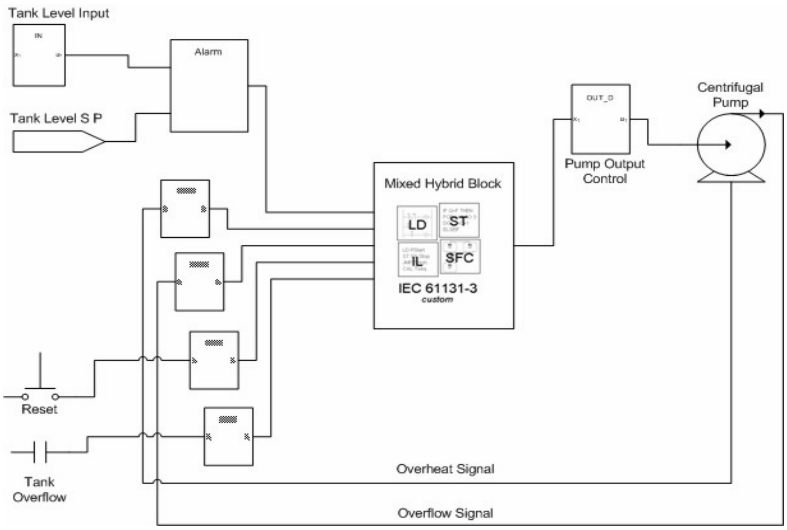
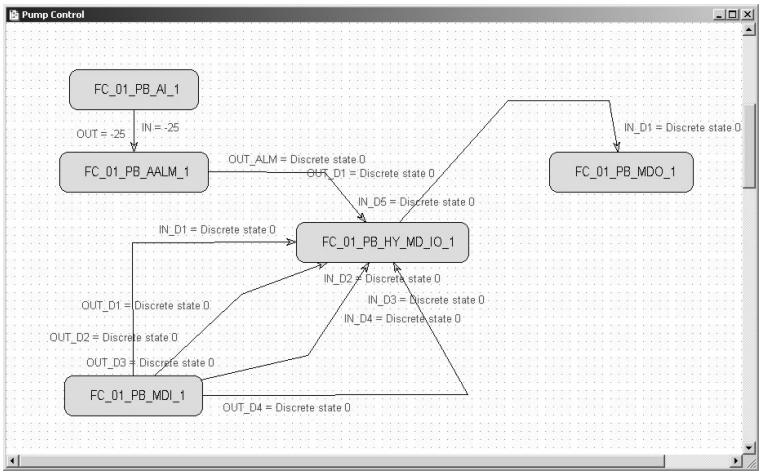
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating Instructions

ControlCare Application Designer

IEC 61131-3 Tutorial





BA 038S/04/en/07.06
Product Version 2.02.xx
70101386

Endress+Hauser
People for Process Automation

Table of Contents

Revision History

Product version	Manual	Changes	Remarks
2.01.xx	BA038S/04/en/08.05	Original manual	
2.02.xx	BA038S/04/en/07.06	Program (Open PCS)	■ FBD language now available ■ CC libraries always active (Chapter 5.2.2) ■ Optimize for speed now default (Chapter 5.2.9)
		Program (Application Designer)	■ FB schedule configured by drag&drop (Chap. 4.5) ■ Incremental download (Chap. 6.3)
		Editorial	■ Update Version and documentation tables

Product Version

The table below indicates the product versions of the main components of ControlCare Field-based Control System. More details on the individual components can be seen in About ControlCare

Product Version	Component	Version
V2.02.xx	ControlCare Application Designer Suite	Version 2.02.xx
	ControlCare PROFIBUS Configurator	Version 2.9xx
	ControlCare Field Control (OPC) Server	Version 3.11.xx
	ControlCare Device Libraries*	Version 2.02.xx
	ControlCare Manuals	Version 2.02.xx
	*Version No. may increase independent of Product Version as the latest devices are added to the library	

Registered Trademarks

PROFIBUS®
Registered trademark of the PROFIBUS User Organisation, Karlsruhe Germany.

FOUNDATION™ Fieldbus
Trademark of the Fieldbus Foundation, Austin, TX 78759, USA

Microsoft® , Windows® , Windows 2000® ,Windows XP®, Windows 2003 Server® and the Microsoft logo are registered trademarks of the Microsoft Corporation.

Acrobat Reader® is a registered trade mark of the Adobe Systems Incorporated.

All other brand and product names are trademarks or registered trademarks of the companies and organisations in question

1 Safety

1.1 Designated use

ControlCare is a field-based control system comprising hardware and software components. It can be used to visualize, monitor and control production processes. The approved usage of the individual units used in the system can be taken from the corresponding parts of the operating instructions.

The software described in this particular manual allows the programming of the hybrid function block in IEC 61131-3 language as well as the engineering, configuring and commissioning of a ControlCare SFC162 FOUNDATION Fieldbus or SFC173 PROFIBUS Field Controller. Two languages have been taken as examples, and the building of appropriate control strategies using these and the function blocks contained in the Field Controller and connected devices are described.

1.2 Installation, commissioning and operation

ControlCare Field Controllers have been designed to operate safely in accordance with current technical safety and EU directives. Essential to their use is the ControlCare Application Designer software suite, which allows control strategies to be created for FOUNDATION Fieldbus and PROFIBUS I/O applications. Field devices, links, junction boxes, cables and other hardware comprising the Fieldbus sytem must also be designed to operate safely in accordance with current technical safety and EU directives.

If devices are installed incorrectly or used for applications for which they are not intended, or if the controller is not configured correctly, it is possible that dangers may arise. For this reason, the system must be installed, connected, configured, operated and maintained according to the instructions in this and the associated manuals: personnel must be authorised and suitably qualified.

1.3 Operational safety

Location

Field Controllers must be mounted in a permanent and weather-protected location in a safe area. The environment shall be a metal cabinet or an installation frame with a well grounded mounting plane. The environment shall be protected.

Hazardous areas

The controller must be connected to networks operating in explosion hazardous areas via barriers or other safety components. When installing components in explosion hazardous areas:

- Ensure that all installion and maintenance personnel are suitably qualified
- Check that all equipment has the appropriate safety certificates
- Observe the specifications in the device certificates as well as national and local regulations.

This topic is discussed in BA013S (FF Guidelines) and BA034S (PROFIBUS Guidelines).

EMC

All modules are suitable for industrial use and conform with the following standard, see Appendix:

- EN 61326: 1997/A1: 1998
  Interference emmision: Class A apparatus
  Interference immunity: as per Annex A, industrial environment

Depending upon the environment in which the bus is operating, particular attention should be paid to the grounding of the bus cables. This topic is discussed in BA013S (FF Guidelines) and BA034S (PROFIBUS Guidelines).

IP Address

A ControlCare Field Controller is normally configured from a workstation connected into the control system backbone. You will require a unique IP address to set it up.

Warning
The use of IP addresses is strictly controlled. Usually your system administrator will be authorised to allocate unique addresses. Assigning an unauthorised address to a Field Controller may result in conflicts within your system and the failure of the associated devices!

Since the system can be accessed and manipulated through the various ControlCare tools, it is advisable to control access both to the workstation and the folders in which the configuration is stored. Always make a back-up of the project.

Technical improvement

Endress+Hauser reserves the right to make technical improvements to its software and equipment at any time and without prior notification. Where such improvements have no effect on the operation of the equipment, they are not documentated. If the improvements effect operation, a new version of the operating instructions is normally issued.

1.4 Conventions and icons

In order to highlight safety relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding icon in the margin.

Safety conventions

Icon	Meaning
	A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned
	**Caution!** Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument
	**Warning!** A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument

1.5 ControlCare documents

Table 1.1 indicates the documents, planned and realized, containing safety relevant information, installation, commissioning and operating instructions for the equipment and software associated with ControlCare.

All documentation available at the time of release is included on the ControlCare CD-ROM and is installed in **Start=>Programs=>Endress+Hauser=ControlCare=Manuals** during set-up.

Component	Description	Document type	Designation	Order No.
System	ControlCare System Overview	Operating manual	BA016S/04/en	56004883
	ControlCare System Design	Operating manual	BA039S/04/en	Planned
	ControlCare System Specifications	Operating manual	BA040S/04/en	56004888
Software	Application Designer Overview	Operating manual	BA017S/04/en	70104301
	Application Designer Drawing Tool	Operating manual	BA032S/04/en	Planned
	Application Designer: FF Tutorial	Operating manual	BA019S/04/en	70101151
	Application Designer: PROFIBUS Tutorial	Operating manual	BA036S/04/en	70101152
	Application Designer: MODBUS Tutorial	Operating manual	BA037S/04/en	70101153
	Application Designer: IEC 61131 Tutorial	Operating manual	BA038S/04/en	70101386
	Field Control (OPC) Servers	Operating manual	BA018S/04/en	71031428
Field Controller	Hardware Installation Guide	Operating manual	BA021S/04/en	56004885
	Commissioning and Configuration	Operating manual	BA035S/04/en	56004887
Function Blocks	Function Block Manual	Operating manual	BA022S/04/en	56004886
Set-Up	Getting Started	Operating manual	BA020S/04/en	56004884
General	FOUNDATION Fieldbus Guidelines	Operating manual	BA013S/04/en	70100707
	PROFIBUS Guidelines	Operating manual	BA034S/04/en	56004242

Tab. 1-1: ControlCare Documentation

2 Task Description

This tutorial describes the steps necessary for setting up the project described below. It does not aim to give an exhaustive account of Application Designer functions, but rather shows you one of a number of methods to reach your goal. The tags and names used in the tutorial are imaginary and will be different in a proper application. A full description of Application Designer functions is to be found in Application Designer Overview BA017S/04/en and Drawing Tool BA032S/04/en (in preparation). Function block descriptions are to be found in BA022/04/en, Function Block manual.

2.1 Application

For this tutorial, the case of pump control for a tank level will be used, see Fig. 2-1.

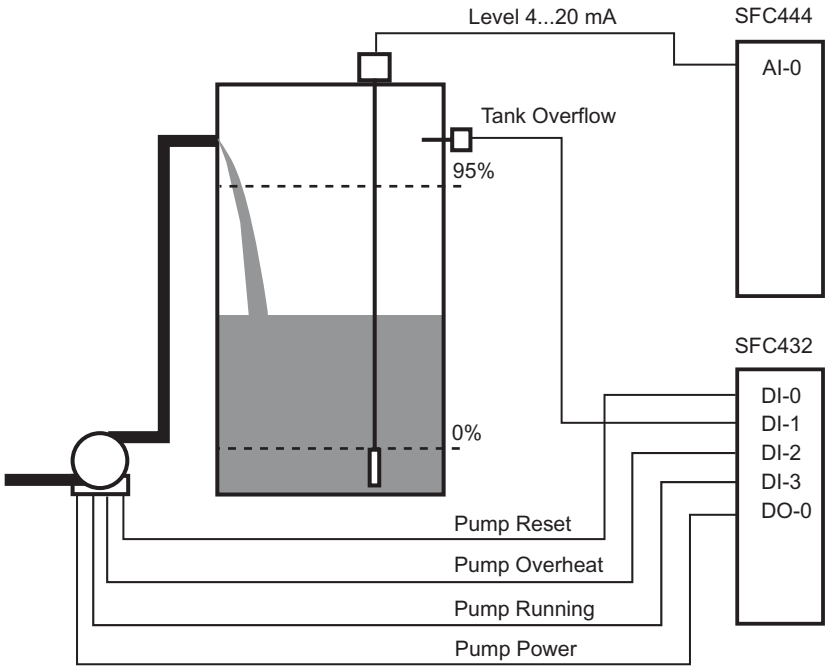


Fig. 2-1: Overview of pump control for tank filling

A centrifugal pump is used to fill the tank with liquid. The level of liquid in a tank is monitored by a level transmitter which outputs a corresponding 4 mA to 20 mA signal. When the tank is full (=95%) the pump must be switched off. In order to provide overspill protection for the tank, should the level transmitter fail, a level limit switch with relay output is built in at an appropriate height. The pump itself provides Overheat and Running signals, and a switch is provided for pump reset.

The signals are acquired as follows:

- 4 mA to 20 mA level to AI-0 input of a SFC444 Analog Input module
- Level Overflow, Pump Reset, Pump Overheat and Pump Running signals to DI-0 to DI-3 inputs of a SFC432 Mixed Discrete I/O module: 0 V = False, 24 V = True
- Pump output current from DO-0 output of the SFC432 Mixed Discrete I/O module: NO relay, False = Pump ON, True = Pump OFF, Fail Safe = Pump OFF

For the tutorial the control is done in a PROFIBUS SFC173 Field Controller, but since there is no PROFIBUS DP network connected to it, the procedure described also applies to the FOUNDATION SFC162 Fieldbus Controller.

Fig. 2-2 shows a schematic diagram of the pump control application. The analog level input is fed to an Analog Alarm block that generates a true signal when the "full" level is reached. This is a standard function block, and eliminates the need to provide a similar signal conditioning program within the hybrid block. All discrete signals are connected directly to the hybrid function block which generates an output signal according to the status of the application.

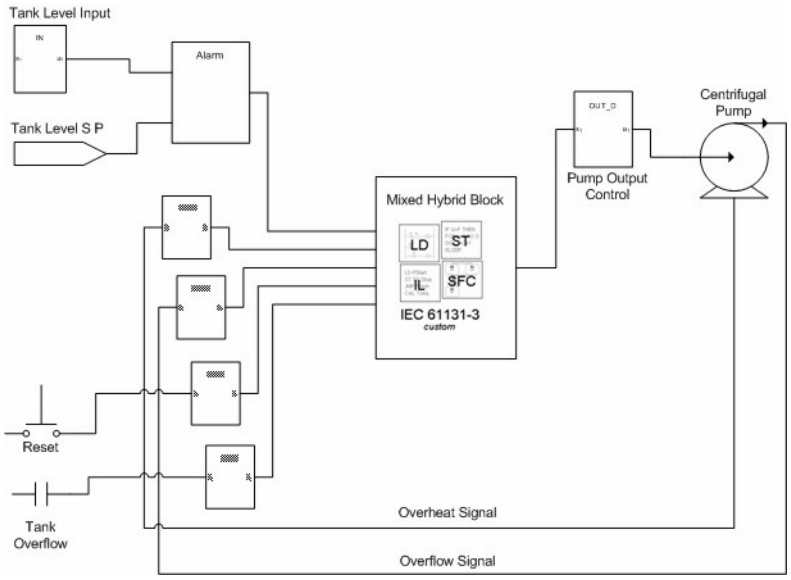


Fig. 2-2: Schematic diagram of pump control application

2.1.1 Control strategy

Fig. 2-3 shows the corresponding control strategy. The level signal is fed to the Analog Input block, and after scaling to 0% to 100% is passed on to the Analog Alarm block. This generates a true or false signal according to the level in the tank. The discrete input signals are collected in a Multiple Discrete Input block and the pump output control signal is fed to a Multiple Discrete Output block. The control algorithm is programmed in the hybrid block.

It should be noted that the control strategy can also be created with 4x Discrete Input blocks and and 1x Discrete Output block.

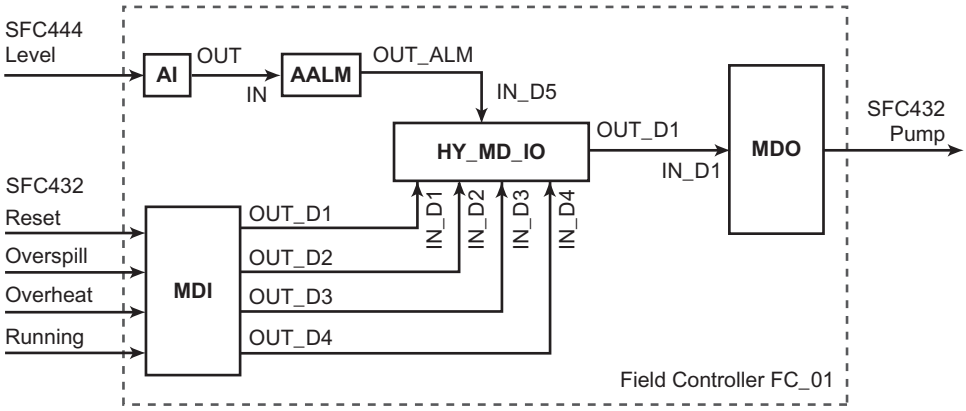


Fig. 2-3 Control strategy for pump control application

2.1.2 Control algorithm

The truth table for the hybrid function block has is as follows:

Function	IN_D0	IN_D1	IN_D2	IN_D3	IN_D4	OUT_D0
Tank "Empty"	–	–	–	–	False	False
Tank Full	–	–	–	–	True	True
Tank Overflow	–	True	–	–	–	True
Pump Reset	True	–	–	–	–	True
Pump Overheat	–	–	True	–	–	True
Pump Running	–	–	–	True	–	False

The tank overflow and pump overheat conditions must lead to immediate switch off of the pump. The pump running signal is automatically generated by the pump itself, and is provided, e.g. for a visualization of the application.

2.1.3 Network

The project uses a PROFIBUS SFC173 Field Controller with local I/O. The procedure for a FOUNDATION Fieldbus SFC162 is exactly the same. The network is assumed to be constructed as shown in Fig. 2-4.

- The level signal is acquired via a SFC444 Analog Input module
- The level overspill and pump signals are acquired by a SFC432 Discrete Input/Output module
- The pump is connected to a SFC432 Discrete Input/Output module.

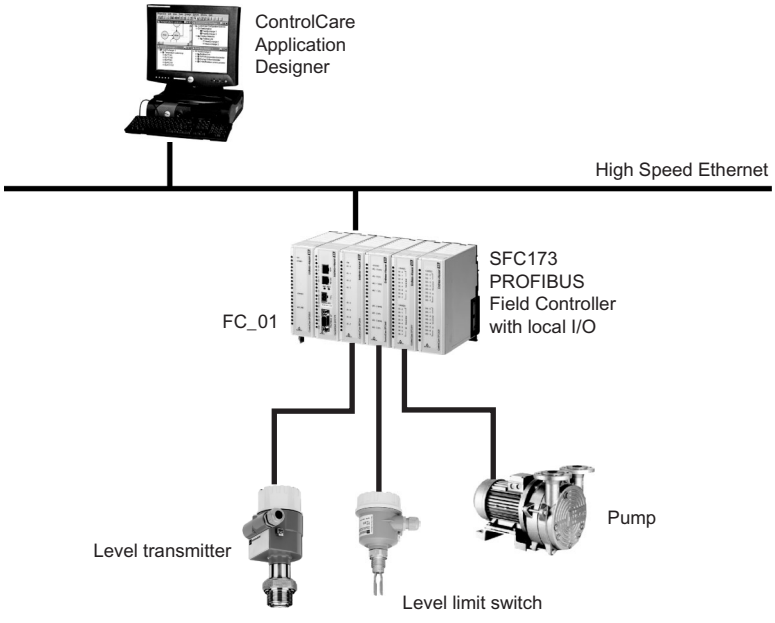


Fig. 2-4 Network for application example

2.2 Preliminaries

2.2.1 Installation and commissioning

Before you can start the IEC 61131-3 tutorial, Application Designer and OpenPCS must be installed on your computer, the SFC173 PROFIBUS Controller installed and commissioned and a connection made to your computer. Instructions on how to do this are to be found in:

- Operating Instructions BA020S/04/en, Getting Started
- Operating Instructions BA021S/04/en, Field Controller: Hardware Installion
- Operating Instructions BA035S/04/en, Field Controller: Commissioning and Configuration

Not all project steps are described in detail, so it is recommended that you also have the PROFIBUS or FOUNDATION Fieldbus tutorials at hand:

- Operating Instructions BA019S/04/en, Application Designer: FOUNDATION Fieldbus tutorial
- Operating Instructions BA036S/04/en, Application Designer: PROFIBUS tutorial

2.2.2 Rack assembly

The SFC173 Field Controller, SFC444 Analog Input module and SFC432 Discrete I/O module have combined power demand of 67 mA @ 24 VDC and 940 mA@ 5 VDC. Even allowing for a tolerance of 20%, this is easily covered by a SFC050 or SFC056 rack power module (300 mA @ 24 VDC and 3000 mA @ 5 VDC). See Chapter 10 of BA040S/04/en, ControlCare, System Specifications.

The Field Controller and local I/O are mounted on a SFC901A rack assembly with **address = 1** (I/O cannot be mounted on a rack with the address "0".) The parameters for commissioning the Field Controller are shown in Table 2-1.

Tab. 2-1: Parameter settings for rack in hardware configuration and function blocks

Rack 1	**Slot 0**	**Slot 1**	**Slot 2**	**Slot 3**
Module	SFC050	SFC173	SFC444	SFC432
IO_TYPE_Rx	No I/O	No I/O	8 Analog Input	8 DiscIn 4 DiscOut
Channel Group A	–	–	1200	1309
Channel Group B	–	–	–	1319

Note!

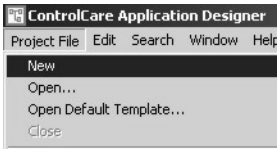
- The channels used to connect to the modules to the function blocks are given by the Rack (R), Slot (S), Group (G) and I/O point (P) indices = RRGSP, whereby counting starts at "0".
- Since Multiple Discrete Input and Output blocks are being used for the discrete signals, the I/O point index is "9", see BA035S/04/en, Field Controller, Commissioning and Configuration.

3 Create a PROFIBUS Network

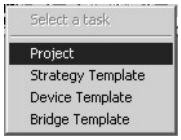
3.1 Create a new project

1 Start ControlCare Application Designer by clicking on the icon on your destop or via **Start => Programs => Endress+Hauser => ControlCare => ControlCare Application Designer**

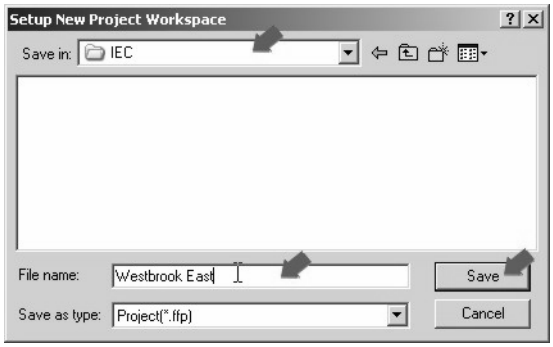
2 The project starts from a blank application screen
– With the right mouse key select **Project File=>New**



3 The **Document Type** box appears: Click the option **Project**



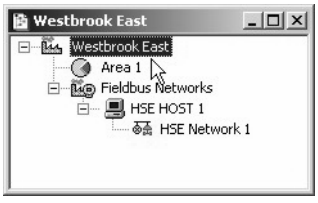
4 The **New Project** dialog box opens:



1. Choose the folder where the project will be saved.
2. Type the name of the project in the File Name box.
3. Click **Save.**

If the new project is not to be created, click **Cancel.**

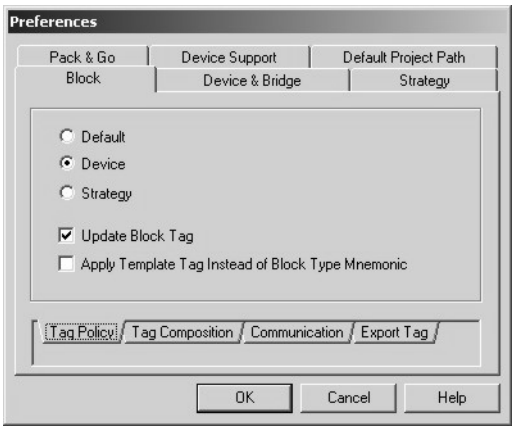
5 ON saving, ControlCare Application Designer
– automatically creates a folder with the entered file name within the selected folder
– automatically creates a project, adding the HSE Network network and the HSE Host



3.2 Determine the naming preferences

Before you start, you can set preferences for the way your project is created. Of particular interest at this stage is the labelling of the function blocks.

1 Press **Project File** => **Preferences**
  – The **Preferences** Dialog appears



Tag Policy

Tag Policy determines how the blocks are labelled by default if no tag names are entered

1 Select the folder **Block** and the subfolder **Tag Policy**, then check the following buttons
  – **Device**
  – **Update Block Tag**

2 Press **OK** to confirm your selection
  – Application Designer will now automatically rename any blocks created in the control strategy window as they are assigned to the devices by adding the device tag as prefix.

Tag Composition

Tag Composition determines how the block identifiers are added to the block tag if no block name is entered.

1 Select the subfolder **Tab Composition**:
  – Default setting is "_".
  – **This is mandatory if hybrid function blocks are to be used**
  – Check **Prefix**

2 Press **OK** to confirm your selection
  – Application Designer will now automatically compose the blocks according to your selection, e.g. TagName_Block_n.

Export Tag

Export Tag causes tags to be automatically exported every time the project goes online

1 Select the subfolder **Export Tag**
  – Check the **Automatic** button
  – Press **OK** to confirm your selection

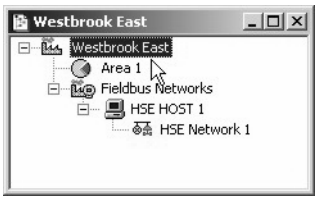
2 Right-click on the **Project File** menu and select **Save Entire Configuration** to save your preferences.

3.3 Add a gateway (SFC173)

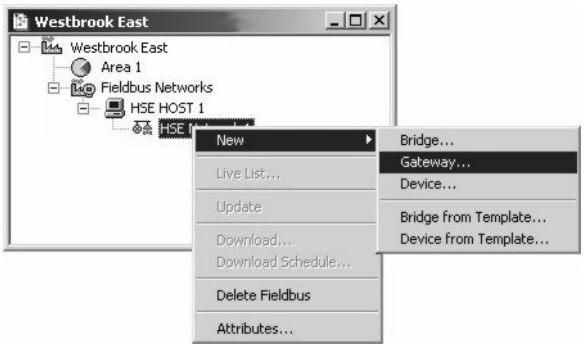
Note!

- If you are using a FOUNDATION Fieldbus SFC162 Field Controller, the procedure is exactly the same, except that you must add a "bridge" not a "gateway".

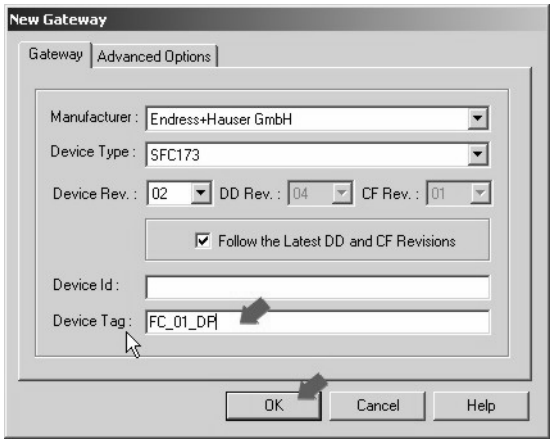
1 In the project workspace, click on "**+**" to expand the tree:



2 Now right-click on the **HSE Network** leaf and select **New=>Gateway**



3 The **New Gateway** dialog box appears:
Select the SFC173 Field Controller and type in a device TAG = **FC_01_DP**



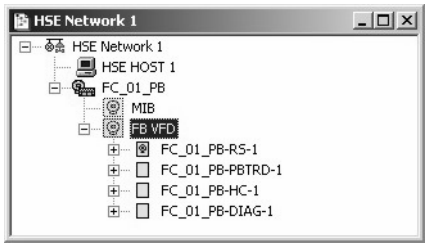
If you do not type in a tag, the default will be "Gateway n", where n is a consecutive number. At this point, the Fieldbus Network does not have a direct correspondence to any of the existing controllers.

4 Press **OK** to create the Gateway.

5 Right-click on the **Project File** menu and select **Save Entire Configuration** to save the project.

3.4 Set up the Hardware Configuration block

1 Double click on the **HSE Network** leaf, the HSE Network window opens:
   – Expand the **FC_01_PB** and **FB_VFD** leaves

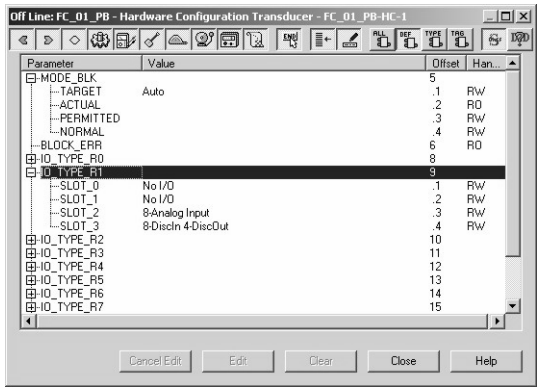


2 Double-click on the **FC_01_PB_HC_1** leaf to open the **Off Line Characterization** dialog To change parameters:

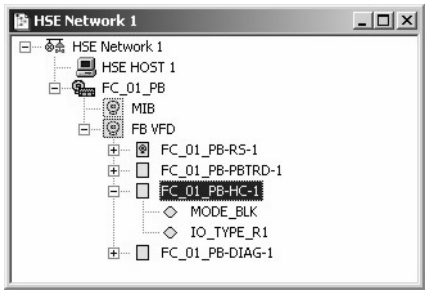
   – Expand the parameter leaf
   – Double click on value space
   – Enter the parameter or select it from the drop-down menu
   – Confirm with End **Edit**

3 Expand the **MODE_BLK** parameter left and check that **Target** is set to **Auto**

4 Expand the **IO_TYPE_R1** parameter leaf and set the following parameters, see Table 2-1, Chapter 2.2.2
   – **Slot_0**: No I/O
   – **Slot_1**: No I/O
   – **Slot_2**: 8 Analog Input
   – **Slot_3:** 8 DiscIn 4 DiscOut



5 Click **Close**, then save the configuration
   – Right-click on the **Project File** menu and select **Save Entire Configuration** to save the project, which now looks like this.



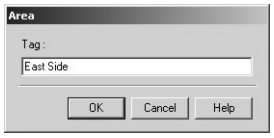
4 Create a Control Strategy

Having created a physical view of the process instrumentation, in this case the Field Controller, the next step is to create control strategy. This is done in the logical view of the plant. This represents the plant as Areas/Process Cells in accordance with ISA S88/IEC 61518. Only one Area is allowed in the project, but this may have any number of Process Cells.

4.1 Add a Process Cell

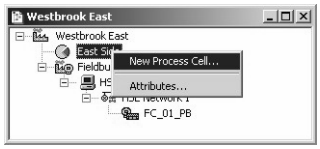
1 Click on the "**Area 1**" leaf in the project and select **Attributes...**

2 The **Attributes** dialog box appears

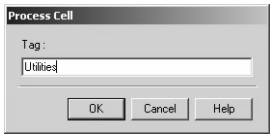


– Enter a name for the area, e.g. East Side
– Click **OK** to store your changes

3 Click on the Area leaf again and select **New Process Cell...**

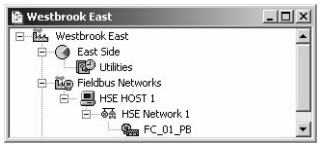


4 The **Process Cell** dialog box appears



– Enter a name for the process cell, e.g. Utilities
– Click **OK** to store your changes

5 Your project should now look something like this:

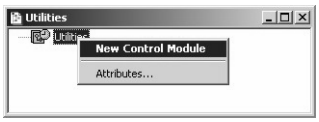


6 Open **Project File**, then press **Save Entire Configuration**, to save the project.

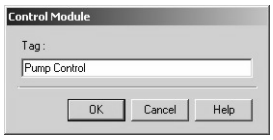
4.2 Add a Control Module

1 Double-click on the Process Cells leaf – a new window with the name of the leaf opens

2 Right-click on the top leaf and select **New Control Module**



3 The **Control Module** dialog box appears



– Enter a name for the control module, e.g. Pump Control
– Click **OK** to store your changes

4 The project now looks something like this:

5 For a real project, Step 2 and 3 would be repeated until all the required control modules for a particular process cell have been added. This allows each control loop or control loop group to be set up and viewed in its own control strategy window.

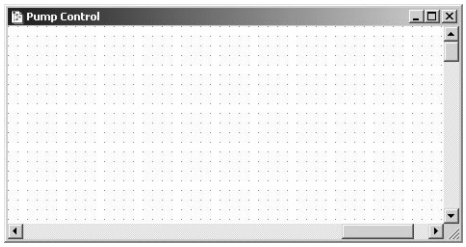
6 Open **Project File**, then press **Save Entire Configuration**, to save the project.

4.3 Add Function Blocks to the Control Strategy

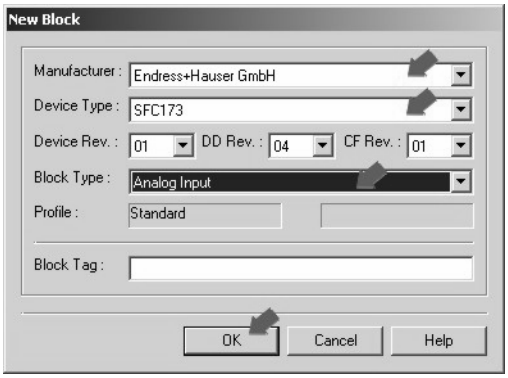
Note!

- The function blocks used in the tutorial are selected from the device manufacturer's device list. It is also possible to select standard function blocks from the "Fieldbus Foundation" list. This ensures that the control strategy can be executed in any device that supports a particular standard block, irrespective of vendor.
- Endress+Hauser devices support standard function blocks and offer them in the manufacturer specific list.

1 Double-click on the control module leaf or right-click and select **Expand** to open the **Control Strategy** workspace - this has the same name as the leaf

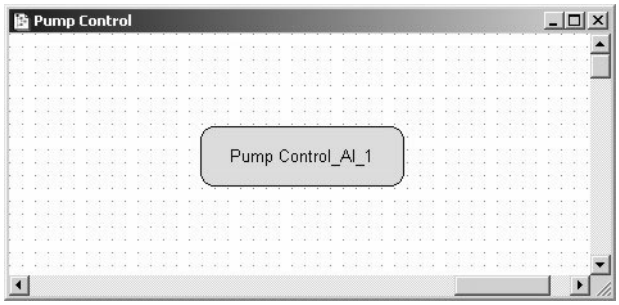


2 Press the Function Block button in the toolbar and click in the workspace
– The **New Block** dialog appears



– Select the **Manufacturer** = Endress+Hauser
– Select the **Device Type** = SFC173
– Select the **Block Type** = Analog Input
– Press **OK** to create the function block

3 The block now appears in the strategy window with the default name



4 Repeat Steps 2 and 3 for the Analog Alarm, Multiple Discrete Input, Hybrid with Discrete I/Os and Multiple Discrete Output blocks

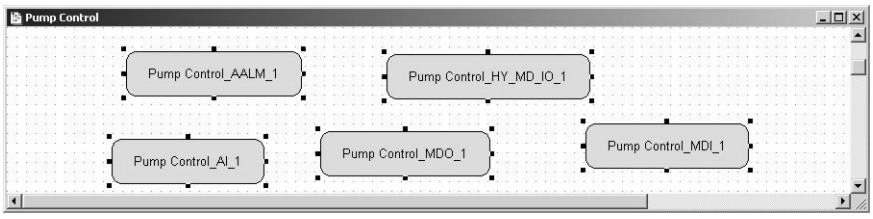
- Level Analog Alarm:
  Manufacturer = Endress+Hauser
  Device Type = SFC173
  Block Type = Analog Alarm

- Flow AI
  Manufacturer = Endress+Hauser
  Device Type = SFC173
  Block Type = Multiple Discrete Input

- Flow PID
  Manufacturer = Endress+Hauser
  Device Type = SFC173
  Block Type = Hybrid with Discrete I/Os

- Positioner AO
  Manufacturer = Endress+Hauser
  Device Type = SFC173
  Block Type = Multiple Discrete Output

5 The control strategy now looks like this



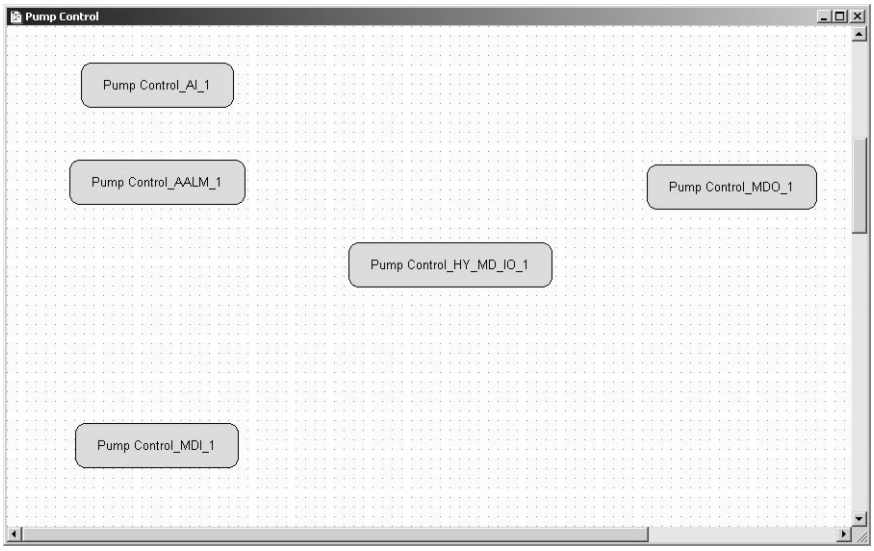
6 Open **Project File**, then press **Save Entire Configuration**, to save the project.

°Note!

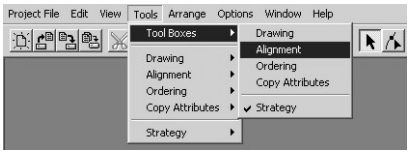
- If you are using the FOUNDATION Fieldbus SFC162 Field Controller, select the blocks from the corresponding SFC162 Block Type list

4.4 Add the Function Block links

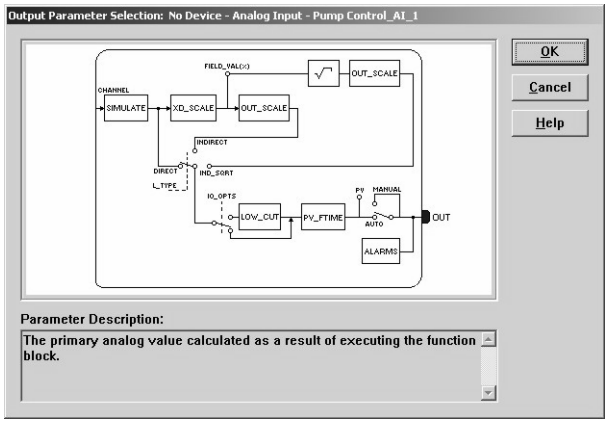
1 In the Control Strategy workspace position the blocks according to your strategy



- The blocks can be dragged and dropped by selecting and holding down the right mouse key
- The blocks can be aligned by selecting, then via **Tools => Alignment => e.g. Middle** followed by a click on the block to which the alignment is to be made
- The **Tools** menu also contains other standard drawing functions such as toolbars, standard shapes, line thickness, colours etc.



2 Click on **Function Block Link** button in the tool bar, the cursor changes to a cross
- Select the **Pump Control_A1_1 block** with the cross: the **Output Parameter Selection** dialog appears

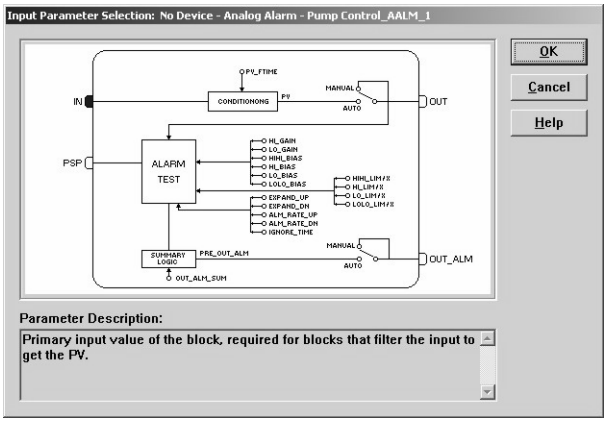


- OUT contains the level value

3 Click the box next to **OUT** – it changes color – then click on **OK**

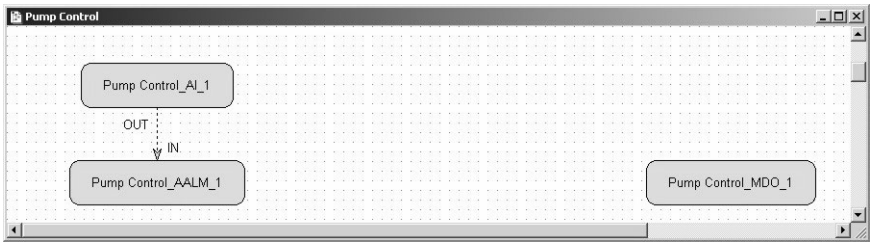
– The **Output Parameter Selection** dialog closes
– The cursor is now connected to a blue dotted line
– Place the Cursor in the Pump Control_AALM_1 block and click to make the link

4 When the link is made, the **Input Parameter Selection** dialog for the Alarm block appears



– Click the box next to **IN** – it changes color – then click on **OK**

5 When the **Input Parameter Selection** dialog changes, the link is made and appears as below:

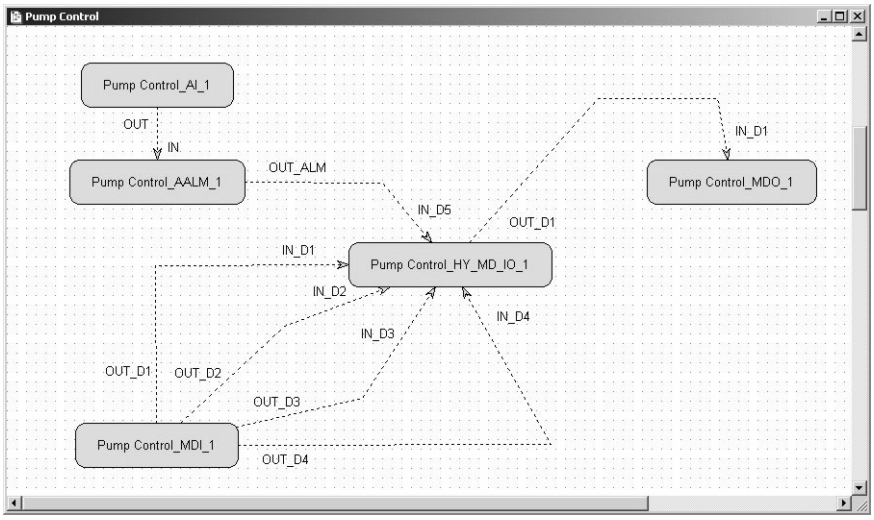


– You may have to move the parameter legends "IN" and "OUT" by selecting and positioning with the left mouse key depressed

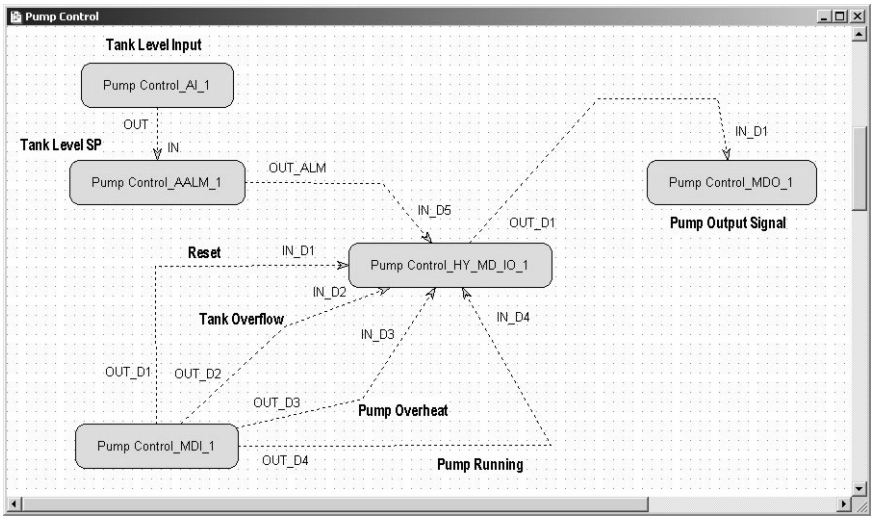
6 Repeat steps 2 to 5 and make the following links between the function blocks

– Pump Control_AALM_1 to Pump Control_HY_MD_IO_1
  OUT_ALM to **IN_D5**
– Pump Control_MDI_1 to Pump Control_HY_MD_IO_1=
  OUT_D1 to **IN_D1**
  OUT_D2 to **IN_D2**
  OUT_D3 to **IN_D3**
  OUT_D4 to **IN_D4**
– Pump Control_HY_MD_IO_1 to Pump Control_MDO_1
  OUT_D1 to **IN_D1**

7 Your Control Strategy now looks something like this



8 By using the **Tools => Drawings => Text** option, you can now add text to the strategy to make clear the function of each block and parameter:

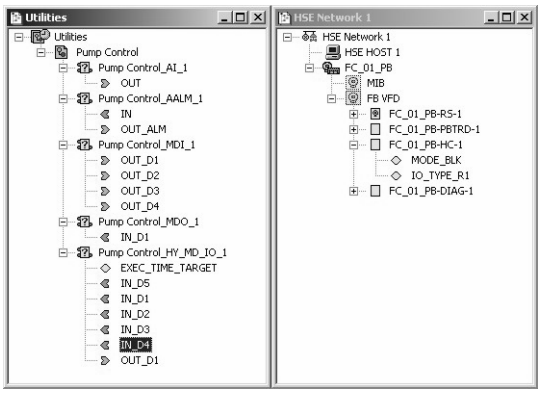


9 Click on the **Project View** workspace and **Export Tags**..., see Chapter 3.10
– Open **Project File**, then press **Save Entire Configuration**, to save the project.

4.5 Attach the function blocks to the controller

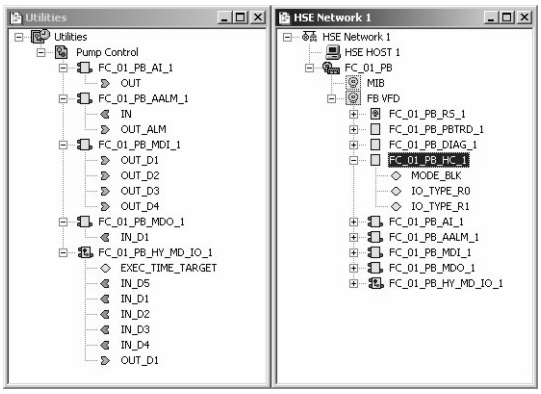
The blocks that are always necessary for the Field Controller (RS, PBTR0, HC and DIAG) are created automatically when it is added to the Fieldbus Network. Do not delete these blocks! The order of assignation of the strategy function blocks to the controller determines the order of execution (can be changed by drag&drop).

1 Close the Control Strategy window and place the **Utilities** (Control Module) and **HSE Network 1** dialogs side-by-side
   – The function blocks and links you created have been added to the Utilities tree
   – There is a question mark "?" in each function block icon



2 Drag and drop the Pump Control_AI_1 block from the Utilities into the HSE Network 1 dialog and place it on the FB VCF leaf
   – The block is attached to the Field Controller
   – The name changes (set to do so in Preferemces, see Chapter 3.2)
   – The question mark disappears from the block in the Utilities dialog

3 Repeat step 2 for all blocks – your project now looks like this:



4 Open **Project File**, then press **Save Entire Configuration**, to save the project.

4.6 Characterize the I/O function blocks

The Analog and Digital I/O blocks can now be characterized as follows.

1 In the **HSE Network 1** dialog, double-click on the block leaf
   – The **Off Line Characterization** dialog for the block appears

2 To change parameters:

   – Expand the parameter leaf
   – Double click on value space
   – Enter the parameter or select it from the drop-down menu
   – Confirm with End **Edit**

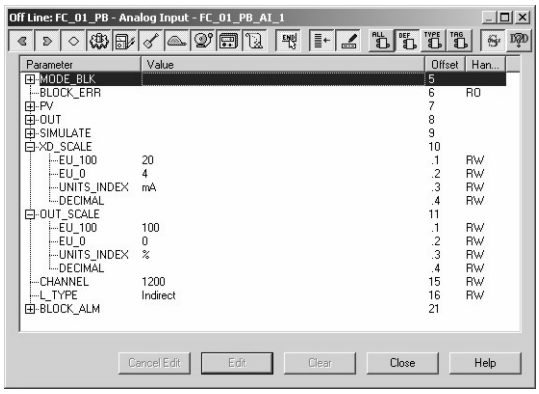
3 Click **Close** to close the block and

4.6.1 Analog Input block

The AI block is attached to the SFC444 Analog Input module. This delivers a 4 mA to 20 mA signal that must be scaled to 0 % to 100%. The channel parameter is that in Table 2-1, Chapter 2.2.2.

1 Double-click on **FC_01_PB_AI_1** and enter the following parameters

   – **MODE_BLK**
      TARGET: Auto
   – **XD_SCALE**
      EU_100: 20
      EU_0: 4
      UNITS_INDEX: mA
   – **OUT_SCALE**
      EU_100: 100
      EU_0: 0
      UNITS_INDEX: %
   – **CHANNEL:** 1200
   – **L_TYPE**: Indirect



2 Press **Close** to close the dialog

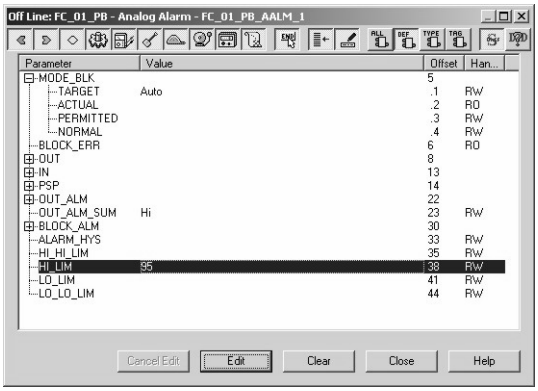
3 Open **Project File**, then press **Save Entire Configuration**, to save the project.

4.6.2 Analog Alarm block

The Analog alarm block monitors the incoming level signal. When the signal exceeds the HI limit = 95%, the OUT_ALM signal changes from FALSE to TRUE

1 Double-click on **FC_01_PB_AALM_1** and enter the following parameters

- **MODE_BLK**
  TARGET: Auto
- **ALT_ALM_SUM:** Hi
- **HI_LIM:** 95



2 Press **Close** to close the dialog

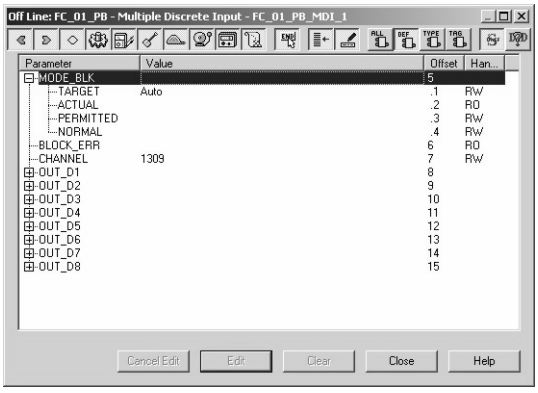
3 Open **Project File**, then press **Save Entire Configuration**, to save the project.

4.6.3 Multiple Discrete Input block

The MDI block is attached to the SFC432 Discrete Input/Output module. This delivers FALSE for a 0 VDC signal and TRUE for a 24 VDC signal. The channel parameter is that in Table 2-1, Chapter 2.2.2.

1 Double-click on **FC_01_PB_MDI_1** and enter the following parameters

- **MODE_BLK**
  TARGET: Auto
- **CHANNEL:** 1309



2 Press **Close** to close the dialog

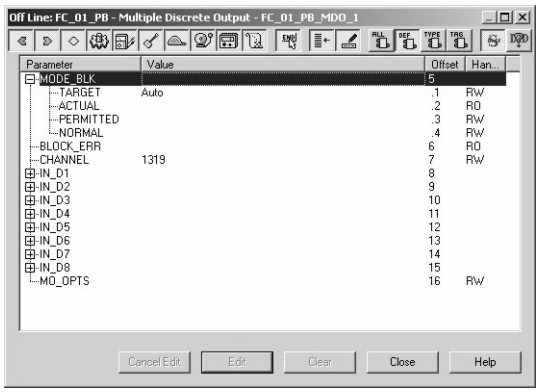
3 Open **Project File**, then press **Save Entire Configuration**, to save the project.

4.6.4 Multiple Discrete Output block

The MDO block is attached to the SFC432 Discrete Input/Output module to which the pump power is connected. A FALSE signal causes the relay to close and the pump runs. A TRUE signal causes the relay to open and the pump stops. The relays are Normally Open (NO) so that a in the event of a power failure, the pump fails to safe = stop. The channel parameter is that in Table 2-1, Chapter 2.2.2.

1 Double-click on **FC_01_PB_MDO_1** and enter the following parameters

- **MODE_BLK**
  TARGET: Auto
- **CHANNEL:** 1319



2 Press **Close** to close the dialog

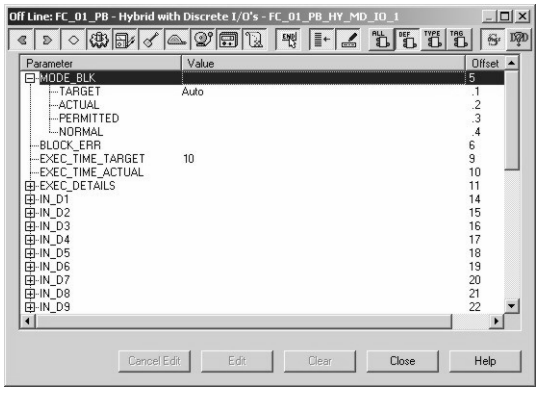
3 Open **Project File**, then press **Save Entire Configuration**, to save the project.

4.6.5 Hybrid Discrete I/Os block

The HYDIO block adds the logic to the control strategy. It must be put into Auto. At this point the target execution time **EXEC_TIME_TARGET** should be left at the default value of 10 ms.

1 Double-click on **FC_01_PB_HY_MD_IO_1** and enter the following parameter

- **MODE_BLK**
  TARGET: Auto



2 Press **Close** to close the dialog

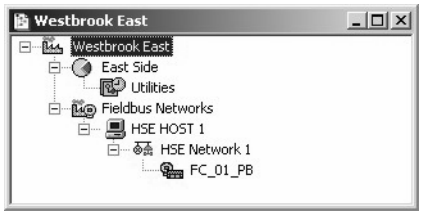
3 Open **Project File**, then press **Save Entire Configuration**, to save the project.

4.7 Export tags

Note!

- You should use the Export Tags function everytime you change the configuration of the project, so that the OPC server information is always up-to-date.
- Application Designer can be set to automatically export the tags every time the project goes online, see Chapter 3.2.

1 Activate the project view by clicking in its workspace



2 Right click on the project name, a context menu appears

3 Select the option **Export Tags...**.
   – The Export Tags dialog confirms the successful export

   – Press **OK** to close the dialog

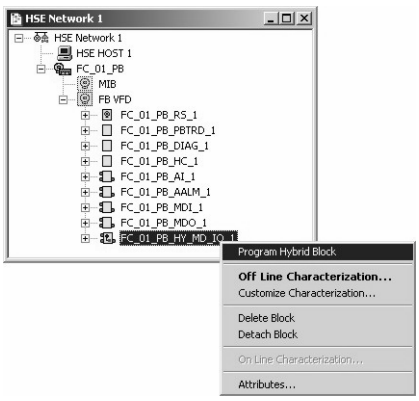
4 Open **Project File**, then press **Save Entire Configuration**, to save the project.

5 Program the Hybrid Function Block

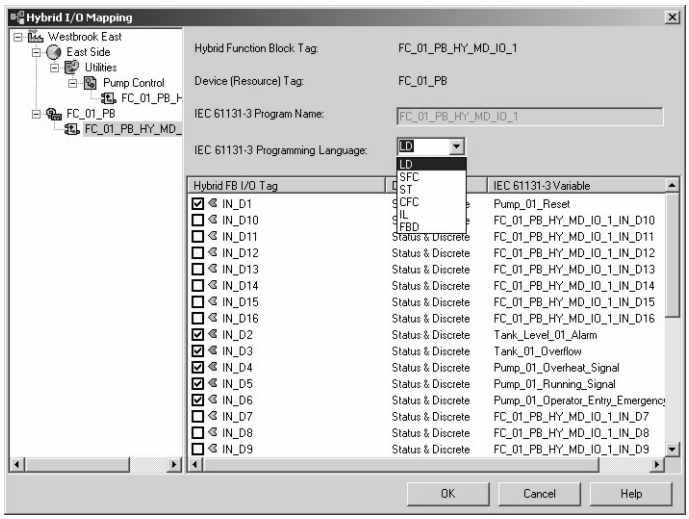
The hybrid function block can now be programmed. In this tutorial Ladder Logic will be used.

5.1 Customize the IEC 61131-3 variables

1 In the **HSE Network 1** tree, right click on the leaf **FC_01_PB_HY_MD_IO_1** and select **Program Hybrid Block**

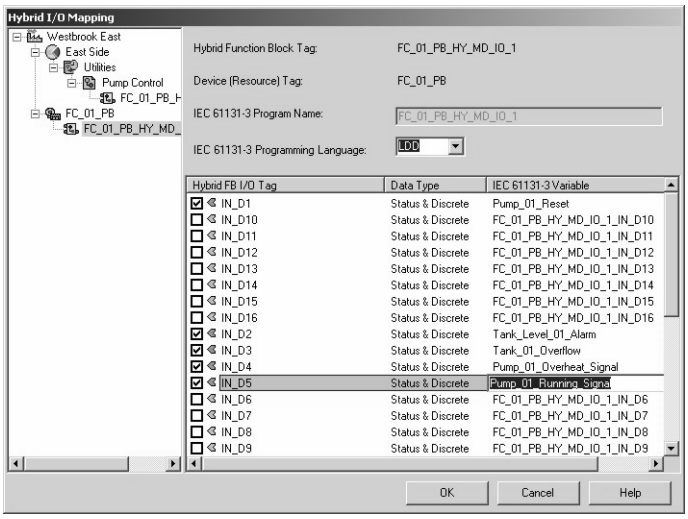


2 The **Hybrid I/O Mapping** dialog opens
- In the **IEC 61131-3 Programming Language** menu select **LD** (Ladder Logic)
- Confirm the change by pressing **Yes** in the query box that appears after selection
- The programmed links appear in green with the tick box ticked

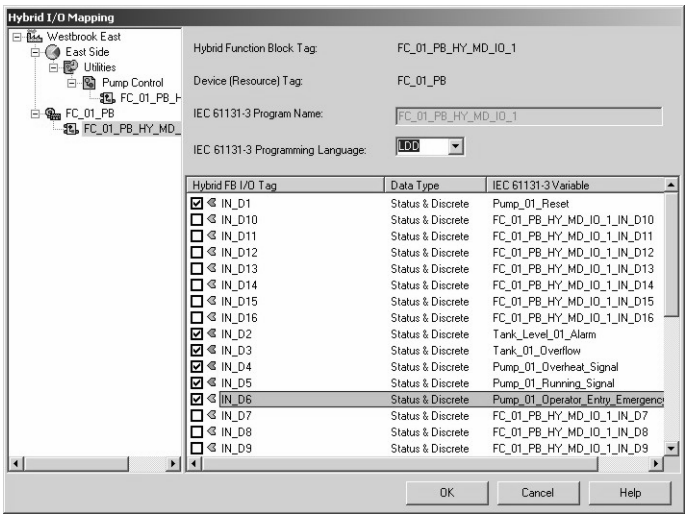


3 Now customize the hybrid I/O mapping by changing the **IEC 61131-3 Variable** names
  IN_D1: Pump_01_Reset
  IN_D2: Tank_Level_01_Alarm
  IN_D3: Tank_01_Overflow
  IN_D4: Pump_01_Overheat_Signal
  IN_D5: Pump_01_Running_Signal
  OUT_D1: Pump_01_Output_Control
- Select the line by clicking over it with the mouse then click over the parameter
- Enter the new name: must start with a letter, use underlines not spaces
- Press **Enter** to store

4 The Hybrid I/O Mapping now looks like this:



5 At this point you can also add parameters that are should receive an OPC Tag for use by e.g. a SCADA program
- Click the tick box to register the parameter
- Enter the variable name
- In our example: IN_D6 = Pump_01_Operator_Entry_Emergency

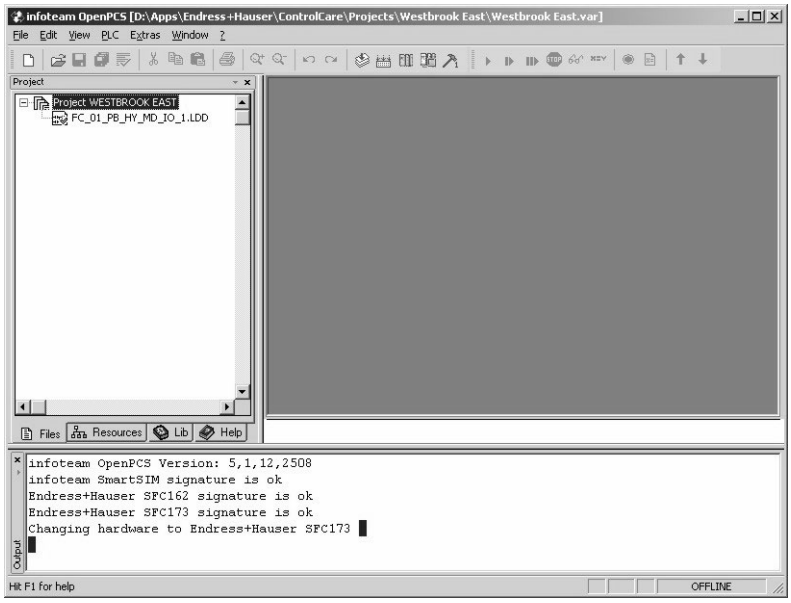


6 When all parameters have been customized, press **OK** to open the programming environment.

5.2 Program the hybrid function block

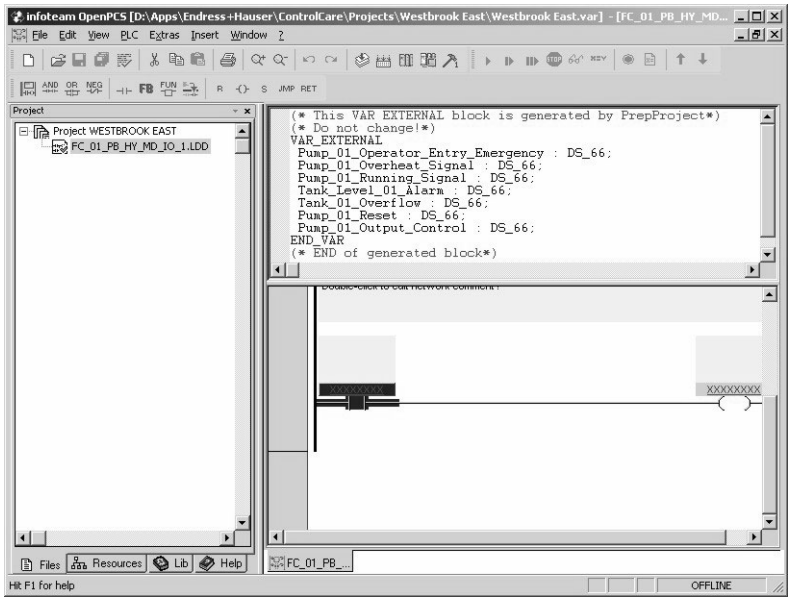
5.2.1 OpenPCS programming tool

1 After the **OK** button has been pressed, the OpenPCS programming tool opens:



- The **Files** pane of the Project window shows the program files
- The **Resources** pane shows the hybrid block task attached to the Field Controller
- The **Lib** pane shows the libraries available
- The **Help** pane opens the Online help tree
- A **Catalog** window might also appear – it can be closed by pressing the "x"
- The **Log** window tracks program events – it can be closed by pressing the "x"

2 Double-click on FC_01_PB_HY_MD_IO_1.LDD: the editor opens with the declared external variables (the log window at the bottom was closed for this screenshot)

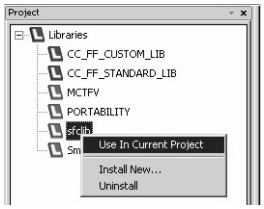


5.2.2 Activate the libraries

The variables used in ladder diagram must be converted to a data type appropriate to ladder logic programming language. To this end ControlCare activates two libraries by default:

- **CC_FF_CUSTOM_LIB** to map the custom FF function blocks
- **CC_FF_STANDARD_LIB** to map the standard FF function blocks

These appear red in the library pane (select the **Lib** tab)

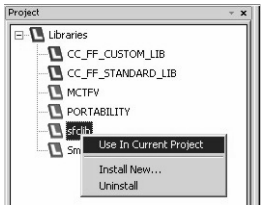


Note!
- For ControlCare Product Version 2.01.xx, the libraries have to be activated by hand
- For SFC programming the sfclib must be activated, see below and the OpenPCS online help

Activating a library

In order to activate additional libraries, e.g. sfclib for SFC programming, the following procedure is used:

1 Select the **Lib** pane:
   – Right-click on e.g **sfclib** and select **Use in Current Project**
   – The project book turns red = active



Installing a library

If the libraries are not installed:

1 Right-click on **Libraries**, select **Install New...**,

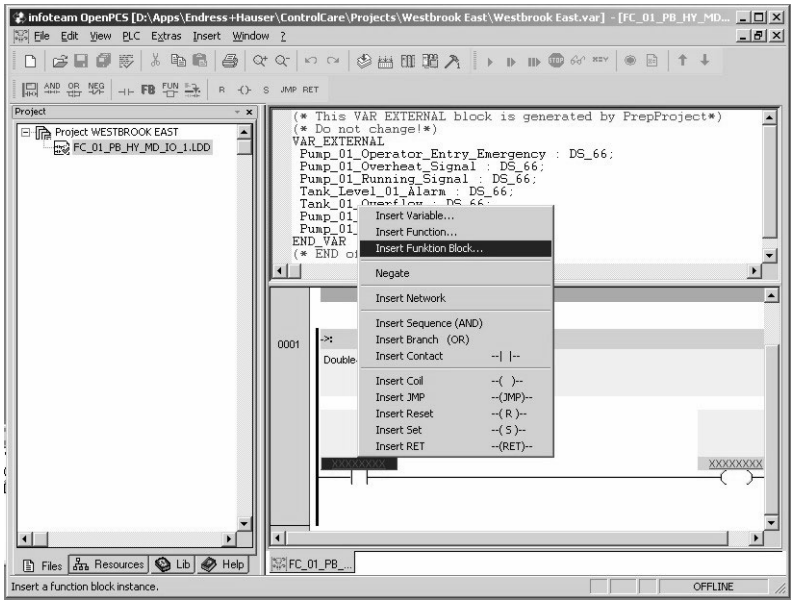
2 Browse to the folder containing the LIB files and select the library required

3 Press **OK** twice to install.

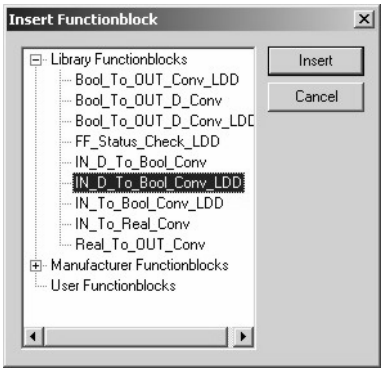
5.2.3 Insert function block instance

1 Click on the **Files** tab and, if not already visible, go back to the Ladder Diagram programming tool by double clicking on the LDD file.

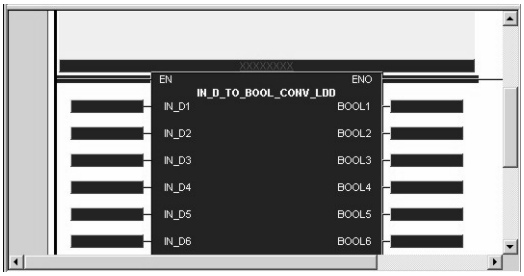
2 Go to the first rung and right-click the first contact: select the **Program Funktion Block…**



3 The **Insert Function Block** dialog opens
- Expand the **Library Function Blocks** tree
- Select the function block **IN_D_To_Bool_Conv_LDD** (Discrete Input to Boolean Conversion for Ladder Diagram Function Block)
- Press **Insert**



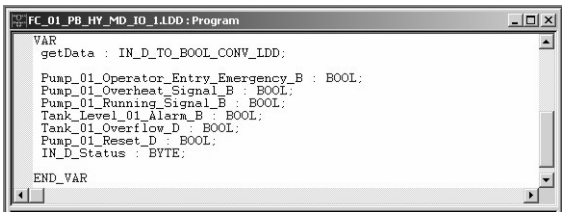
4 The function block Instance is inserted in the lower part of the workspace



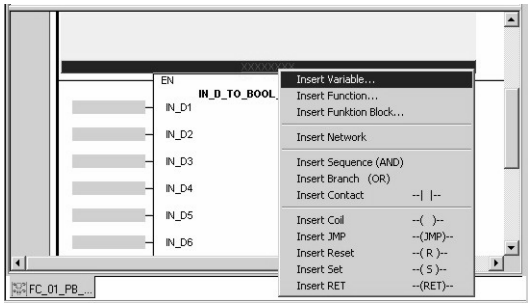
5.2.4 Declare the function block instance for data acquisition

In order to use this function block you must declare both a function block instance and the variables that will keep the values returned by it.

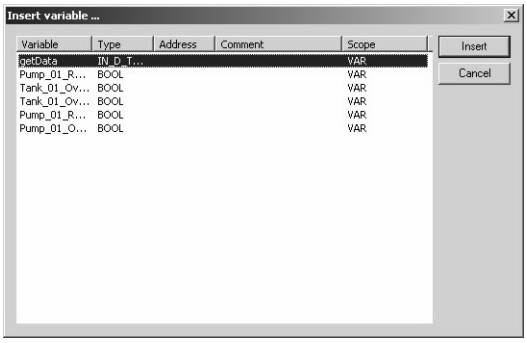
1 Declare the function block and variables in the upper pane of the programming window
   – The format is VAR/FB and variable declaration/END_VAR, see figure



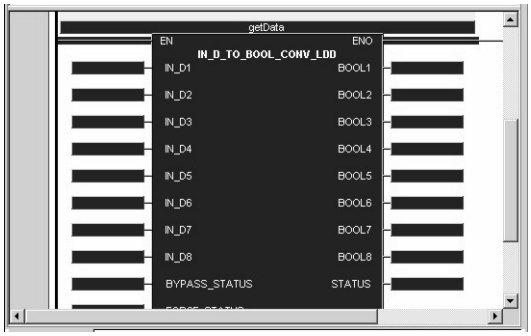
2 In the lower pane, right-click on the red XXXXXXX and select Insert Variable



3 Select the getData function block instance and press **Insert**



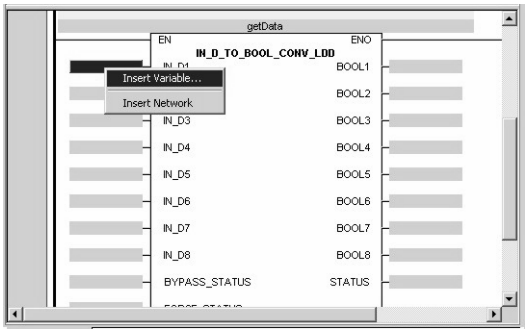
4 The red XXXXXX in the lower pane is changed to getData



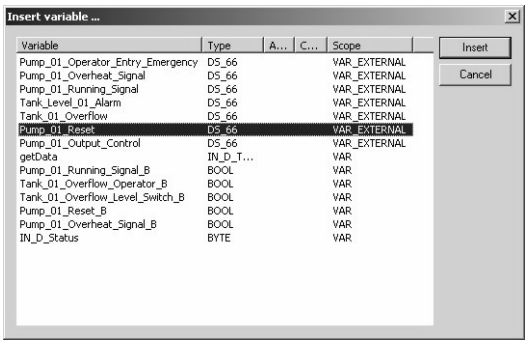
5.2.5 Assign the variables to the getData instance

The DS_66 variables must now be assigned to the left of the block, the Boolean variables to the right.

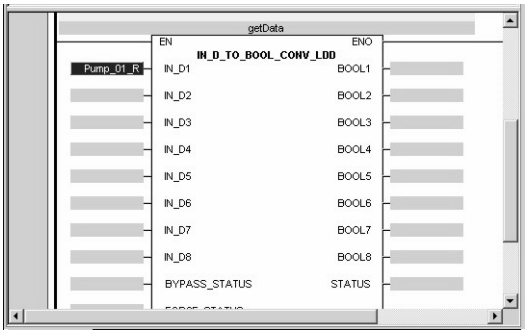
1 In the lower programming pane, right-click on the **IN_D1 space** and select **Insert Variable**



2 Select the variable associated with **IN_D1** (Pump Reset) from the Variable list and press **Insert**



3 The variable is inserted into the block



4 Repeat Steps 1 and 2 for the variables **IN_D2** to **IN_D4**: Tank_01_Overflow, Pump_01_Overheat_Signal, Pump_01_Running_Signal, Tank_01_Level_Alarm, Pump_01_Operator_Entry_Emergency

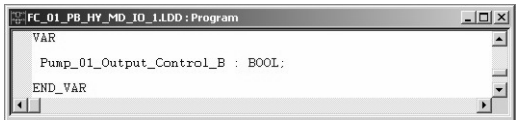
5 Now repeat the procedure for the corresponding boolean variables
- **BOOL_1** to **BOOL_5** on the right-hand side of the block.
- IN_D_Status in the **STATUS** field.

6 Finally, right-click on the Coil symbol at the extreme right of the rung and select **Delete.**

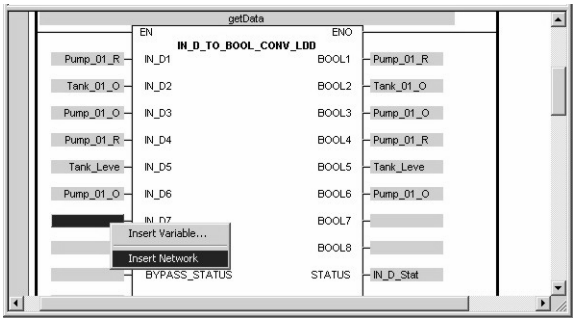
5.2.6 Create a boolean variable for the output

The inputs are now ready to be used easily in a ladder logic, they are all booleans so they can be directly inserted in the rungs. We are only missing a boolean variable to save the discrete output to be sent back to ControlCare as feedback. Declare it and we will be ready to start creating the ladder logic

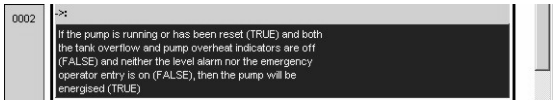
1 Declare the variable Pump_01_Output_Control_B as a boolean in the top pane of the programming window



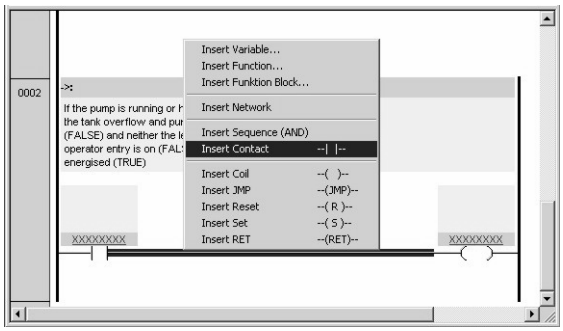
2 Now create another rung for the ladder by right-clicking blow at the right of the function block in the lower pane and selecting **Insert Network**



3 If required, insert a comment indicating the function performed by double clicking in the space below the scissors

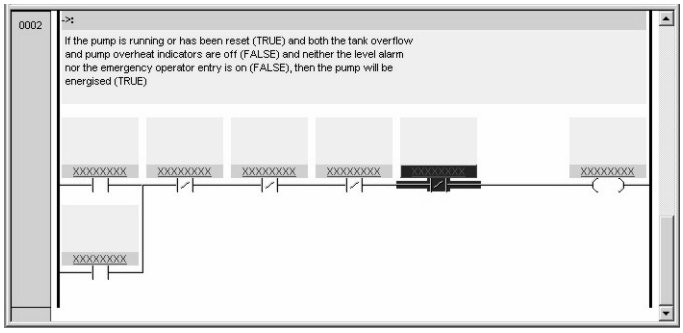


4 Now insert the diagram elements by right clicking on the selected rung and selecting **Insert Contact**

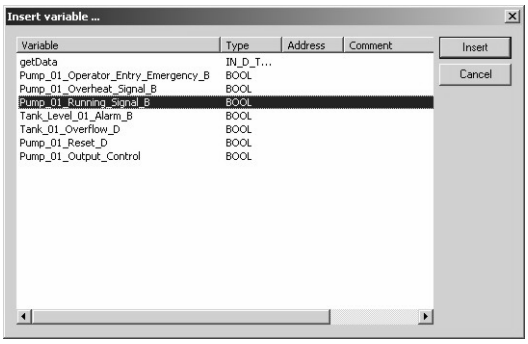


- A contact can be negated by right-clicking on the contact and selecting **Negate**
- An OR can be created by right-clicking on the contact and selecting **Insert Branch (OR)**
- An AND can be created by right-clicking on the contact and selecting **Insert Sequence (AND)**

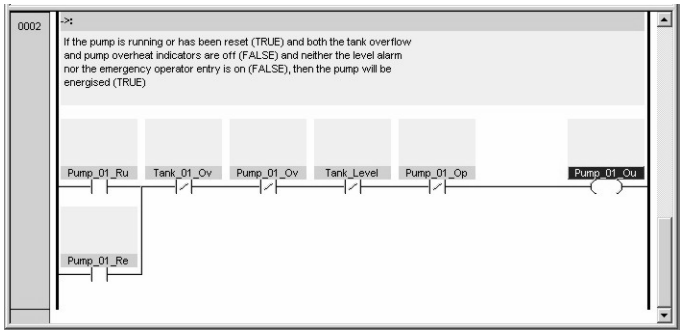
5 Now proceed to create the logic sequence:
- OR Contact
- 4x negated contacts



6 Now right-click on the first contact and select **Insert Variable**
- The Insert variable dialog Opens, select Pump_01_Running_Signal_B
- The variable is assigned to the contact



7 Repeat Steps 1 and 2 for the variables Pump_01_Reset_B, Tank_01_Overflow_B, Pump_01_Overheat_Signal_B, Pump_01_Operator_Entry_Emergency_B, Tank_01_Level_Alarm_B, Pump_01_Control_Output_B

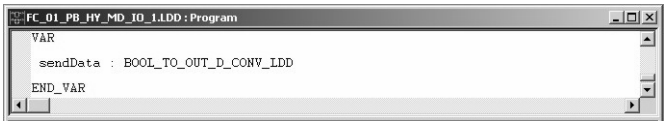


8 The logic is now complete

5.2.7 Create an output block

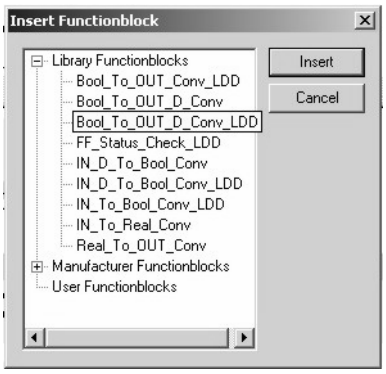
We now need an output block to convert the boolean into a hybrid function block signal for the Field Controller I/O modules.

1 Declare the block sendData in the upper pane of the programming window

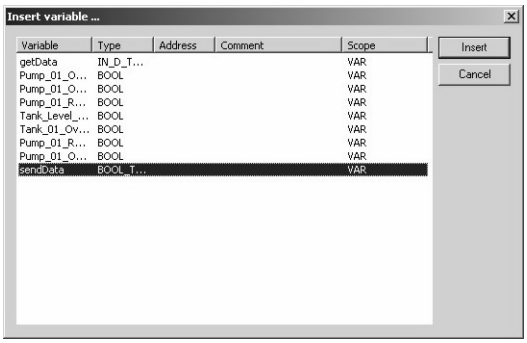


2 In the lower pane, right-click below Rung 0002 of the ladder and select **Insert Network**
– If required, insert a comment about the function of the rung

3 Right-click on the red XXXXXX and select **Insert Function Block**
– The **Insert Function Block** dialog appears
– Select the option **BOOL_TO_OUT_D_CONV_LDD**



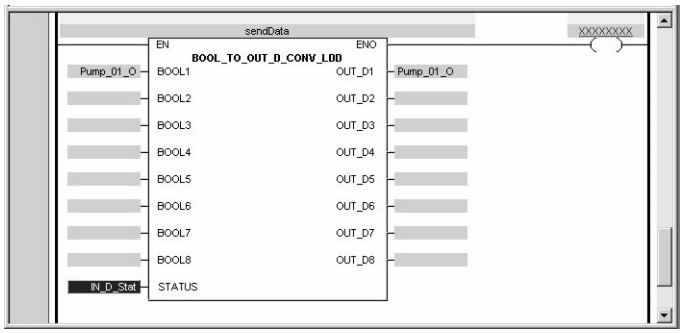
4 Right-click on the XXXXXX at the top of the function block and select **Insert Variable**
– The **Insert Variable** dialog appears
– Select **sendData**



5 Now right-click on the first space to the right of the function block and select **Insert Variable**
   – Add the variables Pump_01_Output_Control_B to **BOOL1**

6 Repeat for
   – IN_D_Status to **STATUS**
   – Pump_01_Output_Control to **OUT_D1**

7 The now block looks like this



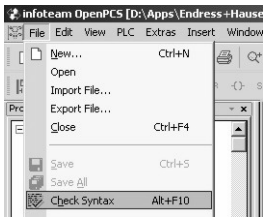
8 Finally, right-click on the Coil symbol at the extreme right of the rung and select **Delete.**

9 Open the **File** menu and select **Save All**

5.2.8 Trouble-shoot the project

Now that the project is complete, it is recommended that the project is checked for errors.

1 Open the **File** menu and select **Check Syntax**



2 OpenPCS runs a check on all syntax in your program and publishes a log at the bottom of the workspace.
   – If errors are found eliminate them and check the syntax again
   – You can move from error to error with the F4 and Shift F4 keys

3 When the program is free of errors, open the **File** menu and select **Save All.**

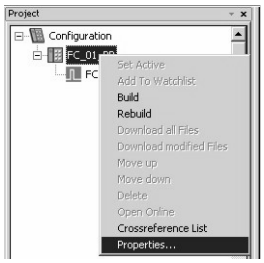
5.2.9 Optimize performance

OpenPCS allows the hybrid function block to be optimized for speed or size during compilation. Default setting is optimized for speed. Optimizing for size causes the block to run slower than if it is speed optimized, and is recommended only when there are memory problems, e.g. when a large number of hybrid function blocks with long programs are in use. For our example, the default settings will be used, so that the project can now be compiled and downloaded, see Chapter 6.

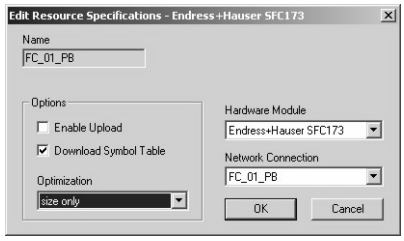
Changing the performance settings

Should you decide to optimize for size, preceed as follows. The seetings are made in both the resources and the hybrid function block

1 Click on the **Resources** tab, then right-click on **Controller** leaf and select **Properties**

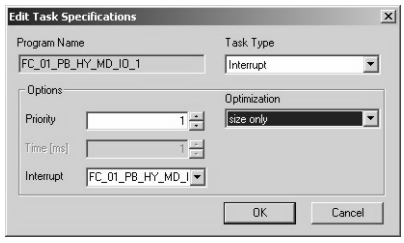


2 The **Edit Resource Specifications** dialog appears



– In the **Optimization** pull-down menu select e.g. "**size only**", then press **OK**

3 Now right-click on the **Function Block** leaf and select **Properties**
– The **Edit Task Specifications** dialog appears



– In the **Optimization** pull-down menu select e.g. "**size only**", then press **OK**

6 Go On-line

6.1 Connect to the Field Controller

After the Field Controller and other components have been physically installed in the Fieldbus network (subnet), connection must be established.

The Field Controller SFC173 is delivered with a default IP address of 192.168.164.101, the SFC162 with default address 192.168.164.100. For the purpose of this tutorial, it is suffience to connect to this address, however in practice it would be normal to change this address to one allocated by your IT system administrator.

Warning

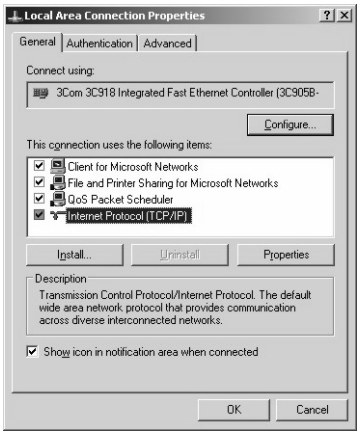
- The use of IP addresses is strictly controlled. Usually your system administrator will be authorised to allocate unique addresses. Assigning an unauthorised address to a Field Controller may result in conflicts within your system and the failure of the associated devices!

6.1.1 Change the IP address of your computer

1 Open the Windows Control Panel by pressing **Start => Settings => Control Panel** and choose the option **Network Connections**

2 Double-click on **Local Area Connection** and in the **Local Area Connection Status** dialog select **Properties**

3 Select **Internet Protocol TCP/IP** then select **Properties** again

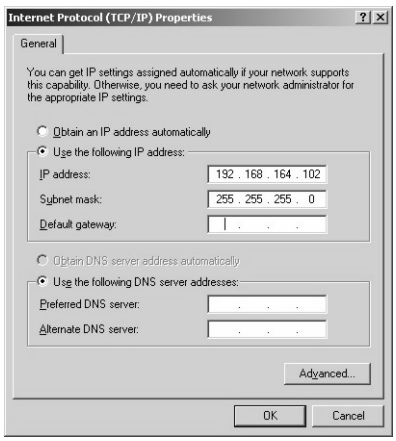


Note!
If "TCP/IP protocol" is not included in the Network, it must be installed by using the Windows setup before you proceed with Step 4.

4 Note the original property settings (e.g. make a screen shot and store it in a Word document) of so that they can be restored at end of the operation.

5 Change the IP address and the Subnet Mask of the computer, so that it is in the same subnet as the Field Controller.

– IP Address 192.168.164.XXX and network mask (Subnet Mask) 255.255.255.0.
– Do not use the addresses 192.168.164.100 or 101,as these are reserved as default addresses for the Field Controllers SFC162 and SFC173 respectively

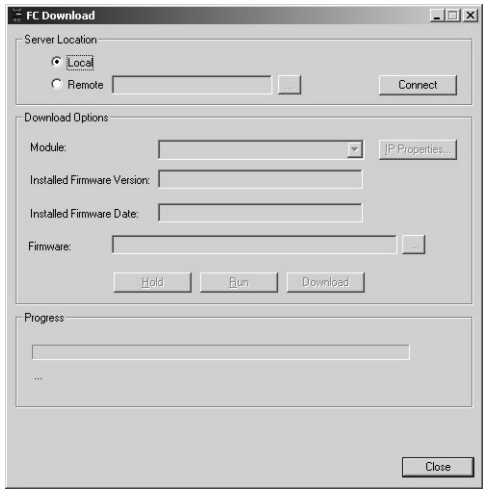


– Click on the **OK** button to confirm your settings

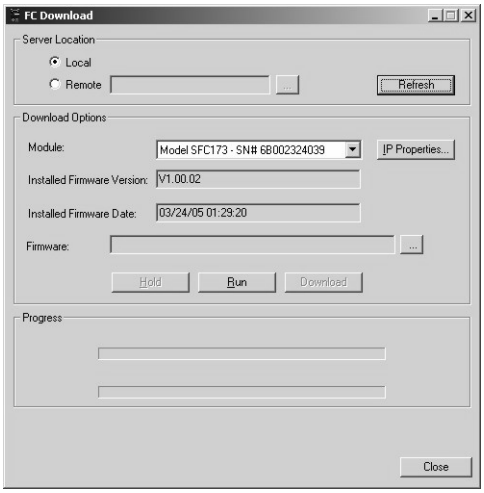
6.1.2 Set the Field Controller IP address

1 Now call FC Tools: **Programs =>Endress+Hauser=>ControlCare=>Tools=>FC Tools**

2 Choose the Field Control (OPC) Server path, default **Local,** then press **Connect**



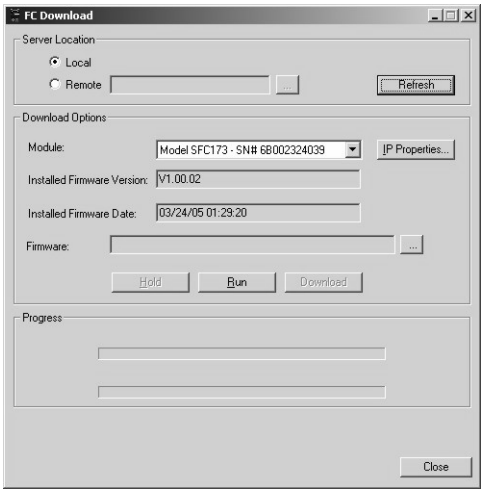
3 Select the desired Field Controller module option **Module** using its serial number as reference. The serial number is printed on the inside of the module door.



4 Press the **Hold** button to interrupt any control activities being executed in the module

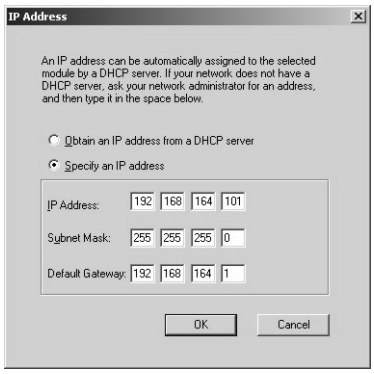
– A confirmation window appears, press **Yes** to continue
– Any application running on the Field Controller will be stopped at this point

5 Check that the HOLD LED on the Controller module is lit, then press **Connect** to continue with the procedure.



– If the HOLD LED does not light, there is a communication problem:
Type PING 192.168.164.101 in the DOS command window and check whether the Field Controller is found. If there is a reply, replace the Ethernet cable by a cross-cable and try Step 4 again.

6 Reselect the desired Controller module, then click on the **IP Properties** button.
Now check the option **Specify an IP address**, then enter the IP Address and the Subnet Mask
- Answer **Yes** to the confirmation box
- Now enter the Field Controller address given to you by your system administrator (in our example we have kept the default address 196.168.164.101)
- Make a note of the IP addesses and the corresponding Controller serial number. This will help in the identification and diagnosis of possible faults.

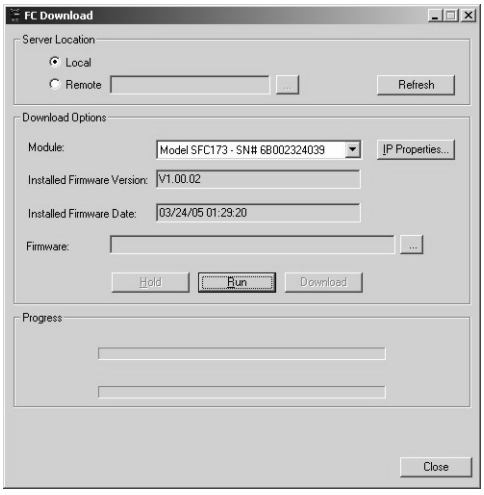


7 Click on **OK** to finish the operation

8 Now change the address of your computer as described in Chapter 6.1.1 to the new domain, so that it can continue to communicate with the Field Controller at its new address:
(Note: if the address domain has not changed, the computer address does not need resetting)
- **Start =>Settings =>Control Panel =>Network Connections**
- **Local Area Connection => Properties**
- **Protocol (TCP/IP)=>Properties**
- Enter an unused IP address and the subnet work address of the new domain
- Press **OK** to finish the process

9 Now return to FC Tools and click on **Refresh**

10 When the Refresh is complete, press **Run** to start the execution of the Field Controller firmware
- Confirm the action with **Yes**



11 Check that the HOLD LED on the Field Controller has extinguished, then press **Close**.

12 The Computer is now connected to the Field Controller

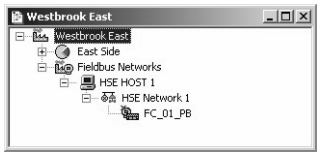
6.2 Generate the live lists

6.2.1 HSE live list

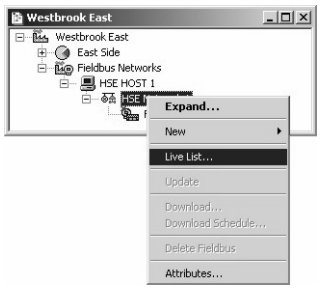
Once the Computer and Field Controller are able to communicate with each other, the connection to the network can be checked by creating a live list.

1 Press the **On-Line** button in the menu toolbar
   – The project goes on on-line

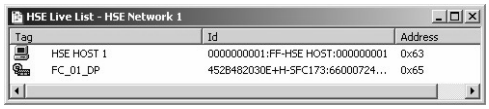
   – A red cross appears against the Field Controller in the Project workspace



2 In the Project workspace, right click on **HSE Network** and select **Live List**



   – A live list is generated of the devices on the HSE network

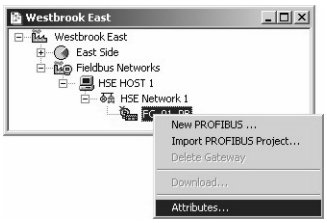


Note!

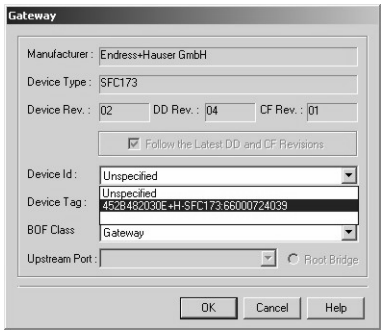
- It may take sometime to generate the live list.
  – The devices found first go grey.
  – They are then assigned a HSE address after which the live list is refreshed with the new data.
  – Address shows the last three digits of the IP address in hexadecimal format
  – The devices then appear in full color.

6.2.2 Assign the Field Controller tag

1 In the project workspace, right click on the **Field Controller** (FC_01_PB) and select **Attributes**...

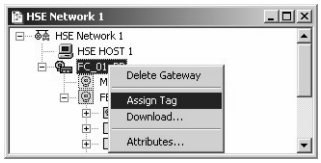


2 The **Attributes** dialog opens
- Open the drop-down menu of the **Device ID** and select the Field Controller associated with the displayed TAG (in our case FC_01_PB) - the serial number is on the front panel
- Do this even though the correct ID is already displayed - the program expects it!

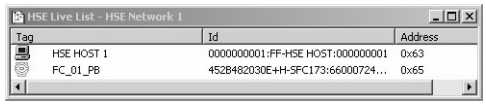


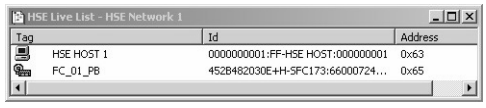
- Confirm your choice with **OK**

3 Double-click on the HSE Network 1 leaf to open the HSE Network 1 dialog
- Right-click on the **FC_01_PB** leaf and select **Assign Tag**



4 The Tag FC_01_PB is assigned to the Field Controller
- The Field Controller in the HSE live list goes grey
- When the Tag has been assigned, it goes block again





5 Open **Project File**, then press **Save**, to save the project

6.3 Download the project

Both the project in ControlCare Application Designer and that in Open PCS must be downloaded to the Field Controller. The downloads can be made in any order.

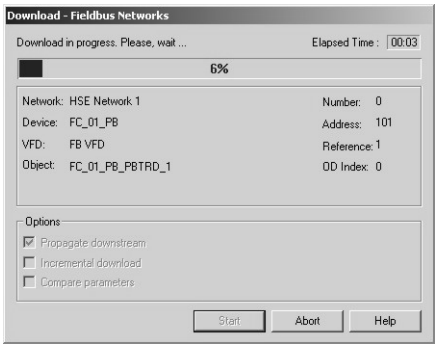
Note!

- The procedure below describes the initial download for the entire HSE network.
- Partial downloads can be made later from lower leaves, when changes are confined to this level
- Incremental downloads can be made to a running project by checking the boxes **Incremental Download** and **Compare Parameters**: Unaffected Local I/Os will hold their last values.

6.3.1 Download the control strategy

1 In the Project workspace right-click on **HSE Network 1**and select **Download**

2 The **Download dialog** appears



– Press **Start** to start the download

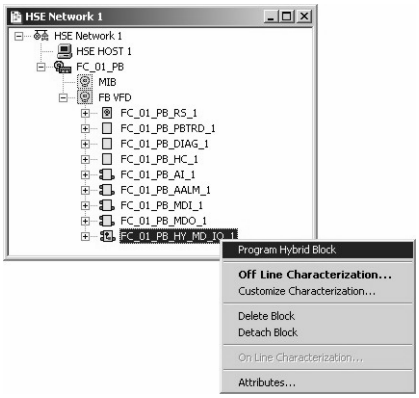
3 The download will be interrupted if the project has not been configured properly, e.g.

– The Controller Tag has not been assigned correctly => Assign Field Controller tags, Chapter 6.2.2
– The I/O moduels have not been correctly defined, see Chapter 4.6

4 When the download is successfully completed, the dialog is closed, and you are ready to download the hybrid block configuration

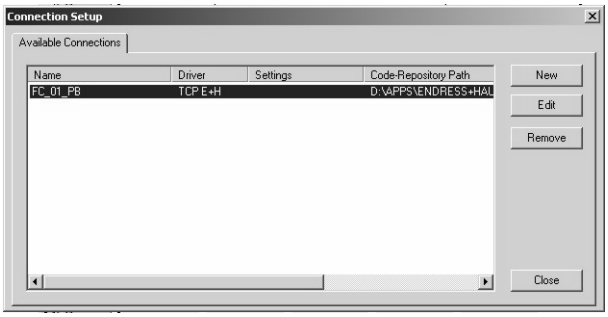
6.3.2 Connect OpenPCS to the controller

1 If OpenPCS is still open, click on the icon to display your project,
otherwise
In the **HSE Network 1** tree, right click on the leaf **FC_01_PB_HY_MD_IO_1** and select **Program Hybrid Block**



– Click **OK** to open OpenPCS
– Open the File menu and click on **Check Syntax,** to check for program errors again (at the moment, the program requires this action before every download)

2 Open the **PLC** menu and select Connections, the **Connection Setup** dialog appears



3 Press the **Edit** button, the **Field Controller Settings** dialog appears
– The dialog immediately scans the HSE network and presents a list of devices

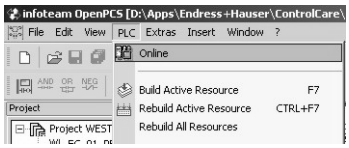
– Select the Field Controller from the list
The serial number on front panel comprises the second part of the ID
– Press **OK** to select the Field Controller
– When a Field Controller has been selected its tag and address appear in the dialog

4 Press **OK** twice to close the two open dialogs and return to the OpenPCS main workspace.

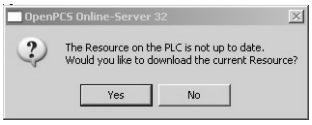
6.3.3 Download the OpenPCS project

Now that connection has been made (the settings are stored, so that the connection need only be made once), OpenPCS can go online and the project can be downloaded. Compilation and download occur automatically when the resources are updated, see Step 2.

1 Open the **PLC** menu and select **Online**

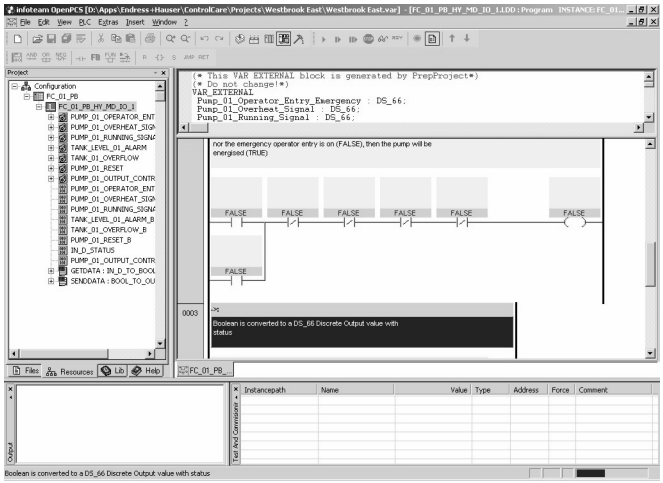


2 OpenPCS ask whether the resources should be updates, answer **Yes**



– The project is downloaded to the Field Controller

3 Now check the project files
– You will see that the names in the ladder logic are now replaced by values

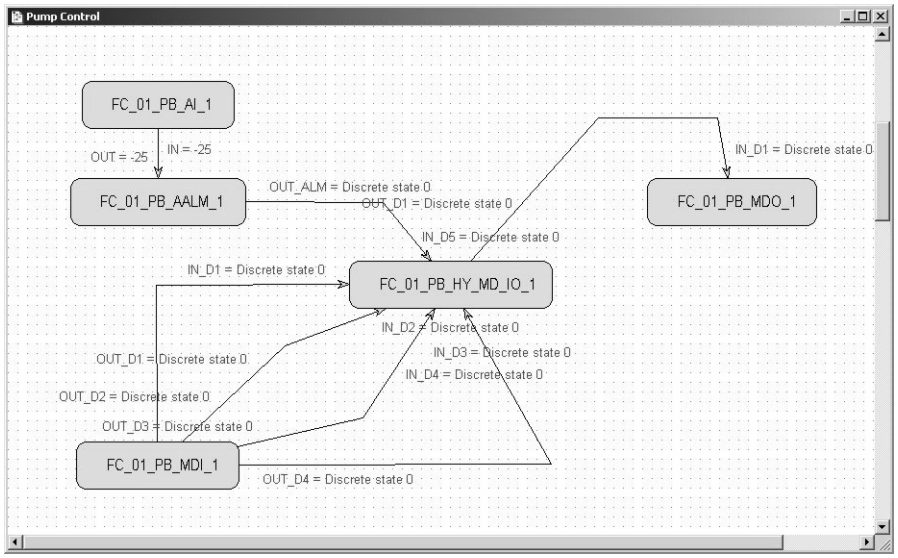


4 OpenPCS offers a number of options for monitoring values – see the on-line help for details.

6.4 Check the control stategy

6.4.1 Control strategy

1 Click in the Control Strategy workspace (Pump control) and press the button  in the menu toolbar – the control strategy also goes "on-line"

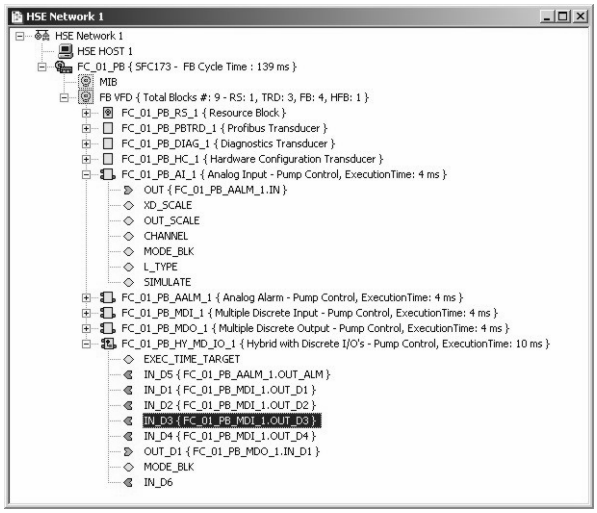


– Values appear in green when the status is good
– Values appear in red if the status is bad - at this stage this is an indication of a communication, block configuration, strategy configuration or device parametrization error

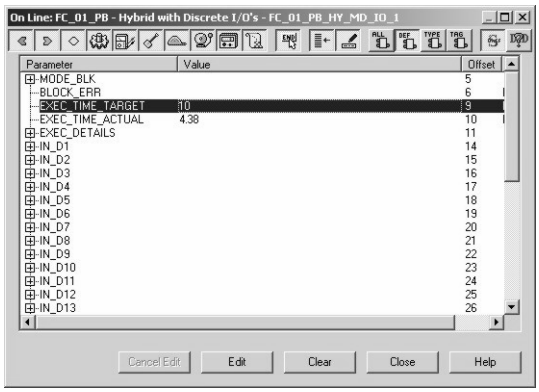
2 If you have the possibility of changing the signals, change each input in turn and check the effect on your strategy.

6.4.2 Hybrid block execution time

1 Open the **HSE Network 1** dialog, then click on the "details" icon in the menu bar
- The execution times are shown next to each block
- The **FC_01_PB_HY_MD_IO_1** block executes at the default time of 10 ms



2 Right-click on the **FC_01_PB_HY_MD_IO_1** block and select **On Line Characterization**



- The parameter EXEC_TIME_ACTUAL shows the time in which the block is executing
- Observe the value for a couple of minutes and note the highest value

3 Press the Online button again to put Application Designer offline

4 Right-click on the **FC_01_PB_HY_MD_IO_1** block and select **Off Line Characterization**
- Double-click on the "value space" next to the parameter **EXEC_TIME_TARGET**
- Enter a value 10% to 20% higher than the highest observed actual execution time
- Press **End Edit** to store the value and **Close** to quit the dialog.

5 Press the Online button to go online again
- Download the strategy once more, see Chapter 6.3.1
- The strategy now runs with the new target execution time

Note!

- Changing EXEC_TIME_TARGET online, see Chapter 6.5.1, causes the calculated value in the details view to change, but the actual schedule is unaffected. In this case too, a download must be made before the parameter becomes effective.

6.5 Modify the project

6.5.1 On-line characterization

Once the project is on-line you may want to change parameters to e.g. tune the control-loop or eliminate configuration errors. With the exception of the **SP** parameter, the function block must be put out of service before the parameter is changed:

1 In the Control strategy workspace double-click on the function block you want to modify, or in the HSE network 1 or Control module workspace, right-click on the function block and select **On-line Characterization**

2 The function block **On-line Characterization** dialog appears:

- Open the **Mode** leaf and double-click in the space next to **Target**
- Set the Target to **OOS** (Out of Service)
- Click **End Edit** to set the parameter

3 Change the parameters you wish to modify

- If appropriate, open the parameter leaf and double-click in the space next to the parameter you require
- Enter the new parameter or select it from the drop-down menu
- Click **End Edit** to set the parameter
- Repeat the procedure for all the parameters you wish to modify

4 Put the function block back into standard operating mode

- Open the **Mode** leaf and double-click in the space next to **Target**
- Set the Target back to the original value (**Auto** (Automatic) or **Cas** (Cascade))
- Click **End Edit** to set the parameter
- Check that the **Mode** really changes to the Target Mode (failure to do so indicates a configuration error)
- Press **Close** to store the values (if you are prompted - answer with **Yes**)

5 Click on the **Project View** workspace and **Export Tags**..., see Chapter 3.10
- Open **Project File**, then press **Save Entire Configuration** to save the project

6 Put the Control stategy back "on-line" to check the results of your modification, Chapter 6.4.

6.5.2 Off-line characterization

You may prefer to change parameters off-line, e.g. when modifying the control strategy or adding new functions to the project.

1 If you are on-line, press the **Off-line** button in the menu toolbar
alternatively, in the PROFIBUS network or Control module workspace, right-click on the function block and select **Off-line Characterization**
– The function block **Off-line Characterization** dialog appears

2 Change the parameters you wish to modify

- If appropriate, open the parameter leaf and double-click in the space next to the parameter you require
- Enter the new parameter or select it from the drop-down menu
- Click **End Edit** to set the parameter
- Repeat the procedure for all the parameters you wish to modify
- Press **Close** to store the values

3 Click on the **Project View** workspace and **Export Tags**..., see Chapter 3.10
– Open **Project File**, then press **Save Entire Configuration** to save the project

4 Press the **On-line** button in the menu toolbar to go on-line again

5 Download the modified project
– In the Project workspace right-click on **HSE Network 1**and select **Download**
– Follow the procedure in Chapter 6.3

6 Put the Control stategy back "on-line" to check the results of your modification, Chapter 6.4.

6.6 Pack and Go

In order to install the project at the customer's site, the project can be packed and unpacked. It is important to remember, especially if you have not been using the actual project devices to test your project, that the instruments on site may be have newer (or even older) DD/CFF/GSD files than the ones you use. The latest DD/CFF/GSD files must then be uploaded to the project and corresponding corrections must be made to configuration, before it is downloaded to the SFC173 Field Controller.

6.6.1 Pack the project

1 Select **Project File => Pack Project...**

2 Answer "**OK**" to the query about missing DD/CFF files

3 **Browse** to the place where you want the packed files folder, e.g. **Endress+Hauser => ControlCare**

4 Press **OK** to pack the project

6.6.2 Unpack the project

1 Select **Project File => Unpack Project...**

2 **Browse** to the packed files folder, e.g. **Endress+Hauser => ControlCare**

3 **Browse** to the desination folder

4 Press **GO** to start unpacking

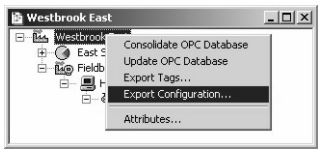
6.7 Export the configuration

For documentation purposes, the project configuration can be exported to an existing ODBC file data source, e.g. Oracle, a machine database, e.g. Excel to provide a record of the current status of the project or to an XML sheet for viewing with a browser.

6.7.1 File data source folder

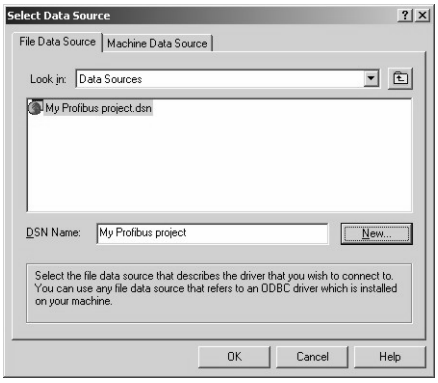
The file data source must have been created before the export.

1 In the Project window, right-click on the Project icon and select **Export Configuration**:



2 The **Select Data Source** dialog box appears

3 In the **File Data Source** folder, select the source that describes the driver that you wish to connect to. You can use any file data source that refers to an ODBC driver which is installed on your machine.
- Use the **New...** button and **Look In** dropdown menu to browse or
- Click the data source icon to select the driver:



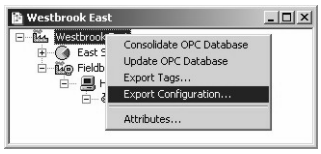
- Press **OK** to make the connection

6.7.2 Machine data source folder

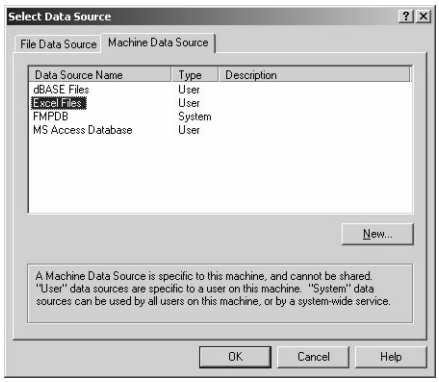
The **Machine Data Source** is specific to the machine, and cannot be shared. "User" data sources are specific to a user on the machine; "System" data sources can be used by all users on the machine, or by a system-wide service. The Machine Data Source must have been created before export.

Procedure

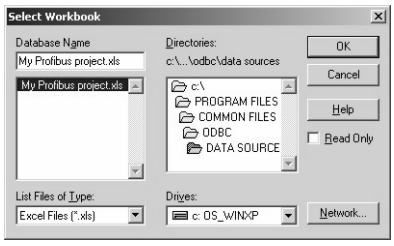
1 In the Project window, right-click on the Project icon and select **Export Configuration**:



2 The **Select Data Source** dialog box appears
- Click on the **Machine Data Source** tab to open the folder
- Double-click the data source name to select the machine, e.g. Excel:

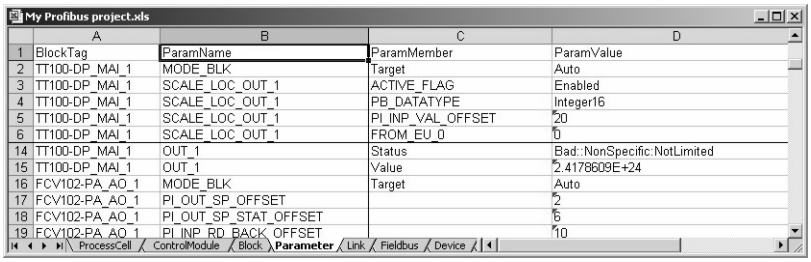


3 The **Select Workbook** dialog box will appear:
- Select the folder where the data file is and double-click the workbook icon.



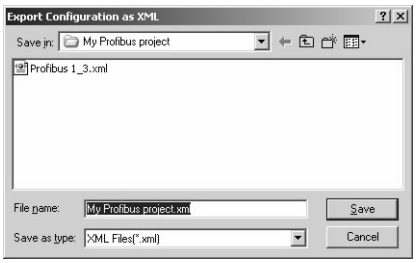
- Your project configuration will be exported to the workbook file.
- A message box appears on completion - press OK

4 Open the Excel file to check the result:

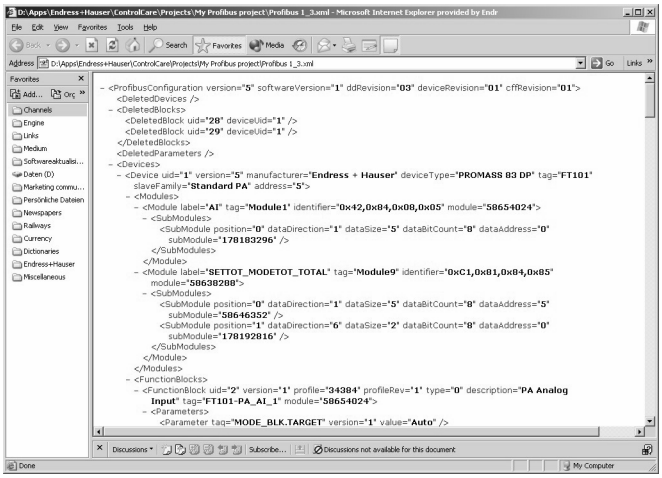


6.7.3 XML file

1 Click in the Project workspace and select **Project File =>Export => Configuration as XML**
– The **Export Configuration as XML dialog** appears



2 Enter a **File Name** and **Save In** location, then press **Save**
– The project is saved as an XML file at the selected location



6.8 Close Application Designer and OpenPCS

When you have completed your session, close Application Designer and OpenPCS

6.8.1 Application Designer

1 If you are on-line, press the **Off-line** button  in the menu toolbar

2 If you have made any modifications while you were on line, you will be prompted to store them
   – If appropriate answer with **Yes**

3 Close the project by clicking on **Project File => Close**

4 Exit Application Designer by clicking on **Project File => Exit**

5 The Field Controller continues to operate with the project configured according to the last download/on-line correction
   – If you switch off the Controller, the project remains stored in its memory
   – It is initialized and re-executed as soon as the Controller is switched on again

6.8.2 Open PCS

1 Open the **PLC** menu and select **Offline**

2 Open the **File** menu and select **Exit**
   – You will be prompted to save if your project has been changed since the last download

6.8.3 Reconnecting Application Designer

Provided your computer is operating in the same IP address domain as the Field Controller, you can reconnect at any time.

1 Start up Application Designer and select the Project you require

2 Press the **On-line** button  in the menu toolbar

3 Expand the various workplaces as required

4 Click in the **Control Strategy** workspace and press the button  in the menu toolbar – the control strategy goes "on-line" with the last configuration that was downloaded.

6.8.4 Reconnecting Application Designer

Provided your computer is operating in the same IP address domain as the Field Controller, you can reconnect at any time.

1 Start up OpenPCS, open the **File** menu and select the project you require
   – Open the **File** menu and run **Check Syntax**

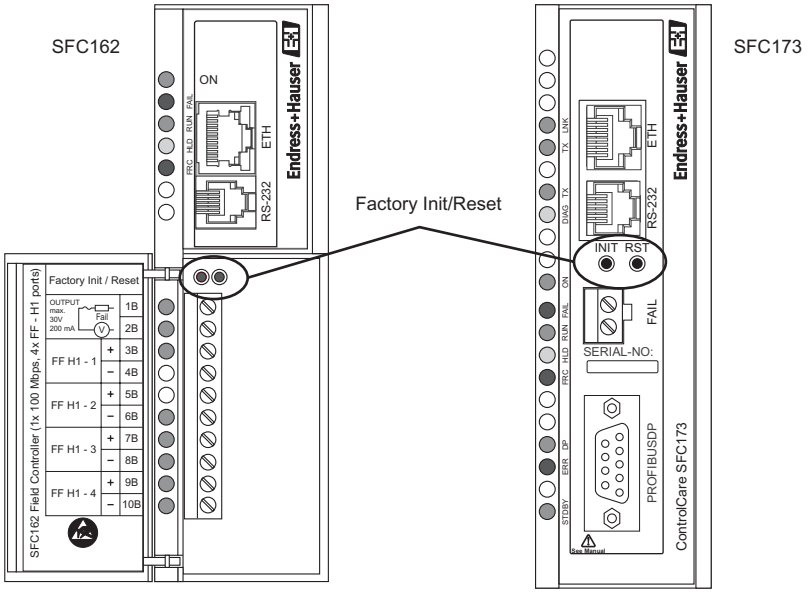
2 Open the **PLC** menu and select **Online**

7 Trouble-Shooting

7.1 Factory initialisation and reset

Warning!

- Do not use the pushbuttons located in the Field Controller unless you are certain that you want to reset the system.



Two pushbuttons located on the SFC173 module, see Fig 8.1, allow the system to be initialised and reset. The function and effect of the buttons is described in the table below.

- To "click " the pushbuttons use a pointed instrument (e.g. a ballpoint pen).

Other functions of the two buttons are to be found Chapter 7 of the Operating Instructions BA035S/04/en, Field Controller: Commissioning and Configuration..

Function	Effect	Procedure
Reset	Resets system: the last configured IP Address is used	▪ Click the right pushbutton - the system **resets (takes several seconds)** ▪ If no IP Address is found, a new one is assigned automatically ▪ Verify that the **RUN** and **ETH LNK** LEDs are lit.
Factory Init	Deletes application, the last configured IP Address is retained	▪ Keeping the left pushbutton pressed, click the right pushbutton ▪ Check that the **FORCE** LED flashes once a second. ▪ Release the left push button. The system resets, see above.

7.2 Field Controller

Problem	Remedy
FC Tools does not show all the Field Controllers that are in the sub-network	There is probably an IP address conflict in this sub-Network. ■ Disconnect all the Field Controllers from the sub-Network and execute the procedure "Connecting the Field Controller to its Sub-Network" for each module, assuring that the address to be used is not associated with other equipment of the network.
FC Tools does not find the Field Controller	■ Make sure that the initial connection procedure was followed and the Field Controller is operating in the same subnet and not with the default address 192.168.164.100/101 ■ Check that the Ethernet cable, see above ■ Check if the network adapter is on and OK: Execure a PING command to its own IP, via DOS PROMPT. ■ Check if the Ethernet connection is OK: Execute a PING command to the Field Controller.
FC Tools does not put the Field Controller in **HOLD**	Use the Mode **HOLD** procedure of Factory Init/Reset. ■ With the Field Controller in **HOLD** mode, execute the firmware update procedure, Section 7.3, using the steps of item 2. ■ If the problem persists, check the related TCP/IP connection (check the cables and **ETH LNK** LED)
Firmware begins to execute but after a certain time it stops	It might be a configuration problem. ■ Use the **Factory Init** procedure and configure the Field Controller again. ■ If the problem persists, download the firmware again as described in Chapter 7.3
HOLD LED remains lit	If the **HOLD** LED remains lit after the Field Controller has been turned on, the firmware may be invalid. ■ Update the firmware as described in Chapter 7.3
ETH LNK LED does not light	Check if the cable is connected correctly, or that the cable is not damaged. Check the specification of the cables: ■ SFC 954 - Cable Standard. To be used in a network between the Field Controller and a Switch/HUB. ■ SFC 955 - Crossed Cable (Cross). To be used point to point between a PC and the Field Controller
ERR LED is lit	PROFIBUS DP error ■ PROFIBUS DP connection has been lost, check connections ■ One or more slaves have not been correctly configured for cyclic data exchange, see BA036S/04/en, Application Designer, PROFIBUS tutorial
FRC LED is flashing (Force)	Field Controller is in reset mode ■ Complete the **RESET** procedure
STDBY LED is lit	Field Controller is in stand-by mode (redundant application)

7.3 Application Designer

Problem	Remedy
Block cannot be attached to a particular device	The block is not supported by that device. ■ Block assigned to wrong device? ■ Latest device revision is not being used – Create a duplicate device following the latest revisions – Attach the block to the duplicate device – If the block attaches, delete the old device, and attach all other blocks to the duplicate device – If necessary, characterize the blocks ■ Device error, contact device manufacturer
Field Controller does not appear in HSE live list	No connection to Field Controller ■ Field Controller is on HOLD, set it to RUN mode ■ IP address is not configured correctly, use PING to check, see above
Red cross appears on HSE Network	No connection to Field Controller ■ Field Controller is on HOLD, set it to RUN mode ■ IP address is not configured correctly, use PING to check, see above
A device does not appear in the live list	Communication error ■ Another device has the same address ■ The device is not powered up ■ The project has been updated but no download has been made yet
Configuration will not download, why?	You have either a communication problem or the configuration is not complete ■ Check that you are on-line - press the On-line button ■ Check that your computer is in the same address domain ■ Check that you have assigned the Field Controller tag ■ Check that you have exported all tags OPC server ■ Check that the parameters are in the recommended order ■ Check that the OPC server is running (look for icon in bottom line) ■ Check that DPV1 has not been activated in the device, see Chapter 3.7
A parameter appears red in my on-line control strategy, why?	The parameter has a bad status ■ Check that the Block Mode is Auto (or Cas) ■ Check that the block has been correctly configured ■ Check that the device is still live (live list) ■ Check that the device address is the same as that you have in your configuration (live list) ■ Check that the parameter has been correctly configured in the PROFIBUS Configurator

For your notes

Index

www.endress.com/worldwide

Endress+Hauser

People for Process Automation