MPS PA Process Automation Applications

Understanding Common Real-Life Operations





Filtering Station
Aquarium, vacuum cleaner, atomizer, sewage plant, waterworks – filters are of critical importance in many areas and the key question is: how can I ensure a constant flow with any level of filter contamination? And how can the filter be cleaned more effectively? Using compressed air?

The learning objectives of the filtration station cover these questions. By the end of the training, learners will grasp the appropriate open- and closed-loop control principles and technologies.



Mixing Station
Food and confectionery, paints, construction materials, pharmaceutical products – the correct proportions of different materials are crucial to the quality of the end product. Constant metering and mixing of the components makes high demands on the controller and the equipment involved in the process.

The mixing station provides state of the art equipment for demanding, motivating projects on one of the most common control loops in process automation – flow control.



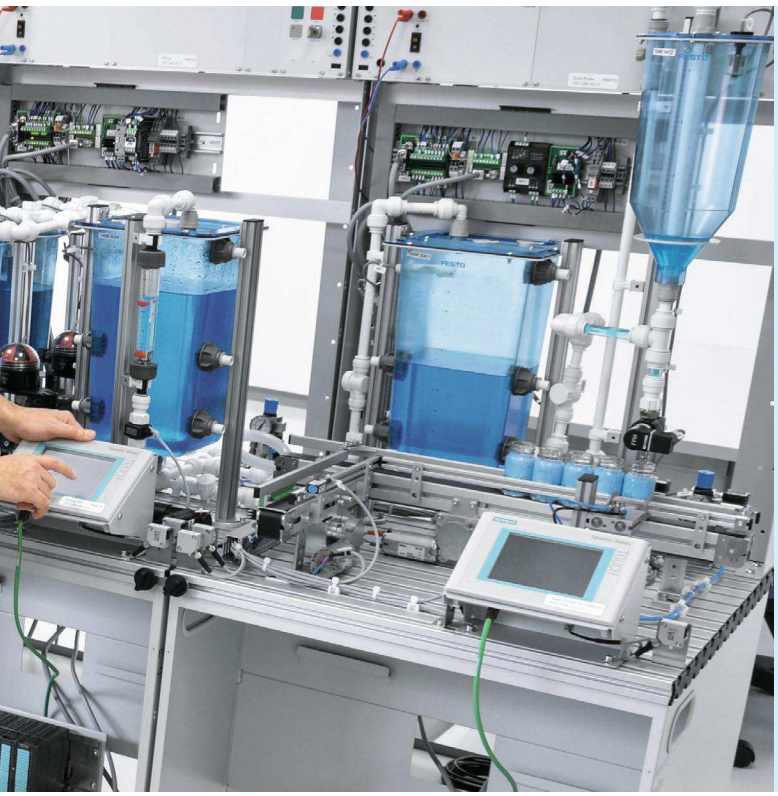
Reactor Station
To extend the shelf life of foods, improve the mixing capacity of liquids or allow them to be mixed, there are a large number of optimized heating processes in the chemical industry.

Temperature control imposes significant demands on electronics components, as managing heat presents its own set of challenges. The realism of the reactor station becomes evident when coupled with the operational and monitoring software.



Bottling Station
Customers get annoyed if there is less in a drinks bottle than it says on the label. For drinks producers, a consistent and guaranteed fill quantity is a crucial quality feature.

The bottling station represents a realistic industrial environment, in which all aspects of a quality optimized filling process can be learned and experienced. The projects focus on level monitoring and positioning of the containers to be filled.



Continuous and Discrete: MPS PA Across Boundaries

Each of the MPS PA stations represents a closed process, such as can be found in an identical or similar form in many industry sectors.

Their control loops provide content for designing demanding courses in measuring and control engineering. They represent the most important continuous processes.

All stations can be combined with one another. The MPS PA stations can be linked to the mechatronic MPS stations and the discrete processes they represent with no problems at all.

The SysLink interface is the basis for this. This means that you can move into the industrial reality of hybrid production with minimal investment.

The interface concept opens a wide range of options for directly combining the individual MPS PA stations. Deciding on one combination or another depends on various factors:
– Training content
– Existing equipment
– Your budget



All Four in One
Anyone who wants to use all four stations in a network should order them as a complete MPS PA 204 system. The advantage: we commission and test the system before it is shipped. All you have to do is supply fresh water.

Commissioning services allow for the combination of on-site commissioning with instruction for the responsible trainers.



Standard with EduTrainer
All stations of the MPS PA will be delivered fully assembled. The stations will come the SIMATIC S7-1500 controller generation in the TIA portal. It delivers maximum performance and user-friendliness for medium and high-end applications in plant automation.



Touch Panel MTP700
Stations also include a preprogrammed touch panel SIMATIC HMI MTP700 Unified Comfort from Siemens, a 7” widescreen touch panel for advanced applications.

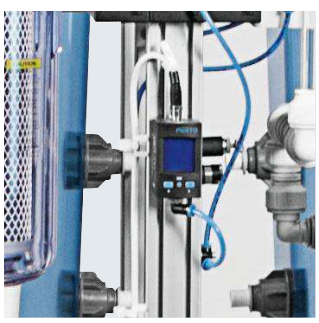
– Multiple interfaces for process communication
– Integrated PROFINET switch
– Programming from WinCC Unified Comfort V16 (TIA portal)

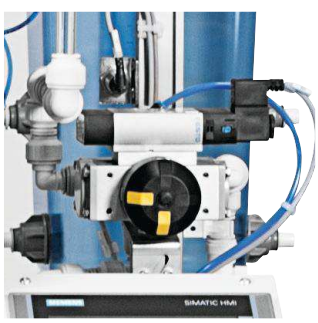
MPS PA Filtration Learning System



Station with optional equipment







Function
The filtration station filters liquids. The filtrate is pumped from the first tank into the second tank through the filter using a knife gate valve. The filtered liquid reaches the second tank via the butterfly valve. It can be pumped onwards to the next station using a separate pump. The filter can be rinsed using a rinse program. Regulated compressed air is blown through the filter to loosen deposits.

Measurement and Control
Sensors detect the filling level of the container. This allows for simple control exercises for monitoring the pumps right up to complete control projects involving complex processes.

Pressure control ensures constant high filter quality during flushing. The pressure sensor with LCD display, analog output and switching output always supplies the correct measurement variable. The controller with P, PI or PID control algorithm ensures constant high filter quality during rinsing via the proportional pressure regulator. Control technology is thus clearly explained.

Shutting off, Opening, Closing
The right selection of process valve, drive, drive accessories and control valve plays an important role in complex process sequences. The filtration station uses a wide range of process components. All the valve actuators are actuated via a directly connected NAMUR valve.

Knife gate valve with linear actuator.

Butterfly valve with sturdy rack and pinion rotary actuator and large visual display.

Three-way ball valve with rack and pinion combination with a constant torque characteristic across the entire swivel range, with large visual display.

MPS PA Filtration Learning System	**8079862**

The most important components at a glance:

1x Filtration station	701291
1x Trolley	541139
1x EasyPort USB 19”	8021637
1x FluidLab-PA Closed-Loop (perpetual license, 1 user)	8208217
1x EduTrainer Universal A4 rack with SIMATIC S7-1512C-1PN	8065600
1x SIMATIC HMI MTP700 Unified Comfort	8189570
1x I/O data cable with SysLink connectors (IEEE 488) at both ends, 2.5 m	34031
1x Analog cable, parallel, 2 m	529141
1x Safety laboratory cable, 3 m	571817

For simple commissioning, simulation and display using the simulation box:

Simulation box, digital/analog	526863
I/O data cable with SysLink connectors (IEEE 488) on both ends, crossover	167106
Analog cable, crossover, 2 m	533039

Recommended accessories:

IEC power cable → festo.com/didactic	
Replacement filter cartridge	544303
Compressor → see below	

Recommended software:

FluidLab-PA Process → Page 170	

Training Aims for Project Work

– Set-up, wiring, and commissioning of a system for process technology
– Selection, application and actuation of process valves
– Measurement of electrical and process-related variables such as level and pressure
– Set-up and commissioning of control circuits
– Analysis of control processes and control circuits
– Parameterization and optimization of P, PI or PID controllers
– Drafting of open-loop and closed-loop control programs
– Process operation and monitoring
– Inspection, maintenance, and servicing

Recommended Learning Material

Workbook

→ page 155



Campus license:

de	8131019
en	8131020

Courses on Festo LX

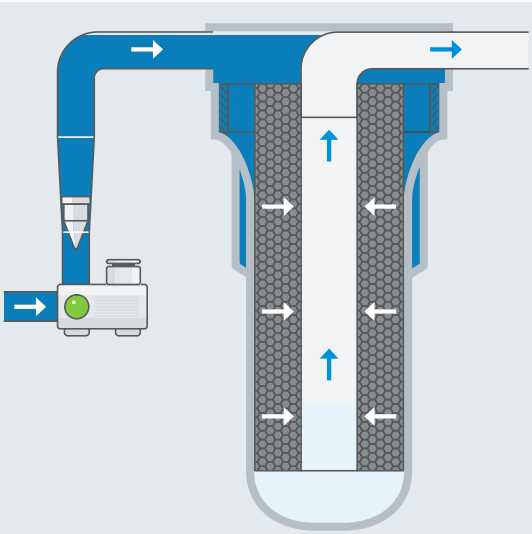
→ Process Automation



→ Open- and Closed-Loop Control
→ Basic Principles of Closed-Loop Control Technology



→ Basics of Production Control





Possibility of Expansion: Compressor

Oil-lubricated, very quiet (45 dB (A)) compressor with pressure reducer and water separator.

230 V	91030
100 V – 120 V	565440

MPS PA Mixing Learning System



Station with optional equipment







Function
The mixing station mixes different recipes from three reservoir tanks. The liquid from one of the three reservoir tanks is pumped into the main tank in a controlled manner by opening the respective two-way ball valve. The finished mixture can be pumped to the next station via a second pump or pumped back to the reservoir tank.

Measurement and Control
The mixing station blends three raw materials according to a set recipe using a constant flow rate. An electro-magnetic flow sensor records the flow rate, which is displayed using a variable-area flowmeter. The output signal from the flow sensor is converted to a standard signal from 0 – 10 V. The mixing station can also be actuated through binary means using the integrated comparator. The controller adjusts the necessary flow rate via the pump with analog control using a simple two-point controller or various dynamic controllers such as P, PI or PID. This permits a clear explanation of control technology.

Always the Right Mixture
The mixing station includes pumps, valves, sensors, and electronic modules for signal conversion, providing a versatile selection from process engineering.

Sensors detect container levels and prevent overflow using extra sensors, eliminating overflow risks.

Signal converters convert all analog signals to standard signals from 0 – 10 V. Practical for the purpose of experimentation: integrated comparators also supply purely binary signals.

Two-way ball valve with rack and pinion combination with a constant torque characteristic across the entire swivel range and directly connected NAMUR valve.

MPS PA Mixing Learning System	**8079863**

The most important components at a glance:

1x Mixing station	701292
1x Trolley	541139
1x EasyPort USB 19"	8021637
1x FluidLab-PA Closed-Loop (perpetual license, 1 user)	8208217
1x EduTrainer Universal A4 rack with SIMATIC S7-1512C-1PN	8065600
1x SIMATIC HMI MTP700 Unified Comfort	8189570
1x I/O data cable with SysLink connectors (IEEE 488) at both ends, 2.5 m	34031
1x Analog cable, parallel, 2 m	529141
1x Safety laboratory cable, 3 m	571817

For simple commissioning, simulation and display using the simulation box:

Simulation box, digital/analog	526863
I/O data cable with SysLink connectors (IEEE 488) on both ends, crossover	167106
Analog cable, crossover, 2 m	533039

Recommended accessories:

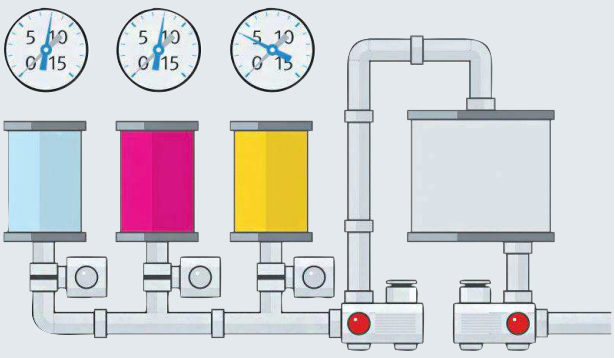
IEC power cable → festo.com/didactic	

For simple commissioning, simulation and display using the simulation box:

Simulation box, digital/analog	526863
I/O data cable with SysLink connectors (IEEE 488) on both ends, crossover	167106
Analog cable, crossover, 2 m	533039
Compressor → see below	

Recommended software:

FluidLab-PA Process → Page 170	



Training Aims for Project Work
- Construction, wiring, and commissioning of a system for process technology
- Selection, application, and connection of various flow sensors
- Measurement of electrical and process-related variables such as level and flow rate
- Design and commissioning of control circuits
- Analysis of control processes and control circuits
- Parameterization and optimization of P, PI or PID controllers
- Drafting of open-loop and closed-loop control programs
- Process operation and monitoring
- Inspection, maintenance, and servicing



Possibility of Expansion: Simulation Box
Commission a station and test its components easily → page 111

Compressor
Oil-lubricated, very quiet (45 dB (A)) compressor with pressure reducer and water separator.

230 V	91030
100 V – 120 V	565440

Recommended Learning Material

Workbook
→ page 155



Campus license:

de	8131019
en	8131020

Courses on Festo LX
- → Process Automation
- → Open- and Closed-Loop Control



- → Basic Principles of Closed-Loop Control Technology
- → Basics of Production Control



MPS PA Reactor Learning System



Station with optional equipment







Function
The reactor station brings liquid to the right temperature. Depending on the recipe selected, different temperature profiles with different stirring times are activated. A cooling pump cools the liquid. The tempered liquid can be pumped onwards to the next station using a separate pump.

Measurement and Control
Sensors detect the filling level of the reservoir in the reactor station. This facilitates lessons on simple control exercises for monitoring the pumps right up to complete control projects involving complex processes.

Exact adherence to the various temperature profiles when activating the recipes is achieved by means of temperature control. The temperature sensor (PT100 resistance thermometer) supplies a unit signal of 0 – 10 V via the measuring transducer. The controller with P, PI or PID control algorithm can approach the setpoint temperature values via the dynamically controlled heating unit and keep the values constant. Simple control exercises, for example control using the two-point controller, can be realized .

Heating and Stirring
Key basic operations in many process engineering systems involve heating and stirring. The reactor station permits experiments in this area.

Infinitely adjustable **heating** with control signal from 0 – 10 V. A safe experimental environment permits integrated linking of the heater with the float switch – thus ruling out the possibility of “running dry” in a practical way.

Stirrer with DC motor

Signal converters convert analog signals from the station to standard signals from 0 – 10 V. Practical for the purpose of experimentation: integrated comparators also supply purely binary signals.

The **water-air cooler** cools down the temperature.

MPS PA Reactor Learning System, 220 V	**8079865**
MPS PA Reactor Learning System, 120 V	**8079864**

The most important components at a glance:

1x Reactor station, 220 V **or**	701293
1x Reactor station, 120 V	8079871

These components apply for both stations:

1x Trolley	541139
1x EasyPort USB 19"	8021637
1x FluidLab-PA Closed-Loop (perpetual license, 1 user)	8208217
1x EduTrainer Universal A4 rack with SIMATIC S7-1512C-1PN	8065600
1x SIMATIC HMI MTP700 Unified Comfort	8189570
1x I/O data cable with SysLink connectors (IEEE 488) at both ends, 2.5 m	34031
1x Analog cable, parallel, 2 m	529141
1x Safety laboratory cable, 3 m	571817
1x Water-air cooler	8080632

For simple commissioning, simulation and display using the simulation box:

Simulation box, digital/analog	526863
I/O data cable with SysLink connectors (IEEE 488) on both ends, crossover	167106
Analog cable, crossover, 2 m	533039

Recommended accessories:

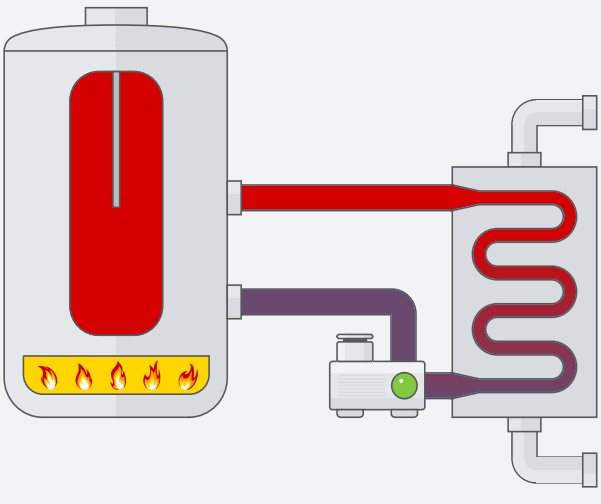
IEC power cable → festo.com/didactic

Recommended software:

FluidLab-PA Process → Page 170
FluidLab-PA Multi-Loop → Page 171

Training Aims for Project Work

– Construction, wiring, and commissioning of a system for process technology
– Selection, application, and connection of temperature sensors
– Measurement of electrical and process-related variables such as level and temperature
– Use and connection of measuring transducers
– Design and commissioning of control circuits
– Analysis of control processes and control circuits
– Parameterization and optimization of P, PI or PID controllers
– Drafting of open-loop and closed-loop control programs
– Process operation and monitoring
– Inspection, maintenance, and servicing





Possibility of Expansion: Cooling Unit with Heat Exchanger

For more options in temperature control experimentation

220 – 240 V, 50/60 Hz	8164444
120 V, 60 Hz	8162598

Recommended Learning Material

Workbook

→ page 155



Campus license:

de	8131019
en	8131020

Courses on Festo LX

→ Process Automation



→ Open- and Closed-Loop Control
→ Basic Principles of Closed-Loop Control Technology



→ Basics of Production Control

MPS PA Bottling Learning System



Station with optional equipment







Function
The bottling station fills bottles with liquid. The liquid is pumped into the dosing tank from the reservoir. These bottles are transported to the filling position via conveyors. A pneumatic separator separates the bottles. The bottles are filled with different filling quantities from the dosing tank in accordance with the recipe selected.

Measurement and Control
The filling level of the dosing tank is detected in the filling station using an analog filling level sensor. The controller regulates the filling level to the required setpoint value via the dynamically controlled pump (0 – 10 V).

The filling level in the dosing tank is kept constant during filling, which optimizes process quality of the filling process. Various control algorithms such as P, PI or PID can be applied and optimized during experiments. The characteristics of the control process can be modified using hand valves already integrated. Control technology is clearly and practically explained in this way.

Transporting, Separating, Filling
Few segments of the diversified process industry are associated with such a wide range of end products as the food industry. All foodstuffs, whether dairy products, baked goods, juice, beer or wine have their own requirements with regard to the handling and production of the corresponding end products. Transporting, separating, proportioning and filling play an important role here.

Optical sensors, adjustable using background suppression, monitor transportation on the conveyors of the bottling station.

The pneumatic separator ensures that there is never more than one bottle at the filling position.

The filling quantity can be easily adjusted by selecting different recipes.

MPS PA Bottling Learning System	**8079866**

The most important components at a glance:

Bottling station	701294
Bottle set	567202
1x Trolley	541139
1x EasyPort USB 19"	8021637
1x FluidLab-PA Closed-Loop (perpetual license, 1 user)	8208217
1x EduTrainer Universal A4 rack with SIMATIC S7-1512C-1PN	8065600
1x SIMATIC HMI MTP700 Unified Comfort	8189570
1x I/O data cable with SysLink connectors (IEEE 488) at both ends, 2.5 m	34031
1x Analog cable, parallel, 2 m	529141
1x Safety laboratory cable, 3 m	571817

For simple commissioning, simulation and display using the simulation box:

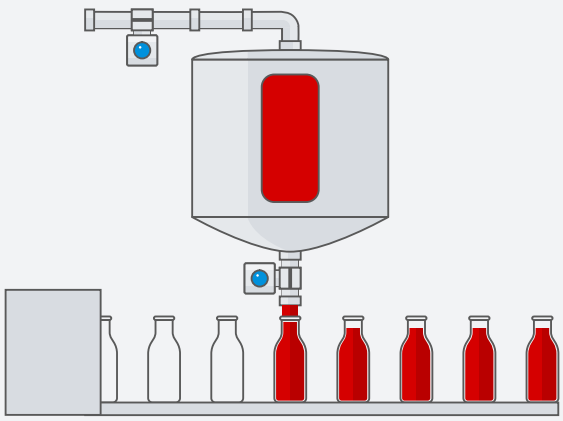
Simulation box, digital/analog	526863
I/O data cable with SysLink connectors (IEEE 488) on both ends, crossover	167106
Analog cable, crossover, 2 m	533039

Recommended accessories:

IEC power cable → festo.com/didactic	
Compressor → see below	
IoT Kit for MPS PA	8162599

Recommended software:

FluidLab-PA Process → Page 170	



Training Aims for Project Work

– Construction, wiring, and commissioning of a system for process technology
– Selection and application of filling level sensors
– Measurement of electrical and process-related variables such as level
– Design and commissioning of control circuits
– Analysis of control processes and control circuits
– Parameterization and optimization of P, PI or PID controllers
– Drafting of open-loop and closed-loop control programs
– Process operation and monitoring
– Inspection, maintenance, and servicing



Possibility of Expansion: IoT Kit for MPS PA

Create a learning scenario to introduce learners to the Internet of Things

Order no.	8162599

Compressor

Oil-lubricated, very quiet (45 dB (A)) compressor with pressure reducer and water separator.

230 V	91030
100 V – 120 V	565440

Recommended Learning Material

Workbook

→ page 155



Campus license:

de	8131019
en	8131020

Courses on Festo LX

→ Process Automation



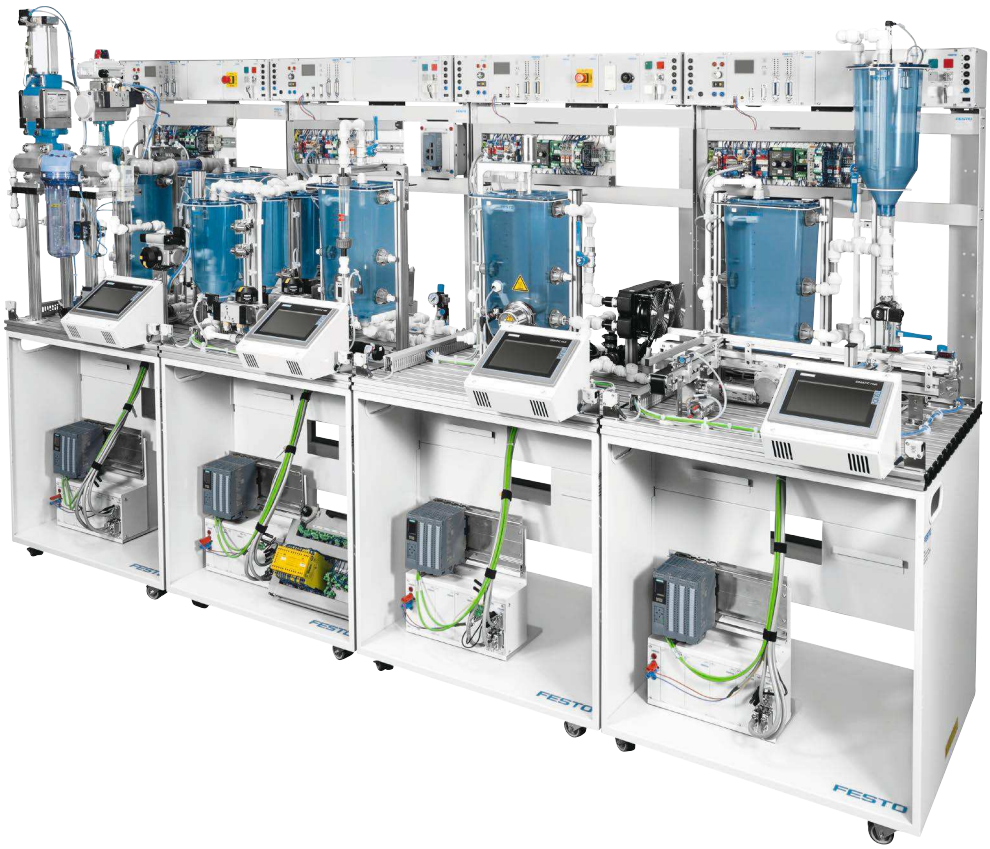
→ Open- and Closed-Loop Control



→ Basic Principles of Closed-Loop Control Technology
→ Basics of Production Control

MPS PA 204 Learning System

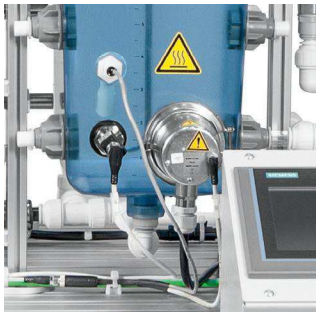
Four Typical Industrial Processes in One System



Function
The system consists of the Filtration, Mixing, Reactor and Bottling stations. The Filtration station filters a fluid. The filtrate is pumped out of the first tank via process valves through the filter into the second tank. The filtered fluid is added to the first tank in the Mixing station.

The Mixing station mixes different recipes from three storage tanks. The finished mixture is pumped to the Reactor station. The Reactor station regulates the temperature of the fluid. Different temperature profiles, with different mixing times, are run depending on the selected recipe. The Bottling station bottles the fluid.

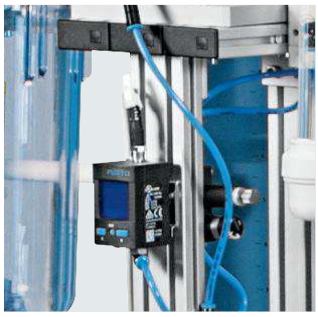
The bottles are carried on conveyor belts to the bottling position. A pneumatic separator separates the bottles. The bottles are filled with different quantities from the dosing tank, depending on the selected recipe.



With a P, PI or PID control algorithm, (closed-loop) control technology is taught in a demonstrative and practical manner. The **temperature** sensor – for the Reactor station a PT100 resistance thermometer is used – delivers a uniform signal of 0 – 10 V via the measuring transducer. By way of the continuously controllable heater the controller sets the nominal temperatures and keeps them constant.



At a constant **flow rate**, the three input materials are mixed into a recipe on the Mixing station. The flow rate is recorded by an electronic flow sensor with an impeller, and is additionally displayed with a float-type flow meter. The controller sets the required flow rate by way of the analog controlled pump.



The **pressure regulation** ensures a constant high filtering quality by means of back-flushing. The pressure sensor features an LCD display, analog output and switching output, always delivering the correct value. A constant high quality is maintained by means of the proportional-pressure regulator.



In the Bottling Station the level of the dosing tank is recorded with an analog **level sensor**. By way of the continuously controllable pump the controller regulates the level to the appropriate control value. During bottling, the level in the dosing tank is kept constant, thereby optimizing the bottling quality.

MPS PA 204 Learning System, 220 – 240 V, 50/60 Hz	**8079868**
MPS PA 204 Learning System, 120 V, 60 Hz	**8079867**

The PLC control packages includes SIMATIC S7-1500
4x EduTrainer Universal with SIMATIC S7-1512C, 4x SIMATIC Touch Panel MTP700 Operator unit, 1x Ethernet switch XB005 EduTrainer Compact

The MPS PA 204 system contains everything you need for training:
- **Stations:** Filtration, mixing, reactor, bottling with trolley, mounting frame and power supply unit
- **Control technology:** 1x PLC control package, 1x EMERGENCY-STOP board, 2x EMERGENCY-STOP control panel, 4x EasyPort
- **Software:** 4x FluidLab-PA Closed-Loop (perpetual license, 1 user)

For simple commissioning, simulation and display using the simulation box:

Simulation box, digital/analog	526863
I/O data cable with SysLink connectors (IEEE 488) on both ends, crossover	167106
Analog cable, crossover, 2 m	533039

Recommended accessories:

IEC power cable → festo.com/didactic	
Replacement filter cartridge	544303
Compressor → see below	
Cooling unit with heat exchanger → see below	
IoT Kit for MPS PA	8162599
Air Control System AirCS equipment set → Page 15	8023858

Recommended software:

FluidLab-PA Process → Page 170	
FluidLab-PA Multi-Loop → Page 171	

Included in the Scope of Delivery: Various Facilities for Measuring, Controlling and Regulating

- Simplifies commissioning, simulation and display using the simulation box
- Multimedia measuring, controlling, regulating, operating, monitoring and commissioning using EasyPort and FluidLab-PA Closed-Loop.
- Start processes in the PLC or operate and monitor them with the touch panel
- The control task is handled by the PLC. The controller parameters are set on the touch panel. All process variables are displayed in a user-friendly way – including trend graphs on the touch panel.

The MPS PA complete system provides everything needed for an efficient start in measurement and control technology.

Successful Project Work Based on Modular Construction

Learning by doing – the MPS PA system offers accessible, hands-on process technology. Project ideas can be implemented in a flash, and risk-free.

Special Training Aims
- Set-up, wiring, and commissioning of a system for process technology
- Measurement of electrical and process engineering variables such as level, flow rate, pressure, and temperature
- Set-up and commissioning of control circuits
- Assessment of control response
- Networking of process engineering systems
- Process operation and monitoring, system management
- Selection, deployment, and control of process fittings
- Analysis of controlled systems and control circuits
- Parameter setting and optimization of P, PI, or PID controllers
- Writing open-loop and closed-loop control programs
- Process operation and monitoring
- Inspection, maintenance, and servicing



Possibility of Expansion: Cooling Unit with Heat Exchanger
For more options in temperature control experimentation

220 – 240 V, 50/60 Hz	8164444
120 V, 60 Hz	8162598

Compressor
Oil-lubricated, very quiet (45 dB (A)) compressor with pressure reducer and water separator.

230 V	91030
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Recommended Learning Material

Workbook
→ page 155



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Courses on Festo LX
→ Process Automation



→ Open- and Closed-Loop Control
→ Basic Principles of Closed-Loop Control Technology



→ Basics of Production Control