Starting up the Axioline F bus coupler for EtherCAT® using TwinCAT®

User manual

PHOENIX CONTACT
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User manual

Starting up the Axioline F bus coupler for EtherCAT® using TwinCAT®

UM EN AXL F BK EC + TWINCAT, Revision 04 2017-04-25

This user manual is valid for:

Designation	Order No.
AXL F BK EC	2688899

8620_en_04

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1 For your safety

Read this user manual carefully and keep it for future reference.

1.1 Labeling of warning notes

This symbol indicates hazards that could lead to personal injury.
There are three signal words indicating the severity of a potential injury.

DANGER
Indicates a hazard with a high risk level. If this hazardous situation is not avoided, it will result in death or serious injury.

WARNING
Indicates a hazard with a medium risk level. If this hazardous situation is not avoided, it could result in death or serious injury.

CAUTION
Indicates a hazard with a low risk level. If this hazardous situation is not avoided, it could result in minor or moderate injury.

This symbol together with the **NOTE** signal word alerts the reader to a situation which may cause damage or malfunction to the device, hardware/software, or surrounding property.

Here you will find additional information or detailed sources of information.

1.2 Qualification of users

The use of products described in this user manual is oriented exclusively to:

– Qualified electricians or persons instructed by them. The users must be familiar with the relevant safety concepts of automation technology as well as applicable standards and other regulations.
– Qualified application programmers and software engineers. The users must be familiar with the relevant safety concepts of automation technology as well as applicable standards and other regulations.

2 About this document

2.1 Purpose of this manual

This user manual helps you to start up Axioline F modules on the Axioline F bus coupler for EtherCAT® using examples.

The TwinCAT® software from Beckhoff is used.

In this manual the TwinCAT® software is used as programming software and as soft-PLC application.

The examples show how to start up a selection of Axioline F I/O modules; however, the explanations can be transferred to every other I/O module of the Axioline F product range.

2.2 Aspects covered

This document covers the following aspects:

- Configuration of the network card for TwinCAT® operation
- Import of the device description files into the TwinCAT® software
- General settings for the master mode in TwinCAT®
- Automatic creation of the bus topology
- Manual creation of the bus topology
- Use of Axioline F modules with the EtherCAT® bus coupler
- User project that shows how process data is linked from hardware to software

2.3 Resources required

The following hardware and software is required to understand the example described in this user manual:

- A PC system that meets the software requirements
- Windows NT/2000/XP/Vista, Windows 7
- A network card with a network chipset that was released by the EtherCAT® User Organization (when the Soft-PLC is used).
- Software system TwinCAT® V2.11 (see Table 2-2 “Software used in the example”)
- EtherCAT® bus coupler (see Table 2-1 “Hardware used in the example”)
  + ESI device description file
- Axioline F modules (see Table 2-1 “Hardware used in the example”)

2.4 Hardware and software used in the example

Table 2-1 Hardware used in the example

Description	Type	Order No.
Axioline F, bus coupler, EtherCAT®, RJ45 socket, transmission speed in the local bus 100 Mbps, degree of protection IP20, including bus base module and Axioline F connector	AXL F BK EC	2688899
Axioline F, digital input module, digital inputs: 32, 24 V DC, connection technology: 1-wire, transmission speed in the local bus 100 Mbps, degree of protection IP20, including bus base module and Axioline F connectors	AXL F DI32/1 1F	2688035
Axioline F, digital output module, digital outputs: 32, 24 V DC, 500 mA, connection technology: 1-wire, transmission speed in the local bus 100 Mbps, degree of protection IP20, including bus base module and Axioline F connectors	AXL F DO32/1 1F	2688051
Axioline F analog input module, 8 inputs: 0-10 V, ±10 V, 0-20 mA, 4-20 mA, ±20 mA, 2-wire connection technology (including bus base module and connectors)	AXL F AI8 1F	2688064
Axioline F, analog output module, analog outputs: 8, 0 V ... 5 V, -5 V ... 5 V, 0 V ... 10 V, -10 V ... 10 V, 0 mA ... 20 mA, 4 mA ... 20 mA, -20 mA ... 20 mA, connection technology: 2-wire, transmission speed in the local bus 100 Mbps, degree of protection IP20, including bus base module and Axioline F connectors	AXL F AO8 1F	2688080
Axioline F temperature module, 8 inputs for connecting resistance temperature detectors (including bus base module and connectors)	AXL F RTD8 1F	2688077
Axioline F function module, 1 SSI interface for an absolute encoder, 1 analog output: 0-10 V, ±10 V, 0-5 V, ±5 V, 0-20 mA, 4-20 mA, ±20 mA, 2-wire connection technology (including bus base module and connectors)	AXL F SSI1 AO1 1H	2688433

For more detailed information on the modules used, please refer to the corresponding documentation. It can be downloaded at phoenixcontact.net/products.

Table 2-2 Software used in the example

Description	Type	Order No.
TwinCAT® software system from Beckhoff	TwinCAT®	Depending on the license

Please refer to the online help of the associated documentation for detailed information on the software.

2.5 Axioline F bus coupler for EtherCAT®

The bus coupler provides the interface between the EtherCAT® system and the I/O modules of the Axioline F product range. It creates the bus signal configuration and the current supply required for the connected bus topology. The bus coupler is currently available for connecting copper cables.

The bus coupler supports all modules of the Axioline F product range from Phoenix Contact.

For detailed information on the bus coupler, please refer to the module-specific data sheet.

2.6 Software TwinCAT® V2.11

The TwinCAT® software system consists of several components; the following of which will be used in the example:

TwinCAT® System Manager

– Configuration tool
– Bus configuration and master settings

TwinCAT® PLC Control

– Development environment for your controller
– Declaration of variables and programming of the user project

Both parts are installed with an integrated help which you can use in addition to this user manual.

Table 2-3 Overview of the individual tasks and the software part used

Task	Software part	Section
Configuring the network card	TwinCAT® System Manager	3
Creating the bus topology	TwinCAT® System Manager	4
Creating a user project	TwinCAT® PLC Control TwinCAT® System Manager	6
Creating an application program	TwinCAT® PLC Control	6
Linking the application program with the bus topology	TwinCAT® System Manager	6.2
Starting the user project	TwinCAT® PLC Control	6.3

3 Configuring the network card for Soft-PLC operation

In order to communicate with the EtherCAT® hardware and to use the PC system as a Soft-PLC, you have to install a network driver supplied by TwinCAT® for the network card.

Configuring the network card as a TwinCAT® interface

- Open the TwinCAT® System Manager.
- Open the “Options” menu item.
- Select the item “Show Real Time Ethernet Compatible Devices…”.

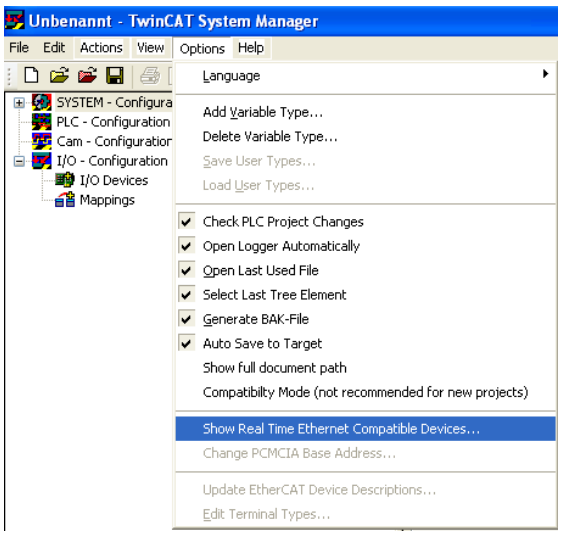

Figure 3-1 “Options, Show Real Time Ethernet Compatible Devices…” menu item

Network cards that are available

An overview of the available network cards is given.

- Select a card that is listed under “Compatible devices”.

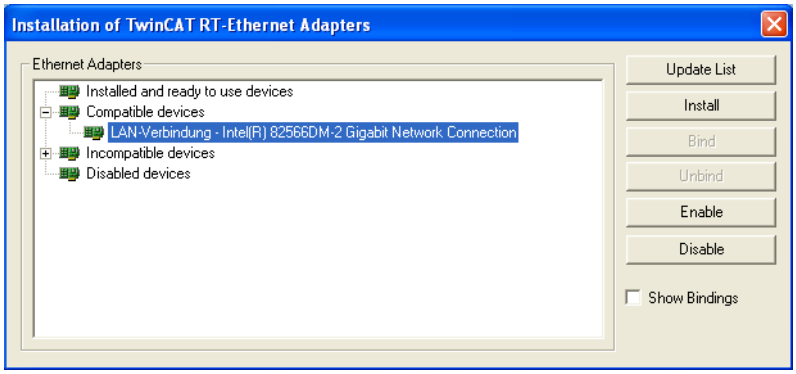

Figure 3-2 Selecting the network card

You can also use any network card that is listed under "Incompatible devices". However, these network cards won't enable realtime communication, high performance.

Installing the driver

- Click the “Install” button to install the driver of the network card for TwinCAT® operation.

After installation the network card is shown under “Installed and ready to use devices”.

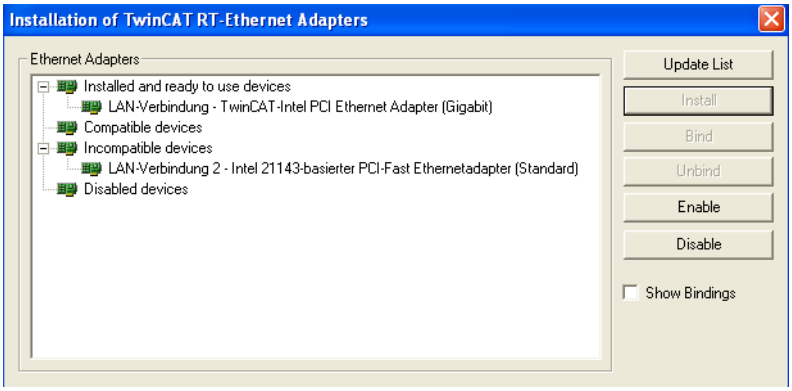

Figure 3-3 Installed network card

4 Mapping the connected EtherCAT® bus topology to the TwinCAT® System Manager

The entire bus topology is mapped and configured in the TwinCAT® System Manager. There are basically two ways of creating a bus topology in the TwinCAT® System Manager:

1. Reading in the bus topology automatically
2. Creating the bus topology manually

4.1 Requirements

Regardless of which way you use, the following is assumed:

– The network card is configured (see Section “Configuring the network card for Soft-PLC operation” on page 11).
– The device description file has been imported.
– A new project has been created.

4.1.1 Importing the EtherCAT® ESI device description file

In order to use the Axioline F bus coupler for EtherCAT®, you must import the ESI device description file in the TwinCAT® software. The software uses the ESI file to interpret the EtherCAT® hardware functions.

You can download the ESI file from the Phoenix Contact homepage under the downloads for the bus coupler.

- Download the EtherCAT® ESI file with the file extension *xml* from the homepage phoenixcontact.net/products.
- Copy the ESI file into the existing EtherCAT® I/O directory.
  For standard installations this is the “C:\TwinCAT®\Io\EtherCAT” directory.

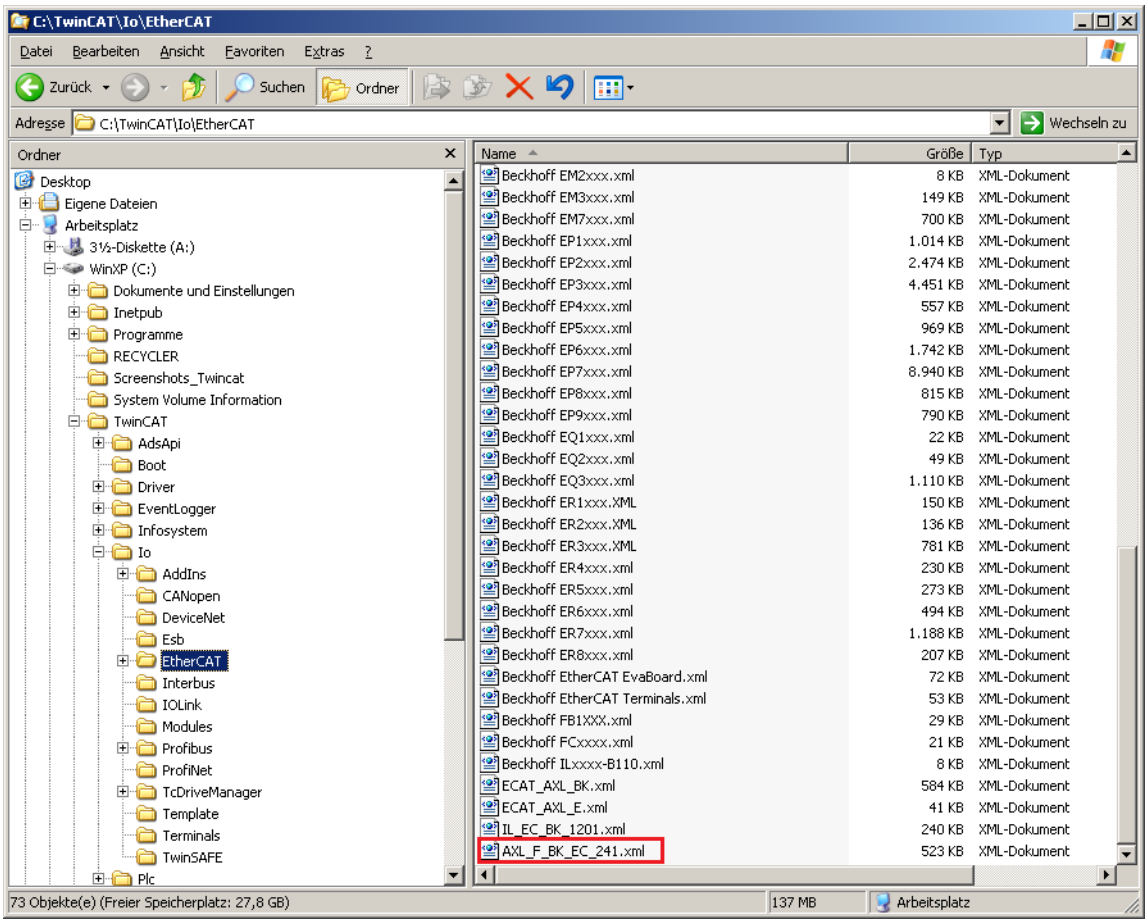

Figure 4-1 Importing the ESI device description file

- Restart the TwinCAT® System Manager.

The ESI device description file is automatically imported into the TwinCAT® device catalog.

The import is shown in the message window.

4.1.2 Creating a new project

- Select the “File, New” menu item to create a new project.

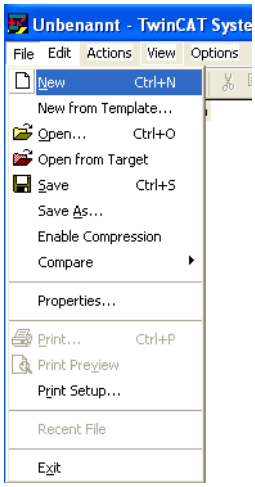

Figure 4-2 Creating a new project

You can either read in the structure or configure it manually.

To do so, proceed as described in the following sections.

– “Reading in the connected EtherCAT® bus topology automatically” on page 16
– or
– “Creating the connected EtherCAT® bus topology manually” on page 19

4.2 Reading in the connected EtherCAT® bus topology automatically

4.2.1 Searching for connected hardware

- In order to search for connected hardware, open the context menu by right-clicking on “I/O Devices”.
- Select the “Scan Devices…” menu item.

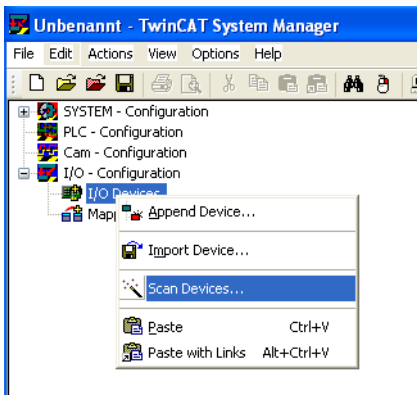

Figure 4-3 “I/O Devices, Scan Devices...” menu item

- Confirm the message with the hint.

Figure 4-4 Confirm the message

4.2.2 Selecting the network card

- In the window that appears, select the network card used and confirm your selection with OK.

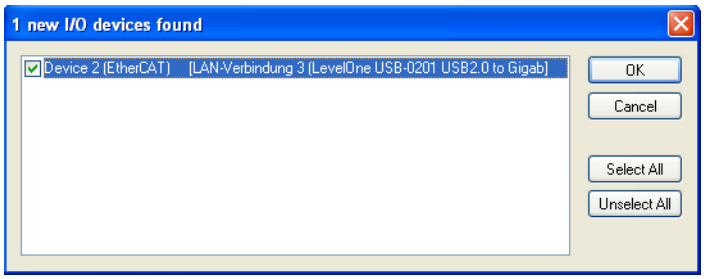

Figure 4-5 Selecting the network card

The bus medium is automatically inserted in the bus topology (in Figure 4-6 “Device 1 (EtherCAT)”).

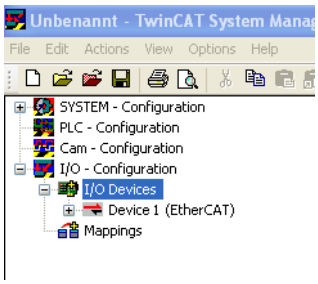

Figure 4-6 Bus medium inserted

4.2.3 Reading in the connected Axioline F bus coupler for EtherCAT® and Axioline F modules

After the EtherCAT® bus medium has been inserted, you will be asked whether you want to scan for new boxes, which means whether you want to search for new connected modules.

- Confirm the message “Scan for boxes” with “Yes”.

Figure 4-7 Confirm the message

The Axioline F bus coupler and the Axioline F modules are inserted automatically into the bus topology in the order in which they are physically connected.

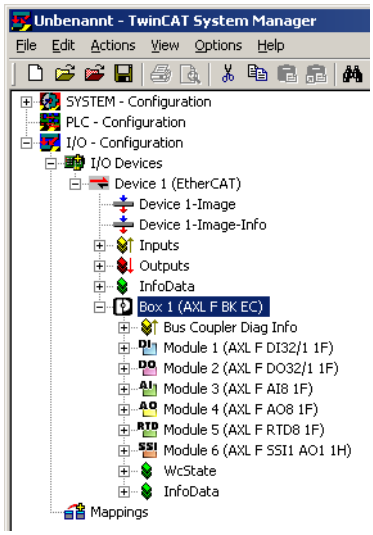

Figure 4-8 Bus topology including bus coupler and I/O modules

4.2.4 Activating the “Free RUN Mode”

You can activate the “Free RUN Mode” once the bus topology has been inserted completely.

When the “Free RUN Mode” is activated, the PC communicates via the network card with the EtherCAT® bus coupler and can exchange process data directly with the connected hardware.

- Confirm the message to activate the “Free RUN Mode”.

Figure 4-9 Activating the “Free Run Mode”

You have read in the bus topology automatically. You can therefore skip Section 4.3. In this case, proceed to Section 5, “Process data of the Axioline F modules”.

4.3 Creating the connected EtherCAT® bus topology manually

If you have read the bus structure according to Section 4.2, you can skip Section 4.3. In this case, proceed to Section 5, “Process data of the Axioline F modules”.

4.3.1 Inserting connected hardware (bus medium)

- Right-click on “I/O Devices” to open the context menu.
- Select the “Append Device…” item.

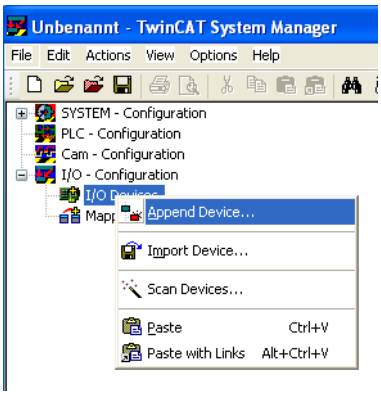

Figure 4-10 “I/O Devices, Append Device...” menu item

- Select the “EtherCAT, EtherCAT” item.

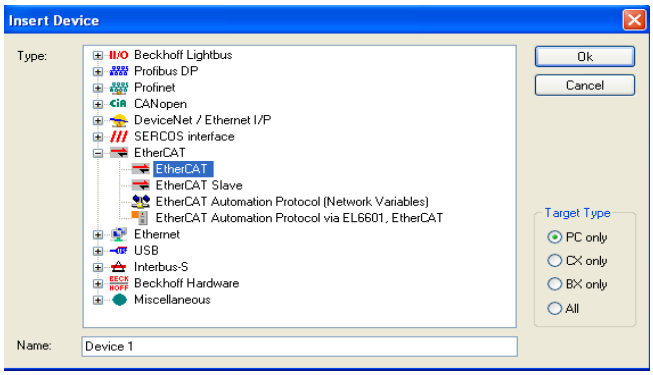

Figure 4-11 Node for inserting the bus medium

The EtherCAT® bus medium is inserted automatically into the bus topology (“Device 1 (EtherCAT)” in Figure 4-12).

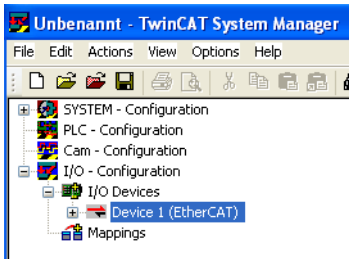

Figure 4-12 Bus medium inserted

4.3.2 Inserting the Axioline F bus coupler for EtherCAT®

After the EtherCAT® bus medium has been inserted, the Axioline F bus coupler for EtherCAT® is selected.

- Right-click on “Device 1 (EtherCAT)” to open the context menu.
- Select the “Append Box…” item.

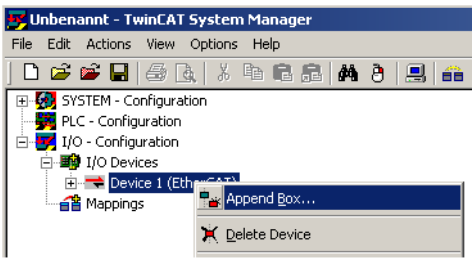

Figure 4-13 “Device 1(EtherCAT), Append Box...” menu item

- In the window that opens, select the connected Axioline F bus coupler for EtherCAT® and confirm your selection with OK.

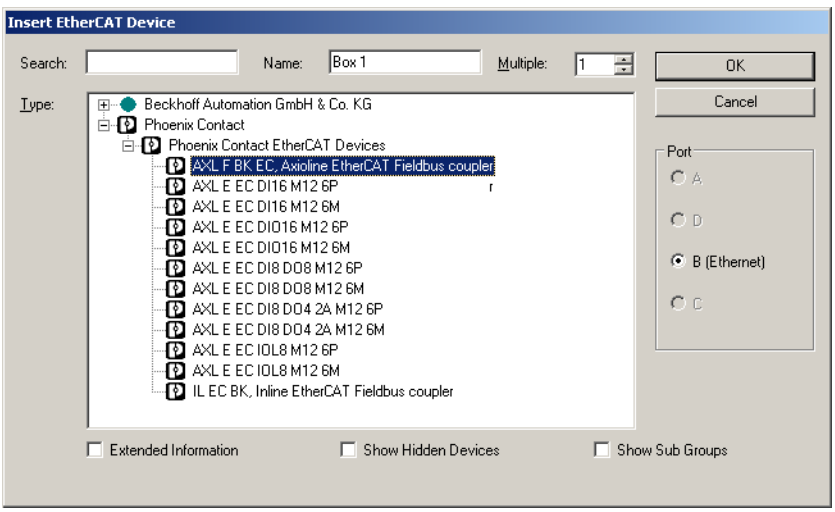

Figure 4-14 Selecting the bus coupler

The selected bus coupler is inserted.

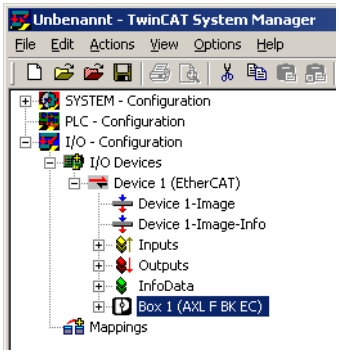

Figure 4-15 Bus coupler inserted

4.3.3 Inserting connected Axioline F modules

Afterwards, add the individual Axioline F I/O modules under the inserted Axioline F bus coupler for EtherCAT®.

- Right-click on “Box 1 (AXL BK ECAT-ME)” to open the context menu.
- Select the “Append Module…” item.

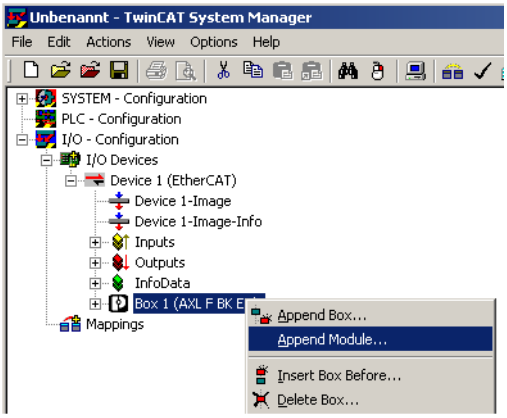

Figure 4-16 “Box 1 (AXL BK ECAT-ME), Append Module…” menu item

The window that opens contains a folder structure. All device descriptions of Axioline F modules hat can be imported into the bus configuration are listed here.

- Open the folder for your first module, e.g., AXL F DI32/1 1F, a digital input module..
- Select the first connected Axioline F module and confirm the selection with OK.

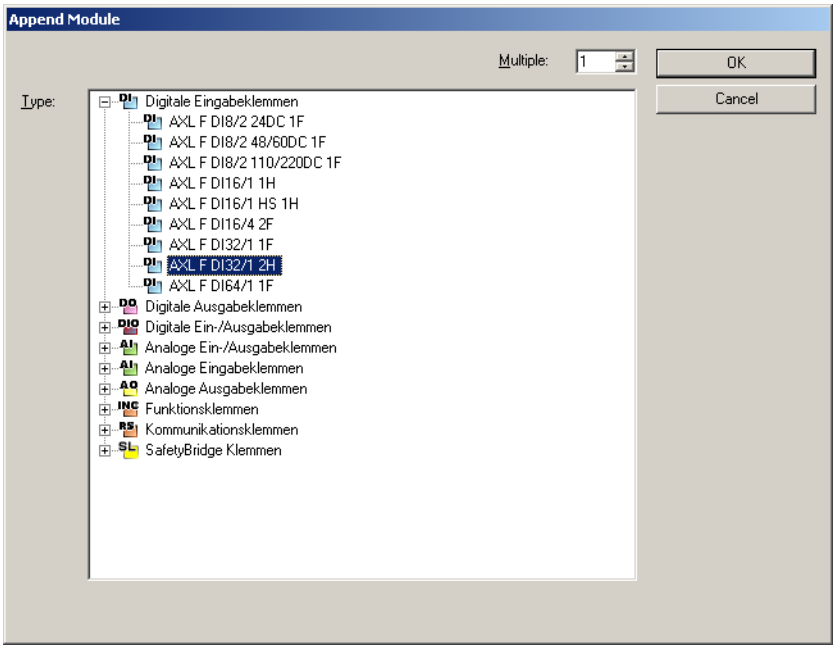

Figure 4-17 Select the first connected Axioline F module

The Axioline F module is inserted into the bus topology.

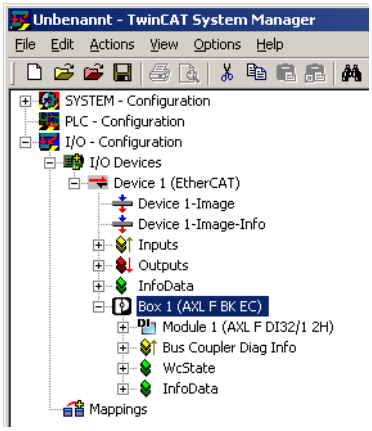

Figure 4-18 First Axioline F module inserted into bus topology

- Select further connected modules by repeating the steps in this section until all Axioline F module required are available in the bus topology.

If desired, you can customize the module name.

- Click on the entry you want to change.
- On the “General” tab, change the name of the module.

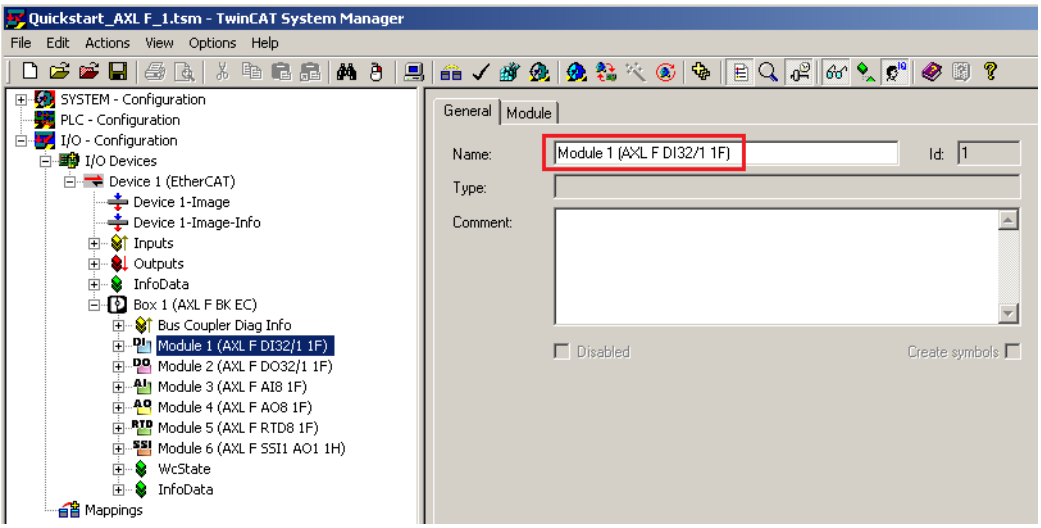

Figure 4-19 Changing the name of the module

5 Process data of the Axioline F modules

This section shows you how you can read or write the process data of the Axioline F modules in the online mode. You can skip this section if you do not want to look at how to handle process data at this point. You do not need the information given in this section to start up the Axioline F modules.

To read or write process data, the TwinCAT® System Manager must be in the “Free Run Mode”.

- Click the “Change Free Run Status” icon to change to the “Free Run Mode”.

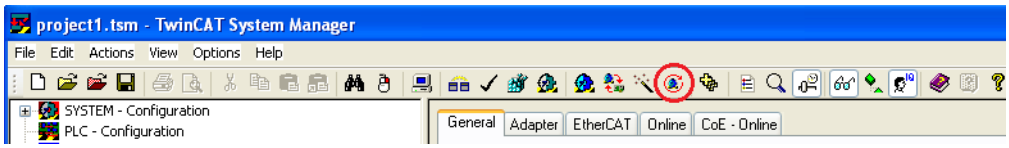

Figure 5-1 Activating the “Free Run Mode”

Now you are in online mode and you can read or write the inputs and outputs of the individual modules.

Note on the software:

To open the “Set Value Dialog” view, you have only the “Write” button available; irrespective of whether you access an output which you can actually write to or whether you access and input which you can read only.

Please refer to the associated data sheet for module-specific information.

5.1 AXL F DI32/1 1F

- Click the entry below the I/O module to open the process data view.

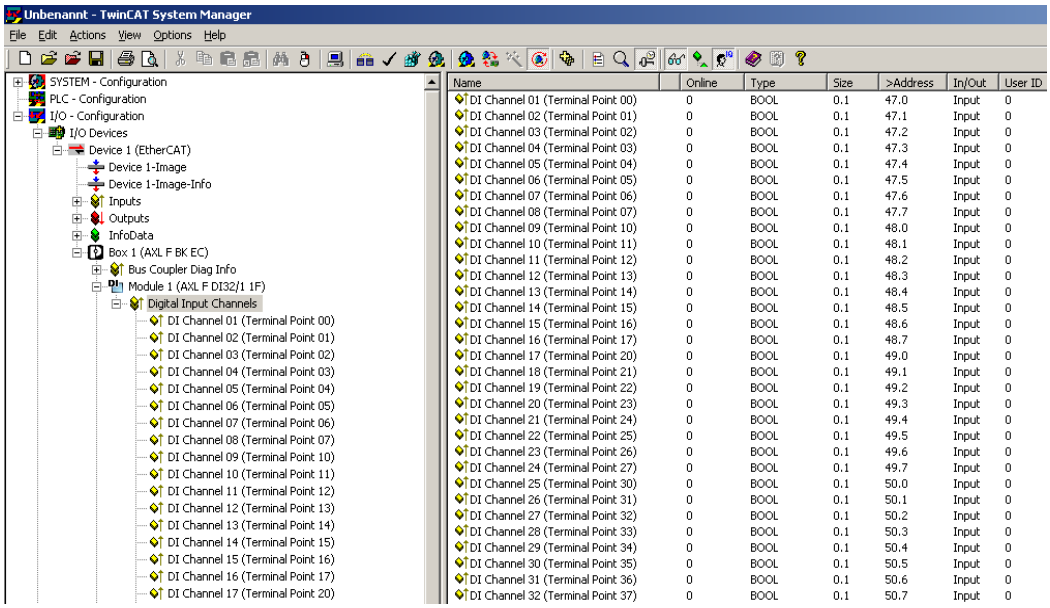

Figure 5-2 AXL F DI32/1 1F process data view

In the window that opens you can see the online signals of the selected I/O module.

- To read individual process data, open the online view by clicking on a digital input, e. g., “DI Channel 01 (Terminal Point 00)”.
- Click the “Write” button to open the “Set Value Dialog” view.

Here you can see the status of the selected input.

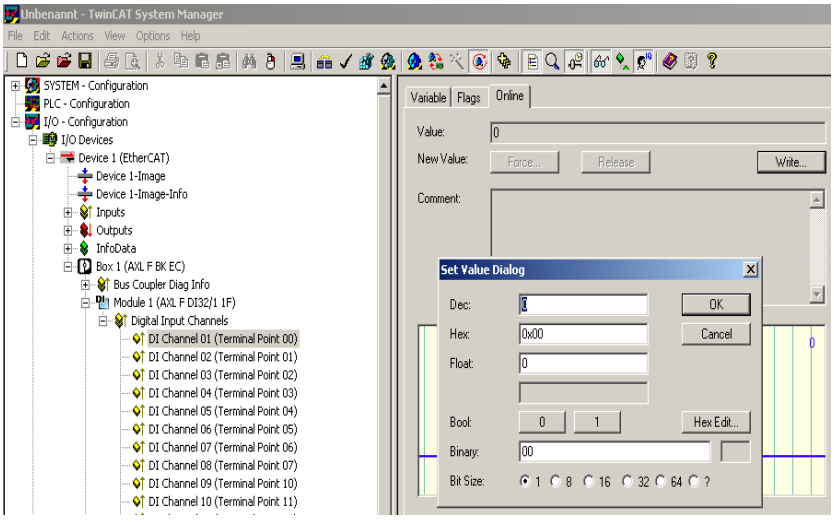

Figure 5-3 “Set Value Dialog” view of the AXL F DI32/1 1F module, input 01

5.2 AXL F DO32/1 1F

- Click the entry below the I/O module to open the process data view.

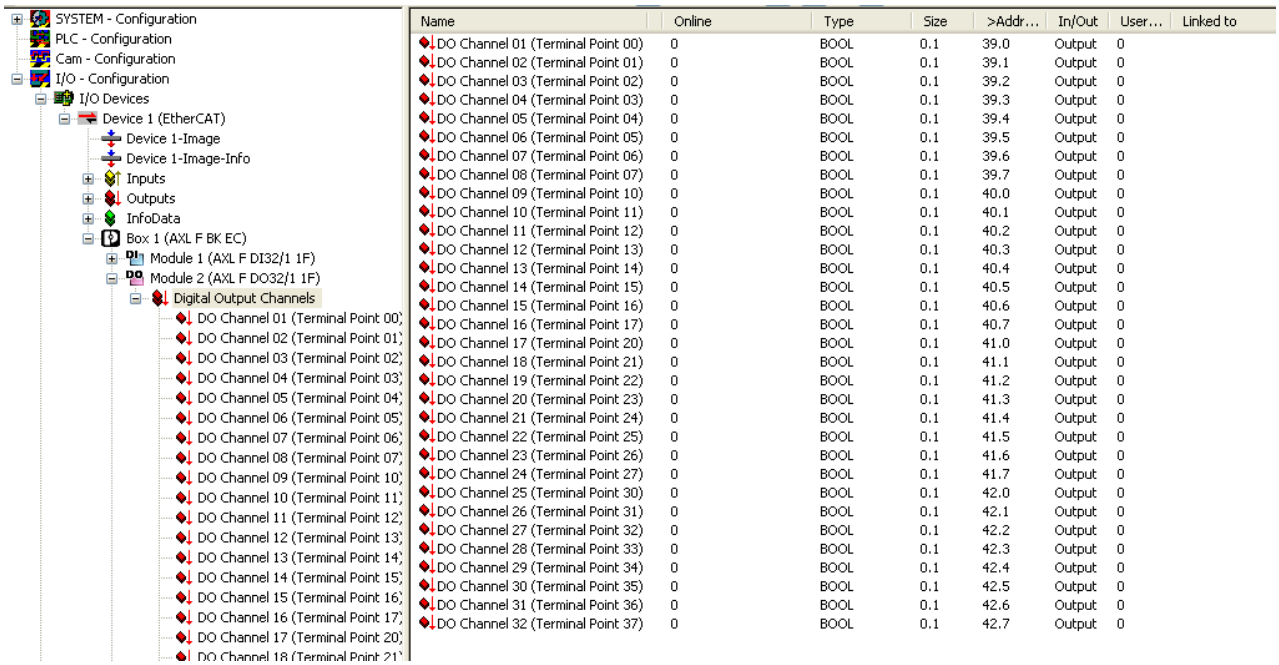

Figure 5-4 Process data view of the AXL F DO32/1 1F module

In the window that opens you can see the online signals of the selected I/O module.

- To write individual process data, open the online view by clicking on a digital output, e. g., “DO Channel 01 (Terminal Point 00)".
- Click the “Write” button to open the “Set Value Dialog” view.

Here you can write the status of the selected output.

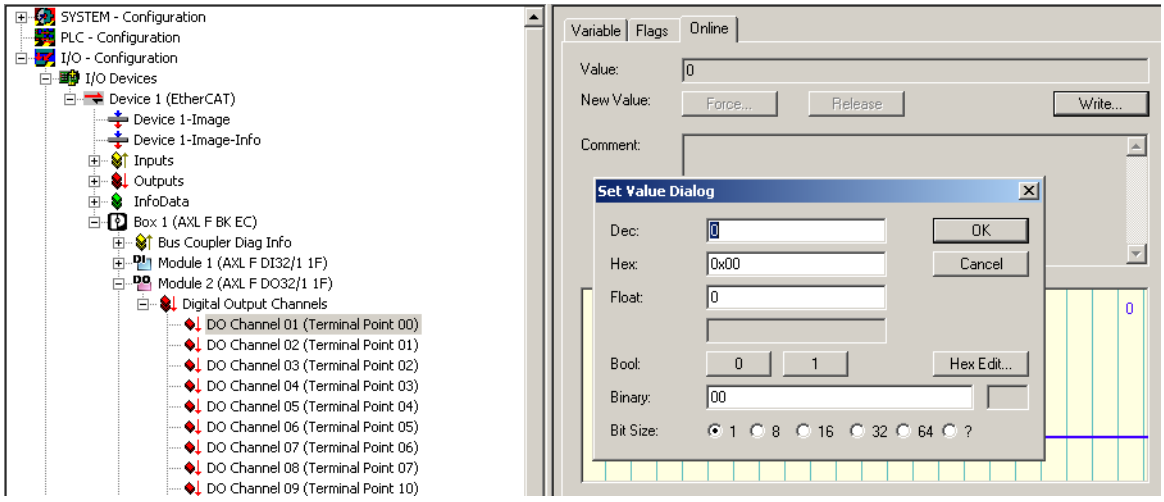

Figure 5-5 “Set Value Dialog” view of the AXL F DO32/1 1F module, output 1

Writing an output

- To write an output, enter a binary value (1/0) in the “Set Value Dialog”.
  1: Enabling the output
  0: Disabling the output

You can do this for any digital output.

- Confirm your entry with OK.

After the entry has been confirmed it will be transferred and you can read the status of the output from the associated status LED of the module. In the example the LED would light up.

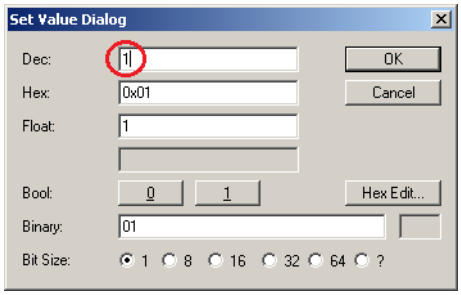

Figure 5-6 Setting the output to 1

5.3 AXL F AI8 1F

- Click the entry below the I/O module to open the process data view.

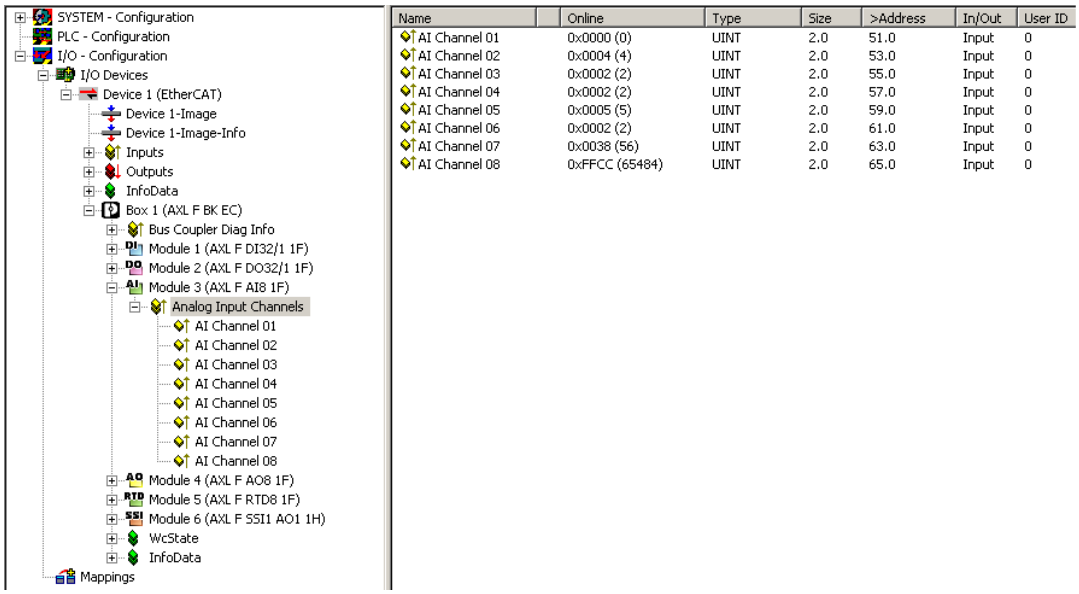

Figure 5-7 Process data view of the AXL F AI8 1F module

In the window that opens you can see the online signals of the selected I/O module.

- To read individual process data, open the online view by clicking on an analog input, e. g., “AI Channel 01”.
- Click the “Write” button to open the “Set Value Dialog” view.

Here you can see the status of the selected input.

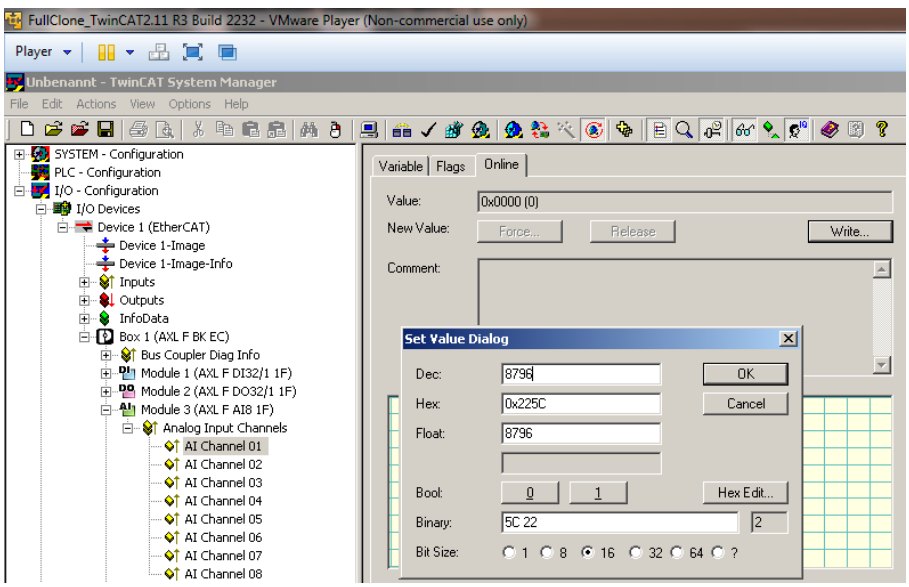

Figure 5-8 “Set Value Dialog” for the AXL F AI8 1F module

5.4 AXL F AO8 1F

This module has input and output process data.

Figure 5-9 Entries for input and output process data

- Click the corresponding entry below the I/O module to open the process data view for the input or output process data.

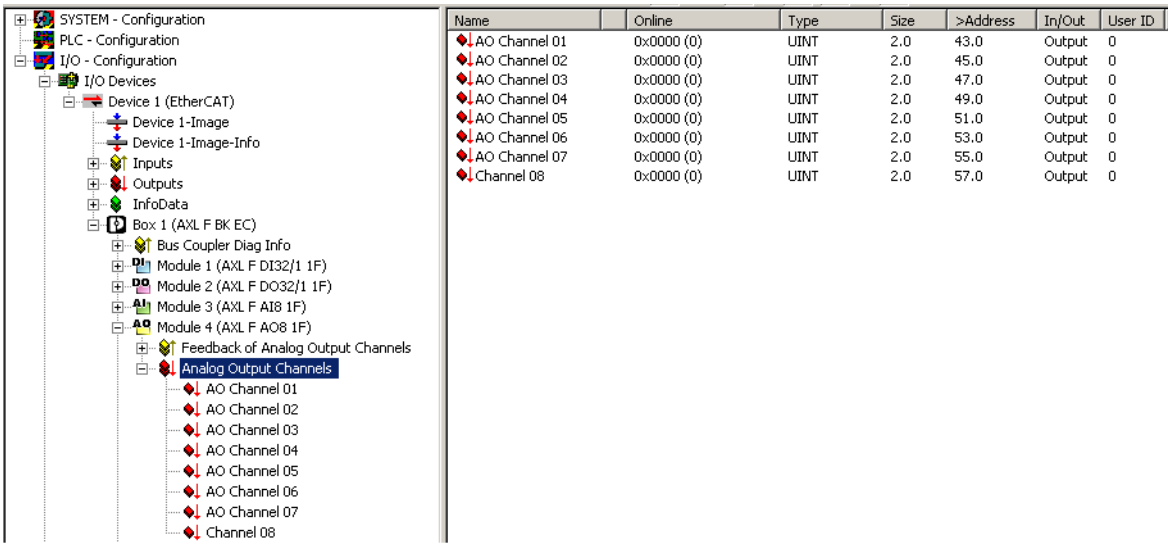

Figure 5-10 Process data view of the AXL F AO8 1F module

In the window that opens you can see the online signals of the selected I/O module.

- To write individual process data, open the online view by clicking on an analog output, e. g., “OAO Channel 01”.
- Click the “Write” button to open the “Set Value Dialog” view.

Here you can write the selected output.

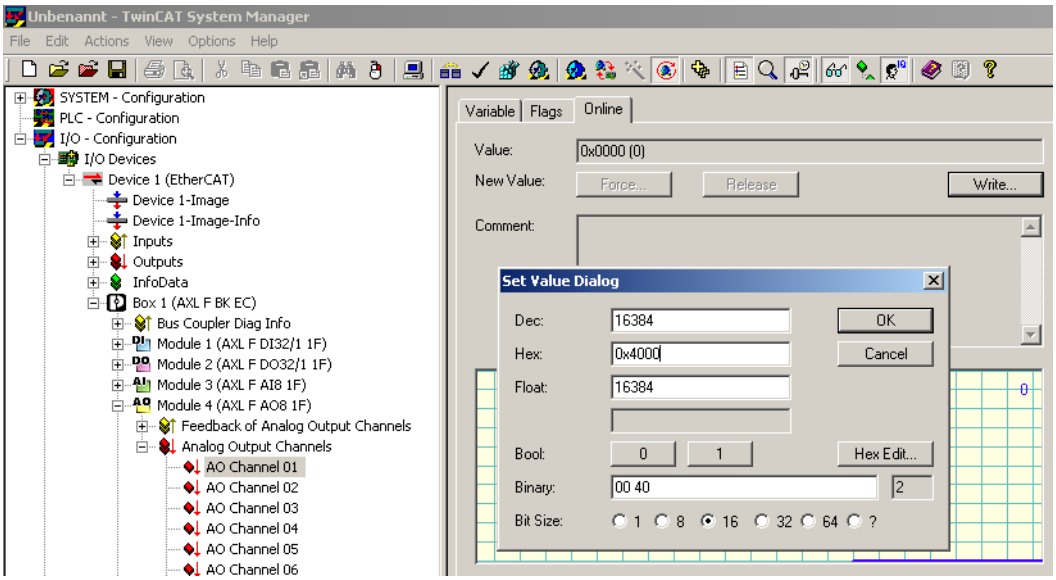

Figure 5-11 “Set Value Dialog” view of the AXL F AO8 1F module

Writing an output

By default, the analog outputs are preconfigured to 0 V ... 10 V. That means that the analog module outputs a voltage of 0 V ... 10 V on the module depending on the process data control.

- Enter a value in the “Set Value Dialog”.
  For hexadecimal values, the values range from 0x0000 to 0x7FFF.
  0x0000: Output of 0 V
  0x7FFF: Output of 10 V

For additional information on the value range, please refer to the data sheet of the module.

You can do this for any analog output.

- Confirm your entry with OK.

After the entry has been confirmed it will be transferred and you can measure the set voltage at the written output.

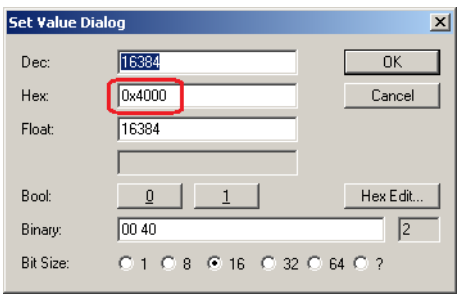

Figure 5-12 Writing an output

The entered value of 0x4000 corresponds to 5 V, approximately.

5.5 AXL F RTD8 1F

- Click the entry below the I/O module to open the process data view.

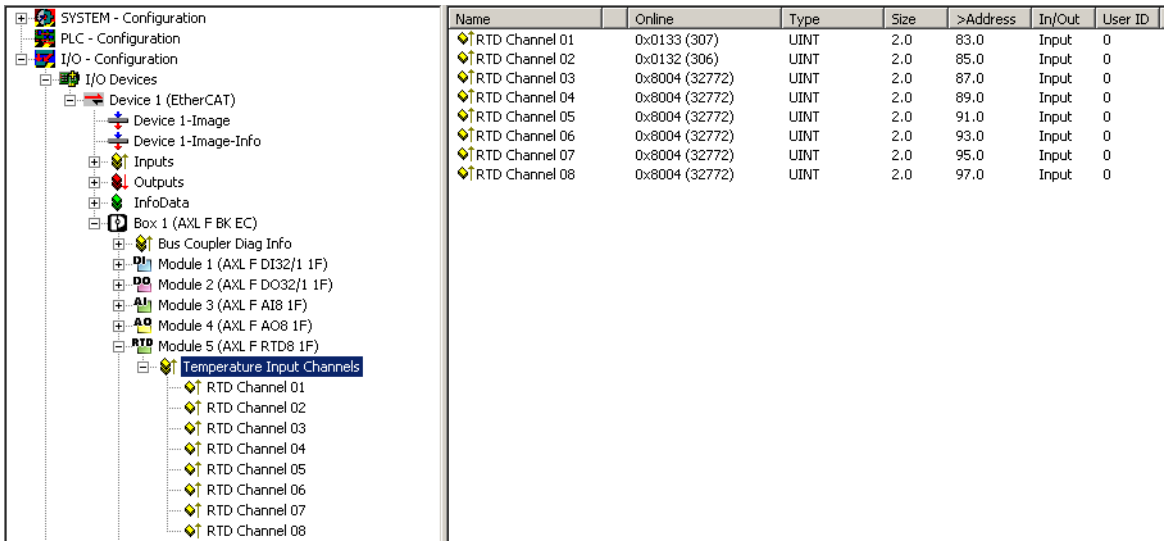

Figure 5-13 Process data view of the AXL F RTD8 1F module

In the window that opens you can see the online signals of the selected I/O module.

- To read individual process data, open the online view by clicking on an analog input, e. g., “RTD Channel 01”.
- Click the “Write” button to open the “Set Value Dialog” view.

Here you can see the status of the selected input.

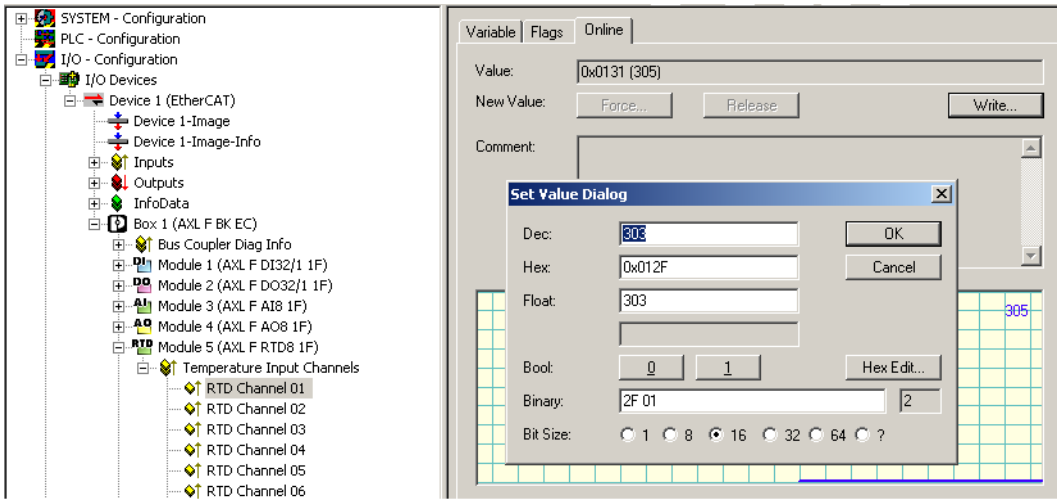

Figure 5-14 “Set Value Dialog” view for the AXL F RTD8 1F module

5.6 AXL F SSI1 AO1 1H

This module has input and output process data.

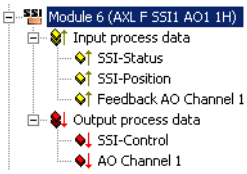

Figure 5-15 Entries for input and output process data

The following data is transmitted in the input process data:

- SSI-Status: Status information of the SSI channel
- SSI-Position: Current position read
- Feedback AO Channel 1: Current analog output value or a corresponding error code

The following data is transmitted in the OUT process data:

- SSI-Control: SSI SetZero bit used for setting the position to zero
- AO Channel 1: Analog output value

Please refer to the module-specific data sheet for detailed information.

Click the corresponding entry below the I/O module to open the process data view for the input and output process data.

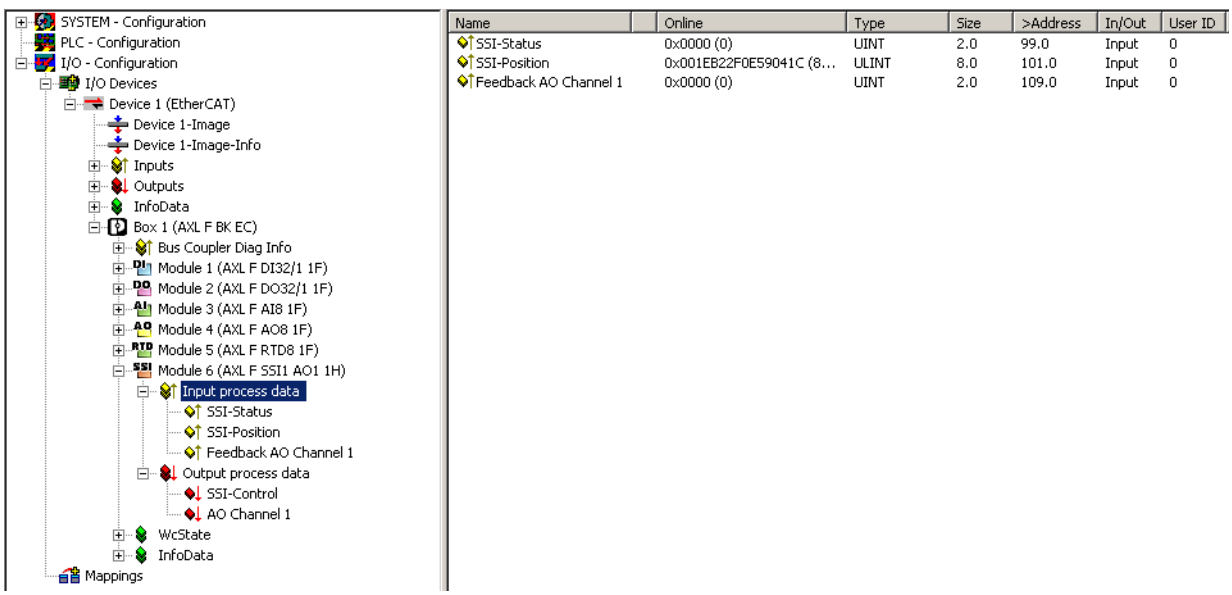

Figure 5-16 Process data view of the AXL F SSI1 AO1 1H module

In the window that opens you can see the online signals of the selected I/O module.

- To write individual process data, open the online view by clicking on the input or output data.
- Click the “Write” button to open the “Set Value Dialog” view.

Here you can write the selected output.

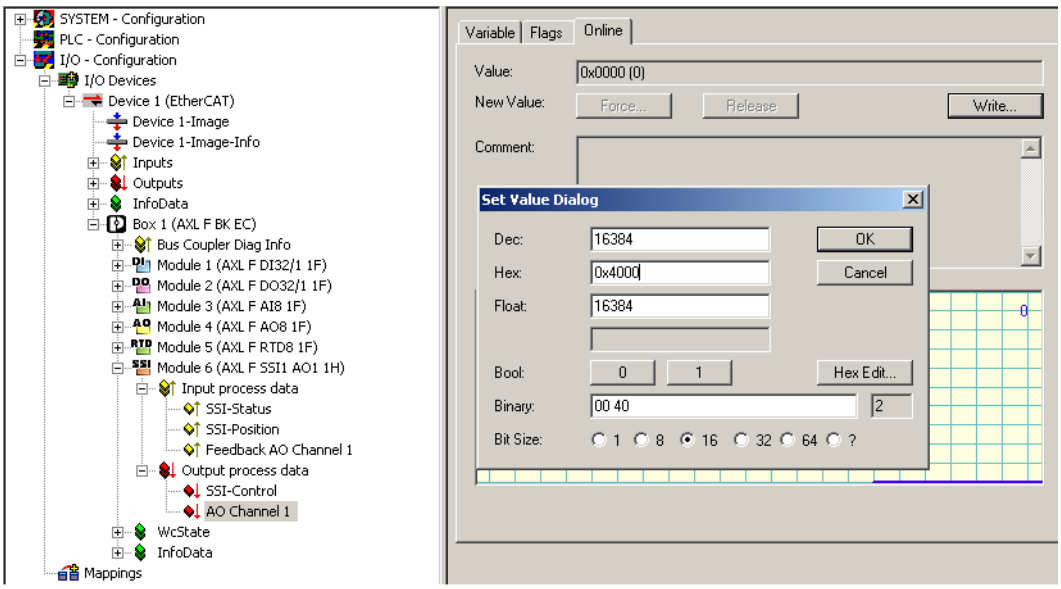

Figure 5-17 “Set Value Dialog” view of the module

Writing an output

- Enter a value in the “Set Value Dialog”, e. g. for "AO Channel 1".
  For hexadecimal values, the values range from 0x0000 to 0x7FFF.
  0x0000: Output of 0 V
  0x7FFF: Output of 10 V
- Confirm your entry by clicking the “OK” button.

After the entry has been confirmed it will be transferred and you can measure the set voltage at the written output.

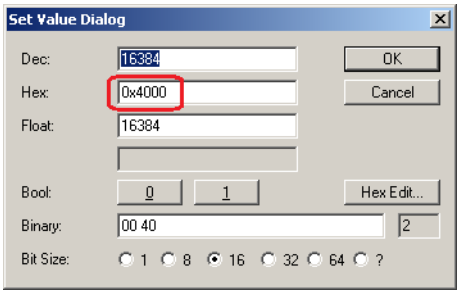

Figure 5-18 Setting the output

The set value of 0x4000 corresponds to 5 V, approximately.

6 Creating a user project

The TwinCAT® PLC Control software is used to create a control program and to transmit it to the PLC (Soft-PLC).

To use a created program you have to link it to the TwinCAT® System Manager.

6.1 Creating an application program with TwinCAT® PLC Control

6.1.1 Opening TwinCAT® System Control

- Open the “TwinCAT® System Control” menu under “Programs, TwinCAT® System Control”.

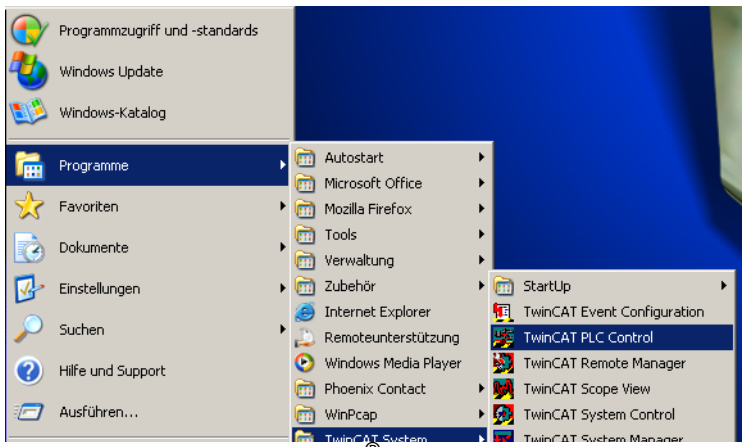

Figure 6-1 Opening TwinCAT® PLC Control

6.1.2 Creating a new project

- Select the “File, New” menu item.

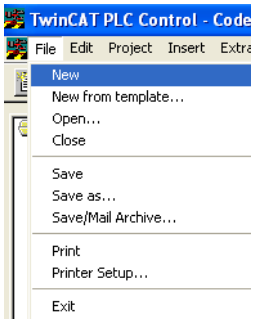

Figure 6-2 “File, New” menu item

Selecting the target system type

When you use the Soft-PLC it is necessary to select the target system type required.

- In the window that opens select the target system type “PC or CX (x86)” for use of the Soft-PLC.
- Confirm your selection with OK.

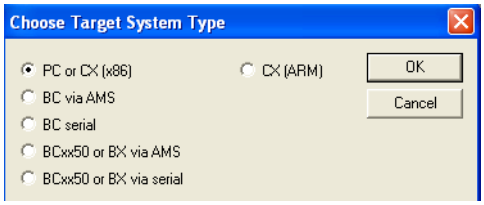

Figure 6-3 Selecting the target system type

Selecting the programming language

- In the window that opens, select the desired programming language; Structured Text (ST) is used in this example.
- Confirm your selection with OK.

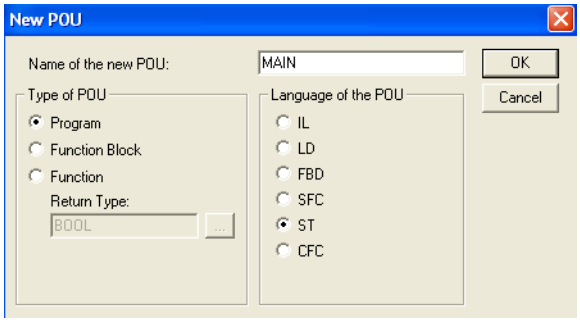

Figure 6-4 Selecting the programming language

After the confirmation, the newly created application program (POU) contains an empty worksheet with the name entered.

6.1.3 Selecting the runtime system

It is necessary to specify a runtime system to get a functioning system.

- Select the “Online, Choose Run-Time System…” menu item.

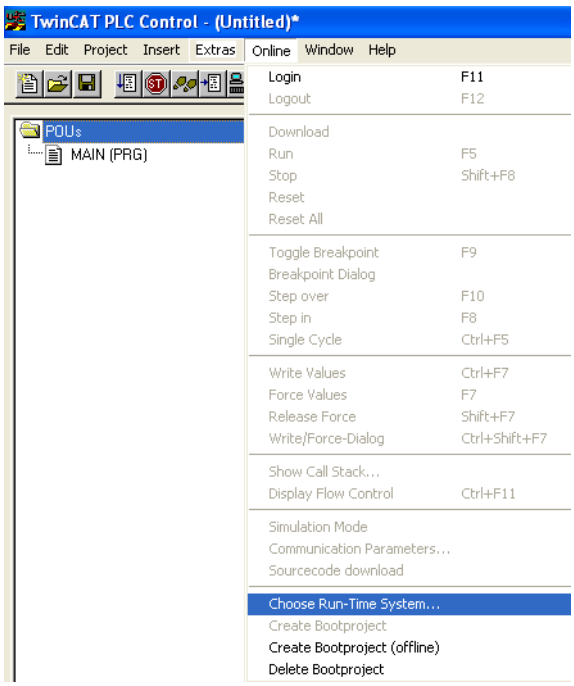

Figure 6-5 “Online, Choose Run-Time System...“

The window that opens lists the runtime systems that can be selected. Only one runtime system will be shown if just one network card has been prepared for TwinCAT® operation.

- Select “Run-Time System1 (Port 801)”.
- Confirm your entry with “OK”.

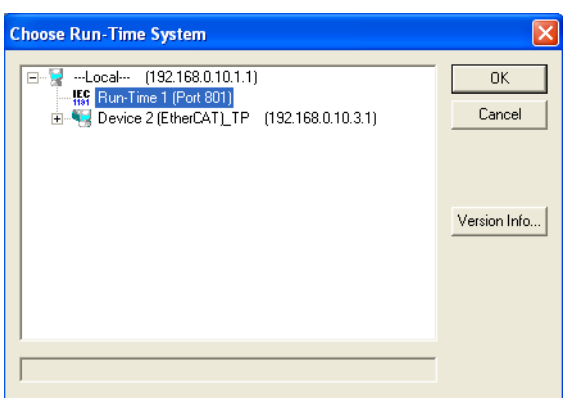

Figure 6-6 Choosing a runtime system

6.1.4 Creating a worksheet (POU)

The term “Worksheet” is used in the document. It corresponds to the term “POU” in the software.

The MAIN worksheet will always be created. You may create further worksheets to structure your application program. The worksheet Analog to process analog variables is created in the example.

- Right-click on “POU” to open the context menu.
- Select the “Add Object…” item.

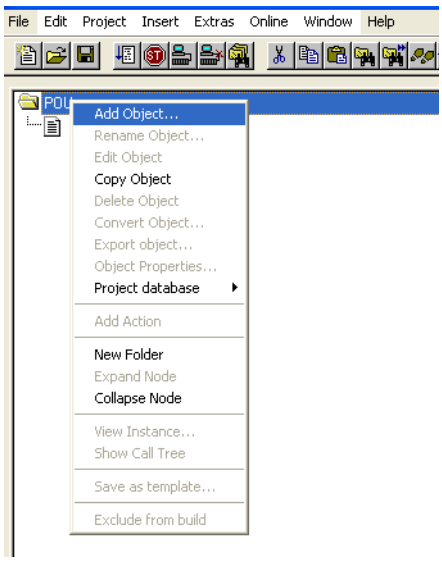

Figure 6-7 “Add Object…” menu item

- In the window that opens select the desired programming language; in our example this is “Structured Text (ST)”.
- Confirm your selection with “OK”.

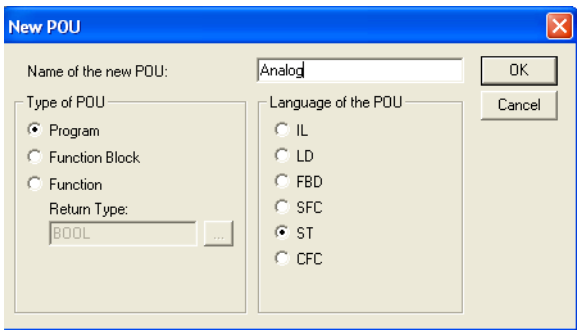

Figure 6-8 Selecting the programming language

6.1.5 Declaring global variables

Global variables have to be created for every application program. These global variables are valid for the entire application program.

The global variables will be declared in the “Global Variables” view. This view is located in the resources of the application program

Hardware addresses

A hardware address must be assigned to a variable to declare it. The hardware addresses can be found in the bus topology of the TwinCAT® System Manager. Each process data word or bit of a module is assigned an address (see red marking in Figure 6-9).

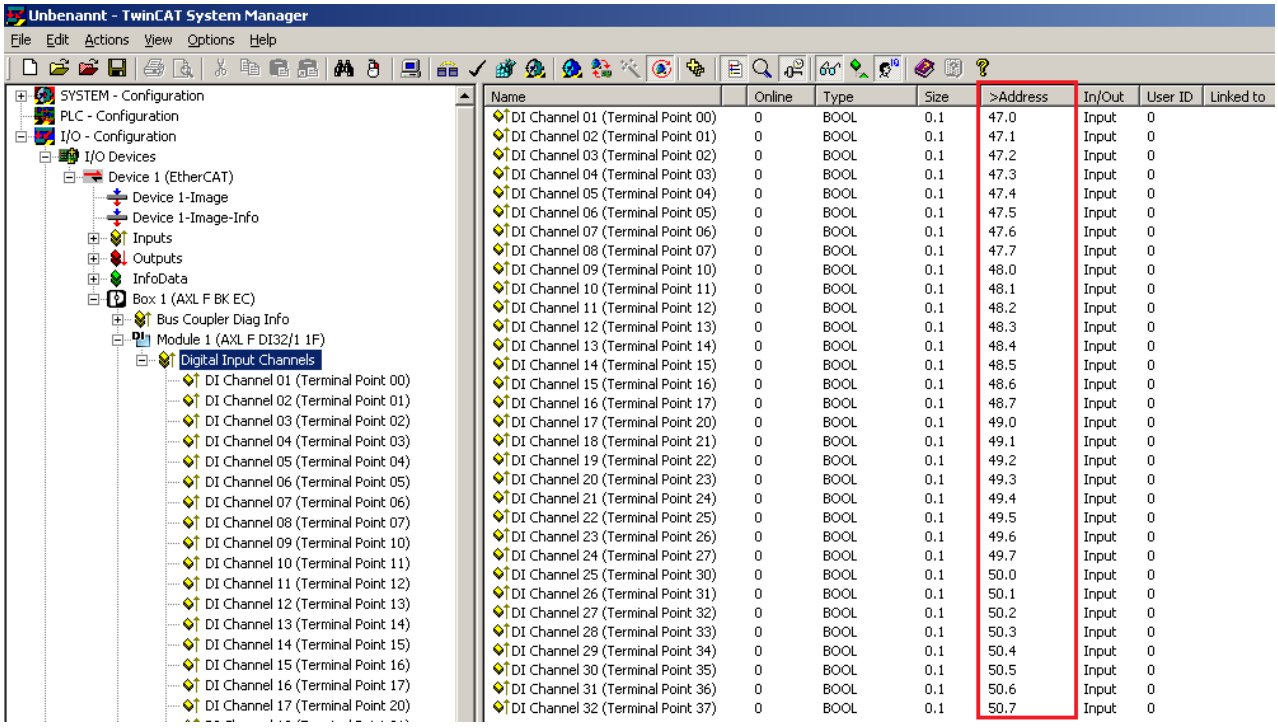

Figure 6-9 Hardware addresses in the TwinCAT® System Manager

Open the global variable view

- Switch to the TwinCAT® PLC Control program.
- Switch to the “Resources” tab.

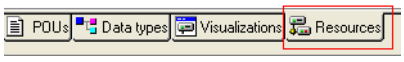

Figure 6-10 “Resources” tab

- Open the “Global Variables” view by double-clicking the corresponding entry.

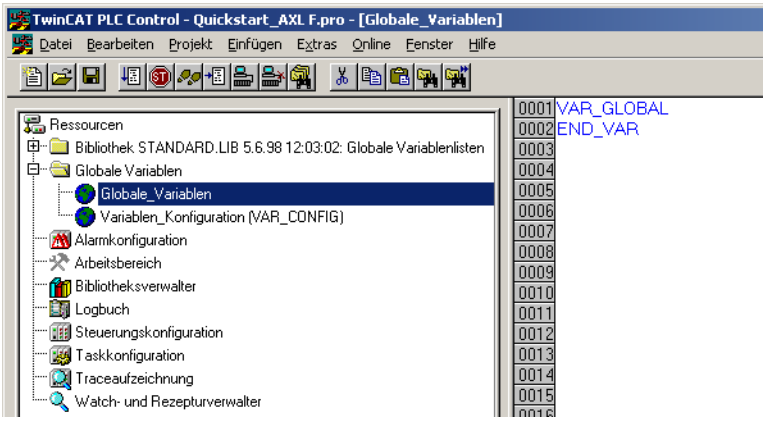

Figure 6-11 Global variables

Declaring global variables

- Declare the global variables that you need for your program.

> Keep to the structure for defining global variables!
>
> The structure is given in the user manual for general CodeSys programming and in the help file for TwinCAT® PLC Control.

The following variables are declared in the example:

– 16 digital inputs (BOOL)
– 16 digital outputs (BOOL)
– 8 analog inputs (UINT)
– 8 analog outputs (UINT)

The analog variables are declared in an ARRAY.

```
0001 VAR_GLOBAL
0002
0003     Analog_IN AT %IB51: ARRAY [0..7] OF UINT;
0004     Analog_OUT AT %QB43: ARRAY [0..7] OF UINT;
0005     BK_Status AT %IB1534: UINT;
0006
0007     Dig_IN01 AT %IX47.0:  BOOL;
0008     Dig_IN02 AT %IX47.1:  BOOL;
0009     Dig_IN03 AT %IX47.2:  BOOL;
0010     Dig_IN04 AT %IX47.3:  BOOL;
0011     Dig_IN05 AT %IX47.4:  BOOL;
0012     Dig_IN06 AT %IX47.5:  BOOL;
0013     Dig_IN07 AT %IX47.6:  BOOL;
0014     Dig_IN08 AT %IX47.7:  BOOL;
0015     Dig_IN09 AT %IX48.0:  BOOL;
0016     Dig_IN10 AT %IX48.1:  BOOL;
0017     Dig_IN11 AT %IX48.2:  BOOL;
0018     Dig_IN12 AT %IX48.3:  BOOL;
0019     Dig_IN13 AT %IX48.4:  BOOL;
0020     Dig_IN14 AT %IX48.5:  BOOL;
0021     Dig_IN15 AT %IX48.6:  BOOL;
0022     Dig_IN16 AT %IX48.7:  BOOL;
0023
0024     Dig_OUT01 AT %QX39.0:  BOOL;
0025     Dig_OUT02 AT %QX39.1:  BOOL;
0026     Dig_OUT03 AT %QX39.2:  BOOL;
0027     Dig_OUT04 AT %QX39.3:  BOOL;
0028     Dig_OUT05 AT %QX39.4:  BOOL;
0029     Dig_OUT06 AT %QX39.5:  BOOL;
0030     Dig_OUT07 AT %QX39.6:  BOOL;
0031     Dig_OUT08 AT %QX39.7:  BOOL;
0032     Dig_OUT09 AT %QX40.0:  BOOL;
0033     Dig_OUT10 AT %QX40.1:  BOOL;
0034     Dig_OUT11 AT %QX40.2:  BOOL;
0035     Dig_OUT12 AT %QX40.3:  BOOL;
0036     Dig_OUT13 AT %QX40.4:  BOOL;
0037     Dig_OUT14 AT %QX40.5:  BOOL;
0038     Dig_OUT15 AT %QX40.6:  BOOL;
0039     Dig_OUT16 AT %QX40.7:  BOOL;
0040
0041 END_VAR
0042
```

Figure 6-12 Declared variables

6.1.6 Creating an application program

The term “Worksheet” is used in the document. It corresponds to the term “POU” in the software.

In the example we implement an assignment from the digital inputs to the digital outputs and from the analog inputs to the analog outputs.

- Switch to the “POU” tab.

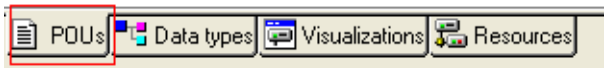

Figure 6-13 “POU” tab

6.1.6.1 MAIN worksheet

Open the MAIN worksheet

- Double-click on “MAIN (PRG)” to open the MAIN programming worksheet.

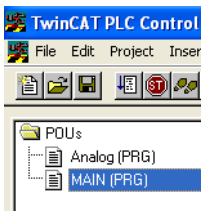

Figure 6-14 MAIN worksheet

Assigning digital inputs to digital outputs

The following program code section shows an example of an assignment from a digital input 1 to the digital output 1. Here, the names are used that have been entered before into the global variable list (see Figure 6-12).

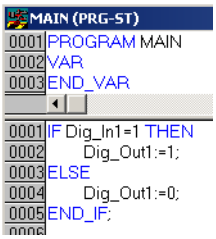

Figure 6-15 Program code section: Assignment of input 1 - output 1

In this example the assignments are programmed consecutively.

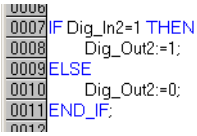

Figure 6-16 Program code section: Assignment of input 2 - output 2

- You can do the assignment for any number of inputs and outputs.

6.1.6.2 Analog worksheet

Open the Analog worksheet

Open the programming worksheet to generate program code.

- Double-click on “Analog (PRG)” to open the Analog programming worksheet.

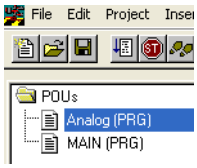

Figure 6-17 Open the Analog worksheet

Assigning analog inputs to analog outputs

The following program code section shows an example of an assignment from analog input 1 to the analog output 1. Here, the names are used that have been entered before into the global variable list (see Figure 6-12).

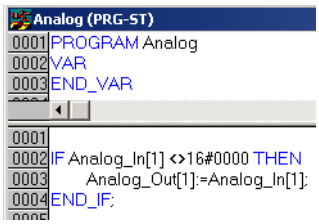

Figure 6-18 Program code section:
Assignment of analog input 1 - analog output 1

In this example the assignments are programmed consecutively.

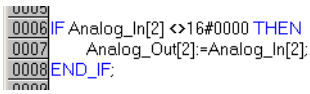

Figure 6-19 Program code section:
Assignment of analog input 2 - analog output 2

- You can do the assignment for any number of analog inputs and outputs.

6.1.7 Configuring a task

The MAIN worksheet is automatically assigned to a task. As soon as you have created additional worksheets it is necessary to assign these worksheets to a task.
The program code is processed cyclically by the task. If you do not assign the worksheet to a task, the worksheet will not be processed in the application program.

In our example, the Analog worksheet was created in addition to the MAIN worksheet; you have to assign the Analog worksheet to a task.

Open the task configuration

- Switch to the “Resources” tab.

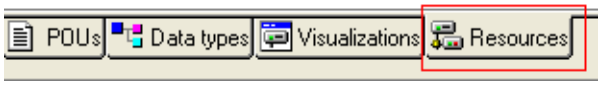

Figure 6-20 “Resources” tab

- Double-click on “Task configuration” to open the configuration of the task.

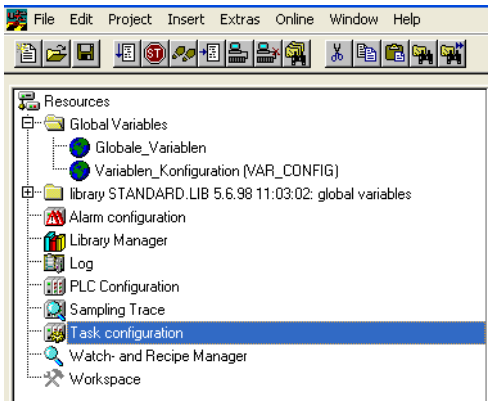

Figure 6-21 Open “Task configuration”

You can append the program code as soon as the task configuration is open.

Open “Append Program Call”

- Right-click the “Standard” item to open the context menu.

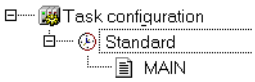

Figure 6-22 Open the context menu of “Standard”

- Select the “Append Program Call” item.

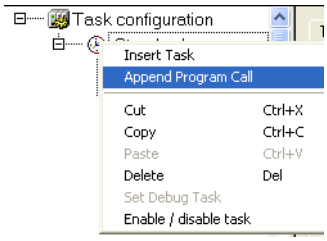

Figure 6-23 “Append Program Call” menu item

Selecting the program

- In the window that opens, select the “Analog (PRG)” entry.
- Confirm your selection with OK.

The analog program is appended to the task.

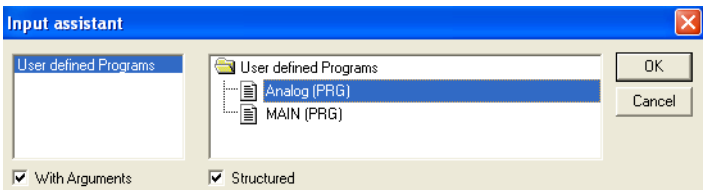

Figure 6-24 Analog program appended to task

Program code appended to the task

After the program has been selected, the program code is appended to the task.

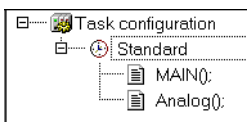

Figure 6-25 Task with the MAIN and Analog programs

When you open the “Standard” menu, the properties window of the task will open as well.

- Enter the cycle time in the window that opens, in our example “T#10ms”.

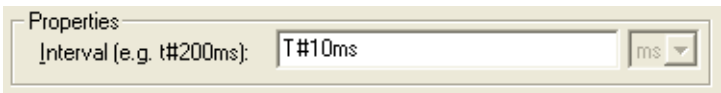

Figure 6-26 Enter the cycle time

6.1.8 Building and storing the application program

Once you have successfully completed all previous steps it is required to build and store the application program.

Building the application program

- To build the application program select the “Project, Rebuild all” menu item.

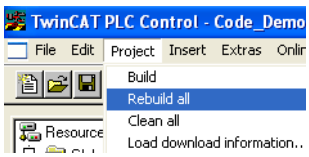

Figure 6-27 Building the application program

Storing the application program

- Select the “File, Save as…” menu item to store the project.
- Enter a name and confirm the entry with OK.

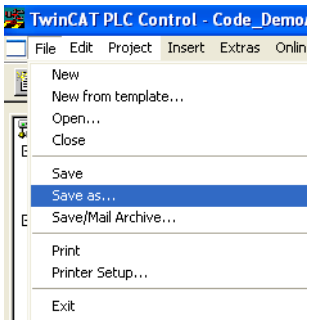

Figure 6-28 Storing the application program

In our example, the application program is stored under the name “Quickstart_AXL F.pro”.

6.2 Linking the application program in the TwinCAT® System Manager with the bus topology

It is necessary to link the global variables created in TwinCAT® PLC Control to the bus topology available from the TwinCAT® System Manager.

To do this, add the created application program to the project in the TwinCAT® System Manager.

Appending the application program

- Open the project with the created bus topology in the TwinCAT® System Manager.
- Open the context menu by right-clicking the “PLC - Configuration” item.
- Select the “Append PLC Project…” item.

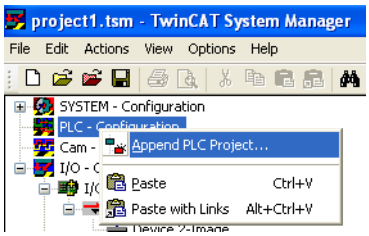

Figure 6-29 “PLC - Configuration, Append PLC Project…” menu item

- In the window that opens select the directory in which the TwinCAT® PLC Control application program is stored.
- Highlight the application and add it to the user project with the “Open” button.

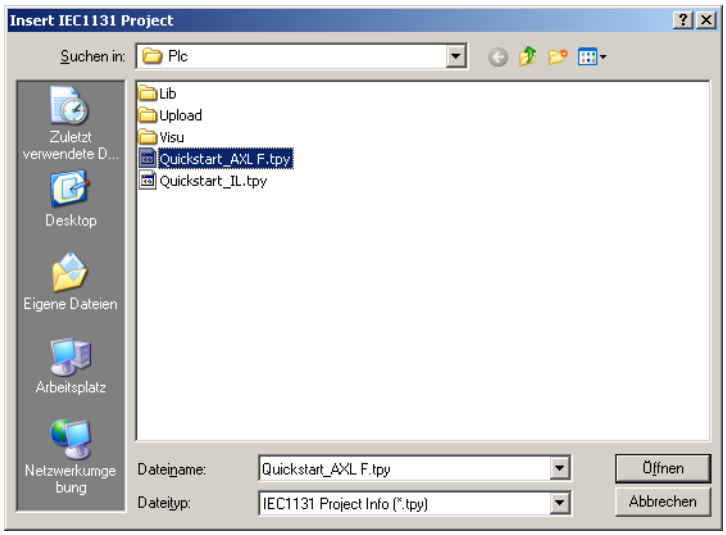

Figure 6-30 Appending the application program to the user project

Appended application program

After you have appended the application program, the program name which was stored in Section “Building and storing the application program” on page 45 is displayed under the “PLC - Configuration” item.

In our example: “Quickstart_AXL F.

The application program is imported automatically with the declared global variables into the bus topology.

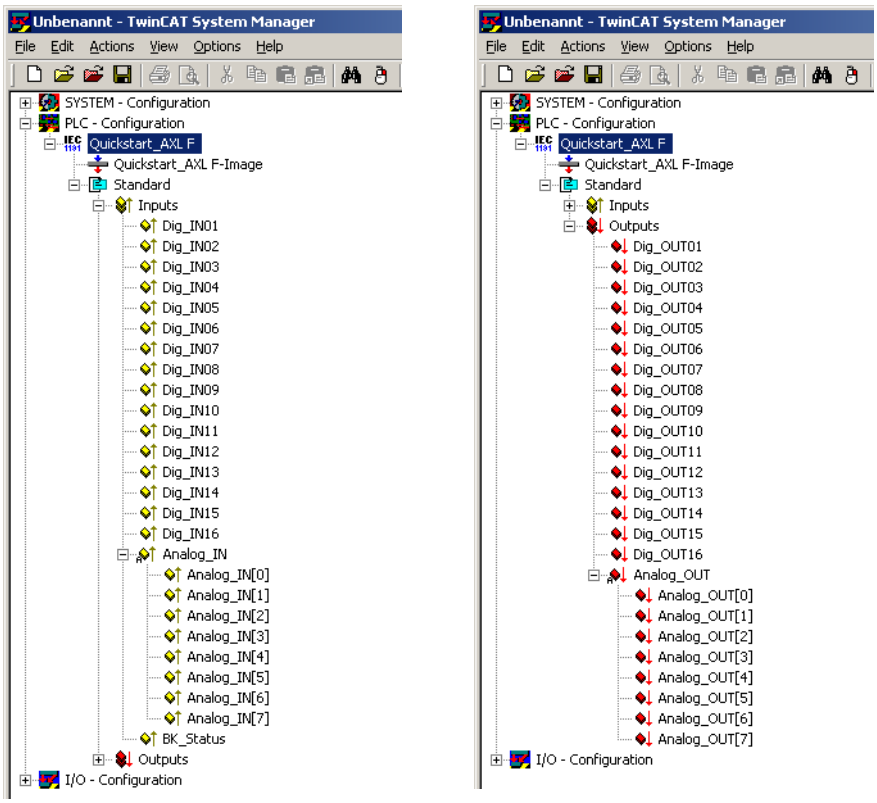

Figure 6-31 Imported program including variables

Assigning global variables to the bus topology

The global variables which can be found under the PLC program can be linked to the hardware located in the bus topology.

- Double-click the variable to be linked.

In the window that opens you can see all hardware process data words/bits which can be linked to the desired variable type.

- To do the linking, select the corresponding process data word/bit and confirm your selection with OK.

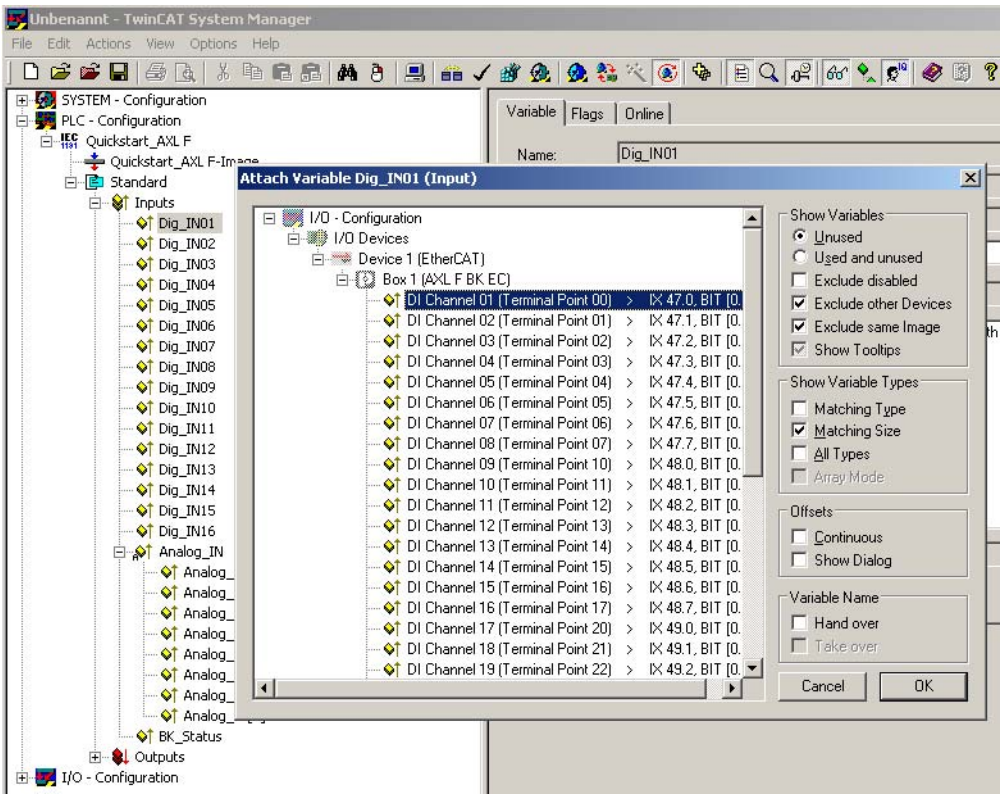

Figure 6-32 Linking the variable to hardware

6.3 Start the completed user project in TwinCAT® PLC Control

To start the completed user project, you have to activate the current configuration in the TwinCAT® System Manager first.

After the configuration has been activated, you have to log on to the Soft-PLC with TwinCAT® PLC Control, before the application program can be started in the TwinCAT® PLC Control environment.

Activate configuration

You have two options of starting/activating the user project in the TwinCAT® System Manager.

Option 1

- Click the “Activate configuration” button.

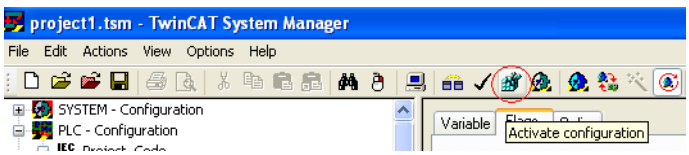

Figure 6-33 Activate configuration (option 1)

Option 2

- Select the menu item “Actions, Activate Configuration…“.

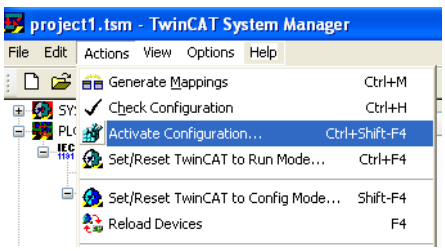

Figure 6-34 Activate configuration (option 2)

The following messages will be displayed after both options:

- Confirm the message that the mapping must be generated again by clicking ?Yes”.

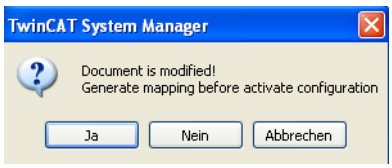

Figure 6-35 Confirm the message

- Confirm the message that old configurations will be overwritten and the new configuration will be activated by clicking “OK”.

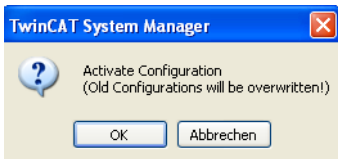

Figure 6-36 Confirm the message

- Confirm the message that TwinCAT® is restarted in RUN mode by clicking “OK”.

Figure 6-37 Confirm the message

The TwinCAT® status is displayed in the TwinCAT® System Manager manager.

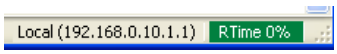

Figure 6-38 Status of TwinCAT®

Logging to the runtime system

After the configuration has been activated, it is necessary to start the user project via TwinCAT® PLC Control. To do this, log in to the controller (runtime system).

- Select the “Online, Login” menu item.

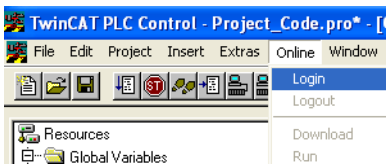

Figure 6-39 Logging into TwinCAT® PLC Control

The following message appears before the connection can be established.

- Confirm the message with “Yes”.

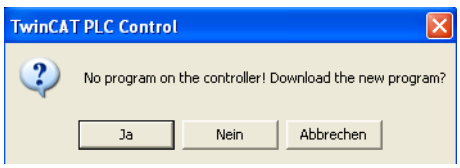

Figure 6-40 Confirm the message

Starting the application program

The program can be started, once the connection to the controller (Soft-PLC) has been established.

- Select the “Online, Start” menu item to start the program.

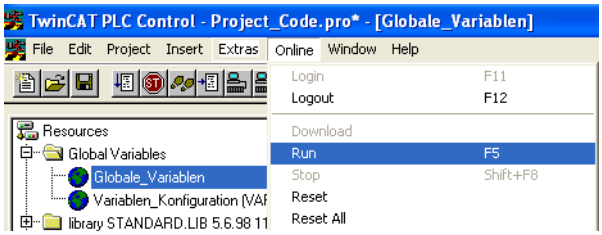

Figure 6-41 Start the application program

6.4 Processing of variables

When the program is started, you can monitor/control the entire processing of variables. The variables show the current status of the hardware.

- Switch to the “POU” tab.

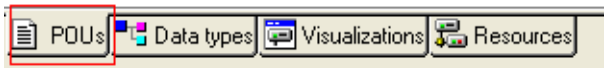

Figure 6-42 “POU” tab

- Double-click a program worksheet, in our example “MAIN()”.

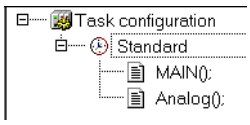

Figure 6-43 Select the program worksheet

In the open window you can check the online status of the variables.

Dig_IN01 = TRUE
Dig_OUT01 = TRUE

Dig_OUT01 = TRUE

Dig_IN02
Dig_OUT02 = FALSE

Dig_OUT02 = FALSE

Dig_IN03 = TRUE
Dig_OUT03 = TRUE

Dig_OUT03 = TRUE

Dig_IN04 = TRUE
Dig_OUT04 = TRUE

Dig_OUT04 = TRUE

Figure 6-44 Online status of the variables

6.5 Result

After you have worked you way through this manual you are familiar with the basic functions and settings of the TwinCAT® software with regard to the Axioline F-EtherCAT® bus coupler.

Further information can be found on the Internet at the following addresses:

Information on Axioline F: phoenixcontact.net/products

Information on the software or EtherCAT®:

– Homepage of the EtherCAT® Technology Group: www.ethercat.org
– Homepage of the software manufacturer: www.beckhoff.de

A Appendix: Methods for addressing and identification on the AXL F BK EC bus coupler

In an EtherCAT® system, a difference is made between addressing and identification.

Addresses are used for the communication between master and slave.

Identifications are used to uniquely identify a slave in an EtherCAT® network, e.g., when using Hot Connect.

A 1 Addressing

- In the TwinCAT® System Manager's bus structure, open the bus coupler (slave) item.

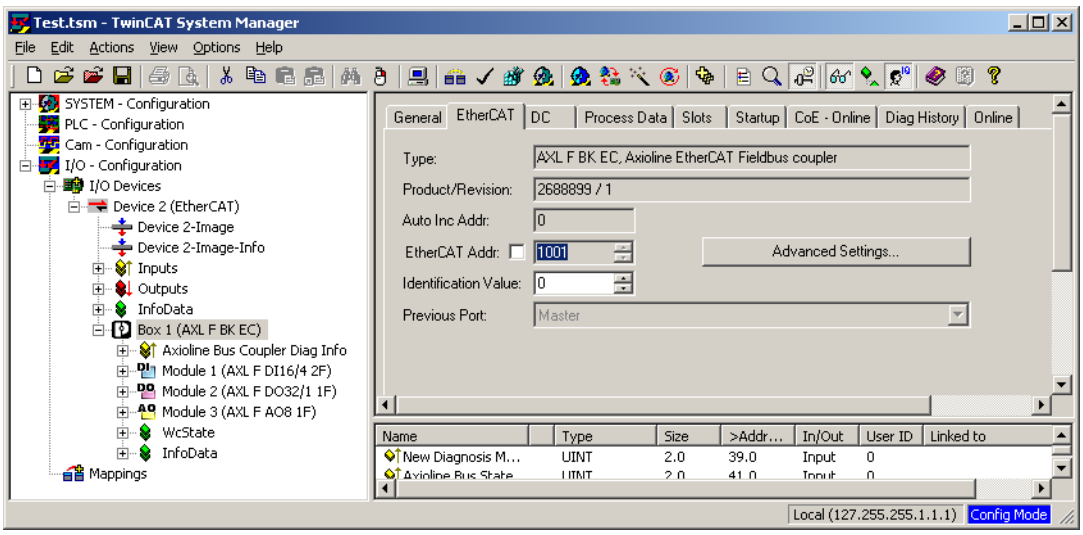

Figure A-1 Address view on the slave

Auto Inc Addr

Auto increment address of the EtherCAT® slave.

Auto increment addressing is used during the startup phase, when the EtherCAT® master assigns the addresses to the EtherCAT® devices.

During auto increment addressing, the slave is not addressed by the master via its unique address, but via its physical position in the EtherCAT® topology. To the first EtherCAT® slave in the ring, the 0000_{hex} address is assigned; this address is decremented by 1 for each of the remaining slaves ($FFFF_{hex}$ (-1), $FFFE_{hex}$ (-2), etc.).

EtherCAT Addr

EtherCAT® address: fixed address of the EtherCAT® slave.

This address is automatically assigned by the EtherCAT® master during the startup phase. To change the default value, select the check box on the left side of the input field.

You can also check the assigned or changed address in the “Memory” window.

- In the slave's address view (see Figure A-1), click the “Advanced Settings ...” button.
- In the “Advanced Settings” window, select “ESC Access, Memory”.

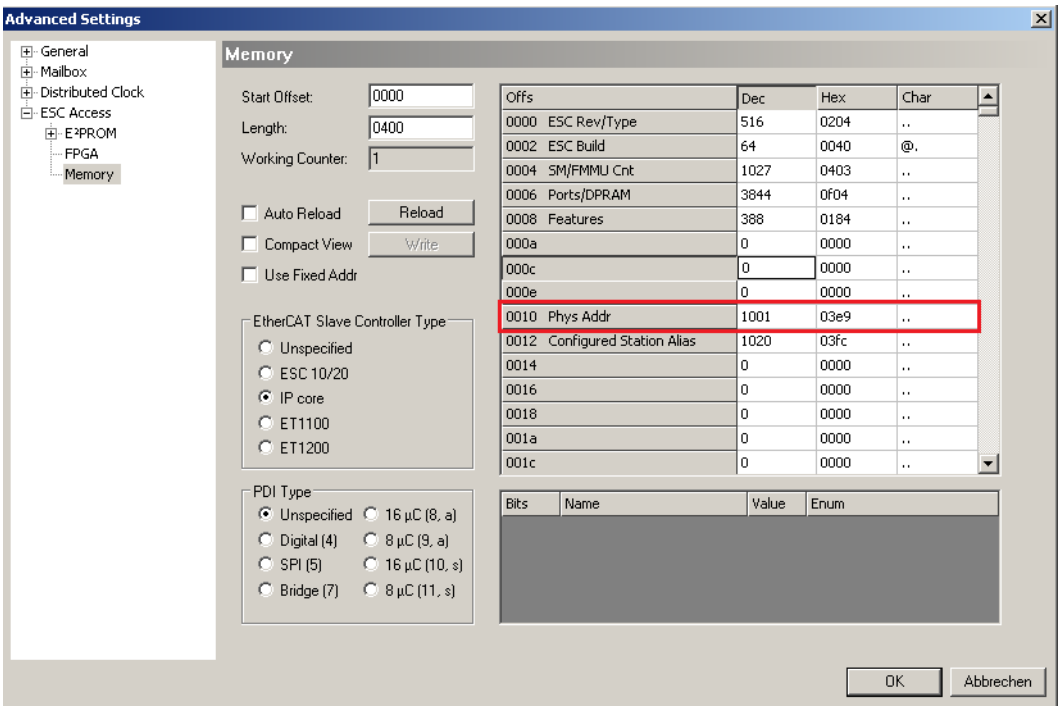

Figure A-2 Physical address of the bus coupler

A 2 Identification

In EtherCAT®, there are two possible methods of identification:

– “Configured Station Alias”, also known as “Second Slave Address”, see appendix A 2.1.

– Explicit Device Identification, see appendix A 2.2 on page 58.

A 2.1 “Configured Station Alias” or “Second Slave Address”

To select this method of identification, proceed as follows:

- In the slave's address view (see Figure A-1), click the “Advanced Settings ...” button.

Below, this path is referred to as “Slave, Advanced Settings ...”.

- In the “Advanced Settings” window, select “General, Identification”.
- Select the “Configured Station Alias (ADO 0x0012)” option.

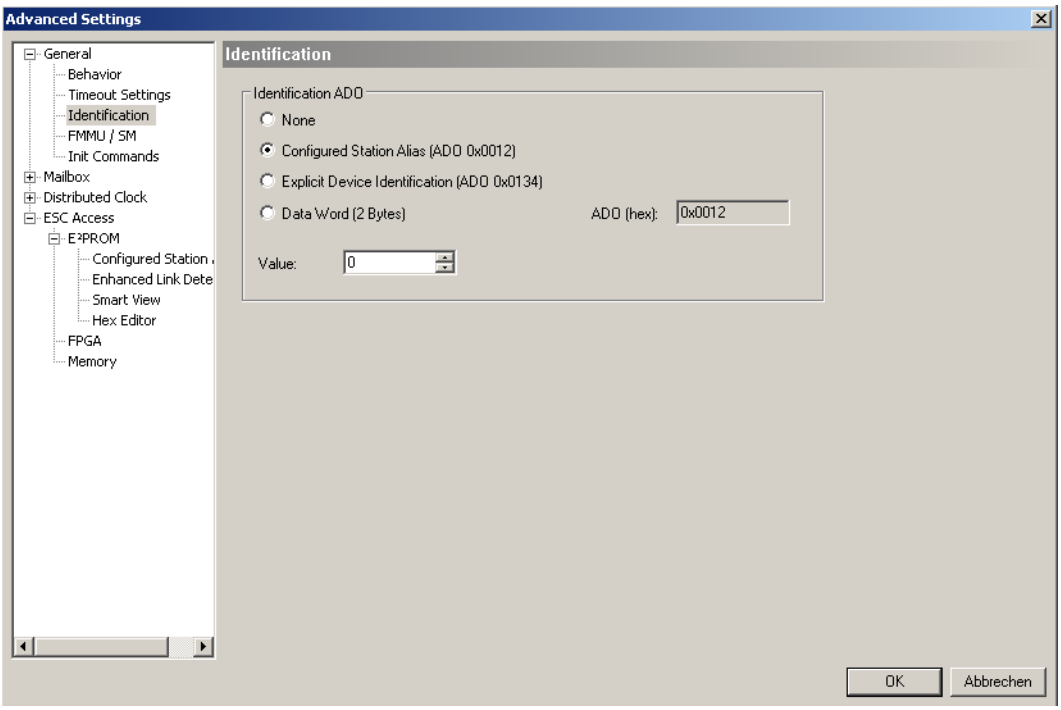

Figure A-3 Selecting the “Configured Station Alias” identification method

The “Second Slave Address” is set by the master via a user interface in the configuration software.

In TwinCAT®, via the TwinCAT® master, set the “Second Slave Address” by proceeding as follows:

- Start up the EtherCAT® slave without any addressing, using a simple configuration. Make sure the slave is in OP, WorkingCounter = 0, no LostFrames.
- In “Slave, Advanced Settings ...”, select “ESC Access, E²PROM, Configured Station Alias”.
- In the “Actual Value (E²PROM)” field, the current address is displayed.
- To change the address, enter the new address in the “New Value” field.

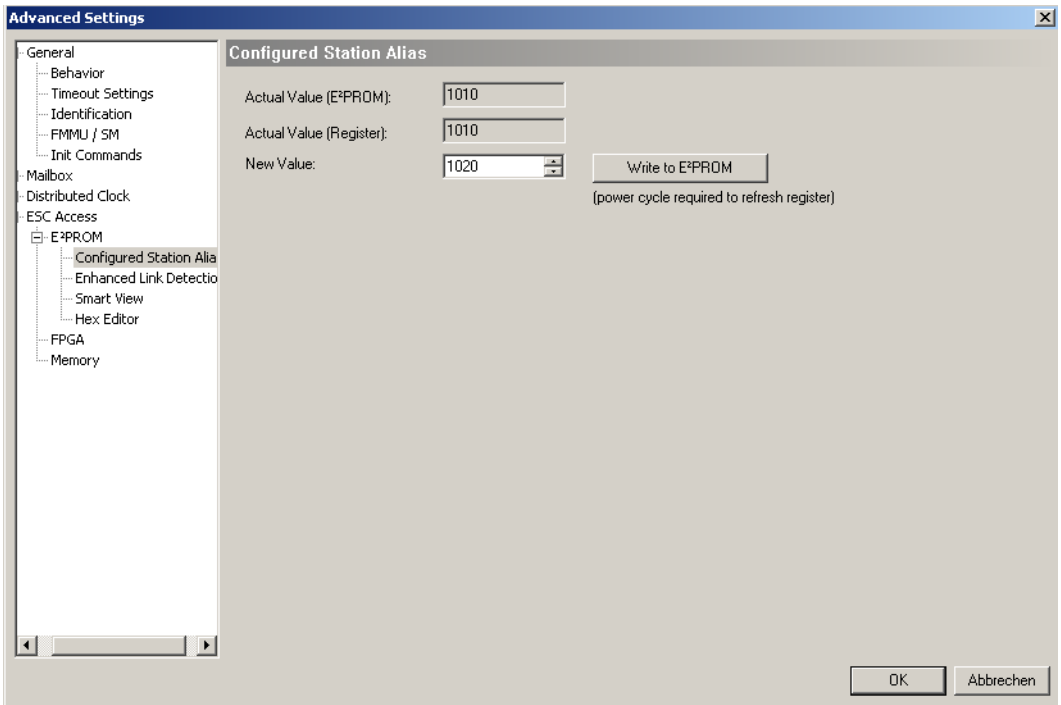

Figure A-4 Changing “Second Slave Address” = “Configured Station Alias”

In this example, the new address is set to $20_{dez}/14_{hex}$.

- Click on the “Write to E²PROM” button.

When the change of address is completed successfully, a notification informs you that the function was completed successfully.
If any error occurs, a notification informs you that the function was aborted due to an error. In this case, please rectify the error.

- Confirm the message with OK.
- Restart the bus coupler. To do so, you can either use the reset button, or disconnect and then reconnect power.

The address is loaded after the restart.

- To check if the new address was loaded correctly, open the “Configured Station Alias” tab again.
- Check the “Actual Value (Register)” value.
- If this value is the same as the “Actual Value (E^2PROM)” value, the change was accepted successfully.

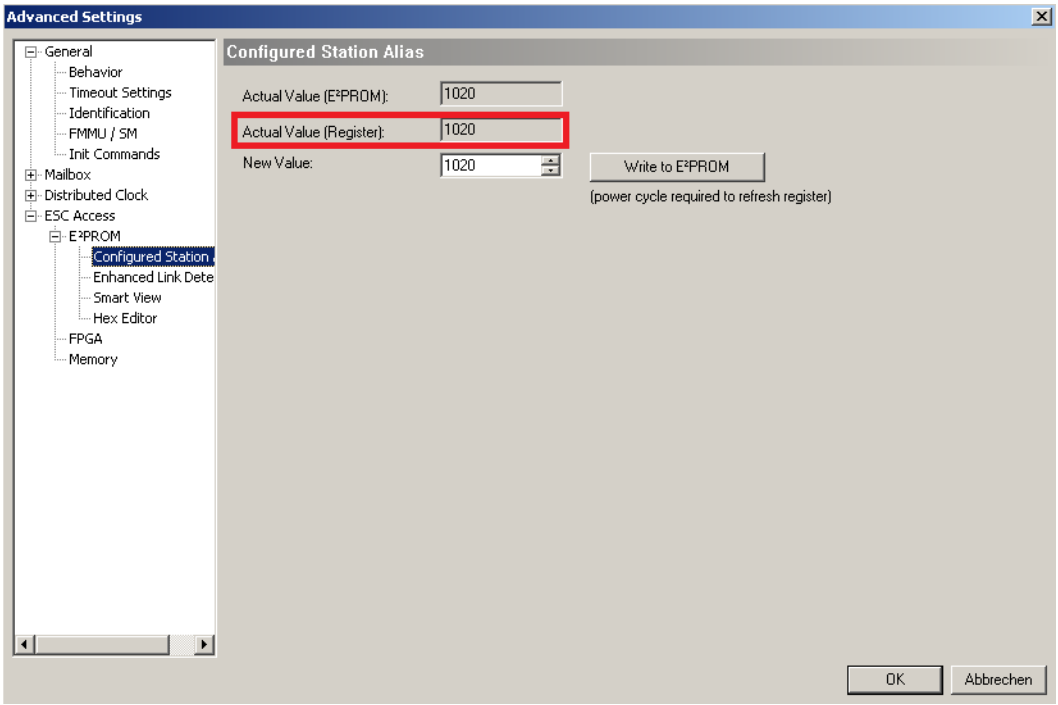

Figure A-5 Successful change of address

A 2.2 “Explicit Device Identification”

This procedure is supported by TwinCAT® 2.11R3 and later versions.

- In “Slave, Advanced Settings ...”, select “General, Identification”.
- Select the “Explicit Device Identification (ADO 0x0134)” option.

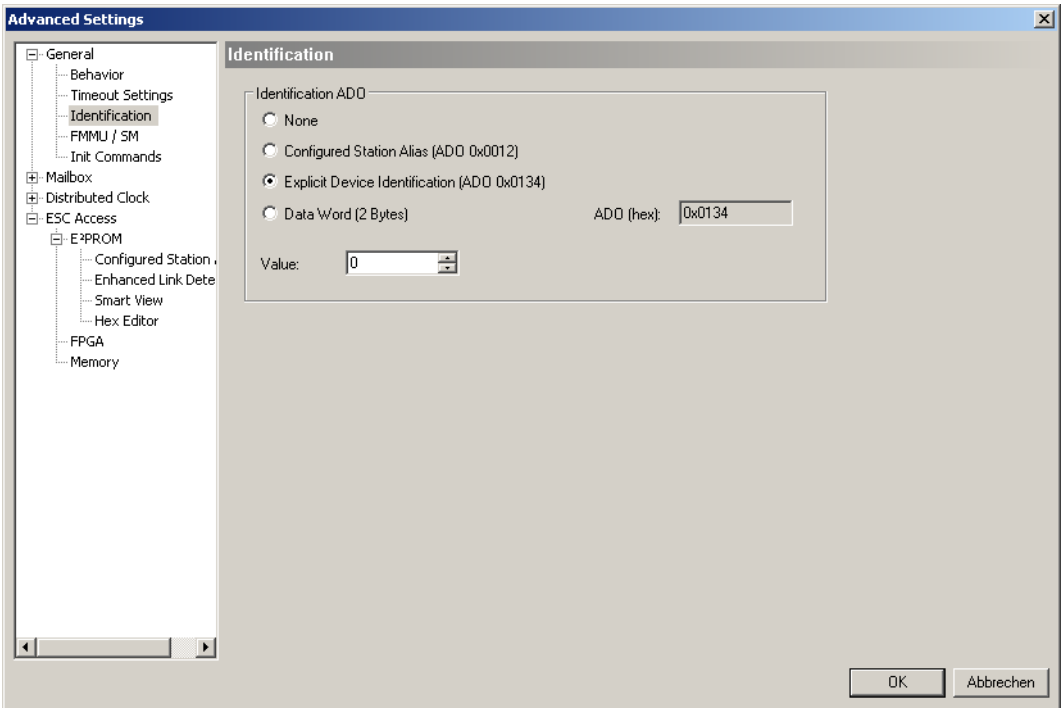

Figure A-6 “Explicit Device Identification”

You can set the bus coupler's Device Identification value by means of the rotary coding switches on the bus coupler.
Upon the master's request, the bus coupler (slave) transmits its ID (0...65535) to the master during the startup phase in the 0134_{hex} “AL Status Register”.

To ensure that the comparison of the ID set on the bus coupler and the ID stored in the software is performed, make the following settings:

- In “Slave, Advanced Settings ...”, select “General, Behavior”.
- Select the “Check Identification” check box.

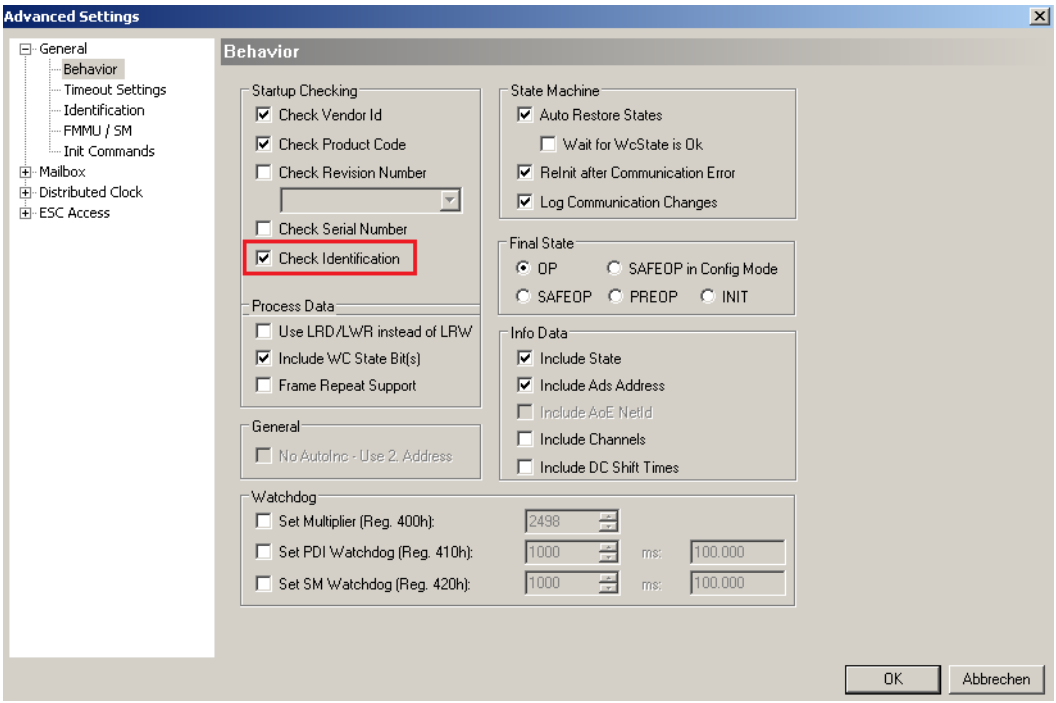

Figure A-7 Selecting “Check Identification”

- Confirm your entry with “OK”.
  The window “Behavior” then closes, and now the active window is the “EtherCAT” tab.
- In the “Identification Value” field, enter the Device Identification Value set by means of the rotary coding switches.

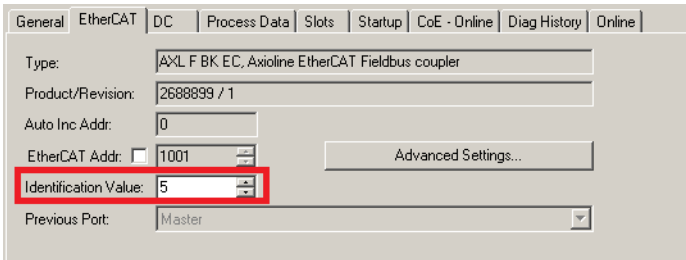

Figure A-8 Device Identification Value

To ensure that slaves following another slave with non-matching Device Identification Values can still be operated, make the following settings:

- In “Slave, Advanced Settings ...”, select “General, Behavior”.
- Select the “Use LRD/LWR instead of LRW” check box.

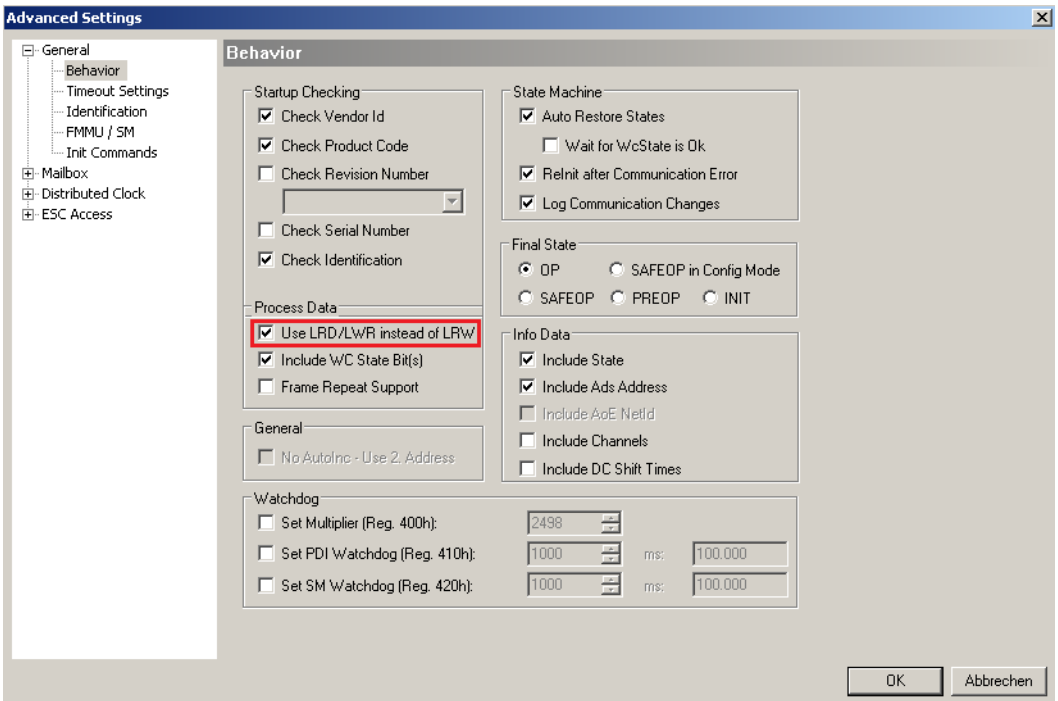

Figure A-9 “Use LRD/LWR instead of LRW”

When the check box is selected, the LRD (Logical Read) command is used for input reading, and the LWR (Logical Write) command is used for output setting.

When the check box is not selected, the LRW (Logical Read/Write) command is used for input reading and output setting.

B Appendix: Hot Connect and changing the bus structure

B 1 EtherCAT® Hot Connect (/Fast Hot Connect)

The TwinCAT® Hot Connect functionality for EtherCAT® enables you to remove pre-configured sections from the data traffic, or add them to the data traffic, before starting a system, or during system operation.

To remove pre-configured sections from the data traffic, disconnect the communication path, or switch off the device.

To add pre-configured sections to the data traffic, connect the communication path, or switch on the device.

The removing or adding is called “flexible topology” or Hot Connect.

To define a group as a Hot Connect Group, proceed as follows:

- In the TwinCAT® System Manager's bus structure, click on the bus coupler (slave) item.
- Right-click to open the slave's context menu and select “Add to Hot Connect Groups...”.

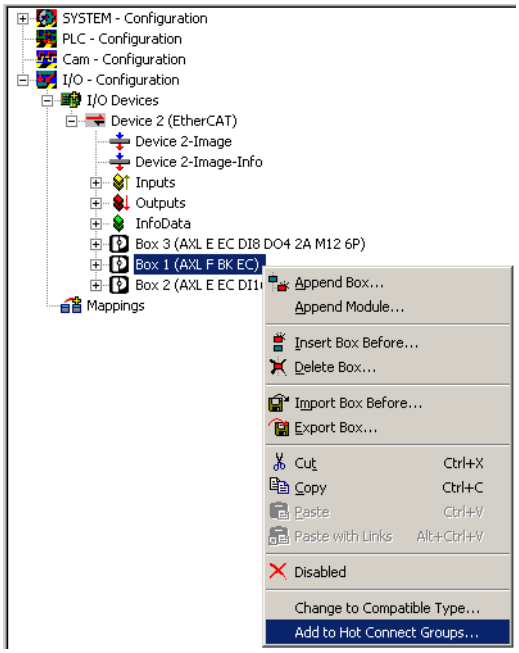

Figure B-1 Adding a slave to a Hot Connect Group

- In the window that appears, select the slave you'd like to add to the Hot Connect Group.
- Specify the method of identification for the slave.
  Specify the “Identification Value” set by means of the rotary coding switches.
  Additionally, you can specify the previous slave's EtherCAT® address under “EtherCAT Addr. of previous Slave”.

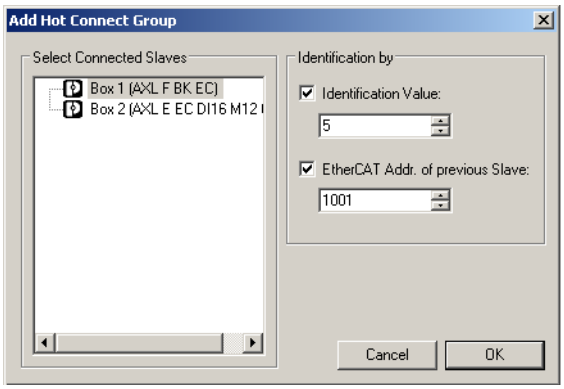

Figure B-2 Specifying the identification method for a Hot Connect Group

When you specify the previous slave's address, the bus station thus parameterized can no longer be connected to or operated at any free port, but only at the EtherCAT® port that follows directly on the specified slave. Using this method significantly reduces the number of possible application sites for such a station.

The settings are also displayed on the slave's “EtherCAT” tab.

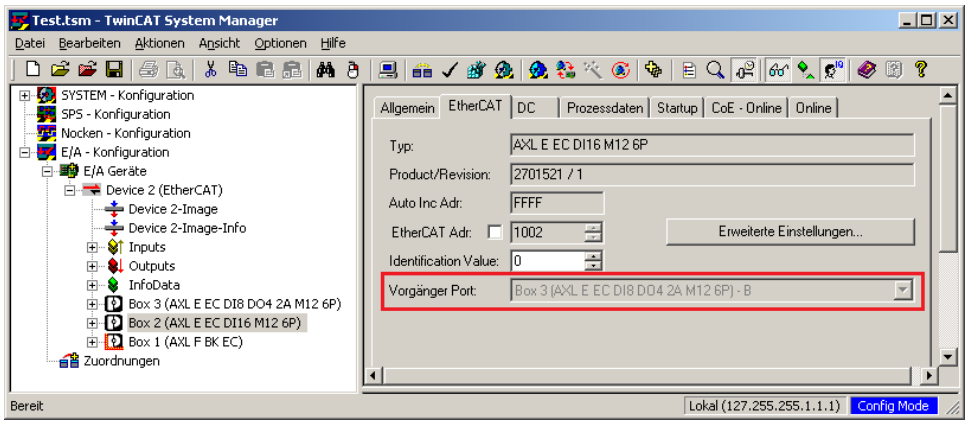

Figure B-3 Display of a Hot Connect Group's previous port

B 2 Changing the bus structure

You can change the bus structure by removing or inserting modules.

B 2.1 Removing a module

To remove a module from the bus configuration, proceed as follows:

- In the “Slots” tab's left window, select the module you want to remove.
- Click the “X” button. The module is removed from the bus configuration.

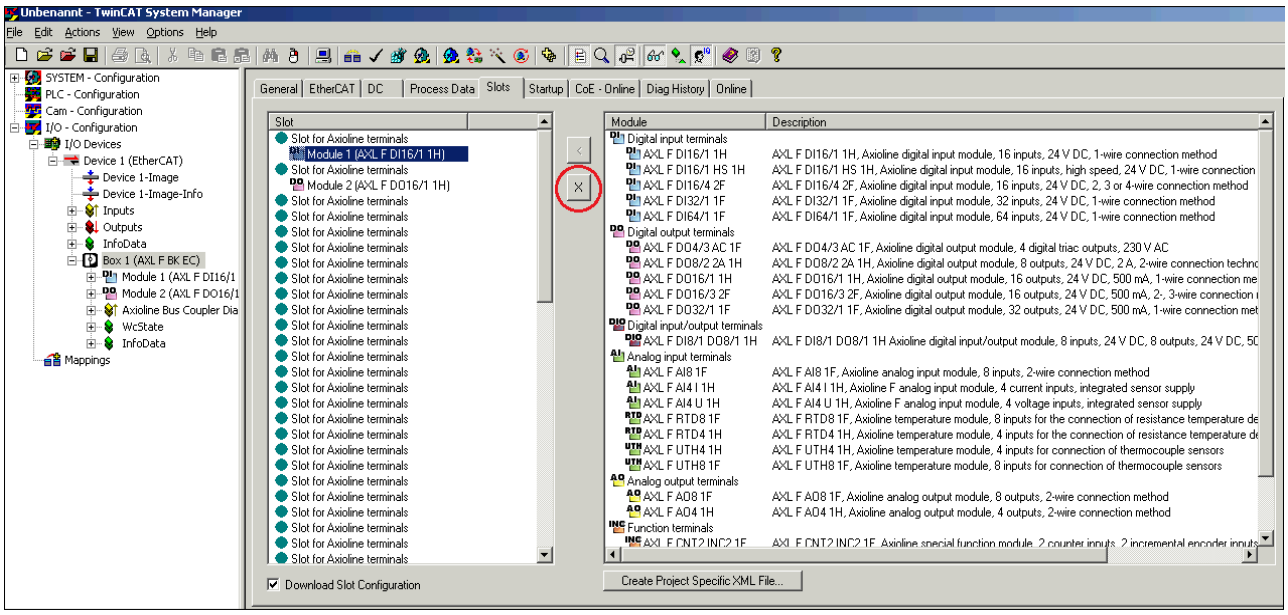

Figure B-4 Removing a module from the bus configuration

B 2.2 Inserting a module

To insert a module into the bus configuration, proceed as follows:

- In the “Slots” tab's left window, select a free slot.
- In the “Slots” tab right window, select the module you want to insert.
- Click the “<” button. The module is inserted into the bus configuration.

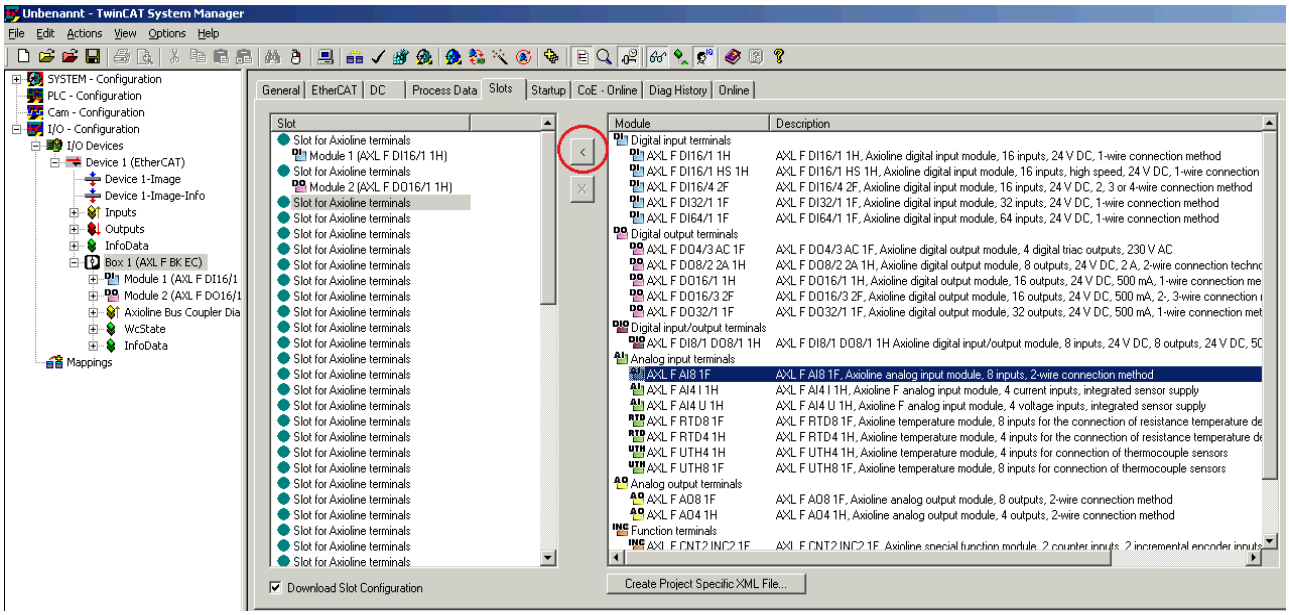

Figure B-5 Inserting a module into the bus configuration

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