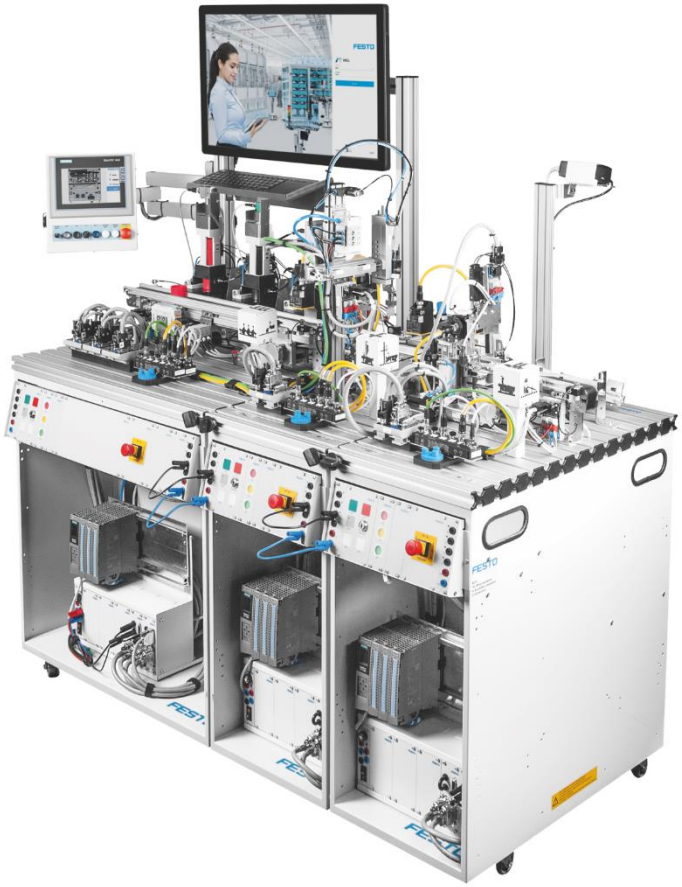
Guidance for Systematic Fault Investigation in Industry 4.0 Systems



Contents

List of illustrations

1 Illustration of the stations and elements related to error investigation

1.1 MPS 403-1

1.1.1 Function

The MPS 403-1 learning system is used to train basic skills and specialist knowledge in the field of automation technology and mechatronics. As a miniaturized production line, it also offers a deep insight into the intelligent networking of machines in the production environment and in their work processes. The system consists of three stations: Distribute Pro, Join and Sort Inline. These stations are networked, equipped with several RFID read and write heads and intelligent sensors based on IO-Link and form an autonomous system.

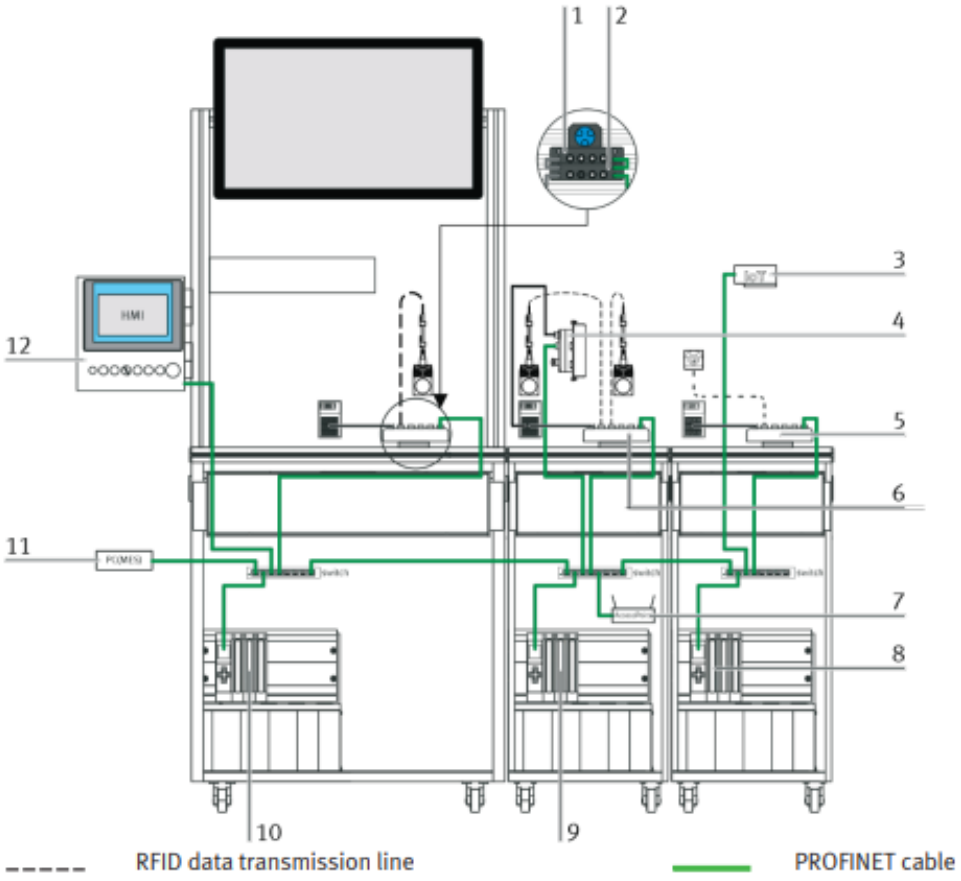
With the web-based software environment around a didactic MES system, MPS 403-1 offers a broad spectrum for learning the latest Industry 4.0 technologies. This software environment contains an integrated web shop, learning content such as IoT retrofitting based on a compact controller, touch panel programming and artificial intelligence with machine learning algorithms. Augmented Reality supported learning concepts as well as a clear didactic preparation of all content with extensive learning documents make this learning system the core of every modern MPS based learning solution.

1.1.2 Layout

The MPS 403-1 contains following components:

- 1x MPS Distribution Por Station
- 1x MPS Joining Station
- 1x MPS Sorting-Inline Station
- RFID kits
- IO-Link Sensors
- IoT Device (in the form of camera evaluation)
- 3x EduTrainer S7-1512C SPS
- 1x Computer with Touch-Monitor for the MES
- Networking of all Stations

1.2 Networking the system

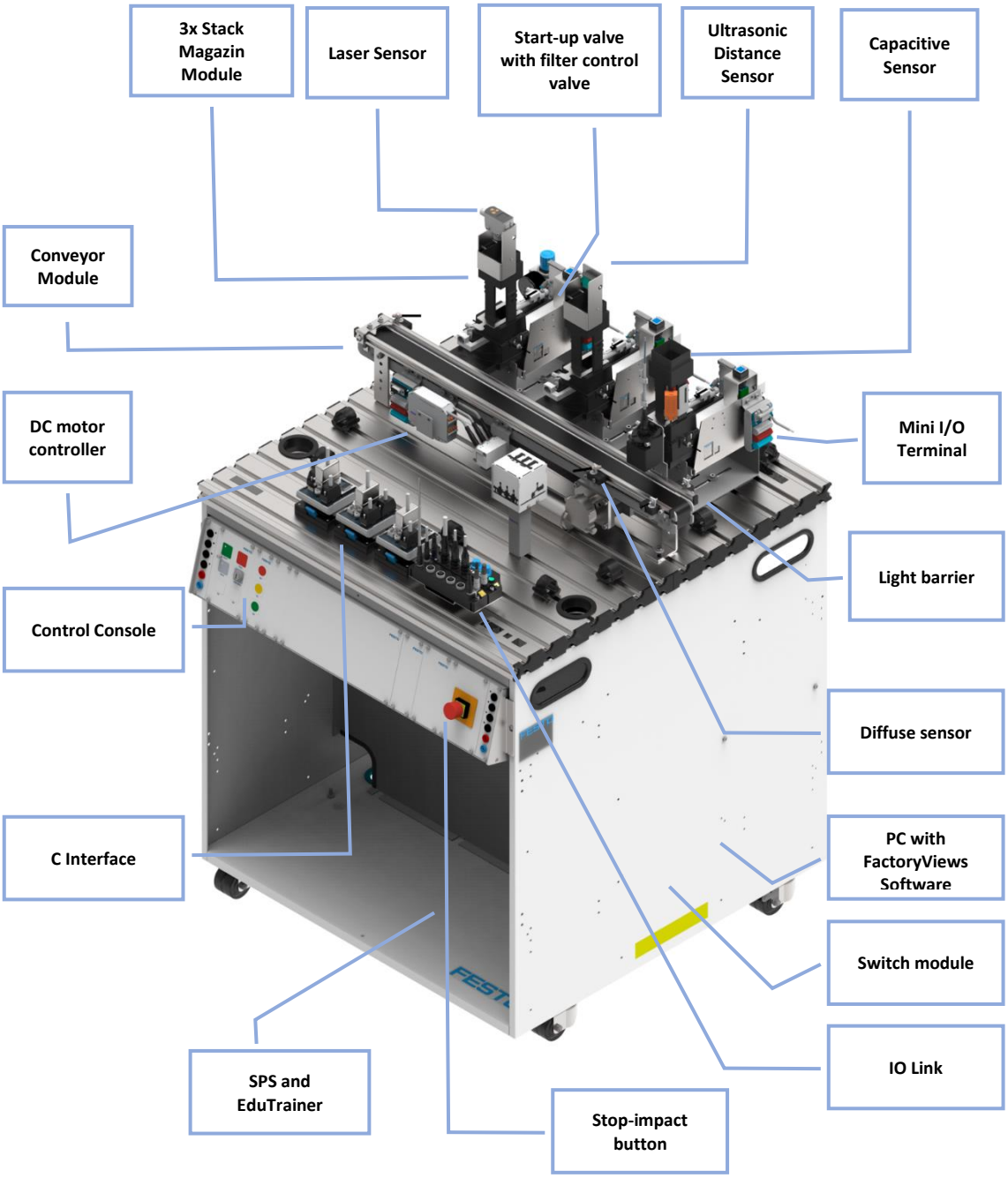


No.	Device	IP address
1	Turck IO-Link Master	172.21.55.12
2	Turck RFID gateway	172.21.55.11
3	IoT device (Raspberry)	172.21.55.46-
4	PROFINET bus node	172.21.55.32
5	Turck RFID gateway	172.21.55.41
6	Turck RFID gateway	172.21.55.31
7	Access point	172.21.0.230
8	Siemens SIMATIC S7-1512C - Sorting PLC	172.21.55.40
9	Siemens SIMATIC S7-1512C - Joining PLC	172.21.55.30
10	Siemens SIMATIC S7-1512C - Distributing Pro PLC	172.21.55.10
11	PC for MES system	172.21.0.90
12	HMI	172.21.55.13

1.3 MPS Distributing Pro 400 Series

1.3.1 Function and structure of the station

The station separates individual workpieces in a stacking magazine. A double-acting cylinder pushes the workpieces out one at a time. The conveyor module transports the workpiece to the right or left. The conveyor can be stopped in order to separate the workpiece. The simple setup process for the MPS Station makes it easy to create a workflow program for the handling process. Different workpieces can be used in the stacking magazine module.



1.3.2 Elements of the Distribute station

1.3.2.1 Conveyer Module

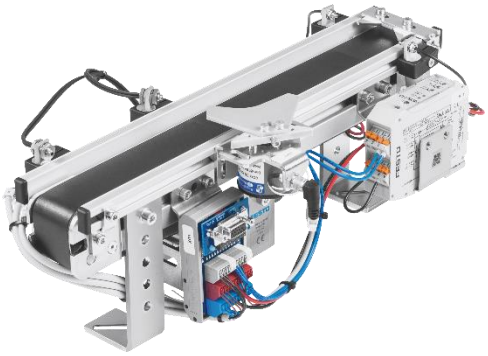


FIGURE 1.3-1 CONVEYER MODULE

Layout
The conveyor module can be mounted on a profile plate, a profile foot or a slotted mounting frame. The DC motor is freely position able. The conveyor module is suitable for the transport of workpieces of 40 mm diameter (e.g., "Body" or "Cylinder for assembly" workpiece sets). The module is supplied fully assembled. The built-in motor controller allows for clockwise/anticlockwise rotation. After removing the bridge between ports 6 and 8 of the motor controller, port 6 of the motor controller can be connected to port 11/12 of the I/O terminal. This allows the belt speed to be controlled via an analog value of 0…10 volts.

Function
The Conveyor module is used to transport and buffer workpieces. Optical proximity switches with fibre-optic cables are used to check that workpieces are present upstream from the feed separator and at the end of the conveyor. The conveyor belt is driven by a DC gear motor. The workpieces can be stopped and separated by an attached electromagnet (solenoid) with separator. The end positions are monitored by inductive proximity switches.

1.3.2.2 Stack Magazine Module

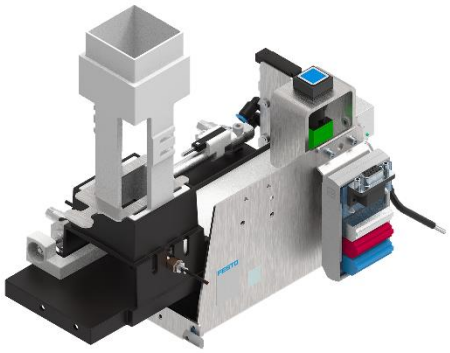


FIGURE 1.3-2 STACK MAGAZINE MODULE

Layout
A light barrier underneath the magazine tube checks to determine whether or not the magazine is empty. An opto-electronic sensor can optionally be screwed into the base, which detects the caps and the workpieces. The position of the ejector cylinder is scanned electrically by proximity sensors. The speed with which the ejector cylinder advances and retracts can be infinitely adjusted via one-way flow control valves. A double-acting cylinder pushes the workpiece at the bottom out of the gravity-fed magazine against an external stop and positions it in the fixture. An opto-electronic sensor can be installed to this fixture and used to detect the caps or the workpieces. This position is the transfer point to the next module. By supplementing the module with the base, its height can be adjusted so that it can be attached directly to, for example, a conveyor module

Function
The stacking magazine module separates workpieces from a magazine. Up to 7 workpieces can be stacked in the magazine tube in any order. Up to 17 workpiece caps can be separated by turning the tube.

1.3.2.3 RFID kit

FIGURE 1.3-3 RFID KIT

Layout
The RFID system consists of a transponder/tag on or in an item, which contains an identification code, and a read/write head for reading or writing this identifier.

Function
The RFID module (identification using electromagnetic waves) refers to a technology for transmitter/receiver systems for automatic and touchless identification and localization of objects via radio waves.

1.3.2.4 IO-Link Smart Sensors

FIGURE 1.3-4 IO-LINK SMART SENSORS

Layout
The IO-Link system concsists of: • 1x IO-Link Gateway • 1x Optical IO-Link distance sensor • 1x Ultrasonic IO-Link distance sensor • 1x Capacitive IO-Link proximity switch • Connection and supply line • Mounting plate for Quickfix adapter

1.3.2.5 C interface

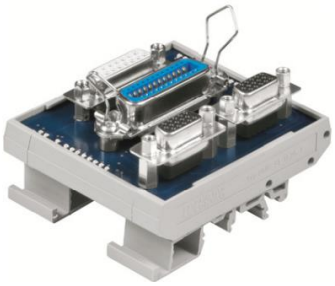


Figure 1.3-5 c interface

Layout
The C interface is the interface between the MPS® modules and the PLC. One or two MPS® modules can be connected to the D-Sub HD sockets. The digital inputs and output can be connected to a PLC via the 24-pin IEEE-488 socket (SysLink). In the case of MPS® modules with analogue inputs and outputs, these can be picked off via the 15-pin D-Sub socket. LEDs indicate the statuses of the inputs and outputs, making it easy to monitor the switching status and enable systematic troubleshooting. The interface can be mounted on an H-rail.

1.3.2.6 Start-up valve with filter control valve

FIGURE 1.3-6 START-UP VALVE WITH FILTER CONTROL VALVE

Layout
The filter regulator with pressure gauge, on/off valve, push-in fitting and quick coupling plug is mounted on a swiveling retainer. The filter bowl is fitted with a metal bowl guard. The unit is mounted on the profile plate by means of cheese head screws and T-head nuts (mounting alternative “C”). Attached is a quick coupling socket with threaded bush and connector nut for plastic tubing PUN 6 x 1.

Funktion
The filter with water separator cleans the compressed air of dirt, pipe scale, rust and condensate. The pressure regulator adjusts the compressed air supplied to the set operating pressure and compensates for pressure fluctuations. An arrow on the housing indicates the direction of flow. The filter bowl is fitted with a filter drain screw. The pressure gauge shows the preset pressure. The on/off valve exhausts the entire control. The 3/2-way valve is actuated via the blue sliding sleev

1.3.2.7 8-Port Gigaabit Switch

FIGURE 1.3-7 8 -PORT GIGAABIT SWITCH

Funktion
An 8-port switch allows up to 8 devices to be connected via a network. These are simply connected to the switch with LAN cables to be able to exchange data and be networked with each other.

1.3.2.8 EduTrainer Preferred variant MPS

FIGURE 1.3-8 EDUTRAINER PREFFERED VARIANT MPS

Aufbau

The controller family SIMATIC S7-1500 is a new controller generation in the TIA portal and a milestone in automation. It delivers maximum performance and user-friendliness for medium and high-end applications in machine and plant automation.

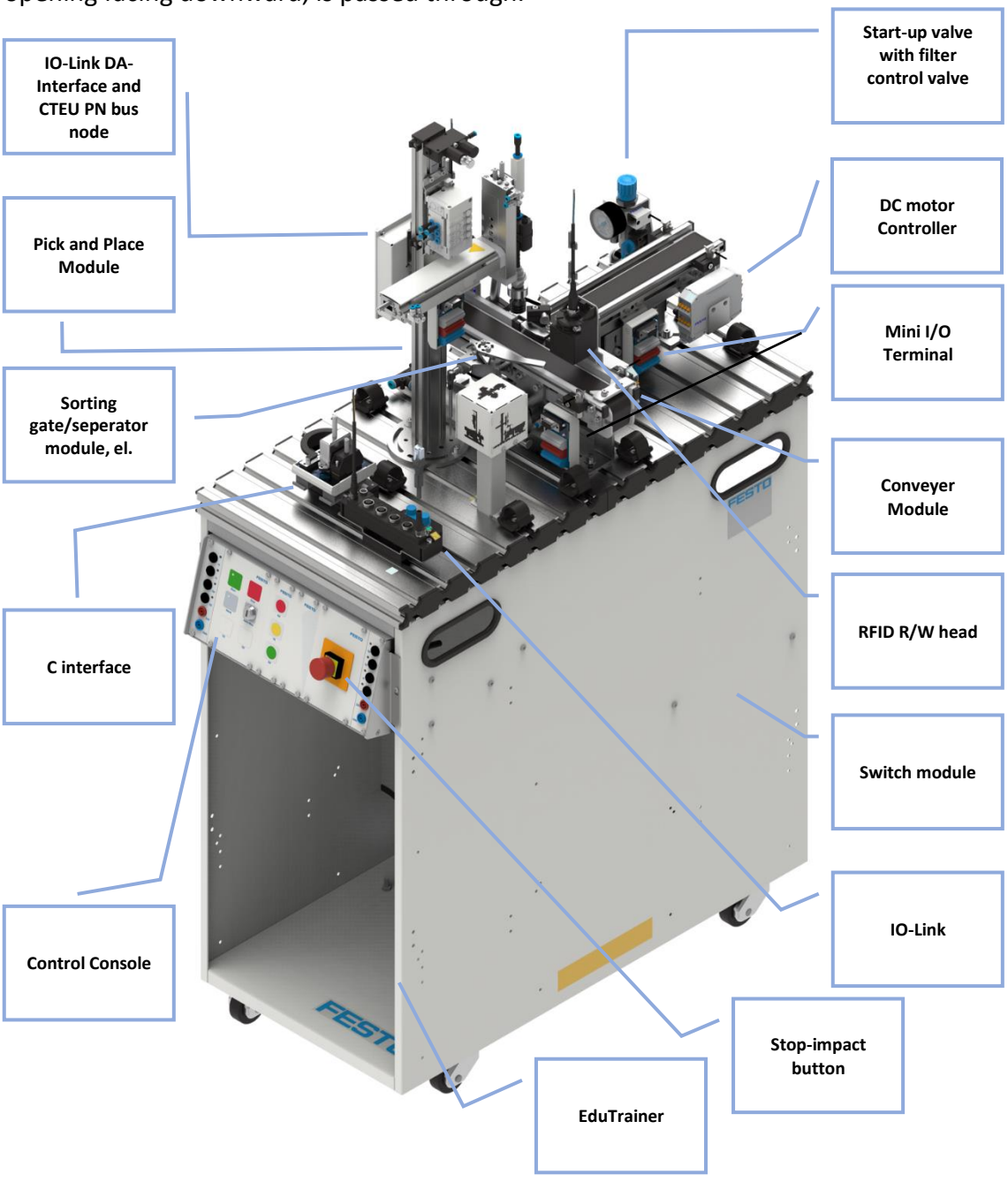
- PLC EduTrainer® support system for use in teaching and training
- Equipped with PLCs from different manufacturers
- Two series: universal and compact
- Equipped with 19 simulation moduls
- Individually configurable or pre-assembled

1.4 MPS Joining 400 Series

1.4.1 Funktion und Aufbau der Station

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

The station measures the alignment of the workpieces and decides whether a workpiece with the opening facing upward is to receive a cap, or a workpiece with the opening facing downward, is passed through.



1.4.2 Elements of the Joining station

1.4.2.1 Pick and Place Module

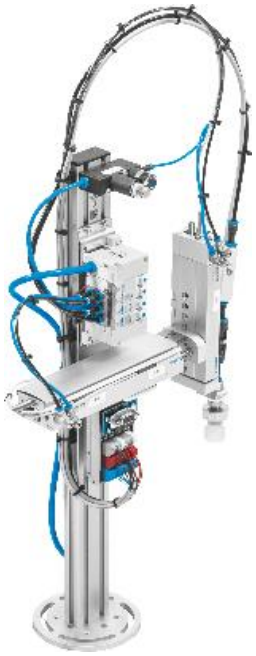


FIGURE 1.4-1 PICK AND PLACE MODULE

Layout
A bellows suction cup picks up the workpieces. Directly to the bellows suction cup a vacuum filter is mounted to prevent dirt particles to reach the vacuum generator. A pressure switch signals the secure gripping of the workpiece. By a pressure regulator, the force of the vertical slide unit (Z-axis) can be adjusted. The module is supplied complete with slide units, vacuum generator, vacuum filter, bellows suction cup, pressure switch, valve terminal, pressure regulator, and electrical interface.

Function
The Pick and Place module is a pneumatic handling device. The module is based on precise slide units. End positions of the slides are sensed electrically via proximity sensors. Arrangement of the proximity sensors, the assembly position and the assembly height can be adjusted.

1.4.2.2 Distance sensor

FIGURE 1.4-2 DISTANCE SENSOR

Function
The module is a distance sensor. It measures the distance between the sensor and an object. Quantities such as distance, displacement and position are measured by means of a distance sensor. A sensor or controller measures the change in distance and converts it into an electrical signal. Distance signals are sent to the control unit via various interfaces.

1.4.2.3 Stopper Module

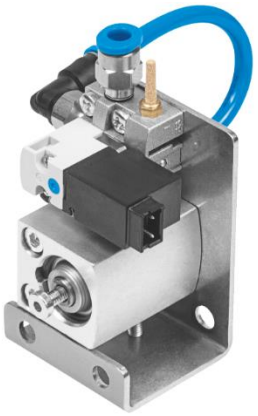


FIGURE 1.4-3STOPPER, SIMPLE WITH VALVE

Layout
The Stopper module is a single-acting pneumatic cylinder with a valve.

Function
It is used in assembly lines to force the workpieces on the conveyor belt to stop. A cylinder extends from the module at 90° to the direction of travel of the conveyor belt. As a result, the workpiece is thus brought to a stop. At the same time, the conveyor belt stops. Stops the workpiece on the belt until the measurement for orientation with the distance sensor is made and evaluated.

1.4.2.4 Sorting gate/seperator Module

FIGURE 1.4-4 SORTING GATE/SEPERATOR MODULE, EL.

Function
The switch module can separate or sort out workpieces on a conveyor belt. It stops and steers the workpiece to the position to join the workpiece cover until the joining process is complete.

1.4.2.5 RFID R/W head Module

FIGURE 1.4-5RFID R/W HEAD

Layout
An RFID system consists of a transponder/tag, which is located on or in the object and contains the identifier, and a read/write head for writing and reading this identifier.

Function
This describes a radio wave technology for transmitter-receiver systems, which enables the automatic and contactless detection and determination of workpieces.

1.4.2.6 IO-Link DA-Interface

FIGURE 1.4-6 IO-LINK DA-INTERFACE

Layout
Basic unit with integrated I-Port interface for direct connection to a PLC with IO-Link interface. Basic unit with additional fieldbus interface, e.g., CTEU-CO for integration into a CAN-Open network.

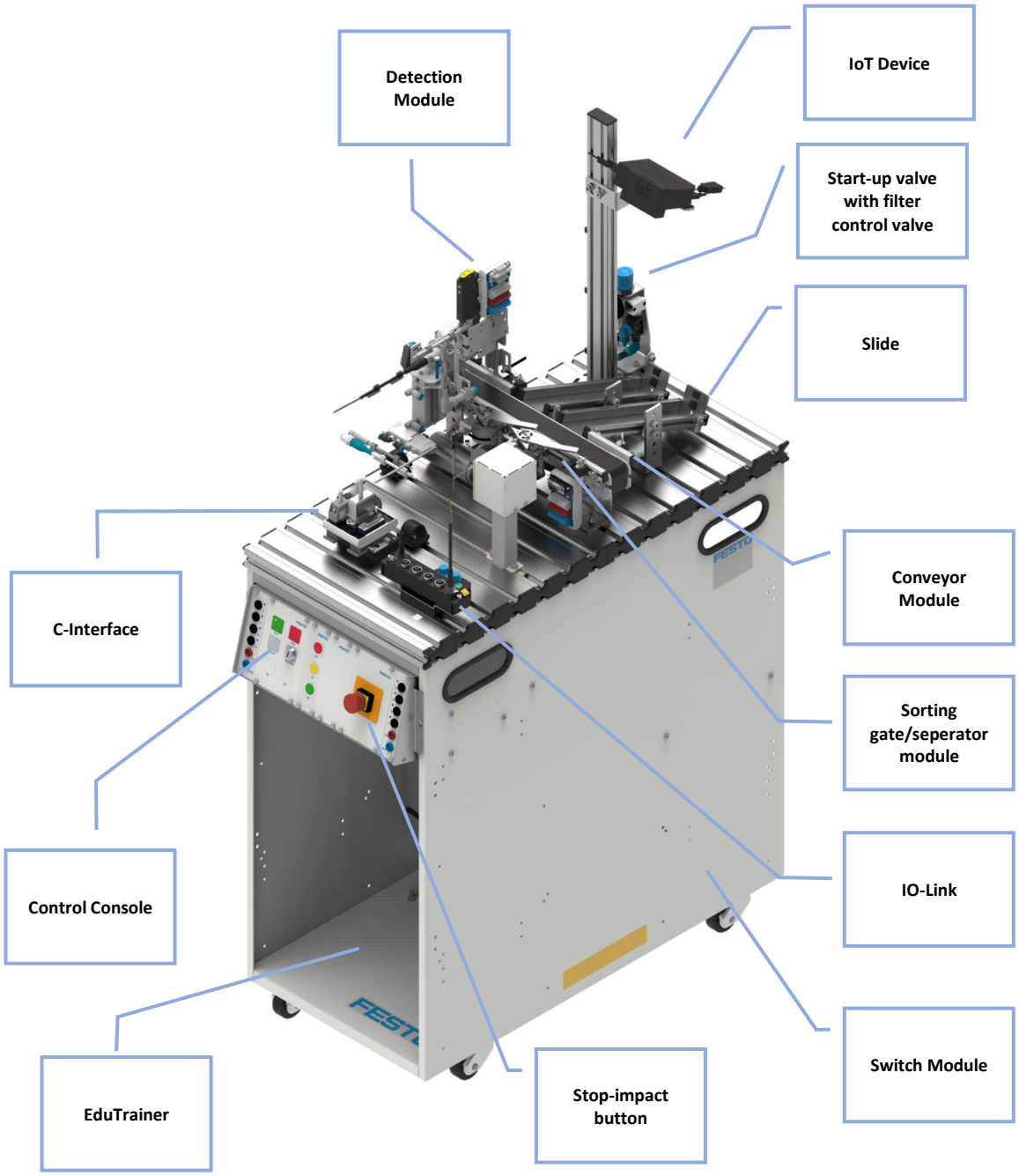
Function
The IO-Link DA interface forms the interface from industrial fieldbuses to digital and analogue input/output signals. The corresponding "CTEU" fieldbus heads from Festo can be connected to the device for the respective fieldbus types. An IO-Link-capable control system can also address the device without further components. For example, the Festo controller CECC-LK can be used to communicate with the IO-Link DA interface.

Basic elements of all stations
Conveyer modules see: Figure 1.3-1 Conveyer module
C-Interface see: Figure 1.3-5 c interface
Start-up valve with filter control valve see**:** Figure 1.3-6 Start-up valve with filter control valve
8-Port Gigaabit Switch see: Figure 1.3-7 8 -Port Gigaabit Switch
EduTrainer see: Figure 1.3-8 EduTrainer preffered variant MPS
RFID Kit see: Figure 1.3-3 RFID Kit

1.5 MPS Sorting Inline 400 Series

1.5.1 Function oft he station

The station was expanded for the MPS System 403-1 with the height-adjustable RFID module. With the RFID read/write head, the RFID tag in the workpiece is read and, depending on the result, the workpiece is discharged. As soon as a chute is full, this is signaled by the Q1 indicator light. After the chutes have been emptied, the station must be reset.



1.5.2 Elements of the Station Sorting Inline

1.5.2.1 Detection Module

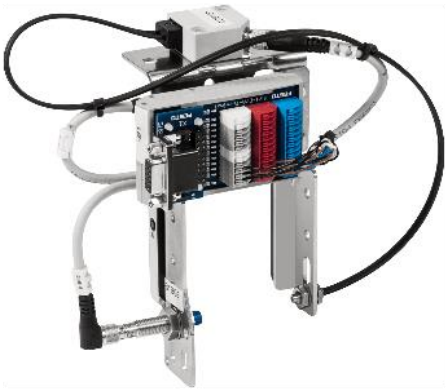


FIGURE 1.5-1 DETECTION MODULE

Layout
The detection module detects the material or the color of the workpieces by means of 3 proximity sensors with digital output. One inductive proximity sensor and two optical proximity sensors are used. • The inductive proximity sensor detects the metallic workpiece. • The diffuse light sensor detects the red and the metallic workpieces. • The fork light barrier detects all workpieces. The respective workpieces are detected by means of the logic operation of the output signals. The detection module can be mounted directly to a guide rail of a conveyor module or a slide module.

Function
The detection module is capable of verifying the presence of red, black and metallic workpieces.

1.5.2.2 RFID R/W head with lift Module

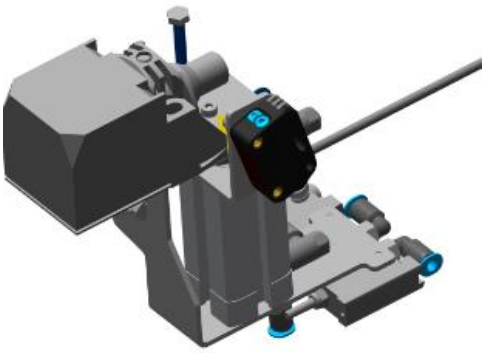


FIGURE 1.5-2 RFID R/W HEAD WITH LIFT

Layout
The RFID R/W head with lift extends the RFID kit with additional read/write headt that can read and write at 2 heights.

1.5.2.3 IoT Device

FIGURE 1.5-3 IOT-DEVICE

Layout
The IoT device consists of a camera mount and the camera itself.

Funktion
The task of this device is to count the workpieces via image processing. The camera must first be taught for the system and tested for functionality. The advantage here is that the device is connected to a network and can therefore transmit, store and process data. The IoT device is also able to recognise the filling status of the chute.

1.5.2.4 Slide Module

FIGURE 1.5-4 SLIDE

Layout
The chute module is used for storing and transporting workpieces

Function
Up to 5 workpieces can be placed on the chute when the mechanical stopper is mounted. The Chute module is used twice in the Sorting station. The chute is used for sorting and feeding workpieces.

Basic elements of all stations
Conveyer modules see: Figure 1.3-1 Conveyer module
C-Interface see: Figure 1.3-5 c interface
Start-up valve with filter control valve see**:** Figure 1.3-6 Start-up valve with filter control valve
8-Port Gigaabit Switch see: Figure 1.3-7 8 -Port Gigaabit Switch
EduTrainer see: Figure 1.3-8 EduTrainer preffered variant MPS
RFID Kit see: Figure 1.3-3 RFID Kit

1 General requirements for operating the devices

General requirements for safe operation of the devices:

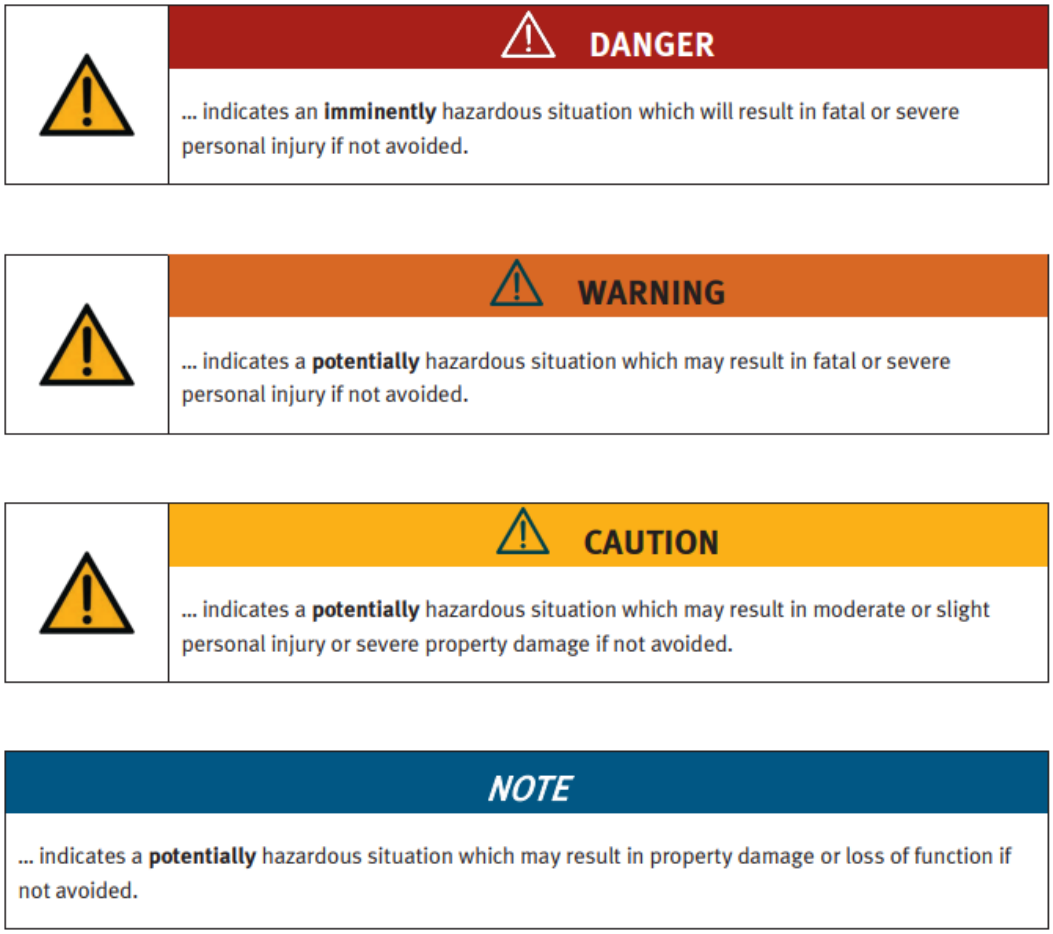
- National regulations for operating electrical systems and equipment must be observed in industrial facilities.
- The laboratory or classroom must be overseen by a supervisor.
  - A supervisor is a qualified electrician or a person who has been trained in electrical engineering, knows the respective 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 by means of:
  - Key actuators
  - Lockable on/off valves
- The laboratory or classroom must be protected by residual current devices (RCDs).
  - Electrical devices (e.g., power supply units, air compressors and hydraulic power units) may only be operated in training rooms which are equipped with residual current devices.
  - Type-B residual current devices 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



DANGER

... indicates an **imminently** hazardous situation which will result in fatal or severe personal injury if not avoided.

WARNING

... indicates a **potentially** hazardous situation which may result in fatal or severe personal injury if not avoided.

CAUTION

... indicates a **potentially** hazardous situation which may result in moderate or slight personal injury or severe property damage if not avoided.

NOTE

... indicates a **potentially** hazardous situation which may result in property damage or loss of function if not avoided.

2.2 Pictograms

Hazard warning

Warning - dangerous electric voltage

Information and/or references to other documentation

3 Intended use

Festo Didactic systems and components may only be used:

- For their intended use for teaching purposes in education and training
- When their safety functions are in perfect condition
- Under observation (no unattended continuous operation)

The components and systems 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 components impaired if they are used incorrectly.

The learning system from Festo Didactic has been developed and produced exclusively for education and training in the field of automation and technology. The training company and/or trainers must ensure that all trainees 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 regulations and instructions which are applicable at the respective place of use must be adhered to.

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 any repairs or modifications to the components and systems that are not described in these operating instructions.

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 occupational 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 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 occupational safety and accident prevention.

5 Work and safety instructions

5.1 General

CAUTION

- Trainees should only work with the components and systems under the supervision of an instructor.
- Observe specifications included in the datasheets for the individual components, and in particular all safety instructions!
- Wear personal protective equipment (safety goggles, safety shoes) when working on circuits.

5.2 Mechanical aspects

WARNING

- **Switch off the power supply!**
  - Switch off both the operating power and the 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 for the actuators.
- **Risk of injury during troubleshooting!**
  - Use a tool such as a screwdriver when actuating mechanical limit switches.

CAUTION

- Mount all of the components securely on the profile plate.
- Make sure limit switches are not actuated from the front.
- Set all components up in a way that enables easy activation of the switches and disconnectors.
- Follow the instructions regarding the positions of the components.

5.3 Electrical aspects

WARNING

Risk of death due to electric shock!

Only circuits are permitted where direct or indirect contact with dangerous voltages is not possible.

- Only use safety laboratory cables with adequate insulation and electric strength.
- Use safety sockets with fully shrouded contact points.
- The protective grounding conductor (green-yellow) must not be interrupted.
- The protective grounding conductor must be connected to the protective grounding conductor system of the building.
- Do not connect voltage sources one after the other (series connection).
- Use voltage sources with safety extra-low voltage (SELV).
- Disconnect from all sources of electrical power. Please note that electrical energy may be stored in individual components.

⚠ CAUTION

- Use safety extra-low voltage only: max. 24 V DC.
- The power supply unit must be operated only with a power supply with a protective grounding conductor.
- Establishing and interrupting electrical connections
  - Electrical connections may only be established in the absence of voltage.
  - Electrical connections may only be interrupted 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.
  - If 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 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.
  - If a ground connection (green and yellow laboratory socket) is available, it must always be connected to protective ground. The protective ground must always be connected first (before connecting voltage), and must always be disconnected last (after disconnecting voltage).
  - Some devices have high leakage current. These devices must be additionally grounded with a protective grounding conductor.
- When replacing fuses, use specified fuses only with the correct current rating and tripping characteristics.
- The device is not equipped with an integrated fuse unless otherwise specified in the technical data.
- Pull the safety plug only when disconnecting connecting cables; never pull the cable.
- Safe operation of the device is no longer possible with
  - visible damage,
  - malfunction,
  - inappropriate storage, or
  - incorrect transport.

  - Switch off the power supply immediately.
  - Protect the device against inadvertent restart.

5.4 Pneumatics aspects

CAUTION

- **Injury from tubing detaching with force**
  - Push the pneumatic tubing into the push-in connector as far as it will go.
  - Secure the tubing near the push-in connector.
  - Only disconnect tubing when it is depressurized.
- **Noise due to escaping compressed air**
  - Noise caused by escaping compressed air may damage your hearing. Reduce noise by using mufflers, or wear hearing protection if noise can't 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	Meaning	Color	Meaning
	Voltage greater than safety extra-low voltage E.g. mains voltage of 90 to 400 V AC per conductor Mains conductor L1 (gray with brown ring)		24 V DC (red)
	Voltage greater than safety extra-low voltage E.g. mains voltage of 90 to 400 V AC per conductor Mains conductor L2 (gray with black ring)		0 V DC (blue)
	Voltage greater than safety extra-low voltage E.g. mains voltage of 90 to 400 V AC per conductor Mains conductor L3 (gray with gray ring)		Safety extra-low voltage, signal input/output (black)
	Voltage greater than safety extra-low voltage E.g. mains voltage of 90 to 400 V AC per conductor Mains conductor (gray)		Protective grounding conductor, configuration as 4 mm safety socket (green-yellow)
	Neutral conductor (gray-blue)		Protective grounding terminal as PE+ contact, (green-yellow)
			Ground connection, internally connected to protective grounding conductor

The component might not include all of the safety sockets shown above. Further safety sockets may be included in the circuit setup due to the use of different components.

The specified protection classes and safe use will be achieved if safety laboratory 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 safety laboratory cable. The operating company bears the responsibility for any removal of this adapter. The adapter can be unscrewed with a 1.5 mm Allen key. The locking mechanism is located in the drilled hole of the adapter. Unscrew the screw in clockwise direction.

7 Guidance for systematic fault investigation

7.1 Troubleshooting

Overview
1. Get an overview of the function of the unit in connection with the overall system
2. Try to clarify whether the unit was performing the required function in the overall system before the fault occurred.
3. If the conditions of use or the range of use of the unit have been changed
4. Were changes (e.g., conversions) or repairs to the overall system (system, electrics, control) carried out on the unit? If yes: Which of them
5. Has the appliance been operated in accordance with its intended use
6. How does the disorder manifest
7. Get a clear idea of the cause of the fault. Consult the immediate operator if necessary.

7.2 System does not switch on or only partially

Problem	Solution
Inputs and outputs only partially or not connected to PLC	Connect plugs and secure with clamps
	Check SysLink connector on EduTrainer
PLC no LED luminaire	Switch on EduTrainer see Figure 7.2-1
	Establish supply voltage with cold device see Figure 7.2-2
	Check power supply to EduTrainer (230V)
No outputs switched to PLC, status LED on orange	Open flap and set PLC to RUN (Manual) Figure 7.2-3
	Load the correct PLC programme

Switch on EduTrainer

FIGURE 7.2-1 SWITCH ON THE VOLTAGE AT THE PLC

Power supply

FIGURE 7.2-2 CONNECTING THE STATION TO THE SUPPLY VOLTAGE

SPS in RUN

FIGURE 7.2-3 SPS MANUELL IN RUN

7.3 Errors in the pneumatics

Connection of the compressed air supply	
 FIGURE 7.3-1 CONNECTING THE STATION TO THE COMPRESSED AIR SUPPLY SYSTEM	1. Compessed air hose 2. Coupling plug for compressed air inlet 3. Adjusting knob 4. Pressure gauge 5. switch-on valve/shut-off valve 6. Push-in fitting for compressed air outlet

Problem	Solution
Cylinders do not extend, compressed air supply disturbed	Check the compressed air supply to the laboratory see Figure 7.3-1
	Switch on compressed air supply
Compressed air supply to maintenance unit	Check pressure setting on pressure regulator
	Open the hand lever on the switch-on valve
	Compressed air must be at least 6 bar Increase pressure
	Valves require at least 2 bar pressure-->Increase pressure
	Check pneumatic hoses for leakage
	Check the correct connection of the pneumatic hoses
	Check coupling plug
Valves do not switch or switch irregularly, not in basic setting, the minimum pressure of 2 bar is not reached.	Hand auxiliary actuation see Figure 7.3-2 and see Figure 7.3-3 Checking the function of cylinder hoses
	Valve plug correctly inserted
	Check the valve connector and the cable connection to the Mini-IO terminal.
Cylinders at station Joining extend too quickly	Is the potentiometer on the HMI turned up (warning message on the HMI in the event of an error)?
	• Close the throttle check valve completely see Figure 7.3-4 • Open the throttle check valve one turn see Figure 7.3-5

	• Open and close the throttle check valve gradually until the desired speed is reached.

Release manual override

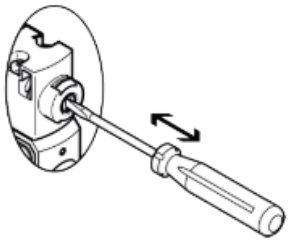


FIGURE 7.3-2 HHB FUMBLING

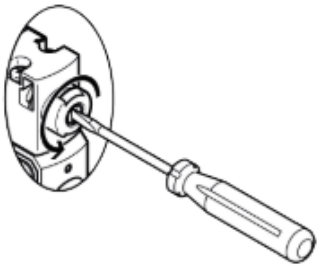


FIGURE 7.3-3 HHB LATCHING

Open and close the throttle check valve

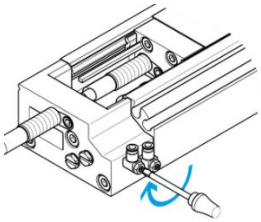


FIGURE 7.3-4 CLOSE THE THROTTLE CHECK VALVE

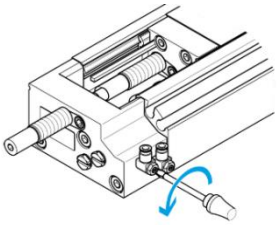


FIGURE 7.3-5 OPEN THROTTLE CHECK VALVE

7.4 Communication problems between stations

Problem	Solution
Workpiece remains at the end of the belt, although the next station is free and ready for operation.	Connect connector Q4 of the slave station to I6 of the station. Connect 0V to 0V see Figure 7.4-1
	Establish connection and communication between stations (1-bit communications) in the network
	Connect digital inputs and outputs correctly
	Cables must be plugged in
Controls do not work as desired	Connect PLC correctly see Figure 7.4-2
	Download the correct PLC application programme
PLC LED flashes red	Call up diagnostics on the PLC display. If "Error in local component "check network connections to ProfiNet participants and check ProfiNet names of participants

Establish 1-bit communication connections

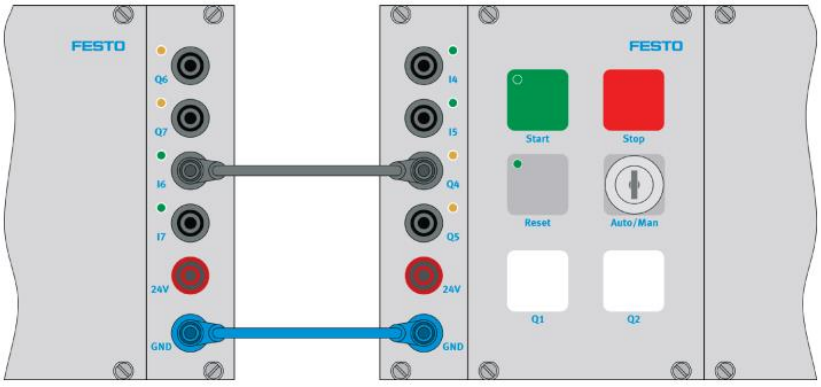
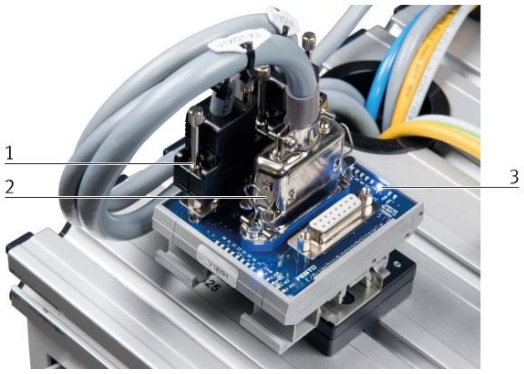


FIGURE 7.4-1 EXAMPLE WITH I/O PLUG CONNECTIONS BETWEEN CONTROL CONSOLES: CONNECT THE Q4 AND GND SOCKETS OF THE DOWNSTREAM STATION TO THE I6 AND GND SOCKETS OF THE UPSTREAM STATION.

Cables correctly connected
 FIGURE 7.4-2 1:D-SUB HD JACK CONNECTS THE C-INTERFACE TO THE MINI-I/O TERMINAL 2: SYSLINK CABLE CONNECTS THE C-INTERFACE TO THE 3: LED STATUS DISPLAY

7.5 System in initial position

Problem	Solution
Defined basic position not reached	Conveyor motor must be off
	Stoppers should be extended
	Slides must be empty
	PLC Programms are loaded and saved in”RUN”!
	All stop buttons pulled
	Vacuum cup on top
	Vacuum off
	Slide retracted
	Points retracted
	No workpieces at the end and beginning of the belt
	Lock extended

7.6 Does not start despite perequisites

Problem	Solution
The stations are not in the home position and start has not been actuated (see manual).	Removing workpieces from the belt
	Station 1: Fill stacking magazines ("Q1" error message if empty)
	Station 2: Putting black lids on tape
	Station 3: Empty chute ("Q1" error message when full)
Reset was not carried out on all stations	Always start against material flow
	Turn key switch to "MAN" clockwise to horizontal position
	"Reset" LED lights up
	"Press "Reset
	If necessary, move the station to the home position
	"Reset" goes off
"START" was not carried out at all stations	Turn key switch to "AUTO" anticlockwise to vertical position
	Start LED lights up, press "START
	Station 1. set key switch AND rotary switch on HMI to "P1" AND slider on HMI display to "Auto".
	Stations are ready

7.7 Individual stations do not start

Problem	Solution
Station 1 Start conditions not met	Conveyor motors must be off
	Cylinder retractedCheck proximity switch
	Stacking magazines filled
Station 2 Start conditions not met	Conveyor motors must be off
	Vacuum cup up and retracted (position conveyor belt 350) -->Check proximity switch
	Vacuum off
	Slide retracted-->Check proximity switch
	Turnout retracted
Station 2 Start conditions not fulfilled, error message I4	Vacuum cup not in home position
Station 3 Start conditions not fulfilled	Conveyor motors must be off
	Slides must be empty

	No workpiece at the end of the conveyor motor
	Turnout extended

7.8 Start system analogue with HMI if first station does not start

Problem	Solution
Does not start because of HMI	Stop-Off Push-button release by turning to the left see Figure 7.8-1
Stack magazine Empty (error message "Light L1" lights up)	Fill stacking magazine
No start Reset mode	Turn switch F1/F2
	Reset lamp lights up blue (press!)
	Turn F1/F2 switch again
	"Press "START
	Station starts
Conveyor modul speed too slow or too fast	Set transport speed via rotary switch

Check stop button

FIGURE 7.8-1 CHECK STOP BUTTON

7.9 Windows does not start

Problem	Solution
Windows does not start	Switch on PC (at back)
	Switch on monitor
	Connect monitor to PC
Keyboard does not work	Switch on keyboard
	Plug the USB transmitter into the PC
	Insert USB licence plug into PC
	Replacing the batteries of the keyboard
Problems with login in Windows	Login User: "Admin“
	Password: „Festo4.0“

Password not accepted	Check Caps Lock
	Check Keyboard Layout Language

7.10 MES does not start

Problem	Solution
MES programme does not open	Open MES4 and log in
	User „Admin“
	Password: Festo4.0
	Work Around-Restart of NodeRed siehe Figure 7.10-1
MES core does not start	Licence available
	Plug in CodeMeter

Work Around-Restart of NodeRed

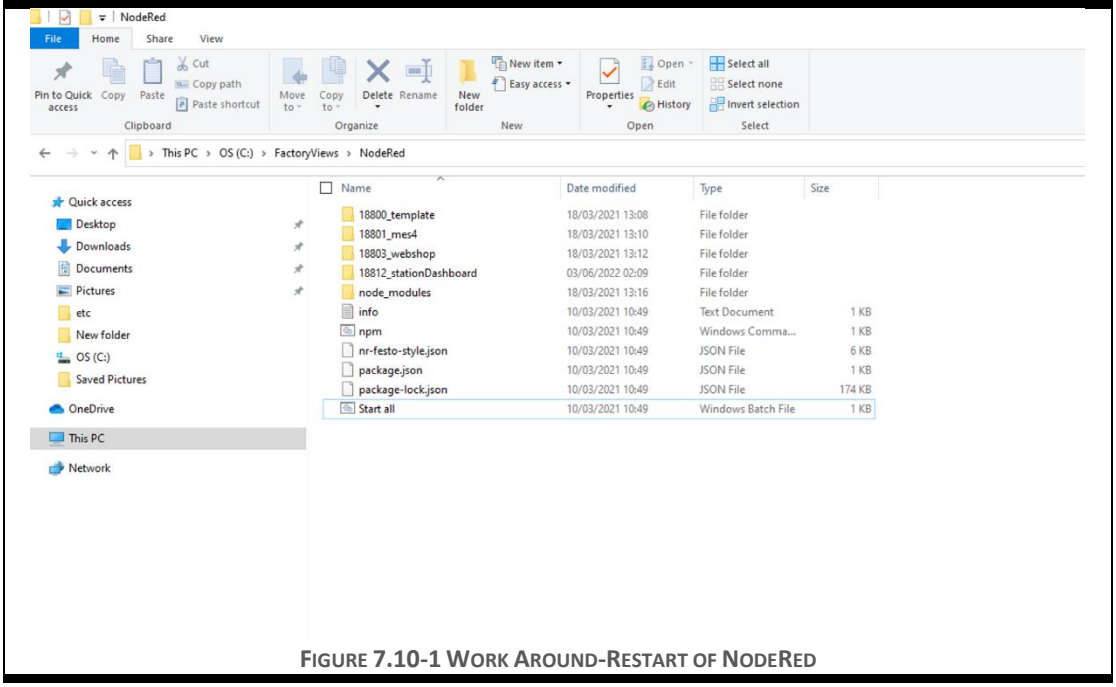


FIGURE 7.10-1 WORK AROUND-RESTART OF NODERED

7.11 Network issues

Problem	Solution
No connection to the network	Switch on router
	Plug in LAN and power cable
	Connecting the wifi to the internal network
	Check IP addresses of the components
	Checking the IP addresses to see if all participants in the network are involved
Switch LEDs are not active	Switch on power supply
MES does not start order	Load correct PLC programme
	Check IP addresses for correctness
Existing problems with the network	Plug in and snap in the network cable correctly
	Check connection from PLC to switch and PC
	Check all participants in the network for reachability with ping and the corresponding IP address. -Open the ping prompt and enter the corresponding address.
Individual stations do not communicate with each other or do not work: Stations are greyed out in the HMI see Figure 7.11-1	Check the connections between the switches and connect them correctly
	Control not in the network

Stations do not communicate greyed out

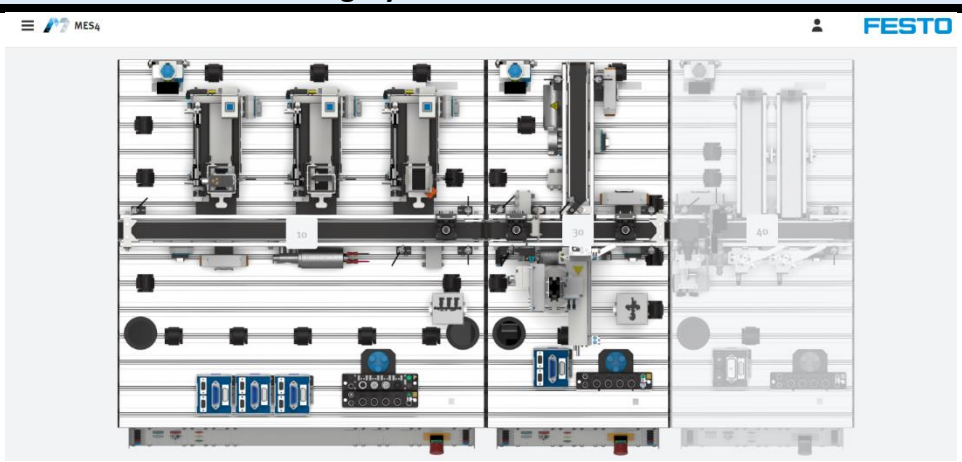


FIGURE 7.11-1 INDIVIDUAL STATIONS DO NOT COMMUNICATE WITH EACH OTHER OR DO NOT WORK: STATIONS ARE GREYED OUT IN THE HMI

7.12 Sensors do not work properly

Problem	Solution
Sensors do not reliably detect workpieces	Check cable connections
	Adjust sensor correctly see Figure 7.12-1
	Adjusting the sensitivity of the fibre optic unit (at the screw)
	Manual check on signal lamps at PLC terminals
	Check sensor inputs in the HMI view "Station", which one is not working properly
Distance sensor reports error	Insert workpiece with correct orientation "opening upwards" see Figure 7.12-4
	Set the shortest distance between sensor and workpiece surface and pay attention to the "dead zone".
Sensor still not working	Maintenance and cleaning with a lint-free cloth or brush
	Cleaning lenses of optical sensors, fibre optics and reflectors

Adjust sensor correctly

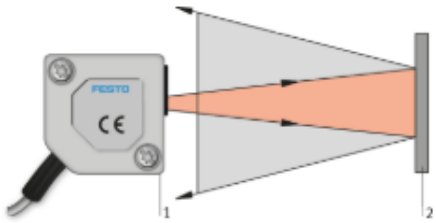


FIGURE 7.12-1 CORRECT ADJUSTMENT: OBJECT IS DETECTED

Readjusting Sensitive Fibre Optic Devices

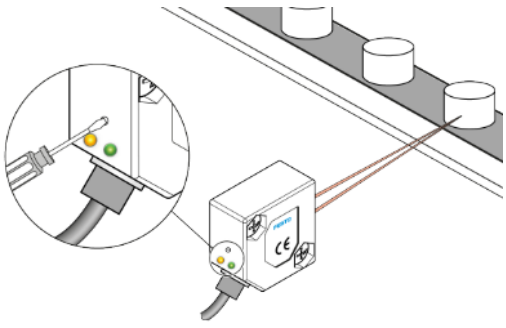


FIGURE 7.12-2 ADJUSTING THE SENSITIVITY AT THE POTENTIOMETER

Workpiece with correct orientation

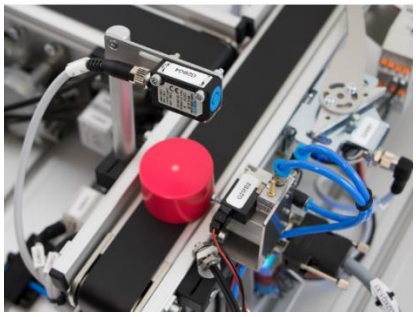


FIGURE 7.12-3 WORKPIECE WITH THE WRONG ORIENTATION "OPENING DOWNWARDS

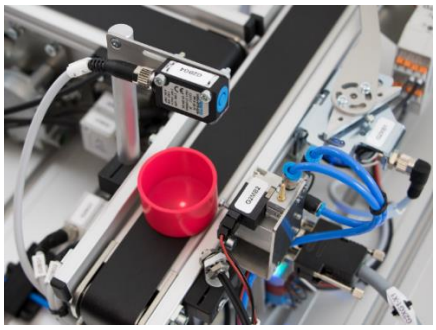


FIGURE 7.12-4 WORKPIECE WITH THE CORRECT ORIENTATION "OPENING UPWARDS

7.13 Malfunctions on the conveyor module

Problem	Solution
Conveyor module does not mvoe	Manually test DC motor controller
	Move belt manually if rigid
	Check connector on C-interface and PLC
	Connect and check inputs/outputs
	Check connections via Mini I/O terminal
	Check optical proximity switches Manually or on the HMI

7.14 Functional problems on the stacking magazine module

Problem	Solution
Fill level not detected	Check lower light barriers see Figure 7.14-1
IO-Link devices do not function properly	Check power supply
	Check digital inputs and outputs (manual)
	Connecting the unit to Ethernet
	Assignment oft he ports • Port 1 Laser sensor magazine 1

	• Port 2 Ultrasonic sensor Magazine 2 • Port 3 Check capacitive magazine
	Select magazine settings via the plus sign on the magazine Remove workpieces from the magazine and press the "Tare" button.
Workpiece is not outputted	Check compressed air
	Check valve
	Position the orientation of the magazine shaft for workpieces correctly see Figure 7.14-2
	Aligning on the stacking magazine and fastening with open-end spanner
Valve does not switch	Check if sub cable is plugged in correctly
	Connect terminal output
	Check connections of inputs/outputs
Double-acting cylinder does not extend	Check proximity switch
	Check compressed air pressure regulator
	Check solenoid valve by manual override
Off and driving speed not adjustable	Check the settings of the throttle check valve with a screwdriver, if it is "closed" it does not move, if it is "open" it moves again.

Readjusting Sensitive Fibre Optic Devices

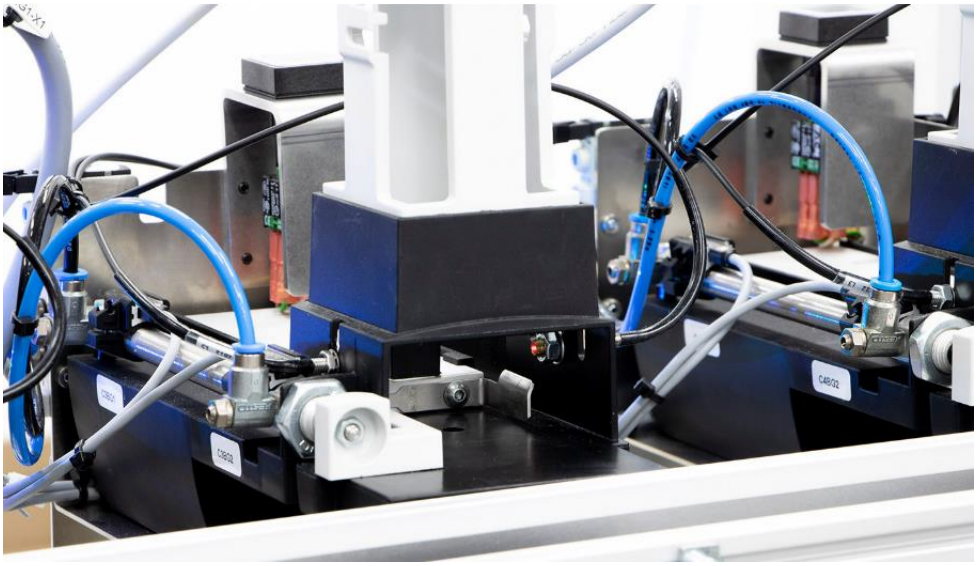


FIGURE 7.14-1 LIGHT BARRIER IN THE STACKING MAGAZINE MODULE

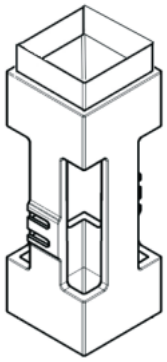
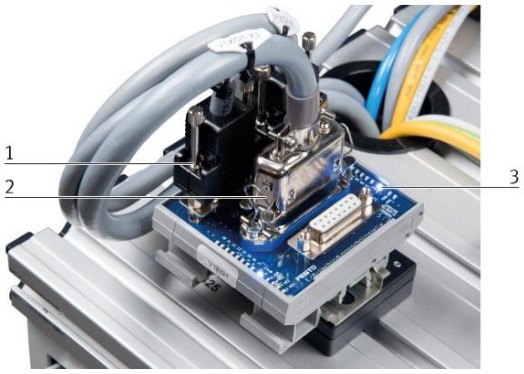
Correct orientation of the stacking magazine


FIGURE 7.14-2 ORIENTATION OF THE STACKING MAGAZINE

7.15 Switching status control and LED's States are not displayed

Problem	Solution
Switching status control and LED's States are not displayed	Connecting channels correctly
	Connect module and C-interface with 15-pole cable and plug and screw see Figure 7.15-1
	Connect C-interface and PLC with 24-pole cable and plug in and clamps see Figure 7.15-1
	Connect analogue inputs and outputs as required
Light beam is not interrupted and hits the receiver. However, signal quality is low - weak signal	Correct adjustment
Light beam is interrupted and does not hit the receiver	One of the chutes is full Empty it or there is a workpiece at the end of the belt Sort the last station Remove it

Cables correctly connected
 FIGURE 7.15-1 1:D-SUB HD SOCKETE CONNECTS THE C-INTERFACE TO THE MINI-I/O TERMINAL 2: SYSLINK CABLE CONNECTS THE C-INTERFACE TO THE 3: LED STATUS DISPLAY

7.16 Problems with the control panel

Problem	Solution
Signals are not emitted	Check communication fields for inputs and outputs
	Check braces
	Check PLC
	Check connection from Syslink to control unit on the inside
PLC flashes red and RFID Bus Gateway lights up red	Possible source of error is Profinet name incorrect --> Correct Profinet name in TIA

7.17 Workpiece is not detected and treated

Problem	Solution
Workpiece travels over entire belt without module actions	RFID head of station 1 check if correct height (Hx32mm)
	In station 1 connect read head to terminal C-1 (C1 is write terminal and C0 is read terminal).
	No tag obstructed Insert workpiece with tag
Workpiece drives through because no day inside	Insert tag into workpieces and restart system

7.18 Workpiece not on defined slide

Problem	Solution
Workpiece not on defined slide	Check the light barrier and mirror, pay attention to the lighting conditions, e.g. sunlight.
	Error in the order, check order
Recognise module does not recognise work backs correctly	Sensor on module correctly adjusted
	Teach" diffuse reflection light sensor on red workpiece
	Module recognition: • Press Teach for 3 seconds and then insert red workpiece "taught" to red
	Keep diffuse sensor clean and align so that receiver receives signal from target object
Metallic/silver workpiece is not recognised	Screw inductive sensor closer (4mm)

7.19 Product problems

Problem	Solution
Incorrect operation leads to problems with product	Create work schedule
	Correctly select setting and measuring errors in the work process
	Set correct parameters
	Use correct parts

7.20 Workpieces are counted incorrectly in Target

Problem	Solution
Workpieces are counted wrongly	Teaching new images on the web interface in the Raspberry Pi
	Select the correct distance to the sensor
	Check power supply
	Check Rasperry Pi LED

7.21 System start ready

All functional problems have been fixed
If everything goes right, the system is ready for the run-through.

8 Further informationen

For information, documentation, and software updates, visit: https://ip.festo-didactic.com

Information and commissioning can be found here: https://ip.festo-didactic.com/InfoPortal/MPS/MPS403I4.0/EN/Commissioning.html