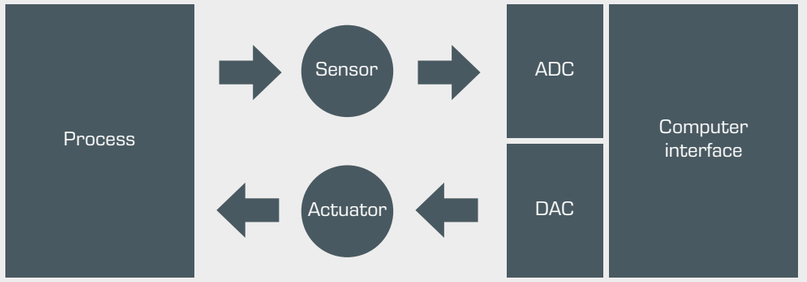
RT 010 – 060
Basic experiments in control engineering

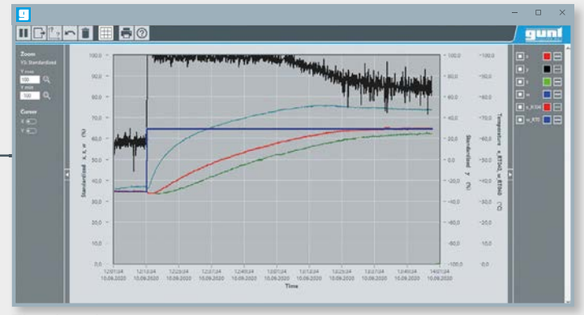
Simple, quickly understandable controlled system models with extensive software functions

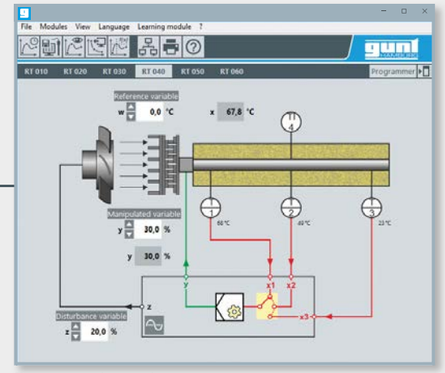
- Temperature
- Level
- Pressure
- Flow
- Position
- Speed

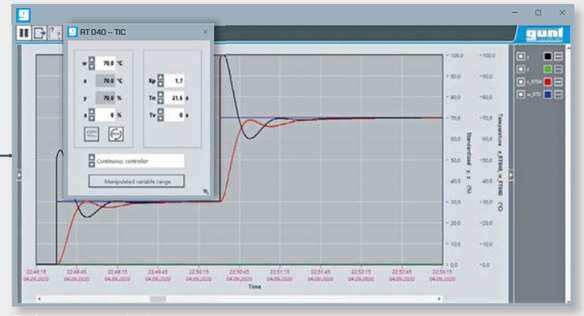
The equipment concept with hardware / software integration (HSI)

Cooperation of hardware and software




Time function


Process schematic


Software simulation


RT 010 Training system level control, HSI

Hardware

- compact experimental units, low space requirements
- ideally suited to multi-user applications
- typical controlled systems from the field of process control engineering such as flow, level, pressure, temperature, speed and position
- high level of observability of processes based on transparent elements (covers, tanks, pipes)
- easy switching from unit to unit by USB connection

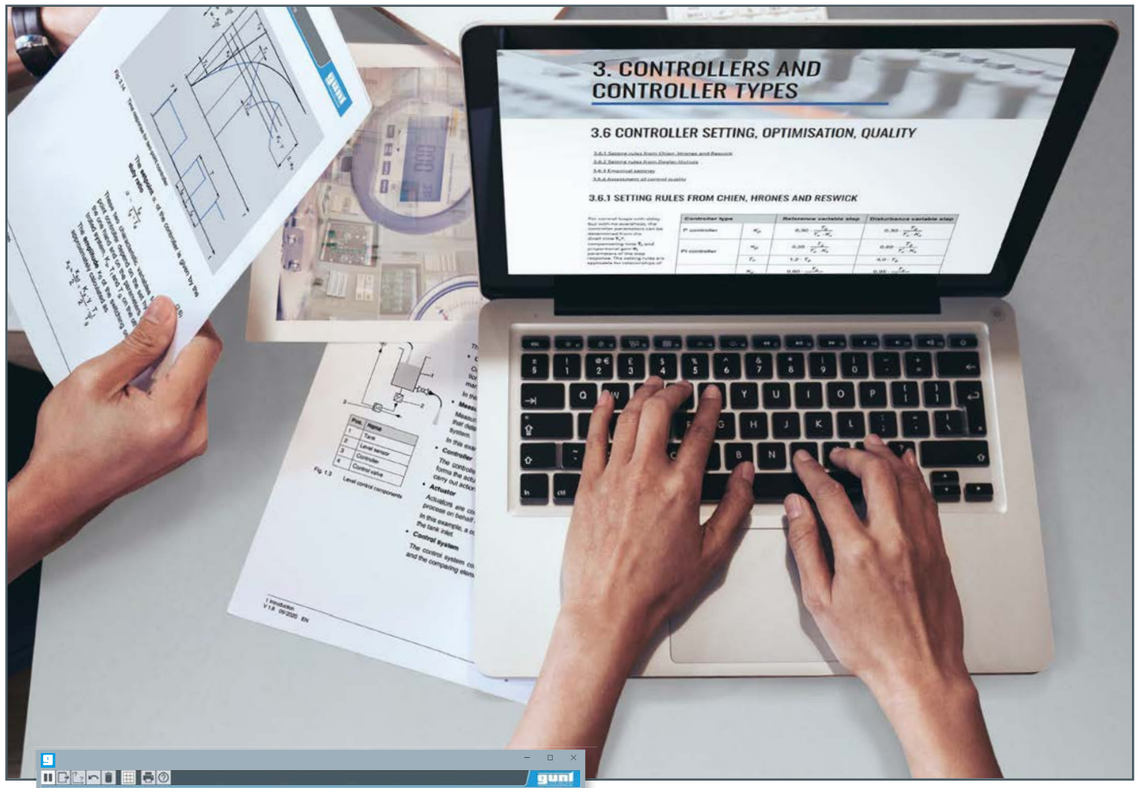
Software

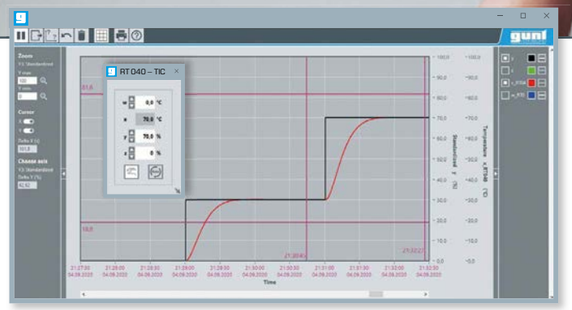
Modern GUNT software for control and data acquisition under Windows

- one software for the entire series
- software controller in real time, with selection of controller type
  - continuous: P, PI, PD, PID
  - switching: 2-point, 3-point
- controller possible with real controlled system or simulation
- display and storage of all process variables
- recording and evaluation of step responses for system identification
- editing of step responses by filtering and decimation
- programmer for own reference variable characteristics with adjustment of a tolerance band
- network capability
- language selectable

Remote Learning
Experimental setup

The series is equipped with a comprehensive didactic accompanying material on the basics of control engineering and a **E-Learn course**. In addition, GUNT software offers a simulation function. Thus, different controlled systems with different controllers can be simulated even without connection to the experimental unit. An optimal preparation of experiments and the teaching of basics can be done comfortably and independent of location, even from home.



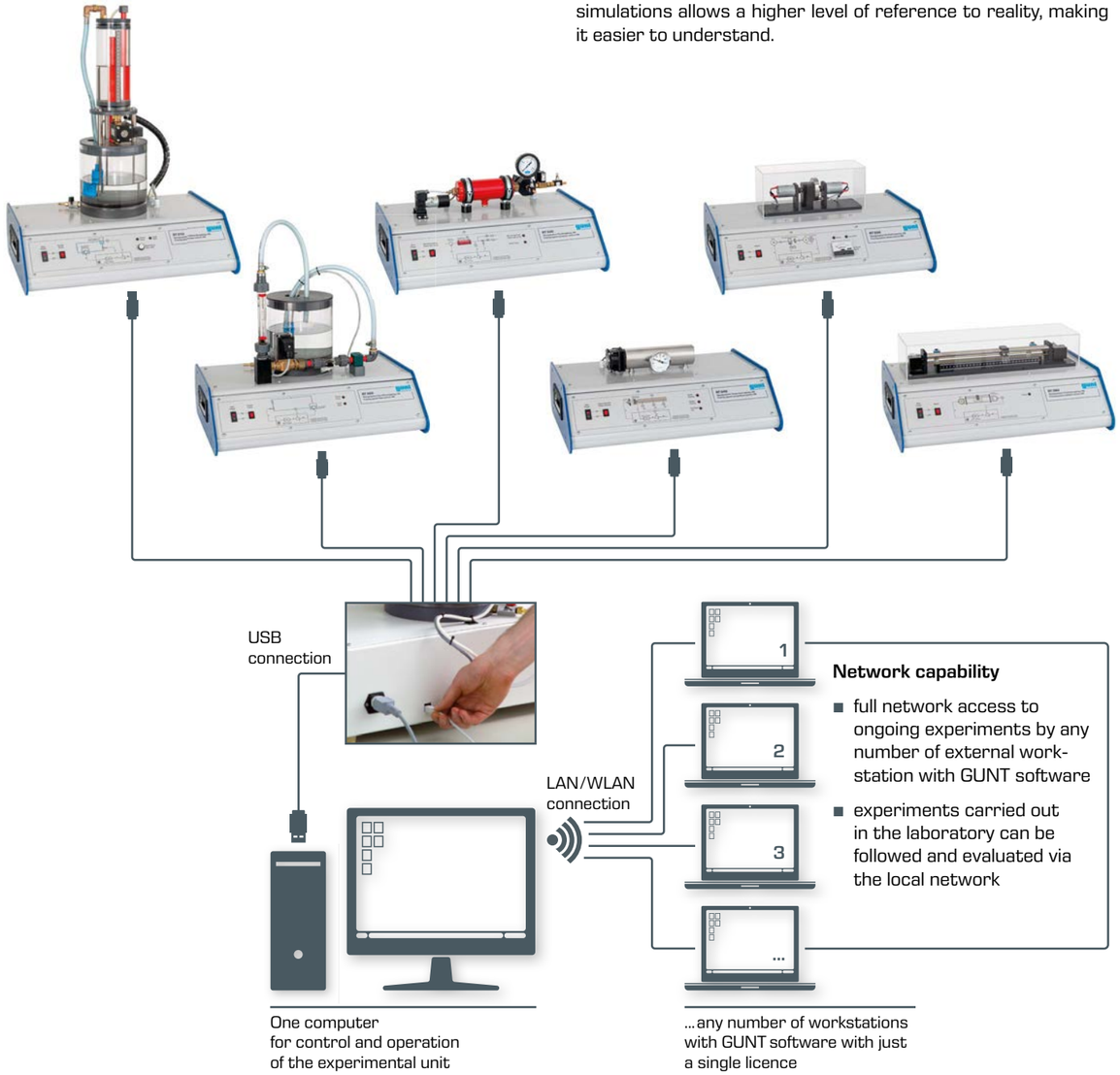


The **simulation function** in the GUNT software can also be used to investigate control engineering issues for which no real system is available.

Lab
Experiment execution

Experiments on **real controlled systems** are carried out in the laboratory. The connection between the experimental unit and the PC is realized via USB interface (external PC required). The network capability of the software supports the setup of teacher-student systems in the local network. Recorded measurement values can be distributed to any number of workstations equipped with GUNT software.

The combination of a clear, real controlled system and software simulations allows a higher level of reference to reality, making it easier to understand.

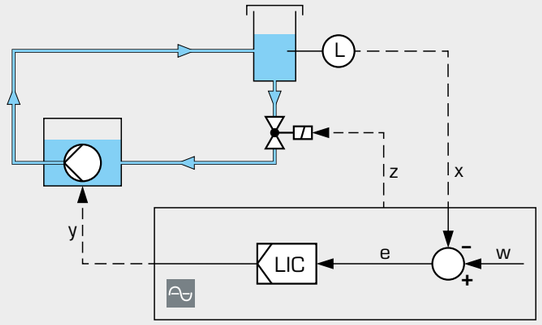


Experiment evaluation and processing of step responses is possible in both simulated and real controlled systems

Hardware

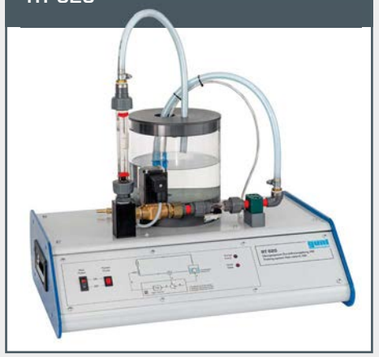
Demonstration of control processes based on real controlled system models

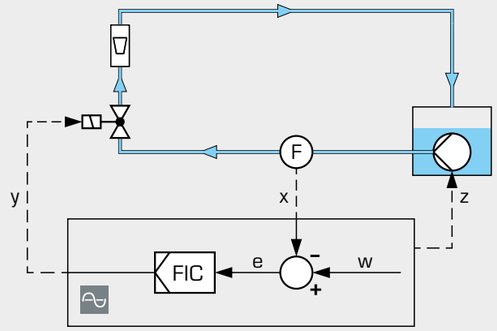
Level control
RT 010



- level determination via pressure sensor
- level control by speed of pump
- electromagnetic valve to generate disturbance variables

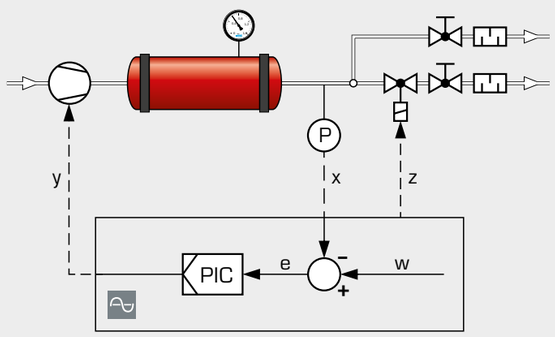
Flow control
RT 020





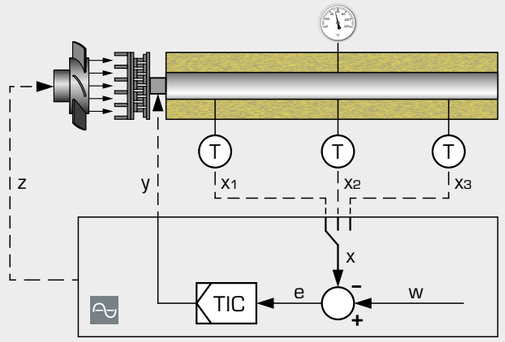
- turbine wheel flow sensor
- electromagnetic proportional valve as actuator
- variable pump speed to generate disturbance variables

Pressure control
RT 030



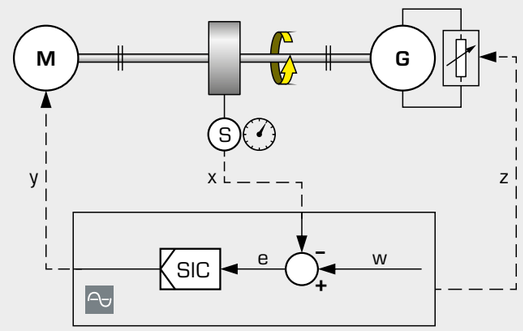
- electronic pressure sensor
- speed controlled diaphragm pump as actuator
- solenoid valve to generate disturbance variables

Temperature control
RT 040



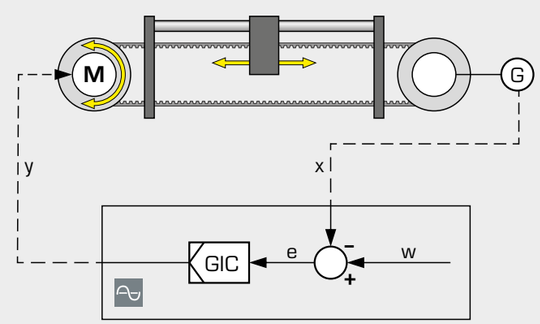
- temperature sensors at three positions
- heating and cooling of a metal bar by Peltier element
- switchable fan to generate disturbance variables

Speed control
RT 050



- inductive speed sensor
- speed control by DC motor
- adjustable load to generate disturbance variables

Position control
RT 060

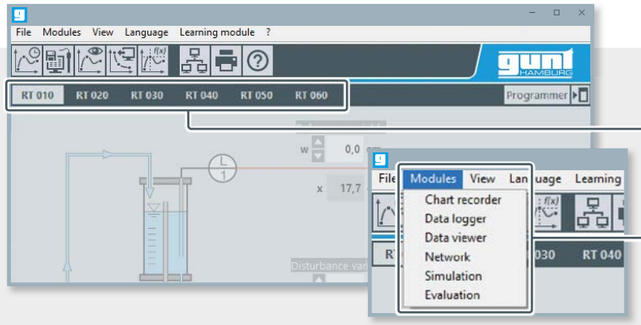


- rotary encoder as displacement sensor
- position control of a carriage by gear motor
- two microswitches to shut down at end positions

Software
Easy operation and extensive functions

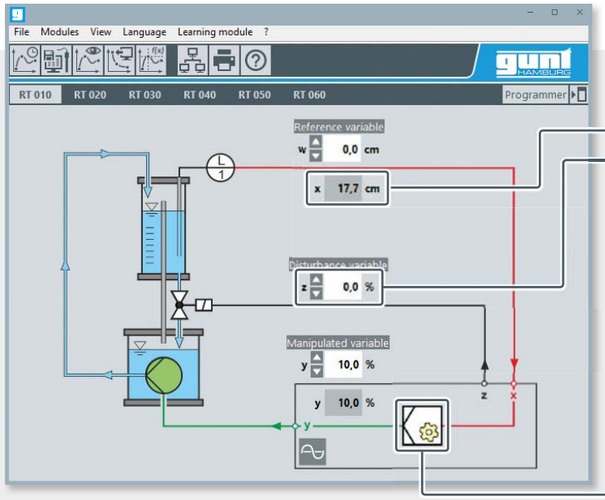
Comprehensive experiment programme for each experimental unit

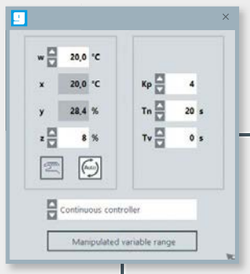
- one software package for the entire series
- control loop analysis
- influence of controller parameters on control action and disturbance response
- stability of the open and closed loop
- controller optimisation



Navigation

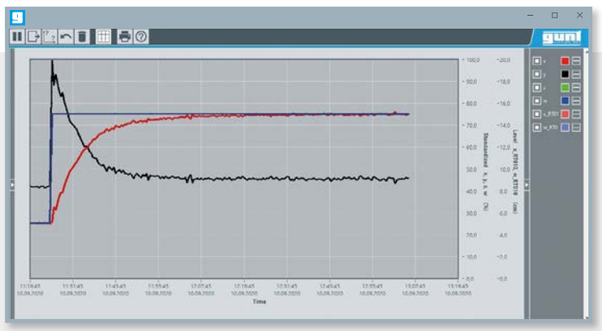
- selection of the desired experimental unit
- selection of additional user interfaces for the active experimental unit





Process schematic

- display of real-time data
- activation of disturbances
- separate control panel for selection of controller type and input of controller parameters



Level control with PID controller, reference variable step

Time functions

- representation of control parameters as a function of time
  - reference variable
  - controlled variable
  - manipulating variable
- selectable colours of backgrounds and lines

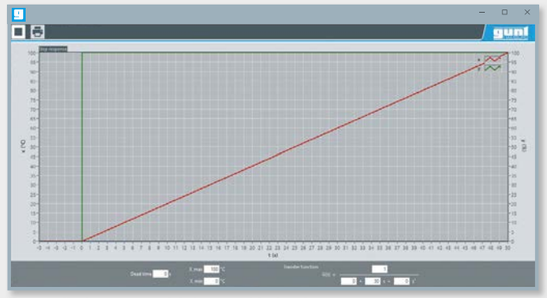
Program sequence with preset time segments and reference variables

Programmer

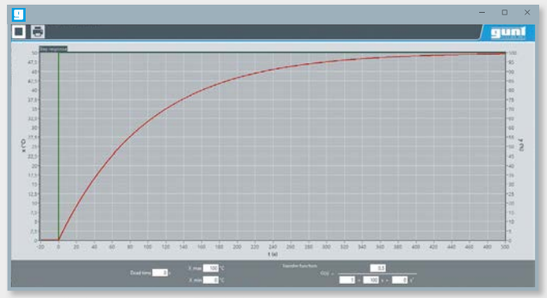
Programmer

With the integrated programmer, reference variables and time segments can be specified in order to perform any desired reference variable characteristics, e.g. with ramps.

Simulation of controlled systems

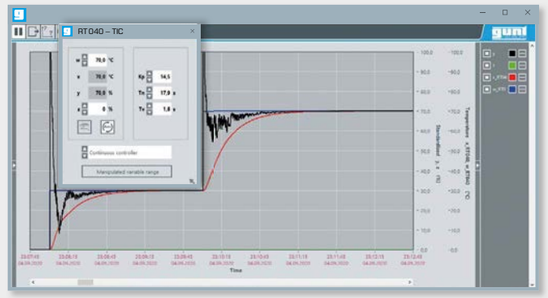


Controlled system with integral behaviour



Controlled system with PT_1 behaviour

Controlled system with PT_2 behaviour



Time curve of a simulated controlled system

Real controlled systems usually have complex properties. The simulation function allows the input and investigation of elementary transfer functions for controlled systems up to 2nd order.

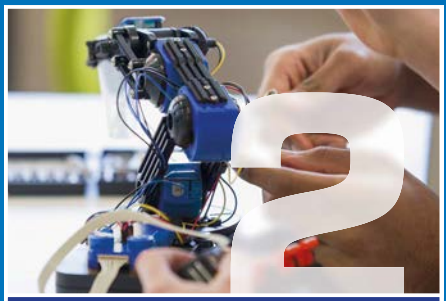
It is also possible to deal with control engineering issues for which no real system is available.

- definition of the controlled system by entering a transfer function
- automatic display of the step response
- all software controller types can be applied to the simulated system
- the behavior of the simulated controlled system is investigated in the same way as that of a real controlled system

The complete GUNT programme

Engineering mechanics and engineering design

- statics
- strength of materials
- dynamics
- machine dynamics
- engineering design
- materials testing



Mechatronics

- engineering drawing
- cutaway models
- dimensional metrology
- fasteners and machine parts
- manufacturing engineering
- assembly projects
- maintenance
- machinery diagnosis
- automation and process control engineering

Thermal engineering

- fundamentals of thermodynamics
- heat exchangers
- thermal fluid energy machines
- internal combustion engines
- refrigeration
- HVAC

Fluid mechanics

- steady flow
- transient flow
- flow around bodies
- components in piping systems and plant design
- turbomachines
- positive displacement machines
- hydraulic engineering

Process engineering

- mechanical process engineering
- thermal process engineering
- chemical process engineering
- biological process engineering
- water treatment

2E Energy & Environment

Energy

- solar energy
- hydropower and ocean energy
- wind power
- biomass
- geothermal energy
- energy systems
- energy efficiency in buildings

Environment

- water
- air
- soil
- waste

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