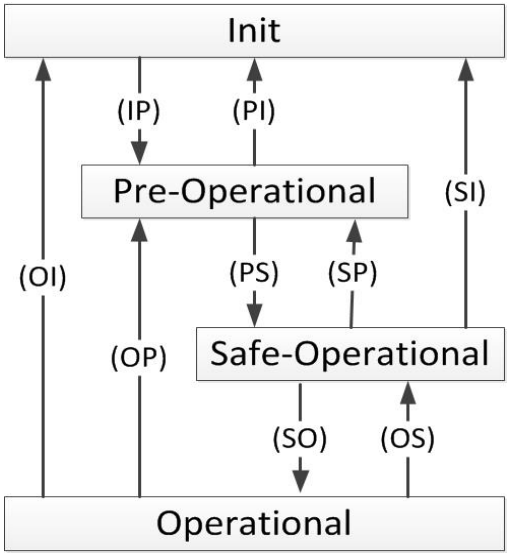
EtherCAT (Ethernet for Control Automation Technology) - Ethernet network control automation technology was originally developed by Beckhoff Company in Germany based on the Ethernet network communication protocol, and applied to the open real-time field bus (Fieldbus) in the field of automation and industrial control technology. Currently this technology is supported and promoted by the EtherCAT Technology Group (ETG) in the future.

EtherCAT architecture of the drive is as follows:

1. **Communication layer:** This protocol covers communication objects (PDO, SDO, Sync, Emergency Object), and related communication object dictionary.
2. **DS402 Drives and motion control device profile:** Defines the behavior of each motion mode and sets the object parameters required for execution.



3.2 State Machine



State Description:

State	Description
Init	Drive has successfully completed initialization after power-up without any errors; there is no communication in the application layer.
Pre-Operational	Mailbox communication can be used at present.
Safe-Operational	PDO input data (TxPDO) can be read. PDO output data (RxPDO) cannot be received.
Operational	For cylic I/O communication, PDO output data (RxPDO) can be processed.
State Switch Command	Description
IP	Start mailbox communication
PI	Discontinue mailbox communication
PS	Start updating input data (TxPDO)
SP	Terminate updating input data (TxPDO)
SO	Start updating output data (RxPDO)
OS	Terminate updating output data (RxPDO)
OP	Terminate updating input/output data
SI	Terminate updating of input data and mailbox communications
OI	Terminate all input/output data updates and mailbox communications

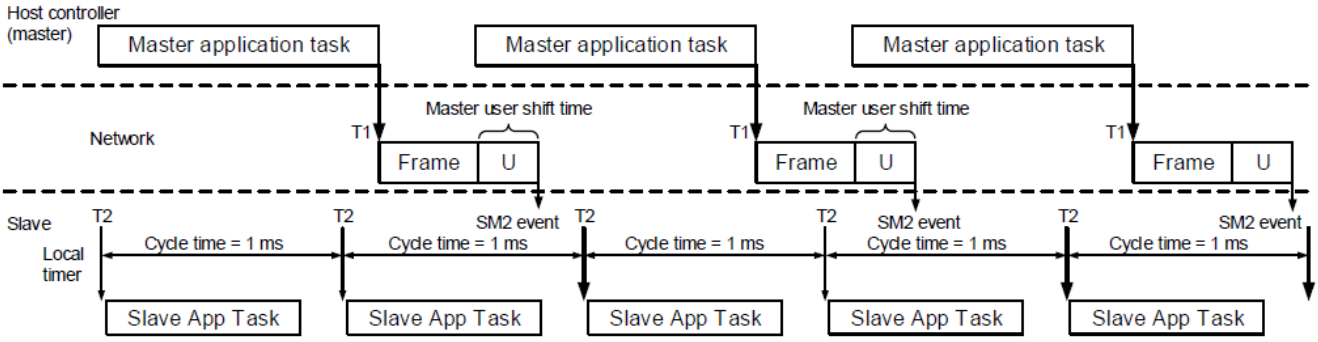
4. System Settings

4.1 Synchronous Mode

The drive supports two synchronization modes: **Free Run Mode** and **DC-Synchronous Mode**. Note that free-running mode is still defined as "synchronous mode" in the EtherCAT specification by the EtherCAT Technology Group (ETG).

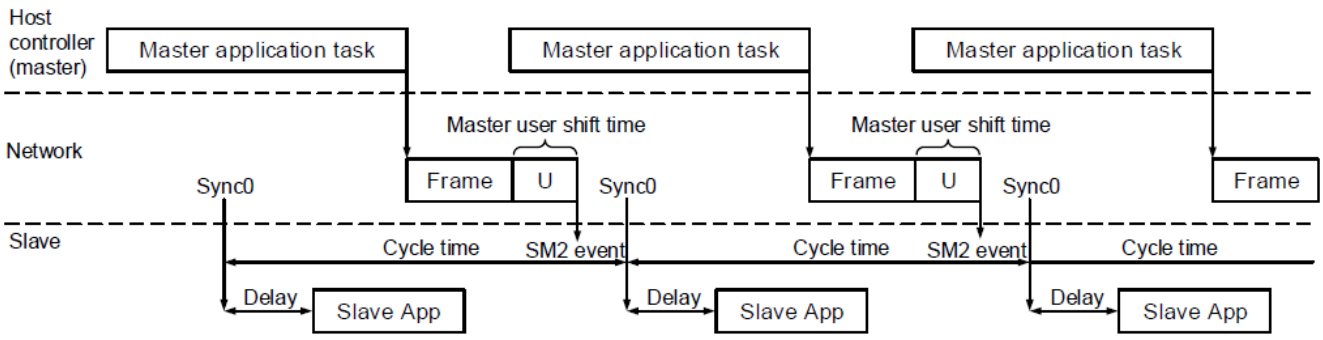
Free Run Mode (Asynchronous)

There is an asynchronous relationship between master station and the slave station, and both have independent clocks for calculating time, that is, the clocks of the master station and the slave station are not synchronized. The commands transmitted and replied between the master station and the slave station are only sequential command exchanges without precise synchronization. For example, the master sends a PDO at time T1 and the slave receives the PDO at T2 after the SM2 event.



DC-Synchronous Mode (SYNC0)

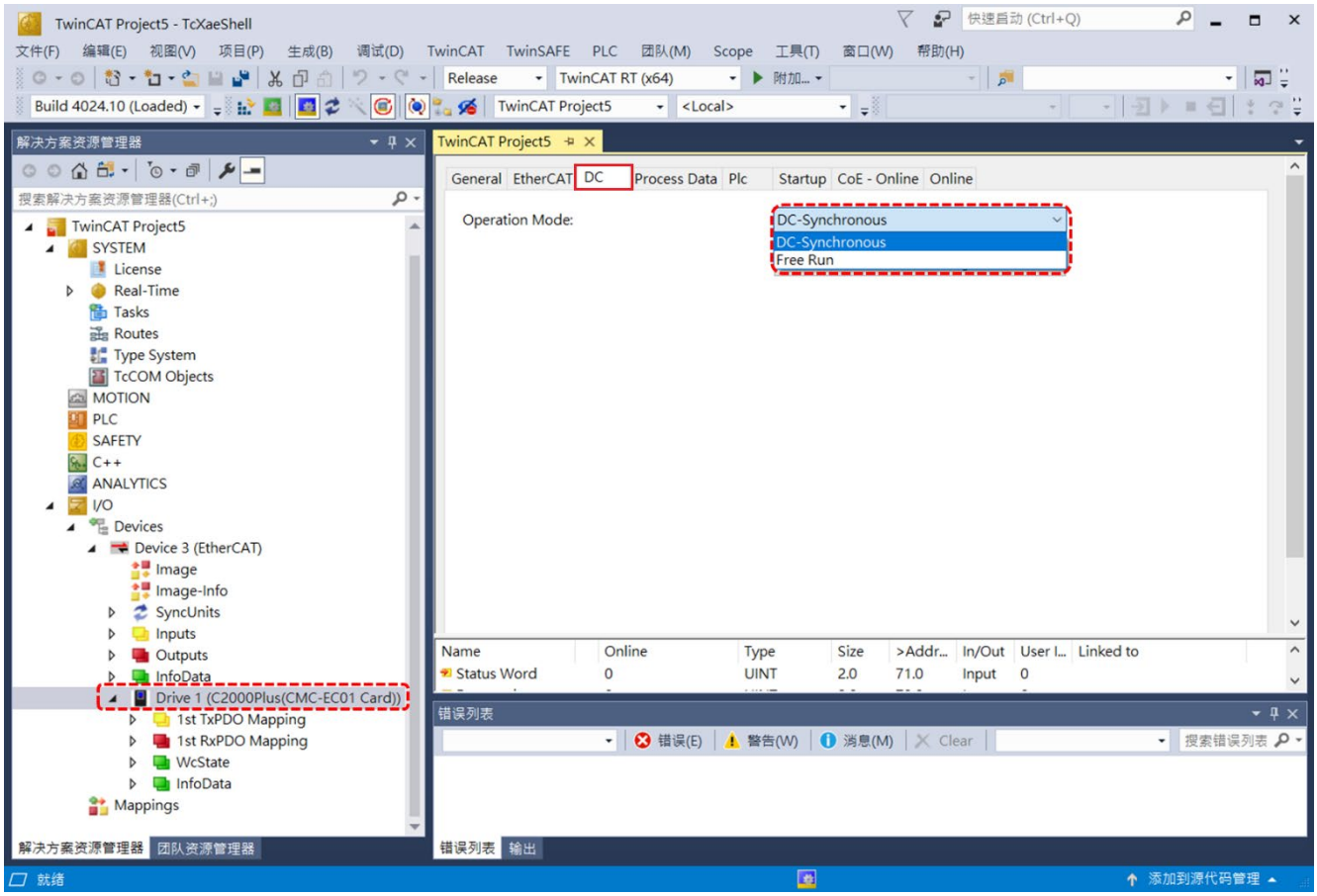
There is precise time synchronization between the master station and the slave station. The master station will periodically execute the control program at a fixed time point according to the synchronous clock and send PDO packets to transmit the command to the slave station and get feedback data from the slave station, the slave station will obtain and update the PDO data at a fixed time according to the synchronous clock.



4.1.1 Sync Mode Selection

DC-Synchronous mode or Free Run mode can be selected by following steps:

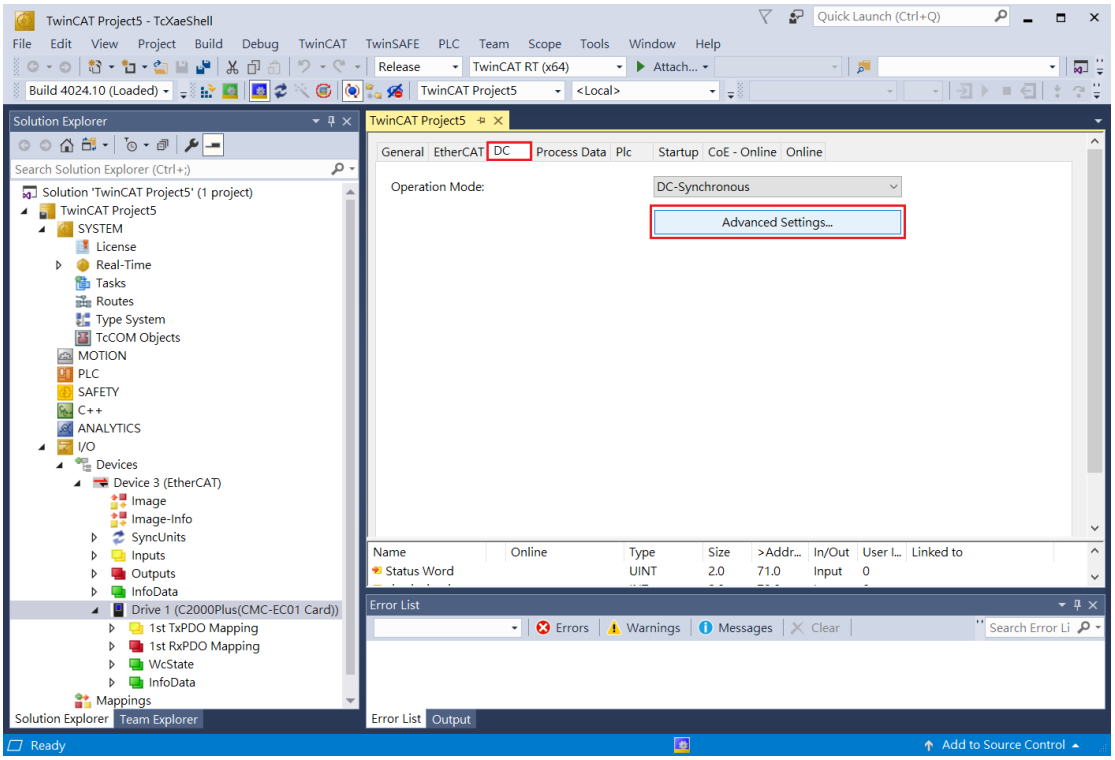
1. Select **Drive 1 (C2000 Plus (CMC-EC01 Card))** in the left window of TwinCAT
2. Select **DC-Synchronous** or **Free Run** as the operation mode under the **DC** tab in the right window.



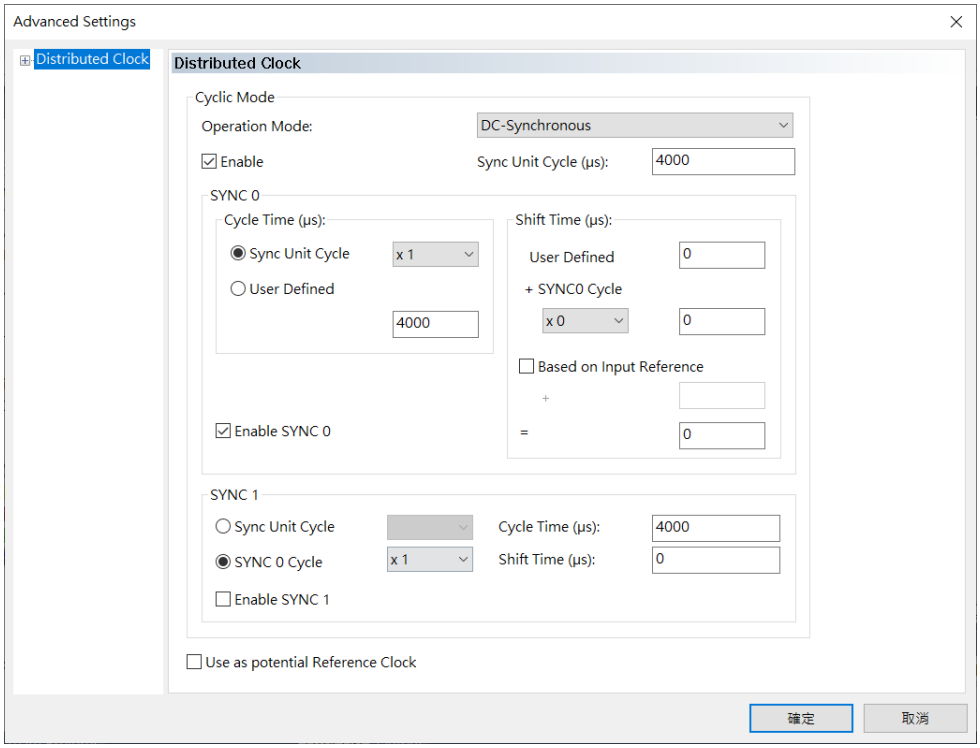
4.1.2 Synchronous Clock Setting

Data exchange cycle can be set by following steps:

1. Select **Drive 1 (C2000 Plus (CMC-EC01 Card))** in the left window of TwinCAT.
2. Click **Advanced Settings** under the **DC** tab in the right window.



3. In the pop-up window, set the synchronization cycle time in **SYNC0 → Cycle Time → Sync Unit Cycle**.



4.2 PDO Mapping Configuration

4.2.1 Default PDO Mapping Configuration

The tables below are the default PDO mapping configurations of EtherCAT drive for data exchange, which is also defined in the XML file of EtherCAT slave. The RxPDO and TxPDO of each group can be worked with each other.

RxPDO Mapping

First group RxPDO mapping VL Mode

RxPDO (0x1600)	Controlword (0x6040)	vl target velocity (0x6042)	Mode of Operation (0x6060)
	Max Torque (0x6072)	Max Motor Speed (0x6080)	

Second group RxPDO mapping CSP Mode

RxPDO (0x1601)	Controlword (0x6040)	Mode of Operation (0x6060)	Max Torque (0x6072)
	Target Position (0x607A)	Max Motor Speed (0x6080)	

Third group RxPDO mapping CST Mode

RxPDO (0x1602)	Controlword (0x6040)	Mode of Operation (0x6060)	Target Torque (0x6071)
	Max Torque (0x6072)	Target Position (0x607A)	Max Motor Speed (0x6080)

TxPDO Mapping

First group TxPDO mapping

TxPDO (0x1A00)	Statusword (0x6041)	Mode of Operation Display (0x6061)	Position Actual Value (0x6064)
	Velocity Actual Value (0x606C)	Torque Actual Value (0x6077)	Error Code (0x603F)

4.2.2 PDO Mapping Setting

The steps to set PDO mapping are as follows:

1. Disable PDO configuration: OD 1C12 sub 0 = 0 (RxPDO), OD 1C13 sub 0 = 0 (TxPDO)
2. Disable PDO mapping settings: OD 1600 sub 0 = 0 (RxPDO), OD 1A01 sub 0 = 0 (TxPDO)
3. Set the content and number of RxPDO mapping objects: OD 1600–1603 sub 1–sub 8 sets the corresponding OD (RxPDO), OD 1600–1603 sub 0 = the corresponding OD number (RxPDO), the following takes OD 1601 as an example:

RxPDO Mapping Parameter Settings	Data	Description
OD 1601 sub1	6040h	Controlword, 16-bit
OD 1601 sub2	6060h	Modes of operation, 8-bit
OD 1601 sub3	6072h	Max torque, 32-bit
OD 1601 sub4	607Ah	Target torque, 32-bit
OD 1601 sub5	6080h	Max motor speed, 32-bit
OD 1601 sub0	5	Set five RxPDO mappings

4. Set the content and number of TxPDO mapping objects: OD 1A00–1A03 sub 1–sub 8 sets the corresponding OD (TxPDO), OD 1A00–1A03 sub 0 = the corresponding OD number (TxPDO), the following takes OD 1A00 as an example:

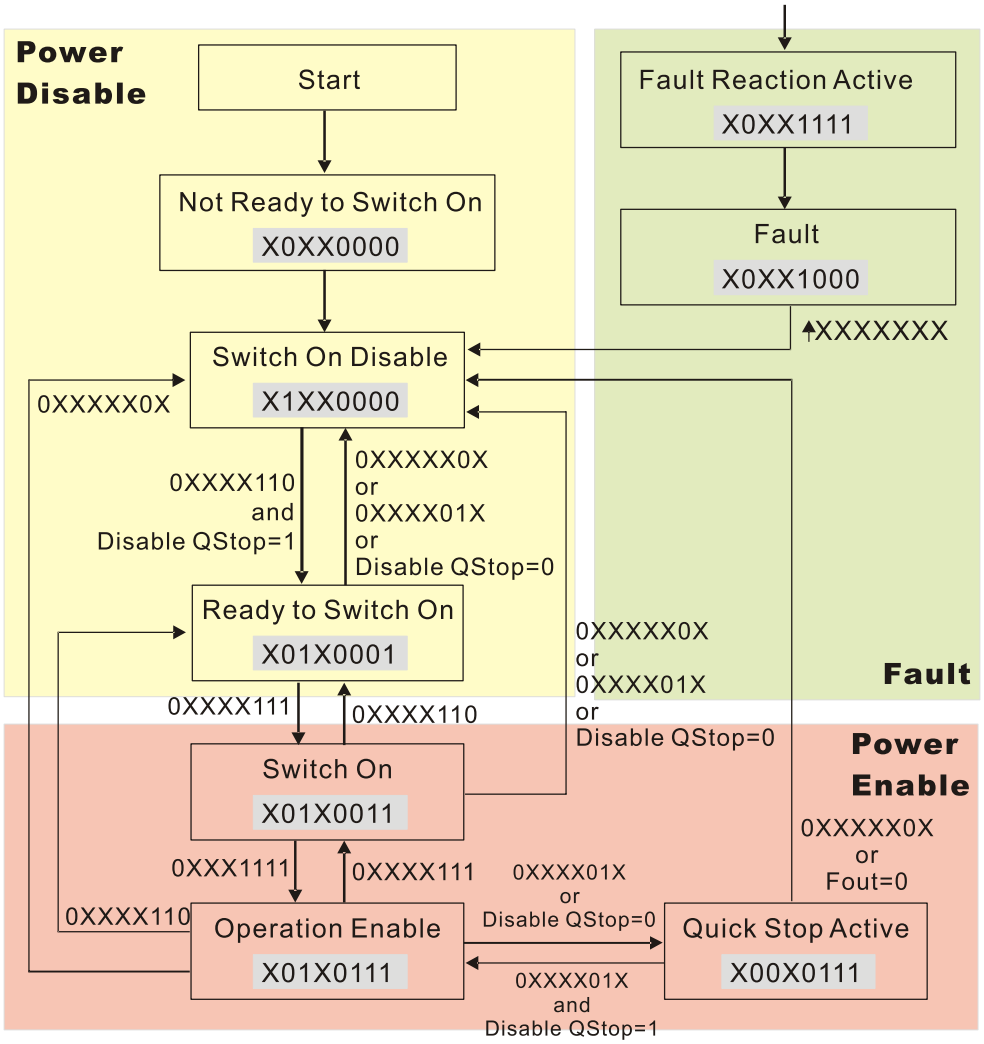
RxPDO Mapping Parameter Settings	Data	Description
OD 1A00 sub1	6041h	Statusword, 16-bit
OD 1A00 sub2	6061h	Modes of operation display, 8-bit
OD 1A00 sub3	6064h	Position actual value, 32-bit
OD 1A00 sub4	606Ch	Velocity actual value, 32-bit
OD 1A00 sub5	6077h	Max motor speed, 32-bit
OD 1A00 sub6	603Fh	Error code, 16-bit
OD 1A00 sub0	6	Set six RxPDO mappings

5. Set the PDO mapping configuration: OD 1C12 sub 1 = 0x1601 (RxPDO), OD 1C13 sub 1 = 0x1A01 (TxPDO)
6. Enable PDO configuration: OD 1C12 sub 0 = 1 (RxPDO), OD 1C13 sub 0 = 1 (TxPDO)

5. CiA402 Device Specification

This chapter describes the motion modes defined by the CiA402 specification under the EtherCAT communication protocol, including its basic operations and related object settings. The host computer controls the drive through the control word (controlword, OD 6040h), reads the present drive status by reading the status word (statusword, OD 6041h), and the drive completes the motor motion behavior according to the control instructions of the host computer.

5.1 CANopen over Ethernet (CoE) State Machine



NOTE: In the figure above, the string next to the arrow is the control word (controlword), and the string in the status box is the status word (statusword).

The state machine is divided into three sections:

Section	Description
Power Disable	Drive has no PWM output
Power Enable	Drive has PWM output
Fault	Error occurred

There are nine states in the three sections:

State	Description
Start	Boot
Not Ready to Switch On	Drive is in the process of initializing
Switch On Disable	Drive initialization is completed
Ready to Switch On	Drive is waiting to enter Switch On, and the motor is not activated
Switch On	Drive has PWM output at this time, and reference command is invalid
Operation Enable	Drive is enabled and moves according to the control command
Quick Stop Active	The drive stops according to the setting method
Fault Reaction Active	Drive detects occurrence of an alarm and stops according to the setting mode, and the motor is still in the state of excitation at this time
Fault	Motor servo off

Control word (controlword, OD 6040h) bit description

15–9	8	7	6–4	3	2	1	0
Reserved	Halt	Fault reset	Operation mode specific	Enable operation	Quick stop	Enable voltage	Switch on

Status word (statusword, OD 6041h) bit description

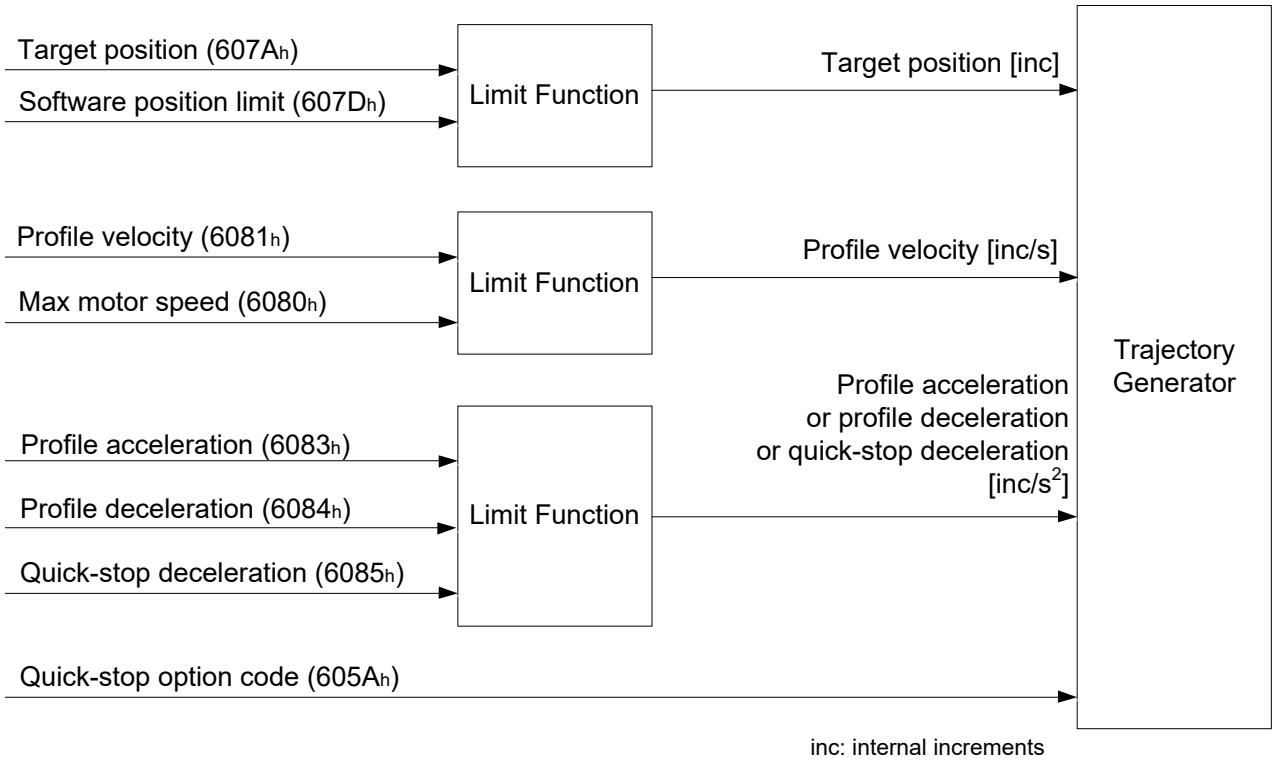
15–14	13–12	11	10	9	8	7
Reserved	Operation mode specific	Reserved	Target reached	Remote	Reserved	Warning

6	5	4	3	2	1	0
Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enable	Switch on	Ready to switch on

5.2 EtherCAT Operation Mode

5.2.1 Profile Position Mode

After the drive receives the position command sent by host, it controls the motor to reach the target position. In this mode, host only gives drive target position, speed command and acceleration and deceleration settings at the beginning. The motion planning, from command triggering to target position reaching, is planned and executed by the drive motion command generator.



The operation steps are as follows:

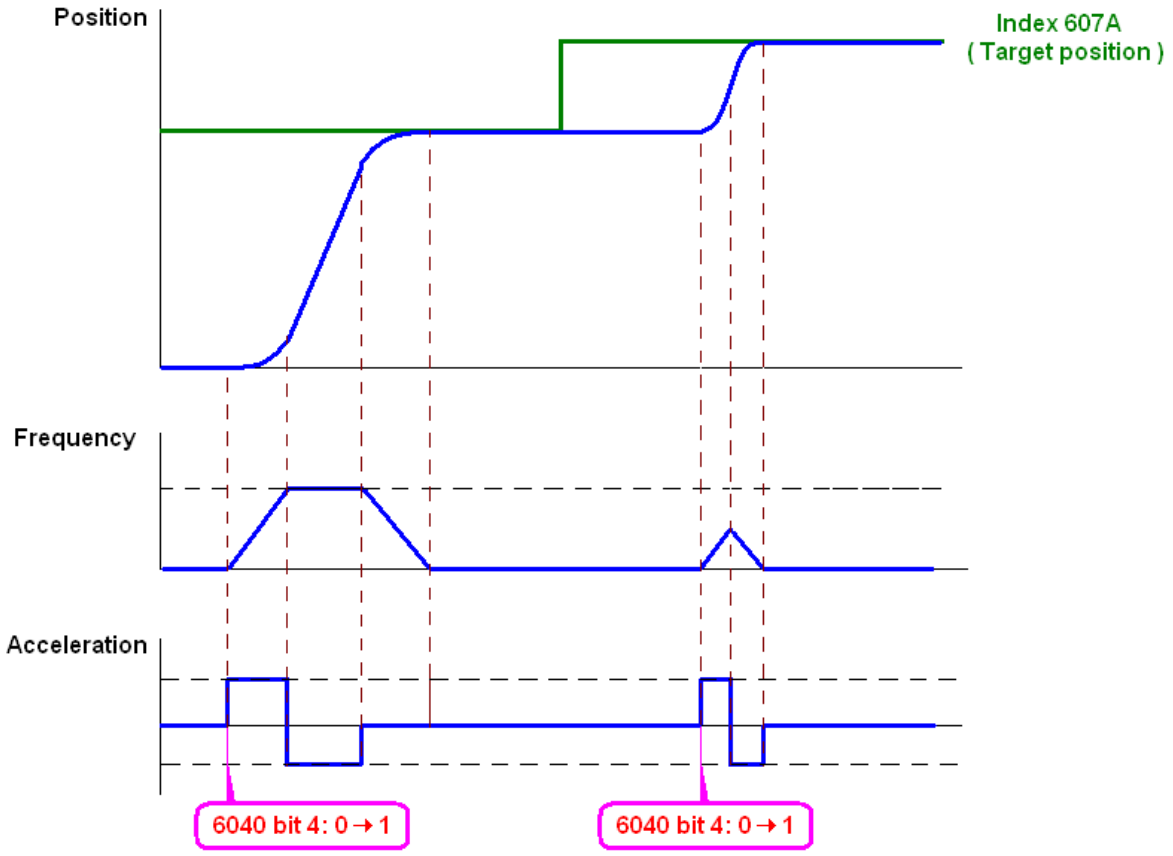
1. Setting mode: OD 6060h = 01h, which is the profile position mode
2. Set the target position: OD 607Ah (Unit: user unit PUU)
3. Set speed command: OD 6081h (Unit: PUU/sec)
4. Set acceleration time slope: OD 6083h (Unit: Pulse/sec^2)
5. Set deceleration time slope: OD 6084h (Unit: Pulse/sec^2)
6. Set the control command: OD 6040h, the control word command makes the drive operate according to the above settings by using the following steps. For the state machine of the drive, refer to OD 6041h.
   (1) OD 6040h = 06h, the drive enters Ready to Switch On state
   (2) OD 6040h = 0Eh, the drive enters Switch On state (Servo On)
   (3) OD 6040h = 0Fh, the drive enters Operation Enable state
   (4) OD 6040h = 1Fh, rising-edge of the control word Bit 4 triggers the drive to start moving (See OD 6040h PP mode Bit 4–6 action options in Section "A.3.3. OD 6000h Communication Object Group".)

The corresponding control commands are as follows:

Steps	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
(1)	0	0	1	1	0	Shutdown (Close)
(2)	0	0	1	1	1	Switch On (Drive Servo On Ready)
(3)	0	1	1	1	1	Enable Operation (Drive Servo On)
(4)	1	1	1	1	1	Command Trigger (Rising-edge Trigger)

Read drive information

1. OD 6064h, to observe motor feedback position
2. OD 6041h, status word of the drive, bit 10 target reached (0: Target position is not reached; 1: Target position is reached)



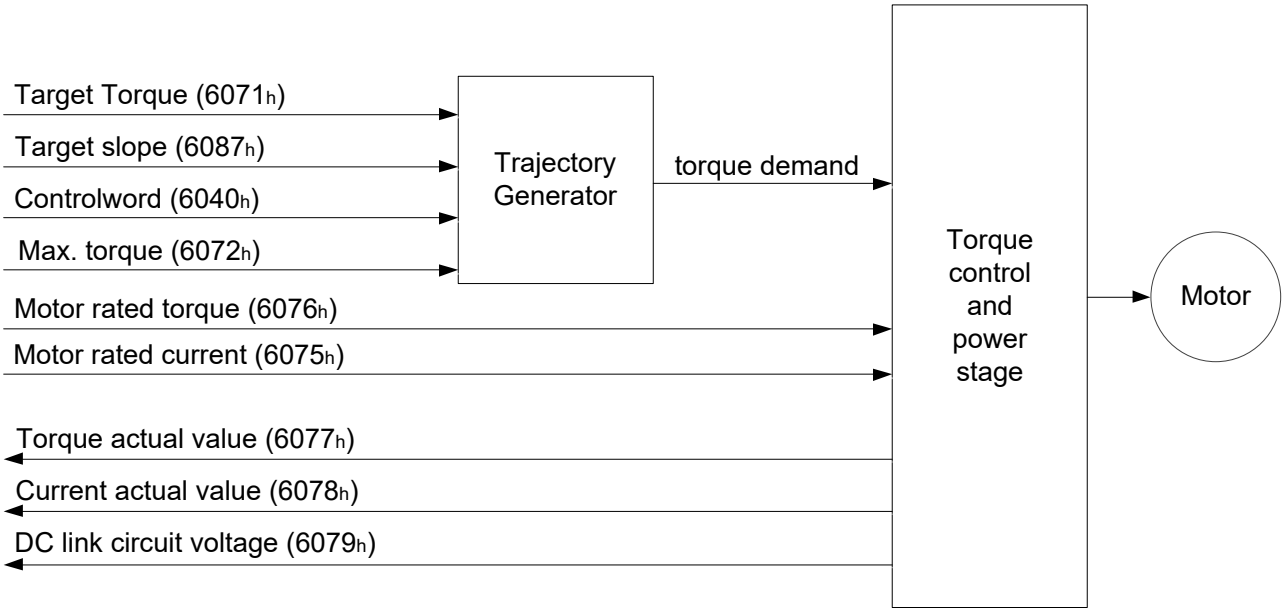
Related Object List

Index	Name	Data Type	Attribute	PDO Mapping
6040h	Controlword	UNSIGNED16	RW	Y
6041h	Statusword	UNSIGNED16	RO	Y
6060h	Mode of operation	INTEGER8	RW	Y
6061h	Mode of operation display	INTEGER8	RO	Y
6064h	Position actual value	INTEGER32	RO	Y
6065h	Following error window	UNSIGNED32	RW	N
6067h	Position window	UNSIGNED32	RW	N
6068h	Position window time	UNSIGNED16	RW	N

Index	Name	Data Type	Attribute	PDO Mapping
607Ah	Target position	INTEGER32	RW	Y
607Dh	Software position limit	INTEGER32	RW	N
6080h	Max motor speed	UNSIGNED32	RW	Y
6081h	Profile velocity	UNSIGNED32	RW	N
6083h	Profile acceleration	UNSIGNED32	RW	N
6084h	Profile deceleration	UNSIGNED32	RW	N
6085h	Quick stop deceleration	UNSIGNED32	RW	N

5.2.2 Profile Torque Mode

After the drive receives the torque command sent by host, it controls the motor to reach the target torque. In this mode, the target torque, torque curve and other settings are given by the host. Motion is planned and executed by the drive motion command generator.



The operation steps are as follows:

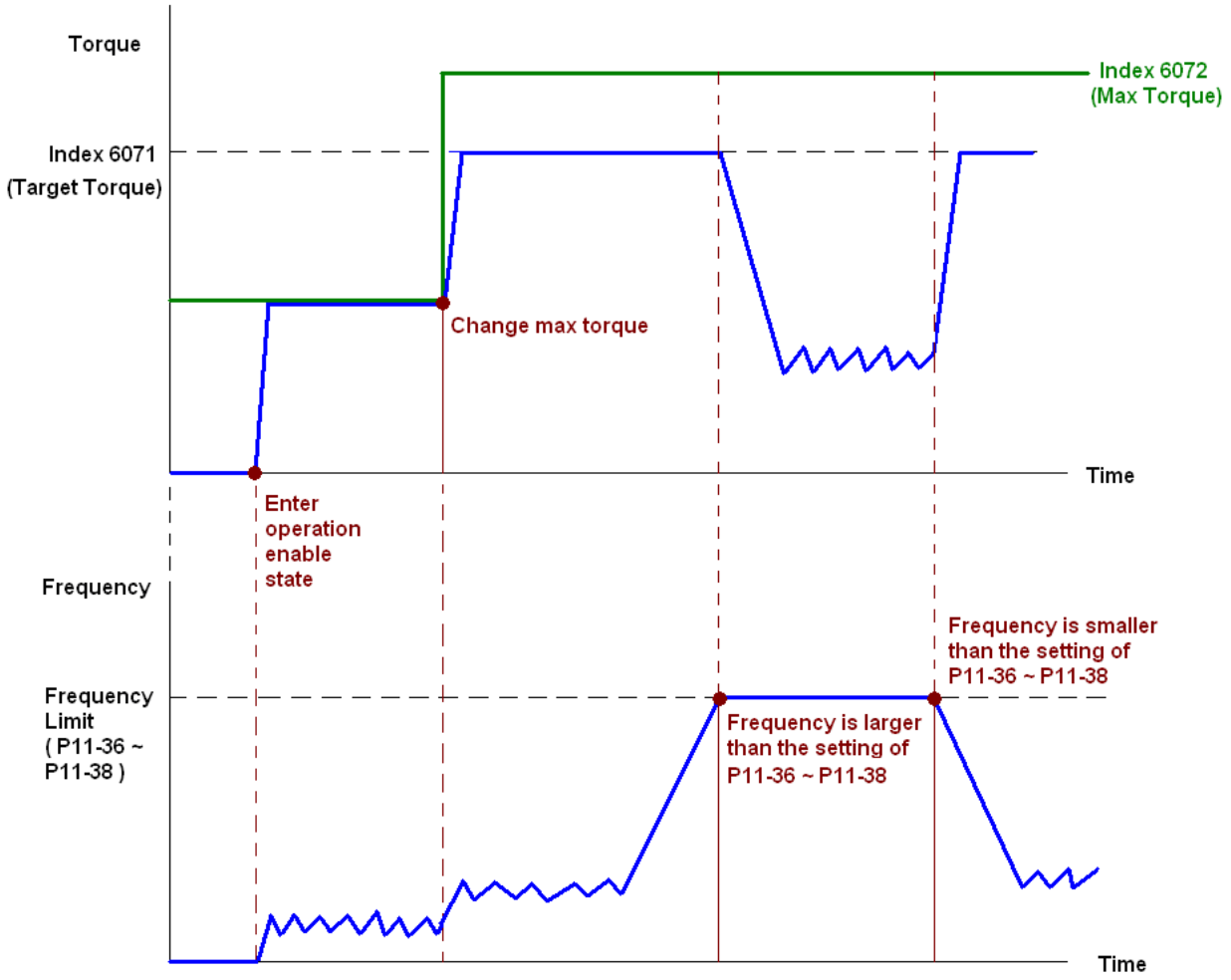
1. Setting mode: OD 6060h = 04h, which is the profile torque mode
2. Set torque slope: OD 6087h
3. Set torque command: OD 6071h (Unit: 0.1% of the drive rated torque)
4. Set the control command: OD 6040h, the control word command makes the drive operate according to the above settings by using the following steps. For the state machine of the drive, refer to OD 6041h.
   (1) OD 6040h = 06h, the drive enters Ready to Switch On state
   (2) OD 6040h = 0Eh, the drive enters Switch On state (Servo On)
   (3) OD 6040h = 0Fh, the drive enters the Operation Enable state, which means there is torque output

   The corresponding control commands are as follows:

Steps	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
(1)	0	0	1	1	0	Shutdown (Close)
(2)	0	0	1	1	1	Switch On (Drive Servo On Ready)
(3)	0	1	1	1	1	Enable Operation (Drive Servo On)

Read drive information

1. OD 6077h, to observe motor output torque (0.1% of the motor rated torque)
2. OD 6041h, status word of the drive, bit 10 target reached (0: Target torque is not reached; 1: Target torque is reached)

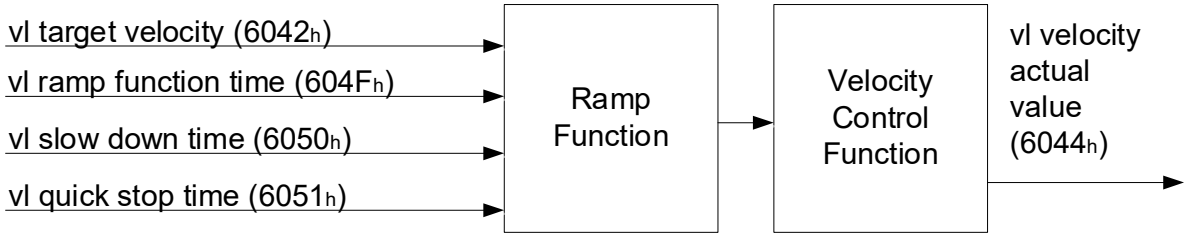


Related Object List

Index	Name	Data Type	Attribute	PDO Mapping
6040h	Controlword	UNSIGNED16	RW	Y
6041h	Statusword	UNSIGNED16	RO	Y
6060h	Mode of operation	INTEGER8	RW	Y
6061h	Mode of operation display	INTEGER8	RO	Y
6071h	Target torque	INTEGER16	RW	Y
6072h	Max torque	UNSIGNED16	RW	Y
6075h	Motor rated current	UNSIGNED32	RO	N
6077h	Torque actual value	INTEGER16	RO	Y
6078h	Current actual value	INTEGER16	RO	N
6079h	DC link circuit voltage	UNSIGNED32	RO	N
6087h	Torque slope	UNSIGNED32	RW	N

5.2.3 Velocity Mode

The host sends the speed command, acceleration and deceleration and other information to the drive, and the drive executes related speed control behaviors.



The operation steps are as follows:

1. Setting mode: OD 6060h = 02h, which is the velocity mode
2. Set speed command: OD 6042h (Unit: RPM)
3. Set acceleration time: OD 604Fh (Unit: ms)
4. Set deceleration time: OD 6050h (Unit: ms)
5. Set the control command: OD 6040h, the control word command makes the drive operate according to the above settings by using the following steps. For the state machine of the drive, refer to OD 6041h.
   (1) OD 6040h = 06h, the drive enters Ready to Switch On state
   (2) OD 6040h = 0Eh, the drive enters Switch On state (Servo On)
   (3) OD 6040h = 0Fh, the drive enters Operation Enable state
   (4) OD 6040h = 7Fh, the drive starts running
   The corresponding control commands are as follows:

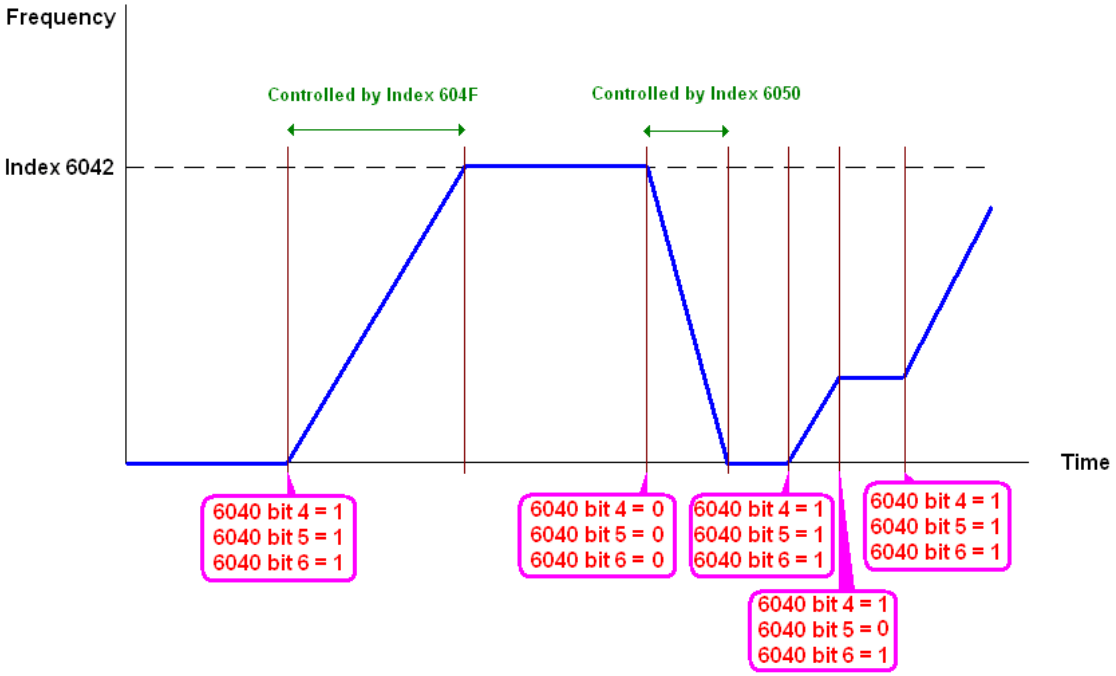
Steps	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
(1)	0	0	0	0	1	1	0	Shutdown (Close)
(2)	0	0	0	1	1	1	0	Switch On (Drive Servo On Ready)
(3)	0	0	0	1	1	1	1	Enable Operation (Drive Servo On)
(4)	1	1	1	1	1	1	1	Run to target speed

When using the velocity mode (OD 6060h = 02h), the corresponding behavior of controlword operation bit (bit 4–6) is as follows:

OD 6040h			Behavior
bit 6	bit 5	bit 4	
1	0	1	Maintain at present speed
1	1	1	Run to target speed
X	X	X	Decelerate to 0 RPM

Read drive information

1. OD 606Ch, to observe the motor speed
2. OD 6041h, status word of the drive, bit 10 target reached (0: Target speed is not reached; 1: Target speed is reached)

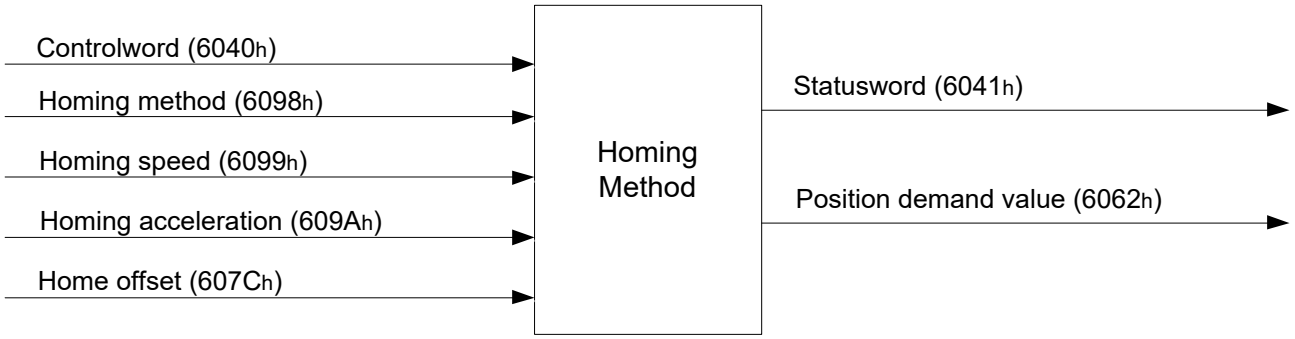


Related Object List

Index	Name	Data Type	Attribute	PDO Mapping
6040h	Controlword	UNSIGNED16	RW	Y
6041h	Statusword	UNSIGNED16	RO	Y
6060h	Mode of operation	INTEGER8	RW	Y
6061h	Mode of operation display	INTEGER8	RO	Y
6042h	vl target velocity	INTEGER16	RW	Y
6043h	vl velocity demand	INTEGER16	RO	N
6044h	vl velocity actual value	INTEGER16	RO	Y
604Fh	vl ramp function time	INTEGER16	RW	N
6050h	vl slow down time	INTEGER16	RW	N

5.2.4 Homing Mode

The purpose of homing is to establish the coordinate system of the drive. After the coordinate system is established, the drive can execute the position command given by host. Thirty-five homing modes defined by the CiA402 specification are supported by the drive, including modes such as searching the origin switch, positive and negative limits, and Z pulse.



The operation steps are as follows:

1. Setting mode: OD 6060h = 06h, which is the homing mode
2. Set the origin offset value: OD 607Ch
3. Set the origin searching method: OD 6098h
4. Set the speed when searching for the origin switch: OD 6099h sub1 (Pulse/sec)
5. Set the speed of searching for Z pulse: OD 6099h sub2 (Pulse/sec)
6. Set the homing acceleration/deceleration time: OD 609Ah
7. Set the control command: OD 6040h, the control word command makes the drive operate according to the above settings by using the following steps. For the state machine of the drive, refer to OD 6041h.
   (1) OD 6040h = 06h, the drive enters Ready to Switch On state
   (2) OD 6040h = 0Eh, the drive enters Switch On state (Servo On)
   (3) OD 6040h = 0Fh, the drive enters Operation Enable state
   (4) OD 6040h = 1Fh, the drive starts running
   The corresponding control commands are as follows:

Steps	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
(1)	0	0	1	1	0	Shutdown (Close)
(2)	0	0	1	1	1	Switch On (Drive Servo On Ready)
(3)	0	1	1	1	1	Enable Operation (Drive Servo On)
(4)	1	1	1	1	1	Command Trigger (Rising-edge Trigger)

Read drive information

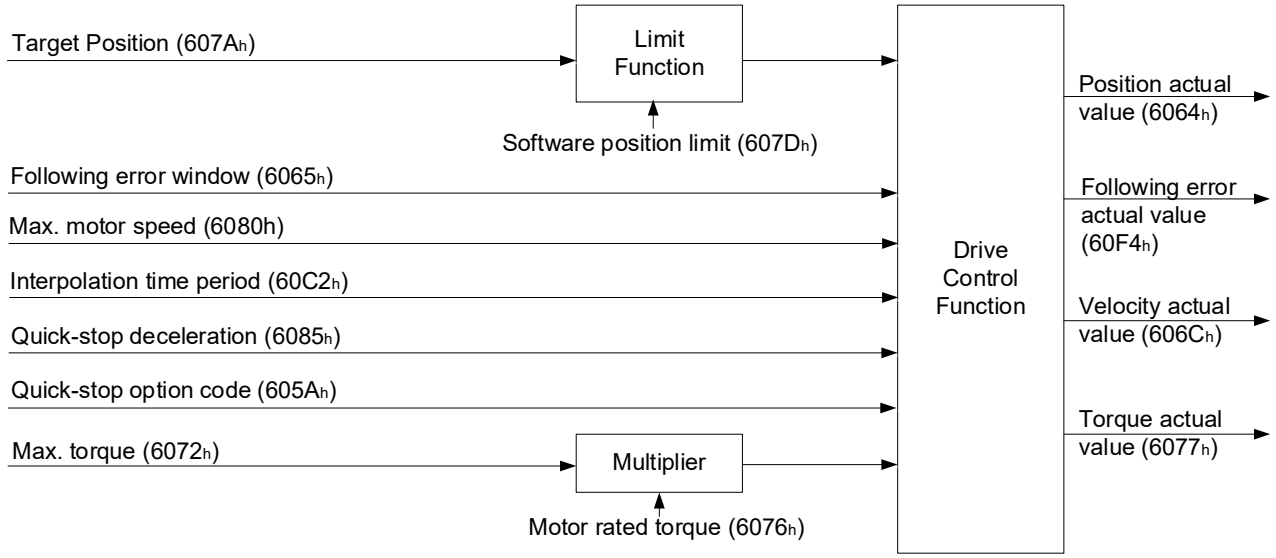
1. OD 6041h, to acquire the drive status
2. OD 6064h, to obtain the motor feedback position at present

Related Object List

Index	Name	Data Type	Attribute	PDO Mapping
6040h	Controlword	UNSIGNED16	RW	Y
6041h	Statusword	UNSIGNED16	RO	Y
6060h	Mode of operation	INTEGER8	RW	Y
6061h	Mode of operation display	INTEGER8	RO	Y
6065h	Following error window	UNSIGNED32	RW	N
6067h	Position window	UNSIGNED32	RW	N
6068h	Position window time	UNSIGNED16	RW	N
607Ch	Home offset	INTEGER32	RO	N
607Dh	Software position limit	INTEGER32	RW	N
6098h	Homing method	UNSIGNED8	RW	N
6099h	Homing speeds	UNSIGNED32	RW	N
609Ah	Homing acceleration	UNSIGNED32	RW	N

5.2.5 Cyclic Synchronous Position Mode

The host plans the path in the cyclic synchronous position mode and sends PDOs periodically. In this mode, when the host computer transmits each PDO, it simultaneously transmits the data of the target position (target position) and the control command (controlword) to the drive.



The operation steps are as follows:

1. Setting mode: OD 6060h = 08h, which is the cyclic synchronous position mode
2. Set the target position: OD 607Ah (Unit: PUU)
3. Set the control command: OD 6040h, the control word command makes the drive operate according to the above settings by using the following steps. For the state machine of the drive, refer to OD 6041h.
   (1) OD 6040h = 06h, the drive enters Ready to Switch On state
   (2) OD 6040h = 0Eh, the drive enters Switch On state (Servo On)
   (3) OD 6040h = 0Fh, the drive enters Operation Enable state
   The corresponding control commands are as follows:

Steps	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
(1)	0	0	1	1	0	Shutdown (Close)
(2)	0	0	1	1	1	Switch On (Drive Servo On Ready)
(3)	0	1	1	1	1	Enable Operation (Drive Servo On)

Read drive information

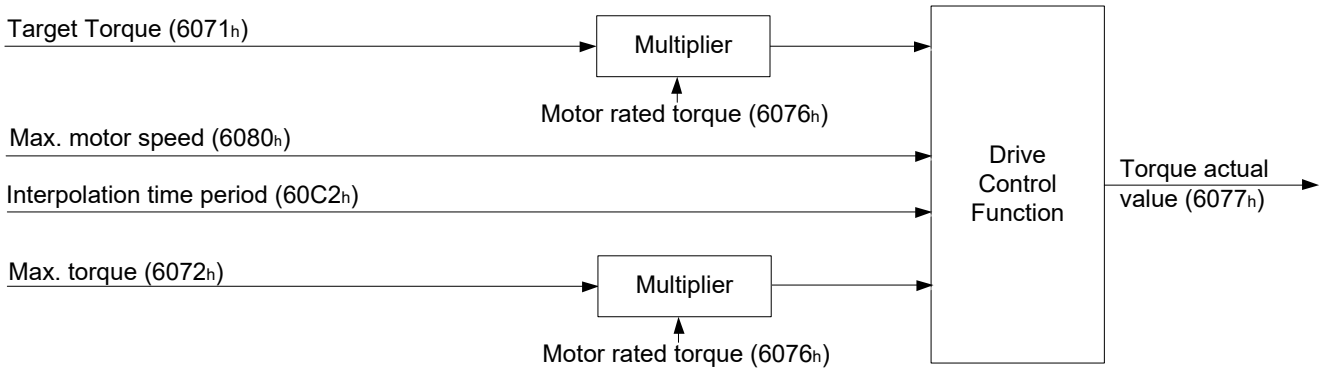
1. OD 6064h, to observe the motor feedback position
2. OD 6041h, status word of the drive, bit 10 target reached (0: Target position is not reached; 1: target position is reached)

Related Object List

Index	Name	Data Type	Attribute	PDO Mapping
6040h	Controlword	UNSIGNED16	RW	Y
6041h	Statusword	UNSIGNED16	RO	Y
6060h	Mode of operation	INTEGER8	RW	Y
6061h	Mode of operation display	INTEGER8	RO	Y
605Ah	Quick stop option code	INTEGER16	RW	N
6064h	Position actual value	INTEGER32	RO	Y
6065h	Following error window	UNSIGNED32	RW	N
6067h	Position window	UNSIGNED32	RW	N
6068h	Position window time	UNSIGNED16	RW	N
606Ch	Velocity actual value	INTEGER32	RO	Y
6072h	Max torque	UNSIGNED16	RW	Y
6077h	Torque actual value	INTEGER16	RO	Y
607Ah	Target position	INTEGER32	RW	Y
607Dh	Software position limit	INTEGER32	RW	N
6080h	Max motor speed	UNSIGNED32	RW	Y
6085h	Quick stop deceleration	UNSIGNED32	RW	N

5.2.6 Cyclic Synchronous Torque Mode

The host plans the torque in the cyclic synchronous torque mode. In this mode, when the host computer transmits each PDO, it simultaneously transmits the data of target position (target torque) and control command (controlword) to the drive.



The operation steps are as follows:

1. Setting mode: OD 6060h = 0Ah, which is the cyclic synchronous torque mode
2. Set torque slope: OD 6087h
3. Set target torque: OD 6071h (Unit: 0.1% of the drive rated torque)
4. Set the control command: OD 6040h, the control word command makes the drive operate according to the above settings by using the following steps. For the state machine of the drive, refer to OD 6041h.
   (1) OD 6040h = 06h, the drive enters Ready to Switch On state
   (2) OD 6040h = 0Eh, the drive enters Switch On state (Servo On)
   (3) OD 6040h = 0Fh, the drive enters the Operation Enable state, which means there is torque output

   The corresponding control commands are as follows:

Steps	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
(1)	0	0	1	1	0	Shutdown (Close)
(2)	0	0	1	1	1	Switch On (Drive Servo On Ready)
(3)	0	1	1	1	1	Enable Operation (Drive Servo On)

5. Set the target torque: OD 6071h (Unit: 0.1% of the drive rated torque)

Read drive information

1. OD 6077h, to observe motor output torque (0.1% of the motor rated torque)
2. OD 6041h, status word of the drive, bit 10 target reached (0: Target torque is not reached; 1: Target torque is reached)

Related Object List

Index	Name	Data Type	Attribute	PDO Mapping
6040h	Controlword	UNSIGNED16	RW	Y
6041h	Statusword	UNSIGNED16	RO	Y
6060h	Mode of operation	INTEGER8	RW	Y
6061h	Mode of operation display	INTEGER8	RO	Y
606Ch	Velocity actual value	INTEGER32	RO	Y
6071h	Target torque	INTEGER16	RW	Y
6072h	Max torque	UNSIGNED16	RW	Y
6077h	Torque actual value	INTEGER16	RO	Y
6080h	Max motor speed	UNSIGNED32	RW	Y

6. Communication Warning/Fault Codes

6.1 Drive Warning/Fault Codes

ID No.	Warning/Fault Code	Warning/Fault Name	Description	Corrective Actions
81	ECto_WARN	EtherCAT communication time-out	Communication time-out warning between the communication card and the host computer	Check if communication system is properly connected. Check if connection to the host computer is normal.
89	ECCb_WARN	Communication card detached	Communication card detachment warning	Reinstall the communication card. Replace the communication card or drive.
111	SYCE_WARN	Sync error	Command source of the drive is NOT the communication card. This warning is displayed when synchronization signal (packet) is lost after synchronization mode is set.	The host computer reconfigures the drive.
161	SYCE_ERR	Sync error	Command source of the drive is the communication card. This fault is displayed when synchronization signal (packet) is lost after synchronization mode is set.	The host computer reconfigures the drive.

6.2 SDO Abort Code

SDO Abort Code	Description
0x05030000	Bit converting error due to segment transmission
0x05040000	SDO time-out
0x05040001	Client/servo command is invalid or does not exist
0x05040005	Register overflows when executing SDO
0x06010000	Access is not supported
0x06010001	Attempt to read a write-only object
0x06010002	Attempt to write to read-only object
0x06010003	Sub-index cannot be written, sub-index should be 0
0x06020000	Object does not exist in object dictionary
0x06040041	Unable to map object to PDO
0x06040042	The number and length of mapping objects exceed the PDO length
0x06040043	Parameter data format is not compatible
0x06040047	There is a problem about drive compatibility
0x06060000	Access failed due to hardware error (save or restore error)
0x06070010	Data Type does not match; parameter length does not match
0x06070012	Data Type does not match; parameter length is too long
0x06070013	Data Type does not match; parameter length is too short
0x06090011	Sub-index does not exist
0x06090030	Parameter value is out of range
0x06090031	The setting value is too large
0x06090032	The setting value is too small
0x06090033	Detected Module Ident List (0xF030) does not match Configured Module Ident list (0xF050)
0x06090036	The setting value is smaller than the lower limit value
0x08000000	General error
0x08000020	Data cannot be read or written
0x08000021	Data cannot be accessed due to local control
0x08000022	Data cannot be accessed due to present state
0x08000023	Object dictionary does not exist

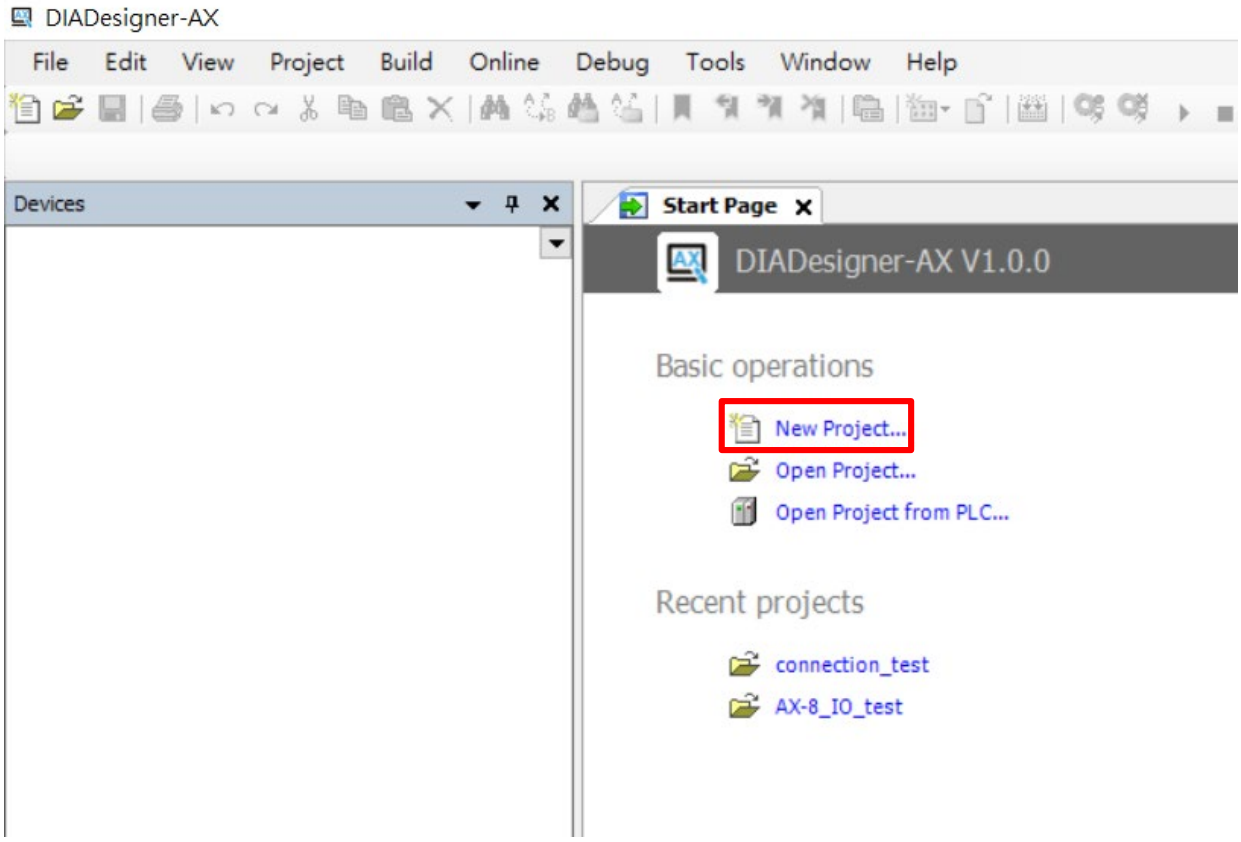
7. Operation Example

7.1 Delta PLC – AX-8 Operation Example (Designer-AX (Codesys base))

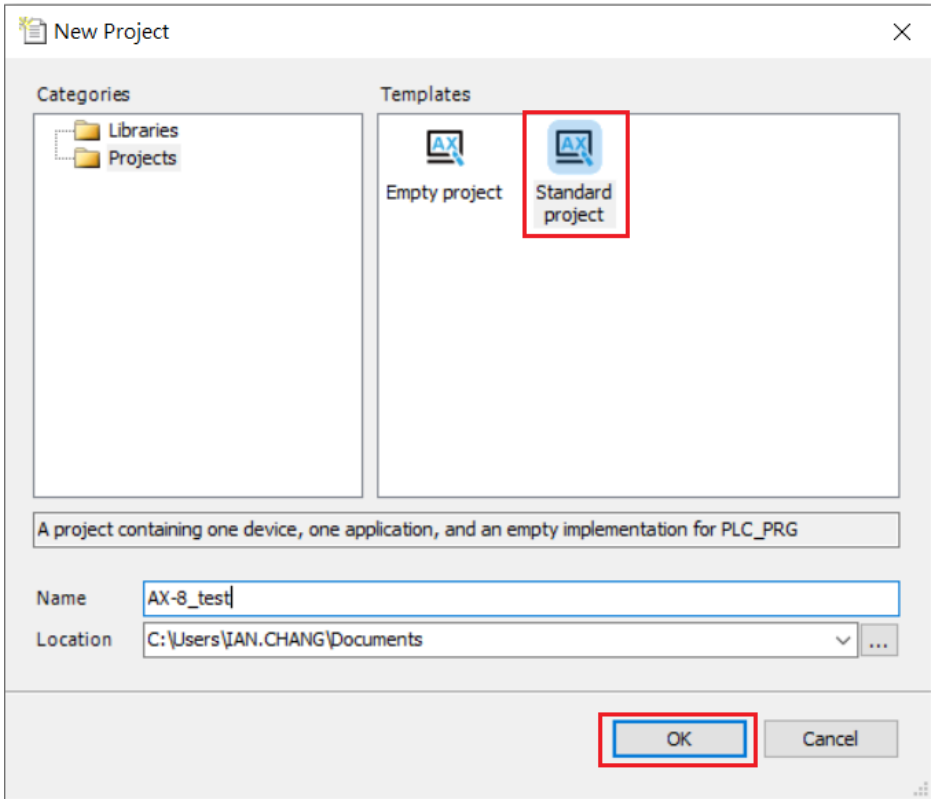
Device	AX-8	GLAN1 IP: 192.168.0.10
	Computer	Network Card IP: 192.168.0.123
	Drive: C2000 Plus Communication Card: CMC-EC01	
Software	DIADesigner-AX	V1.1.0 or above

1. Connect CMC-EC01 to AX-8 through the EtherCAT port, and connect AX-8 to the computer through the Ethernet port (GLAN1).

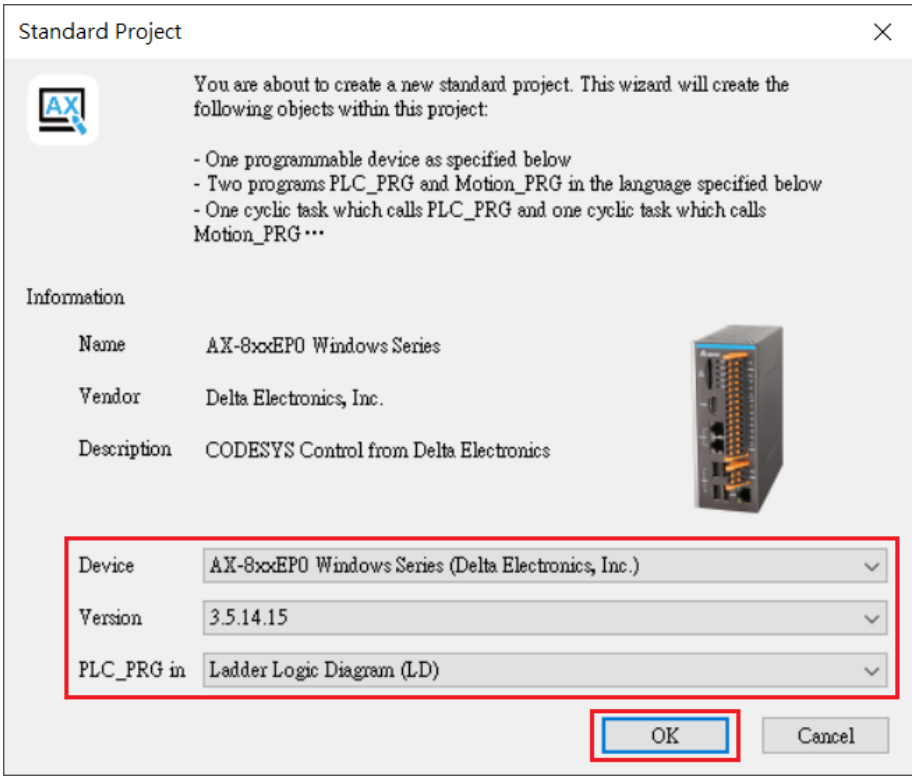
2. Open DIADesigner-AX software, and then click **New Project**



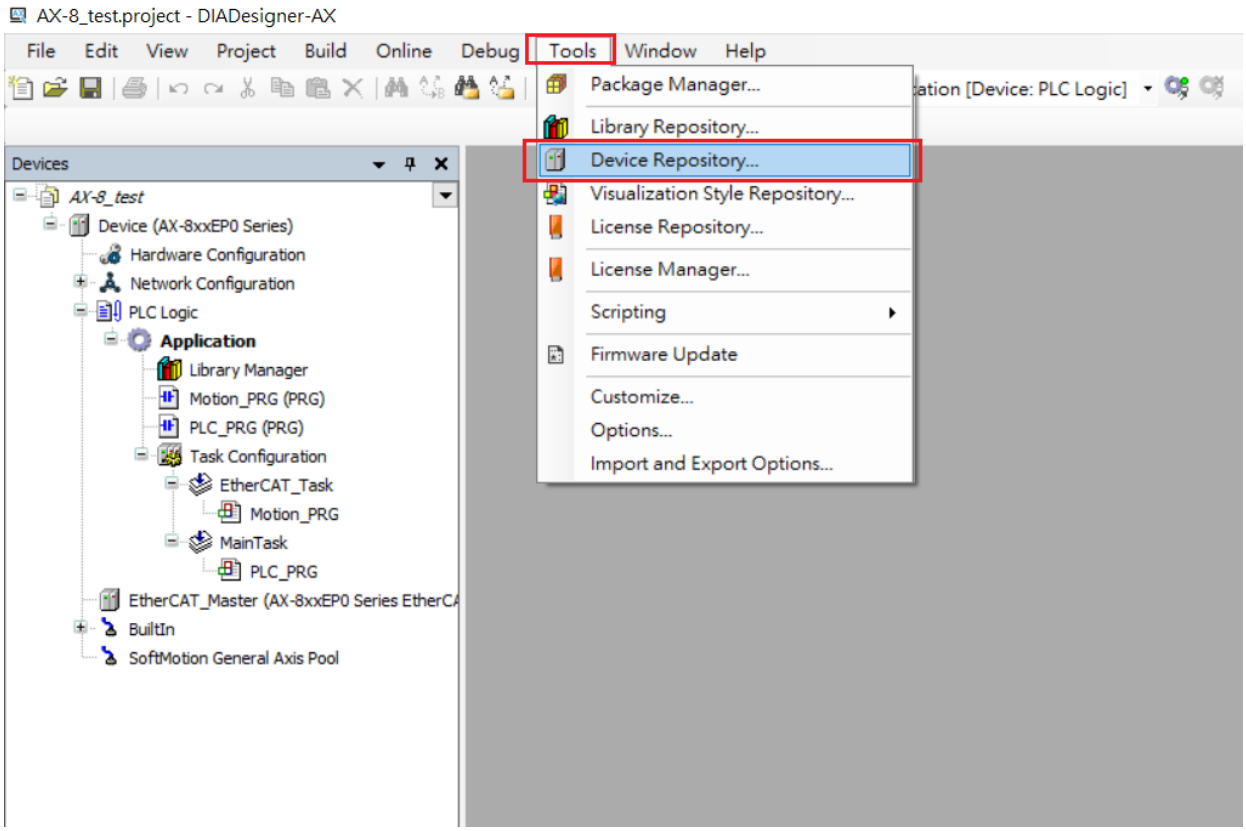
3. In the **New Project** window, select the **Standard project**, and then click **OK**.



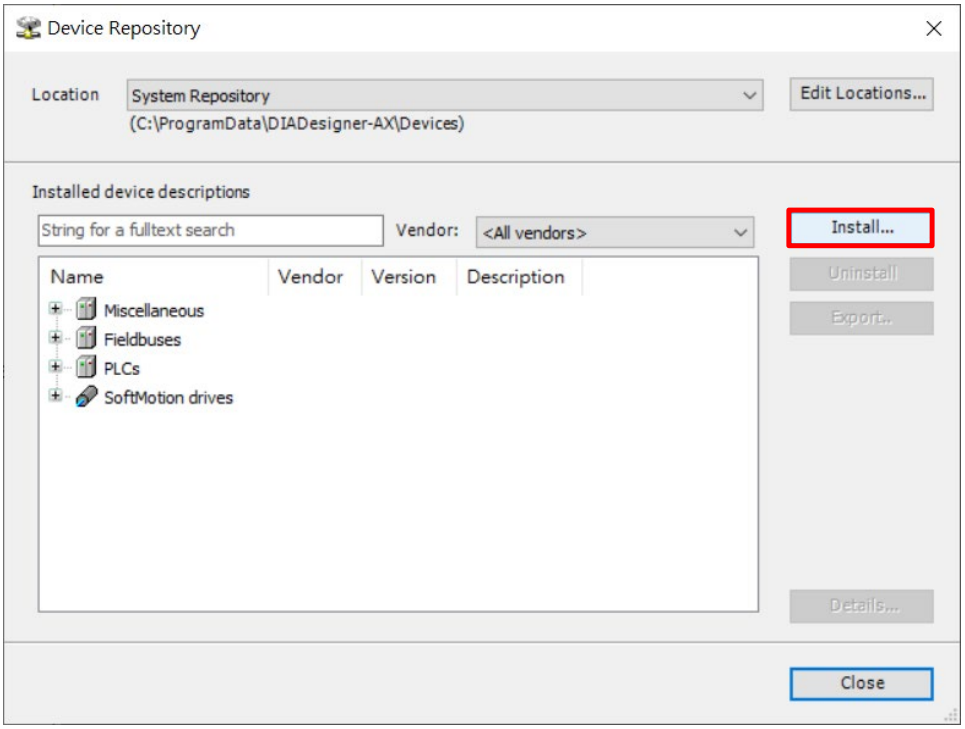
4. In the **Standard Project** window, select the device **AX-8xxEP0 Windows Series, Version,** **PLC_PGR in** (program type), and then click **OK** to create a new project.



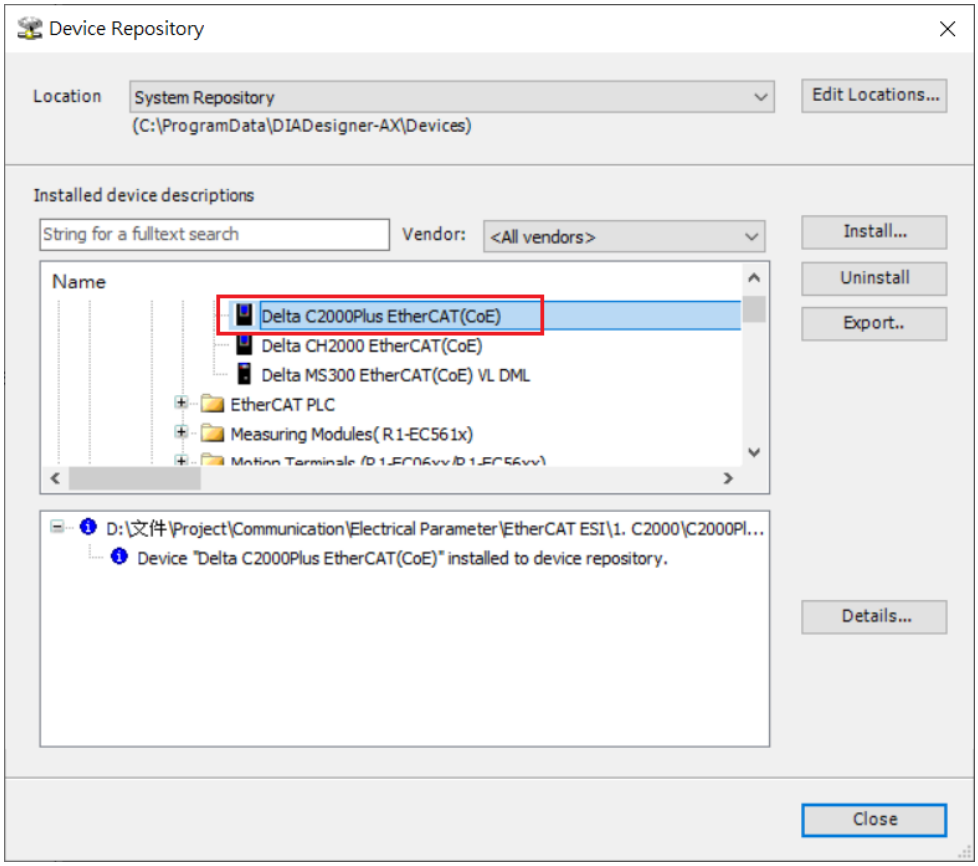
5. After the project is opened, click **Tools → Device Repository** to open the **Device Repository** window



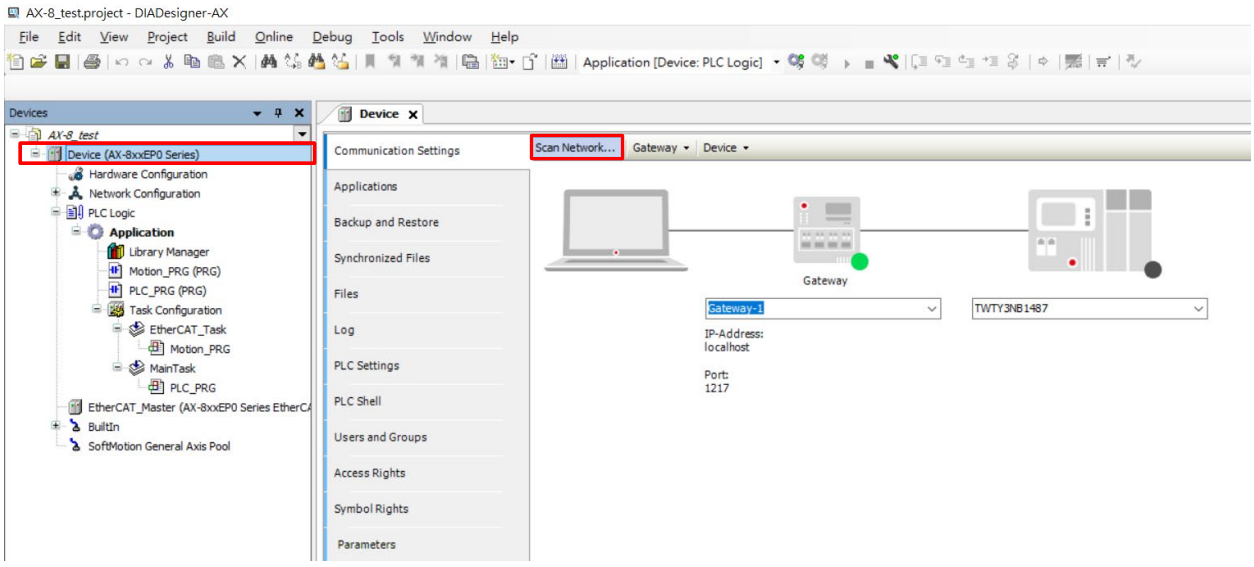
6. The **Device Repository** window appears, and then click **Install**.



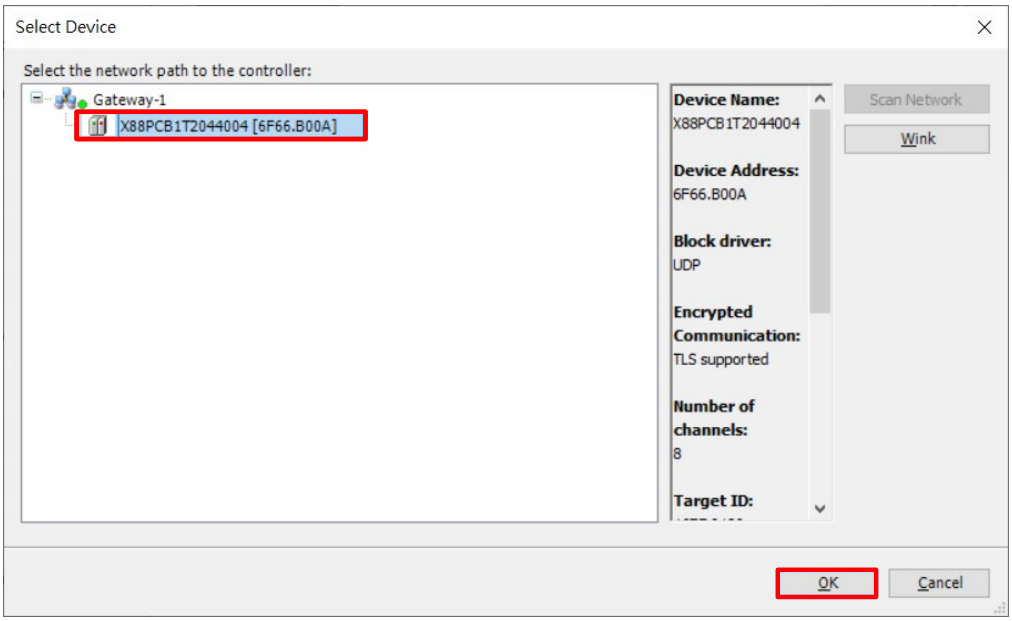
7. Import the ESI file of C2000 Plus

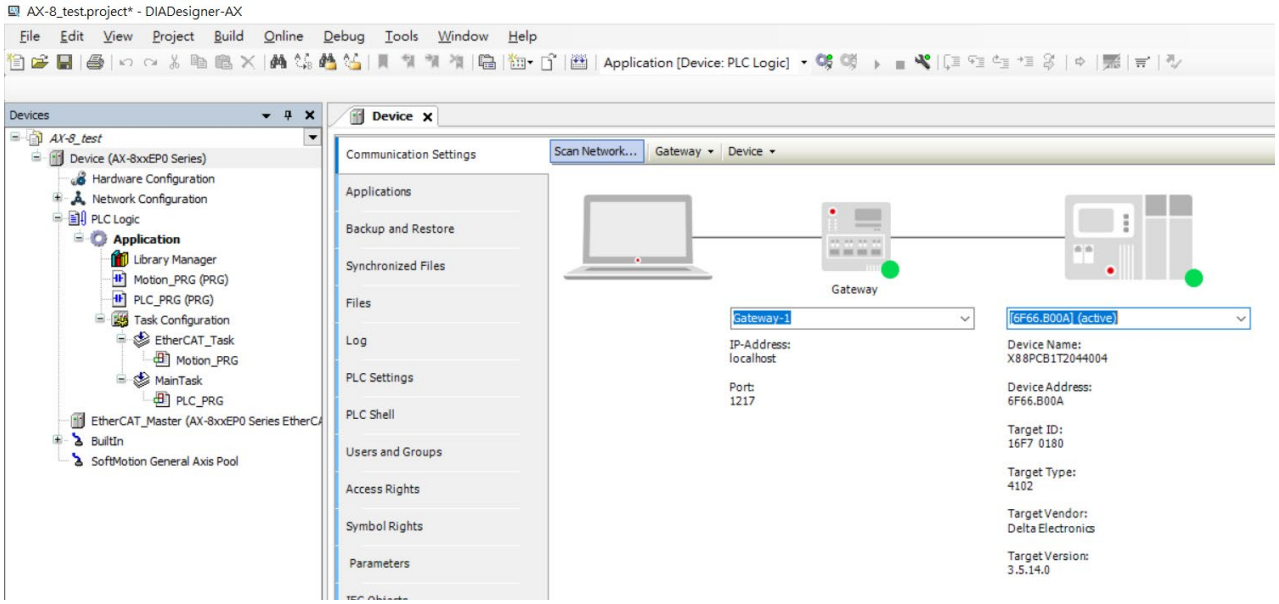


8. Double-click **Device (AX-8xxEP0 Series)**, and then click **Scan Network…**

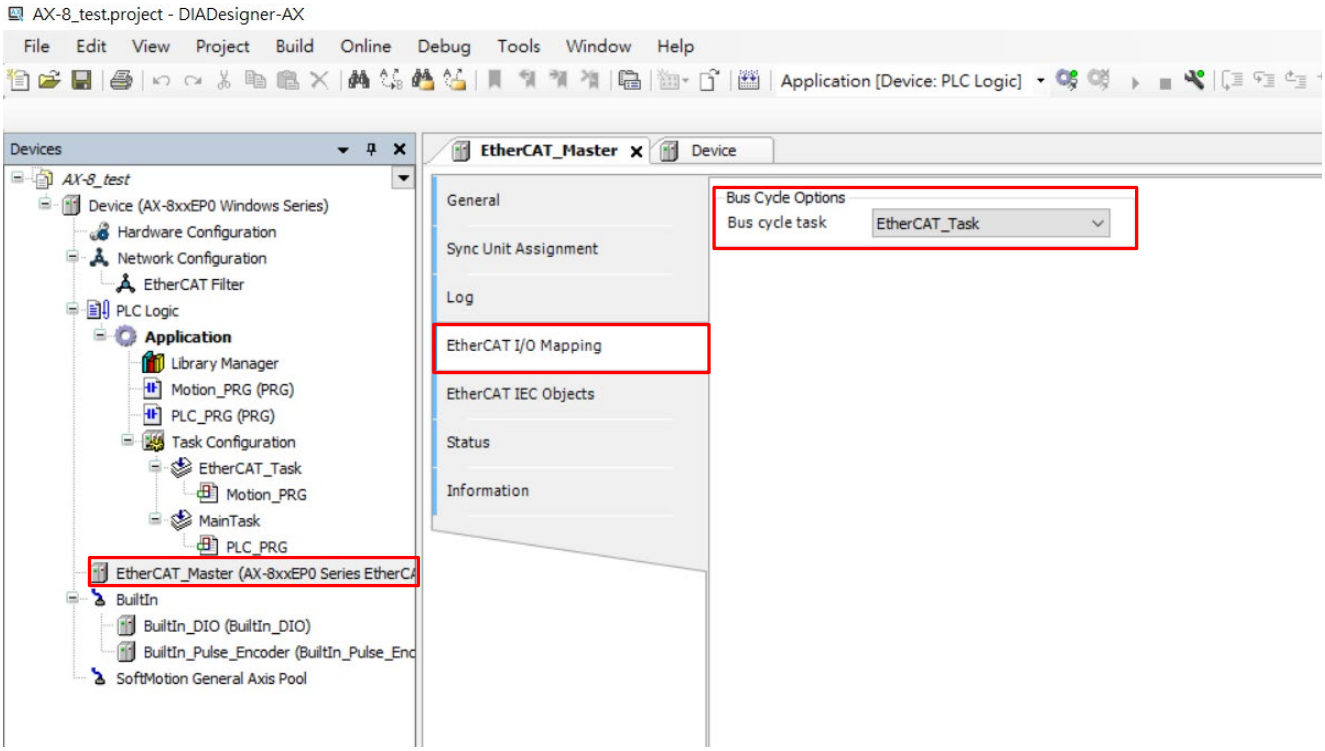


9. If the computer is correctly connected to the AX-8, the serial number of the connected AX-8 will be displayed. Select **the serial number**, and then click **OK**. Then, a device selection page appears.

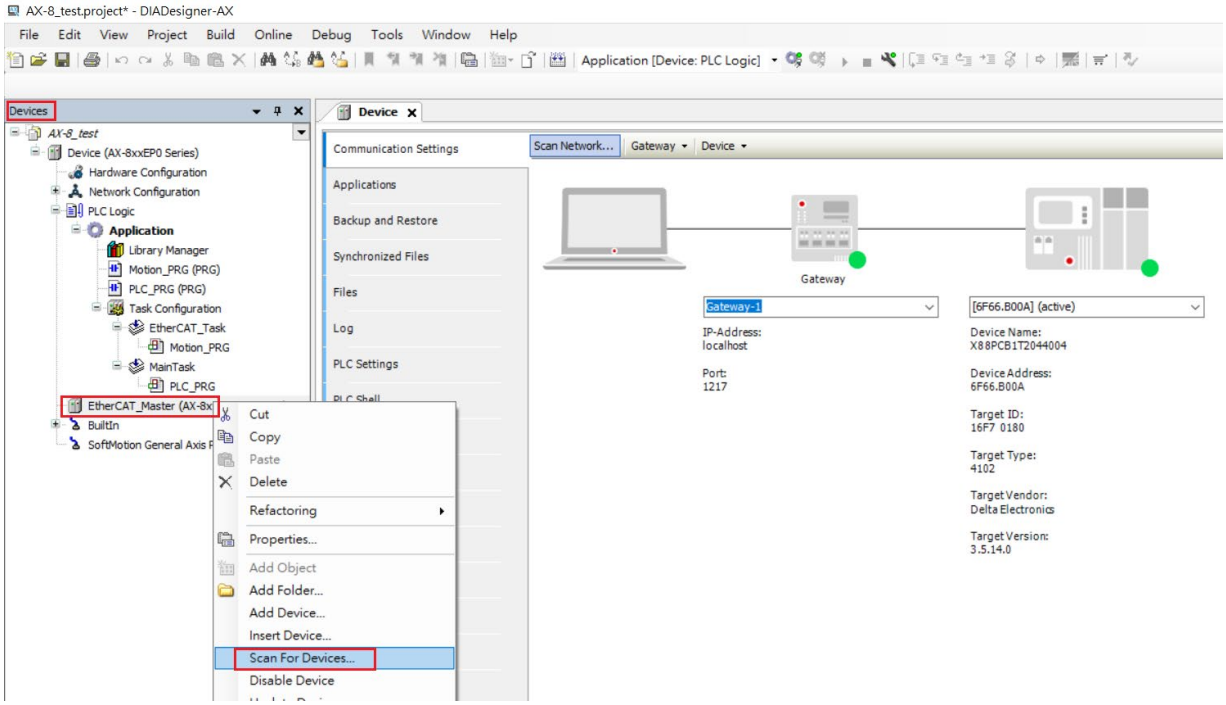




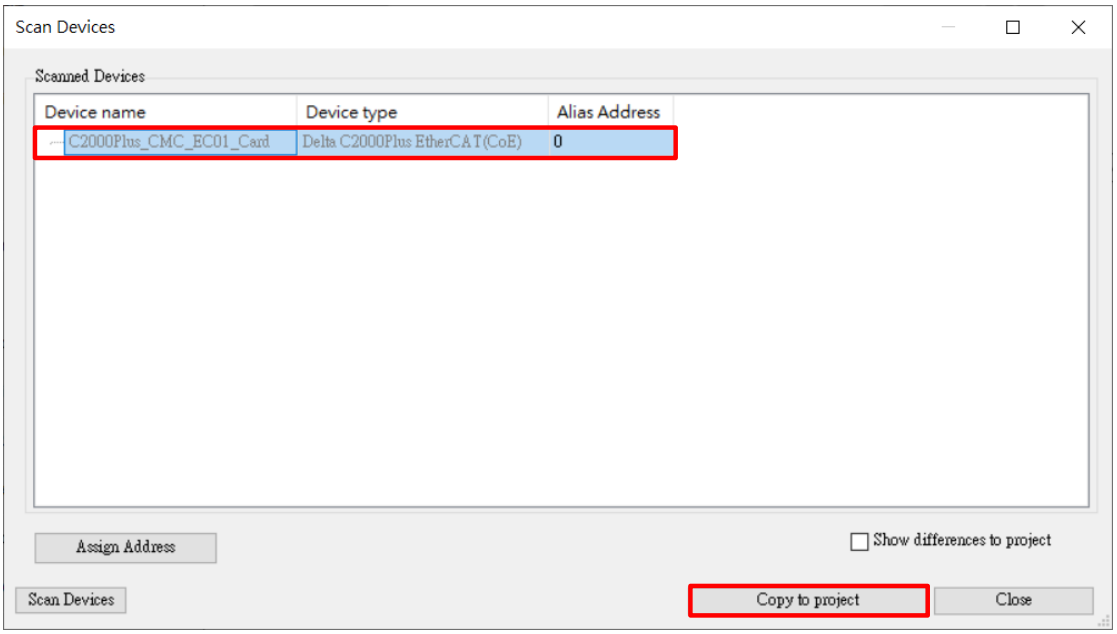
10. In the **Devices** window, click **EtherCAT_Master (AX-8xxEP0 Series EtherCAT Master)**, go to the **EtherCAT I/O Mapping** tab, and verify the **Bus Cycle Options** is set to **EtherCAT_Task**.



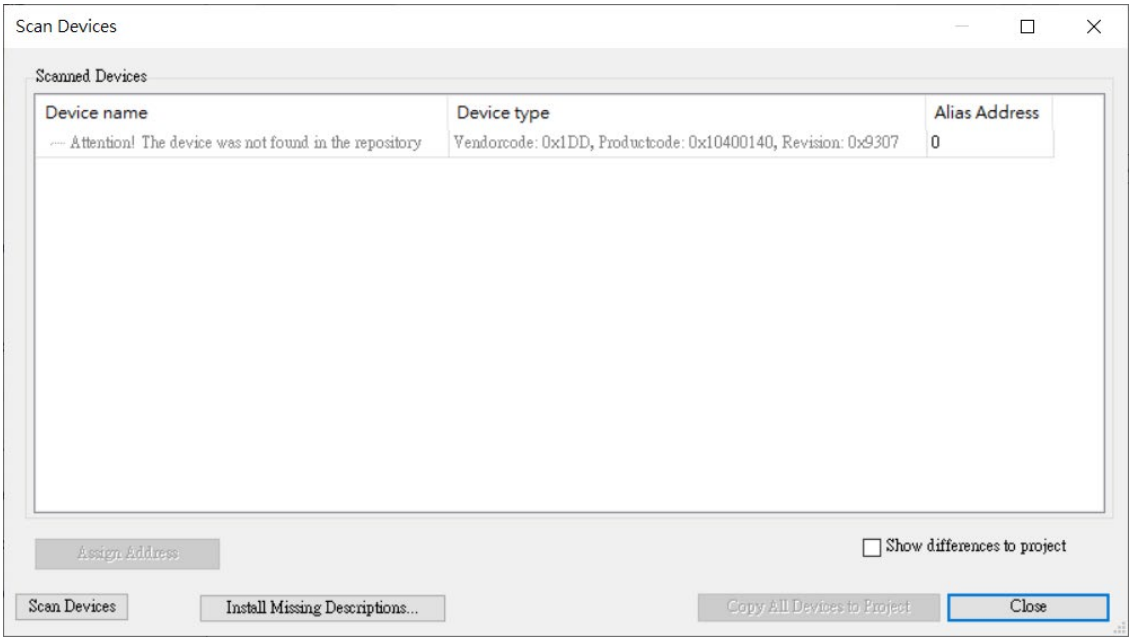
11. In the **Devices** window, right-click on the **EtherCAT_Master (AX-8xxEP0 Series EtherCAT Master)**, and then select **Scan For Devices…**



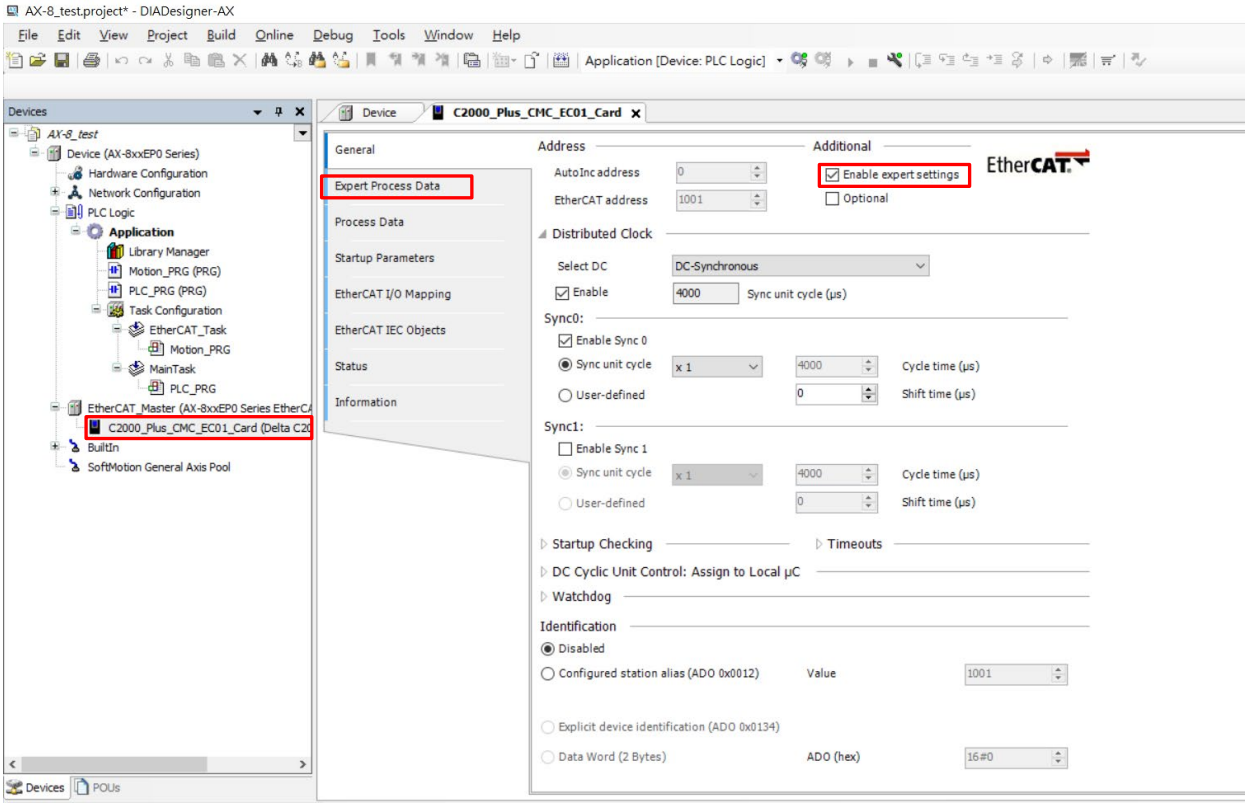
12. The C2000 Plus model description will appear in the pop-up window. Select the C2000 Plus model description, and then click **Copy to project**.



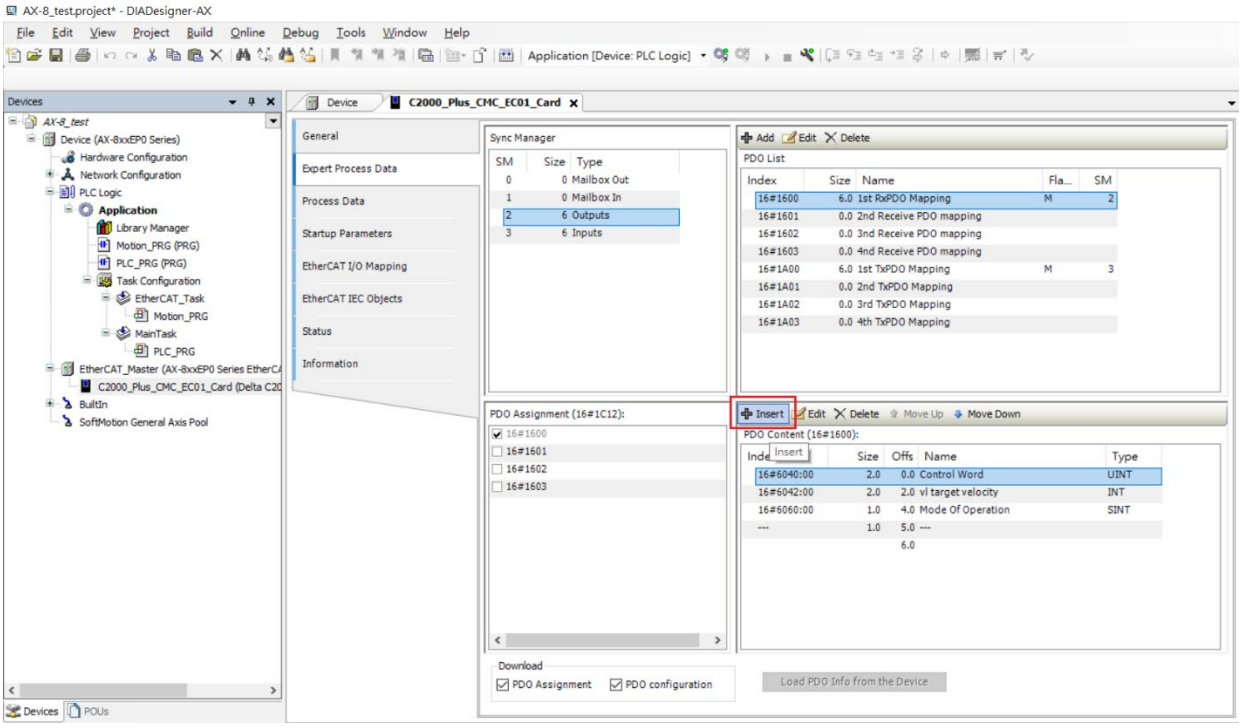
13. If the window is blank, check if the wiring between CMC-EC01 and AX-8 is correct. If the information below appears in the window, refer to Step 5 to Step 7 mentioned above to make sure ESI file is correctly imported.



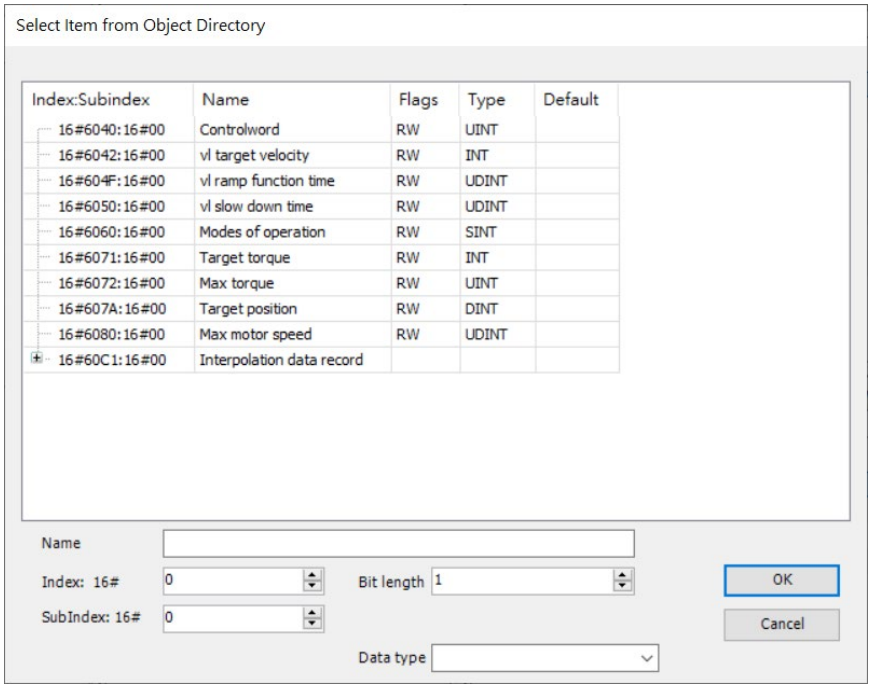
14. In the **Devices** window, double-click **C2000_Plus_CMC_EC01_Card (Delta C2000 Plus EtherCAT (CoE))** to open the tab. Then, check **Enable expert settings**, and click **Expert Process Data** at the left side of the tab to configure PDO mapping.



15. In the lower right window of the **Expert Process Data** screen, click **Insert**.



16. The PDO object mapping window will pop up. Select the PDO object to be mapped.



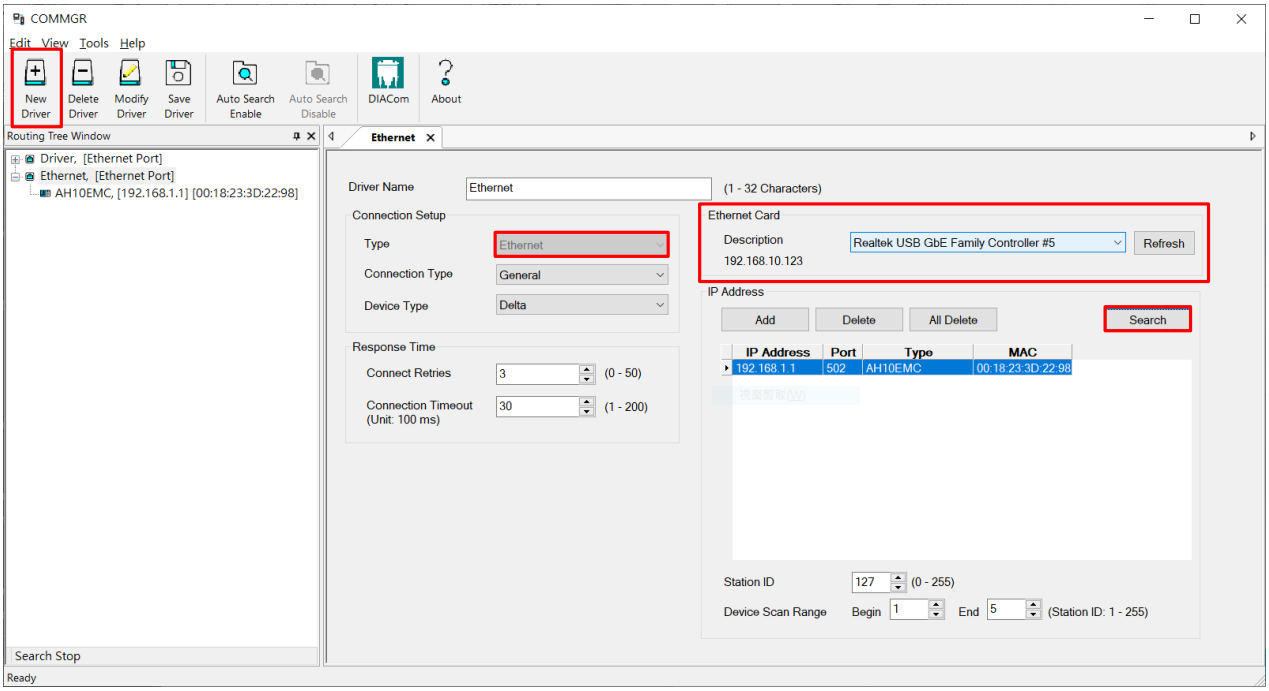
17. When the steps above are completed, the axis group can be established and PLC programming can be performed.

7.2 Delta PLC – AH10EMC Operation Example (ECAT Builder)

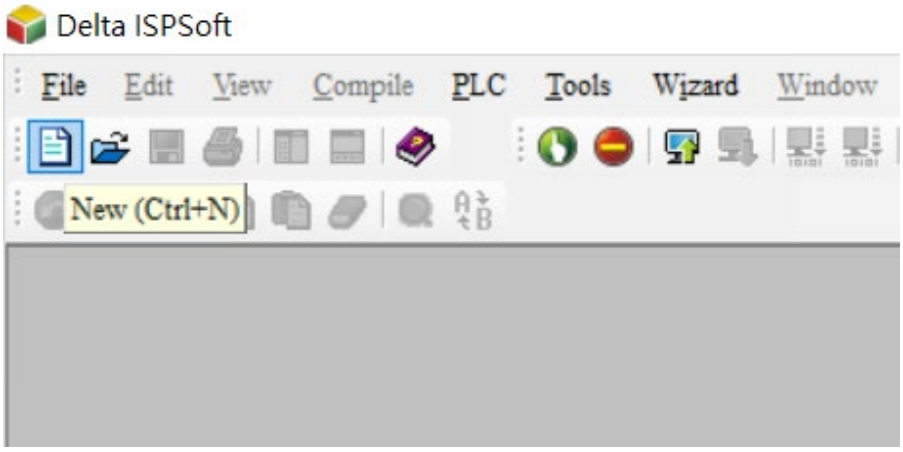
Device	AH10EMC	IP: 192.168.1.1
	Computer	Network Card IP: 192.168.1.123
	Drive: CH2000 Communication Card: CMC-EC01	
Software	COMMGR	V1.11 or above
	ISPSoft	V3.10 or above
	ECAT Builder	V1.07 or above

1. Connect CMC-EC01 to the AH10EMC EtherCAT port, and connect the AH10EMC to the computer through the Ethernet port.

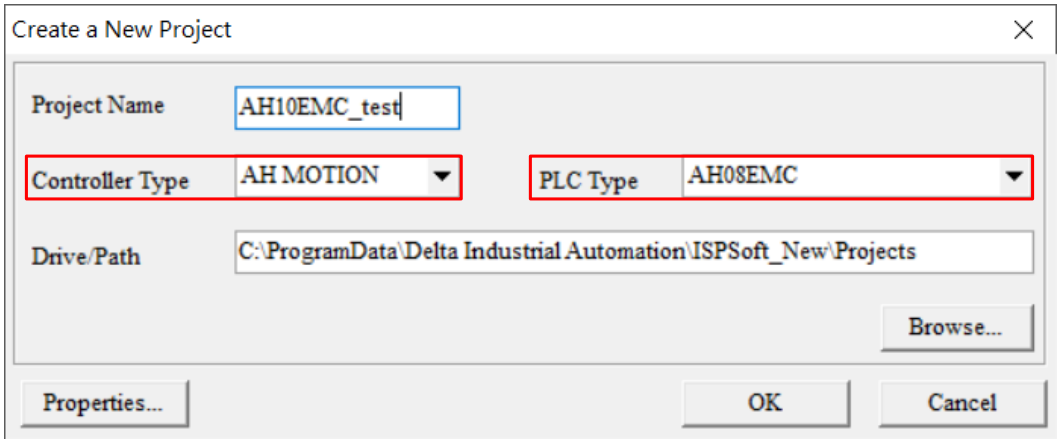
2. Open the COMMGR software, click **New Driver** menu at the top, select the connection setup type as **Ethernet** in the **Ethernet** tab, select the correct **Ethernet Card**, and then click **Search** to verify that the AH10EMC appears in the list. Then, click the **Save Driver** menu for ISPSoft connection.



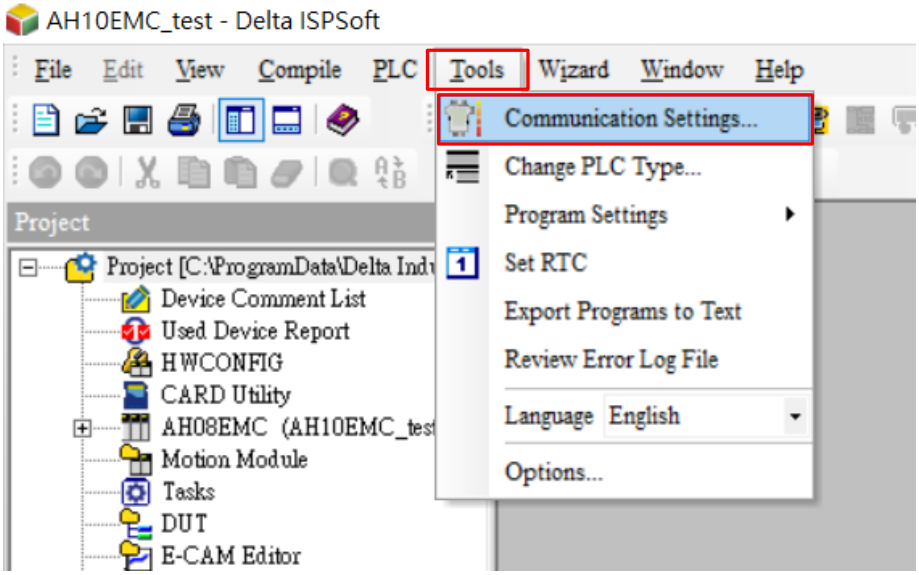
3. Open ISPSoft software, and then click **New (Ctrl+N)** to create a new project



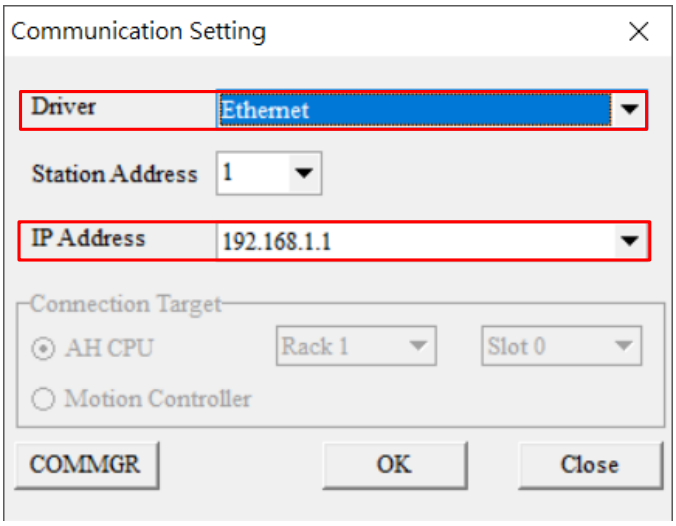
4. Select **AH MOTION** for controller type and **AH10EMC** for PLC type



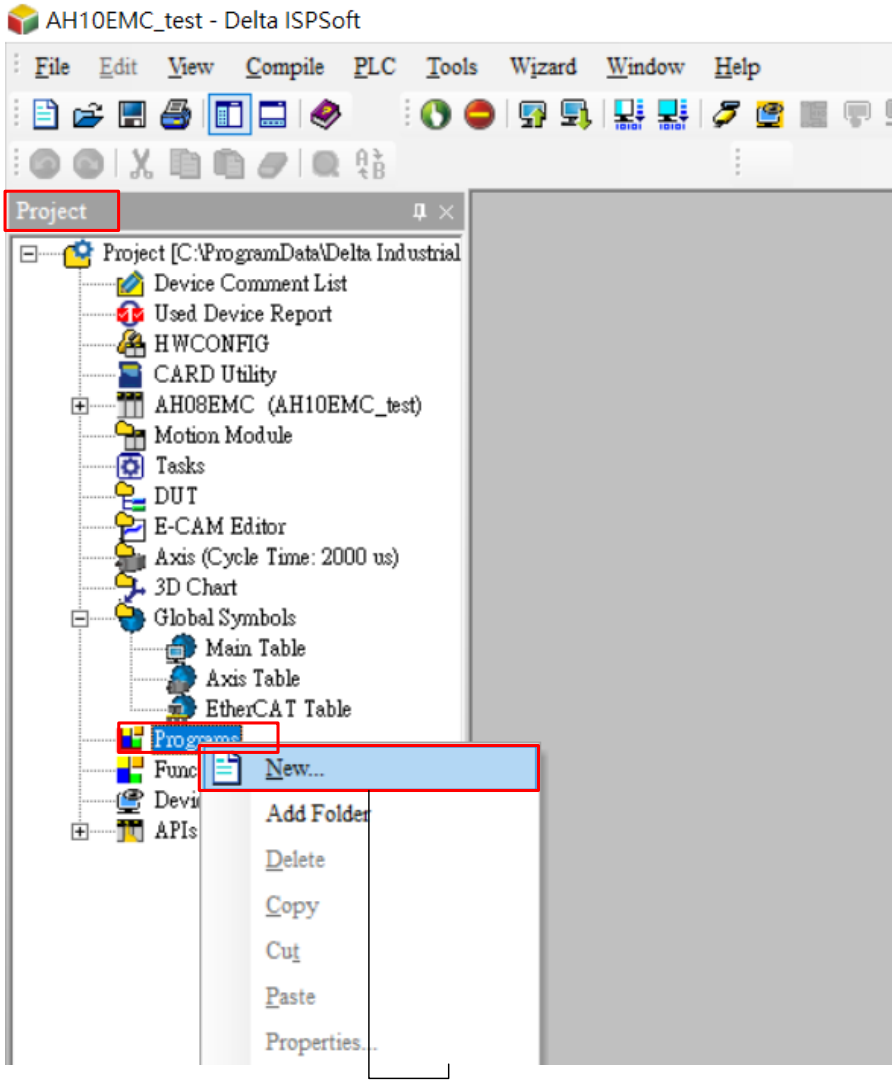
5. Click **Tools→Communication Settings**

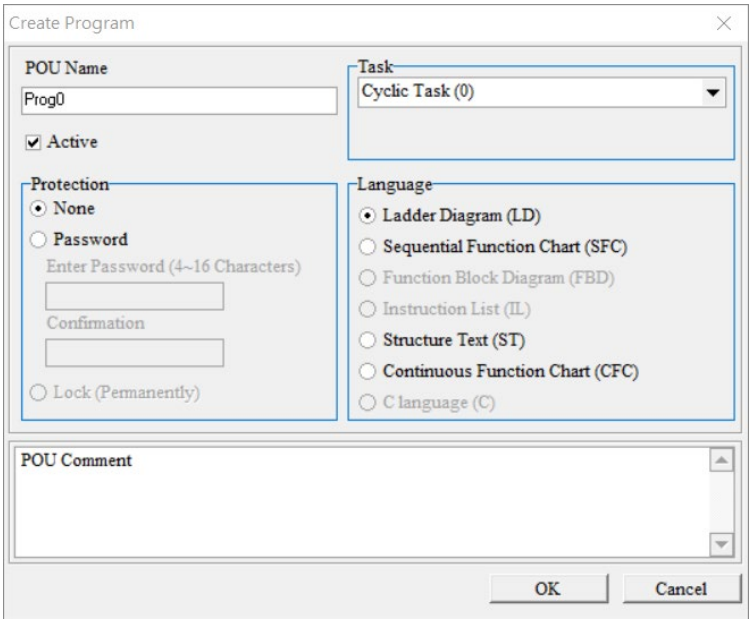


6. Select **the name of the communication channel** (that is, the **Driver Name** created in COMMGR in Step 2 mentioned above), and the **IP Address** of the PLC.

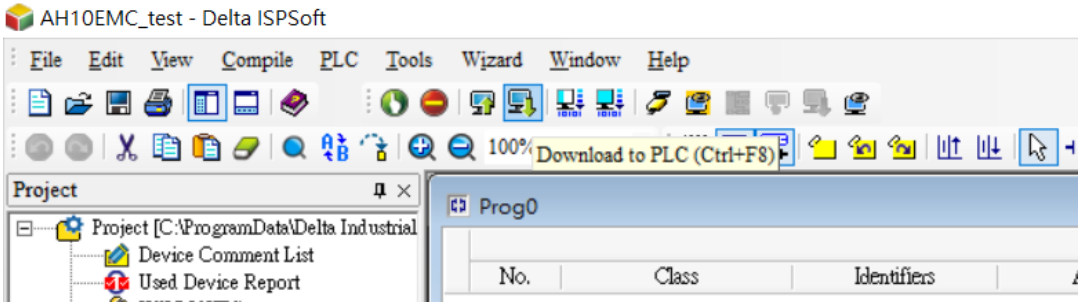


7. In the **Project** panel, right-click **Programs**, and then click **New** to create an empty program.

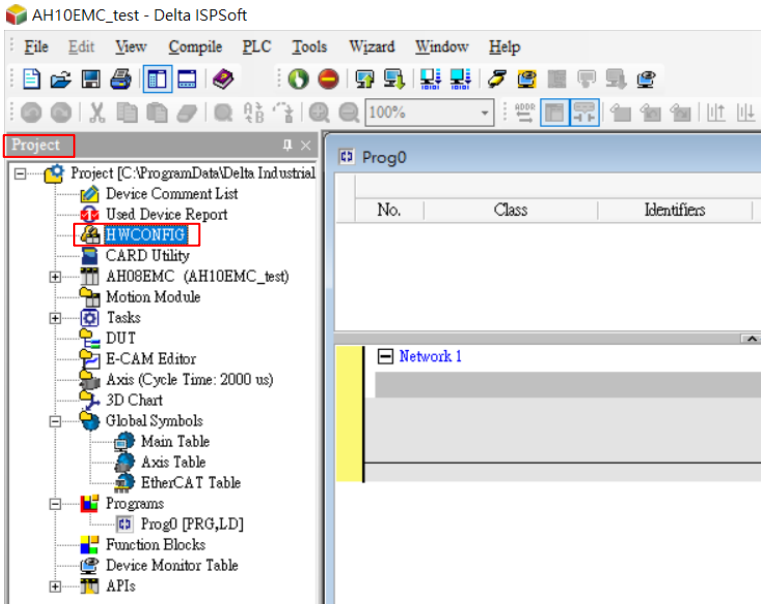


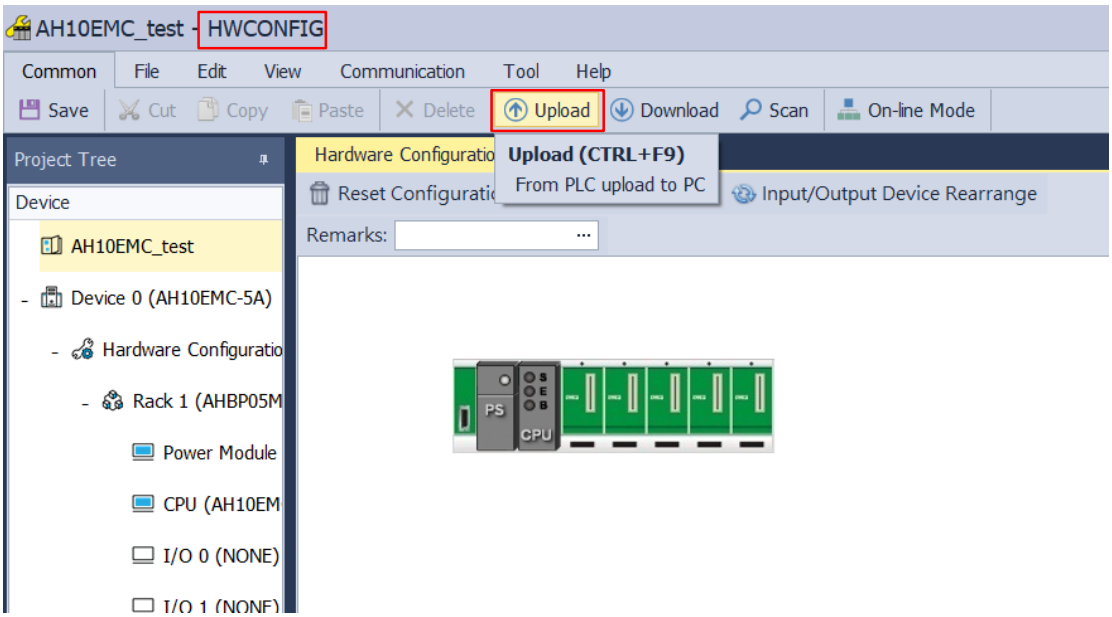


8. Click **Download to PLC** to make sure that the PLC program can be run. If so, the connection between computer and PLC is completed. PLC programs can be edited after EtherCAT connection configuration is established.

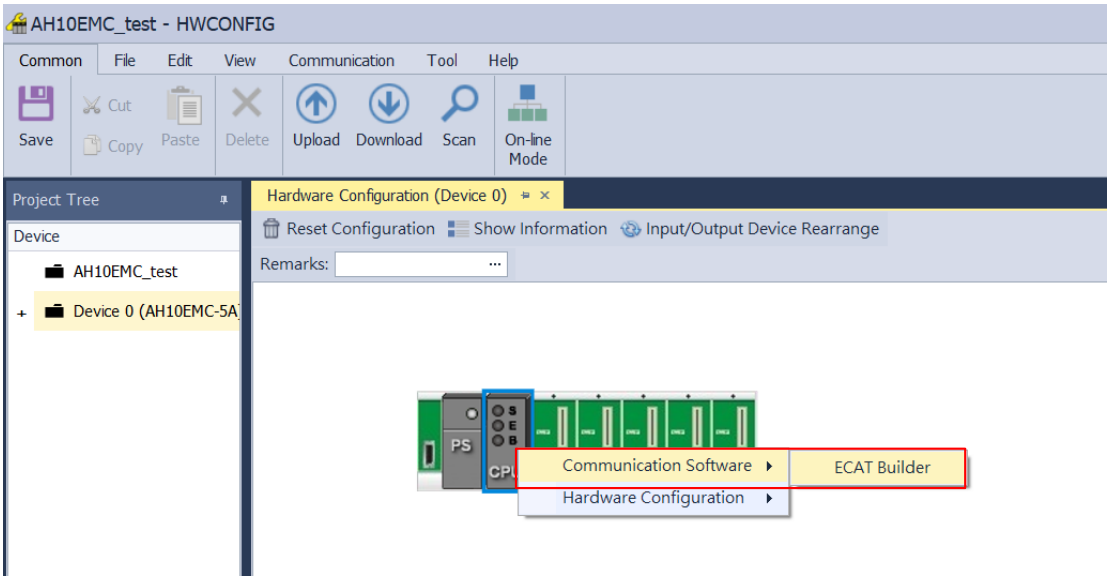


9. In the **Project** panel, double-click **HWCONFIG**. After the HWCONFIG software is opened, click **Upload** to upload PLC parameters and configurations to HWCONFIG.

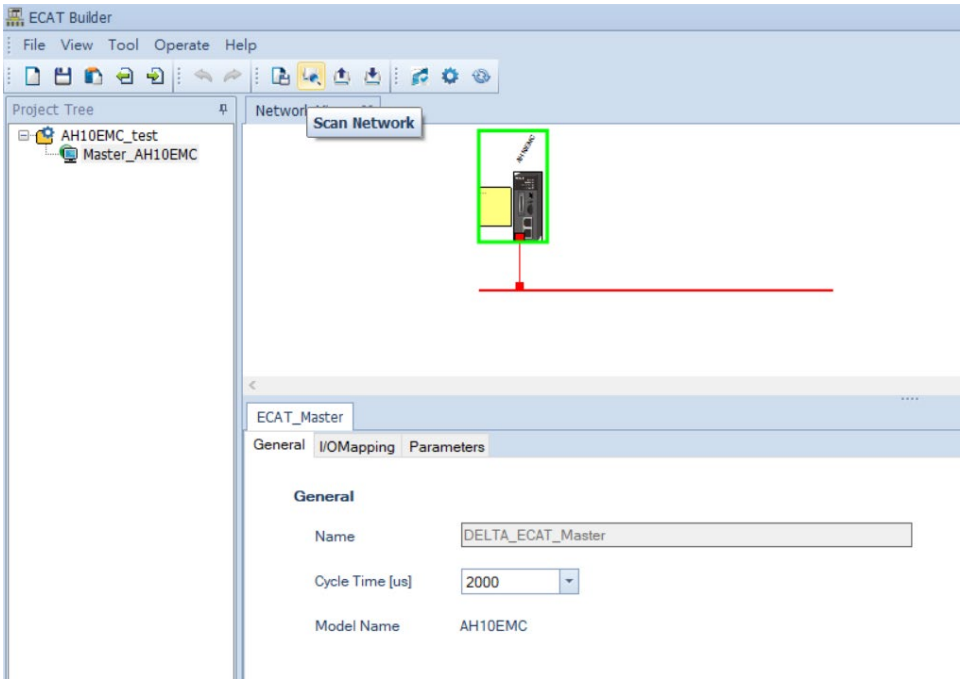


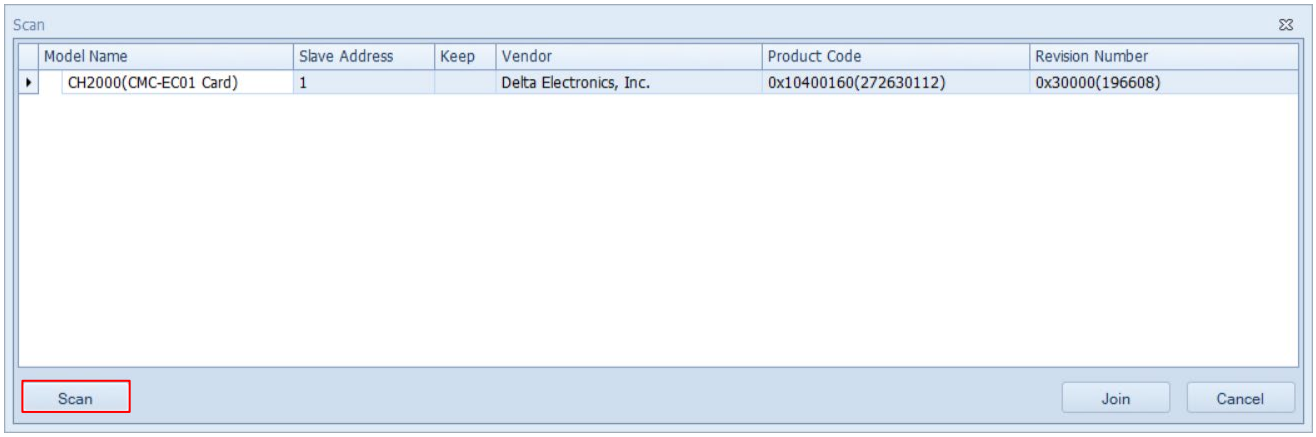


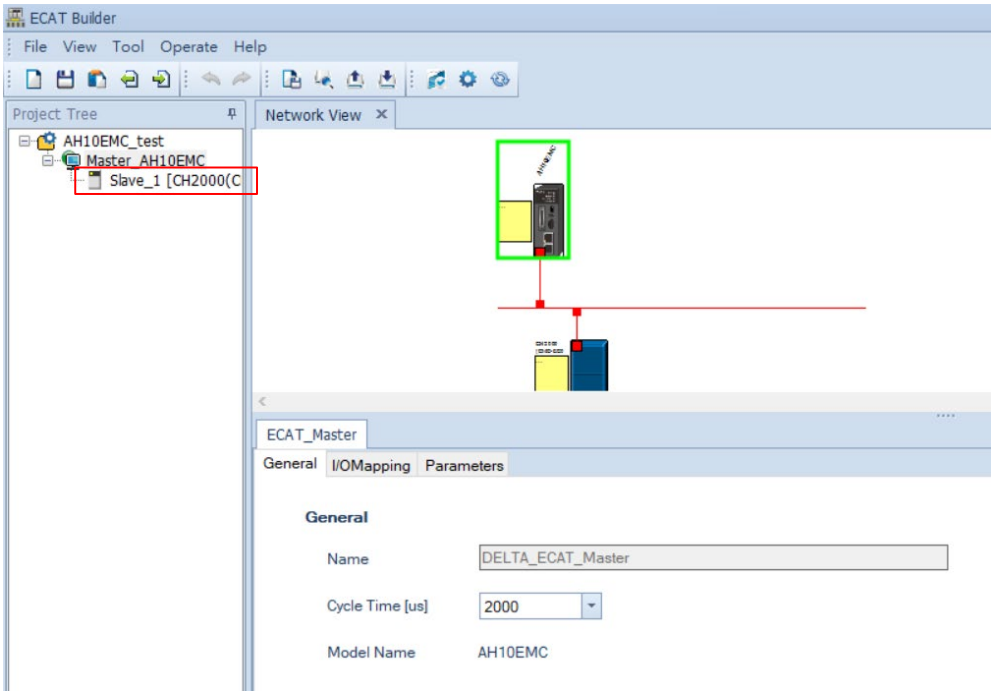
10. Right-click the CPU module **picture**, select **Communication Software→ECAT Builder** to open ECAT Builder software and configure ECAT master/slave related settings.



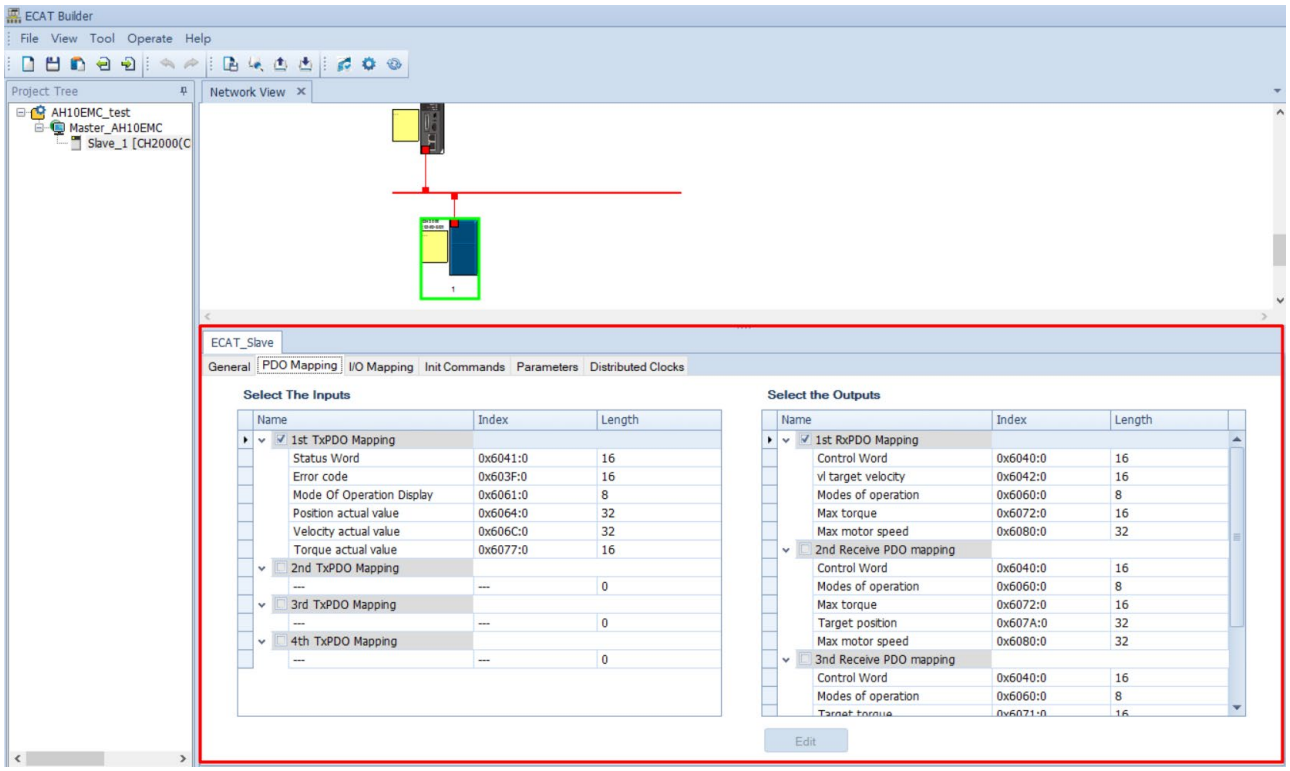
11. Click **Scan Network**, click **Scan** in the pop-up window, and select **CH2000 (CMC-EC01)** to import to the network. If the CH2000 device is not found, check if the wiring is correct, or refer to the following sections regarding ESI importing process to import the ESI file of the slave device, and then scan.

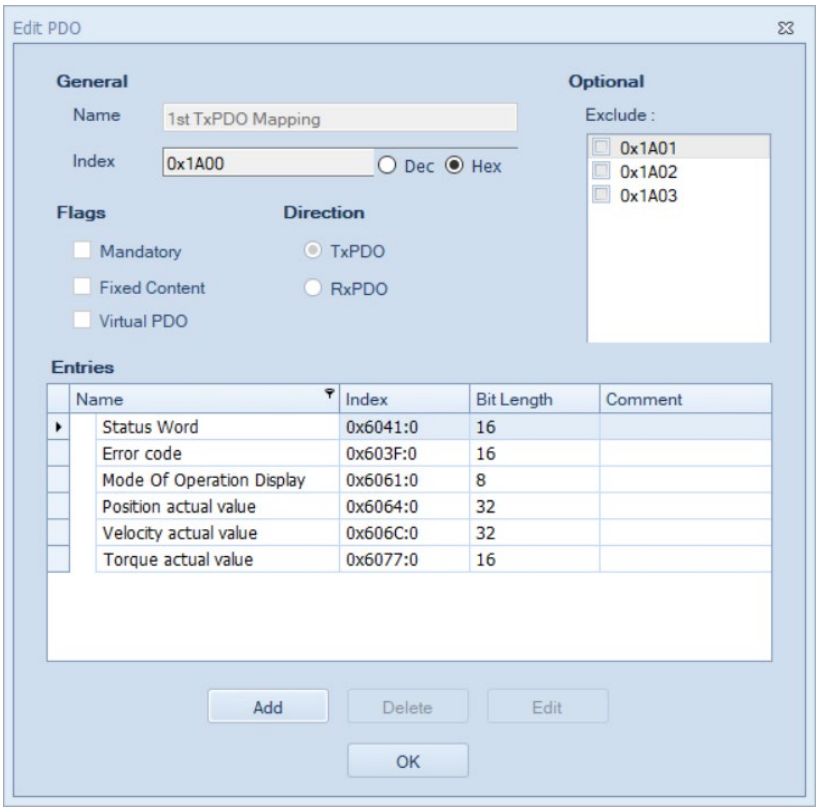

ECAT Builder
File View Tool Operate Help
Project Tree
AH10EMC_test
Master_AH10EMC
Scan Network
ECAT_Master
General I/OMapping Parameters
General
Name
DELTA_ECAT_Master
Cycle Time [us]
2000
Model Name
AH10EMC


Scan
Model Name
Slave Address
Keep
Vendor
Product Code
Revision Number
CH2000(CMC-EC01 Card)
1
Delta Electronics, Inc.
0x10400160(272630112)
0x30000(196608)
Scan
Join
Cancel

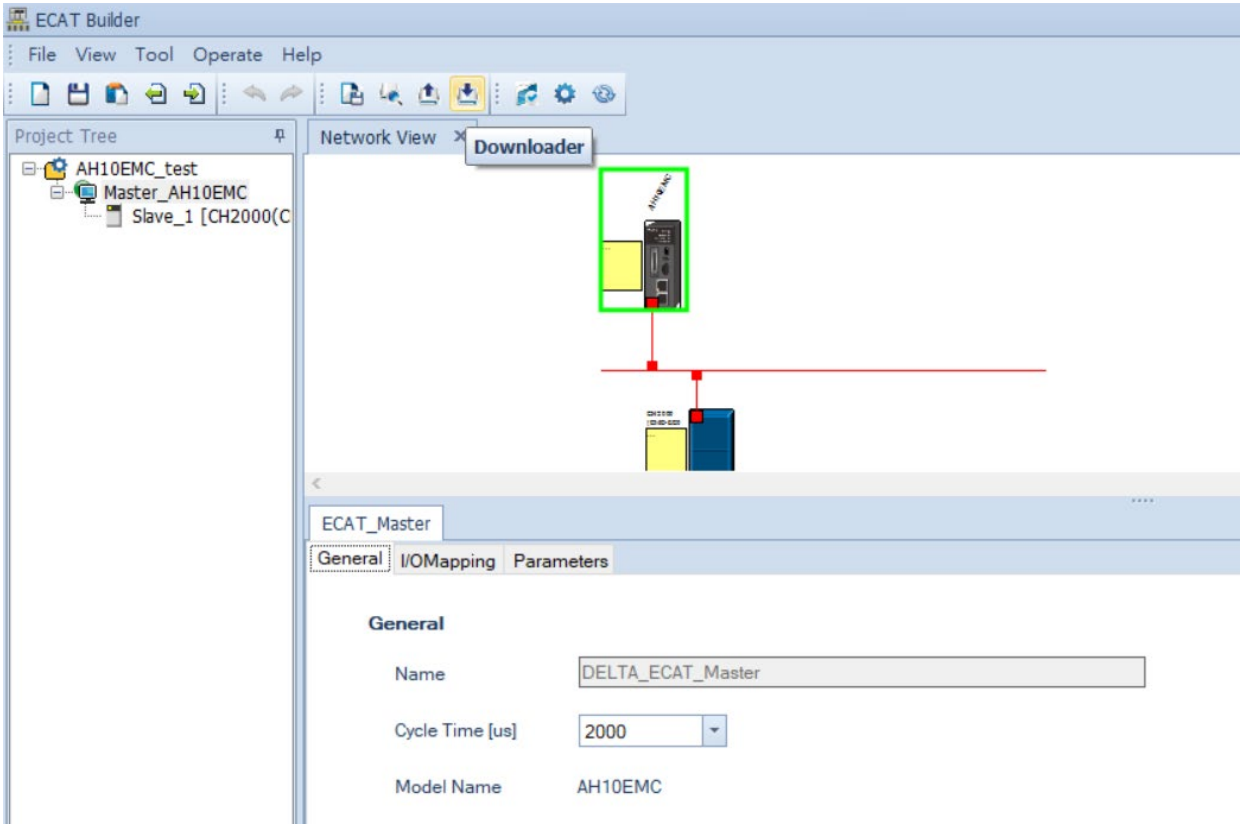

ECAT Builder
File View Tool Operate Help
Project Tree
Network View
AH10EMC_test
Master_AH10EMC
Slave_1 [CH2000(C
ECAT_Master
General I/OMapping Parameters
General
Name
DELTA_ECAT_Master
Cycle Time [us]
2000
Model Name
AH10EMC

12. After CH2000 has been imported into the **Network View**, click the CH2000 device to perform **PDO Mapping**, and then click **Edit** to add or delete objects.



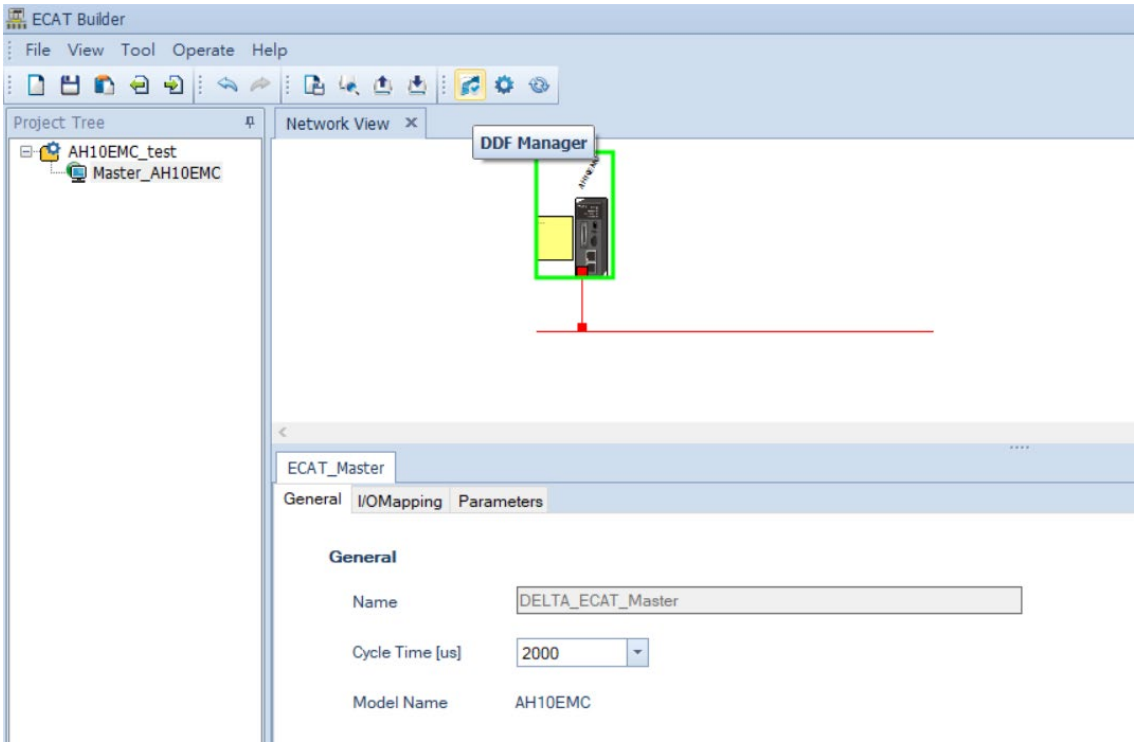


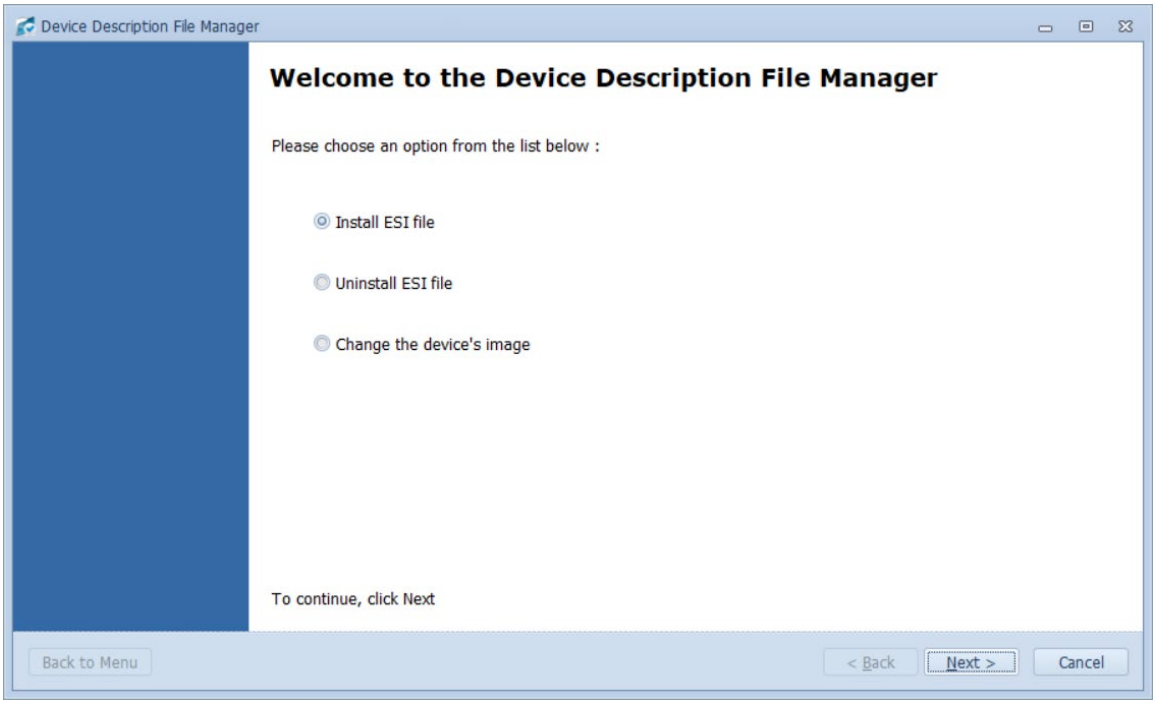
13. After editing is completed, click **Downloader** to download all configurations to AH10EMC. After closing ECAT Builder and HWCONFIG software, PLC programs can be written in ISPSoft.



- How to import the ESI file

  Click **DDF Manager** and follow the steps to import the ESI file. ESI files can be downloaded from Deltas official download center (see Section 2.5 for more information).





Appendix A. Object Descriptions

A.1 Object Specifications

A.1.1 Object Type

Object Type	Description
Variable	A single value, such as a UNSIGNED8, Boolean, float, INTEGER16, etc.
Array	Objects with multiple data fields composed of multiple variables of the same data type, such as UNSIGNED16 arrays, etc. Sub-index 0 data type is UNSIGNED8, so it is not array data.
Record	An object with multiple data fields consisting of multiple variables of different data types. Sub-index 0 is UNSIGNED8, so it is not RECORD data.

A.1.2 Data Type

Data Type	Size	Range
BOOLEAN	1 bit	0–1
UNSIGNED8	1 byte	0–255
UNSIGNED16	2 bytes	0–65535
UNSIGNED32	4 bytes	0–4294967295
INTEGER8	1 byte	-128 to 127
INTEGER16	2 bytes	-32768 to 327671
INTEGER32	4 bytes	-2147483648 to 2147483647
VISIBLE STRING	-	-

A.2 Object Dictionary

A.2.1 OD 1000h Communication Group

Index	Object Type	Name	Data Type	Attribute
1000h	Variable	Device type	UNSIGNED32	RO
1001h	Variable	Error register	UNSIGNED8	RO
1008h	Variable	Device name	STRING	RO
100Ah	Variable	Software version	STRING	RO
1018h	Record	Identity	IDENTITY	RO
1600h	Record	Receive PDO mapping	PDOMAPPING	RW
1A00h	Record	Transmit PDO mapping	PDOMAPPING	RW
1C12h	Array	RxPDO assign	UNSIGNED16	RW
1C13h	Array	TxPDO assign	UNSIGNED16	RW

A.2.2 OD 3000h Drive Group

The objects defined here are the related settings of the drive parameters and the reading of the drive status information. The setting methods of the related objects are as follows:

The index value 300Xh corresponds to the Xth group of the drive parameters, and the sub-index values 1–64h (hexadecimal) correspond to the parameters 0–99 in the parameter group.

Example: Set parameter 05-33 (select induction motor or permanent magnet synchronous motor), the index value is 3005h, and the sub-index value is 22h (34).

Drive Status Information Object

Index	Object Type	Name	Data Type	Attribute	PDO Mapping
3021h	Array	Driver info table 1	UNSIGNED16	RO	N
3022h	Array	Driver info table 2	UNSIGNED16	RO	N
3026h	Array	Remote IO	UNSIGNED16	RO	N

A.2.3 OD 6000h Communication Object Group

Index	Object Type	Name	Data Type	Attribute	PDO Mapping
6007h	Variable	Abort connection option code	INTEGER16	RW	N
603Fh	Variable	Error code	UNSIGNED16	RO	Y
6040h	Variable	Controlword	UNSIGNED16	RW	Y
6041h	Variable	Statusword	UNSIGNED16	RO	Y
6042h	Variable	vl target velocity	INTEGER16	RW	Y
6043h	Variable	vl velocity demand	INTEGER16	RO	N
6044h	Variable	vl velocity actual value	INTEGER16	RO	Y
604Fh	Variable	vl ramp function time	INTEGER16	RW	N
6050h	Variable	vl slow down time	INTEGER16	RW	N
6051h	Variable	vl quick stop time	INTEGER16	RW	N
605Ah	Variable	Quick stop option code	INTEGER16	RW	N
605Ch	Variable	Disable operation option code	INTEGER16	RW	N
6060h	Variable	Modes of operation	INTEGER8	RW	Y
6061h	Variable	Modes of operation display	INTEGER8	RO	Y
6062h	Variable	Position demand value	INTEGER32	RO	N
6064h	Variable	Position actual value	INTEGER32	RO	Y
6065h	Variable	Following error window	UNSIGNED32	RW	N
6067h	Variable	Position window	UNSIGNED32	RW	N
6068h	Variable	Position window time	UNSIGNED16	RW	N
606Ch	Variable	Velocity actual value	INTEGER32	RO	Y

Index	Object Type	Name	Data Type	Attribute	PDO Mapping
6071h	Variable	Target torque	UNSIGNED32	RO	Y
6072h	Variable	Max torque	UNSIGNED32	RO	Y
6075h	Variable	Motor rated current	UNSIGNED32	RO	N
6077h	Variable	Torque actual value	INTEGER16	RO	Y
6078h	Variable	Current actual value	INTEGER16	RO	N
6079h	Variable	DC link circuit voltage	UNSIGNED32	RO	N
607Ah	Variable	Target position	INTEGER32	RW	Y
607Ch	Variable	Home offset	INTEGER32	RO	N
607Dh	Array	Software position limit	INTEGER32	RW	N
6080h	Variable	Max motor speed	UNSIGNED32	RW	Y
6081h	Variable	Profile velocity	UNSIGNED32	RW	N
6083h	Variable	Profile acceleration	UNSIGNED32	RW	N
6084h	Variable	Profile deceleration	UNSIGNED32	RW	N
6085h	Variable	Quick stop deceleration	UNSIGNED32	RW	N
6087h	Variable	Torque slope	UNSIGNED32	RW	N
6091h	Array	Gear ratio	UNSIGNED32	RW	N
6098h	Variable	Homing method	UNSIGNED8	RW	N
6099h	Array	Homing speeds	UNSIGNED32	RW	N
609Ah	Variable	Homing acceleration	UNSIGNED32	RW	N
60F4h	Variable	Following error actual value	UNSIGNED32	RW	N
6502h	Variable	Supported drive modes	INTEGER32	RO	N

A.3 Object Details

A.3.1 OD 1000h Communication Group

Object 1000h: Device type

Index	1000h
Name	Device type
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

Object 1001h: Error register

Index	1001h
Name	Error register
Object Type	Variable
Data Type	UNSIGNED8
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED8

Object 1008h: Device name

Index	1008h
Name	Device name
Object Type	Variable
Data Type	STRING
Read/Write Permission	RO
PDO Mapping Setting	No

Object 100Ah: Software version

Index	100Ah
Name	Software version
Object Type	Variable
Data Type	STRING
Read/Write Permission	RO
PDO Mapping Setting	No

Object 1018h: Identity

Index	1018h
Name	Identity
Object Type	RECORD
Read/write Permission	RO
PDO Mapping Setting	No

Sub-Index	0
Name	SubIndex 000
Data Type	UNSIGNED8
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED8

Sub-Index	1
Name	Vendor ID
Data Type	UNSIGNED32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

Sub-Index	2
Name	Product code
Data Type	UNSIGNED32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

Sub-Index	3
Name	Revision
Data Type	UNSIGNED32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

Sub-Index	4
Name	Serial number
Data Type	UNSIGNED32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

Object 1600h–1603h: Receive PDO Mapping Parameter

Index	1600h / 1601h / 1602h / 1603h
Name	Receive PDO mapping
Object Type	RECORD
Data Type	PDO mapping
Read/Write Permission	RW
PDO Mapping Setting	No
Note	The total length of objects in a group of PDOs cannot exceed 64-bit

Sub-Index	0
Name	Number of Objects
Data Type	UNSIGNED8
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	0: Disabled 1–8: Set the number of PDO mappings and enable the function
Default	0

Sub-Index	1–8
Name	Mapping entry (n)
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED32
Default	0

Object 1A00h–1A03h: Transmit PDO Mapping Parameter

Index	1A00h / 1A01h / 1A02h / 1A03h
Name	Transmit PDO Mapping Parameter
Object Type	RECORD
Data Type	PDO mapping
Read/Write Permission	RW
Note	The total length of objects in a group of PDOs cannot exceed 64-bit

Sub-Index	0
Name	Number of Objects
Data Type	UNSIGNED8
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	0: Disabled 1–8: Set the number of PDO mappings and

	enable the function
Default	0

Sub-Index	1–8
Name	Mapping entry (n)
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED32
Default	0

Object 1C12h: RxPDO assign

Index	1C12h
Name	RxPDO assign
Object Type	ARRAY
Data Type	UNSIGNED16
Read/Write Permission	RW
PDO Mapping Setting	No

Sub-Index	0
Name	Number of assigned RxPDOs
Data Type	UNSIGNED8
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	0–1
Default	1

Sub-Index	1
Name	Index of assigned RxPDO
Data Type	UNSIGNED16
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	0x1600 / 0x1601 / 0x1602 / 0x1603
Default	0x1600

Object 1C13h: TxPDO assign

Index	1C13h
Name	TxPDO assign
Object Type	ARRAY
Data Type	UNSIGNED16
Read/Write Permission	RW
PDO Mapping Setting	No

Sub-Index	0
Name	Number of assigned TxPDOs
Data Type	UNSIGNED8
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	0–1
Default	1

Sub-Index	1
Name	Index of assigned TxPDO
Data Type	UNSIGNED16
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	0x1A00 / 0x1A01 / 0x1A02 / 0x1A03
Default	0x1A00

A.3.2 OD 3000h Drive Group

Index	300Xh
Name	Driver parameter
Object Type	Variable
Data Type	UNSIGNED16
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED16
Default	N/A

Access/change drive parameters using this object group, and drive parameters can only be changed through SDO.

The setting method is described as follows:

The index value 300Xh corresponds to the Xth group of the drive parameters, and the sub-index values 1–64h (hexadecimal) correspond to the parameters 0–99 in the parameter group.

Example: Set parameter 05-33 (select induction motor or permanent magnet synchronous motor), the index value is 3005h, and the sub-index value is 22h (34).

Object 3021h: Driver info table 1

Index	3021h
Name	Driver info table 1
Object Type	Array
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No

Sub-Index	0
Name	SubIndex 000
Data Type	UNSIGNED8
Read/Write Permission	RO
PDO Mapping setting	No

Sub-Index	1
Name	[2100h] Warn / Error
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	2
Name	[2101h] Drive status 1
Data Type	UNSIGNED16
Read/Write Permission	RO

PDO Mapping Setting	No
Unit	Pulse

Sub-Index	3
Name	[2102h] Frequency command 1
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	4
Name	[2103h] Output frequency
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	5
Name	[2104h] Output current
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	6
Name	[2105h] DC bus voltage
Data Type	UNSIGNED16
Read/Write Permissions	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	7
Name	[2106h] Output voltage
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	8
Name	[2107h] Multi-speed step
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	9
Name	[2108h] Max output torque
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	10
Name	[2109h] Trigger count
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	11
Name	[210Ah] PF angle
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	12
Name	[210Bh] Output torque
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	13
Name	[210Ch] Real speed (rpm)
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	14
Name	[210Dh] PG feedback count
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	RO
Unit	Pulse

Sub-Index	15
Name	[210Eh] PG2 pulse count
Data Type	UNSIGNED16

Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	16
Name	[210Fh] Output power
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Object 3022h: Driver info table 2

Index	3022h
Name	Driver info table 2
Object Type	Array
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No

Sub-Index	0
Name	SubIndex 000
Data Type	UNSIGNED8
Read/Write Permission	RO
PDO Mapping Setting	No

Sub-Index	1
Name	[2200h] Max output current
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	2
Name	[2201h] Counter value
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	3
Name	[2202h] Actual output frequency
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	4
Name	[2203h] DC-BUS voltage
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	5
Name	[2204h] Output voltage
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	6
Name	[2205h] Output power angle
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	8
Name	[2207h] Real speed
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	9
Name	[2208h] Output torque
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	10
Name	[2209h] PG feedback
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	11
Name	[220Ah] PID feedback
Data Type	UNSIGNED16

Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	12
Name	[220Bh] AVI value
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	13
Name	[220Ch] ACI value
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	14
Name	[220Dh] AUI value
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	RO
Unit	Pulse

Sub-Index	15
Name	[220Eh] IGBT temperature
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	16
Name	[220Fh] Driver temperature
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	17
Name	[2210h] DI status
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	18
Name	[2211h] DO status
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	19
Name	[2212h] Multi-speed step
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	20
Name	[2213h] CPU DI status
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	21
Name	[2214h] CPU DO status
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	22
Name	[2215h] PG1 Encoder pulse
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	23
Name	[2216h] PG2 input frequency
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	24
Name	[2217h] PG2 input count
Data Type	UNSIGNED16

Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	25
Name	[2218h] Position error
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	26
Name	[2219h] Overload Counting
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	27
Name	[221Ah] GFF percent
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	28
Name	[221Bh] DC bus ripple
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	29
Name	[221Ch] PLC D1043 value
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	30
Name	[221Dh] PM Magnetic section
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	31
Name	[221Eh] User page displays
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	32
Name	[221Fh] Output Value of Pr.00-05
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	33
Name	[2220h] Number of motor turns
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	34
Name	[2221h] Position of Motor
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	35
Name	[2222h] Fan speed
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	36
Name	[2223h] Speed/Torque mode
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	37
Name	[2224h] Carrier frequency
Data Type	UNSIGNED16

Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	39
Name	[2226h] Driver status
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	40
Name	[2227h] Actual torque
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	41
Name	[2228h] Torque command
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	42
Name	[2229h] KWH value
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	43
Name	[222Ah] PG2 Pulse In, L W
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	44
Name	[222Bh] PG2 Pulse In, H W
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	45
Name	[222Ch] PG1 Pulse In, L W
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	46
Name	[222Dh] PG1 Pulse In, H W
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	47
Name	[222Eh] PID Reference
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	48
Name	[222Fh] PID Offset
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	49
Name	[2230h] PID Output Frequency
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	51
Name	[2232h] Aux Frequency
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	52
Name	[2233h] Main Frequency
Data Type	UNSIGNED16

Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	53
Name	[2234h] Aux+Main Frequency
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	54
Name	[2235h] KTY84 or PTC
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Sub-Index	55
Name	[2236h] ADDA Card AI10
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	Pulse

Object 3026h: Remote IO

Index	3026h
Name	Remote IO
Object Type	Array
Data Type	UNSIGNED16
Read/Write Permission	RW
PDO Mapping Setting	No

Sub-Index	1
Name	[2600h] DI Status
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No
Unit	N/A

Sub-Index	2
Name	[2601h] Input Terminal Buffer Status 1
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	No

Unit	N/A

Sub-Index	65
Name	[2640h] DO Set Value
Data Type	UNSIGNED16
Read/Write Permission	RW
PDO Mapping Setting	No
Unit	N/A

Sub-Index	66
Name	[2641h] Output Terminal Buffer Status 1
Data Type	UNSIGNED16
Read/Write Permission	RW
PDO Mapping Setting	No
Unit	N/A

A.3.3 OD 6000h Communication Object Group

Object 6007h: Abort connection option code

Index	6007h
Name	Abort connection option code
Object Type	Variable
Data Type	INTEGER16
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	0: No action 2: Switch on Disable 3: Quick Stop
Default	2

- Object 6007h=0: Disconnection error will be ignored, and no warning is displayed or no action is taken.
- Object 6007h=2: When disconnection occurs, CANopen state will be switched to Switch on Disabled, warning code ECto is displayed, and the drive stops according to the settings of object 605Ah. Once the connection cable is back to normal, the warning code will be automatically cleared.
- Object 6007h=3: When disconnection occurs, CANopen state will be switched to Quick Stop, warning code ECto is displayed, and the drive stops according to the settings of object 605Ch. Once the connection cable is back to normal and communication is successfully connected, the warning code will be automatically cleared.

Object 603Fh: Error code

Index	603Fh
Name	Error code
Object Type	Variable
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	Yes
Setting Range	UNSIGNED32
Default	0

Object 6040h: Controlword

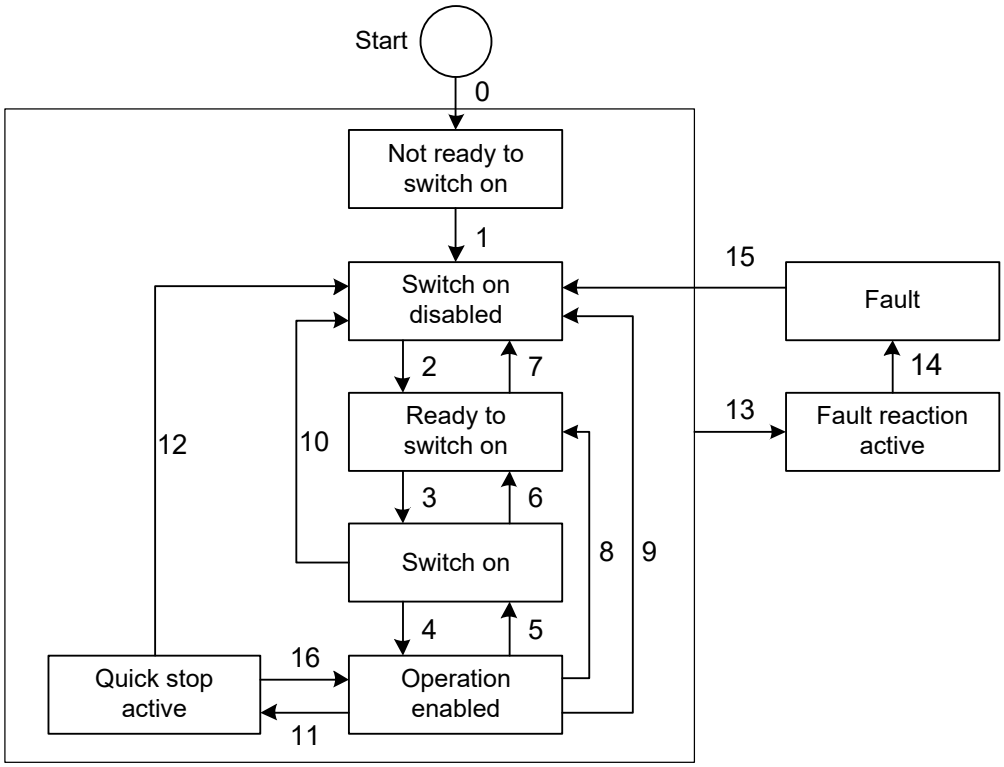
Index	6040h
Name	Controlword
Object Type	Variable
Data Type	UNSIGNED16
Read/Write Permission	RW
PDO Mapping Setting	Yes
Setting Range	UNSIGNED16
Default	0

Bit Description

Bit	Function	Description
Bit 0	Switch on	-
Bit 1	Enable voltage	-
Bit 2	Quick stop	-
Bit 3	Enable operation	-
Bit 4–6	Operation mode specific	See the table of Definition of Each Mode below.
Bit 7	Fault reset	-
Bit 8	Halt	-
Bit 9–15	Reserved	-

Definition of Each Mode

Bit	Definition of Each Mode					
	VL	PP	Homing	PT	CSP	CST
Bit 4	Enable ramp	New set-point	Homing operation start	-	-	-
Bit 5	Unlock ramp	Change set immediately	-	-	-	-
Bit 6	Reference ramp	0: Absolute target position 1: Relative target position	-	-	-	-
Bit 8	Halt	Halt	Halt	-	-	-



The state switch is defined in the table below:

State Switch	Event	Action
0, 1	Executes automatically after power-on	Device start-up and initialization
2	Shutdown command	None
3	Switch on command	Drive is ready to serve on
4	Enable operation command	Drive is servo on and executes motion mode
5	Disable operation command	Drive is servo off
6	Shutdown command	None
7	Disable voltage or Quick stop command	None
8	Shutdown command	Drive is servo off
9	Disable voltage command	Drive is servo off
10	Disable voltage or Quick stop command	None
11	Quick stop command	Quick Stop function is enabled
12	Disable voltage command	Drive is servo off
13, 14	Warning/Fault is triggered	Drive is servo off
15	Warning/Fault is cleared	None
16	Enable operation; no alarm command	Motion control behavior is restarted

The state can be switched using the control command Controlword (6040h). The commands are described as follows:

Command	Bit of Controlword (6040h)					State Switch
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shutdown	0	X	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on + Enable operation	0	1	1	1	1	3 + 4
Disable voltage	0	X	X	0	X	7, 9, 10, 12
Quick stop	0	X	0	1	X	7, 10, 11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4, 16
Fault reset		X	X	X	X	15

NOTE: 0 means the bit is OFF; 1 means the bit is ON; X means the bit is not affected;  is a rising-edge triggered.

Object 6041h: Statusword

Index	6041h
Name	Statusword
Object Type	Variable
Data Type	UNSIGNED16
Read/Write Permission	RO
PDO Mapping Setting	Yes
Setting Range	UNSIGNED16
Default	0

Bit Description

Bit	Function	Description
Bit 0	Ready to switch on	Bit 0 to Bit 6: Indicates the present status of the drive, see the table below for details.
Bit 1	Switched on	
Bit 2	Operation enabled	
Bit 3	Fault	
Bit 4	Voltage enabled	
Bit 5	Quick stop	
Bit 6	Switch on disabled	
Bit 7	Warning	Warning state, the drive maintains servo on
Bit 8	Reserved	-
Bit 9	Remote	-
Bit 10	Target reached	-
Bit 11	Internal limit active	Triggers software limit, this bit is ON
Bit 12–13	Operation mode specific	See the table of Definition of Each Mode below.
Bit 14	External limit active	Triggers hardware limit, this bit is ON
Bit 15	Reserved	-

Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
0	-	-	0	0	0	0	Not ready to switch on
1	-	-	0	0	0	0	Switch on disabled
0	1	-	0	0	0	1	Ready to switch on
0	1	-	0	0	1	1	Switch on
0	1	-	0	1	1	1	Operation enabled
0	0	-	0	1	1	1	Quick stop active
0	-	-	1	1	1	1	Fault reaction active
0	-	-	1	0	0	0	Fault

NOTE: 0 means the bit is OFF; 1 means the bit is ON; - means the bit is None

Definition of Each Mode

Bit	Definition of Each Mode						
	VL	PP	Homing	IP	PT	CSP	CST
Bit 10	-	Target reached	Target reached	Target reached	Target reached	-	-
Bit 12	-	-	Homing reached	-	-	-	-
Bit 13	-	Following error	Homing error	Following error	-	Following error	-

Object 6042h: vl target velocity

Index	6042h
Name	vl target velocity
Object Type	Variable
Data Type	INTEGER16
Read/Write Permission	RW
PDO Mapping Setting	Yes
Setting Range	INTEGER16
Default	0
Unit	RPM

This object is the speed command value in Velocity Mode.

Object 6043h: vl velocity demand

Index	6043h
Name	vl velocity demand
Object Type	Variable
Data Type	INTEGER16
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	INTEGER16
Unit	RPM

This object is the speed command calculated by the drive in Velocity Mode.

Object 6044h: vl velocity actual value

Index	6044h
Name	vl velocity actual value
Object Type	Variable
Data Type	INTEGER16
Read/Write Permission	RO
PDO Mapping Setting	Yes
Setting Range	INTEGER16
Unit	RPM

This object is the actual running speed value in Velocity Mode.

Object 604Fh: vl ramp function time

Index	604Fh
Name	vl ramp function time
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED32
Default	10000
Unit	ms

This object is the time it takes to accelerate from 0 RPM to 6042h in Velocity Mode.

Object 6050h: vl slow down time

Index	6050h
Name	vl slow down time
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED32
Default	10000
Unit	ms

This object is the time it takes to decelerate from 6042h to 0 RPM in Velocity Mode.

Object 6051h: vl quick stop time

Index	6051h
Name	vl quick stop time
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	Refer to drive Pr.01-45 Pr.01-45=0, Setting Range: 10–600000 Pr.01-45=1, Setting Range: 100–6000000
Default	1000
Unit	ms

This object is the time it takes to decelerate from 6042h to 0 RPM in Quick Stop Active state under Velocity Mode.

Object 605Ah: Quick stop option code

Index	605Ah
Name	Quick stop option code
Object Type	Variable
Data Type	INTEGER16
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	0: Disable drive function 1: Decelerate to stop using slow down ramp and switch to Switch on Disabled (cannot return to OP) 2: Decelerate to stop using quick stop ramp and switch to Switch on Disabled (cannot return to OP) 5: Decelerate to stop using slow down ramp and maintain in Quick Stop state (returns to OP) 6: Decelerate to stop using quick stop ramp and maintain in Quick Stop state (returns to OP)
Default	2

This object is the action options of 6040h (Controlword) when the Quick Stop bit is triggered.

Object 605Ch: Disable operation option code

Index	605Ch
Name	Disable operation option code
Object Type	Variable
Data Type	INTEGER16
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	0: Disable drive function 1: Stop using brake deceleration; disable drive function
Default	1

This object is the action options of the drive when the state is switched from Operation Enable to Switched On.

Object 6060h: Modes of operation

Index	6060h
Name	Modes of operation
Object Type	Variable
Data Type	INTEGER8
Read/Write Permission	RW
PDO Mapping Setting	Yes
Setting Range	UNSIGNED32
Default	8

This object sets the operation mode. The operation mode is described as follows:

Setting Value	Operation
0	Reserved
1	Profile Position Mode
2	Velocity Mode
3	Reserved
4	Profile Torque Mode
5	Reserved
6	Homing Mode
8	Cyclic Synchronous Position Mode
9	Reserved
10	Cyclic Synchronous Torque Mode

Object 6061h: Modes of operation display

Index	6061h
Name	Modes of operation display
Object Type	Variable
Data Type	INTEGER8
Read/Write Permission	RO
PDO Mapping Setting	Yes
Setting Range	INTEGER8
Default	0

This object displays the present operation mode.

Object 6062h: Position demand value

Index	6062h
Name	Position demand value
Object Type	Variable
Data Type	INTEGER32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	INTEGER32
Unit	Pulse

This object is the difference command calculated by the drives internal interpolator in Profile Position Mode.

Object 6064h: Position actual value

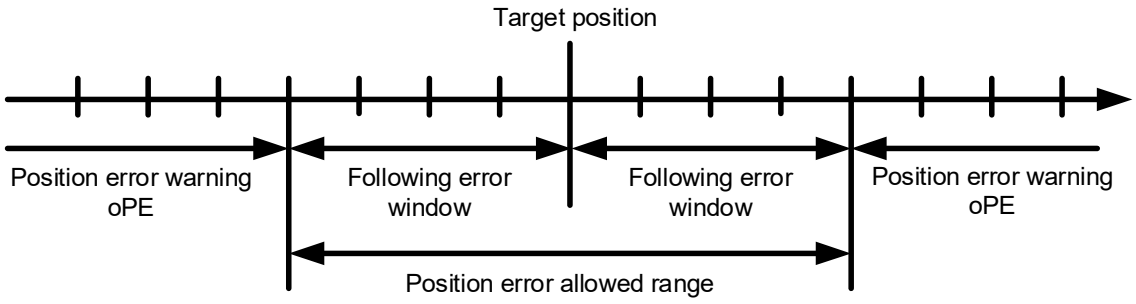
Index	6064h
Name	Position actual value
Object Type	Variable
Data Type	INTEGER32
Read/Write Permission	RO
PDO Mapping Setting	Yes
Setting Range	INTEGER32
Unit	Pulse

This object is the position actual value feedback by the drive in Profile Position Mode.

Object 6065h: Following error window

Index	6065h
Name	Following error window
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED32
Default	1000
Unit	Pulse

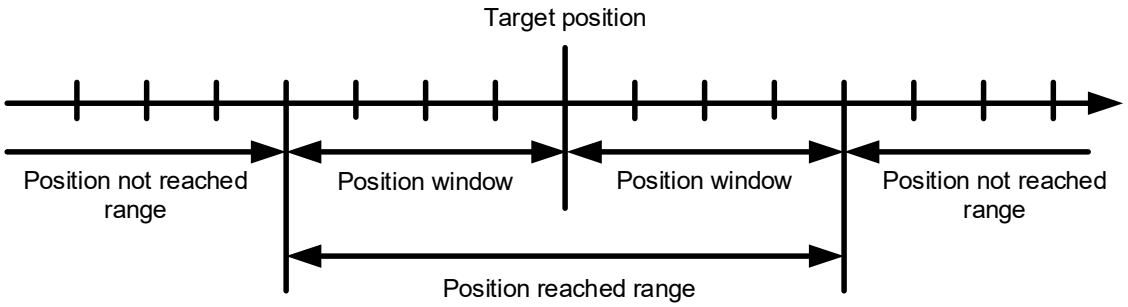
When the Following error actual value (604Fh) exceeds this value, warning code oPE will be displayed on the drive.



Object 6067h: Position window

Index	6067h
Name	Position window
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	Refer to drive Pr.10-00 Pr.10-00=8, setting range: 0–262140 Pr.10-00≠8, setting range: 0–65535
Default	10
Unit	Pulse

In Profile Position Mode, when the absolute value of the error between Target Position (607Ah) and Position actual value (6064h) is less than this object (6067h), and the error time is less than Position window time (6068h), bit 10 (Target Reached) of Statusword (6041h) will be outputted.



Object 6068h: Position window time

Index	6068h
Name	Position window time
Object Type	Variable
Data Type	UNSIGNED16
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED16
Default	500
Unit	ms

In Profile Position Mode, when the absolute value of the error between Target Position (607Ah) and Position actual value (6064h) is less than Position window (6067h), and the error time is less than this object (6068h), bit 10 (Target Reached) of Statusword (6041h) will be outputted.

Object 606Ch: Velocity actual value

Index	606Ch
Name	Velocity actual value
Object Type	Variable
Data Type	INTEGER32
Read/Write Permission	RO
PDO Mapping Setting	Yes
Setting Range	INTEGER32
Unit	RPM

This object shows the speed at which the motor is currently running.

Object 6071h: Target torque

Index	6071h
Name	Target torque
Object Type	Variable
Data Type	INTEGER16
Read/Write Permission	RW
PDO Mapping Setting	Yes
Setting Range	INTEGER16
Default	0
Unit	0.1% (motor rated torque)

Target torque is outputted, and unit is 0.1% of the motor rated torque.

Object 6072h: Max torque

Index	6072h
Name	Max torque
Object Type	Variable
Data Type	UNSIGNED16
Read/Write Permission	RW
PDO Mapping Setting	Yes
Setting Range	UNSIGNED16
Unit	0.1% (motor rated torque)

Maximum torque limit is outputted, and unit is 0.1% of the motor rated torque. This object can be set to adjust the maximum torque limit of the motor.

Object 6075h: Motor rated current

Index	6075h
Name	Motor rated current
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32
Unit	mA

This object shows the rated current on the motor nameplate.

Object 6077h: Torque actual value

Index	6077h
Name	Torque actual value
Object Type	Variable
Data Type	INTEGER16
Read/Write Permission	RO
PDO Mapping Setting	Yes
Setting Range	INTEGER16
Unit	0.1% (motor rated torque)

This object displays the torque percentage currently outputted by the motor. Unit is 0.1% of the motor rated torque.

Object 6078h: Current actual value

Index	6078h
Name	Current actual value
Object Type	Variable
Data Type	INTEGER16
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	INTEGER16
Unit	mA

This object displays the present output current value of the motor.

Object 6079h: DC link circuit voltage

Index	6079h
Name	DC link circuit voltage
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32
Unit	100V

This object displays the present DC bus voltage of the drive.

Object 607Ah: Target position

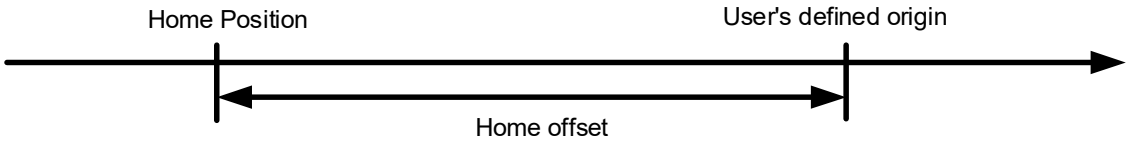
Index	607Ah
Name	Target position
Object Type	Variable
Data Type	INTEGER32
Read/Write Permission	RW
PDO Mapping Setting	Yes
Setting Range	INTEGER32
Default	0
Unit	Pulse

The target position in Profile Position Mode or Cyclic Synchronous Position Mode.

Object 607Ch: Home offset

Index	607Ch
Name	Home offset
Object Type	Variable
Data Type	INTEGER32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	INTEGER32
Default	0
Unit	Pulse

This object is in Homing Mode. After the origin reference point is defined, offset this setting value is to define the origin of the user.



Object 607Dh: Software position limit

Index	607Dh
Name	Software position limit
Object Type	ARRAY
Data Type	INTEGER32
Read/Write Permission	RW
PDO Mapping Setting	No

Sub-Index	0
Name	SubIndex 000
Data Type	UNSIGNED8
Read/Write Permission	RO
PDO Mapping Setting	No

Sub-Index	1
Name	Min position limit
Data Type	INTEGER32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	-2147483648 ~ +2147483647
Default	0
Unit	Pulse

Sub-Index	2
Name	Max position limit
Data Type	INTEGER32

Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	-2147483648 ~ +2147483647
Default	0
Unit	Pulse

When setting this value, note that Max position limit (607Dh sub-index 1) must be larger than Min position limit (607Dh sub-index 2).

Object 6080h: Max motor speed

Index	6080h
Name	Max motor speed
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	Yes
Setting Range	UNSIGNED32
Unit	RPM

This object sets the maximum speed at which the motor operates. If you need to adjust the maximum speed of the motor, set it using this object. When the drive parameter 05-33 is set to 0, the value of Pr.05-03 will be automatically entered into this object; when the drive parameter 05-33 is set to 1 or 2, the value of Pr.05-36 will be automatically entered into this object (if you would like parameter values to be automatically entered, remove this object from the default PDO).

Object 6081h: Profile velocity

Index	6081h
Name	Profile velocity
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	Maximum: $599 \times PPR \times \frac{2}{Pole} \times \frac{Pr.10\text{-}18}{Pr.10\text{-}17}$ Minimum: $0.01 \times PPR \times \frac{2}{Pole} \times \frac{Pr.10\text{-}18}{Pr.10\text{-}17}$
Default	72000
Unit	Pulse/sec.

This object is used in the position planning mode (Profile Position Mode), and corresponds to the drive Pr.11-43. See Appendix A.4 for the calculation method.

Object 6083h: Profile acceleration

Index	6083h
Name	Profile acceleration
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	Maximum: $\frac{6081h}{0.01}$ Minimum: $\frac{6081h}{655.35}$
Default	72000
Unit	Pulse/sec^2

This object is used in the position planning mode (Profile Position Mode), and corresponds to the drive Pr.11-44. See Appendix A.4 for the calculation method.

Object 6084h: Profile deceleration

Index	6084h
Name	Profile deceleration
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	Maximum: $\frac{6081h}{0.01}$ Minimum: $\frac{6081h}{655.35}$
Default	72000
Unit	Pulse/sec^2

This object is used in the position planning mode (Profile Position Mode), and corresponds to the drive Pr.11-45. See Appendix A.4 for the calculation method.

Object 6085h: Quick stop deceleration

Index	6085h
Name	Quick stop deceleration
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	Refer to drive Pr.01-45 When Pr.01-45=0 Maximum: $\frac{\text{Pr.01-00}}{0.01} \times \frac{2}{\text{pole}} \times \text{PPR}$ Minimum: $\frac{\text{Pr.01-00}}{600} \times \frac{2}{\text{pole}} \times \text{PPR}$ When Pr.01-45=1 Maximum: $\frac{\text{Pr.01-00}}{0.1} \times \frac{2}{\text{pole}} \times \text{PPR}$ Minimum: $\frac{\text{Pr.01-00}}{6000} \times \frac{2}{\text{pole}} \times \text{PPR}$
Default	72000
Unit	Pulse/sec^2

When the Controlword (6040h) triggers the Quick Stop bit, and the deceleration methods referenced by the Quick stop option code (605Ah) are 2 and 6, decelerate to 0 RPM according to this deceleration time.

Object 6087h: Torque slope

Index	6087h
Name	Torque slope
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED32
Default	200
Unit	ms

This object sets the time it takes for the motor to run from 0% to 100% rated torque.

Object 6091h: Gear ratio

Index	6091h
Name	Gear ratio
Object Type	Array
Data Type	UNSIGNED32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

Sub-Index	0
Name	SubIndex 000
Data Type	UNSIGNED8
Read/Write Permission	RO
PDO Mapping Setting	No

Sub-Index	1
Name	Motor revolutions
Data Type	INTEGER32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	1~65535
Default	100

Sub-Index	2
Name	Shaft revolutions
Data Type	INTEGER32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	1~65535
Default	100

Sub-index 1 of this object corresponds to drive Pr.10-05, and sub-index 2 corresponds to drive Pr.10-04.

Object 6098h: Homing method

Index	6098h
Name	Homing method
Object Type	Variable
Data Type	UNSIGNED8
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED8
Default	35

There are 35 types of homing modes for this object (15 / 16 / 31 / 32 are reserved). For details, refer to the definition of CiA402 specification.

Object 6099h: Homing speeds

Index	6099h
Name	Homing speeds
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

Sub-Index	0
Name	SubIndex 000
Data Type	UNSIGNED8
Read/Write Permission	RO
PDO Mapping Setting	No

Sub-Index	1
Name	Speed during search for switch
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	Maximum: $599 \times PPR \times \frac{2}{pole} \times \frac{Pr.10\text{-}18}{Pr.10\text{-}17}$ Minimum: $0.01 \times PPR \times \frac{2}{pole} \times \frac{Pr.10\text{-}18}{Pr.10\text{-}17}$
Default	9600
Unit	Pulse/sec.

Sub-Index	2
Name	Speed during search for zero
Data Type	UNSIGNED32
Read/Write Permission	RW
PDO Mapping Setting	No
Setting Range	Maximum: $599 \times PPR \times \frac{2}{pole} \times \frac{Pr.10\text{-}18}{Pr.10\text{-}17}$ Minimum: $0.01 \times PPR \times \frac{2}{pole} \times \frac{Pr.10\text{-}18}{Pr.10\text{-}17}$
Default	2400
Unit	Pulse/sec.

Sub-index 1 of this object corresponds to drive Pr.11-70, and sub-index 2 corresponds to drive Pr.11-71. See Appendix A.4 for the calculation method.

Object 609Ah: Homing acceleration

Index	609Ah
Name	Homing acceleration
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	Maximum: $\frac{\text{6099h-01}}{\text{0.01}}$ Minimum: $\frac{\text{6099h-01}}{\text{600}}$
Default	960
Unit	Pulse/sec^2

This object is the time it takes to accelerate/decelerate from 0 RPM to Homing speeds (6099h) sub-index 1 (Speed during search for switch) in Homing Mode.

Object 60F4h: Following error actual value

Index	60F4h
Name	Following error actual value
Object Type	Variable
Data Type	INTEGER32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	INTEGER32

Object 6502h: Supported drive modes

Index	6502h
Name	Supported drive modes
Object Type	Variable
Data Type	UNSIGNED32
Read/Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

A.4 Reference Table of CiA402 Object and Drive Pr. Unit

Object and Drive Pr. Conversion	Formula
6081 (pulse/s) → Pr.11-43 (Hz)	$Pr.11\text{-}43 = \frac{6081}{PPR} \times \frac{P}{2} \times \frac{Pr.10\text{-}17}{Pr.10\text{-}18}$
6083 (pulse/s^2) → Pr.11-44 (s)	$Pr.11\text{-}44 = \frac{6081}{6083}$
6084 (pulse/^{2}) → Pr.11-45 (s)	$Pr.11\text{-}45 = \frac{6081}{6084}$
6085 (pulse/s^2) → Pr.01-46 (s)	$Pr.01\text{-}46 = \frac{Pr.01\text{-}00}{6085} \times \frac{2}{P} \times PPR \times \frac{Pr.10\text{-}18}{Pr.10\text{-}17}$
6099-01 (pulse/s) → Pr.11-70 (Hz)	$Pr.11\text{-}70 = \frac{6099\text{-}01}{PPR} \times \frac{P}{2} \times \frac{Pr.10\text{-}17}{Pr.10\text{-}18}$
6099-02 (pulse/s) → Pr.11-71 (Hz)	$Pr.11\text{-}71 = \frac{6099\text{-}02}{PPR} \times \frac{P}{2} \times \frac{Pr.10\text{-}17}{Pr.10\text{-}18}$
609A (pulse/s^2) → Pr.11-72 (s)	$Pr.11\text{-}72 = \frac{6099\text{-}01}{609A}$
607C (pulse) → Pr.11-73 (Rev), Pr.11-74 (pulse)	607C = Pr.11-73 ×Single circle pulse number + Pr.11-74

NOTE: PPR (Pulse per Revolution) = Pr.11-62 × 65536 + Pr.11-63

Appendix B. Revision History

Issued Edition	Issued Date	Application	Revision History
02	February, 2023	(1) Drive Firmware Version: C2000 Plus V3.07 / CH2000 V2.07 or above (2) CMC-EC01 Option Card Firmware Version: V3.00 or above	First edition. **NOTE:** To align with the operation manual in Chinese version, the issued edition of English version starts from v02.