



CMM-EC02

EtherCAT Communication Card Operation Manual



Applicable Products:
CMM-EC02 (MS300 / MH300 Option Card)

Application

Drive Firmware Version: MS300 V1.07 / MH300 V1.02 or later
CMM-EC02 Communication Card Firmware Version: V1.01 or later



<http://www.deltaww.com/>

DELTA_IA-MDS_VFD-M300 Series_CMM-EC02_OM_Eng_20211209

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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 completely to avoid device damage or personal injury.

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Issued Edition 01

Issued Date: December 2021

1. Introduction

1.1 Network Functions and Specifications

■ Ethernet Specifications

| Item | Specifications |
|----------------------------------|---|
| Interface | RJ45 |
| Number of Ports | 2 ports |
| Communication Mode | IEEE802.3, IEEE802.3u |
| Cable | Category 5e shielding 100 M |
| Transmission Speed | 10 / 100 Mbps Auto-Defect |
| Communication Protocol | EtherCAT |
| Synchronization 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 | Velocity Mode |

■ Environment Conditions

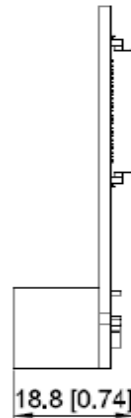
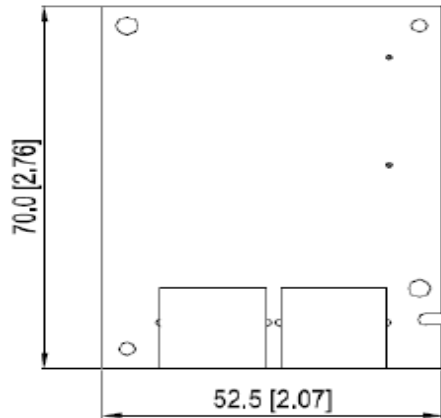
| Item | Specifications |
|----------------------------|---|
| Noise Immunity | ESD (IEC 61800-5-1, IEC 6100-4-2) EFT (IEC 61800-5-1, IEC 6100-4-4) Surge Test (IEC 61800-5-1, IEC 6100-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 6100-4-6) |
| Operating Temperature | -10°C–50°C (temperature),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

■ Electrical Specifications

| Item | Specifications |
|----------------------|---|
| Power Supply Voltage | 15 V _{DC} (supplied by MH300 / MS300 drives) |
| Power Consumption | 0.8 W |
| Insulation Voltage | 500 V _{DC} |
| Weight (g; approx.) | 27 (g) |

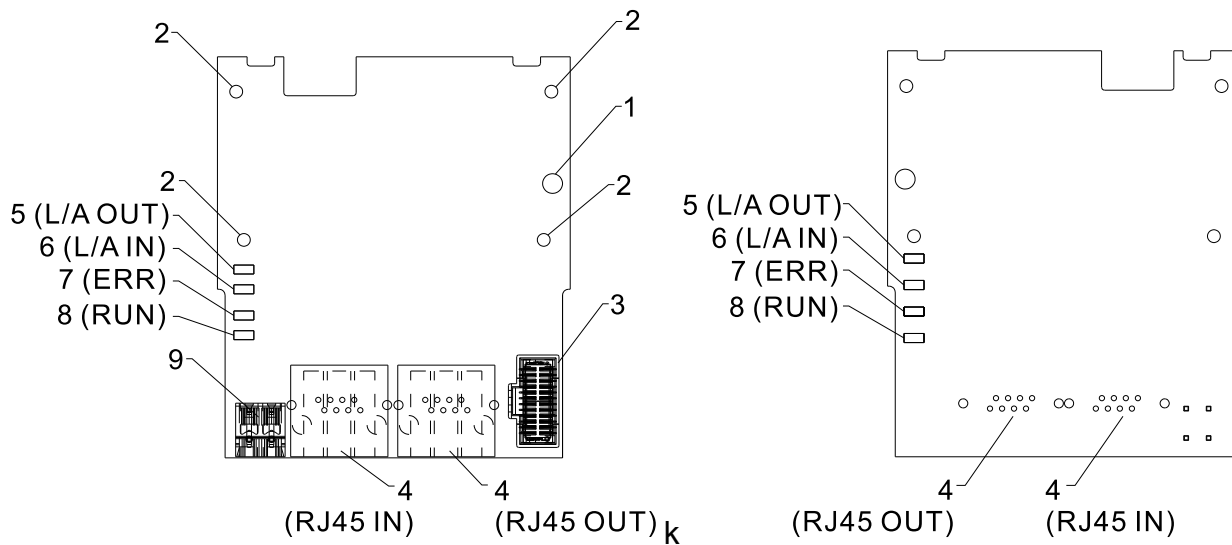
1.2 Product Appearance

1.2.1 Panel Cut Out Dimensions



Unit: mm [inch]

1.2.2 Components

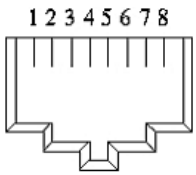


| | |
|--|---|
| 1. Screw fixing hole | 5. L/A OUT (OUT LINK indicator) |
| 2. Positioning hole for communication card | 6. L/A IN (IN LINK indicator) |
| 3. Control board connection port | 7. ERR (ERR indicator) |
| 4. RJ45 connection port | 8. RUN (Communication card RUN indicator) |
| | 9. Ground terminal block |

1.3 LED Indicators

| Name | Indicator Status | | Indication |
|----------|------------------|-------|---|
| RUN | Green | On | Normal status |
| | | Blink | Pre-operation (on / off 200 ms) |
| | | | Safe mode (on 200 ms / off 1000 ms) |
| Off | Initial status | | |
| ERROR | Red | Blink | Basic configuration error (on / off 200 ms) |
| | | | Status switch error (on 200 ms / off 1000 ms) |
| | | | Time-out (on 200 ms twice / off 1000 ms) |
| Off | No error | | |
| IN LINK | Green | On | Network connected |
| | | Blink | Network in operation |
| | | Off | Network not connected |
| OUT LINK | Green | On | Network connected |
| | | Blink | Network in operation |
| | | Off | Network not connected |

1.4 RJ45 PIN Definition

| RJ45 Diagram | PIN # | 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 Application

1.5.1 Applicable firmware version and supporting mode

| | |
|---|-----------------------------------|
| Applicable motor drive firmware version | MS300 V1.07 / MH300 V1.02or later |
| Communication card firmware version | CMM-EC02 V1.01 or later |

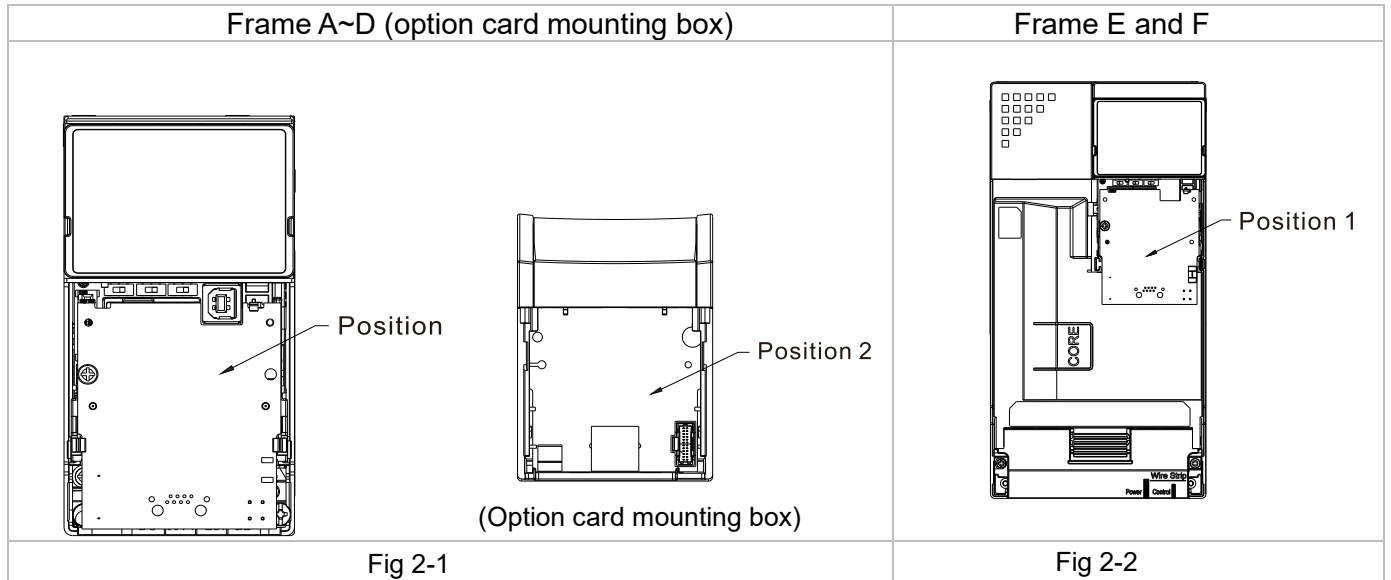
NOTE: This user manual applies to MH300 and MS300 (hereafter referred to as “M300 series”).

2. Installation and Wiring

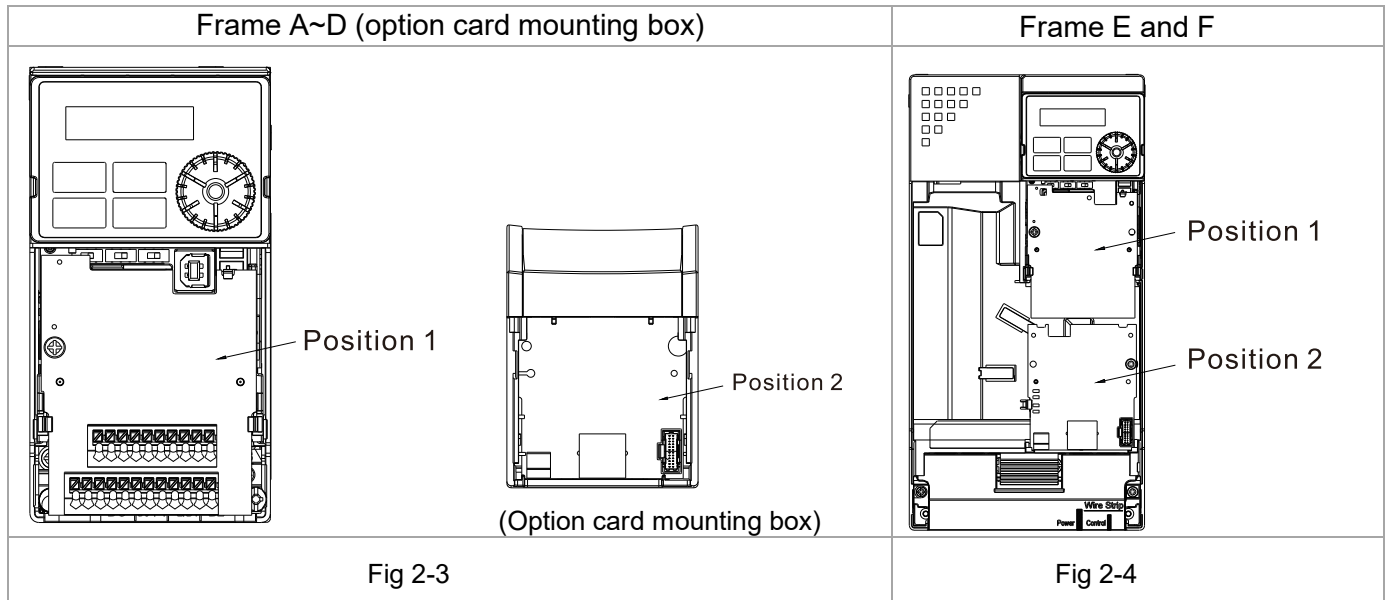
This section introduces how CMM-EC02 connects to the M300 series and how CMM-EC02 links to the internet.

2.1 Mounting Position of Communication Card

- MS300 Mounting Position of Communication Card



- MH300 Mounting Position of Communication Card



2.2 Install and Remove Option Cards

2.2.1 Communication Cable and Grounding

- Communication Cable

You have to order a communication card together with a communication cable, otherwise you won't be able to use the communication card. Verify the communication card model name and the mounting position to mount that communication card, then select the right communication cable. There are two kinds of communication cable, select the right cable in the table below according to the mounting position.

| Communication card | CMM-EC02 * | |
|--|---------------------|---------------------|
| Frame | Mounting Position 1 | Mounting Position 2 |
| | Communication cable | Communication cable |
| A | CBM-CL01A | CBM-CL01A |
| B | | CBM-CL02A |
| C | | |
| D | | |
| E | | |
| F | | |
| G | | |
| H | | |
| I | | |
| NOTE: CMM-EC02 communication card is shipped with a mounting box. Order CBM-CL01A or CBM-CL02A together with CMM-EC02 according to the mounting position. | | |

CBM-CL01A

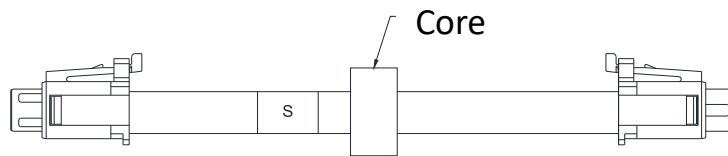


Fig 2-5

CBM-CL02A

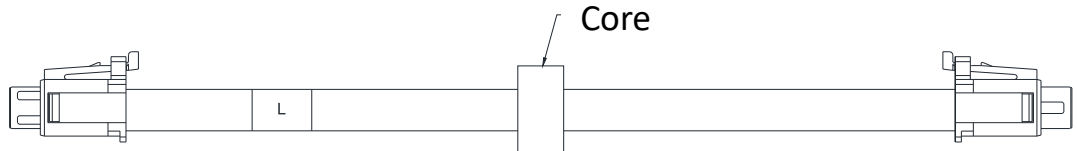


Fig 2-6

- Grounding

- You must ground the communication card when wiring CMM-EC02. The ground terminal is included in the communication card package, as shown in Fig.2-7.
-

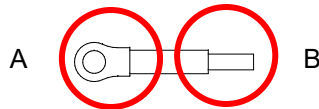


Fig 2-7

- Recommended wire size for grounding:
 - ☑ Wire gauge 16–20 AWG
 - ☑ Category 5 (Cat5 / Cat5e), Class D or above cable according to ISO/IEC 24702 (ISO/IEC 11801-3) and EIA/TIA 568-A-5
 - ☑ Maximum cable length 100 m
- Installation of the ground terminal:
 - ☑ When grounding, it is recommended to use grounding specifically for communication or clean grounding
 - ☑ The PE terminal for CMM-EC02 includes PE1 and PE2. It is recommended to ground PE1 and PE2 at the same time and adjust according to actual situation.
 - ☑ PE1 (communication reference ground): connects to communication reference ground internally. Connecting PE1 to the ground reduces noise from those in application.
 - ☑ PE2 (RJ45 shielded layer): connects to RJ45 shielded layer internally. Connecting PE2 to the ground reduces noise from periphery.
 - ☑ Grounding example: If you cannot use grounding specifically for communication, you can ground the drive's PE to the equipment. The B end of the grounding wire connects to the ground terminal block of the communication card, as the circle shows in Fig.2-8. The A end of the grounding wire connects to the drive's PE, as the circles show in Fig.2-9, Fig.2-10, Fig.2-11 and Fig.2-12 by different frames for MS300/MH300.

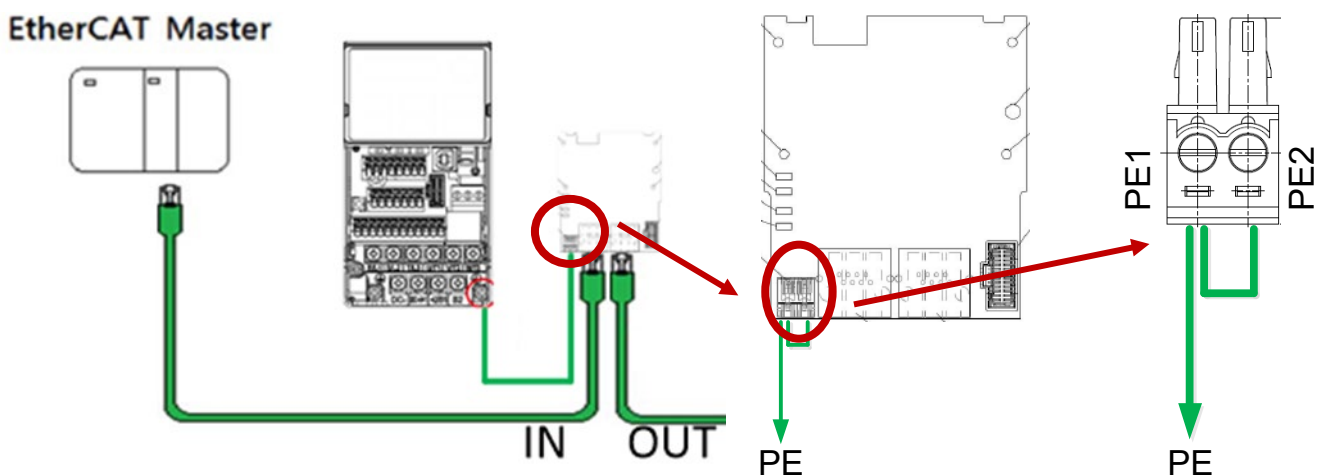


Fig 2-8

MS300 Frame A-C

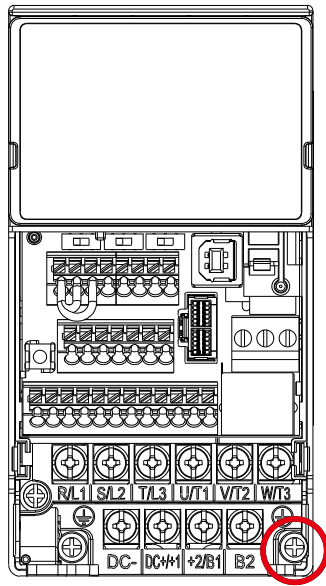


Fig 2-10

Torque ($\pm 10\%$)

Frame A: 9 kg-cm [7.8 lb-in.] [0.88 Nm]

Frame B: 15 kg-cm [13.0 lb-in.] [1.47 Nm]

Frame C: 20 kg-cm [17.4 lb-in.] [1.96 Nm]

MS300 Frame D-F

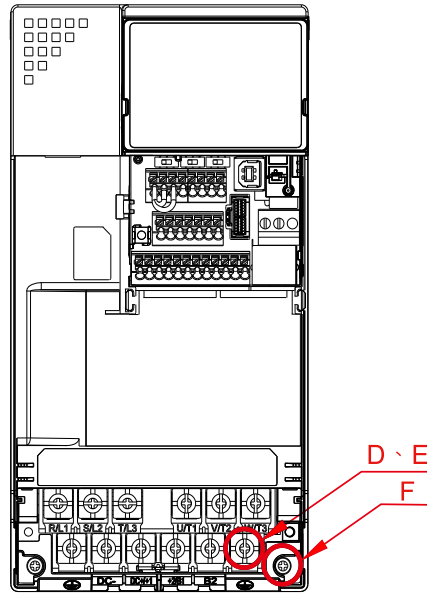


Fig 2-9

Torque ($\pm 10\%$)

Frame D: 20 kg-cm [17.4 lb-in.] [1.96 Nm]

Frame E: 25 kg-cm [21.7 lb-in.] [2.45 Nm]

Frame F: 20 kg-cm [17.4 lb-in.] [1.96 Nm]

MH300 Frame A-C

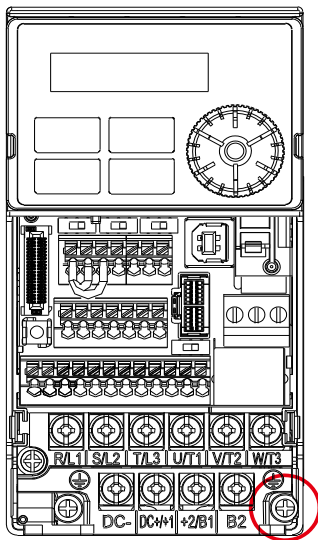


Fig 2-11

Torque ($\pm 10\%$)

Frame A: 9 kg-cm [7.8 lb-in.] [0.88 Nm]

Frame B: 15 kg-cm [13.0 lb-in.] [1.47 Nm]

Frame C: 20 kg-cm [17.4 lb-in.] [1.96 Nm]

MH300 Frame D-F

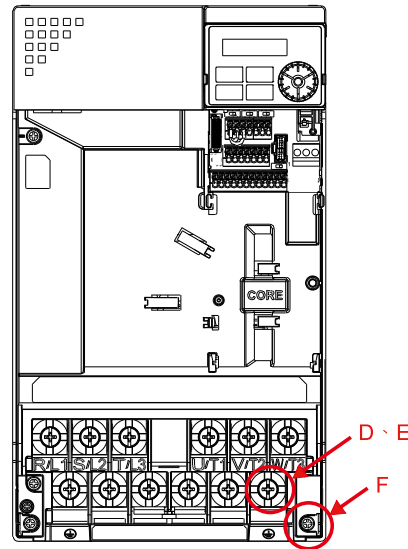


Fig 2-12

Torque ($\pm 10\%$)

Frame D: 20 kg-cm [17.4 lb-in.] [1.96 Nm]

Frame E: 25 kg-cm [21.7 lb-in.] [2.45 Nm]

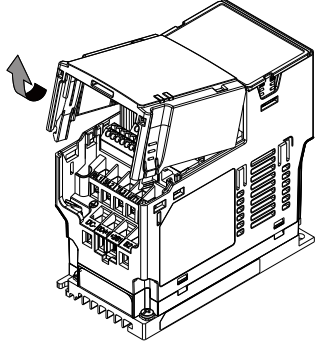
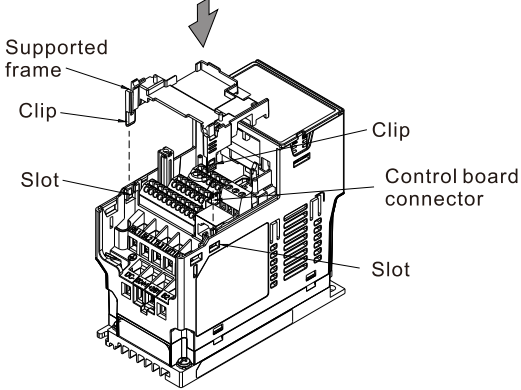
Frame F: 20 kg-cm [17.4 lb-in.] [1.96 Nm]

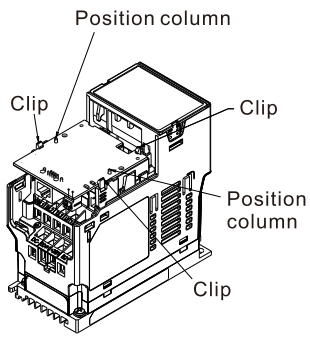
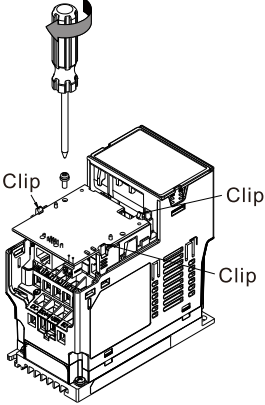
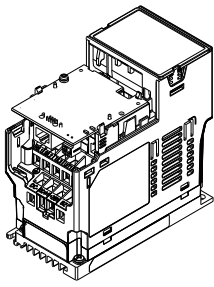
2.2.2 MS300 Installation

MS300 Mounting Position 1 (See Section 2.1 for Details on Mounting Position) Frame A-F

Installation method: Back-mount the communication card by connecting flat cables to the control board.

- Turn off the power of the motor drive, and then remove the front cover, as shown in Fig.2-13.
- Assemble the connection cable: Connect the connector at one end of the connection cable to the control board connector. Refer to Section 2.2.1 for more information on connection methods.
- Assemble the supported frame of the option card: Aim the two clips at the two slots on the motor drive, and then press downward to have the two clips engage the slots, as shown in Fig.2-14.
- Assemble the connection cable: Connect the connector at the other end of the connection cable to the connector of the communication card.
- Assemble the communication card: Have the terminal block and connector of the communication card face downward, aim the two holes of the communication card to the position column and press downward so that the three clips engage the communication card, as shown in Fig.2-15.
- Make sure that three clips properly engage the communication card and then tighten the screws (suggested torque value: 4–6 kg-cm [3.5–5.2 lb-in.] [0.39–0.59 Nm]), as shown in Fig.2-16.
- Assembly is completed, as shown in Fig.2-17.

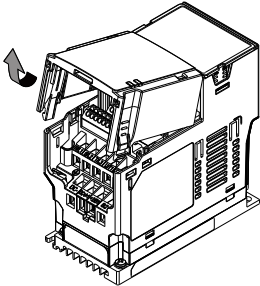
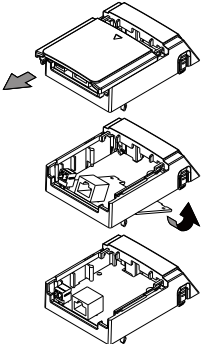
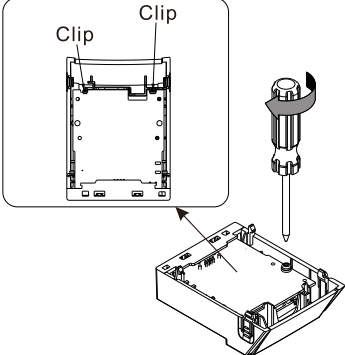
| Step1: Remove the front cover | Step 2: Assemble the supported frame |
|--|---|
|  |  |
| Fig 2-13 | Fig 2-14 |

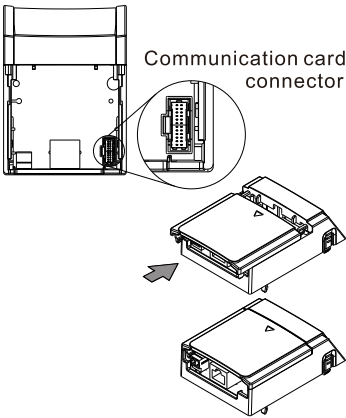
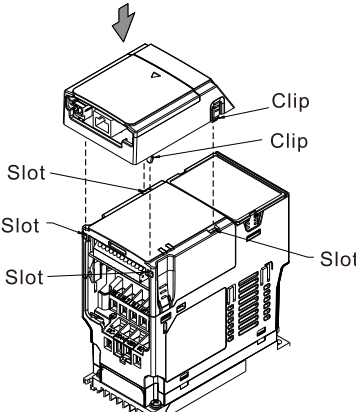
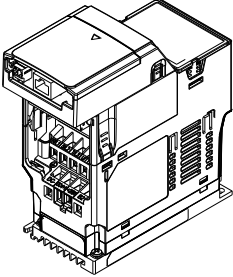
| Step 3: Assemble the communication card | Step 4: Tighten the screws | Step 5: Assembly completed |
|---|--|---|
|  |  |  |
| Fig 2-15 | Fig 2-16 | Fig 2-17 |

MS300 Mounting Position 2 (See Section 2.1 for Details on Mounting Position) - Frame A–D (Not Applicable for Frame E and F)

Installation method: Front-mount the communication card by connecting flat cables to the control board.

- Turn off the power of the motor drive, and then remove the front cover, as shown in Fig.2-18.
- Assemble the communication card: Detach the upper cover of the mounting box for the communication card by slipping and make the terminal block and connector of the communication card face upward. Fix the front end of the communication card to the slots, and then rotate it, as shown in the Fig.2-19.
- Make sure that two clips properly engage the communication card on the backside, and then tighten the screws (suggested torque value: 4–6 kg-cm [3.5–5.2 lb-in.] [0.39–0.59 Nm]), as shown in Fig 2-20.
- Assemble the connection cable: Connect the connector at one end of the connection cable to the control board connector. Refer to Section 2.2.1 for more information on connection methods.
- Attach the front cover of the drive.
- Assemble the connection cable: Connect the connector at the other end of the connection cable to the connector of the communication card.
- Attach the upper cover to the mounting box for the option card, as shown in Fig.2-21.
- Assemble the mounting box for the option card: Aim the four clips of the mounting box for the option card at the slots on the upper cover of the motor drive, and then press downward to have the four clips engage the slots, as shown in the Fig.2-22.
- Assembly is completed, as shown in Fig.2-23.

| Step1: Remove the front cover | Step 2: Assemble the communication card | Step 3: Tighten the screws |
|---|---|---|
|  |  |  |
| Fig 2-18 | Fig 2-19 | Fig 2-20 |

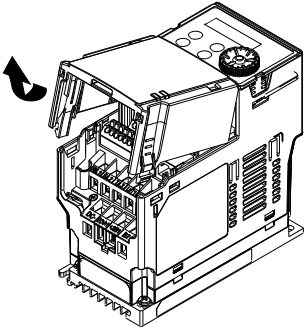
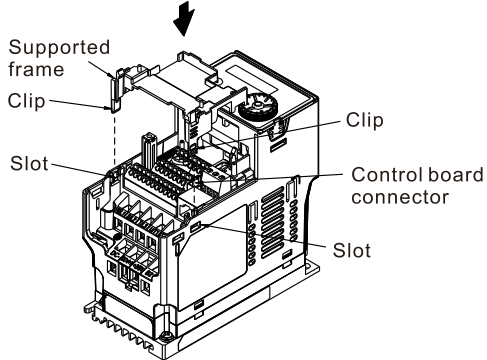
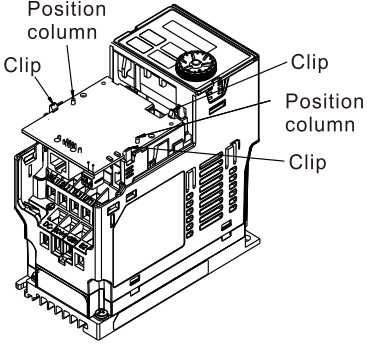
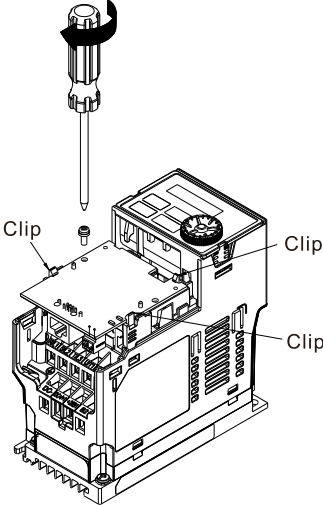
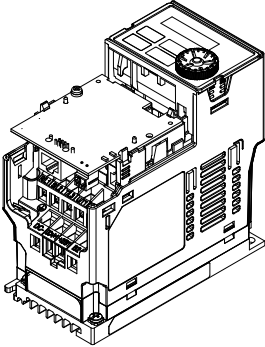
| Step 4: Attach the upper cover to the mounting box | Step 5: Assemble the mounting box for the option card | Step 6: Assembly completed |
|---|---|---|
|  |  |  |
| Fig 2-21 | Fig 2-22 | Fig 2-23 |

2.2.3 MH300 Installation

MH300 Mounting Position 1 (See Section 2.1 for Details on Mounting Position) – Frame A – I

Installation method: **Back-mount** the communication card by connecting **flat cables** to the control board.

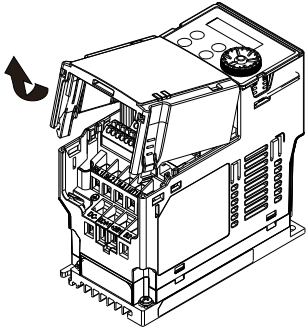
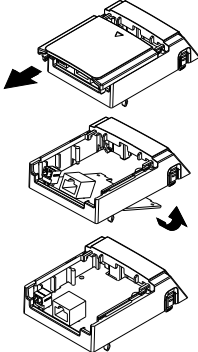
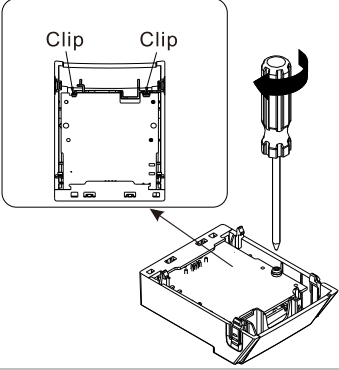
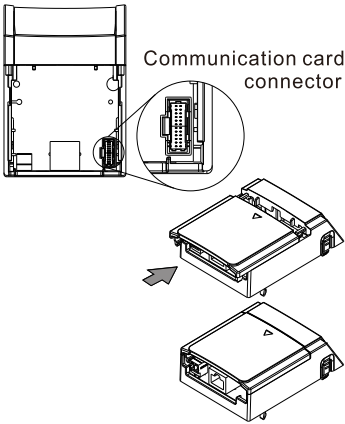
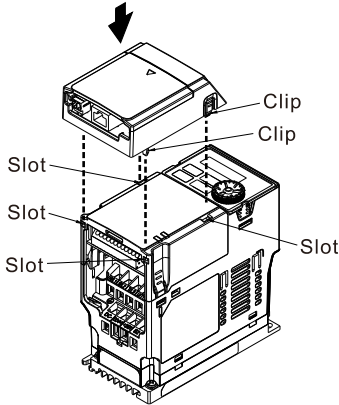
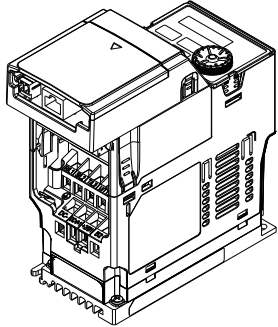
- Turn off the power of the motor drive, and then remove the front cover, as shown in Fig.2-24.
- Assemble the connection cable: Connect the connector at one end of the connection cable to the control board connector. Refer to Section 2.2.1 for more information on connection methods.
- Assemble the supported frame of the option card: Aim the two clips at the two slots on the motor drive, and then press downward to have the two clips engage the slots, as shown in Fig.2-25.
- Assemble the connection cable: Connect the connector at the other end of the connection cable to the connector of the communication card.
- Assemble the communication card: Have the terminal block and connector of the communication card face downward, aim the two holes of the communication card to the position column and press downward so that the three clips engage the communication card, as shown in Fig.2-26.
- Make sure that three clips properly engage the communication card, and then tighten the screws (suggested torque value: 4–6 kg-cm [3.5–5.2 lb-in.] [0.39–0.59 Nm]), as shown in Fig.2-27.
- Assembly is completed, as shown in Fig.2-28.

| | | |
|--|---|---|
| <p>Step 1: Remove the front cover</p>  <p>Fig 2-24</p> | <p>Step 2: Assemble the supported frame</p>  <p>Fig 2-25</p> | |
| <p>Step 3: Assemble the communication card</p>  <p>Fig 2-26</p> | <p>Step 4: Tighten the screws</p>  <p>Fig 2-27</p> | <p>Step 5: Assembly completed</p>  <p>Fig 2-28</p> |

2.2.4 MH300 Mounting Position 2 (See Section 2.1 for Details on Mounting Position) - Frame A–D

Installation method: **Front-mount** the communication card by connecting **flat cables** to the control board.

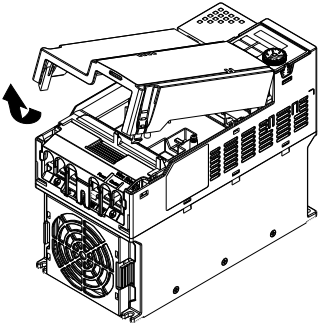
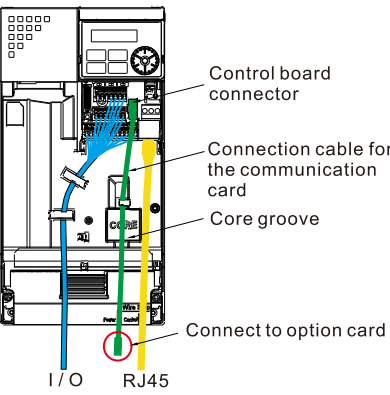
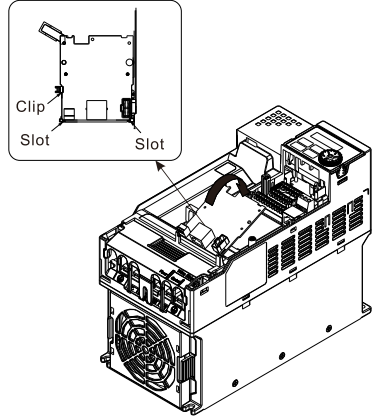
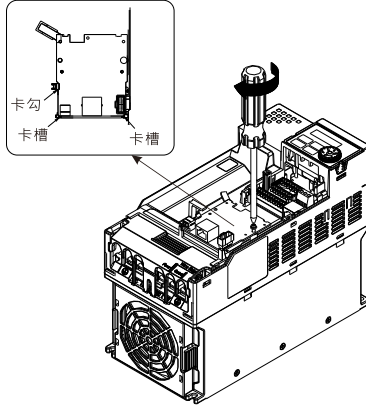
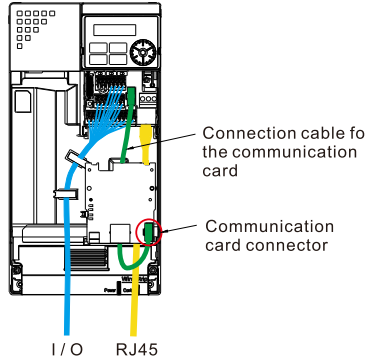
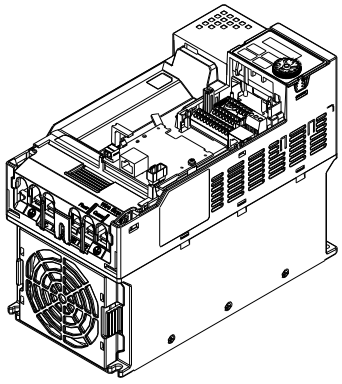
- Turn off the power of the motor drive, and then remove the front cover, as shown in Fig.2-29.
- Assemble the communication card: Detach the upper cover of the mounting box for the communication card by slipping and make the terminal block and connector of the communication card face upward. Fix the front end of the communication card to the slots, and then rotate it, as shown in the Fig.2-30.
- Make sure that two clips properly engage the communication card on the backside, and then tighten the screws (suggested torque value: 4–6 kg-cm [3.5–5.2 lb-in.] [0.39–0.59 Nm]), as shown in Fig.2-31.
- Assemble the connection cable: Connect the connector at one end of the connection cable to the control board connector. Refer to Section 2.2.1 for more information on connection methods.
- Attach the front cover of the drive.
- Assemble the connection cable: Connect the connector at the other end of the connection cable to the connector of the communication card.
- Attach the upper cover to the mounting box for the option card, as shown in Fig.2-32.
- Assemble the mounting box for the option card: Aim the four clips of the mounting box for the option card at the slots on the upper cover of the motor drive, and then press downward to have the four clips engage the slots, as shown in the Fig.2-33.
- Assembly is completed, as shown in Fig.2-34.

| | | |
|---|---|---|
| <p>Step 1: Remove the front cover</p>  <p>Fig 2-29</p> | <p>Step 2: Assemble the communication card</p>  <p>Fig 2-30</p> | <p>Step 3: Tighten the screws</p>  <p>Fig 2-31</p> |
| <p>Step 4: Attach the upper cover to the mounting box</p>  <p>Fig 2-32</p> | <p>Step 5: Assemble the mounting box for the option card</p>  <p>Fig 2-33</p> | <p>Step 6: Assembly completed</p>  <p>Fig 2-34</p> |

2.2.5 MH300 Mounting Position 2 (See Section 2.1 for Details on Mounting Position) - Frame E and F

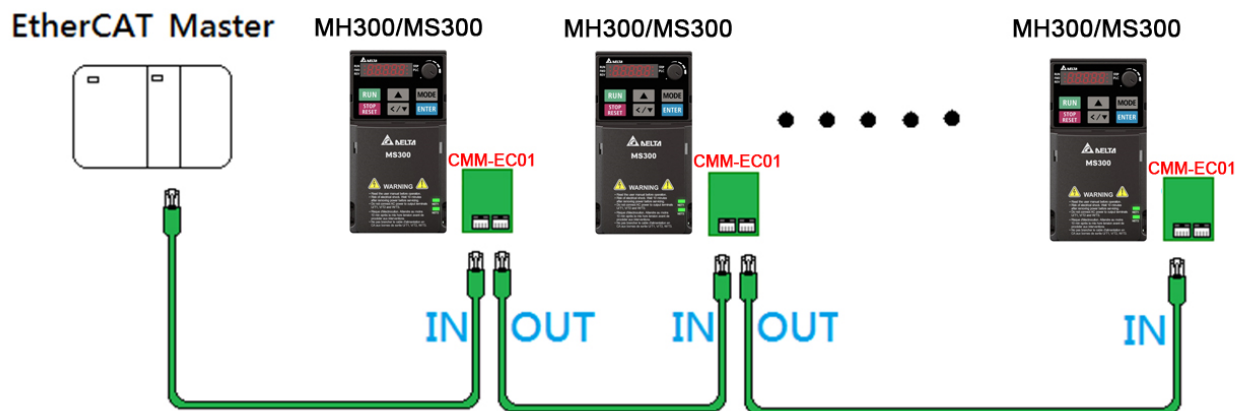
Installation method: **Front-mount** the communication card by connecting **flat cables** to the control board.

- Turn off the power of the motor drive, and then remove the front cover, as shown in Fig.2-35.
- Assemble the connection cable: Connect the connector at one end of the connection cable to the control board connector. Refer to Section 2.1.1 for more information on connection methods. Wire the cables as Fig.2-36 shows and make sure the core is placed in the groove.
- Assemble the communication card: Have the terminal block and connector of the communication card face upward. Fix the front end of the communication card to the slots, and then rotate it, as shown in the Fig.2-37.
- Make sure that the clip properly engages the communication card, and then tighten the screws (suggested torque value: 4–6 kg-cm [3.5–5.2 lb-in.] [0.39–0.59 Nm]), as shown in Fig.2-38.
- Assemble the connection cable: Connect the connector at the other end of the connection cable to the connector of the communication card, as shown in Fig.2-39.
- Assembly is completed, as shown in Fig.2-40.

| | | |
|--|---|---|
| <p>Step 1: Remove the front cover</p>  | <p>Step 2: Assemble the connection cable</p>  | <p>Step 3: Assemble the communication card</p>  |
| <p>Fig 2-35</p> | <p>Fig 2-36</p> | <p>Fig 2-37</p> |
| <p>Step 4: Tighten the screws</p>  | <p>Step 5: Assemble the connection cable</p>  | <p>Step 6: Assembly completed</p>  |
| <p>Fig 2-38</p> | <p>Fig 2-39</p> | <p>Fig 2-40</p> |

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 CMM-EC02 is from left (IN) to right (OUT). The diagram below shows the correct wiring for front-mounting CMM-EC02.



After finishing assembling the hardware, supply power to the drive. Then, Pr.09-60 on the drive should display "EtherCAT", with a current value of 6. If not, make sure your version of the drive is correct and verify if the communication card is correctly connected.

2.4 MH300 / MS300 Drive Settings

When you operate MH300 / MS300 through CMM-EC02, you must set the communication card as the source of controls and settings for MH300 / MS300. Use the keypad to configure the following parameter addresses to the corresponding values:

| Keypad Pr. | Settings / Displayed Value | Function Description |
|------------|----------------------------|--|
| Pr.00-20 | 8 | Set communication card as the source of Frequency command. |
| Pr.00-21 | 5 | Set communication card as the control source. |
| Pr.09-60 | 6 | Communication card identification: When CMM-EC02 communication card is connected, this parameter displays "6" (EtherCAT Slave). |
| Pr.09-30 | 1 | Communication decoding method: EtherCAT only supports decoding method 2 (60xx). |

2.5 ESI (EtherCAT Slave Information)

To make PLC or the host controller identify MH300 / MS300, you must load the product description file (ESI file). Download the description files from Delta's download center.

http://www.deltaww.com/iadownload_acmotordrive.

☑ The file name for M300 series:

MS300: DELTA_IA-MDS_MS300_CMM-EC02_Vx-xx_EC_EP_yyyymmdd.xml

MH300: DELTA_IA-MDS_MH300_CMM-EC02_Vx-xx_EC_EP_yyyymmdd.xml

NOTE:

1. Vx-xx is the firmware version for EtherCAT communication card.
2. yyyymmdd is the release year/month/date.

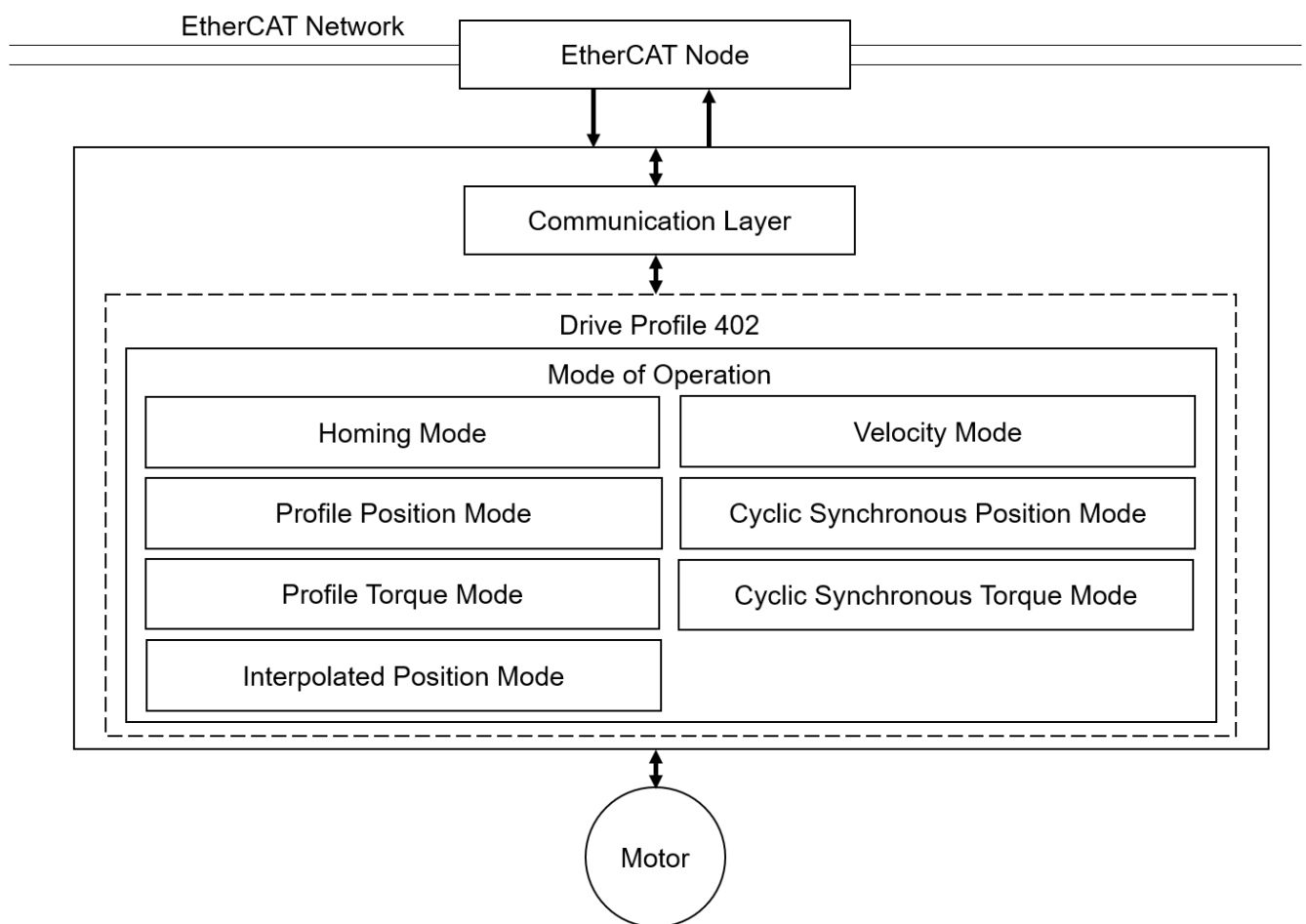
3. Introduction to EtherCAT

3.1 Protocol

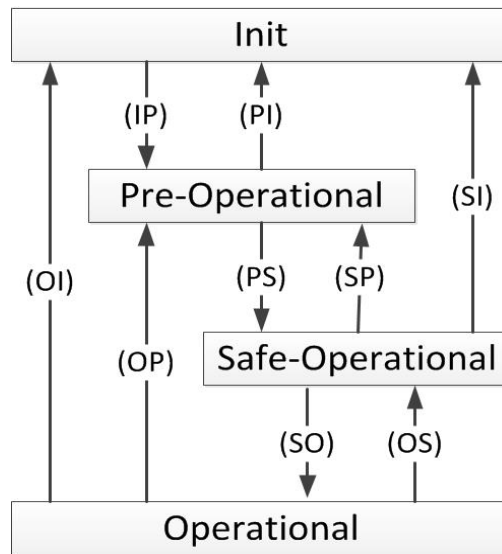
EtherCAT (Ethernet for Control Automation Technology) was created by a German company Beckhoff based on the Ethernet communication protocol which is applicable on the industrial automation and industrial open, real-time, on-site fieldbus technology. The EtherCAT Technology Group (ETG) currently supports and promotes future development of this technology

The Ethernet structure of a motor drive is shown in the image below.

1. Communication layer: This protocol covers communication objects such as PDO, SDO, Sync and Emergency Objects. It also covers related communication object dictionary.
2. DS402 is the motion control layer (Drives and motion control device profile) It defines the action of different motions and the parameter setting of the objects when



3.2 EtherCAT State Machine



State Description:

| State | Description |
|-----------------------|--|
| Init | The drive successfully finishes initializing after power-on, and no error occurs. There are no communications for the application layer. |
| Pre-Operational | Can use mailbox communication for the current status. |
| Safe-Operational | Can read PDO input data (TxPDO) Cannot receive PDO output data (RxPDO) |
| Operational | Executes cyclic I/O communications. Can process PDO output data (RxPDO). |
| 'State Switch Command | Description |
| IP | Starts mailbox communication. |
| PI | Interrupts mailbox communication. |
| PS | Starts updating input data (TxPDO). |
| SP | Stops updating input data (TxPDO). |
| SO | Starts updating output data (RxPDO) |
| OS | Stops updating output data (RxPDO) |
| OP | Stops updating input/output data. |
| SI | Stops updating input data and mailbox communication. |
| OI | Stops all input/output data update and mailbox communication. |

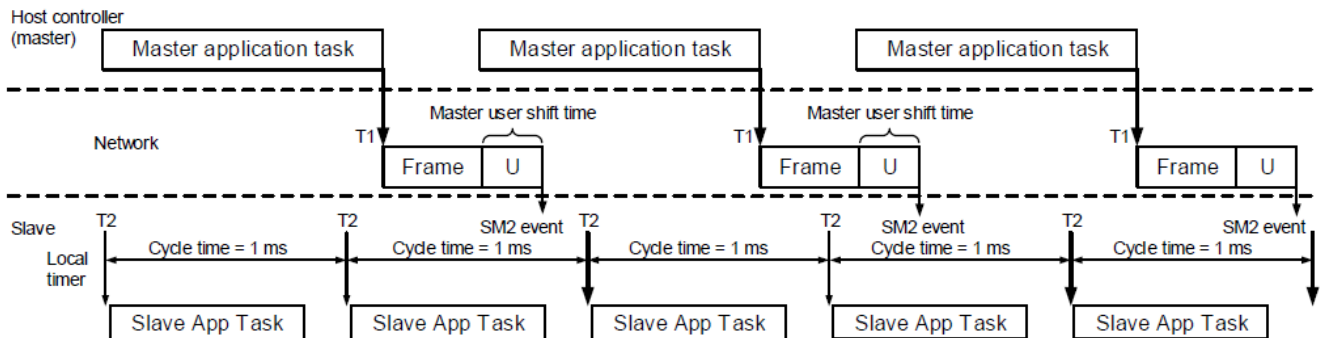
4. System Setup

4.1 Asynchronous

The motor drive currently supports only Free Run mode (Asynchronous)

Free Run Mode (Asynchronous)

The master and slave stations run asynchronously. Each station has an individual clock that calculates the time. In other words, the clocks of the master and slave are not synchronized. The command and feedback transmissions between the master and slave are based on a sequential order instead of a precise time synchronization. For example, the master sends a PDO at time T1, and the slave receives the PDO at T2 after the SM2 event.



4.2 PDO mapping configuration

4.2.1 Default PDO mapping configuration

The following table shows the default PDO mapping configuration of the EtherCAT motor drive for data exchange. This is also defined in the XML file of the EtherCAT slave. You can modify the PDO mapping configuration according to the requirements.

RxPDO mapping

First group of RxPDO mapping in VL Mode

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

TxPDO mapping

First group of 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 Set PDO mapping

The settings are as follows:

1. Disable the PDO configuration: set OD 1C12 sub 0 to 0 (RxPDO) and OD 1C13 sub 0 to 0 (TxPDO).
2. Disable the PDO mapping setting: set OD 1600 sub 0 to 0 (RxPDO) and OD 1A01 sub 0 to 0 (TxPDO).
3. Set the contents and number of RxPDO mappings: set OD 1600 to 1603 sub 1 to sub 8 (RxPDO) for the content and set OD 1600 to 1603 sub 0 (RxPDO) for the number of RxPDO mappings. Take the OD 1601 as an example.

| Mapping parameter setting for RxPDO | 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 5 for the number of RxPDO mappings |

4. Set the contents and number of TxPDO mappings: set OD 1A00 to 1A03 sub 1 to sub 8 (TxPDO) for the content and set OD 1A00 to 1A03 sub 0 (TxPDO) for the number of TxPDO mappings. Take the OD 1A00 below as an example

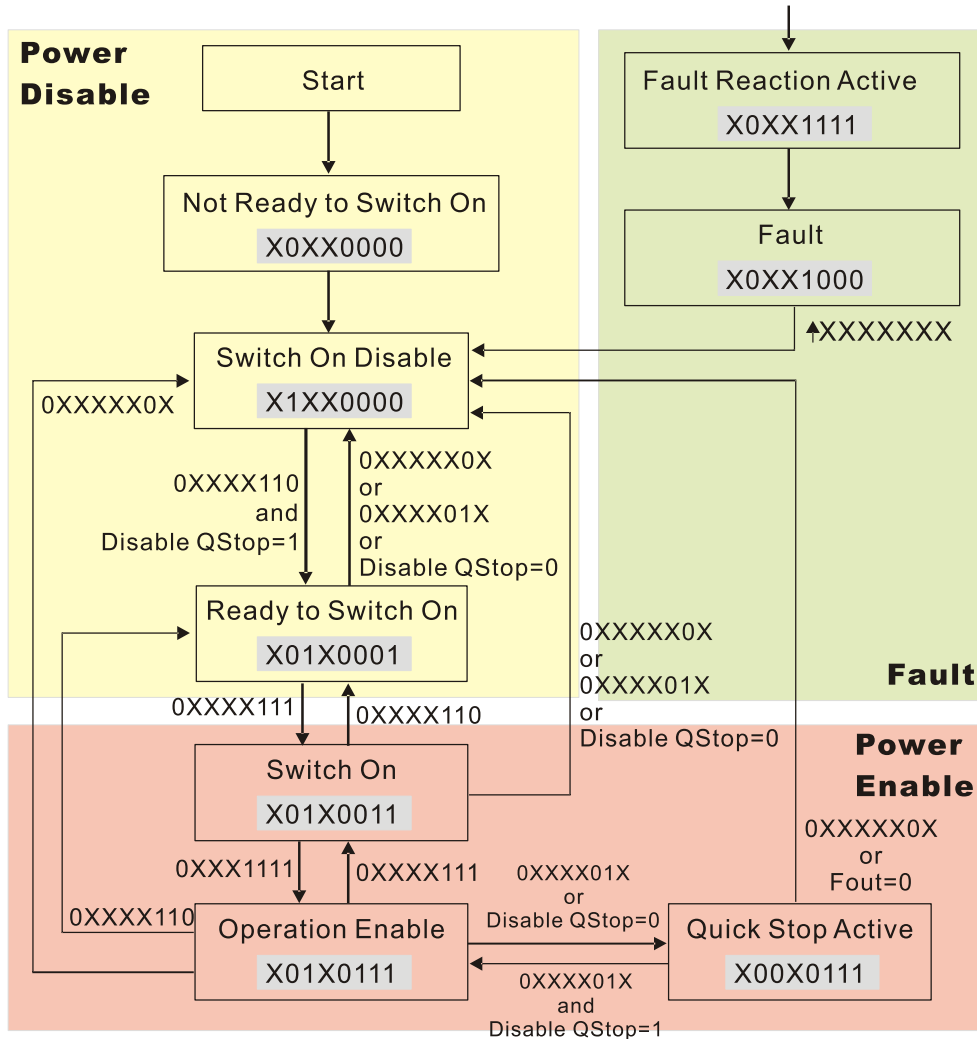
| Mapping parameter setting for RxPDO | Data | Description |
|-------------------------------------|-------|---|
| OD 1A00 sub1 | 6041h | Statusword, 16-bit |
| OD 1A00 sub2 | 6061h | Modes of operation display, 8-bit |
| OD 1A00 sub3 | 6064h | Position actual value, 32-bit |
| OD 1A00 sub4 | 606Ch | 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 6 for the number of RxPDO mappings. |

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

5. CiA402 equipment regulation

This section describes the modes of operation specified by CiA402 when the motor drive is in the EtherCAT mode. The contents include basic operation and setting of related objects. The host controller controls the motor drive through the control word (OD 6040h) and read the current status of the motor drive through the status word (OD 6041h). The motor drive follows the commands from the host controller to run the motors.

5.1 CANopen over Ethernet (CoE) State Machine



NOTE: As shown in the diagram above, the strings beside the arrows are the control words and the strings in the squares are the status words.

The state machine can be divided into three blocks.

| Block | Description |
|---------------|--------------------------------------|
| Power Disable | Motor drive doesn't have PWM output. |
| Power Enable | Motor drive has PWM output. |
| Fault | Faults occur |

The three big blocks are composed of 9 status

| Status | Description |
|------------------------|--|
| Start | Power-on |
| Not Ready to Switch On | The motor drive is initializing. |
| Switch On Disable | The motor drive finishes initializing. |
| Ready to Switch On | The motor drive is waiting to be switch on (energized). The motor isn't excited. |
| Switch On | The motor drive now has PWM output. The reference command is invalid. |
| Operation Enable | Motor is enabled, it runs by following control commands. |
| Quick Stop Active | Motor stops by following parameter setting. |
| Fault Reaction Active | The motor drive detects warning / fault and stops by following parameter settings. The motor is still excited. |
| Fault | The motor is not excited. |

Control Word (controlword, OD 6040h): Description of Bit

| 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): Description of Bit

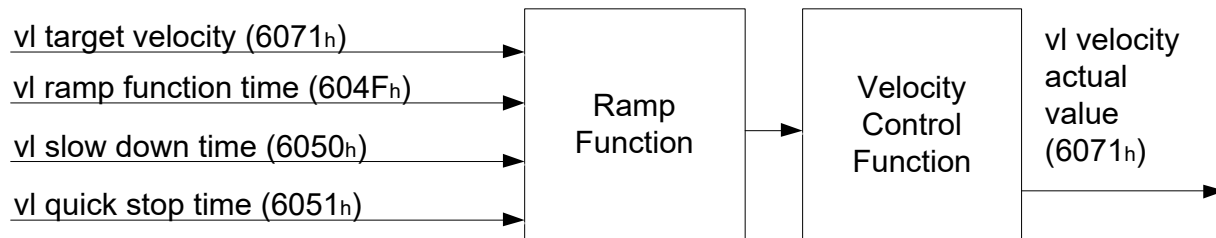
| 15~14 | 13~12 | 11 | 10 | 9 | 8 | 7 |
|----------|-------------------------|----------|----------------|--------|----------|---------|
| Reserved | Operation mode specific | Reserved | Target reached | Remote | Reserved | Warning |

| 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 Velocity Mode

The host controller sends velocity command and acceleration / deceleration data to a motor drive. Then the motor drive controls the velocity.



Operation Steps are as follows:

1. Set mode: OD 6060h = 02h as velocity mode
2. Set velocity command. OD 6042h (unit: RPM)
3. Set acceleration time OD 604Fh (unit: ms)
4. Set deceleration time OD 6050h (unit: ms)
 - (1) Set control commands OD 6040h. By following the control word commands listed below to do the setup, the motor drive operates as mentioned above. Refer to the description of OP 6041h to see the contents of the state machine.
 - (2) OD 6040h = 06h, the motor drive goes into < Ready to Switch On > state.
 - (3) OD 6040h = 0Eh, the motor drive goes into < Switch On > Servo On state.
 - (4) OD 6040h = 0Fh, the motor drive goes into < Operation Enable > state.
 - (5) OD 6040h = 7Fh, the motor drive starts running.

Control commands are defined as follows:

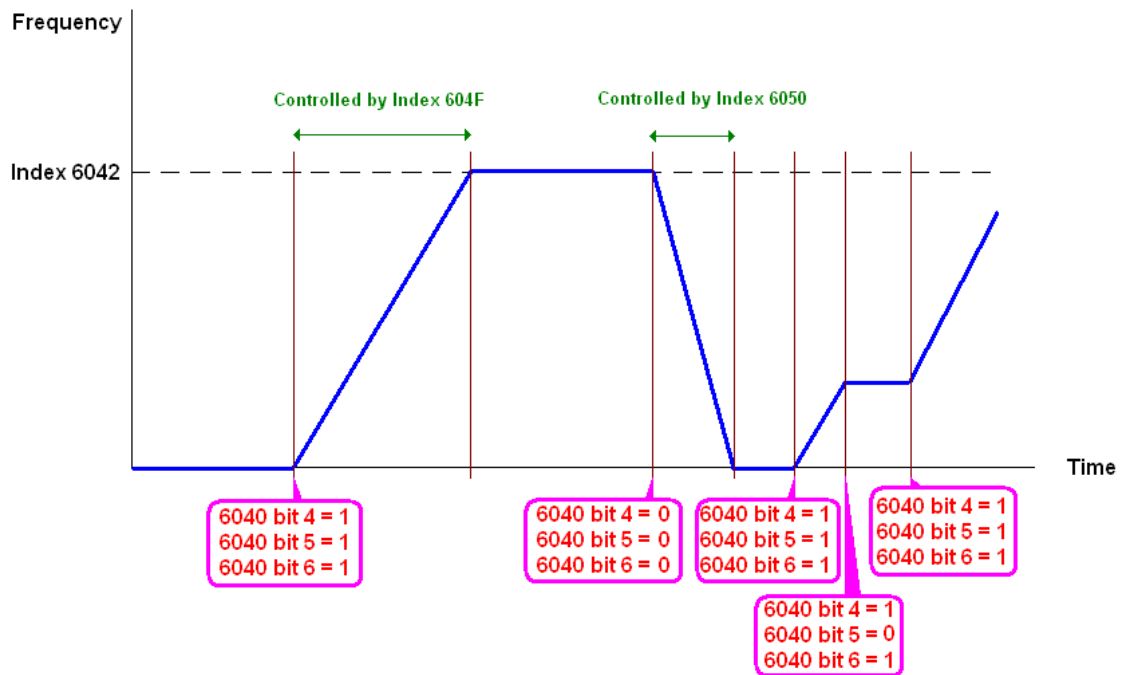
| Step | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Description |
|------|-------|-------|-------|-------|-------|-------|-------|------------------------------------|
| (1) | 0 | 0 | 0 | 0 | 1 | 1 | 0 | Shutdown |
| (2) | 0 | 0 | 0 | 0 | 1 | 1 | 1 | Switch On (Enable Servo On ready) |
| (3) | 0 | 0 | 0 | 1 | 1 | 1 | 1 | Enable Operation (Enable Servo On) |
| (4) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Runs to the target speed. |

When using the velocity mode (OD 6060h = 02h), the controlword bit (bit 4 ~ bit 6) is defined as follows:

| OD 6040h | | | Description |
|----------|-------|-------|-------------------------|
| bit 6 | bit 5 | bit 4 | |
| 1 | 0 | 1 | Maintain current speed |
| 1 | 1 | 1 | Run to the target speed |
| X | X | X | Decelerate to 0 RPM |

Read Motor Drive Data

- OD 606Ch: to observe motor rotation speed
OD 6041h: Motor drive's state word, bit 10 target reached (0: Not running to target speed; 1: Run to the target speed)



Index Related to the Motor Drive

| Index | Definition | Form | Attribute |
|-------|---------------------------|------------|-----------|
| 6040h | Controlword | UNSIGNED16 | RW |
| 6041h | Statusword | UNSIGNED16 | RO |
| 6060h | Mode of operation | INTEGER8 | RW |
| 6061h | Mode of operation display | INTEGER8 | RO |
| 6042h | vl target velocity | INTEGER16 | RW |
| 6043h | vl velocity demand | INTEGER16 | RO |
| 6044h | vl velocity actual value | INTEGER16 | RO |
| 604Fh | vl ramp function time | INTEGER16 | RW |
| 6050h | vl slow down time | INTEGER16 | RW |

6. Communication Warning / Fault Table

6.1 Motor drive warning / fault table

| ID No. | Warning / Fault / Code | Warning / Fault Name | Description | Corrective Action |
|--------|------------------------|---------------------------------|--|---|
| 81 | ECto_WARN | EtherCAT communication time out | Timer out warning on the Communication between communication card and the host controller. | -Verify if communication system is wiring correctly. -Verify if the upperhost is connecting correctly. |
| 89 | ECCb_WARN | Communication card disconnected | Warning on the disconnected communication card | -Reinstall the communication card. -Change a new communication card or change a new motor drive. |
| 111 | SYCE_WARN | Synchronization warning | The source of communication is not the communication card. Loss of synchronization signal (data packet) after setting up the synchronization mode. A warning message pops up. | -Reinstall a motor drive to the upperhost. |
| 161 | SYCE_ERR | Synchronization fault | The source of command is the communication card. Loss of synchronization signal (data packet) after setting up the synchronization mode. A fault message pops up. | Reinstall a motor drive to the upperhost. |

6.2 SDO Abort Code

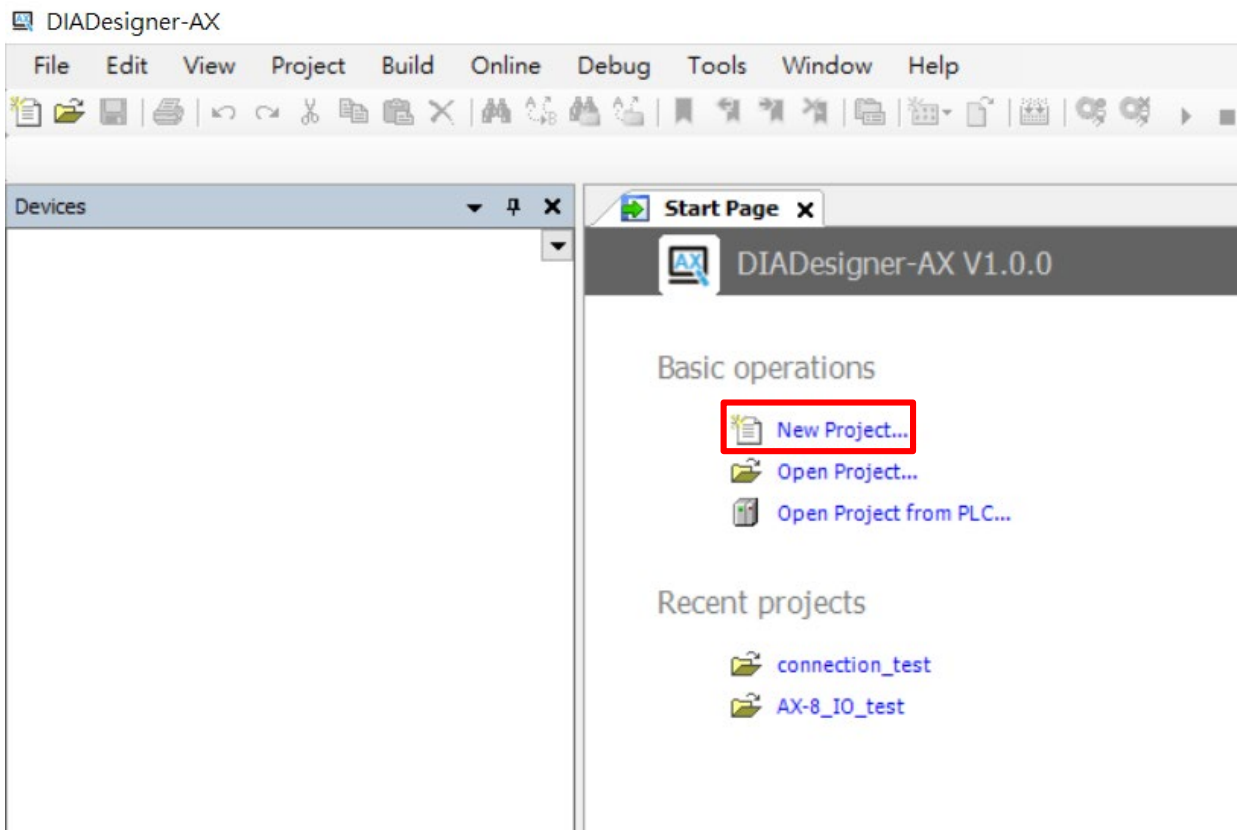
| SDO Abort Code | Description |
|----------------|--|
| 0x05030000 | Deflection fault while doing segment transmission |
| 0x05040000 | SDO time out. |
| 0x05040001 | Client / servo command are invalid or don't exist. |
| 0x05040005 | Register overflow when running SDO. |
| 0x06010000 | Not supported access |
| 0x06010001 | Try to read a write-only object |
| 0x06010002 | Try to write a read-only object |
| 0x06010003 | Unable to write into sub-index. The sub-index has to be 0. |
| 0x06020000 | The object doesn't exist in the object dictionary. |
| 0x06040041 | Unable to map the object to PDO |
| 0x06040042 | The number and the length of the objects mapped to PDO is longer than PDO. |
| 0x06040043 | Format of the parameter is not compatible. |
| 0x06040047 | Compatibility issue of motor drive. |
| 0x06060000 | Fail to save due to hardware error. (Saving or returning to origin fault) |
| 0x06070010 | Incorrect data type; wrong parameter length. |
| 0x06070012 | Incorrect data type; parameter length is too long |
| 0x06070013 | Incorrect data type; parameter length is too short. |
| 0x06090011 | Sub-index doesn't exist. |
| 0x06090030 | The parameter value is out of bounds. |
| 0x06090031 | Setting value is too big. |
| 0x06090032 | Setting value is too small. |
| 0x06090033 | Detected Module Ident List (0xF030) and Configured Module Ident list (0xF050) don't match. |
| 0x06090036 | Setting value is smaller than the lower limit. |
| 0x08000000 | General error |
| 0x08000020 | Data cannot be read or written. |
| 0x08000021 | Data access denied due to local control. |
| 0x08000022 | Data access denied due to current status. |
| 0x08000023 | Object dictionary doesn't exist. |

7. Operation Example

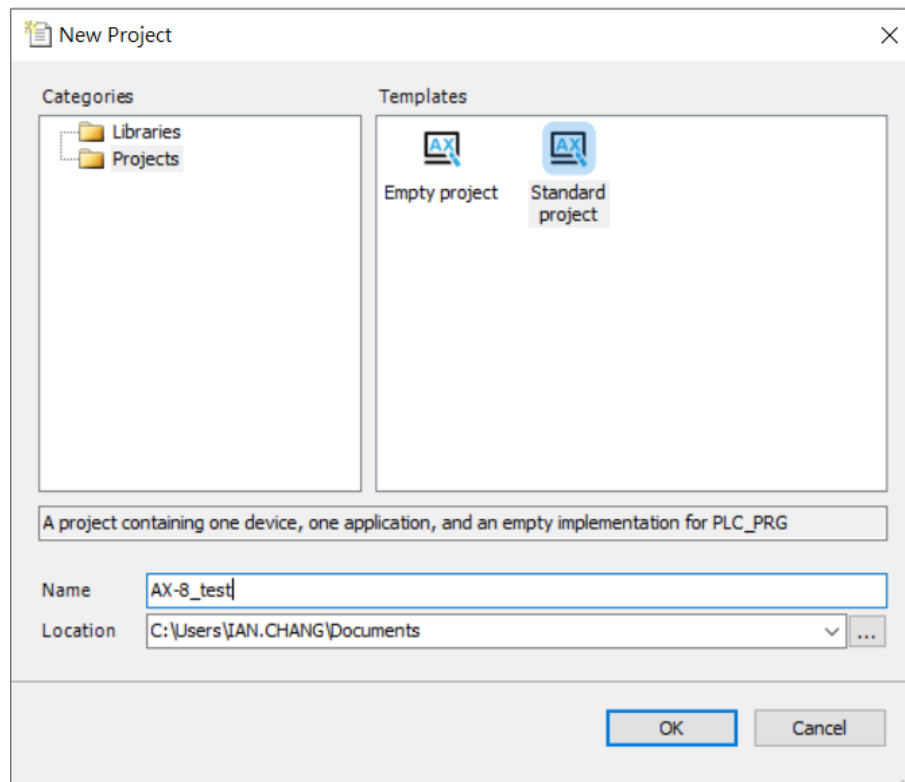
7.1 Delta PLC-AX-8 Operation Example (Designer-AX (Codesys base))

| | | |
|-----------|---|--------------------------------|
| Equipment | AX-8 | GLAN1 IP: 192.168.0.10 |
| | Computer | Network card IP: 192.168.0.123 |
| | Motor drive: M300 Communication card: CMM-EC02 | |
| Software | DIADesigner-AX | V1.1.0 and above |

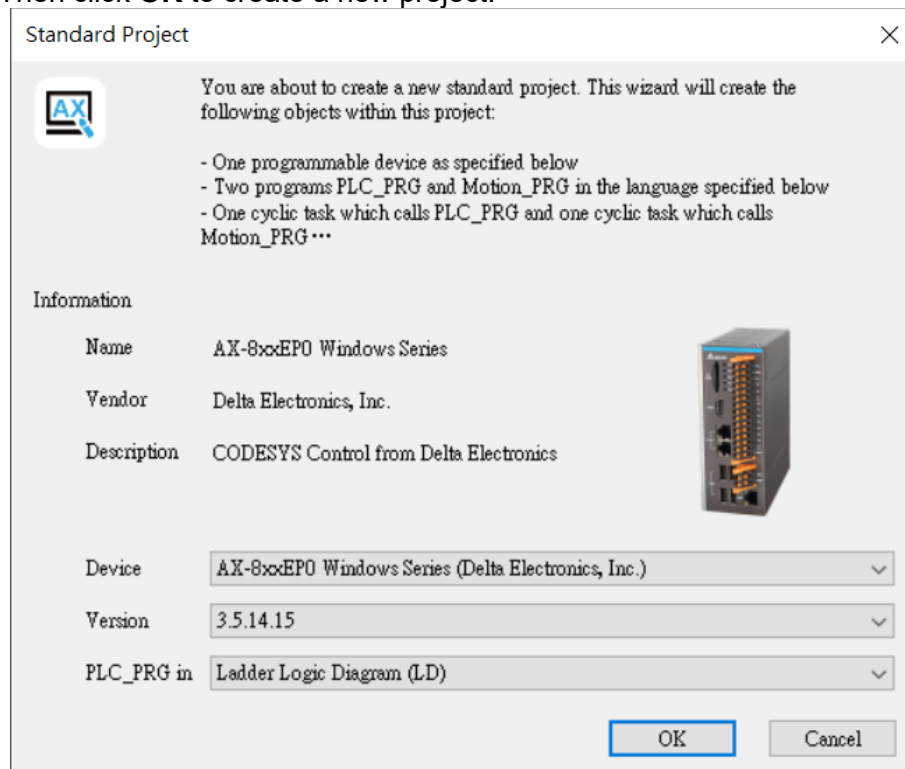
1. Connect CMM-EC02 to AX-8 EtherCAT port. Then Connect the AX-8 to the Computer via Ethernet port (GLAN1)
2. Run DIADesigner-AX software, then click on **New Project**



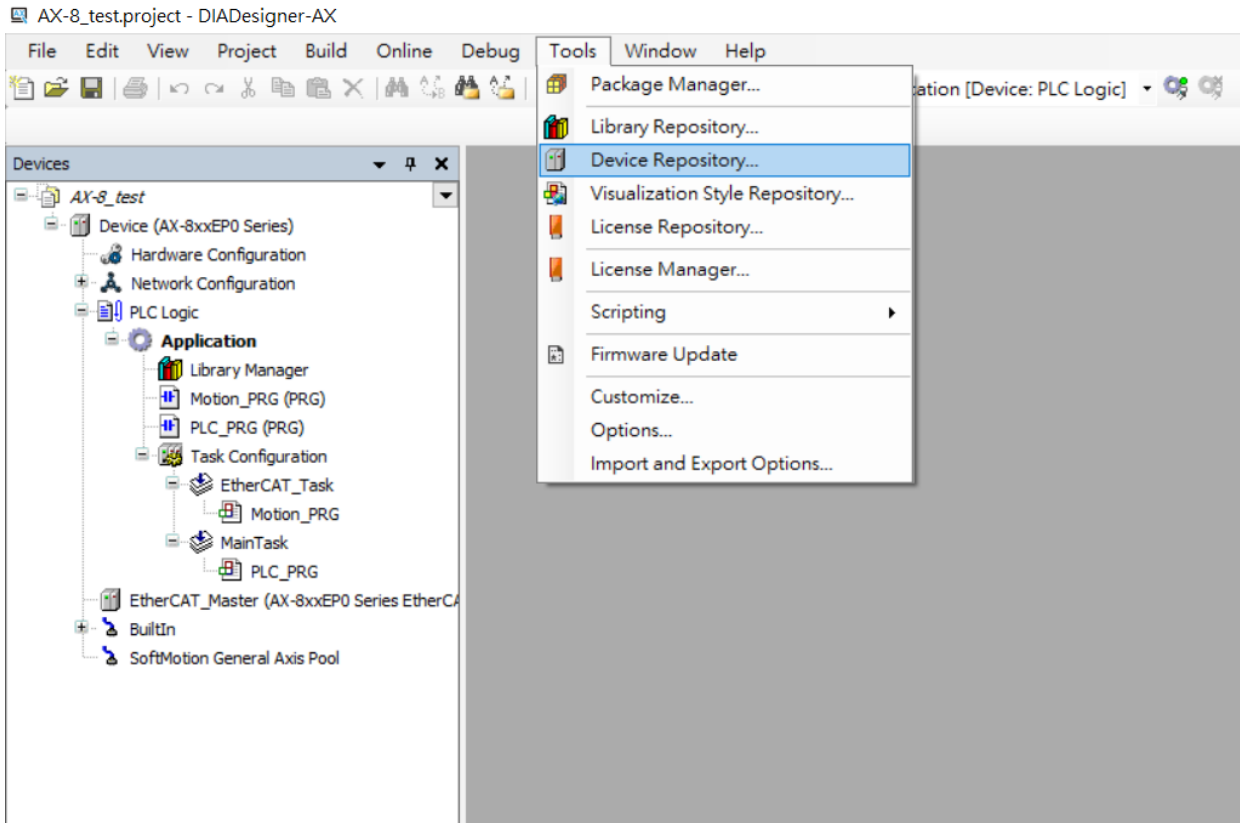
3. Select **Standard project** in the **New Project** window.



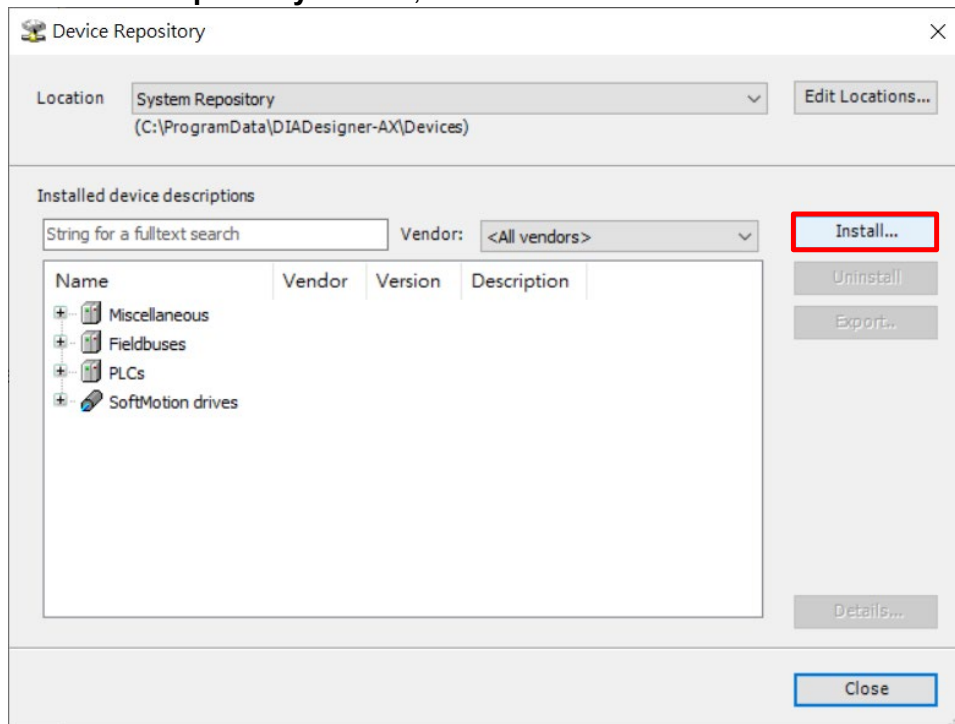
4. In the **Standard Project** window, choose the device **AX-8xxEP0 Windows Series, Version and PLC_PRG in**. Then click **OK** to create a new project.



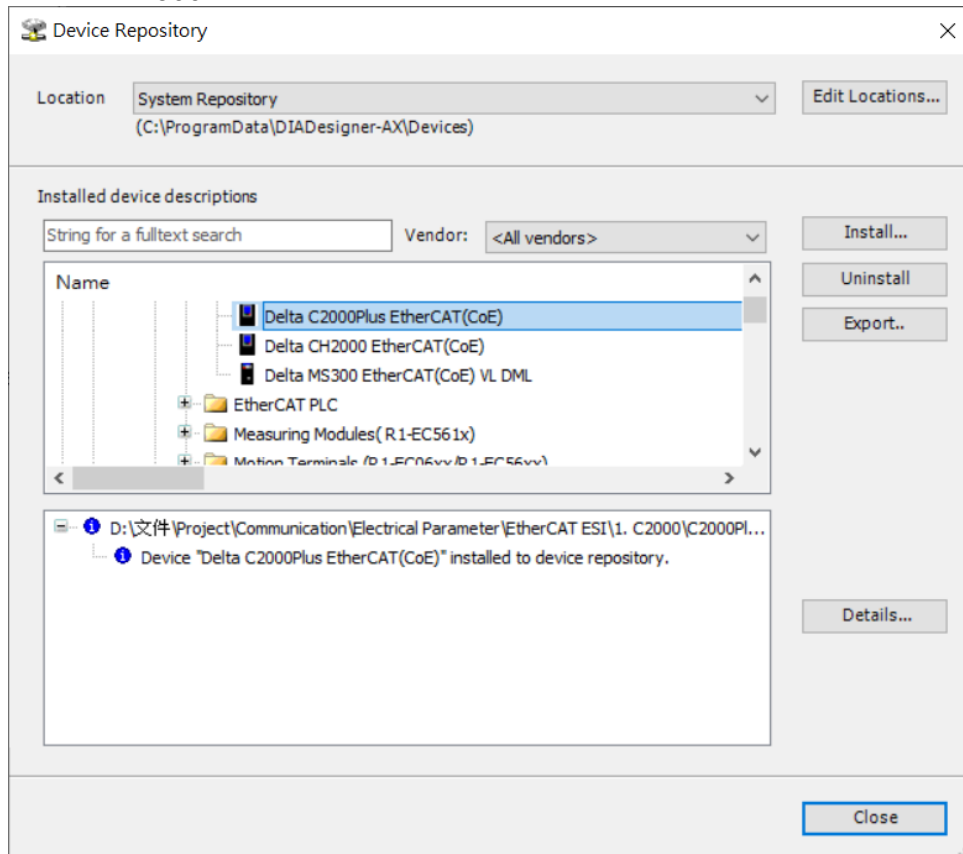
5. After you create a new project, go to **Tools**→**Device Repository** to open a **Device Repository** window.



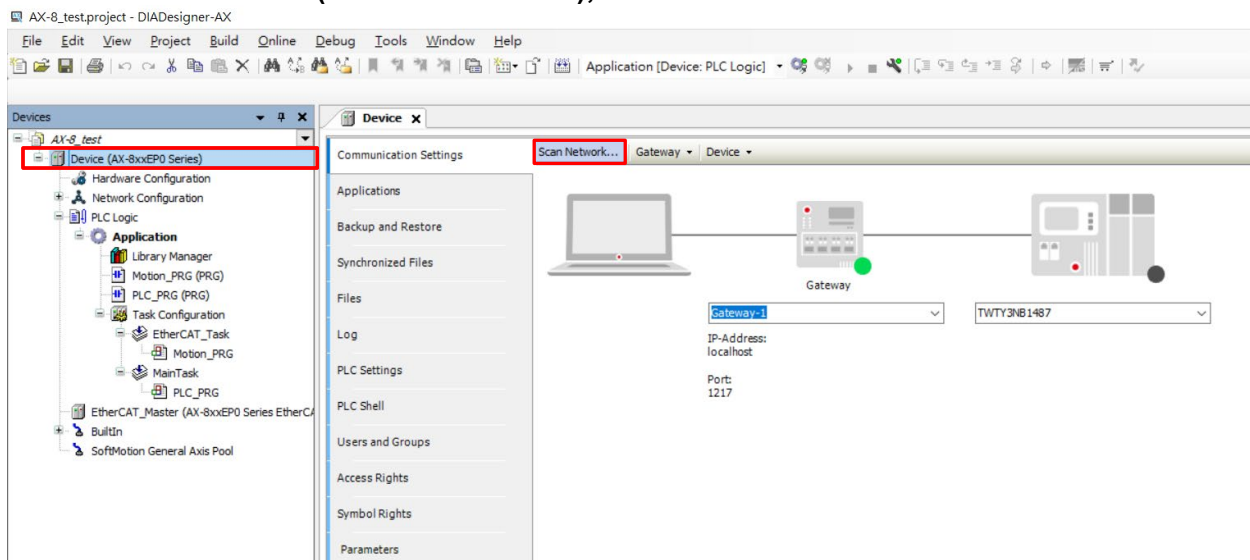
6. After you open a **Device Repository** window, click **Install**.



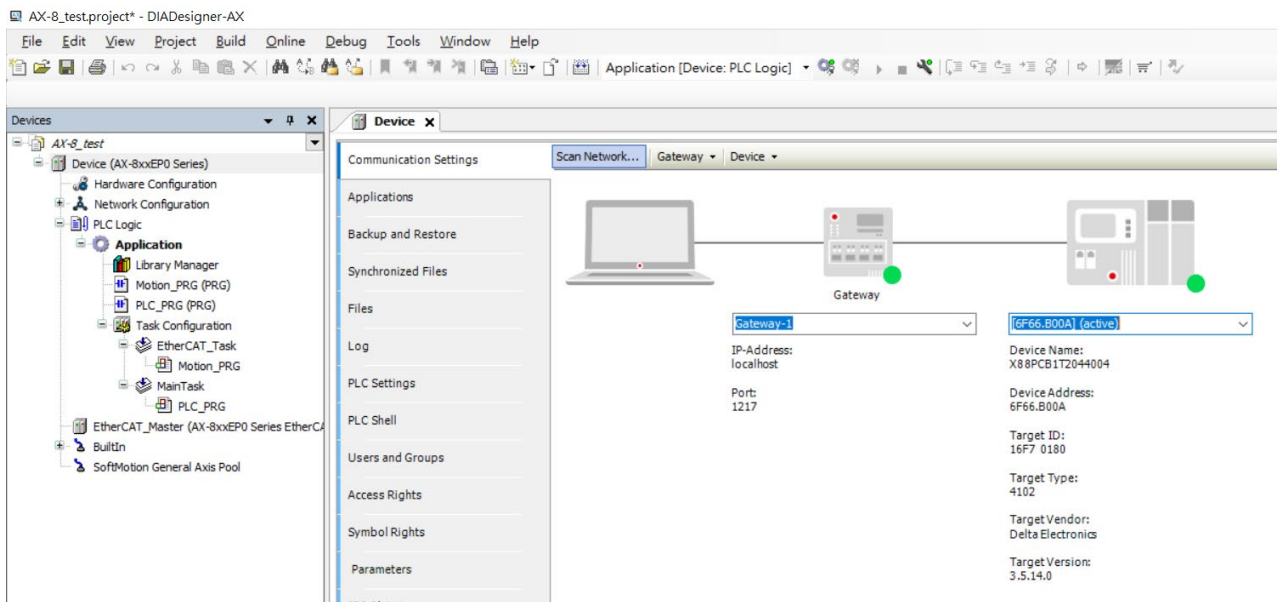
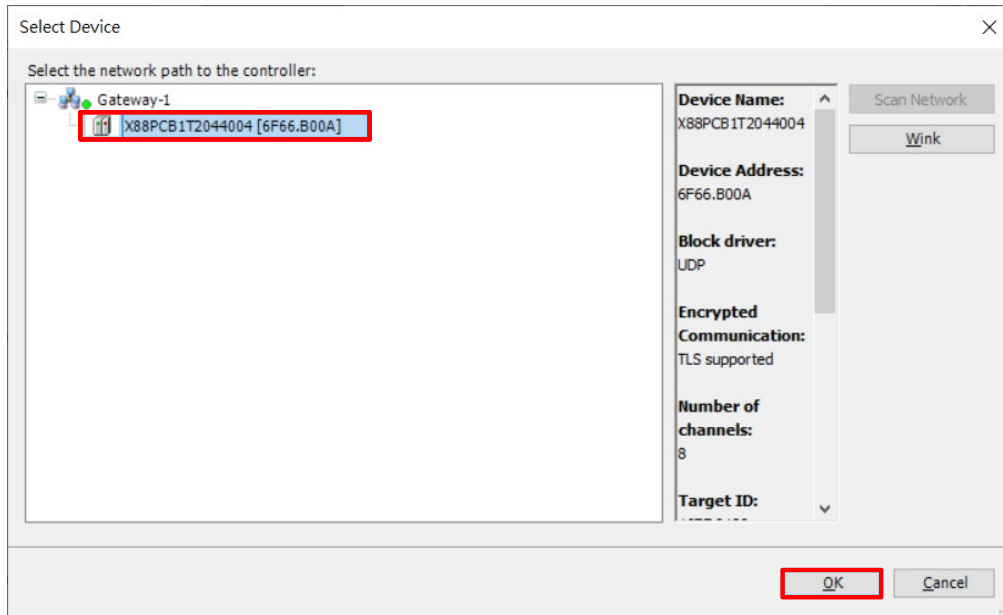
7. Import an ESI filer of MS300



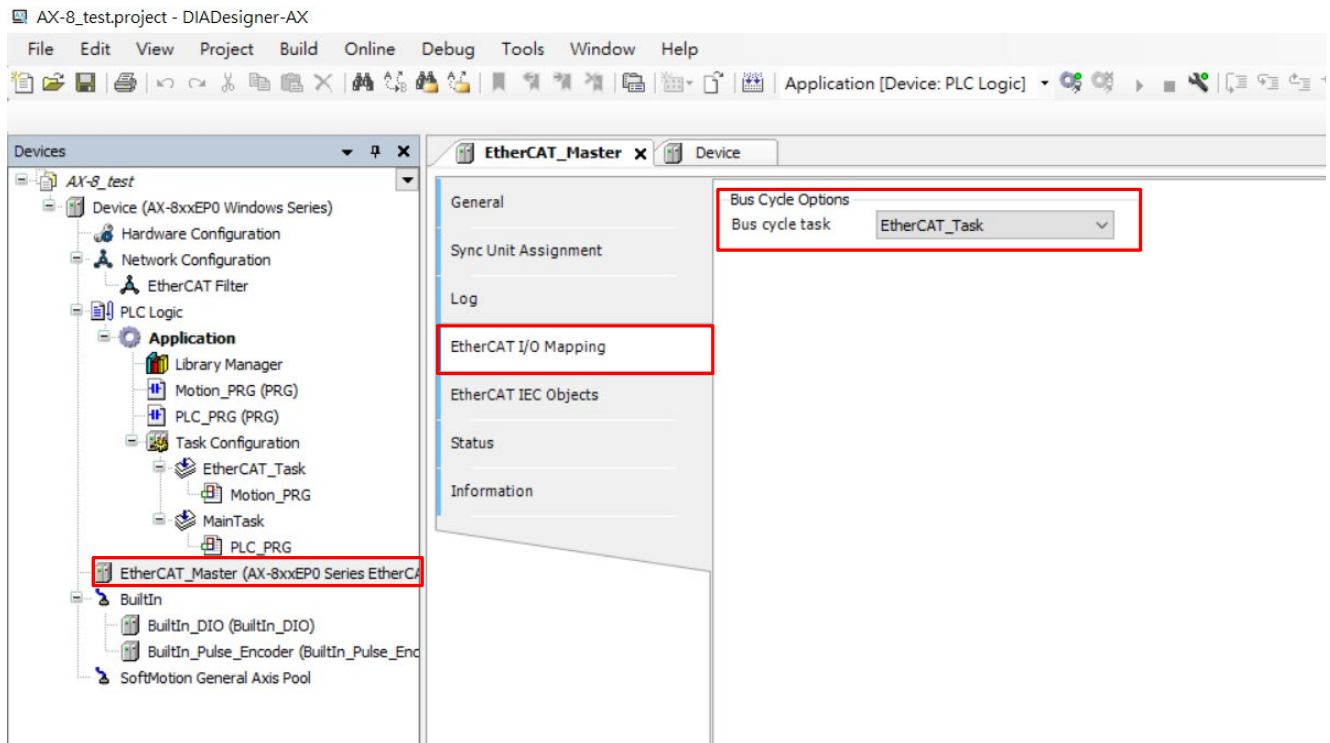
8. Double click on **Device (AX-8xxEP0 Series)**, then click **Scan Network**.



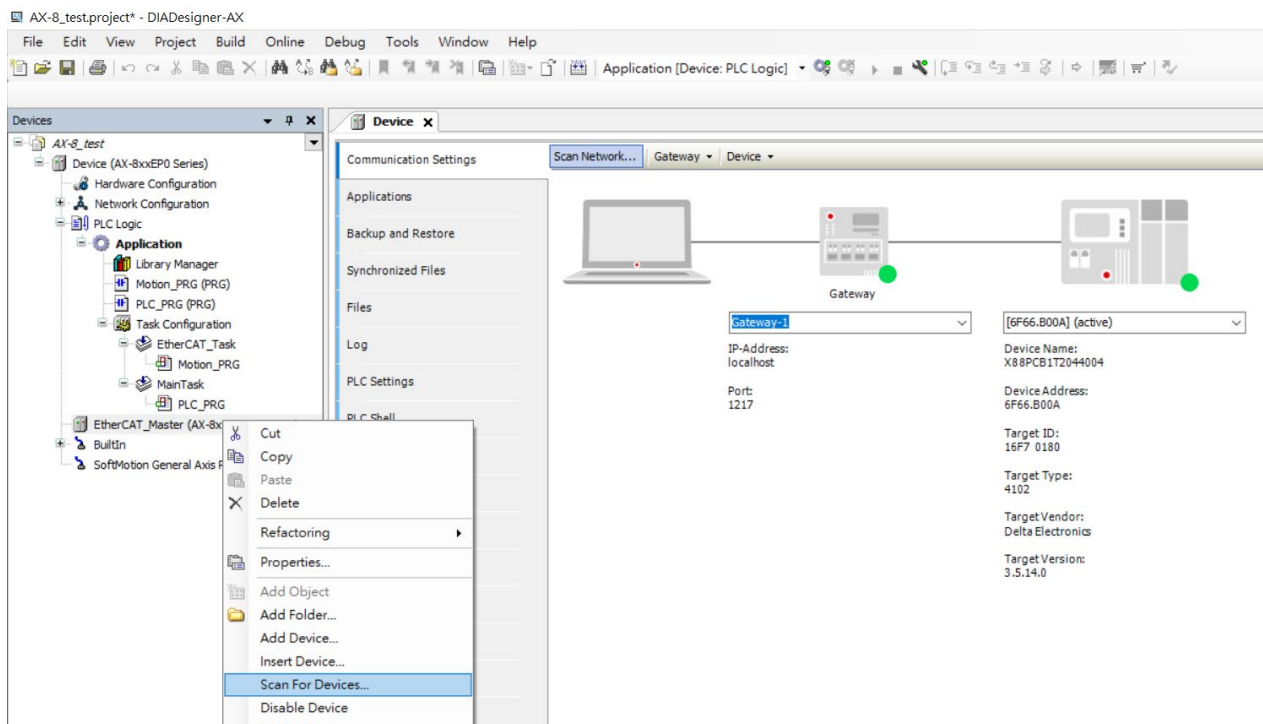
9. If you connect the computer and the AX-8 correctly, you can see the AX-8's serial number. Click **OK**, you can see AX-8 hardware information.



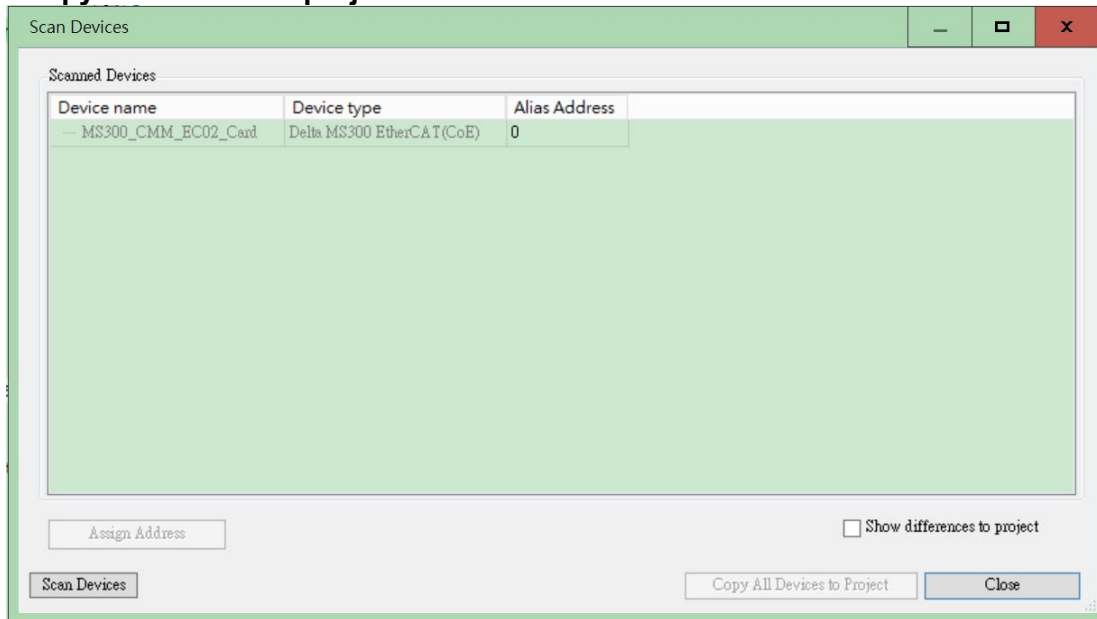
10. In the **Devices** window, select **EtherCAT_Master (AX-8xxEP0 Series EtherCAT Master)**, then go to **EtherCAT I/O Mapping** tab to make sure that **Bus Cycle Options** is set as **EtherCAT_Task**.



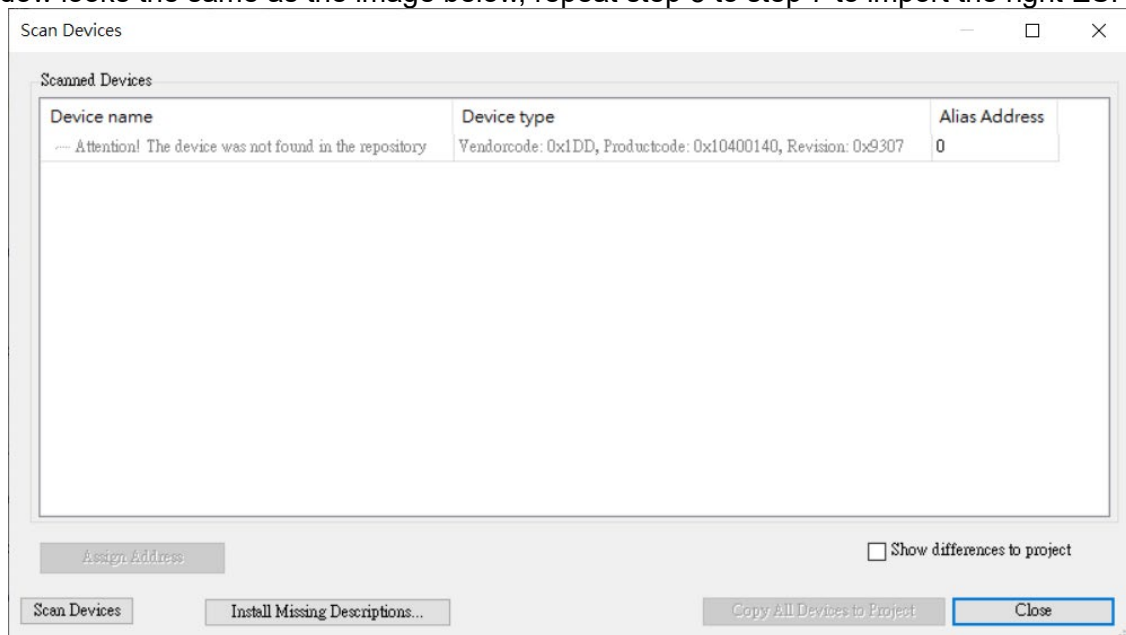
11. In the **Devices** window, right click on the **EtherCAT_Master (AX-8xxEP0 Series EtherCAT Master)**, then select **Scan for Devices**.



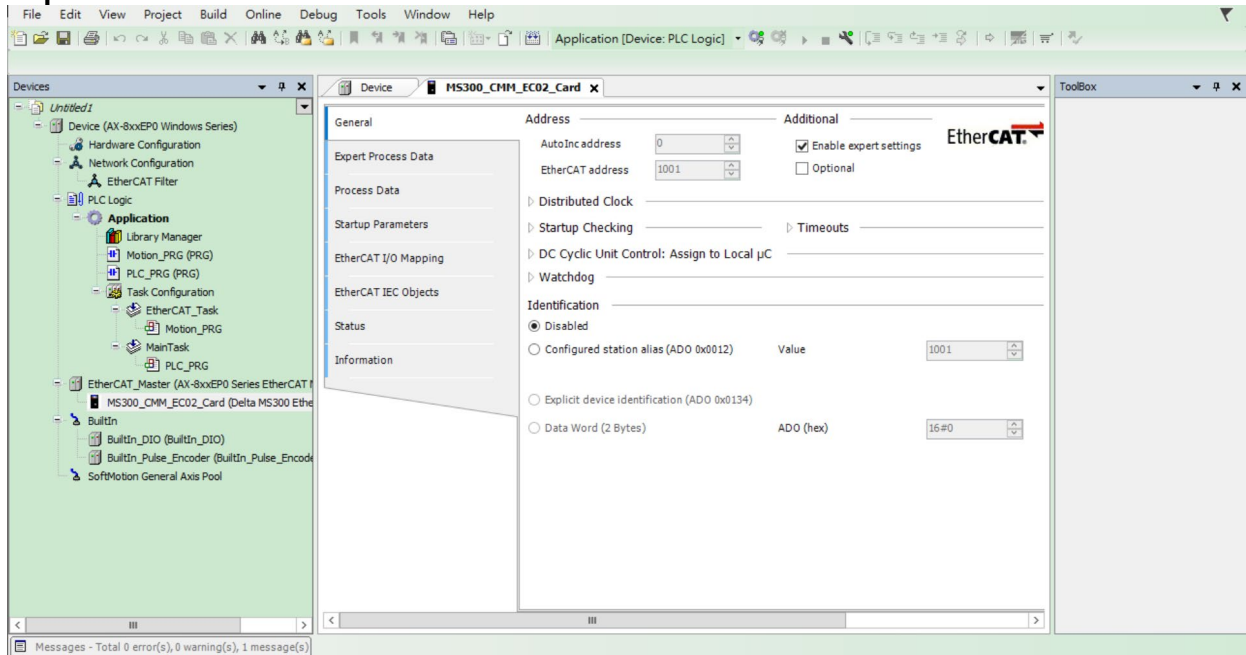
12. The pop-up window shows the description of M300 model. Now select the M300 model description and click **Copy All Devices to project**.



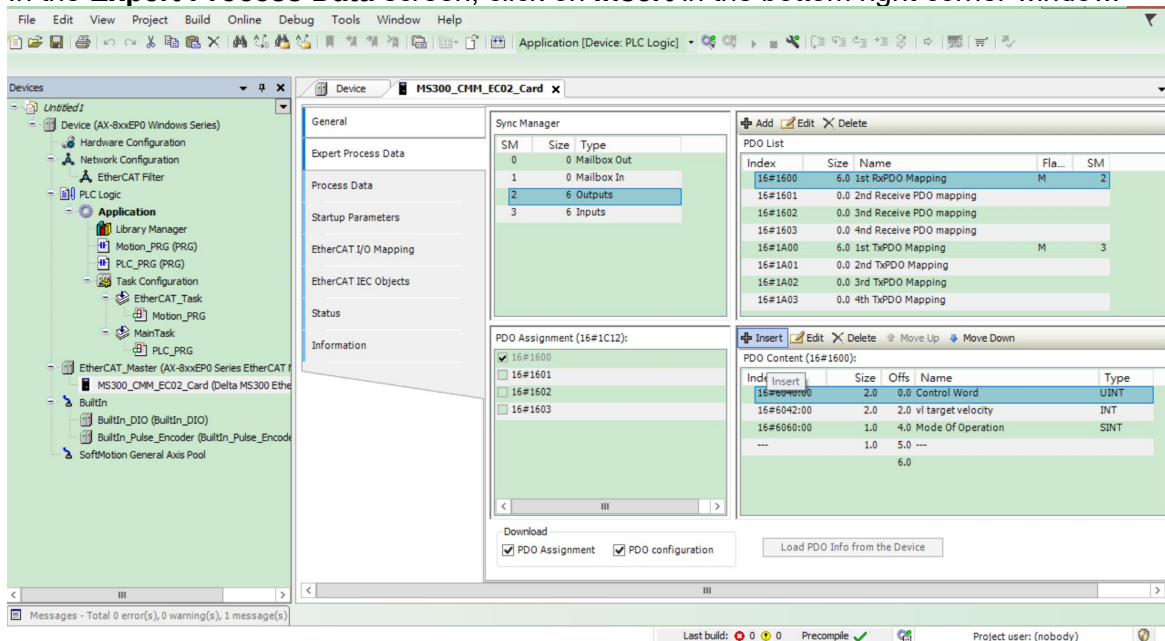
13. If the pop-up window is blank, verify if the wiring between CMM-EC02 and AX-8 is correct. If the pop-up window looks the same as the image below, repeat step 5 to step 7 to import the right ESI file.



14. In the **Devices** window, double click on **M300_CMM_EC01_Card (Delta M300 EtherCAT (CoE))** to open a tab. In the tab, check the **Enable expert settings**, then on the left side of the tab, click **Expert Process Data** to start PDO reflection.



15. In the **Expert Process Data** screen, click on **Insert** in the bottom right corner window.



16. A PDO Object mapping window pops up. Select a PDO object to map.

Select Item from Object Directory

| Index:Subindex | Name | Flags | Type | Default |
|----------------|-----------------------|-------|-------|---------|
| 16#6040:16#00 | Controlword | RW | UINT | |
| 16#6042:16#00 | vl target velocity | RW | INT | |
| 16#604F:16#00 | vl ramp function time | RW | UDINT | |
| 16#6050:16#00 | vl slow down time | RW | UDINT | |
| 16#6060:16#00 | Modes of operation | RW | SINT | |

Name

Index: 16# Bit length

SubIndex: 16#

Data type

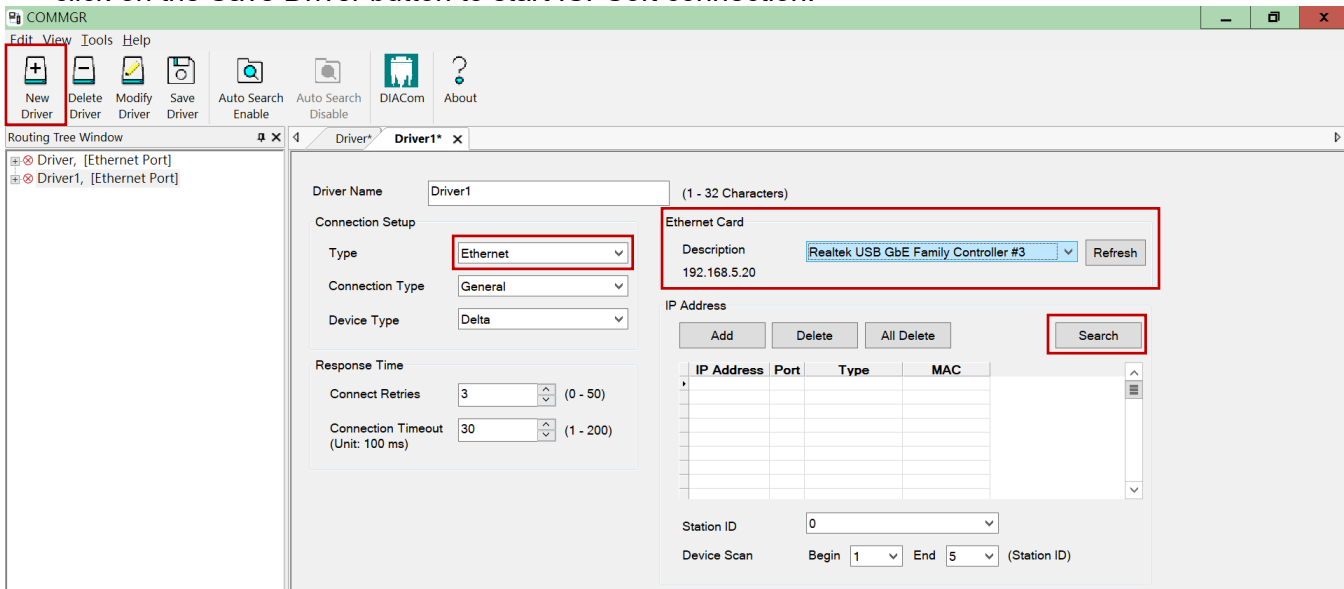
OK Cancel


17. After you finish the steps mentioned above, you've created a framework and you can start programming PLC.

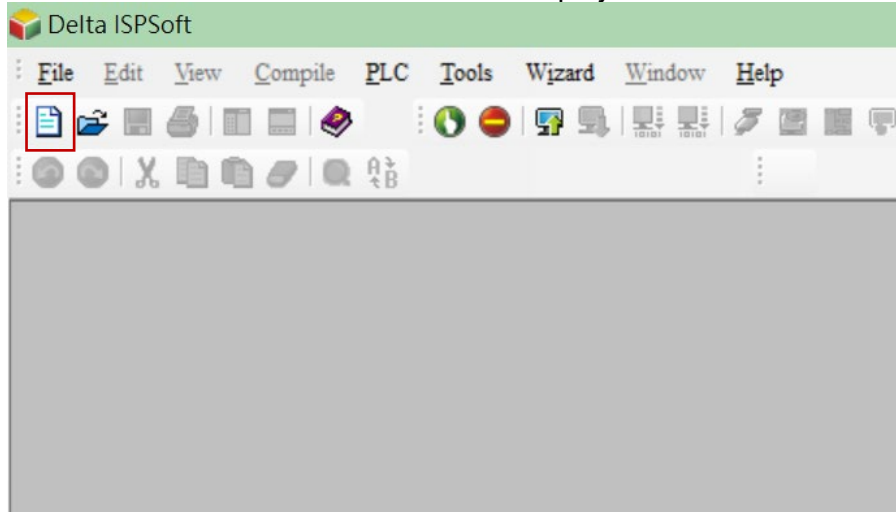
7.2 Delta PLC – AH10EMC Operation Example (ECAT Builder)

| | | |
|-----------|--|--------------------------------|
| Equipment | AH10EMC | IP: 192.168.1.1 |
| | Computer | Network card IP: 192.168.1.123 |
| | Motor drive: MS300 / MH300 Communication card: CMM-EC02 | |
| Software | COMMGR | V1.11 and above |
| | ISPSoft | V3.10 and above |
| | ECAT Builder | V1.07 and above |

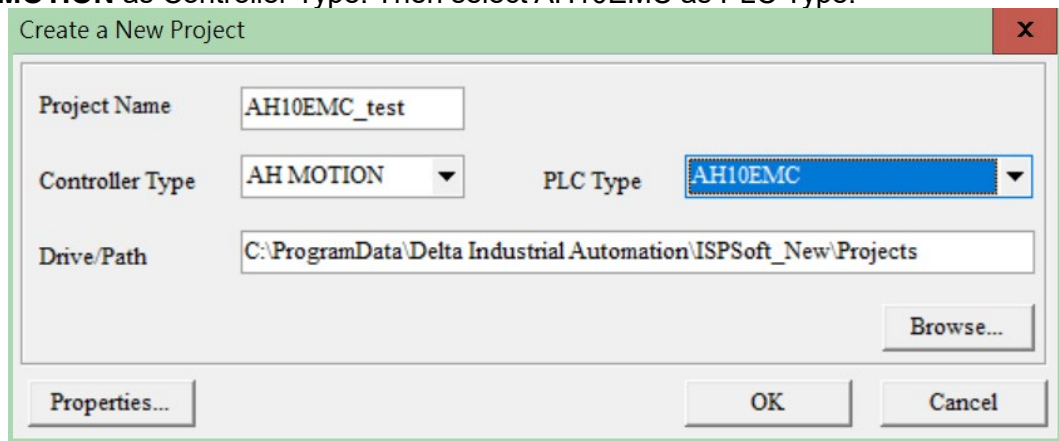
1. Connect CMM-EC02 to AH10EMC EtherCAT port. Then connect AH10EMC to the computer via Ethernet port.
2. Run COMMGR software, click on the **New Driver** button. Then on the Ethernet tab, select Ethernet in the Connection Setup Type drop-down list. Select the right Ethernet card in the Ethernet Card description drop down list. Then click the Search button, verify if AH10EMC is in the table. Now click on the Save Driver button to start ISPSoft connection.



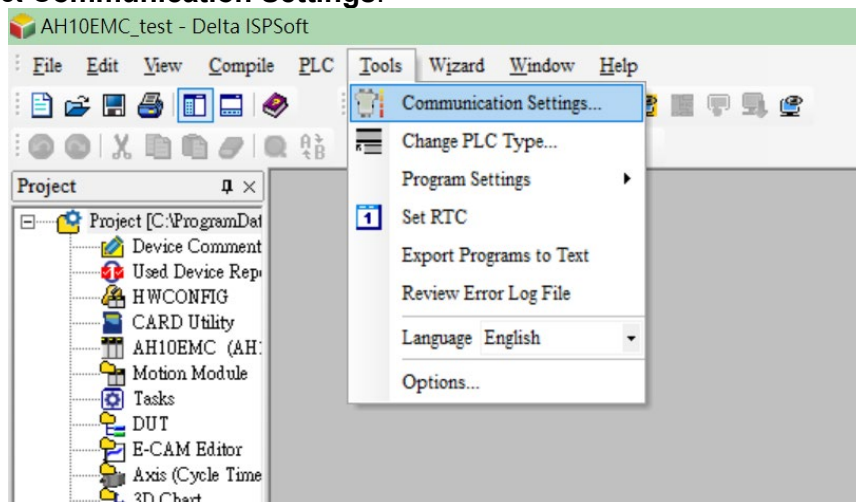
3. Run ISPSOft software. Click on icon  to create a new project.



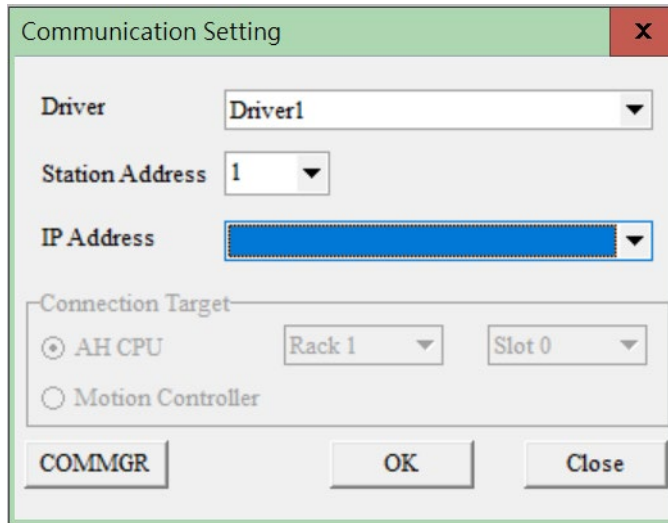
4. Select **AH MOTION** as Controller Type. Then select AH10EMC as PLC Type.



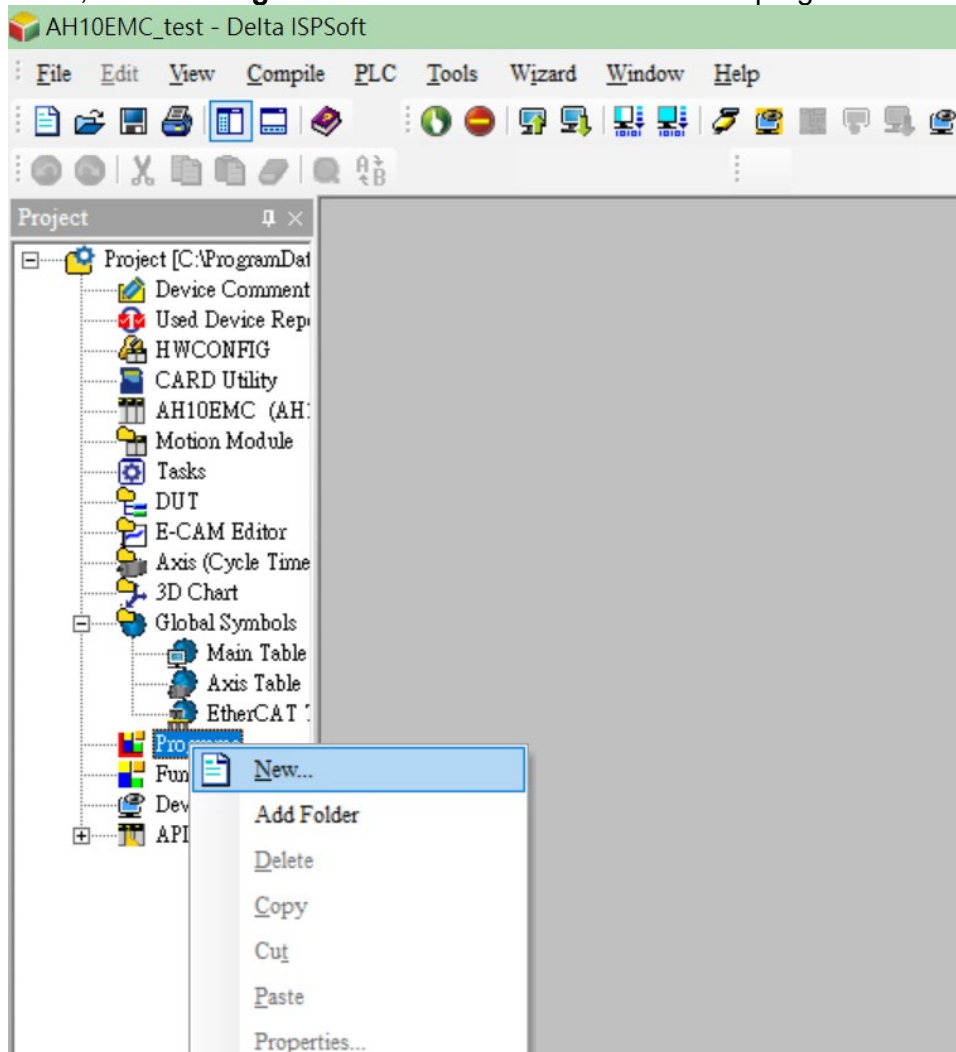
5. Click **Tools**, select **Communication Settings**.

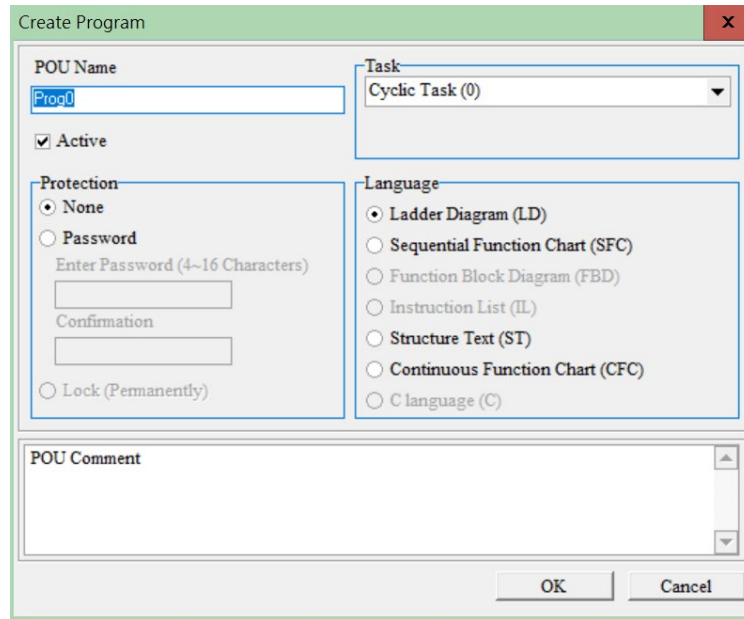


6. Select a name for the **Driver** (the driver name which you created in step 2 of COMMGR). Then select an **IP Address** 192.168.1.1.

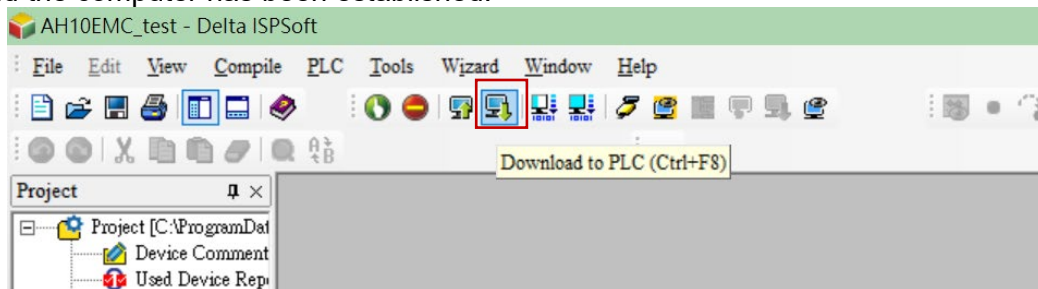


7. In the **Project** area, click on **Program** then click **New** to create a blank program.

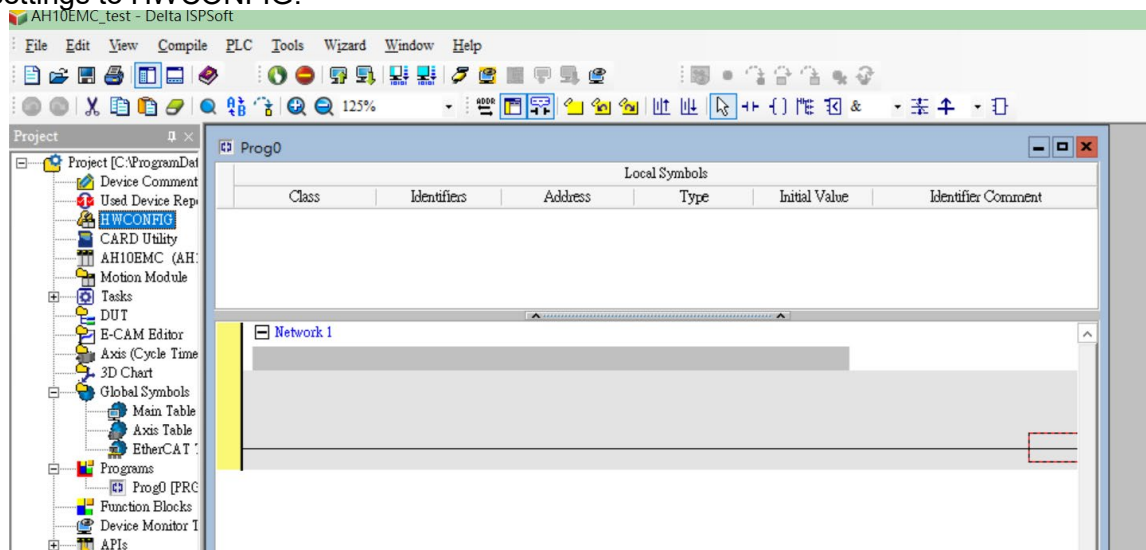


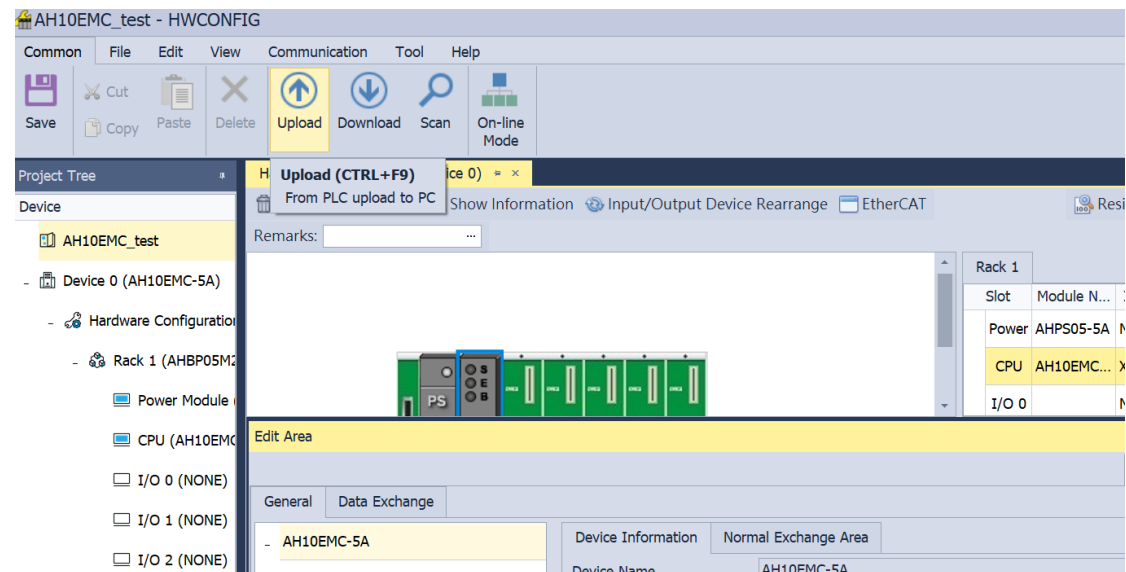


8. Click the **Download to PLC** button, as soon as the PLC starts to run, the connection between the PLC and the computer has been established.

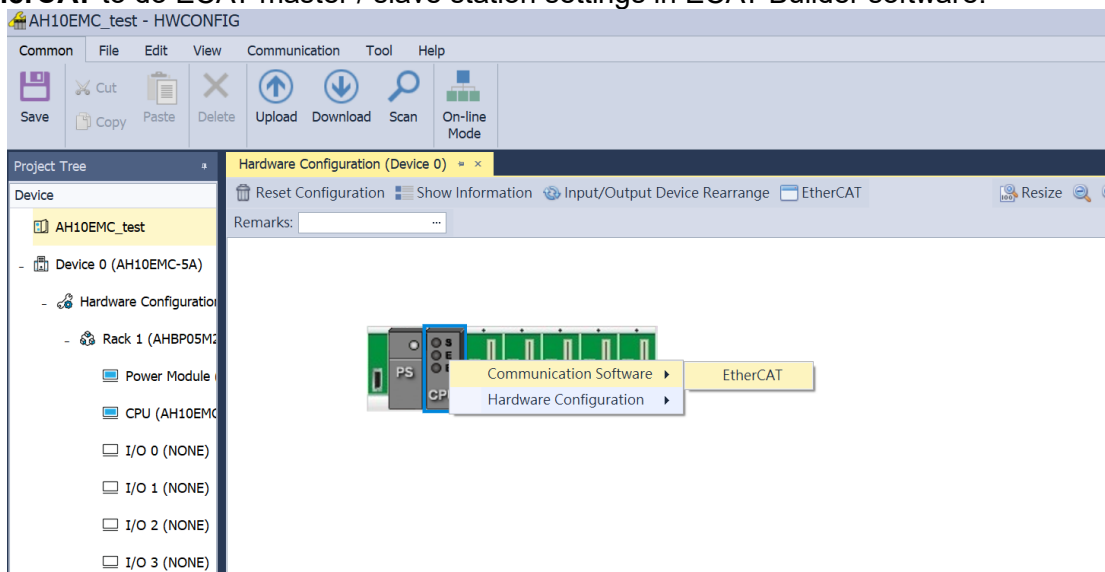


9. In the Project area, double click **HWCONFIG**. Click **Upload** button to upload PLC parameters and related settings to HWCONFIG.

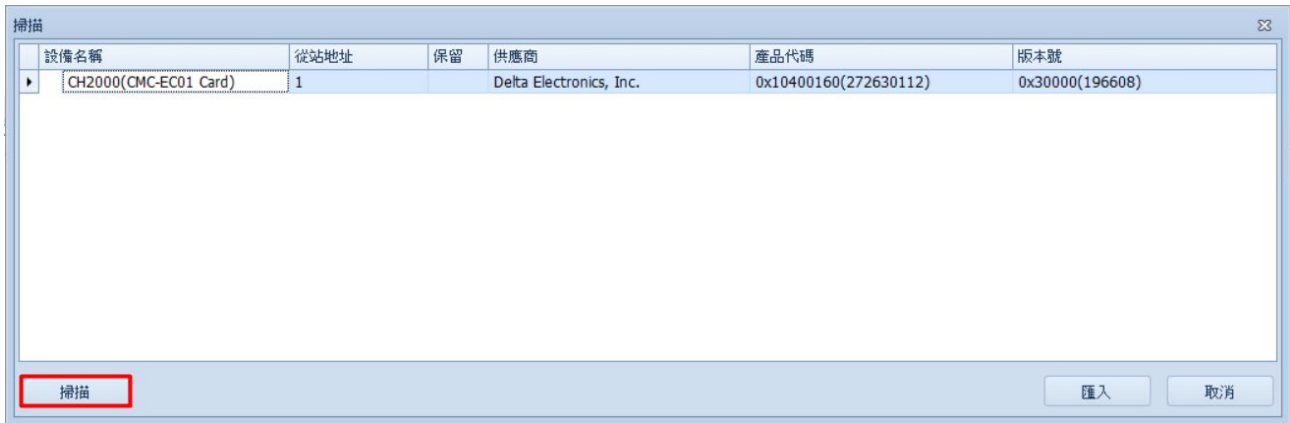
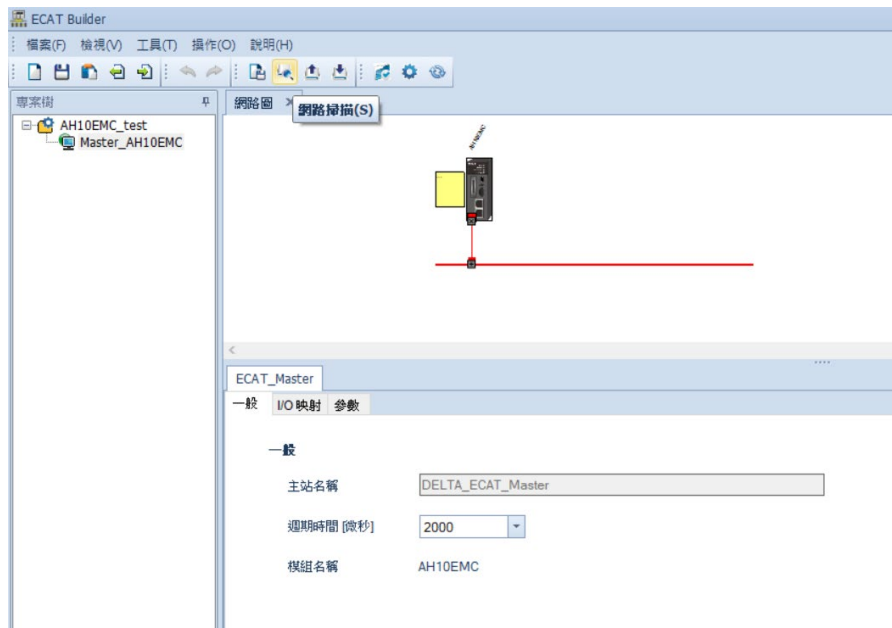


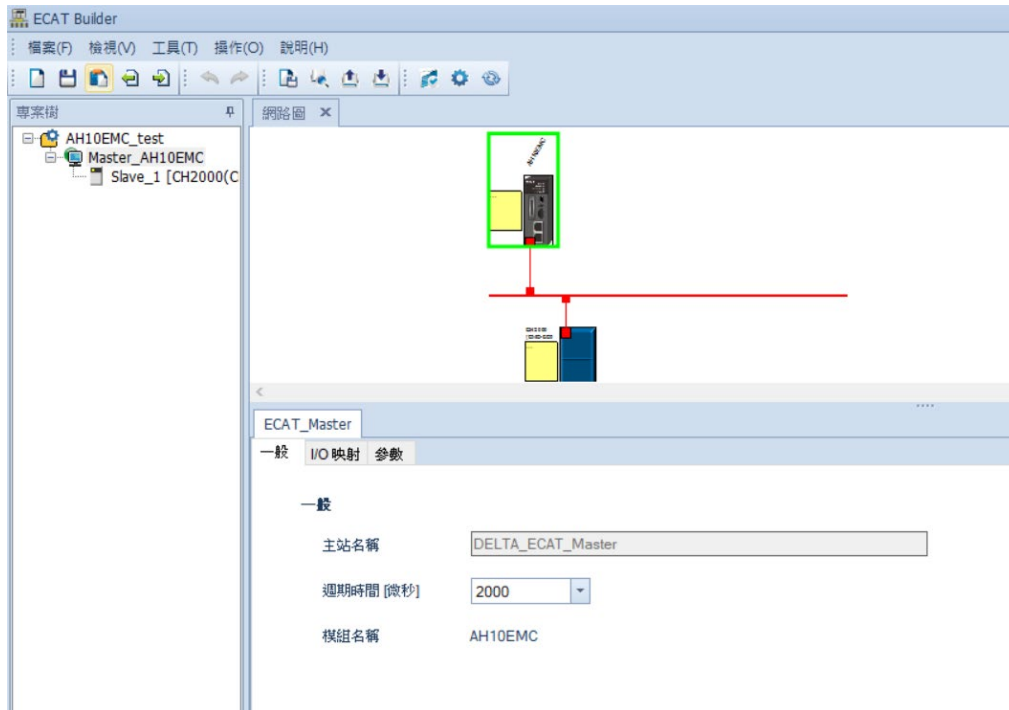


10. Right click on the **CPU module** image as shown below, select **Communication Software** then click **EtherCAT** to do ECAT master / slave station settings in ECAT Builder software.

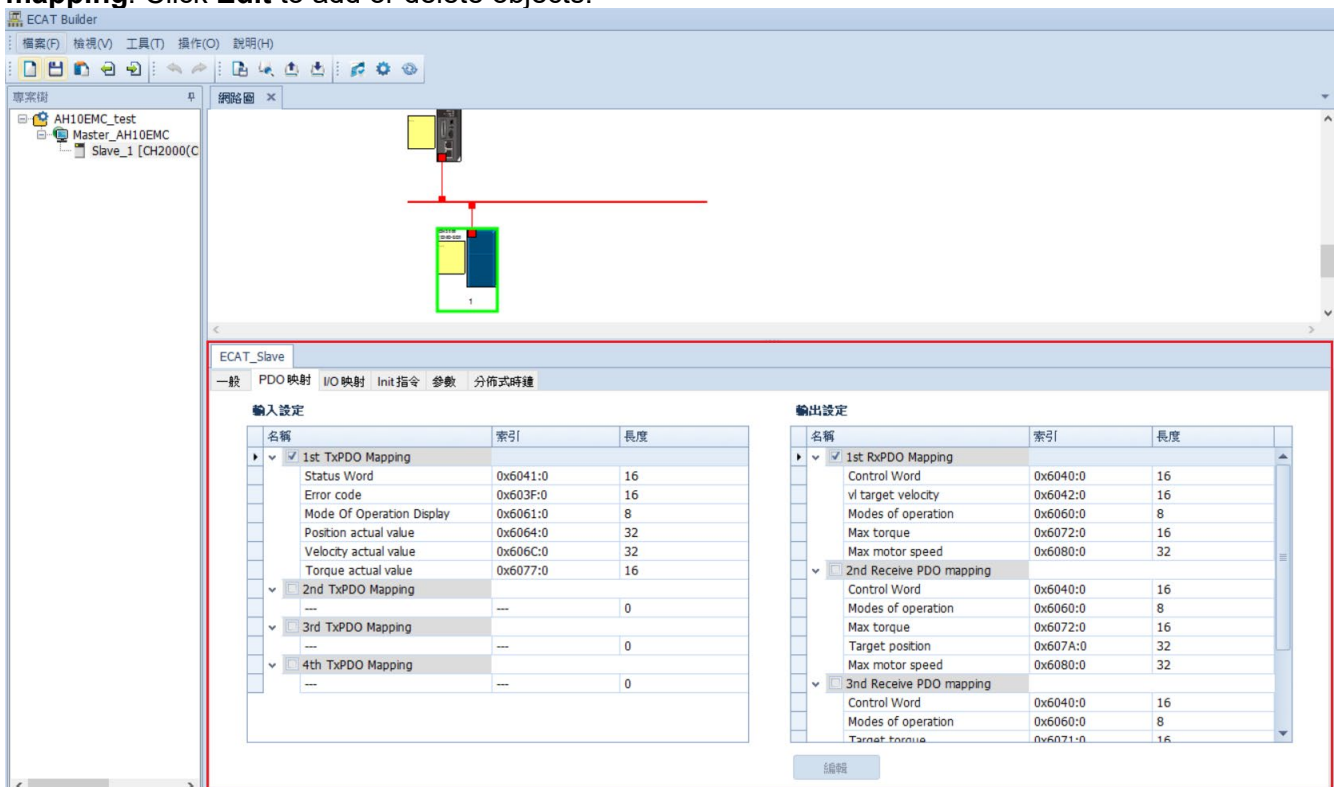


11. Click on the **Network Scan** button, then click **Scan** on the pop-up window. Then select **MS300 / MH300 (CMM-EC02)** in the **Equipment Name** to export to the network. If the scan result doesn't show MS300 / MH300 equipment, verify if the wiring is correct. Refer also to the ESI Import Process at the end of this chapter to import ESI files of slave station and scan again.





12. Import MS300 / MH300 into **Network Diagram**, then select MS300 / MH300 equipment to do to **PDO mapping**. Click **Edit** to add or delete objects.



編輯 PDO ☰

一般

名稱

索引 Dec Hex

旗標 **方向**

強制性 TxPDO

固定內容 RxPDO

虛擬 PDO

選項

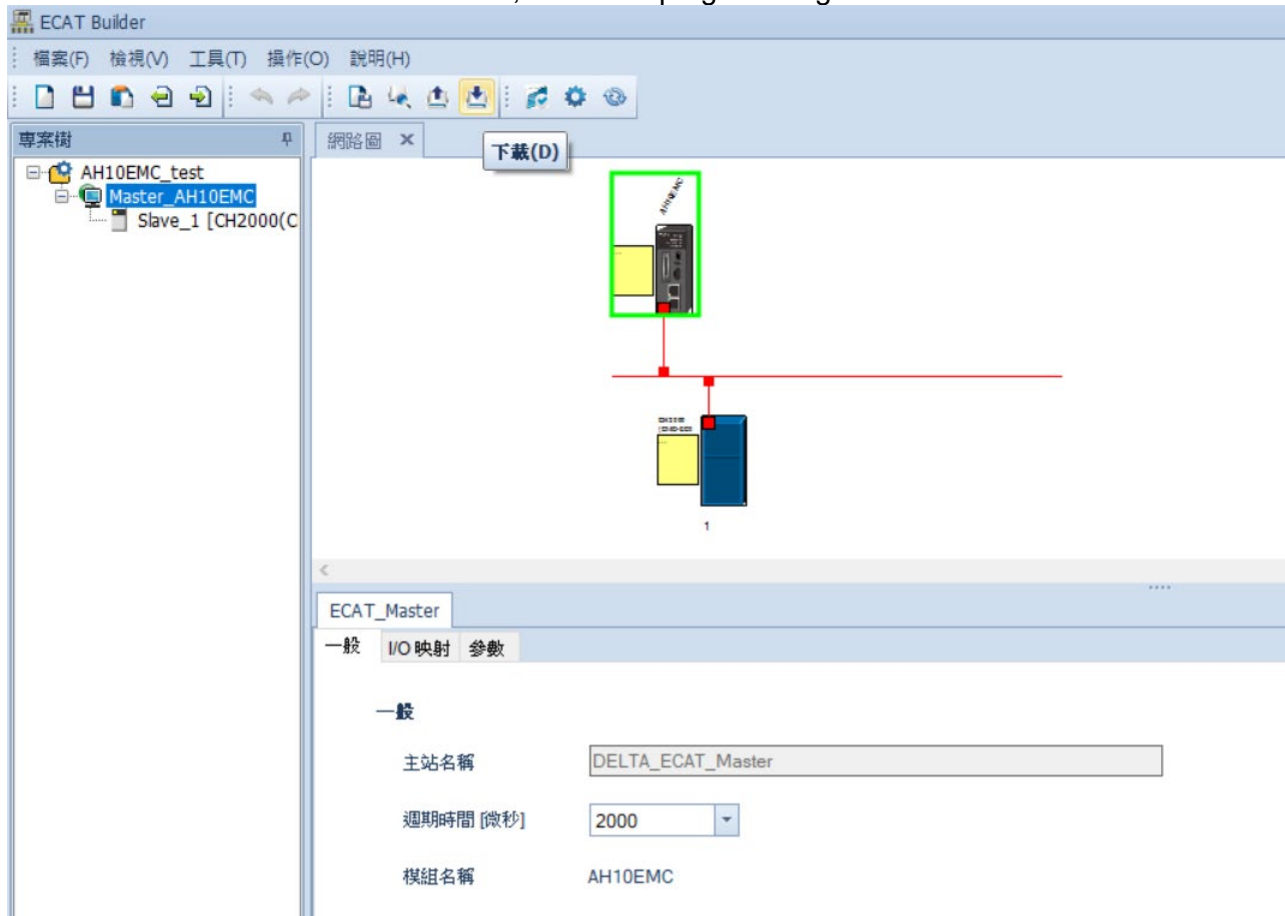
排除:

- 0x1A01
- 0x1A02
- 0x1A03

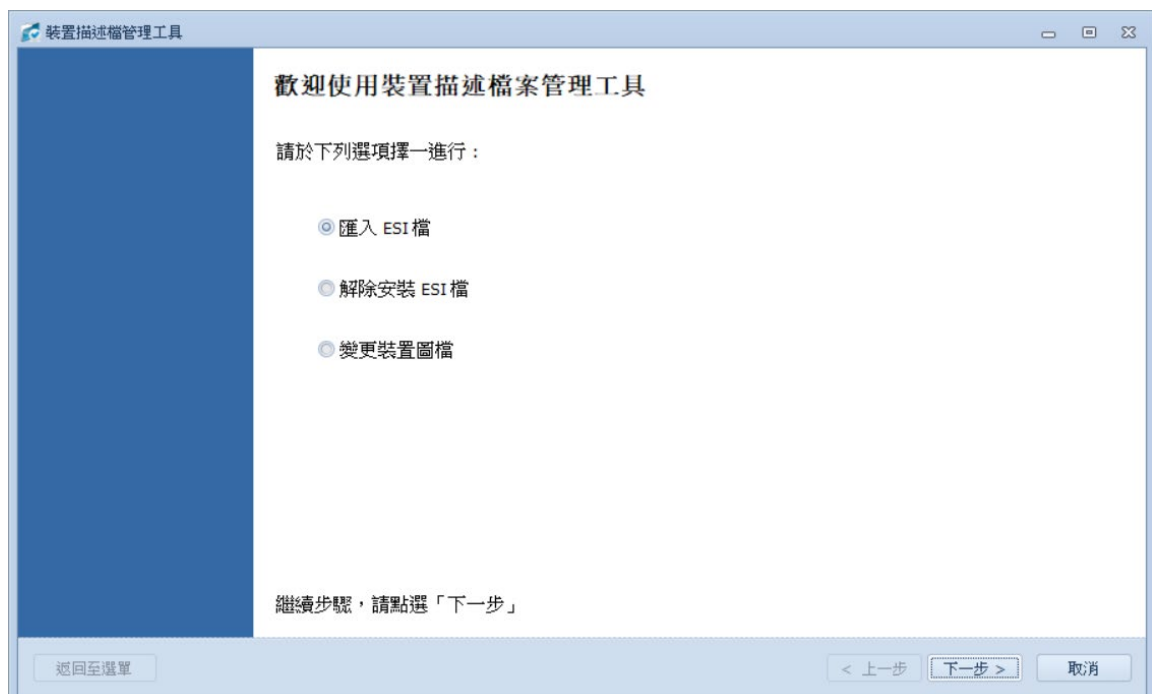
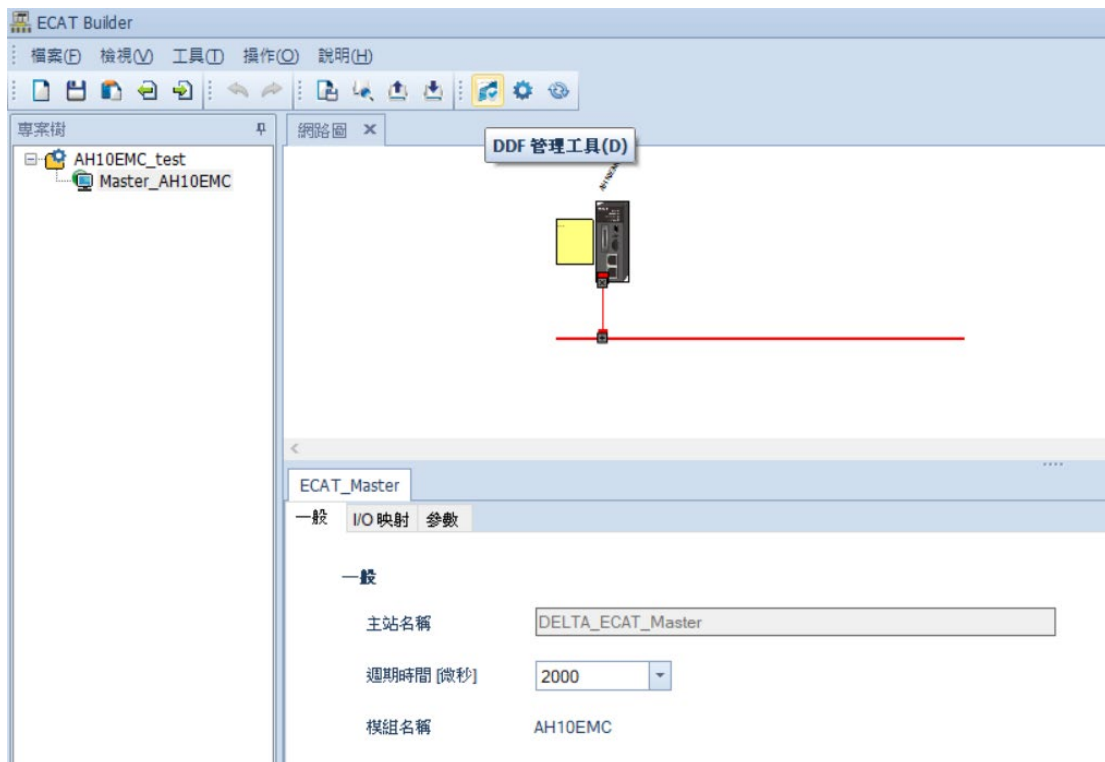
項目

| 名稱 | 索引 | Bit 長度 | 註解 |
|---------------------------|----------|--------|----|
| ▶ Status Word | 0x6041:0 | 16 | |
| vi velocity demand | 0x6043:0 | 16 | |
| Mode Of Operation Display | 0x6061:0 | 8 | |
| | -- | 8 | |

13. After you finish editing, click the **Download** button to download all the settings to the AH10EMC. Close ECAT Builder and HWCONFIG, then start programming PLC in the ISPSOft



- Import the ESI file
Click **DDF Management Tool** button, then follow step by step to import the ESI file. You can download ESI file in Delta's download center (See section 2.5).



Appendix A.

A.1 Description of Object Specification

A.1.1 Object Type

| Object Type | Description |
|-------------|--|
| Variable | A single value such as a UNSIGNED8, a Boolean, a float and an INTEGER16 |
| Array | An object with multiple data fields composed of multiple variables of the same data type such as UNSIGNED16. The Sub-index 0 data belongs to UNSIGNED8, so it's not classified as array data |
| Record | An object with multiple data fields composed of multiple variables of the same data type. The Sub-index 0 data belongs to UNSIGNED8, so it's not classified as record data. |

A.1.2 Data Type

| Data Type | Data 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 | -128~127 |
| INTEGER16 | 2 bytes | -32768~32767 |
| INTEGER32 | 4 bytes | -2147483648~2147483647 |
| 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 Motor Drive's Parameter Group

The objects defined here are related to the settings of the motor drive's parameters. The setting methods are as follows:

Index 300Xh are related to motor drive's parameter Group X. The sub-index 1h~64h (hexadecimal) correspond to the parameter Group X-00 to Group X-99.

For example: Set Pr.05-33 (Induction motor or permanent magnet synchronous motors selection). The Index is 3005h and the sub-index is 22h (34).

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 |
| 6502h | Variable | Supported drive modes | INTEGER32 | RO | N |

A.3 Detailed Information about Objects

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 a PDO set cannot be longer than 64-bit. |

| | |
|-----------------------|--|
| Sub-Index | 0 |
| Name | Number of Objects |
| Data Type | UNSIGNED8 |
| Read-Write Permission | RW |
| PDO MAPPING SETTING | No |
| Setting Range | 0: Disable 1~8: Set number of PDO mapping and enable this function. |
| Factory Setting | 0 |

| | |
|-----------------------|-------------------|
| Sub-Index | 1~8 |
| Name | Mapping entry (n) |
| Data Type | UNSIGNED32 |
| Read-Write Permission | RW |
| PDO MAPPING SETTING | No |
| Setting Range | UNSIGNED32 |
| Factory Setting | 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 a PDO set cannot be longer than 64-bit. |

| | |
|-----------------------|--|
| Sub-Index | 0 |
| Name | Number of Objects |
| Data Type | UNSIGNED8 |
| Read-Write Permission | RW |
| PDO MAPPING SETTING | No |
| Setting Range | 0: Disable 1~8: Set number of PDO mapping and enable this function. |
| Factory Setting | 0 |

| | |
|-----------------------|-------------------|
| Sub-Index | 1~8 |
| Name | Mapping entry (n) |
| Data Type | UNSIGNED32 |
| Read-Write Permission | RW |
| PDO MAPPING SETTING | No |
| Setting Range | UNSIGNED32 |
| Factory Setting | 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 |
| Factory Setting | 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 |
| Factory Setting | 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 |
| Factory Setting | 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 |
| Factory Setting | 0x1A00 |

A.3.2 OD 3000h Motor Drive's Parameter Group

| | |
|-----------------------|------------------|
| Index | 3XXXh |
| Name | Driver parameter |
| Object Type | Variable |
| Data Type | UNSIGNED16 |
| Read-Write Permission | RW |
| PDO MAPPING SETTING | No |
| Setting Range | UNSIGNED16 |
| Factory Setting | N/A |

You can read/write motor drive's parameters via this object group. The motor drive's parameter can only be changed by SDO.

The setting methods are as follows:

Index 300Xh are related to motor drive's parameter Group X. The sub-index 1h~64h (hexadecimal) correspond to the parameter Group X-00 to Group X-99.

For example: Set Pr.05-33 (Induction motor or permanent magnet synchronous motors selection). The Index is 3005h and the sub-index is 22h (34).

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 function 2: Switch on Disable 3: Quick Stop |
| Factory Setting | 2 |

- When object 6007h = 0, CANopen ignores a disconnection fault, no warning and do nothing.
- When object 6007h =2, CANopen turns to **Switch on Disable** and displays ECto. CANopen then follows the setting at object 605Ah to trigger parking. When reconnection is successful, the warning code disappears.
- When object 6007h = 3, CANopen turns to Quick Stop and displays ECto. CANopen then follows the set=ting at object 605Ch to trigger parking. When reconnection is successful, the warning code clears.

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 |
| Factory Setting | 0 |

Object 6040h : Controlword

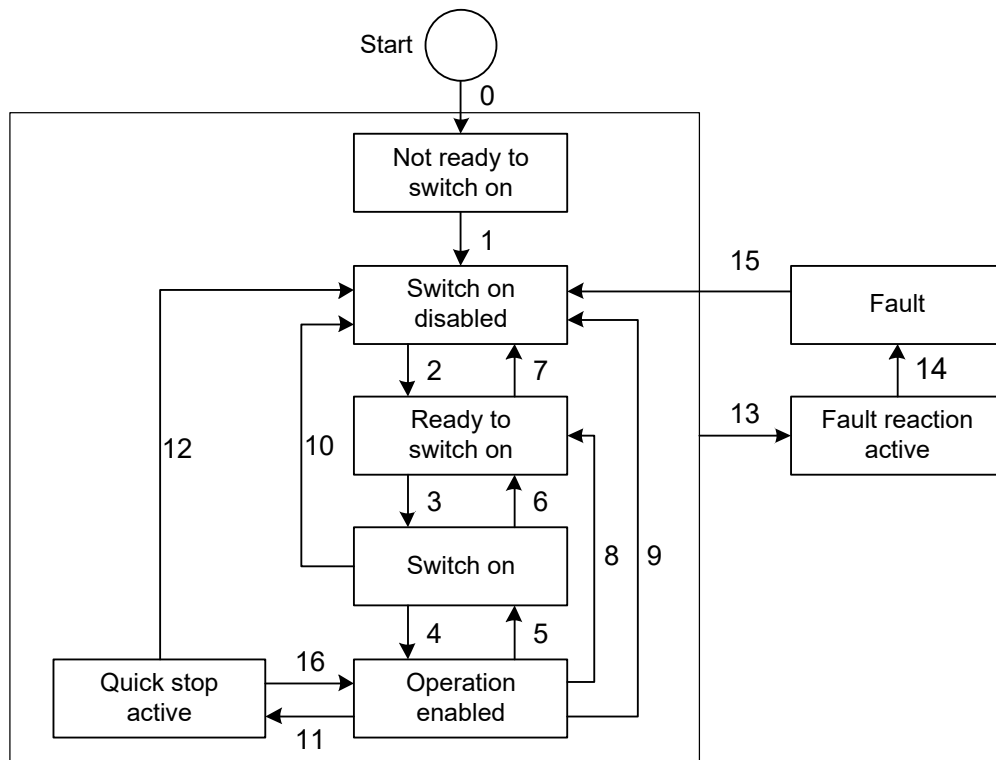
| | |
|-----------------------|-------------|
| Index | 6040h |
| Name | Controlword |
| Object Type | Variable |
| Data Type | UNSIGNED16 |
| Read-Write Permission | RW |
| PDO MAPPING SETTING | Yes |
| Setting Range | UNSIGNED16 |
| Factory Setting | 0 |

Description of different bits

| Bit | Function | Description |
|--------------|-------------------------|---|
| Bit 0 | Switch on | - |
| Bit 1 | Enable voltage | - |
| Bit 2 | Quick stop | - |
| Bit 3 | Enable operation | - |
| Bit 4~Bit 6 | Operation mode specific | Refer to the Specific Model Definition table blow |
| Bit 7 | Fault reset | - |
| Bit 8 | Halt | - |
| Bit 9~Bit 15 | Reserved | - |

Specific Model Definition table:


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




Status Switching Definition table

| Status Switching | Event | Action |
|------------------|---------------------------------------|---|
| 0 · 1 | Auto run after powering on | Activate the device and initialize. |
| 2 | Shutdown command | N/A |
| 3 | Switch on command | Motor drive prepares for servo on |
| 4 | Enable operation command | Motor drive has servo on and is in operation. |
| 5 | Disable operation command | Servo has servo off. |
| 6 | Shutdown command | N/A |
| 7 | Disable voltage or Quick stop command | N/A |
| 8 | Shutdown command | Motor drive has servo off. |
| 9 | Disable voltage command | Motor drive has servo off. |
| 10 | Disable voltage or Quick stop command | N/A |
| 11 | Quick stop command | Enable Quick Stop function. |
| 12 | Disable voltage command | Motor drive has servo off |
| 13 · 14 | Warning / Fault codes pop up | Motor drive has servo off. |
| 15 | Warning / Fault codes clear | N/A |
| 16 | Enable operation ; no alarm command | Restart operation command. |

Via Controlword (6040h), status can be changed, the commands are as follows:

| Command | Bit of Controlword (6040h) | | | | | Status Change |
|------------------------------|---|-------|-------|-------|-------|-----------------|
| | 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 = Bit is off; 1 = Bit is on; X = Bit is not affected;  = positive edge triggering

Object 6041h : Statusword

| | |
|-----------------------|------------|
| Index | 6041h |
| Name | Statusword |
| Object Type | Variable |
| Data Type | UNSIGNED16 |
| Read-Write Permission | RO |
| PDO MAPPING SETTING | Yes |
| Setting Range | UNSIGNED16 |
| Factory Setting | 0 |

Description of different bits

| Bit | Function | Description |
|---------------|-------------------------|--|
| Bit 0 | Ready to switch on | Bit 0 to Bit6 display current status of the motor drive. See 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 status: motor drive still has servo on. |
| Bit 8 | Reserved | - |
| Bit 9 | Remote | - |
| Bit 10 | Target reached | Target reached |
| Bit 11 | Reserved | - |
| Bit 12~Bit 13 | Operation mode specific | See Specific Model Definition table below. |
| Bit 14 | Reserved | - |
| 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 = bit is off; 1 = bit is on; - means that bit is not functional.

Specific Model Definition table:

| Bit | Specific Model Definition | | | | | | |
|--------|---------------------------|-----------------|-----------------|-----------------|----------------|-----------------|-----|
| | VL | PP | Homing | IP | PT | CSP | CST |
| Bit 10 | - | Target reached | Target reached | Target reached | Target reached | - | - |
| Bit 12 | - | - | Homing attained | - | - | - | - |
| 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 |
| Factory setting | 0 |
| Unit | RPM |

This object is a velocity command value under the 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 a velocity command calculated by the motor drive under the 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 under the 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 |
| Factory setting | 10000 |
| Unit | ms |

This object is the time spent when the motor drive accelerates from 0 RPM to 6042h under the 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 |
| Factory setting | 10000 |
| Unit | ms |

This object is the time spent when the motor drive decelerates from 6042h to 0 RPM under the 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 | Motor drive parameter 01-45 Pr.01-45=0 · Setting Range : 10~600000 Pr.01-45=1 · Setting Range : 100~6000000 |
| Factory setting | 1000 |
| Unit | ms |

This object is at velocity mode. It's the time required for decelerating from 6402h to 0 RPM.

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 motor drive function 1: Decelerate to stop by slow down ramp then Switch on Disabled (cannot be back to OP) 2: Decelerate to stop by quick stop ramp then Switch on Disabled (cannot be back to OP) 5: Decelerate to stop by slow down ramp and keep on Quick Stop status (can be back to OP) 6: Decelerate to stop by quick stop ramp and keep on Quick Stop status (can be back to OP) |
| Factory Setting | 2 |

This object is a choice behavior when 6040h (Controlword) triggers Quick Stop bit.

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 motor drive 1: Decelerate to stop; disable motor drive |
| Factory Setting | 1 |

This object is a choice behavior of the motor drive when the status switches 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 |
| Factory Setting | 8 |

This object is to set up the operation mode. The operation modes are as follows:

| Setting Value | Operation Mode |
|---------------|----------------------------------|
| 0 | Reserve |
| 1 | Profile Position Mode |
| 2 | Velocity Mode |
| 3 | Reserve |
| 4 | Profile Torque Mode |
| 5 | Reserve |
| 6 | Homing Mode |
| 7 | Interpolated Position Mode |
| 8 | Cyclic Synchronous Position Mode |
| 9 | Reserve |
| 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 |
| Factory Setting | 0 |

This object shows the current operation mode.

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 |