

8130882

403-1 System

FESTO

**MPS
Systems**

Operating instructions



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Translation of the original operating instructions

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For the sake of readability throughout these operating instructions, all gender-specific terms are to be considered to refer to both the feminine and the masculine form, except when referring to a particular person.



CAUTION

These operating instructions must always be available to the user.
The operating instructions must be read before commissioning.
The safety instructions must be observed
Non-observance may result in severe personal injury or damage to property.

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1 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.
 - 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.


2 Safety Instructions and Pictograms

2.1 Safety instructions

| | |
|---|--|
|  | <div data-bbox="762 367 1018 434">  DANGER </div> <p>... indicates an imminently hazardous situation which will result in death or severe personal injury if not avoided.</p> |
|---|--|

| | |
|---|---|
|  | <div data-bbox="751 651 1029 719">  WARNING </div> <p>... indicates a possibly hazardous situation which may result in death or severe personal injury if not avoided.</p> |
|---|---|

| | |
|--|--|
|  | <div data-bbox="758 938 1021 1005">  CAUTION </div> <p>... indicates a possibly hazardous situation which may result in moderate or slight personal injury or severe property damage if not avoided.</p> |
|--|--|

| | |
|---|--|
|  | <div data-bbox="820 1240 965 1296"> <i>NOTICE</i> </div> <p>... indicates a possibly hazardous situation which may result in property damage or loss of function if not avoided.</p> |
|---|--|

2.2 Pictograms



Warning regarding of a danger point



Warning regarding dangerous electric voltage



Information and/or references to other documentation

3 Use for Intended Purpose

Festo Didactic components and systems may only be used:

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

The components and systems are designed in accordance with the latest technology and recognized safety rules. Nevertheless, incorrect use can lead to risk of severe or fatal injury for the user and third parties and damage to the components.

The learning system from Festo Didactic 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 these operating instructions.

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 which serve any purpose other than training and/or vocational education, unless such damages have been caused by Festo Didactic due to malicious intent or gross negligence.



4 For Your Safety

4.1 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.

These operating instructions include the most important instructions for safe use of the components and systems. In particular, the safety instructions must be adhered to by all persons who work with these components and systems. Furthermore, all pertinent accident prevention rules and regulations which are applicable at the respective place of use must be adhered to.

| | |
|---|---|
|  | <div style="background-color: #e67e22; color: white; padding: 5px; text-align: center;">  WARNING </div> <p>Malfunctions which could impair safety must be eliminated immediately!</p> |
|---|---|

| | |
|--|---|
|  | <div style="background-color: #f1c40f; color: black; padding: 5px; text-align: center;">  CAUTION </div> <p>Improper repairs or modifications may result in unforeseeable operating states. Do not carry out any repairs or changes to the components and systems that are not described in these operating instructions.</p> |
|--|---|

4.2 Obligations of the operating company

The operating company undertakes to allow only those persons to work with the components and systems who:

- Are familiar with the basic regulations regarding work safety and accident prevention and have been instructed in the use of the components and systems.
- Have read and understood the safety chapter and warnings in these operating instructions.

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



4.3 Obligations of the trainees

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



- Read the chapter concerning safety and the warnings in these operating instructions.
- Familiarize themselves with the basic regulations regarding work safety and accident prevention.



5 Work and Safety Instructions

5.1 General



|  |  CAUTION |
|---|---|
| | <ul style="list-style-type: none"> • Trainees should only work with the circuits under the supervision of an instructor. • Observe the specifications included in the technical data for the individual components, and in particular all safety instructions! • Wear personal safety equipment (safety glasses, safety shoes) when working on circuits. |



5.2 Mechanical safety



|  |  WARNING |
|--|--|
| | <ul style="list-style-type: none"> • Switch off the power supply. <ul style="list-style-type: none"> – Switch off the working and control power before working on the circuit. – Only reach into the setup when it's at a complete standstill. – Be aware of potential overtravel times for the drives. • Risk of injury during troubleshooting. Use a tool such as a screwdriver to actuate limit switches. |

|  |  CAUTION |
|---|---|
| | <ul style="list-style-type: none"> • Mount all of the components securely on the profile plate. • Make sure that limit valves are not actuated from the front. • Set all components up so that it's easy to activate the switches and interrupters. • Follow the instructions about positioning the components. |



5.3 Electrical safety



|  |  DANGER |
|---|---|
| | <ul style="list-style-type: none"> • Risk of death in case of interrupted protective earth conductor! <ul style="list-style-type: none"> – The PE 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! <p>Contact voltages of > 25 V AC or > 60 V DC are not permissible. Coming into contact with voltages of > 50 V AC or 120 V DC may be fatal.</p> <ul style="list-style-type: none"> – Do not connect voltage sources in series. • Risk of death due to electric shock! <p>Protect the outputs of the power supply units (output sockets/terminals) and connector cables connected to them from direct contact.</p> <ul style="list-style-type: none"> – Only use connector cables with adequate insulation and electric strength. – Use safety sockets with fully shrouded contact points. |

|  |  WARNING |
|---|--|
| | <ul style="list-style-type: none"> • Disconnect from all sources of electrical power. <ul style="list-style-type: none"> – Switch off the power supply before working on the circuit. – Please note that electrical energy may be stored in individual components. Further information on this issue is available in the data sheets and operating instructions included with the components. – Caution! <p>Capacitors inside the device may still be charged even after being disconnected from all sources of voltage.</p> |

| | |
|---|--|
|  | <div style="background-color: #FFD700; text-align: center; padding: 5px; margin-bottom: 10px;">  CAUTION </div> <ul style="list-style-type: none"> • Use safety extra-low voltage (SELV) only: max. 24 V DC. • The power pack must only be operated using a power supply with a PE conductor. • Establishing and disconnecting electrical connections <ul style="list-style-type: none"> – Electrical connections may only be established in the absence of voltage. – Electrical connections may only be disconnected in the absence of voltage. – Always pull on the plug when disconnecting connecting cables; never pull the cable. • Maximum permissible current loads for cables and devices must not be exceeded. <ul style="list-style-type: none"> – Always compare the current ratings of the device, the cable and the fuse. – 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. <ul style="list-style-type: none"> – Hot surfaces are identified with a corresponding warning symbol. • Make sure that connecting cables are not subjected to continuous tensile loads. • Devices with a ground connection must always be grounded. <ul style="list-style-type: none"> – If a grounding terminal (green-yellow laboratory socket) is available, it must always be connected to the protective grounding. The protective grounding must always be connected first (before voltage) and must always be disconnected last (after voltage). – Some devices have a high leakage current. These devices must be additionally grounded with a PE conductor. • When replacing fuses, use specified fuses only with the correct current ratings and tripping characteristics. • The device is not equipped with an integrated fuse unless otherwise specified in the technical data. • In the case of <ul style="list-style-type: none"> – visible damage, – malfunction, – incorrect storage, – incorrect transport, hazard-free operation of the device is no longer possible. <ul style="list-style-type: none"> – Switch off the power supply immediately. – Protect the device against inadvertent restart. |
|---|--|











5.4 Pneumatic safety

| | |
|---|---|
|  | <div style="background-color: #e67e22; color: white; padding: 5px; text-align: center;">  WARNING </div> <ul style="list-style-type: none"> • Depressurize the system! <ul style="list-style-type: none"> – Switch off the compressed air supply before working on the circuit. – Check the system with pressure gauges to make sure that the entire circuit is pressure-free. – Please note that energy may be stored in pressure reservoirs. Further information on this issue is available in the datasheets and operating instructions included with the components. • Risk of injury when switching compressed air on! Cylinders may advance and retract automatically. • Risk of accident due to advancing cylinders! <ul style="list-style-type: none"> – 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 of the rigid components in the setup. • Risk of accident due to pneumatic tubing slipping off! <ul style="list-style-type: none"> – Use shortest possible tubing connections. – If pneumatic tubing slips off: Switch off the compressed air supply immediately. • Do not exceed the maximum permissible pressure of 6 bar (600 kPa). • Do not switch on the compressed air until all the tubing connections have been established and secured. • Do not disconnect pneumatic tubing while under pressure. <ul style="list-style-type: none"> – Do not attempt to connect pneumatic tubing or push-in connectors with your hands or fingers. |
|---|---|

| | |
|---|--|
|  | <div data-bbox="758 197 1021 257"> CAUTION</div> <ul style="list-style-type: none">• Setting up the pneumatic circuit<ul style="list-style-type: none">– 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.• Dismantling the pneumatic circuit<ul style="list-style-type: none">– Switch off the compressed air supply before dismantling the circuit.– Press the blue release ring down so that the pneumatic tubing can be pulled out.• Noise due to escaping compressed air<ul style="list-style-type: none">– 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 sets are equipped with mufflers. Do not remove these mufflers. |
|---|--|

6 Safety Sockets

Unless otherwise indicated in the technical data, the following color coding applies for supply and signal connections on components of the Festo Didactic Automation and Technology Learning System.

| Color | Function | Color | Function |
|---|---|---|---|
|  | Voltage greater than SELV e.g. supply voltage of 90 to 400 V AC per conductor external conductor L1 (grey-brown) |  | 24 V DC (red) |
|  | Voltage greater than SELV e.g. supply voltage of 90 to 400 V AC per conductor external conductor L2 (grey-black) |  | 0 V DC (blue) |
|  | Voltage greater than SELV e.g. supply voltage of 90 to 400 V AC per conductor external conductor L3 (grey-dark grey) |  | SELV Signal input/signal output (black) |
|  | Voltage greater than SELV e.g. supply voltage of 90 to 400 V AC per conductor external conductor (grey) | | |
|  | Neutral conductor (grey-blue) | | |
|  | PE conductor, configuration as 4 mm safety socket (green-yellow) | | |
|  | Protective grounding terminal as PE+ contact, delivery status (green-yellow) | | |




Depending on the type of component, some of the safety sockets listed may not be present. The circuit design may contain additional safety sockets due to the use of different components.

The specified protection class and safe use can only be assured if laboratory safety cables supplied by Festo Didactic are used.

The protective grounding terminal is designed as PE+ contact. This connection provides a low-impedance, safe protective grounding conductor connection. The mechanically incompatible connection prevents a connection error with a 4 mm laboratory safety cable.

The operator bears the responsibility for any removal of this adapter. The adapter can be unscrewed with a 1.5 mm socket head screw. The detent is located in the drilled hole of the adapter. Unscrew the screw in clockwise direction.

| | |
|---|--|
|  | <div data-bbox="751 555 815 611"></div> <div data-bbox="845 571 1027 611">WARNING</div> <div data-bbox="392 656 679 687">Danger of electric shock!</div> <div data-bbox="387 694 1370 766">Damaged safety laboratory cables must be blocked immediately and removed from the laboratory area!</div> |
|---|--|

7 Technical Data

7.1 General data

| Parameter | Value |
|---|--|
| Operating pressure | 600 kPa (6 bar) |
| Operating voltage | 4x 230 V "IEC power cable" Each station 24 V DC, 4 A, ≤ 100 W output power, SELV/PELV limited power supply (LPS) |
| Digital inputs/outputs Inputs: 28 (15+6+7) Outputs: 19 (9+6+4) | Max. 24 V DC Max. 2 A per output Max. 4 A total |
| Analog inputs/outputs Inputs: 1 Outputs: 0 | 0 ... 10 V DC or ±10 V DC |
| Digital input/outputs via IO-Link gateway (Distributing Pro station) Inputs: 3 | 24 V DC Max. 0.5 A per output Max. 2 A total |
| Digital input/outputs via IO-Link DA interface (Joining station) Inputs: 4 Outputs: 4 | 24 V DC Max. 0.5 A per output Max. 2 A total |
| Digital inputs/outputs via RFID gateway (Sorting Inline station) Inputs: 1 Outputs: 1 | 24 V DC Max. 0.5 A per output Max. 2 A total |
| Electrical connection | Standard power plug RJ-45 network connection |
| Pneumatic connection | Plastic tubing with 6 mm outside diameter |
| Compressed air consumption at 600 kPa (continuous cycle) | 10 l/min. |
| Dimensions | 1400 x 700 x 1705 mm |
| Subject to change | |

7.2 Terminal assignment table for Distributing Pro station

Digital (XG1)

| Function | SysLink | Color | Designation |
|----------|---------|--------------|---|
| I0 | 13 | Gray-pink | Workpiece at start of conveyor |
| I1 | 14 | Red-blue | Workpiece at intermediate conveyor position |
| I2 | 15 | White-green | No workpiece at end of conveyor |
| I3 | 16 | Brown-green | |
| I4 | 17 | White-yellow | HMI start button |
| I5 | 18 | Brown-yellow | HMI stop button |
| I6 | 19 | White-gray | HMI key switch |
| I7 | 20 | Gray-brown | HMI reset |
| Q0 | 1 | White | Conveyor forward |
| Q1 | 2 | Brown | Conveyor belt reverse |
| Q2 | 3 | Green | Creep speed on |
| Q3 | 4 | Yellow | |
| Q4 | 5 | Gray | HMI indicator light for start |
| Q5 | 6 | Pink | HMI indicator light for reset |
| Q6 | 7 | Blue | HMI indicator light 1 |
| Q7 | 8 | Red | HMI indicator light 2 |
| 24 V A | 9+10 | Black | 24 V supply for outputs |
| 24 V B | 21+22 | White-pink | 24 V supply for inputs |
| GND A | 11 | Brown-pink | 0 V power supply for outputs |
| GND A | 12 | Purple | 0 V power supply for outputs |
| GND B | 23+24 | White-blue | 0 V supply for inputs |

Digital (XG2)

| Function | SysLink | Color | Designation |
|----------|---------|--------------|---------------------------------|
| I0 | 13 | Gray-pink | Gate valve magazine 1 retracted |
| I1 | 14 | Red-blue | Gate valve magazine 1 advanced |
| I2 | 15 | White-green | Magazine 1 empty |
| I3 | 16 | Brown-green | Activate magazine 1 |
| I4 | 17 | White-yellow | Gate valve magazine 2 retracted |
| I5 | 18 | Brown-yellow | Gate valve magazine 2 advanced |
| I6 | 19 | White-gray | Magazine 2 empty |
| I7 | 20 | Gray-brown | Activate magazine 2 |
| Q0 | 1 | White | Advance gate valve magazine 1 |
| Q1 | 2 | Brown | Magazine 1 activated |
| Q2 | 3 | Green | |
| Q3 | 4 | Yellow | |
| Q4 | 5 | Gray | Advance gate valve magazine 2 |
| Q5 | 6 | Pink | Magazine 2 activated |
| Q6 | 7 | Blue | |
| Q7 | 8 | Red | |
| 24 V A | 9+10 | Black | 24 V supply for outputs |
| 24 V B | 21+22 | White-pink | 24 V supply for inputs |
| GND A | 11 | Brown-pink | 0 V power supply for outputs |
| GND A | 12 | Purple | 0 V power supply for outputs |
| GND B | 23+24 | White-blue | 0 V supply for inputs |

Digital (XG3)

| Function | SysLink | Color | Designation |
|----------|---------|--------------|---------------------------------|
| I0 | 13 | Gray-pink | Gate valve magazine 3 retracted |
| I1 | 14 | Red-blue | Gate valve magazine 3 advanced |
| I2 | 15 | White-green | Magazine 3 empty |
| I3 | 16 | Brown-green | Activate magazine 3 |
| I4 | 17 | White-yellow | |
| I5 | 18 | Brown-yellow | |
| I6 | 19 | White-gray | |
| I7 | 20 | Gray-brown | |
| Q0 | 1 | White | Advance gate valve magazine 3 |
| Q1 | 2 | Brown | Magazine 3 activated |
| Q2 | 3 | Green | |
| Q3 | 4 | Yellow | |
| Q4 | 5 | Gray | |
| Q5 | 6 | Pink | |
| Q6 | 7 | Blue | |
| Q7 | 8 | Red | |
| 24 V A | 9+10 | Black | 24 V supply for outputs |
| 24 V B | 21+22 | White-pink | 24 V supply for inputs |
| GND A | 11 | Brown-pink | 0 V power supply for outputs |
| GND A | 12 | Purple | 0 V power supply for outputs |
| GND B | 23+24 | White-blue | 0 V power supply for inputs |



Cable jumpers are connected from emergency stop to bit 1.5 for all PLC EduTrainer Universal standard MPS versions.

7.3 Terminal assignment table, Joining station

Digital (XG1)

| Function | SysLink | Color | Designation |
|----------|---------|--------------|---|
| I0 | 13 | Gray-pink | Workpiece at start of conveyor (1) |
| I1 | 14 | Red-blue | Workpiece at intermediate conveyor position (1) |
| I2 | 15 | White-green | No workpiece at end of conveyor (1) |
| I3 | 16 | Brown-green | Workpiece orientation not correct, digital |
| I4 | 17 | White-yellow | Workpiece at start of conveyor (2) |
| I5 | 18 | Brown-yellow | |
| I6 | 19 | White-gray | No workpiece at end of conveyor (2) |
| I7 | 20 | Gray-brown | |
| Q0 | 1 | White | Conveyor belt (1) forward |
| Q1 | 2 | Brown | Conveyor belt (1) backward |
| Q2 | 3 | Green | Advance feed separator |
| Q3 | 4 | Yellow | Retract stopper |
| Q4 | 5 | Gray | Conveyor belt (2) forward |
| Q5 | 6 | Pink | Conveyor belt (2) reverse |
| Q6 | 7 | Blue | |
| Q7 | 8 | Red | |
| 24 V A | 9+10 | Black | 24 V supply for outputs |
| 24 V B | 21+22 | White-pink | 24 V supply for inputs |
| GND A | 11 | Brown-pink | 0 V power supply for outputs |
| GND A | 12 | Purple | 0 V power supply for outputs |
| GND B | 23+24 | White-blue | 0 V power supply for inputs |

Analog

| Function | D-SUB-15 | Color | Designation |
|----------|----------|-------|---|
| AI0 | 8 | | Workpiece orientation not correct, analog |



Cable jumpers are connected from emergency stop to bit 1.5 for all PLC EduTrainer Universal standard MPS versions.

Digital (XG2 via IO-Link DA interface)

| Function | SysLink | Color | Designation |
|----------|---------|--------------|------------------------------|
| I0 | 13 | Gray-pink | Slide retracted |
| I1 | 14 | Red-blue | Slide advanced |
| I2 | 15 | White-green | Suction cup up |
| I3 | 16 | Brown-green | Workpiece suction-gripped |
| I4 | 17 | White-yellow | |
| I5 | 18 | Brown-yellow | |
| I6 | 19 | White-gray | |
| I7 | 20 | Gray-brown | |
| Q0 | 1 | White | Retract slide |
| Q1 | 2 | Brown | Advance slide |
| Q2 | 3 | Green | Suction cup down |
| Q3 | 4 | Yellow | Vacuum on |
| Q4 | 5 | Gray | |
| Q5 | 6 | Pink | |
| Q6 | 7 | Blue | |
| Q7 | 8 | Red | |
| 24 V A | 9+10 | Black | 24 V supply for outputs |
| 24 V B | 21+22 | White-pink | 24 V supply for inputs |
| GND A | 11 | Brown-pink | 0 V power supply for outputs |
| GND A | 12 | Purple | 0 V power supply for outputs |
| GND B | 23+24 | White-blue | 0 V power supply for inputs |

Cable jumpers are connected from emergency stop to bit 1.5 for all PLC EduTrainer Universal standard MPS versions.



In the case of XG2, all signals are transmitted via a bus node, which addresses the signals with different protocols depending on the controller.

- With a Siemens PLC: ProfiNet,
- with an Allen Bradley PLC: Ethernet IP

7.4 Terminal assignment table for Sorting Inline

Digital (XG1)

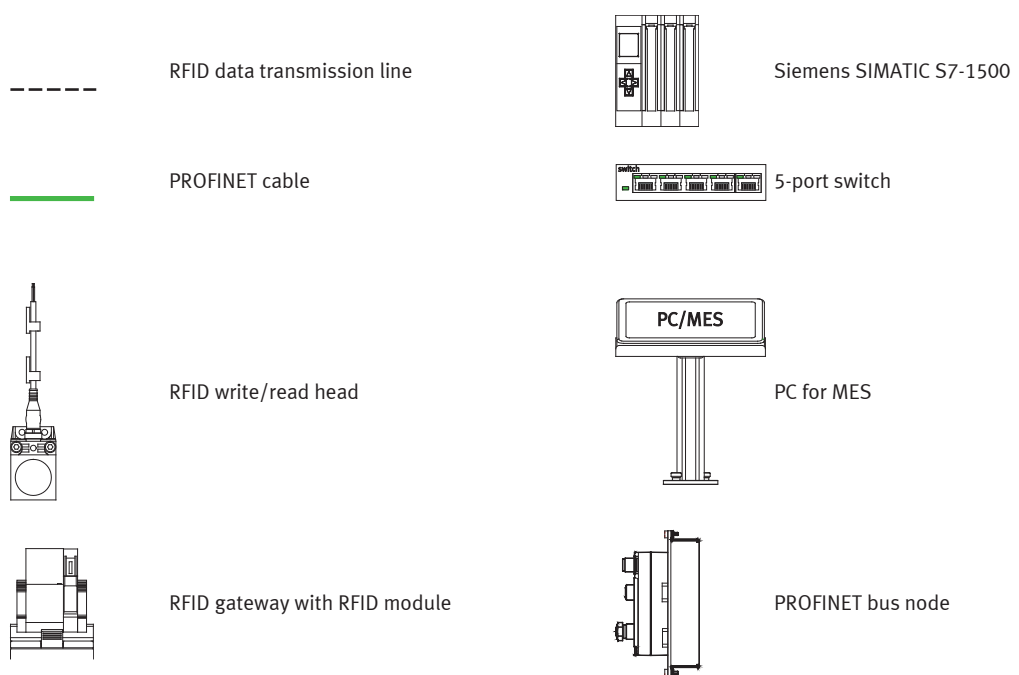
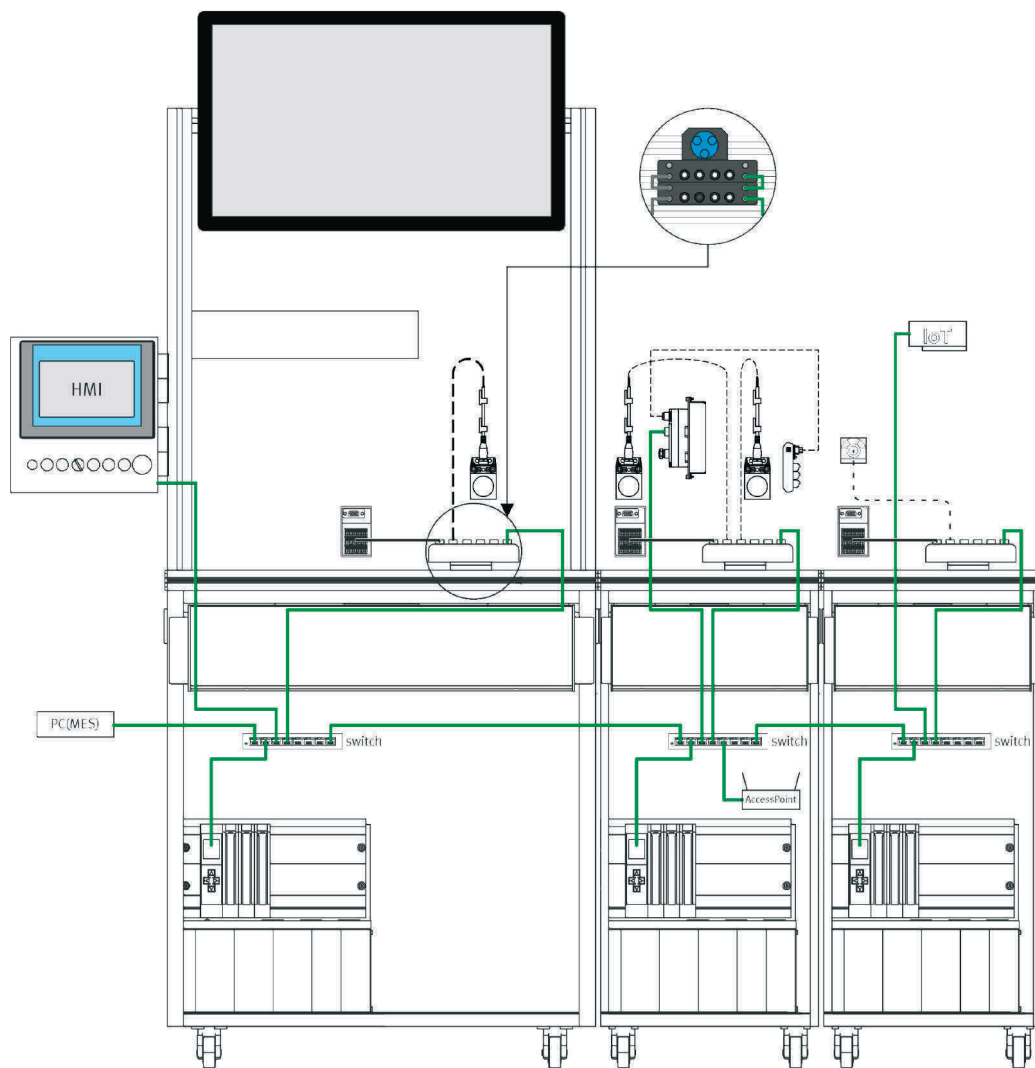
| Function | SysLink | Color | Designation |
|----------|---------|--------------|--|
| I0 | 13 | Gray-pink | Workpiece at start of conveyor |
| I1 | 14 | Red-blue | Deflector 1 advanced |
| I2 | 15 | White-green | Deflector 2 advanced |
| I3 | 16 | Brown-green | Slide is full/workpiece not at end of conveyor |
| I4 | 17 | White-yellow | Workpiece detected |
| I5 | 18 | Brown-yellow | Workpiece not black |
| I6 | 19 | White-gray | Workpiece metallic |
| I7 | 20 | Gray-brown | |
| Q0 | 1 | White | Conveyor forward |
| Q1 | 2 | Brown | Conveyor belt reverse |
| Q2 | 3 | Green | Advance deflector 1 |
| Q3 | 4 | Yellow | Advance deflector 2 |
| Q4 | 5 | Gray | |
| Q5 | 6 | Pink | |
| Q6 | 7 | Blue | |
| Q7 | 8 | Red | |
| 24 V A | 9+10 | Black | 24 V supply for outputs |
| 24 V B | 21+22 | White-pink | 24 V supply for inputs |
| GND A | 11 | Brown-pink | 0 V power supply for outputs |
| GND A | 12 | Purple | 0 V power supply for outputs |
| GND B | 23+24 | White-blue | 0 V power supply for inputs |



Cable jumpers are connected from emergency stop to bit 1.5 for all PLC EduTrainer Universal standard MPS versions.

7.5 Networking the system

In the case of the MPS system 403-1 with Siemens controllers, the controllers, the PROFINET bus node, and the RFID gateways are connected to each other via three 8-port switches. These switches are found at the rear in the respective stations in the carriage.



8 Transport, Unpacking, Scope of Delivery

8.1 Transport

The MPS systems and stations are delivered in a crate. 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 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.

8.2 Unpacking

Carefully remove the padding material from the crate when unpacking the system or 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.

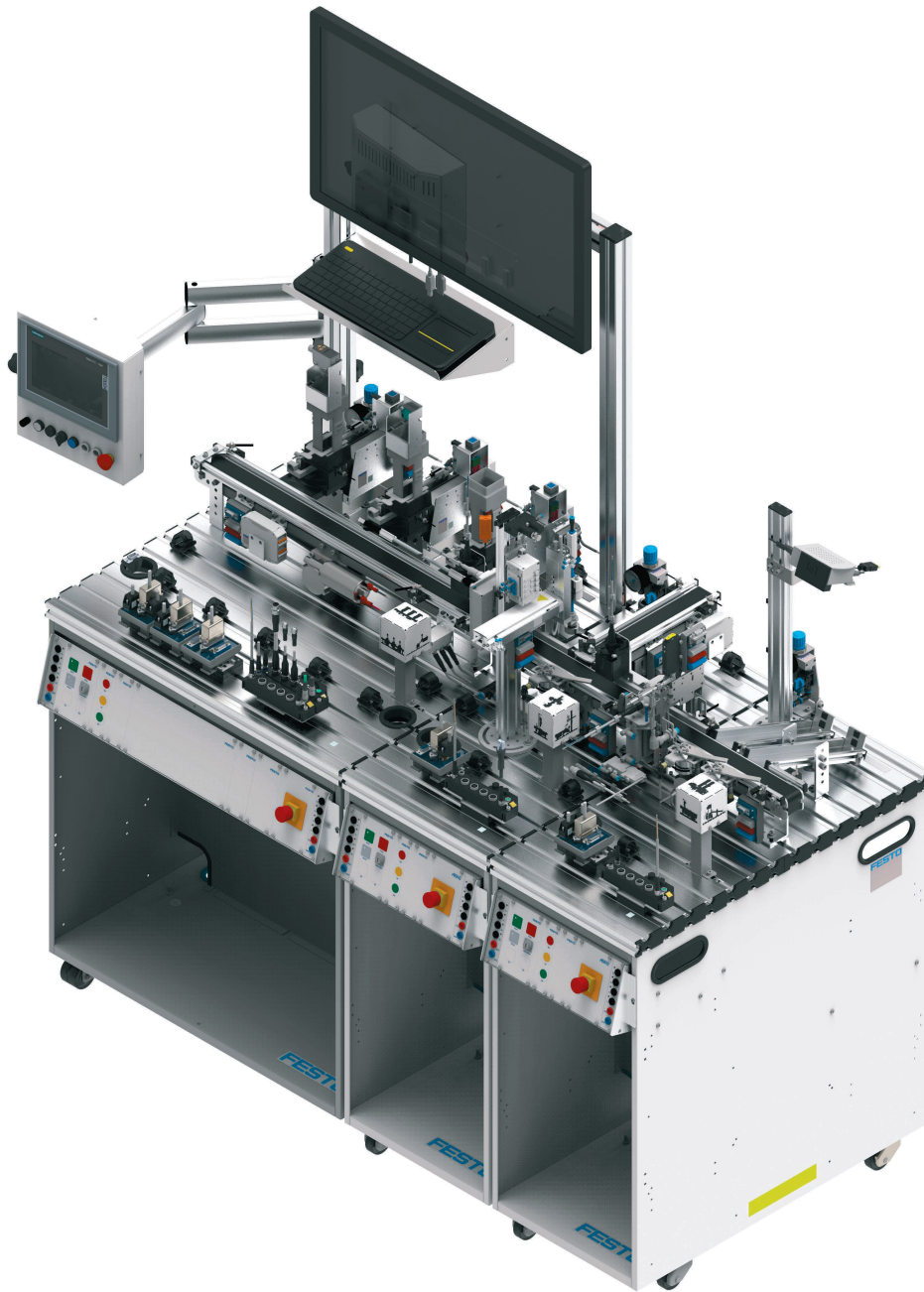
8.3 Scope of delivery

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

- Report any discrepancies without delay to Festo Didactic.

9 Design

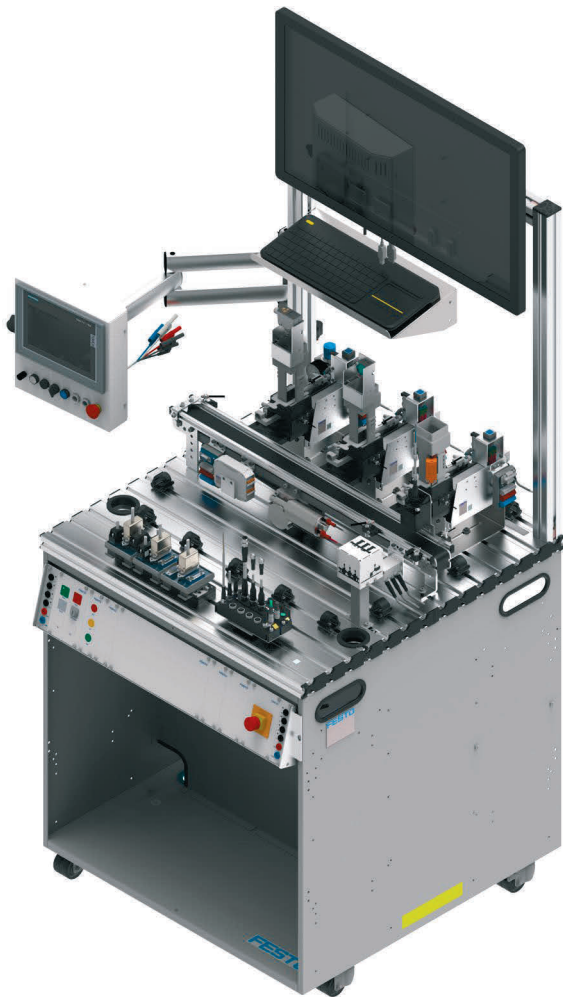
9.1 The MPS system 403-1



View, from left to right: Distributing Pro station, Joining station, Sorting Inline station

The MPS system 403-1 addresses, among other things, the topics of intelligent networking of machines and sequences using the example of a miniaturized production line. The system consists of three slightly adjusted standard stations: Distributing Pro, Joining, and Sorting Inline.

9.2 The Distributing Pro station



The Distributing Pro station is a feeder unit. Feeder units fulfil the function of holding, sorting and feeding workpieces.

In addition, feeder units also enable workpieces to be sorted according to several characteristics (workpiece shape, weight etc.).

Feeder units include:

- Magazines with separator function
- Vibratory hopper conveyors
- Inclined conveyors
- Hoppers with feed separators

Workpieces which can be handled by feeder units include:

- Electroplated parts
- Molded plastic parts
- Punched parts and turned parts

For MPS system 403-1, the Distributing Pro station is equipped with three Stacking magazine modules and a 700 mm Conveyor module.

It also includes IO-Link sensors for detecting the level in the magazines, pushbuttons for deactivating the individual stacking magazines, and an RFID module.

After the workpiece base has been pushed out of the stacking magazine module, the RFID read/write head writes the work order number, the position number and the functions to the RFID tag in the workpiece base.

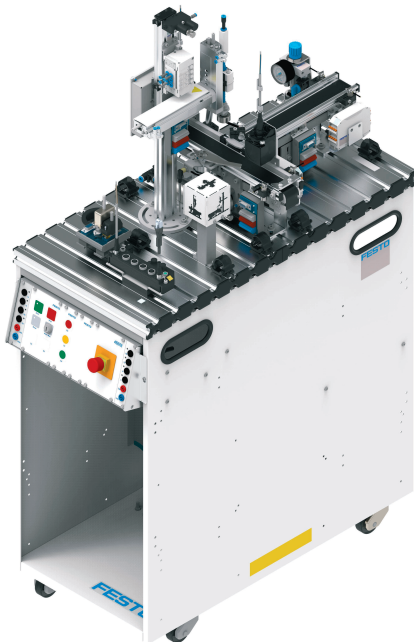
In the first station, the order number (ONo) and order position (OPos) are written in a JSON string onto the RFID tag located in the workpieces. The ONo and OPos are then read in the following stations. After they are read, a query quoting the ONo and OPos is sent to the central MES system. The MES system then sends parameters for the work steps to the station that sent the query.



For additional information, please see the following document:
Distributing Pro station, document no. 8128256

You can find this document on the internet at the following address:
www.ip.festo-didactic.com

9.3 The Joining station



The Joining station consists of a Separating station expanded to include a Pick&Place module, bus node, RFID module, and an additional RFID write/read head.

The Pick&Place module is equipped with a suction cup for joining the workpiece caps and the MPS workpiece bases.

The station can remove workpiece bases from, or place them into, the flow of materials. The workpiece base is held in the joining position at the deflector.

The scope of delivery includes the parallel gripper conversion kit, which is required if EasyKit workpieces need to be joined.

The function of the Joining station is to:

- Remove workpieces from the flow of materials
- Place workpieces into the flow of materials
- Mount workpiece caps on the MPS workpiece bases



Microcontroller workpiece caps can be mounted on the MPS workpiece bases with the Joining station. You can use a mounting kit (order no. 8064882) for this, in order to switch over from a suction cup to a parallel gripper with gripper jaws.

The Joining station combines the handling functions "inspection" and "joining".

The inspection function assigns certain properties to differently oriented workpieces by acquiring data (actual values) and comparing them with predefined values (setpoints).

Depending on the properties determined, either a joining process is started or the workpiece is passed through at the deflector. The workpieces have to be transported individually so that they do not get mixed up and the joining process is not impaired.



Distance sensor output signals

The distance sensor supplies both an analog and a binary output signal. The binary switching output can be adapted to the measurement requirement via a simple teach-in process.

Thanks to the bus node expansions, the Pick&Place module can be used with various bus protocols depending on the controller.

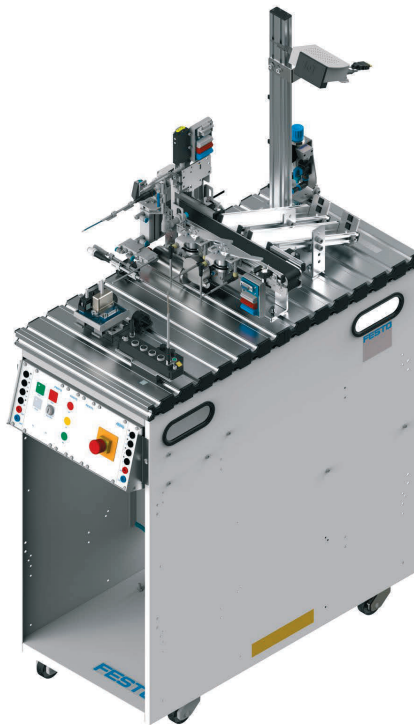
The station has been expanded for the MPS System 403-1 Industry 4.0 to include the RFID module.



For additional information, please see the following document:
Joining station, document no. 8065303

You can find this document on the internet at the following address:
www.ip.festo-didactic.com

9.4 The Sorting Inline station



Sorting is a sub-concept of the “change quantity” handling function. The conveyor is equipped with branches for sorting the workpieces. Various deflectors are set, depending on the workpiece.

The workpieces must travel individually so as not to interfere with the switching operations of the deflectors.

Workpieces are sorted in the Sorting Inline station according to the content of the RFID tag. If negative results are obtained during quality inspection, the workpieces are sorted out to a scrap chute.

The station has been expanded for the MPS System 403-1 to include the height-adjustable RFID module. The RFID tag in the workpiece is read by the RFID read/write head and, depending on the results, the workpiece is ejected.

It is also possible for the Robotino with electric gripper to retrieve the workpiece at the end of the conveyor belt. The Handshake module is required for communication between the Robotino and the MPS station.

The function of the Sorting Inline station is to:

- Sort workpieces according to their characteristics
- Sort workpieces according to RFID tag content



For additional information, please see the following document:
Sorting Inline station, document no. 8129442

You can find this document on the internet at the following address:
www.ip.festo-didactic.com

9.5 The Siemens TP700 HMI



The TP700 Comfort touch panel from the Siemens HMI series is a 7" touch panel for advanced applications.

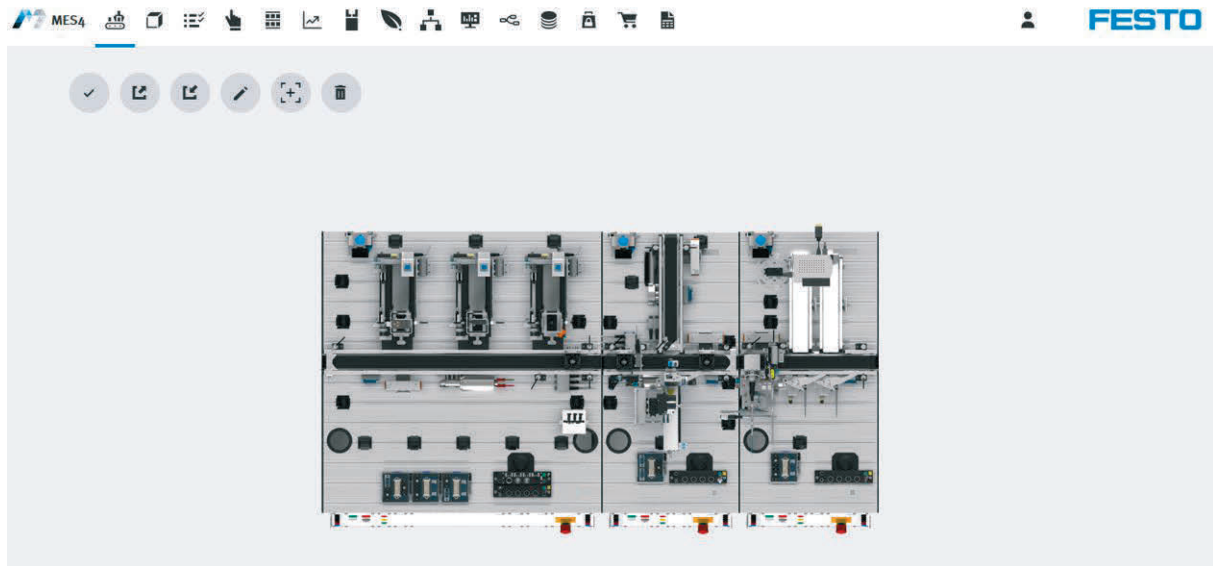
The Comfort panel's features include:

- Comprehensive high-end functionality: archive, VB scripts and various viewers for displaying system documentation (e.g. as PDF files) or in the form of Internet pages
- Multiple interfaces for process communication
- Integrated PROFINET switch
- Programming from WinCC Comfort V15 (TIA portal)

The functions of the HMI are:

- Displaying the level in the magazines
- Displaying signal states
- Operating actuators
- Operating the station
- Reading the parameter data of the IO-Link sensors
- Setting the parameters of the IO-Link sensors
- Setting the runtime monitoring for the push-out cylinders

9.6 MES



The MES can be used to plan products and work orders, which are written to an RFID tag using RFID technology.

In the first station, the order number (ONo) and order position (OPos) are written onto the RFID tag located in the workpieces. The ONo and OPos are then read in the following stations. After they are read, a query quoting the ONo and OPos is sent to the central MES system. The MES system then sends parameters for the work steps to the station that sent the query.

A detailed description of the MES software can be found in separate documentation

The software is normally required for all parts of the MPS system 403-1.

9.7 IO-Link sensors

IO-Link is a standardized I/O technology (IEC 61131-9) for communicating with both sensors and actuators.

An IO-link consists of the following components:

- IO-Link Master (IO-Link multiprotocol module)
- IO-Link devices

These are field devices such as "intelligent" sensors, RFID readers, valves, I/O modules.

Intelligent in this context means that a device has a serial number or certain parameter data (such as switching delay, limits or characteristics), which are readable or writable via the IO-Link protocol.

- Unshielded 3- or 5-conductor standard cables
- IO-Link configuration tool for project engineering and parameterizing the IO-Link system



The IO-Link sensors on the magazine shaft of the Stacking magazine module can be used in combination with the light barrier to indicate the level in the magazine:

- Optical distance sensor: exact value 1-7 (analog)
- Ultrasonic sensor: exact value 1-7 (analog)
- Capacitive sensor: level limit
empty ($x=0$)*, half full ($0 < x < 4$), full ($x > 3$)

* Only detectable in combination with a light barrier in the magazine

10 Function

The MPS System 403-1 represents a small production line consisting of three slightly modified stations: Distributing Pro, Joining and Sorting Inline. The entire system is networked and has been expanded to include several RFID write/read heads.

The MPS system processes work orders which have been entered in the MES, by separating a workpiece at the start of the sequence and writing the order number and the position number to the integrated RFID tag at the end of the first station.

The downstream Joining station reads the RFID tag and decides what will happen to the workpiece based on the work order.

In the final sorting station, the RFID tags are read and the workpieces are distributed to either to the end of the belt or to one of the two chutes, depending on the work order.

11 Sequence Description

11.1 Start-up prerequisites

- Workpieces present in the three Stacking magazine modules.
Left: red workpieces; center: black workpieces; right: silver workpieces
- No workpieces in the system's material flow process.
- All stations in initial position and started up.

11.2 Initial position

- Belt motors off at the stations
- Stopper advanced
- Chutes not full

11.3 Resetting

The stations of a system are always reset in the opposite order to the direction of material flow. In this case from the Sorting Inline station to the Joining station, and finally the Distributing Pro station.

- Turn the key switch in the clockwise direction to the horizontal position (MAN)
The reset LED lights up
- Press the reset button
- Advance the station to its initial position if necessary
The reset LED goes out
- Turn the key switch in the counter-clockwise direction to the vertical position (AUTO).
The start LED lights up
The station is ready for operation

11.4 Starting the stations

A system's stations are always started in the order opposite to the direction of the material flow, and thus in this case from right to left. After successful resetting, press the start buttons at the control panels from right to left.

11.5 Sequence

1. Enter the work order in the MES computer
2. Press the start button at the Distributing Pro station
3. A workpiece of the color defined in the order is fed from the stacking magazine
4. Distributing Pro station conveyor motor on
5. The workpiece is stopped at the RFID write/read head for reading/writing
6. The work order number and the order position are written to the RFID tag
7. Distributing Pro station conveyor motor on
8. The workpiece is transferred to the Joining station
9. The workpiece is detected at the Joining station
10. Joining station conveyor motor on
11. The workpiece is detected at the start of the Joining station's conveyor belt
12. Distributing Pro station conveyor motor off
13. The workpiece is stopped at the Joining station's first RFID write/read head for reading/writing
14. The RFID tag is read

Work order "do not mount cap on workpiece and feed to next station"

15. MES notifies the PLC program that the cap mounting stage needs to be skipped for this workpiece.
16. Joining station conveyor motor on
17. When the processing of the order is complete, the stopper cylinder retracts.
18. The deflector is activated
19. Since no cap will be mounted, the deflector is retracted again
20. The workpiece is detected at the end of the first conveyor
21. Sorting Inline station motor on
22. Workpiece is detected at the start of the Sorting Inline station's conveyor
23. Joining station conveyor motor off
24. Workpiece in downstream station

Work order "mount cap on workpiece"

25. MES notifies the PLC program that a cap needs to be mounted for this workpiece.
26. Joining station conveyor motor on
27. When the processing of the order is complete, the stopper cylinder retracts.
28. The deflector is activated
29. The workpiece is stopped at the deflector
30. Joining station conveyor motor off
31. A cap is detected at the end of the second conveyor
32. Second conveyor motor on
33. A cap is detected at the start of the second conveyor
34. Second conveyor motor off
35. The Pick&Place module suction grips the cap
36. The Pick&Place module joins the cap and the workpiece
37. The Pick&Place module returns to its initial position
38. The deflector is retracted

39. Joining station conveyor motor on
40. The workpiece is detected at the end of the first conveyor
41. Sorting Inline station conveyor motor on
42. Workpiece is detected at the start of the Sorting station's conveyor
43. Joining station conveyor motor off

44. Workpiece in downstream station
45. The detection module determines the color of the workpiece
46. The workpiece is stopped at the Sorting Inline station's RFID write/read head for reading/writing
47. If color checking has been activated, the color specified in the work order string is compared with the detected color.
48. Sorting Inline station conveyor motor on

- According to the inspection results and the order (workpiece ejected to the defined chute)**
49. Deflector to the defined chute is advanced
50. Workpiece ejected
51. Deflector to the defined chute is retracted
52. Conveyor motor off

- According to the inspection results and the order (workpiece is transported to end of conveyor)**
53. Workpiece at end of conveyor
54. Conveyor motor off
55. Workpieces retrieved or (for example) retrieved by Robotino

56. System ready for next run

12 Commissioning

12.1 General information on using MPS systems and stations

The systems and stations of the MPS are normally delivered in the following state:

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



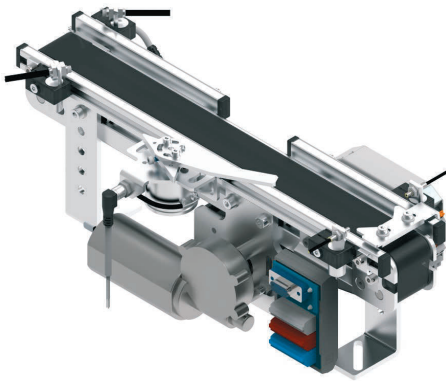
When stations are combined, the mechanical setup, as well as sensor positions and settings, may have to be changed.

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

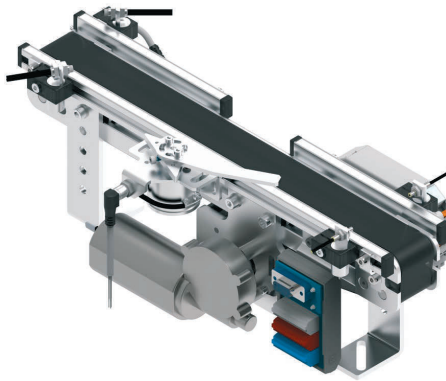
All components, tubing connections and cabling are clearly identified, so that all of the connections can be readily restored as required.

12.2 Mechanical commissioning

If the Distributing Pro and Joining stations are operated with other downstream stations, the stoppers at the end of the conveyor module have to be removed.



Setup as individual station,
the stopper at the end of the conveyor is mounted



Setup with downstream station,
the stopper at the end of the conveyor is removed

12.3 Pneumatic commissioning

First the mechanical setup must be completed. Connect the system's stations to the compressed air supply in the room. The service units required are located at the rear of each station. The quick coupling plug has a nominal width of 5 mm.

If the existing system has a nominal width of 7.9 mm, the service unit's quick coupling plug can be replaced with a larger one (adapter from $\frac{1}{8}$ to $\frac{1}{4}$ required). After the system has been connected to the compressed air supply, it can be pressurized to 600 kPa (6 bar). Pneumatic commissioning is then finished.

12.4 Electrical commissioning

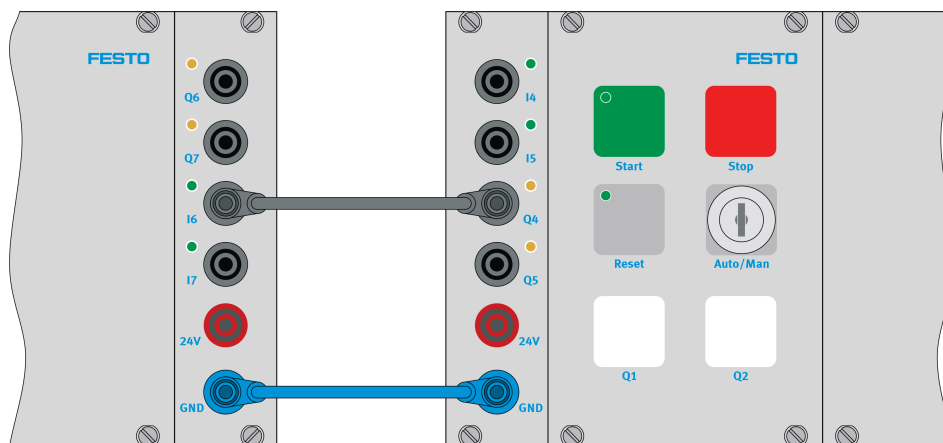
Now the system has to be supplied with electrical power. This is normally done via the SysLink cable, which is connected to the PLC. Distributor blocks are therefore included, also for the connection of additional stations. If the cable length from the distributor block needs to be increased, this can only be carried out by appropriately trained, skilled personnel. The plug socket used must be fused appropriately for the consuming devices.

In order to avoid problems during operation, individual fusing (16 A) of the system is strongly recommended.

12.5 Establishing 1-bit communication links

The communication lines for use within the system are shipped loose and have to be plugged in.

Communication connections between the stations have to be set up in accordance with the following example. The example has been kept general but it is applicable for all stations. Any deviations from this standard will be pointed out.



Example with I/O plug connections between control consoles: connect the Q4 and GND sockets of the downstream station to the I6 and GND sockets of the upstream station.

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

12.6 Workstation

You will require the following items in order to commission the MPS system with the sample programs:

- Dust-free laboratory environment
- Compressed air supply: 600 kPa (6 bar)
- A PC with installed PLC programming software

12.7 Power supply

- The stations are supplied with electrical power from a power pack with an output voltage of 24 V dc (max. 4 A).
- The entire station is supplied with electrical power from the PLC.

12.8 Loading PLC programs

Proceed as described in the user manuals for the programming software used in order to load the PLC programs.

Current PLC programs can be found at the following website in the Internet:

www.ip.festo-didactic.com



13 Accessories

- MPS trolley, 700 x 700
without height adjustment, order no.: 8106686
- MPS trolley, 700 x 350
without height adjustment, order no.: 8033248
- Control console, SysLink, order no.: 195764 or 8127609
- EduTrainer Universal
Siemens SIMATIC S7-1512C-1PN (MPS), order no. 8095754
- I/O data cable with SysLink connectors (IEEE 488), 2.5 m, order no. 34031
- Simulation box, digital, order no. 170643
- Workpiece set “Cylinder bodies”, order no. 167021
- Workpiece set “For cylinder assembly”, order no. 162239
- Workpiece set “Housings”, order no. 534619
- Grounding set for MPS trolley, order no. 8088988
- PE+ protective grounding connecting cable, assortment comprising:
8x PE+ cables, 100 mm
4x PE+ cables, 400 mm
4x PE+ cables, 1500 mm
order no.: 8067503
- PE+ adapter set, 4 mm to PE+, assembly instructions and tools
order no.: 8067500

14 Maintenance and Care

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 area of the proximity sensors
- The entire component/the system



NOTICE

Do not use aggressive or abrasive cleaning agents.

15 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:

www.ip.festo-didactic.com



16 Disposal



Electronic waste contains reusable materials and must not be disposed of with the rubbish. Bring electronic waste to a designated municipal collection point.

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