RT 451
Level control

Control and operation via touch screen or a PC with GUNT software. Observation and analysis of the experiments at any number of workstations via LAN/WLAN.

Description

- **digital control of the level via PLC**
- **integrated touch screen or PC with GUNT software as HMI**
- **network capable GUNT software with data acquisition for remote learning**
- **use of smart sensors, configuration via PLC: change, save and transfer parameters during operation**

The series RT 451 – 455 is constructed entirely from industrial components in order to teach control engineering in a practical manner. The use of smart sensors lays the foundations for Industry 4.0 applications. Smart sensors provide signal processing in addition to the capture of measured values thanks to integrated evaluation electronics. Besides process data, it is also possible to exchange configuration, diagnostic or statistical data. In practice this makes it faster to change over production lines, for example, or enables predictive maintenance.

The RT 451 trainer has all components required for an open and closed control loop. The controlled system represents a transparent tank. This is fed with water from a storage tank via a pump. The measuring element in the tank is a smart level sensor which detects the level as the controlled variable. An electropneumatic control valve with a positioner is installed in the feed line to the tank as an actuator. This is fitted with a bypass. Defined disturbance variables can be generated via a proportional valve with motor drive in the tank outlet.

The level is detected by the smart level sensor using electromagnetic pulses (principle of the guided microwave). The sensor has an IO-Link interface for interference-free transfer of measured values and the exchange of configuration data.

For further experiments, a cascade control system can be set up together with RT 452.

The trainer is controlled and operated via the integrated PLC and the touch screen or via GUNT software (external PC required). The control response is displayed in the form of a time function. The network capable software makes it possible to follow and analyse the experiments at any number of workstations via a LAN/WLAN connection to the local network.

Learning objectives/experiments

- design and function of a level control system
- investigate the properties of open and closed loops
- investigate disturbance and reference variable response
- manipulating variable limitation and effect on the control system
- fault finding (fault simulation via PLC)
- familiarisation with industrial control engineering components:

Siemens PLC as digital controller,
smart level sensor with IO-Link interface as measuring element,
electropneumatic control valve with positioner as actuator

- together with RT 452: investigate cascade control of level and flow rate
- familiarisation with IO-Link as communications interface for smart sensors
  - ▸ standardised, open technology
  - ▸ interference-free measured value transfer
  - ▸ exchange of configuration data
  - ▸ system design (IO-Link device, IO-Link master, PLC)

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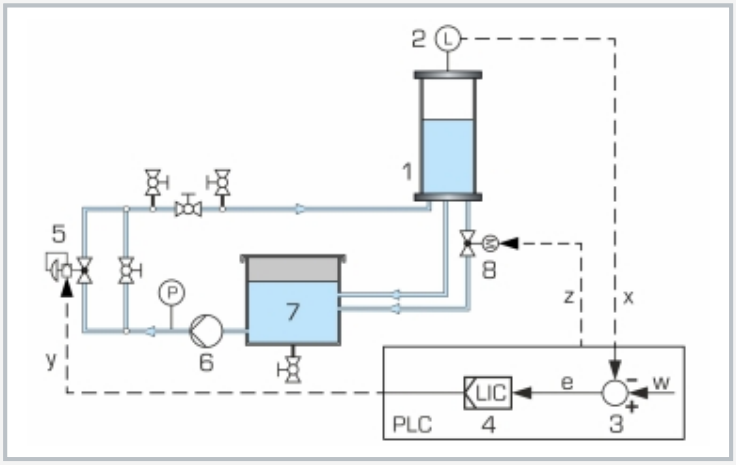
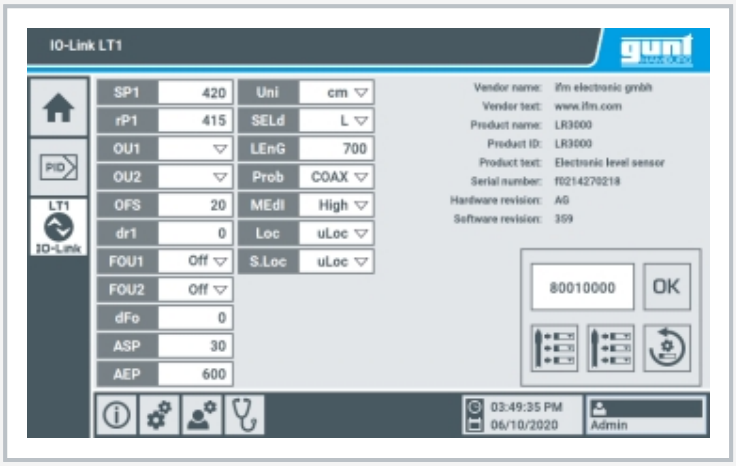
1 smart level sensor, 2 transparent tank, 3 proportional valve with motor drive, 4 storage tank, 5 pump, 6 manometer, 7 control valve, 8 touch screen



1 controlled system: tank, 2 measuring element: smart level sensor, 3 comparator: part of the PLC, 4 digital controller integrated into PLC, 5 actuator: control valve, 6 pump, 7 storage tank, 8 generate disturbance variables via proportional valve with motor drive in tank outlet
x controlled variable: level, y manipulated variable: degree of opening of control valve that directly affects the water supply, z disturbance variable: adjustable drain from the tank, w reference variable: input values, e control deviation, L level, P pressure



Screenshot from the PLC: configuration of smart level sensor via IO-Link

Specification

[1] level control process with standard industrial components and smart sensor technology
[2] digital control via PLC, controller can be parametrised as P, PI, or PID controller
[3] controlled system: transparent tank with overflow and scale
[4] measuring element: smart level sensor with IO-Link interface for interference-free transfer of measured values and exchange of configuration data, measurement using the principle of the guided microwave
[5] smart level sensor configured via PLC
[6] actuator: electropneumatic control valve with positioner
[7] generate disturbance variables via proportional valve with motor drive, operation via PLC
[8] closed water circuit
[9] remote learning: follow and analyse experiments at any number of workstations with LAN/WLAN connection via network capable GUNT software
[10] GUNT software for data acquisition via LAN under Windows 10
[11] multimedia instructional materials online in GUNT Media Center

Technical data

Transparent tank: 4,5L
PLC
- type: Siemens SIMATIC S7-1200
- modules: compact CPU (8 DI, 6 DO, 2 AI), analogue I/O module (4 AI, 2 AO), IO-Link master

Smart level sensor
- communications interface: IO-Link
- length of probe: 700mm

Pneumatically operated control valve DN 25
- K_{vs} value: 4,0
- nominal stroke: 15mm

Pump
- max. flow rate: 4,5m^3/h
- max. head: 12,3m

Storage tank: 50L

Measuring ranges
- pressure: 0...2,5bar
- level: 30...600mm
- degree of opening: 2x 0...100%

230V, 50Hz, 1 phase; 230V, 60Hz, 1 phase
120V, 60Hz, 1 phase; UL/CSA optional
LxWxH: 2030x790x1987mm
Weight: approx. 205kg

Required for operation

compressed air connection: 4...10bar
PC with Windows recommended

Scope of delivery

trainer, 1 GUNT software, 1 set of accessories, 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