FESTO

Learning system
Process automation

FluidLab® PA for MPS® PA Manual

V 3.0

EN
12/08

Intended use

This software has been developed and produced exclusively for further and vocational training in the fields of process automation and communication. The training companies and/or trainers must ensure that all trainees observe the safety precautions which are specified in the manuals provided.
Festo Didactic hereby excludes all liability for damages incurred by trainees, the training company and/or any third parties, which occur during use of the system in situations serving any purpose other than training, unless such damages have been caused by Festo Didactic due to malicious intent or gross negligence.

Order no.	
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Designation	FluidLab® PA Software
Revision level	12/2008
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1 Introduction

FluidLab® PA initial window

In combination with EasyPort digital/analogue, FluidLab® PA software provides users with the ability to measure and analyse signals from up to 8 digital and 4 analogue inputs, and 2 analogue outputs.

The following three main functions have been integrated into FluidLab® PA:

M as in measure, i.e. acquire and evaluate measured quantities from up to 8 digital / 4 analogue input signals

C as in control, i.e. binary or continuous control of up to 8 digital / 2 analogue outputs

R as in regulate, i.e. freely selectable closed-loop control functions such as 2-point, P, I, PI and PID control

Station-specific tasks which can be executed with FluidLab® PA include:

- Commissioning and testing of an MPS® PA station
- Analysis of process components and controlled systems included in an MPS® PA station
- Observation and analysis of process sequences at a station
- Experimentation with, as well as configuration and optimisation of control processes
  (2-point, P, PI, and PID controllers)
- Analysis of control response

In combination with MPS® PA stations, work is possible with the following controlled systems:

- MPS® PA Filtration Station – pressure control system
- MPS® PA Mixing Station – flow control system
- MPS® PA Reactor Station – temperature control system
- MPS® PA Bottling Station – filling-level control system

The following control functions can be set up for these 4 controlled systems:

- MPS® PA Filtration Station
  - 2-point control of the pressure control system with a standard analogue signal
  - Continuous-action control of the pressure control system with a standard analogue signal

- MPS® PA Mixing Station
  - 2-point control of the flow control system with a standard analogue signal
  - Continuous-action control of the flow control system with a standard analogue signal

- MPS® PA Reactor Station
  - 2-point control of the temperature control system with a standard analogue signal
  - Continuous-action control of the temperature control system with a standard analogue signal

- MPS® PA Bottling Station
  - 2-point control of the filling-level control system with a standard analogue signal
  - Continuous-action control of the filling-level control system with a standard analogue signal

1.1 MPS® PA system

Festo Didactic's process automation and technology learning system is geared towards various educational backgrounds and vocational requirements. The MPS® PA system allows for training and vocational education which is targeted at real-life company situations. The hardware is comprised of didactically prepared industrial components.

The MPS® PA system provides you with a convenient and practically oriented method, by means of which you can convey new key qualifications including:

- Social competence
- Technical competence
- Methodological competence

In addition to this, teamwork, willingness to cooperate and organisational skills can be trained as well.

Actual project phases can be taught in training projects. These include:

- Planning
- Assembly
- Programming
- Commissioning
- Operation
- Maintenance
- Troubleshooting

1.2 Training aims

Training aims can be pursued in the following areas:

- Process engineering
  - Read and prepare flowcharts and documentation
- Electrical engineering
  - Correct wiring of electrical components
- Sensor technology
  - Correct use of sensors
  - Measurement of non-electrical, process engineering and control technology values
- Control technology
  - Fundamentals of closed-loop control technology
  - Expansion of measurement chains into closed-loop control circuits
  - Analysis of controlled systems
  - P, I and D controllers
  - Optimisation of a controlled system
- Commissioning
  - Commissioning of a controlled system
  - Commissioning of a process system
- Troubleshooting
  - Inspection, maintenance and servicing of process systems
  - Control and observe processes using a PC
  - Systematic troubleshooting for a process system

1.3 Important instructions

Fundamental prerequisites for safe use and trouble-free operation of FluidLab® PA include knowledge of basic safety precautions and safety regulations.

These operating instructions include the most important directions for safe use of FluidLab® PA software.

In particular the safety precautions must be adhered to by all persons who work with FluidLab® PA.

Beyond this, all pertinent accident prevention rules and regulations, which are applicable at the point of use, must be adhered to.

1.4 Obligations of the operating company

The operating company undertakes to allow only those persons to work with FluidLab® PA who:

- are familiar with the basic regulations regarding work safety and accident prevention, and have been instructed in the use of FluidLab® PA software.
- have acknowledged by signature the fact that they have read and understood the chapter concerning safety, and the warnings in these operating instructions.

Personnel are tested at regular intervals for safety-conscious work habits.

1.5 Obligations of the trainees

All persons who have been entrusted to work with the MPS® PA system undertake to complete the following steps before beginning work:

- Familiarise themselves with the basic regulations regarding work safety and accident prevention
- Acknowledge by signature the fact that they have read and understood the chapter concerning safety, and the warnings in these operating instructions

1.6 Dangers associated with FluidLab® PA

FluidLab® PA is configured using state-of-the-art technology and in accordance with recognised safety rules. Nevertheless, life and limb of the user and third parties may be endangered, and the machine or other property may be damaged during its use.

FluidLab® PA may only be used:

- For the intended purpose
- When its safety functions are in perfect condition

Faults which may impair safety must be eliminated immediately!

1.7 Guarantee and liability

Our “general terms and conditions of sale and delivery” are always applicable. These are made available to the operating company no later than upon conclusion of the sales contract. Guarantee and liability claims resulting from personal injury and/or property damage are excluded if they can be traced back to one or more of the following causes:

- Use of the machine for anything other than its intended purpose
- Improper installation, commissioning, operation and maintenance of the machine
- Operation of the machine with defective safety equipment, or with improperly attached or non-functional safety and protective equipment
- Non-compliance with directions included in the operating instructions with regard to transport, storage, installation, commissioning, operation, maintenance and set-up of the machine
- Unauthorized modifications to the machine
- Inadequate monitoring of machine components which are subject to wear
- Improperly executed repairs
- Disasters resulting from the influence of foreign bodies and acts of God

Festo Didactic hereby excludes all liability for damages incurred by trainees, the training company and/or any third parties, that occur during use of the system in situations which serve any purpose other than training and/or vocational education, unless such damages have been caused by Festo Didactic due to malicious intent or gross negligence.

1.8 Recommended operating conditions

This software has been developed and manufactured exclusively for further and vocational training in the fields of process automation and communication. The respective training companies and/or trainers must ensure that all trainees observe the safety precautions which are specified in the accompanying documentation.

Use for intended purpose also encompasses:

- Compliance with all directions included in the operating instructions
- Completion of inspection and maintenance tasks

2 Safety precautions

General information

- Trainees may only work at the station under the supervision of a trainer.
- Observe specifications included in the data sheets for individual components and in particular all safety instructions!

Electrical

- Electrical connections must only be made or broken in the absence of voltage!
- Use low voltage only (max. 24 V DC).
- The heater is operated with 230 V AC electrical power. Observe all applicable safety regulations during commissioning! (DIN VDE 0113 [EN 60204])

Pneumatics

- Do not exceed the maximum permissible pressure of 800 kPa (8 bar).
- Do not switch on compressed air until all of the tubing connections have been completed and secured.
- Do not disconnect tubing while under pressure.
- Be especially careful when switching on compressed air. Cylinders may advance or retract automatically.

Mechanical components

- Mount all components securely to the base plate.
- Do not touch the station unless all moving parts have come to a complete standstill.
- The pump must be positioned so that it is submerged. The inlet nozzle must be positioned underneath the outlet nozzle (see data sheet).

Process engineering

- The containers must only be filled during voltage-free status!
  Switch off 24 V DC and 230 V AC supply power!
- Use clean, drinking (recommended) tap water, to ensure a longer period of maintenance-free operation of the stations (pump).
- The maximum permissible operating temperature of +65° C for the containers must not be exceeded.
- The submersible heater may only be put into operation when it is entirely immersed in water.
- The maximum permissible operating pressure of 0.5 bar for the liquid in the tubing must not be exceeded.
- The pump must not be permitted to run dry. The pump must not be used with seawater, contaminated liquids or viscous media.
- Empty all liquid from the stations/system before changing the piping layout.
- Liquid can be emptied from the station by opening the drain valve!

3 Technical data

Parameter	Value
Digital inputs	Up to 8
Digital outputs	Up to 8
Analogue inputs	Up to 4
Analogue outputs	Up to 2
Measuring ranges Analogue input voltage Analogue output voltage	 0 to 10 V DC 0 to 10 V DC

Voltage signals may only be used in combination with the EasyPort digital/analogue!

4 Transport / unpacking / scope of delivery

Transport
FluidLab® PA is supplied on a CD ROM.

The freight forwarder and Festo Didactic must be notified of any transport damage without delay.

Unpacking
Carefully remove the packaging materials when unpacking the equipment. Make sure that no damage occurs whilst unpacking the equipment.

Examine the equipment for possible damage after unpacking. The freight forwarder and Festo Didactic must be notified of any damage without delay.

Scope of delivery
Check delivered items against the packing slip and your purchase order. Festo Didactic must be notified of any discrepancies without delay.

5 Installation

Note

The installation routine described applies to the FluidLab® PA version for the MPS® PA Stations, as well as to the version for the Compact Workstation.

5.1 Package design

The Fluid Lab®–PA software is delivered on CD.
It comes packed in a setup.exe. To start the installation process just launch the executable file out of the Windows® Explorer.
Fluid Lab®–PA needs several components of third party distributors to work successfully. See the description below for details.

The basic components of the software package are:

- Fluid Lab®–PA program files
- EzOCX driver (Third party distributor files)
- LabVIEW© Runtime environment (Version 8.2.1) (Third party distributor files)

optional

- EasyPortUSB driver (Third party distributor files)

5.2 Fluid Lab®–PA program files

Table of the sub-folders created on your local system after the installation process has been finished successfully:

Folder name	Description
addFiles	Folder for additional components like icons, internet links, etc.
Settings	Folder where pre-settings are stored in.
German	Files for the German version of Process Lab
English	Files for the English language version of Process Lab.
Spanish	Files for the Spanish language version of Process Lab
French	Files for the French language version of Process Lab.
EzOCX	Driver for the connection with the EasyPort USB
National Instruments	Runtime for FluidLab-PA

Note

A main folder is defined in the setup routine where the folders specified above are copied to. It is possible that files from third party distributors are copied to other folders.

5.3 EzOCX driver

The EcOCX driver is needed for communication between Fluid Lab®–PA software and EasyPort USB via USB cable.

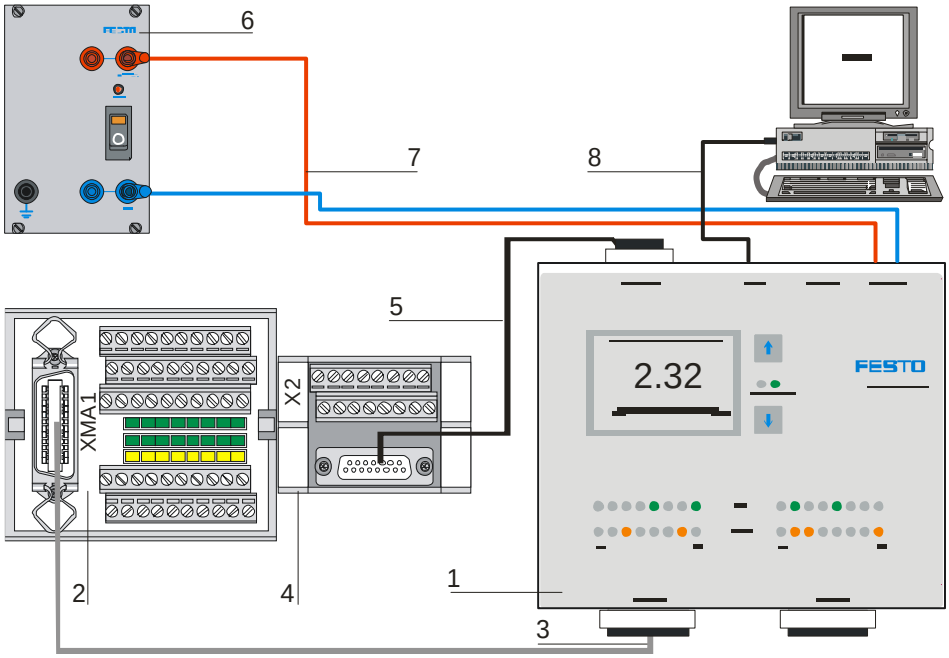
5.4 LabVIEW© runtime engine 8.2.1

Because Fluid Lab®–PA is developed with LabVIEW© of National Instruments© the software uses a runtime environment to be executed on your system.

5.5 Hardware

Required hardware:

- PC (min.: Pentium II 450MHz, 128MB RAM, 100MB free memory)
- MPS® PA Compact Workstation or EduKit® PA with I/O-board



Hardware connections Compact Workstation – EasyPort USB

1	EasyPort USB
2	I/O terminal Syslink
3	SysLink cable
4	Analog terminal
5	Analogue cable, 15-PIN, parallel
6	Power supply 24 V DC, 4,5 A
7	Labor cable with Safty plug(red/blue)
8	USB Cable oder PC data cable RS 232

5.6 Cable connections

All cable connections are described as an example for a Compact-Workstation with EasyPort USB

- EasyPort USB – station: connect the Port 1 (Digital I/O) of the EasyPort with the XMA1 socket of the I/O terminal (2) of the Compact-Workstation with a SysLink cable (3).
- EasyPort USB – station: connect the Port 3 (Analog I/O) of the EasyPort with the X2 socket of the analog terminal(4) of the PCS Compact-Workstation with a analog cable (5).
- EasyPort USB – PC: connect USB port of the EasyPort with PC with a USB cable (8).
- EasyPort USB – Power supply: connect the EasyPort power socket (- 24V +) to a 24VDC voltage supply

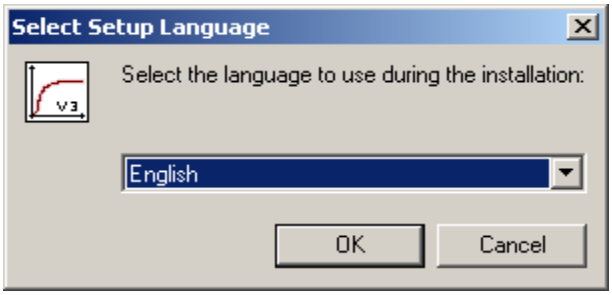
5.7 Starting installation

It is advisable to exit all other programmes before you start installing FluidLab® PA.

Insert the installation CD into the CD drive. An installation routine should start automatically and assists you throughout the installation process.
If the installation routine does not start automatically, open Windows Explorer and click the icon of the CD drive into which the CD has been inserted. Then click the “setup.exe” file.

5.8 Selecting the set-up language

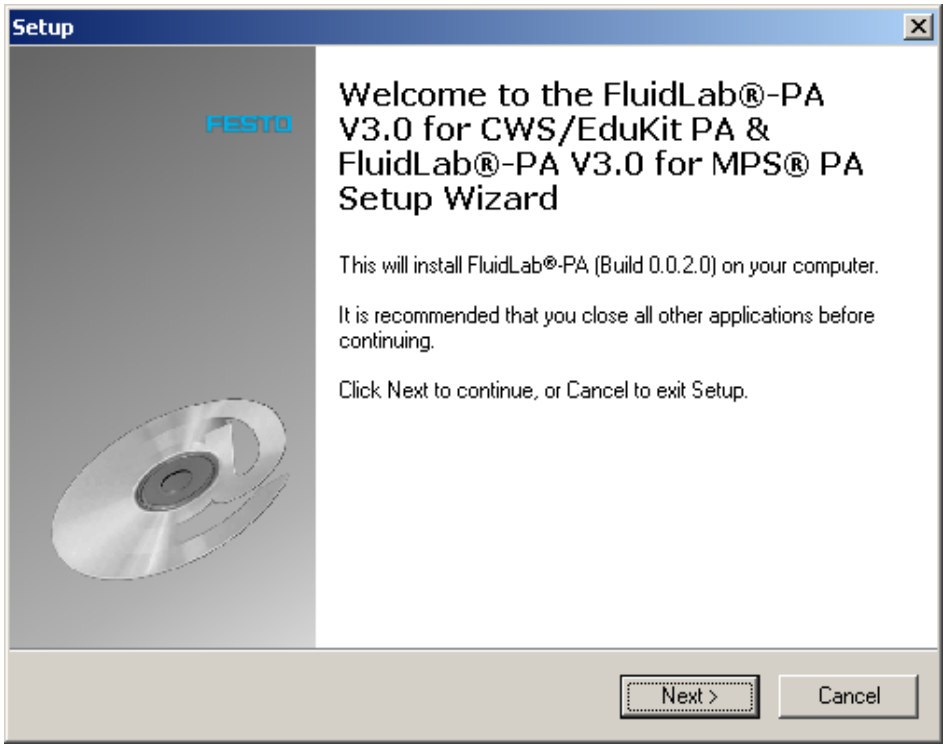
Various languages can be selected for the installation routine including German, English, Spanish, French or Swedish. The language selection takes place in the first dialog box.



Select language

5.9 Welcome window

The FluidLab® PA version and the installer version are displayed in the welcome window.



Welcome window

All of the subsequent windows included in the installation routine have the same layout.
Click the “Next” button in order to continue to the next window.
Click the Cancel button in order to abort the installation process.
In the windows that follow, you can click the “Back” button to return to the previous window.

5.10 License agreement

In order to install FluidLab® PA software, you must accept the licence agreement.
Read the licence agreement carefully.
If you accept the agreement, select the “I accept the agreement” option.

License agreement

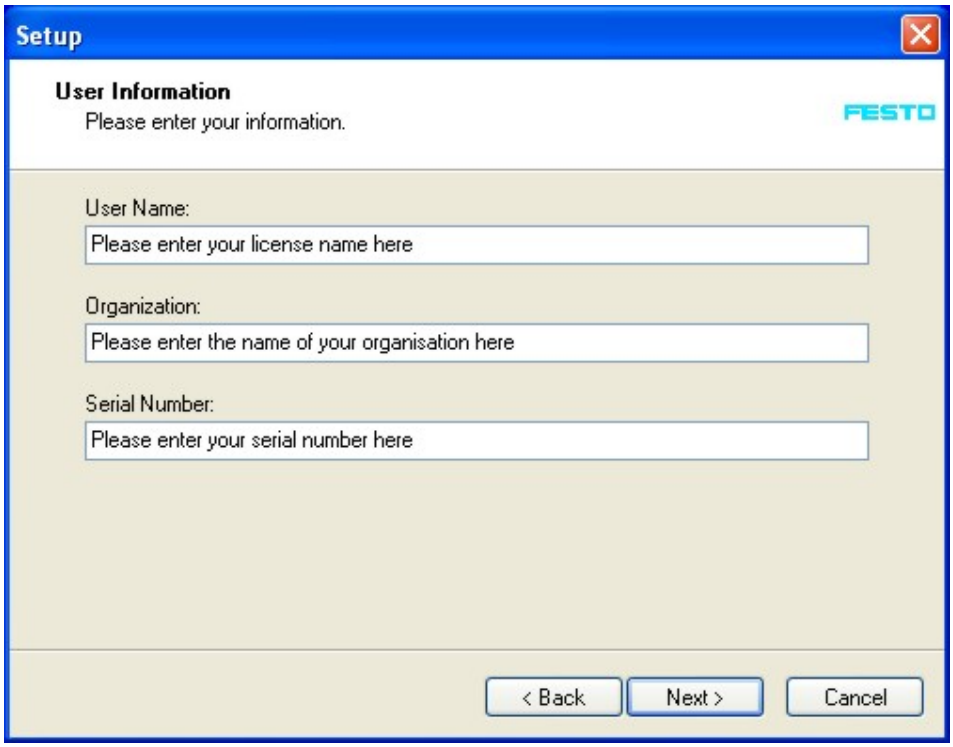
Click the “Next” button in order to continue the installation

5.11 Licence data

In order to ensure that you are authorised to use the full version of FluidLab® PA software, you'll need to enter your licence data during the installation process.

The needed information can be found on the back site of your CD-ROM cover (fields labelled "User Name" and "Serial number").

Be sure to enter these fields correctly. Upper case letters, lower case letters and blanks must be entered as seen below! If any entries are incorrect, it will only be possible to use the demo version of FluidLab® PA which has limited functionality.



Licence data

After completing your entries, click the "Next" button.

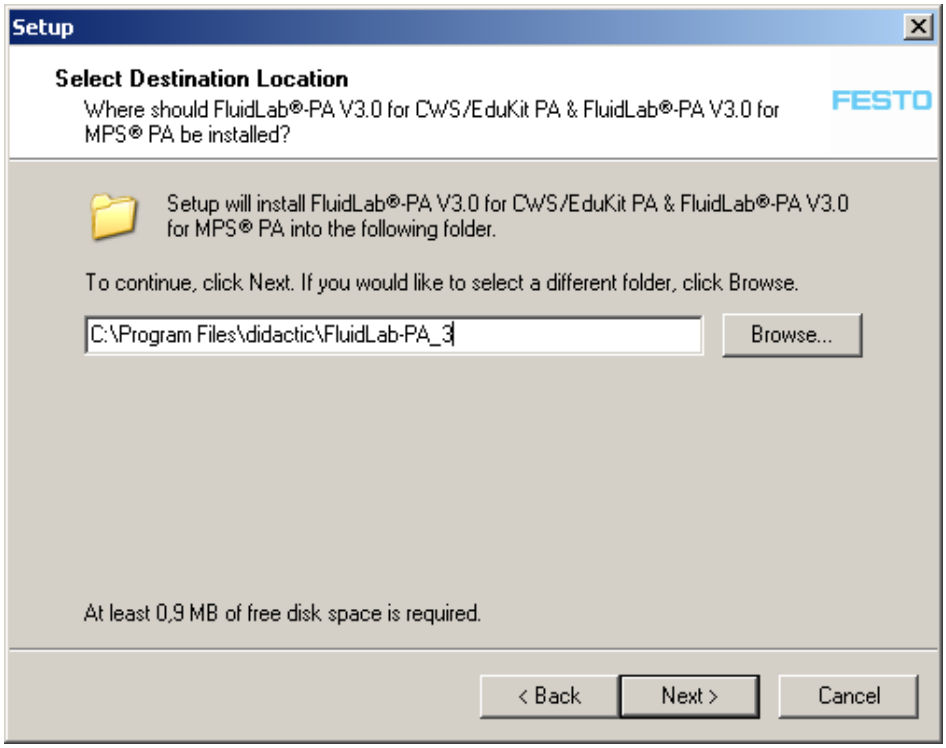
Note

You are able to change the license status by editing the "FGB.ini" file manually with Notepad.exe e.g. after the successful installation of Fluid Lab®–PA. This file can be found in the main installation. Also for demo mode or false input the license can be changed in the information window.

The file has to be layouted as follows:
First line: License name + carriage return + line feed
Second line: License key

5.12 Destination location

Select a destination folder to which all of the files for FluidLab® PA software are to be copied.

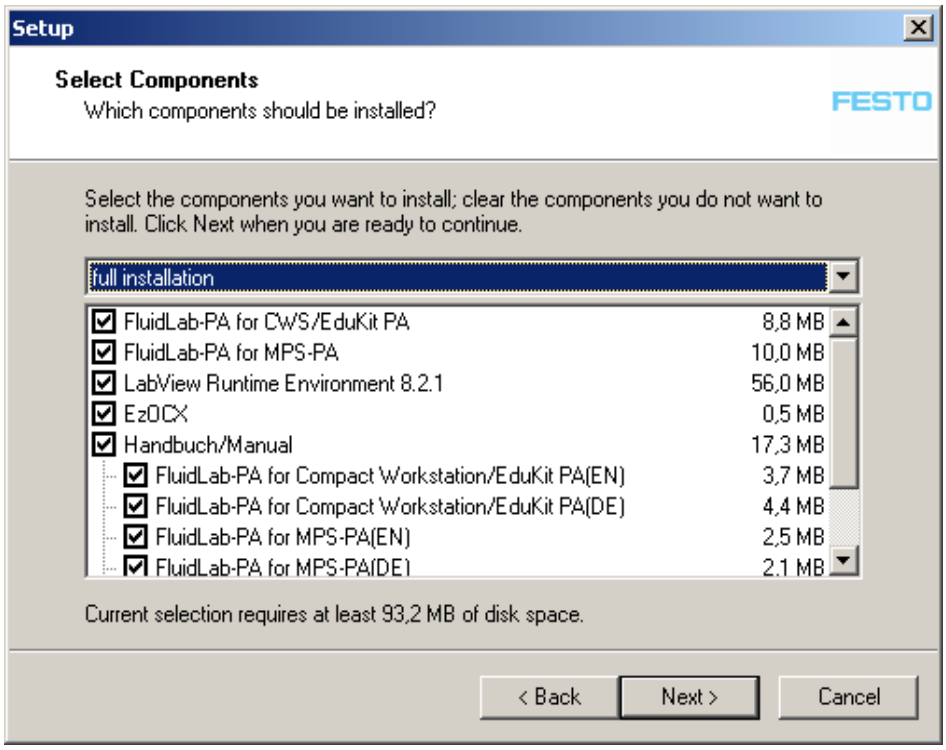


Destination location

Click the “Next” button in order to continue the installation.

5.13 Components

Select the components that you would like to install.



Components

After selecting the desired components, click the “Next” button

List of components

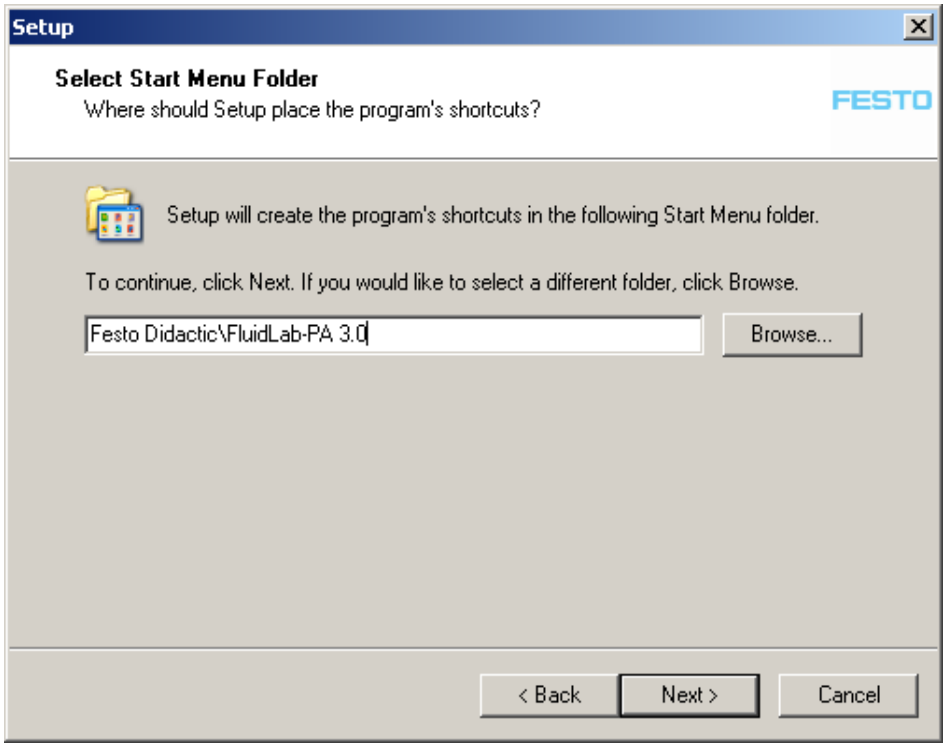
Parameter	Description	optional
Fluid Lab®-PA for CWS/EduKit PA	All required program files (without required files from other manufacturers)	Yes
Fluid Lab®-PA für MPS® PA	All required program files (without required files from other manufacturers)	Yes
LabView Runtime Environment. 8.2.1	Runtime for Fluid Lab®-PA	Yes
EzOCX	Driver for data communication via RS 232	Yes
Manuals MPS®PA	Manuals for MPS®PA in English and German	Yes
- Manuals Compact Workstation	Manuals for Compact Workstation in English and German	Yes

Component selection

Components	Parameter					
	FluidLab® PA for MPS® PA	**FluidLab® PA for Compact Workstation**	**LabView Runtime Env. 7.1**	**EzOCX**	**MPS® PA Manuals**	**Compact Workstation Manuals**
FluidLab® PA for MPS® PA	Yes		Yes	Yes	Yes	
FluidLab® PA for Compact Workstation		Yes	Yes	Yes		Yes
User defined installation	X	X	X	X	X	X
Full installation	Yes	Yes	Yes	Yes	Yes	Yes

5.14
Start menu folder

Select the folder in the start menu, where the shortcuts required for FluidLab® PA will be created.



Select start menu folder

Created shortcuts inside the start menu folder:

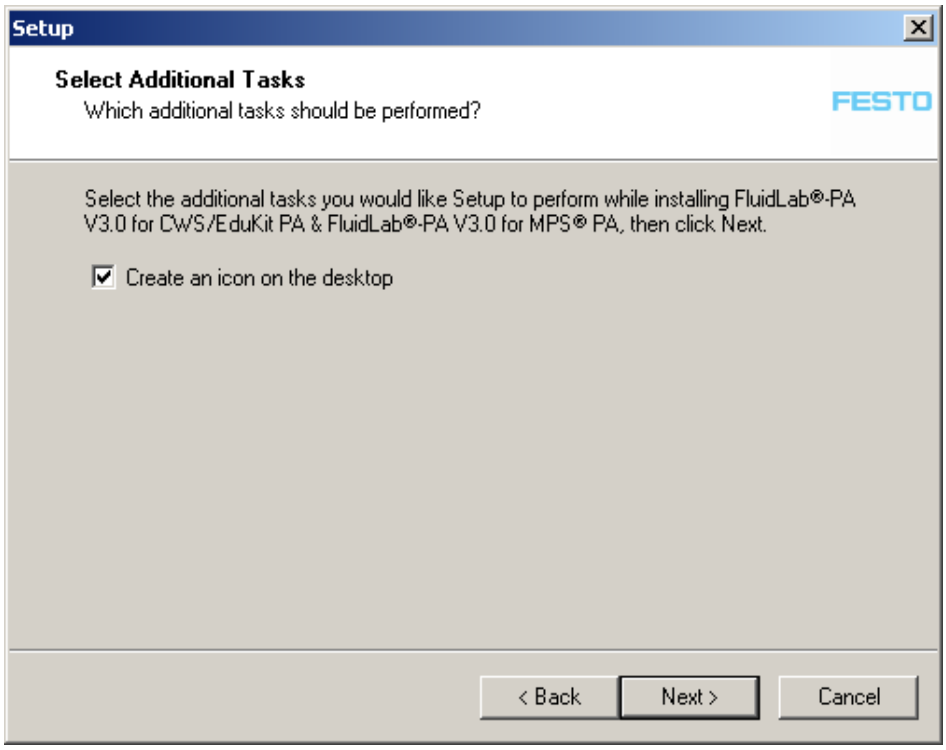
- "Fluid Lab®-PA (CWS or EduKit PA)" – to start the software for Compact Workstation
- "Fluid Lab®-PA (MPS-PA)" – to start the software for MPS®-PA
- "Uninstall Fluid Lab®-PA" – to uninstall the Fluid Lab®–PA software
- Internet sub folder with:
  - Link to Festo Didactic home page
  - Link to Adiro home page
- "Manuals" –Sub folder with links to the installed manuals
- Click the "Next" button in order to continue the installation.

Click the "Next" button in order to continue the installation.

Note: You need an active Internet connection to use the Internet shortcuts.

5.15 Additional tasks

You can choose whether or not a desktop icon will be created for FluidLab® PA.

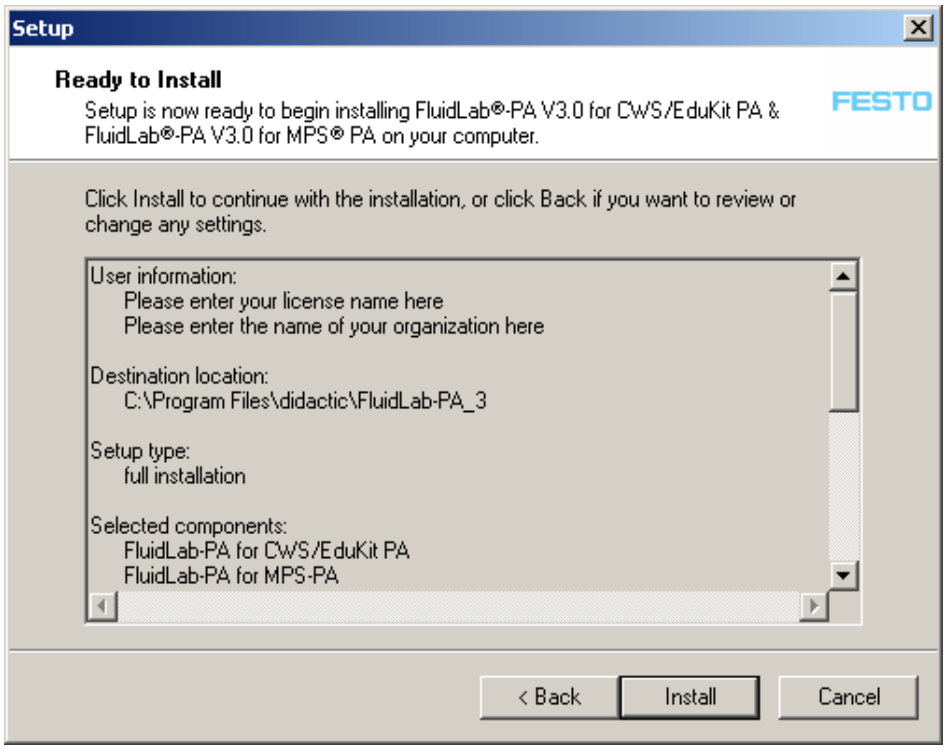


Create a desktop icon

Click the “Next” button in order to continue the installation.

5.16
Ready to Install

This window displays a summary of all of the selections you have made so far.



Ready to install

Click the “Install” button in order to start the installation.

Note

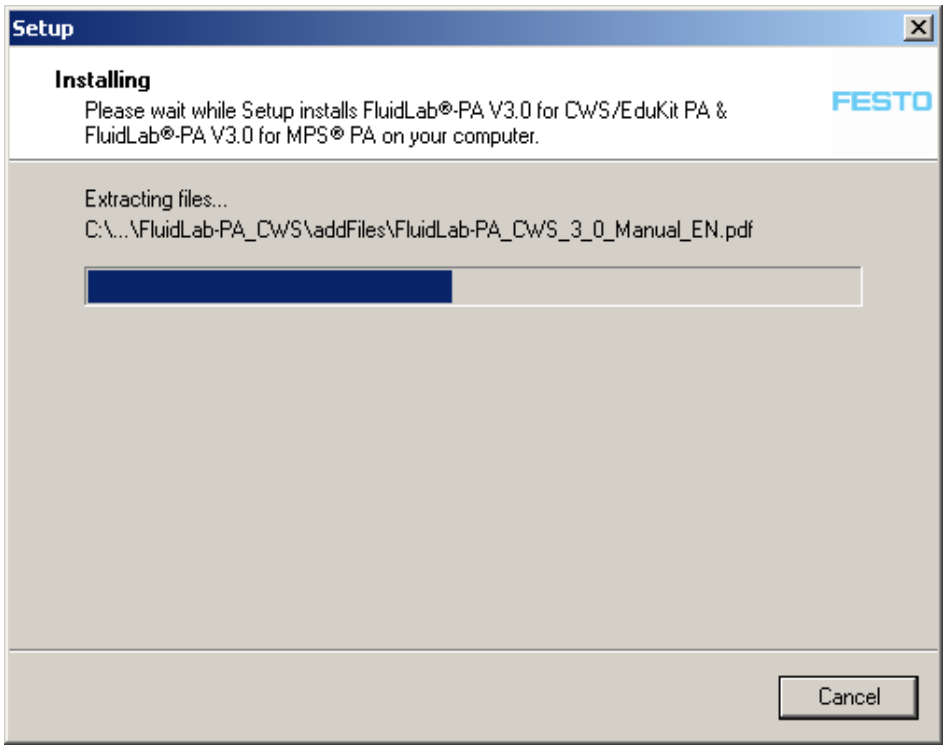
The appearance of this window may vary depending upon the components to be installed.

5.17 The installation process

The window shown below appears during installation.
All required files are copied to the hard disk.

A progress bar shows the current status of the installation process.

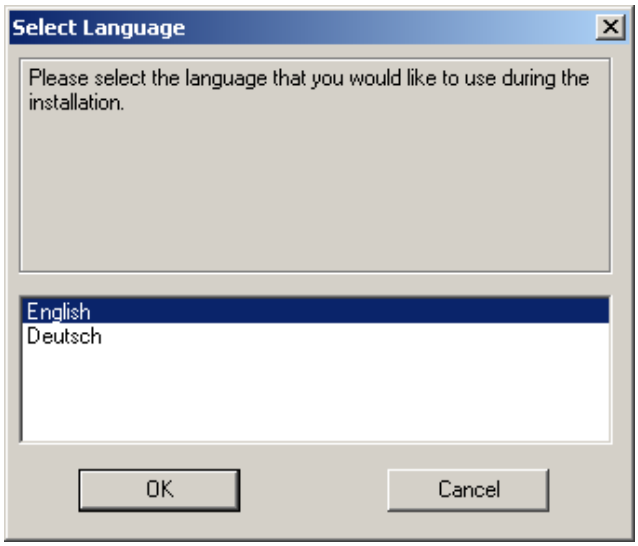
Please wait until the installation process has been completed.
The length of time required for installation depends upon the PC specification.



Installation process

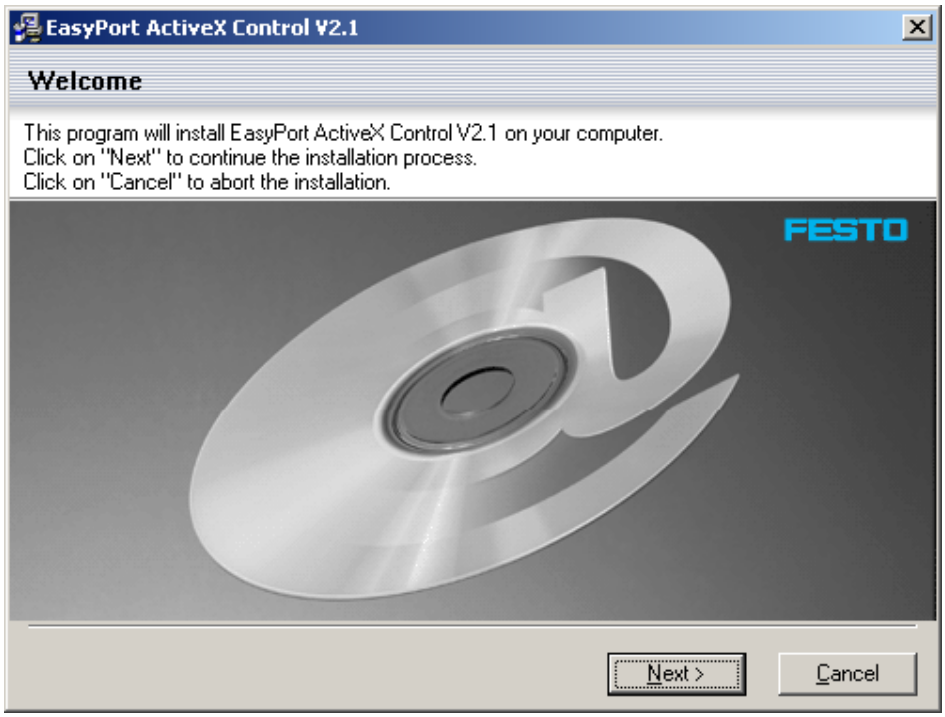
5.18 Installation Active-X

The installation of the Active-X is automatically started.



Select Language

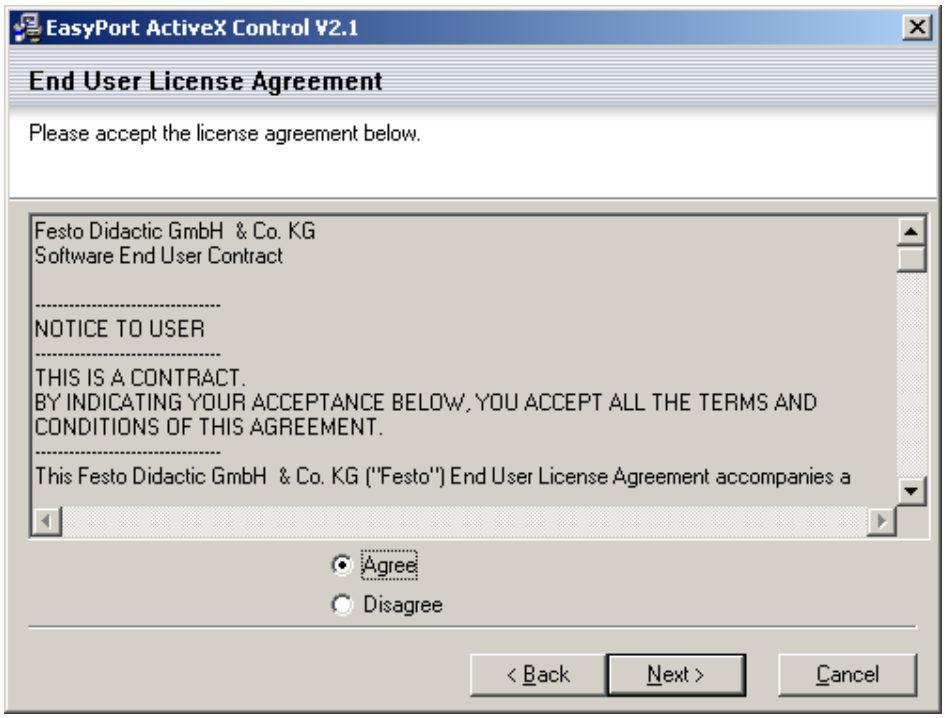
Select language and click on „OK“.



EzOcx32

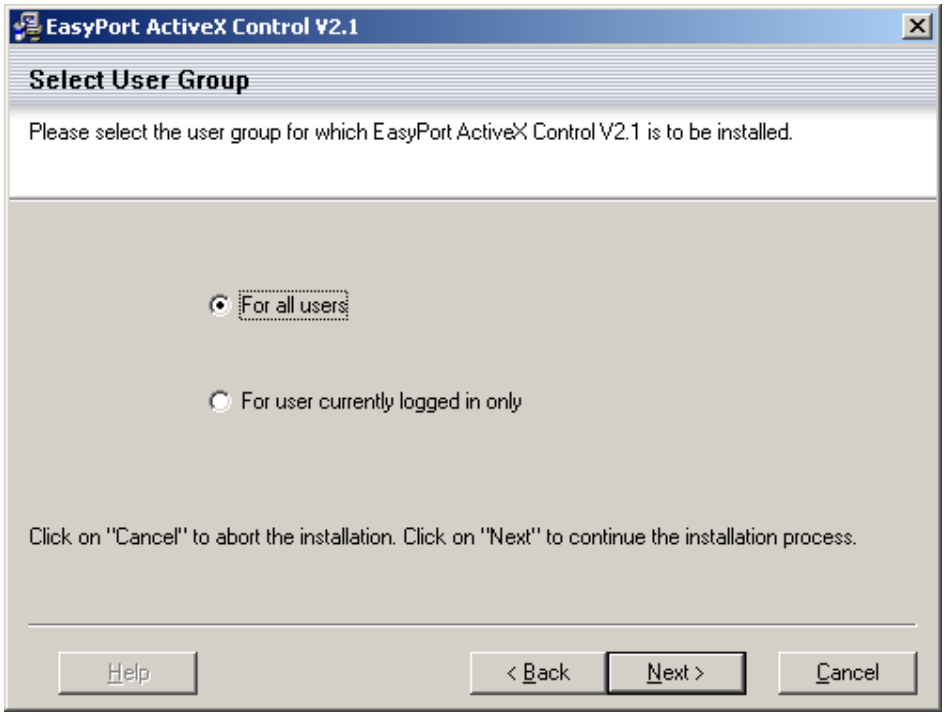
Click on the “Next” button in order to start the installation.

In order to install EasyPort Active X Control, you must accept the licence agreement.
Read the licence agreement carefully.
If you accept the agreement, select the “I accept the agreement” option.



End User License Agreement

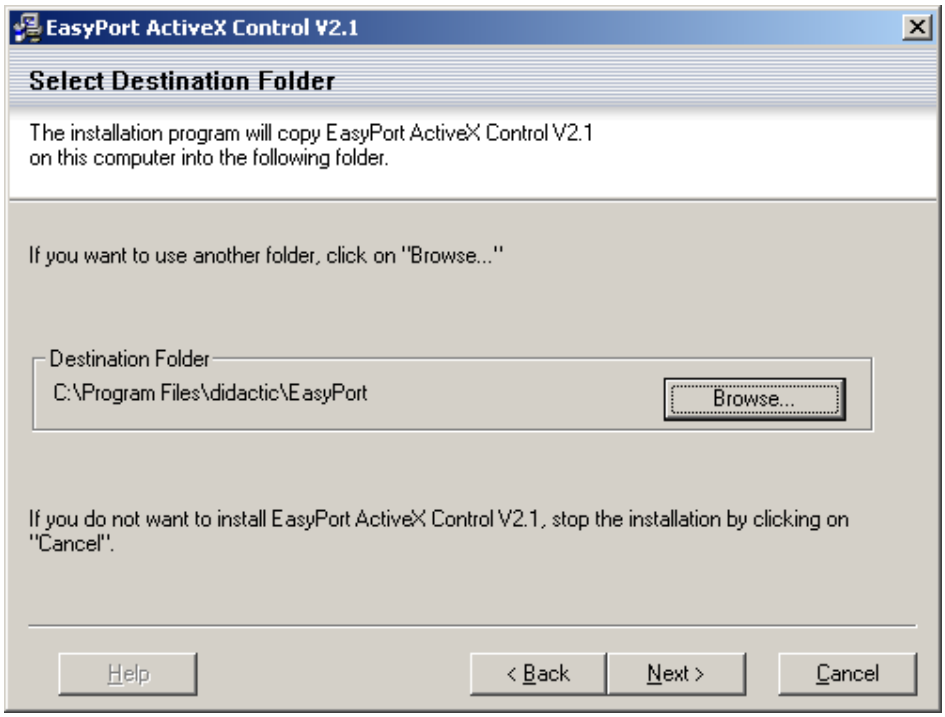
Click on the “Next” button.



Select User Group

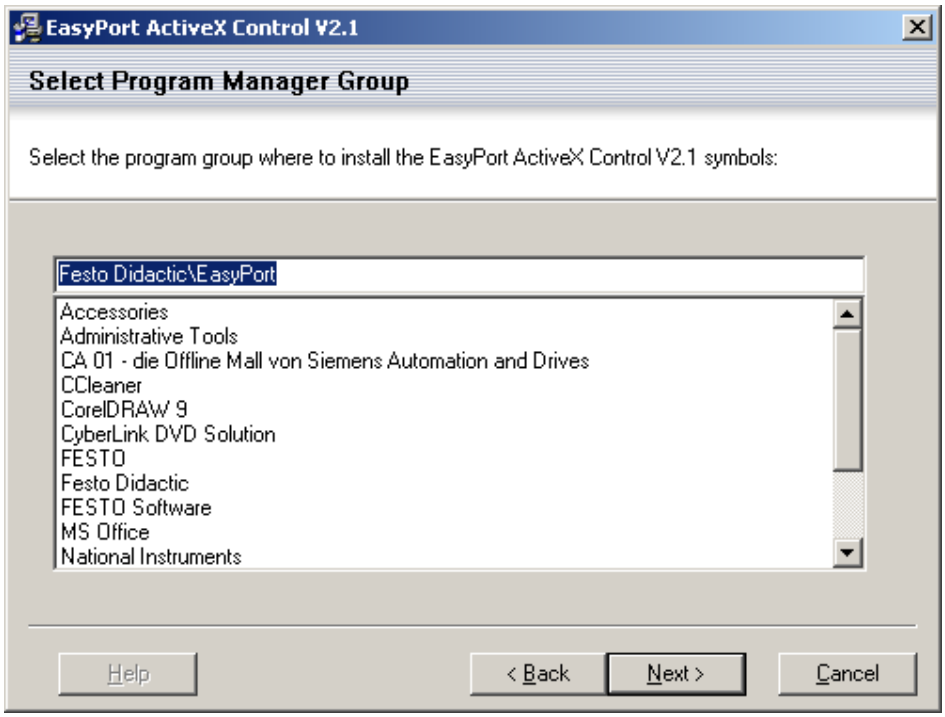
Selec user groupe and click on the “Next” button.

Select the destination folder to which the driver files will be copied



Select Destination Folder

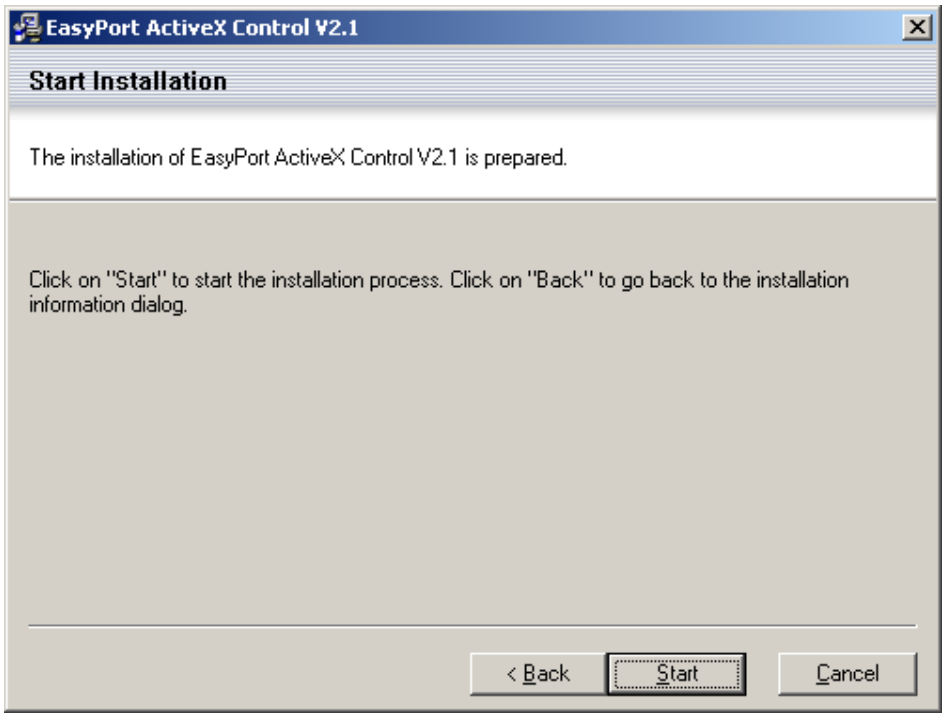
Click the “Next” button in order to continue the installation.



Select Program Manager Group

Click on the “Next” button in order to continue the installation.

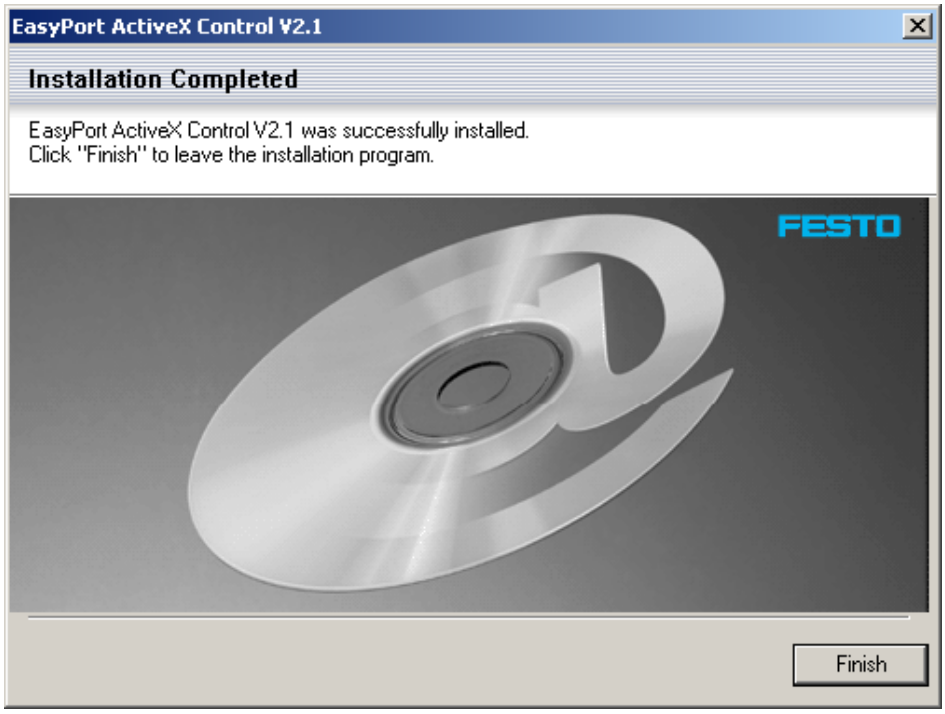
Acknowledge once again if you want to install the driver.



Start Installation

Click on the “Next” button in order to start the installation.

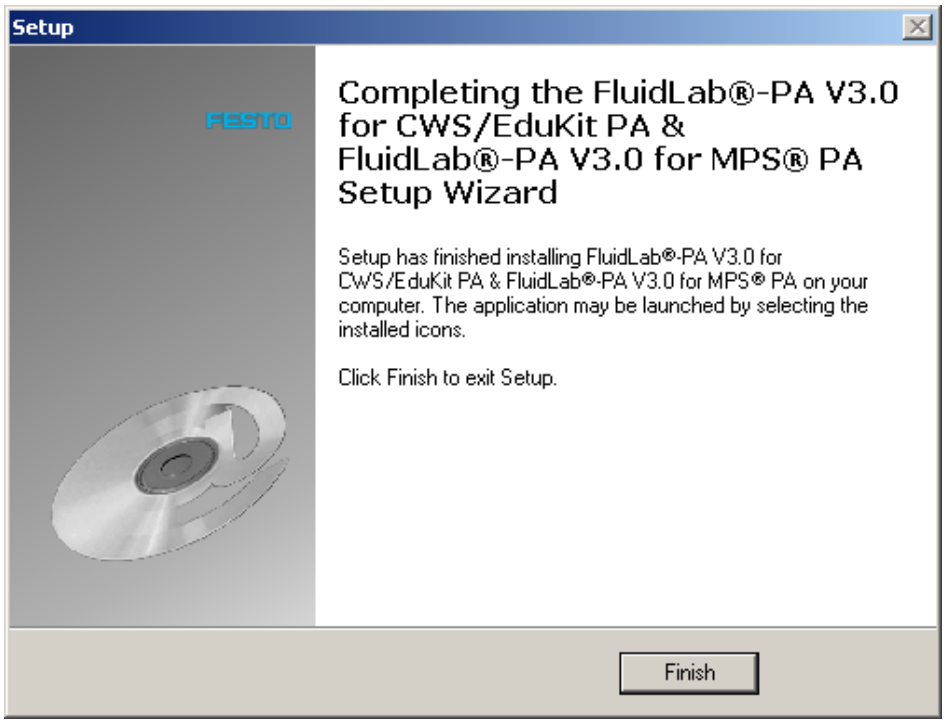
Driver installation has been successfully completed.



Installation Completed

Click on the “Finish” button in order to end the installation.

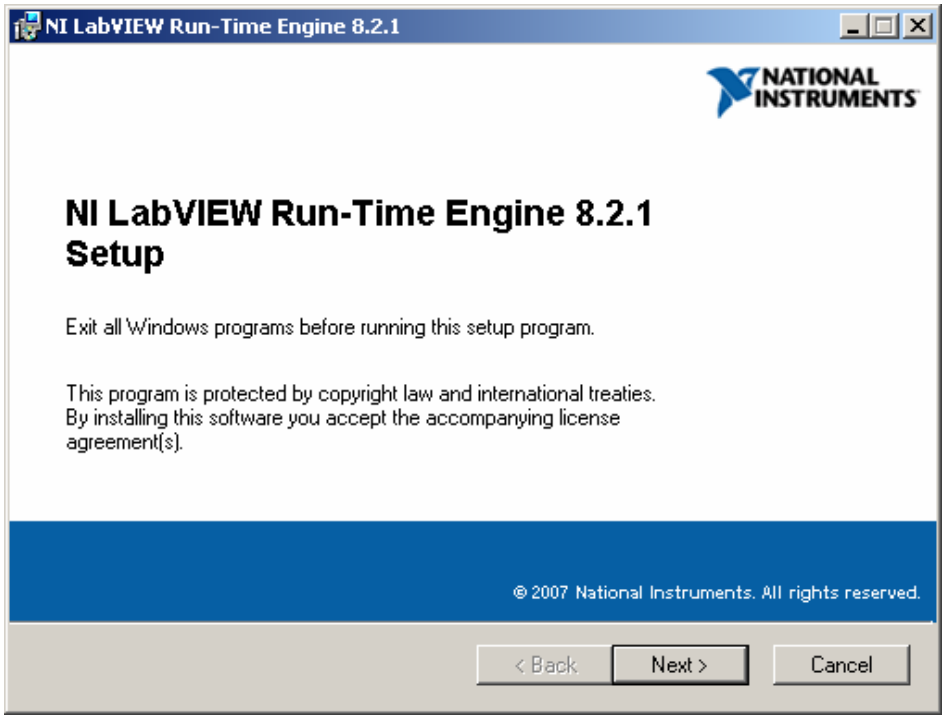
After a successful installation of the Fluid Lab®–PA software program files a window will appear as shown below.
This is the end of the Fluid Lab®–PA installation routine. Click the “Finish” –button to complete.



Installation complete

5.19 Installation Run-Time Engine 8.2.1

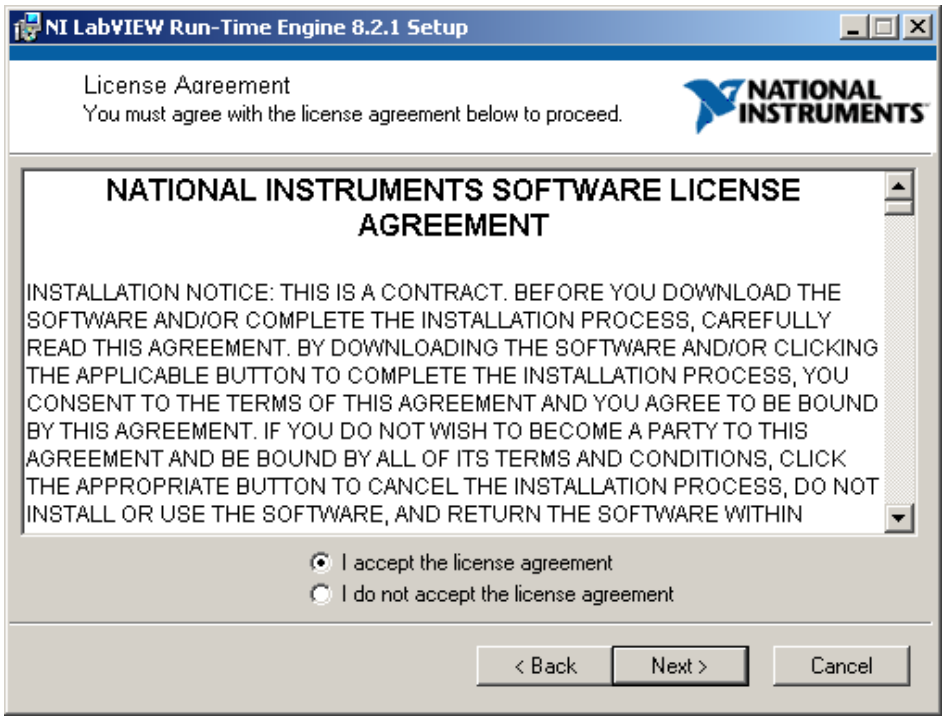
The following window appears when the driver installation process has been completed.



Run-Time Engine Setup

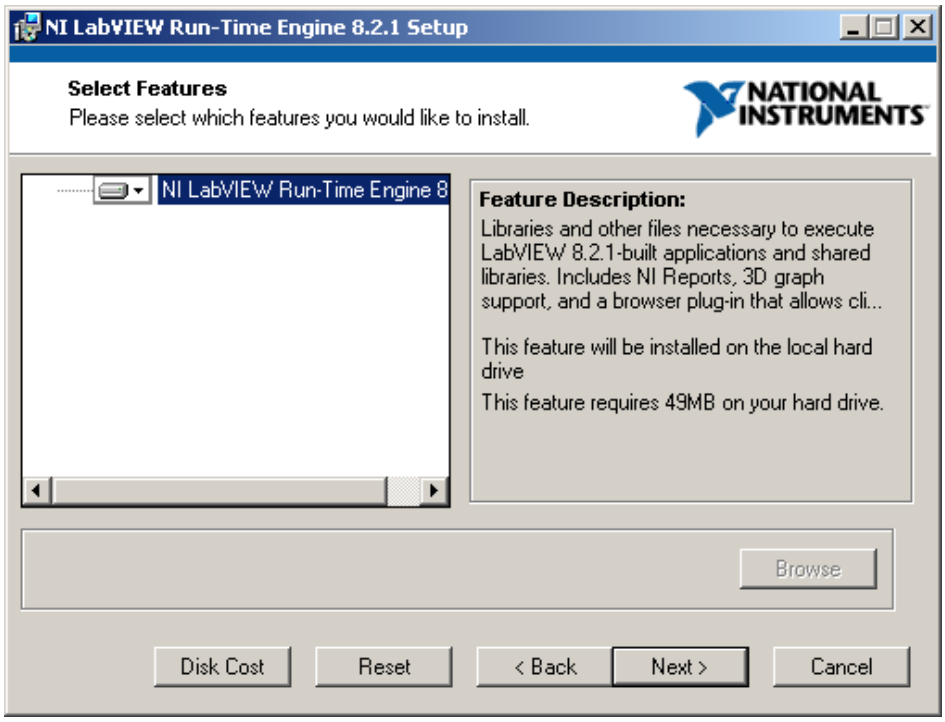
Click the “Next” button to start the installation.

In order to install Runtime Engine 8.2.1, you must accept the licence agreement.
Read the licence agreement carefully.
If you accept the agreement, select the “I accept the licence agreement” option“.



Licence Agreement

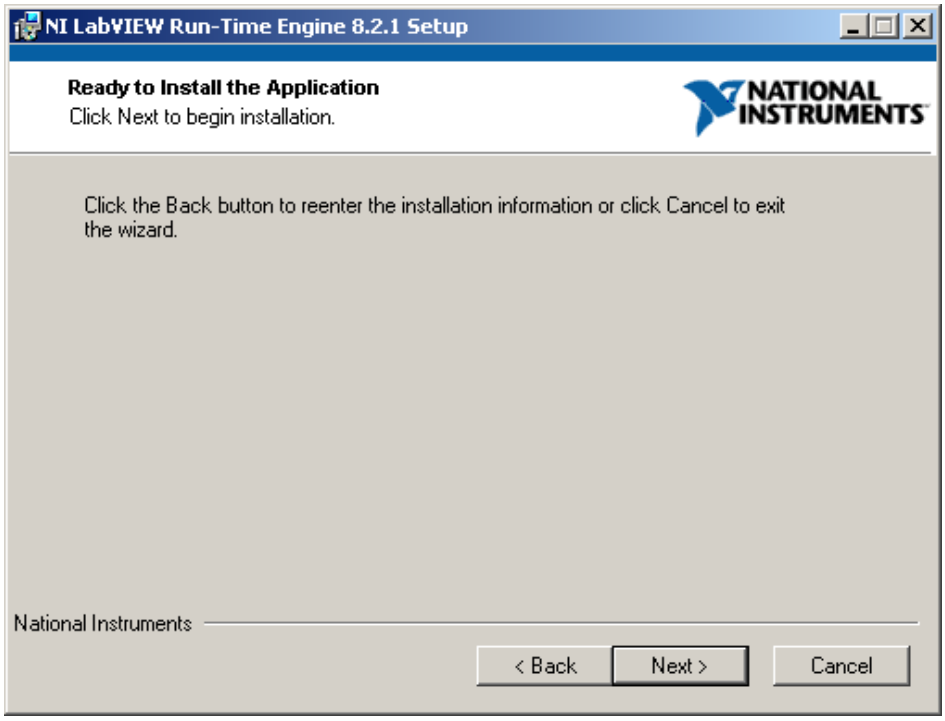
Click the “Next” button in order to continue the installation.



Select Features

Click the “Next” button in order to continue the installation.

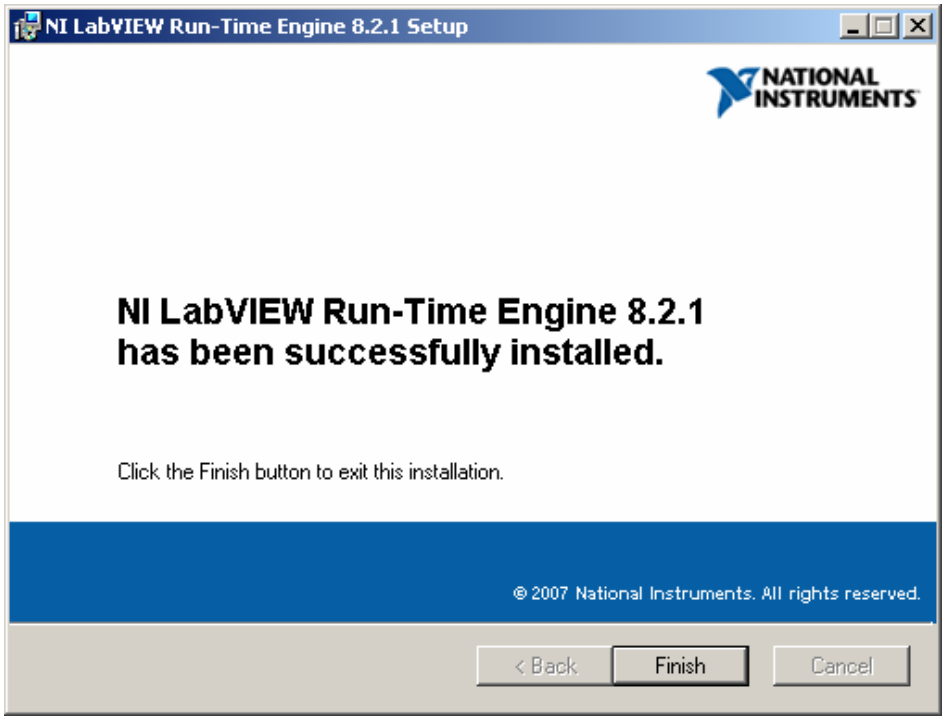
Acknowledge once again if you want to install Runtime Engine 8.2.1.



Ready to Install the Application

Click the “Next” button in order to start the installation.

Driver installation has been successfully completed.



Installation complete

Click the “Finish” button to exit installation.

Notice

It is recommended to restart your system after installation.

5.20 Uninstall the Fluid Lab®–PA

FluidLab® PA software can be automatically removed from your PC. Click "Uninstall FluidLab® PA" in the start menu folder.

Please note that only FluidLab® PA files are removed during the uninstall process, not files from other manufacturers.

6 Layout and function

6.1 Main menu

Start the software program.

A short cut for starting the program is usually included in the Windows start menu folder under “Start → Programs → Festo Didactic → FluidLab PA”.

If you selected the option to create a desktop icon for FluidLab® PA during the installation process (see section 5.15, “Additional tasks”), it will now be visible on the desktop:

FluidLab® PA for MPS® PA

Click the icon to start FluidLab® PA for MPS® PA software.

Main menu window

This window is the software's central component. You can access all of the functions provided by FluidLab® PA from this window.

Number	Function
1	Select a station
2	Set up interfaces
3	Display information
4	Language selection
5	Initialise communication to EasyPort
6	FluidLab® PA version
7	Your licence name

6.2 Language selection

FluidLab® PA is available in several languages. Click the “Language” button in the main window. A dialogue box appears which permits language selection from the following:

- German
- English
- French (available soon)
- Spanish (available soon)
- Other languages available upon request

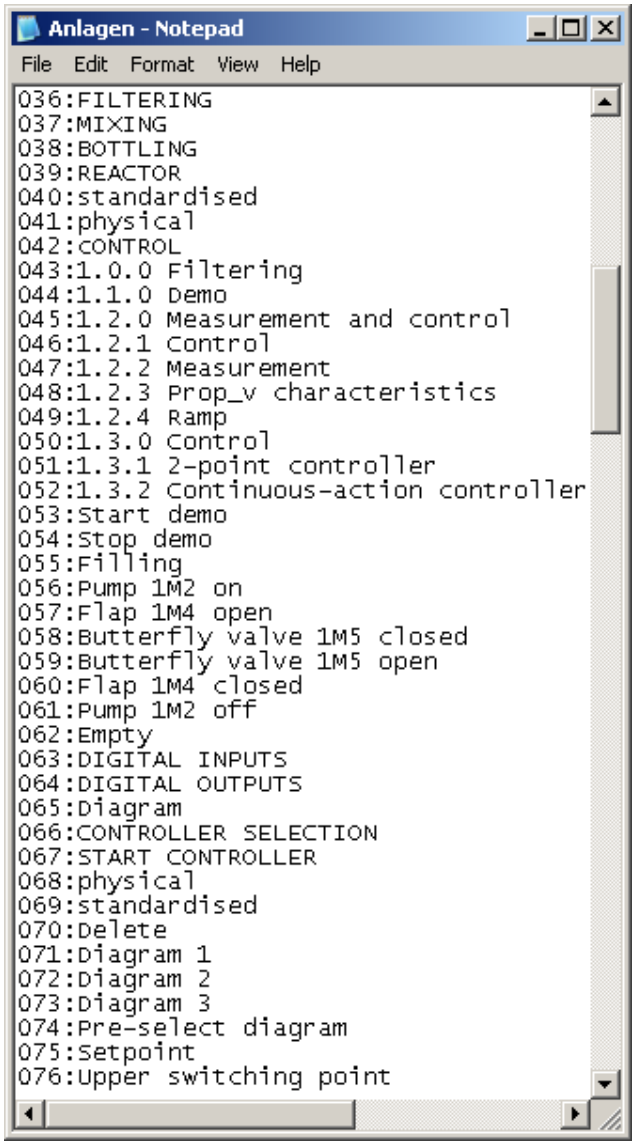
Language selection

6.2.1 Window captions

The captions used to identify components in FluidLab® PA can be changed. Use an editor to do this, for example Microsoft© Notepad.
All relevant data is located in the folders included in the main FluidLab® PA folder, and vary only with regard to their filename extensions:

- German window captions ...\German\ RegeIn.GER
- English window captions ...\English\ RegeIn.ENG
- French window captions ...\French\ RegeIn.FRA
- Spanish window captions ...\Spanish\ RegeIn.SPA

...



Microsoft© Editor for editing window captions

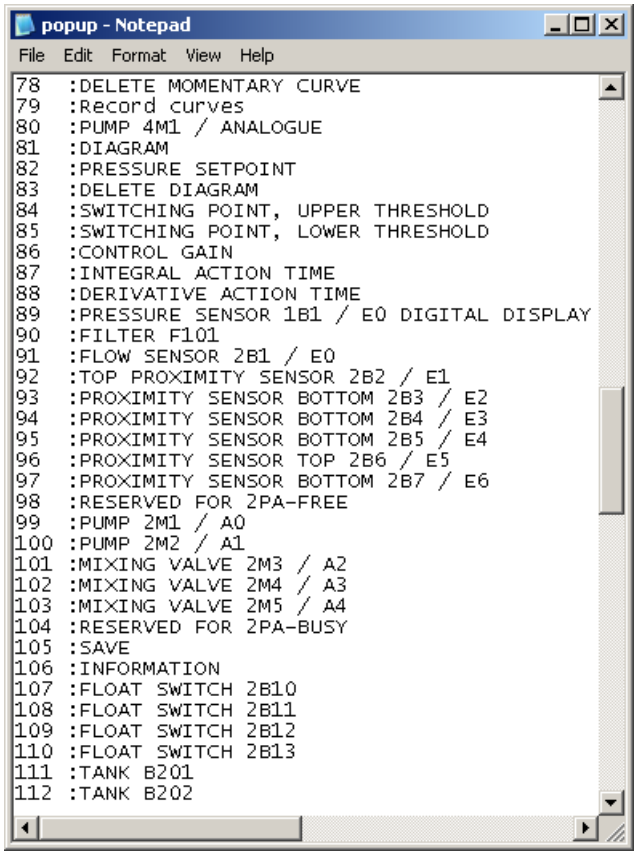
File structure	Each line begins with a number which is followed by a colon. The window caption begins after the colon. It is not advisable to change the layout. Change only the text, which appears to the right of the colon!
Note	Use short captions, because long captions may not be fully displayed for some of the software's components!

6.2.2 Popups

FluidLab® PA supports the software user by means of a popup function.
A short help text appears when the mouse pointer is moved over graphic components. Position the mouse pointer over the respective component for a brief period of time in order to display the popup.
The popups can be changed as desired (e.g. using Microsoft©Notepad).

Separate files exist for each language supported by FluidLab® PA, and only vary with regard to their filename extensions. These files are located in the folders included in the main FluidLab® PA file folder:

- German popup texts ...\German\ popup.GER
- English popup texts ...\English\ popup.ENG
- French popup texts ...\French\ popup.FRA
- Spanish popup texts ...\Spanish\ popup.SPA
- ...



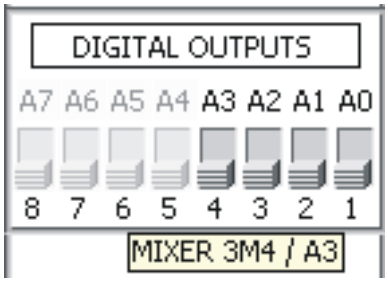
Microsoft© Notepad with popup file

File structure

Each line begins with a number which is followed by a colon. The popup text displayed in FluidLab® PA begins after the colon.

Example:

In order to change the popup text for the mixer, edit line 135.



Popup for mixer

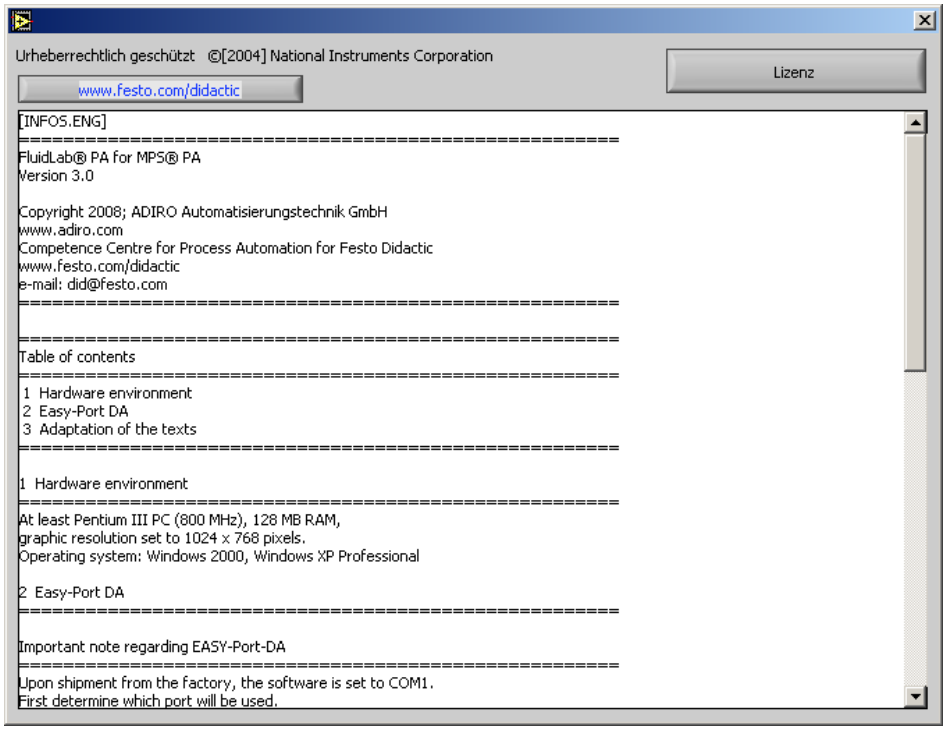
Note

The length of any given line in the popup file should not exceed 54 characters. If this length is exceeded, the text might not be displayed in full.

All text files have been set up in advance for use with the MPS® PA stations.

6.3 Information

Click the “Information” button in the main window. A window appears containing various information such as copyrights and system requirements.



Information window

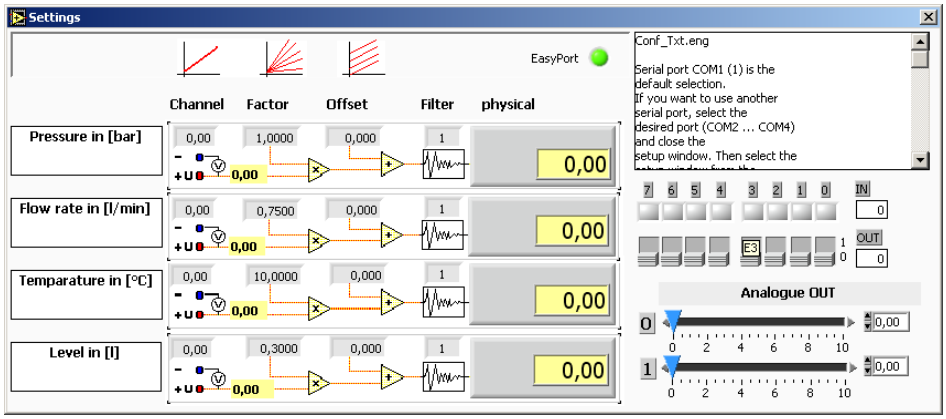
If running in demo mode or at false input of the license the button “Lizenz” is visible.

License input

Please enter your license name and code again. On right input the window will automatically close. See backside of the Fluidlab-PA CD for license information.

6.4 Settings

Click the “Settings” button in the main window. The settings window appears.



Settings window

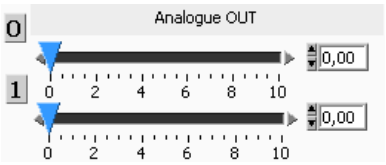
Note

Please note that FluidLab® PA software, in combination with the EasyPort digital/analogue, is only configured for processing signals within a range of 0 to 10 V.

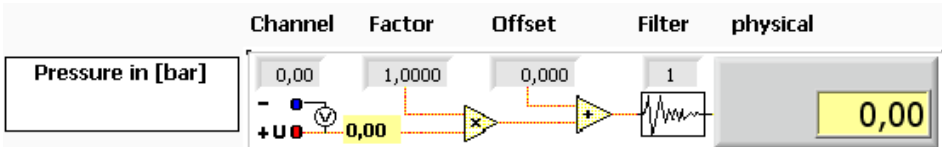
Check the functions of binary sensors and actuators.

Digital inputs and outputs in the settings window

Check all analogue actuators for correct functioning. Adjust the slider in order to change the analogue variable output.



Analogue outputs in the settings window



Channel 0

The 0 to 10 V analogue signal from a sensor must be converted to the corresponding physical value.
This conversion is based on a straight line equation:

$$Y = a \cdot x + b$$

where a = factor, b = offset, x = sensor voltage and y = standardised measured value.

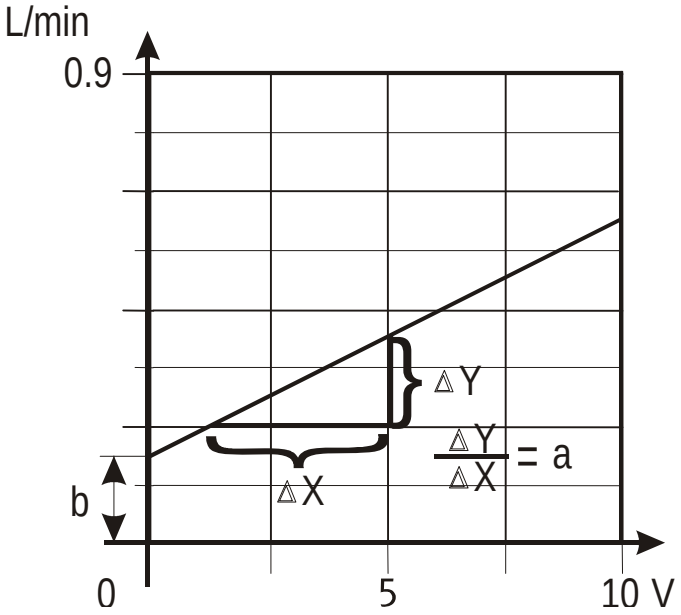
Example:
A flow sensor reads out a voltage signal within a range of 0 to 10 V for a measuring range of 0.3 to 9.0 litres per minute.
In this case, factor “a” is calculated as follows:

$$a = \frac{y - b}{x} = \frac{9.0 - 0}{10} = 0.9$$

The offset is found by shifting of the line’s initial point to the origin.

$$x = \frac{y - b}{a} = \frac{0.3 - 0}{0.9} = 0.33$$

$$b = -X_0, = -0.33$$



Graph of straight line equation

Description of the input channels

Component	Description
Channel 0	Analogue input channel 0
Factor 0	Factor by which input voltage is multiplied, default value: 0.6
Offset 0	Zero balancing, default value: 0
Channel 1	Analogue input channel 1
Factor 1	Factor by which input voltage is multiplied, default value: 0.9
Offset 1	Zero balancing, default value: 0
Channel 2	Analogue input channel 2
Factor 2	Factor by which input voltage is multiplied, default value: 10
Offset 2	Zero balancing, default value: 0
Channel 3	Analogue input channel 3
Factor 3	Factor by which input voltage is multiplied, default value: 0.3
Offset 3	Zero balancing, default value: 0
Filters	Moving average method with 0 to 90 measuring cycles default value: 2

I/O allocations for the MPS® PA Filtering Station

Digital inputs and outputs

Input bit	Description
0	Pressure sensor 1B1 / E0
1	Top proximity sensor 1B2 / E1
2	Bottom proximity sensor 1B3 / E2
3	Top proximity sensor 1B4 / E3
4	Bottom proximity sensor 1B5 / E4
5	Butterfly valve open and flap down 1B7 / E5
6	Butterfly valve closed and flap up 1B9 / E6
7	1PA-FREE*-

Output bit	Description
0	Blow-out pressure 1M1 / A0
1	Pump 1M2 /A1
2	Pump 1M3 / A2
3	Flap up 1M4 and close butterfly valve 1M5 / A3
4	3-way ball valve 1M6 /A4
5	Mixer 1M7 / A5-
6	Unused
7	1PA-BUSY*

Analogue inputs and outputs

Input channel	Description	Analogue terminal
0	Pressure sensor, 0.05 to 6 bar / 0 to 10 V DC	UE1
1	Unused	UE2
2	Unused	UE3
3	Unused	UE4

Output channel	Description	Analogue terminal
0	Analogue output voltage for blow-out pressure from 0 to 10 V DC	UA1
1	Analogue output voltage for following pump station from 0 to 10 V DC	UA2

Note

Before commencing work with FluidLab® PA, it is advisable to test each sensor and actuator individually for correct functioning, and to make sure that the hardware has been correctly connected.

Example: I/O allocations for the MPS® PA Mixing Station

Digital inputs and outputs

Input bit	Description
0	(Flow sensor 2B1 / E0)
1	Top proximity sensor 2B2 / E1
2	Bottom proximity sensor 2B3 / E2
3	Bottom proximity sensor 2B4 / E3
4	Bottom proximity sensor 2B5 / E4
5	Top proximity sensor 2B6 / E5
6	Bottom proximity sensor 2B7 / E6
7	2PA-FREE*

Output bit	Description
0	Pump 2M1 /A0
1	Pump 2M2 /A1
2	Mixing valve 2M3 / A2
3	Mixing valve 2M4 / A3
4	Mixing valve 2M5 / A4
5	Unused
6	Unused
7	2PA-BUSY*

Analogue inputs and outputs

Input channel	Description	Analogue terminal
0	Flow sensor, 0.3 to 9 l/min / 0 to 10 V DC	UE1
1	Unused	UE2
2	Unused	UE3
3	Unused	UE4

Output channel	Description	Analogue terminal
0	Analogue output voltage for the mixing pump from 0 to 10 V DC	UA1
1	Unused	UA2

Note

Before commencing work with MPS® PA, it is advisable to test each sensor and actuator individually for correct functioning, and to make sure that the hardware has been correctly connected.

Example: I/O allocations for the MPS® PA Reactor Station

Digital inputs and outputs

Input bit	Description
0	Temperature sensor 3B1 / E0
1	Top proximity sensor 3B2 / E1
2	Bottom proximity sensor 3B3 / E2
3	Unused
4	Unused
5	Unused
6	Unused
7	3PA-FREE*

Output bit	Description
0	Heater 3M1 / A0
1	Pump 3M2 /A1
2	Pump 3M3 / A2
3	Mixer 3M4 / A3
4	Unused
5	Unused
6	Unused
7	3PA-BUSY*

Analogue inputs and outputs

Input channel	Description	Analogue terminal
0	Temperature sensor, 0 to 100° C / 0 to 10 V DC	UE1
1	Unused	UE2
2	Unused	UE3
3	Unused	UE4

Output channel	Description	Analogue terminal
0	Analogue output voltage for the heater from 0 to 10 V DC	UA1
1	Analogue output voltage for the mixer from 0 to 10 V DC	UA2

Note

Before commencing work with FluidLab® PA, it is advisable to test each sensor and actuator individually for correct functioning, and to make sure that the hardware has been correctly connected.

Example: I/O allocations for the MPS® PA Bottling Station

Digital inputs and outputs

Input bit	Description
0	Ultrasonic sensor 4B1 / E0
1	Top proximity sensor 4B2 / E1
2	Bottom proximity sensor 4B3 / E2
3	Diffuse sensor, bottle at beginning of conveyor belt 4B4 / E3
4	Diffuse sensor, bottle in filling 4B5 / E4
5	Diffuse sensor, bottle at end of conveyor belt 4B6 / E5
6	Unused
7	4PA-FREE*

Output bit	Description
0	Pump 4M1 /A0
1	Filling valve 4M2 A1
2	Conveyor motor 4M3 / A2
3	Feed separator 4M4 / A3
4	Unused
5	Unused
6	IP-N-FO* (PA conveyor belt busy)
7	4PA-BUSY*

Note

* For system operation, no function in FluidLab® PA.

Analogue inputs and outputs

Input channel	Description	Analogue terminal
0	Ultrasonic sensor, 0 to 3 l / 0 to 10 V DC	UE1
1	Unused	UE2
2	Unused	UE3
3	Unused	UE4

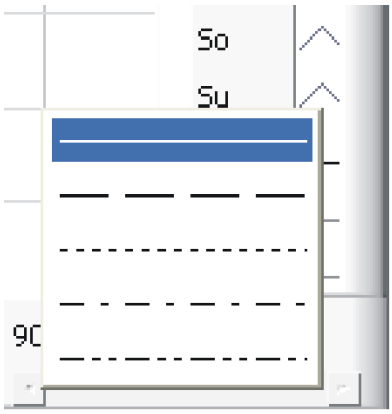
Output channel	Description	Analogue terminal
0	Analogue output voltage for the pump from 0 to 10 V DC	UA1
1	Unused	UA2

Note

Before commencing work with FluidLab® PA, it is advisable to test each sensor and actuator individually for correct functioning, and to make sure that the hardware has been correctly connected.

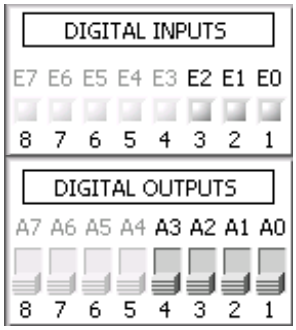
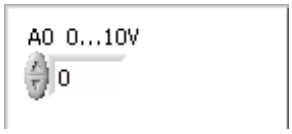
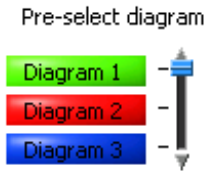
6.5 Graph settings

Line colour, style, thickness etc. for the graphs can be changed to suit preferences as desired.
Move the mouse to the desired signal in the signal selection menu (see screenshot below). Click with the left mouse key. A set-up menu appears.



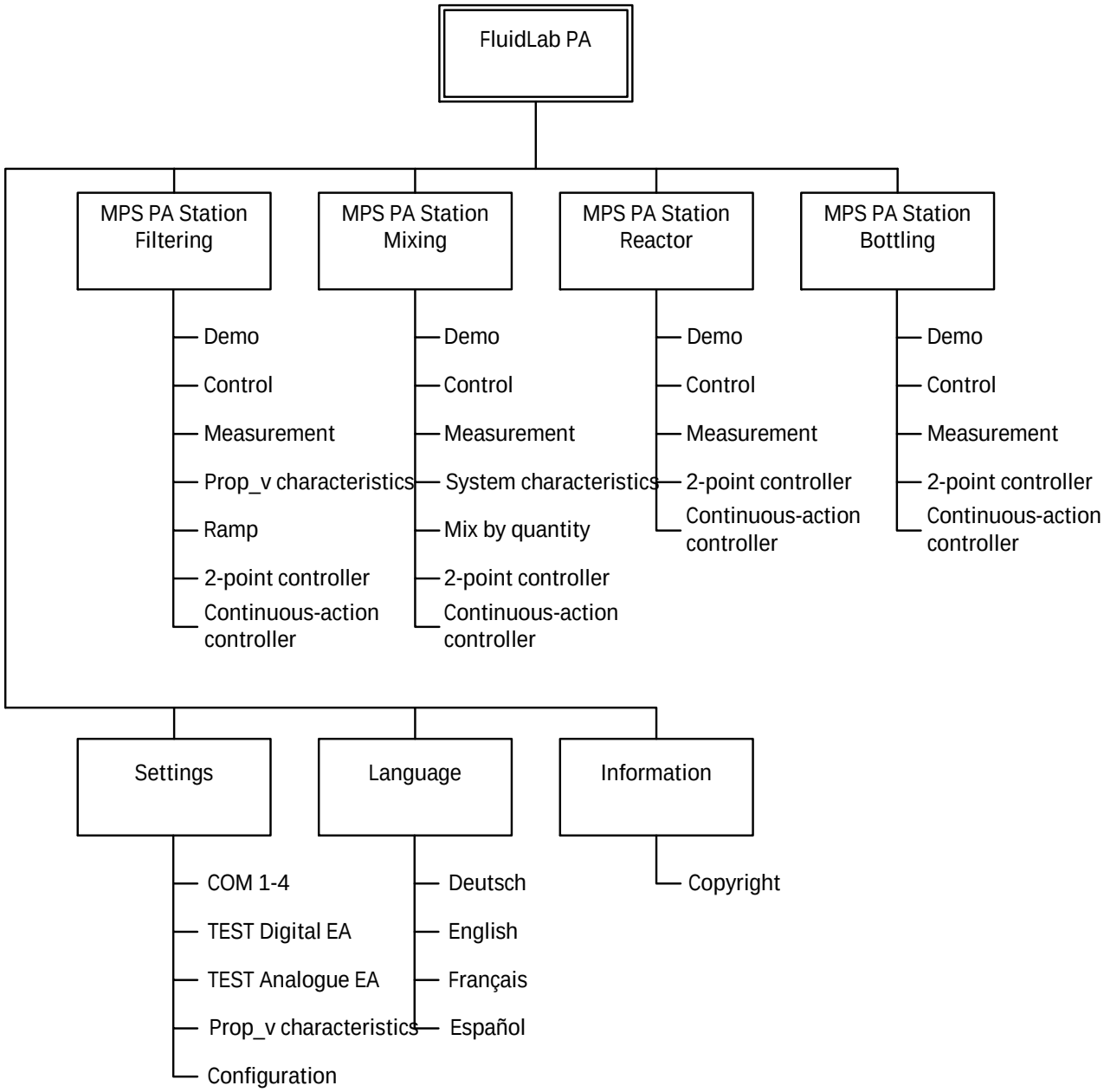
Graph settings

Table of available functions in the measuring and control window (in conjunction with the MPS® PA Mixing Station)

Function/name	Function/layout	Description
Digital inputs and outputs		Actuators and digital sensors, all disabled buttons are displayed as deactivated by appearing in light grey.
Analogue outputs		Analogue output channels, 0 to 10 V
Measuring and control		Up to three characteristic curves can be displayed here, one on top of the other.

FluidLab® PA software is subdivided into 7 main menus: 4 station and 3 information and set-up menus.

Menu overview

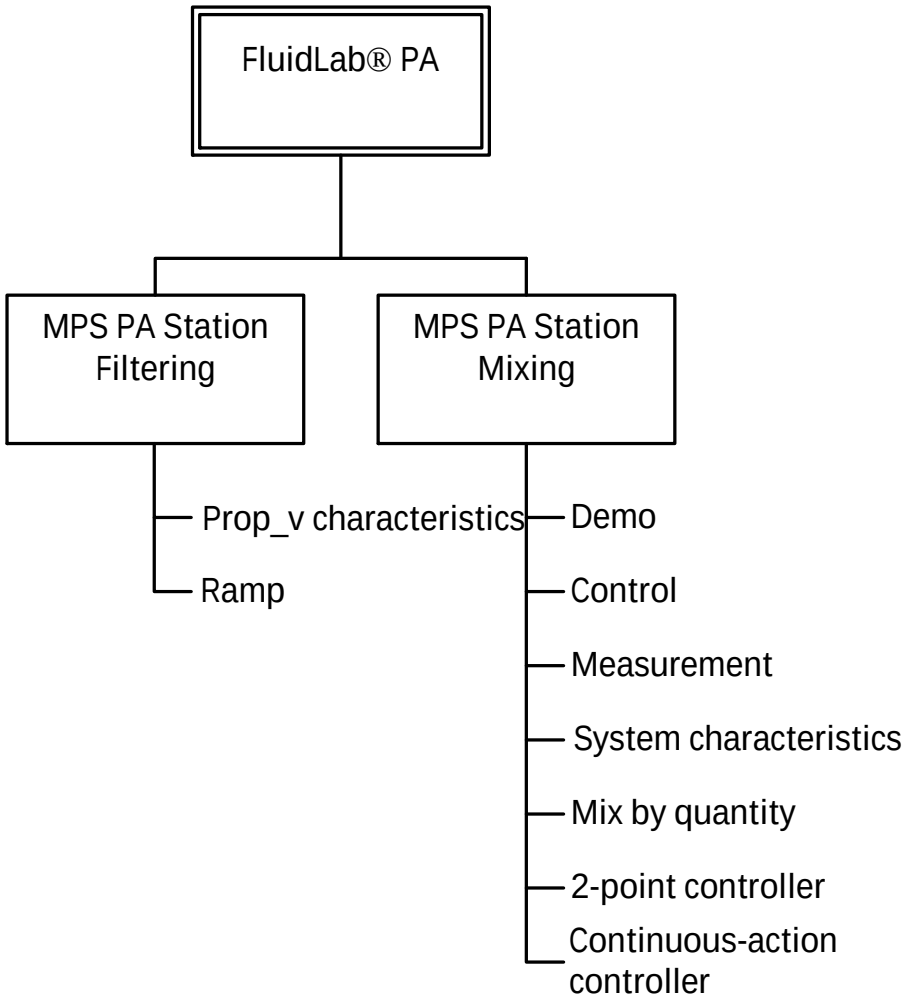


FluidLab® PA software structure

7 Examples for MPS® PA Mixing Station

Use of FluidLab® PA software is explained using the mixing menu window as an example.

Using FluidLab® PA software

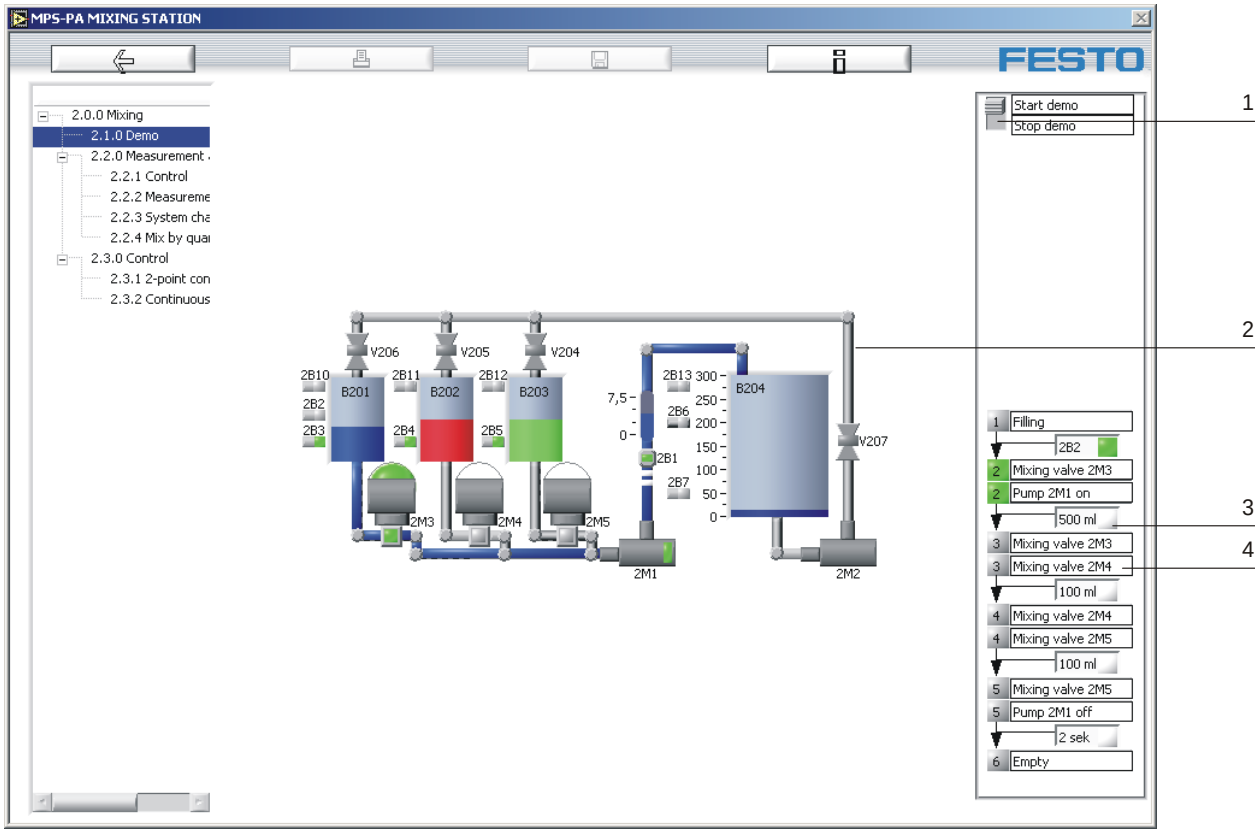


Note:

All of the menu items for the filtration, reactor and bottling stations are similar to those included with the mixing station.

7.1 Demo

The “Demo” menu provides you with an introduction to the process used by the MPS® PA Mixing Station.



Demo sequence

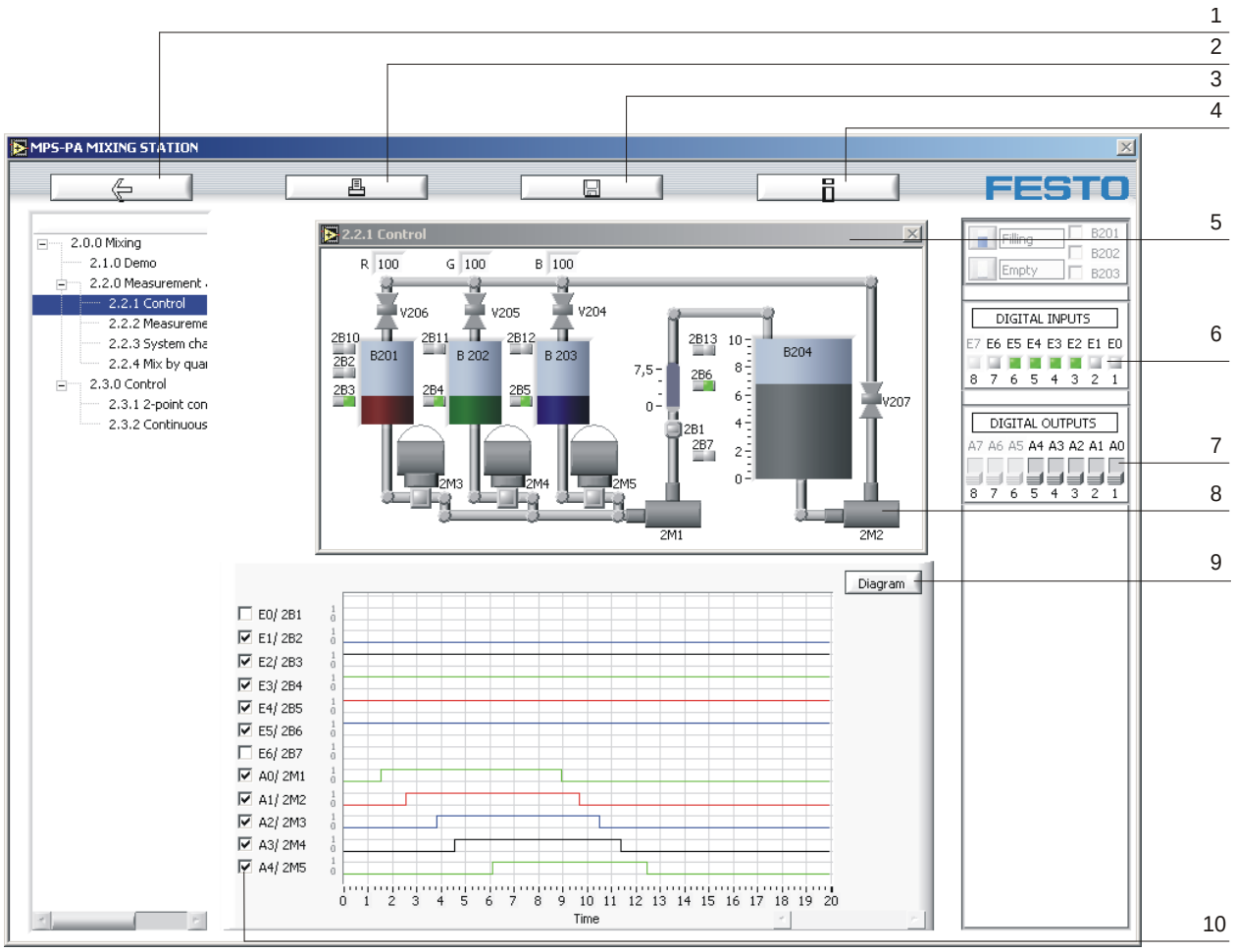
1 “Start demo” button
2 Animation
3 Process
4 Steps

This part of the program is an auto-running animation [2] which appears in the middle of the window. The demo sequence can be started at the top right [1].
A sequence of steps is displayed at the bottom right. The individual steps of the demo sequence can be monitored here. Active steps [4] are identified by means of LEDs.
The processes [3] are located between the steps. The next step cannot be executed until the processes have been completed.

If the “Demo” menu is exited, the animation is automatically stopped and reset. The “Save” and “Print” options are disabled in this program component!

7.2 Control

The digital inputs and outputs can be set up and monitored in the “Control” menu.



Control

1 Return to main menu
2 Print
3 Save
4 Information
5 Animation window
6 Digital inputs
7 Digital outputs
8 Components (pump for example)
9 Display characteristic curves
10 Select control characteristics

The digital inputs [6] are displayed as LEDs. The digital outputs [7] can be switched on and off manually at the user interface or in the animation window [5] by clicking the components, for instance [8]. System performance can be monitored in the animation window.

The control characteristics which are displayed in the diagram can be selected individually. This is achieved by clicking the checkbox [10] on the left-hand side of the diagram.

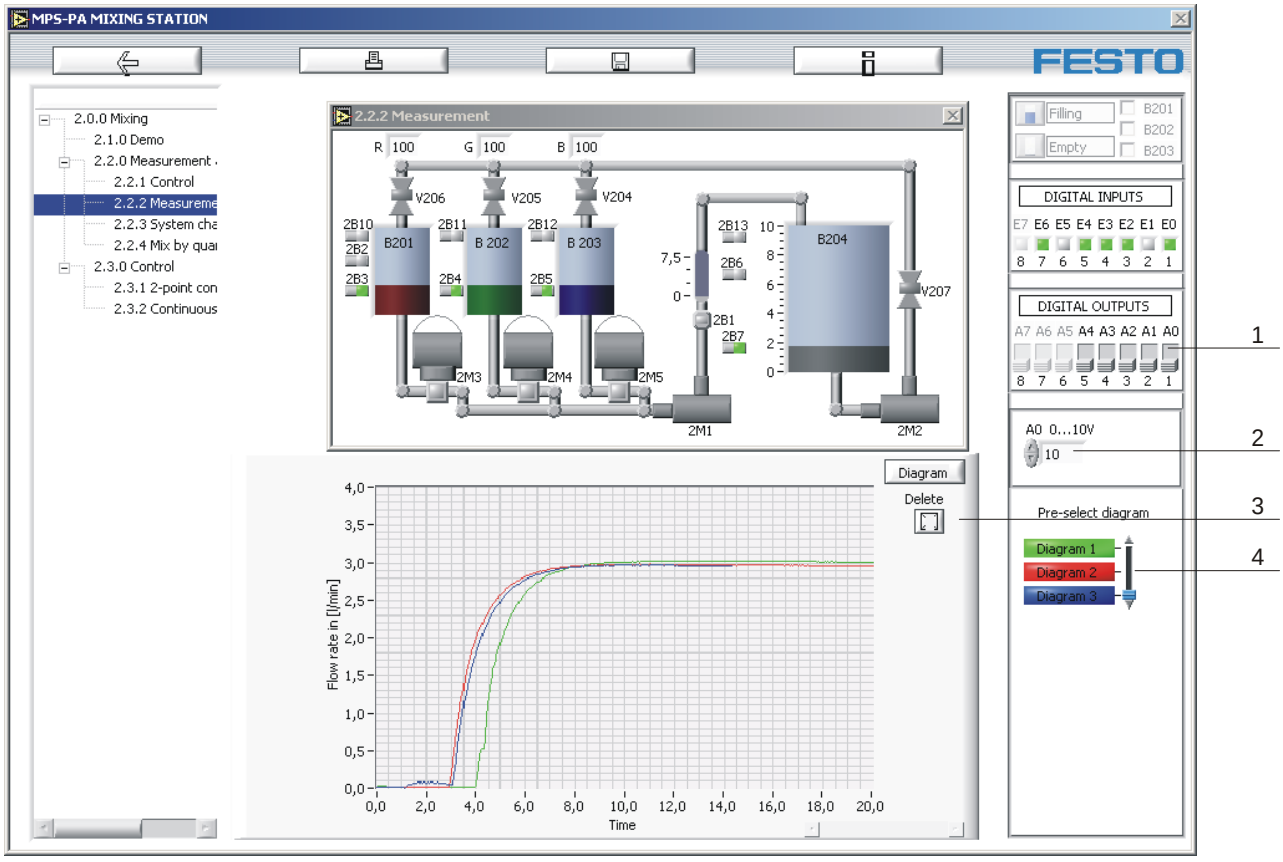
After selecting the desired components, click the “Diagram” button [9] in order to start displaying the characteristic curves.
Control characteristics can no longer be selected or unselected after display of the characteristic curves has been started!

The old characteristic curves are deleted in the event of a restart!

Options such as save [2], print [3] and information [4] are disabled during display of characteristics.
You can return to the main menu by clicking the “Back” button [1].

7.3 Measurement

In order to determine performance of the piping/pump system, the optimum measuring range of the flow sensor and the operating range of the pump must be known. Performance will vary depending upon the storage container from which medium is pumped to the mixing tank.



Measurement

1 Activate output
2 Control voltage
3 Delete selected characteristic curve
4 Select characteristic curve

Analogue sensors and actuators can be operated and monitored in the “Measurement” menu. Up to three characteristic curves can be recorded here, superimposed on one another, allowing for a direct comparison of the controlled systems.

Control voltage [2] can be set as desired from 0 to 10 V.
Click digital output A0 [1] in order to activate the output.

Note

If the pump does not function in the analogue mode, reset the jumper on the connection board of the MPS® PA Mixing Station to “Analogue”.

The “Diagram” button has to be clicked in order to start the display. Selection can be made from among three diagrams using the slider [4].
Switching from one diagram to another is not possible during display.

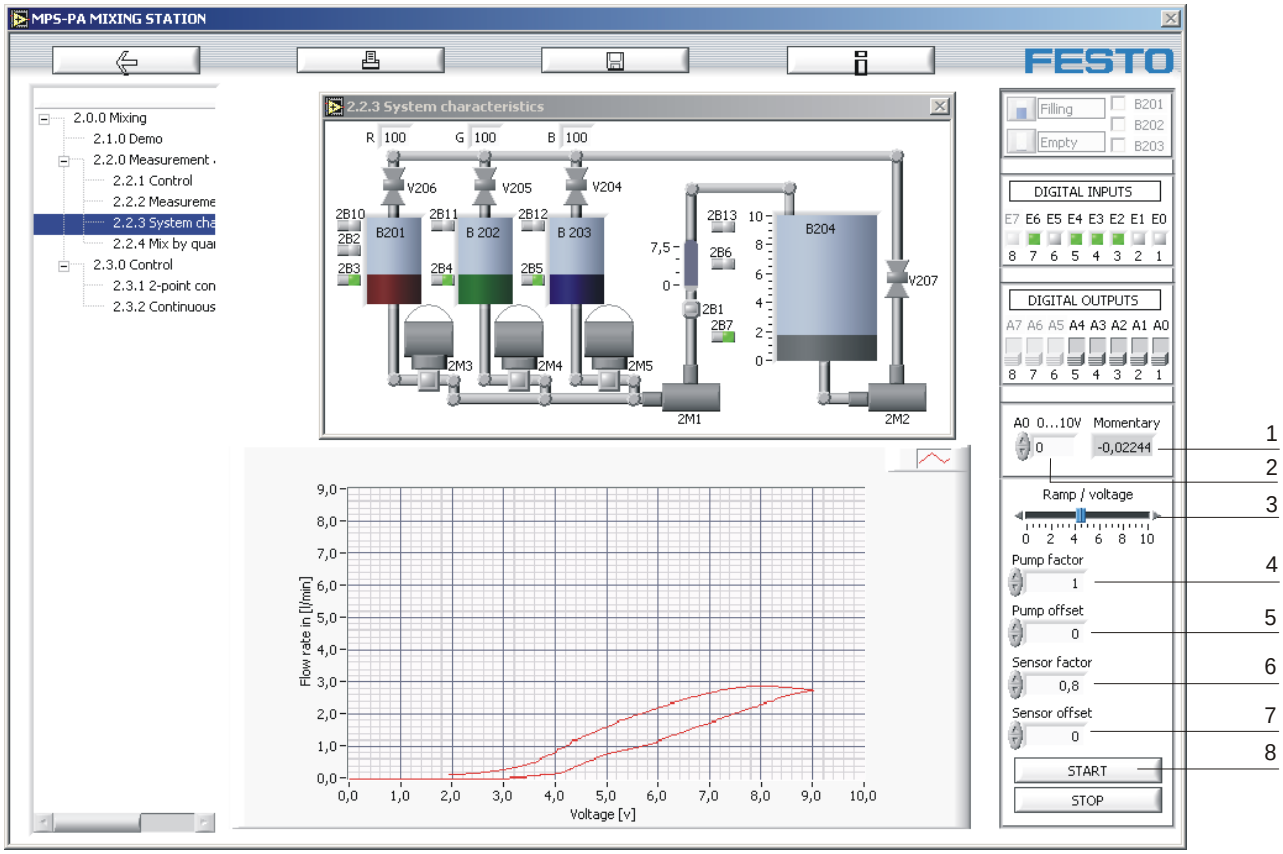
If the display is restarted, the new characteristic curve begins at time t=0. The existing characteristic curve is only deleted if the “Delete” button [3] is clicked before restarting.

7.4 System characteristics

The volumetric flow rate from the mixing pump to the mixing tank must be constant in order to assure good mixing results. The controller's variable setpoint (working point) should be selected such that the controlled system reaches the desired value. In order to ascertain the working point, first the lowest possible value in the controlled system is acquired (in this case lowest possible flow rate), and then the highest possible value in the controlled system is acquired (in this case highest possible flow rate). The working point is the mean value calculated from lowest and highest possible flow rates.

Signal matching for the sensor signal

Together with the downstream F/U measuring transducer, the flow sensor supplies a voltage signal. This can be converted to litres/minute with the help of the data sheets.



System characteristics

1 Momentary (current)output voltage
2 Maximum variable output
3 Time ramp
4 Pump factor

5 Pump offset
6 Sensor factor
7 Sensor offset
8 Display characteristic curve

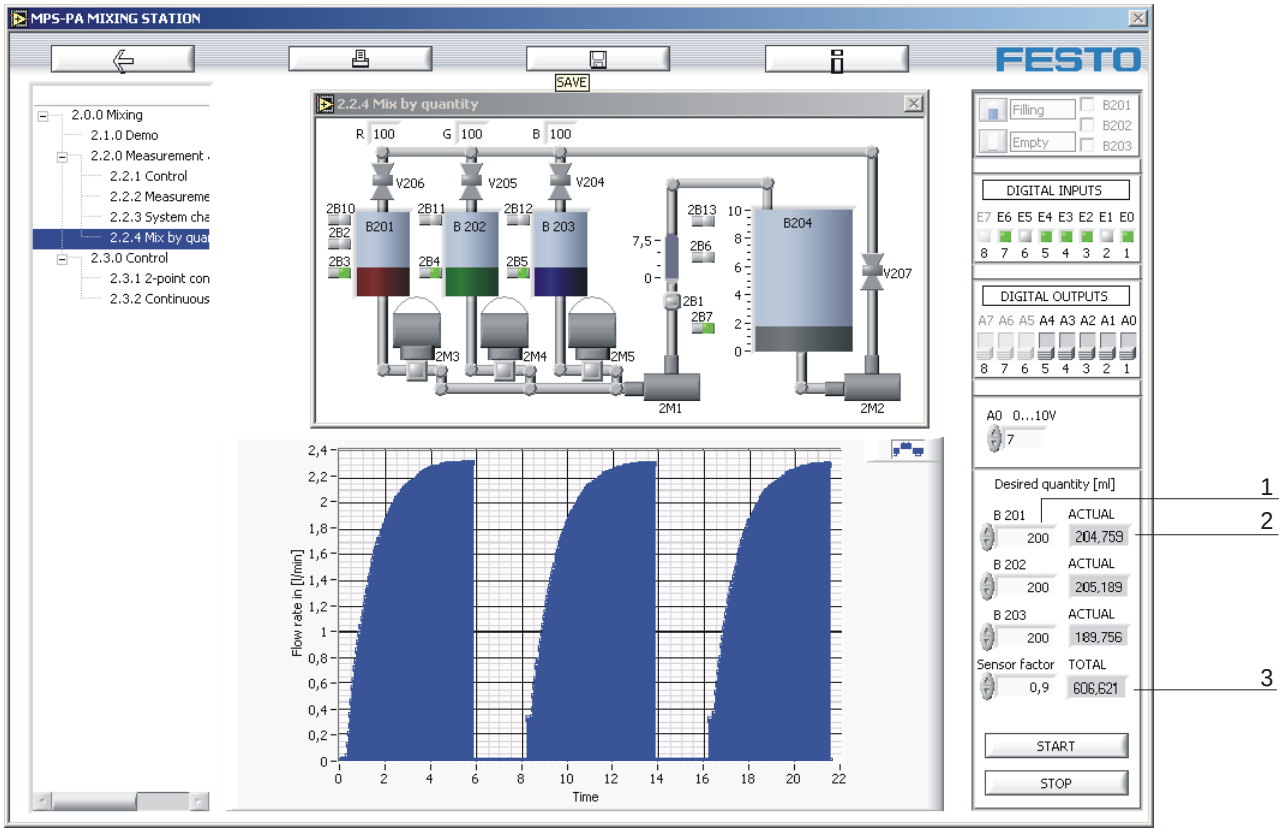
Select the maximum variable output value for pump 2M1. By means of a time ramp [3], values from 0 to the maximum output value are transmitted to pump 2M1. The momentary (current) voltage value [1] is displayed in the extra window.

The pump factor [4] and offset [5], as well as the sensor factor [6] and offset [7], can be set here in order to achieve an optimised characteristic curve for the system. After clicking the “Start” button [8], the characteristic curve of the flow sensor is displayed on the diagram.
The lowest and highest possible flow rates can be read directly from the graph in order to determine the working point.

Functions such as “Save”, “Print” and “Information”, as well as changing to other menus, are disabled while tests are being executed.

7.5 Mixing by quantity

This part of the program continuously monitors and sums up momentary volumetric flow. Each drop of water is added up until the desired quantity is reached.



Mixing by quantity

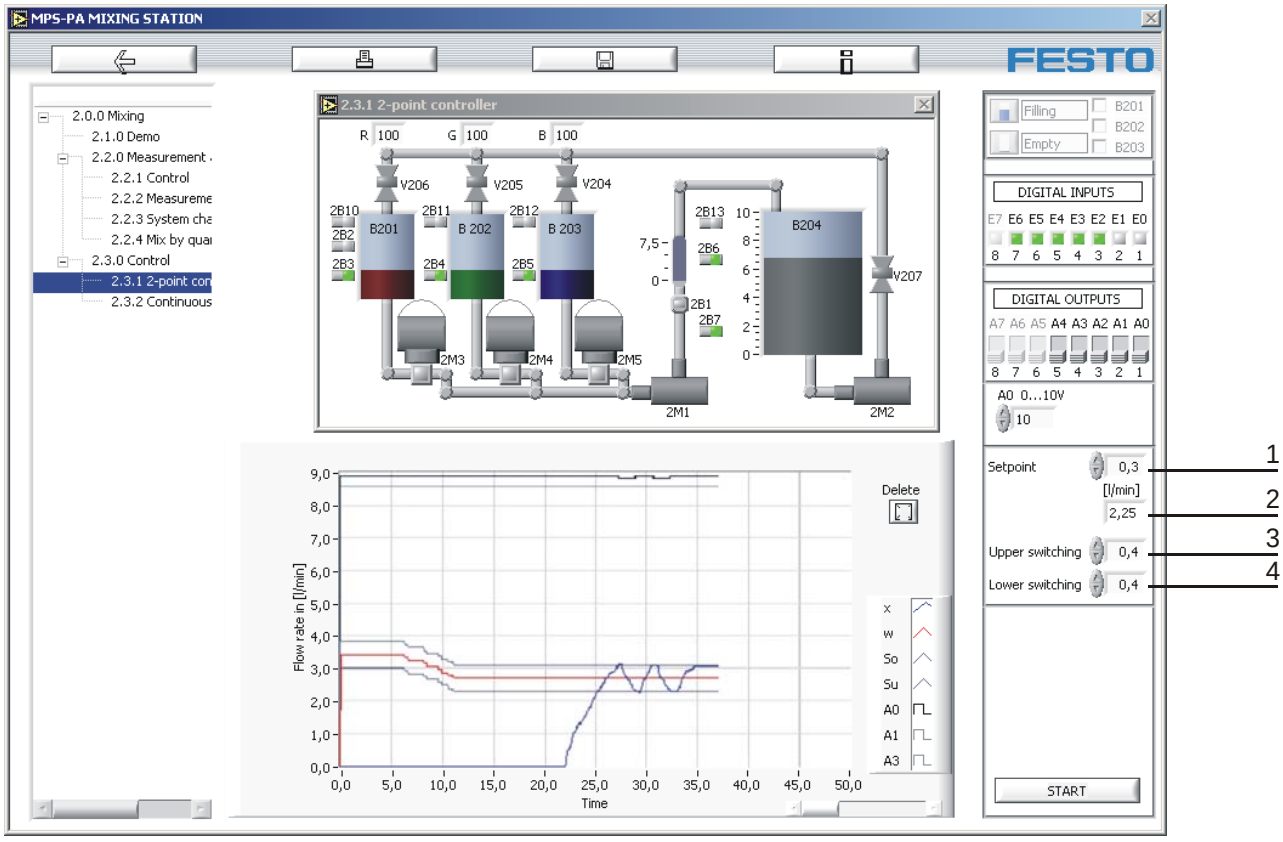
1 Desired quantity [ml]
2 Actual flow rate value
3 Sum of flow rate values

Select the output value for pump 2M1. Enter the desired quantity [1] in millilitres for each individual storage container, then start the display. The actual quantity [2] which is pumped from the desired storage containers, as well as the total quantity [3], are displayed.

7.6 2-point controller

A 2-point controller is a discontinuous controller with two states, for example if the actual value is less than the setpoint the pump is switched on, and when the actual value is greater than the setpoint the pump is switched back off again. In order to

ensure that a final control element is not continuously switched on and off, upper and lower switching limits [2 and 3] are included which result in a hysteresis which extends above and below the setpoint.



2-point controller

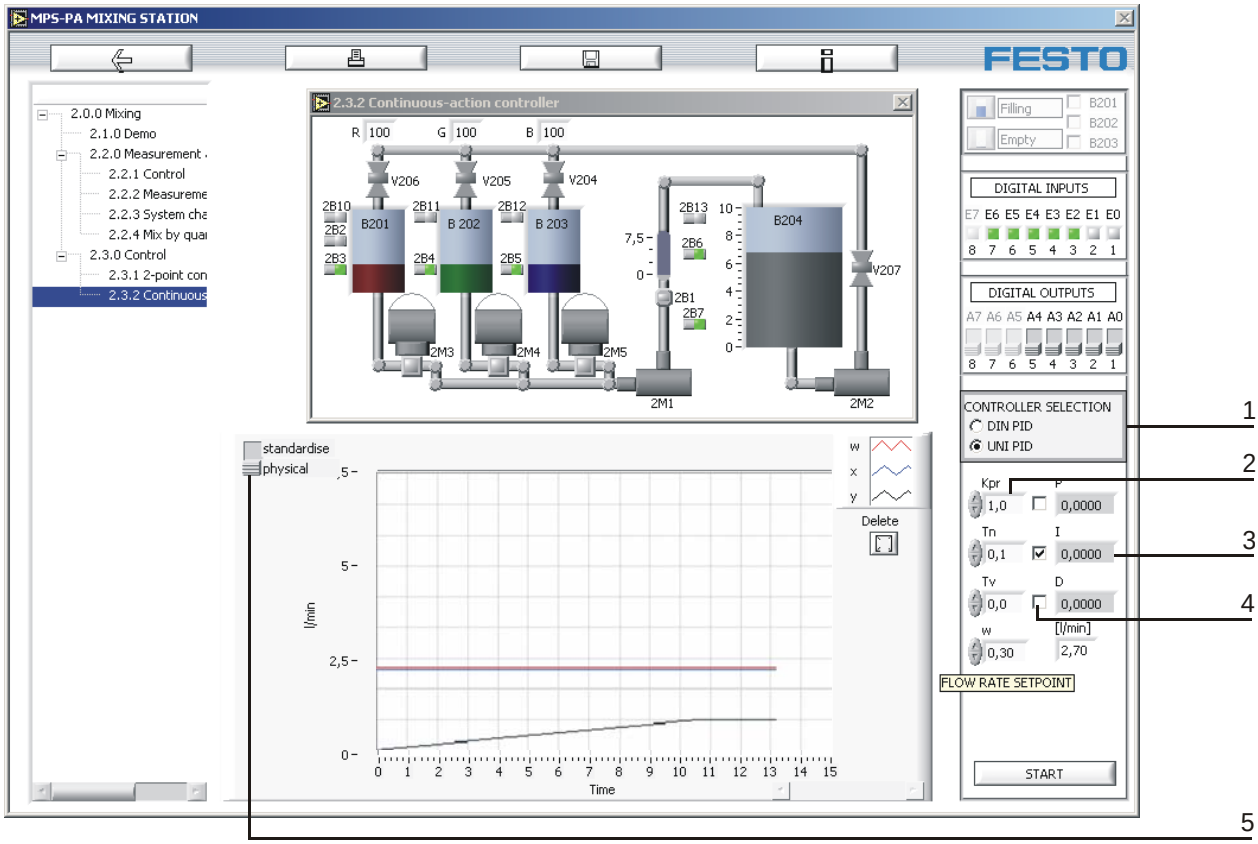
1 Standardised setpoint entry (0 ... 1)
2 Setpoint display [l/min]
3 Upper threshold value
4 Lower threshold value

Select the output value for pump 2M1 (recommended: 10 V) or reset the jumper on the connection board of the MPS® PA Mixing Station to “digital”. Enter the setpoint value [1]. which is normalised, i.e. the value is between 0 and 1. This value can be converted to a physical quantity, and corresponds to the value in the diagram.

A limit can be set above the setpoint using the upper threshold value, and another below the setpoint by the lower threshold value. These values correspond to the physical quantity.
Start the control process by clicking the “Start” button.

7.7 Continuous action controller

As opposed to 2-point controllers, continuous-action controllers generate a continuous signal for the output variable, the magnitude of which depends upon system deviation.

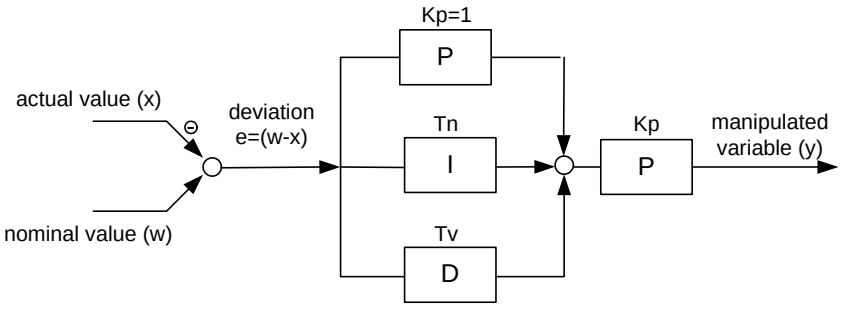


Continuous action controller

1 Select either DIN or UNI PID controller
2 Controller parameters
3 Actual value of the controller section
4 Configure controller types

Select either the DIN or the UNI PID controller [1].

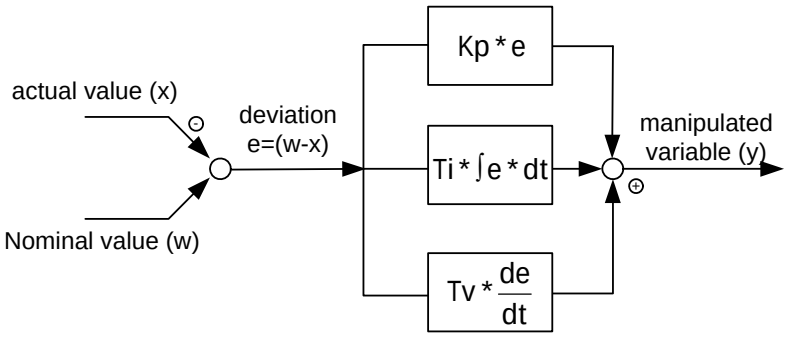
With the DIN PID controller, the P component is connected in series so that it influences all other components.



DIN PID controller

$$y = Kp \cdot \left(e + \frac{1}{Tn} \cdot \int e \cdot dt + Tv \cdot \frac{de}{dt} \right)$$

With the UNI PID controller, all components are set up in parallel and thus do not influence each other.



UNI PID controller

$$y = Kp \cdot e + Ti \int e \cdot dt + Tv \cdot \frac{de}{dt}$$

$$Ti \cdot Kp = Tn$$

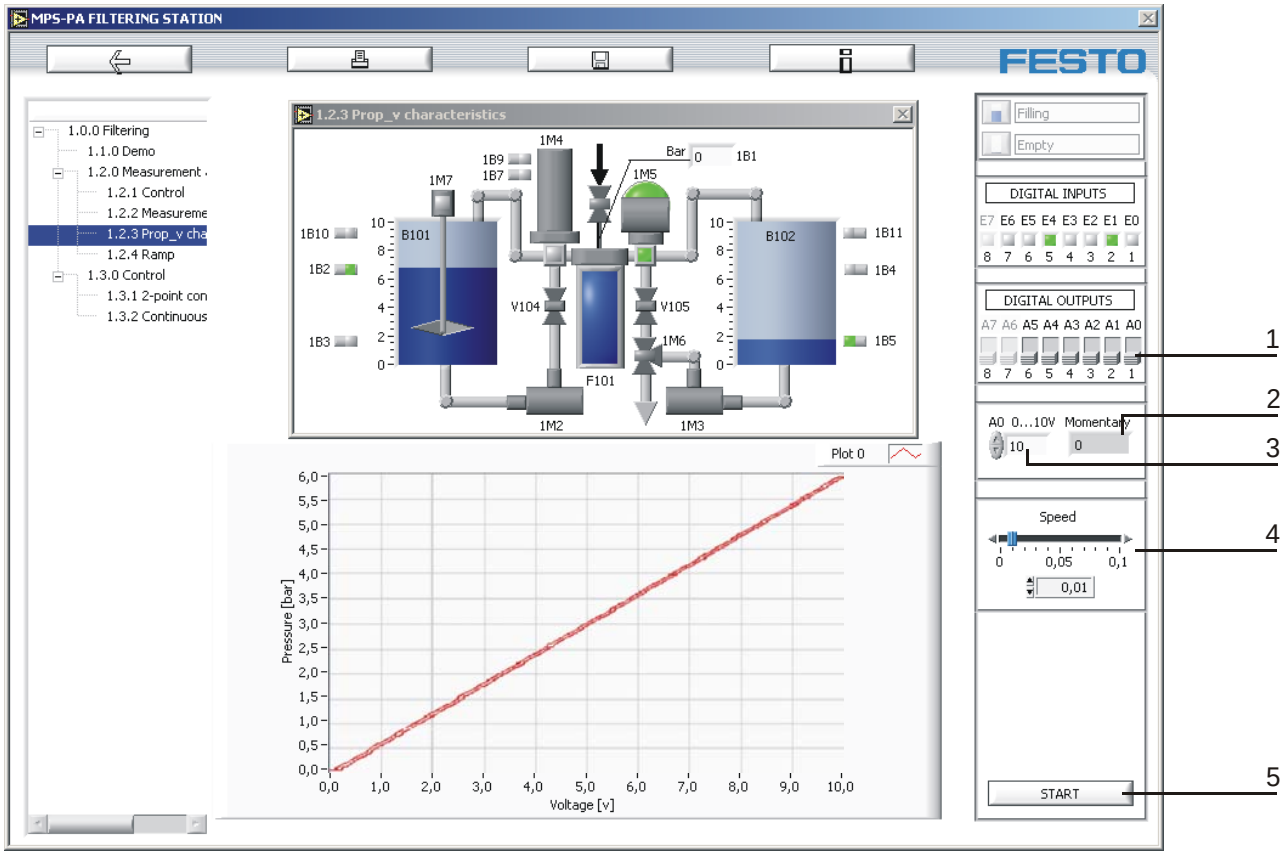
Configure your controller type by clicking the respective checkbox [4].

The following types of controllers can be configured:
P controller
I controller
PI controller
PD controller or
PID controller

Enter amplification factor [2]. Select the desired form of presentation [5] for the graph display. Start the control process by clicking the “Start” button. The actual value of the controller section is displayed [3].

7.8 Prop_v characteristics

The controller's variable setpoint (working point) should be selected such that the controlled variable of the controlled system reaches the desired value. In order to ascertain the working point, first the lowest possible controlled variable value is acquired (in this case lowest possible pressure), and then the highest possible controlled variable value is acquired (in this case highest possible pressure).



Characteristic curve, proportional pressure regulator

1 Activate output
2 Momentary (current) output voltage
3 Maximum manipulated variable
4 Time ramp
5 Record characteristic curve

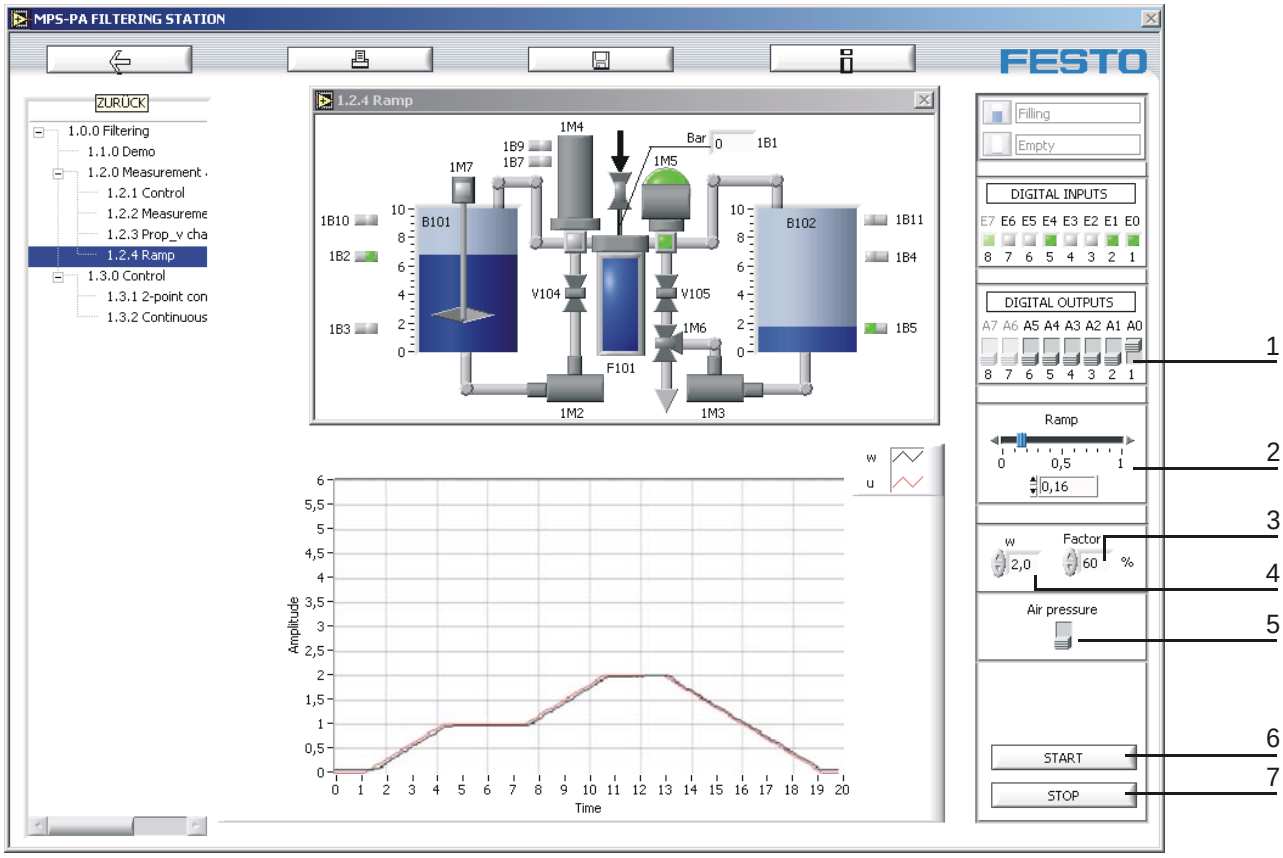
Select the maximum output variable [3] for the proportional pressure regulator. By means of a time ramp [4], values from 0 to the maximum output value are sent to the proportional pressure regulator. The momentary (current) voltage value [2] is displayed in the extra window.

After clicking the “Start” button [5], the characteristic curve of the pressure sensor is displayed in the graph.
The lowest and highest possible pressure values can be read directly from the graph in order to determine the working point.

Functions such as “Save”, “Print”, “Information”, as well as changing to other menus, are disabled while tests are being executed.

7.9 Pressure levels via ramp

In actual practice, it is best for the system to avoid surges by applying signals with the help of a ramp instead of abruptly.



Pressure levels via ramp

1 Activate output
2 Time ramp
3 Proportional pressure regulator factor
4 Setpoint
5 Ramp control
6 Start
7 Stop

Activate the proportional pressure regulator output [1]. Select a value between 0 and 1 in the time ramp [2]. Select the setpoint [4] for the proportional pressure regulator. The proportional pressure regulator's voltage-pressure ratio is set via the factor function [3]. After clicking the "Start" button [6], the characteristic curve of the pressure sensor is displayed on the graph. Pressure in the proportional pressure

regulator can be built up or reduced gradually via the ramp control function [5]. Stop displaying on the graph by clicking the “Stop” button.

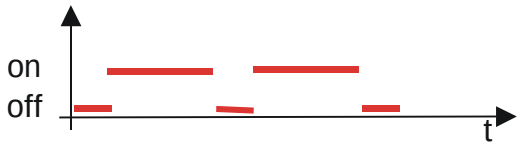
Functions such as “Save”, “Print”, “Information”, as well as changing to other menus, are disabled while tests are being executed.

8 Troubleshooting

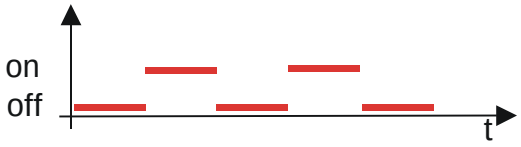
8.1 No communication with EasyPort digital/analogue

No measured values appear.

- Make sure that the power supply is correctly connected and switched on.
- Make sure that all cables are correctly connected.
- Check the green status LED on the EasyPort digital/analogue.

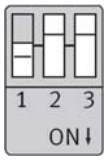


LED is illuminated for a long “on” period followed by a short “off” period: connection OK.



LED is illuminated with equal “on” and “off” periods: no active connection.

- Determine whether or not COM ports 1 through 4 are already assigned to other software applications!
- Exit the other software and restart FluidLab® PA.
- Check the switch settings at your EasyPort digital/analogue.



Measured values are incorrect

If the displayed values do not correspond to the actual physical values, check the offset value and factor settings in the “Settings” window.

8.2 User interface

FluidLab® PA doesn't start.

- LabVIEW Runtime environment is not installed.

The window is displayed incorrectly.

- The software is configured for a resolution of 1024 x 768 pixels. Change your Windows© display settings.

The measured values appear, but no lines are displayed in the diagram.

- Check the graph settings (for minimum and maximum axis values).
- Check the colour settings for the graph (white on white?).

The measured values oscillate significantly.

- Check filters ("Settings" window).

The digital inputs can be read, but the digital outputs cannot be set.

- An old version of the LabVIEW Runtime Engine (older than 7.1) is installed on your PC.

Settings in Windows XP

If you use Windows XP, select the following settings:

- View: Windows classic
- Screen resolution: 1024 x 768
- Display: 96 dpi

Please contact our Competence Centre for Process Automation for online support at info@adiro.com.