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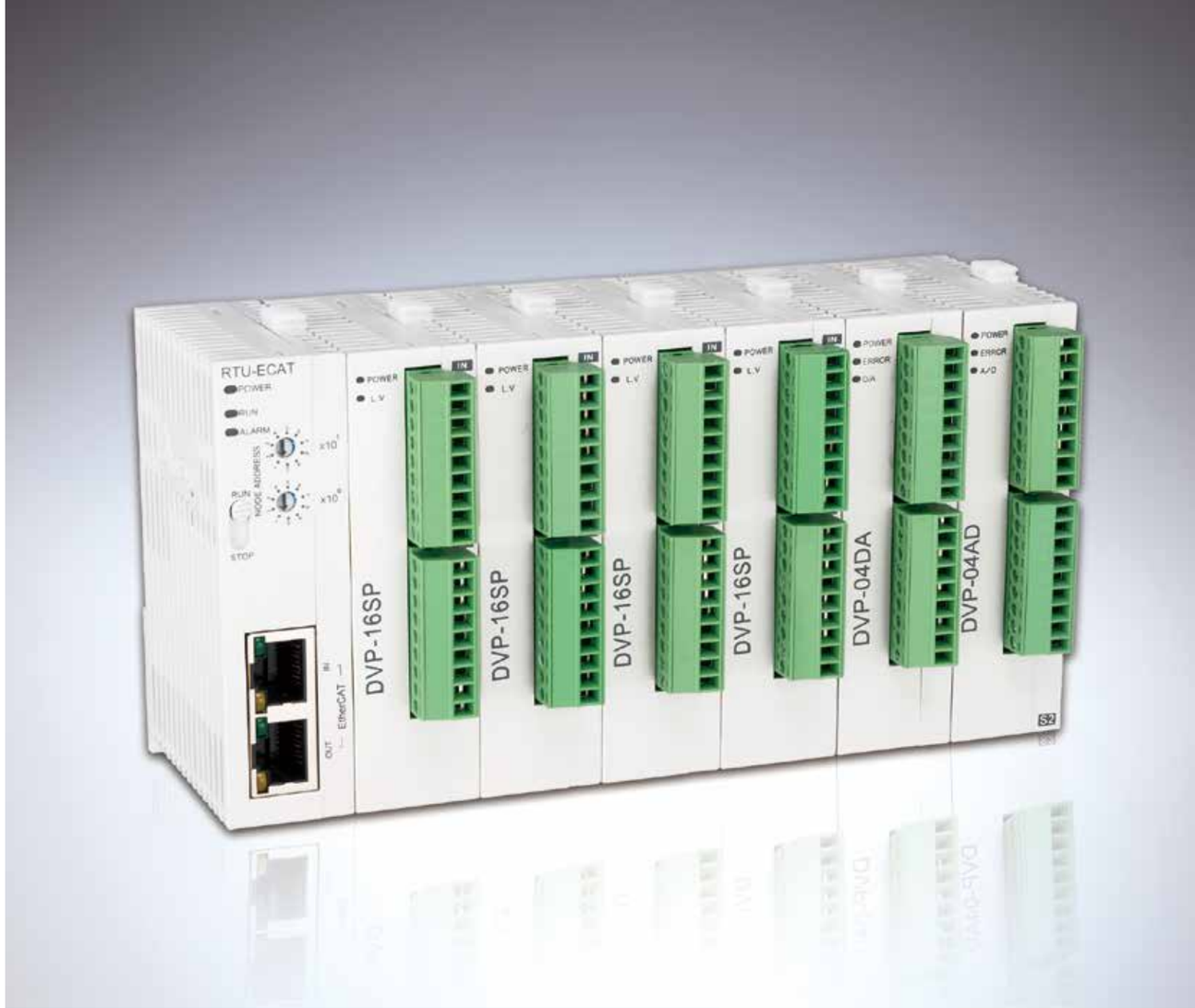


Digitized Automation for a Changing World

# RTU-ECAT
# EtherCAT Remote IO Communication Module Operation Manual

www.deltaww.com

# RTU-ECAT Operation Manual

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# Chapter 1 Preface

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1

| ⚠ Caution |
|---|
| ● This manual provides an introduction to product functions, specifications, installation, basic operations and settings.<br>● This product is an OPEN TYPE device and therefore should be installed in an enclosure free of airborne dust, humidity, electric shock and vibration. The enclosure should prevent non-maintenance staff from operating the device (e.g. key or specific tools are required for operating the enclosure) in case that danger and damage on the device may occur.<br>● Be sure to read the manual carefully and follow the instructions so as to avoid injuries to personnel and damage to products. |

## 1.1 Explanation of Symbols in This Manual

- **Precautions before operation**

Before operation, please read relevant safety instructions carefully so as to prevent an injury to personnel and damage to products.

| | |
|---|---|
| ⚠ Danger | indicates the highly potential hazards. Severe personal injury or even death **will** result if you do not follow the instructions. |
| ⚠ Warning | indicates the potential hazards. Minor personal injury or even death **may** result if you do not follow the instructions. |
| ⚠ Caution | indicates much attention should be paid. A bad accident can occur if you do not follow the instructions. |

## 1.2 Revision History

| Version | Revision | Release Date |
|---|---|---|
| 1st | The first version was published. | April 10, 2020 |
| 2nd | 1. Added Section 6.4 Refresh Refresh Time Parameter for RTU-ECAT's Right Side IO modules.<br>2. Deleted Section 7.2 and Section 7.3. | June 30, 2022 |

2

# Chapter 2 Overview

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1. Thank you for choosing Delta RTU-ECAT. To ensure correct installation and operation of RTU-ECAT, please read this manual carefully before use.
2. This manual only provides introductory information on RTU-ECAT. For more detailed information on EtherCAT protocol, please refer to relevant references or literatures.
3. RTU-ECAT is defined as an EtherCAT slave and DVP-S series DI/DO modules and special modules can be connected on its right side.
4. Refer to **DVP-PLC Application Manual: Special Modules** for more details on how to use DVP-S series special modules.

## 2.1 Characteristics

- Compliant with the EtherCAT protocol, RTU-ECAT supports PDO, SDO and other services in the COE protocol.
- Supports Distributed Clock SYNC and SyncManagers SYNC.
- On its right side, RTU-ECAT connects DVP-S series right-side modules with maximum 128 digital input points and 128 digital output points as well as maximum 8 special modules such as analog modules, temperature modules, pulse modules and etc.
- Maximum 14 DVP-S series digital modules and special modules in total can be connected to the right side of RTU-ECAT.
- Users can select that the output values of right-side special modules and digital output point values of digital modules keep the same as they are before disconnection or change to zero when RTU-EtherCAT is disconnected from the master.

## 2.2 Specifications

■ Electrical specification

| Item | Specification |
|---|---|
| Power voltage | 24 VDC (-15% ~ 20%) |
| Consumption power | 1.8 W |
| Isolation voltage | 500 V |

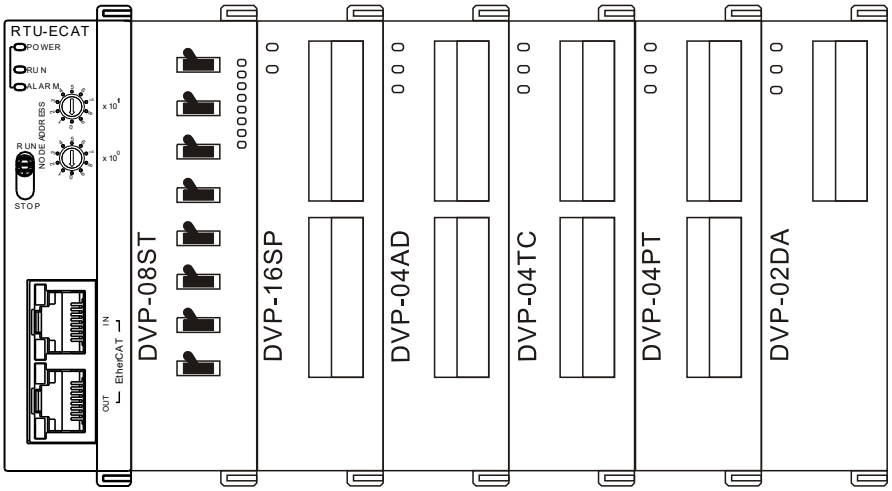
■ EtherCAT specification

| Item | Specification |
|---|---|
| Communication protocol | EtherCAT Protocol |
| Supported service | CoE（PDO, SDO） |
| Physical layer | 100BASE-TX |
| Baud rate | 100Mbps |
| Transmission medium | Cat 5 or above shielded cable |
| Transmission distance | 100m |
| Topology Structure | Linear topology |

■ Environment

| Item | Specification |
|---|---|
| Noise Immunity | ESD（IEC 61131-2, IEC 61000-4-2）: 8KV Air Discharge, 6KV Contact Discharge<br>EFT（IEC 61131-2, IEC 61000-4-4）: Power Line: 2KV, Digital I/O: 1KV<br>Communication I/O: 2KV<br>Damped-Oscillatory Wave: Power Line: 1KV, Digital I/O: 1KV<br>RS（IEC 61131-2, IEC 61000-4-3）: 80MHz ~ 1000MHz, 10V/m; 1400MHz ~ 6000MHz, 3V/m |
| Operation | 0ºC ~ 55ºC (temperature), 50 ~ 95% (humidity), pollution degree 2 |
| Storage | -25ºC ~ 70ºC (temperature), 5 ~ 95% (humidity) |
| Vibration/shock resistance | Standard: IEC 61131-2, IEC 68-2-6 (TEST Fc)/IEC 61131-2 & IEC 68-2-27 (TEST Ea) |
| Safety | Conforms to IEC 61131-2, UL 61010-1, UL 61010-2-201 |
| Barometric pressure-altitude | Operating: 1080~795hPa (-1000~2000m)<br>Storage: 1080~660hPa (-1000~3500m) |
| Weight | 84g |

## 2.3 Extension Modules Connectable to RTU-ECAT




■ Digital modules connectable to RTU-ECAT

| DI/DO module (Model name) | Default I/O mapping data (EtherCAT master → RTU-ECAT) | Default I/O mapping data (RTU-ECAT → EtherCAT master) |
|---|---|---|
| DVP08SM11N | N/A | 8 bits |
| DVP08SM10N | N/A | 8 bits |
| DVP16SM11N | N/A | 16 bits |

| DI/DO module (Model name) | Default I/O mapping data (EtherCAT master → RTU-ECAT) | Default I/O mapping data (RTU-ECAT → EtherCAT master) |
|---|---|---|
| DVP06SN11R | 8 bits | N/A |
| DVP08SN11R/T | 8 bits | N/A |
| DVP08SN11TS | 8 bits | N/A |
| DVP16SN11T | 16 bits | N/A |
| DVP16SN11TS | 16 bits | N/A |
| DVP08SP11R/T | 8 bits | 8 bits |
| DVP08SP11TS | 8 bits | 8 bits |
| DVP16SP11R/T | 8 bits | 8 bits |
| DVP16SP11TS | 8 bits | 8 bits |
| DVP32SM11N | N/A | 32 bits |
| DVP32SN11TN | 32 bits | N/A |
| DVP08ST11N | N/A | 8 bits |

■ Special modules connectable to RTU-ECAT

| Special module (Model name) | Default IO mapping data (EtherCAT master →RTU-ECAT) | | Default IO mapping data (RTU-ECAT → EtherCAT master) | |
|---|---|---|---|---|
| | Start CR | Length (words) | Start CR | Length (words) |
| DVP02DA-S | CR10 | 2 | N/A | N/A |
| DVP04DA-S | CR6 | 4 | N/A | N/A |
| DVP04DA-S2 | CR6 | 4 | N/A | N/A |
| DVP04AD-S | N/A | N/A | CR12 | 4 |
| DVP04AD-S2 | N/A | N/A | CR12 | 4 |
| DVP06AD-S | N/A | N/A | CR12 | 6 |
| DVP04TC-S | N/A | N/A | CR14 | 4 |
| DVP04PT-S | N/A | N/A | CR18 | 4 |
| DVP06PT-S | N/A | N/A | CR18 | 6 |
| DVP06XA-S | CR10 | 2 | CR12 | 4 |
| DVP06XA-S2 | CR10 | 2 | CR12 | 4 |
| DVP01PU-S | CR42 | 4 | CR33 | 4 |
| DVP02TUL-S | CR4 | 2 | CR2 | 2 |
| DVP02TUR-S | CR4 | 2 | CR2 | 2 |
| DVP02TUN-S | CR4 | 2 | CR2 | 2 |

**Note:**

When special modules are connected to RTU-ECAT, the start one of CRs for data upload and download and the length of data to be uploaded and downloaded can be set up via the EtherCAT network configuration tool.

**MEMO**

3

# Chapter 3 Profile and Parts

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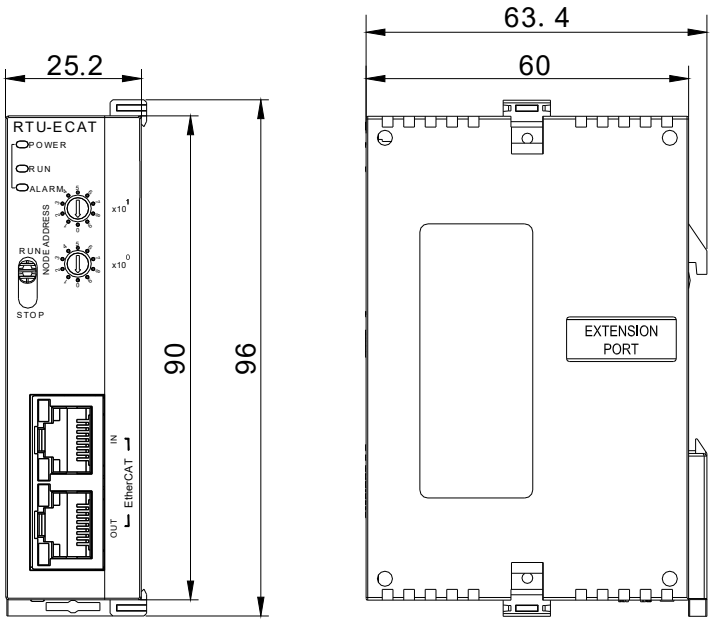
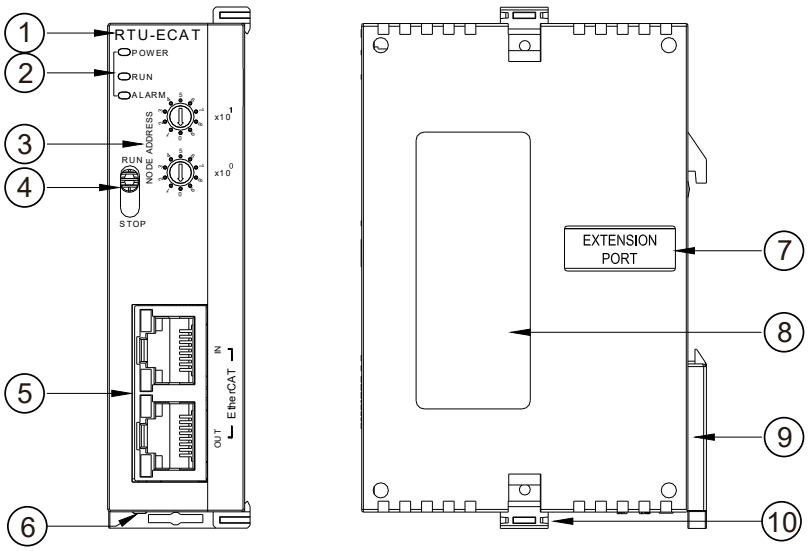
## 3.1 Profile and Dimension




Unit: mm

## 3.2 Parts



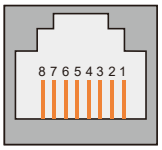

| | |
|---|---|
| 1. Model Name | 6. 24V DC power port |
| 2. State indicators | 7. Right-side extension module port |
| 3. Address switch | 8. Nameplate |
| 4. RUN/STOP switch | 9. DIN rail clip |
| 5. EtherCAT port | 10. Extension module fixing clip |

## 3.3 EtherCAT Port

EtherCAT port is used for the EtherCAT communication.

See the following table for the definitions of pins.

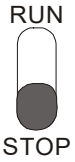
| PIN | Signal | Description |
|---|---|---|
| 1 | Tx+ | Positive pole for transmitting data |
| 2 | Tx- | Negative pole for transmitting data |
| 3 | Rx+ | Positive pole for receiving data |
| 4 | Reserved | Reserved |
| 5 | Reserved | Reserved |
| 6 | Rx- | Negative pole for receiving data |
| 7 | Reserved | Reserved |
| 8 | Reserved | Reserved |




EtherCAT

## 3.4 RUN/STOP Switch

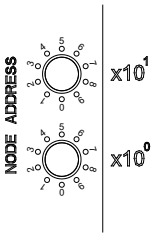
| RUN/STOP switch | Description |
|---|---|
| STOP → RUN | 1. To re-detect the number of extension modules and digital points.<br>2. To read/write the data in the extension module. |
| RUN → STOP | To stop reading/writing the data in the extension module. |




## 3.5 Address Switches

The switches are used for setting up the node address of RTU-ECAT on EtherCAT network.

| Switch setting | Description |
|---|---|
| 0 ~ 99 | EtherCAT node address |




Example:

If you need to set the node address of RTU-ECAT to 26, simply switch the corresponding switch of $x10^1$ to 2 and the corresponding switch of $x10^0$ to 6.

**Notes:**

- ✓ Please set up the node address when the power is switched off. After the setup is completed, re-power RTU-ECAT.
- ✓ When RTU-ECAT is operating, changing the setting of the node address will be invalid.
- ✓ Use the slotted screwdriver to rotate the switch carefully in case the switch is scratched.

## 3.6 Extended IO Interface

The interface is used for connecting Delta DVP-S series DI/DO extension modules and special modules.

# 4

## Chapter 4 Installing and Wiring

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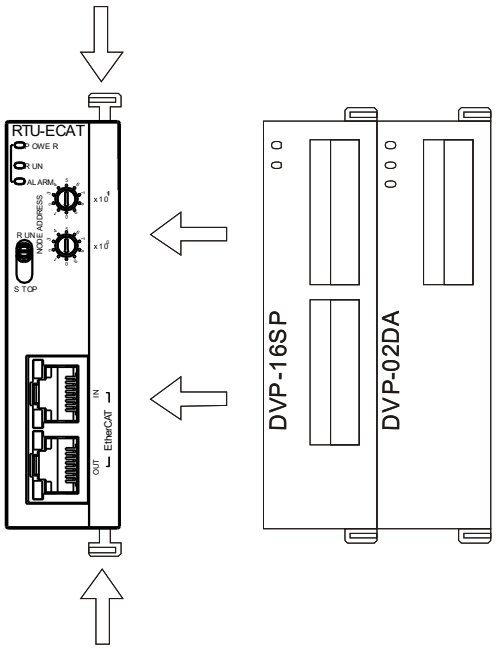
4.5.1 Ground ..... 4-5

## 4.1 Installing RTU-ECAT and DVP-S Extension Modules

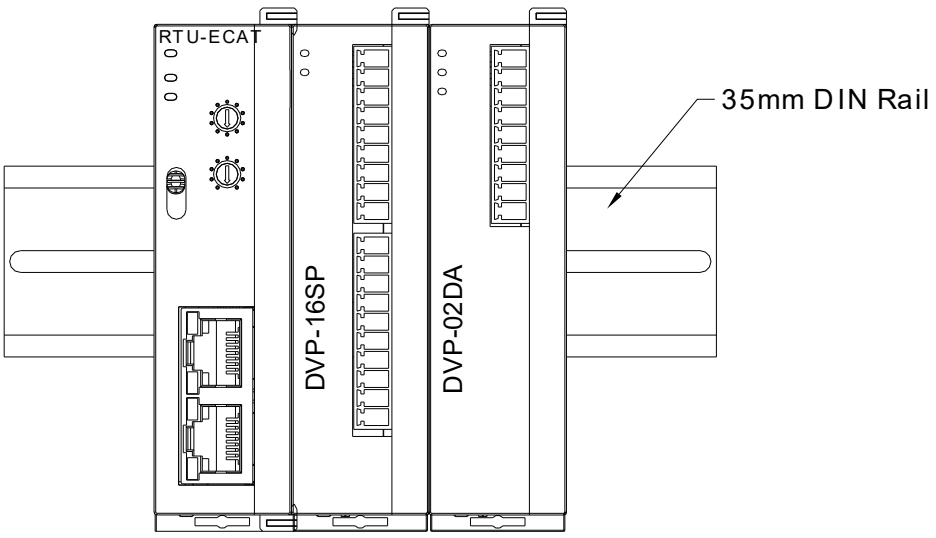
- Open the fixing clips on the top and bottom of RTU-ECAT, aim the extension module at the guiding holes and keep them met.
- Press the fixing clips on the top and bottom of RTU-ECAT to fix extension modules and ensure that the connection is fine.





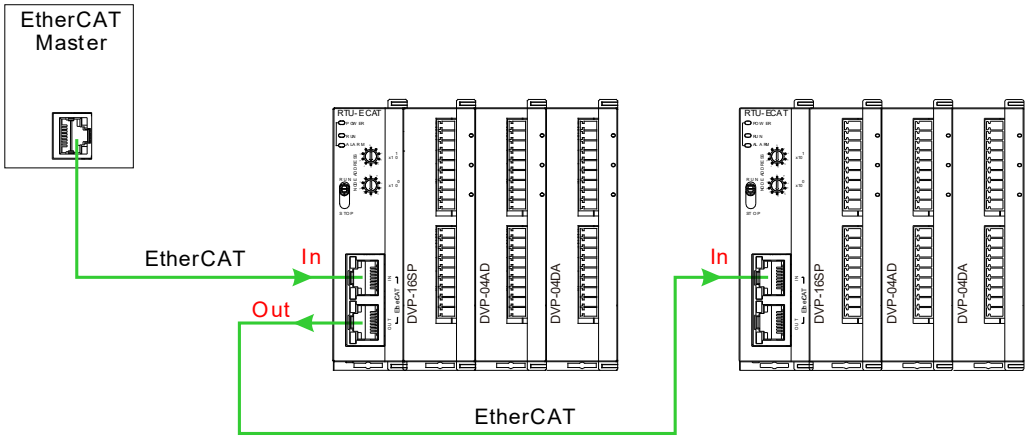

## 4.2 Installing RTU-ECAT and DVP-S Modules on DIN Rail

- Use the 35mm standard DIN rail.
- Open the DIN rail clips of RTU-ECAT and extension modules. Insert RTU-ECAT and extension modules into the DIN rail.
- Press the DIN rail clips of RTU-ECAT and extension modules to fix them on the DIN rail, as shown below.



## 4.3 Connecting to EtherCAT Port

- There is a strict network topology requirement for the EtherCAT network. The network must follow the rule that the input port of the next RTU-ECAT should be connected to the output port of the previous RTU-ECAT .
- Please use Delta cables as EtherCAT cables. For specifications of Delta cables, refer to Appendix 1.




## 4.4 Wiring

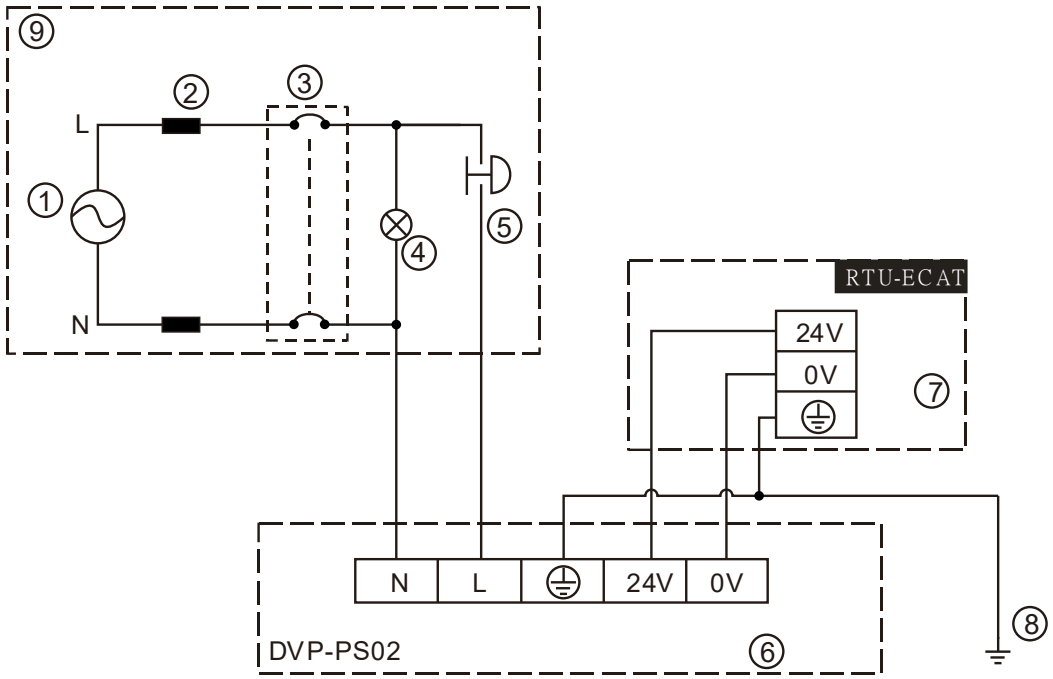
## 4.5 Power Input

The power input of RTU-ECAT is 24V DC. Please notice the following points during use.

**⚠ Warning**

- Connect the supply power to the two terminals, 24V and 0V and the grounding terminal to the earth. Be cautious that the RTU-ECAT device may be damaged if the positive and negative polarities of the supply power are connected reversely.
- Please be sure to use certified power supply with SELV output or certified power supply providing double insulation evaluated by UL60950, or UL61010-1 and UL61010-2-201 standards
- The diameter of the power wire must be between 12 and 28AWG and the rated temperature should be greater than 70°C. The power terminal block plug wiring torque is 4.5 in-lbs.
- The cables of the AC power 110V, 220V and DC power 24V must be twisted and connected to the module as short as possible in length.
- Do not combine the AC 110V, 220V, and DC 24V cables with the main circuit and I/O signal cables together and please keep them away from each other. If the space permits, it's recommended to separate these lines by more than 100mm.

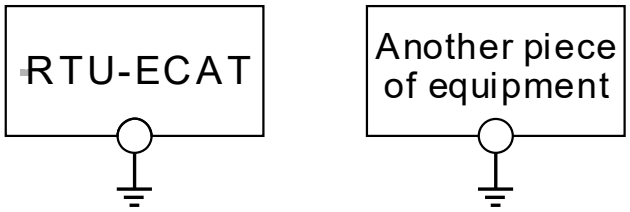
**RTU-ECAT Safety Circuit Wiring**




| | |
|---|---|
| ① | AC power supply: 100 ~ 240VAC; 50/60Hz. |
| ② | Power supply circuit protection fuse |
| ③ | System circuit isolation device: The electromagnetic contactor, relay and other switch can be used as the isolation device to prevent the system from becoming unstable when the power supply is discontinuous. |
| ④ | Power indicator |
| ⑤ | Emergency stop button: The button cuts off the system power supply when an accidental situation takes place. |
| ⑥ | Delta power module DVP-PS02/24VDC |
| ⑦ | RTU-ECAT device |
| ⑧ | Ground |
| ⑨ | Safety circuit |

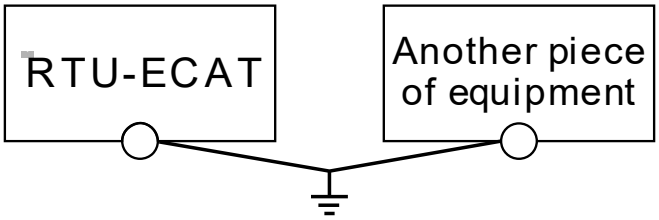
### 4.5.1 Ground

- The diameter of the ground should not be less than the diameters of the cables connected to the terminals L and N.
- If using multiple pieces of equipment, use a single-point ground.



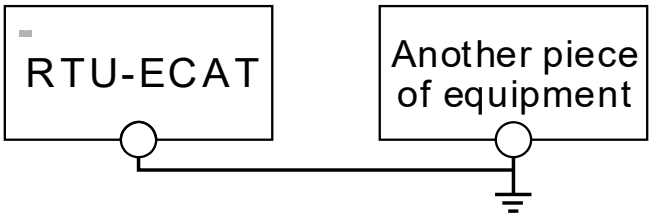

The single-point ground is better.

- If you cannot use a single-point ground, use a common-point ground.




The common-point ground is permitted.

- Do not connect equipment ground wires together as shown below.




The equipment can not be grounded in this way.

**MEMO**

5

# Chapter 5 Configuring RTU-ECAT

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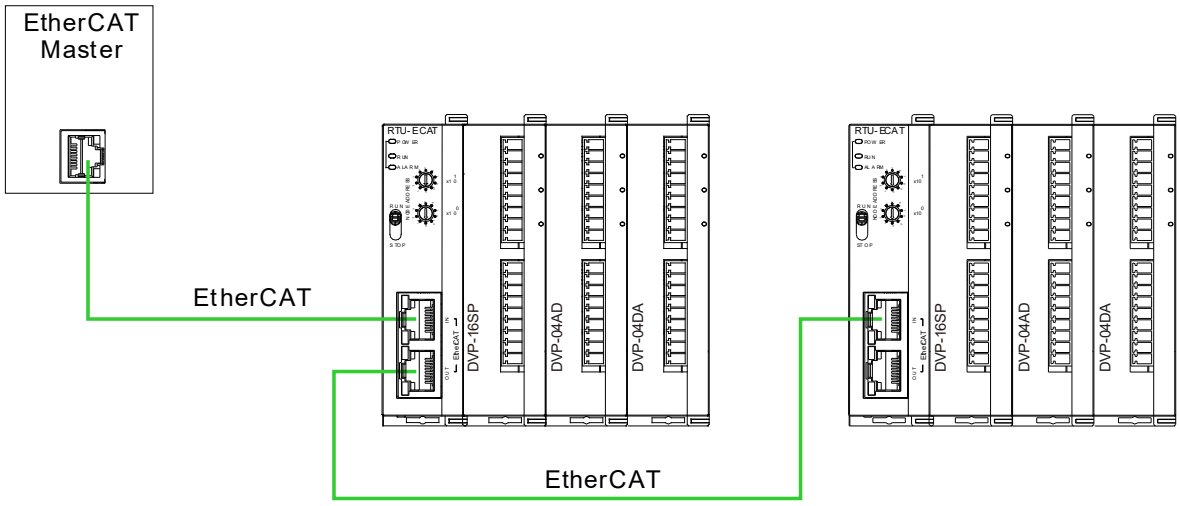
5.2.4 Data Exchange Configuration Interface of Special Modules .....5-7

This section describes how RTU-ECAT as an EtherCAT slave realizes the data exchange between EtherCAT master and DVP-S series extension modules.

- EtherCAT master transmits the data to extension modules.
- The input data from extension modules are transmitted back to EtherCAT master.




5

## 5.1 Terms

| No. | Name | Unit | Explanation |
|---|---|---|---|
| 1 | Control word | Word | Sets the mode of RTU-ECAT. When the content of the control word is 8000Hex, RTU-ECAT is in STOP state. When the content of the control word is 8001Hex, RTU-ECAT is in RUN state.<br>See section 6.3 for more details on the control word. |
| 2 | Status | Word | Status includes Error register (for error information), LV state (for voltage status), Error module number (for right-side module number) and Error list (for extension module errors)<br>See section 6.3 for more details. |
| 3 | Digital input points | Bit | The number of digital input points is a multiple of 8. The number is regarded as 8 when it is less than 8 and as 16 when it is greater than 8 but less than 16. |
| 4 | Digital output points | Bit | The number of digital output points is a multiple of 8. The number is regarded as 8 when it is less than 8 and as 16 when it is greater than 8 but less than 16. |
| 5 | Special module number | Unit | Number of special modules connected to RTU-ECAT<br>Range: 0~8 |
| 6 | Input data length | Word | The total length of input data of special modules on the right of RTU-ECAT |
| 7 | Output data length | Word | The total length of output data of special modules on the right of RTU-ECAT |

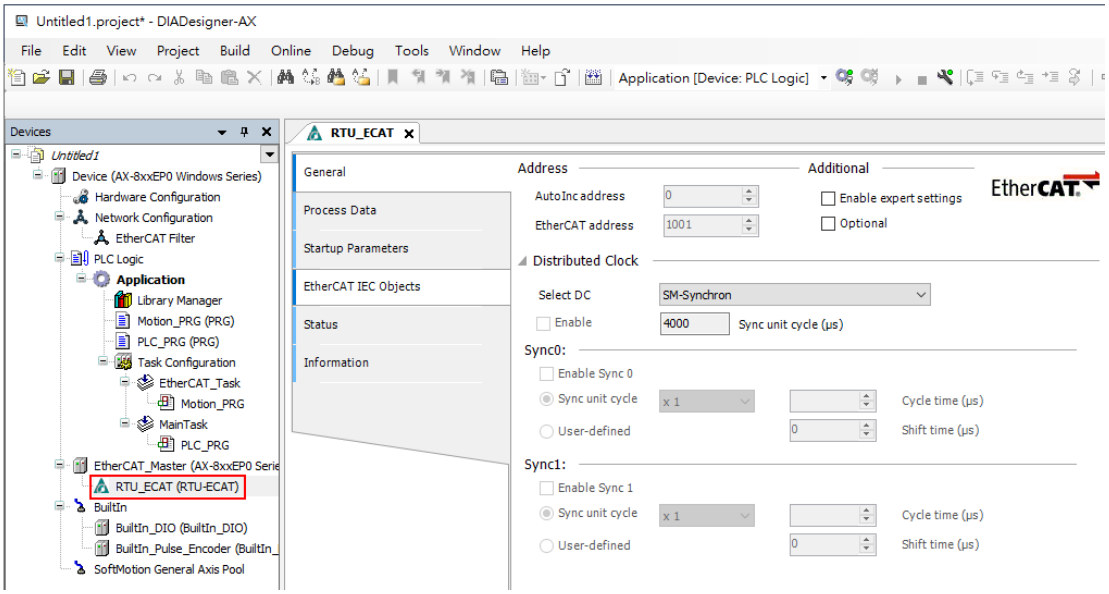
| No. | Name | Unit | Explanation |
|---|---|---|---|
| 8 | IO mapping | N/A | The IO mapping between RTU-ECAT and the special modules connected to it. |

## 5.2 Introduction to the Software Interfaces

This section introduces the configuration of RTU-ECAT by taking the DIADesigner-AX software as an example.

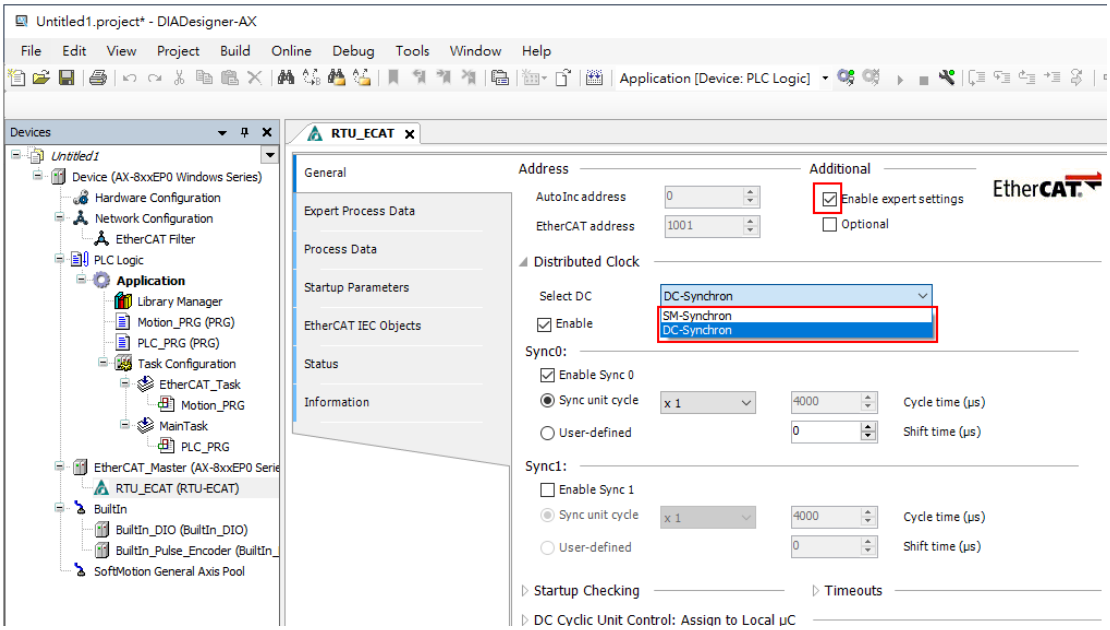
### 5.2.1 Main Interface for RTU Configuration

Double click the RTU-ECAT symbol on the left-side area of the DIADesigner-AX window as below. The main RTU configuration interface appears then.



### 5.2.2 DC Interface

On the RTU configuration interface, tick the checkbox of **Enable expert settings** and then select one option in the field of **Select DC** under **Distributed Clock**.

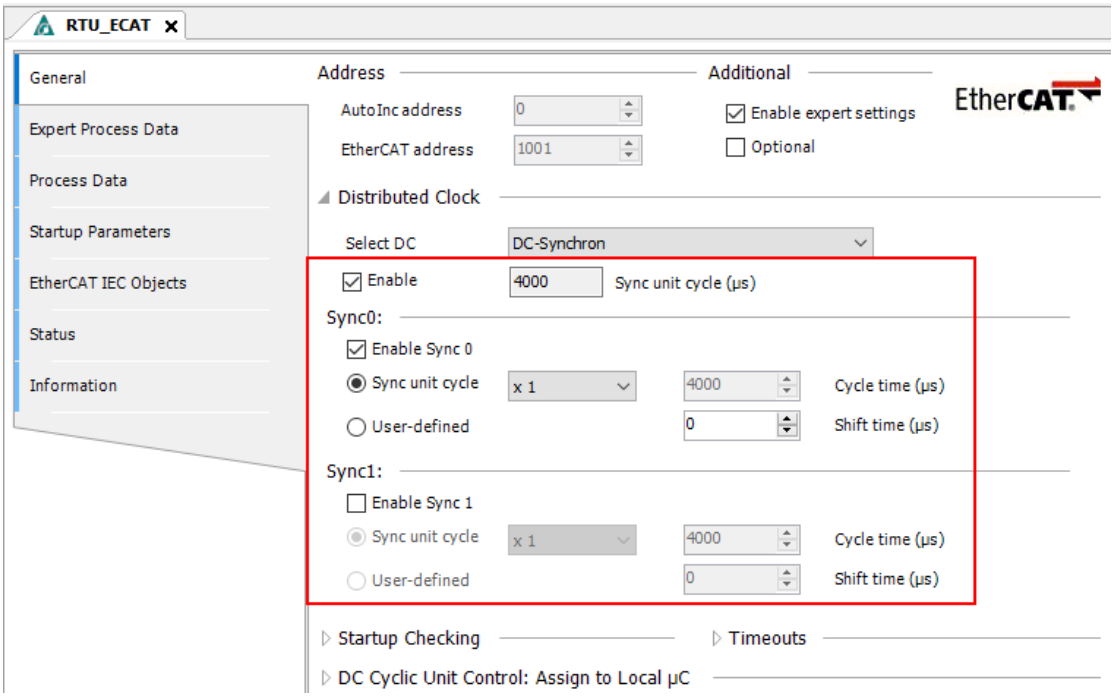



**Distributed Clock (Operation Mode):**

RTU-ECAT supports two operation modes: SM-Synchron and DC-Synchron. Either of the two operation modes can be chosen from the pull-down box.

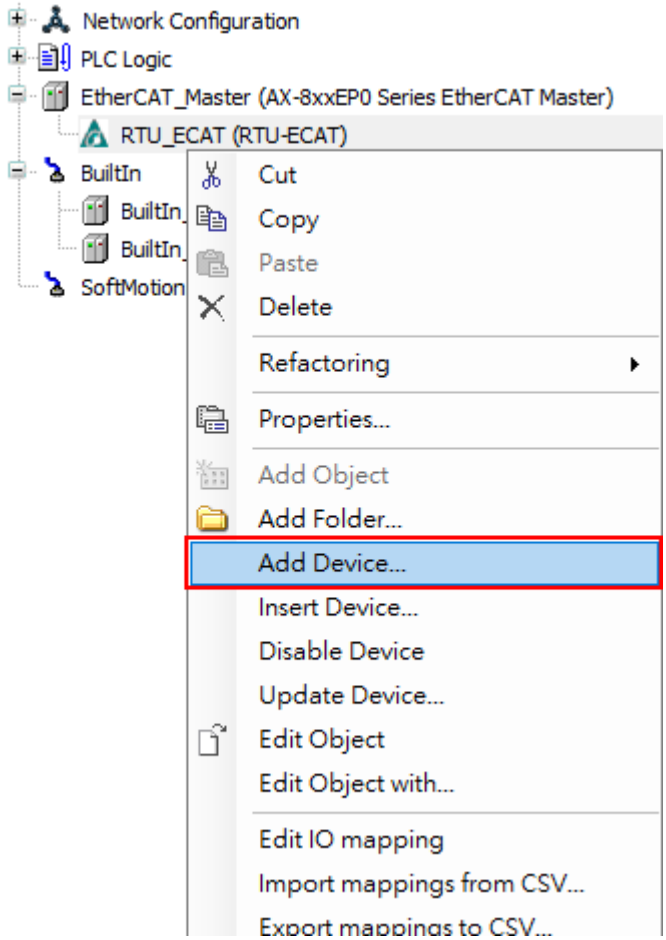
**Advanced Settings:**

When choosing DC-Synchron as the operation mode, configure related parameters on the following “Advanced Settings” interface.

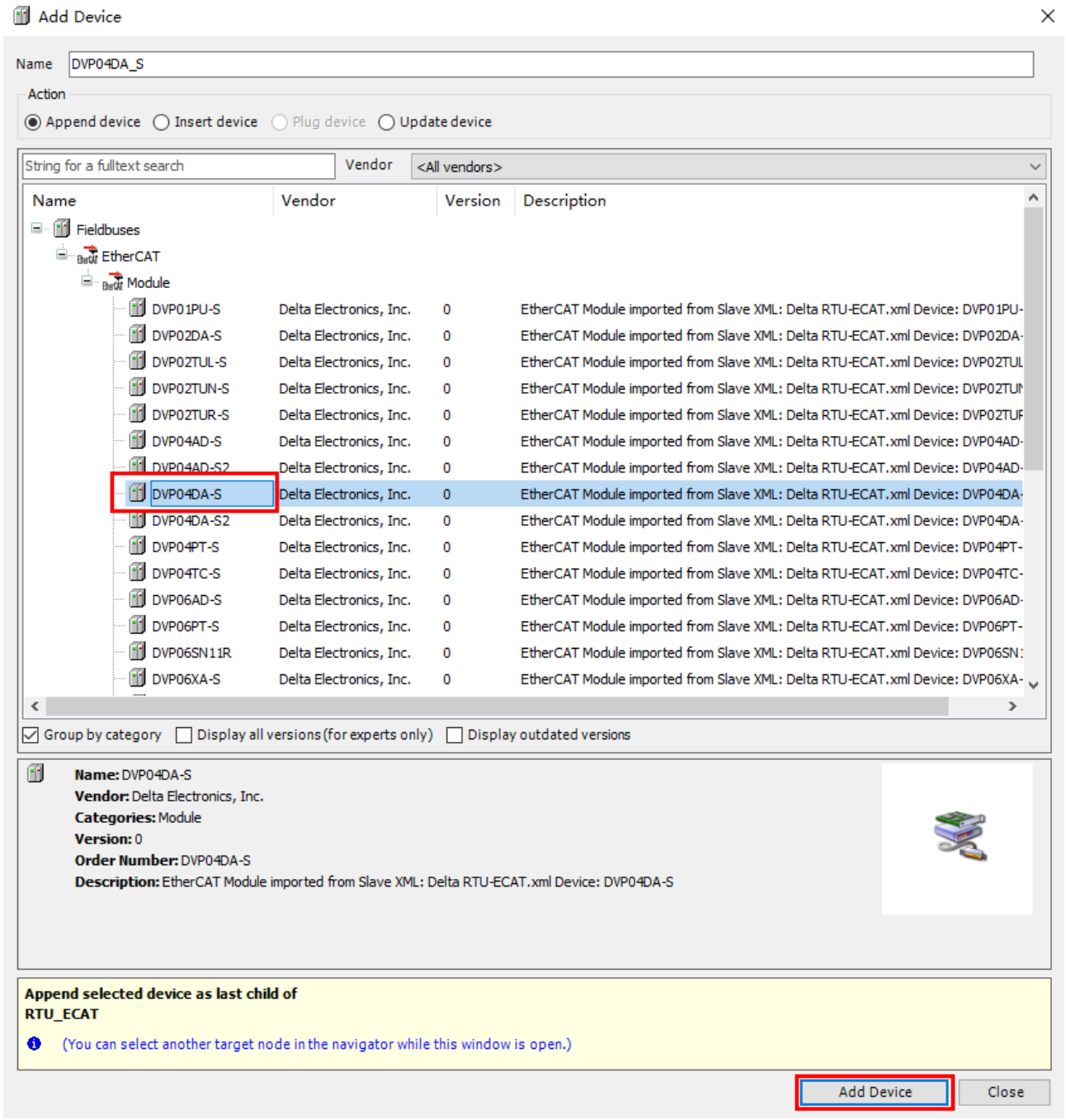


### 5.2.3 Right-side Configuration of RTU-ECAT

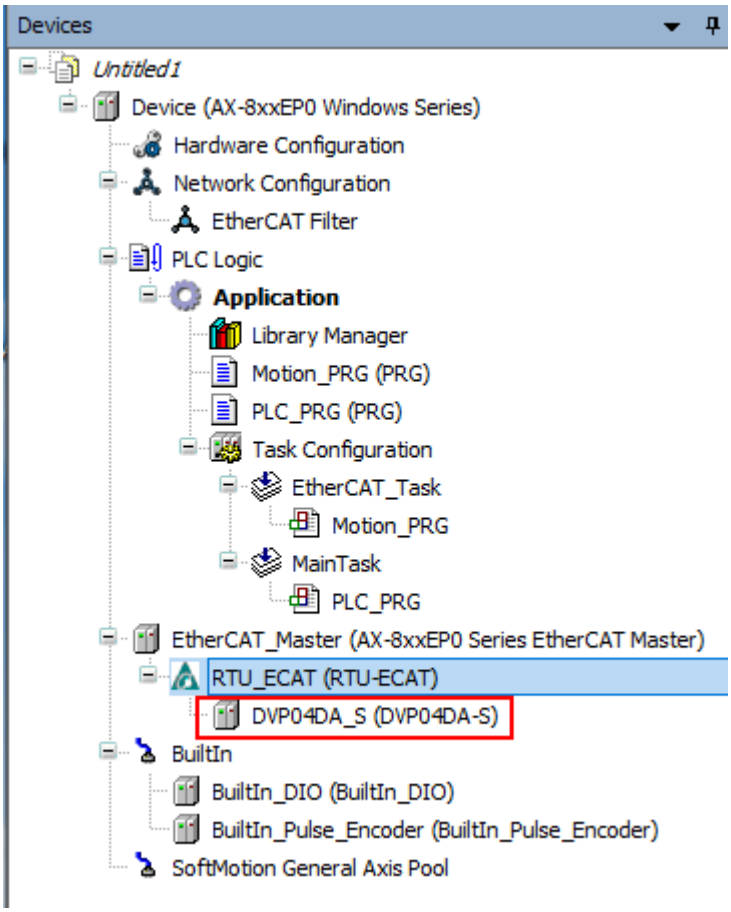
On the left-side area, right-click the RTU-ECAT symbol and then select the "**Add Device …**" option from the dropdown menu that pops up.




The **Add Device** dialog box pops up, where you configure the modules according to the actually connected modules on the right side of RTU-ECAT by selecting the desired module name, and then clicking the **Add Device** button or performing a double-click on the module name.



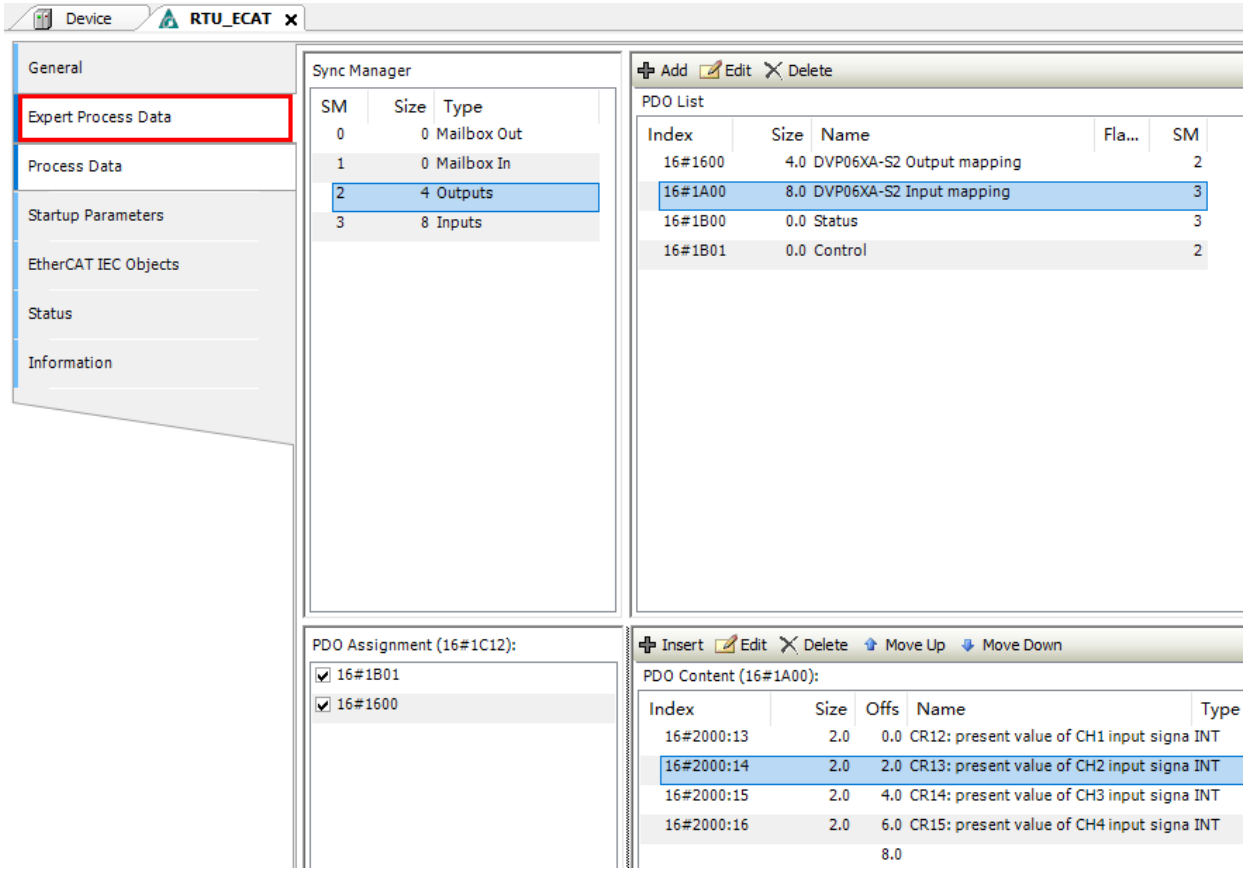

Then you can see that the module is successfully added to RTU-ECAT as shown in the following figure.




Be noted that the extension modules must be added in order from the first one.

### 5.2.4 Data Exchange Configuration Interface of Special Modules

On the main RTU configuration interface, click on **"Expert Process Data"** tab. The data exchange configuration interface of modules appears then. Take the special module DVP06XA-S2 for example here.


Device
RTU_ECAT
General
Expert Process Data
Process Data
Startup Parameters
EtherCAT IEC Objects
Status
Information
Sync Manager
SM Size Type
0 0 Mailbox Out
1 0 Mailbox In
2 4 Outputs
3 8 Inputs
Add Edit Delete
PDO List
Index Size Name Fla... SM
16#1600 4.0 DVP06XA-S2 Output mapping 2
16#1A00 8.0 DVP06XA-S2 Input mapping 3
16#1B00 0.0 Status 3
16#1B01 0.0 Control 2
PDO Assignment (16#1C12):
16#1B01
16#1600
Insert Edit Delete Move Up Move Down
PDO Content (16#1A00):
Index Size Offs Name Type
16#2000:13 2.0 0.0 CR12: present value of CH1 input signa INT
16#2000:14 2.0 2.0 CR13: present value of CH2 input signa INT
16#2000:15 2.0 4.0 CR14: present value of CH3 input signa INT
16#2000:16 2.0 6.0 CR15: present value of CH4 input signa INT
8.0

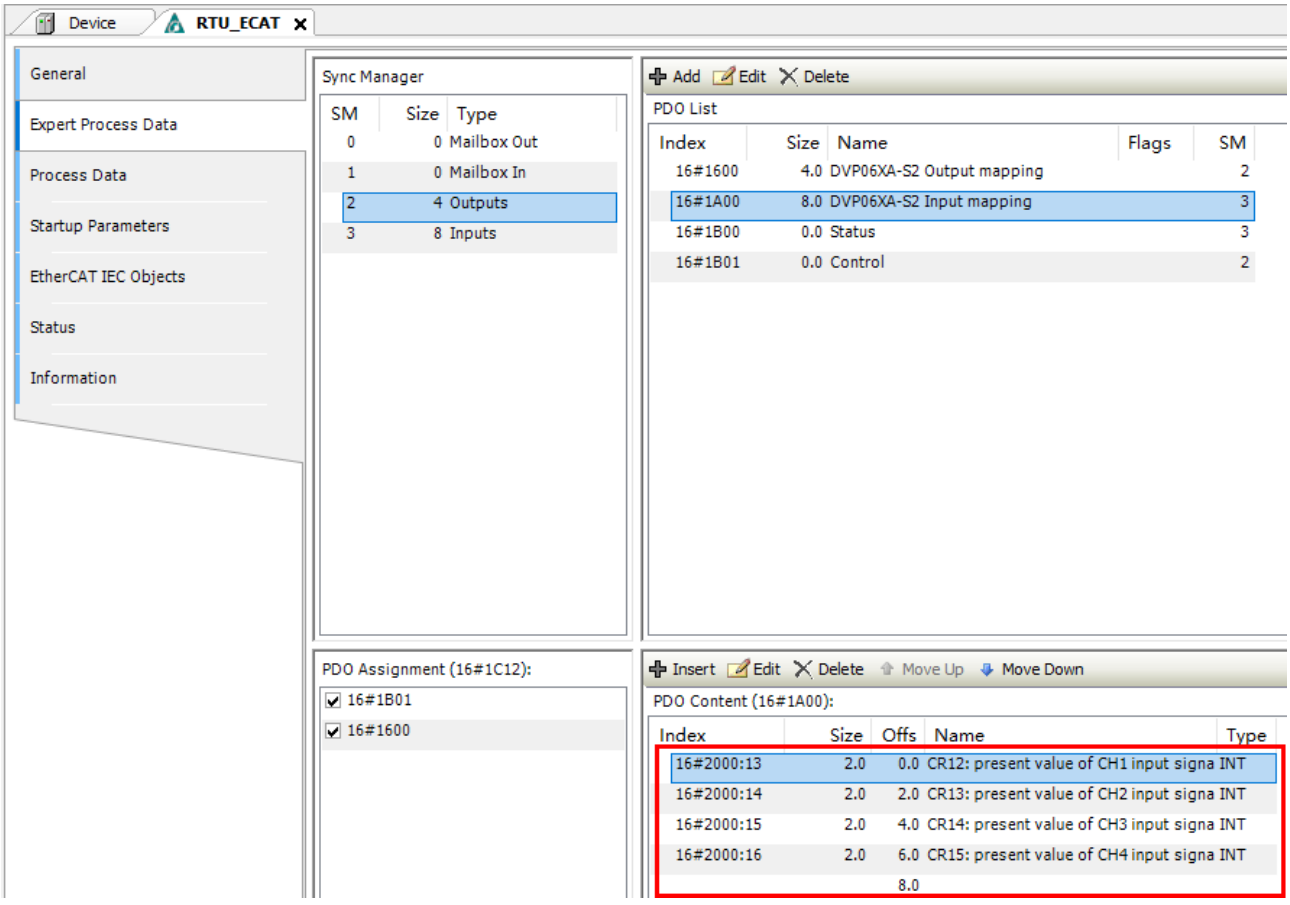
Explanation of PDO List on the configuration interface of special modules

| Item | Description |
|---|---|
| Status | The parameters related to RTU-ECAT state and the CRs with the property of Read in the special modules which have been configured can be added or deleted |
| Control | The control word in RTU-ECAT and the CRs with the property of Write in the special modules which have been configured can be added or deleted. |
| DVP06XA-S2 Input mapping | The CRs with the property of Read in DVP06XA-S2 can be added or deleted. |
| DVP06XA-S2 Output mapping | The CRs with the property of Write in DVP06XA-S2 can be added or deleted. |

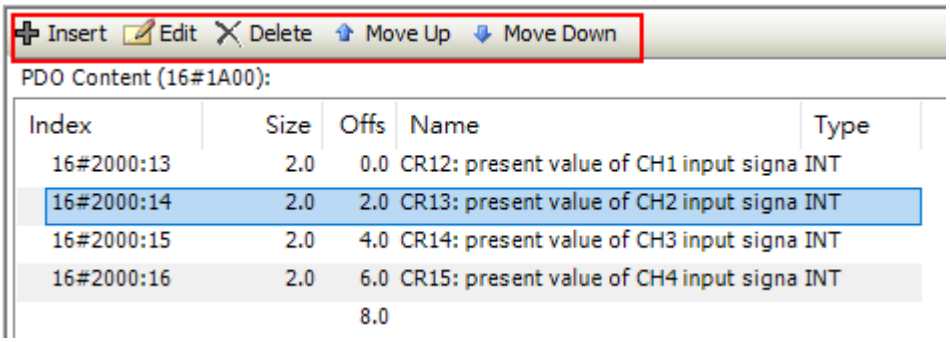
**How to configure the input/output mappings of a special module**

Here is an example of the input mapping configuration.

Select the row where “DVP06XA-S2 Input mapping” is in the “PDO List” field and then configure input mapping parameters in the “PDO Content” field.



Select one of the rows in the red box above to perform the action: Insert , Edit, Delete, Move Up or Move Down.




Explanation of the pull-down menu

| Item | Description |
|---|---|
| Insert | Add or insert a CR with the property of Read in the module.<br>Selecting “Insert” in the place of an existing CR means to insert a CR row here.<br>Selecting “Insert” in the empty place means to add a CR row in the end. |
| Edit | Edit current parameter information such as Name, Index, Sub Index, Data Type and etc. |
| Delete | Delete one CR which has already been added |
| Move Up | Move to the previous row |
| Move Down | Move to the next row |

6

# Chapter 6 Introduction of Parameters

## Table of Contents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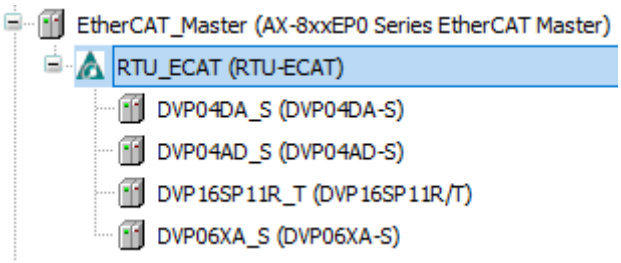
## 6.1 Parameters for Right-side Special Modules

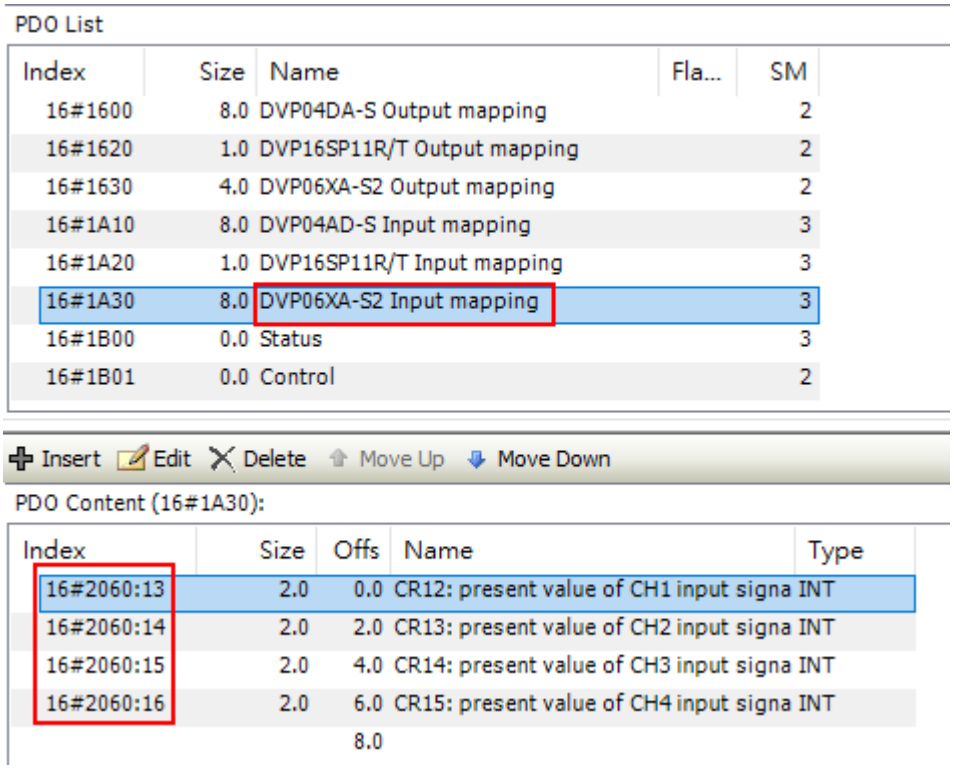
The index of the special module on the right of RTU-ECAT ranges from 16#2000 to 16#21A0 and the index value is determined by the position of the special module on the right of RTU-ECAT. For example, when the special module is the first one on the right of RTU-ECAT, its index is 16#2000. When the special module is the second one on the right of RTU-ECAT, its index is 16#2020. Similarly, when the special module is the 14$^{th}$ one on the right of RTU-ECAT, its index is 16#21A0.

As shown below, DVP04DA-S, DVP04AD-S, DVP16SP11T and DVP06XA-S are connected on the right of RTU-ECAT in order and then the index for DVP04DA-S is 16#2000, for DVP04AD-S is 16#2020 and for DVP06XA-S is 16#2060.




Each subindex of a special module corresponds to one CR parameter of the special module. When the special module is located as the first one on the right of RTU-ECAT, the index 16#2000 and subindex 16#1 correspond to CR0 of the special module. When the special module is the second one on the right of RTU-ECAT, the index 16#2020 and subindex 16#7 correspond to CR6 of the special module.

For example, DVP04DA-S, DVP04AD-S, DVP16SP11T and DVP06XA-S are connected on the right of RTU-ECAT in order and the indexes and subindexes for DVP06XA-S parameters are shown below.


PDO List
Index Size Name Fla... SM
16#1600 8.0 DVP04DA-S Output mapping 2
16#1620 1.0 DVP16SP11R/T Output mapping 2
16#1630 4.0 DVP06XA-S2 Output mapping 2
16#1A10 8.0 DVP04AD-S Input mapping 3
16#1A20 1.0 DVP16SP11R/T Input mapping 3
16#1A30 8.0 DVP06XA-S2 Input mapping 3
16#1B00 0.0 Status 3
16#1B01 0.0 Control 2
Insert Edit Delete Move Up Move Down
PDO Content (16#1A30):
Index Size Offs Name Type
16#2060:13 2.0 0.0 CR12: present value of CH1 input signa INT
16#2060:14 2.0 2.0 CR13: present value of CH2 input signa INT
16#2060:15 2.0 4.0 CR14: present value of CH3 input signa INT
16#2060:16 2.0 6.0 CR15: present value of CH4 input signa INT
8.0

Explanation of paramters for special modules on the right of RTU-ECAT

| Index | Subindex | Description |
|---|---|---|
| 16#2000 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 1st one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 1st one on the right of RTU-ECAT. |
| | … | … |
| 16#2020 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 2nd one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 2nd one on the right of RTU-ECAT. |
| | … | … |
| 16#2040 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 3rd one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 3rd one on the right of RTU-ECAT. |
| | … | … |
| 16#2060 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 4th one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 4th one on the right of RTU-ECAT. |
| | … | … |
| 16#2080 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 5th one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 5th one on the right of RTU-ECAT. |
| | … | … |
| 16#20A0 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 6th one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 6th one on the right of RTU-ECAT. |
| | … | … |
| 16#20C0 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 7th one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 7th one on the right of RTU-ECAT. |
| | … | … |
| 16#20E0 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 8th one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 8th one on the right of |

| Index | Subindex | Description |
|---|---|---|
| | | RTU-ECAT. |
| | … | … |
| 16#2100 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 9th one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 9th one on the right of RTU-ECAT. |
| | … | … |
| 16#2120 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 10th one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 10th one on the right of RTU-ECAT. |
| | … | … |
| 16#2140 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 11th one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 11th one on the right of RTU-ECAT. |
| | … | … |
| 16#2160 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 12th one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 12th one on the right of RTU-ECAT. |
| | … | … |
| 16#2180 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 13th one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 13th one on the right of RTU-ECAT. |
| | … | … |
| 16#21A0 | 16#1 | The index and subindex that CR0 parameter corresponds to when the special module is located as the 14th one on the right of RTU-ECAT. |
| | 16#2 | The index and subindex that CR1 parameter corresponds to when the special module is located as the 14th one on the right of RTU-ECAT. |
| | … | … |

## 6.2 Parameters for Connection Status of Right-Side Modules

The index 16#8200 shows the actual connection state of the modules on the right of RTU-ECAT

| | | | |
|---|---|---|---|
| 16#8200:16#00 | Detected information | | |
| :16#01 | Digital in | RO | UINT |
| :16#02 | Digital out | RO | UINT |
| :16#03 | Anolog module number | RO | UINT |
| :16#04 | Anolog module ID1 | RO | UINT |
| :16#05 | Anolog module ID2 | RO | UINT |
| :16#06 | Anolog module ID3 | RO | UINT |
| :16#07 | Anolog module ID4 | RO | UINT |
| :16#08 | Anolog module ID5 | RO | UINT |
| :16#09 | Anolog module ID6 | RO | UINT |
| :16#0A | Anolog module ID7 | RO | UINT |
| :16#0B | Anolog module ID8 | RO | UINT |

Explanation of parameters

| Index | Subindex | Description | Data type | Access type |
|---|---|---|---|---|
| 16#8200 | 16#1 | The number of digital input points | Word | RO |
| | 16#2 | The number of digital output points | Word | RO |
| | 16#3 | The number of special modules | Word | RO |
| | 16#4 | The model code of the 1st special module | Word | RO |
| | 16#5 | The model code of the 2nd special module | Word | RO |
| | 16#6 | The model code of the 3rd special module | Word | RO |
| | 16#7 | The model code of the 4th special module | Word | RO |
| | 16#8 | The model code of the 5th special module | Word | RO |
| | 16#9 | The model code of the 6th special module | Word | RO |
| | 16#A | The model code of the 7th special module | Word | RO |
| | 16#B | The model code of the 8th special module | Word | RO |

## 6.3 Control Word and Status Indication Parameters

### 6.3.1 Control Word Parameter

Explanation of control word parameter

| Index | Subindex | Description | Data type | Access type |
|---|---|---|---|---|
| 16#A001 | 16#1 | Control Word | WORD | RW |

Explanation of control word parameter bits

| Bit | Value | Description |
|---|---|---|
| Bit 0 | 0 | RTU-ECAT is set to STOP as bit 15 of the control word parameter is 1 and bit 0 is 0. |
| | 1 | RTU-ECAT is set to RUN as bit 15 of the control word parameter is 1 and bit 0 is 1. |
| Bit 1 | 0 | The output values of right-side special modules and digital output point values of digital modules keep the same as they are before disconnection when RTU-EtherCAT is disconnected from the master. |
| | 1 | The output values of right-side special modules change to zero and digital output points of digital modules change to OFF when RTU-EtherCAT is disconnected from the master. |
| Bit 2 | 0/1 | Reserved |
| Bit 3 | 0/1 | Reserved |
| Bit 4 | 0/1 | Reserved |
| Bit 5 | 0/1 | Reserved |
| Bit 6 | 0/1 | Reserved |
| Bit 7 | 0/1 | Reserved |
| Bit 8 | 0/1 | Reserved |
| Bit 9 | 0/1 | Reserved |
| Bit 10 | 0/1 | Reserved |
| Bit 11 | 0/1 | Reserved |
| Bit 12 | 0/1 | Reserved |
| Bit 13 | 0/1 | Reserved |
| Bit 14 | 0/1 | Reserved |
| Bit 15 | 0 | Control word is disabled. When the bit value is 0, RTU-ECAT can not be controlled to enter RUN or STOP state via bit0 in the control word. |

| Bit | Value | Description |
|---|---|---|
| | 1 | Control word is enabled. When the bit value is 1, RTU-ECAT can be controlled to enter RUN or STOP state via bit0 in the control word. |

### 6.3.2 Status Indication

List of RTU-ECAT status indication parameters

| Index | Subindex | Description | Data type | Access type |
|---|---|---|---|---|
| 16#1001 | 16#0 | Error register which contains RTU-ECAT error information | WORD | RO |
| 16#A000 | 16#1 | LV state which is voltage status | BYTE | RO |
| | 16#2 | Error module number which is the number of the module in error on the right side | BYTE | RO |
| | 16#3 | Error list which shows errors of extension modules | ARRAY [1..8] OF BYTE | RO |

Explanation of RTU-ECAT status indication parameters

■ Error register（RTU-ECAT error）

| Status value | Description | How to correct |
|---|---|---|
| 0x1000（4096） | The special modules on the right of RTU-ECAT are inconsistent with the configuration in the software. | 1. Ensure that the special modules configured in the software match the modules actually connected.<br>2. Ensure that the connection between the right-side special modules and RTU-ECAT is normal. |
| 0x1001（4097） | The special modules and digital modules on the right of RTU-ECAT are inconsistent with the configuration data. | 1. Ensure that the special module number and input and output point numbers of digital modules configured in the software match the modules actually connected.<br>2. Ensure that the connection between the right-side modules and RTU-ECAT is normal. |

| Status value | Description | How to correct |
|---|---|---|
| 0x1002 (4098) | An error occurs in the special modules on the right of RTU-ECAT | 1. Ensure that the power supply to the right-side special modules is normal.<br>2. Check the error information of the special modules on the right of RTU-ECAT.<br>Configure the error status CR registers for the right-side special modules to the input data of IO data and then get to know the cause based on the values in the error status CRs.<br>Refer to error status CRs in DVP-PLC Application Manual: Special Modules for more details on error codes of special modules. |
| 0x1004 (4100) | The modules configured in the software are inconsistent with those actually connected and meanwhile an error in extension modules on the right of RTU-ECAT occurs. | 1. Ensure the modules configured in the software match those actually connected.<br>2. Ensure the power supply to the right-side modules works normally.<br>3. Check the error information of the right-side modules and then get rid of it according to the instructions in the module manual. |
| 0x1005 (4101) | The special modules configured on the right of RTU-ECAT exceeds 8 units. | Ensure that the number of special modules configured in the software is no more than 8 units. |

■ LV state (voltage status)

| Bit | Value | Description | How to correct |
|---|---|---|---|
| Bit 0 | 0 | The voltage for RTU-ECAT is normal. | -- |
| | 1 | The voltage for RTU-ECAT is abnormal. | Check if the voltage of the power supply to RTU-ECAT is normal. |
| Bit 1~bit 7 | 0/1 | Reserved | Reserved |

■ Error module number (The number of the right-side module in error)

| Bit | Value | Description | How to correct |
|---|---|---|---|
| Bit 0 | 0 | The 1st special module on the right of RTU-ECAT is normal. | -- |

| Bit | Value | Description | How to correct |
|---|---|---|---|
| | 1 | The 1st special module on the right of RTU-ECAT is alarming. | Refer to “Error list (Extension module error information)” below. |
| Bit 1 | 0 | The 2nd special module on the right of RTU-ECAT is normal. | -- |
| | 1 | The 2nd special module on the right of RTU-ECAT is alarming. | Refer to “Error list (Extension module error information)” below. |
| Bit 2 | 0 | The 3rd special module on the right of RTU-ECAT is normal. | -- |
| | 1 | The 3rd special module on the right of RTU-ECAT is alarming. | Refer to “Error list (Extension module error information)” below. |
| Bit 3 | 0 | The 4th special module on the right of RTU-ECAT is normal. | -- |
| | 1 | The 4th special module on the right of RTU-ECAT is alarming. | Refer to “Error list (Extension module error information)” below. |
| Bit 4 | 0 | The 5th special module on the right of RTU-ECAT is normal. | -- |
| | 1 | The 5th special module on the right of RTU-ECAT is alarming. | Refer to “Error list (Extension module error information)” below. |
| Bit 5 | 0 | The 6th special module on the right of RTU-ECAT is normal. | -- |
| | 1 | The 6th special module on the right of RTU-ECAT is alarming. | Refer to “Error list (Extension module error information)” below. |
| Bit 6 | 0 | The 7th special module on the right of RTU-ECAT is normal. | -- |
| | 1 | The 7th special module on the right of RTU-ECAT is alarming. | Refer to “Error list (Extension module error information)” below. |
| Bit 7 | 0 | The 8th special module on the right of RTU-ECAT is normal. | -- |
| | 1 | The 8th special module on the right of RTU-ECAT is alarming. | Refer to “Error list (Extension module error information)” below. |

■ Error list（Extension module error information）

| Bit | Description |
|---|---|
| Error list[0] | The error code in the 1st special module on the right of RTU-ECAT; the error code value is the value in the error status CR of the special module. For details, refer to error status CRs in DVP-PLC Application Manual: Special Modules. |
| Error list[1] | The error code in the 2nd special module on the right of RTU-ECAT; the error code value is the value in the error status CR of the special module. For details, refer to error status CRs in DVP-PLC Application Manual: Special Modules. |
| Error list[2] | The error code in the 3rd special module on the right of RTU-ECAT; the error code value is the value in the error status CR of the special module. For details, refer to error status CRs in DVP-PLC Application Manual: Special Modules. |
| Error list[3] | The error code in the 4th special module on the right of RTU-ECAT; the error code value is the value in the error status CR of the special module. For details, refer to error status CRs in DVP-PLC Application Manual: Special Modules. |
| Error list[4] | The error code in the 5th special module on the right of RTU-ECAT; the error code value is the value in the error status CR of the special module. For details, refer to error status CRs in DVP-PLC Application Manual: Special Modules. |
| Error list[5] | The error code in the 6th special module on the right of RTU-ECAT; the error code value is the value in the error status CR of the special module. For details, refer to error status CRs in DVP-PLC Application Manual: Special Modules. |
| Error list[6] | The error code in the 7th special module on the right of RTU-ECAT; the error code value is the value in the error status CR of the special module. For details, refer to error status CRs in DVP-PLC Application Manual: Special Modules. |
| Error list[7] | The error code in the 8th special module on the right of RTU-ECAT; the error code value is the value in the error status CR of the special module. For details, refer to error status CRs in DVP-PLC Application Manual: Special Modules. |



## 6.4 Refresh Time Parameter for RTU-ECAT's Right Side IO modules

### 6.4.1 Parameter Explanation

The time for scanning the right-side IO modules out for a cycle can be monitored through the **IOrefresh** parameter (Index: A000, Subindex: 11) so as to adjust the EtherCAT cycle time and control the status switch time for the input points and output points based on this parameter.

For example, when 14 pieces of DVP16SP (with 8 digital inputs and 8 digital outputs) are connected on the right side of RTU-ECAT, you can use SDO to check that the **IoreFresh** (refresh time) is 5 ms. In this case, it is suggested that the EtherCAT cycle time should be set between 2.5 ms and 5 ms.

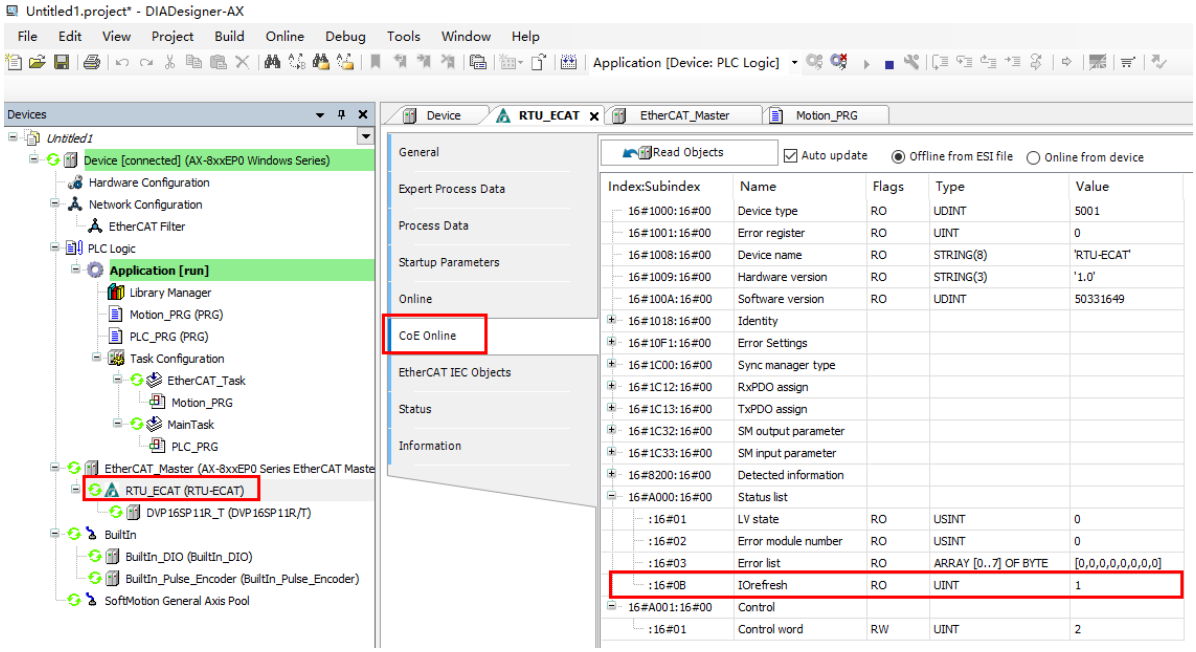
| | | | | |
|---|---|---|---|---|
| 16#A000:16#00 | Status list | | | |
| :16#01 | LV state | RO | USINT | 0 |
| :16#02 | Error module number | RO | USINT | 0 |
| :16#03 | Error list | RO | ARRAY [0..7] OF BYTE | [0,0,0,0,0,0,0,0] |
| :16#0B | IOrefresh | RO | UINT | 5 |

In this case, we suggest that the actual status switch time for the input points and output points should be greater than 5 ms. If the switch time is less than or equal to 5 ms, the input and output status may fail to update due to the too short switch time.

### 6.4.2 How to Read Right-Side IO Refresh Time through SDO and PDO

- Read the value through SDO

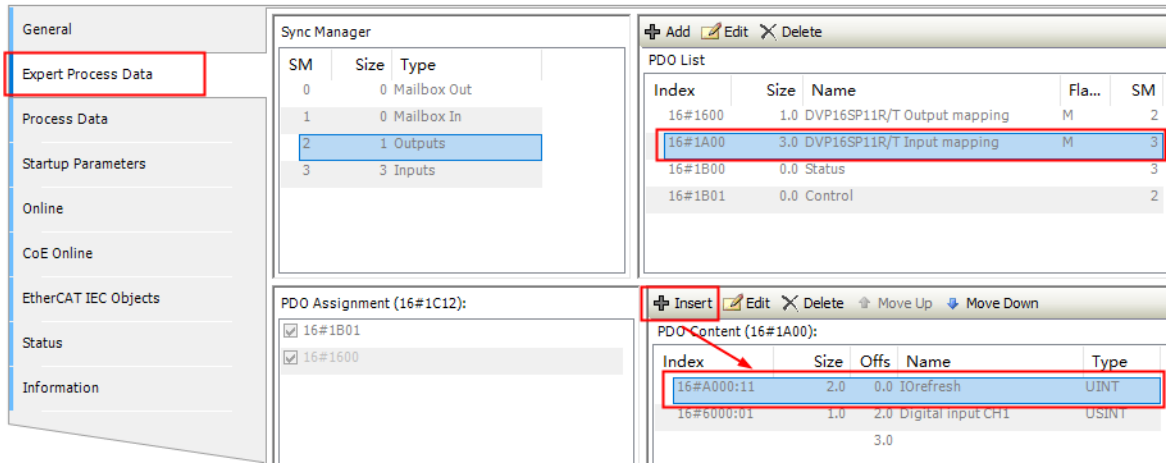
Double click **RTU-ECAT** on the left-side Devices area and then select "**CoE Online**" below. Clicking 16#A000: 16#0B, the maximum value of the right-side IO refresh parameter is 1 (UINT), which is read through SDO and the maximum refresh time is 1 ms as shown in the following figure.

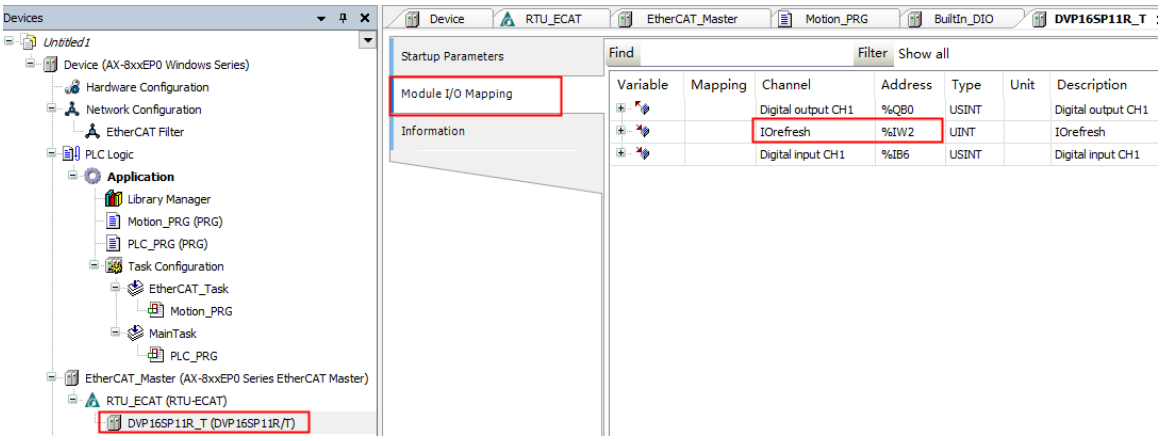



- Read the value through PDO

Double click **RTU-ECAT** on the left-side Devices area and then select "**Expert Process Data**". Clicking "**16#1A00 DVP16SP11R/T Input mapping**" in the right-side PDO List and then **"Insert"** in the **PDO Content**, a dialog box will pop up, where you select 16#A000: 16#0B and then click "**OK**" to add the parameter to the PDO Input List.

After that, the maximum value 1 is read through the corresponding device address %IW2 in the program and thus the maximum refresh time is 1 ms as shown in the figure below.


General
Expert Process Data
Process Data
Startup Parameters
Online
CoE Online
EtherCAT IEC Objects
Status
Information
Sync Manager
SM Size Type
0 0 Mailbox Out
1 0 Mailbox In
2 1 Outputs
3 3 Inputs
Add Edit Delete
PDO List
Index Size Name Fla... SM
16#1600 1.0 DVP16SP11R/T Output mapping M 2
16#1A00 3.0 DVP16SP11R/T Input mapping M 3
16#1B00 0.0 Status 3
16#1B01 0.0 Control 2
PDO Assignment (16#1C12):
16#1B01
16#1600
Insert Edit Delete Move Up Move Down
PDO Content (16#1A00):
Index Size Offs Name Type
16#A000:11 2.0 0.0 IOrefresh UINT
16#6000:01 1.0 2.0 Digital input CH1 USINT
3.0


Devices
Untitled1
Device (AX-8xxEP0 Windows Series)
Hardware Configuration
Network Configuration
EtherCAT Filter
PLC Logic
Application
Library Manager
Motion_PRG (PRG)
PLC_PRG (PRG)
Task Configuration
EtherCAT_Task
Motion_PRG
MainTask
PLC_PRG
EtherCAT_Master (AX-8xxEP0 Series EtherCAT Master)
RTU_ECAT (RTU-ECAT)
DVP16SP11R_T (DVP16SP11R/T)
Device RTU_ECAT EtherCAT_Master Motion_PRG BuiltIn_DIO DVP16SP11R_T
Startup Parameters
Module I/O Mapping
Information
Find Filter Show all
Variable Mapping Channel Address Type Unit Description
Digital output CH1 %QB0 USINT Digital output CH1
IOrefresh %IW2 UINT IOrefresh
Digital input CH1 %IB6 USINT Digital input CH1

**MEMO**

7

# Chapter 7 Application Examples

## Table of Contents

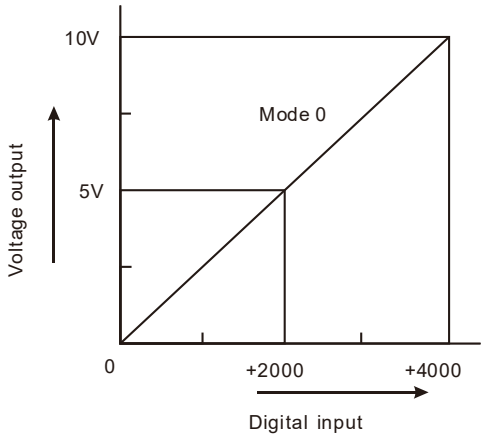
**7.1 Using Delta AX8 Series CPU with RTU-ECAT..... 7-3**

This section describes how to configure RTU-ECAT module parameters in an example when RTU-ECAT works together with an EtherCAT master.

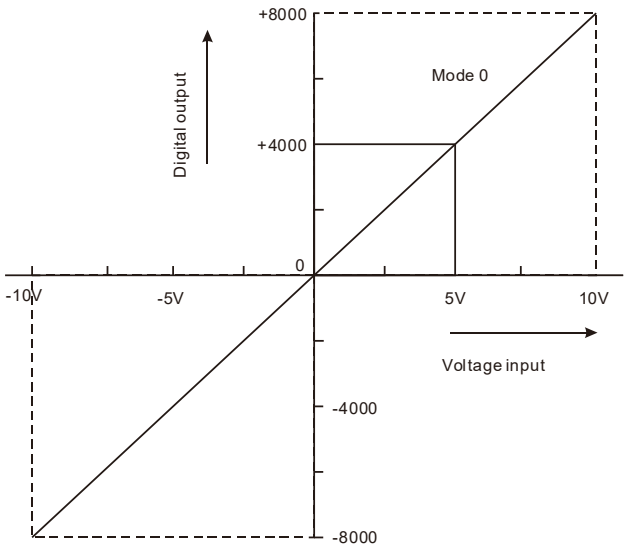
- **Control requirement**

1. DVP16SP11T is controlled to change its outputs Y0~Y7 to ON and its inputs X0~X7 are monitored via RTU-ECAT.
2. Channel 1 ~ channel 4 of DVP04DA-S are controlled to output the voltage of 5V via RTU-ECAT.
3. The analog data conversion values of Channel 1 ~ channel 4 of DVP04AD-S are read via RTU-ECAT.

- **Digital-Analog Relations for DVP04DA-S and DVP04AD-S**

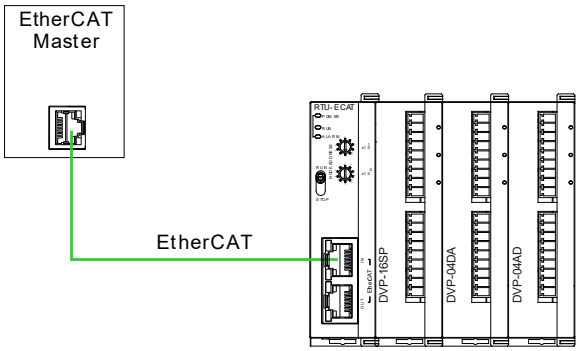



Digital input- Voltage output relation
for DVP04DA-S in mode 0




Digital output- Voltage input relation
for DVP04AD-S in mode 0

- **Constructing an EtherCAT network with RTU-ECAT**




- **Devices used in the example:**

| Device Name | Description |
|---|---|
| AX-832E CPU | Delta AX-8 series motion controller CPU |
| DIADesigner-AX | Delta EtherCAT configuration software |
| RTU-ECAT module | Delta EtherCAT remote IO module |
| DVP04DA-S | Delta analog output module |
| DVP04AD-S | Delta analog input module |
| DVP16SP11T | Delta digital IO module with 8 input points and 8 output points |

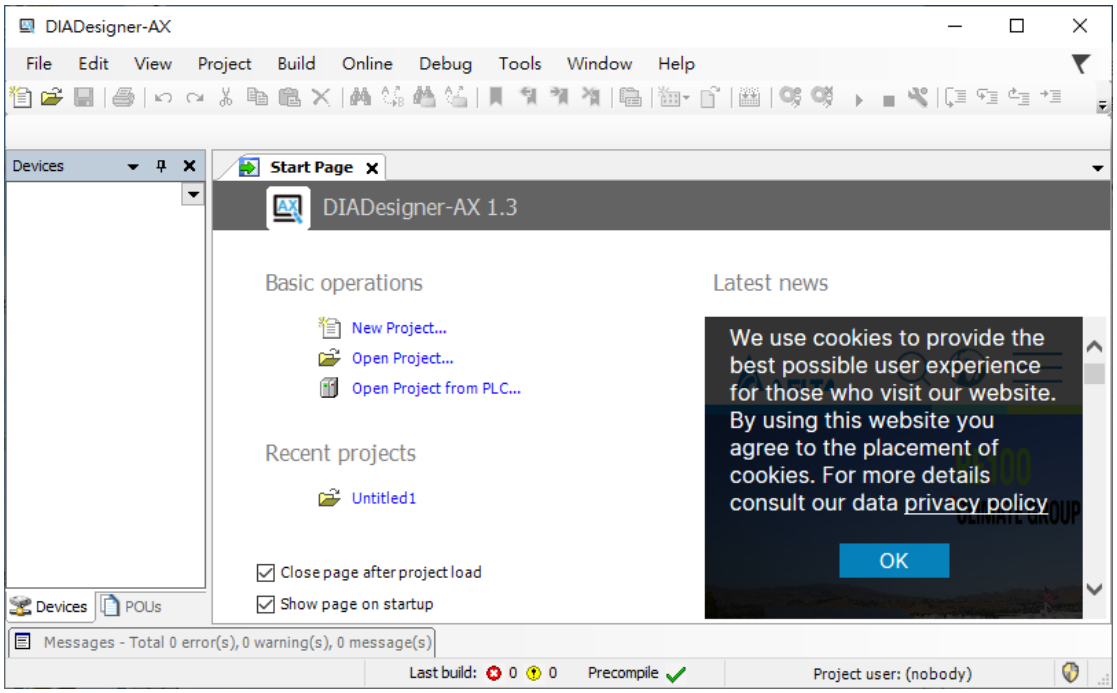
Note:

1. Please ensure that DVP16SP11T, DVP04DA-S, DVP04AD-S and RTU-ECAT modules work normally and the whole network wiring is proper.
2. Refer to **DVP-PLC Application Manual: Special Modules** for more about DVP04DA-S and DVP04AD-S.

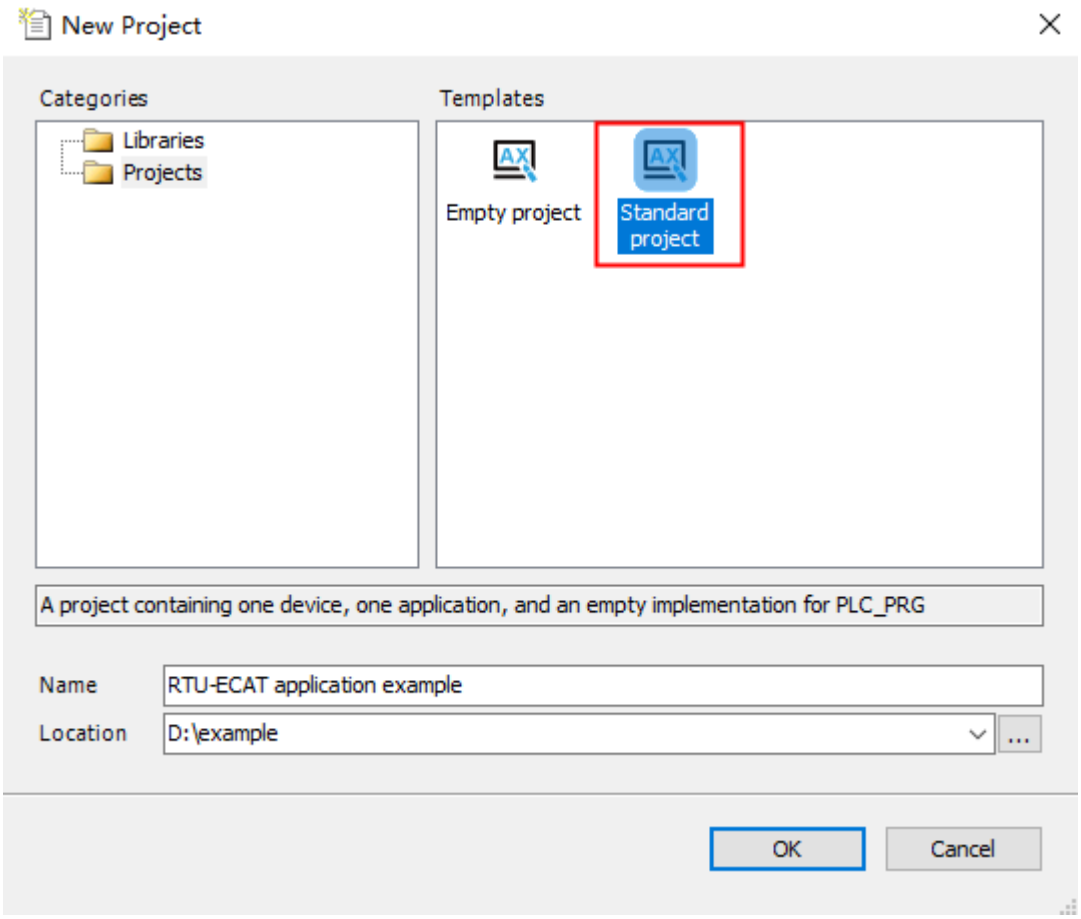


## 7.1 Using Delta AX8 Series CPU with RTU-ECAT

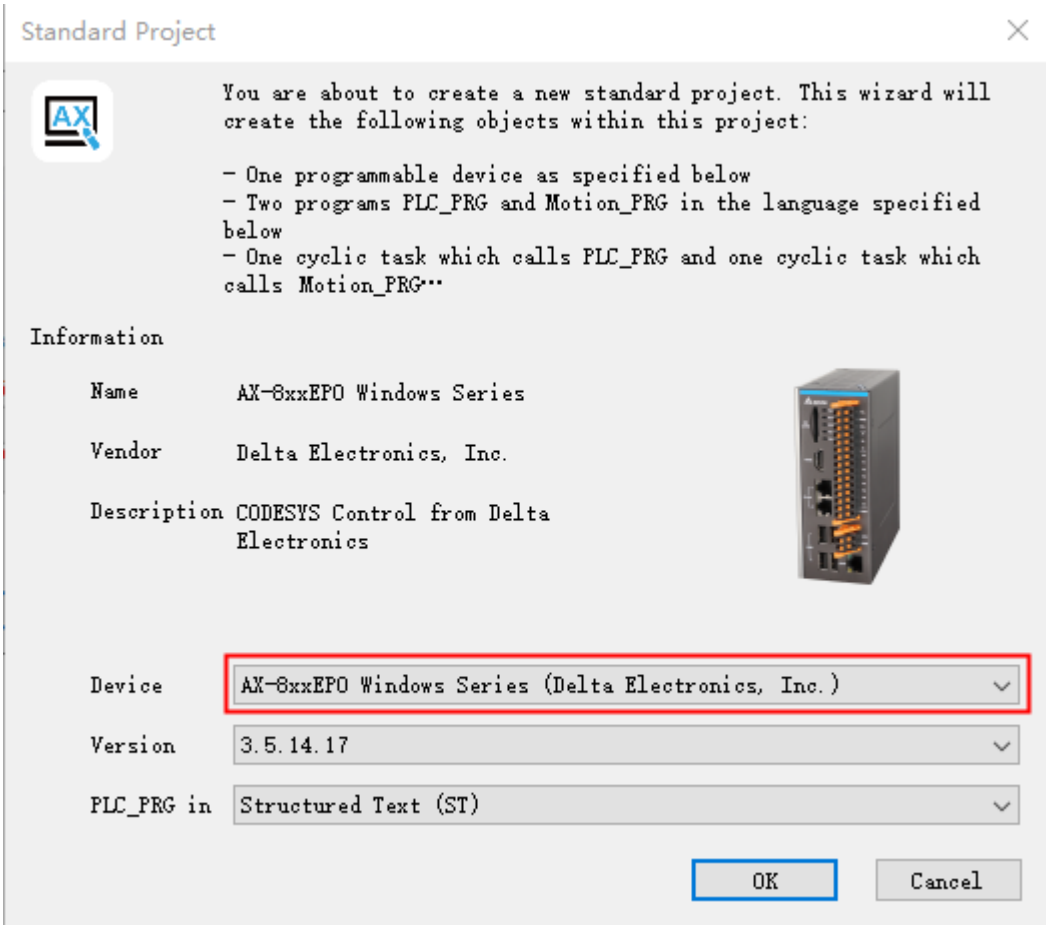
1. Download DIADesigner-AX software from Delta official website and install it. And then start the software.



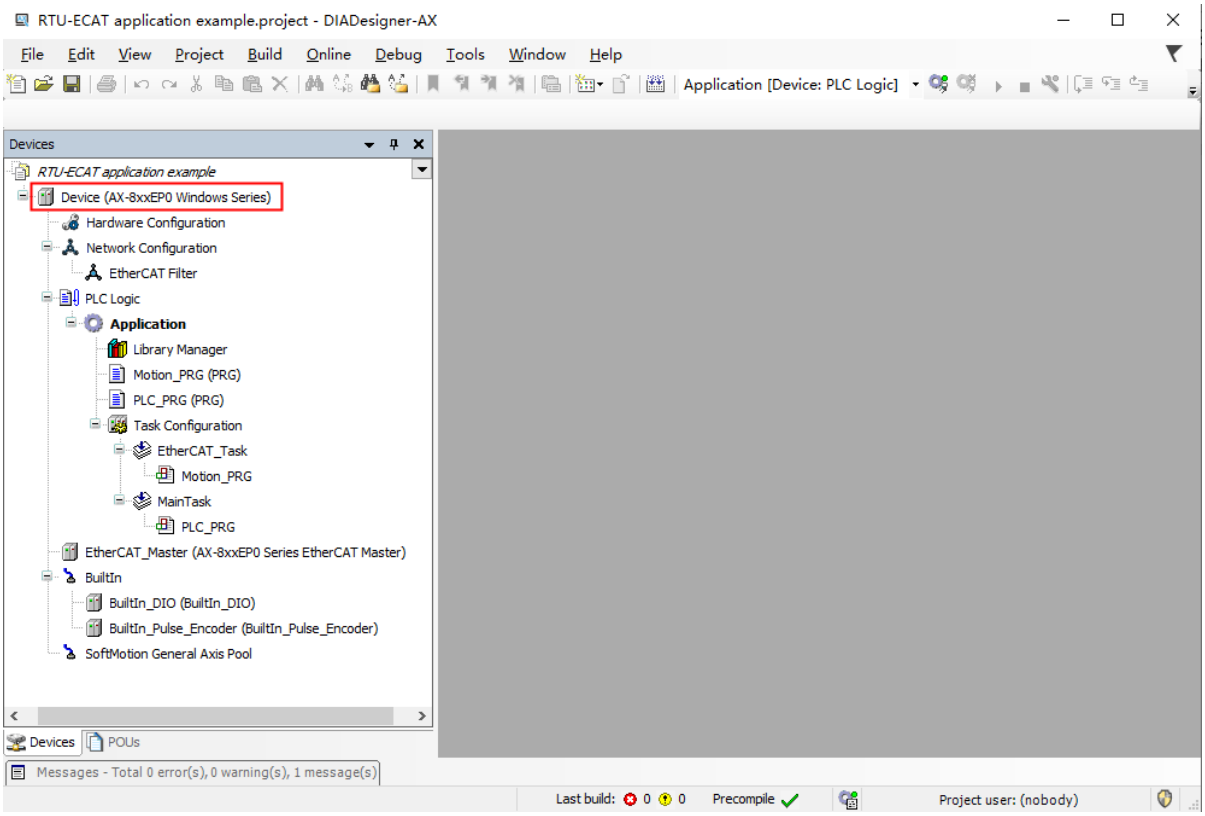

2. A new project is created by selecting the icon in the red box and then typing a project name and storage location as below.




3. Click “OK” button to complete the setting. Afterward, select “AX-8xxEP0 Windows Series (Delta Electronics, Inc.)” in the “Device” field and then click “OK” in the pop-out window.

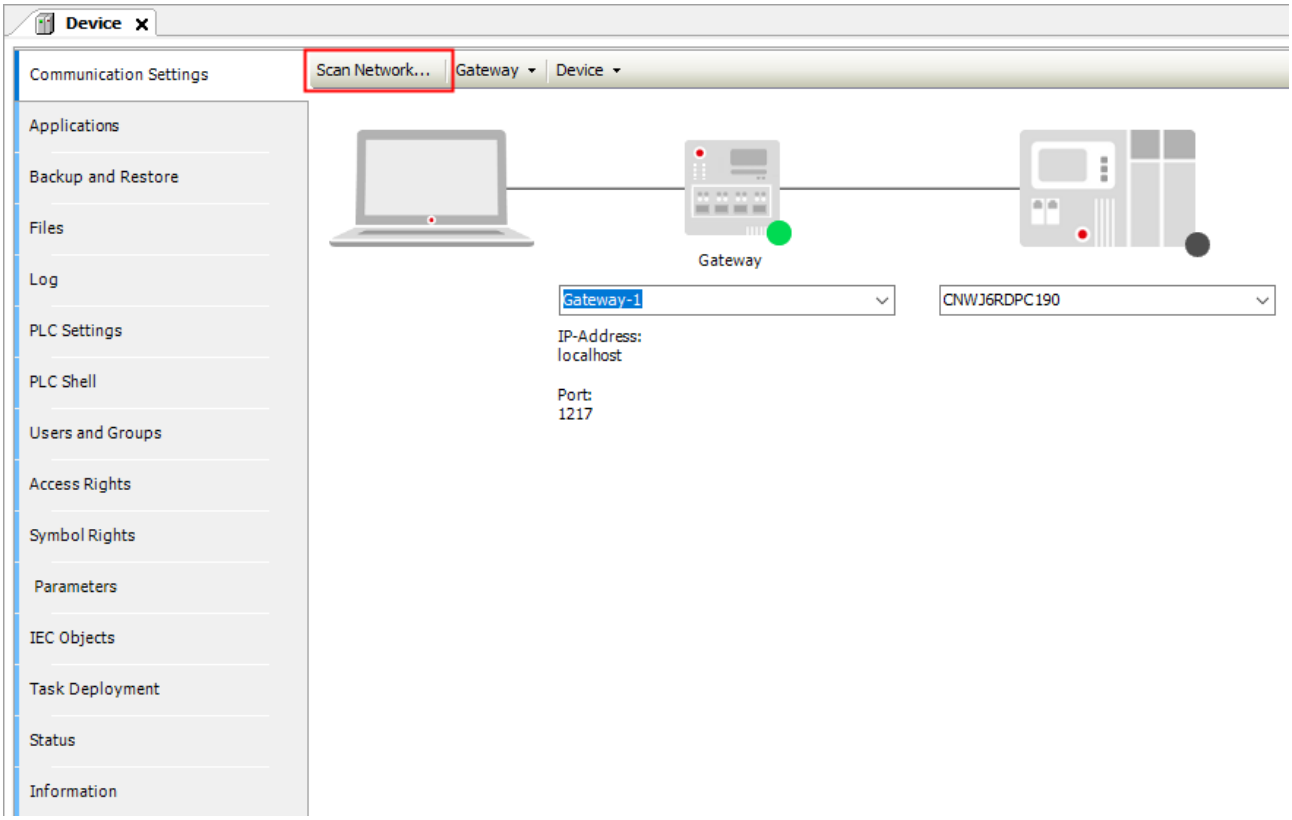



4. The created new project is shown as below.

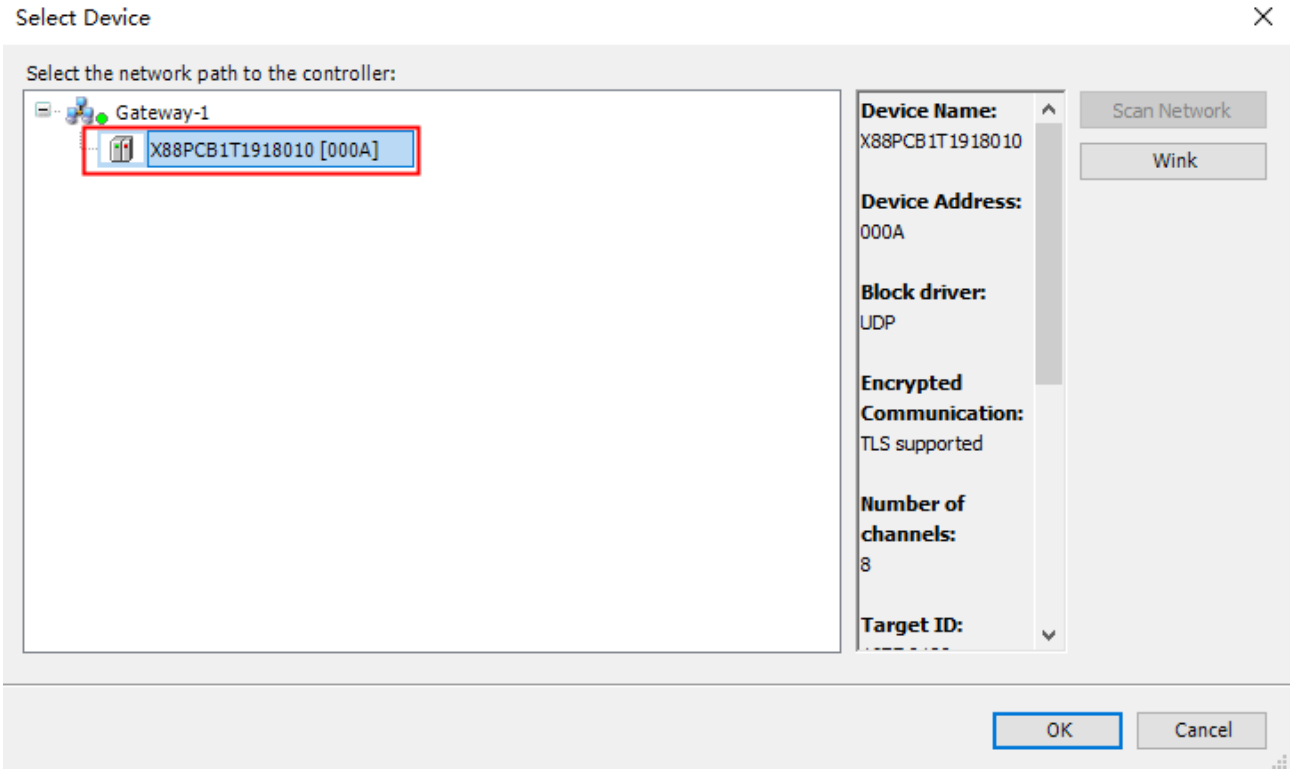



5. Double-click on “Device” in the red box above and then click on “Scan Network…” in the red box in the

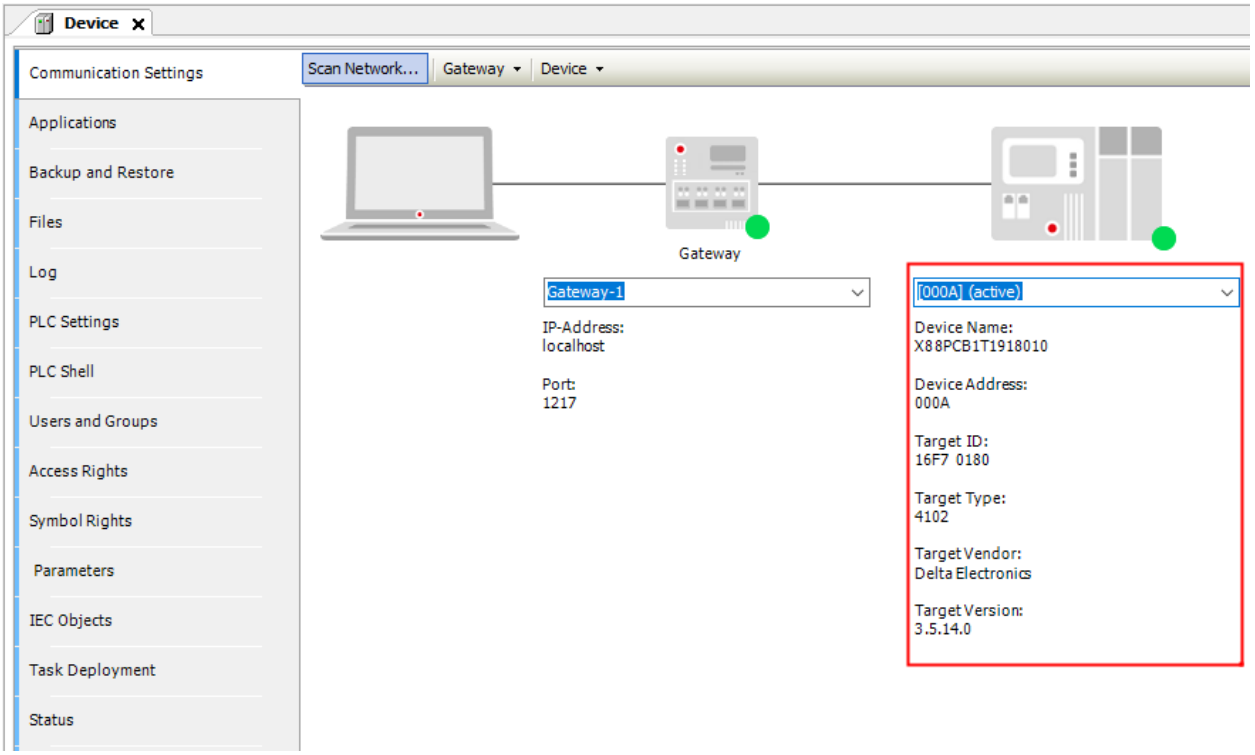
following window.



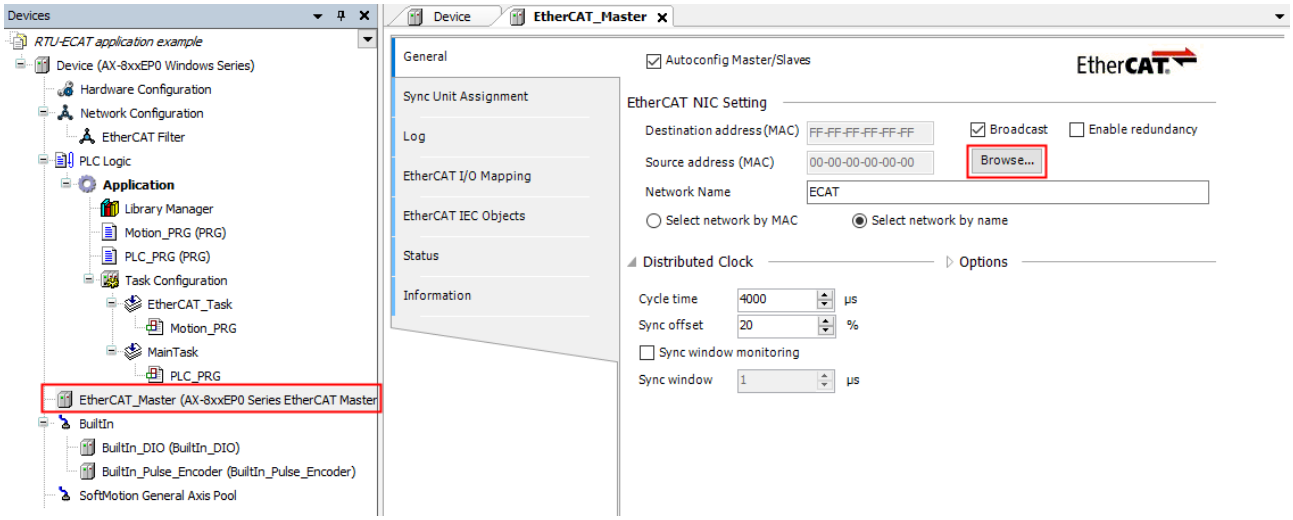

6. Then the following window appears, where AX-8 series controller will be searched for automatically. After the AX-8 controller shows up, select the controller and click “OK” button.



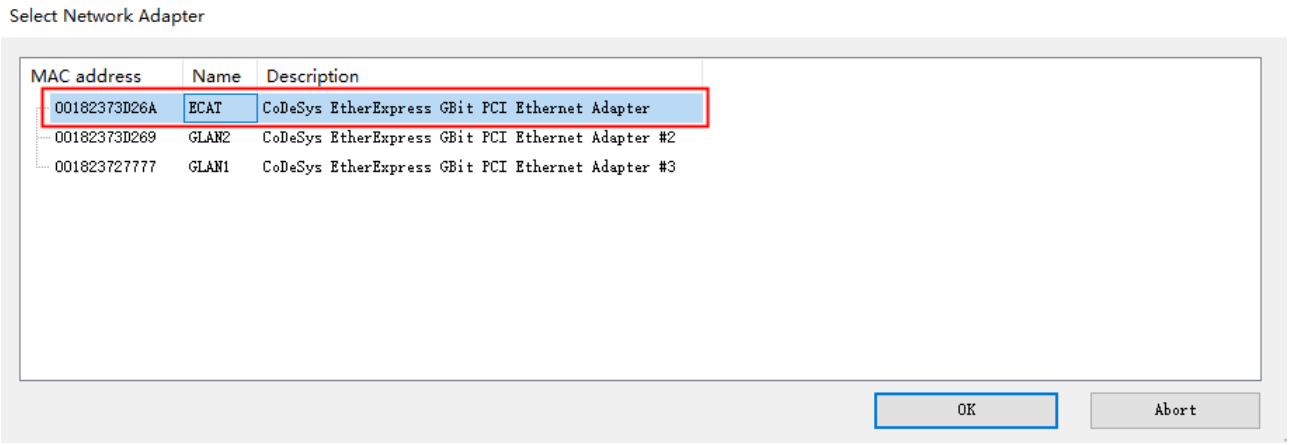

7. After the operations above are done, the connected PLC will automatically show up as below.



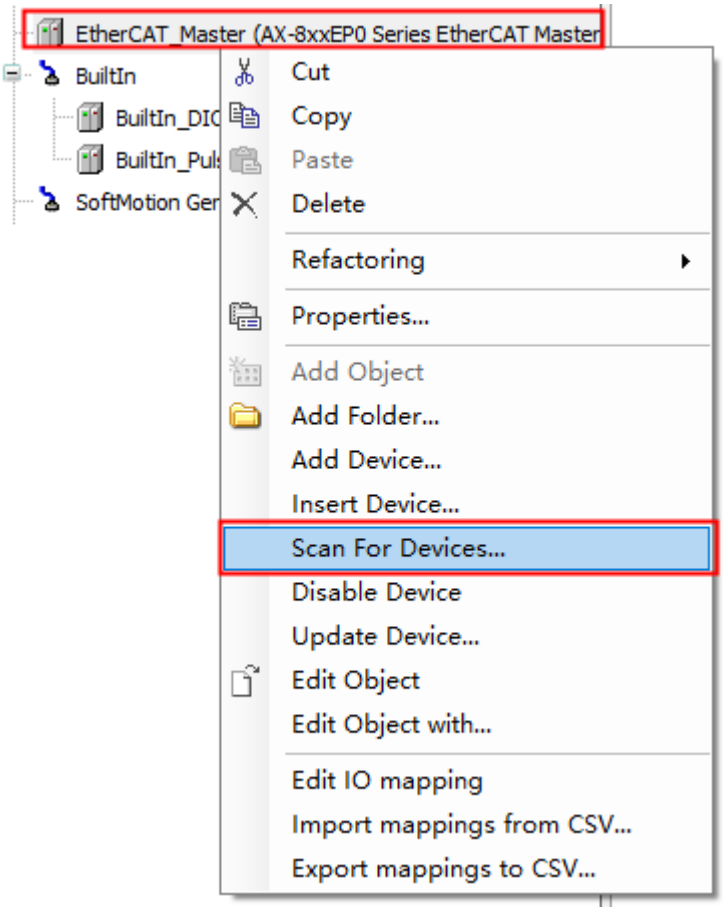

8. Double-click on “EtherCAT Master” in the red box below to open the “EtherCAT Master” tab.



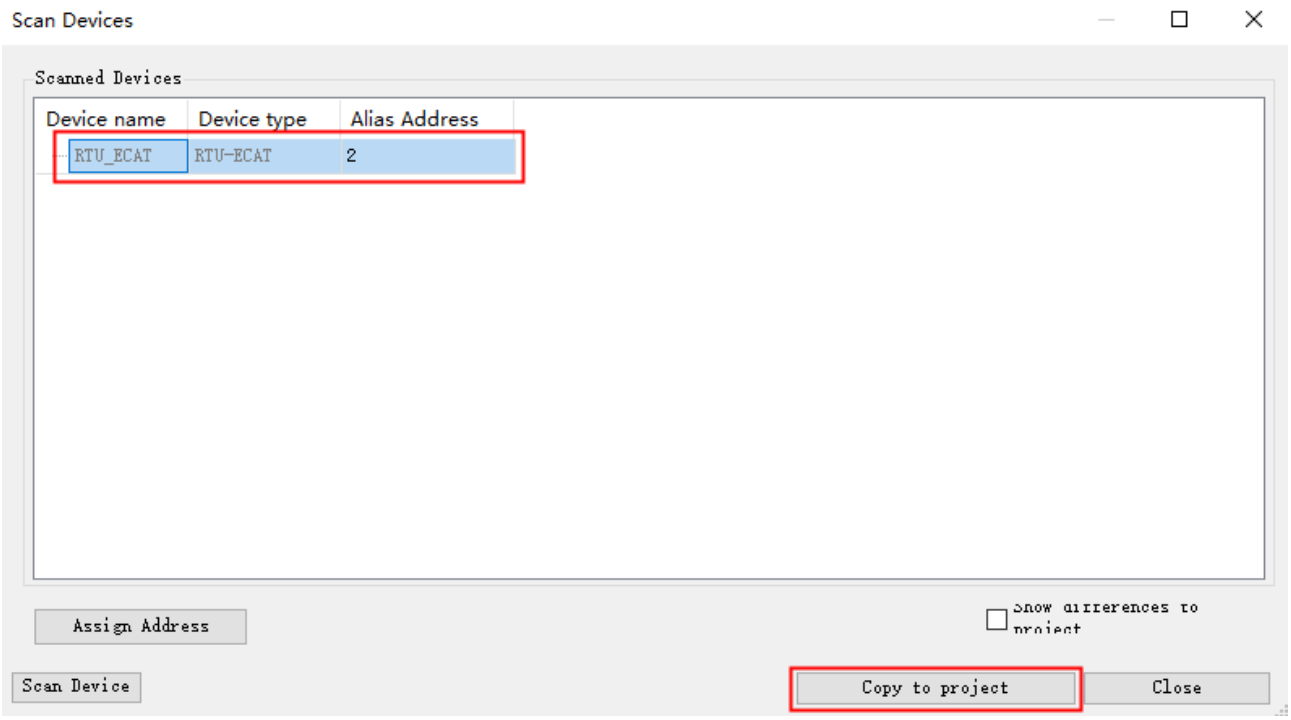

Click “Browse” button in the “EtherCAT Master” configuration area, then select the ECAT port from the pop-out “Select Network Adapter” window as below and afterwards click “OK” button.



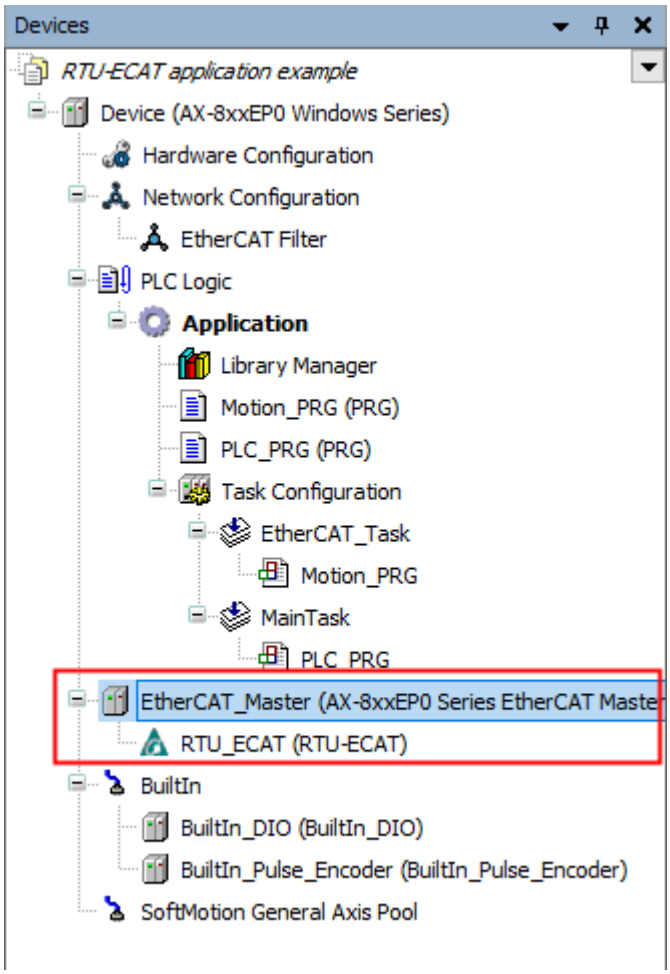

9. Right-click on the “EtherCAT Master” after the above action is done and then choose “Scan For Devices…” from the context menu.




10. Then the following “Scan Devices” window appears with the scanned slave as follows.

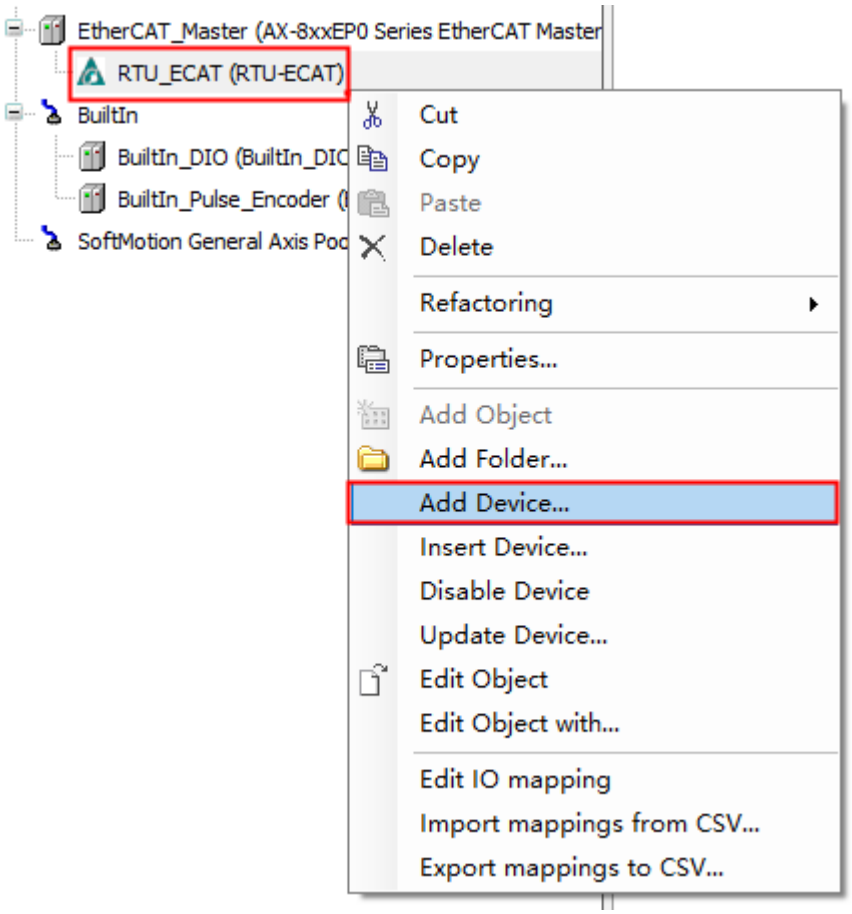



11. After the software scan is complete, select the scanned RTU-ECAT and then click on “Copy to project” to add the RTU-ECAT to the EtherCAT configuration as shown below.

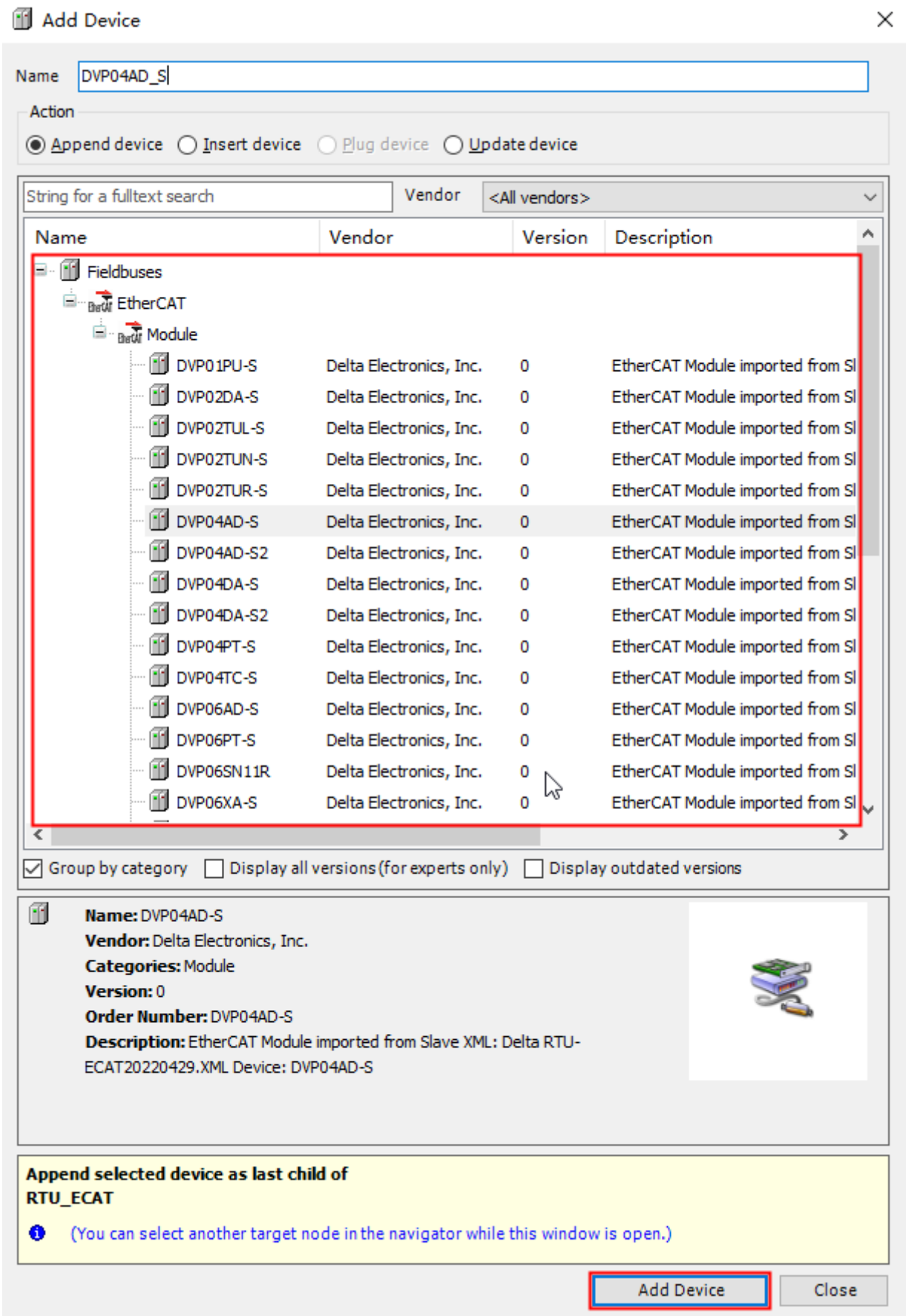



Note:
If you need to add the RTU-ECAT parameters for read and write actions after adding the RTU-ECAT, set up the RTU-ECAT parameters first, and then add the extension modules.

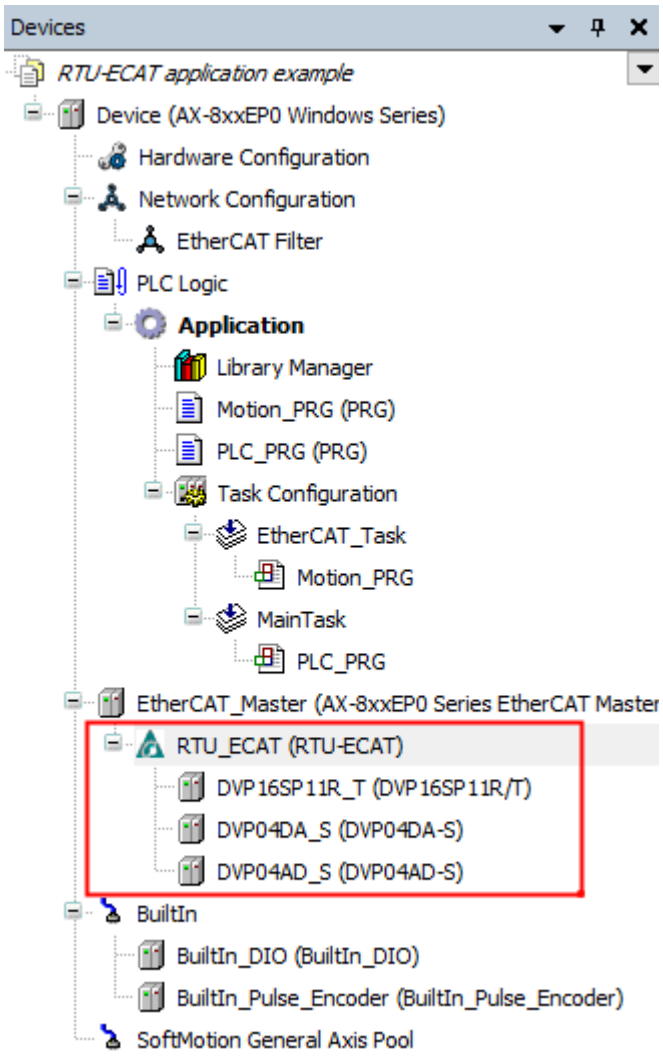
12. Right-click on the RTU-ECAT after it has been added to the master and select “Add Device” from the context menu to add extension modules.



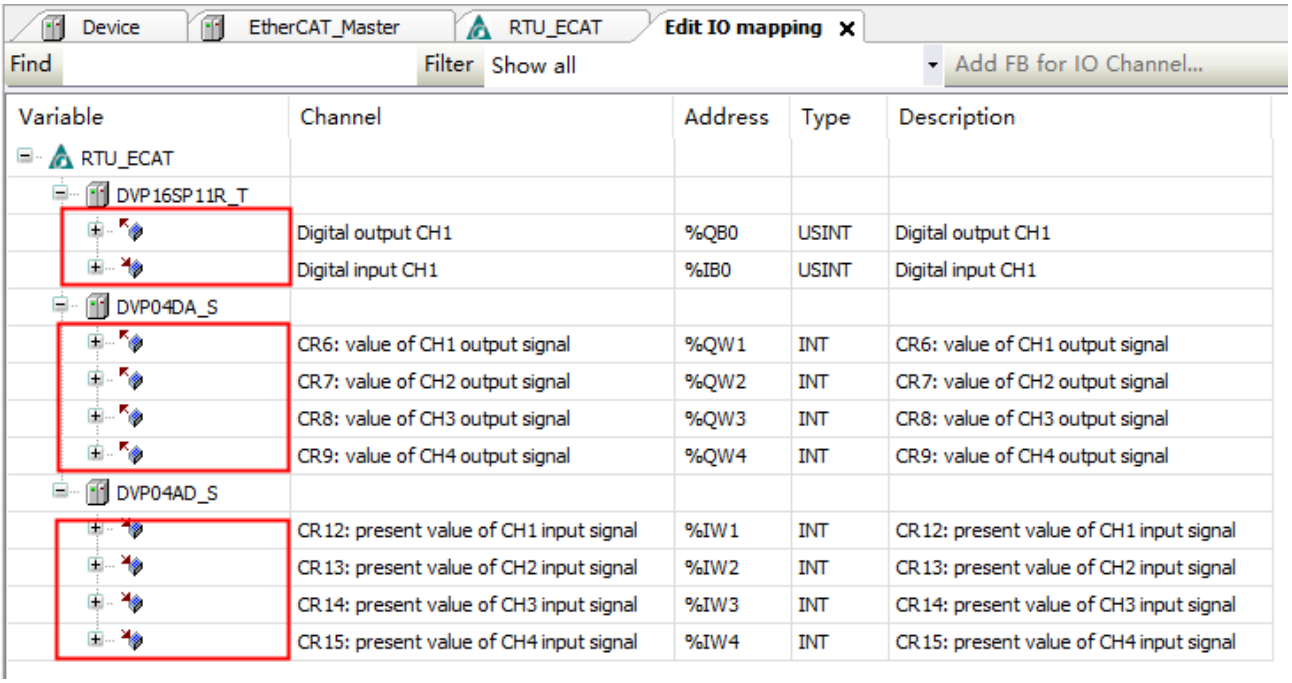

13. The following “Add Device” window appears, where you select extension modules.


Add Device
Name
DVP04AD_S
Action
Append device
Insert device
Plug device
Update device
String for a fulltext search
Vendor
<All vendors>
Name
Vendor
Version
Description
Fieldbuses
EtherCAT
Module
DVP01PU-S Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP02DA-S Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP02TUL-S Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP02TUN-S Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP02TUR-S Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP04AD-S Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP04AD-S2 Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP04DA-S Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP04DA-S2 Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP04PT-S Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP04TC-S Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP06AD-S Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP06PT-S Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP06SN11R Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
DVP06XA-S Delta Electronics, Inc. 0 EtherCAT Module imported from Sl
Group by category
Display all versions (for experts only)
Display outdated versions
Name: DVP04AD-S
Vendor: Delta Electronics, Inc.
Categories: Module
Version: 0
Order Number: DVP04AD-S
Description: EtherCAT Module imported from Slave XML: Delta RTU-ECAT20220429.XML Device: DVP04AD-S
Append selected device as last child of
RTU_ECAT
(You can select another target node in the navigator while this window is open.)
Add Device
Close

14. Find out and select DVP16SP11R/T in the red box above and then click “Add Device” button to add DVP16SP11T/R to RTU-ECAT. In the same way, add DVP04DA-S and DVP04AD-S respectively to the RTU-ECAT configuration.




15. After the above configuration setting is complete, right-click on the RTU-ECAT and select “Edit IO Mapping” from the context menu to review the IO mapping information of RTU-ECAT.



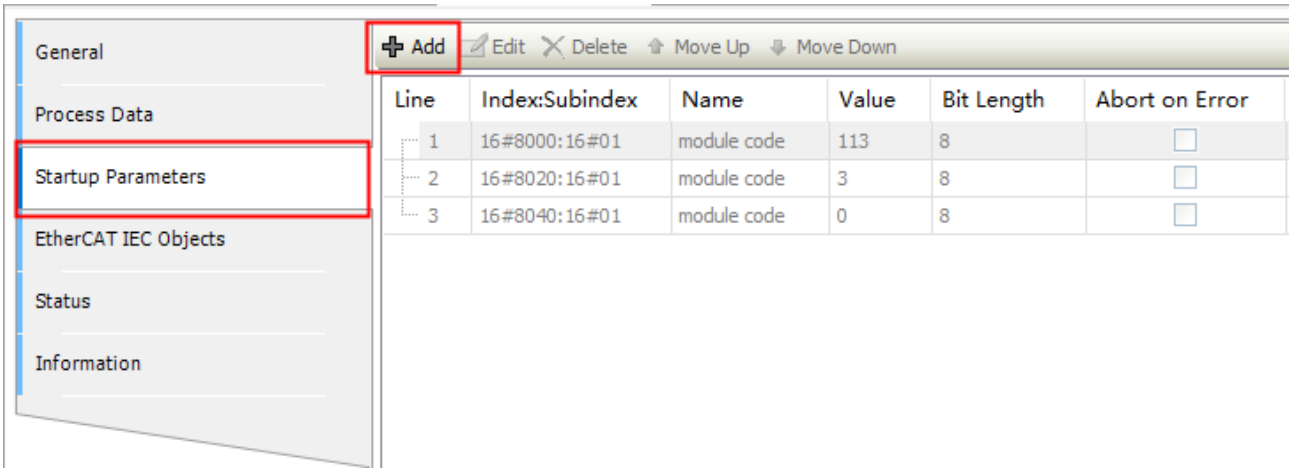

Variables can be combined in the red boxes above. When module channels are not combined to variables, the I and Q devices in the “Addresss” column are valid. The values of module channels can be read through the I and Q devices in the program.

When module channels are combined to variables , the I and Q devices in the “Addresss” column are invalid. The values of module channels can be read through variables in the program.

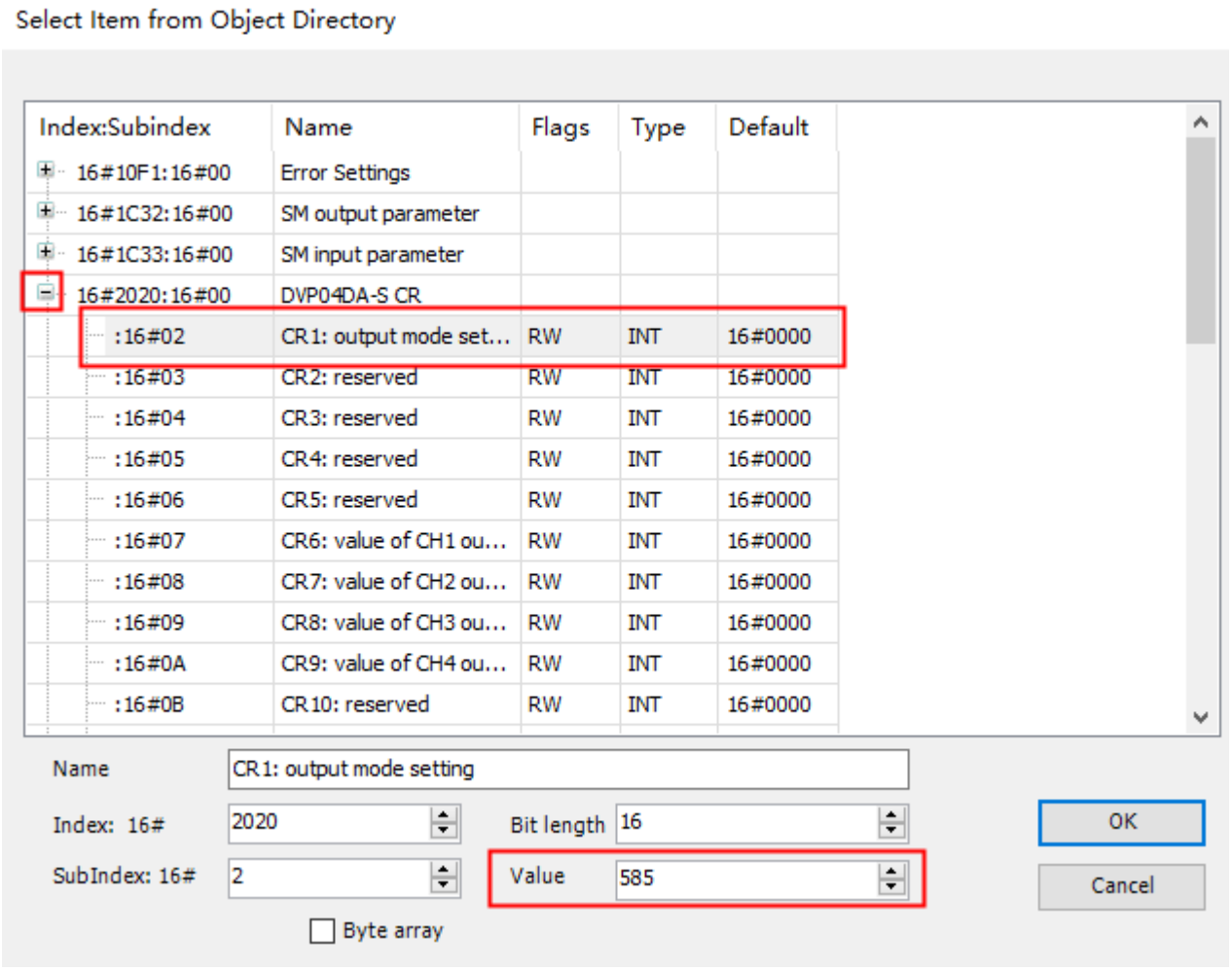
E.g. when module channels are not combined with variables, write 255 in %QB0 device in the program to change the Y0~Y7 output of DVP16SP11T into ON. If channel 1~ channel 4 of DVP04DA-S output 5V voltage, write 2000 to %QW1~QW4 in the program and then read the value converted from the analog data of channel 1~ channel 4 of DVP04AD-S in %IW1~%IW4.

If you need to modify the mode of channel 1~ channel 4 of DVP04DA-S, click “Startup Parameters” in the configuration interface of RTU-ECAT to open the “Startup” configuration interface and then click

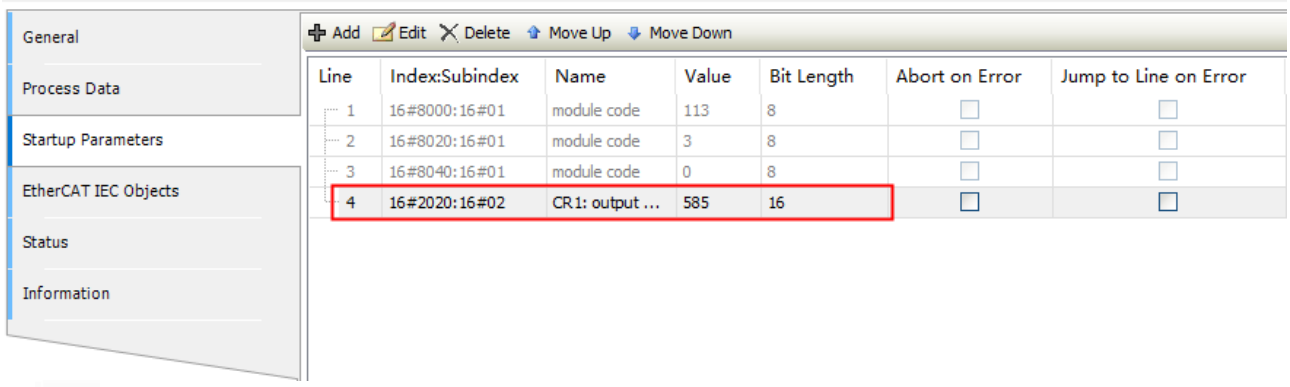
button as follows.



Click Add button and then click icon beside DVP04DA-S in the pop-out window to unfold all configurable CRs of DVP04DA-S. Then select the option “CR1: output mode setting” and enter 585 (16#249) in the “Value” field.




Click “OK” button to finish the setting. The “Startup Parameters” interface is disaplayed as follows after the setting is over.




Click login button to download the EtherCAT configuration data to the AX8 series CPU. Then the mode of channel 1~ channel 4 of DVP04DA-S is automatically switched to mode 1. Refer to **DVP-PLC Application Manual: Special Modules** for details on CR1 in DVP04DA-S.

**MEMO**

# Chapter 8 Error Diagnosis and Trouble-shooting

## Table of Contents

**8.1 LED Indicator Diagnosis ..... 8-2**
**8.2 Status Indication Diagnosis ..... 8-3**

RTU-ECAT provides two diagnostic methods, LED indicator diagnosis and status indication diagnosis.

## 8.1 LED Indicator Diagnosis

**POWER LED**

| LED status | Indication | How to correct |
|---|---|---|
| Off | Power is abnormal. | Make sure that RTU-ECAT is powered. |
| Green light on | Power is normal. | -- |

**ALARM LED**

| LED status | Indication | How to correct |
|---|---|---|
| Off | RTU-ECAT works normally or lacks the work power. | -- |
| Red light blinking | Possible causes:<br>1. The configuration data of RTU-ECAT are invalid;<br>2. The extension modules on the right of RTU-ECAT are in error or are offline. | 1. Check if the modules on the right of RTU-ECAT are consistent with those configured in the software.<br>2. Check out the error information of the modules on the right of RTU-ECAT and then deal with the errors by following related module manual instructions.<br>3. Check if the power supply and wiring of the modules on the right of RTU-ECAT are fine.<br>4. Make sure that the wiring of EtherCAT cables is proper. |
| Red light on | RTU-ECAT is under voltage | Check if the power supply for RTU-ECAT is normal. |

**RUN LED**

| LED status | Indication | How to correct |
|---|---|---|
| Off | RTU-ECAT in STOP mode | 1. Ensure that the power supply for RTU-ECAT and the connection are fine.<br>2. Check if the RUN/STOP switch of RTU-ECAT has been switched to RUN.<br>3. Check if the control word of RTU-ECAT is effective and controlling RTU-ECAT in STOP state. |
| Green light on | RTU-ECAT in RUN mode | -- |

**EtherCAT LED**

| LED | LED status | Indication | How to correct |
|---|---|---|---|
| Green light | ON | The EtherCAT port has been connected to the EtherCAT network. | -- |
| | OFF | The EtherCAT port has not yet been connected to the EtherCAT network. | Ensure that the hardware connection to the EtherCAT port is proper. |
| Yellow light | Blinking | Data are being transmitted or received via the EtherCAT port | -- |
| | ON | No data are being transmitted or received via EtherCAT port. | Add RTU-ECAT to the master. |
| | OFF | There is no hardware connection to the EtherCAT port. | Ensure that the hardware connection to the EtherCAT port is proper. |

## 8.2 Status Indication Diagnosis

The status indication parameters of RTU-ECAT are used to display the operating states of special modules and DI/DO modules. See section 6.3.2 for details on related status indication parameters.

**MEMO**

# Appendix A List of Accessories

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# A.1 Accessories for EtherCAT Communication

- **Cables**

| Figure | Model | Length | Diameter ( AWG ) |
|---|---|---|---|
| | UC-EMC003-02A | 0.3M | 4#22 PVC |
| | UC-EMC005-02A | 0.5M | 4#22 PVC |
| | UC-EMC010-02A | 1.0M | 4#22 PVC |
| | UC-EMC020-02A | 2.0M | 4#22 PVC |
| | UC-EMC050-02A | 5.0M | 4#22 PVC |
| | UC-EMC100-02A | 10.0M | 4#22 PVC |
| | UC-EMC200-02A | 20.0M | 4#22 PVC |