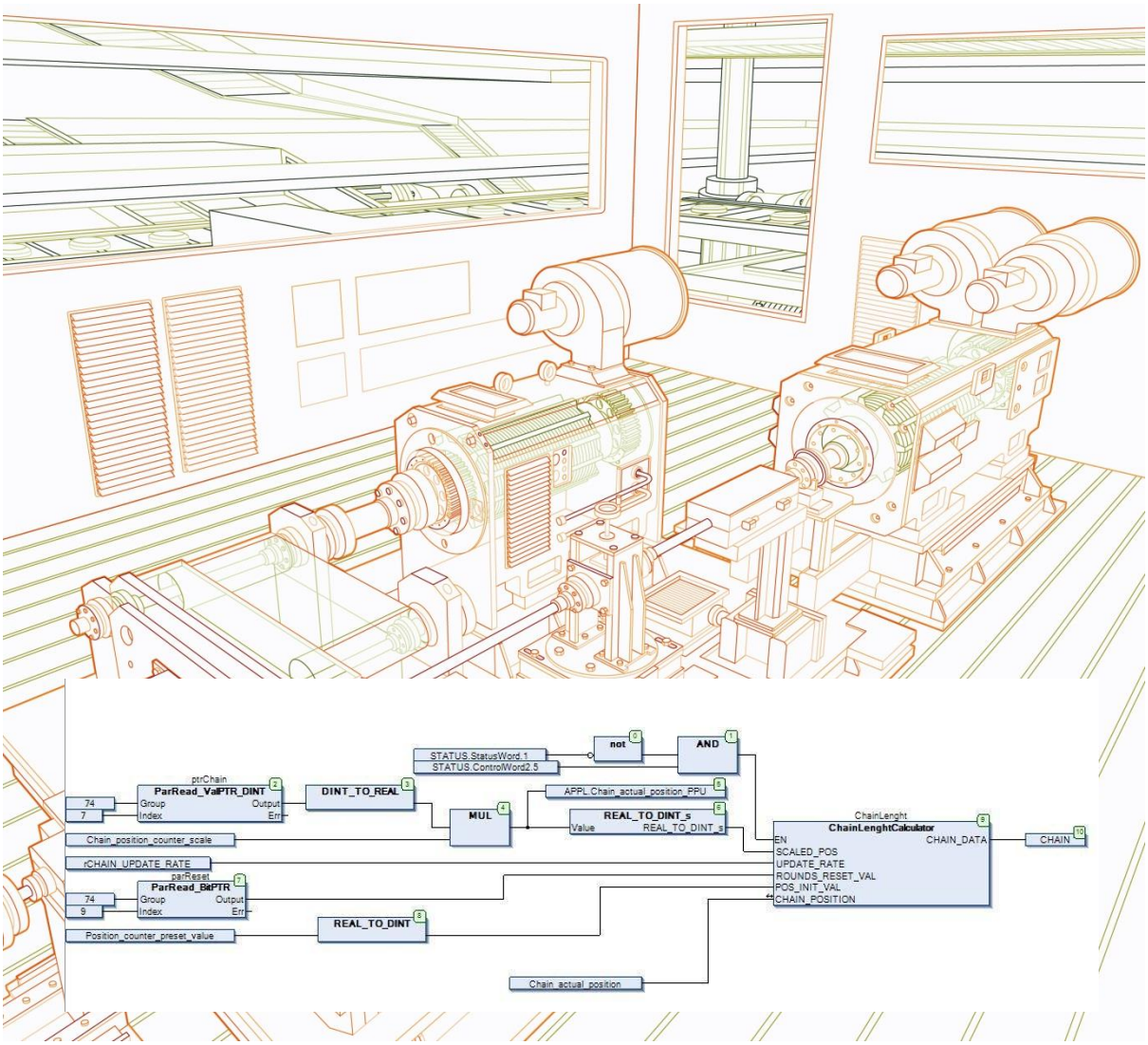
ABB industrial drives

Programming manual

Drive application programming (IEC 61131-3)



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List of related manuals

Drive application and firmware manuals and guides	Code (English)
Drive application programming manual (IEC 61131-3)	*3AUA0000127808*
ACS880 primary control program firmware manual	*3AUA0000085967*
Drive composer start-up and maintenance PC tool user's manual	*3AUA0000094606*
AC500 Control Builder PS501 Complete English documentation	*3ADR025078M02xx*
Option manual and guides	
FDCO-01/02 DDCS communication modules user's manual	*3AUA0000114058*
FEA-03 F-series extension adapter user's manual	*3AUA0000115811*
FAIO-01 analog I/O extension module user's manual	*3AUA0000124968*
Digital I/O Extension FIO-01 user's manual	*3AFE68784921*
Analog I/O Extension FIO-11 user's manual	*3AFE68784930*

You can find manuals and other product documents in PDF format on the Internet. See section *Document library on the Internet* on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.

Programming manual

Drive application programming (IEC 61131-3)

3AUA0000127808 Rev D

EN

EFFECTIVE: 2016-04-04

Table of contents

1

Introduction to the manual

Contents of this chapter

This chapter gives basic information on the manual.

Compatibility

This manual applies to the ABB drives equipped with the application programming functionality. For example, ABB ACS880 and DCX880 industrial drives can be ordered with the application programming functionality. The drive must be equipped with N8010 Application programming license on ZMU-02.

This manual is compatible with the following product releases:

- ABB Automation Builder 1.2.2 or later
- Drive composer pro 1.10 or later

For more details of compatibility information, refer the corresponding ACS880 or DCX880 drive software release notes or contact your ABB representative.

Target audience

This manual is intended for a personnel performing drive application programming or for understanding the programming environment capabilities. The reader of the manual is expected to have basic knowledge of the drive technology and programmable devices (PLC, drive and PC) and programming methods.

Safety instructions

Follow all safety instructions delivered with the drive.

- Read the complete safety instructions before you load and execute the application program on the drive or modify the drive parameters. The complete safety instructions are delivered with the drive as either part of the hardware manual, or, in the case of ACS880 multidrives, as a separate document.
- Read the firmware function-specific warnings and notes before changing parameter values. These warnings and notes are included in the parameter descriptions presented in chapter *Parameters* of the firmware manual.

WARNING! Ignoring the following instruction can cause physical injury or damage to the equipment.

Do not make changes to drive in the online mode or download programs while the drive is running to avoid damages to the drive.

Purpose of the manual

This manual gives basic instructions on the drive-based application programming using ABB Automation Builder programming tool. The programming tool is the international IEC 61131-3 programming standard. The online help of Automation Builder contains more detailed information of the IEC languages, programming methods, editors and tool commands.

Contents of the manual

The manual consists of the following chapters:

- Getting started
- *Overview of drive programming*
- *Creating application program*
- *Features*
- *DriveInterface*
- *Application parameter and events*
- *Configuring extension I/O modules*
- *Libraries*
- *Practical examples and tips*
- *Appendix A: Incompatible features between ACS880 Drive and AC500 PLC IEC programming*
- *Appendix B: Unsupported features*
- *Appendix C: ABB drives system library*
- *Appendix D: ABB D2D function blocks*
- *Appendix E: ABB drives standard library*

Related documents

A list of related manuals is printed on the inside of the front cover.

Terms and abbreviations

Term/ Abbreviation	Description
ACS-AP-x	ACS-AP-I or ACS-AP-S control panel used with ACS880 and DCX880 drives. The control panel has an USB connector enabling a PC tool connection for common architecture drives.
BCU	Type of control unit used in ACS880 and DCX880 drives
AB	ABB Automation Builder programming tool
CFC	Continuous function chart programming language
DDCS	Distributed drives communication system. This protocol is used in communication between ABB drive equipment.
DI	Digital input
Drive composer pro	ABB Drive composer is a 32-bit Windows application for commissioning and maintaining ABB common architecture drives. The full version is called Drive composer pro.
DUT	Data type unit
FAIO-01	Analog I/O extension module for DDCS bus including 2 bipolar/unipolar current/voltage and 2 unipolar current outputs.
FB	Function block, type of POU
FBD	Function block diagram programming language
FDCO -01/02	DDCS optical bus communication adapter.
FDIO-01	Digital I/O extension module for DDCS bus inclusing 3-digital inputs and 2-relays.
FEA-03	Extension adapter base board in DDCS link including 2 F-series I/O modules.
FIO-01	Digital I/O extension module for DDCS bus including 4 bidirectional digital inputs/outputs and 2 relays.
FIO-11	Analog and digital I/O extension module for DDCS including 3 analog inputs, 1 analog output and 2 bidirectional digital inputs/outputs.
FUN	Function, type of POU
IEC 61131-3 programming	Standardized programming language for industrial automation. Established by the International Electro-technical Commission (IEC)
IL	Instruction list programming language
LD	Ladder diagram programming language
OPC server	OPC DA server interface for Drive composer pro that allows other programs, such as Automation Builder, to communicate with the drive.
PIN	IEC variable of the block, which can be connected to other blocks.

Term/ Abbreviation	Description
PLC	Programmable logic controller
POU	Program organization unit. POU unit is a unit, object or area where you can write the program code. Also called as Block.
PRG	Program, type of POU
RTS	Run-time system
SFC	Sequential function chart programming language
ST	Structured text programming language
ZCU	Type of control unit used in ACS880 and DCX880 drives that consists of a ZCON board built into a plastic housing. The control unit may be fitted onto the drive/inverter module, or installed separately.

For more detailed descriptions, see Automation Builder online help.

2

Getting started

Contents of this chapter

This chapter includes the following information required for programming ACS880 and DCX880 drives using ABB Automation Builder tool:

- Quick steps for *Setting up the programming environment*.
- Procedure for *Upgrading a new device*, *Changing an existing device* and *Viewing device information*.

Setting up the programming environment

The following software installations are required for programming ACS880 and DCX880 drives. For details of version, refer the corresponding ACS880 or DCX880 drive software release notes or contact your ABB representative.

- ACS880 drive or DCX880 converter with Drive application programming license (N8010)
- ABB Automation Builder 1.2.2 or later
- ACS-AP-x control panel and micro USB cable
- Drive composer pro 1.10 or later

The Drive composer pro enables setting and monitoring of the drive parameters and signals. The control panel acts as a USB/RS485 converter between Automation Builder, Drive composer pro and the drive.

To setup ACS880 or DCX880 drive programming environment follow the pre-requisites and installation steps listed below.

Pre-requisites:

- The ABB Automation Builder supports Windows XP and Windows 7 (32-bit and 64-bit versions) operating systems.
- You must have Administrator user rights to install Automation Builder.

Installation steps:

1. Install Drive composer pro to enable communication with the target drive. For more details, see *Drive composer user's manual* (3AUA0000094606 [English]).
2. In the Drive composer pro **System info** → **Products/Licenses**, check that the ACS880 or DCX880 drive has an active IEC programming license and the drive firmware version is correct. For details of version, refer the corresponding ACS880 or DCX880 drive software release notes or contact your ABB representative.

Install ABB Automation Builder version 1.2.2 or later according to the instruction guide included in the installation media of Automation Builder. All drive application programming related components are automatically installed as well.

In Automation Builder, select **Install Software Packages for** → **Programmable Drive**.

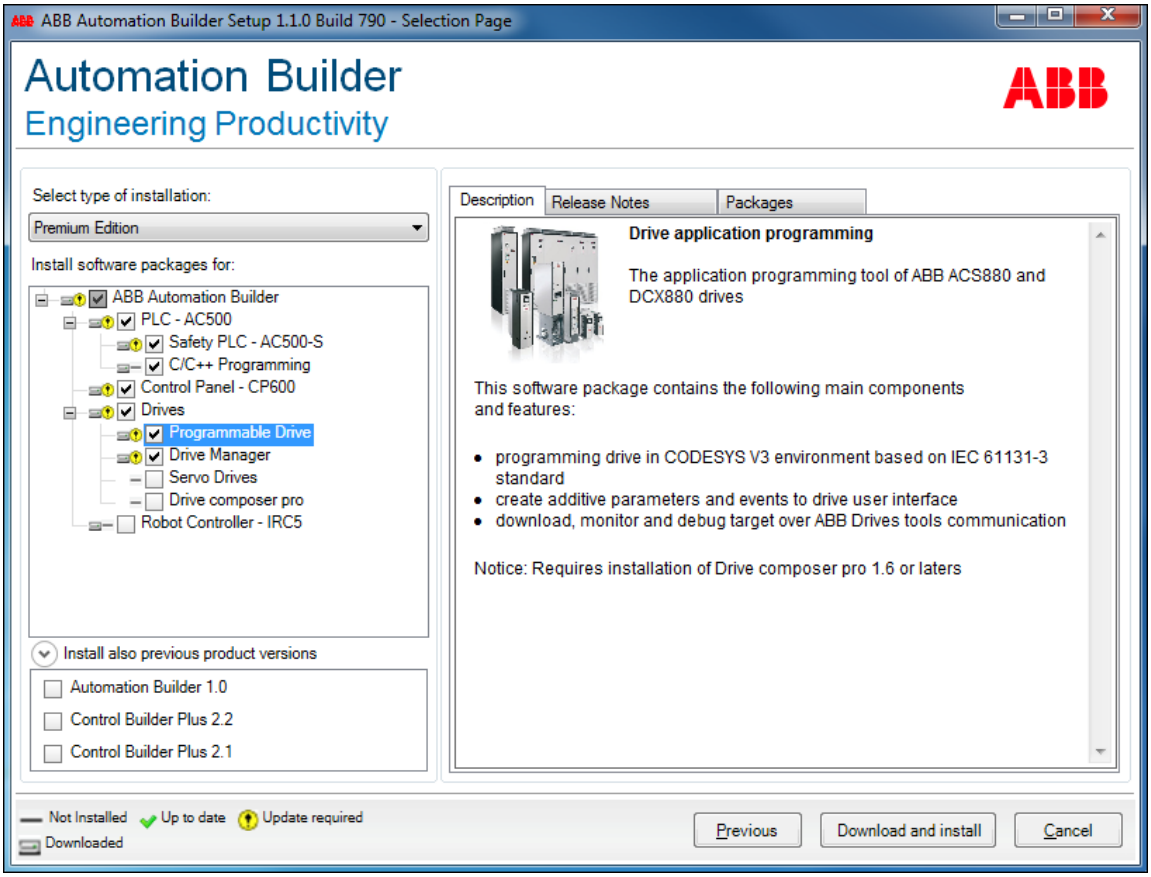


Figure 1: Automation Builder – Selecting software packages for installation

To allow parallel communication with Automation Builder and Drive composer pro, follow these steps:

1. In the main menu of Drive composer pro, click **View** →**Settings**.
2. In the Settings window, select **Share connection with Automation Builder** check box and click **Save**.

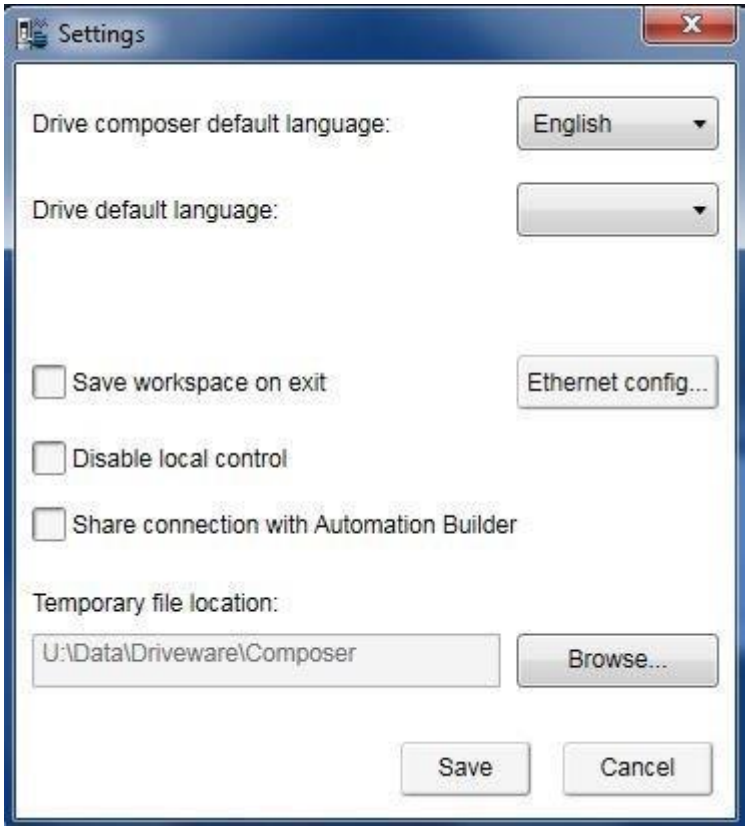


Figure 2: Drive Composer Pro settings

After configuring the settings, restart Drive composer pro.

Drive composer now connects to the drive and allows opening the Automation Builder.

Now you can create an application program. See section, *Creating application program*.

3

Overview of drive programming

Contents of this chapter

This chapter provides an overview of ACS880 and DCX880 drive programming environment and a typical work cycle of drive application programming.

Drive application programming

ABB ACS880 and DCX880 industrial drives can be ordered with the application programming functionality. It allows you to add your own program code to the drive using the ABB Automation Builder programming tool (version 1.2.2 or later). The programming method and languages are based on the IEC 61131-3 programming standard. ABB Automation Builder is also used for configuring and programming the ABB AC500 PLC family devices.

With the drive application programming, you can create application specific features on top of the drive firmware functionality. You can utilize the standard and extension I/O and communication interfaces of the drive along with the appropriate firmware signals. Your program is executed in parallel with the drive control tasks using the same hardware resources.

In addition, you can create your own parameters and events (faults and warnings) that are visible on the ACS-AP-x control panel and in the Drive composer pro/entry commissioning tools.

Note: For using ABB Automation Builder online with the drive, enable the drive application programming license in the target drive. See section, *Establishing online connection to the drive*.

System diagram

The following simplified system diagram shows the application programming environment in the same control unit as the drive firmware.

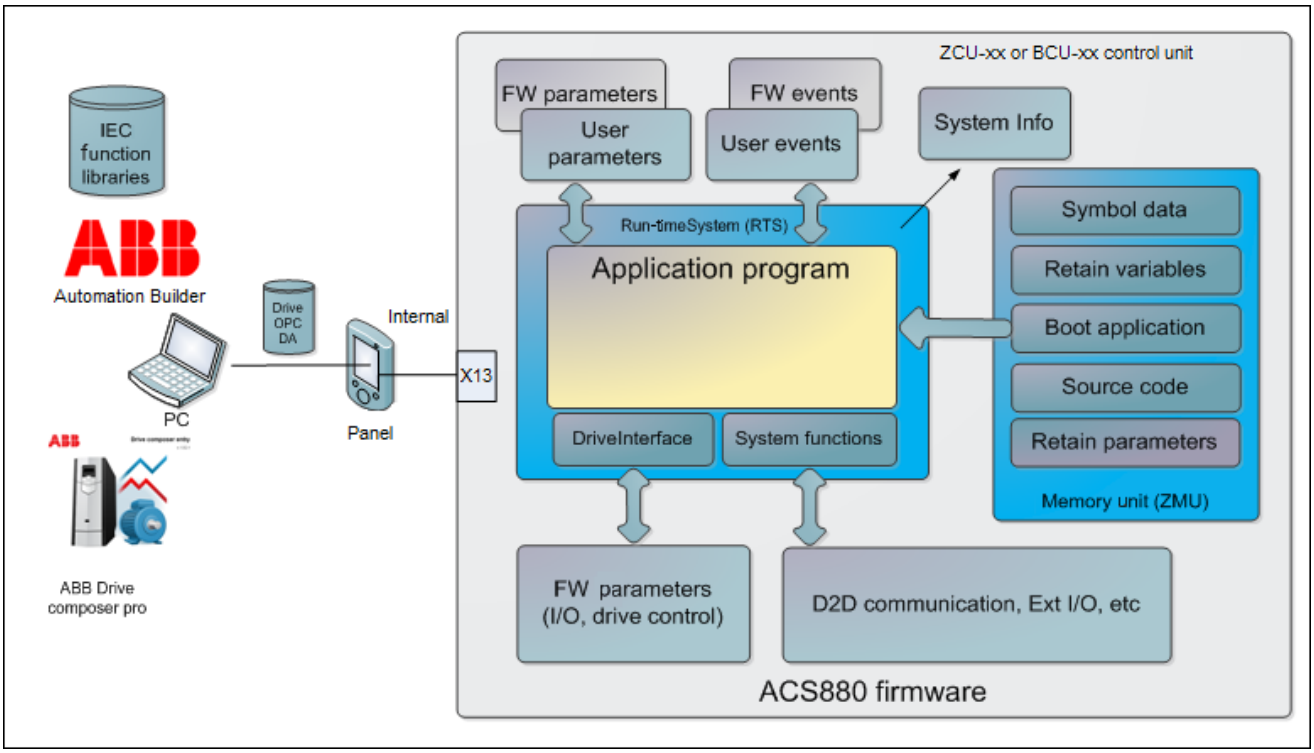


Figure 3: Application programming environment – System diagram

The following list describes the main components for application programming.

Drive control unit:

- Run-time system (RTS) executes the application program.
- DriveInterface allows input/output mapping between the application program and drive firmware parameters.
- System function library enables access to the drive system services (parameters/ events/ drive-to-drive communication, extension I/O).
- User made parameters.
- User made events (fault, warnings).
- Drive System info includes version information of the application program.
- Drive firmware parameters with I/O controls.
- D2D function blocks enable drive to drive communication, I/O extension modules, and so on for application programming.

Drive memory unit:

- Creates a permanent version of the application program (Boot application).
- Retains values of the application program variables .
- Consists of application source code (Note that the size of the memory is limited).

- Includes symbol and address information of the application program variables for monitoring purposes.

PC tool programs:

- ABB Automation Builder for application program development and online operations.
- ABB Drive composer pro for drive parameter, signal, event log monitoring and settings.
- Application program function libraries (for example, ABB standard library).
- The USB/ACS-AP-x control panel enables communication between the Automation Builder, Drive composer pro and the drive.

Programming work cycle

The following steps describes a typical work cycle of the drive application programming tasks of performing the module:

1. Creating a new project, adding objects, defining the target and first program module in the Devices tree.
2. Defining the interface to drive firmware parameters (I/O access, drive control) in the **DriveInterface** object.
3. Defining user parameters and events (ApplicationParametersandEvents**)** module in the Devices tree.
4. Developing the program structure and coding program units.
5. Defining the program execution task configuration editor.
6. Compiling and loading the code using **Build** menu.
7. Creating boot applications if new parameters, mappings, events or task configuration are added in the **Online** menu.
8. Debugging the program code (stepping, forcing variables and breakpoints) in the **Online** menu.
9. Monitoring program variables in Automation Builder and Drive composer pro from the watch windows of the **View** menu.
10. Repeating the cycle from step 2 to 8 for testing the program.

Special tasks

The following special tasks are part of the drive application programming tasks:

1. Saving or restoring the source code to the permanent memory of the drive using the **Online** menu.
2. Saving the drive IEC symbol data to permanent memory of the drive from the **Devices** tree using the option **Add Symbol configuration object to the tree**.
3. Naming and versioning the application from the Application properties window or Project information.
4. Removing the application from the target using **Reset origin** window on the **Online** menu.

Programming languages and modules

The programming environment supports programming languages as specified in the IEC 61131-3 standard with some useful extensions. The following programming languages are supported:

- Ladder diagram (LD)
- Function block diagram (FBD)
- Structured text (ST)
- Instruction list (IL)
- Sequential function chart (SFC)
- Continuous function chart (CFC), normal and page-oriented CFC editor

A program can be composed of multiple modules like functions, function blocks and programs. Each module can be implemented independently with the above mentioned languages. Each language has its own dedicated editors. For more information of the programming languages, see **Automation Builder** online help and chapter *Features*.

Libraries

Program modules can be implemented in projects or imported into libraries. A library manager is used to install and access the libraries.

The two main types of libraries are:

- Local libraries (IEC language source code, for example, AS1LB_Standard_ACS880_V3_5)
- External libraries (external implementation and source code, for example, AY1LB_System_ACS880_V3_5)

Local libraries include source code or can be compiled. If the library is compiled, source code is not included in the library.

External libraries include AC500 PLC libraries used with the drive target by opening the library project in Windows as Automation Builder project files (before V3.0).

For more information on compatibility, see chapter *Libraries*.

Program execution

The program is executed on the same central processing unit (CPU) as the other drive control tasks. In real time applications, programs are typically executed periodically as cyclic tasks. The programmer can define the cyclic task interval. For more information, see chapter *Features*.

DriveInterface

The DriveInterface object enables input and output mapping between the application program and the drive firmware using the drive firmware parameters used in the application program. This list of parameters may be different for each drive firmware versions. For more details on implementing the DriveInterface and updating parameter list, see section *DriveInterface*.

ApplicationParametersandEvents

The ApplicationParameterandEvents Manager (APEM) object allows creating application parameter groups, parameters, parameter types, parameter families, units and application events for the drive in Automation Builder environment. For more details on how to create parameter related tasks and application events, see section *ApplicationParametersandEvents*.

4

Creating application program

Contents of this chapter

This chapter describes the procedure to create application program.

For details of instructions and further development steps see chapters *DriveInterface*, *Application parameter and event creation*, *Features* and *Libraries*. For more detailed descriptions, see also the Automation Builder online help.

Creating a new project

After starting ABB Automation Builder programming environment, you can create a new project.

1. In the Start Page, click **New Project** or in the main menu, click **File** → **New Project**.

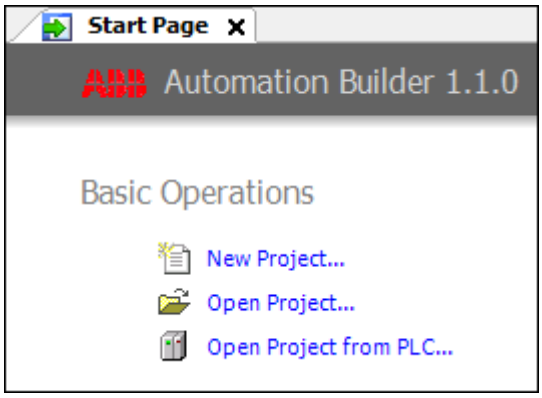


Figure 4: Automation Builder – Create a new project

2. In the New Project dialog box, select **ACS880** or **DCX880** project and click **OK**.

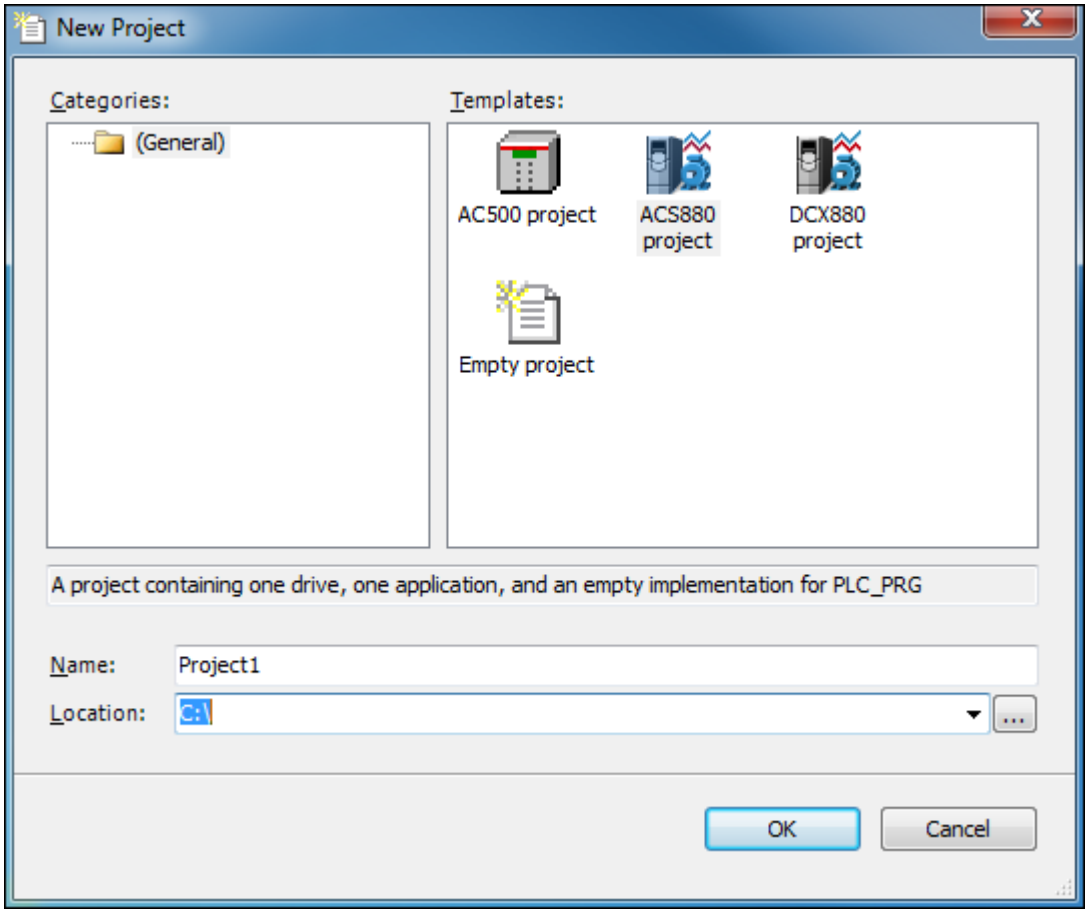


Figure 5: Select a project

Note: If required, rename the project in Name field and select the desired Location in the file system.

3. In the Standard Project dialog box, select the type of control unit in **Device** drop-down list.

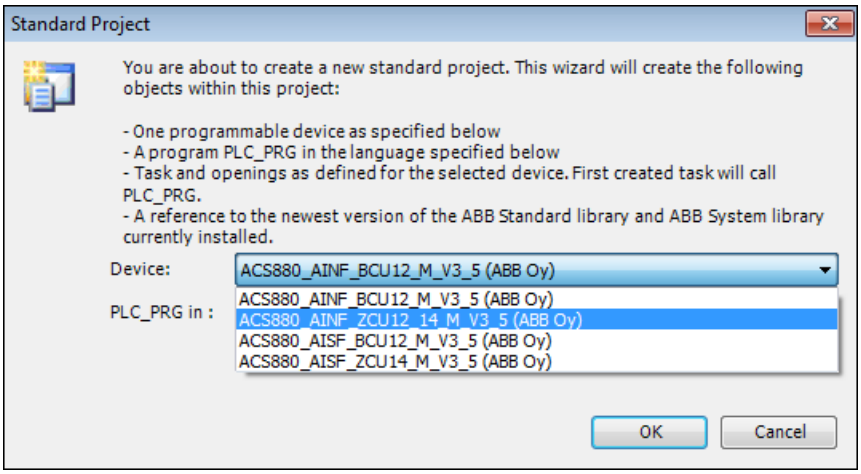


Figure 6 Selecting device

Check the control unit type of the target drive either from the unit itself, from the hardware manual of drives or contact your local ABB representative.

4. In the **PLC_PRG in** drop-down list, select a programming language and click **OK**.
   - You can later add program modules made with other languages to the project.

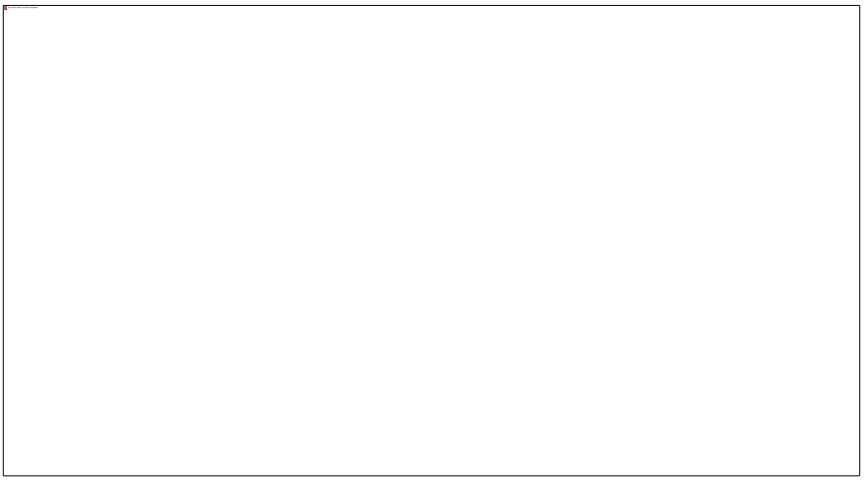


Figure 7: Select a programming language

A simple project for an ACS880 target drive is created in the Devices tree.

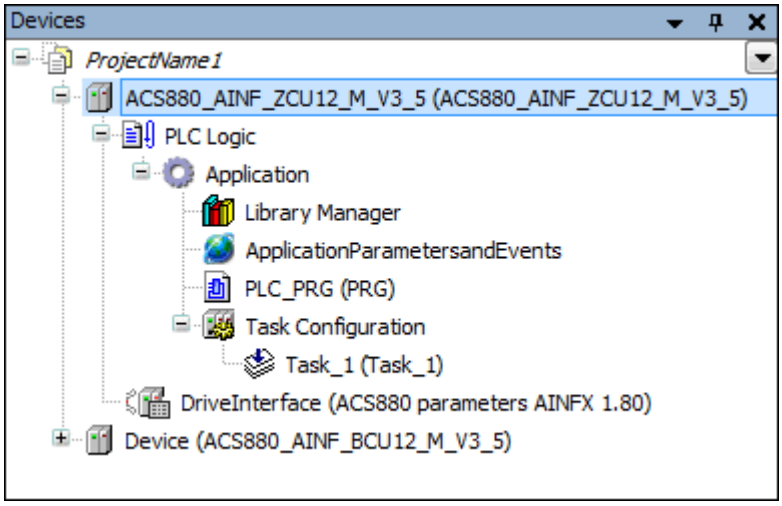


Figure 8: New project created in the Devices tree

The Devices tree includes:

- PLC Logic
- DriveInterface for firmware signal and parameter mapping
- Application (for example, you can add the following objects under Application)
  - Library Manager for installing function libraries
  - ApplicationParametersandEvents for creating user parameters and events
  - Program organization units (POUs)
  - Task Configuration module for defining in which task the POUs are executed
  - Text list
  - Symbol configuration
  - Global variable list
  - Data type units (DUT)

For changing the device type, see section *Changing an existing device*.

Updating project information

You can update a Company name and Version number for the application program in the Project Information window. This information is visible in Drive composer tool and ACS-AP-x control panel in the **System info** display. It also helps to identify the loaded application without the Automation Builder tool. You can also name the application from the application tool.

To update project information in Automation Builder, follow these steps:

1. In the main menu, click **Project** →**Project Information**.

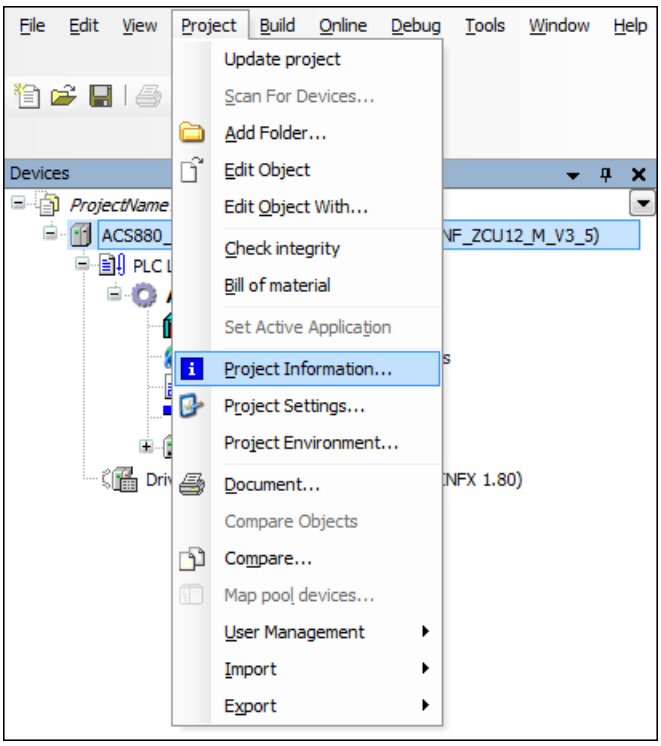


Figure 9 Updating project information

2. In the Project Information window, select **Summary** tab, update the desired information and click **OK**.

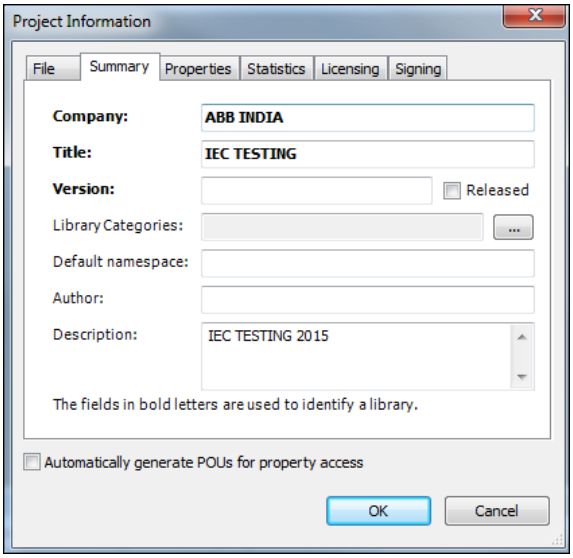


Figure 10: Project information

The updated project information is not loaded to the target application. Further steps explain how to copy this information to the application information fields.

3. In the **Devices** tree, right click **Applications** and select **Properties**.

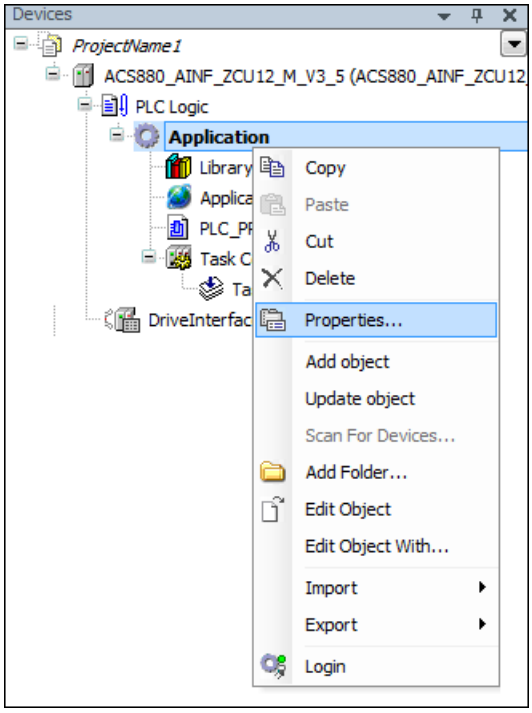


Figure 11 Application properties

4. In Properties window, click **Information** tab and then click **Reset to values from project information** and click **OK**.

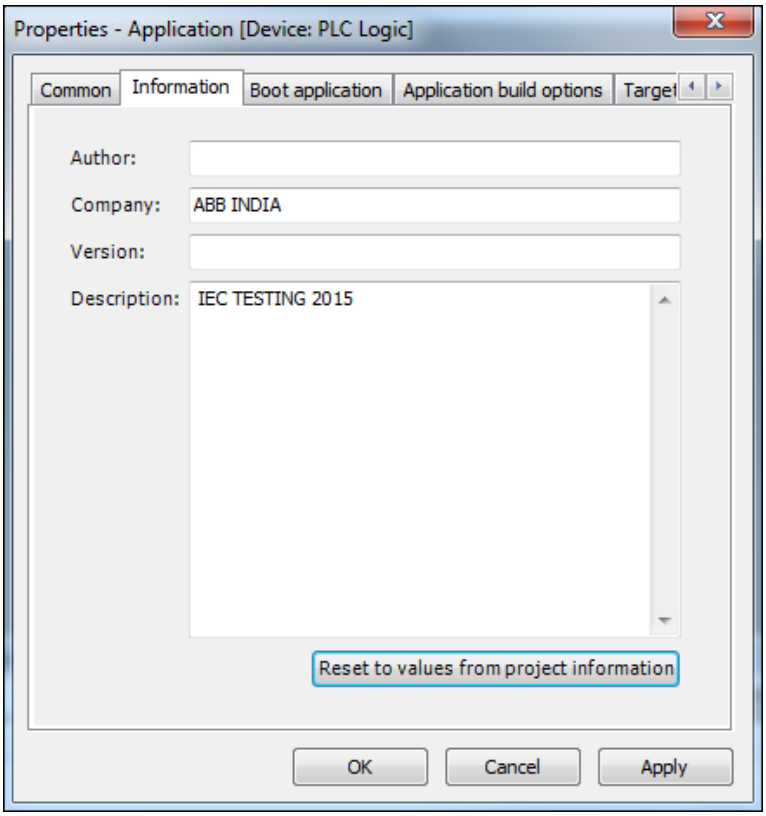


Figure 12: Copy information to application information fields

The Automation Builder tool version and project identification code are registered automatically.

Appending a new POU

To append a new POU, follow these steps:

1. In the Devices tree, right-click **Application** and select **Add object**.

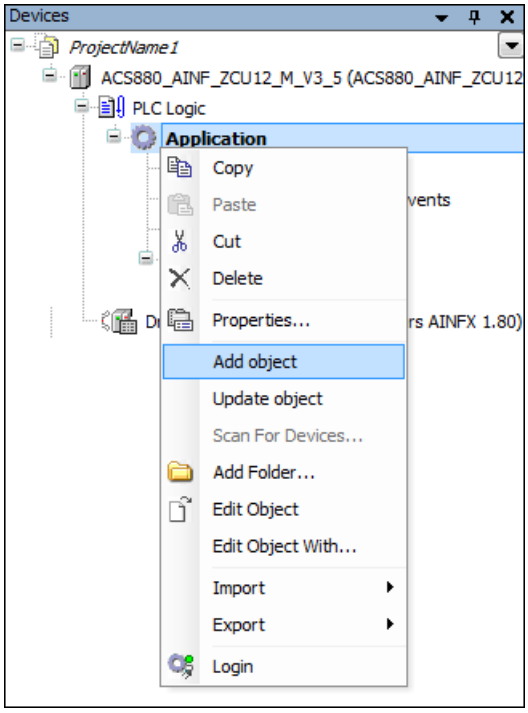


Figure 13 Application add object

2. Select **POU** and click **Add object**.

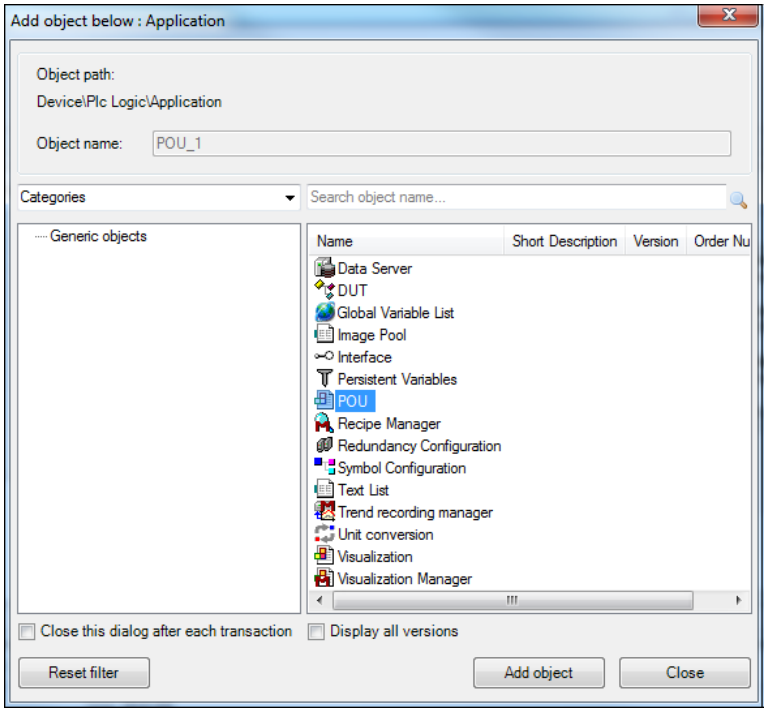


Figure 14 Add POU object

3. In the Add POU window, Name the POU, select the Type of the POU and the used implementation language and then click **Add**.

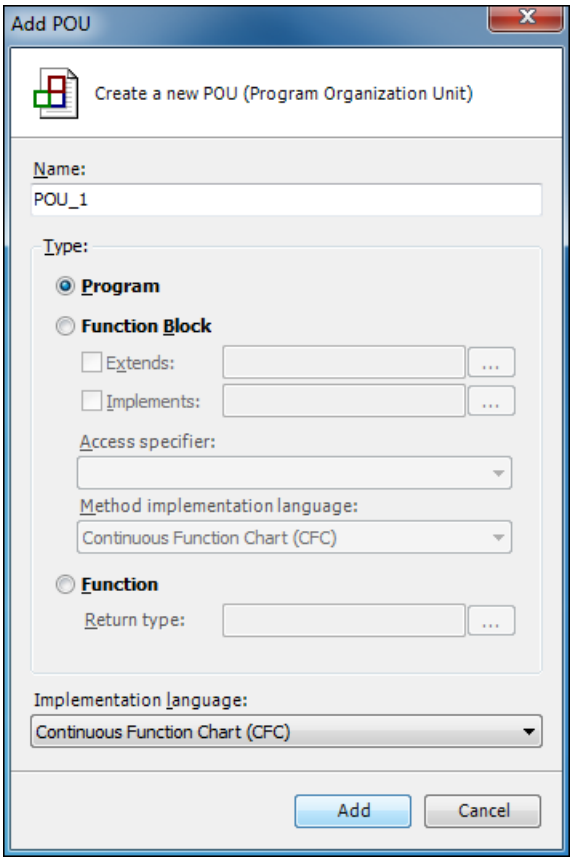


Figure 15: Add POU

The appended POU, xxx (PRG) is added to the Devices tree under application and the POU window is displayed with the declaration part and the program code.

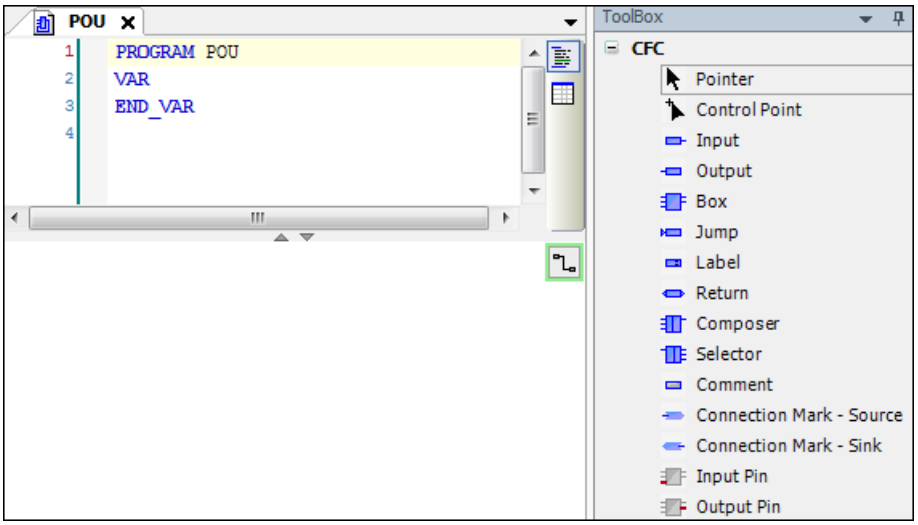


Figure 16 POU page

Writing a program code

A program organization unit (POU) is a unit, object or area where you can write the program code. The units can be created either directly under the Applications in the Devices tree or in a separate POUs window (**View** ->**POUs** or click **POUs** in the lower left corner).

The POU includes a declaration part (the upper window) and a program code part (the lower window).

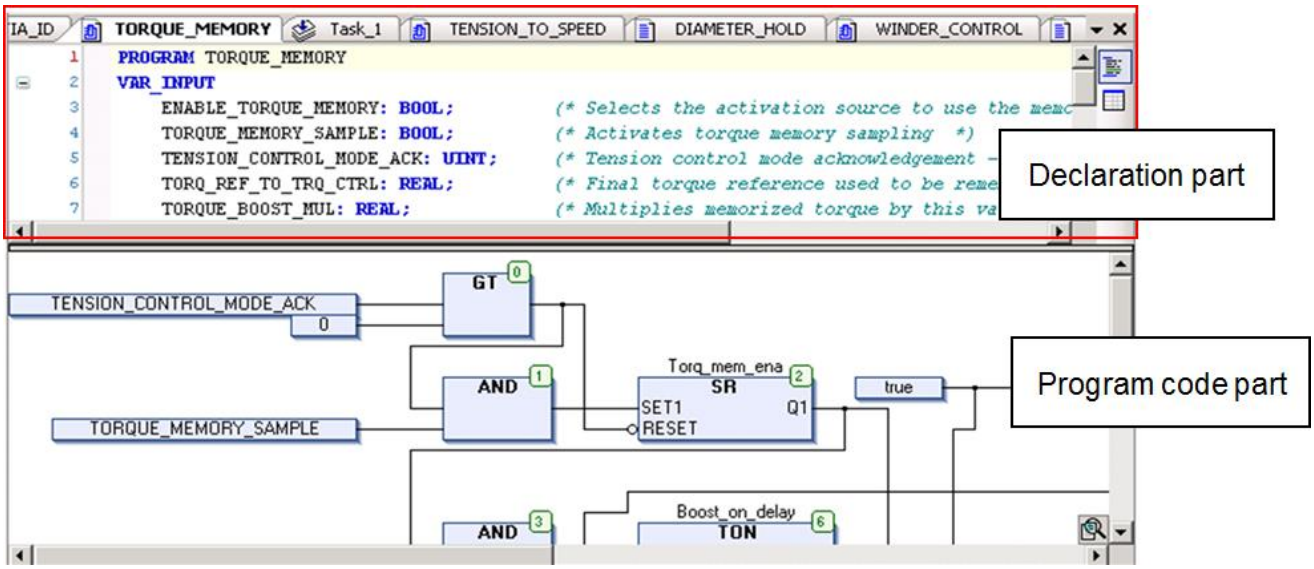


Figure 17: POU window

There are two different types of views for declaration part: a textual view and tabular view. You can switch between these views by clicking the buttons.

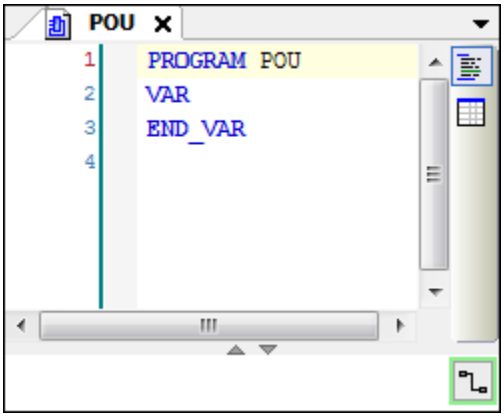


Figure 18 POU view type

Continuous function chart (CFC) program

This example shows how to create a new project in the CFC implementation language.

Adding elements

1. In the Devices tree, select the **xxx (PRG)** under the Application.

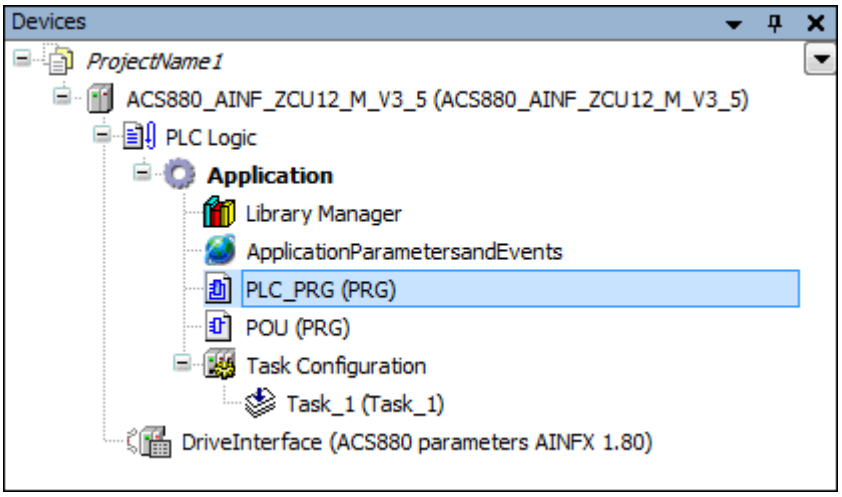


Figure 19 PLC PRG

2. In the View menu, select **ToolBox**.

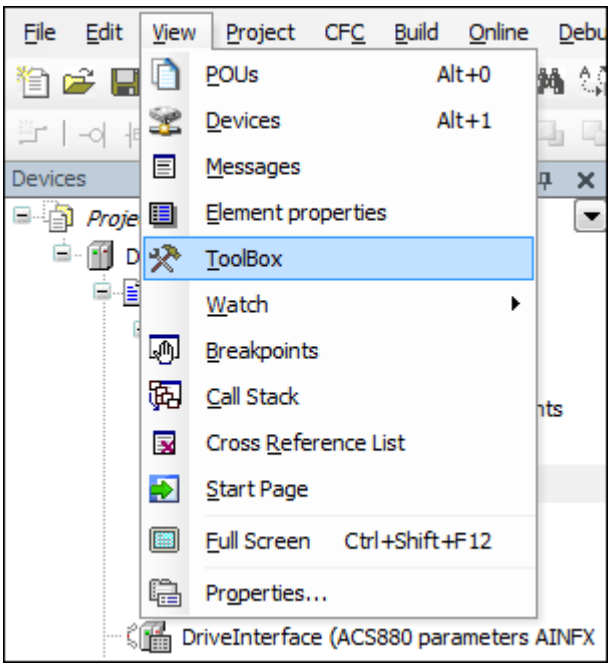


Figure 20 ToolBox

ToolBox components are displayed and are used to add a CFC scheme.

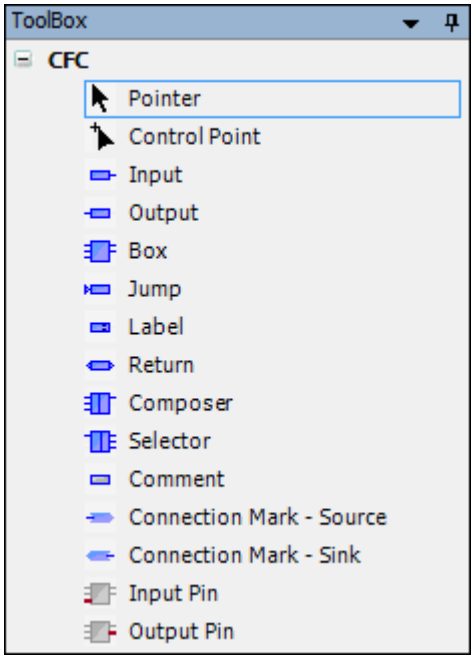


Figure 21: CFC scheme

If an empty ToolBox list is already displayed on the right side of the window, double-click the **xxx (PRG)** to display the Toolbox and the POU window. You can add, for example, SEL and AND elements (logic operators, functions), use the Box element in the ToolBox list.

3. In the ToolBox list, drag the **Box** and drop in the program code area.

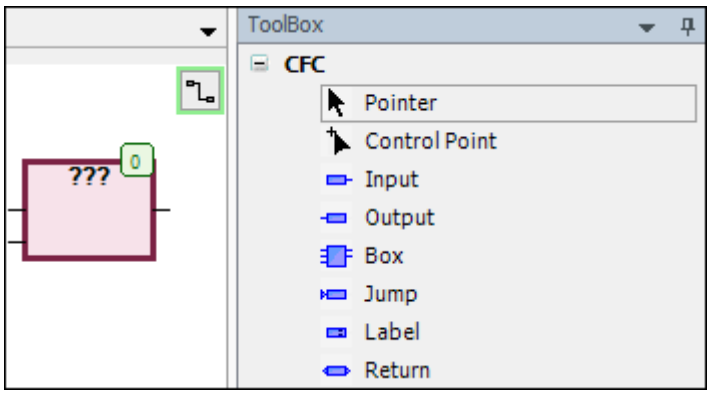


Figure 22: ToolBox: Box element

4. Enter the name of the function or operand in the **???** field.
   - You can also use Input Assistant to find the function, keyword, and operator. To start Input Assistant, click ... or press F2.

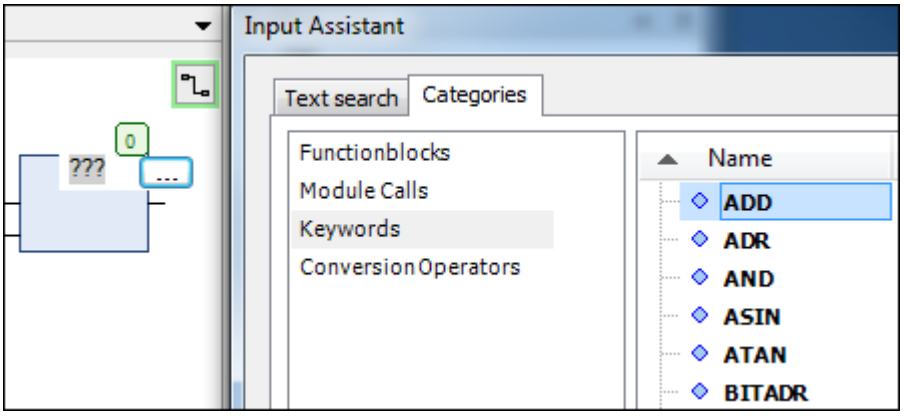


Figure 23: Input assistant

Note: The number in the upper right corner of the white box indicates the execution order of the function.

5. Right-click on input or output element and select **Negate** to invert.

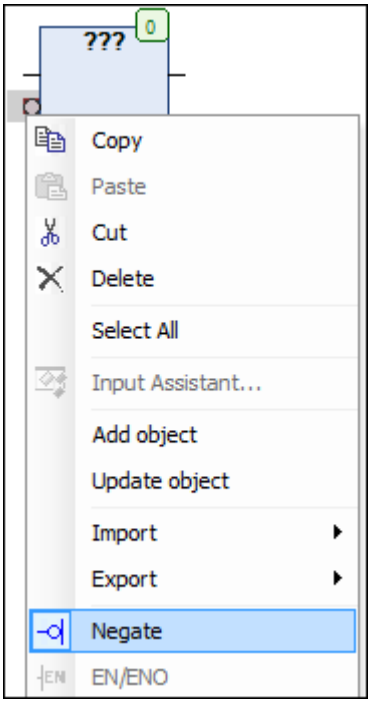


Figure 24: Invert input/ouput

Setting the execution order of the elements

Each element has its own execution order. The number in the upper right corner of the element indicates the sequence in which the elements in a CFC network are executed in the online mode. Processing starts from the element with the lowest number, that is 0. Note that the sequence influences the result and are changed in certain cases.

To set execution order of the elements, follow these steps:

1. Right-click on element and click **Execution Order** and select **Set Execution Order**.

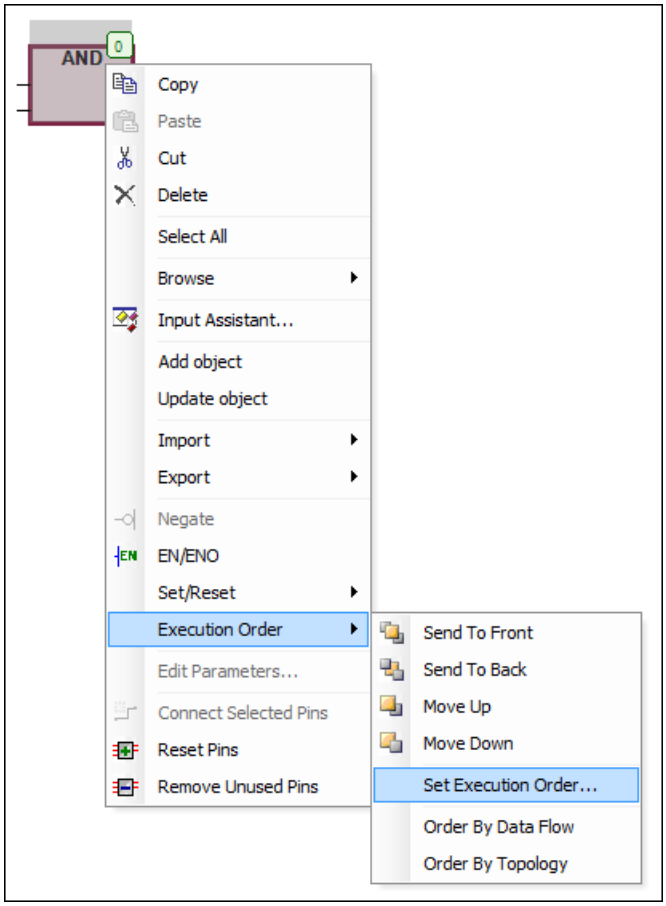


Figure 25: Execution order

2. In the **Set Execution Order** window, type **New Execution Order** number and click **OK**.

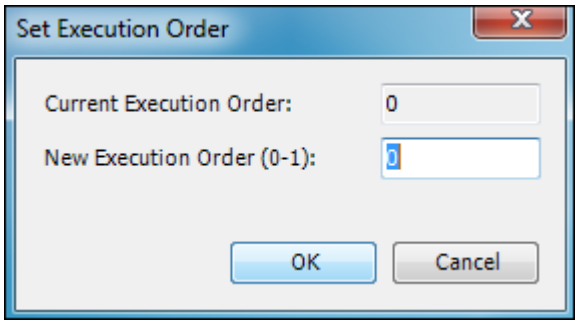


Figure 26 Set execution order

The block execution order is changed.

Adding comments to a CFC program

In the ToolBox, select **Comment** and drag to desired point in the program code area and enter the comment text.

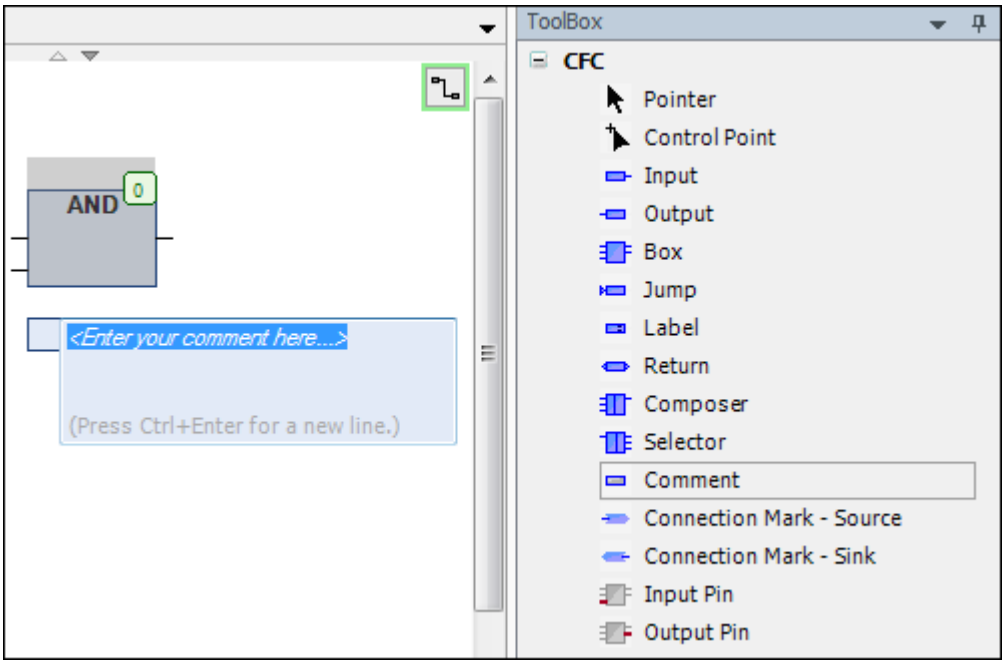


Figure 27: Add comment to a CFC program

Declaring variables

To create a new variable, you can either declare it in the declaration part of the editor window or use Auto declaration.

Depending on the type of the declaration view (textual or tabular) add a new variable by writing its properties to a new text row (textual view) or use the TAB button (tabular view). For changing between the views, see section *Writing a program code*.

1. In the program code area, select the required object.
2. In the main menu, click **Edit** → **Browse** → **Auto Declare**.

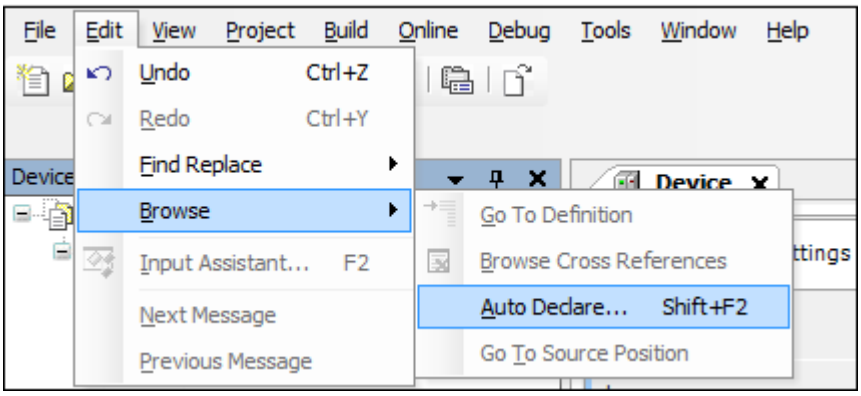


Figure 28 Auto declare option

The Auto Declare window is displayed.

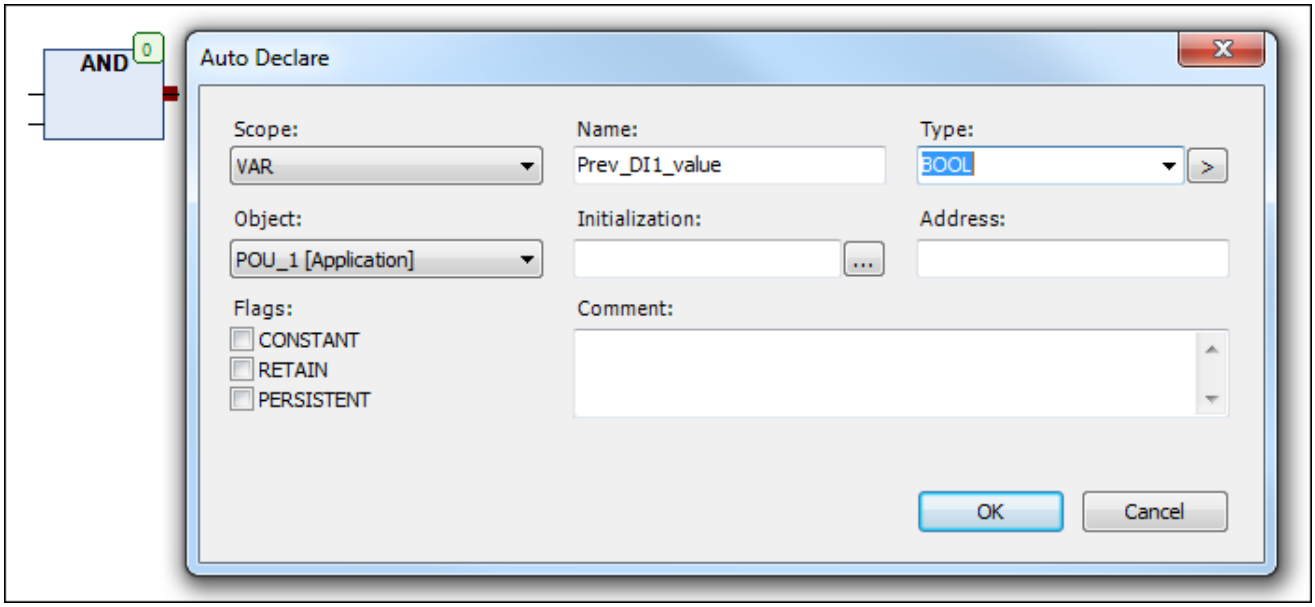


Figure 29 Auto declare variables

If you enable the option to declare unknown variables automatically (**Tools** → **Options** → **SmartCoding**), the Auto Declare window opens every time you use an unknown variable in your program and you can declare the variable instantly.

3. Define the **Scope**, **Name** and **Type** of the variable (mandatory).
   - Scope defines the type of variable (global, input, output, etc.).
   - Name is a unique identifier of the variable and represents the purpose of the variable.
   - Type is the IEC data type of the variable.

   Optionally, you can also define the **Initialization** value, **Address**, **Comment** or **Flags** for the variable.

   Flags have the following meaning:

   - **CONSTANT** means that the variable value cannot be changed and the variable maintains its initial value all the time.
   - **RETAIN** keeps its value over reboot and warm reset.
   - **PERSISTENT** is not supported.

Adding inputs and outputs

You can add inputs and outputs by selecting **ToolBox** elements. See section *Adding elements*.

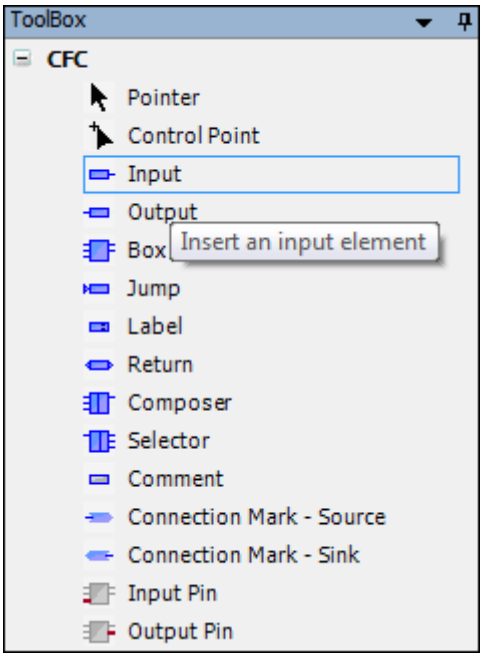


Figure 30: ToolBox for adding inputs and outputs

Another way to add inputs and outputs straight to a block is to select a pin of a block and start typing the name of a variable.

1. In the program code area, select the pin of the block.

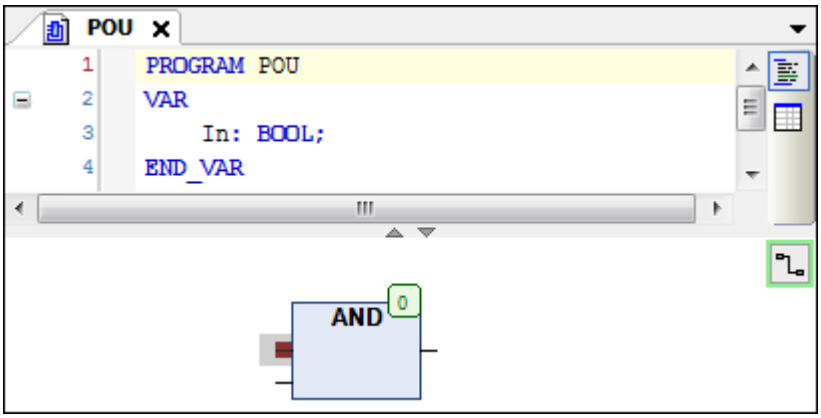


Figure 31 Naming inputs and outputs

2. Name the input or output by writing the variable name to the block or use input assistant as described in *Declaring variables*.
3. To connect the input or output block to a pin, left-click the line connected to the block and drag it to a pin of another block.

Creating a block scheme

Example:

Create the following CFC program:

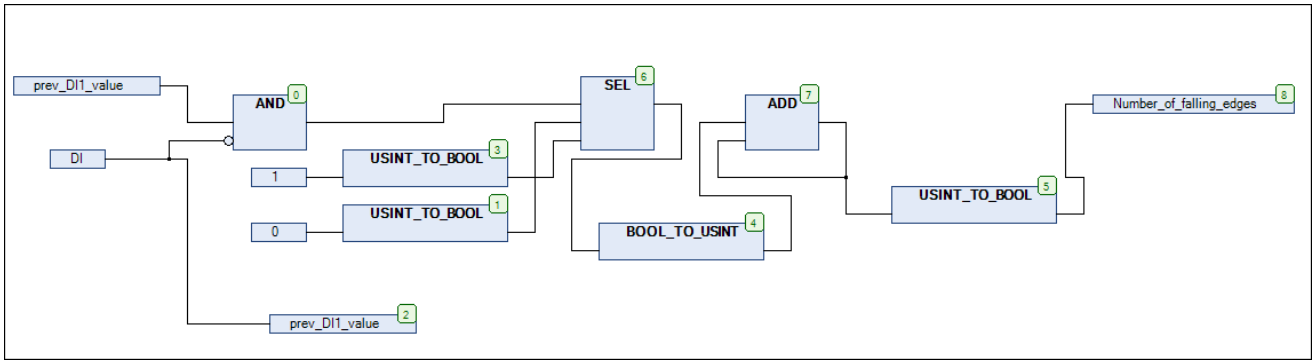


Figure 32: Example of CFC program

The following local variables are required in the block scheme.

```
1  PROGRAM PLC_PRG
2  VAR
3
4      Number_of_falling_edges: BOOL;
5      prev_DI1_value: BOOL;// := False;
6      DI: BOOL;// := True;
7  END_VAR
8
```

Figure 33 Local variables

During block scheme programming, the already created variables are displayed in the Input Assistant and new declarations are added to the variable declaration area.

For using the Input Assistant, see section *Adding elements* in *Continuous function chart (CFC) program*.

Preparing a project for download

To prepare a project for download, follow these steps:

1. In the main menu, click **Build** and select **Build**.

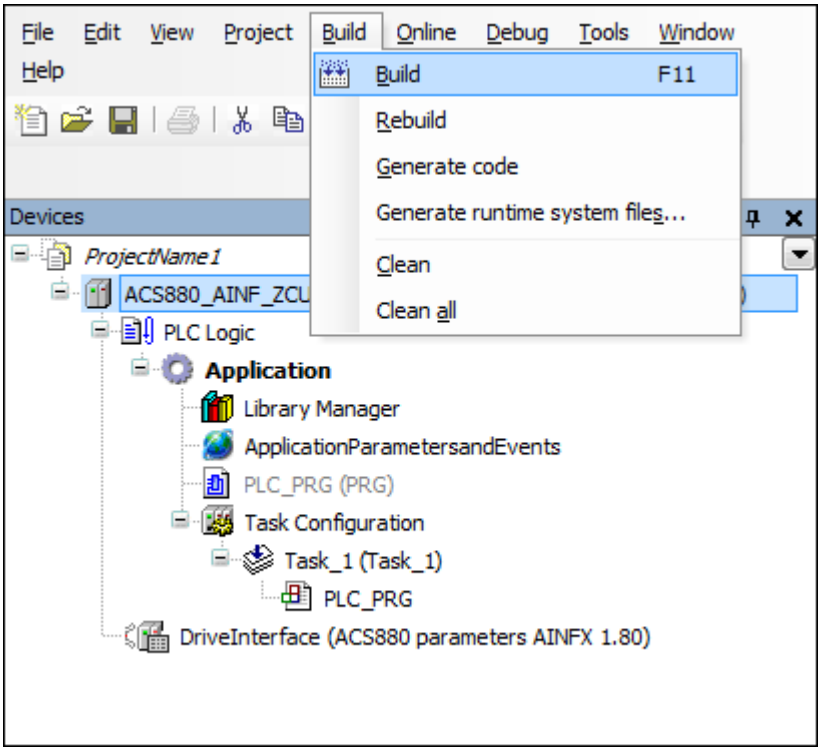


Figure 34 Build

2. In the **View** menu, select **Messages**. A Messages window is displayed**.**
   - Check that there are no errors or warnings. Otherwise, check and fix the application.

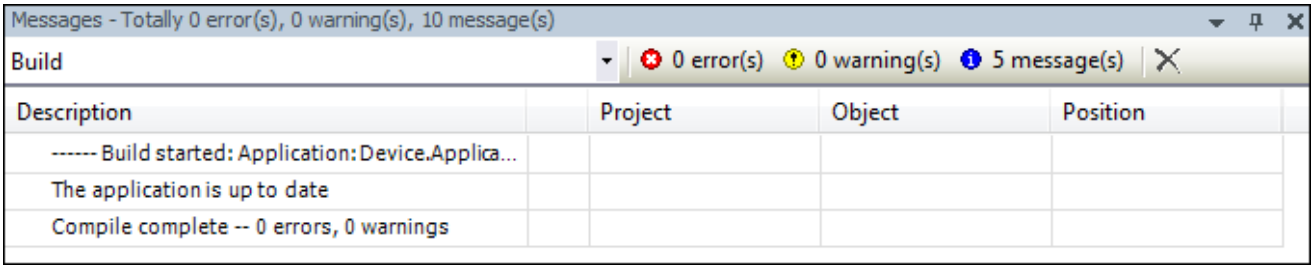


Figure 35: Build project message window

In the example, the process is successfully completed without any errors or warnings and the project is ready for download.

Establishing online connection to the drive

The Automation Builder communication gateway handles communication between Automation Builder and the drive. The gateway is a software component that starts automatically at the power-up of the PC after installing Automation Builder.

Before starting with the communication setup, follow the pre-requisites listed below.

Pre-requisites:

1. Connect PC to a drive through USB port of the ACS-AP-x control panel using a standard USB data cable (USB Type A <-> USB Type Mini-B). For information on making the control panel to PC USB connection, see *ACS-AP-x control panel user's manual* (3AUA0000085685 [English]).
2. Make sure the ACS-AP-x USB driver is installed. For installation procedure, refer *Drive composer user's manual* (3AUA0000094606 [English]).
3. Make sure the drive has application programming license N8010. To check license information in Drive composer pro and in ACS-AP-x control panel, go to **System info** → **Licenses**.

To establish online connection to the target drive after defining the device type, follow these steps:

1. In the Devices tree, double-click **ACS880_AINF_ZCU12_14_M_V3_5** and then click **Communication Settings**.
   - Gateway-1 is displayed by default.

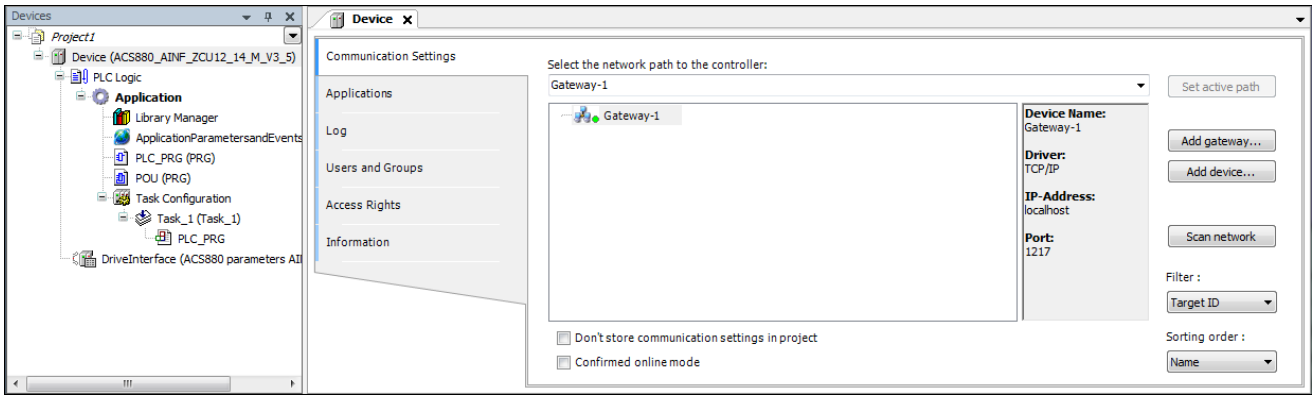


Figure 36: Communication settings

Note: If the gateway displays red , the CODESYS Gateway V3 is disabled in local control panel settings.

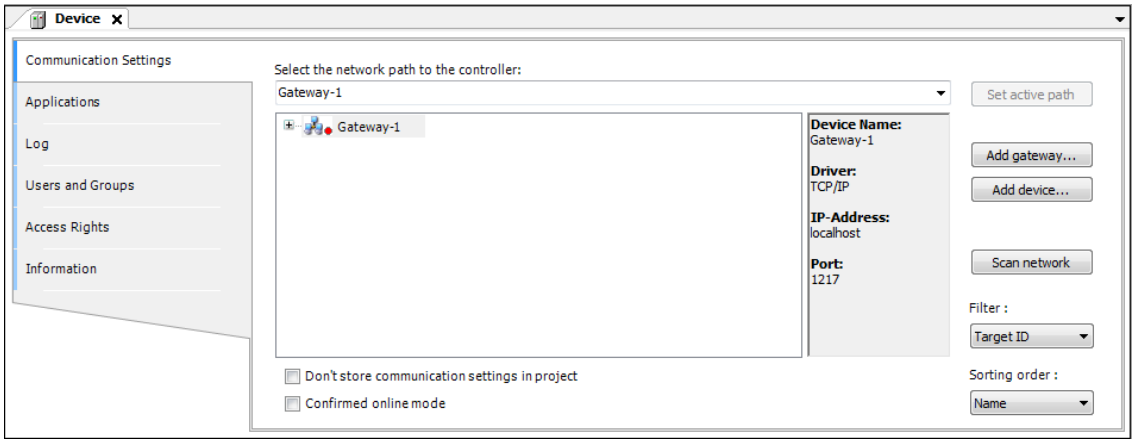


Figure 37 Gateway disabled

2. In the local computer, open **Control panel** → **Administrative Tools** → **Services**.
3. In the Services window, double-click **CODESYS Gateway V3**.

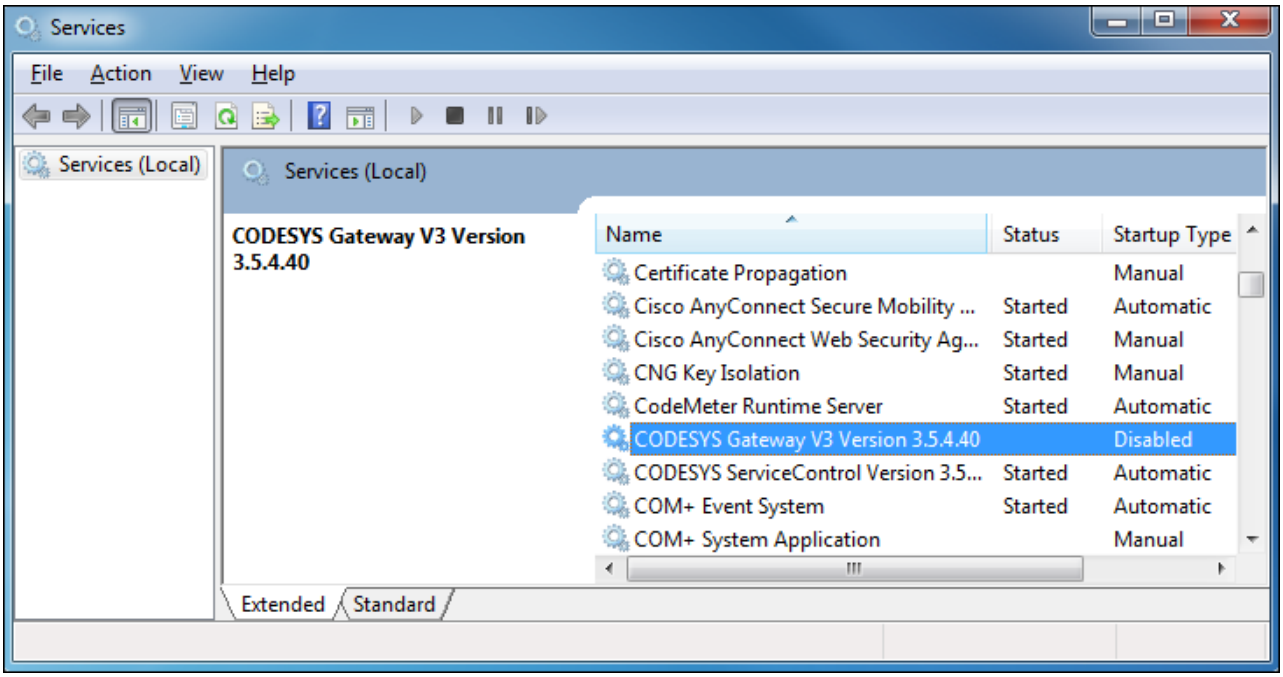


Figure 38 Gateway services

A **Properties** window is displayed.

4. In the Properties window, select the desired **Startup type** from the available drop-down list and click **OK**.

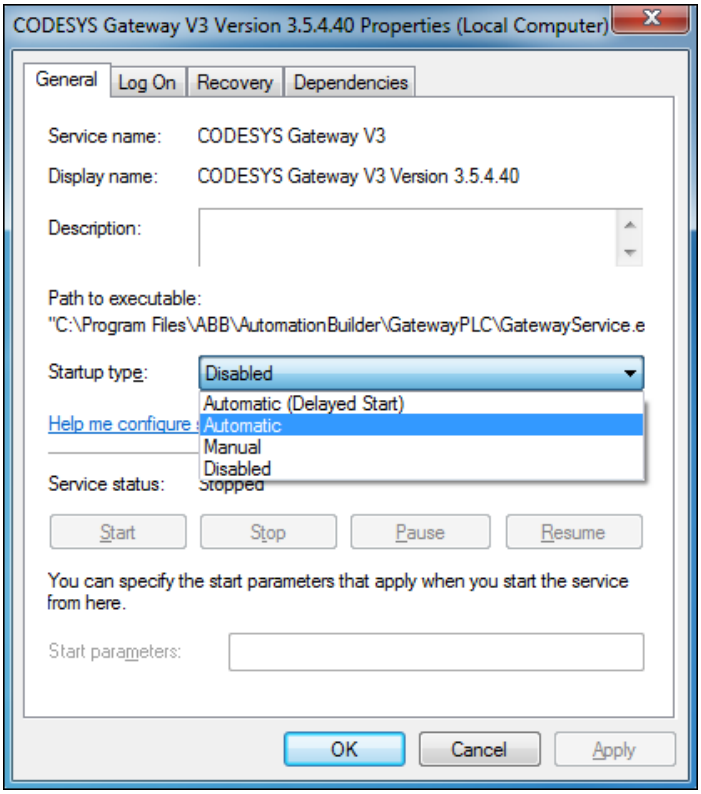


Figure 39 Startup type

CODESYS Gateway V3 is enabled and turned to green .

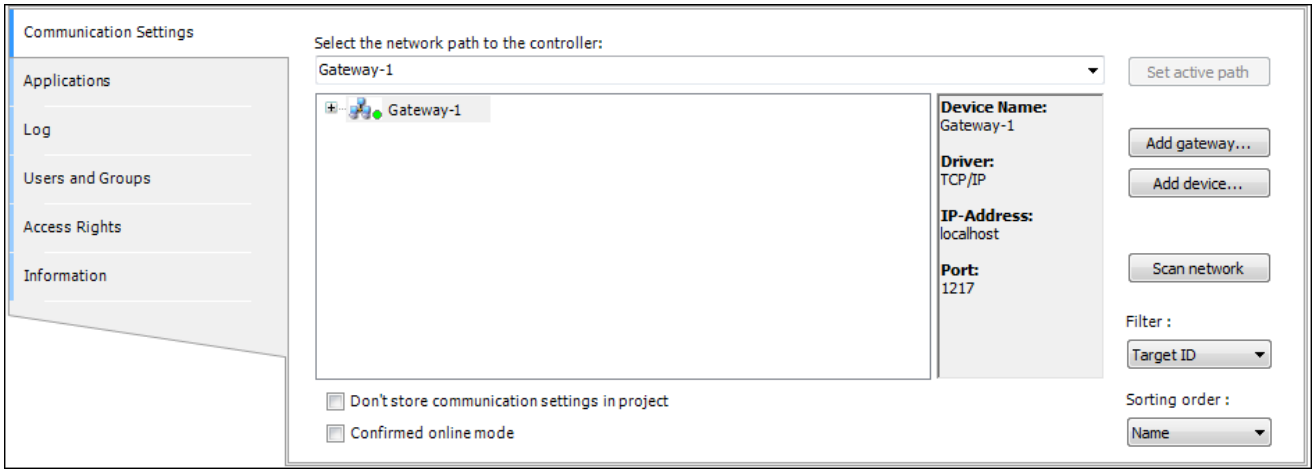


Figure 40 Gateway enabled

5. Ensure that the following default communication settings are correct.
    - Node Name: Gateway-1
    - Driver: TCP/IP
    - IP-Address: localhost (Remote gateways are not scanned)
    - Port: 1217
6. If Gateway-1 is not available, click **Add gateway**.

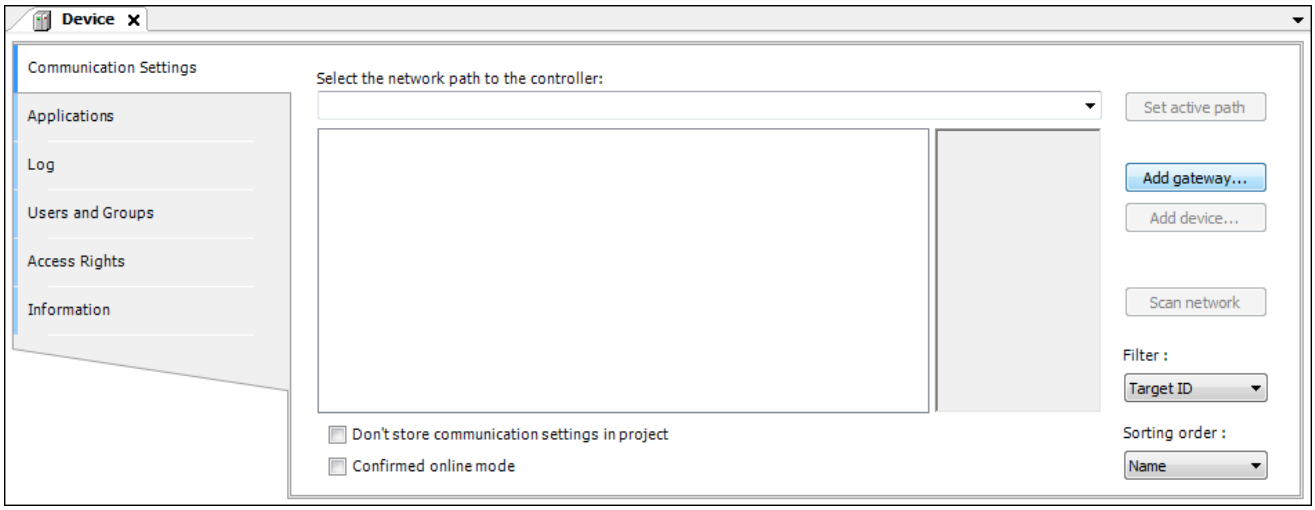


Figure 41 Add new gateway

7. In the Gateway window, select the appropriate settings and click **OK**.

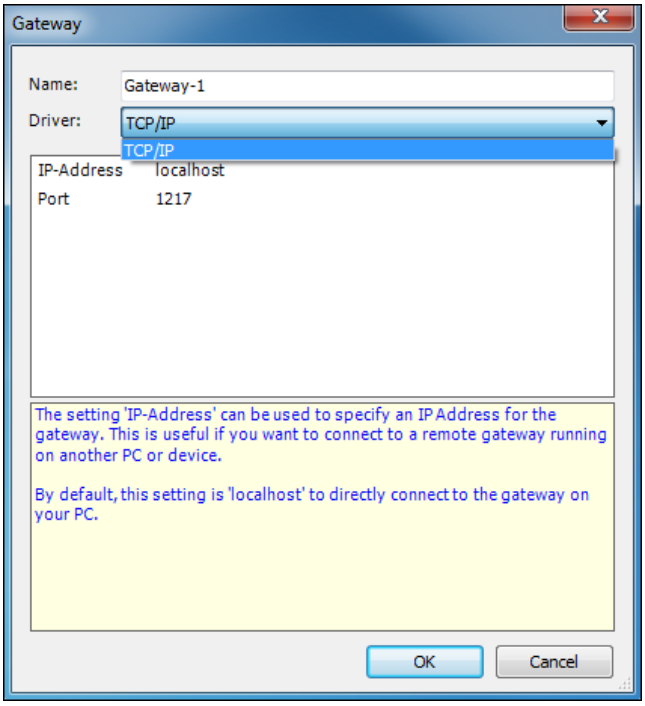


Figure 42 Gateway settings

8. Check that the USB cable is connected to the USB connector of the ACS-AP-x control panel and the drive is powered.

   For communication related problems, see practical examples and tips for *Solving communication problems*.

9. Double-click **Gateway-1** or click **Scan network** to search the target device.

   - Filter Target ID displays only devices that are of the same type as the device selected in the Devices window.
   - The gateway device is added under Gateway-1.

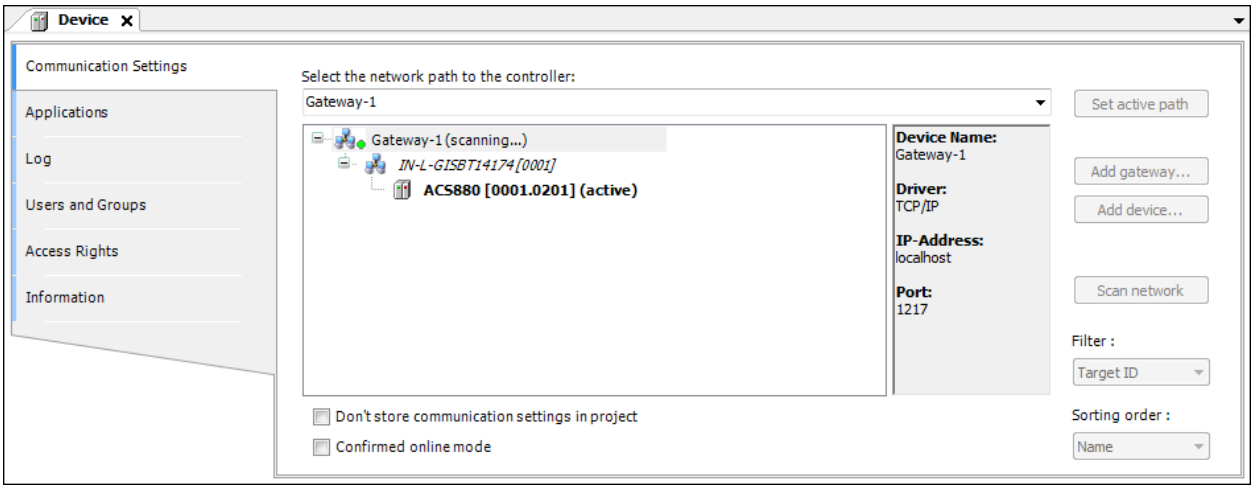


Figure 43: Adding devices under Gateway

10. Under Gateway**-1**, double-click or right-click the device and click **Set active path**.

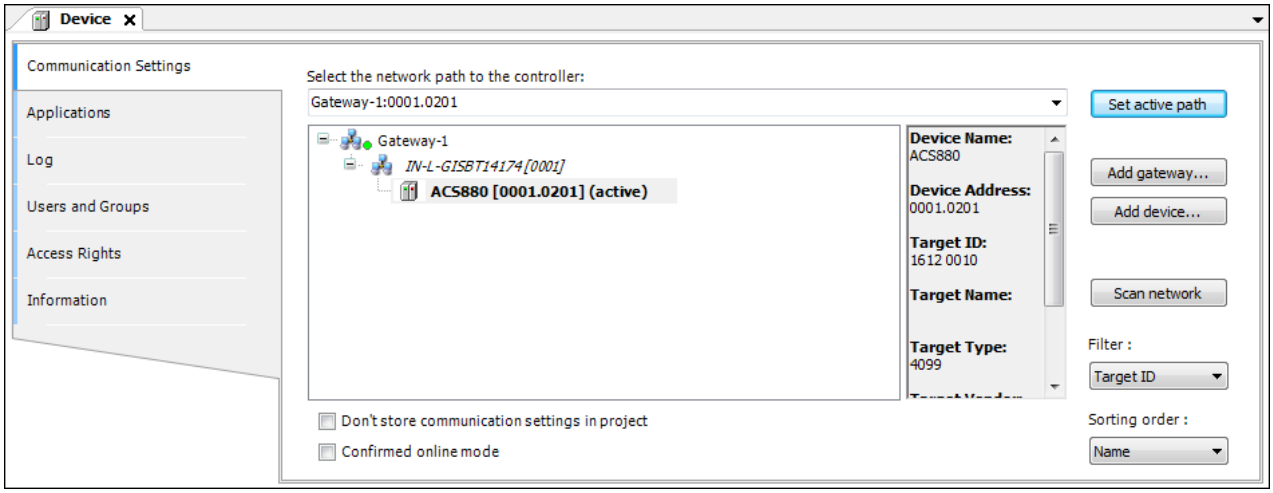


Figure 44: Activating devices under gateway

- If the drive has appropriate license code, the selected device is set as active path and is ready for downloading a program to the drive. See section *Downloading the program to the drive*.
- If the drive does not have the required license code, the selected device is displayed with no license.

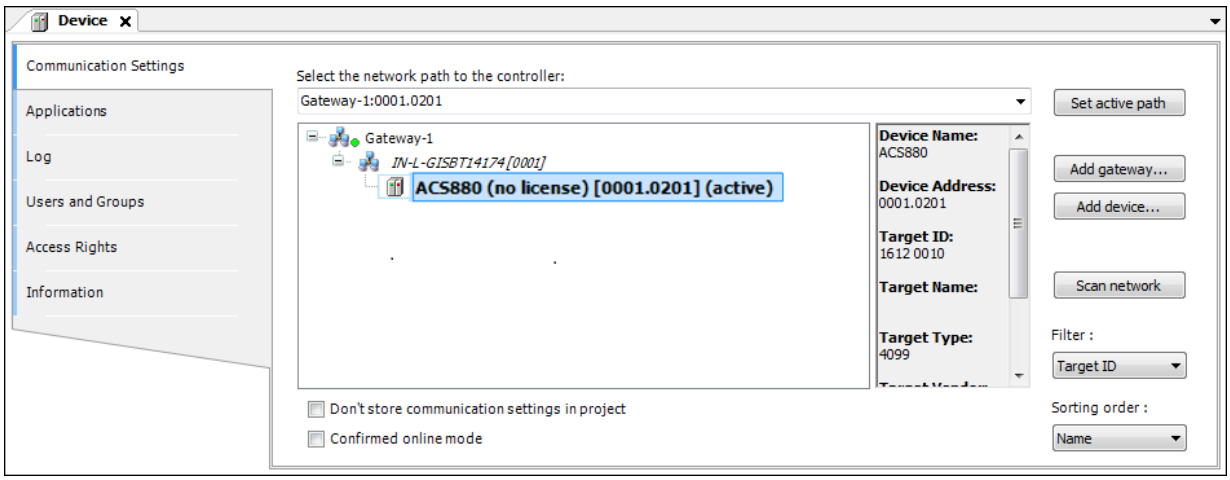


Figure 45: No license notification

Note: To see which port and node is used by each device, see the information in the device name in brackets [GGGG.PPNN] where:

- GGGG is the gateway number
- PP is the OPC channel number
- NN is the OPC node number

Downloading the program to the drive

After the project is ready for online communication with the drive, you can download and execute the written program to the drive. Check that the active path to the target device is defined in the communication settings. For more information, see section *Establishing online connection to the drive*.

1. In the main menu, click **Online** → **Login**.

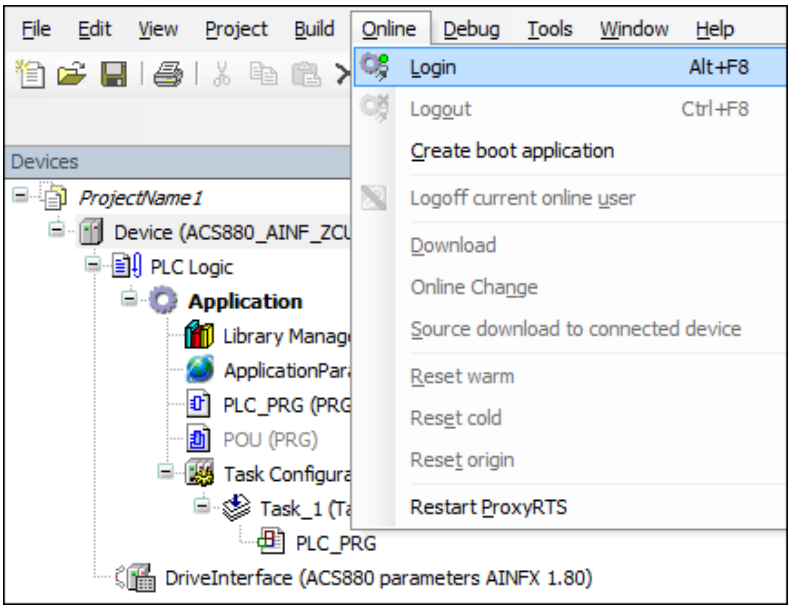
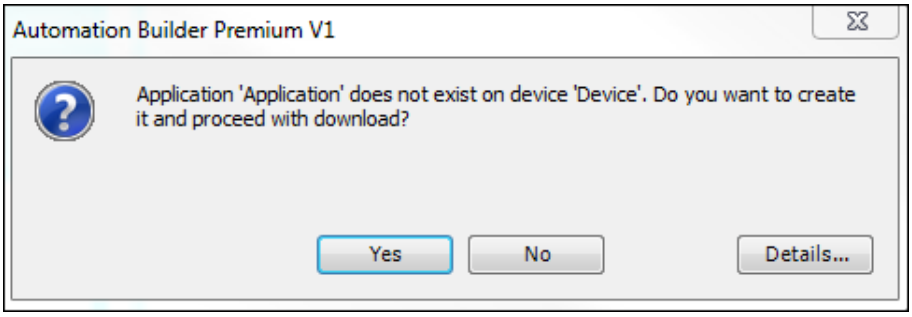


Figure 46 Login

If there already exists a program on the drive, the following dialog is displayed. Click **Yes**.



or

If the program is not downloaded before, the following dialog is displayed. Click **Yes**.

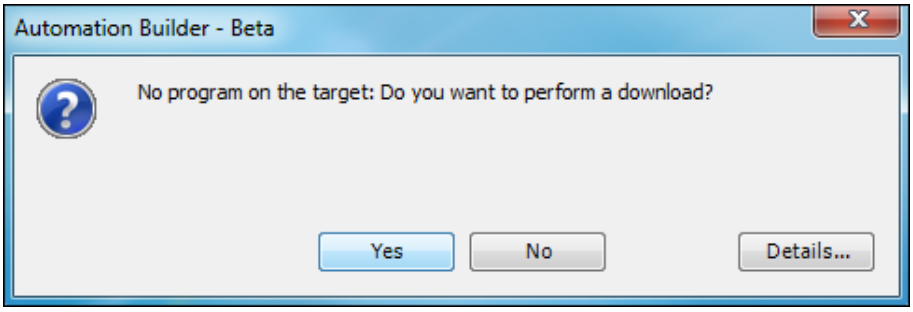


Figure 47: Perform a download

After the download is complete, the background color of the device name and the application name in the Devices tree changes. The program is in stop mode and the status is shown in brackets **[stop]**. You can start the program by selecting **Start** in the **Debug** menu.

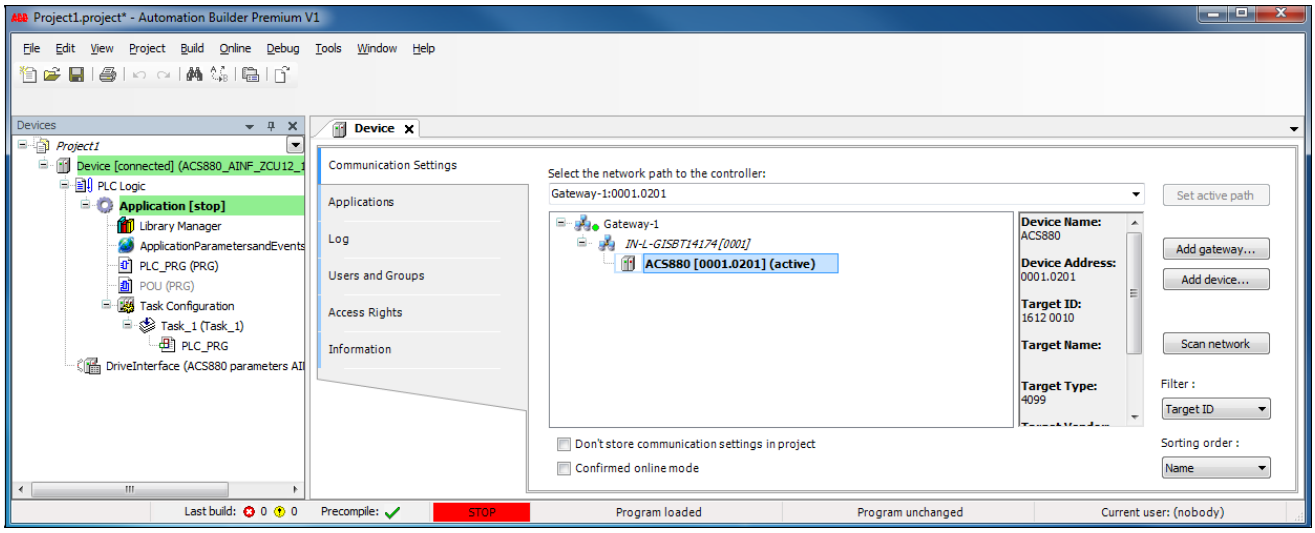


Figure 48 Program in stop mode

For more information on downloading program, see section *Application download options* in chapter *Features*.

Creating a boot project

The regular downloading moves the application program to the RAM memory of the drive. Creating a boot project copies the application to the non-volatile memory of the drive memory card and thus retains the application after power cycle or reboot. For more details, see section *Application download options*.

To create a boot project, follow these steps:

1. In the main menu, click **Online** and select **Create boot application**.

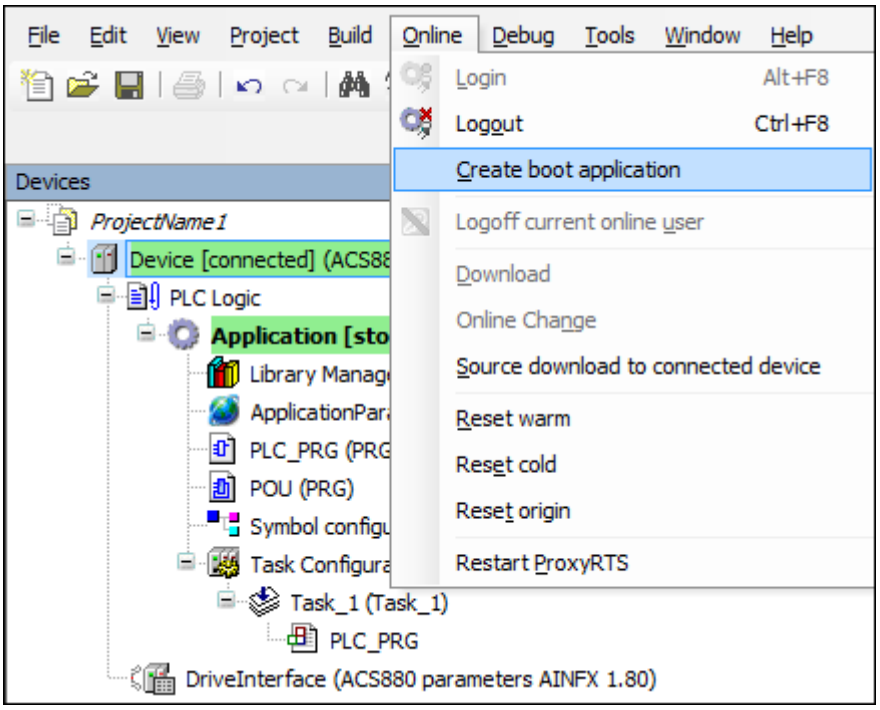


Figure 49: Create boot application

The following message is displayed. Click **Yes** to reboot the drive.

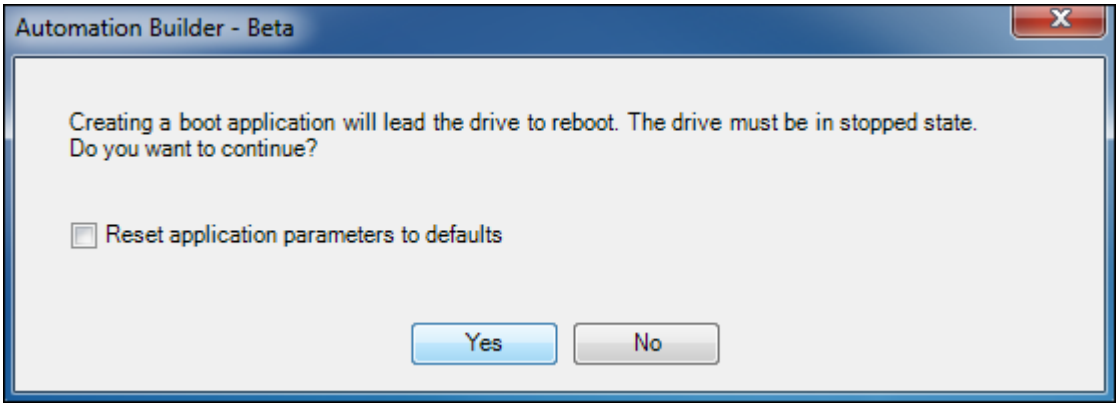


Figure 50: Reboot drive after boot project

The reset to default values is optional. If you select **Reset application parameters to defaults** option, the next boot resets all the application parameters to their default values. The previously set values are not restored from the permanent memory.

Select this option when a new application is loaded to drive or a reset origin has been performed or when application parameters of the new application are different from the previously loaded application.

Note: It is recommended to select the **Reset application parameters to defaults** option whenever you load a new application to the drive or whenever you change the parameter definitions of the existing application (APEM).

After creating the boot application, the status changes from STOP to RUN.

2. System prompts to save the boot application, click **Save**.

Executing the program

To execute a program, follow these steps:

1. In the main menu, click **Debug** → **Start**.

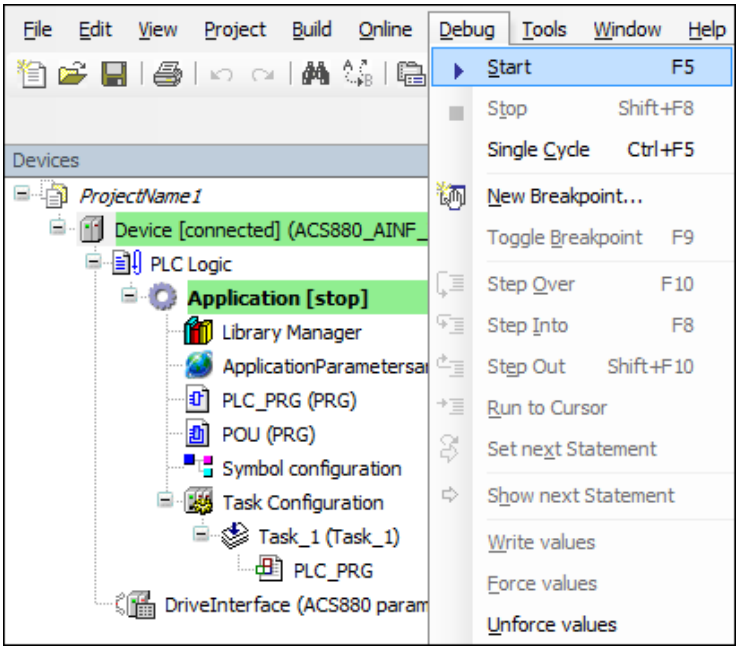


Figure 51: Debug menu

The application status changes to [run] and notifies that the program is executed successfully.

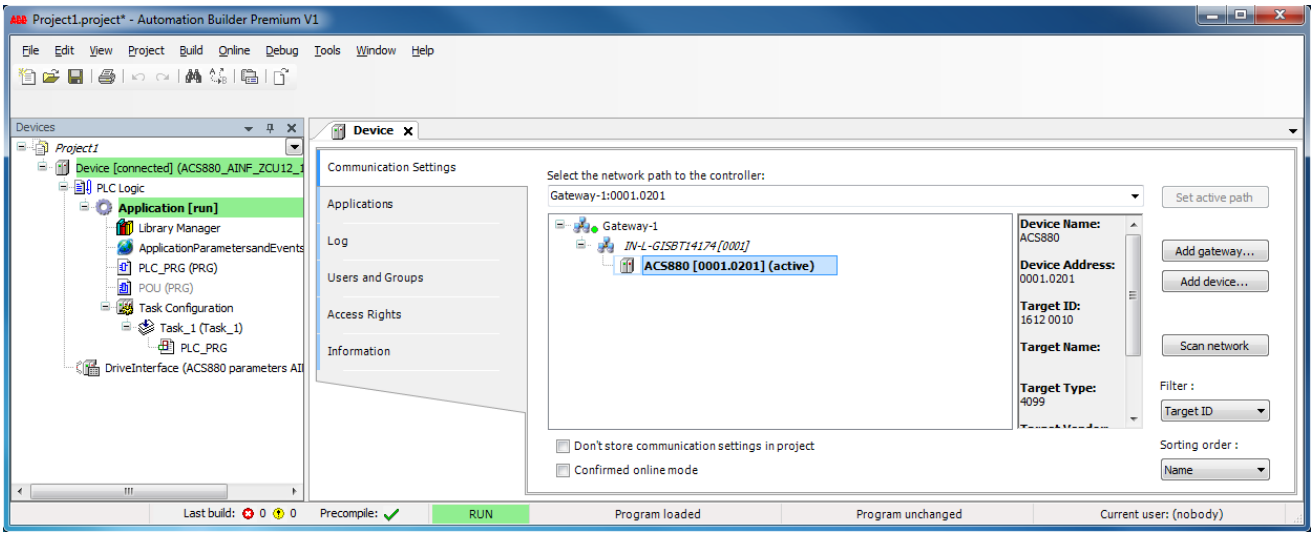


Figure 52 Executing a program

2. To set or change a value of an existing variable, double-click the cell in the **Prepared value** column, type a new value and press **Enter**.
3. In the **Debug** menu select **Write values** to apply the prepared value to the variable.
4. In the **Debug** menu, select **Force values** to force the prepared value to the variable.
5. In the **Debug** menu, select **Unforce values** to unforce a forced value.

The variable value is changed. The current variable values are displayed in the Value column and in the source code near the variable.

6. In the **Debug** menu, click **Stop** and then in the **Online** menu, click **Logout** to logout.

WARNING! Ignoring the following instruction can cause physical injury or damage to the equipment.

Do not debug or make changes to drive in the online mode or while the drive is running to avoid damage to the drive.

5

Features

Contents of this chapter

This chapter describes the device handling information and features supported by Automation Builder.

Device handling

In the application programming environment, devices represent hardware. The device description file contains information about the target device (drive) from the programming point of view like the device identifier, compiler type and memory size. The ABB Automation Builder installation package installs the device description files automatically.

The device description may be updated later and a new file can be installed. The system monitors that a project with an incompatible device description file is not loaded to the drive.

The following topics describe device handling:

- *Viewing device information*
- *Upgrading or adding a new device*
- *Changing an existing device*
- *Viewing software updates*

Viewing device information

To view the detailed device information, follow these steps:

- In Devices tree, double-click device and click **Information** tab.

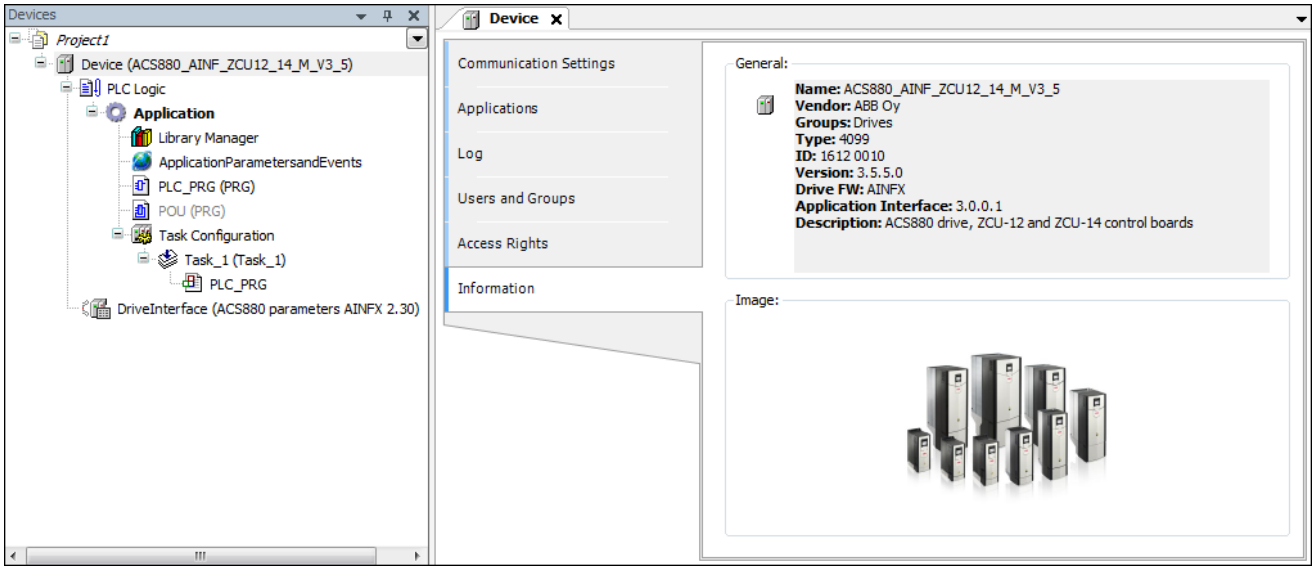


Figure 53: Device information

The Device ID (1612 0010), Drive FW name (AINFX) and application interface version (3.0.0.1) must be identical in the project and drive target. In Drive composer pro, use the **System info** option to check that the drive target has the corresponding application interface version and device type and drive firmware name (displayed in parameter 7.04).

You can also check if the drive target has the corresponding application interface version and device ID.

- In Drive composer pro, click **System info** and in **Products** click **More**.

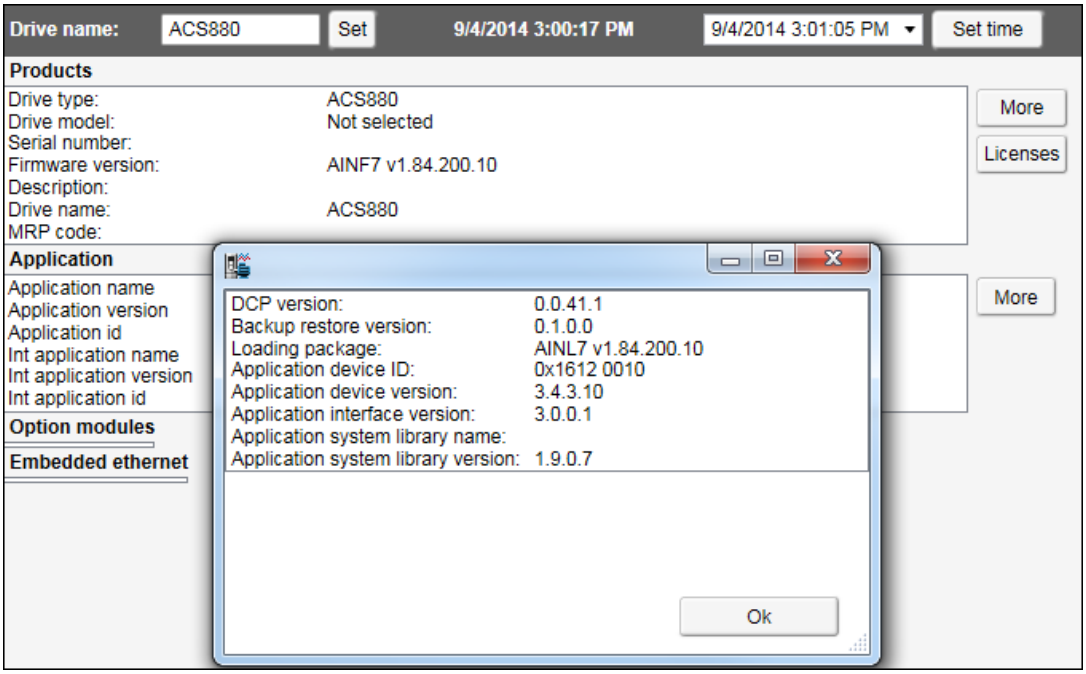


Figure 54: Checking drive compatible application and device

The name and version of the available system library is displayed. Make sure this information matches with the installed system library of the Automation Builder project.

For more information, see parameter *7.23* for Application name and parameter *7.24* for version in ACS880 FW.

For details of available functions, see chapter *Libraries*.

Upgrading or adding a new device

You can upgrade or add a new device to the programming environment.

1. In the main menu of Automation Builder, click **Tools** and select **Device Repository**.

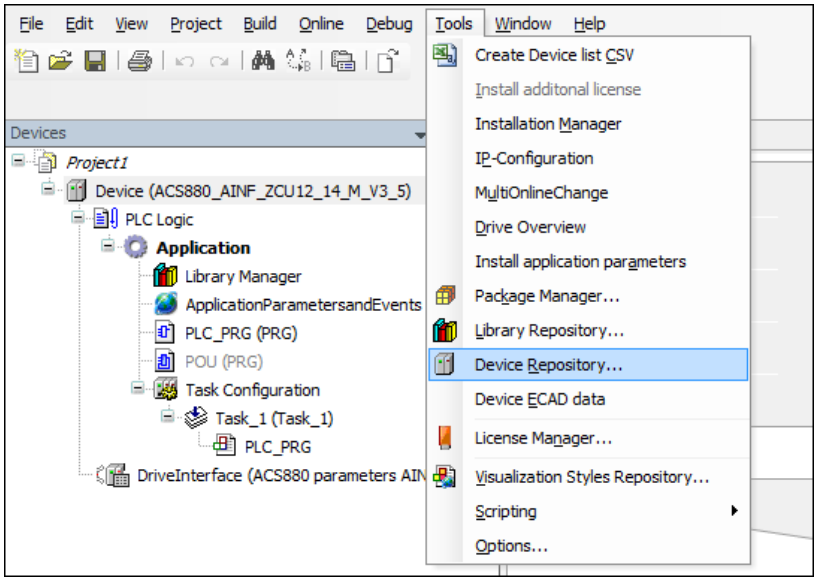


Figure 55 Automation Builder device repository

Device repository window is displayed.

2. Click **Install** to select device description file.

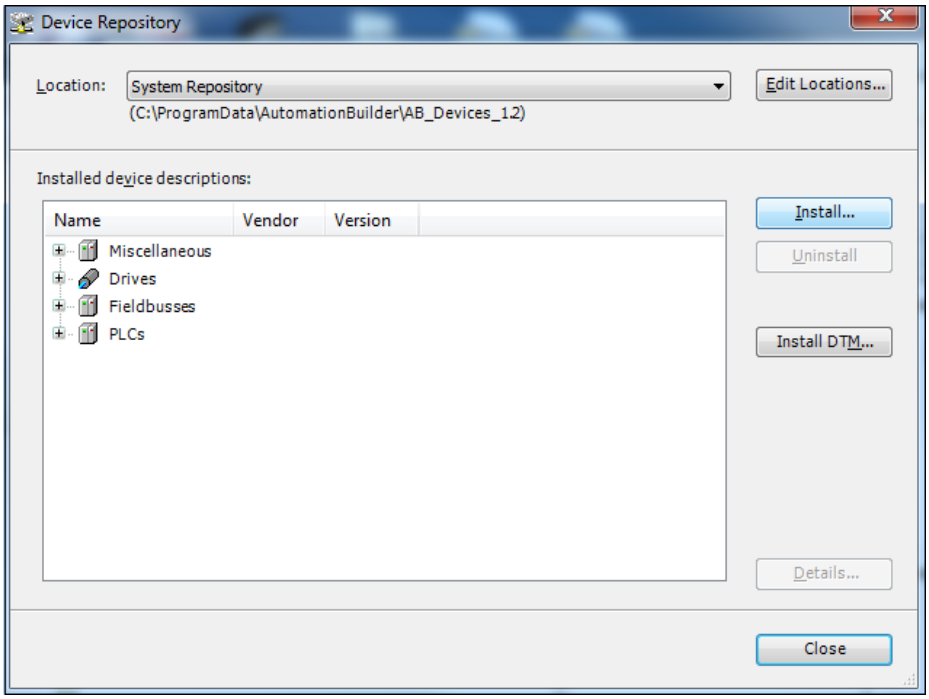


Figure 56: Device Repository window

3. In the Install Device Description window, browse and select the device description file (*.devdesc.xml*) in the file system.

   Now you can add a new device to projects or upgrade currently existing devices in the project.

Changing an existing device

You can change an existing device in Automation Builder project.

1. In the Devices tree, right-click on Device and select **Update objects** or in the main menu, click **Project** → **Update project**.

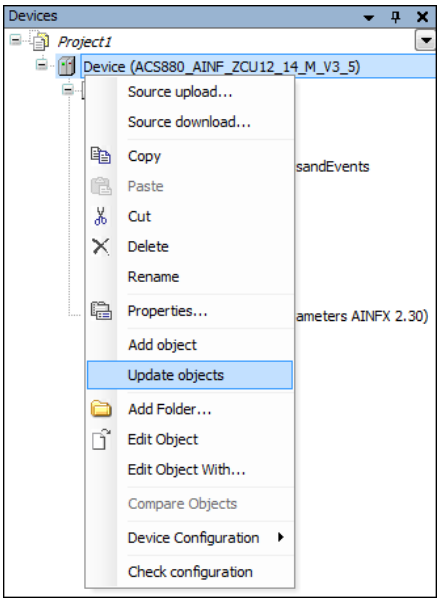


Figure 57: Update an object

The Update objects window displays the available device types.

2. Select the required drive device and click **Update objects**.

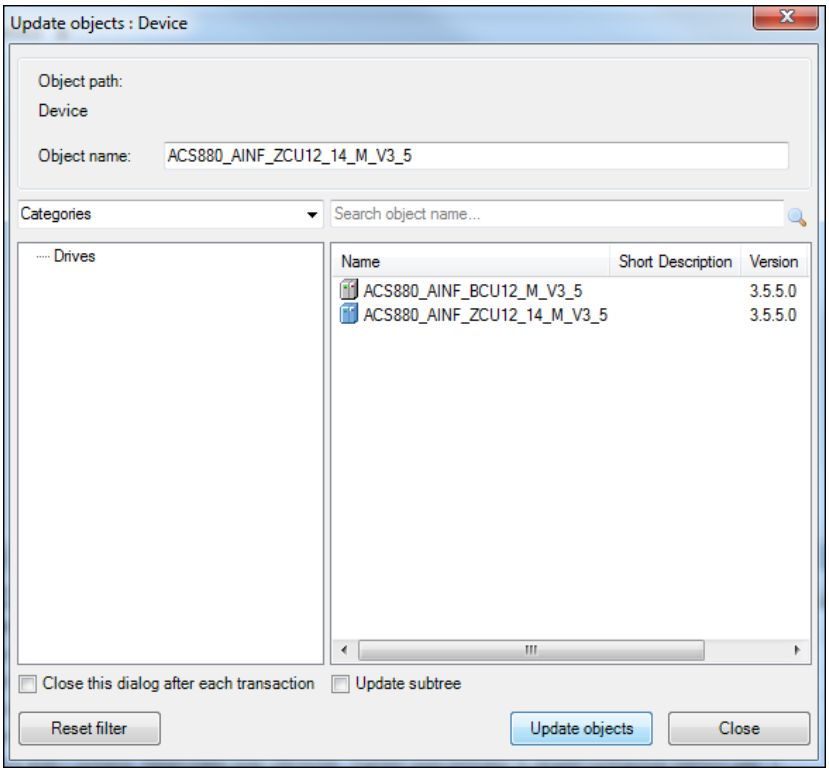


Figure 58 Update object device

Viewing software updates

- In the Automation Builder start page, click *Automation Builder* to download Automation Builder update packages.

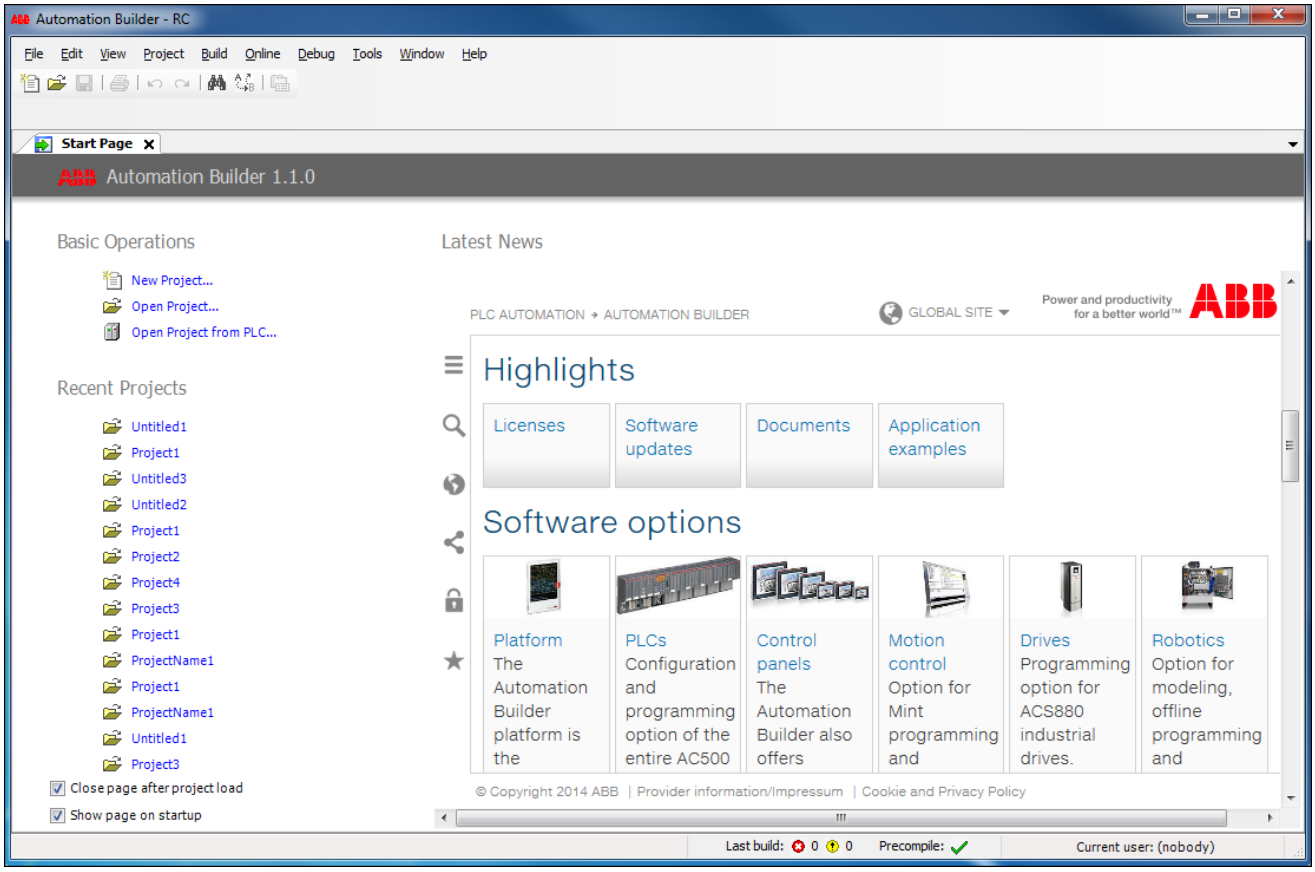


Figure 59: Automation Builder start page

This link is the download center for low voltage products and systems (India). For example, you can find Automation Builder Service Release 1 – Release note, Automation Builder update packages, and so on.

Program organization units (POU)

The POU types are:

- A program (PRG) may have one or several inputs/outputs. A program may be called by another POU but cannot be called in a function (FUN). It is not possible to create program instances.
- A function (FUN) has always a return value and may have one or several inputs/outputs. The functions contain no internal state information.
- A function block (FB) has no return value but may have one or several outputs as declared in the variable declaration area. A function block is always called using its instance and the instance must be declared in a local or global scope.

  A created project may have POUs with a specified implementation language. Each added POU has its own implementation language.

For more detailed description of the POU types, see the *IEC programming environment user manual* and the *IEC 61131-3 open international standard*.

Data types

The ABB drives application programming does not support some of the standard IEC data types like BYTE, SINT, USINT and STRING. The following list gives the standard IEC data types, sizes and ranges.

Data type	Size (bits)	Range	Supported by BCU-xx	Supported by ZCU-xx	Notes
BOOL	8/16*	0, 1 (FALSE, TRUE)	Yes	Yes	8 bit →BCU-xx 16 bit → ZCU-xx
SINT	8	-128...127	Yes	No	
INT	16	$-2^{15}...2^{15}-1$	Yes	Yes	
DINT	32	$-2^{31}...2^{31}-1$	Yes	Yes	
LINT	64	$-2^{63}...2^{63}-1$	No	Yes	
USINT	8	0...255	Yes	No	
UINT	16	0...65535	Yes	Yes	
UDINT	32	$0...2^{32}$	Yes	Yes	
ULINT	64	$0...2^{64}$	No	Yes	
BYTE	8	0…255	Yes	No	
WORD	16	0...65535	Yes	Yes	
DWORD	32	$0...2^{32}-1$	Yes	Yes	
LWORD	64	$0...2^{64}-1$	No	Yes	
REAL	32	$-1.2*10^{-38}...3.4*10^{38}$	Yes	Yes	
LREAL	64	$-2.3*10^{-308}...1.7*10^{308}$	Yes	Yes	Slow. Do not use.
TIME	32	0 ms... 1193h2m47s295ms	Yes	Yes	
LTIME	64	0 ns...~213503d	Yes	Yes	
TOD	32	00:00:00...23:59:59	Yes	Yes	
DATE	32	01.01.1970...~06.02.2106	Yes	Yes	
DT	64	01.01.1970 00:00... ~06.02.2106 00:00	Yes	Yes	
STRING[xx]		0...255 characters	Yes	No	
WSTRING[xx]		0...32767 characters	Yes	Yes	

Drive application programming license

The drive application programming license N8010 is required for downloading and executing the program code on the ACS880 or DCX880 drives. To check license information in Drive composer pro or in ACS-AP-x control panel, go to **System info** -> **Licenses**. If the required license code is not available, contact your local ABB representative.

Application download options

Before executing an application in the drive, download the application to the drive memory. After downloading, the application software is embedded in the firmware of the drive and has access to system resources.

Note: It is not recommended to download a program to the RAM memory when the drive is in RUN mode. The drive must be in STOP mode and Start inhibits must be possible to set.

Before download, ensure that there is no fieldbus device, M/F-link or D2D-link connected to the drive and Drive composer is not running data monitoring or back-up/restore at same time.

There are two different download options:

- **Download** – This is a regular download method that copies the compiled application to the drive RAM memory. As a result, it is possible to execute the application, but after a power cycle or reboot the memory is erased. This download method does not alter an application that is located in the drive boot memory (ZMU) and the original application is available for use after a reboot.
- **Create boot application** – This download method copies the application to the non-volatile memory of the drive memory card. This way the application remains intact after a power cycle or reboot. You should be logged into the drive to perform this operation. Features that can work only after restarting the drive should be downloaded with this method.

Create boot application command (**Online** → **Create boot application**) also includes booting the drive. Rebooting stops the execution of the complete drive firmware for some time. For this reason, it is allowed only when the drive is stopped and start inhibition is granted to the Automation Builder.

Note:

- Firmware parameter mapping, task configuration, application parameters and event configuration are activated only after the boot application is loaded and the drive is booted.
- Start inhibition is not granted if the drive is running, disabled (DIL, Safety function active) or faulted. Make sure that these conditions do not exist before downloading the program.

Removing the application from the target

Use the Reset option if the application includes many changes like application parameter changes or the application is replaced by another application. If the target already includes an application, use the **Reset origin** selection in the **Online** tab before downloading a new application.

This command removes (clears all) old applications from the target and all the application related references. Use this command at least once before the final version of application is loaded. The command can be used only in the online mode. See also *Reset options.*

When you are prompted with the following message, click **Yes**.

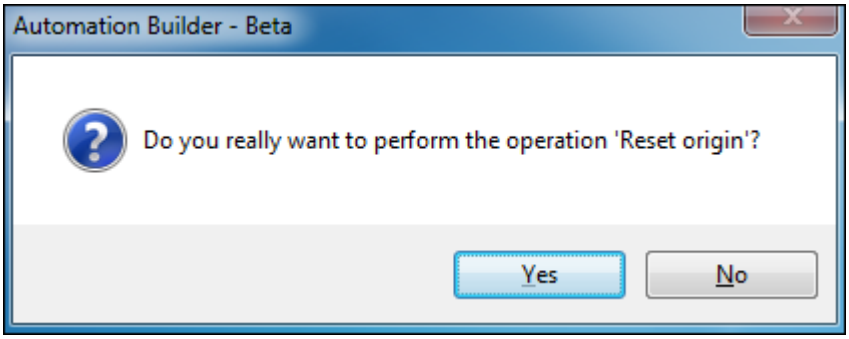


Figure 60: Initiate reset origin

After you initiate the Reset origin option, the following message is displayed. Click **Yes.** The command is executed only if Automation Builder receives the permission from the drive.

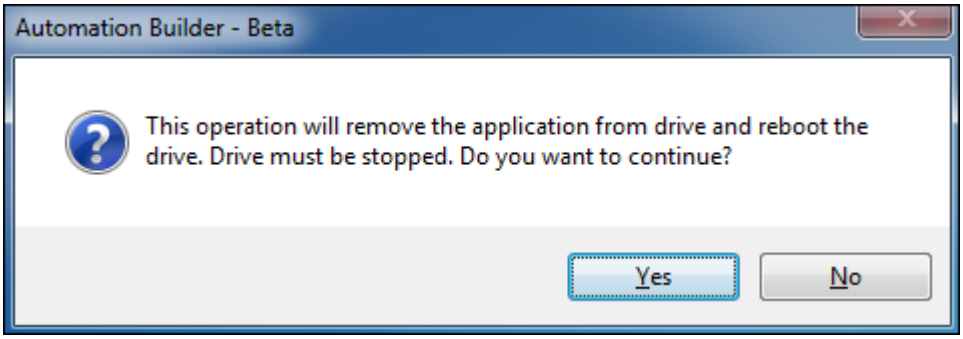


Figure 61: Confirm reset origin

Retain variables

Retain variables includes the RETAIN flag used to retain values throughout the drive reboot and warm reset. A cold reset sets the retain variable to its initial value. The values of retain variables are cyclically stored in the flash memory of the drive and restored to the stored value after the restart of the program. The retain variables are stored in a separate 256-byte memory area which defines the limits of their amount.

WARNING! In a function block, do not declare a local variable as RETAIN because the complete instance of the function block is saved in the retain memory area and this large function block instance may lead to running out of memory space.

In firmware version 1.7 and later, the power control board works with the parameter settings:

- If parameter 95.04 = Internal 24V, retain values are saved immediately at the time the drive loses power, meaning it is not cyclical.
- If parameter 95.04 = External 24V, retain values are saved at periodic intervals of 3 minutes. So the recovered variable may not be the recent value.

Note: Declaring a local variable in a function as RETAIN has no effect and the variable is not saved in the retain memory area.

The existing retain variables cannot be linked to application parameters.

Task configuration

The task configuration object handles call configuration of programs. A task is a project unit that defines which program is called in the project and when it is called. The project can have more than one task with different time levels.

There are two types of tasks:

- Cyclic task (Task_1, Task_2 and Task_3) – These tasks are processed cyclically according to the task cycle time interval. The following table lists the time intervals available for cyclic application programs. The highest priority is given to the task with the shortest execution interval.

Task	Time interval
Task_1	1 … 100 ms
Task_2	10 … 100 ms
Task_3	100 … 1000 ms

- Pre_task – This task is executed only once at start-up of the application program. This feature is useful for one time initialization. POUs (blocks) assigned into this task are executed before the start of cyclic tasks.

Note: The application program consists of its own quota of CPU resources. If the limit exceeds, the drive tips to task overflow fault. For details, see ACS880 Firmware manual.

Adding tasks

To add tasks to Task Configuration, follow these steps:

1. In the Devices tree, right-click **Task Configuration** and select **Add Object**.

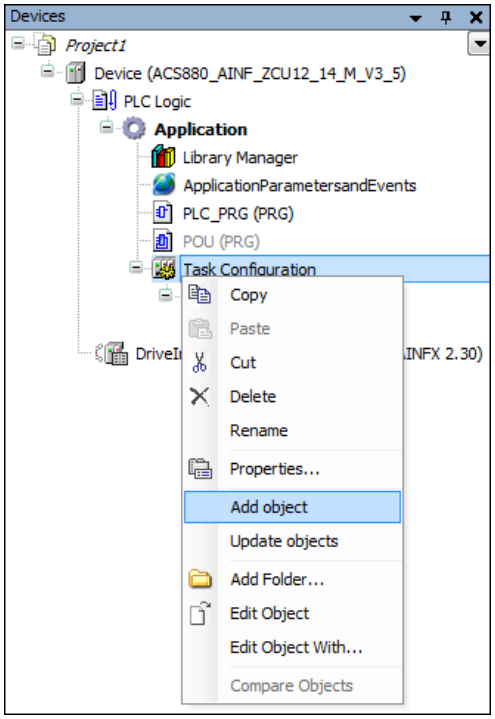


Figure 62 Task configuration

2. Select **Task** and click **Add object**.

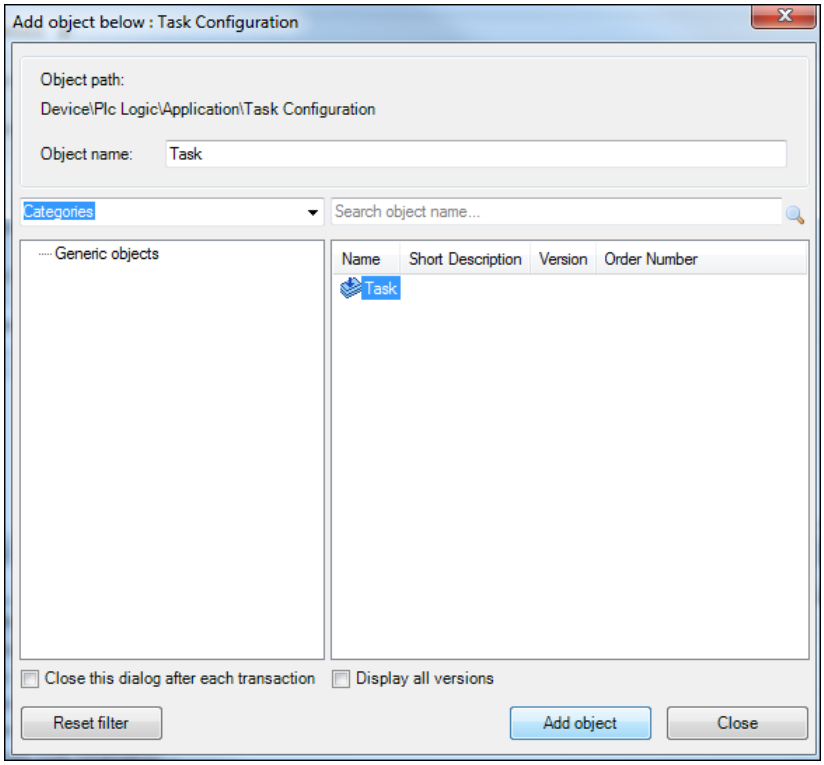


Figure 63 Task

3. In the **Task** drop-down list, select a task and click **Add**.

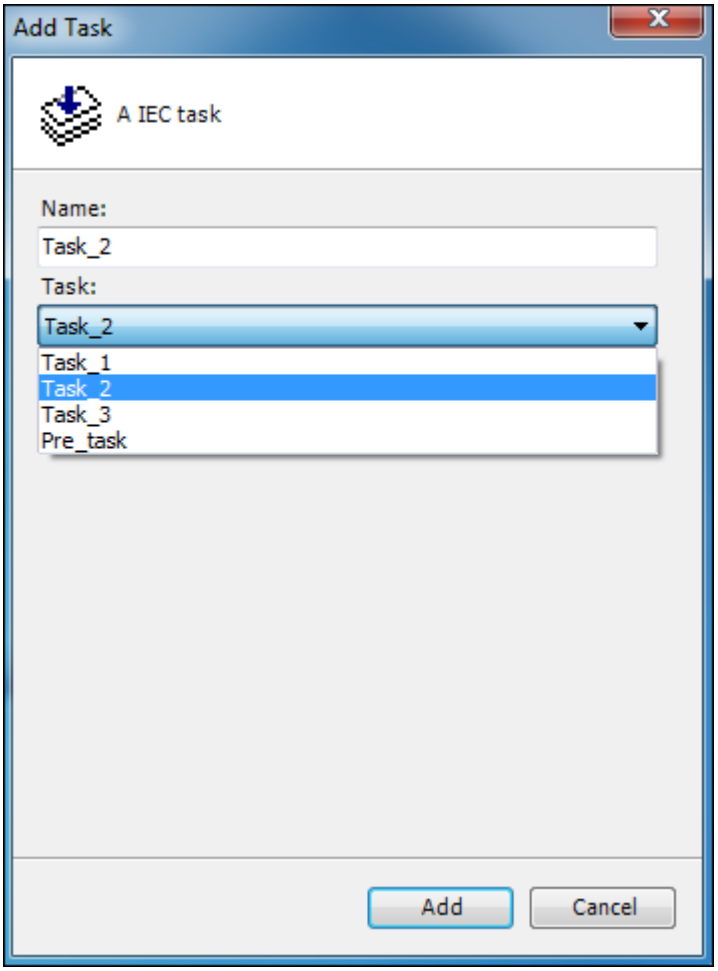


Figure 64: Add tasks

The selected tasks are added in the **Task Configuration** object.

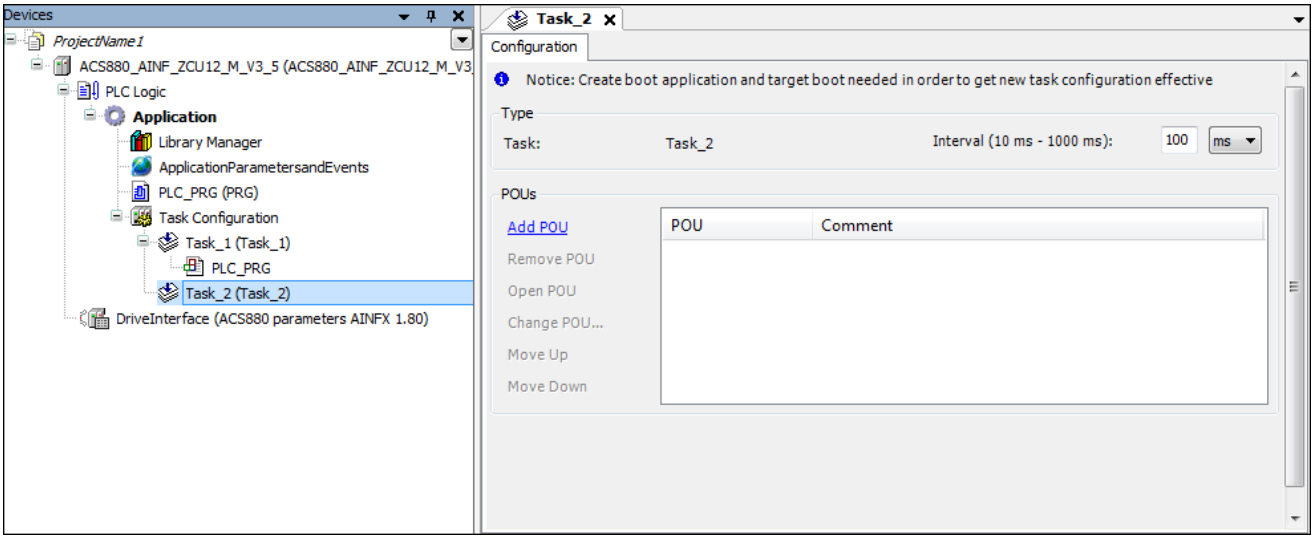


Figure 65: Tasks added

4. Click **Add POU** in the newly added **Task_2** screen.

5. In the Input Assistant window, click **Categories** and then select **PLC_PRG** and click **OK**.

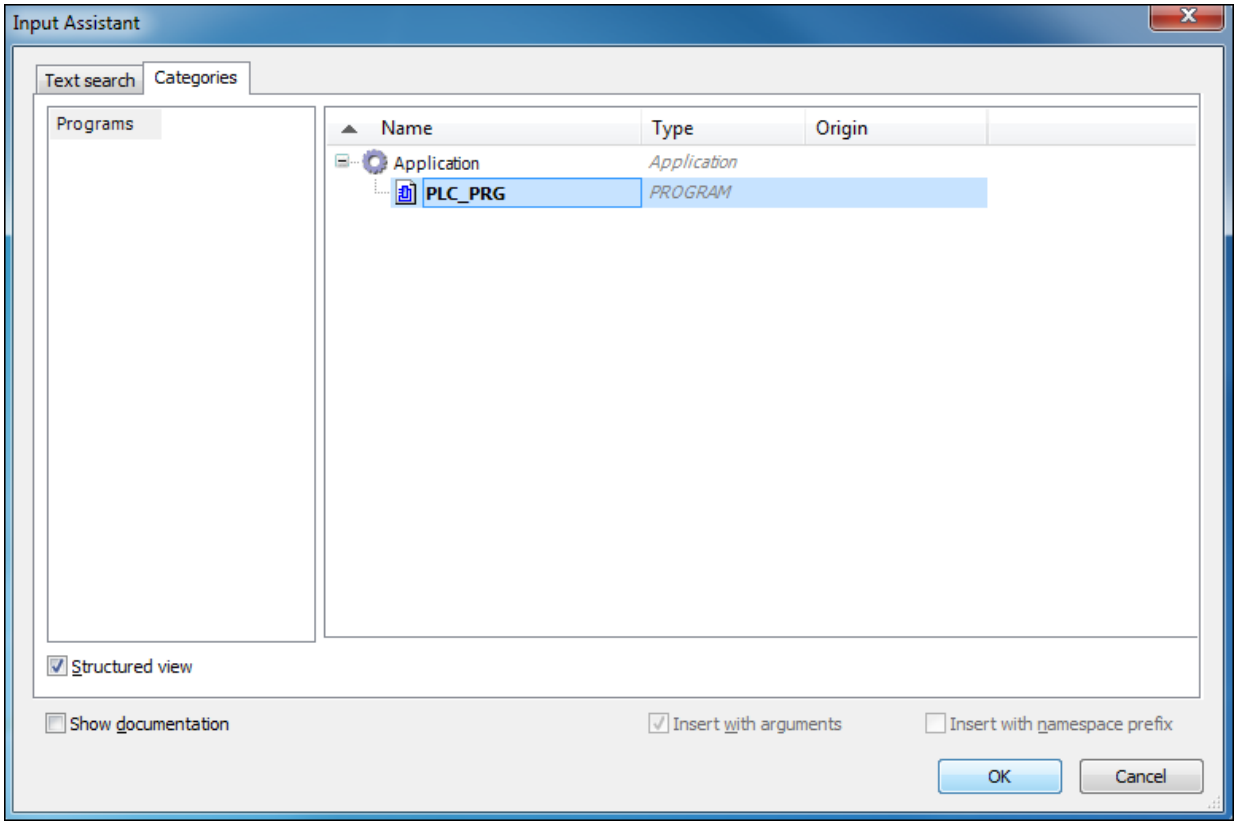


Figure 66 Add POU input assistant

6. PLC_PRG is added to Task_2. Drag **PLC_PRG** to **Task Configuration** object.

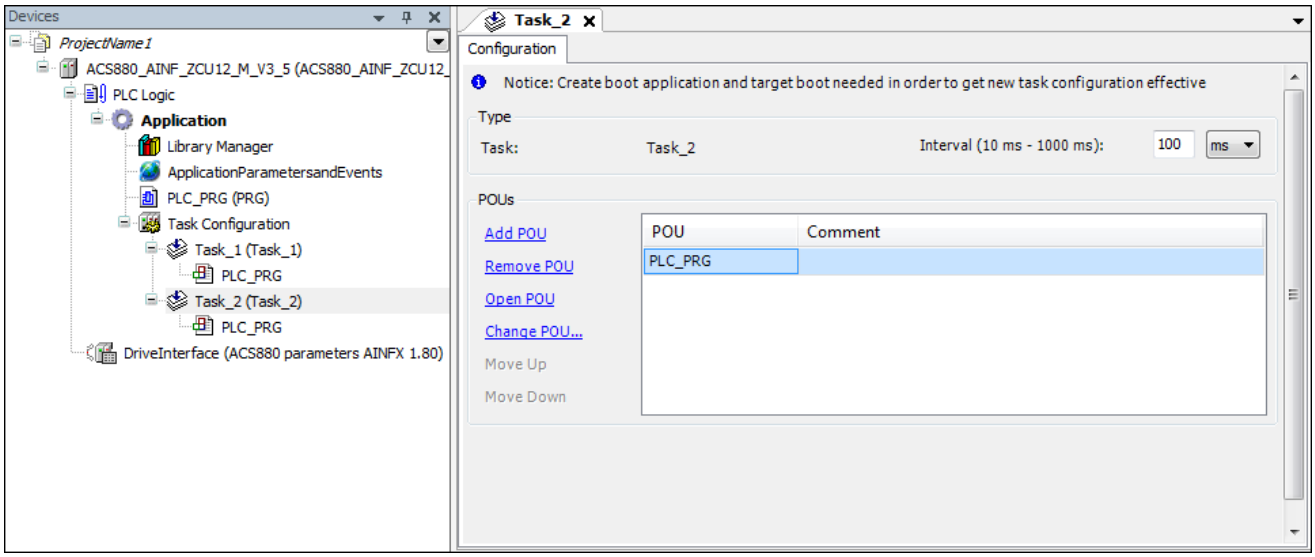


Figure 67 New PLC PRG

Monitoring tasks

Before adding the tasks for monitoring in Automation Builder, check parameter **7.21 Application environment status** in Drive composer pro.

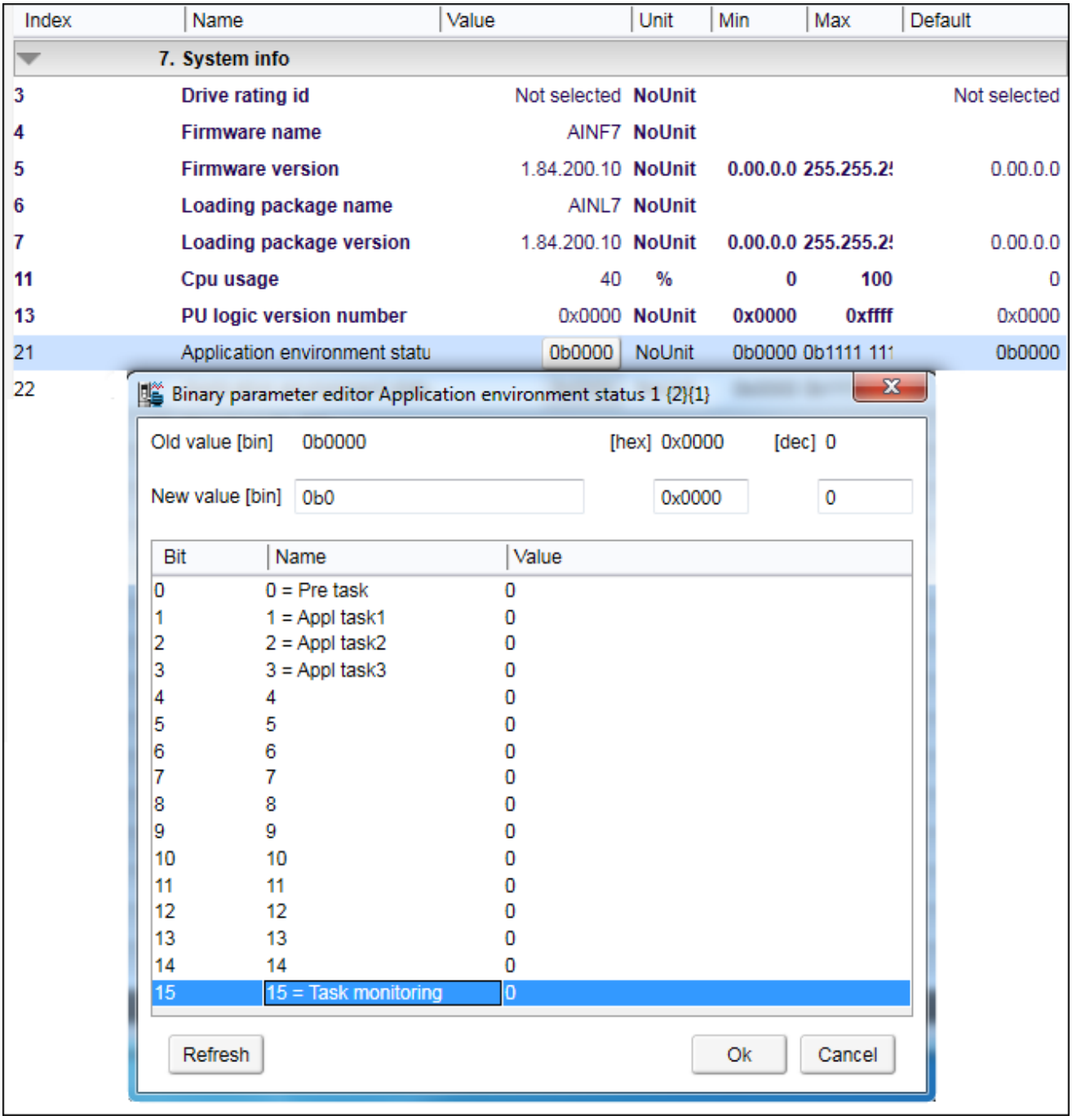


Figure 68: Drive composer pro, parameter 7.21

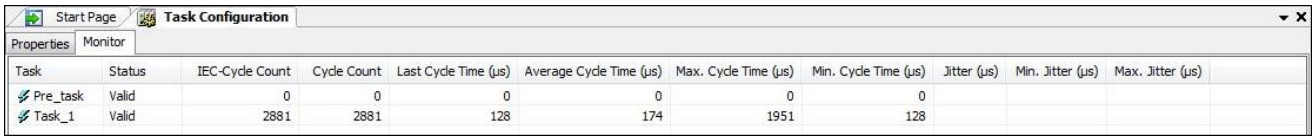
The parameter bits 7.21.0, 7.21.1, 7.21.2, and 7.21.3 are used to monitor the application task related execution. To check the continuous execution of tasks, write the specific task bit to 0. The executing task bits are updated to 1, except the Pre task, which executes only once.

The calculation of tasks execution cycle (duration) is disabled by default. To view the tasks execution monitoring in Automation Builder, change Bit 15 = Task monitoring to high.

To add task monitoring view in Automation Builder, follow these steps:

1. In the Devices tree, double click **Task Configuration**.
2. Click **Monitor** tab to check the status report of available tasks.

   The status report of available tasks appears.



Task	Status	IEC-Cycle Count	Cycle Count	Last Cycle Time (µs)	Average Cycle Time (µs)	Max. Cycle Time (µs)	Min. Cycle Time (µs)	Jitter (µs)	Min. Jitter (µs)	Max. Jitter (µs)
Pre_task	Valid	0	0	0	0	0	0			
Task_1	Valid	2881	2881	128	174	1951	128			

Figure 69: Task monitoring view

Note: The values in the task monitoring view are updated only setting the parameter 7.21.15 to high in Drive composer pro. This setting is configured again after the power cycle or boot or control board.

You can evaluate the total (task 1-3) CPU load using the parameters 7.40 IEC Application Cpu usage peak and 7.41 IEC Application Cpu load average. For parameter descriptions, see ACS880 primary control program firmware manual [3AUA0000085967 (English)].

Uploading and downloading source code

Optionally, the source code of the project can be saved in the drive. This feature is located in Automation Builder main menu **Online** -> **Source download to connected device** and it ensures that the files are easy to obtain if needed.

To retrieve the saved source code from the drive to a new project, follow these steps:

1. In the Devices tree, right-click **Device** and select **Source upload**.

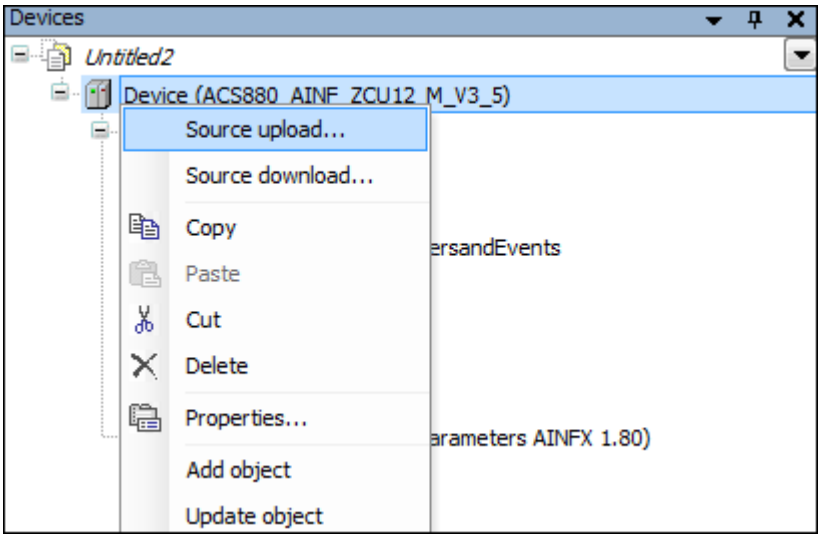


Figure 70 Source upload

2. Select the drive and click **OK**.

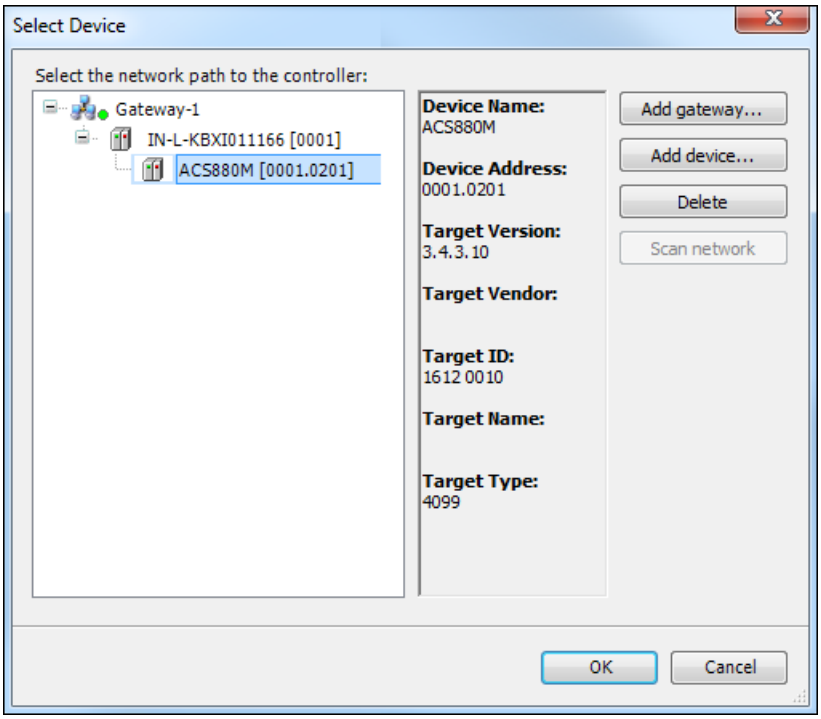


Figure 71 Source upload device

The size of the source code is limited to 500 KB. Check the archiving option to minimize the source code size (**File** → **Project Archive** → **Save/Send Archive…**). Note that referenced devices and libraries are needed, the rest is optional.

Note: If the source code is saved on the ZMU memory unit, you can retrieve the program with another PC without the authors consent unless the project is password protected.

Adding symbol configuration

To add symbol configuration in Automation Builder project, follow these steps:

1. In the Devices tree, right-click **Application** and select **Add object**.

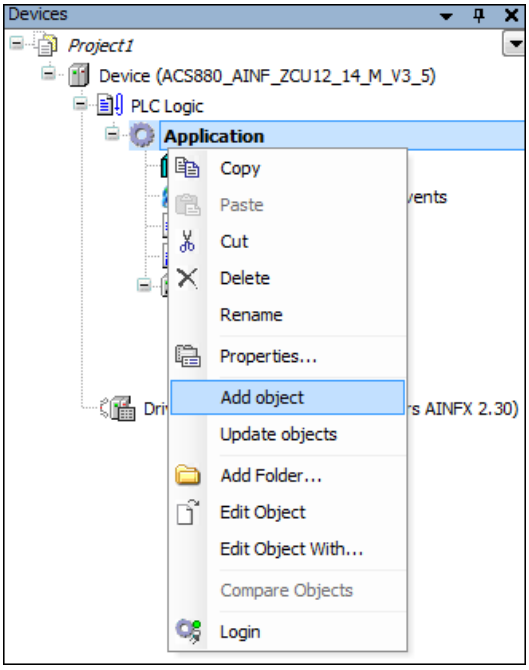


Figure 72 Add object for symbol configuration

2. Select **Symbol configuration** and click **Add object**.

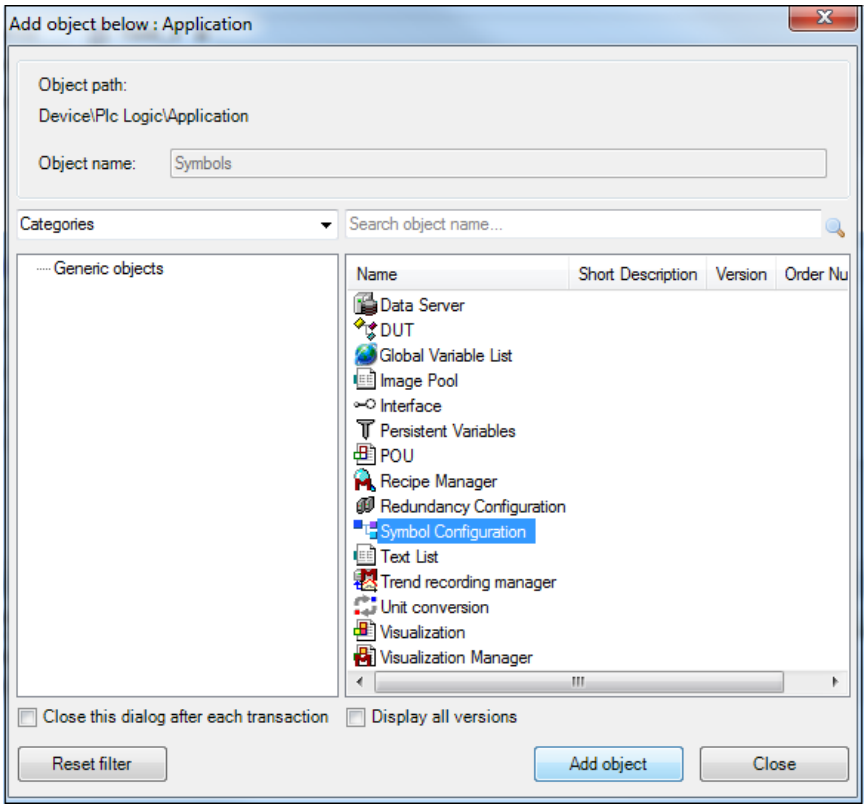


Figure 73 Symbol configuration

3. In the Add Symbol configuration window, click **Add**.

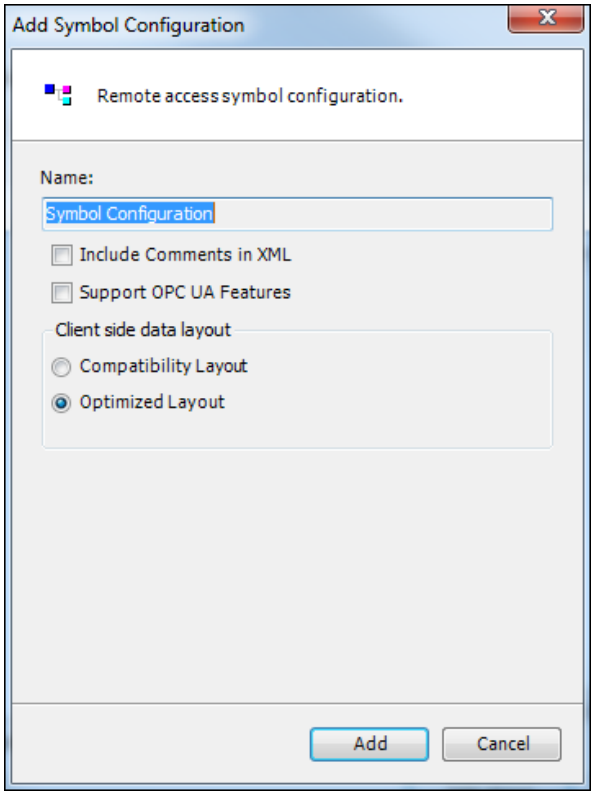


Figure 74 Add symbol configuration

Symbol configuration object is added to the project.

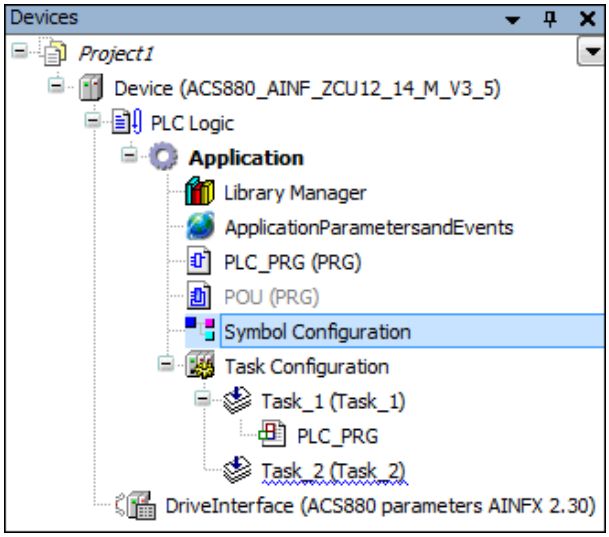


Figure 75 Symbol configuration object

After adding Symbol configuration object to the project, the IEC variable to symbol data is loaded into the drive during the create boot application download. See section *Application download options*. This feature provides Drive composer pro access to the application variables which is used for graphical monitoring and debugging.

For more information on the Symbol configuration editor and adding variables, see Automation Builder Online help.

Debugging and online changes

The following debugging features and variable forcing are supported:

- Start / stop program execution
- Setting breakpoints
- Stepping code line by line or by function
- Forcing variables (constant setting of variable values)
- Writing variables (single setting of variable values)

Note: Online changes of the program code are not supported.

WARNING! Ignoring the following instruction can cause physical injury or damage to the equipment.

Do not set breakpoints and force variables on a running drive that is connected to motor.

Safe debugging

When debugging the application program of a running drive connected to motor in the online mode, avoid the following actions:

- stopping the application program
- setting breakpoints to the application program
- forcing variable values
- assigning values to outputs
- changing the values of a local variable in function blocks
- assigning invalid input values

Breakpoints stop the entire application, instead of just the task that has the currently active breakpoint.

Reset options

You can reset the application, using the reset selections in the **Online** mode.

1. In the Devices tree, select the **Application**.
2. In the main menu, click **Online** and select the desired reset method.

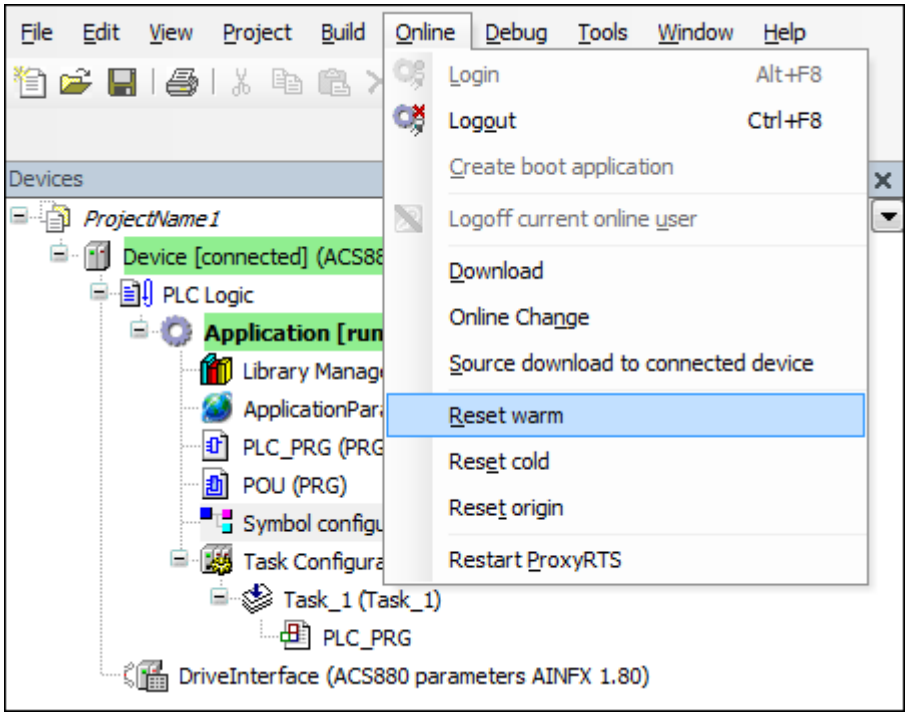


Figure 76 Reset options

- **Reset warm** resets all variables of the currently active application to their initial values (except retain and persistent variables). In case of specific initial values, the variables are reset exactly to those specific values.
- **Reset cold** resets all variables (normal and retain) of the currently active application to their initial values.
- **Reset origin** erases the application, downloaded to the drive from the RAM and the memory unit (Boot application). In case of specific initial values, variables are reset to those specific values. Drive firmware parameter mappings, user-defined parameters and events are also removed. Finally the drive is restarted.

Note: The reset origin action cannot be undone. However, the parameter values of the old application are not removed. These values can be removed only when creating the next boot application by selecting the **Reset application parameters to defaults** option. See section *Creating a boot project.*

If the application is stopped, press F5 to restart the application.

Memory limits

To see the effective size of the program, follow these steps:

- In the main menu, click **Build** and select **Clean** or **Clean All** to remove temporary code sections from the program.

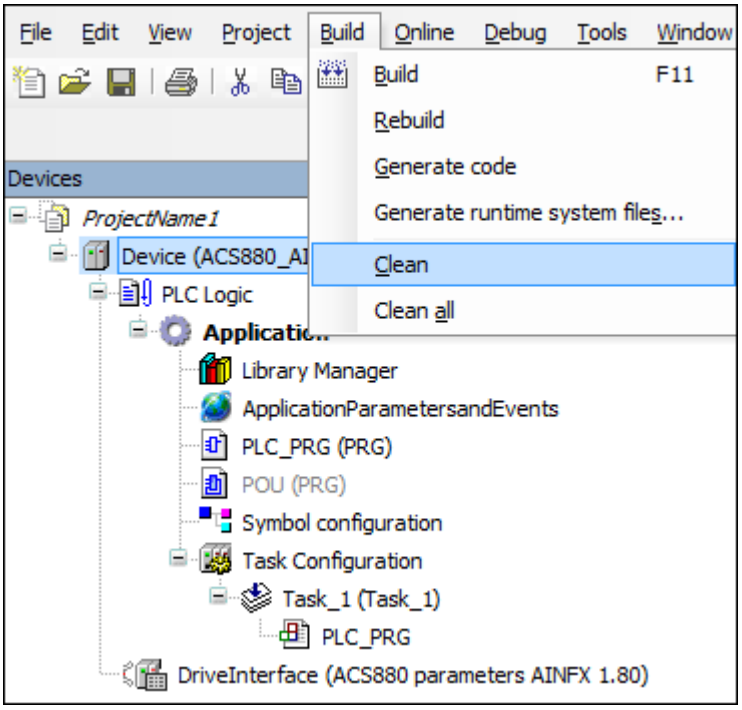


Figure 77 Build clean

The build report shows the actual memory allocation.

Memory area 0 is assigned for code and data. Memory area 1 is assigned for retain variables. See the example screen below.

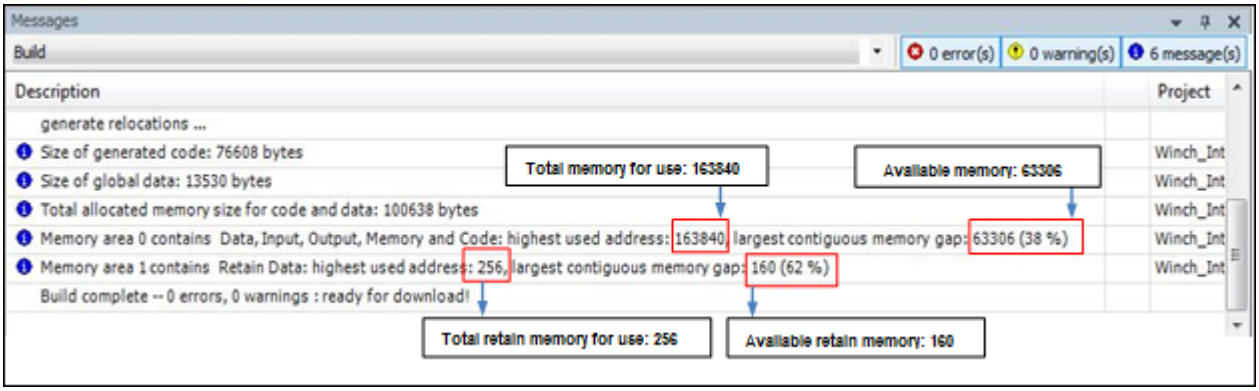


Figure 78: Memory limits – example

Note: To optimize the memory consumption, avoid using function blocks and unnecessary variable definitions.

CPU limitation

The maximum execution load of the application is limited to a certain value of 5 to 15% depending on the drive type. To know the actual load limit, contact your local ABB representative.

Use parameter *7.11 Cpu usage* to check the application load which monitors the CPU load. To know the load difference, compare the values between with and without the application. Ensure that the difference value is not greater than the value limit. If the application exceeds the limit, the drive trips to the task overload fault *6481*. The fault is registered to the event log of the drive and the fault-specific AUX code indicates the overloaded tasks (10 = task 1, 11 = task 2 and 12= task 3).

You can evaluate the total (task 1-3) CPU load using the parameters *7.40 IEC Application Cpu usage peak* and *7.41 IEC Application Cpu load average*. For parameter descriptions, see *ACS880 primary control program firmware manual [3AUA0000085967 (English)].*

Perform CPU load tests to ensure that the drive is capable of adequately running the application. Enable the required drive functions during the execution of the application. For example, motor control, communication modules, encoders, and so on.

Application loading package

This feature allows the user to create loading package containing an application program for ACS880 drive. Loading package file is built with Automation Builder command **Create Boot Application** in case the tool is in online connection to the drive.

Loading package file must be placed to the corresponding project folder with the file name *<project_name>_<device>_<application>.lp*. The user can load application loading package using Drive loader 2.1 tool. Application loading package functionality supports from AINFX 2.01 firmware version onwards.

Before loading the package, Drive loader tool checks for the correct actual drive type and firmware version to load the package. It also checks for the correct drive application programming interface and programming license (N8010) is active in target drive.

To include symbol data and source code to application wrap file and loading package using Automation Builder, follow these steps:

1. In the main menu of Automation Builder, click **Project** and then select **Project Settings**.

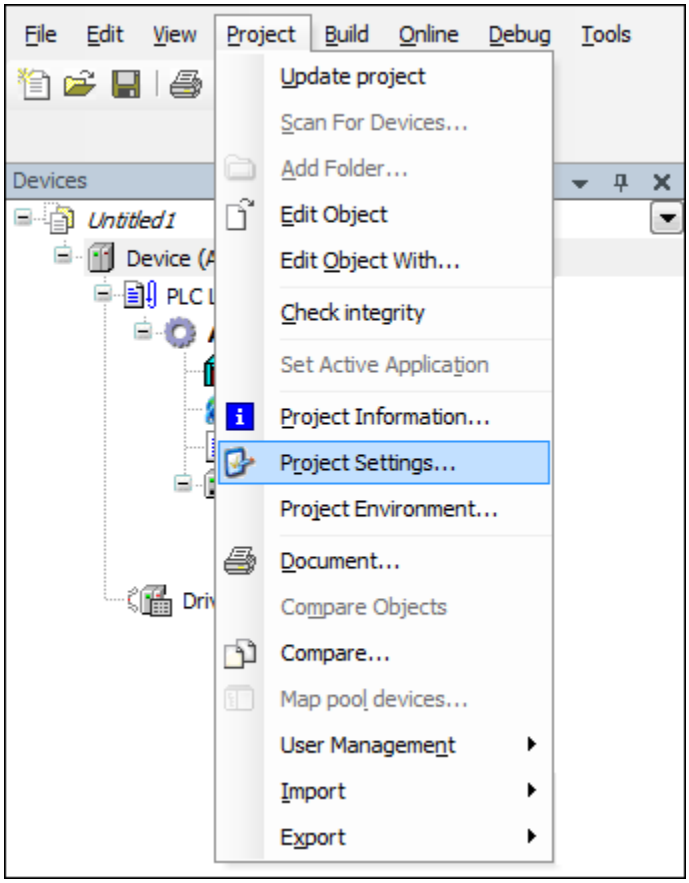


Figure 79 Project settings

Project settings window is displayed.

2. In the Project Settings window, click **Application loading settings** and select the desired check boxes.

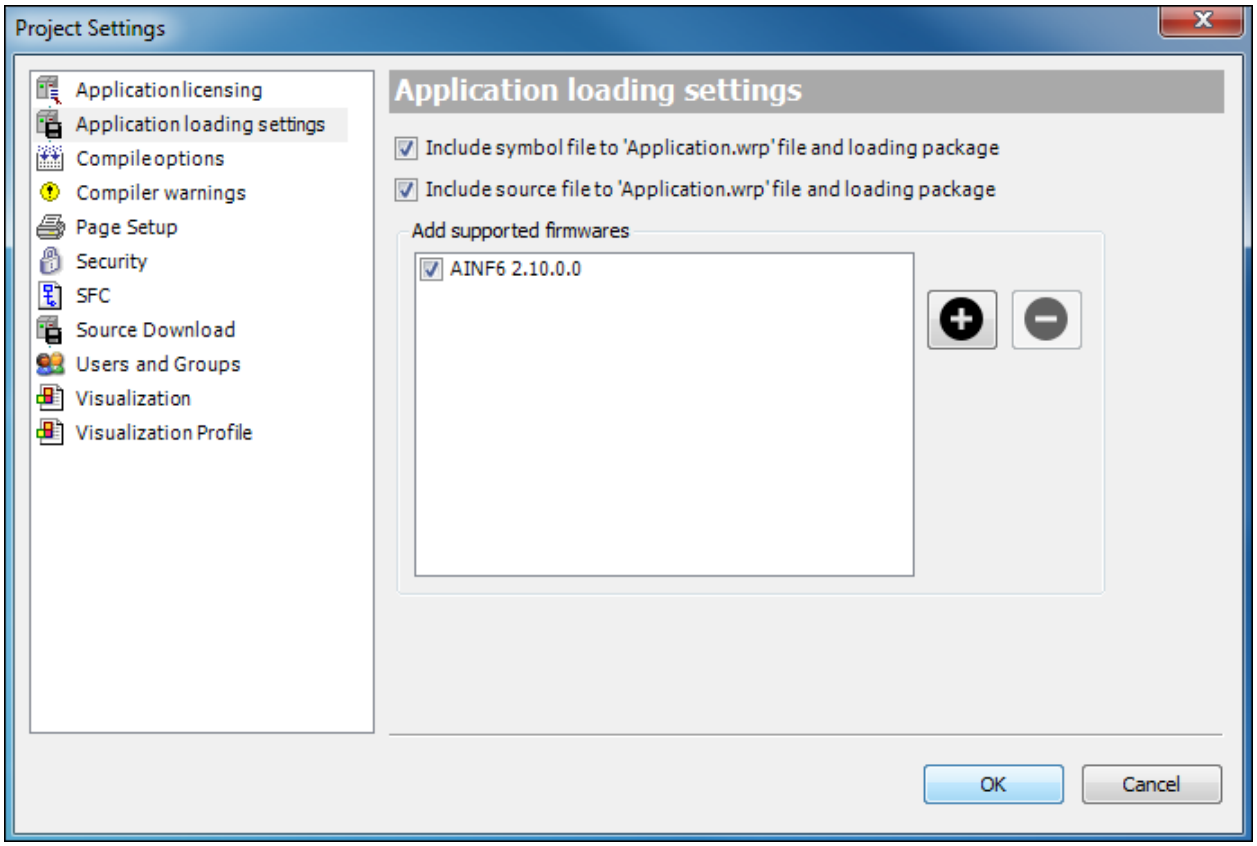


Figure 80 Application loading settings

It is also possible to add more supported firmware versions to the application loading package.

Note: Ensure that the application is working correctly with the added firmwares.

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3. Click ⊕ to add new firmware.
4. Enter the firmware details and click **Ok**.

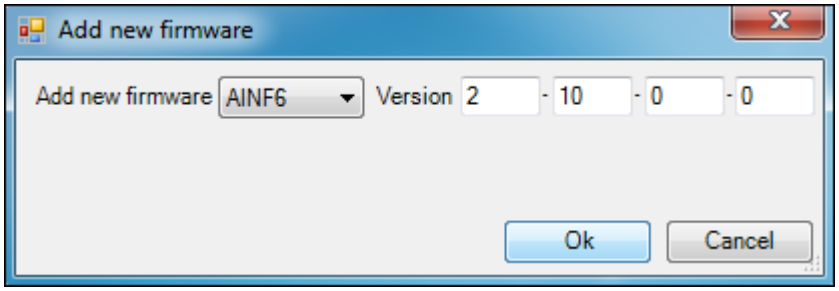


Figure 81 Adding supported firmwares

The added firmware is displayed in the Application loading settings.

Downloading loading package to a drive

Drive loader tool is used to download loading package to common platform drives.

1. Start Drive loader tool.
2. Click **Open** to download a loading package or click **Scan** to scan for a connected device.

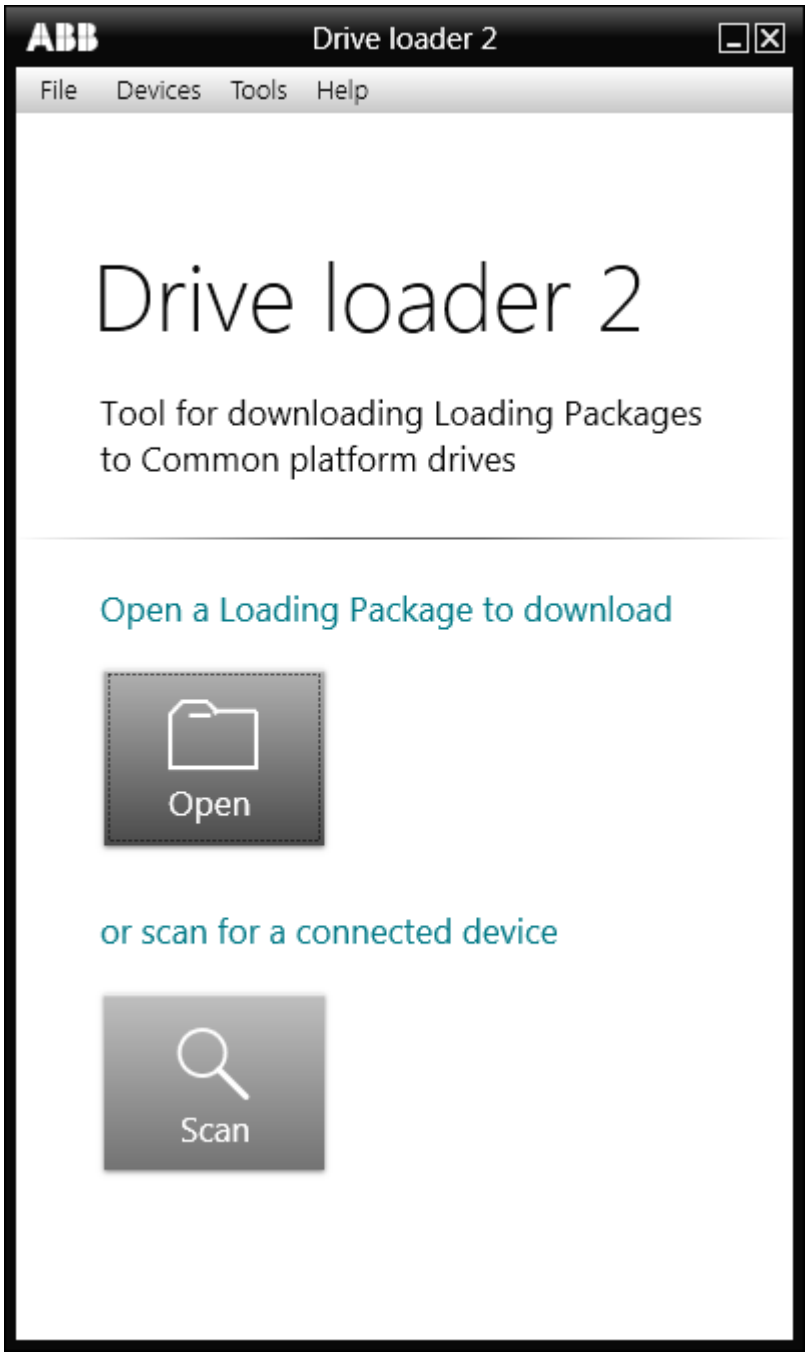


Figure 82 Drive loader tool

3. Select the desired loading package file (*.lp*) and click **Open**.

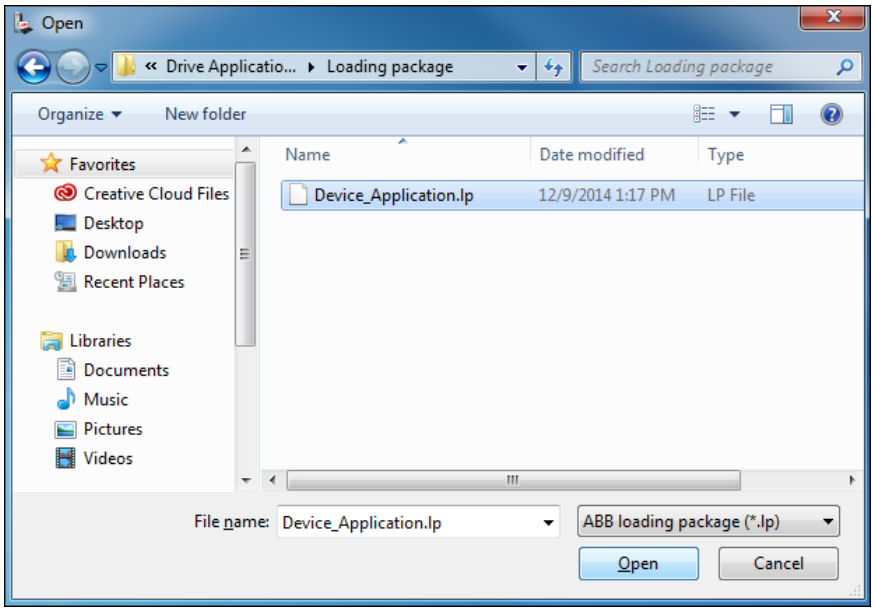


Figure 83 Loading package

4. Select the desired drive and click **Select**.

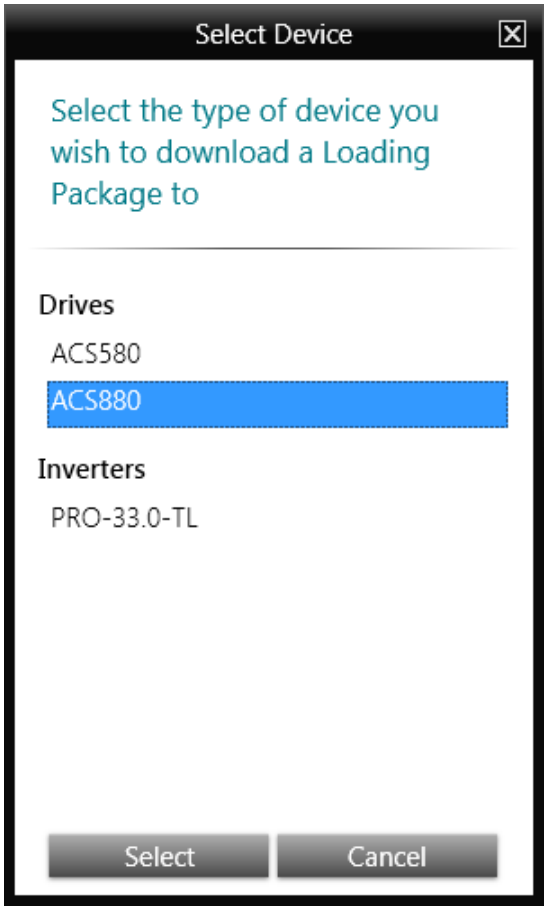


Figure 84 Drive selection

5. In the **Software Set** drop-down list, select the appropriate selection.
   - 1: Loads new application, set application parameters to default and removes user sets from the drive.
   - 2: Loads new application.
   - 3: Removes the application from the drive (reset origin). Before using this option, the user must first load application loading package using options 1 or 2.
   - 4: Removes user sets from the drive.

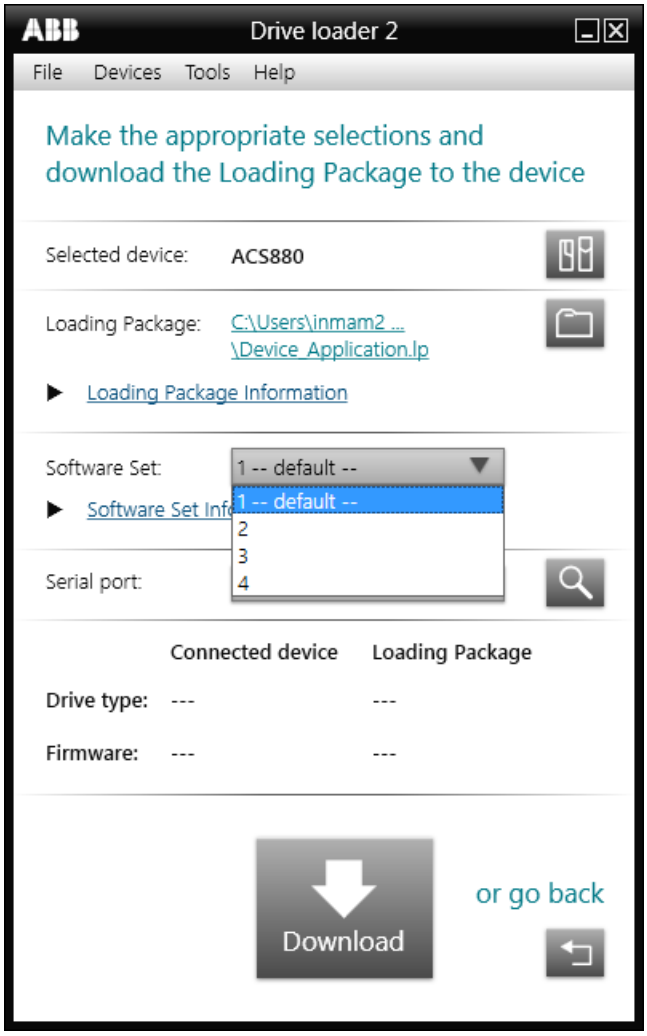


Figure 85 Software set

6. Select the desired communication **Serial port** and click **Download**.

   Before starting downloading, drive loader checks for the following:
   - Correct control board (ZCU/BCU).
   - Same device ID in Automation Builder project and drive control board.
   - Correct version of application environment.
   - Programming license loaded to target (N8010).
   - FW version supported in loading package.

Note: Before starting downloading, ensure Automation Builder and Drive composer are not running at the same time.

A warning message is displayed. Click **OK**.

Figure 86 Warning message

7. In case of restrictions due to incompatible firmware version, the Drive loader stops and displays an error message.

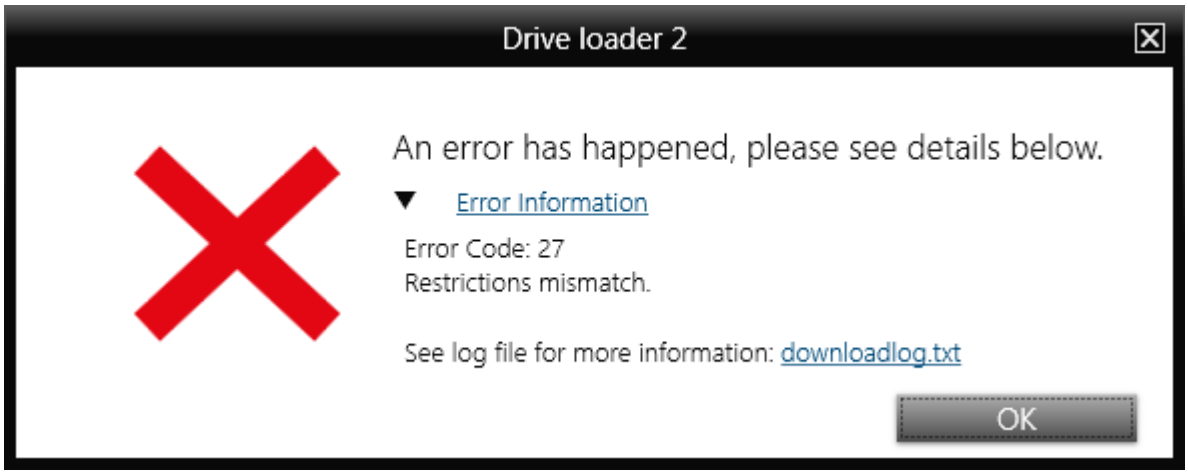


Figure 87 Error message

8. Click ***downloading.txt*** to view error log file.

6

DriveInterface

Contents of this chapter

This chapter describes how to implement DriveInterface and map input/output settings between the application programs and drive firmware parameters.

Implementing DriveInterface

The interface between the drive firmware and application is implemented using DriveInterface.

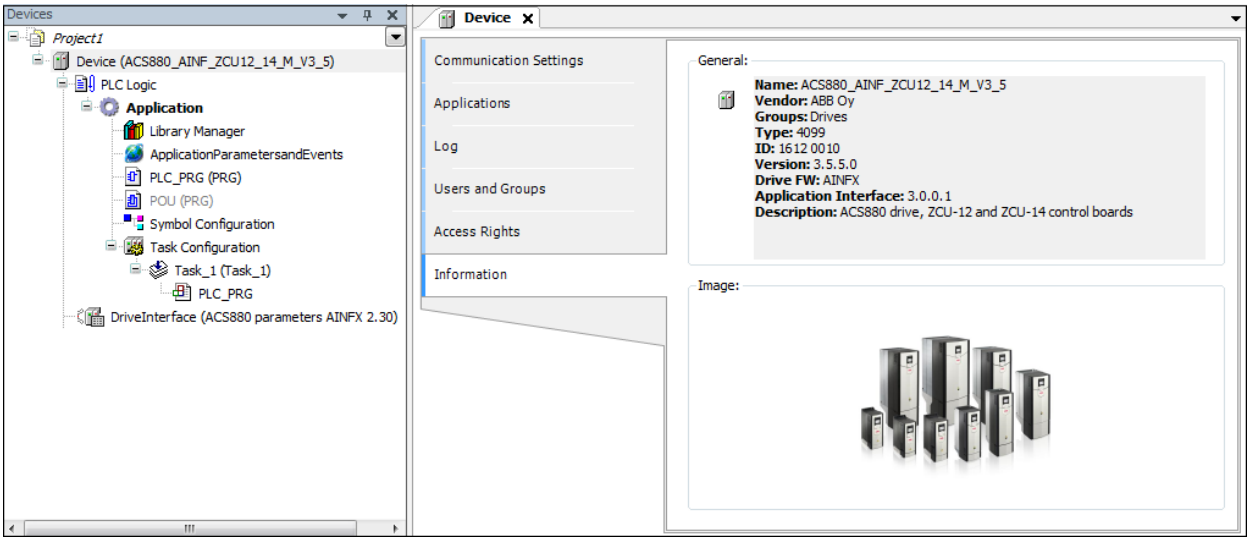
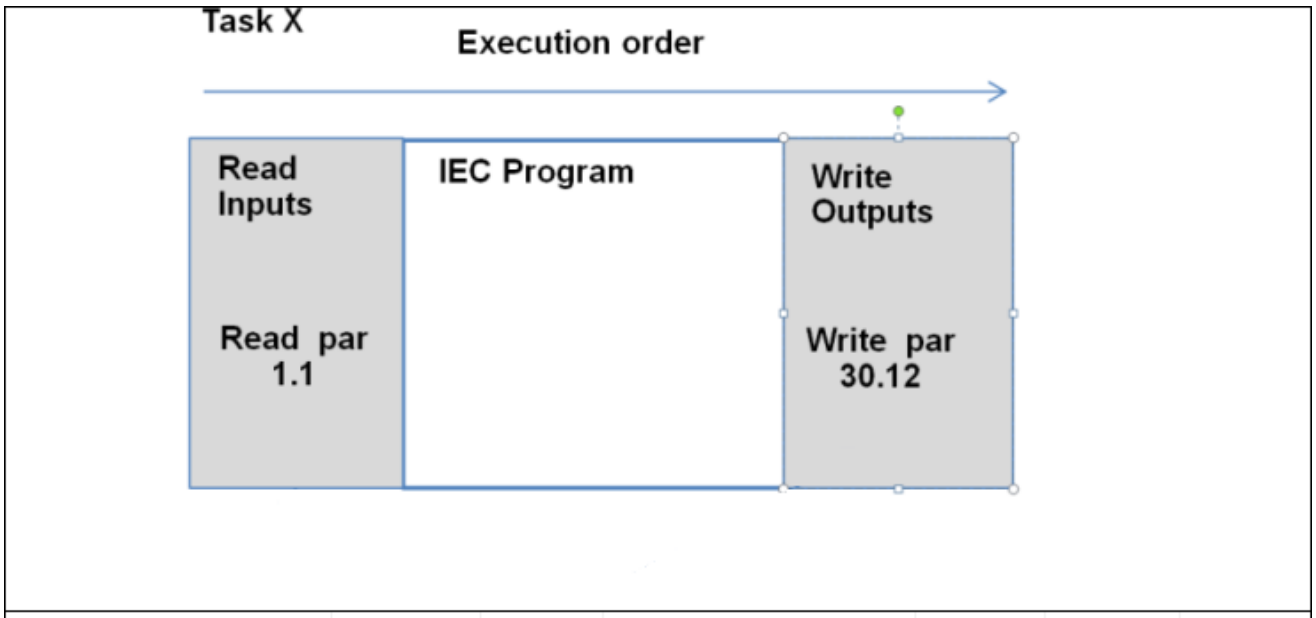


Figure 88: DriveInterface

DriveInterface consists of all drive firmware parameters list that can be used in the application program. This list is specific for each drive firmware (a new firmware may have new parameters).

You can assign a parameter to be an input for the application program and define that the parameter is read at the beginning of the task execution. Similarly, user can assign parameters to be an output of the application.



Parameter Name	Assignment	Mapping	IEC Variable	Data Type	Min	Max
1 Actual values						
1 Motor speed used	Input		Device_Motor_speed_used_1_1	REAL	-30000.00	30000.00
30 Limits						
12 Maximum speed	Output		Device_Maximum_speed_30_12	REAL	-30000.00	30000.00

Figure 89: DriveInterface – Assigning parameters for outputs in the application

Note:

- The parameter to IEC variable mappings is valid only after creating a boot application. For more details, see section *Application download options.*
- Drive interface is not completely covering all drive parameters. If the firmware parameter is not available in the drive interface list, use the AY1LB library functions to read/write firmware parameters.
- In order to fully remove drive parameter settings from drive, use Reset origin option. Also, re-save user sets (see parameter 96.08) after removing or replacing the application. As user set may have incorrect mapping of firmware parameter to non-existing application.

Selecting the parameter set

A drive can have different parameters depending on the firmware version. Before performing parameter modification, ensure that the correct parameter set is selected in DriveInterface. The changes to parameter set in DriveInterface removes all parameter mapping data.

To change the currently selected parameter set, follow these steps:

1. In the Devices tree, right-click **DriveInterface** and select **Update objects**.

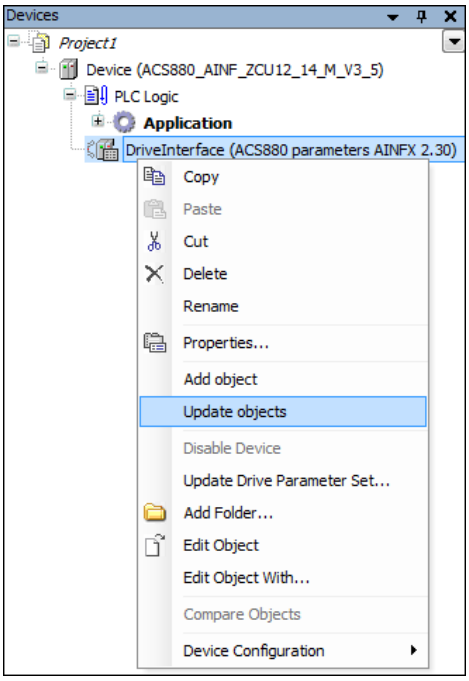


Figure 90 DriveInterface update object

2. In the Update object window, select the correct parameter set for the current target and click **Update objects**.

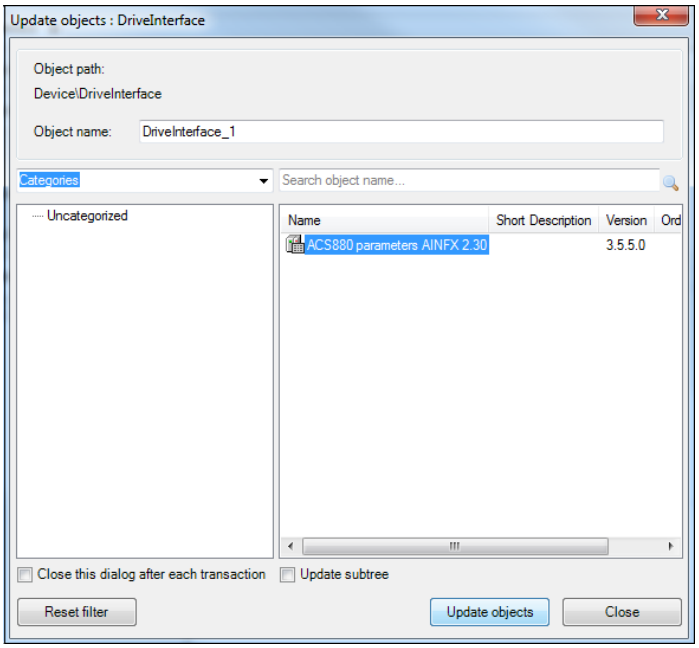
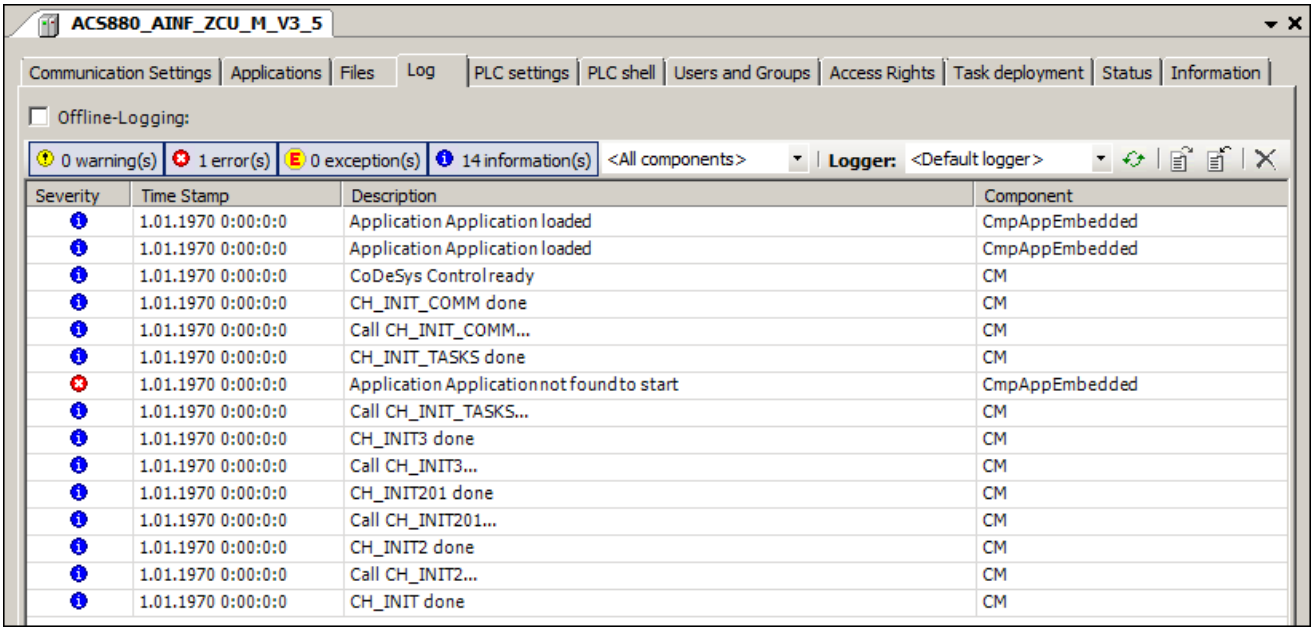


Figure 91 DriveInterface parameter set

Viewing parameter mapping report

When you download the application program, a report of unresolved parameter mappings between the project parameters and actual parameters in the drive is written in the PLC log.



Severity	Time Stamp	Description	Component
	1.01.1970 0:00:0:0	Application Application loaded	CmpAppEmbedded
	1.01.1970 0:00:0:0	Application Application loaded	CmpAppEmbedded
	1.01.1970 0:00:0:0	CoDeSys Control ready	CM
	1.01.1970 0:00:0:0	CH_INIT_COMM done	CM
	1.01.1970 0:00:0:0	Call CH_INIT_COMM...	CM
	1.01.1970 0:00:0:0	CH_INIT_TASKS done	CM
	1.01.1970 0:00:0:0	Application Application not found to start	CmpAppEmbedded
	1.01.1970 0:00:0:0	Call CH_INIT_TASKS...	CM
	1.01.1970 0:00:0:0	CH_INIT3 done	CM
	1.01.1970 0:00:0:0	Call CH_INIT3...	CM
	1.01.1970 0:00:0:0	CH_INIT201 done	CM
	1.01.1970 0:00:0:0	Call CH_INIT201...	CM
	1.01.1970 0:00:0:0	CH_INIT2 done	CM
	1.01.1970 0:00:0:0	Call CH_INIT2...	CM
	1.01.1970 0:00:0:0	CH_INIT done	CM

Figure 92: Parameter mapping report

For more details on downloading, see sections *Downloading the program to the drive* and *Application download options*.

Mapping example

To read digital input DI1 of the ACS880 control unit to the previous CFC example (*Creating a block scheme*), open group 10 and select index 1.

1. In the Devices tree, double-click **DriveInterface**.

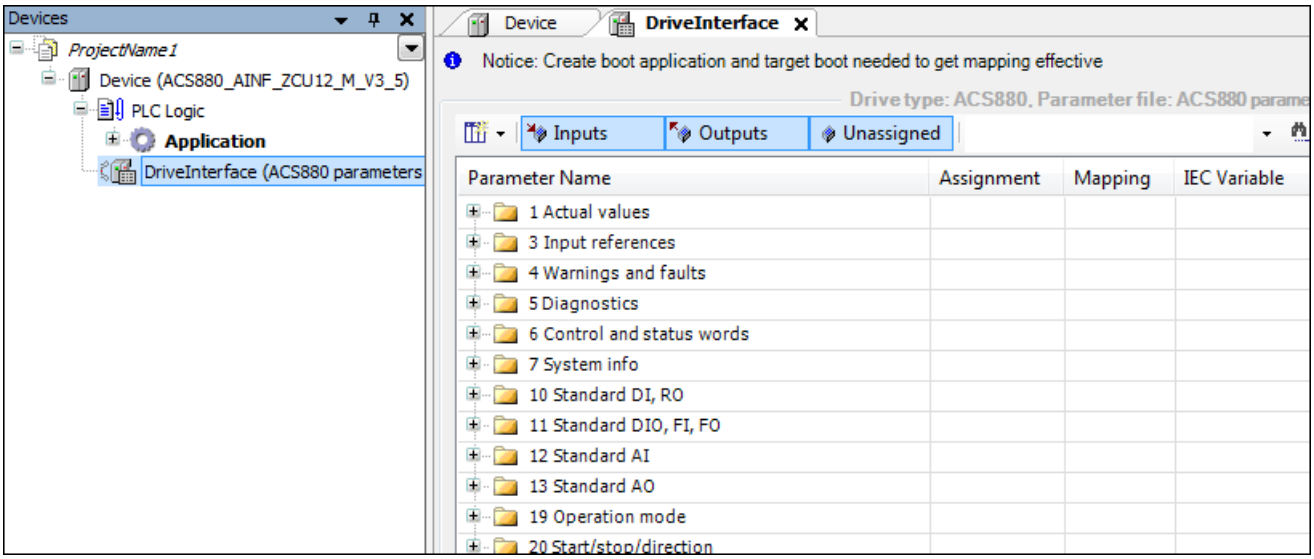


Figure 93: Parameter mapping window

2. In the Driveinterface window, right-click on the required **Assignment** cell and select **Input** or you can also select the desired **Assignment** from the available drop-down list.

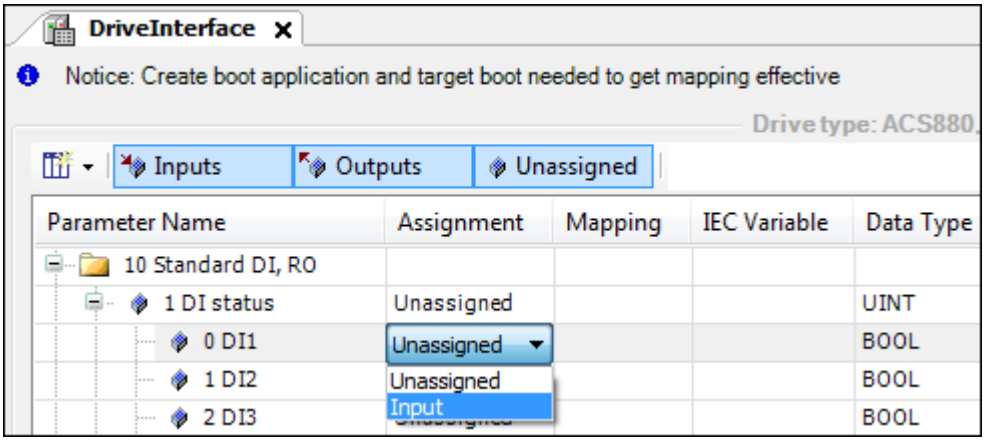


Figure 94: Selecting input for parameter mapping

3. Double-click default IEC variable name **Device_DI1_10_1**. A button is displayed to the right of the selected name to change the name.

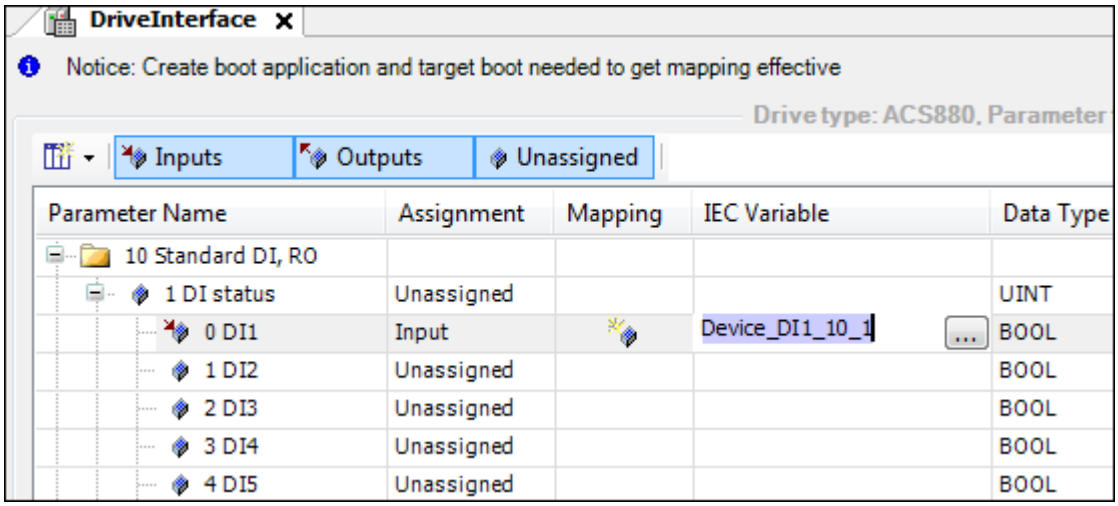


Figure 95: Default IEC variable name

4. Click ... to change the name. Input Assistant window is displayed.
5. Click **Categories** and then expand **DriveInterface** tree to select the Device and click **OK**.

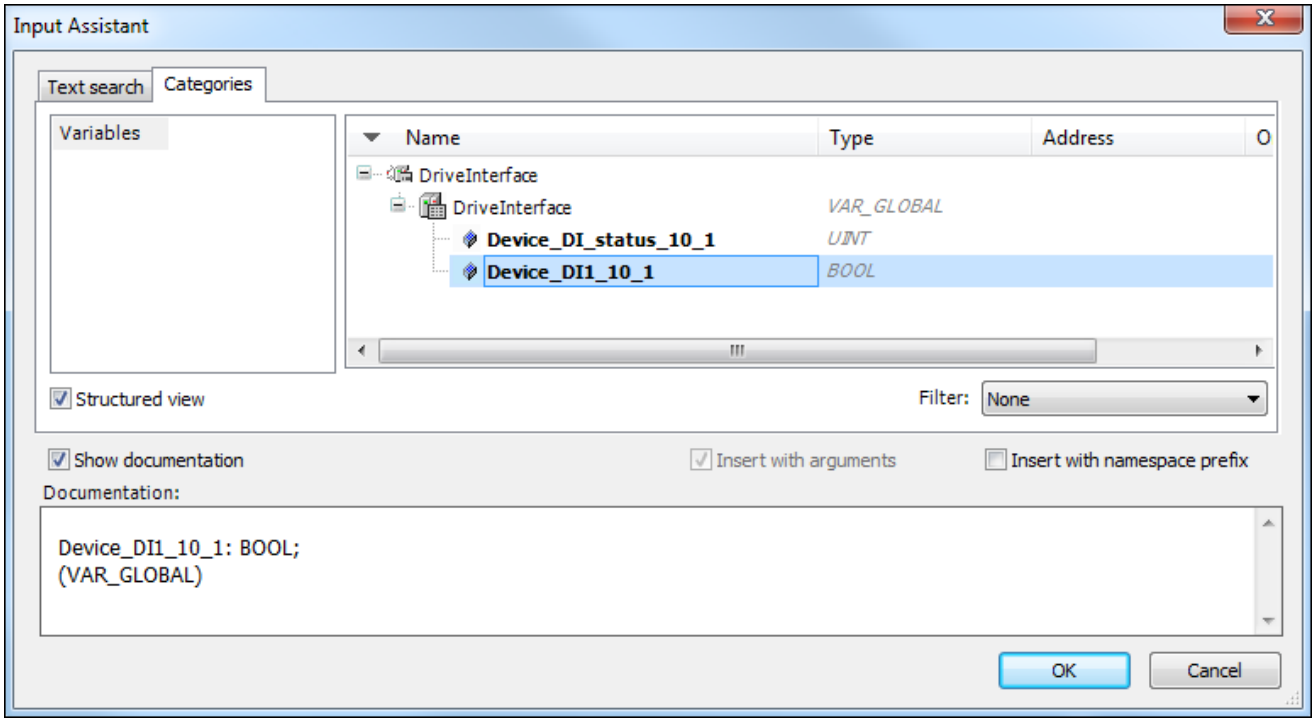


Figure 96: DriveInterface Input assistant

IEC variable name is changed.

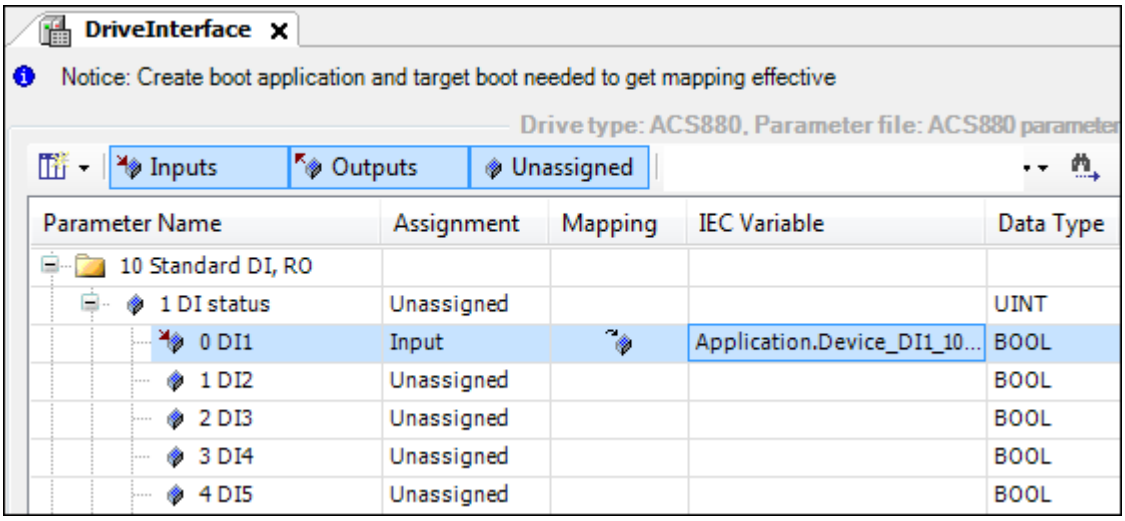


Figure 97 DriveInterface variable name

Note: If you want to select existing variable DI1 from the POU variable list, expand **Application** and under POU, select DI1. DI1 is connected to drive parameter 10.1. DI status bit 0.

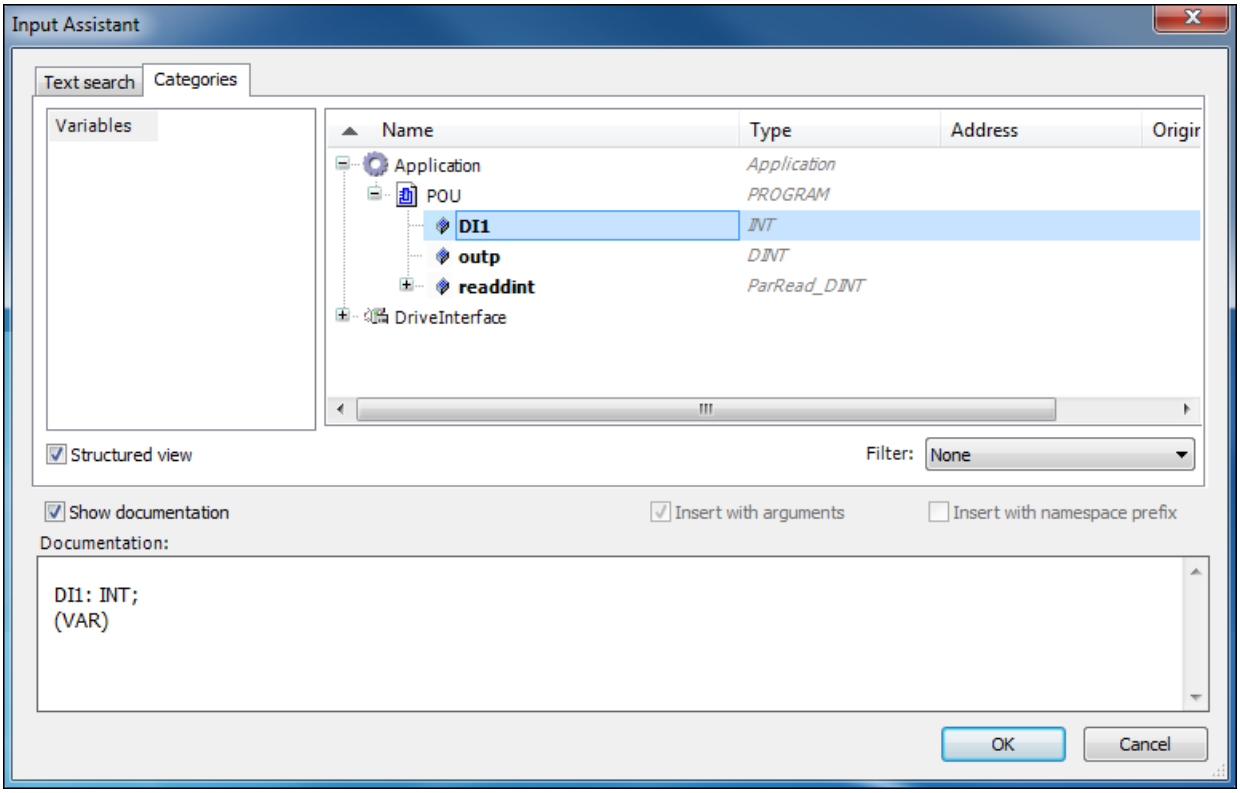


Figure 98 Existing variable

The mapped parameters are available as IEC variables in the program editors (press F2).

Note: Bit and value pointer parameters can be used as outputs and then the pointer is linked directly to the application memory.

Updating drive parameters from installed device

You can update the parameter list from the installed device or you can take the actual drive parameter set used in DriveInterface from Drive composer pro. See section *Updating drive parameters from parameters file*.

To update the parameters from the installed device, follow these steps:

1. In the Devices tree, right click **DriveInterface** and select **Update Drive Parameter Set**.

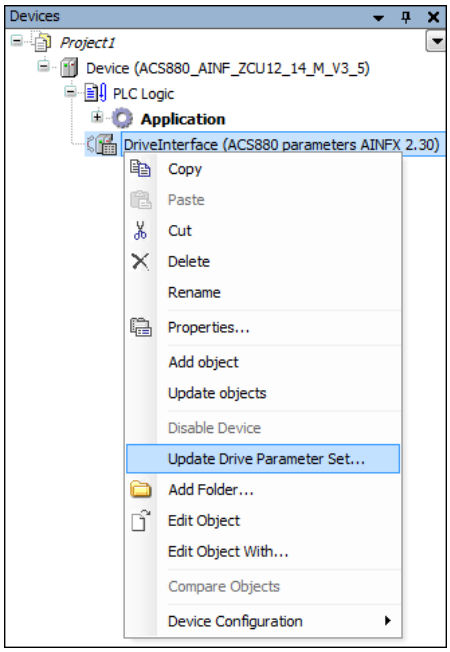


Figure 99: Update drive parameter set

2. In **From installed device** option, expand **Miscellaneous** and select the device and then click **Update**.

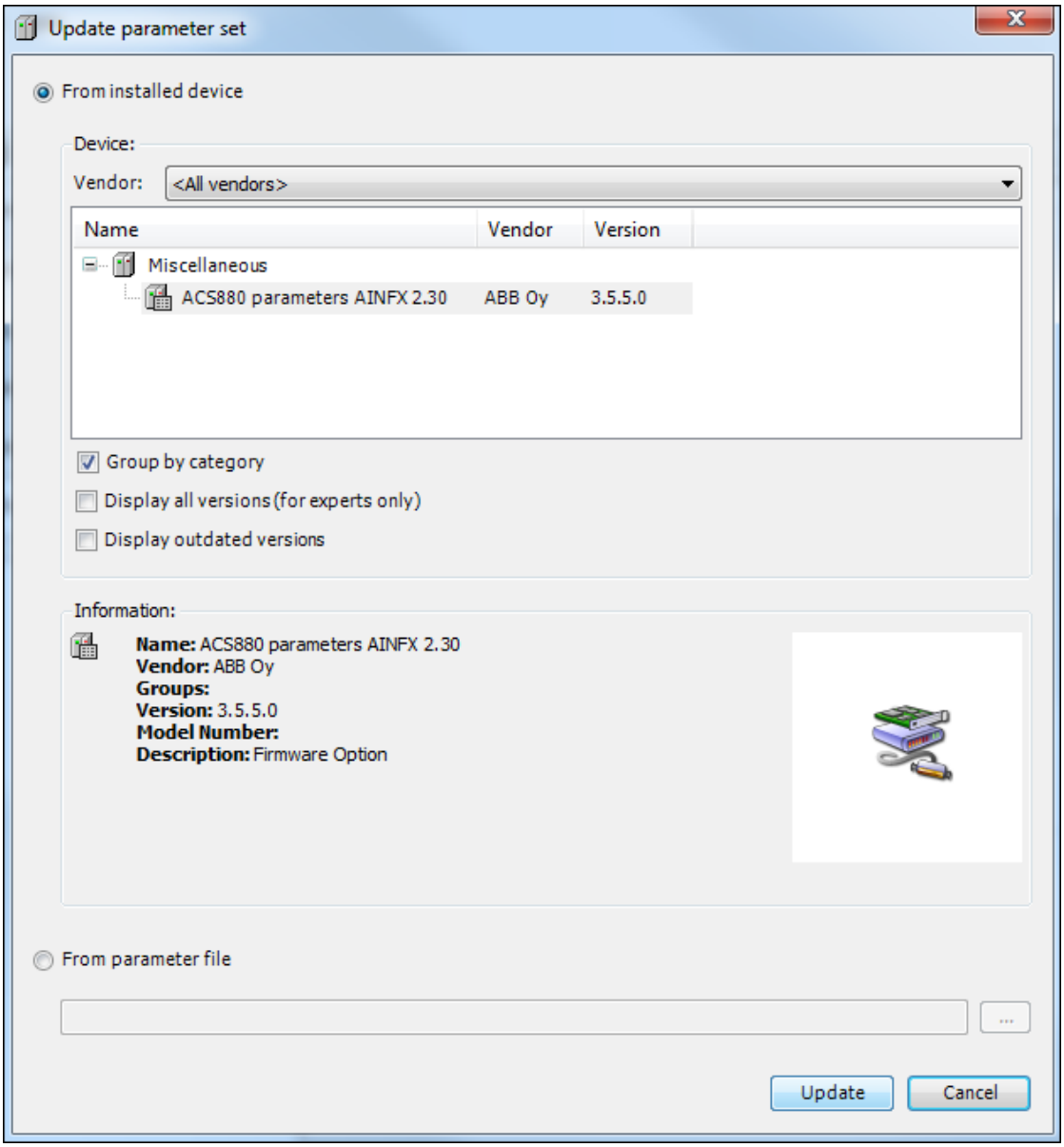


Figure 100: Update parameter from installed device

The parameter list from the selected device is displayed.

Updating drive parameters from parameters file

Optionally, you can update the actual drive parameter set using the Drive composer pro backup file.

To update the parameters backup file, follow these steps:

1. In the Devices tree, right click **DriveInterface** and select **Update Drive Parameter Set**.

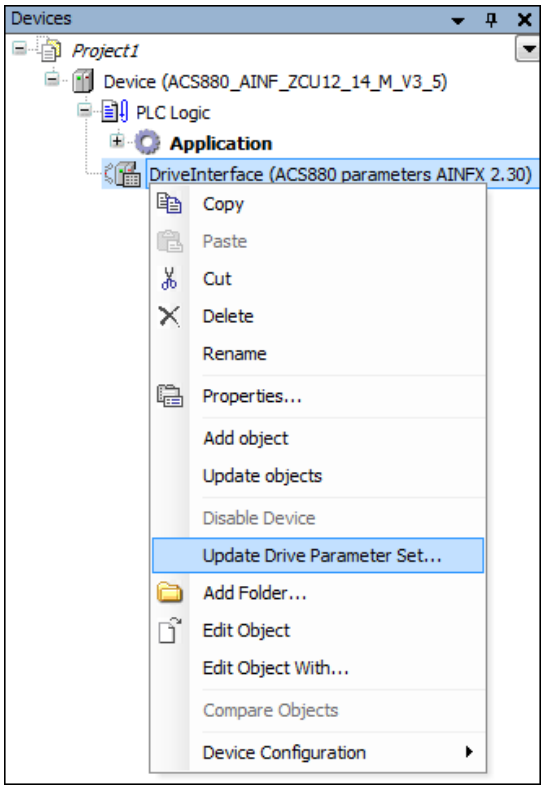


Figure 101 Update drive parameter set

2. In the Update parameter set window, select **From parameter file** option and browse to select *dcparams* (*.xml*) backup file and then click **Update**.

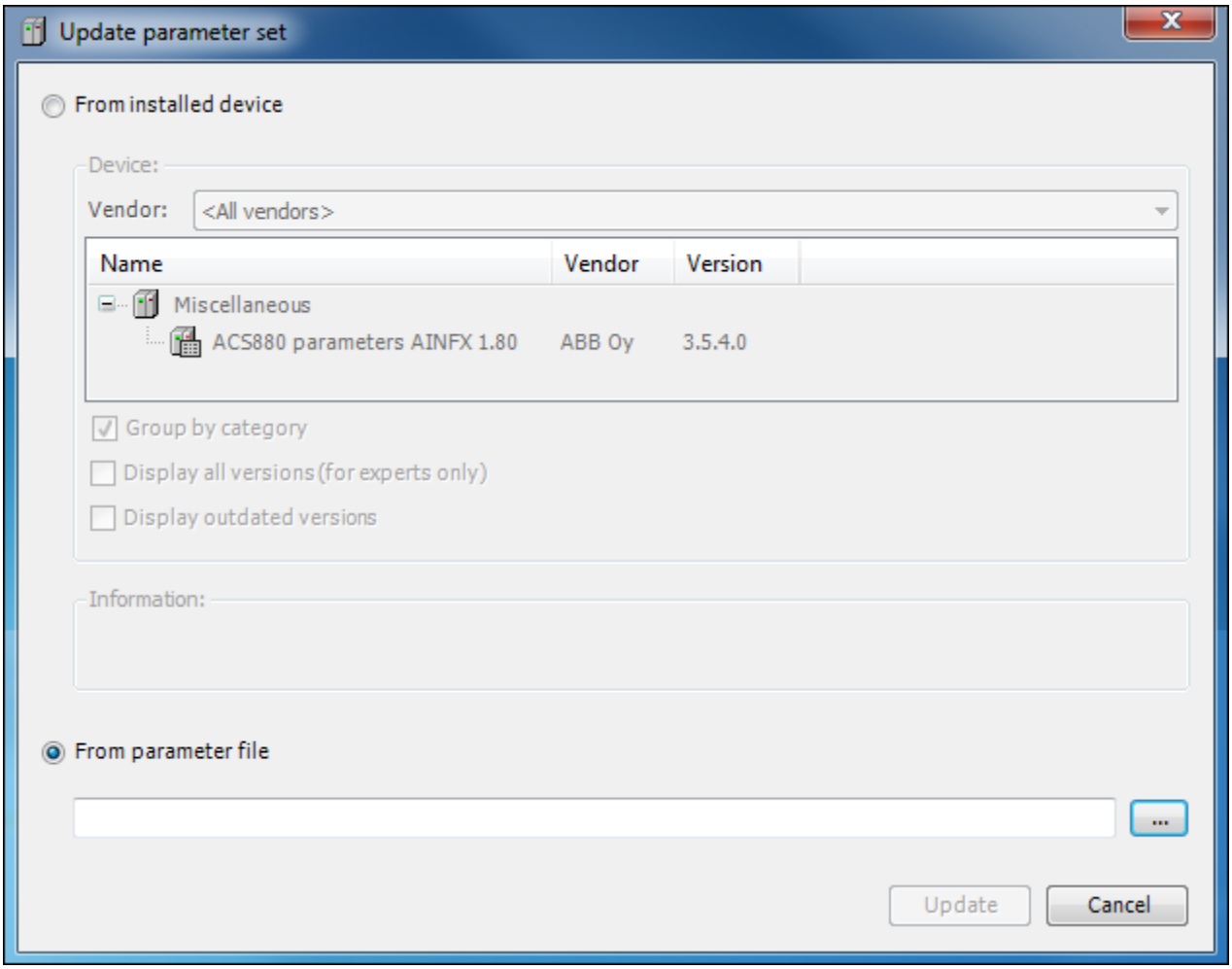


Figure 102: Select parameter file

The changes/deleted parameters are displayed. Click **OK**.

Setting parameter view

In Automation Builder, you can select the required parameter details to view in the ACS-AP-x control panel and the Drive composer pro display:

1. In the Devices tree, double-click **DriveInterface**.

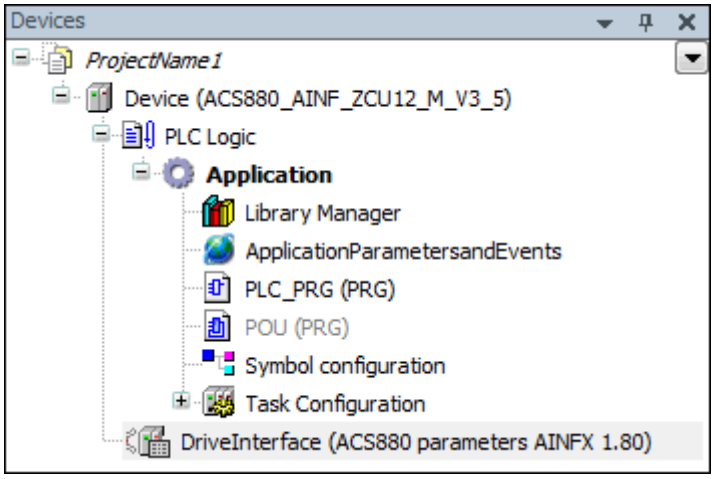


Figure 103 DriveInterface parameter view

2. In the upper-left corner of the **DriveInterface** window, select **Settings.**

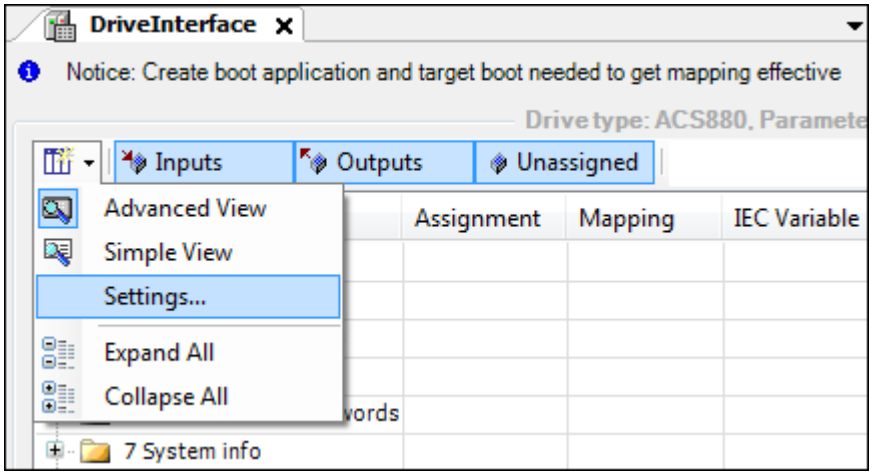


Figure 104: DriveInterface settings

3. Select the required view option for the corresponding parameter and click **OK**.

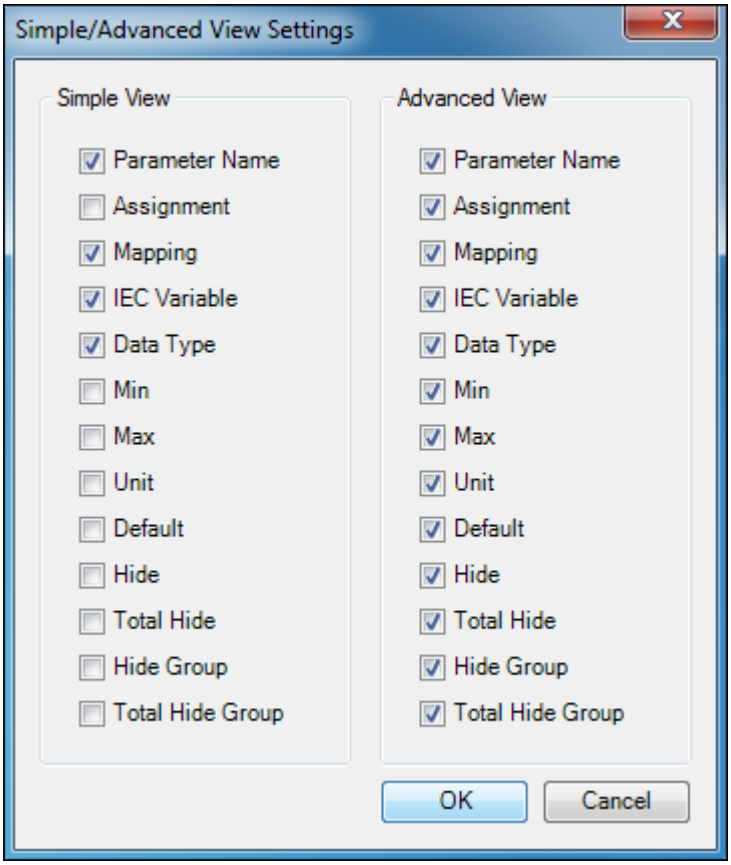


Figure 105: Hide options

The selected options in the view list are displayed in the DriveInterface parameter window.

7

Application parameter and events

Contents of this chapter

This chapter describes how to use the Parameter Manager and provides detailed information on parameter settings.

ApplicationParametersandEvents

You can create your own application parameters and events visible in the panel and Drive Composer pro tools.

1. In the Devices tree, right-click **Applications** and then click **Add Object**.

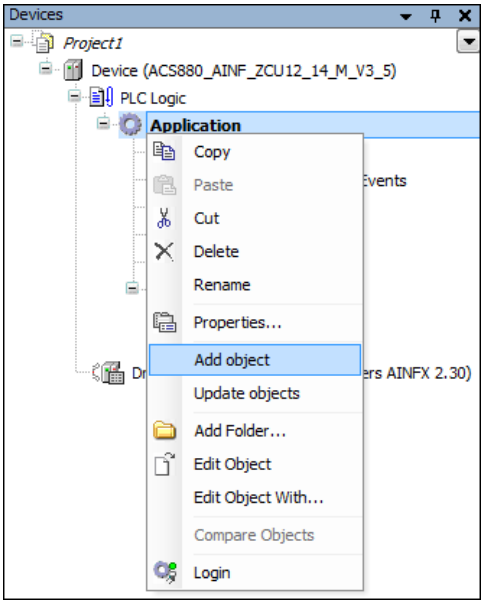


Figure 106: ApplicationParameterandEvents tool

2. In the Add object window, select **Application Parameters** and click **Add object**. Add Application Parameters window is displayed.

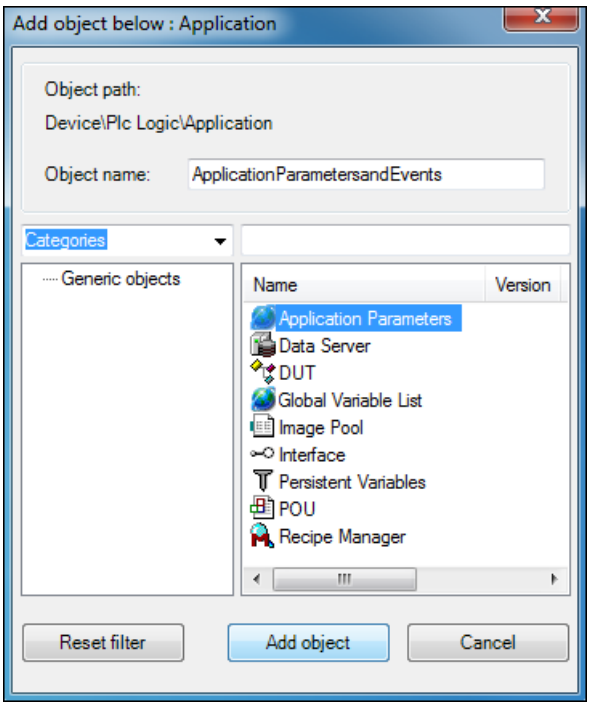


Figure 107 Application parameters

Note: You can create only one ApplicationParametersandEvents object at the time.

3. Click **Add** to add the Application Parameters to Devices tree.

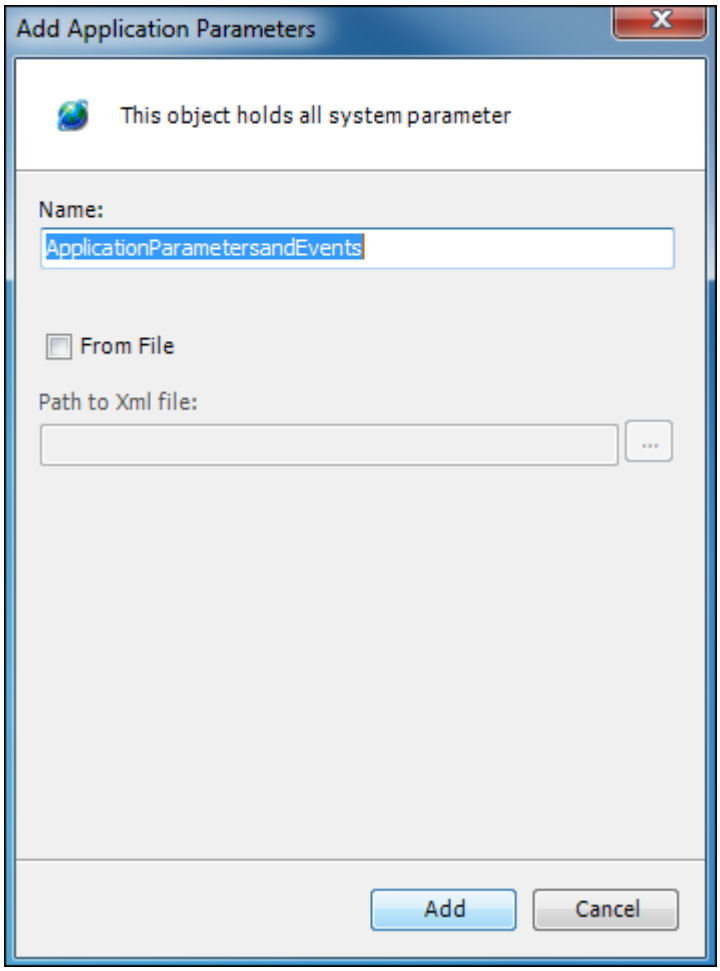


Figure 108 Add application parameters

ApplicationsParametersandEvents object is added under Applications in the Devices tree.

ParameterManager

In the ParameterManager window, you can create new groups of parameters, parameter families, selection lists, units, events and language translations for the names of all the previous items.

- In the Devices tree/Application, double-click the **ApplicationParametersandEvents** object. The ParameterManager window is displayed.

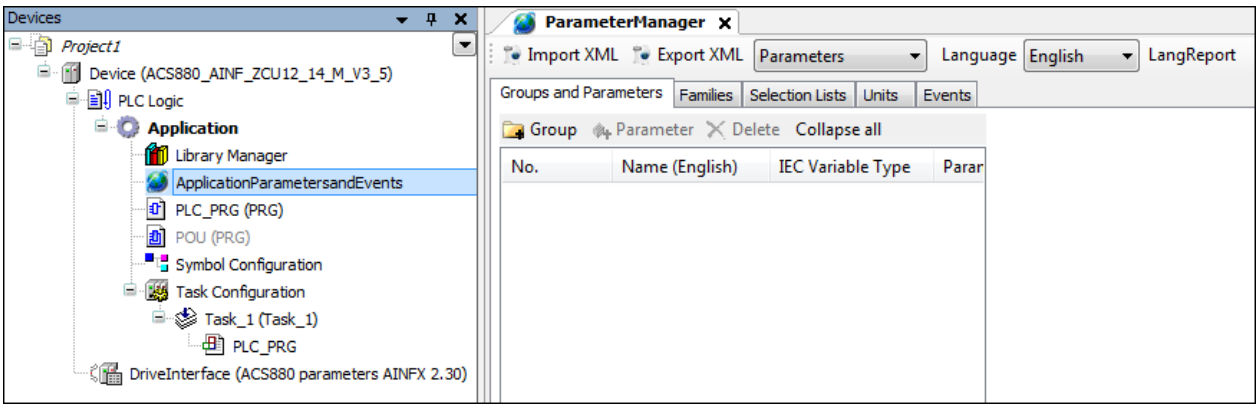


Figure 109: Parameter manager window

Creating parameter groups

All the drive parameters belong to a specific parameter group. Before creating any new parameters create a new parameter group. Ensure that all the groups have unique name and number. You can change the group number and name. You can also add translations into other languages in addition to the default language which is English.

- In the ParameterManager window, click Group to add group.

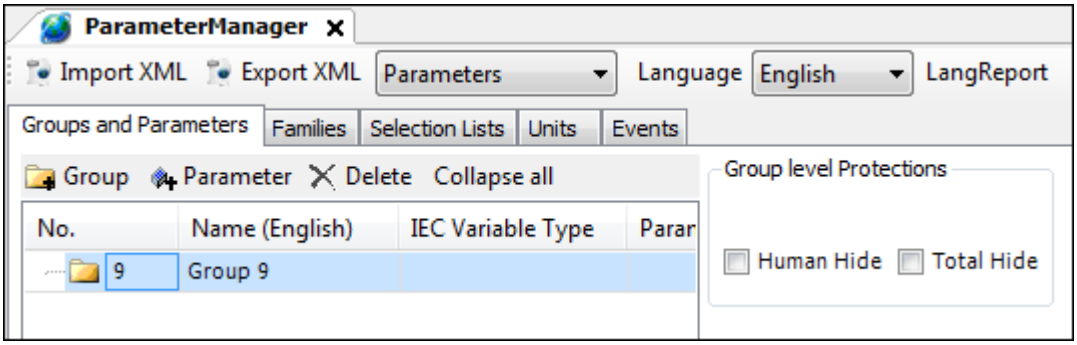


Figure 110 Adding parameter group

ParameterManager automatically selects the first free parameter group number that is not used in the drive firmware or ParameterManager.

Creating parameters

1. In the ParameterManager window, select a parameter group.
2. Click Parameter to create a new parameter.

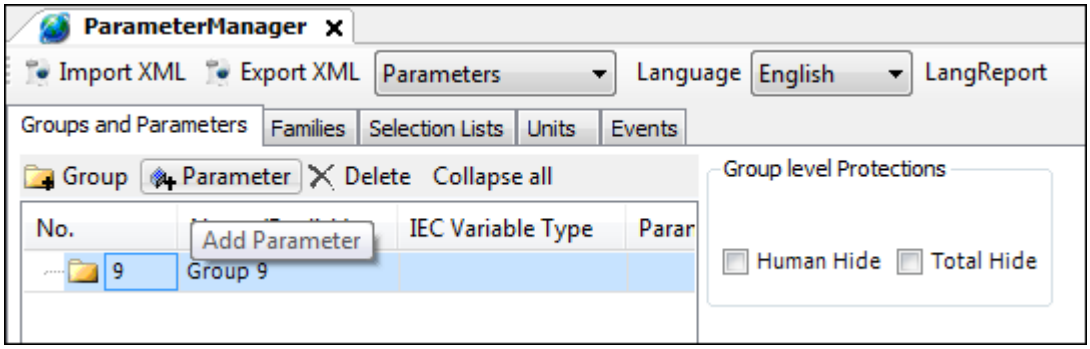


Figure 111 Adding new parameter

The Parameter Settings window is displayed. You can set the properties of the parameter. See section *Parameter Settings*. The Parameter Settings window is identical for all the parameters but there are also custom settings available depending on the parameter type. For more information on the type-specific windows, see section *Parameter types*.

3. In the Parameter Settings window, enter the **Name** of a parameter and click **Add**.

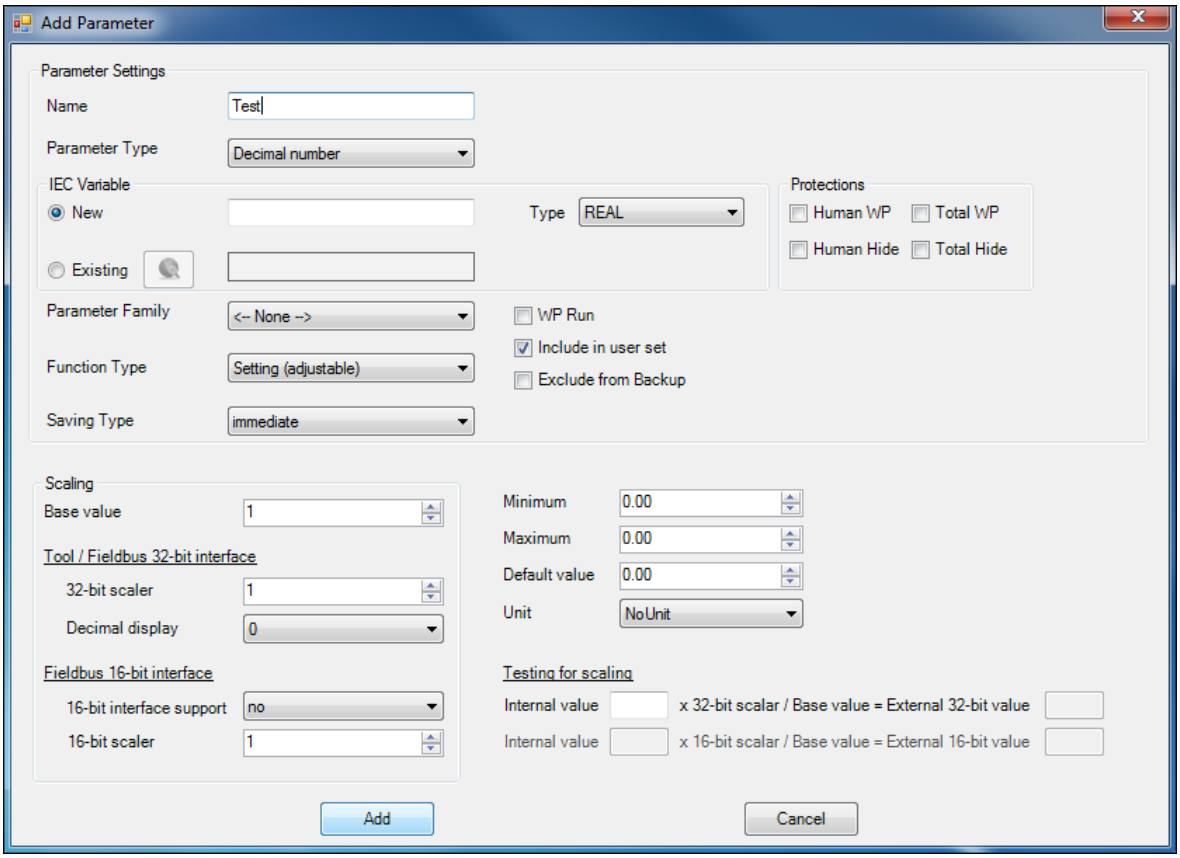


Figure 112 Naming parameter

The new parameter added to the selected group.

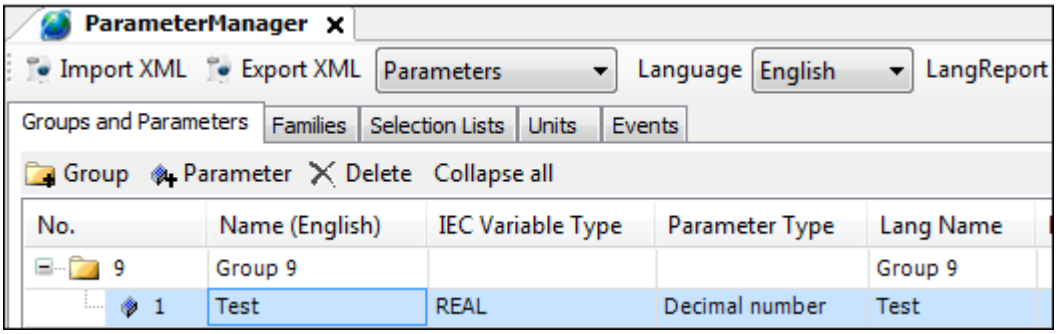


Figure 113 New parameter

Parameter settings

In the Parameter Settings window, you can set parameter properties.

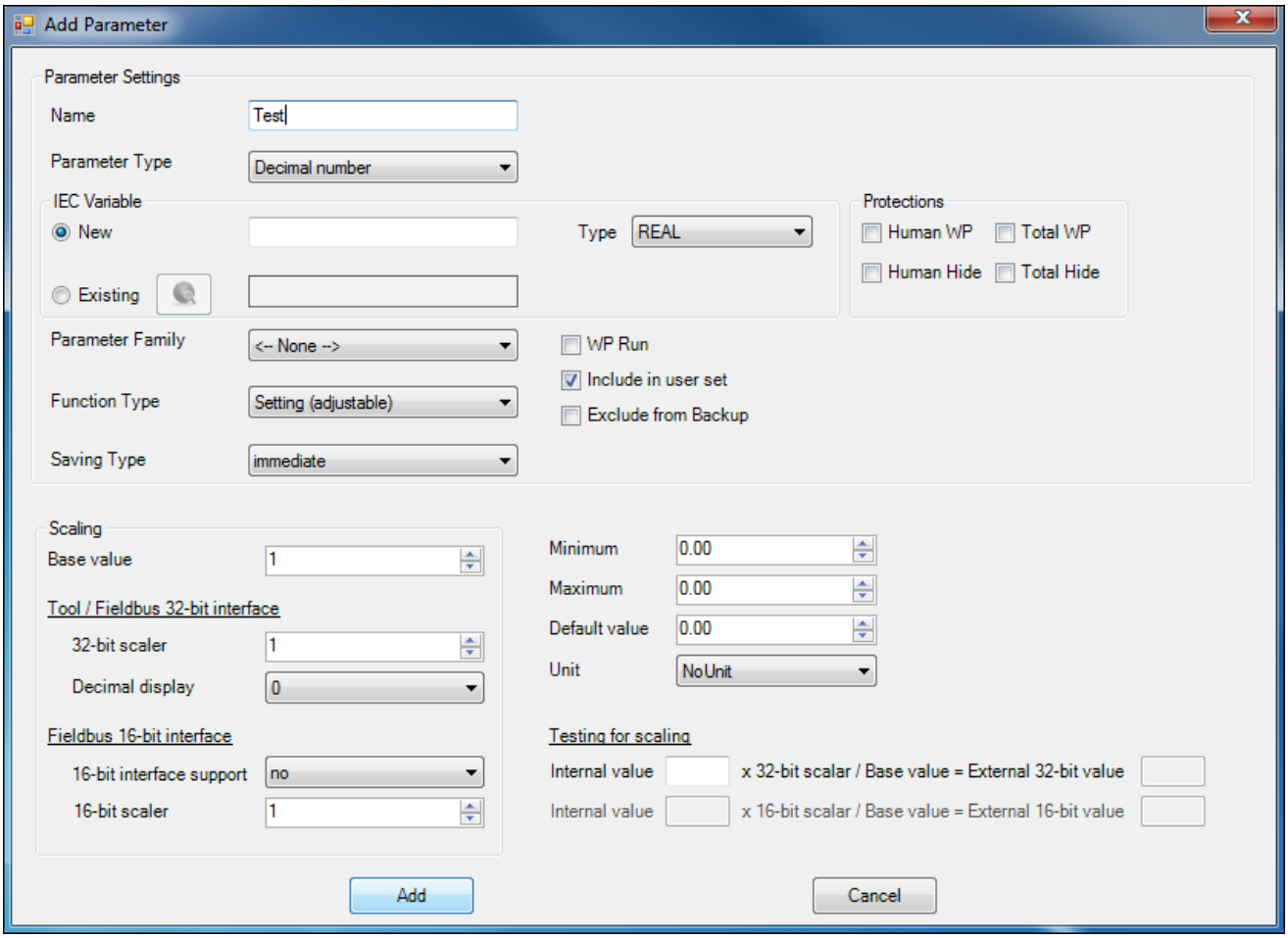


Figure 114: Parameter settings window

Parameter name is the name shown in the parameter list when using Drive composer or ACS-AP-x control panel.

Parameter type defines the kind of parameter created. There are following parameter types:

- Decimal number
- Formatted number
- Bit pointer
- Value pointer
- Plain value list and
- Bit list (16 bit)

For more information, see section *Parameter types*.

IEC variable name is used to define an IEC variable for the parameter.

- The **New** option maps the parameter to a new IEC variable. If you do not give a name for the new IEC variable, the parameter name is used as the IEC variable name.

  When you create a new IEC variable, you must select the variable type, for example, REAL. For more information on the variable types, see section *Data types* in chapter *Features*. The selected parameter type restricts the variable type selection and only the allowed types are shown in the IEC variable/Type list.

- The **Existing** option maps the parameter to an already existing IEC variable by finding the parameter from the list of the Input Assistant or writing the name to the field.

Parameter family includes a parameter as part of the parameter family and inherits the settings defined for the family. For more information, see section *Parameter families.*

Function types are flag configurations for parameters which determine the parameter behavior with the ACS-AP-x control panel and PC tool displays. There are five different configurations:

- **Setting (adjustable)** – This function type is a generic configuration parameter. When a parameter with this function type is changed by ACS-AP-x control panel or Drive composer, the changed value is saved. If the value is written cyclically, the saving type for the parameter must be no (for example, motor speed limits).
- **Setting (reverts to default)** – This function type is used for requesting a function. When this request is processed, the parameter returns to its default value.
- **Signal (read only)** – This function type displays the application parameter value in the ACS-AP-x control panel or Drive composer. A parameter of this function type does not have any meaningful default value.
- **Signal (resettable)** – This function type is identical to the read-only signal and also allows resetting parameters to their default values.
- **Custom** – This function type enables you to change values in the application.

Saving types define the method of storing the parameter value to the non-volatile memory. There are three different saving types:

- **No** – This type does not store the parameter values changes done in the ACS-AP-x control panel or Drive composer pro.
- **Powerfail** – If the parameter 95.04 is set as Internal 24V, the powerfail type parameters are saved immediately at the time of power failure in the drive. If parameter 95.04 = External 24V, the values are saved at periodic intervals of 1 minute. The power fail saved parameters are limited to < 10.
- **Immediate** – If the parameter value is changed using keypad or PC tool, this type saves the value immediately within 10 seconds. This saving type is used for controls, but not for signals.

Protection, hiding and excluding from backup allows you to set the following protections for parameters or set them on the parameter group level by selecting a parameter group in ParameterManager.

- **Human WP/Human Hide** write-protects/hides the parameter from a human user manipulation. This setting can be bypassed using configuration tools, fieldbus controllers, and so on.
- **Total WP/Total Hide** write protects/hides the parameter from any kind of manipulation outside firmware. These parameters are used only by the application.

The following settings are for parameters only:

- **WP Run** protects the parameter from writing when the drive is running.
- **Include in user set** includes parameter as part of the process where all parameters become a user set.
- **Exclude from Backup** leaves the parameter out of parameter backup, but restores the default parameter values. This setting applies only for parameters.

Minimum, Maximum and Default value are set for decimal and formatted numbers.

- **Minimum** and **Maximum** define the limits for the value of the parameter. These values should not exceed the limits of the data type defined for the parameter.
- **Default value** is the value of the parameter at the start-up of the program and it must be within the limits defined by the minimum and maximum values. The default value returns if you restore defaults or clear all with parameter 96.06 (see the drive firmware manual).

Scaling

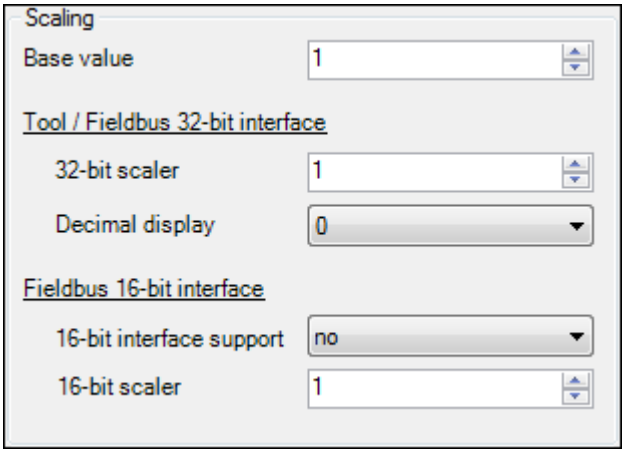


Figure 115: Scaling

Base value is the internal firmware value. The scaling values in Base value, 32-bit scaler and 16-bit scaler should match each other and define how a value of the parameter is represented in other contexts. Scaling for all the other values of the parameter is calculated on the basis of the scaling values defined.

If the scaling factor is 1, meaning direct transform from one representation to another, use the same number for all of the scaling values.

Example:

The firmware uses values 0…1 for motor rotation speed measurement. The maximum speed is 1500 rpm, and therefore the ACS-AP-x control panel displays 1500 rpm when the internal value is 1 (the maximum speed). The 16-bit fieldbus device shows 100%.

In this example the values are:
Base value = 1
Value (32-bit int) = 1500
Value (16-bit int) = 100

Tool/Fieldbus 32-bit interface

- **32-bit scaler** - 32-bit external value (for example, Drive composer or ACS-AP-x control panel)
- **Decimal display** - Decimal display defines the number of decimal digits displayed on the Drive composer or ACS-AP-x control panel. This setting applies only for external value, but has no effect on the internal value.

Fieldbus 16-bit interface

- **16-bit interface support** - This field defines if the 16-bit external format is allowed, for example, in fieldbus devices and how it is scaled to the 32-bit external format:

  No – 16-bit external format is not allowed.

  Direct – 32-bit scaling is used but the value is displayed as a 16-bit value. Therefore, value (16-bit int) is considered meaningless.

  Scaled – separate 16-bit scaling is used. Value (16-bit int) must be defined.

- **16-bit scaler** - 16-bit external value (for example, fieldbus devices)

Testing for scaling

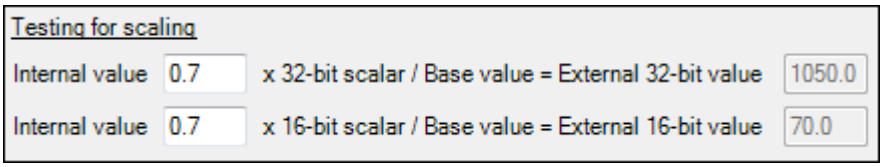


Figure 116: Testing for scaling

Internal value - Calculates the scaling of 32 and 16 bit fieldbus interface with the corresponding IEC variable. For description of formula, see *PAR_SCALE_CHG* function block.

Linking parameter to application code

The **IEC variable** field in the **Parameter settings** window enables to link a parameter to an application program code. There are two options to link a parameter with an application program code.

- The **New** option adds a new IEC variable to programs and is visible in the input assistant under ApplicationParametersandEvent object.
- The **Existing** option allows linking a parameter to the existing IEC program variable using browser. Make sure to select the correct data type. If you change the link to the existing IEC variable, a build error occurs. See the message box for information on incorrect linked parameters. Check the full path to correct the missing linked parameters according to the program.

Note: The existing retain variables cannot be linked to application parameters.

Parameter types

In the Parameter Settings window, you can select the Parameter Type for the newly created parameter.

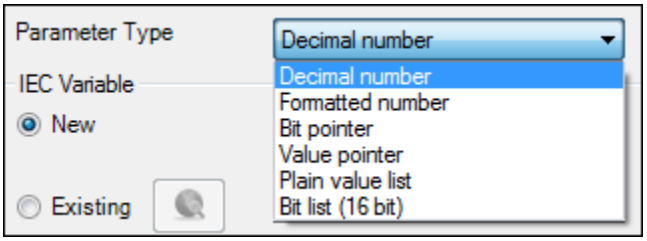


Figure 117: Parameter type

Decimal number creates a parameter with actual numeric contents, either decimal or non-decimal numbers. The available IEC types are REAL, UDINT, UINT, DINT and INT.

Formatted number parameter type is used to make special purpose parameters like date displays, version texts, passcodes, and so on. The available IEC types are UDINT, UINT, DINT and INT. In the **Display format for Data Parameter**, you can define the format in which the value should be displayed in the Drive composer or ACS-AP-x control panel.

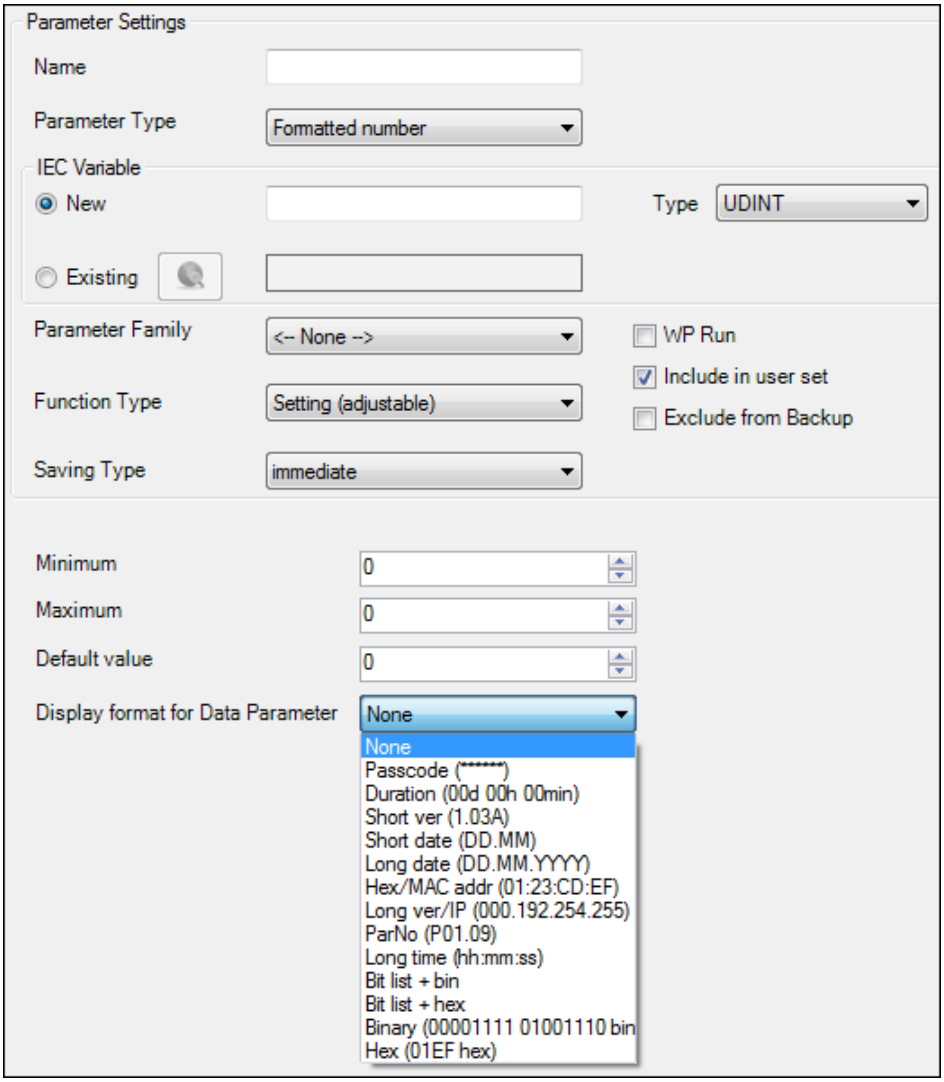


Figure 118: Display format for data parameter

Bit pointer creates a pointer parameter which can be assigned to point to a bit of another parameter. You must associate the bit pointer parameter to a selection list (a bit pointer list) that must be created beforehand. For more information, see section *Selection lists*. The only available IEC type for bit pointer is BOOL. You can define the default selection from the list.

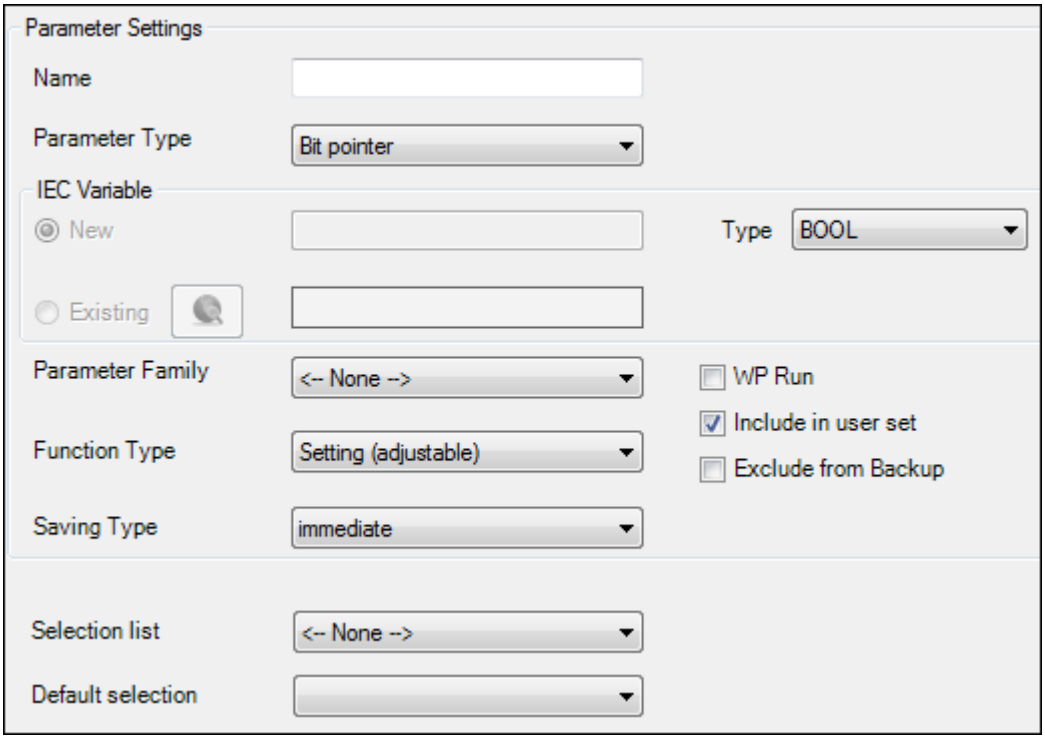


Figure 119: Selection list

Value pointer creates a pointer parameter which can be assigned to point to another parameter. You must associate the value pointer parameter to a selection list (a value pointer list). For more information, see section *Selection lists*. The only available IEC type for the value pointer is UDINT. You can define the default selection from the list.

Plain value list must be associated to a selection list (a plain value list) and it allows only values of the list as its own value. The available IEC types are UDINT, UINT, DINT and INT. You can define the default selection from the list.

Bit list (16 bit) consists of maximum 16 Boolean values (bits). You can add new rows (bits) to the list using the **Bitlist row** button. You can change the names of the bits and their values to represent their purpose. The default value is the bit value at the start-up of the program. The only available IEC type is UINT.

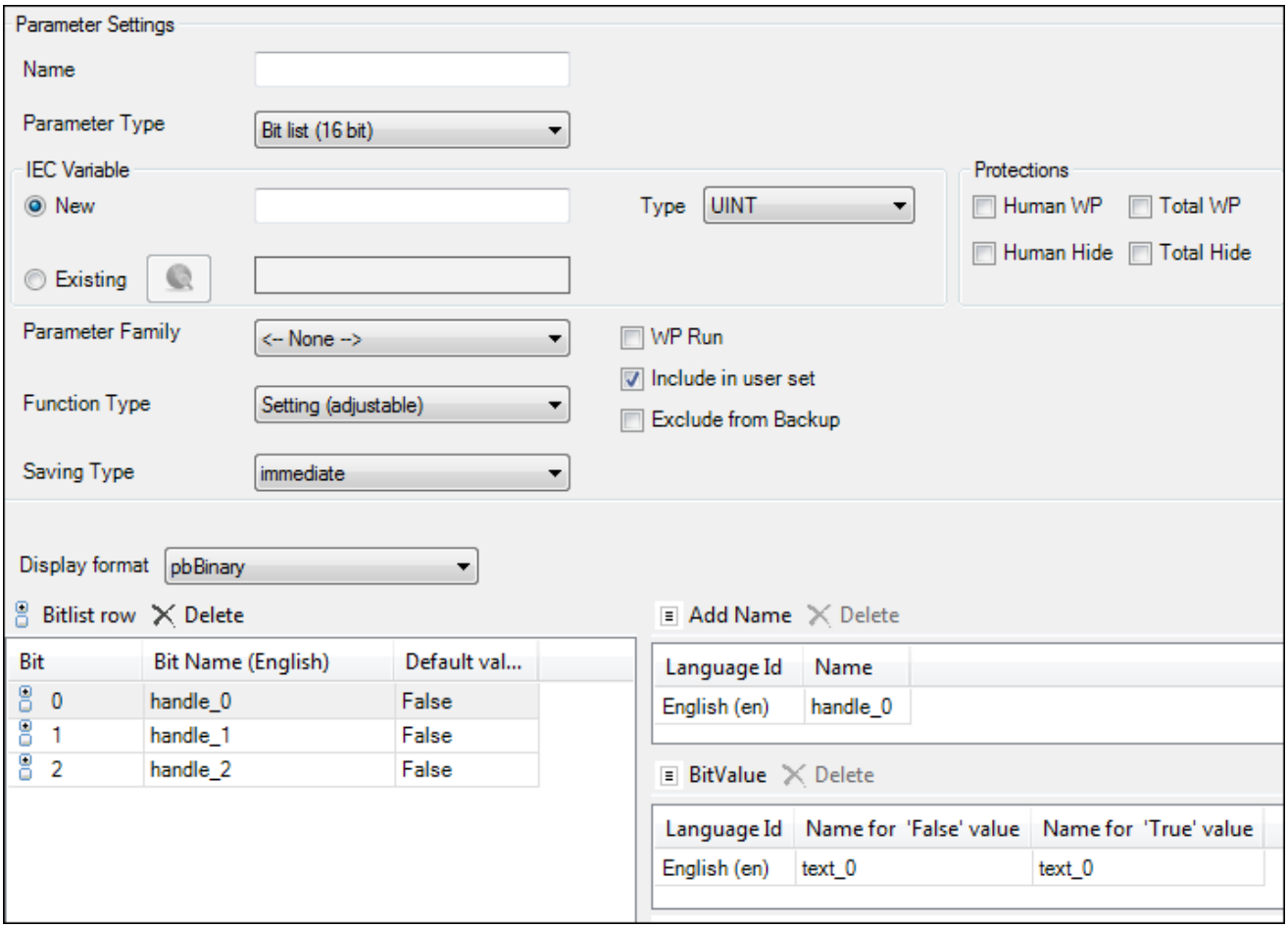


Figure 120: Bitlist rows in Add Parameter window

Parameter families

If a parameter shares some of its attributes (scaling, minimum/maximum, and so on) with another parameter, it can belong to a family that describes these common attributes. This way, when the attribute is changed in one parameter, it is also changed in all parameters belonging to the same family. The system library includes a function block to modify parameter attributes like PAR_UNIT_SEL functions. See AY1LB_System_ACS880_V3_5 library *in Appendix C: ABB drives system library*.

If you select a parameter family **Version** style, make sure the family has a unique **Name**. The parameter families can define limit or scaling properties or both of them.

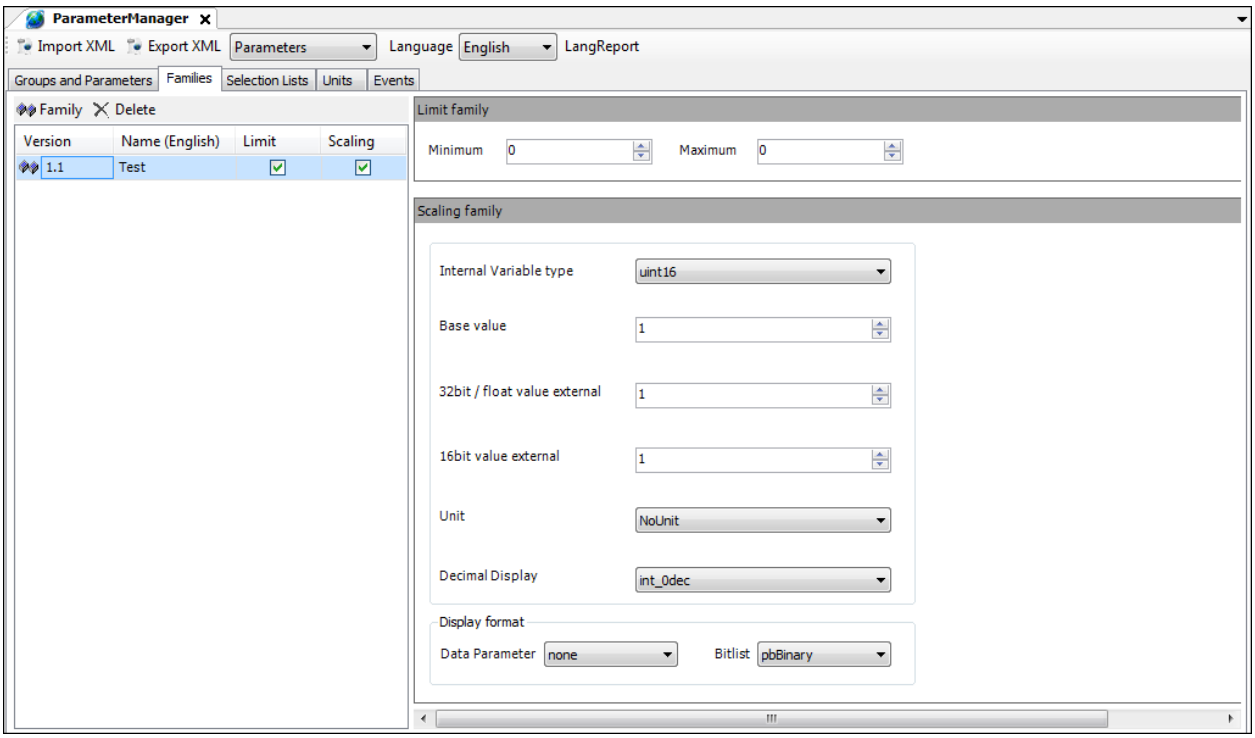


Figure 121: Parameter families

Selection lists

Selection lists are always associated to a parameter of the same type as in the list and they can be accessed only through the parameters.

1. In ParameterManager window, click **Selection lists** tab and then click **Selection list** to add values.

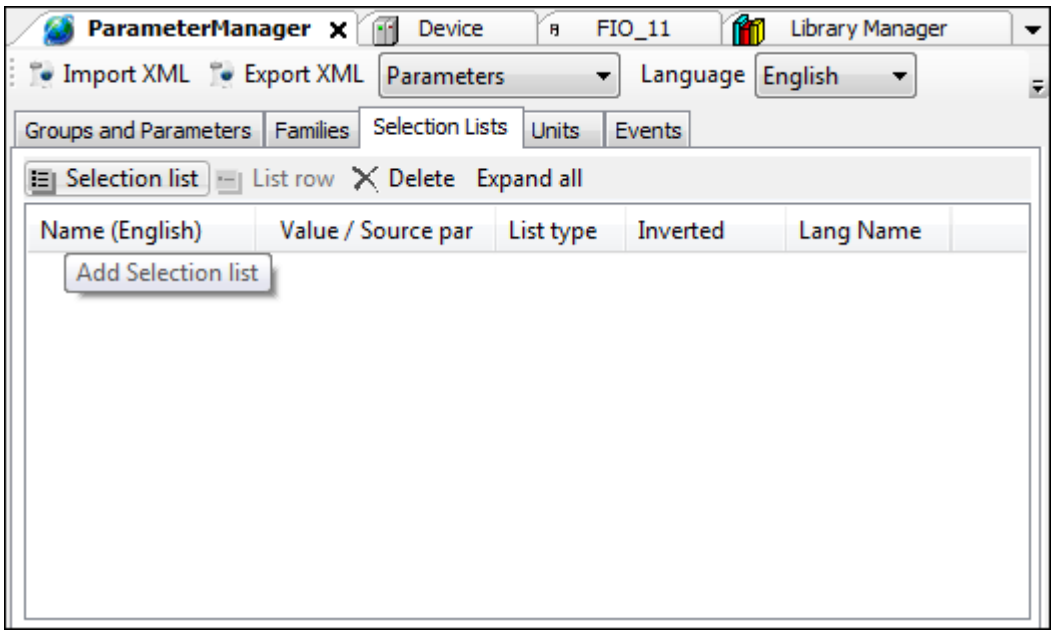


Figure 122 Selection lists

2. Select the Type of selection list and enter the name and then click **Add**.

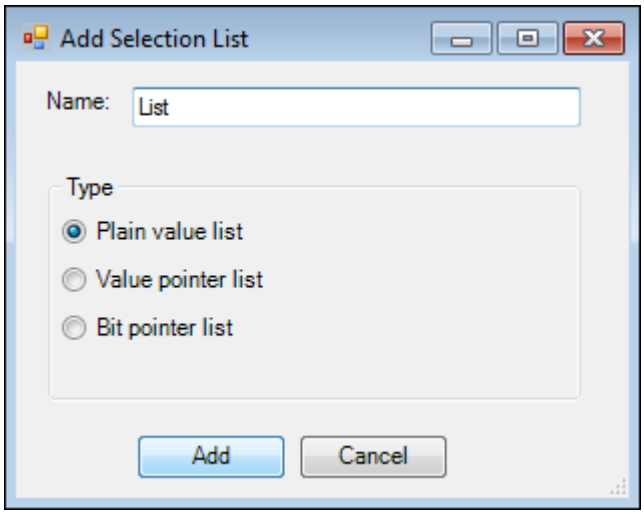


Figure 123 Add selection lists

The selection list is created. You can add the list row by clicking on **List row** button. If you want to rename the list, double-click on the created list.

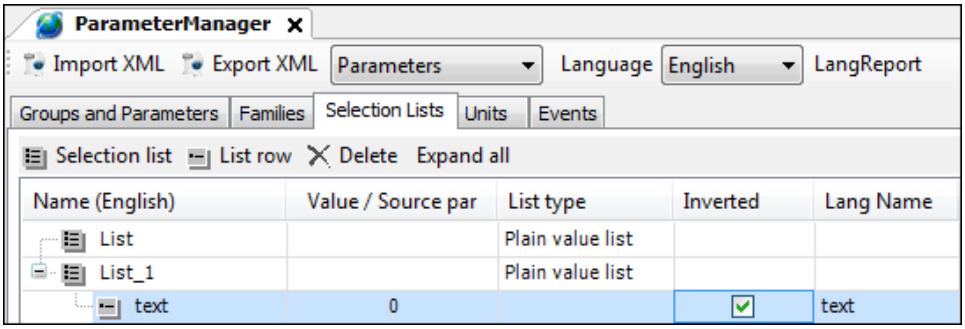


Figure 124 Selection lists

Note: You cannot change the type of the selection. If want to change the type of selection, delete and create a new selection list.

Selection list name – The text visible to the user. Note that the name is not the official text since the language translator just uses this text as a source when creating the official language texts.

Value/Source par – The value of the list row. For the bit and value pointers, it is the index of the row in the list. For the value lists, it is an actual selectable value.

List type – There are three different types of selection lists:

- **Bit pointer list** – By default, it has the **const_false** and **const_true** values. You can add to the bit pointer list single bits of any parameter of the appropriate type.
- **Value pointer list** – By default, it has the **const_null** value. You can add to the value pointer list any parameter which has the same data type as the pointer associated to the list.
- **Plain value list** – You can add to the plain value list any values of types INT, DINT, UINT or UDINT. The type has to be the same as the type of the pointer associated to the list.

Inverted – When a bit /value is read from a source parameter, it is inverted /negated for output when the inverted flag is set.

Units

You can create own units for the application parameters. A unit has a unique number and a name. The allowed unit codes for the application program are 128…255.

You can add translations of the name into other languages.

1. In the ParameterManager view, click **Units** tab.

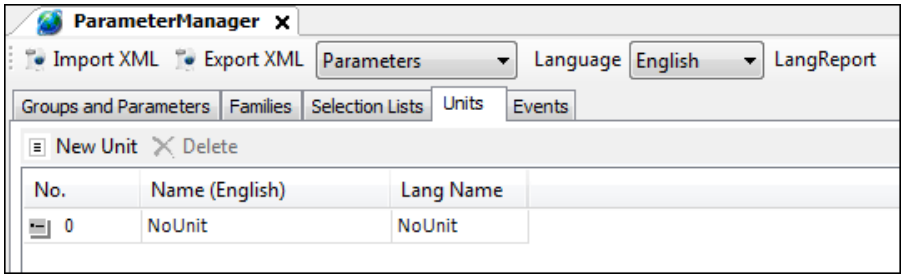


Figure 125 Unit

2. Click **New Unit** to add unit and click **Add** to add Language Id.

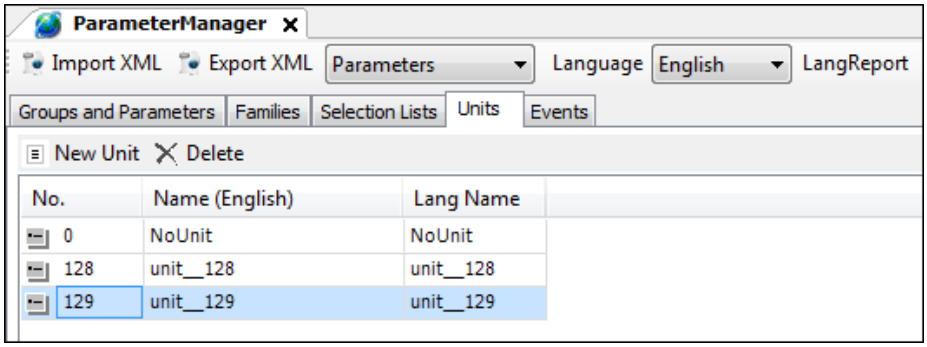


Figure 126 Units and translations

The units are attached to parameters in the **Add Parameter** options in **Parameter Settings** window.

Application events

You can configure your own application events (faults or warnings). The application program then triggers the event and the event registers in the drive event logger with a time stamp. This tool defines the event ID code, type and event name (with translation).

- In the ParameterManager view, click **Events** tab and then click **Event** to add Event.

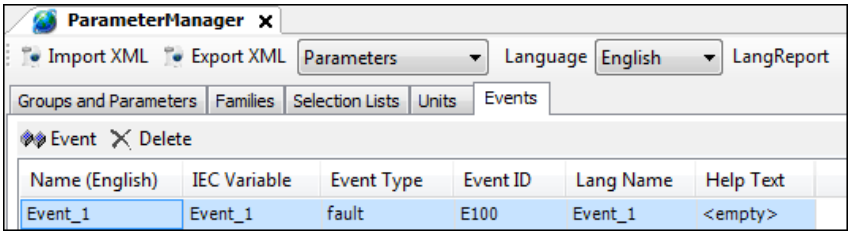


Figure 127 Events

Events dialog box gives the following information:

- **Name**, in this example ***Event_1***. The Event name is displayed on the ACS-AP-x control panel and in the Drive composer tools when the event is activated / deactivated.
- **Event Type**, in this example ***fault***.

  The following event types are supported:

  1 = Fault (Trips the drive.)

  2 = Warning (Is registered to the event logger.)

  3 = Pure event (Is registered to another logger.)
- **Event ID**, in this example *E100*. Each type of event has its numerical range (ID code). You can select the ID code within the range.

The event is activated by using the EVENT function block in the program code (library AY1LB_System_ACS880_V3_5, see chapter *Libraries*). Every event must have its own instance of the EVENT block. The EVENT function block must have the same ID code and type as defined in the previous dialog box.

8

Configuring extension I/O modules

Contents of this chapter

This chapter contains general information on how to configure F-Series extension I/O in drive application programming through Automation Builder programming tool.

Configuring extension I/O module

FEA-03

The FEA-03 F-series Extension adapter is used to locate additive F-series modules like FIO-01, FIO-11 or FAIO-01 modules. The FEA-03 module contains 2-slots with 2-switches each. You can add FIO-01, FIO-11 or FAIO-01 modules to the slots of the control board or FEA-03 module. The application programming supports 7-extension I/O modules. See parameter group *14 I/O extension module 1* in *ACS880 primary control program firmware manual [3AUA0000085967 (English)].*

For example, the below figure illustrates the maximum configuration of FSeries modules on the Control board (ZCU) and FEA-03 adapters supported by ACS880. It contains 3-firmware and 7-program modules. Node numbers 1, 2, 3 are on control board slot 1, 2, 3 and the remaining node numbers are FEA-modules and their node numbers are defined by F-Series module switch.

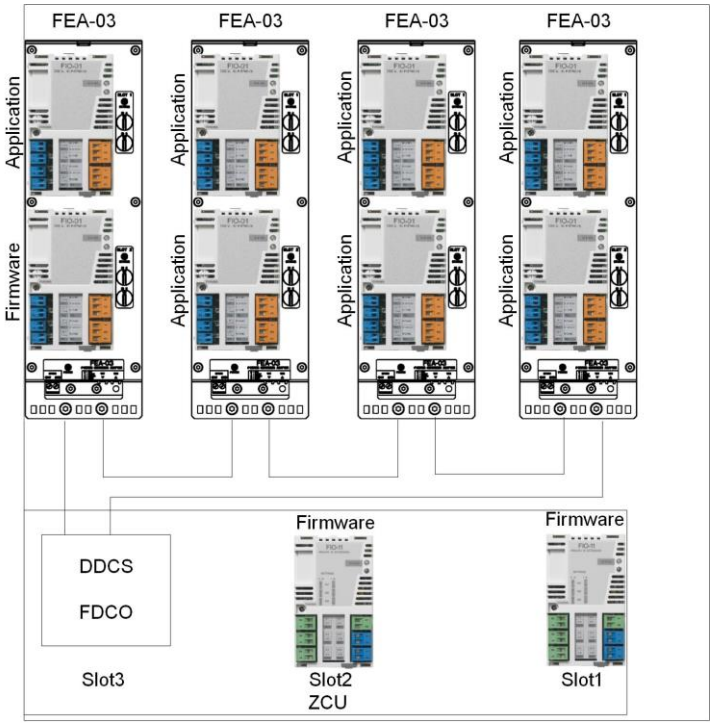


Figure 128 Extension I/O configuration

Node numbers

The node numbers 1-3 are reserved for extension I/O modules that are placed on the slots of control board and the other node numbers can be used for modules in FEA object.

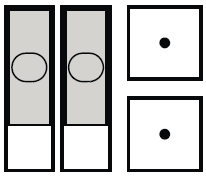
The upper switch defines the first digit and the lower switch defines the second digit of the node ID. For example in case of node address 6, turn the lower switch to 6 and check that the upper switch points to 0.

Figure 129 Module node number

Selecting input signal type

You can select the unit (mA or V) of an analog signal by sliding the switches of FIO module next to the input either up for current signal or down for voltage signal.

Current signal



Voltage signal

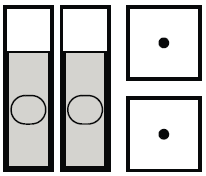
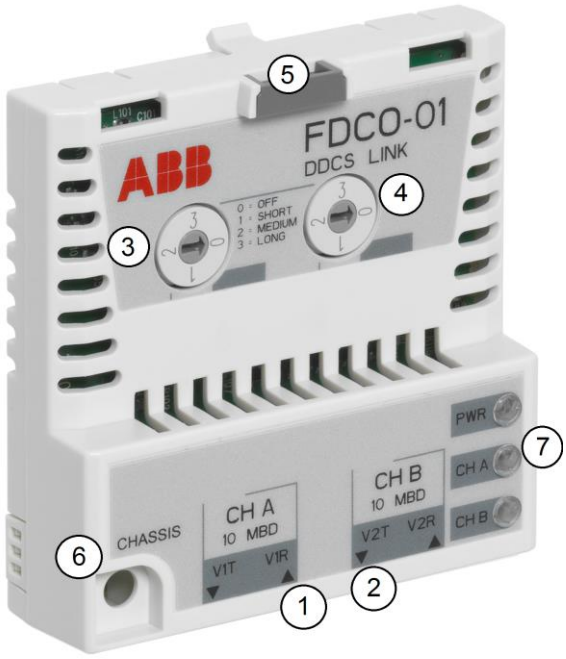


Figure 130 FIO module

FDCO

In FDCO adapter, select the channel number based on the used slot. Communication slot for FDCO adapter is defined by parameter *60.41 Extension adapter com port* based on the used slot and channel. For the descriptions of parameter, see *ACS880 primary control program firmware manual [3AUA0000085967 (English)].*

For example, if FDCO adapter is placed on slot 2 and channel A is used, slot2 A is selected for Extension adapter com port. For further details, see *FDCO-01/02 DDCS communication modules user's manual [3AUA0000114058 (English)].*



1 Connector for channel A
2 Connector for channel B
3 Selector for channel A
4 Selector for channel B
5 Lock
6 Mounting screw
7 LEDs

Extension I/O in drive application program

Adding F-series module

1. In the Automation Builder Device tree, right-click and select **Add object**.

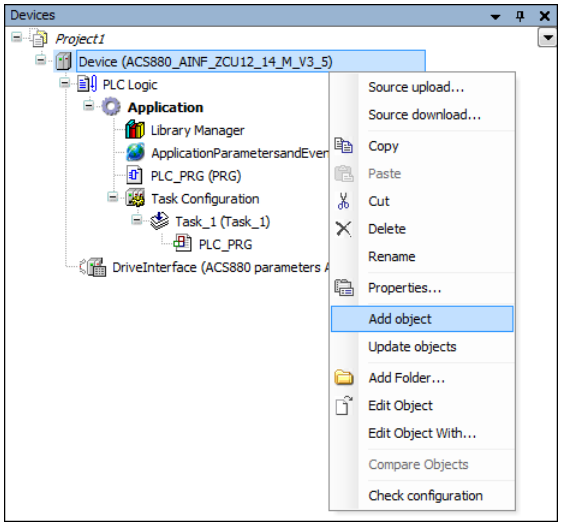


Figure 131 FSeriesIO-Add object

2. Select **FSeriesIO** and click **Add object**.

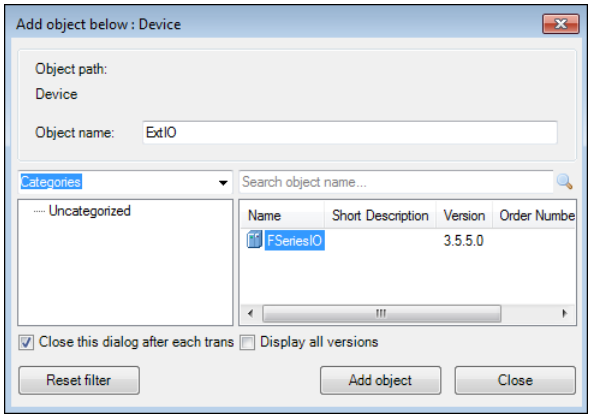


Figure 132 FSeriesIO object

The FSeriesIO extension is added to the project. It has 3-empty slots. You can add FIO-01, FIO-11 or FAIO-01 modules to FSeries slots. FDCO adapter is required if you are using FEA-03 module.

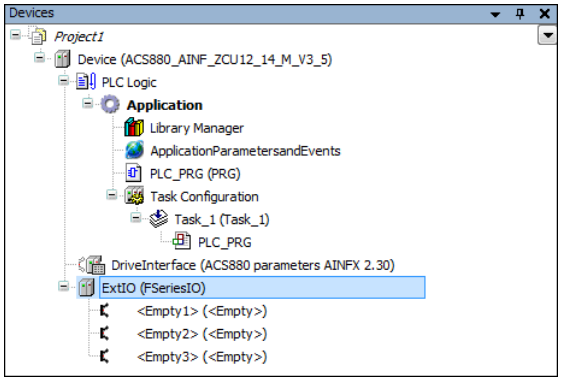


Figure 133 FSeriesIO slots

Note: You can add only one FDCO adapter to FSeriesIO extension. Because it has only one communication port for FDCO adapter in the firmware. See parameter *60.41 Extension adapter com port* in *ACS880 primary control program firmware manual [3AUA0000085967 (English)].*

3. In the ExtIO (FSeriesIO), right-click on empty slot and click **Add object**.

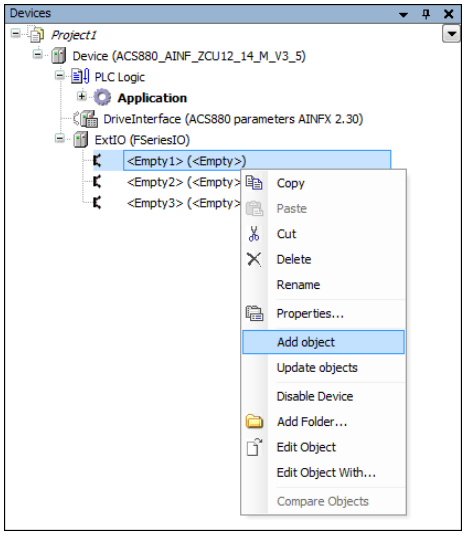


Figure 134 Emptyslot 1 - Add object

4. Select FDCO-01/02 adapter and click **Replace object**.

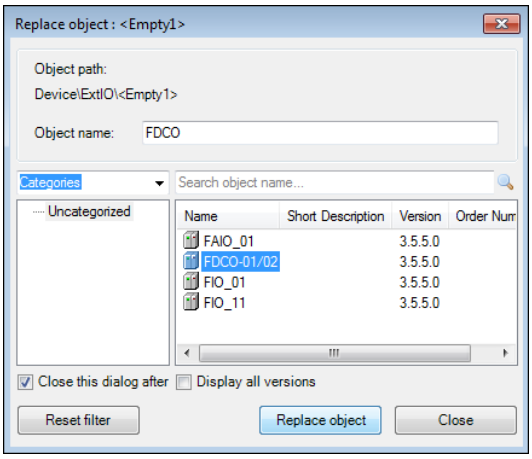


Figure 135 FDCO-01/02

FDCO-01/02 adapter is added to the Slot of FSeriesIO module.

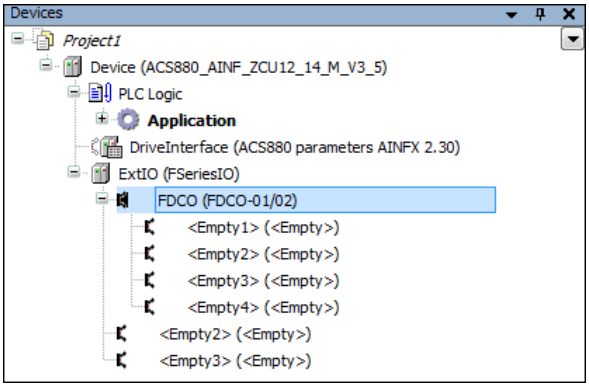


Figure 136 FDIO 01/02 slots

5. In the FDCO (FDCO-01/02), right-click on empty slot and click **Add object**.

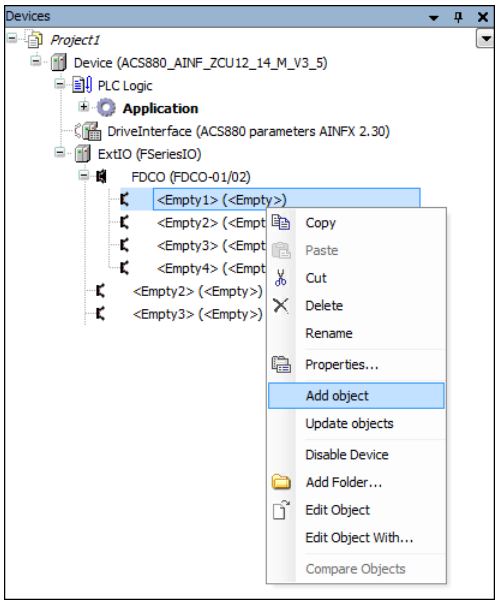


Figure 137 FDCO module

6. Select FEA-03 and click **Replace object**.

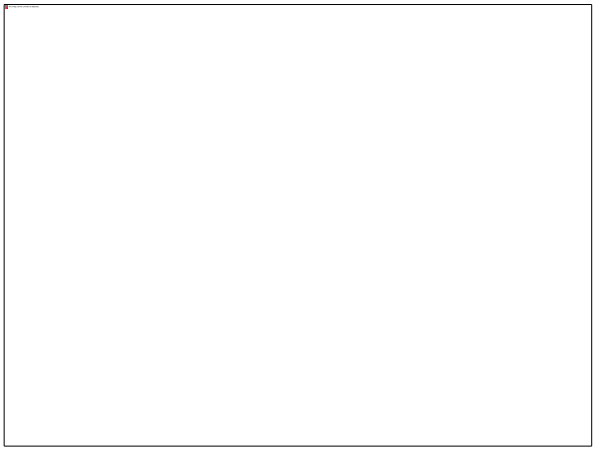


Figure 138 FEA-03 module

7. In the FEA (FEA-03) module, right-click on an empty slot and click **Add object**.

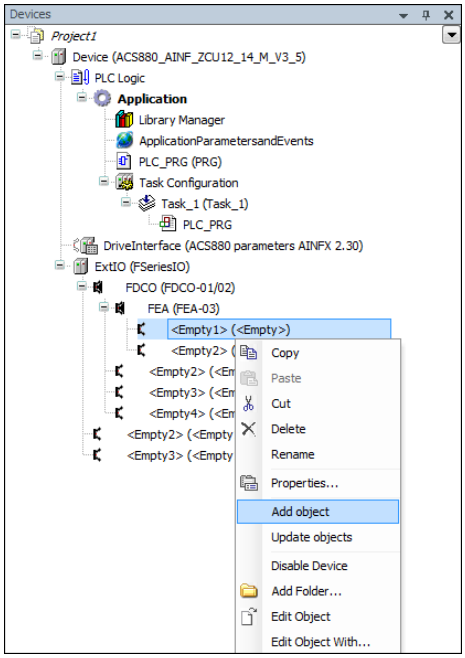


Figure 139 FEA-03 add object

8. Select **FIO-01** module and click **Replace object**.

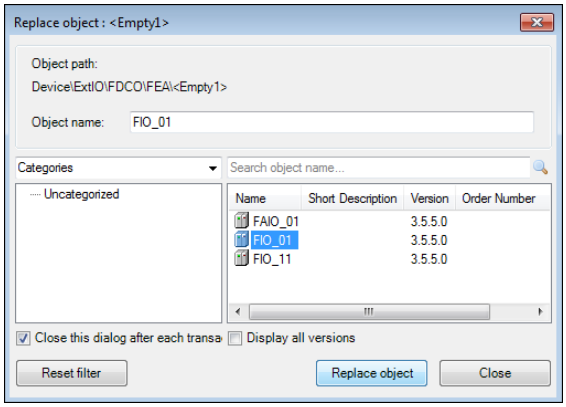


Figure 140 FIO-01 module

Similarly, you can add FIO-11 or FAIO-01 modules to FEA-03 empty slots.

Setting module data

Adding node number

1. In the Automation Builder, double-click **FIO_01** or any other module.
2. Click **I/O-Bus Module Parameters** tab and add the node number in the value field.

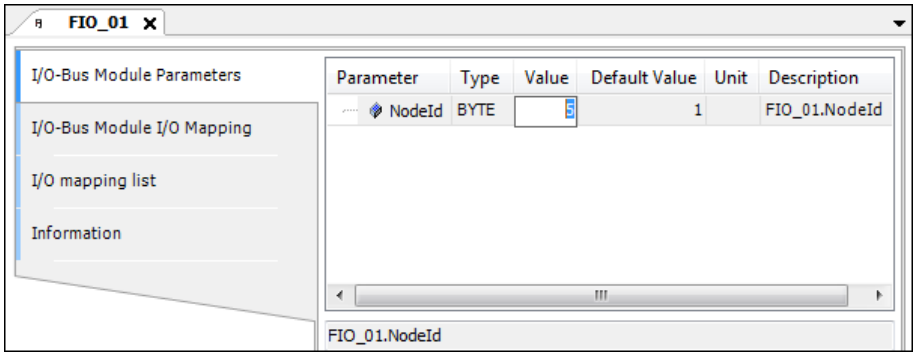


Figure 141 Node number

The node numbers 1, 2 or 3 are based on slot numbers. The node numbers 4-10 are used if the I/O module is placed on FEA-03 module.

I/O mapping variabes

1. In the Automation Builder, double-click **FIO-01** or any other module.
2. Click **I/O-Bus Module I/O Mapping** tab and create I/O mapping variables in Variable column.

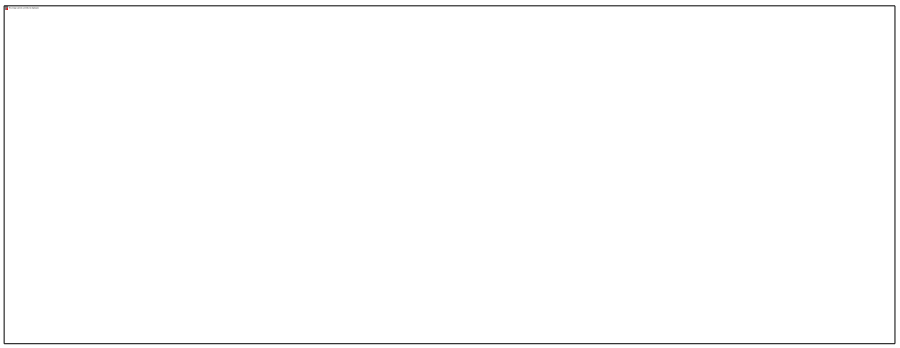


Figure 142 I/O mapping variables

The variable names must be individual. You can have maximum 100 mapping variables. I/O mapping variables do not support Mapping to existing variables.

FIO-01 Module data

You can find the general information of FIO-01 module by clicking on Information tab.

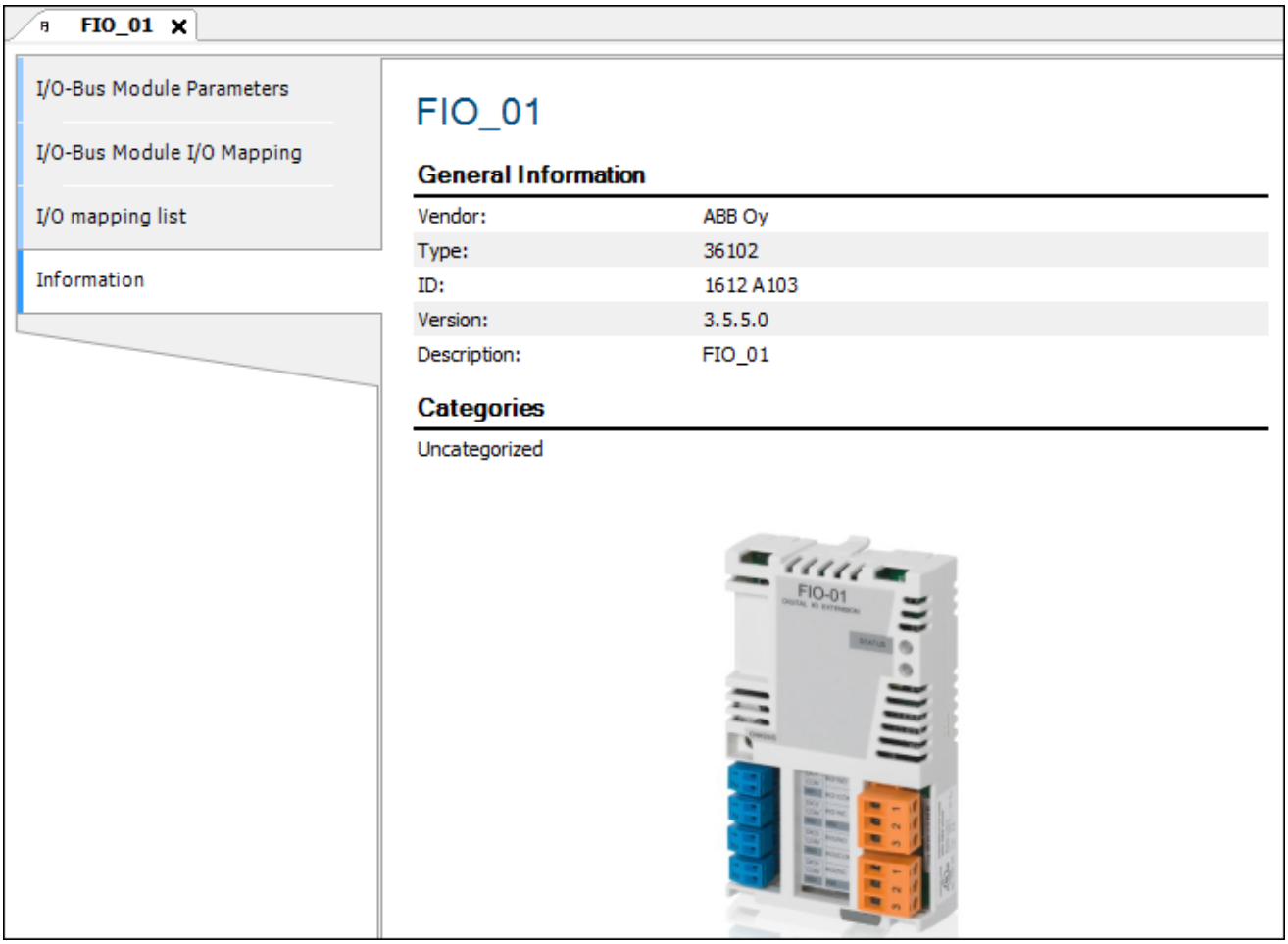


Figure 143 FIO-01 information

FIO-01 Channel descriptions

Channel	Descriptions
Status	0 = Not active 1 = Initializing state 2 = Active 3 = No communication
Control	0 = Inactivate 1 = Activate FIO-01module
DIOx_FilterTime	Defines the filtering time constant (0.8…100.0ms). This time is applied for all filtered inputs (optional).
DIOx_ChDir (x=1-4)	0 = DIO is used as a digital output (default value). 1 = DIO is used as a digital input.

DIOx_Output (x=1-4)	1/0 = ON/OFF status of digital output if channel is used as output (ChDir = 0). The corresponding ON and OFF time delays are applied if they are defined.
DIOx_ONDelay (x=1-4)	Defines activation delay (0.0…300.0s) applied for digital input/output. This channel is optional.
DIOx_OFFDelay(x=1-4)	Defines deactivation delay (0.0…300.0s) applied for digital input/output. This channel is optional.
DIOx_FiltInput (x=1-4)	1/0 = ON/OFF status of digital input if channel is used as input (ChDir = 1). Filter time is applied if it is defined. Time delays are never applied.
DIOx_Input (x=1-4)	1/0 = ON/OFF status of digital input if channel is used as input (ChDir = 1). The corresponding ON and OFF time delays are applied if they are defined.
ROx_Output (x=1-2)	1 = Relay is energized (ON). 0 = Relay is de-energized (OFF).
ROx_ONDelay (x=1-2)	Defines activation delay (0.0…300.0s) applied for delayed state (optional).
ROx_OFFDelay (x=1-2)	Defines deactivation delay (0.0…300.0s) applied for delayed state (optional).
ROx_DelayState (x=1-2)	1/0 = ON/OFF status of relay. The corresponding ON and OFF time delays are applied if they are defined.

FIO-11 Module data

You can find the general information of FIO-11 module by clicking on Information tab.

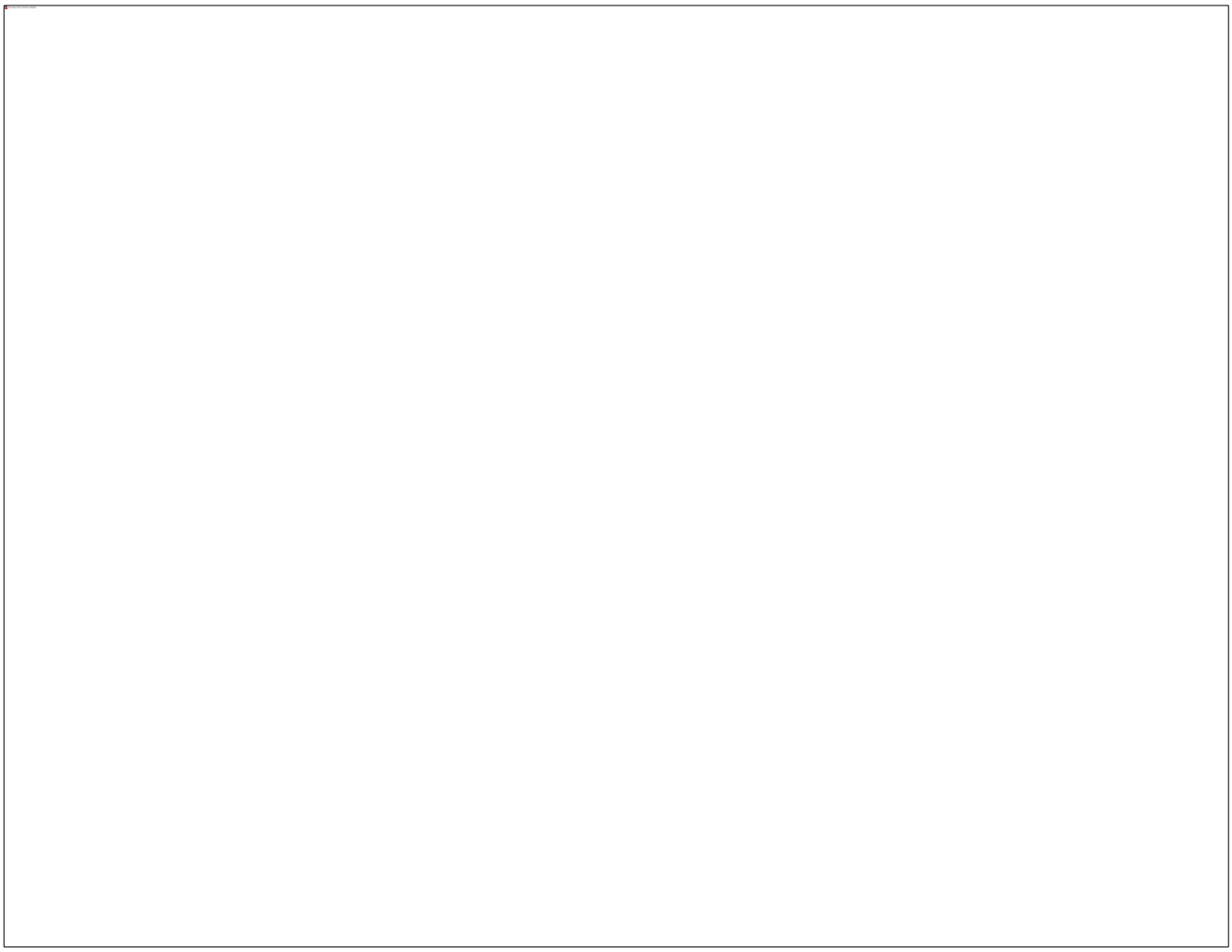


Figure 144 FIO-11 General information

FIO-11 Channel descriptions

Channel	Description
Status	0 = Not active 1 = Initializing state 2 = Active 3 = No communication
Control	0 = Inactivate 1 = Activates FIO-11 module
DIOx_FilterTime	Defines the filtering time constant (0.8…100.0ms). This time is applied for all filtered inputs (optional).

DIOx_ChDir (x=1,2)	0 = DIO is used as a digital output (default value). 1 = DIO is used as a digital input.
DIOx_Output (x=1,2)	1/0 = ON/OFF status of digital output if the channel is used as a output (ChDir = 0). The corresponding ON and OFF time delays are applied if they are defined.
DIOx_ONDelay (x=1,2)	Defines activation delay (0.0…300.0s) applied for digital input/output. This channel is optional.
DIOx_OFFDelay(x=1,2)	Defines deactivation delay (0.0…300.0s) applied for digital input/output. This channel is optional.
DIOx_FiltInput (x=1,2)	1/0 = ON/OFF status of digital input if the channel is used as a input (ChDir = 1). Filter time is applied if it is defined. Time delays are never applied.
DIOx_Input (x=1,2)	1/0 = ON/OFF status of digital input if the channel is used as a input (ChDir = 1). The corresponding ON and OFF time delays are applied if they are defined.
AOx_ForceSel	1 = A forced value is applied for an analog output (optional for testing purposes). 0 = Forcing is not in use.
AO1_FiltTime	Defines the filter time constant (0.000…30.000s). This time is applied for the filtered analog output. This channel is optional.
AO1_FiltMin	Defines the minimum output value for an analog output (0.000...22.000mA).
AO1_FiltMax	Defines the maximum output value for an analog output (0.000...22.000mA).
AO1_FiltMinScaled	Defines the real value (-32768.0…32767.0) that corresponds to the minimum output value (*AO1_FiltMin*). The source value is defined in *AO1_ScaledOut*.
AO1_FiltMaxScaled	Defines the real value (-32768.0…32767.0) that corresponds to the maximum output value (*AO1_FiltMax*). The source value is defined in *AO1_ScaledOut*.
AO1_ScaledOut	Defines the output source value.
AO1_ForceData	Defines the forced value that can be used instead of the output source value *AO1_ScaledOut*. This channel is optional. The forced value (0.000...22.000mA) is applied for *AO1_Actual* without checking the minimum or maximum output values. Filter time is not applied.

AO1_Actual	The actual analog output value (0.000...22.000mA). The value is same as in *AO1_Filtered* if forcing in not in use.
AO1_Filtered	The filtered and scaled analog output value (0.000...22.000mA).
AIx_ForceSel	0 = Forcing is not in use (optional for testing purposes). 1 = Force AI1 to a value of *AI1_ForceData*. 2 = Force AI2 to a value of *AI2_ForceData*. 3 = Force AI1 to a value of *AI1_ForceData* and AI2 to a value of *AI2_ForceData.* 4 = Force AI3 to a value of *AI3_ForceData*. 5 = Force AI1 to a value of *AI1_ForceData* and AI3 to a value of *AI3_ForceData.* 6 = Force AI2 to a value of *AI2_ForceData* and AI3 to a value of *AI3_ForceData.* 7 = Force AI1 to a value of *AI1_ForceData*, AI2 to value a of *AI2_ForceData* and AI3 to value of *AI3_ForceData*.
AIx_Unit (x=1-3)	Unit selection. This setting must match the corresponding hardware setting on the I/O extension module. 2 = V (Volts) 10 = mA (milliamperes)
AIx_Min (x=1-3)	Defines the minimum value for an analog input (-22.000...22.000mA or V).
AIx_Max (x=1-3)	Defines the maximum value for an analog input (-22.000...22.000mA or V).
AIx_MinScaled (x=1-3)	Defines the real value (-32768.0…32767.0) that corresponds to the minimum analog input value (*AIx_Min*).
AIx_MaxScaled (x=1-3)	Defines the real value (-32768.0…32767.0) that corresponds to the maximum analog input value (*AIx_Max*).
AIx_FiltTime (x=1-3)	Defines the filter time constant for the analog input (0.000…30.000s). This time is applied for analog inputs *AIx_Actual and AIx_Scaled.* This channel is optional.
AIx_FiltGain (x=1-3)	Selects the hardware filtering time for analog input. This channel is optional. (0 = no filtering, 1 = 125 us, 2 = 250 us, 3 = 500 us, 4 = 1 ms, 5 = 2 ms, 6 = 4ms, 7 = 7,9375 ms).
AIx_ForceData (x=1-3)	Defines the forced value that can be used instead of the true reading of input. This channel is optional. The forced value (-22.000...22.000mA or V) is applied for *AIx_Actual* without checking minimum or maximum values. Filter time is not applied.
AIx_Actual (x=1-3)	Displays the value of an analog input (-22.000...22.000mA or V).

AIx_Scaled (x=1-3)	Displays the value of an analog input (-22.000...22.000mA or V) after scaling.
AIx_Switch (x=1-3)	0 = Unit selection matches the corresponding hardware setting. 1 = Unit selection does not match the corresponding hardware setting.

FAIO-01 Module data

You can find the general information of FAIO-01 module by clicking on Information tab.

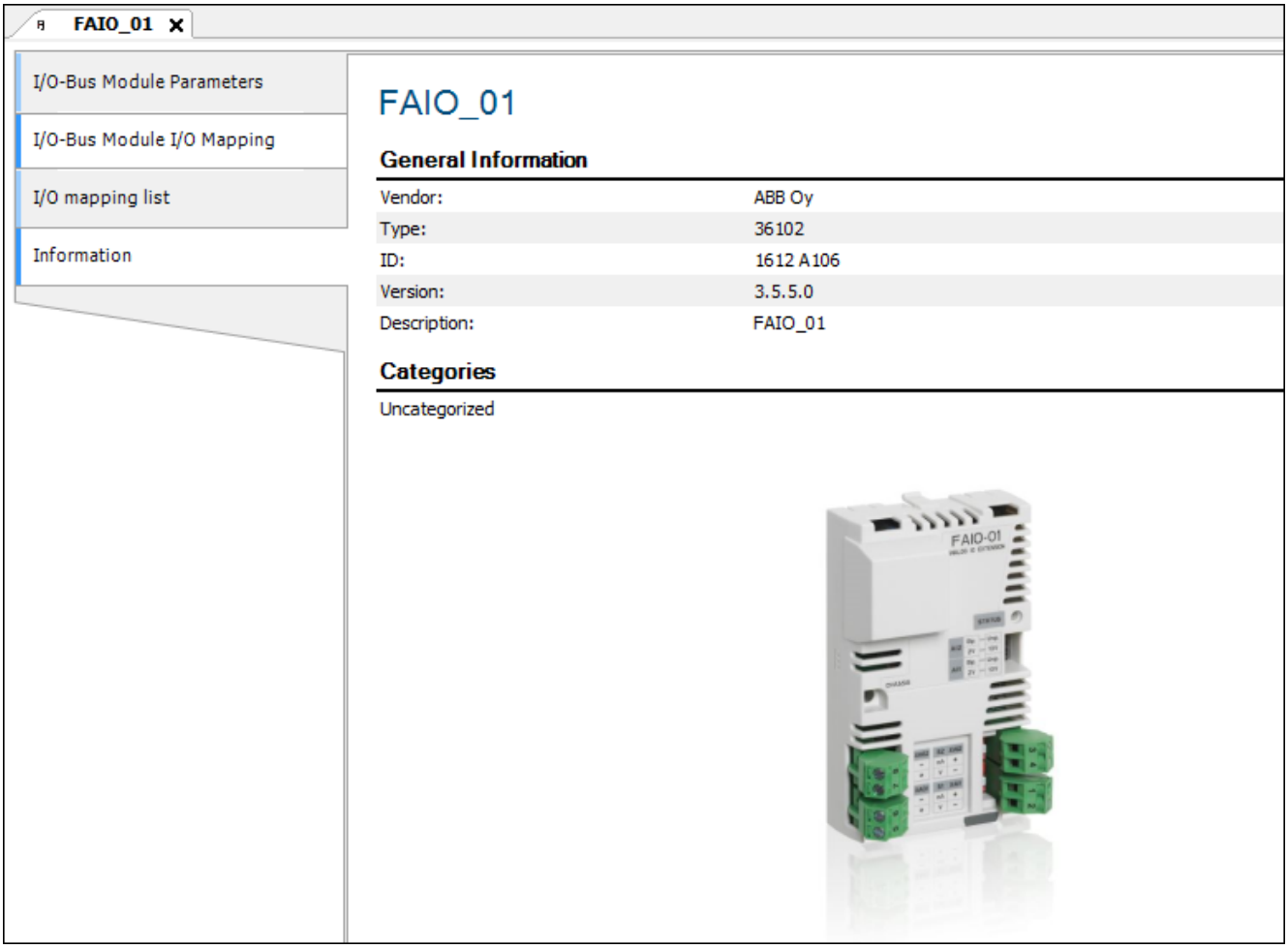


Figure 145 FAIO-01 General information

FAIO-01 Channel descriptions

Channel	Description
Status	0 = Not active 1 = Initializing state 2 = Active (successfully activated by Control) 3 = No communication
Control	0 = Inactivate

	1 = Activate FAIO-01 module.
AOx_ForceSel	0 = Forcing is not in use output (optional for testing purposes). 1 = *AO1_ForceData* is applied to an analog output *AO1_Actual*. 2 = *AO2_ForceData* is applied to an analog output *AO2_Actual*. 3 = Both *AO1_ForceData* and *AO2_ForceData* are applied.
AOx_FiltTime (x=1,2)	Defines the filter time constant (0.000…30.000s). This time is applied to the filtered analog output *AOx_Filtered* (optional).
AOx_FiltMin (x=1,2)	Defines the minimum output value to an analog output (0.000...22.000mA).
AOx_FiltMax (x=1,2)	Defines the maximum output value to an analog output (0.000...22.000mA).
AOx_FiltMinScaled (x=1,2)	Defines the real value (-32768.0…32767.0) that corresponds to the minimum output value (AOx_FiltMin). The source value is defined in *AOx_ScaledOut*.
AOx_FiltMaxScaled (x=1,2)	Defines the real value (-32768.0…32767.0) that corresponds to the maximum output value (AOx_FiltMax). The source value is defined in *AOx_ScaledOut.*
AOx_ScaledOut (x=1,2)	Defines the output source value.
AOx_ForceData (x=1,2)	Defines the forced value that can be used instead of the output source value *AOx_ScaledOut*, (optional). The forced value (0.000...22.000mA) is applied for *AOx_Actual* without checking the minimum or maximum output values. Filter time is not applied.
AOx_Actual (x=1,2)	The actual analog output value (0.000...22.000mA). The value is same as in *AOx_Filtered* if forcing is not in use.
AOx_Filtered (x=1,2)	The filtered and scaled analog output value (0.000...22.000mA).
AIx_ForceSel	0 = Forcing is not in use (optional for testing purposes). 1 = Force AI1 to the value of *AI1_ForceData*. 2 = Force AI2 to the value of *AI2_ForceData*. 3 = Force AI1 to the value of *AI1_ForceData* and AI2 to value of *AI2_ForceData*.
AIx_Unit (x=1,2)	Unit selection. This setting must match the corresponding hardware setting on the I/O extension module. 2 = V (volts) 10 = mA (milliamperes)
AIx_Min (x=1,2)	Defines the minimum value to an analog input (-22.000...22.000mA or V).
AIx_Max (x=1,2)	Defines the maximum value to an analog input (-22.000...22.000mA or V).
AIx_MinScaled (x=1,2)	Defines the real value (-32768.0…32767.0) that corresponds to the minimum analog input value (*AIx_Min*).

AIx_MaxScaled (x=1,2)	Defines the real value (-32768.0…32767.0) that corresponds to the maximum analog input value (*AIx_Max*).
AIx_FiltTime (x=1,2)	Defines the filter time constant to an analog input (0.000…30.000s). This time is applied for the analog inputs *AIx_Actual* and *AIx_Scaled,* (optional).
AIx_FiltGain (x=1,2)	Selects the hardware filtering time to an analog input, (optional). (0 = no filtering, 1 = 125 us, 2 = 250 us, 3 = 500 us, 4 = 1 ms, 5 = 2 ms, 6 = 4 ms, 7 = 7,9375 ms).
AIx_ForceData (x=1,2)	Defines the forced value that can be used instead of the true reading of the input, (optional). The forced value (-22.000...22.000mA or V) is applied for *AIx_Actual* without checking minimum or maximum values. Filter time is not applied.
AIx_Actual (x=1,2)	Displays the value of an analog input (-22.000...22.000mA or V).
AIx_Scaled (x=1,2)	Displays the value of an analog input (-22.000...22.000mA or V) after scaling.
AIx_Switch (x=1,2)	0 = Unit selection matches the corresponding hardware setting. 1 = Unit selection does not match the corresponding hardware setting.

Fault codes

If the F-series I/O configuration fails, a warning *A7AB Extension I/O configuration failure* is logged in the Event log.

Auxiliary codes	**Descriptions**
0x1000 – 0x1006	Application related F-series ExtIO configuration file is broken.
0x2000 – 0x2006	Task configuration error in configuration file.
0x2001	No enough communication capacity for requested module type and update times (fast cycle).
0x2002	No enough communication capacity for requested module type and update times (exceeded maximum allowed messages).
0x4000 – 0x4006	DDCS configuration error in configuration file.
0x4003	Unknown task id in DDCS configuration.

9

Libraries

Contents of this chapter

This chapter contains general information of libraries and description of the ABB drives system and standard libraries. You can find more detailed information in Appendix C: ABB drives system library and Appendix E: ABB drives standard library.

Library types

The following libraries are installed by default in Automation Builder for drive programming.

Default libraries:

- ABB drives system library (AY1LB_System_ACS880_V3_5)
- ABB drives standard library (AS1LB_Standard_ACS880_V3_5).

Optional libraries:

- All generic Automation Builder IEC libraries (standard and util) can be installed, but ABB does not guarantee their correct functioning. Note the data type limitations described in *Data types*).

The Library Manager controls and manages the library usage in the project. Each project has its own Library Manager which is added by default when you create a new project.

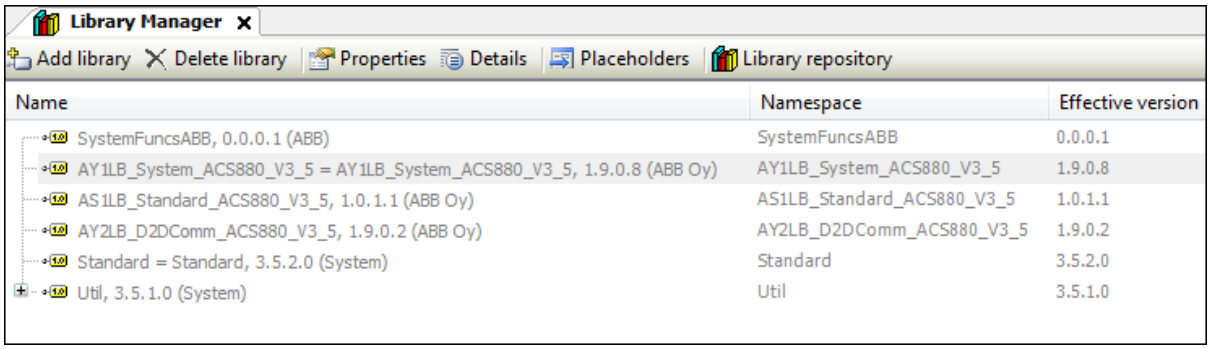


Figure 146: Library Manager

ABB drives standard library contains the most common and useful functions and function blocks for drive control. All the functions are implemented locally using structured text language. The automation builder and standard libraries include additional general purpose functions.

ABB drives system library includes all the drive-specific functions to interface the application with the drive firmware and I/O interface. This library has external implementation in the drive system software.

Note: Make sure the drive has the corresponding system library installed:

1. In the Drive composer pro **System info**, select **More** in **Products**.
2. Check that the Application System Library displayed in the Drive composer pro has the same library version as the Automation Builder project. If the versions are not matching, part of the library may be incompatible.

Adding a library to the project

To add a Library Manager (library container) to the project:

1. In the Devices tree, right-click **Application** and select **Add object**.
2. In the Add object window, select **Library Manager** and click **Add object**.
3. Double-click **Library Manager**. Library Manager window is displayed.

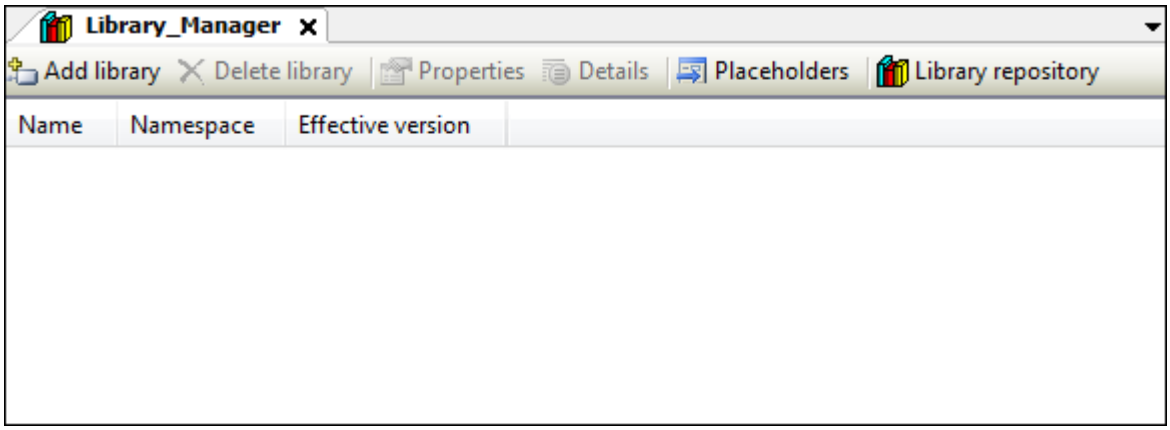


Figure 147: Library manager

4. Click **Add library** to add library.

5. In the Add Library window, click **Advanced**.

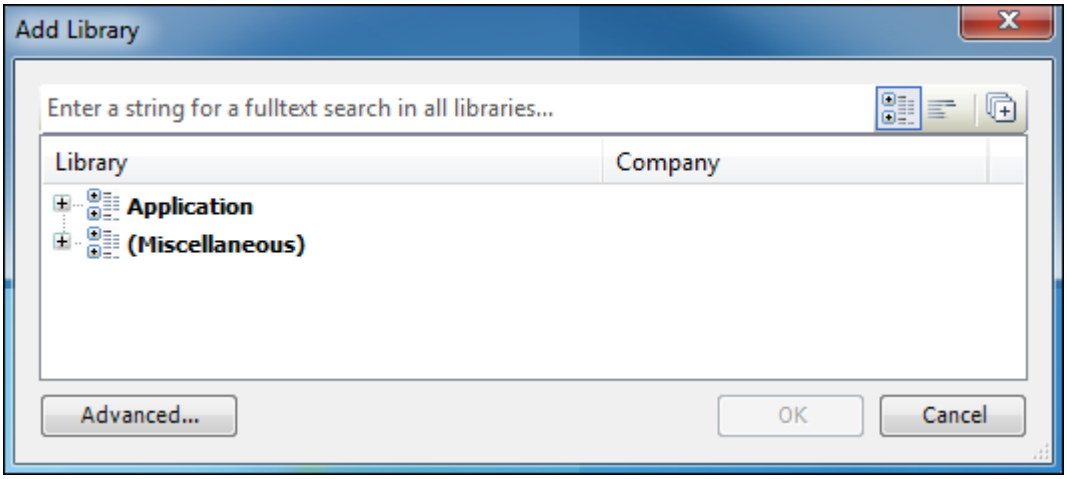


Figure 148 Advanced option

6. Select the required library and click **OK**.

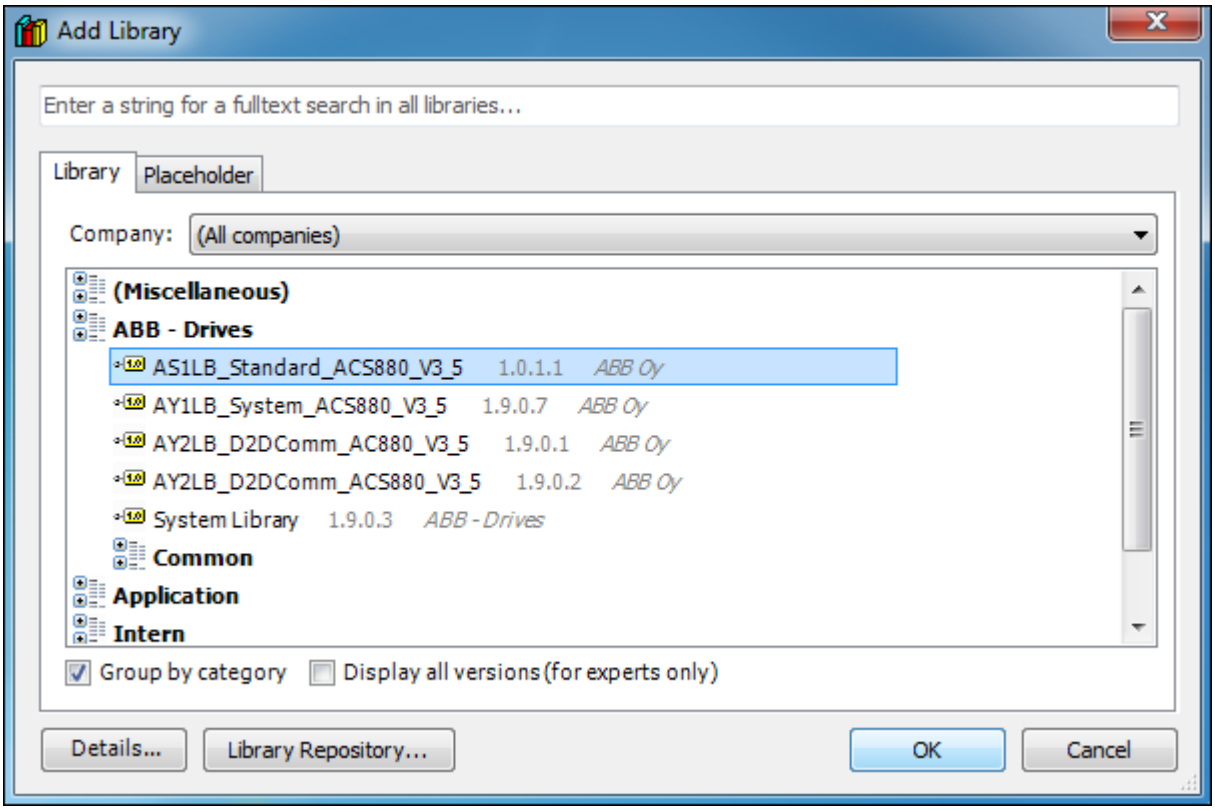


Figure 149: Add library

The selected library is added successfully.

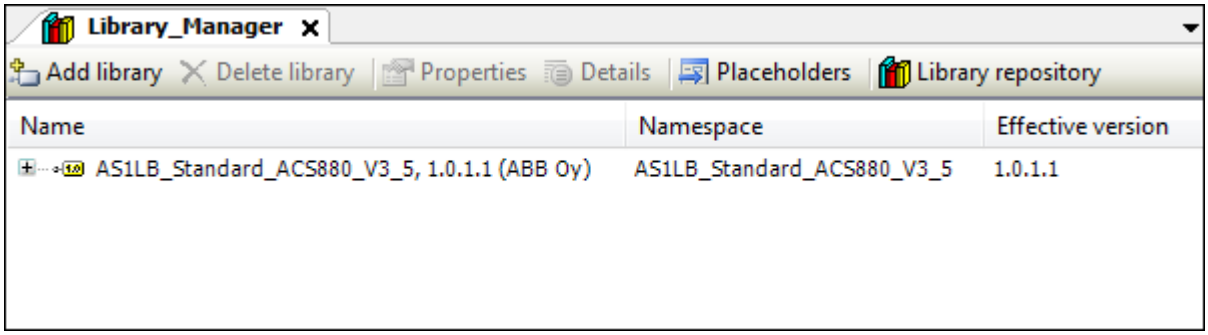


Figure 150: New library added in Library Manager

Note: To make SFC language programs or functions, the IeCSfc system library must be available in the project.

Creating a new library

The application programming environment allows you to create your own libraries to be used in the projects. After starting the programming environment, a new library can be created with the New Project dialog.

1. In the New Project dialog box, click **Empty project**, type the library **Name** and **Location**, then click **OK**.

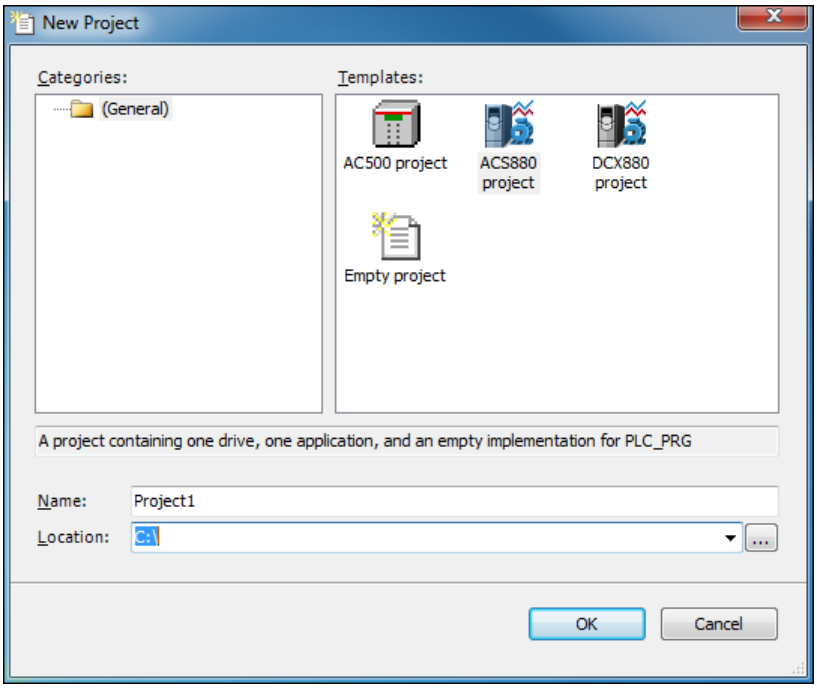


Figure 151: Creating a new library

   The new library is added into the POUs tree.

2. To add a new POU into the created library, select **POUs** in the **View** menu.
3. Right-click on project name, select **Add Object** -> **POU**.
4. Give the new POU a name, for example, POU1.
5. Select the type of the POU, for example, **Function Block** and the implementation language, for example, **Structured Text (ST)** and then click **Add**.
6. Open the created POU and add the following code into the variables declaration window:

```
FUNCTION_BLOCK POU1

VAR_INPUT
    DI1 : BOOL;
END_VAR

VAR_OUTPUT
    RO1 : BOOL;
END_VAR

VAR
    prev_DI1_value : BOOL;
END_VAR
```

Figure 152: Variables declaration window

Add the following code into the code area:

```
IF DI1 = FALSE AND prev_DI1_value = TRUE THEN
    RO1 := NOT(RO1);
END_IF

prev_DI1_value := DI1;
```

Figure 153: Code area

7. After the code is added all library objects must be checked before the library export. On the **Build** menu, select **Check all Pool Objects**.
8. To use the created library in the future, select **Project -> Project Information** and fill in the following information on the created project: company, title and version.

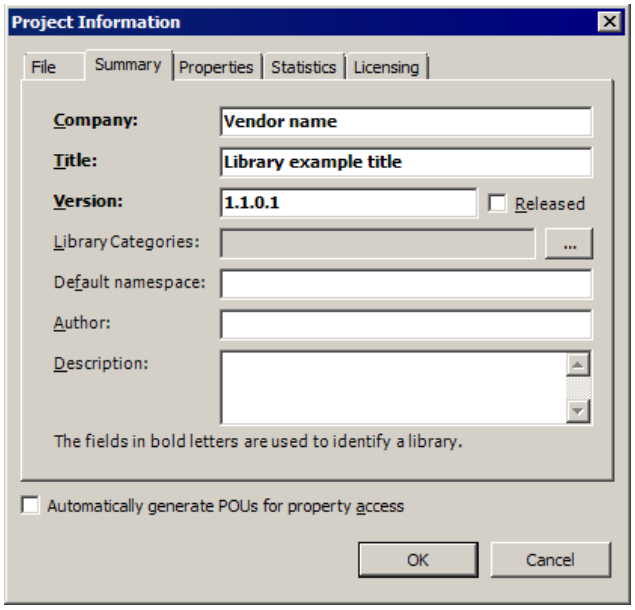


Figure 154: Project information

9. After the information is added, it is possible to install this library directly to the Library Repository. On the **File** menu, select **Save Project and Install into Library Repository**.

   Or

10. To save the library as a usual file, select **Save Project as**… on the **File** menu.

    Or

11. To save the library as a compiled library file, select **Save Project as Compiled Library** on the **File** menu.

Note: To protect the library source code, you must use a compiled library file. The non-compiled library format does not protect the source code.

Installing a new library

If the needed library is not in the repository, it must be installed before use.

To install a new library, follow these steps:

1. Open **Library Manager** and click **Add library**.
2. In the Add Library window, click **Advanced**.
3. Click **Library Repository**.

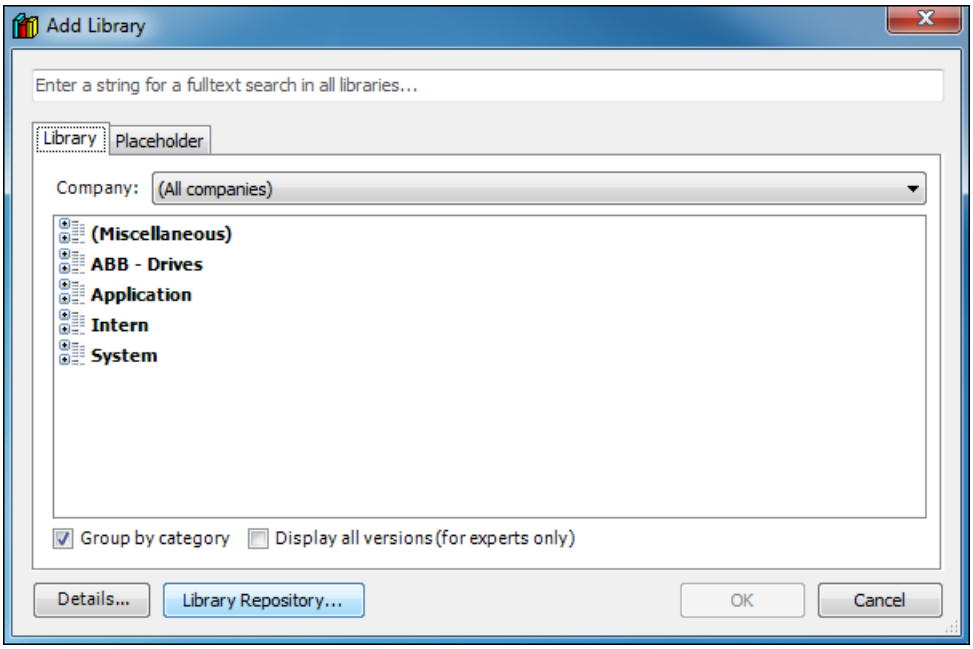


Figure 155 Library repository

4. In the Library Repository window, click **Install**.

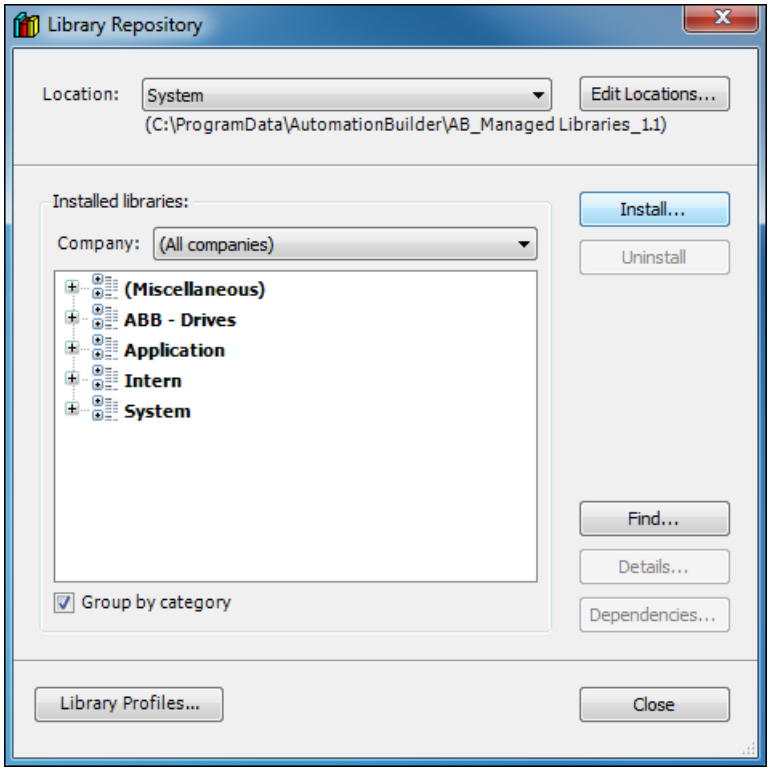


Figure 156 Installing library

5. Browse/select the required compiled library and click **Open**.

   A new library is installed into the Library Repository and is ready for use in the project.

Managing library versions

Automation Builder allows you to use different versions of the selected library according to project requirements.

To change the current effective library version:

1. Open **Library Manager**.
2. Select the required library and click the **Properties**.

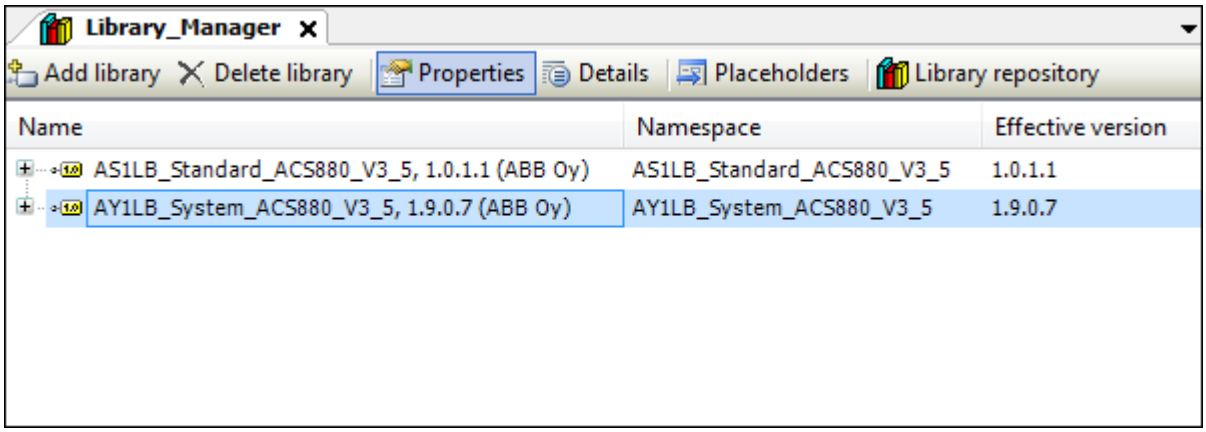


Figure 157 Library manager properties

3. Select the **Specific version** in the drop-down list and click **OK**.

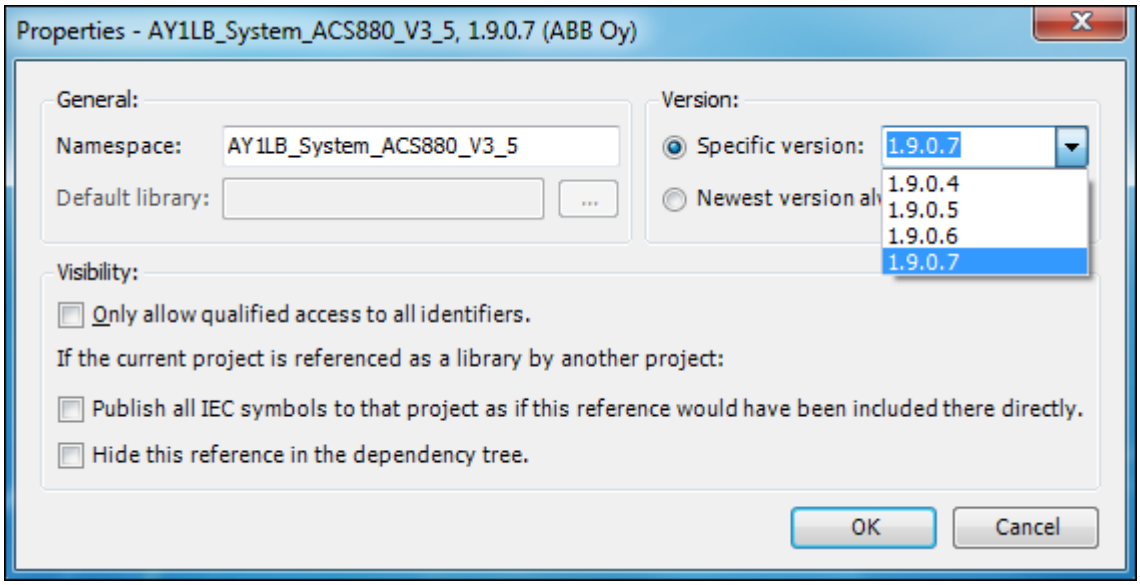


Figure 158: System library version

The library version is changed and can be used in the project.

If you want to add a new library version that is not in the **Specific version** list, install the version first. See section *Installing a new library*.

10

Practical examples and tips

Contents of this chapter

This chapter gives practical examples and tips on working with Automation Builder.

Solving communication problems

Follow the instructions when the scan network does not find any drives.

a. Check the communication settings.

b. In Windows **Computer Management** -> **Device Manager**, check that your communication port is correctly installed.

c. If the USB Serial Port (COMX) is not displayed under Device Manager, check that the corresponding USB/communication port driver is installed.

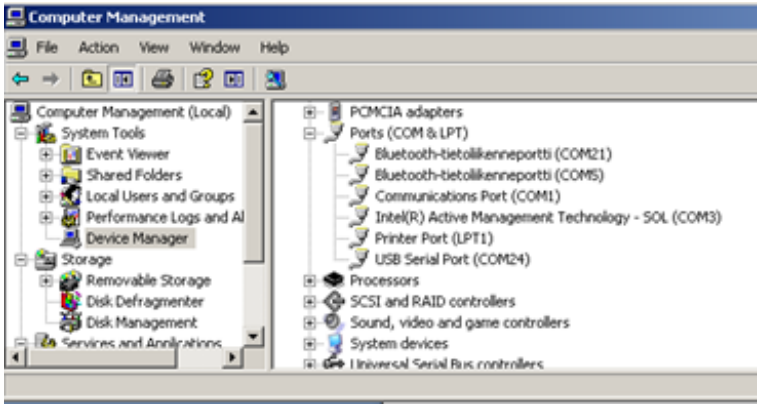


Figure 159: Checking communication port installation

d. To check that the OPC server (DriveDA.exe) has started in Windows Task Manager, select Ctrl + shift + esc **-> Processes**.

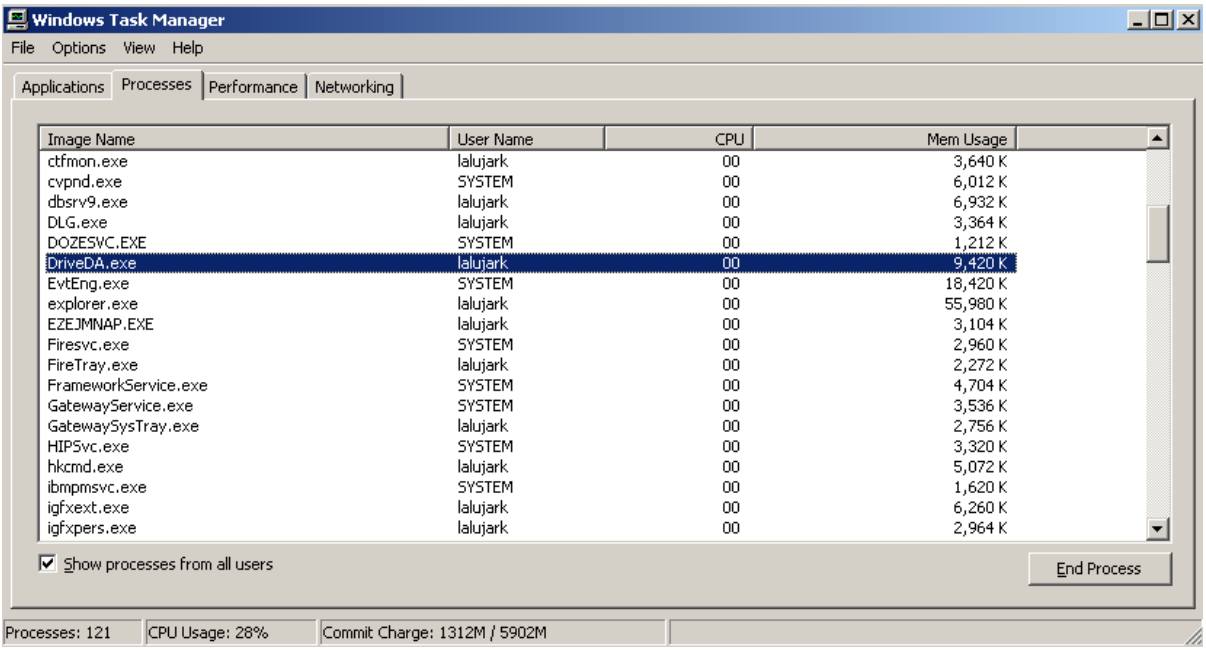


Figure 160: Checking OPC server in Windows task manager

e. Check that Drive composer pro (Drive OPC) finds the connection to the drive.

Note: You must allow Automation Builder to share communication with Drive composer pro.

To work in parallel with Drive composer pro, you must do the register setting of DriveDA OPC server. This register setting is not included in the installation setup of Automation builder version 1.2.2.

For details on how to allow Automation Builder to share communication with Drive composer pro, see chapter *Setting up the programming environment*.

The reinstallation of the Drive composer pro adds a new InprocServer object to the registry.

Figure 161: Registry

Follow the instructions when the communication fails while establishing online connection to the drive.

a. Check the Firewall settings in your PC that may block connections to devices. ABB Automation Builder needs port 1217 for connecting to the gateway.

b. If multiple nodes are displayed, it can mean that ProxyRTS is started twice or that the IP address is not set as localhost (should not be possible to change).

To resolve this proxy issue, follow these steps:

i. In Windows task manager, close **DriveDA.exe.**
ii. From the **Online** menu in Automation Builder, select **Restart ProxyRTS**.

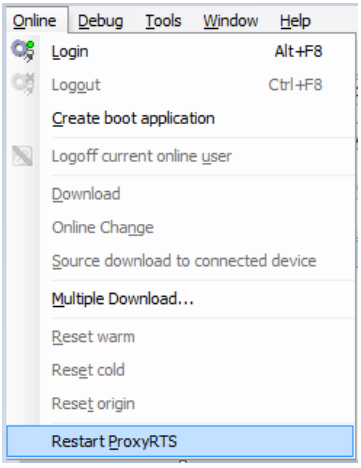


Figure 162: Restart ProxyRTS

Follow the instructions when the communication fails between Automation Builder/Drive composer pro and drive.

- Check the control panel version to be newer than the version in the below screen.

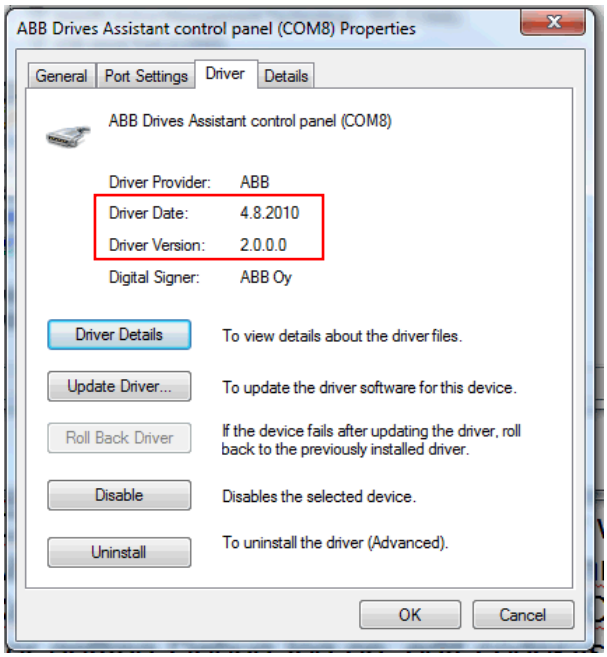


Figure 163: Control panel driver details

- Check the Driver date.

Note: The next panel driver version is not known. For version details, refer the corresponding ACS880 drive software release notes or contact your ABB representative.

Solving other problems

Question: How to prevent unauthorized access to an application that is running in the drive?

Answer

A compiled project as well as the downloaded source code can be password protected. You can make a backup copy of the protected application. The backup copy is encrypted and you need a password for downloading or executing the copied application. The IEC function libraries and projects can be protected as well by means of automation builder.

Question: How to fix an unknown device in a project?

Answer

Install the desired device description to the device repository if you do not have it already. Then upgrade the device in the project to the newly installed one, by right-clicking the device in the project and selecting **Update Device…**.

Question: How to remove a boot application from the flash memory card?

Answer

Select **Online -> Reset origin**. Note that this removes the application permanently from the drive. Ensure that you have the source project available.

Question: What to do when I continuously receive “The project handle 0 is invalid” error message?

Answer

There are two ways to get rid of the error:

- Select **Window** -> **Close All Editors** and then restart automation builder.
- Save the project into a new empty folder.

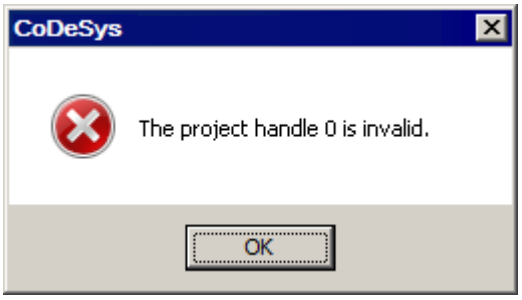


Figure 164: Error message “The project handle 0 is invalid”

Question: What to do when stack overflow fault 6487 occurs?

- If stack overflow fault 6487 occurs, the number of the local variables inside a function is too large. Unfortunately the limit of the local variables is relatively small. The stack usage is high especially if there are, for example, division operands inside the EXPT function.
- Also if the division function's divider is zero (an exceptional case), the stack usage is high.

Answer

Do not make big functions. Try to make a compact function with a limited number of the variables (40 REAL). If the function is too large, change some of the local variables to global variables (use, for example, multiple global variable lists GVL to group variables by functions). Consider to use function blocks or program modules instead of functions.

Question: How to optimize the memory usage of the drive application?

The code memory of the application is running out. How to optimize the program?

Answer

The drive application programming environment has relatively limited memory and execution capacity. There are a couple of tips to minimize the program code:

- Use functions as much as possible.

Note: If there are many variables inside the function, the risk of stack overflow increases.

- Try to design the application so that you do not need to create many instances of big function blocks. Instead of function blocks use programs or functions.
- Use DriveInterface to access drive parameters instead of the parameter read / write functions

Question: How to solve the problem causing error message "Creating boot application failed: Adding Application Parameters & Groups to UFF generator: XmlDeserializationFailed"?

Answer

This problem is related to Application parameters and events module

- Check that all Value pointer, Bit pointer and Plain value list type of parameters have the correct Selection List.
- Check that the Bit list (16 bit) parameters do not have same Bit names (English) multiple times (for example, text Bit_Handle_0 occurs twice).
- Check the tool message box for details.

11

Appendix A: Incompatible features between ACS880 Drive and AC500 PLC IEC programming

Contents of this chapter

This chapter lists the features that are not compatible between ACS880 Drive and AC500 PLC IEC programming V3 and V2.3.

Incompatible features

- Unlike the newer V3, V2.3 does not allow functions to have multiple outputs, thus the VAR_OUTPUT or VAR_IN_OUT tags cannot be included in the description part of functions. Converting the function into a function block solves this issue and provides an identical interface on both platforms at the cost of additional memory usage.
- Single-line comments “//” are not supported in V2.3. Use block comments instead “(*…*)”.
- Array initialization has different syntax. For this reason, it is not possible to have code that initializes an array to non-default values at declaration that is suitable for both versions. This can be solved by writing values to the array once right after the code is called.
- Boolean operations are not allowed for integer types other than BYTE, WORD and DWORD in V2.3.
- Namespaces are not supported in V2.3.
- At least one statement is required for IF, ELSEIF and ELSE instructions in V2.3.

- References are not supported in V2.3. Assigning a value directly instead of a reference can eliminate this limitation.
- Unions are not available in V2.3.
- Indexed access to variable pointers is not allowed in V2.3. For this reason, a pointer to the first element of an array cannot be used to access elements. Instead, the pointer needs to be declared as a pointer to an array of elements. For example:
  a. ptr: POINTER TO ARRAY[0..10] OF REAL
  b. instead of ptr: POINTER TO REAL; to access ptr[5]
- In the newer V3, {attribute ‘hide_all_locals’} is used to hide local variables, whereas V2.3 {library private} is used. These pragmas can be combined to produce code that works in both programming environments (only a warning is produced).

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Appendix B: Unsupported features

The ACS880 and DCX880 drives do not support the following standard IEC programming V3 features:

- Persistent variable type is not supported. In case the variable is saved over power cycle, retain variable is used. Also, user defined drive parameter can be created to save value of the variable.
- Target-based tracing. You can use the Monitor feature in Drive composer pro. See *Drive composer user's manual* (3AUA0000094606 [English]).
- Some data types are not supported.
- The number of program execution tasks are limited to 4. One of the task is a pre task which is executed only once after power up. Other tasks are cyclically executed.
- Program code simulation is not supported.
- Target based visualization is not supported.

13

Appendix C: ABB drives system library

Contents of this chapter

This appendix contains detailed information of the function blocks of the ABB drives system library (AS1LB_Standard_ACS880_V3_5)

Introduction to ABB drives system library

The ABB drives system library is intended to be used with the ACS880 drives. It provides event, parameter read/write and program time level function blocks for application programming in the automation builder environment. The description of the features in this document is based on the ABB drives system library version 1.9.1.0.

Note: Using the Drive composer pro System info, check that the drive has the corresponding system library installed. In the **System info**, the system library version is located under the **Products/ More** view. The system library versions must be the same in the drive and the application program project.

Function blocks of the system library

Function block name	Description
Event function blocks	
EVENT	Send the application event.
ReadEventLog	Read the drive's faults and warnings.
Parameter change function blocks	
PAR_UNIT_SEL	Changes the unit of a parameter.
PAR_SCALE_CHG	Changes the parameter scaling attributes.
PAR_LIM_CHG_DINT	Changes the limits of a parameter in DINT data format.
PAR_LIM_CHG_REAL	Changes the limits of a parameter in REAL data format.
PAR_LIM_CHG_UDINT	Changes the limits of a parameter in UDINT data format.
PAR_DEF_CHG_DINT	Changes the default values of a parameter in DINT data format.
PAR_DEF_CHG_REAL	Changes the default values of a parameter in REAL data format.
PAR_DEF_CHG_UDINT	Changes the default values of a parameter in UDINT data format.
PAR_DISP_DEC	Changes the decimal display of a parameter.
PAR_REFRESH	Notifies PC tools and panel of any parameter attribute changes.
Parameter protection	
PAR_PROT	Protects individual parameters.
PAR_GRP_PROT	Protects a parameter group.
Parameter read function blocks	
ParReadBit	Read the value of a bit in a packed-Boolean-type parameter.
ParRead_DINT	Read the value of a DINT/INT type parameter.
ParRead_REAL	Read the value of a REAL type parameter.
ParRead_UDINT	Read the value of a UDINT/UINT type parameter.
Parameter write function blocks	
ParWriteBit	Write the value to a bit of a packed-Boolean-type parameter.
ParWrite_DINT	Write the value to a REAL/DINT/INT type parameter.
ParWrite_INT	Write the value to an INT/DINT/REAL type parameter.
ParWrite_REAL	Write the value to a REAL type parameter.

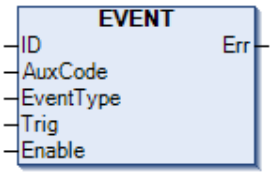
Function block name	Description
ParWrite_UDINT	Write the value to an UDINT/UINT type parameter.
Pointer parameter read function blocks	
ParRead_BitPTR	Read the pointed bit value from a bit pointer type parameter.
ParRead_INT	ParRead_INT reads the value of a INT/DINT/REAL type of parameter.
ParRead_ValPTR_DINT	Read the pointed DINT/INT value from a value pointer type parameter.
ParRead_ValPTR_REAL	Read the pointed REAL value from a value pointer type parameter.
ParRead_ValPTR_UDINT	Read the pointed UDINT/UINT value from a value pointer type parameter.
Set pointer parameter function blocks	
ParSet_BitPTR_IEC	Set a bit pointer parameter to point to a bit type IEC variable.
ParSet_ValPTR_IEC_DINT	Set a value pointer parameter to point to a DINT type IEC variable.
ParSet_ValPTR_IEC_REAL	Set a value pointer parameter to point to a REAL type IEC variable.
ParSet_ValPTR_IEC_UDINT	Set a value pointer parameter to point to an UDINT type IEC variable.
ParSet_BitPTR_Par	Set a bit pointer parameter to point to a bit of a packed Boolean parameter.
ParSet_ValPTR_Par	Set a value pointer parameter to point to a value parameter.
Task time level function block	
UsedTimeLevel	Show time level (ms) of the program where the function block is located.

Event function blocks

EVENT

Summary

The application event function block is used to trigger a predefined event (fault/warning/pure) from the IEC code. The event is registered to drive event logger.



Connections

Inputs

Name	Type	Value	Description
ID	WORD	0xE100.. 0xE2FF	Identification of the event (constant, cannot be changed on run time). This is a unique value of the event. You can find the supported values in the ApplicationParametersAndEvent tool. A certain range is reserved for each application event type. Faults: 0xE100…E1FF Warnings: 0xE200.. 0xE2FF
AuxCode	DWORD	ANY	The auxiliary code that you can set freely (constant).
EventType	WORD	1,2	Type of the event (constant, cannot be changed on run time). Supported event types: Fault = 1, Warning = 2, Pure = 8 (Notice is not supported).
Trig	BOOL	T/F	The high level (TRUE) of this pin sends/activates the event, if Enable is set to TRUE. Warning is deactivated automatically, when Trig falls down. To clear the fault, give the reset command.
Enable	BOOL	T/F	Enable/disable event sending.

Outputs

Name	Type	Value	Description
Err	WORD	ANY	The value is typically 0x0000. 0x0001 = Not used 0x0002 = Event is not user-defined event 0x0003 = Event type error 0x0004 = Event ID type error 0x0005 = Not used 0x0006 = Unknown event type

Description

You can configure an application event with the ApplicationParametersandEvents in Automation Builder tool. (See *Application parameter and event creation*). This tool defines the ID and the event text (description).

Automation Builder supports the following event types: Fault, Warning and Pure.

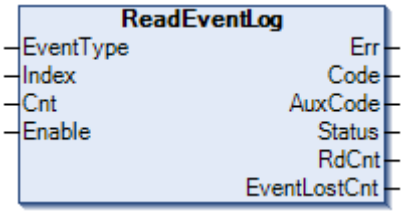
The event ID, text, auxiliary code, time and operation data is registered into the drive event logger. The application events can be shown using the ACS-AP-x control panel and Drive composer tools, or using the ReadEventLog block on the application level. A fault can be reset, for example, using the control panel or Drive composer pro tool.

Note: The current firmware supports execution of three event functions in the same task cycle. If there are more event functions, do not enable all of them at the same time.

ReadEventLog

Summary

ReadEventLog is a special block for reading faults and warnings from the drive event system. The block does not read events or use the drive event or fault loggers. Instead it gets the events straight from the event system itself.



The purpose of the block is to forward drive events, for example, to external systems, like automation user interfaces.

Inputs

Name	Type	Value	Description
EventType	UINT	0	Not used. The block returns the drive's faults and warnings. Can be set to 0.
Index	UINT	0	Not used. Can be set to 0.
Cnt	UINT	0…6	Number of the wanted events at a time. (0…6)
Enable	BOOL	T/F	Enable / disable the block execution. The falling edge of this pin clears all the output vectors.

Outputs

Name	Type	Value	Description
Err	UINT	N/A	Not used.
Code	Array of UINT[10]	Any of allowed events codes	Event code (ID). The block supports maximum 6 events at a time.
AuxCode	Array of UINT[10]	ANY	Auxiliary code of the event.
Status	Array of UINT[10]	ANY	Status of the event. 1 = The event has been activated. 2 = The event has been deactivated. 3 = Acknowledgement requested. 4 = The event is reactivated (warnings). 5 = All faults have been deactivated.
RdCnt	UINT	0…6	The number of the get/read events at a time. Maximum 6 RdCnt value = 0 indicates that there are no new

			events.
EventLostCnt	UINT	ANY	The number of the lost events (for monitoring).

Note: The current firmware supports execution of three event functions in the same task cycle. If there are more event functions, do not enable all of them at the same time.

It is recommend to use event blocks only on the tasks which cycle time setting is higher than 50ms.

Description

The block packs the event *Code*, *AuxCode* and *Status* to vectors that the user can read. The block does not sort faults and warnings from each other. The 1st event in the vector is the oldest one.

The block returns the maximum *Cnt* number of events in each execution cycle depending on how many events exist at this time on the drive. *RdCnt* indicates how many events are got in each execution cycle. The vectors and *RdCnt* are updated in every execution cycle if new events exist. For this reason, only the value of *RdCnt* matters when reading the event data from vectors. The older events are overwritten by the newer ones.

Example:

In the 1st execution cycle, the user reads 2 events, for example, events 11, 12 (*RdCnt* = 2). Both are valid. 12 is the last one.

In the 2nd execution cycle, the user reads 1 event, for example, 21 (*RdCnt* = 1).

Now values 21, 12 can be seen in the *Code* vector, but because *RdCnt* is 1, only the first value is valid (21). (12 read in the previous cycle.)

Vectors are cleared only on the falling edge of the *Enable* pin.

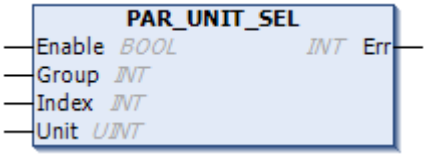
EventLostCnt indicates the number of the lost events. The value should be 0. In the opposite case, the reason can be too slow execution cycle of this block.

Note: The execution cycle of this block is slow. To optimize the application resources, it is recommended to use only one instance of this block.

Parameter change function blocks

PAR_UNIT_SEL

Summary



PAR_UNIT_SEL block enables changing the unit of a parameter from the IEC application. If one parameter of the family parameter is changed using this block, the change applies to all other parameters of that parameter family.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables unit change at the rising edge
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Unit	UNIT	128…255	Unit selection

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The rising edge of *Enable* input implies the unit change of a parameter. *Group* and *Index* define the parameter to be changed and *Unit* defines the unit of the parameter. The unit strings and corresponding codes are defined in the Automation Builder, ApplicationparameterandEvents manager (APEM). The units in the range of 128 to 255 only can be changed using this function block.

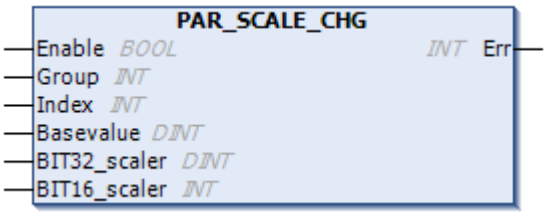
Note: Use only the units defined in APEM. Selecting undefined units are not notified by the *Err* output.

Err returns an error code if there is an error during a unit change, for example, the unit for change is beyond the selection range. If the unit selection and change operation is successful, *Err* returns a 0.

PAR_SCALE_CHG

Summary

PAR_SCALE_CHG block enables changing the parameter scaling attributes from the IEC application. Initial scaling values are defined in the Parameter family settings.



Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables scale change at the rising edge
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Basevalue	DINT	128…255	Scales internal value to external 32 or 16 bit interface. Used as divider.
BIT32_scaler	DINT	ANY	Scaling factor for external 32 bit interface in panel (ACS-AP-I), DriveComposer and fieldbus interface. The value is used as a multiplayer.
BIT16_scaler	INT	ANY	Scaling factor for external 16 bit interface for fieldbus interface. The value is used as a multiplayer.

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

This function block enables changing the parameter scaling factor that scales the internal value for DriveComposer-tool, ACS-AP-I panel and fieldbus interface. The initial values of the scaling factors are defined in ApplicationparameterandEvents manager (APEM) for all user parameters. The changed parameter scaling applies to all parameters of a specific family (scaling) defined in APEM.

The rising edge of *Enable* input implies the parameter scaling change. *Group* and *Index* define the parameter to be changed. The *Basevalue* scales the internal value to external 32 or 16 bit interface.

The *BIT32_scaler* and *BIT16_scaler* are used as scaling interfaces.

The *Err* output returns an error code if there is an error during the scaling change operation. If the scaling changes are successful, *Err* returns a 0.

External 32-bit scaling

This is used by (ACS-AP-I), Drive Composer and PLC over fieldbus adapter. If the parameter type is REAL, the number of decimals influence the scaling defined in ApplicationparametersandEvents manager or the PAR_DISP_DEC block.

If external value is requested as 32-bit integer, the internal float is scaled to external float with the same scaling factor and then converted to 32 bit integer with extra numbers for decimal values,

depending on the display format of decimals. For example: The value 1.23456 is displayed as 1.235 if the display format is 3 decimals.

Scaling formula:

$$External\_value(32\ bit) = \frac{BIT32\_scaler \times 10^{(Decimals)}}{Basevalue} \times IEC\_program\_variable(internal\ value)$$

External 16-bit scaling

This scaling is used only for fieldbus interface to fit internal value with higher number of bits to the 16 bit scale. The 16 bit external value uses its own scaling factor with no display format for decimals.

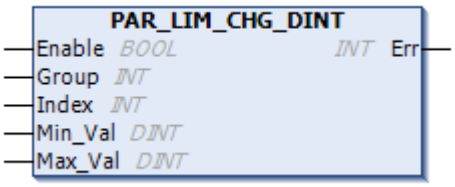
Scaling formula:

$$External\_value(16\ bit) = \frac{BIT16\_scaler}{Basevalue} \times IEC\_program\_variable(internal\ value)$$

Parameter limit change

PAR_LIM_CHG_DINT

Summary



The PAR_LIM_CHG_DINT block enables changing the minimum and maximum values (in DINT data format) of a parameter from the IEC application. The changes in the limit values apply to all parameters belonging to same parameter family defined in APEM.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables changing parameter limits at the rising edge
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Min_Val	DINT	ANY	New minimum value in DINT data format
Max_Val	DINT	ANY	New maximum value in DINT data format

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The rising edge of *Enable* input implies the changed parameter limit values. *Group* and *Index* define the parameter to be changed. The *Min*_Val and *Max*_Val are used to set the new minimum and maximum values of the parameter respectively.

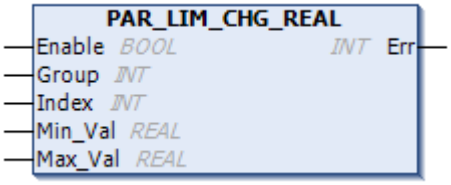
Note: Ensure the following conditions while defining the minimum and maximum values:

- The *Min_Val* must be greater than *Max_Val*.
- The *Max_Val* must be lesser than *Min_Val*.
- *Min_Val* should not be equal to *Max_Val*.

Err returns an error code if there is an error during the limits changes operation, for example, the new limits are beyond the range. If the change operation is successful, *Err* returns a 0.

PAR_LIM_CHG_REAL

Summary



The PAR_LIM_CHG_REAL block enables changing the minimum and maximum values (in REAL data format) of the parameter from the IEC application. The changes in the limit values apply to all parameters belonging to same parameter family defined in APEM.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables changing parameter limits at the rising edge
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Min_Val	REAL	ANY	New minimum value in REAL data format
Max_Val	REAL	ANY	New maximum value in REAL data format

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The rising edge of *Enable* input implies the changed parameter limit values. *Group* and *Index* define the parameter to be changed. The *Min*_Val and *Max*_Val are used to set the new minimum and maximum values of the parameter respectively.

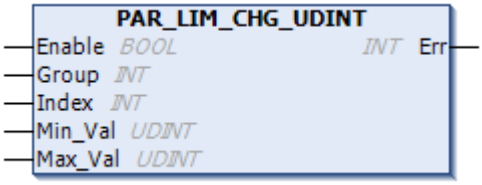
Note: Ensure the following conditions while defining the minimum and maximum values:

- The *Min_Val* must be greater than *Max_Val*.
- The *Max_Val* must be lesser than *Min_Val*.
- *Min_Val* should not be equal to *Max_Val*.

Err returns an error code if there is an error during the limits changes operation, for example, the new limits are beyond the range. If the change operation is successful, *Err* returns a 0.

PAR_LIM_CHG_UDINT

Summary



The PAR_LIM_CHG_UDINT block enables changing the minimum and maximum values (in UDINT data format) of a parameter from the IEC application. The changes in the limit values apply to all parameters belonging to same parameter family defined in APEM.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables changing parameter limits at the rising edge
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Min_Val	UDINT	ANY	New minimum value in UDINT data format
Max_Val	UDINT	ANY	New maximum value in UDINT data format

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The rising edge of *Enable* input implies the changed parameter limit values. *Group* and *Index* define the parameter to be changed. The *Min*_Val and *Max*_Val are used to set the new minimum and maximum values of the parameter respectively.

Note: Ensure the following conditions while defining the minimum and maximum values:

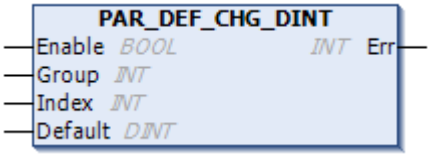
- The *Min_Val* must be greater than *Max_Val*.
- The *Max_Val* must be lesser than *Min_Val*.
- *Min_Val* should not be equal to *Max_Val*.

Err returns an error code if there is an error during the limits changes operation, for example, the new limits are beyond the range. If the change operation is successful, *Err* returns a 0.

Parameter default value change

PAR_DEF_CHG_DINT

Summary



The PAR_DEF_CHG_DINT block enables changing the default values (in DINT data format) of a parameter from the IEC application. The value changes apply to all parameters of that specific parameter family defined in APEM.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables changing the default value of a parameter at the rising edge
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Default	DINT	ANY	New default value in DINT data format

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

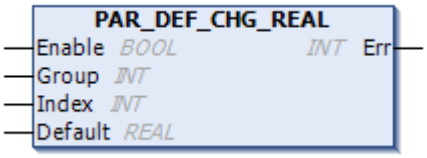
The rising edge of *Enable* input implies the changed parameter default values. *Group* and *Index* define the parameter to be changed. The input *Default* is used to set the new default value of the parameter.

Note: Define a default value within the minimum and maximum value.

Err returns an error code if there is an error during the change operation. If the default value change operation is successful, *Err* returns a 0.

PAR_DEF_CHG_REAL

Summary



The PAR_DEF_CHG_REAL block enables changing the default values (in REAL data format) of a parameter from the IEC application. The value changes apply to all parameters of that specific parameter family defined in APEM.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables changing the default value of a parameter at the rising edge
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Default	REAL	ANY	New default value in REAL data format

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

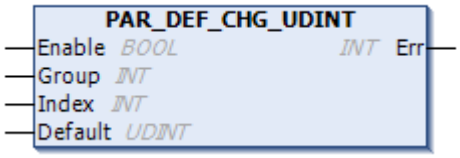
The rising edge of *Enable* input implies the changed parameter default values. *Group* and *Index* define the parameter to be changed. The input *Default* is used to set the new default value of the parameter.

Note: Define a default value within the minimum and maximum value.

Err returns an error code if there is an error during the change operation. If the default value change operation is successful, *Err* returns a 0.

PAR_DEF_CHG_UDINT

Summary



The PAR_DEF_CHG_UDINT block enables changing the default values (in UDINT data format) of a parameter from the IEC application. The value changes apply to all parameters of that specific parameter family defined in APEM.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables changing the default value of a parameter at the rising edge
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Default	UDINT	ANY	New default value in UDINT data format

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The rising edge of *Enable* input implies the changed parameter default values. *Group* and *Index* define the parameter to be changed. The input *Default* is used to set the new default value of the parameter.

Note: Define a default value within the minimum and maximum value.

Err returns an error code if there is an error during the change operation. If the default value change operation is successful, *Err* returns a 0.

Parameter decimal display

PAR_DISP_DEC

Summary

PAR_DISP_DEC block enables changing the number of displayed decimals of a parameter from the IEC application. If one parameter of the family parameter is changed using this block, the change applies to all other parameters of that parameter family.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables decimal display change at the rising edge
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Decimals	UNIT	128…255	Number of decimals to display

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

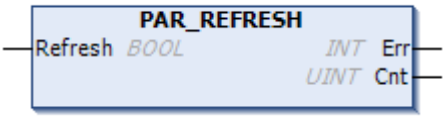
The rising edge of *Enable* input implies the decimal display change of a parameter. *Group* and *Index* define the parameter to be changed and the input *Decimals* defines the number of decimal values to display. If the parameter is in REAL data format, the value is scaled for fieldbus interface by scaling factor $10^{(decimals)}$.

Err returns an error code if there is an error during a unit change, for example, the unit for change is beyond the selection range. If the unit selection and change operation is successful, *Err* returns a 0.

PAR_REFRESH

Summary

PAR_REFRESH block notifies PC tools and panel of any parameter attribute changes.



Connections

Input

Name	Type	Value	Description
Refresh	BOOL	T/F	Enables refresh at the rising edge

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output
Cnt	UINT	ANY	Counts the number of refresh activation

Description

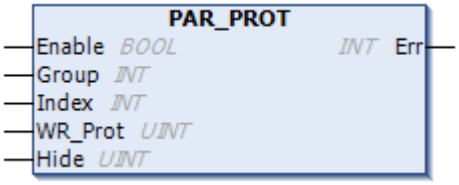
The rising edge of *Refresh* input notifies any parameter changes to PC tools and panel.

WARNING! Every time you activate the **Refresh** input in Automation Builder, a notification appears in Drive Composer prompting to refresh the parameters. Click **OK** to apply the parameter changes.

Err returns an error code if the parameter protection is applied successfully, *Err* returns a 0. The output *Cnt* increments at every activation of the input *Refresh*.

Parameter protection

PAR_PROT



Summary

PAR_PROT block is used for protecting individual parameters. This block enables write protection and hides flags dynamically from the IEC application. The changes do not apply to any other parameter of the specific family.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables protection change at the rising edge
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
WR_Prot	UNIT	ANY	Applies write protection 0 = No protection 1 = Human WP [Drive Composer (Pro/Entry) and ACS-AP-I/ ACS-AP-S control panel]
Hide	UINT	ANY	Hides flags 0 = No protection 1 = Human WP [Drive Composer (Pro/Entry) and ACS-AP-I/ ACS-AP-S control panel]

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The rising edge of *Enable* input implies the protection change of a parameter. *Group* and *Index* define the parameter to be changed. The inputs *WR_Prot* and *Hide* define the parameter for write protection and parameter to hide respectively.

Err returns an error code if there is an error during a parameter protection change. If the parameter protection is applied successfully, *Err* returns a 0.

PAR_GRP_PROT

Summary

PAR_GRP_PROT block is used to protect a parameter group. This block enables write protection and hides flags dynamically from the IEC application.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables protection at the rising edge
Group	INT	ANY	Parameter group
WR_Prot	UNIT	ANY	Applies write protection 0 = No protection 1 = Human WP [Drive Composer (Pro/Entry) and ACS-AP-I/ ACS-AP-S control panel]
Hide	UINT	ANY	Hides flags 0 = No protection 1 = Human WP [Drive Composer (Pro/Entry) and ACS-AP-I/ ACS-AP-S control panel]

Output

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The rising edge of *Enable* input implies the protection change of a parameter group. *Group* defines the group to be changed. The inputs *WR_Prot* and *Hide* define the parameter group to be write protected and hidden.

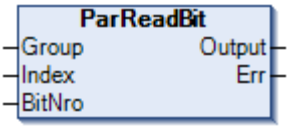
Err returns an error code if there is an error during a protection change. If the parameter group protection is applied successfully, *Err* returns a 0.

Parameter read function blocks

ParReadBit

Summary

ParReadBit reads the value of a bit in a packed Boolean type parameter.



Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
BitNro	INT	ANY	Bit number

Outputs

Name	Type	Value	Description
Output	BOOL	T/F	Output value
Err	INT	ANY	Error output

Description

The function block reads the value of a bit in a packed Boolean type parameter. *Group* and *Index* define the parameter to be read and *BitNro* defines the number of the bit. The value of the bit read is returned from *Output*.

Err returns an error code if there is an error during the read operation, for example, the parameter is not found or it is a parameter of a wrong type. If the read operation is successful, *Err* returns a 0.

ParRead_INT

Summary

ParRead_INT reads the value of a INT/DINT/REAL type parameter.

Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index

Outputs

Name	Type	Value	Description
Output	INT	ANY	Output value
Err	INT	ANY	Error output

Description

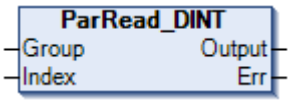
The function block reads the value of a DINT or INT type parameter. *Group* and *Index* define the parameter to be read. The value of parameter is returned from *Output*. The type of output is INT even if the parameter to be read is of the DINT/REAL type.

Err returns an error code if there is an error during the read operation, for example, the parameter is not found or it is a parameter of a wrong type. If the read operation is successful, *Err* returns a 0.

ParRead_DINT

Summary

ParRead_DINT reads the value of a DINT/INT type parameter.



Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index

Outputs

Name	Type	Value	Description
Output	DINT	ANY	Output value
Err	INT	ANY	Error output

Description

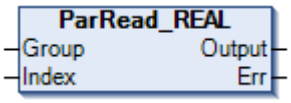
The function block reads the value of a DINT or INT type parameter. *Group* and *Index* define the parameter to be read. The value of the parameter is returned from *Output*. The type of *Output* is DINT even if the parameter to be read is of the INT type.

Err returns an error code if there is an error during the read operation, for example, the parameter is not found or it is a parameter of a wrong type. If the read operation is successful, *Err* returns a 0.

ParRead_REAL

Summary

ParRead_REAL reads the value of a REAL type parameter.



Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index

Outputs

Name	Type	Value	Description
Output	REAL	ANY	Output value
Err	INT	ANY	Error output

Description

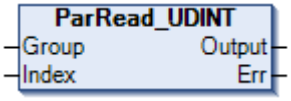
The function block reads the value of a REAL type parameter. *Group* and *Index* define the parameter to be read. The value of the parameter is returned from *Output*.

Err returns an error code if there is an error during the read operation, for example, the parameter is not found or it is a parameter of a wrong type. If the read operation is successful, *Err* returns a 0.

ParRead_UDINT

Summary

ParRead_UDINT reads the value of a UDINT/UINT type parameter.



Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index

Outputs

Name	Type	Value	Description
Output	UDINT	ANY	Output value
Err	INT	ANY	Error output

Description

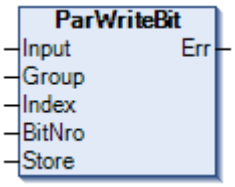
The function block reads the value of a UDINT or UINT type parameter. *Group* and *Index* define the parameter to be read. The value of the parameter is returned from *Output*. The type of the output is UDINT even if the parameter to be read is of the UINT type.

Err returns an error code if there is an error during the read operation, for example, the parameter is not found or it is a parameter of a wrong type. If the read operation is successful, *Err* returns a 0.

Parameter write function blocks

ParWriteBit

Summary



ParWriteBit writes a value to a bit of a packed Boolean type parameter.

Connections

Inputs

Name	Type	Value	Description
Input	BOOL	T/F	Input value
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
BitNro	INT	ANY	Bit number
Store	BOOL	T/F	Store input

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

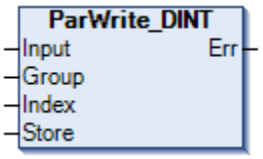
Description

The function block writes the value of *Input* into a selected bit of a packed Boolean type parameter. *Group* and *Index* define the parameter to be written and *BitNro* define the number of the bit. *Store* defines if the current written value of the parameter is stored to the flash memory. During the power-up of the drive, the value of the parameter is set to the latest stored value.

Err returns an error code if there is an error during the write operation, for example, the parameter is not found or it is a parameter of a wrong type. If the write operation is successful, *Err* returns a 0.

ParWrite_DINT

Summary



ParWrite_DINT writes a value to a REAL/DINT/INT type parameter.

Connections

Inputs

Name	Type	Value	Description
Input	DINT	ANY	Input value
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Store	BOOL	T/F	Store input

Outputs

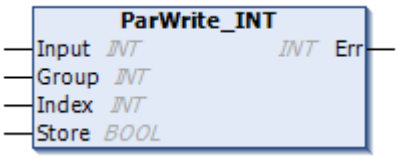
Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The function block writes the value of *Input* into a selected DINT or INT type parameter. The type of the *Input* is DINT even if the parameter to be written is of the INT/REAL type. *Group* and *Index* define the parameter to be written. *Store* defines if the current written value of the parameter is stored to the flash memory. During the power-up of the drive, the value of the parameter is set to the latest stored value.

Err returns an error code if there is an error during the write operation, for example, the parameter is not found or it is a parameter of a wrong type. If the write operation is successful, *Err* returns a 0.

ParWrite_INT



Summary

ParWrite_INT writes a value to an INT/DINT/REAL type parameter.

Connections

Inputs

Name	Type	Value	Description
Input	INT	ANY	Input value
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Store	BOOL	T/F	Store input

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

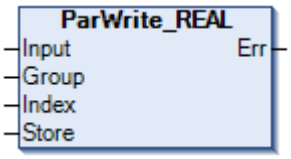
The function block writes the value of *Input* into a selected INT type parameter. The type of the *Input* is INT even if the parameter to be written is of the DINT/REAL type. In case of application parameter, select 16-bit interface support.

Group and *Index* define the parameter to be written. *Store* defines if the current written value of the parameter is stored to the flash memory. During the power-up of the drive, the value of the parameter is set to the latest stored value.

Err returns an error code if there is an error during the write operation, for example, the parameter is not found or it is a parameter of a wrong type. If the write operation is successful, *Err* returns a 0.

ParWrite_REAL

Summary



ParWrite_REAL writes a value to a REAL type parameter.

Connections

Inputs

Name	Type	Value	Description
Input	REAL	ANY	Input value
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Store	BOOL	T/F	Store input

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

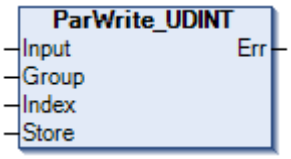
The function block writes the value of *Input* into a selected REAL type parameter. *Group* and *Index* define the parameter to be written. *Store* defines if the current written value of the parameter is stored to the flash memory. During the power-up of the drive, the value of the parameter is set to the latest stored value.

Err returns an error code if there is an error during the write operation, for example, the parameter is not found or it is a parameter of a wrong type. If the write operation is successful, *Err* returns a 0.

ParWrite_UDINT

Summary

ParWrite_UDINT writes a value to a UDINT/UINT type parameter.



Connections

Inputs

Name	Type	Value	Description
Input	UDINT	ANY	Input value
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Store	BOOL	T/F	Store input

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The function block writes the value of *Input* into a selected UDINT or UINT type parameter. The type of *Input* is UDINT even if the parameter to be written is of the UINT type. *Group* and *Index* define the parameter to be written. *Store* defines if the current written value of the parameter is stored to the flash memory. During the power-up of the drive, the value of the parameter is set to the latest stored value.

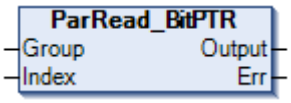
Err returns an error code if there is an error during the write operation, for example, the parameter is not found or it is a parameter of a wrong type. If the write operation is successful, *Err* returns a 0.

Pointer parameter read function block

ParRead_BitPTR

Summary

ParRead_BitPTR reads the pointed bit value from a bit pointer type parameter.



Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index

Outputs

Name	Type	Value	Description
Output	BOOL	ANY	Output value
Err	WORD	ANY	Error output

Description

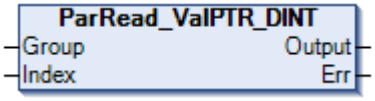
The function block reads the pointed value of a bit pointer type parameter. *Group* and *Index* define the pointed parameter to be read. The pointed value of the parameter is returned from *Output*.

Err returns an error code if there is an error during the read operation, for example, the parameter is not found or it is a parameter of a wrong type. If the read operation is successful, *Err* returns a 0.

ParRead_ValPTR_DINT

Summary

ParRead_ValPTR_DINT reads a pointed DINT/INT value from a value pointer type parameter.



Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index

Outputs

Name	Type	Value	Description
Output	DINT	ANY	Output value
Err	INT	ANY	Error output

Description

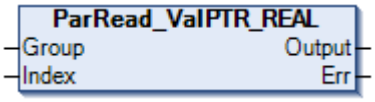
The function block reads the pointed value of a DINT or INT pointer type parameter. *Group* and *Index* define the pointed parameter to be read. The pointed value of the parameter is returned from *Output*. The type of *Output* is DINT even if the parameter type is INT.

Err returns an error code if there is an error during the read operation, for example, the parameter is not found or it is a parameter of a wrong type. If the read operation is successful, *Err* returns a 0.

ParRead_ValPTR_REAL

Summary

ParRead_ValPTR_REAL reads a pointed REAL value from a value pointer type parameter.



Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index

Outputs

Name	Type	Value	Description
Output	REAL	ANY	Output value
Err	INT	ANY	Error output

Description

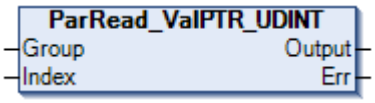
The function block reads the pointed value of a REAL pointer type parameter. *Group* and *Index* define the pointed parameter to be read. The pointed value of the parameter is returned from *Output*.

Err returns an error code if there is an error during the read operation, for example, the parameter is not found or it is a parameter of a wrong type. If the read operation is successful, *Err* returns a 0.

ParRead_ValPTR_UDINT

Summary

ParRead_ValPTR_UDINT reads a pointed UDINT/UINT value from a value pointer type parameter.



Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index

Outputs

Name	Type	Value	Description
Output	UDINT	ANY	Output value
Err	INT	ANY	Error output

Description

The function block reads the pointed value of a UDINT or UINT pointer type parameter. *Group* and *Index* define the pointed parameter to be read. The pointed value of the parameter is returned from *Output*. The type of *Output* is UDINT even if the parameter type is UINT.

Err returns an error code if there is an error during the read operation, for example, the parameter is not found or it is a parameter of a wrong type. If the read operation is successful, *Err* returns a 0.

GetPtrParConf

Summary

GetPtrParConf shows the source parameter settings. Source parameter must be value pointer, bit pointer or formatted number (parameterIndexFB).

Conections

Inputs

Name	Type	Value	Description
S_Group	INT	ANY	Source parameter group
S_Index	INT	ANY	Source parameter index

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output. 0 = OK 3 = Invalid mapping type.
S_Type	INT	0-6	Source parameter type: 0 = Unsigned 16-bit integer 1 = Signed 16-bit integer 2 = Unsigned 32-bit integer 3 = Signed 32-bit integer 4 = 32-bit Value pointer 5 = 32-bit Floating pointer 6 = 32-bit Bit pointer
T_Group	INT	ANY	Destination parameter group.
T_Index	INT	ANY	Destination parameter index.
BitNro	INT	0-31	Bit number, when bit mapping is used.
ListIdx	INT	0-N	Index of list, when list is used.
Format	INT	0-5	Showing, what type of mapping (external interface) is selected. If 0, no available. u32MAPFLAG_I16 (1) u32MAPFLAG_U16 (2) u32MAPFLAG_FLOAT (3) u32MAPFLAG_I32 (4) u32MAPFLAG_U32 (5)

Description

Block is showing source parameter settings.

If source parameter type is formatted number/ parameterIndexFB, then parameter supports additional selection dialog (Other) in tools (selection list), where external interface selection can be changed. Format pin is showing the selection.

Based on this information (16bit/32bit/Float), original destination parameter(s) can be referenced by other blocks.

This is useful for example in cases, where the same destination parameter has different scaling factors, depending on mapped data type (16bit or 32bit).

Note that this selection is not affecting into interface, which is used by source parameter and in case source parameter is application parameter with option formatted number/ parameterIndexFB, it cannot be directly used by any other blocks.

When value pointer type source parameter is mapped into some destination parameter, T_Group, T_Index are showing the destination parameter.

If the source parameter points into application variable, it cannot be mapped. All the other outputs are 0.

If the source parameter (parameterIndexFB) is supporting external interface settings with Set pointer parameter/other, then Format is showing selected external interface.

If the source parameter is mapped into list, then T_Group, T_Index are showing the parameter, which corresponds the list member. BitNro is showing selected bit, and ListIdx is showing selected list index.

If the list member represent constant value, then T_Group = 0. T_index is showing either 1 (list member =TRUE) or 0 (list member=FALSE) value.

If the source parameter is mapped into bit (BitPtr), then BitNro is showing selected bit number. T_Group, T_Index are indicating the destination parameter.

If source parameter is mapped into formatted number with display format parameterIndexFB, S_Type is NUMTYPE_u32 (2) and Format is showing selected external interface.

Avoid to put this block into fast cycle and keep the amount of blocks(instances) in minimum.

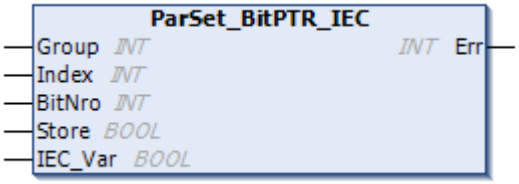
Set pointer parameter to IEC variable function blocks

Note: The old applications which are using these blocks of the earlier system library version (1.9.0.x) must be updated to the new library version (1.9.1.0.) Otherwise the application loading fault xxx occurs (aux code : 0x800A). You can also notice that the old *Par_set_ValPtr_IEC_xx* are storing the value by default and new block must have store input TRUE to have equal function. However it not recommend to use *Store* option if the value is changed repeatedly.

ParSet_BitPTR_IEC

Summary

ParSet_BitPTR_IEC sets a bit pointer parameter to point to a bit type IEC variable.



Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
BitNro	INT	0	Bit setting is not supported.
Store	BOOL	T/F	New value is stored to permanent memory of the drive. Default is FALSE, but no storing.
IEC_Var	BOOL	T/F	IEC variable

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The function block sets a bit pointer type parameter to point to an IEC variable of the Boolean type, that is, the IEC variable overwrites the value of the bit pointer. The parameter to point must be of the bit pointer type. *Group* and *Index* define the parameter. **The *BitNro* input must be set to zero** since (at least in this library version) the type of *IEC_Var* must be Boolean and type of the parameter to be set must be bit pointer. Therefore the bit number cannot be chosen. The *Store* pin is used to save the pointer setting to the drive permanent memory. During next power up, the drive memorizes this setting. The *IEC_Var* input is the IEC variable to be pointed.

Err returns an error code if there is an error during the set operation, for example, the parameter is not found or it is a parameter of a wrong type. If the set operation is successful, *Err* returns a 0.

ParSet_ValPTR_IEC_DINT

Summary

ParSet_ValPTR_IEC_DINT sets a value pointer parameter to point to a DINT type IEC variable.

Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Store	BOOL	T/F	New value is stored to permanent memory of the drive. Default is FALSE, but no storing.
IEC_Var	DINT	ANY	IEC variable

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The function block sets a value pointer type parameter to point to an IEC variable of the DINT type, that is, the IEC variable value overwrites the value of the value pointer. The parameter to point must be a value pointer to the DINT or INT type. *Group* and *Index* define the parameter. The *Store* pin is used to save the pointer setting to the drive permanent memory. During next power up, the drive memorizes this setting. The *IEC_Var* input is the IEC variable to be pointed.

Err returns an error code if there is an error during the set operation, for example, the parameter is not found or it is a parameter of a wrong type. If the set operation is successful, *Err* returns a 0.

ParSet_ValPTR_IEC_REAL

Summary

ParSet_ValPTR_IEC_REAL sets a value pointer parameter to point to a REAL type IEC variable.

Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Store	BOOL	T/F	New value is stored to permanent memory of the drive. Default is FALSE, but no storing.
IEC_Var	REAL	ANY	IEC variable

Outputs

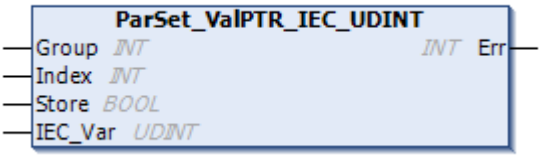
Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The function block sets a value pointer type parameter to point to an IEC variable of the REAL type, that is, the IEC variable value overwrites the value of the value pointer. The parameter to point must be a value pointer to the REAL type. *Group* and *Index* define the parameter. The *Store* pin is used to save the pointer setting to the drive permanent memory. During next power up, the drive memorizes this setting. The *IEC_Var* input is the IEC variable to be pointed.

Err returns an error code if there is an error during the set operation, for example, the parameter is not found or it is a parameter of a wrong type. If the set operation is successful, *Err* returns a 0.

ParSet_ValPTR_IEC_UDINT



Summary

ParSet_ValPTR_IEC_UDINT sets a value pointer parameter to point to a UDINT type IEC variable.

Connections

Inputs

Name	Type	Value	Description
Group	INT	ANY	Parameter group
Index	INT	ANY	Parameter index
Store	BOOL	T/F	New value is stored to permanent memory of the drive. Default is FALSE, but no storing.
IEC_Var	UDINT	ANY	IEC variable

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The function block sets a value pointer type parameter to point to an IEC variable of the UDINT type, that is, the IEC variable value overwrites the value of the value pointer. The parameter to point must be a value pointer to the UDINT or UINT type. *Group* and *Index* define the parameter. The *Store* pin is used to save the pointer setting to the drive permanent memory. During next power up, the drive memorizes this setting. The *IEC_Var* input is the IEC variable to be pointed.

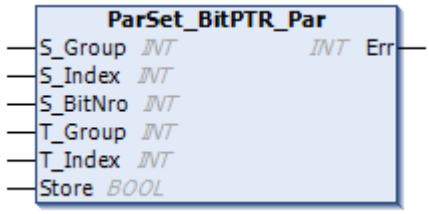
Err returns an error code if there is an error during the set operation, for example, the parameter is not found or it is a parameter of a wrong type. If the set operation is successful, *Err* returns a 0.

Set pointer parameter to parameter function blocks

ParSet_BitPTR_Par

Summary

ParSet_BitPTR_Par sets a bit pointer parameter to point to a bit of a packed Boolean parameter.



Connections

Inputs

Name	Type	Value	Description
S_Group	INT	ANY	Source parameter group
S_Index	INT	ANY	Source parameter index
S_BitNro	INT	ANY	Source bit number
T_Group	INT	ANY	Target parameter group
T_Index	INT	ANY	Target parameter index
Store	BOOL	T/F	New value is stored to permanent memory of the drive. Default is FALSE, but no storing.

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The function block sets a bit pointer parameter to point to a bit of a packed Boolean type parameter. *S_Group* and *S_Index* define the parameter to be pointed (the source) and *S_BitNro* defines the number of the bit. *T_Group* and *T_Index* define the pointer parameter (the target) which points to the source parameter. The target parameter must be a Bit Pointer type and the source parameter must be a packed Boolean type. The *Store* pin is used to save the pointer setting to the drive permanent memory. During next power up, the drive memorizes this setting.

Err returns an error code if there is an error during the set operation, for example, the parameter is not found or it is a parameter of a wrong type. If the set operation is successful, *Err* returns a 0.

ParSet_ValPTR_Par

Summary

ParSet_ValPTR_Par sets a value pointer parameter to point to a value parameter.

Connections

Inputs

Name	Type	Value	Description
S_Group	INT	ANY	Source parameter group
S_Index	INT	ANY	Source parameter index
T_Group	INT	ANY	Target parameter group
T_Index	INT	ANY	Target parameter index
Store	BOOL	T/F	New value is stored to permanent memory of the drive. Default is FALSE, but no storing.

Outputs

Name	Type	Value	Description
Err	INT	ANY	Error output

Description

The function block sets a value pointer parameter to point to a value parameter. *S_Group* and *S_Index* define the parameter to be pointed (the source). *T_Group* and *T_Index* define the pointer parameter (the target) which points to the source parameter. The target parameter must be a pointer parameter of the same type as the source parameter which must be a value parameter. The *Store* pin is used to save the pointer setting to the drive permanent memory. During next power up, the drive memorizes this setting.

Err returns an error code if there is an error during the set operation, for example, the parameter is not found or it is a parameter of a wrong type. If the set operation is successful, *Err* returns a 0.

Task time level function block

UsedTimeLevel

Summary

UsedTimeLevel shows the time level (ms) of the program (task execution cycle) where the function block is located.

Connections

Inputs

Name	Type	Value	Description
NONE			

Outputs

Name	Type	Value	Description
Output	INT	ANY	Used time level in ms

Description

The function block shows the time level of the program (task cycle) in which the particular function block is located. *Output* gives the time level in milliseconds.

Error codes

The following list gives the most common error codes related to the function blocks of the ABB drives system library. The error codes are received from the *Err* output and they indicate if there is an error during the performance of the function block.

Error code	Error code number	Description
e_success	0 (hex 0)	Success, no error
e_WriteProtected	4 (hex 4)	The parameter is write-protected.
e_Hidden	5 (hex 5)	The parameter is hidden.
e_illegalOperation	6 (hex 6)	Illegal operation, for example, the parameter type is incorrect.
e_lowLimit	9 (hex 9)	Parameter minimum value is exceeded.
e_highLimit	10 (hex A)	Parameter maximum value is exceeded
e_noValueInList	11 (hex B)	No value in the list
e_parNotFound	13 (hex D)	The parameter is not found.
e_OutsideIndexArea	774 (hex 306)	Outside index area
e_OverLappingGroup	775 (hex 307)	Overlapping group
e_UffError	777 (hex 309)	UFF error

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Appendix D: ABB D2D function blocks

Contents of this chapter

This appendix contains detailed information of the drive to drive (D2D) communication function blocks of the ABB drives D2DComm library *AY2LB_D2DComm_ACS880_V3_5*.

Introduction to ABB D2D function blocks

The ABB D2D function blocks are intended to be used with the ACS880 drives. It provides drive to drive communication and drive to drive configuration function blocks for application programming in the automation builder environment. The description of the features in this document is based on the ABB drives D2D communication library version 1.9.0.2.

Note: In the Drive Composer Pro system information, make sure the drive has the corresponding system library installed. In **System info**, the D2DComm library version is located under the **Products/ More** view. The D2DComm library versions must be the same in the drive and the application program project.

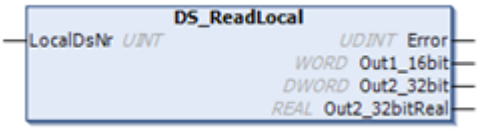
D2D function blocks of D2DComm library

Function block name	Description
Data read/write	
DS_ReadLocal	Reads data from the local dataset.
DS_WriteLocal	Writes data to local dataset.
Drive to drive communication	
D2D_TRA	Transmits data to a remote drive.
D2D_REC	Receives data from the remote drive.
D2D_TRA_REC	Transmits and receives data from the remote drive.
D2D_TRA_MC	Transmits multicast messages to group of drives.
Drive to drive configuration	
D2D_Conf	Configures token management on master drive.
D2D_Conf_Token	Configures the node related transmission cycle of token on master drive.
D2D_Master_State	Returns status of master drive connected with D2D link, except its own status.

Data read/write blocks

DS_ReadLocal

Summary



DS_ReadLocal block reads the dataset value from the local dataset table. The 48 bit dataset composes of 16 bit and 32 bit parts. The 32 bit part is available both in DWORD or REAL data formats in the function block output. Inputs are pointer to actual data. Dataset composes of three words in the output:

- 16 bit (WORD)
- 32 bit (DWORD or REAL)

Connections

Inputs

Name	Type	Value	Description
LocalDsNr	UINT	1…255	Local dataset number

Outputs

Name	Type	Value	Description
Error	UDINT	ANY	Error output
Out1_16bit	WORD	ANY	16-bit part of the dataset in WORD format
Out2_32bit	DWORD	ANY	32-bit part of the dataset as DWORD format
Out2_32bitReal	REAL	ANY	32-bit part of the dataset as REAL format

Description

The function block reads the local dataset value from the local dataset table. *LocalDsNr* defines the local dataset number.

Output *Out1_16bit* returns the first 16 bit of dataset as WORD data.

Output *Out2_32bit* returns 32 bit part of dataset as DWORD data.

Output *Out2_32bitReal* returns 32 bit part of dataset as REAL data.

Error returns an error code if there is an error during the read operation, for example, the dataset is not found or if the dataset is beyond the dataset number range of 1…255. If the read operation is successful, *Error* returns a 0.

DS_WriteLocal

Summary

DS_WriteLocal block writes data to local dataset. The 48 bit dataset composes of 16 bit and 32 bit parts. Inputs are pointers to actual data.

Connections

Inputs

Name	Type	Value	Description
LocalDsNr	UINT	128…255	Local dataset number
pDataIn1_16bit	WORD POINTER	-	Pointer to 16 bit value
pDataIn2_32bit	DWORD POINTER	-	Pointer to 32 bit data (REAL, DWORD)

Outputs

Name	Type	Value	Description
Error	UDINT	ANY	Error output

Description

The DS_WriteLocal function writes data to the local dataset. *LocalDsNr* defines the local dataset number from 128 to 255. The input data of 16 bit and 32 bit is connected to the pointer inputs *pDataIn1_16bit* and *pDataIn2_32bit* respectively using the ADR operand.

Note: The data set numbers 128 to 255 are reserved for application programming. However, you can set the data set numbers 1 to 127. There is risk of conflict with firmware dataset.

Error returns an error code if there is an error during the write operation, for example, the dataset is not found or if the dataset is beyond the dataset number range of 128…255. If the write operation is successful, *Error* returns a 0.

D2D communication blocks

General

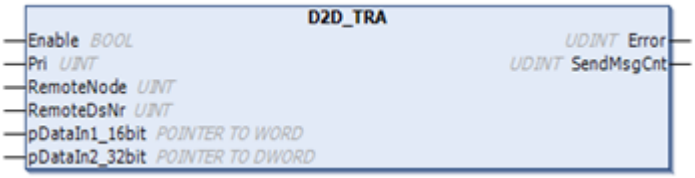
The D2D_TRA, D2D_REC and D2D_TRA_REC blocks can be used only in a master drive. These blocks can work independently without token configuration. The D2D_TRA_MC block can be used in both master and follower drives. When used in a follower drive, the token send configuration must be done using D2D_Conf_Token and D2D_Conf blocks.

The D2D_Master_State block can be used without token configuration in both the master and follower drives as well as the local dataset blocks DS_ReadLocal and DS_WriteLocal.

D2D_TRA

Summary

D2D_TRA block sends data from a Master drive to a remote Follower drive. The 48 bit data composes of 16 bit and 32 bit parts. The input data is given directly to the function block inputs and so local datasets are not required.



Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables/disables sending data.
Pri	UINT	1/2	Defines the priority of sending data; Standard (1) or Low priority (2).
RemoteNode	UINT	1…62	Defines the remote drive node address.
RemoteDsNr	UINT	128….255	Defines the remote drive dataset number.
pDataIn1_16bit	WORD POINTER	-	Pointer to 16 bit value
pDataIn2_32bit	DWORD POINTER	-	Pointer to 32 bit data (REAL, DWORD)

Outputs

Name	Type	Value	Description
Error	UDINT	ANY	Error output
SendMsgCnt	UDINT	ANY	Counts successfully transmitted messages

Description

The D2D_TRA function sends application variables data from the master drive to a remote follower drive. The *Enable* input enables or disables sending data. At the rising edge of *Enable* input *Pri*, *RemoteNode* and *RemoteDsNr* are used. The input *Pri* defines the priority of data transmission.

- Standard (1): The priority is set to Standard if fast response (2 ms) is required. However, maximum of 2 blocks can be executed in the same cycle.
- Low priority (2): The priority is set to Low priority if slow response is required. It is possible to execute up to 64 blocks in the same cycle.
    - 10 ms cycle time - 10 blocks are executed
    - 100 ms cycle time - 64 blocks are executed

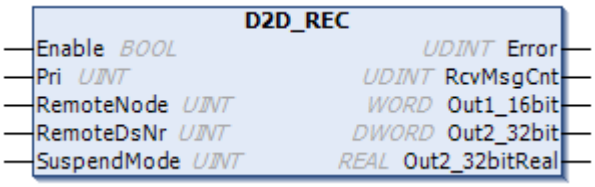
The inputs *RemoteNode* and *RemoteDsNr* define the remote drive node address and dataset number respectively, where the data is sent and stored. The input data of 16 bit and 32 bit is connected to the pointer inputs *pDataIn1_16bit* and *pDataIn2_32bit* respectively using ADR operand.

Error blocks input values and operation status if there is an error while sending data. If data is sent successfully, *Error* returns a 0. The *SendMsgCount* tracks the number of successfully sent messages.

For details of how data is sent in WORD and REAL data format to remote drive, see *Example 1: D2D_TRA / D2D_REC blocks*.

D2D_REC

Summary



D2D_REC block enables the master drive to receive data from a remote follower drive. The block receives one 48 bit dataset from follower dataset table. The response is available at the output signals in 16 bit and 32 bit parts. An additional 32 bit data is available in REAL format as own output.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables/disables receiving data.
Pri	UINT	1/2	Defines the priority of receiving data; Standard (1) or Low priority (2).
RemoteNode	UINT	1…62	Defines the remote drive node address.
RemoteDsNr	UINT	128…255	Defines the remote drive dataset number.
SuspendMode	UINT	0/1	Defines the behaviour of the application task whether the D2D message is sent. 0 = message not sent 1 = message sent

Outputs

Name	Type	Value	Description
Error	UDINT	ANY	Error output
RcvMsgCnt	UDINT	ANY	Counts successfully received messages
Out1_16bit	WORD	ANY	16-bit dataset output value
Out2_32bit	DWORD	ANY	32-bit dataset output value
Out2_32bitReal	REAL	ANY	32-bit dataset output value in Real format.

Description

The D2D_REC block receives data from remote drive. The *Enable* input enables or disables receiving data. At the rising edge of *Enable* input the inputs *Pri*, *RemoteNode*, *RemoteDsNr* and *SuspendMode* are used. The input *Pri* defines the priority of receiving data.

- Standard (1): The priority is set to Standard if fast response (2 ms) is required. However, maximum of 2 blocks can be executed in the same cycle.
- Low priority (2): The priority is set to Low priority if slow response is required. It is possible to execute up to 64 blocks in the same cycle.
    - 10 ms cycle time - 10 blocks are executed
    - 100 ms cycle time - 64 blocks are executed

The inputs *RemoteNode* and *RemoteDsNr* define the remote drive node address and dataset number respectively. The remote node number is set using parameter 60.02 in the ACS880 Primary Control Program. The input *SuspendMode* defines the behavior of the application task whether the intended message is sent.

0 = continues actual application task execution

1 = indicates that actual application task execution is pending to send messages and to receive response of messages sent.

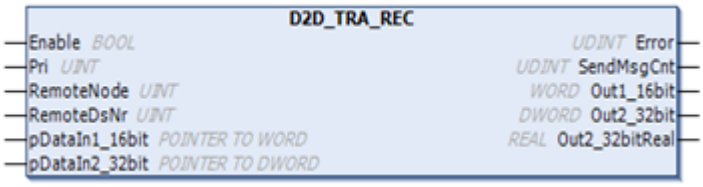
Error blocks input values and operation status if there is an error while receiving data. If receiving data is successful, *Error* returns a 0. The *RcvMsgCount* tracks the number of successfully received messages.

The 16 bit and 32 bit data at the output returns from *Out1_16bit* and *Out2_32bit* respectively. The 32 bit data of real data format returns from *Out2_32bitReal.*

For details of receiving data to master drive, see *Example 1: D2D_TRA / D2D_REC blocks*.

D2D_TRA_REC

Summary



D2D_TRA_REC block enables the master drive to send and receive data from the remote drive. The 16-bit and 32-bit parts of the dataset are defined in the corresponding pointer type inputs. The response is available at the output signal in 16-bit and 32-bit parts. An additional 32-bit data is available in REAL format as own output.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables/disables receiving data.
Pri	UINT	1/2	Defines the priority of receiving data; Standard (1) or Low priority (2).
RemoteNode	UINT	1…62	Defines the remote drive node address.
RemoteDsNr	UINT	128…255	Defines the remote drive dataset number.
pDataIn1_16bit	WORD POINTER	ANY	16 bit value connecting through ADR block
pDataIn2_32bit	DWORD POINTER	ANY	32 bit integer or real value connecting through ADR block

Outputs

Name	Type	Value	Description
Error	UDINT	ANY	Error output
SendMsgCnt	UDINT	ANY	Counts successfully transmitted messages
Out1_16bit	WORD	ANY	16-bit dataset output value
Out2_32bit	DWORD	ANY	32-bit dataset output value
Out2_32bitReal	REAL	ANY	32-bit dataset output value in Real format.

Description

The D2D_TRA_REC block sends data from master drive and receives data from the remote drive. The *Enable* input enables/disables sending or receiving data. At the rising edge of *Enable* input the inputs *Pri*, *RemoteNode* and *RemoteDsNr* are used. The input *Pri* defines the priority of receiving data.

- Standard (1): The priority is set to Standard if fast response (2 ms) is required. However, maximum of 2 blocks can be executed in the same cycle.
- Low priority (2): The priority is set to Low priority if slow response is required. It is possible to execute up to 64 blocks in the same cycle.

- 10 ms cycle time - 10 blocks are executed
- 100 ms cycle time - 64 blocks are executed

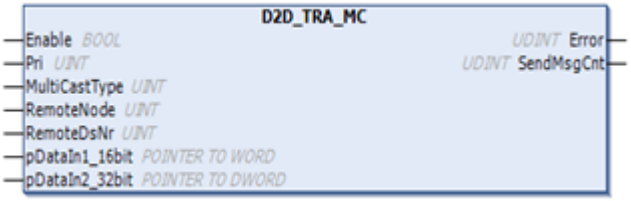
The inputs *RemoteNode* and *RemoteDsNr* define the remote drive node address and dataset number respectively. The response data is read from the dataset number *RemoteDsNr*+1 of the remote drive. The data is selected using pointer inputs *pDataIn1_16bit* and *pDataIn2_32bit.*

Error blocks input values and operation status if there is an error while sending or receiving data. If sending or receiving data is successful, *Error* returns a 0. The *SendMsgCount* tracks the number of successfully sent messages.

The 16-bit and 32-bit data at the output returns from *Out1_16bit* and *Out2_32bit* respectively. The additional output *Out2_32bitReal* returns 32-bit data in REAL data format.

D2D_TRA_MC

Summary



D2D_TRA_MC block enables the drive (Master or Follower) to send multicast messages to a group of drives. This block also allows sending follower to follower point to point messages.

The multicast address is defined in the *D2D_Conf* block.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables/disables receiving data.
Pri	UINT	1/2	Defines the priority of receiving data; Standard (1) or Low priority (2).
MultiCastType	UINT	0/1	Allows sending multicast message types.
RemoteNode	UINT	1…62	Defines the remote drive node address.
RemoteDsNr	UINT	128…255	Defines the remote drive dataset number.
pDataIn1_16bit	WORD POINTER	ANY	16 bit value connecting through ADR block
pDataIn2_32bit	DWORD POINTER	ANY	32 bit integer or real value connecting through ADR block

Outputs

Name	Type	Value	Description
Error	UDINT	ANY	Error output
SendMsgCnt	UDINT	ANY	Counts successfully transmitted messages

Description

The D2D_TRA_MC block sends multicast messages to a group of drives. It is possible for the Master drive to receive messages from the Follower driver. For sending point to point messages or standard multicast messages, the Follower drives need token messages from the Master drive.

The *Enable* input enables/disables sending data. At the rising edge of *Enable* input the inputs *Pri*, *MultiCastType*, *RemoteNode* and *RemoteDsNr* are used.

The input *Pri* defines the priority of receiving data.

- Standard (1): The priority is set to Standard if fast response (2 ms) is required. However, maximum of 2 blocks can be executed in the same cycle.
- Low priority (2): The priority is set to Low priority if slower response is sufficient. Up to 64 blocks can be executed in the same cycle.
    - 10 ms cycle time - 10 blocks are executed
    - 100 ms cycle time - 64 blocks are executed

The input *MultiCastType* enables sending multicast messages of 3 different types:

- Follower point to point transmit (3)
- Standard Multicast (4): This message type requires all Follower/Master drives to have a corresponding multicast address equal to the *RemoteNode*.
- Broadcast (5): In this message type all drives in the drive to drive link receive the message including the Master drive. In this mode, the input *RemoteNode* must be set to 255.

The inputs *RemoteNode* and *RemoteDsNr* define the remote drive node address and dataset number respectively. The data is selected using pointer inputs *pDataIn1_16bit* and *pDataIn2_32bit.*

Error blocks input values and operation status if there is an error while sending or receiving data. If sending or receiving data is successful, *Error* returns a 0. The *SendMsgCount* tracks the number of successfully sent messages.

D2D configuration blocks

D2D_Conf

Summary

D2D_Conf block configures token management on the master drive. The D2D_Conf_Token block must be executed before the D2D_Conf block because configuration data is built based on the node data in D2D_Conf_Token block.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables/disables configuration data in Master drive. Value FALSE stops sending token from master to follower(s).
MCastGrp	UINT	-	Defines multicast group address.
TokenTxmCycle	UINT	1000…10000	Sends the interval of token message. 0 = indicates that current configuration is removed

Outputs

Name	Type	Value	Description
Error	UDINT	Any	Error output

Description

The D2D_Conf block is intended to execute only once, and for this reason, the block should be assigned to Pre_Task. However, the block can be assigned to any task and in cyclic tasks, the *Enable* input controls the execution, including run time configuration.

The configured data is effective on the master drive after enabling the D2D_Conf block. The *Enable* input enables/disables the configuration data on the master drive. The rising edge of *Enable* input triggers the configuration setup. The next rising edge overwrites the *Enable* input of D2D_Conf_Token block, even if it is set to FALSE.

The input *TokenTxmCycle* is the base transmission cycle of token. The node related transmission cycle is attained by multiplying this value set in the *D2D_Conf_Token* block.

Error blocks input values and operation status if there is an error in the configuration data. If configuration is successful, *Error* returns a 0.

Master use

The master drive has a message queue to handle cyclic transmission of the token messages to follower drive. This queue can hold maximum 64 token messages. The standard multicast group of master drive (address) is defined by the input *MCastGrp*.

Follower use

In the follower drive, only the multicast group (MCastGrp) can be defined and *TokenTxmCycle* is not used. The master drive transmits the token messages to follower drives. After receiving a token the follower is able to transmit a message from the D2D message queue.

For example of token configuration, see *Example 2: Token send configuration using D2D_Conf_Token and D2D_Conf blocks*.

D2D_Conf_Token

Summary

D2D_Conf_Token block configures the follower drive related token message send cycle. In follower mode, the output *Error* is set.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL		Enables/disables the master drive from sending the token to follower drive.
RemoteNode	UINT	1…62	Defines the node address of the follower drive where the token is transmitted.
TxmCycMultiplier	UINT		Token send cycle. Multiplies the input input *TokenTxmCycle* in block *D2D_Conf*. If value is 0, node is removed from configuration.

Outputs

Name	Type	Value	Description
Error	UDINT	Any	Error output

Description

The *D2D_Conf_Token* block is used to configure the node related transmission cycle of token on master drive. This block is intended to execute only once from the *Pre_Task*. However, the block can be assigned to any task and in cyclic tasks, the *Enable* input controls the execution, including run time configuration. The settings are effective in the master only after executing the *D2D_Conf* block.

All node related *D2D_Conf_Token* blocks must be executed before *D2D_Conf* by setting the input *Enable* to TRUE. On run time in the Master drive, the *Enable* input enables/disables the use of follower node. However this selection is overwritten at the next rising edge of *Enable* in the *D2D_Conf* block.

The *RemoteNode* and *TxmCycMultiplier* are set on the rising edge of *Enable*. The configuration is effective after the next rising edge of *Enable* in the block *D2D_Conf*. This configuration can be done on run time also.

By setting the *TxmCycMultiplier* = 0, the node related token send can be removed permanently. At the next rising edge of *Enable* in *D2D_Conf_Token* and *D2D_Conf* blocks, the node is removed from token configuration.

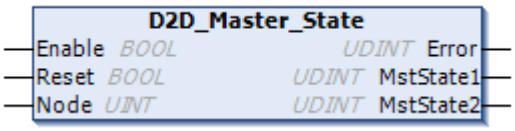
Error blocks input values and operation status. The error messages are listed below:

Bit	Error code	Meaning
0	D2D_MODE_ERR	D2D mode is not Master
5	TOO_SHORT_CYCLE	Token interval(s) are short or communication is overloaded
6	INVALID_INPUT_VAL	Input value (target node and/or cycle time) are out of range
7	GENERAL_D2D_ERR	D2D driver failed to initialize message

For example of token configuration, see *Example 2: Token send configuration using D2D_Conf_Token and D2D_Conf blocks*.

D2D_Master_State

Summary



D2D_Master_State block reads bit related Master state of all the drives connected into the D2D link. From the master drive, this block broadcasts the master state to other drives using node number. This block works without token management configuration.

Connections

Inputs

Name	Type	Value	Description
Enable	BOOL	T/F	Enables/disables block execution
Reset	BOOL	0/1	Resets all master state bits on rising edge
Node	UINT	1…62	Node address

Outputs

Name	Type	Value	Description
Error	UDINT	ANY	Error output
MstState1	UDINT	0…31	Drive/node related master bits 0…31. Bit 0 == Node1
MstState2	UDINT	32…63	Drive/node related master bits 32…63.

Description

The *D2D_Master_State* block is used when there is a risk to have multiple masters in same D2D link. This enables creating systems with redundant masters. The block returns status of all Master drives connected into the D2D link, except its own state, which can be set and read using parameter 60.3 (M/F mode). As the Master drive broadcasts its state to other drives based on Node address, the panel port communication port parameter 49.1 (Node ID number) should also be using the same value.

The master drive state bits are updated when the input *Reset* is set FALSE. The reset function can be used whenever there is state change from Master to Slave.

The input *Node* is same as parameter 60.2 (M/F node address).

Error blocks input values and operation status. In the follower drive, the output Error returns the D2D_MODE_ERR code to notify that the drive is not able to broadcast master state; however the block is able to read other drive states.

The output *MstState1* includes drive/node related master bits 0 to 31. If this output is set, the drive is Master.

The output *MstState2* includes drive/note related master bits 32 to 63.

Examples: D2D blocks

Example 1: D2D_TRA / D2D_REC blocks

This example describes how the *D2D_TRA* and *D2D_REC* blocks are used for sending and receiving data.

The *D2D_TRA* block is used for sending data in WORD and REAL data format to remote drive address 1 and dataset 128. The *DS_ReadLocal* block is used for reading the dataset in remote drive.

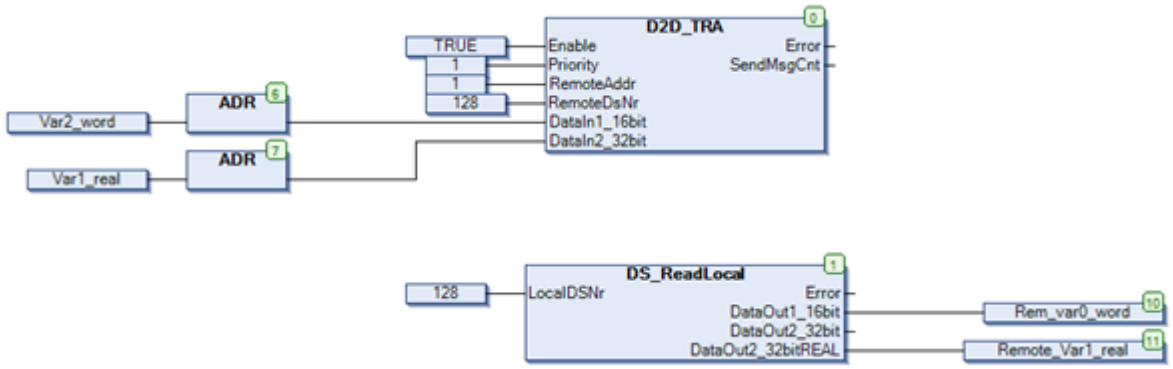


Figure 165: Sending data using D2D_TRA block

The *DS_WriteLocal* block is used for writing WORD and UDINT value to remote drive dataset 129. The *D2D_REC* block is used to receive data to master drive.

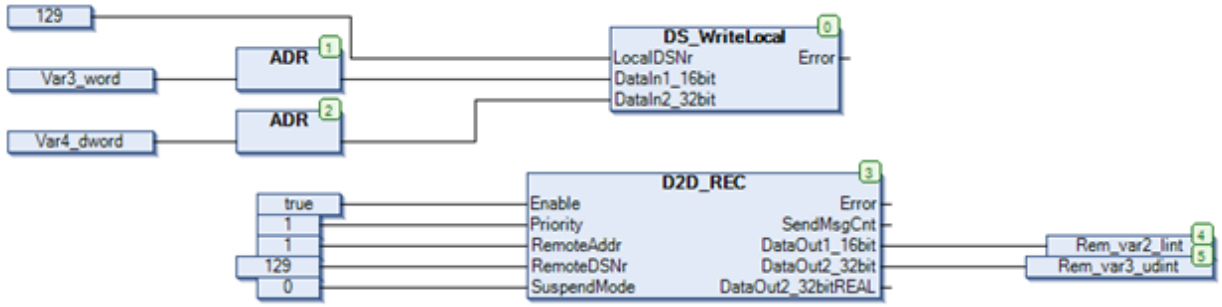


Figure 166: Receiving data using D2D_REC block

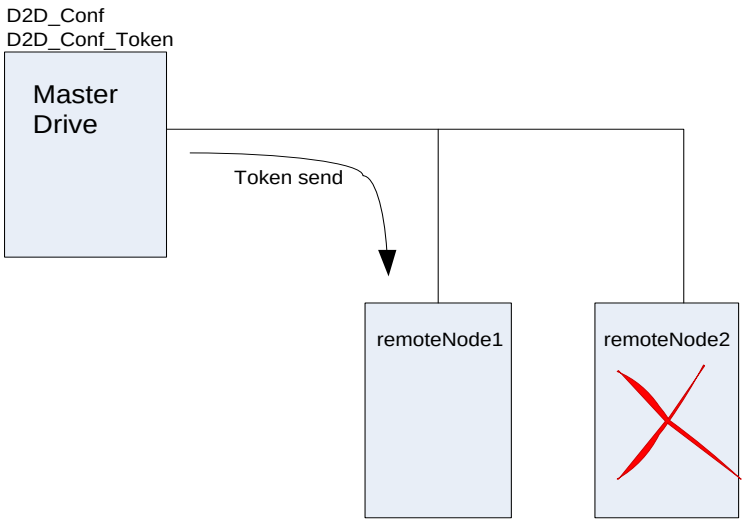
Example 2: Token send configuration blocks

This example describes how the *D2D_Conf_Token* and *D2D_Conf* blocks are used for sending tokens.

In token send configuration, the master drive configures the token. After the follower receives a token from the mater, the follower node sends follower to follower (point to point) or multicast message.

Using the *D2D_Conf_Token* block you can add a node into the token send configuration with own instance or common instance. The below examples is a common instance configuration using the ConfToken. When all the nodes are included the *D2D_Conf* is executed.

In this example, a previous configuration with the following nodes existed: *remoteNode1* and *remoteNode2*. A new configuration is set that includes only remoteNode1 for which *remoteNode2* must be removed from the existing configuration.



Each testStep represents a separately executed run cycle.

testStep(1) - *remoteNode1* is added into new configuration

testStep(3) - *remoteNode2* is removed from configuration

testStep(4) - D2D_Conf is invoked and starts sending token to *remoteNode1*

```
VAR
    ConfToken:      D2D_Conf_Token;
    ConfD2D:         D2D_Conf;
VAR_END

CASE testStep OF

      0:  // Initialize configuration blocks
       ConfToken(Enable:= FALSE);
       ConfD2D(Enable:= FALSE);
                  testStep:= testStep + 1;

      1:  // Add remoteNode1 into configuration set-up (on rising edge of
      Enable)
       ConfToken(Enable:= TRUE, TxmCycMultiplier:= 2, RemoteNode :=
      remoteNode1);
       testStep:= testStep + 1;

      2:  // Reset Enable pin
       ConfToken(Enable:= FALSE);
       testStep:= testStep + 1;

      3:  // Remove  remoteNode2 from configuration set-up, by setting
      TxmCycMultiplier:= 0
       ConfToken(Enable:= TRUE, TxmCycMultiplier:= 0, RemoteNode :=
      remoteNode2);
       testStep:= testStep + 1;

      4:  // Launch new D2D configuration on rising edge of Enable (start
      of communication with  remoteNode1)
       ConfD2D(Enable:= TRUE, TokenTxmCycle:= 1000);
       testStep:= testStep + 1;

      10: // Stop sending tokens (end of the communication)
       ConfD2D(Enable:= FALSE);
       testStep:= testStep + 1;
```

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Appendix E: ABB drives standard library

Contents of this chapter

This appendix contains detailed information of the basic and special functions of the ABB drives standard library (AS1LB_Standard_ACS880_V3_5)

Introduction to ABB drives standard library

The ABB drives standard library is intended to be used with the ACS880 drives and the AC500 PLC. It provides frequently used control elements for application programming in automation builder. Unlike the standard libraries provided by 3S-Smart Software Solutions, most of the function blocks in the library use floating point numbers. This provides a more flexible development environment as the programmer does not need to worry about handling wide numerical ranges and scaling.

The drive version of the library is generated from the PLC version to ensure that the code is not altered in any way. For compatibility, some functions are implemented as function blocks because the PLC does not support multiple outputs for functions. The functions do not have a state and thus require less memory. This is also why the drive version of the library has these blocks as functions (that is, there are 2 versions available in the drive version).

Input values are checked to be within the defined limits. If for some reason the block detects that a value is out of range, it can:

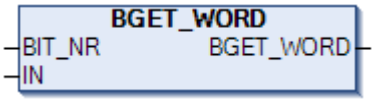
1. Limit the value to the maximum or minimum value. For example, if the time constant is set to a very large value or a negative value, it is limited inside the block to ensure the correct execution.
2. Produce an error signal. For example, if the low limit for the output is greater than the high limit, the block cannot operate and produces an error.

The function blocks with a state have a balance reference and balance mode. This feature provides the means to force the control system to a new state. By enabling the balance mode, the blocks operate as if the balance reference is the calculated output of the block. Internal variables are also adjusted so that once the balance mode is disabled the process continues from the balance reference value.

Basic functions

BGET

Summary



The BGET function reads one selected bit from a WORD or a DWORD (includes size check).

Connections

Inputs

Name	Type	Value	Description
BIT_NR	UINT	0…31	Bit number
IN	DWORD, WORD	ANY	Data input

Outputs

Name	Type	Value	Description
BGET	BOOL	TRUE, FALSE	Bit value

Function

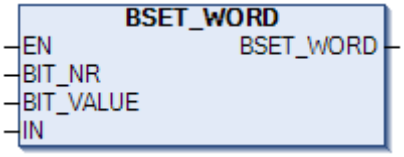
The output (BGET) is the selected bit (*BIT_NR*) of the input word (*IN*).

If *BIT_NR* is 0, the bit is 0. If *BIT_NR* is 31, the bit is 31.

If the bit number is not within the range of 0…31 (for DWORD) or 0…15 (for WORD), the output is 0.

BSET

Summary



The BSET function changes the state of one selected bit of a WORD or a DWORD (includes size check).

Connections

Inputs

Name	Type	Value	Description
EN	BOOL	TRUE, FALSE	Enable block
BIT_NR	UINT	0…31	Bit number
BIT_VALUE	BOOL	TRUE, FALSE	New value for bit
IN	DWORD, WORD	ANY	Data input

Outputs

Name	Type	Value	Description
BSET	DWORD, WORD	ANY	Changed word

Function

The value of a selected bit (*BIT_NR*) of the input (*IN*) is set as defined by the bit value input (*BIT_VALUE*).

If *BIT_NR* is 0, the bit is 0. If *BIT_NR* is 31, the bit is 31. The function must be enabled by the enable input (*EN*).

If the function is disabled or the bit number is not within the range of 0…31 (for DWORD) or 0…15 (for WORD), the input value is stored to the output as it is (that is, no bit setting occurs).

Example:

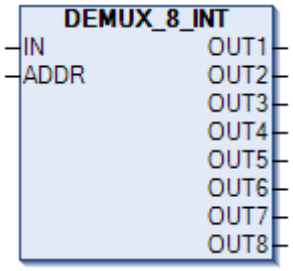
EN = 1, BIT_NR = 3, BIT_VALUE = 0

IN = 0000 0000 1111 1111

BSET = 0000 0000 1111 0111

DEMUX

Summary



The demultiplexer function block is available with 2, 4 and 8 inputs for the BOOL, DINT, INT, REAL and UDINT data types.

Since the block does not need internal memory, it also comes as a function (automation builder for PLC does not support multiple outputs for functions).

Connections

Inputs

Name	Type	Value	Description
IN	BOOL, DINT, INT, REAL, UDINT	ANY	Input
ADDR	UINT	1…8	Address

Outputs

Name	Type	Value	Description
OUT1…8	BOOL, DINT, INT, REAL, UDINT	ANY	Output 1…8

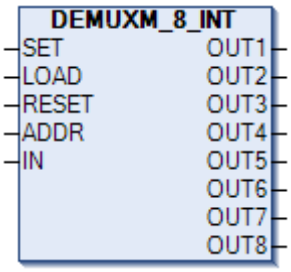
Function

The input value (I*N*) is stored to the output (*OUT1…8*) selected by the address input (*ADDR*). All other outputs are set to 0.

If the address input is not from 1 to 8, all outputs are set to 0.

DEMUXM

Summary



The demultiplexer function block with an internal memory to store output values is available with 2, 4 and 8 inputs for the BOOL, DINT, INT, REAL and UDINT data types.

Connections

Inputs

Name	Type	Value	Description
SET	BOOL	TRUE, FALSE	Set
LOAD	BOOL	TRUE, FALSE	Load (Set only once)
RESET	BOOL	TRUE, FALSE	Reset
ADDR	UINT	1…8	Address
IN	BOOL, DINT, INT, REAL, UDINT	ANY	Input

Outputs

Name	Type	Value	Description
OUT1…8	BOOL, DINT, INT, REAL, UDINT	ANY	Output 1…8

Function

DEMUXM is used as a demultiplexer with memory. It remembers the assigned values to outputs and continues sending them until changed or reset.

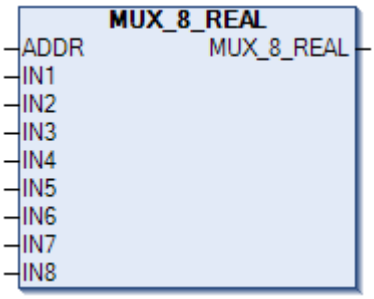
The input value (*IN*) is stored to the output (*OUT1…8*) selected by the address input (*ADDR*) if the load input (*LOAD*) or the set input (*SET*) is 1.

When the load input is set to 1, the input value is stored to the output only once. When the set input is set to 1, the input value is stored to the output every time the block is executed. The new set input overrides the load input.

If the address input is not from 1 to 8, the outputs are not affected by the input value.

If *RESET* = 1, all outputs are set to 0 and the block's memory is reset.

MUX



Summary

The multiplexer function for the REAL data type as the automation builder version does not support this type. The function block is available with 2, 4 and 8 inputs.

Connections

Inputs

Name	Type	Value	Description
ADDR	UINT	1…8	Address
IN1…8	REAL	ANY	Inputs 1…8

Outputs

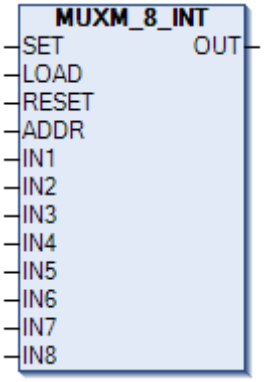
Name	Type	Value	Description
MUX	REAL	ANY	Selected input value

Function

The value of an input (*IN1…8*) is selected by the address input (*ADDR*) and stored to the output (*MUX*).

If the address input is not from 1 to 8, the output is set to 0.

MUXM



Summary

The multiplexer function block with an internal memory to store the output is available with 2, 4 and 8 inputs for the BOOL, DINT, INT, REAL and UDINT data types.

Connections

Inputs

Name	Type	Value	Description
SET	BOOL	TRUE, FALSE	Set
LOAD	BOOL	TRUE, FALSE	Load
RESET	BOOL	TRUE, FALSE	Reset
ADDR	UINT	0…8	Address
IN1…8	BOOL, DINT, INT, REAL, UDINT	ANY	Inputs 1…8

Outputs

Name	Type	Value	Description
OUT	BOOL, DINT, INT, REAL, UDINT	ANY	Output

Function

MUXM is used as a multiplexer with a memory. It remembers the assigned value of the output and continues sending it until changed or reset.

The value of an input (*IN1…8*) is selected by the address input (*ADDR*) and is stored to the output (*MUX*) if the *LOAD* input or the *SET* input is 1.

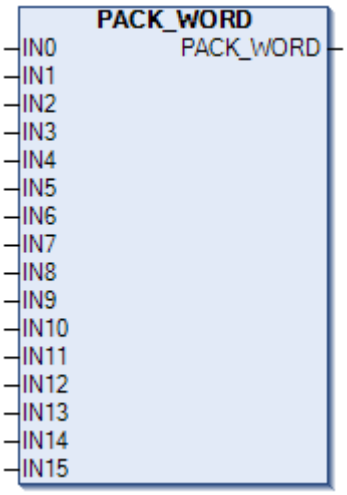
When the load input is set to 1, the input value is stored to the output only once. When the set input is set to 1, the input value is stored to the output every time the block is executed. The new set input overrides the load input.

If the address input is not from 1 to 8, the output is not affected by input value. If *RESET* = 1, the output is set to 0 and the block's memory is reset.

PACK

Summary

The PACK function sets the BOOL inputs into a WORD or a DWORD.



Connections

Inputs

Name	Type	Value	Description
IN0…31	BOOL	TRUE, FALSE	Bits

Outputs

Name	Type	Value	Description
PACK	WORD, DWORD	ANY	Resulting pack of bits

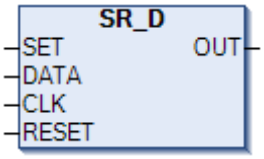
Function

The PACK function takes an input set of bits and packs it in to a word.

SR_D

Summary

The SR-D function block is an extension to a normal SR trigger with an additional memory input D trigger. The Reset signal overrides all other control signals and clears the internal block state. The Set signal forces the output to the TRUE state.



Connections

Inputs

Name	Type	Value	Description
SET	BOOL	TRUE, FALSE	Set Input
DATA	BOOL	TRUE, FALSE	Data Input
CLK	BOOL	TRUE, FALSE	Clock, rising edge active
RESET	BOOL	TRUE, FALSE	Reset

Outputs

Name	Type	Value	Description
OUT	BOOL	TRUE, FALSE	Output signal

Function

The SR-D block implements D trigger with the *SET*, *RESET* controls. The data is stored from D input when the clock changes from 0 to 1. The *SET* signal forces the output to the TRUE state. If R is active, the output is always FALSE. The *RESET* signal overrides all other control signals and clears the internal block state.

When the clock input (*CLK*) is set from 0 to 1, the *DATA* input value is stored to the output (*OUT*).

When *RESET* is set to 1, the output is set to 0.

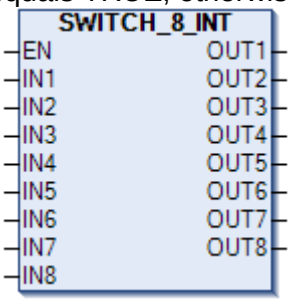
Truth table

SET	RESET	DATA	CLK	Previous output	OUT
Any	1	Any	Any	Any	0
1	0	Any	Any	Any	1
0	0	Any	0	Q_{n-1}	Q_{n-1}
0	0	0	0->1	Any	0
0	0	1	0->1	Any	1

SWITCH

Summary

The SWITCH function block sets the outputs the same as the input if *EN* equals TRUE, otherwise all outputs are 0. SWITCH is available with 2, 4 and 8 inputs and outputs for the BOOL, DINT, INT, REAL and UDINT data types.



Since the block does not need internal memory, it also comes as a function (automation builder for PLC does not support multiple outputs for functions).

Connections

Inputs

Name	Type	Value	Description
EN	BOOL	TRUE, FALSE	Enable
IN1…8	BOOL, DINT, INT, REAL, UDINT	ANY	Input 1…8

Outputs

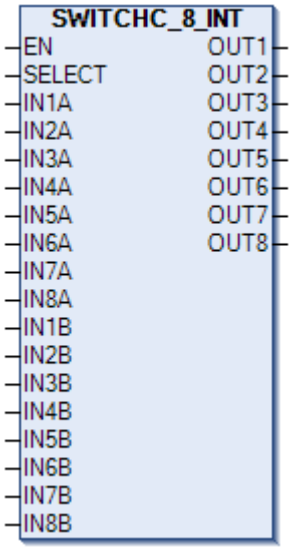
Name	Type	Value	Description
OUT1…8	BOOL, DINT, INT, REAL, UDINT	ANY	Output 1…8

Function

The output (*OUT1…8*) is equal to the corresponding input (*IN1…8*) if the block is enabled (*EN* = 1). Otherwise the output is 0.

SWITCHC

Summary



The SWITCHC function block has two channels. A channel can be chosen by using the Select signal. If Select equals FALSE, channel A is active. If Select equals TRUE, channel B is active. If the *EN* signal is not active, all outputs are 0. SWITCHC is available with 2, 4 and 8 input pairs and outputs for the BOOL, DINT, INT, REAL and UDINT data types.

Since the block does not need an internal memory, it also comes as a function (automation builder for PLC does not support multiple outputs for functions).

Connections

Inputs

Name	Type	Value	Description
EN	BOOL	TRUE, FALSE	Enable
SELECT	BOOL	TRUE, FALSE	Select
IN1…8A	BOOL, DINT, INT, REAL, UDINT	ANY	Input A 1…8
IN1…8B	BOOL, DINT, INT, REAL, UDINT	ANY	Input B 1…8

Outputs

Name	Type	Value	Description
OUT1…8	BOOL, DINT, INT, REAL, UDINT	ANY	Output A 1…8

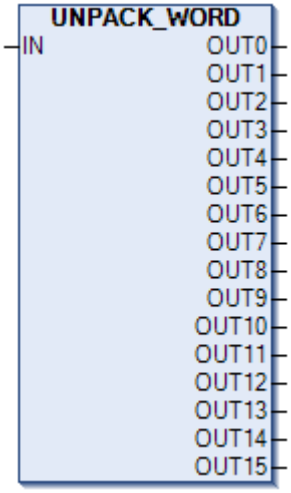
Function

The output (*OUT1…8*) is equal to the corresponding channel A input (*IN1…8A*) if the activate input signal (*SELECT*) is 0. The output is equal to the corresponding channel B input (*IN1…8B*) if the activate input signal (*SELECT*) is 1.

If the block is disabled (*EN* = 0), all outputs are set to 0.

UNPACK

Summary



The UNPACK function block splits a WORD or a DWORD into a set of BOOL outputs.

Since the block does not need an internal memory, it also comes as a function (automation builder for PLC does not support multiple outputs for functions).

Connections

Inputs

Name	Type	Value	Description
IN	WORD, DWORD	ANY	Input data

Outputs

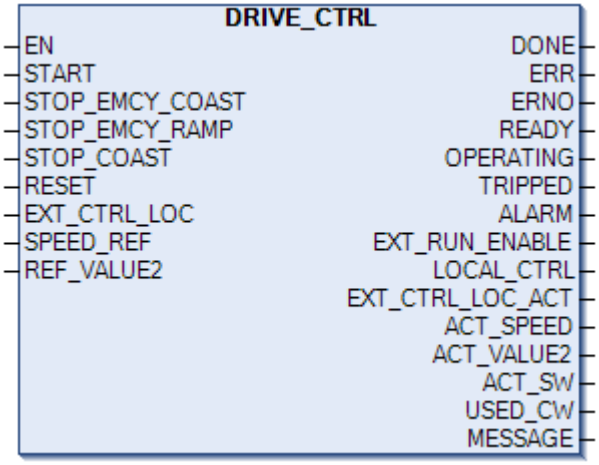
Name	Type	Value	Description
OUT0…31	BOOL	TRUE, FALSE	Output bits

Function

The Unpack function takes an input word and returns it as a set of bits.

Special functions

Drive control



Summary

The drive control program offers basic controls of an ACS880 drive for application programmers. A similar function block for the PLC to control the drive exist is in the PS553 library.

Connections

Inputs

Name	Type	Value	Description
EN	BOOL	TRUE, FALSE	Enable function block - TRUE. Additionally configures the drive to use the application program. See parameters 19.11, 20.1, 20.6, 22.11 and 26.11.
START	BOOL	TRUE, FALSE	TRUE = start drive FALSE = stop along currently active stop ramp. See parameter 6.2.0.
STOP_EMCY_COAST	BOOL	TRUE, FALSE	Emergency coast stop to drive: FALSE = stop by coast TRUE = no stop See parameter 6.2.1.
STOP_EMCY_RAMP	BOOL	TRUE, FALSE	Emergency stop to drive FALSE = stop by ramp TRUE = no stop See parameter 6.2.2.
STOP_COAST	BOOL	TRUE, FALSE	TRUE = coast stop FALSE = normal operation See parameter 6.2.3.
RESET	BOOL	TRUE, FALSE	Resets drive and internal parameter errors. See parameter 6.2.7.
EXT_CTRL_LOC	BOOL	TRUE, FALSE	Selects external control location (EXT1/EXT2). See parameters 6.2.11 and 19.11.
SPEED_REF	REAL	ANY	Speed reference value. See parameter 22.11.
REF_VALUE2	REAL	ANY	Torque reference value. See parameter 26.11.

Outputs

Name	Type	Value	Description
DONE	BOOL	TRUE, FALSE	Execution finished when output DONE = TRUE.
ERR	BOOL	TRUE, FALSE	Error occurred during execution when output ERR = TRUE
ERNO	ENUM	ANY	Internal error code
READY	BOOL	TRUE, FALSE	Ready to switch on See parameter 6.11.0
OPERATING	BOOL	TRUE, FALSE	Drive is operating.
TRIPPED	BOOL	TRUE, FALSE	Drive FAULT See parameter 6.11.3.
ALARM	BOOL	TRUE, FALSE	Drive has an alarm See parameter 6.11.7.
EXT_RUN_ENABLE	BOOL	TRUE, FALSE	Run enable status See parameter 6.18.5.
LOCAL_CTRL	BOOL	TRUE, FALSE	Drive control location: LOCAL See parameter 6.11.9.
EXT_CTRL_LOC_ACT	BOOL	TRUE, FALSE	Actual external control location EXT2 selected See parameter 6.16.11.
ACT_SPEED	REAL	ANY	Actual speed (in rpm) read from drive See parameter 1.01.
ACT_VALUE2	REAL	ANY	Actual torque (in %) read from drive See parameter 1.10.
ACT_SW	WORD	ANY	Main status word read from drive See parameter 6.11.
USED_CW	WORD	ANY	Application control word See parameter 6.02.
MESSAGE	ENUM	ANY	State of the function block

Function

The program uses drive parameters as an interface to the drive.

An application control word (06.02) is used to control the drive. It sets the EXT1 command (20.01) and EXT2 command (20.06) parameters to Application Program. The control word is defined in the ABB Drives control profile.

When the drive is in the operational state, the *OPERATING* output is set to TRUE to indicate the current state of the state machine.

The program is enabled by setting the *EN* signal to TRUE. Once active, the block sets the configuration parameters to the desired values once: Parameters 19.11, 20.01, 20.06, 22.11 and 26.11 are set to Application Program. The parameters are intentionally changed once enable to change them manually while the program is running.

The drive status is obtained from the Main status word (06.11) and Status word 1 (06.16). The actual speed (*ACT_SPEED*) and torque (*ACT_VALUE2*) data are obtained from parameters Motor speed used (01.01) and Motor torque % (01.10).

When the program is disabled, Application control word is set to 0 once.

If the EXT1 and EXT2 parameters are not set to the correct value while the program is enabled, an error is produced.

Error codes and the *ERR* outputs are internal program errors and not drive fault codes. Internal parameter errors do not prevent the program from functioning.

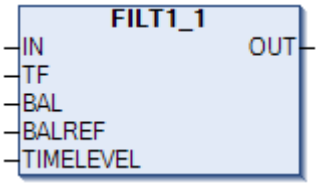
Limiting

Only one instance of drive control is allowed. This is why it is implemented as a program.

Filter

Summary

The FILT1_1 function block provides filtering of the high frequency part of the input signal. The block acts as a single-pole low pass filter for the REAL numbers. The balancing function permits the output signal to track an external reference.



Connections

Inputs

Name	Type	Value	Description
IN	REAL	ANY	Input signal for the actual value
TF	REAL	0…ANY	Filter time constant (ms)
BAL	BOOL	TRUE, FALSE	Balance input, activates the tracking mode.
BALREF	REAL	ANY	Value for the tracking mode
TIMELEVEL	INT	1…ANY	Task interval in milliseconds, default = 10 ms

Outputs

Name	Type	Value	Description
OUT	REAL	ANY	Filtered actual value

Function

The function filters the input signal using the current input and previous output.

The transfer function for a single-pole filter with no pass band gain is:

$$G(s) = 1/(1 + sTF) \qquad (1)$$

To get the function for the output, in the first step cross-multiply the equation:

$$O(s) * (1 + sTF) = 1 * I(s) \qquad (2)$$

Resolving the parenthesis gives:

$$O(s) + sTF * O(s) = I(s) \qquad (3)$$

To get the equation to the time domain *s* has to be replaced by derivation:

$$O(t) + TF * \dot{O}(t) = I(t) \qquad (4)$$

Since this is a first order approximation function block, the derivation can be replaced by a difference:

$$O(t) + TF * \left(\frac{O(t) - O(t-1)}{Ts}\right) = I(t) \qquad (5)$$

Where: *Ts* is the cycle time of the program in milliseconds (time difference between *t* and *t*-1).

The final filtering algorithm (6) is calculated by using the following formula that is obtained from (5) by extracting *O(t)*:

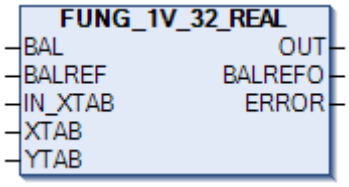
$$O(t) = \frac{I + (TF / Ts) * O(t-1)}{TF / Ts + 1} \qquad (6)$$

If *TF* = 0 or negative, the output value is set to the input value.

Because of the REAL data type limitation, the *TF/Ts* ration is limited to 8000000, to ensure that it is always possible to add 1 to the real value.

Function generator

Summary



The FUNG_1V function block is used for generation of an optional function of one variable, y = f(x). The function is described by a number of coordinates. Linear interpolation is used for values between these coordinates. An array of 8, 16 or 32 coordinates can be specified. The balancing function permits the output signal to track an external reference and gives a smooth return to the normal operation.

Since the block does not need an internal memory, it also comes as a function (automation builder for PLC does not support multiple outputs for functions).

Connections

Inputs

Name	Type	Value	Description
BAL	BOOL	TRUE, FALSE	Input for activation of the balancing mode
BALREF	REAL	ANY	Balance reference Input for the reference value in the balancing mode
IN_XTAB	REAL	ANY	Input signal for the function
XTAB	REAL[N]	ANY	Table of X coordinates for the function
YTAB	REAL[N]	ANY	Table of Y coordinates for the function

Outputs

Name	Type	Value	Description
OUT	REAL	ANY	Value of the function
BALREFO	REAL	ANY	TRUE if the high limit is reached.
ERROR	BOOL	TRUE, FALSE	TRUE when the input is outside the table range or when the table contains unsorted (low to high) data for the input coordinates.

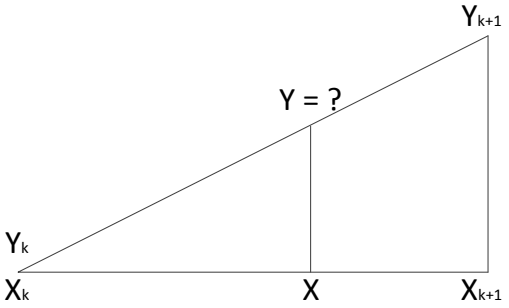
Function

The function generator FUNG_1V calculates output signal Y for a value at input X. Calculation is performed in accordance with a piece-by-piece linear function which is determined by vectors XTAB and YTAB. For each X value in XTAB, there is a corresponding Y value in YTAB. The Y value at the output is calculated by means of linear interpolation of the XTAB values, between which lies the value of input X. The values in XTAB must increase from low to high in the table.

The output of the block depends only on the current input values, in other words, it does not have any state.

Interpolation

The generated function is performed as follows:



$$Y = Y_k + \frac{(X - X_k)(Y_{k+1} - Y_k)}{(X_{k+1} - X_k)}$$

Balancing

If *BAL* is set to TRUE, the value at Y is set to the value of the *BALREF* input. The X value which corresponds to this Y value is obtained at the *BALREFO* output. On balancing, the X value is calculated by interpolation in the same way the Y value is calculated during the normal operation. To permit balancing, the values in YTAB must increase from low to high in the table.

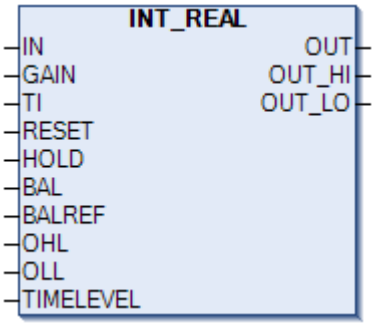
Limiting

If input signal X is outside the range defined by XTAB, the Y value is set to the highest or lowest value in YTAB. If *BALREF* is outside the YTAB value range in the *BAL* mode, the value at Y is set to the value at the *BALREF* input and *BALREFO* is set to the highest or lowest value in XTAB.

Integrator

Summary

The INT_REAL function block integrates the input. The output signal can be limited within limit values. The balancing function permits the output signal to track an external reference and gives a smooth return to the normal operation.



Connections

Inputs

Name	Type	Value	Description
IN	REAL	ANY	Input signal for the actual value
GAIN	REAL	ANY	Gain input
TI	REAL	0…ANY	Integration time (ms)
RESET	BOOL	TRUE, FALSE	Clear integrated value
HOLD	BOOL	TRUE, FALSE	Stops integration when set to TRUE
BAL	BOOL	TRUE, FALSE	Balance input, activates the tracking mode
BALREF	REAL	ANY	Value for the tracking mode
OHL	REAL	ANY	High input limit
OLL	REAL	ANY	Low input limit
TIMELEVEL	INT	1…ANY	Task interval in milliseconds, default = 10 ms

Outputs

Name	Type	Value	Description
OUT	REAL	ANY	Output value
OUT_HI	BOOL	TRUE, FALSE	TRUE if the high limit is reached.
OUT_LO	BOOL	TRUE, FALSE	TRUE if the low limit is reached.

Function

The INT function can be written in the time plane as:

$$O(t) = K / T_i (\int I(t) dt)$$

The main controlled property is that the output signal retains its value when the input signal *I(t)* = 0.

Clearing

The integrated value is cleared when *RESET* = TRUE (all internal variables are cleared).

Tracking

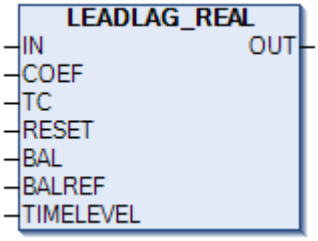
If *BAL* is set to TRUE, the integrator immediately goes into the tracking mode and the output value is set to the value of the *BALREF* input. If the value at *BALREF* exceeds the output signal limits, the output is set to the applicable limit value. On return to the normal operation from the tracking mode, integration continues from the tracking reference.

Limiting

The output value is limited between *OHL* and *OLL*. If the actual value exceeds the upper limit, the *OUT_HI* output is set to TRUE. If it falls below the lower limit, the *OUT_LO* output is set to TRUE. If the limits have incorrect values, both *OUT_HI* and *OUT_LO* are set to TRUE.

Lead lag

Summary



The LEADLAG_REAL function block is used to filter the input signal and provide a phase shifted output. This block acts as a lead/lag filter based on the *COEF* input value.

Connections

Inputs

Name	Type	Value	Description
IN	REAL	ANY	Input signal for the function block
COEF	REAL	ANY	Constant that determines the filter type
TC	REAL	0…ANY	Time constant (ms)
RESET	BOOL	TRUE, FALSE	Resets the function block
BAL	BOOL	TRUE, FALSE	Activates the balance mode
BALREF	REAL	ANY	Balance reference Input for the reference value in the balancing mode.
TIMELEVEL	INT	1…ANY	Task interval in milliseconds, default = 10 ms

Outputs

Name	Type	Value	Description
OUT	REAL	ANY	Output signal

Function

The transfer function for the lead/lag filter is:

$$\frac{1+\alpha T_c s}{1+T_c s}$$

The lead/lag filter has two input parameters *TC* and *α* (*COEF*):

If *α* > 1, the filter acts as a lead filter.

If *α* < 1, the filter acts as a lag filter.

If *α* = 1, no filtering is applied.

The filter algorithm is calculated using the following formula:

dn = X - B1*dnMem

Y = A0*dn + A1*dnMem

dnMem = dn

Where,

A0 = (1 + *α***Tc*) / (1 + *Tc*),

A1 = (1 - *α***Tc*) / (1 + *Tc*),

B1 = (1 - *Tc*) / (1 + *Tc*)

X is the input signal.

Y is the output signal.

The initial value of *dnMem* is set to zero.

Note: If *α* or *TC* input to the block is negative, the corresponding negative input is assigned to zero before the filter algorithm is calculated.

Because of the REAL data type limitation, the TC/Ts ration is limited to 8000000, to ensure that it is always possible to add 1 to the real value

Balancing

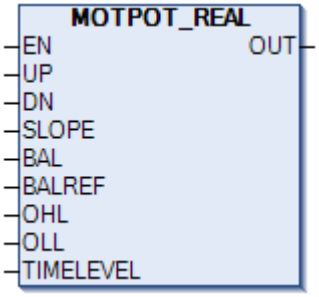
If *BAL* is set to TRUE, the value at Y is set to the value of the *BALREF* input. The block operates normally during this time which means that the internal variable is always calculated.

Reset

If *RESET* is set to TRUE, the internal variable *dnMem* is set to zero and input value X is returned.

Motor potentiometer

Summary



The MOTPOT_REAL (motor potentiometer) function block is used to generate the reference based on the activation of the Boolean (*UP* and *DN*) inputs. The rate of change of a reference signal is controlled by the slope time and limits. The current value is retained after a power cycle.

Connections

Inputs

Name	Type	Value	Description
EN	BOOL	TRUE, FALSE	Enables operations.
UP	BOOL	TRUE, FALSE	Enables count up
DN	BOOL	TRUE, FALSE	Enables count down.
SLOPE	UINT	0..65535	Delay time to count from *OLL* to *OHL* and vice versa
BAL	BOOL	TRUE, FALSE	Sets the output to *BALREF* or limit if it exceeds the limit.
BALREF	REAL	ANY	Sets the output value when he *BAL* input is active.
OHL	REAL	ANY	High input limit
OLL	REAL	ANY	Low input limit
TIMELEVEL	INT	1…ANY	Task interval in milliseconds, default = 10 ms

Outputs

Name	Type	Value	Description
OUT	REAL	ANY	Output value

Function

The MOTPOT functional block is used to control the rate of change of an output reference signal. Digital inputs are normally used as the *UP* and *DOWN* inputs.

The rate of change of a reference signal is controlled by the slope time parameter. If the enable pin (*EN*) is set to TRUE, the reference value rises from minimum to maximum during the slope time.

EN turns on the MOTPOT function. If *EN* is set to FALSE, the output is zero. Based on the *UP* or *DN* inputs getting activated, the output reference increases or decreases to the maximum or minimum value based on the slope. If both *UP/DN* inputs are activated / deactivated, the output is neither incremented nor decremented and is in a steady state.

Clearing

When *EN* is set to FALSE, the output and internal values are set to zero.

Tracking

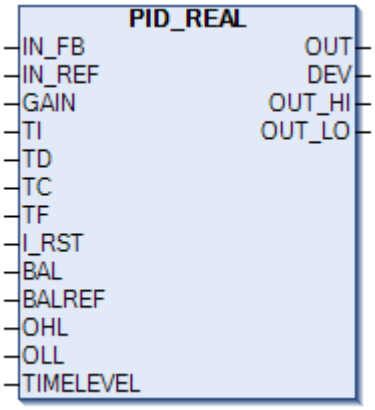
If *BAL* is set to TRUE, the output is set to the value of the *BALREF* input. If the value at *BALREF* exceeds the output signal limits, the output is set to the applicable limit value.

Limiting

The output value is limited between *OHL* and *OLL*. If the actual value exceeds the upper limit, the output is set to the *OHL* input value. If it falls below the lower limit, the output is set to the *OLL* input value.

PID

Summary



The PID_REAL (Proportional-Integral-Derivative) element can be used as a generic PID regulator in feedback systems. The main extension of the element is that a derivative correction term with a filter is included. Another major extension is the antiwindup protection. The output signal can be limited with limit values specified at special inputs (*OHL* and *OLL*). The balancing function permits the output signal to track a gradual return to the normal operation. After any parameter change or error condition, the integral term of the correction is readjusted so that the output does not change abruptly (“bumpless transfer”).

Connections

Inputs

Name	Type	Value	Description
IN_FB	REAL	ANY	Actual input value
IN_REF	REAL	ANY	Reference input value
GAIN	REAL	ANY	Proportional gain
TI	REAL	0.. ANY	Integration time (ms)
TD	REAL	0.. ANY	Derivation time (ms)
TC	REAL	0.. ANY	Anti-windup correction time (ms)
TF	REAL	0.. ANY	Filter time (ms)
I_RST	BOOL	TRUE, FALSE	Clear integrator
BAL	BOOL	TRUE, FALSE	Balance input, activates the tracking mode.
BALREF	REAL	ANY	Value for the tracking mode
OHL	REAL	ANY	High input limit
OLL	REAL	ANY	Low input limit
TIMELEVEL	INT	1…ANY	Task interval in milliseconds, default = 10 ms

Outputs

Name	Type	Value	Description
OUT	REAL	ANY	Output signal
DEV	REAL	ANY	Deviation (*IN_FB - IN_REF*)
OUT_HI	BOOL	TRUE, FALSE	TRUE if the high limit is reached.
OUT_LO	BOOL	TRUE, FALSE	TRUE if the low limit is reached.

Function

The differential equation describing the PID controller before saturation/limitation that is implemented in this block is:

$OUT_{presat}(t) = Up(t) + Ui(t) + Ud(t)$

Where:

OUT_{presat} is the PID output before saturation

Up is the proportional term

Ui is the integral term with saturation correction

Ud is the derivative term

t is time.

The proportional term is:

$Up(t) = Kp * DEV(t)$

Where:

$Kp = P$ is the proportional gain of the PID controller

$DEV(t)$ is the control deviation (see below).

The integral correction term is:

$$Ui(t) = \frac{Kp}{Ti} * \int_0^t DEV(\tau)d\tau + Kc * (OUT(t) - OUT_{presat}(t))$$

Where:

Kc = integral antiwindup correction gain of the PID controller

$OUT(t)$ = saturated/limited output signal of the controller

The antiwindup correction

$K_c * \left(OUT(t) - OUT_{presat}(t)\right)$ is thus taken to be part of the integral correction term.

Windup is a phenomenon that is caused by the interaction of an error integral action and saturations. All actuators have limitations: a motor has limited speed, a valve cannot be more than fully opened or fully closed, and so on. For a control system with a wide range of operating conditions, it is possible that the control variable reaches the actuator limits. When this happens, the feedback loop is broken and the system runs as an open loop because the actuator remains at its limit independently of the process output. If a controller with the integrating action is used, the error continues to be integrated. This means that the integral term may become very large or, in other words, it “winds up”. It is then required that the error has the opposite sign for a long period before things return to normal. The consequence is that any controller with the integral action may give large transients when the actuator saturates.

The derivative term is:

$$Ud(t) = Kp * Td * \frac{d(DEV(t))}{dt}$$

Where:

Td is the derivative time constant.

The differential equations above are transformed into difference equations by backward approximation.

This term is also filtered to make it resistant to high frequency noise.

$$G(s) = 1/(1 + s * TF)$$

Smooth transfer

The controller guarantees a smooth transfer in many special situations where, for example, control parameters are abruptly changed. This means that in such a bumpless cycle the output retains its previous value. This is performed by resetting the integrator term *Ui* to:

$$Ui(t) = OUT(t) - Up(t) - Ud(t).$$

Smooth functionality is not triggered in the first cycle by change in *Ti*, *Tc*, *Td* and *Tf*.

Gain, time constants

The proportional gain *Kp* is directly an input parameter. The integrator, derivative and antiwindup gains *Ki*, *Kd* and *Kc* must be calculated from the corresponding time constants *Ti*, *Td* and *Tc* which are input parameters. The derivative gain is:

$$Kd = {}^{Td}/_{T}$$

Where:

T is the time level (execution cycle) of the block (in milliseconds as the time constants).

The integral gain is determined from *Ti* as follows:

$Ki = 0$, if $Ti = 0$

$Ki = {}^{T}/_{Ti}$, if $T < Ti$

$Ki = 1$, if $T \geq Ti > 0$

The anti-windup gain is determined similarly by Tc:

$Kc = 0$, if $Tc = 0$

$Kc = {}^{T}/_{Tc}$, if $T < Tc$

$Kc = 1$, if $T \geq 0$

Thus the values of Ki and Kc are limited to the range 0 ≤ Ki, Ti ≤ 1.

If Tc = 0, Kc = 0 and anti-windup correction is disabled.

If Ti = 0, Ki = 0. The module does not update the integral term *Ui*, not even by the anti-windup correction. Thus the integrator term retains its original value as long as Ki remains zero.

The element stores the “current” set of gains Kp, Ki, Kc and Kd and time constants Ti, Tc and Td, which it uses for calculating the control output(s).

Filtering

This derivative is filtered using a single-pole low pass filter. The following algorithm is used to calculate the filtered value:

$$y(t) = \frac{Kd * \left(Up(t) - Up(t-1)\right) + \frac{T_f}{T} * y(t-1)}{1 + \frac{T_f}{T}}$$

Where,

T is the time level (execution time) of the block (in milliseconds as the time constants).

If the filter time constant is left unassigned, it defaults to 0 which means that the derivative is calculated without filtering. The time constant is limited to 8000000*time level to avoid underflow.

Tracking

If *BAL* is set to TRUE, the regulator goes into the tracking mode and the output follows the value at *BALREF*. If the value at *BALREF* exceeds the output signal limits (*OLL* and *OHL*), the output is set to the applicable limit value. The return from the tracking state is bump less.

Limitation function

The limitation function limits the output signal to the value range from *OLL* to *OHL*. If the pre-saturated output exceeds *OHL*, *OUT* is set to *OHL* and *OUT_HI* is set to TRUE. If the pre-saturated output falls below *OLL*, *OUT* is set to *OLL* and *OUT_LO* is set to TRUE. Bump less return from limitation is requested if and only if the anti-windup correction is not in use, that is,. *Ki* = 0 or$Kc = 0$.

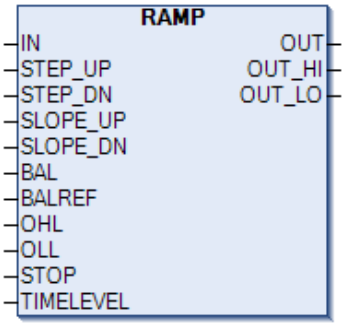
IF *OLL* < *OHL,* both *OUT_HI* and *OUT_LO* are set to TRUE and *OUT* retains the value that it had in the execution cycle before the error occurred. After this error, the return to the normal operation is smooth

Limiting

The output value is limited between *OHL* and *OLL*. If the actual value exceeds the upper limit, *OUT_HI* is set to TRUE. If it falls below the lower limit, *OUT_LO* is set to TRUE.

Ramp

Summary



The RAMP is used to limit the rate of change of a signal. The output signal can be limited with limit values specified at special inputs. The balancing function permits the output signal to track an external reference.

Connections

Inputs

Name	Type	Value	Description
IN	REAL	ANY	Input signal for the actual value
STEP_UP	REAL	0.. ANY	The greatest allowed positive STEP change
STEP_DN	REAL	0.. ANY	The greatest allowed negative STEP change
SLOPE_UP	REAL	0.. ANY	Positive ramp for the output
SLOPE_DN	REAL	0.. ANY	Negative ramp for the output
BAL	BOOL	TRUE, FALSE	Balance input, activates the tracking mode.
BALREF	REAL	ANY	Balance reference Input for the reference value in the tracking mode
OHL	REAL	ANY	High input limit
OLL	REAL	ANY	Low input limit
STOP	BOOL	TRUE, FALSE	Holds the output (stops ramping)
TIMELEVEL	INT	1…ANY	Task interval in milliseconds, default = 10 ms

Outputs

Name	Type	Value	Description
OUT	REAL	ANY	Output value
OUT_HI	BOOL	TRUE, FALSE	TRUE if the high limit is reached
OUT_LO	BOOL	TRUE, FALSE	TRUE if the low limit is reached

Function

The main property of the RAMP element is that the output signal tracks the input signal, while the input signal is not changed more than the value specified at the step inputs. If the input change is greater than the specified step changes, the output signal is first changed by *STEP_UP* or *STEP_DN* depending on the direction of change. After that the output signal is changed by *SLOPE_UP* or *SLOPE_DN* per second, until the values at the input and output are equal. This means that if *STEP_DN* = *STEP_UP* = 0, a pure ramp function, that is, SLOPE/sec is obtained at the output. The greatest step change allowed at the output is specified by the *STEP_UP* and *STEP_DN* inputs for the respective direction of change.

All parameters are specified as absolute values with the same unit as the input. Slopes specify the change in units per second. Certain constants are pre-calculated to make the execution time of the element as short as possible. The results are stored internally in the element. These constants are recalculated if the *SLOPE_UP* or *SLOPE_DN* values are changed.

Calculation of the output

If Input (*t*) = Output (*t*-1), then Output (*t*) = Input (*t*)

If Input (*t*) > Output (*t*-1), then the change of the output O value is limited as follows:

- An internal auxiliary variable VPOS follows the input value with the maximum rate of change defined by *SLOPE_UP*. If the input value is greater than VPOS + *STEP_UP*, the output value is limited to the value VPOS +*STEP_UP*. If the input value is less than VPOS + *STEP_UP*, the output value is set to be equal to the input.

If *SLOPE_UP* = 0, the output value does not rise no matter what the value of *STEP_U*P and *IN* is.

If Input (*t*) < Output (*t*-1), then the change of the Output value is limited as follows:

- An internal auxiliary variable VPOS follows the input value, with the maximum rate of change defined by *SLOPE_DN*. If the input value is less than VPOS – STEP_DN, the output value is limited to the value VPOS – *STEP_DN*. If the input value is greater than VPOS – *STEP_DN*, the output value is set to be equal to the input.

If *SLOPE_DN* = 0, the output value does not lower no matter what the value of *STEP_DN* and *IN* is.

Tracking

If *BAL* is set to TRUE, the ramp immediately goes into the tracking mode and the output is set to the value of *BALREF*. If the value at *BALREF* exceeds the output signal limits, the output is set to the applicable limit value. During the tracking mode VPOS = Output = *BALREF*. The return to the normal operation is done as if a unit step had occurred at the input.

Limiting

The limitation function limits the output signal to the values at the *OHL* inputs for the upper limit and *OLL* for the lower limit. If the actual value exceeds the upper limit, *OUT_HI* is set to TRUE. If it falls below the lower limit, *OUT_LO* is set to TRUE. In the limiting state VPOS(*t*) and OUT(*t)* are set to the applicable limit value.

IF *OLL* < *OHL*, both *OUT_HI* and *OUT_LO* are set to TRUE and *OUT* retains the value that it had in the execution cycle before the error occurred.

Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/searchchannels.

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