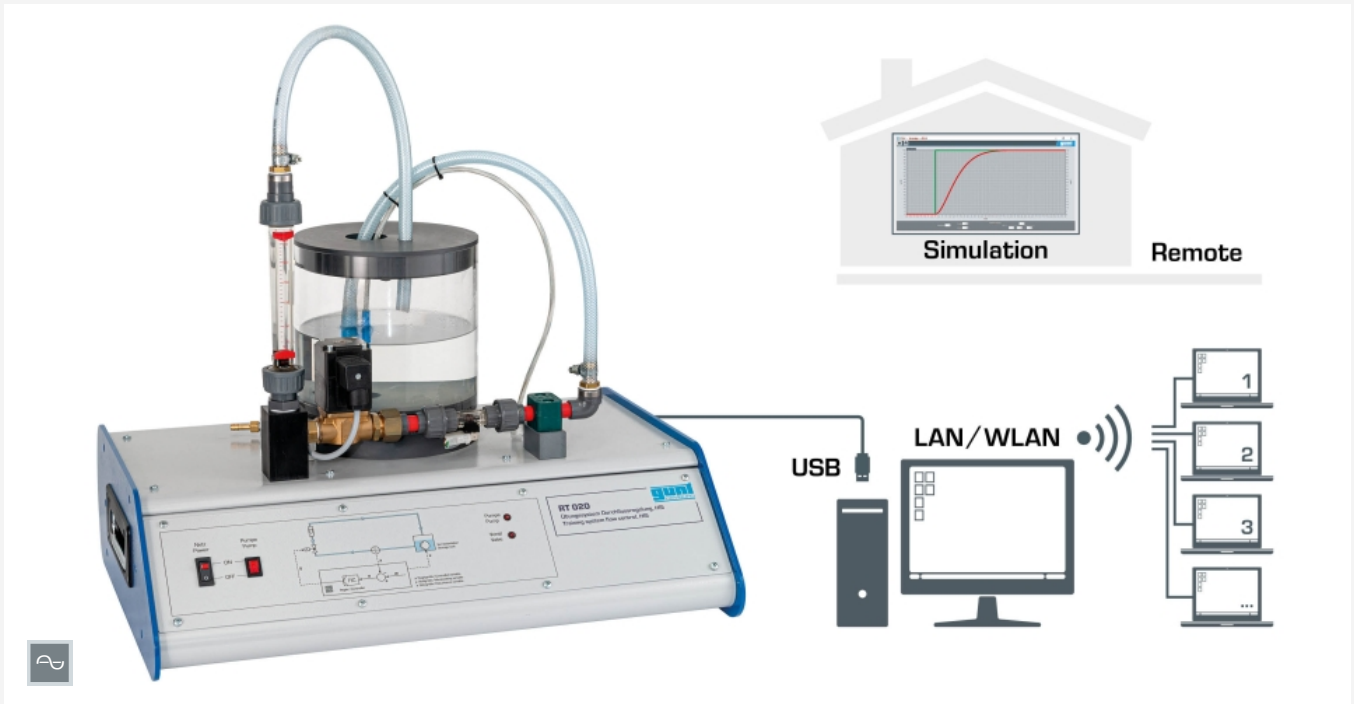# RT 020
Training system flow control, HSI

Description

- **basic control engineering relationships using the example of a flow control**
- **configurable and parametrisable software controller with extensive functions**
- **experiment preparation and software simulation for remote learning**
- **experiments can be followed and analysed on the local network**

The RT 020 device offers basic experiments on a flow controlled system. A pipe section, through which media flows, serves as the controlled system. The flow rate in the pipe represents the controlled variable, which is measured by a measuring element, in this case a turbine wheel flow rate sensor. The output signal from the sensor is fed to the software controller. The output signal from the controller influences the actuator, in this case the electromagnetic proportional valve. The valve position changes the flow rate in the pipe. The pump speed – and therefore the delivery rate – can be controlled via the software in order to study the effect of disturbance variables. The control response is displayed in the form of a time dependency. There is a rotameter located inside the pipe, allowing the flow rate to be observed at any time.

The powerful GUNT software for the entire device series – in the form of Hardware/Software Integration (HSI) – is a major component for the entire series. The experimental unit and the PC are connected via a USB interface (external PC required).

The impact that modifications to the system behaviour have can be studied quickly and easily with the help of the software. An integrated programmer allows you to set reference values and time intervals to carry out reference value progressions. Further aspects of control engineering are studied using software simulations for controlled systems up to the 2nd order.

The combination of the clear, real-world controlled system and simulations of other controlled systems in the RT 010 – RT 060 device series aids understanding. Preparations for the experiments, as well as software simulations can be carried out in Remote Learning environments. The experiments can be observed at any number of workstations on the local network.

Learning objectives/experiments

- fundamentals of control engineering using the example of a flow controlled system
- open control loop response
- controlled system without feedback
- effects of different controller parameters and methods on the closed loop system response
- controller optimisation by changing the controller parameters: K_p, T_n, T_v
- recording of step responses: manipulating variable step, reference value step and disturbance variable step
- manipulating variable limitation and effect on the control system
- effect of disturbance variables
- software simulation of different controlled systems (P, I, PT_1, PT_2)
- comparison of different controlled system parameters

- specific GUNT software for the entire device series
- controller: manual, uncontrolled manual operation, continuous controller, two or three-point controller
- programmer for your own reference value progressions
- design of disturbance variable controllers
- recording of time dependencies
- remote learning: software simulation at any number of workstations

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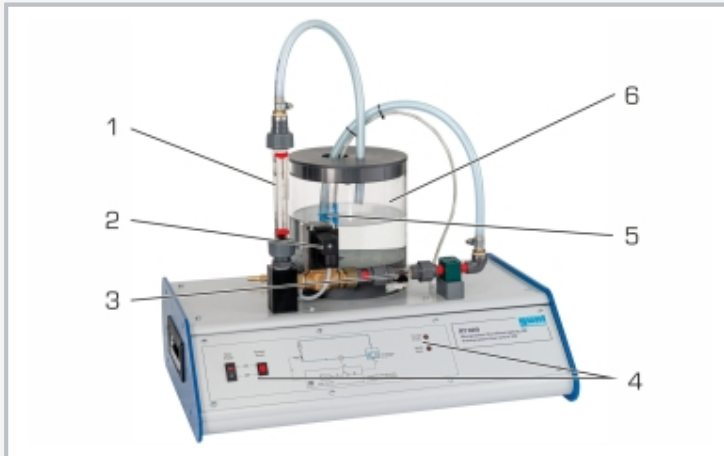
1 rotameter, 2 proportional valve, 3 turbine wheel for rate sensor, 4 displays and controls, 5 speed-controlled pump, 6 storage tank
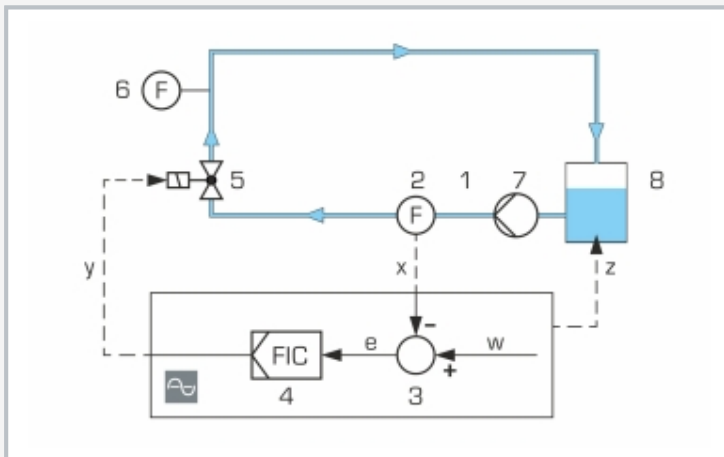
1 controlled system: flow rate in the pipe, 2 measuring element: turbine wheel for rate sensor, 3 comparator: part of the GUNT software, 4 software controller, 5 actuator: electromagnetic proportional valve, 6 rotameter, 7 disturbance variable generated by changing the pump speed, 8 storage tank

x controlled variable: flow rate, y manipulating variable: opening degree of the proportional valve, z disturbance variable: pump delivery rate, w reference value: input values, e control deviation, F flow rate

Software screenshot: flow control with PI controller, reference value step

Specification

[1]   flow control: typical controlled system
[2]   controlled system: pipe with flow
[3]   controlled variable: flow rate
[4]   measuring element: turbine wheel flow rate sensor
[5]   software controller can be configured and parametrised as P, PI, PID and switching controller
[6]   actuator: electromagnetic proportional valve
[7]   disturbance variable generated by changing the pump speed
[8]   rotameter for observing the flow rate
[9]   storage tank for closed water circuit
[10] software simulation: various controlled systems
[11] GUNT software: option to connect any number of external workstations on the local network to follow and analyse the experiment
[12] experiment preparation and software simulation at any number of workstations for remote learning
[13] GUNT software with control functions and data acquisition via USB under Windows 10
[14] multimedia instructional materials online in GUNT Media Center

Technical data

Storage tank: approx. 3000mL

Pump, speed-controlled
- power consumption: 18W
- max. flow rate: 8L/min
- max. head: 5m

Proportional valve: Kvs: $0,7m^3/h$

Software controller can be configured and parametrised as P, PI, PID and switching controller

Measuring ranges
- flow rate: 20...250L/h (rotameter)
- flow rate: 0,5...3L/min (turbine wheel flow rate sensor)

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase
120V, 60Hz, 1 phase
UL/CSA optional
LxWxH: 600x450x600mm
Weight: approx. 21kg

Required for operation

PC with Windows

Scope of delivery

1   experimental unit
1   GUNT software + USB cable
1   set of accessories
1   set of instructional material

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Optional accessories

020.30009   WP 300.09   Laboratory trolley