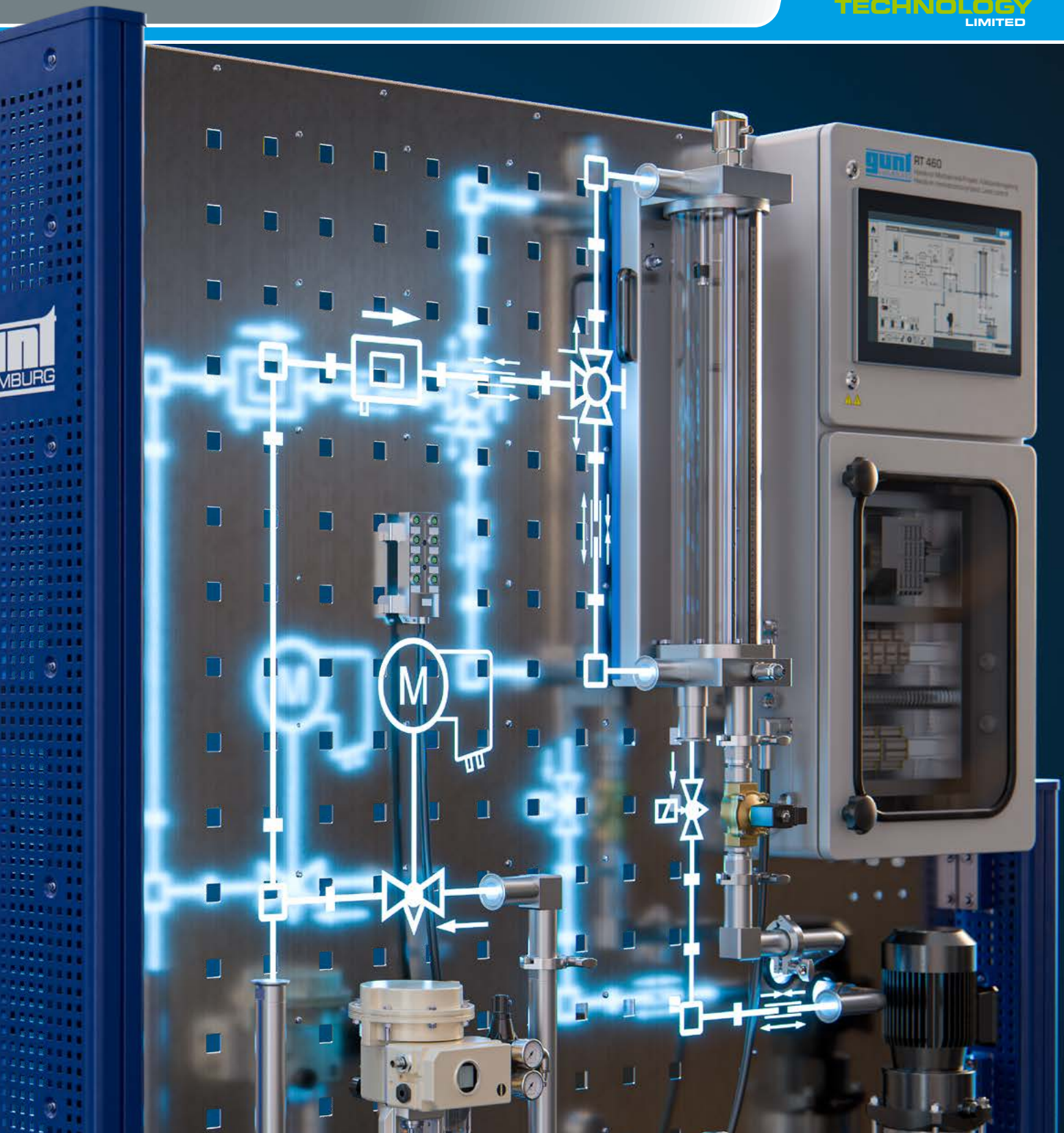




RT460

Hands-on mechatronics project: level control



Introduction

The RT 460 Hands-on mechatronics project trainer enables you to plan, commission and optimise a level or flow control system using standard industrial components. Trainees and students in the field of mechatronics learn to combine theory and practice.

The consistent hands-on approach means theoretical content is immediately put into practice. This promotes cross-system thinking, enhances problem-solving skills and provides learners with the best possible preparation for the demands of modern industrial and automation technology. All the key stages of a mechatronic process – from signal acquisition and control to analysis of dynamic system behaviour – are taught in a practical manner.

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Imprint

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RT460 Hands-on
mechatronics project
www.gunt.de



Interdisciplinary learning objectives

Mechatronics, electrical engineering, control engineering

Modern mechatronics combines **mechanics**, **electronics**, **sensor technology** and **automation technology**. GUNT's hands-on approach applied in the RT 460 trainer offers a practical mechatronics training system for automation technology.

The learning objectives follow the course plans for mechatronics and control engineering. They can be worked on a modular basis as individual projects or as a complete project spanning several weeks. Work can be carried out either as a team or as an individual assignment.

Applications of the RT460 in the mechatronics and control engineering course plan

- visualisation of mechatronic systems: block diagram, signal flow diagram
- P, I and D controllers and their combinations
- practical implementation and simulation of the designed controllers
- PLC (Programmable Logic Controller)
- applied mechatronics: control of electric drives and mechatronic components
- level or flow control

Development of digital skills

- working with the GUNT planning software
- use of digital learning media



Planning and documentation

- signal flow diagram
- piping diagram including parts list
- wiring diagram
- terminal diagram
- process schematic



Mechanical assembly

- positioning of actuators and sensors
- assembly of pipes and pipe components



Electrical assembly

- connection of electronic and electrical components
- wiring in the switch cabinet

Configuring the components

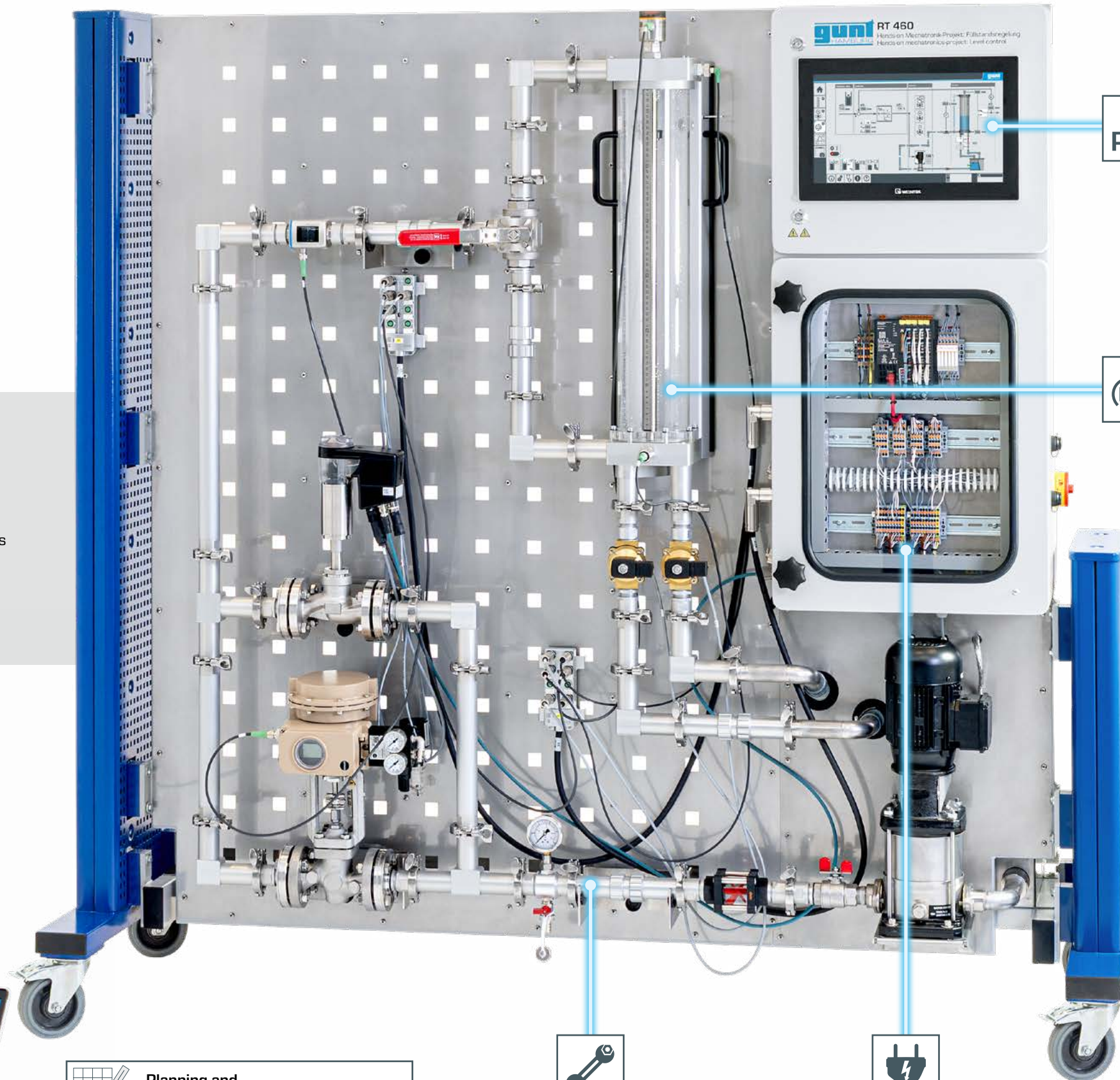
- connection configuration in the PLC
- selection of interfaces and characteristics for sensors and actuators
- selecting different types of control systems (two-point, P, I, and D control and their combinations; cascade control)

Commissioning

- leak test
- functional test

Testing and optimisation

- setting and optimising control parameters
- familiarisation with the advantages and disadvantages of sensor and actuator principles
- familiarisation with the advantages and disadvantages of different types of control systems





GUNT Media Center

Digital learning made easy



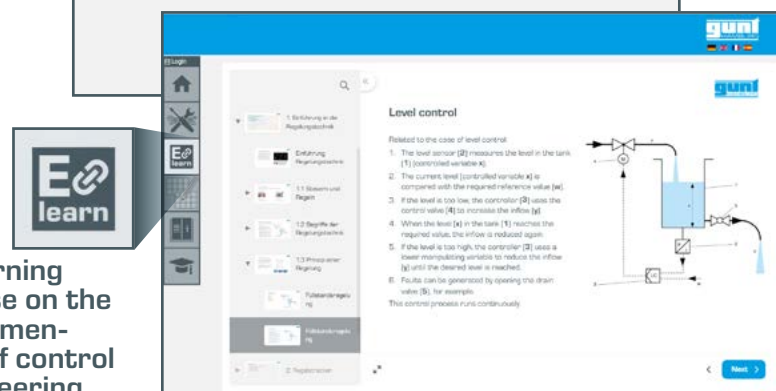
The **Media Center** is a **didactic platform** developed by GUNT that offers specific learning materials for GUNT devices. By combining hardware on an industrial level with digital data packages, we support the future professional development of students.

The level control for the RT 460 device is planned independently using the **GUNT planning software** in the Media Center and documented digitally. During the creation of individual plans, knowledge of mechanics, electrical engineering, electronics and control engineering is applied, interlinked and consolidated. Different configurations are achievable within a defined scope using the pipe elements and components provided.

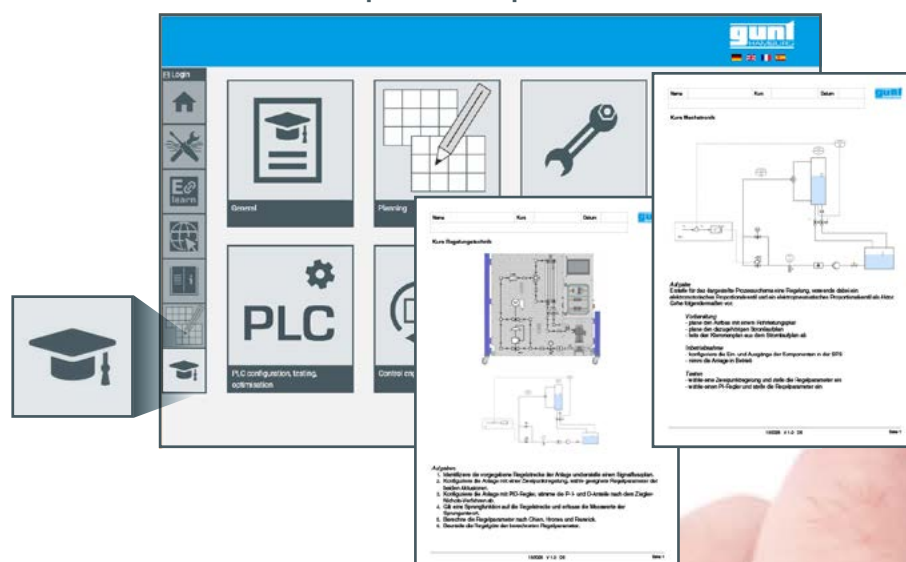
Information such as manuals, data sheets and videos



E-learning course on the fundamentals of control engineering

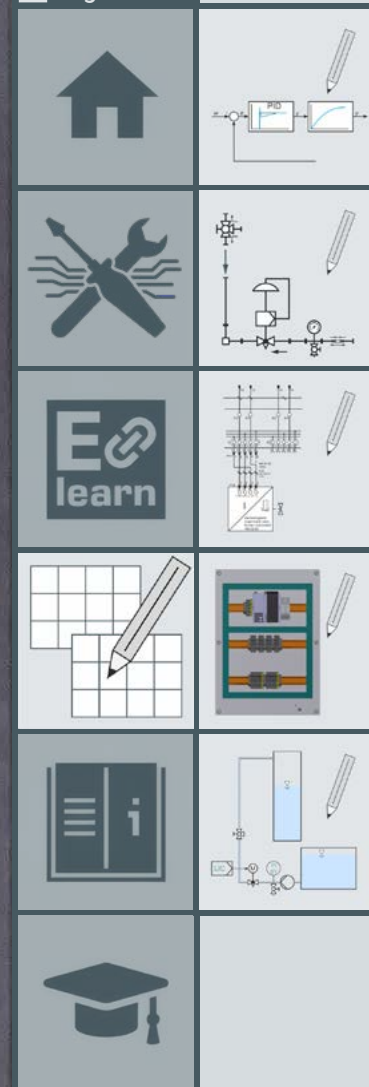


Exercises with password-protected solutions

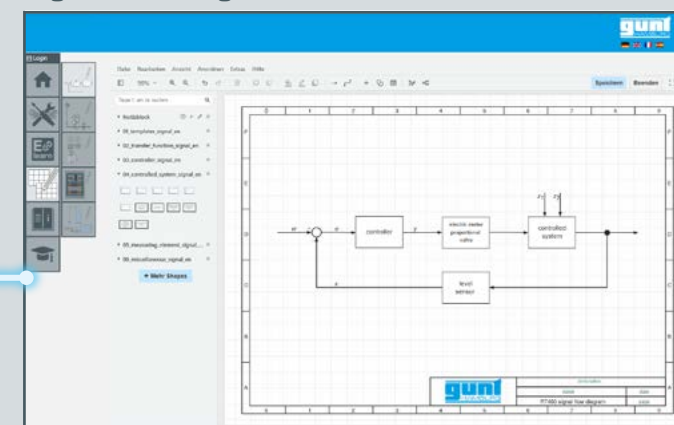


GUNT planning software with tailored libraries

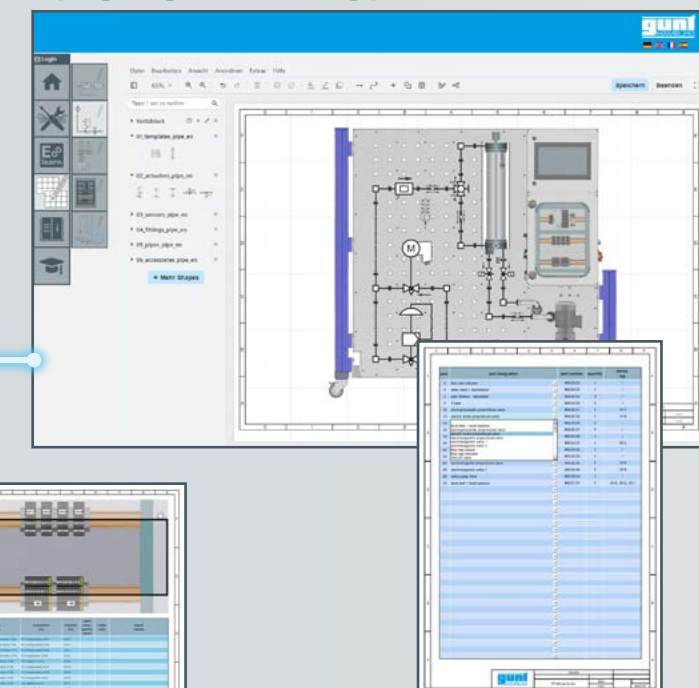
Login



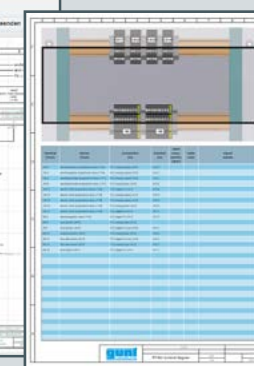
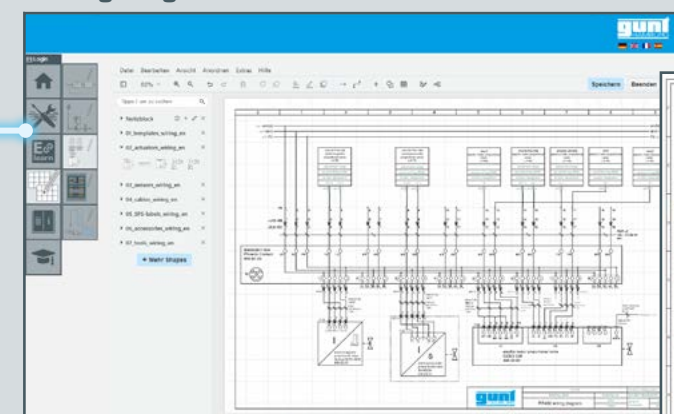
Signal flow diagram



Piping diagram including parts list

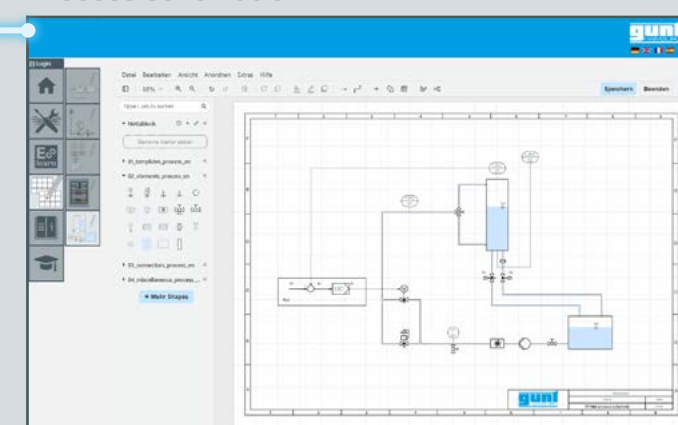


Wiring diagram



Terminal diagram

Process schematic





Planning and assembly of a level control system

Example of a project work process



1

Signal flow diagram

Planning the flow of information and visualisation of interrelationships

2

Mechanics

Planning and assembly of mechanical components

3

Electrical and electronic systems

Planning and assembly of electrical components and assignment of functions in the PLC

4

Configuring the components in the PLC



5

Commissioning

Leak test and functional test of the trainer



6

Testing and optimising the level control

In the PLC, for example, different types of control systems are modified and compared

7

Process schematic and signal flow diagram

Summary of the level control as implemented and optimised. If necessary, revise the general signal flow diagram in line with the implemented control system.

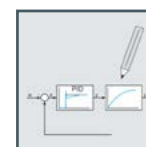
8

Project documentation



1 Signal flow diagram

Information flows and automation logic



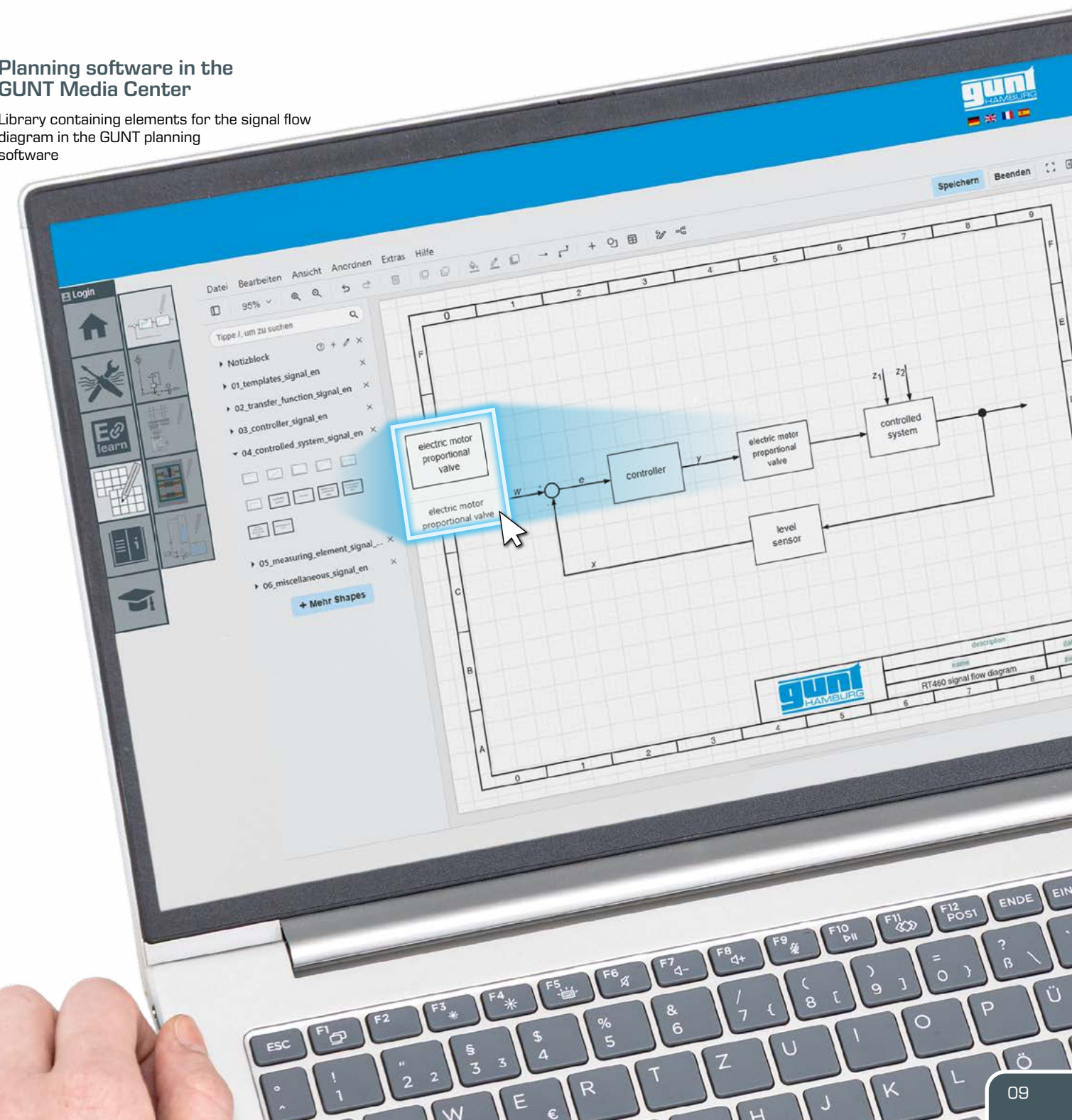
Visualisation of the mathematical and logical relationships involved in level control

- combination of mechanics, electronics and software
- planning the flow of information and the controlled system
- selecting the type of control

Once the level control has been tested, the selected control is checked and adjusted if necessary. The signal flow diagram can be adjusted retrospectively in line with findings.

Planning software in the GUNT Media Center

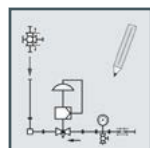
Library containing elements for the signal flow diagram in the GUNT planning software





2 Mechanics

Customised planning and assembly of mechanical components



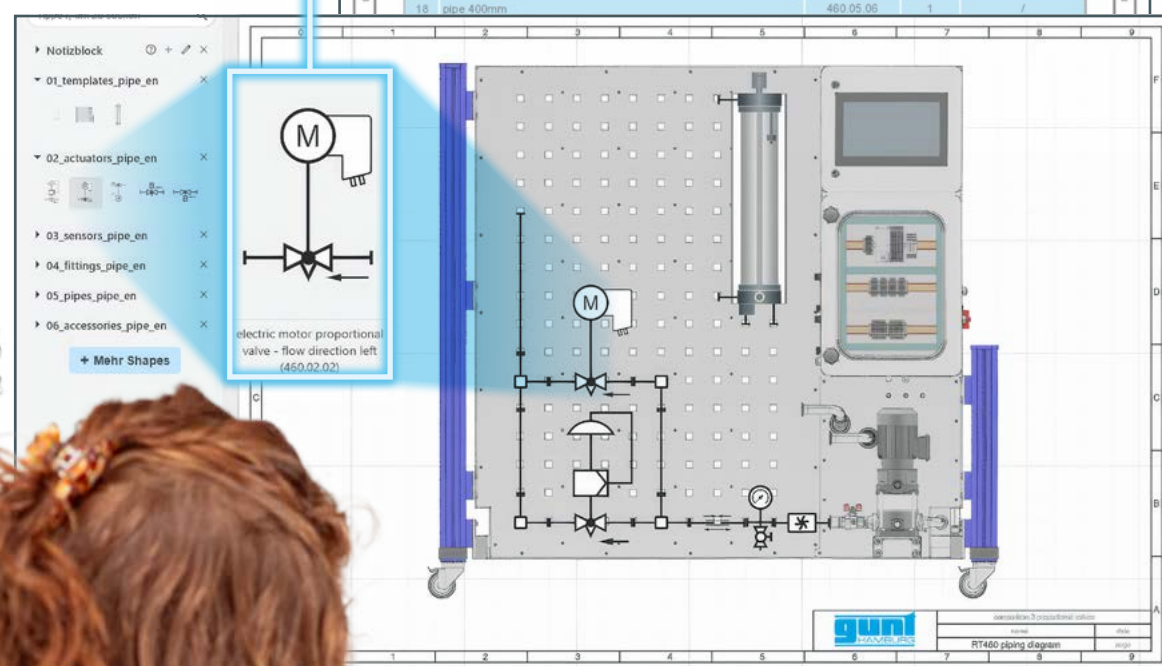
Complete, digital planning of pipes and components

- spatial arrangement and positioning of the actual industrial components
- selecting the right pipe elements
- PDF template for creating a digital parts list

Parts list to be edited digitally: components supplied can be selected from a drop-down list

pos.	part designation	part number	quantity	device tag
2	flow rate indicator	460.03.02	1	/
4	drain valve + manometer	460.04.03	1	/
6	pipe 200mm - adjustable	460.05.04	4	/
8	T-pipe	460.05.02	2	/
10	electromechanical proportional valve	460.02.01	1	-Y17
12	electric motor proportional valve	460.02.02	1	-Y19
14	pipe 400mm	460.05.01	7	/
16	pipe bend 90°	460.05.01	7	/
18	pipe 400mm	460.05.06	1	/

Library in the GUNT planning software is tailored to the pipes, actuators and sensors supplied



Visual aid provided by displaying the trainer in the background and a predefined grid

Planning software in the GUNT Media Center

Hands-on assembly

Easy assembly based on the customised parts list. Simple handling of components on the assembly panel with a grid.

Digital documentation and planning documents



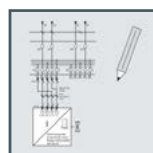
Safe and space-saving storage of components in boxes directly at the trainer



3 Electrical and electronic systems

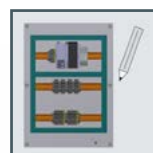
Customised planning and assembly of electrical components

Create digital wiring diagrams and terminal diagrams



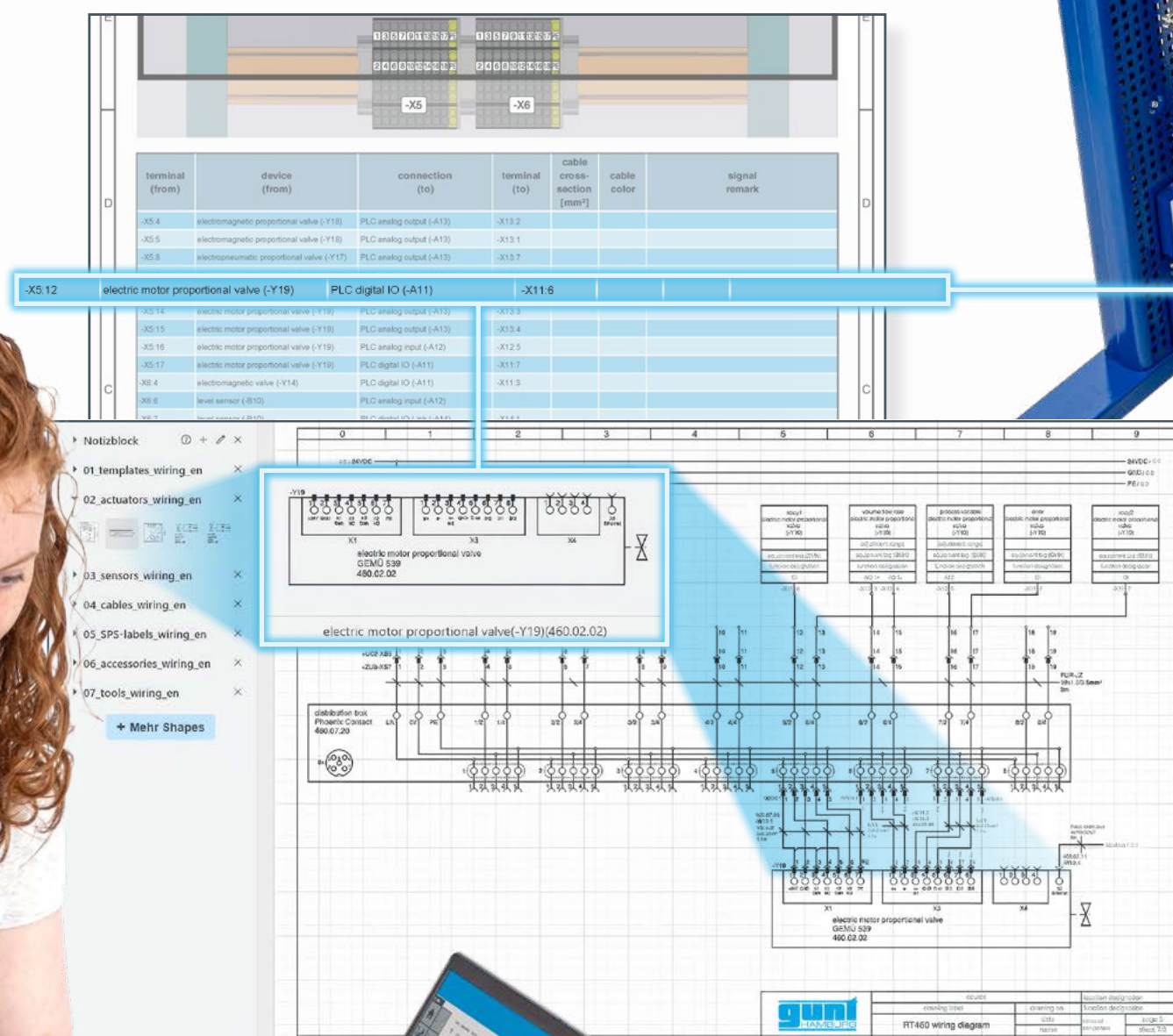
Wiring diagram

- planning of signal and control lines
- specifying connections
- assignment of functions in the PLC



Terminal diagram

- diagram showing available terminal blocks
- drop-down list for selecting terminals and planned components



The library in the GUNT planning software is tailored to the components supplied. Automatic alignment to a predefined grid.

Planning software in the GUNT Media Center

Hands-on assembly

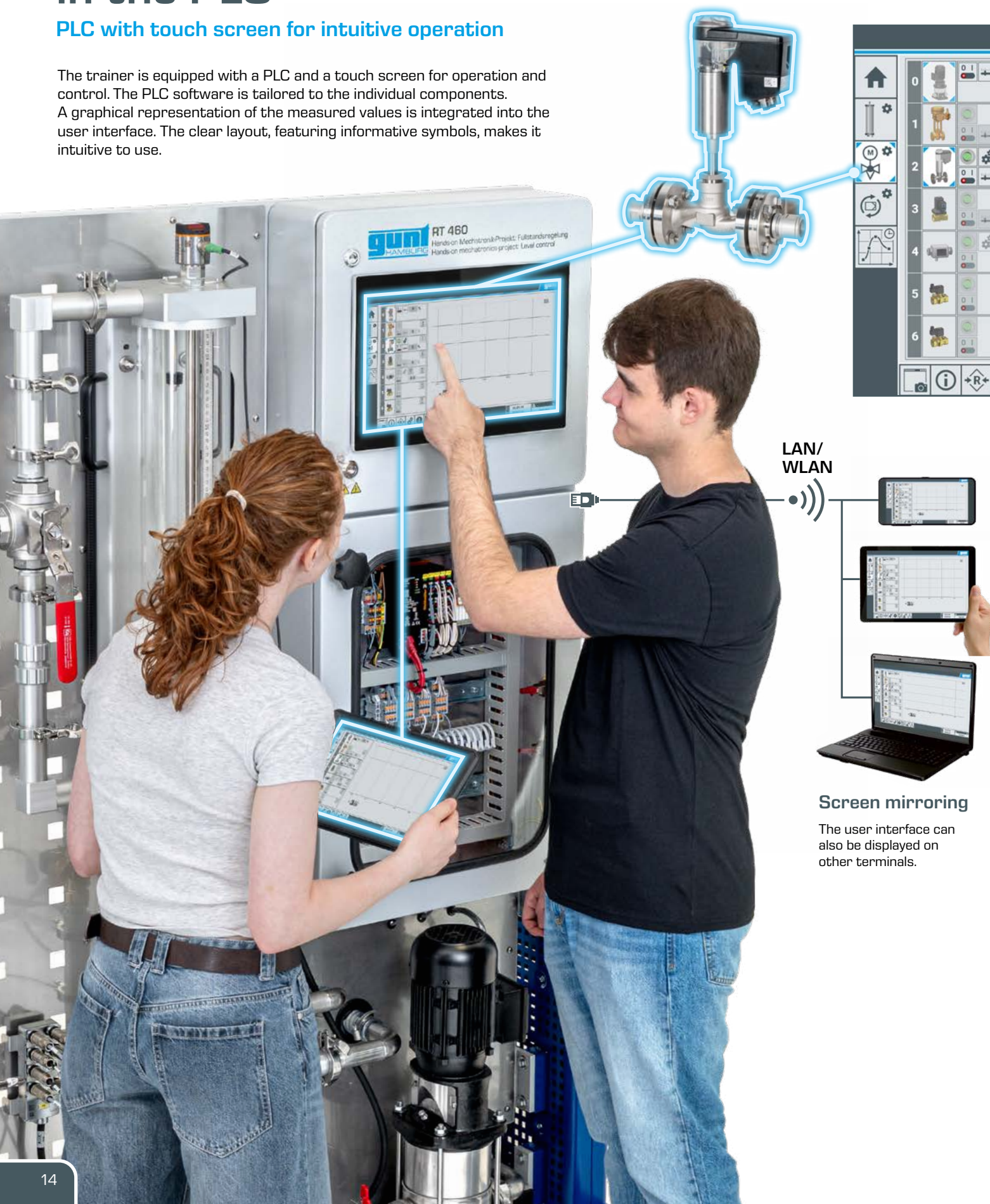
Safe wiring using the terminal diagram on a pre-fitted switch cabinet with 24 V extra low voltage (ELV) connected.



4 Configuring the components in the PLC

PLC with touch screen for intuitive operation

The trainer is equipped with a PLC and a touch screen for operation and control. The PLC software is tailored to the individual components. A graphical representation of the measured values is integrated into the user interface. The clear layout, featuring informative symbols, makes it intuitive to use.

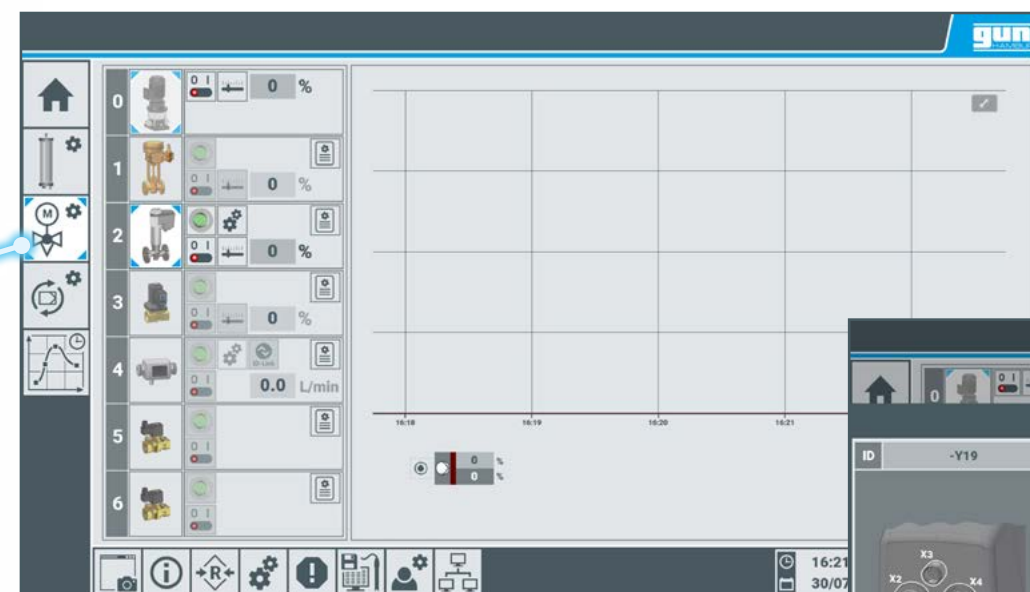


LAN/
WLAN



Screen mirroring

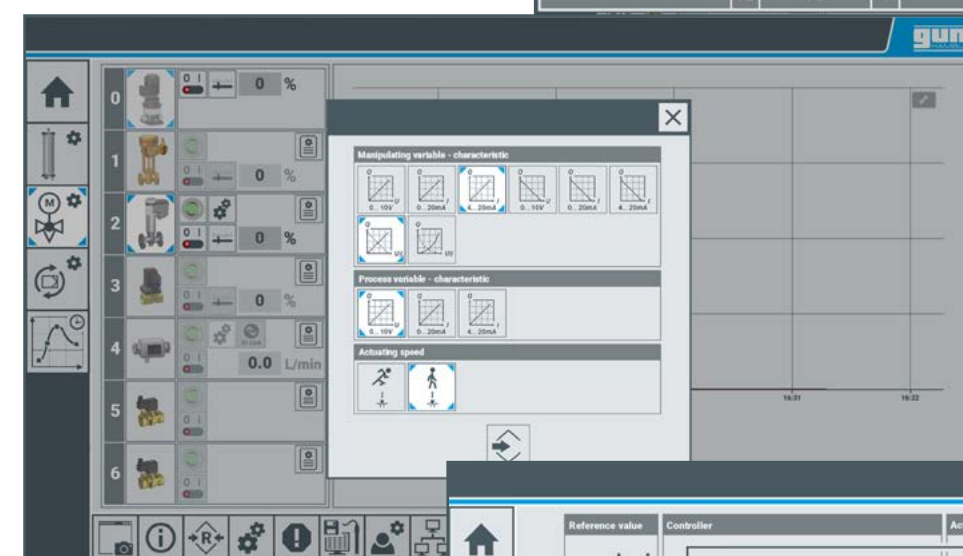
The user interface can also be displayed on other terminals.



Selecting, switching on and switching off the components. Configuration of certain actuators via Modbus, I/O-Link or manually.

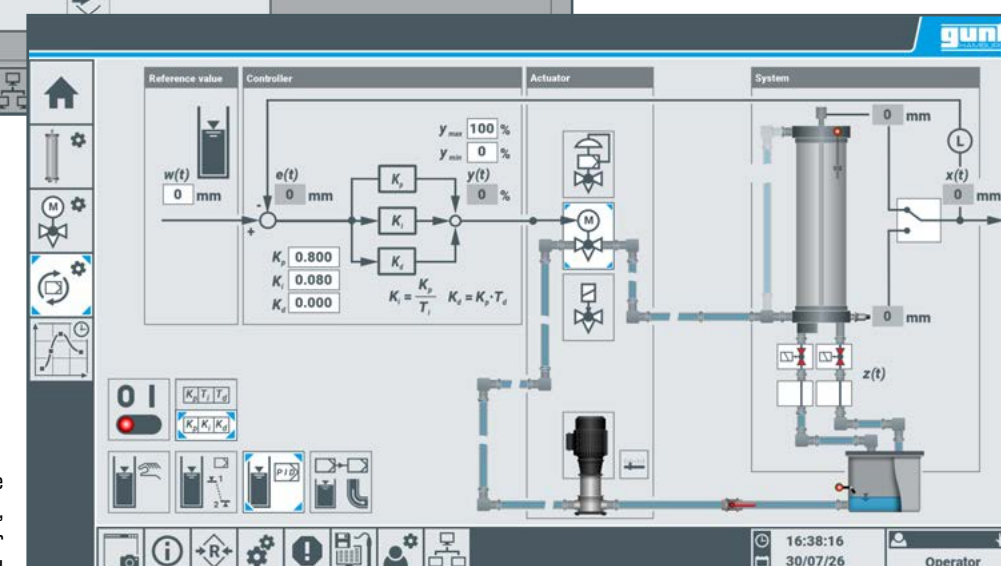


Configuration of the PLC's inputs and outputs for controlling the used component



Configuring the characteristics for the selected component

Selecting and configuring the control system: two-point, P, I, and D control and their combinations; cascade control





5 Commissioning

Leak test and functional test

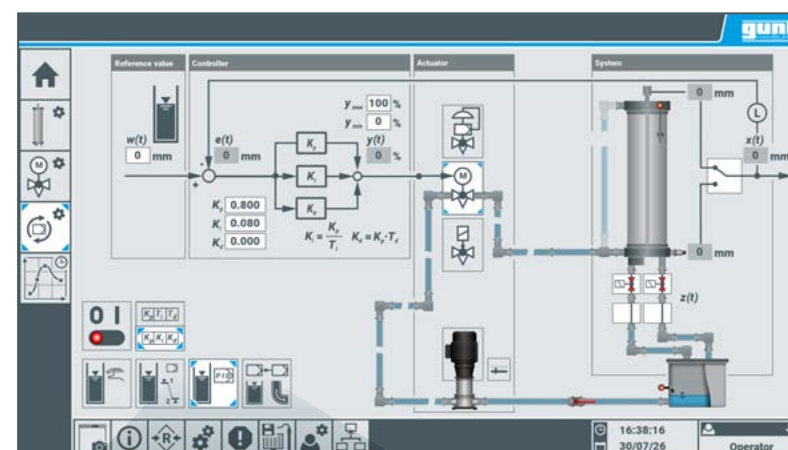
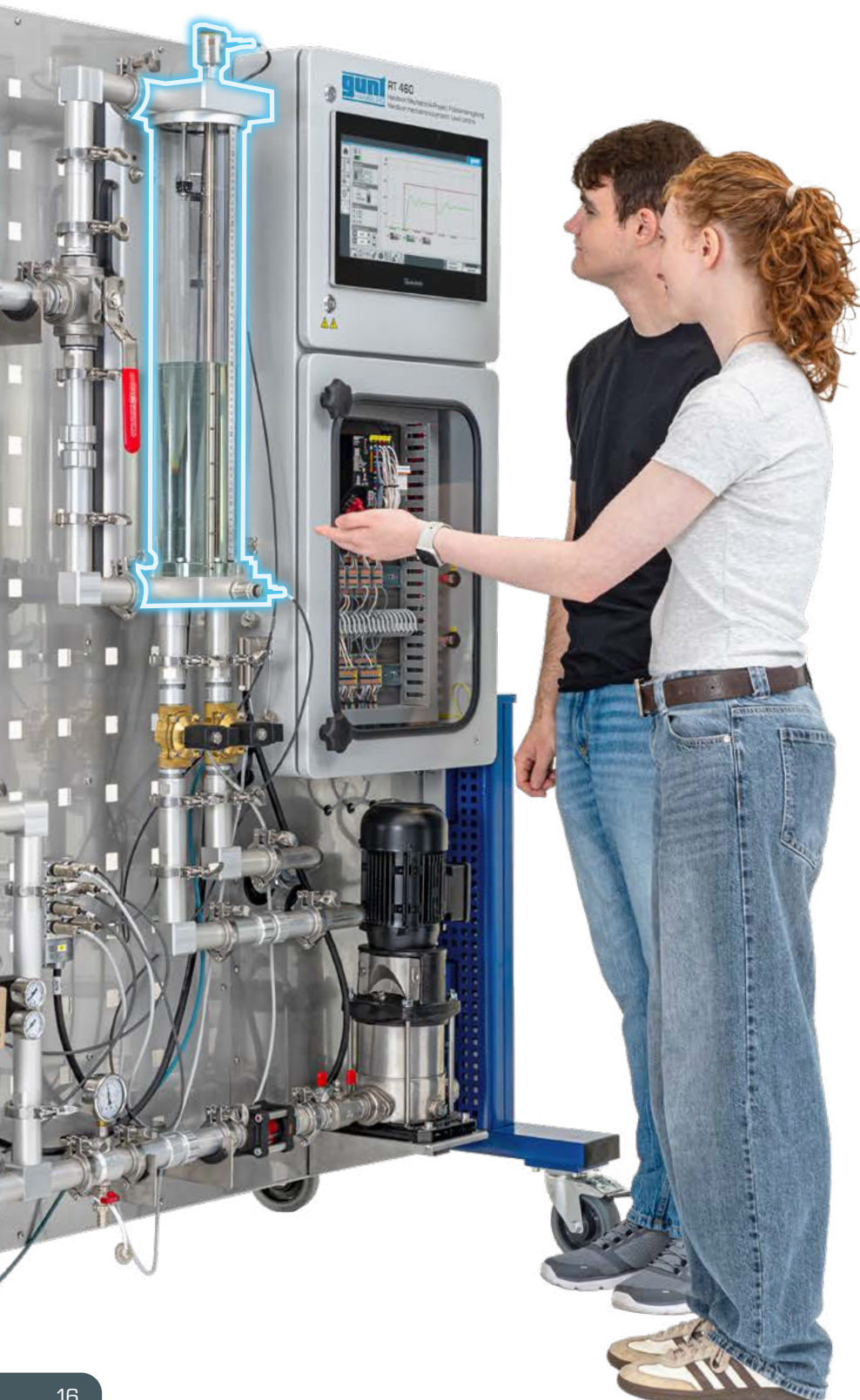
The individual assembly is checked for leaks. The correct control of the components via the PLC is verified.

6 Level control

Testing and optimisation

The experiments range from two-point control, to P, I or D control and their combinations, to cascade control.

Various control systems and controllers are selected on the PLC's touch screen, and the control parameters are set. For example, a step change function is applied to the controlled system and the measured values of the step response are recorded.



Data acquisition

Data is acquired via the PLC and saved to the internal memory. Stored measured values can be easily transferred from the trainer to the end devices via the integrated router. This allows experiments to be followed and analysed individually.

7 Process schematic

Customised design of a process schematic

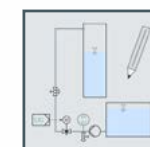


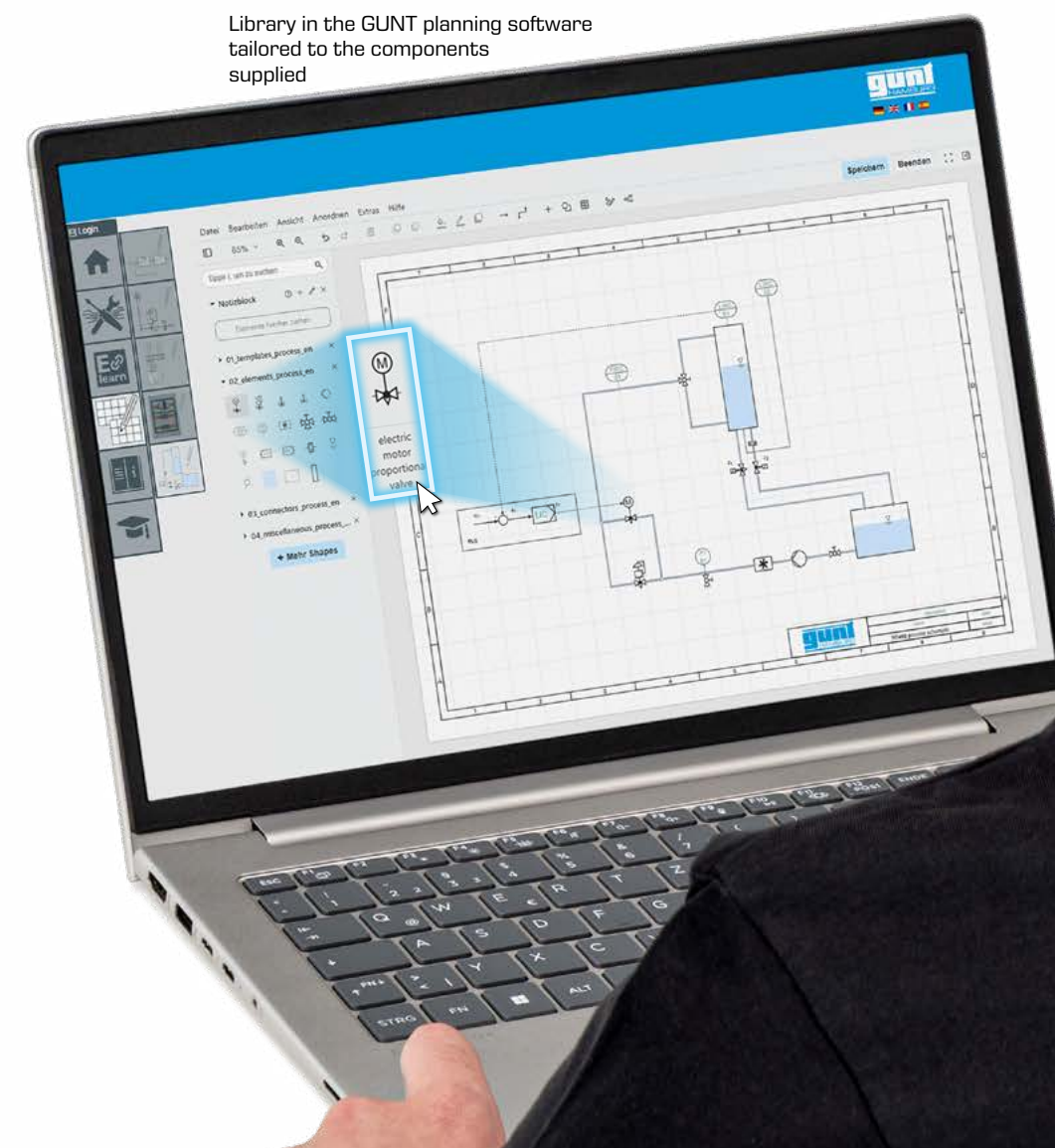
Illustration of the concept, material flow and chain of effects in customised level control

- illustration of:
 - ▶ material flow
 - ▶ components used
 - ▶ measurement and control points
- identification of measurement and control points
- visualisation of the controlled system and the flow of information

Once the level control has been tested, the selected type of control is checked and, where necessary, amended. The signal flow diagram can be adjusted retrospectively in line with findings.

Planning software in the GUNT Media Center

Library in the GUNT planning software tailored to the components supplied



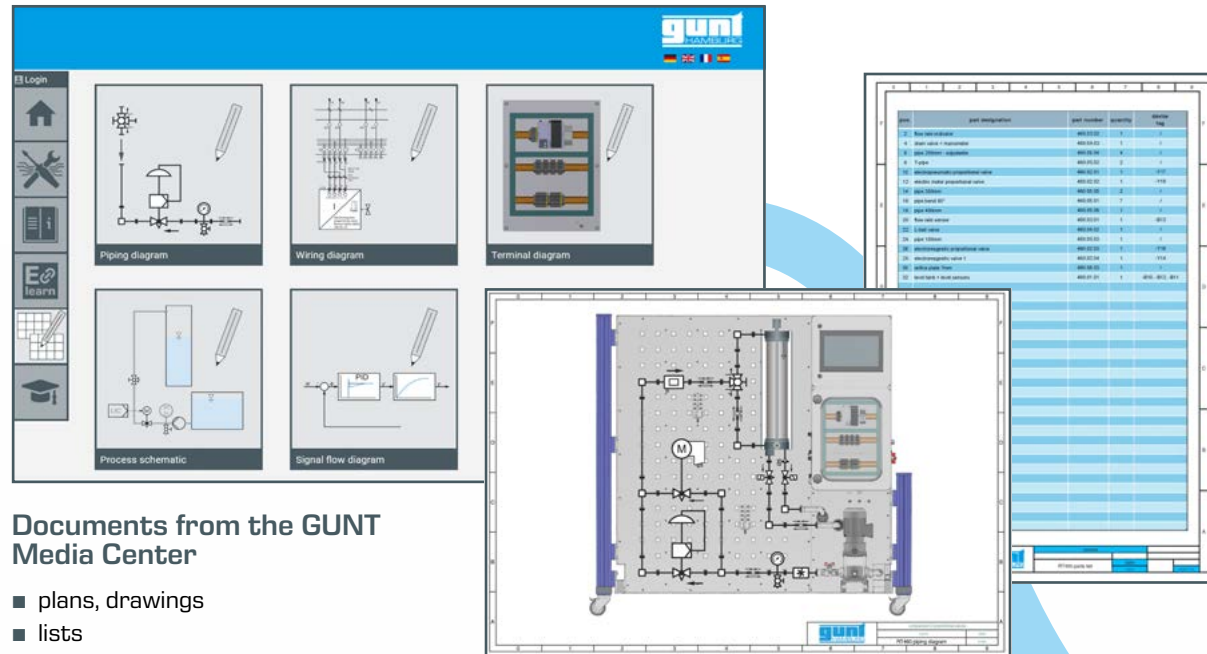


8 Project documentation

Digital documents with a standardised structure

Digital planning and data collection enable all planning documents and measurement analyses to be stored in one digital project folder. Alternatively, the project documentation can be provided in paper form using printouts.

The standardised and consistent structure of the documents makes it easier to compare and assess individual projects.



Documents from the GUNT Media Center

- plans, drawings
- lists

Data from the integrated PLC

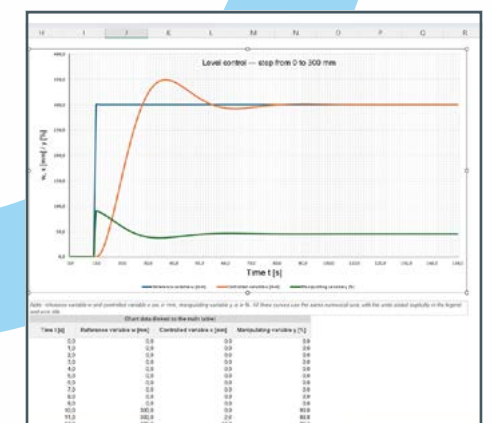
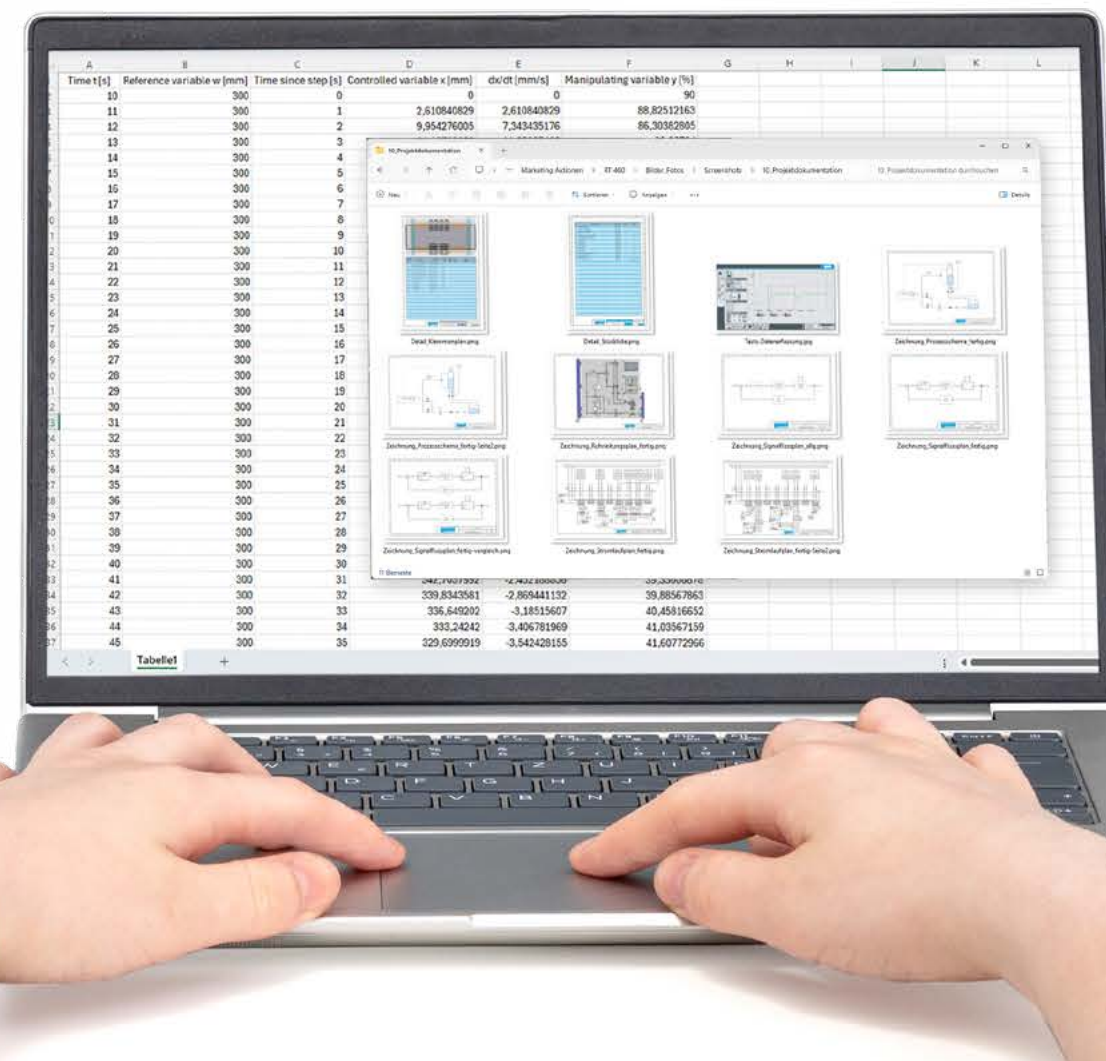
- screenshots
- CSV data for creating tables and graphs from stored measured values



+5, +12, +32,
+30, +26, -2,
-28,
1, 42



Finalised project documentation



Additional exercises for control engineering

Processing CSV data in a spreadsheet, e.g. using MS Excel



Highlights for teachers

Ready to teach

- carefully tailored to the course plans and curricula for mechatronics and control engineering
- clear and accessible presentation of theoretical content
- flexible adaptation of the level of study to different institutions (vocational schools, colleges, universities)
- modular and interdisciplinary approach to the fields of mechanics, electrical engineering, electronics and control engineering
- variable scope of work, ranging from individual standalone projects to comprehensive project work lasting several weeks
- flexible implementation as an individual project or as part of group work
- experiential learning through hands-on experiences
- developing digital skills through the use of the GUNT Media Center



Ready for soft skills

- developing planning and project management skills: organising workflows independently
- strengthening teamwork and communication skills: who takes on which role, who does what
- developing language skills: learning specialist terminology
- training in problem-solving skills: identifying problems, finding solutions
- developing analytical thinking: understanding complex theory – applying it in practice
- fostering spatial awareness and imagination: digital planning, practical implementation
- strong practical focus: trying out activities and functions on real industrial components and recognising them in a professional context

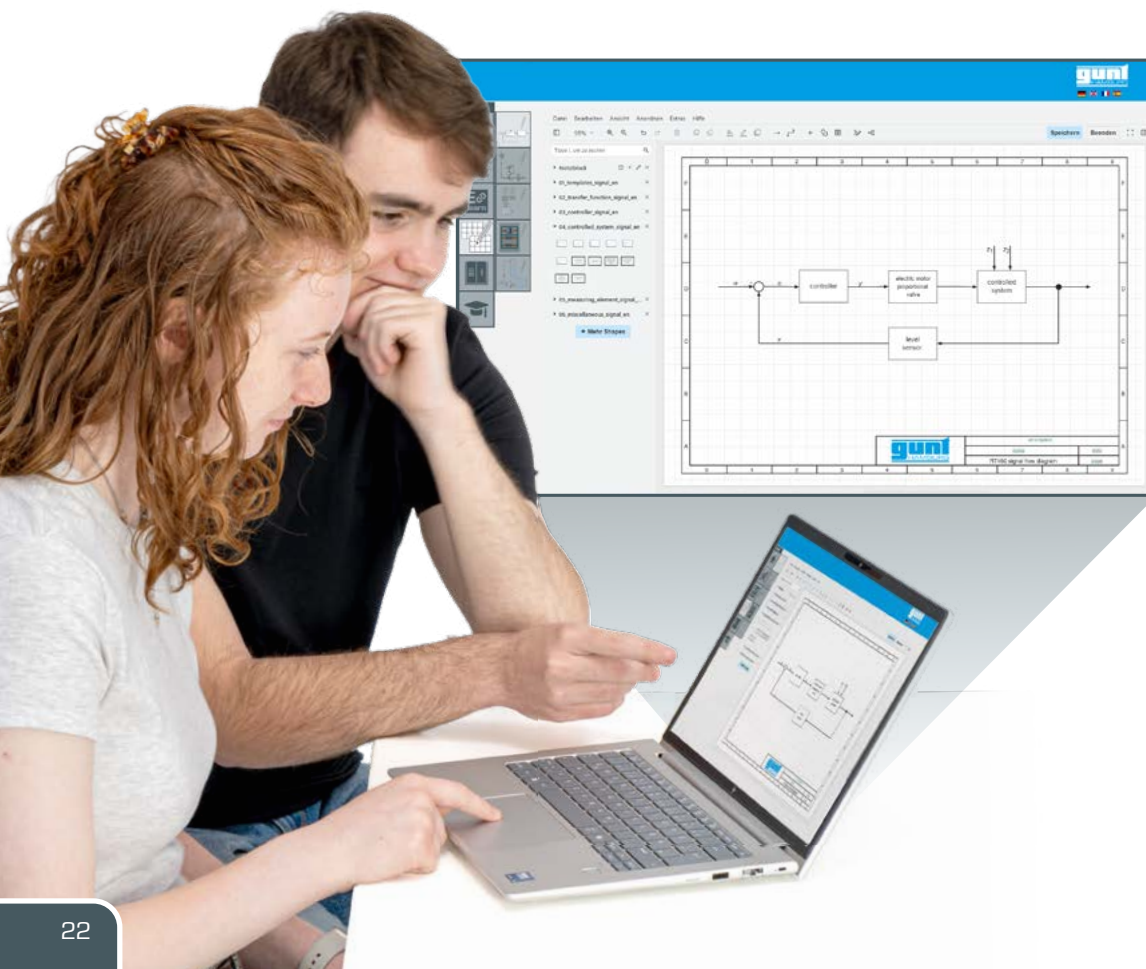
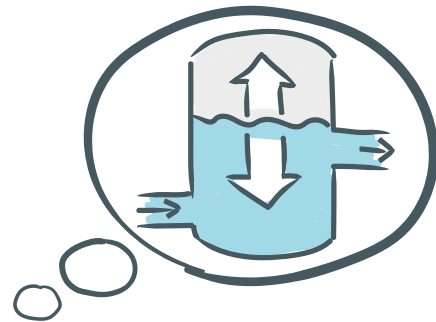




Highlights for students

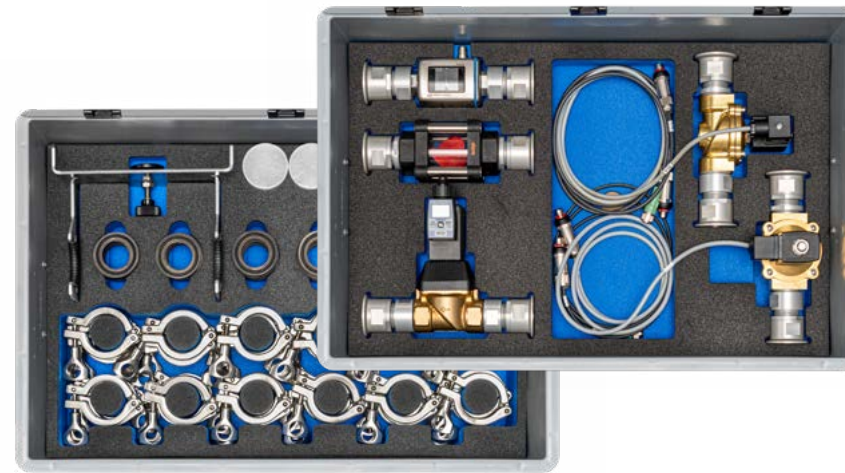
Ready to plan

- independent development of ideas and proposed solutions, including digital planning and implementation
- joint discussion of proposed solutions within the team
- easy start of planning with no installation required
- integrated GUNT planning software featuring a full range of software tools for planning
- permanent online availability of all content via the GUNT Media Center
- centralised access to all the necessary information on theory and practical application
- preparation can be carried out anywhere and at any time using standard web browsers
- flexible storage and on-demand printing of all finished plans



Ready for assembly

- all components can be found effortlessly within the storage system thanks to custom-fit foam inlays
- easy insertion of components thanks to the grid on the assembly panel
- tool-free connection of prefabricated pipe elements using Tri-Clamp pipe connections
- simple wiring to the pre-fitted switch cabinet
- working safely with a 24 V extra low voltage (ELV) power supply at the front switch cabinet
- direct use of the pre-programmed PLC



Storage and supply at the rear of the trainer

- space-saving storage of all components on the trainer
- including all necessary materials and tools
- safe operation thanks to separate, protected 230V electrical system and service access at the rear
- mobile and flexible use in classrooms thanks to the water tank and closed-circuit system

Approved quality – Made in Germany

- industrial components for practical training
- repeated assembly and disassembly in accordance with individual plans
- sustainable use and durability thanks to high-quality components
- long-term availability of components



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