DIADesigner-AX Software Manual

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Related Documents

Document Name	Document ID
DIADesigner User Manual	DIAS-Manual-0003-EN
DIAScreen User Manual	DIAS-Manual-0004-EN
Software Download and Installation Manual	DIAS-Manual-0005-EN
DIADesigner-AX Online Help	N/A

Revision History

Version	Issue Date	Revision
1.0.0	12/08/2020	The first version was published.
1.1.0	02/19/2021	1. Section 1.2: Added Support Controller AX-308EA0MA1P, AX-364ELA0MA1T, AX-300NA0PA1, AX- 324NA0PA1P. 2. Section 5.5: Added how to Add RIO Module Process. 3. Section 8.4: Added Models that Support the firmware update function. 4. Section 5.10.1: Updated the running clock configuration tab to the system settings tab and add the device IP address setting field. 5. Section 6.2.5: Updated Ethernet General Tab. 6. Section 5.10.4: Added high-speed IO Settings,divided into AX-364EL/AX-308 AND AX-324. 7. Section 5.11.5: Added Introduction to the new free encoder. 8. Section 8.2: Added Introduction to the new device storage library.
1.2.0	07/30/2021	1. Section 1.2: Added support controller AX-304ELA0PA1T, AX-304ELA0PA1P, AX-316EA0MA1T. 2. Section 3.2.4: Added update device function description. 3. Section 3.2.5: Added the description of editing I/O mapping function.

Version	Issue Date	Revision
		4. Section 5.7: Added power module description. 5. Section 8.4: Updated the firmware update instructions. 6. Section 5.10.3: Added description of new device diagnosis function. 7. Section 6.2.4.5: Added description of parameter backup and restore functions. 8. Section 5.10.4.1.4: Added Po axis pin selection. 9. Section 6.2.4 and 5.11: Supported floating points for mechanism parameters. 10. Section 5.11.1.1: Added New axis parameter Dynamic Limits for AX-8xxEP0 series synchronous axis 11. Section 6.2.4.4: Added multiple EtherCAT instructions in AX-8xxEP0 series. 12. Section 8.2: Added device storage library description.
1.3.0	05/31/2022	1. Section 4.2.3: Added Notes on setting array variables. 2. Section 4.2.5: Added Variable Export and Import. 3. Section 5.9: Added Setting the AS02LC Wizard. 4. Section 8.4: Updated Firmware Update Instructions. 5. Updated Section 5.10.1: Added IP address setting support for AX-8 series. 6. Section 5.11.1.2: Added CoE parameters.

Version	Issue Date	Revision
		7. Revised Section 5.11.3: Added speed axis, revised origin return settings and added modes -1~-4. 8. Chapter 9: Added Password Management and Data Protection Mechanism. 9. Section 9.1: Added Project ID/PLC ID. 10. Section 9.10: Added Permission Settings.
1.3.1	10/18/2022	1. Updated Section 1.2: Updated List of supported devices. 2. Section 4.3: Added Auto-completion. 3. Updated Section 5.10.1 Added support for AX-8xx-EP0 Linux series devices, display IP address and MAC address, and added IP settings to take effect immediately after downloading. 4. Updated Section 6.2.5.1: EtherNet/IP Scanner Operation 5. Updated Section 6.2.5.3 EtherNet/IP Local Adapter Procedure Update.
1.4.0	03/31/2023	1. Chapter 2: Overall revised installation and uninstallation steps and system requirements. 2. Section 1.2: Added MH300 series and CH2000 series to supported devices. 3. Section 3.1.2: Revised adding a device. 4. Section 3.1.3: Revised communication settings and added the ability to show Mac-Address and IP-Address. 5. Section 3.1.6: Revised declaring variables.

Version	Issue Date	Revision
		6. Section 3.2.4: Updated updating device. 7. Section 3.2.4.1: Added the update device list dialog. 8. Chapter 4: Added Programming Reference chapter 9. Section 4.2.1-4.2.3: Added creating array and structure variables and setting up comments 10. Section 4.2.4.1: Added setting up retain persist variables. 11. Section 4.2.5: move variable export and import to this section. 12. Section 5.1: Revised adding modules and updated figures to add Network modules. 13. Section 5.5: Revised adding remote I/O modules. 14. Section 5.7: Revised adding power module. 15. Section 5.2: Added function cards. 16. Section 5.2.1.1: Added modbus channel configuration page. 17. Section 5.10.1: Revised system settings and added retain settings. 18. Section 5.10.2: Added system parameters for AX-8 series controller. 19. Section 5.10.1: Added system settings for AX-8 series controller. 20. Section 5.11.7: Added SoftMotion version compatibility. 21. Section 6.2.6: Added supporting PROFINET version 4.3.0.0.

Version	Issue Date	Revision
		22. Chapter 7: Updated the overview. 23. Section 7.1: Updated exporting the symbol configuration file. 24. Section 8.2: Revised device repository. 25. Section 8.2.1: Revised installing device description file. 26. Section 8.6: Added startup command. 27. Section 8.7: Added resource monitor. 28. Section 8.8: Added tracing variables. 29. Section 8.10: Added software diagnosis tool. 30. Section 9.10.1: Added import management files. 31. Section 9.10.2: Added export management files. 32. Section 9.10.3: Revised adding user and group settings. 33. Section 9.10.4: Revised setting up access right.
1.5.0	09/30/2023	1. Section 1.2: Updated Supported Devices section. 2. Section 3.1.7: Revised Programming section 3. Section 3.1.8: Revised Download and Run the Application section. 4. Section 3.2.3: Added new section on Standard Toolbar. 5. Section 4.1: Added this section for IEC61131-3 overview. 6. Section 4.2.5: Revised and restructured variable export and import, added online export and import.

Version	Issue Date	Revision
		7. Section 4.3: Revised auto-completion to add smart input. 8. Section 5.2: Revised and restructured Function Card section and added Detect Slaves Automatically option. 9. Section 5.3: Added IO-Link Device. 10. Section 5.4: Added EtherCAT Coupler section. 11. Section 5.5: Revised Remote I/O moudule section. 12. Section 5.6: Added Module Current Consumption Calculation section. 13. Section 5.9: Revised and restructured this AS02LC-A section and its sub sections. 14. Section 5.10: Updated for AX-C, AX-5, AX-864E30CE2T, and AX-864E30ME2T. 15. Section 5.10.1: Added Read Retain Mode and Writer Retain Size Mode. 16. Section 6.2.4.5: Update Parameter Backup and Restore section and added the sub-sections. 17. Section 6.2.6: Added PROFINET I/O 18. Section 5.11: Updated axis introduction. 19. Section 5.11.1: Revised Synchronoous Axis. 20. Section 5.11.1.2: Updated CoE Parameters section. 21. Section 6.1.1: Updated Network Configuration Topology Diargram section. 22. Section 6.1.2: Added EtherCat Topology section. 23. Section 8.1.1: Added General option section.

Version	Issue Date	Revision
		24. Section 8.8.1.1 : Added how to add time value to trace. 25. Chapter 9: Revised and restructured Sections 9.1–9.10.
1.5.2	12/29/2023	1. Section 5.11.2–5.11.5: Revised adding and setting different axes. 2. Chapter 6: Revised the structure of the chapter. 3. Section 6.2.4.3: Added EtherCAT devices scan. 4. Section 6.2.6.3: Revised OPC UA Settings sections. 5. Chapter 7: Revised the HIM Interactive chapters. 6. Section 8.1.1: Updated general options. 7. Section 8.3: Revised Library Manger sections. 8. Section 8.5: Revised Package Manger sections.
1.6.0	3/29/2024	1. Section 1.2: Updated supported devices. 2. Setion 5.6: Updated the power consumption de-scrioption. 3. Section 5.8: Added the motion control modules. 4. Section 5.10.4.1.5: Updated the IN filter time value range. 5. Section 5.11.1.2.1: Added changing the CoE para-meter display mode. 6. Section 5.11.1 –5.11.1.2: Added descriptions for ASDA-W3-E. 7. Section 5.11.6: Revised the axis group sections.

Version	Issue Date	Revision
		8. Section 6.1.2: Updated EtherCAT Topology and added sub sections. 9. Section 6.2.2.1: Updated descriptions for Data Bits. 10. Section 6.2.4.1: Updated EtherCAT master settings. 11. Section 6.2.4.3: Updated EtherCAT device scanning. 12. All: updated the EtherCAT Master Softmotion name.
1.7.0	9/30/2024	1. Section 2.2: Updated a note of installing multiple versions of DIADesigner-AX. 2. Section 1.2: Updated supported devices. 3. Section 3.2.1: Added opening a project in a multi-version DIADesigner-AX environment. 4. Section 4.4: Added Recipe descriptions. 5. Section 4.5: Added creating Robotics projects. 6. Section 5.2.1.1, 5.2.2.1: Updated the SCMRS transmission mode. 7. Section 5.4: Added R1-C00CE00 coupler. 8. Section 5.9: Added the AX-501LC10-0A module, and updated the Load Cell module content. 9. Section 5.11.1: Added ASDA-H3-E servo drive. 10. Section 5.11.3: Updated the velocity axis section to add MX300-E device. 11. Secion 5.11.7: Updated the homing mode settings to add new devices.

Version	Issue Date	Revision
		12. Section 6.2.3: Updated the description of Network interface. 13. Section 6.2.5.1: Added product code and vendor code to EtherNet/IP Scanner. 14. Section 6.2.6.3: Added the PROFINET coupler section. 15. Updated some figures of new user interface.
1.7.1	1/17/2025	1. Section 1.2: Updated supported devices. 2. Section 5.10.4: Revised the structure for the High-speed I/O settings and added AX-864EP1ME1TP. 3. Section 5.11.1.1: Updated Transmission Mechanism settings and added a **Motor Setting** tab. 4. Section 8.4.1: Added a note of firmware package download path.
1.8.0	4/28/2025	1. Section 1.2: Updated supported devices. 2. Section 4.1.1–4.1.2: Added descriptions of Delta Toolbox and Ladder Diagram. 3. Section 4.2.4: Added %M mode persistent editor. 4. Section 5.4: Added R3-C00CE00-0A coupler. 5. Section 5.8.1 and 5.8.2: Updated HC and PU content. 6. Section 5.11.1.1: Updated the parameter settings of linear motor. 7. Section 5.11.7: Added –4 to –1 homing mode for ASDA-E3 and E3C series.

Version	Issue Date	Revision
		8. Section 5.11.8: Updated version compatibility. 9. Section 8.9: Added the product rating function.

Table of Contents

Chapter 1: DIADesigner-AX Overview

DIADesigner-AX is the IEC 61131-3 programming tool for Delta's new generation motion controller – AX series and adopts many applied instructions, especially Motion library.

The multilingual environment and the user-friendly interface provide a convenient and efficient development environment.

1.1 DIADesigner-AX Function

DIADesigner-AX provides:

- All editors of the IEC 61131-3 (FBD, LD, ST, SFC) and different variants of the standard editors.
- Powerful and proven library concept for the reuse of application.
- Project configuration through wizards.
- Input assistance for the input and configuration of data.
- User-friendly programming with mouse and keyboard in all IEC 61131-3 editors.
- Extensive debugging and online features for the fast optimization of the application code and to speed up testing and commissioning.
- Numerous security features for the protection of the source code and for safeguarding the operation of the controller.
- Programmable devices from different manufacturers.
- Extendible and adaptable user interfacewithout leaving the framework.
- Transparent internal structures of the development tool and the available components.
- Many seamlessly integrated tools for different kinds of automation tasks.
- Two built-in configurations:
  Hardware Configuration: It is used to configure hardware for a system, and manage parameters.
  Network Configuration: It is used to configure networks for a PLC system, and manage data exchanges.
  DIADesigner-AX provides various solutions for motion control including PLCopen MC function block, G-code editor, E-CAM editor, positioning planning chart tool and many more.

- Support PLCopen POUs for single and multi-axis movements.
- Support PLCopen POUs for add-on functions like diagnostics, stop, CAM controller.
- Additional POUs for different tasks like monitoring dynamic data or following error, operating CAMs and CAM controllers.
- Integrated graphical CAM editor with extensive configuration options
- Virtual and logical axes are supported.
- Integrated drivers for numerous, CANopen and EtherCAT drives.
- Configuration of the Drives / Servo based on standard field devices.

1.2 Supported Devices

DIADesigner-AX v1.8.0 supports the following devices. For more information about the devices, see the device documentation.

Type	Product Series
Controller	Motion PLC: • AX-304ELA0PA1T, AX-304ELA0PA1P, AX-308EA0MA1T, AX-308EA0MA1P, AX-316EA0MA1T, AX-332EP0MB1T, AX-332EP0MB1P, AX-364ELA0MA1T • AX-516EB0MB1P, AX-516EB0MB1T, AX-532EB0M-B1P, AX-532EB0MB1T, AX-564EB0MB1P, AX-564E-B0MB1T, AX-564ELB0MB1T, AX-564ELB0MB1P • AX-8xxEP0 Linux series, AX-8xxEP0 Windows series

Type	Product Series
	• AX-864E30CE2T, AX-864E30ME2T, AX-8H1E30CD2T, AX-8H1E30CD2P, AX-864EP1ME1TP • AX-C06EB0MD1T, AX-C06EB0MD1P, AX-C12E-B0MD1T, AX-C12EB0MD1P, AX-C12EB0CD1T, AX-C12EB0CD1P, AX-C24EB0MD1T, AX-C24EB0MD1P Logic PLC: AX-300NA0PA1, AX-324NA0PA1P
AC Motor Drive	C2000 plus series, MS300 series, MH300 series, CH2000 se-ries, MX300-E series
AC Servo Drive	ASDA-A2-E series, ASDA-B3-E series, ASDA-A3-E series, ASDA-A3-EP series, ASDA-W3-E series, ASDA-E3-E series, ASDA-E3C series, ASDA-H3-E series
Remote I/O	EtherCAT: R1-C series, R1-EC series, R2-EC series, R3-C series, RTU-ECAT series, AX-500CEC00 series, ASRTU-EC series EtherNet/IP: AS200 series, AS300 series, AHCPU series

Chapter 2: Installation

This chapter introduces how to use DIAInstaller to install, uninstall, and update DIADesigner-AX.

2.1 System Requirements

The following table lists the system requirements to run DIADesigner-AX.

Item	System Requirements
Operating System	Windows 10/11 (64-bit)
CPU	Intel Celeron 540 1.8 GHz (min.) Intel Core i5 M520 2.4 GHz (min.)
Memory	4 GB or above
Hard Disk Drive	10 GB or above
Monitor	Resolution: 1920 x 1080 Pixels recommended
Keyboard/Mouse	General keyboard mouse or Windows-compatible device
PC interface	EtherNet, USB, Serial port (depends on product interface)
Software	Need to install Microsoft .Net Framework 4.8

2.2 Install DIADesigner-AX

DIAInstaller is used to easily download, install, uninstall, and update all DIAStudio software. You can download DIAInstaller from diastudio.deltaww.com. For more information about DIAInstaller, see *DIAInstaller User Manual*.

Prerequisites

- DIAInstaller is installed.

To install DIADesigner-AX

1. Open DIAInstaller.
2. Click  at the upper-right corner to sign in.
3. Go to **All Apps** and find DIADesigner-AX.
4. In **Available Versions**, select a version.

5. Click  and then select **Install**.
6. Select components to install. You can select the full components or customize the components to install.
7. In the **DIADesigner-AX** dialog, follow the on-screen instructions to complete the installation.

Note:

- You can click **Updates** to check if there are any new versions or patches.
- You can configure the settings of DIAInstaller by clicking  .
- Starting from version 1.7.0, you can install two different versions of DIADesigner-AX on the same computer.

2.3 Uninstall DIADesigner-AX

Follow the steps to uninstall DIADesigner-AX in DIAInstaller.

To uninstall DIADesigner-AX

1. In DIAInstaller, go to **Installed**, and select **Uninstall**.
2. Select the components to uninstall. You can select the full components or customize the components to uninstall and then click **Uninstall**.
3. In the **DIADesigner-AX** dialog, follow the on-screen instructions to complete the uninstallation.

2.4 Update DIADesigner-AX

Follow the steps to update DIADesigner-AX.

To update DIADesigner-AX

1. In DIAInstaller, go to **Updates**.
2. Find DIADesigner-AX.
3. In **Available Versions**, select a version.
4. Do one of the following:
    - Select **Update** and then follow the on-screen instructions to complete the update.
    - Click  and select **Download** to download the installation file to the local path, and then select **Show in folder** to find the EXE file to install.

Chapter 3: Getting Started with DIADesigner-AX

DIADesinger-AX adhares to the IEC-61131 standard progromming. In this quick start example, you will program a simple refrigerator controller.

3.1 Example Description

The completed project **RefrigeratorControl.project_archive** can be found in the DIADesigner-AX installation directory in the Projects sub-directory. In addition to the sample project, you will create one here step-by-step.

- As with a conventional refrigerator, the user specify the temperature via rotary control.
- The refrigerator determines the actual temperature using a sensor. When it is too high, the refrigerator starts the compressor with an adjustable delay.
- When the desired temperature is reached, the compressor will start to cool down minus one degree of hysteresis. The hysteresis here prevents the actual temperature from fluctuating too much within the range of the set temperature, causing the compressor to be turned on and off continuously.
- When the door is open, a lamp lights up inside the refrigerator. When the door is open too long, a beeping acoustic signal sounds.
- If the compressor does not reach the set temperature despite the activity of the motor over a long period of time, then the buzzer emits a steady acoustic signal.

The cooling function is controlled by the main program in the application, while another POU controls the signal management. There are required function blocks in the standard library. The example has no physical temperature sensor or actuator, so you must write a program to simulate heating/cooling. In this way, the operation of the refrigerator controller can be monitored in the online mode.

3.1.1 Create a Project

After the project is created, it is stored in a .project file in the folder you specified.

To create a project

1. Do one of the following:
   - On **Start Page**, click **New Project**.
   - On the quick access bar, click  .
   - Select **File** > **New Project**.
2. In the **New Project** dialog, select **Standard Project** as a template, specify a name and a storage location for the project, and then click **OK**.
3. In the **Standard Project** dialog, select the controller, DDF version, and programming language, and then click **OK**.

3.1.2 Add a Device

DIADesigner-AX supports controllers, servo drives, and AC drives. After the project is created, you can add devices to the project or the device levels.

To add a device

1. On the **Devices** pane, right-click the project name or a device, and then select **Add Device**.
2. In the **Add Device** dialog, select the device, enter **Name**, and then click **Add Device**.

Only the latest version of the device is listed by default. If you want to select the earlier versions of the device, select the **Display all version (for experts only)** checkbox.

3.1.3 Set up Communication

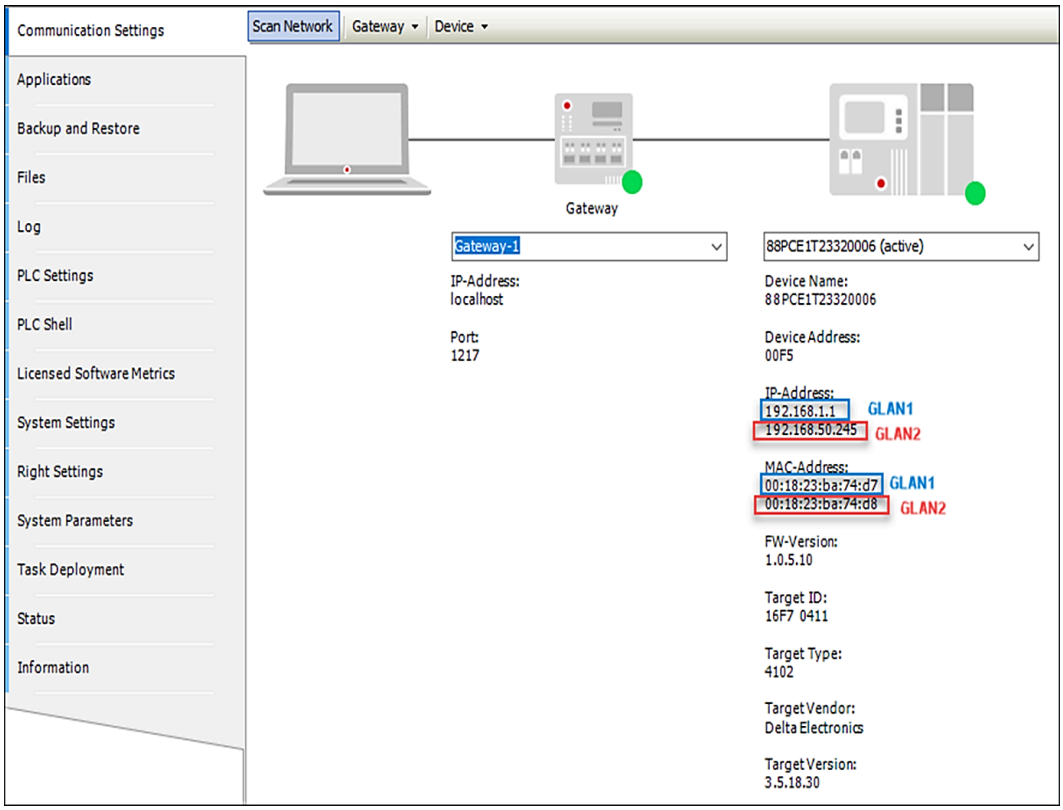
You can use **Communication Settings** to configure and establish communications with the controller.

Prerequisites

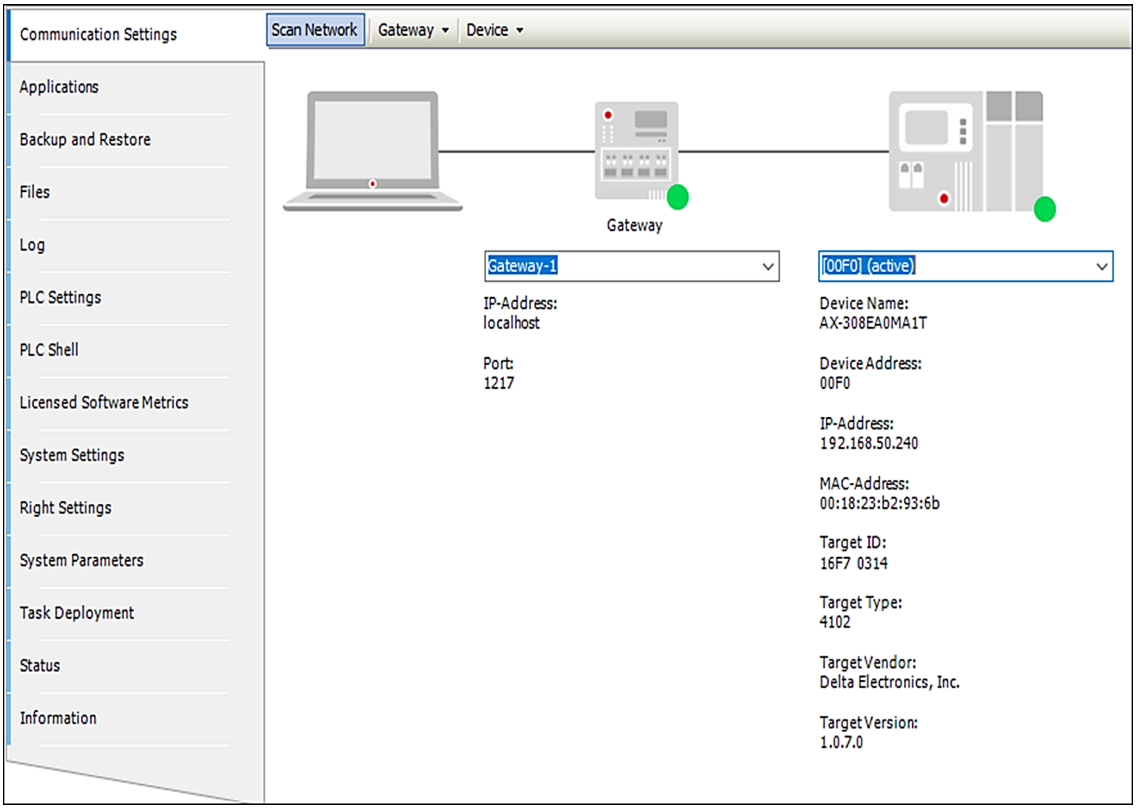
- Set up the local gateway.

To establish communications with the controller

1. On the **Devices** pane, double-click the controller.
2. Go to **Communication Settings**.
3. Click **Scan Network**.
4. In the **Select Device** dialog, select your controller.
   - The IP-Address and MAC-Address are N/A if you specify the username and password in the controller.
   - If you select an AX-8xxEP0 Linux series controller, the IP-Address and MAC-Address will show if the controller firmware version is 1.0.4.4 or later.
   - If you select an AX-8xxEP0 Windows series controller, the IP-Address and MAC-Address will show if the controller firmware version is 1.0.4.12 or later.
   - There are two EtherNet ports on both AX-8xxEP0 Linux and AX-8xxEP0 Windows series controllers. The first IP-Address and MAC-Address are for GLAN1 and the second IP-Address and MAC-Address are for GLAN2.



5. Click **OK**. The device is active and the information shows on the **Communication Settings** pane.



6. Go to **System Settings**.

7. In the **Network** area, click **Read from PLC** to synchronize the IP address from the controller.

Note:

- If you select an AX-8xxEP0 Linux series controller, the **Read from PLC** function will be available if the controller DDF version is 3.5.15.21 or later and the controller firmware version is 1.0.4.4 or later.

- If you select an AX-8xxEP0 Windows series controller, the **Read from PLC** function will be available if the controller DDF version is 3.5.14.17 or later and the controller firmware version is 1.0.4.12 or later.

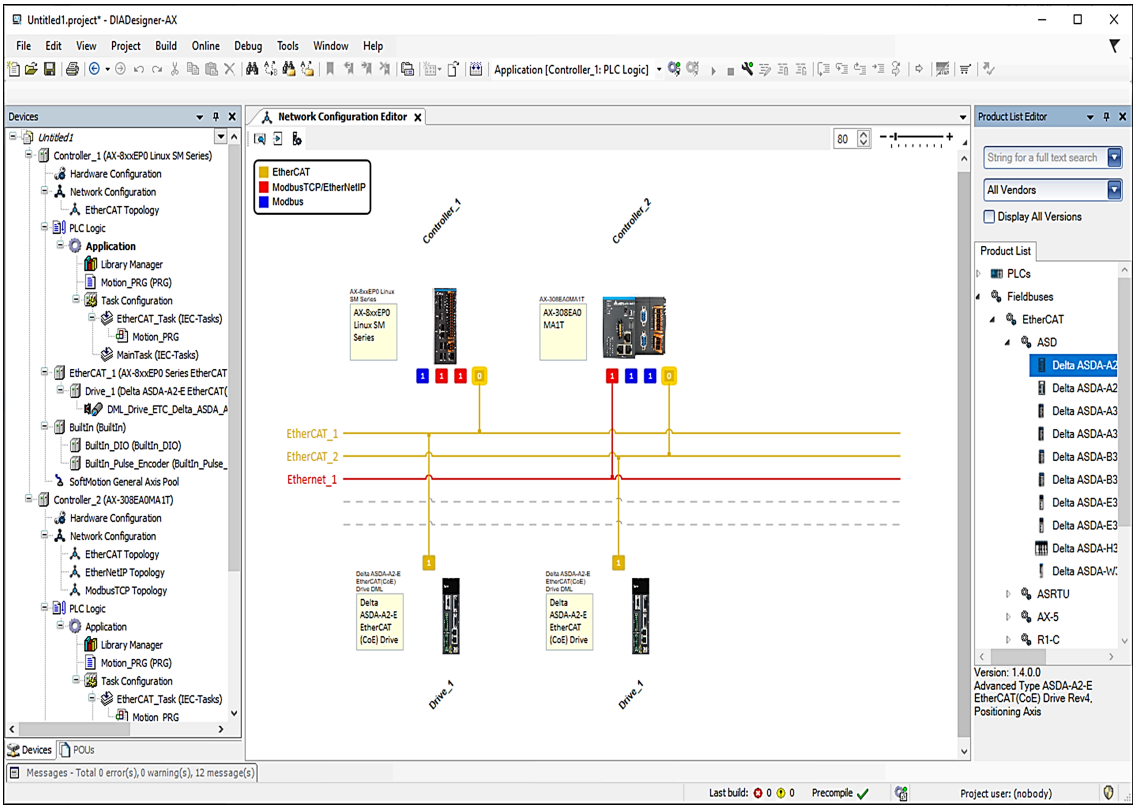
3.1.4 Configure Network

Network Configuration Editor shows the industrial network topology and provides an intuitive and visible approach to configuring the network. After the device is

added, you can view its network topology, add devices, and configure the network connection.

To set up a network connection

1. On the **Devices** pane, double-click **Network Configuration**.
2. On the **Product List** pane, double-click the device or drag it to **Network Configuration Editor**.
3. Click the device port icon and drag it to the network line or other device's port to set up a network connection.



3.1.5 Configure Hardware

In the **Hardware Configuration** editor, you can add modules to the controller, scan devices, and view the device information.

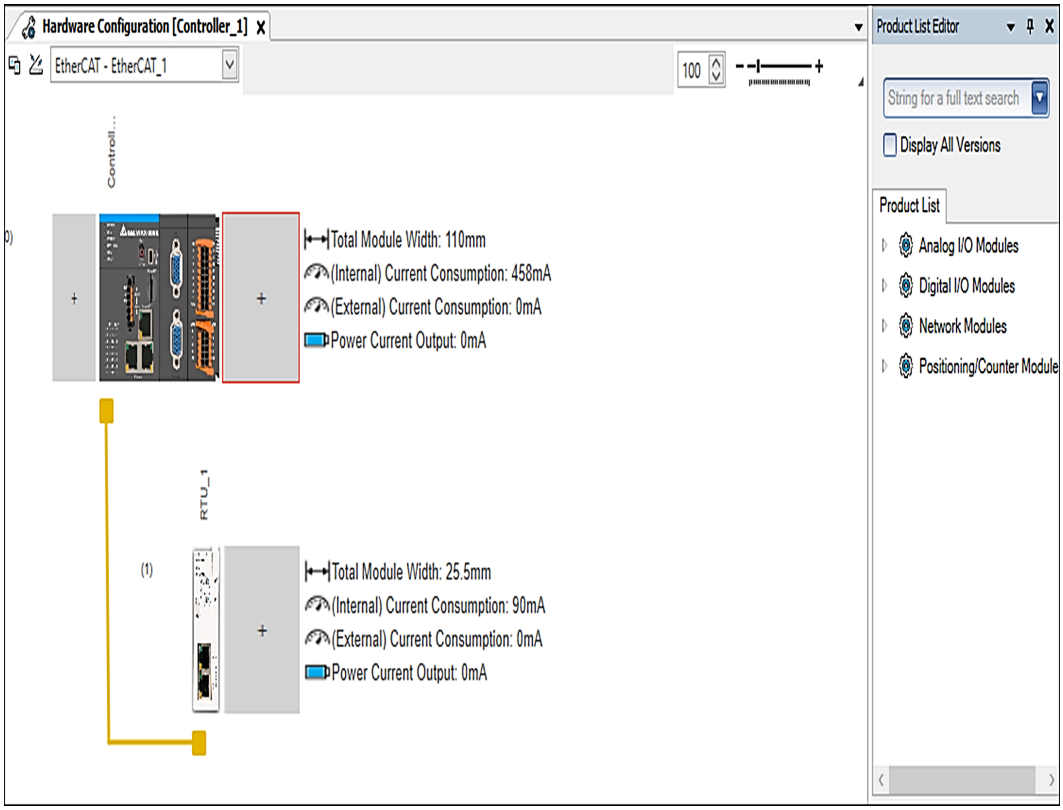
To add a module to the controller

1. On the **Devices** pane, double-click **Hardware Configuration**.
2. In the **Hardware Configuration** editor, click the extension placeholder. Available modules will be listed in **Product List**.

3. Expand **Product List** and do one of the following:

   - Double-click the module.

   - Drag the module to the placeholder.



3.1.6 Declare Variables

Before creating a program, you need to declare the variables for the application by creating a Global Variable List under **Application**.

To declare variables

1. On the **Devices** pane, right-click **Application**, and then select **Add object** > **Global Variable List**.

2. In the **Add Global Variable List** dialog, enter the name for the list and then click **Add**. The default name is GVL.

3. Click  to switch to the tabular view.

4. Click  to insert a new variable.

5. In the **Name** box, enter **rTempActual**.

6. Do one of the following to select **Data type**.

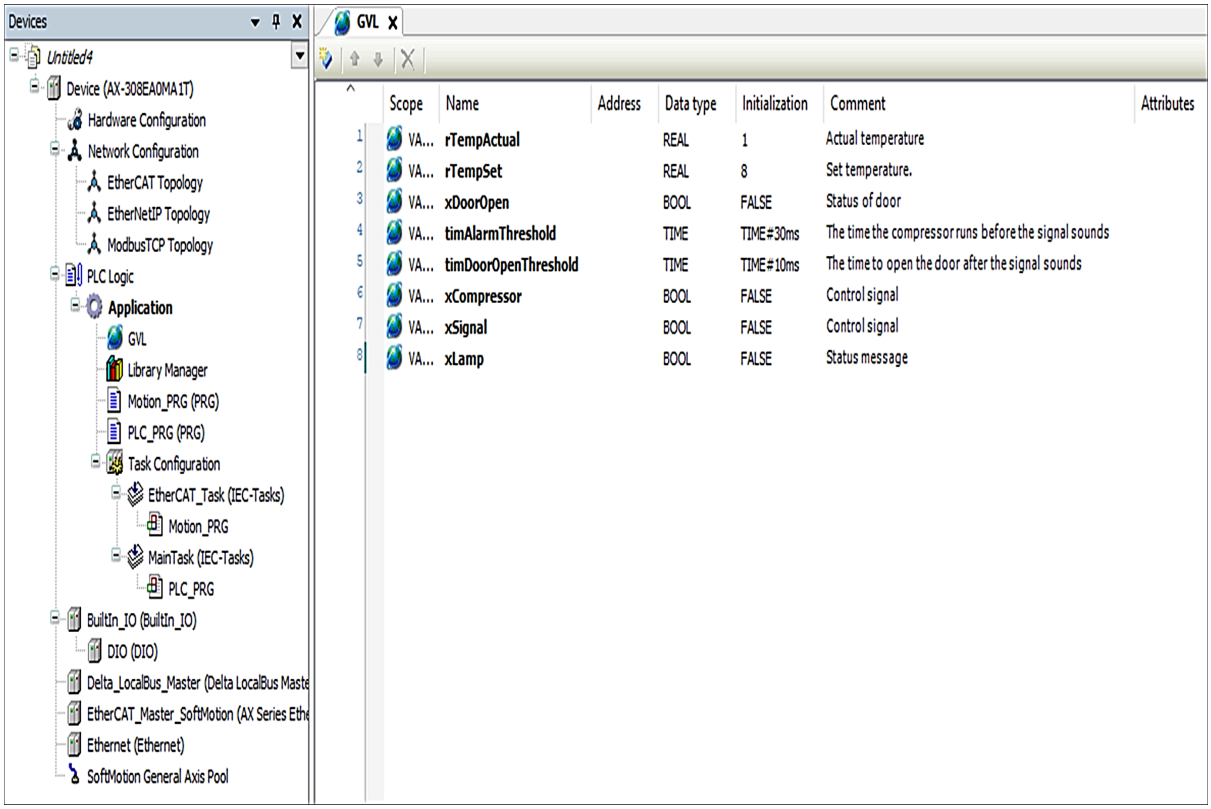
   - Enter the initial letter “R” of the data type, and then select **REAL** from the list shown below.

   - Double-click the **Data type** box and click  and then select**Input Assistant** dialog, on the **Categories** tab, select **Standard Types** > **REAL**, and then click **OK**.

7. In the **Initialization** box, enter a number value, for example, 8.0.

8. Declare the following variables in the same way.

Name	Data Type	Initialization	Description
rTempActual	REAL	1.0	Actual temperature
rTempSet	REAL	8.0	Set temperature.
xDoorOpen	BOOL	FALSE	Status of door
timAlarmThreshold	TIME	TIME#30S	The time the compressor runs before the signal sounds
timDoorOpenThreshold	TIME	TIME#10S	The time to open the door after the signal sounds
xCompressor	BOOL	FALSE	Control signal
xSignal	BOOL	FALSE	Control signal
xLamp	BOOL	FALSE	Status message



3.1.7 Programming

Programming is creating internal logic for a programmable logic controller (PLC). This section introduces how to use different types of languages to create programs to realize a cooling control project.

3.1.7.1 Create a Program for Cooling Control in the CFC Editor

The compressor is activated and cooled if the actual temperature is higher than the temperature set point plus a hysteresis. The compressor is switched off if the actual temperature is lower than the temperature set point minus the hysteresis.

You can describe a main function of the application program in the main program block **PLC_PRG**, which is created by default.

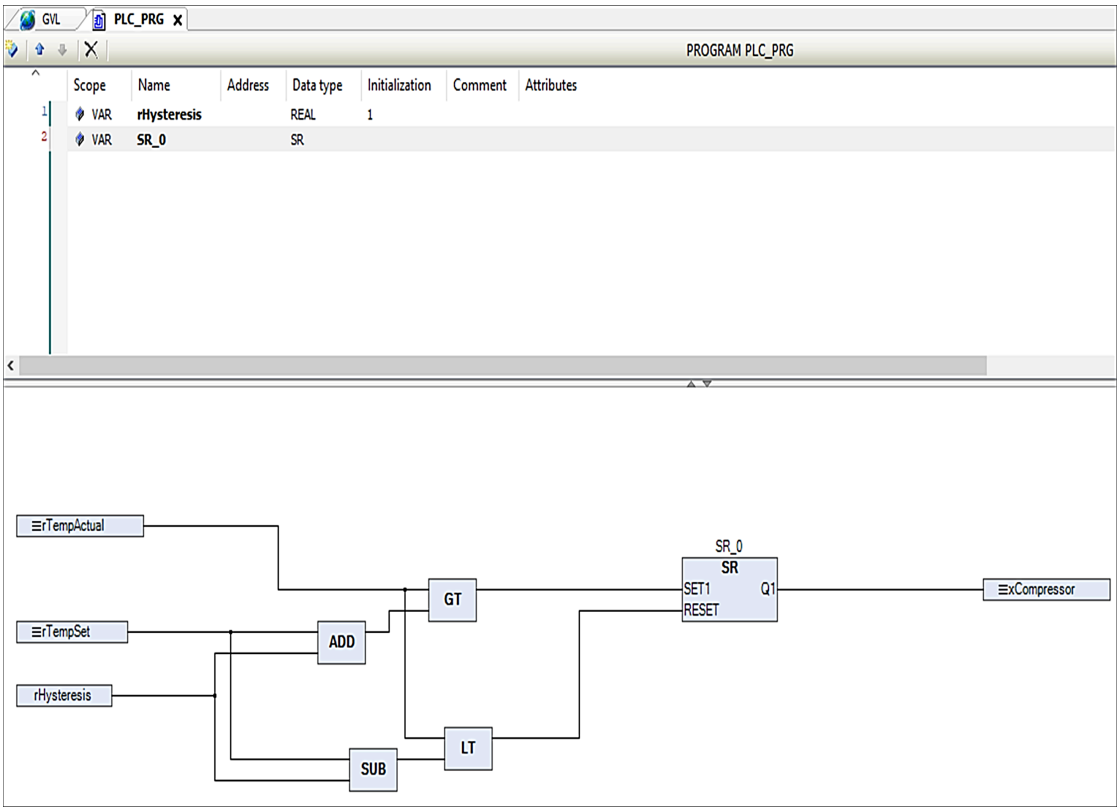
Prerequisites

- Declare the variables mentioned in Declare variables.

To create a main program for cooling control in the CFC editor

1. Create a standard project.
2. In the **Standard Project** dialog, select **Continuous Function Chart (CFC)** for **PLC_PRG in**.
3. On the **Devices** pane, double-click **PLC_PRG**.
4. On the **Delta ToolBox** pane, drag **Input** to the editor.
5. Click ??? > ... .
6. In the **Input Assistant** dialog, select **Application** > **GVL** > **rTempActual** to assign the variable to **Input**.
7. Drag another **Input** and assign variable **rTempSet** to it.
8. Drag another **Input** and rename it with **rHysteresis**.
9. Declare the variable. Select **Data type** as **REAL** and enter 1 for **Initialization**.
10. Drag **Box** to the editor and enter **ADD** in ???.
11. Connect the **rTempSet** and **rHysteresis** pins to the **ADD** input pins.
12. On the **Delta ToolBox** pane, drag **Box** to the editor on the right side of the **ADD** function block and enter **GT** in ???.
13. Connect the **rTempActual** pin to the upper input pin of the **GT** function block.
14. Connect the **ADD** function block output pin to the lower input pin of the **GT** function block.
15. On the **Delta ToolBox** pane, drag **Box** to the editor on the right side of the **GT** function block and enter **SR** in ??? to start or stop the cooling compressor.
16. Declare the variable name as **SR_0** and **Data type** as **SR**.
17. Connect the output pin of **GT** function block to the **SET1** input pin of the **SR_0** function block.
18. Drag **Output** to the editor and assign variable **xComppressor** to it.
19. Connect the **xCompressor** pin to the **SR** output pin **Q1**.

20. Set up a condition under which the compressor should be turned off again (under this condition, the **RESET** input of the **SR** function block will get a TRUE signal). Use **SUB** (subtraction) and **LT** (less than) function blocks.



3.1.7.2 Create a Program for Signal Management in the LD Editor

Now you need to implement the signal management program for the alarm buzzer and for power switch of the lamp. The ladder diagram (LD) language is recommended.

Create the following three signal programs respectively in three networks in the LD editor:

- A continuous acoustic signal sounds when the compressor runs too long because the temperature is too high.
- An intermittent signal sounds when the refrigerator's door is open for too long.
- The light is on as long as the refrigerator's door is open.

To create a continuous acoustic signal program in the LD editor

1. On the **Devices** pane, right-click **Application** and then select **Add Object** > **POU**.
2. In the **Add POU** dialog, enter **Signal** for name and select **Ladder Logic Diagram (LD)** for **Implementation Language**.
3. Click **Add**.
4. On the **Delta ToolBox** pane, expand **Function Blocks** and then drag **TON** to the first network (Network 1) in the editor.
5. Declare the variable name as **TON_0** and **Data type** as **TON**.
6. Assign variable **xCompressor** to the upper input of the **TON** function block so that the function block is activated as soon as the cooling compressor starts to run.
7. On the **Delta ToolBox** pane, expand **Ladder Elements** and then drag **Coil** to the editor.
8. Assign variable **xSignal** to the coil.
9. Assign variable **timAlarmThreshold** to the input pin **PT** of **TON_0** to define the time from the activation of **TON_0** to when the signal should sound.
10. Right-click **TON** and then select **Remove unused FB call parameters**.

To create an intermittent signal program in the LD editor

1. Right-click Network 1 and then select **Insert Network (Below)**.
2. On the **Delta ToolBox** pane, drag **TON** to Network 2.
3. Declare the variable name as **TON_1** and **Data type** as **TON**.
4. Assign variable **xDoorOpen** to the input pin **IN**.
5. Assign variable **timDoorOpenThreshold** to the input pin **PT**.

   As in Network 1, you implement **TON** for time-controlled activation of the signal. This time it is triggered by the global variable **GVL.xDoorOpen** and **GVL.timDoorOpenThreshold**.
6. On the **Delta ToolBox** pane, drag **Box** to the output pin **Q** of **TON_1**.

7. Add blink in the library and declare the variable name as **blink_1** and Data type as **BLINK**.
8. Assign variable **blink_1** to the function block.
9. On the **Delta ToolBox** pane, drag two **Contact** and connect to the **OUT** output pin of the **BLINK** function block.
10. Assign variable **TON_1.Q** to the contact directly after the output **Q** and assign the global variable **xDoorOpen** to the second contact.
11. Drag **Coil** after the two contacts and then assign the global variable xSignal.
12. Declare the local variable **timSignalTime : TIME := T#1S;** and assign this variable to the input pins **TIMELOW** and **TIMEHIGH**.

    The cycle time is 1 second for TRUE and 1 second for FALSE.
13. Right-click **TON** and then select **Remove unused FB call parameters**.

The signal should sound intermittently when the door is open too long.

To create a turning lamps on program in the LD editor

1. Right-click Network 2 and then select **Insert Network (Below)**.
2. Drag **Contact** to Network 3 and assign global variable **xDoorOpen**.
3. Drag **Coil** next to it and assign global variable **xLamp**.

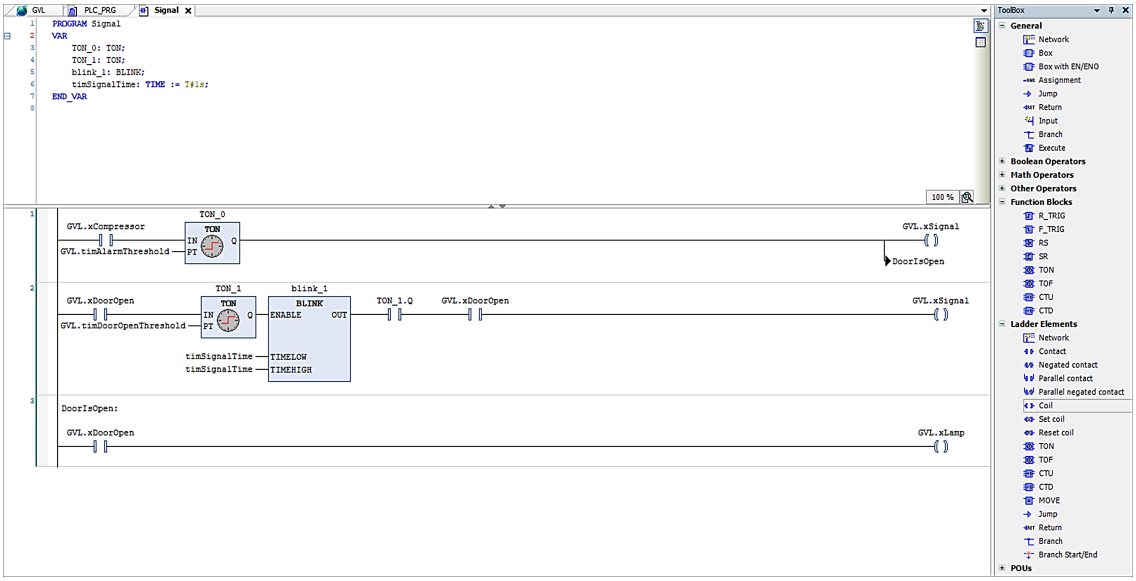
The lamp should be on as long as the door is open.

DIADesigner-AX processes the networks of an LD in succession. You need to insert a jump to Network 3 at the end of Network 1 to ensure that after running Network1, Network 3 runs.

To add a label and jump to run Network 3 after running Network 1

1. Right-click Network 3 and then select **Insert Label**.
2. Replace the text with **DoorIsOpen**.
3. On the **Delta ToolBox** pane, drag **Jump** to the Network 1.
4. Click  and select **DoorIsOpen** from the label identifiers.

5. Click **OK**.



3.1.7.3 Call the Signal Program in the Main Program

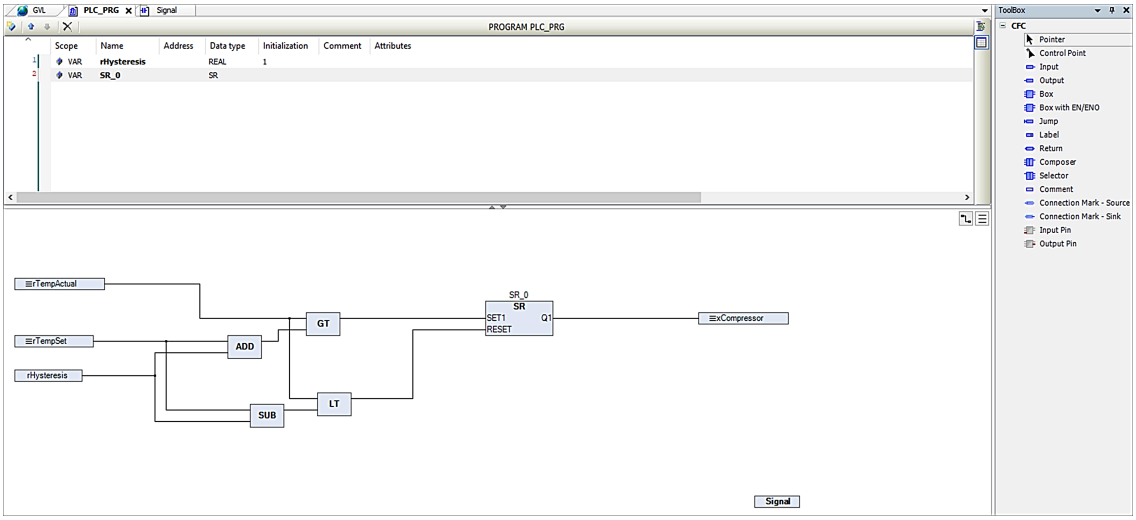
The main program **PLC_PRG** should call the **Signal** program for signal processing.

To call the Signal program in the main program

1. In **PLC_PRG**, on the **Delta ToolBox** pane, drag Box to the editor.

2. Click  and in the **Input Assistant** dialog, select **POU / Program and Function Calls** > **Application** > **Signal**.

3. Click **OK**.



3.1.7.4 Create an ST Program for a Simulation

The application in this example project is not linked to real sensors and actuators. To monitor the operation of the refrigerator controller in online mode, you should write a program for the simulation of rises and falls in temperature.

The program increases the temperature until the main program **PLC_PRG** determines that the temperature set point has been exceeded and activates the cooling compressor. The simulation program then lowers the temperature again until the main program deactivates the compressor.

To create an ST program for a simulation

1. On the **Devices** pane, right-click **Application** and then select **Add Object** > **POU**.
2. In the **Add POU** dialog, enter **Simulation** for name and select Structured Text (ST) for implementation language.
3. Click **Add**.
4. Enter the following program in the ST editor.

```
PROGRAM Simulation
VAR
//The temperature is decreased on a time delay when the
    //compressor has been activated.
    T1: TON;
    P_Cooling: TIME:=T#500MS;
    //Signal for decreasing the temperature
    xReduceTemp: BOOL;
//The temperature is increased on a time delay when the
//compressor has been activated.
    T2: TON;
    //Delay time when the door is closed
P_Environment: TIME:=T#2S;
//Delay time when the door is open
P_EnvironmentDoorOpen: TIME:=T#1S;
//Signal for increasing the temperature
xRaiseTemp: BOOL;
    //Delay time
timTemp: TIME;
iCounter: INT;
END_VAR

//No function, just for demonstration purposes
iCounter := iCounter+1;
//After the compressor has been activated due to rTempActual being
//too high, the temperature decreases.
//The temperature is decreased by 0.1°C per cycle after a delay of
//P_Cooling.
IF GVL.xCompressor THEN
    T1(IN:= GVL.xCompressor, PT:= P_Cooling, Q=>xReduceTemp);
    IF xReduceTemp THEN
        GVL.rTempActual := GVL.rTempActual-0.1;
        T1(IN:=FALSE);
    END_IF
END_IF

//If the door is open, warming occurs faster; SEL selects
//P_EnvironmentDoorOpen.
timTemp:=SEL(GVL.xDoorOpen, P_Environment, P_EnvironmentDoorOpen);

//If the compressor is not working, then the cooling chamber becomes
//warmer.
//The temperature is incremented by 0.1°C per cycle after a delay of
//timTemp.

T2(IN:= TRUE, PT:= timTemp, Q=>xRaiseTemp);
IF xRaiseTemp THEN
    GVL.rTempActual := GVL.rTempActual + 0.1;
    T2(IN:=FALSE);
END_IF
```

GVL | PLC_PRG | Signal | Simulation

```
PROGRAM Simulation
VAR
    //The temperature is decreased on a time delay when the
    //compressor has been activated.
    T1: TON;
    P_Cooling: TIME:=T#500MS;
    //Signal for decreasing the temperature
    xReduceTemp: BOOL;
//The temperature is increased on a time delay when the
//compressor has been activated.
    T2: TON;
    //Delay time when the door is closed
P_Environment: TIME:=T#2S;
//Delay time when the door is open
P_EnvironmentDoorOpen: TIME:=T#1S;
//Signal for increasing the temperature
xRaiseTemp: BOOL;
    //Delay time
timTemp: TIME;
iCounter: INT;
END_VAR
```

```
//No function, just for demonstration purposes
iCounter := iCounter+1;
//After the compressor has been activated due to rTempActual being
//too high, the temperature decreases.
//The temperature is decreased by 0.1°C per cycle after a delay of
//P_Cooling.
IF GVL.xCompressor THEN
    T1(IN:= GVL.xCompressor, PT:= P_Cooling, Q=>xReduceTemp);
    IF xReduceTemp THEN
        GVL.rTempActual := GVL.rTempActual-0.1;
        T1(IN:=FALSE);
    END_IF
END_IF

//If the door is open, warming occurs faster; SEL selects
//P_EnvironmentDoorOpen.
timTemp:=SEL(GVL.xDoorOpen, P_Environment, P_EnvironmentDoorOpen);

//If the compressor is not working, then the cooling chamber becomes
//warmer.
//The temperature is incremented by 0.1°C per cycle after a delay of
//timTemp.

T2(IN:= TRUE, PT:= timTemp, Q=>xRaiseTemp);
IF xRaiseTemp THEN
    GVL.rTempActual := GVL.rTempActual + 0.1;
    T2(IN:=FALSE);
END_IF
```

Note: Visualization is recommended for convenient operation and monitoring of the entire control program. You can add a **Visualization** object to the project. For more information, see CODESYS Visualization.

3.1.7.5 Define the Programs to Run in the Task Configuration

The default task configuration contains the call for the main program **PLC_PRG**. You also need to add the call for the **Simulation** program.

To add the call for the Simulation program

1. On the **Devices** pane, drag **Simulation** to **MainTask**.
2. Double-click **MainTask** to configure the task.

3.1.7.6 Debug the Application Program

Use the following steps to check syntax errors for the programs.

To debug a program

1. Press **F11** to have the entire application checked for syntax errors.
   The results will be shown on the **Messages** pane at the lower-left corner.
2. Select any message and press **F4** to jump directly to the location.

3.1.8 Download and Run the Application

Before downloading the application to the controller, ensure the application has been compiled without errors.

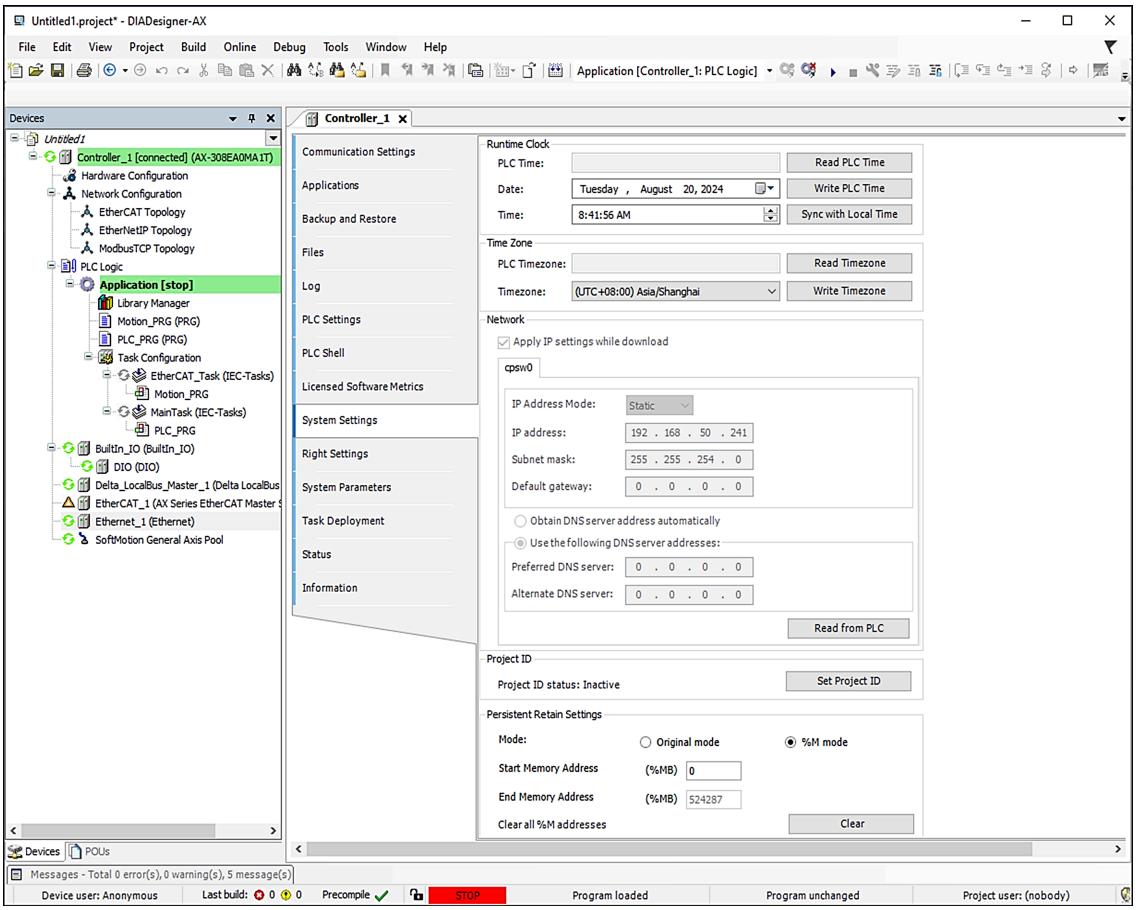
Prerequisites

- The controller is connected.

To download the application to the controller

1. (optional) In the **System Settings** tab, clear the **Apply IP settings while download** checkbox if you want to keep the IP address of the target controller.
2. On the menu bar, click **Online** > **Login**.
   A dialog asking whether to download the application to the controller opens.

3. Click **Yes**. The current status of the controller appears in the taskbar: STOP.



To run the application

- On the menu bar, click  or press **F5**.

The current status of the controller appears in the taskbar: RUN.

3.1.9 Share HMI Tags

DIADesigner-AX supports exporting the user-defined variables to the XML file. The XML files can be imported DIAScreen. Variables in the XML file can be shared as tags between the controller and Delta HMI devices. For more information, see HMI Interactive.

3.2 Create and Manage Projects

When a project is created, the structure for the project is automatically created. The devices and program elements in the project shows in an organized tree view. You can manage program elements and access additional device configuration editors.

3.2.1 Open a Project

Use the following steps to open an existing project.

To open a project

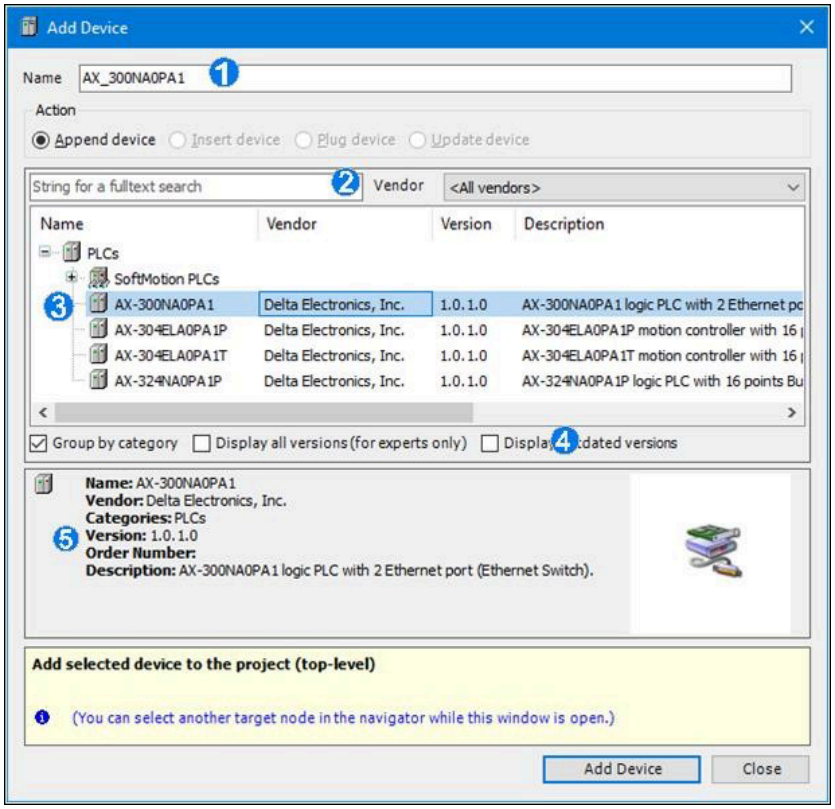
- On the menu bar, click **File** > **Open Project**. Or, double-click the project file.

When double-clicking to open a project in a multi-version DIADesigner-AX environment:

- If a version of DIADesigner-AX installed is the same as the version of the project to be opened, the project is opened directly using that same DIADesigner-AX version. For example, If DIADesigner-AX version 1.6.0 and 1.7.0 are installed on the computer, the version 1.6.0 project will be opened by DIADesigner-AX version 1.6.0.
- If the versions of the installed DIADesigner-AX are all later than the version of the project to be opened, you need to select which version of DIADesigner-AX to open the project.
- If the versions of the installed DIADesigner-AX are all earlier than the version of the project to be opened, you need to install a later version DIADesigner-AX.

3.2.2 Add Device Dialog

The Add Device dialog consists of the following information.



Legend	Description
1	Enter the device name and select to either append a device, insert a device, plug a device, or update a device.
2	Search based on the device name and vendor.
3	Display the available device with its name, vendor, version, and description.
4	Select to group the devices by category, to display either all versions or only display outdated versions.
5	Display the details of the selected device.

The following table lists the differences among Append device, Insert device, Plug device and Update device.

Setting	Description
Append device	Add the selected device below the selected object in the device tree.

Setting	Description
Insert device	Add the selected device at the same level as the selected object below it in the device tree.
Plug device	Add the selected device to the selected slot. If the slot is already occupied, the new module replaces the existing module.
Update device	Replace the device selected in the device tree by the selected device. **Note:** Depending on the device, this may overwrite the existing configuration with the default values in the editor.

3.2.3 Standard Toolbar

The following table lists the icons and functions in the standard toolbar.

Item	Description
	Click to add a new project.
	Click to open an existing project.
	Click to save the project.
	Click to print the project.
	Click to go to the previous opened editor. It locates the position you last stopped in the editor. Click  to select and open the editor that was opened in the history. You can view up to 10 history records.
	Click to go to the next opened editor. It locates in the position you last stopped in the editor.

Item	Description
	Click to undo the previous action.
	Click to redo the last action.
	Click to cut.
	Click to copy.
	Click to paste.
	Click to delete.
	Click to find the text in the active editor.
	Click to replace the text in the active editor.
	Click to find the text in the current project.
	Click to replace the text in the current project.
	Click to add a bookmark in the language editor for easy navigation.
	Click to go to the previous bookmark.
	Click to go to the next bookmark.
	Click to delete bookmarks in the language editor.
	Click to open the **Properties** dialog of the current editor.
	Click to add the following objects: • Action • Method

Item	Description
	• Property • Transition
	Click to edit objects.
	Click to generate code.
	Click to select the active application.
	Click to log in to the controller.
	Click to log out from the controller.
	Click to start running the program.
	Click to stop running the program.
	Click to enter Online Config Mode for the current application.
	Click to write values to the variables.
	Click to run the statement from the breakpoint to debug. To step over means to jump the sub POU if any.
	Click to run the statement from the breakpoint to debug. To step into means to go into and run the sub POU if any.
	Click to jump out of the current sub POU you have stepped in-to. To step out means to jump out of the sub POU and return to the calling POU.
	Click to set a cursor. The program runs from the current breakpoint position and stops at the cursor position without running the code of this line.
	Click to run the statement to the position before the cursor.

Item	Description
	Click to show the current breakpoint position.
	Click to switch between different localizations.
	Click to go to CODESYS store.
	Click to accept differences between the project compared to the current project.

3.2.4 Update Devices

DIADesigner-AX provides a device update function. You can update devices in the project to devices of different versions or types.

To update devices

1. Do one of the following:
    - On the menu bar, select **Project** > **Update Device**.
    - Right-click the device that you want to update and select **Update Device**.
2. In the **Update Device** dialog, select the device to be updated to.
3. (optional) You can select **Update same devices in project** to update all the devices with the same ID and type in the project.
4. Click **Update Device**.
5. In the **Update Device List** dialog, check the update information and select the version for the target device.
6. Click **Update**.

3.2.4.1 Update Device List Dialog

The following table lists the settings in the **Update Device List** dialog.

Item	Description
Device Name	The name of the device in the project tree.

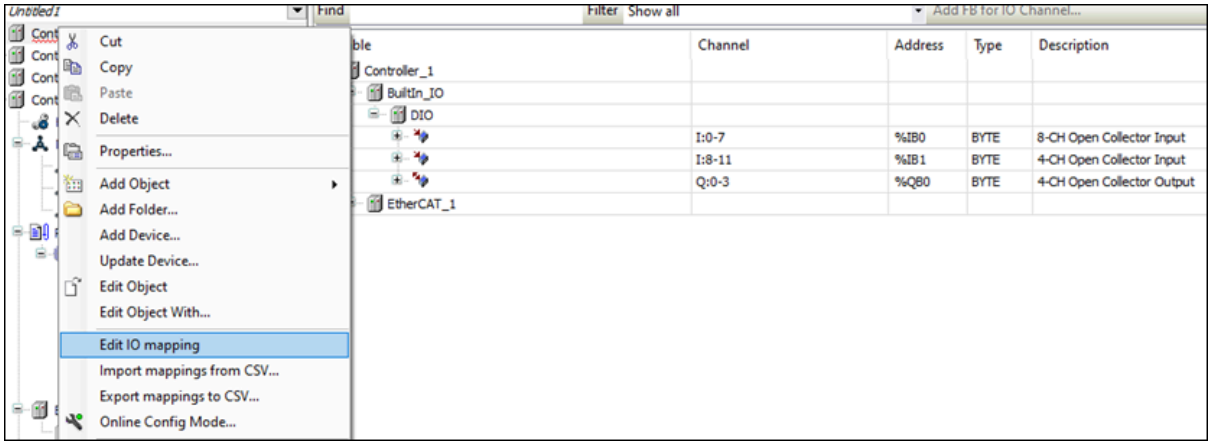
Item	Description
Source	The type and version of the original device.
Target	The type and version of the target device. You can select the version in the dropdown list.
	Some data and configurations may not be updated to the target device due to incompatibility.
	This device will be removed.
	The device will be successfully updated and the configuration will be transferred to the target device.  **Note:** If the source device's version is no longer supported, you cannot roll back to it after updating, so in this case, the target device is the same by default and will not change after updating. If you want to update to another version, change the target device.
Don't show again	If you select the checkbox, the **Update Device List** dialog will not show again. If any updating error occurs, you need to check it manually.

3.2.5 Edit IO Mapping Tab

How do I open the Edit IO mapping tab?

- On the **Devices** pane, right-click the controller and select **Edit IO mapping**.

On the **Edit IO mapping** tab, all I/O maps of the currently device are displayed, including the I/O maps of all additional devices in the project.



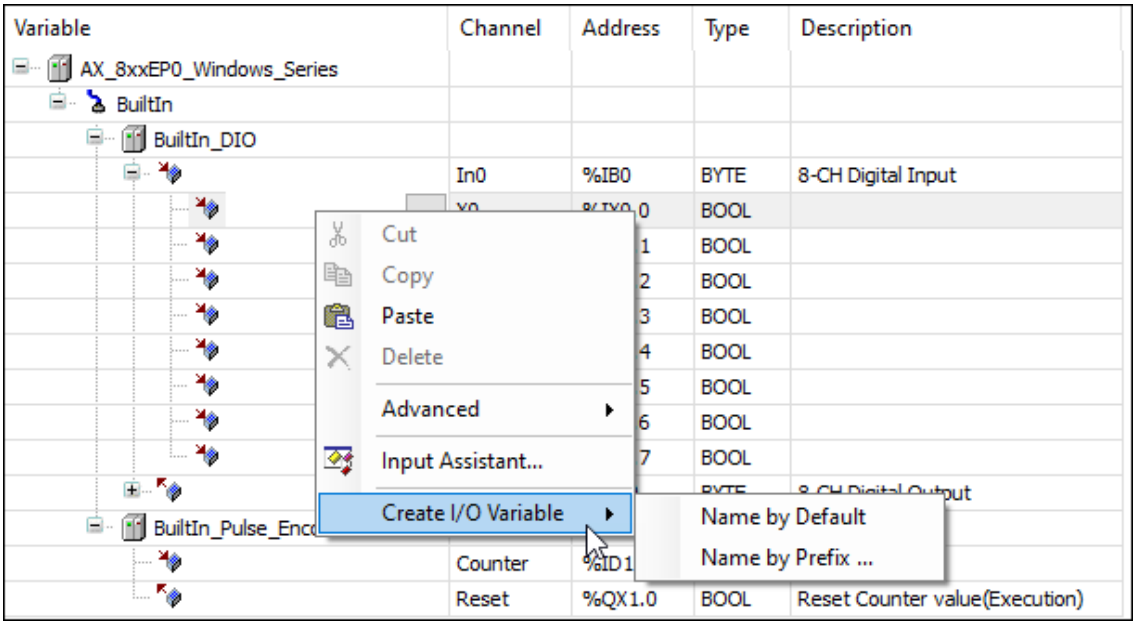
The following table shows the options in the **Edit IO mapping** editor.

Function	Description
Find	Enter the keyword to search the variables. The search result will be marked in yellow.
Filter	Select the I/O allocation filter displayed in the mapping table: • Show all. • Show only inputs. • Show only mapped variables. • Show only mapping to existing variables. • Show only mapping to new variables. • Show only outputs. • Show only unmapped variables.

You can create the I/O variable and name them by the following method:

- **Name by Default**

- **Name by Prefix**



Chapter 4: Programming Reference

The Programming Reference section provides information relevant to a AX series controller.

4.1 IEC61131-3 Programming

IEC61131-3, published by International Electrotechnical Commission (IEC) standardizes the syntax and semantics of the programming languages used for programmable controllers. This set of standards improved the interoperability, reusability, and efficiency of programming. Based on the IEC61131-3 standards, DIADesigner-AX integrated programming languages that manufacturers and users can follow.

- DIADesigner-AX supports the following IEC61131-3 programming languages.
  - Structured Text (ST)
  - Ladder Diagram (LD)
  - Sequential Function Chart (SFC)
  - Function Block Diagram (FBD)
  - Instruction List (IL)
  - Continuous Function Charts (CFC)—An IEC61131-3 extension language, derived from the Function Block Diagrams (FBD)
- The concept of Variable is adopted. You can replace a register address with a variable. A Program is more readable and the time of assigning addresses is saved.
- The architecture related to Program Organization Units (POUs) is adopted. A traditional program is divided into several independently-developed program organization units. The architecture of a program can be more modular and can be maintained more easily by calling Functions and Function Blocks.
- Program Organization Units (POUs) are managed and organized through the concept related to tasks. The development of programs is upgraded to the management of projects. The large-scale development of programs can be managed more easily.

4.1.1 Delta ToolBox

The enhanced **Delta ToolBox** gives a more user-friendly programming experience, designed to simplify navigation tailored to your preference. It provides IEC standard operators (such as Boolean and math operators), function blocks, and POU defined in the current program for the LD editor. **Delta ToolBox** also provides AX Series Standard Instructions, AX Series Motion Control Instructions, and basic language-specific instructions. By default, the toolbox only shows the elements supported by the current editor.

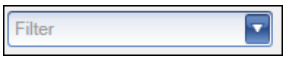
You can do the following in **Delta ToolBox**.

- Customize instruction categories.
- Add instructions from **Input Assistant**.
- Drag the element to the editor for programming.

Note: If you close the toolbox, you can reopen it from the menu bar > **View** > **Delta ToolBox**.

4.1.1.1 Delta ToolBox Settings

The following table lists the settings in the toolbox and their descriptions.

Setting	Descriptions
	Enter keywords to filter folders and elements whose names contain the keywords. You can click  to clear all search histories.
	Click to open the **New Category** dialog to add a new folder to contain customized instructions. You can categorize instructions by creating different folders. Enter descriptions for this category in the **New Category** dialog, and the descriptions will be shown at the bottom of the toolbox when you click the folder.

Setting	Descriptions
	The folder's placement depends on the current cursor position. • If you click the button when the cursor focuses on a blank area, the folder will be added to the bottom of the list. • If you click the button when the cursor focuses on a customized folder, the folder will be added as a child folder. **Note:** Customized folders can only be created under **My Favorites** or by clicking a blank area.
	Click to open the **Input Assistant** dialog to add a new instruction from the library to the selected customized folder.
	Click to delete the selected customized folder or the instruction in the folder.
	Click to move up the selected instruction or folder. You can only move the instructions in **My Favorites** and customized folders or move customized folders.
	Click to move down the selected instruction or folder. You can only move the instructions in **My Favorites** and customized folders or move customized folders.
	Click to export the instructions in **My Favorites** and customized folders to an XML file of the current editing toolbox. If you want to see your custom data of the last saved project, go to C:\ProgramData\Delta Industrial Automation\DIAStudio\DIADesigner-AX_XXXXXXXX\ToolBox Data.
	Click to import an XML file containing the instructions in **My Favorites** and customized folders. The imported data will replace the original data.

The following table lists the context menu by right-clicking the element or blank area in the toolbox.

Setting	Descriptions
Add to Favorites	Select to add the selected instruction to **My Favorites**.
Delete	Select to delete the selected customized folder or the instruction in the folder.
New category	Select to add a new folder. It works the same as clicking  .
Rename	Select to rename the selected customized folder or enter descriptions.

If you have saved the project, the toolbox will retain its customized data when reopening a project or DIADesigner-AX.

4.1.2 Ladder Diagram (LD)

LD is a graphical programming language representing electrical relay logic using horizontal lines (rungs) and vertical lines (rails) that resemble a ladder. Each rung represents a specific control operation, with inputs on the left side and outputs on the right. This format allows for easy visualization and understanding of the control logic.

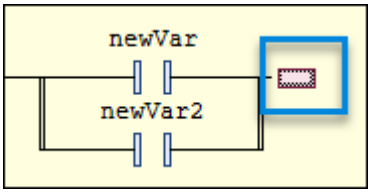
LD is mainly composed of networks which contain elements like contacts, coils, function blocks, and branches. These elements are inserted, dragged, copied, and pasted to networks to build the execution logic of the program.

To set the font, operands, network title, and comment display of the LD editor, on the menu bar, select **Tools** > **Options** > **FBD, LD and IL editor**.

The LD editor offers to:

- Expand or collapse a network or all networks.
- Select multiple elements.
- Copy, paste, insert, or delete multiple elements.

- Connect the start and end points by drawing lines to create a parallel contact.
- Comment or uncomment multiple networks.
- Add an element to the right of the closed parallel contact by right-clicking or dragging elements to the rectangle.



- Drag elements from the toolbox to the editor.
- Perform online commissioning functions such as monitoring, writing values, forcing values, and breakpoints.

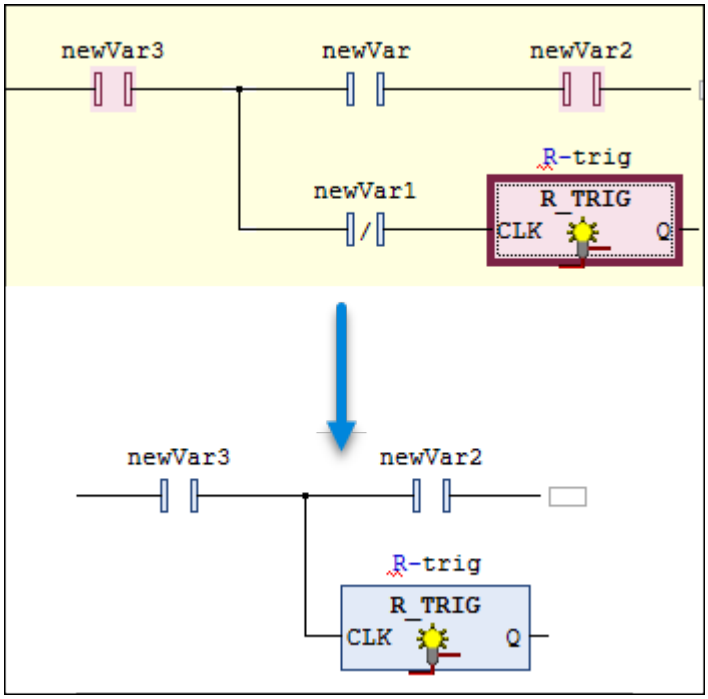
4.1.2.1 Select Elements

You can select an element or network at a time, select multiple elements in the same network, or select multiple networks.

You can select multiple elements:

- Contiguously by pressing **Shift**.
  Select the first element within the rectangle, hold the **Shift** key, and then select the last element.
- Non-contiguously by pressing **Ctrl**.
  Select the first element, hold the **Ctrl** key, and then select other elements. You can also select the element to undo the selection.
- Through a box selection.
  Click the left mouse button and drag a box, and then release the mouse button to select all element inside the box.

Note: If the selected elements are across multiple branches, you can only paste or drag them to a new network not a specified position.



4.1.2.2 Drag Elements

The LD editor supports drag-and-drop editing. You can select one or more elements for the drag-and-drop operation.

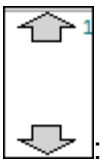
To drag elements

- On the **Delta Toolbox** pane, drag an element to the network in series.
- Drag elements within the current LD editor to another LD editor.
- Drag the element in the network to another element of the same type to replace it.

The dragged elements are moved from the original place to the new place. If you want to keep them in both places, press and hold the **Ctrl** key and drag directly without releasing the mouse.

When you drag an element, the LD editor shows the available positions to drop the element.

-  : You can drag the element here and insert it in series.
-  : You can insert a parallel element above or below the element.

  You can only drag multiple elements before or after an element.
-  : You can add a network containing the dragged elements above or below the current network and the dragged elements are deleted from the original position.

4.1.2.3 Draw Lines

Starting from DIADesigner-AX version 1.8.0, the LD editor supports dragging the start point on a line to the available end point to create a parallel contact.

Prerequisites

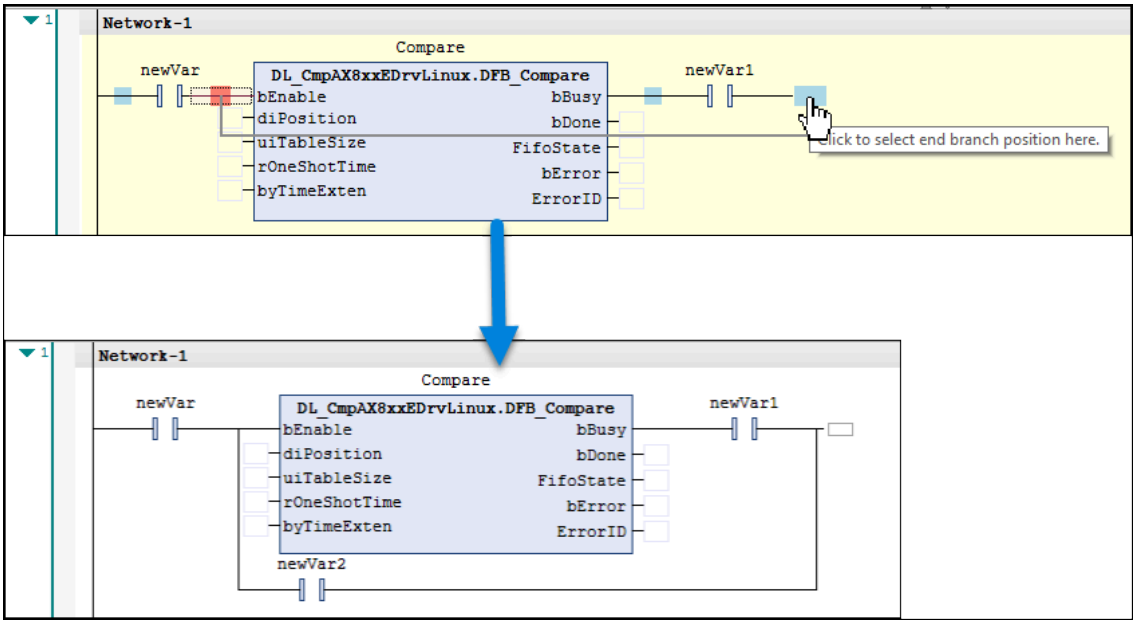
The start and end points must be on the same line.

To connect points to create a parallel contact

1. Select a start position on the line.

   The start position is shown as a red square.
2. Drag lines to the available end position.

The available position is shown as a light blue square.



Note:

- The parallel contact created this way is closed by single vertical lines, indicating an OR operation. If you want to perform an SCE (Short-Circuit Evaluation) operation for the parallel structure, use Set Branch Start/End Point.
- You cannot drag lines across branches. For example, the start point is on the left side of the branch and the end point is on the right side.

4.1.2.4 Copy, Cut, and Paste Elements

DIADesigner-AX version 1.8.0 optimizes the diagram logic by solving copying and pasting logic issues, resulting in a more streamlined programming experience.

You can copy, cut, and paste selected elements both within the same POU and across different POUs. The following elements can be copied: networks, contacts, coils, function blocks, strings, and branch lines. When pasted, the elements will automatically generate a new logic at the selected line position. However, you cannot paste copied or cut elements onto another element to replace it.

4.1.2.5 Add Elements

You can add elements to the editor using the toolbar, **Delta ToolBox**, and context menu.

To add elements to the editor

- On the toolbar, select the element.

  You can customize the toolbar commands from the menu bar > **Tools** > **Customize** > **Toolbars** > **FBD/LD/IL**.

- On the **Delta ToolBox** pane, drag the element to the editor.

- Right-click the network or elements and select the option from the context menu.

4.1.2.6 Delete Elements

The LD editor supports deleting the selected element and blank branch line.

4.1.2.7 Context Menu Settings

The following table lists the default context menu shown when right-clicking a network or an element.

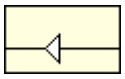
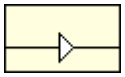
Setting	Descriptions
Collapse All Networks	Select to collapse all networks. If you only want to collapse a single network, click  on the leftmost side of the network.
Expand All Networks	Select to expand all networks. If you only want to expand a single network, click  on the left-most side of the network.
Insert Network	Select to add a network above the selected net-work.
Insert Network (Below)	Select to add a network below the selected net-work.

Setting	Descriptions
Insert Label	Select to insert a jump label to the selected network to indicate the jump position of a jump element.
Toggle Network Comment State	Select to comment or uncomment the selected networks. You can select multiple networks and then use this command for batch commenting or uncommenting. If the network is commented, the code of the entire network will not run.
Insert Box	Select to open the **Input Assistant** dialog to select the function block to be added to the selected position. Insertion position (Suitable for all boxes): • If a network is selected, the new box is inserted at the end. • If an element is selected, the new box is inserted to its left. This option is not available for the function block without inputs or outputs.
Insert Empty Box	Select to add an empty function block to the selected position without using the **Input Assistant** dialog. You can enter the function block name to specify the function block type. This option is not available for the function block without inputs or outputs.
Insert Empty Box with EN/ENO	Select to add an empty function block with an Enable Boolean input and an Enable Out Boolean output to the selected position without using the input assistant. This function block only runs when EN is TRUE. You can enter the

Setting	Descriptions
	function block name to specify the function block type. This option is not available for the function block without inputs or outputs.
Insert Box with EN/ENO	Select to open the **Input Assistant** dialog to select the function block with EN/ENO input and output to be added to the selected position. This option is not available for the function block without inputs or outputs.
Insert Execute Box	Select to add an **Execute** function block to the selected position. This option is not available for the function block without inputs or outputs.
Insert Box Parallel (below)	Select to add an empty function block below the selected function block. This option is not available for the function block without inputs or outputs.
Insert Coil	Select to output a coil. If the selected position is a coil, return, jump, or function block output connection lines, a new coil is inserted below.
Insert Set Coil	Select to output a set coil. The operation is the same as **Insert Coil**.
Insert Reset Coil	Select to output a reset coil. The operation is the same as **Insert Coil**.
Insert Contact	Select to add a Normally Open (NO) contact in series. Insertion positions:

Setting	Descriptions
	• If a network is selected, the new contact will be inserted at the end. • If a horizontal line is selected, the new contact will be inserted at the current position. • If an element is selected, the new contact will be inserted on the left of the element.
Insert Negated Contact	Select to add a Normally Closed (NC) contact in series. The insertion positions are the same as that of Insert Contact.
Insert Contact (right)	Select to add an NO contact to the right of the selected element in series. If a network is selected, the new contact is inserted at the end.
Insert Contact Parallel (below)	Select to add an NO contact below the selected position in parallel. The selected position can be a contact or function block. This option is not available for the function block without inputs or outputs.
Insert Contact Parallel (above)	Select to add an NO contact above the selected position in parallel. The selected position can be a contact or function block. This option is not available for the function block without inputs or outputs.
Insert Negated Contact Parallel (below)	Select to add a negated contact below the selected contact in parallel.

Setting	Descriptions
Paste Contacts	• Paste below: Select to paste a contact below the selected position and create a parallel structure. • Paste right(after): Select to paste a contact to the right of the selected position. • Paste above: Select to paste a contact above the selected position and create a parallel structure. The paste position can be a contact or lines between contacts. You cannot paste a contact to multiple elements at once.
Insert Jump	Select to add a jump element. The jump position is the label position in the network. Jump across networks is supported.
Insert Return	Select to add a return element. When the inputs are valid, the current POU returns to the caller POU.
Insert Branch	Select to add a non-closed branch below the selected line position. You cannot close a branch. A branch only ends with a coil. If a contact is selected, the branch is inserted after it. You cannot select coils or boxes and run this command.
Insert Branch Below	Select to add a non-closed branch below the selected branch. The insertion position should be the start of the branch.
Insert Branch Above	Select to add a non-closed branch above the selected branch. The insertion position should be the start of the branch.

Setting	Descriptions
Go to…	Select to open the **Go to Network** dialog to specify the target network number or label to jump to.
Negation	Select to negate the function block input and output, jump, return, contact value, or coil.
Edge Detection	Select to add the edge trigger to contacts, function block input lines, coil input lines, jump element input lines, and return element input lines. Select a contact and run this command.  indicates the rising edge and  indicates the falling edge. For adding edge detection to the line:  indicates the rising edge and  indicates the falling edge. Rising edge detection is equivalent to the R_TRIG function block and falling edge detection is equivalent to the F_TRIG function block. The edge detection function is added only to input lines of the BOOL type.
Set/Reset	Select to add a Set or Reset output function for the function block's coils and BOOL output lines. The Set output is shown as S, and the Reset output is shown as R. This command can be run multiple times and switch among Set, Reset, and normal output.
Set Branch Start/End Point	Select to set the selected position as the start point and then select an available end point to create a parallel contact. The parallel structure

Setting	Descriptions
	is closed by double vertical lines, indicating an SCE (Short-Circuit Evaluation) operation is performed. If you want to perform an OR operation, use Insert Contact Parallel (below) or Draw Lines.
Set Output Connection	Select to set this output pin as the main output of the function block. A function block only has one main output linked to the subsequent element.
Update parameters	Select to update the input and output parameters of the selected function block if there are changes.
Remove unused FB call parameters	Select to delete the unused input and output parameters. When the inputs or outputs of the function block are **???** or empty, they are not shown.

4.2 Variable

Use variables to store and process information. The variable types include:

- Local variable (VAR)
- Input variable (VAR_INPUT)
- Output variable (VAR_OUT)
- I/O variable (VAR_IN_OUT)
- Temporary variable (VAR_TEMP)
- Global variable (VAR_GLOBAL)

You can also add flags to the variable to specify the attribute:

- Retain variables (RETAIN)
- Persistent variable (PERSISTENT)
- Constant variable (CONSTANT)

You can set up variables in POU, Global Variable List, Network Variable List, Persistent Variables, and the DUT editor.

The following table identifies the variable parameters and their descriptions.

Item	Description
Scope	Type of the variable.
Name	Name of the variable.
Address	The address that stores the variable.
Data Type	Data type of the variable. A standard data type or a user-defined data type.
Initialization	The value of a variable when a controller starts running for the first time.
Comment	User-defined text for the variable.
Attribute	Properties of the variable.
Dimension	The number of elements of an array. For example, [1..10,1..5] represents a two-dimensional array containing a total of 50 elements.

4.2.1 Create an Array Variable

An array is a collection of data elements of the same data type. One and multi-dimensional arrays are supported. Use the following steps to create array variables in the LD POU editor. You can use the same steps for the other supported editors.

To create an array variable

1. Create a project.
2. On the **Devices** pane, right-click **Application,** and then select **Add Object** > **POU**.
3. In the **Add POU** dialog, enter the POU name and select **Ladder Logic Diagram (LD)** in **Implementation language**, and then click **Add**.
4. In the variable declaration editor, click  to switch to Tabular View, and then click  to insert a variable.
5. Enter a name for the variable.
6. Double-click the **Data Type** box and click  and then select **Array Wizard**.
7. In the **Array dialog**, enter **Dimensions** and **Base Type**. If you want to find a base type, click  and select **Input Assistant**. In the **Input Assistant** dialog, search the base type under **Text Search**, or select one from **Standard Types** or **Structured Types** under **Categories**.

4.2.2 Create a Structure Variable

You can create structures in a project as DUT (Data Unit Type). Use the following steps to create structure variables.

To create a structure variable

1. Create a project.
2. On the **Devices** pane, right-click **Application,** and then select **Add Object** > **DUT**.
3. In the **Add DUT** dialog, enter the name and select a type, and then click **Add**.
4. In the **DUT** editor, enter the text for the structure.
5. Create a POU.
6. In the variable declaration editor, click  to switch to Tabular View, and then click  to insert a variable.

7. Enter a name for the variable.
8. Double-click the **Data Type** box and click  , and then select **Input Assistant**.
9. In the **Input Assistant** dialog, on the **Categories** tab, select **Structured Types**.
10. Expand the **Application** node, and select the DUT you created, and then click **OK**.

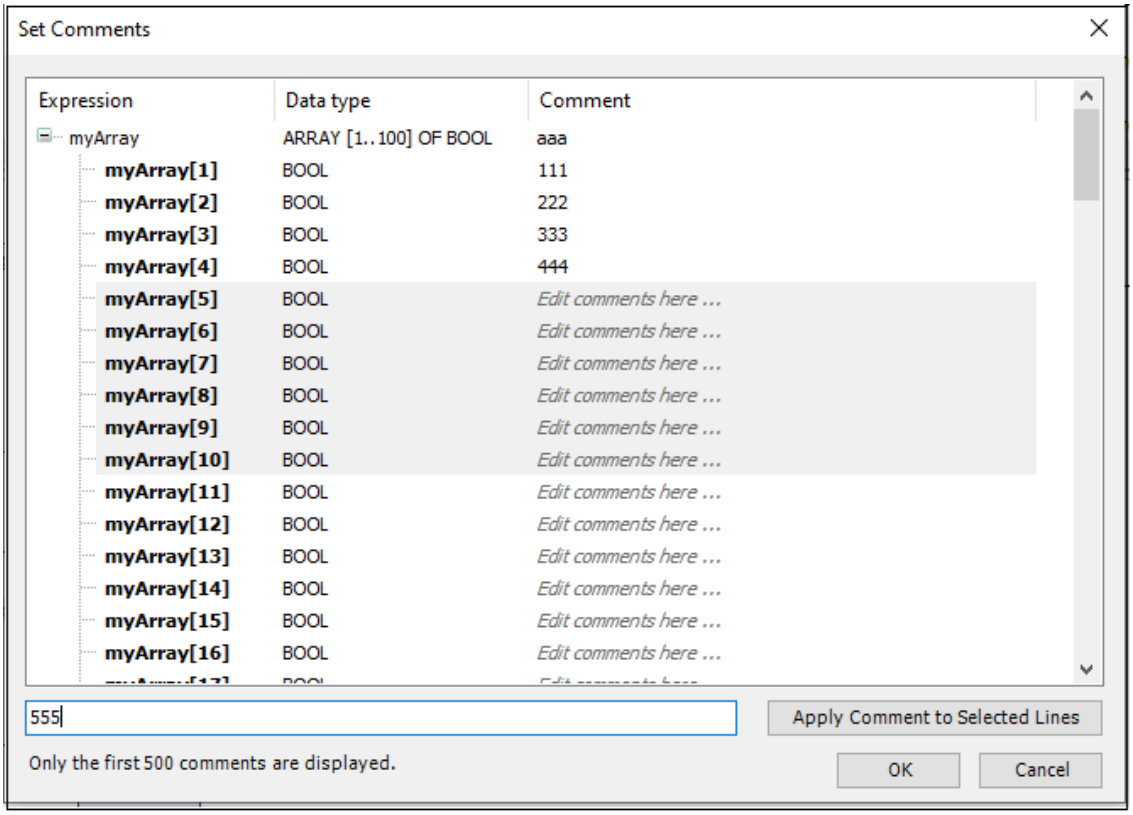
4.2.3 Set up Comments for Array and Structure Variables

You can set up comments for array and structure variables in:

- POU editors (FBD, LD, ST, CFC, and SFC), and the Method editor
- Global Variable List
- Global Variable List (tasklocal)
- Network Variable List (Sender)
- Persistent Variables

To set array and structure variable comments

1. Create an array or structure variable.
2. Do one of the following to open the **Set Comments** dialog:
   - Right-click the variable, and then select **Set Comments**.
   - Double-click the **Comment** box and then click  .
3. In the **Set Comments** dialog, enter the comments for the variable and the sub-elements.
   If you want to enter the same comment for multiple lines, select the lines and enter the comment in the bottom textbox, and then click **Apply Comments to Selected Lines**.

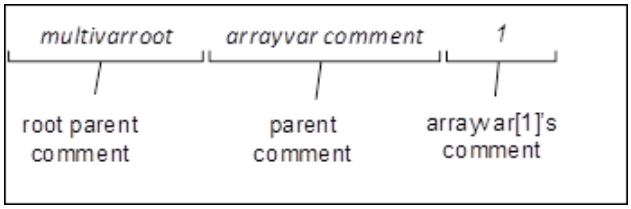


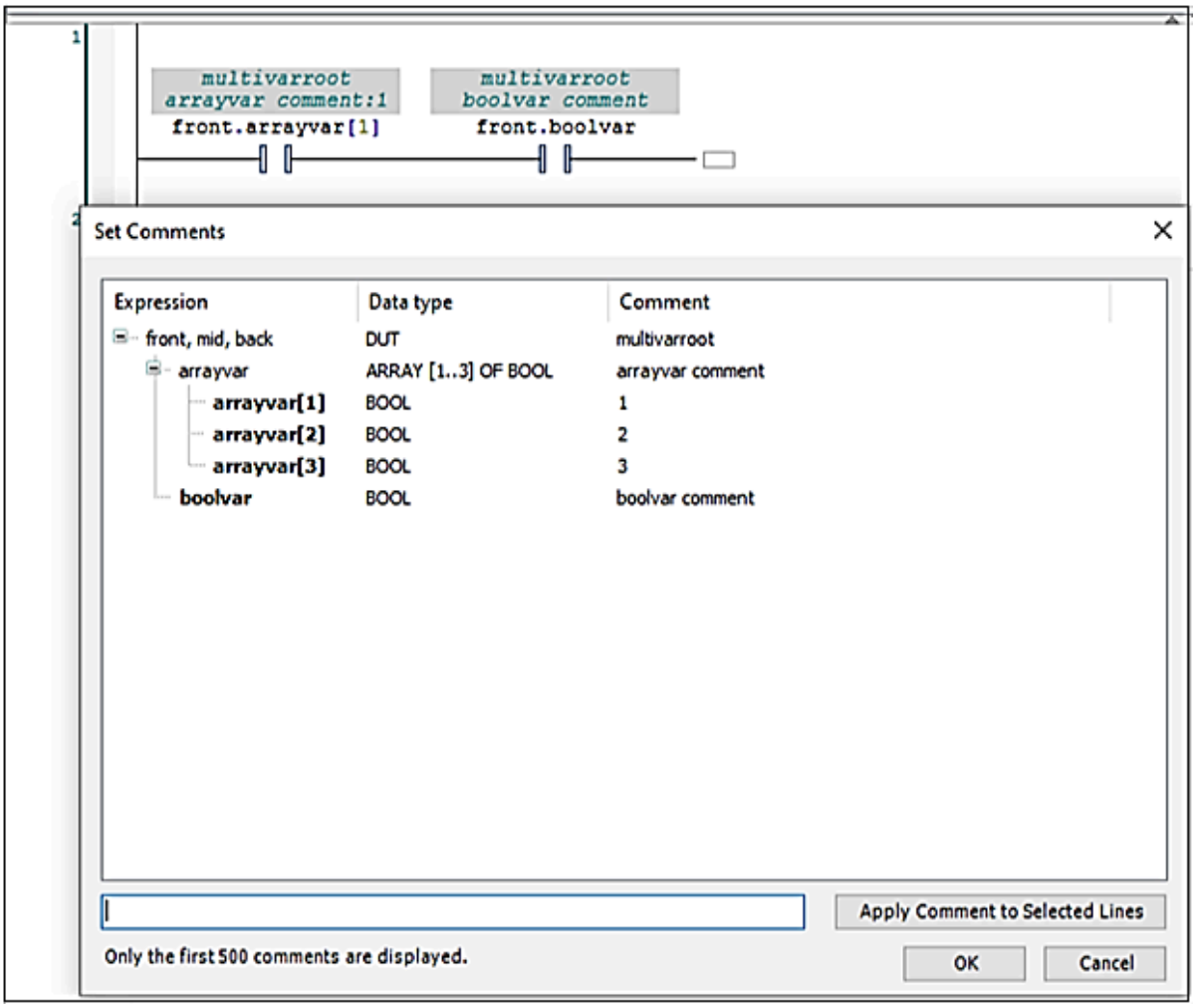
4. Click **OK**. The sub-comments will be synchronized and shown in the **Attributes** column.

To view the comments in the POU editor

1. Insert an element in the POU editor and assign a variable to it.
2. Do one of the following:
   - Check the tooltip by hovering over the element.
   - Go to **Tools** > **Options** > **FBD**, **LD and IL editor**, and select **Show symbol comment**, then go back to the **POU** editor and view the symbol label.

Note: After the comment is set, it will be shown with all the comments of its parent levels. In the following example, arrayvar[1] is assigned to Contact, and when you view the comments of arrayvar[1], it will show *multivarroot arrayvar comment:1*.





4.2.4 Persistent Retain Variable

Persistent retain variables protect the variables from power failure, and their value are retained after a download or controller restart.

The following table lists the status of variable values after performing different actions.

Action	Variable	Retain Variable	Persistent Retain Variable
Online Change	Retain	Retain	Retain

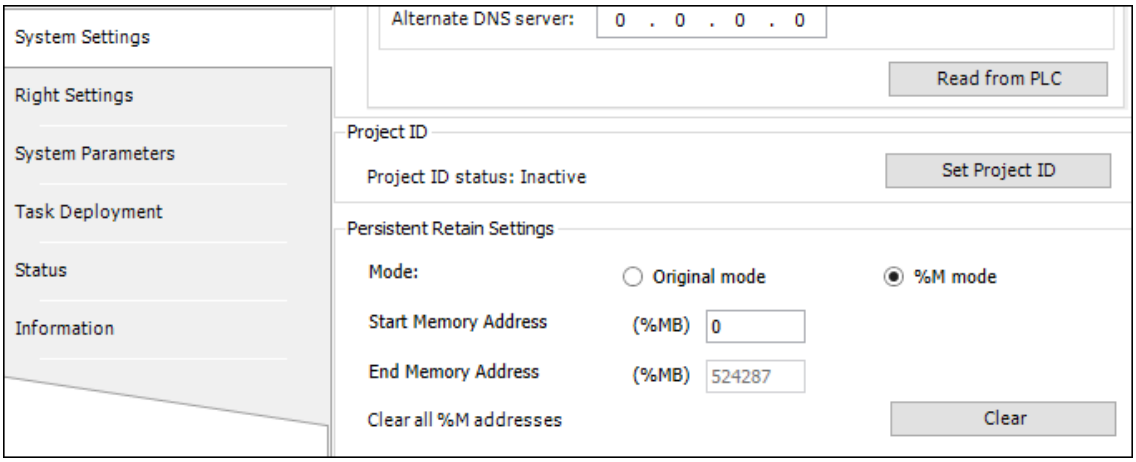
Action	Variable	Retain Variable	Persistent Retain Variable
Power Failure	Initialize	Retain	Retain
Reset Warm	Initialize	Retain	Retain
Reset Cold	Initialize	Initialize	Retain
Download	Initialize	Initialize	Retain
Reset Origin	Initialize	Initialize	Initialize

4.2.4.1 Create a Persistent Retain Variable in the %M mode

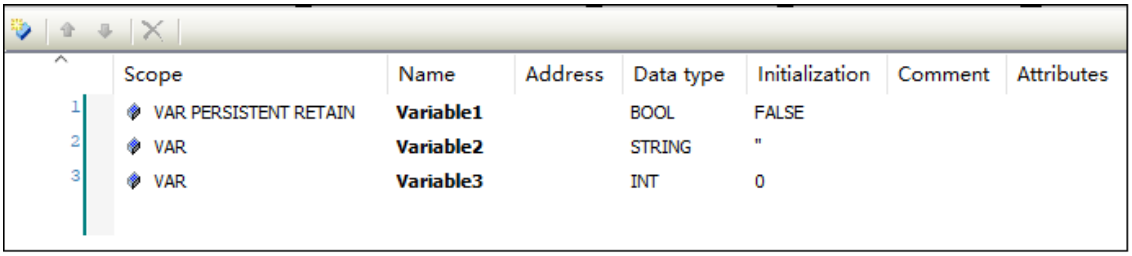
Use the following steps to create a persistent retain variable in the %M mode.

To create a persistent retain variable

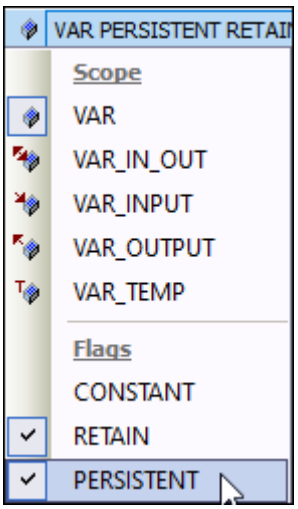
1. On the **Devices** pane, double-click the controller.
2. Go to **System Settings** > **Retain Settings** and select **%M mode**.
3. Enter **Start Memory Address**. The value can start with the default value in **Start Memory Address** and cannot exceed the value in **End Memory Address**.



4. Go to **Application**, add a POU program or open an existing one.
5. Insert variables in the POU program. Enter **Name**, **Data type**, and **Initialization**.



6. Select the variable and click  , and then select **Retain** and **Persistent**.



7. To call this POU:

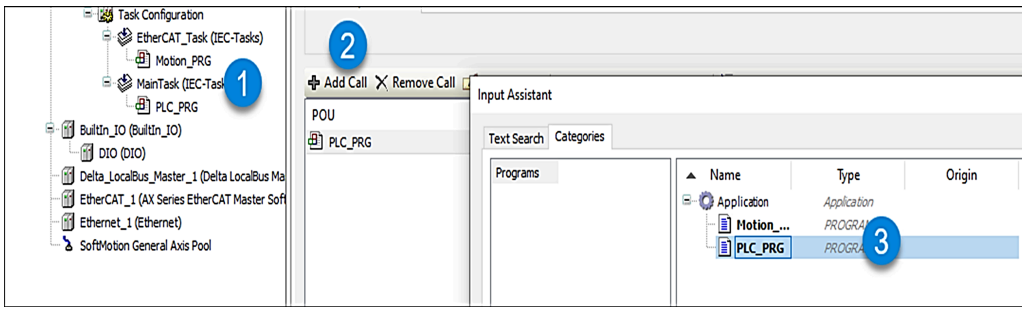
   a. Go to **Devices** > **Task Configuration**.

   b. Double-click **MainTask**.

   c. On the **MainTask** tab, click **Add Call**.

   d. Select the POU, and click **OK**.

Note: The persistent variables in the **Global Variable List** also need to be called in the task under the application.



8. Click  to generate the code. The persistent editor is added under the **Application** node, and the persistent retain variable is added to the list.
   Go back to the POU and check the **Address** column of the variables. The persistent retained variable memory addresses are assigned.

9. Connect to the controller, click  to log in, and download the application to the device.

Note: To avoid persistent retain variable loss, we do not recommend restoring the application in %M mode.

4.2.4.2 Persistent Retain Modes

DIADesinger-AX supports the original mode and the %M mode for persistent retain variables. You can switch the mode in **System Settings** > **Persistent Retain Settings**. For more information, see System Settings.

Supported devices for the %M mode:

- AX-3 v1.0.4.1 or later
- AX-5
- AX-8 (Linux) v3.5.15.45 or later
- AX-8 (Windows) v3.5.14.30 or later
- AX-C

The following table lists the difference between the original and the %M modes.

Item	%M Mode	Original Mode
Variable source	All persistent retain variables declared in the active application.	All persistent retain variables declared in the active application and in the persistent editor.
Persistent editor	Shows the persistent retain variables. The variables	Support copying the persistent retain variables to the editor.

Item	%M Mode	Original Mode
	(except for function block type variables) in the list do not occupy extra controller memory space.	The copied variables also occupy the controller's memory space.
Timing to update the variable list	Build the project or click  to refresh the editor.	Build the project, right-click the editor, and then select **Add All Instance Paths**.
Re-assign address	Retain the value.	Not retain the value.

4.2.4.2.1 Migrate Variables Before Switching the Mode

If you have created persistent retain variables in the persistent editor in the original mode, switching to the %M mode will cause these variables to be lost. We recommend using the following steps to backup the persistent variables of the original mode beforehand.

To migrate the persistent retain variable

1. On the menu bar, select **Tools** > **Scripting** > **Execute Script File**.
2. Select the following file and then click **Open**.
   C:\Program Files\Delta Industrial Automation\DIAStudio\DIADesigner-AX x.x \CODESYS\Tools\new_persistent_tool.py

> **Note:** This is the default installation path. If you have installed DIADesigner-AX in a different location, locate the file in your installation folder.

After running the tool, a new GVL is created and the variables declared in the original persistent editor will be migrated to the GVL.

4.2.4.3 Persistent Editor of the %M Mode

DIADesiger-AX supports an enhanced persistent editor for the %M mode.

How do I open the persistent editor of the %M mode?

Do one of the following:

- On the **Devices** pane, right-click **Application** and then select **Add Object** > **Persistent Variables** > **Add**.
- After persistent retain variables are declared, click  to build the project. The persistent editor will be automatically created.

The following table lists the options and descriptions of the persistent editor of the %M mode.

Item	Description
	Click to load the latest persistent retain variables to the editor. All the persistent retain variables declared in different places throughout the application are loaded, and the memory addresses are assigned. This button is only available in the offline mode and when the application is active.
	Click to clear all the %M addresses of the persistent variables in the editor. The addresses in declared editors are also deleted. This button is only available in the offline mode.

The following table lists the columns and descriptions in the persistent editor.

Item	Description
Expression	Shows the combination of POU (GVL) name, variable name, and library namespace. Click  to expand the array or structure type variables. By default, the array variable can show up to 1000 child elements.

Item	Description
Address	Shows the assigned memory address of the variable. In the offline mode, the address is editable but only for the root variable declared in the application.
Type	Shows the data type of the variable. Double-click this column of an array variable to open the **Monitoring Range** dialog to change the range of the array to be monitored.
Initialization	Shows the initialization value that has been assigned to the variable.
Current value	Shows the current value of the variable. It is only shown in the online mode.
Prepared value	Shows the prepared value of the variable. It is only shown and editable in the online mode. The values are synchronized to the declared editors. After the prepared value is written to the current value, it is cleared from this column.
Comment	Shows the comment of the variable.

The following table lists the context menu shown when right-clicking a variable in the editor.

Item	Description
Browse	• Go to Definition: select to show the definition location of the variable. • Display Cross Reference: select to show all occurrence locations of the variable in the **Cross Reference List** view. • Display Global Reference: select to show all the occurrence locations of all variables with

Item	Description
	the same name in the **Cross Reference List** view. • Display Call Tree: select to open the call tree which shows the callers and calls of the variable.
Save Current Values to Recipe	Select to save the variable value to the recipe. This option is only available in the online mode.
Restore Values from Recipe	Select to upload the variable value from the recipe. This option is only available in the online mode.
Export Variables	Select to export the variable to an XLS or XML file. This option is only available in the online mode.
Import Variables	Select to import the variable from an XLS or XML file. This option is only available in the online mode.
Display Mode	Select the value format when monitoring values in the online mode.
Add to Watchlist	Select to add the variable to a watch list for online monitoring.

In the persistent editor of the %M mode, boxes with a white background is editable, while those with gray background are not. Variables shown in gray font color are of function block type or declared in the library.

4.2.4.4 Online Change in the %M Mode

In the %M mode, removing a variable releases the memory space it occupies in the controller, making it available for new variables. This avoids gaps that use additional memory.

Modifying a variable's name and then performing online change will reset its value to initialization. However, modifying its address, initialization value, comment, scope or attribute will retain the variable's value. This is a standard rule of online change for all persistent retain variables.

The following lists the value status of specific data types of persistent retain variables in terms of different online change triggering conditions.

- Structure
  - Change the name or data type of a field: The value of the changed field is initialized while values of other fields are retained.
  - Add a field: The value of the new field is initialized while the values of existing fields are retained.
  - Delete a field: The values of the left fields are retained.
- Enumeration
  - Change the name of a literal: The variable’s value is retained.
  - Change the type of a literal: If the type is changed to a type of larger occupied byte size, the value of the variable is retained. If the type is changed to a type of smaller occupied byte size, the value of the variable is initialized.
  - Add a new literal: The variable's value is retained.
  - Delete a literal: The variable’s value is retained, but the literal name is changed. (shift to show the next literal name). If the current value is not in the enumeration, it will be shown as an integer (the underlying ordinal value of the literal).
- Union
  - Add or delete a member: If the union size is not changed, the variable’s value is retained. Otherwise, the value is initialized.
- Alias
  - Change the data type: The variable’s value is initialized.
- Subrange

- Change the data type: The variable's value is initialized.
- Change the range: If the current value is in the new range, the variable's value is retained. Otherwise, the variable's value is initialized.

- Function Block
  - Change the name or data type of a member: The value of the changed member is initialized while the values of other members are retained.
  - Add a member: The value of the new member is initialized while the existing members are retained.
  - Delete a member: The values of the left members are retained.

- Array
  - Add an element: The value of the new element is initialized, while the values of existing members are retained.
  - Delete an element: The values of the left elements are retained.

4.2.4.5 Address Assignment Rules

Persistent retain variables are assigned to the M area in the controller's memory. The following rules apply to address assignment.

- The address range is between the **Start Memory Address** and **End Memory Address** you set in **System Setting** > **Persistent Retain Settings**.
- Starting from the start memory address, variables are assigned to the available addresses based on the space they need.
- The addresses in the persistent editor are synchronized with those in the declared editors, and vice versa.
- If a function block containing declared persistent variables is used in multiple locations, the persistent variables will be assigned different addresses.

- Each variable member is stored in an address that starts at an integer multiple of the member's size. For example, two variables, Var1(BOOL, 2 bytes) and Var2 (DINT, 4 bytes), if Var1's address = %MB0, Var2's address = %MB4, not %MB2.

- For the AX-3 series controller, except for the AX-332 controller, the address assigned to variables of structure and union types follows an 8-byte alignment rule. For example, if Var1's address = %MB0, then Var2's address = %MB8, Var3's address = %MB16.

4.2.5 Variable Export and Import

You can export and import variables from and to all objects that can declare variables.

4.2.5.1 Export Variables

Take Global Variable List as an example. Use the following steps to export variables from Global Variable List.

To export variables from Global Variable List

1. In the **Global Variable List** editor, add variables.
2. Right-click the editor, and then select **Export Variables**.
3. In the **Save as** dialog, select the file format to save. Support XLS and XML files.
4. Click **Save**.

When the controller is online, DIADesigner-AX supports exporting variable's current value and its elements' current value. You can edit the value in the exported file.

4.2.5.2 Import Variables

Take **Global Variable List** as an example. Use the following steps to import variables to **Global Variable List**.

To import variables to Global Variable List

1. In the **Global Variable List** editor, right-click the editor and then select **Import Variables**.
2. In the **Import Variables** dialog, browse to select the file to be imported. The imported file format should be .xml or .xls.
3. Select the properties to be imported.
4. Select **Actions Upon Conflicts** options to decide what to do when the variable name to be imported conflicts with that in Global Variable List.
5. Click **Import**.
   The import result is displayed in the lower-left corner.

When the device is online, if you import the variables that were exported online, DIADesigner-AX supports overwriting the current value of the existing variables.

4.3 Smart Input and Auto-completion

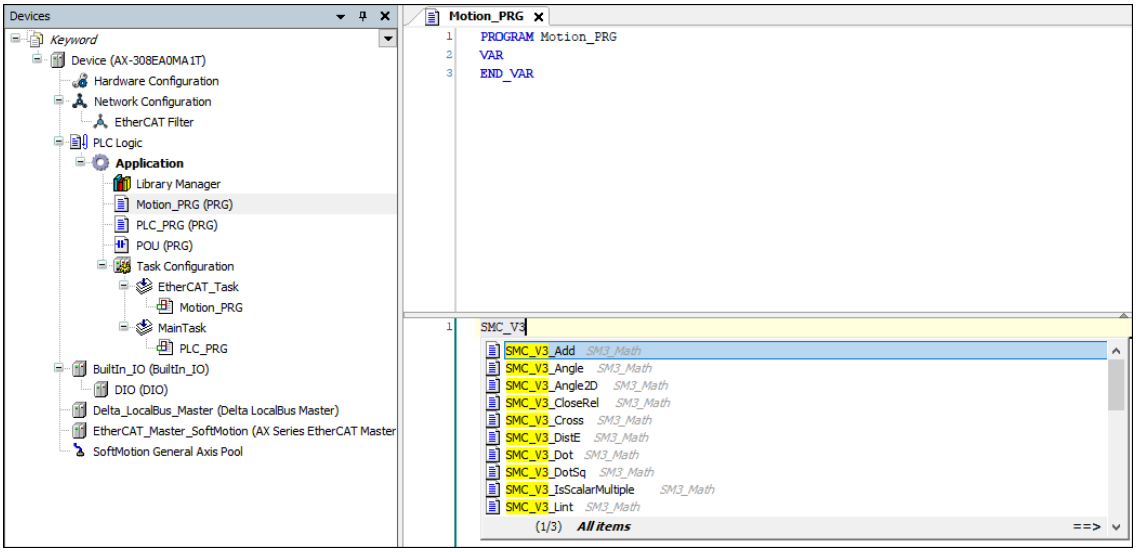
When programming with ST language, entering the keyword automatically shows the related element list. You can select the element in the list and press **Tab** to automatically complete the input.

Supported elements:

- Variables
- POU / Program and Function Calls
- Instance Calls
- Function Blocks
- Keywords
- Conversion Operators
- ST statement: IF…THEN…, FOR…TO…DO, WHILE…DO…, CASE…OF…, and REPEAT…UNTIL…

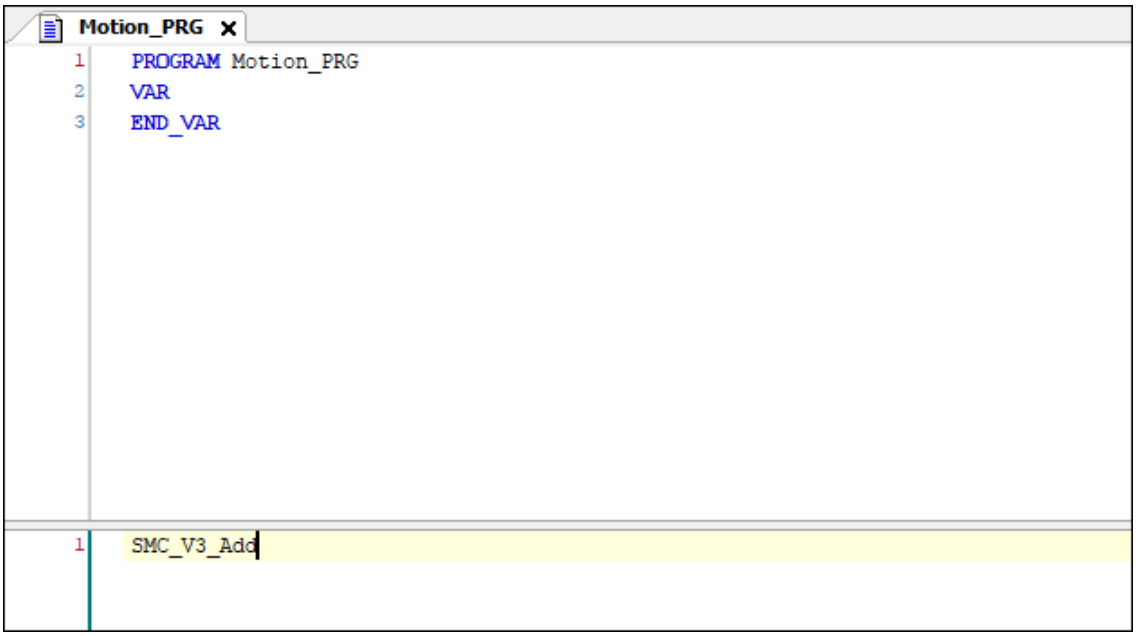
To complete the input automatically

1. Enter the keyword of the ST element in the ST editor. For example, SMC_V3.

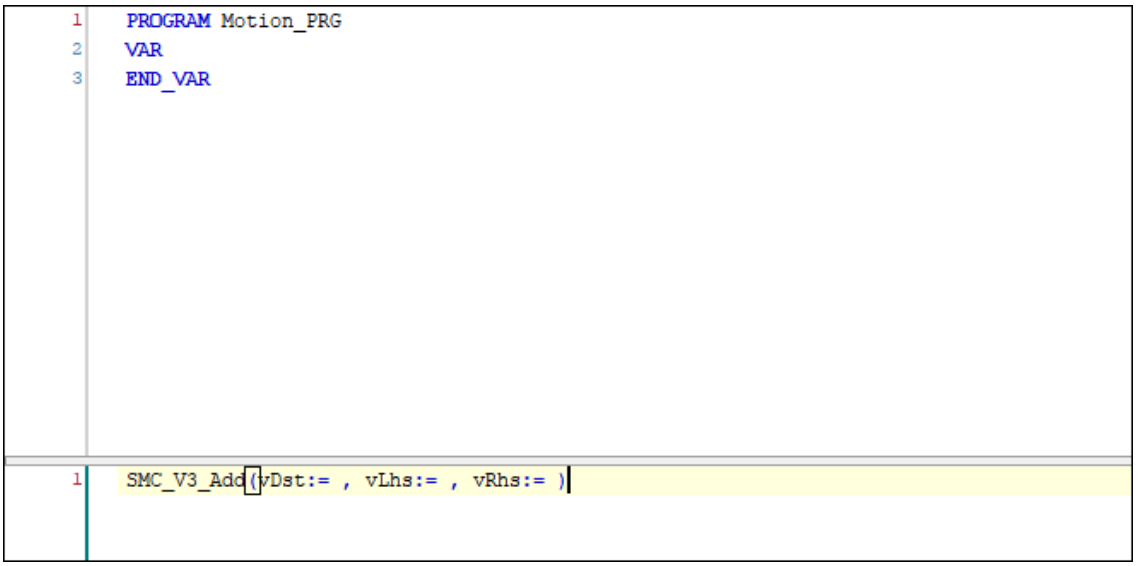


Press the **Left** or **Right** key to switch among different views. For example, **All items**, **Keywords**, **Global declarations**, or **Local declarations**.

2. Select **SMC_V3_Add** from the list and press **Enter**.



3. Press **Tab**. The parameter template of **SMC_V3_Add** is automatically completed.



4.4 Recipe

Use recipes to change or read recipes values for a specific set of variables (recipe definition) on the controller at the same time.

You can define the basic settings for recipes, such as location and format, in **Recipe Manager** and add any number of recipe definitions under **Recipe Manager**. Recipe Definition includes one or more recipes of the variables.

You can save a recipe to a file or write directly from a file to the controller.

4.4.1 Create a Recipe

Use the following steps to create a recipe.

To create a recipe

1. On the **Devices** pane, right-click **Application**, and then select **Add Object** > **Recipe Manager**.
2. In the **Add Recipe Manager** dialog, enter the name of Recipe Manager, and then click **Add**.
3. On the **Devices** pane, right-click Recipe Manager and then select **Add Object** > **Recipe Definition**.

4. In the **Add Recipe Definition** dialog, enter the name of Recipe Definition, and then click **Add**.
5. In the Recipe Definition editor, right-click the blank row and then select **Insert Variable**.
6. Right-click the editor and then select **Add a New Recipe**.
7. In the **New Recipe** dialog, enter the name of the recipe and then click **OK**. You can add multiple recipes as needed.
8. Enter the recipe value for this variable in this box.
9. Right-click the recipe value column and then select **Save Recipe** to save the recipe as a file on the computer.

When the controller is online, **Recipe Manager** and **Recipe Definition** will be automatically added to the project tree if selecting **Save Current Values to Recipe** in the Persistent Variables list.

4.4.2 Recipe Manager Settings

The following table lists the Storage options and descriptions of Recipe Manager.

Settings	Description
Storage type	Select the storage type to save the recipe. • Textual: Saves the recipe in a readable format. • Binary: Saves the recipe in a non-readable binary format. This format requires less storage space. **Note:** You can read binary recipes again only if you have not changed the variable lists.
File path	Select the file path to save the recipe on the computer or enter a relative path of the target system on the controller to save the recipe on the controller, for example, PlcLogic/.

Settings	Description
	If you enter a relative path, select **Save recipe changes to recipe files automatically** on the **General** tab to take effect.
File extension	Enter the file extension of the recipe file.
Separator	Select the separator between the variable name and values in the recipe file.
Available Columns Selected Columns	Select the information and order that you want to save in the recipe file.
Save as Default	Click to use the settings on the tab throughout the entire project for all other Recipe Managers.

The following table lists the General options and descriptions of Recipe Manager.

Settings	Description
Recipe management in the PLC	Select to save the recipes to the controller at runtime and turn on the following **Save Recipe** and **Load Recipe** settings.
Save Recipe	
Save recipe changes to recipe files automatically	Select to automatically update the recipe file on the controller after online changes.
Load Recipe	
Load only by exact match of variable list	Select to load the recipe from the file only if it contains the same variable list as the application's recipe definition.
Load matching variables by variable name	Select to only load the recipe values of variables whose names in the application's recipe definition are the same as those in the recipe file.

Settings	Description
Overwrite existing recipes on download	Select to overwrite values in recipe files with the same name on the controller with the configured values from the project after starting the application. This option is only available when **Storage Type** is **Textual** and **Save recipe changes to recipe files automatically** is selected. The default name of the recipe file is in the format of <recipe name>.<recipe definition name>.<file extension>.
Write Recipe	
Limit the variable to min/max when recipe value is out of the range	Select to write the defined minimum or maximum value to the variable on the controller if the recipe value is out of range.
Do not write to a variable when the recipe value is out of the min/max range	Select not to write the recipe value to the variable on the controller if the value is out of the defined minimum or maximum range.
Read Recipe	
Check recipe for changes	Select to save the recipe file automatically if the recipe value has changed by using the function block RecipeManCommands to read recipes. However, it affects performance because it generates additional code for checking.

4.4.3 Recipe Settings

The following table lists the items and descriptions of the context menu after right-clicking a variable in the Recipe Definition editor.

Settings	Description
Cut	Select to cut the selected variable row. This option is only available offline.

Settings	Description
Copy	Select to copy the variable row.
Paste	Select to paste the variable row above. This option is only available offline.
Delete	Select to delete the variable row. This option is only available offline.
Select All	Select to select all variables.
Browse	Select to show the variable's declaration location or open the Call Tree pane. This option is only available online and when you right-click the variable name column.
Refactoring	Select to rename the variable. This option is only available offline and when you right-click the variable name column.
New Breakpoint	Select to open the **New Breakpoint** dialog to define the settings for a new breakpoint. This option is only available online.
Toggle Breakpoint	Select to set a breakpoint or clear an existing breakpoint. This option is only available online.
Run to Cursor	Select to run the program until a specified position is marked by the cursor. This option is only available online and when the program is halted at the current break position.
Set Next Statement	Select to determine which statement to run next. This option is only available online and when the program is halted at the current break position, and you have marked any line in any POU with the cursor.
Unforce All Values of <device.application>	Select to unforce all values of the variables from the selected application. The variables get their current values from the controller. This option is only available online.
Display mode	Select the display mode of Current Value.
Insert Variable	Select to insert a variable before the selected position. This option is only available in Flat list view.

Settings	Description
Add Child	Select to add the declared child variable of the selected variable to the recipe definition list. This option is only available in Structured view.
Add Sibling	Select to add the declared sibling variable of the selected variable the recipe definition list. This option is only available in Structured view.
Update Structured Variables	Select to open the **Update Structured Variables** dialog to update the whole recipe definition if the declaration of a structured variable or a POU has changed.
Update Selected Variables	Select to open the **Update Structured Variables** dialog to only update the selected variable if the declaration of a structured variable or a POU has changed. This option is only available in Structured view.
Add a New Recipe	Select to open the **New Recipe** dialog to insert a recipe value column into the recipe definition.
Remove Recipe	Select to delete the recipe. This option is only available when you right-click the recipe column.
Load Recipe	Select to load a recipe from a file. This option is only available when you right-click the recipe column.
Save Recipe	Select to save the recipe to a file. This option is only available when you right-click the recipe column.
Read Recipe	Select to read the current value of variables on the controller and overwrite the recipe values. This option is only available online and when you right-click the recipe column.
Read and Save Recipe	Select to read the current value of variables on the controller and overwrite the recipe values and save the recipe to a file. This option is only available online and when you right-click the recipe column.

Settings	Description
Write Recipe	Select to write the recipe value to the current value of variables on the controller. This option is only available online and when you right-click the recipe column.
Load and Write Recipe	Select to load a recipe from a file and write the recipe value to the current value of variables on the controller. This option is only available online and when you right-click the recipe column.
Upload Recipes from Device	Select to overwrite the recipe values in the project with the values on the controller. This option is only available online.

4.5 Robotics Project

To create robotics projects swiftly, DIADesigner-AX 1.7.0 and later versions support a robotics project template. The template generates projects containing axis groups, axis devices, POU objects, and variables necessary for robot operations. DIADesigner-AX allows the direct programming of robots and their control via an AX series controller.

4.5.1 Create a Robotics Project

Use the following steps to create a robotics project.

Prerequisites

- Install the robotics package. Go to DIAStudio Download to download the package.

  For more information about the installation of a package, see Install and Uninstall a Package.

To create a robotics project

1. On the menu bar, select **File** > **New Project**.
2. In the **New Project** dialog, select the **Robotics project** template.
3. Enter the project name and project location, and then click **OK**.

4. In the **Robotics Project** dialog, enter the name and select the robot type for each robot. Click + to add robots. The maximum robots you can add is 6.

   Note: The name must start with an English character or underscores and only contain English characters, numbers, and underscores.

5. Click **OK**.

For more information about the configuration and usage of the robotics solution, see the documents in the **docs** folder in the path where you installed the robotics package. The default path is C:\Users*username*\Robotics\docs.

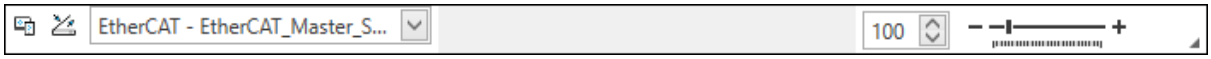
Chapter 5: Hardware Configuration

In the **Hardware Configuration** editor, you can view the hardware information, add modules, set module parameters, detect and diagnose the hardware online.

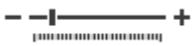
How do I open the **Hardware Configuration** editor?

- On the **Devices** pane, double-click **Hardware Configuration**.

The **Hardware Configuration** toolbar is shown on the top of the editor.



The following table lists the settings in the toolbar and their descriptions.

Setting	Description
	Click to show the module information.
	Click to scan the online device.
	Select the remote I/O network.
	Select or enter the value to zoom in or zoom out.
	Drag to zoom in or zoom out.

5.1 Add an Extension Module

You can add an extension module to the right side of the controller in the **Hardware Configuration** editor. There are four types of modules you can select to add.

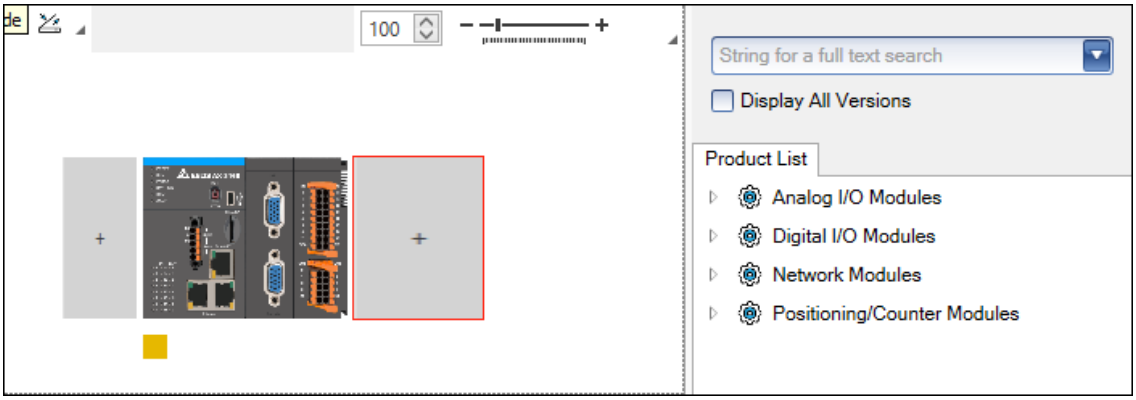
- Analog I/O Modules
- Digital I/O Modules
- Network Modules (AX-3 only, support adding up to four)
- Motion Control Modules
- Positioning/Counter Modules

Supported controllers:

- AX-3 series
- AX-5 series

To add an extension module

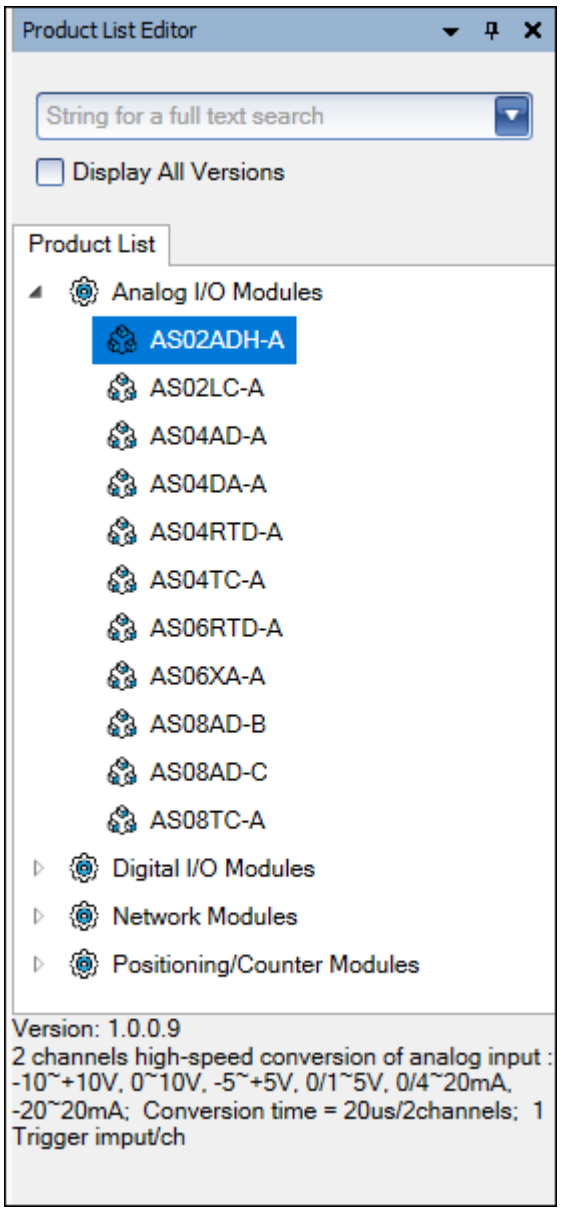
1. On the **Devices** pane, double-click **Hardware Configuration**.
2. In the **Hardware Configuration** editor, click the extension placeholder on the right side of the controller, and then available modules will be listed in **Product List**.



3. Expand **Product List** and add the module. Do one of the following:

- Double-click the module.
- Drag the module to the placeholder.

When you click the module in the list, you can view the module information at the bottom of the **Product List** pane.



4. (optional) You can right-click the module, and then cut, copy, paste, or delete the module if needed.

5.2 Add a Function Card

If you add a Network Module AS00SCM-A to the controller, you can also add function cards to expand the function of the module. The AS00SCM-A module provides two slots to add the following function cards.

- AS-F232
- AS-F422
- AS-F485
- AS-FCOPM (slot two only)

Use the following steps to add a function card.

Prerequisites

- Add the AS00SCM-A module to the controller.

To add a function card

- Do one of the following:
    - In the **Hardware Configuration** editor, click the slot on the AS00SCM-A module, and then add the function card from **Product List**.
    - On the **Devices** pane, under **AS00SCM-A**, right-click the **<Empty>** node and then select **Plug Device**. In the **Plug Device** dialog, select the function card, and then click **Plug Device**.

5.2.1 Configure Function Card as Modbus Master COM Port

The function card can be configured as a Modbus master COM port.

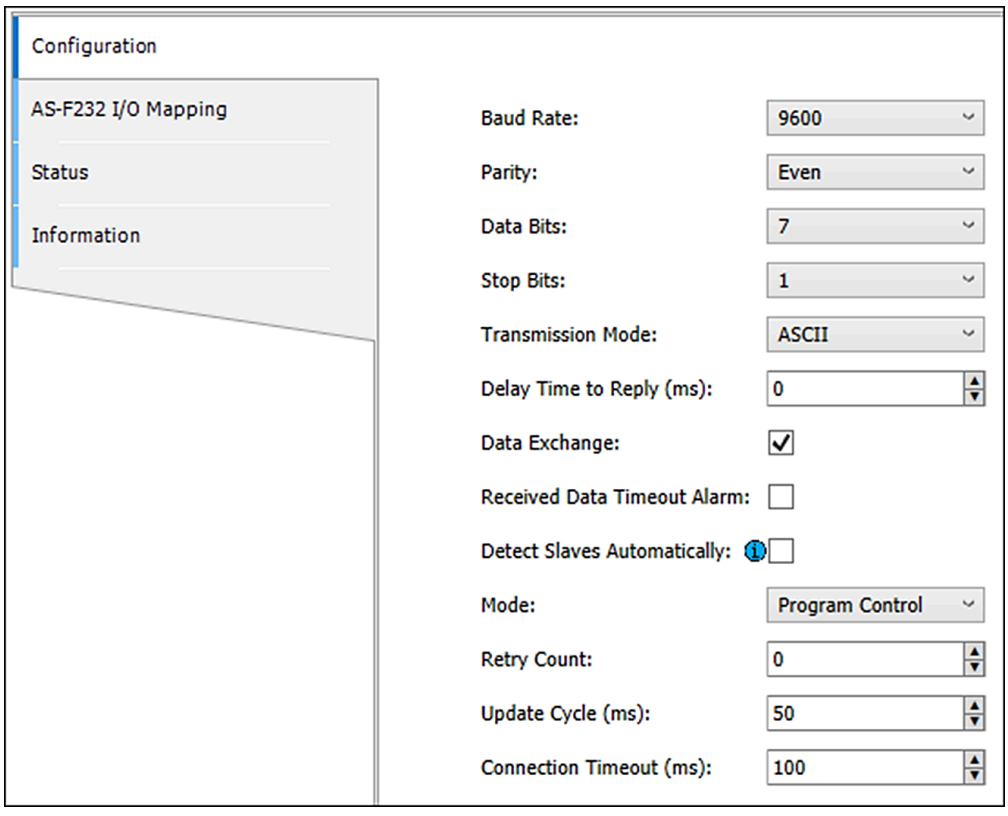
To configure the function card as a Modbus master COM port

1. Add one of the following function cards:
    - AS-F232
    - AS-F422
    - AS-F485
2. Double-click the function card and go to **Configuration**
3. Select the **Data Exchange** checkbox
4. Click **Add Channel**. You can add a total of 32 channels.
5. In the **Modbus Channel** dialog, configure and enable the channel.
6. On the **AS-XXX I/O Mapping** pane, configure the I/O mappings to map the input and output. For more information, see Edit I/O Mapping.

5.2.1.1 Function Card Settings (Modbus Master)

The following table shows the function card settings when it is set as a Modbus COM port master.

Configuration

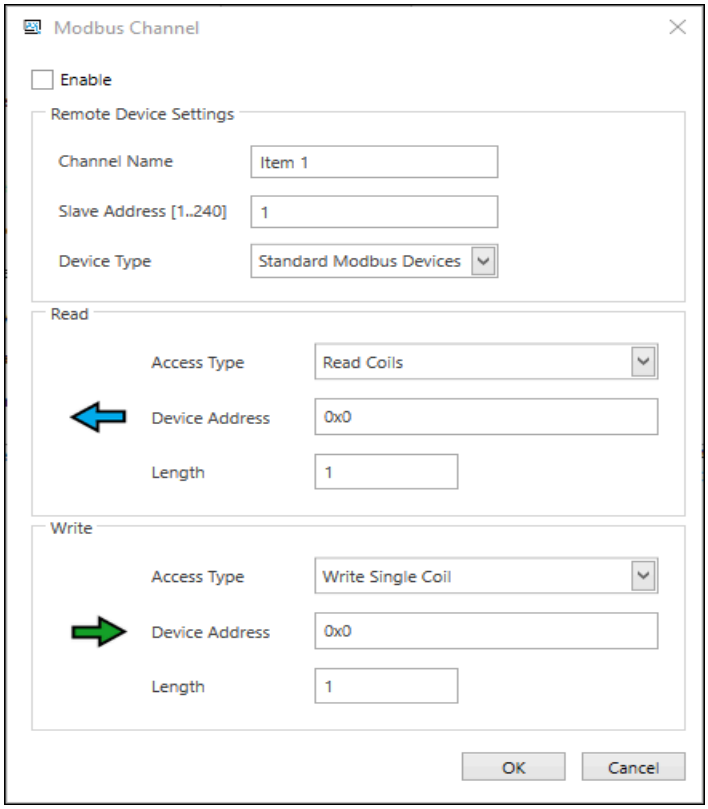


Settings	Description
Baud Rate	Select the baud rate (in bits/second).
Parity	Select the parity bit usage in the communication packets.
Data Bits	Select the number of bits of data per character.
Stop Bits	Select the number of stop bits per character.
Transmission Mode	Select the mode of transmission: • **RTU**: Transmitted in binary. • **ASCII**: Transmitted in ASCII code (currently not supported by all drivers). • **SCMRS**: Transmitted using the communication protocol defined by each slave. You can perform this by the DFB_SCMRS instruction (only support the function card version 1.0.0.3 or later).
Delay Time to Reply (ms):	Select or enter the delay time to respond after receiving a communication command. The value range is 0–100000.
Data Exchange	Select to turn on or turn off data exchange between master and slave. Turn it on when configuring the function card as the Modbus master COM port.
Received Data Timeout Alarm	Select to turn on or turn off receiving alarm when timeout.
Detect Slaves Automatically	Select to turn on or turn off automatic detection whether the slave exists before data exchange. **Note:** Before selecting this option, ensure the slave device is powered on before the master device.
Mode	Select the execution mode of data exchange.

Settings	Description
	• **Program Control**: The data exchange is controlled by the program. • **PLC Run**: When the controller is in RUN mode, the data exchange starts automatically. Once the controller's status changes to Stop, the communication disconnects. • **Always Enable**: The data exchange starts once the controller is started.
Retry Count	Select or enter the number of times of COM Port re-communication. The value is 0–10.
Update Cycle (ms)	Select or enter the amount of time for an update. The value is 0–6000.
Connection Time-out	Select or enter the amount of time for no connection response. The value is 0–6000.

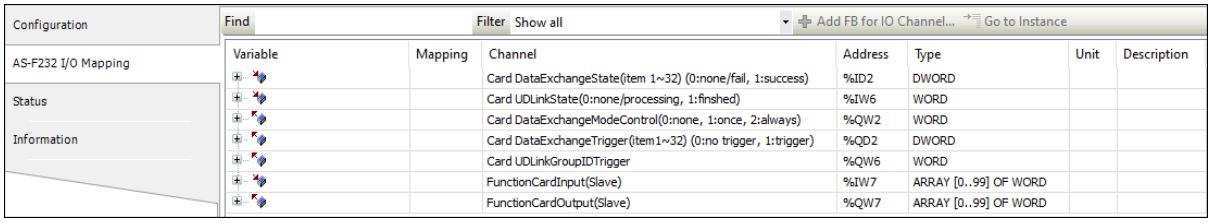
After you click **Add Channel**, the **Modbus Channel** dialog shows. The following table shows the settings and descriptions.

Modbus Channel



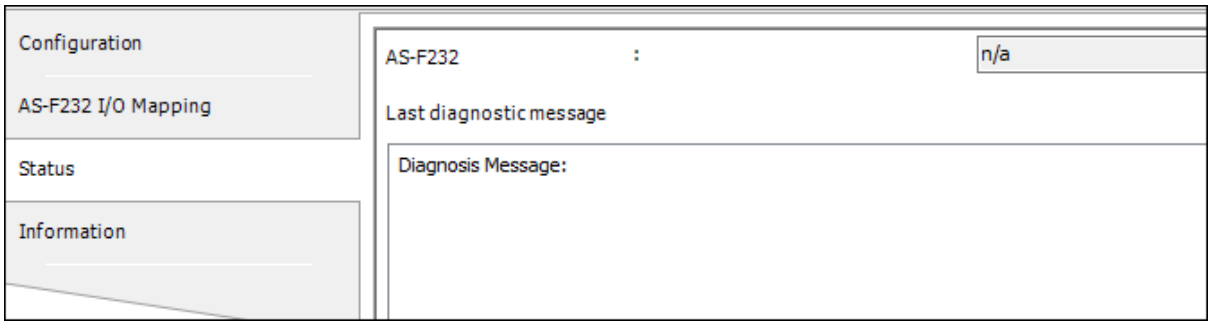
Settings	Description
Enable	Select to turn on or turn off the data exchange channel.
Channel Name	Enter the name of the channel.
Slave Address	Enter the slave address. The valid range is 1–240.
Device Type	Select the device type.
Access Type	Select the **Read** and **Write** access type. If **Read/Write Multiple Registers** is selected for either **Read** or **Write**, it will also synchronize with the other.
Device Address	Select the device address and enter the value in hexadecimal format.
Length	Enter the word length that reads or writes from or to the register. The value varies with different **Access Type** and **Device Address.**

AS-XXX I/O Mapping



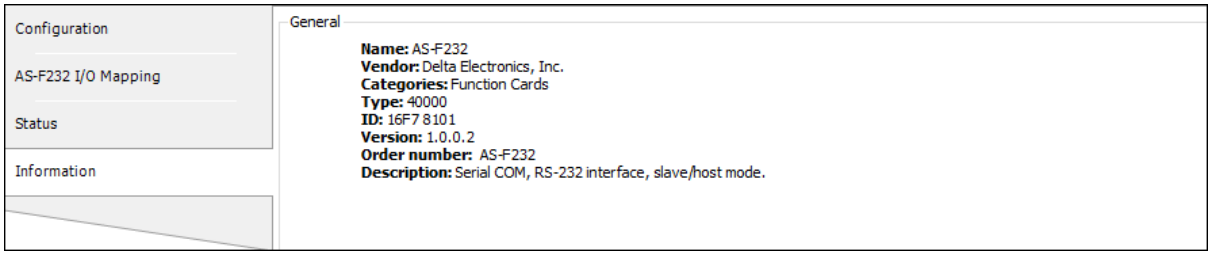
Create and map variables. For more information, see Edit I/O Mapping.

Status



Shows the function card's current status.

Information



Shows the function card's general information.

5.2.2 Configure Function Card as Modbus Slave COM Port

Use the following steps to configure the function card as a Modbus slave COM port.

To configure the function card as a Modbus slave COM port

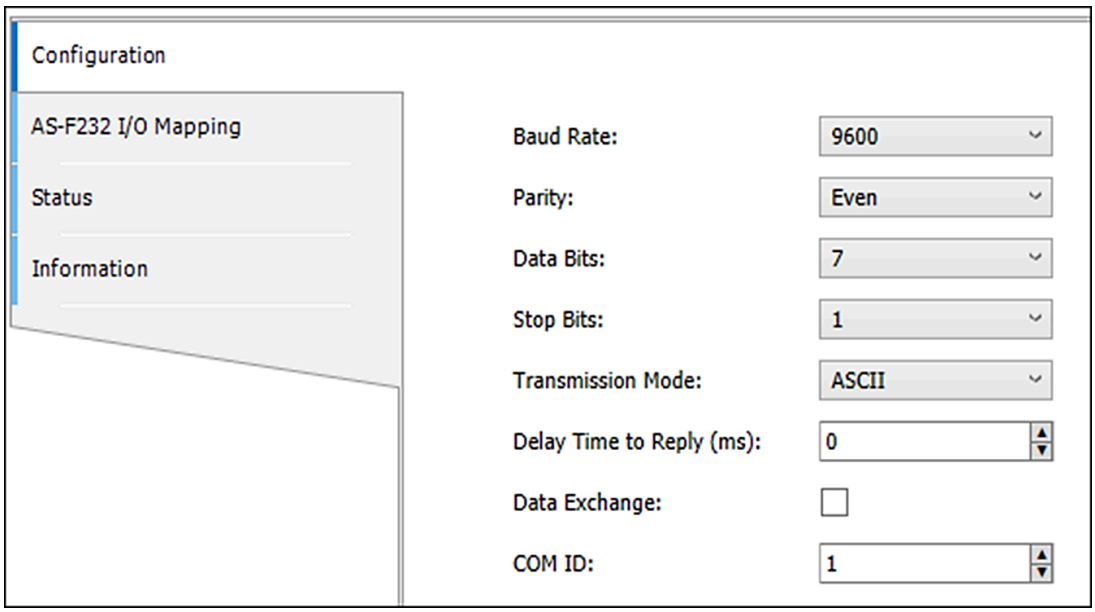
1. Add one of the following function cards:
    - AS-F232
    - AS-F422
    - AS-F485

2. Double-click the function card and go to **Configuration**.
3. Clear the **Data Exchange** checkbox.
4. On the **AS-XXX I/O Mapping** pane, configure the settings and I/O mappings of the function card. When configured as a Modbus slave, the function card can provide 100 input and 100 output Word addresses. For more information, see Edit I/O Mapping.

5.2.2.1 Function Card Settings (Modbus Slave)

The following table shows the function card settings when it is set as a Modbus slave COM port.

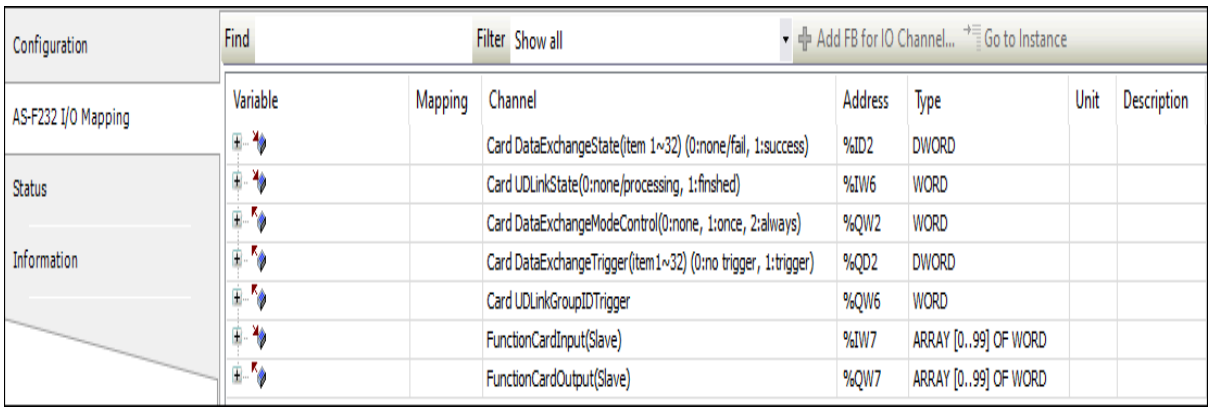
Configuration



Settings	Description
Baud Rate	Select the baud rate (in bits/second).
Parity	Select the parity bit usage in the communication packets.
Data Bits	Select the number of bits of data per character.
Stop Bits	Select the number of stop bits per character.
Transmission Mode	Select the mode of transmission:

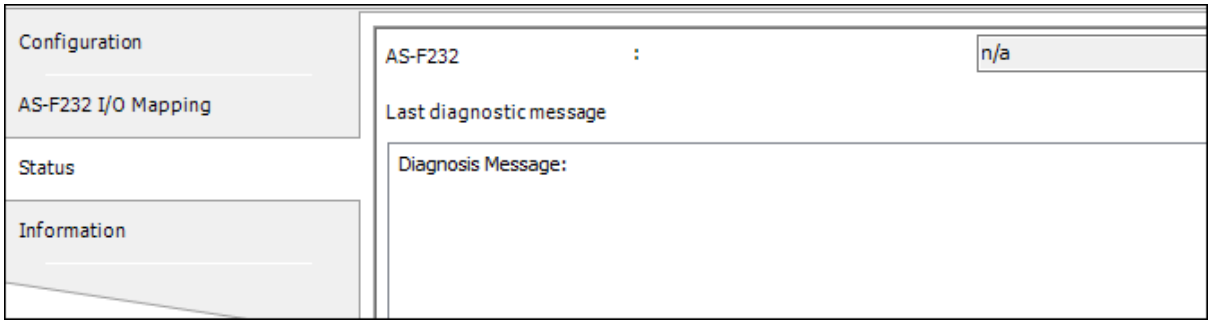
Settings	Description
	• **RTU**: Transmitted in binary. • **ASCII**: Transmitted in ASCII code (currently not supported by all drivers). • **SCMRS**: Transmitted using the communication protocol defined by each slave. You can perform this by the DFB_SCMRS instruction (only support the function card version 1.0.0.3 or later).
Delay Time to Reply (ms):	Select or enter the delay time to respond after receiving a communication command. The value range is 0–100000.
Data Exchange	Select to turn on or turn off the data exchange between master and slave. Turn it off when you configure the function card as the Modbus slave COM port.
COM ID	Select or enter the COM ID number. The value range is 1–247.

AS-XXX I/O Mapping



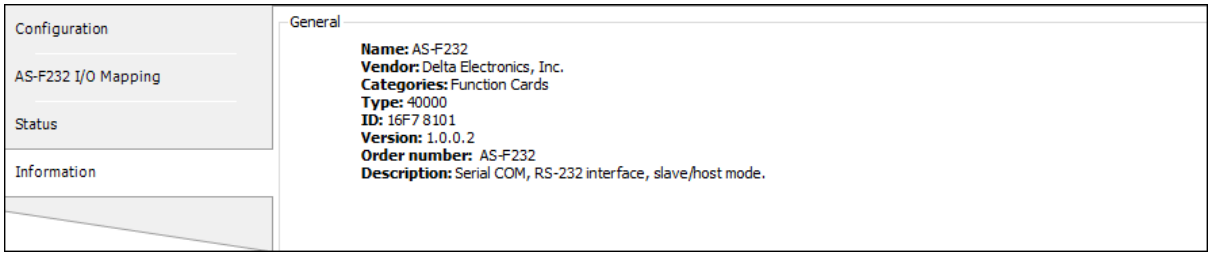
Create and map variables. For more information, see Edit IO Mapping Tab.

Status



Shows the function card's current status.

Information



Shows the function card's general information.

5.2.3 Configure Function Card as a CANopen Slave

Use the following steps to configure the function card as a CANopen slave.

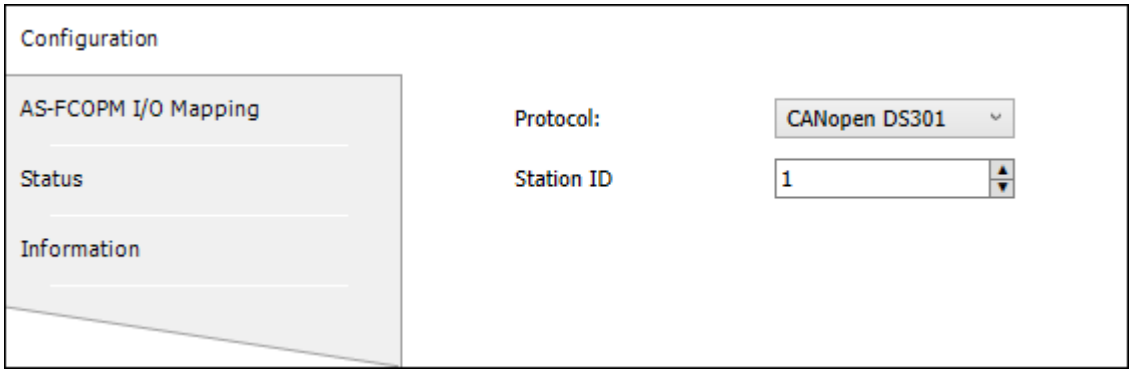
To configure the function card as a CANopen slave

1. Add the function card AS-FCOPM in slot two under the AS00SCM-A module.
2. Double-click the function card and then go to **Configuration**.
3. Enter **Station ID** from 1 to 127.
4. On the **AS-FCOPM IO Mapping** pane, configure the I/O mappings to map the input and output. For more information, see Edit I/O mapping.

5.2.3.1 Function Card Settings (CANopen Slave)

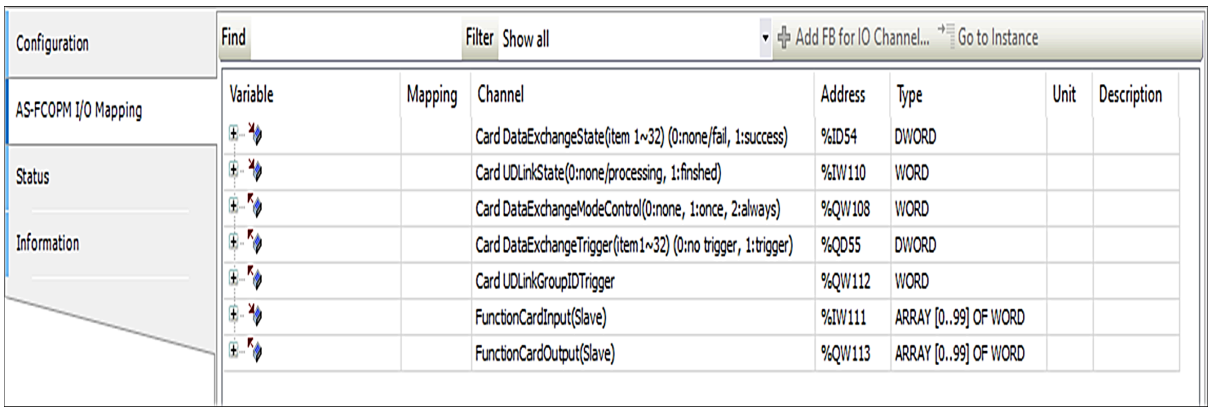
The following table shows the function card settings when it is set as a CANopen slave.

Configuration



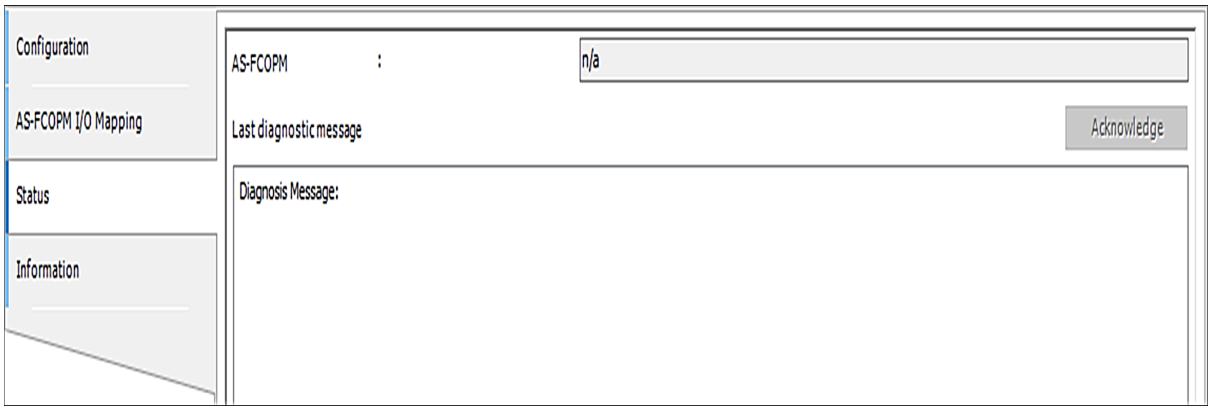
Settings	Description
Protocol	Select the CANopen DS301 protocol.
Station ID	Set up the address of the station. The value range is 1–127.

AS-FCOPM I/O Mapping



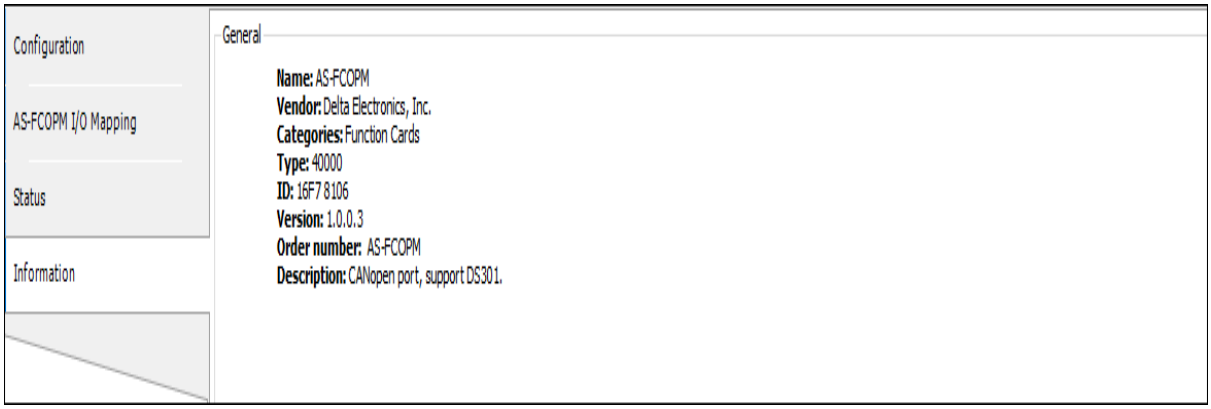
Create and map variables. For more information, see Edit I/O mapping.

Status



The function card's current status.

Information



The function card's general information.

5.3 Add an IO-Link Device

Adding a Network Module AS04SIL-A to the controller can also add an IO-Link device to expand the module's function. The Standard I/O (SIO) can be added directly, while to add the IO-Link device, you must first install the IO Device Profile.

To add an IO-Link device

1. Select **Tools** > **Device Repository**.
2. In the **Device Repository** dialog, click **Install**.
3. Select an IO Device Profile to install.
4. On the **Devices** pane, under **AS04SIL-A**, right-click the **<Empty>** node and then select **Plug Device**.
5. In the **Plug Device** dialog, select **Fieldbuses** > **IO-Link Device**. Select the IO-Link device you installed and then click **Plug Device**.

5.4 Add an EtherCAT Coupler

Coupler provides an option to connect the controller with the Remote I/O modules. The Remote I/O modules can be arranged side-by-side in a scalable way on the right side of couplers. DIADesigner-AX supports adding the following couplers.

- ASRTU-EC16AP1PA, ASRTU-EC16AP1TA
- AX-500CEC00-0A

- R1-EC5500
- R1-C00CE00-0A
- R3-C00CE00-0A
- RTU-ECAT

Note: The logic controllers do not support adding couplers and Remote I/O modules.

To add an EtherCAT coupler

1. On the **Devices** pane, right-click **EtherCAT_X** and select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **EtherCAT** > **Slave** > **Delta Electronics, Inc.** > **System Couplers**.
3. Select one of the couplers and then click **Add Device**.

5.5 Add a Remote I/O Moudule

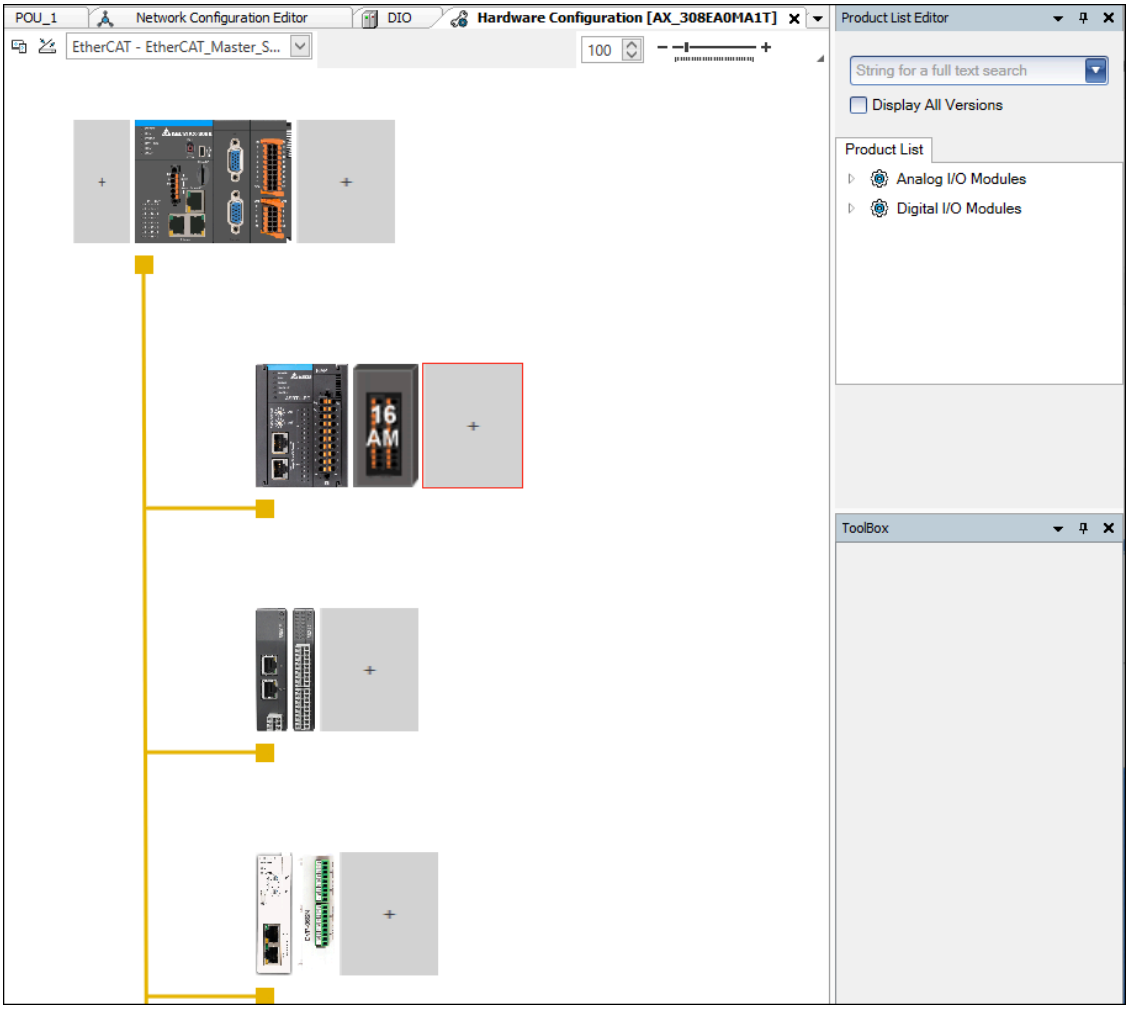
After the coupler is added, it will show on the **Hardware Configuration** editor. You can add the Remote I/O module to the couplers.

To add a Remote I/O module

1. On the **Hardware Configuration** editor, click the expansion area on the right side of the coupler.
2. In **Product List**, select a Remote I/O module, and do one of the following:
    - Double-click the module.
    - Drag the module to the expansion area.
3. (optional) You can right-click the module, and then cut, copy, paste, or delete the module if needed.

Or

1. Scan network and select a gateway.
2. On the **Devices** pane, right-click **EtherCAT_X** and then select **Scan for Devices**.
3. In the **Scan Devices** dialog, select the device and click **Copy to project**.



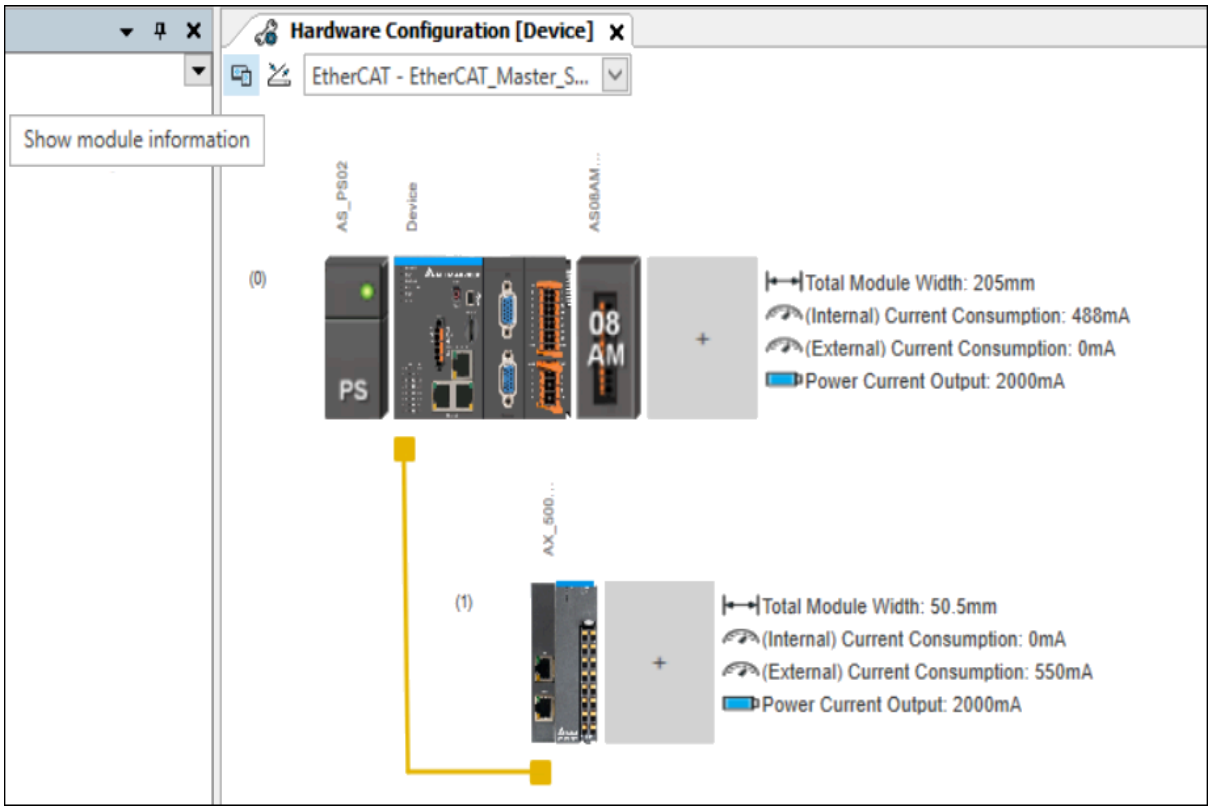
Note:

- AX-500CEC00-0A coupler also supports adding **Power Supply Modules**.
- Up to 64 remote I/O modules can be added to the AX-308 or AX-316 series controller.

- Up to 16 remote I/O modules can be added to the AX-304 series controller.
- Up to 96 remote I/O modules can be added to the AX-364 series controller.

5.6 Module Current Consumption Calculation

On the **Hardware Configuration** editor, click  to show the module information.

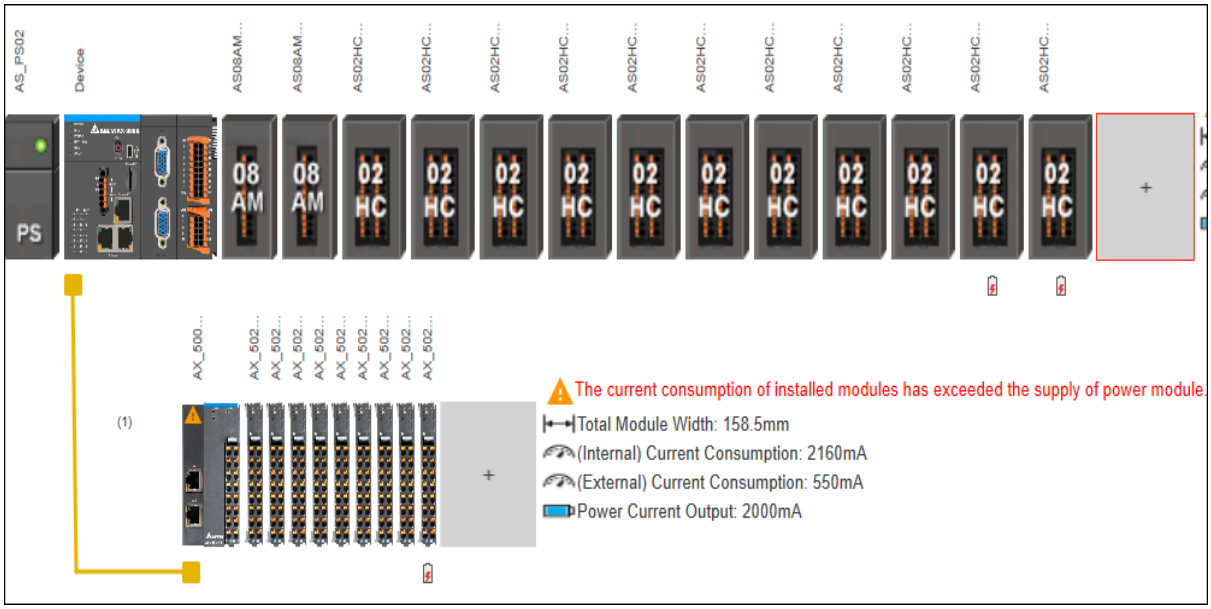


The following table lists the information and description of a module.

Item	Description
Total Module Width	The total width of the modules mounted to a controller or a coupler.
(Internal) Current Consumption	The total internal current consumption.
(External) Current Consumption	The total external current consumption.

Item	Description
Power Current Output	The maximum current power output of the device (only show values for couplers).

After adding modules, their internal and external current consumption will be calculated and updated in the information. Once the total internal current consumption of the modules mounted to the right of the coupler or the power supply device output exceeds the maximum current output, a warning message shows and an icon shows under the module that has exceed the maximum current output.



5.7 Add a Power Supply Module

The power supply modules supply power to the controller. It can only mount to the controller and do not have any configuration data.

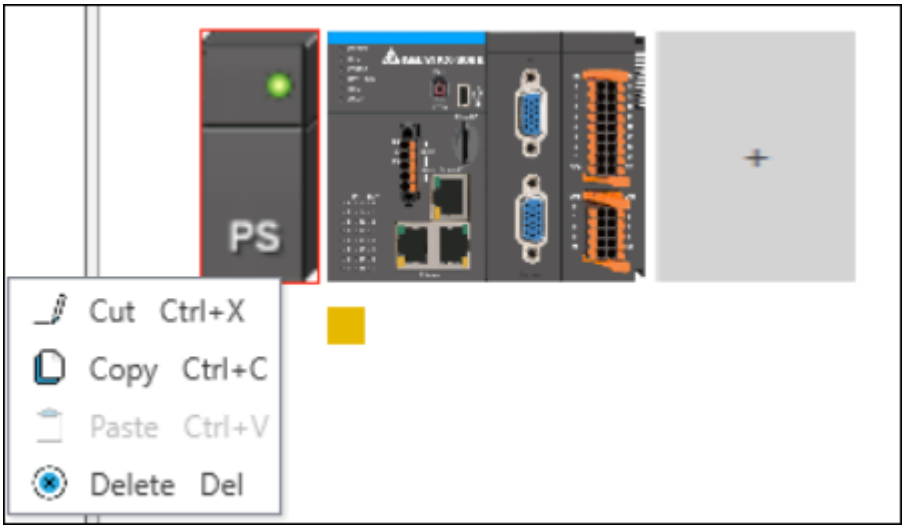
To add a power module

1. On the **Devices** pane, double-click **Hardware Configuration**.
2. On the **Hardware Configuration** editor, click the expansion placeholder, and the power supply modules will be listed in **Product List**.
3. Expand the module list and add the power supply module. Do one of the following:

- Double-click the module.
- Drag and drop the module to the placeholder.

When you click the module, you can view the module information at the bottom of the **Product List** pane.

4. (optional) You can right-click the module, cut, copy, paste or delete the module if needed.



5.8 Add a Motion Control Module

Use the following steps to add a motion control module.

To add a motion control module

Do one of the following:

1. Add an AX-5 series controller.
2. On the **Devices** pane, under **EtherCAT_X**, right-click **AX5_Local_IO_Bus** and then select **Add Device**.
3. In the **Add Device** dialog, select **Fieldbuses** > **EtherCAT** > **Slave** > **Delta Electronics, Inc.** > **Motion Control Modules** > one of the motion modules, and then click **Add Device**.

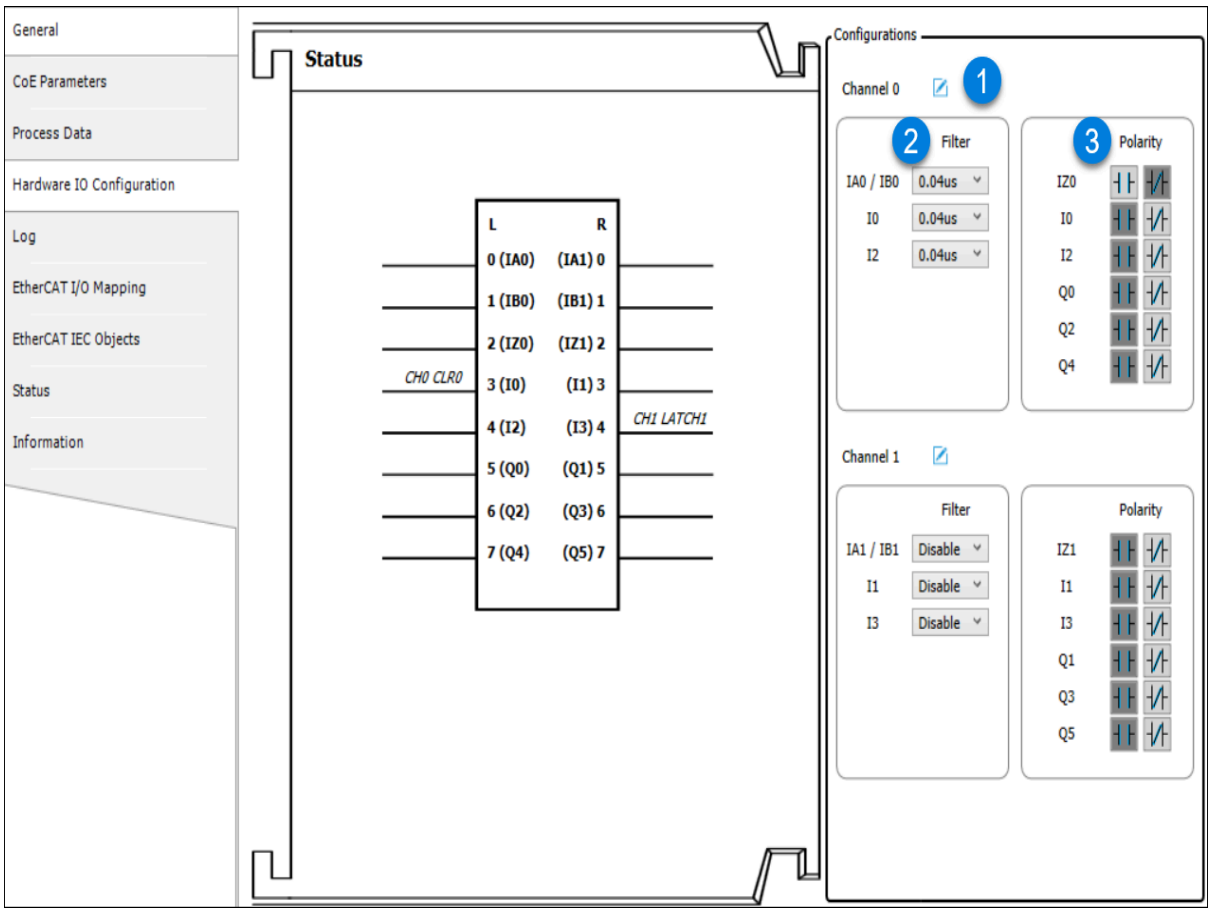
Or

1. Add a controller.
2. On the **Devices** pane, right-click **EtherCAT_X**, and then select **Add Device**.
3. In the **Add Device** dialog, select **Fieldbuses** > **EtherCAT** > **Slave** > **Delta Electronics, Inc** > **System Couplers** > **AX-500CEC00-0A (Ethercat coupler)**, and then click **Add Device**.
4. Under **AX-500CEC00-0A**, add one of the motion modules.

5.8.1 AX-502HC Hardware IO Configuration Page

DIADesigner-AX provides an interface to configure the hardware I/O of the AX-502HC motion module.

The following table shows the hardware I/O settings and descriptions.



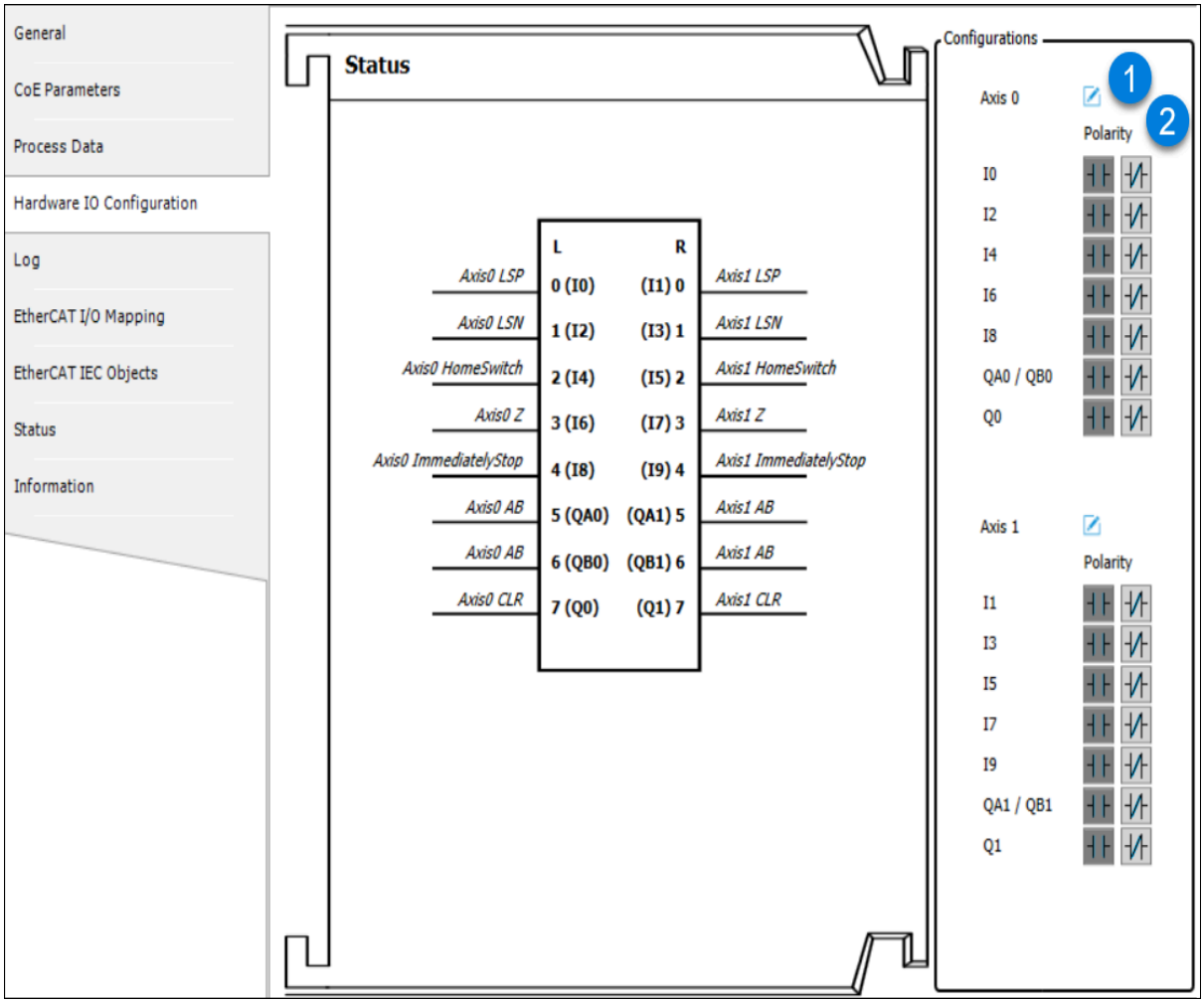
Settings	Description
1 Pin Selection	Click  to open the **Pin Selection** dialog and select the I/O terminal number.

Settings	Description
	Note: If two pins select the same I/O terminal number, the system automatically changes the first one to **None**.
2 Filter	Select the filter time. The default value is **Disable**.
3 Polarity	Click  to set the contact polarity to A contact.
	Click  to set the contact polarity to B contact.

5.8.2 AX-502PU Hardware IO Configuration Page

DIADesigner-AX provides an interface to configure the hardware I/O of the AX-502PU motion module.

The following table shows the hardware I/O settings and descriptions.



Settings	Description
1 Pin Selection	Click to open the **Pin Selection** dialog and select the I/O terminal number.
2 Polarity	Click to set the input contact polarity to A contact.
	Click to set the input contact polarity to B contact.

5.9 Add a Load Cell Module

A load cell module supports connecting the load cells directly to the controller without requiring an external signal converter. DIADesigner-AX supports adding the following load cell modules.

- AS02LC-A
- AX-501LC10-0A

To add a load cell module

- AS02LC-A
  - Add an ASRTU coupler and then add the AS02LC-A module.
  - Add the AS02LC-A module directly to the AX-3 series controller with firmware version 1.0.3.0 or later.
- AX-500CEC00-0A
  - Add an AX-500CEC00-0A coupler and then add the AX-501LC10-0A module.
  - Add the AX-501LC10-0A module directly to the AX-5 series controller.

5.9.1 Open the Calibration Tab

The load cell module must be calibrated to ensure the weight is read accurately. DIADesigner-AX supports calibrating the load cell module.

To open the calibration tab

1. Configure **Communication Settings** to connect to the controller attached to the load cell module.
2. Ensure the devices is added properly in the project.
3. On the toolbar, click  .
4. On the **Devices** pane, double-click the load cell module.

5.9.2 Calibrate the Load Cell Module

Use the following steps to calibrate the load cell module.

To calibrate the load cell module

1. Select a channel.
2. Enter **Total Calibration Points** and **Weight** of each calibration point to set calibration criteria.
   The range of calibration points is 2–20.
3. Click **Start**.
4. Click each calibration point, put the weight that matches the weight value entered earlier on the load cell, and then click **Calibrate**. Repeat this step for each calibration point you set.
   The module will return the raw data of each calibration point.
5. Click **Stop**. The weight calibration is completed.

   While calibrating, you can view the channel's status in **Channel X Status** and the module's status in **Module Status**.

5.9.3 Calibration Settings

The following table lists the calibration settings of the load cell module.

Settings	Description
Upload	Upload the parameters from the controller to the software.
Download	Download parameters to the controller.
Import	Import the weight parameters from a CAL file. **Note:** Also import the module's parameters for AX-3 series.
Export	Export the weight parameters to a CAL file. **Note:** Also export the module's parameters for AX-3 series.

The following table lists the settings of the channel.

Settings	Description
Start	Click to turn on calibration.
Calibrate	Click to get the raw data from the module of each calibration point.
Stop	Click to stop calibration.
Clear Error	Click to clear errors if any. Check **Channel X Status** for software errors and **Module Status** for hardware errors.
Download	Click to download the configuration of the current channel to the online device.

The following table lists the options for handling tare weight.

Setting	Description
Tare	Click to remove the tare weight of the item placed on the channel (continuous peeling is possible).
Clear Tare	Click to restore the tare weight recorded in the channel.
Zero	Click to reset the display value of the channel to 0.

5.10 Controller Configuration and Settings

This section introduces the system, network, and other settings of AX series controllers.

For more information on the hardware and operations of the CPU or modules, see *Catalogs*, *Hardware Manual,* and *Operation Manual*.

Before setting parameters, check the facts that affects the CPU module and the whole system to prevent damage to the system. The parameters set only takes effect after they are downloaded to the CPU device module.

5.10.1 System Settings

How do I open the **System Settings** tab?

- On the **Devices** pane, double-click the device and then go to **System Settings**.

Use the following tables to view and configure the settings.

Runtime Clock

Setting	Description
Read PLC Time	Click to read the time and time zone from the controller. **PLC Time** and **PLC Timezone** are updated accordingly.
Date	Set the date.
Time	Set the time.
Write PLC Time	Click to write the date and time based on the selected time-zone to the controller. **PLC Time** and **PLC Timezone** are up-dated accordingly.
Sync with Local Time	Click to sync all the time, date, and timezone settings with the computer time.

Note: This function is not available for AX-8 Windows series controllers.

Time Zone

Setting	Description
Read Timezone	Click to read timezone information from the controller.
Write Timezone	Click to write the timezone to the controller. **PLC Timezone** is updated accordingly.

Note: This function is not available for AX-8 Windows series controllers.

Network

Setting	Description
Enable Gateway and DNS Setting	Select to turn on the default gateway and DNS server set-tings. Only available for AX-332, AX-5, and AX-C series con-trollers.

Setting	Description
IP Address Mode	Select the IP address mode of Static or DHCP.
IP address	Set the IP address, subnet mask, and default gateway in the Static mode.
Obtain DNS server address automatically	Select to obtain the DNS server address automatically. This function is only available when selecting **DHCP** as the IP address mode for AX-332, AX-5, and AX-C series controllers.
Use the following DNS server addresses:	Select to enter **Preferred DNS server** and **Alternate DNS server**.
Read from PLC	Click to read and update the IP address from the active device.
Apply IP settings while download	Select to apply the changed IP address after download.

Project ID

Settings	Description
Set Project ID	Click to set Project ID and PLC ID. For more information, see Password Management and Data Protection Mechanism.

Note: This function is not available for the AX-8 Windows controller.

Persistent Retain Settings

Setting	Description
Original mode	Select to keep CODESYS persistent variable mode.
%M mode	Select to set up the %M address to retain persistent variables. • **Start Memory Address**: Enter the value for the start memory address. The value can start from 0 and cannot exceed the value in **End Memory Address**.

Setting	Description
	Note: For the AX-8 Linux series, the start value can start from 0 only when you select **Extended size** for **Retain Size**. • **End Memory Address**: The end memory address is not editable.
Clear	Click to clear all the %M addresses assigned to the variables.

Retain Size

This function is only available for AX-8 Linux series controllers.

Setting	Description
Read Retain Size Mode	Click to read and show the retain size mode of the controller. Use this to check whether the controller's retain size mode is consistent with the mode selected in the project before login.
Write Retain Size Mode	Click to write the current retain size mode to the controller. The change takes effect after a controller restart.
Default size	Select to use the default retain memory size.
Extended size	Select to extend the retain memory size.

5.10.2 System Parameters

How do I open the **System Parameters** tab?

- On the **Devices** pane, double-click the device and then go to **System Parameters**.

System Parameters shows the communication and controller basic parameters.

Use the following tables to view and configure the parameters.

Item	Description
Parameter	Shows the parameter name, not editable.

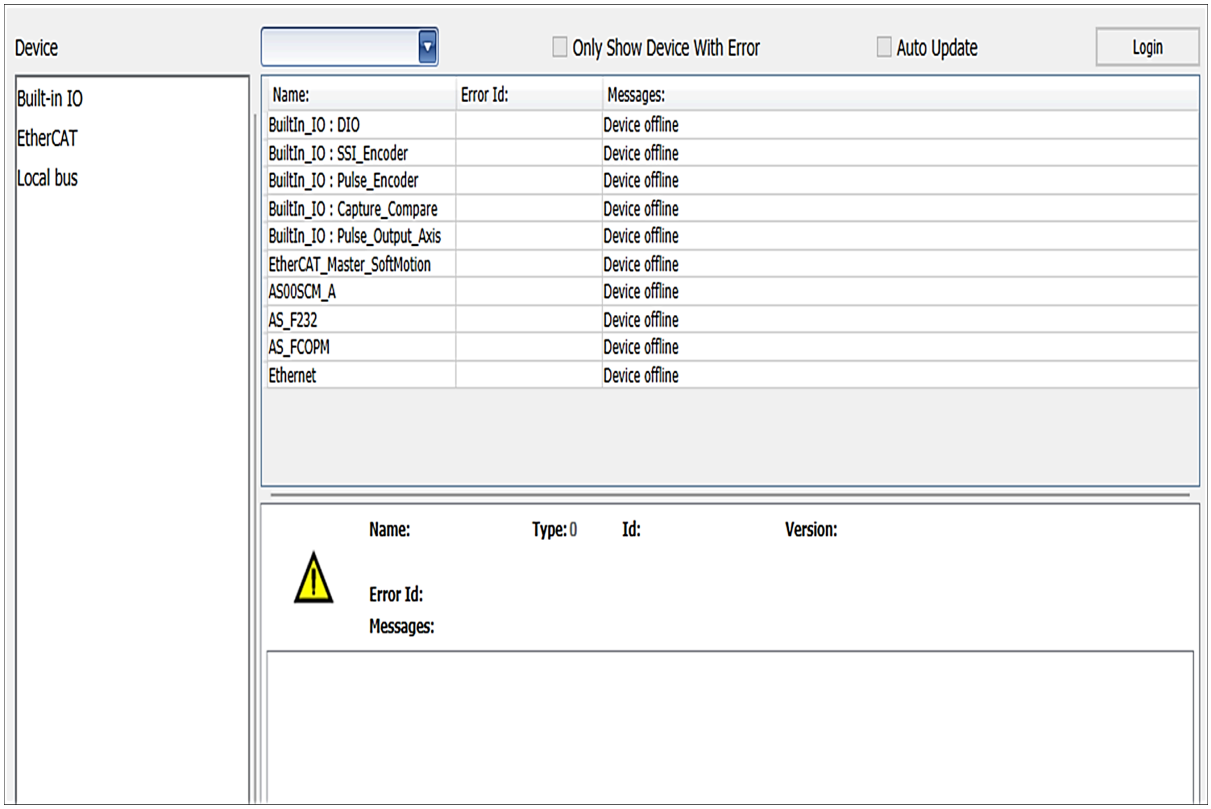
Item	Description
Type	Shows the data type of the parameter, not editable.
Value	Shows the initial value of the parameter or the corresponding symbol name. Double-click the field to change the value or select from the dropdown list to change the value if the parameter is editable.
Default Value	Shows the default value of the parameter defined by the device description, not editable.
Unit	Shows the unit of measure for the value (example: “ms” for milliseconds), not editable.
Description	Shows the description of the parameter specified by the device description, not editable.

5.10.3 Device Diagnosis

How do I open the **Device Diagnosis** page?

- Right-click the controller, and then select **Device Diagnosis**.

If an error occurs while the controller is running, you can open **Device Diagnosis** to inquire about the hardware errors.



The following table lists the settings in the **Device Diagnosis** page and their descriptions.

Setting	Description
Device	Lists the device category in the project tree. You can click one category to show the devices of this category.
Search	Enter keywords to search the device.
Only Show Device With Error	Select to show devices with errors.
Auto Update	Select to update device status automatically.
Update	Click to update the device status.
Name	Shows the device name.
Error Id	Shows the error ID. You can see troubleshooting or error code chapters in different manuals for the device error code.

Setting	Description
	• Built-In IO: *Delta AX-3 Series Operation Manual* • EtherCAT: ◦ *Delta ASDA-A2 Series Servo Drive User Manual* ◦ *Delta ASDA-A3 Series Servo Drive User Manual* ◦ *Delta ASDA-B3 Series Servo Drive User Manual* ◦ Other corresponding manuals for non-Delta servos • Local Bus: ◦ *AX-3 Series Operation Manual* ◦ *AS Series Module Manual*
Messages	Shows the device status.

5.10.4 High-speed I/O Settings

How do I open the **Hardware IO Configuration** page?

- On the **Devices** pane, double-click **BuiltIn_IO**.

High-speed I/O provides the following settings.

- SSI Encoder: Set up the SSI encoding type, clock frequency, SSI data length, and other functions.
- Counter/Timer: Set up the high-speed counter variable counting mode, and pulse encoder, enable the Z-phase signal, or declare the high-speed timer variable.
- Capture/Compare: Set up the high-speed capture variables and high-speed comparators.

- Pulse Output: Set up the pulse output mode, direction, origin return mode, and parameters.
- DIO: Set up the filter, polarity, and DIO I/O mappings.

5.10.4.1 High-Speed I/O Settings Supported

The following table lists the comparison of high-speed I/O configurations.

Configurations	AX-304	AX-308	AX-316	AX-324	AX-332	AX-364	AX-5	AX-C	AX-864EP1ME1TP
SSI		x	x		x	x			
Counter	x	x	x	x	x	x	x	x	
Timer	x	x	x	x		x	x		
Capture	x	x	x	x	x	x	x	x	
Compare	x	x	x	x	x	x	x	x	
Pulse Output Axis	x	x	x	x	x	x	x	x	
DIO	x	x	x	x	x	x	x	x	
Interrupt	x	x	x	x		x	x		x

Note:

1. This section does not applied to AX-300NA0PA1 and AX-8 other controllers.
2. There is no differential encoder in AX-304 and AX-324.

5.10.4.1.1 BuiltIn IO: SSI Encoder Configuration

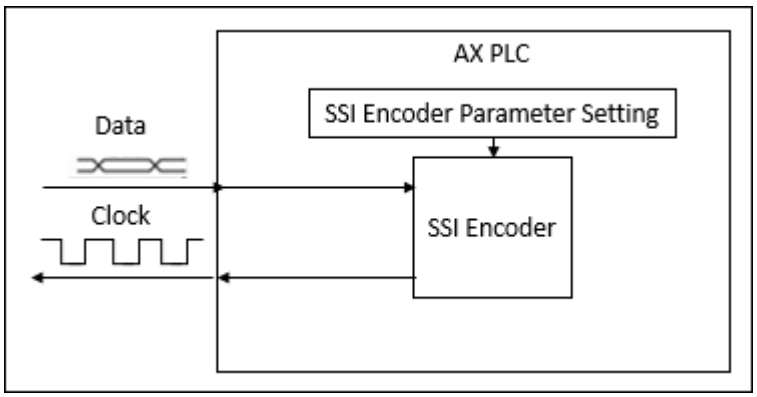
How do I open the **SSI Encoder Configuration** page?

1. On the **Devices** pane, double-click **BuiltIn_IO** and go to **Hardware IO Configuration**.
2. Select **SSI Encoder**.

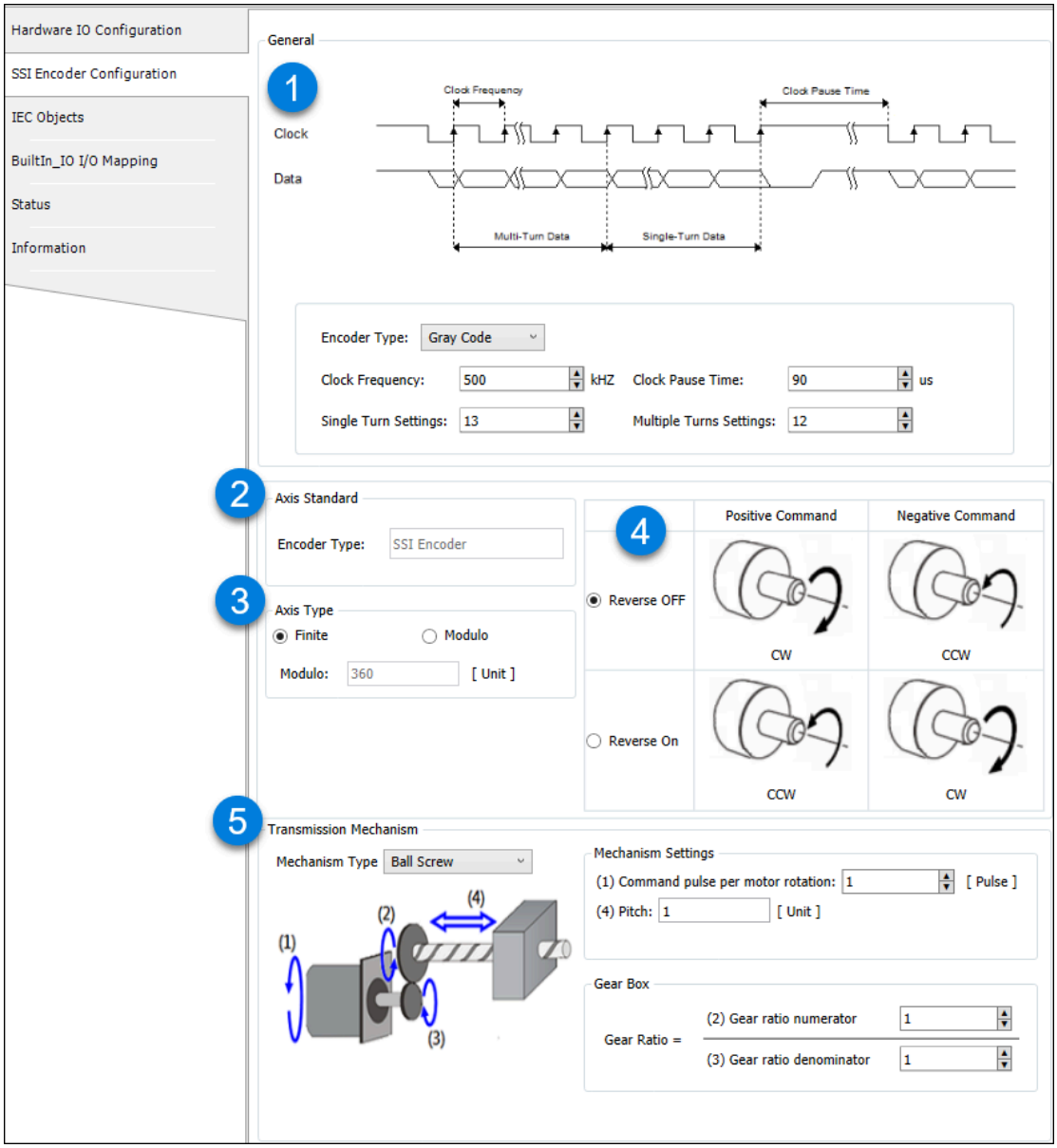
The **SSI Encoder Configuration** tab shows below **Hardware IO Configuration**.

The AX series controller supports a set of SSI encoder functions on the I/O end. It is connected to the controller through the D-SUB interface. This interface provides 5V power output for the encoder power. The parameters required by the encoder can be received through the hardware configuration channel.

SSI Encoder architecture



The following tables show the SSI Encoder settings and descriptions.



1 General

Setting	Description
Encoder Type	Select the encoding type.
Clock Frequency	Select or enter the frequency of the transmission clock signal used for SSI encoder communication. The value range is 0–10000. **Note:** AX-332 and AX-C can only select the value from the list.

Setting	Description
Clock Pause Time	Select or enter the time that the data line remains low after the last falling edge of the clock and before the data line is pulled high (see the SSI encoder data sheet). The value range is 0–65523. **Note:** AX-332 and AX-C can only select the value from the list.
Single Turn Settings	Select or enter the bit length of the single turn resolution (see the SSI encoder data sheet). The value range is 0–65523.
Multiple Turns Settings	Select or enter the bit length of the multi-turn resolution (see the SSI encoder data sheet). The value range is 0–65523.

2 Axis Standard

Setting	Description
Encoder Type	Shows the SSI encoder type.

3 Axis Type

Setting	Description
Finite / Modulo	Select the axis type. When the modulo axis is selected, enter the rotation value. The default value is 360.

4 Positive/Negative Command

Setting	Description
Reverse OFF / On	Select the forward or reverse command.

5 Transmission Mechanism

Setting	Description
Mechanism Type	Select the mechanism type.

Setting	Description
Mechanism Settings	Set the parameter value for the selected mechanism. The settings differ by type. The default value is 1.
Gear Ratio	Select or enter the gear ratio's numerator and denominator. The default value is 1.

You can right-click **BuiltIn_IO**, and then select **Edit IO Mapping** to set up the SSI Encoder Mapping variables. The following table lists Encoder Position and Error ID descriptions on the **Edit IO Mapping** page.

Item	Description
Encoder Position	The location of SSI
ErrorID	The SSI Encoder Communication status 0: No Error 1: Error Communication 2: Wrong Parameter Setting

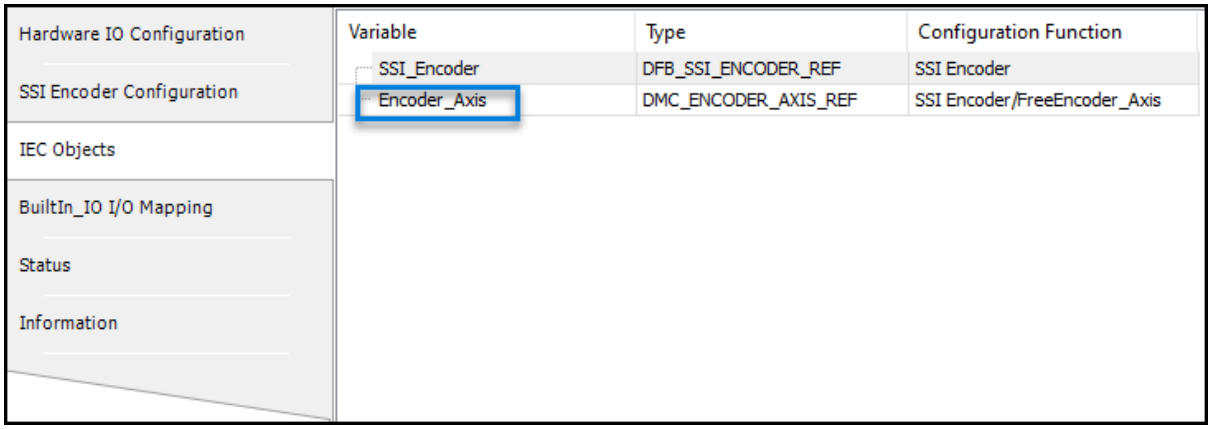
- ErrorID = 1 when the SSI Encoder is not connected or the SSI Encoder is disconnected from the CPU.To clear the error, check the connection between the SSI encoder and CPU. The updated firmware ensures the communication channel is connected correctly to restore EncoderPosition updates of BusCycle. There are many reasons for the cause of errors, for example, the SSI encoder incorrectly connected, a broken SSI encoder, or an abnormal drive board.

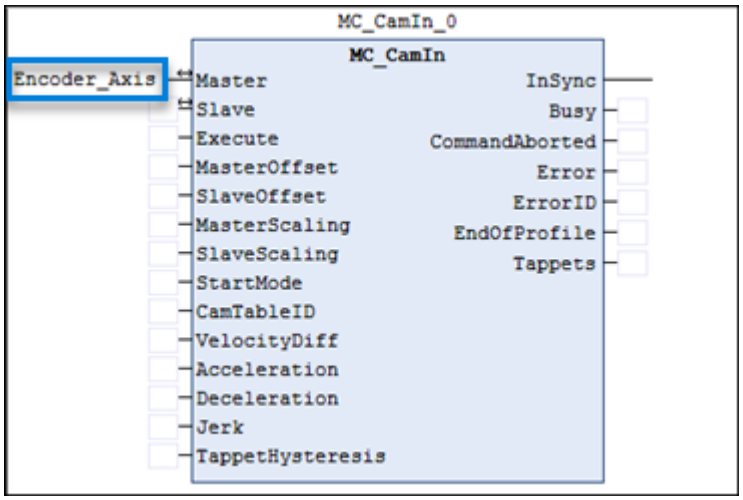
- ErrorID = 2 when MultiTurns + SingleTurns is greater than 32. To clear the error, ensure the value of MultiTurns + SingleTurns does not exceed 32.

SSI Encoder used in a program

The SSI encoder device contains the axis encoder variables that can be used for MC function blocks in POU, for example, **MC_CamIn**.

Use the variable **Encoder_Axis** when the axis is used in POU.





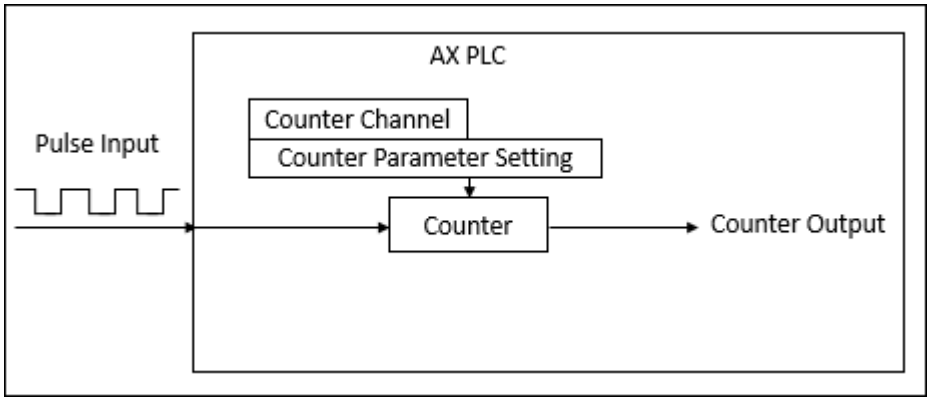
5.10.4.1.2 BuiltIn IO: Counter/Timer Configuration

How do I open the **Counter Configuration** page?

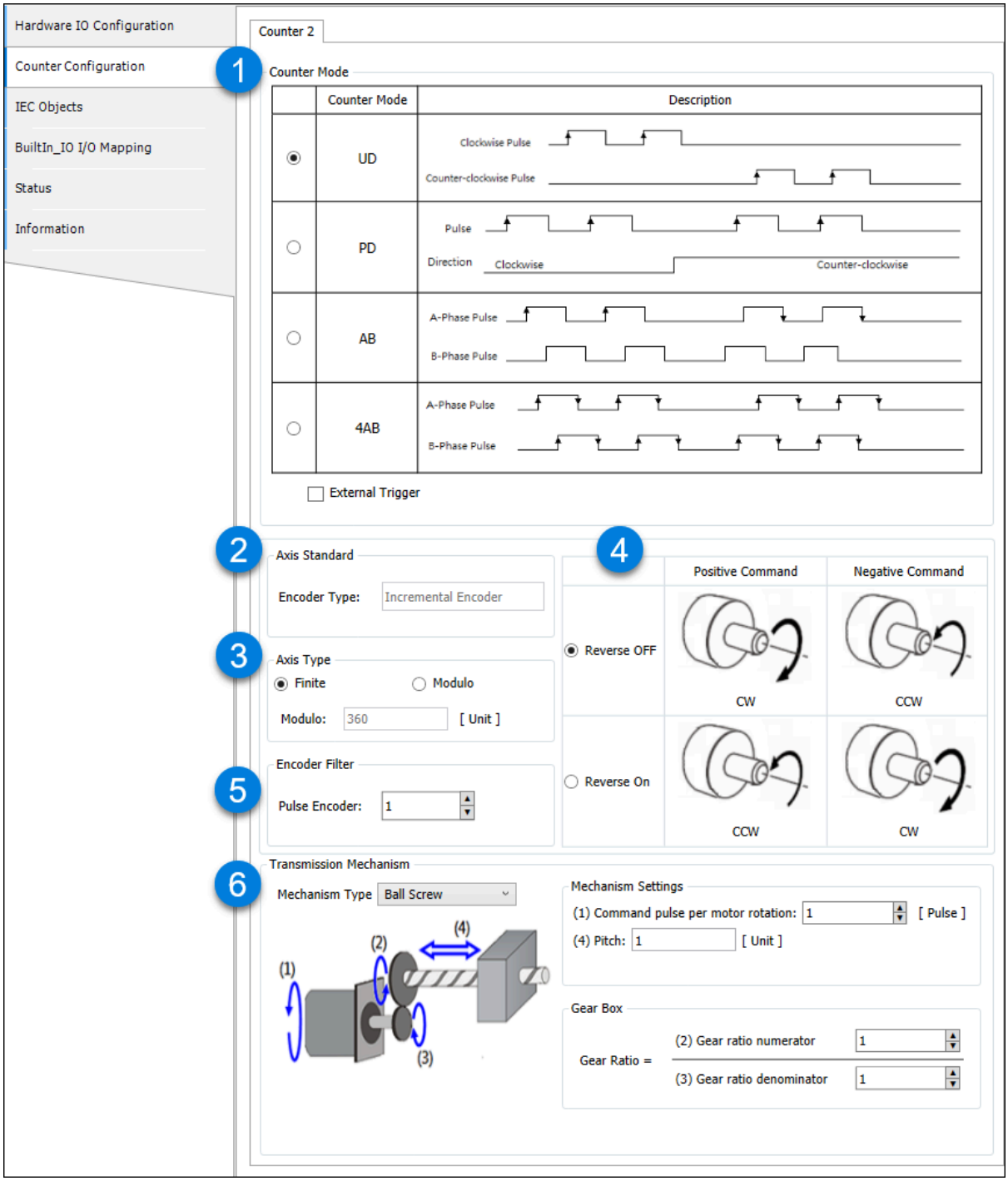
1. On the **Devices** pane, double-click **BuiltIn_IO** and go to **Hardware IO Configuration**.
2. Select a counter.

The **Counter Configuration** tab shows below **Hardware IO Configuration**.

High-speed counter



The following tables show the Counter settings and descriptions.



1 Counter Mode

Setting	Description
UD	Forward pulse train and reverse pulse train
PD	Pulse train + direction

Setting	Description
	Note: AX-332 and AX-C do not support.
AB	AB phase pulse train **Note:** AX-332 and AX-C do not support.
4AB	AB phase pulse train (4x)
External Trigger	Select to turn on the Z phase signal. **Note:** AX-332 and AX-C do not support.

2 Axis Standard

Setting	Description
Encoder Type	Shows the encoding type.

3 Axis Type

Setting	Description
Finite	Set linear or rotary axis.
Modulo	Set the modulo value. This function is only available when selecting **Modulo** as the axis type. The default value is 360.

4 Positive/Negative Command

Setting	Description
Reverse OFF/On	Select the forward or reverse command.

5 Encoder Filter

Setting	Description
Pulse Encoder	Select the pulse encoder. The value range is 1–100.

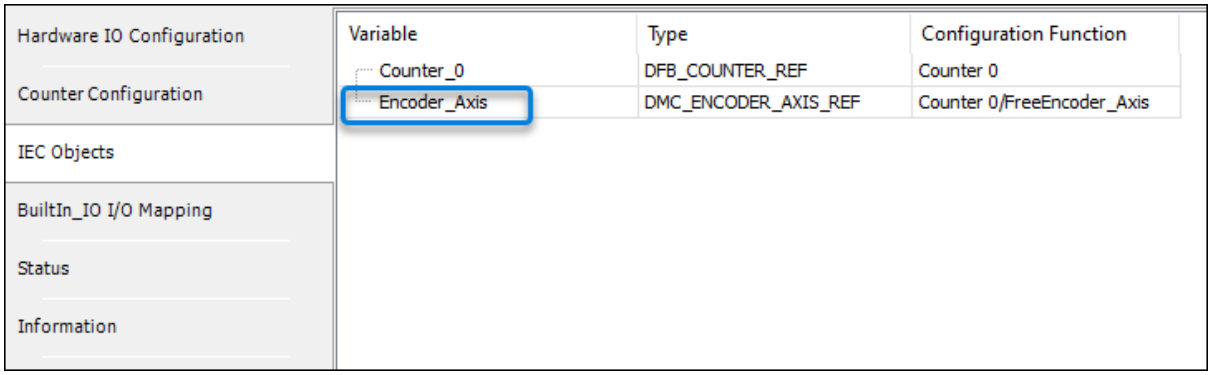
6 Transmission Mechanism

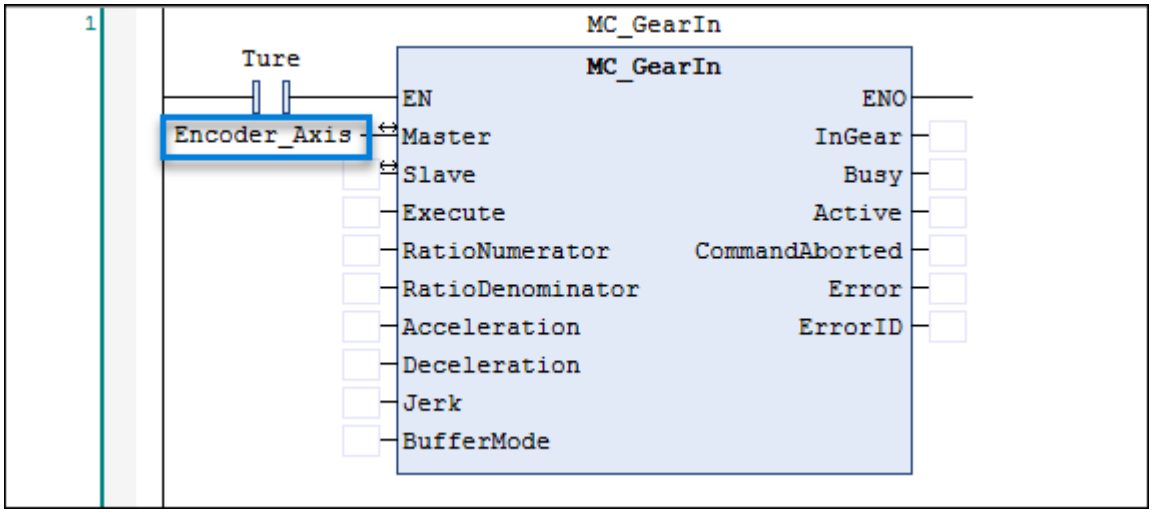
Setting	Description
Mechanism Type	Select the mechanism type.
Mechanism Settings	Set the parameter value for the selected mechanism. The settings differ by type. The default value is 1. • **Command pulse per motor rotation**: Enter the number of pulses required for a motor to rotate for one cycle. • **Pitch**: Enter the pitch of the screw. • **Diameter**: Enter the diameter of the gear. Diameter*π = Movement distance per motor rotation • **Movement distance per motor rotation**: Enter the distance the motor moves to rotate for a cycle.
Gear Ratio	Select or enter the (2) gear ratio's numerator (number of teeth of the worktable) and (3) denominator (number of teeth of the motor gear) to set the reduction ratio. The default value is 1.

Counter used in a program

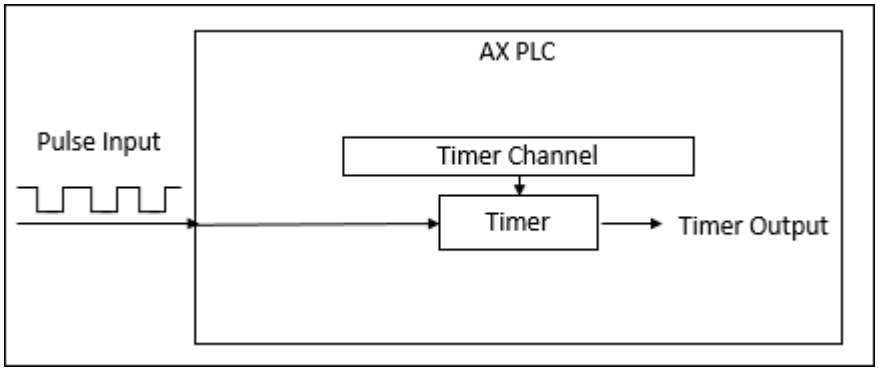
The high-speed counter contains the axis encoder variables that can be used for MC function blocks in POU, for example, **MC_GearIn**).

Use the variable **Encoder_Axis** when the axis is used in POU.





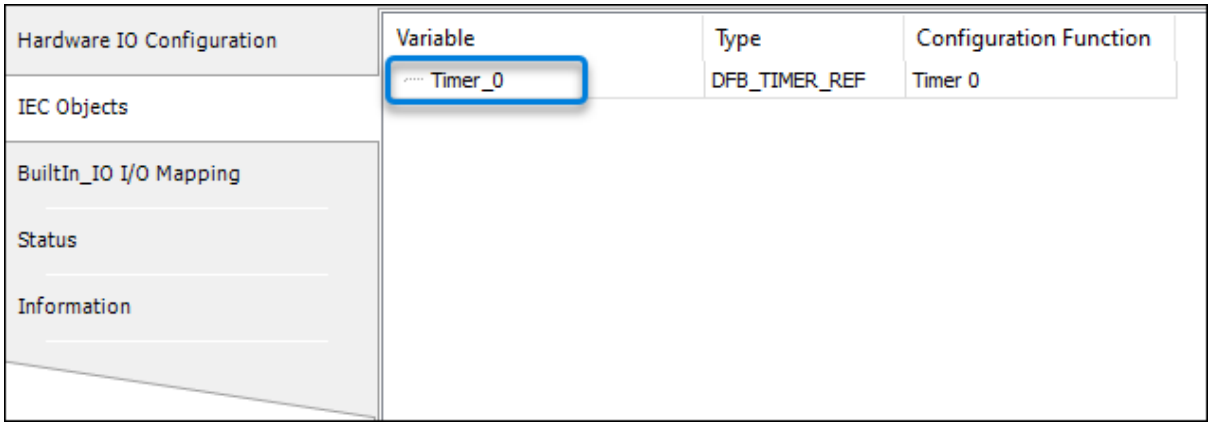
High-speed timer

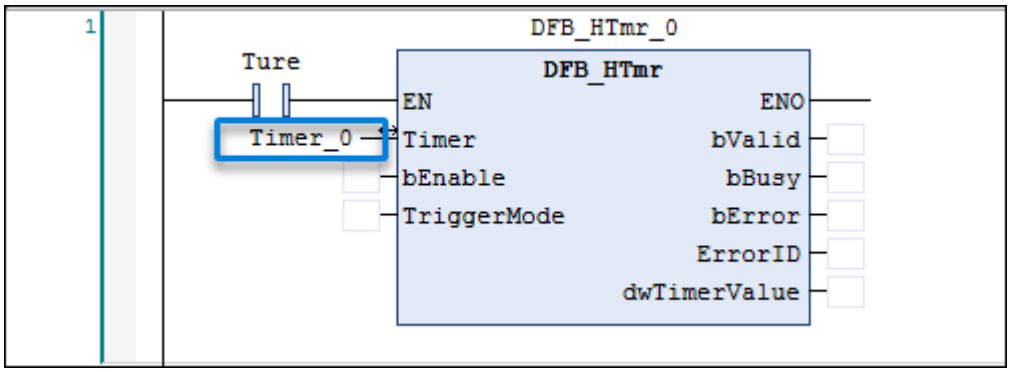


Timer used in a program

Timer contains variables that can be used for function blocks in POU, for example, **DFB_HTmr**.

In the **Hardware IO Configuration** page, select a Timer pin, for example, **Timer 0**. The variable **Timer_0** will show on the **IEC Objects** page. Use this name when the axis is used in POU.

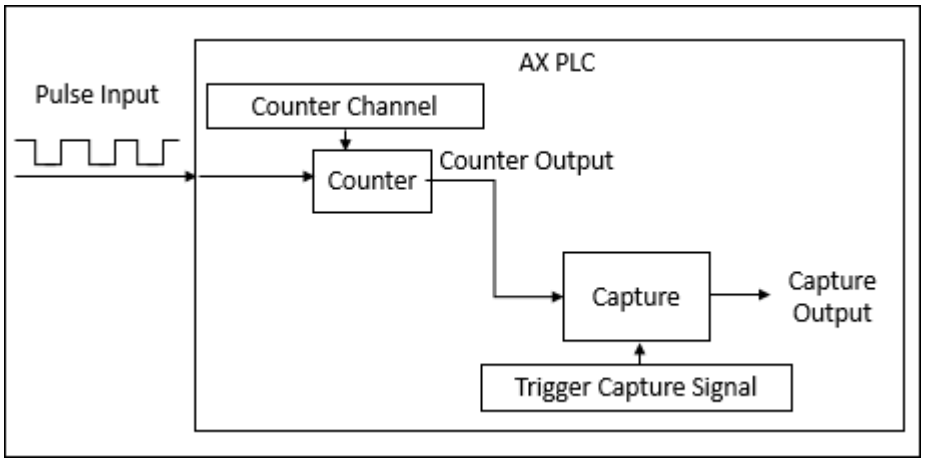




5.10.4.1.3 BuiltIn IO: Capture/Compare Configuration

This section describes the high-speed comparator and capture functions.

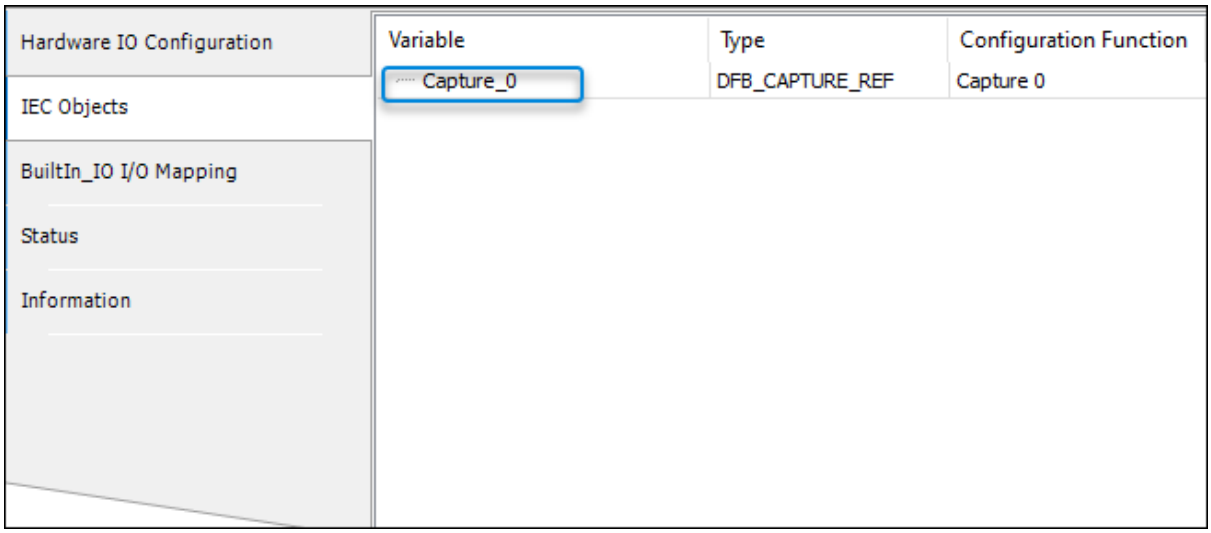
Capture

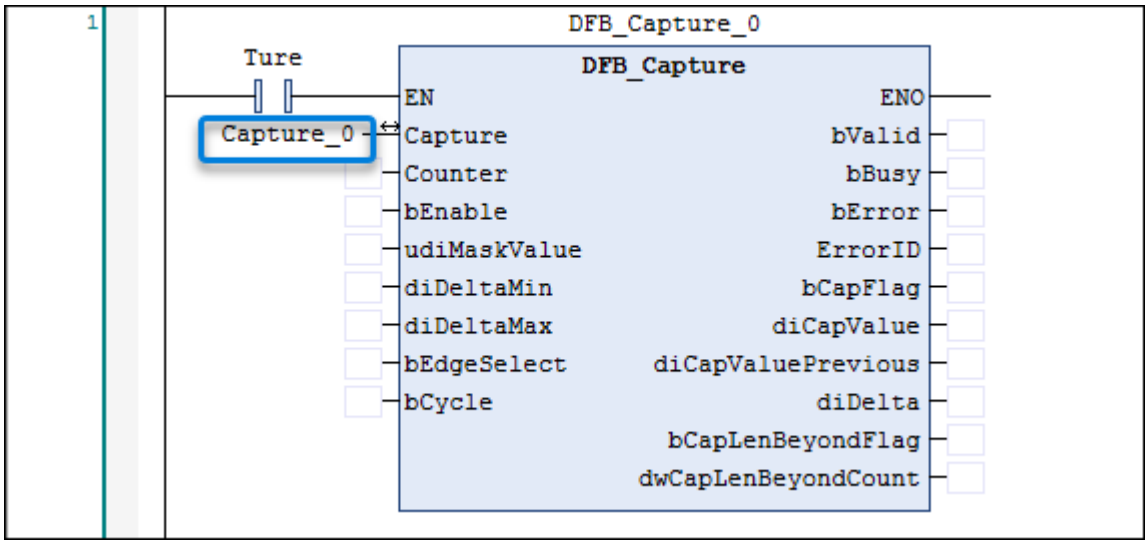


Capture used in a program

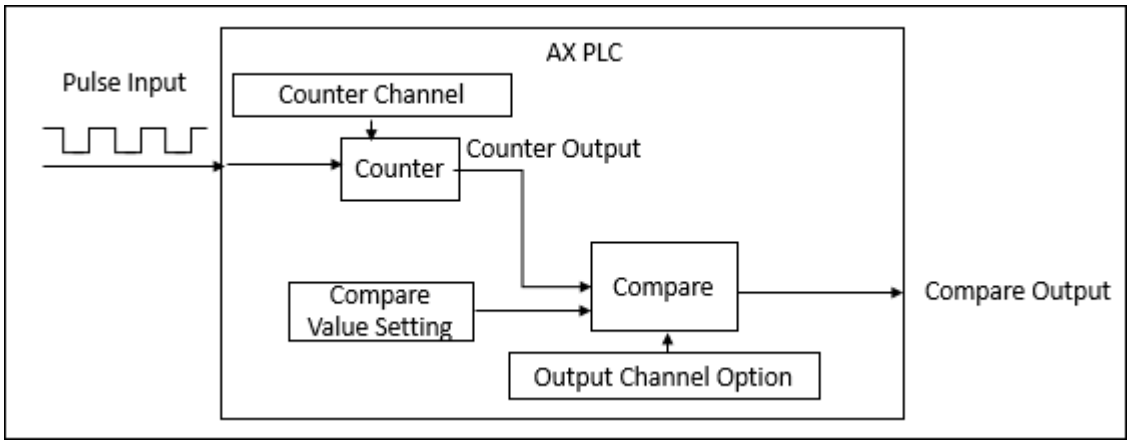
Capture variables can be used for MC function blocks in POU, for example, **DFB_Capture**.

On the **Hardware IO Configuration** page, select a Capture pin, for example, **Capture 0**. The variable **Capture _0** will show on the **IEC Objects** page. Use this name when the axis is used in POU.





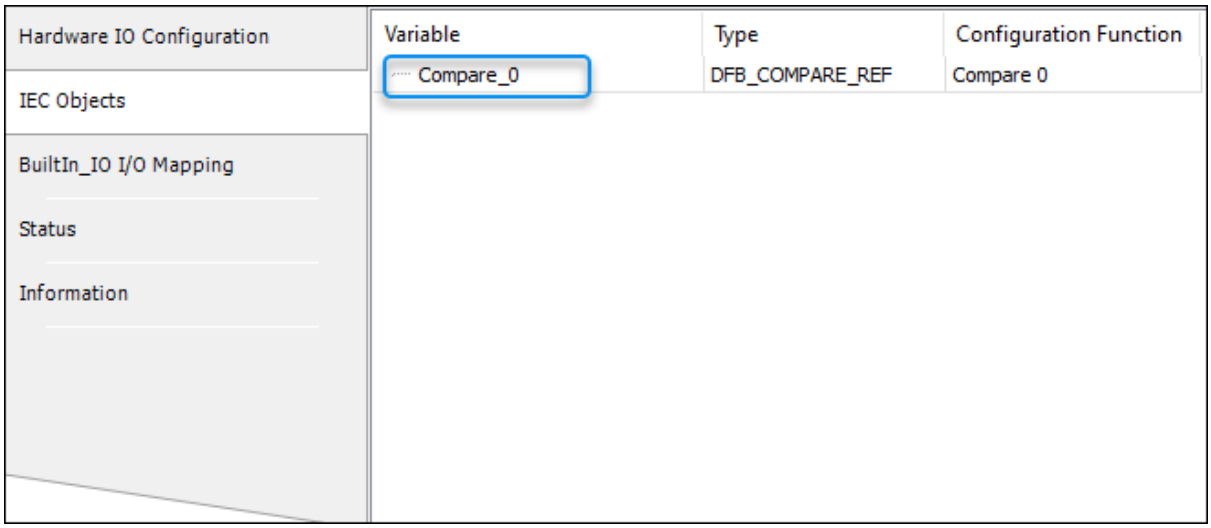
Compare

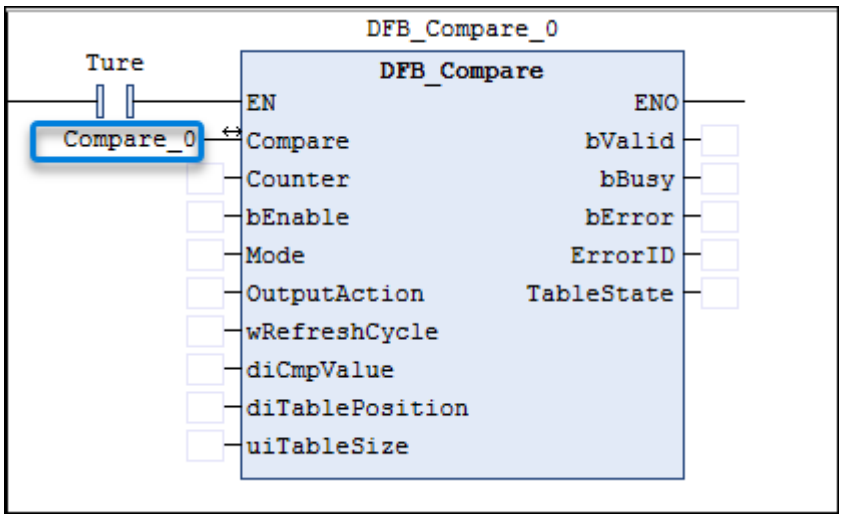


Compare used in a program

Compare variables can be used for MC function blocks in POU, for example, **DFB_Compare**.

On the **Hardware IO Configuration** page, select a Compare pin, for example, **Compare 0**. The variable **Compare_0** will show on the **IEC Objects** page. Use this name when the axis is used in POU.





5.10.4.1.4 BuiltIn IO: PoAxis Configuration

How do I open the **PoAxis Configuration** page?

1. On the **Devices** pane, double-click **BuiltIn_IO** and go to **Hardware IO Configuration**.
2. Select **Pulse Output Axis**.

The **PoAxis Configuration** tab shows below **Hardware IO Configuration**.

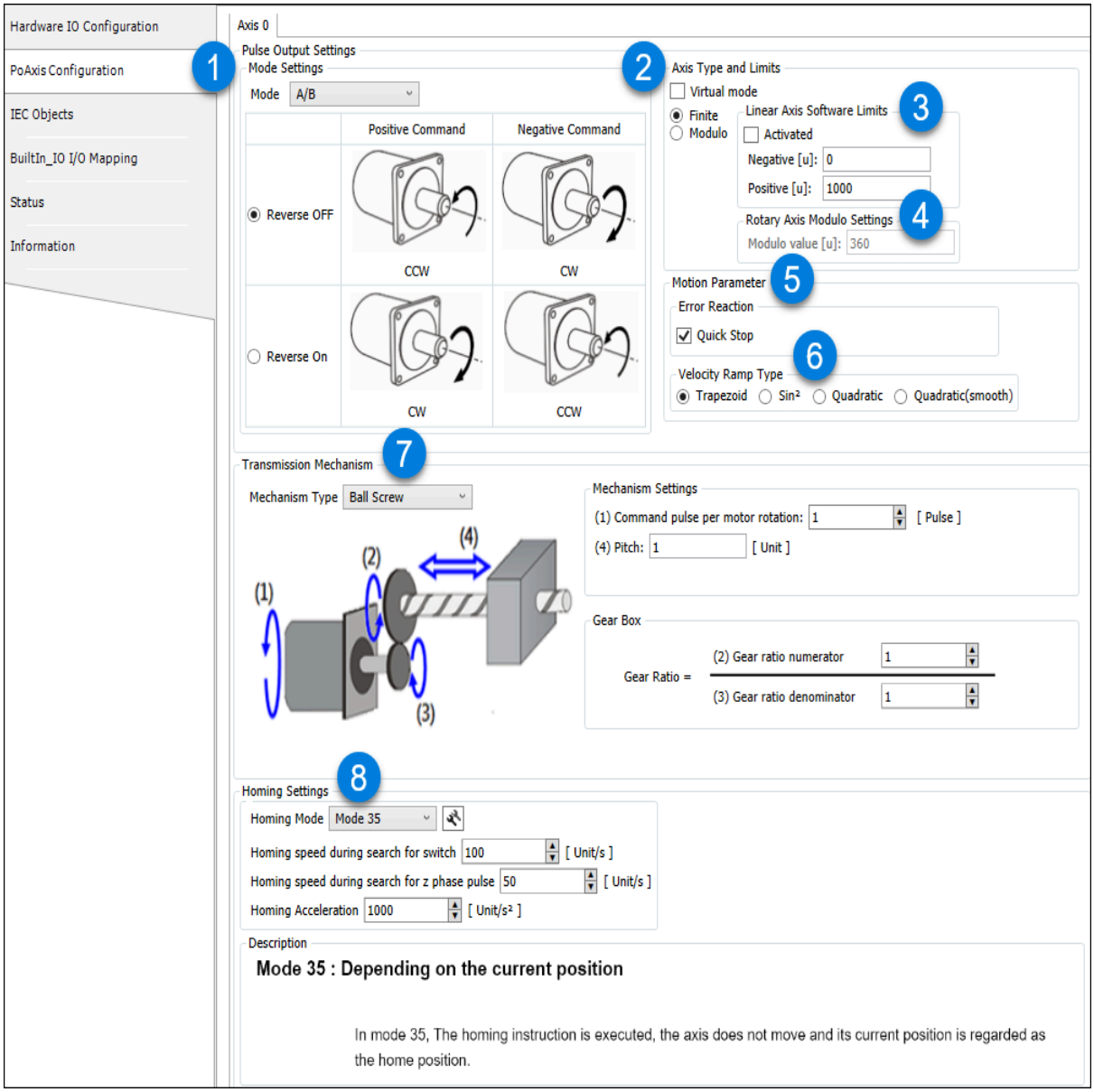
This section describes the I/O pulse output function module.

After selecting a Pulse Output Axis, you can click  to open the **Pin Selection** dialog and select the I/O terminal number of **LSP**, **LSN**, **Z Phase**, and **Home Switch**.

Note:

- If two pins select the same I/O terminal number, the system automatically changes the first one to **None**.
- The I/O terminal number will not show if **Counter**, **Capture**, or **Compare** occupies it.
- If you select a Pulse Output Axis, but the pin is already occupied by **Counter** or others, the **Pin Selection** dialog will open automatically to let you select other pins.

The following tables show the PoAxis settings and description.



1 Mode Settings

Setting	Description
Mode	Select the pulse output type.
Reverse OFF / On	Select the forward or reverse command.

2 Axis Type and Limits

Setting	Description
Virtual mode	Select to start virtual axis.

Setting	Description
Finite / Modulo	Select to set the axis type.

3 Linear Axis Software Limits

Setting	Description
Activated	Select to start software limit (only supports linear axis).
Negative [u]	Enter reverse software limit. The default value is 0.
Positive [u]	Enter forward software limit. The default value is 1000.

4 Rotary Axis Modulo Settings

Setting	Description
Modulo value [u]	Enter a circle range (only supports rotary axis). The default value is 360.

5 Error Reaction

Setting	Description
Quick Stop	Select to stop the axis in emergency.
Deceleration [u/s^2]	Enter the axis decelerating to stop value (only shows when the **Quick Stop** checkbox is not selected). The default value is 1000.

6 Velocity Ramp Type

Setting	Description
Trapezoid Sin^2 Quadratic Quadratic(smooth)	Select the axis motion curve.

7 Transmission Mechanism

Setting	Description
Mechanism Type	Select the mechanism type.
Mechanism Settings	Set the parameter value for the selected mechanism. The settings differ by type. The default values are 1. • **Command pulse per motor rotation**: Shows the number of pulses required for a motor to rotate for one cycle. • **Pitch**: Enter the scalable distance the worktable moves for a unit. See the following picture for examples. • **Diameter**: Enter the diameter of the gear. Diameter*π = Movement distance per motor rotation • **Movement distance per motor rotation**: Enter the distance the motor moves to rotate for a cycle.
Gear Ratio	Select or enter the (2) gear ratio's numerator (number of teeth of the worktable) and (3) denominator (number of teeth of the motor gear) to set the reduction ratio. The default values are 1.

(4) Pitch value	Worktable movement distance base	Function block input value	The actual distance the worktable moves
10000	100 cm	10000	100 cm
100	100 cm	100	100 cm
10000	100 cm	1	0.01 cm
100	100 mm	1	1 mm

8 Homing Settings

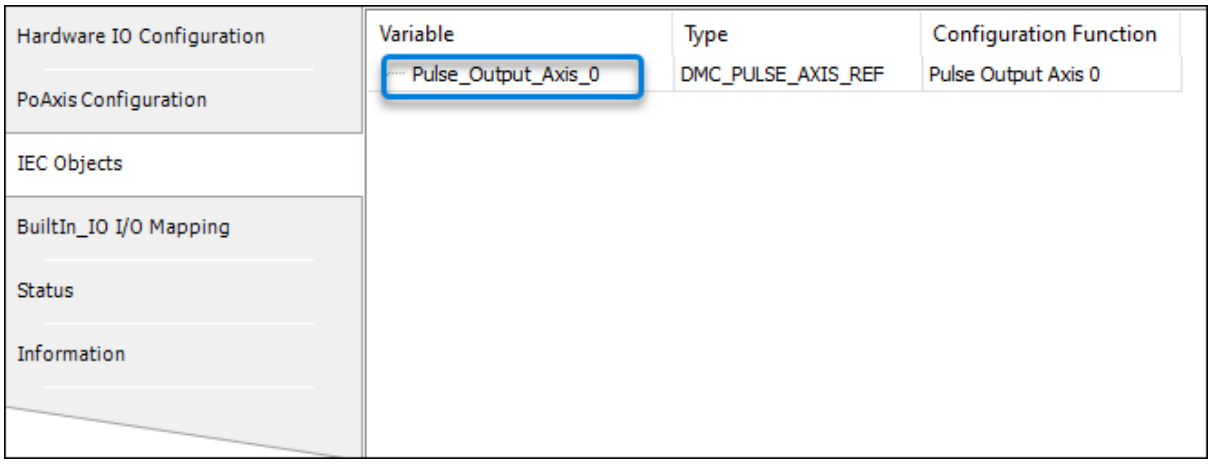
Setting	Description
Homing Mode	Select the homing mode. The actual homing mode is determined by the drive.

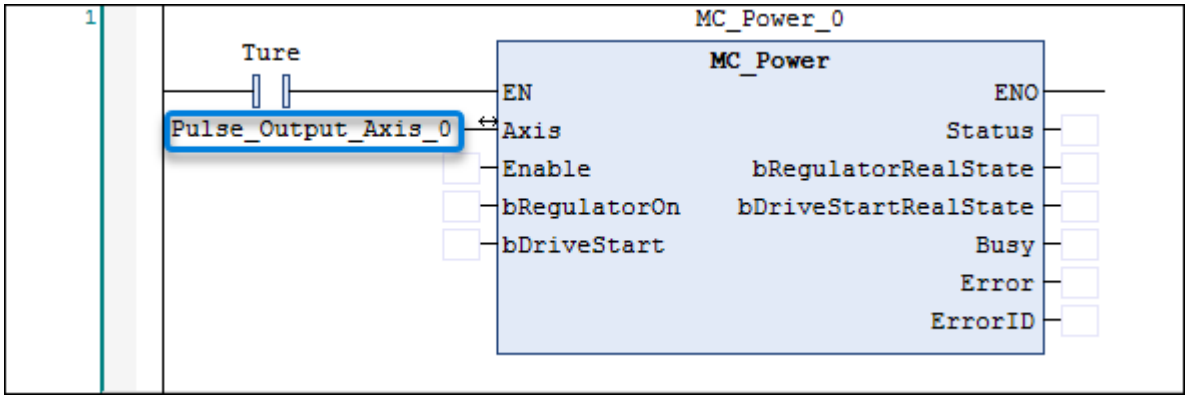
Setting	Description
	You can click  to open the **Homing Mode Assistant** dialog to decide the homing mode based on your selection. The default value is Mode 35.
Homing speed during search for switch	Select or enter the homing switch speed. The default value is 100.
Homing speed during search for z phase pulse	Select or enter the Z-Seek speed. The default value is 50.
Homing Acceleration	Select or enter the acceleration rate of the axis when searching for the velocity change. The default value is 1000.

Pulse Output Axis used in a program

Pulse Output Asix variables can be used for MC function blocks in POU, for example, **MC_Power**.

On the **Hardware IO Configuration** page, select a Pulse Output pin, for example, **Pulse Output Axis 0**. The variable **Pulse _Output_Axis_0** will show on the **IEC Objects** page. Use this name when the axis is used in POU.





5.10.4.1.5 DIO: DIO Configuration

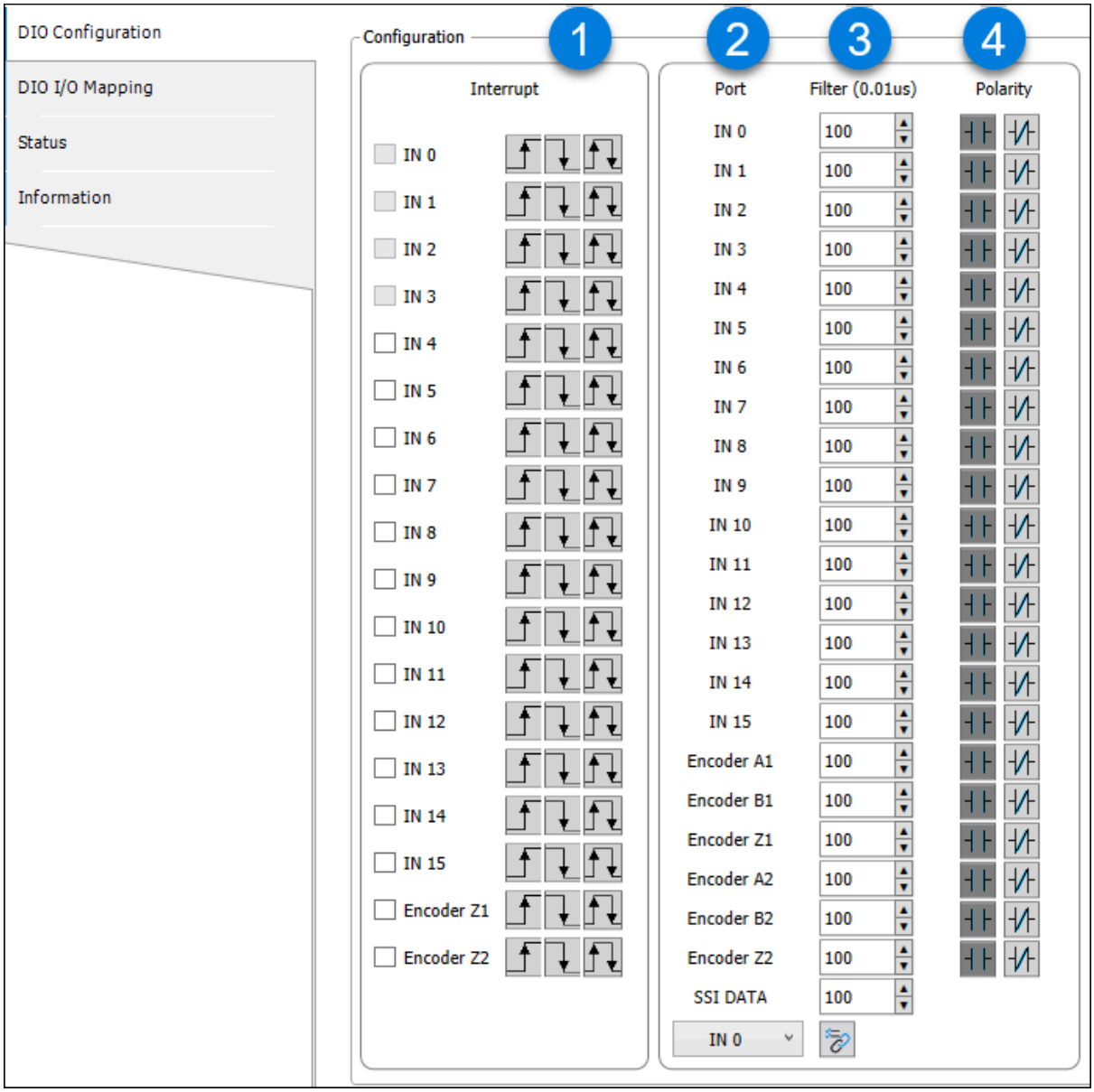
How do I open the **DIO Configuration** page?

- On the **Devices** pane, under the **BuiltIn_IO** node, double-click **DIO**.

The DIO device sets the I/O points of the host to interrupt, filter, and polarity.

The following tables show the DIO settings and description.

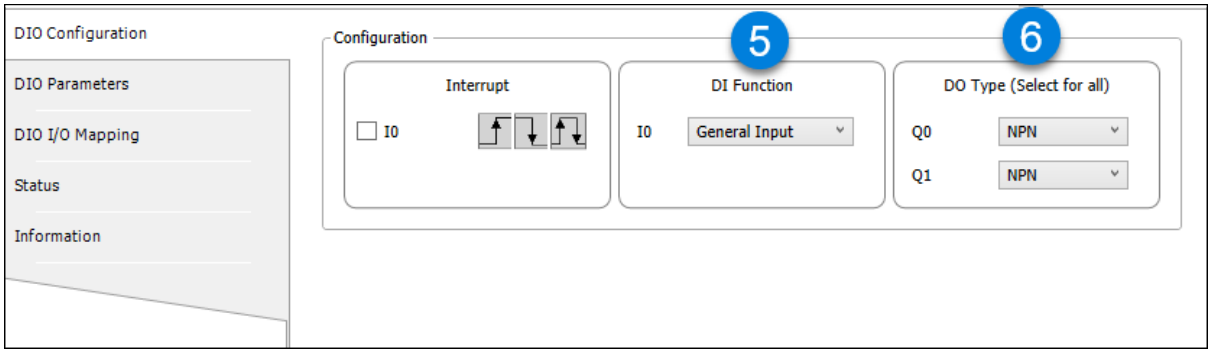
Note: The following figure is an example of the AX-308 **DIO Configuration** page. The user interface differs for different controllers.



Setting	Description
1 Interrupt	Select to turn on the external interrupt. Select to set the input contact to upper differential signal after the external interrupt is turned on. Select to set the input contact to the lower differential signal after the external interrupt is turned on. Select to set the input contacts to the upper and lower differential signals after the external interrupt is turned on.

Setting	Description
2 Port	Shows the contact number.
3 Filter	Select or enter the IN filter time. The value range is 0–30,000,000.
4 Polarity	Click to set the input contact polarity to A contact.
	Click to set the input contact polarity to B contact.

AX-864EP1ME1TP DIO Configuration



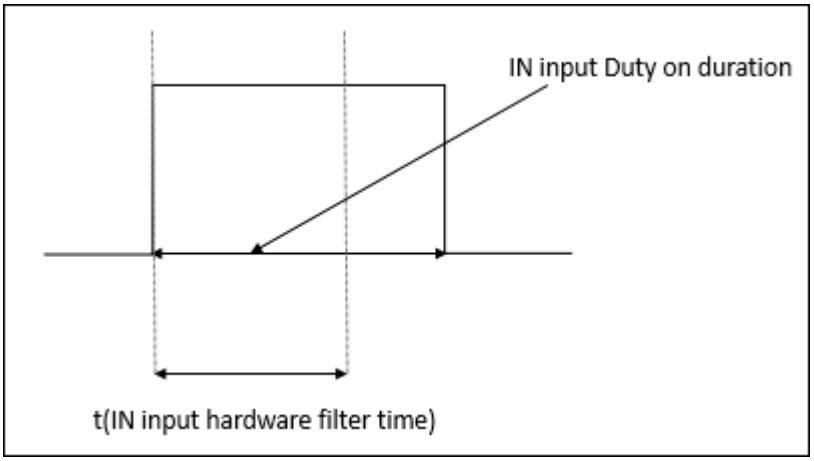
Setting	Description
5 DI Function	Select the Ix to work as a general input contact or special software function.
6 DO Type (Select for all)	Select the polarity type for the output contact. Selecting an option for one output contact synchronize the other output contacts to the same option.

I/O Interrupt used in a task

1. On the **DIO** page, turn on the interrupt function.
2. On the **Devices** pane, double-click the task that needs to set up interrupt.
3. On the **Task** page, select **External** for **Type**.
4. Select an interrupt for **External event**.

The IN input hardware filter time is less than the IN input Duty On duration, as shown in the following:

1. Hardware filter input range is 1–50000000, and the unit is 0.1us.



2. The relationship between filter frequency and time is:

Filter frequency × 2 (Hz): Filter frequency = 1/(2×t); t is the filter time (unit 0.01 μs).

When the input frequency is higher than the filter frequency range, the signal will be filtered.

This function is for the IN input points such as DFB_Capture, DFB_Hcnt, DFB_HTmr, DFB_Compare, and the body I/O interrupt.

5.10.4.1.6 High-speed I/O Settings (AX-8)

This section describes the High-speed I/O settings of the AX-8 series controller.

5.10.4.1.6.1 BuiltIn_DIO

How do I open the **BuiltIn DIO** page?

- On the **Devices** pane, double-click **BuiltIn_DIO**.

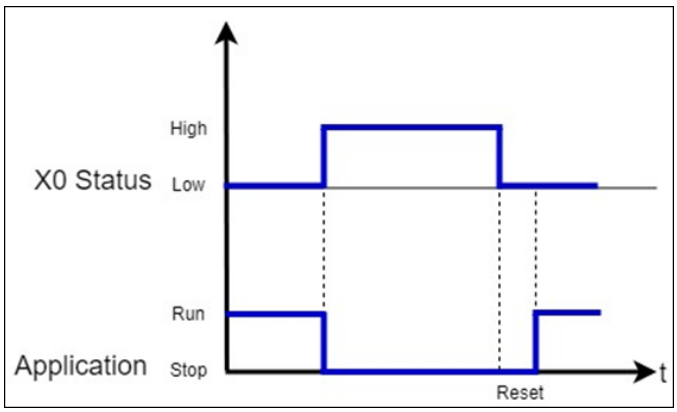
The following tables show the Parameter settings and description.

Setting	Description
DI Filter Select	Select the input filter time for X0 to X7.
X0 Function Type Choose	Select X0 as a general output or special software function.
DO Output Inverse	Set the output reserve value for Y0 to Y7.

Note: The value should be selected offline. After downloading, the field shows Run.

Stop/Start PLC Control Timing diagram

- When X0 is Low, Application → Reset → Run
- When X0 is High, Application Stop



5.10.4.1.6.2 BuiltIn Pulse Encoder (AX-8xxEP0 series only)

How do I open the **BuiltIn Pulse Encoder** page?

- On the **Devices** pane, double-click **BuiltIn Pulse Encoder**.

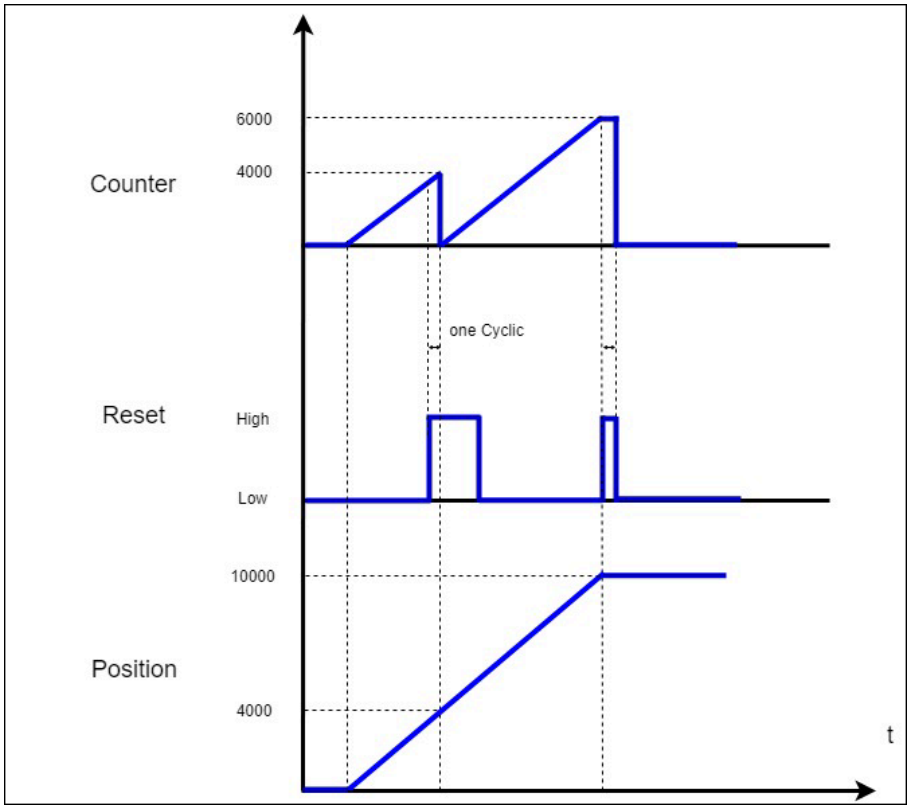
The following table shows the BuiltIn Pulse Encoder Parameters settings and descriptions.

Setting	Description
Pulse Encoder input type	Select the input type.
Pulse Encoder input direction	Select the input direction.
Pulse Encoder Z Inverse	Select the Pulse Encoder Z direction.
Pulse Encoder Filter Level	Enter the pulse encoder filter level.

Note: The value should be selected offline. After downloading, the field shows Run.

On the **BuiltIn Pulse Encoder** page, go to **BuiltIn_Pulse_Encoder I/O Mapping** to set the counter and reset mappings.

Reset Timing diagram



5.11 Motion Control Device

Motion control equipment is mainly used to set axis parameters for most applications. DIADesigner-AX provides a user-friendly editing environment where you can view an IEC object in **IEC Objects** and its axis parameters related to motion control in **Library Manager**.

In a motion control system, the object of motion control is called an axis which has different forms, including physical servo drives, encoders and virtual servo drives. The following table lists all axis types.

Type	Description
Synchronous axis	Perform servo and synchronous motion control such as electronic cams through EtherCAT communication. **Note:** Synchronous axis needs to be used with the **DL_MotionControl** and **SM3_Basic** library.
Positioning axis	Perform basic positioning control, such as absolute and relative positioning through EtherCAT communication. **Note:** Positioning axis needs to be used with the **DL_MotionControl** library.
Velocity axis	Perform velocity control and torque control.
Pulse type servo axis	Perform physical servo control through pulse.
Virtual axis	Only used in the program to run motion control commands without physical servo motors.
Encoder axis	Use physical encoder (SSI encoder or incremental encoder) as the signal source.
Virtual encoder axis	Only used in the program without physical encoders.

5.11.1 Add a Synchronous Axis

Supported slave device:

- ASDA-A2-E, ASDA-A3-E, ASDA-A3-EP, ASDA-B3-E, ASDA-W3-E, ASDA-E3-E, ASDA-E3C-E, ASDA-H3-E
- R1-EC5621

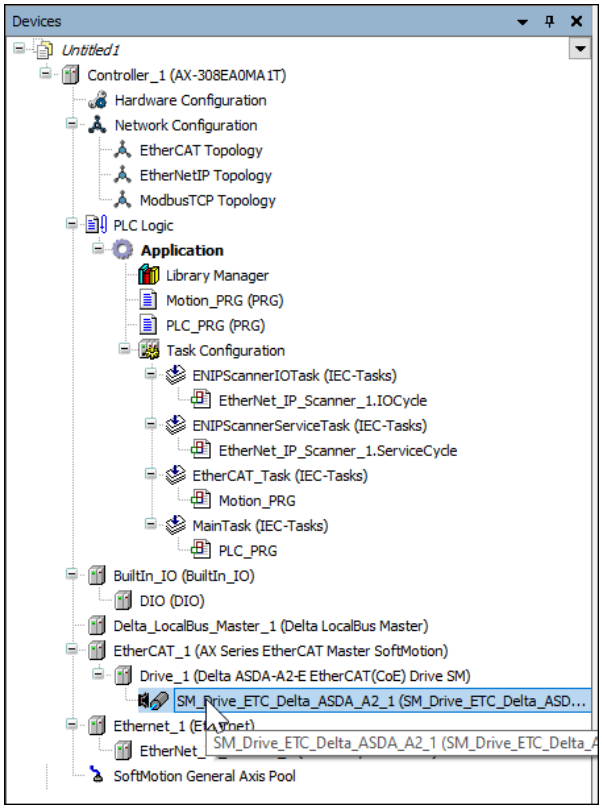
The multi-axis servo system ASDA-W3 supports adding up to 12 axes.

Use the following steps to add a synchronous axis.

To add a synchronous axis

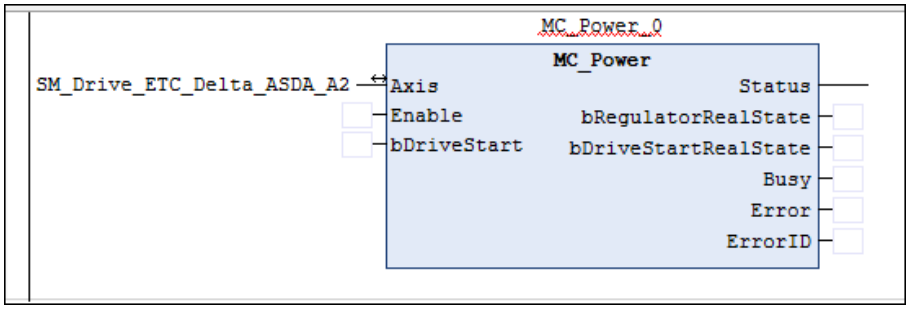
1. On the **Devices** pane, right-click **EtherCAT_X** and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbus** > **EtherCAT** > **Slave** > **Delta Electronics, Inc.** and then select a slave.

When the servo is added to the project, the system automatically generates its servo axis (you can rename it).



If select **Delta ASDA-W3-E EtherCAT (CoE) Drive**, after adding to the project, you need to right-click it to add its SM axis.

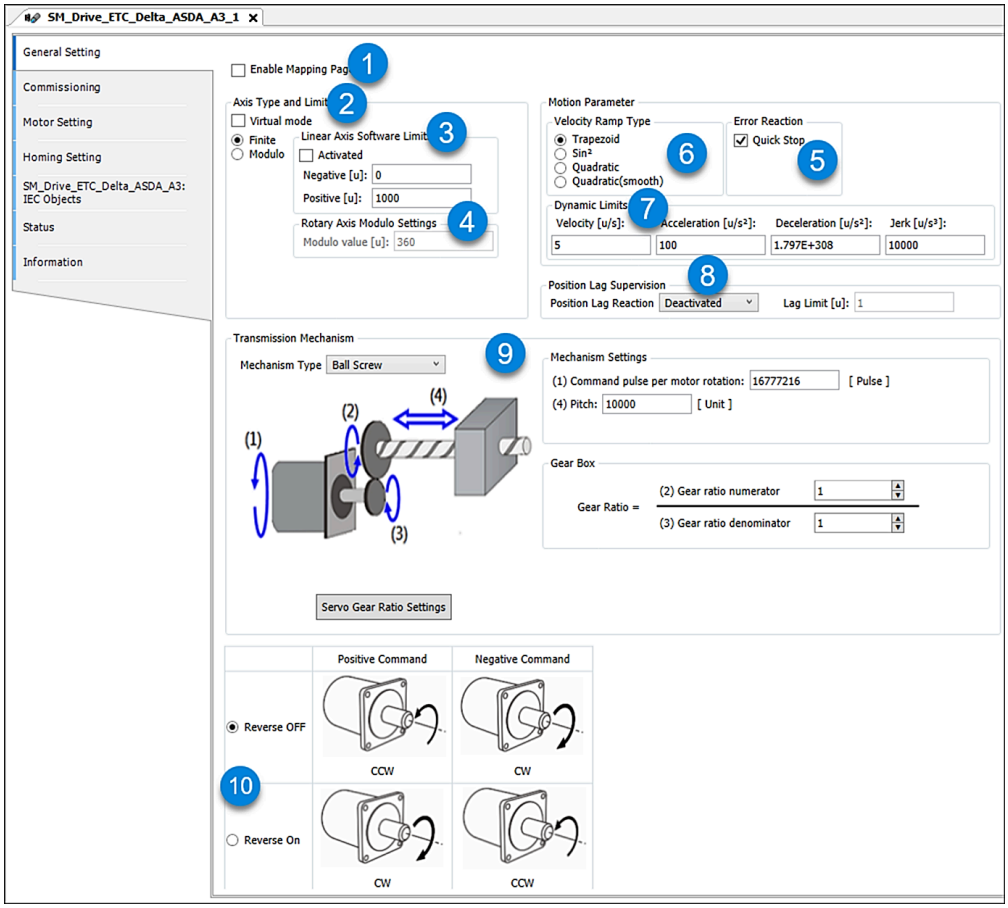
When using the motion function block, if you need to use the corresponding axis, enter the name of the axis as the variable to the Axis parameter, for example, **SM_Drive_ETC_Delta_ASDA_A2** in the Axis parameter.



5.11.1.1 Synchronous Axis Settings

After creating a servo axis or virtual axis, you can configure the corresponding axis parameters. The following tables list the axis parameters and descriptions.

General



1 Enable Mapping Page

Setting	Description
Enable Mapping Page	Select to show the **Scaling/Mapping** tab.

2 Axis Type and Limits

Setting	Description
Virtual mode	Select to turn on the virtual mode.

Setting	Description
	The drive is replaced by a simulation similar to a virtual drive unit. When there is a coupled drive, this does not have any effect on the fieldbus device.
Finite	Select to set the axis type as a linear axis. The drive has a fixed work area.
Modulo	Select to set the axis type as modulo. The drive turns endlessly without limiting the traversing range.

3 Linear Axis Software Limits

Setting	Description
Activated	Select to turn on the software limit (only supports linear axis). Position values are restricted by the lower limit **Negative** and the upper limit **Positive**.
Negative [u]	Enter reverse software limit.
Positive [u]	Enter forward software limit.

4 Rotary Axis Modulo Settings

Setting	Description
Modulo value [u]	Enter one circle range. This function is only available when selecting **Modulo** as the axis type. The default value is 360.

5 Error Reaction

Setting	Description
Quick Stop	Select to stop the axis in emergency.
Deceleration [u/s^2]	Enter the axis decelerating to stop value (only shows when the **Quick Stop** checkbox is cleared).

6 Velocity Ramp type

Setting	Description
Trapezoid Sin^2 Quadratic Quadratic (smooth)	Select the axis motion curve.

7 Dynamic Limits (Only for AX-8 series)

Setting	Description
Velocity [u/s] Acceleration [u/s^2] Deceleration [u/s^2] Jerk [u/s^3]	Enter the dynamic limit of velocity, acceleration, deceleration, and jerk.

8 Position Lag Supervision

Setting	Description
Position Lag Reaction	Select the behavior of the axis after overflow.
Lag Limit [u]	Enter the overflow value.

9 Transmission Mechanism

Setting	Description
Mechanism Type	Select the mechanism type.
Mechanism Settings	Set the parameter value for the selected mechanism. The settings differ by type.

<table>
<tr><th>Setting</th><th>Description</th></tr>
<tr><td></td><td>

Command pulse per motor rotation: Shows the number of pulses required for a motor to rotate for one cycle.
Pitch: Enter the scalable distance the worktable moves for a unit.

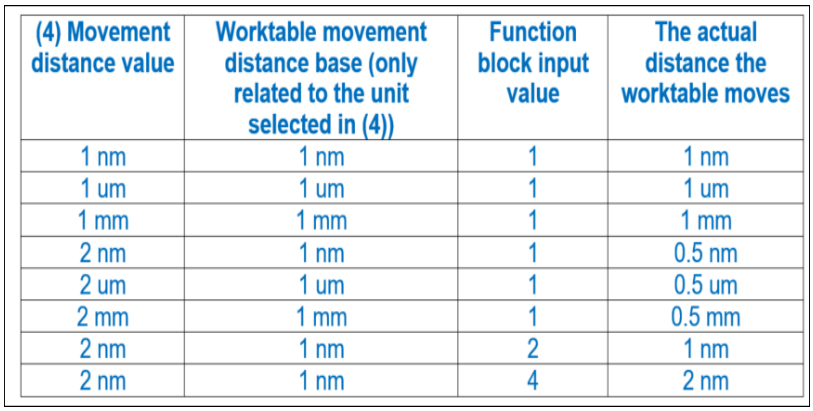
See the following picture for examples.
<table>
<tr><th>(4) Pitch value</th><th>Worktable movement distance base</th><th>Function block input value</th><th>The actual distance the worktable moves</th></tr>
<tr><td>10000</td><td>100 cm</td><td>10000</td><td>100 cm</td></tr>
<tr><td>100</td><td>100 cm</td><td>100</td><td>100 cm</td></tr>
<tr><td>10000</td><td>100 cm</td><td>1</td><td>0.01 cm</td></tr>
<tr><td>100</td><td>100 mm</td><td>1</td><td>1 mm</td></tr>
</table>

Diameter: Enter the diameter of the gear. Diameter*π = Movement distance per motor rotation
Movement distance per motor rotation: Enter the distance the motor moves to rotate for a cycle.
Command pulse: Shows the number of pulses needed to move 1 mm, nm, or μm of the worktable. The unit is selected in (4).

This setting is only available when selecting Linear Motor in the Motor Setting tab.
Movement distance: Enter the scalable distance the worktable moves for 1 mm, nm, or μm. If no specific requirements exist, set the value to 1.

This setting is only available when selecting Linear Motor in the Motor Setting tab.

</td></tr>
</table>

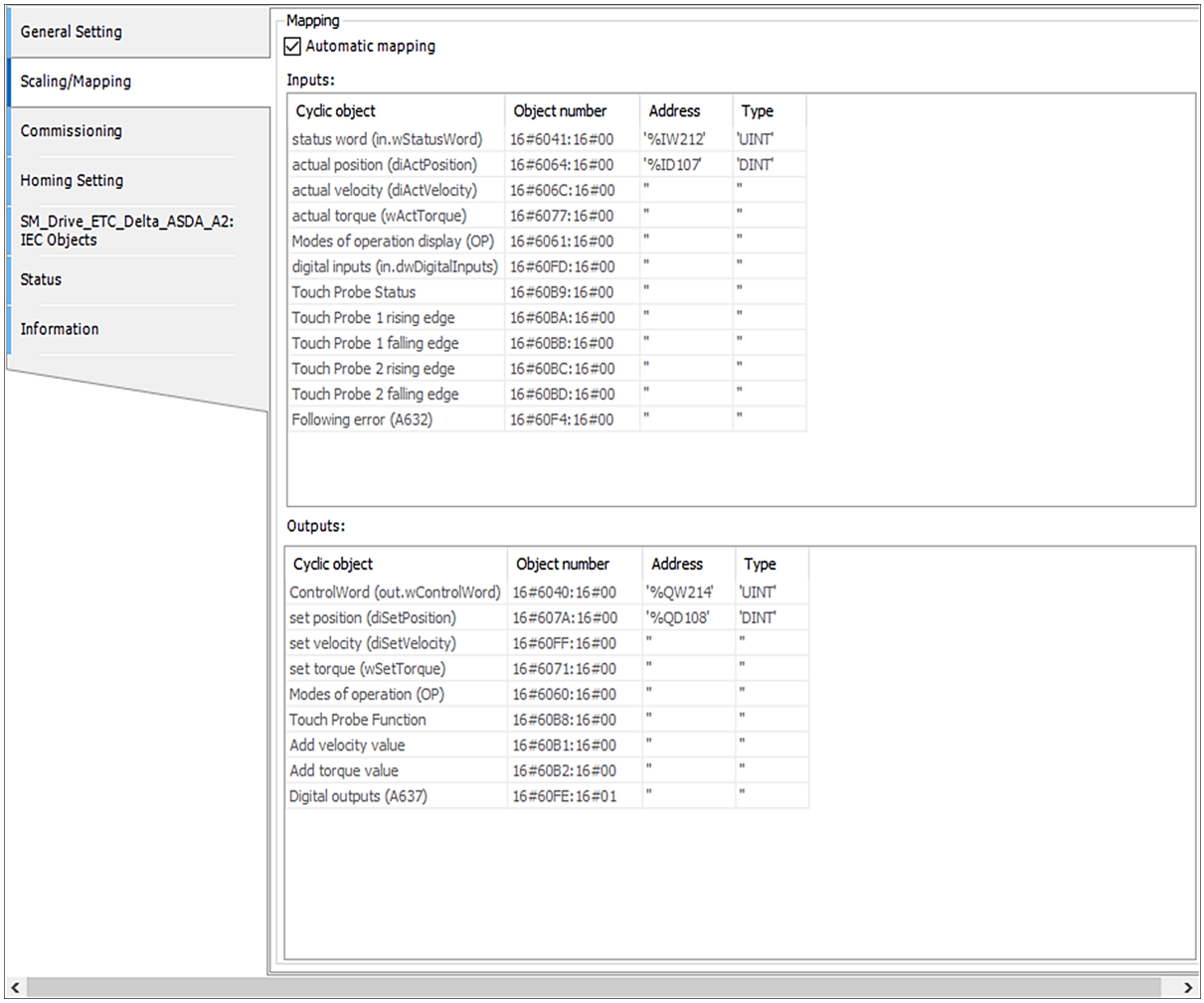
Setting	Description
	See the following picture for examples. 
Gear Ratio	Select or enter the (2) gear ratio's numerator (number of teeth of the worktable) and (3) denominator (number of teeth of the motor gear) to set the reduction ratio. Not available for Linear Motor.
Servo Gear Ratio Settings	Enter **Unit numerator** (P1-44) and **Unit denominator** (P1-45) to get the value of (1).

(4) Movement distance value	Worktable movement distance base (only related to the unit selected in (4))	Function block input value	The actual distance the worktable moves
1 nm	1 nm	1	1 nm
1 um	1 um	1	1 um
1 mm	1 mm	1	1 mm
2 nm	1 nm	1	0.5 nm
2 um	1 um	1	0.5 um
2 mm	1 mm	1	0.5 mm
2 nm	1 nm	2	1 nm
2 nm	1 nm	4	2 nm

10 Positive/Negative Command

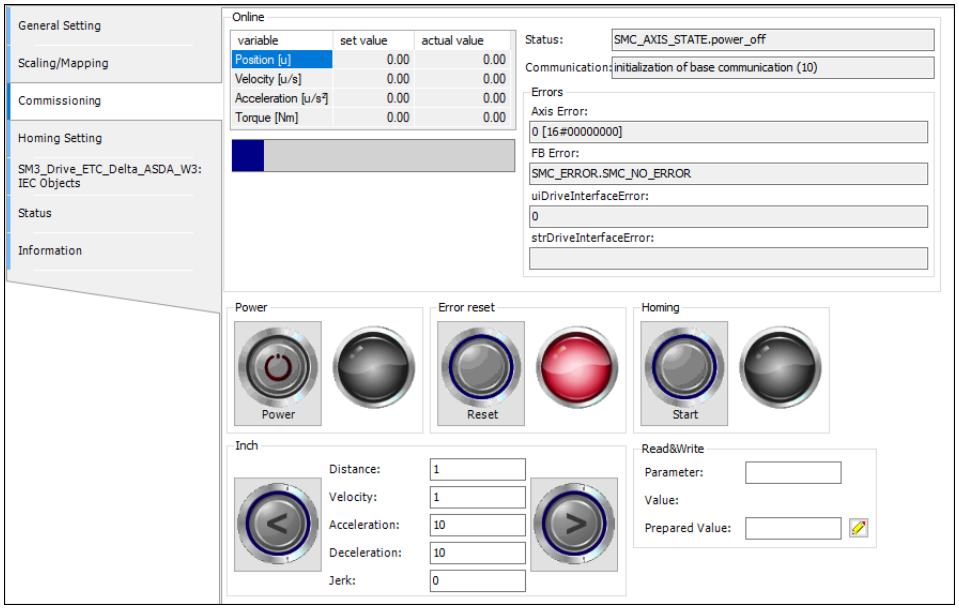
Name	Description
Reverse OFF/Reverse On	Select the forward or reverse command.

Scaling/Mapping



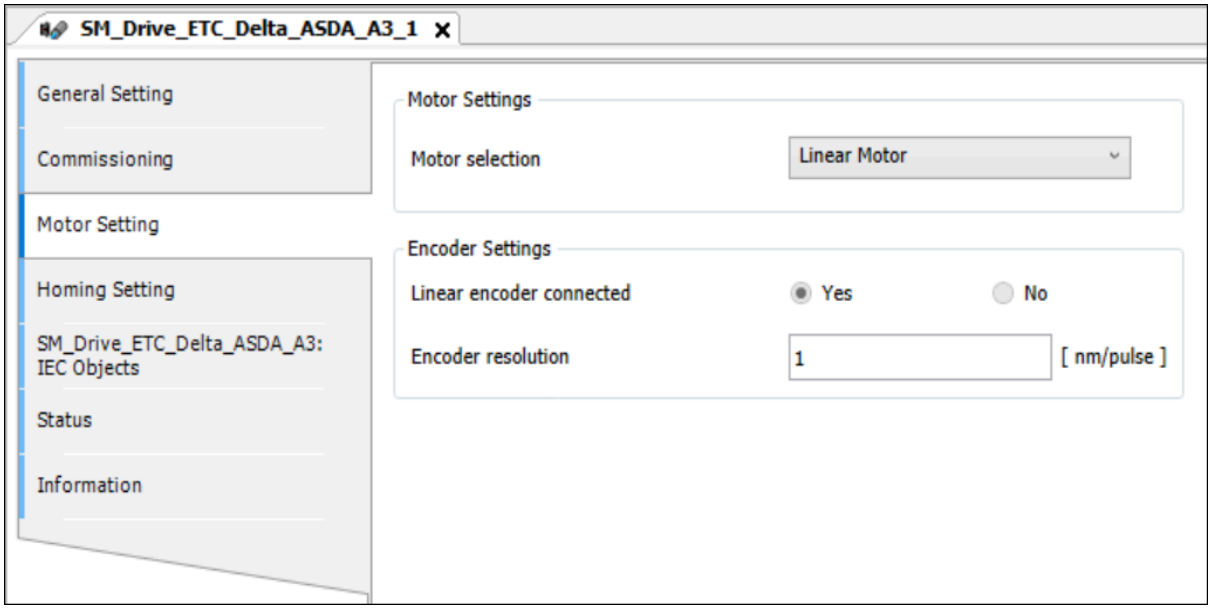
Setting	Description
Automatic mapping	Select to automatically map the IEC parameters that affect the drive to the corresponding inputs and outputs of the device.

Commissioning



This tab is used for testing purposes when commissioning physical drives. It is available only if **Online Config Mode** is turned on. In this mode, the development system is connected to the device; however, an application does not have to be downloaded.

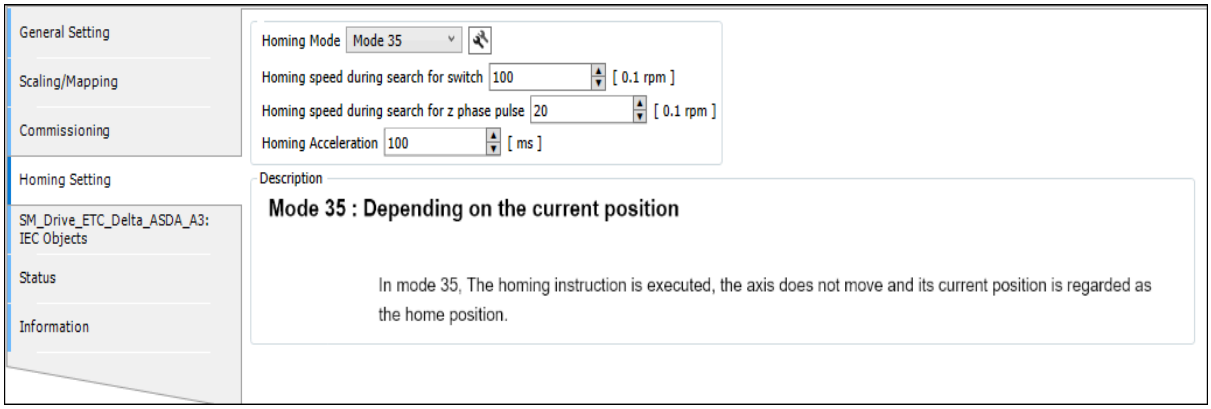
Motor Setting (Only available for the ASDA-A3 and A3-EP series)



Setting	Description
Motor Settings	
Motor selection	Select the motor type based on the actual topology. The selection will change **Transmission Mechanism** settings in the **General Setting** tab.

Setting	Description
Encoder Settings Only available when **Motor selection** is **Linear Motor**.	
Linear encoder connected	Select whether to connect the encoder to the axis. For linear motors, the encoder is connected by default. Other motor types will be supported in the future.
Encoder resolution	Enter the optical encoder resolution. The value range is 1– 200,000,000.

Homing Setting

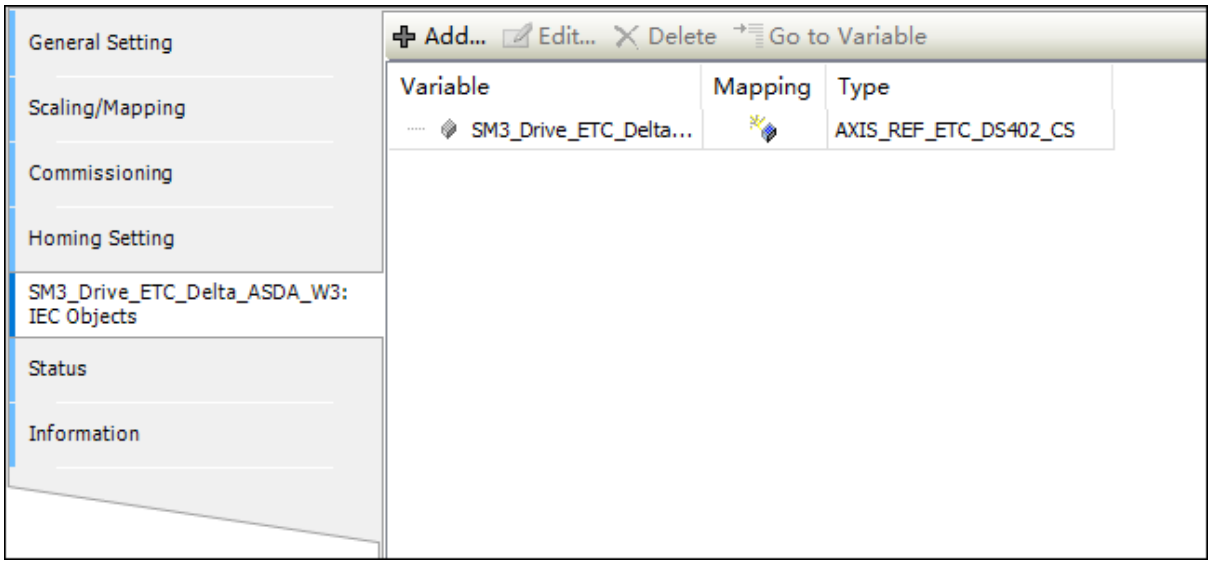


Setting	Description
Homing Mode	Select the homing mode. The actual homing mode is determined by the drive. You can click  to open the **Homing Mode Assistant** dialog to decide the homing mode based on your selection.
Homing speed during search for switch	Select or enter the homing switch speed. The unit of this setting for A3 and A3-EP linear motor is μm/s.
Homing speed during search for z phase pulse	Select or enter the Z-Seek speed. The unit of this setting for A3 and A3-EP linear motor is μm/s.

Setting	Description
Homing Acceleration	Select or enter the acceleration rate of the axis when searching for the velocity change.

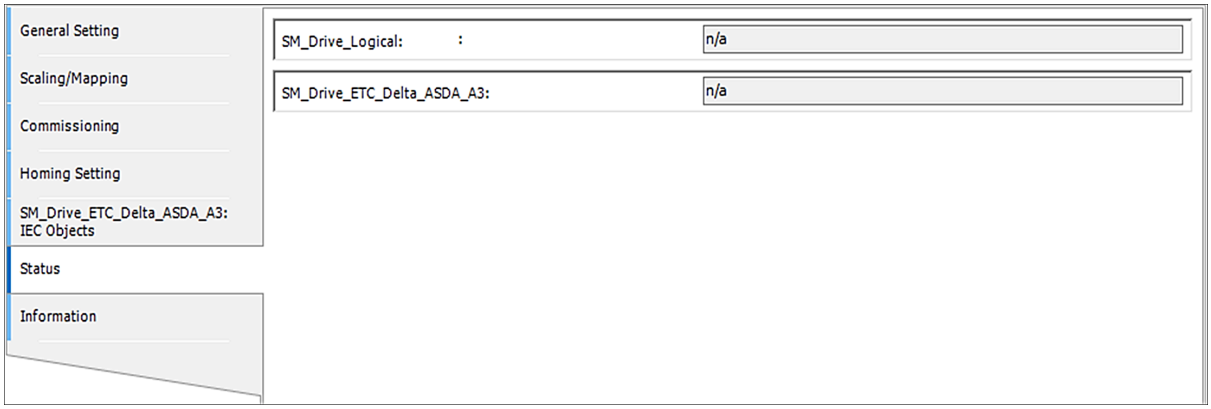
Note: The unit of homing settings for ASDA-W3 is user unit/s.

IEC Objects



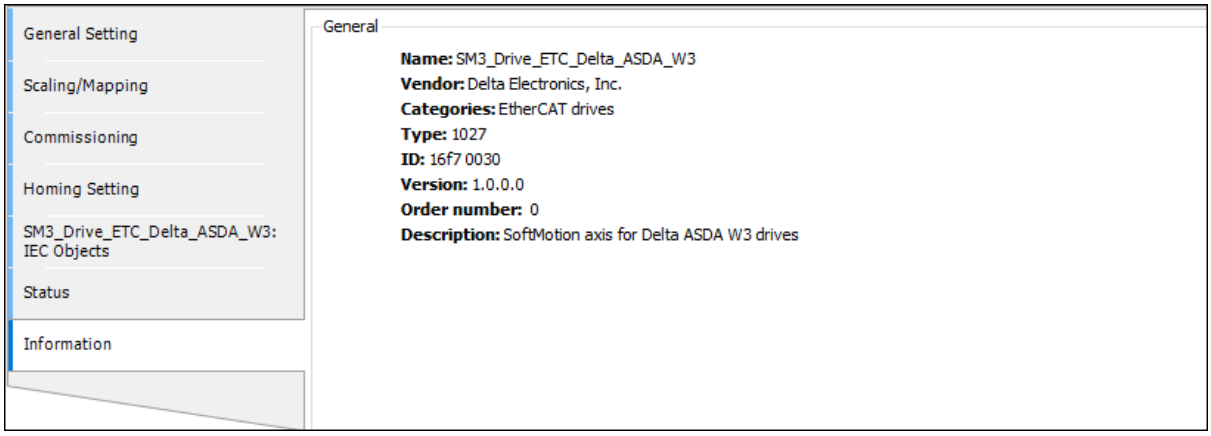
Lists the "objects" that access the device from the IEC application. In the online mode, this is used as the monitoring view.

Status



Shows the status of the drive.

Information



The general information of the drive.

5.11.1.2 CoE Parameters

CoE parameter configuration applies to the following devices.

- ASDA-A3-E, A3-EP
- ASDA-B3-E
- ASDA-E3-E
- ASDA-W3-EAS-RTU
- AX-5 EtherCat Remote I/O modules

These devices also support device update. For more information about how to update the device, see Update Devices.

How do I open the CoE configuration page?

1. Add a supported device.
2. Double-click the device, and then click **CoE Parameters**.

All Parameters and Favorites

All the CoE parameters are listed in **All Parameters** category, and you can right-click them to add to **Favorites** category. You can only edit the parameter when the module is online. Click  to expand **All Parameters** and then select a device, only the parameter of this device shows.

The following table lists the settings of **All Parameters** category and their descriptions.

Setting	Description
	Click to upload the selected parameters to the software.
	Click to upload all parameters to the software. You need to click this button when you first connect to the device so that the parameters in the device can be updated to the CoE parameter editor.
	Click to download the selected parameters to the device.
	Click to download all parameters to the device.
	Click to synchronize the value of the selected parameter to the corresponding ones in **Startup Parameters**.
	Click to synchronize all the parameters to the corresponding ones in **Startup Parameters**.
	Click to compare the values. Provides results where **Value** does not match **Current Value**.

The following table lists the options that you can select when you right-click the parameter and their descriptions.

Setting	Description
Add to Favorites	Click to add the selected parameter to **Favorites** category.
Add to Startup Parameters	Click to add the selected parameter to **Startup Parameters** category.
Import	Click to import parameters from an .xml file.
Export	Click to export parameters to an .xml file.

Startup Parameters

The parameter listed under this category writes the value to the module after the module is started. You can edit the parameter when the device is not connected.

The following table lists the settings to manage startup parameters and descriptions.

Setting	Description
	Click to delete the parameter.
	Click to move up the parameter.
	Click to move down the parameter.

5.11.1.2.1 Change the CoE Parameter Value Display Mode

DIADesigner-AX supports changing the format of the CoE parameter values when monitoring in the online mode. You can change the value format to:

- Binary
- Decimal
- Hexadecimal

Prerequisites

- The project is in the online mode.

To change the display mode of the CoE parameter value

1. On the menu bar, select **Project** > **Project Settings** > **Monitoring**.
2. On the **Monitoring** pane, under **Display Mode for Integer Variables**, select one of the display modes.
3. Click **OK**.

Or

1. On the menu bar, select **Debug** > **Display Mode**.
2. Select one of the display modes.

5.11.2 Add a Positioning Axis

A positioning axis provides the basic positioning control functions through EtherCAT communication, for example, the absolute positioning and relative positioning. The positioning axis needs to be matched with the **DL_MotionControlLight** library.

To add a positioning axis

1. On the **Devices** pane, right-click **EtherCAT_X**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **EtherCAT** > **Slave** > **Delta Electronics, Inc.**, and then select one of the following devices.
    - C2000Plus
    - CH2000
    - ASDA-A2-E DML
    - ASDA-A3-E DML
    - ASDA-B3-E DML
    - ASDA-E3-E DML
    - ASDA-W3-E DML

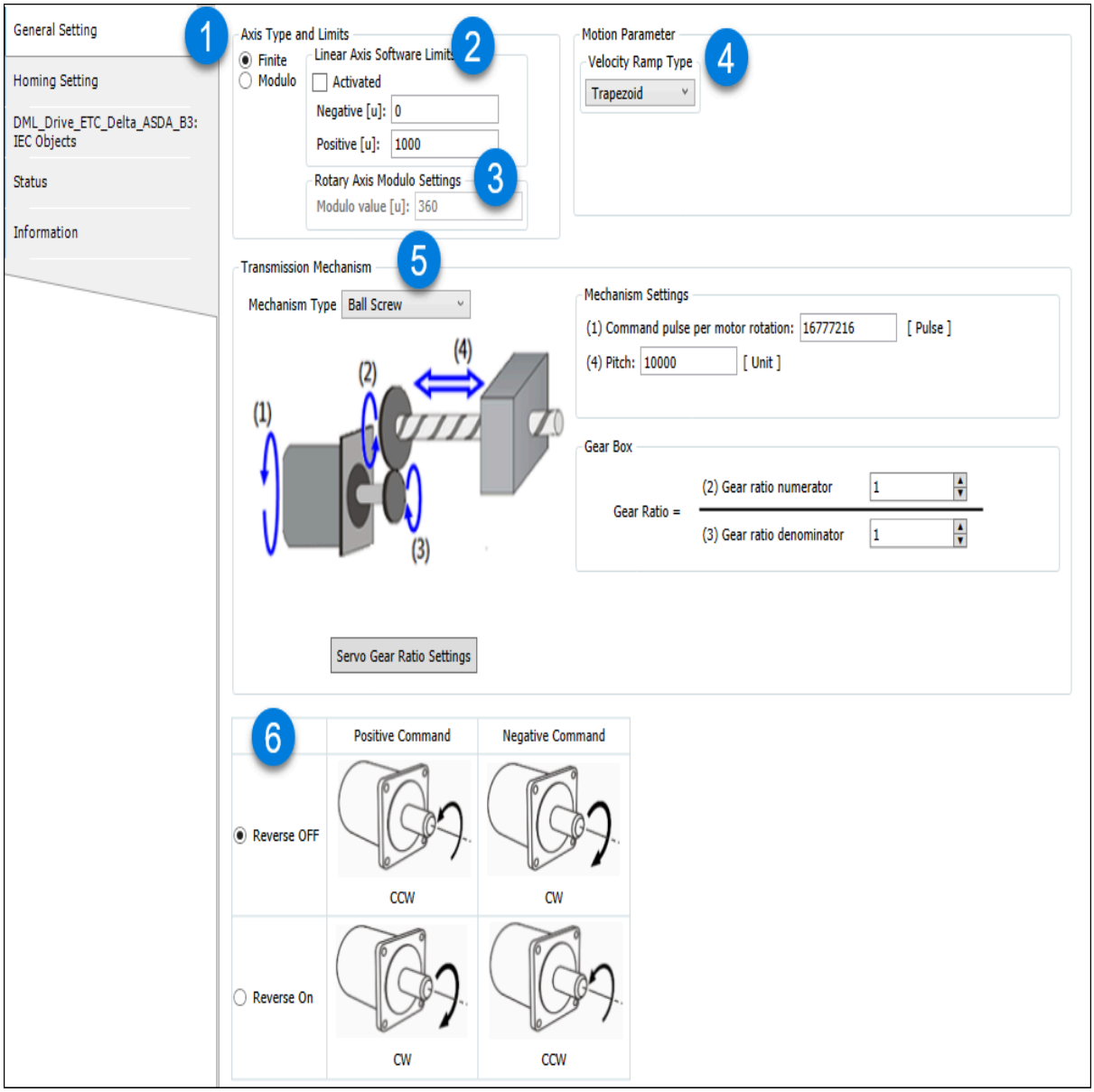
    After adding ASDA-W3 to the project, you need to right-click it to add its positioning axis.

    The multi-axis servo system ASDA-W3 supports adding up to 12 axes.
3. Click **Add Device**.

5.11.2.1 Positioning Axis Settings

After adding a positioning axis, you can configure the axis parameters. The following tables list the axis parameters and descriptions. Settings may vary slightly depending on the device. For more information about the supported functions of each device, see the respective device manuals.

General Setting



1 Axis Type and Limits

Setting	Description
Finite	Select to set the axis as a linear axis. The drive has a fixed work area.
Modulo	Select to set the axis type as modulo. The drive turns endlessly without limiting the traversing range.

2 Linear Axis Software Limits

Setting	Description
Negative [u]	Enter reverse software limit.
Positive [u]	Enter forward software limit.
Activated	Select to turn on the software limit (only supports linear axis). Position values are restricted by the lower limit **Negative** and the upper limit **Positive**.

3 Rotary Axis Modulo Settings

Setting	Description
Modulo value [u]	Enter one circle range. This function is only available when selecting **Modulo** as the axis type. The default value is 360.

4 Velocity Ramp Type

Setting	Description
Trapezoid	Select a trapezoidal velocity profile (with constant acceleration in each segment).
S-curve	Select the S-curve as the velocity ramp type. If select this type, set the acceleration range and deceleration range.

5 Transmission Mechanism

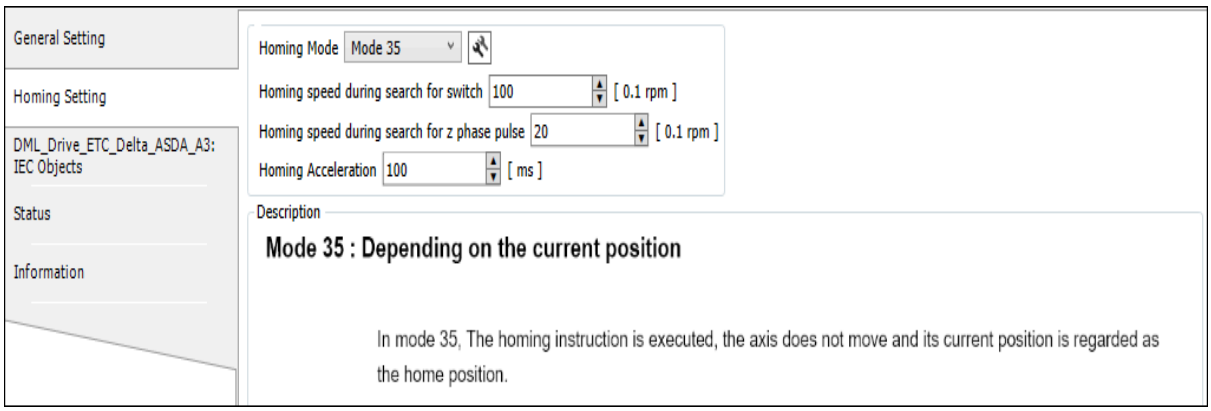
Setting	Description
Mechanism Type	Select the mechanism type.
Mechanism Settings	Set the parameter value for the selected mechanism. The settings differ by type. • **Command pulse per motor rotation**: Shows the number of pulses required for a motor to rotate for one cycle. • **Pitch**: Enter the scalable distance the worktable moves for a unit.

Setting	Description
	See the following picture for examples. <table><tr><th>(4) Pitch value</th><th>Worktable movement distance base</th><th>Function block input value</th><th>The actual distance the worktable moves</th></tr><tr><td>10000</td><td>100 cm</td><td>10000</td><td>100 cm</td></tr><tr><td>100</td><td>100 cm</td><td>100</td><td>100 cm</td></tr><tr><td>10000</td><td>100 cm</td><td>1</td><td>0.01 cm</td></tr><tr><td>100</td><td>100 mm</td><td>1</td><td>1 mm</td></tr></table> • **Diameter**: Enter the diameter of the gear. Diameter*π = Movement distance per motor rotation • **Movement distance per motor rotation**: Enter the distance the motor moves to rotate for a cycle.
Gear Ratio	Select or enter the (2) gear ratio's numerator (number of teeth of the worktable) and (3) denominator (number of teeth of the motor gear) to set the reduction ratio.
Servo Gear Ratio Settings	Enter **Unit numerator** (P1-44) and **Unit denominator** (P1-45) to get the value of (1).

6 Positive/Negative

Setting	Description
Reverse OFF/Reverse On	Select the forward or reverse command.

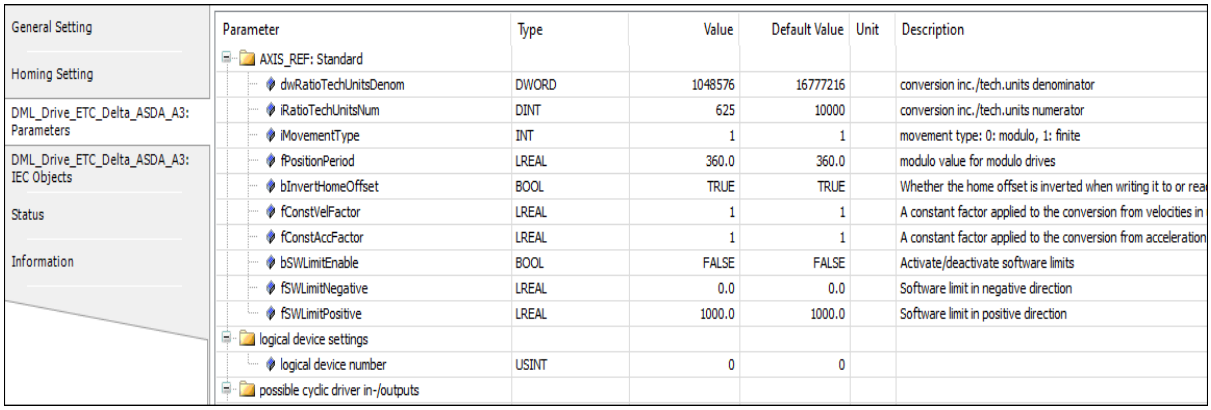
Homing Setting



Setting	Description
Homing Mode	Select the homing mode. The actual homing mode is determined by the drive. You can click  to open the **Homing Mode Assistant** dialog to decide the homing mode based on your selection.
Homing speed during search for switch	Select or enter the homing switch speed.
Homing speed during search for z phase pulse	Select or enter the Z-Seek speed.
Homing Acceleration	Select or enter the acceleration of the axis when searching for the velocity change.

Note: The unit of homing settings for ASDA-W3 is user unit/s.

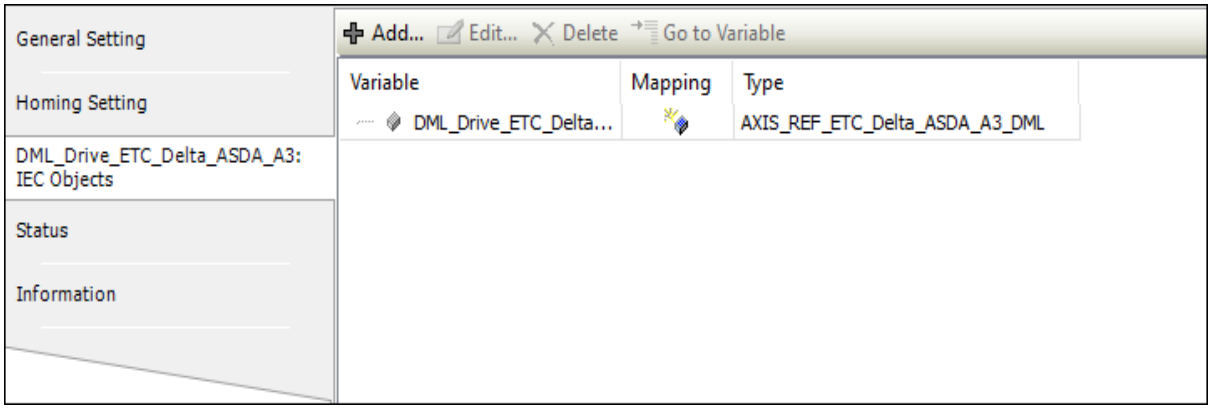
Parameters



Shows the device-specific parameters.

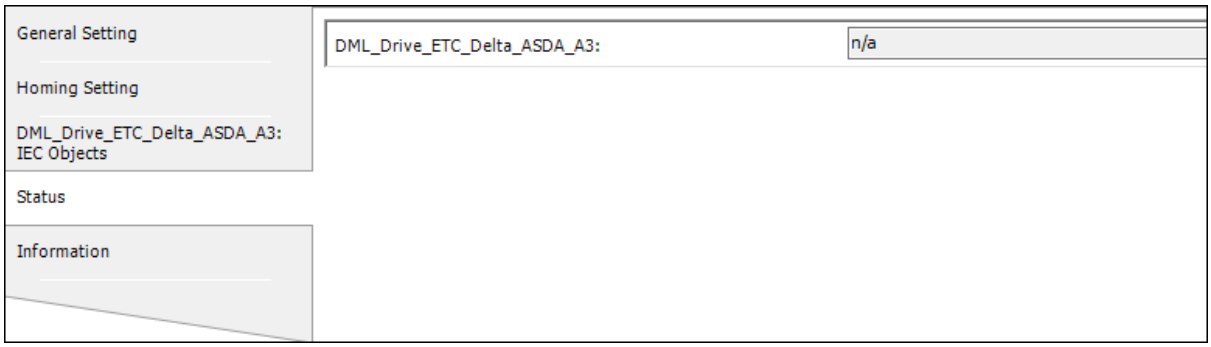
To show this tab, on the menu bar, select **Tools** > **Options** > **Device editor** > **Show generic device configuration views**.

IEC Objects



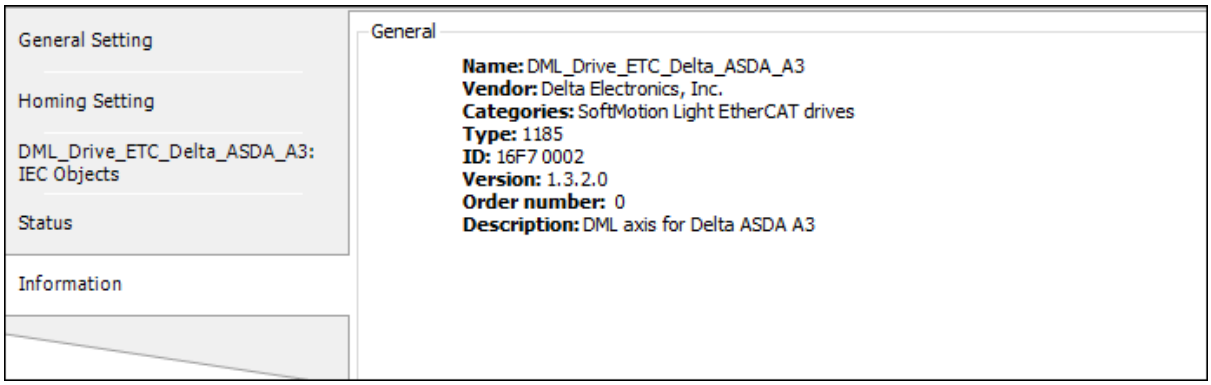
Lists the "objects" that access the device from the IEC application. In the online mode, this is used as the monitoring view.

Status



Shows the status of the drive.

Information



Shows the general information of the drive.

5.11.2.2 Axis Reference (Axis_REF_DML)

The following table lists the control type of the axis and their instructions.

Category	Functions	Description
Single-axis motion control instructions	Positioning control	MC_": Motion control instructions based on PLCopen "DMC_": Delta's motion control instructions "SMC_": Motion instructions "MC_XXX_DML": Delta's motion control instructions for positioning axis
	Velocity control	
	Torque control	
	Synchronous control	
	Administrative	
Multi-axis motion control instructions	Axis group movement	Multi-axis movement
	Multi-axis management	Multi-axis setting, monitoring, and reset

5.11.3 Add a Velocity Axis

The velocity axis provides the velocity control and torque control. The velocity axis needs to be matched with the **DL_MotionControlLight** library.

To add a velocity axis

1. On the **Devices** pane, right-click **EtherCAT_X**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbus** > **EtherCAT** > **Slave** > **Delta Electronics, Inc.** > **AC Motor Drives** > **Delta Softmotion Light – Velocity Axis** and then select one of the following devices.
    - C2000Plus
    - CH2000
    - MH300
    - MS300
    - MX300-E
3. Click **Add Device**.

4. (For MX300) Right-click the **<Empty>** node and then select **Plug Device**.

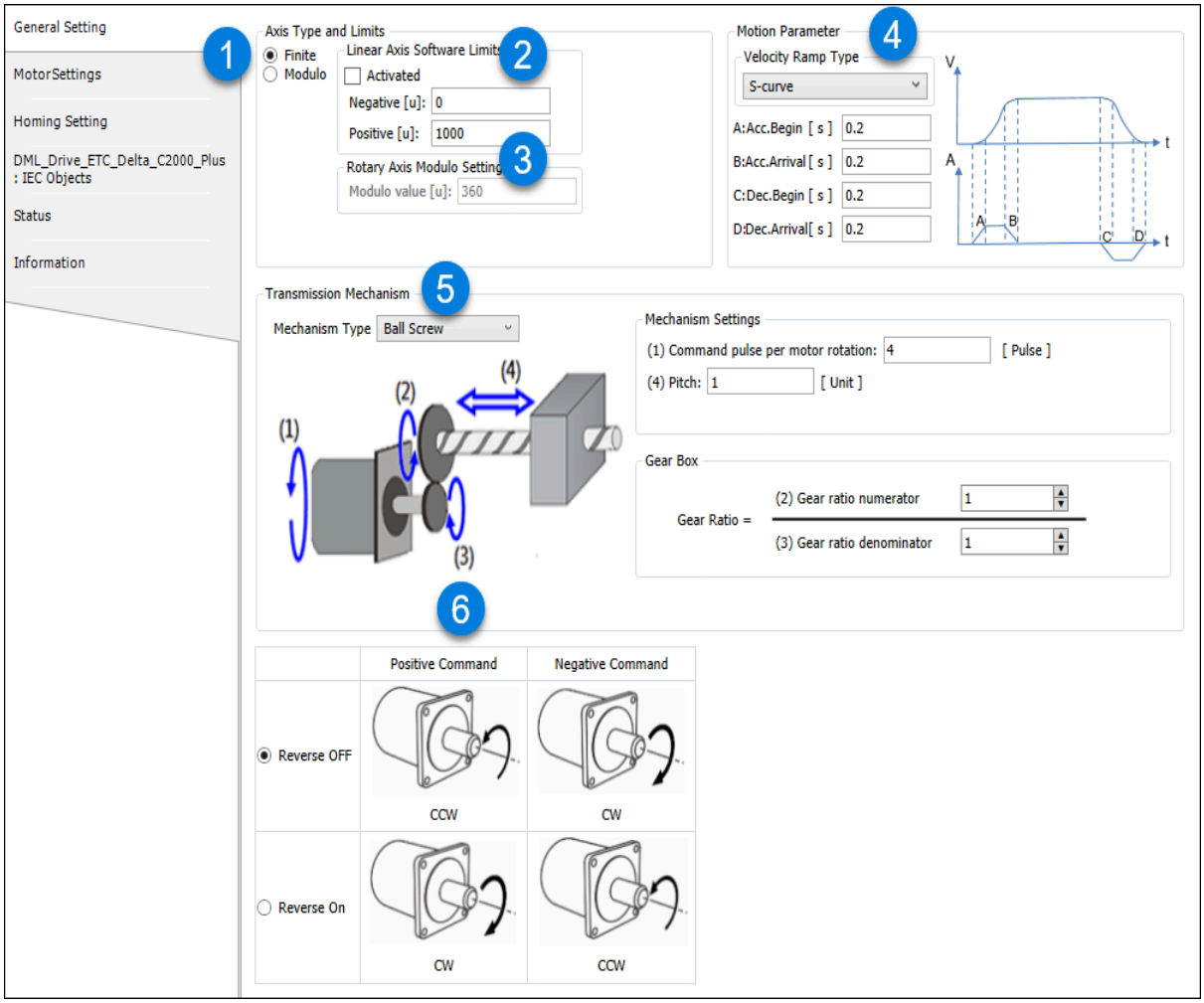
   Note: The node position you select to plug the device should match the Absolute Axis Number you set for the axis using the keypad on the MX300 hardware device. For example, if the Absolute Axis Number you set is 10 (parameter 09-57=10), you must plug the device into the 10th **<Empty>** node. To find the Absolute Axis Number, you can go online, select **Scan for Devices**, and then check the Absolute Axis Number from the scanned INV axis.

5. In the **Plug Device** dialog, select **MX300 Frequency Converter-Axis-VL-DML** and then click **Plug Device**.

5.11.3.1 Velocity Axis Settings

After adding a velocity axis, you can configure the axis parameters. The following tables list the axis parameters and descriptions. Settings might vary slightly depending on the device. For more information about the supported function of each device, see the respective device manuals.

General Setting



1 Axis Type and Limits

Setting	Description
Finite	Select to set the axis as a linear axis. The drive has a fixed work area.
Modulo	Select to set the axis type as modulo. The drive turns endlessly without limiting the traversing range.

2 Linear Axis Software Limits

Setting	Description
Negative [u]	Enter reverse software limit.

Setting	Description
Positive [u]	Enter forward software limit.
Activated	Select to turn on the software limit (only supports linear axis). Position values are restricted by the lower limit **Negative** and the upper limit **Positive**.

3 Rotary Axis Modulo Settings

Setting	Description
Modulo value [u]	Enter one circle range. This function is only available when selecting **Modulo** as the axis type. The default value is 360.

4 Velocity Ramp Type

Setting	Description
Trapezoid	Select a trapezoidal velocity profile (with constant acceleration in each segment).
S-curve	Select the S-curve velocity profile. If selecting this type, set the acceleration range and deceleration range.

5 Transmission Mechanism

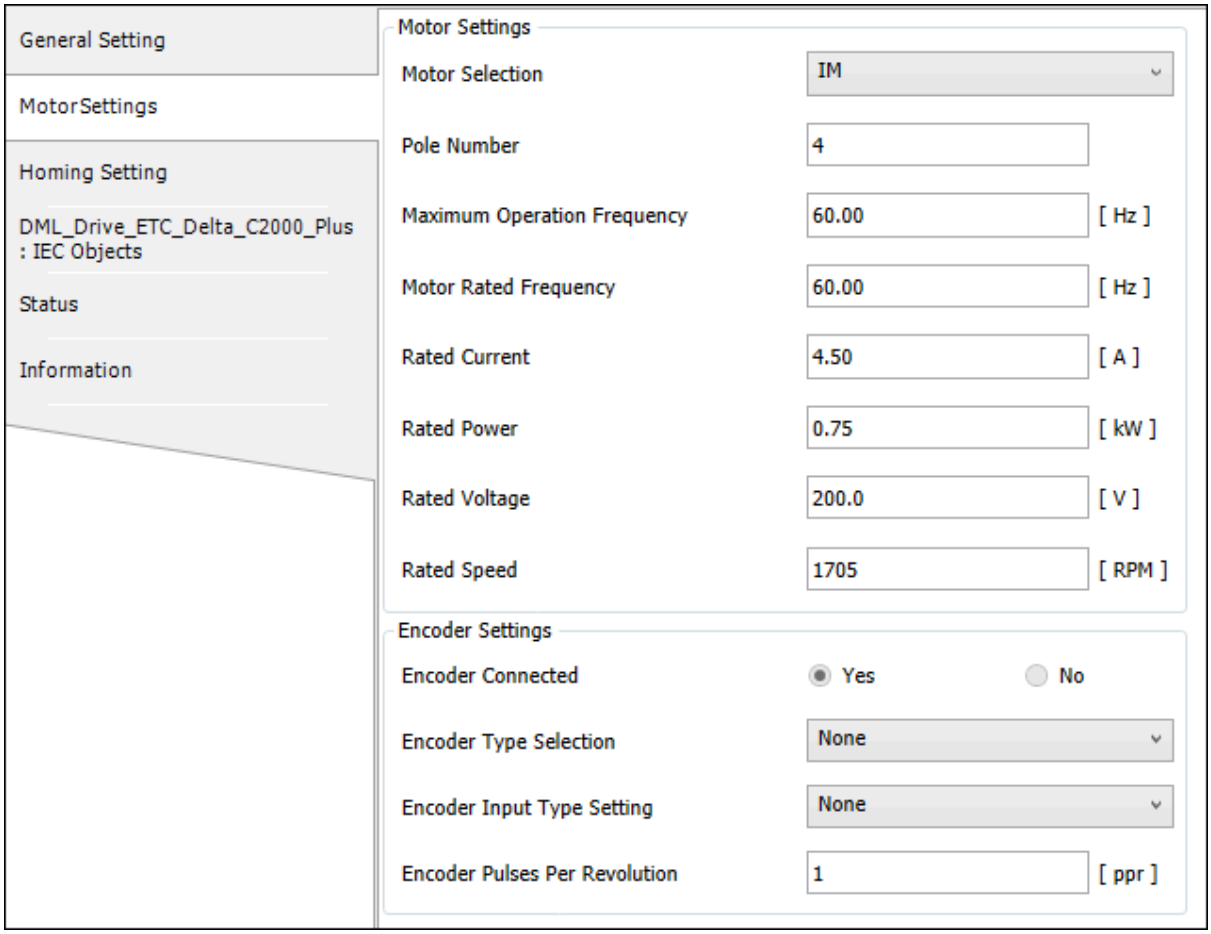
Setting	Description
Mechanism Type	Select the mechanism type.
Mechanism Settings	Set the parameter value for the selected mechanism. The settings differ by the mechanism type. • **Command pulse per motor rotation**: The value can only be edited in **Motor Settings** > **Encoder Pulse Per Revolution**. It is four times the value set in **Encoder Pulse Per Revolution**. MX300-E does not support editing this value.

Setting	Description
	• **Pitch**: Enter the scalable distance the worktable moves for a unit. See the following picture for examples. (4) Pitch value / Worktable movement distance base / Function block input value / The actual distance the worktable moves 10000 / 100 cm / 10000 / 100 cm 100 / 100 cm / 100 / 100 cm 10000 / 100 cm / 1 / 0.01 cm 100 / 100 mm / 1 / 1 mm • **Diameter**: Enter the diameter of the gear. Diameter*π = Movement distance per motor rotation • **Movement distance per motor rotation**: Enter the distance the motor moves to rotate for a cycle.
Gear Ratio	Select or enter the gear ratio's numerator and denominator.

6 Positive/Negative Command

Setting	Description
Reverse OFF/Reverse On	Select the forward or reverse command.

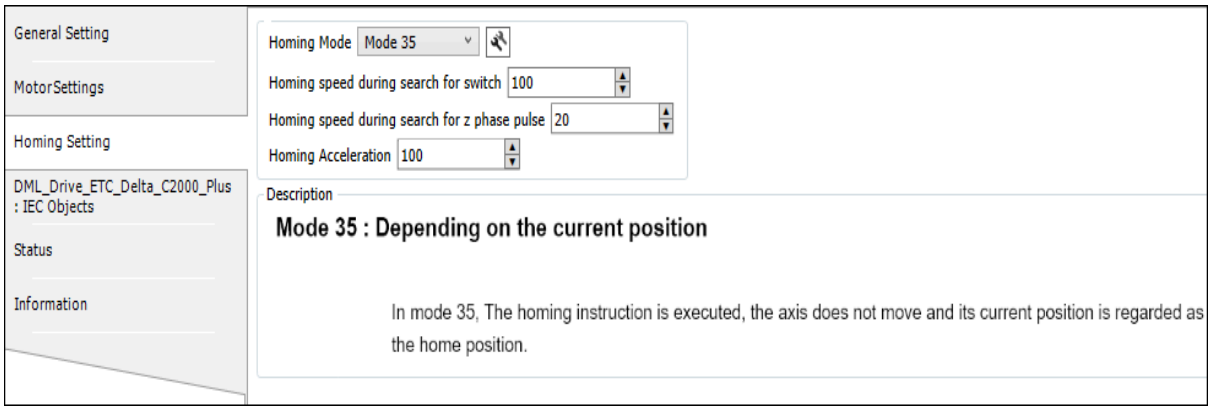
Motor Settings



Set the parameters of the existing motor and encoder for Delta drives.

Note: MX300-E does not support the encoder.

Homing Setting

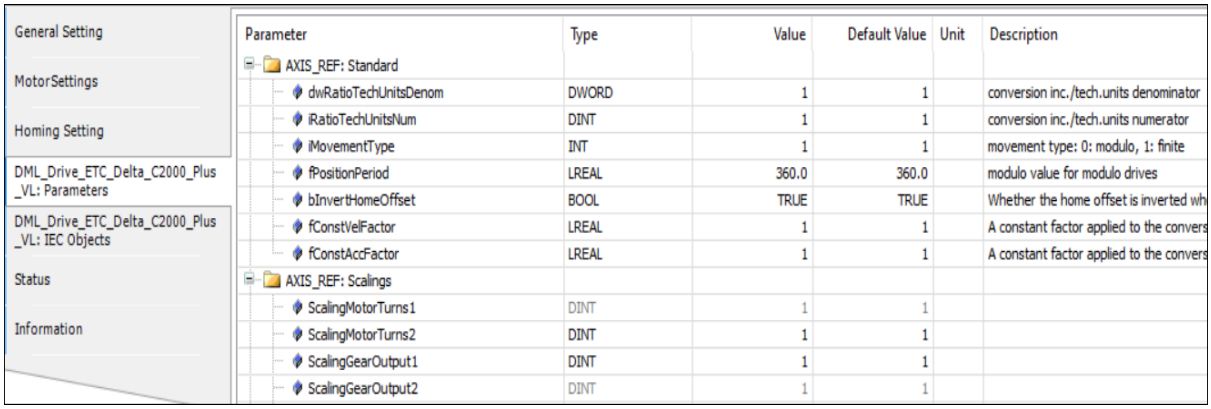


Setting	Description
Homing Mode	Select the homing mode. The actual homing mode is determined by the drive.

Setting	Description
	You can click  to open the **Homing Mode Assistant** dialog to decide the homing mode based on your selection.
Homing speed during search for switch	Select or enter the homing switch speed.
Homing speed during search for z phase pulse	Select or enter the Z-Seek speed.
Homing Acceleration	Select or enter the acceleration of the axis when searching for the velocity change.

Note: Only C2000Plus and CH2000 support **Homing Setting**.

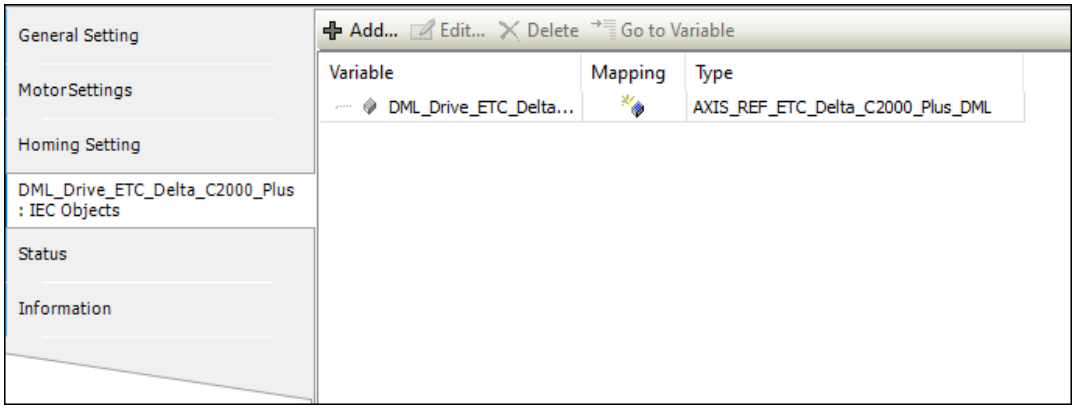
Parameters



Shows the device-specific parameters.

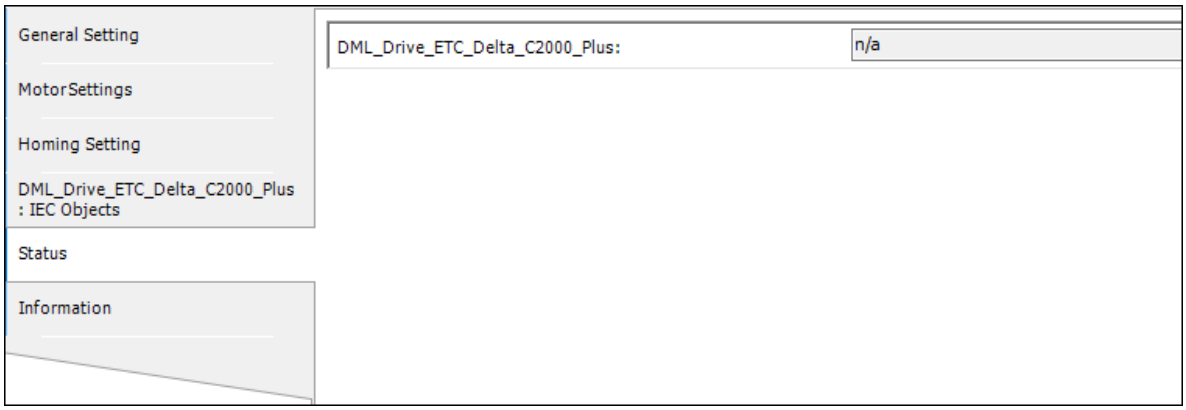
To show this tab, on the menu bar, select **Tools** > **Options** > **Device editor** > **Show generic device configuration views**.

IEC Objects



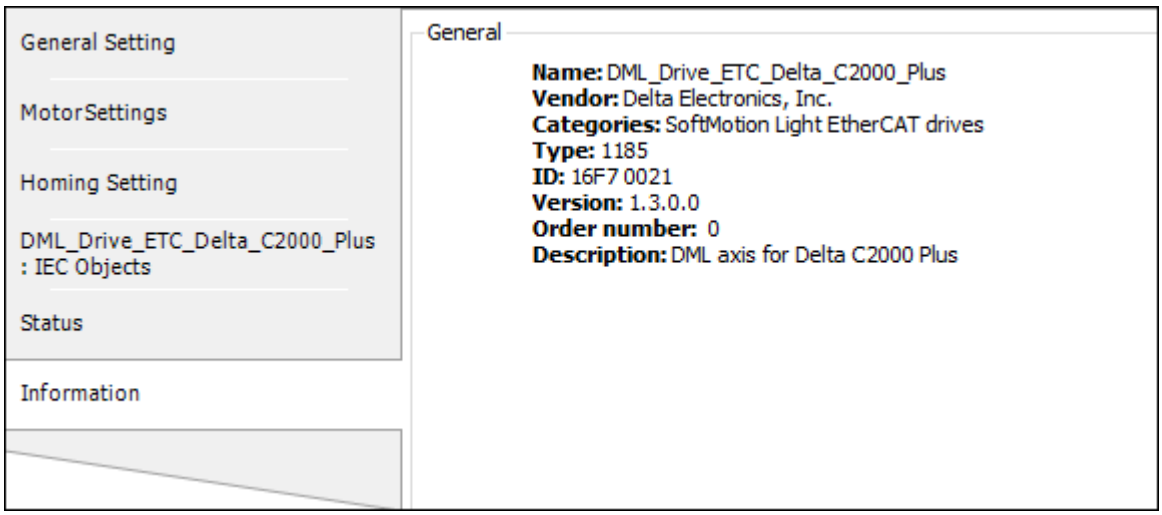
Lists the "objects" that access the device from the IEC application. In the online mode, this is used as the monitoring view.

Status



Shows the status of the drive.

Information



Shows the general information of the drive.

5.11.4 Add a Virtual Drive

A virtual drive is an analog drive in the software to test programs or implement extended functions, for example, the axis motion control and the cam driver control. The virtual drive is not connected to any physical servo and is only used in the program to run motion control commands.

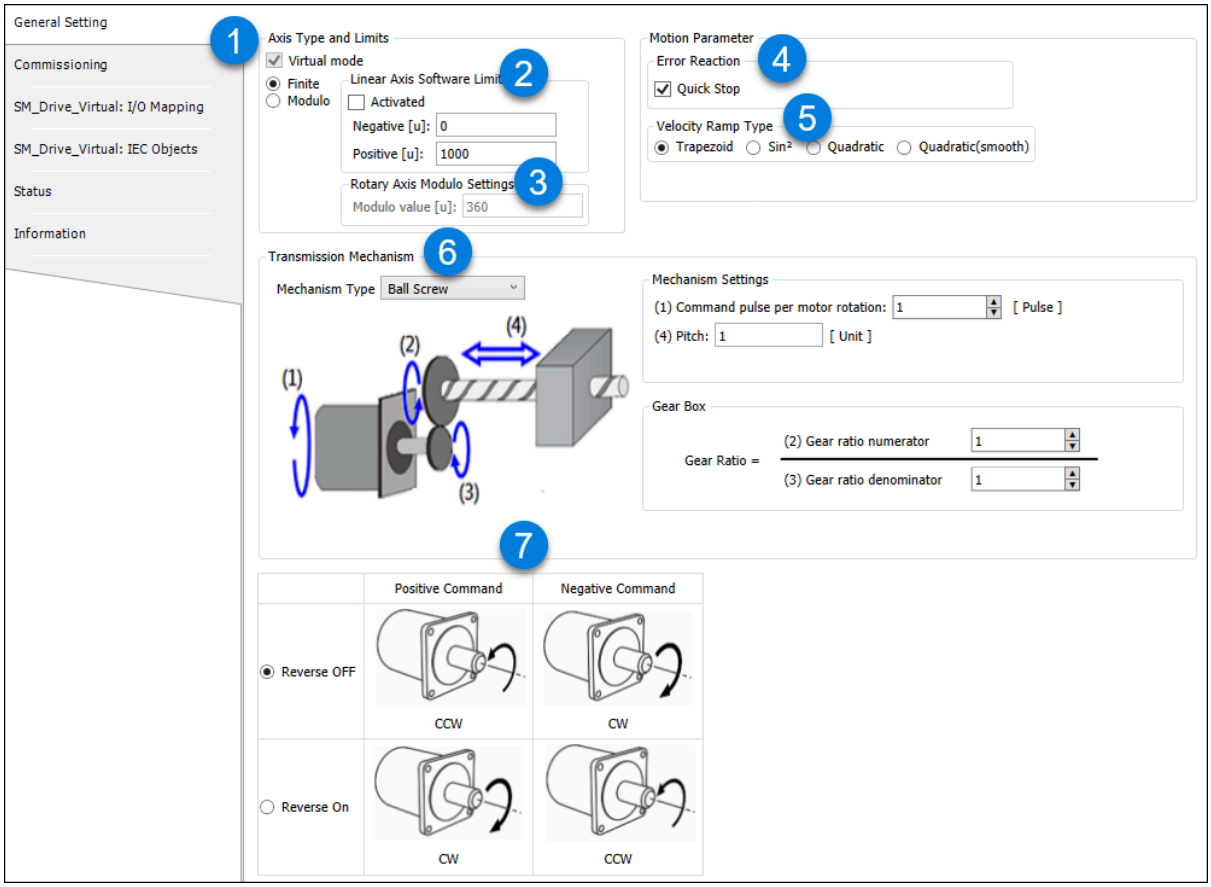
To add a virtual drive

1. On the **Devices** pane, right-click **SoftMotion General Axis Pool** and then select **Add Device**.
2. In the **Add Device** dialog, select **Softmotion drives** > **virtual drives** > **SM_Drive_Virtual**.
3. Click **Add Device**.

5.11.4.1 Virtual Drive Settings

After adding a virtual drive, you can configure the virtual drive parameters. The following tables list the parameters and descriptions.

General



1 Axis Type and Limits

Setting	Description
Virtual mode	Not editable.
Finite	Select to set the axis as a linear axis. The drive has a fixed work area.
Modulo	Select to set the axis type as modulo. The drive turns endlessly without limiting the traversing range.

2 Linear Axis Software Limits

Setting	Description
Activated	Select to turn on the software limit (only supports linear axis). Position values are restricted by the lower limit **Negative** and the upper limit **Positive**.
Negative [u]	Enter reverse software limit.
Positive [u]	Enter forward software limit.

3 Rotary Axis Modulo Settings

Setting	Description
Modulo value [u]	Enter one circle range. This function is only available when selecting **Modulo** as the axis type. The default value is 360.

4 Error Reaction

Setting	Description
Quick Stop	Select to stop the axis in emergency.
Deceleration [u/s^2]	Enter the axis decelerating to stop value (only shows when the **Quick Stop** checkbox is cleared).

5 Velocity Ramp Type

Setting	Description
Trapezoid Sin^2 Quadratic Quadratic (smooth)	Select the axis motion curve.

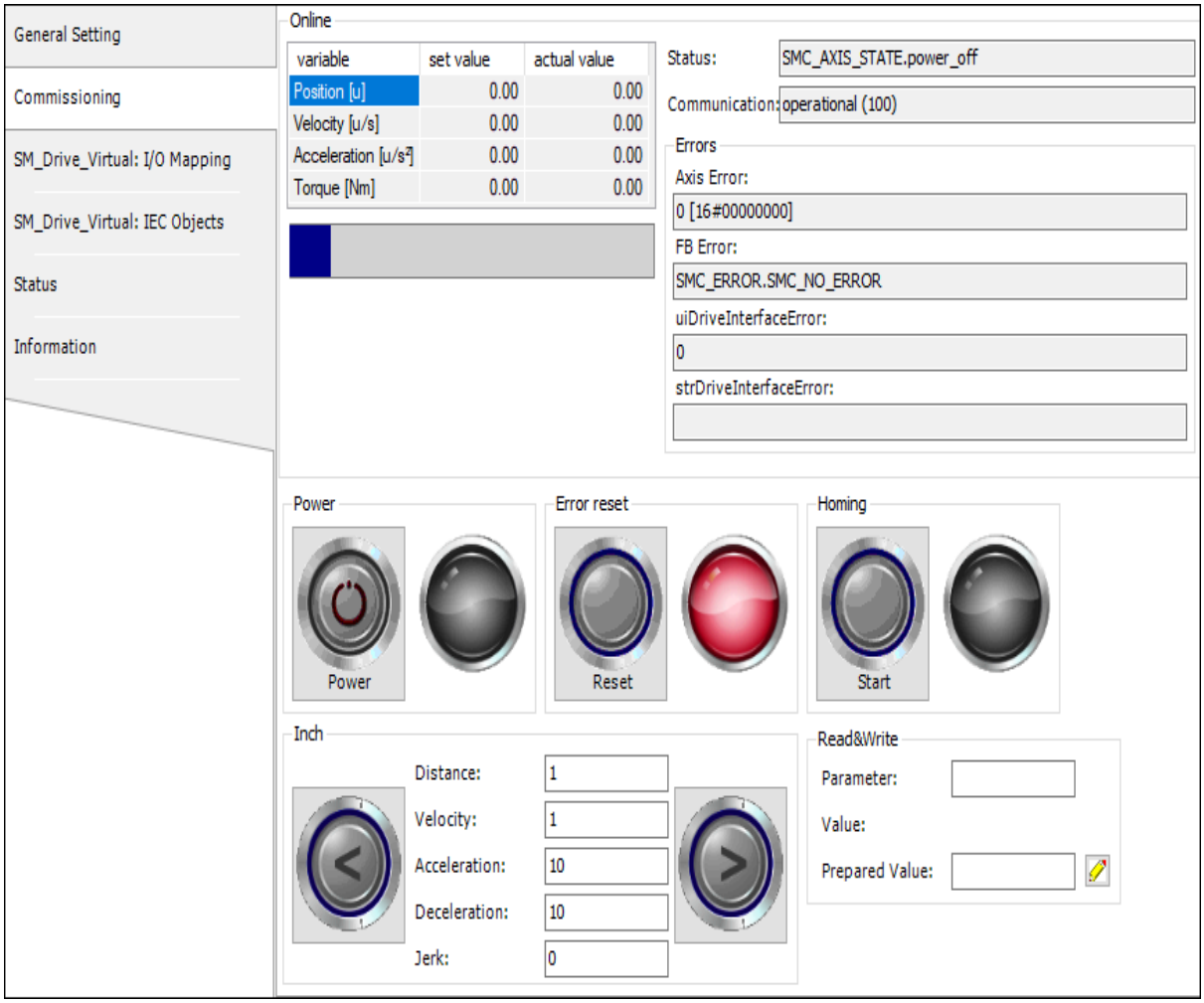
6 Transmission Mechanism

Setting	Description
Mechanism Type	Select the mechanism type.
Mechanism Settings	Set the parameter value for the selected mechanism. The settings differ by type. • **Command pulse per motor rotation**: The value can only be edited in **Motor Settings** > **Encoder Pulse Per Revolution**. It is four times the value set in **Encoder Pulse Per Revolution**. MX300-E does not support editing this value. • **Pitch**: Enter the scalable distance the worktable moves for a unit. See the following picture for examples. (4) Pitch value / Worktable movement distance base / Function block input value / The actual distance the worktable moves 10000 / 100 cm / 10000 / 100 cm 100 / 100 cm / 100 / 100 cm 10000 / 100 cm / 1 / 0.01 cm 100 / 100 mm / 1 / 1 mm • **Diameter**: Enter the diameter of the gear. Diameter*π = Movement distance per motor rotation • **Movement distance per motor rotation**: Enter the distance the motor moves to rotate for a cycle.
Gear Ratio	Select or enter the (2) gear ratio's numerator (number of teeth of the worktable) and (3) denominator (number of teeth of the motor gear) to set the reduction ratio.

7 Positive/Negative Command

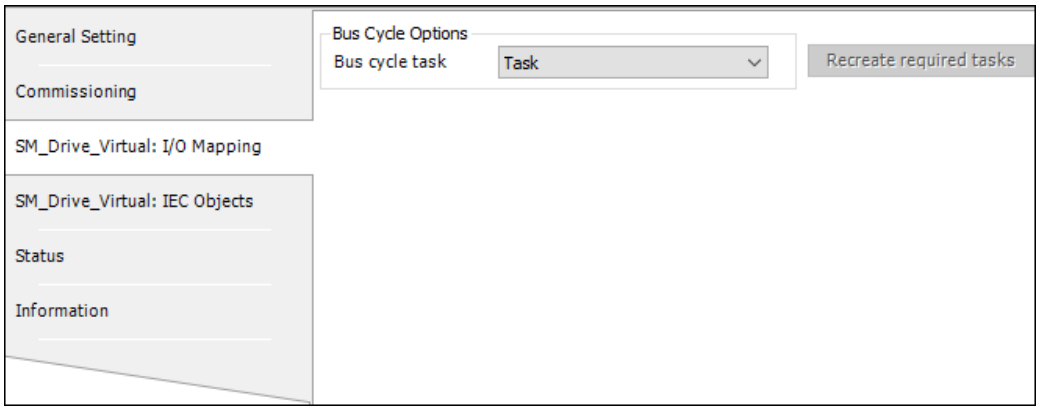
Setting	Description
Reverse OFF/Reverse On	Select the forward or reverse command.

Commissioning



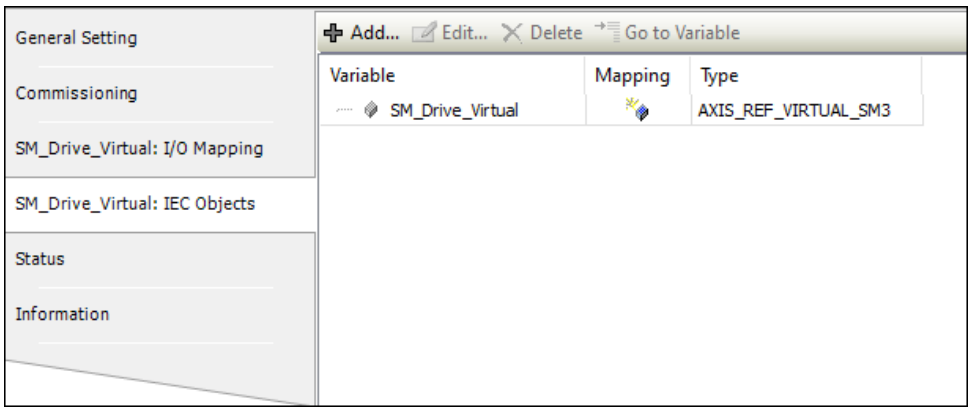
This tab is used for testing purposes when commissioning physical drives. It is available only if the Online Config Mode is enabled. In this mode, the development system is connected to the device; however, an application does not have to be downloaded.

I/O Mapping



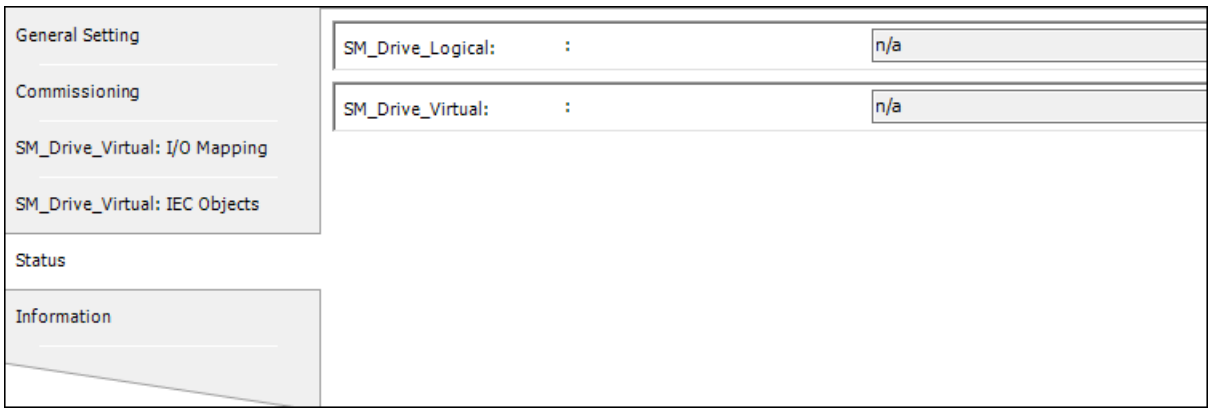
Setting	Description
Bus cycle task	Select a bus cycle task.
Recreate required task	Click to recreate the selected task.

IEC Objects



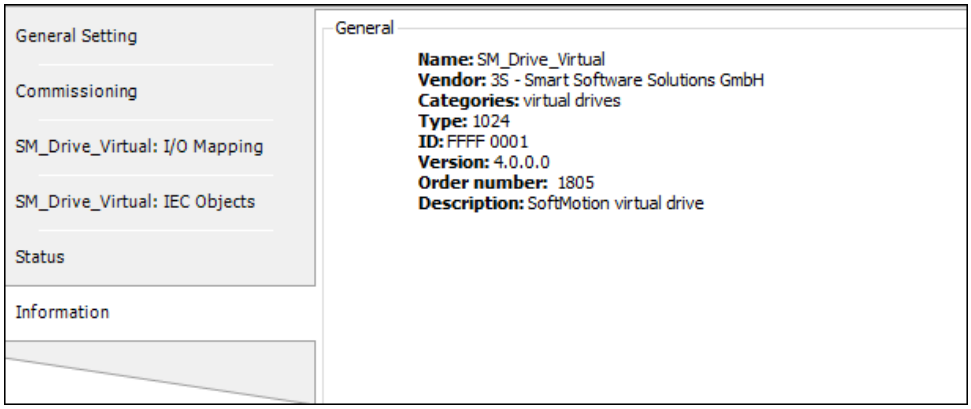
Lists the "objects" that access the device from the IEC application. In the online mode, this is used as the monitoring view.

Status



Shows the status of the virtual drive.

Information



Shows the general information of the virtual drive.

5.11.5 Add a Free Encoder

Use the free encoder to connect to the external encoder electronic signal source, which is commonly used for precise positioning during motion control.

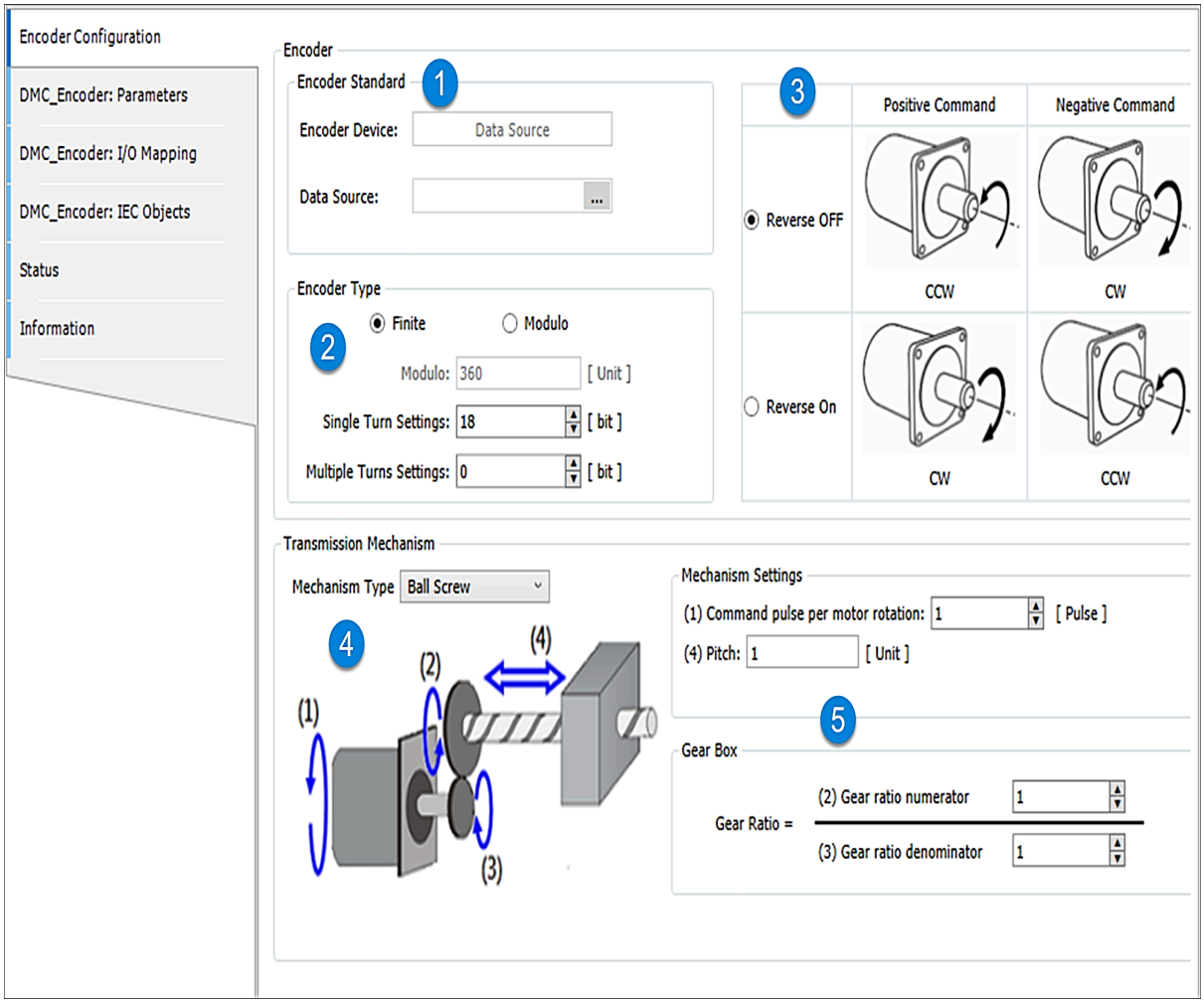
To add a free encoder to the project

1. On the **Devices** pane, right-click **SoftMotion General Axis Pool**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Free Encoder** > one of the encoders.
3. Click **Add Device**.

5.11.5.1 DMC Encoder Settings

After adding a DMC encoder (Delta's encoder), you can configure the encoder parameters. The following tables list the encoder parameters and descriptions for AX-3 controllers.

Encoder Configuration



1 Encoder Standard

Setting	Description
Data Source	Click ... to select a UDINT variable under Motion_PRG to map to the encoder.
Encoder Device	Not editable.

2 Encoder Type

Setting	Description
Finite/Modulo	Select a linear or rotary encoder.

Setting	Description
	• **Modulo**: The encoder turns endlessly without limiting the traversing range. • **Finite**: The encoder is limited.
Modulo	Enter one circle range. The motor rotates one circle after the encoder rotates the Modulo value set. This function is only available when selecting **Modulo** as the encoder type. The default value is 360.
Single Turn Settings	Select or enter the bit length of the single-turn resolution. This function is only available when selecting **Finite** as the encoder type.
Multi Turns Settings	Select or enter the bit length of the multi-turn resolution. This function is only available when selecting **Finite** as the encoder type.

3 Positive/Negative Command

Setting	Description
Reverse OFF/Reverse On	Select the forward or reverse command.

4 Transmission Mechanism

Setting	Description
Mechanism Type	Select the mechanism type.
Mechanism Settings	Set the parameter value for the selected mechanism. The parameters differ by the mechanism type.

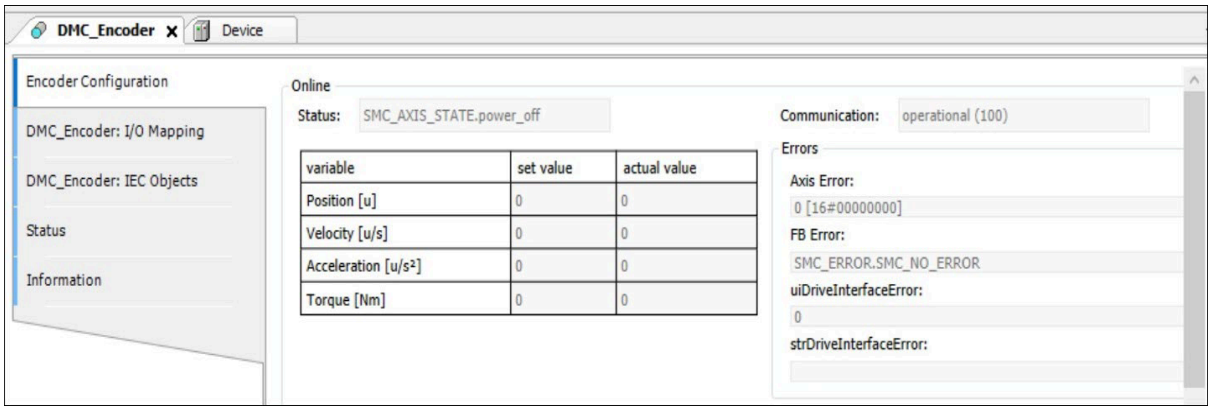
<table>
<tr><th>Setting</th><th>Description</th></tr>
<tr><td></td><td>

Command pulse per motor rotation: Shows the number of pulses required for a motor to rotate for one cycle.
Pitch: Enter the scalable distance the worktable moves for a unit.
See the following picture for examples.
<table>
<tr><th>(4) Pitch value</th><th>Worktable movement distance base</th><th>Function block input value</th><th>The actual distance the worktable moves</th></tr>
<tr><td>10000</td><td>100 cm</td><td>10000</td><td>100 cm</td></tr>
<tr><td>100</td><td>100 cm</td><td>100</td><td>100 cm</td></tr>
<tr><td>10000</td><td>100 cm</td><td>1</td><td>0.01 cm</td></tr>
<tr><td>100</td><td>100 mm</td><td>1</td><td>1 mm</td></tr>
</table>

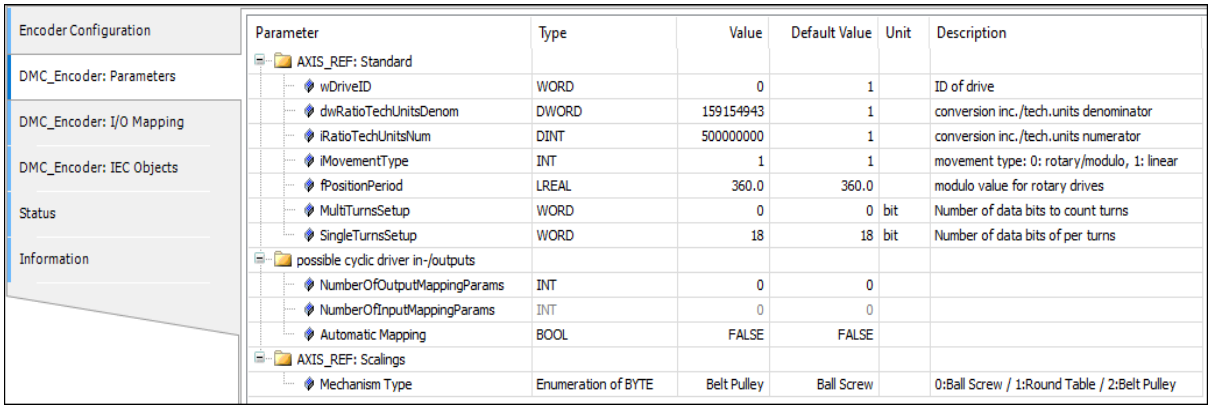
Diameter: Enter the diameter of the gear. Diameter*π = Movement distance per motor rotation
Movement distance per motor rotation: Enter the distance the motor moves to rotate for a cycle.

</td></tr>
<tr><td>Gear Ratio</td><td>Select or enter the gear ratio’s numerator and denominator.</td></tr>
</table>

When the encoder is connected, the online monitoring information is shown.



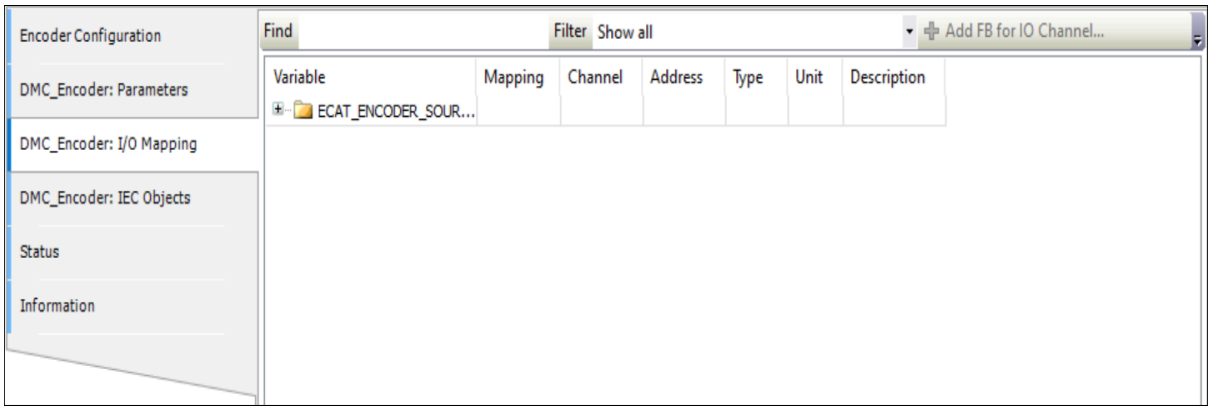
DMC_Encoder: Parameters



Shows the device-specific parameters.

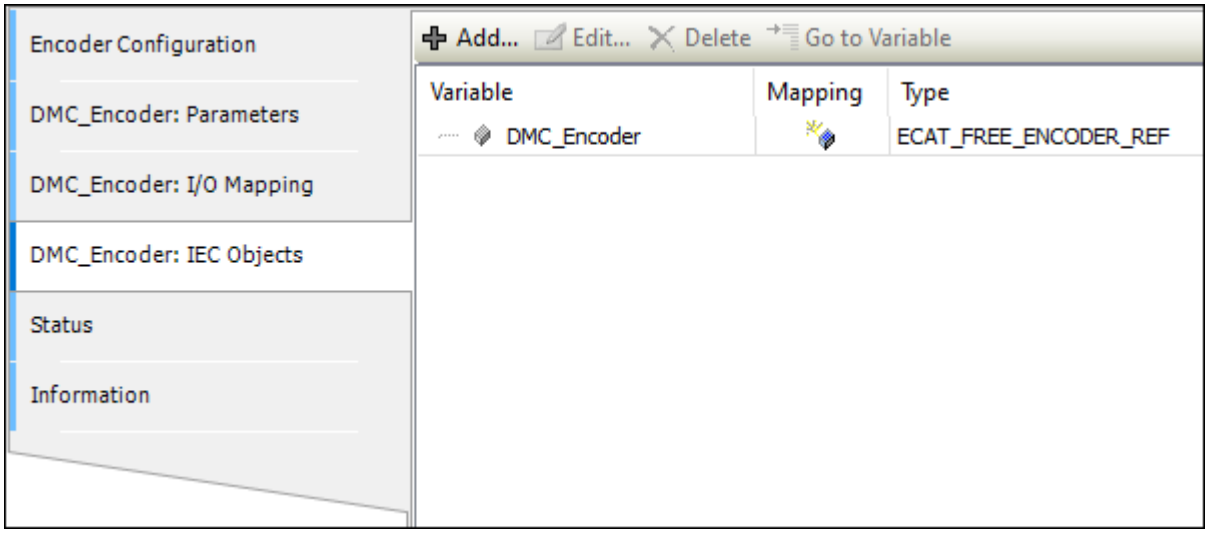
To show this tab, on the menu bar, select **Tools** > **Options** > **Device editor** > **Show generic device configuration views**.

DMC_Encoder: I/O Mapping



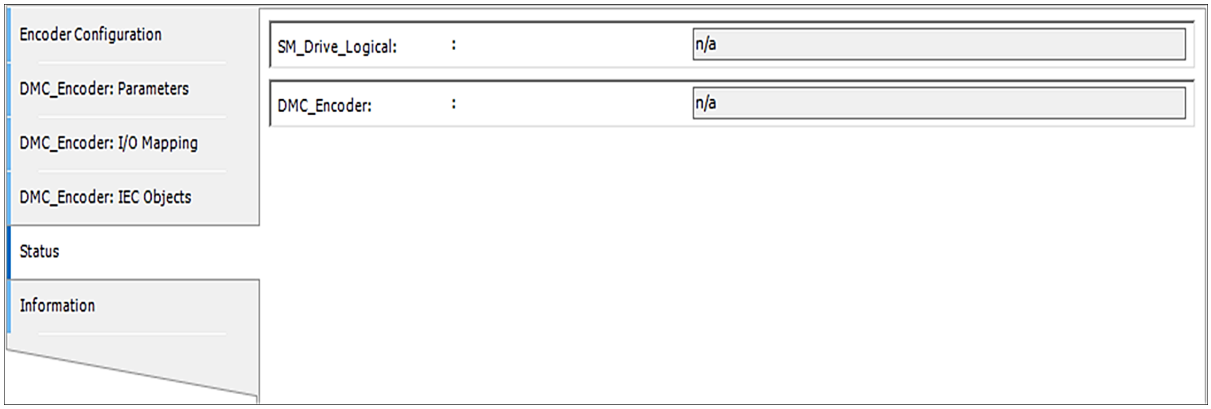
IShows the available channels and allows for the mapping of input, output, and memory addresses of the controller to variables or entire function blocks of the application.

DMC_Encoder: IEC Objects



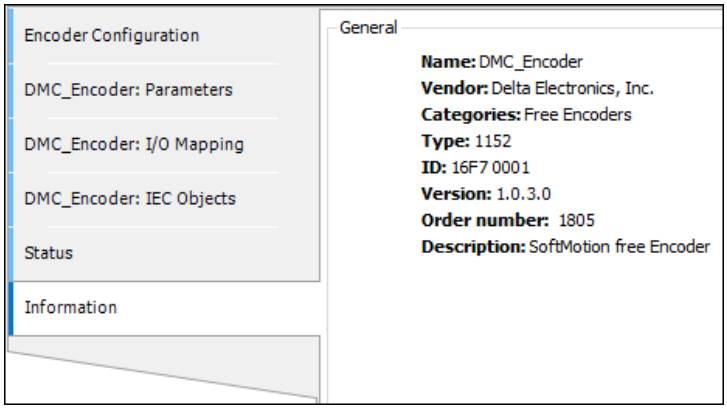
Lists the "objects" that access the device from the IEC application. In the online mode, this is used as the monitoring view.

Status



Shows the status of the encoder.

Information

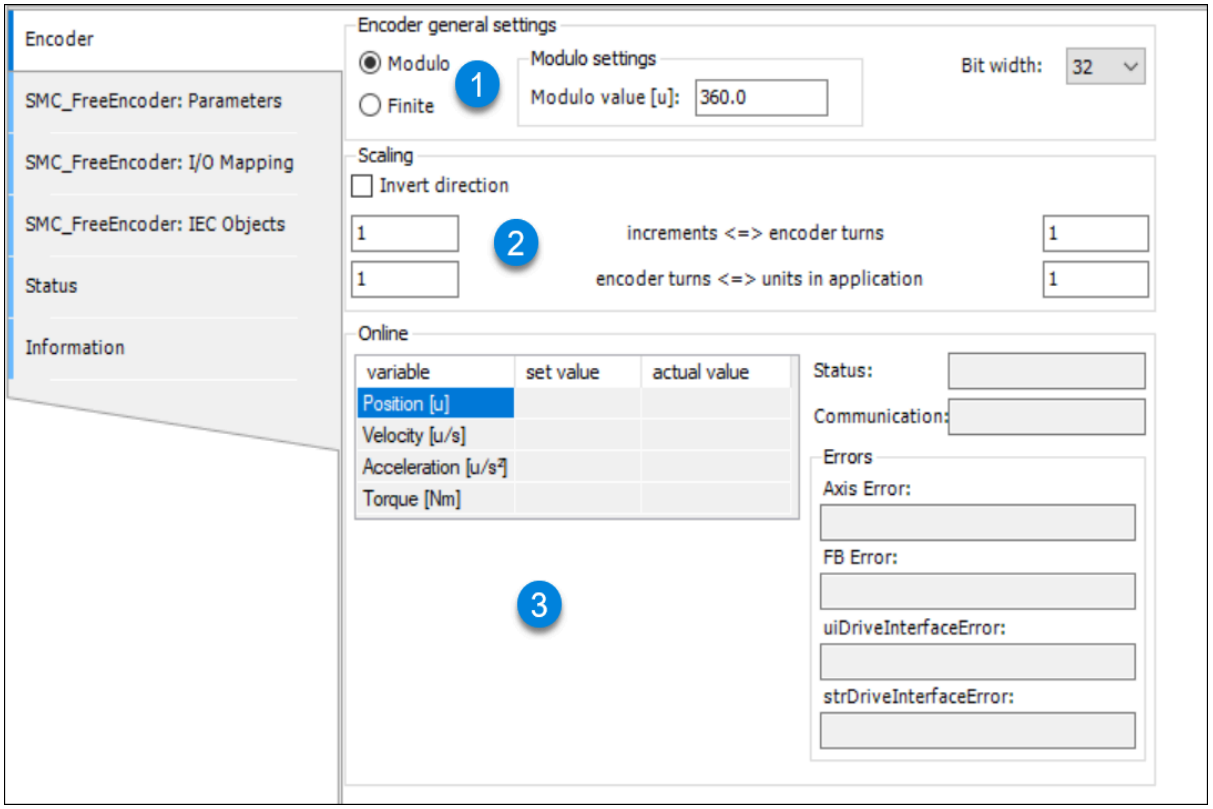


Shows the general information of the encoder.

5.11.5.2 SMC Encoder Settings

After adding a SMC encoder, you can configure the encoder parameters. The following tables list the encoder parameters and descriptions.

Encoder



1 Encoder general settings

Setting	Description
Modulo/Finite	Select a linear or rotary encoder. • **Modulo**: The encoder turns endlessly without limiting the traversing range. • **Modulo Value [u]**: Enter one circle range. The motor rotates one circle after the encoder rotates the Modulo value set. This function is only available when selecting **Modulo** as the encoder type. The default value is 360. • **Finite**: The encoder is limited.

Setting	Description
Bit width	Select a bit width.

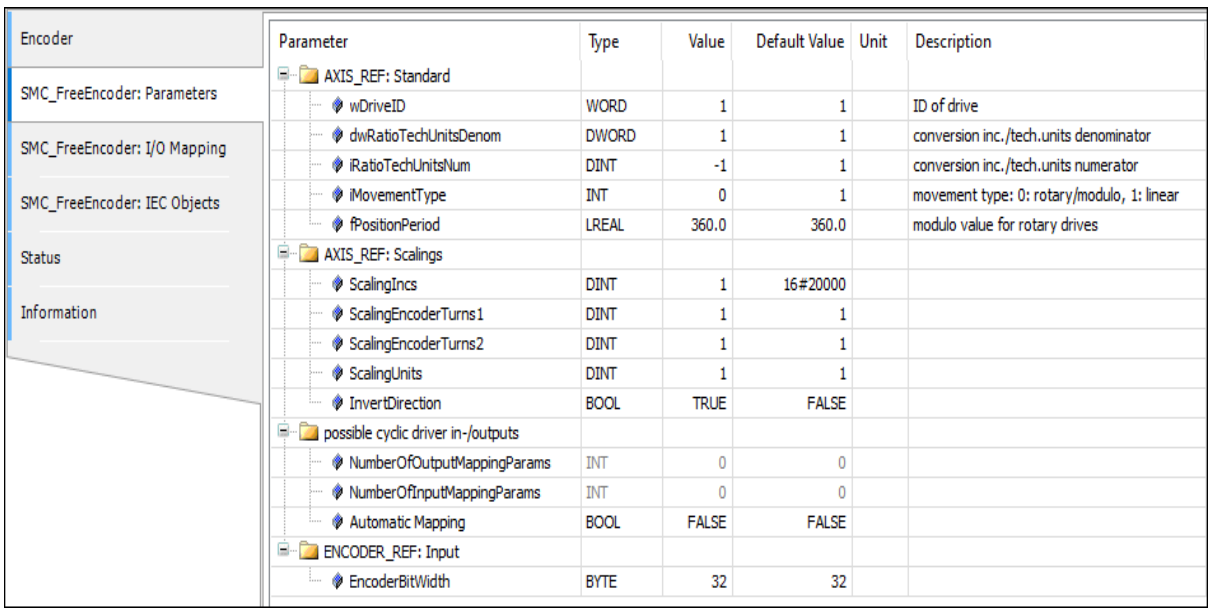
2 Scaling

Setting	Description
Invert direction	Select to allow the encoder to receive the specified values with inversed signs and rotate in the opposite direction.
increments < = > encoder rotations	Enter the number of increments which correspond to the number of complete encoder rotations.
encoder rotations <=> units in application	Enter the encoder turns which correspond to units in application.

3 Online

Setting	Description
Status	Shows the current status of the encoder.
Communication	Shows the current communication status.
Errors	Shows the related errors.

SMC_FreeEncoder: Parameters

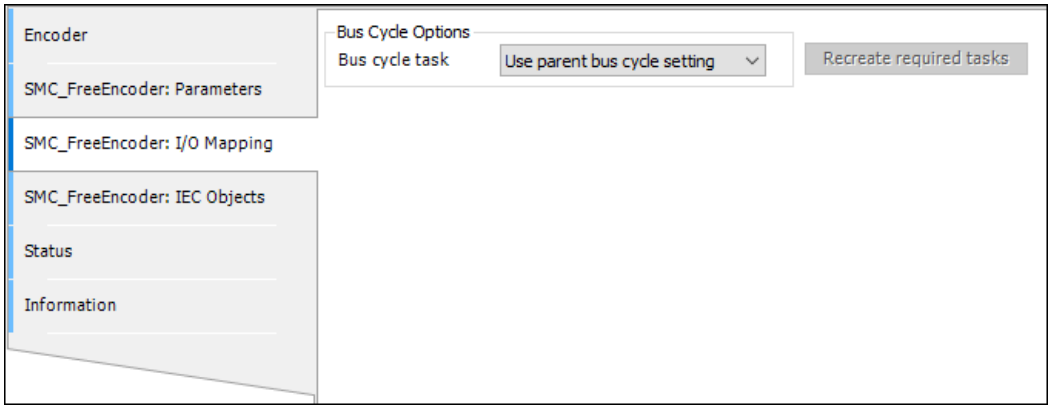


Parameter	Type	Value	Default Value	Unit	Description
AXIS_REF: Standard					
wDriveID	WORD	1	1		ID of drive
dwRatioTechUnitsDenom	DWORD	1	1		conversion inc./tech.units denominator
iRatioTechUnitsNum	DINT	-1	1		conversion inc./tech.units numerator
iMovementType	INT	0	1		movement type: 0: rotary/modulo, 1: linear
fPositionPeriod	LREAL	360.0	360.0		modulo value for rotary drives
AXIS_REF: Scalings					
ScalingIncs	DINT	1	16#20000		
ScalingEncoderTurns1	DINT	1	1		
ScalingEncoderTurns2	DINT	1	1		
ScalingUnits	DINT	1	1		
InvertDirection	BOOL	TRUE	FALSE		
possible cyclic driver in-/outputs					
NumberOfOutputMappingParams	INT	0	0		
NumberOfInputMappingParams	INT	0	0		
Automatic Mapping	BOOL	FALSE	FALSE		
ENCODER_REF: Input					
EncoderBitWidth	BYTE	32	32		

Shows the device-specific parameters.

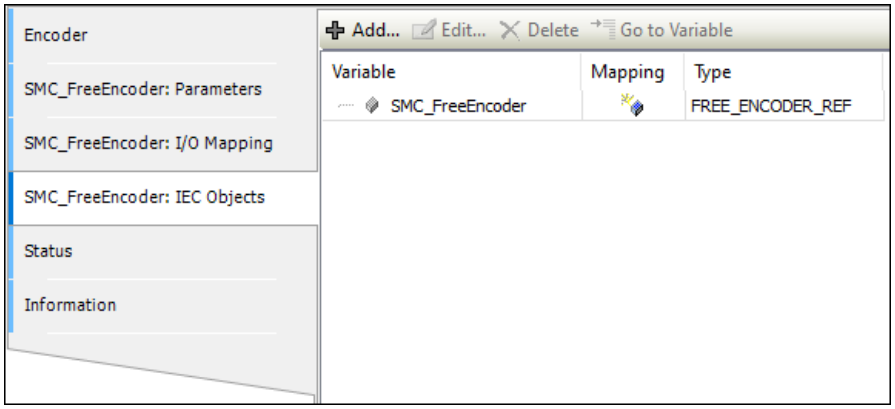
To show this tab, on the menu bar, select **Tools** > **Options** > **Device editor** > **Show generic device configuration views**.

SMC_FreeEncoder: I/O Mapping



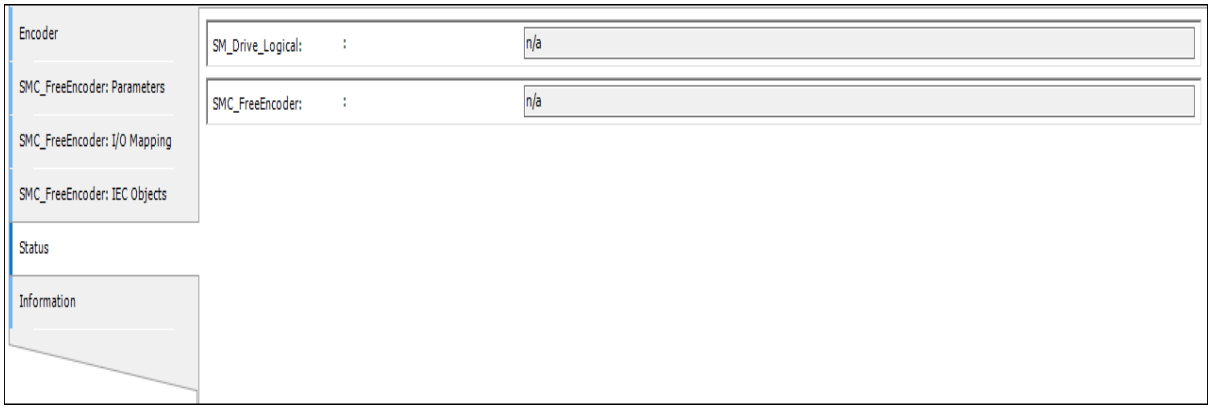
Setting	Description
Bus cycle task	Select a bus cycle task to synchronize with the SMC encoder communication time.

SMC_FreeEncoder: IEC Objects



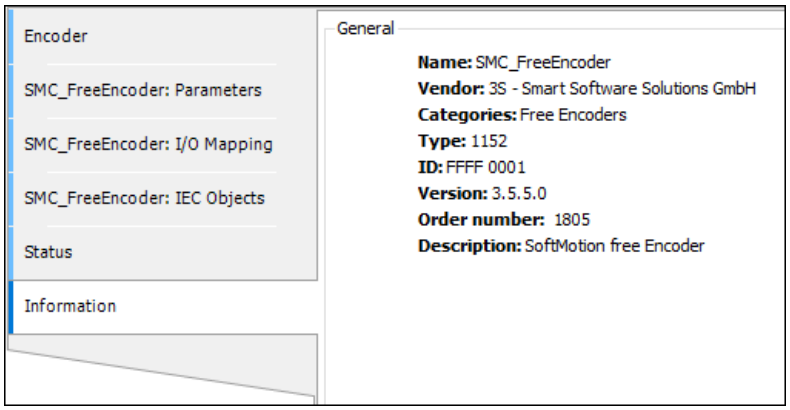
Lists the "objects" that access the device from the IEC application. In the online mode, this is used as the monitoring view.

Status



Shows the status of the encoder.

Information



Shows the general information of the encoder.

5.11.6 Axis Group

The axis group defines the mechanism relationship between axes. Use the axis group movement when running multiple axes and running linear and circular interpolation. DIADesigner-AX supports setting the axis group.

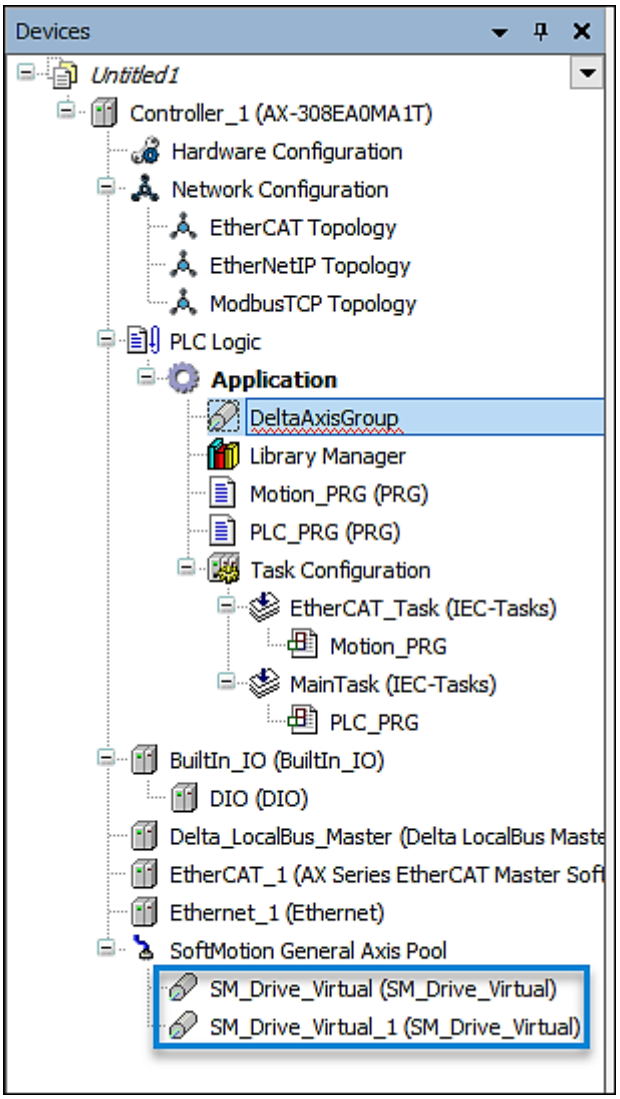
Maximum control axes	Linear interpolation	6 axes
	Circular interpolation	6 axes (3 follower axes)

5.11.6.1 Add an Axis Group

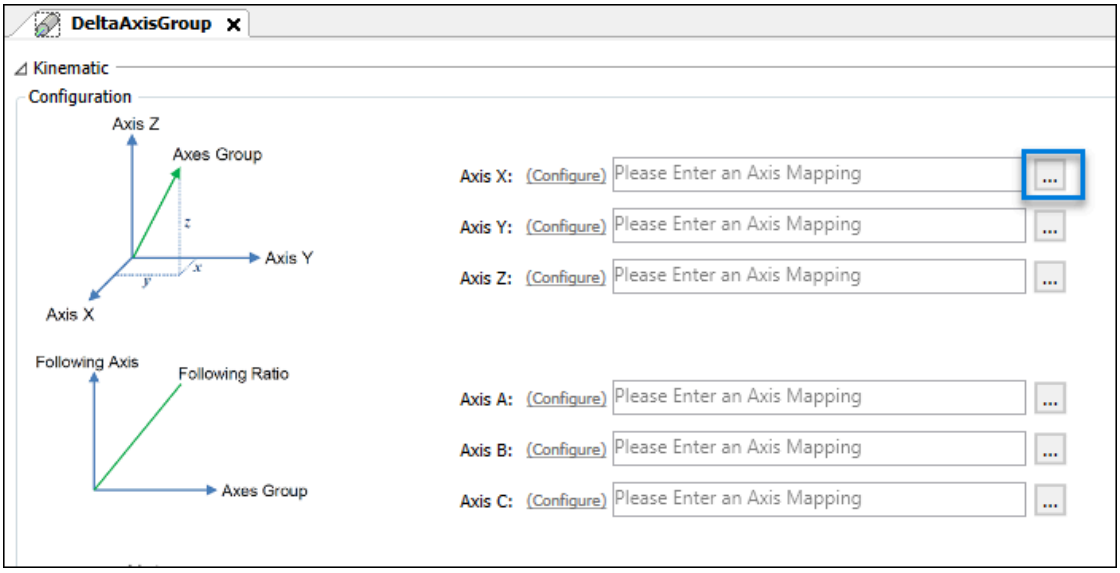
To use the axis group movement, you must create the axis group and add individual axes.

To create an axis group

1. Add axes. Take two virtual axes as an example. For more information about adding a virtual axis, see Add a Virtual Drive.



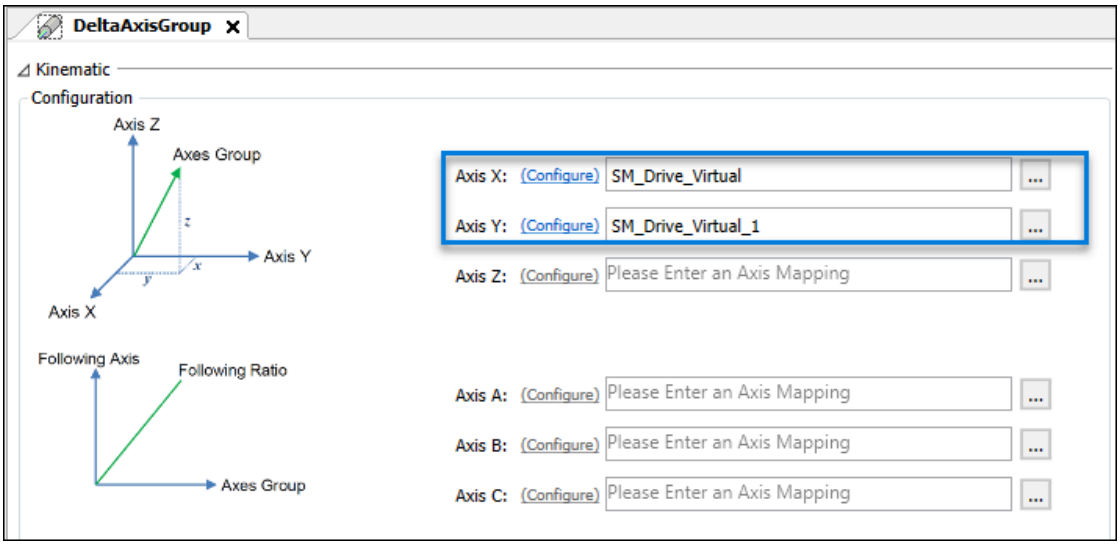
2. Right-click **Application**, and then select **Add Object** > **Delta Axis Group**.
3. In the **Add Delta Axis Group** dialog, enter the name, and then click **Add**.
4. On the **DeltaAxisGroup** pane, in the **Axis X** row, click ...



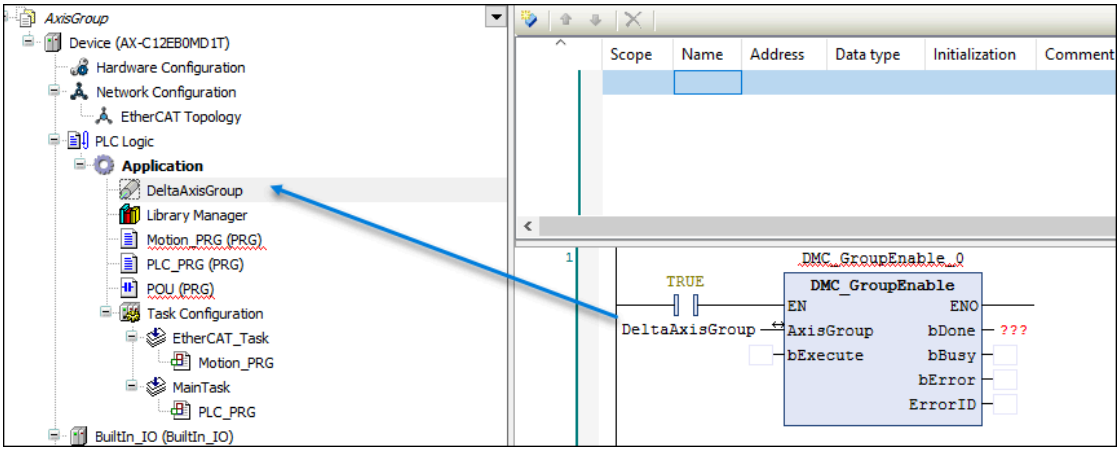
5. In the **Input Assistant** dialog, select the virtual axis **SM_Drive_Virtual**, and then click **OK**.

6. In the **Axis Y** row, click  .

7. In the **Input Assistant** dialog, select the virtual axis **SM_Drive_Virtual_X**, and then click **OK**.



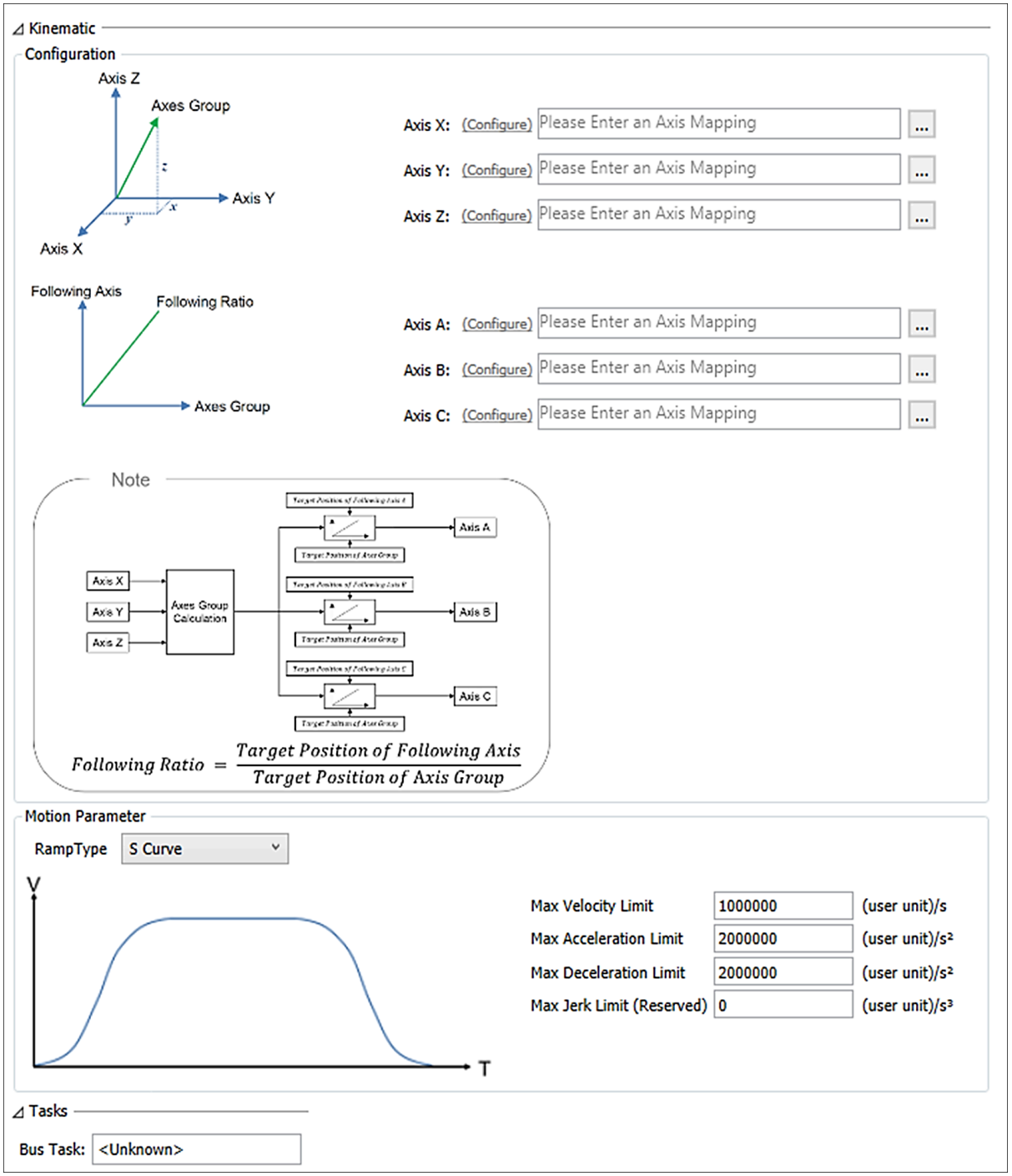
8. Add the **DMC_GroupEnable** function block in **Motion_PRG**, and enter the axis group name in the **AxisGroup** pin.



9. Compile the program and fix errors if any.
10. Log in and download the program.

5.11.6.2 Axis Group Settings

After adding an axis group, you can configure the axis group parameters. The following tables list the axis group parameters and descriptions.



Kinematic

Setting	Description
Axis X	Enter or select the X axis in the axis group.
Axis Y	Enter or select the Y axis in the axis group.
Axis Z	Enter or select the Z axis in the axis group.
Axis A	Enter or select the A axis in the axis group.

Setting	Description
Axis B	Enter or select the B axis in the axis group.
Axis C	Enter or select the C axis in the axis group.

Motion Parameter

Setting	Description
RampType	Select the velocity curve type.
Maximum Velocity Limit	Enter the maximum velocity of the axis group. An error occurs when the axis group movement velocity exceeds the value set.
Maximum Acceleration Limit	Enter the maximum acceleration of the axis group. An error occurs when the axis group movement acceleration exceeds the value set.
Maximum Deceleration Limit	Enter the maximum deceleration of the axis group. An error occurs when the axis group movement deceleration exceeds the value set.
Maximum Jerk Limit (Reserved)	Enter the maximum acceleration (jump) of the axis group. This function is reserved.

Tasks

Setting	Description
Bus Task	Set the axis group task.

5.11.7 Homing Setting Reference

The following table shows the devices and their homing functions and settings.

Function:

1. Homing speed during search for switch
2. Homing speed during search for z phase pulseswitch
3. Homing acceleration
4. Torque Detection Level
5. Level Reached Timer

Homing Mode		Function					Device						
		1	2	3	4	5	A2	A3	B3	E3/ E3C	H3	C2000 Plus	CH2000
-4	Reverse to look for the collision point	V	V	V	V	V		V	V	V	V		
-3	Go forward to look for the collision point	V	V	V	V	V		V	V	V	V		
-2	Reverse to look for the collision point and then re-turn to look for Z pulse	V	V	V	V	V		V	V	V	V		
-1	Go forward to look for the collision point and then re-turn to look for Z pulse	V	V	V	V	V		V	V	V	V		
1	Depend on the negative lim-it switch and Z-pulse	V	V	V			V	V	V	V	V	V	V
2	Depending on the positive lim-	V	V	V			V	V	V	V	V	V	V

Homing Mode		Function					Device						
		1	2	3	4	5	A2	A3	B3	E3/ E3C	H3	C2000 Plus	CH2000
	it switch and Z pulse												
3	Depend on the home switch and Z pulse	V	V	V			V	V	V	V	V	V	V
4		V	V	V			V	V	V	V	V	V	V
5		V	V	V			V	V	V	V	V	V	V
6		V	V	V			V	V	V	V	V	V	V
7	Depend on the home switch, and positive limit and Z pulse	V	V	V			V	V	V	V	V	V	V
8		V	V	V			V	V	V	V	V	V	V
9		V	V	V			V	V	V	V	V	V	V
10		V	V	V			V	V	V	V	V	V	V
11	Depending on the home switch and negative lim-it switch Z-phase pulse	V	V	V			V	V	V	V	V	V	V
12		V	V	V			V	V	V	V	V	V	V
13		V	V	V			V	V	V	V	V	V	V
14		V	V	V			V	V	V	V	V	V	V
17	Similar to mode 1 that depending on the negative limit switch but without Z-pulse	V	V	V			V	V	V	V	V	V	V
18	Similar to mode 2 that depending on the positive limit switch. but without Z pulse	V	V	V			V	V	V	V	V	V	V
19	Similar to mode 3 that depend-	V	V	V			V	V	V	V	V	V	V
20		V	V	V			V	V	V	V	V	V	V

Homing Mode		Function					Device						
		1	2	3	4	5	A2	A3	B3	E3/ E3C	H3	C2000 Plus	CH2000
	ing on the home switch but without Z pulse												
21	Similar to mode 5 that depending on the home switch. but without Z pulse	V	V	V			V	V	V	V	V	V	V
22		V	V	V			V	V	V	V	V	V	V
23	Similar to mode 7 that depending on the home switch and positive limit switch but without Z pulse	V	V	V			V	V	V	V	V	V	V
24		V	V	V			V	V	V	V	V	V	V
25	Similar to mode 10 that depending on the home switch and positive limit switch but without Z pulse	V	V	V			V	V	V	V	V	V	V
26		V	V	V			V	V	V	V	V	V	V
27	Similar to mode 11 that depending on the home switch and negtive limit switch but without Z pulse	V	V	V			V	V	V	V	V	V	V
28		V	V	V			V	V	V	V	V	V	V
29	Similar to mode 14 that depending on the home	V	V	V			V	V	V	V	V	V	V
30		V	V	V			V	V	V	V	V	V	V

Homing Mode		Function					Device						
		1	2	3	4	5	A2	A3	B3	E3/ E3C	H3	C2000 Plus	CH2000
	switch and negtive limit switch but without Z pulse												
33	Depending on Z pulse in the nega-tive direction	V	V	V			V	V	V	V	V	V	V
34	Depending on Z pulse in the posit-ige direction	V	V	V			V	V	V	V	V	V	V
35	Depending on the current position	V	V	V			V	V	V	V	V	V	V

Note: The Homing Setting -1~-4 is only applicable to ASDA-A3-E, ASDA-B3-E, and ASDA-H3-E devices.

5.11.8 SoftMotion Version Compatibility

Softmotion v4.10 is supported from DIADesigner-AX version 1.4.0. Use the following table to check the version compatibility among SoftMotion, Axis devices, and related libraries. You can modify the version or update the device if any related incompatible errors exist.

DML or VLDML Axis Device Version	Supported Device										Soft-Motion Version	Library
	C2000+CH2000	MH300 MS300	MX 300	A2	A3	B3	E3	W3	R1-EC5621	AX-502PU		DL_ Mo-tion Con-trolLight
1.0.0.0				V	V	V					4.6.1.0	1.0.0.13
1.0.0.5				V		V			V			1.0.0.13
1.0.0.6					V							1.0.0.13

DML or VLDML Axis Device Version	Supported Device										Soft-Motion Version	Library
	C2000+CH2000	MH300MS300	MX 300	A2	A3	B3	E3	W3	R1-EC5621	AX-502PU		DL_ Motion ControlLight
1.0.0.14				V	V	V			V			1.0.0.13
1.1.0.0	V	V		V	V	V			V			1.1.0.0
1.3.0.0	V	V		V	V	V			V		4.6.1.0 4.10.0.0 4.16.0.0	1.3.0.0 and later
1.3.2.0				V	V	V						1.3.0.0 and later
1.4.0.0	V			V					V			1.4.0.0 and later
1.4.0.1		V			V	V	V	V				1.4.0.0 and later
1.4.1.2	V	V			V							1.4.1.2 and later
1.4.1.4			V									1.4.1.2 and later
1.4.2.x*	V	V	V	V	V	V	V	V	V	V		1.4.2.x* and later

Note: * indicates that the version is that released in the software.

To update the axis device version

1. On the **Devices** pane, right-click the Axis device, and then select **Update Device**.
2. In the **Update Device** dialog, select the latest version (for example, v1.3.0.0), and then click **Update Device**.
3. In the **Update Device List** dialog, check the Source and Target version, and then click **Update**.

To change the SoftMotion version

1. Go to **Project** > **Project Settings**.
2. Select **SoftMontion**.
3. On the **SoftMotion** pane, select the version, and then click **OK**.

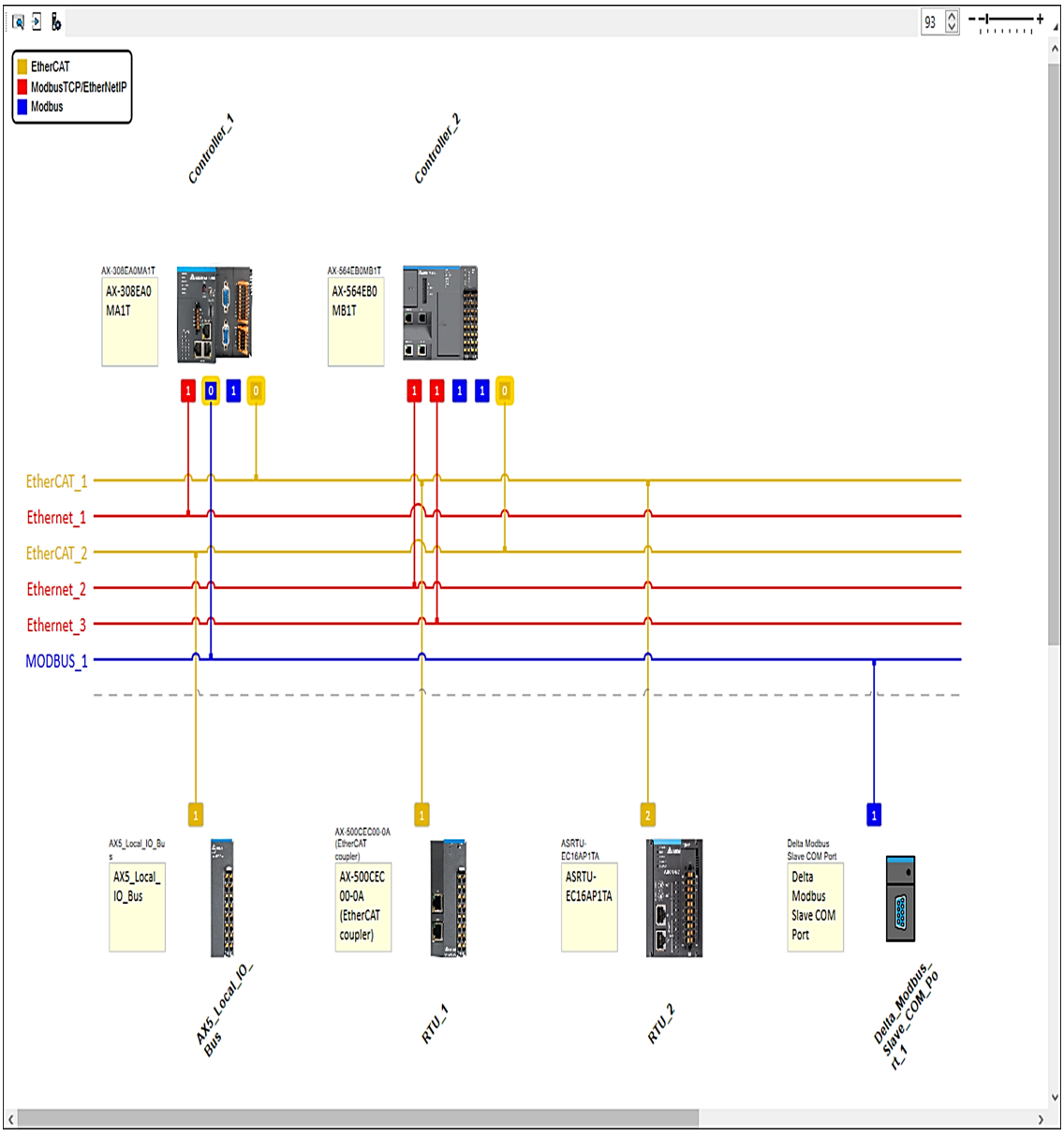
To change the library version

1. On the **Devices** pane, double-click **Library Manager**.
2. On the **Library Manager** pane, click **Placeholders**.
3. In the **Placeholders** dialog, select the library version, and then click **OK**.

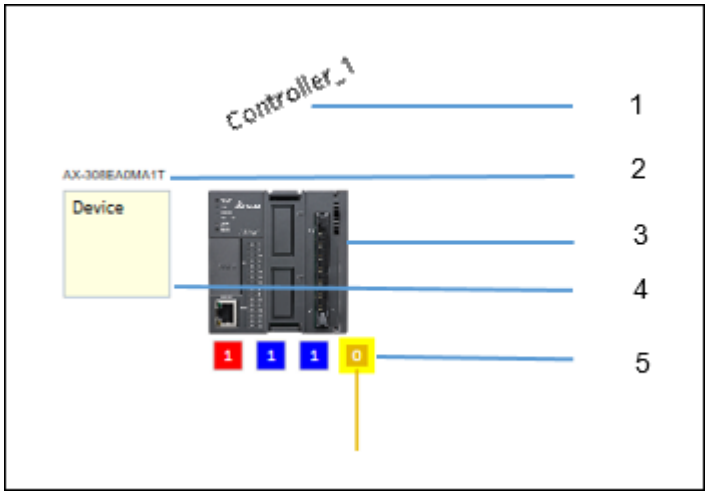
Chapter 6: Network Configuration

In **Network Configuration Editor**, you can do the following:

- View the device and network information.
- Double-click or drag the device in **Product List** to add it to the editor.
- Cut, copy, and paste the device.
- Configure the network for a project.

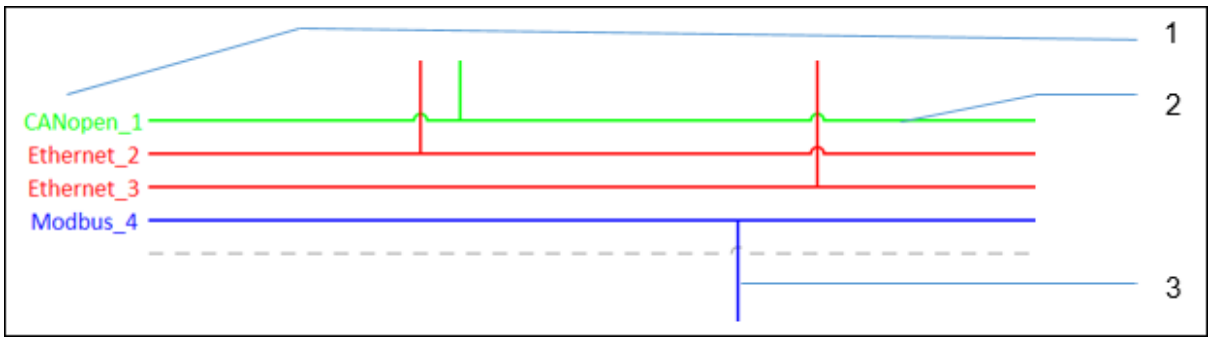


Device information includes the following:



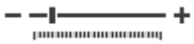
1. Device name
2. Device default name (won't change if the name is changed on the project tree)
3. Device image
4. Box to enter note
5. Communication ports on the device

Network information includes the following:



1. Network name
2. Network lines
3. Connections to the devices

The following table lists the toolbar items and descriptions in **Network Configuration Editor**.

Setting	Description
	Click to scan the connected devices and show in the editor. Only support scanning the devices connecting with Ethernet or EtherCAT protocol.
	Click to open the **Device Repository** dialog to install a device. The installed device will show in **Product List** > **Fieldbuses**, and then you can add the device to the editor.
	Click to open the **Axis Selection** dialog. Double-click the axis to open the **Select the Device Description** dialog to change the axis.
	Select or enter the value to zoom in or zoom out on the editor.
	Drag to zoom in or zoom out on the editor.

6.1 Network Topology

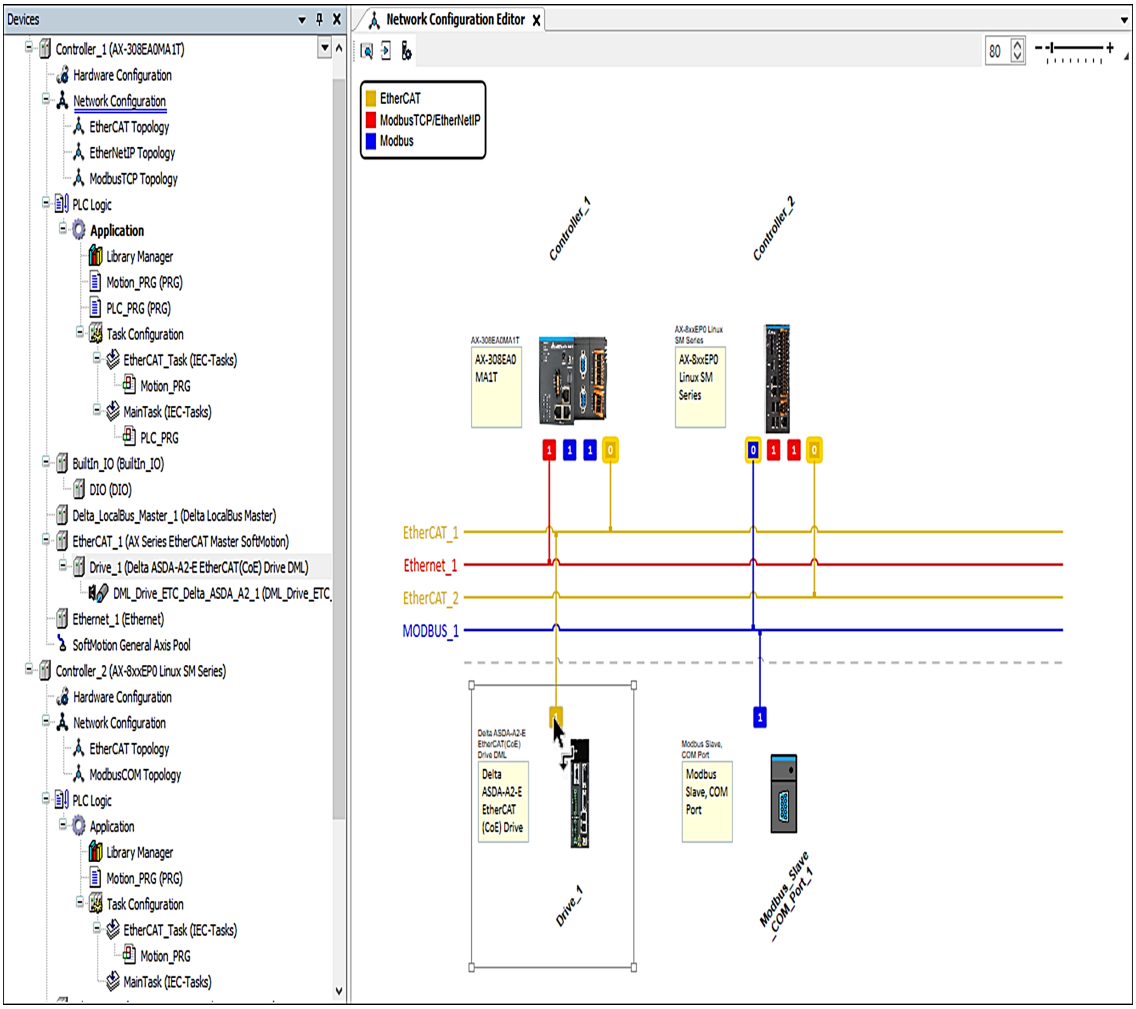
Network topology refers to how various nodes, devices, and connections on your network are physically or logically arranged in relation to each other.

6.1.1 Set up Network Topology

Use the following steps to set up a network topology.

To set up a network topology

1. On the **Devices** pane, double-click **Network Configuration**.
2. From **Product List** > **PLCs**, double-click or drag the device to the **Network Configuration Editor**.
3. Click the device port and connect to the network line.



4. Set the controller as master and connect to slave devices. Right-click the controller and then select **Set As Master / Scanner** > **Port x**.

Note:

- If you import a project from a higher version to a lower version, the slave device can only restore part of it. The network configuration topology may also be different because different network devices support different software versions.
- You can delete slave devices and network lines simultaneously in **Network Configuration Editor** when deleting slave devices from the project tree. On the menu bar, select **Tools** > **Options** > **Deletingslave devices** from the project tree also deletes the devices and network lines in Network Configuration Editor simultaneously.

If the slave device is connected to different controllers in the same network, the slave device and network line are deleted in **Network Configuration Editor** as long as the slave device is no longer connected to any master controller and is all deleted in the project tree.

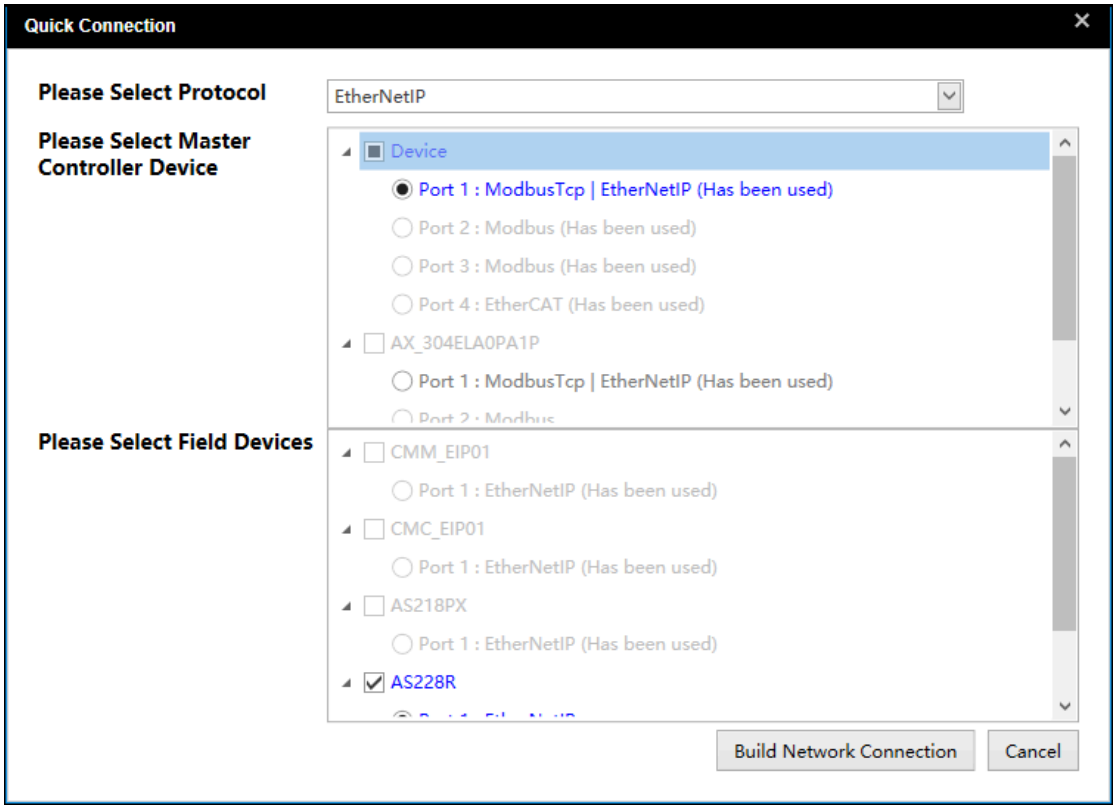
6.1.1.1 Quick Connection

How do I open the **Quick Connection** dialog?

- In **Network Configuration Editor**, right-click the blank area and then select **Quick Connection**.

The **Quick Connection** dialog helps you quickly build a complex network connection.

The following table lists the items and descriptions in the **Quick Connection** dialog.



Setting	Description
Please Select Protocol	Select the protocol to build the connection line.
Please Select Master Controller Device	Select one master controller based on the selected protocol.
Please Select Field Devices	Select the slave devices to connect to the selected protocol.
Build Network Connection	Click to connect the selected protocol with the selected devices. The slave devices will also show in the project tree.

6.1.2 EtherCAT Topology

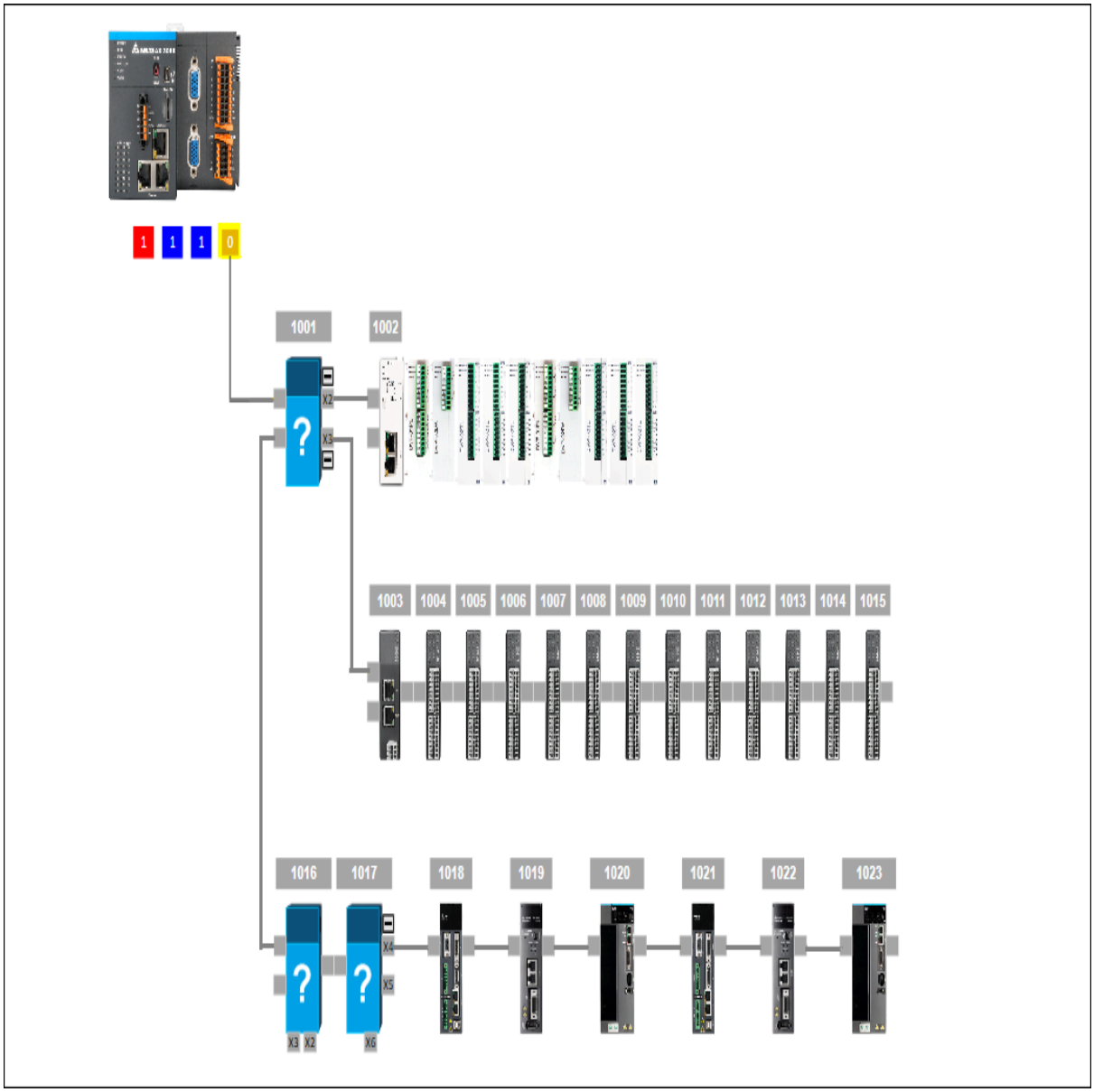
How do I open **EtherCAT Topology**?

- On the **Devices** pane, expand **Network Configuration**, and then double-click **EtherCAT Topology**.

Use EtherCAT Topology to show the topology of devices in the EtherCAT network in the project. From DIADesigner-AX version 1.5.0, EtherCAT Topology supports showing the junction device with more than three ports and the sub devices under the junction device.

In **EtherCAT Topology**, you can:

- Locate network errors.
- Turn on the **Show Device Name** toggle switch to show the name of each device in the topology.
- Click  to hide the sub devices and click  to show them.
- View the EtherCAT address by the number above the device.

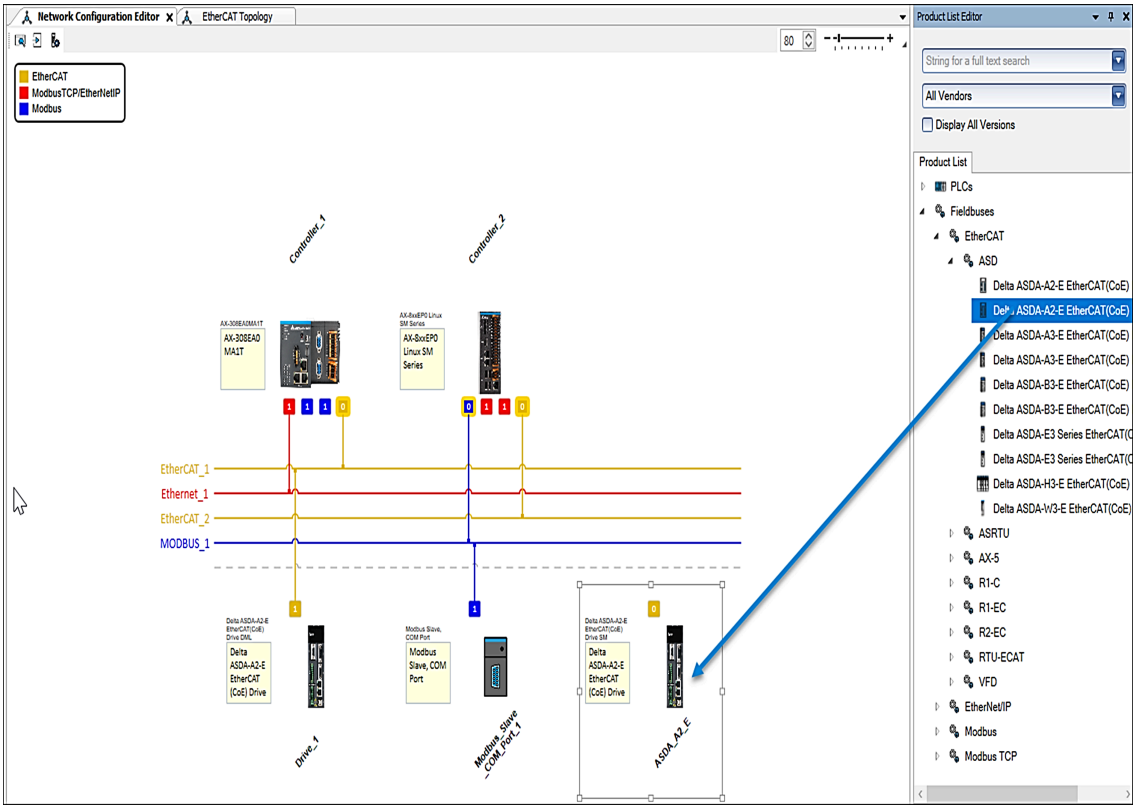


6.1.2.1 Set up EtherCAT Topology

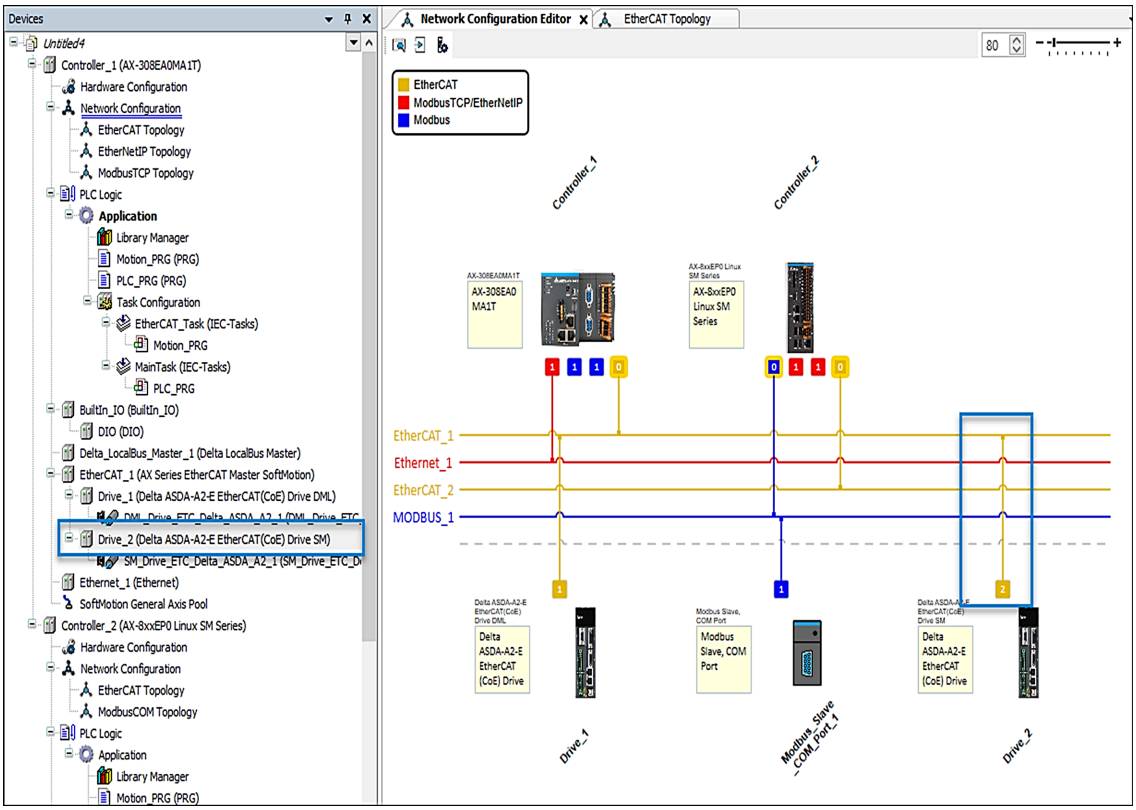
Use the following steps to set up EtherCAT Topology.

To set up EtherCAT Topology

1. On the **Devices** pane, double-click **Network Configuration**.
2. In **Product List**, select **Fieldbuses** > **EtherCAT** > one of the devices.
3. Drag the device to **Network Configuration Editor**.

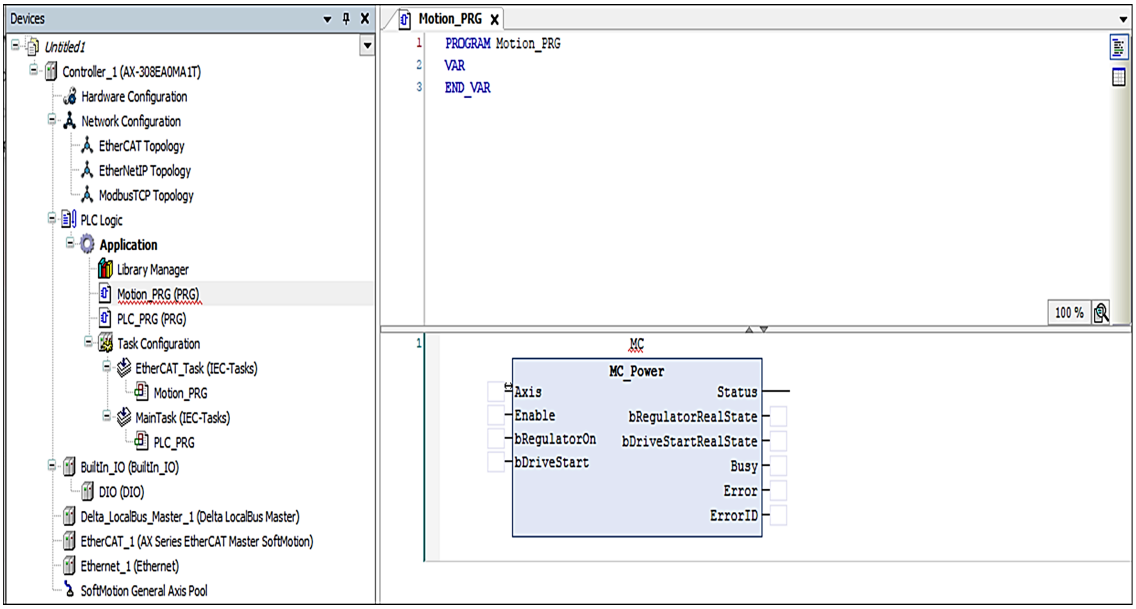


4. Connect the slave device to the EtherCAT line.



5. In **EtherCAT Topology**, double-click the device to open the parameter page to set EtherCAT parameters. For more information, see EtherCAT Settings.

Note: When you start programming, use the motion function block to write the program in the POU under EtherCAT_Task to ensure the motion function block runs normally.



6.1.2.2 EtherCAT Device Diagnosis

This section describes the basic diagnosis functionalities and the most typical errors of the devices within an EtherCAT network. Use this function to diagnose the EtherCAT errors for master and slave devices online.

To diagnose errors within an EtherCAT network

1. Log in to the controller.

   Note: The diagnosis function is not available in the simulation mode.

2. On the **Devices** pane, double-click **EtherCAT Topology**.

3. Click  to diagnose the EtherCAT network. You can also click  to get the diagnosis information continuously. If you switch to another editor, the auto diagnosis stops. When you switch back, the auto diagnosis starts again.

4. Click the device respectively to view its diagnosis information on the **Properties** pane.
5. (optional) Turn on the **Clear Register** toggle switch to clear the historical register data of all slaves before auto and manual diagnosis.

You can view the diagnosis result and status on the **Messages** pane at the bottom.

6.1.2.2.1 EtherCAT Diagnosis Device Status

The master device controls the operation of each EtherCAT slave device. Depending upon the state, different functions are accessible or executable in the EtherCAT slave.

Device Status

The following table lists the status and its descriptions of the master device (controller).

Status	Description
 Hard Error	The device is mismatched.

The following table lists the status and its descriptions of the slave devices.

Status	Description
 Hard Error	The device is mismatched.
 Soft Error	The device has software errors, such as unsupported cycle time.
 Init	Communication is established, but mailbox communication and process data are not available.

Status	Description
 Pre-Operational	Mailbox communication is possible, but process data is not transferred.
 Safe-Operational	Process data has already been transferred. Inputs are read, but outputs are not given.
 Operational	All process data is transferred. The slave copies the output data of the master to its outputs.
 BootStrap	The firmware file is transferred to or from the slave.

You can set and change the slave device state. Right-click the device and then click **Set State** to set the state of the current slave to the selected one.

Note: This function is not available if the application stops running.

Port Status

To locate the device with errors quickly in the EtherCAT topology, ports are shown in different colors to indicate the communication status.

Status	Description
 Normal	Read the register successfully. There is no CRC/RX error or Lost Link.
 Warning	Read the register successfully. There is a CRC/RX error or Lost Link.

Status	Description
 No-Comm	Have not or failed to read the register.

6.1.2.2.2 EtherCAT Diagnosis Properties and Errors

On the **Properties** pane, you can view the properties and errors for both master and slave devices.

The following table lists the properties, errors and its descriptions of the master device (controller).

Item	Description
Property	Shows the basic information about the controller.
Clear Memory Data	Click **Clear** to set the memory data of all slaves to zero. You need to click  to get the latest diagnosis information.
Bus Load	Shows the fieldbus load.
Frame Counter	
Acknowledge	Click to set all frame counters to zero. You need to click  to get the latest diagnosis information. This option is not available if you click  .
Send Frames	Shows the number of total EtherCAT frames sent.
Frames Per Second	Shows the number of frames sent per second.
Lost Frames	Shows the number of total lost frames. A frame is lost due to Electro Magnetic Compatibility (EMC), connection, or other hardware problems. In addition, if the CRC does not match, then this counter increases as the network driver skips the frame.
Rx Error	Shows the number of missing received frames. Each sent frame must be received at least in the next IEC cycle. If the

Item	Description
	runtime system (TCP-IP stack) is busy or the priority is low, then frames will be delayed for sending or receiving and this counter will increase.
Tx Error	Shows the number of frames that was not sent.
Last Message	Shows the last message of the EtherCAT stack.
Task Information	
Task Name	Shows the task you select in **EtherCAT_Master_SoftMotion** > **EtherCAT I/O Mapping** > **Bus cycle task**.
Task Priority	Shows the priority of the task.
Average Cycle Time	Shows the average cycle time of the task.
Max Cycle Time	Shows the maximum cycle time of the task.
Min Cycle Time	Shows the minimum cycle time of the task.

The following table lists the errors and its descriptions of the slave device.

Item	Description
Property	Shows the basic information about the device and its diagnosis message.
State Machine	
Current State	Shows the current state of the slave state machine.
Request State	Shows the requested state of the slave state machine. If the slave device is in the "Init" state and the "Op" state is requested, the slave device then passes through the "Pre-Op" and "Safe-Op" states before reaching the "Op" state.
Suggestion	Shows the suggestion of how to fix the current topology error.
Diagnosis Message	Shows the diagnosis message.
DLL Status	Shows the DLL status of the active port.

Item	Description
	• No Carrier / Open: No carrier signal exists at the port, but the port is open. • No Carrier / Closed: No carrier signal exists at the port, and the port is closed. • Carrier / Open: A carrier signal exists at the port, and the port is open. • Carrier / Closed: A carrier signal exists at the port, but the port is closed.
Lost Link	Shows the number of interrupts in the hardware communication channel during which frames are not sent to the neighboring device.
Port CRC	Shows the number of errors that occurred through the cyclic redundancy check for the active port.
Rx Error	Shows the number of times of the data losses of the network card during sending and receiving.
AL Status	
Error Code	Shows the AL status error code.
Error Text	Shows the AL status code meaning.

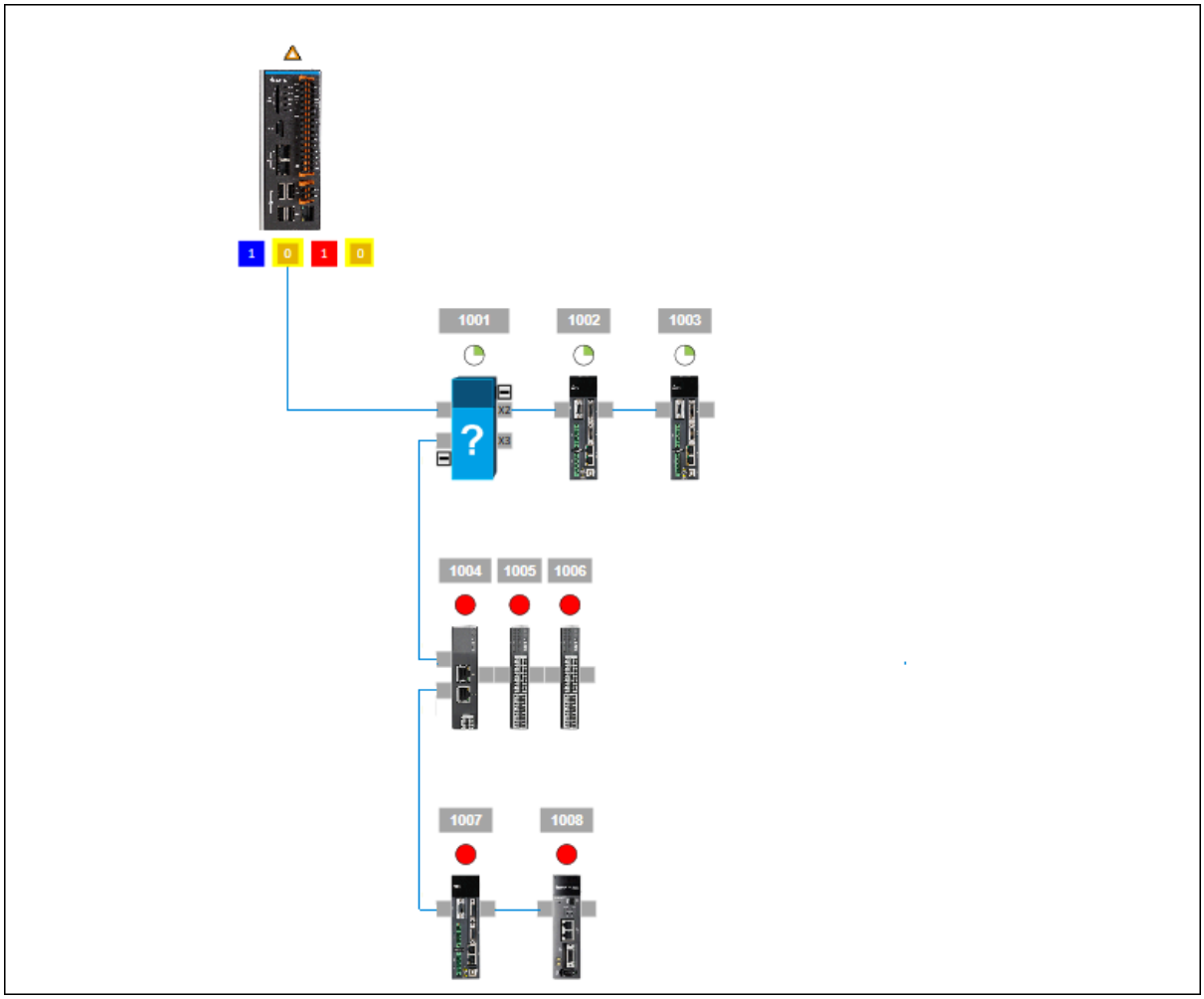
6.1.2.2.3 EtherCAT Diagnosis Scenarios

This section provides some EtherCAT diagnosis scenarios and the corresponding topology examples for an intuitive explanation.

Scenario 1: Networking failed

The device in the project tree does not match the physical device.

Example:

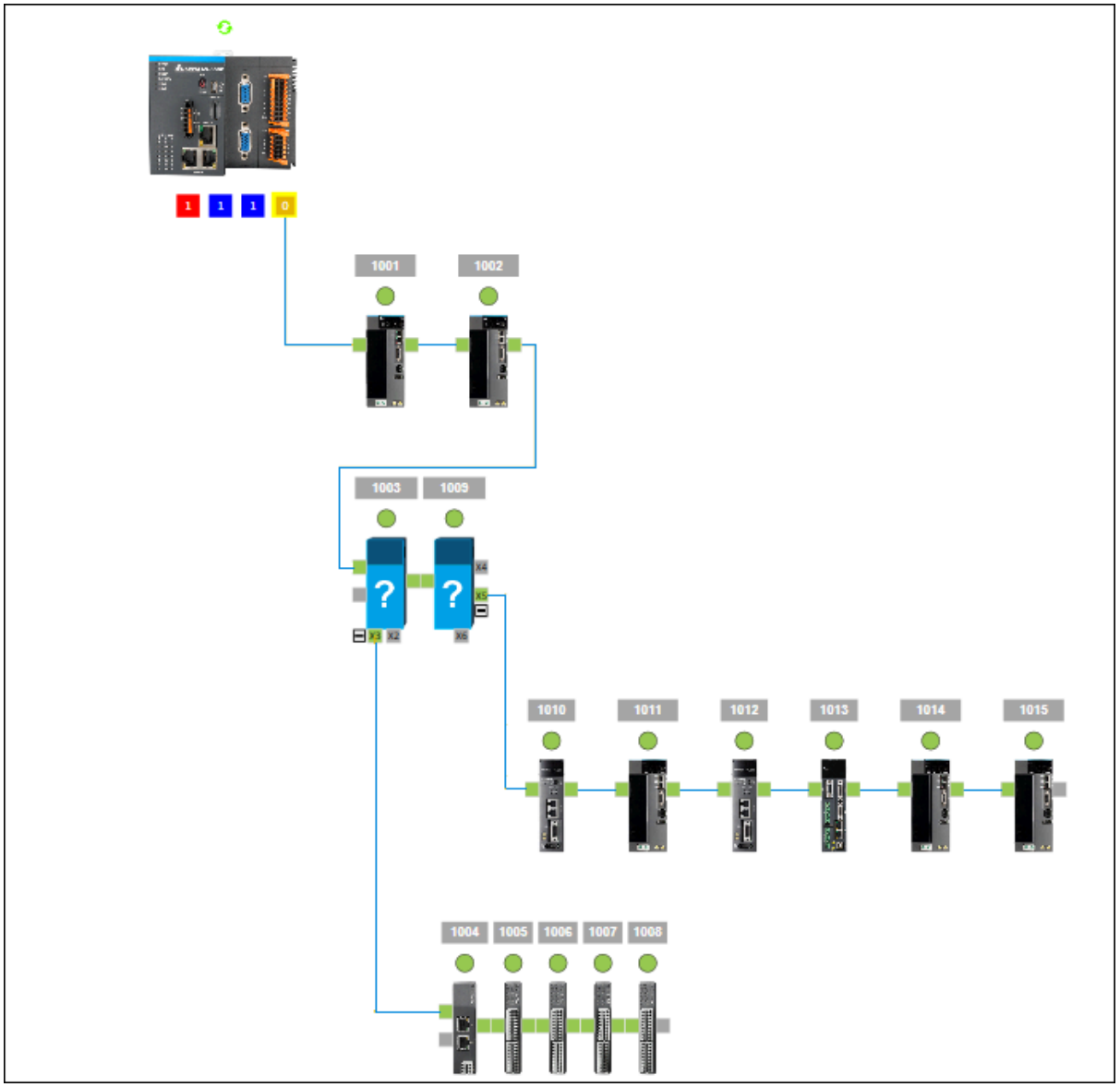


Note: If a device has a hard error, the following devices connected will all be in the hard error status. In this case, you must check and fix all the hard errors from the first device.

Scenario 2: Networking succeeded

The devices in the project tree match the physical devices.

Example:

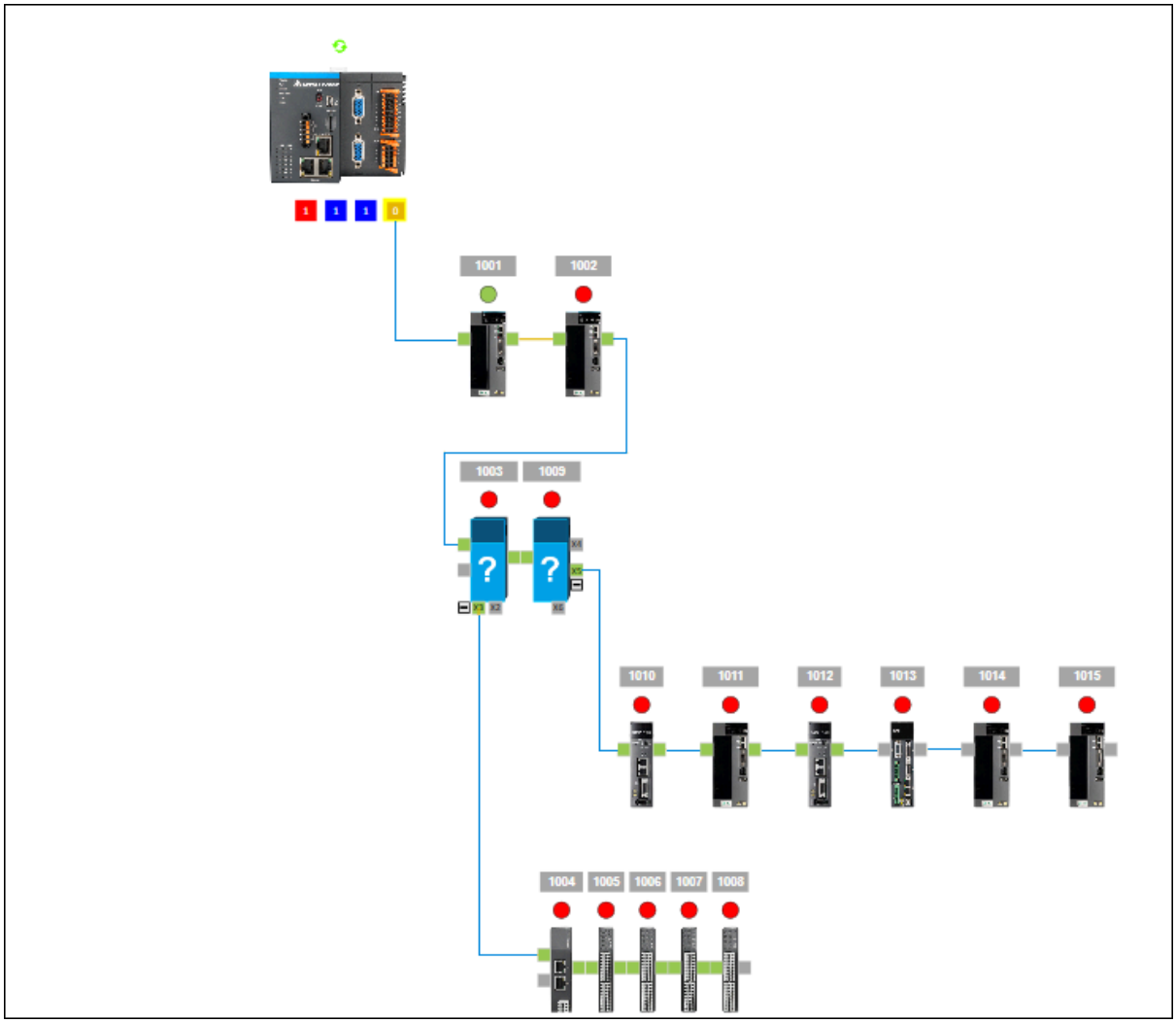


Scenario 3: Unplug the cable and plug it back

In the successful network, unplug the cable of a slave device and plug it back. Check the diagnosis result of the two situations.

- Unplug the cable of a device.

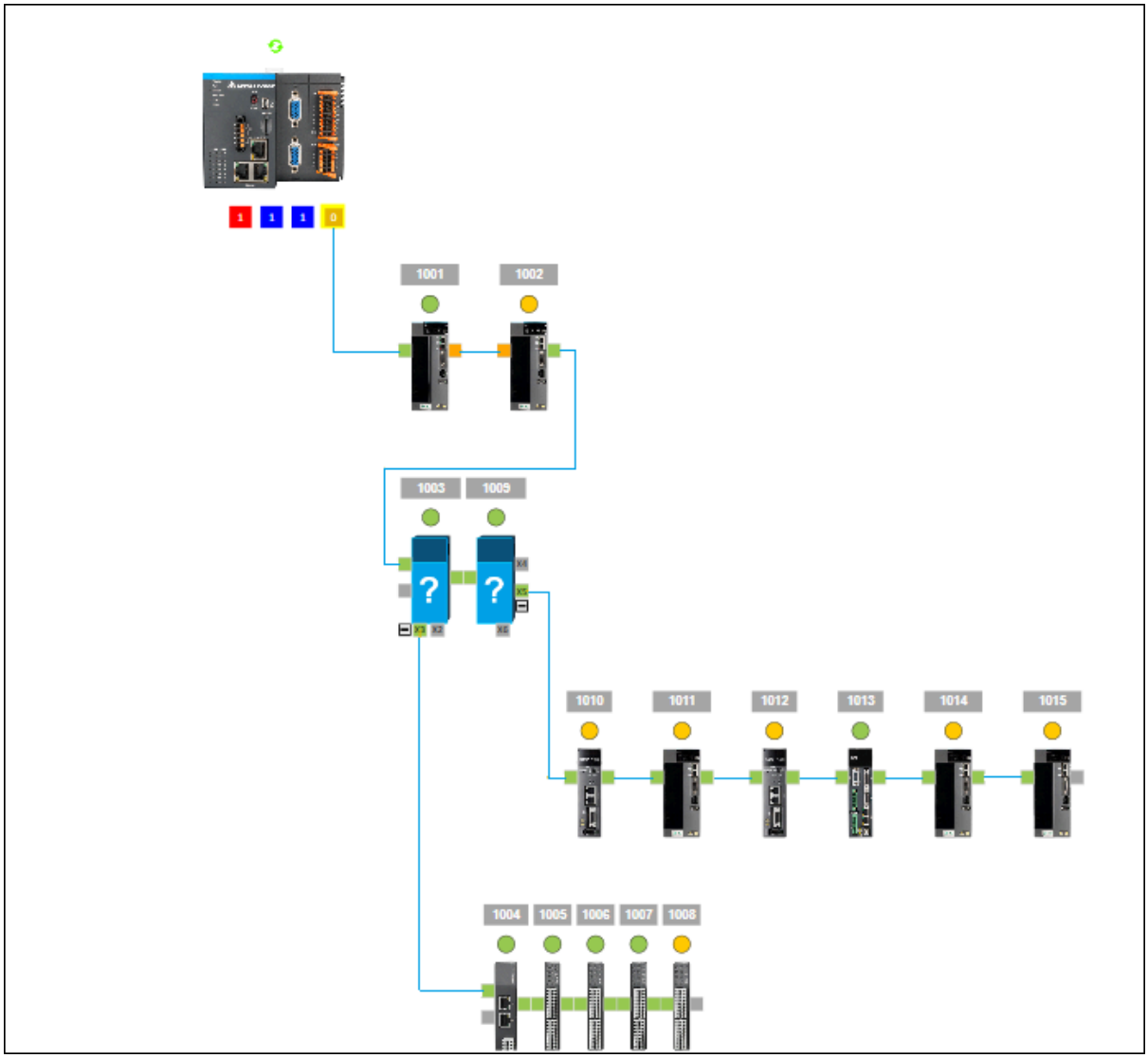
Example:



Note: In this scenario, the disconnected devices and devices connected to it will be in a hardware error state. The port of the first device will turn gray first, and the following devices need to wait for a few seconds to turn gray.

- Plug the cable back and diagnose again.

Example:



Note: In this scenario, some ports are green while some are orange. The orange port indicates that the link has been lost before (Lost link is not 0).

6.1.2.2.4 Set up Alias Address for the Slave Device

In **EtherCAT Topology**, the device address shows on the top of the device. You can use the following steps to change the address to an alias address.

To set up the alias address

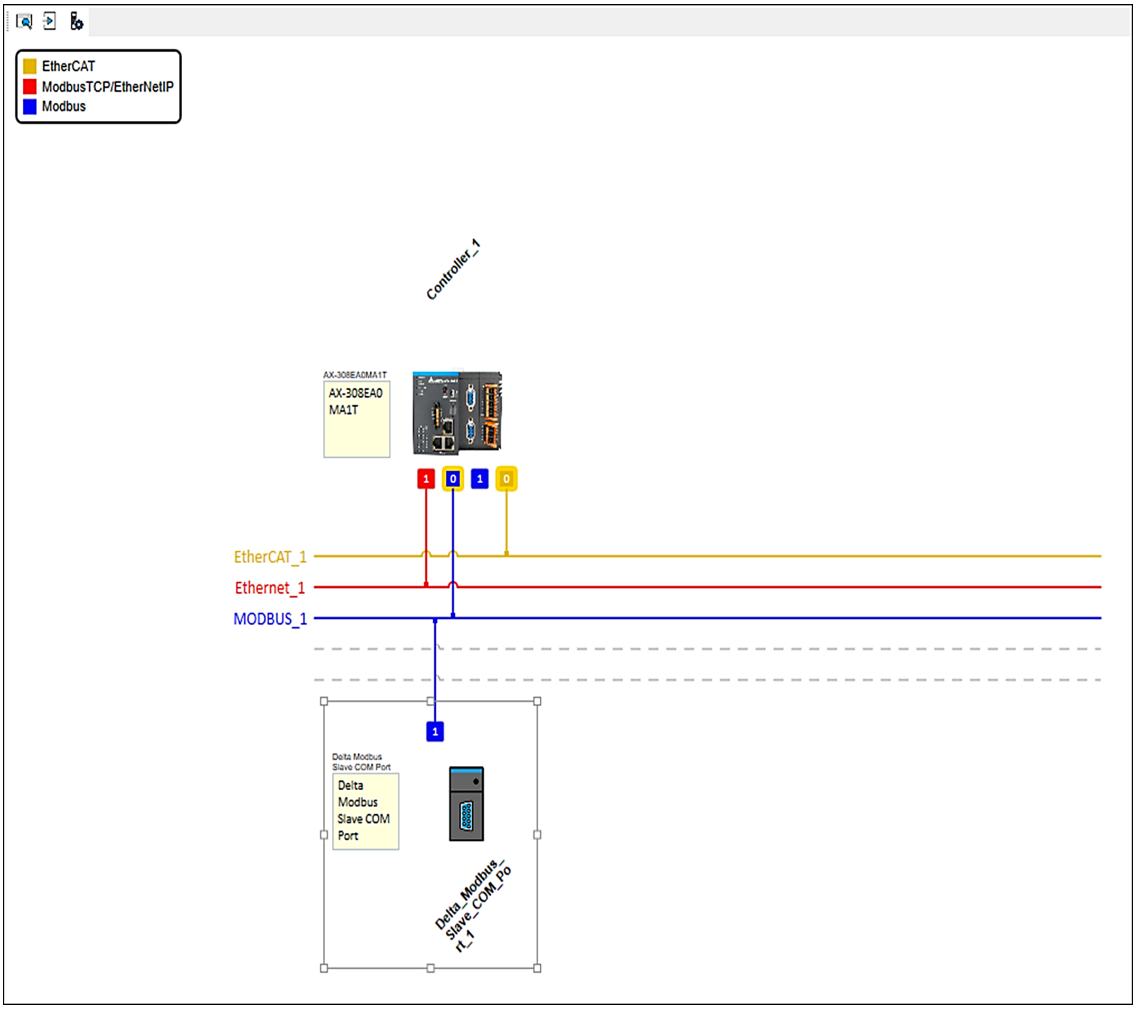
1. Double-click the slave device to open its configuration page.
2. On the **General** tab, select **Expert settings** or **Optional** to show the **Identification** settings.
3. Select **Configure station alias** and then enter or select an alias address.

6.1.3 Set up Modbus Topology

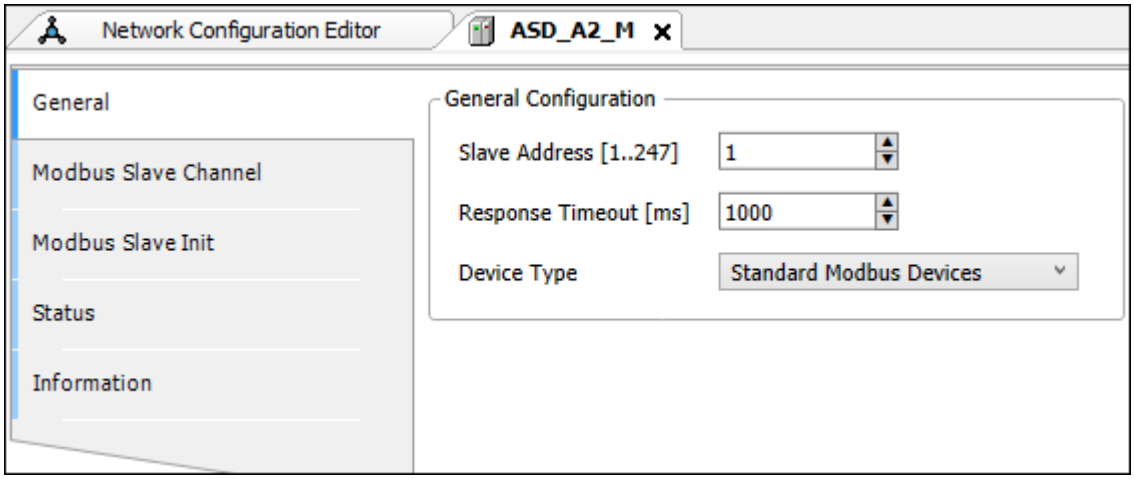
Use the following steps to set up Modbus Topology.

To set up Modbus Topology

1. On the **Devices** pane, double-click **Network Configuration**.
2. In **Product List**, select **Fieldbuses** > **Modbus** > one of the devices.
3. Drag the device to **Network Configuration Editor**.
4. Connect the slave device to the Modbus line.



5. Right-click the controller and then select **Set As Master/Scanner > Port x : Modbus** to set the controller as Modbus master.
6. Double-click the slave device to open the parameter page to set Modbus parameters.



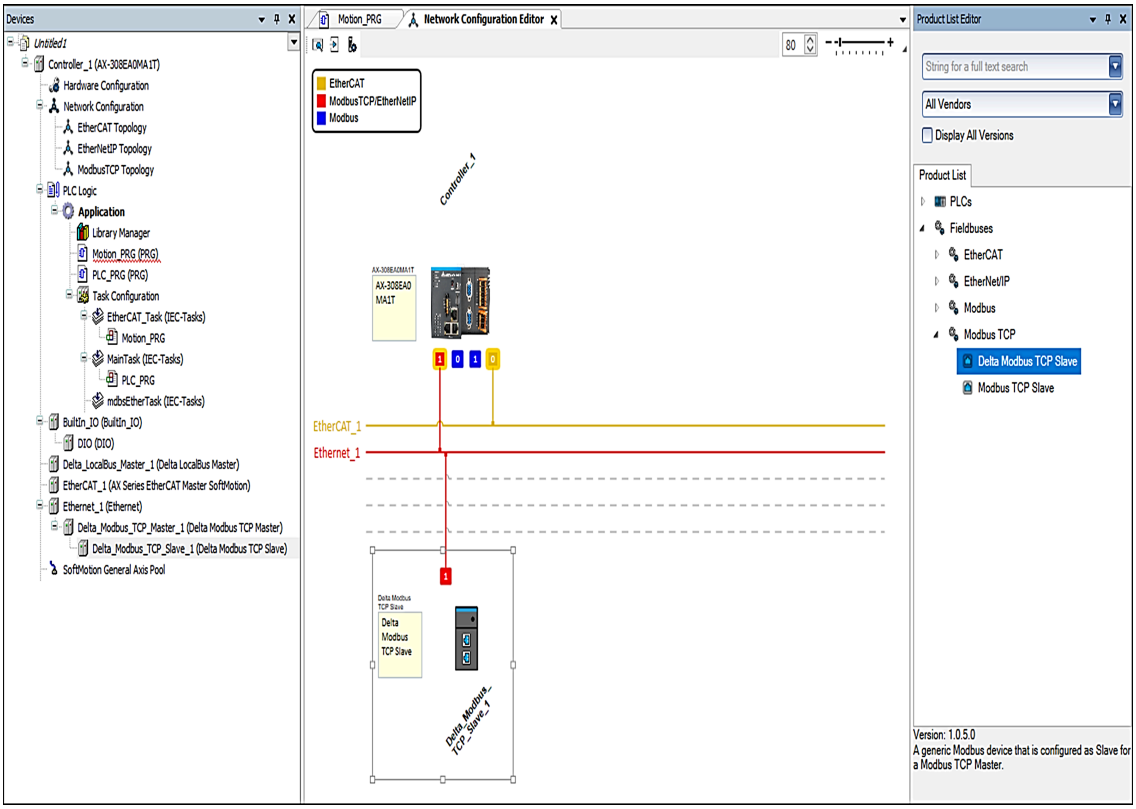
For more information, see Modbus COM Settings.

6.1.4 Set up Modbus TCP Topology

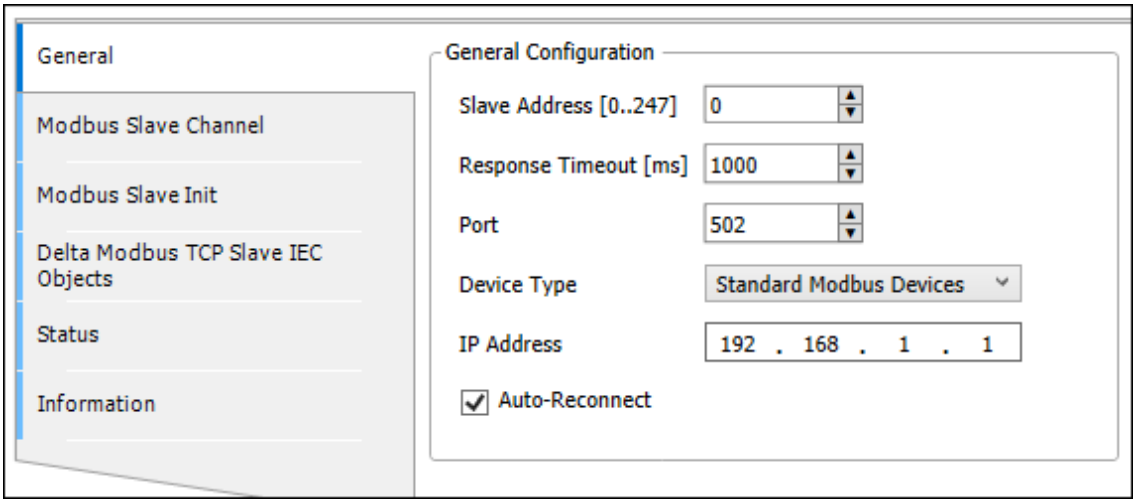
Use the following steps to set up Modbus TCP Topology.

To set up Modbus TCP Topology

1. On the **Devices** pane, double-click **Network Configuration**.
2. In **Product List**, select **Fieldbuses** > **Modbus TCP** > one of the devices.
3. Drag the device to **Network Configuration Editor**.
4. Connect the slave device to the Modbus TCP line.
5. Right-click the controller and then select **Set As Master/Scanner > Port x : ModbusTcp** to set the controller as Modbus TCP master.



6. Double-click the slave device to open the parameter page to set Modbus TCP parameters.



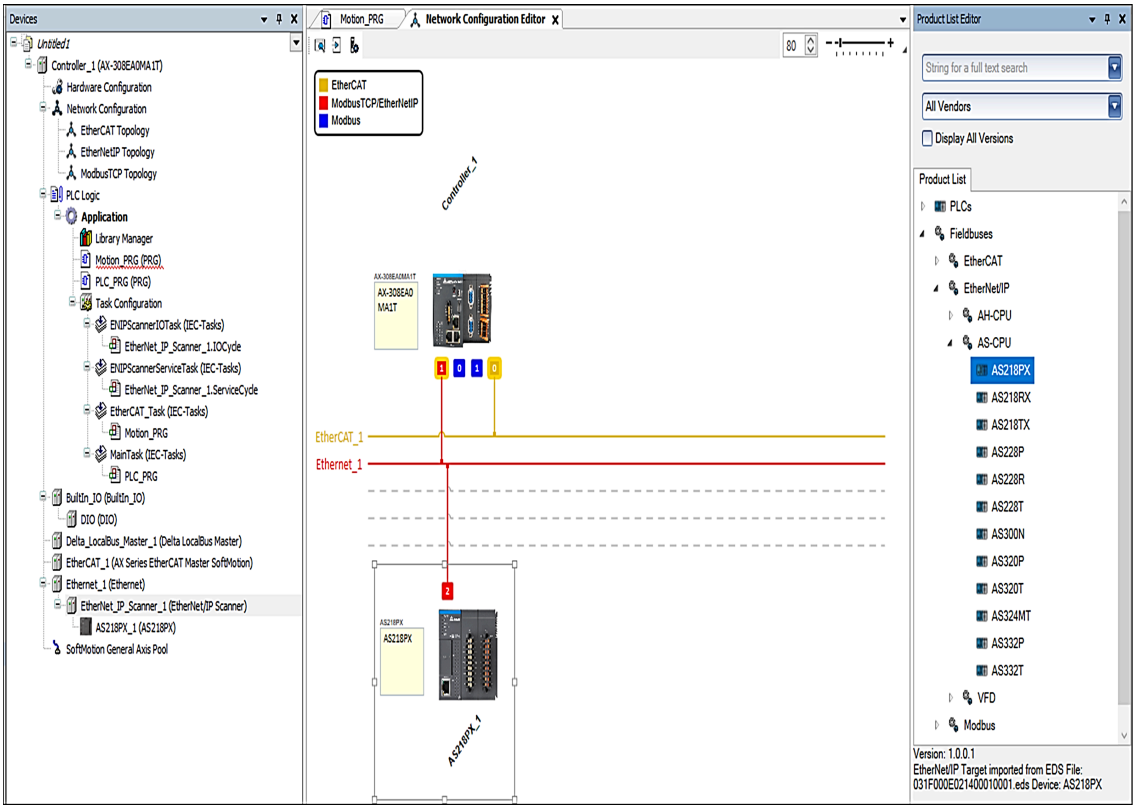
For more information, see Modbus TCP Settings.

6.1.5 Set up EtherNet/IP Topology

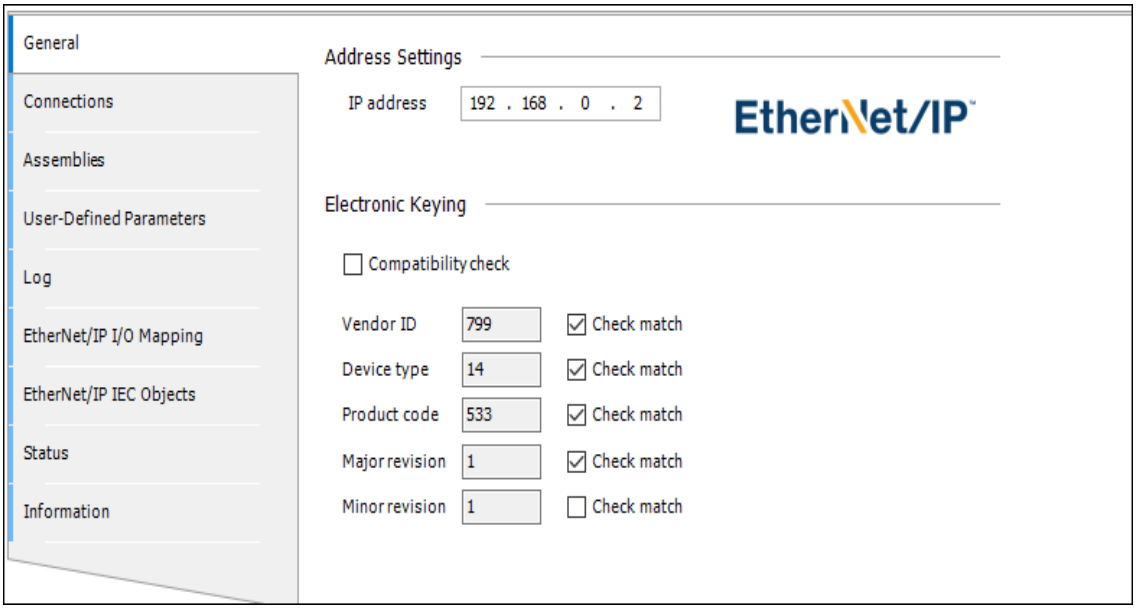
Use the following steps to set up EtherNet/IP Topology.

To set up EtherNet/IP Topology

1. On the **Devices** pane, double-click **Network Configuration**.
2. In **Product List**, select **Fieldbuses** > **EtherNet/IP** > one of the devices.
3. Drag the device to **Network Configuration Editor**.
4. Connect the slave device to the **EtherNet/IP** line.
5. Right-click the controller and then select **Set As Master/Scanner > Port x : EtherNet/IP** to set the controller as EtherNet/IP master.



6. Double-click the slave device to open the parameter page to set EtherNet/IP parameters.

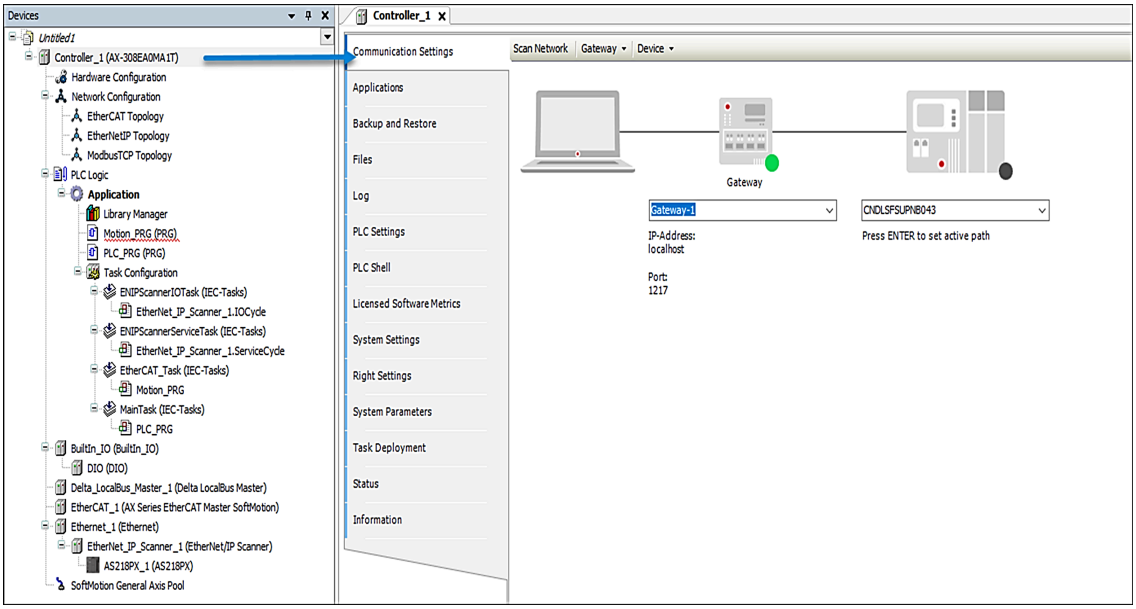


For more information, see EtherNet/IP Settings.

6.2 Communication Setting

How do I open the **Communication Settings** tab?

- On the **Devices** pane, double-click the controller and then go to **Communication Settings**.



The following table lists the functions and descriptions on the **Communication Settings** tab.

Function	Description
Scan Network	Click to open the **Select Device** dialog that lists all configured gateways and related devices. Select the target device from the list to connect.
Gateway	• **Add New Gateway**: Click to open the **Gateway** dialog to add a new gateway channel. • **Manage Gateways**: Click to open the **Manage Gateways** dialog with an overview of all gateways. You can add, delete gateways, or change their order. • **Configure the Local Gateway**: Click to open the **Gateway Configuration** dialog to configure the block drivers for the local gateway.
Device	• **Options** ◦ **Add Current Device to Favorites**: Select to add the current device to the list of favorite devices. ◦ **Manage Favorite Devices**: Select to open the **Manage Favorite Devices** dialog. You can add, delete favorite devices, or change their order in the list. The first one is the default device. ◦ **Filter Network Scans by Device ID**: Select to only display devices with the same target ID when clicking **Scan Network**. ◦ **Confirmed Online Mode**: For security reasons, select to show a confirmation dialog when calling the following online commands: Force Values, Write Values, Unforce All Values, Single Cycle, Start, Stop.

Function	Description
	◦ **Store Communication Settings in Project**: Select to save the communication settings in the project for reuse on the same computer. **Note:** If you use the project on another computer, then you need to reset the active path. • **Rename Active Device**: Click to open the **Change Device Name** dialog to change the name of the currently connected device. • **Wink Active Device**: Select to wink the active device. • **Send Echo Service**: Select to send five echo services to the controller to test the network connection. The services are sent first without a payload and then with a payload. The scope of the payload depends on the communication buffer of the controller. • **Encrypted Communication**: Select to encrypt the communication to this controller. After encrypted, a certificate of the controller is required to log in to the controller. This function is unavailable if you select **View** >**Security Screen** > **Enforce encrypted communication**.

6.2.1 Connect to a Controller

After setting up the communication, connect to the controller where the application should run.

To connect to a controller

1. On the **Communication Settings** tab, click **Scan Network**.
2. In the **Select Device** dialog, select the controller to connect and then click **OK**.

Or

1. Enter the target controller IP address (Example: 192.168.101.109), device address (Example: [056D]), or device name (Example: My Device).
2. Press **Enter**.

> **Note:** Searching by device name requires a unique name in the network.

6.2.1.1 Connection Status

After logging in to the controller, you can view the connection status of the device on the left side of the device in the project tree.

- : The device is connected and the application is running. Data exchanges if **Update I/O while in stop** on the **PLC Settings** tab is selected.
- : The application is not running.
- : There were errors but are fixed now.
- : The device is in preoperative mode and is not running yet. Diagnostic information is available.
- : The device is not exchanging data; bus error, no configuration, or simulation mode.
- : The device is running in demo mode for 30 minutes. After 30 minutes, the demo mode will end and the fieldbus will end the data exchange.
- : The device is configured but not operational. No data exchanges.

-  : Redundancy mode is active. The fieldbus master is not sending any data because another master is active.
-  : The device is running, but its child device is not. The child device is not visible due to the collapsed device tree.

6.2.2 Modbus COM Settings

Use the following steps to add Modbus COM.

To add Modbus COM

1. On the **Devices** pane, right-click the controller, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus Serial Port** > **Delta Modbus COM** (or **Modbus COM**).
3. Click **Add Device**.

6.2.2.1 Delta Modbus COM

How do I open the **Delta Modbus COM** page?

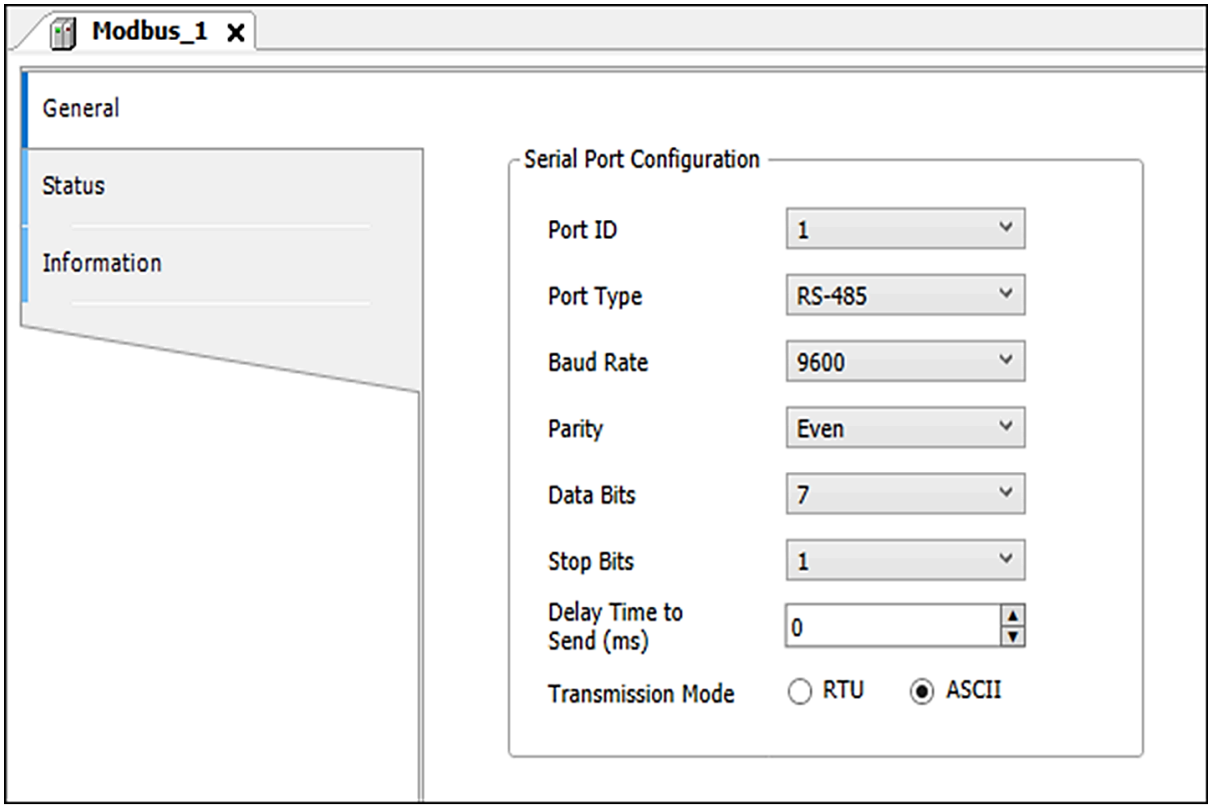
- On the **Devices** pane, double-click **Modbus_X**.

Supported controller:

- AX-3
- AX-5
- AX-C
- AX-864E30CE2T, AX-864E30ME2T, AX-8H1E30CD2T, AX-8H1E30CD2P

The following table lists the settings and descriptions of Delta Modbus COM.

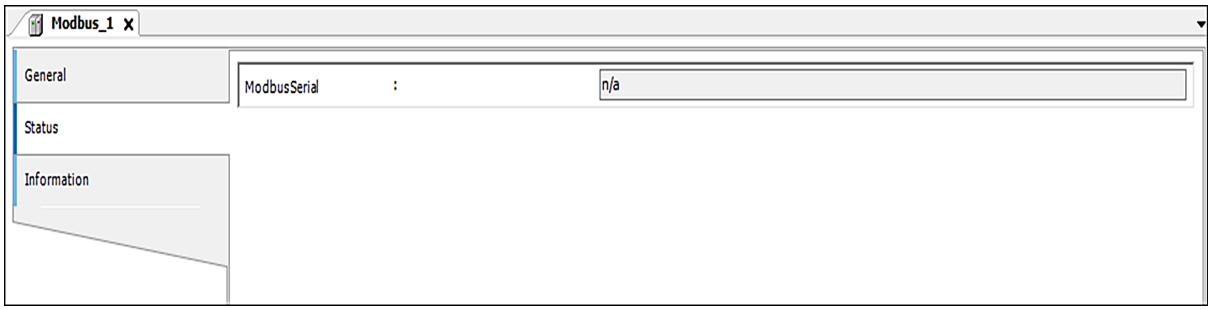
General



Setting	Description
Port ID	Select a port ID.
Port Type	Select RS-232 or RS-485 port.
Baud rate	Select the tandem transmission rate (in bits/second).
Parity	Select the parity bit usage in the communication packets.
Data Bits	Select the number of bits of data per character. For the AX-C controller, **7** is not available for **None Parity**.
Stop Bits	Select the number of stop bits per character.
Delay Time to Send (ms)	Select or enter the time to delay packet sending.
Transmission Mode	Select the mode of transmission.

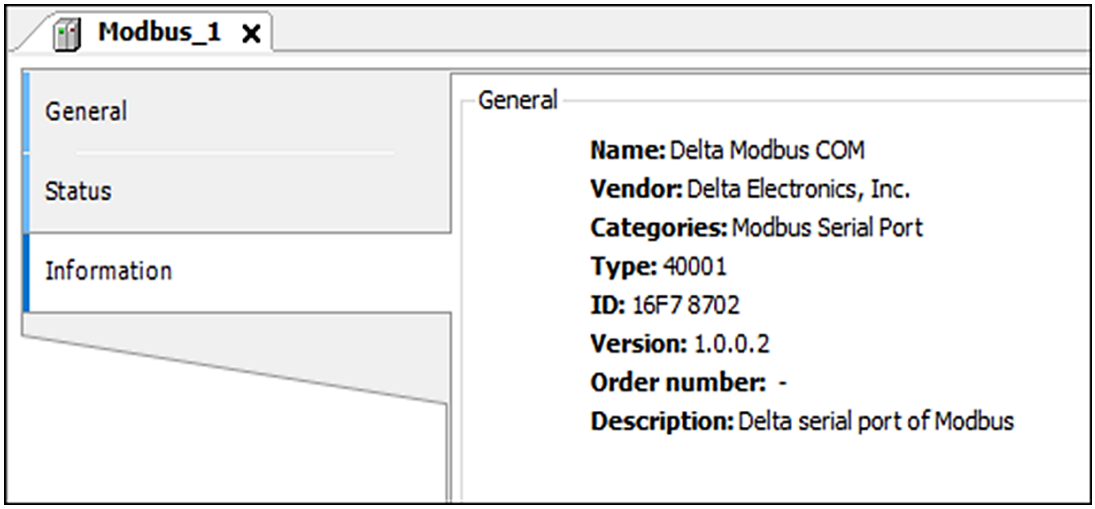
Setting	Description
	• **RTU**: Transmission in binary. • **ASCII**: Transmission in ASCII code (currently not supported by all drivers).

Status



Shows the status of the Delta Modbus COM serial port.

Information



Shows the general information of Delta Modbus COM.

6.2.2.1.1 Delta Modbus Master COM Port

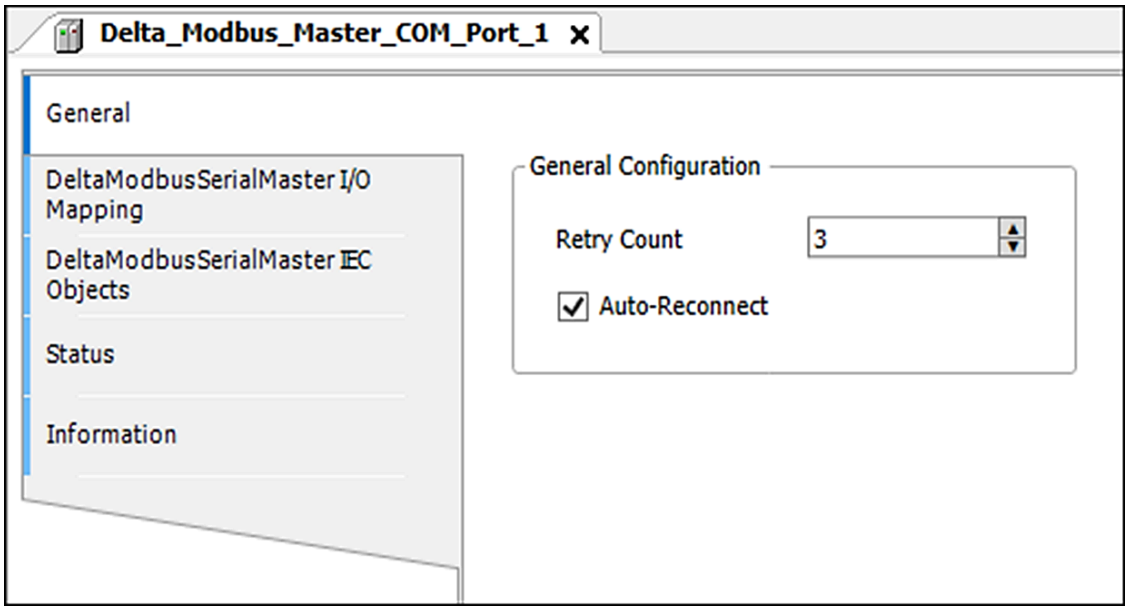
How do I open the **Delta Modbus Master COM Port** page?

1. On the **Devices** pane, right-click **Modbus_X**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus Serial Master** > **Delta Modbus Master COM Port**, and then click **Add Device**.
3. On the **Devices** pane, double-click **Delta Modbus Master COM Port_X**.

Use the settings in the **Delta Modbus Master COM Port_X** page to configure the port when the controller is used as the Modbus master station.

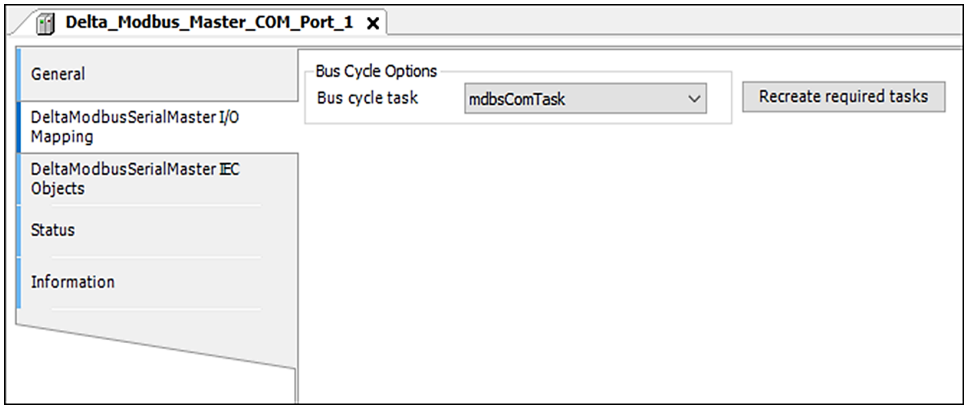
The following table lists the settings and descriptions of Delta Modbus Master COM Port.

General



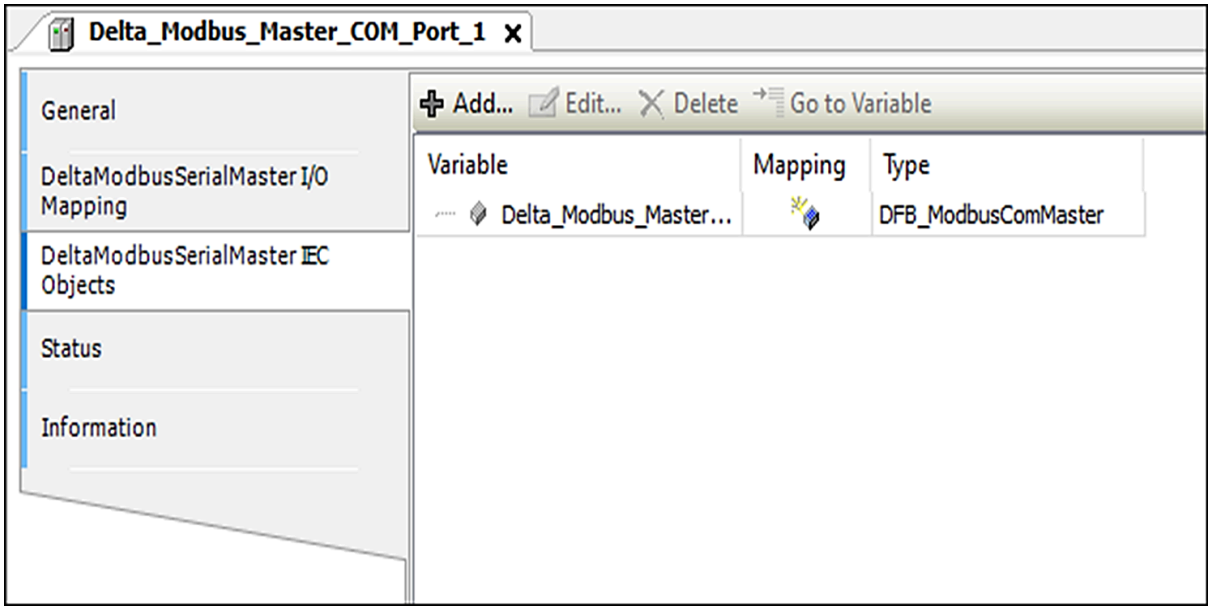
Setting	Description
Retry Count	Select or enter the number of times of COM Port re-communication.
Auto-Reconnect	Select to automatically confirm the error and attempt to continue running the ModbusModbus command after an error occurs.

Delta Modbus Serial Master I/O Mapping



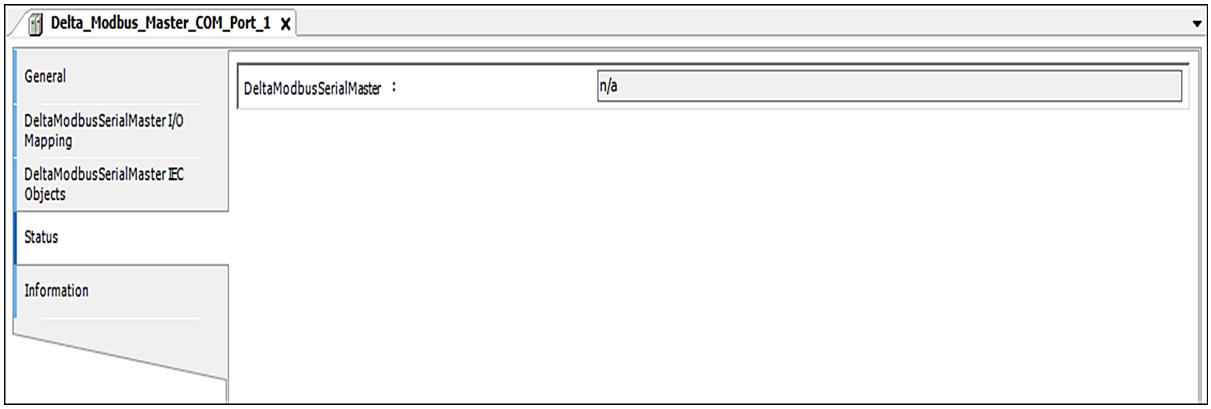
Setting	Description
Bus cycle task	Select a bus cycle task to synchronize with the Modbus communication time.
Recreate required task	Click to create a ModbusModbus COM task.

Delta Modbus Serial Master IEC Objects



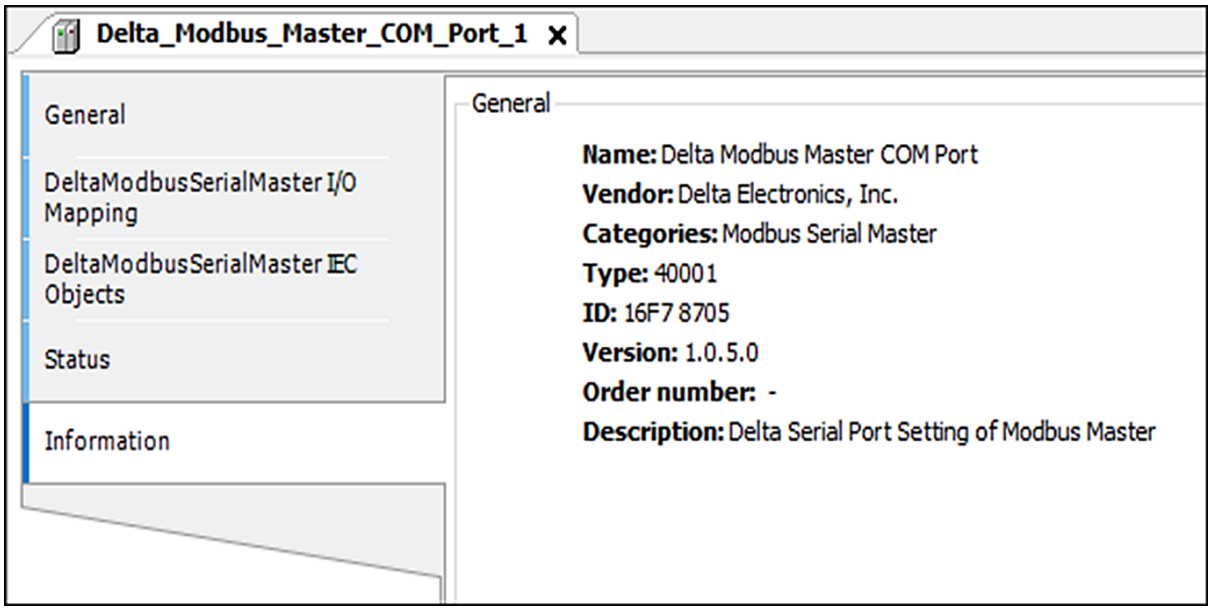
Configure the variable information of Delta Modbus Master COM Port. In the online mode, this is used as the monitoring view.

Status



Shows the execution status of Delta Modbus Master COM Port.

Information



Shows the general information of Delta Modbus Master COM Port.

Note:

- Each ModbusModbus Serial Port can add one ModbusModbus Master COM Port, and each ModbusModbus Master COM Port can add 32 ModbusModbus Slave COM Ports.
- Up to 32 Modbus Slave COM Port with RS232 can be added. RS232 only supports 1-to-1 communication, so only the first Modbus Slave COM Port can be used. RS485 is without this limitation.

6.2.2.1.2 Delta Modbus Slave COM Port

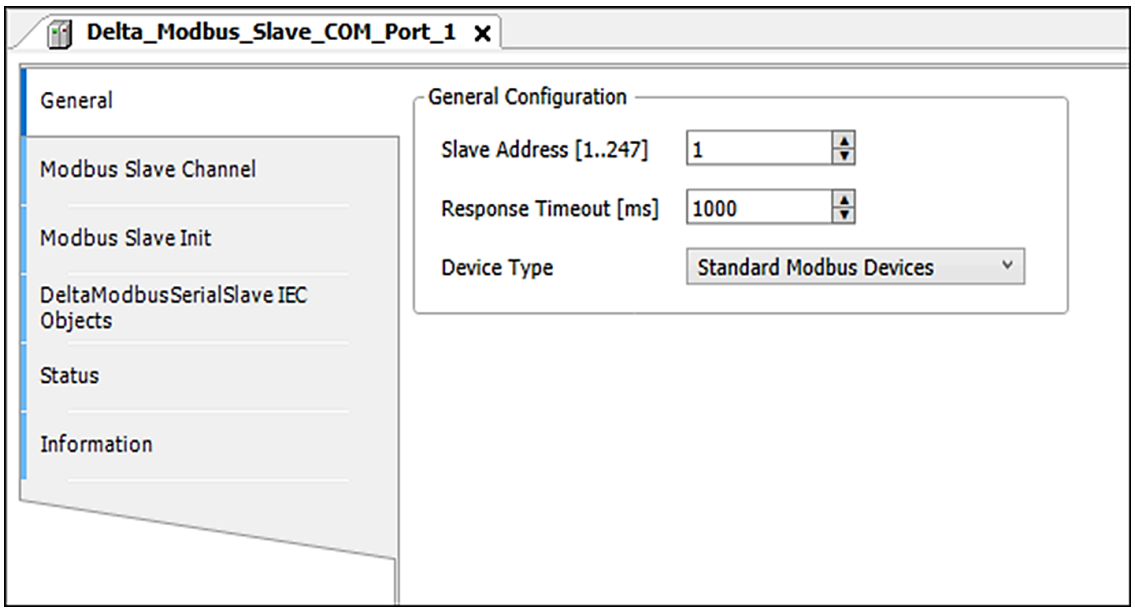
How do I open the **Delta Modbus Slave COM Port** page?

1. On the **Devices** pane, right-click **Delta Modbus Master COM Port_X**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus Serial Slave** > **Delta Modbus Slave COM Port**, and then click **Add Device**.
3. Double-click **Delta Modbus Slave COM Port_X**.

Use the settings in **Delta Modbus Slave COM Port_X** page to configure the slave station to be connected when the controller is used as the Modbus master station.

The following table lists the settings and descriptions of Delta Modbus Slave COM Port.

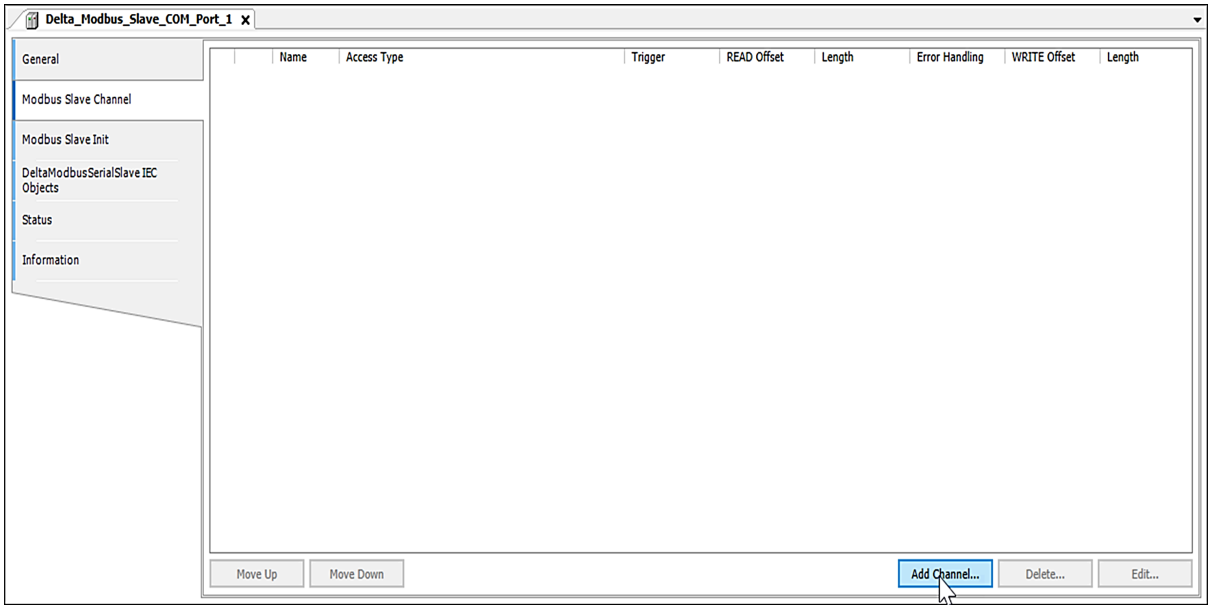
General



Setting	Description
Slave Address [1..247]	Select or enter the slave station number.
Response Timeout [ms]	Select or enter the time interval for the master to wait for the response from a slave node. This is configured especially for this slave node and overwrites the general response timeout setting of the respective master.

Setting	Description
Device Type	Select the device type. You can select standard Modbus devices or Delta devices. If you select Delta devices, the system converts the protocol into Modbus protocol automatically so that you do not need to see the register map for the conversion.

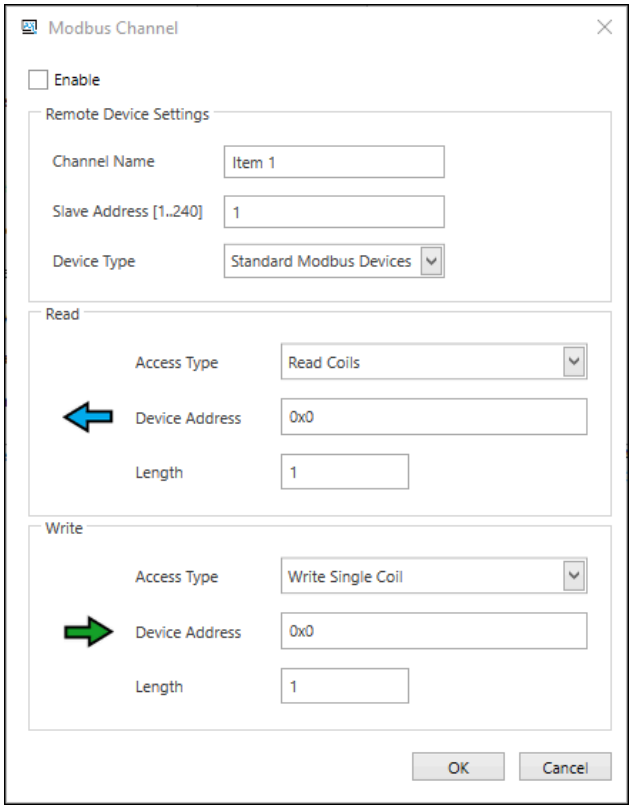
Modbus Slave Channel



Add slave channels. Each channel represents a single Modbus request. You can create up to 10 channels for each slave. The controller will send out Modbus request packets in the chronological order. All channels share the same Modbus connection.

Click **Add Channel** to open the **Modbus Channel** dialog. The following table lists the settings and descriptions.

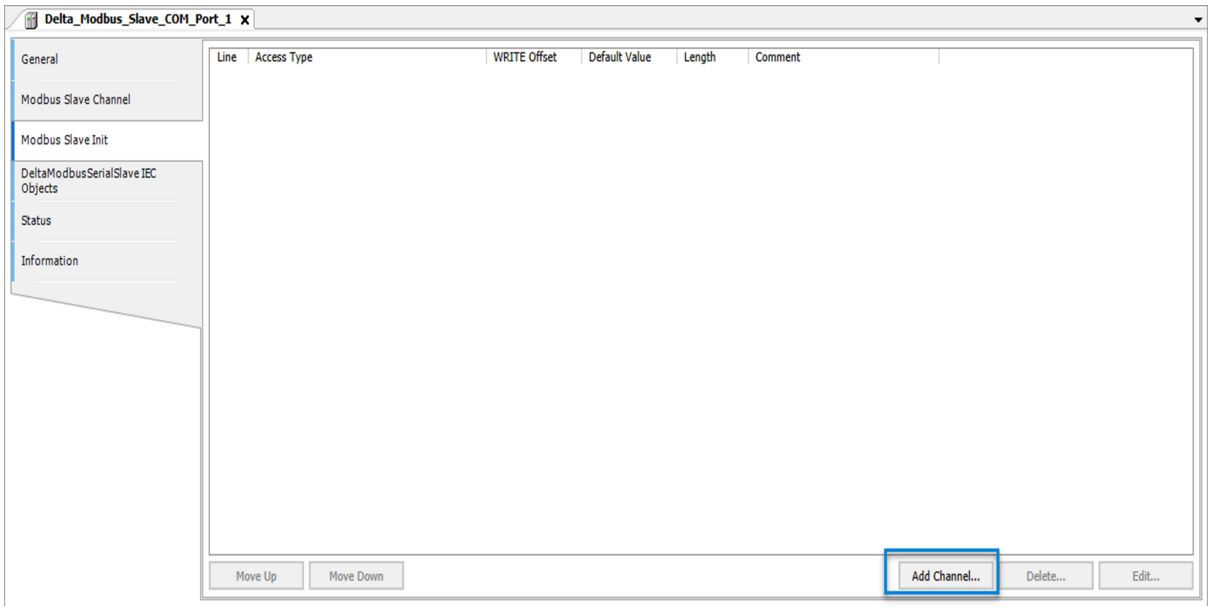
Modbus Channel



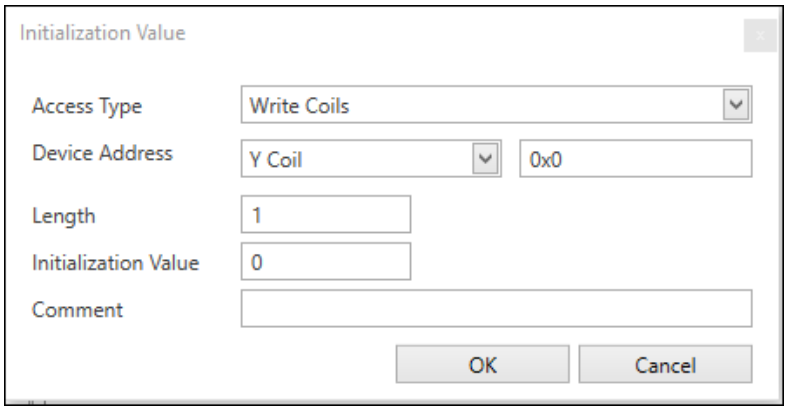
Setting	Description
Enable	Select to turn on the data exchange channel.
Name	Enter the name of the channel.
Access Type	Select the access type.
Trigger	Select the trigger. • Cyclic: The request occurs periodically according to the cyclic time set. • Rising edge: The request occurs as a reaction to a rising edge of the Boolean trigger variables. The trigger variable is defined in the I/O Mapping. • Application: The request is triggered by the Modbus COM Channel function block.
Comment	Enter notes for the channel.
Device Address	Enter the device address in the hexadecimal format.

Setting	Description
Length	Enter the word length that reads or writes from or to the register. The value varies with different **Access Type** and **Device Address**.
Error Handling	Select the option when communication error occurs.

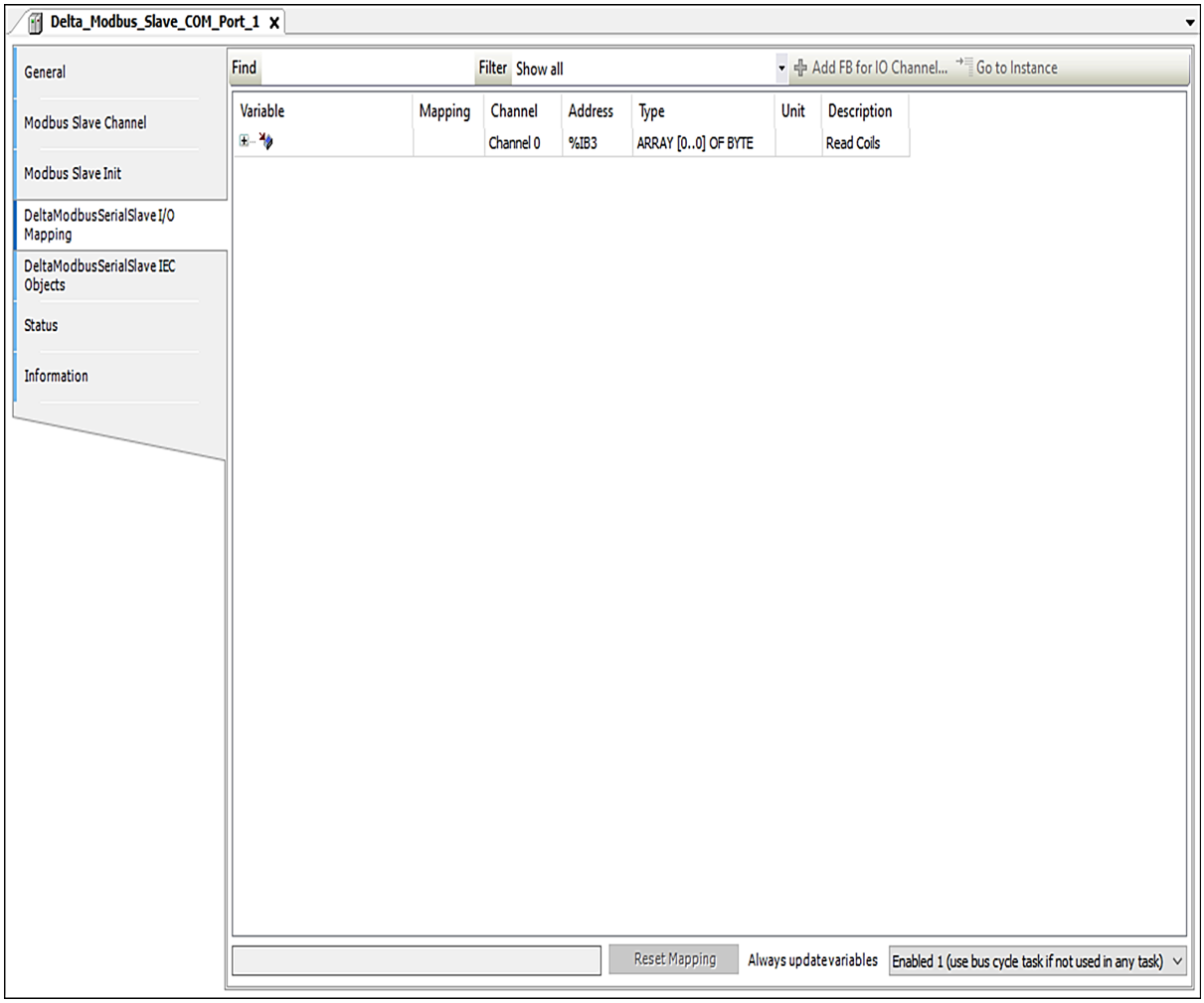
Modbus Slave Initialization



After the Modbus connection between the controller and the slave devices is established, you can click **Add Channel** to edit the **Initialization Value** of the Coil or Register.

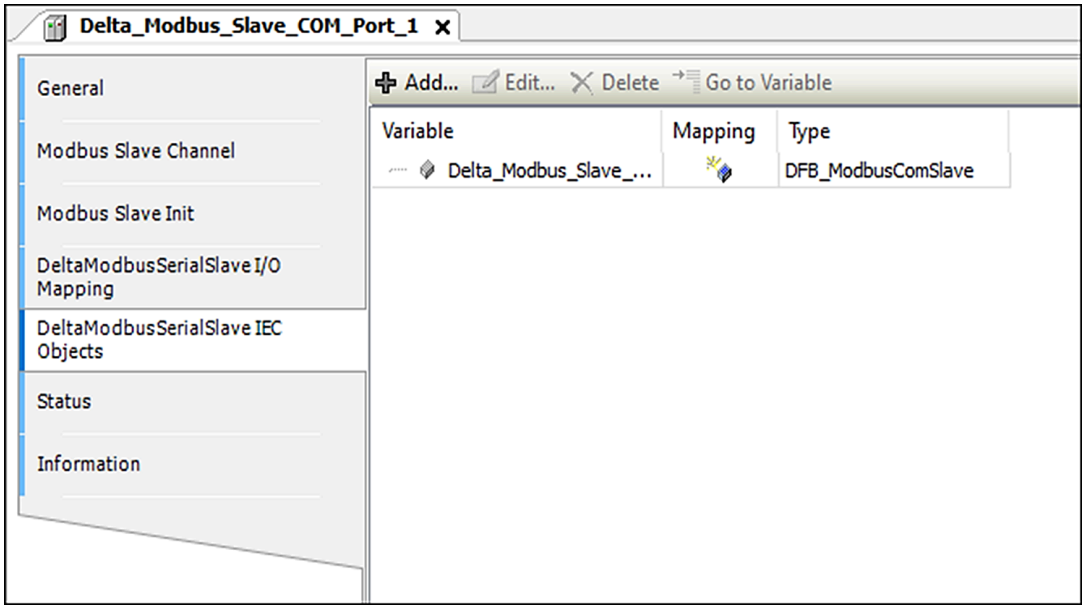


Delta Modbus Serial Slave I/O Mapping



Set the mapping variable after the Modbus Slave Channel is added.

Delta Modbus Serial Slave IEC Objects

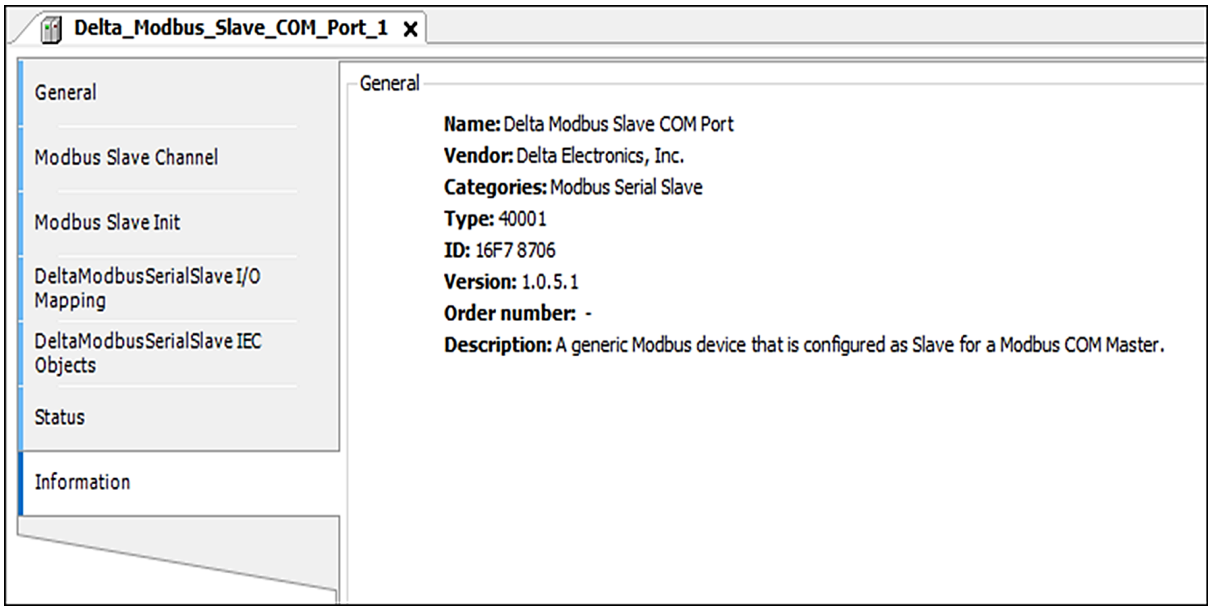


Shows the variable information of Delta Modbus Slave COM Port.

Status

Shows the execution status of Delta Modbus Slave COM Port.

Information



The general information of Delta Modbus Slave COM Port.

6.2.2.1.3 Delta Modbus Serial Device

How do I open the **Delta Modbus Serial Device** page?

1. On the **Devices** pane, right-click **Modbus_X**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus Serial Device** > **Delta Modbus Serial Device**, and then click **Add Device**.

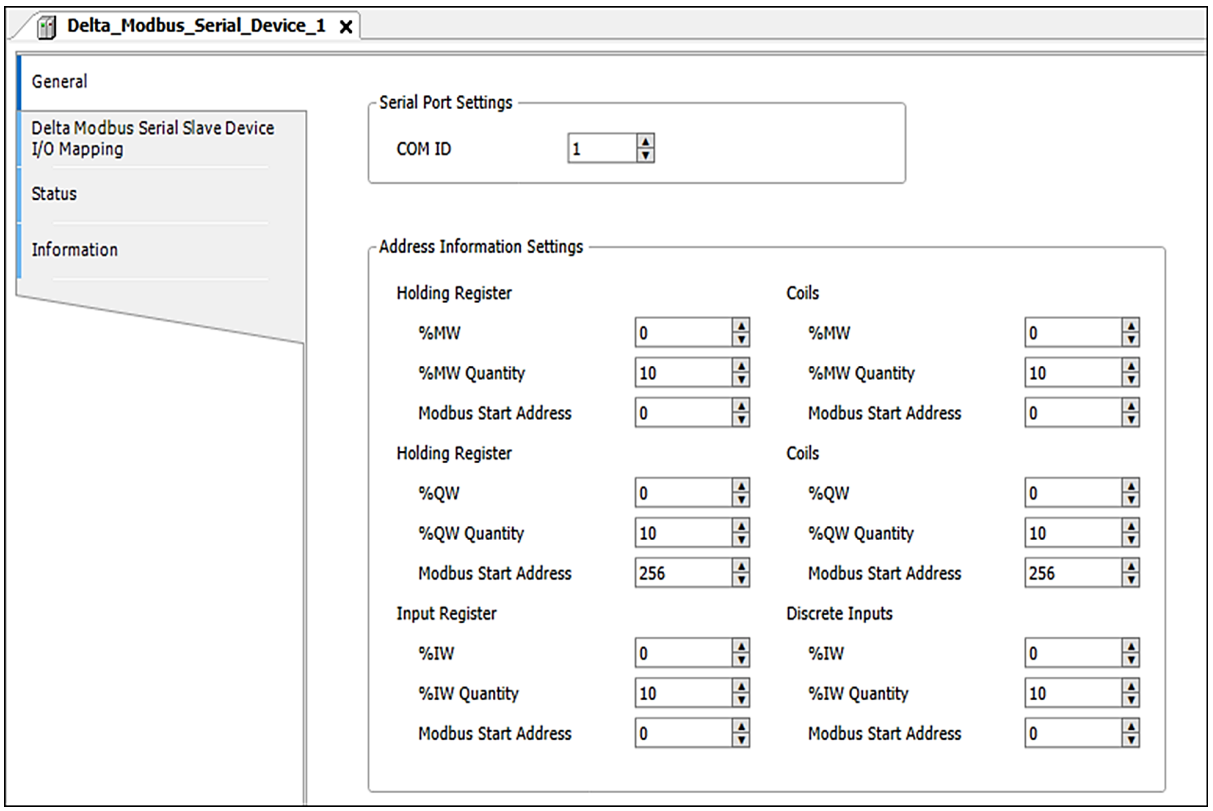
Note: If Delta Modbus Master COM Port is added, you need to delete it first then add Delta Modbus Serial Device.

3. On the **Devices** pane, double-click **Delta Modbus Serial Device_X**.

AX controllers can act as a Modbus Serial slave device after you add Delta Modbus Serial Device and configure the related settings.

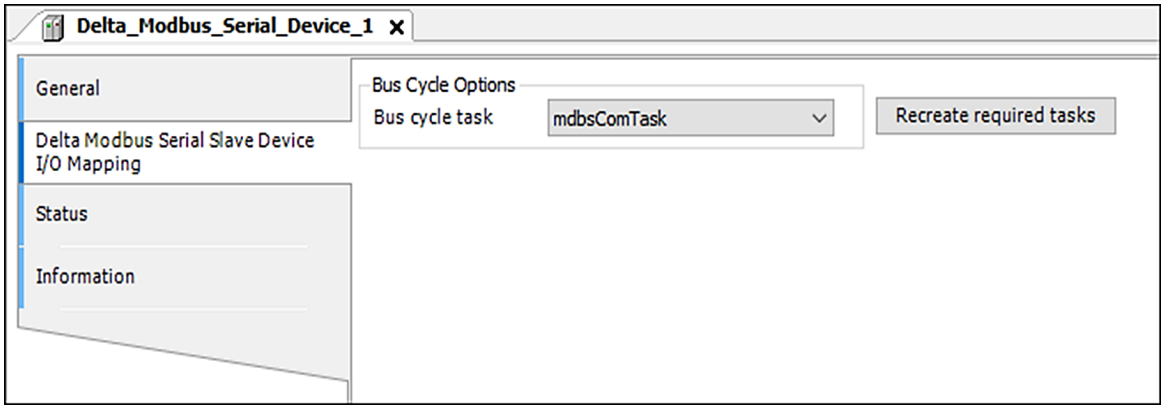
The following lists the settings and descriptions of Delta Modbus Serial Device.

General



Select and enter the station number of the controller and the allowed Coils or Registers section. If Modbus Serial Master uses Delta specific communication protocol, all sections can be accessed without restrictions.

Delta Modbus Serial Slave Device I/O Mapping

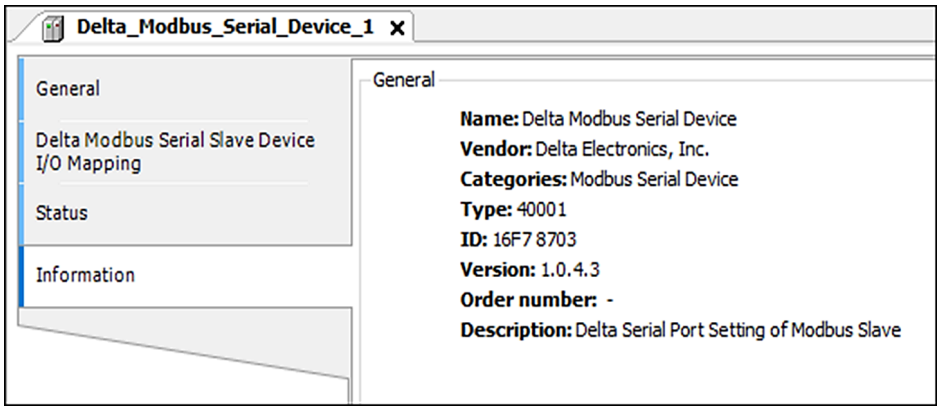


Setting	Description
Bus cycle task	Select a bus cycle task to synchronize with the Modbus communication time.
Recreate required task	Click to create a Modbus COM task.

Status

Shows the execution status of Delta Modbus Serial Device.

Information



Shows the general information of Delta Modbus Serial Device.

6.2.2.2 Modbus COM

How do I open the **Modbus COM** page?

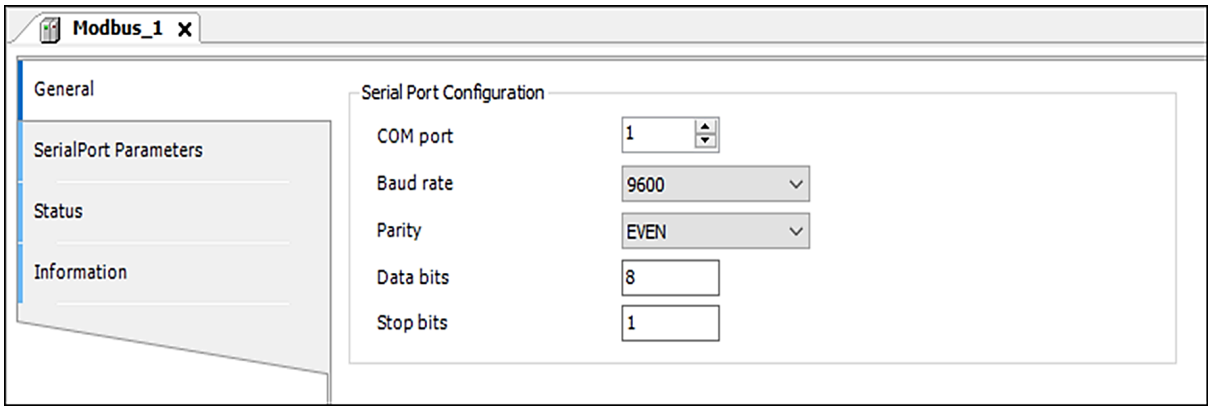
1. On the **Devices** pane, right-click the AX-8 controller, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus Serial Port** > **Modbus COM**, and then click **Add Device**.
3. On the **Devices** pane, double-click **Modbus_X** (**Modbus COM**).

Supported controller:

- AX-8 Windows Series
- AX-8 Linux Series

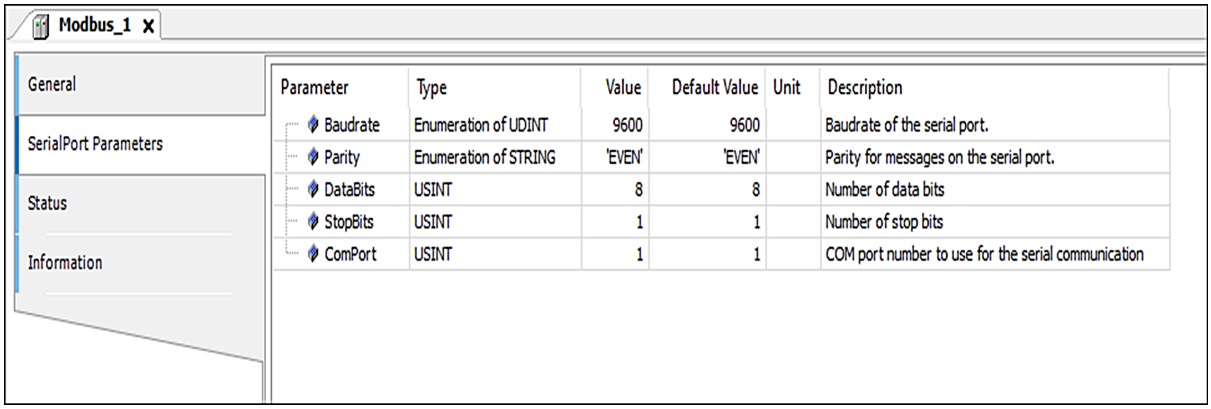
The following tables list the settings and descriptions of Modbus COM.

General



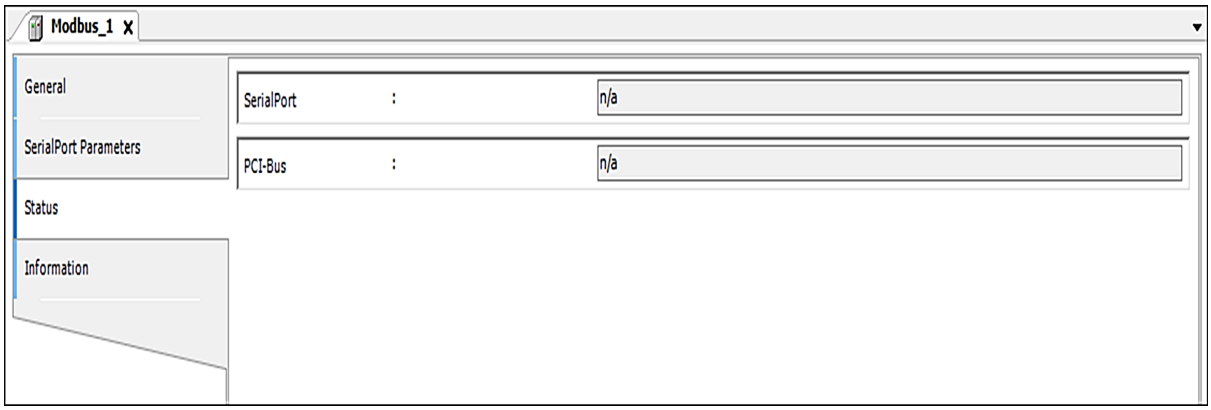
Setting	Description
COM port	Select or enter a port ID.
Baud rate	Select the baud rate (in bits/second).
Parity	Select the parity bit usage in the communication packets.
Data bits	Enter the number of bits of data per character.
Stop bits	Enter the number of stop bits per character.

Serial Port Parameters



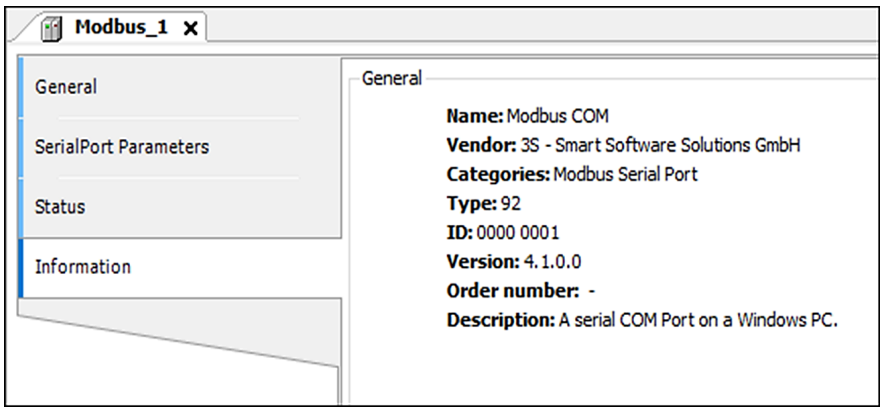
Edit the parameter information.

Status



Shows the status of the Modbus COM serial port.

Information



Shows the general information of Modbus COM.

6.2.2.2.1 Modbus Master COM Port

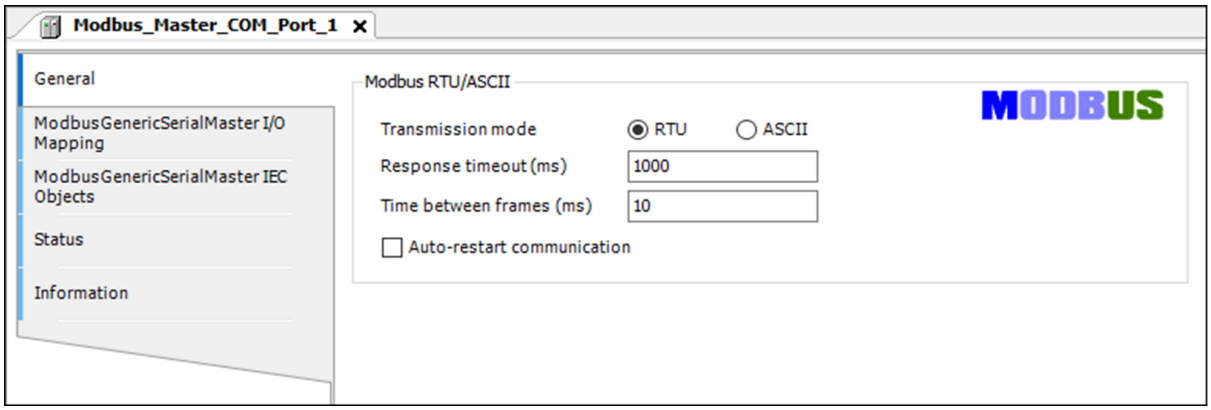
How do I open the **Modbus Master COM Port** page?

1. On the **Devices** pane, right-click **Modbus_X**(**Modbus COM**), and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus Serial Master** > **Modbus Master, COM Port**, and then click **Add Device**.
3. On the **Devices** pane, double-click **Modbus Master COM Port_X**.

Use the settings in **Modbus Master COM Port_X** page to configure the port when the controller is used as the Modbus master station.

The following table lists the settings and descriptions of Modbus Master COM Port.

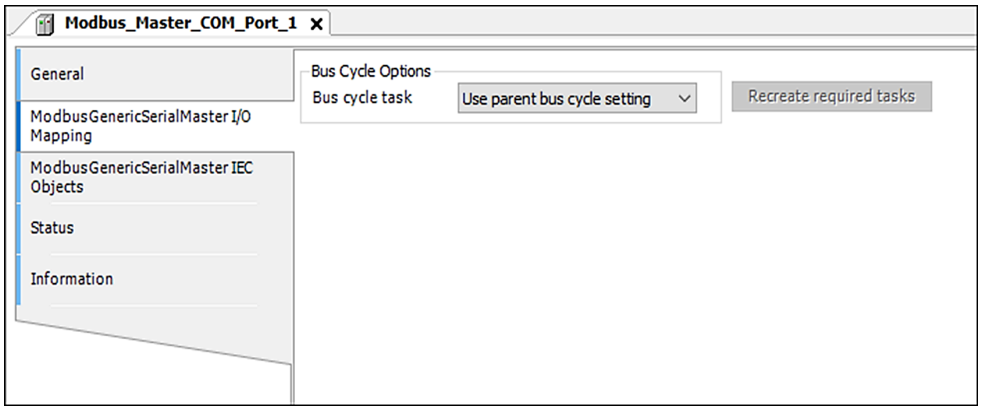
General



Setting	Description
Transmission mode	Select the mode of transmission. • **RTU**: Transmission in binary. • **ASCII**: Transmission in ASCII code (currently not supported by all drivers).
Response timeout (ms)	Enter the interval that the master waits for the answer from a slave. If the slaves do not answer within this interval, an error will be recorded for the implicit slave function block. The value entered for the time interval is also the default value for each slave if no specified value is set.

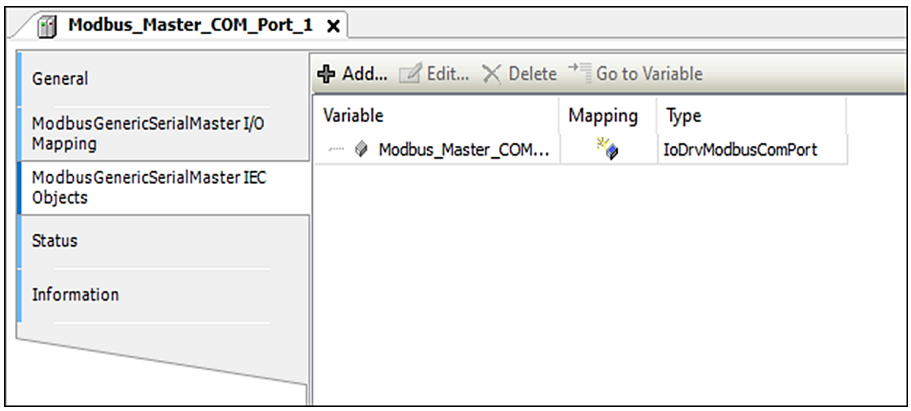
Setting	Description
Time between frames (ms)	Enter the master's pause sending time between the last response (and a timeout) and the next request. Use this parameter to make the communication less liable to disruption.
Auto-restart communication	Select to automatically confirm the error and restart the communication after an error occurs.

Modbus General Serial Master I/O Mapping



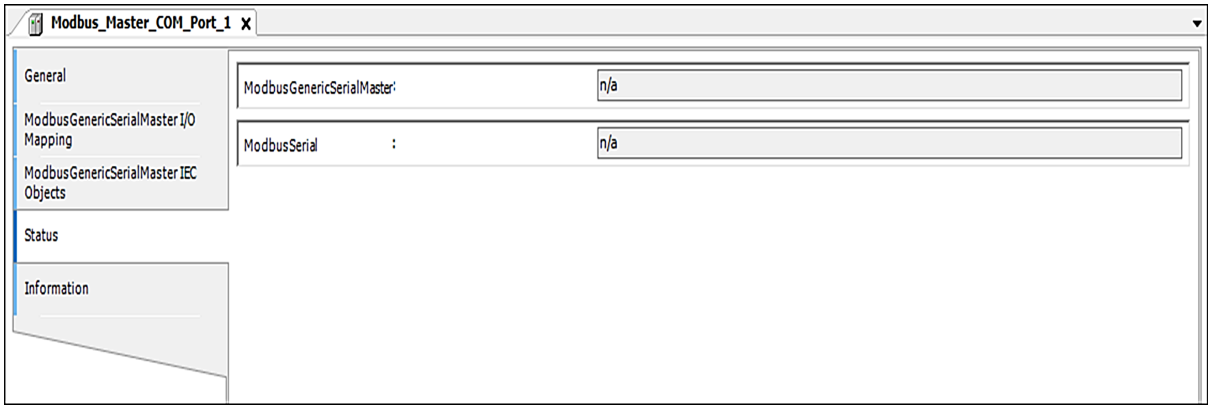
Setting	Description
Bus cycle task	Select a bus cycle task to synchronize with the Modbus communication time.

Modbus Serial Master IEC Objects



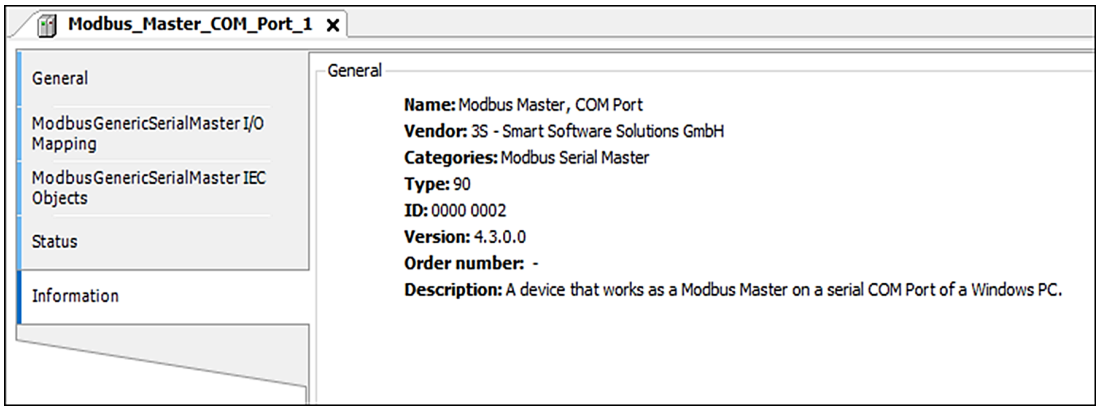
Show the variable information of Modbus Master COM Port.

Status



Shows the execution status of Modbus Master COM Port.

Information



Shows the general information of Modbus Master COM Port.

6.2.2.2.2 Modbus Slave COM Port

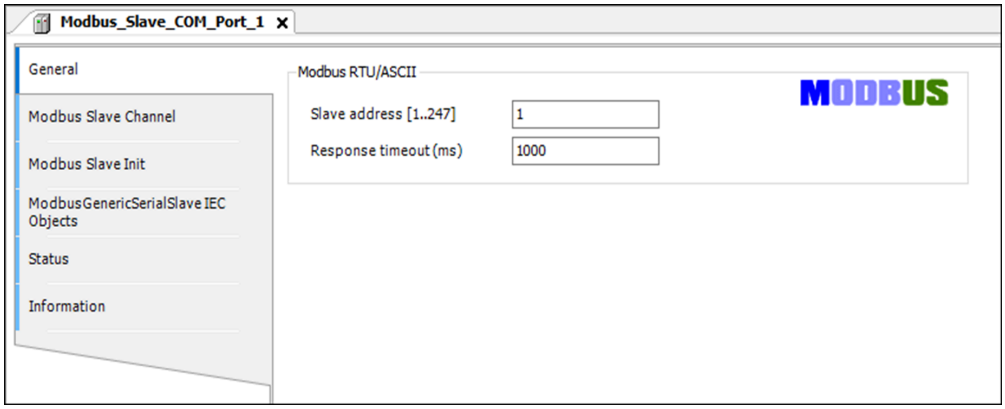
How do I open the **Modbus Slave COM Port** page?

1. On the **Devices** pane, right-click **Modbus Master COM Port_X** and select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus Serial Slave** > **Modbus Slave , COM Port** and then click **Add Device**.
3. On the **Devices** pane, double-click **Modbus Slave COM Port_X**.

Use the settings in **Modbus Slave COM Port_X** page to configure the slave station to be connected when the AX-8 series controller is used as the Modbus master station.

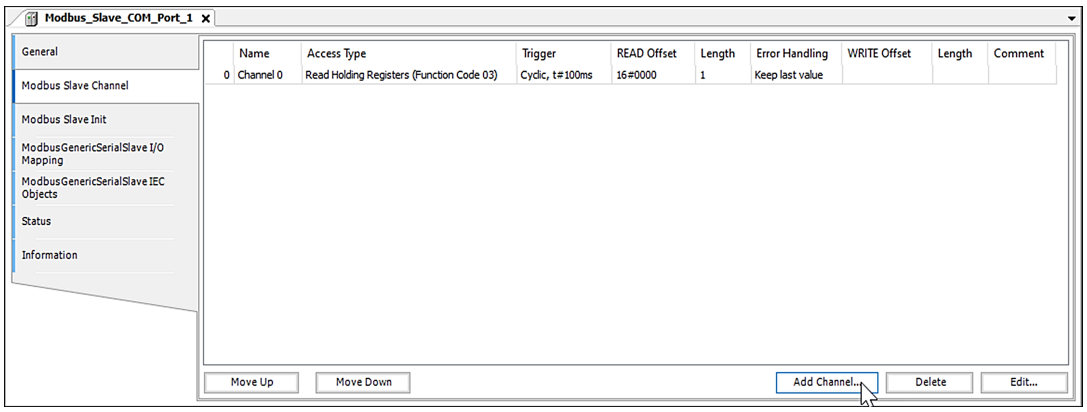
The following table lists the settings and descriptions of Modbus Slave COM Port.

General



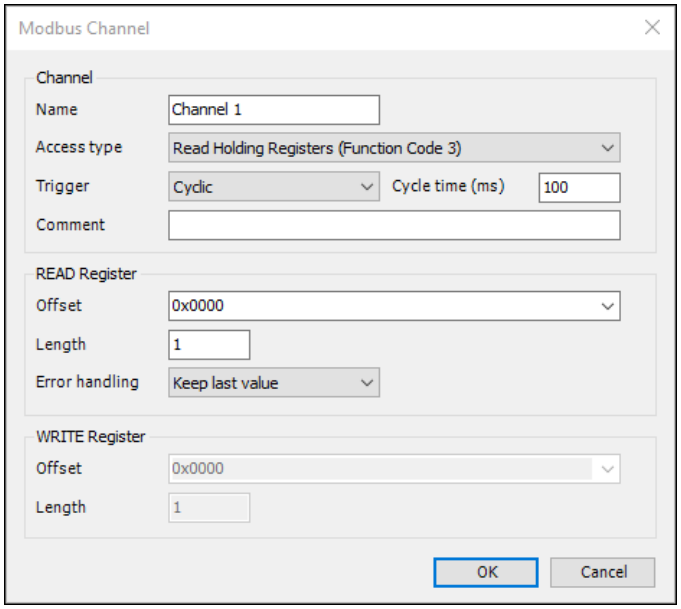
Setting	Description
Slave address [1..247]	Enter the address of a serial Modbus device.
Response timeout [ms]	Enter the time interval for the master to wait for the response from the slave. This timeout value is configured for this slave and overwrites the general response timeout setting of the master.

Slave Channel



Add slave channels. Each channel represents a single Modbus request.

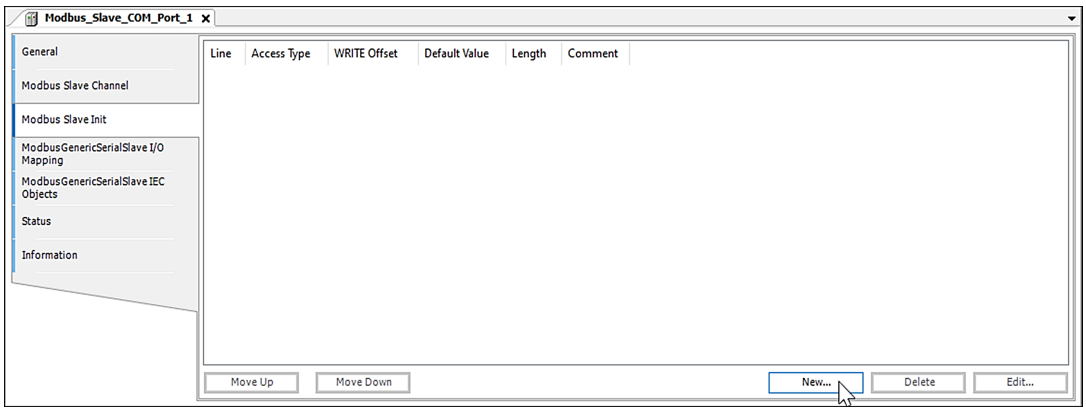
Click **Add Channel** to open the **Modbus Channel** dialog. The following table shows the settings and descriptions.



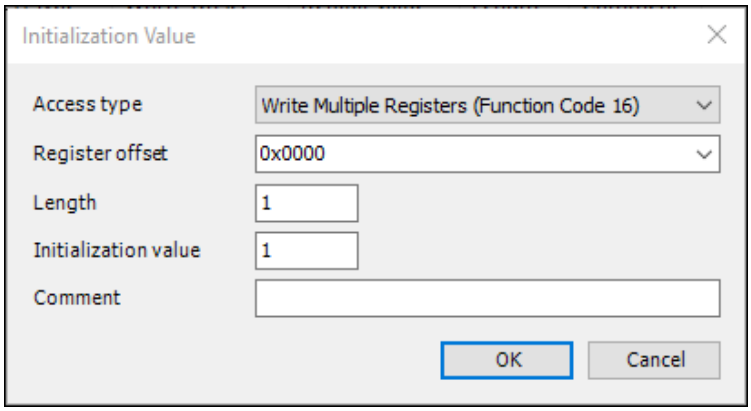
Setting	Description
Name	Enter the name of the channel.
Access type	Select the access type.
Trigger	Select the trigger. • **Cyclic**: The request occurs periodically according to the cyclic time set. • **Rising edge**: The request occurs as a reaction to a rising edge triggered by the Boolean variables. The trigger variable is defined in the I/O Mapping. • **Application**: The request is triggered by the Modbus COM Channel function block.
Cycle time (ms)	Enter the cycle time when the trigger is Cyclic. **Note:** The request interval should be the same or a multiple of the cycle time of the application.
Comment	Enter the description of the channel.

Setting	Description
Offset	Enter the start address where reading should start (value range 0–65535).
Length	Enter the word length that reads or writes from or to the register. The value varies with different **Access Type** and **Device Address**.
Error handling	Select the option when a communication error occurs.

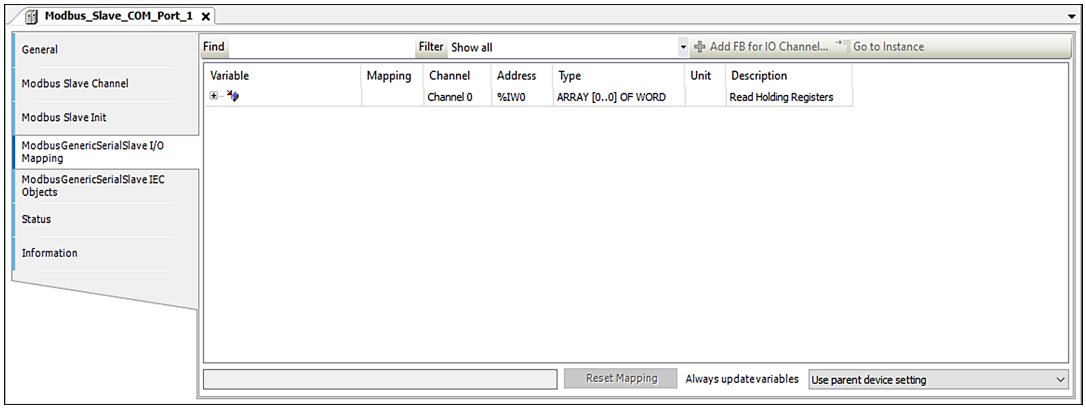
Modbus Slave Initialization



After the Modbus connection between the controller and the slave devices is established, you can click **New** to edit the **Initialization Value** of the Coil or Register.

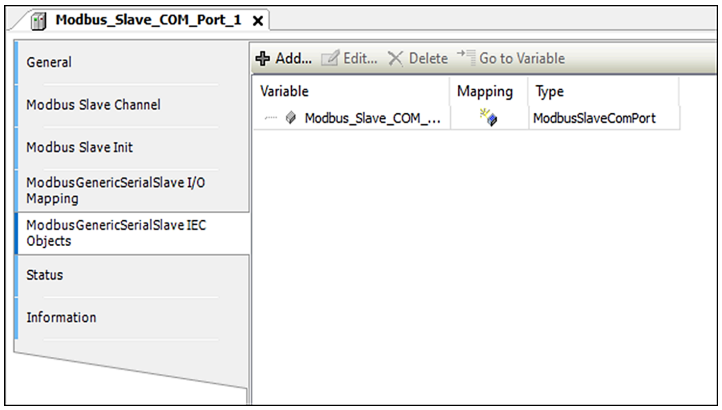


Modbus Generic Serial Slave I/O Mapping



Set the mapping variable after **Modbus Slave Channel** is added.

Modbus Generic Serial Slave IEC Objects

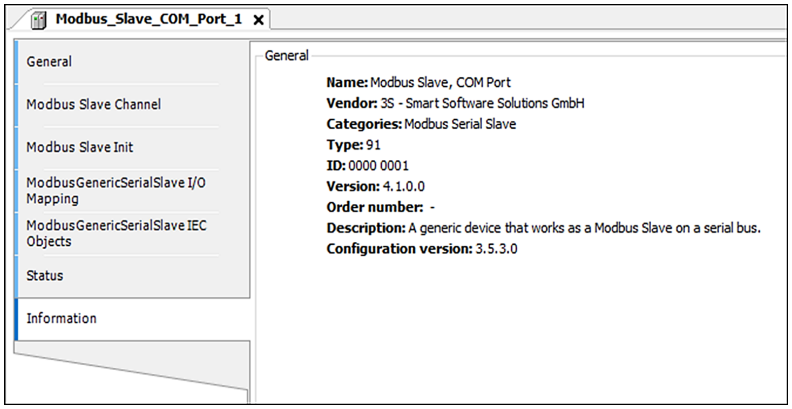


Shows the variable information of Modbus Slave COM Port.

Status

Shows the execution status of Modbus Slave COM Port.

Information



Shows the general information of Modbus Slave COM Port.

6.2.2.2.3 Modbus Serial Device

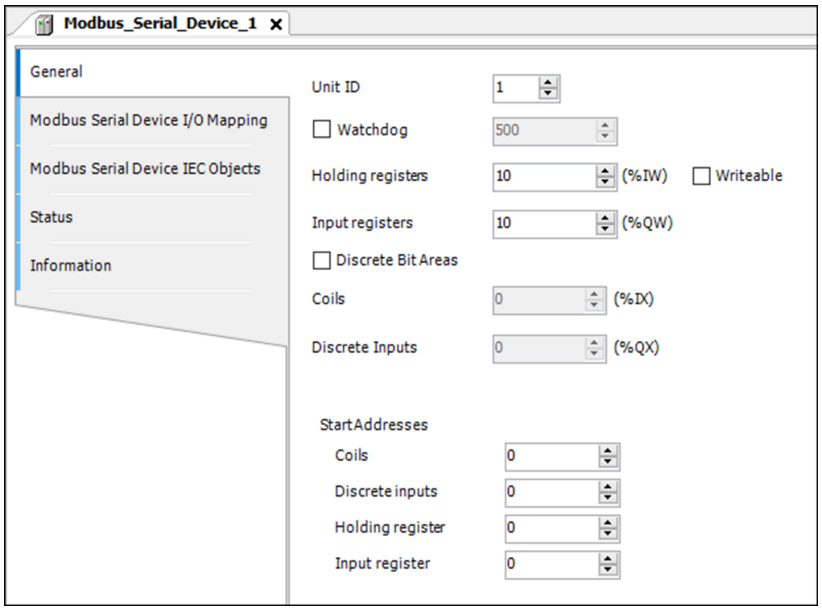
How do I open the **Modbus Serial Device** page?

1. On the **Devices** pane, right-click **Modbus_X** (**Modbus COM)**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus Serial Device** > **Modbus Serial Device**, and then click **Add Device**.
3. On the **Devices** pane, double-click **Modbus Serial Device_X**.

The AX-8 controller can act as a Modbus Serial Slave device after you add Modbus Serial Device and configure the related settings.

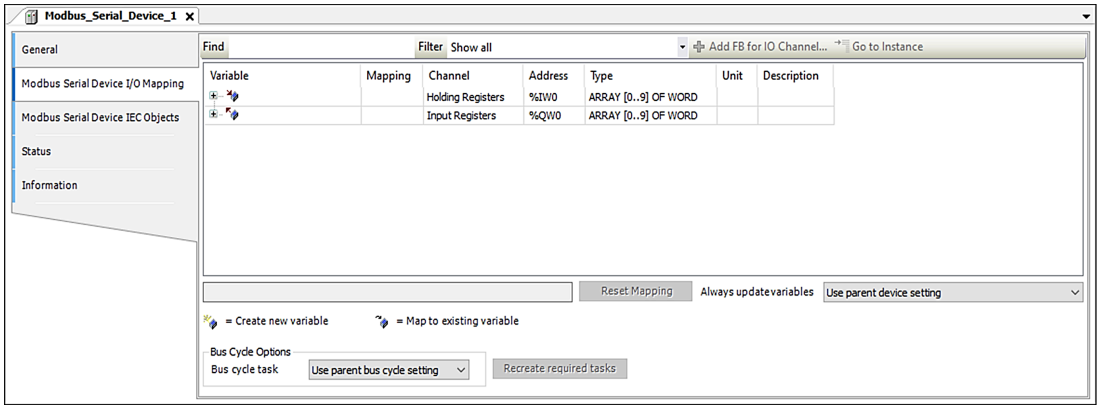
The following table lists the settings and descriptions of Modbus Serial Device.

General



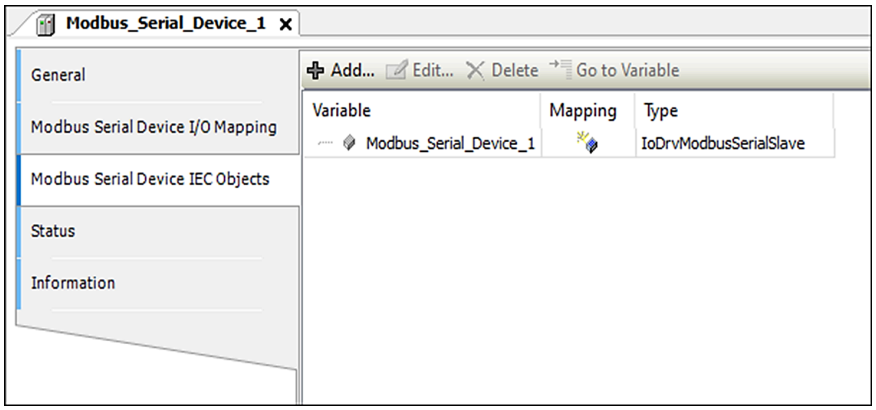
Setting	Description
Unit ID	Select or enter the unit ID of the slave device.
Watchdog	Select to activate the watchdog function. The incoming data (Holding Registers / %I range) is set to zero when the Modbus device does not receive any valid query from the master. • **Holding registers (%IW)**: Select or enter the number of holding registers. The value range is 1–4096. • **Writable**: Select to generate writable I/O mappings (%QW addresses) instead of read-only I/O mappings (%IW addresses). This option allows the holding registers to be set by the Modbus device application (servo application) though the usual I/O mapping. • **Input registers (%QW)**: Select or enter the number of input registers. The value range is 1–4096.
Discrete Bit Areas	Select to enable the discrete input and enter the value for: • Coils • Discrete Inputs
Start Address	Select or enter values for: • Coils • Discrete inputs • Holding register • Input register

Modbus Serial Device I/O Mapping



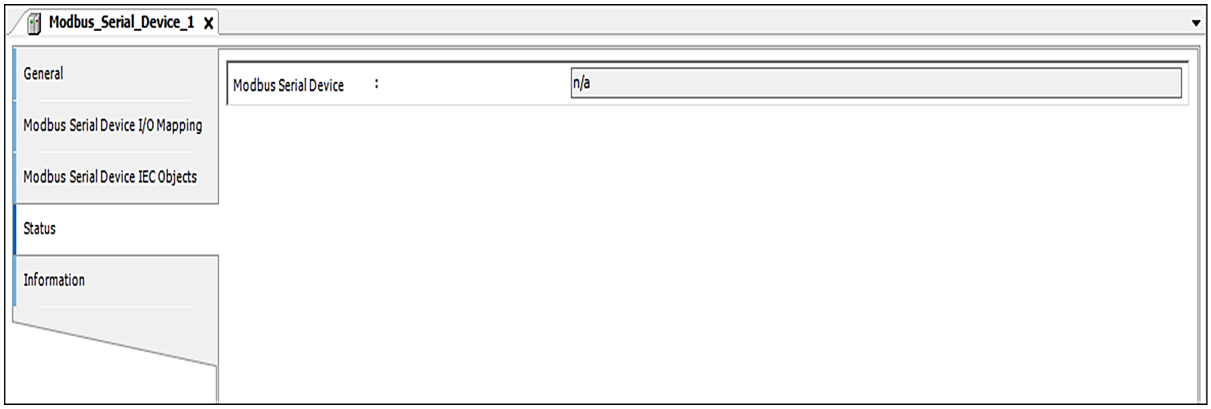
Set the mapping variable after **Modbus Slave Channel** is added.

Modbus Serial Device IEC Objects



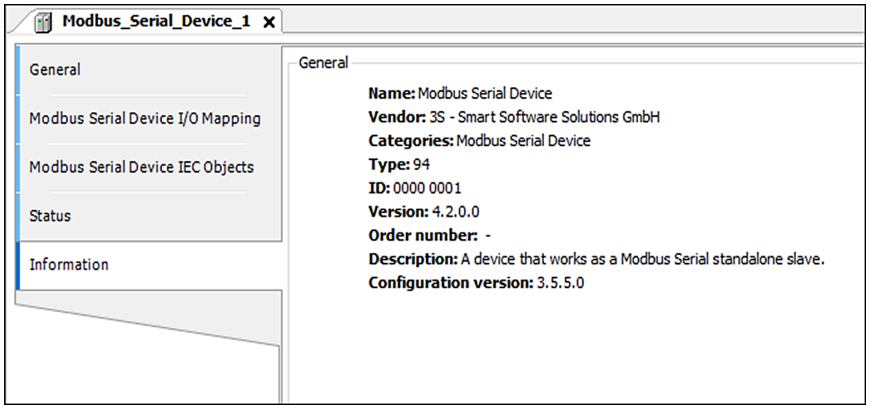
Shows the variable information of Modbus Serial Device.

Status



Shows the execution status of Modbus Serial Device.

Information



Shows the general information of Modbus Serial Device.

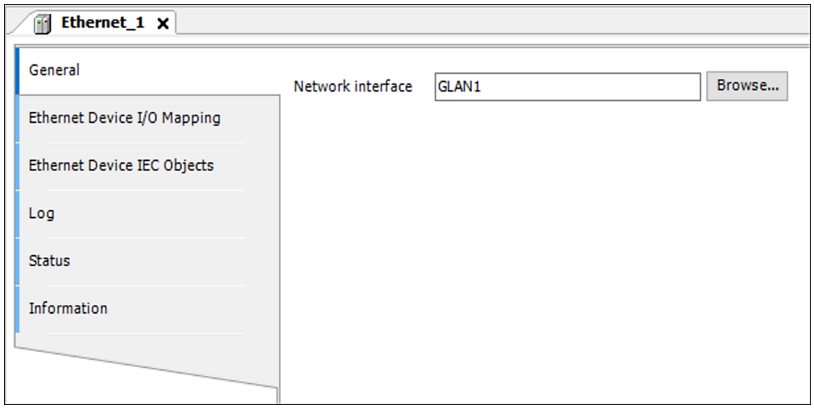
6.2.3 Modbus TCP Settings

How do I open the **Ethernet** page?

1. On the **Devices** pane, right-click the controller and select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Ethernet Adapter** > **Ethernet**, and then click **Add Device**.

The following tables list the settings and descriptions of Ethernet.

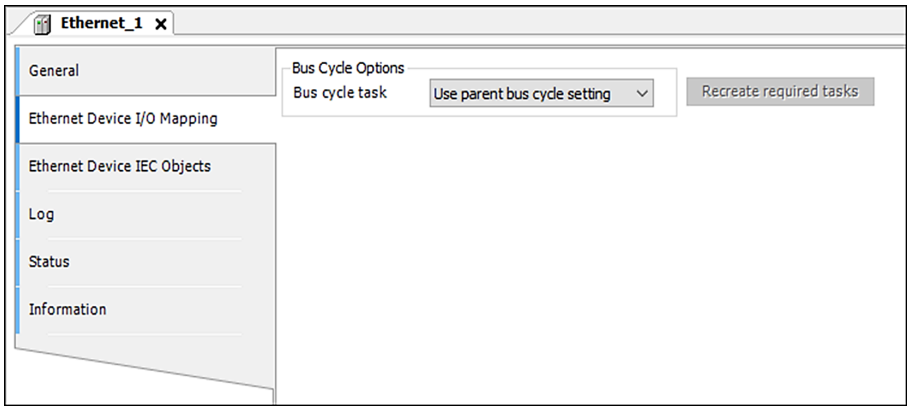
General



Setting	Description
Network interface	Shows the current controller's network interface name. Click **Browse** to select other communication interface. Only available when going online. **Note:** For AX-8 controllers, if there are two EtherCAT nodes in the project tree (the network interface

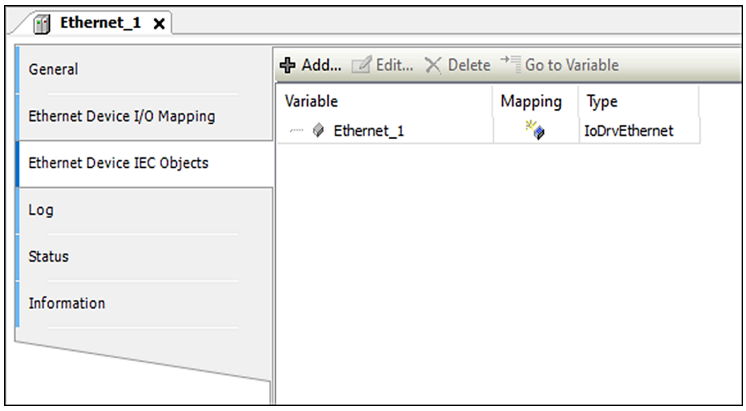
Setting	Description
	GLAN1 is used), and you add an Ethernet node, its network interface name is GLAN2 by default.

Ethernet Device I/O Mapping



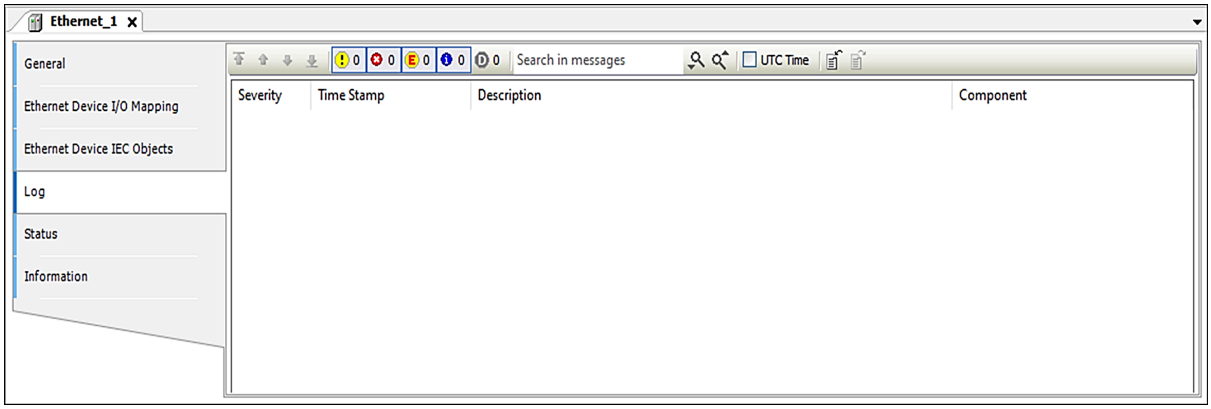
Setting	Description
Bus cycle task	Select a bus cycle task to synchronize with the Modbus communication time.

Ethernet Device IEC Objects



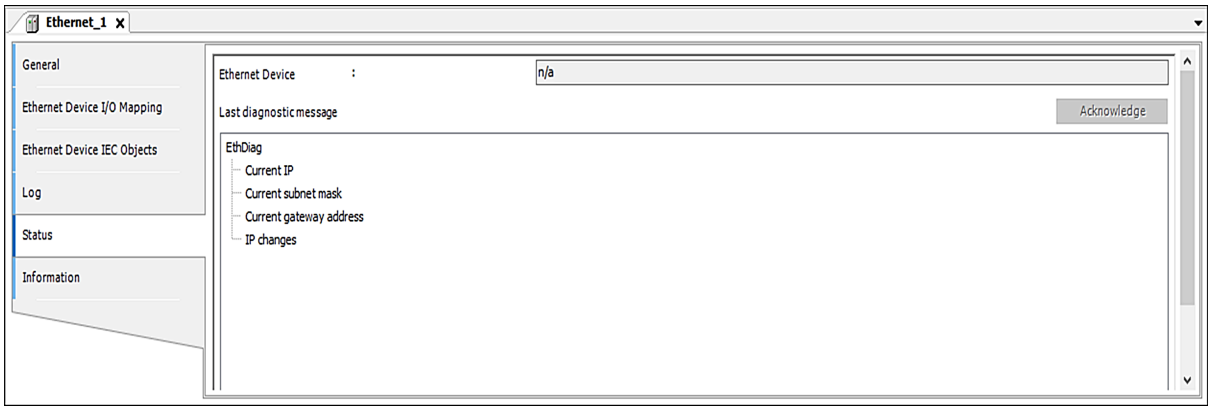
Shows the variable information of **Ethernet**.

Log



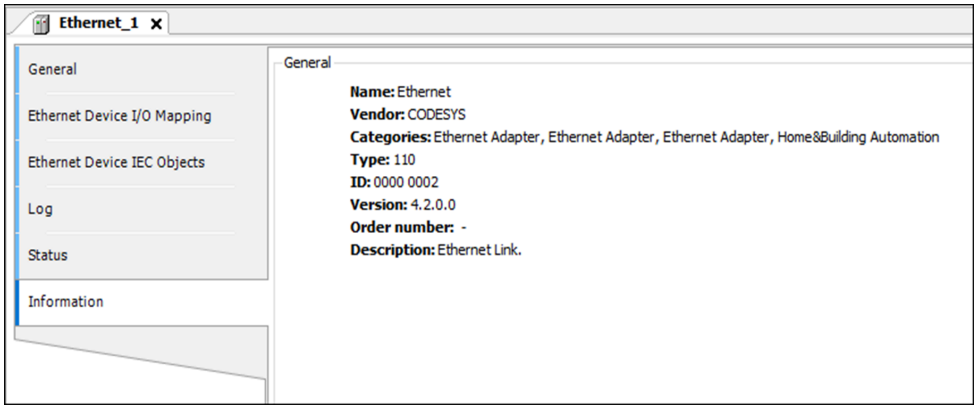
Shows logs of the communication.

Status



Shows the status of the Ethernet device, for example, the Running or Stopped status.

Information



The general information of Ethernet.

6.2.3.1 Delta Modbus TCP

This section introduces Delta Modbus TCP device configuration.

Supported controller:

- AX-3
- AX-5
- AX-C
- AX-864E30CE2T, AX-864E30ME2T, AX-8H1E30CD2T, AX-8H1E30CD2P

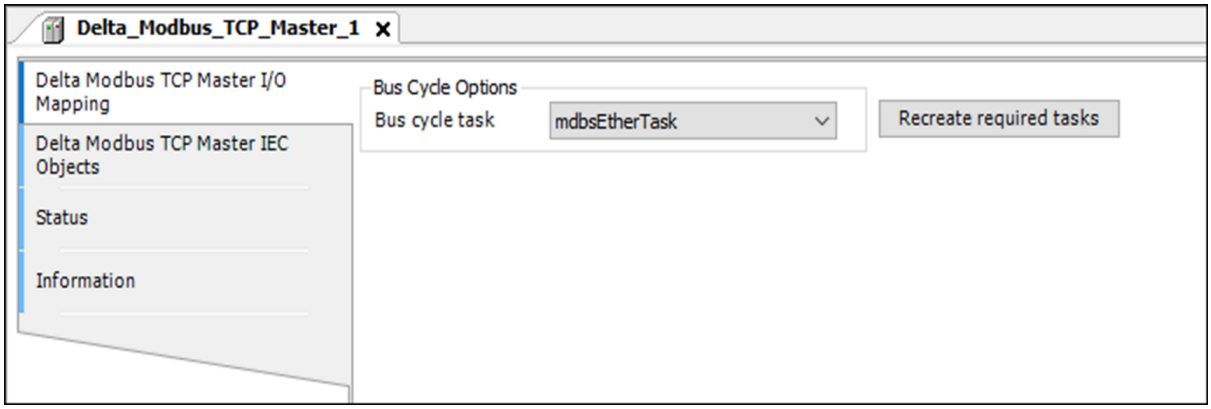
6.2.3.1.1 Delta Modbus TCP Master

How do I open the **Delta Modbus TCP Master** page?

1. On the **Devices** pane, right-click **Ethernet_X(Ethernet)**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus > Modbus TCP Master** > **Delta Modbus TCP Master**, and then click **Add Device**.
3. On the **Devices** pane, double-click **Delta Modbus TCP Master_X**.

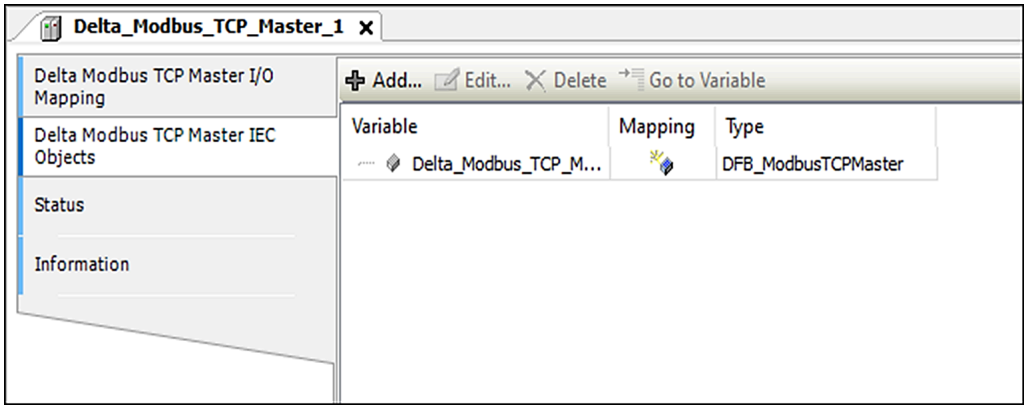
Use the settings in the **Delta Modbus TCP Master_X** page to configure the port when the controller is used as the Modbus TCP master station.

Delta Modbus TCP Master I/O Mapping



Setting	Description
Bus cycle task	Select a bus cycle task to synchronize with the Modbus communication time.
Recreate required tasks	Click to create a Modbus EtherNet task.

Delta Modbus TCP Master IEC Objects



Shows the variable information of Delta Modbus TCP Master.

6.2.3.1.2 Delta Modbus TCP Slave

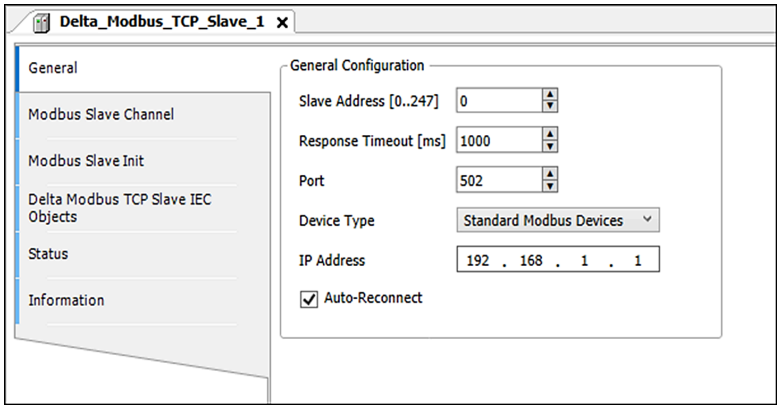
How do I open the **Delta Modbus TCP Slave** page?

1. On the **Devices** pane, right-click **Delta Modbus TCP Master_X**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus TCP Slave** > **Delta Modbus TCP Slave**, and then click **Add Device**.
3. On the **Devices** pane, double-click **Delta Modbus TCP Slave_X**.

Use the settings in the **Delta Modbus TCP Slave_X** page to configure the slave station to be connected when the controller is used as the Modbus TCP master station.

The following table lists the settings and descriptions of Delta Modbus TCP Slave.

General



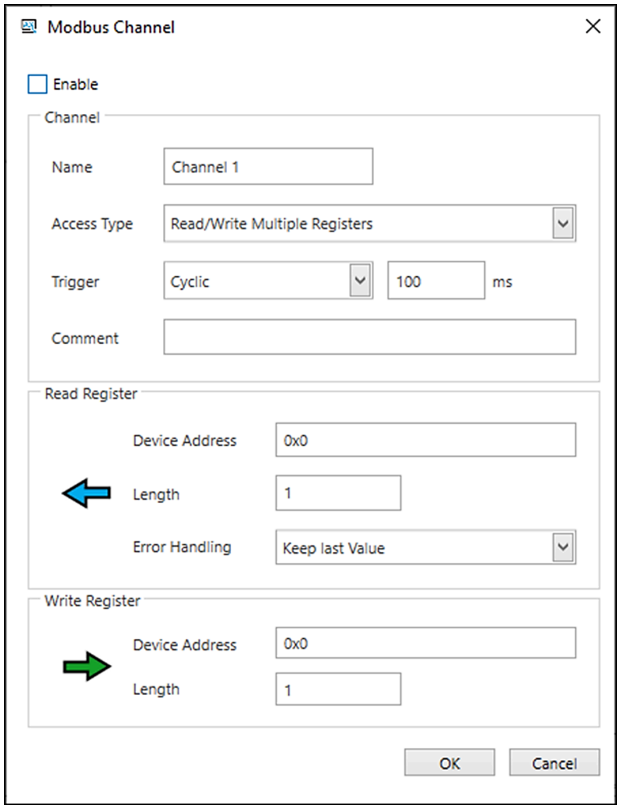
Setting	Description
Slave Address [0..247]	Select or enter the slave station number.
Response Timeout [ms]	Select or enter the time interval for the master to wait for the response from a slave node. This setting is configured especially for this slave node and overwrites the general response timeout setting of the respective master.
Port	Select or enter the port number of the slave.
Device Type	Select the device type. You can select standard Modbus devices or Delta devices. When you select Delta devices, the system converts the protocol into Modbus protocol automatically so that you do not need to see the register map for the conversion.
IP Address	Enter the IP address of the slave device.
Auto-Reconnect	Select to perform the reconnection after a timeout or error occurs.

Modbus Slave Channel

Add slave channels. Each channel represents a single Modbus request. You can create up to 10 channels for each slave. The controller sends out Modbus request packets in chronological order. All channels share the same Modbus connection.

Click **Add Channel** to open the **Modbus Channel** dialog. The following table lists the settings and descriptions.

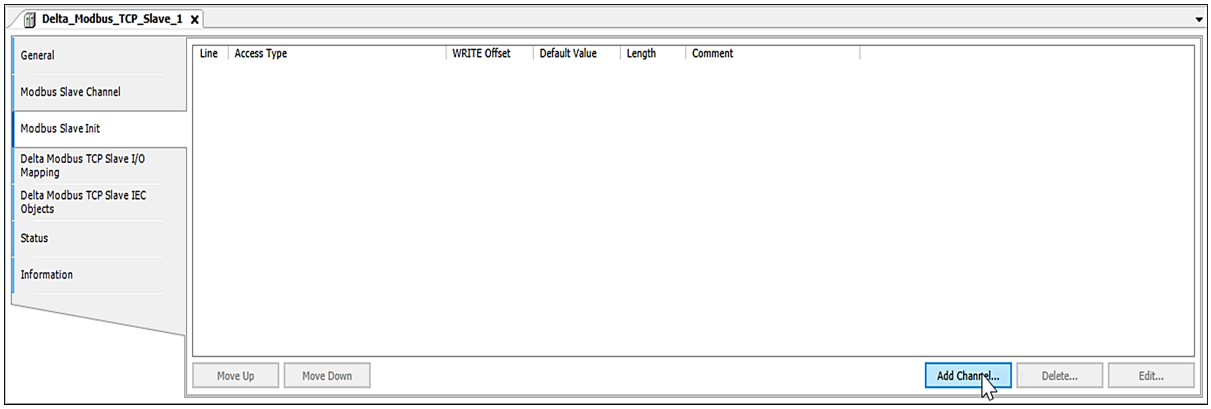
Modbus Channel



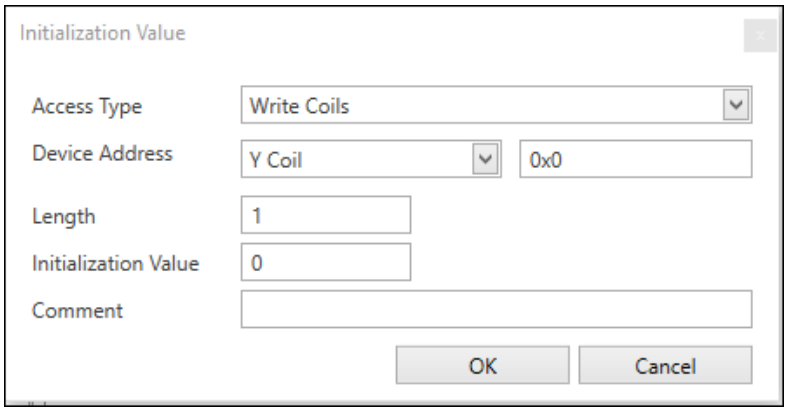
Setting	Description
Enable	Select to turn on the data exchange channel.
Name	Enter the name of the channel.
Access Type	Select the access type.
Trigger	Select the trigger. • **Cyclic**: The request occurs periodically according to the cyclic time set. • **Rising edge**: The request occurs as a reaction to a rising edge of the Boolean trigger variables. The trigger variable is defined on the **I/O Mapping** tab. • **Application**: The request is triggered by the Modbus COM Channel function block.
Comment	Enter notes for the channel.

Setting	Description
Device Address	Enter the device address in the hexadecimal format.
Length	Enter the word length that reads or writes from or to the register. The value varies with different **Access Type** and **Device Address**.
Error Handling	Select the option when a communication error occurs.

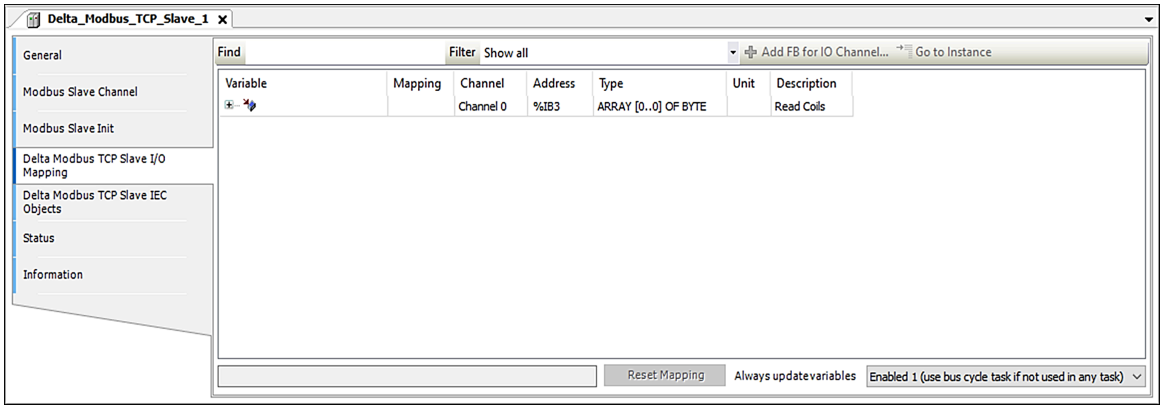
Modbus Slave Initialization



After the Modbus connection between the controller and the slave devices is established, you can click **Add Channel** to edit **Initialization Value** of the Coil or Register.



Delta Modbus TCP Slave I/O Mapping



Set the mapping variable after adding channel in the **Modbus Slave Channel**.

6.2.3.1.3 Delta Modbus TCP Slave Device

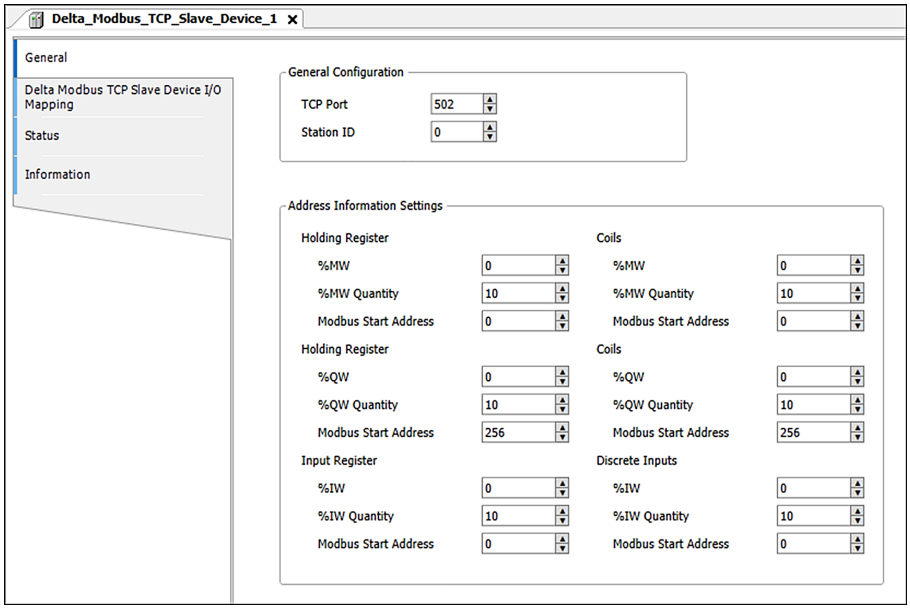
How do I open the **Delta Modbus TCP Slave Device** page?

1. On the **Devices** pane, right-click **Ethernet_X (Ethernet)**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus TCP Slave Device** > **Delta Modbus TCP Slave Device**, and then click **Add Device**.
3. On the **Devices** pane, double-click **Delta Modbus TCP Slave Device_X**.

AX controllers can act as a Modbus TCP slave device after you add Delta Modbus TCP Slave Device and configure the related settings.

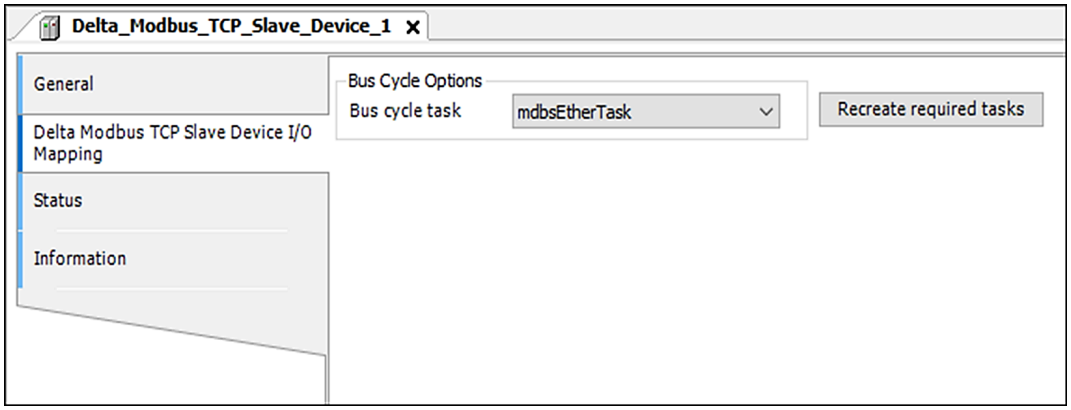
The following tales lists the settings and descriptions of Delta Modbus TCP Slave Device.

General



Select or enter the TCP port, the controller station ID, and the allowed Coils or Registers section. If Modbus Serial Master uses Delta-specific communication protocol, all sections can be accessed without restrictions.

Delta Modbus TCP Slave Device I/O Mapping



Setting	Description
Bus cycle task	Select a bus cycle task to synchronize with the Modbus communication time.
Recreate required tasks	Click to create a Modbus Ethernet task.

6.2.3.2 Modbus TCP

This section introduces Modbus TCP device configuration for AX-8 series controllers.

6.2.3.2.1 Modbus TCP Master

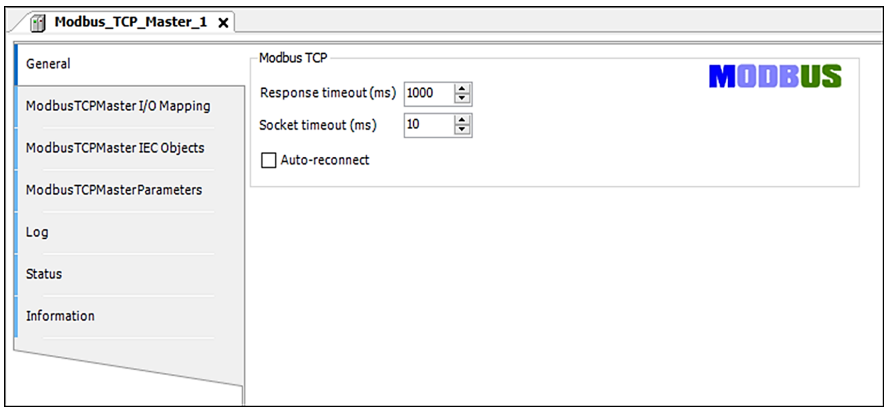
How do I open the **Modbus TCP Master** page?

1. On the **Devices** pane, right-click **Ethernet_X**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus TCP Master** > **Modbus TCP Master**, and then click **Add Device**.
3. On the **Devices** pane, double-click **Modbus TCP Master_X**.

Use the settings in the **Modbus TCP Master_X** page to configure the port when the AX-8 is used as the Modbus TCP master station.

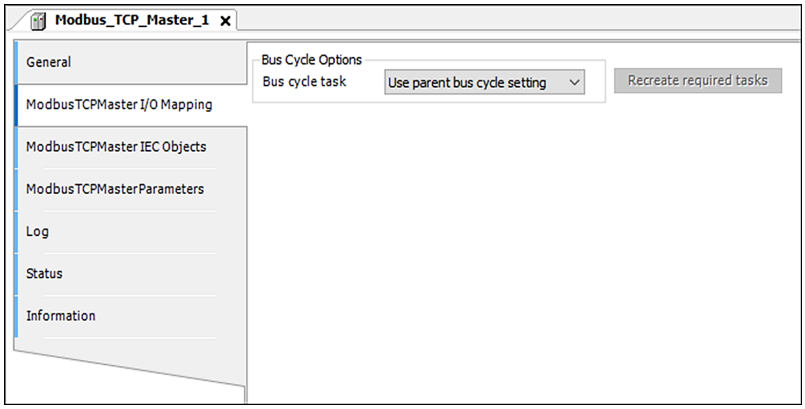
The following table lists the settings and descriptions of Modbus TCP Master.

General



Setting	Description
Response timeout (ms)	Select or enter the interval that the master will wait for the answer from a slave. If the slaves do not answer within this interval, an error is recorded for the implicit slave function block. The value entered for the time interval is also the default value for each slave if no specified value is set.
Socket timeout (ms)	Select or enter the maximum time to wait for incoming TCP/IP packages. The bus cycle task can be blocked during this time.
Auto-reconnect	Select to perform the reconnection after a timeout or error occurs.

Modbus TCP Master I/O Mapping



Setting	Description
Bus cycle task	Select a bus cycle task to synchronize with the Modbus communication time.

6.2.3.2.2 Modbus TCP Slave

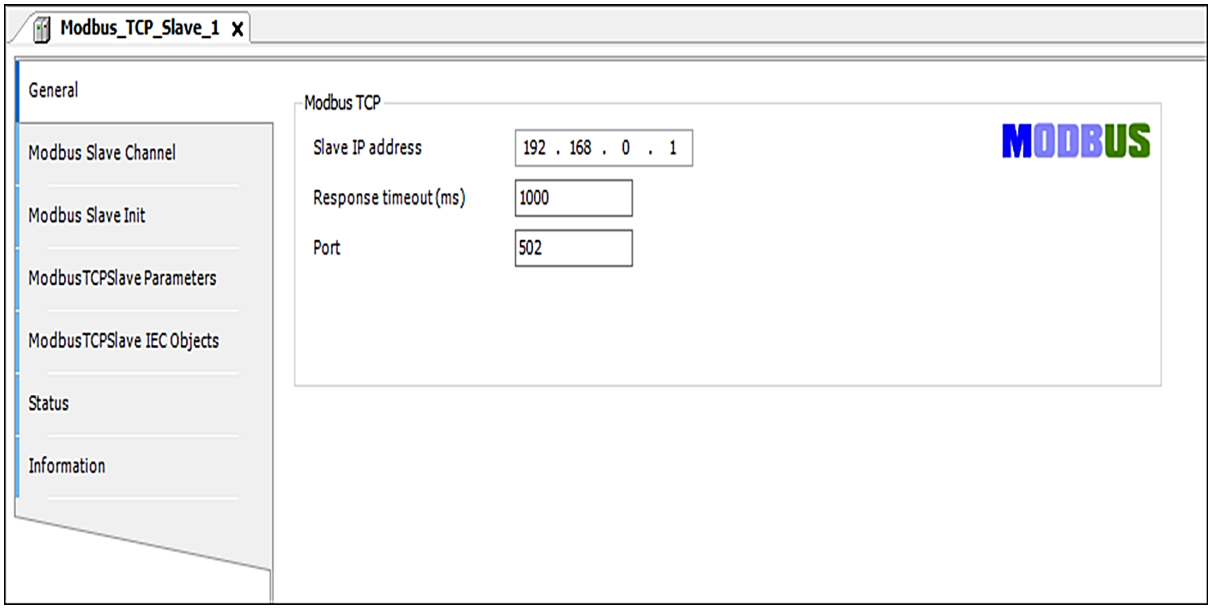
How do I open the **Modbus TCP Slave** page?

1. On the **Devices** pane, right-click **Modbus TCP Master_X** and select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus TCP Slave** > **Modbus TCP Slave**, and then click **Add Device**.
3. On the **Devices** pane, double-click **Modbus TCP Slave_X**.

Use the settings in the **Modbus TCP Slave_X** page to configure the slave station to be connected when the AX-8 series controller is used as the Modbus TCP master station.

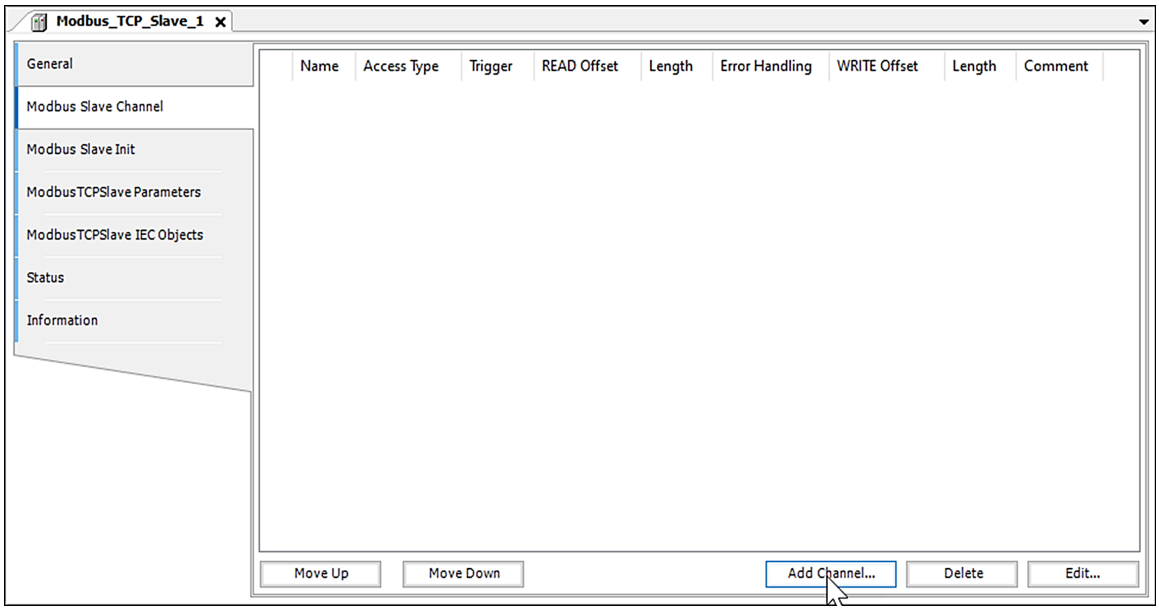
The following table lists the settings and descriptions of Modbus TCP Slave.

General



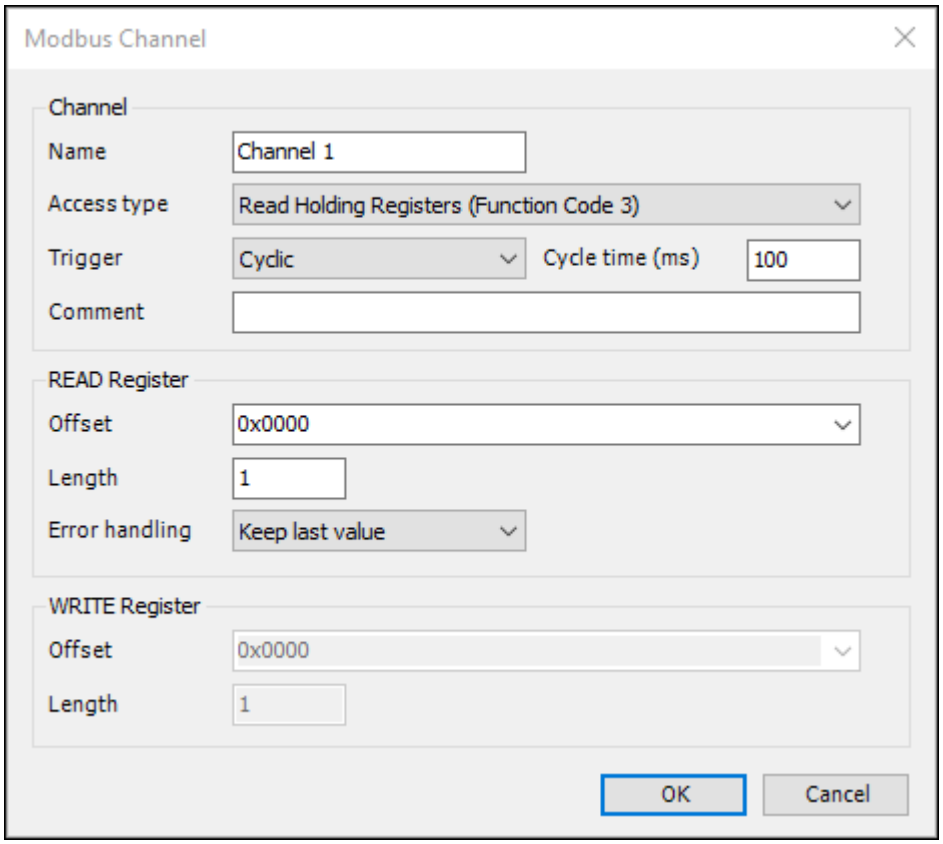
Setting	Description
Slave IP address	Enter the IP address of the Modbus TCP slave device.
Response timeout [ms]	Enter the time interval for the master to wait for the response from the slave. This timeout value is configured for this slave and overwrites the general response timeout setting of the master.
Port	Enter the port number of the Modbus TCP slave device.

Modbus Slave Channel



Add slave channels. Each channel represents a single Modbus request.

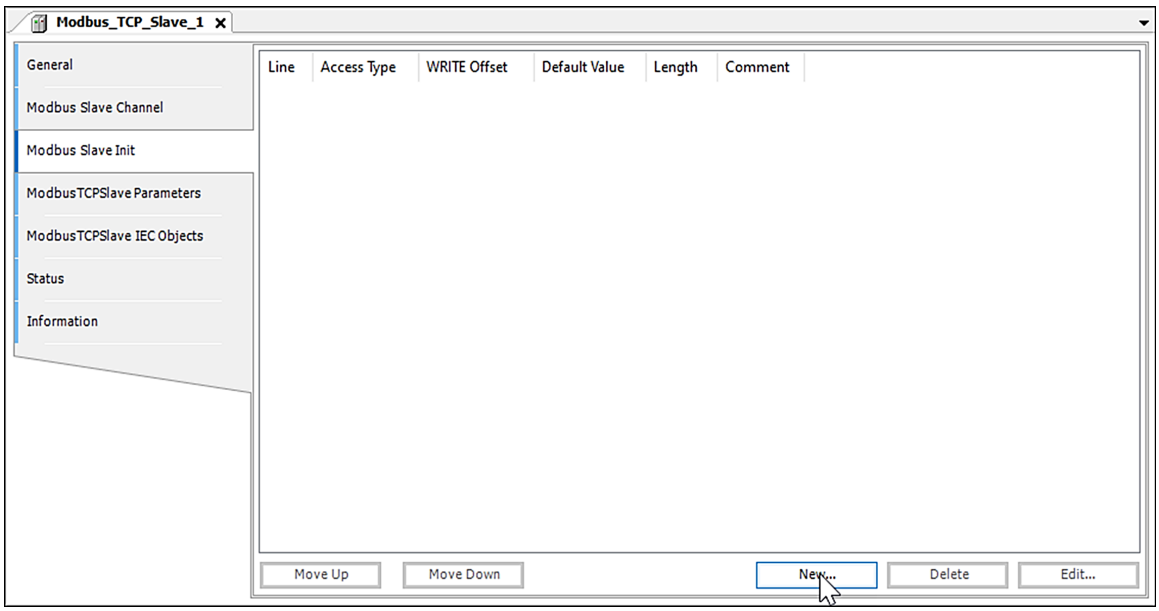
Click **Add Channel** to open the **Modbus Channel** dialog. The following table lists the settings and descriptions.



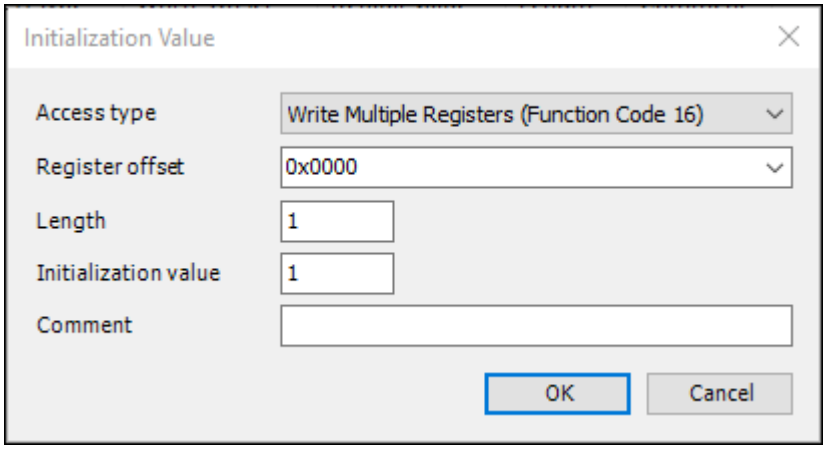
Setting	Description
Name	Enter the name of the channel.
Access type	Select the access type.
Trigger	Select the trigger. • **Cyclic**: The request occurs periodically according to the cyclic time set. • **Rising edge**: The request occurs as a reaction to a rising edge triggered by the Boolean variables. The trigger variable is defined on the **I/O Mapping** tab. • **Application**: The request is triggered by the Modbus Com Channel function block.
Cycle time (ms)	Enter the cycle time when the trigger is **Cyclic**.

Setting	Description
	Note: The request interval should be the same as or a multiple of the cycle time of the application.
Comment	Enter the description of the channel.
Offset	Enter the start address where reading should start (value range 0–65535).
Length	Enter the word length that reads or writes from or to the register. The value varies with different **Access Type**.
Error Handling	Select the option when a communication error occurs.

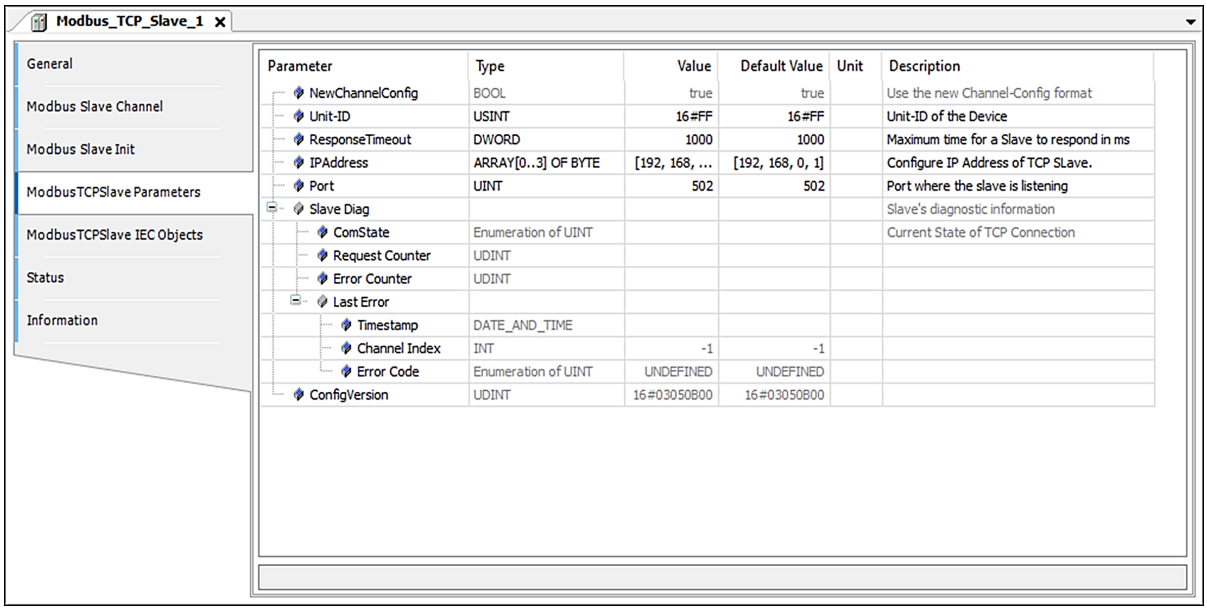
Modbus Slave Initialization



After the Modbus connection between the controller and the slave devices is established, you can click **New** to edit the **Initialization Value** of the Coil or Register.



Modbus TCP Slave Parameters



Set the parameter values of Modbus TCP Slave.

6.2.3.2.3 Modbus TCP Slave Device

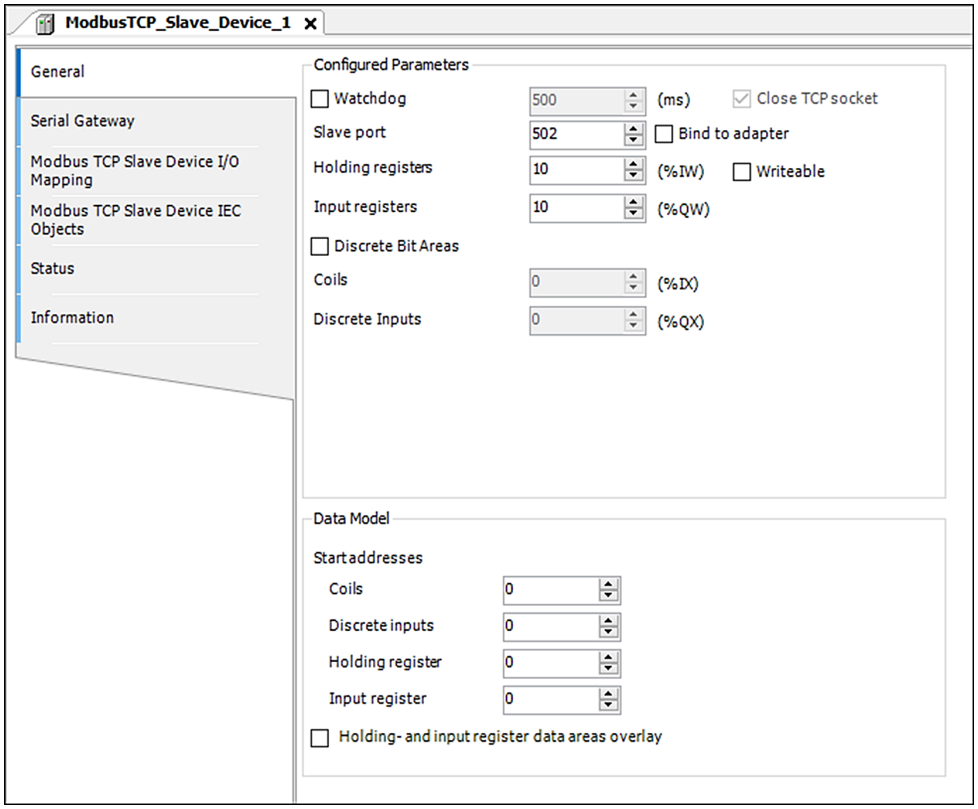
How do I open the **Modbus TCP Slave Device** page?

1. On the **Devices** pane, right-click **Ethernet_X(Ethernet)**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Modbus** > **Modbus TCP Slave Device** > **Modbus TCP Slave Device**, and then click **Add Device**.
3. On the **Devices** pane, double-click **Modbus TCP Slave Device_X**.

The AX-8 controller can act as a Modbus TCP Slave device after you add Modbus TCP Slave Device and configure the related settings.

The following table lists the settings and descriptions of **Modbus TCP Slave Device**.

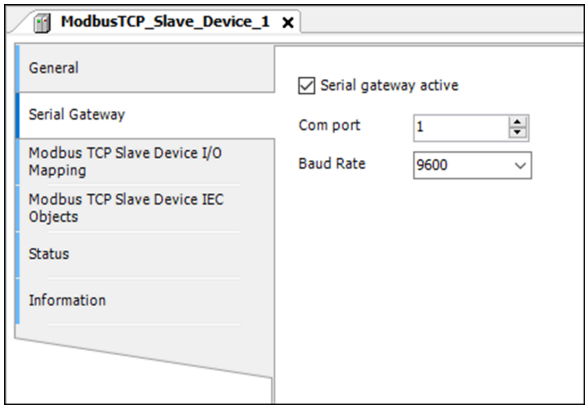
General



Setting	Description
Watchdog	Select to turn on the watchdog function. The incoming data (Holding Registers / %I range) is set to zero when the Modbus device does not receive any valid query from the master. • **Holding registers (%IW)**: Select or enter the number of holding registers. The value range is 2–4096. • **Writable**: Select to generate writable I/O mappings (%QW addresses) instead of read-only I/O mappings (%IW addresses). This option allows the holding regis-

Setting	Description
	ters to be set by the Modbus device (servo application) through the usual I/O mapping. • **Input registers (%QW)**: Select or enter the number of input registers. The value range is 2–4096.
Close TCP socket	Select to close the TCP socket.
Slave Port	Select or enter the slave port number.
Bind to adapter	Select to bind the server socket of the Modbus slave to the IP address of the assigned Ethernet Adapter.
Discrete Bit Areas	Select to turn on the discrete input and enter the value for: • Coils: Number of Modbus coils • Discrete Inputs: Number of Modbus discrete inputs
Start addresses	Select or enter the start address of the respective Modbus data area: • Coils • Discrete inputs • Holding register • Input register
Holding – and input register data areas overlay	Select to overlay the process image by the holding and input register.

Serial Gateway



Setting	Description
Serial gateway active	Select to turn on the TCP/RTU gateway.
Com port	Select or enter the COM port number used.
Baud Rate	Select the transmission rate (in baud).

6.2.4 EtherCAT Settings

The configuration of EtherCAT modules is based on the device description files for the master and slave devices employed and can be adapted in the project in configuration dialogs. To make sure the most straightforward and most error-free use possible, we recommend standard applications for activating the option of **Auto config master/slaves** so that the majority of the configuration settings are done automatically.

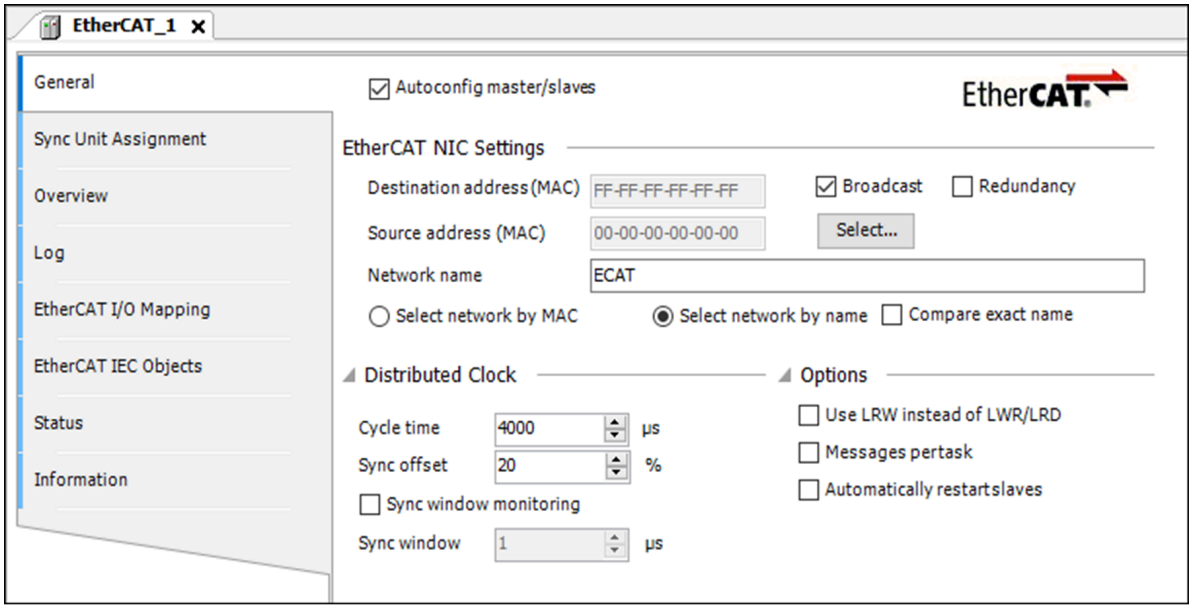
Note: The EtherCAT settings in this section do not apply to AX-300NA0PA1 and AX-324NA0PA1P.

6.2.4.1 EtherCAT Master Settings

How do I open the **EtherCAT** page?

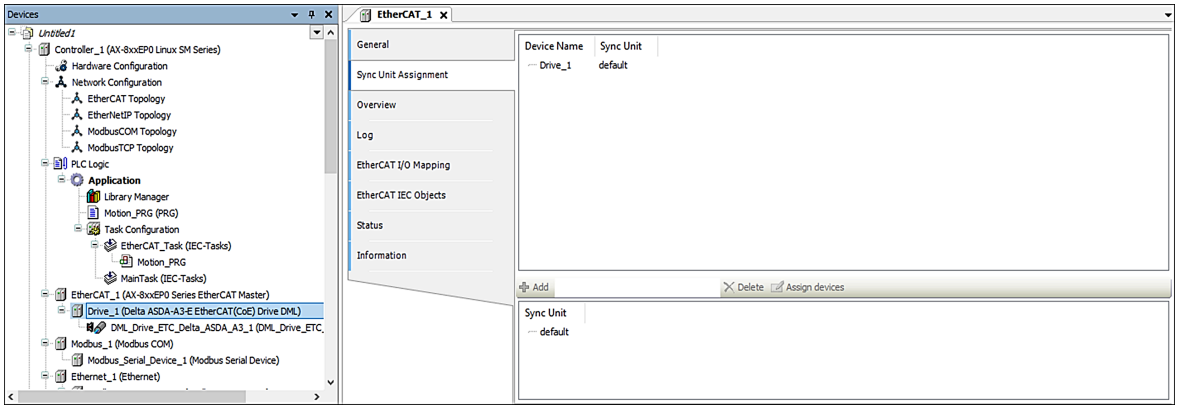
- On the **Devices** pane, double-click **EtherCAT_X**.

General



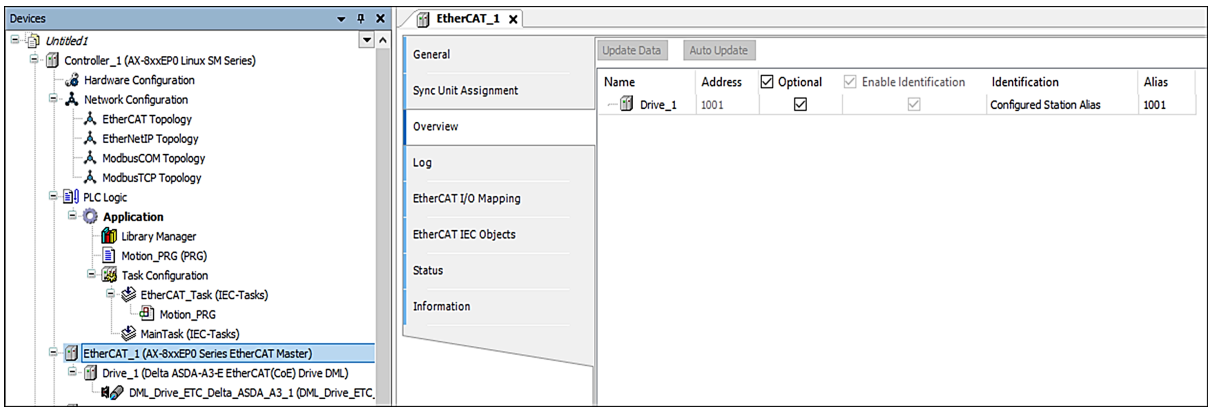
For the details of the settings, see Tab: EtherCAT Master – General.

Sync Unit Assignment



For the details of the settings, see Tab: EtherCAT Master – Sync Unit Assignment.

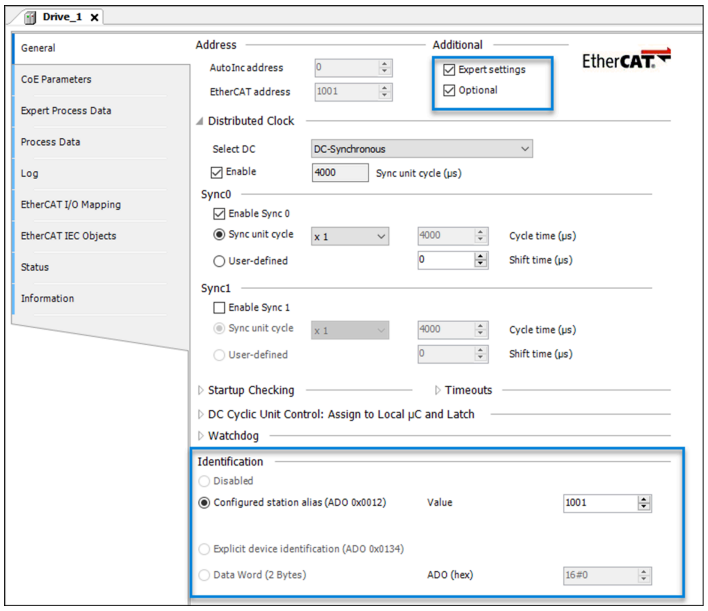
Overview



You can set the alias address of all EtherCAT slaves offline. The following table lists the settings and descriptions on the **Overview** tab.

Setting	Description
Update Data	Click to refresh the status of all slaves. This option is only available online.
Auto Update	Click to read all slaves cyclically. This option is only available online.
Name	Shows the device name.
Address	Shows the EtherCAT address.
Optional	Select to turn on **Enable Identification** and change the **Identification** option from **Disable** to others and turn on **Optional** on the slave device's configuration page. You can select the header to configure for all slaves. The status of this option is synchronized with that on the slave configuration page.
Enable Identification	Select to change the **Identification** option from **Disable** to others and show advanced settings on the slave device's configuration page. You can select the header to configure for all slaves. The status of this option is synchronized with that on the slave configuration page. This column is hidden online.
Identification	Shows the default available setting under **Identification** on the slave configuration page. You can click the field to select other settings. Only available when **Optional** or **Enable Identification** is selected.
Alias	Click to select or enter the alias address of the slave.
State	Shows the current state of the slave devices. Only shows when the controller is online. • INIT: The slave is in the initialization state. • PREOP: The slave is in the "Pre-Operational" state. • SAFEOP: The slave is in the "Safe-Operational" state.

Setting	Description
	• OP: The slave is in the "Operational" state. • BOOT: The slave is in the "Bootstrap" state. • ERR: An error in the slave • NO_COMM: No communication with the slave • LNK_MIS: A connection to the slave is missing (Port = A, B, C, or D). • LNK_ADD: There is a connection to the slave (Port = A, B, C, or D) but not configured in the project tree.
CRC	Shows the number of CRC errors for each active port. Only shows online.



6.2.4.2 EtherCAT Slave Settings

How do I open the **EtharCAT Slave** page?

1. On the **Devices** pane, right-click **EtherCAT _X**, and then select **Add Device**.
2. In the **Add Device** dialog, select a device and then click **Add Device**.
3. Double-click the device in the project tree.

Or

1. Scan the network and select a gateway.
2. On the **Devices** pane, right-click **EtherCAT_X** and then select **Scan for Devices**.
3. In the **Scan Devices** dialog, select the device and click **Copy to project**.
4. Double-click the device in the project tree.

6.2.4.3 EtherCAT Devices Scan

How do I open the **Scan Devices** dialog?

- On the **Devices** pane, right-click **EtherCAT_X** and then select **Scan for Devices**.

Use **Scan for Devices** to detect the devices in the network and you can apply the scanned devices to the project tree.

DIADesigner-AX provides the following major enhanced device scanning functions.

- Compare the scanned and configured devices by alias address.
- Show the various comparison results in different colors.
- Automatically merge the scanned device to the project tree.
- Scan the junction device and its child device.
- Set the alias address of all EtherCAT slaves online.

The following table lists the basic and enhanced scanning settings and their descriptions. You can add, remove, and move the devices for the project tree according to the scanned devices.

Setting	Description
Scanned Devices	Shows the physical devices connected to the controller.
Configured Devices	Shows the devices configured in the project tree.

Setting	Description
Device name	Shows the device name.
Device type	Shows the specific device type.
Alias address	Shows the address that is stored in the ADO 0×0012 register for the scanned device and the station alias configured in the project for the configured device. You can change the alias address for the scanned device.
New address	Enter a new alias address for the slave device and then click **Writealias address to EEPROM** to write the new alias address to EEPROM. This option is only available when selecting **Write address**.
Write address	Select to allow entering a new alias address in the **New address** column. You can select the header to configure for all slaves.
Writing results	Shows the results of the writing alias address to the EEPROM operation.
Turn on alias address	Select to compare the devices by alias address and device type. If the alias address, device type, and slot are the same, then mark the device as Matched. You can select the header to configure for all slaves.
Comparison results	Shows the comparison result between the device connected and the device in the project tree. • Matched: The device in the project tree is the same as the device connected. The corresponding matched device will be highlighted. • Added: The device is connected but not in the project tree. • Moved: The matched device is moved to a different slot. The corresponding moved device will be highlighted.

Setting	Description
	This result only shows when **Turn on alias address** is selected. • Changed: Its child devices are different from that of the scanned devices. • Disabled: The device is disabled. • Removed: The device is not connected and will be deleted from the project tree after clicking **OK**.
	Click to copy the selected device in the **Scanned Devices** pane to the position before the selected device in the **Configured Devices** pane.
	Click to copy the selected device in the **Scanned Devices** pane to the position after the selected device in the **Configured Devices** pane.
	Click to delete the selected device.
	Click to turn off the selected device and always keep it in the project tree. This function is unavailable after login.
	Click to turn on the selected device.
	Click to move the selected device up. You can only move the device between the same level node or between connectors.
	Click to move the selected device down. You can only move the device between the same level node or between connectors.
Write alias address to EEPROM	Click to write the new alias address to EEPROM. This option is not available if **Write address** is not selected.
Stop writing alias address	Click to stop writing the new alias address to EEPROM.

Setting	Description
Ignore unknown devices when auto merging	Select to not compare unknown devices.
Auto merge	Click to merge the devices in the **Scanned Devices** pane to the **Configured Devices** pane.
Restore	Click to undo all the changes.
Scan devices	Click to start a new scan.
OK	Click to apply the changes to the project tree.

Note: For the MX300 empty slot, Copy, Delete, Disable, Move up, and Move down functions are not available; for the MX300 Frequency Converter module, Disable is not available.

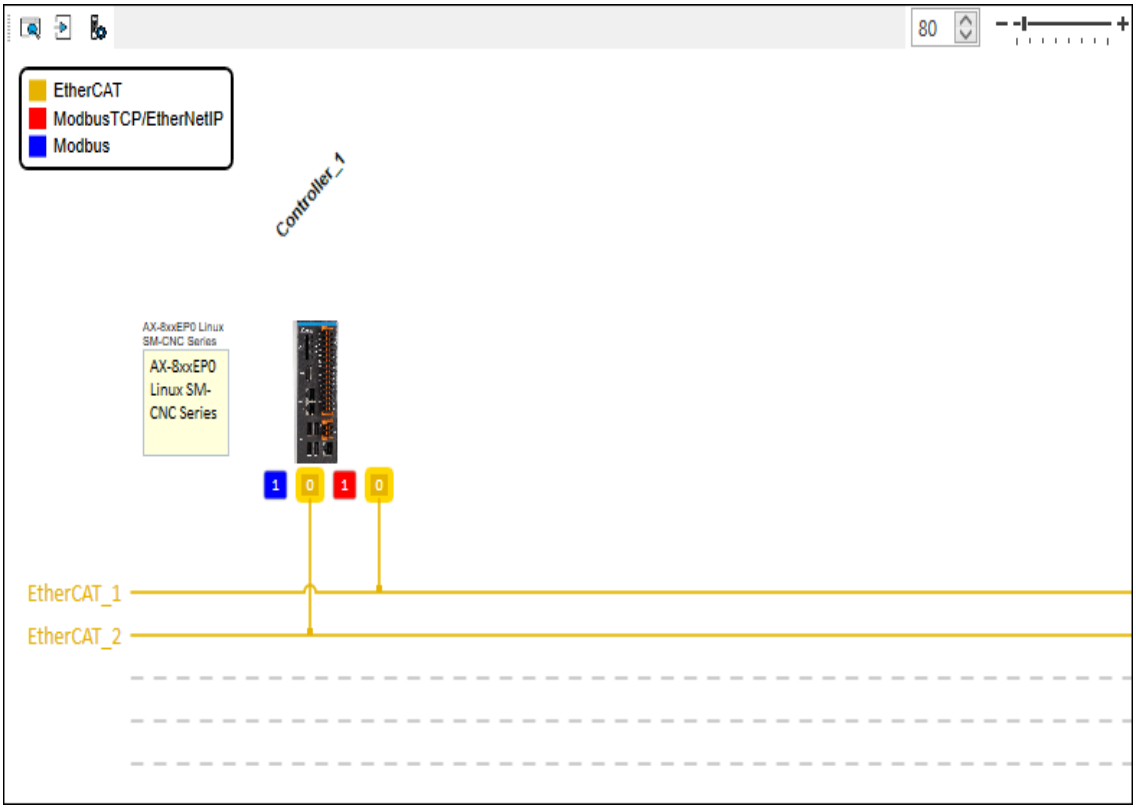
To use the original device scanning function, on the menu bar, select **Tools** > **Options** > **General**, and clear the **Turn on enhanced EtherCAT scanning** checkbox.

6.2.4.4 Add Multiple EtherCAT Ports to the AX-8 Series Controller

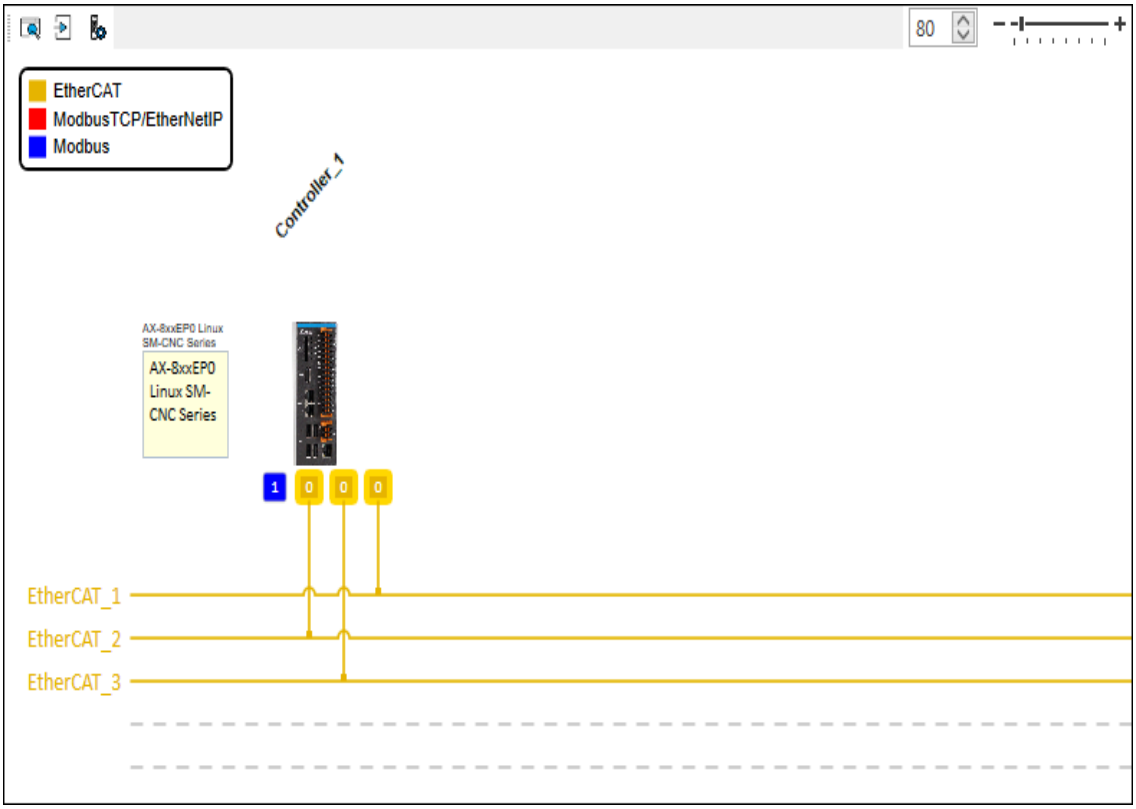
The AX-8 series controller supports adding up to three EtherCAT ports (AX-8 without high speed IO series support adding two). Use the following steps to add multiple EtherCAT ports.

To add multiple EtherCAT ports

1. On the **Devices** pane, right-click the AX-8 series controller and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **EtherCAT** > **Master** > **AX Series EtherCAT Master**, and then click **Add Device**. Two EtherCAT ports show.



3. Repeat step 2 to add the third EtherCAT port.



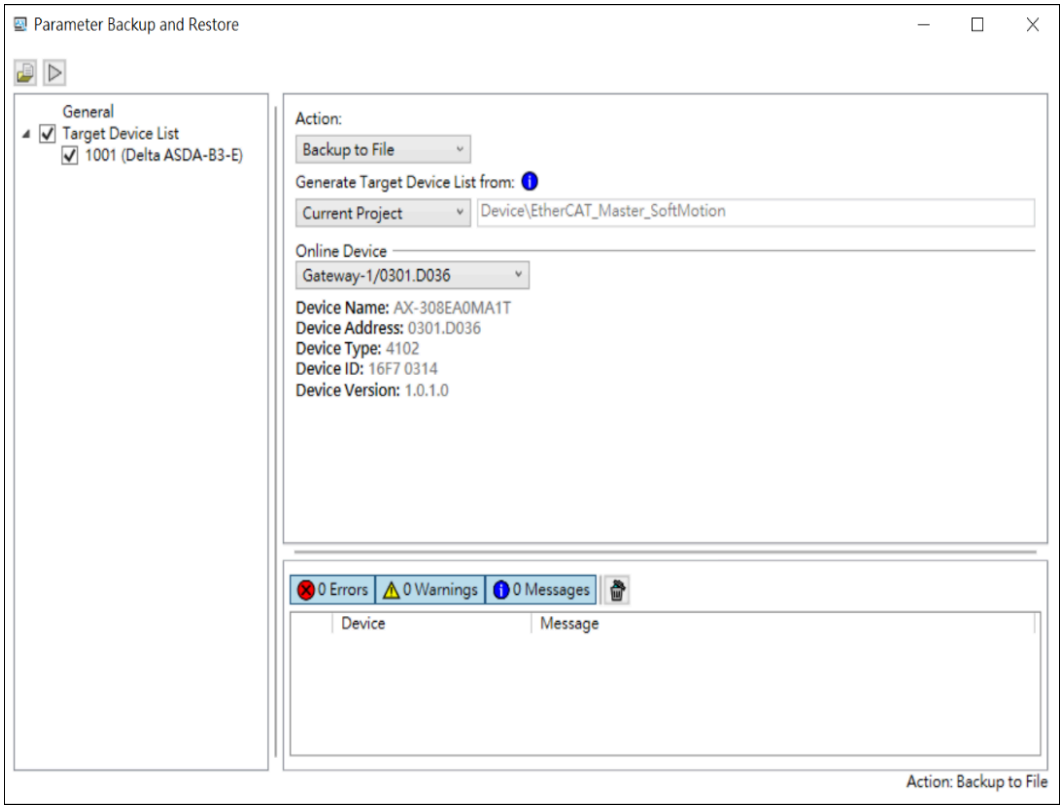
6.2.4.5 Parameter Backup and Restore

The Parameter Backup and Restore function backs up and restores parameters of the EtherCAT slave device.

- Supported controllers:
  - AX-3 series
  - AX-332 version 1.0.5.9 and later
  - AX-5 series
  - AX-8 Linux version 3.5.15.55 and later
  - AX-8 Windows version 3.5.14.35 and later
  - AX-8 series
  - AX-C series version 1.0.2.10 and later
- Supported SoftMotion devices:
  - ASDA-A3-E version 11165, sub version 92
  - ASDA-B3-E version 10665, sub version 75

How do I open the **Parameter Backup and Restore** dialog?

- Do one of the following:
  - Click Tools > Parameter Backup and Restore.
  - On the **Devices** pane, right-click **EtherCAT_X** > **Parameter Backup and Restore**.



The following table lists the settings and description of Parameter Backup and Restore.

Setting	Description
General	Select the target device. When selecting **Current Project** or **Online Topology** in Generate Target Device List from, the target slave device list will show under **General**.
Action	Select the following actions:

Setting	Description
	• **Backup to File**: Back up the parameters of the slave device to a computer file. • **Backup to SD Card**: Back up the parameters of the slave device to the SD card of the controller. • **Restore from File**: Restore the slave device parameters from a computer file. • **Restore from SD Card**: Restore the slave device parameters from the SD card of the controller.
Generate Target Device List from	Select the source of the Generate Target Device List. • Archive File • Current Project • Online Topology
Online Device	Browse and select the controller on the network.
Archive 	Click to open the Save As dialog to save the archived file.
Start 	Click to start to back up or restore parameters.

6.2.4.5.1 Back up parameters to File

Use the following steps to back up parameters to a file in your computer.

To back up parameters to a file

1. In the **Parameter Backup and Restore** dialog, select **Backup to File**.
2. In **Generate Target Device List from**, select an option. If you select **Archive File**, you need to browse and select the previously archived files.
3. In **Online Device**, browse and select an online device.
4. Click  to start the parameter backup.
5. Click **Yes** if the following dialog shows.

6.2.4.5.2 Back up Parameters to an SD Card

Use the following steps to back up parameters to an SD card attached to the controller.

To back up parameters to an SD card

1. In the **Parameter Backup and Restore** dialog, select **Backup to SD Card**.
2. In **Generate Target Device List from**, select an option. If you select **Archive File**, you need to browse and select the previously archived files.
3. In **Online Device**, browse and select an online device.
4. Click  to start the parameter backup.
5. Click **Yes** if the following dialog shows.

6.2.4.5.3 Restore Parameters from a Computer File

Use the following steps to restore parameters from a file in the computer.

To restore parameters from a computer file

1. In the **Parameter Backup and Restore** dialog, select **Restore from File**.
2. In **Generate Target Device List from**, select an option. If you select **Archive File**, you need to browse and select the previously archived files.
3. In **Online Device**, browse and select an online device.
4. Click  to start to restore parameters.
5. Click **Yes** if the following dialog shows.

6.2.4.5.4 Restore Parameter from an SD Card

Use the following steps to restore parameters from an SD card.

To restore parameters from an SD card

1. In the **Parameter Backup and Restore** dialog, select **Restore from SD Card**.
2. In **Generate Target Device List from**, select an option. If you select **Archive File**, you need to browse and select the previously archived files.
3. In **Online Device**, browse and select an online device.
4. Click  to start to restore parameters.

5. Click **Yes** if the following dialog shows.

6.2.5 EtherNet/IP Settings

Ethernet Industrial Protocol (EtherNet/IP) is an open industrial networking standard managed by ODVA (Open DeviceNet Vendors Association).

EtherNet/IP works on a TCP/UDP/IP-based Ethernet network and uses the most widely deployed collections of Ethernet standards to provide a broad range of applications in different industries that require high speed and stability, including Factory Automation (FA), Building Automation (BA), Process Automation (PA), and many more.

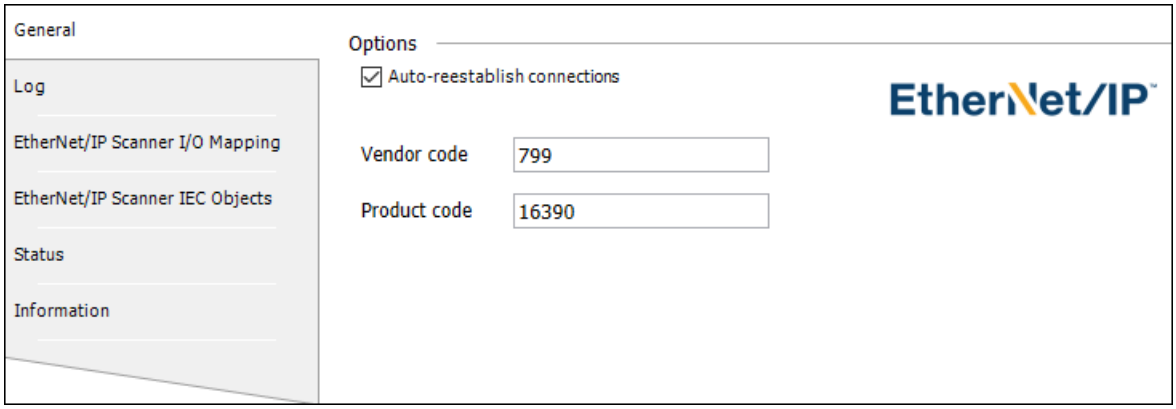
6.2.5.1 EtherNet/IP Scanner

How do I open the **EtherNet/IP Scanner** page?

1. On the **Devices** pane, right-click **Ethernet_X (Ethernet)**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **EtherNet/IP** > **EtherNetIP Scanner** > **EtherNet/IP Scanner**, and then click **Add Device**.
3. On the **Devices** pane, double-click **EtherNet/IP Scanner_X**.

The following table lists the settings and descriptions of EtherNet/IP Scanner.

General



Setting	Description
Auto-reestablish connections	Select to perform the reconnection after a timeout or error occurs.
Vendor code	View or modify the default vendor code of EtherNet/IP Scanner.
Product code	View or modify the default product code of EtherNet/IP Scanner.

6.2.5.2 EtherNet/IP Remote Adapter

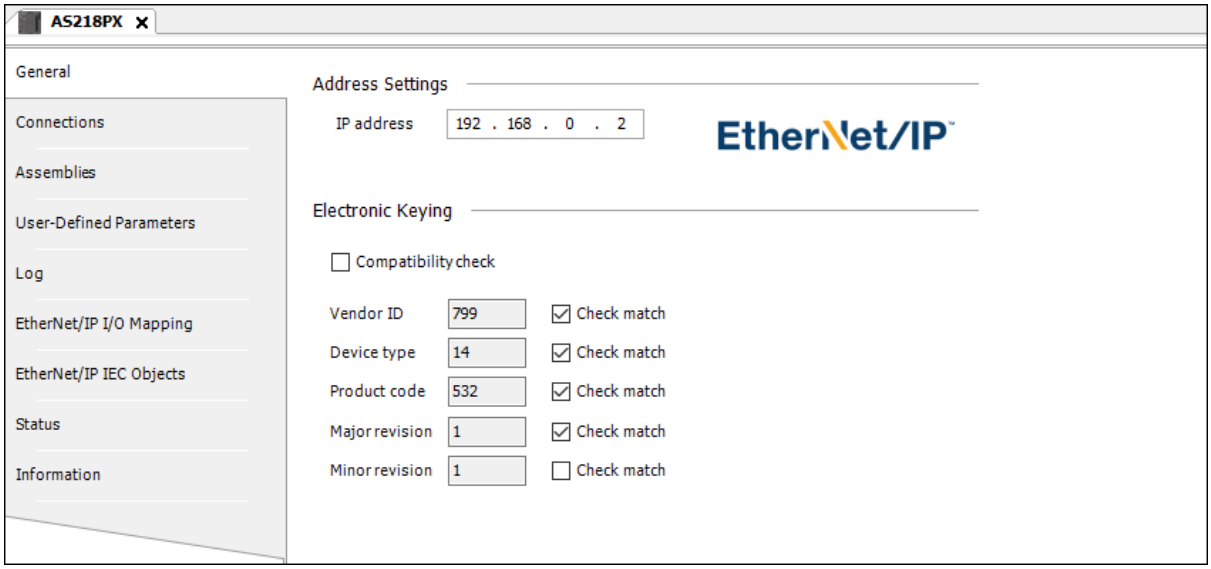
How do I open the **Ethernet/IP Remote Adapter** page?

1. On the **Devices** pane, right-click **EtherNet IP Scanner_X**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **EtherNet/IP** > **EtherNet/IP Remote Adapter**. Select an adapter and then click **Add Device**.
3. On the **Devices** pane, double-click the adapter.

If you want to use a third-party EtherNet/IP remote adapter, go to **Tools** > **Device Repository** and install the EtherNet/IP standard EDS file.

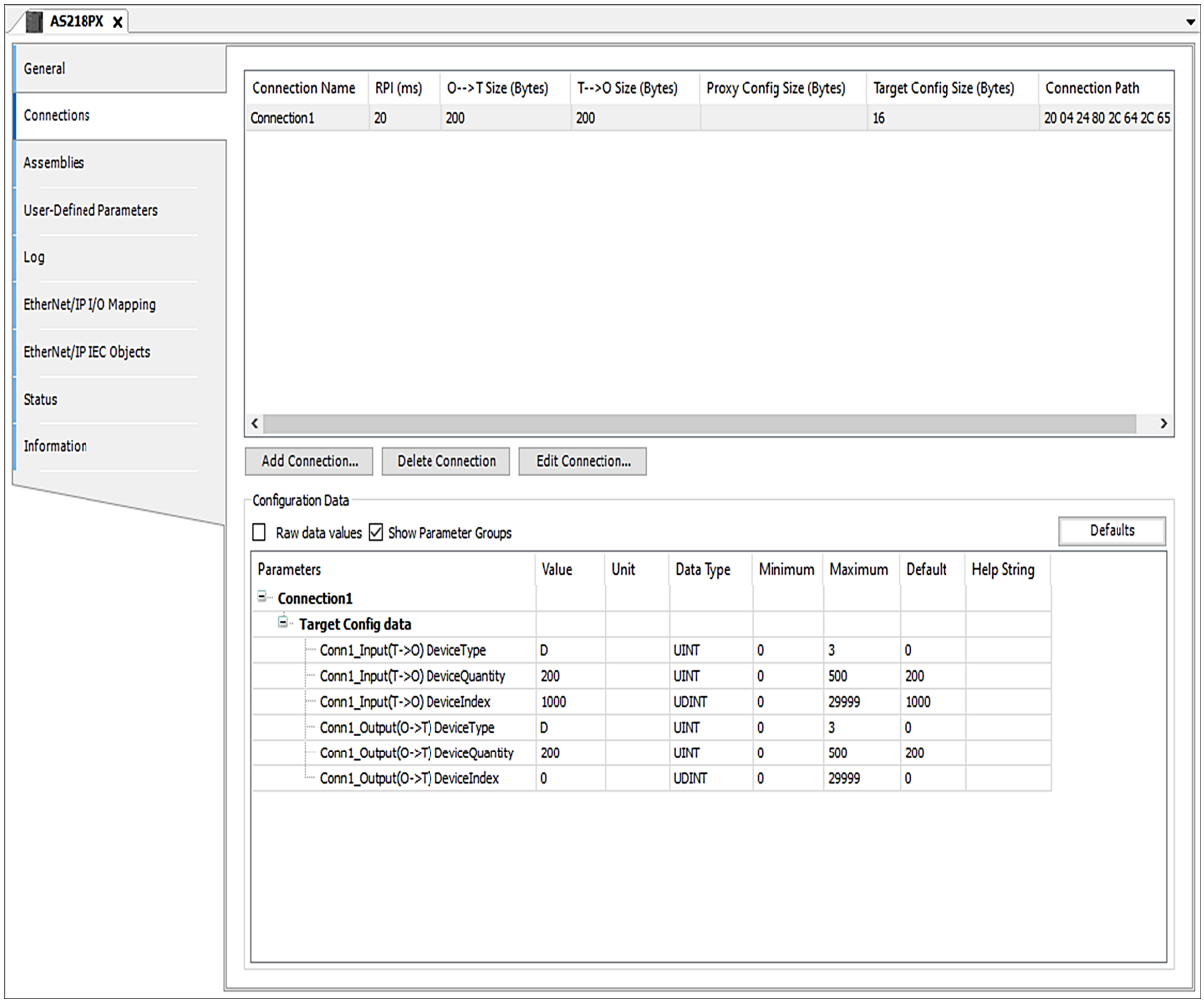
The following table lists the settings and descriptions of the EtherNet/IP remote adapter.

General



Setting	Description
Address Settings	
IP address	Enter the EtherNet/IP remote adapter IP address.
Electronic Keying	
Compatibility check	Select to check whether the key values in the EDS file are compatible with the device.
Check match	Select to check whether the following information in the EDS file is compatible with the device. • Vendor ID • Device type • Product code • Major revision • Minor revision If the check fails, the I/O connection with the device will not establish, and an error message will show on the status page.

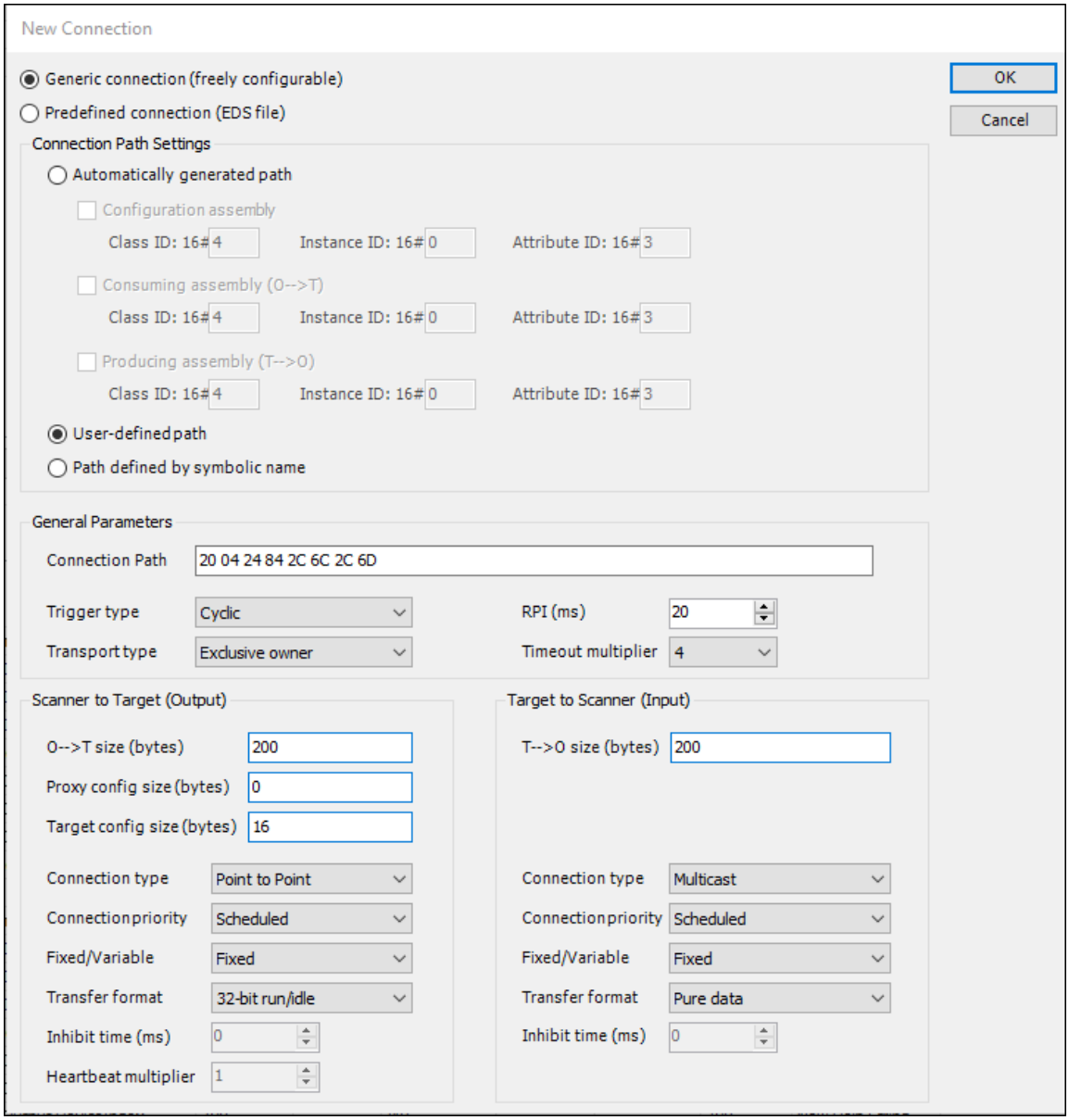
Connections



Setting	Description
Connection Name	Shows the connection name.
RPI (ms)	Shows the requested packet interval (the exchange interval of input/output data). Editable.
O → T Size (Bytes)	Shows the producer data size from the scanner to the adapter (Originator → Target). You can double-click the box to open the **Edit Connection** dialog to edit the value.
T → O Size(Bytes)	Shows the consumer data size from the adapter to the scanner (Target → Originator). You can double-click the box to open the **Edit Connection** dialog to edit the value.
Proxy Config Size (Bytes)	Shows the size of the proxy configuration data.

Setting	Description
Target Config Size (Bytes)	Shows the target configuration data size.
Connection path	Show the connection path data. The data is represented as: address - configuration object - input object - output object.
Add Connection	Click to open the **New Connection** dialog to set up the parameters of the new connection.
Delete Connection	Click to remove the selected connection from the list.
Edit Connection	Click to open the **Edit Connection** dialog to modify the parameters of the existing connection.

Click **Add Connection** to open the **New Connection** dialog. Use the settings in this dialog to create a new connection.



Setting	Description
Generic connection	Select to configure new connections. • **Automatically generated path**: The connection path is automatically generated based on the combined configuration, consumption and production values. • **User-defined path**: Enter the connection path. • **Path defined by symbolic name**: The path is defined by the symbolic name.

Setting	Description
	Note: The device must support a symbolic connection path.
Predefined connection	Select to use the existing connection in the EDS file. You can change the configuration data defined in the EDS file.
General Parameters	
Connection Path	The connection path is used to address one or more objects in the adapter that provides input data and receives output and configuration data. **Note:** The connection path is set up to a custom path.
Trigger type	Select the trigger type. • **Cyclic**: Periodically exchange data at intervals set by RPI. • **Status change**: After changing the scanner output or adapter input, data will be exchanged automatically. • **Application**: Not implemented
Transport type	For details, see the CIP specification.
RPI (ms)	Select or enter the time interval (in milliseconds) at which the transmitting application requests data to be transmitted to the target application. The value must be a multiple of the bus cycle task.
Timeout multiplier	Select the timeout multiplier. If the device fails, there will be a time delay (RPI x timeout multiplier) before the device status switches to Error.
Scanner to Target (Output) /Target to Scanner (Input)	

Setting	Description
O → T size (Bytes)	The size of producer data from scanner to adapter (Originator → Target)
T → O Size (bytes)	Consumer data size from adapter to scanner (Target –> Originator)
Proxy Config size (Bytes)	The size of the proxy configuration data
Target Config size (Bytes)	Target configuration data size
Connection type	• **Empty**: No network connection is established. • **Multicast**: The network connection has been established. Connection data can be received by multiple user. • **Point-to-point**: A network connection has been established. Connection data can only be received by one user.
Connection Priority	Using two scanners with different priorities for a target may cause conflicts. Adjusting the connection priority can solve this problem.
Fixed/Variable	For detailed information on parameters, see CIP specifications.
Transfer format	Conversion format
Inhibit time (ms)	Prohibited time
Heartbeat multiplier	Extend the time interval for the scanner to send heartbeat messages to the adapter. This value is multiplied by the RPI value. **Example**: RPI = 10 ms, and heartbeat multiplier = 10 causes a message to be sent every 100 ms.

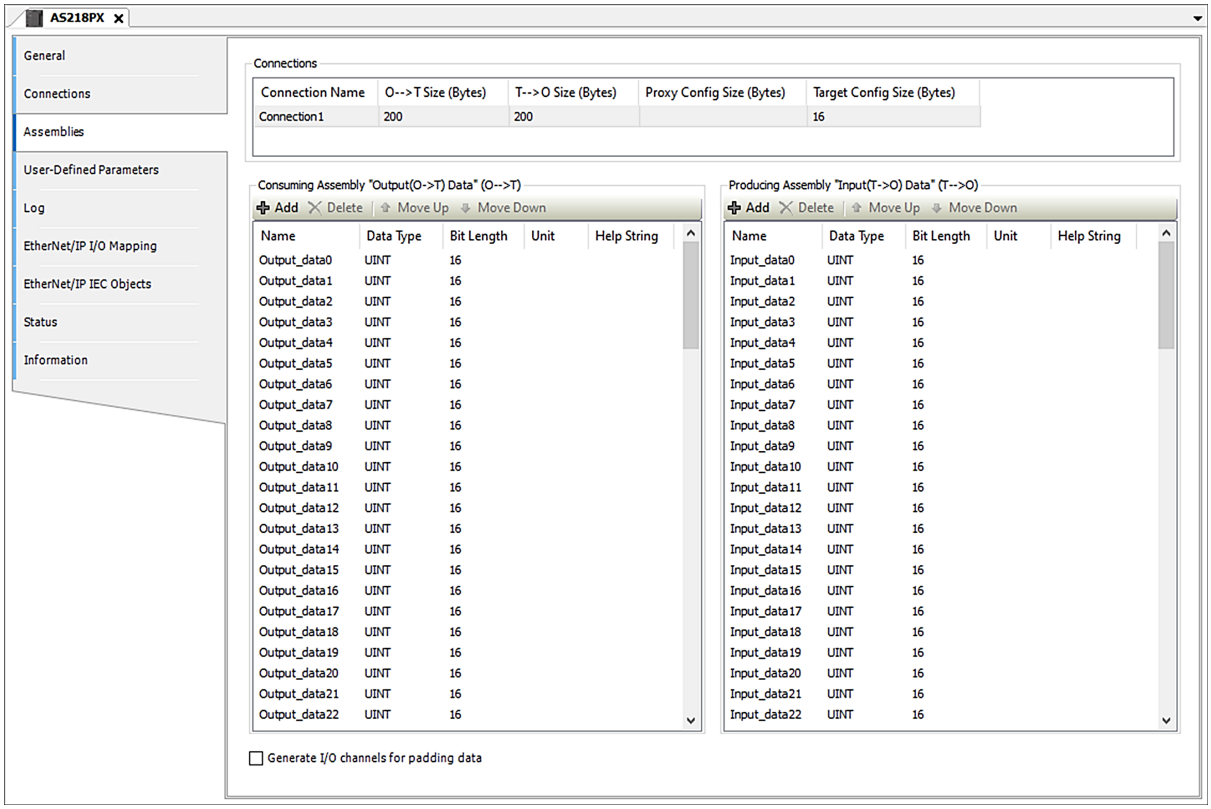
Setting	Description
	Note: The transmission format is Heartbeat.

Configuration Data

Under Configuration Data, the connection with the configuration parameters in the EDS file is displayed. The connections are subdivided into configuration groups.

Project	Description
Raw data values	If scaling parameters are defined for the data in the EDS file, the value can be displayed as raw data or converted data. • **Startup**: Display data without any conversion. For the Enum data type, the index of the enumeration value will be displayed. • **Not started**: Display data and conversion. For the Enum data type, the enumeration value will be displayed.
Show Parameter Groups	Displays the parameter group.
Defaults	Set as default.
Value	Double-click to change the value. According to the Data Type, you can specify the value directly in the input box, or select from the drop-down list.

Assemblies



Shows the connections. After you select a connection, the consuming assembly and producing assembly information shows. You can **Add**, **Delete**, **Move Up**, **Move Down** the item, and edit each item.

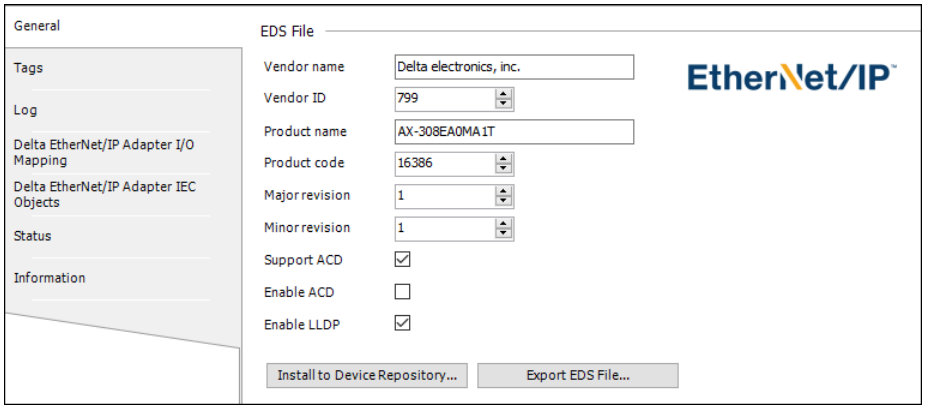
6.2.5.3 EtherNet/IP Local Adapter

How do I open the **EtherNet/IP Local Adapter** page?

1. On the **Devices** pane, right-click **Ethernet_X(Ethernet)**, and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **EtherNet/IP** > **EtherNet/IP Local Adapter** > **Delta EtherNet/IP Adapter** (or **EtherNet/IP Adapter**), and then click **Add Device**.
3. On the **Devices** pane, double-click Delta **EtherNet IP Adapter_X** (or **EtherNet IP Adapter_X**).

The following table lists the settings and descriptions of Delta EtherNet/IP Adapter.

General



Setting	Description
Install to Device Repository	Click to install the device to the device repository. After the device is installed, it will be added under **EtherNet/IP Scanner** as a remote adapter. You need to update the device automatically.
Export EDS File	Click to export the EDS file. The EDS file will be saved on the local computer and can be used in an external setting environment.

6.2.5.3.1 Add EtherNet/IP Module

The controller can act as an EtherNet/IP Adapter after you add and configure the EtherNet/IP Modules.

To add and set up EtherNet/IP Module

1. On the **Devices** pane, right-click **Delta EtherNet IP Adapter _X** (or **EtherNet IP Adpater_X**), and then select **Add Device**.
2. In the **Add Device** dialog, select **Delta EtherNet/IP Module** (or **EtherNet/IP Module**), and then click **Add Device**.
3. On the **Devices** pane, double-click **Delta EtherNet IP Module_X** (or **EtherNet IP Module_X**).
4. On the **Assemblies** page, select **Consuming Assembly** and **Producing Assembly**.

Note: Select the same connection for **Consuming Assembly** and **Producing Assembly**. For example, if **Consuming Assembly** selects **Conn1_Output**, **Producing Assembly** should select **Conn1_Input**.

5. In the **Consuming Assembly** and **Producing Assembly** areas, click **Add** to create parameters respectively.

6.2.6 PROFINET I/O Settings

PROFINET I/O is a Fieldbus protocol that enables communication between controllers and distributed field devices in Ethernet. The protocol classifies devices into I/O Controllers, I/O Supervisors, and I/O Devices with specific services. PROFINET I/O uses three communication channels to exchange data: standard UDP/IP and TCP/IP channels, real-time (RT) channels, and synchronous real-time (IRT) channels. Standard UDP/IP and TCP/IP channels are used in the parameterization and configuration of devices and acyclic operations; Real-time (RT) channels are used in cyclic data transmission and alarms; Synchronous real-time (IRT) channels are used in motion controls.

CODESYS PROFINET version 4.3.0.0 and later is supported.

6.2.6.1 Add a PROFINET Device

Use the following steps to add a PROFINET device.

To add a PROFINET device

1. On the **Devices** pane, right-click the controller and then select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **EtherNet/IP** > **Ethernet Adapter** > **Ethernet**, and then click **Add Device**.
3. Right-click **Ethernet_X (Ethernet)** and select **Add Device**.

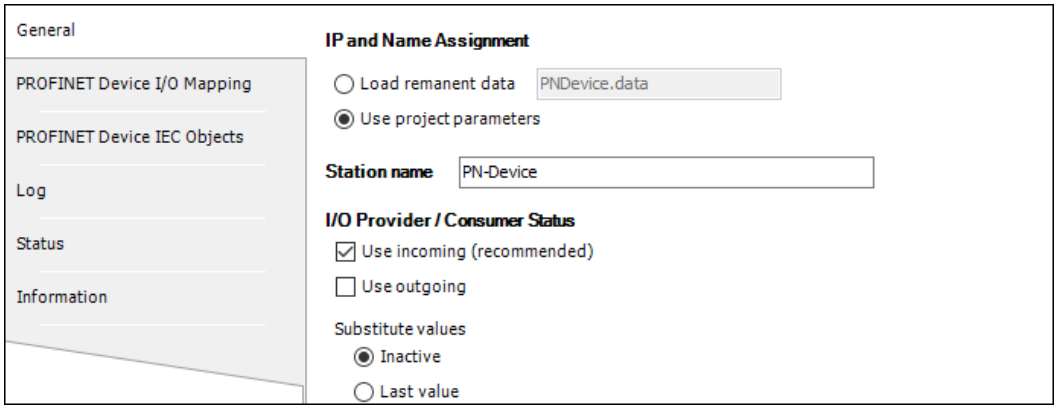
4. In the **Add Device** dialog, select **Fieldbuses** > **Profinet IO** > **Profinet IO Device** > **CODESYS PROFINET Device**, and then click **Add Device**.

5. Right-click **CODESYS_PROFINET_Device_X** and select **Add Device**. You can select the input and output I/O modules according to your needs.

6.2.6.2 PROFINET Device Settings

The following table and figures show the PROFINET settings.

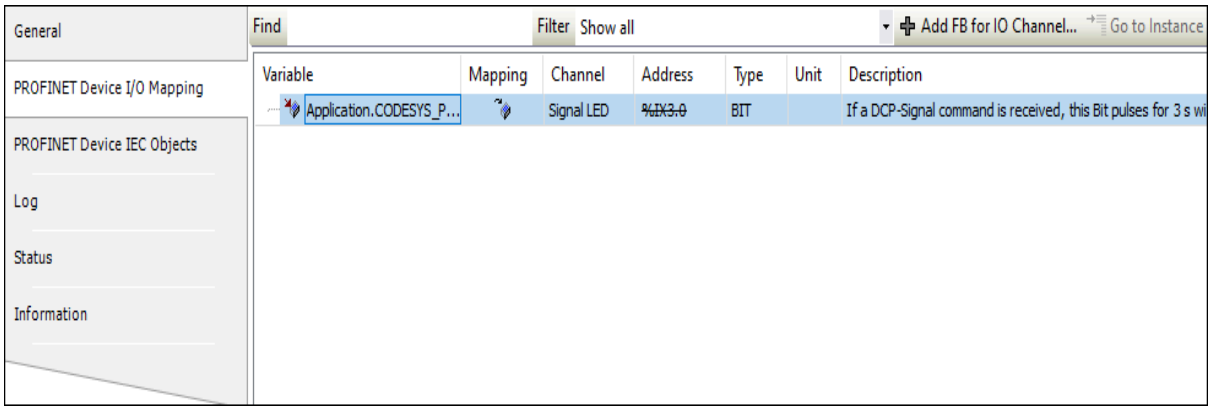
General



Setting	Description
Load remanent data	Select the IP and name assignment. If selecting this option, the IP settings and the station name in the controller's PNDevice.data file are used. The IP address is 0.0.0.0 and the station name is blank initially.
Use project parameters	Select the IP and name assignment. If selecting this option, when starting the device, the values defined in the project for IP configuration and station name are used initially. (Not recommended)
Station name	Enter the station name of the PROFINET device.
I/O Provider / Consumer Status	Select the I/O provider and consumer status.

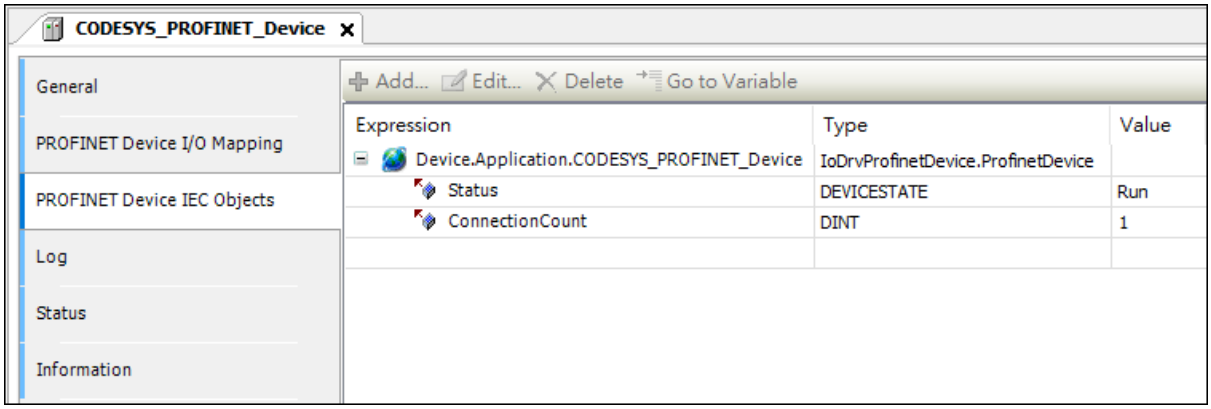
Setting	Description
	• **Use incoming**: The I/O data for the provider and consumer status is generated, which is received by the controller. • **Use outgoing**: The I/O data for the provider and consumer states is generated, which is sent to the controller.
Substitute values	Select the substitute value for the output data. • **Inactive**: The outputs are set to inactive, for example, 0. • **Last value**: The output data retain the last valid value. The value is retained even if the connection to the controller has been interrupted.

PROFINET Device I/O Mapping



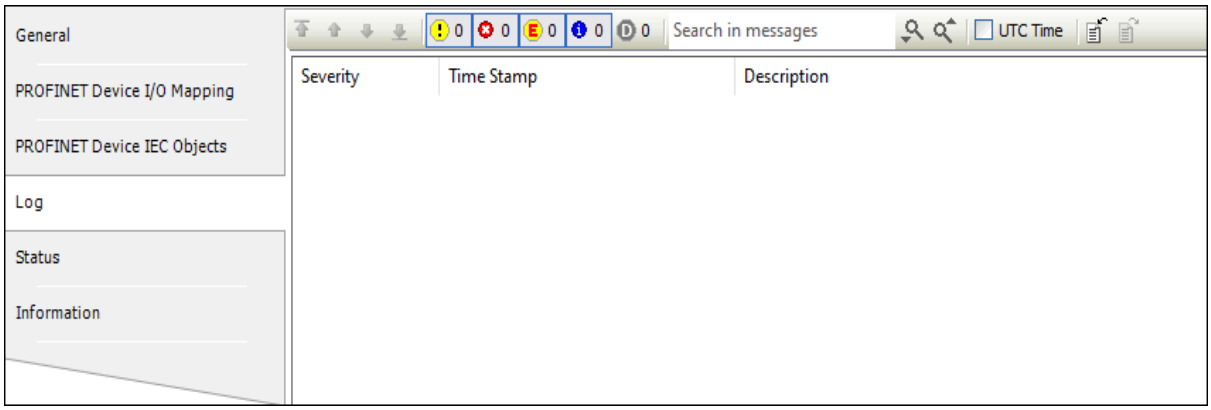
Create and map variables. For more information, see Edit I/O mapping.

PROFINET Device IEC Objects



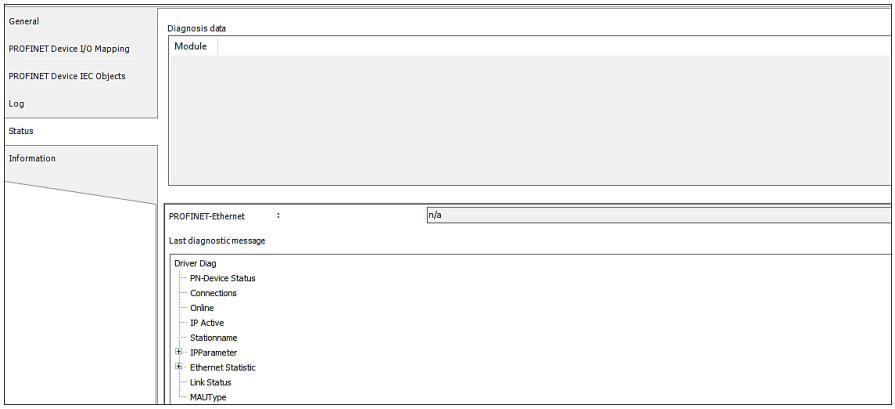
Shows the running status and connection count.

Log



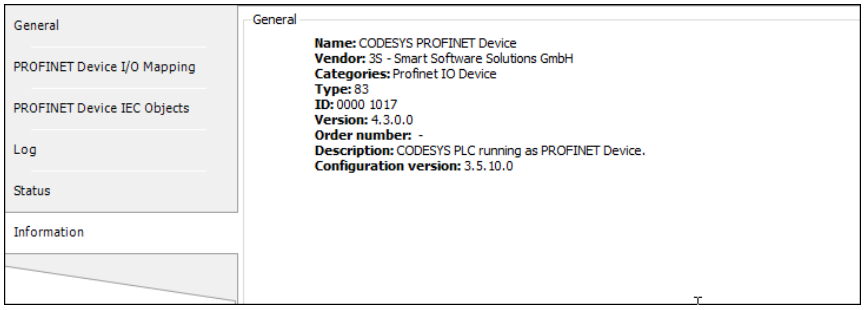
Shows the log details.

Status



Shows the PROFINET device's running status.

Information



Shows the PROFINET device's general information.

6.2.6.3 Add a PROFINET Coupler

AX-5 series controllers support adding a PROFINET coupler and then adding the input and output PROFINET modules.

To add an AX-5 PROFINET coupler

1. On the **Devices** pane, right-click **Ethernet_X (Ethernet)** and select **Add Device**.
2. In the **Add Device** dialog, select **Fieldbuses** > **Profinet IO** > **Profinet IO Master** > **PN-Controller**, and then click **Add Device**.
3. Right-click **PN Controller_X** and select **Add Device**.
4. In the **Add Device** dialog, select **Fieldbuses** > **Profinet IO** > **Profinet IO Slave** > **I/O**.
5. Select a coupler, and then click **Add Device**.

After adding the PROFINET coupler, you can add the PROFINET I/O modules according to your needs.

6.2.7 OPC UA Settings

OPC UA Server is included in the AX series controller. Use OPC UA Client to access the control interface of the controller to communicate with OPC UA Server through a TCP connection.

OPC UA Server supports the following functions.

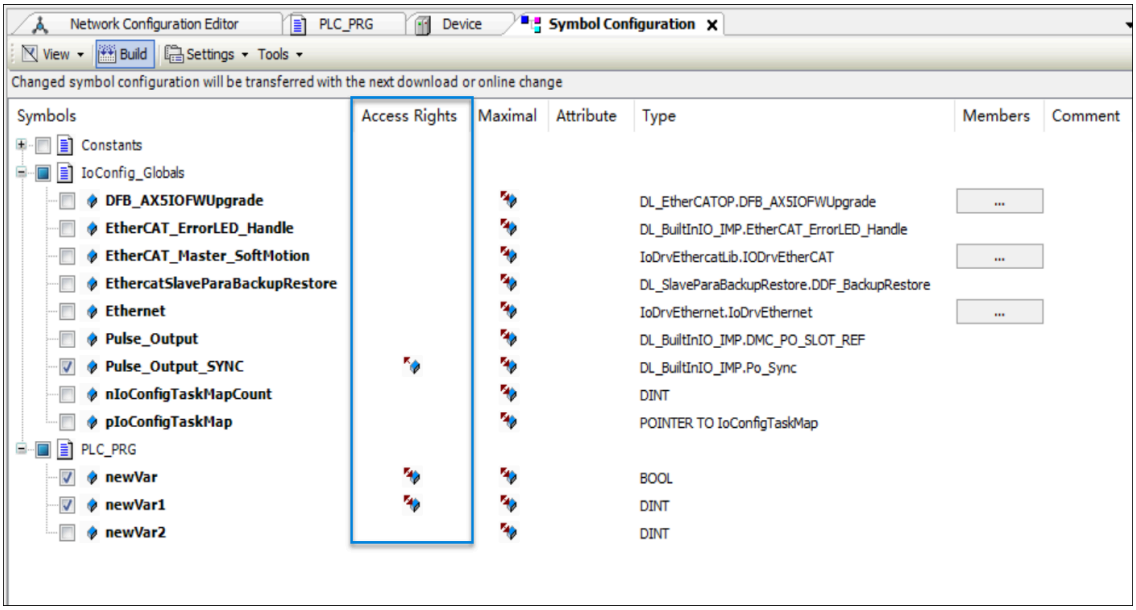
- Browse data types and variables.
- Standard read or write
- Value change notification (for subscribed and monitored items)
- Basic256SHA256 encrypted communication

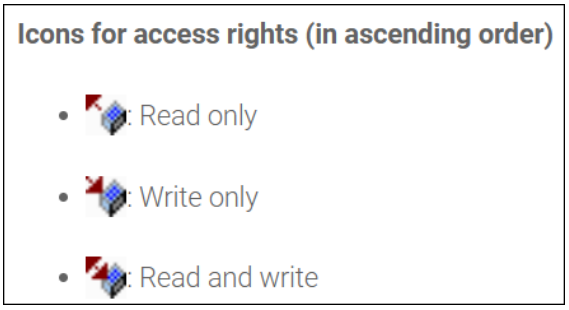
6.2.7.1 Assign OPC UA Access Rights to Variables

To use OPC UA Server, you need to assign OPC UA access rights to variables to allow OPC UA Client to read and write the variables.

To assign OPC UA access rights to variables

1. Declare different types of variables.
2. On the **Devices** pane, right-click **Application** and then select **Add Object** > **Symbol Configuration**.
3. In the **Add Symbol Configuration** dialog, select **Support OPC UA features** and then click **Add**.
4. In the **Symbol Configuration** editor, click **Build**.
5. Select the variable to allow OPC UA Client to access.
6. Click the icon in the **Access Right** column to set read and write rights for each variable.





7. Click **Build**.
8. Download the project to the controller.

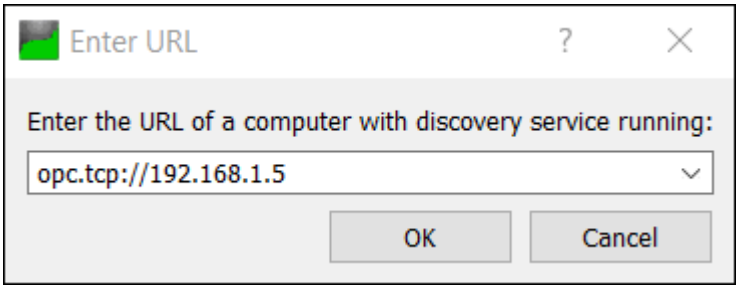
6.2.7.2 Establish a General Connection with UaExpert

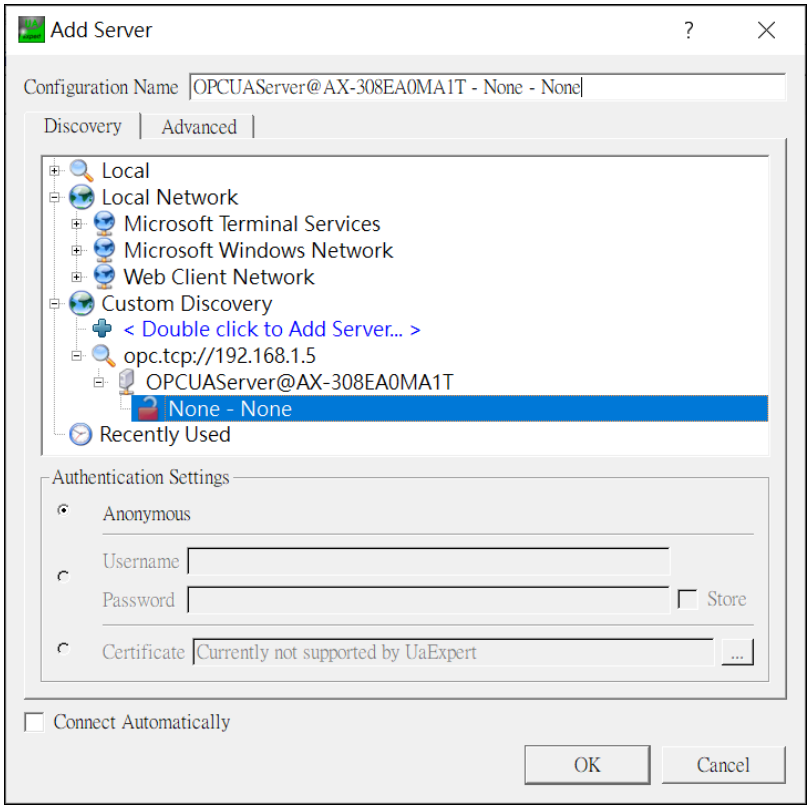
UaExpert is a full-featured OPC UA Client and is freely accessible.

Use the following steps to set up a general connection between UaExpert and AX series controller OPC UA Server. Other OPC UA Clients can follow the similar steps.

To establish a general connection between UaExpert and AX series controller OPC UA Server

1. Download UaExpert from http://www.unified-automation.com/downloads/opc-ua-clients.html.
2. Open **UaExpert**.
3. In the **Unified Automation UaExpert** dialog, click  .
4. In the **Add Server** dialog, under **Custom Discovery**, double-click **Add Server**.
5. In the **Enter URL** dialog, enter opc.tcp://*controller IP address*, and then click **OK**. The server is added.

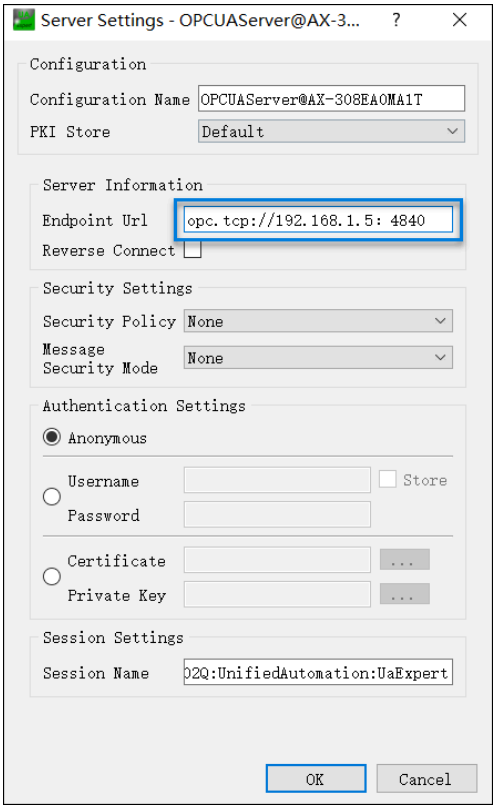




6. Expand the server, select **None-None** (no Security Policy and no Message Security Mode), and then click **OK**.

7. On the **Project** pane, right-click the server and then select **Properties**.

8. In the **Server Settings** dialog, change the **Endpoint Url** to opc.tcp://*controller IP address*:4840 and then click **OK**.



9. On the **Project** pane, right-click the server and then select **Connect**.
   The variables are shown on the **Address Space** pane.

6.2.7.3 Establish an Encrypted Connection with UaExpert

To encrypt data and securely exchange data with the client, the server needs a certificate when establishing a connection for the first time, and the client must trust the certificate. Then, the server also needs to trust the certificate sent by the client.

The process includes the following three parts.

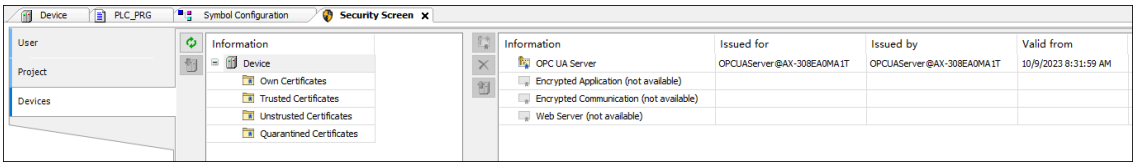
1. Add OPC UA certificate in DIADesigner-AX.
2. Trust the certificate sent by the server in UaExpert.
3. Trust the certificate sent by UaExpert in DIADesigner-AX.

To add OPC UA certificate in DIADesigner-AX

1. Connect to the controller.
2. (Optional) Set the user account and password. For more information, see Set up Users and Groups.

3. On the menu bar, select **View** > **Security Screen**.
4. Select **Devices**.
5. Click  > **Device** (controller name).

   All services in the controller that require certificates are shown on the right pane.
6. Select **OPC UA Server** (not available), and then click  .
7. In the **Certificate Settings** dialog, set the certificate.

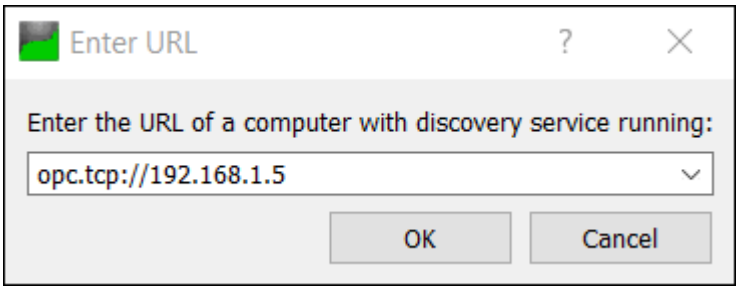


Note: Make sure the certificate is not expired.

8. Restart the runtime system.

To trust the certificate sent by the server in UaExpert

1. In the **Unified Automation UaExpert** dialog, click  .
2. In the **Add Server** dialog, under Custom Discovery, double-click Double click to Add Server.
3. In the **Enter URL** dialog, enter opc.tcp://*controller IP address*, and then click **OK**. The server is added.

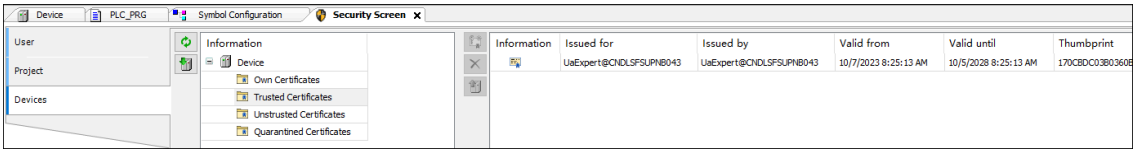


4. Expand the server, select an encrypted communication.
5. In **Authentication Settings**, select **Anonymous** or **Username** based on the user management settings in DIADesigner-AX.

6. Click **OK**.
7. On the **Project** pane, right-click the server and then select **Properties**.
8. In the **Server Settings** dialog, change the Endpoint Url to opc.tcp://*controller IP address*:4840 and then click **OK**.
9. On the **Project** pane, right-click the server, and then select **Connect**.
10. In the **Certificate Validation** dialog, click **Trust Server Certificate** and then click **Continue**.

To trust client certificate in DIADesigner-AX

1. In the **Security Screen** editor, click **Quarantined Certificate**.
2. Drag the UaExpert certificate to **Trusted Certificate**.



After the server and client have trusted each other's certificate, go back to UaExpert to connect to the server. Click **Ignore** if the **Connect Error** dialog shows.

6.2.7.4 Change Variable Values in UaExpert

Use the following steps to change the variable value.

To change the variable value

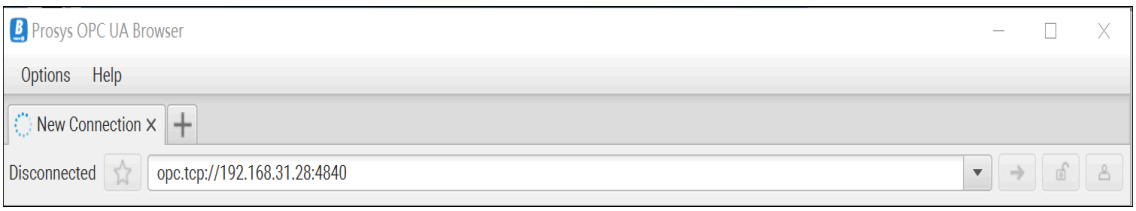
1. On the **Address Space** pane, select the variable and drag it to **Data Access View**.
2. Double-click the **Value** column to change the value.

6.2.7.5 Establish an Encrypted Connection with Prosys OPC UA Browser

Take Prosys OPC UA Browser as another example. The server and client also need to trust the certificate sent by each other.

To establish an encrypted connection with Prosys OPC UA Browser

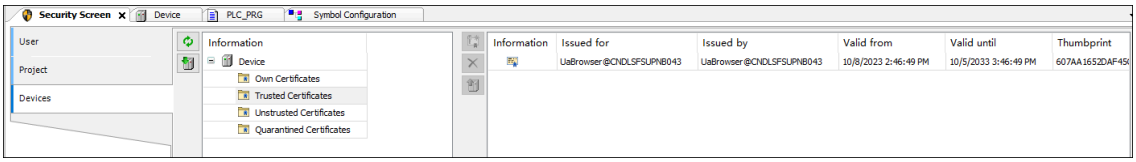
1. Download Prosys OPC UA Browser from https://downloads.prosysopc.com/opc-ua-client-downloads.php.
2. Open Prosys OPC UA Browser.
3. In the **Prosys OPC UA Browser** dialog, enter opc.tcp://*controller IP address*:4840, and then click  .



4. In the **Security Settings** dialog, select Security Mode and Security Policy, and then click **OK**.
5. In the **User Authentication** dialog, select **Anonymous** or **Username** based on the user management settings in DIADesigner-AX, and then click **OK**.
6. In the **Accept Certificate?** dialog, click **Accept Permanently**.
7. In DIADesigner-AX, in the **Security Screen** editor, click **Quarantined Certificate**.

   If no response, click  to refresh.

8. Drag the UaBrowser certificate to **Trusted Certificate**



Chapter 7: HMI Interactive

DIADesigner-AX supports exporting the user-defined variables to the XML file and then DIAScreen imports the XML file to communicate between the controller and Delta HMI devices.

For more information, see *DIAScreen Software User Manual*.

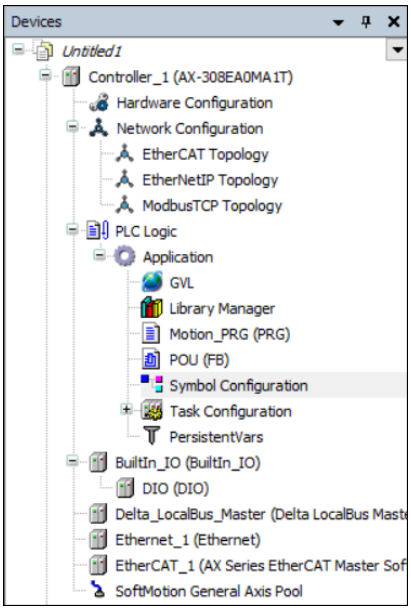
7.1 Export Variables from DIADesigner-AX

You can use **Symbol Configuration** to create symbol descriptions for project variables. The variables can be exported to an XML file from **Symbol Configuration**.

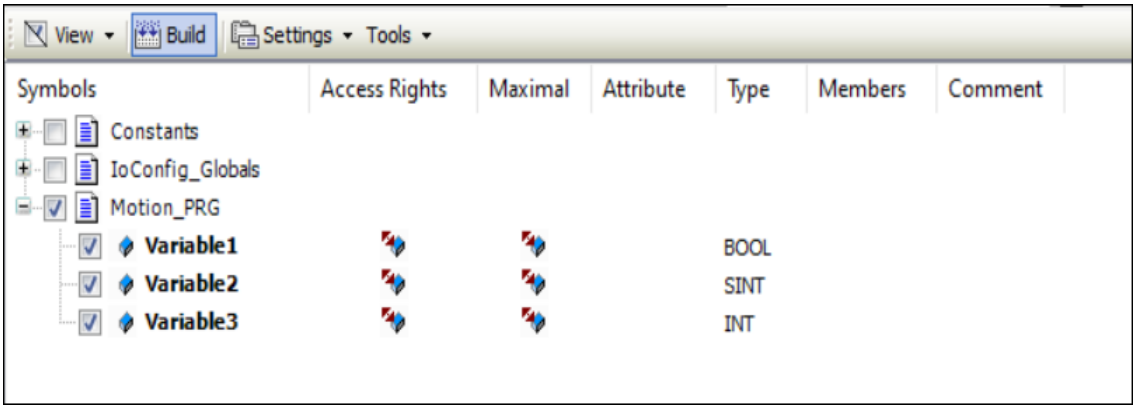
To export variables

1. On the **Devices** pane, right-click **Application**, and then select **Add Object** > **Symbol Configuration**.
2. In the **Add Symbol Configuration** dialog, select **Include comments in XML** and **Support OPC UA features**, and then click **Add**.

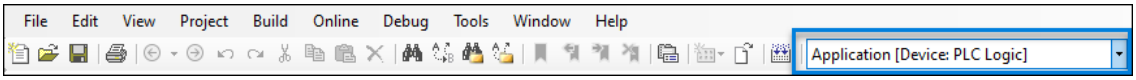
   Note: You can only add one **Symbol Configuration** in the same application.



3. On the **Symbol Configuration** editor, click Build or press **F11**, and then select variables in the symbol list.



4. Select the active application in the quick access toolbar if there are multiple applications under the same project.



5. Do one of the following to download the XML file of the active application.

   - Click  .
   - Press **F11**.
   - On the menu bar, click **Build** > **Generate Code**.

   The XML file will be saved in the same folder as that of the project. You can find the file path from **File** > **Save Project as**.

   You can also extract the .tgs file to find the XML files.

7.2 Import Tags to DIAScreen with DOP-100 Series Model

DIAScreen supports importing the XML file generated from the DIADesigner-AX project. DOP-100 series HMI supports sharing tags with DIADesiger-AX and CODESYS Development System.

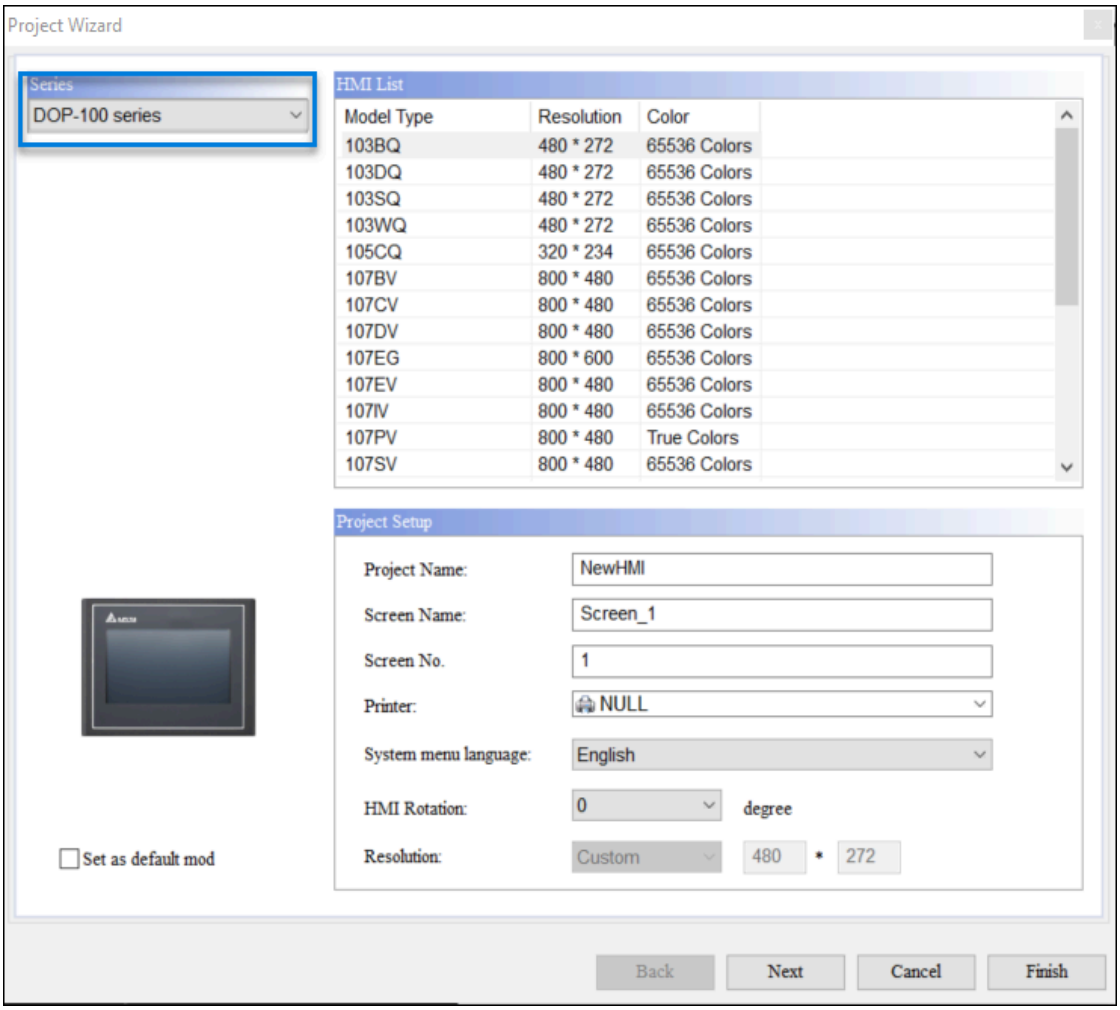
Use the following steps to import tags to DIAScreen with the DOP-100 series model.

To import tags to DIAScreen

1. Open **DIAScreen**.
2. Click **New project**.

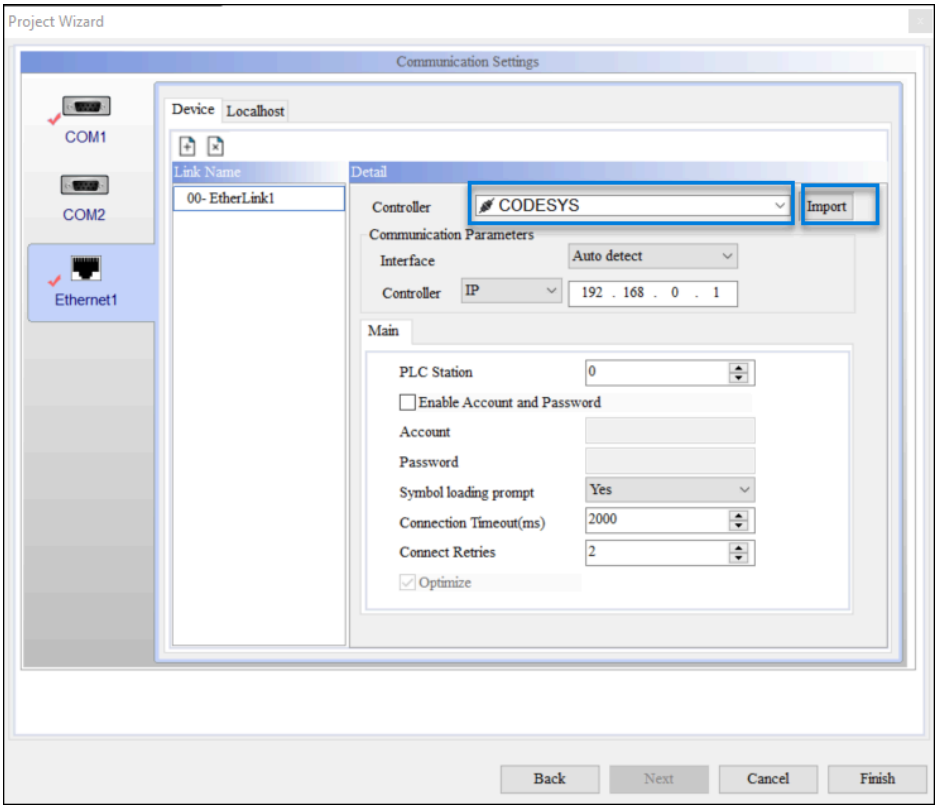
3. In the **Project Wizard** dialog, under the **Series** list, select **DOP-100 series**.

4. In **HMI List**, select an HMI model type and then click **Next**.



5. Click **Ethernet1** >  .

6. Select **CODESYS** in **Controller** and then click **Import**.



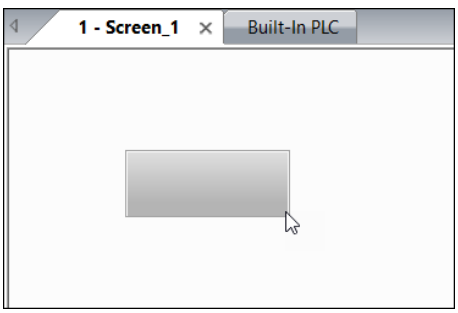
7. In the **Tag List** dialog, click  .

8. Select the XML file you exported from DIADesigner-AX and then click **OK**.

9. In the **Project Wizard** dialog, configure **Communication Parameters** of the controller and then click **Finish**.

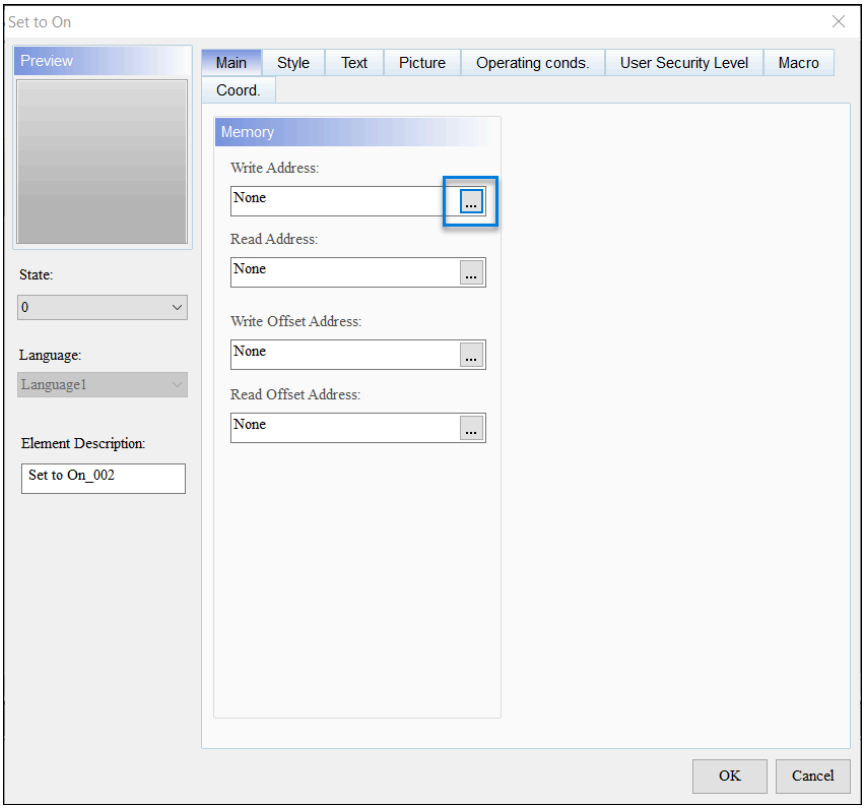
10. On the **1- Screen 1** pane, right-click the blank area and then select an element, for example, **Button** > **Set to On**.

11. On the **1- Screen 1** pane, draw the graphic element.

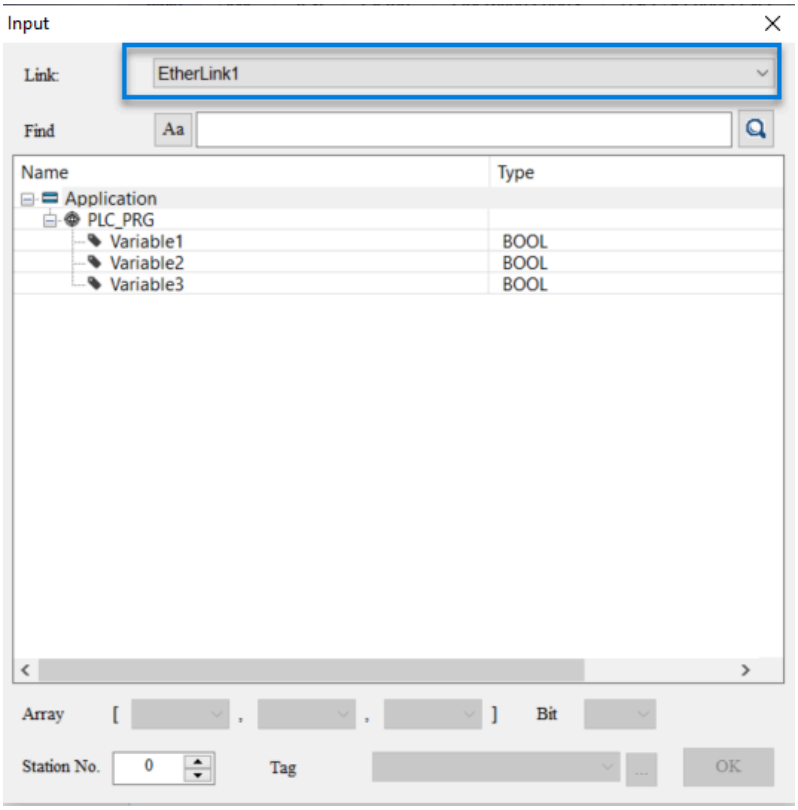


12. Double-click **Set to On**.

13. In the **Set to On** dialog, under **Write Address**, click  .



14. In the **Input** dialog, select **EtherLink1** for **Link**. The imported variables will be listed below.



15. Select a variable and then click **OK**.

The **Set to On** graphic element is linked with the variable.

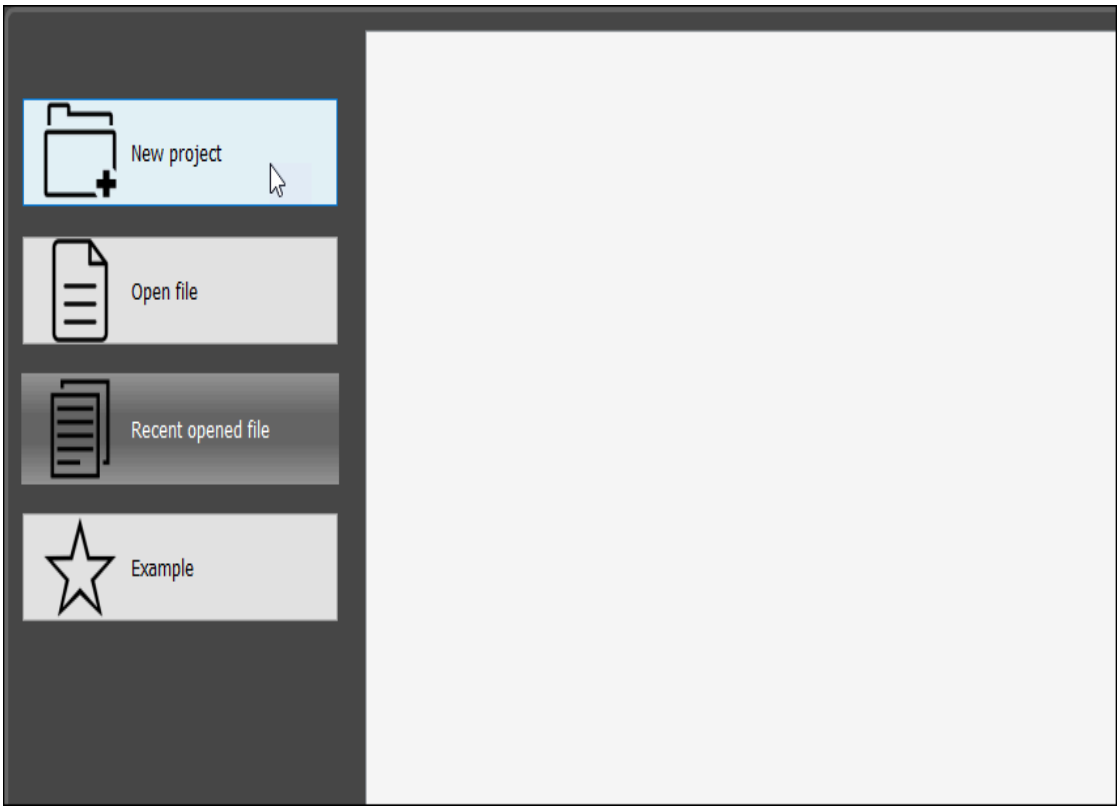
16. Repeat step 10–15 to add multiple graphic elements.
17. On the menu bar, click **Project** and then select **Compile All** to compile the project.
18. Click **Download All Data** to download the screen data to the HMI device.

7.3 Import Variables to DIAScreen with AX-8 Series Model

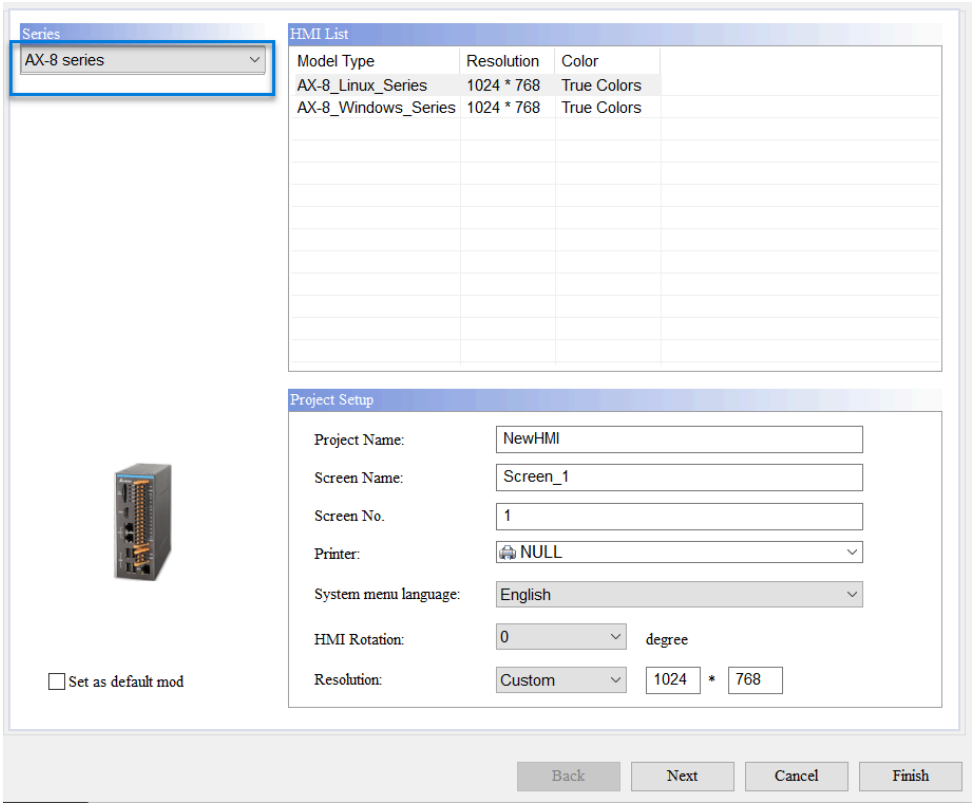
AX-8 series controller has built-in HMI. Use the following steps to import tags with AX-8 series model.

To import tags to DIAScreen

1. Open **DIAScreen**.
2. Click **New project**.



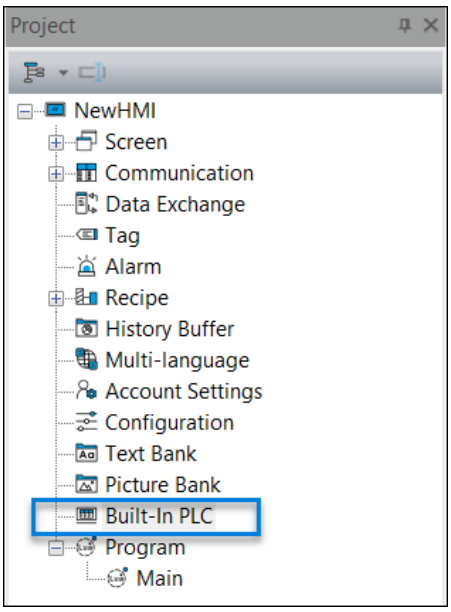
3. In the **Project Wizard** dialog, under the **Series** list, select **AX-8 series**.



4. In **HMI List**, select an **AX-8 series** and then click **Next**.

5. Configure **Communication Parameters** of the controller and then click **Finish**.

6. On the **Project** pane, double-click **Built-In PLC**.

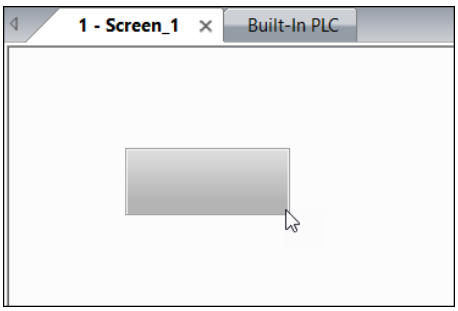


7. On the **Built-In PLC** pane, click  .

8. Select the XML file you exported from DIADesigner-AX and then click **Open**.

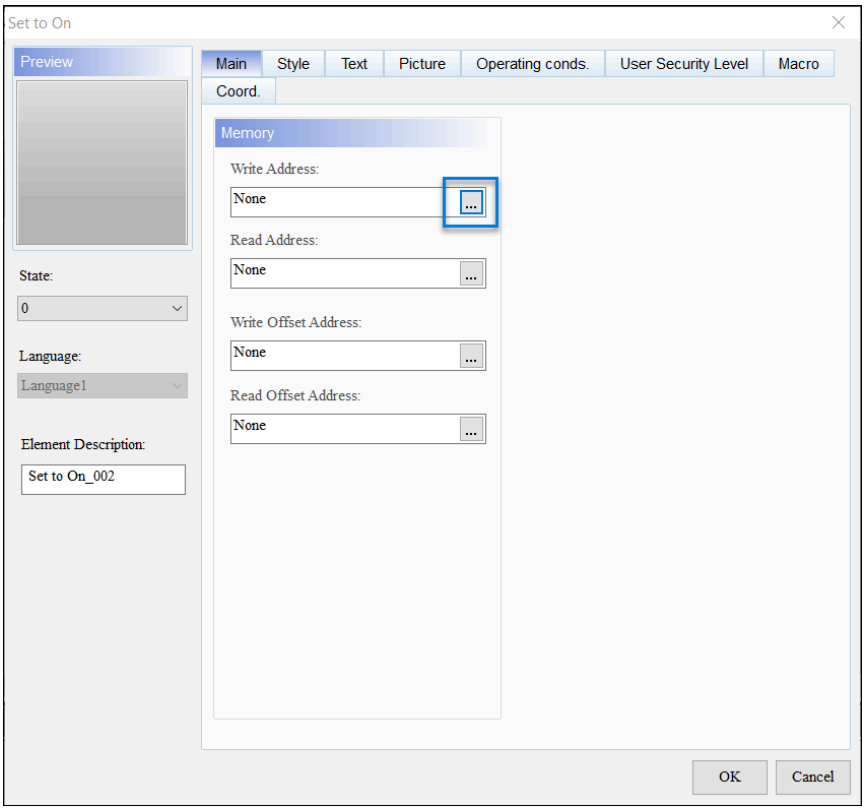
9. On the **1- Screen 1** pane, right-click the blank area and then select an element, for example, **Button** > **Set to On**.

10. On the **1- Screen 1** pane, draw the graphic element.

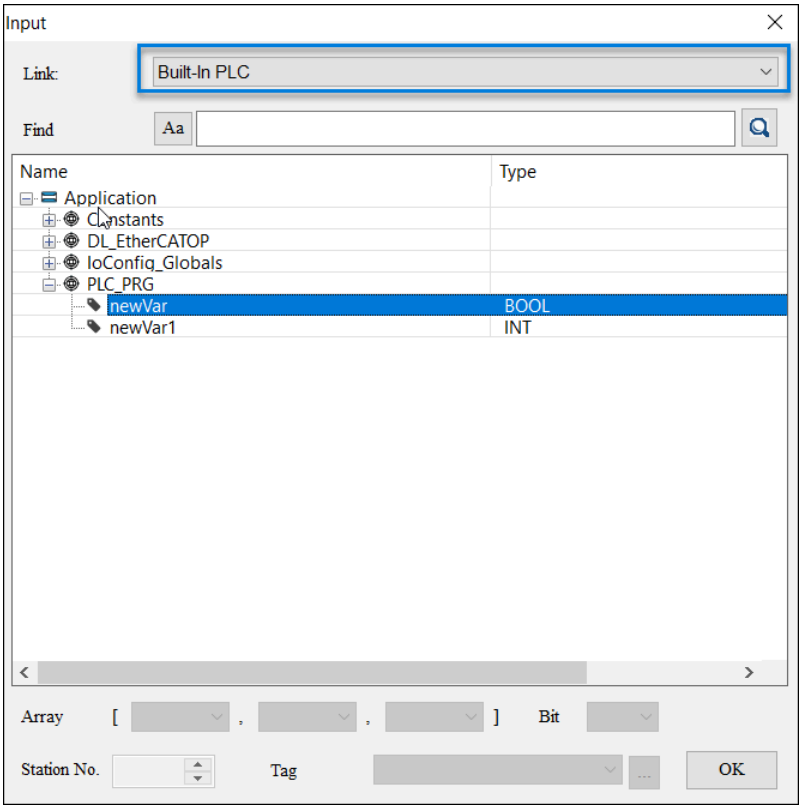


11. Double-click **Set to On**.

12. In the **Set to On** dialog, under **Writer Address**, click ...



13. In the **Input** dialog, select **Built-In PLC** for **Link**. The imported variables will be listed below.



14. Select a variable and then click **OK**.
    The **Set to On** graphic element is linked with the variable.

15. Repeat step 8–13 to add multiple graphic elements.

16. On the menu bar, click **Project** and then select **Compile All** to compile the project.

17. Click **Download All Data** to download to the AX-8 series controller.

7.4 Upload and Download

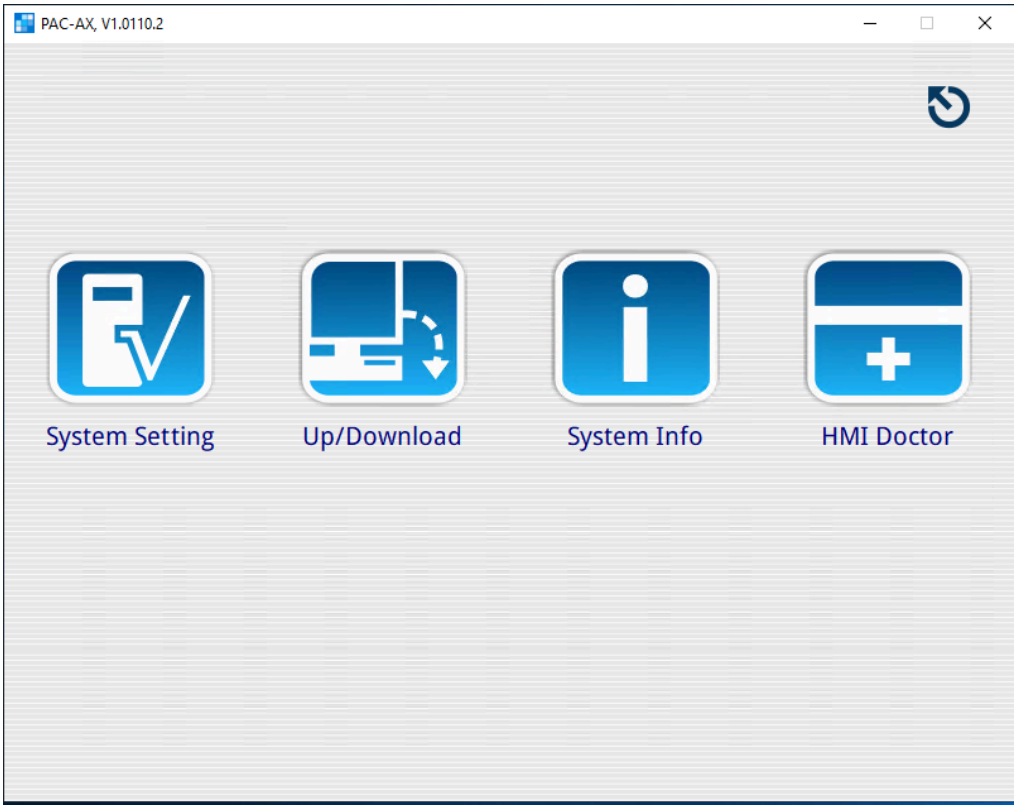
You can upload an application from DIADesigner-AX to an HMI device and also download an application from the HMI device. This allows you to change the running project for different needs.

Supported devices:

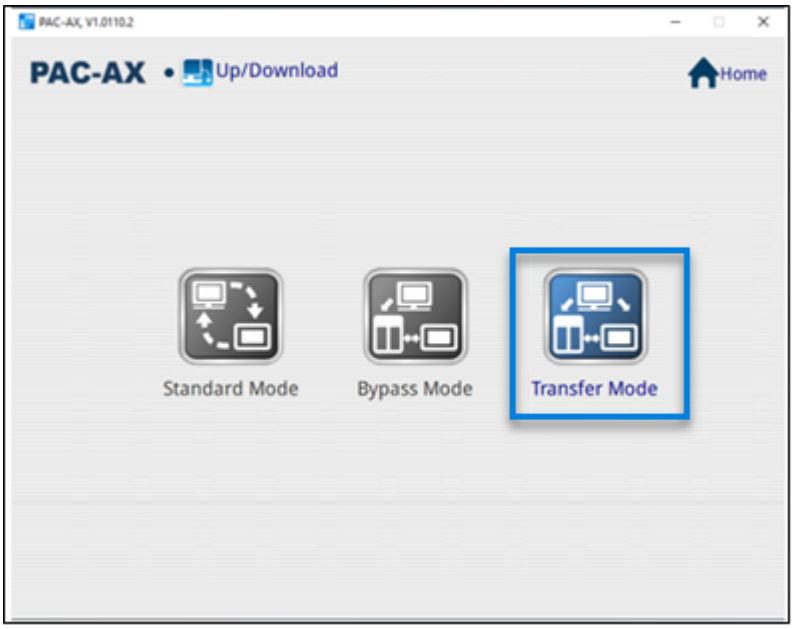
- DOP-100 series
- AX-8 series

To upload the application file

1. On the HMI screen, press the blank area for more than three seconds to start the screen system.
2. Click  .
3. Click **Up/Download**.



4. Click **Transfer Mode**.



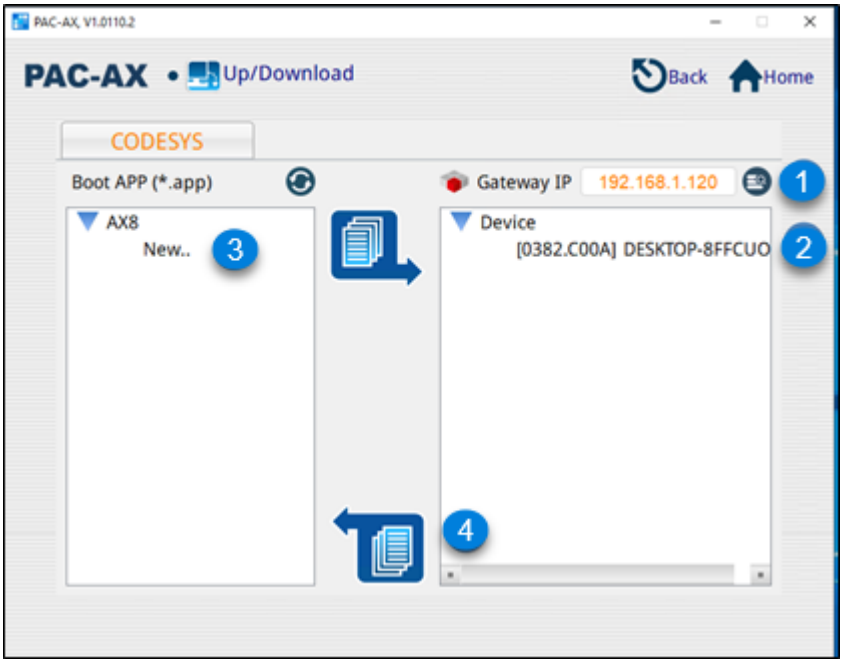
5. Do one of the following to upload the application file.

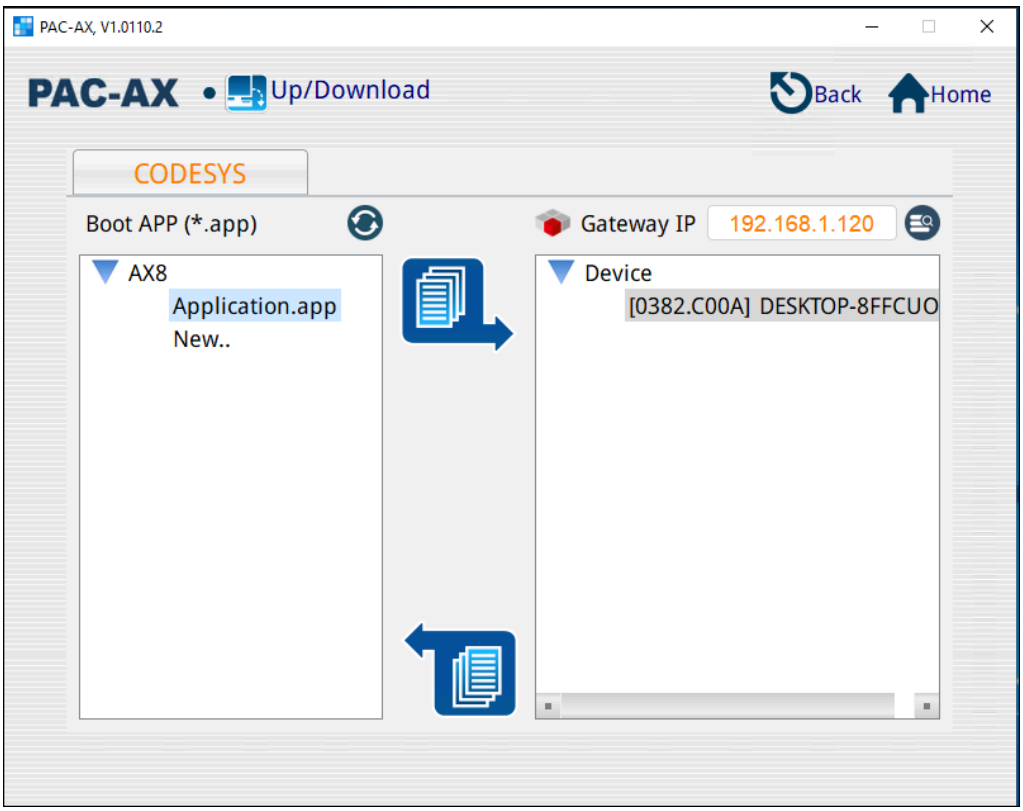
    - Open the DIADesigner-AX project and click **Online** > **Create Boot Application**.
    - Save the APP and CRC files in the project directory to the following path:
        - DOP-100 series: USB flash drive
        - AX-8 series: \Delta Industrial Automation\PLC-APP

Or

1. Click  to search the controller.

   The controller needs to be started and login in the DIADesigner-AX project.
2. Select the controller.
3. Select the folder path to upload.
4. Click  to upload.

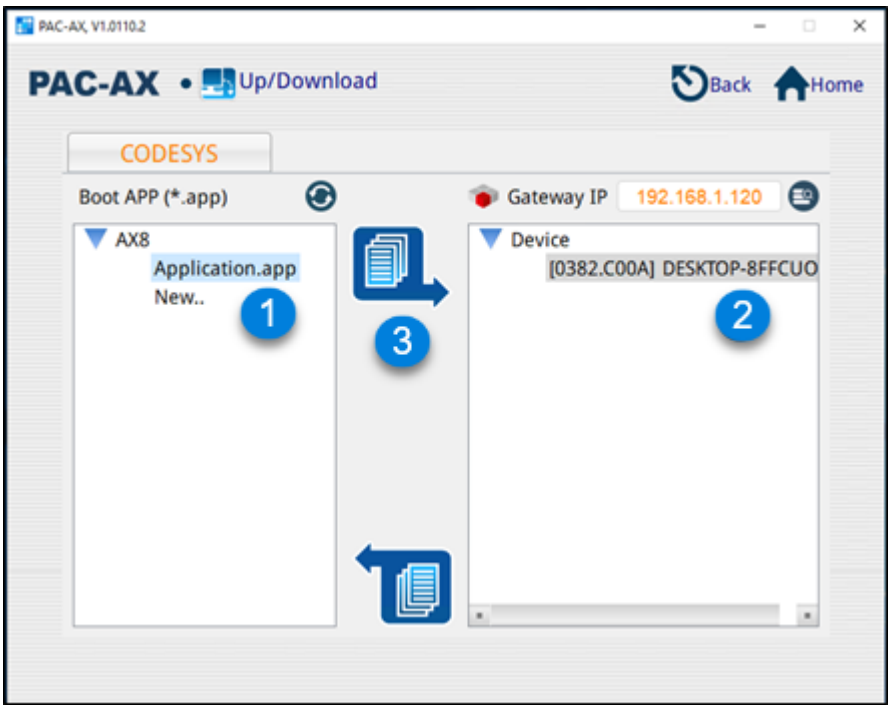




To download the application file

1. Select the application file to be downloaded.
2. Select the controller.

3. Click  to download.



Chapter 8: Tools and Configurations

Use the options available in the **Tools** menu to customize the development environment and access additional tools.

8.1 Options

How do I open the **Options** dialog?

- Select **Tools** > **Options**.

Use the **Options** dialog to configure the appearance and the behaviour of the user interface for DIADesigner-AX.

8.1.1 General

The following table lists the settings and descriptions in the **General** tab.

Setting	Description
Deleting slave devices from the project tree also deletes the devices and network lines in Network Configuration Editor simultaneously	Select to delete slave devices and network lines simultaneously in **Network Configuration Editor** when deleting the slave device from the project tree. **Note:** If the slave device is connected to different controllers in the same network, the slave device and network line are deleted in **Network Configuration Editor** as long as the slave device is no longer connected to any master controller and is all deleted in the project tree.
Enable all the devices (include sub devices) update	Select to update and add all supported sub devices and remove unsupported sub-devices when updating devices.
Turn on enhanced EtherCAT scanning	Select to turn on the enhanced functions of device scanning for EtherCAT.
Read alias address from ADO 0×0012 register	Select to read the device alias address from the ADO 0x0012 register. If clear the checkbox, read from EEPROM.
Show Legend in Network Configuration Editor	Select to show the color icon of each network line in **Network Configuration Editor**.

8.2 Device Repository

How do I open **Device Repository**?

- Select **Tools** > **Device Repository**.

The device repository is used to manage the device description files installed in the local system. You can also install a third-party device description file in **Device Repository** and add the device to the project.

Use the following table to configure the **Device Repository** dialog.

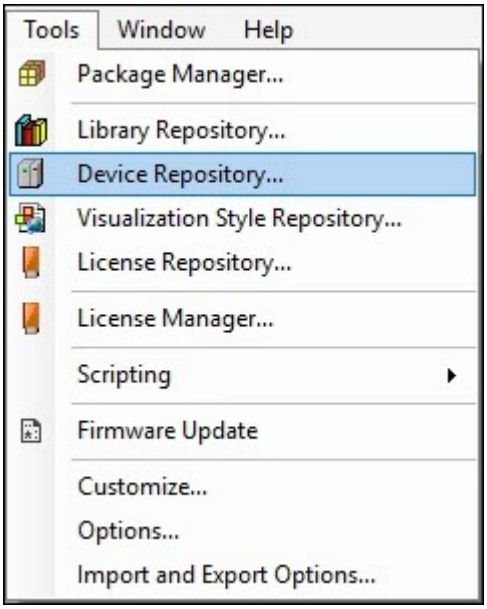
Setting	Description
Location	Select the device repository directory on the local system and the save location currently set.
Edit locations	Click to edit repository locations. The default location is System Repository.
Vendor	Select the manufacturers to see available devices.
Install	Click to install the device description file.
Uninstall	Click to remove the selected device.
Export	Click to export the device description file.
Details	Click to show detailed information of the selected device.

8.2.1 Install Device Description File

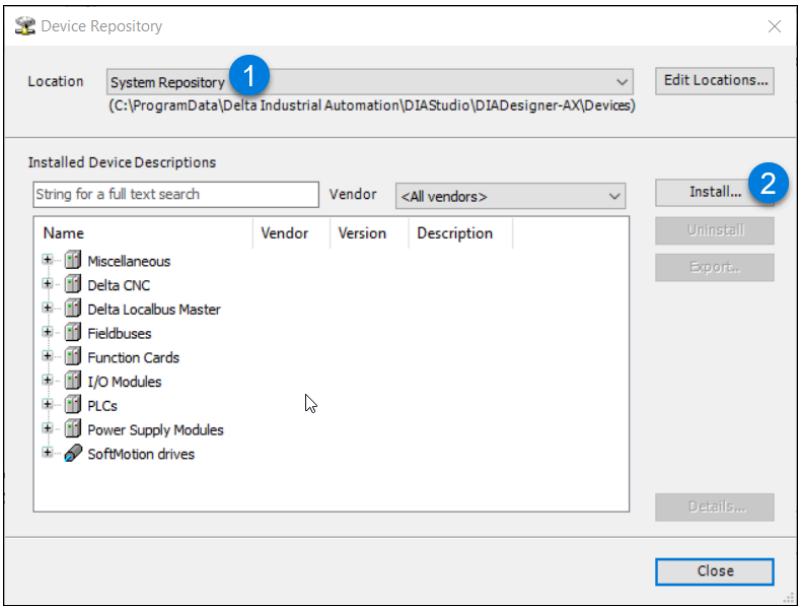
Use the following steps to install device description file.

To install the device description file

1. Select **Tools** > **Device Repository**.



2. In the **Device Repository** dialog, select **System Repository** as the location, and then click **Install**.



3. In the **Install Device Description** dialog, select the file type (recommend selecting **Automatic detection**), and then select the file to be installed and click **Open**.

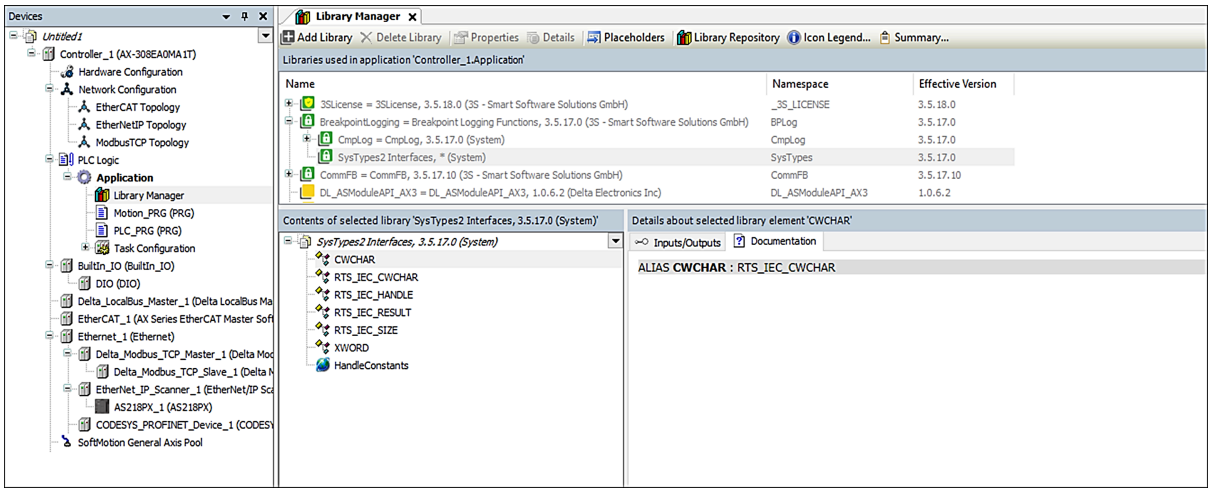
   After installation, you can find the new device description file under the device component it belongs to, and it is available when you add this type of device to the project.

8.3 Library Manager

How do I open the **Library Manager** pane?

- On the **Devices** pane, under **Application**, double-click **Library Manager**.

Library Manager provides an overview of the libraries used in the application. You can add the pre-installed libraries from the library repository to your application, delete them, or edit their properties. In addition to the pre-installed libraries, you can also create and install more libraries.



For more information about Library Manager, see Object: Library Manager.

8.3.1 Install and Uninstall a Library

Library Repository defines which libraries have been installed on the local system and can be used in the application. Use Library Repository to install more libraries.

To install a library

1. On the menu bar, click **Tools** > **Library Repository**.
2. In the **Library Repository** dialog, click **Install**.
3. In the **Select Library** dialog, select a library and then click **Open**.

To uninstall a library

1. On the menu bar, click **Tools** > **Library Repository**.
2. In the **Library Repository** dialog, select the library you want to uninstall and then click **Uninstall.**

8.3.2 Add a Library

After a library is installed, you can add it to the application.

To add a library

1. On the **Devices** pane, under **Application**, double-click **Library Manager**.
2. On the **Library Manager** pane, click **Add Library**.
3. In the **Add Library** dialog, select a library, and then click **OK**.

8.3.3 Export Library Files

You can edit the library properties in the **Properties** dialog. This function is recommended for library developers or users with library development knowledge.

To edit the library properties

1. On the **Library Manager** pane, right-click the library and then select **Properties**.
2. In the **Properties** dialog, edit the properties of the library.

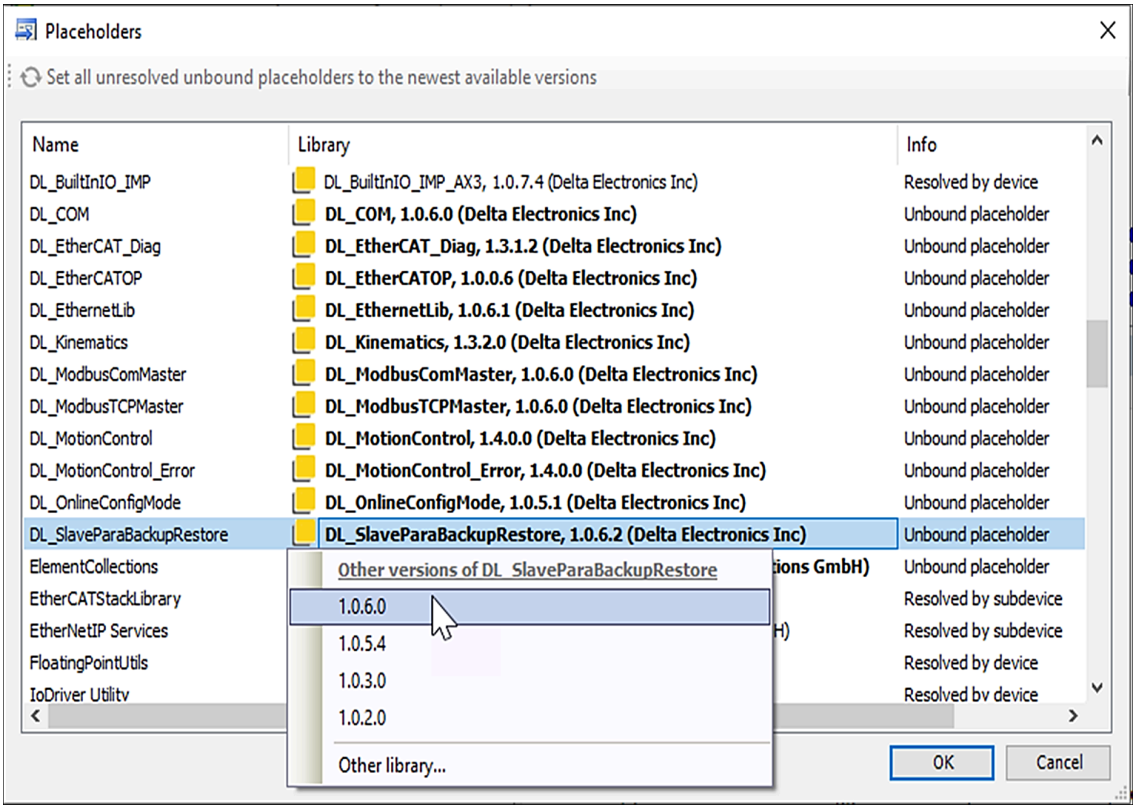
8.3.4 Change the Placeholder Library Version

A library placeholder is a placeholder that references a particular library. The placeholder shows the current library resolution of the application. Use the **Placeholder** dialog to change the version of the library placeholder when the library placeholder cannot be resolved.

To change library placeholder version

1. On the **Library Manager** pane, click **Placeholders**.
2. In the **Placeholders** dialog, double-click the field in the **Library** column of the placeholder whose resolution version you want to change.
3. In the dropdown list, select a version.

4. Click **OK**.



8.4 Firmware Update

With the update of the host and module versions, different controllers may have different available functions and parameters. DIADesigner-AX provides a device description file (DDF) that defines functions and parameters. When DIADesigner-AX is installed, the latest version of the DDF will be installed. The DDF includes the firmware information of all versions. When there is a need for new functions or parameters, the firmware version of the controller needs to be updated. The AX-8xxEP0 Windows Series controller does not support the firmware update.

8.4.1 Update the Firmware

Use the following steps to update the firmware of the controller.

Prerequisites

- The controller is connected.

To update the firmware

1. On the menu bar, click **Tools** > **Firmware Update**.
2. In the **Firmware Package Updater** dialog, do one of the following:
   - In **Path**, click  to browse the firmware package that will be used for firmware update.
   - Click  to download the firmware package from the server, and then click  to select the package.

     Note: You can customize the firmware package download path in the menu bar > **Tools** > **Options** > **Online Download**. The default path is C:\Users\XXX\Documents.
3. In **Online Device**, select the controller to be updated.
4. Ensure that **Device Type** and **Device ID** of the firmware package match that of the online device selected.
5. Click **Update**.

8.4.2 Firmware Package Updater Dialog

The following table lists the settings and descriptions of the Firmware Package Updater dialog.

Setting	Description
Firmware Package	
Path	Select the firmware package saved on the computer.
Vendor	Shows the firmware package manufacturer.
Device Type	Shows the firmware package device type number.
Device ID	Shows the firmware package device ID.
Device Version	Shows the firmware package device version number.
Mini FW Version	The firmware package is compatible with the minimum firmware version that can be updated.

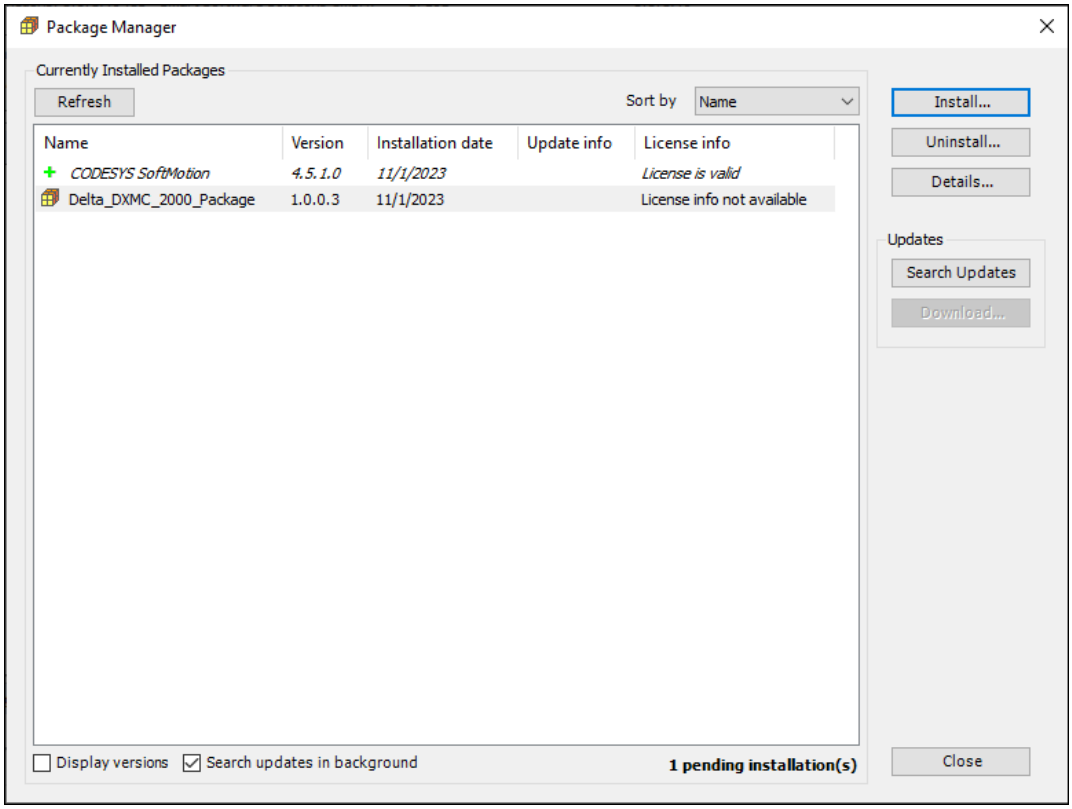
Setting	Description
Protected Package	If selected, the package is encrypted. Not editable.
	Click to download the firmware package online. Users in China are recommended to select **China** as the download server. The download speed is faster.
Integrity Details	
Signature Check	Automatically verify the firmware signature file after selecting the firmware package.
Hash Value Check	Automatically verify the hash value after selecting the firmware package.
Online Device	
Online Device	Select the controller to be updated.
Device Name	Shows the controller name.
Device Address	Shows the device address.
Device Type	Shows the controller device type number.
Device ID	Shows the controller device ID.
Device Version	Shows the controller device version number.
Update Progress	
Progress	Shows the update progress after clicking **Update**.

8.5 Package Manager

How do I open the **Package Manager** dialog?

- On the menu bar, select **Tools** > **Package Manager**.

Package Manager extends the standard installation with additional configuration settings. You can install, uninstall, and manage packages. The package is a compressed file with a *.package file extension.



The package components include the following:

- Plug-in
- Library
- Device descriptions
- Supplier’s description
- Profiles
- Information profiles
- Profile changes
- Files
- Extensions for configuration of the menu, toolbar, keyboard shortcuts, and views
- Help modules

- Complete menu configurations for special profiles
- Complete toolbar configurations for special profiles
- Complete keyboard configurations for special profiles
- Options
- Library profiles

Package Manager provides the following settings.

Setting	Description
Refresh	Click to refresh the installed package list.
Install	Click to install the package. Browse the packages and select the package to install. The installation steps include: • **Check package signatures**: Select **Allow unsigned and self-signed packages** to install an unsigned or self-signed package. • **Installation - License Agreement**: It only shows if the package contains a license agreement. • **Installation - Choose Setup Type** ◦ Complete setup: install all components. ◦ Typical setup: install the standard set of components defined in the package. ◦ Customized setup: install the selected components.

Setting	Description
	• **Installation - Target Versions**: Select the versions that the package should upgrade. • **Installation - Directories**: Select the target installation path.
Uninstall	Click to uninstall the package. • When **Display versions** is not selected, all versions of the selected package will be uninstalled. • When **Display versions** is selected and you do not select a node or select the root node, all versions of the selected package will be uninstalled. • When **Display versions** is selected and you select a package version under the root node, only the selected version will be uninstalled.
Details	Click to view the detailed information of the package.
Updates	
Search Updates	Click to search for updates.
Download	Click to open the **Download Package** dialog to download and install the update packages.
Display versions	Select to show all versions of installed packages.
Search updates in background	Select to search for updates for the selected package every hour automatically. The update package is listed in the **Update Info** column.

8.5.1 Install and Uninstall a Package

Use the following steps to install a package.

To install a package

1. On the menu bar, select **Tools** > **Package Manager**.
2. In the **Package Manager** dialog, click **Install**.
3. In the **Open** dialog, select a package file and then click **Open**.
4. In the **Installation** dialog, follow the package installation guidance to install the package. For more information about the installation options, see Package Manager.
5. After the installation completes, click **Finish**.

> **Note:** If you want to use the function blocks in the library OSCAT BASIC, you must install the OSCAT BASIC. The location of the package is C:\Program Files\Delta Industrial Automation\DIAStudio \DIADesigner-AX 1.x\CODESYS\Packages.

To uninstall a package

1. On the menu bar, select **Tools** > **Package Manager**.
2. In the **Package Manager** dialog, select the package and then click **Uninstall**.
3. In the **Uninstallation** dialog, follow the guidance to uninstall the package.
4. After the uninstallation completes, click **Finish**.

8.6 Startup Command

How do I open **Startup Command**?

- On the **Devices** pane, right-click the controller and then select **Startup Command**.
- Select **Tools** > **Startup Command**.

Startup Command supports configuring and generating different commands to a .PLCCmd.ini.scmd file and saving it to a portable device. Once the portable device is attached to the controller, the command will be run after a restart of the controller.

> **Note:** An SD card of 64G or less is recommended.

Supported device:

- AX-3 series controllers
- AX-5 series controllers
- AX-8 series controllers (Except for the AX-8 Windows series)
- AX-C series controllers

Note: AX-8 series and AX-332 controllers only suggest using SD memory card as the portable device. For the AX-332 controller, you need to open the 

cover to find the hidden Micro SD slot. For more information about inserting a memory card, see *AX-3 Series Operation Manual* .

Use the following table to configure the **Startup Command** dialog.

Setting	Description
	Click to open the **Command** dialog to add or insert commands.
	Click to open the **Template** dialog to select the command template.
	Click to export the command configuration file.
	Click to import the command configuration file.
Append Command	Select to add commands.
Insert Command	Select to insert commands before the selected command.
Restore Application from Selected Device	Select to restore the application file from the current application to the controller.
Restore Application from Portable Device	Select to restore the application file from the portable device to the controller.

Setting	Description
Restore Source from Current Project	Select to restore the source file from the current project to the controller.
Restore Source from Portable Device	Select to restore the source file from the portable device to the controller.
Reset to Factory Settings	Select to reset the controller to the factory settings.
Backup Application	Select to back up the application file from the controller to the portable device.
Backup Source	Select to back up the source file from the controller to the portable device.
Firmware Update	Update the controller firmware from the portable device.
Keep	Select to always run this command.
Execution Time	Clear **Keep** and enter **Execution Times** (1–65536). After running the number of times you defined, the command will be deleted.
Exit	Select to stop and exit after running this command.

8.6.1 Add and Generate Commands

Use backup and restore commands to save and recover the file in case of an unexpected data loss, or to transfer files from one controller to another. Use the firmware update command to update the controller firmware via the file in the portable device. Use the reset to factory settings command to delete all the data and settings in the controller.

8.6.1.1 Back up Application or Source

Use the following steps to backup the application or the source.

Prerequisites

- The portable device is attached.

To back up the application or the source

1. Open the **Startup Command** dialog.
2. Click  .
3. In the **Command** dialog, select **Append Command**, and then select **Back up Application** or **Back up Source**.
4. Click **OK**.
5. In the **Startup Command** dialog, set up the execution of the command via **Keep**, **Execution Times**, or **Exit**.
6. (optional) Click **?** to precompile commands to check the required space, and verify errors if any.
7. Click **Generate**. The command file is generated in the portable device.

Note: Only the FAT32 format portable device is supported. A message will ask you to format your portable device to FAT32 if it is not. You can follow the steps to format it.

8.6.1.2 Restore Application or Source

Use the following steps to backup the application or the source.

To restore the application or the source from the portable device

1. Open the **Startup Command** dialog.
2. Click  .
3. In the **Command** dialog, select **Append Command**, and then select **Restore Application from Portable Device** or **Restore Source from Portable Device**.
4. Click **OK**.
5. In the **Startup Command** dialog, set up the execution of the command via **Keep**, **Execution Times**, or **Exit**.

6. (optional) Click **?** to precompile commands to check the required space, and verify errors if any.
7. Click **Generate**.
8. Attach the portable device to the target controller. The command will be run after a restart of the controller.

Note: Make sure the restore file exists before running the command to restore the application or source file from the portable device.

To restore the application or the source from the the current project

1. Connect to the controller.
2. Open the **Startup Command** dialog.
3. Click  .
4. In the **Command** dialog, select **Append Command**, and then select **Restore Application from Selected Device** or **Restore Source from Current Project.**
5. Click **OK**.
6. In the **Startup Command** dialog, set up the execution of the command via **Keep**, **Execution Times**, or **Exit**.
7. (optional) Click **?** to precompile commands to check the required space, and verify errors if any.
8. Click **Generate**.

8.6.1.3 Add Additional Files

When you select **Restore Source from Current Project**, you can also add the additional files.

To add additional files

1. Open the **Startup Command** dialog.
2. Click  .

3. In the **Command** dialog, select **Append Command** > **Restore Source from Current Project**, and then click **OK**.
4. In the **Startup Command** dialog, in the **Settings** column, click **Additional Files**.
5. In the **Additional Files** dialog, select the files and then click **OK**. These settings are synchronized with **Project** > **Project Settings** > **Source Download** > **Additional Files**, and can be saved with the project.

8.6.1.4 Update Firmware

Use the following steps to update firmware.

To update firmware

1. Open the **Startup Command** dialog.
2. Click  .
3. In the **Command** dialog, select **Append Command** > **Firmware Update**, and click **OK**.
4. In the **Startup Command** dialog, in the **Settings** column, click  , select the firmware package file, and then click **Open**.
5. In the **Startup Command** dialog, set up the execution of the command via **Keep**, **Execution Times**, or **Exit**.
6. (optional) Click **?** to precompile commands to check the required space, and verify errors if any.
7. Click **Generate**. The command file is generated in the portable device.

   Note: Only FAT32 format portable device is supported. A message will ask you to format your portable device to FAT32 if it is not. You can follow the steps to format it.

8. Attach the portable device to the target controller. The command will be run after a restart of the controller.
9. After the firmware update completed, restart the controller again.

8.6.1.5 Reset to Factory Settings

Use the following steps to reset to the factory settings

To reset to the factory settings

1. Open the **Startup Command** dialog.
2. Click  .
3. In the **Command** dialog, select **Append Command** > **Reset to Factory Setting**, and click **OK**.
   All the data and settings in the controller will be deleted after running this command.
4. In the **Startup Command** dialog, set up the execution of the command via **Keep**, **Execution Times**, or **Exit**.
5. (optional) Click ? to precompile commands to check the required space, and verify errors if any.
6. Click **Generate**. The command file is generated in the portable device.

   Note: only FAT32 format portable device is supported. A message will ask you to format your portable device to FAT32 if it is not. You can follow the steps to format it.

7. Attach the portable device to the target controller. The command will be run after a restart of the controller.
8. After running the command, restart the controller again.

8.6.2 Add and Generate Template Commands

The template command provides you with two command combinations that are convenient for widely used situations. Select one of the following options if you want to apply the application or source file to another controller.

- Backup & Restore Application
- Backup & Restore Source

Prerequisites

- The portable device is attached.

To add and generate template commands

1. Open the **Startup Command** dialog.
2. Click  .
3. Select one of the templates, and then click **OK**.
4. Click **Generate**. The command file is generated in the portable device.

   Note: Only FAT32 format portable device is supported. A message will ask you to format your portable device to FAT32 if it is not. You can follow the steps to format it.

5. Attach the portable device to the controller to back up the file.
6. Attach the portable device to the other controller to restore the file.

8.6.3 Import and Export Commands

You can export and import the command configuration to an XML file.

To export commands

1. Open the **Startup Command** dialog.
2. Add the command.
3. Click  .
4. Enter **File Name**, and then select a path to save the command configuration file.
5. Click **Save**.

To import commands

1. Open the **Startup Command** dialog.
2. Click  , and select the command configuration file to be imported.
3. Click **Open**. The commands will be listed in the **Startup Command** dialog.

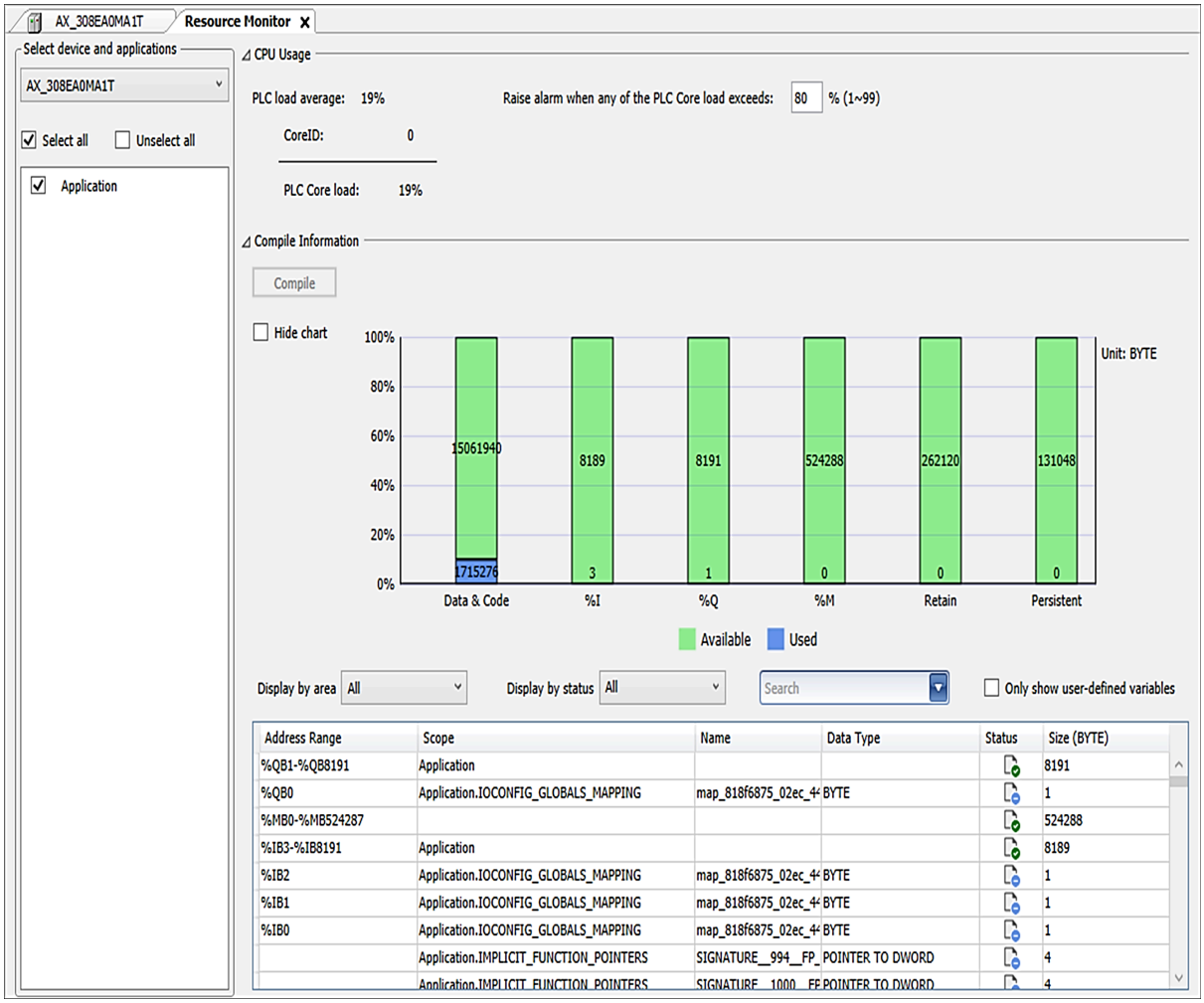
8.7 Resource Monitor

How do I open **Resource Monitor**?

- Select **Tools** > **Resource Monitor**.

Resource Monitor is only available when there is a project with AX series controllers.

Use **Resource Monitor** to monitor the controller CPU usage in real time and the variable usage, such as the size of variables assigned to different storage areas.



8.7.1 Monitor Variable Usage

Use the following steps to view the variable usage.

To monitor variable usage

1. On the **Select device and application(s)** pane, select the device and applications that you want to monitor.

   If you edit devices or applications on the **Devices** pane, it will be updated in real-time on the **Select device and application(s)** pane.

2. On the **Compile Information** pane, click **Compile**.

All user-defined variables and system variables are monitored.

The following table lists the variable compilation information.

Item	Description
Address Range	Shows the address range of I%, M%, or Q%.
Scope	Shows the location of the variable. The scope format: Application name + Signature name.
Name	Shows the variable name.
Data Type	Shows the variable data type.
Status	Shows the usage condition of the address. •  : Used: There are variables assigned to the address. •  : Available: No variables assigned to the address within this range. •  : Conflict: Different variables are assigned to the same address.
Size (BYTE)	Show the variable size or the size of the address section.

On the **Compile Information** pane, you can:

- Double-click the variable in the table to see where it is being used.
- Filter the variables by area or status.
- Search the variable by the variable name, address range, or scope.
- Select **Only show user-defined variable** to filter out the system variables.
- Select **Hide Chart** to hide the bar chart to expand the variable table.

8.7.2 Monitor the Online Controller CPU Usage

Use the following steps to monitor the controller CPU usage when the controller is online.

To monitor the online controller CPU usage

1. On the **Devices** pane, double-click the device.
2. On the **Device** editor, select **Communication Settings** > **Scan Network**, and then select the device.
3. Click **System Settings** > **Read from PLC**.
4. Log in to the controller.

The **CPU Usage** at the lower-right corner will show. You can also double-click it to launch **Resource Monitor**.

Resource Monitor monitors the CPU usage of the corresponding online controller.

The following table lists the items monitored online.

Item	Description
PLC load average	Shows the average PLC load.
Raise alarm when any of the PLC Core load exceeds %	The **CPU Usage** at the lower-right corner turns red when any of the **PLC Core load** exceeds the specified value.
CoreID	Shows the Core ID.

Item	Description
PLC Core load	Shows the PLC Core load in real time.

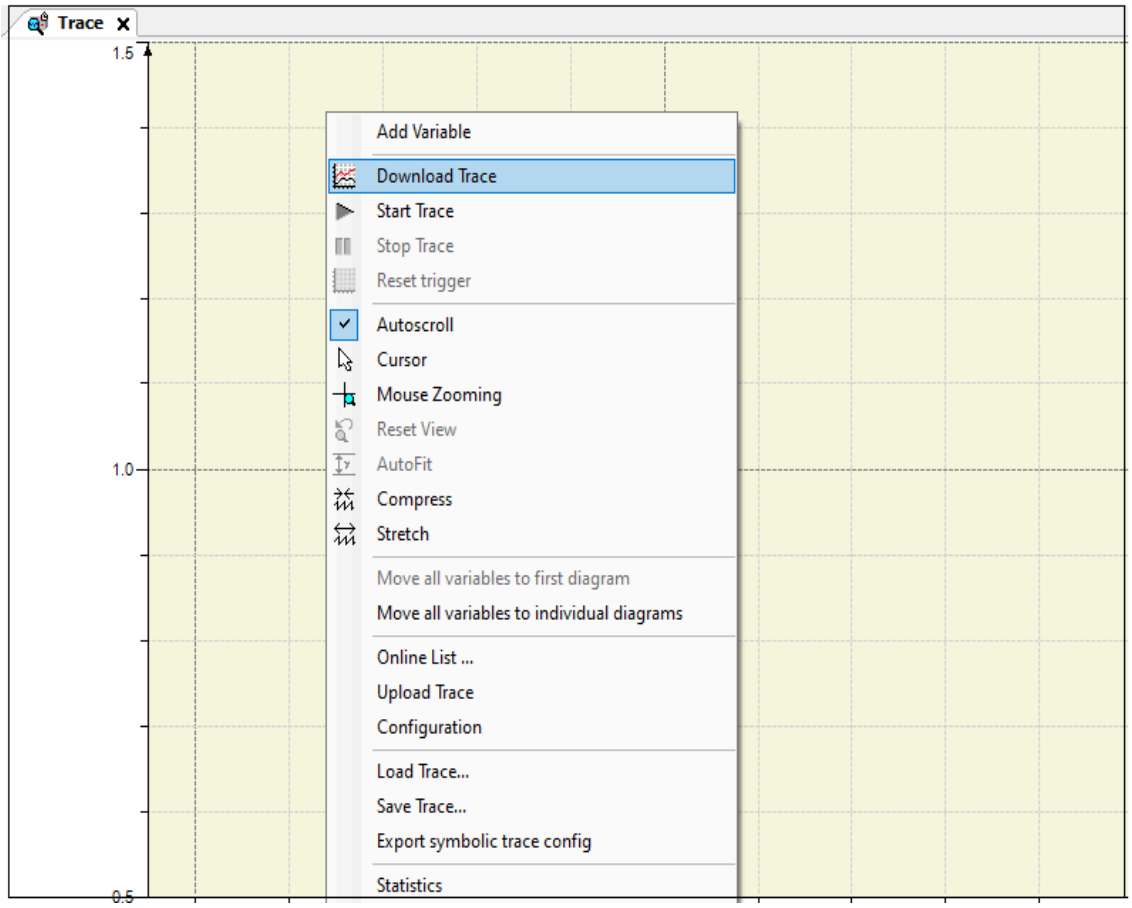
Note: If you log in under simulation mode, CPU usage monitoring will not be available.

8.8 Trace Variables

Trace is used to monitor variables and show the variables' value change in amplitude charts.

To trace variables

1. On the **Devices** pane, right-click **Application** and select **Add Object** > **Trace**.
2. In the **Add Trace** dialog, enter a name, select a task, and click **Add**.
3. On the trace tab, click **Add Variable**.
4. In the **Trace Configuration** dialog, click ... next to **Variable**.
5. In the **Input Assistant** dialog, select a trace variable or traceable parameter and click **OK**.
6. Log in to the controller.
7. Right-click the **Trace** field and select **Download Trace** to start monitoring.



8. (optional) You can select **Move all variables to individual diagrams** to show the trace separately for multiple variables.

8.8.1 Automatically Save Traces

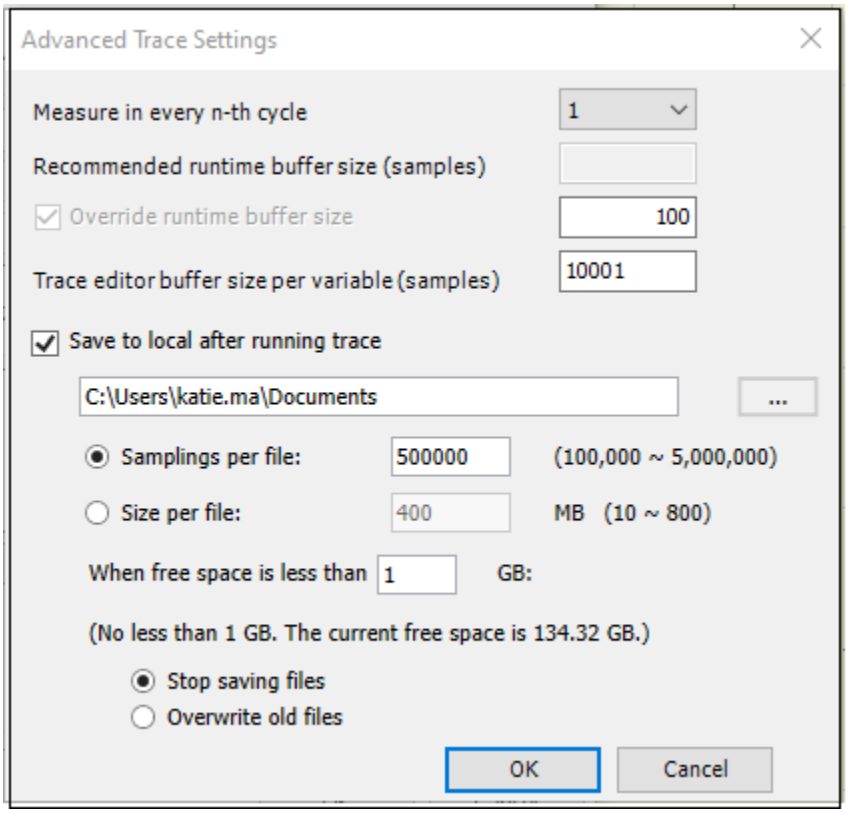
DIADesigner-AX supports automatically saving the trace data to a local .csv file after the trace starts. Saving samplings will only stop when the free disc space reaches the lower limit you set up.

To automatically save traces

1. On the trace tab, click **Configuration**.
2. In the **Trace Configuration** dialog, click **Advanced**.
3. In the **Advanced Trace Settings** dialog, select **Save to local disc after running trace** to turn on more options.
4. Select a local path to save the file.
5. Do one of the following:

- Select **Samplings per file**, and then enter the number of samplings saved to one .csv file.
- Select **Size per file**, and then enter the size limit of the .csv file.

6. Enter the minimum disc space and select an option when reaching this limit.



8.8.1.1 Add Time Value to the Trace File

The .csv file which automatically saves the trace data does not contain the time value for each traced item. Use the following steps to add the time value to the .csv file.

To add time value to the trace file

1. On the **Devices** pane, double-click **Library Manager**.
2. In the **Library Manager** editor, click **Add Library**, and then search and add **SysTimeRtc** and **SysTypes Interfaces** libraries.
3. Open POU and add the following code to get the time value from the controller.

```
udiUtcTime := SysTimeRtcGet(udiResult);
IF udiResult <> 0 THEN
RETURN;
END_IF
(*converts the utc time (seconds) to a SYSTIMEDATE with year,
month , day, and time etc. *)
udiResult := SysTimeRtcConvertUtcToDate(udiUtcTime, strTimeDate);
IF udiResult <> 0 THEN
RETURN;
END_IF
(*converts the utc time to the local time, regarding timezone and
summer time in seconds *)
udiResult := SysTimeRtcConvertUtcToLocal(udiUtcTime,
udiUtcTimeLocal);
IF udiResult <> 0 THEN
RETURN;
END_IF
// Convert the UTC seconds to a DATE_AND_TIME variable
dt#yyyy-mm-dd-hh:mm:ss :
Date_and_time_format := UDINT_TO_DT(udiUtcTimeLocal);
```

4. Click the following variables in the code to open the **Auto Declare** dialog to declare variables.

```
Date_and_time_format: DATE_AND_TIME;
strTimeDate: SysTimeRtc.SYSTIMEDATE;
udiUtcTime: DWORD;
udiUtcTimeLocal: DWORD;
udiResult: RTS_IEC_RESULT;
```

5. On the toolbar, click  to generate code.
6. Log in to the controller.
7. Add a trace and add the *Date_and_time_format* variable, and then download the trace. For more information about how to add and download trace, see Trace Variables.
8. Open the automatically saved.csv file and find the Date_and_time_format column to check the time values for each traced item.

8.9 Product Rating

You can provide feedback on DIADesigner-AX or its individual features by rating in the star system and entering your comments. Your feedback will guide future

software updates and ensure that the software evolves in line with user preferences and needs.

To rate the product

1. On the upper-right corner of DIADesigner-AX, click  and then select **Sign In**.
2. In the **Sign In/Sign Up** dialog, enter your DIAStudio account information and click **Sign in**. If you do not have an account, sign up for a new one.
3. On the menu bar, select **Help** > **Product Rating**.
4. In the **Product Rating** dialog, rate the item on a scale of 0.5 points to 5 points, and enter your comments if there are any.
5. Click **Send**.

8.10 Software Diagnosis

Software Diagnosis is a tool to diagnose the running environment for DIADesigner-AX and collect the system and software information. The tool shows all the compatible and incompatible items.

The tool is installed automatically when installing DIADesigner-AX.

The tool supports diagnosing two versions of DIADesigner-AX (version 1.3.1 and another) installed on the computer at the same time.

To diagnose the environment

1. Go to C:\Program Files\Delta Industrial Automation\DIAStudio\Diagnosis Tool.
2. Double-click **SoftwareDiagnosis**.
3. Click **Collect** to start the diagnosis. If you want to stop diagnosing, click **Cancel**.
4. Look for the red items that indicate incompatible issues.
5. Select the red item.
6. On the **Prompt Information** pane, check the solution.

You can click **Save as** to export the diagnosis information as an XML file or a zip file.

You can click **Open File** to open the generated XML file.

You can search for related information in the search box.

Select the **Only show incompatible items** checkbox to filter and show the items that are not compatible with the operating system.

Chapter 9: Protection Mechanism Overview

DIADesigner-AX provides protection mechanisms for user-developed projects to ensure the projects are fully protected.

The following is the password protection structure provided by DIADesigner-AX. You can set passwords and adopt different data protection mechanisms according to your needs.

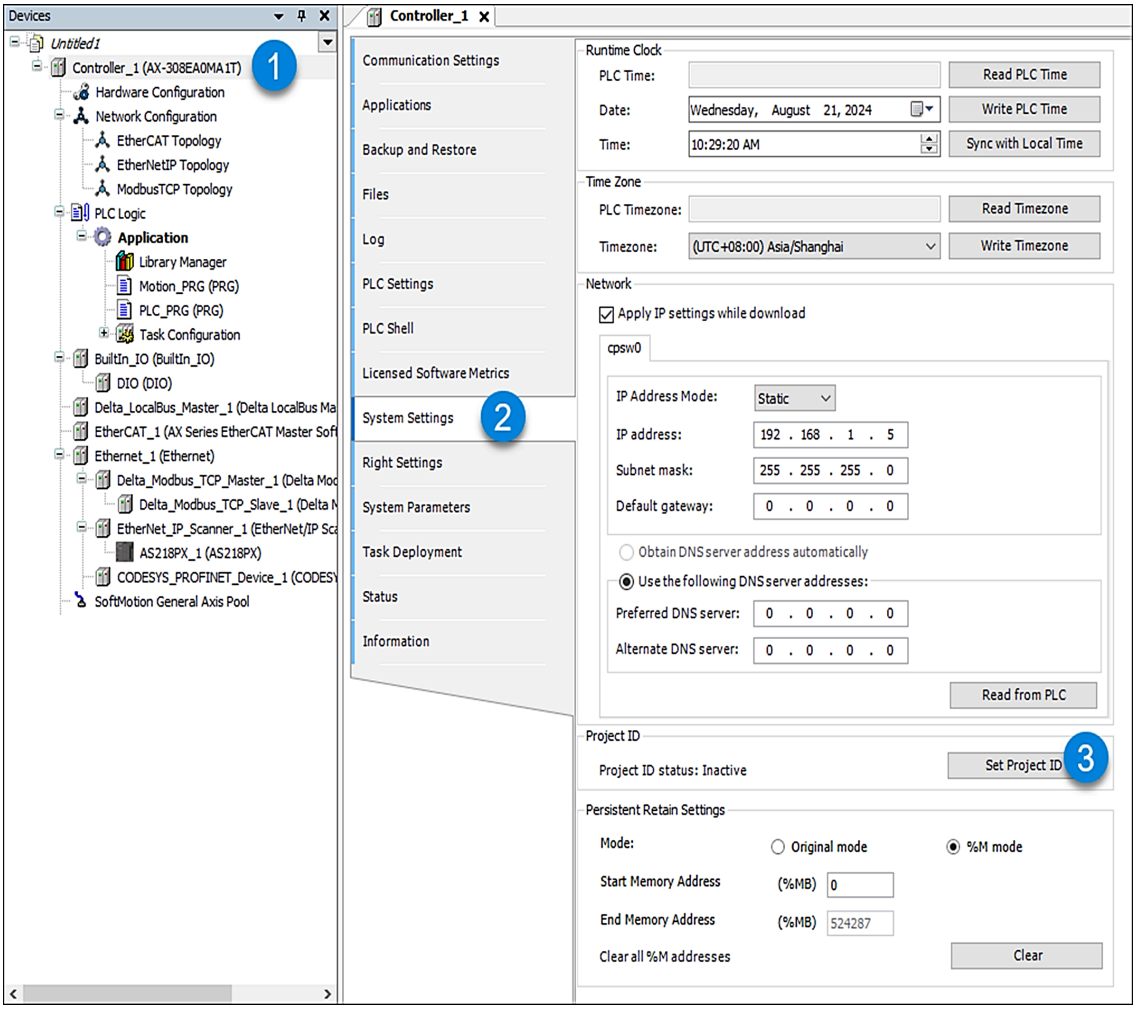
Password Type		Description
Designer-AX Project	Engineering ID (Project ID)	The ID is the authentication information used as the first check. Before down-loading a project, the Project ID set in the project and the PLC ID set in the host must be the same. Therefore, the protection mechanism can restrict cer-tain projects to download only to certain hosts.
PLC	PLC identification code (PLC ID)	

9.1 Set Project ID

Use the following steps to set Project ID.

To set Project ID

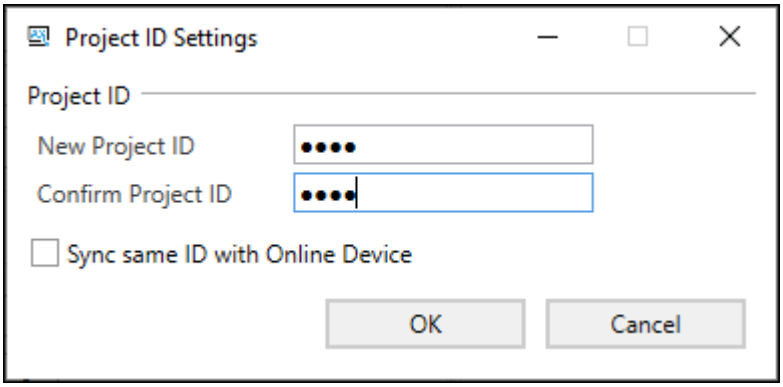
1. On the **Devices** pane, double-click the device and then select **System Settings** > **Set Project ID**.



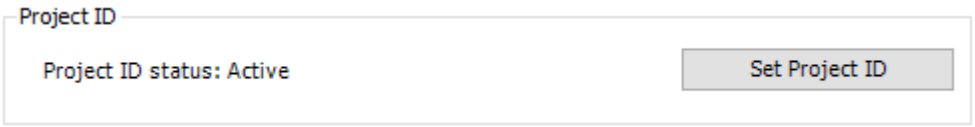
2. In the **Project ID Settings** dialog, enter **New Project ID** and **Confirm Project ID**.

   The length of the password should be 4–16 characters.

   You can select the **Sync same ID with Online Device** checkbox to set PLC ID at the same time as the Project ID. For more information, see Set Project ID and PLC ID simultaneously.



3. Click **OK**. Once the password is set successfully, the **Project ID status** will be **Active**.

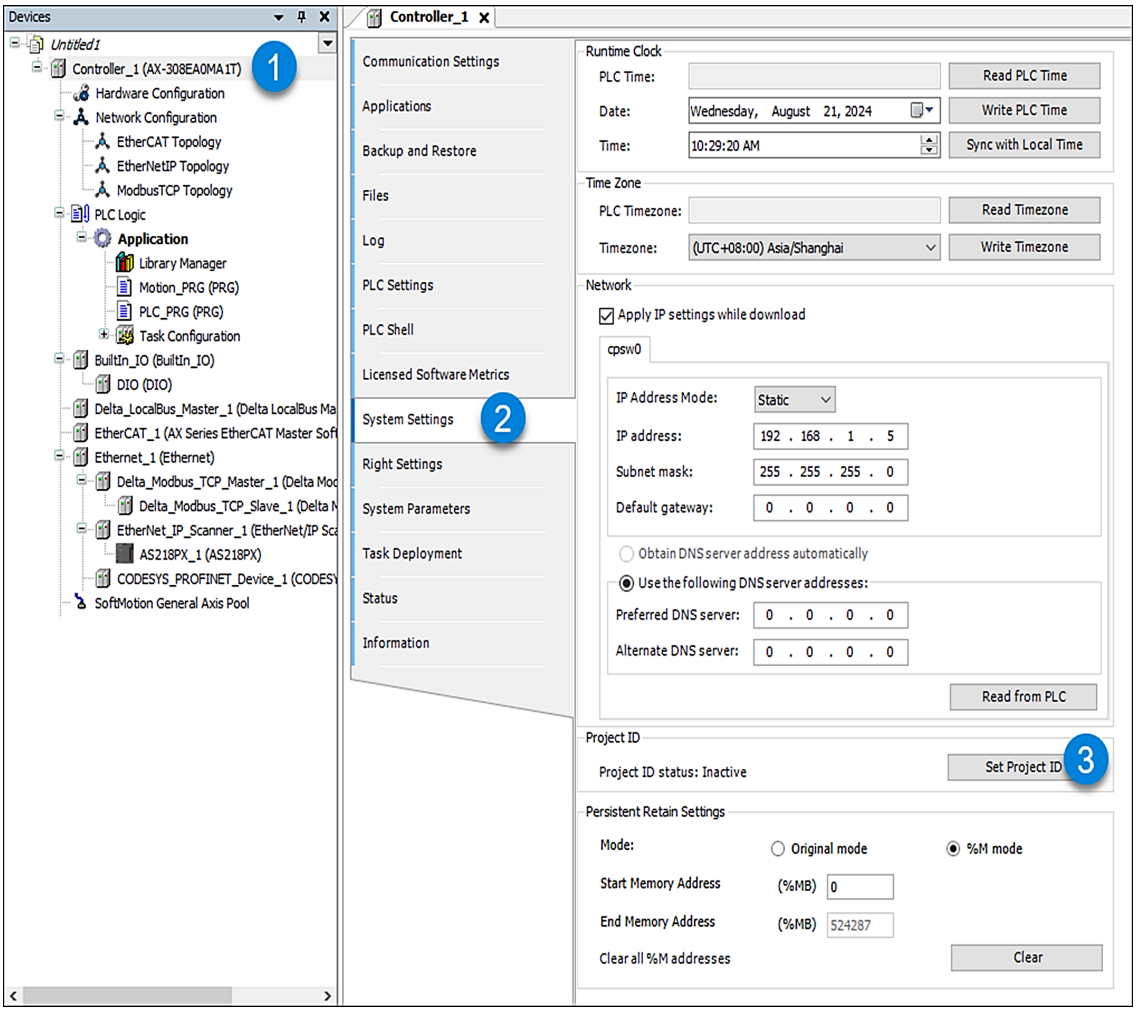


9.2 Modify Project ID

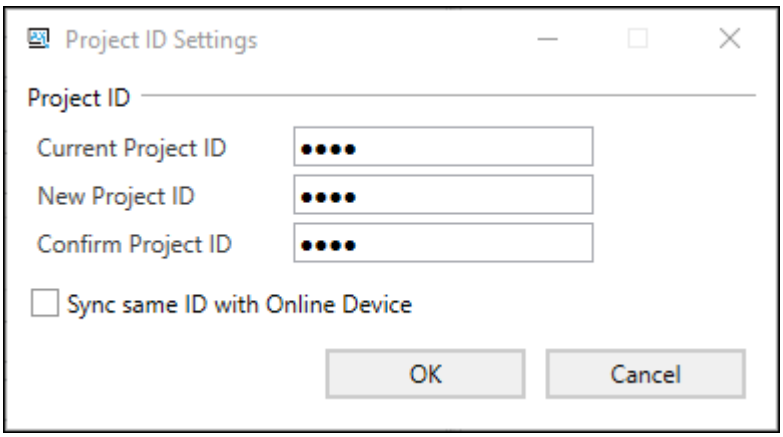
Use the following steps to modify Project ID.

To modify Project ID

1. On the **Devices** pane, double-click the device and then select **System Settings** > **Set Project ID**.



2. In the **Project ID Settings** dialog, enter **Current Project ID** (old password), **New Project ID** (new password), and **Confirm Project ID** (confirm the new password).



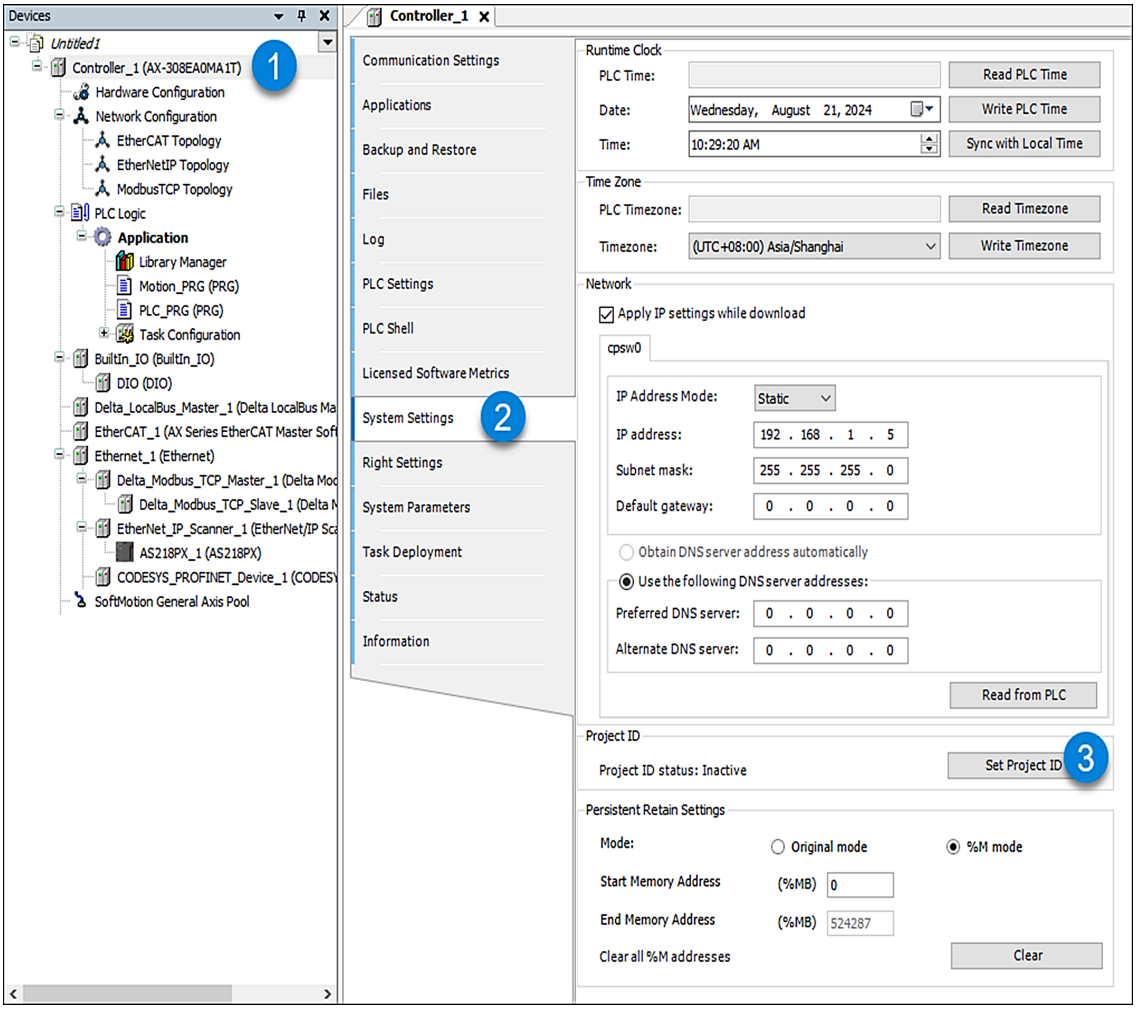
3. Click **OK**.

9.3 Clear Project ID

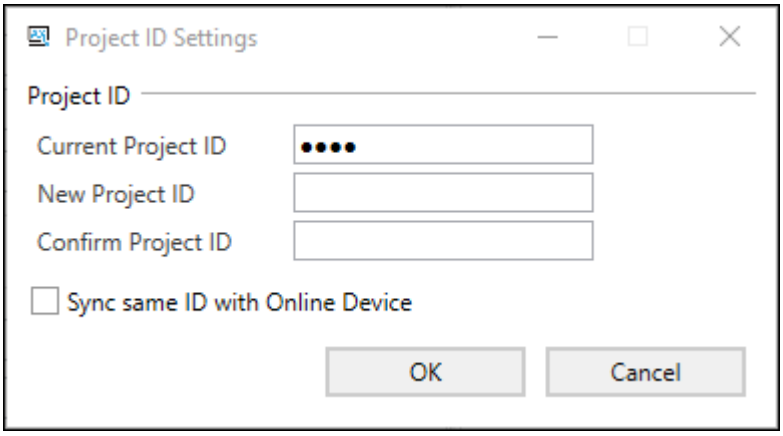
Use the following steps to clear Project ID.

To clear Project ID

1. On the **Devices** pane, double-click the device and then select **System Settings** > **Set Project ID**.



2. In the **Project ID Settings** dialog, enter **Current Project ID.** Leave **New Project ID** and **Confirm Project ID** blank.



3. Click **OK**.

9.4 Set PLC ID

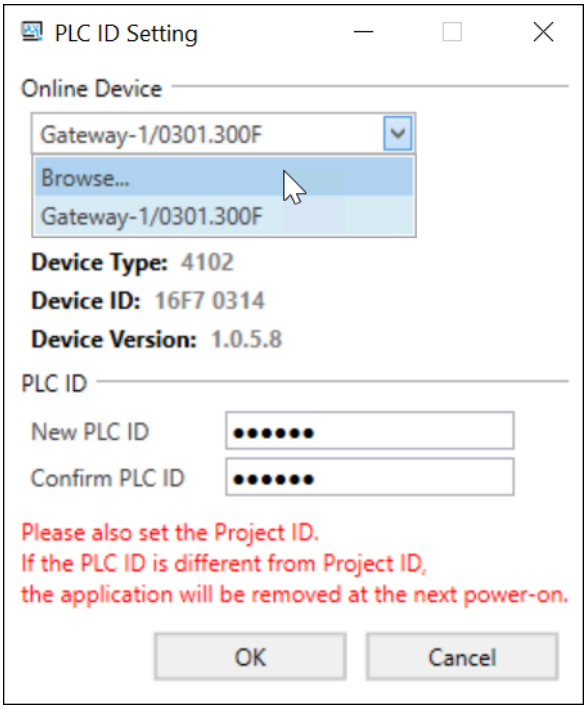
Use the following steps to set PLC ID. PLC ID setup and modification only supports AX-3 series controllers with firmware version 1.0.3.0 or later.

Prerequisites

- The controller is connected.

To set PLC ID

1. On the menu bar, select **Tools** > **PLC ID**.
2. In the **PLC ID Setting** dialog, click the **Online Device** dropdown menu and then click **Browse**.



3. In the **Select Device** dialog, select the device and click **OK**.
4. In the **PLC ID Setting** dialog, enter **New PLC ID** and **Confirm PLC ID**.
5. Click **OK**.

9.5 Modify PLC Identification Code

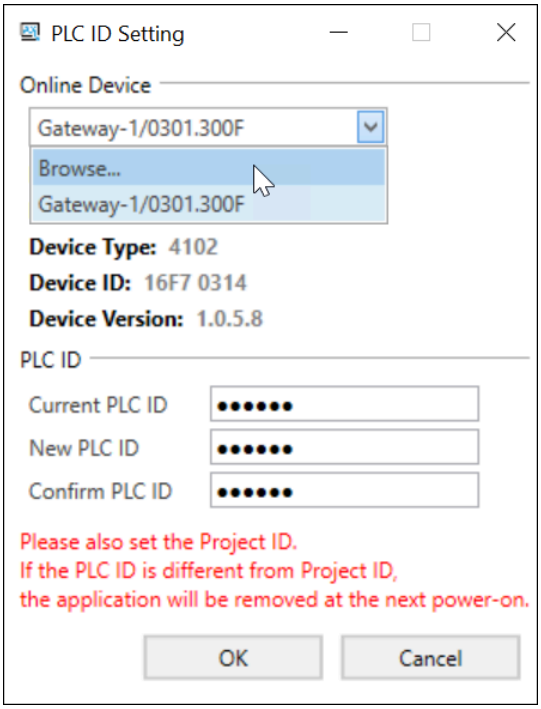
Use the following steps to modify PLC ID.

Prerequisites

- The controller is connected.

To modify PLC ID

1. On the menu bar, select **Tools** > **PLC ID**.
2. In the **PLC ID Setting** dialog, click the **Online Device** dropdown menu and select **Browse**.



3. In the **Select Device** dialog, select the device and click **OK**.
4. In the **PLC ID Setting** dialog, enter **Current PLC ID** (original password), **New PLC ID** (new password), and **Confirm PLC ID** (confirm the new password).
5. Click **OK**.

9.6 Clear PLC ID

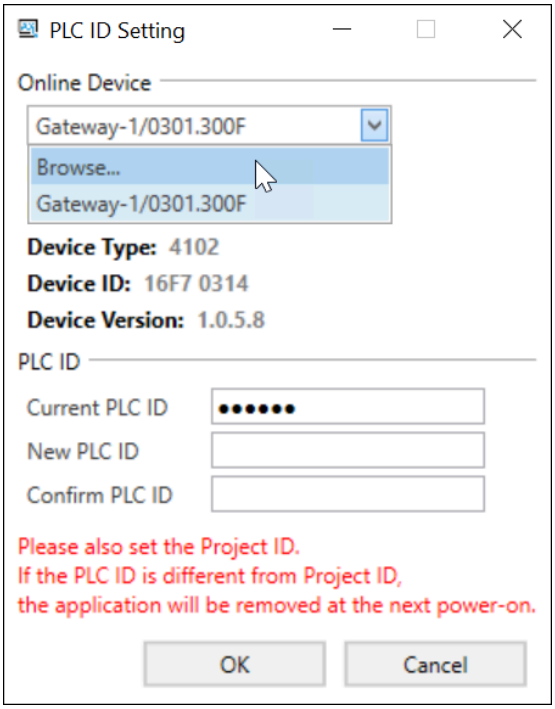
Use the following steps to clear PLC ID.

Prerequistes

- The controller is connected.

To clear PLC ID

1. On the menu bar, select **Tools** > **PLC ID**.
2. In the **PLC ID Setting** dialog, click the **Online Device** dropdown menu and select **Browse**.



3. In the **Select Device** dialog, select the device and click **OK**.
4. In the **PLC ID Setting** dialog, enter **Current PLC ID** (original password) and leave **New PLC ID** and **Confirm PLC ID** blank.
5. Click **OK**.

9.7 Set Project ID and PLC ID Simultaneously

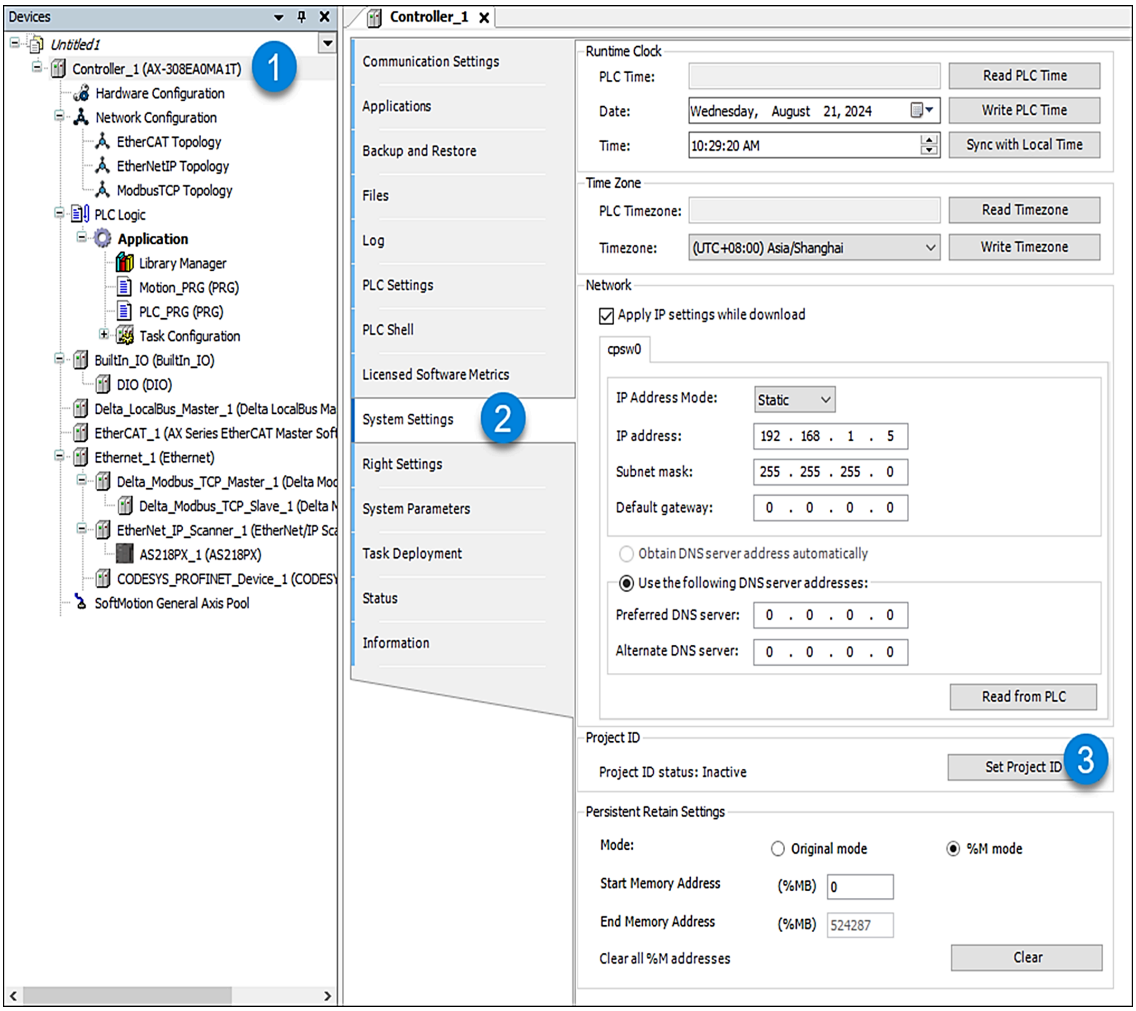
Use the following steps to set Project ID and PLC ID at the same time. PLC ID setup and modification only supports AX-3 series controllers with firmware version 1.0.3.0 or later.

Prerequisites

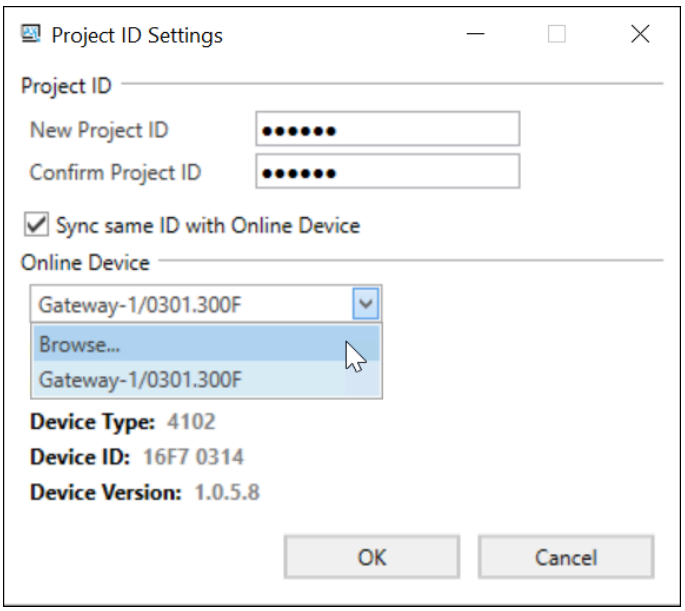
- The controller is connected.

To set Project ID and PLC ID simultaneously

1. On the **Devices** pane, double-click the device and then select **System Settings** > **Set Project ID**.



2. In the **Project ID Settings** dialog, enter **New Project ID** and **Confirm Project ID**, and then select **Sync same ID with Online Device**.



3. Browse to select the controller.
4. (optional) If the controller already has a PLC ID, enter **Current PLC ID**.
5. Click **OK**. PLC ID and Project ID are set to the same.

9.8 Modify Project ID and PLC ID Simultaneously

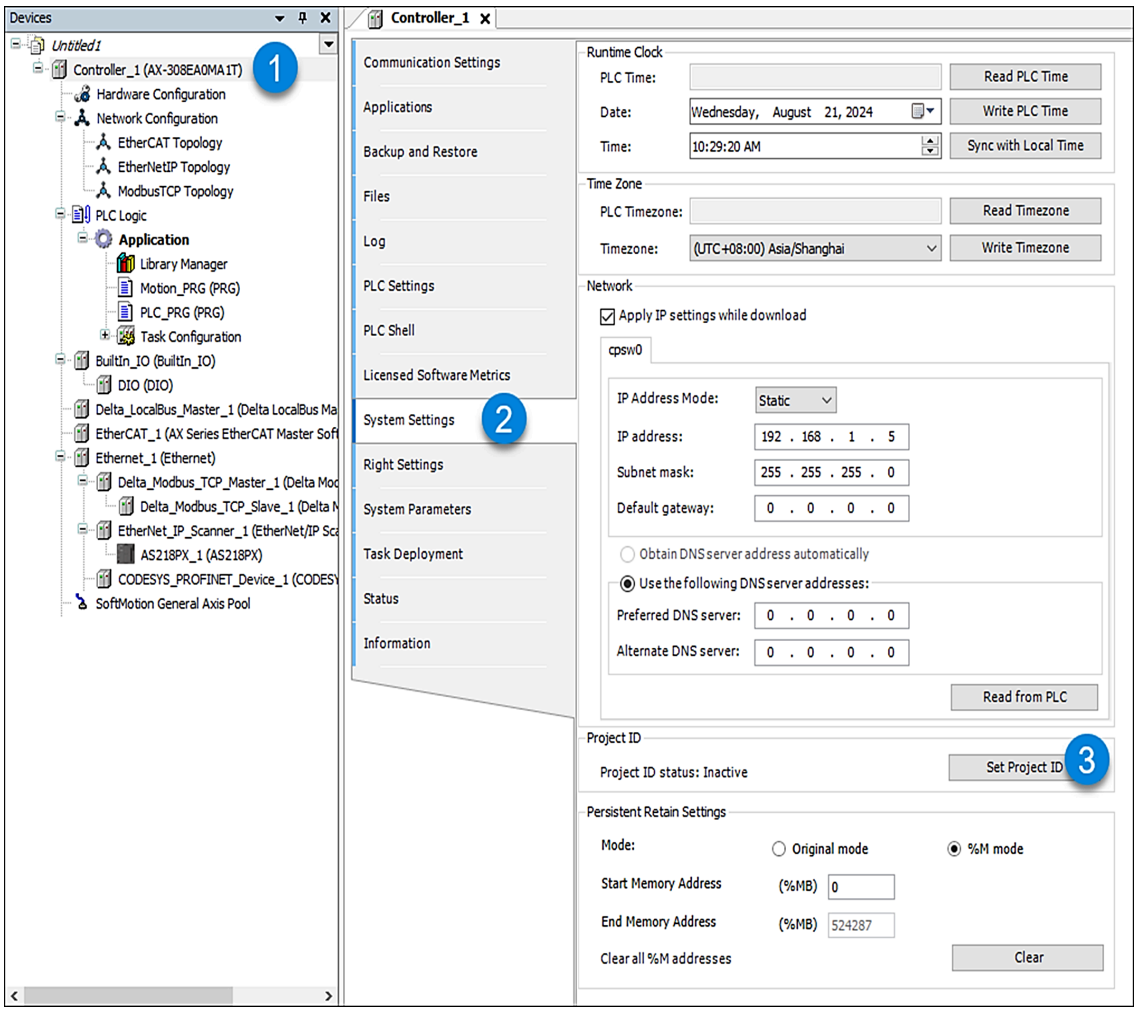
Use the following steps to modify Project ID and PLC ID at the same time.

Prerequisites

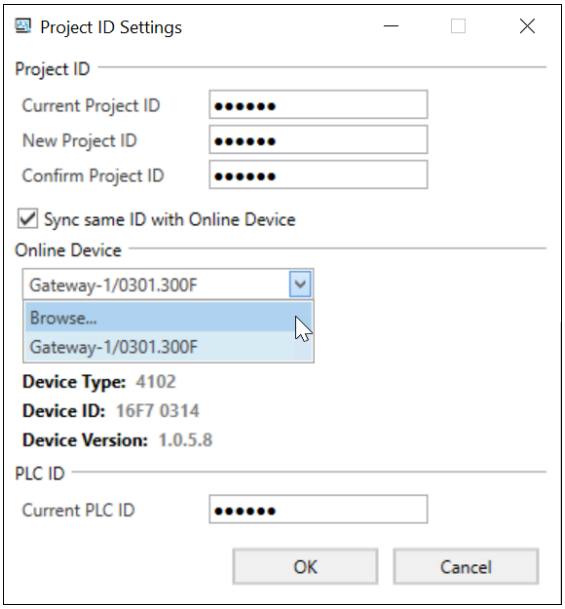
- The controller is connected.

To modify Project ID and PLC ID simultaneously

1. On the **Devices** pane, double-click the device and then select **System Settings** > **Set Project ID**.



2. In the **Project ID Settings** dialog, select **Sync same ID with Online Device**.



3. Browse to select the controller.
4. Enter **Current Project ID**, **New Project ID**, **Confirm Project ID**, and **Current PLC ID**.
5. Click **OK**. PLC ID and Project ID are set to the same.

9.9 Clear Project ID and PLC ID Simultaneously

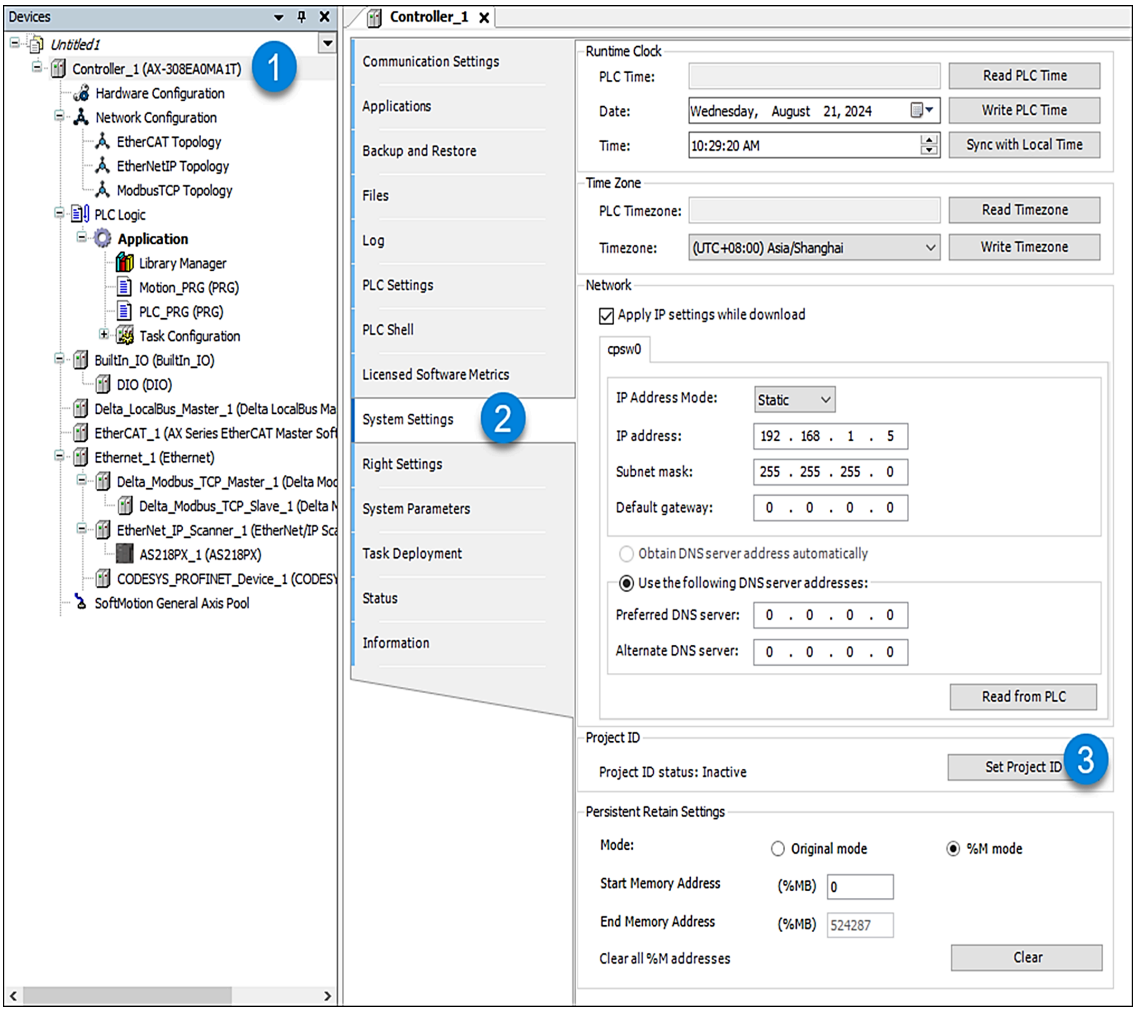
Use the following steps to clear Project ID and PLC ID at the same time.

Prerequisites

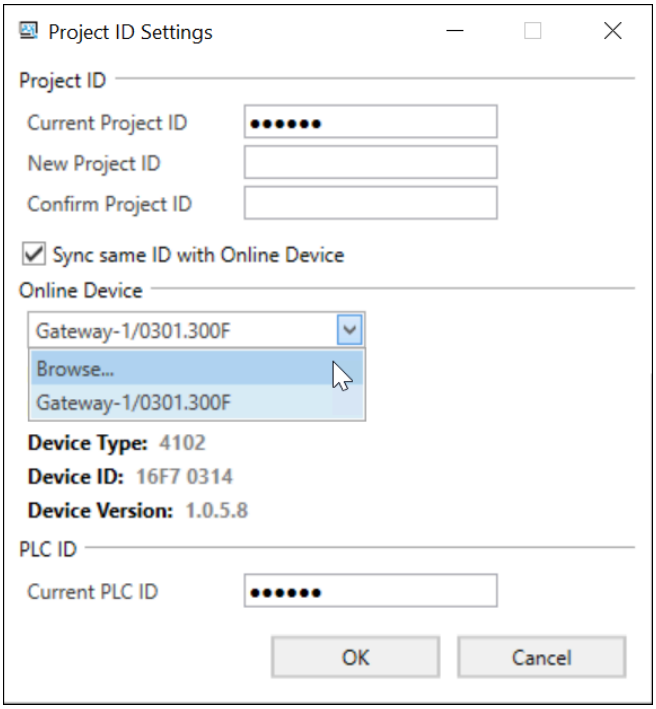
- The controller is connected.

To clear Project ID and PLC ID simultaneously

1. On the **Devices** pane, double-click the device and then select **System Settings** > **Set Project ID**.



2. In the **Project ID Settings** dialog, select **Sync same ID with Online Device**.



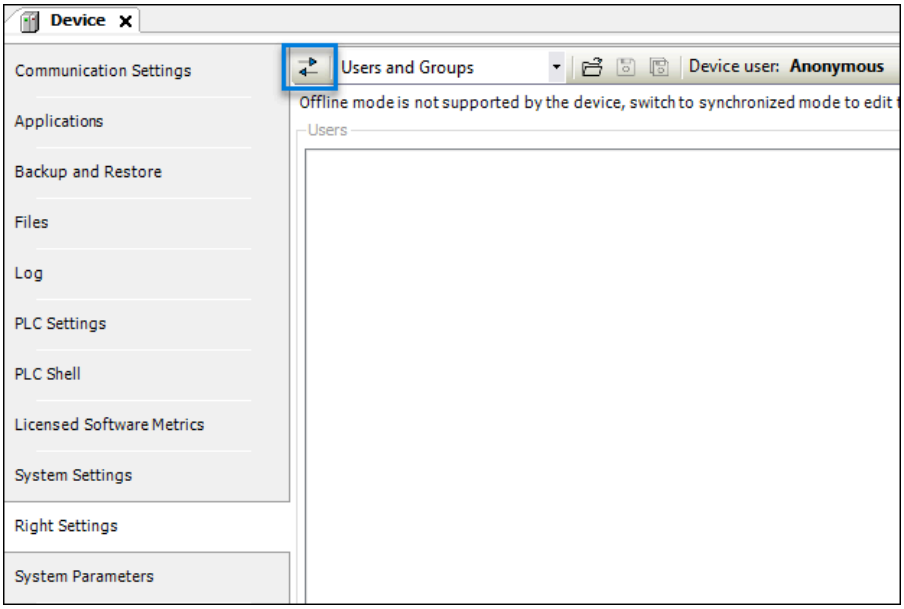
3. Browse to select the controller.
4. Enter **Current Project ID** and **Current PLC ID**. Leave **New Project ID** and **Confirm Project ID** blank.
5. Click **OK**.

9.10 Set Rights

You cannot undo or redo settings on this pane. Starting from version 1.4.0, if you select the AX-3 series controller and its version is 1.0.5.0 or later, and select **Users and Groups** on the **Right Settings** pane, an encryption function is available for importing and exporting management files.

To set rights

1. Create a New Project or open an existing one.
2. Connect to the network first.
3. Select **Right Settings**, and then click  to synchronize with the controller.



4. The account password is “Administrator” by default. When logging in for the first time, you need to change the password from the default “Administrator” to another. If the password is lost, it can only be restored to the factory value.

9.10.1 Import Management Files

You can import users and user groups and access configurations from the local computer.

To import management files

1. On the **Devices** pane, double-click the controller.
2. On the **Device** editor, select **Right Settings**.
3. Click  .
4. Select the *.rsu2 or *.dum2 file.
   The *.dum2 file is the configuration file for all settings on the **User and Groups** pane.

   The *.rsu2 file is the configuration file for all settings on the **Right Settings** pane.

   In the synchronization mode, DIADesigner-AX only supports importing the *.dum2 file.
5. (optional) In the **Enter Password** dialog, enter **Password**, and then click **OK**.

The password was assigned when the user management file was exported.
This encryption function is only available when you select:

- The AX-3 series controller and its version is 1.0.5.0 or later.
- Select the **User and Groups** pane.

Note: The import of a device user management by means of a *.dum2 file completely overwrites the existing user management on the device. To log in to the device again afterward, you need authentication data from the recently imported user management.

6. In the **Device User Logon** dialog, enter **Username** and **Password** and click **OK**.
7. Click  and log in again.

9.10.2 Export Management Files

You can only export users and user groups and access configurations in the synchronization mode.

To export user management files

1. On the **Devices** pane, double-click the controller.
2. On the **Device** editor, select **Right Settings**.
3. Click  .
4. Click  to only export the configurations in the **Users and Groups** pane or the **Access Rights** pane or click  to export all configurations on the **Right Settings** pane.
5. Enter **File name**, and click **OK**.
6. (optional) In the **Enter Password** dialog, enter **Password**.
   This encryption function is only available when you select:

- The AX-3 series controller and its version is 1.0.5.0 or later.
- Select the **User and Groups** pane.

Note: You need to enter this password when importing the *.dum2 file.

7. Click **OK**.

9.10.3 Set up Users and Groups

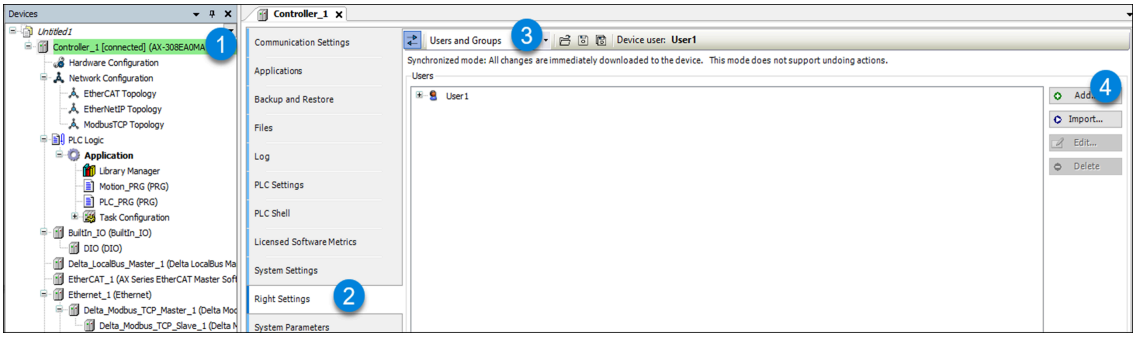
You can adjust user management for the first time in a project and adjust the definitions of users and groups to which they belong.

Prerequisites

- Turn on and synchronize the device where user management will be established and ensure that the configuration has not been adjusted.

To add a user

1. On the **Devices** pane, double-click the controller.
2. On the **Device** editor, select **Right Settings** > **Users and Groups**.
3. Click **Add** next to the **Users** pane.



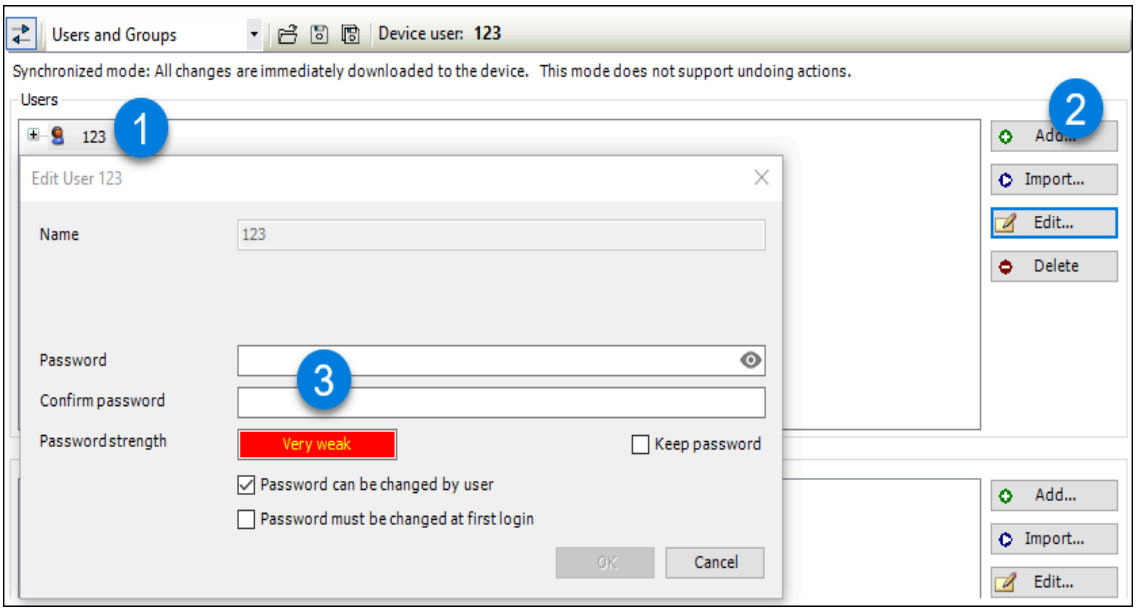
4. In the **Add User** dialog, enter **Name**, select the default group for the user being added, and then enter **Password**, and **Confirm password**.
5. Click **OK**.

To add a user group

1. On the **Devices** pane, double-click the controller.
2. On the **Device** editor, select **Right Settings** > **Users and Groups**.
3. Click **Add** next to the **Groups** pane.
4. Enter **Name**, and then select group members.
5. Click **OK**.

To modify the user password

1. On the **Users** pane, select the user that you want to change the password for.
2. Click **Edit**.
3. In the **Edit User** dialog, enter **Password** and **Confirm password**.
4. Click **OK**.

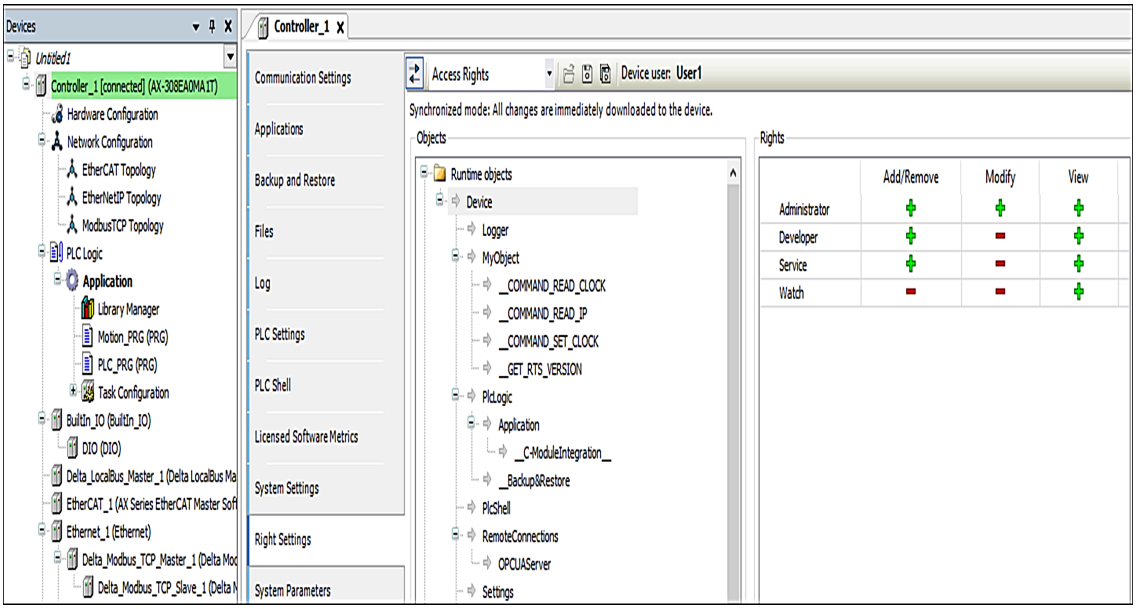


9.10.4 Set up Access Rights

You can configure whether group members have the right to view, edit, or delete objects, and add or delete sub-objects in objects.

To configure the access rights

1. On the **Devices** pane, double-click the controller.
2. On the **Device** editor, select **Access Rights**.



3. On the **Objects** pane, select the object that you want to configure the access right for.

4. On the **Rights** pane, double-click the access.

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Industrial Automation Headquarters

Delta Electronics, Inc.
Taoyuan Technology Center
No.18, Xinglong Rd., Taoyuan District,
Taoyuan City 33068, Taiwan
TEL: 886-3-362-6301 / FAX: 886-3-371-6301

Asia

Delta Electronics (Shanghai) Co., Ltd.
No.182 Minyu Rd., Pudong Shanghai, P.R.C.
Post code : 201209
TEL: 86-21-6872-3988 / FAX: 86-21-6872-3996
Customer Service: 400-820-9595

Delta Electronics (Japan), Inc.
Tokyo Office
Industrial Automation Sales Department
2-1-14 Shibadaimon, Minato-ku
Tokyo, Japan 105-0012
TEL: 81-3-5733-1155 / FAX: 81-3-5733-1255

Delta Electronics (Korea), Inc.
Seoul Office
1511, 219, Gasan Digital 1-Ro., Geumcheon-gu,
Seoul, 08501 South Korea
TEL: 82-2-515-5305 / FAX: 82-2-515-5302

Delta Energy Systems (Singapore) Pte Ltd.
4 Kaki Bukit Avenue 1, #05-04, Singapore 417939
TEL: 65-6747-5155 / FAX: 65-6744-9228

Delta Electronics (India) Pvt. Ltd.
Plot No.43, Sector 35, HSIIDC Gurgaon,
PIN 122001, Haryana, India
TEL: 91-124-4874900 / FAX : 91-124-4874945

Delta Electronics (Thailand) PCL.
909 Soi 9, Moo 4, Bangpoo Industrial Estate (E.P.Z),
Pattana 1 Rd., T.Phraksa, A.Muang,
Samutprakarn 10280, Thailand
TEL: 66-2709-2800 / FAX : 662-709-2827

Delta Electronics (Australia) Pty Ltd.
Unit 20-21/45 Normanby Rd., Notting Hill Vic 3168, Australia
TEL: 61-3-9543-3720

Americas

Delta Electronics (Americas) Ltd.
Raleigh Office
P.O. Box 12173, 5101 Davis Drive,
Research Triangle Park, NC 27709, U.S.A.
TEL: 1-919-767-3813 / FAX: 1-919-767-3969

Delta Greentech (Brasil) S/A
São Paulo Office
Rua Itapeva, 26 – 3˚ Andar - Bela Vista
CEP: 01332-000 – São Paulo – SP - Brasil
TEL: 55-11-3530-8643 / 55-11-3530-8640

Delta Electronics International Mexico S.A. de C.V.
Mexico Office
Gustavo Baz No. 309 Edificio E PB 103
Colonia La Loma, CP 54060
Tlalnepantla, Estado de México
TEL: 52-55-3603-9200

EMEA

Headquarters: Delta Electronics (Netherlands) B.V.
Sales: Sales.IA.EMEA@deltaww.com
Marketing: Marketing.IA.EMEA@deltaww.com
Technical Support: iatechnicalsupport@deltaww.com
Customer Support: Customer-Support@deltaww.com
Service: Service.IA.emea@deltaww.com
TEL: +31(0)40 800 3900

BENELUX: Delta Electronics (Netherlands) B.V.
De Witbogt 20, 5652 AG Eindhoven, The Netherlands
Mail: Sales.IA.Benelux@deltaww.com
TEL: +31(0)40 800 3900

DACH: Delta Electronics (Netherlands) B.V.
Coesterweg 45, D-59494 Soest, Germany
Mail: Sales.IA.DACH@deltaww.com TEL:
+49(0)2921 987 0

France: Delta Electronics (France) S.A.
ZI du bois Challand 2, 15 rue des Pyrénées,
Lisses, 91090 Evry Cedex, France
Mail: Sales.IA.FR@deltaww.com
TEL: +33(0)1 69 77 82 60

Iberia: Delta Electronics Solutions (Spain) S.L.U
Ctra. De Villaverde a Vallecas, 265 1º Dcha Ed.
Hormigueras – P.I. de Vallecas 28031 Madrid
TEL: +34(0)91 223 74 20

Carrer Llacuna 166, 08018 Barcelona, Spain
Mail: Sales.IA.Iberia@deltaww.com

Italy: Delta Electronics (Italy) S.r.l.
Via Meda 2–22060 Novedrate(CO)
Piazza Grazioli 18 00186 Roma Italy Mail:
Sales.IA.Italy@deltaww.com
TEL: +39 039 8900365

Russia: Delta Energy System LLC
Vereyskaya Plaza II, office 112 Vereyskaya str.
17 121357 Moscow Russia
Mail: Sales.IA.RU@deltaww.com
TEL: +7 495 644 3240

Turkey: Delta Greentech Elektronik San. Ltd. Sti. (Turkey)
Şerifali Mah. Hendem Cad. Kule Sok. No:16-A
34775 Ümraniye – İstanbul
Mail: Sales.IA.Turkey@deltaww.com
TEL: + 90 216 499 9910

GCC: Delta Energy Systems AG (Dubai BR)
P.O. Box 185668, Gate 7, 3rd Floor, Hamarain Centre
Dubai, United Arab Emirates
Mail: Sales.IA.MEA@deltaww.com
TEL: +971(0)4 2690148

Egypt + North Africa: Delta Electronics
Unit 318, 3rd Floor, Trivium Business Complex, North 90 street,
New Cairo, Cairo, Egypt
Mail: Sales.IA.MEA@deltaww.com

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