MPS PA Compact Workstation
Process Instrumentation

Process Automation

User Guide



Festo Didactic
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8187627

Process Automation

MPS PA Compact Workstation Process Instrumentation

User Guide

8187627

Order no.: 8187627 (Printed version) 8187628 (Electronic version)
First Edition 2023/03
Revision level: 2026/01

By the staff of Festo Didactic

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Internet: www.festo.com
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Printed in Canada
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ISBN 978-2-89834-277-6 (Printed version)
ISBN 978-2-89834-278-3 (Electronic version)
Legal Deposit - Bibliothèque et Archives nationales du Québec, 2023
Legal Deposit - Library and Archives Canada, 2023

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Table of Contents

Learning Unit 1 - Document Preliminaries 5
Safety Symbols and Procedures 5
General requirements for operating the devices 7
Intended use 8

Learning Unit 2 - For Your Safety 11
Important information 11
Obligations of the operating company 11
Obligations of the trainees 11
Dangers when handling the components and systems 11

Learning Unit 3 - Work and Safety Instructions 13
General remarks 13
Mechanical system 14
Electrical system 15
Pneumatics 18
Process technology 19
Cyber security 20

Learning Unit 4 - Technical Data 23
General data 23
Pin allocation tables 24

Learning Unit 5 - Transport, Unpacking, and Scope of Delivery 31
Transport 31
Unpacking 31
Scope of delivery 31

Learning Unit 6 - Design 33
The Compact Workstation Process Instrumentation 33
The CWS-PI Station 34
Overview of components 37
Main components 39
Level monitoring 42
Proximity switches 42
Overflow safety 43
Threshold function 44
Switch-on protection for heating 45
Pump 45
Proportional valve 46
Heating 46
Controlling the heat element 47
2W ball valve with pneumatic rotary drive 48
Compressed air supply 49
Additional accessories 50
Directly controlled 2-way solenoid valve, brass 50
Directly controlled 2-way solenoid valve, plastic 51
Pilot-operated 2-way solenoid valve, brass 51
Water-air cooler 52

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Cooling unit with heat exchanger 53
Stirrer 55
Centrifugal pump with 3-phase AC-motor 56
Electrical cabinet with frequency convertor 56
Electrical connection technology 57
Connection board 57
Mounting frame 58
19" frame 59
PLC EduTrainer Universal S7-1512C (optional) 60
Control console with operator unit TP700 Comfort (optional) 61
EasyPort and FluidLab-PA closed-loop V5 (optional) 61
USB device server (optional) 62
Trolley 700 62

Learning Unit 7 - Function 65
Level control function 65
Flow rate control function 67
Pressure control function 70
Pressure control function – Setup for controlling 71
Temperature control system 73

Learning Unit 8 - Commissioning 77
Workstation 78
Filling and emptying 79
Power supply 79
Compressed air supply 79
Choosing controlled system 80
Control with PLC EduTrainer and control console 82
Cable connections between station and EduTrainer PLC 82
Cable connections between control console and PLC EduTrainer 83
Loading sample project – Siemens S7-1500 CPU1512C 84
Loading sample project – Siemens TP700 Comfort 84
Starting the sequence 85
Operation on the control console with operator unit TP700 Comfort 85
Visualization project for touch panel 86
Visualization project 87
Control with EasyPort 19" 92
FluidLab-PA closed-loop settings 93
Adjusting sensors 94
Float switch, cover installation 95
Float switch, lateral installation 95
Flow sensor, electromagnetic 96

Learning Unit 9 - Maintenance and Troubleshooting 99
Maintenance 99
Error in the piping system and tanks 99
Error in the pneumatic system 100
Error in the electrical system 101
Mechanical faults 102

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Error due to parameterization 103

Learning Unit 10 - Further information and updates 105

Learning Unit 11 - Disposal 107

Equipment disposal 107

Learning Unit 12 - Appendix 109

MPS PA resource files 109
Parts lists 109
PI-diagrams 109
Loop lists 110
Loop diagrams 110
Electrical circuit diagrams 110
Pneumatic circuit diagrams 110
Data sheets 111

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Document Preliminaries

Safety Symbols and Procedures

The following table lists the safety and common symbols that may be used in this document and on the equipment. Before performing procedures with the equipment, you should read all sections regarding safety in the User Guide accompanying the equipment. Additional safety procedures are given before any task requiring specific safety precautions.

Symbol	Description
	**DANGER** indicates a hazard with a high level of risk, which, if not avoided, will result in death or serious injury.
	**WARNING** indicates a hazard with a medium level of risk, which, if not avoided, could result in death or serious injury.
	**CAUTION** indicates a hazard with a low level of risk, which, if not avoided, could result in minor or moderate injury.
	**NOTICE** indicates a hazard with a potentially hazardous situation, which, if not avoided, may result in property damage.
	Caution, risk of danger. Consult the relevant user documentation.
	Caution, risk of electric shock.
	Caution, lifting hazard.
	Caution, hot surface.

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Symbol	Description
	Caution, risk of fire.
	Caution, risk of explosion.
	Caution, belt drive entanglement hazard.
	Caution, chain drive entanglement hazard.
	Caution, gear entanglement hazard.
	Caution, hand crushing hazard.
	Static sensitive contents. Observe precautions for handling electrostatic discharge sensitive devices.
	Notice, non-ionizing radiation.
	Consult the relevant user documentation.
	Radio Equipment Directive (RED) geographical restrictions – consult the relevant user documentation.
	Direct current.
	Alternating current.
	Both direct and alternating current.

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Symbol	Description
	Three-phase alternating current.
	Earth (ground) terminal.
	Protective conductor terminal.
	Frame or chassis terminal.
	Equipotentiality.
	On (supply).
	Off (supply).
	Equipment protected throughout by double insulation or reinforced insulation.
	In position of a bi-stable push control.
	Out position of a bi-stable push control.

General requirements for operating the devices

General requirements for safe operation of the devices:

- National regulations for operating electrical systems and equipment must be observed in commercial facilities.
- The laboratory or classroom must be overseen by a supervisor.

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- A supervisor is a qualified electrician or a person who has been trained in electrical engineering, knows the respective safety requirements and safety regulations and whose training has been documented accordingly.

The laboratory or the classroom must be equipped with the following devices:

- An emergency-off device must be provided.
  - At least one emergency-off device must be located within, and one outside of the laboratory or the classroom.
- The laboratory or classroom must be secured so that operating voltage and compressed air supply cannot be activated by any unauthorized persons, for example with:
  - A key switch
  - Lockable on-off valves
- The laboratory or classroom must be protected by residual current devices (RCDs).
  - Electrical devices (e.g., power supply units, compressors and hydraulic power units) may only be operated in training rooms which are equipped with residual current devices.
  - Type B residual current circuit breakers with a residual current of ≤ 30 mA must be used.
- The laboratory or classroom must be protected by overcurrent protection devices.
  - Fuses or circuit breakers
- No damaged or defective devices may be used.
  - Damaged devices must be banned from further use and removed from the laboratory or classroom.
  - Damaged connecting cables, pneumatic tubing and hydraulic hoses represent a safety risk and must be removed from the laboratory or classroom.

Intended use

Festo Didactic systems and components must only be used:

- For their intended use in teaching and training applications
- When their safety functions are in perfect condition

Festo Didactic systems and components are designed in accordance with the latest technology and recognized safety rules. However, life and limb of the user and third parties may be endangered and the components may be impaired if they are used incorrectly.

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The Festo Didactic learning system has been developed and produced exclusively for education and training in the field of automation technology. The training company and/or trainers must ensure that all apprentices observe the safety precautions described in this workbook.

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

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For Your Safety

Important information

Knowledge of the basic safety instructions and safety regulations is a fundamental prerequisite for safe handling and trouble-free operation of Festo Didactic components and systems. This document includes the most important instructions for safe use of Festo Didactic components and systems.

In particular, the safety instructions must be adhered to by all persons who work with Festo Didactic components and systems. Furthermore, all pertinent accident prevention rules and regulations that are applicable at the respective place of use must be adhered to.

Obligations of the operating company

The operator undertakes only to allow those persons to work with the Festo Didactic components and systems who:

- Are familiar with the basic regulations regarding work safety and accident prevention and have been instructed in the use of Festo Didactic components and systems.
- Have read and understood the chapter concerning safety and the warnings in this document.

Personnel should be tested at regular intervals to ensure that they are safety-conscious in their work habits.

Obligations of the trainees

All persons who have been entrusted to work with Festo Didactic components and systems shall complete the following steps before beginning work:

- Read the chapter about safety and warnings in this document
- Familiarize themselves with the basic regulations regarding occupational safety and accident prevention

Dangers when handling the components and systems

Festo Didactic systems and components are designed in accordance with the latest technology and recognized safety rules. However, life and limb of the user or third parties may be endangered and the machine or other property may be damaged during their use.

Festo Didactic systems and components must only be used:

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- for their intended purpose
- when in perfect working condition



⚠ WARNING

Malfunctions which could impair safety must be eliminated immediately!



⚠ CAUTION

Improper repairs or modifications may result in unforeseeable operating states. Do not carry out repairs on the device.

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Work and Safety Instructions

General remarks



⚠ WARNING

- Trainees should work with the circuits only under the supervision of an instructor.
- Electrical devices (e.g., power supply units, compressors, and hydraulic power units) may only be operated in training rooms which are equipped with residual current devices (RCDs).
- Observe specifications included in the technical data for the individual components, and in particular all safety instructions!
- Malfunctions which might impair safety must not be generated when the device is operated for training purposes.
- Wear your personal protective equipment (safety goggles, safety shoes) when working on the circuits.

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Mechanical system

NOTICE

- Switch off the power supply.
  - Switch off both the working power and control power before working on the circuit.
  - Only reach into the setup when it is at a complete standstill.
  - Be aware of potential overtravel times of actuators.
- Mount all of the components securely on the profile plate.
- Make sure limit switches are not operated from the front.
- Risk of injury during troubleshooting.

  Use a tool to operate the limit switches, for example a screwdriver.
- Set all components up so that it's easy to activate the switches and interrupters.
- Follow the instructions regarding positioning of the components.

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Electrical system

⚠ WARNING

- **Risk of fatal injury in case of interrupted PE conductor!**
  - The protective conductor (yellow-green) must not be interrupted, either inside or outside of the device.
  - The insulation of the protective conductor must never be damaged or removed.

- **Risk of death from series connection of power supply units!**

  Contact voltages of greater than 25 V AC or 60 V DC are not permissible.

  Coming into contact with voltages of greater than 50 V AC or 120 V DC may be fatal.
  - Do not connect voltage sources in series.



- **Risk of death due to electric shock!**

  Protect the outputs of the power supply units (output sockets/terminals) and cables connected to them from direct contact.
  - Only use cables with adequate insulation and electric strength.
  - Use safety sockets with fully shrouded contact points.

- **Disconnect from all sources of electric power!**
  - Switch off the power supply before working on the circuit.
  - Please note that electrical energy may be stored in individual components.

    Information on this issue is available in the datasheets and operating instructions included with the components.
  - **Caution!**

    Capacitors inside the device may still be charged even after being disconnected from all sources of voltage.



⚠ CAUTION

- Devices with a grounding terminal must always be grounded.
    - If a ground connection (green/yellow laboratory socket) is available, it must always be connected to protective ground. The protective grounding must always be connected first (before voltage) and disconnected last (after voltage).
    - Some devices have high leakage current. These devices must be additionally grounded with a protective earth conductor.
- Use safety extra-low voltages only: max. 24 V DC.
- The power supply unit must be operated only with a power supply with a grounding conductor.
- Establishing and disconnecting electrical connections
    - Electrical connections may be established only in the absence of voltage.
    - Electrical connections may be disconnected only in the absence of voltage.
- Maximum permissible current loads for cables and devices must not be exceeded.
    - Always compare the current ratings of the device, the cable, and the fuse to ensure that they match.
    - In the event that these are not the same, use a separate upstream fuse in order to provide appropriate overcurrent protection.
- Use only connecting cables with safety plugs for electrical connections.
- When laying connecting cables, make sure they are not kinked or pinched.
- Do not lay cables over hot surfaces.
    - Hot surfaces are indicated by a corresponding warning symbol.
- Make sure that connecting cables are not subjected to continuous tensile loads.
- The device is not equipped with a built-in fuse unless otherwise specified in the technical data.
- Pull the plug only when disconnecting connecting cables; never pull the cable.

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	• Hazard-free operation of the device is no longer possible in the case of:
	  • Visible damage
	  • Malfunction
	  • Incorrect storage
	  • Incorrect transport.
	  • Switch off the power supply immediately.
	  • Protect the device against an inadvertent restart.

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Pneumatics



⚠ WARNING

- Depressurize the system.
  - Switch off the compressed air supply before working on the circuit.
  - Use pressure gauges to check whether the entire circuit is pressure-free.
  - Please note that energy may be stored in reservoirs. Information on this issue is available in the datasheets and operating instructions included with the components.
- Do not exceed the maximum permissible pressure of 6 bar (600 kPa).
- Do not switch on the compressed air until all the tubing connectors have been joined and secured.
- Do not disconnect tubing while under pressure.
- Do not attempt to seal or plug pneumatic tubing or plug connectors with your hands or fingers.
- Risk of injury when switching on compressed air!

  Cylinders can advance and retract automatically.
- Risk of accident due to advancing cylinders.
  - Always position pneumatic cylinders so that the piston rod's working space is unobstructed over the entire stroke range.
  - Make sure that the piston rod cannot collide with any rigid components of the setup.
- Risk of accident due to pneumatic tubing slipping off!
  - Use shortest possible barbed tubing connectors.
  - If pneumatic tubing slips off: Switch off the compressed air supply immediately.
- Pneumatic circuit setup:

  Connect the devices with plastic tubing with an outside diameter of 4 or 6 mm. Push the pneumatic tubing into the push-in connector as far as it will go.
- Switch off the compressed air supply before dismantling the circuit.

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- Dismantling the pneumatic circuit
  Press the blue release ring down so that the pneumatic tubing can be pulled out.
- Noise due to escaping compressed air
  - Noise caused by escaping compressed air may damage your hearing. Reduce noise by using pneumatic mufflers, or wear hearing protection if noise cannot be avoided.
  - All of the exhaust ports of the components included in the equipment set are equipped with mufflers. Do not remove these mufflers.

Process technology

⚠ WARNING



- Always fill the tanks when the power is switched off!
- Switch off the 24 V DC and 230 V AC power supply!
- Use tap water of drinking water quality (recommended) to ensure longer maintenance-free operation of the stations (valves, pump, etc.).
- The maximum operating temperature of the containers of +65°C must not be exceeded.
- Only start up the heater when the heating element is completely immersed in the liquid.
- The maximum operating pressure for the liquid in the pipes must not exceed 0.5 bar.
- Do not allow the pump to run dry. The pump must not be used with seawater, contaminated liquids, or viscous media.
- Drain the liquid in the stations/system before making changes in the piping layout.
- The liquid in the station can be drained by opening the drain valves!
- No liquid should be left in the system for a long period of time, as bacteria such as Legionella can form in it.

Cyber security

Festo Didactic provides products with security functions that support the safe operation of plants, systems, machines, and networks. Protecting these assets from cyber threats, however, requires a comprehensive and regularly updated security concept. Festo's products and services form only part of such a strategy.

The customer is responsible for preventing unauthorized access to equipment and networks. Connections to company networks or the Internet should be made only when necessary and only with appropriate security measures, such as firewalls, network segmentation, defense-in-depth strategies, etc.

Without these measures, connecting products to a network can expose vulnerabilities that allow unauthorized remote access, potentially affecting the entire system. This access can be exploited for data theft, manipulation, or sabotage. Common threats include Denial-of-Service attacks, remote code execution, privilege escalation, ransomware, and other malicious activities. In industrial environments, such attacks can create unsafe conditions, endangering both people and equipment.

Customers should follow Festo's security guidelines and keep their products up to date. Festo continuously improves its products for greater security and strongly recommends installing updates promptly. Using outdated or unsupported versions increases exposure to cyber threats.

Report security issues to the Festo Product Security Incident Response Team (PSIRT) in German or English by email at psirt@festo.com or through the online form at https://www.festo.com/psirt.

⚠ WARNING

Unsecure operating conditions due to software tampering

- Software tampering (e.g., viruses, Trojans, malware, worms) can cause unsafe system conditions, potentially leading to serious injury or property damage.
- Keep all software up to date.
- Integrate all automation and actuator components into a comprehensive industrial security concept aligned with current technological standards.
- Ensure all installed products are included in your security concept.
- Use protective tools, such as antivirus software, to scan files on removable storage media for malware.

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⚠ WARNING

Firmware Update Security

This warning applies only to products with updatable firmware. To protect the security and integrity of your system, follow these guidelines during the firmware update process:

- **Download source.** Obtain firmware updates only from the official manufacturer's website.
- **Do not tamper.** Do not modify or interfere with the firmware update process.
- **Update process.** Strictly follow the firmware update instructions provided in the user guide.

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Technical Data

General data

Table 1: Technical data (subject to changes).

Parameter	Value
Operating pressure (compressed air)	600 kPa (6 bar)
Max. operating pressure in piping (water)	50 kPa (0.5 bar)
Operating voltage	24 V DC, 4 A, ≤ 100 W output power, SELV/ PELV limited power supply (LPS)
Digital inputs/outputs Inputs: 8 Outputs: 5 Analog inputs/outputs Inputs: 4 Outputs: 2	Max. 24 V DC Max. 0.5 A per output Max. 4 A total
Signal range of the final control elements Pump (0...24 V DC)	Voltage 0...10 V
Operating range of the level control system	0...10 L/min
Measuring range of the level sensor	0...10 L/min
Signal of the level sensor	Current 4...20 mA
Operating range of the flow control system	0...10 L/min
Measuring range of the flow sensor	0...10 L/min / 2,64 gpm
Signal of the flow rate sensor	Current 4...20 mA
Operating range of the pressure control system	0...30 kPa (0...300 mbar)

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Parameter	Value
Measuring range of the pressure sensor	0...40 kPa (0...400 mbar) / 0-58 PSI
Signal of the flow pressure sensor	Current 4...20 mA
Operating range of the temperature control system	0...60 °C
Measuring range of the temperature sensor	0...100 °C
Signal of the temperature sensor	Resistance PT100 -50° C...+150° C
Electrical connection	24-pin IEEE-488 socket (SysLink) 15-pin ISO 4903 socket (Sub-D)
Pneumatic connection	Plastic tubing with 6 mm outside diameter
Compressed air consumption at 600 kPa (continuous cycle)	5 l/min
Process connections	Flexible piping system DN10 ($Ø_a$ 15mm)
Volumetric flow rate of the pump	~10 l/min
Tank volume storage tanks/main tank	max. 3 l / 10 l
Dimensions of the station	700 x 700 x 907 mm
Dimensions of the profile plate	700 x 700 x 32 mm
Weight	51 kg

Pin allocation tables

Table 2: Digital terminals.

I/O	Reference designation	Designation	Terminal	SysLink PIN	SysLink wire color
I0	-BF1	Vibronic sensor, filling level, lower limit tank B101	9	13	Gray-pink

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I/O	Reference designation	Designation	Terminal	SysLink PIN	SysLink wire color
I1	-BG2	Float switch tank B101 level high alarm	10	14	Red-blue
I2			11	15	White-green
I3	-BG13	Sensor, capacitive tank B101 level lower limit	12	16	Brown-green
I4	-BG14	Sensor, capacitive tank B101 level higher limit	13	17	White-yellow
I5	-BG15c	Position indicator 2way ball valve V102 position closed	14	18	Brown-yellow
I6	-BG15o	Position indicator 2way ball valve V102 position open	15	19	White-gray
I7	-KF10	Vibronic sensor, lower level limit, upper tank B102	16	20	Gray-brown
Q0	-MA1	Solenoid valve 2way ball-valve V102 open	1	1	White
Q1	-MA2	Heating ON, binary, in tank B101	2	2	Brown
Q2	-MB3	Relay, Preselection of pump P101 0=binary/ 1=analogue	3	3	Green
Q3	-MB4	Motor controller Pump P101 binary ON	4	4	Yellow
Q4	-MB5	Load relay for proportional valve V106 drive electronic KK6	5	5	Gray
Q5		Optional: Switch-over relay K2 water-air cooler	6	6	Pink
Q6		Not used	7	7	Blue

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I/O	Reference designation	Designation	Terminal	SysLink PIN	SysLink wire color
Q7		Optional: 2way solenoid valve V121 open cooling circuit	8	8	Red
24 V A		24 V power supply for outputs	24 V A	9+10	Black
24 V B		24 V power supply for inputs	24 V B	21+22	White-pink
GND A		0 V power supply for outputs	GND A	11	Brown-pink
GND A		0 V power supply for outputs	GND A	12	Purple
GND B		0 V power supply for inputs	GND B	23+24	White-blue

Cable jumpers are connected from emergency off to bit 1.5 on all preferred PLC versions.

Table 3: Analog terminals.

I/O	Reference designation	Designation	Terminal	Sub-D PIN	Sub-D color
UE1	-BF1	Analog input 0-10V, level sensor with converter 0...10 l	1	8	Red
UE2	-BG2	Analog input 0-10V, flow sensor with converter 0...10 l/min	2	7	Blue
UE3		Analog input 0-10V, pressure sensor with converter 0...400 mbar	3	15	White-yellow
UE4	-BG13	Analog input 0-10V, temperature sensor with converter 0...100 °C	4	14	Brown-green
IE1	-BG14		5	5	Gray

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I/O	Reference designation	Designation	Terminal	Sub-D PIN	Sub-D color
IE2	-BG15c		6	4	Yellow
IE3	-BG15o		7	13	White-gray
IE4	-KF10		8	12	Red-blue
UA1	-MA1	Analog output 0-10V, pump PL1 control range 0...100%	9	1	White
UA2	-MA2	Analog output 0-10V, proportional valve VC6 control range 0...100%	10	2	Brown
IA1	-MB3		11	10	Gray-pink
IA2	-MB4		12	9	Black
24 V B	-MB5	24 V power supply for inputs	VB		
GND B		0 V power supply for inputs	GB	6	Pink
24 V A		24 V power supply for outputs	VA		
GND A		0 V power supply for outputs	GA	3	Green

Table 4: Control panel (option).

I/O	Reference designation	Designation	Terminal	SysLink PIN	SysLink wire color
I0	-SF1	START button	13		Gray-pink
I1	-SF2	STOP button (NC contact)	14		Red-blue

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I/O	Reference designation	Designation	Terminal	SysLink PIN	SysLink wire color
I2	-SF3	AUTO/MAN key switch	15		White-green
I3	-SF4	RESET button	16		Brown-green
I4	I4	Communication input I4	17		White-yellow
I5	I5	EMERGENCY STOP (NC contact)	18		Brown-yellow
I6	I6	Communication input I6, downstream station process ready	19		White-gray
I7	I7	Communication input I7	20		Gray-brown
Q0	-PF1	Indicator light START	1		White
Q1	-PF2	Indicator light RESET	2		Brown
Q2	-PF3	Indicator light function Q1	3		Green
Q3	-PF4	Indicator light function Q2	4		Yellow
Q4	Q4	Communication output Q4, station ready for process	5		Gray
Q5	Q5	Communication output Q5	6		Pink
Q6	Q6	Communication output Q6	7		Blue
Q7	Q7	Communication output Q7	8		Red
24 V A		24 V power supply for outputs	9+10		Black
24 V B		24 V power supply for inputs	21+22		White-pink
GND A		0 V power supply for outputs	11		Brown-pink

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I/O	Reference designation	Designation	Terminal	SysLink PIN	SysLink wire color
GND A		0 V power supply for outputs	12		Purple
GND B		0 V power supply for inputs	23+24		White-blue



Communication input I5 is used as an EMERGENCY-STOP signal input in PLC EduTrainers.

The inputs and outputs of the control panel are located on the second byte of the EduTrainer.

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Transport, Unpacking, and Scope of Delivery

Transport

The MPS PA systems and stations are delivered in a crate on a pallet. The packaging material is designed so that it can be reused as long as it has not been damaged during transport. Please keep the original packaging and use it if you need to transport the MPS PA system or station again.

The crate may only be transported with a suitable pallet jack or forklift. The crate must be secured against tipping over and falling.

- Report transport damage without delay to the freight forwarder and Festo Didactic.

Unpacking

Carefully remove the padding material from the crate when unpacking the station. When unpacking the system or station, make sure that none of its assemblies have been damaged.

Examine the system or station for possible damage after unpacking.

- Report any damage without delay to the freight forwarder and Festo Didactic.

Scope of delivery

Check delivered items against the delivery note and the purchase order.

- Report any discrepancies without delay to Festo Didactic.

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Design

The Compact Workstation Process Instrumentation

The MPS PA Compact Workstation is available in different designs to suit individual training outcomes:

- Basic design
- Process instrumentation (PI)
- Energy or customized solutions...

The Compact Workstation Process Instrumentation consists of the following main components:

- MPS PA CWS-PI station with 19" frame incl. 24 V DC power supply and accessories
- Trolley (order no. 541139)

Additional components are:

- EasyPort USB 19" (order no. 8021637) incl. connecting cable (length 1 m)
- FluidLab PA closed loop (order no. 544304)
- USB device server
- EduTrainer Universal MPS PA: A4 rack with SIMATIC S7-1500 (order no. 8065600)
- 1x I/O data cable with SysLink connectors to IEEE 488, crossed (order no. 167106)
- 1x analog cable, parallel (order no. 529141)
- Safety laboratory cable, 3 m (order no. 571817)
- Control console with SIMATIC Touch Panel TP700 (order no. 8079869)

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Figure 1: Front view Compact Workstation Process Instrumentation.

The CWS-PI Station

The MPS PA Compact Workstation includes four closed-loop systems with digital and analog sensors and actuators. With a PLC or controller, you can run them individually or cascaded:

- level control system
- flow rate control system
- pressure control system
- temperature control system

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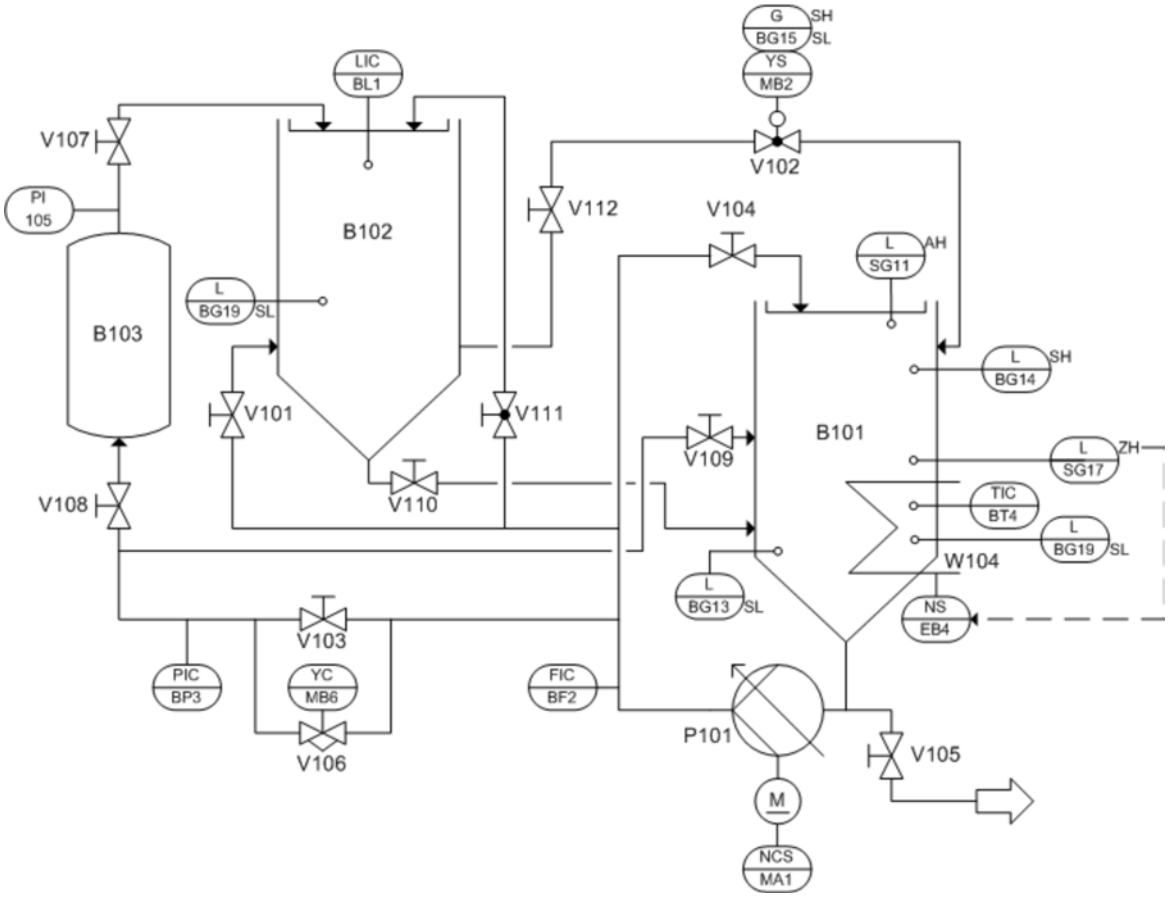


Figure 2: PI-diagram to ISO10628 and EN 62424: CWS-PI station with optional water-air-cooler.

You can use the four closed-loop systems for the following functions:

- two-point control of a level control system with an analog standard signal
- continuous control of a level control system with an analog standard signal
- continuous control of a flow rate control system using a pump as the controlled system and an analog standard signal
- continuous control of a flow rate control system using a proportional valve as the controlled system and an analog standard signal
- continuous control of a pressure control system using a pump as the controlled system and an analog standard signal
- continuous control of a pressure control system using a proportional valve as the controlled system and an analog standard signal
- two-point control of a temperature control system with an analog standard signal

The basic components of the MPS PA Compact Workstation Process Instrumentation are:

- Two-rod probe for continuous measurement in conductive liquids; measuring range: 50–355 mm
- Magnetic-inductive flow meter, up to 0–10 L/min, with on-site display; HART transmitter with 4…20 mA output; programmable manually and via PC software with HART modem
- Intelligent pressure sensor with ceramic measuring cell, with on-site display and standard 4…20 mA output; programmable manually and via PC software with adapter cable
- Pressure gauge for 0…1 bar
- PT100 temperature sensor with on-site display and standard 4…20 mA output; programmable manually and via PC software with adapter cable
- Two capacitive proximity switches for min/max level in the lower tank
- Float switch for threshold function (electromechanical) in the upper tank
- Float switch for overflow alarm monitoring in the lower tank
- Float switch to protect the heating system
- Centrifugal pump
- Motor controller for pump
- Proportional valve with electronic control module
- Heating system with integrated microcontroller
- 2-way ball valve with pneumatic rotary drive (SYPAR) and sensor box
- I/O terminal for binary signals: 8 inputs and 8 outputs
- Terminal for analog signals: four 0–10 V inputs and two 0–10 V outputs
- Two two-channel process converters with sensor supply, LCD and LED status display; programmable with HART RS232 interface; programmable manually and via PC software
- Piping system, including four transparent segments
- Pressure tank (reactor), 2 L, stainless steel
- Two water tanks, 10 L, square
- Manual valve
- Service unit
- Cable ducts
- Aluminum profiles
- Profile plate 700 × 700 mm
- 19" mounting frame
- Mounting frame for ER units or A4 Edutrainers

Recommended additional accessories are:

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- 24 V DC power supply for the 19" frame
- PLC or closed-loop controller, for example, EasyPortUSB or EduTrainer Universal with PLC
- Trolley
- Basic control panel for the 19" frame
- Touch panel (HMI)

The functions of each closed-loop system depend on the combination of (manual) valves used. They also depend on the PLC programming and the controller configuration or parameter settings.

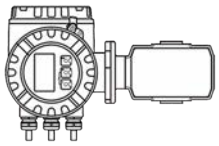
To use the station, you need a control kit and a 24 V DC power supply.

Overview of components

The following table shows all electric devices of the MPS®PA Compact Workstation in ever design, which are: included (✓) or not included (blank). Components and functions in this operating instruction are explained for the basic design.

Table 5: Electric devices of the MPS®PA Compact Workstation.

Description	Component	Basic design	Process instrumentation (PI)	Energy
Pump		✓	✓	✓
Proportional valve		✓	✓	✓
Heating		✓	✓	✓

Description	Component	Basic design	Process instrumentation (PI)	Energy
Ultrasonic sensor		✓		✓
Flow rate sensor		✓		✓
Pressure sensor		✓		✓
Temperature sensor		✓		✓
Level probe, capacitive			✓	
Magnetic-inductive flow meter			✓	
Pressure sensor			✓	

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Description	Component	Basic design	Process instrumentation (PI)	Energy
Temperature sensor			✓	
Level switch, vibronic		✓	✓	✓
2way ball valve with pneumatic rotary drive		✓	✓	✓
DC-wattmeter				✓
PAC4200 AC power meter				✓

Main components

The following components are included in the scope of delivery. The data sheets can be found in numerical order as a PDF data sheet collection.

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Table 6: Main components.

Datasheets	Designation	Order no.	Quantity
	Two-rod probe for continuous measurements		1
	Magnetic-inductive flow meter HART transmitter with 4...20 mA output		1
	Pressure sensor with on-site display and standard 4...20 mA output		1
	PT100 temperature sensor with on-site display and standard 4...20 mA output		1
	Vibronic level sensor		2
170712	Pump	170712	1
689201	Tank, square	548595	2
160236	Pressure vessel	160236	1
162844	Pressure gauge	162844	1
690588	Sensor, capacitive	549824	2
691282	Float switch, lateral installation	691282	1
BGPN0111	2W ball valve unit with pneumatic quarter-turn actuator and position indicator	BGPN0111	1
	I/O board		1
8025736	I/O terminal	8025736	1
8025737	Analog terminal	8025737	1
541150	Motor controller	541150	1
150768	Starting current limiter	150768	1
BEEL0426	H-rail relay, 2 changeover contacts	268327	2
17070x	Pipe, straight, pipe section of 800 mm	304518	4 m

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Datasheets	Designation	Order no.	Quantity
17070x	L-plug connector	170701	7
17070x	T-plug connector	170702	8
17070x	Hand lever valve	170703	9
17070x	Blanking plug	170705	2
17070x	Push-in angle 90° connector	690590	14
9543	Ball valve DN15	9543	1
159410	Aluminum profile plate 700 x 700	159410	1
540691	Start-up valve with filter control valve	540691	1

Table 7: Small parts included in the scope of delivery of the station.

Item	Designation	Order no.	Quantity
1	T-plug connector for 6 mm tubing	153304	1
2	Plastic tubing, PUN 6x1	152963	5 m
3	Pipe and tubing cutters	7658	1
4	Pipe section 15 mm x 800 mm	304518	1
5	L-plug connector	170701	1
6	Push-in angle 90° connector	690590	1
7	Double non-return valve Connection 15 mm	170704	1
8	Hand lever valve	170703	1
9	Tubing D:MPS-PA-B-SCHL.15/1100	696710	1
10	Blanking plug	170705	2
11	4 mm safety laboratory cables, 1000 mm, red	376938	1

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Item	Designation	Order no.	Quantity
12	4 mm safety laboratory cables, 1000 mm, blue	376938	1
13	Stem to hose connector	696711	2

Level monitoring

The following technical examples for level monitoring are integrated into the MPS PA Compact Workstation:

- Proximity switches
- Float switch for overflow safety
- Float switch for threshold function
- Float switch as switch-on protection for heating

Proximity switches

Two capacitive proximity switches BG13 (1) and BG14 (2) are mounted on a profile plate on the side of the lower tank B101. You can adjust the switches mechanically. Use the screw to set the sensing distance through the tank wall. The 24 V binary input signals are connected to the I/O terminal XD1.

The minimum level of tank BG01 is indicated by the lower sensor BG13. At the minimum level, the heating element EB4 must be fully immersed in the liquid.

The maximum level of tank BG01 is indicated by the upper sensor BG14. In the reset position, both sensors must be activated.

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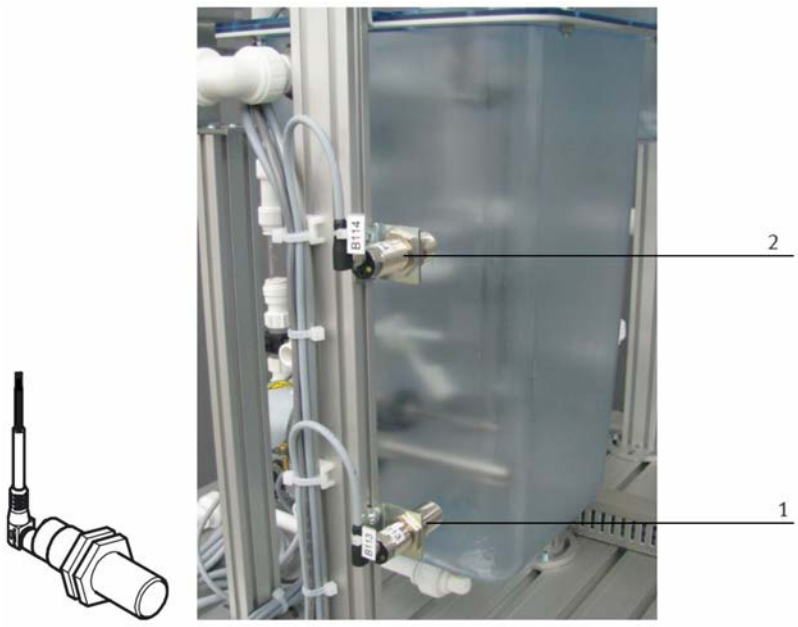


Figure 3: Level monitoring with capacitive proximity switches BG13 and BG14.

Overflow safety

Overflow in tank BG01 is monitored by float switch SG11 (1). If the level exceeds the maximum, the transparent float cylinder moves upward. Magnets inside the cylinder activate a reed contact.

The 24 V binary input signal (NO) is connected to the I/O terminal XD1. In the PLC program, the overflow signal should trigger an alarm and affect ball valve V102 and pump P101. With electrical modifications, you can also use the overflow switch to shut off the pump or valve via a relay circuit or to signal an emergency relay.

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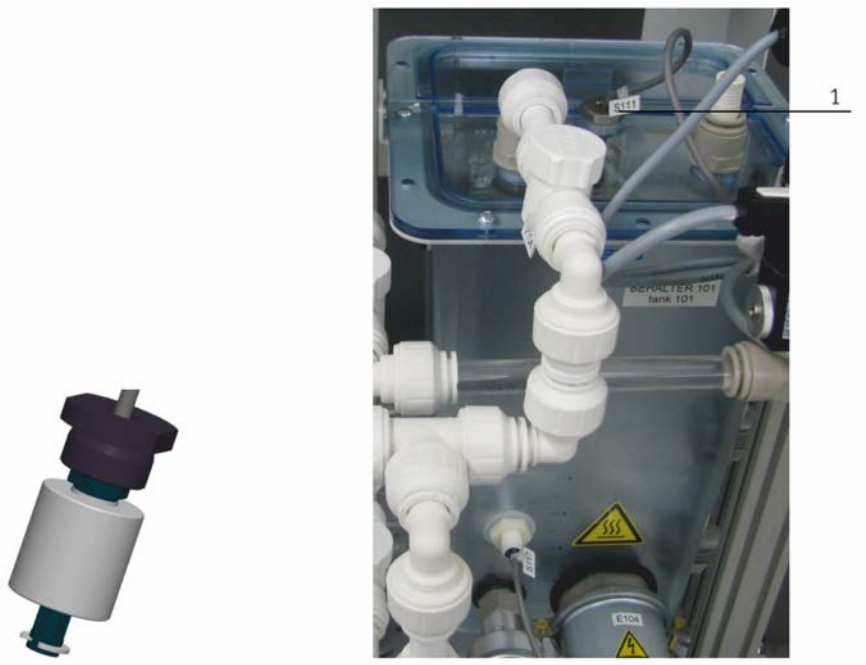


Figure 4: Level monitoring with float switch for overflow safety SG11.

Threshold function

The rising fluid level in the upper tank B102 is monitored at a defined minimum level by float switch BG19 (1). If you change the mounting position, the switch can also indicate a falling level.

The 24 V binary input signal (NC) is connected to the I/O terminal XD1. The switch cable has a plug connector for easy connection and disconnection when you change the mounting position.



Figure 5: Level monitoring with float switch for threshold function BG19.

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Switch-on protection for heating

The float switch monitors the falling fluid level in the tank. It prevents heating if the level drops below the critical point. The heating element must be fully immersed in the fluid.

The switch cable has a plug connector and is connected directly to the heating element and to the connecting cable for the I/O connecting board.



Figure 6: Float switch as switch-on protection for heating.

Pump

The centrifugal pump P101 (1) is the controlling equipment used in all controlled systems. The pump is delivering fluid from a reservoir tank B101 through the piping system.

The pump must not be operated running dry. Before commissioning the reservoir tank or piping system to/from the pump should be filled with fluid.

(O2 at XD1) it is possible to switch from digital binary control to analog control variable from 0 to 24 V. At digital binary control (O2 = 0) the pump is turn on/off with an additional output (O3 at XD1). At analog control (O2 = 1) the drive voltage from analog output signal channel 0 (UA1 at XD3) is setting the speed of the pump from 0 to 10 V.

⚠ WARNING

Please also see the data sheet of the pump for further safety instructions!



Figure 7: Controlling equipment – Pump P101 (1).

Proportional valve

The proportional valve V106 (1) is a directly actuated 2/2-way valve for flow control of fluids. It can be used as an adjustable remote element in open- or closed-loops. The valve piston is lifted of its seat as a function of the solenoid coil current and releases the flow through the valve.

The control electronic of the proportional valve is activated with a binary output. (Q4 at XD1). An analog signal from channel 1 (UA2 at XD3) is driving the signal input of the proportional valve with a standard analog signal from 0 to 10 V.

The standard analog signal is transformed into a pulse-width modulation (PWM) and the opening of the valve is infinitely adjustable. The frequency of the PWM can be adapted for different valve types.



Figure 8: Controlling element proportional valve V106.

Heating

The heating element is controlled by an internal micro controller on activation of a binary output (Q1 at XD1).

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NOTICE

Notes on safety

- The maximum operating temperature of the tanks must not exceed 65°C.
- Do not operate the heating unit unless the heating element is fully immersed in fluid.
- Critical temperature at the heat element: at temperature around 50-60°C the heating is internal automatically switched off. If the temperature value drops below 45°C the heating is switched on again.
- Critical temperature at the micro controller of the heating: at a semiconductor temperature of around 90°C the heating is internal automatically switched off. If the temperature value drops below 85°C the heating is switched on again.

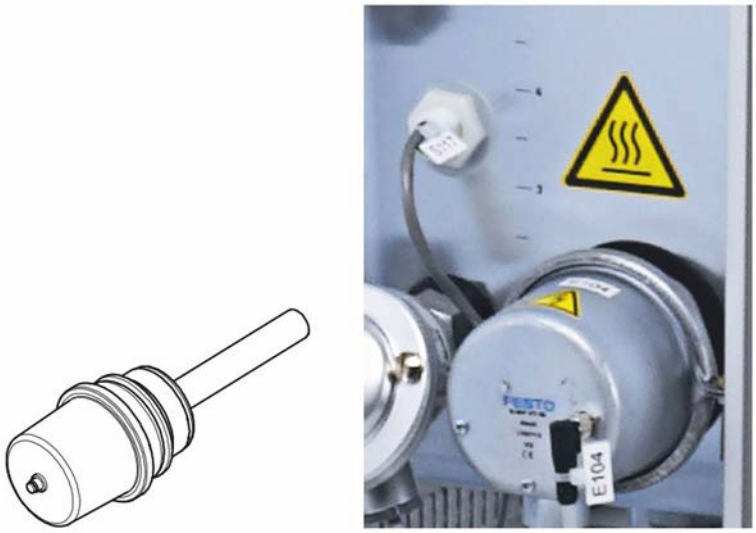


Figure 9: Heating.

Controlling the heat element

The heating can be controlled in binary mode or continuously (analog). In the MPS PA Compact Workstation, the heating is controlled **in binary mode only**. To use the heating as a continuous output element, pulse-width modulation (PWM) is used. The controller switches the heating on and off with a constant period T (for example, 10 s). By changing the on-time t_1, you change the thermal power Q. Increasing the on-time increases the thermal power.

Legend

t1: ON-time

t2: OFF-time

T: time period

Q: thermal power

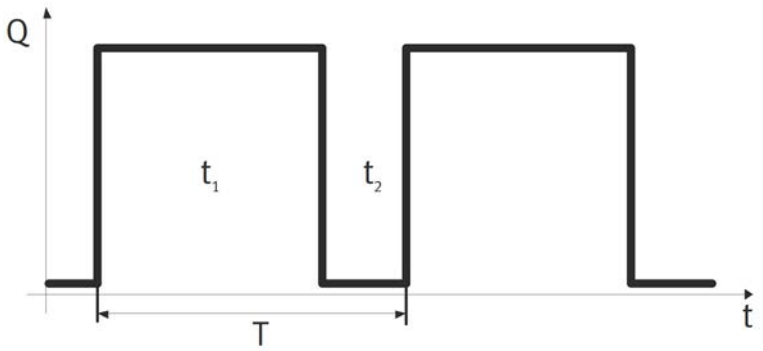


Figure 10: PWM with a pulse-width ratio of 75%.

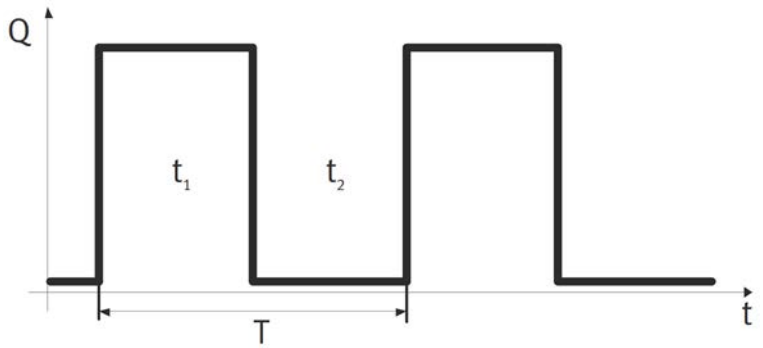


Figure 11: PWM with a pulse-width ratio of 50%.

2W ball valve with pneumatic rotary drive

The process valve V102 consist of a 2-way ball valve and are opened and closed by a pneumatic quarter-turn actuator. The actuating device consists of a brass ball valve (1) with quarter-turn actuator of type COPAR (4), rack and pinion principle with flanged-on 5/2-way NAMUR valve (3) with solenoid coil (2) and position indicator (5). The outlet of the lower tanks into the mixing tank can be opened by switching the 2W ball valves.

Legend

1. 2W ball valve, brass
2. Solenoid coil
3. 5/2 way NAMUR valve for pilot control
4. Quarter-turn actuators of type COPAR
5. Position indicator

Some models include an optional sensor box with an inductive double sensor.

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⚠ CAUTION

Loud noises are generated when the actuator is moving!

⚠ CAUTION

Parts rotate when the actuator is moved, there is a danger of crushing!



Figure 12: 2W ball valve with pneumatic quarter-turn actuator (similar to figure).

Compressed air supply

The maintenance unit consists of a filter regulator with a pressure gauge and an on/off valve for the compressed-air supply, mounted on a swivel bracket. The on/off valve pressurizes and vents the connected MPS PA station. The station accessories included in the scope of delivery are:

- Plastic tubing PUN 6 × 1, 5 m
- T-plug connector for 6 mm tubing

⚠ CAUTION

Loud noises are generated when operating the maintenance unit!



Figure 13: On-off valve with filter regulator.

Additional accessories

The common functions of the station can be extended and customized with modular components. Following components are not included to the delivery of the MPS-PA Compact Workstation and should be ordered additionally.

Directly controlled 2-way solenoid valve, brass

Directly controller solenoid valves are used to automate manual valve functions of the MPS PA Compact Workstation. The solenoid valves are integrated into the piping. The solenoid is switch on with a load relay.

The 2-way solenoid valves are used for the following functions:

- Inlet feed tank B102 (supplement for V101)
- Tank-to-tank process with pump P101 (supplement for V101)
- Drain valve for tank B101

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Figure 14: Directly controlled 2-way solenoid valve, brass.

Directly controlled 2-way solenoid valve, plastic

A 2-way solenoid valve in plastic design is used for the MPS PA Compact Workstation to control the cooling circulation, supplied together with the cooling unit with heat exchanger (C44001). The solenoid is switch on with a load relay.



Figure 15: Directly controlled 2-way solenoid valve, plastic.

Pilot-operated 2-way solenoid valve, brass

A 2-way solenoid valve is servo- or pilot-operated to open with less magnetic force at a minimum feed pressure of the media. It is assembled into the piping or at a T-connector. Because of its low power consumption, the solenoid can be switched directly with a binary PLC output.

A pilot-operated solenoid valve is used to feed fresh water from the drinking water pipeline to the station tank B101.

	**⚠ WARNING**
	Refer to the data sheet for the 2/2-way solenoid valve, and the safety regulations as well.

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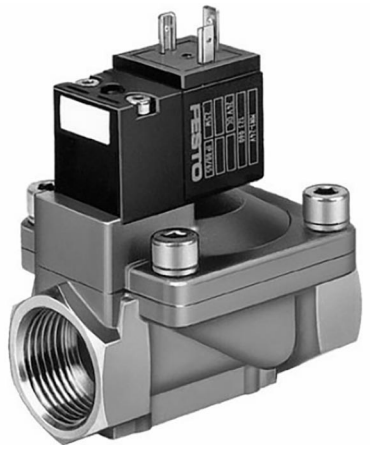


Figure 16: Pilot-operated 2-way solenoid valve.

Water-air cooler

The MPS PA Compact Workstation is completed with the additional functions for:

- Cooling with a heat exchanger
- Closed-loop speed control with variable-speed fans

The water-air cooler W120 is installed with pluggable pipe connectors into the piping system. It cools down the media as low as the room temperature using the pump for through-feed method.

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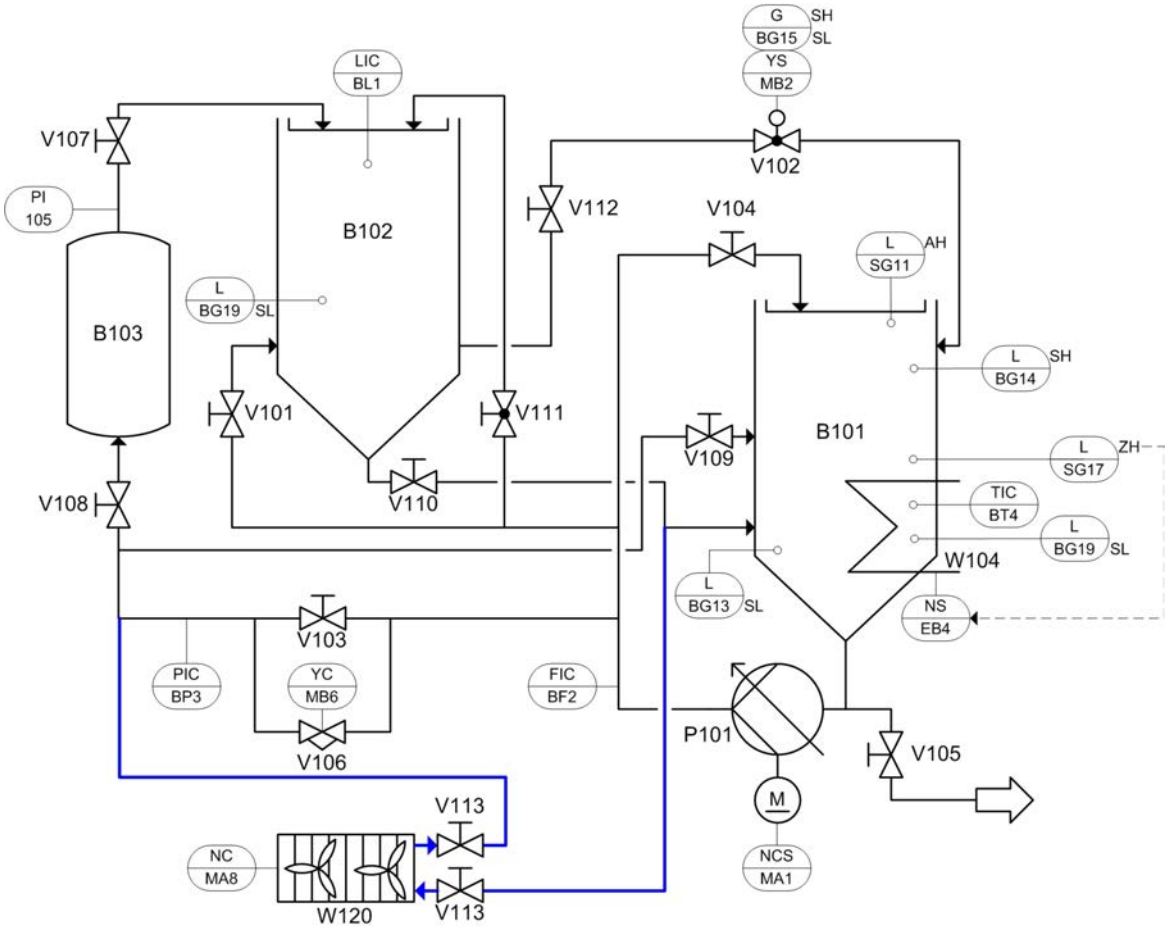


Figure 17: PI diagram of the station with water-air cooler (EN62424/ISO10628).

The process media has to be pumped with P101 through the piping system. Set manual valves as described in chapter 6.9 for “Pressure control with pump” and also open manual valves V113 and V114. With manual valves V113 and V114 the cooling circuit can be closed.

The water-air cooler is activated with relay K2. Relay K2 switches over:

- Analog output CH1 from proportional valve V106 to manipulated value for fan speed control 0-10 V → 0-100 %.
- Analog input CH 2 from pressure sensor B102 to measure value for fan speed feedback 0-10 V → 0-6000 r/min.

The speed control of the fan motors is driven continuous with a 0-10 V DC control voltage. An encoder provides a feedback signal from the motors – only one motor encoder is connected. The speed variable square wave signal is converted with a frequency transducer 0-200 Hz into a voltage signal 0-10 V. The water-air cooler is connected with a plug-in cable to the IO-board of the station.

Cooling unit with heat exchanger

The process temperature of the process media inside the tank should be reduced.

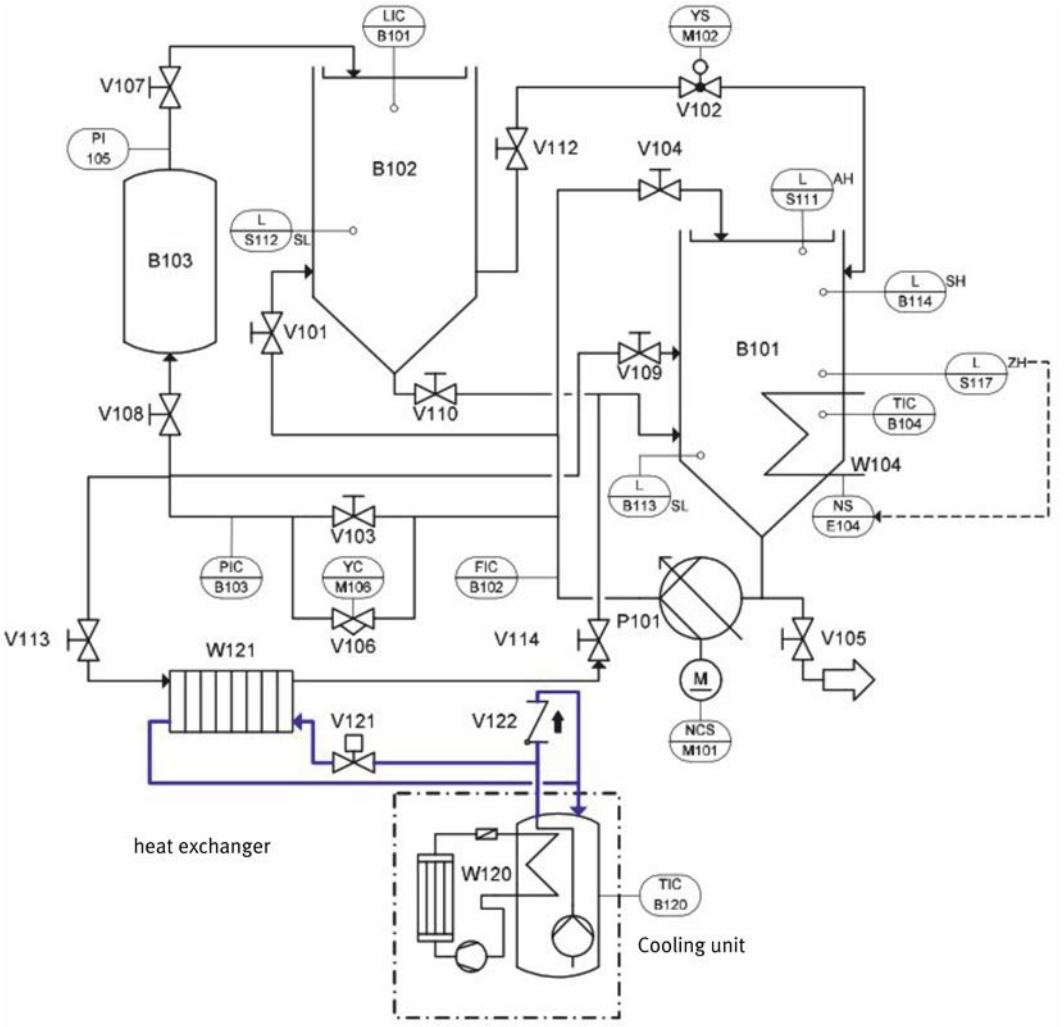


Figure 18: PI-diagram for heat exchanger for cooling circuit W121 with cooling unit W120.

The liquid in tank B101 is pumped with P101 in a tank-to-tank circuit through a plate heat exchanger via valves V103 → V113 → V114. The system temperature of the tank is measured with the PT100 temperature sensor, PCE-task "TIC B104" for process value.

The cooling circuit is activated with the cooling unit in an internal and external loop. Switch-on the cooling unit, set the cooling setpoint to "10°C" and start "Pump". Using the internal loop, the cooling unit pre-cools down the cooling liquid through one-way valve V122. It is recommended to use the supplied anti-freeze liquid. When the cooling solenoid valve V121 is opened, the external cooling circuit via the plate heat exchanger is running to dissipate heat from the process media. The circulating cooler uses a microprocessor-based temperature controller for thermostatic temperature control with internal Pt100 resistive sensor.

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⚠ WARNING

- The minimum operating temperature of the process or cooling media must not fall below 5°C to prevent freezing.
- Only activate the cooling unit after commissioning according to the specification.

Stirrer

The stirrer R107 consists of a drive unit (motor), a compensating coupling and a stirring rod. The stirrer is attached to a profile by means of a mounting plate. The stirrer is mixing the process media in tank B101. Only activate the stirrer when submerged into the process media.



Figure 19: Stirrer module.

Connection technology: the stirrer is controlled by means of a motor controller. The motor controller is activated with a digital output. In the case of manual control, the manipulated variable can be adjusted within a range of 0 to 10 V with the adjustment screw at the motor controller.



Figure 20: Motor controller.

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⚠ WARNING

Please also see the data sheet of the stirrer and motor controller for further safety instructions!

Centrifugal pump with 3-phase AC-motor

Instead of the standard pump in basic design, a centrifugal pump with 3-phase AC-motor can be installed.



Figure 21: Centrifugal pump with 3-phase AC-motor – for illustration only.

Electrical cabinet with frequency convertor

For continuous control of the pump speed a frequency convertor (FC) is assembled in an electrical cabinet.

The pump is controlled by means of a frequency converter. The parameters of the frequency converter can be configured with the basic operator panel (BOP). Please observe the notes included in the operating instructions for the Micromaster M420 frequency converter. The adjustable parameters of the frequency converter for pump P101 are listed in the following section. Control of the pump with FC is similar to the standard pump. The FC is activated by a digital output (O3 at XMA1). Analog control is set with digital output and switch-over relay K1 (O2 at XMA1). At analog control (O2 = 1) the drive voltage from analog output signal channel 0 (UA1 at X2) is setting the speed of the pump from 0 to 10 V.

An status signal additionally indicates a configurable operating state to the control system. The rotary speed or frequency is limited to "25 Hz" for safety reasons.

The pump may not be permitted to run dry. Before commissioning, the lower storage tank and the piping system to/from the pump must first be filled with the liquid to be pumped. Refer to the data sheets for the pump and the frequency converter, and the safety regulations as well!

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Figure 22: Electrical cabinet with frequency convertor.

Electrical connection technology

Connection board

The connection board serves as an interface for the analog and digital input and output signals. All analog signals are converted to 0...10 V and applied to the analog terminal. The binary signals, max. eight inputs and eight outputs per station, are applied to the I/O terminal. This ensures compatibility with EasyPort, SimBox, and PLC trainers.

Legend

1. Mounting plate
2. XMA1 I/O terminal (SysLink station): Connection of inputs, e.g. capacitive proximity sensor and connection of outputs, e.g. pumps. Proportional valve, 2way-ball valve.
3. X2 Analog terminal: actual values of level, flow rate, pressure and temperature and manipulated variable y of pump and proportional valve.
4. Relay K1: Control of the pump. If K1 is active, the pump can be controlled with a continuous manipulation voltage of 0-10V.
5. Power relay K106: activating power electronic fort he proportional valve
6. A4 Motor controller: binary and analog control of the pump.

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7. Measuring transformer A1 I/U:

   - Channel 1: Signal of the cap. probe for level measurement is converted from 4-20 mA current signal to 0-10 V standard signal voltage.
   - Channel 2: Signal of the mag.-ind. flow sensor is converted from 4-20 mA current signal into 0-10 V standard signal voltage.

8. Measuring transformer A2 I/U:

   - Channel 1: Signal of the pressure sensor is converted from 4-20 mA current signal into 0-10 V standard signal voltage.
   - Channel 2: Signal of the temperature sensor is converted from 4-20 mA current signal into 0-10 V standard signal voltage.

9. A5 Starting current limiter: limits the maximum starting current of the motor controller to prevent voltage drops at the controller.

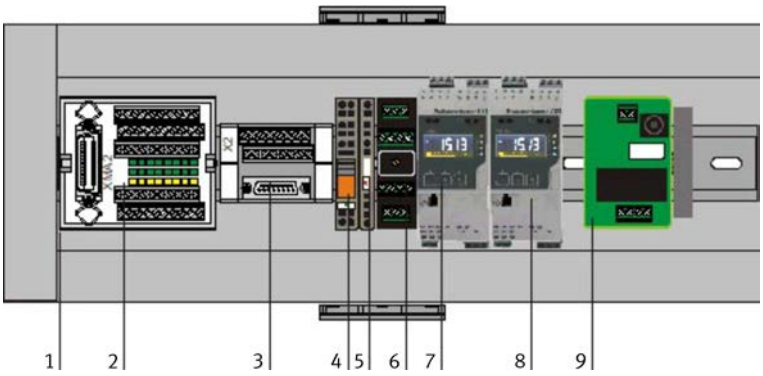


Figure 23: I/O-board of design "Process instrumentation" (similar to figure).

Mounting frame

The mounting frame of the MPS PA Compact Workstation consists of a two-row ER-frame for EduTrainers and a 19" base frame for 19" units.

The connection board is plugged into the ER frame.

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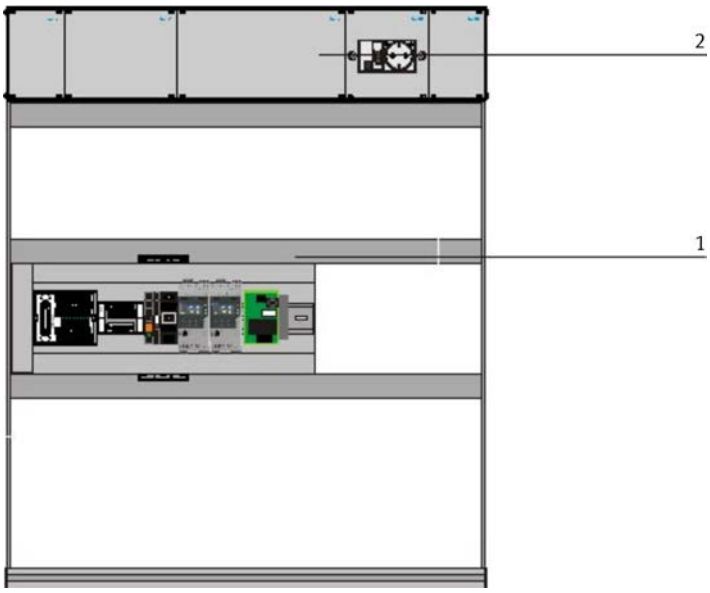


Figure 24: ER mounting frame (similar to figure).

19" frame

The following components are installed in the 19" frame of the station:

- Mains connection 120 V / 230 V AC with IEC 60320 cold appliance socket, Form C13
- 19" power supply 24 V DC/4.5A
- Easyport 19“ USB (optional: with Control-Kit PC3)
- 19" control panel with 3 push buttons, 1 key switch and 4 indicator (optional: with Control-Kit with PLCs)



⚠ WARNING

Switch off the device and unplug the power supply before assembly, repair, maintenance, or cleaning.

Follow the user documentation, especially all safety instructions. Failure to do so may cause severe injury or property damage.



⚠ WARNING

Improper use can cause electric shock!

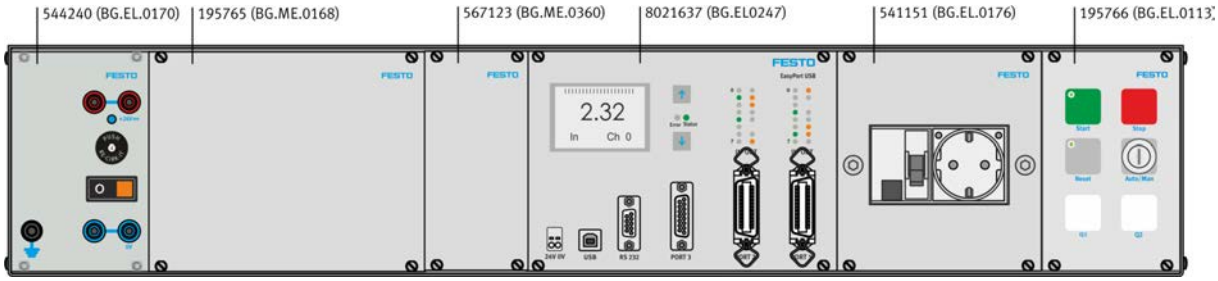


Figure 25: 19" frame - Example setup with Easyport 19" for Compact Workstation.

PLC EduTrainer Universal S7-1512C (optional)

The Siemens SIMATIC controller CPU S7-1512C-1PN is integrated in an EduTrainer Universal.



Figure 26: PLC EduTrainer Universal with S7-1512C.

The compact CPU S7-1512C-1PN has the following technical data:

- Main memory: 250 KB for programs and 1 MB for data
- Memory card 24 MB
- Interface: PROFINET IRT with 2-port switch

and the following composition of inputs and outputs:

- 32 digital inputs (24 V DC) / 32 digital outputs (24 V DC / 0.5 A)
- 5x analog inputs, 4x U/I, 1x R/RTD, 16 bit resolution / 2x analog outputs, 2x U/I, 16 bit resolution

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The support system of the EduTrainer Universal, size 1 (W x H) 305 x 300 mm, can be placed on a table or in an MPS PA station. The 19" module with 2x SysLink connector with 8 digital inputs and 8 digital outputs each and 1x D-Sub 15-pin connector with 4 analog inputs and 2 analog outputs establishes the signal connections to the MPS PA station and the control panel. The emergency stop bridge allows the connection of a safety circuit to switch off 8 digital outputs with the emergency stop board.

The S7-1512C controller is connected to the automation network with a network cable (6 m).

The sample project in combination with the TP700 Comfort control console enables the operation of the MPS PA station.

Control console with operator unit TP700 Comfort (optional)

The control console is mounted on the front right of the profile plate. The 7" operator unit TP700 Comfort operates with a resolution of 800 x 480 pixels. The electrical connections with the operating device are established through a flexible cable bushing. The power supply is provided via a 2-core cable from the connection board to 24 V DC. The operator unit TP700 Comfort is connected to the controller, for example an S7-1512C, using a network cable (6 m).



Figure 27: Control console with operator unit TP700 Comfort.

EasyPort and FluidLab-PA closed-loop V5 (optional)

In addition to control via PLC and operator unit, the Compact Workstation Process Instrumentation includes an EasyPort, which is permanently installed in the 19" frame. With FluidLab PA closed-loop V5, process data can be recorded and evaluated step by step, or the fundamentals of control technology can be learned and developed. The EasyPort is used to connect a PC to actual hardware.

Optionally, the binary control of the process with the digital technology module or the GRAFCET can be created in combination with FluidSim.

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Figure 28: EasyPort 19" USB.

USB device server (optional)

With the 2-port USB device server, you can connect your USB devices and use them via the network. An EasyPort USB and all other USB device types become network-compatible.

The USB device, that is to say the EasyPort and thus the MPS PA station, can now be placed anywhere in the network/classroom and does not have to be connected directly to the computer. In addition, several users can access the learning scenario one after the other.



Figure 29: USB device server.

Trolley 700

The trolley makes an MPS PA Station a compact and mobile unit. The station is mounted on the trolley. The EduTrainer Universal, size 1, can be inserted and the emergency stop board attached. Appropriate through-holes in the side and rear panels enable orderly routing of cables.

The front side is equipped with mountings for panels. The trolley is supplied complete with twin castors.

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Dimensions:

- Height: 750 mm (including castors, to bottom edge of profile plate)
- Width: 700 mm
- Depth: 700 mm



Figure 30: Trolley 700.

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Function

Level control function

The function of the level controlled system is to regulate the filling level of a fluid in a reservoir tank. The controlled filling level system can be used as I- or PT1 controlled system.

The pump P101 delivers a fluid from a storage tank B101 to a reservoir tank B102 via a piping system. The level of the fluid inside tank B102 is monitored with an analog sensor B101 at measuring point "LIC BL1" and read as actual value. The actual value should be kept on a certain level also if disturbances or set point changes occur.

The flow rate (speed) of pump P101 can be a binary or variable control variable. A 2-point or continuous controller can be used in the control system. To disturb the controlled system, the liquid can be drained into the lower tank by changing the opening width with manual valve V112 and opening ball valve V102. As a further disturbance variable, the manual valve V110 can be opened.



Figure 31: Controlled level system – ultrasonic sensor B101 (measuring point LIC B101) for basic design.

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The capacitive probe, the ground rod (counter electrode) and the medium form an electrical capacitor. If the probe is in air, a certain low initial capacity is measured. If the container is filled, the capacitance of the capacitor increases as the probe is covered. From a conductivity of 30 µs/cm, the measurement is independent of the DK value of the liquid. The oscillator of the probe converts the measured capacitance into a current proportional to the level in the range of 4 to 20 mA and thus enables the level to be interpreted.

The probe can be manually adjusted to the tank application - please note the manufacturer documentation and chapter "Setup" for details.

The analog current signal (4-20 mA) of the capacitive probe is connected to the measuring transformer A1. The transformer changes the analog current signal into a standard voltage signal (0-10 V). The standard voltage signal is connected to the analog terminal XD3 (UE1).



Figure 32: Level measurement with capacitive probe.

The fluid quantity of the pump P101 can be a binary or manipulated value. As controlling system, a two-position or a continuous element can be used.

As a disturbance, it is possible to open/close the ball valve V102 partly or totally to drain the upper into the lower tank or open/close hand valve V104.

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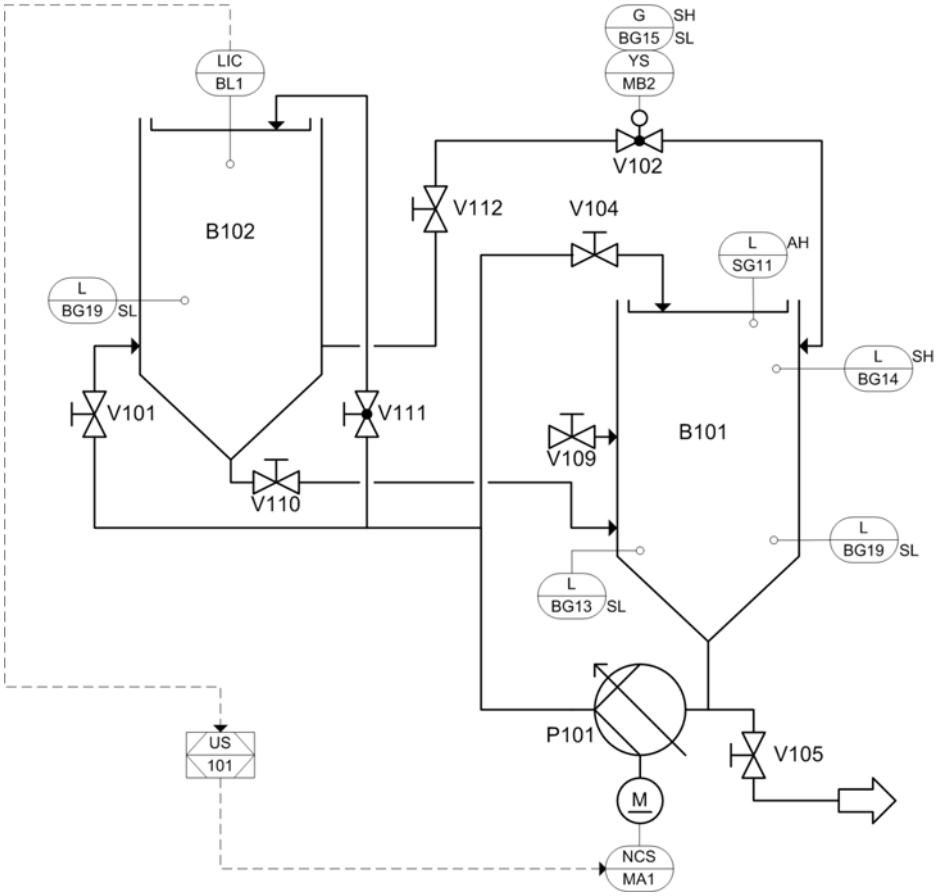


Figure 33: PI-diagram of the close loop level control system (EN62424/ISO10628).

Flow rate control function

In a piping system or a filter unit the flow velocity of a fluid shall be regulated.

The system used is a controlled system with self-regulation (P-controlled system). It does not have a time delay. The control loop in combination with the pump (PT1 behavior) creates a easily controllable system.



Figure 34: Controlled flow rate system – pump P101 with flow sensor B102 (measuring point "FIC BF2").

The pump delivers a fluid from the reservoir via a piping system. The actual value measured with a sensor should be kept on a certain flow rate also if disturbances or set point changes occur.

As controlling system, a continuous element can be used. There are two operation modes:

- Flow rate control by the means of the pump P101 as controlled system. Manipulated value is the voltage of the pump, which sets the revolution speed.
- Flow rate control by the means of the proportional valve V106 as controlled system. Manipulated value is the voltage of the valve coil, which sets the stroke of the valve piston. The pump P101 is running with a constant revolution speed.

The sensor signal is connected to the measuring transformer. The transformer changes the 4-20 mA signal into a standard voltage signal (0-10 V). The standard voltage signal is also connected to the analog terminal XD3 (UE2).

As a disturbance, it is possible to open/close the hand valve V104 or V109 partly or totally.

For a bidirectional measurement of liquids with a minimum conductivity of ≥ 50 ≥/cm a magnetic-inductive flow measurement system is used in the version "process instrumentation". The sensor output can be set to the maximum volume flow of the feed pump. The sensor is equipped with a local display and can show the actual flow rate, the total flow rate, and other values.

The sensor can be adjusted manually or parameterized via software - please refer to the manufacturer's documentation for details.

The analogue current signal (4-20 mA) of the flow sensor is led as standard signal to the measuring transformer and is converted into a standard signal voltage (0-10 V). The standard signal voltage is connected to the analog terminal XD3 (UE2).

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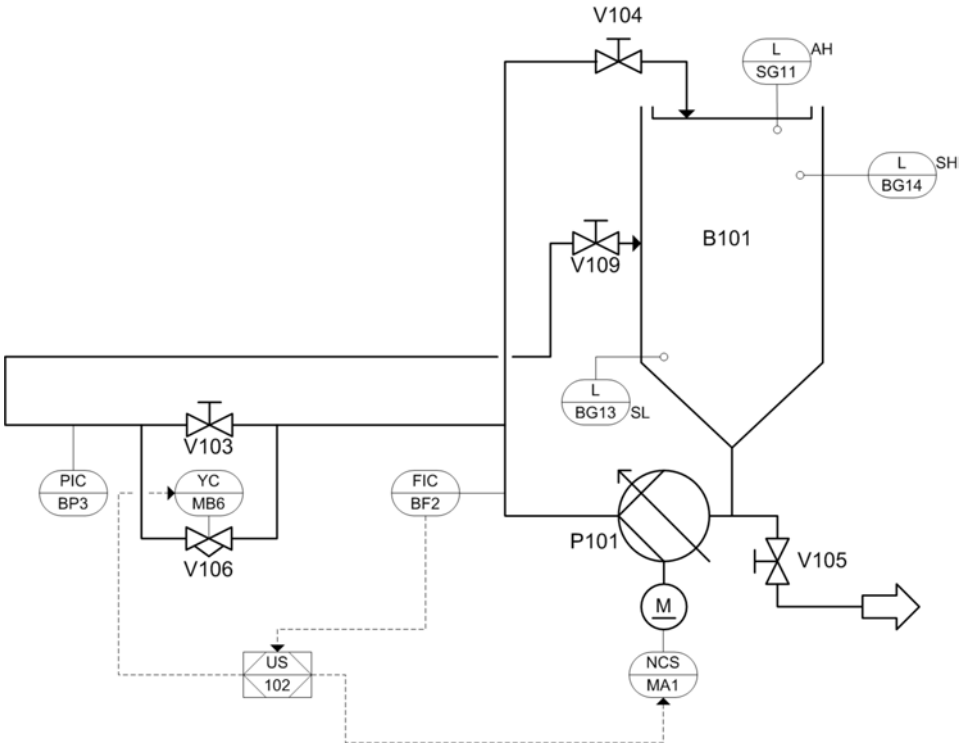


Figure 35: PI-diagram of the close loop flow rate control system (EN62424/ISO10628).

Table 8: Parameter of the flow rate sensor DN10.

Main menu	Parameter	User settings
System unit	unit vol. flow	l/min
	unit Vol. V	l
Operation	Language	English
Display	Format	XXX.XX
Current output	current range	4-20 mA (25 mA) HART
	value 20mA	15 l/min
	time constant	1 s
Imp./stat. output	operating mode	OFF
Communication	TAG Name	FIC-B102

Main menu	Parameter	User settings
Process parameter	low flow cut off	0 l/min
System parameter	*	no changes
Sensor data	*	no changes
Supervision	*	no changes
Simulation system	*	no changes

Pressure control function

The process pressure of a fluid inside a pressure tank or a pipe system shall be regulated. The controlled pressure system used is a controlled system with self-regulation (PT1-controlled system). Because the pressure tank is partly filled with gas (air) it is an energy storage system.

Via a piping system, the pump P101 delivers a fluid from a reservoir into a gas-prefilled pressure tank B103. The pressure of the gas (air) in the pressure tank is detected by means of a relative pressure sensor in the form of an actual value. The actual value should be kept on a certain pressure also if disturbances or set point changes occur.

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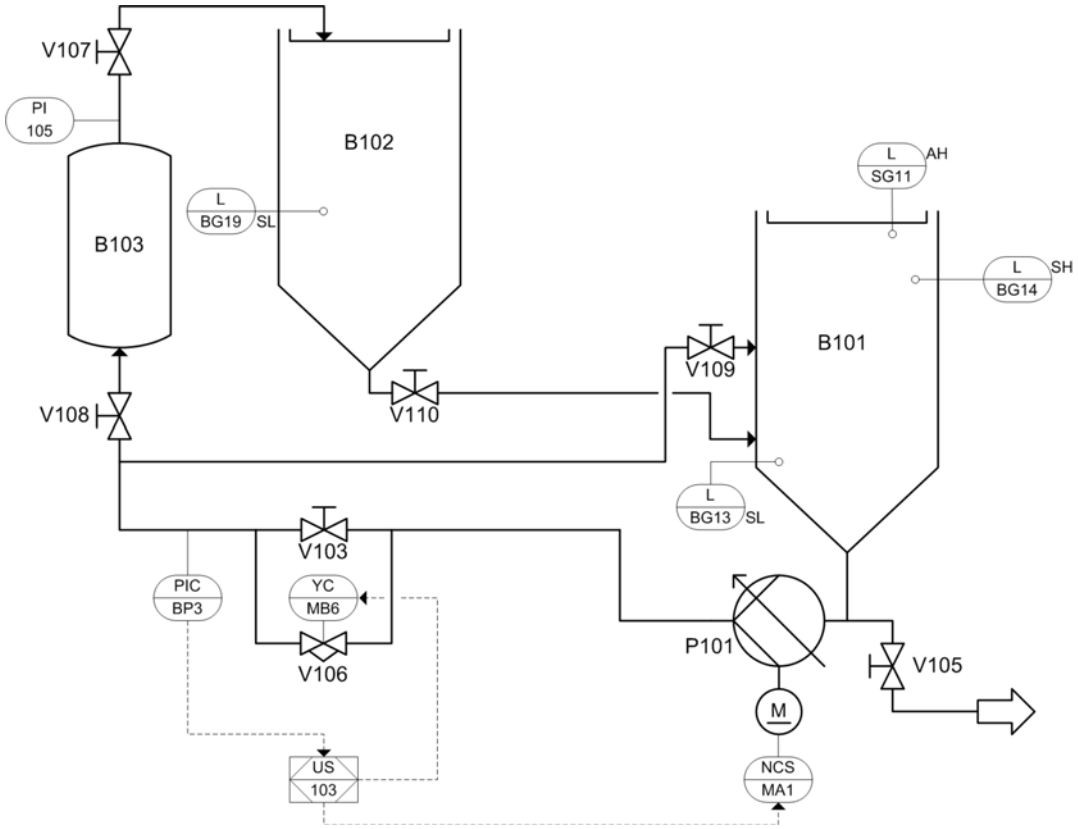


Figure 36: Controlled pressure system –tank B103 with pressure sensor BP3 (measuring point "PIC B1P3").

Pressure control function – Setup for controlling

As controlling system, a continuous element can be used. During control a pressure is buildup and controlled from liquid to gaseous medium in the pressure container B103. The amount of liquid inside of the pressure tank can be increased by opening/ closing of the exhaust valve V107 if the pump P101 is running before using closed-loop control. It is recommended to setup the water level of the pressure tank at half level with V107 for an optimal work range during closed-loop control.

The media pressure is detected by means of a relative piezoresistive sensor B103 in the form of an actual value. The standard voltage signal of the pressure sensor is connected to the analog terminal XD3 (UE3). A measuring transformer is not necessary. The sensor can be easily unplugged from the pipe system. Please be aware that there could be a build up or locked-in pressure in the pipe.

There are two operation modes:

- Pressure control by the means of the pump P101 as controlled system. Manipulated value is the voltage of the pump, which sets the revolution speed.
- Pressure control by the means of the proportional valve V106 as controlled system. Manipulated value is the voltage of the valve coil, which sets the stroke of the valve piston. The pump P101 is running with a constant revolution speed.

For disturbance is it possible to partly or totally open/close the hand valve V109.

To empty the pressure tank hand valves V 109, V 108 and V107 should be opened and pump P101 switched off. Please notice that the water level of the pressure container cannot drop below the level of the lower tank B101. Maybe it can be necessary to pump water from lower to upper tank B102.



Figure 37: Pressure gauge at PCE-task "PI 105".

Additionally, the tank pressure can be read with a pressure gauge.



Figure 38: Pressure measurement with adjustable pressure sensor.

The process pressure in the pipeline system is measured with a pressure switch for safe measurement and monitoring of relative pressure B103 at the EI&C measuring point "PIC BP3".

The sensor can be adjusted manually or parameterized via software - please refer to the manufacturer's documentation for details.

The analogue current signal (4-20 mA) of the pressure sensor is fed as standard signal to transducer A2 and is converted into a standard signal voltage (0-10 V). The standard signal voltage is connected to the analog terminal XD3 (UE3).

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Table 9: Parameters of the pressure sensor.

Main menu	Parameter	User settings
BASE	UNIT	bar
	ZERO	0.0 bar
	TAU	0.0 s
OUT	FUNC	NO
	SP	0.400 bar
	RSP	0.380 bar
OUT2	FNC2	4-20mA
	SP2	
	RSP2	
4-20	SETL	0.000 bar
	SETU	0.400 bar
SERV	LOCK	–

Temperature control system

The fluid process temperature of a heat exchanger shall be regulated.

The controlled temperature system used is a controlled system with self-regulation (PT1-controlled system). Because the conversion of energy happens slowly these controlled system has a big time constant (of time delay).

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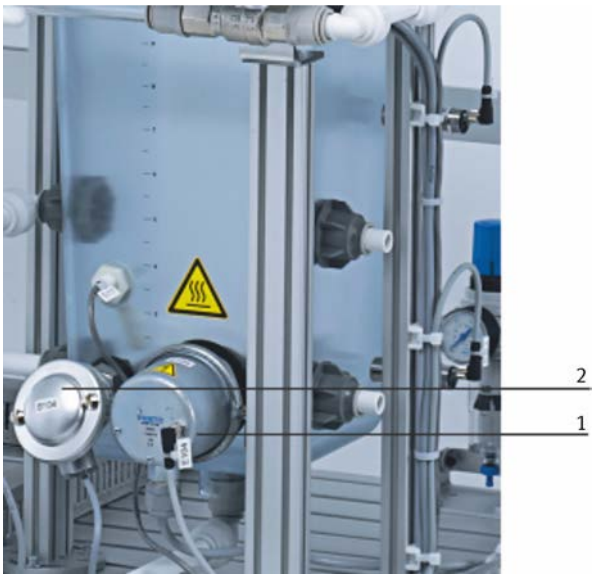


Figure 39: Controlled temperature system – tank B101 with temperature sensor BT4.

The water in the reactor container B101 of the heat exchanger EB4 is heated by means of a heating element and is recirculated by means of the pump P101.

A PT100 sensor BT4 (2) is used for measuring the system temperature at measuring point 'TIC BT4' in the form of an actual value. The actual value should be kept on a certain temperature also if disturbances or set point changes occur.

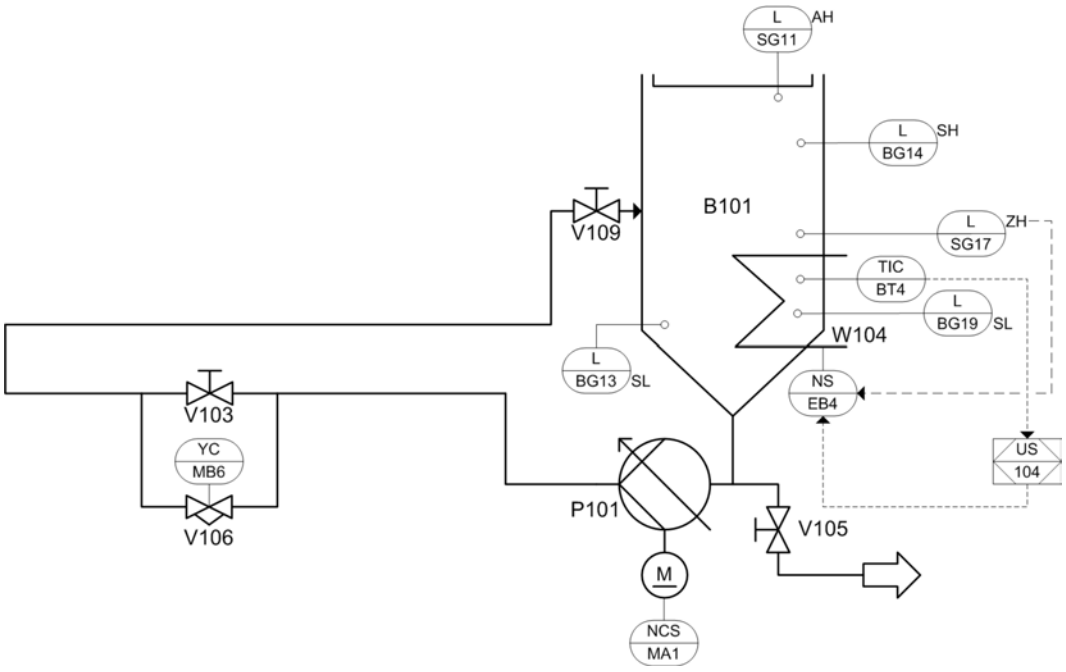


Figure 40: PI-diagram of the temperature control system.

The on/off switching period of the heating element E104, which is the manipulated variable, determines the heat output of the heat exchanger. As controlling system, a two-point element can be used. For disturbance is it possible to use cold fluid or (e.g., ice cubes) or mix with water from the upper tank.

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The heating is controlled by an internal micro controller. With a binary output (O1 at XMA1) the heating can be switched on/off.

In the process instrumentation version, an adjustable PT100 resistance thermometer B103 with local display is installed.

The sensor can be adjusted manually or parameterized via software - please refer to the manufacturer's documentation for details.

The analogue current signal (4-20 mA) of the flow sensor is led as standard signal to transducer A2 and is converted into a standard signal voltage (0-10 V). The standard signal voltage is connected to the analog terminal X2 (UE4).



Figure 41: Temperature measurement as process instrumentation.

Table 10: Parameter temperature sensor.

Main menu	Parameter	Factory settings	User settings
BASE	UNIT		bar
	ZERO		0.0°C
	TAU		1.0 s
OUT	FUNC	HYNO	
	SP	45°C	
	RSP	44.5°C	
OUT2	FNC2	HYNO	

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Main menu	Parameter	Factory settings	User settings
	SP2	0.220 bar	
	RSP2	0.218 bar	
4-20	SETL	0.0°C	0.0°C
	SETU	150.0°C	100.0°C
SERV	LOCK	0	

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Commissioning

The stations of the MPS PA are generally

- Fully assembled
- Individually adjusted and ready for use
- Pre-commissioned
- Tested

Commissioning is normally limited to visual inspection in order to ensure correct tubing connections, wiring, and operating voltage supply.

All components, tubing connections and cabling are clearly identified, so that all of the connections can be readily restored.

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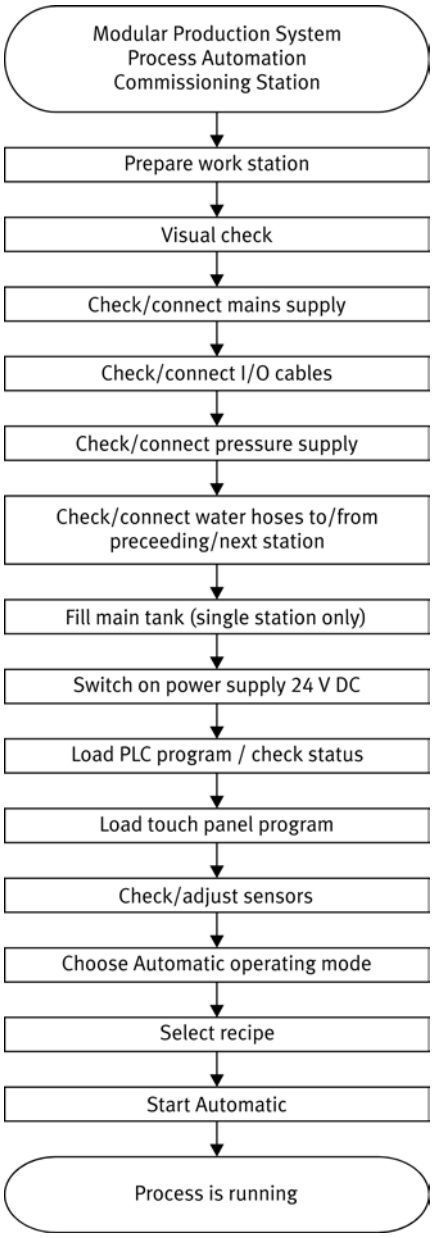


Figure 42: Flow chart for commissioning of an MPS PA station.

Workstation

To commission the MPS PA station with the sample programs, you need:

- A mounted and adjusted MPS PA station
- Acontrol console with operator unit (for example, TP700)
- A PLC EduTrainer with 16 digital inputs and outputs, four analog inputs, and two analog outputs
- A 24 V DC power supply, 4 A, ≤ 100 W output power, SELV/PELV limited power source (LPS)
- Compressed air supply: 600 kPa (6 bar)

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- A PC with PLC programming software installed
- Two I/O cables (SysLink) and one analog cable

Filling and emptying

1. Switch off the power supply and pull out the mains plug.
2. Check the piping and tubing connection of the components for correct seating.
3. Close the exhaust valve.
4. Switch off the compressed air supply.
5. Fill the main tank with max. 6 liters of clean tap water. The float switch (overflow protection) must not be mechanically actuated. The float must be horizontal and cover the reed contact.
6. Check the piping of the components for tightness.
7. Remove splashing water.
8. Switch on the power supply at the 24 VDC power supply unit.
9. Check if the LEDs of the two capacitive proximity sensors indicate a signal after filling.
10. You can empty the storage tanks by pumping the liquid into the mixing tank or by opening the hand valve in the drain line and draining the liquid into a separate tank. To do this, insert a suitable pipe or piece of tubing into the drain connection.



Always empty the station completely if it will not be used for a long time.

Power supply

- The stations are supplied with electricity from a power supply with 24 V DC voltage (max. 4 A).
- The power supply for the entire station is provided via the PLC EduTrainer, SimuBox, or the EasyPort 19" USB.

Compressed air supply

The service unit is connected via a coupling plug. The quick coupling socket (KD3-CK-6) is included in the scope of delivery of the service unit:

11. Connect the plastic tubing PUN 6x1 to the coupling socket.

12. Connect the plastic tubing PUN 6x1 to your compressed air supply. If necessary, use the T-plug connector for 6 mm tubing.

13. Connect the quick coupling socket to the quick coupling plug of the service unit.

14. Check the display of the pressure gauge and set a pressure of 6 bar at the filter regulator.



Figure 43: On-off valve with filter regulator.

Choosing controlled system

To use a specific controlled system integrated in the MPS PA Compact Workstation, see the following table for the required settings of the manual valves and actuators.

PLC or controller programming, configuration, or parameter settings depend on the selected controlled system and signal type. For example, in the level control system, the ultrasonic sensor uses a 4 to 20 mA signal. This signal is converted to a standard 0 to 10 V voltage signal.

Therefore, you must configure the input signal on the controller.

The configuration of the PLC or controller depends on the device used. The following control types can be used with the Compact Workstation:

- PLC, for example, Simatic S7-1500 CPU 1512C
- EasyPort with Fluid Lab-PA educational software
- Digital/analog simulation box

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Table 11: Choosing the controlled system of MPS PA Compact Workstation.

Component	Level-controlled system	Flow-controlled system	Component	Level-controlled system	Flow-controlled system	Component
Measuring point of the sensor	LIC102 B101	FIC101 B102		PIC103 B103		TIC104 B104
Pump P101	Controlling element	Controlling element	Digital on	Controlling element	Pump P101	Controlling element
Prop. valve V106	Off	Off	Controlling element	Off	Prop. valve V106	Off
Heating element E104	Off	Off	Off	Off	Heating element E104	Off
Hand valve V101	Open	Closed	Closed	Closed	Hand valve V101	Open
Ball valve V102	Open/ Closed	Closed	Closed	Closed	Ball valve V102	Open/ Closed
Hand valve V103	Closed	Closed	Closed	Open	Hand valve V103	Closed
Hand valve V104	Closed	Open	Closed	Closed	Hand valve V104	Closed
Drainage valve V105	Closed	Closed	Closed	Closed	Drainage valve V105	Closed
Hand valve V107	Closed	Closed	Closed	Closed	Hand valve V107	Closed
Hand valve V108	Closed	Closed	Closed	Open	Hand valve V108	Closed
Hand valve V109	Closed	Closed	Open	Open/ Closed	Hand valve V109	Closed

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Component	Level-controlled system	Flow-controlled system	Component	Level-controlled system	Flow-controlled system	Component
Hand valve V110	Closed	Closed	Closed	Closed	Hand valve V110	Closed
Hand valve V112	Open/ Closed	Closed	Closed	Closed	Hand valve V112	Open/ Closed

Control with PLC EduTrainer and control console

Cable connections between station and EduTrainer PLC

The cable connections are described and shown for an MPS PA station connected to a PLC control **without power supply** in the EduTrainer Universal as MPS-PA preferred variant:

- Connect the digital I/Os of the EduTrainer (3/A) and the I/O terminal (5) XD1 of the station with I/O data cable SysLink (7) or check the connection.
- Connect the digital I/Os of the EduTrainer (3/B) and control panel (4) with the I/O data cable SysLink or check the connection.
- Connect analog I/Os of the EduTrainer (3/C) and analog terminal XD3 (6) of the station with analog I/O data cable (8) or check the connection.
- Connect the EduTrainer laboratory sockets to the power supply and power supply unit with laboratory cables (9 - 4 mm safety plug red = + / blue = –) or check the connection.
- Connect your PC or operator unit with a network cable to the PLC controller (not shown) or check the connection.

Legend

1. I/O connection board MPS-PA station
2. Power supply unit 24 V DC, 4.5 A
3. Edutrainer Universal with PLC (option)
4. Control panel (option)
5. I/O terminal SysLink
6. Analog terminal
7. SysLink I/O data cable, parallel (034031)
8. Analog cable, 15-pin, parallel (529141)
9. Laboratory cable with safety laboratory sockets (red/blue)

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10. SysLink I/O data cables, parallel (034031, not shown in figure)

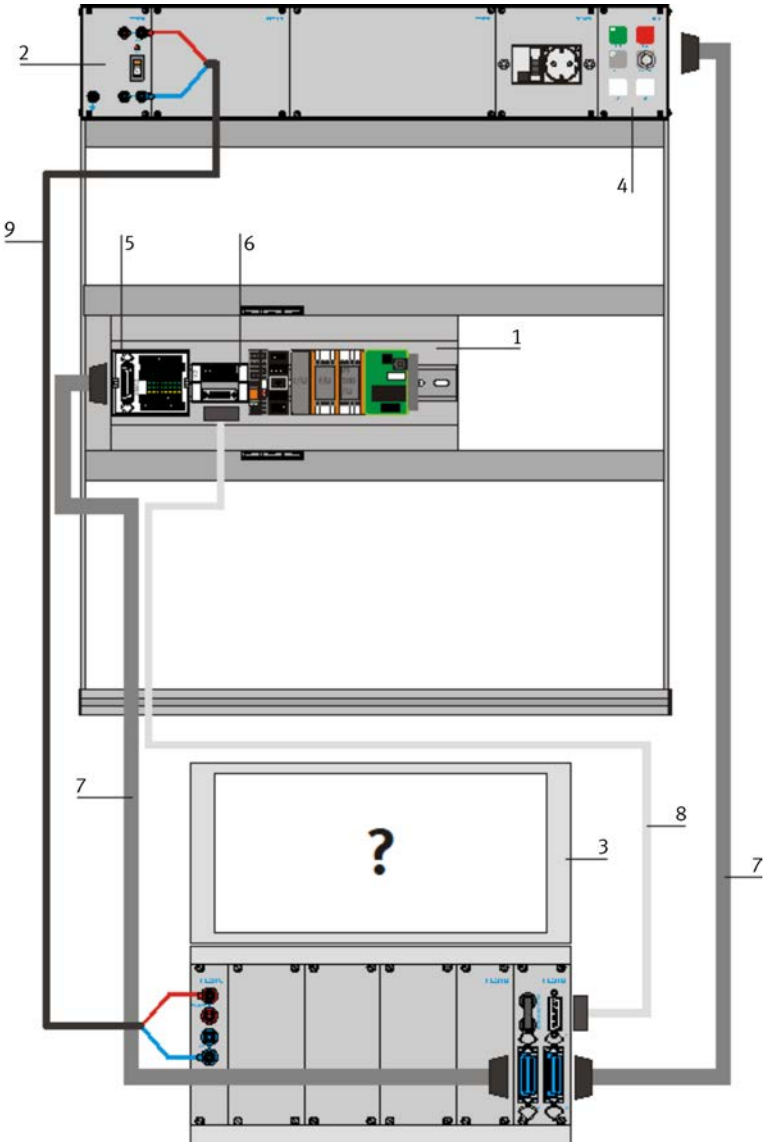


Figure 44: Cable connection MPS PA Station – EduTrainer Universal without power supply.

Cable connections between control console and PLC EduTrainer

The cable connections are described for a control console with TP700 Comfort connected to a PLC EduTrainer. On delivery, the cables in the control console are already connected. To remove the connections, the front panel on the front of the control console must be removed and the cable through feed opened on the back.

Procedure

- Connect the network cable from the operator unit to the PLC controller (not shown) or check the connection.

- Check/Connect the power supply cable in the control console. The operating device is supplied via the SysLink terminal and only switches on when the PLC EduTrainer is connected to the station and the 24 V DC power supply unit has been switched on.

Loading sample project – Siemens S7-1500 CPU1512C

For example, use an EduTrainer Universal with Siemens S7-1500 CPU1512C.

Programming software: Siemens STEP7 version 14 (SP1) or higher

1. Connect the PC and PLC with the network cable
2. Switch on the power supply
3. Switch on the compressed air supply
4. Unlock emergency stop switches (if present)
5. Reset the memory of the PLC
6. Set the CPU switch to the STOP position
7. Start the TIA-Portal development environment
8. Unarchive the file, e.g., **C41008_CWS-PI_Level_XXX.zap1X** in directory... \MPS-PA_Compact_Workstation_PI\Sources_Quellen\PLC_Programs\Step7_PLC_Program of the supplied USB drive.
9. Load the project into the PLC. Help can be found at the following link:

Getting started.

https://support.industry.siemens.com/cs/document/78027451/guide-de-prise-en-main-du-simatic-s7-1500

10. CPU switch in RUN position

Loading sample project – Siemens TP700 Comfort

For example, use a control console with Siemens TP700 Comfort.

Programming software: Siemens STEP7 version 15.1 (SP1) or higher

1. Connect the PC and HMI with the network cable

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2. Switch on the power supply

3. Start the TIA-Portal development environment

4. In the de-archived project (see above), select the corresponding sub-project of the station "tpBottling".

5. Load the project into the operator unit. Help can be found at the following link:

Getting started.

https://support.industry.siemens.com/cs/document/90156682/simatic-hmi-quick-install-guide-basic-panels-2nd-generation

Starting the sequence

1. Check the power supply and compressed air supply.

2. Empty/Fill the station as described in "chapter 11.2 Filling and emptying".

3. Select the automatic operating mode with/without downstream station.

4. Select a recipe in the process type.

5. Press the Start button.

6. The station starts the sequence.

The sequence can be stopped at any time by pressing the emergency stop button or the STOP button.

Operation on the control console with operator unit TP700 Comfort

The control console is mounted on the front right of the profile plate. First, connect all the components of the station. Check whether the PLC is in operation and the program is loaded.

Visualization project for touch panel

There are several options to operate the MPS-PA Compact Workstation with a EduTrainer-Universal PLC (Control-Kit) through a touch panel (HMI = human machine interface). For the illustrated PLC types are example visualization projects available.

In general, the physical connection between PLC and touch panel is established with a network cable using RJ45 plugs.

Table 12: Control options for the MPS-PA Compact Workstation.

EduTrainer Universal with PLC	Touch panel (HMI)	Communication	Software for visualization project
Siemens S7-300 (PN) 	Siemens TP700 Comfort 	Industrial Ethernet/ Profinet	Siemens Simatic TIA-Portal WinCC Advanced V13
Siemens S7-1200 	Siemens KTP700 Basic 	Industrial Ethernet/ Profinet	Siemens Simatic TIA-Portal WinCC Basic V13
Siemens S7-1500 	Siemens TP700 Comfort 	Industrial Ethernet/ Profinet	Siemens Simatic TIA-Portal WinCC Advanced V13

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EduTrainer Universal with PLC	Touch panel (HMI)	Communication	Software for visualization project
Festo CPX-CEC 	Festo FED550/ CDPX 7" 	Industrial Ethernet Modbus	Festo Designer Studio V1.90
AB Compactlogix 	Allen Bradley PanelView +600 	EtherNet/IP	Rockwell Automation Factory Talk View V7.0 Machine Edition

Visualization project

The touch panel visualization project starts with the main page. As an example, the visualization project for a Siemens touch panel TP700 Comfort is illustrated.

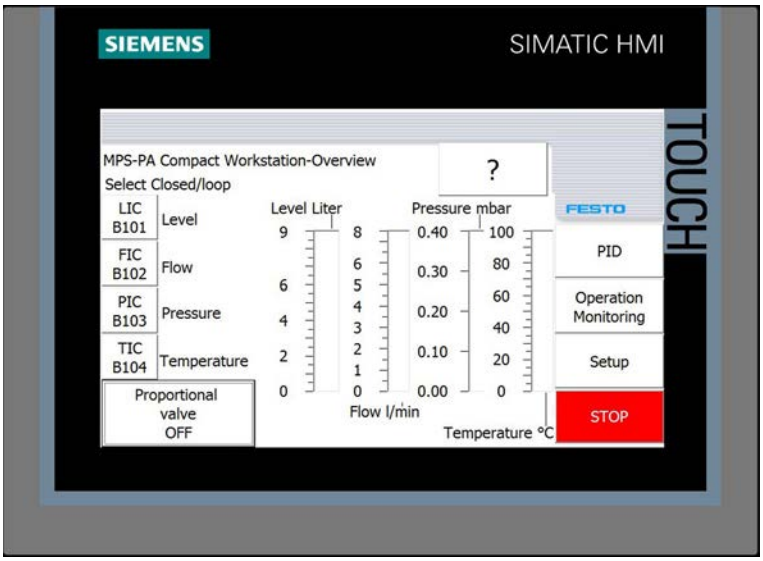


Figure 45: Visualization project example TP700 Comfort – Main page.

Choose subordinate pages from the main page (starting picture) with functions for:

- Manual operation or after selection of the control-loop: PID controller
- Monitoring
- Setup - select language for DE, EN, ES, FR, and parameter
- STOP: abort all active functions
- Selection of the control-loop: Level-Flow-Pressure-Temperature
- Select proportional valve for control-loops flow or pressure
- Bar graph of analog process values

- **Manual operation**

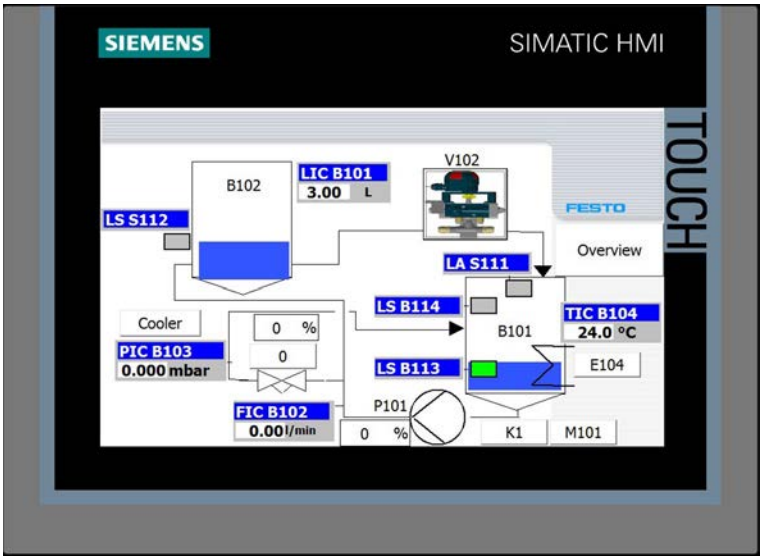


Figure 46: Visualization project example TP700 Comfort – Manual operation.

Functions:

- Display sensor signals
- Operating actuators, switching and continuous
- Station overview of PCE-task and final control elements

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- **Monitoring**

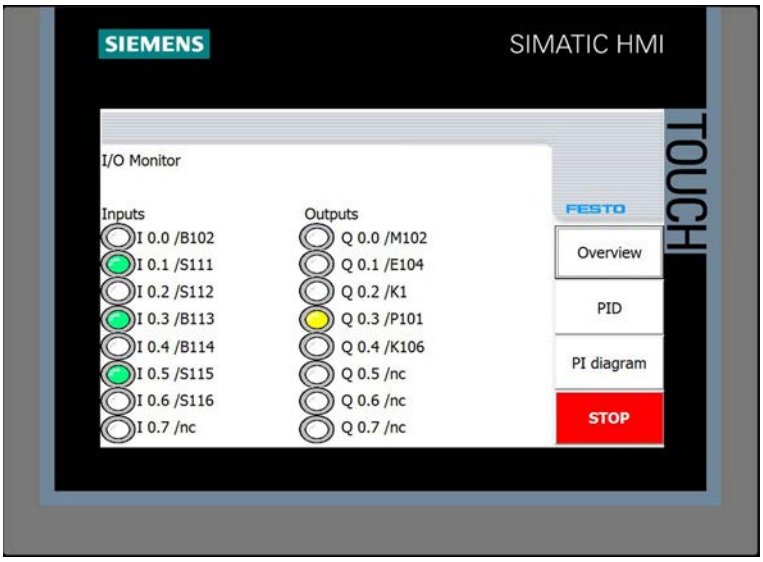


Figure 47: Visualization project example TP700 Comfort – Monitoring.

Functions:

- Display signals of binary inputs and outputs.
- STOP: abort all active functions

- **Setup**

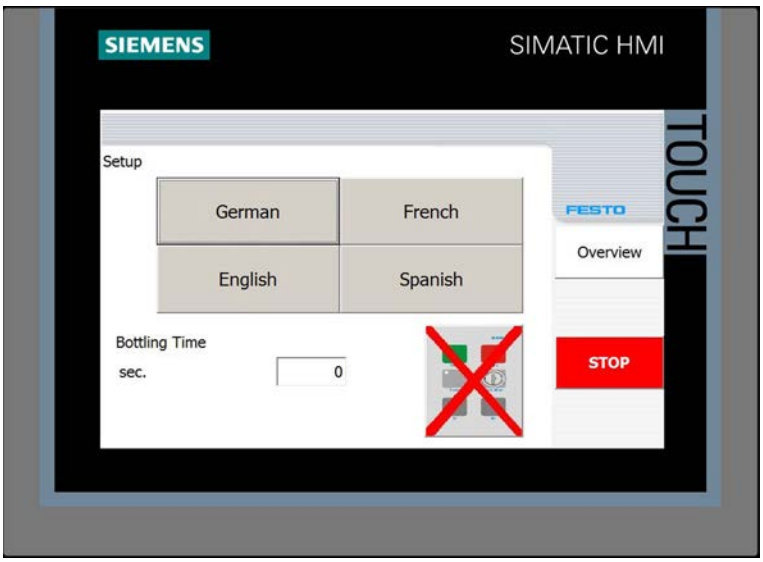


Figure 48: Visualization project example TP700 Comfort – Setup.

Functions:

- Select language for DE, EN, ES, FR
- Setting parameters for bottling time, when bottling function is switched on for level control

- Setting 19" control panel connected: activated/ deactivated (see illustration).

  If activated and the control panel is not truly connected than the STOP-input (normally closed) aborts all functions!

- **PID controller in manual mode**

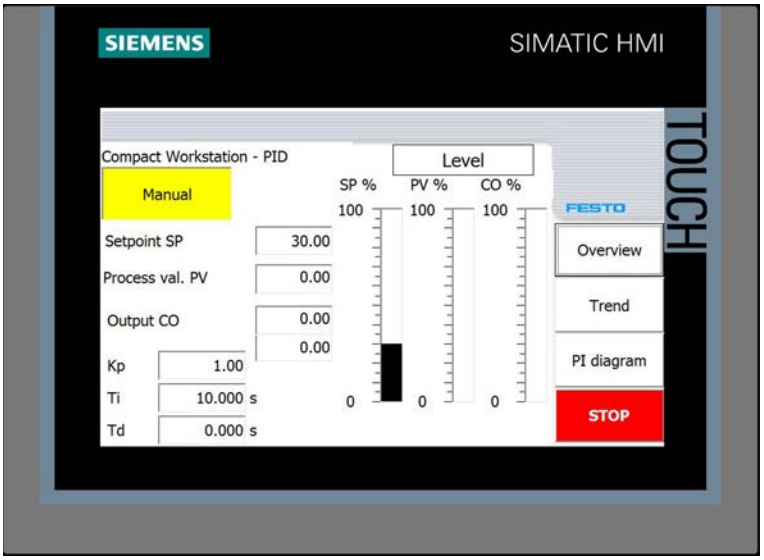


Figure 49: Visualization project example TP700 Comfort – PID controller in manual mode.

Functions:

- Display and operation of controller values and parameters.
- Operation of Manual and Automatic Mode of the controller. If Manual is selected the manual manipulated value is active.

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- **PID controller in automatic mode**

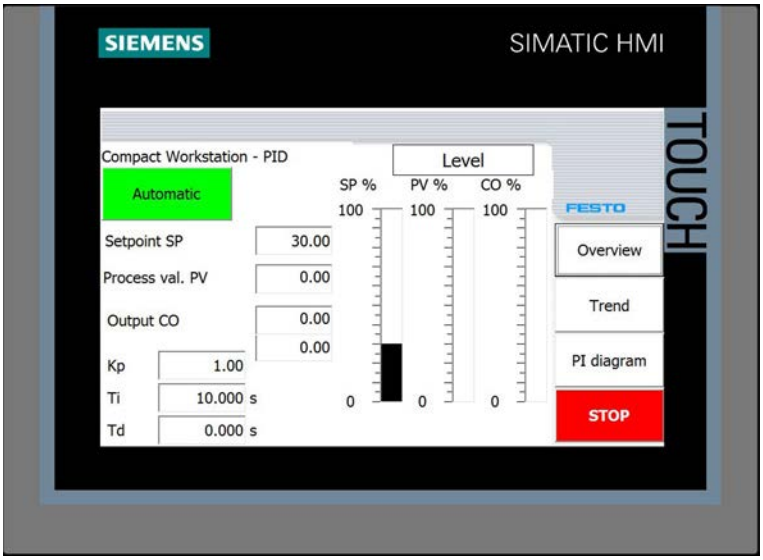


Figure 50: Visualization project example TP700 Comfort – PID controller in automatic mode.

Functions:

- Display and operation of controller values and parameters.
- Operation of Manual and Automatic Mode of the controller. If Automatic is selected, the controller constitutes the manipulated value.
- STOP: abort all active functions

- **P&I diagram**

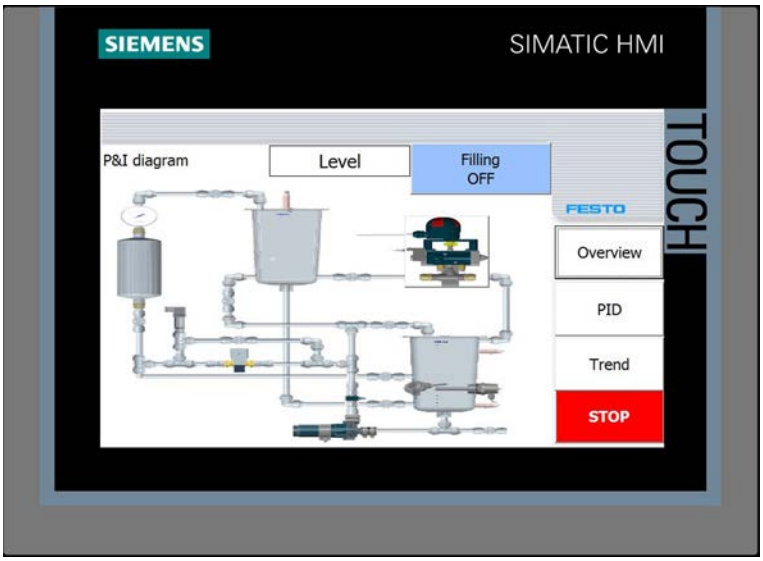


Figure 51: Visualization project example TP700 Comfort – P&I diagram.

Functions:

- Activate bottling process for level control
- STOP: abort all active functions

Control with EasyPort 19"

The cable connections are for one MPS PA station connected to EasyPort 19" described and illustrated:

- He Connect digital I/Os of port 1 of the EasyPort and the I/O terminal (4) XD1 of the station with I/O data cable SysLink (6) or check the connection.
- Connect the digital I/Os of port 2 of EasyPort and the control panel (9) with I/O data cable SysLink (4) or check the connection.
- Connect the analog I/Os of port 3 of the EasyPort and analog terminal XD3 (5) of the station with analog I/O data cable (7) or check the connection.
- Connect EasyPort for power supply and power supply unit with laboratory cables (7 - 4 mm safety plug red = + / blue = -) or check the connection.
- Connect your PC or operator unit to EasyPort using a network cable (not shown) or check the connection.

Legend

1. I/O connection board MPS-PA station
2. Power supply unit 24 V DC, 4.5 A
3. EasyPort 19"
4. I/O terminal SysLink
5. Analog terminal
6. SysLink I/O data cable, parallel (034031)
7. Analog cable, 15-pin, parallel (529141)
8. Laboratory cable with safety laboratory sockets (red/blue)
9. Control panel with I/O data cable SysLink, parallel (034031)

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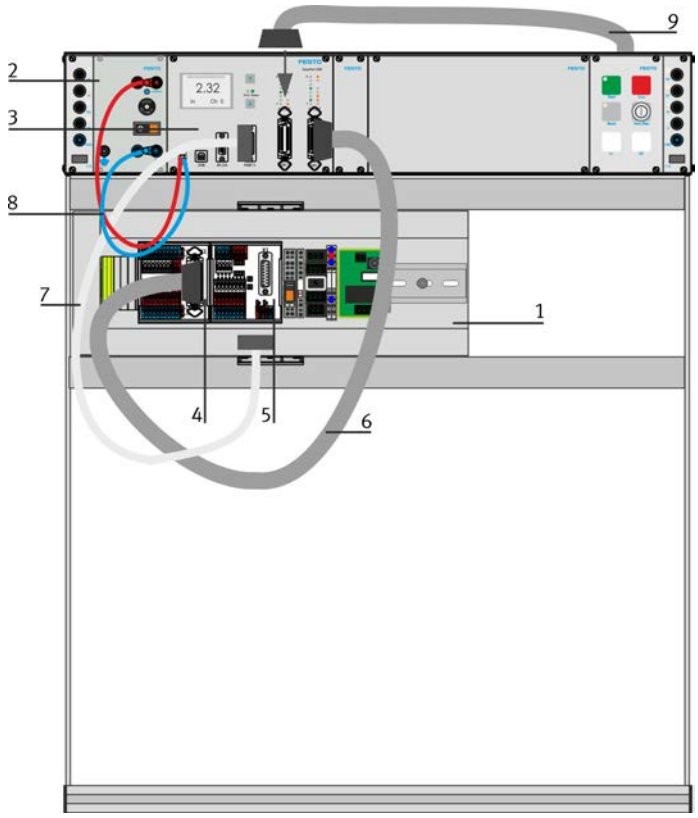


Figure 52: Cable connection MPS PA Station – EasyPort 19".

FluidLab-PA closed-loop settings

Select the station:

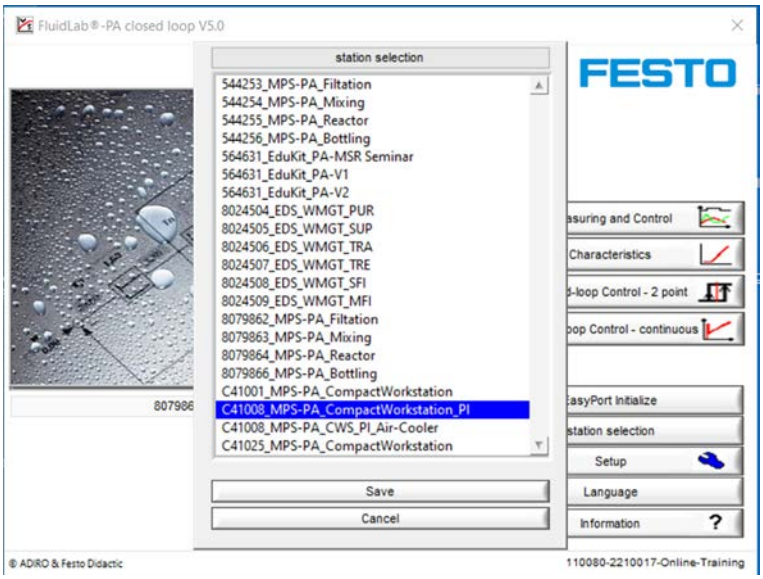


Figure 53: Station selection window.

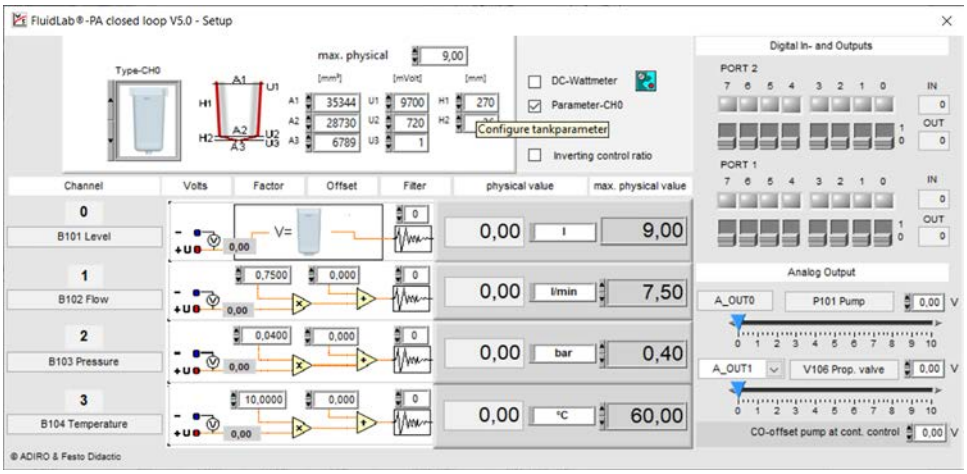


Figure 54: Setup window.

Adapt tank parameters U1, U2 and U3 individually.

Adjusting sensors

The two capacitive proximity sensors are used for level detection in the main tank. They should be adjusted so that you can detect the liquid in the tank without contact, but not the container surface. The liquid changes the capacitance of a capacitor integrated in the proximity sensor.

The capacitive proximity sensors are used at the positions of the lower level and the upper level.

Prerequisites

- The tank and a profile for installing the mounting brackets are mounted
- Electrical connection of the capacitive proximity sensor is established
- Power supply switched on.

Procedure

1. Mount the proximity switches with the mounting bracket so that they do not touch the tank. Distance in each case 5 mm from the tank.

2. Fill the tank with liquid.

3. The proximity sensors are set to the following values:

   - Storage tank 1: 1.6 l (bottom); 2.7 l (top)
   - Storage tank 2: 0.5 l (bottom);
   - Storage tank 3: 0.5 l (bottom)
   - Main tank: 0 l (bottom); 6 l (top)

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4. Move the sensors up or down until the switching status display (LED) switches on at the respective volume level.

   The proximity sensor must be triggered by the liquid in the tank. If there is no liquid in the tank, no signal may be present.

5. Check the positioning and adjustment of the proximity sensor by repeated filling and emptying of the tank.

Float switch, cover installation

The float switch is designed for installation in a 3 l tank. The float switch opens when the maximum liquid level in the tank is exceeded and switches off the pumps via the relay.

Prerequisites

- The tank is mounted.
- Electrical connection of the float switch established.
- Power supply switched on.

Procedure

1. The float switch is led from the inside through the cover opening in the tank and screwed from the outside.

2. Connect the float switch. The switch must emit a signal without liquid.

3. Fill the tank and determine if the float switch interrupts the signal when the maximum fill level is exceeded. The float must move upward.

4. Check the positioning and adjustment of the sensor by repeated filling and emptying.

   Make sure that the float always moves freely and does not jam due to dirt.

Float switch, lateral installation

The float switch is designed for installation in a 10 l tank. The float switch opens when the maximum liquid level in the tank is exceeded and switches off the pumps via the relay.

Prerequisites

- The tank is mounted.
- Electrical connection of the float switch established.
- Power supply switched on.

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Procedure

1. The float switch with cable is led from the inside through the upper left opening in the tank and screwed from the outside. The float must be mounted to swivel upward.

2. Connect the float switch. The switch must emit a signal without liquid.

3. Fill the tank and determine if the float switch interrupts the signal when the maximum fill level is exceeded. The float must move upward.

4. Check the positioning and adjustment of the sensor by repeated filling and emptying.

Make sure that the float always moves freely and does not jam due to dirt.

Flow sensor, electromagnetic

The flow sensor is intended for installation in the piping. The sensor is set at the factory for a 0-10V analog signal proportional to the flow rate and a binary switching signal for the flow rate limit value of 3 l/min. Check the setting parameters of the sensor.

Table 13: Setting parameters of the sensor.

Parameter	Description	Factory settings	User settings
SP1	Switching point	5.00	3.00
rP1	Reset point	4.90	2.5
OU1	Switching signal	HNO	HNO
OU2	Analog output signal	I	U
AEP	Analog end value for volumetric flow rate (l/min)	25.00	10.00

Further information can be found in the operating instructions for the flow sensor.

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Prerequisites

- The sensor is mounted in the piping.
- Electrical connection of the sensor is established.
- Control is connected.
- Power supply switched on.

Procedure

With a flow rate of > 3 l/min, the LED 8 "SP1" must light up in the display.

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Maintenance and Troubleshooting

Maintenance

Festo Didactic systems and components are to a great extent maintenance free. The following components should be cleaned at regular intervals with a soft, lint-free cloth or brush:

- The lenses on the optical sensors, the fiber optics, and the reflectors
- The active surface of the proximity sensor
- The entire station



Always use water of drinking water quality. If the MPS PA Station is not used for a longer period of time, the water should be drained off, the remaining water should be removed from the containers and pipes with a wet vacuum cleaner and rubbed dry with a lint-free cloth.

Observe the instructions in the data sheets!

Error in the piping system and tanks

The following table shows errors that can be simulated through use of the manual valves or that occur due to incorrect operation.

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Table 14: Error in piping system and tanks.

Location	Error / Disturbance variable / Danger potential	Effect of the error, disturbance variable, or danger	Causes	Detection and prevention
Storage tanks B101	The pump draws in air	Pump makes noises, air bubbles in the rising line	The piping upstream of the pump is not exhausted after emptying.	See inspection pipe for air bubbles.
Storage tanks B101	Overflow	When filling water exceeding 10L	Float switch without function or blocked	The float switch is not movable
Upper tank B102	Overflow	When filling water exceeding 10L	Float switch without function or blocked	The float switch is not movable
Hand ball valve V111	Restrict supply to upper tank inlet	Longer filling time	Close hand ball valve V111	Observation of FluidLab PA curve

Error in the pneumatic system

The following table shows errors that can be simulated through use of the pneumatic components or that can occur due to incorrect operation.

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Table 15: Error in the pneumatic system.

Location	Error / Disturbance variable / Danger potential	Effect of the error, disturbance variable, or danger	Causes	Detection and prevention
Service unit/ compressor	No compressed air supply	The 2W ball valve does not move despite the 24VDC signal present at the 5/2W solenoid valve	Compressor off, compressed air line not plugged in, pressure regulator set to zero bar or simply hand valve on service unit switched off	Inspect the pressure gauge/ manometer on the service unit
Cable between service unit and solenoid valves	Pneumatic tubing pinched	The 2W ball valve does not move despite the 24VDC signal present at the Namur solenoid valve	Kink off the hose and secure it with cable ties	Unplug the compressed air tubing from the solenoid valve, hold the tubing tightly, switch the signal to the solenoid valve and check whether air escapes

Error in the electrical system

The following table shows errors that can be simulated through use of the electrical components or that can occur due to incorrect operation.

Table 16: Electrical faults.

Location	Error / Disturbance variable / Danger potential	Effect of the error, disturbance variable, or danger	Causes	Detection and prevention
19" frame back/ underside	Power supply faulty	No electrical function	Unplug the IEC power cable or remove the micro fuse	Observe the light at the power supply switch or measure the voltage

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Location	Error / Disturbance variable / Danger potential	Effect of the error, disturbance variable, or danger	Causes	Detection and prevention
I/O terminal	No switching function	24 VDC outputs do not switch, sensors are not displayed by LEDs	Unplug the SysLink cable from the I/O terminal	Visual inspection
Pump P101	Flow rate too low	Flow rate too low, increased filling time	On the motor controller, exchange ports 1 and 2 of the pump	Display of flow rate at only ~ 2 l/min
Pump P101	Flow rate too low	Flow rate too low, increased filling time	Turn the adjusting screw on the motor controller counterclockwise with a small screwdriver	Select the tank.
SysLink I/O terminal	Signal statuses faulty	Switching signals are not displayed or are displayed incorrectly	Slide switch is in position NPN instead of PNP	Visual inspectionwith data sheet, observe representation

Mechanical faults

The following table shows errors that can be influenced mechanically or can occur as a result of incorrect operation.

Table 17: Mechanical faults.

Location	Error / Disturbance variable / Danger potential	Effect of the error, disturbance variable, or danger	Causes	Detection and prevention
Storage tanks B101	Filling level via capacitive sensors	Incorrect or absent signal display	Turn the sensor or adjust the mounting bracket along the profile	Visual inspection of I/O check

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Error due to parameterization

The following table shows errors that can be influenced by incorrect setting of parameters or can occur as a result of incorrect operation.

Table 18: Parameter error.

Location	Error / Disturbance variable / Danger potential	Effect of the error, disturbance variable, or danger	Causes	Detection and prevention
Pump	Characteristic curve not linear	At higher gains Kp, oscillations occur in the control circuit	System performance	Set the offset of the reference variable in FluidLab-PA
Flow sensor	Measured value in FluidLab-PA does not agree with display on the sensor	Measurement error or inaccuracy or incorrect setting	Setting parameter of the sensor adjusted or reset to factory setting	Check or adjust the parameters on the sensor display or via the SmartBridge app
EasyPort	Connection to EasyPort	Connection cannot be established	Set the EasyPort address, e.g., 2	At the EasyPort using the Address buttons

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Further information and updates

Further information and updates of the technical documentation for the Festo Didactic components and systems are available at the following website:

Festo Didactic wesite

https://ip.festo-didactic.com/InfoPortal/

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Disposal

Equipment disposal

Do not discard the equipment with normal waste: it contains electrical and electronic components. A specialist must dismantle the product. Each component must be recycled or disposed of according to your local legislation.

It is the owner's responsibility to make provisions for the equipment recycling and safe disposal.

Waste from Electrical and Electronic Equipment (WEEE) directive:

- In accordance with European regulations, used electrical and electronics devices cannot be disposed of in unsorted municipal waste. The symbol of the waste bin on wheels indicates the necessity for separate collection. For environmental protection, make sure the equipment is disposed of in the waste sorting processes designed for this purpose. DIRECTIVE 2012/19/EU of the EUROPEAN PARLIAMENT AND OF the COUNCIL of 4 July 2012 on waste electrical and electronic equipment (WEEE).



The presence of this symbol on the equipment indicates the necessity of separate collection.

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Appendix

MPS PA resource files

The resources for the MPS PA courses are included in the following files:



MPS PA Compact Fundamentals of Closed-Loop Control resources.

https://lx.festo.com/media/8cfcb079f5064683a188e16b0f3cffcc



MPS PA Compact Workstation Process Instrumentation resources.

https://lx.festo.com/media/55d89f96839942d89638c64562673dce



MPS PA 204 resources.

https://lx.festo.com/media/77ef6c5e35d6400d859853ffb44f2e19

Parts lists

- MPS PA Compact Workstation part list

PI-diagrams

- MPS PA Compact Workstation, basic design
- MPS PA Compact Workstation, basic design, with water-air cooler
- MPS PA Compact Workstation, basic design, with cooling unit

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Loop lists

- Continuous control of a level control system using an analog standard signal
- Continuous control of a flow-rate control system with a pump as the controlled system using an analog standard signal
- Continuous control of a flow-rate control system with a proportional valve as the controlled system using an analog standard signal
- Continuous control of a pressure control system with a pump as the controlled system using an analog standard signal
- Continuous control of a pressure control system with a proportional valve as the controlled system using an analog standard signal
- Two-point control of a temperature control system using an analog standard signal

Loop diagrams

- Continuous control of a level control system using an analog standard signal
- Continuous control of a flow-rate control system with a pump as the controlled system using an analog standard signal
- Continuous control of a flow-rate control system with a proportional valve as the controlled system using an analog standard signal
- Continuous control of a pressure control system with a pump as the controlled system using an analog standard signal
- Continuous control of a pressure control system with a proportional valve as the controlled system using an analog standard signal
- Two-point control of a temperature control system using an analog standard signal

Electrical circuit diagrams

- MPS PA Compact Workstation, basic design
- MPS PA Compact Workstation, basic design, with water-air cooler
- MPS PA Compact Workstation, basic design, with cooling unit
- Control panel
- DR19

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Pneumatic circuit diagrams

- MPS PA Compact Workstation, basic design

Data sheets

Collection of MPS PA data sheets

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