EQUIPMENT FOR ENGINEERING EDUCATION

RT450 MODULAR PROCESS AUTOMATION TRAINING SYSTEM

The ideal way to teach and learn about automation in all its aspects

- Flexible
- Practical
- Modular
- Various Learning Levels

THE SYSTEM PROVIDING AN EASY INTRODUCTION TO A COMPLEX SUBJECT

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Teaching Concept and Learning Content

RT 450 offers you a flexible and versatile learning platform to provide school and college students with a practical introduction to a wide range of topics and issues in the field of process automation. The close interlinking of practical skills with theoretical/analytical aspects promotes thorough learning.

You can teach systematically categorised learning content or just as well combine complex material into integrated project work. For successful deployment of RT 450 the fundamentals of the subject should already have been taught in advance.

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Typical questions:
- What are the functions of the components in an automation system?
- What are the functional principles underlying the various transducers?
- Is an alimentation needed to operate the unit?
- What signals are put out?
- What input signals are accepted?
- How are the components symbolically represented? …and much more.
Learning Topics: Learning the Fundamentals of Control Engineering by Experimentation

Examples of learning content
(all taught by experimentation)

- Response of the controlled system
  - How does the controlled variable respond to a step change in the manipulating variable?
- Controlled system with compensation
- Controlled system without compensation
- Control action in manual or automatic mode
- Various levels of intervention in an industrial digital controller
  - Operating level
  - Parameter level
  - Configuration level
- Controller settings via keypad
- Effects of the elementary transfer elements of a controller on the manipulating variable
  - PI/D component and the various combinations of them (parameter settings)
- Critical controller settings
  - Oscillation
- Recording the step response to a change of
  - Manipulating variable
  - Disturbance variable
- Permanent control deviation of P controller as a function of controller gain
- Controller with switching or continuous function
- ...and much more

Example of learning content
(all taught by practical exercise)

- Basic concepts of setup
  - Operating level
  - Parameter level
  - Configuration level
- Setting an industrial digital controller
  - Operation manual/automatic, setpoint changes
  - Parameterisation e.g. select P, I and D components of the controller
  - Configuration e.g. set controller mode: switching, continuous ... and much more
- Setting a digital 3-channel line recorder, e.g.
  - Paper feed rates
  - Input definitions for the individual channels
  - Setting display ranges
- Familiarisation with a software solution for user-friendly setting of industrial digital controllers
  - Parameterisation
  - Configuration
  - Saving and managing projects
  - Data transfer between controller and PC

NOTE
To prepare the learning success with the RT 450 system, we recommend first conducting experiments with our RT010, RT030 and RT350 training systems.
Learning Topics: Specific Control Applications

The flexibility of the system enables a large number of specific control applications to be set up and tested by way of experiment.

For a level control system, for example, the control device may be an industrial digital controller with continuous output or a PLC for example. The actuator may be a pneumatically operated valve with an electro-pneumatic positioner or a motorised valve featuring a range of actuation options.

You can measure the level using a capacitive sensor or a pressure sensor to record the hydrostatic pressure on the tank bottom.

...and of course you can analyse your own ideas and issues by way of experiment.

Examples of learning content (all taught by experimentation)

- Pressure control with two pressure tanks connected in series
- Level control with an open or closed tank
  also: program control with an industrial digital controller or with a PLC
  - With a capacitive level sensor
  - or with a pressure sensor
  - With a motorised valve or electro-pneumatic control valve
- Flow control
  - With many variants
- Temperature control
  - With an electric heater, switching mode
  - or with an electro-pneumatically operated control valve and electric heater in continuous operation
- Cascade control
  - Level / flow
- Flow characteristic for an electro-pneumatically operated control valve dependent on valve position
- Flow characteristic for an electric motorised valve with position detection

RT 450: Level control with a continuous controller or with a PLC
Windhoek Polytechnic, Namibia
The Polytechnic of Namibia provides courses in core areas of automation based on experimentation using the GUNT RT 450 system. Its laboratory houses six complete experimental setups. Of them, four are prepared for experiments relating to pressure, level, flow and temperature. Two systems are used by students to develop and realise their own projects. All systems have a Profibus computer communications interface.

Learning Topics: Planning and Displaying

For all skilled staff, technicians and engineers, the planning and displaying of process and piping systems, electrical circuits, signal and communication structures etc. is a key part of their professional qualification.

The exercises which students can conduct with the RT 450 training system offer wide-ranging options to develop and advance those skills.

Examples of learning content
(all taught by practical exercise)

- Read, edit, understand and create a PI flow diagram for a control loop. Understand the standardised symbols.
- Create a draft design for assembling a specific control application on the RT 450 frame.
- Create a pipework diagram and the associated component list.
- Create an electrical measurement and control location diagram for electrical integration of the control components.
- Create circuit, wiring diagrams and plan of terminal connections.
- Display and explain the communications concept: e.g. Profibus.

Learning Topics: Practical Exercises

The basic idea underlying the RT 450 training system is not to create a permanent setup which will remain the same for all time. On the contrary: the system enables a wide range of adaptations to be made very easily. The setup can be customised to users’ specific ideas and projects. Consequently, a range of skills are repeatedly required which can be intensively practised through to their professional execution. Few tools are needed.

Examples of learning content
(all taught by practical exercise)

- Mounting the module panels on the mounting profiles of the RT 450 frame.
- Making the pipework connection for the water circuit.
- Cutting to length and preparing the pipes.
- Fixing together using clamp fittings.
- Cutting to length, laying and connecting compressed air hoses.
- Cutting to length and stripping electrical cables, and fitting ferrules to them.
- Connecting the electrical wiring.
- Testing the electrical connections.
RT 450 MODULAR PROCESS AUTOMATION TRAINING SYSTEM

Learning Topics: Familiarisation with Communication and Visualisation Systems

State-of-the-art automation is characterised in that data can be interchanged between system components. The data are carried over bus systems.

Automation components (controllers, sensors) are highly variable in their setting and configuration. These setup procedures are usually carried out by dedicated software.

Examples of learning content

- Basic concept of a networked automation system
- Communication over bus systems
- Integration of a software application
- Familiarisation with hardware: Profinet cards, Profinet plug-in modules on controllers, PLC, PLC Profinet module and measurement sensors
- Interfaces, installation procedures, errors, faults
- Dedicated configuration software for controllers, recorders, PC cards etc.

RT 450.40 is pre-set for two controllers and the PLC over Profinet. Changes can be made at any time.

Technical Details

Electrical connections – signal connections

The instruments assembled on individual panels are pre-wired on the rear.

As a teaching aid, the connections are categorised and separated accordingly on the various connector assemblies: analog inputs, analog outputs, binary outputs, 24V supply, etc.

These prepared connectors are routed to the corresponding terminal arrays on the control cabinets.

The electrical connections made by the students are limited to those routed to the process (sensors, valves, etc.) and to those necessary to teach correct construction of the electrical current loops.

Process connections

The process connections – in this case only water – are normally made by plastic pipes, ensuring that a correct, industrial-standard system is established. This procedure takes time, and of course consumes material. If you need to reconfigure more often and quickly, the water connections can very well be made by hoses. This has no influence on the functionality or the data acquired.

The compressed air is supplied via hoses.

In preparation for covering the topic of communication networks in automation, we recommend our training systems:

- RT 360 Networking of Industrial Controllers and
- RT 370 Setup of Field Bus Systems.

This enables students to develop the fundamental knowledge which will then make it easier to work with the RT 450 training system.

Data interchange between the application and the communications interface is run via a dual-port memory.

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<th>PC application</th>
<th>Dual-port memory</th>
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<td>Outputs Process map</td>
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<tr>
<td>Input data</td>
<td>Inputs Process map</td>
</tr>
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<td>Outbox</td>
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The topology of the field bus used, with master and slaves.
The Instructional Material

We have compiled a comprehensive range of instructional material for the RT 450 training system which will greatly assist you in getting to know the system and in preparing your lessons and laboratory experiments and exercises.

The instructional material comprises

- Manual: RT 450 system description, approx. 130 pages
- Manual: fundamentals of control engineering, approx. 20 pages
- All electrical diagrams for the overall system and for all components
- Completed reference experiments and sample exercises, approx. 25 worksheets and relevant answers
- Materials as paper printouts in a folder and additionally as PDF files on a CD

Updates

When any updates or additions to the RT 450 system are made – in particular with regard to the instructional material and the software – you, as a GUNT customer, will be notified accordingly.

Training

If you require installation or training services for the training system, we will be glad to help.