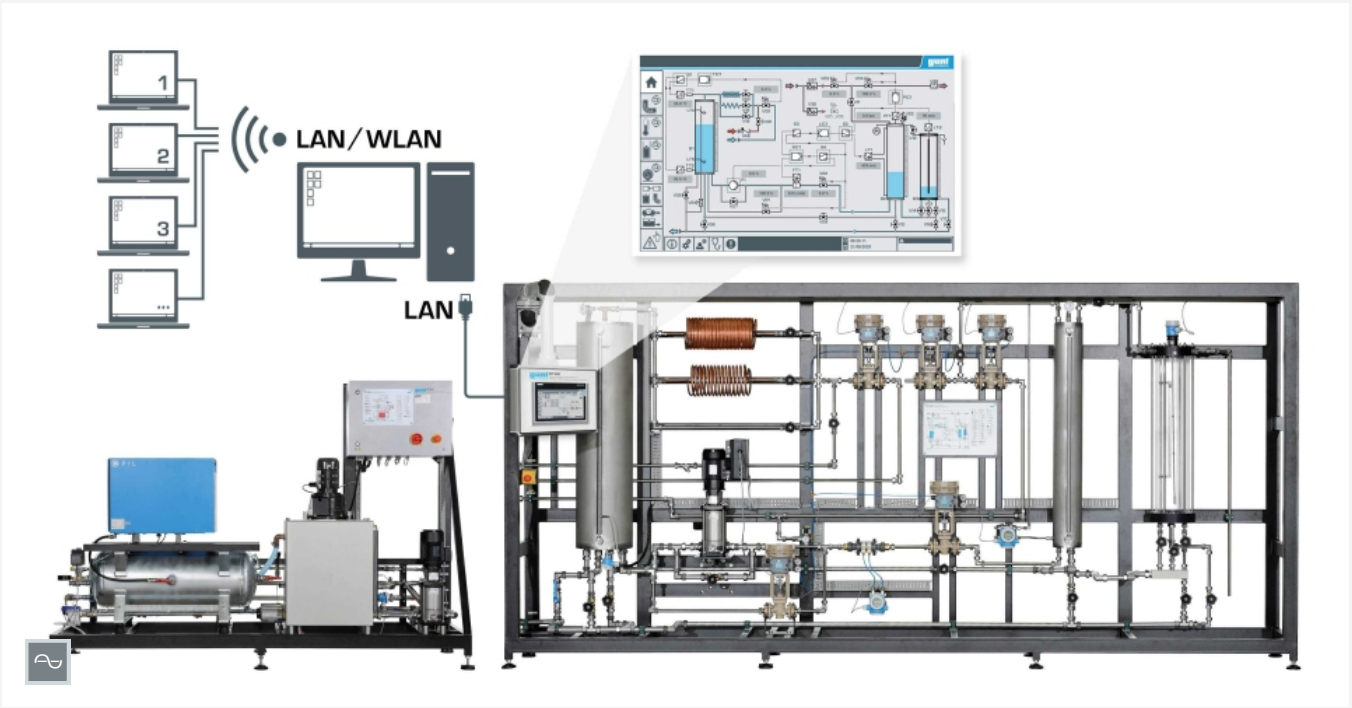
RT 590

Process control engineering experimental plant



Complete experimental setup with supply unit (left) and trainer (right). Control and operation via touch screen or a PC with GUNT process control software. Observation and evaluation of the experiments by any number of workstations via LAN/WLAN connection.

Description

- **control of level, flow rate, pressure, temperature and cascade control of level and flow rate**
- **PLC: four integrated controllers and simulation of typical faults**
- **plant control and configuration via touch screen or software**
- **network capability: network access to ongoing experiments by any number of external workstations**

The supply of processes with media such as water and compressed air in industry is usually provided from a separate, centralised supply unit. Control and monitoring of the processes are also centralised.
RT 590 represents such a practical scenario. The experimental plant includes a separate supply unit and a trainer with touch screen for controlling and monitoring the processes.

The trainer includes a water circuit with a pump, collecting tank and graduated tank. In this circuit, the flow rate and level are controlled. Electropneumatic control valves are used as actuators. The speed-controlled pump with frequency converter can also be used for flow control. The level control can also be executed under counter pressure or as cascade control. A transparent tank can be connected to facilitate learning with a second order level controlled system.

For pressure control compressed air is used as working medium. The graduated tank serves as the controlled system. The level of liquid in the tank can be varied to give time-varying response of the controlled system.

The temperature is controlled either in the collecting tank or in the inlet of the tank. For this purpose, cold water is added to the warm water in the inlet via a control valve. Three delay sections are used to set different dead times.

In addition, the experimental plant enables practical fault analysis based on simulated typical faults such as cable break, frozen measured values or a reduced setting range.

The plant is operated and controlled by the integrated PLC with touch screen or by a PC with GUNT process control software. The time functions of the process variables are displayed and the controllers are parameterised. The GUNT process control software enables the data acquisition. Any number of workstations with the GUNT process control software can be used for observation and evaluation of the experiments via LAN/ WLAN connection using only one licence.

Learning objectives/experiments

- familiarisation with industrial process engineering plant
- flow rate control
- level control with first order controlled system with and without counter pressure
- level control with second order controlled system
- cascade control of level and flow rate
- pressure control with time-varying response of the controlled system
- temperature control with time-varying response of the controlled system
- control response with different controlled variables and actuators
- control valves as actuators with different operating modes
- controller with different operating modes
- fault finding

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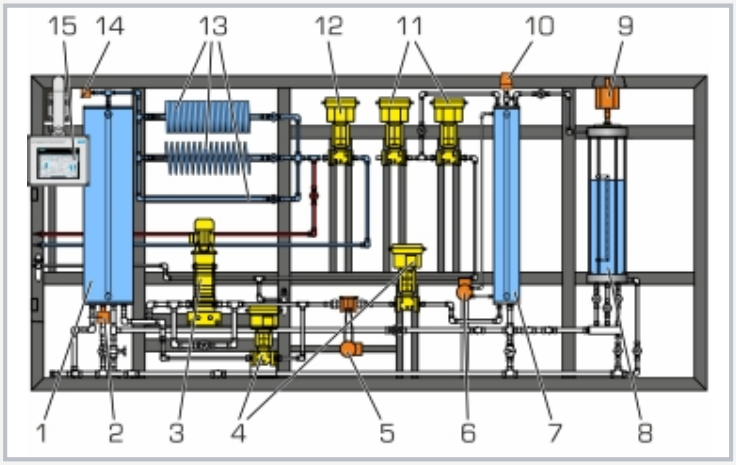
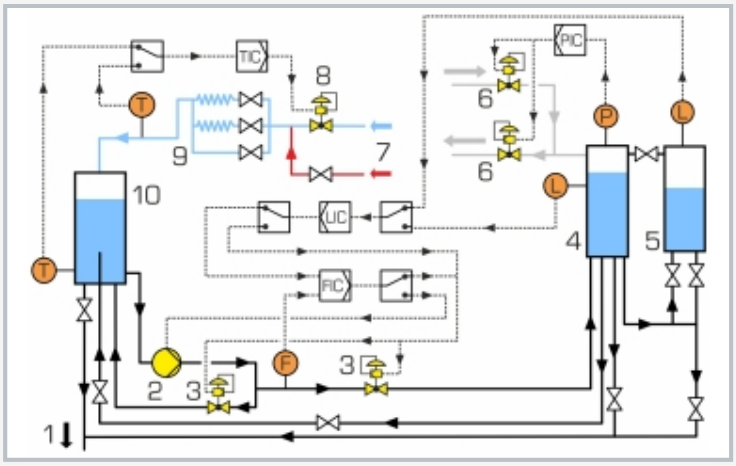
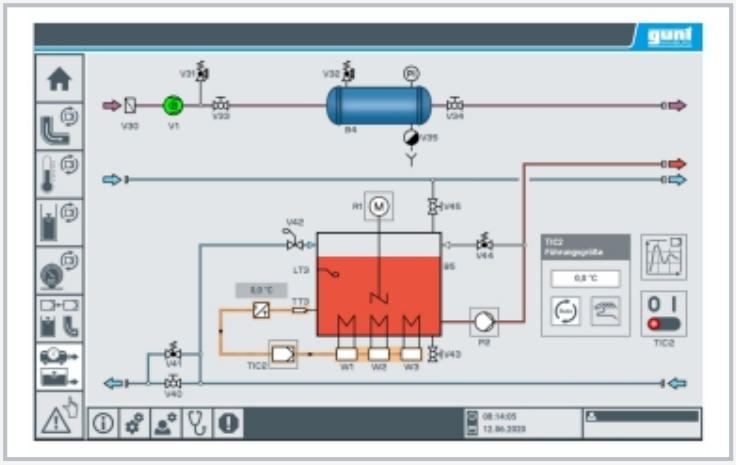


1 collecting tank, 2 temperature sensor in collecting tank, 3 pump, 4 control valves for flow control, level control, cascade control of level and flow rate, 5 flow rate sensor, 6 level sensor, 7 graduated tank for first order level control and pressure control, 8 transparent tank for second order level control, 9 level sensor, 10 pressure sensor, 11 compressed air control valve, 12 cold water control valve, 13 delay section, 14 temperature sensor in inlet, 15 touch screen



Process schematic trainer
1 water drain, 2 pump, 3 control valves for flow control, level control, cascade control of level and flow rate, 4 graduated tank for first order level control and pressure control, 5 transparent tank for second order level control, 6 compressed air control valve, 7 warm and cold water inlet, 8 cold water control valve, 9 delay sections, 10 collecting tank;
F flow rate, L level, P pressure, T temperature;
FIC flow rate controller, LIC level controller, PIC pressure controller, TIC temperature controller



Screenshot PLC: process schematic supply unit

Specification

[1] control of level, flow rate, temperature and cascade control with water as working medium
[2] pressure control with compressed air as working medium
[3] trainer with pump and 3 tanks
[4] supply unit with compressor, pressure vessel, pump and heater supplies compressed air, warm and cold water
[5] first order level control with or without counter pressure, or second order level control
[6] temperature control with three delay sections
[7] 5 electropneumatic control valves and a speed-controlled pump with frequency converter as actuators
[8] practical fault analysis using simulated typical faults, e.g. cable break
[9] plant control via PLC with touch screen or GUNT process control software
[10] network capability: LAN/WLAN connection of any number of external workstations with GUNT software for observation and evaluation of the experiments
[11] GUNT process control software with data acquisition via LAN under Windows 11

Technical data

PLC
- type: Siemens SIMATIC S7-1200
- modules: compact CPU (14 DI, 10 DO, 2 AI), 3 analogue I/O modules (8 AI, 4 AO, 2 AO)

Trainer
- tanks
  - collecting tank: 95L
  - graduated tank: 25L
  - transparent tank: 25L
- pump: max. flow rate approx. 40L/min, max. head approx. 57m

Supply unit
- warm water tank: 130L
- heater power output: 3x 6kW
- compressor
  - max. pressure: 10bar, pressure vessel: 90L

Controller parameterisable: P, PI or PID controller

Measuring ranges
- flow rate: 0...80L/min
- level: 2x 0...1,2m; 1x 0...0,5m
- temperature: 3x 0...200°C
- pressure: 0...6bar

400V, 50Hz, 3 phases; 400V, 60Hz, 3 phases
230V, 60Hz, 3 phases; UL/CSA optional
LxWxH: 4400x740x2100mm (trainer)
LxWxH: 2400x730x1620mm (supply unit)
Total weight: approx. 1500kg

Required for operation

cold water connection: 30L/min
PC with Windows recommended

Scope of delivery

experimental plant, 1 set of accessories, 1 GUNT process control software, 1 set of instructional material

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Optional accessories

as a supplement to expand the learning objectives

MT 101	Assembly exercise: pneumatically driven control valve
or	
MT 102	Assembly exercise: electrically driven control valve