C93112

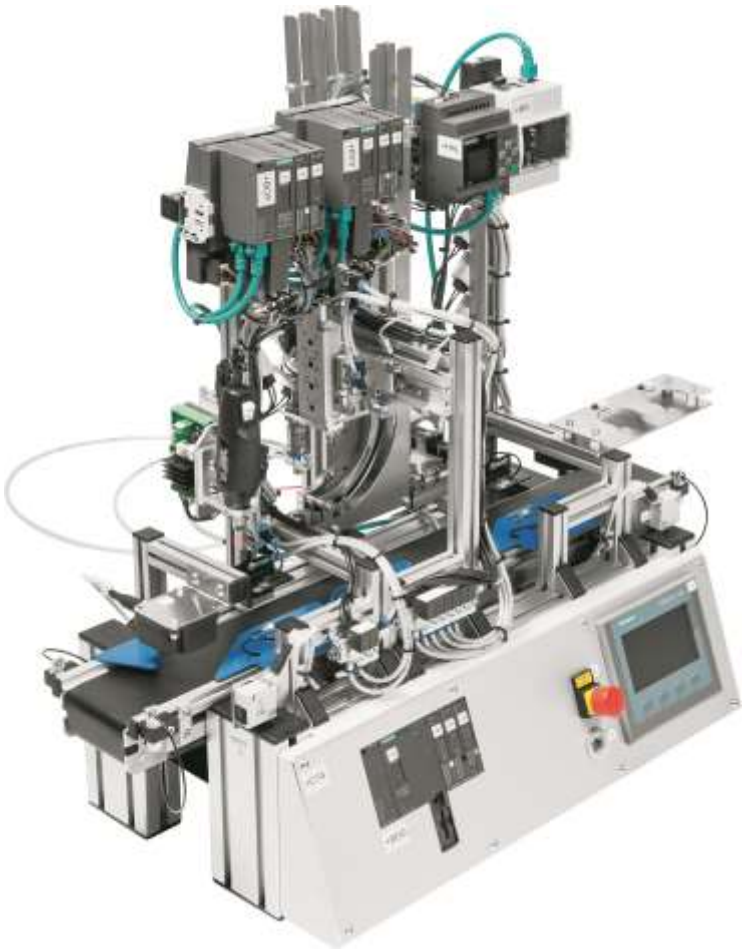
MPS®TS Compact Trainer I4.0

FESTO

MPS transfer system

On the way to Industry 4.0

Workbook



Festo Didactic
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Author: Jürgen Helmich, Adiro
Layout: 10/2015, Frank Ebel

+49 711 3467-0 www.festo-didactic.com
+49 711 34754-88500 did@de.festo.com

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1 General prerequisites for operating the devices

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 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).
  - Type B residual current circuit breakers with a residual current of ≤ 30 mA
- The laboratory or classroom must be protected by overcurrent protection devices.
  - Fuses or circuit breakers
- 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.
- No damaged or defective devices may be used.
  - Damaged devices must be barred from further use and removed from the laboratory or classroom.

General requirements for safe operation of the devices:

- Do not lay cables over hot surfaces.
  - Hot surfaces are identified with a corresponding warning symbol.
- 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.
  - In the event that these are not the same, use a separate upstream fuse in order to provide appropriate overcurrent protection.
- Devices with an earth terminal must always be grounded.
  - If an earth connection (green-yellow laboratory socket) is available, it must always be connected to protective earth. Protective earth must always be connected first (before voltage), and must always be disconnected last (after voltage).
- The device is not equipped with an integrated fuse unless otherwise specified in the technical data.

2 Pictograms

This document and the hardware described herein include warnings concerning possible hazards which may arise if the system is used incorrectly. The following pictograms are used:

Warning
This pictogram indicates that non-observance may result in serious personal injury or damage to property

3 Use for intended purpose

The stations of the modular production system may only be used:
- For their intended purpose in teaching and training applications
- When their safety functions are in flawless condition

The stations are designed in accordance with the latest technology as well as recognized safety rules. However, life and limb of the user and third parties may be endangered, and the components may be impaired, if they're used incorrectly

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

Festo Didactic hereby excludes any and all liability for damages suffered by trainees, the training company and/or any third parties, which occur during use of the equipment sets 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

Fundamental prerequisites for safe use and trouble-free operation of the MPS® include knowledge of basic safety precautions and safety regulations. This manual includes the most important instructions for safe use of the MPS®.

In particular the safety precautions must be adhered to by all persons who work with the MPS®. Beyond this, all pertinent accident prevention rules and regulations which are applicable at the respective location of use must be adhered to.

4.2 Obligations of the operating company

The operating company undertakes to allow only those persons to work with the MPS® who:

- Are familiar with the basic regulations regarding work safety and accident prevention and have been instructed in the use of the MPS®
- Have read and understood the section concerning safety and the safety precautions

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 MPS® undertake to complete the following steps before beginning work:

- Read the section concerning safety and the safety precautions in this manual
- Familiarize themselves with the basic regulations regarding work safety and accident prevention

4.4 Dangers associated with the modular production system

The MPS® has been manufactured in accordance with the latest technology and recognized safety rules. Nevertheless, life and limb of the user and third parties may be endangered, and the machine or other property may be damaged during its use.

The MPS® may only be used:

- For its intended purpose
- When its safety functions are in flawless condition

Faults which may impair safety must be eliminated immediately!

4.5 Working safely

General

- Trainees should only work with the training device under the supervision of a trainer.
- Electrical devices (e.g. power packs, compressors and hydraulic units) may only be operated in training rooms which are equipped with residual current devices (RCDs).
- Observe specifications included in the technical data for the individual components, and in particular all safety instructions!
- Faults which may impair safety must not be generated in the training environment and must be eliminated immediately.
- Wear personal safety gear (safety glasses, safety shoes) when working on circuits.

Mechanical safety

- Switch off the power supply!
  - Switch off working and control power before working on the training device.
  - Only reach into the setup when it's at a complete standstill.
  - Be aware of potential overtravel times for the drives.
- Mount all of the components securely to the slotted profile plate.
- Make sure that limit valves are not actuated from the front.
- Danger of injury during troubleshooting!
  Use a tool to actuate the limit switches, for example a screwdriver.
- Set all components up so that activation of switches and disconnectors is not made difficult.
- Adhere to the instructions regarding positioning of the components.

Electrical safety

- Disconnect from all sources of electrical power!
  - Switch off the power supply before working on the training device.
  - 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.
- Use only extra-low voltage: maximum 24 V DC.
- Establishing and disconnecting 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.
  - In the event that these are not the same, use a separate upstream fuse in order to provide appropriate overcurrent protection.
- Only use 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 an earth terminal must always be grounded.
  - If an earth connection (green-yellow laboratory socket) is available, it must always be connected to protective earth. Protective earth must always be connected first (before voltage), and must always be disconnected last (after voltage).
  - Some devices have high leakage current. These devices must be additionally grounded with a protective conductor.
- The device is not equipped with an integrated fuse unless otherwise specified in the technical data.
- Only pull the safety plugs when disconnecting connecting cables – never pull the cable.

Pneumatic safety

- Depressurize the system!
  - Switch off the compressed air supply before working on the training device.
  - Check the system with pressure gauges to make sure that the training device is fully depressurized.
  - Please note that energy may be stored in air reservoirs.
    Further information on this issue is available in the data sheets and operating instructions included with the components.
- Do not exceed the maximum permissible pressure of 6 bar (600 kPa).
- Do not activate compressed air until all of the tubing connections have been completed and secured.
- Do not disconnect tubing while under pressure.
- Do not attempt to connect tubing or push-in connectors with your hands or fingers.
- Danger of injury when switching compressed air on!
  Cylinders may advance and retract automatically.
- Risk of accident due to advancing cylinders!
  - Always position pneumatic cylinders so that the piston rod's working space is unobstructed over the entire stroke range.
  - Make sure that the piston rod cannot collide with any rigid components of the setup.
- Danger of accident due to tubing slipping off!
  - Use shortest possible tubing connections.
  - In the event that tubing slips off:
    Switch off the compressed air supply immediately.
- Pneumatic circuit setup:
  Connect the devices with plastic tubing with an outside diameter of 4 or 6 mm. Push the tubing into the push-in connector as far as it will go.
- Switch compressed air supply off before dismantling the circuit.
- Pneumatic circuit dismantling
  Press the blue release ring down, after which the tubing can be pulled out.
- Noise due to escaping compressed air
  - Noise caused by escaping compressed air may damage your hearing. Reduce the noise by using silencers, or wear hearing protection if the noise cannot be avoided.
  - All of the exhaust ports for the components included in the equipment set are equipped with silencers.
    Do not remove these silencers.

5 Technical data

5.1 General data

Parameter	Value
Operating pressure	600 kPa (6 bar)
Operating voltage	24 V DC, 4.5 A
Main controller: S7-CPU1512SP-1PN Digital inputs/outputs Inputs: 4 Outputs: 5 IO-Link Inputs: 2	 Max. 24 V DC Max. 2 A per output Max. 4 A total RFID reader: Siemens RF240R
Drilling module ET200SP Profinet IO device Digital inputs/outputs Inputs: 3 Outputs: 3	 Max. 24 V DC Max. 2 A per output Max. 4 A total
Insertion module ET200SP Profinet IO device Digital inputs/outputs Inputs: 7 Outputs: 6	 Max. 24 V DC Max. 2 A per output Max. 4 A total
Pick-by-light module – manual workstation LOGO!8 Ethernet device Digital inputs/outputs Inputs: 5 Outputs: 4	 Max. 24 V DC Relay outputs
KTP400 display and control unit	Image size: 480 x 272 pixels 64,000 colors, 4 function keys
Industrial Ethernet switch: SCALANCE XB005, unmanaged	5 ports with RJ45 sockets Transmission speed:10 Mbit/s, 100 Mbit/s
DC wattmeter (power meter)	Max. measuring voltage: 30 V DC Max. measuring current: 5 A (can be switched to 2.5 A) Ethernet TCP, V4, configuration via web interface
Raspberry Pi2 data center, single-board computer in top-hat rail mount housing with voltage transformer: 24 to 5 V DC for micro USB connection Broadcom BCM2836 chip ARM Cortex-A7 processor, 4 x 900 MHz Dual-core VideoCore IV Multimedia co-processor with OpenGL ES 2.0 OpenVG, 1080p30 h.264 high-profile decoder	1 GB RAM Video outputs: HDMI™ Audio Output: 3.5 mm jack, HDMI™ 8 GB micro SD memory card 10/100 Ethernet RJ45 on-board 4 x USB 2.0
Electrical connection	Direct wiring of sensors and actuators Distributed periphery via Ethernet/Profinet
Pneumatic connection	Plastic tubing with 6 mm outside diameter
Compressed air consumption at 600 kPa (continuous cycle)	3 l/min.
Dimensions (W x D x H)	700 x 400 x 635 mm
Weight	24 kg
Subject to change	

6 Transport, unpacking, scope of delivery

6.1 Transport

MPS® stations are delivered in a crate on a pallet base.
The crate may only be transported with a suitable pallet jack or forklift. The crate must be secured against tipping over and falling.
The freight forwarder and Festo Didactic must be notified of any transport damage without delay.

6.2 Unpacking

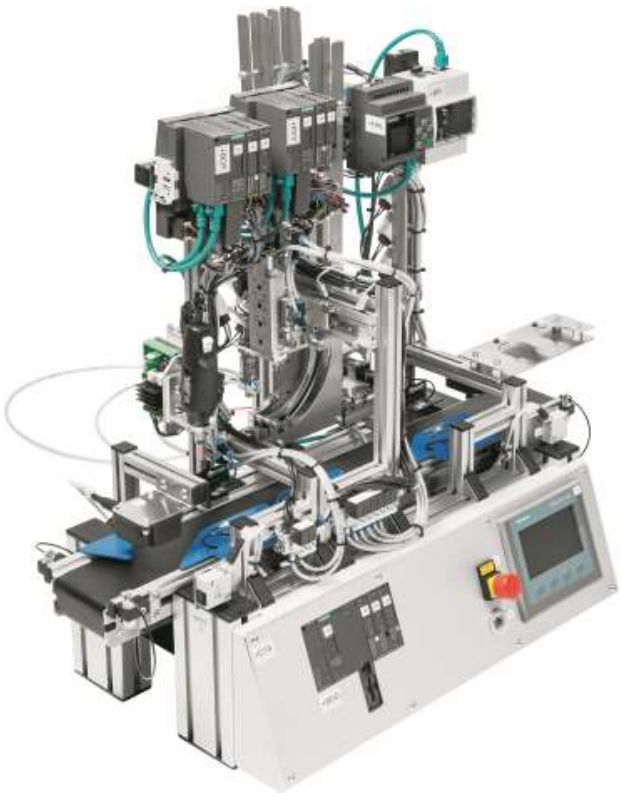
Carefully remove the padding material from the crate when unpacking the station. When unpacking the station, make sure that none of the station assemblies have been damaged.
Examine the station for possible damage after unpacking. The freight forwarder and Festo Didactic must be notified of any damage without delay.

6.3 Scope of delivery

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

7 Layout and function

7.1 The MPS® TS Compact Trainer I4.0

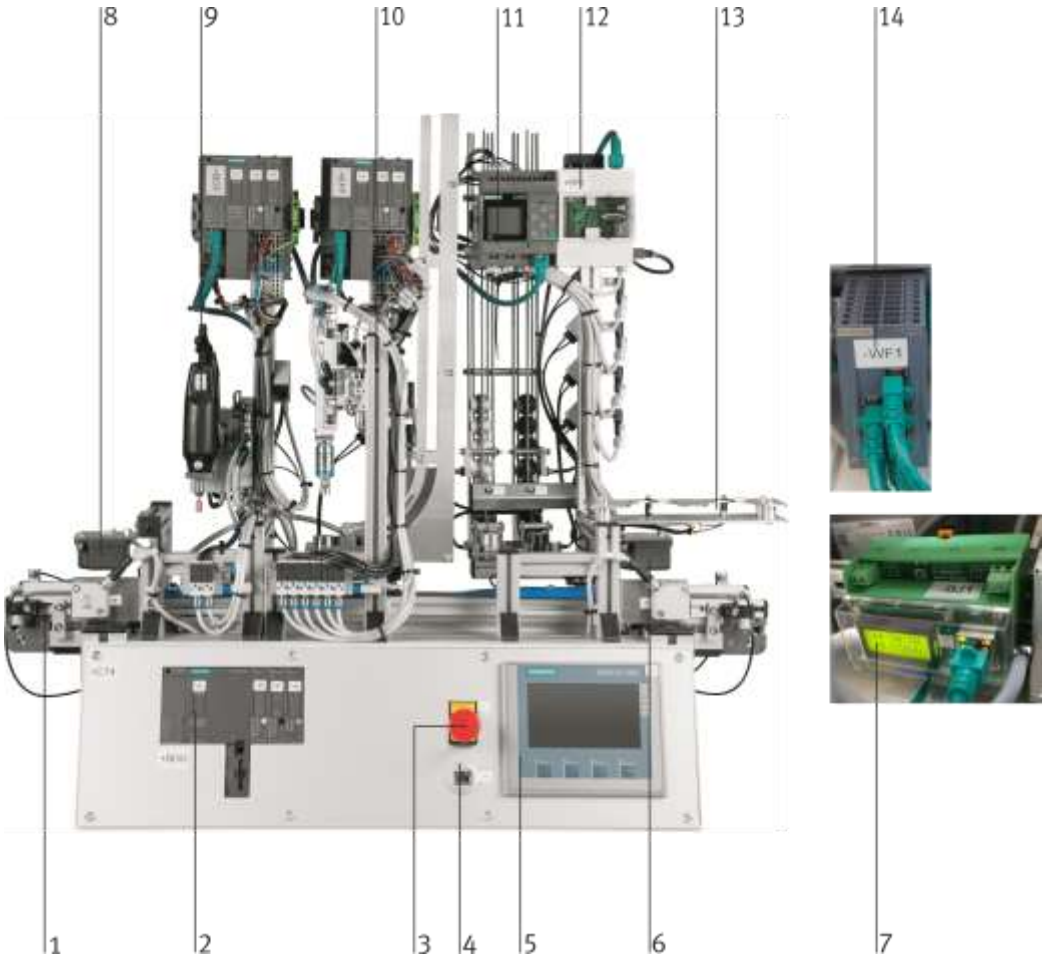


The MPS® transfer system serves as a basis for the MPS® TS Compact Trainer I4.0. A CPS (cyber-physical system) is set up with currently available automation components. A modern S7-1500 industrial controller is at the heart of this autonomous and highly communicative unit. The PLC is programmed via the TIA Portal. The KTP400 display and control unit serves as a user interface for intuitive operation and machine operator guidance. Data is exchanged with the intelligent workpiece (a bearing roller) via an RFID read-write system which communicates with the controller via an IO-Link interface. The PLC is equipped with an integrated web server for fast process diagnostics with standard IT technologies.
The MPS® TS Compact Trainer I4.0 integrates the following main components in the spirit of the smart factory:

- Conveyor with 2 RFID sensors
- Integrated S7-1500 CPU1512SPF-1PN controller with 8 digital inputs and 8 digital outputs and an IO-Link communication module
- KTP400 Basic display and control unit
- Drilling module with ET200SP Profinet IO device
- Insertion module with ET200SP Profinet IO device
- Pick-by-light module – manual workstation with LOGO!8 Ethernet device
- Bearing roller workpiece set with RFID tag
- Bearing hub workpiece set with 3 different materials

It provides a turnkey learning scenario for quick and safe introduction to the issue of **"**On the way to Industry 4.0**"**. Compatibility with already existing MPS transfer systems and MPS stations must be clarified on a project-specific basis.

7.2 Production scenario

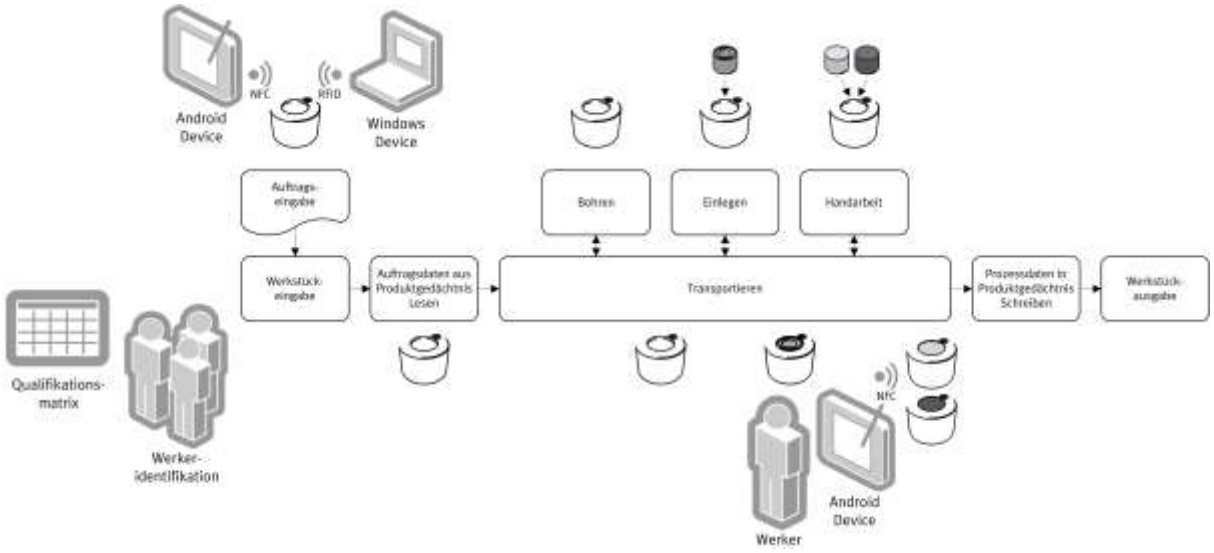


Overview MPS® TS Compact Trainer I4.0

1 Transfer line, beginning of conveyor
2 S71512SP F 1PN main controller
3 Emergency off pushbutton
4 RJ45 network access
5 KTP400 display and control unit
6 RFID reader, end of conveyor
7 DC wattmeter, at back
8 RFID reader, beginning of conveyor
9 Drilling module with ET200SP Profinet IO device
10 Insertion module with ET200SP Profinet IO device
11 Pick-by-light module – manual workstation with LOGO!8 mini control system
12 Raspberry Pi single-board computer
13 Manual workplace, tray
14 Scalance XB005 network switch, at back

7.2.1 Process sequence

The operator starts the production process for a bearing roller with a bearing hub at the display and control unit (5). The workpiece, which keeps its own work plan in digital product memory, is positioned at the beginning of the conveyor (1). The RFID reader (8) scans the order data and the work plan from the workpiece's product memory and transmits them to the main controller (2). The workpiece is transported to the next process step. The drilling process is executed at the drilling module (9) in accordance with the number of drilling strokes specified in the work plan. The work plan in product memory specifies the required type of bearing hub. The workpiece is transported either to automatic assembly of the steel bearing hub at the insertion module (10) or the manual workstation module (11). The operator manually assembles the aluminum or POM bearing hubs in accordance with the work plan at this workstation. Machine operator guidance by means of pick-by-light indicates correct assembly and storage locations to the operator. The operator removes the workpiece (bearing roller) from the assembly conveyor and positions it at the indicated assembly position in the workpiece tray (13). The order-specific stock picking location is signaled to the operator. During final assembly of the roller, the operator inserts the bearing hub into the roller, places the assembly back onto the assembly conveyor and acknowledges completion of the operation. The finished product is transported further. Digital product memory is updated with process data by means of an RFID write operation at the end of the conveyor (6), after which the workpiece is unloaded.



Process sequence overview

7.2.2 The intelligent workpiece

Utilized workpieces have a digital product memory based on an RFID data carrier which is compliant with ISO 15693. This memory contains complete production data as a tabular process plan. During the production process, process-relevant production data are additionally stored to product memory such as the current production step, time stamps for the beginning and completion of production, and quality data. After completion of the production process, traceability is made possible by means of unique serial numbers. And thus individual production with a lot size of 1 can be implemented.

7.2.3 Order entry

One of the characteristics of Industry 4.0 is the storage of order data to the workpiece. In order to transfer this data out of the MPS® TS Compact Trainer I4.0 to the workpiece's RFID chip and check it, an RFID write/read module with USB port and an RFID PC application are included in the scope of delivery. The data records can be loaded as a text file and saved.

7.3 The transfer system

Similar to photo

The transfer system is used to transport the workpieces. Presence of the workpieces at the beginning and end of the conveyor is substantiated by optical through-beam sensors with fiber-optic cables.
The module is fully assembled. Clockwise and counterclockwise motor operation (forward/reverse), as well as low-speed operation, can be selected with the integrated motor controller.

The conveyor belt is driven by means of a DC geared motor.

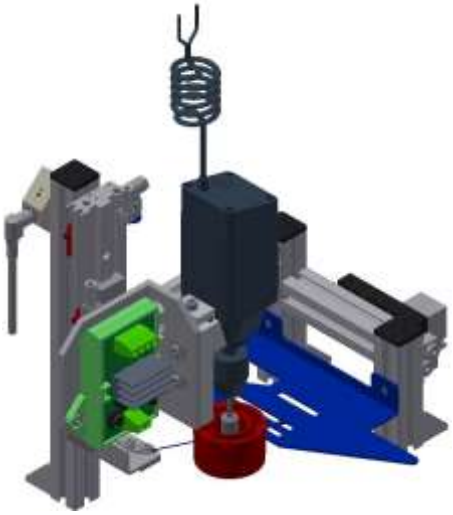
An emergency off mushroom actuator interrupts power supply to the actuators directly, and must be unlocked after actuation.

The Simatic S7-1500 CPU1512SP-1PN main controller and the KTP400 Basic display and control unit are installed to the front panel of the carrier system. The DC wattmeter for measuring power at electrical power consumers is located on the inside of the front panel. A network switch is mounted at the back.

Equipped with the MPS SensLink interface, the MPS® TS Compact Trainer I4.0 can be integrated into a broad range of learning scenarios.

ID	ET200SP Profinet device	Designation
+BDG	IP address: 192.168.0.1	Installation location
-8B1	I1.0	Coupling sensor receiver (0 = right follow-up conveyor is occupied)
-1B1	I1.4	Through-beam sensor at beginning of the transfer line
-S5	I1.5	Emergency stop button, transfer line
-1B3	I1.6	Through-beam sensor at end of the transfer line
-8K1	Q1.0	SensLInk sender (1=transferline is busy)
-2Q1_A1	Q1.4	Conveyor drive clockwise rotation (forward)
-2Q1_A2	Q1.5	Conveyor drive counter-clockwise rotation (backward)
-2Q1_A3	Q1.6	Conveyor drive slow speed
-2Q1_STO	Q1.7	Conveyor drive stop

7.4 The drilling module



The task of the drilling module is to:

- Move workpieces to the correct position
- Machine the workpiece by adding a drill hole (simulation)

The module drills workpieces (symbolically). The workpieces are detected on the conveyor belt by an optical diffuse sensor. The drilling machine is moved down by means of a pneumatic slide.

Advancing and retracting speed of the linear slide can be infinitely adjusted with the help of one-way flow control valves.

If a workpiece is positioned underneath the drilling machine by the transfer system via the baffle plate, and if the fiber-optic cable at the baffle plate detects the workpiece, the conveyor belt is stopped and an automatic sequence is started. The linear slide moves down and symbolically drills a hole. The linear cylinder then travels back up to its initial position.
When the linear slide is at the top, the conveyor belt is re-started and the workpiece leaves the module.

ID	ET200SP Profinet device	Designation
+BOF	IP address: 192.168.0.11	Installation location
-1B1	I100.0	Reed switch, linear slide, drill up
-1B2	I100.1	Reed switch, linear slide, drill down
-4B1	I100.3	Through-beam sensor, workpiece in module
-1M1	Q100.0	Solenoid coil, linear slide, drilling machine up
-1M2	Q100.1	Solenoid coil, linear slide, drilling machine down
-11Q1	Q100.2	Starting current limiter for drilling machine power-up

7.5 The insertion module

The insertion module inserts bearing hubs into a workpiece (bearing roller). The workpieces are advanced to a precisely defined position by the transfer line with the help of a baffle plate and an advancing stopper cylinder. A through-beam sensor detects the workpiece. The transfer line is stopped. The bearing hub can now be removed from the gravity-feed magazine. A handling device (linear gantry) with gripper grasps the bearing hubs and inserts them into the waiting roller. When the insertion process has been completed and the linear gantry has returned to its initial position, the transfer line is started, the stopper cylinder is retracted and the workpiece moves on.

ID	ET200SP Profinet device	Designation
+EFF	IP address: 192.168.0.12	Installation location
-1B1	I110.0	Reed switch, X-axis at conveyor belt
-1B2	I110.1	Reed switch, X-axis at magazine
-2B1	I110.2	Reed switch, Z-axis, gripper up
-2B2	I110.3	Reed switch, Z-axis, gripper down
-3B1	I110.4	Reed switch, gripper open
-4B1	I110.5	Through-beam sensor, workpiece in magazine
-5B1	I110.6	Through-beam sensor, workpiece in module
-1M1	Q110.0	Solenoid coil, linear slide, X-axis to conveyor belt
-1M2	Q110.1	Solenoid coil, linear slide, X-axis to magazine
-2M1	Q110.2	Solenoid coil, linear slide, Z-axis up
-2M2	Q110.3	Solenoid coil, linear slide, Z-axis down
-3M1	Q110.4	Solenoid coil, gripper, open
-5M1	Q110.5	Solenoid coil, stopper cylinder, advance

7.6 The pick-by-light manual workstation module

An operator manually inserts bearing hubs into the unfinished bearing roller at the pick-by-light manual workstation module. The workpieces are advanced to a defined position by the transfer line with the help of a baffle plate. A through-beam sensor detects the workpiece (bearing roller). The transfer line is stopped. The operator then removes the bearing roller from the conveyor belt and places it into the assembly tray.

The assembly tray has two assembly locations. The required assembly location in the assembly tray is indicated by means of a blue LED:
Position 1 (-7P1): assembly
Position 2 (-8P1): rework

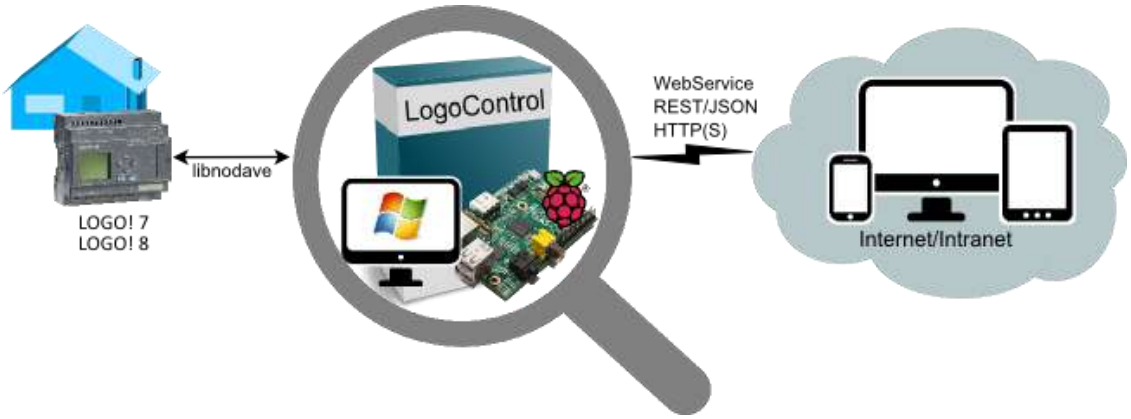
The gravity-feed magazine for the bearing hubs allocated to the respective work step is indicated to the operator at the pick-by-light module by an LED. The operator grasps the bearing hubs and inserts them into the roller. The finished assembly is then returned to its previous conveyor belt position. The workpiece is detected by the through-beam sensor, the transfer line is started and the workpiece advances to the RFID reader.

ID	LOGO!8 Ethernet device	Designation
+HAL	IP address: 192.168.0.13	Installation location
-4B1	I1	Through-beam sensor, workpiece in module
-5B1	I2	Magazine 1, aluminum bearing hub in pick position
-6B1	I3	Magazine 2, POM bearing hub in pick position
-7B1	I4	Magazine 1, aluminum bearing hub fill-level, 7 pieces remaining
-8B1	I5	Magazine 2, POM bearing hub fill-level, 7 pieces remaining
-5P1	Q1	LED indicator, pick-by-light, magazine 1: pick aluminum bearing hub
-6P1	Q2	LED indicator, pick-by-light, magazine 2: pick POM bearing hub
-7P1	Q3	LED indicator, tray position 1: assembly
-8P1	Q4	LED indicator, tray position 2: rework

7.7 Raspberry Pi single-board computer data center

The Raspberry Pi is a single-board computer which is used to archive and evaluate the statuses of the LOGO, and display them via its own web server. The raspberry Pi also functions as an NTP time server within the local network.

LogoControl has been installed so that the Raspberry Pi can access data at the LOGO!8. LogoControl expands the Siemens LOGO into an external web server for individual visualization based on HTML and an open web service API for connection of third party programs. LogoControl provides an open API on the basis of a web service (REST/JSON) for the connection of any number of external clients.



Overview of data communication with LogoControl

Data can be read out from the LOGO via simple http commands with the help of LogoControl.
http://192.168.0.10:8088/rest/devices/{deviceId}/attributes/{attributeId}/value

The data are read out to a sample application, namely **"**HAL.exe**"** (C++ program), and written cyclically (0.5 s) to the MySQL database.

The data are made available within the local network via a web server.
http://192.168.0.10

The **"**HAL.exe**"** sample program also provides the option of setting system time at the Raspberry Pi. The program checks once every 0.5 seconds to determine whether or not a new time has been saved to the database to this end. Time (local time) can be set on the data center's website at http://192.168.0.10.

Notes:
The Raspberry Pi doesn't have an internal battery, which means that system time (UTC) stops in the event that supply power is interrupted. As a result, it must always be set when the device is started.

And thus local time is read out of the LOGO!8 by the Raspberry when it's restarted and then used as system time on the basis of the time zone selected in the system settings.

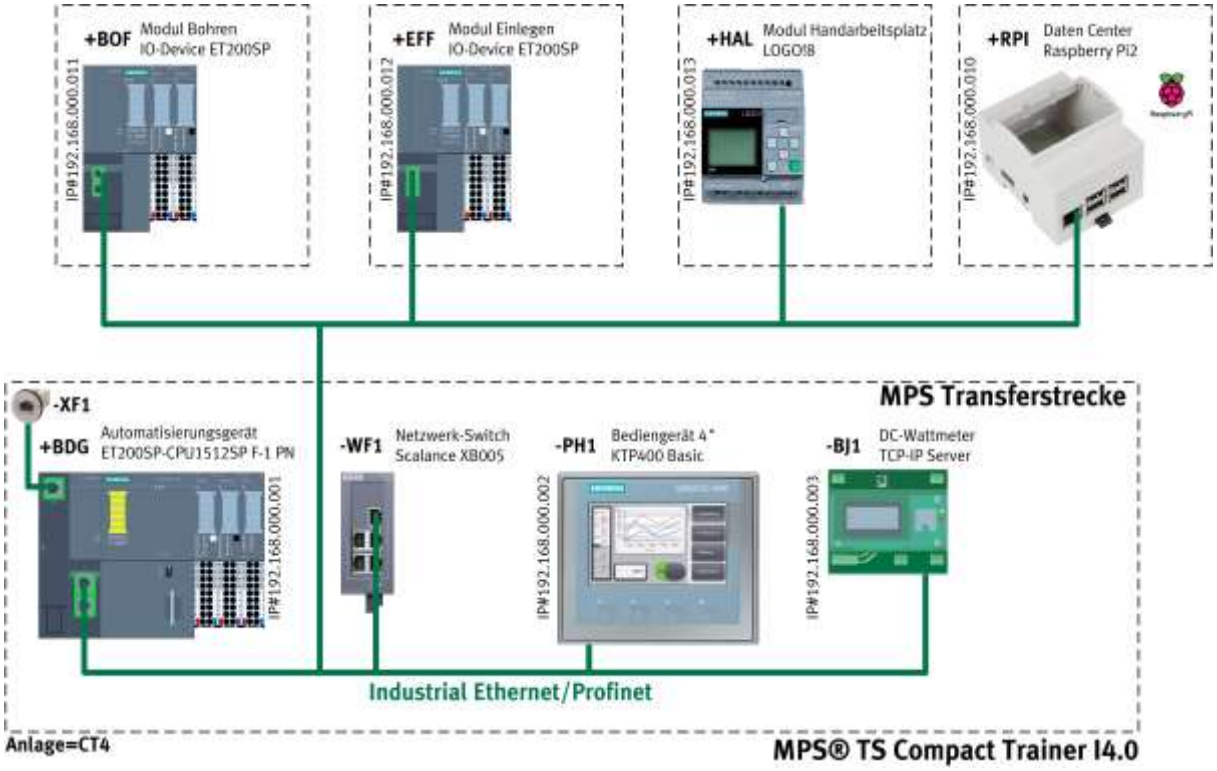
Upon delivery, the following applications are included in the Raspberry Pi:

- Raspbian (operating system)
- Eclipse (C++)
- Apache web server
- MySQL / PHP MyAdmin
- VNC server
- LogoControl
- NTP server
- WiFi access point with SSID: WLANraspberry, password: Raspberry, IP address: 192.168.10.1
  DHCP IP address space: 192.168.10.2-254, lease 2h

ID	Raspberry Pi data center	Designation
+RPI	IP address: 192.168.0.10	Installation location
-WF2	WiFi stick	EDIMAX EW-7811Un
-TA1	Voltage transformer	Power pack, 24 V DC → 5 V DC, 3.5 A, 15 W, with micro USB cable

7.8 Automation network

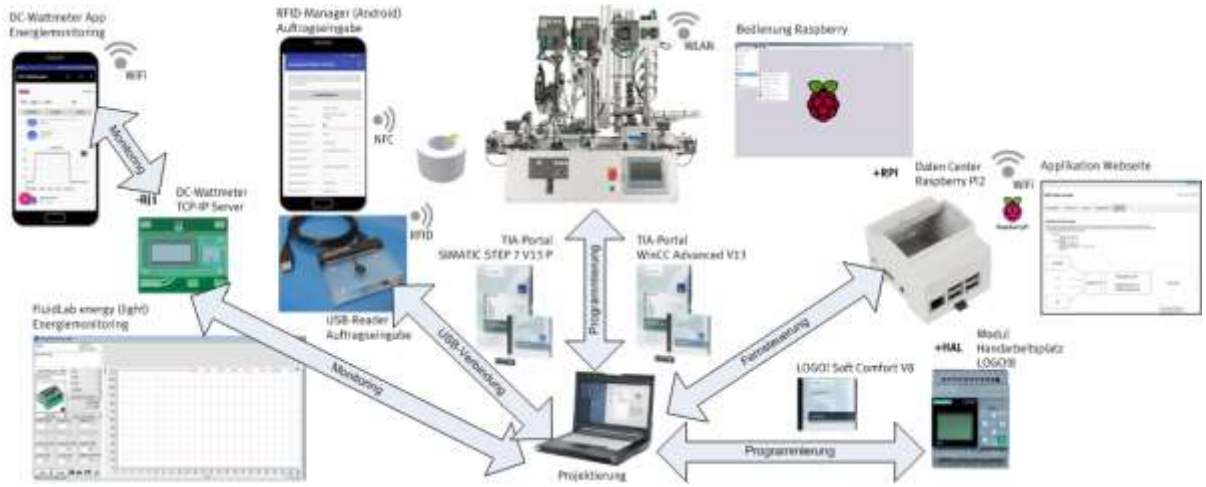
The devices of the MPS® TS Compact Trainer I4.0 are connected to a network switch via network cables. There's an RJ45 panel mount socket for the programming unit on the front panel.



System overview of the devices

7.9 Software tools

The use of software development tools can be practiced in an extremely small space with the MPS® TS Compact Trainer I4.0.



Software tools of the MPS® TS Compact Trainer I4.0

The following software is included in scope of delivery:

- TIA Portal STEP7 V13 SP1 or higher
- TIA Portal WinCC Basic V13 SP1 or higher
- S7-PCT V3.4 HF1 and higher
- LOGO!Soft Comfort V8.0 and higher
- RFID application and driver for USB reader
- FluidLab energy light

The following sample applications are included in the scope of delivery:

- S7 sample project, main controller for S7-1500 CPU1512SP-1PN, KTP400 Basic display and control unit and IO-Link Master ET200SP
- Sample project, manual workstation for LOGO!8
- Sample application for Raspberry Pi as image file

8 Commissioning

Learning objectives

After completing this section:

- You'll be able to create a commissioning report.
- You'll be able to establish the connections necessary for operation.
- You'll be able to load a sample project to the PLC and the display and control unit, and test it.
- You'll be able to assign a Profinet device name.
- You'll be able to load a sample project to a mini control system and test it.
- You'll be able to configure a device via the web interface.
- You'll be able to load an IO-Link master module by means of a PC tool.
- You'll be able to restore the operating system of single-board computer.
- You'll be able to remote control the Raspberry Pi single-board computer.
- You'll be able to configure the basic settings of the Raspberry Pi single-board computer.

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 unambiguously identified, so that all of the connections can be readily restored as required.

Work assignments

1. Document your commissioning work steps in the commissioning report.
2. Prepare your PC and your workstation, and connect the MPS® TS Compact Trainer I4.0 to supply power and compressed air supply.
3. Load the sample project for the Siemens S7-1500 CPU1512SP-1PN controller with Siemens programming software TIA Portal Step7 V13 or higher.
4. Load the sample project for the KTP400 Basic display and control unit with Siemens programming software TIA Portal Step7 V13 or higher.
5. Assign the Profinet device name to the drilling and insertion modules with ET200SP Profinet IO device using Siemens pro software TIA Portal (V13 SP1 Up9).
6. Load the "manual workstation" sample project to the LOGO!8 mini control system with Siemens programming software LogoSoft! Comfort (V8.0).
7. Configure the IP address and measured value display at the DC wattmeter via the web interface.
8. Load the configuration of the IO-Link communications module of the ET200SP and the RFID readers with TIA Portal tool S7-PCT.
9. Restore the operating system of the Raspberry Pi single-board computer.
10. Set the local time zone and, if necessary, the system language of the Raspberry Pi single-board computer.

Work aids

- Utilized hardware: MPS® TS Compact Trainer I4.0, compressed air supply, 24 V DC power pack, PC
- Utilized software:
  - TIA Portal STEP7 V13 SP1 update 9 and higher, TIA Portal WinCC Basic V13 SP1 update 9 and higher, S7-PCT V3.4 HF1 and higher
  - LOGO!Soft Comfort V8.0 and higher
  - Internet browser, VNC viewer etc.
- Commissioning report
- Documentation, TIA Portal help system, workbook, Internet

Exercise 1: Commissioning report

All phases of initial commissioning and recommissioning of the MPS® TS Compact Trainer I4.0 should be documented with the help of a commissioning report.

Create the commissioning report:

- Document the required commissioning steps in the following commissioning report and confirm completion by entering the date and signing the report.

	Commissioning report	**Project:**	
Location	**Activity**	**Completed**	**Note/observation**
=CT4	Establish connections – power supply.		
=CT4	Establish connections – compressed air supply.		
PC	Set the project computer within the respective IP address range, for example 192.168.0.100.		
+BDG	Commission S71512SP-1F controller hardware and load sample application.		
-PH1	Commission KTP400 controller hardware and load sample application.		
+BOF	Assign Profinet IO device name for drilling module ET200SP IM155-6.		
+EFF	Assign Profinet IO device name for insertion module ET200SP IM155-6.		
+HAL	Load "manual workstation" sample project to the LOGO!8 mini control system.		
-BJ1	Configure the IP address and measured value display at the DC wattmeter.		
+BDG	Configuring the IO-Link communication module and the RFID readers.		
+RPI	Restore the operating system of the Raspberry Pi single-board computer.		
+RPI	Remote control of the Raspberry Pi single-board computer		
+RPI	Localization of the Raspberry Pi single-board computer		
+BOF	Set end position queries for the drilling cylinder. Adjust stroke motion of the drilling cylinder.		
+EFF	Set end position queries for the handling unit / gripper. Adjust stroke motion of the handling unit / gripper.		
Date		Completed by:	

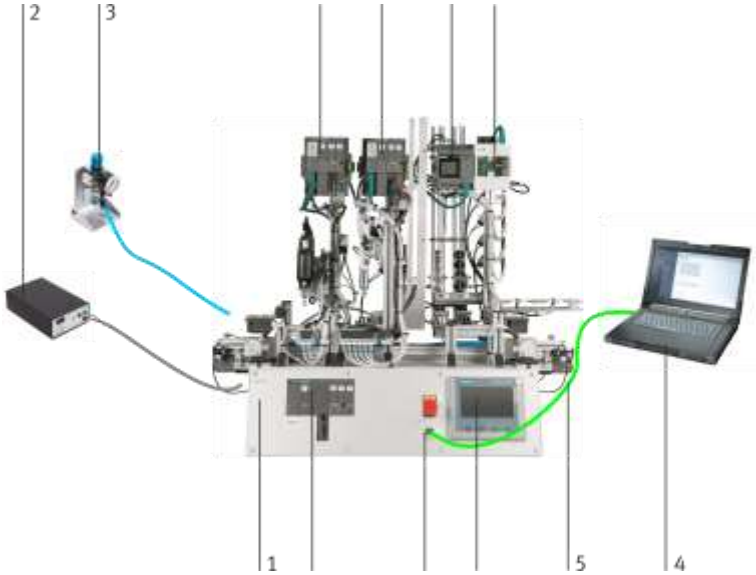
Exercise2: Establishing connections

You'll need the following in order to commission the MPS® TS Compact Trainer I4.0 with the sample programs:

- The assembled and adjusted MPS® TS Compact Trainer I4.0
- Power pack: 24 V DC, 4.5 A
- Compressed air supply with 600 kPa (6 bar)
- A PC with installed PLC programming software
- A network cable

Analyzing the setup

– Analyze the setup shown below with regard to the utilized components and enter the missing numbers for the components in the sketch.



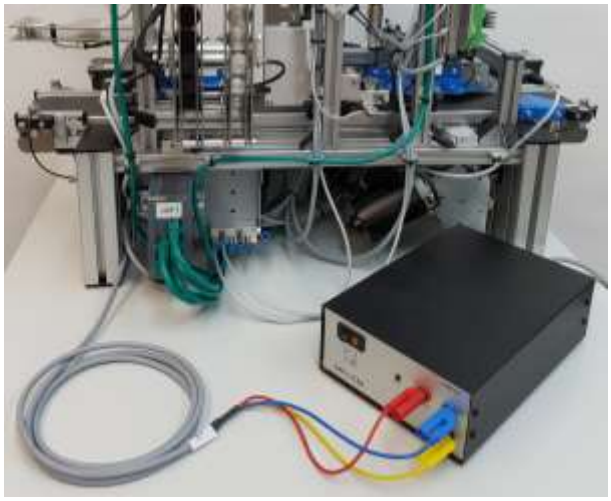
1: MPS® TS Compact Trainer I4.0, 2: power pack, 3: compressed air supply, 4: PC, 5: network cable,
6: insertion module with ET200SP, 7: RJ45 socket with network cable, 8: pick-by-light module with LOGO!,
9: CPU1512SP-1F, 10: KTP400 display and control unit, 11: drilling module with ET200SP, 12: data center with Raspberry Pi

Information: power supply

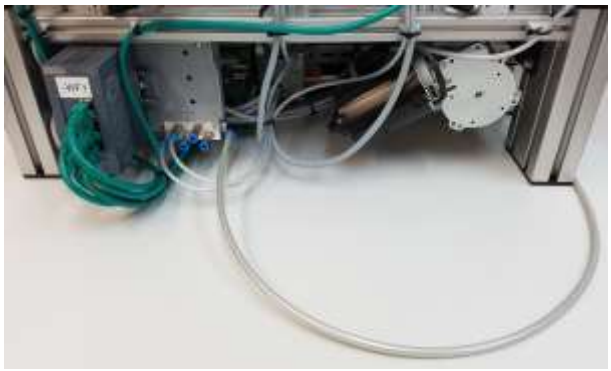
- The MPS® TS Compact Trainer I4.0 is supplied with electrical power from a 24 V DC power pack (max. 5 A).
- 24 V DC supply power for modules and the device is hard-wired in the carrier system for the transfer line.
- 5 V DC is supplied to the Raspberry Pi2 data center by a DC-DC voltage converter via the USB port of the IOT device.

Cable and tubing connections

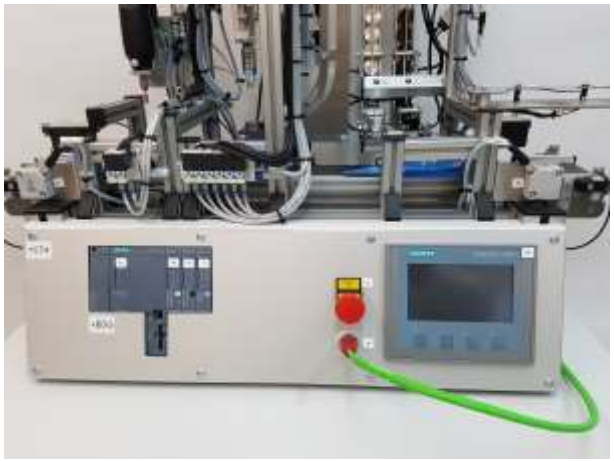
1. CompactTrainer power pack: Insert the 4 mm safety plugs into the sockets in the power pack.



2. Connect the 5-way pneumatic manifold of the Syslink distribution board on the back to compressed air supply using 6 mm compressed air tubing (on-site) and set to a system pressure of ~ 5 to 6 bar.



3. PC to CompactTrainer: Connect the PC to the RJ45 socket in the front panel of the MPS® TS Compact Trainer I4.0 via a network cable. The RJ45 socket is directly connected to the Ethernet interface of the S7-1500 CPU1512SP-1PN, and is looped through to the Industrial Ethernet switch.



Preparing the workstation

Configure the IP address of the project computer. An IP address within the same address space as the training device is recommended for connection to the PLC, the HMI and the Profinet IO devices, for example: IP 192.168.0.100, subnet mask: 255.255.255.0

In order to avoid errors within the network, please contact your IT administrator if you want to connect the training device in your local area network.

If the DC wattmeter has been reset to its default value (192.168.1.199), connection to the device via the device website can only be established with a PC whose IP address lies within the same address space, for example IP 192.168.0.100, subnet mask: 255.255.255.0.

Expert tip: deleting PLC data

Proceed as follows if you want to make sure that your PLC (S7-1500) is set to the default factory settings.

Prerequisite:

PC with MMC memory card reader.

Information concerning the described components can be found in the manual for the ET200SP.

1. Switch off controller supply power.
2. Remove the Simatic memory card (e.g. 512 MB) from the CPU slot.

3. Insert the Simatic memory card into the memory card reader at the PC.
4. If your Simatic memory card is not empty, delete the “SIMATIC.S7S” folder as well as the “S7_JOB.S7S” file from the memory card, e.g. with the help of the Windows Explorer.
5. Switch controller supply power back on again.
6. Perform a general reset manually at the mode selector switch of the S7-1500 CPU.
7. Switch controller supply power back off again.
8. Insert the Simatic memory card back into the CPU slot.
9. Switch on controller supply power and set the mode selector switch of the S7-1500 CPU to “RUN”.

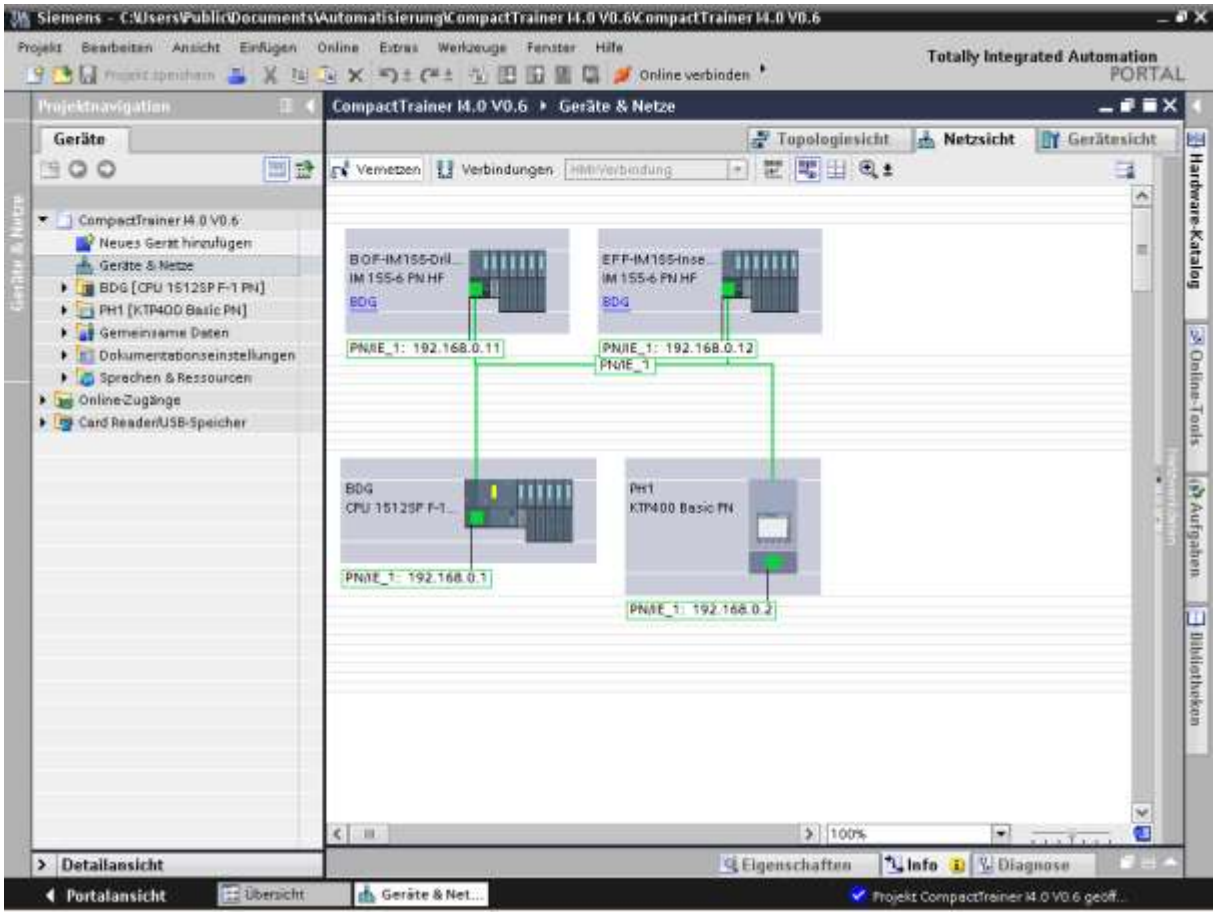
Exercise 3: Commissioning and loading S71512SP-1F and KTP400 controller hardware

Procedure

Start the TIA Portal in the project view and retrieve/open the sample project for the MPS® TS Compact Trainer I4.0 for the Siemens S7-1500 CPU1512SP-1PN controller and the KTP400 display and control unit from the technical documentation: ...\CompactTrainer_I40_Sources\S7-1500\

For example CompactTrainer I4.0 VX.X.zap13

The following project parameters are set: failsafe CPU password: “Festo”

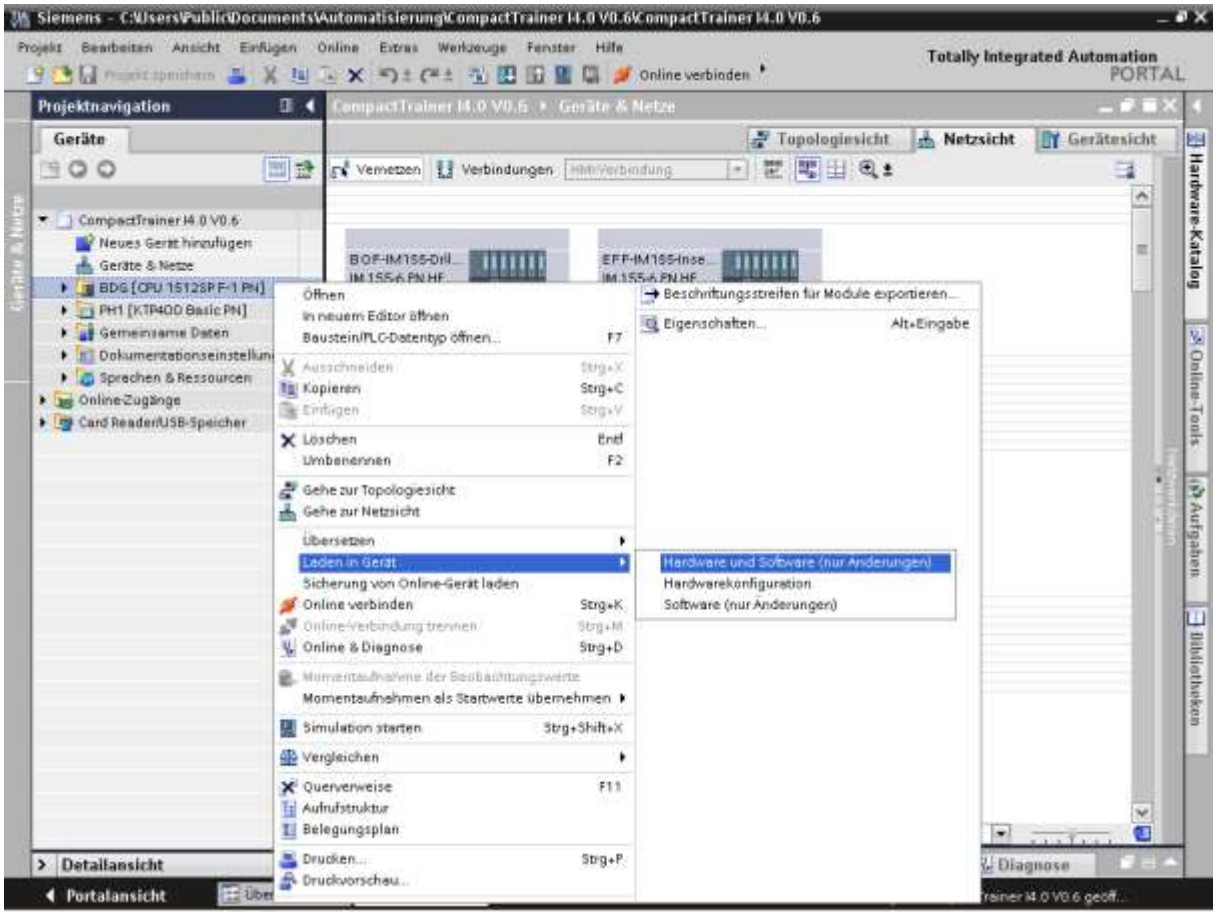


Note regarding symbols

Right click

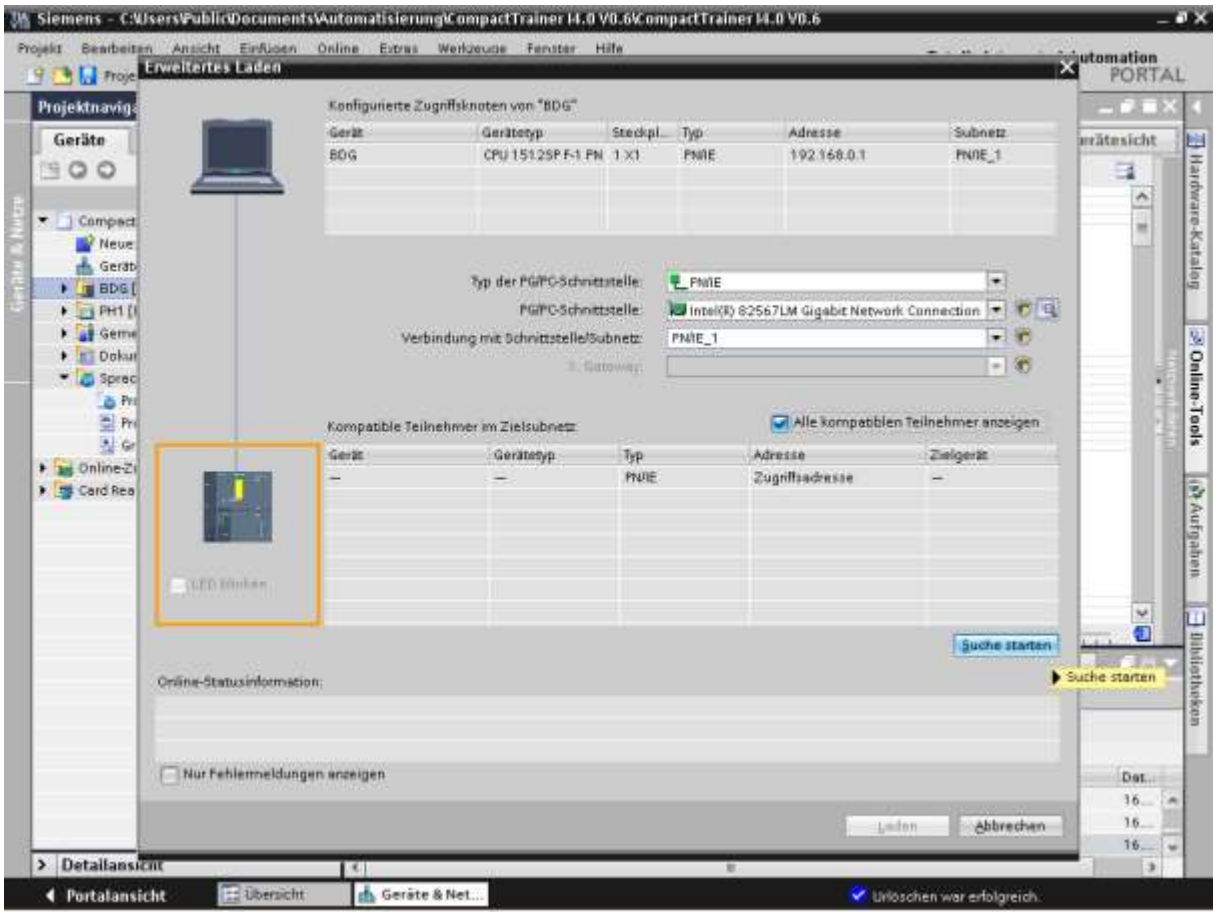
Left click

1. Loading the main controller:
→ Select PLC → ☝ → load to device
→ Hardware and software (changes only)



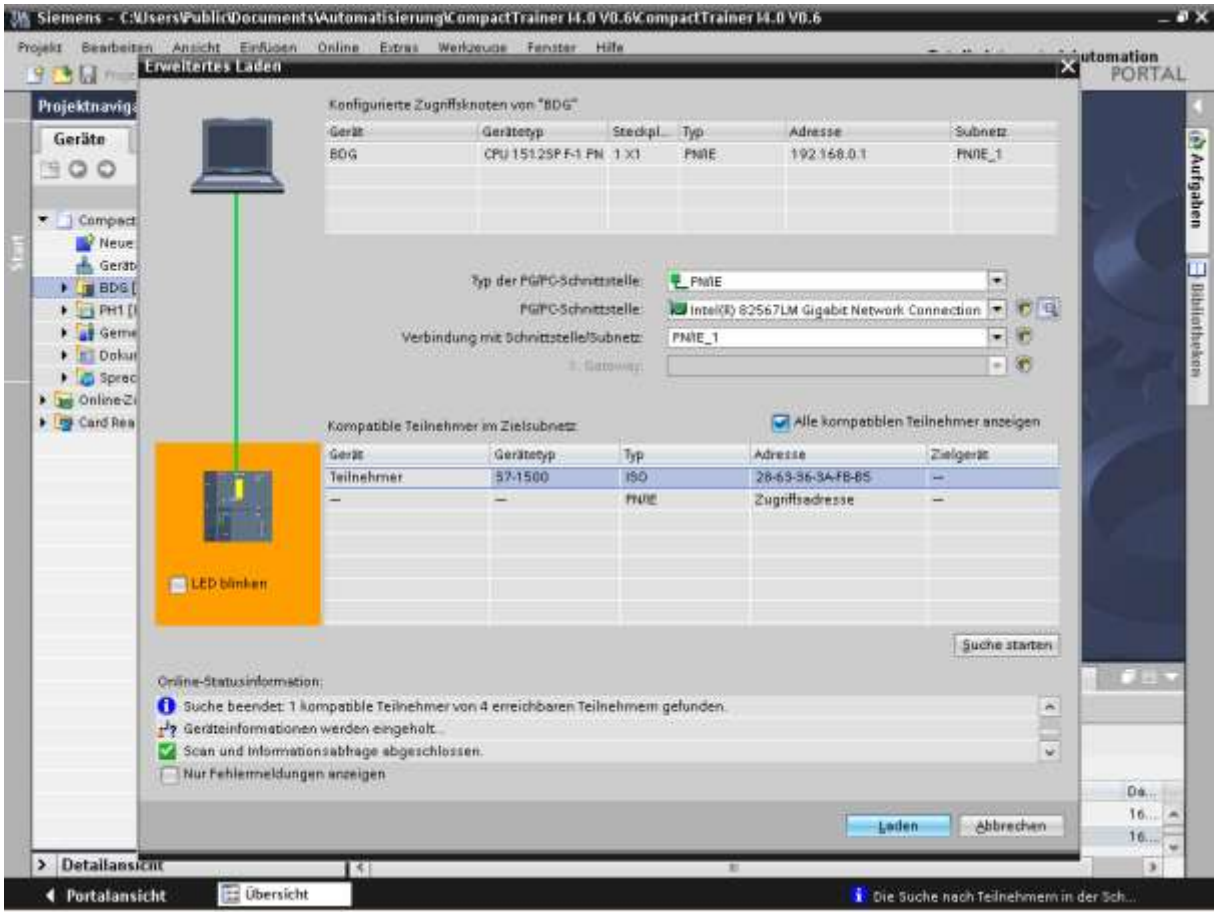
→ Hardware and software (changes only)

2. Select the PD/PC interface. In our example, the PD/PC interface is the existing LAN adapter for your network connection. Compare this with the settings in the Windows Control Panel under **"**Network and Sharing Center**"**.



→ Start search

3. Select a device.

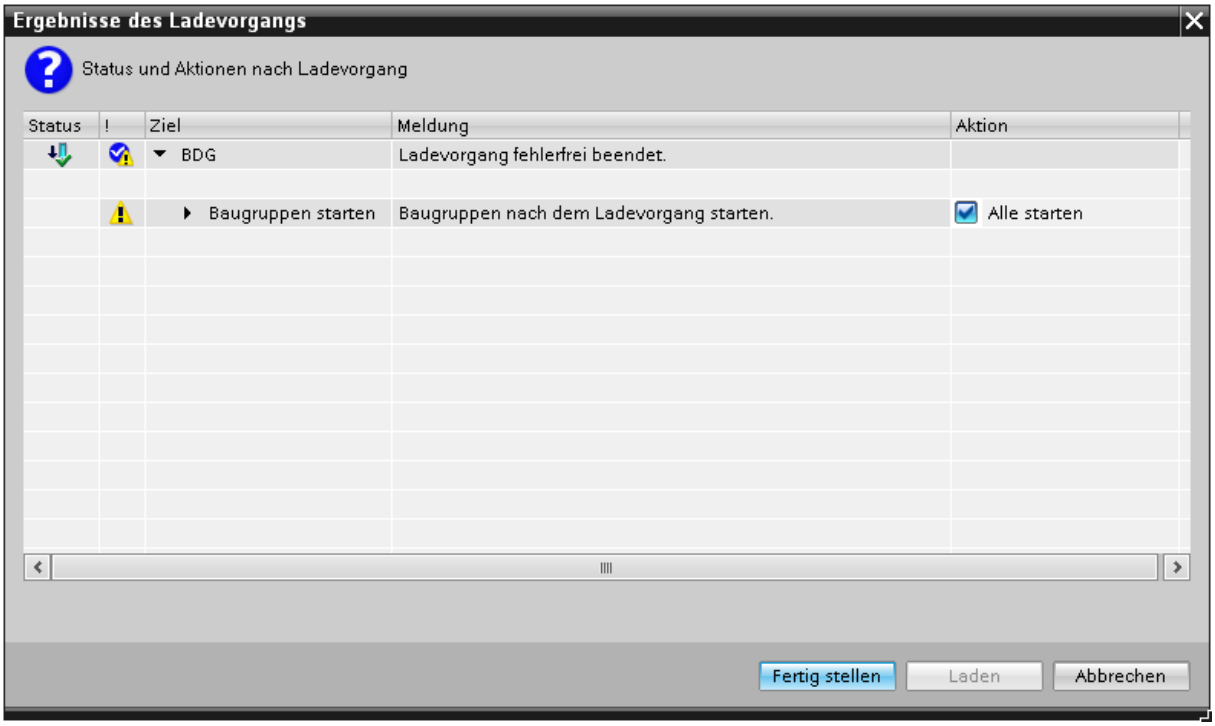


→ Load

4. Select “Overwrite all”.

→ Load

5. Select “Overwrite all”.

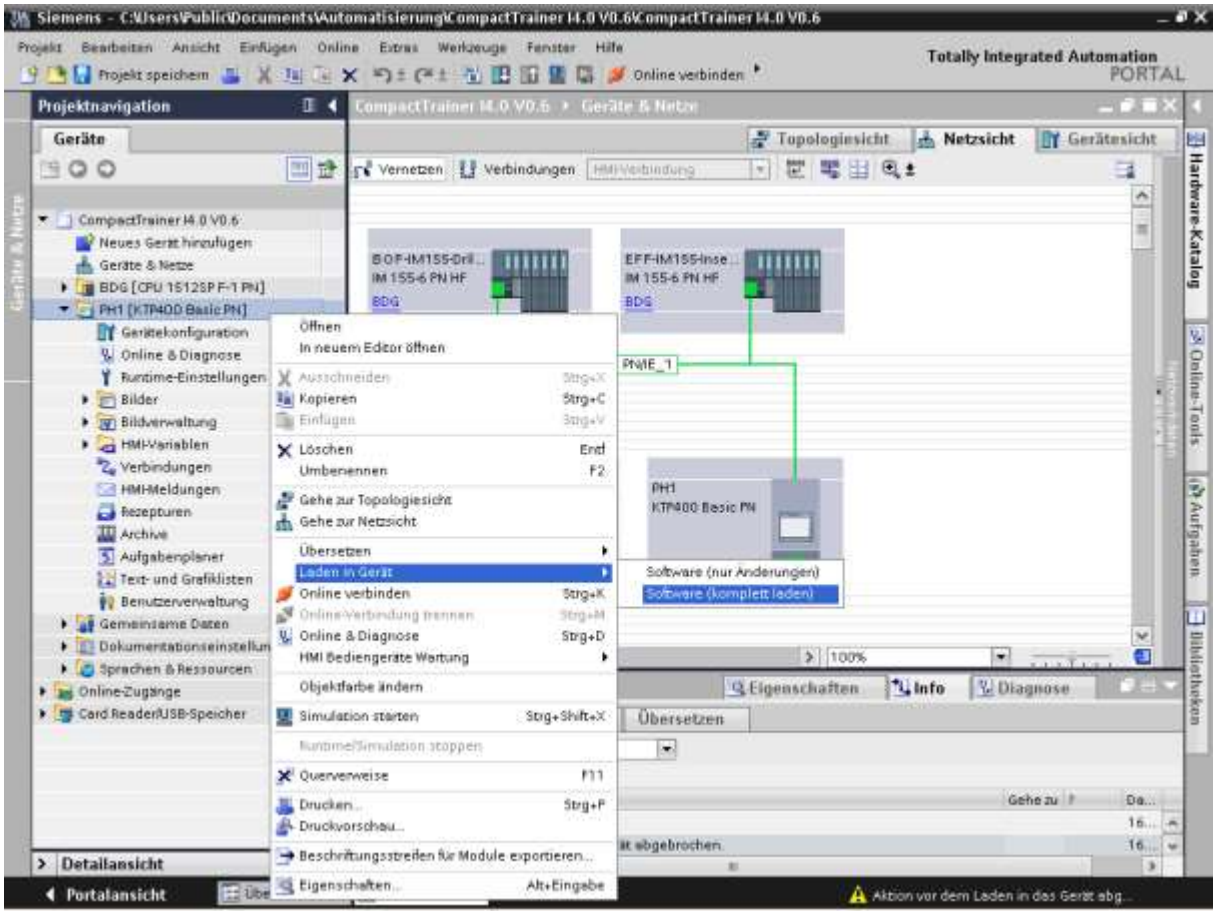


→ Finish

Exercise 4: Commissioning and loading the KTP400

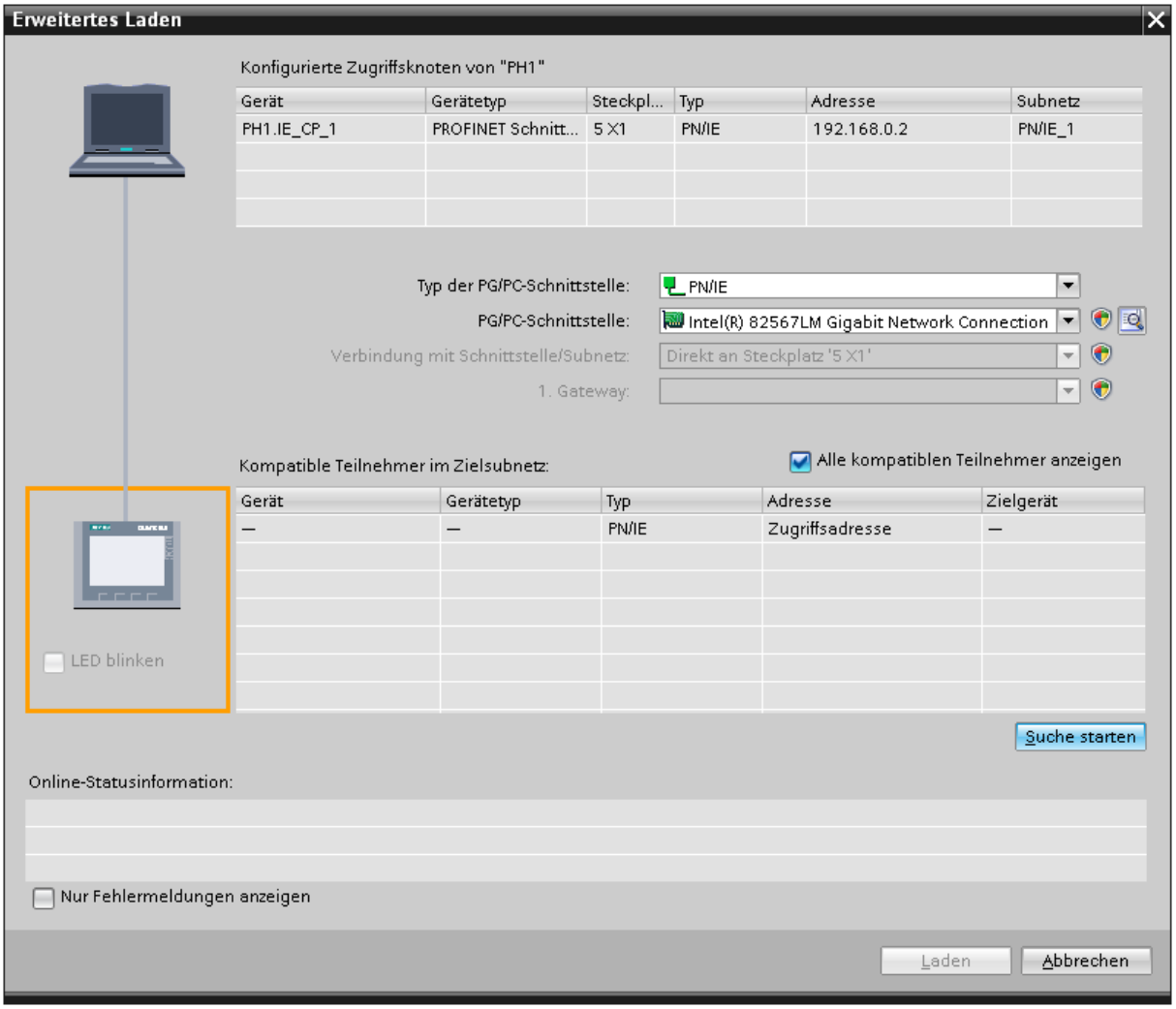
Procedure

1. Select the display and control unit → → load to device



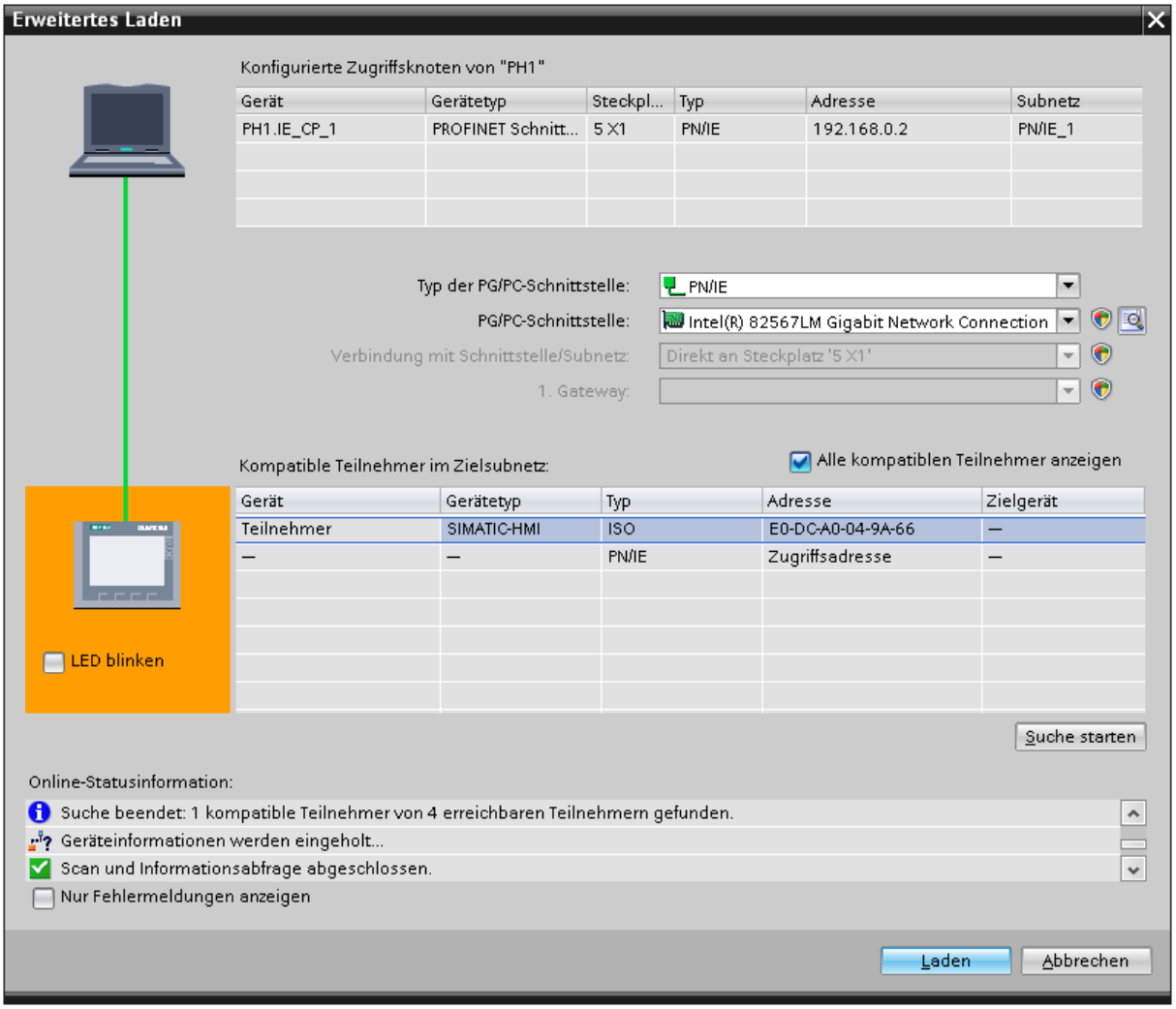
→ Software (load completely)

2. Select the PD/PC interface. In our example, the PD/PC interface is the existing LAN adapter for your network connection. Compare this with the settings in the Windows Control Panel under “Network and Sharing Center”.



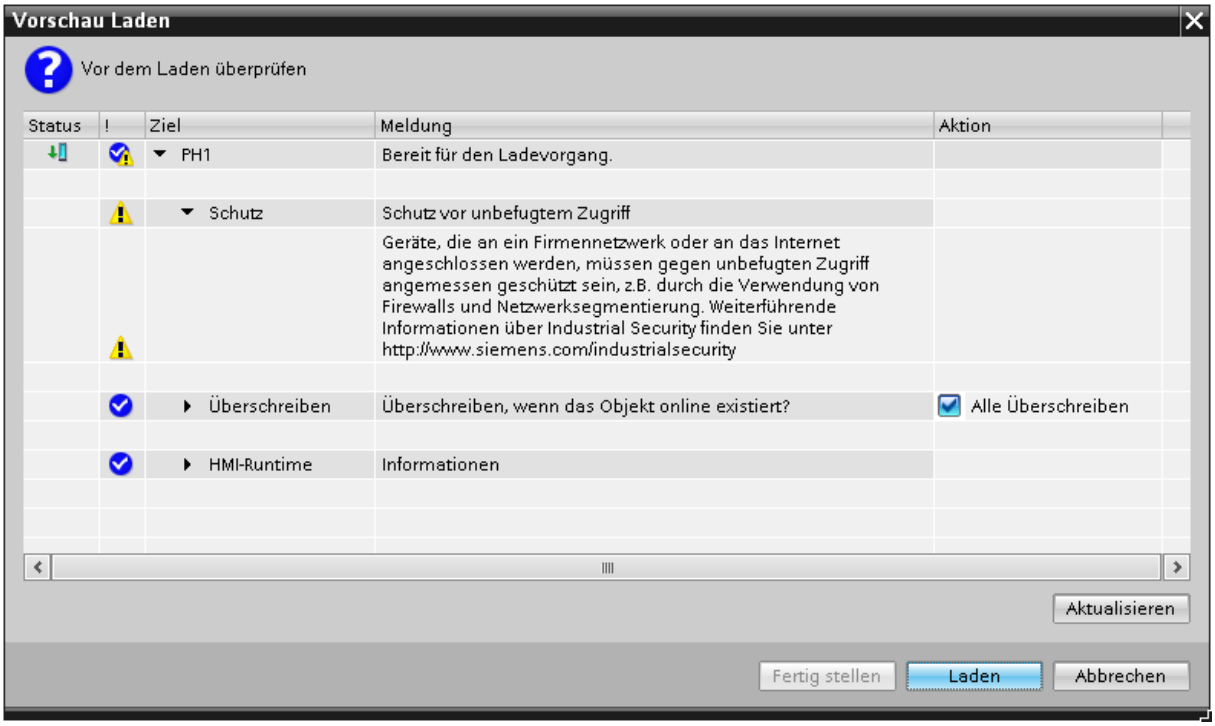
→ Start search

3. Select detected device.



→ Load

4. Overwrite all values.



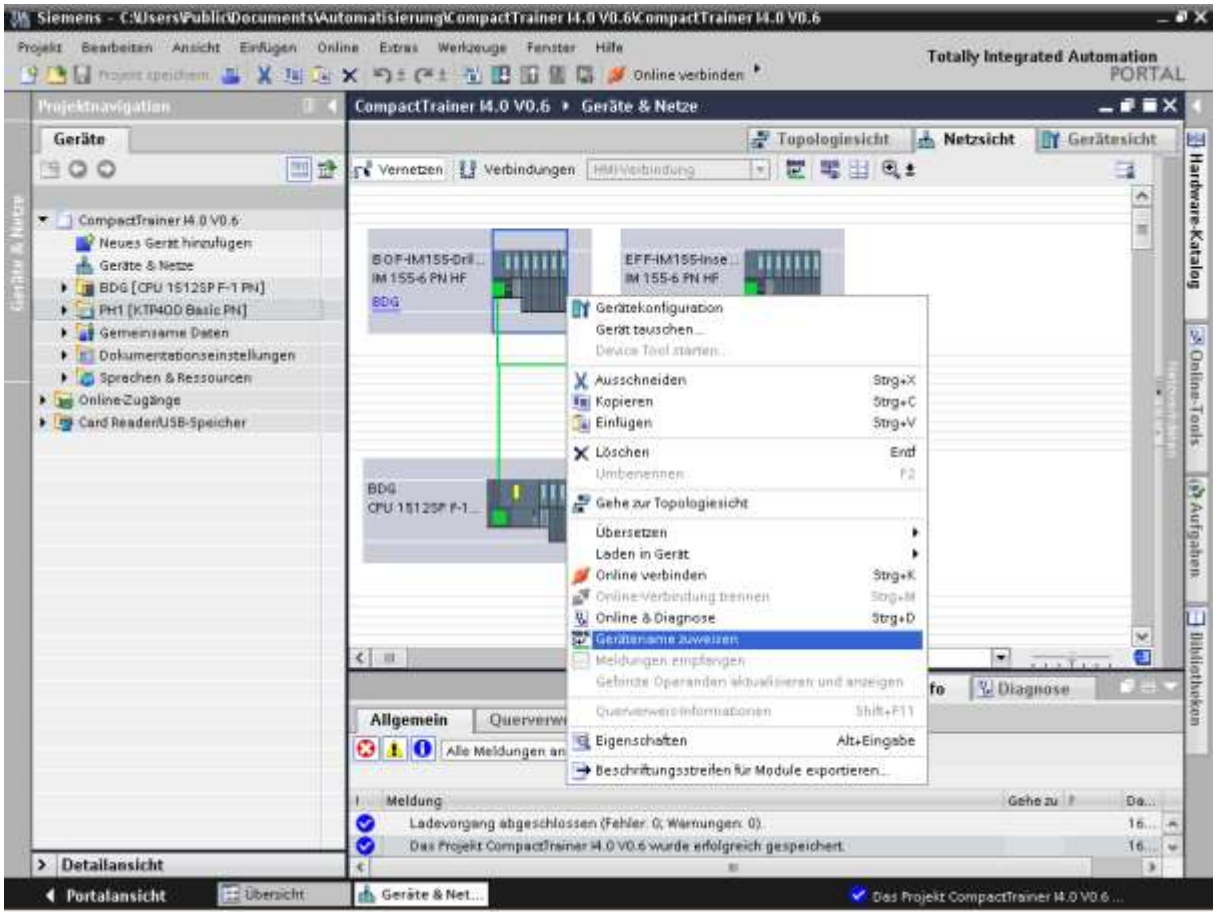
→ Load

Exercise4: Assigning a Profinet IO device name for ET200SP IM155-6

Procedure

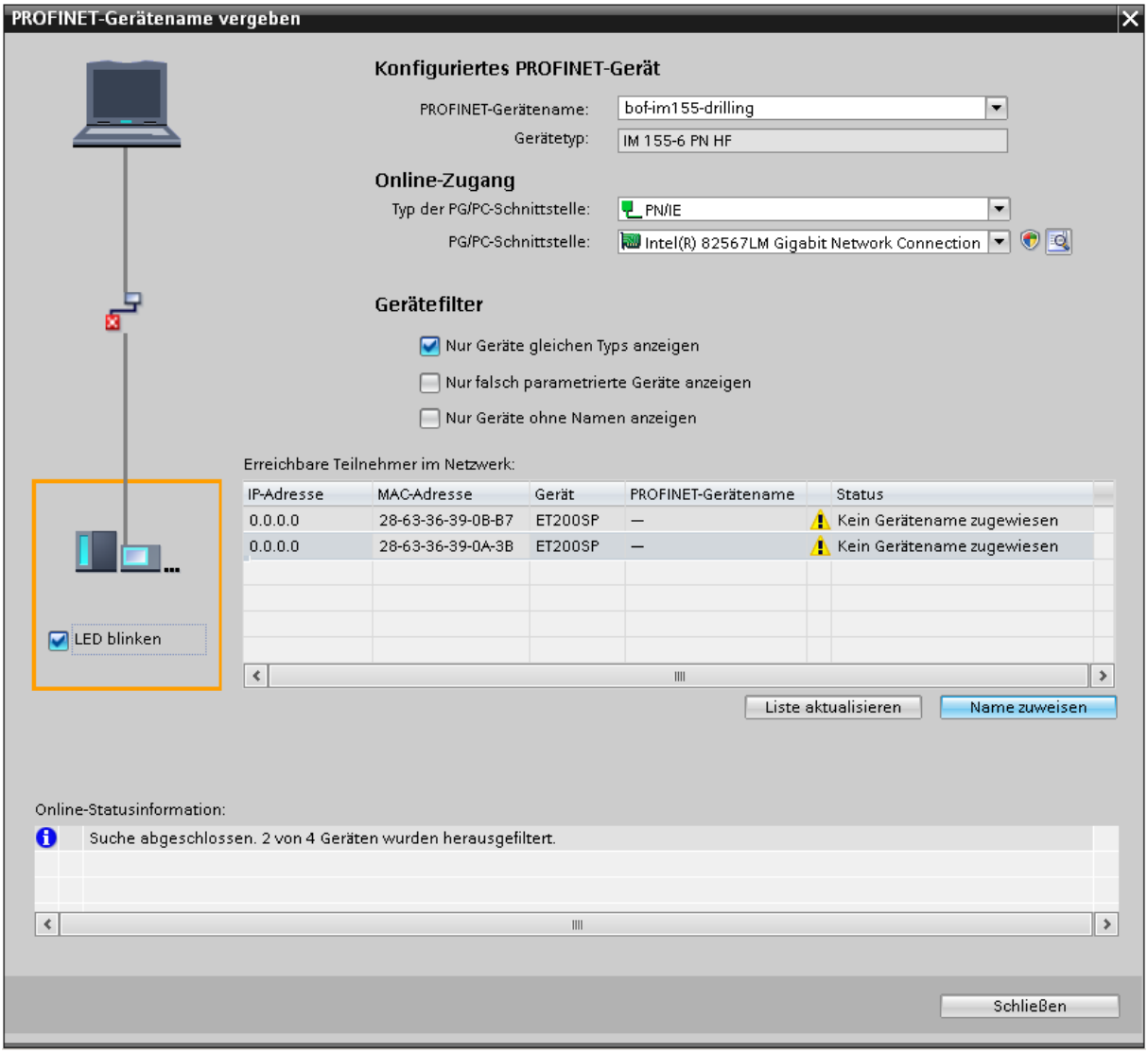
Start Siemens TIA Portal programming software and retrieve/open the sample project for the Siemens S7-1500 CPU1512SP-1PN controller and the KTP400 Basic display and control unit. The project file is included in the technical documentation:
...\CompactTrainer_I40_Sources\S7-1500\CompactTrainer I4.0 VX.X.zap13

The Profinet device name should be assigned to the Profinet IO drilling and insertion devices IM155-6PN-HF. Open the project's network view to this end: 2 x Devices & networks → select BOF-IM155 drilling →



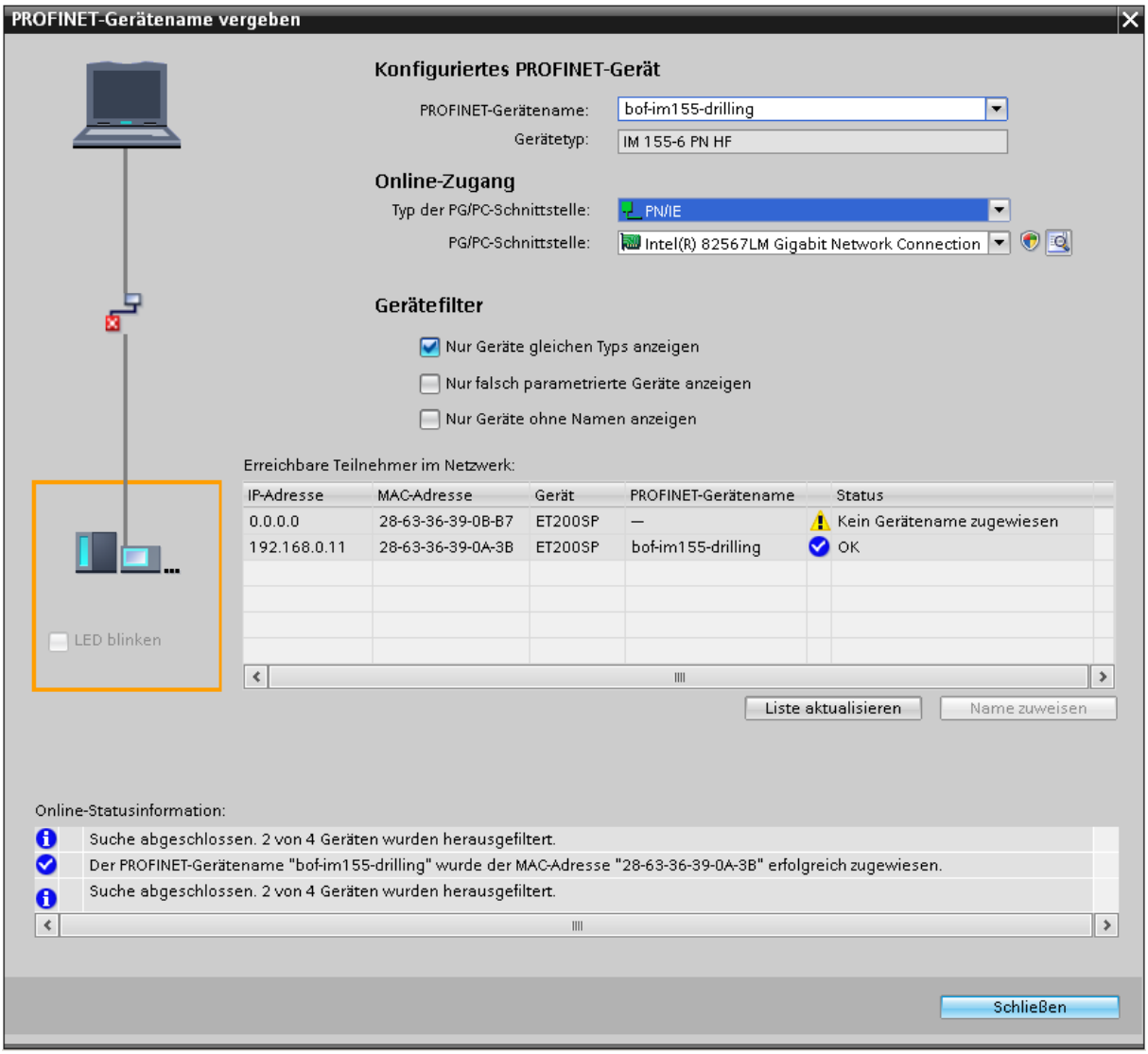
→ Assign device name

Select the first device from table → Blinking LED (for purpose of identification).
→ If the drilling module's LEDs blink → select/highlight the device
(or select another device from the list and test with "Blinking LED").



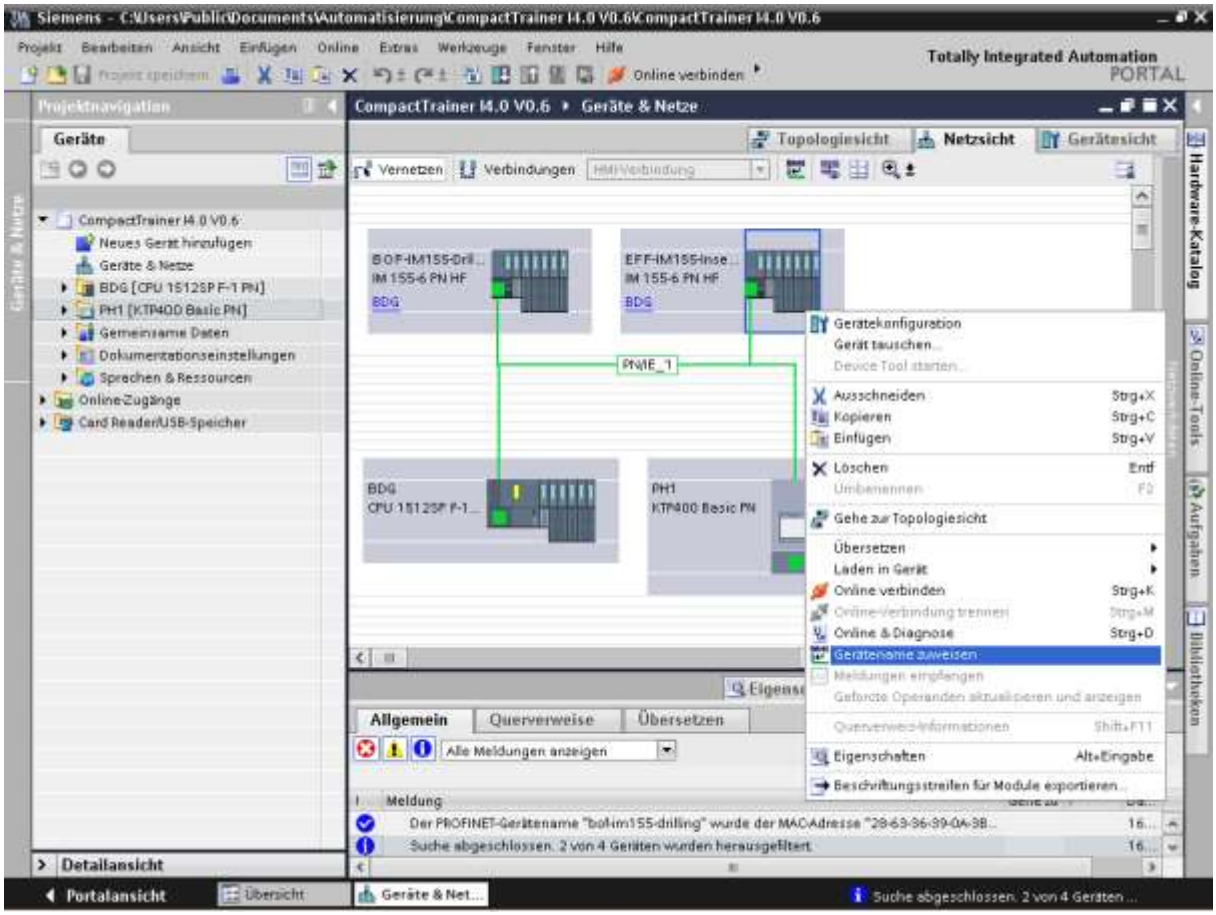
→ Assign name

The device name has now been assigned and displayed.



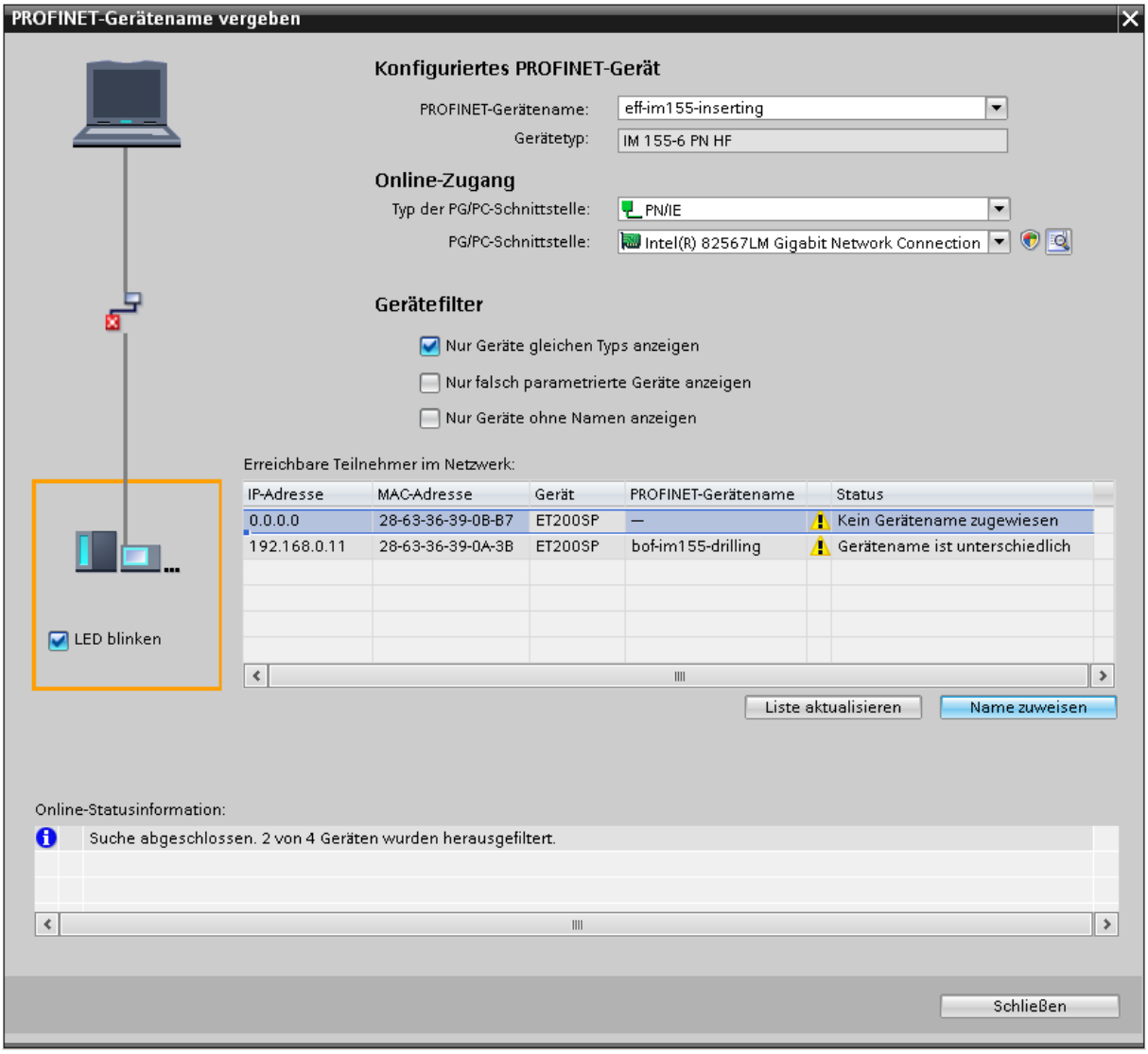
→ Close

The Profinet device name should be assigned to the Profinet IO insertion device IM155-6PN-HF.
→ Select EFF-IM155 drilling →



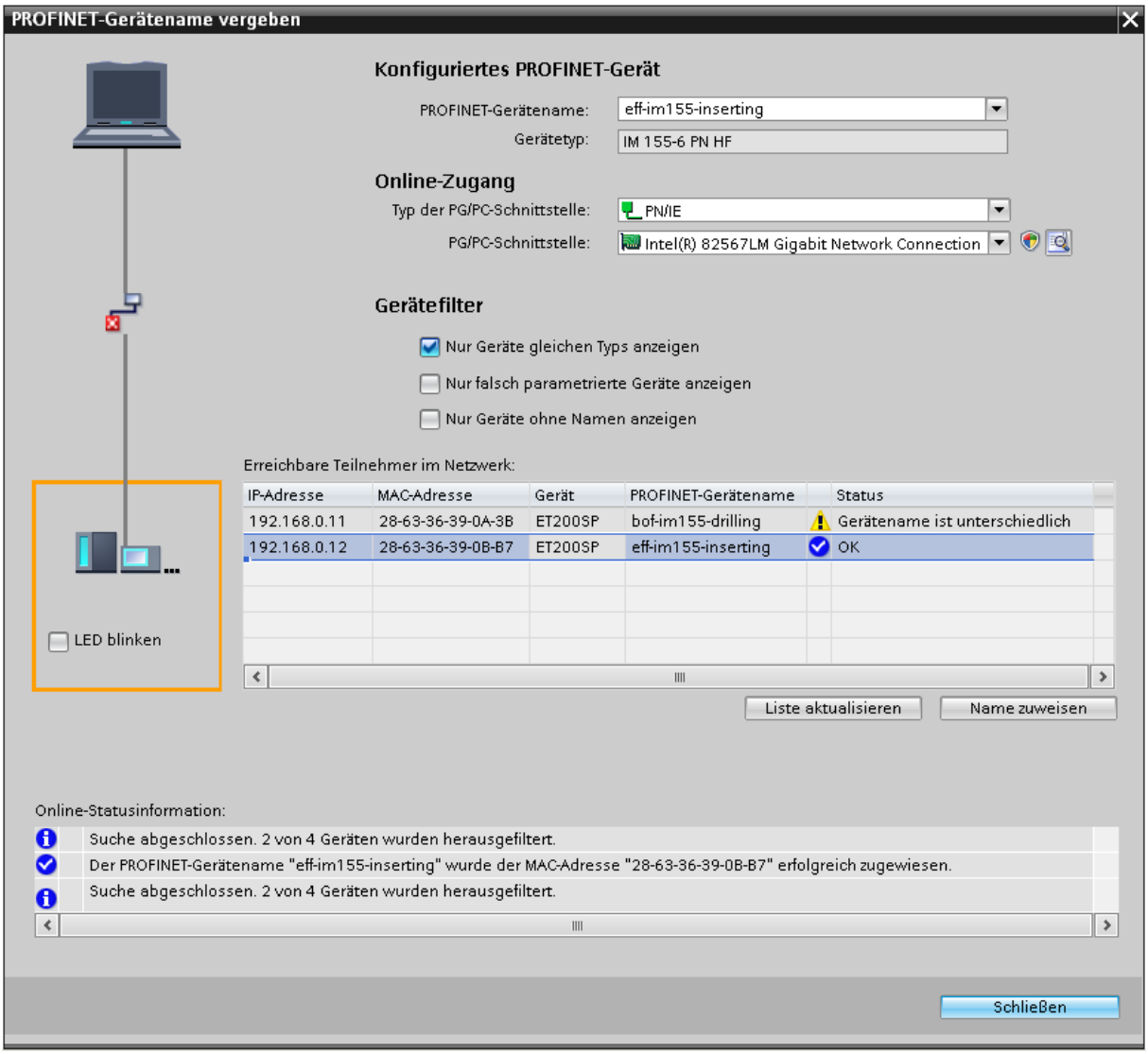
→ Assign device name

Select the device from table → blinking LED (for purpose of identification).
→ If the insertion module's LEDs blink → select/highlight the device
(or select another device from the list and test with "Blinking LED").



→ Assign name

The device name has now been assigned and displayed.



→ Close

Exercise 5: Loading the “manual workstation” sample project to the LOGO!8 mini control system

Note

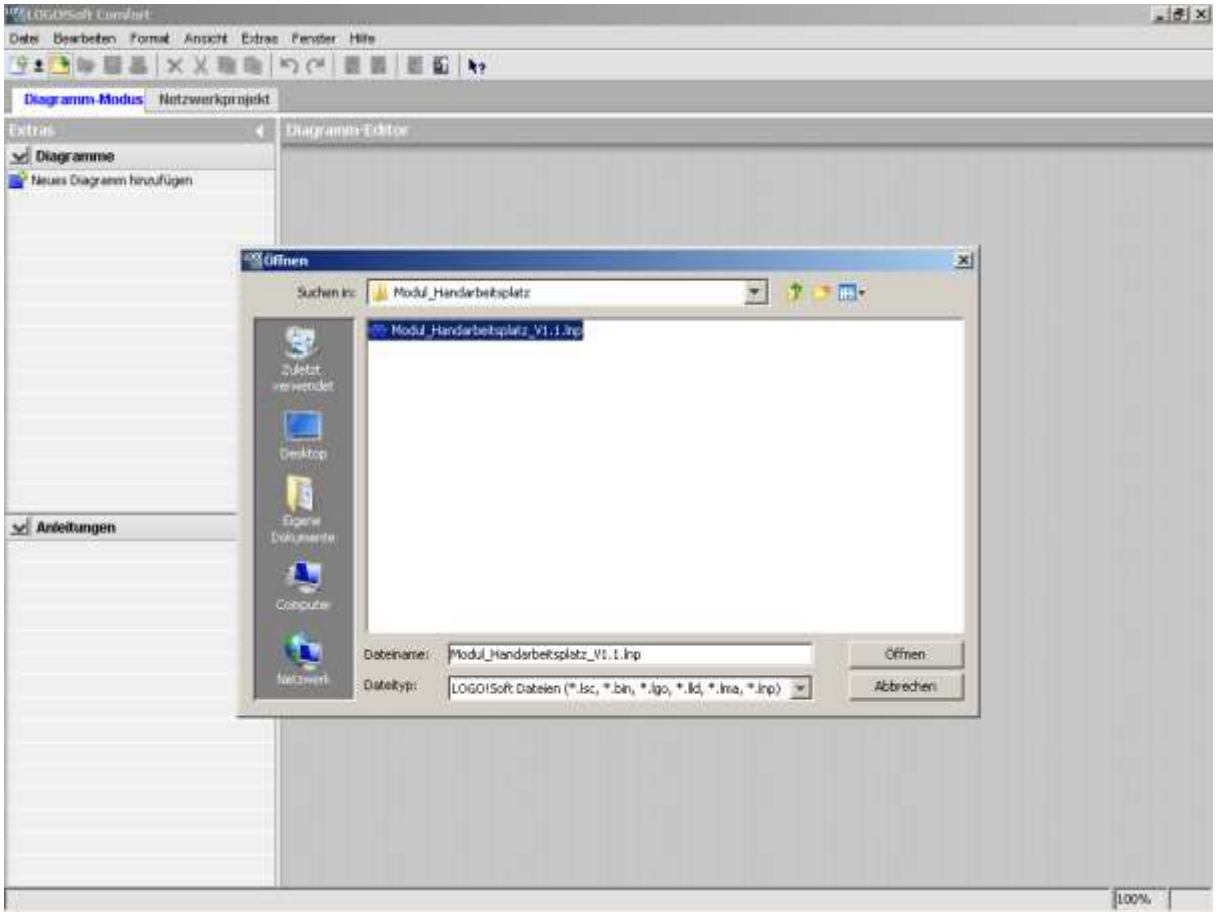
Logo Comfort software as of V8.1 is required for LOGO!8 hardware version FS04.

1. Manually configure the IP address of the LOGO!8:

LOGO display → Network + OK → IP address + OK → OK

→ Use the scroll keys ↑↓ to configure the IP address: 192.168.0.13 + OK → ESC → ESC

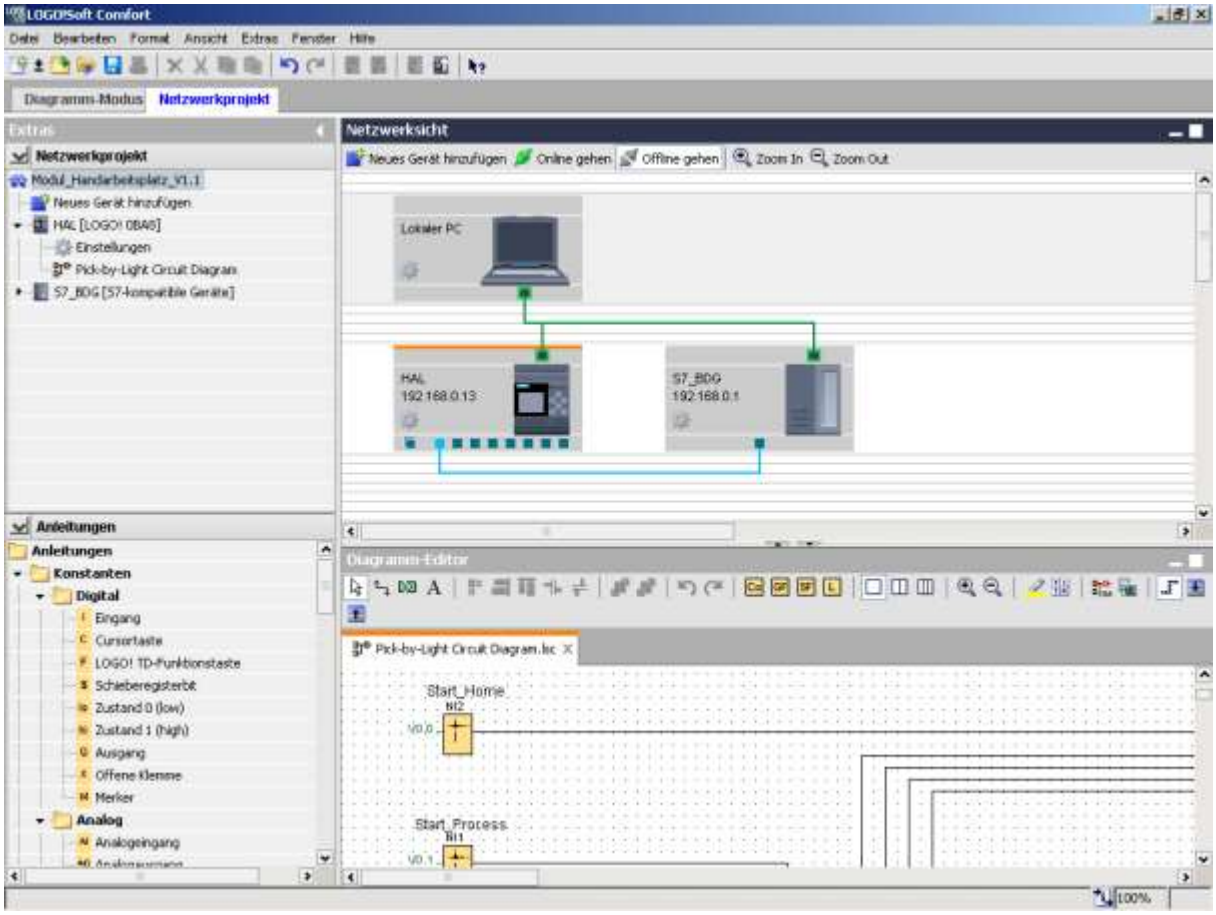
2. Start LOGO! Soft Comfort and open the LOGO project (similar to screenshot shown below).



With LOGO Soft Comfort up to V8.0, the program name is: Module_manual-workstation_V1.1.lnp

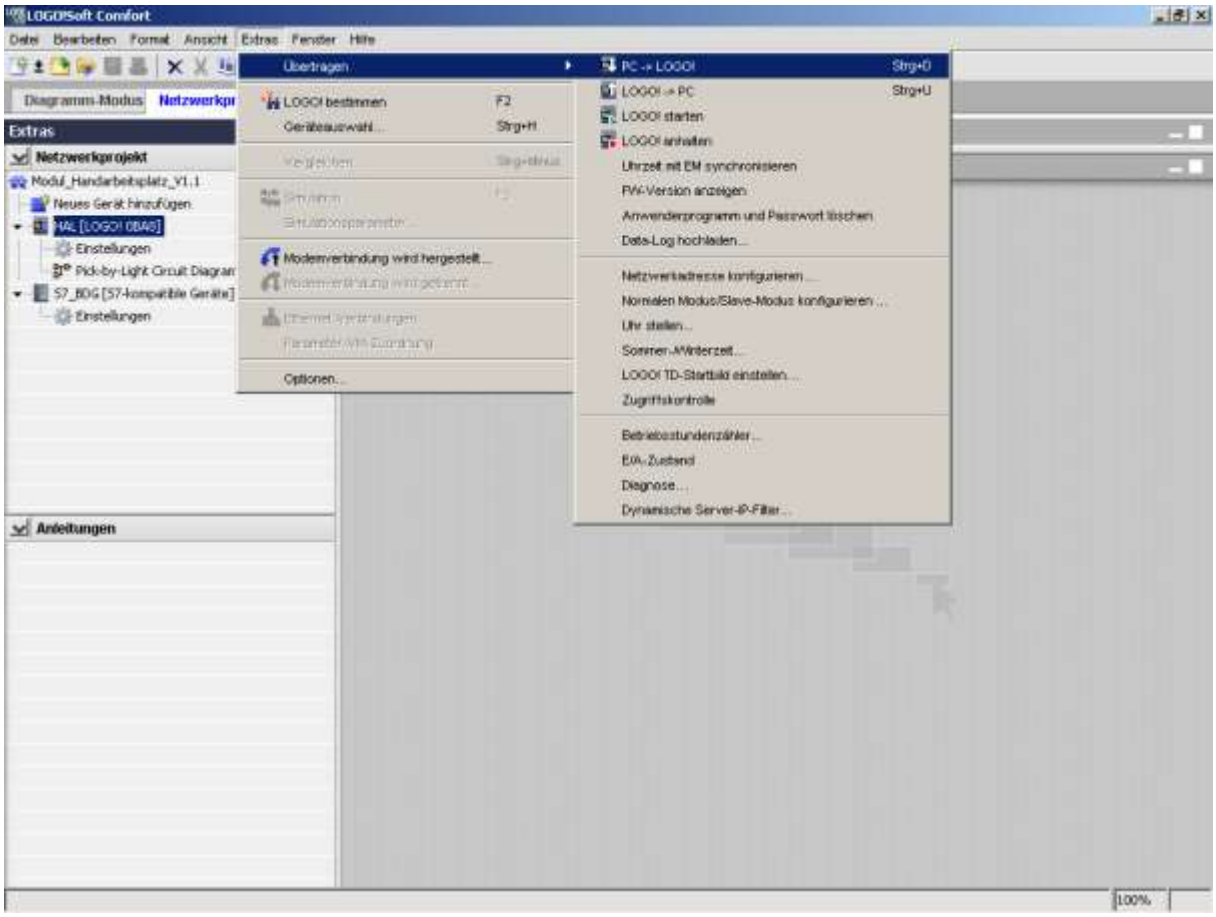
As of Logo Soft Comfort V8.1, the program name is: Module_manual-workstation_1-2.mnp

In the open project, the manual workstation sequence is projected in communication with the main controller (S7-1512SPF-1PN).



Load the program to the LOGO.

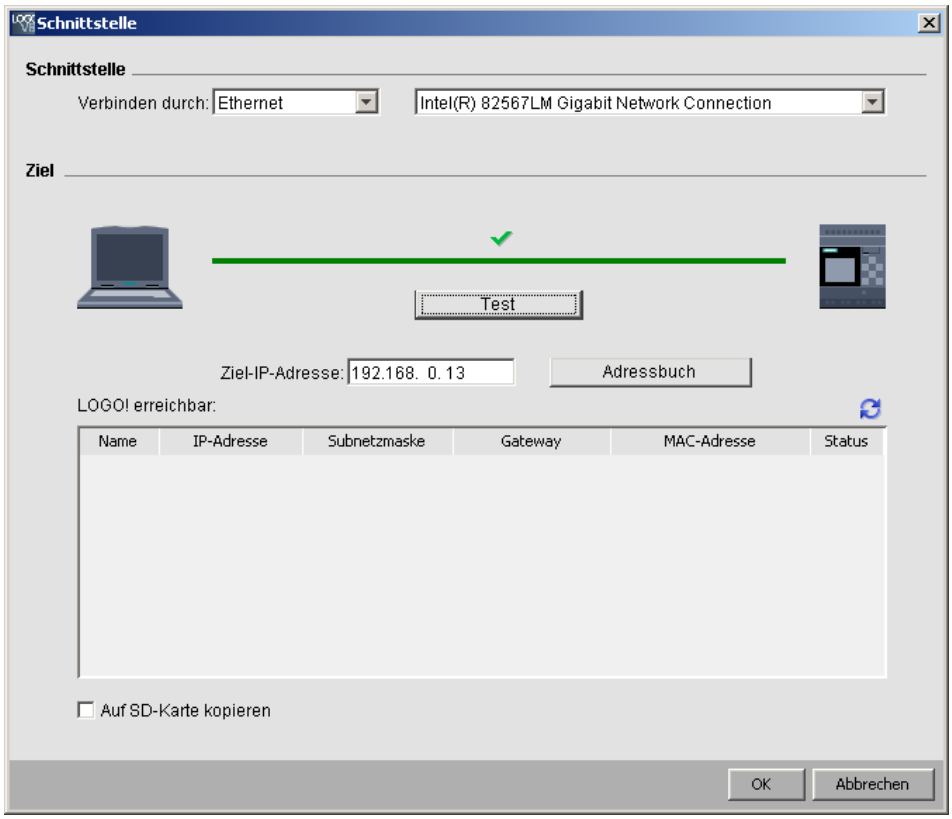
→ Extras →Transfer → PC - > LOGO!



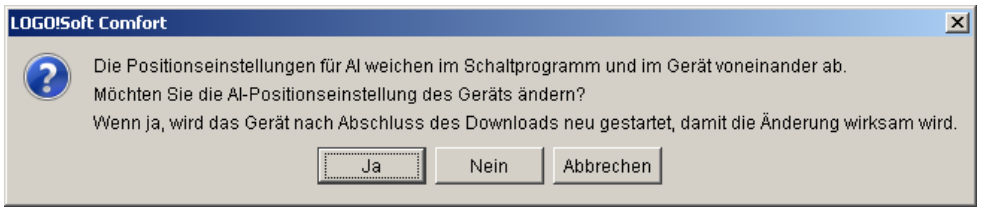
→ PC - > LOGO!

Check the communications connection.

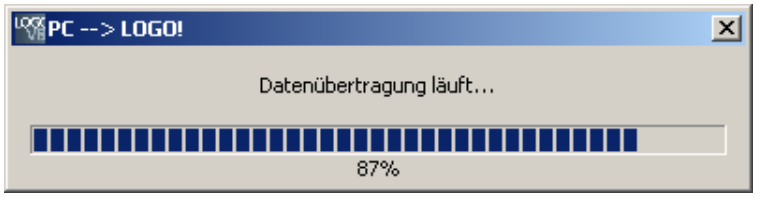
→ Test → the connection test must be completed successfully!

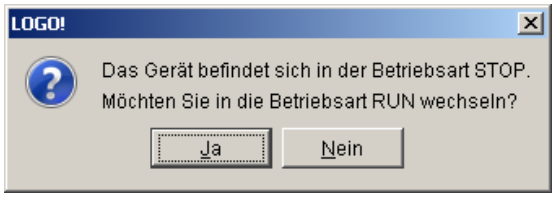


→ OK



→ Yes





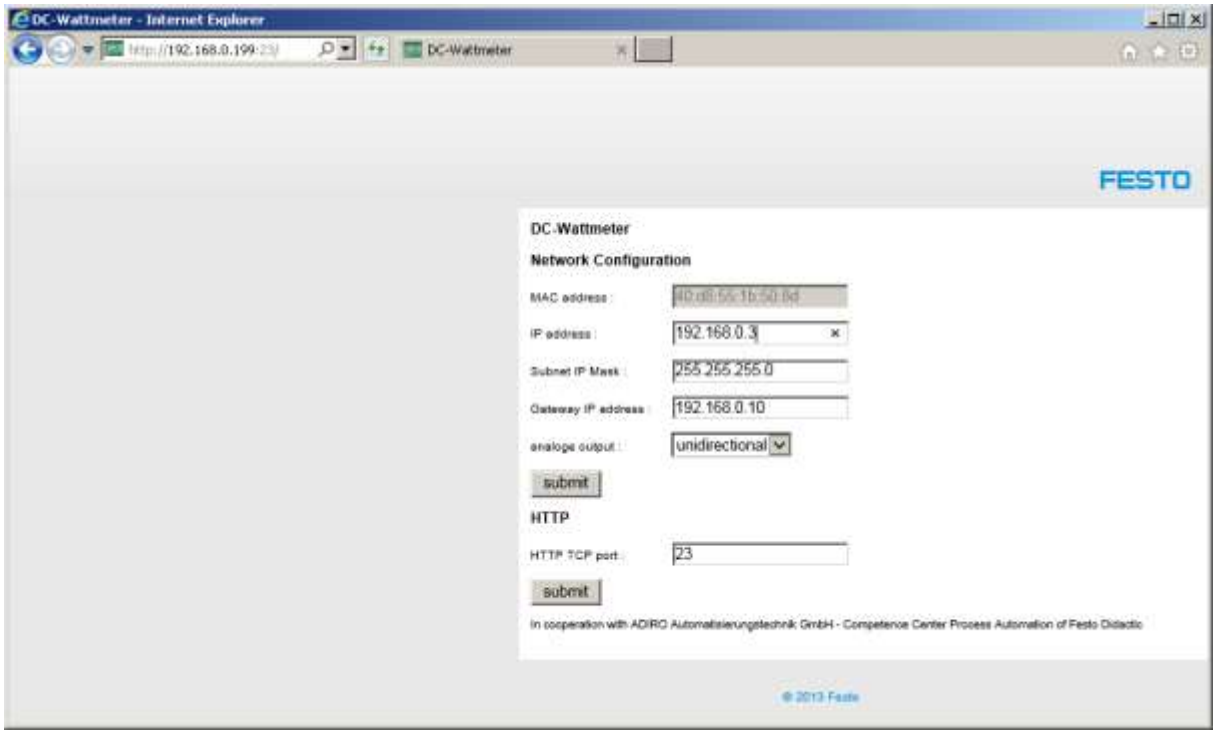
→ Yes

The program of the LOGO controller can now be tested.

Exercise 6: Configuring the IP address and measured value display at the DC wattmeter

If the DC wattmeter has been reset to its default value (192.168.1.199), connection to the device via the device website can only be established with a PC whose IP address lies within the same address space, for example IP 192.168.1.100, subnet mask: 255.255.255.0.

Configure the IP address to the project setting:
MAC address: IP 192.168.0.3
Subnet IP mask: 255.255.255.0
Gateway: 192.168.0.10
Analog output: unidirectional (important: if the field is empty the device doesn't boot!)
http TCP port: 23



→ Submit

The device must now be rebooted ("power cycle" or "turn off, turn on, works again").

Exercise 7: Configuring the IO-Link communication module and the RFID readers

Information

IO-Link is a point-to-point connection between a master and a device. Conventional as well as intelligent sensors/actuators connected via unshielded 3-wire standard cables can be used as devices with the IO-Link master. IO-Link is downward compatible with conventional digital sensors and actuators. Switching status and data channels are laid out in 24 V DC technology.

Together with the IO-Link master module, the SIMATIC ET 200SP distributed periphery integrates fast and simple IO-Link communication with sensors and actuators into the well-established PROFIBUS and PROFINET fieldbus systems for Totally Integrated Automation.

Visit the following websites for more information concerning IO-Link:
http://www.io-link.com/en/Technology/what_is_IO-Link.php?thisID=76
http://w3.siemens.com/mcms/automation/en/industrial-communications/io-link/Pages/Default.aspx

IO-Link software: Port Configuration Tool

With its Port Configuration Tool (“S7 PCT”), STEP7 Engineering permits parameterization of Siemens IO-Link master modules and IO-Link devices. S7 PCT is integrated into STEP7 as of V5.4 SP5 and is invoked via the hardware configuration of the IO-Link master. In addition to this program format which is integrated into STEP7 Engineering, a separately installable stand-alone version of S7-PCT is available as well.

With the help of the Port Configuration Tool, the parameter data of the IO-Link devices can be set, changed, copied and saved to the STEP7 project: in this way, all configuration data and parameters are stored consistently all the way down to the device level.

Prerequisites

- TIA Portal STEP7 V13 SP1 update 9 and higher, TIA Portal WinCC Basic V13 SP1 update 9 and higher
- S7-PCT V3.4 HF1 (Port Configuration Tool) and higher
- Ethernet network adapter

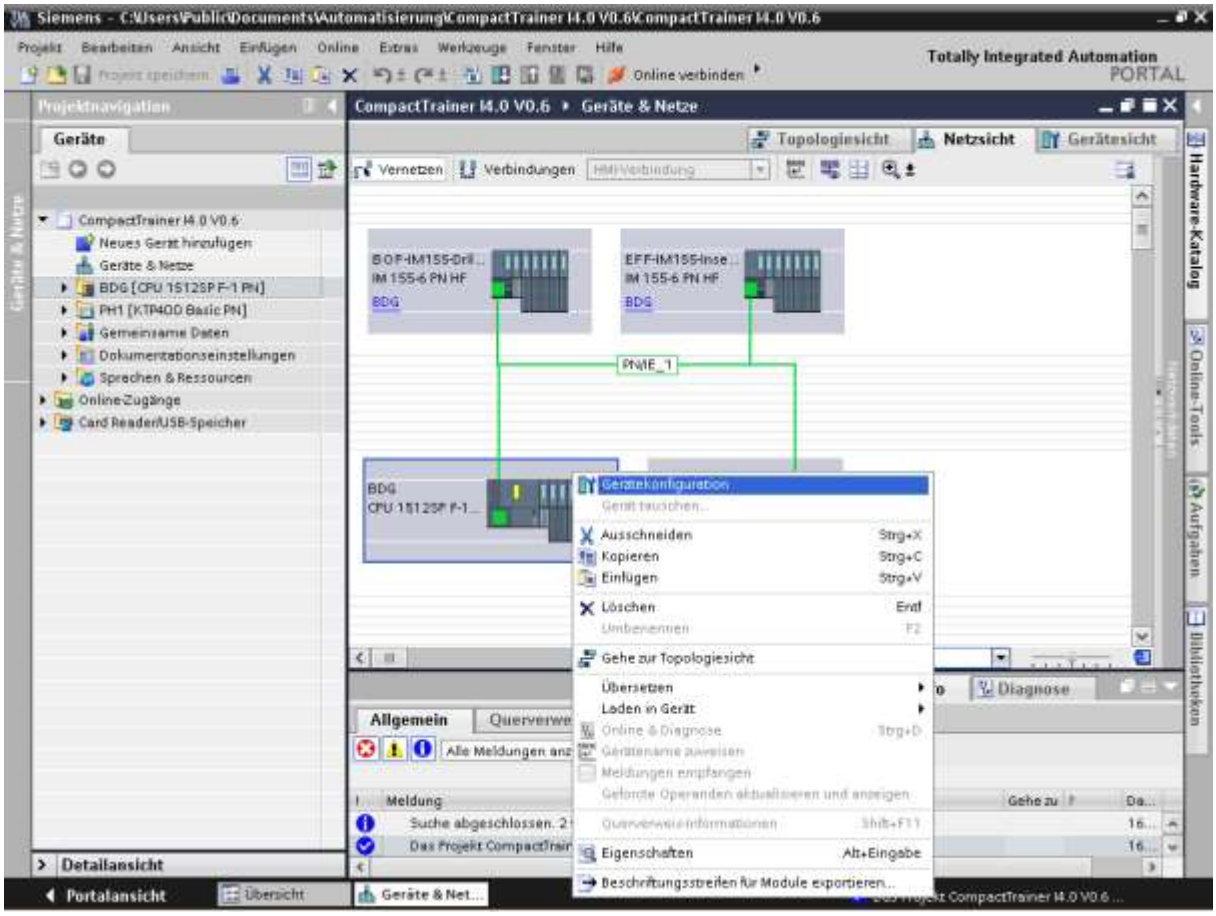
Procedure

The configuration of the IO-Link master is included in the S7 sample project. The configuration data must be loaded to the IO-Link master and the two IO-Link devices (RFID reader RF240R).

Start the TIA Portal in the project view and retrieve/open the sample project for the MPS® TS Compact Trainer I4.0 for the Siemens S7-1500 CPU1512SP-1PN controller and the KTP400 display and control unit from the technical documentation: ...\CompactTrainer_I40_Sources\S7-1500\

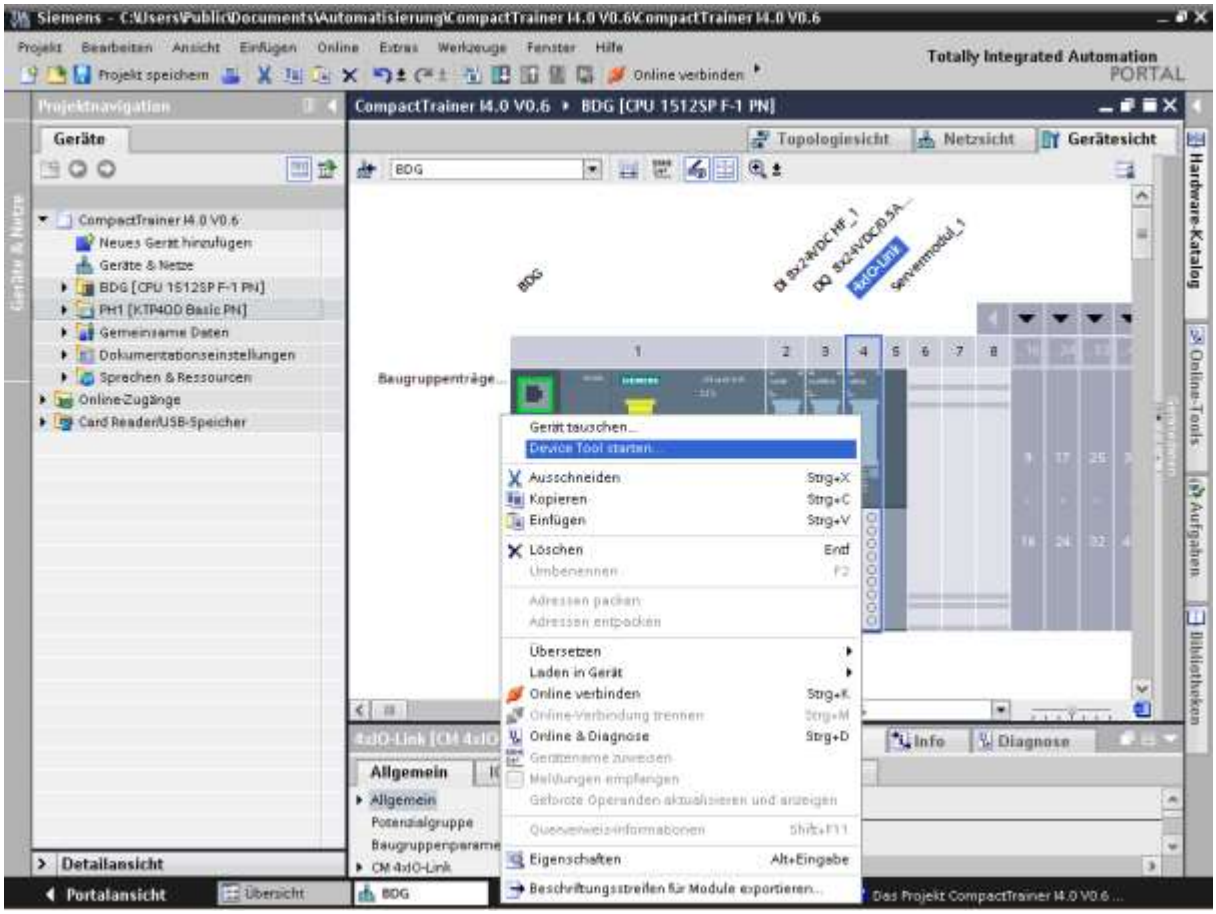
For example: CompactTrainer I4.0 VX.X.zap13

Open the project's network view to this end: 2 x Devices & networks → select BDG (CPU1512SP F-1PN) →

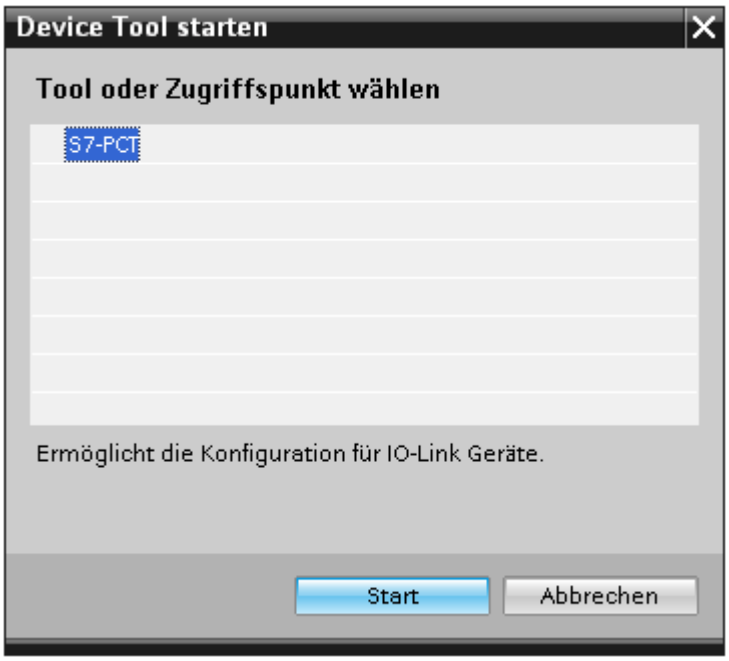


→ Device configuration

→ Select the IO-Link master module in the device view (4xIO-Link).

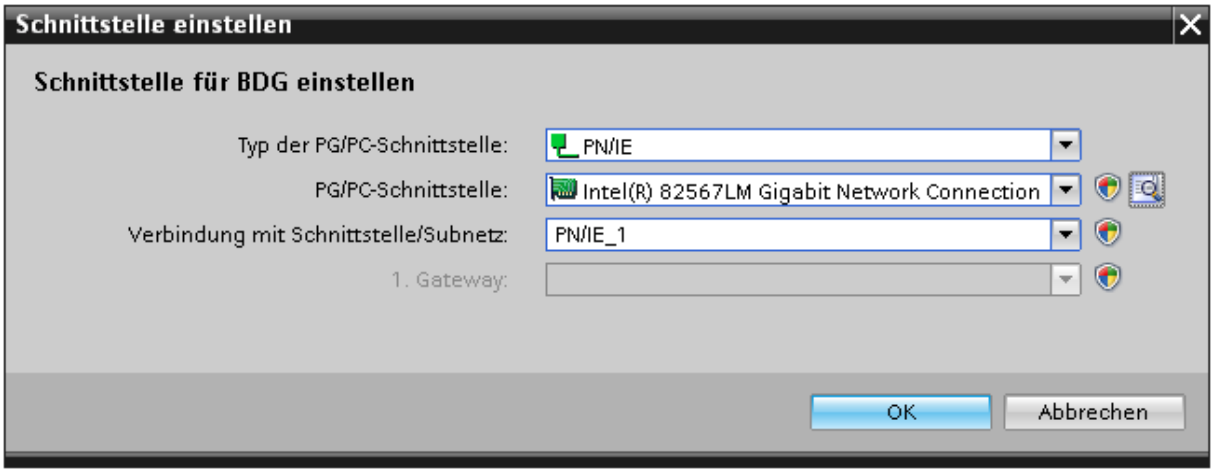


→ Start Device Tool

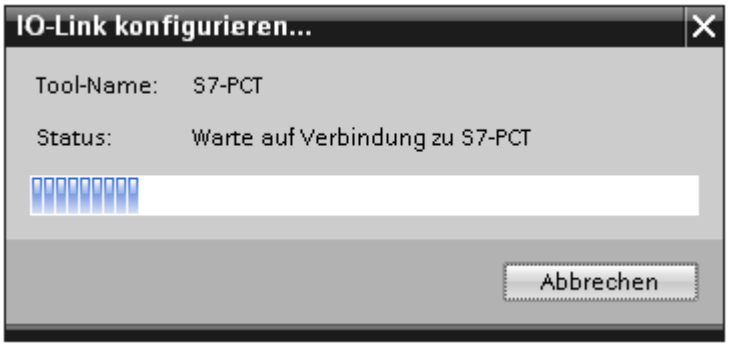


→ Start

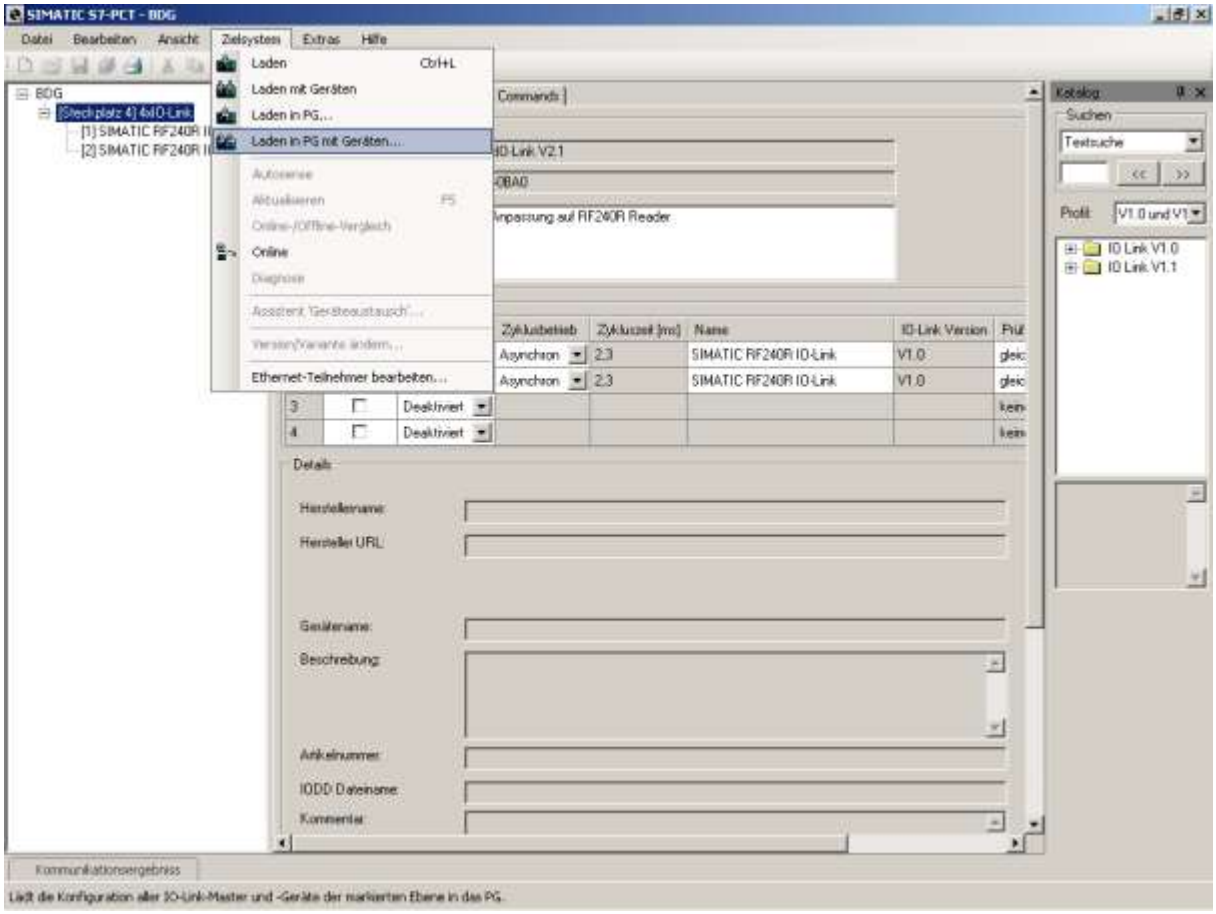
→ Configure interface → Type: PN/IE → PD/PC interface: <network adapter>
→ Connection: PN/IE_1



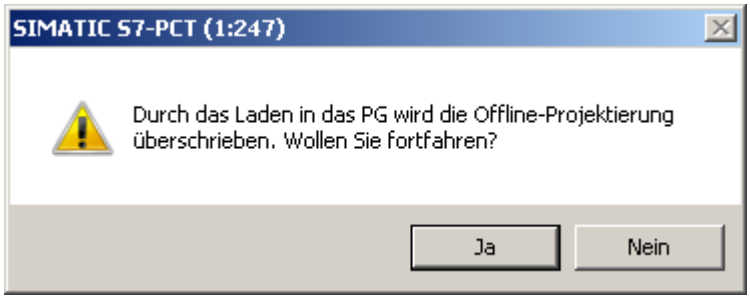
→ OK



The Simatic S7-PCT is started → Target system.

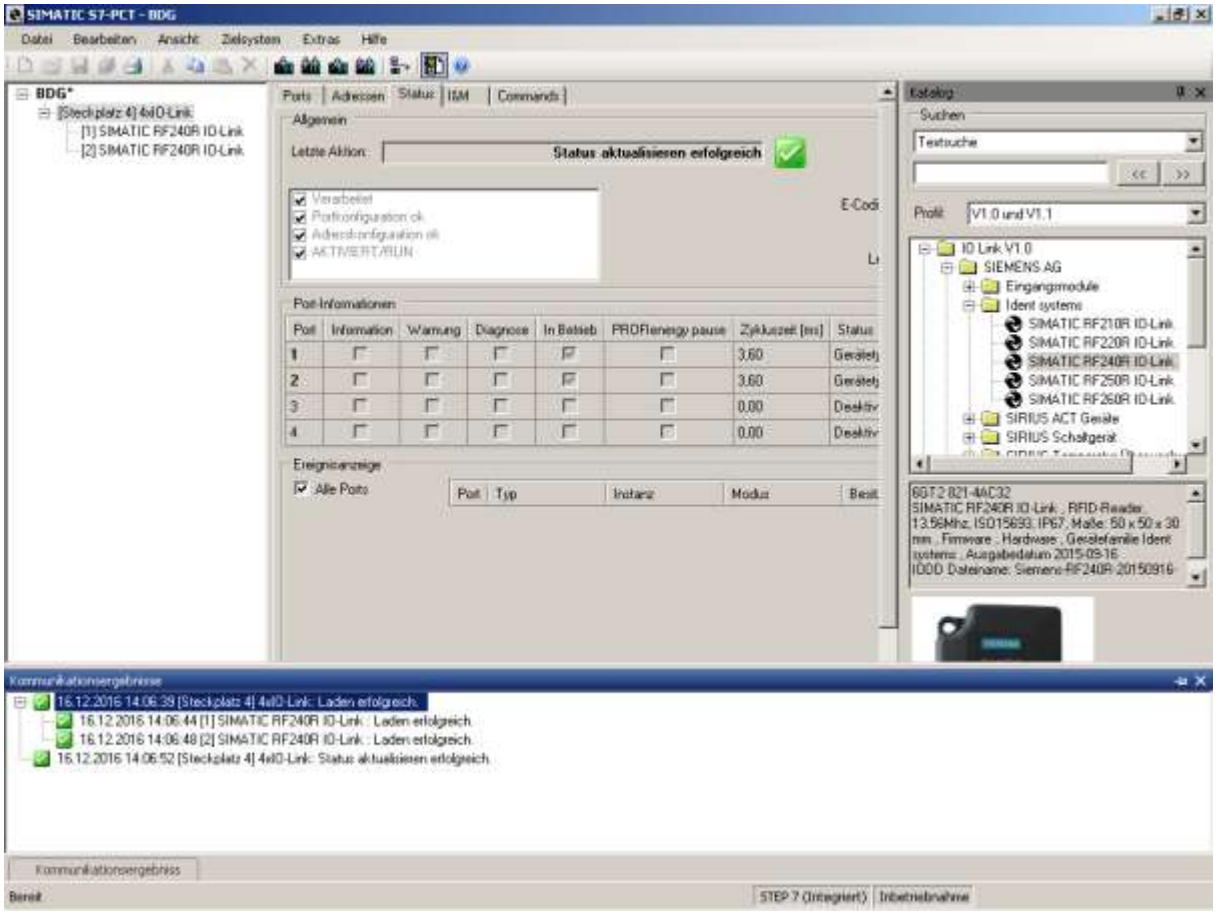


→ Load to PD with devices



→ Yes

Project parameters have been transferred successfully.



Exercise 8: Restoring the operating system of the Raspberry Pi single-board computer

Procedure

Win32 Disk Imager freeware, for example, is available for generating a backup of the Raspberry Pi with Windows. Win32 Disk Imager creates bootable USB sticks and SD cards.

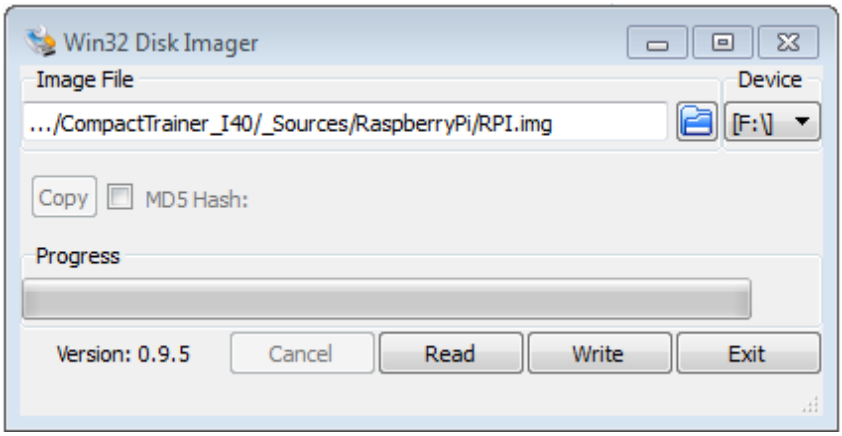
The download link is included in the technical documentation:
...\CompactTrainer_I40_Software\DiskImager

Upon delivery, the micro SD card (8GB) with the Raspbian V4.x operating system and the software applications required for operation of the CT4 is preinstalled.

The image file is included in the technical documentation:
...\CompactTrainer_I40_Sources\RaspberryPi

When commissioning for the first time or in the event of data loss, the image can be restored as follows:

1. Disconnect the Raspberry Pi from supply power by removing the micro USB cable.
2. Remove the micro SD card from the card slot in the Raspberry Pi.
3. Insert the micro SD card (in the micro SD card adapter) into an SD card slot at your PC, or use a USB card reader.
4. Select the destination drive under "Device".
5. Select the image file from the data storage medium with the technical documentation.



→ Write

6. The write process lasts about 15 minutes.
7. After completion, insert the micro SD card back into the Raspberry Pi card slot and reconnect supply power.

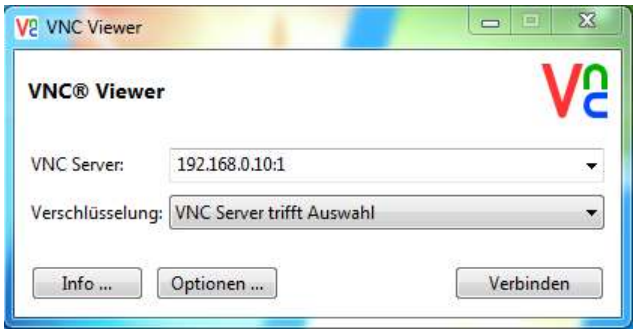
Exercise 9: Remote controlling the Raspberry Pi single-board computer

A VNC server is installed to the Raspberry Pi for the purpose of remote control. A virtual desktop is displayed at the PC via the VNC client, thus permitting remote control and remote maintenance of the Raspberry Pi.
The download link is included in the technical documentation:

...\CompactTrainer_I40_Software\VNC\

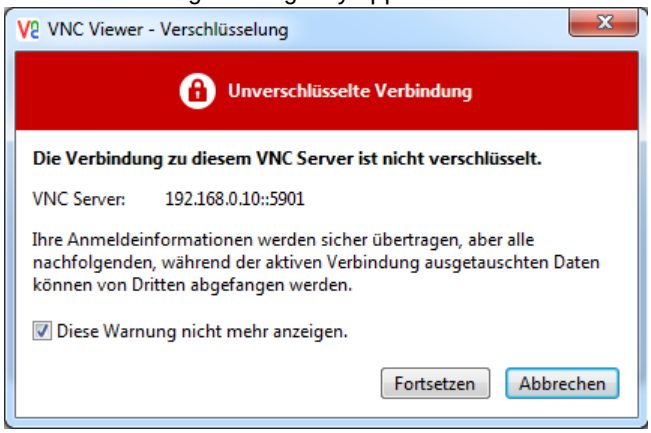
Procedure

1. Check to see if you have a network connection from your PC to the data center (192.168.0.10). Use the Windows command prompt with the PING command, for example.
2. Start the VNC viewer and enter the IP address and the port to be used for the connection:



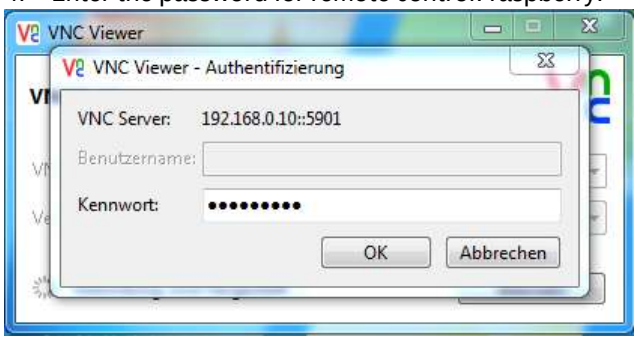
→ Connect

3. The following warning may appear when started for the first time:



→ Next

4. Enter the password for remote control: raspberry.



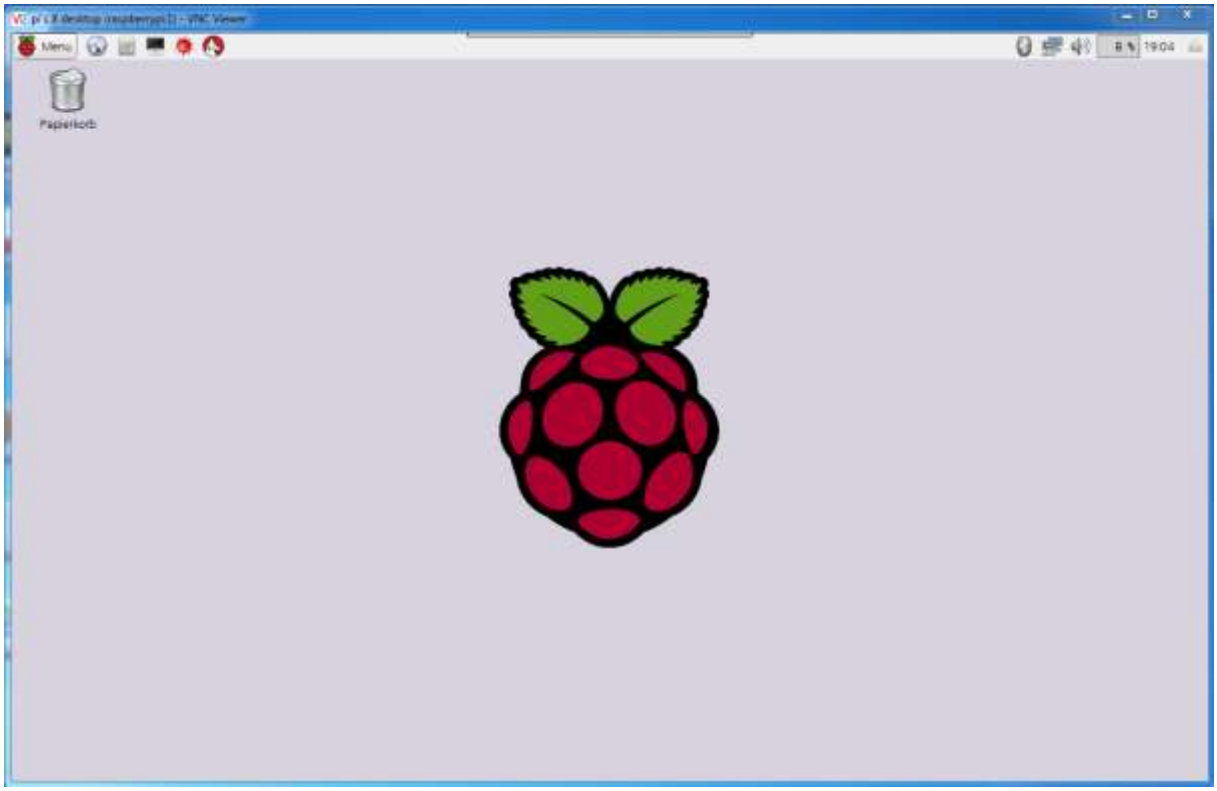
→ OK

Exercise 10: Localizing the Raspberry Pi single-board computer

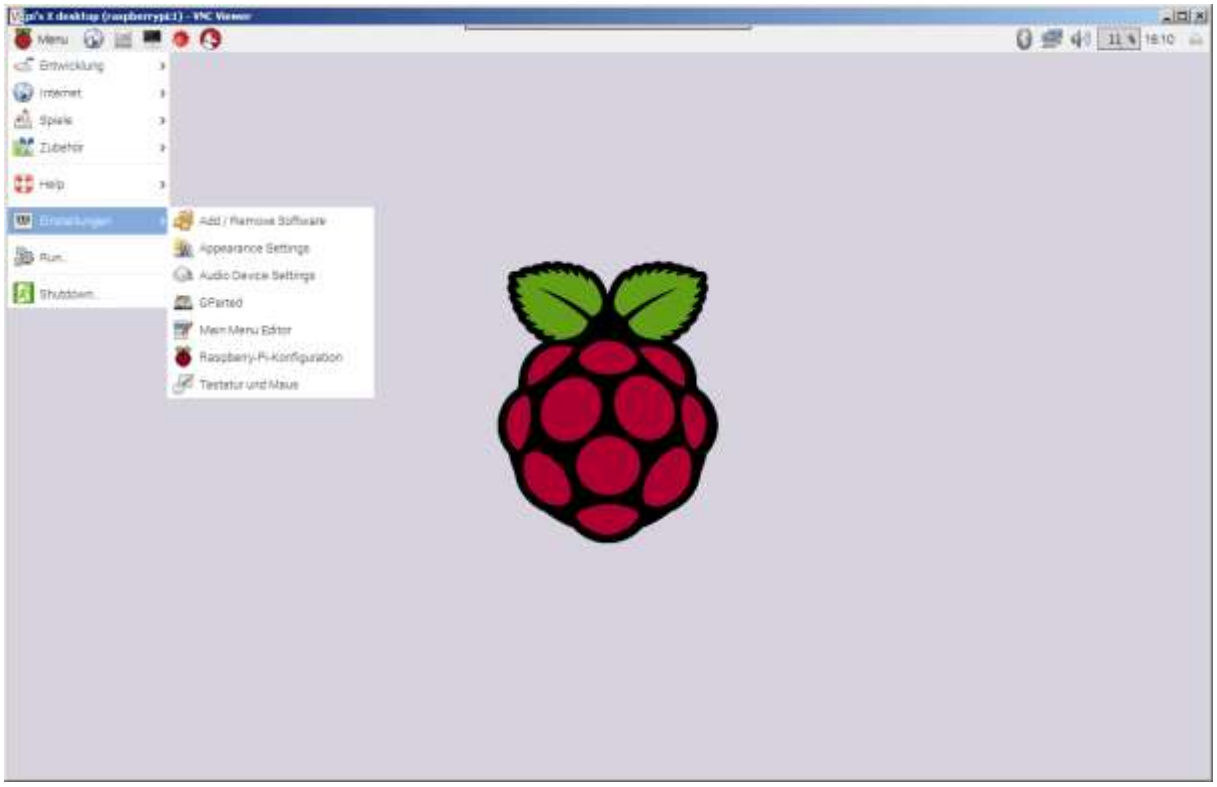
Procedure

Upon delivery, the operating system of the Raspberry Pi single-board computer is set to English. System language, time zone and the country setting for the WLAN can be selected with the help of remote control via the VNC viewer during (initial) commissioning.

Establish a connection to the Raspberry Pi data center as described in exercise 9.

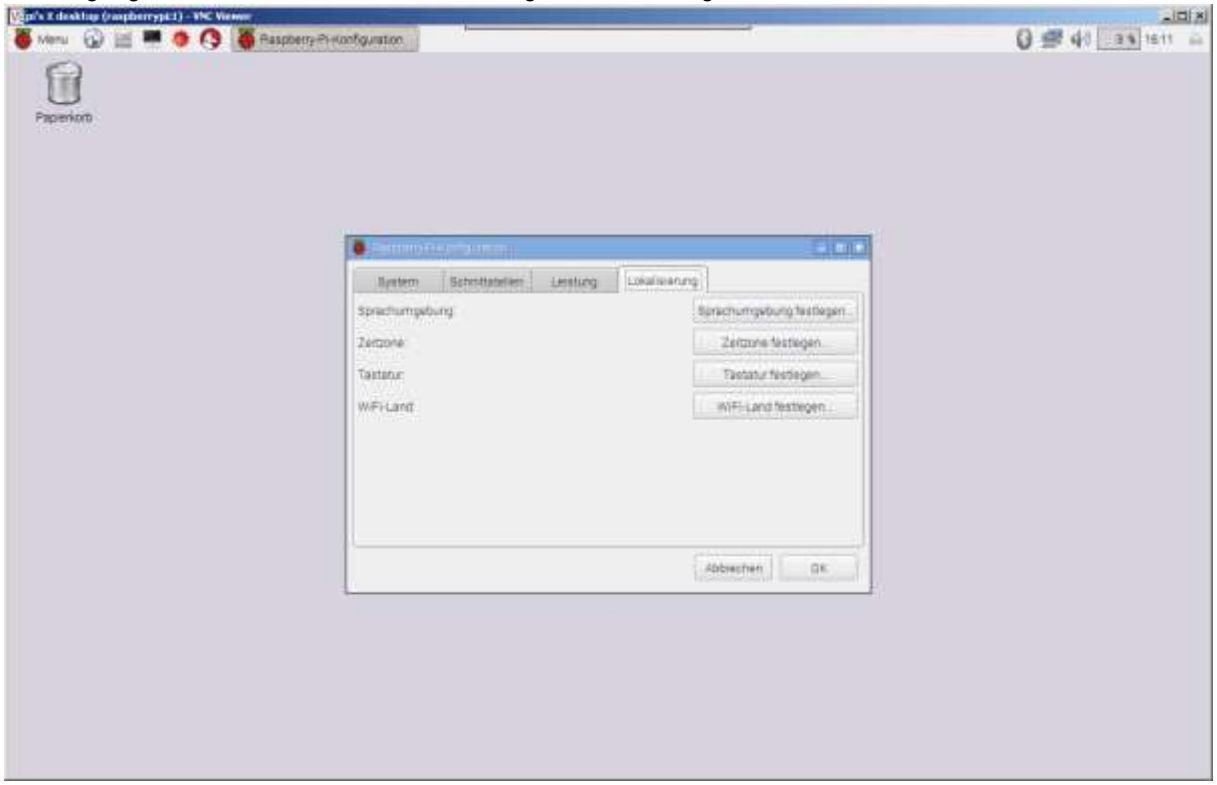


→ Menu → Settings



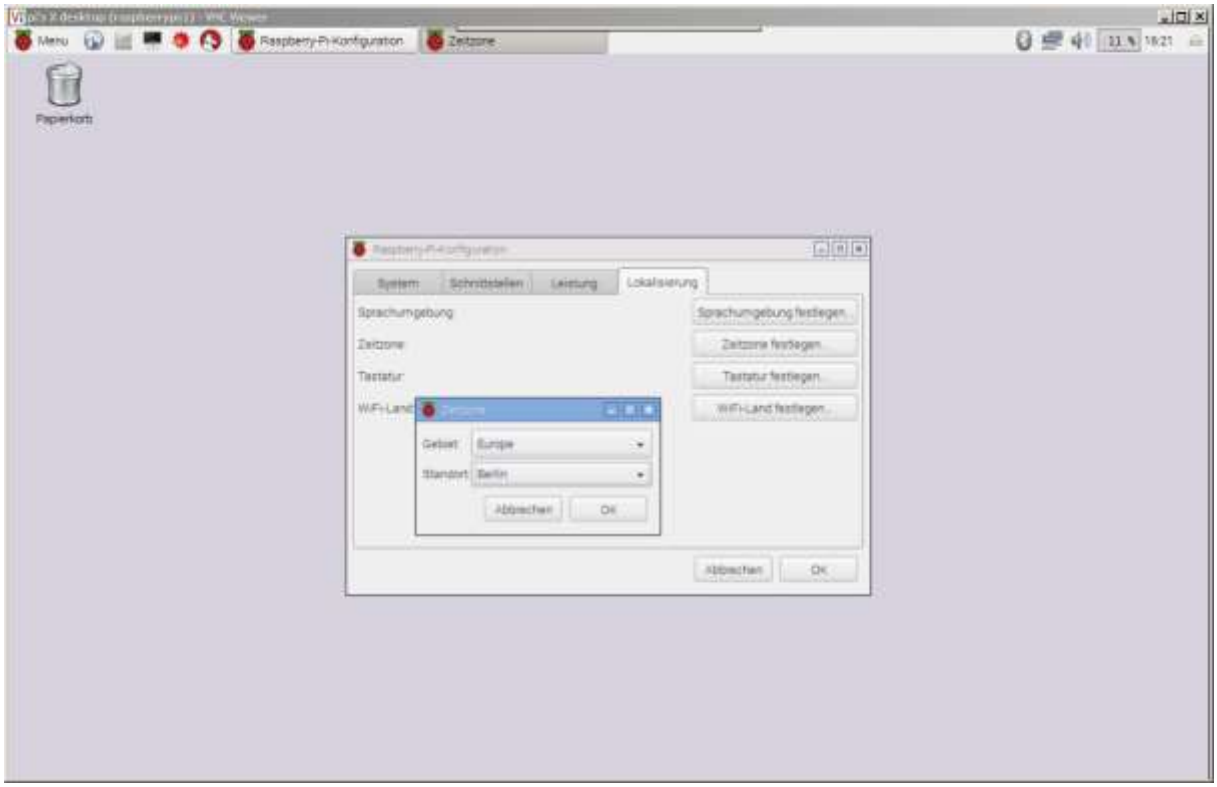
→ Raspberry Pi configuration

The language of the user interface can be changed after clicking “Locale”.



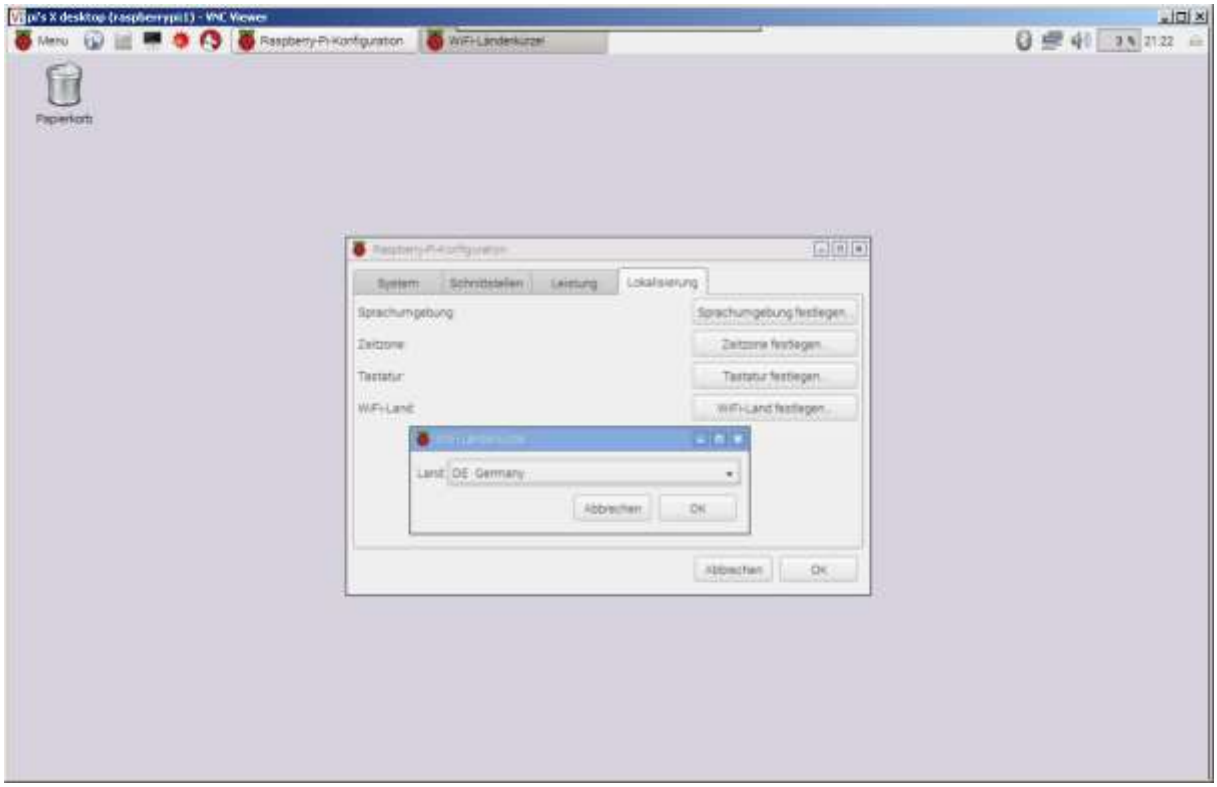
→ Set time zone

→ The time zone is set by selecting a region, for example Europe, and a location, for example Berlin.



→ OK

→ Set the WiFi country code → Country: for example DE (Germany)



→ OK

9 Production process: getting started

Learning objectives

After completing this section:

- You'll be able to read the workpiece's product memory and write work order data to it.
- You'll be able to operate the production system.
- You'll be able to manufacture finished goods.
- You'll be able to operate the data center.

Work assignments

1. Enter a work order with the RFID application for the USB reader and write the data to the workpiece's (roller's) digital product memory.
2. Operate the production system in the demo mode (continuous operation without changing the digital product memory).
3. Operate the production system in the automatic mode for one-off production of rollers with bearing hub.

Work aids

- Utilized hardware: MPS® TS Compact Trainer I4.0, compressed air supply, 24 V DC power pack, PC
- Utilized software:
  - TIA Portal STEP7 V13 SP1 update 9 and higher
  - TIA Portal WinCC Basic V13 SP1 Update 9 and higher
  - S7-PCT V3.4 HF1 and higher
  - LOGO!Soft Comfort V8.0 and higher
  - Internet browser
  - VNC viewer

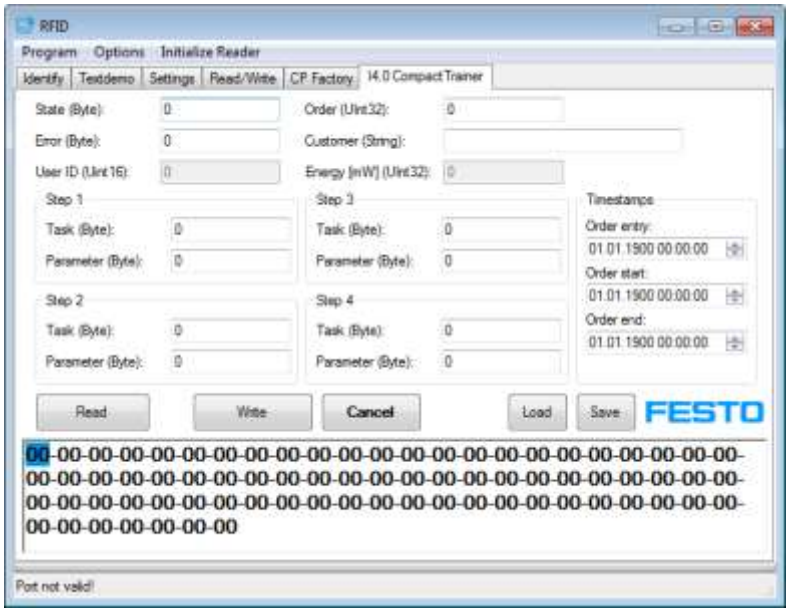
Exercise 1: Order entry

Procedure: PC order entry

The work order is entered via a USB RFID reader-writer. Install the supplied driver as described in "Quick-Install_USB_BaseDriver_03DE.pdf".
…*MPS_TS_CompactTrainer_I40**Software**USB-Reader*\

USB RFID reader-writer

Run the file: SampleApp_iID_interface_prot.V4_VS2010.exe
…*MPS_TS_CompactTrainer_I40**Software**RFID-Applikation*



Order entry data values are displayed in popups.

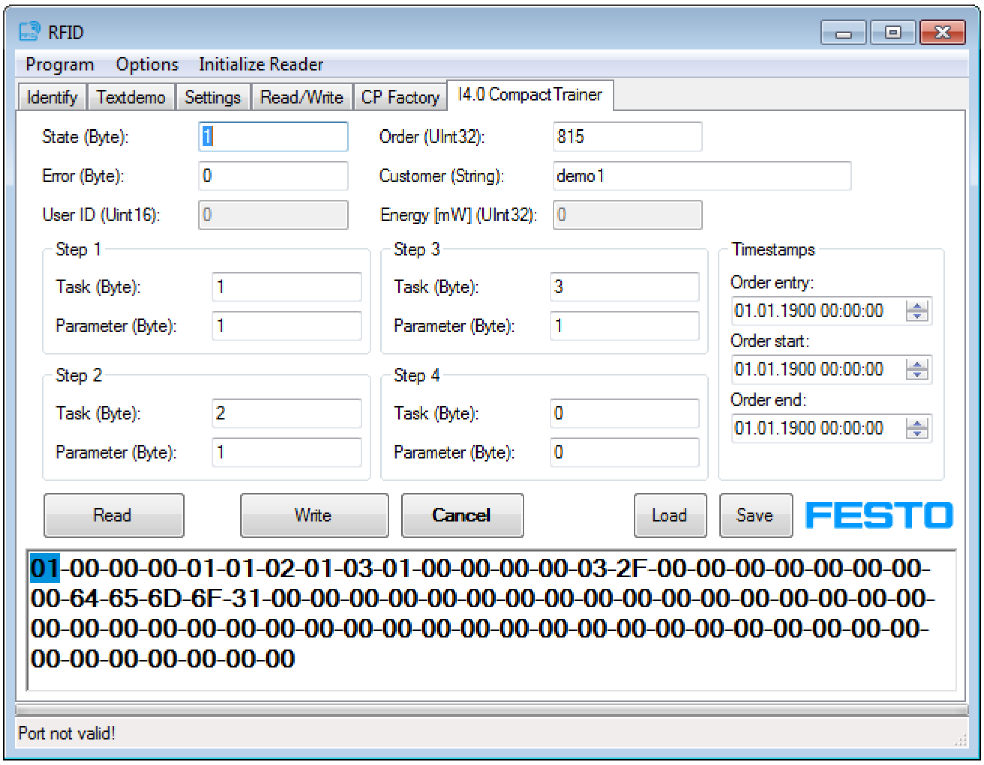
Program functions

Function	Description
Read	Read RFID data from the workpiece tag
Write	Write RFID data to the workpiece tag
Cancel	Cancel the write or read operation
Load	Loading a parameter record
Save	Save a parameter record

Work order data in digital product memory

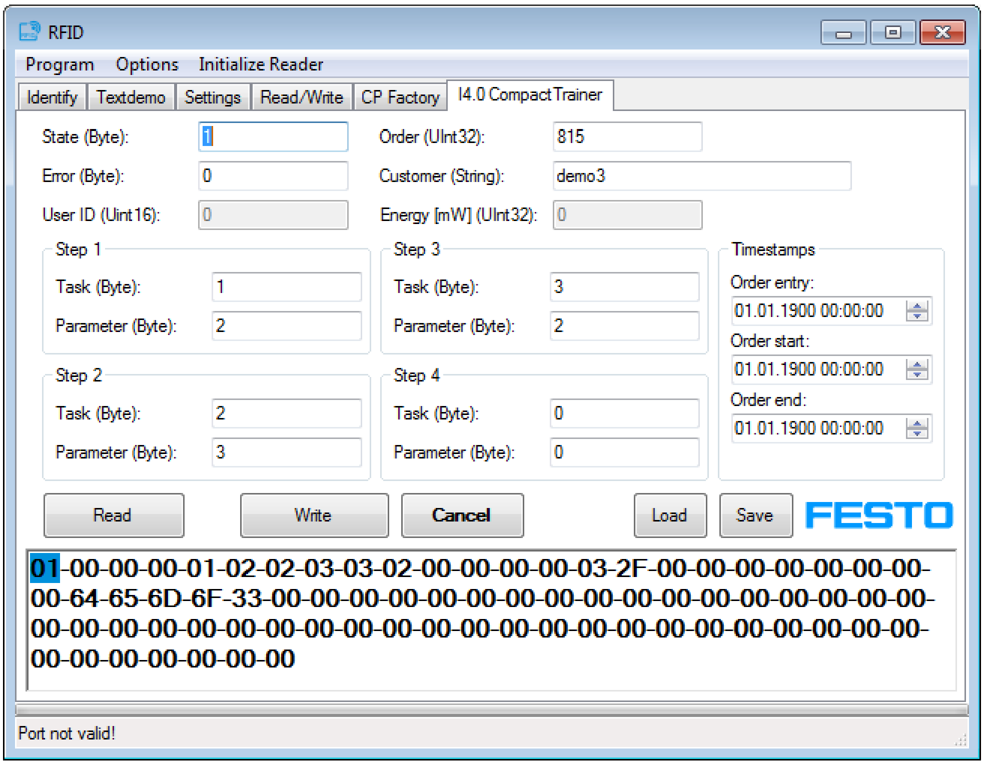
Variable	Data values	Description
State	0 = not programmed 1 - 4 = next step 30 = work order completed	Status of the production work order After production has been completed the state byte must be reset from the value ‘‘30’’ back to ‘‘1’’, in order to conduct a new production process with the workpiece.
Error	0 = no errors 1 = drilling error 2 = insertion error 3 = magazine empty, manual workstation	Error status of the production work order / workpiece
User ID	1 ... 32767	Logged on user For example 12301 = John Doe, 12303 = Jane Doe
Or	0 - 4,294,967,295	Work order number, consecutive
Customer	31 ASCII characters	Customer name
Energy	0 - 4,294,967,295	Energy consumption [mW] for the production work order
Steps 1 - 4	Task: 1 = drill 2 = insert the bearing hub 3 = discharge workpiece 4 = reserved	Work order steps, freely configurable Parameters: Drill: number of drilling strokes (1, 2) Insert bearing hub: 1 = aluminum, 2 = plastic, 3 = steel Discharge: 1 = after RFID, 2 = at light barrier
Timestamps	Order entry	Work order entry
	Order start	Beginning of work order processing
	Order end	Completion of the work order

- **Sample parameter record 1: drill = 1 x, insert = 1 (aluminum), discharge = 1 (at RFID at end of conveyor)**



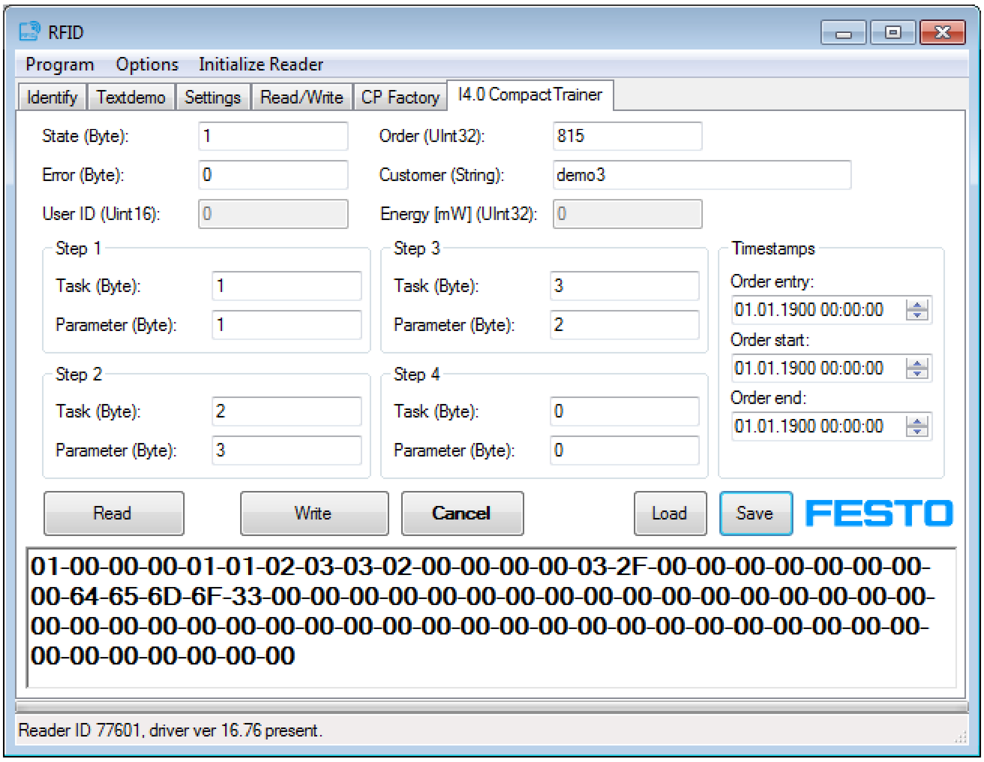
...\MPS_TS_CompactTrainer_I40\Software\RFID-Applikation\ demo2_parameter.txt

- **Sample parameter record 2: drill = 2 x, insert = 2 (POM), discharge = 2 (at light barrier at end of conveyor)**



...\MPS_TS_CompactTrainer_I40\Software\RFID-Applikation\ demo2_parameter.txt

- **Sample parameter record 3: drill = 1 x, insert = 3 (steel), discharge = 2 (at light barrier at end of conveyor)**



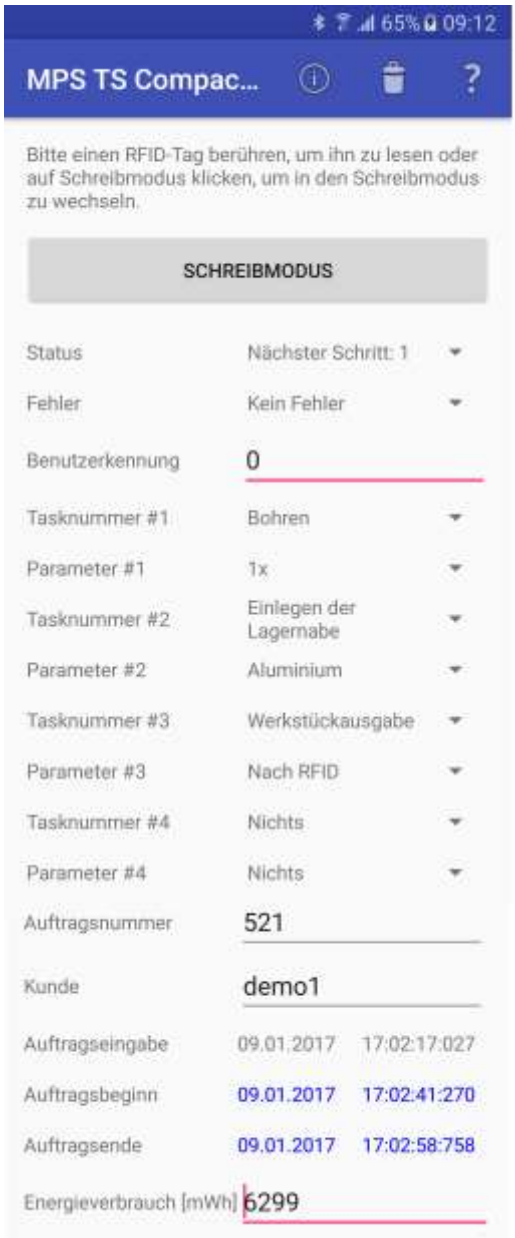
...\MPS_TS_CompactTrainer_I40\Software\RFID-Applikation\ demo3_parameter.txt

Procedure: order entry at an Android smartphone

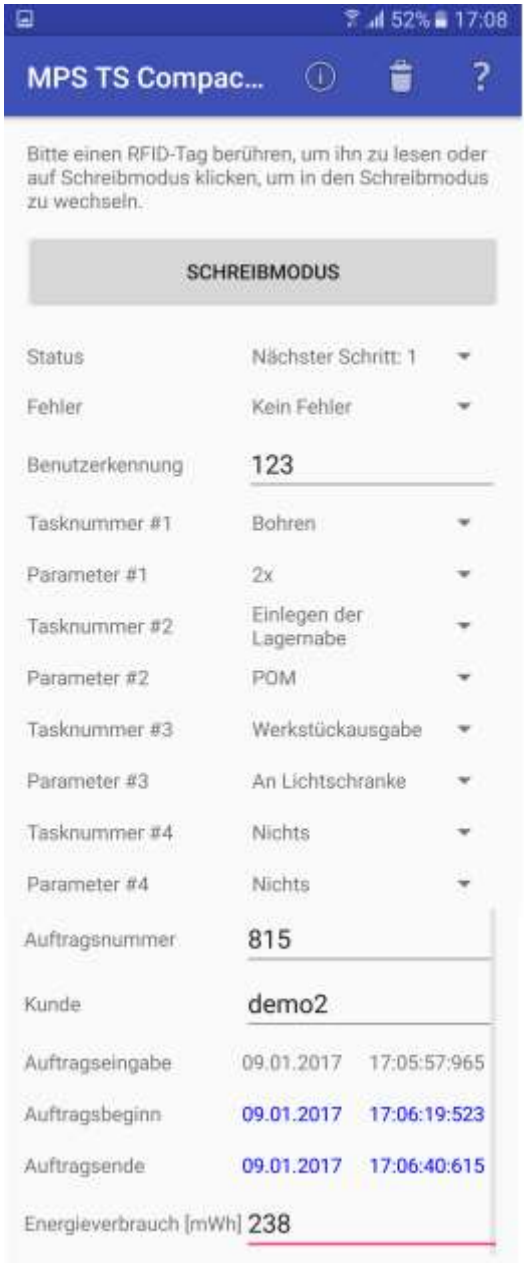
The RFID app can be made available to testers.
Send us your Gmail address via the following QR code:

Note:
After production has been completed, the state entry must be reset from the value “Finished” back to “Next step: 1”, in order to conduct a new production process with the workpiece.

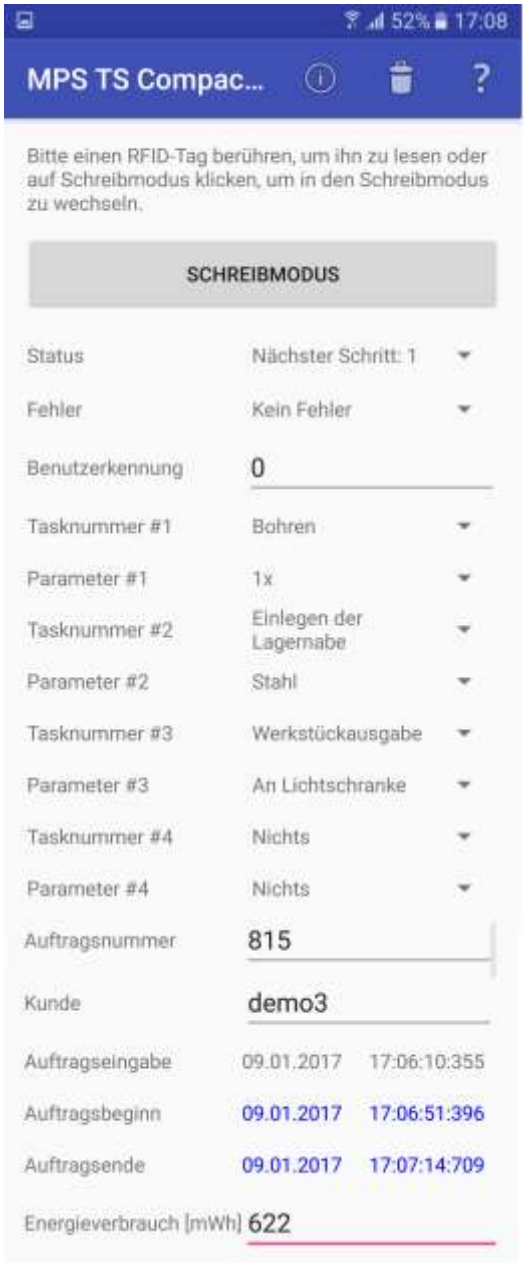
Sample parameter record 1: drill = 1 x, insert = 1 (aluminum), discharge = 1 (at RFID at end of conveyor)



- **Sample parameter record 2: drill = 2 x, insert = 2 (POM), discharge = 2 (at light barrier at end of conveyor)**



- **Sample parameter record 3: drill = 1 x, insert = 3 (steel), discharge = 2 (at light barrier at end of conveyor)**



Exercise 2: Starting the demo sequence

Procedure: setting up the production system

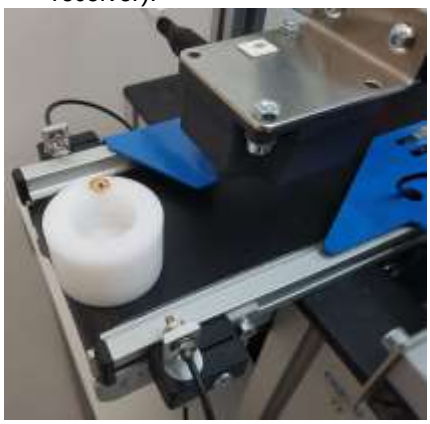
1. Check power supply and compressed air supply.
2. Remove workpieces at transfer points between modules and from the conveyor before manual reset.
3. The gravity-feed magazine for the insertion module must be filled with 10 steel bearing hubs.
4. At least 7 but no more than 10 aluminum bearing hubs must be loaded into the left gravity-feed magazine at the manual workstation and at least 7 but no more than 10 POM bearing hubs (black plastic) must be loaded into the right gravity-feed magazine.
5. Start the resetting process. The resetting process is carried out after clicking the RESET button.

Procedure: Starting the demo sequence

The work order data don't have to be written to the workpiece's digital product memory in order to produce the demo workpiece!

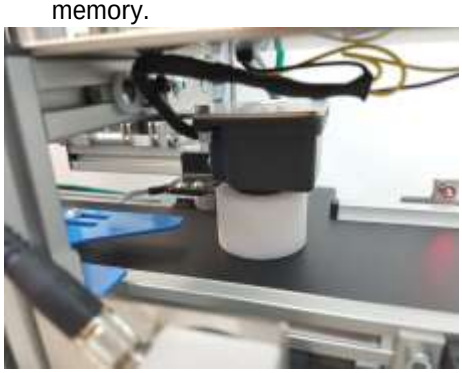
A product is produced, namely a bearing roller with steel hub.

1. Start the station's work sequence. The process is started after clicking the "Demo" button.
2. Place a workpiece onto the belt at the beginning of the conveyor (between the light barrier's emitter and receiver).

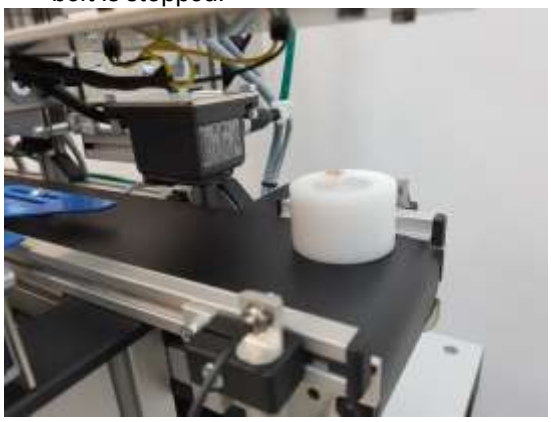


3. The workpiece is transported to the RFID reader at the beginning of the conveyor in the creep speed mode, and is then stopped. The parameter record for the demo work order is loaded to work order memory (see sample parameter record 3).
4. The unfinished roller is then transported to the drilling module and is stopped there at the module's light barrier. The drilling process is executed once.
5. When machining has been completed, the workpiece is transported to the insertion module and is stopped at a defined position by the flat stopper cylinder. The steel hub is removed from storage by the insertion module and is precisely inserted into the unfinished roller.

6. The workpiece is stopped at the RFID writer/reader and status and timestamps are written to its memory.



7. The finished product is transported to the end of the conveyor up to the light barrier and the conveyor belt is stopped.



8. If the demo sequence is not interrupted, the workpiece is returned to the beginning of the conveyor after 7 seconds.
9. The workpiece is stopped again at the beginning of the conveyor and the demo sequence is started over after an additional 7 seconds.

Notes

- The demo sequence can be stopped at any time by pressing the emergency stop button or by clicking the “STOP” button.
- The workpiece may only be removed from the conveyor belt after it has been stopped!
- A simulated sequence without specifying any work order data in product memory can be started by clicking the “DEMO” button.

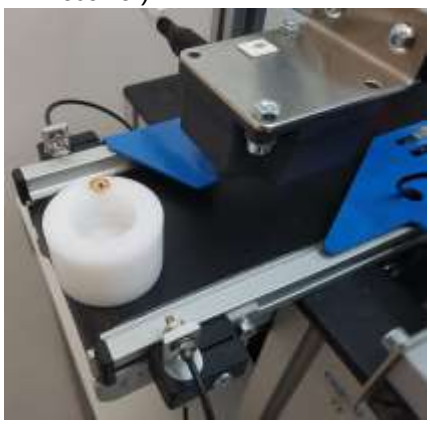
Exercise 3: Starting a production work order

Procedure for starting the process sequence using the workflow for the manual workstation

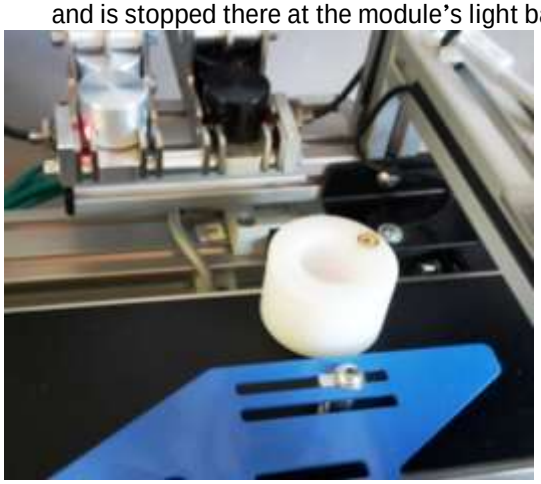
The work order data have to be written to the workpiece's digital product memory in order run a production work order (see work order entry)!

A bearing roller with aluminum hub will be produced, for example (see sample parameter record 1).

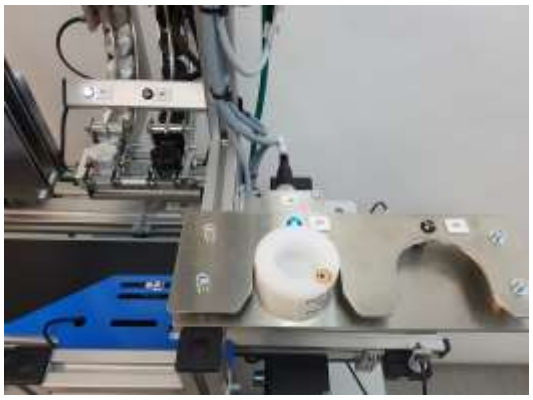
1. Start the station's work sequence. The process is started after clicking the "AUTO" button.
2. Place a workpiece onto the belt at the beginning of the conveyor (between the light barrier's emitter and receiver).



3. The workpiece is transported to the RFID reader at the beginning of the conveyor in the creep speed mode, and is then stopped. The parameter record for the work order is loaded from digital product memory to work order memory.
4. The unfinished roller is then transported to the drilling module and is stopped there at the module's light barrier. The drilling process is executed once, for example.
5. When machining has been completed, the workpiece is transported to the manual workstation module and is stopped there at the module's light barrier.

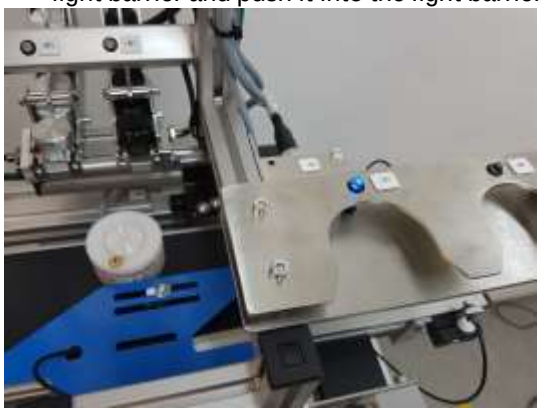


6. Remove the workpiece from the conveyor and set it into the indicated tray position at the manual workstation (left).



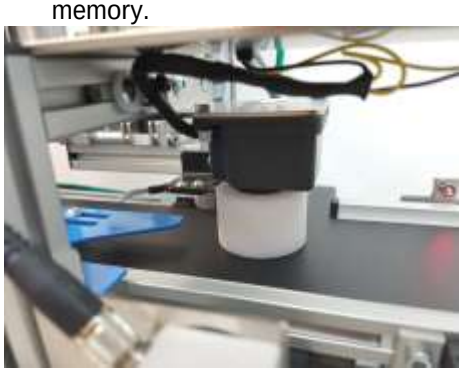
7. The left LED at the pick by light module's gravity-feed magazine for the aluminum bearing hubs light up for withdrawal from storage. Remove the aluminum bearing hub and insert it into the roller.

8. Remove the finished assembly from the tray and place it back onto the conveyor belt upstream from the light barrier and push it into the light barrier's beam path.

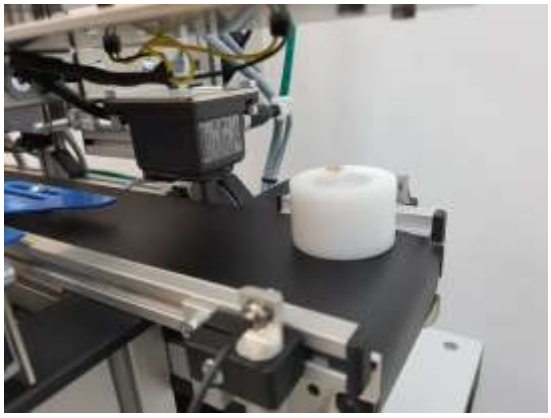


Caution: the workpiece is transported further automatically!

9. The workpiece is stopped at the RFID writer/reader and individual production data are written to its memory.



10. The finished product is transported to the end of the conveyor up to the light barrier and the conveyor belt is stopped.

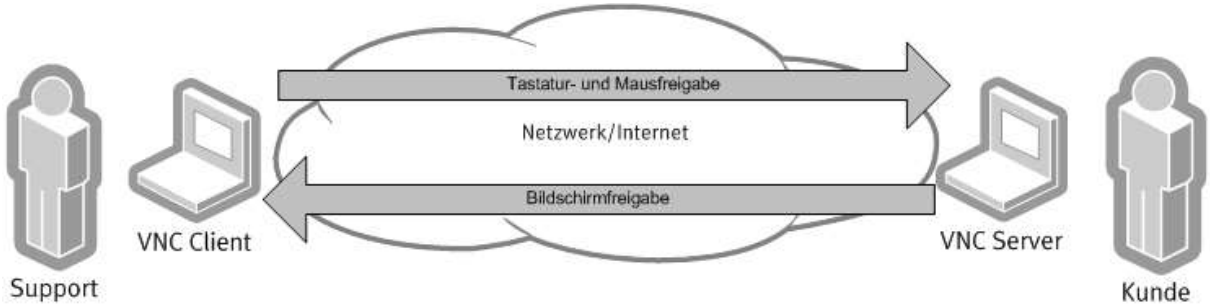


11. The finished product can now be removed.

Exercise 4: Using the data center

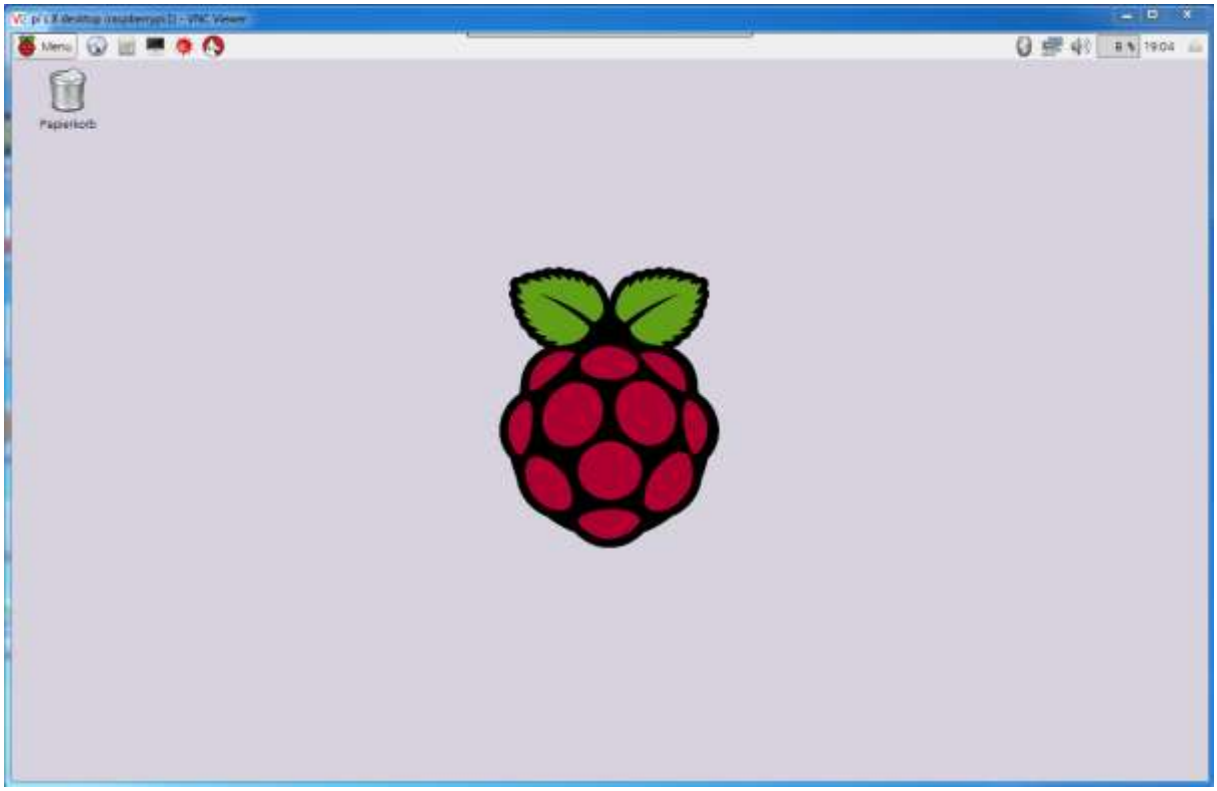
Prerequisite

Establish a connection with the Raspberry Pi data center via remote control. The procedure is described in exercise 9 of section 8, “Commissioning”.



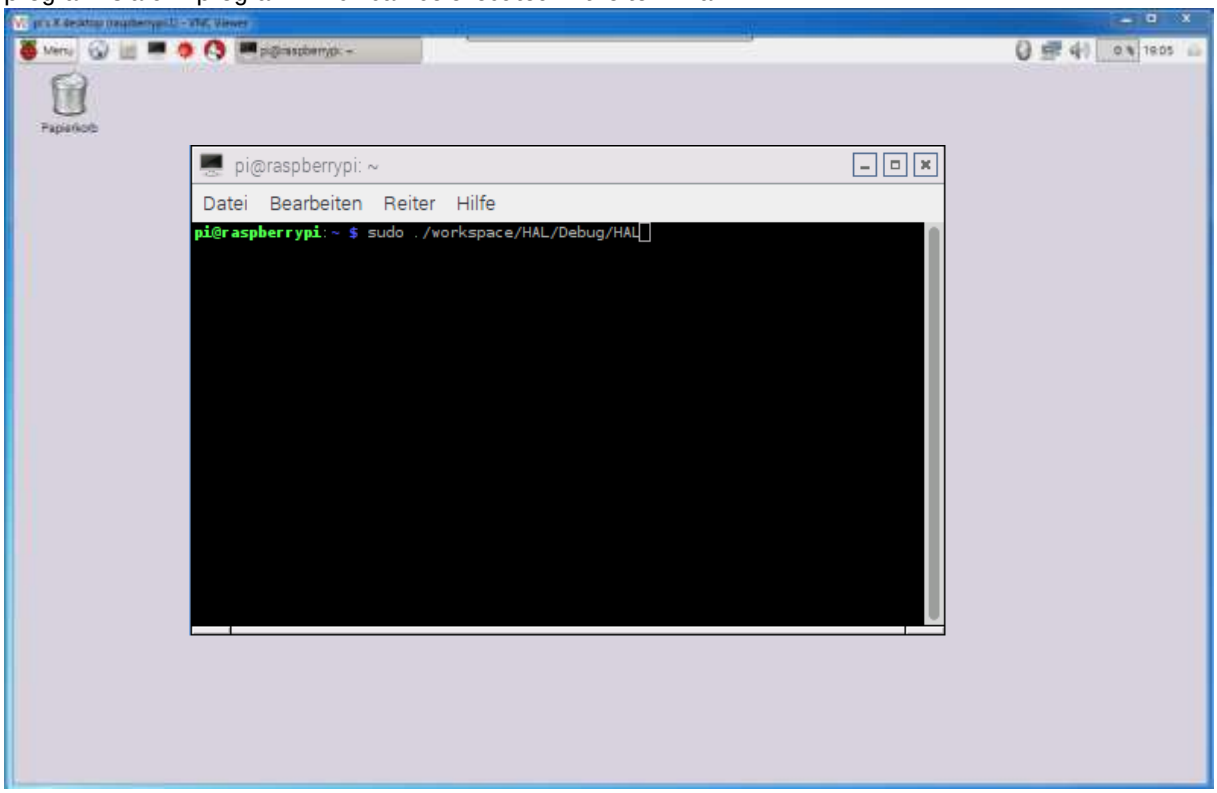
Checking data communication with the LOGO mini control system

If remote maintenance connection has been successful, the desktop of the Raspberry Pi is displayed at the host computer, from which it can be remote controlled.

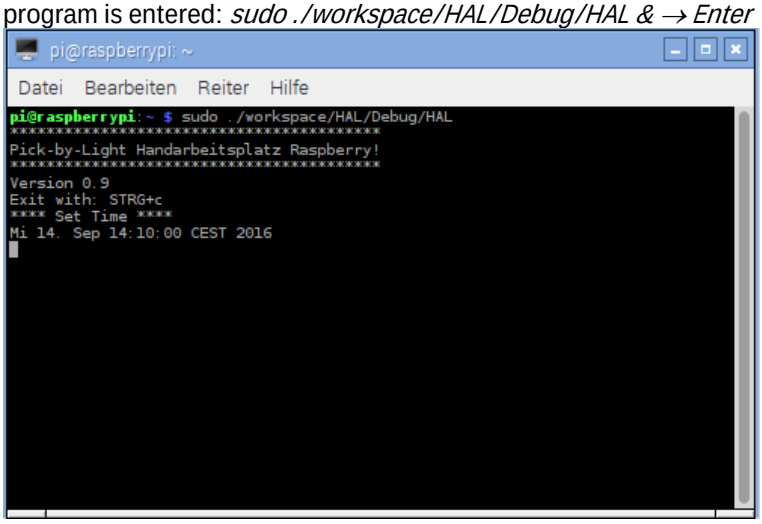


Starting the “HAL.exe” sample program

The “HAL” program must be started or already running for data to be cyclically read out of the LOGO. The program is a C++ program which can be executed in the terminal.



And thus the terminal for the Raspbian user interface is opened and the command line for starting the program is entered: *sudo ./workspace/HAL/Debug/HAL & → Enter*



The keyword “sudo” means that the program is running as an administrator. The rest of the text is the path to the .exe.

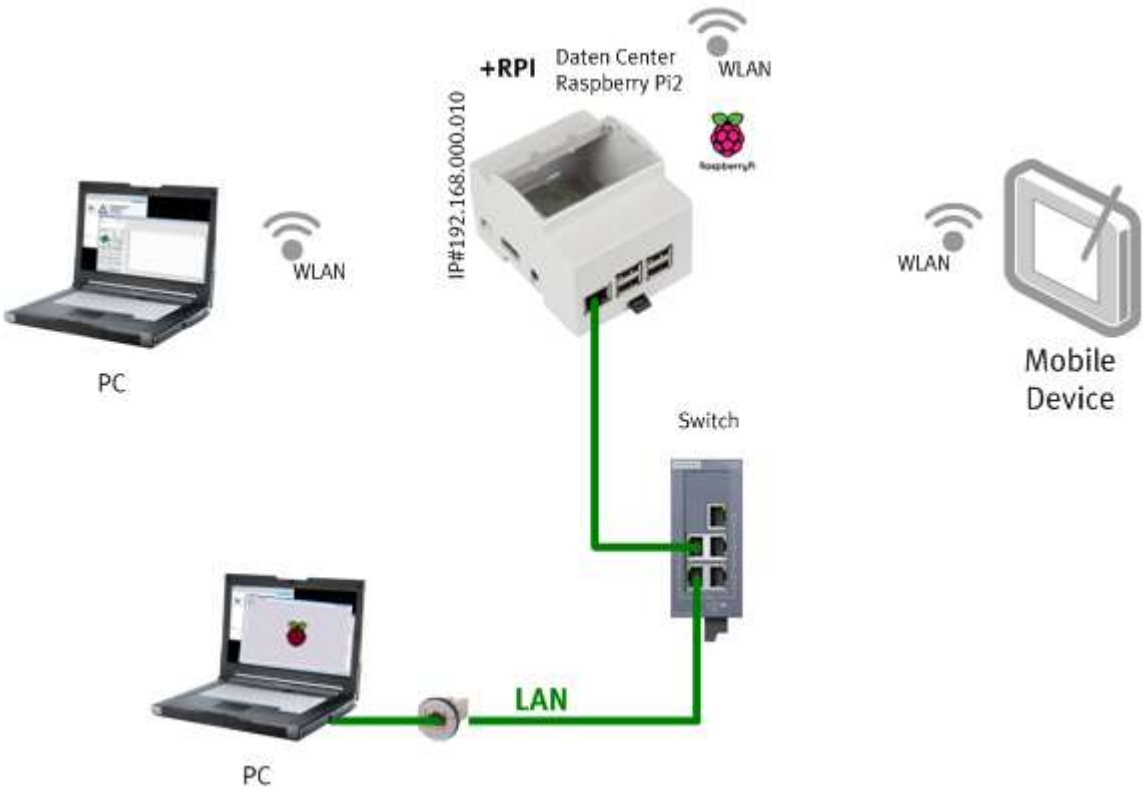
After the software has been started successfully terminal output appears, for example “*Version 0.9*”, as well as information indicating how to exit the program: STRG+C.

If a date has been saved to the database for setting system time, this is acknowledged by the message “**** Set Time ****” and a display of the time. Time can be set via the Raspberry website at http://192.168.0.10. LOGO time is set actively with “Set Time” and is additionally made available in the network by means of NTP.

Data center website

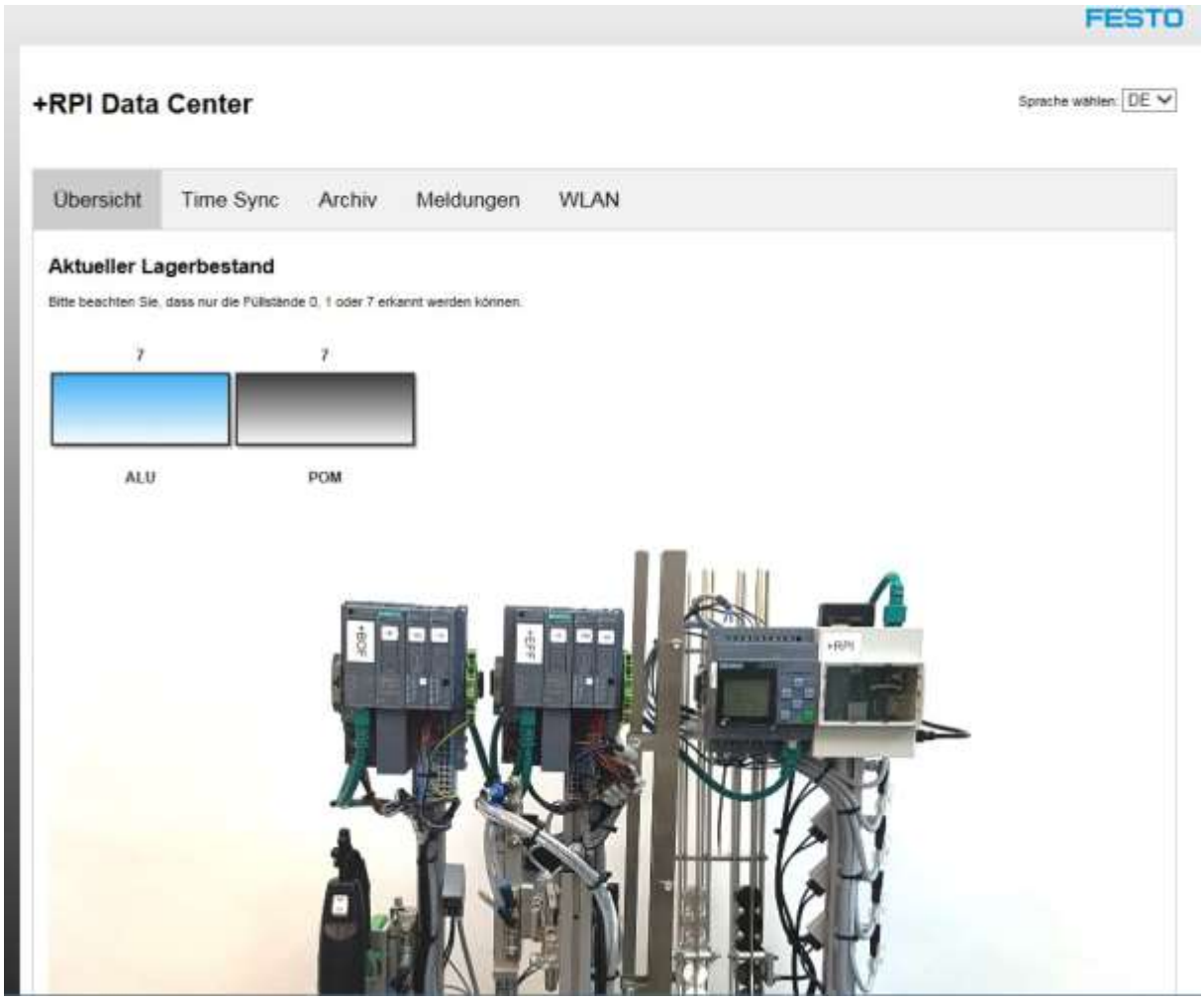
Connection can be established with the website of the data center by means of:

- Network access via LAN
- WLAN connection with smartphone, tablet etc.
- Remote control via VNC LAN or WLAN.

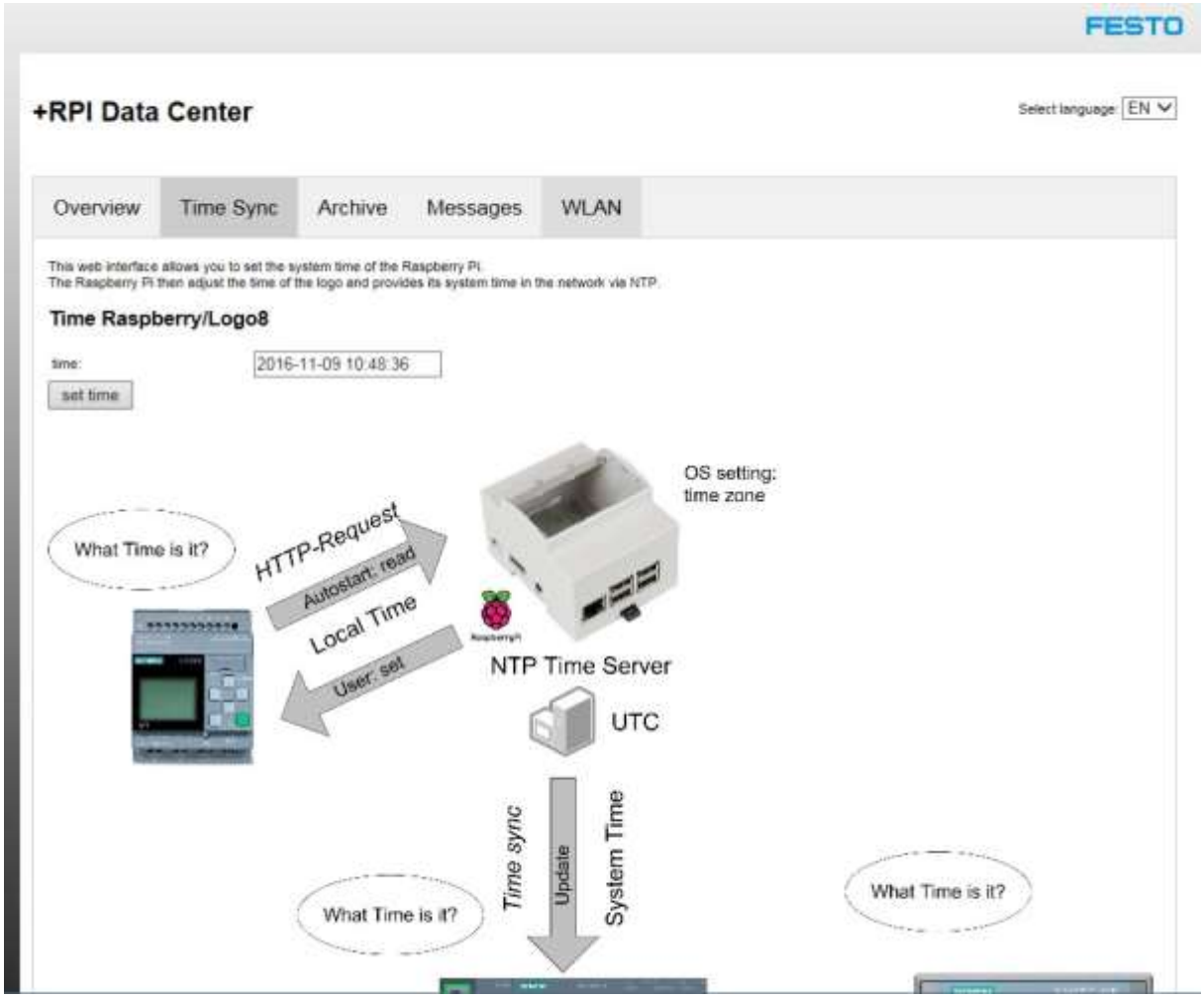


Accessing the data center

The Raspberry Pi is equipped with a preinstalled Apache web server. This makes it possible to make websites available within the network. The data center's website can be accessed at http://192.168.0.10.



The main functions, the stock levels of the manual workstation and the language switching option (DE/EN) are displayed in the overview page.



You can set time at the Raspberry Pi (HAL.exe automatically sets LOGO time simultaneously as well), and you can read out and display the archived statuses of the LOGO.

10 Maintenance and care

MPS® stations are maintenance-free for the most part. The following components should be cleaned at regular intervals with a soft, lint-free cloth or brush:

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

Note
Do not use aggressive or abrasive cleaning agents.

11 Additional information and updates

Further information and updates to the technical documentation of the MPS® stations can be found on the Internet at:

www.festo-didactic.com → Service → MPS® mechatronic systems

Festo Didactic SE
Rechbergstr. 3
D-73770 Denkendorf
Germany

+49 711 3467-0
+49 711 34754-88500
www.festo-didactic.com
did@de.festo.com